Welcome to the
1993 ZJ Jeep Grand Cherokee
and Supplements
Electronic Service Manual

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FOR INSTRUCTIONS

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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.

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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.

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CHRYSLER CORPORATION

SERVICE MANUAL and SUPPLEMENT

1993 JEEP®
GRAND CHEROKEE
GRAND WAGONEER

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

CHRYSLER CORPORATION
SERVICE & PARTS DIVISION

Chrysler Corporation reserves the right to make changes in design or to make additions to or improvements in its products without imposing any obligations upon itself to install them on its products previously manufactured.

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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.

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.

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.

The Component and System Index of this manual identifies the correct group 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.

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.

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.

Information describing the operation and use of standard and optional equipment is included in the Owner's Manual provided with the vehicle.

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. This terminology standard (J1930) is required to comply with the 1993 California Air Research Board (CARB) requirements.

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

GROUP TAB LOCATOR PAGE

INTRODUCTION

CONTENTS

DESIGNATIONS, LABELS/PLATES/DECALS, CODES AND DIMENSIONS/WEIGHTS

INDEX

VEHICLE DESIGNATION

The Vehicle Code Designation for Grand Cherokee vehicles is ZJ. The code is used to identify the vehicle in charts, captions and in service procedures. The vehicle code is different than the Vehicle Identification Number (VIN) or the wheelbase/model code.

VEHICLE SAFETY CERTIFICATION LABEL

A certification label is attached to the left side B-pillar (Fig. 1). The label certifies that the vehicle conforms to Federal Motor Vehicle Safety Standards (FMVSS).The label also lists the:

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

VEHICLE IDENTIFICATION NUMBER (VIN) PLATE

The Vehicle Identification Number (VIN) plate is attached to the top left side of the instrument panel. The VIN contains 17 characters that provide data concerning the vehicle. Refer to the decoding chart to determine the identification of a vehicle.

The Vehicle Identification Number is also imprinted on the:

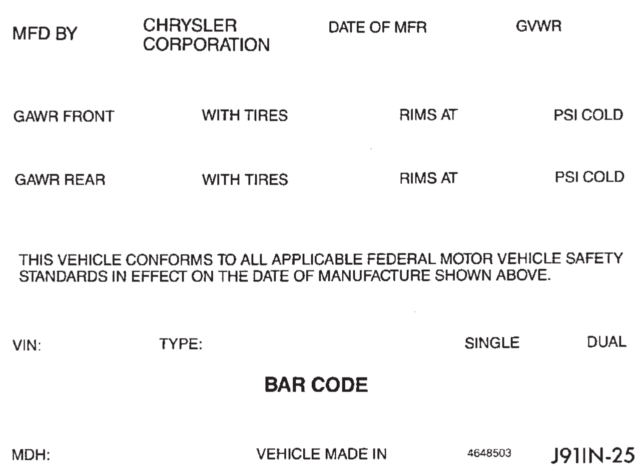


Fig. 1 Vehicle Safety Certification Label

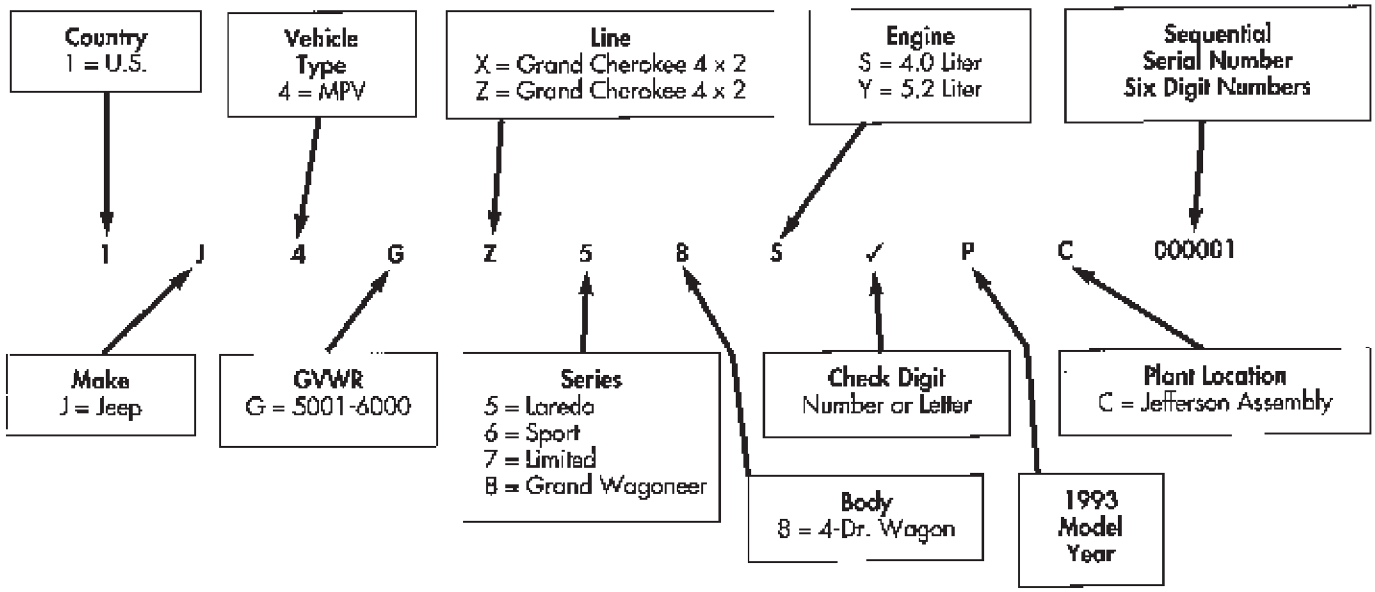
- Body Code Plate
- Equipment Identification Plate
- Vehicle Safety Certification Label
- Frame rail

BODY CODE PLATE

A metal Body Code plate is attached (riveted) to the top, left side of the radiator reinforcement. 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 to line 7 (as applicable) at the top of the code plate (Fig.2).

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

VEHICLE IDENTIFICATION NUMBER (VIN) DECODING



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Lines 4 through 7 on the plate are imprinted in sequence according to the following descriptions:

- 3-character sales code
- 3-digit numerical code
- 6-digit SEC code

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

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

The last nine positions of row 7 will contain a 2-digit code and a 6-digit serial number.

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

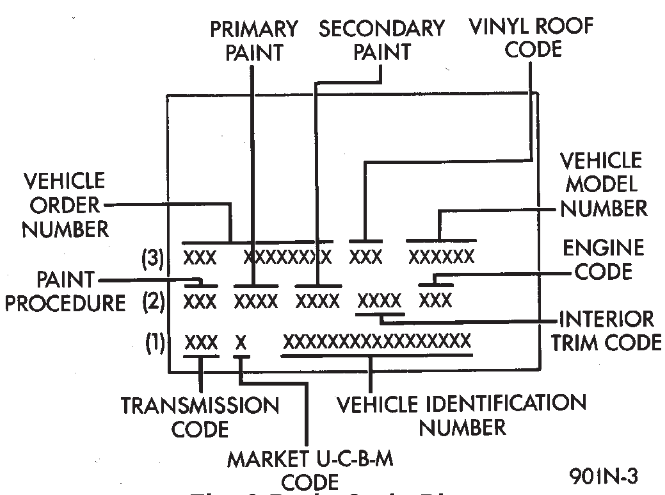

Fig. 2 Body Code Plate

When a second body 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

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

Refer to the applicable group for identification data.

BODY 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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VEHICLE DIMENSION

The Vehicle Dimension chart provides the dimensions for each type of Grand Cherokee vehicle.

VEHICLE WEIGHTS

The Vehicle Weights chart provides:
- The Gross Vehicle Weight Rating (GVWR),
- The payload
- The curb weight for each vehicle type/wheelbase

VEHICLE DIMENSIONS

EXTERIOR DIMENSIONS

WHEEL BASE cm/in	TRACK FRONT	TRACK REAR cm/in	LENGTH	OVERALL WIDTH cm/in	HEIGHT
2691	1473	1473	4488	1758	1635
105.9	58.0	58.0	176.7	69.2	64.4

INTERIOR DIMENSIONS

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
991	994	1044	945	1480	1463	1445	1252
39.0	39.1	41.1	37.2	58.3	57.6	56.9	49.3

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VEHICLE WEIGHTS

VEHICLE	BODY[1] STYLE	WHEEL/ TIRE	GVWR[2]	PASSENGER WEIGHT (MAX)	CARGO[3] WEIGHT (MAX)	GAWR[4] FRONT	GAWR[4] REAR
ZJ 4WD	74	P205/75R15 15 × 7	5300	750	400	2500	2905
ZJ 2WD	74	P205/75R15 15 × 7	4950	750	400	2500	2905

All Weights Listed In Pounds.
74 = 4-Door Body

[2]Gross Vehicle Weight Rating
[3]For MJ Vehicles, including options
[4]Gross Axle Weight Rating

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TRAILER TOWING SPECIFICATIONS

The Trailer Towing Specifications chart provides:

- The maximum trailer tongue weight
- The maximum trailer weight
- The maximum combined weight of the trailer/load/towing vehicle with a specific engine/transmission/axle combination.

INTERNATIONAL VEHICLE CONTROL AND DISPLAY SYMBOLS

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

TRAILER TOWING SPECIFICATIONS

VEHICLE LINE	MAX TRAILER[2] WEIGHT	MAX TONGUE WEIGHT	MAX GCWR[1]	ENGINE	REAR AXLE RATIO	TRANSMISSION
ZJ 4WD	2268 kg 5000 lb	340 kg 750 lb	4332 kg 9550 lb	4.0 6 cyl	3.55	Automatic w/aux. cooler
ZJ 2WD	2268 kg 5000 lb	340 kg 750 lb	4173 kg 9200 lb	4.0 6 cyl	3.55	Automatic w/aux. cooler

NOTE: All weights with standard tires and GVWR Packages except as indicated. All automatic transmission applications require the auxiliary transmission oil cooler. All applications require the following additional equipment: 500-ampere battery, maximum engine cooling, heavy duty shock absorbers, front stabilizer bar, heavy-duty variable load flasher, and wiring harness for the trailer lights.

[1] Maximum gross combined weight of loaded trailer and towing vehicle.

[2] Maximum full-frontal-area trailer length of 23 feet recommended.

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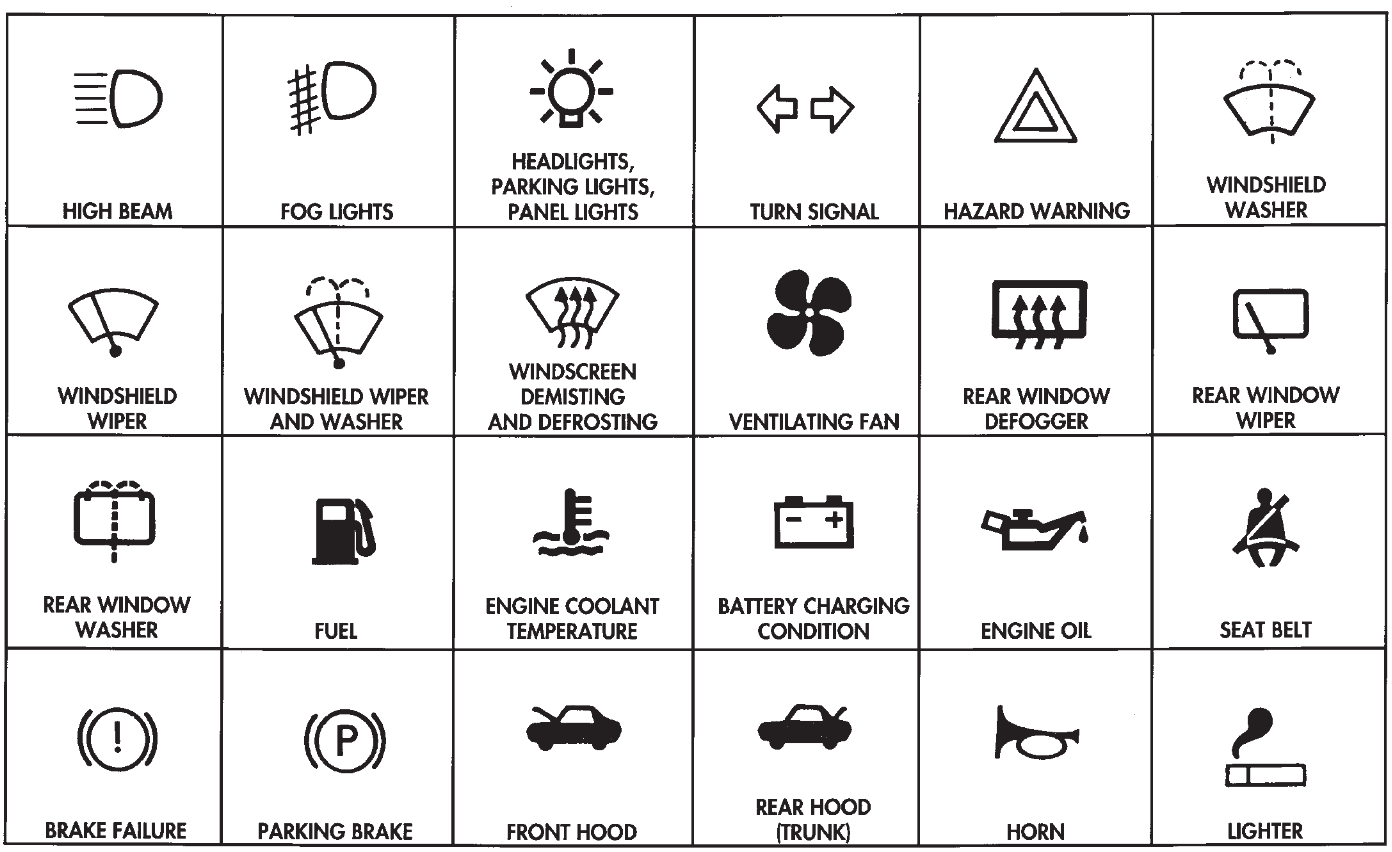
INTERNATIONAL CONTROL AND DISPLAY SYMBOLS



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MEASUREMENT AND TORQUE SPECIFICATIONS

INDEX

SPECIFICATION NOTATIONS

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

It is important to retain the original attaching hardware for assembly of the components. If the attaching hardware is not reusable, hardware with equivalent specifications must be used.

METRIC AND ENGLISH/SAE CONVERSION

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

TORQUE SPECIFICATIONS

TORQUE CHARTS

A torque chart for fasteners is provided at the end of each group (of service information). Refer to the Standard Torque Specifications chart to determine torque values not listed in the group (Figs. 1 and 2).

It is important to be aware that the torque values listed in the chart are based on clean and dry bolt threads. Reduce the torque value by 10 percent when the bolt threads are lubricated and by 20 percent if new.

STANDARD TORQUE SPECIFICATIONS

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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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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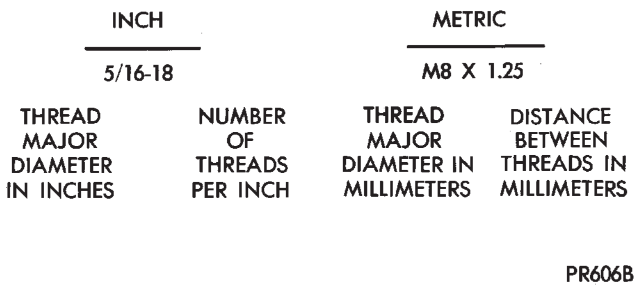
BOLT THREAD AND GRADE/CLASS IDENTIFICATION

THREAD IDENTIFICATION

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

THREAD NOTATION—SAE AND METRIC



GRADE/CLASS IDENTIFICATION

The SAE bolt strength grades range from grade 2 to grade 8. The higher the grade number, the greater the bolt strength. Identification is determined by the line marks on the top of each bolt head (Fig. 1). The actual bolt strength grade corresponds to the number of line marks plus 2.

- 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
- 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. 2). The higher the class number, the greater the bolt strength. Some metric nuts are imprinted with a single-digit strength class on the nut face.

METRIC CONVERSION

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

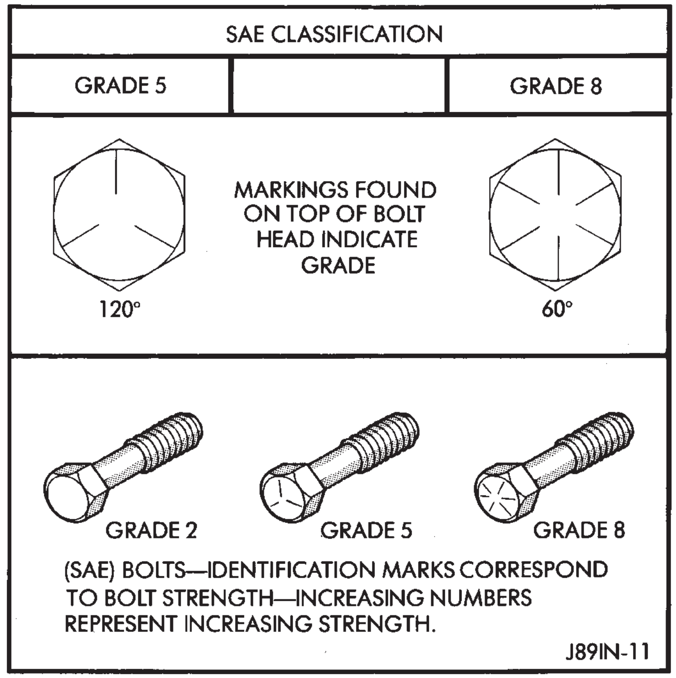


Fig. 1 SAE Bolt Grade Identification

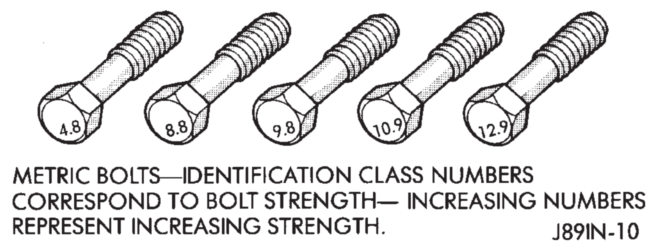


Fig. 2 Metric Bolt Class Identification

METRIC CONVERSION

in-lbs to N•m

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

N•m to in-lbs

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

ft-lbs to N•m

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

N•m to ft-lbs

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

in. to mm

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

mm to in.

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

J901N-10

LUBRICATION AND MAINTENANCE

CONTENTS

GENERAL INFORMATION

INDEX

INTRODUCTION

Lubrication and maintenance is divided into required and recommended service tasks. The required service tasks must be completed to verify emission controls function correctly. The recommended service tasks should be completed to maintain safety and durability.

This information will assist service personnel in providing maximum protection for each owner's vehicle.

Conditions can vary with individual driving habits. It is necessary to schedule maintenance as a time interval as well as a distance interval.

It is the owner's responsibility to determine applicable driving condition. Also to have vehicle serviced according to the maintenance schedule, and to pay for necessary parts and labor.

Vehicles with a Gross Vehicle Weight Rating (GVWR) of 3 855 kg (8,500 lbs.) or less must conform to light duty emission standards. Vehicles with a Gross Vehicle Weight Rating (GVWR) of 3 856 kg (8,501 lbs.) or more must conform to heavy duty emission standards.

The GVWR for each vehicle is listed on the Safety Certification Label. This label is affixed to driver side door pillar (Fig. 1).

Additional maintenance and lubrication information is listed in the Owner's Manual.

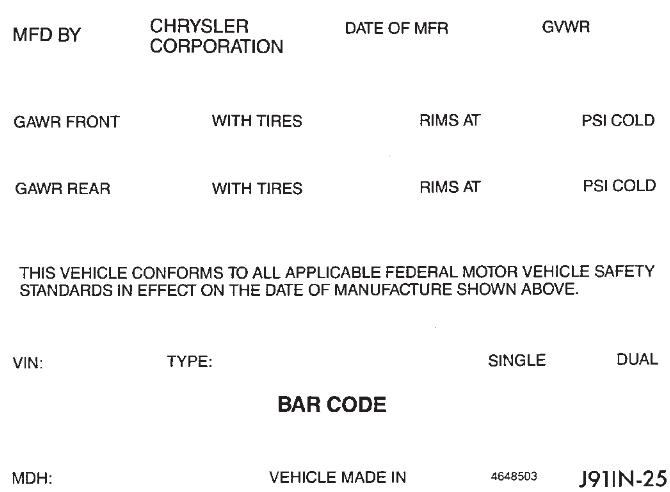


Fig. 1 Vehicle Safety Certification Label

SEVERE DRIVING CONDITIONS

Vehicles subjected to severe driving conditions should decrease the interval between component maintenance. Severe driving conditions are defined as:

- Frequent short trip driving less than 24 km (15 miles)
- Frequent driving in dusty conditions
- Trailer towing
- Extensive engine idling
- Sustained high speed operation
- Desert operation
- Frequent starting and stopping
- Cold climate operation

• Commercial service

When a vehicle is continuously subjected to severe driving conditions, lubricate:

• Body components
• All driveline coupling joints
• Steering linkage

More often than normal driving conditions

DUSTY AREAS

With this type of severe driving condition, special care should be given to:

• Engine air cleaner filter
• PCV filter
• Crankcase ventilation system
• Brake booster control valve air filter.

OFF-ROAD (4WD) OPERATION

After off-road (4WD) operation, inspect underside of vehicle. Inspect:

• Tires
• Body structure
• Steering components
• Suspension components
• Exhaust system
• Threaded fasteners

HARSH SURFACE ENVIRONMENTS

After long operation in harsh environments, brake drums, brake linings, and rear wheel bearings should be inspected and cleaned.

ROUTINE MAINTENANCE

The following routine maintenance is recommended on a monthly basis:

TIRES—Inspect tires for unusual wear/damage.

BATTERY—Inspect and clean terminals. Determine acid level and add distilled water, if necessary.

FLUIDS—Determine if component fluid levels are acceptable. Add fluid, if necessary.

LIGHTS/ELECTRICAL—Test all electrical systems in vehicle for proper operation.

It is also recommended that engine oil and washer fluid level be determined at each fuel fill-up.

FUEL REQUIREMENTS

GASOLINE ENGINES

All engines require use of unleaded gasoline to reduce harmful effects of lead to the environment. Also unleaded fuel is necessary to prevent damage to the catalytic converter/O_2 sensor. 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 below fuel gauge and on fuel filler door. Vehicles also have fuel filler tubes that are specially designed to accept only small-diameter nozzles.

CLASSIFICATION OF LUBRICANTS

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

• Society of Automotive Engineers (SAE)
• American Petroleum Institute (API)
• National Lubricating Grease Institute (NLGI)

ENGINE OIL (FIG. 2)

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. These are specified with a dual SAE viscosity grade which indicates cold-to-hot temperature viscosity range.

API SERVICE GRADE

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

Conformance to API Service Grade specifications is determined by tests that measure ability of an oil to control:

• Engine wear
• Bearing corrosion
• Sludge
• Varnish
• Oil thickening
• Rust
• Piston deposits

For maximum gasoline engine protection, use API Service Grade SG, SG/CD or SG/CE engine oil.

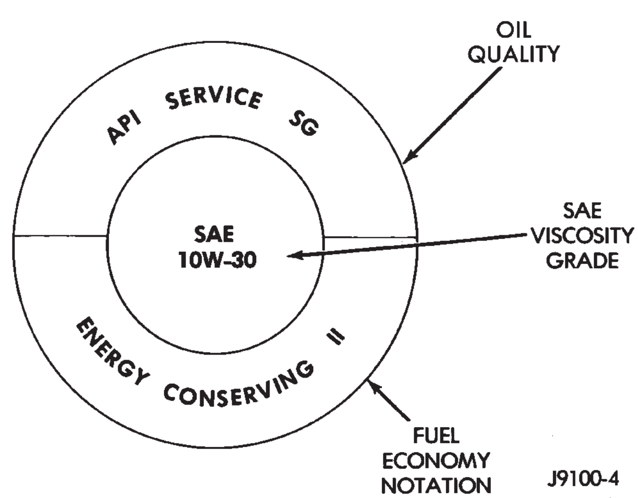


Fig. 2 SAE Oil Viscosity Grade & API Service Grade

GEAR LUBRICANTS

A dual grade is also used to specify viscosity of multi-purpose gear lubricants.

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

Mopar®Synthetic Gear lube is required for use in vehicles with a trailer towing package.

CHASSIS COMPONENT AND WHEEL BEARING LUBRICANTS

Chassis and wheel bearing lubricants that are recommended are identified by the NLGI Certification Symbol. The symbol contains a coded designation. This identifies usage and quality of the lubricant.

The letter G within the symbol designates wheel bearing lubricant. The letter L designates chassis lubricant. When the letters are combined, the lubricant can be used for dual applications.

LUBRICATION AND REPLACEMENT PARTS RECOMMENDATION

Jeep®vehicles are engineered to provide many years of dependable operation. However, lubrication service and maintenance are required for each vehicle. When necessary, MOPAR®brand lubricants and genuine replacement parts are highly recommended. Each MOPAR®brand lubricant and replacement part is designed and to provide dependability and long service life.

COMPONENTS REQUIRING NO LUBRICATION

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

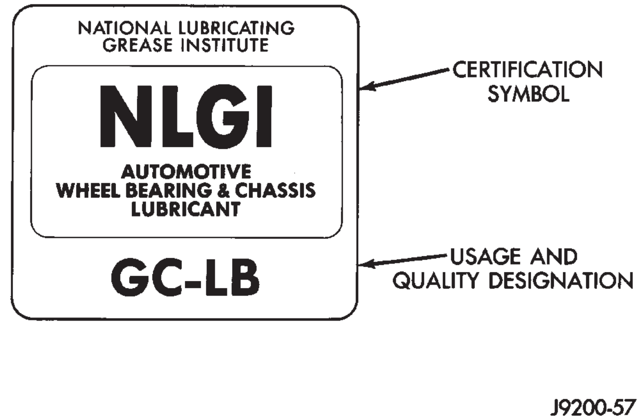


Fig. 3 NLGI Lubricant Container Certification/Identification Symbol

- Generator bearings
- Brake booster cylinder
- Distributors
- Drive belts
- Drive belt idler pulleys
- Idler arms
- Rubber bushings
- Starter motor bearings
- Suspension strut bearings
- Rear wheel bearings
- Throttle control cables
- Throttle linkage ball joints
- Water pump bearings

SCHEDULED MAINTENANCE —ZJ VEHICLES (EXCEPT CALIFORNIA)

Jeep SCHEDULED MAINTENANCE (Except California)

Item Thousand [1]Miles	7.5	15	22.5	30	37.5	45	52.5	60
Kilometers	12	24	36	48	60	72.5	84.5	96.5
EMISSION RELATED:								
Air Cleaner Air Filter – Replace				X				X
Distributor Cap and Rotor – Replace								X
Ignition Wires – Replace								X
Spark Plugs – Replace				X				X
NON-EMISSION RELATED:								
Drive Belt – Adjust				X				X
Drive Belt – Replace								X
Engine Coolant – Check – Level, Hoses, Clamps	X	X	X	X	X	X	X	X
Engine Coolant – Flush and Replace at 36 Months Thereafter – Flush and Replace every 24 Months							X	
Engine Oil – Change Every 6 Months or	X	X	X	X	X	X	X	X
Engine Oil Filter – Replace	X	X	X	X	X	X	X	X
Exhaust System – Check	X	X	X	X	X	X	X	X
Fuel Filter – Replace								X
MONTHS	6	12	18	24	30	36	42	48

[1]Where both time and distance are indicated, follow the interval which occurs first.
X = Scheduled maintenance for all vehicles.

J9300-18

SCHEDULED MAINTENANCE —ZJ VEHICLES (EXCEPT CALIFORNIA)

Jeep SCHEDULED MAINTENANCE (Except California)

Item Thousand [1]Miles	67.5	75	82.5	90	97.5	105	112.5	120
Kilometers	108.5	120.5	133	145	157	169	181	193
EMISSION RELATED:								
Air Cleaner Air Filter – Replace				X				X
Distributor Cap and Rotor – Replace								X
Ignition Wires – Replace								X
Spark Plugs – Replace				X				X
NON-EMISSION RELATED:								
Drive Belt – Adjust				X				X
Drive Belt – Replace								X
Engine Coolant – Check – Level, Hoses, Clamps	X	X	X	X	X	X	X	X
Engine Coolant – Flush and Replace at 36 Months Thereafter – Flush and Replace every 24 Months			X				X	
Engine Oil – Change Every 6 Months or	X	X	X	X	X	X	X	X
Engine Oil Filter – Replace	X	X	X	X	X	X	X	X
Exhaust System – Check	X	X	X	X	X	X	X	X
Fuel Filter – Replace								X
MONTHS	54	60	66	72	78	84	90	96

[1]Where both time and distance are indicated, follow the interval which occurs first.
X = Scheduled maintenance for all vehicles.

J9300-19

SCHEDULED MAINTENANCE —ZJ VEHICLES (CALIFORNIA)

Jeep SCHEDULED MAINTENANCE – CALIFORNIA

Item	Thousand [1]Miles	7.5	15	22.5	30	37.5	45
	Kilometers	12	24	36	48	60	72.5
EMISSION RELATED:							
Air Cleaner Air Filter – Replace					O		
Ignition Wires – Replace							
Spark Plugs – Replace					O		
NON-EMISSION RELATED:							
Drive Belt – Adjust					O		
Drive Belt – Replace							
Engine Coolant – Check – Level, Hoses, Clamps		X	X	X	X	X	X
Engine Coolant – Flush and Replace at 36 Months Thereafter – Flush and Replace every 24 Months							
Engine Oil – Change Every 6 Months or		O	O	O	O	O	O
Engine Oil Filter – Replace		O	O	O	O	O	O
Exhaust System – Check		X	X	X	X	X	X
MONTHS		6	12	18	24	30	36

[1]Where both time and distance are indicated, follow the interval which occurs first.
O = Required. X = Recommended.

J9300-20

SCHEDULED MAINTENANCE —ZJ VEHICLES (CALIFORNIA)

Jeep SCHEDULED MAINTENANCE – CALIFORNIA

Item	Thousand [1]Miles	52.5	60	67.5	75	82.5	90	97.5
	Kilometers	84	96	108	120	132	144	156
EMISSION RELATED:								
Air Cleaner Air Filter – Replace			O				O	
Ignition Wires – Replace			O					
Spark Plugs – Replace			O				O	
NON-EMISSION RELATED:								
Drive Belt – Adjust							O	
Drive Belt – Replace			O					
Engine Coolant – Check – Level, Hoses, Clamps		X	X	X	X	X	X	X
Engine Coolant – Flush and Replace at 36 Months or Thereafter – Flush and Replace every 24 Months or		X				X		
Engine Oil – Change Every 6 Months or		O	O	O	O	O	O	O
Engine Oil Filter – Replace		O	O	O	O	O	O	O
Exhaust System – Check		X	X	X	X	X	X	X
MONTHS		52	60	67	75	82	90	97

Where both time and distance are indicated, follow the interval which occurs first.
O = Required. X = Recommended.

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GENERAL MAINTENANCE SERVICES FOR PROPER VEHICLE PERFORMANCE

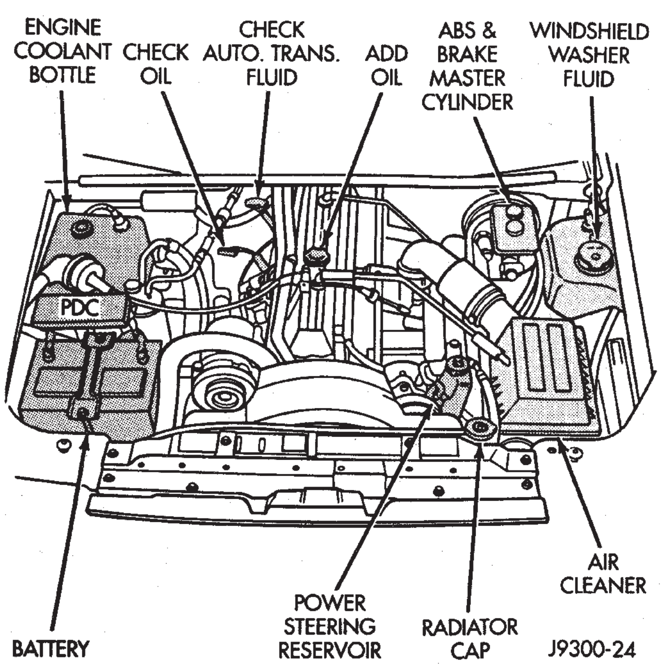
GENERAL MAINTENANCE SERVICES FOR PROPER VEHICLE PERFORMANCE

COMPONENT	SERVICE	MILEAGE (KILOMETERS) OR TIME INTERVAL
STEERING LINKAGE (4 X 4)	LUBRICATE	EVERY 7,500 MILES (12 000 km) OR 6 MONTHS
MANUAL TRANSMISSION	DRAIN & REFILL	
NORMAL SERVICE		EVERY 37,500 MILES (60 000 km)
SEVERE SERVICE		EVERY 18,000 MILES (29 000 km)
AUTOMATIC TRANSMISSION	DRAIN & REFILL	
NORMAL SERVICE		EVERY 30,000 MILES (48 000 km)
SEVERE SERVICE		EVERY 12,000 MILES (29 000 km)
TRANSFER CASE	DRAIN & REFILL	EVERY 30,000 MILES (48 000 km)
BRAKE HOSES	INSPECT	FOR DETERIORATION AND LEAKS WHENEVER BRAKE SYSTEM IS SERVICED AND EVERY OIL CHANGE. REPLACE IF NECESSARY.
PROP SHAFT UNIVERSAL JOINTS	LUBRICATE	
NORMAL SERVICE		EVERY 7,500 MILES (12 000 km)
SEVERE SERVICE		EVERY 3,000 MILES (4 800 km)
FRONT & REAR AXLES	DRAIN & REFILL	
NORMAL SERVICE		EVERY 30,000 MILES (48 000 km)
SEVERE SERVICE		EVERY 12,000 MILES (29 000 km)
AIR BAG SYSTEM	CHECK WARNING LIGHT	EVERY IGNITION 'START'

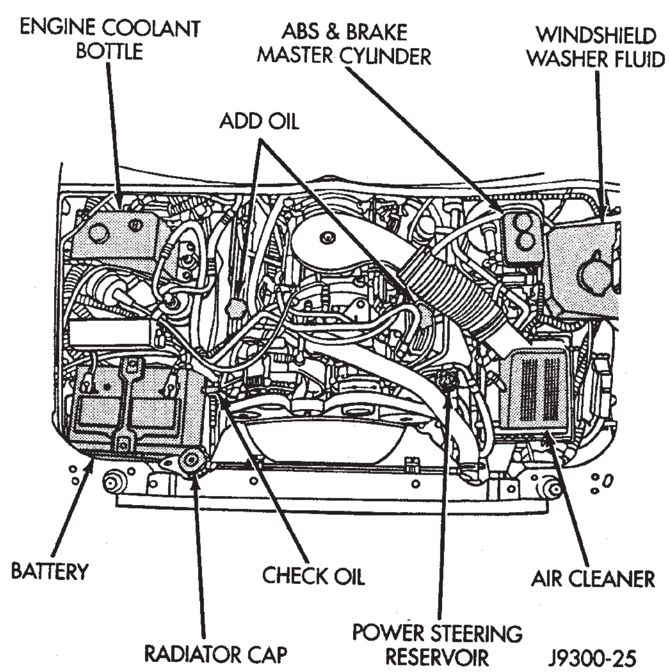
Severe service is defined as: Stop-and-go driving in dusty conditions, extensive idling, frequent short trips, operating at sustained high speeds during hot weather (above +90°F, +32°C), commercial type operation, or trailer towing.

J9300-22

GENERAL MAINTENANCE 4.0L ENGINES



GENERAL MAINTENANCE 5.2L ENGINES



FLUID CAPACITIES

Gas Station Reference

Fuel Selection
Unleaded Gasoline – 87 octane or higher

Engine Oil – API Quality
SERVICE SG OR SG/CD
(SAE 10W-30 Preferred)

API SERVICE SG
SAE 10W-30
ENERGY CONSERVING II

FLUID CAPACITIES

	U.S. Measure	Metric Measure
Fuel (approximate)	23 gal.	87.4 liters
Engine Oil -		
6-Cyl.	6 qt.*	5.7 liters
V-8	5 qt.*	4.7 liters
*with filter change		
Cooling System		
6-Cyl.	9.3 qts.	8.8 liters
V-8	14.9 qts.	14.1 liters

Automatic Transmission Fluid
6-Cyl. Mopar Mercon/Dexron II preferred
8-Cyl. Mopar ATF Plus (Type 7176) preferred
Oil Filter
Mopar 5281090 or equivalent
Spark Plug, Gap, Ignition Timing
Refer to "Vehicle Emission Control Information" label in engine compartment.

TIRE PRESSURES (Full Load)	
P215/75R15	33 psi (227 kPa)
P225/75R15	33 psi (227 kPa)
P225/70R15	33 psi (227 kPa)
P235/75R15	Front 33 psi (227 kPa) Rear 33 psi (227 kPa)

J9300-23

STARTING ASSISTANCE (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, 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 CLAMPS TO CONTACT EACH OTHER. KEEP OPEN FLAMES AND SPARKS AWAY FROM THE BATTERY ACID VENT HOLES. ALWAYS WEAR EYE PROTECTION WHEN INVOLVED WITH VEHICLE BATTERIES.

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

(1) Engage parking brake. Shift automatic transmission to PARK (if a manual transmission, shift to NEUTRAL).

(2) Turn off all lights, and all other electrical loads.

WARNING: ACID IN A DISCHARGED BATTERY CAN FREEZE. DO NOT ATTEMPT TO JUMP START AN ENGINE BEFORE CHECKING CONDITION OF BATTERY ACID. BATTERY COULD EXPLODE AND CAUSE SEVERE PERSONAL INJURY.

CAUTION: Do not permit metal surfaces on vehicles to contact. This could establish ground (negative) continuity between vehicle bodies. This could cause on-board computers to be damaged.

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

CAUTION: Do not allow positive (+) and negative (-) cable clamps to contact each other.

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

(4) Connect a black jumper cable connector clamp to negative (-) terminal on booster battery. Connect

other black jumper cable connector clamp to a good ground source on engine that is to be started (Fig. 5).

Verify engine ground (negative) contact surface area is free of grease. Make sure there is a good connection to bare metal. The engine ground (negative) connection must provide good electrical continuity.

(5) Start engine.

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

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

(7) After engine is started, jumper cables must be disconnected in following order:

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

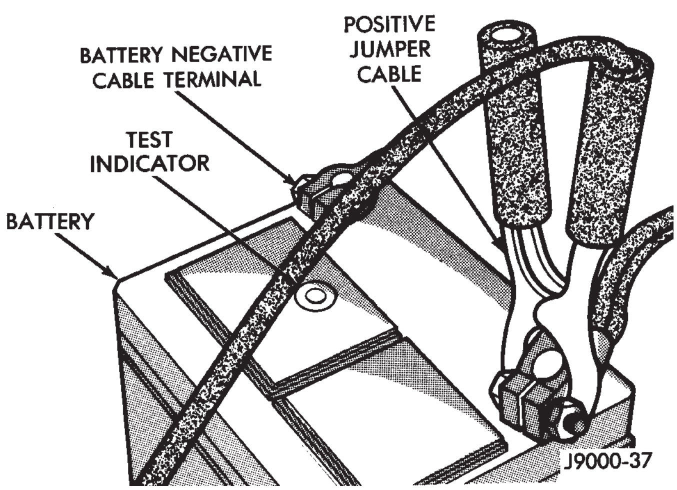


Fig. 4 Positive Jumper Cable Connection

PORTABLE STARTING UNIT

There are many types of portable starting units available for starting engines. Follow manufacturer's instructions.

VEHICLE LIFTING RECOMMENDATIONS

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

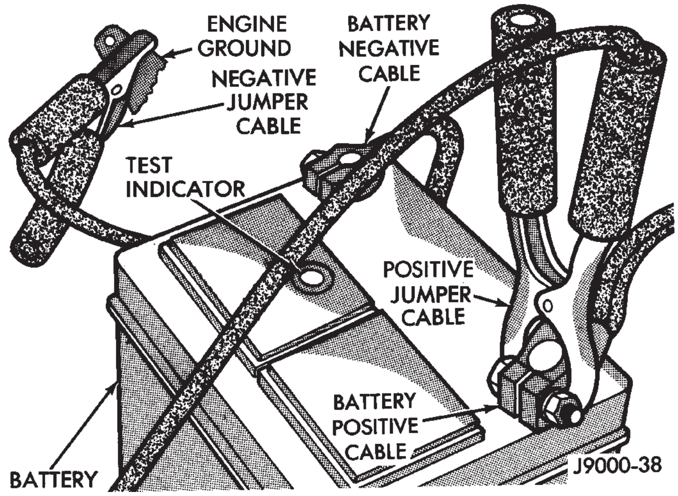


Fig. 5 Both Jumper Cables Connected On Disabled Vehicle

FLOOR JACK

When properly positioned, a floor jack can be used to lift a vehicle (Fig. 6). Support vehicle in raised position with jack stands at front and rear ends of frame rails.

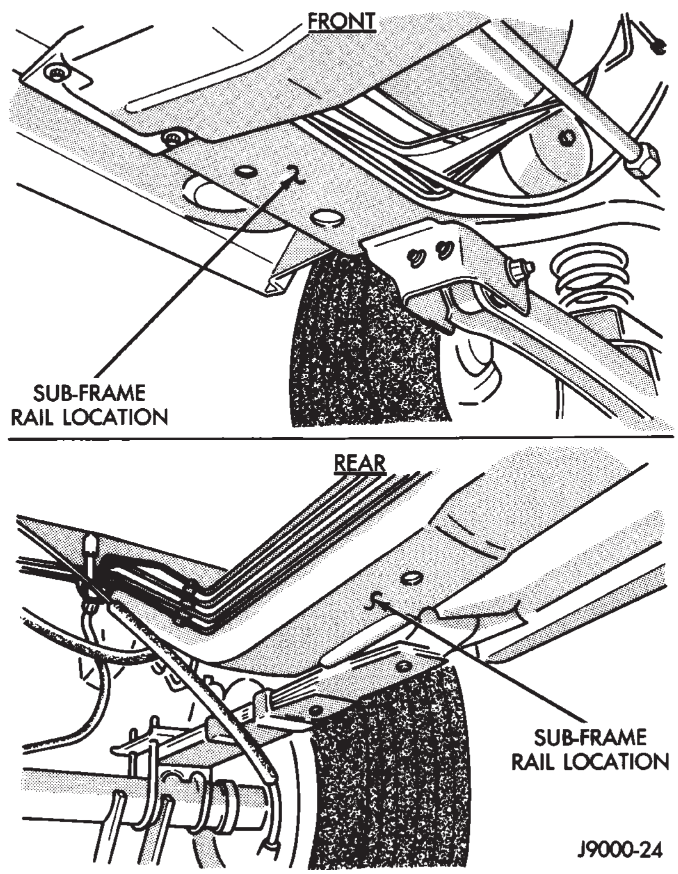


Fig. 6 Correct Vehicle Lifting Locations—Typical

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

• An axle tube

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

Use correct frame rail lifting locations only (Fig. 6).

HOIST

A vehicle can be lifted with:

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

When a frame-contact type hoist is used, verify that lifting pads are positioned properly (Fig. 6).

WARNING: WHEN A SERVICE PROCEDURE REQUIRES THE REMOVAL OF REAR AXLE, FUEL TANK, OR SPARE TIRE, EITHER:

- PLACE ADDITIONAL WEIGHT ON REAR END OF VEHICLE
- ATTACH VEHICLE TO HOIST
- PLACE JACK STANDS UNDER VEHICLE FOR SUPPORT TO PREVENT TIPPING WHEN CENTER OF BALANCE CHANGES

4WD VEHICLES

A standard hoist can be used to lift a 4WD vehicle. Hoist should be inspected for adequate clearance. The lift arms, pads or ramps should be adjusted to ensure that there is adequate clearance (Fig. 7).

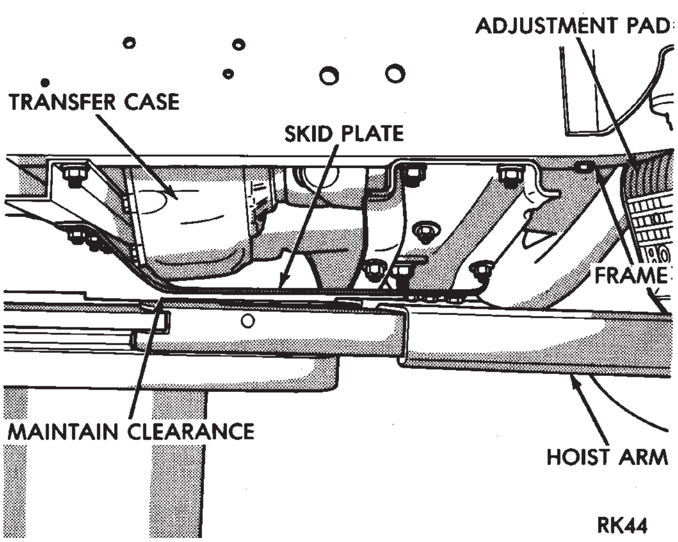


Fig. 7 Lifting 4WD Vehicle With Single-Post Hoist—Typical

When a twin-post hoist is used, a 4 x 4 x 12-inch wood spacer also could be required. Place wood spacer under front axle. This will maintain balance and level lifting.

CAUTION: The block that is used must be secured in a safe manner. This will ensure that it will not unbalance vehicle.

VEHICLE TOWING RECOMMENDATIONS

When it is necessary to tow a vehicle, recommended method is either:

- sling-type, rear-end raised towing method; or
- wheel-lift towing method with a tow dolly located under front wheels.

A vehicle with flat-bed hauling equipment can also be used to transport a disabled vehicle.

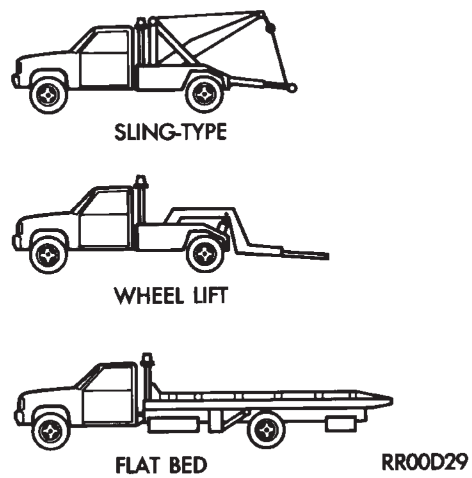


Fig. 8 Tow Vehicles With Approved Equipment

A vehicle equipped with SAE approved sling-type towing equipment can be used. However, many vehicles are equipped with air dams, spoilers, and/or ground effect panels. In this case a wheel-lift towing vehicle or a flat-bed hauling vehicle is recommended. If a flat bed device is used, approach angle should not exceed 15 degrees.

GROUND CLEARANCE

The lifted wheels of disabled vehicle should be a minimum of 10 cm (4 in.) off ground. Make sure there is enough clearance at opposite end. This is critical when towing over rough terrain. If rear wheels are removed, secure brake drums. A 20 cm (8 in.) ground clearance must be maintained between brake drums or rotors and ground.

SAFETY PRECAUTIONS

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

- Remove exhaust pipe tips that interfere with tow sling and crossbar
- Padding should be placed between tow sling/crossbar and any painted surfaces
- If vehicle is damaged, secure loose parts
- Always use a safety chain system that is independent of lifting and towing equipment

- When placing tow hooks on rear axle, position them so they do not damage brake tubing or hoses
- Do not allow any of towing equipment to contact fuel tank
- Do not tow vehicle by connecting to front or rear shock absorbers
- The operator should not go under a vehicle while it is lifted by towing equipment. The vehicle should first be supported by safety stands
- Do not allow passengers in a vehicle being towed
- Observe all state and local laws involving warning signals, night illumination, speed, etc.
- Do not exceed a towing speed of 48 km/h (30 mph)
- Avoid towing distances of more than 24 km (15 miles) whenever possible
- Do not attach tow chains or a tow sling to a bumper, steering linkage, universal joints, or a drive shaft

REAR-END RAISED TOWING

It is recommended that rear-end raised towing method be used. Vehicles can be towed with front wheels on ground for extended distances at speeds not exceeding 48 km/h (30 mph).

(1) Attach J-hooks around axle shaft tubes outboard of rear springs.

(2) Position and center sling under and forward of rear bumper.

(3) Attach safety chains (with pads) at each end of rear bumper.

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

(5) Clamp steering wheel with front wheels in straight ahead position.

CAUTION: Do not use steering column lock to secure front wheels in straight-ahead position.

(6) Shift transmission to NEUTRAL.

FRONT-END RAISED TOWING

If a vehicle cannot be towed from rear, front-end raised towing method normally can be used.

(1) Center sling with bumper and position it at frame front crossmember.

CAUTION: Use tow chains with J-hooks for connecting to disabled vehicle's lower suspension arms. Never use T-hooks.

(2) Route J-hooks and tow chains over steering linkage outboard of coil spring.

(3) Attach J-hooks to outer end of lower suspension arms.

(4) Raise vehicle.

(5) Attach safety chains to disabled vehicle at frame rails.

Vehicles equipped with a MANUAL TRANSMISSION can be towed with rear wheels on ground. Do not exceed speeds of 48 km/h (30 mph) or a distance of 24 km (15 miles). **The transmission must be in neutral.**

Front-end raised towing for a vehicle equipped with an AUTOMATIC TRANSMISSION is not recommended.

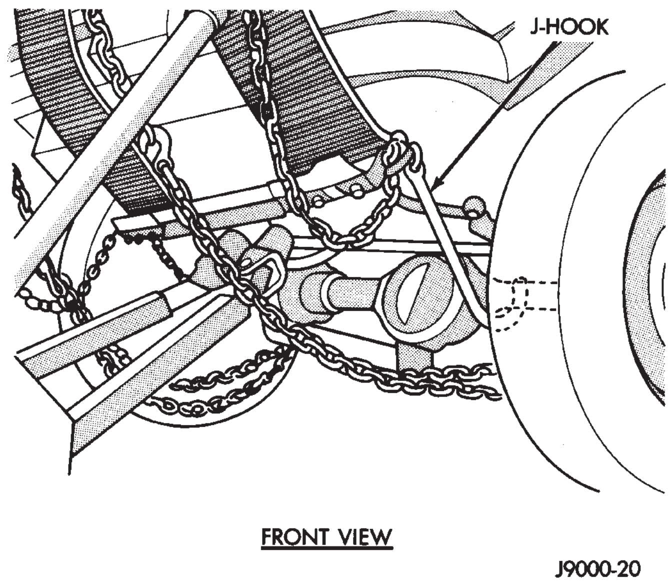


Fig. 9 Front-End Raised Towing—Typical

CAUTION:It is not recommended to flat tow a vehicle.

LOCKED VEHICLE TOWING

When a locked vehicle must be towed, use a tow dolly or flat bed hauler.

ENGINE MAINTENANCE

INDEX

ENGINE BREAK-IN

After first starting a new engine, allow it to idle for 15 seconds before shifting into a drive gear. Also:

- Drive vehicle at varying speeds less than 88 km/h (55 mph) for first 480 km (300 miles).
- Avoid fast acceleration and sudden stops.
- Do not drive at full-throttle for extended periods of time
- Do not drive at constant speeds
- Do not idle engine excessively

A special break-in engine oil is not required. The original engine oil installed is a high quality, energy conserving lubricant.

New engines tend to consume more fuel and oil until after the break-in period has ended.

ENGINE OIL

SPECIFICATIONS

API SERVICE GRADE

Use an engine oil that conforms to API Service Grade S, SG/CD or SG/CE. MOPAR®provides engine oils that conform to all of these service grades.

SAE VISCOSITY

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. These are specified with a dual SAE viscosity grade which indicates cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation (Fig. 1).

ENERGY CONSERVING OIL

An Energy Conserving type oil is recommended for gasoline engines. They are designated as either ENERGY CONSERVING or ENERGY CONSERVING II.

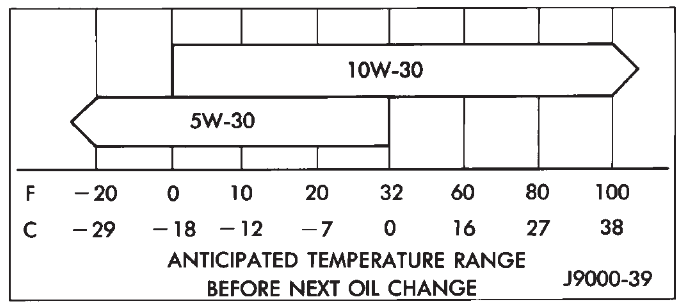


Fig. 1 Temperature/Engine Oil Viscosity—Gasoline Engines

OIL LEVEL INDICATOR (DIPSTICK)

4.0L ENGINES 5.2L ENGINES

The engine oil level indicator is located at right rear of engine on 4.0L engines.

The engine oil level indicator is located at the right front of the engine on 5.2L engines.

ACCEPTABLE OIL LEVEL

To maintain proper lubrication of an engine, engine oil must be maintained at an acceptable level. The acceptable level is indicated between ADD and FULL marks on engine oil level dipstick.

The oil level should be checked periodically. The vehicle should be on a level surface. Wait for five minutes after stopping engine or after vehicle has remained parked overnight. For 4.0 engines, add engine oil only when level indicated on dipstick is at or below ADD mark.

CAUTION: Do not overfill an engine crankcase with oil.

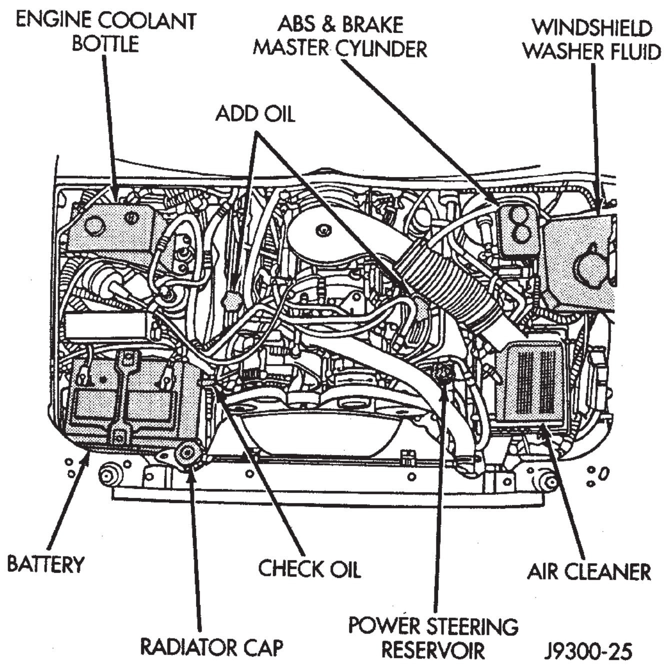


Fig. 2 Engine Oil Dipstick Location 5.2L Engine—Typical

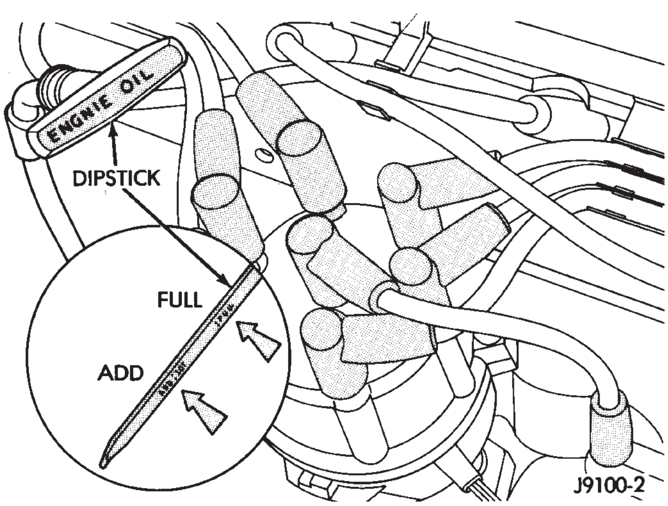


Fig. 3 Engine Oil Dipstick—4.0L Engine

ENGINE OIL CHANGE AND FILTER REPLACEMENT

WARNING: CARE SHOULD BE EXERCISED WHEN CHANGING ENGINE OIL TO MINIMIZE THE LENGTH OF EXPOSURE TIME TO USED ENGINE OIL. PROTECTIVE CLOTHING AND GLOVES SHOULD BE WORN. EXPOSED SKIN SHOULD BE THOROUGHLY WASHED WITH SOAP AND WATER TO REMOVE ANY USED ENGINE OIL. DO NOT USE GASOLINE, THINNER, OR SOLVENTS TO REMOVE USED ENGINE OIL FROM SKIN. DO NOT POLLUTE. DISPOSE OF USED ENGINE OIL PROPERLY. CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA.

ENGINE OIL FILTER

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

OIL CHANGE AND FILTER REPLACEMENT

Bring engine up to normal operating temperature. A more complete drainage of oil will result.

(1) Remove drain hole plug. Drain engine oil from crankcase.

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

For gasoline engines, oil filter should be replaced during every second engine oil change.

(3) Rotate oil filter counterclockwise to remove it.

(4) Clean engine cylinder block oil filter boss.

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

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

(7) Add specified quantity of new engine oil at fill hole location on top of engine cylinder head cover. Wipe off any spilled oil.

(8) Observe oil level on dipstick. Adjust as necessary.

(9) Start engine. Observe oil pressure gauge or warning lamp (as applicable). If oil pressure does not increase, stop engine immediately and determine cause of malfunction.

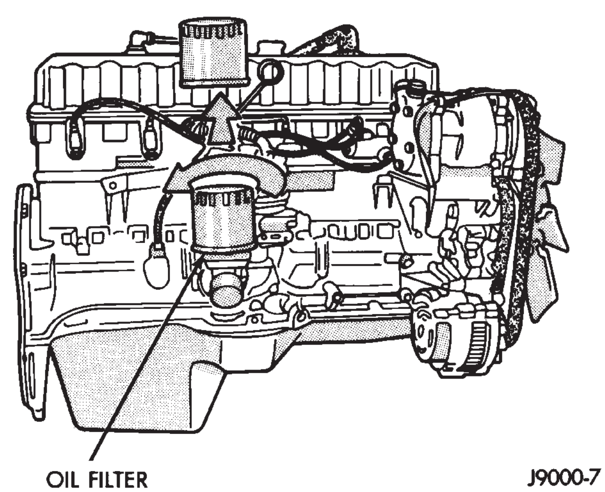


Fig. 4 Oil Filter—4.0L Engine

COOLING SYSTEM

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

INSPECTION SCHEDULE

Determine coolant level. Inspect cooling system hoses/clamps after each service interval has elapsed.

COOLANT LEVEL

It is recommended that engine coolant level be inspected at least once a month during periods of hot weather.

With engine at normal operating temperature, check coolant level in coolant reserve tank. Coolant level must be at least above ADD mark and preferably at FULL mark. Add coolant to coolant reserve tank only.

COOLANT FREEZE PROTECTION

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

It is recommended that degree of coolant protection be tested every 12 months. If coolant is contaminated or rusty, cooling system should be drained and flushed. Refill with a 50/50 mixture of fresh coolant. Refer to Group 7—Cooling Systems for additional information.

SYSTEM INSPECTION

WARNING: IF THE ENGINE HAS BEEN RECENTLY OPERATED, DO NOT REMOVE RADIATOR CAP.

(1) Test radiator cap for proper vacuum sealing and operation. Use caution when removing radiator cap to avoid contact with hot coolant. Place a heavy rag or towel over cap and turn to first stop. Do not press down. Pause to allow pressure to release through overflow tube. Then press down and turn counterclockwise to remove cap.

(2) Inspect coolant overflow tubing and connections at coolant reserve tank and at radiator.

(3) Inspect entire cooling system for leaks. A black-light detector can be used as an aid in detecting source of coolant leaks.

(4) Inspect radiator and air conditioner condenser fins for an accumulation of debris.

(5) If necessary, refer to Group 7—Cooling Systems for additional information and service procedures.

RADIATOR CAP

The radiator cap must be completely tightened to provide proper pressure release and coolant recovery.

DRAIN, FLUSH AND FILL

WARNING: ANTI-FREEZE IS POISONOUS. KEEP OUT OF REACH OF CHILDREN.

Drain, flush, and fill cooling system with correct coolant mixture at interval specified in maintenance schedule.

HOSES AND FITTINGS

It is recommended that rubber hoses be periodically inspected. Inspect all hose fittings for looseness and corrosion. Inspect rubber hoses for brittleness and cracks.

ENGINE AIR CLEANER FILTER ELEMENT

MAINTENANCE SCHEDULE

With normal driving conditions, engine air cleaner filter element should be replaced:

- Light-Duty Cycle—after each 48 000 km (30,000 miles) interval has elapsed
- Heavy-Duty Cycle—after each 38 000 km (24,000 miles) interval has elapsed

When vehicle is operated in dusty areas, filter element should be replaced more often.

SERVICE/REPLACEMENT

(1) Remove air cleaner cover.

(2) Remove air cleaner filter (Fig. 5).

CAUTION: Do not tap filter or immerse filter medium in liquid to remove trapped debris.

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

(4) If filter medium has become partially saturated with oil, replace filter element. Inspect crankcase ventilating system for proper operation.

(5) Wash air cleaner cover and body with cleaning solvent. Wipe it dry.

(6) Install air cleaner filter element. Attach cover to body (Fig. 5).

EMR LAMP AND TIMER SERVICE INFORMATION

Refer to Group 25—Emission Control Systems for timer reset and other related information.

CRANKCASE VENTILATION SYSTEM

All Jeep® engines are equipped with a crankcase ventilation (CCV) system. The vapor is routed back to be burned in engine combustion chambers (Fig. 6).

SYSTEM OPERATION

The 4.0L engine closed crankcase ventilation (CCV) system has a vapor-transfer fitting located on the cylinder head cover. A molded hose is connected between the intake manifold and the fitting.

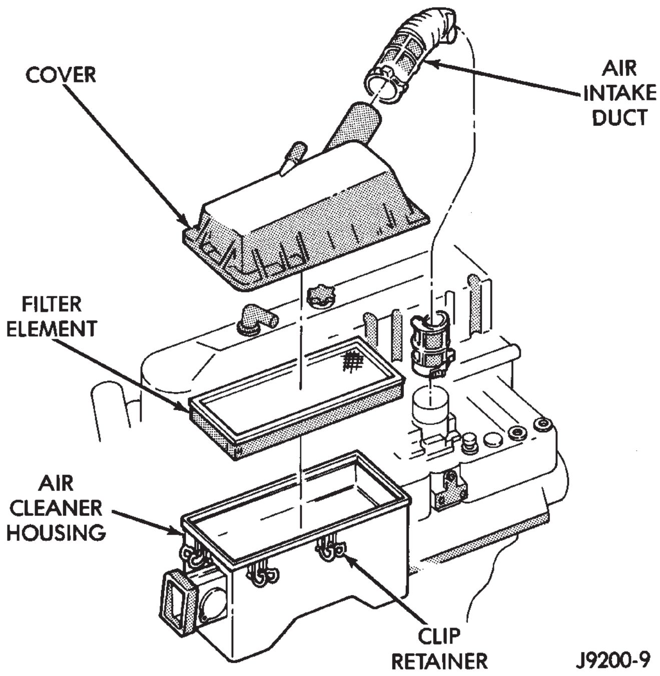


Fig. 5 Engine Air Cleaner

RECOMMENDED MAINTENANCE

Crankcase ventilation (CCV) systems should be tested, inspected and serviced at the same time as the air filter.

Refer to Group 25—Emission Control Systems for additional serviced information.

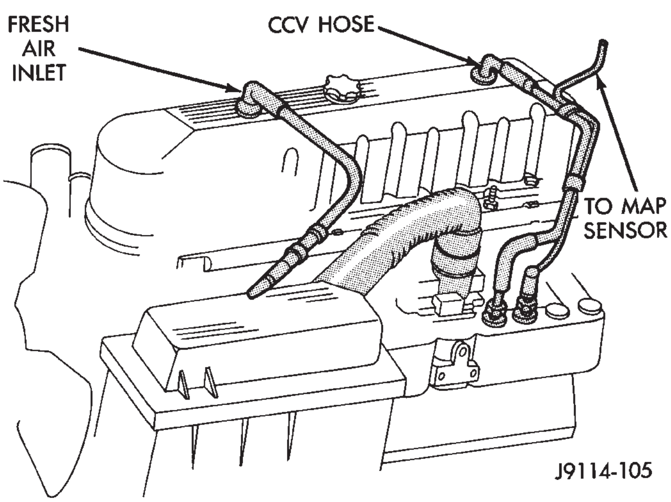


Fig. 6 CCV System—4.0L Engine

FUEL SYSTEM

INSPECTION

The fuel system filler cap, nozzle, tubes, hoses, and connections should be inspected periodically.

FUEL FILTER

Replace fuel filter at interval specified in maintenance schedule. For proper diagnosis and service procedures refer to Group 14, Fuel System.

GAS0LINE ENGINE FUEL REQUIREMENTS

All gasoline engines require fuel that has a minimum octane rating of 87 determined by (R + M)/2 calculation method.

In addition, use of a brand of unleaded gasoline that contains detergent, corrosion and stability additives is recommended. Gasoline with these type of additives will improve fuel economy and reduce emissions.

ALCOHOL/GASOLINE BLENDS

Many brands of blended unleaded gasoline are now available. This type of blended fuel is sometimes referred to as reformulated gasoline.

Unleaded gasoline is blended with oxygenated-type fuels to produce a clean air gasoline in many areas. The use of this type of blended fuel is recommended.

ETHANOL—Unleaded gasoline and ethanol blended fuels are a mixture of 10 percent ethanol and 90 percent unleaded gasoline. This is an acceptable blend of fuel.

MTBE— MTBE blended fuels are a mixture of unleaded gasoline and up to 15 percent MTBE (Methyl Tertiary Butyl Ether). Unleaded gasoline blended with MTBE is acceptable.

ETBE— This fuel is a mixture of unleaded gasoline and up to 17 percent ETBE (Ethyl Tertiary Butyl Ether). Unleaded gasoline blended with ETBE is acceptable.

METHANOL—Do not use unleaded gasoline blended with methanol. The use of this type of alcohol can result in engine performance deterioration and damage to critical components.

Engine problems that result from use of methanol possibly will not be covered by new vehicle warranty.

ADDITIVES MIXED WITH GASOLINE

Use of fuel system cleaning additives should be avoided. Many of these solutions could contain highly active solvents.

VACUUM OPERATED, EMISSION CONTROL COMPONENTS

The vacuum operated emission control components should be serviced at interval specified in maintenance schedule.

Refer to Group 25—Emission Control Systems for additional information.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

Replace EGR valve and tube, and clean passages at interval specified in applicable maintenance schedule. If necessary, refer to Group 25—Emission Control Systems for additional information.

OXYGEN (O_2) SENSOR

Replace O_2 sensor at interval specified in applicable maintenance schedule.

IGNITION CABLES, DISTRIBUTOR CAP AND ROTOR

Replace ignition cables, distributor cap, and rotor at interval specified in applicable maintenance schedule. Refer to Group 8D—Ignition Systems for additional information.

IGNITION TIMING

Test and adjust, if necessary, ignition timing at interval specified in applicable maintenance schedule. Refer to specifications listed on engine Emission Control Information label. Refer to Group 8D—Ignition Systems and to Group 25—Emission Control Systems for additional service information.

SPARK PLUGS

Replace spark plugs at interval specified in applicable maintenance schedule. Refer to Group 8D—Ignition Systems for additional information.

BATTERY

Replace battery at interval specified in applicable maintenance schedule.

RECOMMENDED MAINTENANCE

The battery acid level should be checked and the cable clamps should be inspected for corrosion. This should be done when the engine 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.

INSPECTION/SERVICE

WARNING: WEAR SAFETY GLASSES, RUBBER GLOVES AND PROTECTIVE CLOTHING WHEN HANDLING/SERVICING A BATTERY. THE BATTERY 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. It could possibly be necessary to loosen the battery holddown clamp to remove the caps. Maintain the acid 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. This will prevent it from freezing.

(4) Remove the battery holddown strap and clean the battery case/battery tray. Clean with a bicarbonate of 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/PLASTIC COMPONENTS

INSPECTION

It is recommended that following listed components be inspected at same time as scheduled underhood maintenance is conducted. Rubber/plastic components should be replaced immediately if there is any evidence of deterioration.

Inspect exterior surface of rubber hoses and nylon tubing for evidence of heat damage. The rubber hose and nylon tubing located close to an exhaust manifold should be given attention. Verify nylon tubing located at these areas has not collapsed.

Inspect rubber hose routing to ensure that hoses do not contact any heat source or moving component.

Inspect all hose connections. Verify they are secure and there is no fluid leakage.

ENGINE MOUNTS

Inspect rubber in the engine mounts for excessive wear. Slight wear at ends will not affect functioning of an engine mount. If excessive engine movement is detected, engine mount(s) should be replaced.

SERPENTINE DRIVE BELT

Replace drive belt and adjust drive tension at interval specified in applicable maintenance schedule. If necessary, refer to Group 7—Cooling Systems for replacement and adjustment and procedures.

INSPECTION

It is recommended that serpentine drive belt be routinely inspected for cracks, fraying and excessive wear.

EXHAUST SYSTEM

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

Inspect exhaust system at interval specified in applicable maintenance schedule.

INSPECTION

Inspect for cracked or loose joints, corrosion damage, and worn or broken hangers. Replace all components that are damaged. Do not attempt repair.:

- Exhaust system leaks, misalignment
- Contact with body panels or frame
- Catalytic converter bulging or excessive heat damage

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

AIR-CONDITIONER COMPRESSOR

LUBRICANT AND REFRIGERANT

The lubricant level in air-conditioner compressor should be checked if there are indications that oil was lost. Loss of lubricating oil usually accompanies a loss of refrigerant. The presence of bubbles in filter/drier sight glass indicates that loss of refrigerant has occurred.

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

DRIVETRAIN

INDEX

CLUTCH AND BRAKE PEDAL BUSHINGS

If clutch and brake pedal mechanism squeaks, pivot bushings should be lubricated. Use MOPAR®Multi-Purpose Lubricant, or an equivalent.

CLUTCH MASTER CYLINDER

HYDRAULIC FLUID LEVEL

The clutch master cylinder fluid level should be inspected at same time as scheduled underhood maintenance is conducted. The fluid level should be at internal indicating line (Fig. 1). If fluid level is low, locate and correct any possible leaks. Fill reservoir with clean, moisture-free brake fluid.

CAUTION: Do not allow any petroleum base fluids to contaminate clutch hydraulic system because seal damage will result.

FLUID SPECIFICATION

The only fluid recommended for use is MOPAR®Brake Fluid, or an equivalent product. The product is identified as SAE J-1703 or DOT 3 fluid.**Do not use any other type of fluid.**

CAUTION: Never use reclaimed brake fluid or fluid from an unsealed container. Do not use fluid that has been opened and allowed to stand for an extended length of time.

TRANSMISSIONS

SPECIAL ADDITIVES

Chrysler Motors does not recommend addition of any special additives to a transmission. Black light detection dye can be used as an aid in detecting fluid leaks.

GEAR SHIFTER BOOTS

Inspect shifter boots periodically for stone and heat damage. Replace, if necessary.

SEVERE DRIVING CONDITIONS

The interval between transmission drain and refill maintenance should be decreased to:

- AX15 manual transmission—every 29 000 km (18,000 miles)

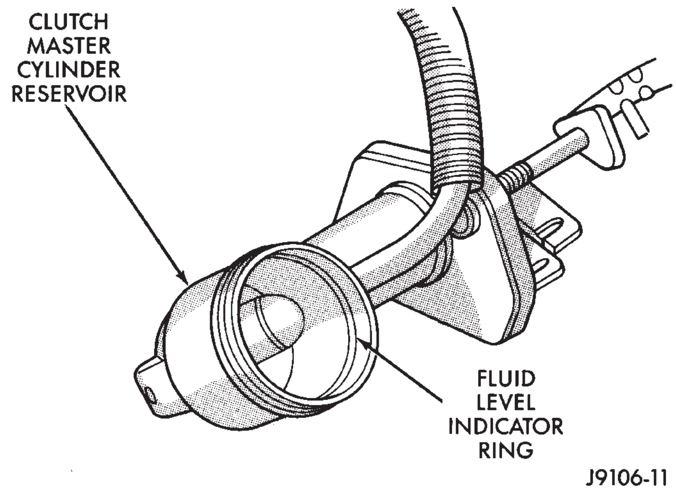


Fig. 1 Fluid Level Indicating Ring

- Automatic transmission—every 19 000 km (12,000 miles)

A severe driving condition includes:

- Extended operation with heavy cargo loads
- Driving in deep mud or snow
- Off-road operation (4WD)
- Trailer towing
- Operation as a commercial vehicle
- Snow plowing

MANUAL TRANSMISSIONS

INSPECTION/LUBE OIL LEVEL

The manual transmission should be inspected for leakage whenever other service is necessary under vehicle. To check lube oil level, remove fill hole plug (Fig. 2). If level is below bottom of fill hole, raise level to bottom of fill hole with:

- SAE 75W90, API Quality Grade GL-5 gear lubricant

DRAIN AND FILL

The AX15 transmission fluid should be changed according to interval listed in Maintenance Schedule. Also, refer to Fluid Capacities chart.

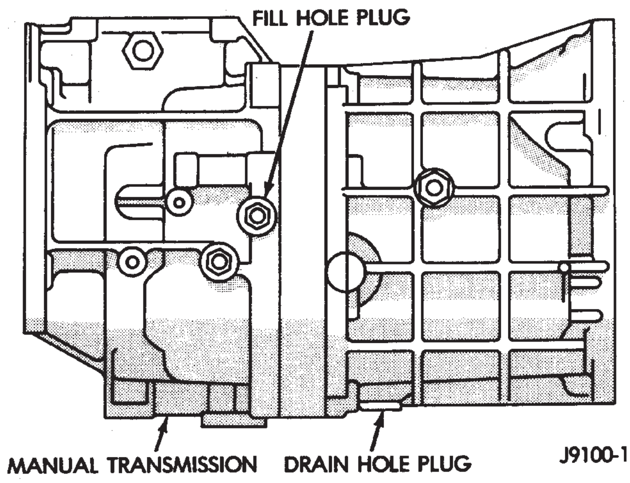


Fig. 2 Manual Transmission Fill/Drain Hole Plugs

AUTOMATIC TRANSMISSIONS

FLUID LEVEL

It is recommended that fluid (ATF) level in automatic transmissions be checked while involved with other underhood maintenance.

Vehicle operation with an incorrect ATF level will greatly reduce life of transmission.

The condition of ATF also should be determined. If ATF is dark in color and has a strong odor, fluid should be changed. Also filter should be replaced and bands adjusted.

The following procedure must be used to check automatic transmission fluid (ATF) level.

(1) Position vehicle on level ground.

(2) Operate engine at idle speed.

(3) Apply parking brake.

(4) Place gear selector in N (neutral).

(5) Remove dipstick from tube. Wipe it clean and determine if ATF is hot or warm.

Hot ATF has a temperature of approximately 82°C (180°F). Warm ATF is when its temperature is between 29-52°C (85-125°F).

(6) Wipe dipstick clean and completely insert it into tube. Remove dipstick from tube and observe ATF level.

(7) If ATF is hot, level should be in crosshatched area that is marked OK.

(8) If ATF is warm, level should be between two dimples.

CAUTION: Do not overfill transmission.

(9) Adjust level of ATF accordingly.

It is important to use correct fluid in AW4 automatic transmission. Mercon™ ATF should be used.

(10) Insert dipstick into tube.

DRAIN, FILTER CHANGE, BAND ADJUSTMENT AND REFILL

The Maintenance Schedule chart lists intervals at which transmission should be serviced. Also, refer to Fluid Capacities chart for fill capacity.

The torque converter does not have a drain plug. No attempt should be made to drain converter. Refer to Group 21—Transmissions for transmission drain and refill procedures.

TRANSFER CASE (4WD VEHICLES)

INSPECTION

The transfer case fluid level should be checked whenever maintenance is necessary under vehicle.

FLUID LEVEL

The vehicle must be level when fluid level is checked.

The transfer case drain/fill hole plugs are located at rear of housing (Fig. 3).

Determine transfer case fluid level according to following procedure.

(1) Raise and support vehicle.

(2) Remove fill hole plug (Fig. 3). The fluid level should be at bottom edge of fill hole. The level can be slightly below bottom edge of fill hole if fluid is cold.

(3) If level is not acceptable, raise fluid level to bottom edge of fill hole with:

• MOPAR®ATF PLUS or an equivalent Dexron II® ATF.

Add fluid in small amounts to raise level.

(4) Install fill hole plug (Fig. 3). Tighten fill hole plug to 27 N•m (20 ft-lbs) torque.

(5) Remove support and lower vehicle.

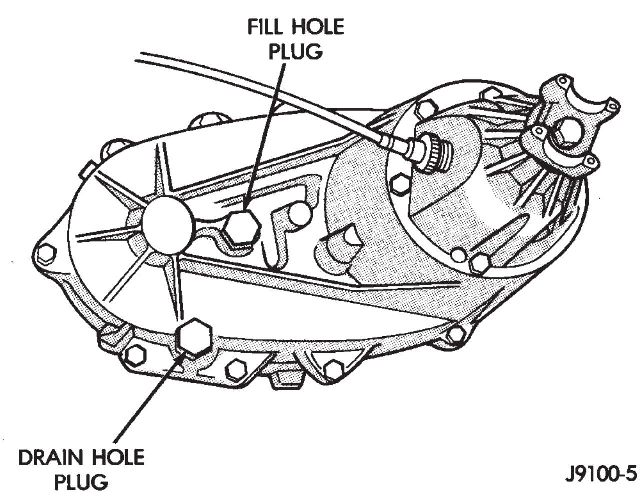


Fig. 3 Transfer Case—Typical

FLUID DRAIN AND REFILL

(1) Raise and support vehicle.

(2) Remove fill hole plug (Fig. 3) from transfer case.

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

(4) Remove drain hole plug. Drain fluid from transfer case into container.

CAUTION: Do not over-tighten drain and fill hole plugs.

(5) Install drain hole plug (Fig. 3). Tighten drain hole plug to 27 N●m (20 ft-lbs) torque.

(6) Fill transfer case to bottom edge of fill hole with:

• MOPAR®ATF PLUS or an equivalent Dexron II® ATF

(7) Install fill hole plug. Tighten plug to 27 N●m (20 ft-lbs) torque.

(8) Remove support and lower vehicle.

FLUID SPECIFICATION

• MOPAR®ATF PLUS or an equivalent Dexron II® ATF

SHIFT MECHANISM

The transfer case shift mechanism should be cleaned and lubricated as necessary to maintain ease of operation.

Lubricate pivot, sliding contact areas and shift linkage pivot ends with light-weight engine oil (Fig. 4).

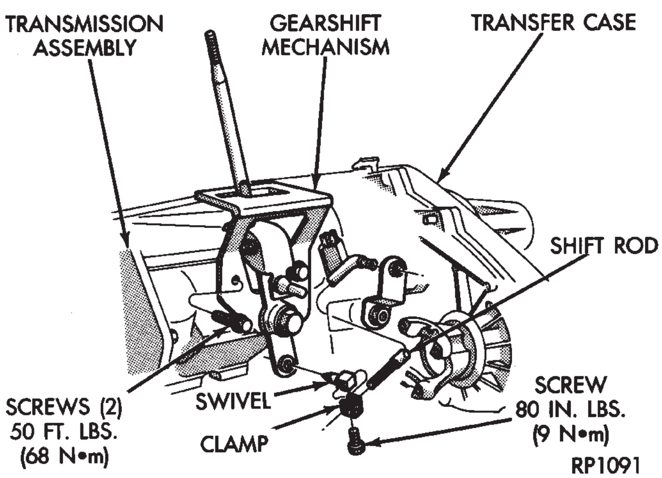


Fig. 4 Shift Mechanism Lubrication—Typical

AXLES

INSPECTION

For normal vehicle operation, periodic axle lubricant level checks are not necessary. However, exterior of axle housing should be inspected for leakage. Check lubricant level to confirm leakage.

LUBRICANT LEVEL

(1) Raise vehicle with an axle or wheel type hoist. Support vehicle.

(2) The rear axle differential housings have a rubber, PRESS-IN type fill plug (Fig. 5). Pry fill plug from differential housing. The front axle (4WD vehicles) differential housings have a threaded-type fill plug (Fig. 5). Remove fill plug from differential housing.

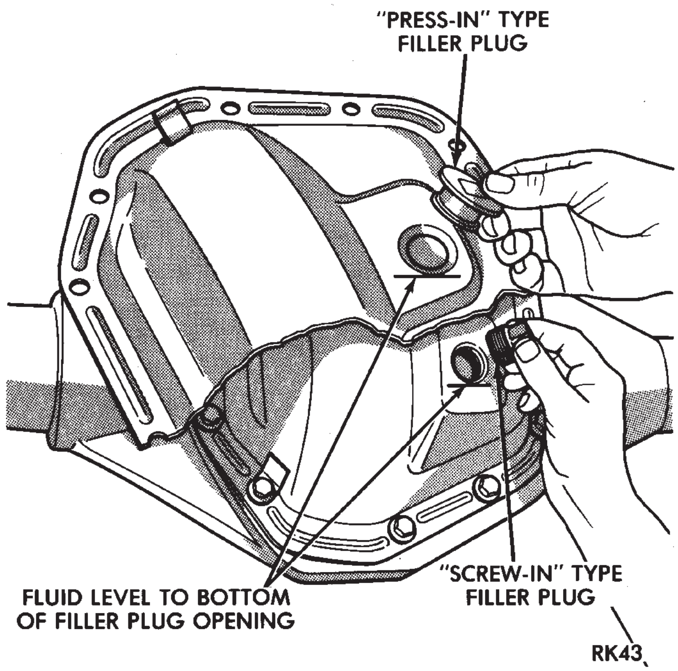


Fig. 5 Axle Fill Plug Location—Typical

(3) The lubricant level should be within 12 mm (1/2 in) of fill hole.

(4) If necessary, add lubricant.

(5) Install fill hole plug in differential housing (Fig. 5).

DRAIN AND REFILL

Periodic axle lubricant change for normal vehicle operation is not necessary. However, lubricant should be changed if it is contaminated. Refer to chart below-.**All axles contain SAE 80W-90 multi-purpose type hypoid gear lubricant when delivered from factory.**

Use same maintenance procedures for rear axles equipped with a limited-slip differential.

LUBRICANT VISCOSITIES FOR ANTICIPATED TEMPERATURE RANGES

Anticipated Temp. Range	Recommended SAE Grade
Above 32°C (90°F)	SAE 140 SAE 80W-140 SAE 85W-140
−23°C to 32°C (−10°F to 90°F)	SAE 90 SAE 80W-90 SAE 80W-140 SAE 85W-140
Below −23°C (−10°F)	SAE 75W SAE 75W-90 SAE 80W SAE 80W-140

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CAUTION: Water contaminated gear lubricant will result in possible failure of axle differential components. Operation of vehicle in water, will require that:

- The lubricant be drained
- The differential housing flushed (except limited-slip differentials)
- The differential refilled with fresh lubricant

LUBRICANT SPECIFICATION

A multi-purpose, hypoid gear lubricant should be used in all axles equipped with either a standard or a limited-slip differential. The use of MOPAR® Synthetic Axle Lube is necessary with trailer towing package. Trac—Loc axles require a friction additive.

FRONT AXLE PIVOT BEARINGS (4 W/D)

The front axle universal joint and pivot bearings are permanently lubricated and normally do not require service.

DRIVE SHAFTS

SLIP-YOKE LUBRICATION

When equipped with lube fittings, it is recommended that slip-yoke splines be lubricated every 9 600 km (6,000 miles). For severe usage, lubricate splines every 1 600 km (1,000 miles).

The method described below will ensure complete lubrication of slip-yoke splines.

(1) Clean Zerk type lubrication fittings.

(2) Use a lubricant dispenser to force lubricant into slip yoke Zerk type lubrication fittings.

(3) Continue lubricating until it appears at pressure relief hole in expansion plug located at slip-yoke end.

(4) Cover pressure relief hole with a finger. Continue to force lubricant into fitting until it appears at slip-yoke seal.

U-JOINT/CV-JOINT LUBRICATION

Lubrication of u-joint couplers that are not equipped with lube (Zerk) fittings is not necessary. Replacement U-joints are equipped with lube fittings. If installed, lubricate them according to information provided below.

Lubricate U-joint and CV-joints every 12 000 km (7,500 miles) for LIGHT DUTY CYCLE vehicles. For HEAVY DUTY CYCLE vehicles, couplers should be lubricated every 9 600 km (6,000 miles). If vehicle is operated in water, U-joint/CV-joint couplers should be lubricated daily.

If a vehicle, is used in a severe driving condition, lubricate U-joint/CV-joints every 4 800 km (3,000 miles).

A severe driving condition includes:

- Off-road driving
- Driving in deep mud or snow
- When 1/3 or more of vehicle operation involves driving with a full-load.

LUBRICANT SPECIFICATION

Drive shaft slip yokes and U-joint/CV-joint couplers should be lubricated with, NLGI GC-LB lubricant. The U-joints/CV-joint couplers should be lubricated with MOPAR®Multipurpose Lubricant, NLGI GC-LB).

CHASSIS AND BODY

INDEX

STEERING LINKAGE

INSPECTION

Whenever a vehicle is raised for lubrication/general maintenance under vehicle, all steering components should be inspected.

LUBRICATION SCHEDULE

The steering linkage is lubricated during manufacture with a long-life chassis lubricant. However, it is recommended that linkage be inspected and lubricated after each:

- 24 000 km (15,000 miles) interval or every 6 months, for 2WD vehicles subject to LIGHT DUTY CYCLE Maintenance Schedule
- 9 600 km (6,000 miles) interval or every 6 months, for 2WD vehicles subject to HEAVY DUTY CYCLE Maintenance Schedule
- 12 000 km (7,500 miles) interval or every 6 months, for 4WD vehicles subject to LIGHT DUTY CYCLE Maintenance Schedule
- 9 600 km (6,000 miles) interval or every 6 months, for 4WD vehicles subject to HEAVY DUTY CYCLE Maintenance Schedule.

LUBRICATION

(1) Inspect steering linkage for looseness and excessive wear.

(2) Replace, all ruptured seals and damaged steering linkage components.

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

(3) Lubricate steering linkage:

- Clean Zerk type lubrication fittings on tie-rod and center link ball-stud ends
- Lubricate ball studs with MOPAR®Multi-Mileage Lubricant
- Wipe excess lubricant from exterior surfaces of ball joints

FRONT SUSPENSION BALL JOINTS

INSPECTION

When a vehicle is raised for lubrication/general maintenance, ball joints should be inspected.

LUBRICATION SCHEDULE

The front suspension ball joints are semi-permanently lubricated during manufacture with a special, long-life chassis lubricant. However, it is recommended that ball joints be inspected and studs lubricated:

- At each 36 000 km (22,500 miles) interval or every 2 years, for vehicles subject to LIGHT DUTY CYCLE Maintenance Schedule
- At each 9 600 km (6,000 miles) interval or every 2 years, for vehicles subject to HEAVY DUTY CYCLE Maintenance Schedule.

4WD vehicles that are frequently driven off-road should be lubricated at every engine oil change.

LUBRICATION

(1) Inspect front suspension.

(2) Replace all torn ball-stud seals and damaged ball joints. Damaged seals should be replaced to prevent leakage and contamination.

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

(3) Lubricate ball studs:

- Clean Zerk type lubrication fittings on ball-stud ends
- Lubricate ball studs with MOPAR®Multi-Mileage Lubricant
- Wipe excess lubricant from exterior surfaces of ball joints

POWER STEERING SYSTEM

FLUID LEVEL

WARNING: THE POWER STEERING FLUID LEVEL SHOULD ALWAYS BE DETERMINED WITH THE ENGINE OFF TO PREVENT PERSONAL INJURY FROM ROTATING ENGINE COMPONENTS.

The power steering fluid should be checked whenever engine is being serviced for other reasons. Clean outside of cap before removing. The fluid should be at proper level indicated on cap dipstick (Fig. 2).

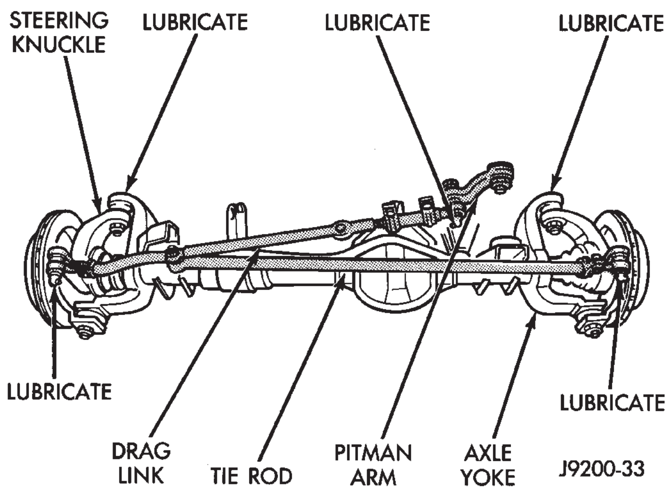

Fig. 1 Steering Components—Typical

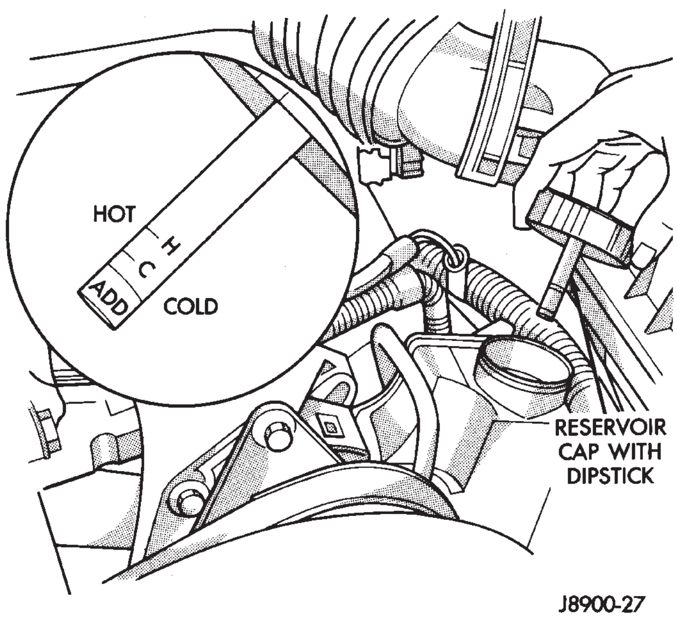

Fig. 2 Power Steering Reservoir & Cap—Typical

The reservoir fluid level can be determined with fluid either hot or cold. If fluid level is below FULL HOT or FULL COLD marks on dipstick, add power steering fluid. The dipstick is attached to reservoir cap (Fig. 2).

FLUID SPECIFICATION

Use only MOPAR®Power Steering Fluid.

FRONT WHEEL BEARINGS

The front wheel bearings on a ZJ vehicle are permanently lubricated. If service is necessary refer to Group 2—Front Suspension And Axle.

LOWER AND UPPER SUSPENSION ARM BUSHINGS

INSPECTION SCHEDULE

The lower and upper suspension arm bushings should be inspected each time underside of vehicle is serviced.

INSPECTION

The lower suspension arm bushings can be visually inspected by raising vehicle on a hoist and inspecting from underneath. The upper suspension arm bushings can be inspected after removing front wheels. If failure exists, replace bushing (refer to Group 2—Front Suspension for proper procedures).

The suspension arm bushings never should be lubricated.

GUIDELINES

(1) Faulty bushings are detected by bushing being off-center in relation to outer sleeve.

(2) Total failure is evident by excessive movement within bushing.

(3) Small cracks in outer, non-confined rubber does not indicate failure of rubber.

POWER BRAKE SYSTEM

Vehicles are equipped with power disc brakes at front wheels and drum brakes at rear wheels.

FLUID SPECIFICATION

Power brake systems require MOPAR®Heavy-Duty Brake Fluid.

The use of an equivalent product identified with FMVSS No. 116, DOT-3 and SAE J-1703 Standard designations is permissible.

Use fresh brake fluid only when adding fluid to reservoir. Never use fluid that does not conform to DOT/SAE Standards, or fluid from a container that has been left open.

CAUTION: The use of a substandard brake fluid could result in sudden brake failure during hard, prolonged braking.

CAUTION: Do not allow petroleum base fluids to contaminate brake fluid. Seal damage will result.

BRAKE FLUID LEVEL

ANTI-LOCK BRAKE SYSTEM

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

(1) Clean cover before removing it.

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

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

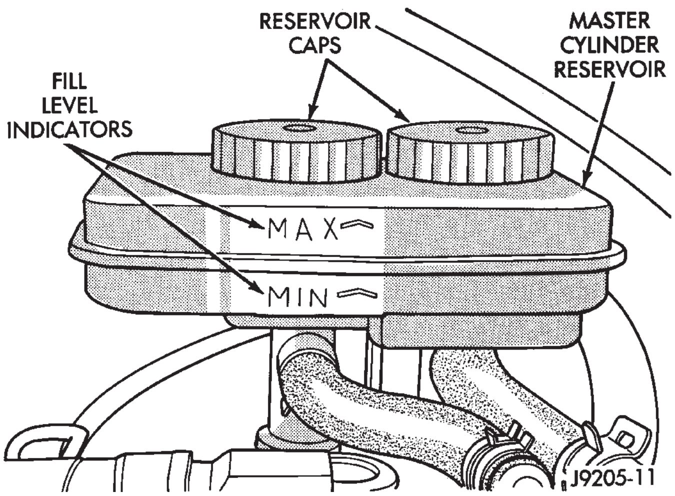

Fig. 3 Reservoir Fluid Level—Anti-Lock Brake System

BRAKE SYSTEM INSPECTION

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

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

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

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

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

(6) Inspect caliper dust boots for damage or tears. Inspect for an indication of brake fluid leakage. Inspect bushings and pins for corrosion. Inspect for tears or a binding condition.

(7) Inspect rear wheel cylinder dust boots for fluid leaks. Inspect pistons and cylinder bores for proper appearance.

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

BRAKE HOSES/TUBING

The rubber brake hoses should be inspected for:
- Correct length
- Severe surface cracking
- Swelling
- Pulling
- Scuffing
- Excessively worn areas

(1) Inspect all hoses for kinks, a distorted condition and fluid leakage.

(2) Inspect hose and tubing routing under vehicle. Verify that no hose/tubing is rubbing against any underbody components.

PARK BRAKE

(1) Engage park brake lever and then release it.

(2) Test parking brake for smooth operation and vehicle-holding capability.

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

(4) With park brake released, rear wheels should rotate without restriction. Adjust park brake cable tension at equalizer. Refer to Group 5—Brakes, for component information.

(5) Repair any park brake malfunctions.

BRAKE OPERATIONAL TEST

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

(2) Note any indication of brake overheating, wheel dragging or vehicle pulling to one side.

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

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

BODY COMPONENT MECHANISMS

LUBRICATION REQUIREMENTS

All operating mechanisms and linkages should be lubricated when necessary. This will maintain ease of operation and provide protection against rust and excessive wear. Door weatherstrip seals should be lubricated to prolong their life as well as to improve door sealing.

LUBRICANT SPECIFICATIONS

All applicable exterior and interior vehicle operating mechanisms should be:
- Inspected
- Cleaned
- All pivoting/sliding contact areas on mechanisms should then be lubricated.

MOPAR®Multi-Mileage Lubricant or an equivalent, should be used to lubricate mechanisms. The door weatherstrip seals should be lubricated with silicone lubricant spray. Refer to Body Lubricant Specifications chart below for additional lubricant applications.

LUBRICATION

(1) When necessary, lubricate body component operating mechanisms with specified lubricants.

BODY LUBRICANT SPECIFICATIONS

COMPONENT	SERVICE INTERVAL	LUBRICANT
Door Hinges	As Required	Engine Oil
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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(2) Apply silicone lubricant to a cloth. Wipe it on door seals to avoid over-spray that can soil passenger clothing.

(3) Before applying lubricant, component should be wiped clean. After lubrication, any excess lubricant should be removed.

(4) The hood latch, latch release mechanism, latch striker and safety latch should be lubricated periodically.

(5) The door lock cylinders should be lubricated 2 times each year (preferably autumn and spring):

• Spray a small amount of lock cylinder lubricant directly into lock cylinder
• Apply a small amount to key and insert it into lock cylinder
• Rotate it to locked position and then back to unlocked position several times
• Remove key. Wipe lubricant from it with a clean cloth to avoid soiling of clothing.

TIRES

RECOMMENDED MAINTENANCE

The condition of tires should be inspected. The inflation pressures tested/corrected at same time as engine oil is changed and oil filter is replaced.

The tires/wheels should be rotated periodically to ensure even tread wear. The tires/wheels should be rotated at first 12 000 km (7,500-miles) interval. Thereafter, at each 24 000 km (15,000-miles) interval.

INSPECTION

Inspect tires for excessive wear, damage. Test tires for recommended inflation pressure. Refer to Group 22—Tires And Wheels for tire pressure charts, tire replacement, and treadwear indicators.

ROTATION

Tires/wheels should be rotated according to recommended interval.

Refer to Group 22—Tires And Wheels for recommended method of tire/wheel rotation.

HEADLAMPS

Every six months check headlamp beams to ensure that headlamp beams are correctly positioned.

AIM ADJUSTMENT

Refer to Group 8L—Lamps for headlamp aim adjustment procedures.

SPEEDOMETER CABLE

SERVICE INFORMATION

Speedometer cable lubrication is not necessary. For service information involving noisy or erratic cables, refer to Group 8E—Instrument Panel and Gauges.

FRONT SUSPENSION AND AXLE

CONTENTS

GENERAL INFORMATION

FRONT SUSPENSION

The Grand 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 front suspension is designed to allow each wheel to adapt to different road surfaces without greatly affecting the opposite wheel. The wheels are mounted to hub/bearings that ride on tapered bearings on the steering knuckle. The hub/bearing design is not serviceable and is replaced as a unit only. The steering knuckles turn (pivot) on replaceable ball studs mounted on the axle tube yokes.

The upper and lower suspension arms use bushings to isolate road noise. The suspension arms are bolted to the frame and axle through the rubber bushings. The lower suspension arm uses cam bolts at the axle

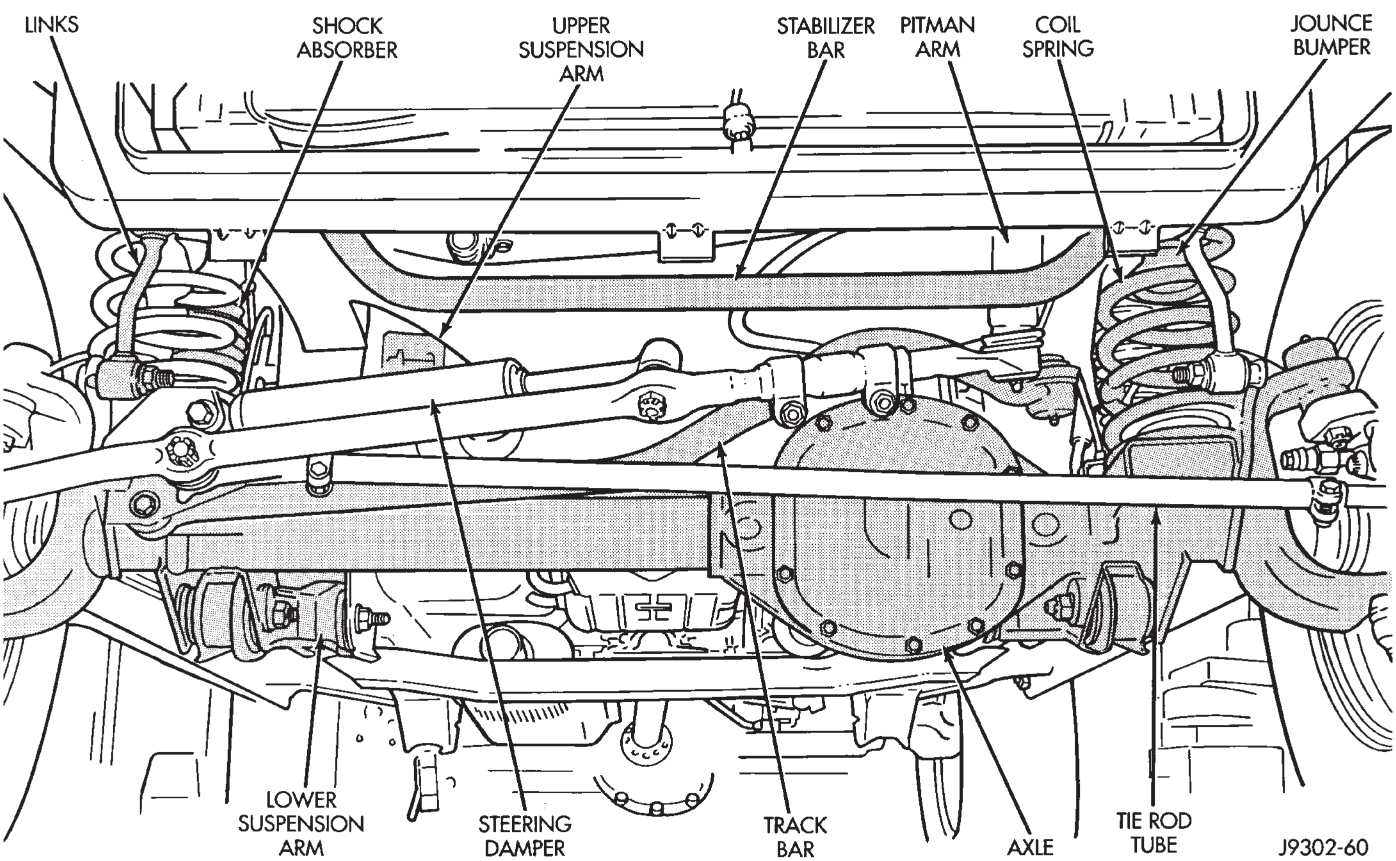


Fig. 1 Front Suspension

to allow for caster and pinion angle adjustment. The suspension arm travel (jounce or rebound) is limited through the use of rubber bumpers.

All suspension components that use rubber bushings should be tightened with the vehicle at normal height. If the springs are not at their normal ride position, vehicle ride comfort could be affected. Rubber bushings must never be lubricated.

The vehicles use coil springs mounted up in the fender shield that is part of the unitized body bracket. There is a rubber doughnut isolator between the top of the spring and bracket. The bottom of the spring seats on the axle pad and is retained with a clip.

Ride control is accomplished through the use of dual-action shock absorbers. The shocks dampen the jounce and rebound as the vehicle travels over various road conditions. The top of the shock absorbers are bolted to the 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 equalize the vehicle body in relationship to the suspension. The bar extends across the front underside of the chassis and connects to the frame rails. The links are connected to the axle brackets. All mounting points of the stabilizer bar are isolated by rubber bushings.

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

FRONT DRIVE AXLE

The integral type housing, has the centerline of the pinion set below the centerline of the ring gear.

The axles are equipped with A.B.S. brake systems. 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.

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. 2). Build date identification codes are stamped on the axle shaft tube cover side.

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

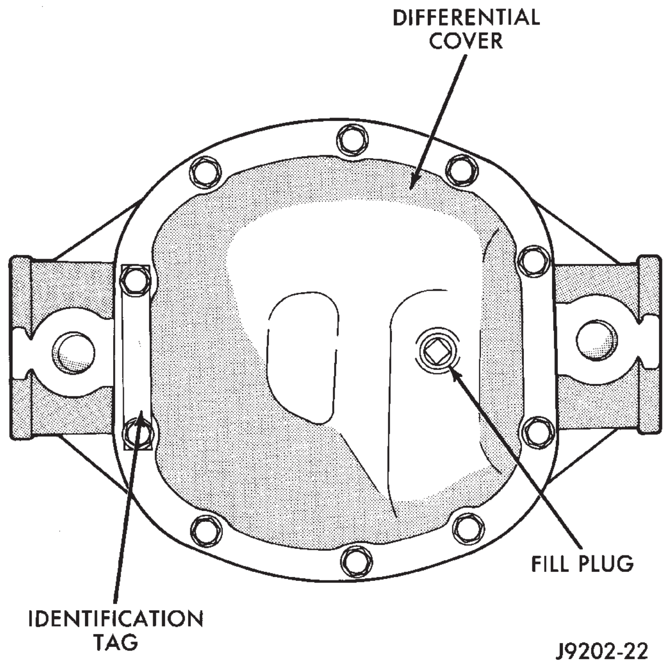


Fig. 2 Model 30 Differential Cover

- 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 the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 3).

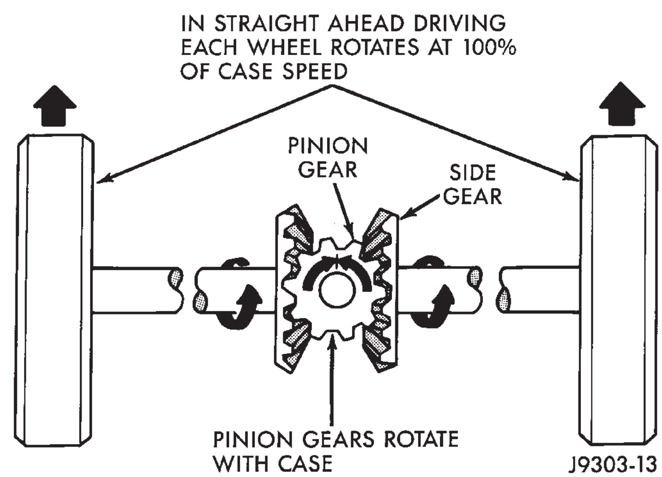


Fig. 3 Differential Operation—Straight-Ahead Driving

When turning corners, the outside wheel must travel a greater distance than the inside wheel in order to complete a turn. This difference must be compensated for in order to prevent the wheels from scuffing and skidding through the turn. To accomplish this, the differential becomes effective allowing the axle shafts to turn at unequal speeds (Fig. 4). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

TUBE AXLE (2WD VEHICLES)

The front axle used on two-wheel drive vehicles is a one-piece, tubular axle (Fig. 5). 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.

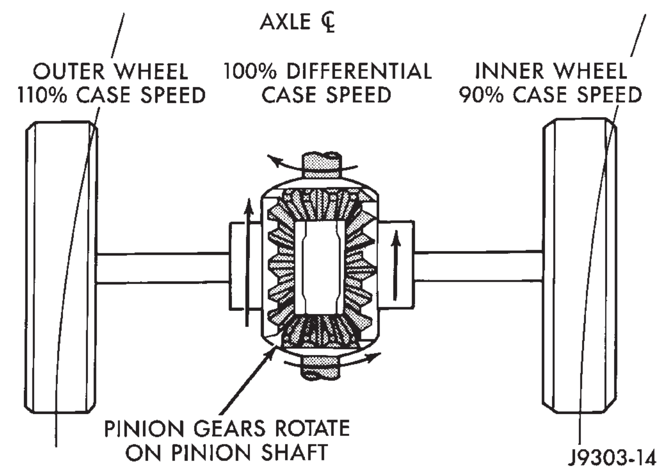


Fig. 4 Differential Operation—On Turns

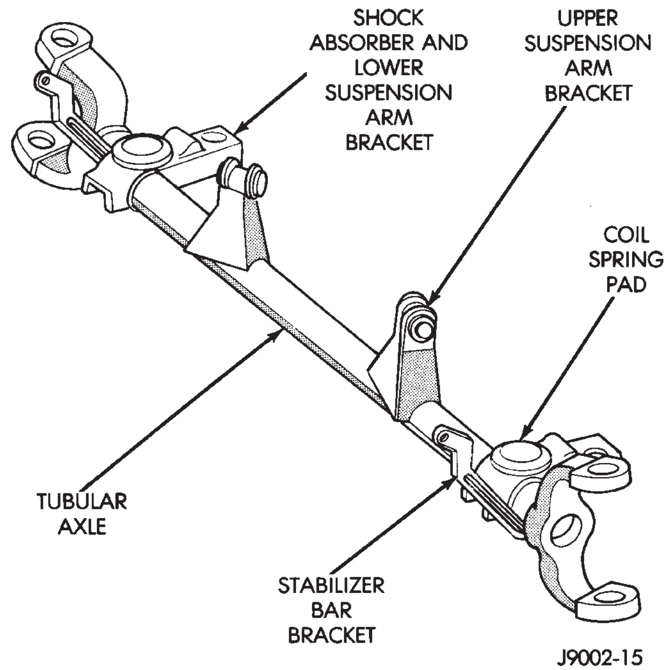


Fig. 5 Front Axle— 2WD Vehicles

FRONT WHEEL ALIGNMENT

GENERAL INFORMATION

Front wheel alignment involves the correct positioning of the tire contact patch in relation to the pavement. The positioning is accomplished through the suspension and steering linkage adjustments. An alignment is essential for efficient steering and directional stability. The most important factors of front end alignment are camber, caster 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.

- CAMBER is the number of degrees the top of the wheel is tilted either inward or outward. An excessive negative camber angle will cause tread wear at the inside of the tire. An excessive positive camber angle will cause tread wear at the outside of the tire (Fig. 1).
- CASTER is the number of degrees of forward or rearward tilt of the steering knuckles. Forward tilt provides a negative caster angle. Rearward tilt provides a positive caster angle (Fig. 1).
- WHEEL TOE POSITION is the difference between the leading and trailing inside edges of the front tires (Fig. 1). Incorrect wheel toe position is the most common cause of unstable steering and steering wheel off-center. 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. This will 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 tread wear. Refer to Group 22, Wheels and Tires for diagnosis information.

(2) Front wheel bearings for wear or adjustment.

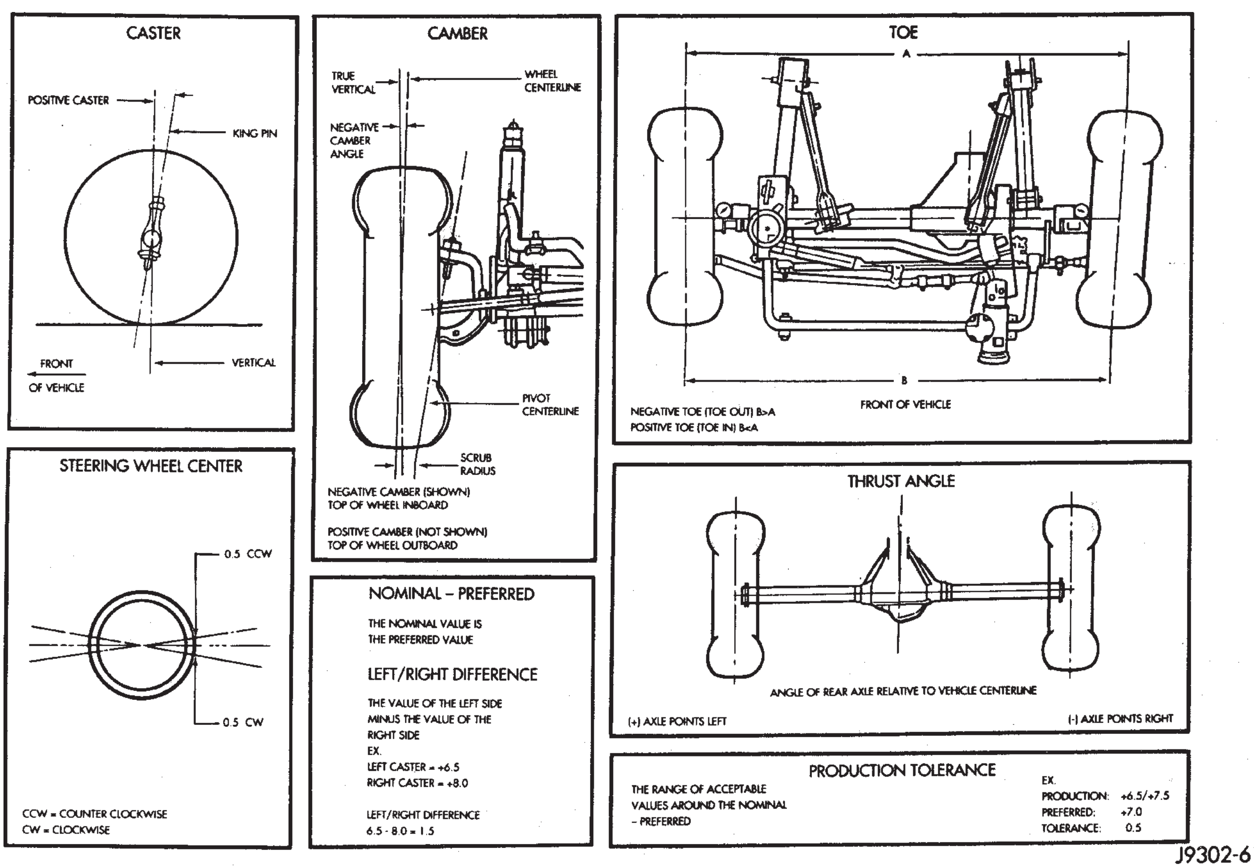


Fig. 1 Wheel Alignment Measurements

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

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

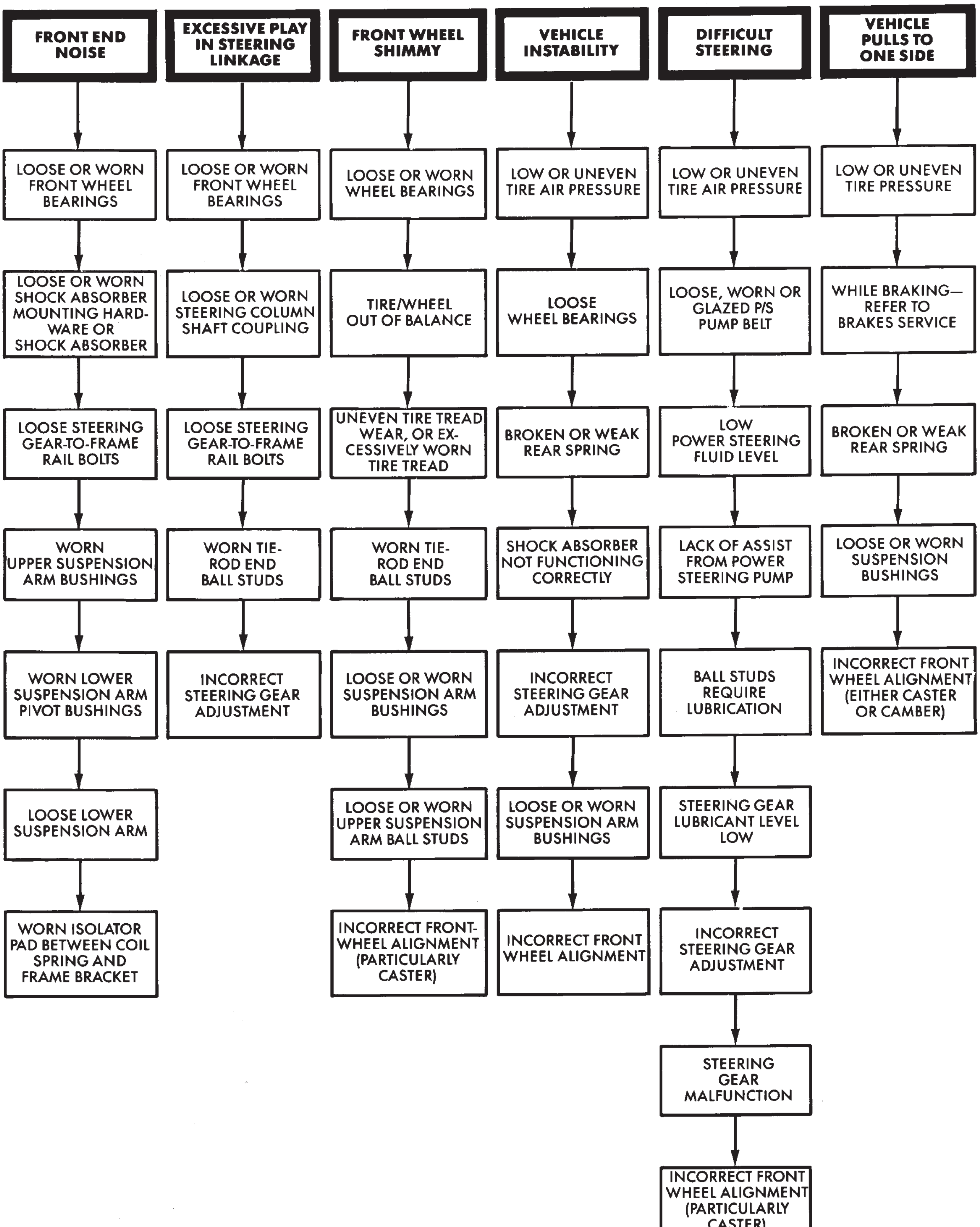
ALIGNMENT MEASUREMENTS AND ADJUSTMENTS

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 when it's at the down position. **Set the front end alignment to specifications while the vehicle is in its NORMALLY LOADED CONDITION.**

CAMBER

The wheel camber angle (Fig. 1) is preset at NEGATIVE 0.25 DEGREES (-0.25°). The angle is not adjustable and cannot be altered.

SUSPENSION AND STEERING SYSTEM DIAGNOSIS



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CASTER

The caster angle (Fig. 1) is set at POSITIVE 7 DEGREES (+7°).

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

During the road test, turn the vehicle to both the left and right. 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 rotating the cams on the lower suspension arm (Fig. 2). **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.**

TOE POSITION

The wheel toe position adjustment should be the final adjustment.

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

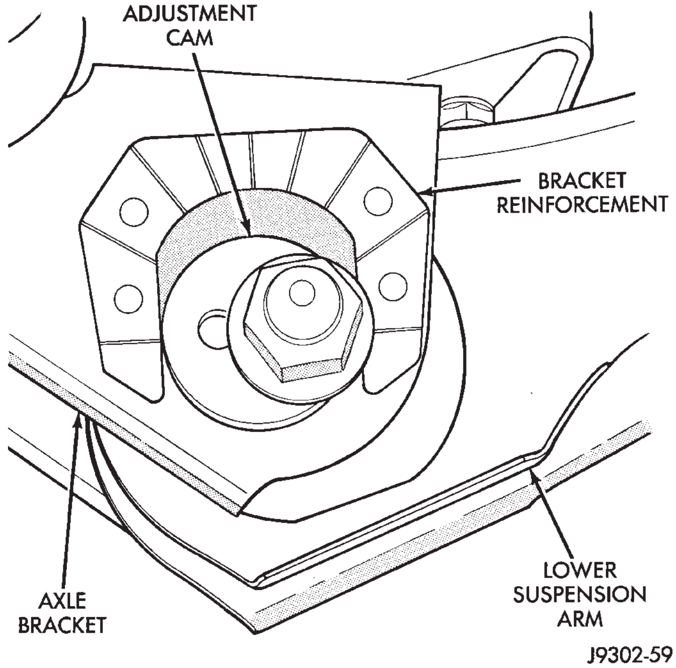

Fig. 2 Cam Adjuster

(2) Loosen the adjustment sleeve clamp bolts (Fig. 3).

(3) Adjust the right wheel toe position with the drag link. Turn the sleeve until the right wheel is at the 0.12 degrees (0.12°) TOE-IN position. Position the

FASTENER TORQUE			
LETTER	N•m	IN. LBS.	FT. LBS.
A	251	—	185
B			
C	74	—	55
D			
E	49	—	36
F	27	—	20

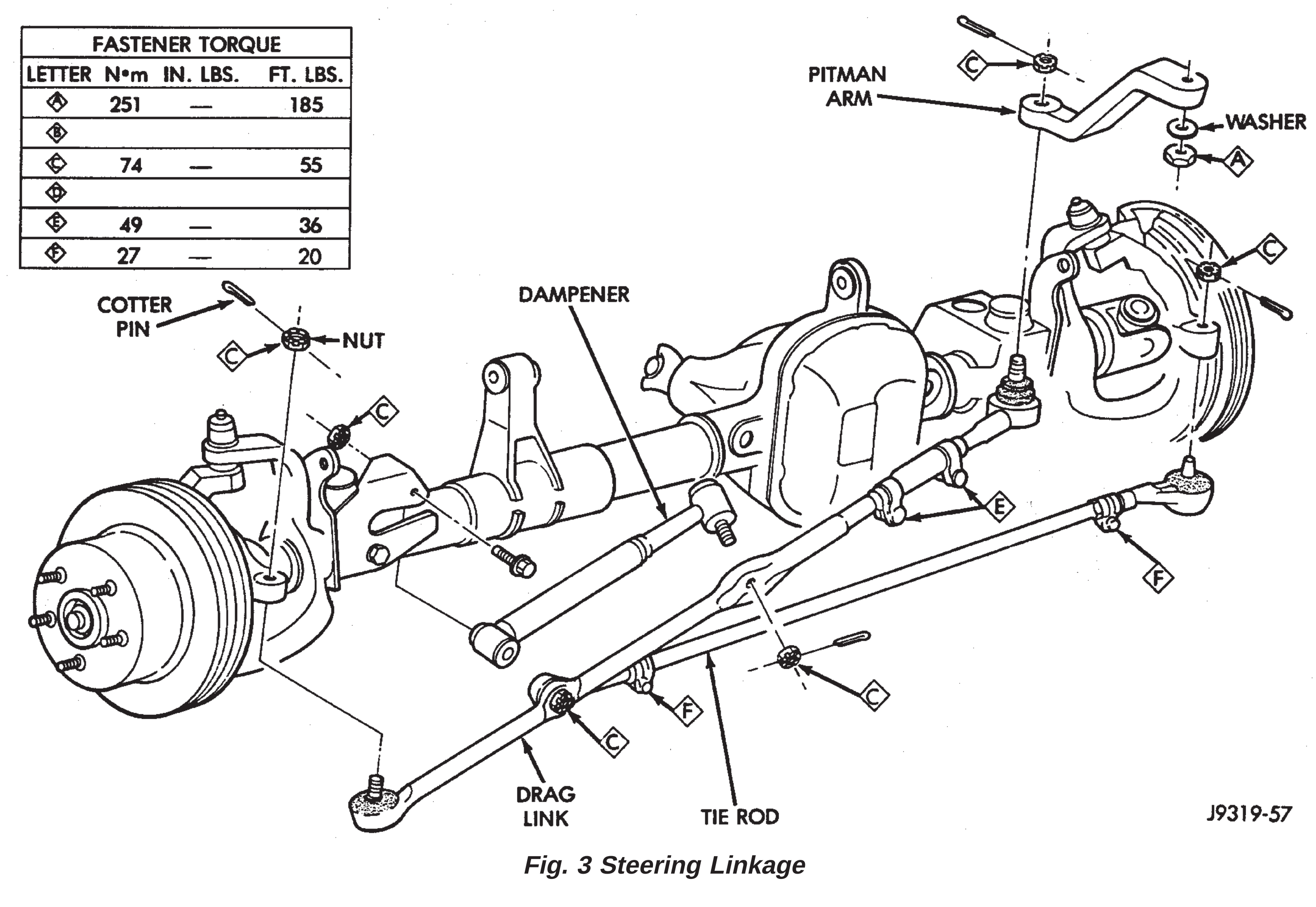

Fig. 3 Steering Linkage

clamp bolts as shown (Fig. 4) and tighten to 49 N●m (36 ft. lbs.) torque. **Make sure the toe setting does not change during clamp tightening.**

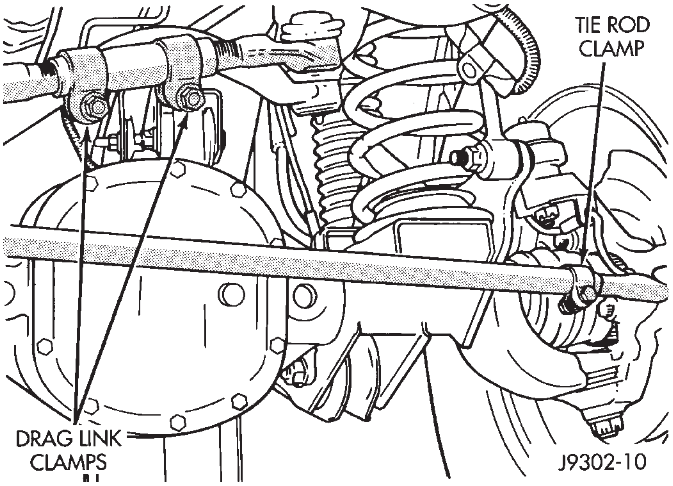

Fig. 4 Drag Link and Tie Rod Clamp Location

(4) Adjust the left wheel toe position with the tie rod. Turn the sleeve until the left wheel is at the 0.12 degrees (0.12°) TOE-IN position. Position the clamp bolts as shown (Fig. 4) 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.

ALIGNMENT SPECIFICATIONS

ADJUSTMENT	SET TO	OK RANGE
CASTER	+7°	6.5° to 7.5°
CAMBER (not adjustable)	-0.25	-0.75 to .50
WHEEL TOE-IN (each side)	0.12	0.12 TO 0.22
OUTSIDE WHEEL TURN ANGLE*	33°	33° to 32°

*Steering stops are not adjustable. J9302-62

FRONT SUSPENSION

INDEX

SERVICE INFORMATION

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. 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.

(4) Remove the frame rail bracket nuts and bolts to remove the track bar bracket (Fig. 1).

INSTALLATION

(1) Install the frame rail bracket and install the bolts and nuts (Fig. 1).

(2) Tighten the bracket to reinforcement plate bottom bolts to 121 N●m (90 ft. lbs.) torque. Tighten the bracket to stud plate nuts to 121 N●m (90 ft. lbs.) torque. Tighten the reinforcement plate side nuts to 95 N●m (70 ft. lbs.) torque.

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

(4) 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 (Fig. 1). Install the retaining nut on the stud.

(5) Remove the supports and lower the vehicle.

(6) Tighten the retaining nut at the axle shaft tube bracket to 75 N●m (55 ft. lbs.) torque.

(7) 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.

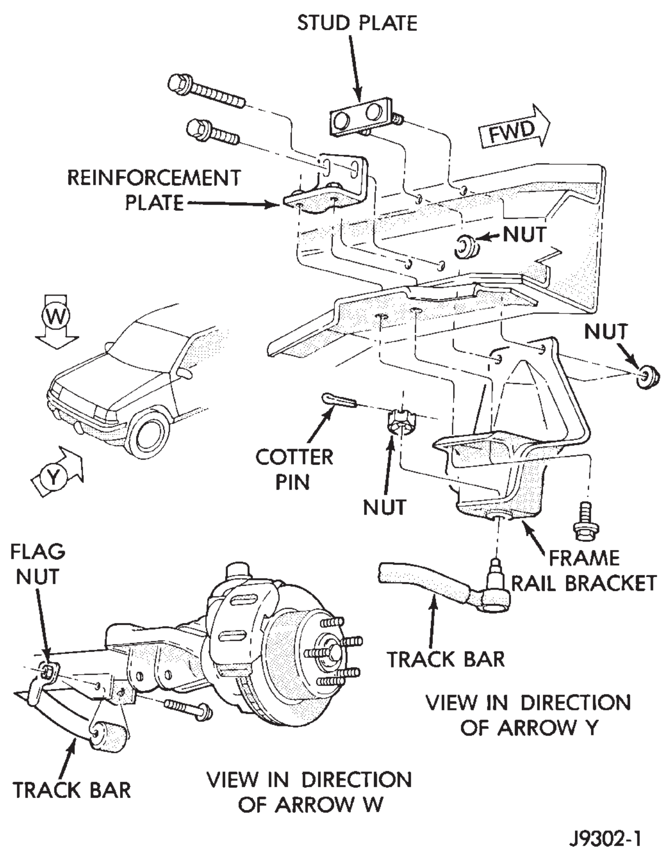

Fig. 1 Track Bar

(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.

INSTALLATION

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

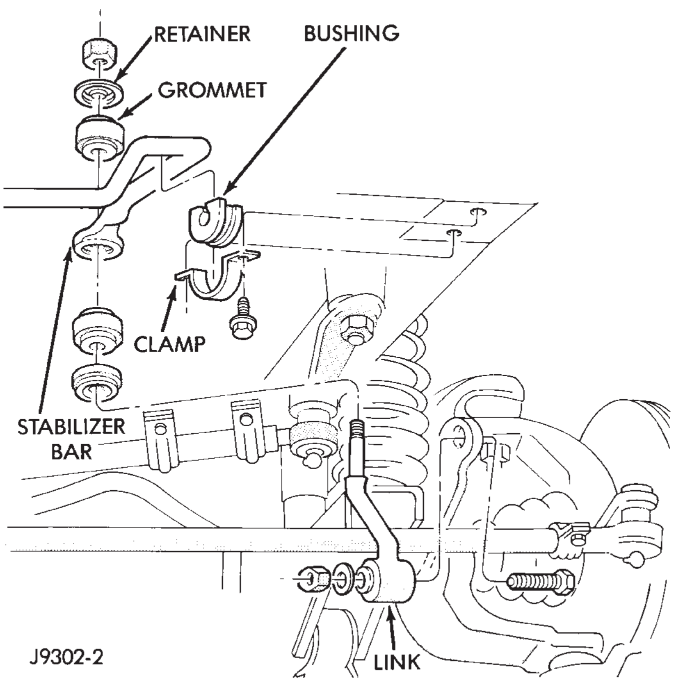

Fig. 2 Stabilizer Bar

(2) 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.

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

(4) 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.

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 and frame bracket to 75 N•m (55 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).

FASTENER TORQUE			
LETTER	N•m	IN. LBS.	FT. LBS.
A	74	—	55
B	176	—	130

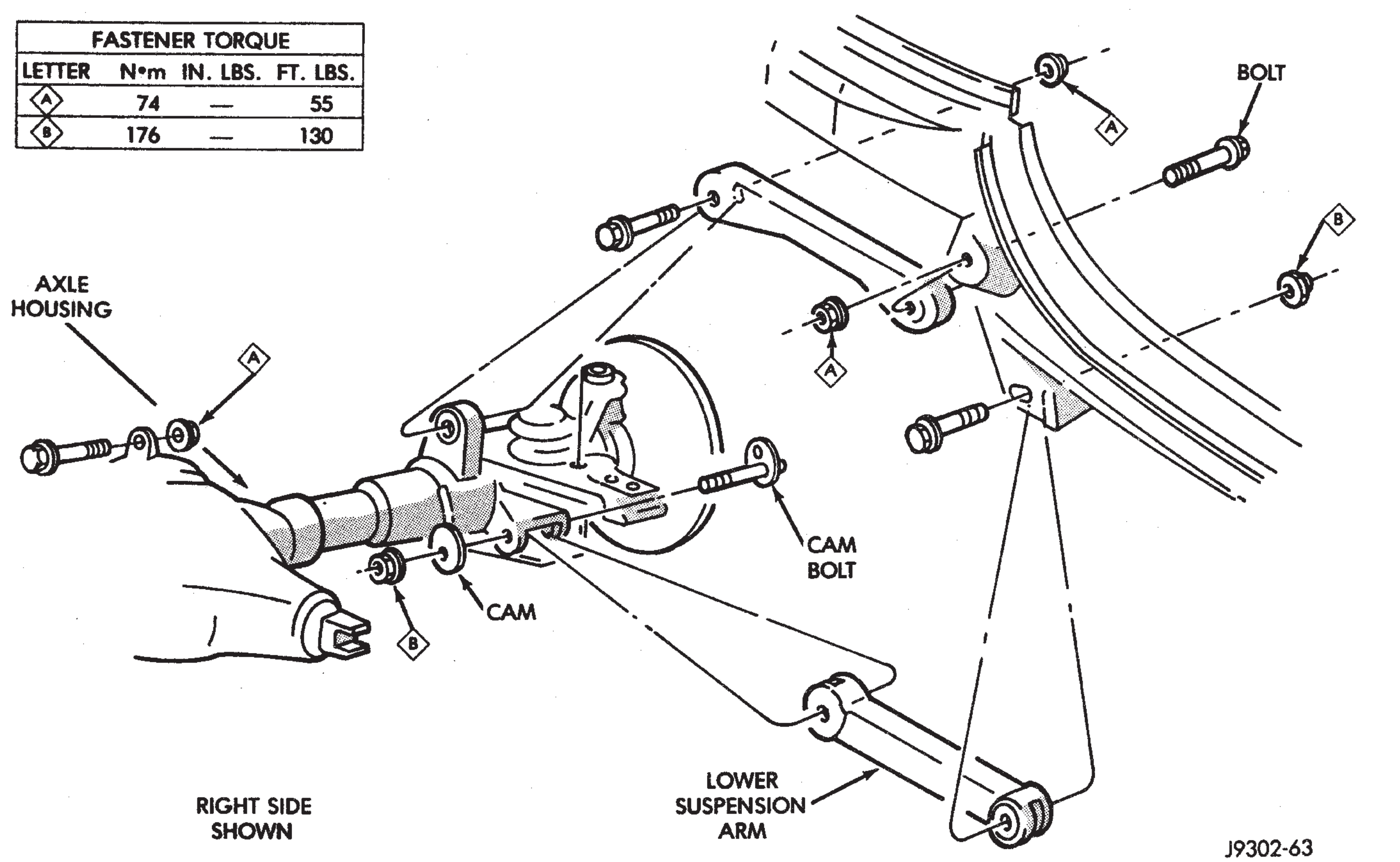

Fig. 3 Upper and Lower Suspension Arms

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

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

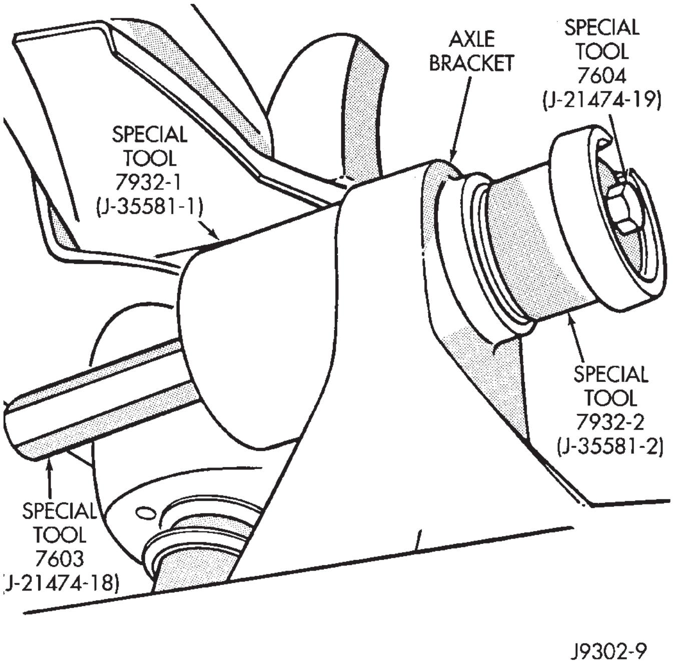

Fig. 4 Axle Bracket Bushing Removal

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).

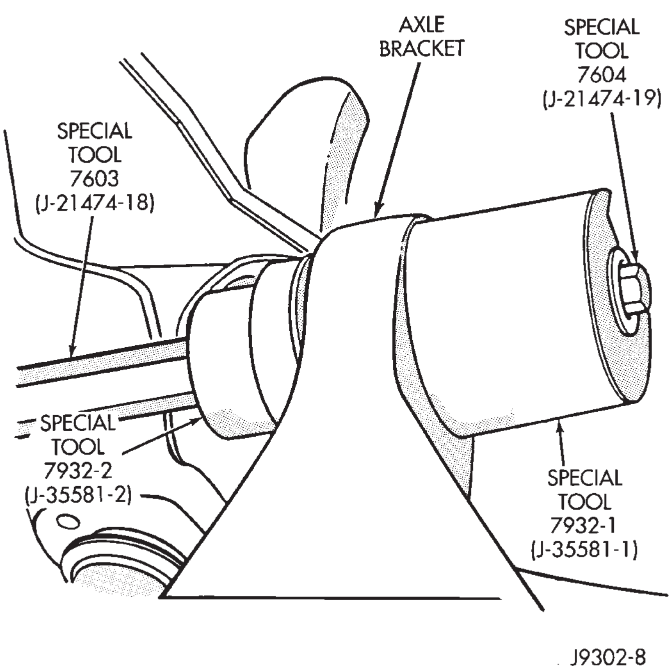

Fig. 5 Axle Bracket Bushing Installation

(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) Paint or scribe alignment marks on the cam adjusters and suspension arm for installation reference (Fig. 6).

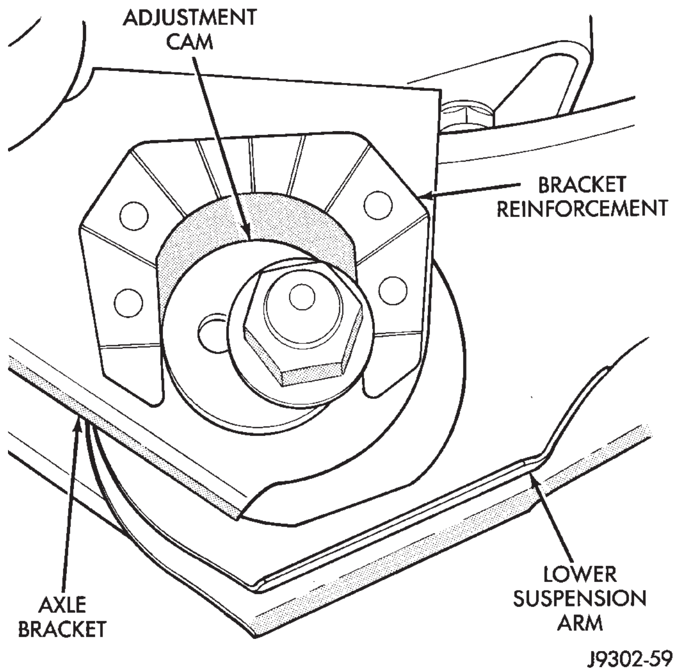

Fig. 6 Cam Adjuster

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

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

INSTALLATION

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

(2) Install the rear bolts and finger tighten the nuts (Fig. 6).

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

(4) Install the bolts and finger tighten the nuts (Fig. 6).

(5) Lower the vehicle.

(6) Tighten the front and rear nuts to 176 N•m (130 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 if any of these conditions exist.

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. 7).

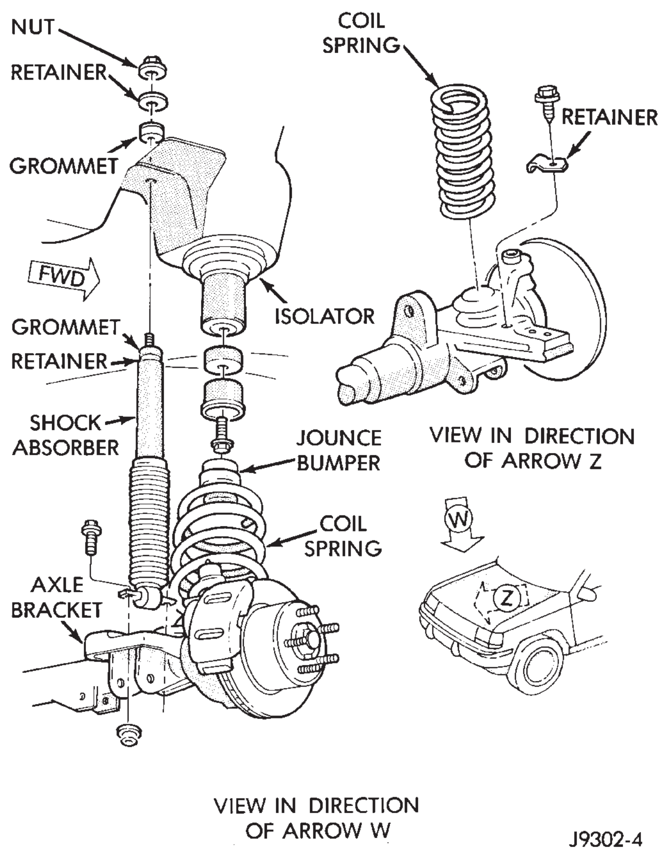

Fig. 7 Coil Spring & Shock Absorber

(2) Remove the lower nuts and bolts from the axle bracket (Fig. 7). 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 23 N●m (17 ft. lbs.) torque.

COIL SPRING

REMOVAL

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

(2) Paint or scribe alignment marks on the cam adjusters and axle bracket for installation reference (Fig. 6).

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

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

(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 screw and remove the spring.

(9) Remove the jounce bumper if necessary from the upper spring mount (Fig. 7).

INSTALLATION

(1) Install the jounce bumper on the upper spring mount. Tighten the screw to 42 N●m (31 ft. lbs.) torque (Fig. 7).

(2) Position the coil spring on the axle pad. Install the spring clip and screw. Tighten the screw 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 arm to the axle.

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

(7) Remove the supports and lower the vehicle.

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

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)
- 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

Common causes of overloading is from full-throttle acceleration. Overloading happens when towing heavier-than-recommended loads. Component breakage can occur when the wheels are spun excessively. Insufficient or incorrect lubricants contribute to breakage through overheating. 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.

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, Wheels And Tires for additional information.

DRIVELINE SNAP

A snap or clunk noise when the vehicle is shifted into gear (or the clutch engaged), can be caused by:
- High engine idle speed
- Loose engine/transmission/transfer case mounts
- Worn U-joints
- Loose spring mounts
- Loose pinion gear nut and yoke
- Excessive ring gear backlash
- Excessive 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. (b) Faulty, brinelled wheel bearing.	(a) Tighten loose nuts. (b) Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	(a) Misaligned axle shaft tube. (b) Bent or sprung axle shaft. (c) End play in drive pinion bearings. (d) Excessive gear backlash between ring gear and pinion gear. (e) Improper adjustment of drive pinion gear shaft bearings. (f) Loose drive pinion gearshaft yoke nut. (g) Improper wheel bearing adjustment. (h) Scuffed gear tooth contact surfaces.	(a) Inspect axle shaft tube alignment. Correct as necessary. (b) Replace bent or sprung axle shaft. (c) Refer to Drive Pinion Bearing Pre-Load Adjustment. (d) Check adjustment of ring gear backlash and pinion gear. Correct as necessary. (e) Adjust drive pinion shaft bearings. (f) Tighten drive pinion gearshaft yoke nut with specified torque. (g) Readjust as necessary. (h) If necessary, replace scuffed gears.
AXLE SHAFT BROKE	(a) Misaligned axle shaft tube. (b) Vehicle overloaded. (c) Erratic clutch operation (d) Grabbing clutch.	(a) Replace broken axle shaft after correcting axle shaft tube alignment. (b) Replace broken axle shaft. Avoid excessive weight on vehicle. (c) Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch. (d) Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	(a) Improper adjustment of differential bearings. (b) Excessive ring gear backlash. (c) Vehicle overloaded. (d) Erratic clutch operation.	(a) Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly. (b) Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly. (c) Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle. (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. (b) Improper grade of lubricant. (c) Excessive spinning of one wheel/tire.	(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) Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant. (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. (c) Cracked differential housing. (d) Worn drive pinion gear shaft seal. (e) Scored and worn yoke. (f) Axle cover not properly sealed.	(b) Replace worn seals. (c) Repair or replace housing as necessary. (d) Replace worn drive pinion gear shaft seal. (e) Replace worn or scored yoke and seal. (f) Remove cover and clean flange and reseal.
AXLE OVERHEATING	(a) Lubricant level too low. (b) Incorrect grade of lubricant. (c) Bearings adjusted too tight. (d) Excessive gear wear. (e) Insufficient ring gear backlash.	(a) Refill differential housing. (b) Drain, flush and refill with correct amount of the correct lubricant. (c) Readjust bearings. (d) Inspect gears for excessive wear or scoring. Replace as necessary. (e) Readjust ring gear backlash and inspect gears for possible scoring.
GEAR TEETH BROKE (RING GEAR AND PINION)	(a) Overloading. (b) Erratic clutch operation. (c) Ice-spotted pavements. (d) Improper adjustments.	(a) Replace gears. Examine other gears and bearings for possible damage. Replace parts as needed. Avoid overloading of vehicle. (b) Replace gears and examine the remaining parts for possible damage. Avoid erratic clutch operation. (c) Replace gears. Examine the remaining parts for possible damage. Replace parts as required. (d) Replace gears. Examine other parts for possible damage. Ensure ring gear backlash is correct.
AXLE NOISE	(a) Insufficient lubricant. (b) Improper ring gear and drive pinion gear adjustment. (c) Unmatched ring gear and drive pinion gear. (d) Worn teeth on ring gear or drive pinion gear. (e) Loose drive pinion gear shaft bearings. (f) Loose differential bearings. (g) Misaligned or sprung ring gear. (h) Loose differential bearing cap bolts.	(a) Refill axle with correct amount of the proper lubricant. Also inspect for leaks and correct as necessary. (b) Check ring gear and pinion gear teeth contact pattern. (c) Remove unmatched ring gear and drive pinion gear. Replace with matched gear and drive pinion gear set. (d) Check teeth on ring gear and drive pinion gear for correct contact. If necessary, replace with new matched set. (e) Adjust drive pinion gearshaft bearing preload torque. (f) Adjust differential bearing preload torque. (g) Measure ring gear runout. (h) Tighten with specified torque.

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MODEL 30 AXLE AND TUBE AXLE (2WD)

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GENERAL INFORMATION

The housing for Model 30 front axles consists of an iron center casting with tubes on each side. The tubes are pressed into and welded to the differential housing.

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

The axle has a 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 cover provides a means for servicing the differential without removing the axle assembly.

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. The shims are located between the differential bearing cones and case. Pinion bearing preload is set and maintained by the use of a collapsible spacer.

PINION GEAR DEPTH MEASUREMENT WITH GAUGE SET D-115-30 is used 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

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
- The factory installed lubricant quantity for the NON-DISCONNECT TYPE AXLE is 50±1 fluid oz.

Refer to Group 0, Lubrication and Maintenance for additional information.

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

DRIVE AXLE ASSEMBLY REPLACEMENT

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheels and tires. Remove the brake components from the axle, refer to Group 5, Brakes.

(3) On 4WD vehicles, disconnect the vent hose from the axle shaft tube.

(4) On 4WD vehicles, mark the front propeller shaft and pinion yokes for installation alignment reference. Disconnect the propeller shaft from the axle.

(5) Disconnect the following components from the axle:

- Stabilizer bar link
- Tie rod and drag link

- Front propeller shaft
- Shock absorbers
- Steering dampener
- ABS brake sensor
- Track bar

(6) Position a floor jack under the axle.

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

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

(9) Remove the upper suspension arm nut and bolt from the axle.

(10) Lower the axle with the jack.

INSTALLATION

It is important to have the springs supporting the weight of the vehicle when the arms and 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.

(1) Raise the axle with a floor jack and align it with the coil springs.

(2) Install the upper and lower suspension arms.

(3) Install the lower suspension arm cam bolt, cam and nut in the axle bracket. Re-align the reference marks. (If installing a new axle housing assembly, a front alignment is recommended to set caster.)

(4) Install the bolts and tighten the nuts on the suspension arms;

- Lower: 176 N•m (130 ft. lbs.) torque
- Upper: 75 N•m (55 ft. lbs.) torque

(5) Install the following components to the axle:

- Track bar bolt — 100 N•m (74 ft. lbs.) torque
- Steering dampener bolt/nut — 75 N•m (55 ft. lbs.) torque
- Shock absorber bolt/nut — 19 N•m (14 ft. lbs.) torque
- Stabilizer bar link nut — 95 N•m (70 ft. lbs.) torque
- Drag link stud nut — 74 N•m (55 ft. lbs.) torque
- Tie rod stud nut — 74 N•m (55 ft. lbs.) torque
- ABS brake sensor
- Axle vent hose
- Front propeller shaft — 19 N•m (14 ft. lbs.) torque

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

(7) Install the wheels and tires.

(8) Check and add gear lubricant if needed.

(9) Lower the vehicle.

(10) 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.**

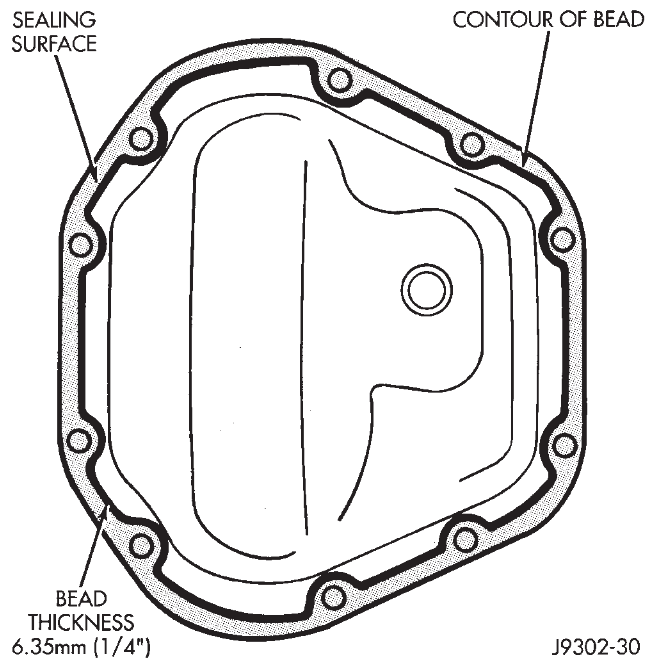

Fig. 1 Typical Housing Cover With Sealant

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 47 N•m (35 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 SHAFT SEAL REPLACEMENT

REMOVAL

(1) Raise and support the vehicle.

(2) Mark the propeller shaft yoke and pinion yoke for installation alignment reference.

(3) Remove the propeller shaft from the yoke.

(4) Rotate the pinion gear three or four times.

(5) 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 in-

stallation reference. **It must be known to properly adjust the pinion gear bearing preload torque after seal installation.**

(6) Remove the pinion yoke nut and washer. Use Remover C-452 and Wrench C-3281 to remove the pinion yoke (Fig. 2).

(7) Mark the positions of the yoke and pinion gear for installation alignment reference.

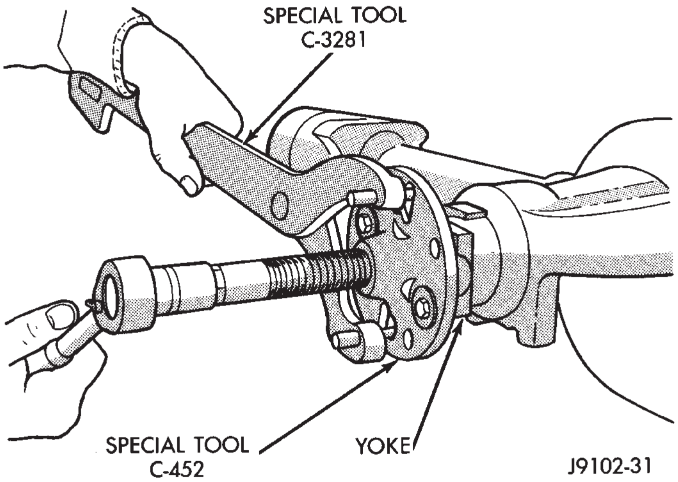

Fig. 2 Pinion Yoke Removal

(8) Use Remover W-251 to remove the pinion gear seal (Fig. 3).

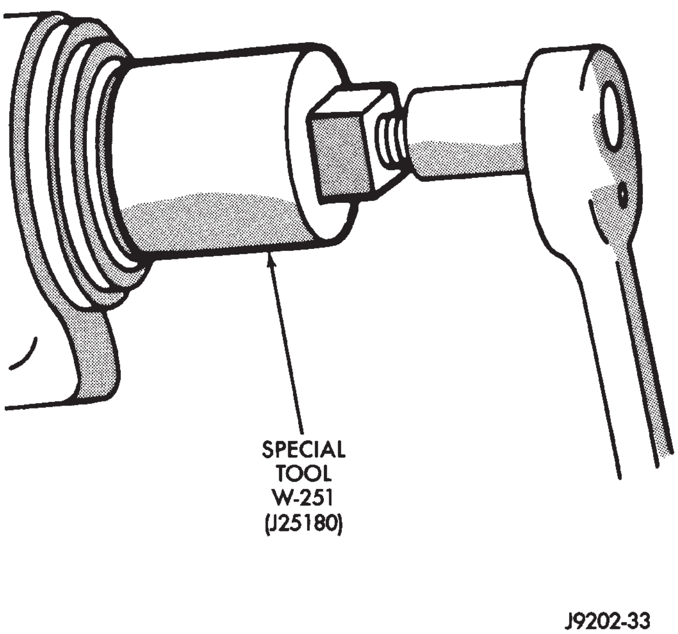

Fig. 3 Seal Removal

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).

(2) Align the installation reference marks and install yoke on the pinion gear with Installer W-162-D.

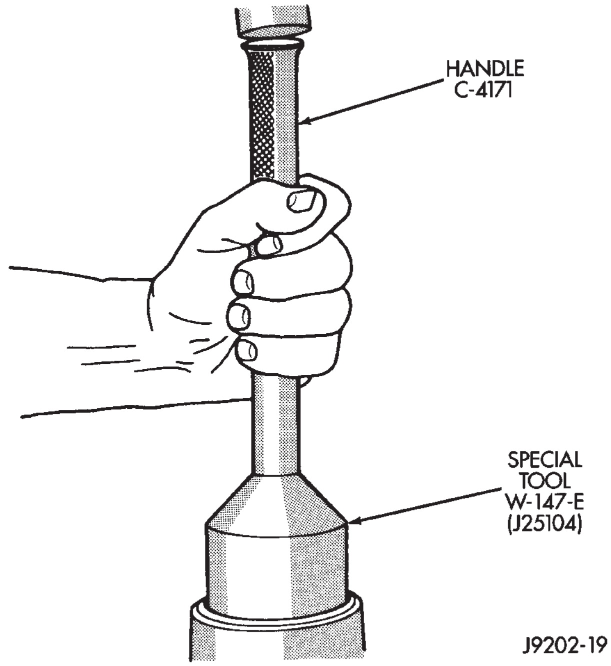

Fig. 4 Pinion Seal Installation

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

CAUTION: Exercise care during the bearing preload torque adjustment. Do not over-tighten, or loosen and then re-tighten the nut. Do not exceed the bearing preload torque. The collapsible preload spacer on the pinion shaft will have to be replaced. The bearing preload torque will be re-adjusted afterward.

(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.

The required preload is equal to amount recorded during removal plus 0.56 N•m (5 in. lbs.). The used bearing preload torque must never exceed 2.25 N•m (20 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. Tighten the pinion shaft nut:

- **No less than 217 N•m (160 ft. lbs.) torque**
- **No greater than 352 N•m (260 ft. lbs.) torque**

(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) Lower the vehicle.

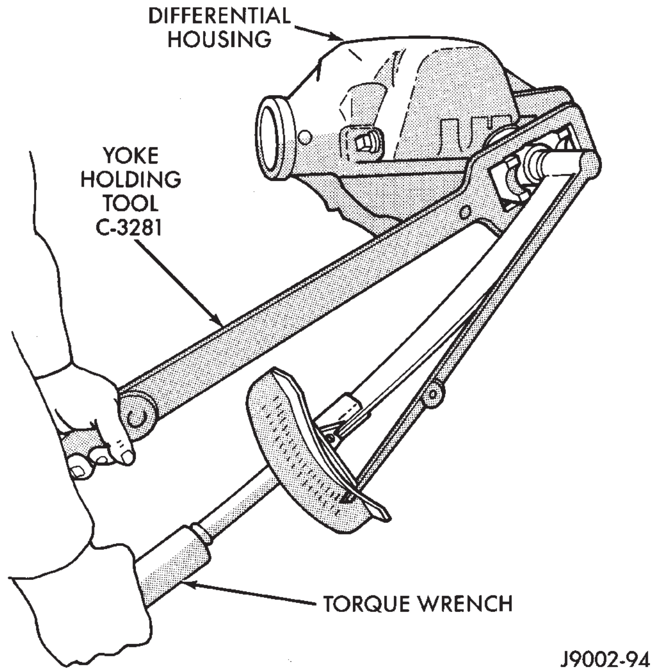

Fig. 5 Tightening Pinion Shaft Nut

HUB BEARING AND AXLE SHAFT

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheels and tires.

(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 4WD vehicles, remove the axle shaft from the housing. **Avoid damaging the axle shaft oil seals in the differential.**

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) On 4WD vehicles, 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 wheels and tires.

(8) 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.

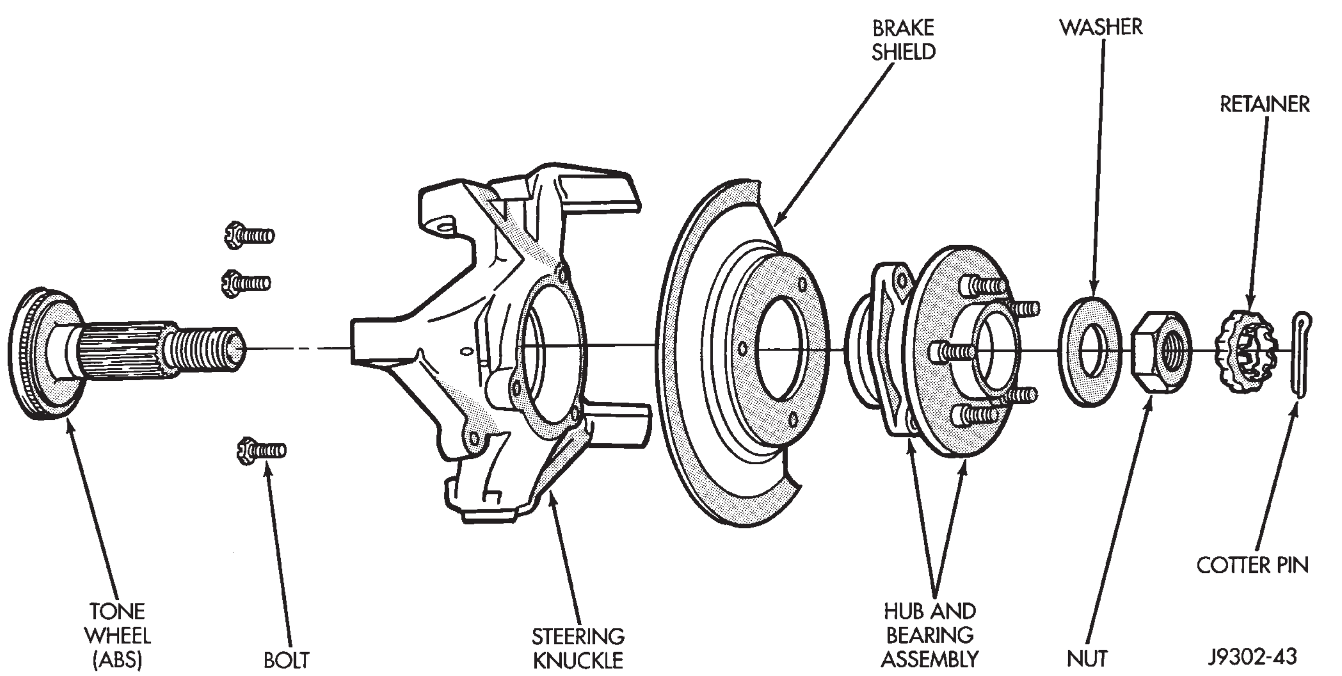

Fig. 6 Hub, Knuckle and Axle Shaft

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).

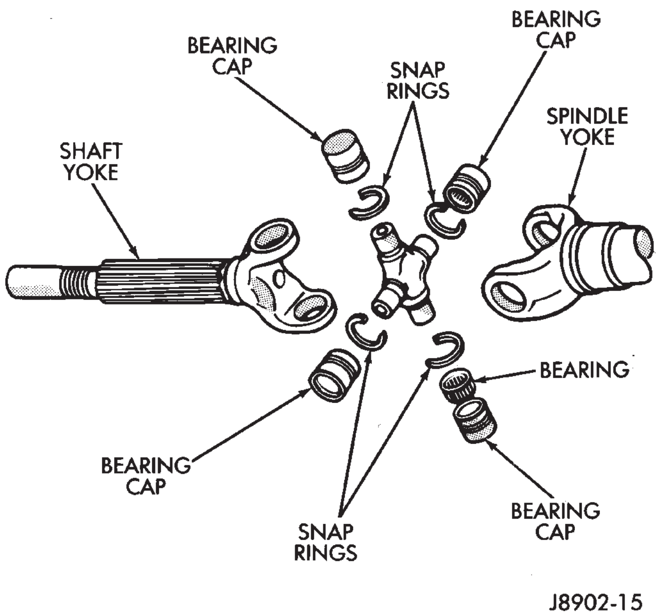

Fig. 7 Axle Shaft Outer U-Joint

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).

(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.

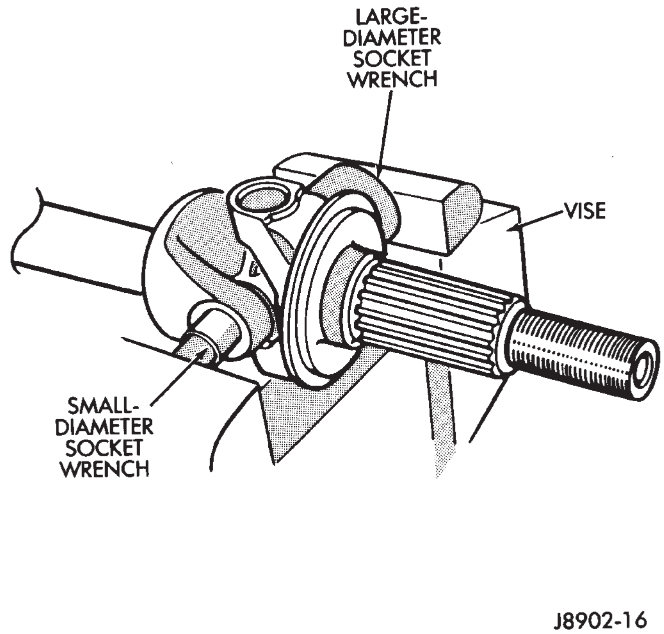

Fig. 8 Yoke Bearing Cap Removal

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.

AXLE SHAFT— CV-JOINT

HANDLING AND CLEANING PRECAUTIONS

Extreme care must be exercised to avoid puncturing or tearing the boots. Also avoid damage to the ABS tone ring pressed onto the CV-joint.

The rubber material in shaft boots is not compatible with oil, gasoline, or petroleum-based cleaning solvents. Do not expose the rubber boots to any of these fluids. Use only soap and water to clean the rubber boots. After cleaning, the rubber boot must be thoroughly rinsed and dried.

INSPECTION

The most common failure of CV-joints is torn or ripped boots and subsequent lubricant loss or contamination. Look for lubricant around the exterior of

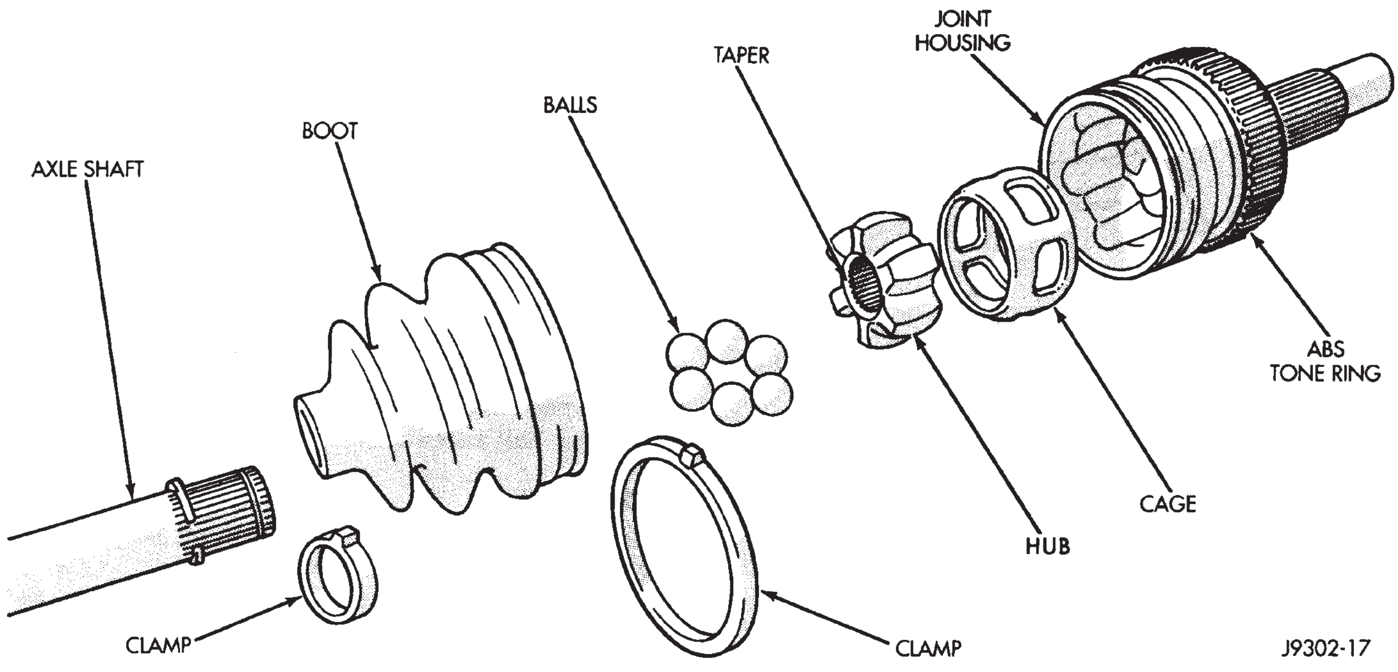

Fig. 9 CV Joint Components

boot. Check if boot is either punctured, torn or that a retaining clamp is loose. If joint was operating satisfactorily and grease does not appear contaminated, replace boot. When a CV drive shaft is removed from the vehicle for service, the boot should be properly cleaned. Inspect the boot for cracks, tears and scuffed areas on the surfaces. If any of these conditions exist, boot replacement is recommended.

If joint is noisy or worn, bypass following disassembly and replace entire unit and boot.

DISASSEMBLY

(1) Remove retaining clamps from the outer CV joint and discard. Slide the boot off the outer joint and down the shaft.

(2) Remove the lubricant to expose the joint components (Fig. 9).

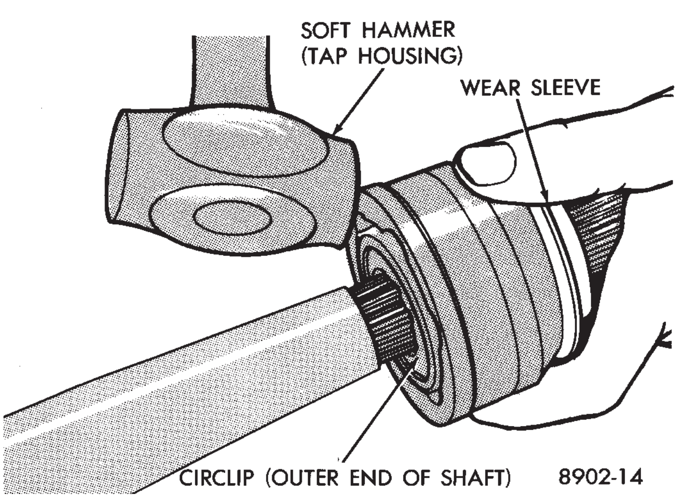

Fig. 10 Joint Removal

(3) Clamp the shaft in a vise (with soft jaws). Give a sharp tap to the top of the housing to dislodge joint from internal circlip. Slide the joint from the shaft. (Fig. 10).

(4) Remove the surplus lubricant. Apply installation alignment marks on the bearing hub, bearing cage and housing with dabs of paint (Fig. 11).

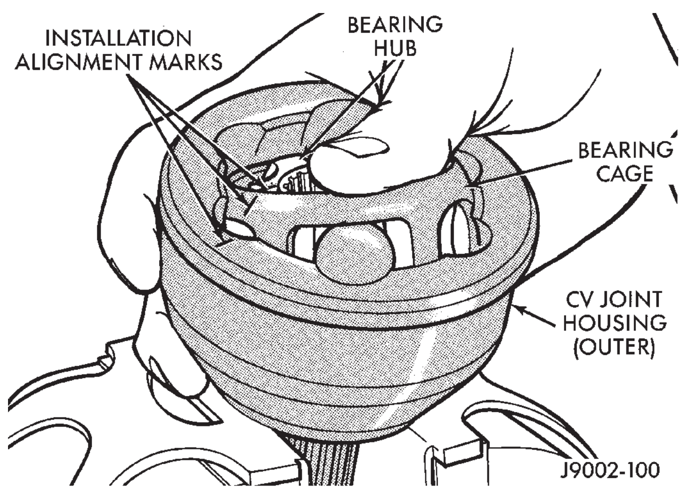

Fig. 11 Ball Access

(5) Place the stub shaft in a soft-jawed vise to avoid damage to the shaft splines.

(6) Press down on one side of the bearing cage/hub to tilt the cage. This will provide access to a ball at the opposite side of the cage. If the CV joint is tight, use a hammer and brass drift to loosen the bearing hub. **Do not hit the bearing cage with the drift.**

(7) Remove the ball from the bearing cage (Fig. 12). If necessary, a small pry bar can be used to pry the ball loose from the cage.

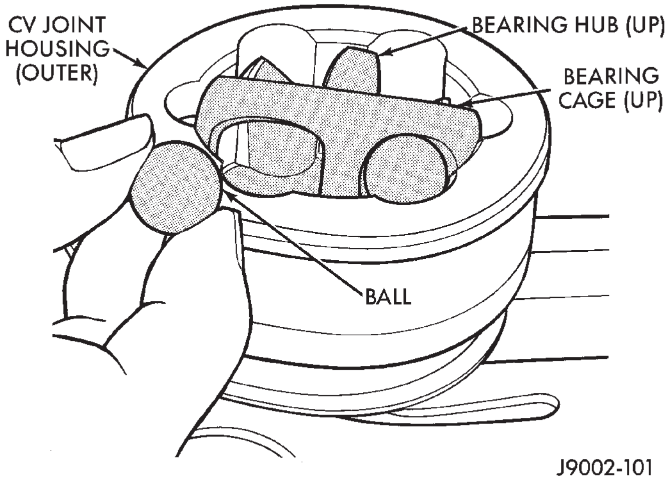

Fig. 12 Ball Removal

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

(9) Tilt the bearing cage and hub to a vertical position to remove (Fig. 13).

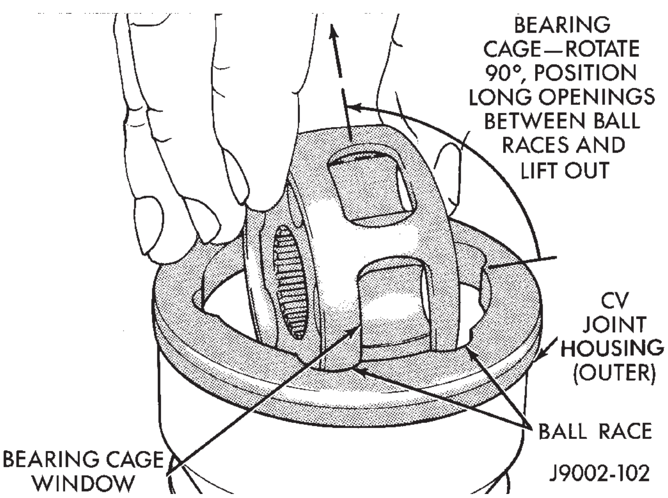

Fig. 13 Bearing Cage & Hub Removal

(10) Insert one of the bearing hub lands into the adjacent cage window and roll it out of the cage (Fig. 14).

INSPECTION

Polished contact surface areas on raceways and bearing cage spheres are normal. If the joints cause a noise or a vibration, replace them.

(1) Inspect the lubricant for grit, dirt, water damage and metallic particles.

(2) Clean all the components with an appropriate solvent and dry them with compressed air.

(3) Inspect the ball raceways in the housing for excessive wear, gouging or scoring.

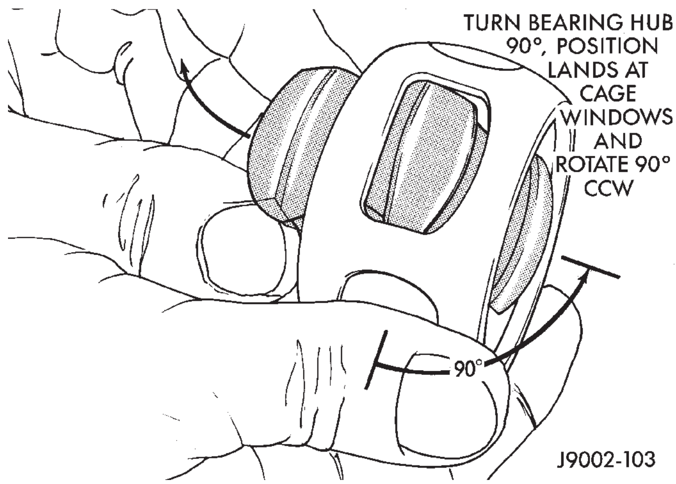

Fig. 14 Bearing Hub Removal

(4) Examine the stub shaft splines and threads for damage.

(5) Inspect the balls for pitting, cracks, scoring and excessive wear. A dull exterior surface is normal.

(6) Inspect the bearing cage for wear, grooves, ripples, cracks and chipping.

(7) Inspect the bearing hub for excessive wear and scoring on ball raceways.

ASSEMBLY

(1) Lightly apply lubricating oil to all joint components before assembling them.

(2) Align the bearing hub, cage and housing (Fig. 11) according to the alignment reference marks.

(3) Insert one of the bearing hub lands into a bearing cage window and roll it into the cage (Fig. 15). Rotate the bearing hub 90° to complete the installation (Fig. 16).

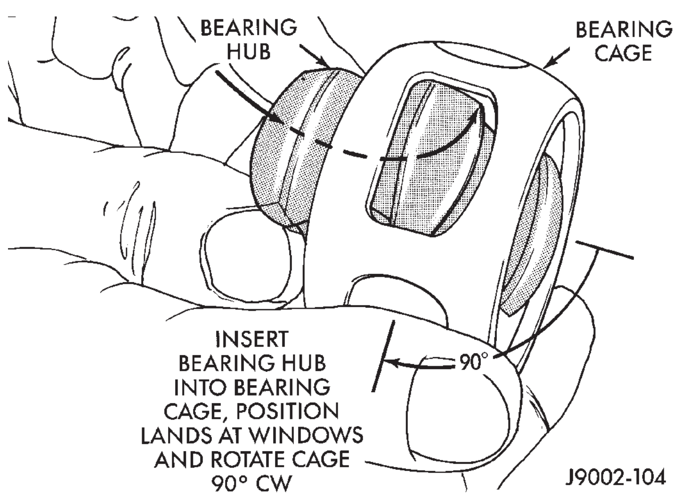

Fig. 15 Bearing Hub Installation

(4) Insert bearing cage/hub into the housing (Fig. 17). Rotate the cage/hub 90° to complete the installation. **Ensure the tapered edge is facing outward (Fig. 18).**

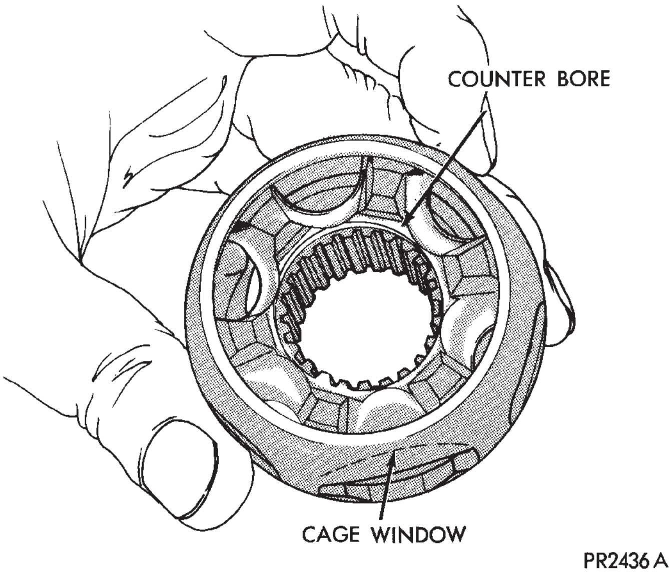

Fig. 16 Assembled Bearing Cage & Hub

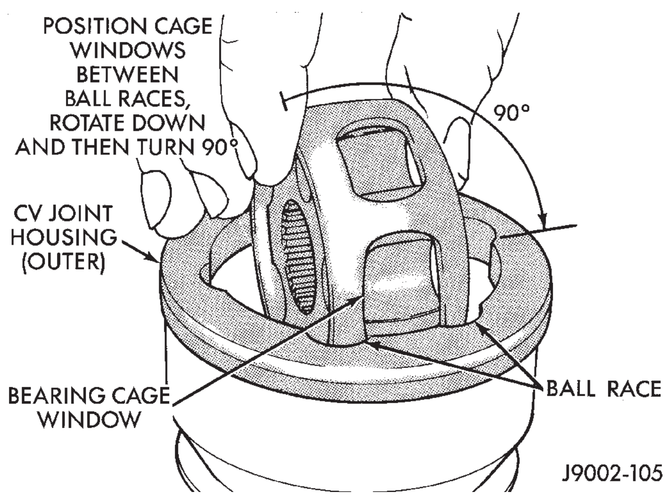

Fig. 17 Bearing Cage & Hub Installation

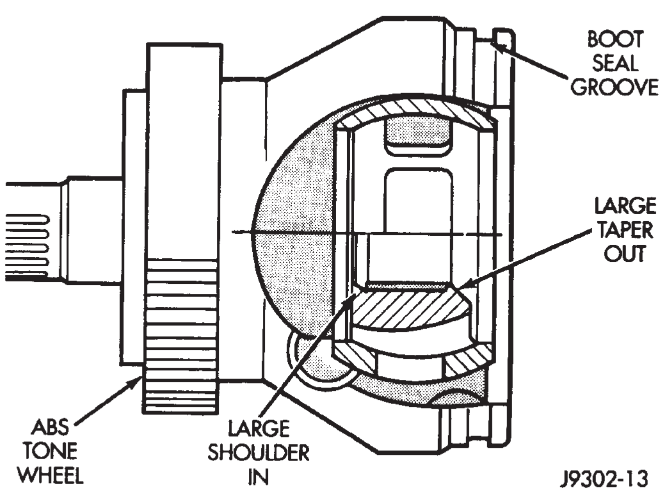

Fig. 18 Assembly Installed

(5) Apply the lubricant included with the replacement rubber boot to the ball raceways. Spread the lubricant equally between all the raceways. One packet of lubricant is sufficient to lubricate the joint.

(6) Tilt the bearing hub and cage and install the balls in the raceways (Fig. 19).

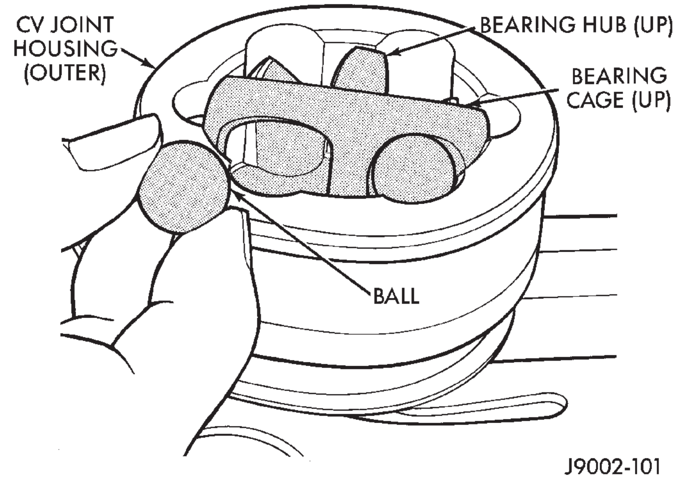

Fig. 19 Ball Installation In Raceway

(7) Install the rubber boot on the axle shaft. Ensure the clamp sealing area is in the grooved section of the axle shaft. Install a new clamp.

(8) Engage the splines and install the joint onto the shaft. Tap sharply with mallet until seated (Fig. 20).

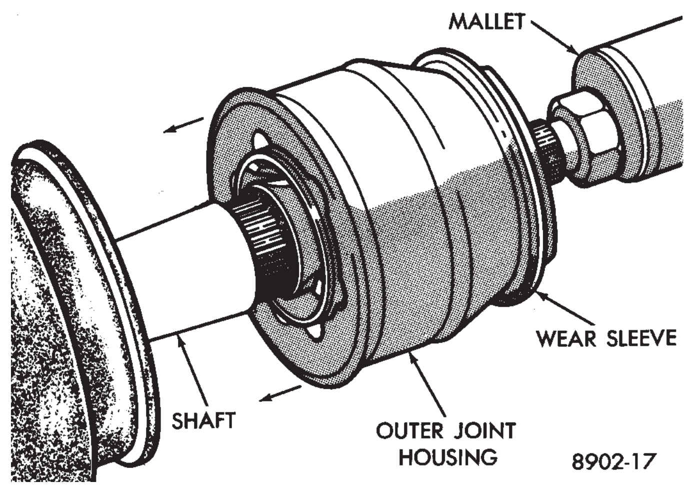

Fig. 20 Joint Installation

(9) Ensure that the snap ring is properly seated in the housing. Pull the outer CV joint from the shaft to test, it should not come off.

(10) Install remaining amount of lubricant to cage and balls.

(11) Place the large diameter end of the rubber boot over the edge of the housing. **Ensure that the boot is not twisted.**

(12) Ensure the clamp sealing area is in the grooved section of the housing. Install a new clamp.

(13) Install the axle shaft, refer to Hub Bearing and Axle Shaft installation.

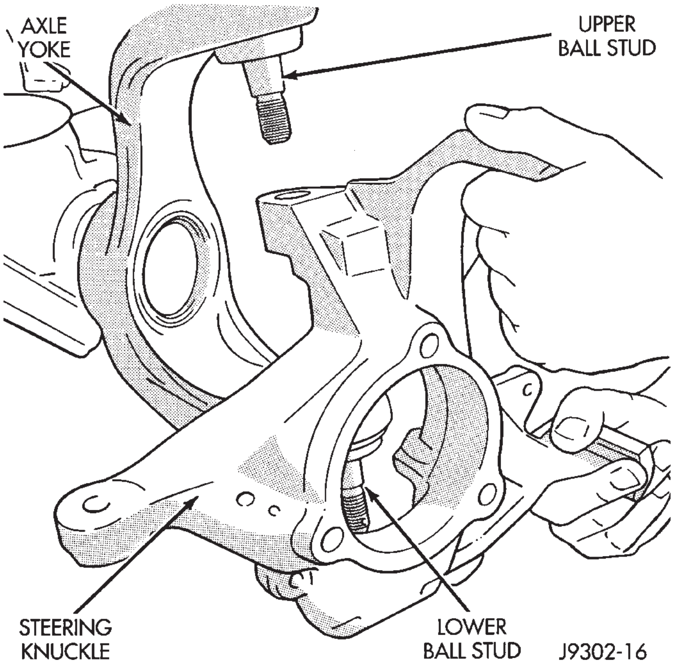

Fig. 21 Steering Knuckle Removal/Installation

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).

KNUCKLE REMOVAL

(1) Remove hub bearing and axle shaft. Refer to the Removal procedures in this Group.

(2) If necessary, 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 pin from the upper ball stud nut. 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. 21).

UPPER BALL STUD REPLACEMENT

(1) Position tools as shown to remove and install ball stud (Fig. 22).

LOWER BALL STUD REPLACEMENT

(1) Position tools as shown to remove and install ball stud (Fig. 23).

KNUCKLE INSTALLATION

(1) Position the steering knuckle on the ball studs.

(2) Install and tighten the bottom retaining nut to 108 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.

(4) Install the Hub Bearing and Axle Shaft. Refer to the installation procedure.

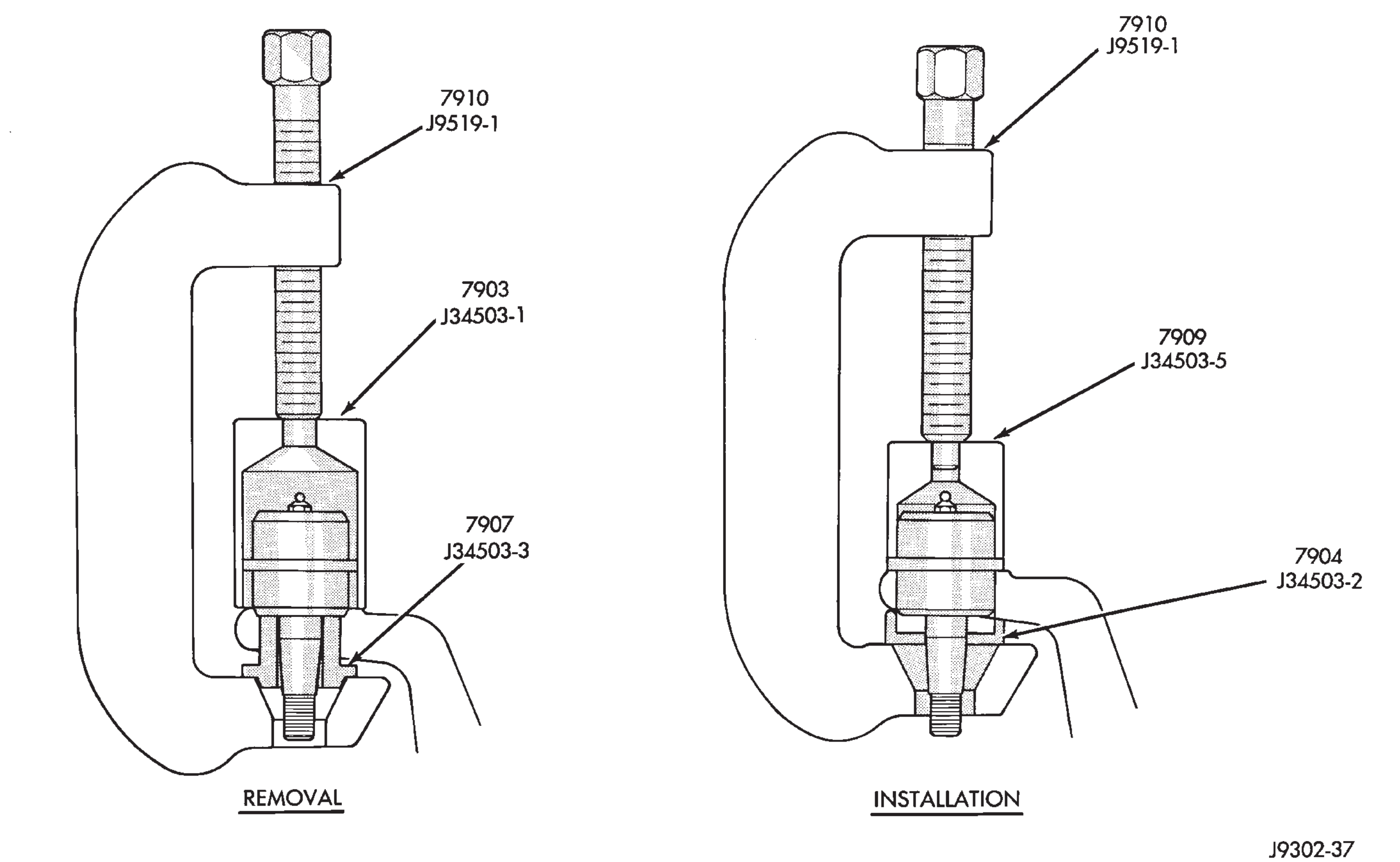

Fig. 22 Upper Ball Stud Remove/Install

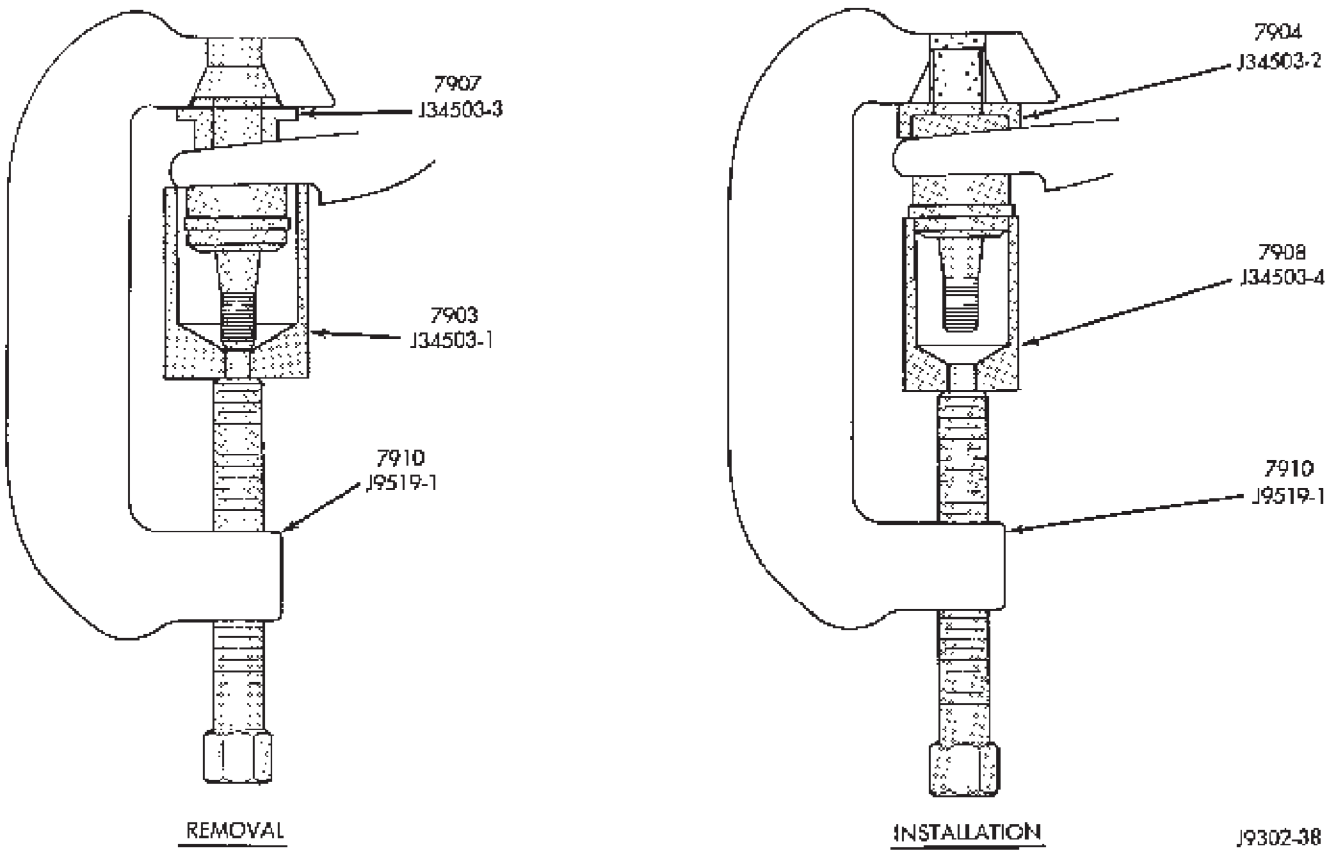

Fig. 23 Lower Ball Stud Remove/Install

(5) If necessary, 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 for proper set-up.

AXLE BUSHING REPLACEMENT

Refer to Axle Bushing Replacement in the Front Suspension section.

DIFFERENTIAL REMOVAL

To service the differential the 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. 24).**

(2) Remove the differential bearing caps.

(3) Position Spreader W-129-A with the tool dowel pins seated in the locating holes (Fig. 25). 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. 25) and zero the indicator.

CAUTION: Do not spread over 0.38 mm (0.015 in.). If the housing is spread too much, it could be distorted or damaged.

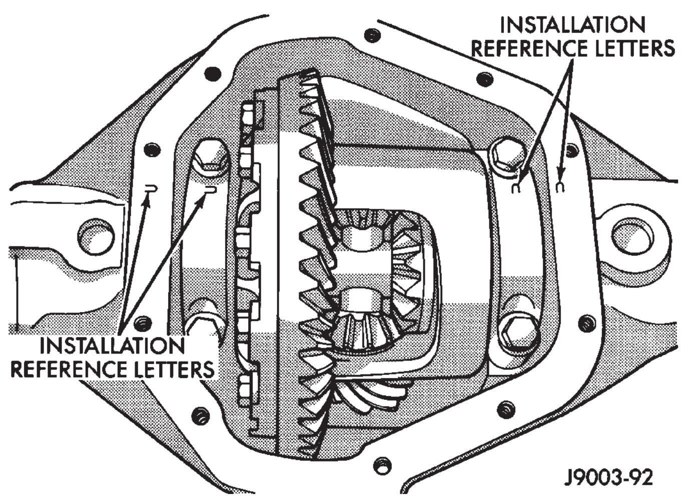

Fig. 24 Bearing Cap Identification

(5) Separate the housing a maximum of 0.38 mm (0.015 in.). Measure the distance with the dial indicator (Fig. 25).

(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. 26).

(8) Remove the case from housing. Mark or tag bearing cups indicating which side they were removed. Remove spreader from housing.

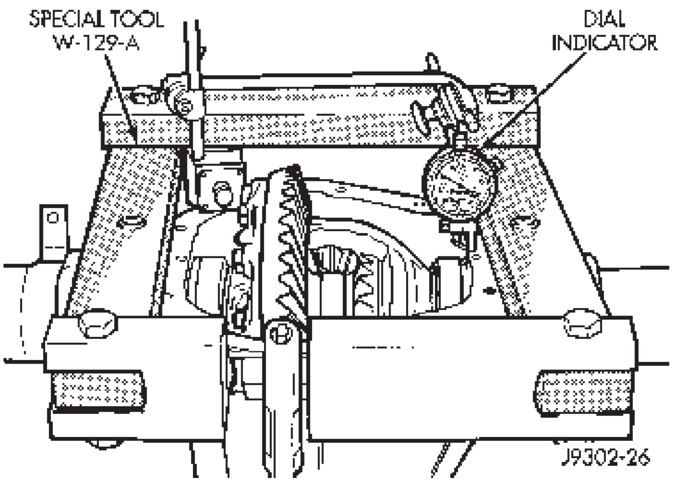

Fig. 25 Spread Differential Housing

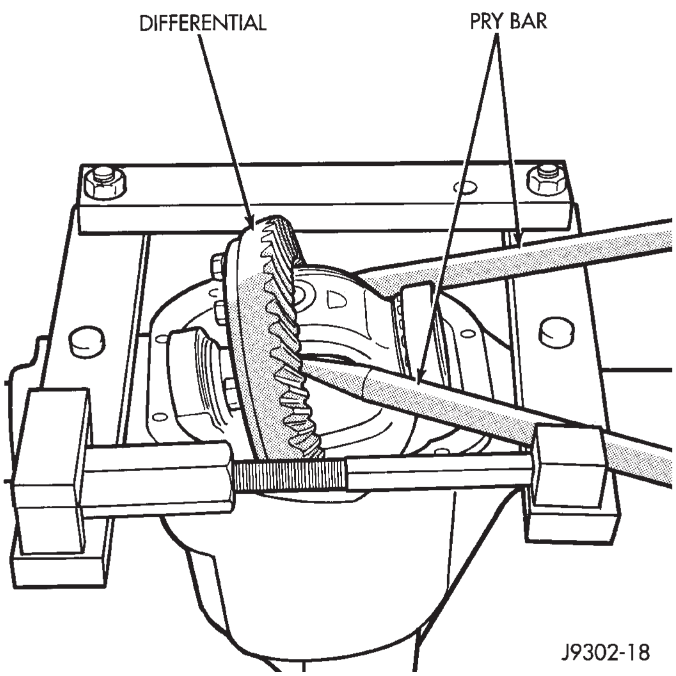

Fig. 26 Differential Removal

AXLE SHAFT OIL SEALS

(1) Remove the inner axle shaft seals with a pry bay.

(2) Install oil seals with Adapter D-112-4, D-112-5 and Turnbuckle D-112 (Fig. 27). Tighten tool until disc bottoms in housing. Be sure the seals are not cocked.

DIFFERENTIAL DISASSEMBLY

(1) Remove the bearings from the differential case with Press C-293-PA, Plug C-293-3, Adapter C-293-39 (Fig. 28).

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.

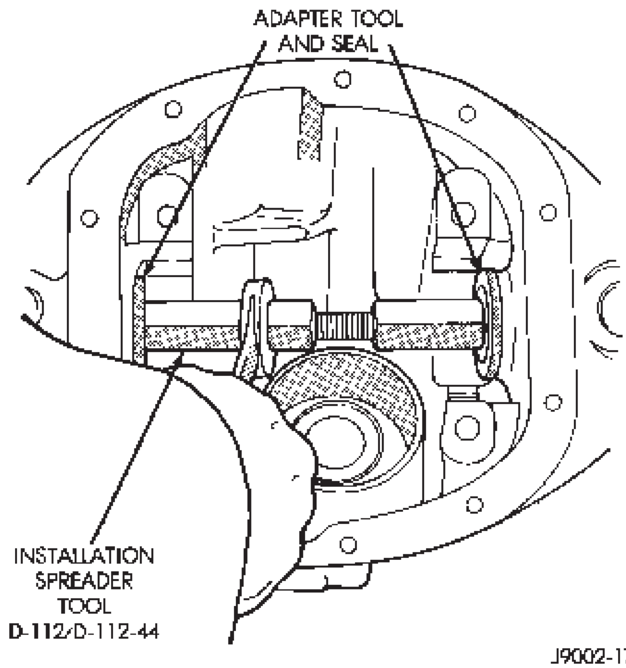

Fig. 27 Axle Shaft Oil Seal Installation

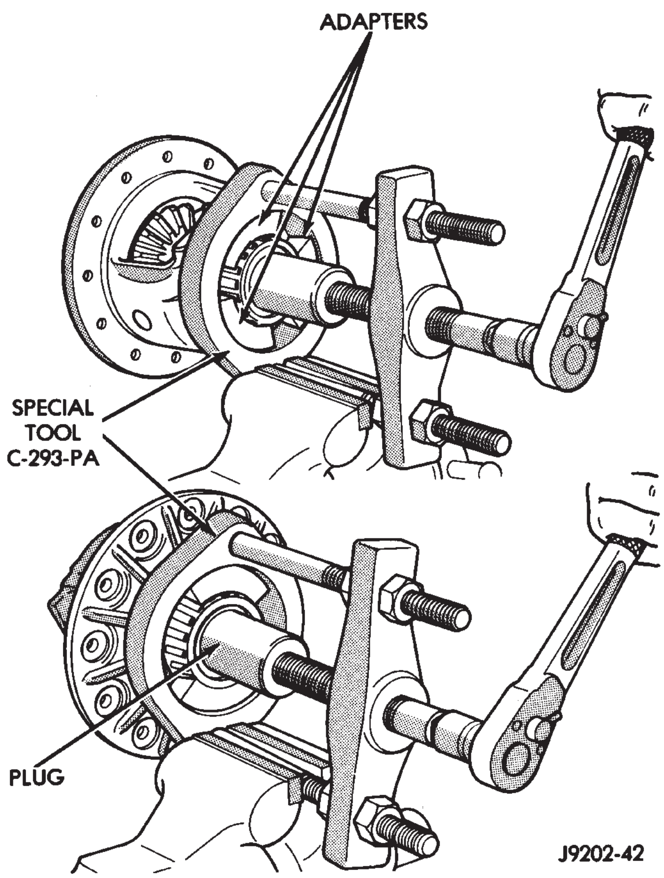

Fig. 28 Differential Bearing Removal

(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 mallet and remove (Fig. 29).

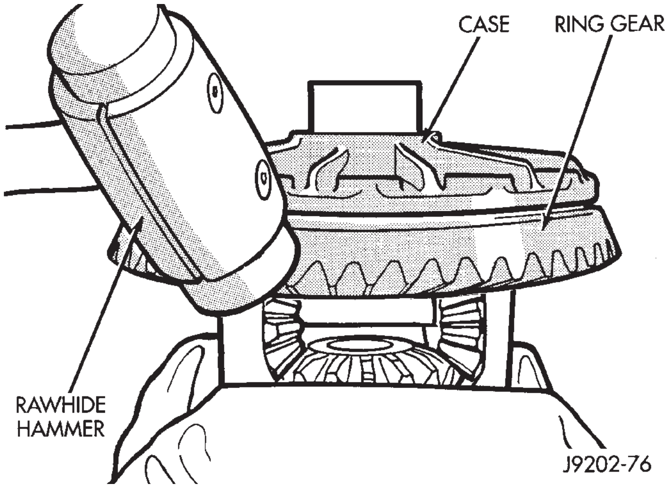

Fig. 29 Ring Gear Removal

(4) Use a drift to remove the pinion gear mate shaft lock pin (Fig. 30).

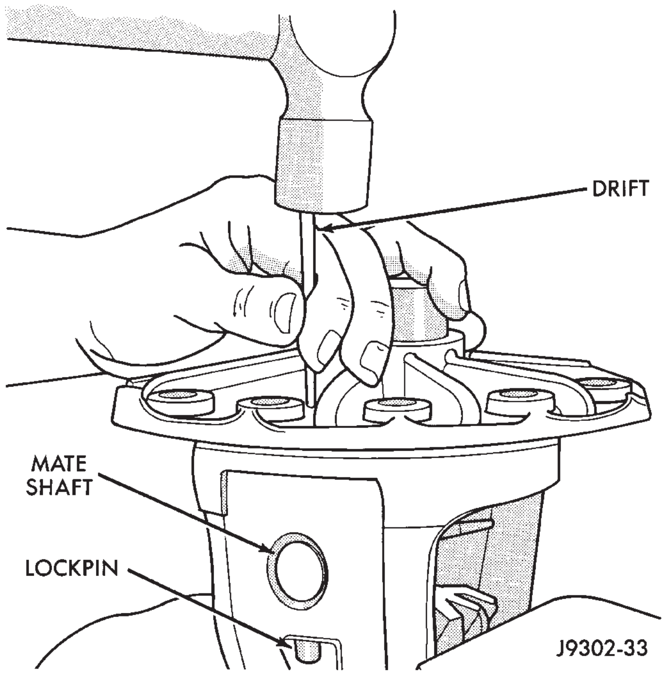

Fig. 30 Mate Shaft Lock Pin Removal

(5) Remove the mate shaft with a drift and hammer (Fig. 31).

(6) Rotate the differential side gears and remove the pinion mate gears and thrust washers (Fig. 32).

(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. 33).

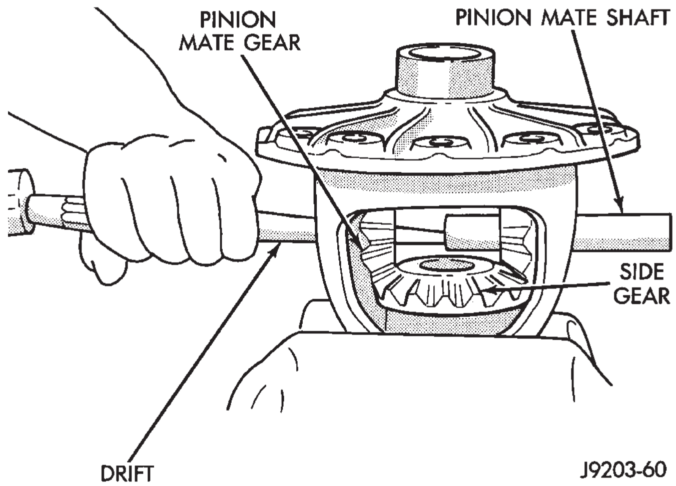

Fig. 31 Mate Shaft Removal

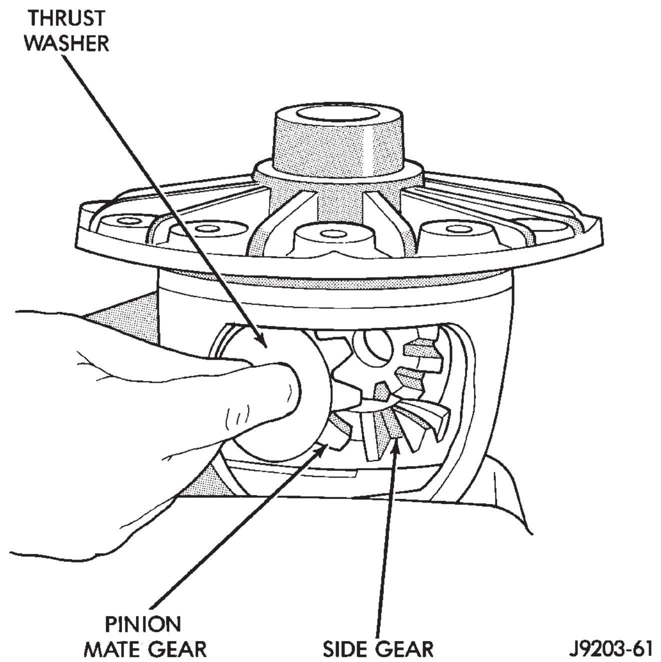

Fig. 32 Pinion Mate Gear Removal

(2) Remove the pinion gear from housing (Fig. 34). Catch the pinion with your hand to prevent it from falling and being damaged.

(3) Remove the pinion gear seal with a slide hammer or pry out with bar.

(4) Remove the collapsible preload spacer (Fig. 35).

(5) Remove oil slinger, front bearing.

(6) Remove the front pinion bearing cup with Remover D-147 and Handle C-4171 (Fig. 36).

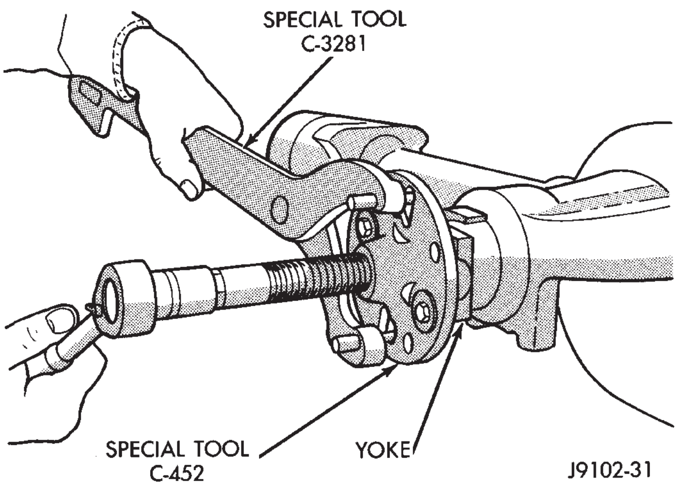

Fig. 33 Pinion Yoke Removal

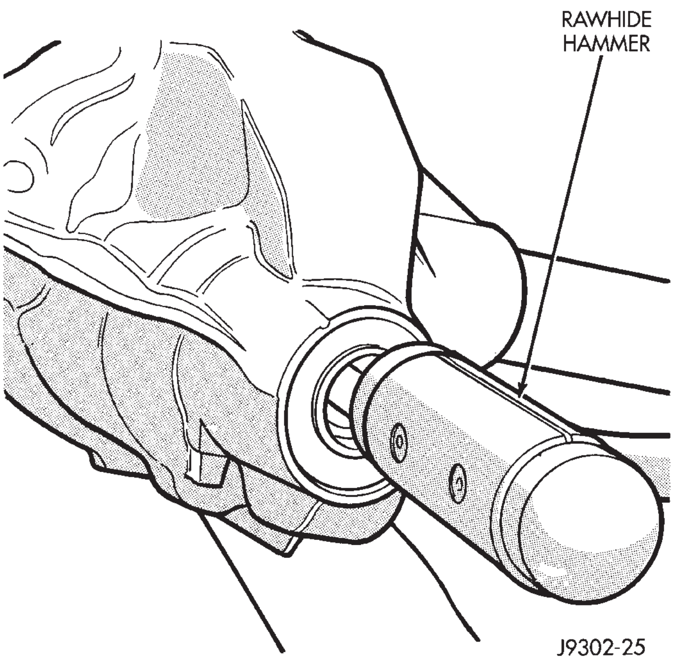

Fig. 34 Remove Pinion Gear

(7) Remove the rear bearing cup from housing with Remover D-149 and Handle C-4171 (Fig. 37).

(8) Remove the inner bearing from the pinion with Puller C-293-PA and Adapter C-293-39 (Fig. 38).

Place adapter rings so they do not damage the bearing cage.

(9) Remove the oil slinger (select thickness-production) from the pinion gear shaft. Record the thickness of the slinger.

CLEANING/INSPECTION

Wash differential components with cleaning solvent and dry with compressed air. **Do not steam clean the differential components.**

Wash bearings with solvent and towel dry, do not dry with compressed air. **Cup and bearing must be replaced as matched sets only.**

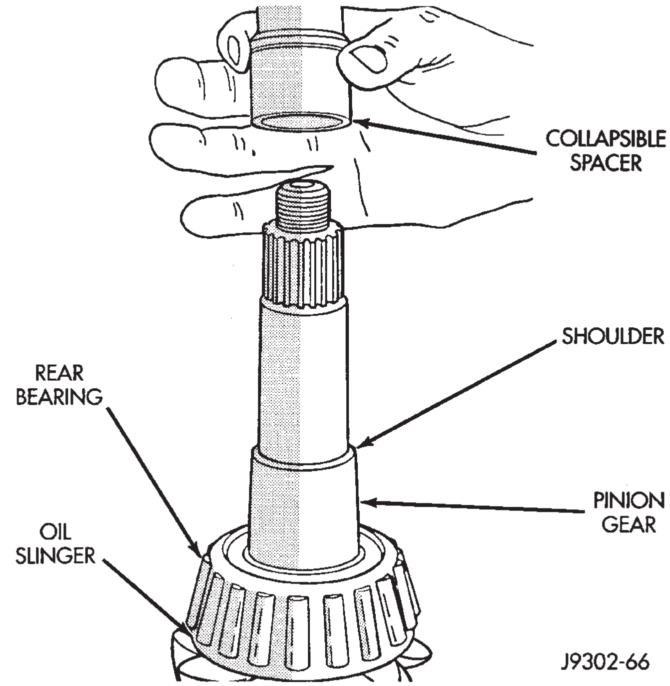

Fig. 35 Collapsible Spacer

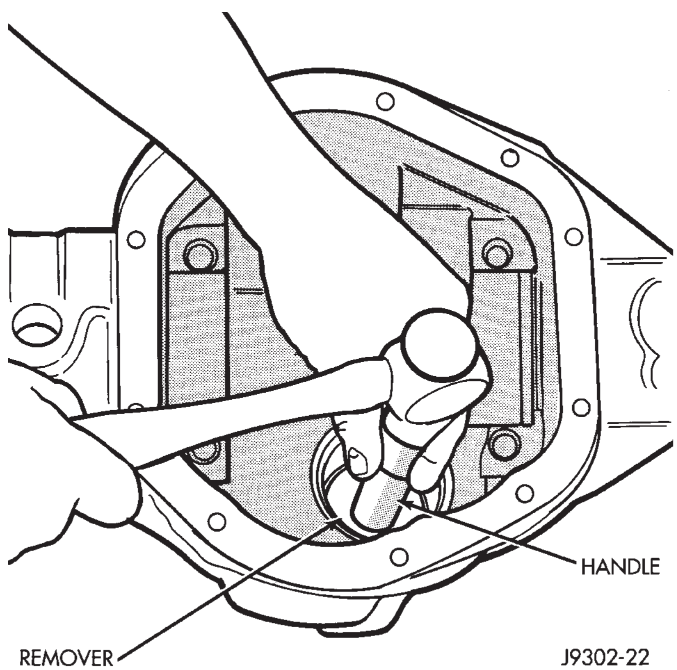

Fig. 36 Front Bearing Cup Removal

Clean the axle shaft tubes with a stiff wire brush or clean cloth.

Inspect the components 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

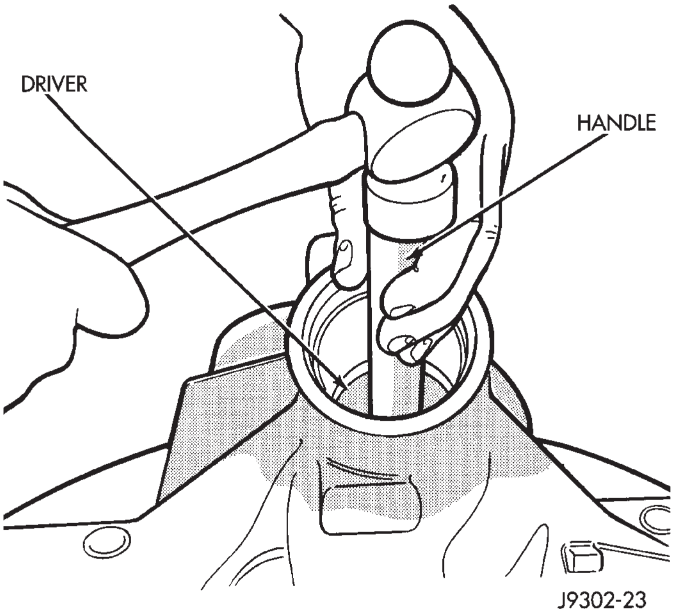

Fig. 37 Rear Bearing Cup Removal

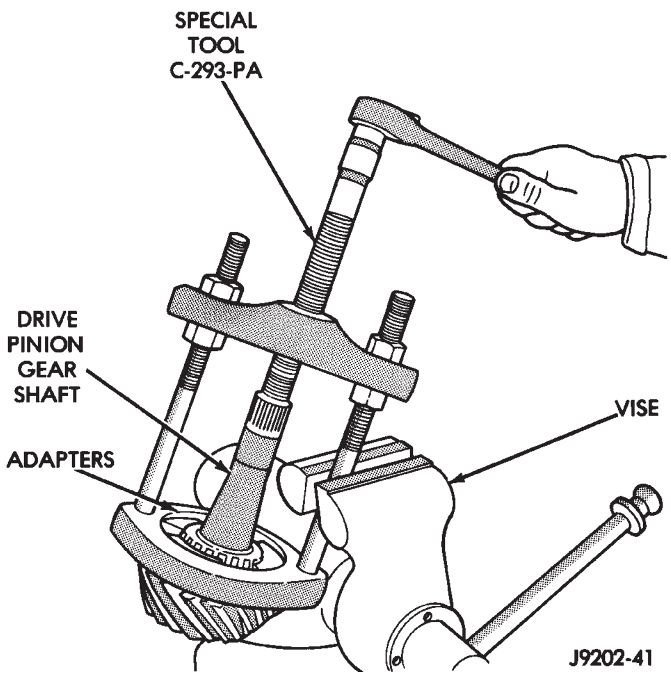

Fig. 38 Inner Bearing Removal

• Wear and damage to pinion gear mate shaft, pinion gears, side gears and thrust washers. Replace as a matched set only.
• Ring and pinion gear for worn and chipped teeth
• Ring gear for damaged bolt threads. Replaced as a matched set only.
• Pinion yoke for cracks, worn splines, pitted areas, and a rough/corroded seal contact surface. Repair or replace as necessary.
• Preload shims for damage and distortion. Install new shims if necessary.

DIFFERENTIAL ASSEMBLY

(1) Install the following components in the differential case.
• 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 lock pin in the differential case and mate shaft with a punch and hammer (Fig. 39). Peen metal part of case over pin in two places.

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.

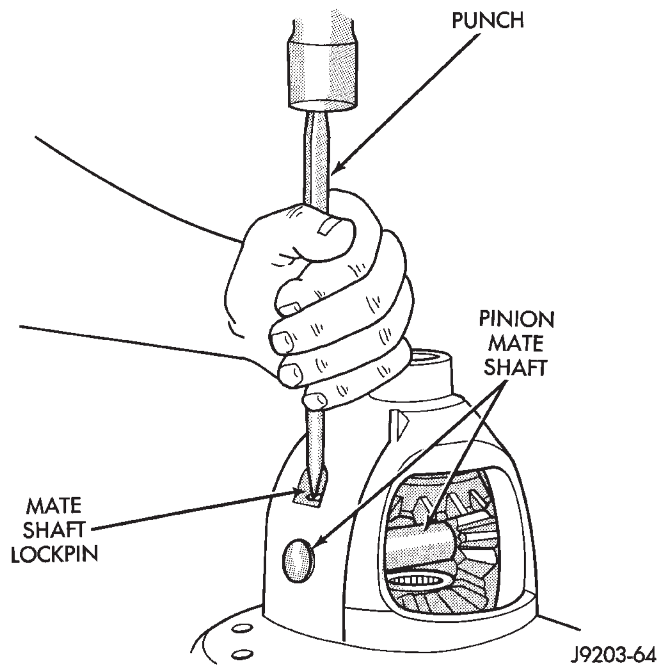

Fig. 39 Mate Shaft Pin Installation

(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 61-81 N●m (45-60 ft. lbs.) torque (Fig. 40).

(5) Lubricate all differential components with a light coat of grease or hypoid gear lubricant.

PINION GEAR DEPTH INFORMATION

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. 41). 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 2.250 inches (57.1 mm) for Model 30 axles. The standard depth provides the best teeth contact pattern.

THE BUTTON END ON THE PINION GEAR HEAD IS NO LONGER A MACHINED-TO-SPECI-

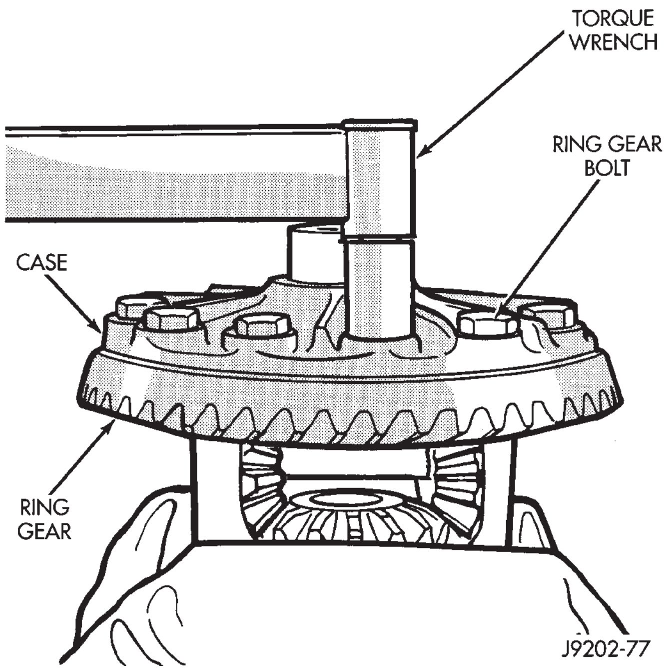

Fig. 40 Ring Gear Bolt Installation

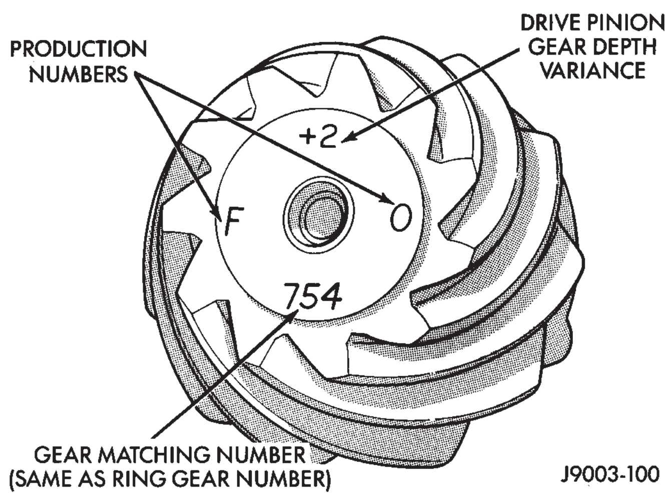

Fig. 41 Pinion Gear ID Numbers

FICATIONS SURFACE. DO NOT USE THIS SURFACE FOR PINION DEPTH SET-UP OR CHECKING (Fig. 42).

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. 43). The shim pack is placed under the inner (rear) bearing cup. To change the pinion adjustment, shims are available in thicknesses of 0.003, 0.005, and 0.010 inch. **If equipped, the oil slinger or baffle must be measured and the thickness included with the total shim pack.**

If a new gear set is being installed, note the number etched into both pinion gears. Add or subtract the thickness of the original depth shims to compensate for the difference in the depth variances. Refer to the Depth Variance charts.

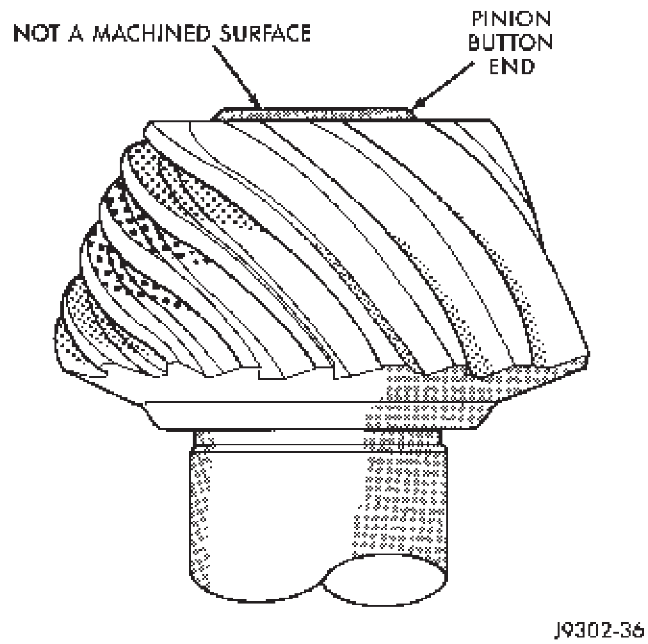

Fig. 42 Pinion Gear Head

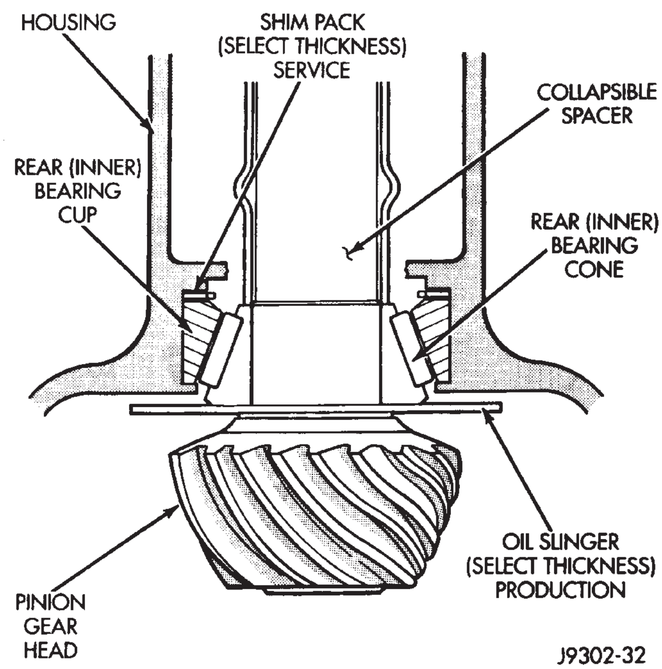

Fig. 43 Shim and Slinger Location

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.

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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Refer to the Pinion Gear Depth Variance Chart.

DIFFERENTIAL AND PINION MEASUREMENT WITH GAUGE SET D-115-30

DIFFERENTIAL ZERO END PLAY MEASUREMENT

(1) Place Master Differential Bearing D-134 (D-348) on the case hubs (Fig. 44).

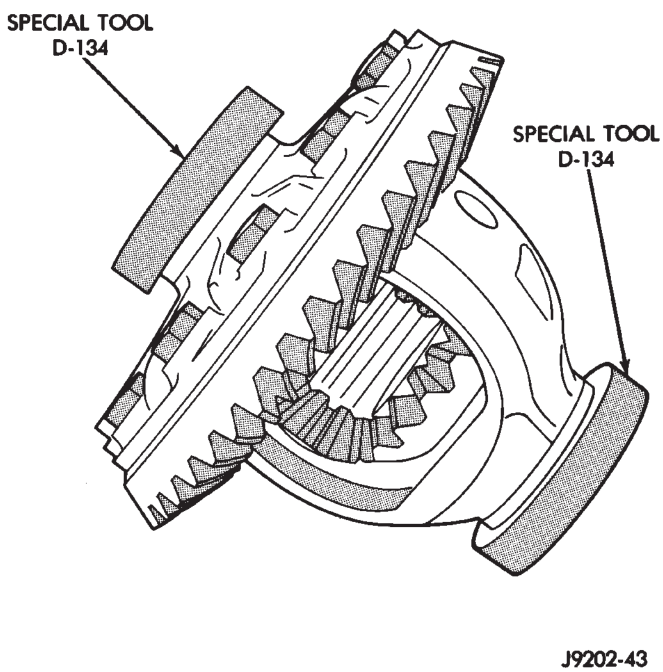

Fig. 44 Master Bearing Tools On Hubs

(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. 45).

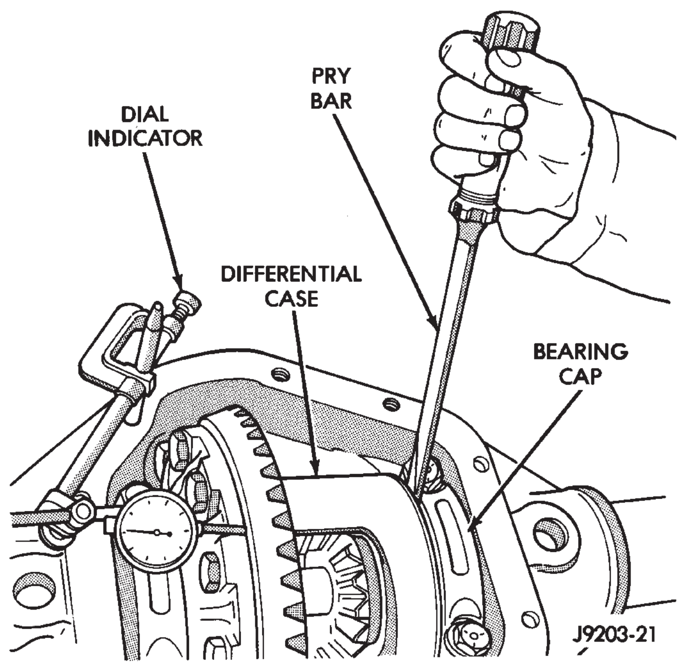

Fig. 45 Differential Case End Play Measurement

(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. 45). 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 and pilot stud.

PINION GEAR DEPTH MEASUREMENT

The following gear depth measurement and adjustment procedure involves using Gauge Set D-115-30 (Fig. 46).

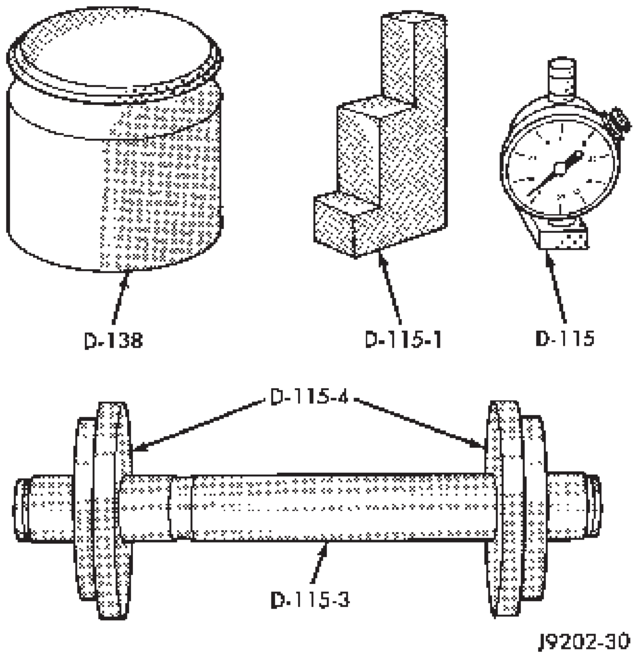

Fig. 46 Pinion Gear Depth Gauge Tool Set D-115-30

(1) Insert Master Pinion Block D-138 into the pinion gear bore (Fig. 47).

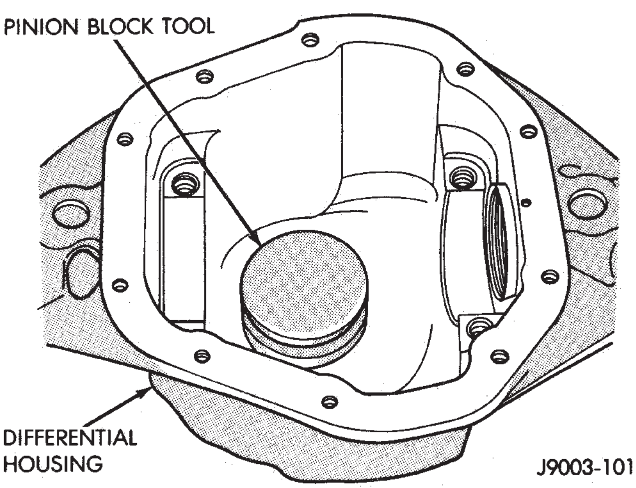

Fig. 47 Pinion Block Tool Inserted In Shaft Bore

(2) Place Disc D-115-4 on Arbor D-115-3 and position in the bearing cradles (Fig. 48).

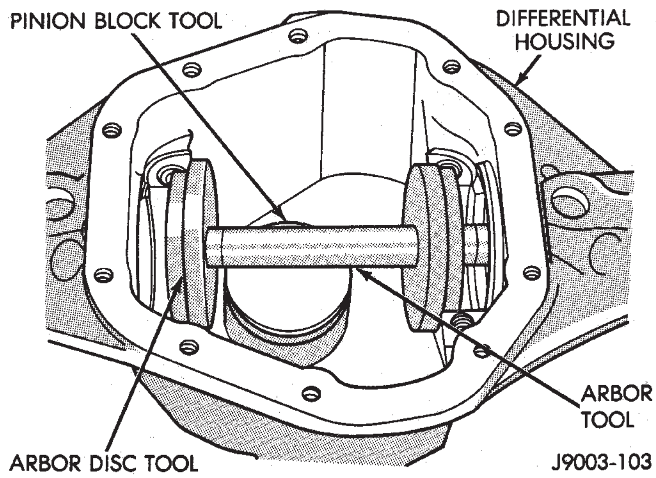

Fig. 48 Gauge Tools In Housing

(3) Place Pinion Height Block D-115-1 on top of master pinion block tool and against arbor tool (Fig. 49).

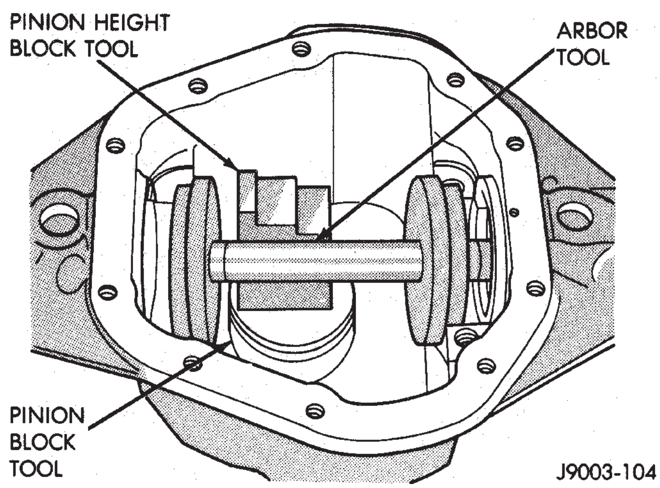

Fig. 49 Pinion Height Block Tool Against Arbor

(4) Firmly place Scooter Block and Dial Indicator D-115 on **the lowest step** of pinion height block tool (Fig. 50). Zero the dial indicator pointer.

(5) Move the gauge block toward the arbor until the indicator plunger contacts the arbor tool (Fig. 50). Slide the gauge block across the arbor while observing indicator. Record the longest travel distance, whether inward (-) or outward (+), indicated by the pointer.

The plunger distance, plus the variance in the gear is the required thickness for the shims.

(6) If equipped, the oil slinger and baffle must be measured and the thickness included with the total shim thickness.

(7) Remove the measurement tools from the differential housing.

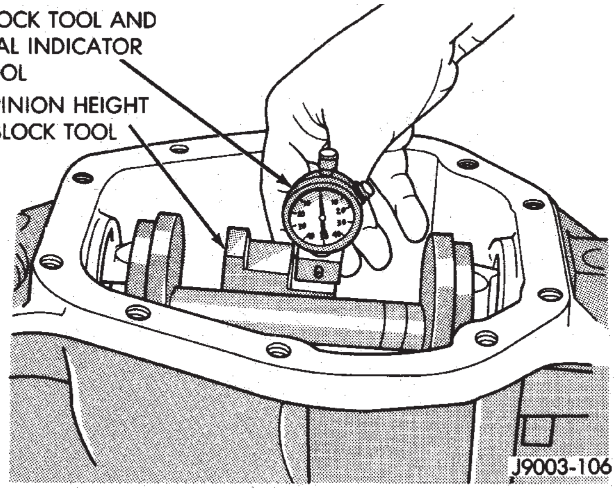

Fig. 50 Pinion Gear Depth Measurement

PINION GEAR ASSEMBLY/INSTALLATION

(1) Place the needed shim pack thickness in the pinion gear rear bearing bore (service only). Install the bearing cup with Installer D-146 and Driver Handle C-4171 (Fig. 51). Ensure cup is correctly seated.

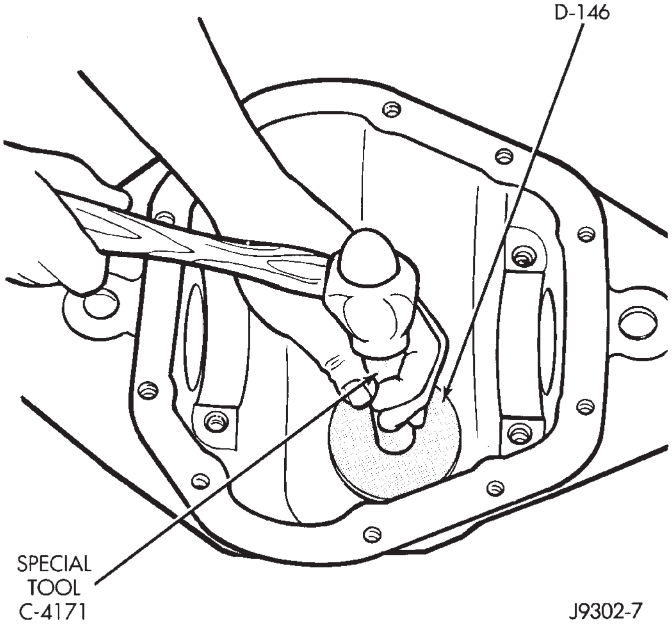

Fig. 51 Pinion Rear Bearing Cup Installation

(2) Install the pinion front bearing cup with Installer D-144 and Handle C-4171 (Fig. 52).

(3) If used, place the oil slinger on the pinion gear. Install the rear (inner) bearing on the pinion gear with Installer W-262 (Fig. 53).

(4) Install a new collapsible preload spacer on pinion shaft. Install the pinion gear in housing (Fig. 54).

(5) Install pinion front bearing and oil slinger. 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. 55).

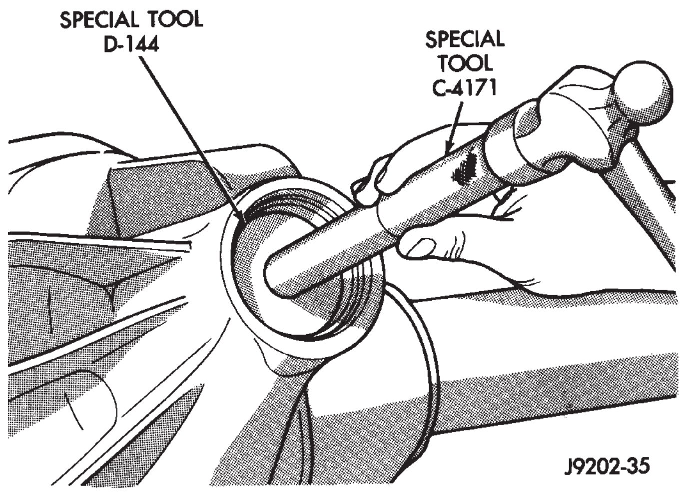

Fig. 52 Pinion Front Bearing Cup Installation

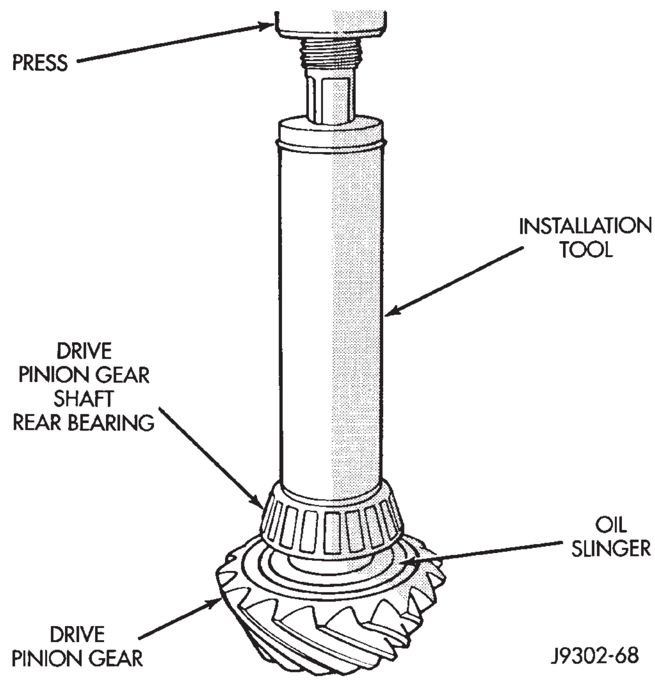

Fig. 53 Rear Bearing Installation

(6) Install yoke with Installer W-162-D and Wrench C-3281 (Fig. 56).

(7) Install the yoke washer AND A NEW NUT on the pinion gear. **Tighten the nut only enough to remove the end play. Do not over-tighten it.**

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.

(8) Use Flange Wrench C-3281 to retain the yoke (Fig. 57). Slowly tighten the nut in small increments

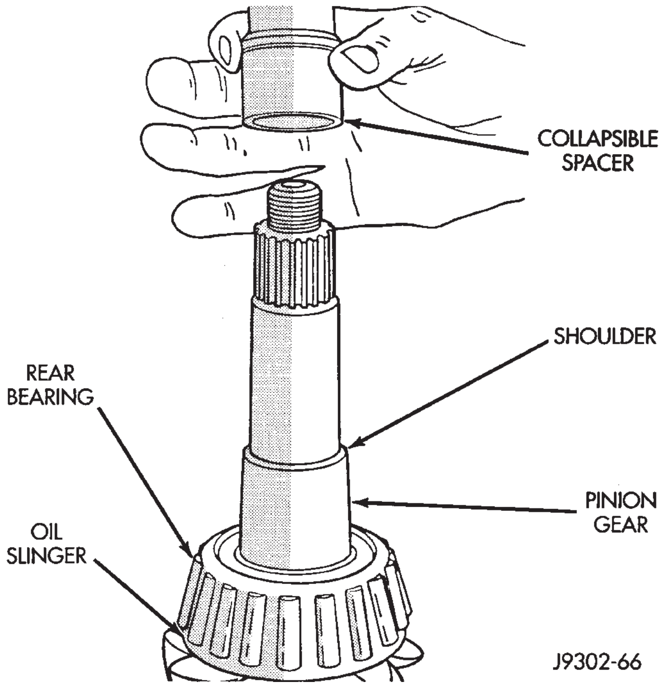

Fig. 54 Collapsible Preload Spacer

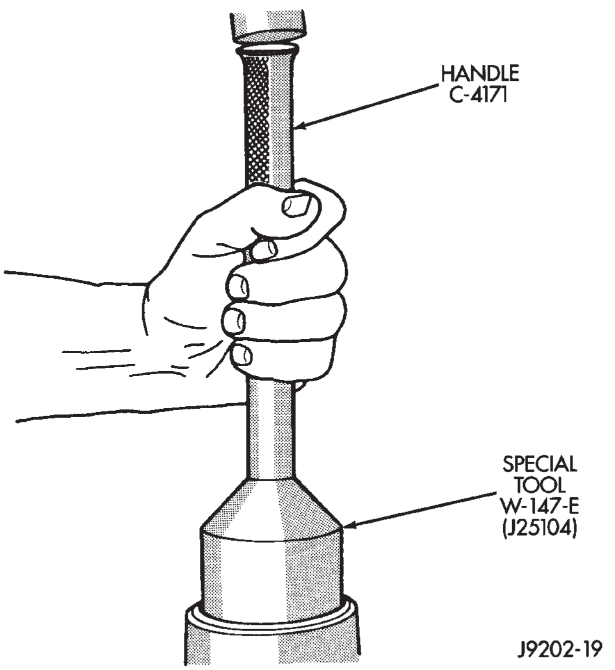

Fig. 55 Pinion Seal Installation

until the rotating torque is achieved. **Measure the preload torque frequently to avoid over-tightening the nut.**

(9) Check bearing preload torque with an inch pound torque wrench (Fig. 58). The torque necessary to rotate the pinion gear should be;

- Original Bearings: 1 to 3 N●m (10 to 20 in. lbs.).
- New Bearings: 1.5 to 4 N●m (15 to 35 in. lbs.).

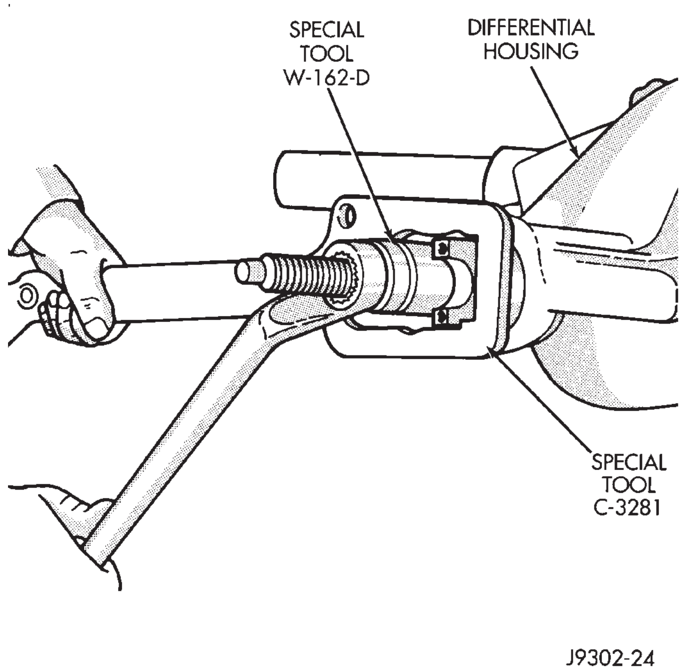

Fig. 56 Pinion Yoke Installation

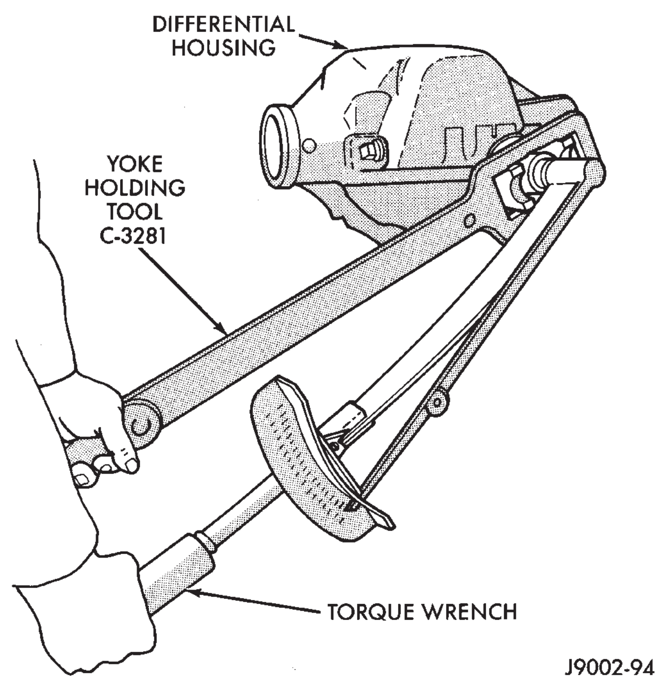

Fig. 57 Tightening Pinion Nut

DIFFERENTIAL SHIM PACK MEASUREMENT AND ADJUSTMENT

(1) Place Master Differential Bearing D-134 (D-348) on the case hubs.

(2) Place Differential assembly in the housing. Assemble Differential bearing caps.

(3) 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. 59). Ensure ring and pinion gear teeth are tightly meshed. Zero the indicator.

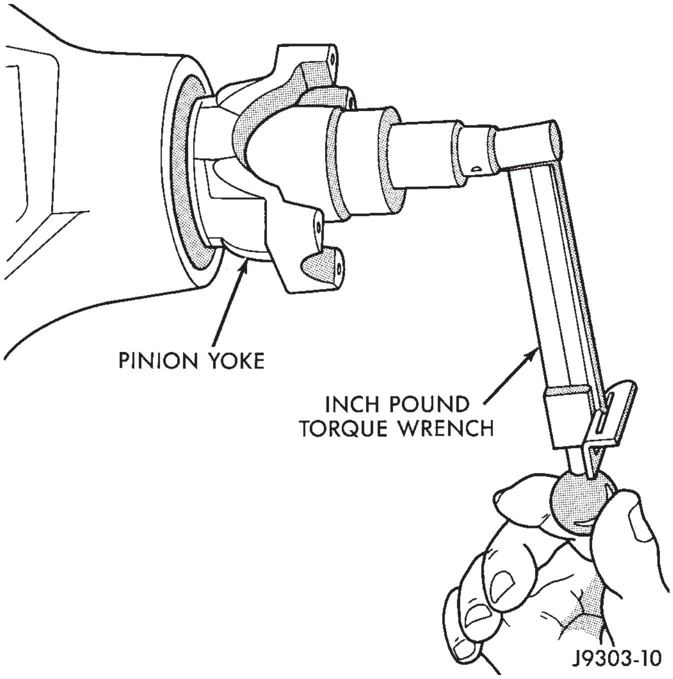

Fig. 58 Check Pinion Gear Torque

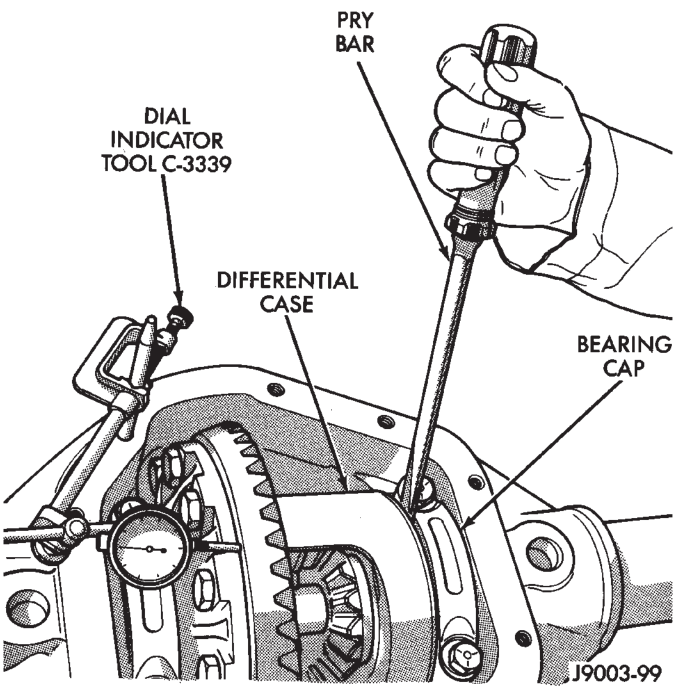

Fig. 59 Shim Pack Measurement

(4) 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. 60). Zero the dial indicator pointer.

(5) 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. 60). The shims must be placed at the ring gear side between the case and bearing.

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. 60 Shim Pack Calculations

(6) Remove indicator and pilot stud.

(7) Remove the differential case from housing.

(8) Remove the master bearing tools from the differential case hubs.

(9) 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. 61).

(10) Position the remaining zero end-play shims on hub at opposite side of case. Include an additional 0.015 in. (0.38 mm) thick shim on this hub. This will provide the required differential bearing preload.

(11) Install bearings on hubs with Installer C-3716-A and Handle C-4171 (Fig. 61).

(12) Match each bearing cup with bearing (original). Install the cups on the bearings.

DIFFERENTIAL INSTALLATION

(1) Position Spreader W-129-A with the tool dowel pins seated in the locating holes (Fig. 62). Install the holddown clamps and tighten the tool turnbuckle finger-tight.

(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. 62) 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.

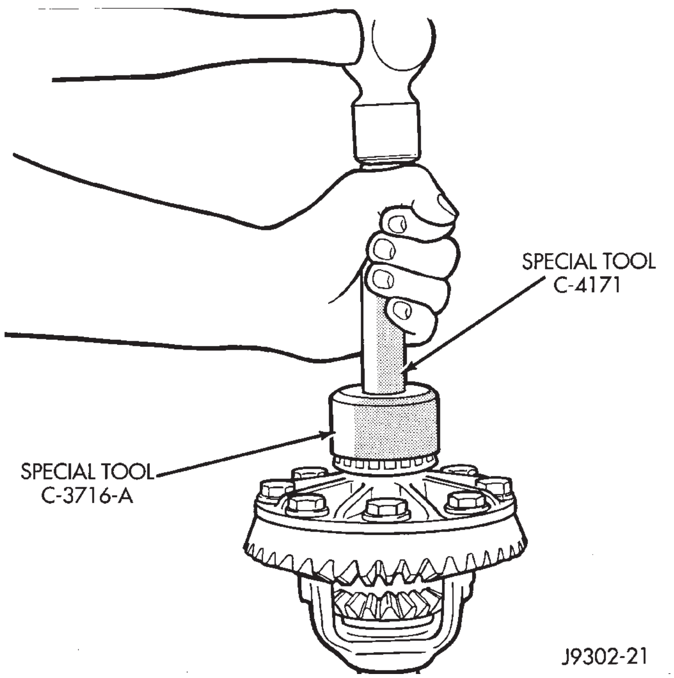

Fig. 61 Differential Bearing Installation

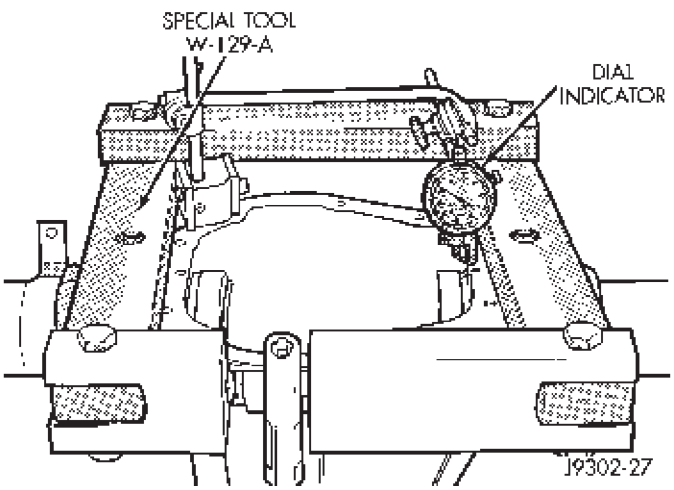

Fig. 62 Spread Differential Housing

(3) Separate the housing enough to install the case in the housing. Measure the distance with the dial indicator (Fig. 62).

(4) Remove the dial indicator.

(5) Install case in the housing. Tap the differential case to ensure the bearings are fully seated (Fig. 63). Remove the spreader.

(6) Install the bearing caps at their original locations (Fig. 64). Tighten the bearing cap bolts to 77 N●m (57 ft. lbs.) torque.

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. 65).

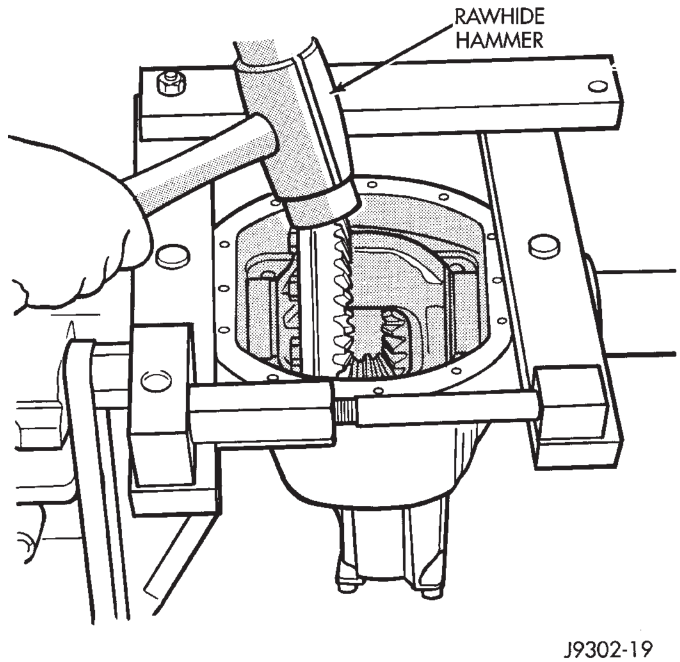

Fig. 63 Differential Installation

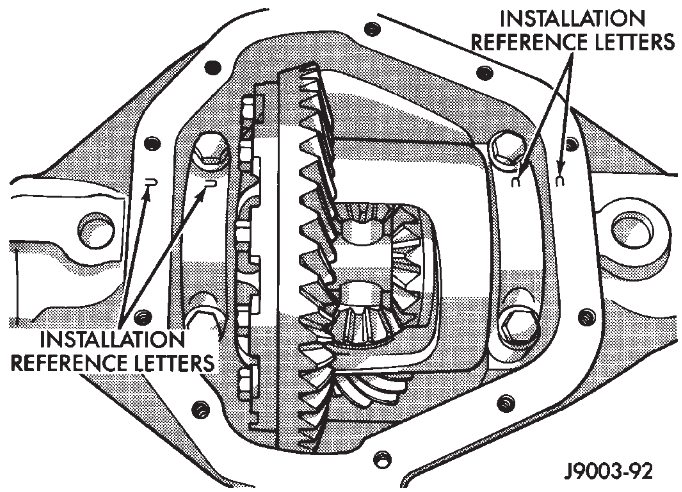

Fig. 64 Differential Bearing Cap Reference Letters

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. 66). **DO NOT INCREASE THE TOTAL SHIM PACK THICKNESS, EXCESSIVE BEARING PRELOAD AND DAMAGE MAY OCCUR.**

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 shim(s) have the correct thickness. It will also show if the ring gear backlash has been adjusted correctly. The backlash must be main-

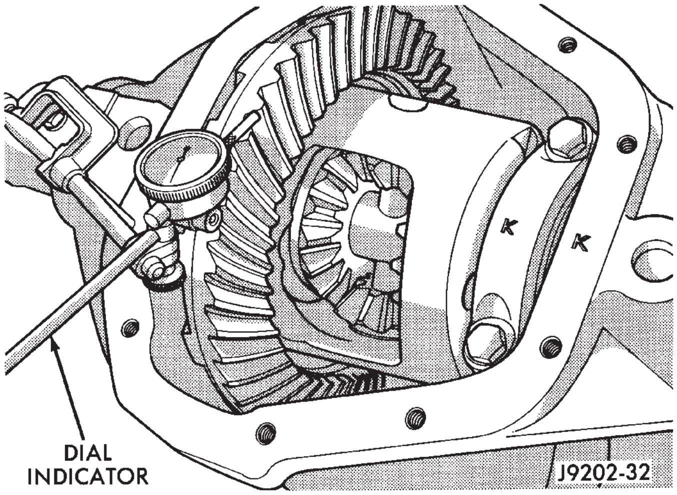

Fig. 65 Ring Gear Backlash Measurement

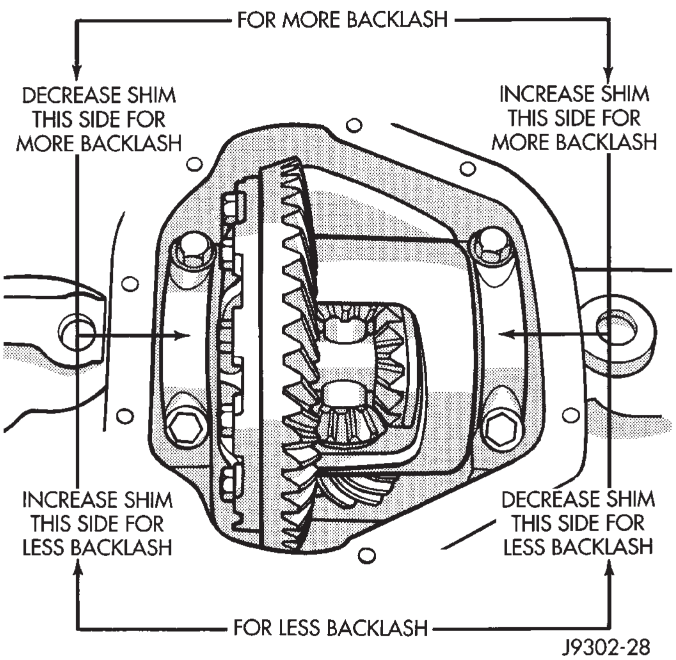

Fig. 66 Backlash Shim Adjustment

tained within the specified limits until the correct tooth contact patterns are obtained.

(2) Apply a thin coat of **hydrated ferric oxide** to the drive and coast side of the ring gear.

(3) Rotate the ring gear several revolutions 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. 67) for interpretation of contact patterns and adjust accordingly.

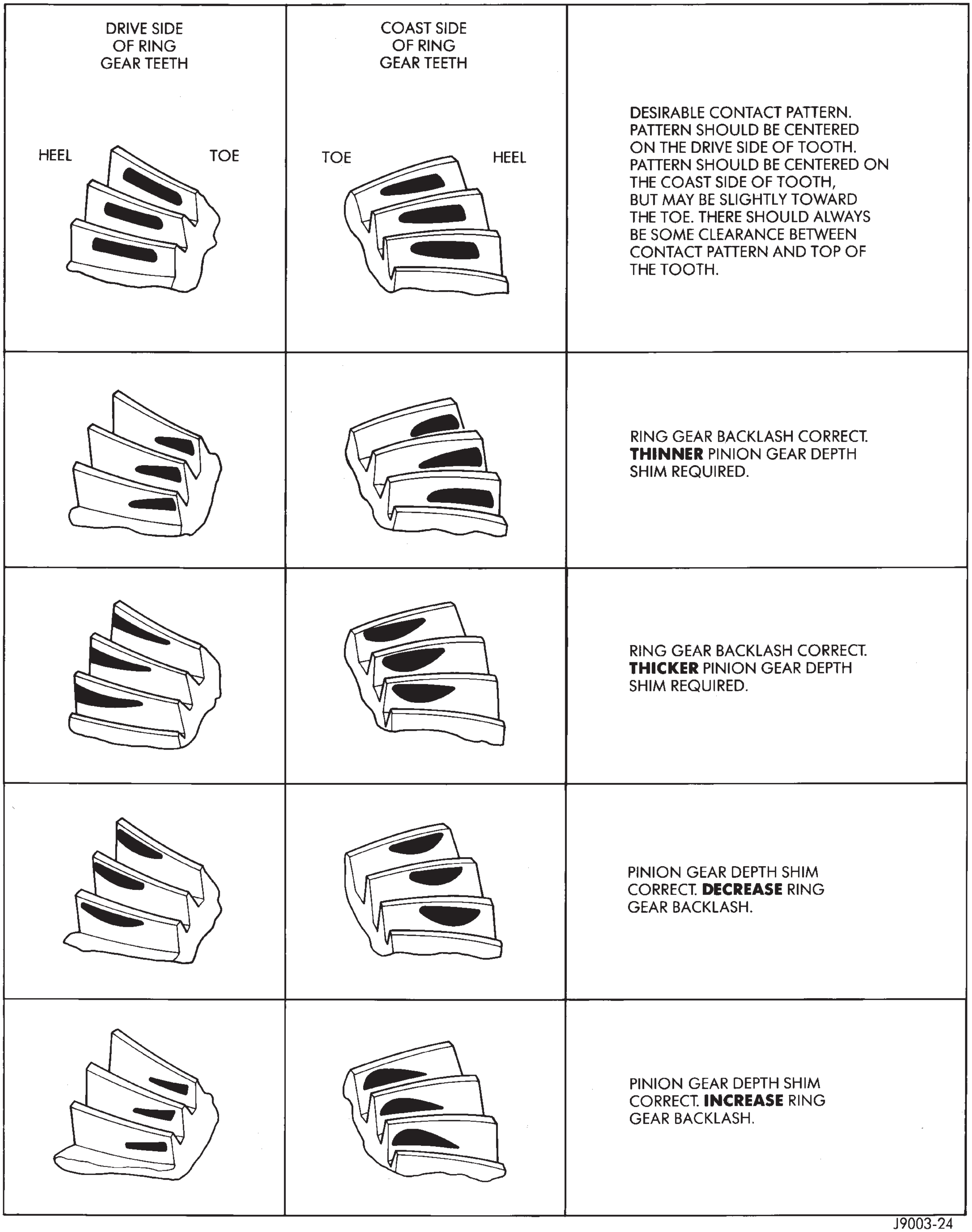

Fig. 67 Gear Tooth Contact Patterns

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. 68). **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 47 N●m (35 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.

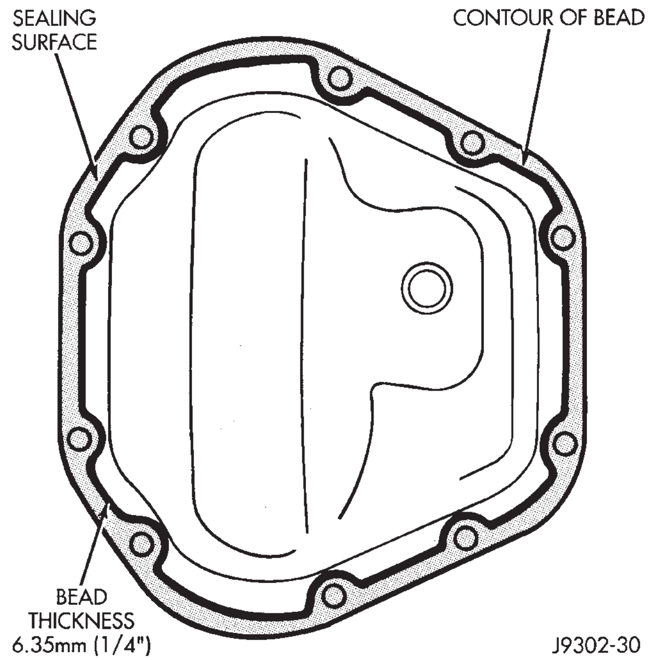

Fig. 68 Typical Housing Cover With Sealant

AXLE SPECIFICATIONS

MODEL 30 FRONT AXLE

Axle Type	Hypoid
Application	ZJ
Ring Gear Diameter	7.125 in. (18.09 cm)
Lubricants	MOPAR Gear Lubricant or Equivalent SAE 75W-90, API Grade GL-5, MIL-L-2105C
Axle Shaft Joint	Cardan, C.V.
Lubricant Capacity	50 oz. (1.48L)
Axle Model	Dana M30F
Axle Ratio	3.55, 3.73
Track	58.5 in.
GAWR	2750 lbs.

Differential Bearing Preload Shim	0.015 in.	0.38 mm
Differential Side Gear-to-Case Clearance	0.000-0.007 in.	0.00-0.18 mm
Ring Gear Backlash	0.005-0.008 in.	0.12-0.20 mm
Drive Pinion Gearshaft Bearing Break-Away Preload Torque	Collapsible Spacer	
Original Bearings	10-20 in. lbs.	1-2 N·m
Replacement Bearings	15-35 in. lbs.	1.5-4 N•m
Drive Pinion Gear Depth	Select Shims	
Standard Setting	2.250 in.	57.1 mm
Side Gear Clearance (max.)	0.006 in.	0.15 mm
Case Runout (max.)	0.006 in.	0.15 mm

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TORQUE SPECIFICATIONS

FRONT SUSPENSION COMPONENTS

DESCRIPTION	TORQUE
Coil Spring Retainer Screw	21 N·m (16 ft. lbs.)
Jounce Bumper Bolt	42 N·m (31 ft. lbs.)
Lower Suspension Arm Nuts	176 N·m (130 ft. lbs.)
Shock Absorber Upper Nut	23 N·m (17 ft. lbs.)
Shock Absorber Lower Bolt/Nut	19 N·m (14 ft. lbs.)
Stabilizer Bar Link Nuts	36 N·m (27 ft. lbs.)
Stabilizer Bar Link Axle Bracket Bolt	95 N·m (70 ft. lbs.)
Stabilizer Bar Clamp Bolts	75 N·m (55 ft. lbs.)
Track Bar Bracket to Reinforcement Plate Bolts	121 N·m (90 ft. lbs.)
Track Bar Bracket to Stud Plate Nuts	121 N·m (90 ft. lbs.)
Track Bar Bracket Reinforcement Plate Side Nuts	95 N·m (70 ft. lbs.)
Track Bar Axle Bracket Bolt	75 N·m (55 ft. lbs.)
Track Bar Ball Stud Retaining Nut	81 N·m (60 ft. lbs.)
Upper Suspension Arm Nuts	75 N·m (55 ft. lbs.)
Wheel Lug Nut 1/2 x 20 with 60° Cone	109 to 150 N·m (80 to 110 ft. lbs.)

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MODEL 30 AXLE

DESCRIPTION	TORQUE
Bearing Cap Bolts	77 N·m (57 ft. lbs.)
Differential Cover Bolts	47 N·m (35 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 (80 ft. lbs.)
Upper Ball Stud Nut	101 N·m (75 ft. lbs.)
Ring Gear Bolts	61 to 81 N·m (45 to 60 ft. lbs.)

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REAR SUSPENSION AND AXLES

CONTENTS

GENERAL INFORMATION

REAR SUSPENSION

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

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

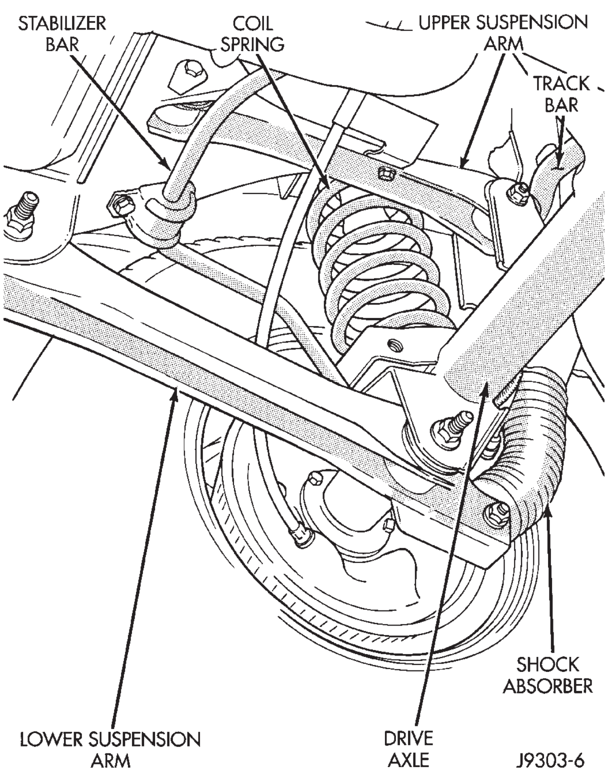

Fig. 1 Rear Suspension

The upper and lower suspension arms use bushings to isolate road noise. The suspension arms are bolted to the frame and axle through the rubber bushings. The upper suspension arm uses cam bolts at the axle to allow for pinion angle adjustment. The cams are available as a service kit and are not installed at the factory. The suspension arm travel (jounce or rebound) is limited through the use rubber bumpers.

All suspension components that use rubber bushings should be tightened with the vehicle at the normal height. If the springs are not at normal ride position, vehicle ride comfort could be affected. Rubber bushings must never be lubricated.

The vehicles use coil springs mounted up in the fender shield that is part of the unitized body bracket. There is a rubber doughnut isolator between the top of the spring and bracket to isolate road noise. The bottom of the spring seats on the axle pad and is retained with a clip.

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

The stabilizer bar is used to minimize vehicle rear sway during turns. The spring steel bar helps to equalize the vehicle body in relationship to the suspension. The bar extends across the underside of the chassis and connects to the frame rails. The links are connected to the axle brackets. All mounting points of the stabilizer bar are isolated by rubber bushings.

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

REAR AXLE

The integral housing, hypoid design has the pinion set below the ring gear.

The axles are equipped with A.B.S. brake systems. The A.B.S. tone rings are pressed onto the axle shaft near the hub flange. For additional information on the A.B.S. system refer to Group 5, Brakes.

The Model 35 axle has the assembly part number and gear ratio listed on a tag. The tag is attached to the housing cover (Fig. 2). Build date identification codes are stamped on the axle shaft tube cover side.

The Model 35 axle is available with Trac-lok (limited slip) differential as an option.

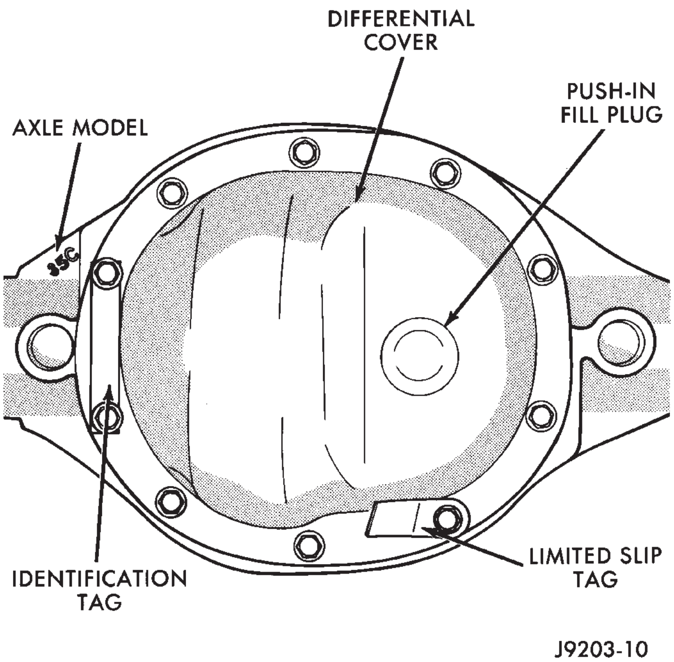

Fig. 2 Model 35 Differential Cover

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 the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 3).

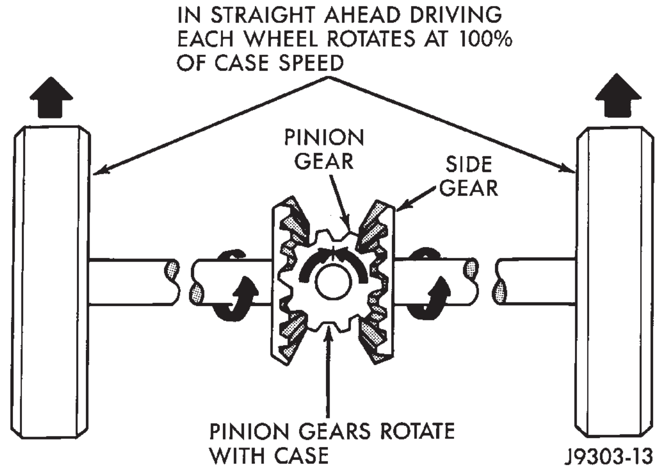

Fig. 3 Differential Operation—Straight-Ahead Driving

When turning corners, the outside wheel must travel a greater distance than the inside wheel in order to complete a turn. This difference must be compensated for in order to prevent the wheels from scuffing and skidding through the turn. To accomplish this, the differential becomes effective allowing the axle shafts to turn at unequal speeds (Fig. 4). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

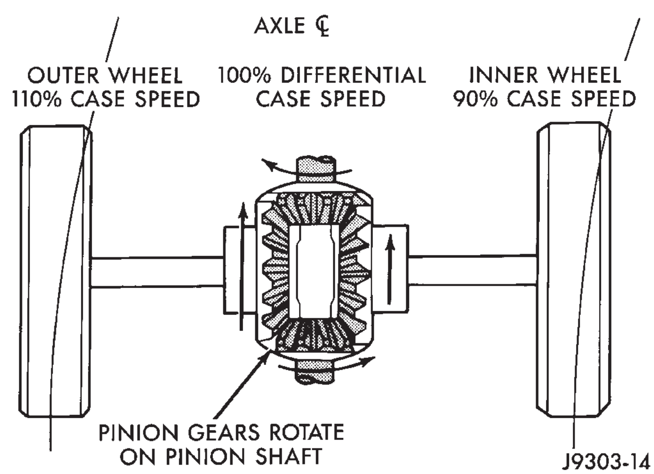

Fig. 4 Differential Operation—On Turns

REAR SUSPENSION

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SERVICE INFORMATION

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

TRACK BAR

REMOVAL

(1) Raise and support the vehicle.

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

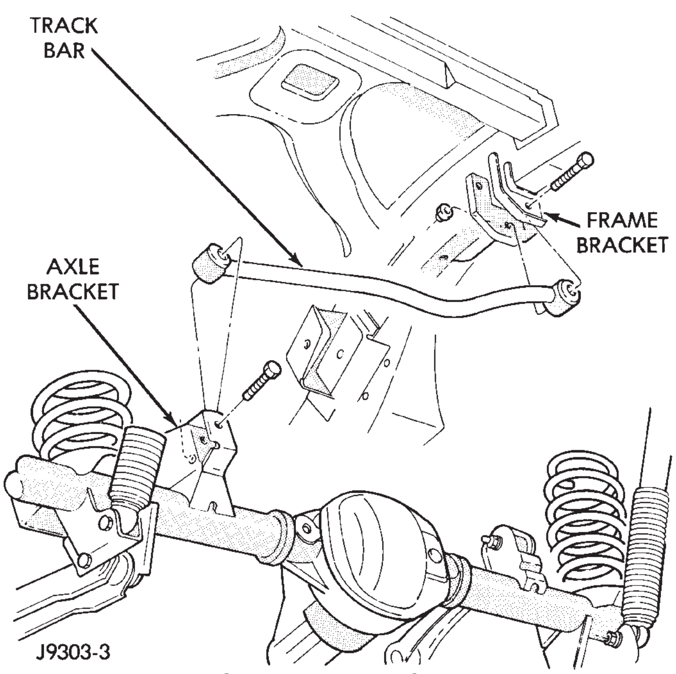

Fig. 1 Rear Track Bar

(3) Remove the bolt from the axle tube bracket (Fig. 1). Remove the track bar.

INSTALLATION

(1) Install the track bar to the axle bracket and install the bolt (Fig. 1).

(2) It may be necessary to pry the axle assembly over to install the track bar. Install the track bar to the frame rail bracket. Loosely install the bolt and flag nut (Fig. 1).

(3) Remove the supports and lower the vehicle.

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

(5) Tighten the nut at the frame rail to 100 N●m (74 ft. lbs.) torque.

STABILIZER BAR

REMOVAL

(1) Raise and support the vehicle. Remove one wheel and tire.

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

(3) Lower the exhaust by disconnecting the muffler and tail pipe hangers.

(4) Disconnect the stabilizer bar from the links.

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

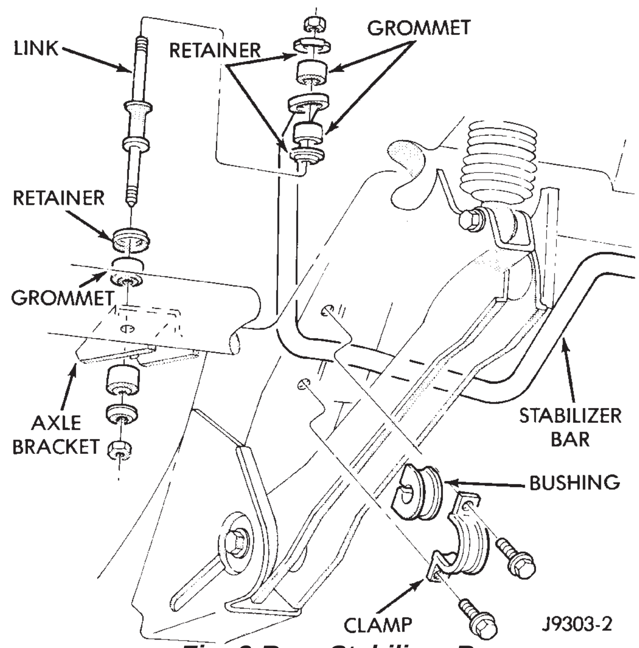

Fig. 2 Rear Stabilizer Bar

INSTALLATION

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

(2) Install the links and grommets onto the stabilizer bar and axle brackets (Fig. 2). Install the nuts and tighten to 36 N●m (27 ft. lbs.) torque.

(3) Connect the muffler and tail pipe to their hangers.

(4) Install the wheel and tire.

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). Remove the ABS wire bracket from the arm.

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

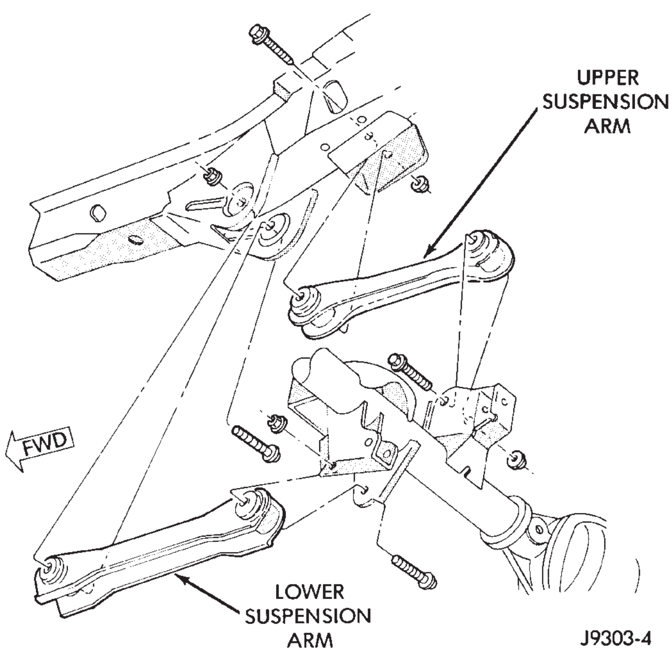

Fig. 3 Upper and Lower Suspension Arms

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). Install the ABS wire bracket onto the arm.

(3) Remove the supports and lower the vehicle.

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

(5) Tighten the nut at the frame rail to 75 N●m (55 ft. lbs.) torque.

LOWER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the lower 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 lower suspension arm.

INSTALLATION

(1) Position the lower suspension arm at the axle bracket and frame rail bracket (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 bracket to 177 N●m (130 ft. lbs.) torque.

(5) Tighten the bolt at the frame rail to 177 N●m (130 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 if any of these conditions exist.

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 upper nut and retainer from the frame rail stud (Fig. 4).

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

INSTALLATION

(1) Install the shock absorber on the upper frame rail stud. Install the shock absorber on the axle bracket (Fig. 4).

(2) Install the retainer and nut on the stud. Tighten the upper nut to 70 N●m (52 ft. lbs.) torque.

(3) Tighten the lower nut to 92 N●m (68 ft. lbs.) torque.

COIL SPRING

REMOVAL

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

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

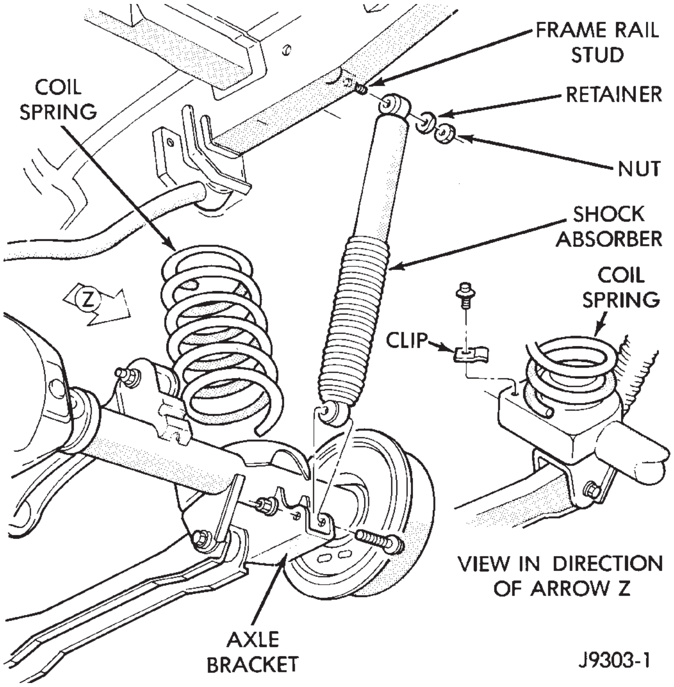

Fig. 4 Rear Coil Spring & Shock Absorber

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

(4) Lower the axle until the spring is free from the upper mount seat. Remove the coil spring clip screw (Fig. 4) and remove the spring.

INSTALLATION

(1) Position the coil spring on the axle pad. Install the spring clip and screw (Fig. 4). Tighten the screw to 22 N●m (16 ft. lbs.) torque.

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

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

(4) Remove the supports and lower the vehicle.

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

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)
- 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

Common causes of overloading is from full-throttle acceleration. Overloading happens when towing heavier-than-recommended loads. Component breakage can occur when the wheels are spun excessively. Insufficient or incorrect lubricants contribute to breakage through overheating. 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.

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, Wheels and Tires for additional information.

DRIVELINE SNAP

A snap or clunk noise when the vehicle is shifted into gear (or the clutch engaged), can be caused by:
- High engine idle speed
- Loose engine/transmission/transfer case mounts
- Worn U-joints
- Loose spring mounts
- Loose pinion gear nut and yoke
- Excessive ring gear backlash
- Excessive 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.

REAR AXLE ALIGNMENT

MEASUREMENT

The following procedure can be used to determine if abnormal rear tire tread wear is the result of a bent or deformed rear axle shaft.

(1) Raise both rear wheels off the surface with a frame contact hoist.

(2) Attach a one-inch long piece of masking tape at the center of each tire tread for use as reference marks.

(3) Rotate the rear wheels until both reference marks face the front of the vehicle. Measure the distance between the outside edges of the two pieces of tape. Record this measurement as the front of tire (FTR) measurement.

(4) Rotate the rear wheels until both reference marks face the rear of the vehicle. Measure the distance between the outside edges of the two pieces of tape. Record this measurement as the rear of tire (RTR) measurement.

(5) Subtract the (RTR) measurement from the (FTR) measurement to obtain the amount of wheel toe. The acceptable rear wheel toe-in position is 1/16 inch (1.6 mm) to 3/16 inch (4.8 mm) toe-out.

(6) Rotate the rear wheels until the reference marks are facing downward. Measure the distance between the outside edges of the two pieces of tape. Record this measurement as the bottom of tire (BTR) measurement.

(7) Average the (FTR) and the (RTR) distance measurements. Subtract the (BTR) measurement from this average distance to obtain the camber. The acceptable amount of camber is 1/16 inch to 3/32 inch (1.6 to 2.4 mm).

(FTR + RTR) DIVIDED BY 2 (TWO) MINUS BTR EQUALS CAMBER

If the (BTR) distance measurement is less than the average FTR and RTR distance measurement, the camber will be positive (+). If the (BTR) distance measurement is greater than the average FTR and RTR distance, the camber will be negative (-).

If the toe position or camber is not acceptable, a bent or deformed rear axle shaft is most likely the cause.

LIMITED SLIP DIFFERENTIAL

Under normal traction conditions, engine torque is divided evenly. With low-traction surfaces, engine torque is transferred to the wheel with the most tire traction. When diagnosing a limited-slip differential problem condition, the wheel with the least traction can continue spinning.

The most common problem is a chatter noise when turning corners. Check for incorrect or contaminated lubricant. Replace the gear lubricant if necessary.

- With **Trac-Lok** differentials add a container of MOPAR® Trac-Lok Lubricant.
- With **Sure-Grip** differentials add a container of MOPAR® Hypoid Gear Additive.

This will correct the condition in most instances. If the chatter persists, clutch damage could have occurred.

After changing the lubricant, drive the vehicle and make 10 to 12 slow, figure-eight turns. This maneuver will pump lubricant through the clutches.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
WHEEL NOISE	(a) Wheel loose. (b) Faulty, brinelled wheel bearing.	(a) Tighten loose nuts. (b) Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	(a) Misaligned axle shaft tube. (b) Bent or sprung axle shaft. (c) End play in drive pinion bearings. (d) Excessive gear backlash between ring gear and pinion gear. (e) Improper adjustment of drive pinion gear shaft bearings. (f) Loose drive pinion gearshaft yoke nut. (g) Improper wheel bearing adjustment. (h) Scuffed gear tooth contact surfaces.	(a) Inspect axle shaft tube alignment. Correct as necessary. (b) Replace bent or sprung axle shaft. (c) Refer to Drive Pinion Bearing Pre-Load Adjustment. (d) Check adjustment of ring gear backlash and pinion gear. Correct as necessary. (e) Adjust drive pinion shaft bearings. (f) Tighten drive pinion gearshaft yoke nut with specified torque. (g) Readjust as necessary. (h) If necessary, replace scuffed gears.
AXLE SHAFT BROKE	(a) Misaligned axle shaft tube. (b) Vehicle overloaded. (c) Erratic clutch operation (d) Grabbing clutch.	(a) Replace broken axle shaft after correcting axle shaft tube alignment. (b) Replace broken axle shaft. Avoid excessive weight on vehicle. (c) Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch. (d) Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	(a) Improper adjustment of differential bearings. (b) Excessive ring gear backlash. (c) Vehicle overloaded. (d) Erratic clutch operation.	(a) Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly. (b) Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly. (c) Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle. (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. (b) Improper grade of lubricant. (c) Excessive spinning of one wheel/tire.	(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) Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant. (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 35 AXLE

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GENERAL INFORMATION

The housing for Model 35 rear axles consists of an iron center casting with 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 below 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 axle shaft and bearings. The axle shafts are retained by C-clips in the differential side gears.

The axles are equipped with ABS brake sensors. The sensors are attached to the brake backing plate 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 removable cover provides a means for servicing the differential without removing the axle assembly.

The Model 35 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 threaded roll pin. Differential bearing preload and ring gear backlash is adjusted by the use of spacer shims. The shims are located between the differential bearing cups. Pinion bearing preload is set and maintained by the use of a collapsible spacer.

LUBRICANT SPECIFICATIONS

Multi-purpose, hypoid gear lubricant should be used for Model 35 axle. The lubricant should have MIL-L-2105C and API GL 5 quality specifications. MOPAR® Hypoid Gear Lubricant conforms to both of these specifications.

- The lubricant for the standard Model 35 axle is SAE 90W gear lubricant.
- Lubricant for Model 35 axle with Trailer Tow and Trac-Lok: SAE 75W-140 SYNTHETIC gear lubricant with friction modifier.
- The lubricant quantity is 40±1 fluid oz..

Refer to Group 0, Lubrication and Maintenance for additional information.

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

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheels and tires. Remove the brake components from the axle, refer to Group 5, Brakes.

(3) Disconnect the vent hose from the axle shaft tube.

(4) Mark the front propeller shaft and pinion yokes for installation alignment reference. Disconnect the propeller shaft from the axle.

(5) Disconnect the following components from the axle:
- Stabilizer bar link
- Rear propeller shaft
- Shock absorbers
- ABS brake sensor
- Track bar at the axle bracket

(6) Position a floor jack under the axle.

(7) Remove the upper and lower suspension arm from the axle bracket.

(8) Lower the axle with the jack.

INSTALLATION

Have the springs supporting the weight of the vehicle when the arms and track bar fasteners

are being torqued. If the springs are not at their normal ride position, vehicle ride comfort could be affected.

(1) Raise the axle with a floor jack and align it with the coil springs.

(2) Position the lower suspension arm at the axle bracket.

(3) Install the upper and lower suspension arms.

(4) Install the bolts and tighten the nuts on the suspension arms;

- Lower: 177 N●m (130 ft. lbs.) torque.
- Upper: 75 N●m (55 ft. lbs.) torque.

(5) Install the following components to the axle:

- Track bar bolt — 100 N●m (74 ft. lbs.) torque
- Shock absorber nut — 60 N●m (44 ft. lbs.) torque
- Stabilizer bar link nut — 36 N●m (27 ft. lbs.) torque
- ABS brake sensor
- Axle vent hose
- Propeller shaft — 19 N●m (14 ft. lbs.) torque

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

(7) Install the wheels and tires.

(8) Check and add gear lubricant if needed.

(9) Lower the vehicle.

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.**

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 47 N●m (35 ft. lbs.) torque.

(8) Refill the differential with MOPAR® Hypoid Gear Lubricant within 13 mm (1/2 in.) below the fill plug hole.

Trac-Lok (limited slip) Differentials; A container of Trac-Lok Lubricant (friction modifier) should be added after repair service or a lubricant change.

(9) Install the fill hole plug and lower the vehicle.

LIMITED SLIP DIFFERENTIAL vehicles should be road tested by making 10 to 12 slow figure-eight turns. This maneuver will pump the lubricant through the clutch discs to eliminate a possible **chatter** noise complaint.

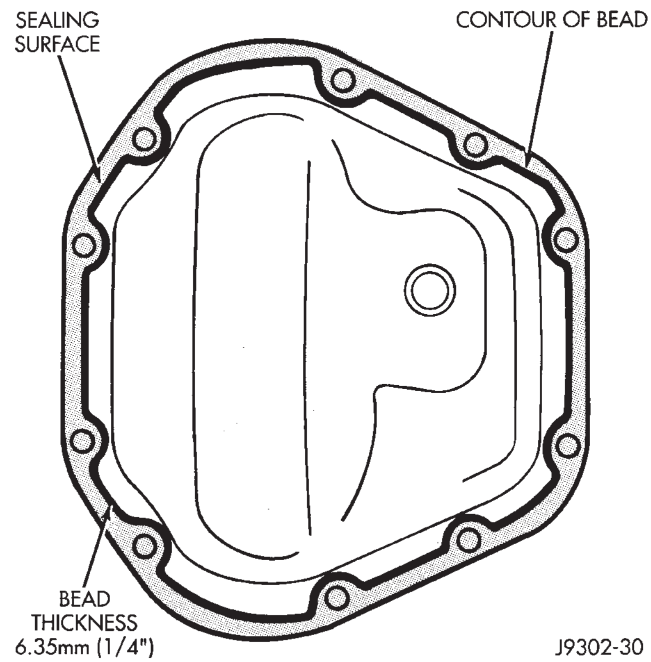

Fig. 1 Typical Housing Cover With Sealant

PINION SHAFT SEAL REPLACEMENT

REMOVAL

(1) Raise and support the vehicle.

(2) Mark the drive shaft yoke and pinion yoke for installation alignment reference.

(3) Remove the drive shaft from the yoke.

(4) Rotate the pinion gear three or four times.

(5) 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.**

(6) Remove the pinion yoke nut and washer. Use Remover C-452 and Wrench C-3281 to remove the pinion yoke (Fig. 2).

(7) Mark the positions of the yoke and pinion gear for installation alignment reference.

(8) Use Remover W-251 to remove the pinion gear seal (Fig. 3).

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).

(2) Align the installation reference marks and install yoke on the pinion gear with Installer W-162-D.

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

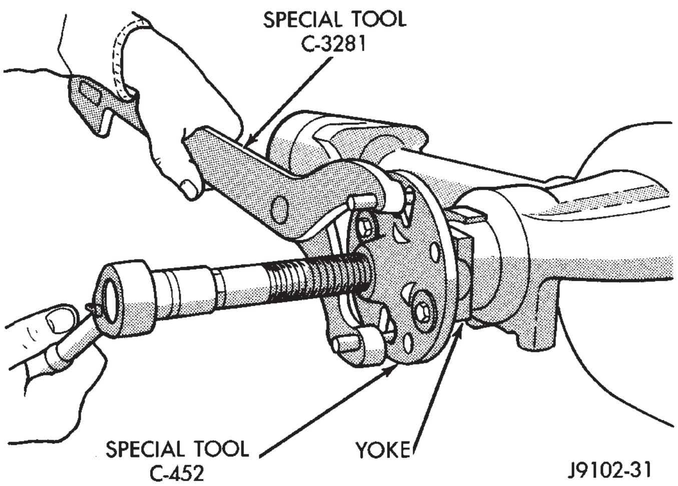

Fig. 2 Pinion Yoke Removal

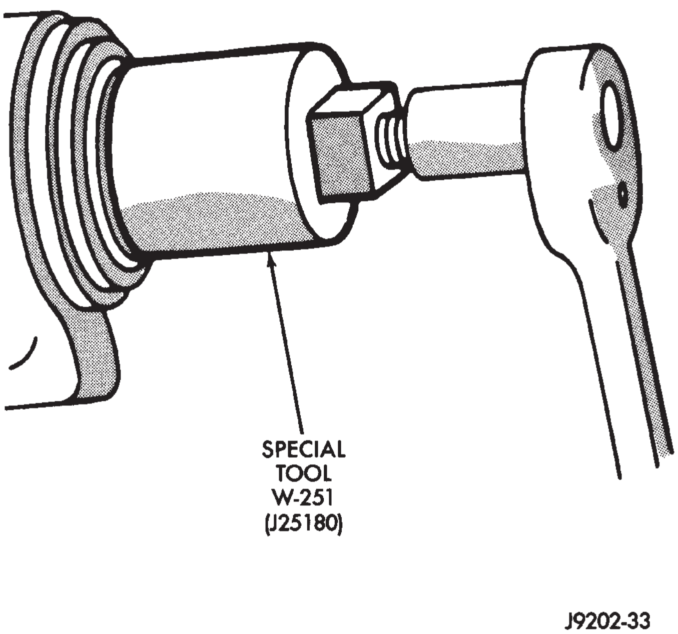

Fig. 3 Seal Removal

CAUTION: Exercise care during the bearing preload torque adjustment. Do not over-tighten, or loosen and then re-tighten the nut. Do not exceed the bearing preload torque. The collapsible preload spacer on the pinion shaft will have to be replaced. The bearing preload torque will be re-adjusted afterward.

(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.

The required preload is equal to the amount at removal plus 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.

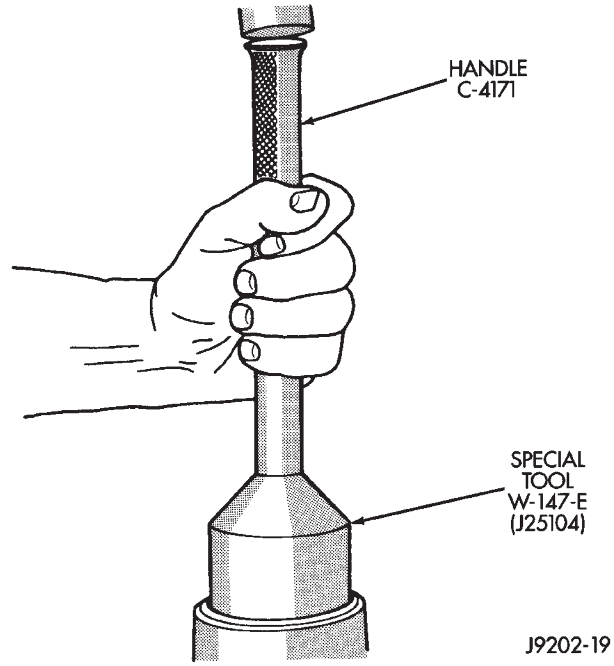

Fig. 4 Pinion Seal Installation

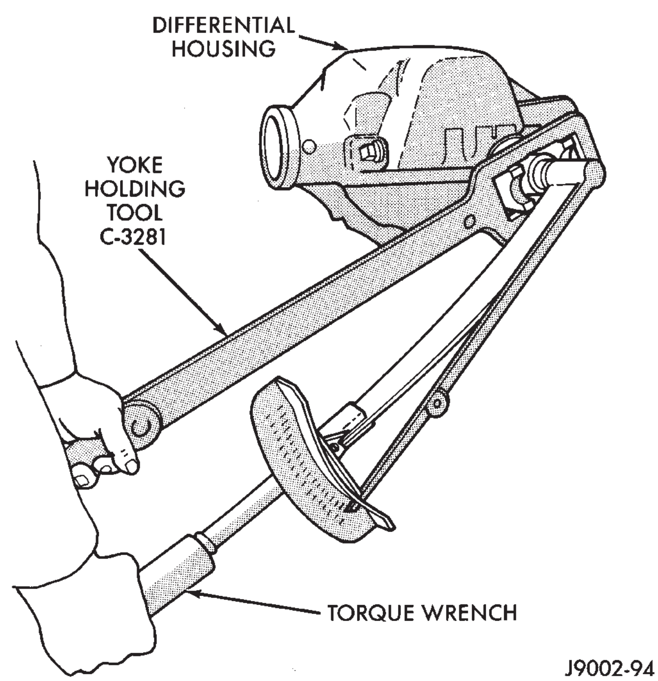

Fig. 5 Tightening Pinion Shaft Nut

(8) Align the installation reference marks and attach the drive shaft to the yoke.

(9) Add API grade GL 5 hypoid gear lubricant to the differential housing, if necessary.

(10) Lower the vehicle.

AXLE SHAFT

REMOVAL

(1) Raise and support the vehicle.
(2) Remove the wheels and tires.
(3) Remove the brake drum.
(4) Clean all the foreign material from housing cover area.
(5) Loosen the housing cover bolts. Drain the lubricant from the housing and the axle shaft tubes. Remove the housing cover.
(6) Rotate the differential case so that the pinion mate gear shaft lock screw is accessible. Remove the lock screw and the pinion mate gear shaft from the case (Fig. 6).

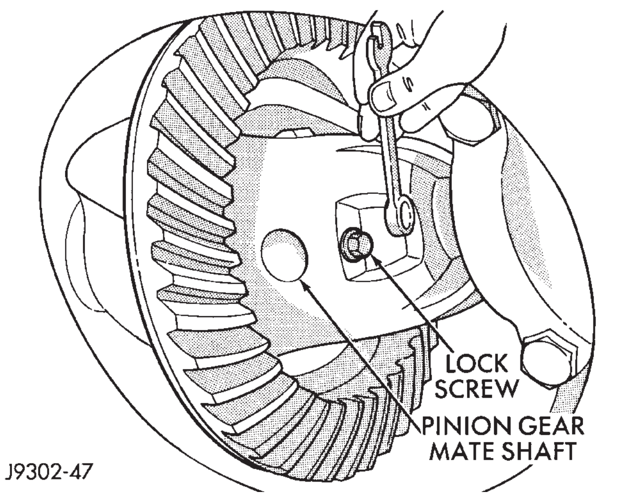

Fig. 6 Mate Shaft Lock Screw

(7) Force the axle shaft in toward the center of the vehicle. Remove the axle shaft C-clip lock from the axle shaft (Fig. 7).

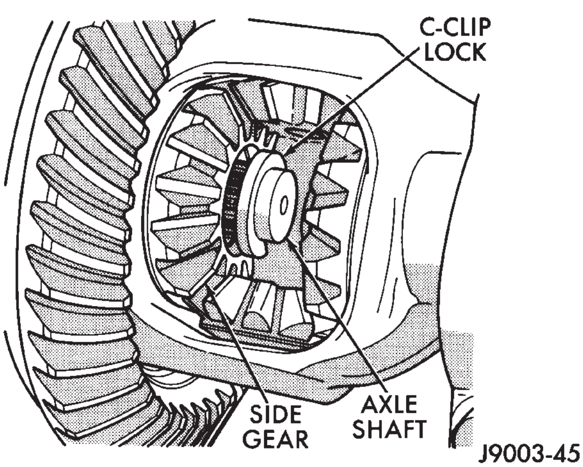

Fig. 7 Axle Shaft C-Clip Lock

(8) Remove the axle shaft. Use care to prevent damage to the axle shaft bearing, which will remain in the axle shaft tube.
(9) Inspect the roller bearing contact surface on the axle shaft for signs of brinelling, spalling and pitting.
(10) If any of these conditions exist, the axle shaft and bearing must be replaced.

INSTALLATION

(1) Lubricate the bearing bore and seal lip with gear lubricant. Insert the axle shaft through the seal, bearing, and engage it with the side gear splines. **Use care to prevent the shaft splines from damaging the axle shaft seal lip.**
(2) Insert the C-clip lock in the end of the axle shaft. Push the axle shaft outward to seat the C-clip lock in the side gear.
(3) Insert the mate shaft into the case and through the thrust washers and pinion gears. Align the hole in shaft with the hole in the differential case and install the lock screw with Loctite® on the threads. Tighten the screw to 19 N●m (14 ft. lbs.) torque.
(4) Install the cover and add fluid. Refer to the Drain and Refill in this section.

AXLE SHAFT SEAL AND BEARING

REMOVAL

(1) Remove the axle shaft. Refer to the Removal procedures in this Section.
(2) Remove the axle shaft seal from the end of the axle shaft tube with a small pry bar.
(3) Remove the bearing if it appears damaged.
The seal and bearing can be removed at the same time with the bearing removal tool.
(4) Remove the axle shaft bearing from the tube (Fig. 8) with Bearing Removal Tool Set 6310 (T.Ar 960-02).
(5) Inspect the axle shaft tube bore for roughness and burrs. Remove as necessary.

CAUTION: Inspect the housing bore for burrs. Remove them if they exist.

INSTALLATION

Do not install the original axle shaft seal. Always install a new seal.
(1) Wipe the bore in the axle shaft tube clean.
(2) Install axle shaft bearing with Installer 6436 and Handle C-4171. Ensure part number on the bearing must go against the Installer.
(3) Install the new axle shaft seal (Fig. 9) with Installer 6437 and Handle C-4171.
(4) Install the Axle Shaft. Refer to the installation procedure.

DIFFERENTIAL REMOVAL

To service the differential the axle shafts must be removed. Refer to the removal procedures in this Group.

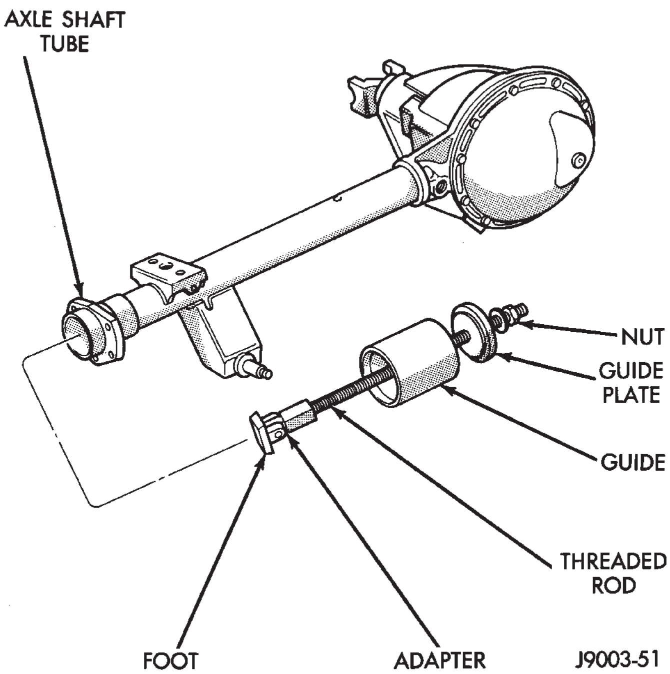

Fig. 8 Axle Shaft Bearing Removal Tool

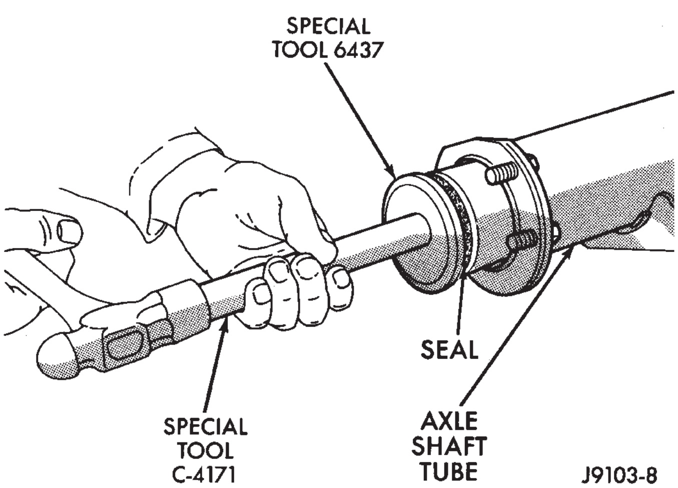

Fig. 9 Axle Shaft Seal Installation

(1) **Note the installation reference letters stamped on the bearing caps and housing machined sealing surface (Fig. 10).**

(2) Remove the differential bearing caps.

(3) Position Spreader W-129-A with the tool dowel pins seated in the locating holes (Fig. 11). 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. 11) 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.

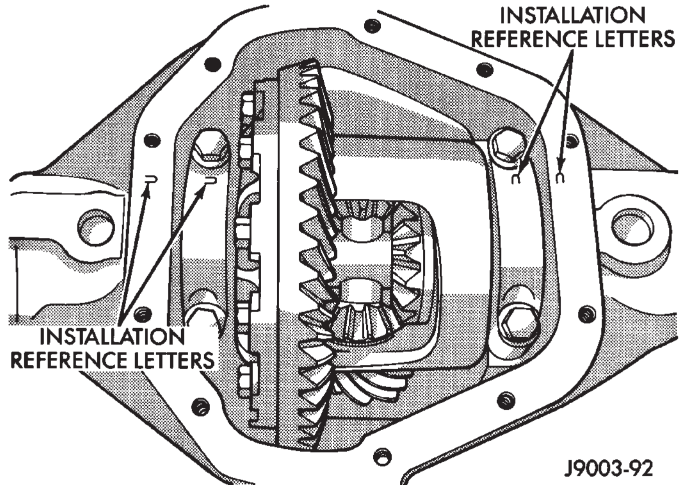

Fig. 10 Bearing Cap Identification

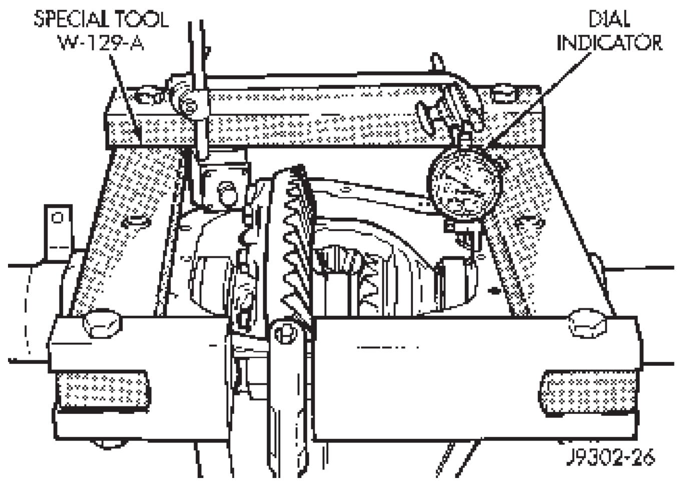

Fig. 11 Spread Differential Housing

(5) Separate the housing enough to remove the case from the housing. Measure the distance with the dial indicator (Fig. 11).

(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. 12).

(8) Remove the case from housing. Mark or tag bearing cups and outboard shim/spacer (selected thickness) indicating which side they were removed. Remove spreader from housing.

DIFFERENTIAL DISASSEMBLY

(1) Remove the bearings from the differential case with Press C-293-PA, Plug SP3289, Adapter C-293-18 (Fig. 13).

Place adapter rings so they do not damage the bearing cage.

(2) 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 mallet and remove (Fig. 14).

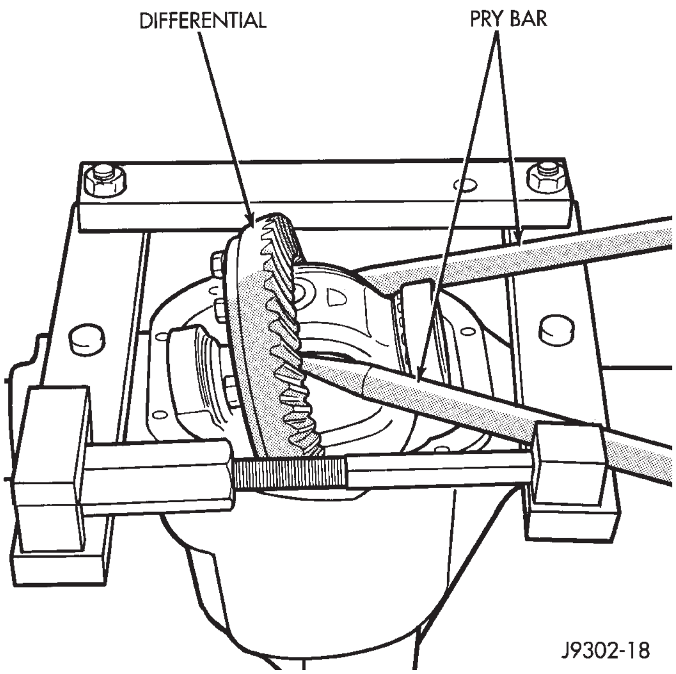

Fig. 12 Differential Removal

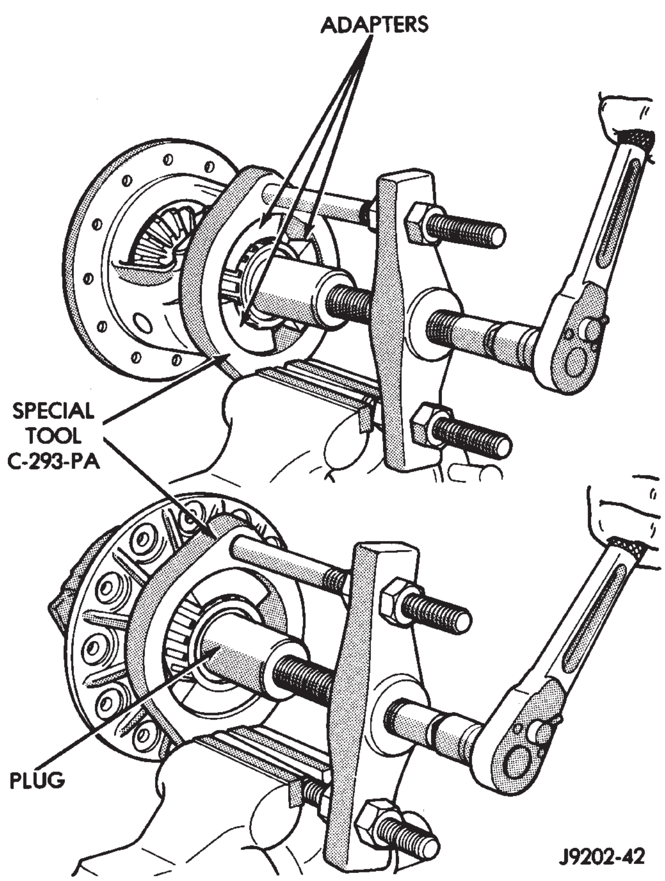

Fig. 13 Differential Bearing Removal

(3) Rotate the differential side gears and remove the pinion mate gears and thrust washers (Fig. 15).

(4) Remove the differential side gears and thrust washers.

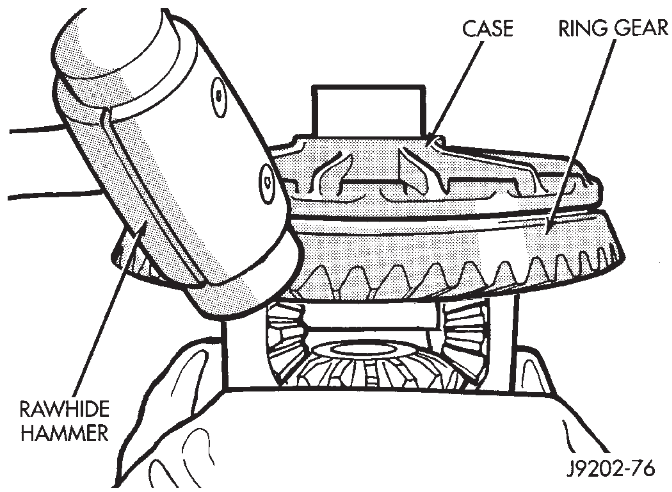

Fig. 14 Ring Gear Removal

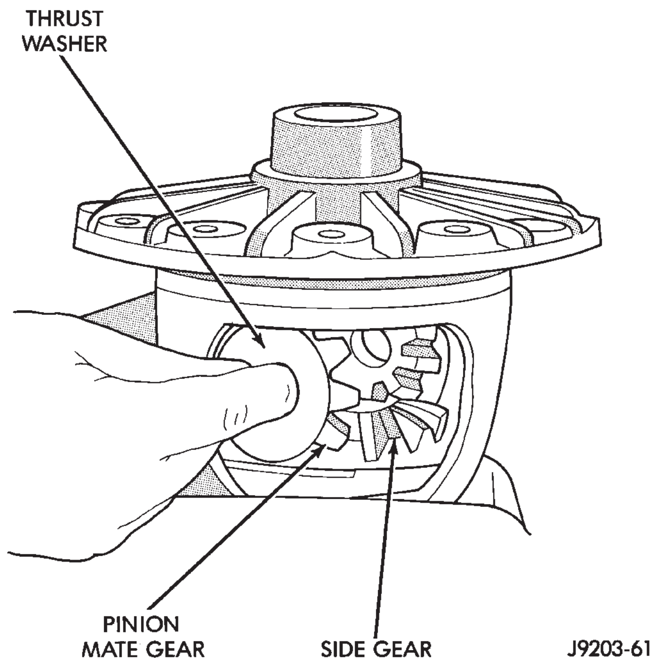

Fig. 15 Pinion Mate Gear Removal

(5) 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. 16).

(2) Remove the pinion gear seal with a slide hammer or pry out with bar.

(3) Remove the pinion gear from housing (Fig. 17). Catch the pinion with your hand to prevent it from falling and being damaged.

(4) Remove the collapsible preload spacer (Fig. 18).

(5) Remove oil slinger, front bearing.

(6) Remove the front pinion bearing cup with Remover D-147 and Handle C-4171 (Fig. 19).

(7) Remove the rear bearing cup from housing (Fig. 20). Use Remover D-148 and Handle C-4171.

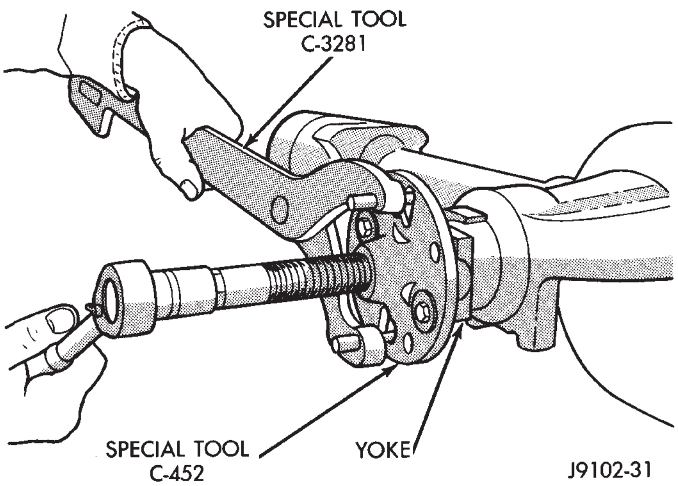

Fig. 16 Pinion Yoke Removal

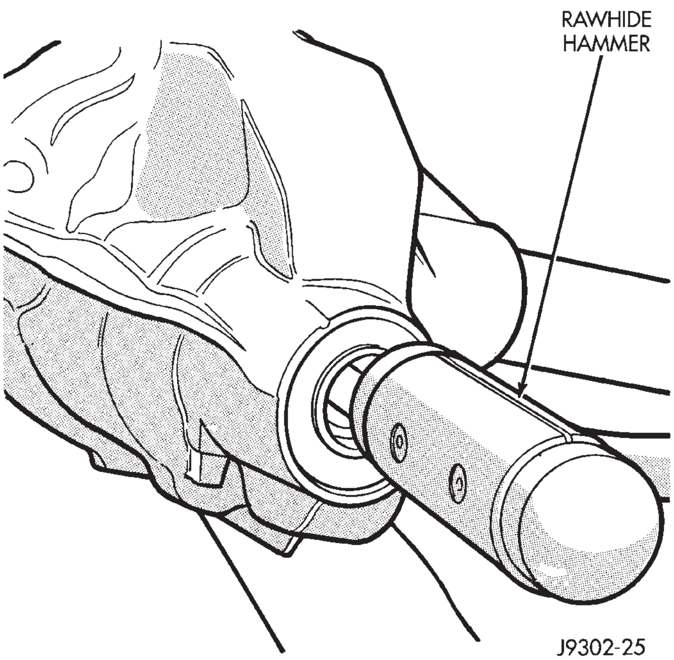

Fig. 17 Remove Pinion Gear

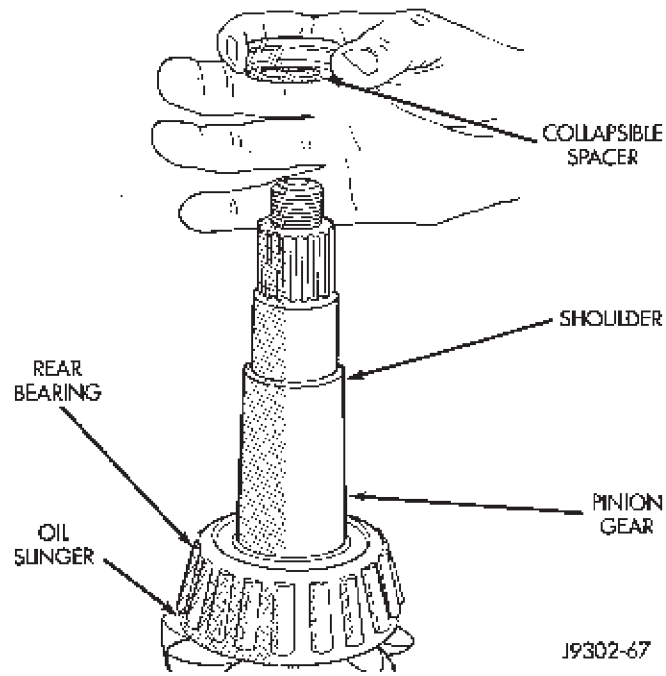

Fig. 18 Collapsible Spacer

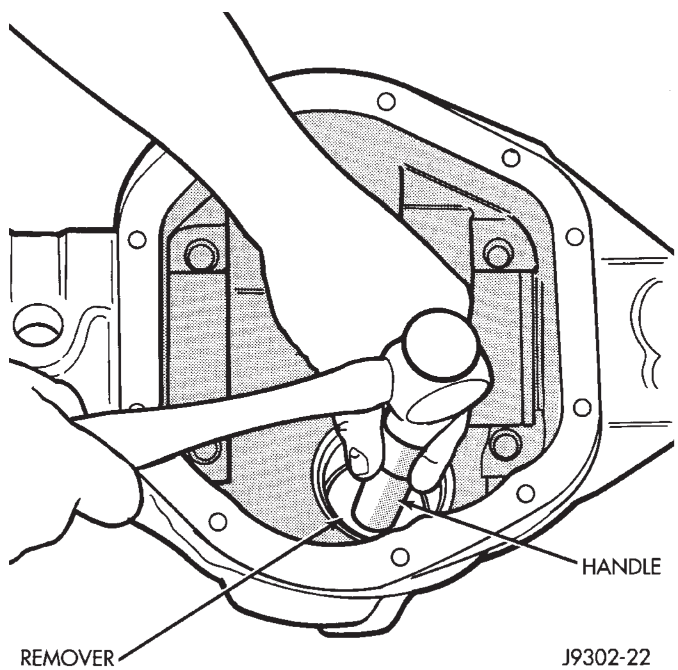

Fig. 19 Front Bearing Cup Removal

(8) Remove the inner bearing from the pinion with Puller C-293-PA and Adapter C-293-39 (Fig. 21).

Place adapter rings so they do not damage the bearing cage.

(9) Remove the depth shims from the pinion gear shaft. Record the thickness of the depth shims.

CLEANING/INSPECTION

Wash differential components with cleaning solvent and dry with compressed air. **Do not steam clean the differential components.**

Wash bearings with solvent and towel dry, do not dry with compressed air. **Cup and bearing must be replaced as a matched sets only.**

Clean the axle shaft tubes with a stiff wire or 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.
- Wear and damage to pinion gear mate shaft, pinion gears, side gears and thrust washers. Replace as a matched set only.
- Ring and pinion gear for worn and chipped teeth.

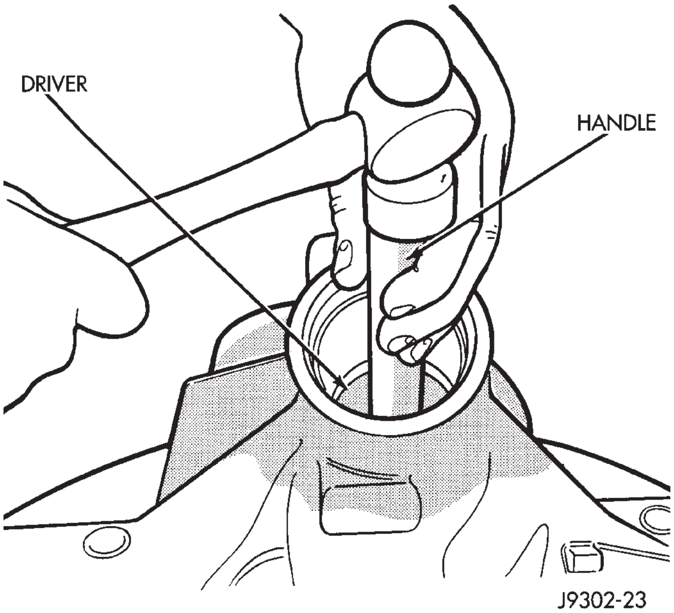

Fig. 20 Rear Bearing Cup Removal

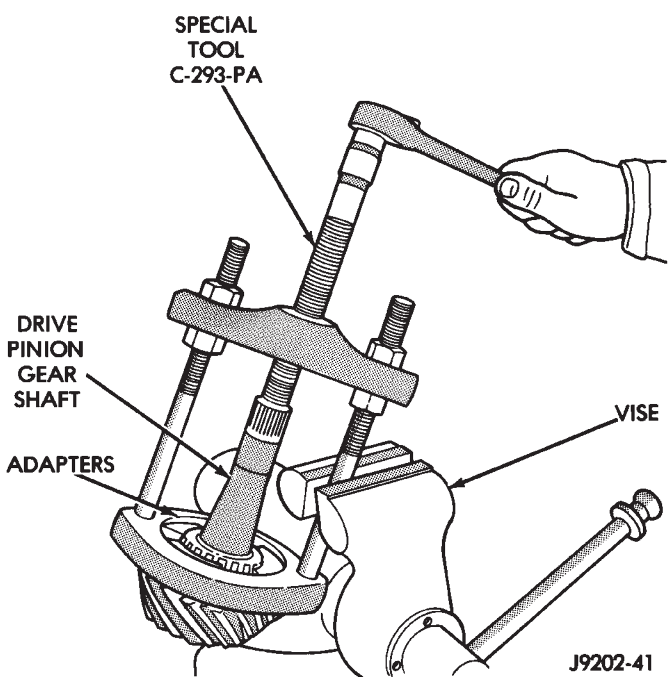

Fig. 21 Inner Bearing Removal

- Ring gear for damaged bolt threads. Replaced as a matched set only.
- Pinion yoke for cracks, worn splines, pitted areas, and a rough/corroded seal contact surface. Repair or replace as necessary.
- Preload shims for damage and distortion. Install new shims if necessary.

DIFFERENTIAL ASSEMBLY

(1) Install the following components in the differential case.

- Differential side gears and thrust washers
- Pinion gears and thrust washers
- Pinion gear mate shaft (align holes in shaft and case)

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

PINION GEAR DEPTH INFORMATION

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. 22). 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 2.095 inches (53.21 mm) for Model 35 axles. The standard depth provides the best teeth contact pattern.

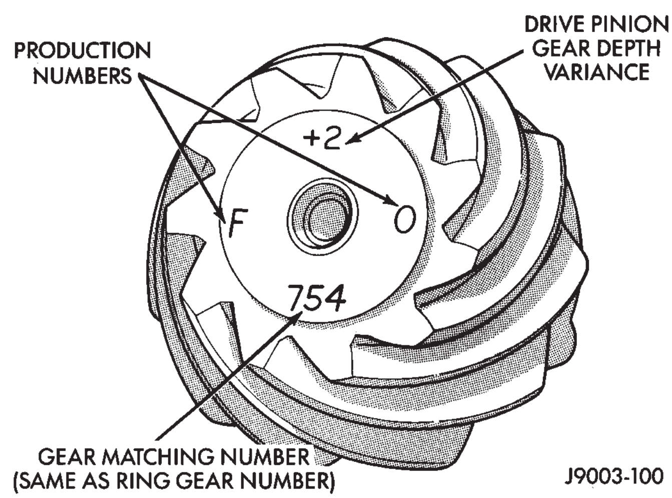

Fig. 22 Pinion Gear ID Numbers

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. 23).

Compensation for depth variance is achieved by shims placed adjacent to the pinion gear rear bearing cup (Fig. 24).

If a new gear set is being installed, note the depth variance etched into both pinion gears. Add or subtract the thickness of the original depth shims to compensate for the difference in the depth variances. Refer to the Depth Variance charts.

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

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.

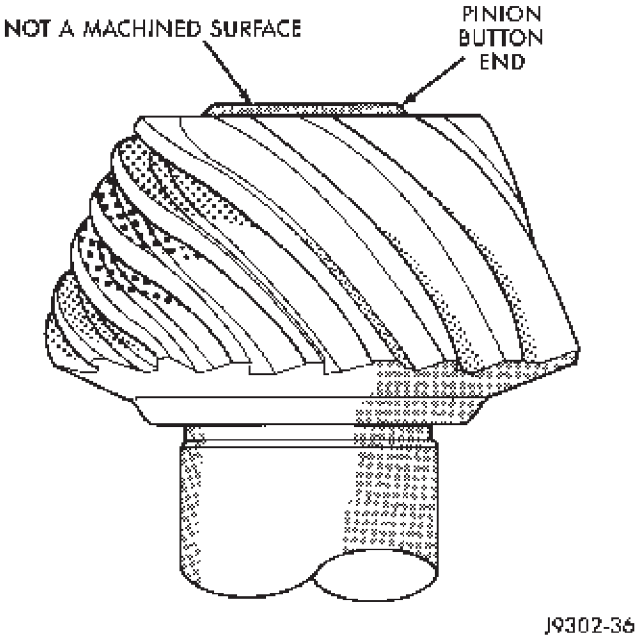

Fig. 23 Pinion Gear Head

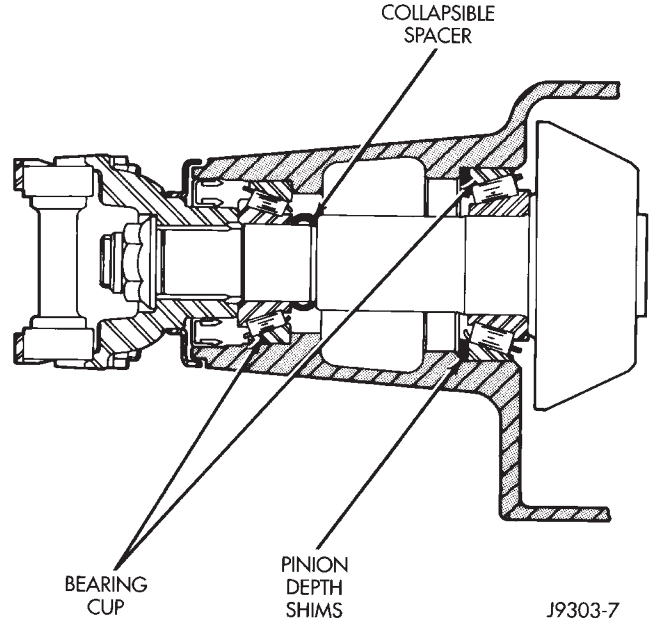

Fig. 24 Shim Locations

PINION GEAR ASSEMBLY/INSTALLATION

(1) Place the depth 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. 25). Ensure cup is correctly seated.

(2) Install the pinion front bearing cup with Installer D-130 and Handle C-4171 (Fig. 26).

(3) Install the rear bearing (and slinger if used) on the pinion gear with Installer W-262 (Fig. 27).

(4) Install a new collapsible preload spacer on pinion shaft and install pinion gear in housing (Fig. 28).

(5) Install pinion front bearing, oil slinger. 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. 29).

(6) Install yoke with Installer W-162-D and Wrench C-3281 (Fig. 30).

(7) Install the yoke washer and a new nut on the pinion gear. **Tighten the nut only enough to remove the end play. Do not over-tighten it.**

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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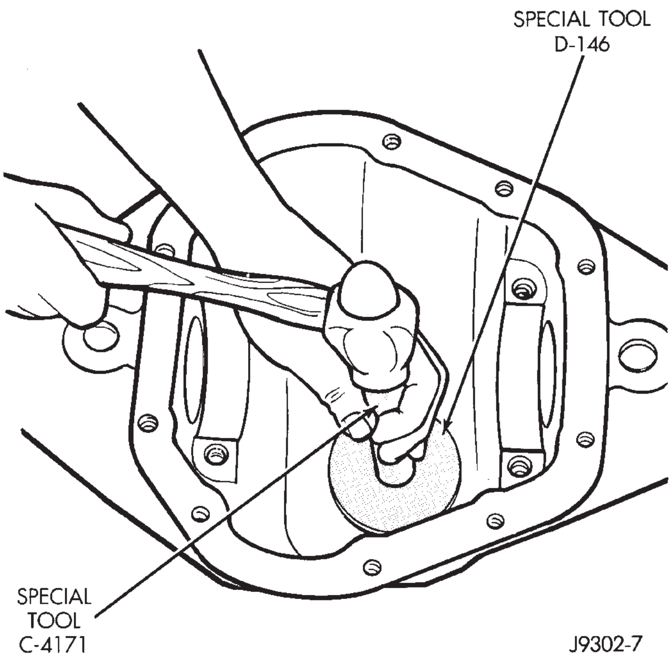

Fig. 25 Pinion Rear Bearing Cup Installation

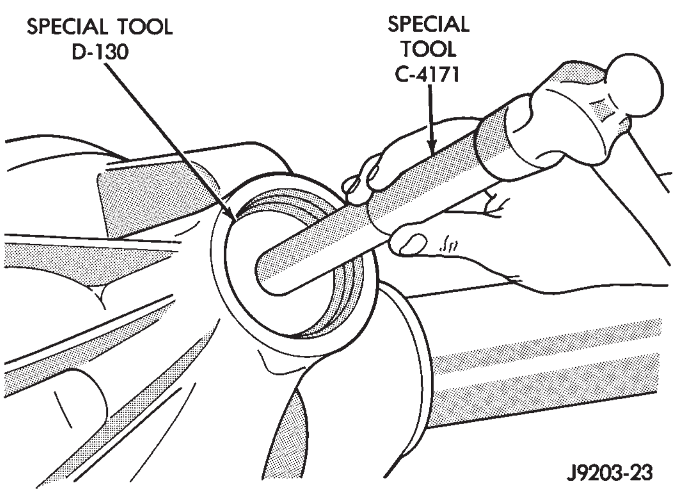

Fig. 26 Pinion Front Bearing Cup Installation

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.

(8) Use Flange Wrench C-3281 to retain the yoke (Fig. 31). Slowly tighten the nut in small increments until the rotating torque is achieved. **Measure the preload torque frequently to avoid overtightening the nut.**

(9) Check bearing preload torque with an inch pound torque wrench (Fig. 32). The torque necessary to rotate the pinion gear should be;

- Original Bearings — 1 to 3 N●m (10 to 20 in. lbs.)
- New Bearings — 2 to 5 N●m (20 to 40 in. lbs.)

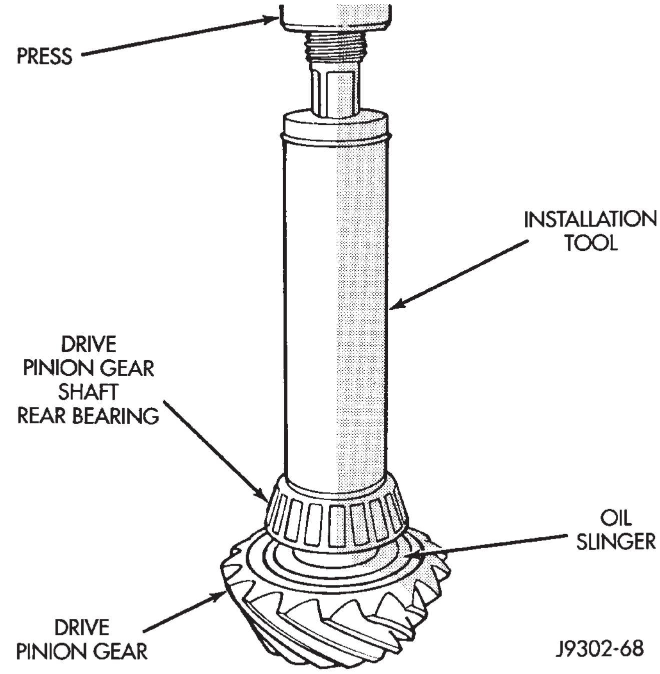

Fig. 27 Shaft Rear Bearing Installation

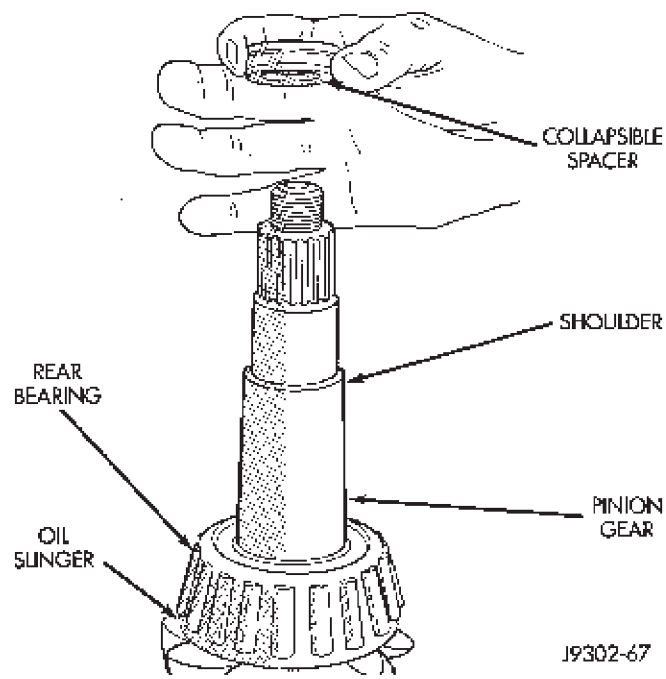

Fig. 28 Collapsible Preload Spacer

DIFFERENTIAL SHIM PACK MEASUREMENT AND ADJUSTMENT

(1) Install the bearings on the hub with Installer 7618 (J-21784) and Driver Handle 8015 (J-8092) (Fig. 33).

(2) Match each bearing cup with bearing (original). Install the cups on the bearings.

(3) Install the differential case in the housing.

(4) Install the outboard shim/spacer (selected thickness) on each side between bearing cup and

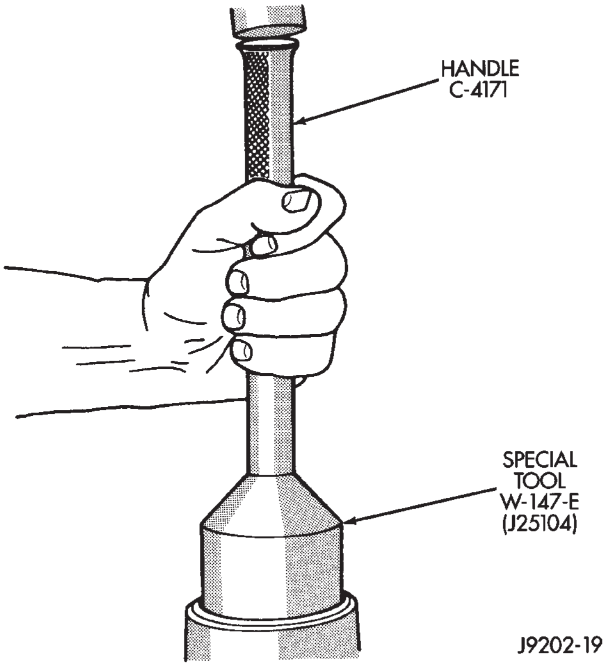

Fig. 29 Pinion Seal Installation

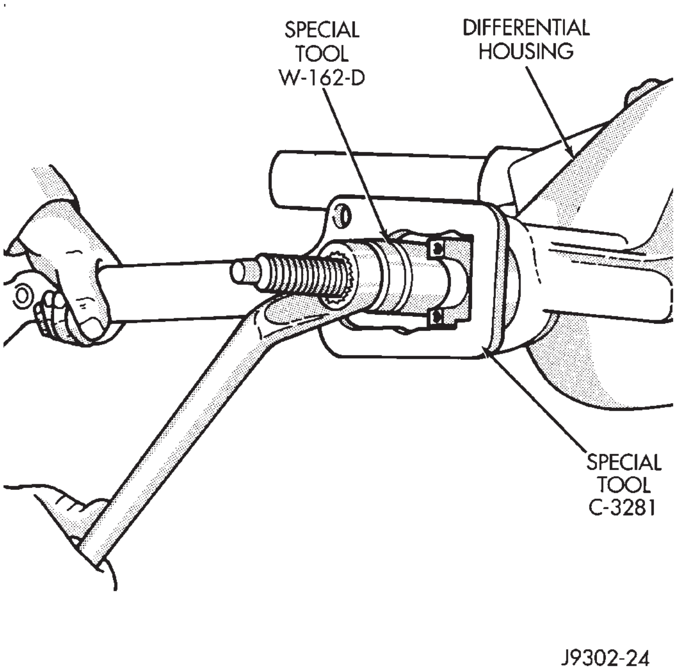

Fig. 30 Pinion Yoke Installation

housing (Fig. 34). Use 0.142 in. (3.6 mm) as a starting point, shim/spacers are available in various thicknesses.

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

(6) Attach a dial indicator to the housing. Position the indicator plunger so that it contacts the ring gear mating surface (Fig. 35).

(7) Pry the differential case to one side and zero the dial indicator pointer.

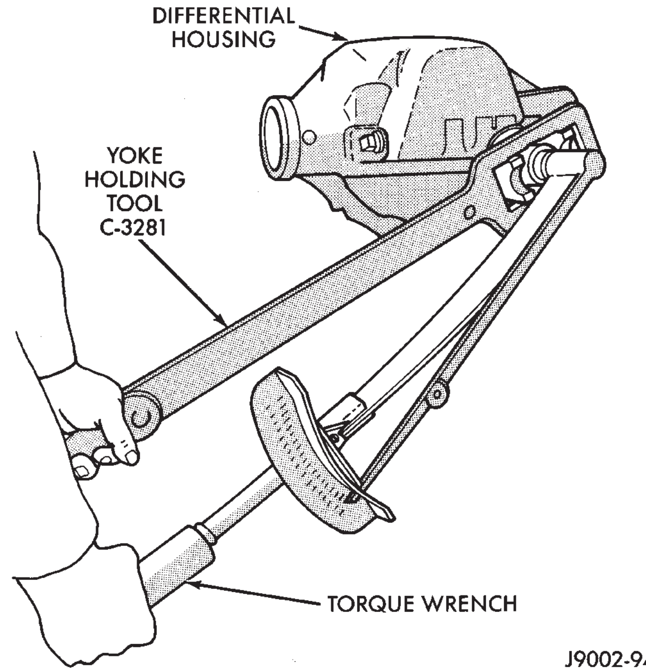

Fig. 31 Tightening Pinion Nut

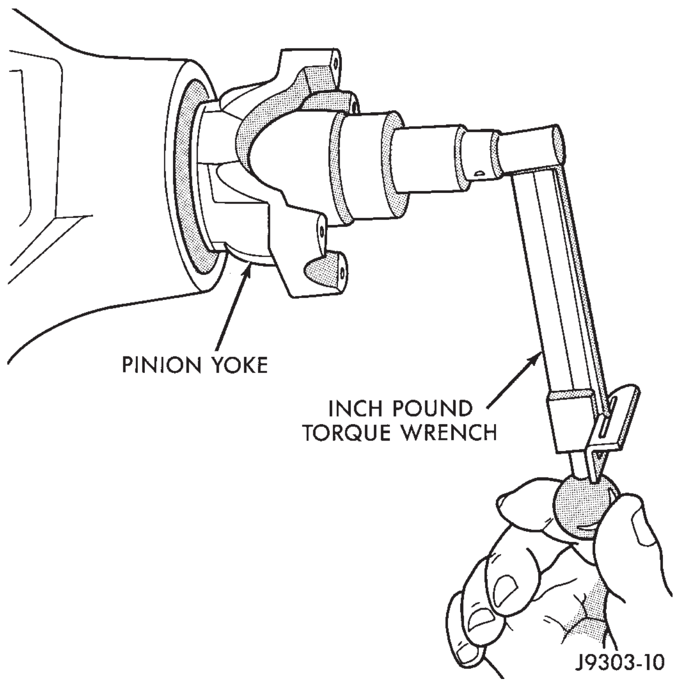

Fig. 32 Check Pinion Gear Torque

(8) Pry the differential case to the opposite side and record indicator reading. Reading is additional shim thickness needed for zero end play. For example, if reading was 0.008 inch (0.20 mm), an additional 0.004-inch (0.10-mm) thick shim will be needed at each side zero end play.

(9) Install zero end-play shims on each side of case.

The differential bearings must be preloaded to compensate for heat and load during operation.

(10) Add an additional 0.004-inch (0.1-mm) to **each** outboard shim/spacer for bearing preload.

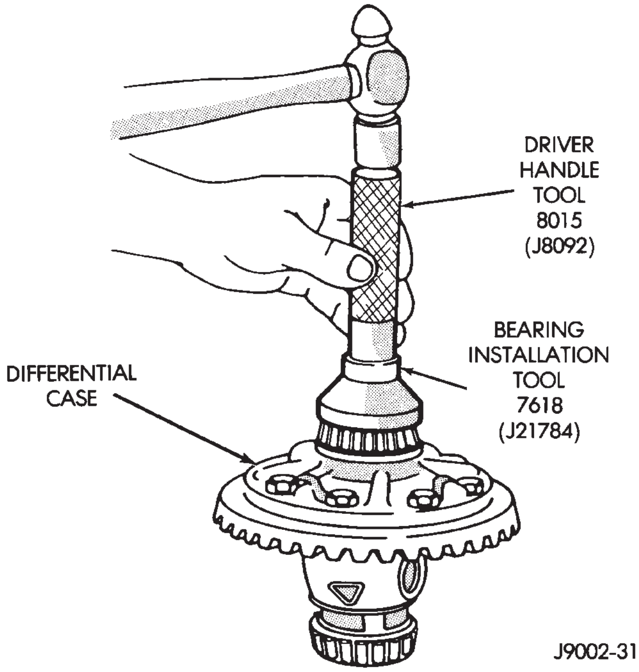

Fig. 33 Differential Bearing Installation

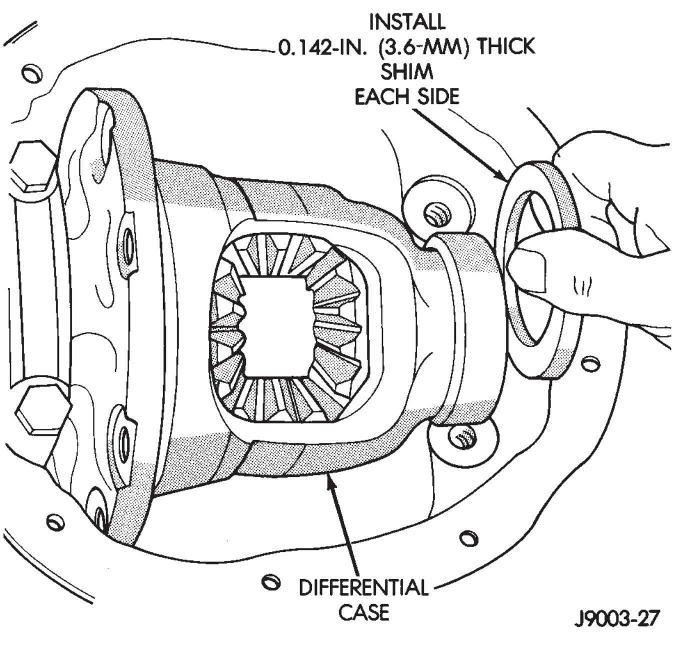

Fig. 34 Differential Bearing Shim Installation

RING GEAR INSTALLATION

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

(2) Install new ring gear bolts and alternately tighten to 61-81 N•m (45-60 ft. lbs.) torque (Fig. 36).

DIFFERENTIAL INSTALLATION

(1) Position Spreader W-129-A with the tool dowel pins seated in the locating holes (Fig. 37). Install the holddown clamps and tighten the tool turnbuckle finger-tight.

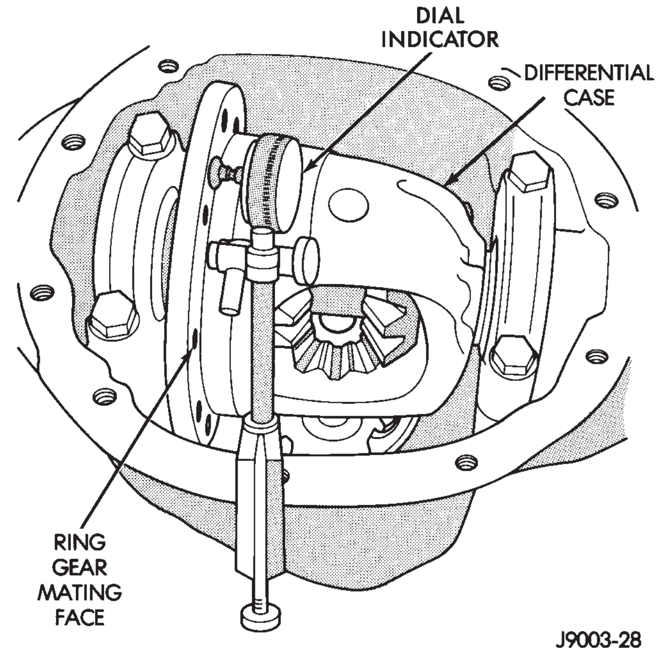

Fig. 35 Shim Measurement

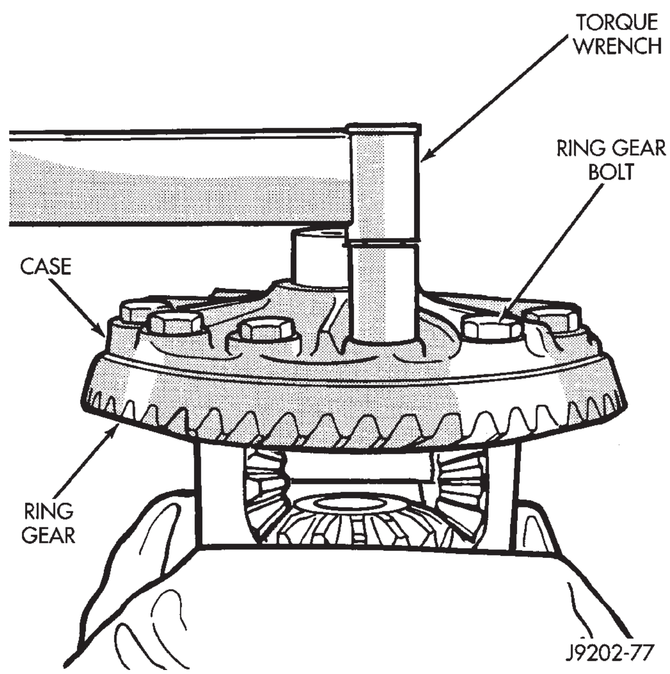

Fig. 36 Ring Gear Bolt Installation

(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. 37) 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) Separate the housing enough to install the case in the housing. Measure the distance with the dial indicator (Fig. 37).

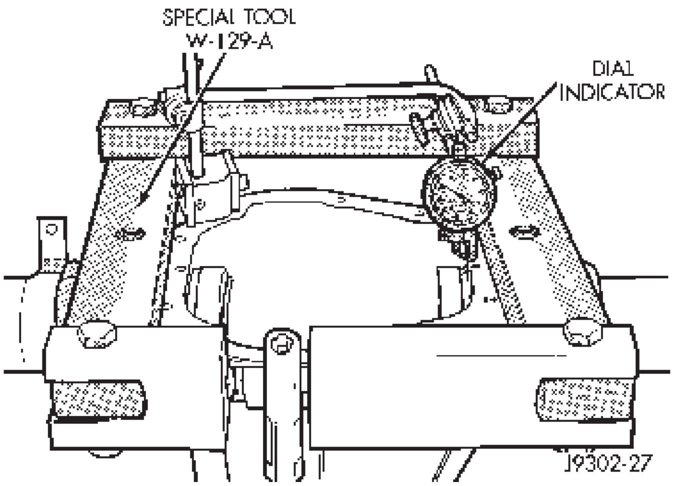

Fig. 37 Spread Differential Housing

(4) Remove the dial indicator.

(5) Install differential and outboard shim/spacer (selected thickness) in housing.

(6) Install case in the housing. Tap the differential case to ensure the bearings are fully seated (Fig. 38). Remove the spreader.

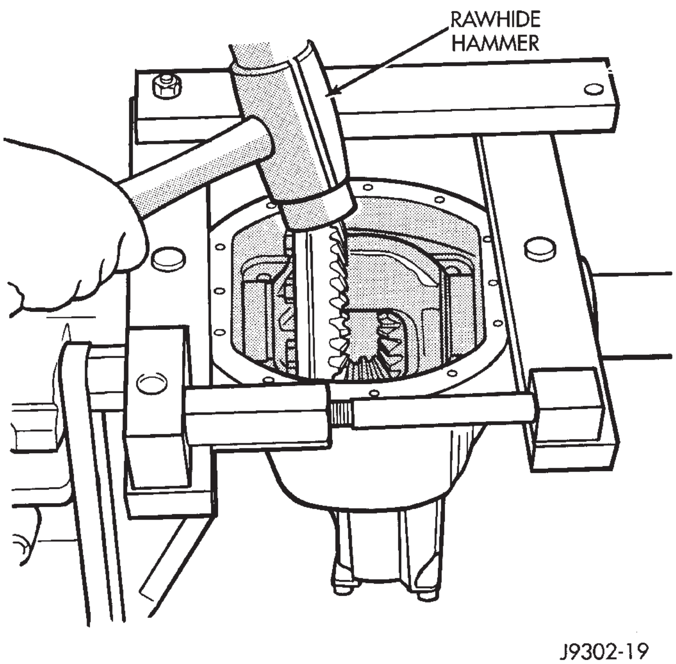

Fig. 38 Differential Installation

(7) Install the bearing caps at their original locations (Fig. 39). Tighten the bearing cap bolts to 77 N●m (57 ft. lbs.) torque.

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. 40).

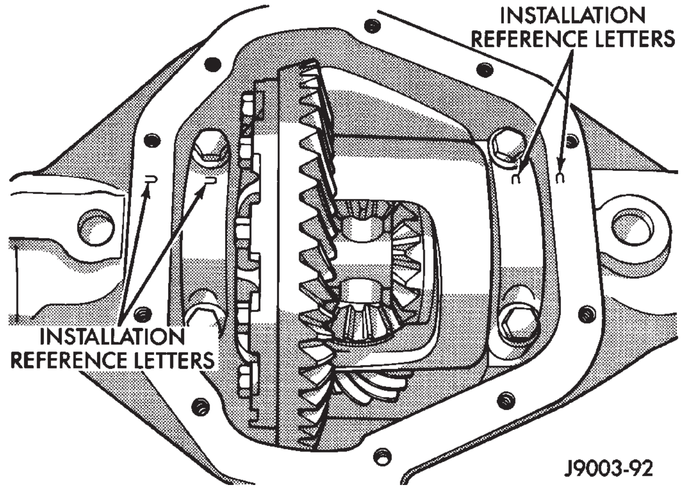

Fig. 39 Differential Bearing Cap Reference Letters

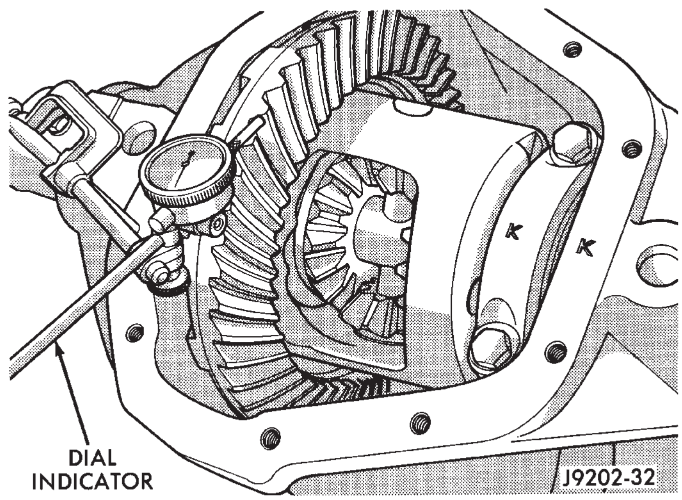

Fig. 40 Ring Gear Backlash Measurement

The ring gear backlash must be within 0.005 - 0.009 inch (0.12 - 0.23 mm). It cannot vary more than 0.002 inch (0.05 mm) between the points checked.

If backlash must be adjusted, spacers are available in various thicknesses. Adjust the backlash accordingly (Fig. 41). **DO NOT INCREASE THE TOTAL SHIM PACK THICKNESS, EXCESSIVE BEARING PRELOAD AND DAMAGE WILL OCCUR.**

The ring gear teeth contact patterns will show if the pinion gear depth shim(s) have the correct thickness. 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**, to 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

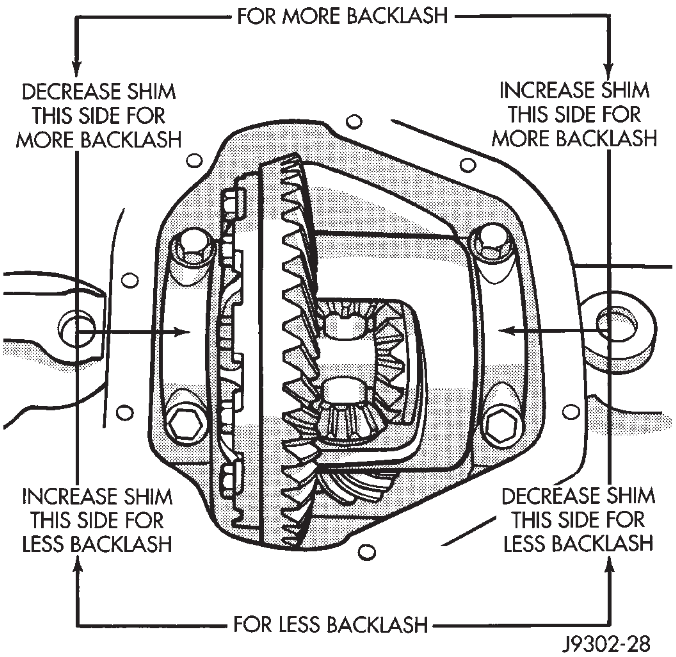

Fig. 41 Backlash Shim Adjustment

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. 42) for interpretation of contact patterns and adjust accordingly.

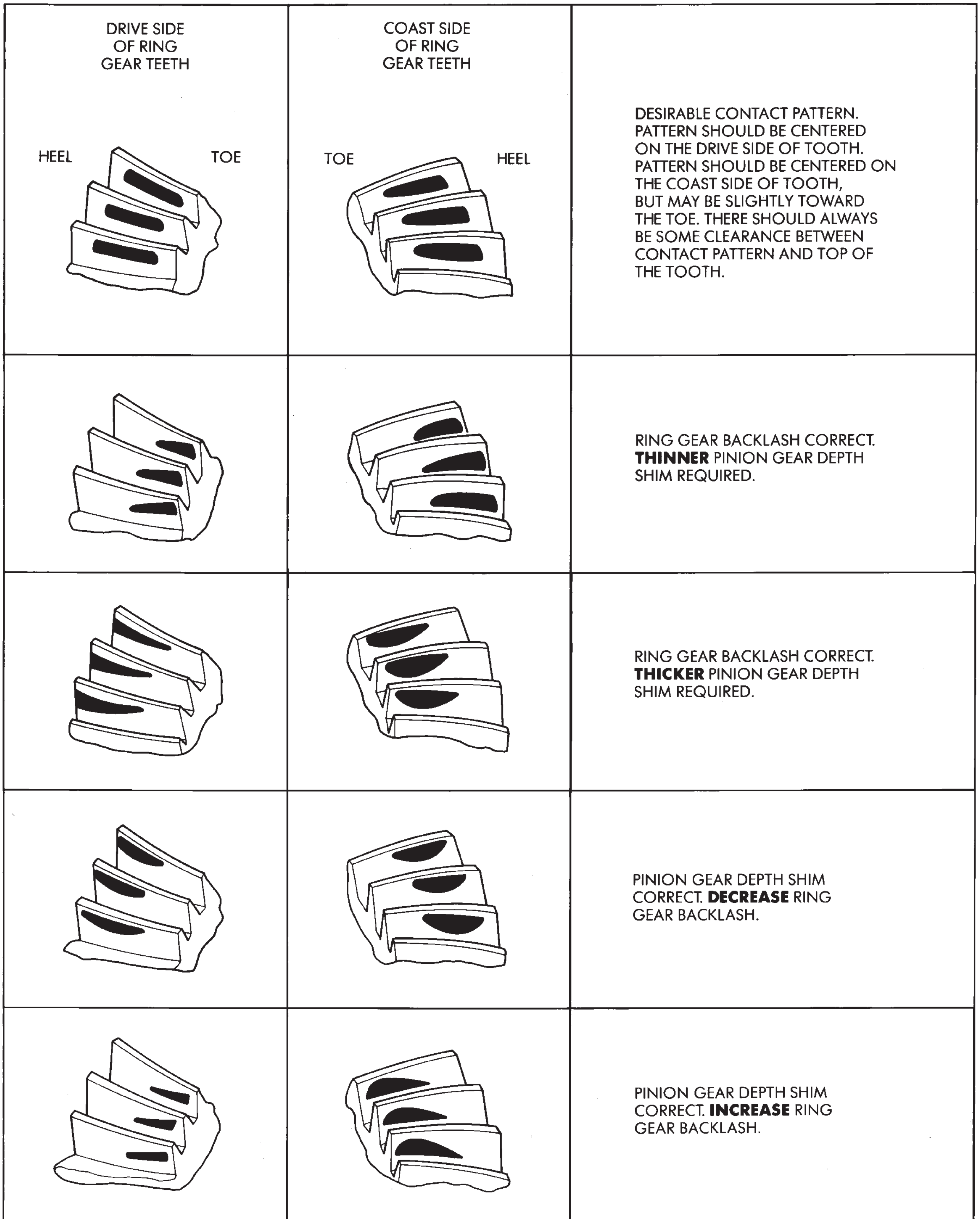

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Fig. 42 Gear Tooth Contact Patterns

FINAL ASSEMBLY

(1) Install the axle shafts. Refer to Axle Shaft Installation within this group.

(2) Scrape the residual sealant from the housing and cover mating surfaces. Clean the mating surfaces with mineral spirits. Apply a bead of MOPAR® Silicone Rubber Sealant on the housing cover (Fig. 43). **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 to 47 N●m (35 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.

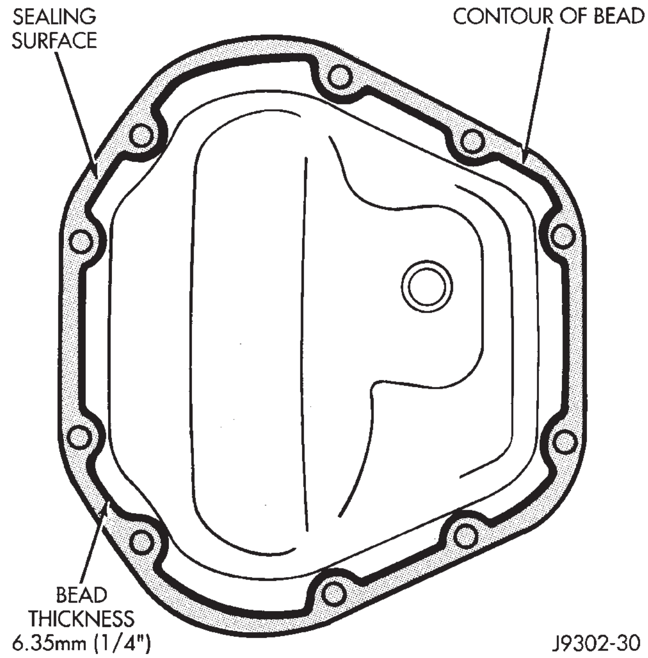

Fig. 43 Typical Housing Cover With Sealant

AXLE SPECIFICATIONS

MODEL 35 REAR AXLE

Axle Type	Semi-Floating, Hypoid
Application	ZJ
Ring Gear Diameter	7.562 in. (19.2 cm)
Lubricants*	MOPAR Gear Lubricant or Equivalent SAE 75W-90, API Grade GL-5, MIL-L-2105C
*Trailer Tow	Synthetic 80W-140
Lubricant Capacity	40 oz. (1.1L)
Axle Model	Dana M35C
Axle Ratio	3.55, 3.73
Track	58.5 in.
GAWR	2950 lbs.

Differential Bearing Preload Shim	0.004 in.	0.1 mm
Differential Side Gear-to-Case Clearance	0.000-0.006 in.	0.00-0.15 mm
Ring Gear Backlash	0.005-0.008 in.	0.12-0.20 mm
Drive Pinion Gearshaft Bearing Break-Away Preload Torque	Collapsible Spacer	
Original Bearings	10-20 in. lbs.	1-2 N·m
Replacement Bearings	15-35 in. lbs.	1.5-4 N•m
Drive Pinion Gear Depth	Select Shims	
Standard Setting	2.095 in.	53.2 mm
Side Gear Clearance (max.)	0.006 in.	0.15 mm
Case Runout (max.)	0.002 in.	0.5 mm

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TRAC-LOK DIFFERENTIAL

OPERATION

In a conventional differential, the torque applied to the ring gear is transmitted to the axle shafts through the differential gears. During normal operation, the torque transmitted to each wheel is equal at all times. However, if one wheel spins, the opposite wheel will generate only as much torque as the spinning wheel.

In the Trac-lok differential, part of the ring gear torque is transmitted through clutch packs. The clutch packs contain multiple disc clutches which have radial grooves on the plates and concentric grooves on the discs.

In operation, the Trac-lok clutches are engaged by two concurrent forces. The first being preload force exerted through Belleville spring washers contained in the clutch packs. The second is from separating forces generated by the side gears as torque is applied through the ring gear (Fig. 1).

The Trac-lok design provides differential action needed for turning corners and for driving straight ahead. However, when one wheel looses traction, the clutch packs transfer additional torque to the wheel having the most traction. Trac-lok differentials resist wheel spin on bumpy roads and provide more pulling power when one wheel looses traction. Pulling power is provided continuously until both wheels loose traction. If both wheels slip due to unequal traction, Trac-lok operation is normal. In extreme cases of differences of traction, the wheel with the least traction may spin.

NOISE DIAGNOSIS

If a noise occurs when turning corners, the most probable cause is incorrect or contaminated lubricant. Before removing the Trac-lok unit for repair, drain, flush and refill the axle with the specified lubricant. Refer to Lubricant change in this Group.

A container of Trac-Lok Lubricant (friction modifier) should be added after repair service or a lubricant change.

Vehicles with a limited slip differential should be road tested by making 10 to 12 slow figure-eight turns. This maneuver will pump the lubricant through the clutch discs to eliminate a possible **chatter or pop** noise complaint.

Refer to Group 0, Lubrication and Maintenance for additional information.

DIFFERENTIAL TEST

WARNING: WHEN SERVICING VEHICLES WITH A LIMITED SLIP DIFFERENTIAL DO NOT USE THE ENGINE TO TURN THE AXLE AND WHEELS. BOTH REAR WHEELS MUST BE RAISED AND THE VEHICLE SUPPORTED. A LIMITED SLIP AXLE CAN EXERT ENOUGH FORCE (IF ONE WHEEL IS IN CONTACT WITH THE SURFACE) TO CAUSE THE VEHICLE TO MOVE.

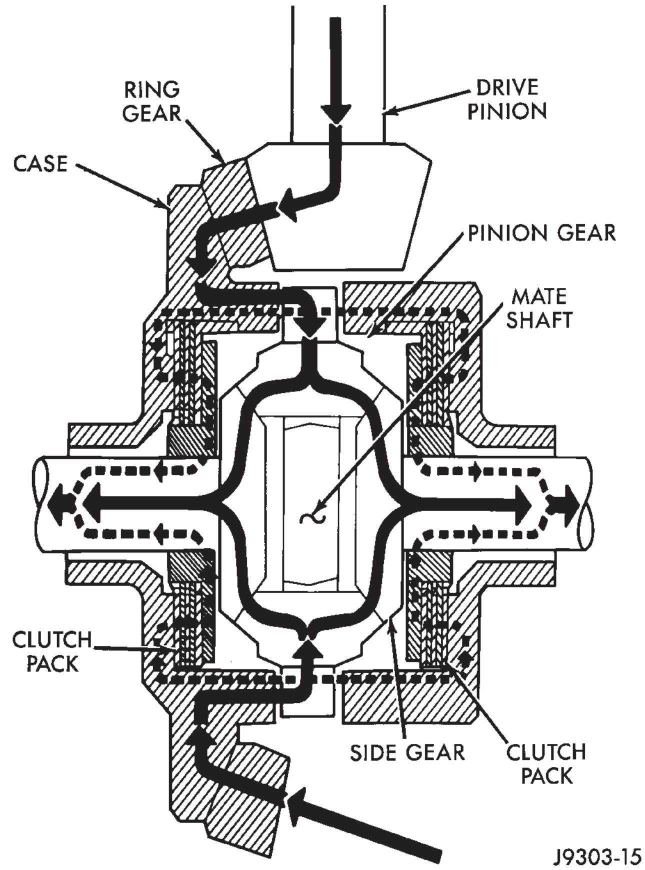

Fig. 1 Limited Slip Differential Operation—Both Wheels Driving

The differential can be tested without removing the differential case from the housing.

(1) Raise the vehicle on a hoist with the ignition OFF, vehicle in park.

(2) Attempt to turn each rear wheel by hand.

- If extremely difficult (or impossible) to turn either wheel, the differential IS functioning normally.
- If relatively easy to turn the wheel, the differential is NOT functioning normally and should be serviced.

DIFFERENTIAL OVERHAUL

The **Trac-Lok** (limited-slip) differential components are illustrated in (Fig. 2). Refer to this illustration during repair service.

DISASSEMBLY

Service to the Trac-Lok differential requires the use of Tool Set C-4487 (J-23781). Refer to Model 35 Axle section in this Group for Differential Removal and Installation.

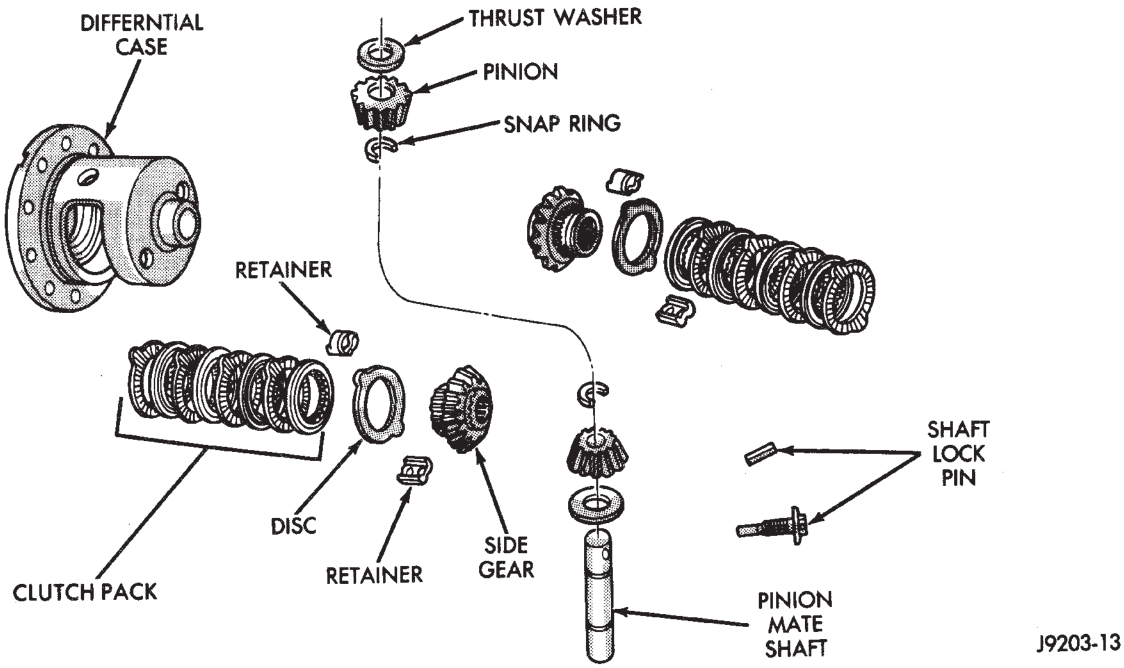

Fig. 2 Trac-Lok Differential Components

(1) Clamp one axle shaft in a vise equipped with soft jaws (Fig. 3).

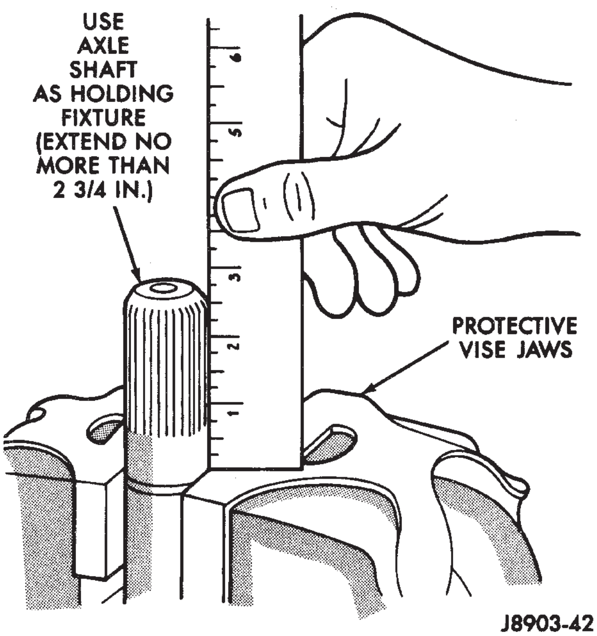

Fig. 3 Axle Shaft As Holding Fixture

(2) Position the differential case on the axle shaft (Fig. 4). Place shop towels under the differential to avoid damage during removal of the ring gear (Fig. 4).

(3) Remove **and discard** the ring gear bolts. Tap the ring gear with a rawhide mallet and remove (Fig. 5).

(4) Remove the pinion gear mate shaft lock screw (Fig. 6).

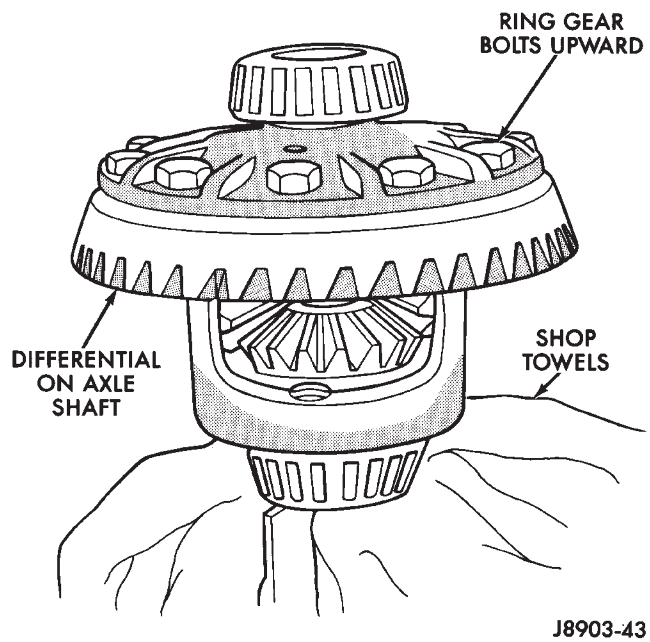

Fig. 4 Differential Case On Shaft

(5) Remove the mate shaft with a drift and hammer (Fig. 7).

(6) Install and lubricate Step Plate C-4487-1 (Fig. 8).

(7) Assemble Threaded Adapter C-4487-3 into top side gear. Thread forcing Screw C-4487-2 into adapter until it becomes centered in adapter plate.

(8) Position a small screw driver in slot of Threaded Adapter C-4487-3 (Fig. 9) to prevent adapter from turning.

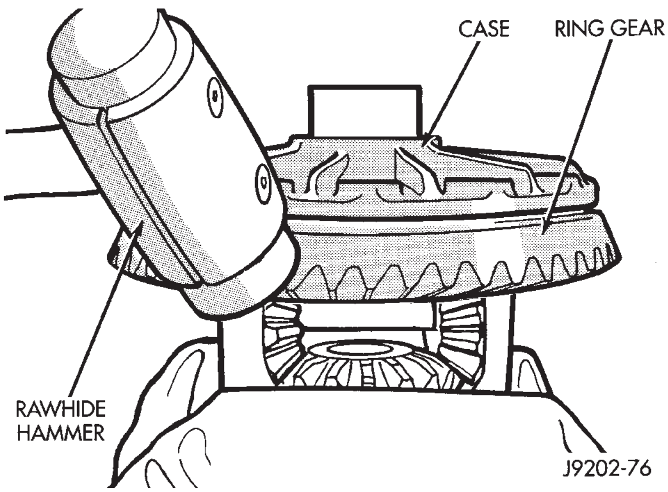

Fig. 5 Ring Gear Removal

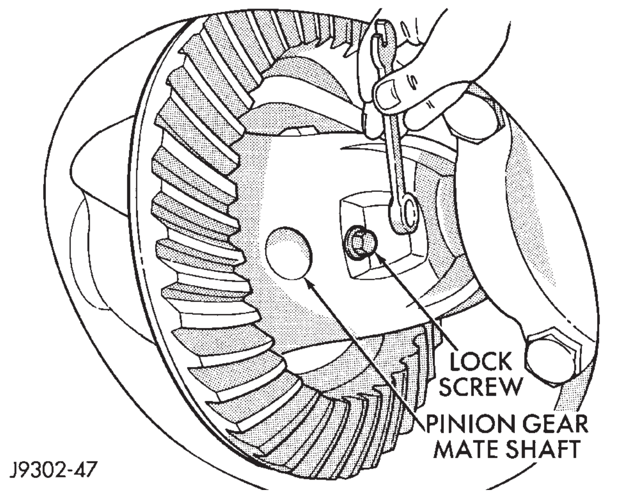

Fig. 6 Mate Shaft Lock Screw

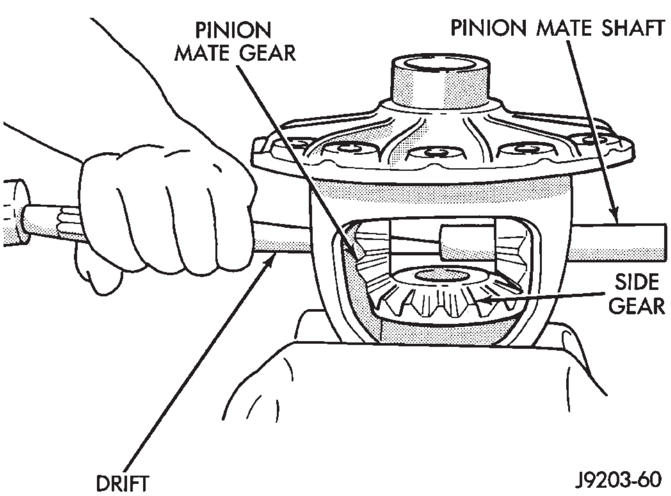

Fig. 7 Mate Shaft Removal

(9) Tighten forcing screw tool enough to relieve clutch pack tension. Remove both pinion thrust washers (Fig. 10).

(10) Loosen the forcing screw tool until the clutch pack tension is relieved.

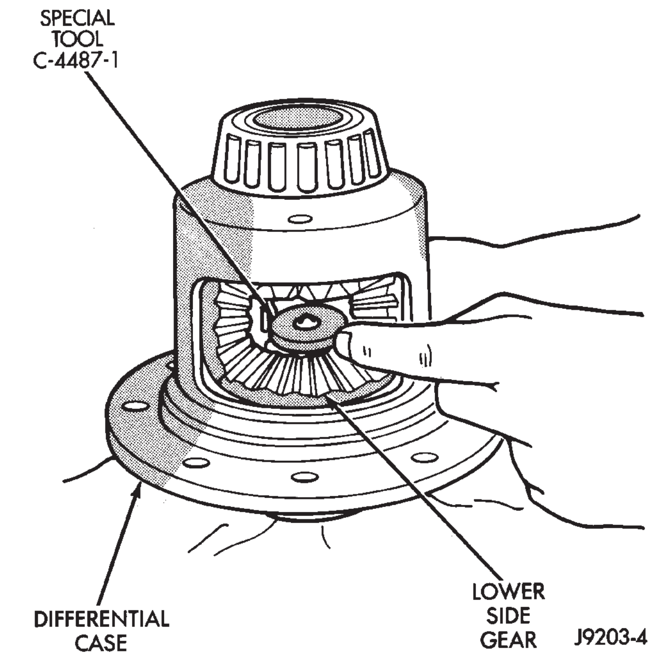

Fig. 8 Step Plate Tool Installation

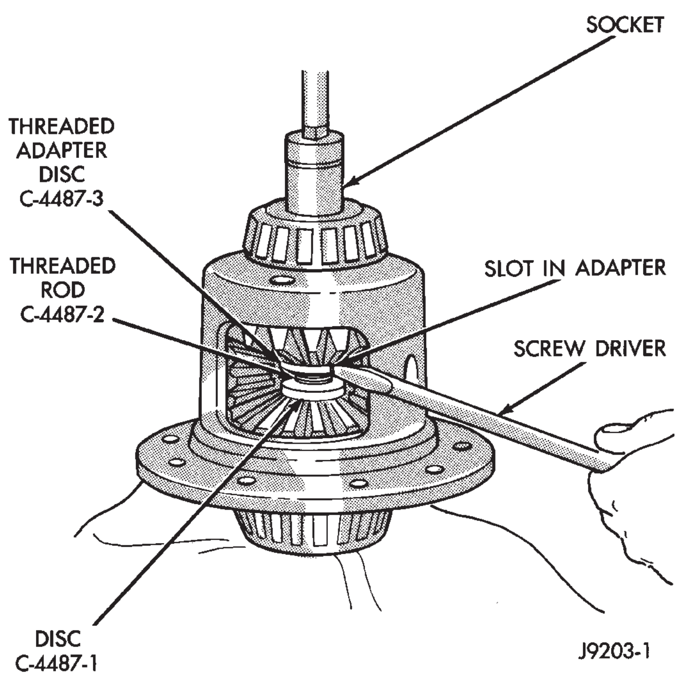

Fig. 9 Threaded Adapter Installation

(11) Insert Turning Bar C-4487-4 in case. Rotate case with tool until pinion gears can be removed (Fig. 11).

(12) Remove top side gear and clutch pack. Keep plates in correct order during removal (Fig. 12).

(13) Remove case from fixture. Remove remaining clutch pack.

(14) Remove clutch pack retaining clips. Mark each clutch pack for installation reference.

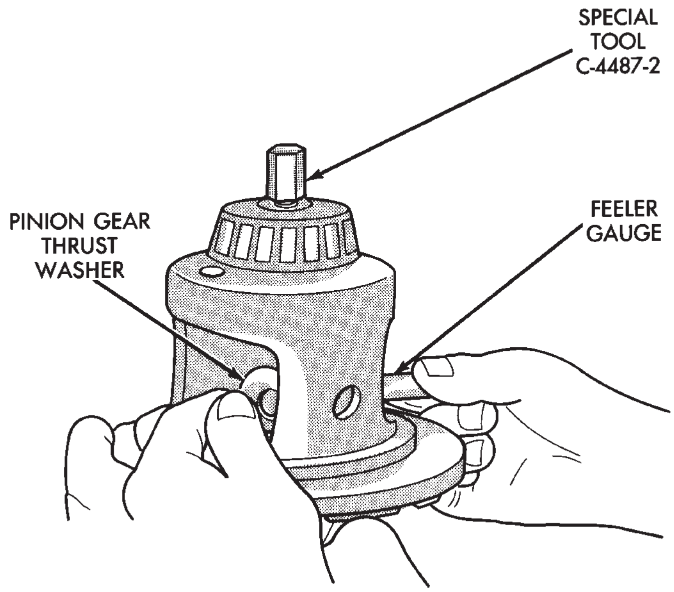

Fig. 10 Remove Pinion Thrust Washer

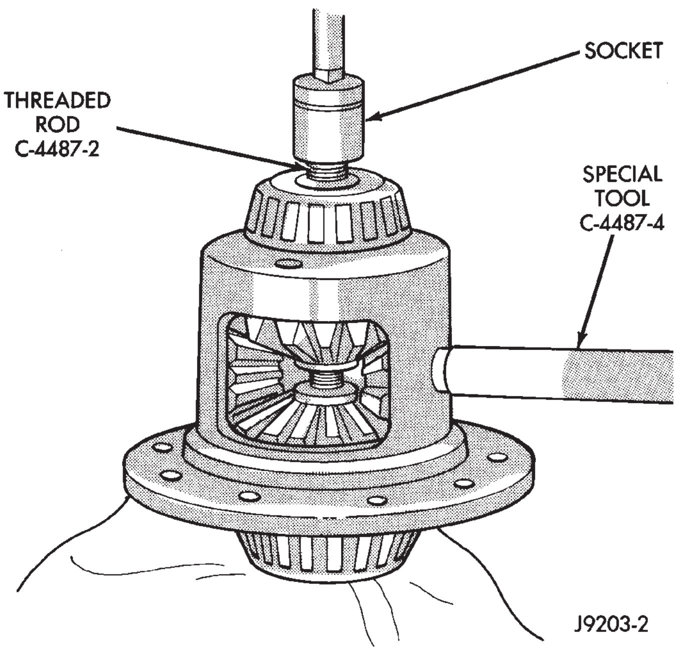

Fig. 11 Pinion Gear Removal

CLEANING AND INSPECTION

(1) Clean all components (Fig. 2) in cleaning solvent. Dry components with compressed air.

(2) Inspect clutch pack plates for wear, scoring or damage. Replace both clutch packs if any one component in either pack is damaged.

(3) Inspect side and pinion gears. Replace any gear that is worn, cracked, chipped or damaged.

(4) Inspect differential case and pinion shaft. Replace if worn or damaged.

ASSEMBLY

(1) The clutch discs are replaceable as complete sets only. **If one clutch disc pack is damaged,**

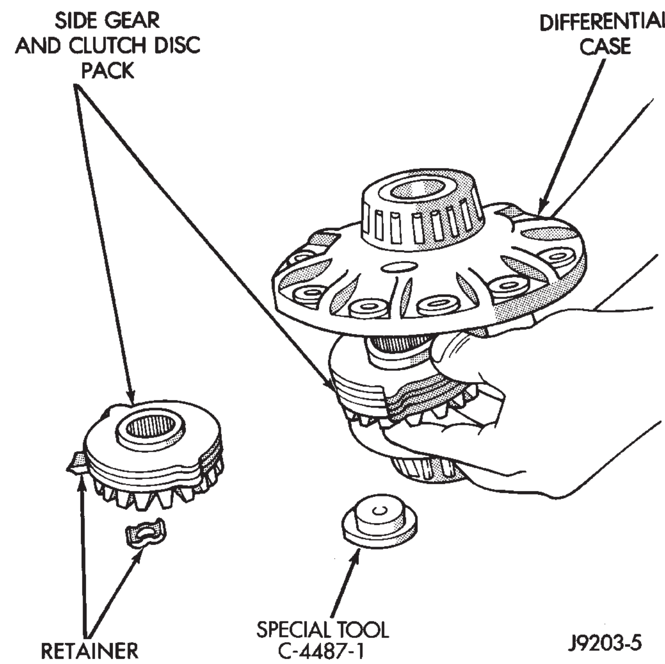

Fig. 12 Side Gear & Clutch Disc Removal

both packs must be replaced. Lubricate each component with gear lubricant before assembly and installation.

(2) Assemble the clutch discs into packs (Fig. 13).

(3) Secure disc packs with retaining clips (Fig. 13).

(4) Position assembled clutch disc packs on the side gear hubs.

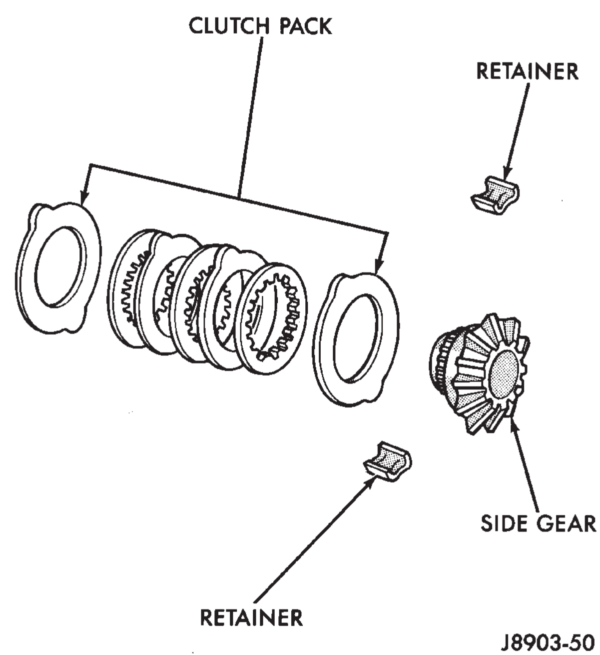

Fig. 13 Clutch Disc Pack

(5) Position case on axle fixture.

(6) Install clutch pack and side gear in lower bore (Fig. 14). **Be sure clutch pack retaining clips remain in position and are seated in the case pockets.**

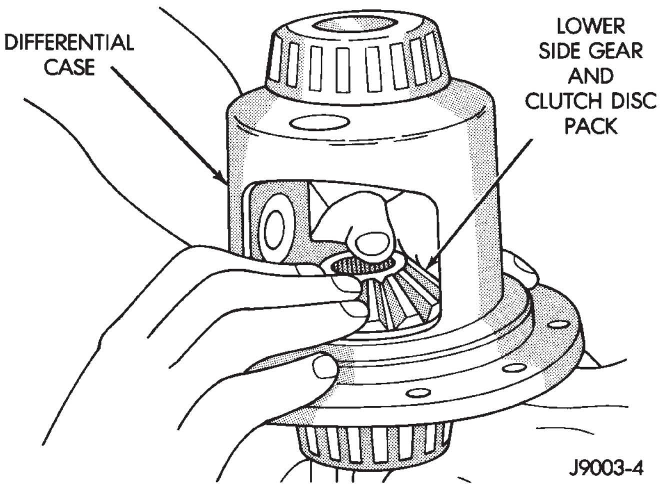

Fig. 14 Clutch Discs & Lower Side Gear Installation

(7) Install lubricated Step Plate C-4487-1 on first clutch pack (Fig. 15).

(8) Install the upper side gear and clutch disc pack (Fig. 15).

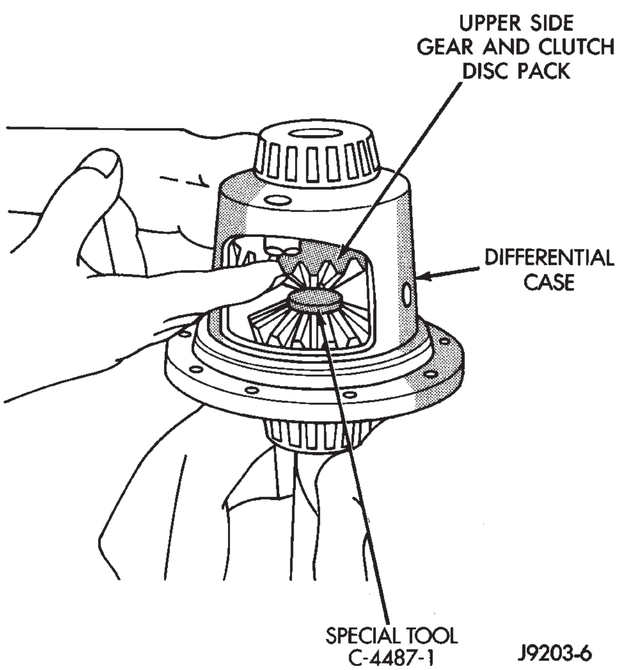

Fig. 15 Upper Side Gear & Clutch Disc Pack Installation

(9) Hold assembly in position. Insert Threaded Adapter C-4487-3 into top side gear, insert forcing Screw C-4487-4.

(10) Tighten forcing screw tool to compress clutch discs.

(11) Install pinion gears. Rotate case with Turning Bar C-4487-4. Make sure holes of pinion mate gears are aligned with case.

(12) Tighten forcing screw to compress the Belleville plates. Lubricate and install pinion gear thrust washers with a small screw driver.

(13) Install the following components in the differential case.

- Pinion gears and thrust washers
- Pinion gear mate shaft (align holes in shaft and case)

(14) Install the pinion mate shaft lock screw with Loctite® on the threads. Tighten the screw to 19 N•m (14 ft. lbs.) torque.

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.

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

(16) Install new ring gear bolts and alternately tighten to 61-81 N•m (45-60 ft. lbs.) torque (Fig. 16).

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

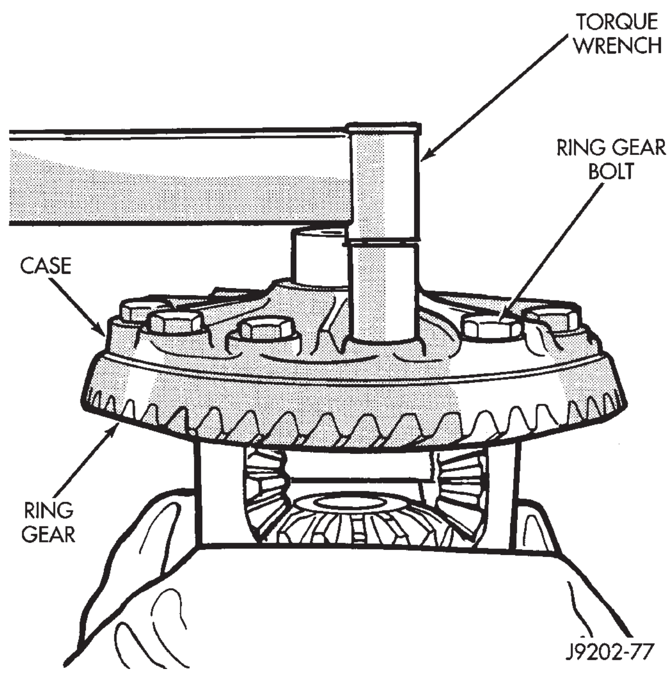

Fig. 16 Ring Gear Bolt Installation

TORQUE SPECIFICATIONS

REAR SUSPENSION COMPONENTS

DESCRIPTION	TORQUE
Jounce Bumper to Frame	20 N·m (15 ft. lbs.)
Lower Suspension Arm Bolt/Nut	177 N·m (130 ft. lbs.)
Shock Lower Bolt/Nut	92 N·m (68 ft. lbs.)
Shock Upper Nut	70 N·m (52 ft. lbs.)
Stabilizer Bar Link Nuts	36 N·m (27 ft. lbs.)
Stabilizer Bar Clamp Bolts	75 N·m (40 ft. lbs.)
Track Bar to Frame Rail Bracket Nut	100 N·m (74 ft. lbs.)
Track Bar Axle Bracket Bolt	100 N·m (74 ft. lbs.)
Upper Suspension Arm Nut	74 N·m (55 ft. lbs.)
Wheel Lug Nut 1/2 x 20 with 60° Cone	109 to 150 N·m (80 to 110 ft. lbs.)

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REAR AXLE MODEL 35

DESCRIPTION	TORQUE
Bearing Cap Bolts	77 N·m (57 ft. lbs.)
Differential Cover Bolts	47 N·m (35 ft. lbs.)
Fill Hole Plug	34 N·m (25 ft. lbs.)
Ring Gear Bolts	61 to 81 N·m (45 to 60 ft. lbs.)

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BRAKES

CONTENTS

GENERAL INFORMATION

INDEX

SERVICE BRAKE COMPONENTS

WHEEL BRAKE UNITS

Front disc brakes and rear drum brakes are used on all models. The front disc brakes consist of single piston calipers and ventilated rotors.

Drum type rear brakes are used on all models. Brake size is 254 x 44 mm (10.0 x 1.75 in.). The assemblies are dual shoe, internal expanding units with a single wheel cylinder. A self adjusting mechanism is used for all applications.

The parking brakes are operated by a hand lever assembly. The lever assembly is connected to the rear brake trailing shoes by cables. Parking brake adjustment is controlled by a cable tensioner attached to the front cable.

VACUUM/HYDRAULIC COMPONENTS

A vacuum operated, 200 mm (7.8 in.), dual diaphragm power brake booster is used on all models. A center feed, dual reservoir master cylinder and a combination proportioning valve and pressure differential switch are used on all models. The proportioning valve is a fixed rate type.

BRAKE WARNING LIGHTS

All models are equipped with two brake warning lights. A red light is used for the service brake system. An amber light is used for the antilock system.

The red light alerts the driver if a pressure differential exists between the front and rear hydraulic systems. The red light also alerts the driver when the parking brakes are applied. The light is located in the instrument cluster.

The amber antilock warning light is also located in the instrument cluster. The light illuminates only when an antilock system fault occurs.

BRAKELINING MATERIAL

Factory installed front and rear brakelining on Grand Cherokee models, is made from organic materials combined with metallic particles. The brakelining material does not contain asbestos.

ANTILOCK BRAKE SYSTEM (ABS)

An antilock brake system (ABS) is standard equipment on Jeep Grand Cherokee models. The antilock system is an electronically operated all wheel brake control system. The system is designed to retard wheel lockup during periods of high wheel slip when braking.

The antilock 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.

Antilock system components consist of:
- 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
- antilock warning light
- pump motor sensor

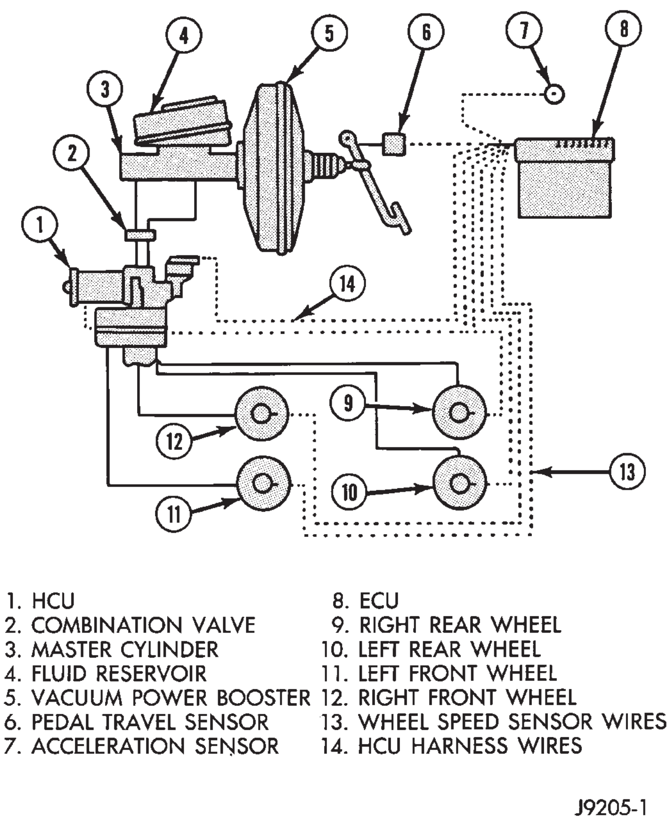

Fig. 1 AntiLock Brake System Basic Layout

BRAKE FLUID/LUBRICANTS/CLEANING SOLVENTS

Recommended brake fluid is Mopar brake fluid or 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, or multi-mileage grease on caliper bushings and slide pins.

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, alcohol, motor oil, transmission fluid, 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.

BRAKE SAFETY PRECAUTIONS

WARNING: ALTHOUGH FACTORY INSTALLED BRAKELINING ON GRAND CHEROKEE MODELS IS MADE FROM ASBESTOS FREE MATERIALS, SOME AFTER MARKET BRAKELINING MAY CONTAIN ASBESTOS. THIS SHOULD BE TAKEN INTO ACCOUNT WHEN SERVICING 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.

ANTILOCK BRAKE SYSTEM DIAGNOSIS

INDEX

DIAGNOSIS PROCEDURE

Antilock system diagnosis involves three basic steps. First is observation of the warning light display. Second is a visual examination for low fluid level, leaks, 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 ABS diagnostic connector is inside the vehicle. It is located at the forward end of the console, just above the accelerator pedal and under the carpet. Access to the connector only requires that the carpeting be moved aside.

Refer to the DRB II scan tool manual for test 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 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 hydraulic control unit 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. Under most conditions, pump and solenoid valve operating sounds should not be audible.

VEHICLE RESPONSE IN ANTILOCK MODE

During antilock braking, the hydraulic control unit solenoid valves cycle rapidly in response to antilock electronic control unit inputs.

The driver will experience a slight pulsing sensation within the vehicle as the solenoids decrease, hold, or increase pressure as needed. Brake pedal pulsing will also be noted and is a normal condition when the solenoids are cycling.

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 antilock 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 OPERATION

The red brake warning light and the amber 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.

ANTILOCK CONTROL UNIT (ECU) DIAGNOSIS

The antilock, electronic control unit (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.

HYDRAULIC CONTROL UNIT (HCU) DIAGNOSIS

The HCU pump and motor and solenoid valve body are services 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 FAULT DIAGNOSIS CHART

The diagnosis chart describes potential antilock system fault conditions. The most probable cause for each fault condition is also provided. The causes of a fault condition are listed in order of probability starting with the most likely cause of a fault.

Use the chart as a guide to repair after initial diagnosis with the DRB II scan tool.

POTENTIAL ABS FAULT CONDITIONS AND CAUSES

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 COMPONENT DIAGNOSIS

INDEX

GENERAL INFORMATION

The diagnosis information in this section covers the vehicle 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 component diagnosis involves determining if the problem is related to a mechanical, hydraulic or vacuum operated part. A preliminary check, 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 causing a problem.

The first diagnosis step is the preliminary 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 outlined in this section.

(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 and condition.

(a) Fluid level should be at the MAX level indicator mark on master cylinder reservoir.

(b) Check fluid condition. 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 reasonably clear and free of foreign material, it is OK.**

(c) Remember that fluid level in front disc brake reservoir will decrease slightly as normal brakelining wear occurs. However, if fluid level is abnormally low, look for leaks at calipers, wheel cylinders, brakelines and master cylinder.

(d) 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.

(e) If fluid separates into layers, or obviously contains oil or substance other than brake fluid, system seals and cups will have to be replaced and hydraulic system flushed.

(5) 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.

(6) 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.

(7) If components checked appear 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.

DIAGNOSING BRAKE PROBLEMS

BRAKE WARNING LIGHT OPERATION

The red brake warning light will illuminate when the parking brakes are applied, when there is a leak in the front or rear wheel brake hydraulic circuit, and as part of the bulb check procedure at startup. A low fluid level and excessively worn brakelining can also trigger the warning light. If the light comes on, first verify that the parking brakes are fully released. Then check pedal action and fluid level. If a problem is confirmed, inspect the wheel brake hydraulic system.

The amber antilock warning light illuminates only when an ABS component has malfunctioned. Refer to the Antilock Brake Diagnosis 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 and the amber antilock warning light is **not** on, worn lining and worn rotors or drums are the most likely cause. If the pedal remains low and the antilock light is on, the problem is with an antilock component. Refer to Antilock Brake System Diagnosis.

If the red warning light is on, a system leak is the most likely cause. A leak at a front caliper, rear wheel cylinder, brakeline, or brake hose will activate the differential pressure switch in the combination valve. The switch will shuttle forward or rearward depending on where the leak is. Switch movement in either direction will complete the electrical circuit to the red warning light causing the light to illuminate.

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.

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
- loose caliper mounting bracket
- distorted brake drum or shoes
- rear brakeshoes binding on worn/damaged support plates

- misassembled components.
- misadjusted brakelight switch
- binding brake pedal
- master cylinder internal fault

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).

An improperly mounted or adjusted brakelight switch can prevent full brake pedal return. The result will be the same as if the cylinder compensator ports are blocked. In this case, the brakes would be partially applied all the time causing drag.

BRAKE FADE

Brake fade is a product of overheating caused by brake drag. However, brake 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. However, light pedal pulsation will occur during periods of high wheel slip (antilock) braking. This is a normal condition and is a result of HCU pump operation.

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.

BRAKE PULL

A front pull condition could be the result of contaminated lining in one caliper, seized caliper piston, binding caliper, loose caliper, loose or corroded slide pins, improper brakeshoes, or a damaged rotor.

A worn, damaged wheel bearing or suspension component are further causes of pull. A damaged front tire (bruised, ply separation) can also cause pull.

A common and frequently misdiagnosed pull condition is where direction of pull changes after a few stops. The cause is a combination of brake drag followed by fade at 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 topping off, or filling the cylinder reservoirs with a non-recommended fluid.

Brake fluid contaminated with only dirt, or debris usually retains a normal appearance. Generally, 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 will also have to be flushed or replaced if the contaminants cannot be removed. 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, generally appears highly 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 and cups.

BRAKE NOISE

Squeak/Squeal

The factory installed brakelining in Grand Cherokee models is made from asbestos free materials. These materials have different operating characteristics than previous lining material. Under certain conditions, asbestos free lining may generate some squeak, groan or chirp noise. This noise is considered normal and does not indicate a problem. The only time inspection is necessary, is when noise becomes constant or when grinding, scraping noises occur.

Constant 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 can also cause squeak/squeal.

Loud brake squeak, squeal, scraping, or grinding sounds are a sign of severely worn brake lining. If the lining has worn completely through in spots, metal-to-metal contact occurs. If the condition is allowed to continue, rotors and drums can become so scored that replacement is necessary.

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

Brake chatter is usually caused by loose or worn components, or glazed/burnt lining. Rotors with hard spots can also contribute to chatter. Additional causes of chatter are out-of-tolerance rotors, brake lining not securely attached to the shoes, loose wheel bearings and contaminated brake lining.

BRAKELINING CONTAMINATION

Brakelining contamination is 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 little or no tread left can produce a grab-like condition 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.

POWER BRAKE 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.

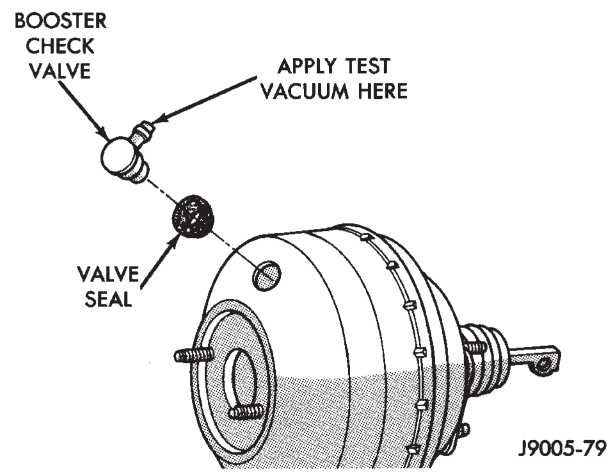

Fig. 1 Vacuum Check Valve And Seal Location

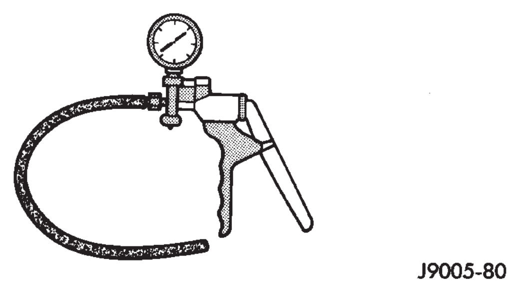

Fig. 2 Typical Hand Operated Vacuum Pump

POWER BRAKE BOOSTER VACUUM TEST

(1) Connect a vacuum gauge to the booster check valve with a short length of hose and a 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.

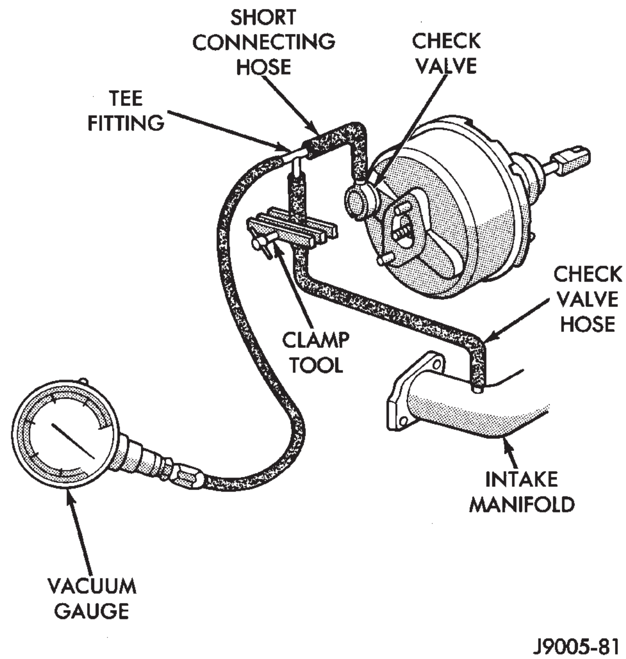

Fig. 3 Booster Vacuum Test Connections

BRAKE ADJUSTMENTS-FLUID LEVEL-BRAKE BLEEDING

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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 BRAKE FLUID LEVEL

Correct brake fluid level is marked on the driver side of the master cylinder reservoir (Fig. 1).

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.

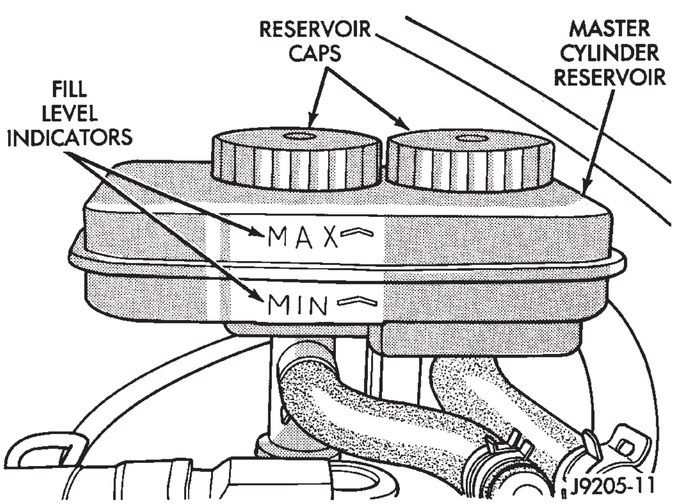

Fig. 1 Master Cylinder Reservoir Fluid Level Indicators

IMPORTANCE OF CLEAN BRAKE FLUID

The antilock system brake fluid must be kept clean and free of any type of contamination. 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. Dirt or foreign material in the system can lead to component malfunction. Always clean the reservoir exterior before checking fluid level or adding fluid. Use clean, fresh fluid only to top off, or refill the system.

CHECKING BRAKE FLUID FOR 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

A different bleeding method is required for the antilock brake system (ABS). It is basically a three step process consisting of: A conventional manual brake bleed. A second bleed using the DRB II scan tool to run the pump. And a repeat of the conventional manual bleed procedure. 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. 2).

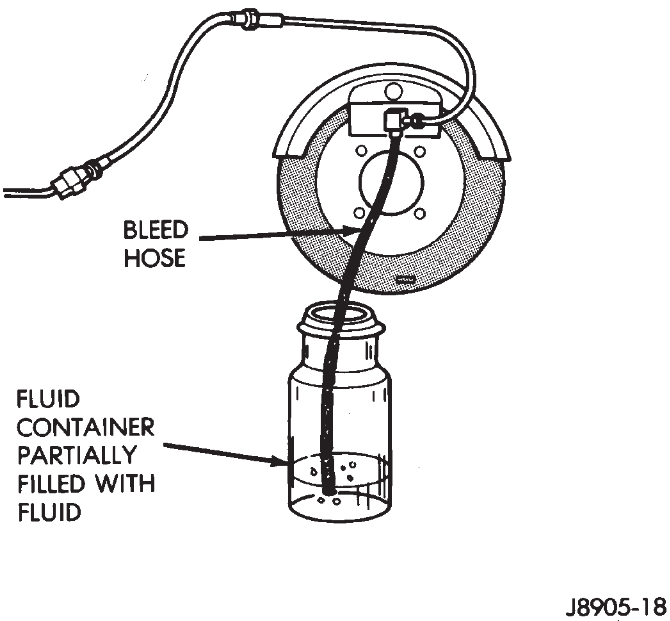

Fig. 2 Bleed Hose Immersed In Glass Container

(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 scan tool software information and diagnostic manual.

(a) Connect scan tool to diagnostic connector. Connector is under instrument panel near steering column.

(b) Run “Bleed Brake” procedure as described in scan tool manual.

(7) Repeat conventional bleeding procedure outlined in steps (1) through (5) and steps (8) and (9).

(8) Top off master cylinder fluid level if necessary.

(9) Verify proper brake operation.

REAR DRUM BRAKESHOE ADJUSTMENT

The rear drum brakes are equipped with a self-adjusting mechanism. Under normal circumstances, the only time adjustment is required is when the shoes are replaced; removed for access to other parts; or when one or both drums are replaced.

The only tool needed for adjustment is a standard drum brake gauge (Fig. 3).

Adjustment is performed with the brakeshoes installed on the support plate. Procedure is as follows:

ADJUSTMENT PROCEDURE

(1) Raise and support rear of vehicle and remove wheels and brake drums.

(2) Verify that left/right adjuster levers and cables are properly connected.

(3) Insert brake gauge in the drum. Expand gauge until gauge inner legs contact braking surface of drum. Then lock gauge in position (Fig. 3).

(4) Adjust brakeshoes to gauge as follows:

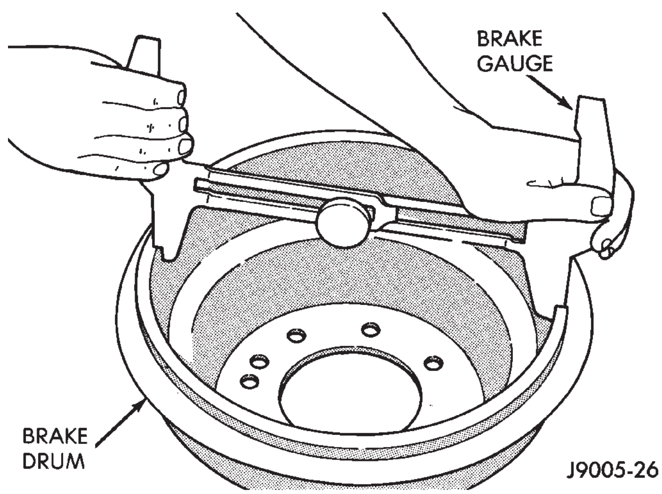

Fig. 3 Adjusting Brake Gauge To Brake Drum

(a) Reverse gauge and place it on brakeshoes. Position gauge legs at brakeshoe centers as shown (Fig. 4).

(b) Hold shoe adjuster star wheel away from adjuster lever.

(c) Turn adjuster star wheel by hand to expand or retract shoes until they fit gauge. Continue adjustment until gauge legs are light drag-fit on brakeshoes.

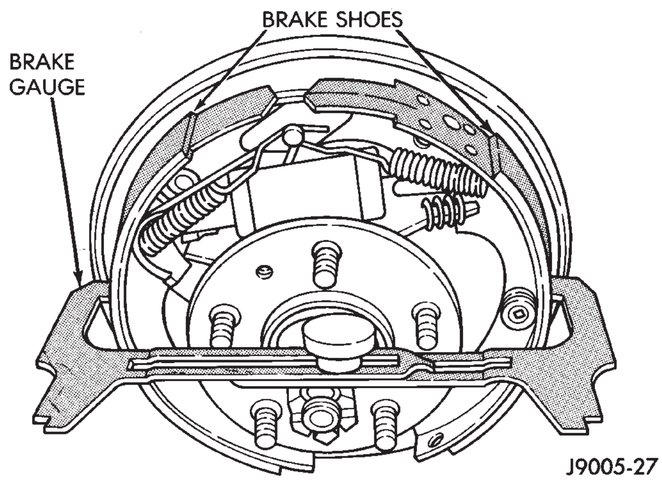

Fig. 4 Adjusting Brakeshoes To Brake Gauge

(5) Repeat adjustment at opposite brakeshoe assembly.

(6) Install brake drums and wheels and lower vehicle.

(7) Make final adjustment as follows: Drive vehicle and make one forward stop followed by one reverse stop. Repeat procedure 8-10 times to actuate self adjuster components and equalize adjustment. Bring vehicle to complete standstill at each stop. Incomplete, rolling stops will not activate the adjuster mechanism.

PARKING BRAKE CABLE ADJUSTMENT

A cable tensioner is used to control parking brake front cable adjustment. The tensioner requires a different method of adjustment than previous models. Perform adjustment only as described in the following procedure to avoid incorrect/ineffective adjustment.

ADJUSTMENT PROCEDURE

(1) Check and adjust rear drum brakeshoes if necessary. Refer to procedure in this section.

(2) Fully apply parking brakes.

(3) Raise vehicle on hoist.

(4) Mark position of adjusting nut on threaded end of cable tensioner (Fig. 5). Use chalk or grease pencil to mark position of nut.

(5) Tighten adjusting nut approximately 13 mm (1/2 in.) farther down threaded end of cable tensioner.

CAUTION: Replace the cable tensioner if there are not enough threads left for proper adjustment. Do not attempt to modify and reuse the tensioner. This practice will result in ineffective parking brake operation. The tensioner should be replaced.

(6) Lower vehicle until wheels are about 15 cm (6 in.) off shop floor.

(7) Release parking brake lever and verify that rear wheels rotate freely without drag.

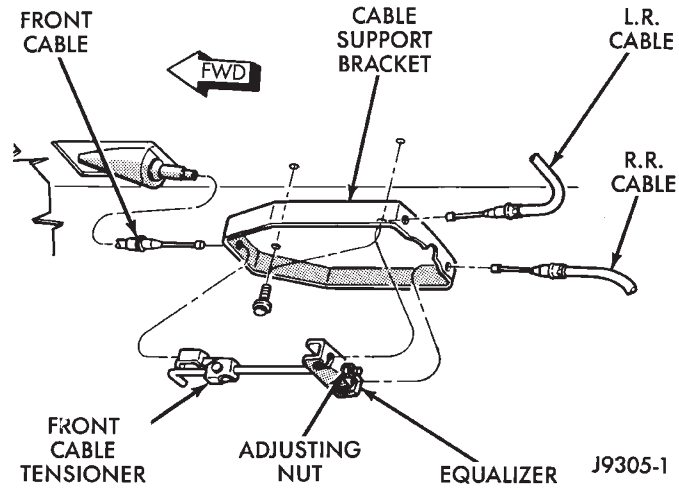

Fig. 5 Parking Brake Adjustment Components

(8) Lower vehicle completely.

REAR WHEEL SPEED 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 0.40 to 1.3 mm (0.0157 to 0.051 in.). If front sensor air gap is incorrect, the sensor is either loose, or damaged.

BRAKELIGHT SWITCH ADJUSTMENT

A plunger-type brakelight switch is used on Grand Cherokee models (Fig. 6). 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 retainer clip is used to secure the switch to a bracket on the pedal support. The clip has tangs that seat in the threads of the switch plunger barrel.

BRAKELIGHT SWITCH ADJUSTMENT PROCEDURE

(1) Check switch adjustment as follows:

(a) Move brake pedal forward by hand and note operation of switch plunger.

(b) Plunger should be fully extended when pedal free play is taken up and brake application begins.

(c) Clearance of approximately 1.5 to 3 mm (1/16 to 1/8 in.) should exist between plunger and pedal at this point.

(2) If switch-to-pedal clearance is OK and brakelights operate correctly, adjustment is not required.

(3) If switch plunger does not fully extend and clearance between pedal and switch barrel is insufficient, adjust switch position as described in step (4).

(4) Grasp brake pedal and pull it rearward as far as possible. Switch plunger barrel will “ratchet” rearward in retaining clip to correct position.

(5) 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.

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 is preferred for tightening purposes.

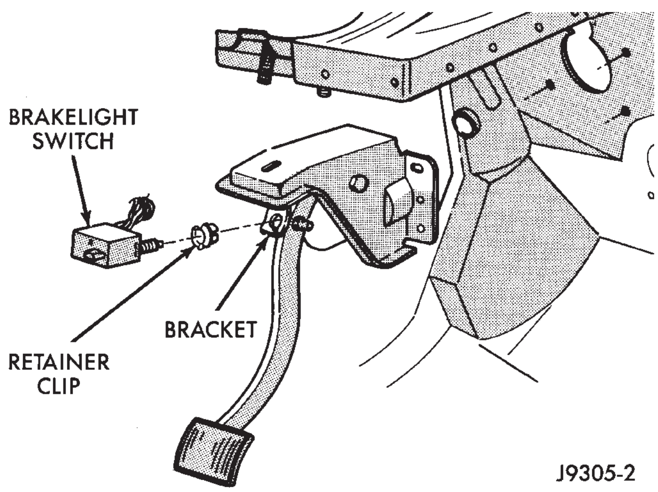

Fig. 6 Brakelight Switch Mounting

The correct tightening sequence is important in avoiding rotor and drum distortion. The correct sequence is in a diagonal crossing pattern (Fig. 7).

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.

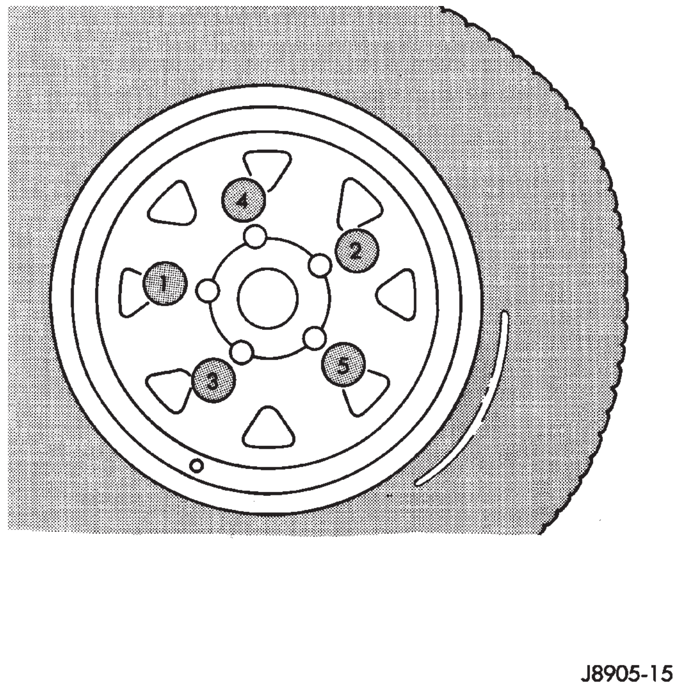

Fig. 7 Wheel Nut Tightening Sequence

ANTILOCK BRAKE OPERATION

INDEX

SYSTEM DESCRIPTION

The Grand Cherokee antilock brake system (ABS) is an electronically operated, all wheel brake control system. Major components are located underhood on the driver side of the vehicle (Fig. 1). Components include the:

- master cylinder/reservoir assembly
- vacuum power brake booster and pedal travel sensor

hydraulic control unit (HCU)

- combination valve
- ABS electrical harnesses

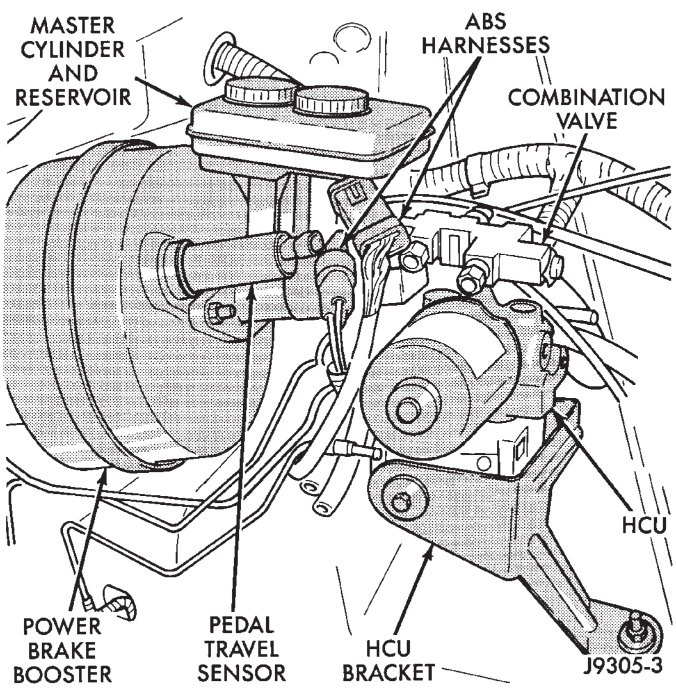

Fig. 1 Antilock System Underhood Components

- interconnecting brakelines

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.

Electronic control 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

HYDRAULIC CONTROL UNIT (HCU)

The hydraulic control unit (HCU) consists of a valve body and pump/motor assembly (Figs. 1 and 2).

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).

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 op-

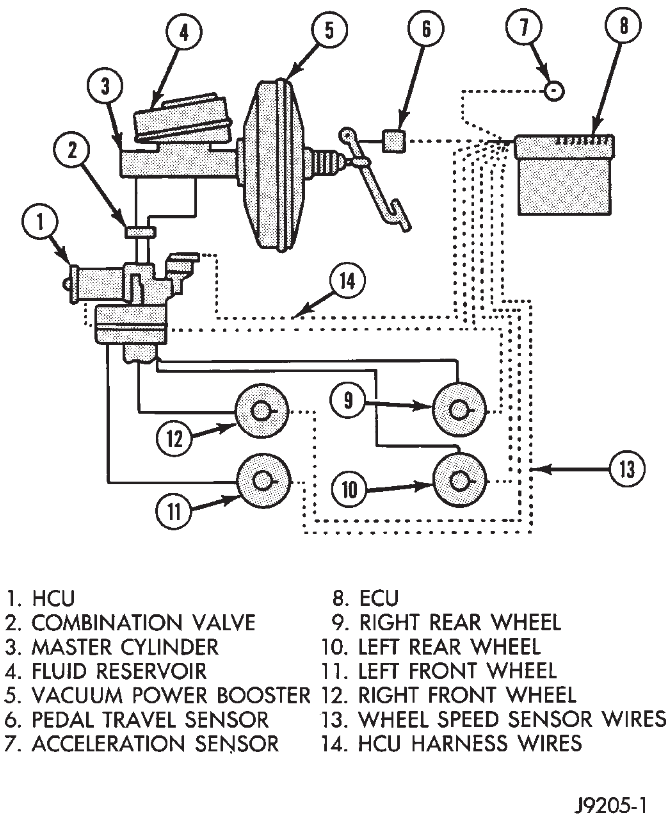

Fig. 2 AntiLock System Basic Layout

eration, 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. 3). 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. 3). 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.

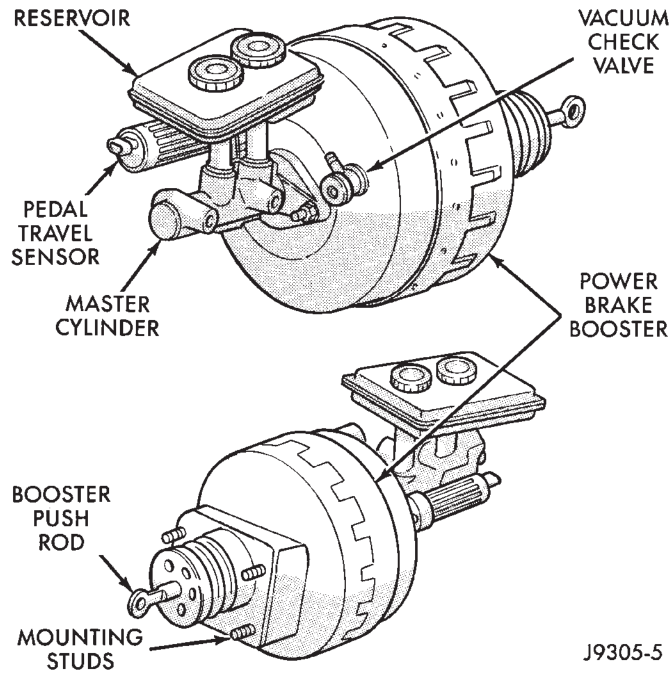

Fig. 3 Antilock Power Brake Booster And Master Cylinder

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 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. 4). 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. 4).

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. 5). The front/rear sensors have the same electrical values but are not interchangeable.

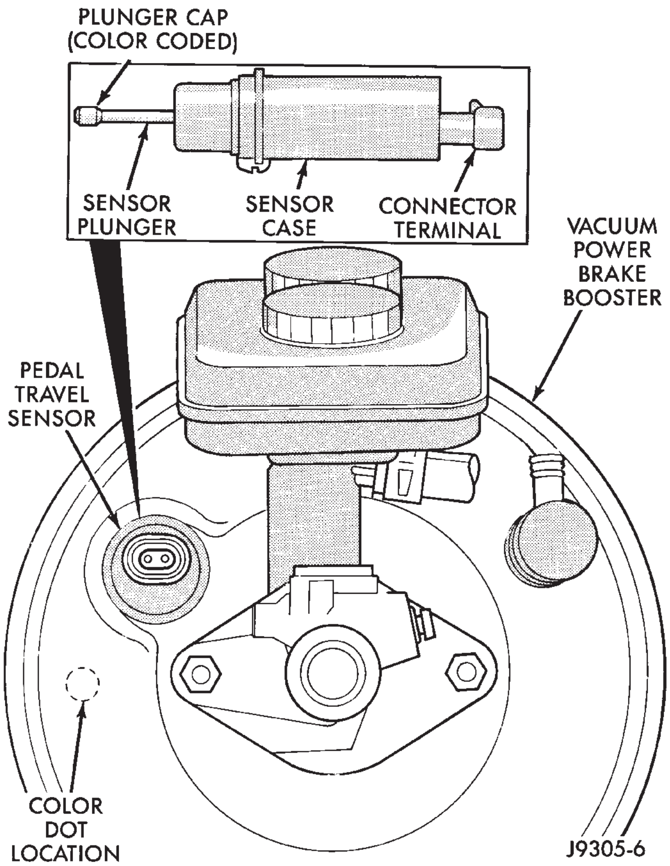

Fig. 4 Pedal Travel Sensor Location

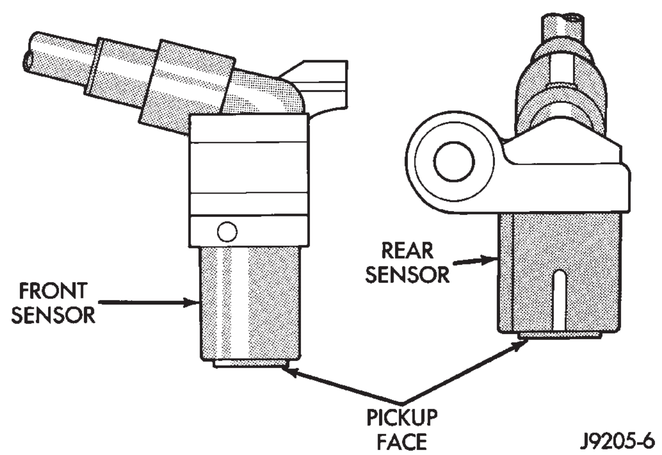

Fig. 5 Wheel Speed Sensors

ELECTRONIC CONTROL UNIT (ECU)

A separate electronic control unit (ECU) monitors, operates and controls the antilock system (Fig. 6). The ECU contains dual microprocessors. The logic block in each microprocessor receives identical sensor signals. These signals are processed and compared simultaneously (Fig. 7).

The ECU is located in the engine compartment. It is mounted on the driver side inner fender panel.

The 6-way antilock diagnostic connector is inside the vehicle. It is located at the forward end of the console just above the accelerator pedal and under the carpeting. Access to the connector only requires that the carpet be moved aside.

The 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.

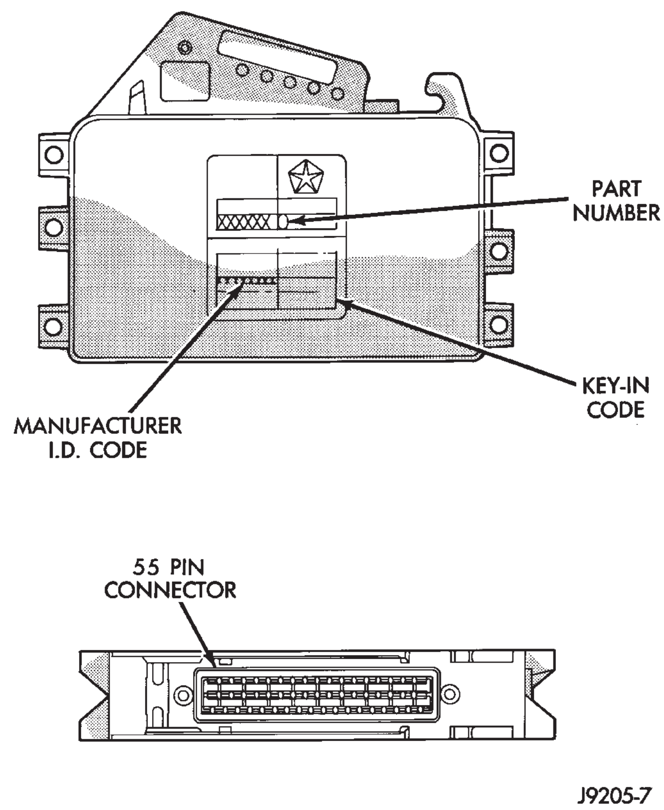

Fig. 6 Anti-Lock ECU

ACCELERATION SWITCH

An acceleration switch (Fig. 8), 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.

SYSTEM RELAYS

The ABS system has two relays, which are the main and motor pump relays. The motor pump relay

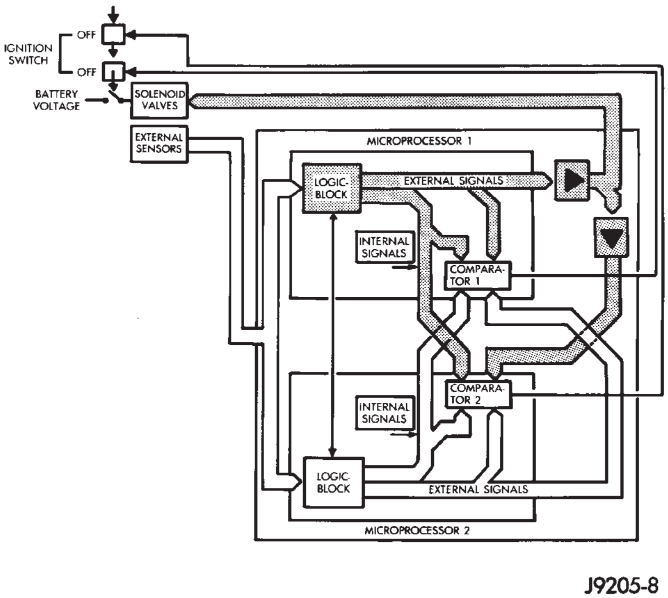

Fig. 7 ECU Dual Microprocessor Schematic

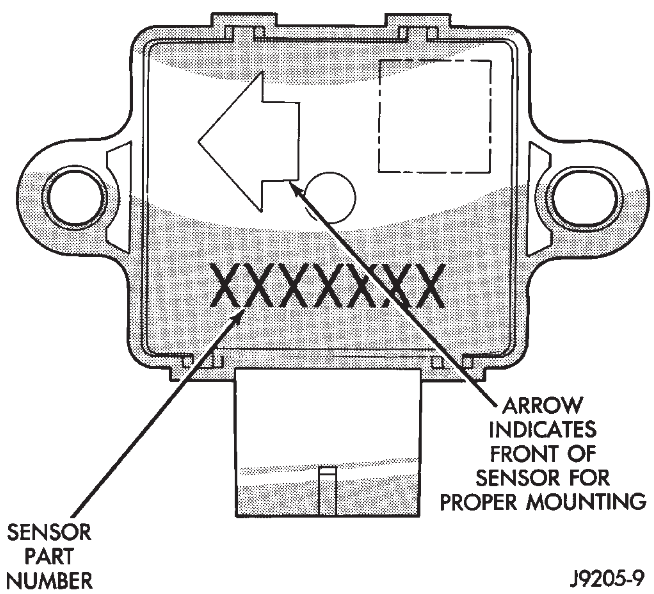

Fig. 8 Acceleration Switch

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.

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 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. 1). 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 SYSTEM OPERATION

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 ABS system has three fluid pressure control channels. The front brakes are controlled separately and the rear brakes in tandem (Fig. 9). 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. 10). 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.

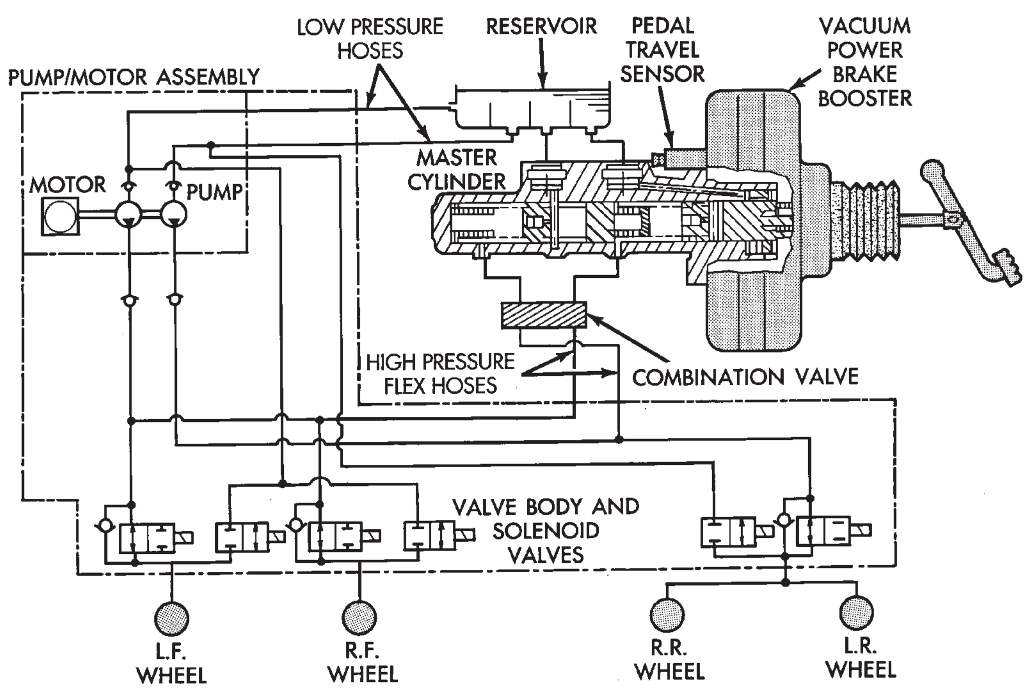

Fig. 9 Three-Channel ABS Hydraulic Control Circuit

Pressure Decrease

The outlet valve is opened and the inlet valve is closed during the pressure decrease cycle (Fig. 10).

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 reservoir. 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. 11). 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. 12). The pressure increase cycle is used to counteract unequal wheel speeds. This cycle controls reapplication of fluid apply pressure after a pressure decrease cycle.

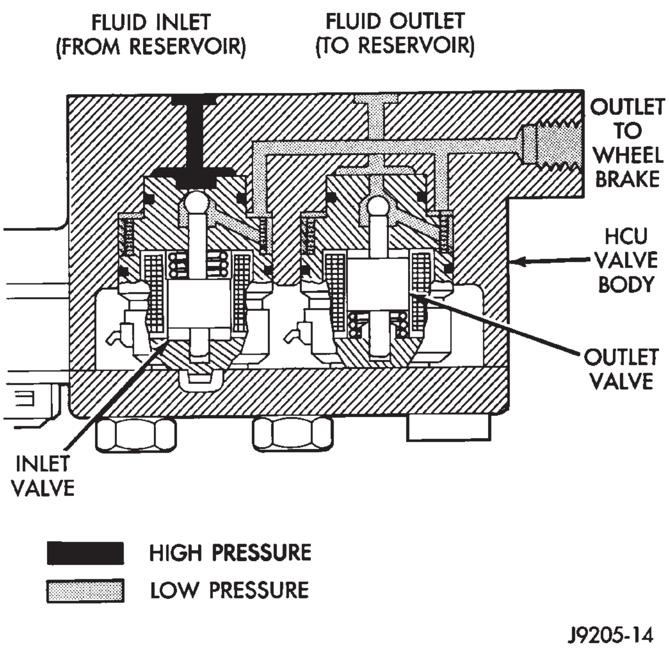

Fig. 10 Solenoid Valves In Pressure Decrease Cycle

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

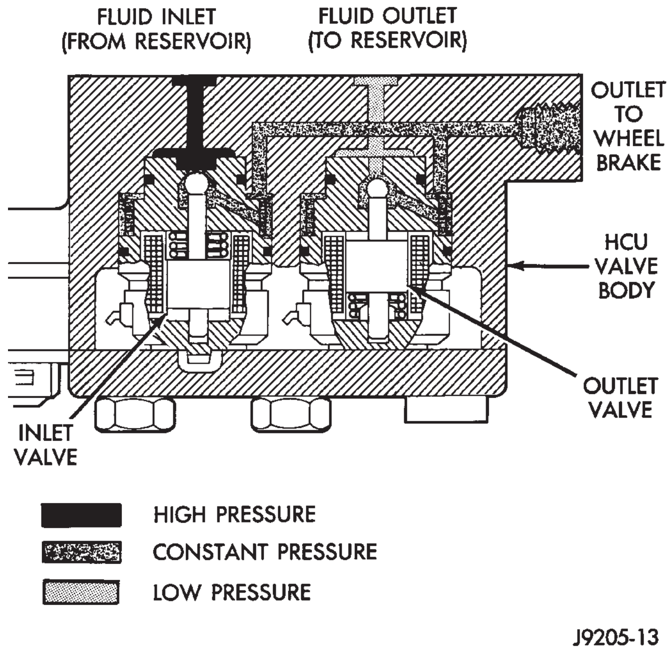

Fig. 11 Solenoid Valves In Pressure Hold Cycle

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. 13). 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.

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 from the reservoir by the pump.

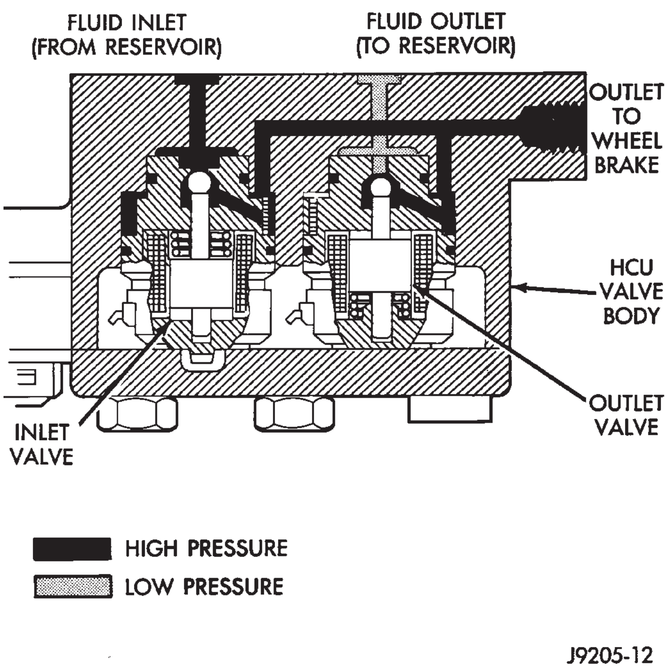

Fig. 12 Solenoid Valves In Pressure Increase Cycle

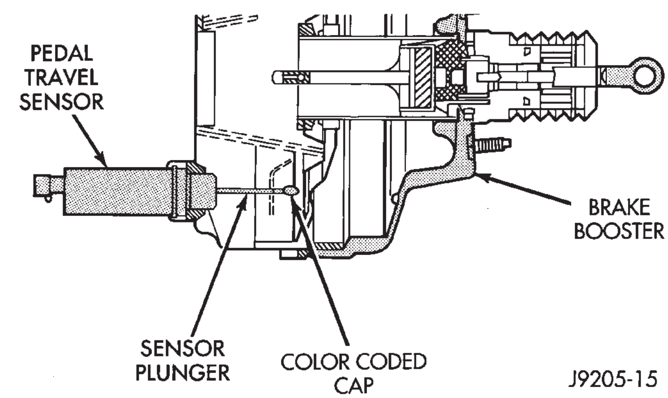

Fig. 13 Pedal Travel Sensor Actuation

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.

MASTER CYLINDER—HCU—COMBINATION VALVE—BRAKELINES

INDEX

SERVICE INFORMATION

The master cylinder, antilock hydraulic control unit (HCU) and combination valve are not serviceable components. If a cylinder, HCU, or valve malfunction should occur, replace the faulty part as an assembly.

The brakelines can be serviced separately when needed. Mopar preformed brakeline is recommended for repair purposes. Brakeline repair is not recommended except as a temporary, emergency-type repair. Refer to the brakeline information in this section for details.

MASTER CYLINDER RESERVOIR FLUID LEVEL

Correct fluid level is to the MAX level indicator on the reservoir (Fig. 1).

The only fluid recommended for the ABS system is Mopar brake fluid, or an equivalent quality fluid meeting standards SAE J1703 and DOT 3. Do not use any other fluid in the ABS system.

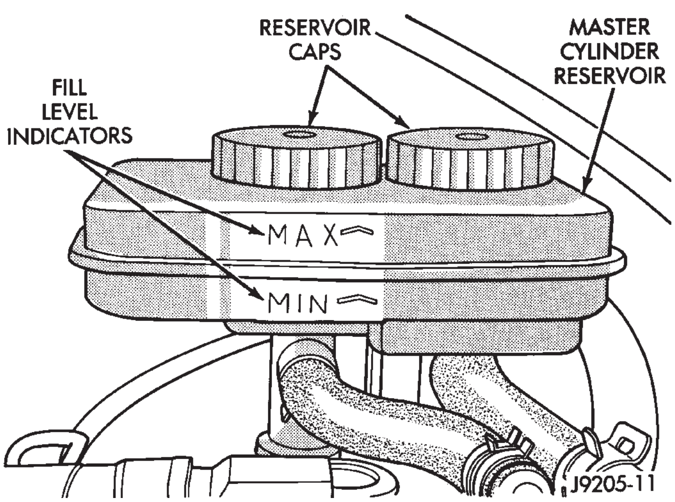

Fig. 1 Reservoir Fluid Level Indicators

MASTER CYLINDER REMOVAL

(1) Disconnect battery negative cable.

(2) Remove windshield washer reservoir.

(3) Pump brake pedal to exhaust all vacuum from power brake booster.

CAUTION: It is very important that all vacuum be exhausted from the booster. Failure to do so could result in damage to the master cylinder-to-booster seal when the cylinder is removed.

(4) Disconnect antilock harness connectors and move wire harnesses aside for working clearance.

(5) Remove clamps that secure reservoir hoses to HCU pipes.

(6) Position small drain container under master cylinder reservoir hoses.

(7) Disconnect reservoir hoses (Fig. 2) from HCU pipes and allow fluid to drain into container. Discard drained fluid.

(8) Disconnect and remove combination valve. Refer to procedure in this section.

(9) Disconnect brakelines at master cylinder.

(10) Remove nuts attaching master cylinder to booster mounting studs (Fig. 3).

(11) Remove master cylinder. Pull cylinder forward and off studs and work it out of engine compartment.

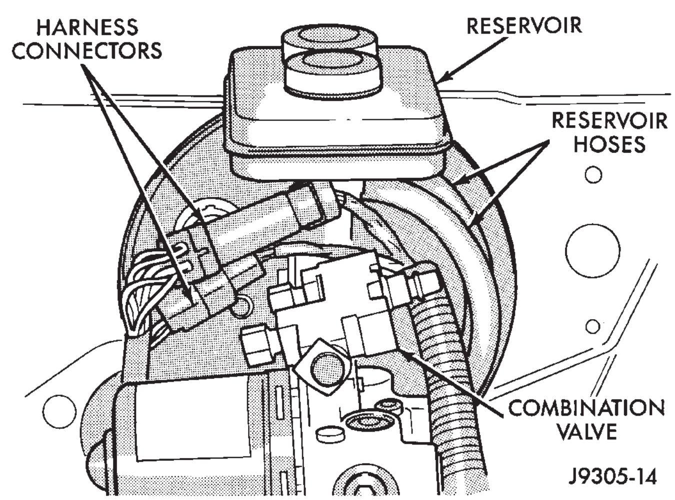

Fig. 2 Harness, Reservoir Hose And Valve Position

MASTER CYLINDER INSTALLATION

(1) If new master cylinder is being installed, bleed cylinder on bench before installing it in vehicle.

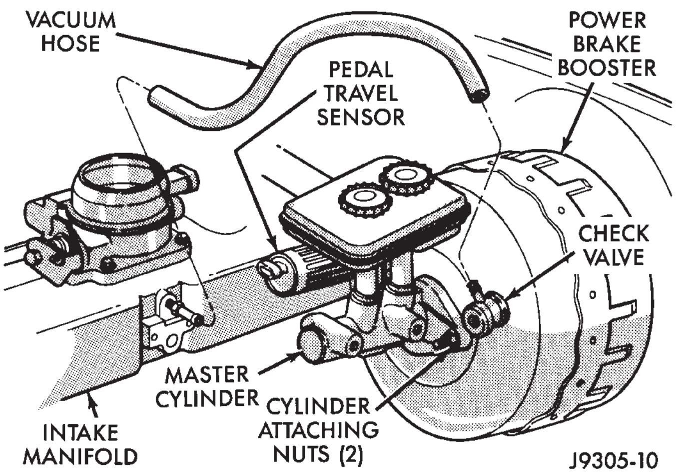

Fig. 3 Master Cylinder Mounting

CAUTION: The seal between the master cylinder and brake booster can be damaged if the cylinder is improperly installed. A vacuum leak may develop if the seal is damaged during installation. To avoid seal damage, install the master cylinder only as described in the following step.

(2) Install master cylinder as follows:

(a) Have helper press brake pedal until booster push rod is visible in opening at front of booster. Then have helper hold brake pedal in position.

(b) Guide master cylinder onto booster mounting studs and onto booster push rod. **Be sure booster push rod is properly aligned and seated in master cylinder.**

(c) Have helper slowly release brake pedal as master cylinder is seated on booster mounting studs. Keep booster push rod centered in master cylinder while seating cylinder.

(d) Install and tighten master cylinder mounting nuts to 25 N●m (220 in. lbs.) torque.

(3) Connect brakelines to master cylinder. Tighten line fittings to 15 N●m (132 in. lbs.) torque.

(4) Connect reservoir hoses to HCU pipes. Be sure hose clamps are securely in place.

(5) Verify that master cylinder and booster are properly attached before proceeding.

(6) Install and connect combination valve.

(7) Connect antilock harnesses (Fig. 2).

(8) Fill master cylinder reservoir and bleed brakes. Refer to bleeding procedures in section dealing with brake bleeding and adjustments.

(9) Install windshield washer reservoir and air cleaner.

(10) Connect battery negative cable.

HCU REMOVAL

(1) Disconnect battery negative cable.

(2) Disconnect pedal travel sensor wire connector (Fig. 4).

(3) Remove air cleaner and hoses (Fig. 5).

(4) Remove windshield washer reservoir (Fig. 5).

(5) Position small drain container under master cylinder reservoir hoses.

(6) Disconnect ABS harnesses (Figs. 5 and 6).

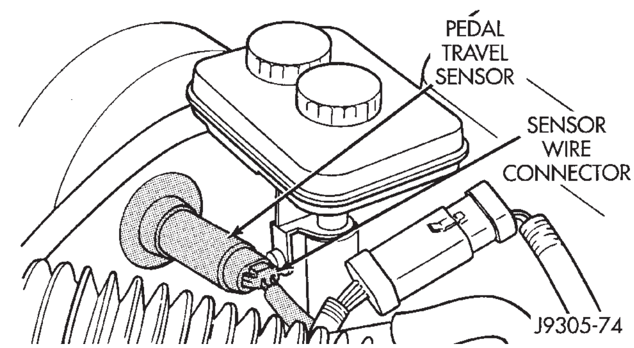

Fig. 4 Pedal Travel Senor Connector Location

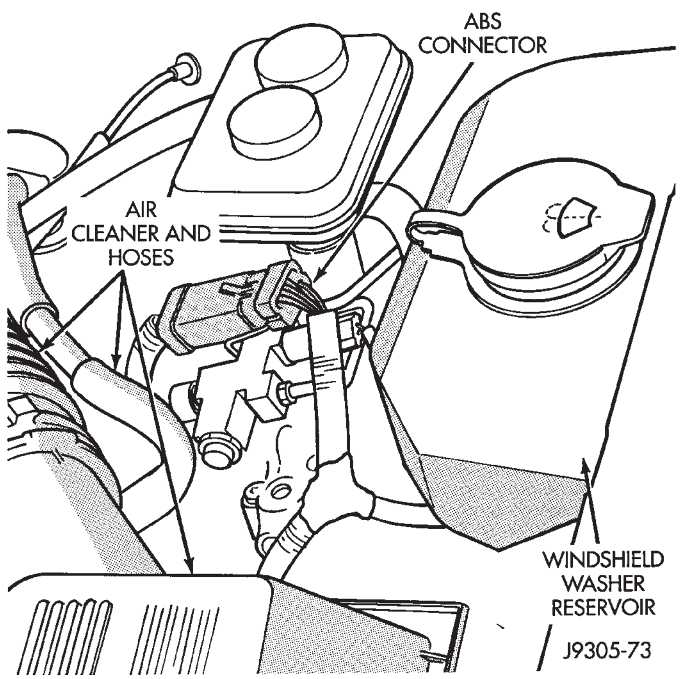

Fig. 5 Components To Be Removed/Disconnected For HCU Access

(7) Remove combination valve. Refer to procedure in this section.

(8) Move harness wires, hoses, lines aside for access to HCU bracket nuts (Fig. 7).

(9) Remove nuts attaching HCU bracket to inner fender panel (Fig. 7).

(10) Mark or tag HCU hydraulic lines for assembly reference.

(11) Disconnect hydraulic lines and hoses at HCU.

(12) Remove HCU. Lift HCU up and off mounting bracket studs. Then work it past brakelines and master cylinder to remove it.

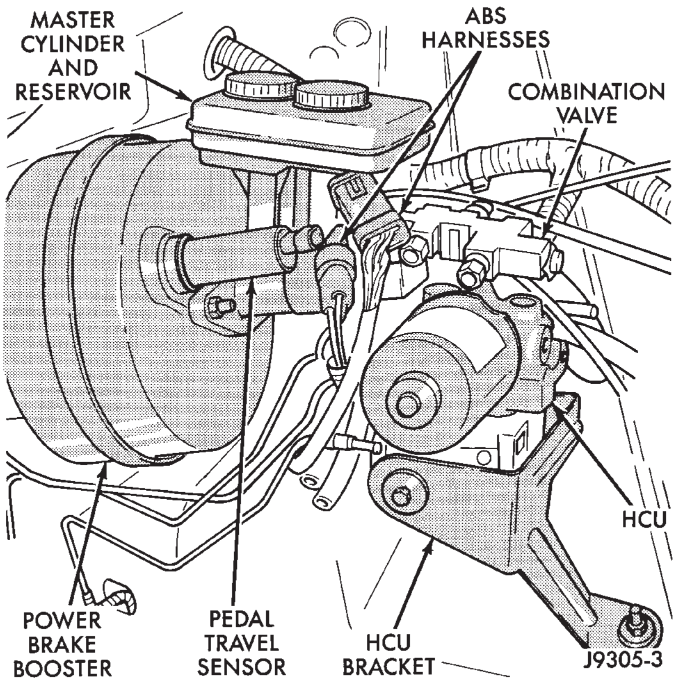

Fig. 6 HCU Location

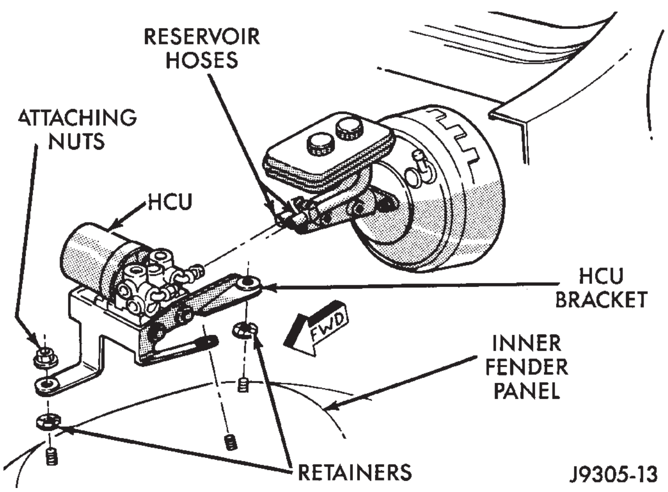

Fig. 7 HCU Bracket Attachment

HCU INSTALLATION

(1) Connect master cylinder reservoir hoses to HCU pipes.

(2) Position HCU assembly on mounting bracket and install attaching nuts. Tighten nuts to 12 N•m (102 in. lbs.) torque.

(3) Connect hydraulic lines and hoses to HCU (Fig. 8). Fitting nuts and bosses on valve body ports are color coded. Be sure lines are properly connected. Tighten line fittings to 12 N•m (106 in. lbs.) torque.

(4) Install and connect combination valve. Tighten brakeline fittings at valve to 21 N•m (185 in. lbs.) torque

(5) Connect harness wires to HCU (Fig. 9).

(6) Check routing of HCU lines/hoses. Be sure lines are not kinked and are clear of engine components.

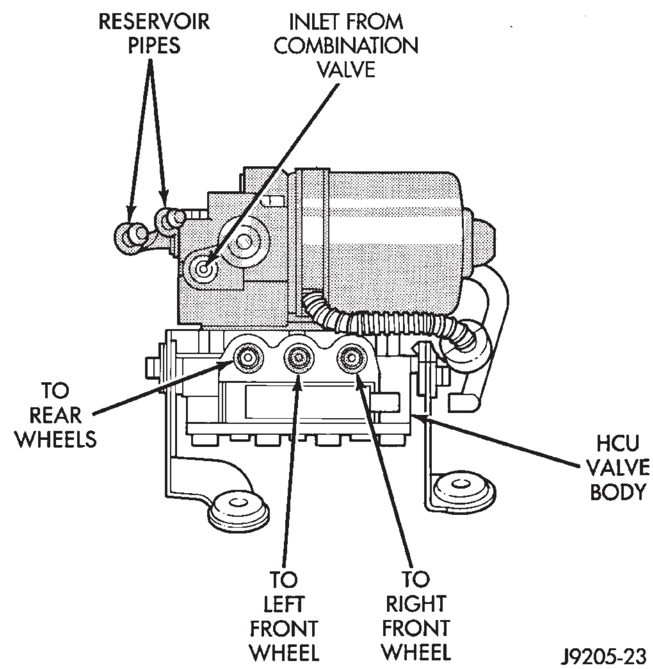

Fig. 8 HCU Hydraulic Line Connections

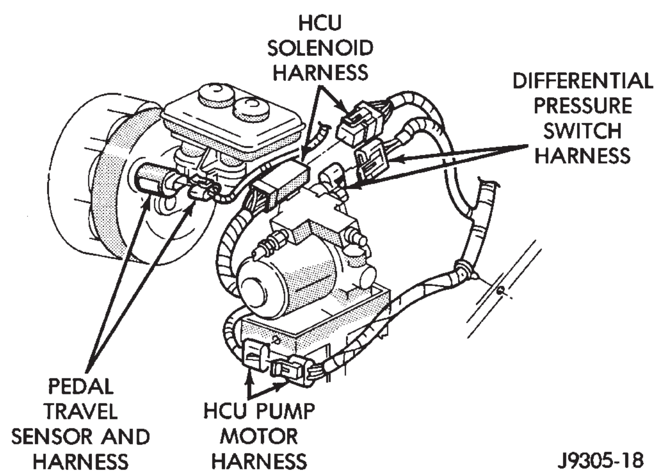

Fig. 9 HCU Harness Connectors

(7) Connect battery negative cable.

(8) Fill master cylinder reservoir with fresh Mopar DOT 3 brake fluid or equivalent.

(9) Bleed brake system. Refer to brake bleeding and adjustments section for procedure.

(10) Install air cleaner and hoses.

(11) Install windshield washer fluid reservoir.

(12) Check brake pedal action before moving vehicle. Bleed brakes again if pedal is not firm (feels soft/spongy).

COMBINATION VALVE REMOVAL

(1) Disconnect battery negative cable.

(2) Remove air induction tube for access to valve, if necessary.

(3) Unsnap wire harness from bracket at top of combination valve. Then disconnect wire connectors.

(4) Disconnect pedal travel sensor harness connector and move harness wires aside for working access if necessary.

(5) Disconnect pressure differential switch wires at terminal on valve (Fig. 10).

(6) Disconnect hydraulic lines at valve.

(7) Remove bolt attaching valve bracket to master cylinder and remove valve.

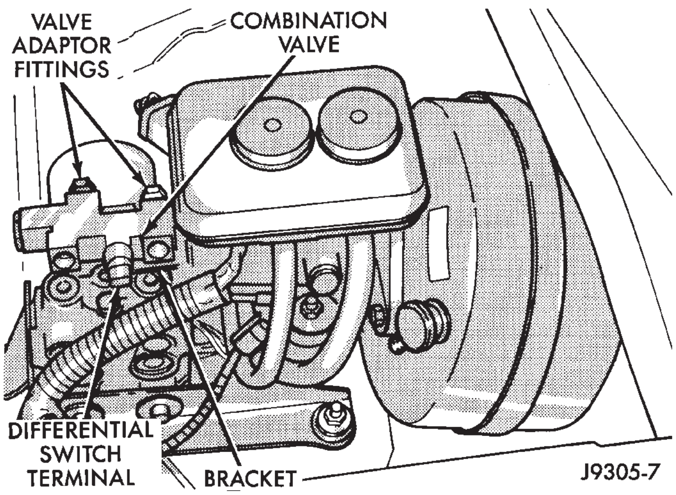

Fig. 10 Combination Valve Mounting

COMBINATION VALVE INSTALLATION

(1) If a replacement combination valve is being installed and it does not have primary and secondary brakeline adaptor fittings (Fig. 11), transfer original adapters to new valve. Tighten adapters to 25 N●m (220 in. lbs.) torque.

(2) Connect brakelines lines to combination valve but do not tighten fittings at this time. Start all line fittings by hand to avoid cross threading.

(3) Position valve mounting bracket on master cylinder and install bracket attaching bolt.

(4) Reconnect pressure differential switch and pedal travel sensor wires.

(5) Tighten brakeline fittings at valve to 21 N●m (185 in. lbs.) torque. Use backup wrench to prevent adapters from turning when tightening line fittings.

(6) Connect and snap harness wire connectors into bracket at top of valve.

(7) Bleed brake system. Refer to procedure in this section.

(8) Verify proper valve operation. If red warning light comes on, parking brakes may be still be applied, system may contain air, or a brakeline fitting is loose. Check and correct as needed.

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 only be replaced. They are not repairable parts.

When installing new, or original brakelines and hoses, lubricate the fitting threads with brake fluid before connection.

BRAKELINE CHARTS

Brakeline charts are provided in illustration Figures 11 and 12. The illustrations show typical brakeline routing, hose connections and component position.

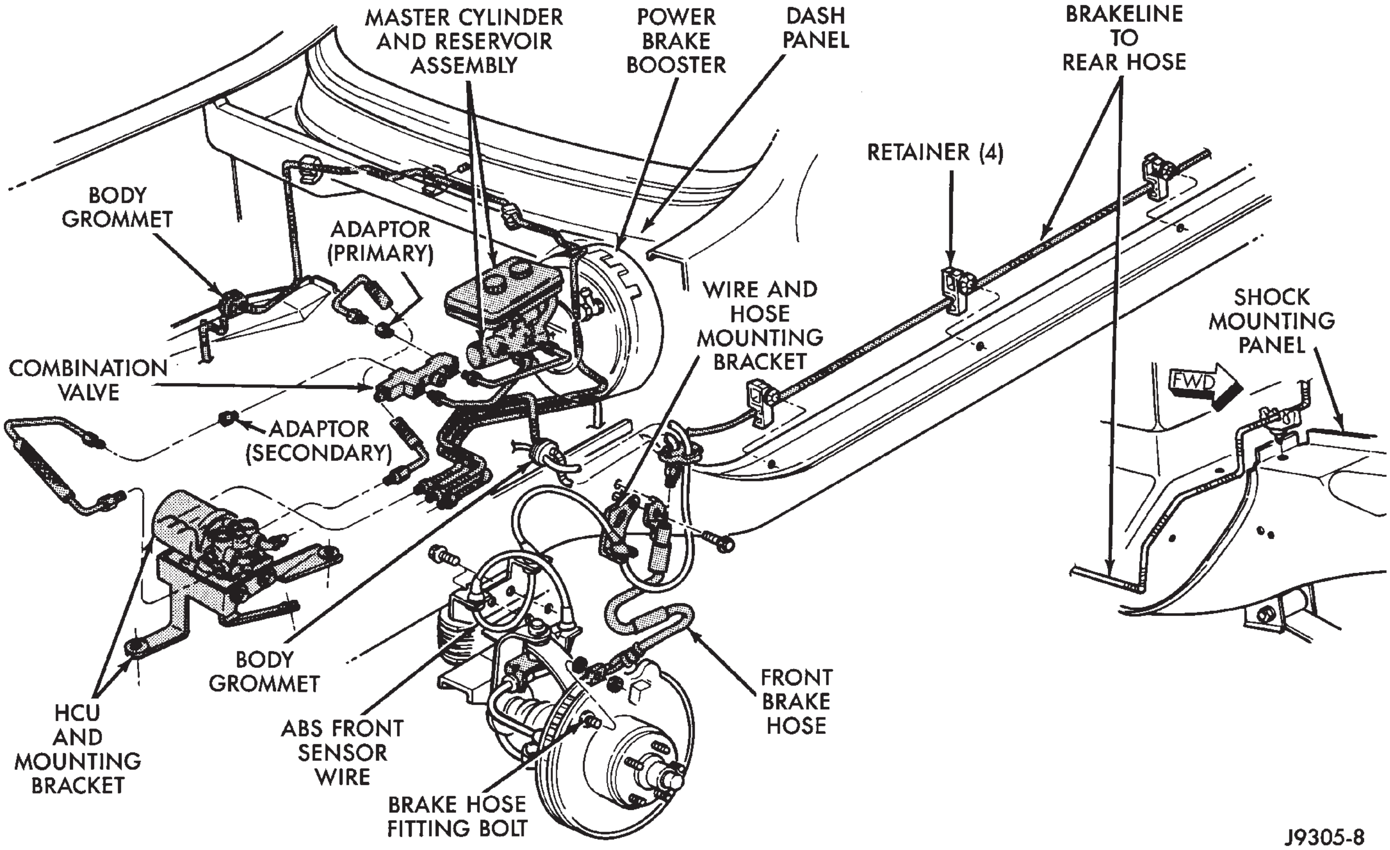

Fig. 11 Front Brakeline Routing And Connections

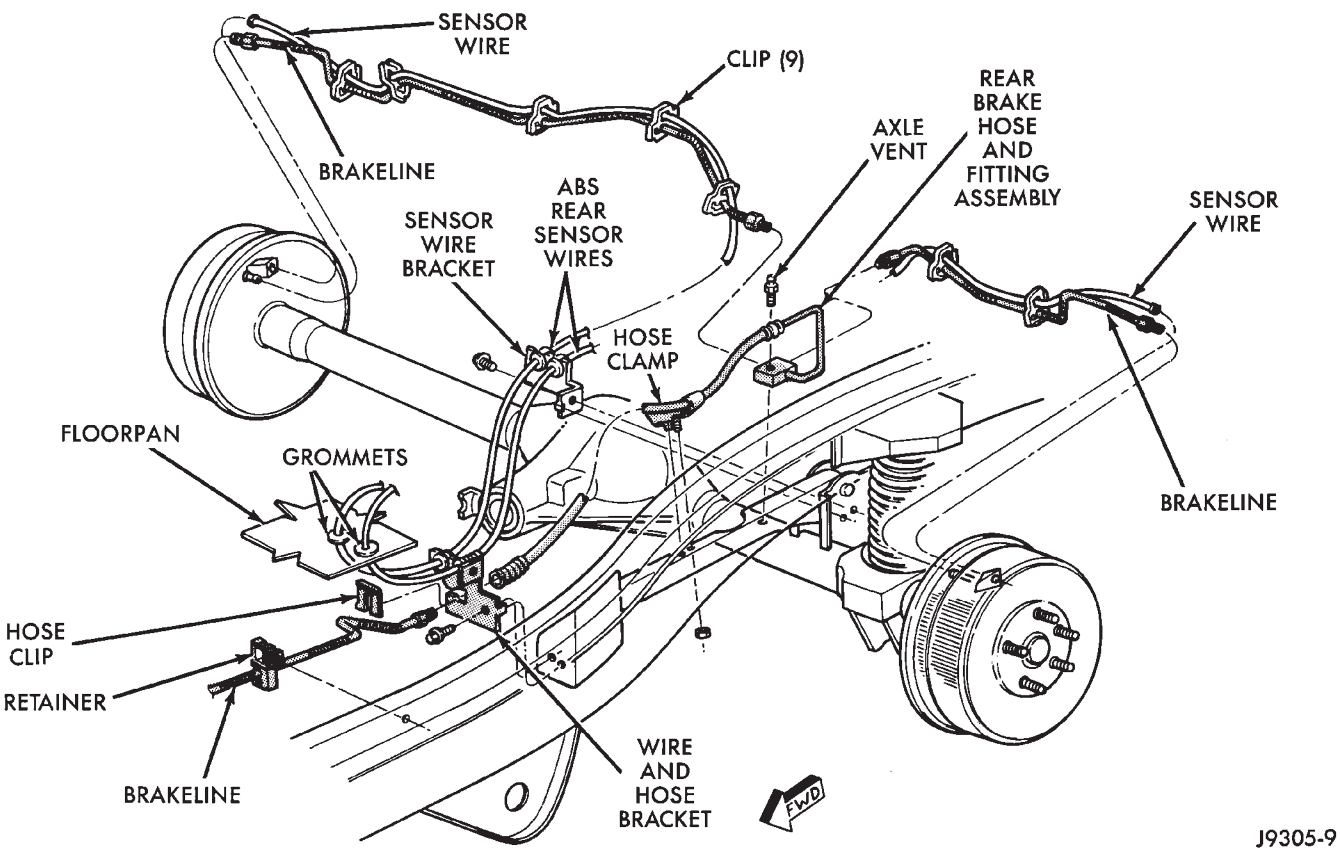

Fig. 12 Rear Brakeline Routing And Connections

POWER BRAKE BOOSTER SERVICE

INDEX

BOOSTER SERVICE INFORMATION

The only serviceable parts on the power brake booster are the check valve, vacuum hose and pedal travel sensor. The booster is not a serviceable component. Replace the booster as an assembly if diagnosis indicates a malfunction.

POWER BRAKE BOOSTER REMOVAL

(1) Pump brake pedal until all vacuum is exhausted from power brake booster.

CAUTION: It is very important that all vacuum be exhausted from the booster. Failure to do so could result in damage to the master cylinder-to-booster seal when the cylinder is removed.

(2) Disconnect battery negative cable.
(3) Disconnect harness wire connectors from pedal travel sensor and brake warning switch on combination valve.
(4) Remove air cleaner and hoses.
(5) Remove windshield washer reservoir.
(6) Position small drain pan under master cylinder reservoir hoses. Pan is needed to catch fluid when hoses are disconnected.
(7) Remove clamps that secure reservoir hoses to HCU pipes. Then remove hoses from pipes. Be sure to keep hoses over drain pan until fluid has stopped flowing.
(8) Remove nuts attaching master cylinder to booster mounting studs. Then remove master cylinder and combination valve as assembly. Slide cylinder forward and off booster mounting studs.
(9) Disconnect vacuum hose at booster check valve.
(10) Working inside vehicle, disconnect booster push rod from brake pedal. Slide retainer clip off pedal stud and slide push rod off stud.
(11) Remove nuts attaching booster to passenger compartment side of dash panel (Fig. 1).
(12) Slide booster forward out of dash panel. Tilt booster upward and remove it from engine compartment.

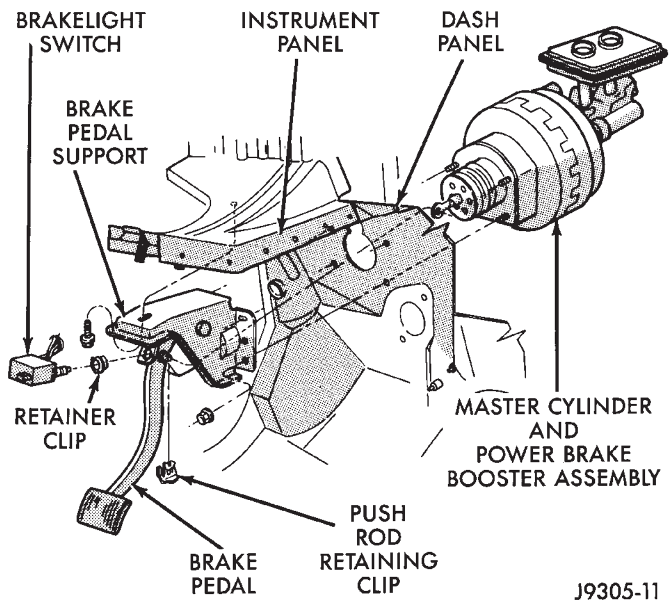

Fig. 1 Power Brake Booster Mounting

POWER BRAKE BOOSTER INSTALLATION

CAUTION: The pedal travel sensor and power brake 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 (Fig. 2) are the same before installation. 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.

(1) If **original** booster and pedal travel sensor will be reinstalled, continue with installation procedure.
(2) If **new** booster is being installed, it will be necessary to inspect and match booster and pedal travel sensor as follows:
(a) If new booster is already equipped with pedal travel sensor, matching will not be necessary. Sensor and booster were prematched by supplier. Continue with booster installation procedure.
(b) If new booster is NOT equipped with a pedal travel sensor, it will be necessary to match and transfer original sensor to new booster. Compare color of sensor cap and color dot on booster shell (Fig. 2). If colors match, install sensor and continue with booster installation procedure. However, if colors **do not match**, select and install correct color cap on sensor plunger before installing sensor in booster.
(3) Install O-ring on pedal travel sensor.

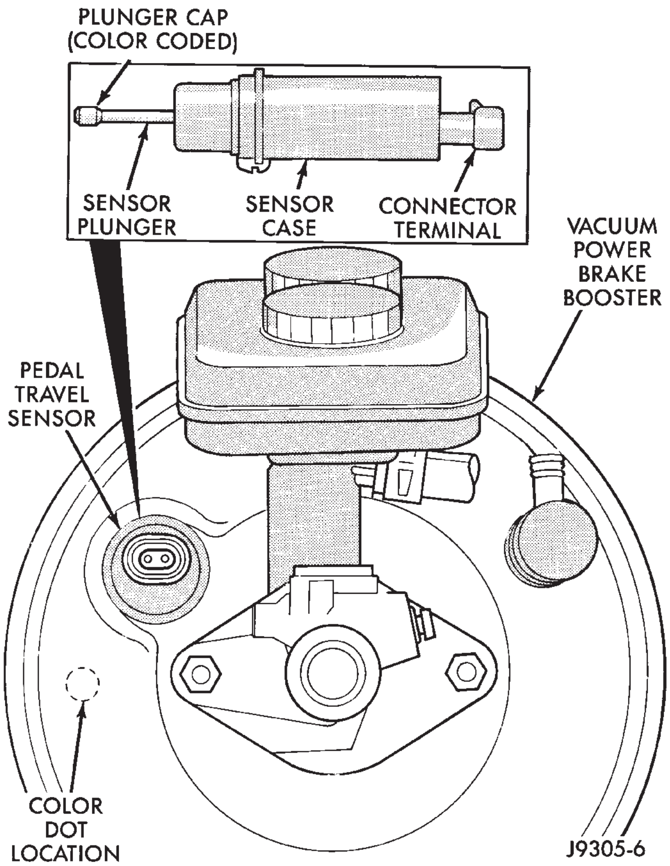

Fig. 2 Booster And Pedal Travel Sensor Color Code Locations

(4) Install sensor retaining ring on booster flange. Be sure retaining ring is firmly seated.

(5) Insert sensor into booster. Be sure sensor is fully seated and engaged in retaining ring.

(6) Position booster on dash panel. Align booster mounting studs with holes in panel and seat booster.

(7) In passenger compartment, install booster attaching nuts on mounting studs. Tighten attaching nuts to 41 N●m (30 ft. lbs.) torque.

(8) Connect booster push rod to brake pedal (Fig. 1).

(9) In engine compartment, install seal on master cylinder. Seal is slight interference fit to help hold it in place.

(10) Attach vacuum hose to booster check valve.

CAUTION: The seal between the master cylinder and brake booster can be damaged if the cylinder is improperly installed. A vacuum leak may develop if the seal is damaged during installation. To avoid seal damage, install the master cylinder only as described in the following step.

(11) Install master cylinder and combination valve assembly on booster as follows:

(a) Have helper press brake pedal until booster push rod is visible in opening at front of booster. Then have helper hold brake pedal in position.

(b) Guide master cylinder and valve assembly onto booster mounting studs and booster push rod. **Be sure booster push rod is properly aligned and seated in master cylinder.**

(c) Have helper slowly release brake pedal as master cylinder is seated on booster mounting studs. Keep booster push rod centered in master cylinder while seating cylinder.

(d) Install and tighten master cylinder mounting nuts to 25 N●m (220 in. lbs.) torque.

(12) Connect brakelines to master cylinder. Tighten line fittings to 15 N●m (132 in. lbs.) torque.

(13) Connect reservoir hoses to HCU pipes. Be sure hose clamps are securely attached and properly located.

(14) Connect pedal travel sensor and combination valve switch wires.

(15) Connect harness wire connectors and snap them into bracket at top of combination valve.

(16) Connect battery negative cable.

(17) Bleed brakes. Refer to brake bleeding and adjustments section for procedure.

(18) Install air cleaner and hoses.

(19) Install windshield washer reservoir.

ANTILOCK ELECTRONIC COMPONENT SERVICE

INDEX

SERVICE INFORMATION

The electronic control unit (ECU) and various sensors used in the antilock brake system are not repairable components. The ECU and the individual sensors are serviced as assemblies only.

The ECU and sensors should not be replaced unless actually faulty. Use the DRB II scan tool to confirm or deny a component malfunction before attempting repair.

PEDAL TRAVEL SENSOR SERVICE

CAUTION: The pedal travel sensor and power 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) Turn ignition switch to OFF position.
(2) Disconnect battery negative cable.
(3) Pump brake pedal to exhaust all vacuum from booster.
(4) Disconnect wires at sensor.
(5) Unseat sensor retaining ring.
(6) Remove sensor from booster (Fig. 2).

PEDAL TRAVEL SENSOR REPLACEMENT INFORMATION

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 (Fig. 1). 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.

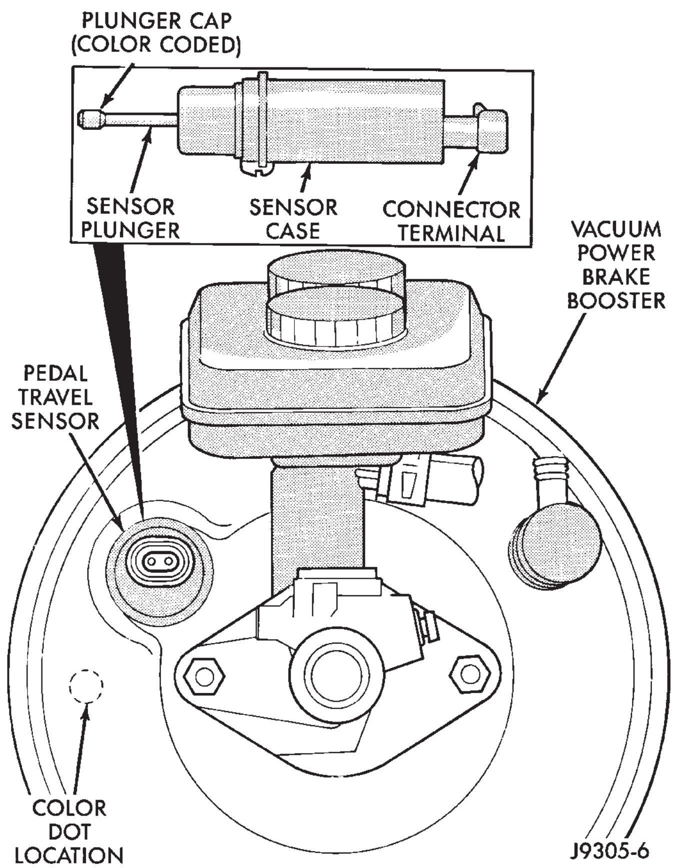

Fig. 1 Booster And Pedal Travel Sensor Color Code Locations

PEDAL TRAVEL SENSOR INSTALLATION

(1) Check color dot on face of power brake booster (Fig. 1). 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.
(8) Connect battery negative cable.

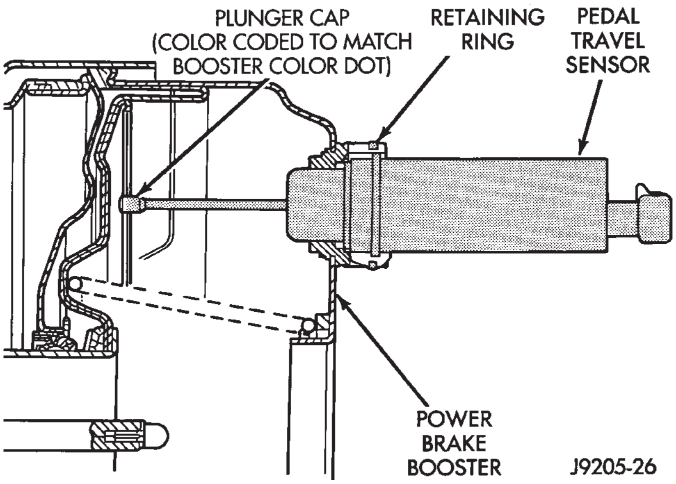

Fig. 2 Pedal Travel Sensor Mounting

AXLE SHAFT TONE WHEEL SERVICE

The axle shaft tone wheels are not serviceable. If a tone wheel becomes damaged, it will be necessary to replace the axle shaft.

The wheel brake components such as the calipers, brakeshoes, wheel cylinders, rotors and drums are all serviced the same as standard brake system components.

FRONT WHEEL SENSOR REMOVAL

(1) Turn ignition switch to OFF position.

(2) Disconnect battery negative cable.

(3) Raise vehicle.

(4) Remove wheel and tire.

(5) Remove bolt attaching front sensor to steering knuckle (Fig. 3).

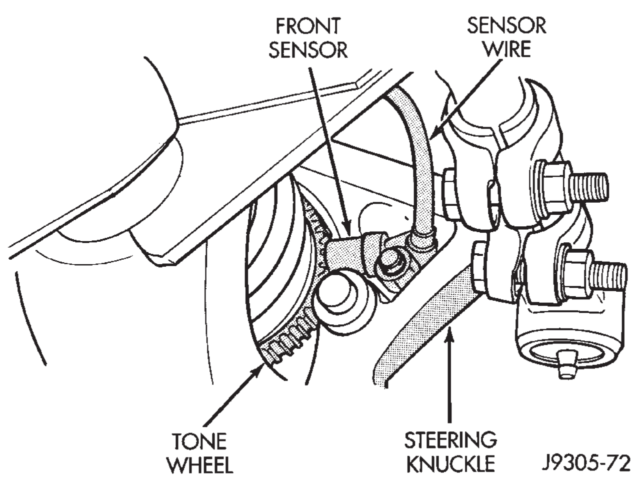

Fig. 3 Front Wheel Sensor Location

(6) Disengage sensor wire from brackets on steering knuckle and frame member (Figs. 4 and 5).

(7) Unseat grommet that secures sensor wire in fender panel (Fig. 5)

(8) In engine compartment, disconnect sensor wire connector at harness plug (Fig. 6).

(9) Remove sensor and wire assembly.

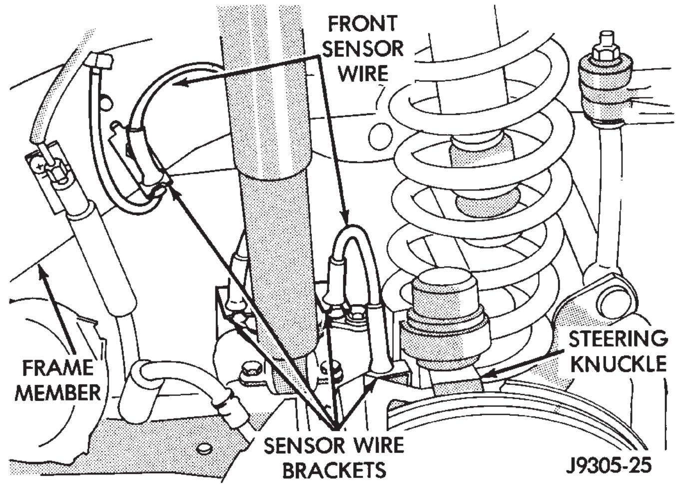

Fig. 4 Front Wheel Sensor Wire Routing

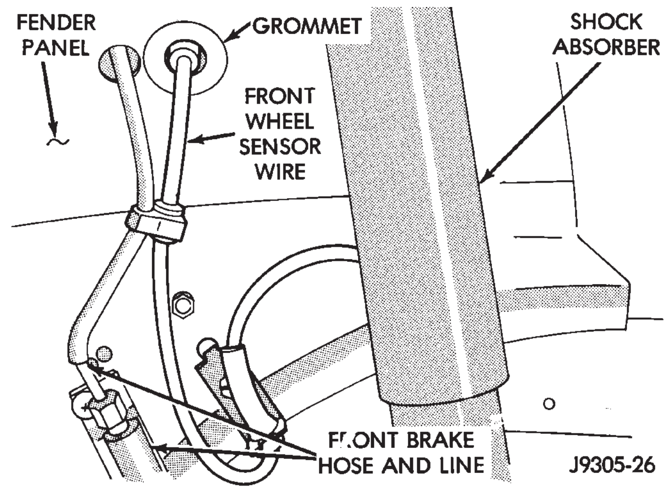

Fig. 5 Front Wheel Sensor Wire Grommet Location

FRONT WHEEL SENSOR INSTALLATION

(1) Apply Mopar Lock N' Seal or Loctite 242 to sensor attaching bolt. 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) Route sensor wire from steering knuckle to fender panel (Figs. 4, 5, and 6).

(5) Engage grommets on sensor wire in brackets on body, chassis, frame, and steering knuckle (Figs. 4, 5 and 6).

(6) Check sensor wire routing. Be sure wire is clear of all chassis components and is not twisted or kinked at any spot.

(7) Seat sensor wire in body grommet and seat grommet in fender panel (Fig. 5).

(8) Connect sensor wire to harness in engine compartment.

(9) Connect battery negative cable.

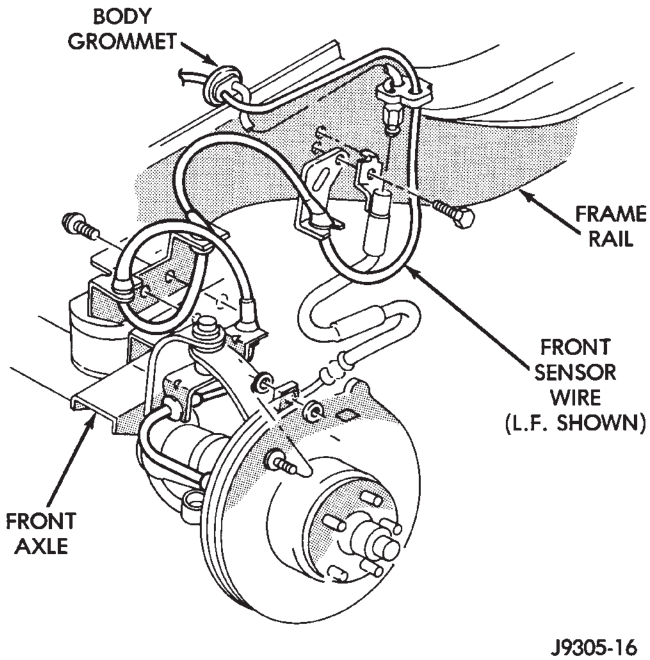

Fig. 6 Front Sensor Wire Routing (Left Front Shown)

REAR WHEEL SENSOR REMOVAL

(1) Turn ignition switch to OFF position.
(2) Disconnect battery negative cable.
(3) Raise and fold rear seat forward. Then move carpeting aside for access to rear sensor connectors.
(4) Disconnect rear sensor wires at harness connectors (Fig. 7).
(5) Push sensor wires and grommets through floorpan holes.
(6) Raise vehicle.
(7) Remove wheel and brake drum.
(8) Disengage sensor wire from axle and chassis brackets and from brakeline retainers (Fig. 8).
(9) Unseat sensor grommet from brake support plate.
(10) Remove bolt attaching sensor to support plate bracket (Fig. 9).
(11) Remove sensor and wire through opening in support plate.

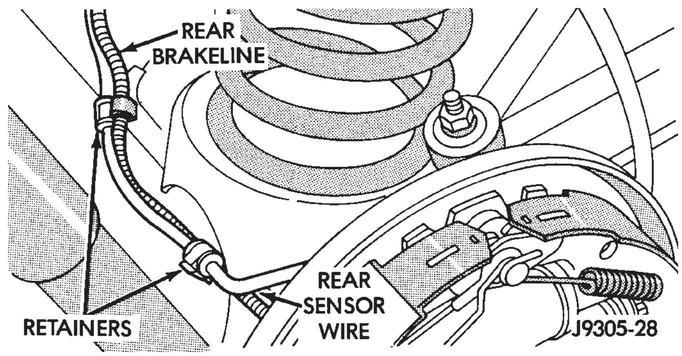

Fig. 8 Rear Wheel Sensor Wire Attachment

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.

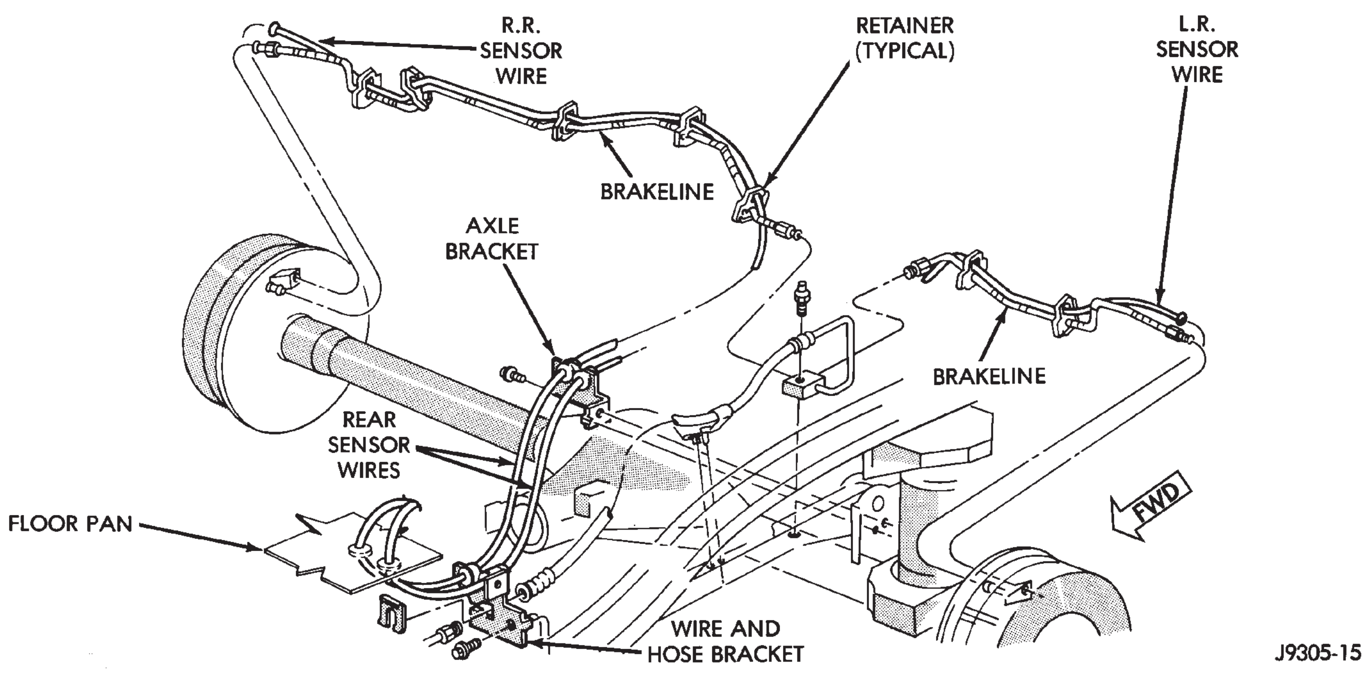

Fig. 7 Rear Wheel Sensor Wire Routing And Connections

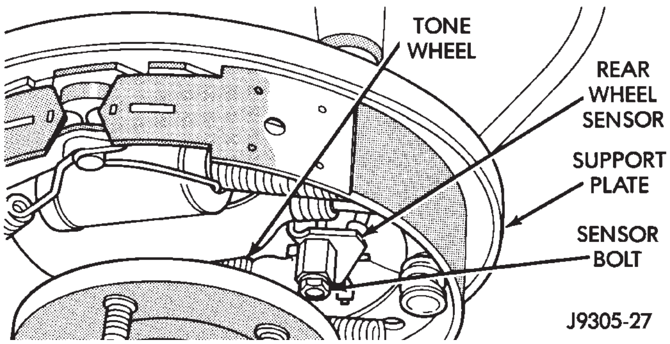

Fig. 9 Rear Wheel Sensor Mounting

(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. 10). Tighten sensor bolt to 14 N●m (124 in. lbs.) torque.

(b) If **new sensor** is being installed, push cardboard spacer on sensor face (Fig. 11) against tone ring. Then tighten sensor bolt to 8 N●m (71 in. 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.

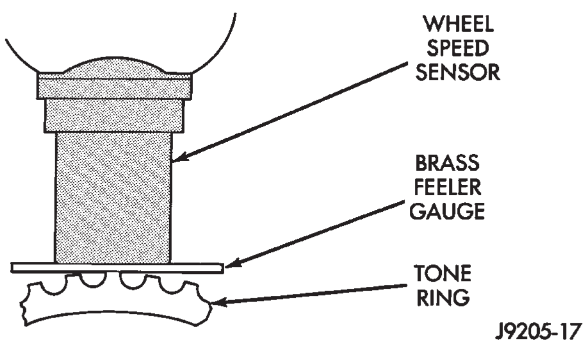

Fig. 10 Setting Air Gap On Original Rear Sensor

(5) Route sensor wires to rear seat area.

(6) Feed sensor wires through floorpan access hole and seat sensor grommets in floorpan.

(7) Secure sensor wire in brackets and in retainers on rear brakelines. Verify that sensor wire is secure and clear of rotating components.

(8) Install brake drum and wheel and lower vehicle.

(9) Fold rear seat and carpet forward for access to sensor wires and connectors.

(10) Connect sensor wires to harness connectors.

(11) Reposition carpet and fold rear seat down.

(12) Connect battery negative cable.

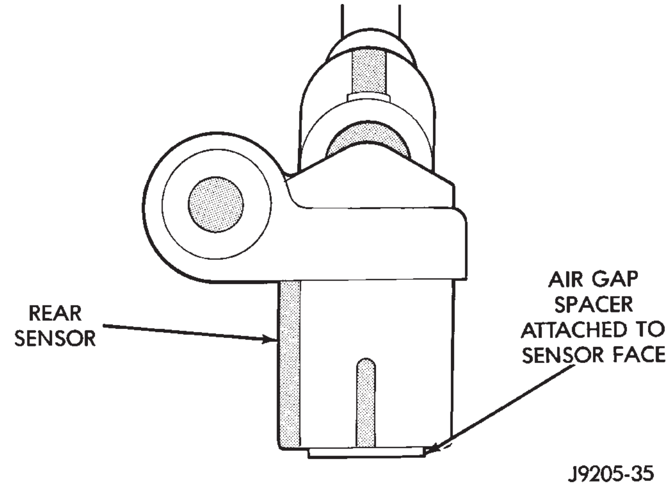

Fig. 11 New Rear Sensor With Air Gap Spacer

ACCELERATION SENSOR REMOVAL

(1) Turn ignition switch to OFF position.

(2) Disconnect battery negative cable.

(3) Tilt rear seat assembly forward for access to sensor.

(4) Disconnect sensor harness (Fig. 12).

(5) Remove screws attaching sensor to bracket.

(6) Remove sensor.

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. 12).

(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 connector is firmly seated.

(5) Move rear seat back to normal position.

(6) Connect battery negative cable.

ELECTRONIC CONTROL UNIT (ECU) SERVICE

The antilock system electronic control unit (ECU) should not be replaced unless actually faulty. Always check ECU operation with the DRB II scan tool to confirm or deny a malfunction.

ECU REMOVAL AND INSTALLATION

The antilock ECU is located in the engine compartment. It is attached to a bracket mounted on the driver side inner fender panel or apron (Fig. 13).

(1) Turn ignition switch to OFF position.

(2) Disconnect battery negative cable.

(3) Remove screws attaching ECU to fender panel bracket.

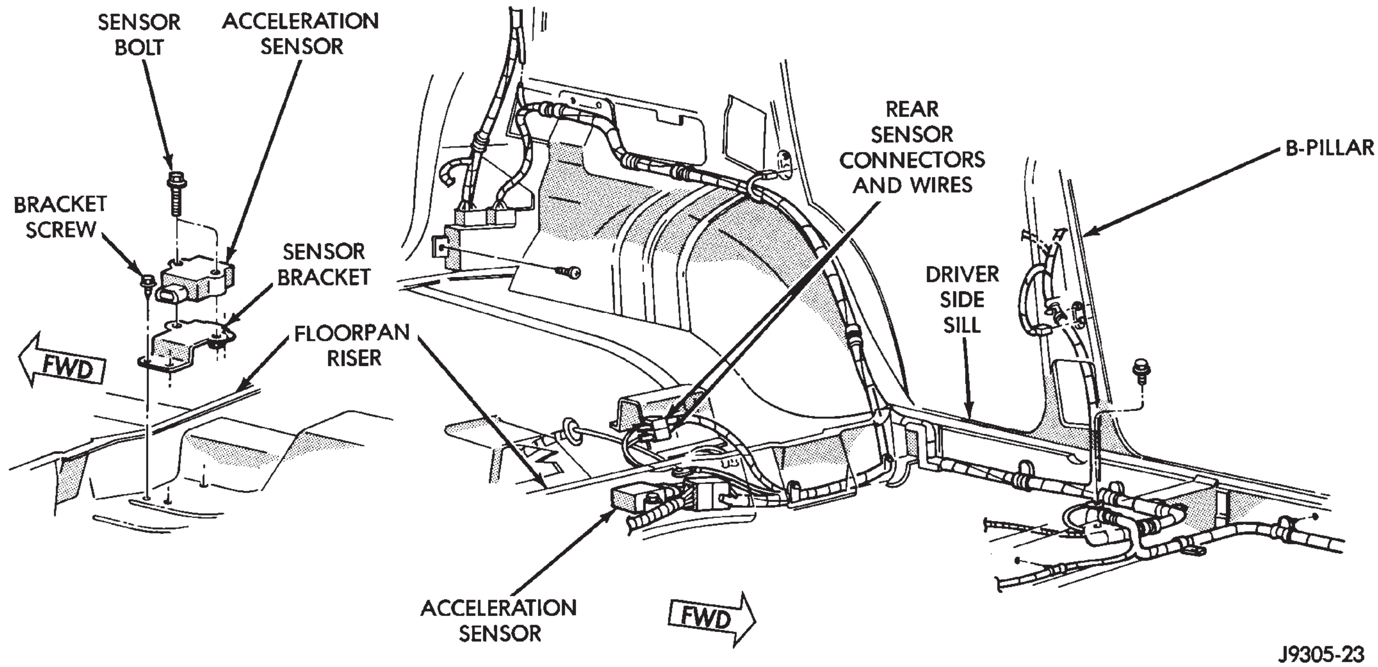

Fig. 12 Acceleration Sensor Mounting

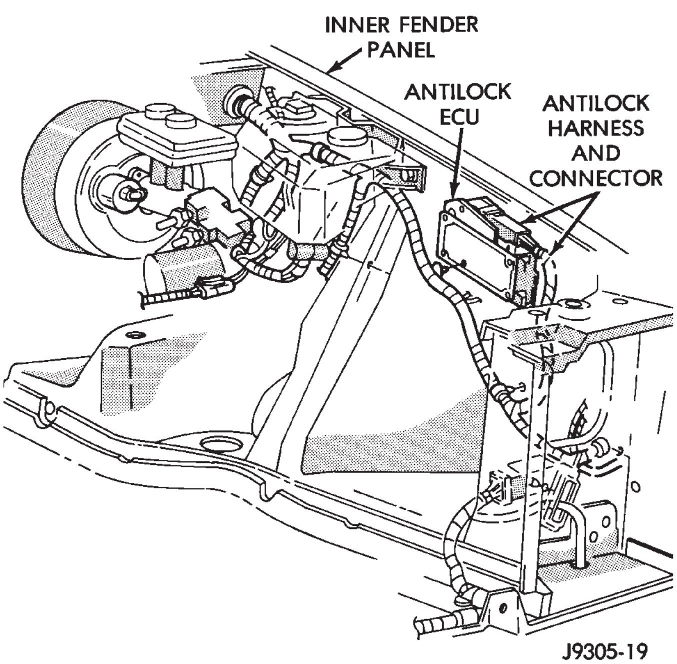

Fig. 13 Antilock ECU Location And Mounting

(4) Lift ECU out of engine compartment for access to harness connector.

(5) Release strap securing harness connector to ECU pin terminals (Fig. 14).

(6) Disconnect and separate harness connector from ECU as follows: Tilt harness connector upward to disengage it from ECU pin terminals. Then slide it out of retaining tangs in ECU.

(7) Obtain replacement ECU if necessary.

(8) Align and attach harness connector to ECU. Slide connector into engagement with tangs on ECU. Then tilt connector downward and into engagement with ECU pin terminals. Exercise care as pin terminals can be damaged if connector is forced into place.

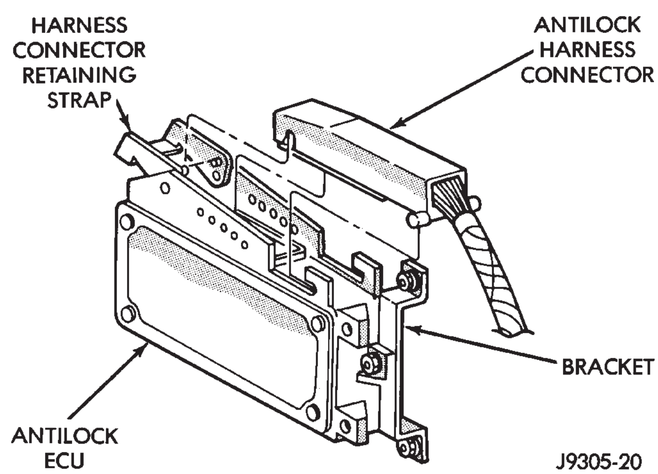

Fig. 14 ECU Harness Connector Attachment

(9) Position ECU on fender panel bracket and install attaching screws.

(10) Connect battery negative cable.

DISC BRAKE SERVICE

INDEX

DISC BRAKESHOE REMOVAL

(1) Raise vehicle and remove front wheels.

(2) If brakeshoes are severely worn, drain small amount of fluid from master cylinder front brake reservoir with suction gun.

(3) Bottom caliper piston with C-clamp. Position clamp screw on outboard brakeshoe and frame of clamp on rear of caliper.

Do not allow the clamp screw to bear directly on the outboard shoe retainer spring. Use a wood or metal spacer between the shoe and clamp screw if necessary. A typical method of bottoming piston with C-clamp is shown in Figure 1.

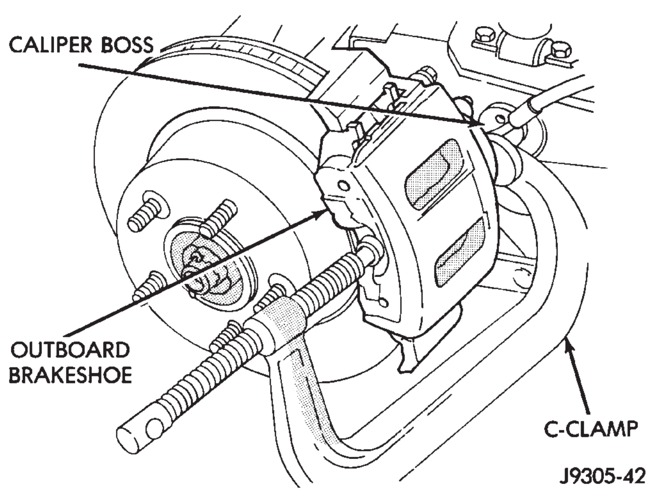

Fig. 1 Bottoming Caliper Piston With C-Clamp

(4) Remove caliper mounting bolts (Fig. 2).

(5) Tilt top of caliper outward. Use pry tool if necessary (Fig. 3).

(6) Lift caliper off steering knuckle (Fig. 4).

(7) **If original brakeshoes will be used, keep them in sets (left and right as they are not interchangeable.**

(8) Remove outboard shoe. Press one end of shoe inward to disengage shoe lug and rotate shoe upward until retainer spring clears caliper. Then press opposite end of shoe inward to disengage opposite shoe lug and rotate shoe up and out of caliper (Fig. 5).

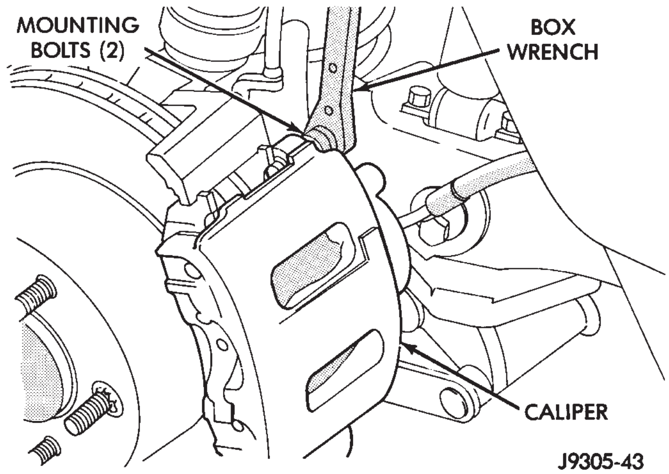

Fig. 2 Removing/Installing Caliper Mounting Bolts

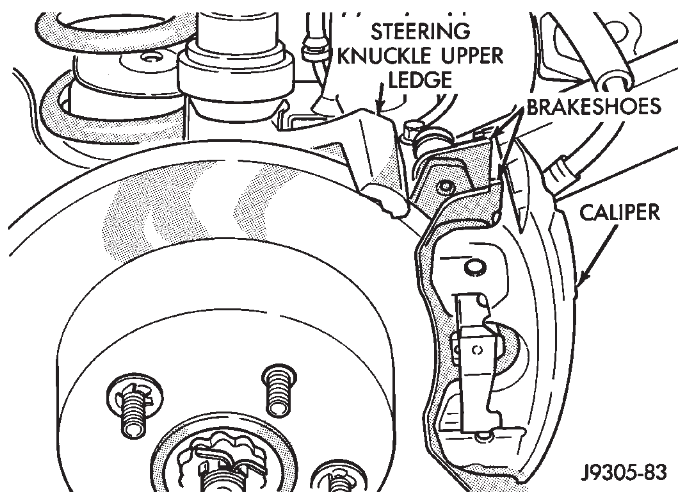

Fig. 3 Tilting Caliper Outward

(9) Remove inboard shoe. Grasp ends of shoe and tilt shoe outward to release springs from caliper piston (Fig. 6). Then remove shoe from caliper.

(10) Support caliper on box, mechanics stool, or similar device. **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. 7). Overhaul caliper if there is evidence of leakage past piston and dust boot. Then inspect caliper bushings and boots (Fig. 7). Replace boots if torn or cut. If bushings or boots are damaged, replace them.

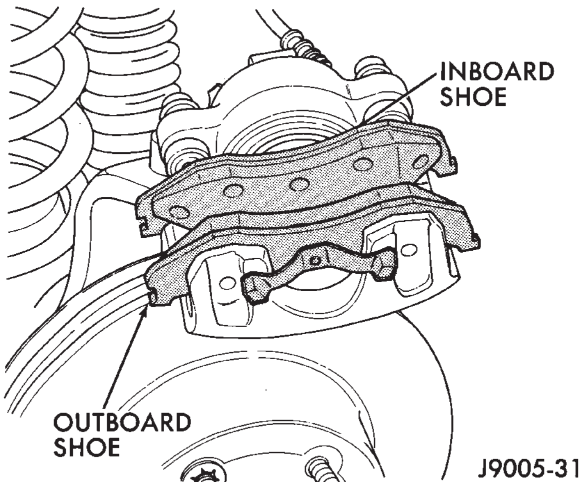

Fig. 4 Caliper Removal

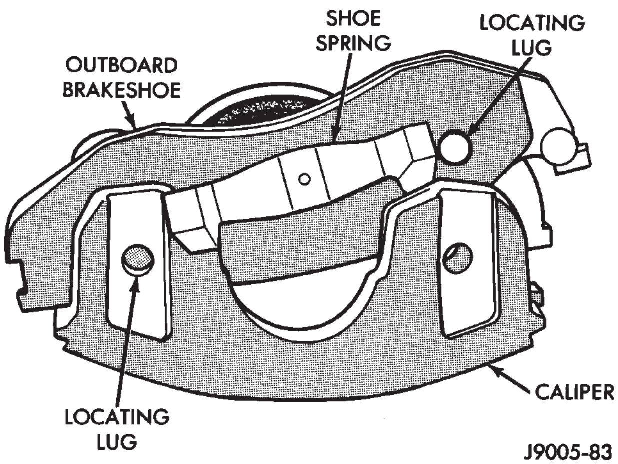

Fig. 5 Removing Outboard Brakeshoe

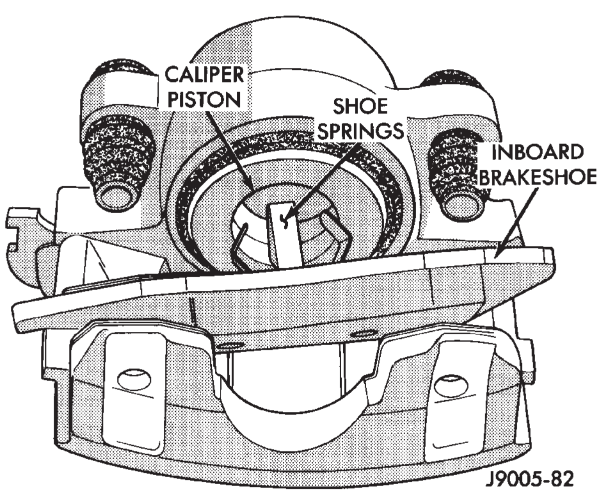

Fig. 6 Removing Inboard Brakeshoe

DISC BRAKESHOE INSTALLATION

(1) Lubricate caliper mounting bolts and bushings (Fig. 7) with GE 661 or Dow 111 silicone grease.

(2) **Keep new or original brakeshoes in sets. They are not interchangeable from side to side.**

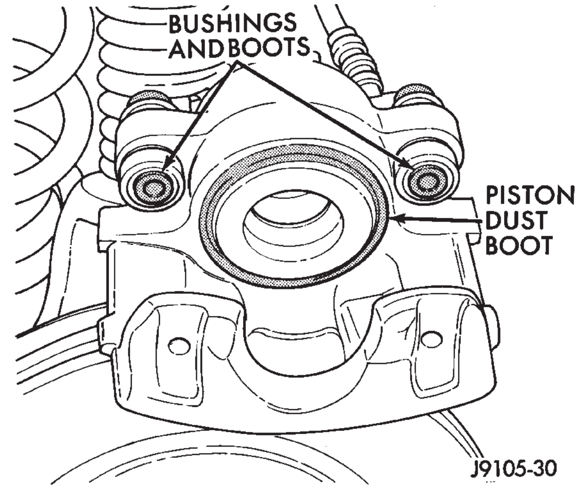

Fig. 7 Caliper Dust Boot And Bushing Locations

(3) Install inboard shoe in caliper (Fig. 8). Be sure shoe retaining springs are fully seated in caliper piston.

(4) Install outboard shoe in caliper (Fig. 9). Start one end of shoe in caliper and rotate shoe downward and into place until shoe locating lugs and shoe spring are seated in caliper.

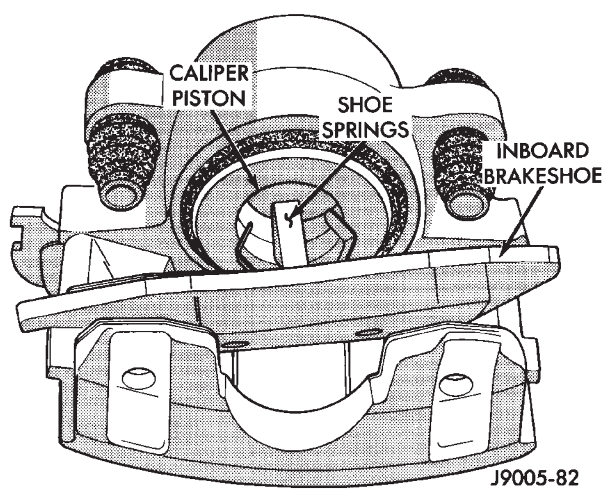

Fig. 8 Installing Inboard Brakeshoe

(5) Verify that locating lugs on outboard shoe are seated in caliper (Fig. 4).

(6) Install caliper. Position notches at lower end of brakeshoes on bottom mounting ledge of steering knuckle. Then rotate caliper onto rotor and seat tabs at upper ends of brakeshoes on top mounting ledge (Fig. 10).

(7) Check brakeshoe position on steering knuckle mounting ledges. Be sure notches at lower end of brakeshoes are securely seated on bottom mounting ledges. Then verify that tabs at upper ends of shoes are seated on top mounting ledge (Fig. 10).

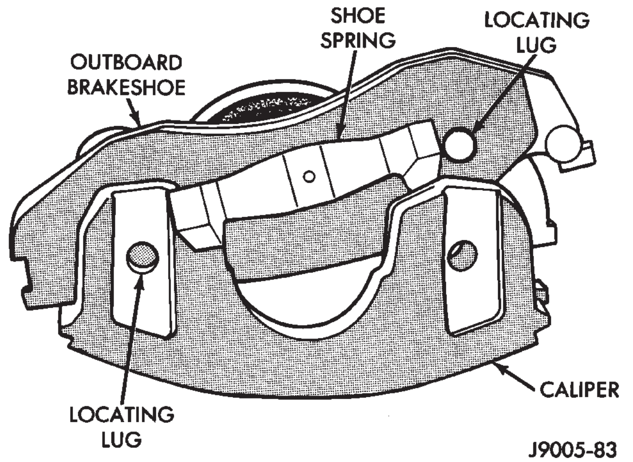

Fig. 9 Installing Outboard Brakeshoe

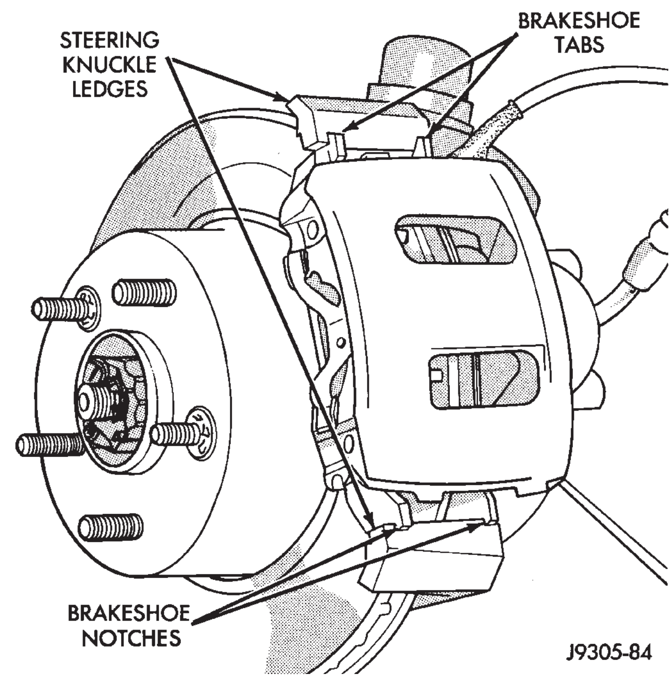

Fig. 10 Caliper And Brakeshoe Installation

CAUTION: Before securing the caliper, be sure the caliper brake hose is not twisted, kinked or touching any chassis components (Fig. 11).

(8) Lubricate and install caliper mounting bolts. Start bolts by hand then tighten bolts to 10-20 N•m (7-15 ft. lbs.) torque.

(9) Install wheels. Tighten lug nuts to 120 N•m (88 ft. lbs.) torque.

(10) Turn ignition On and run pump until it shuts off. Then pump brake pedal until shoes are seated and indicator lights go out.

(11) Top off brake fluid level if necessary. Use Mopar brake fluid or equivalent meeting SAE J1703 and DOT 3 standards only.

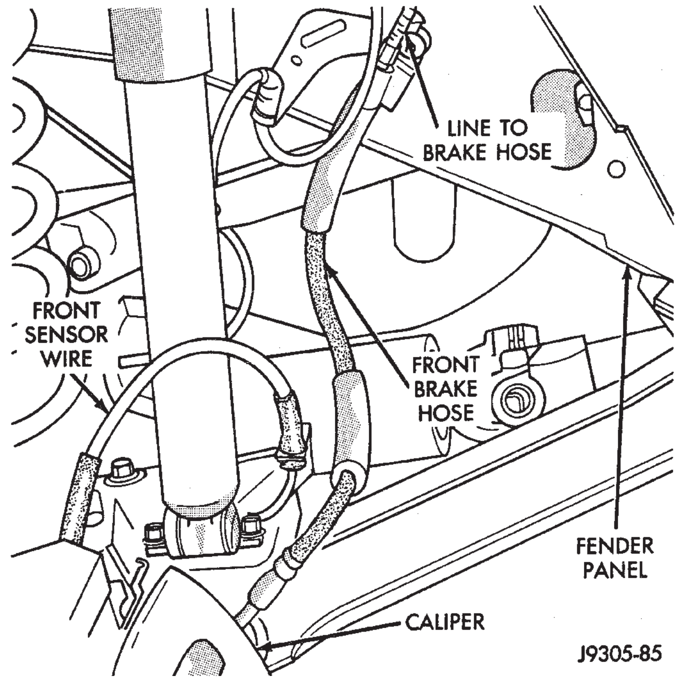

Fig. 11 Correct Front Brake Hose Routing (Driver Side Shown)

DISC BRAKE CALIPER OVERHAUL

CALIPER REMOVAL

(1) Raise vehicle and remove front wheels.

(2) Remove caliper mounting pins (Fig. 2).

(3) Rotate caliper rearward by hand or with pry tool (Fig. 3). Then rotate caliper and brakeshoes off mounting ledges.

(4) Remove caliper fitting bolt and disconnect front brakeline 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, one-inch thickness of shop towels or rags (Fig. 12). Towels are needed to protect caliper piston during removal.

(3) Remove caliper piston with one or two **short bursts** of low pressure compressed air. Direct air through fluid inlet port and ease piston out of bore (Fig. 13).

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 could result in personal injury.

(4) Remove caliper piston dust boot (Fig. 14). Collapse boot with suitable tool and remove and discard boot.

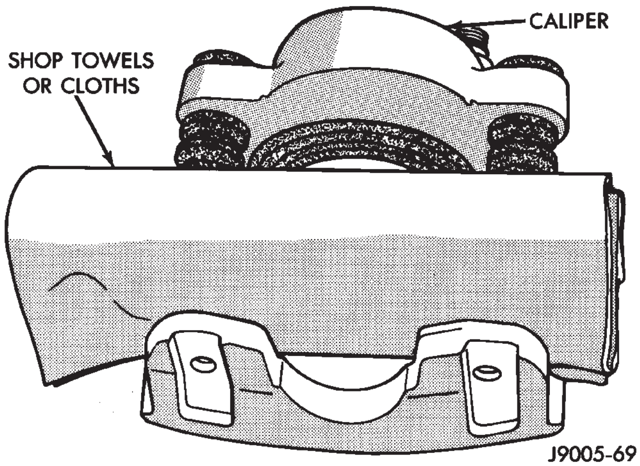

Fig. 12 Padding Caliper Interior To Protect Piston During Removal

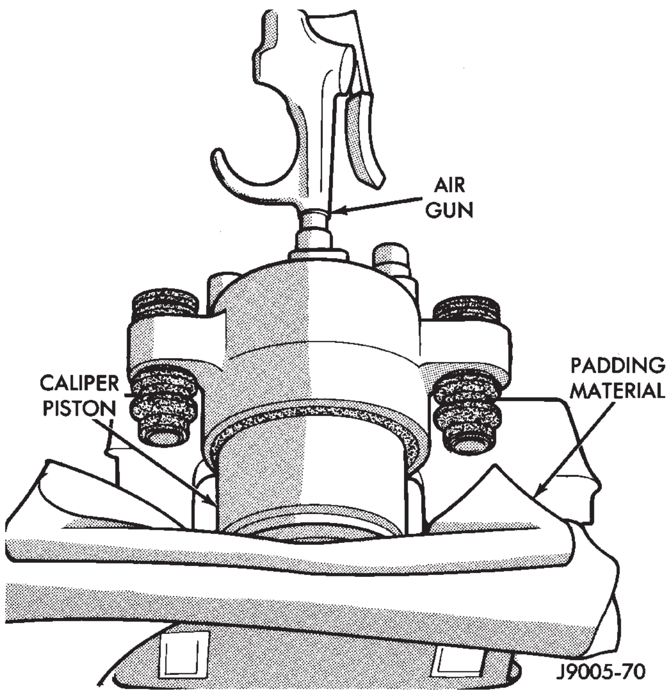

Fig. 13 Removing Caliper Piston

(5) Remove and discard caliper piston seal with pencil, toothpick, or plastic tool (Fig. 15). Do not use metal tools as they will scratch piston bore.

(6) Remove caliper slide bushings and boots (Fig. 16).

CALIPER CLEANING AND INSPECTION

Clean the caliper and piston with clean brake fluid or Mopar brake cleaning solvent only. Do not use gasoline, kerosene, thinner, or any similar type of solvent. These products may leave a residue that could damage the piston and seal.

Wipe the caliper and piston dry with lint free towels or use low pressure compressed air.

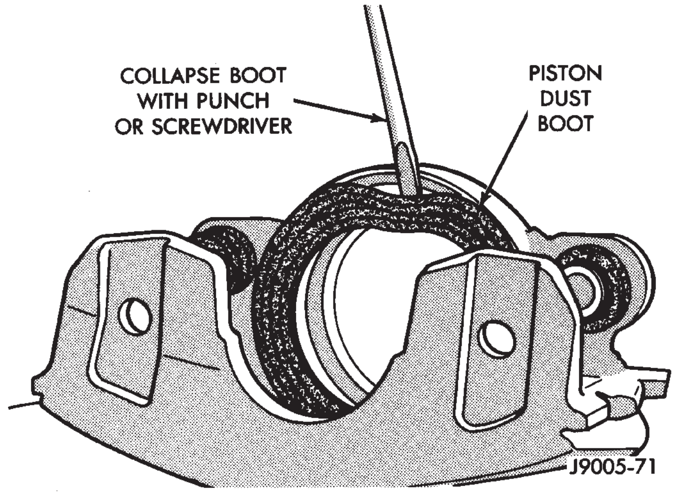

Fig. 14 Removing Caliper Piston Dust Boot

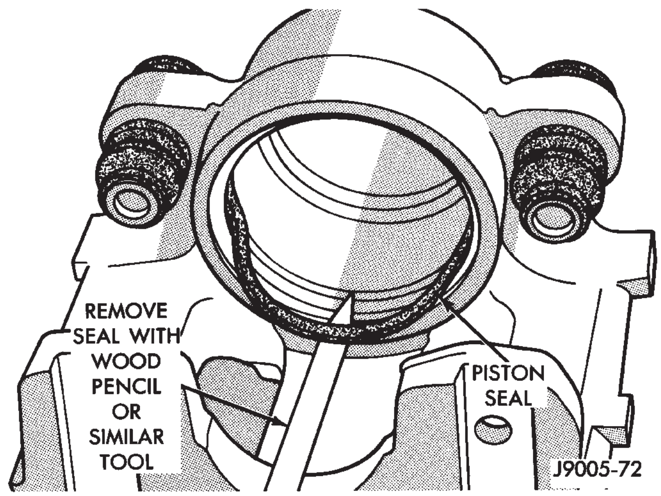

Fig. 15 Removing Caliper Piston Seal

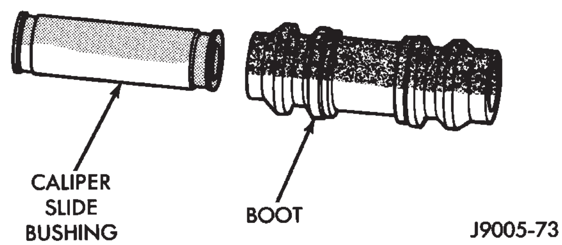

Fig. 16 Caliper Slide Bushing And Boot

Inspect the piston and piston bore. Replace the caliper if the bore is corroded, rusted, or scored. Do not hone the caliper piston bore. Replace the caliper if the bore is damaged.

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 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 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.

CALIPER ASSEMBLY

(1) Coat caliper piston bore, new piston seal and piston with clean, fresh brake fluid.

(2) Lubricate caliper slide bushings and interior of bushing boots with GE 661 or Dow 111 silicone grease.

(3) Install bushing boots in caliper first. Then insert bushing into boot and push bushing into place (Fig. 17).

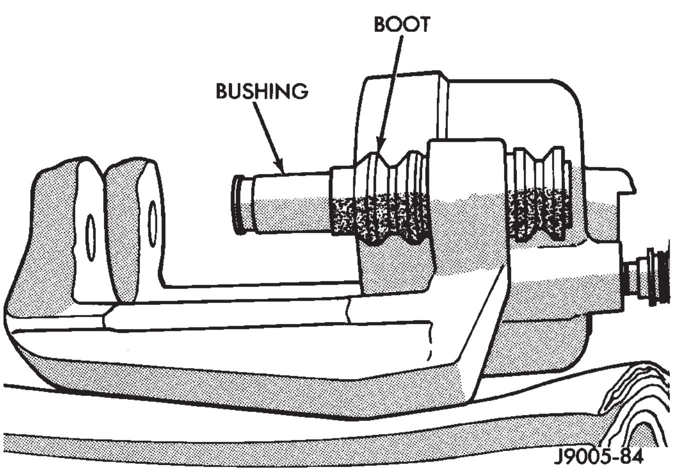

Fig. 17 Installing Slide Bushings And Boots

(4) Install new piston seal in caliper bore. Press seal into seal groove with finger (Fig. 18).

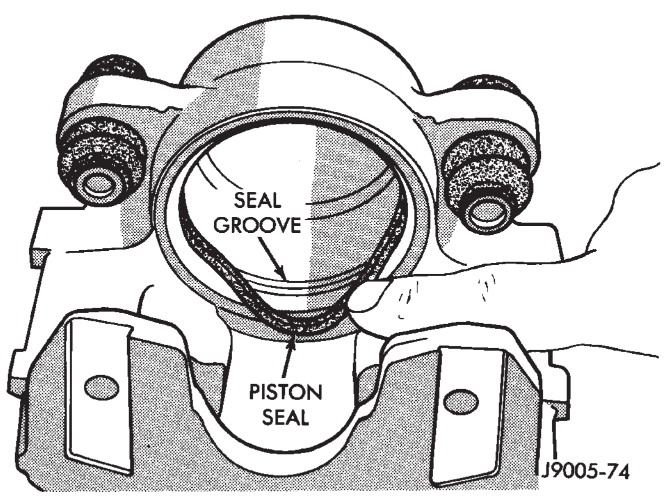

Fig. 18 Installing Piston Seal

(5) Install dust boot on caliper piston (Fig. 19). Slide boot over piston and seat boot in piston groove.

(6) Start caliper piston in bore by hand (Fig. 20). Use a turn and push motion to work piston into seal. Once piston is started in seal, press piston **only part way** into bore.

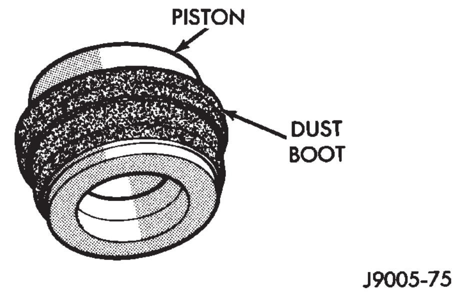

Fig. 19 Installing Dust Boot On Piston

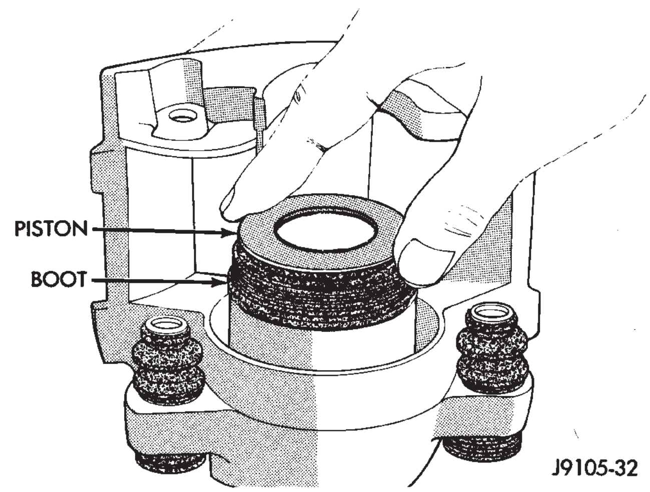

Fig. 20 Installing Caliper Piston

(7) Press caliper piston to bottom of bore.

(8) Seat dust boot in caliper with Installer Tool C-4842 and tool Driver Handle C-4171 (Fig. 21).

(9) Install caliper bleed screw if removed.

CALIPER INSTALLATION

(1) Install brakeshoes in caliper (Figs. 8, 9).

(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. 22).**

(3) Install caliper. Position mounting notches at lower end of brakeshoes on bottom mounting ledge (Fig. 10). Then rotate caliper over rotor and seat notches at upper end of shoes on mounting ledge (Fig. 10).

(4) Coat caliper mounting bolts with GE 661 or Dow 111 silicone grease. Then install and tighten pins to 10-20 N•m (7-15 ft. lbs.) torque.

(5) Position front brake hose clear of all chassis components and tighten caliper fitting bolt to 31 N•m (23 ft. lbs.) torque.

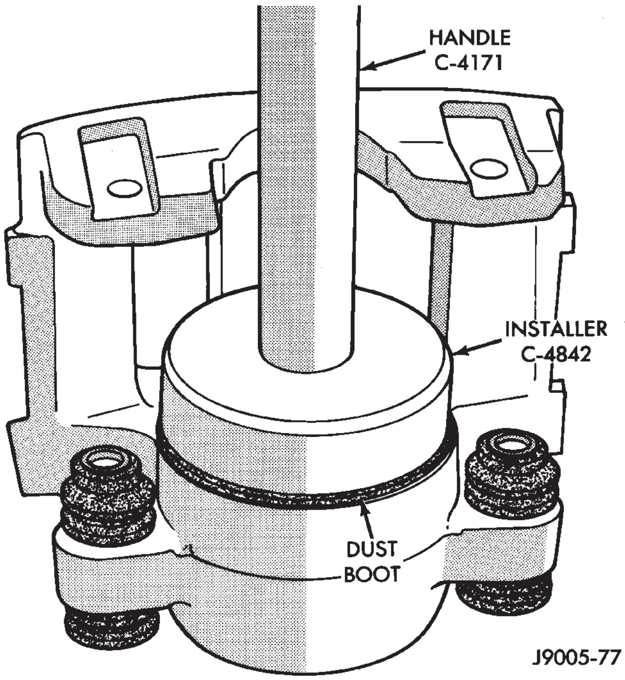

Fig. 21 Seating Dust Boot In Caliper

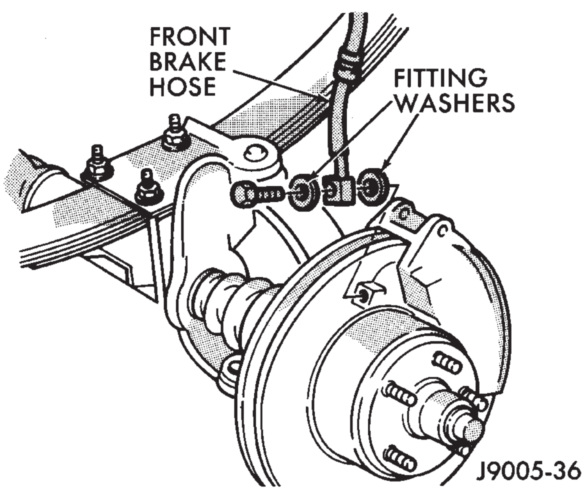

Fig. 22 Front Brake Hose And Fitting Components

(6) Install wheels. Tighten lug nuts to 120 N●m (88 ft. lbs.) torque.

(7) Bleed brake system. Refer to procedures in Service And Adjustments section.

DISC BRAKE ROTOR SERVICE

ROTOR REMOVAL

(1) Raise vehicle and remove wheel.

(2) Remove caliper.

(3) Remove retainers securing rotor to hub studs (Fig. 23).

(4) Remove rotor from hub (Fig. 23).

(5) If rotor shield requires service, remove front hub and bearing assembly.

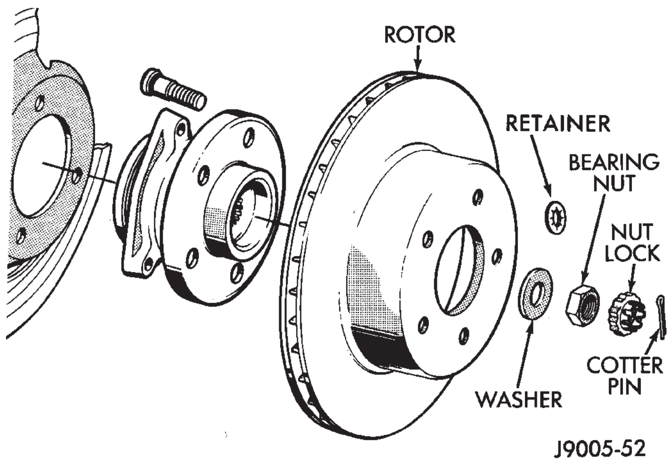

Fig. 23 Disc Brake Rotor Mounting

ROTOR INSTALLATION

(1) Install rotor on hub.

(2) Install caliper.

(3) Install new spring nuts on wheel studs.

(4) Install wheel and lower vehicle.

CHECKING ROTOR THICKNESS

Rotor minimum usable thickness is 22.7 mm (0.89 in.). Do not resurface a rotor if machining would cause thickness to fall below this limit.

Measure rotor thickness at the center of the brake-shoe contact surface. Replace the rotor if worn below minimum thickness, or if refinishing would reduce thickness below the allowable minimum.

CHECKING 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 3/4 inch from the rotor outer circumference for each measurement (Fig. 24).

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.

CHECKING ROTOR LATERAL RUNOUT

Check rotor lateral runout whenever diagnosis indicates pedal pulsation and rapid, uneven brakelining wear.

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. 25).

Use a dial indicator to check lateral runout (Fig. 26).

Maximum allowable rotor lateral runout is 0.13 mm (0.005 in.).

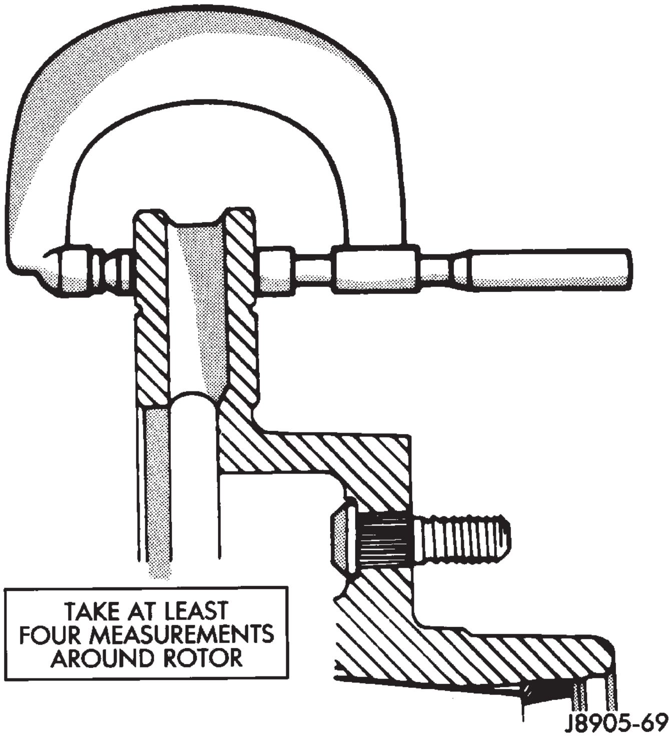

Fig. 24 Measuring Rotor Thickness Variation

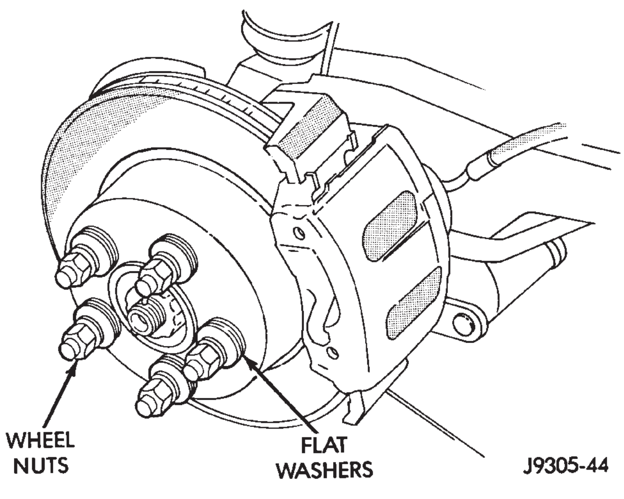

Fig. 25 Securing Rotor For Runout Check

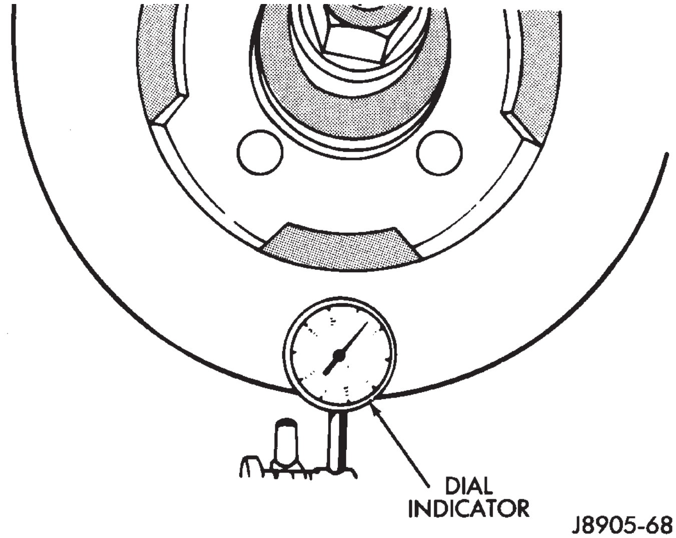

Fig. 26 Checking Rotor Lateral Runout

ROTOR REFINISHING

Rotor brake surfaces can be refinished by sanding and/or machining in a disc brake lathe. Machining can be performed on, or off the vehicle. Use either a standard lathe, or one of the newer style, portable lathes. The portable lathes machine the rotor while in place on the vehicle.

The disc brake lathe must be capable of machining both rotor surfaces simultaneously with dual cutter heads (Fig. 27). **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.

If the rotor surfaces only need minor cleanup of rust, scale, or minor scoring, use abrasive discs to clean up the rotor surfaces. However, when a rotor is scored or worn, machining with cutting tools will be required.

CAUTION: Do not refinish a rotor if machining would cause the rotor to fall below minimum allowable thickness.

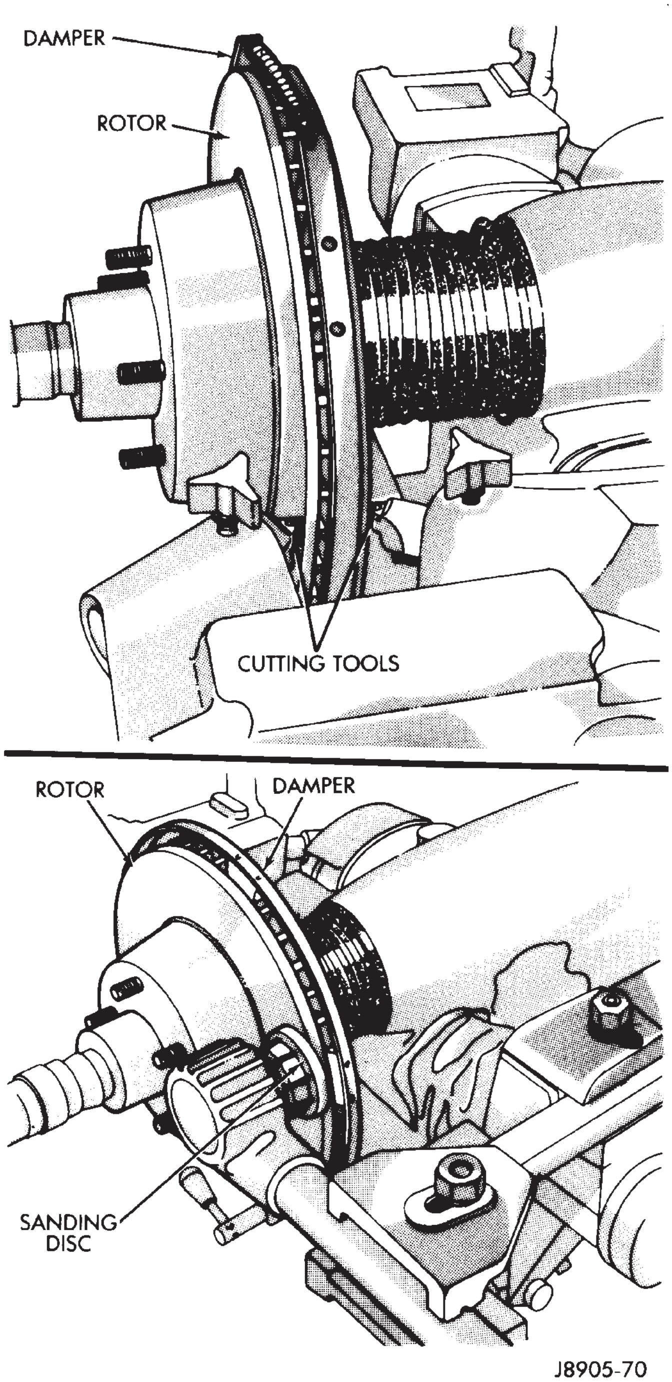

Fig. 27 Rotor Refinishing Equipment

The final finish on the rotor should be a non-directional, cross hatch pattern (Fig. 28). Use sanding discs to produce this finish.

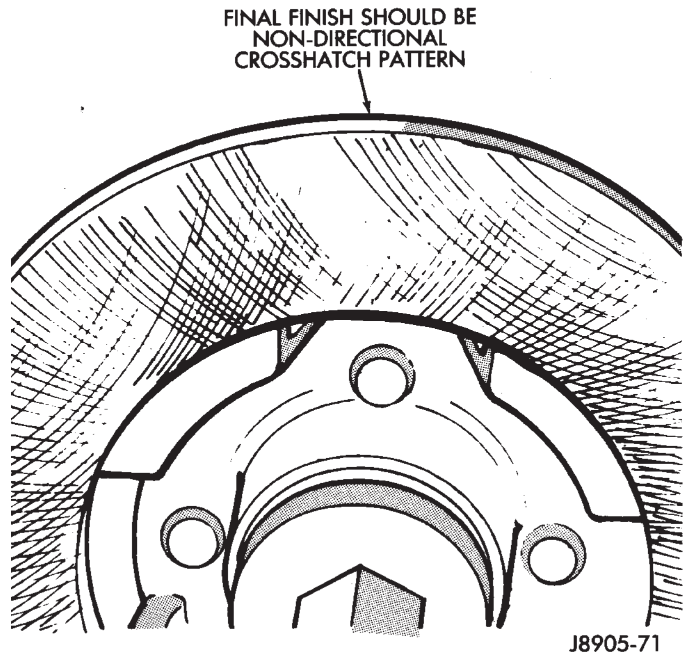

Fig. 28 Correct Final Surface Finish

DRUM BRAKE SERVICE

INDEX

DRUM BRAKESHOE REMOVAL (Fig. 1)

(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 tool.

(6) Remove holddown springs, retainers and pins.

(7) Install clamps 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 (Fig. 1)

(1) Clean and lubricate anchor pin with Mopar multi purpose grease.

(2) Clean and lubricate support plate shoe contact surfaces with Mopar multi purpose grease (Fig. 2).

(3) Lubricate adjuster cable guides, adjuster screw and pivot, parking brake lever and lever pivot pin with Mopar multi purpose grease.

(4) Attach parking brake lever to secondary brakeshoe with washer and new U-clip.

(5) Remove wheel cylinder clamps.

(6) Attach parking brake cable to lever.

(7) Install brakeshoes on support or backing plate. Secure shoes with new holddown springs, pins and retainers.

(8) Install parking brake strut and spring.

(9) Install guide plate and adjuster cable on anchor pin.

(10) Install primary and secondary return springs.

(11) Install adjuster cable guide on secondary shoe.

(12) Lubricate and assemble adjuster screw.

(13) Install adjuster screw, spring and lever and connect to adjuster cable.

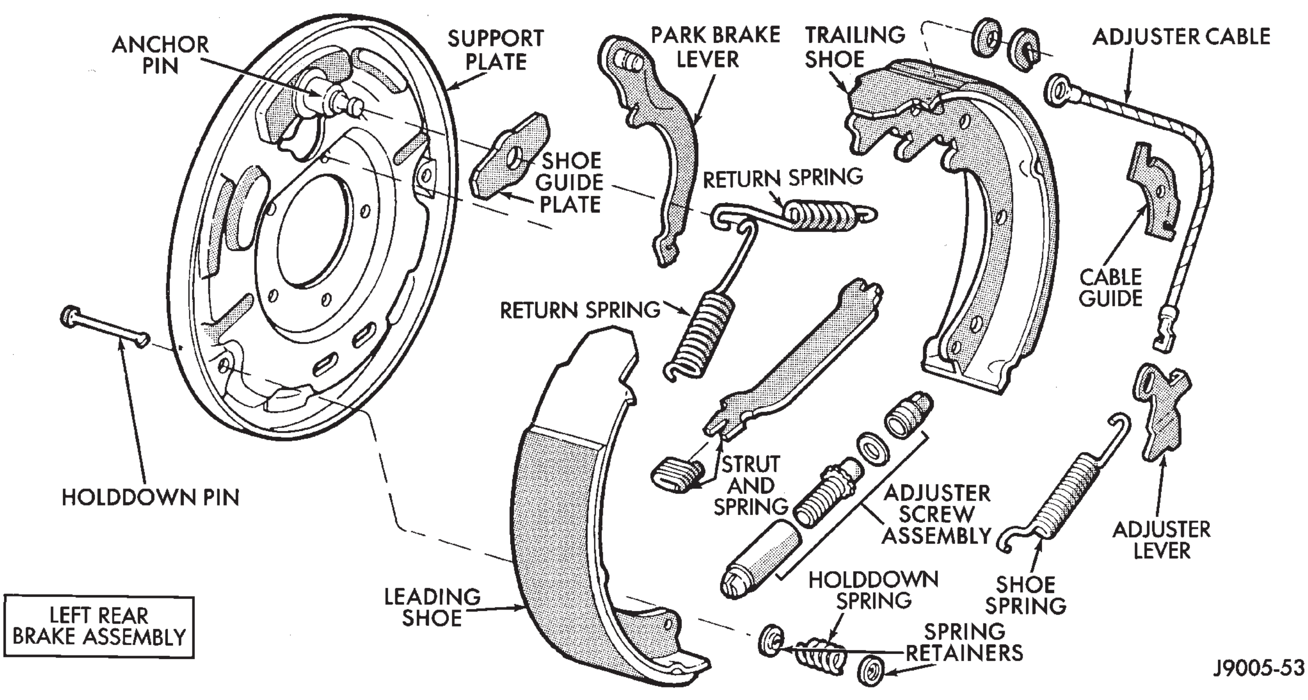

Fig. 1 Ten-Inch Drum Brake Components

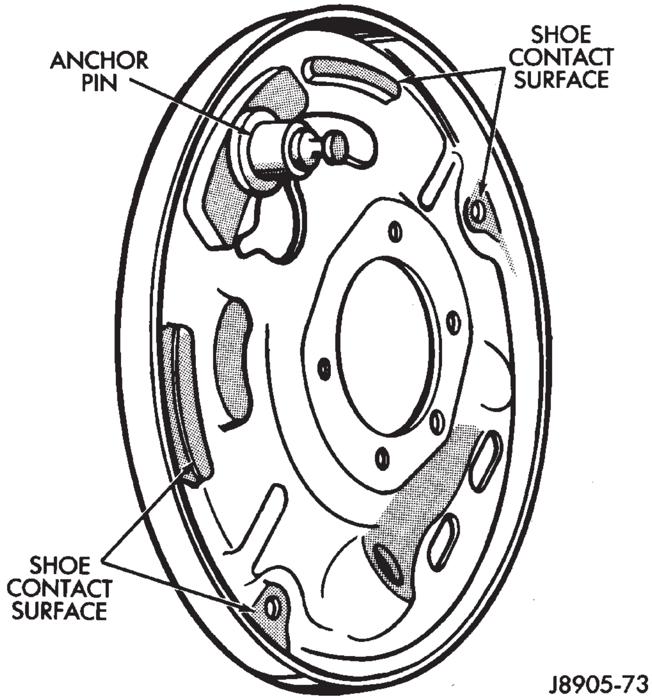

Fig. 2 Shoe Contact Surfaces

(14) Adjust shoes to drum with brake gauge and install brake drum.

(15) Install wheel and tire assembly. Tighten wheel lug nuts to 120 N●m (88 ft. lbs.) torque.

WHEEL CYLINDER REMOVAL

(1) Raise vehicle and remove wheel.
(2) Disconnect brakeline at wheel cylinder.
(3) Remove brakeshoes.
(4) Remove bolts attaching wheel cylinder to backing plate and remove cylinder.

WHEEL CYLINDER OVERHAUL (Fig. 3)

(1) Remove links.
(2) Remove dust boots.
(3) Remove cups and pistons.
(4) Remove spring and expander.
(5) Remove bleed screw.

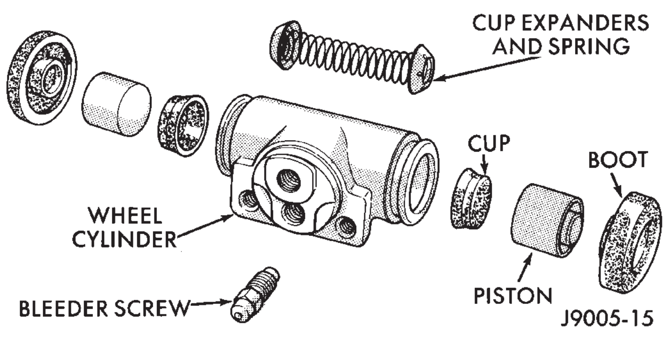

Fig. 3 Wheel Cylinder Components

(6) Clean cylinder, pistons and links with Mopar brake cleaner. Discard cups, boots and expander.

(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.

(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) Start brakeline fitting in wheel cylinder by hand. Install fitting to depth of 2-3 threads. Be sure fitting is not cross threaded.

(2) Position wheel cylinder on backing plate (Fig. 4).

(3) Install and tighten cylinder mounting bolts to 10 N●m (90 in. lbs.) torque.

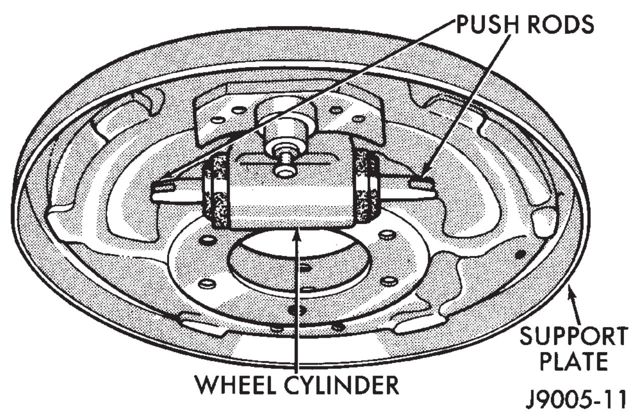

Fig. 4 Wheel Cylinder Mounting

(4) Tighten brakeline fitting to 132 in. lbs. (15 N●m).

(5) Install brakeshoes. Adjust shoes to drum with brake gauge.

(6) Install brake drums.

(7) Install wheel and tire assemblies. Tighten wheel lug nuts to 120 N●m (88 ft. lbs.) torque.

(8) Remove supports and lower vehicle.

(9) Fill master cylinder and bleed brakes.

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.

Maximum allowable diameter for the drum braking surface is generally stamped or cast into the edge of the drum outer face (Fig. 5).

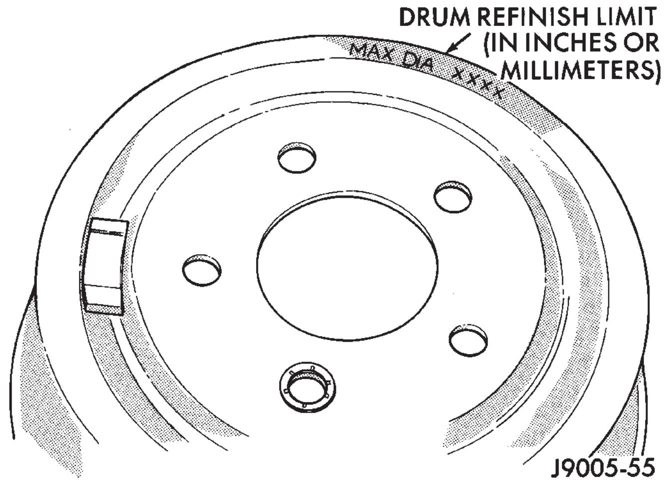

Fig. 5 Typical Location Of Brake Drum Refinish Limit

PARKING BRAKE SERVICE

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PARKING BRAKE LEVER REMOVAL—WITH FULL CONSOLE

(1) Release parking brakes.

(2) Disconnect battery negative cable.

(3) Remove screws at bottom of console storage bin (Fig. 1).

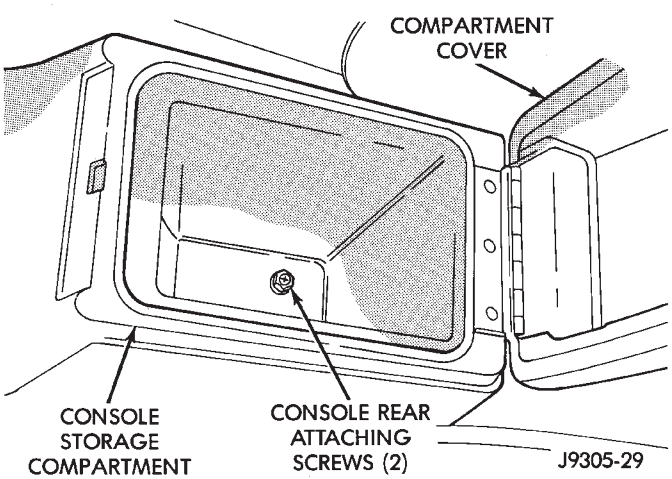

Fig. 1 Full Console Rear Attaching Screw Location

(4) On models with automatic transmission, remove handle from transmission shift lever. Grasp handle and pull up sharply to remove handle from lever.

(5) Unsnap and remove shift lever bezel (Fig. 2). Bezel has two retainer tabs on each side.

(6) Remove bulb from shift lever bezel.

(7) Remove screws attaching front of console. Screws are under shift lever bezel and are accessible once bezel has been removed.

(8) Remove bezel under parking brake lever.

(9) Move transmission and transfer case shift levers rearward.

(10) Raise front of console and remove bulb at rear of transfer case shift lever bezel.

(11) Remove console by lifting it upward and off shift levers.

(12) Disconnect and remove air bag module (Fig. 3).

(13) Disconnect parking brake switch wires.

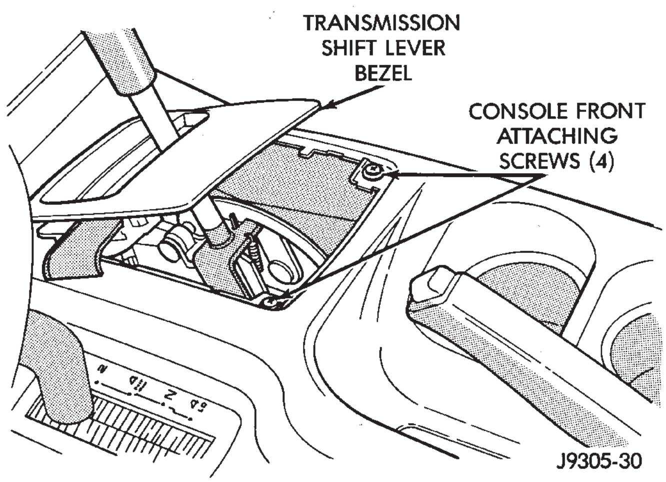

Fig. 2 Full Console Front Attaching Screw Location

(14) Remove parking brake lever attaching screws.

(15) Disengage front cable from parking brake lever and remove lever assembly.

PARKING BRAKE LEVER INSTALLATION—WITH FULL CONSOLE

(1) Attach front cable to parking brake lever.

(2) Install parking brake lever on floorpan.

(3) Connect parking brake switch wires to lever.

(4) Install air bag module and connect all wires to module.

(5) Install console over shift levers and on mounting brackets and floorpan.

(6) Install bulbs in shift lever bezels.

(7) Install console attaching screws.

(8) Install transmission shift lever bezel and install bezel under parking brake lever.

(9) Align and install shift handle on transmission shift lever.

(10) Adjust parking brake front cable if necessary.

(11) Lower vehicle.

(12) Connect battery negative cable.

PARKING BRAKE LEVER REMOVAL—WITH MINI CONSOLE

(1) Release parking brakes if applied.

(2) Disconnect battery negative cable.

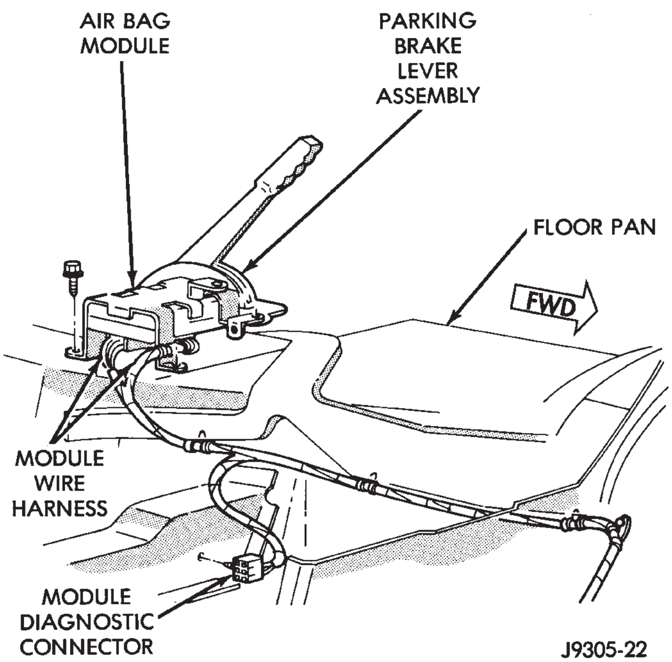

Fig. 3 Air Bag Module Mounting

(3) Raise vehicle on hoist.

(4) Remove front cable adjusting nut and disengage cable tensioner from equalizer. Then remove front cable from tensioner (Fig. 4).

(5) disengage front cable from insert and insert from floorpan (Fig. 4).

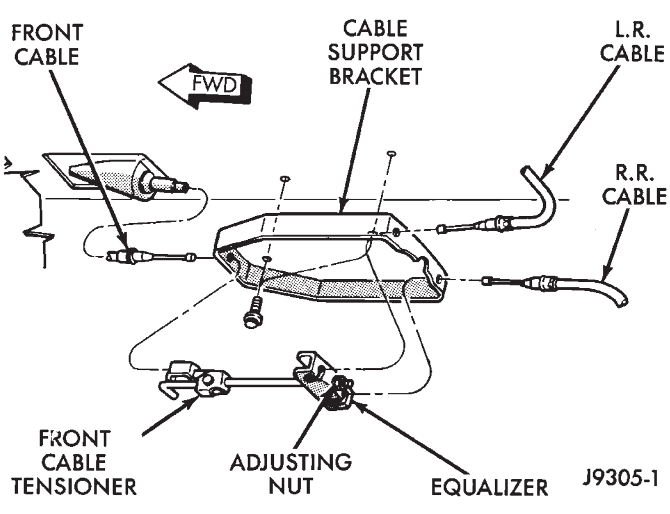

Fig. 4 Parking Brake Front Cable Attachment

(6) Lower vehicle.

(7) Unsnap and remove cup holder from parking brake lever cover (Fig. 5).

(8) Remove screws attaching lever cover to floor pan and remove cover (Fig. 5).

(9) Disconnect wires at parking brake switch and at air bag module (Figs. 3 and 5). Note that air bag module has two sets of wires connected to it.

(10) Remove screws attaching air bag module to floorpan and parking brake lever (Figs. 5 and 6). Then move module aside for access to lever.

(11) Remove screws attaching parking brake lever to bracket (Fig. 7) and lift lever upward for access to front cable.

(12) Disengage front cable from parking brake lever and remove lever assembly from vehicle.

PARKING BRAKE LEVER INSTALLATION—WITH MINI CONSOLE

(1) Connect front cable to lever assembly.

(2) Seat front cable in floor pan.

(3) Install lever assembly on mounting bracket (Fig. 5).

(4) Connect parking brake switch wire.

(5) Install air bag module (Fig. 3). Be sure all module wires harnesses are securely connected.

(6) Install parking lever cover.

(7) Install cup holder in cover.

(8) Raise vehicle.

(9) Assemble front cable, cable tensioner and equalizer.

(10) Adjust parking brake front cable. Refer to procedure in this section.

(11) Lower vehicle.

(12) Connect battery negative cable.

PARKING BRAKE FRONT CABLE REMOVAL

(1) Release parking brakes, if applied.

(2) Disconnect battery negative cable and raise vehicle on hoist.

(3) Remove front cable adjusting nut and disengage cable tensioner from equalizer. Then remove front cable from tensioner (Fig. 4).

(4) disengage front cable from insert and insert from floorpan (Fig. 4).

(5) Lower vehicle.

(6) On models with full console, remove console. Refer to parking brake lever removal procedure for full console.

(7) On models with mini console, unsnap and remove cup holder from parking brake lever cover (Fig. 5). Then remove screws attaching lever cover to floor pan and remove cover (Fig. 5).

(8) Disconnect wires at parking brake switch and at air bag module (Figs. 3 and 7). Note that air bag module has two sets of wires connected to it.

(9) Remove screws attaching air bag module to floorpan and parking brake lever. Then move module aside for access to lever.

(10) Remove screws attaching parking brake lever to bracket and lift lever upward for access to front cable.

(11) Disconnect front cable from parking brake lever and remove cable.

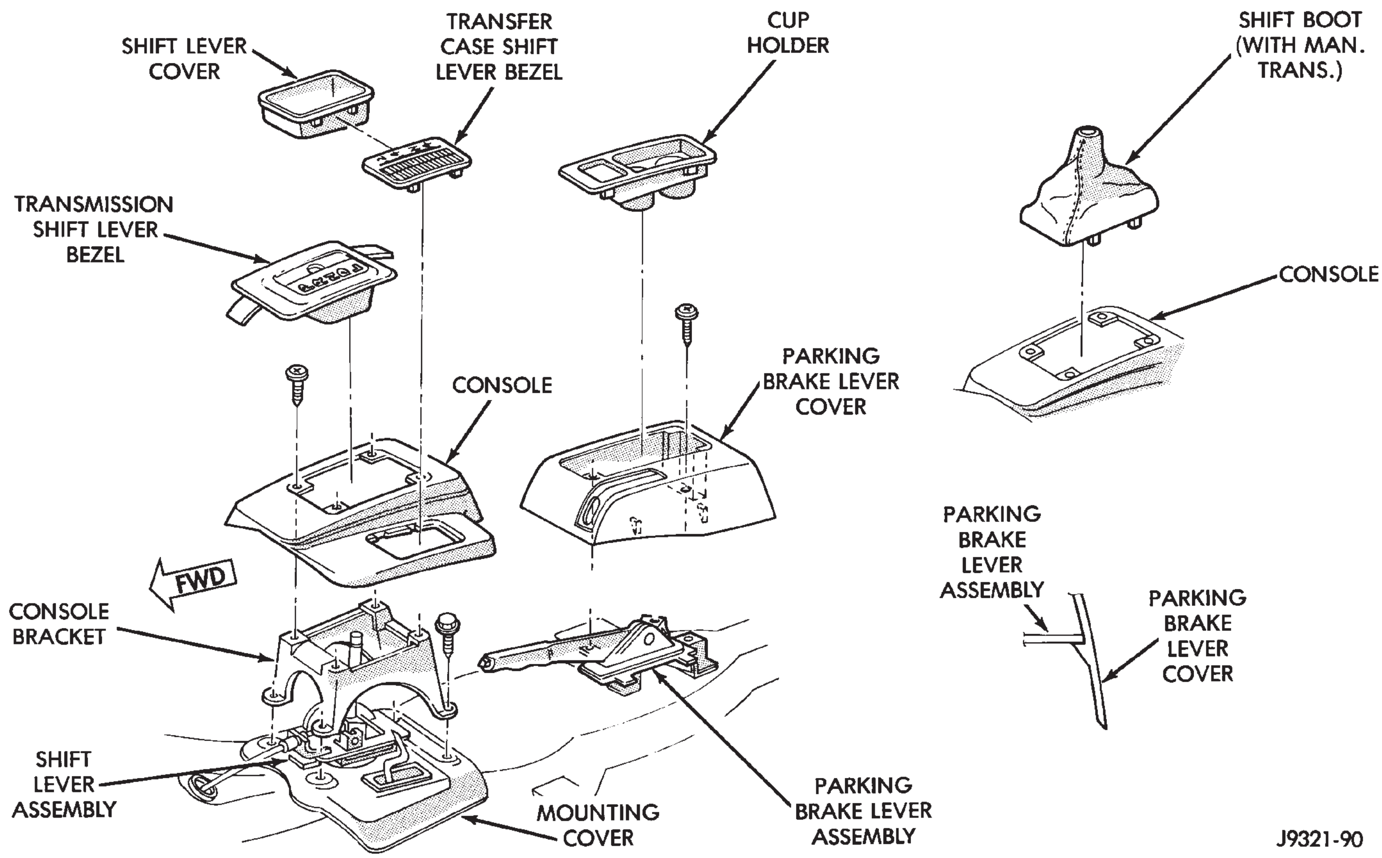

Fig. 5 Mini Console Components

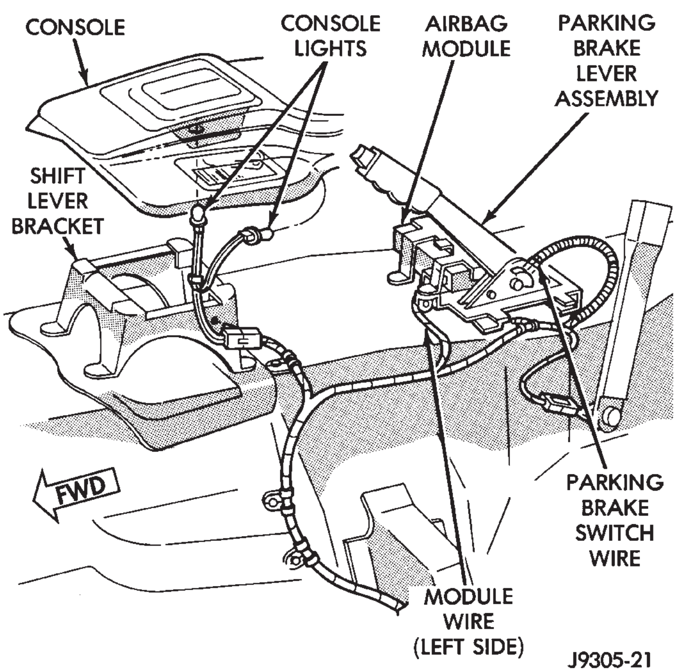

Fig. 6 Parking Brake Lever Mounting

PARKING BRAKE FRONT CABLE INSTALLATION

(1) Connect front cable to lever assembly.
(2) Seat front cable in floor pan.
(3) Install lever assembly on mounting bracket.
(4) Connect parking brake switch wire.
(5) Install air bag module. Be sure all module wires harnesses are securely connected.
(6) Install parking lever cover.
(7) Install cup holder in cover.
(8) Raise vehicle.
(9) Assemble front cable, cable tensioner and equalizer.
(10) Adjust parking brake front cable. Refer to procedure in this section.
(11) Lower vehicle.
(12) Disconnect battery negative cable.

PARKING BRAKE REAR CABLE REMOVAL

(1) Raise vehicle and loosen cable tensioner nut (Fig. 4) until rear cables are slack.
(2) Disengage necessary cable at equalizer and remove cable from body and chassis clips and retainers.
(3) Remove rear wheel and brake drum.
(4) Remove secondary brakeshoe.
(5) Disconnect cable from lever on secondary brakeshoe.
(6) Compress cable retainer with worm drive hose clamp and remove cable from brake support plate.

PARKING BRAKE REAR CABLE INSTALLATION

(1) Install new cable in brake support plate. Be sure cable retainer is fully seated.

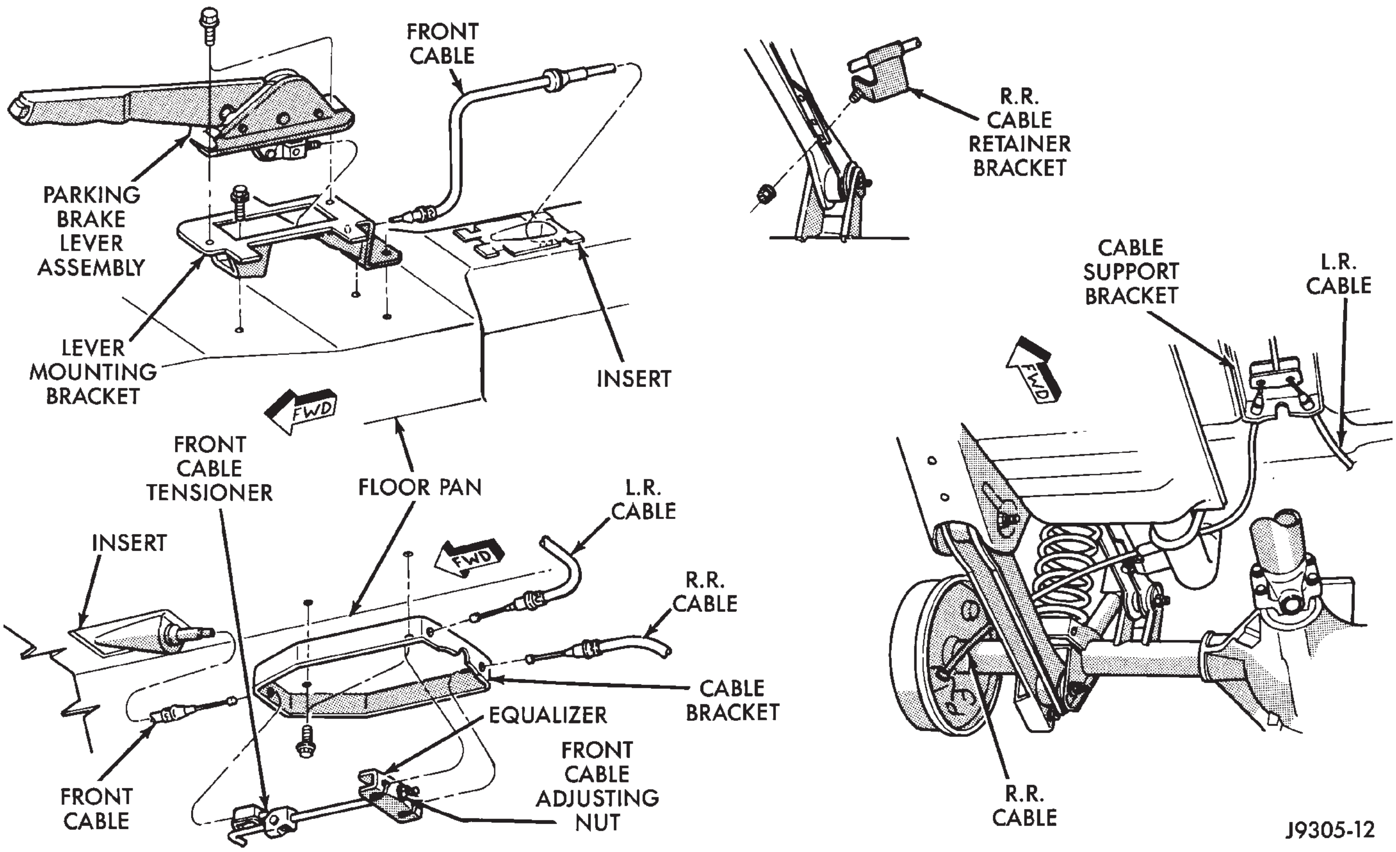

Fig. 7 Parking Brake Lever And Cable Components

(2) Attach cable to lever on secondary brakeshoe and reinstall brakeshoe on support plate.

(3) Adjust rear brakeshoes to brake drum with brake gauge.

(4) Install brake drum and wheel.

(5) Engage cable in equalizer and install nut on cable tensioner (Fig. 4).

(6) Check cable routing. Be sure cable is secured in body and chassis clips and retainers. Also be sure cable is not twisted, kinked or touching any rotating components.

(7) Adjust parking brake front cable as described in following procedure.

PARKING BRAKE FRONT CABLE ADJUSTMENT

(1) Check and adjust rear drum brakeshoes if necessary. Refer to procedure in this section.

(2) Fully apply parking brake.

(3) Raise vehicle on hoist.

(4) Mark position of adjusting nut on threaded end of cable tensioner (Fig. 4). Use chalk or grease pencil to mark position of nut.

(5) Tighten adjusting nut approximately 13 mm (1/2 in.) farther down threaded end of cable tensioner.

CAUTION: Replace the cable tensioner if there are not enough threads left for proper adjustment. Do not attempt to modify and reuse the tensioner. This practice will result in ineffective parking brake operation. The tensioner should be replaced.

(6) Lower vehicle until wheels are about 15 cm (6 in.) off shop floor.

(7) Release parking brake lever and verify that rear wheels rotate freely without drag.

(8) Lower vehicle completely.

BRAKE PEDAL AND SWITCH SERVICE

INDEX

GENERAL INFORMATION

A suspended-type brake pedal is used on all models (Fig. 1). The pedal pivots on a pin 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.

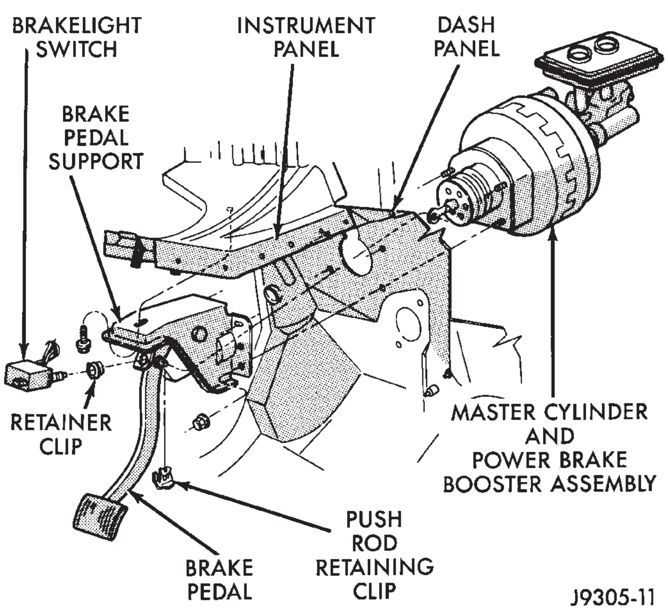

Fig. 1 Brake Pedal And Brakelight Switch Mounting

BRAKE PEDAL REMOVAL (Fig. 1)

(1) Remove lower trim panel and air conditioning duct if necessary.

(2) Remove steering column lower trim panel and bezel.

(3) Remove necessary dash panel-to-instrument panel brace rods.

(4) Remove retainer clip securing booster push rod to pedal.

(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.

BRAKE PEDAL INSTALLATION (Fig. 1)

(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. Secure push rod with original, or new retainer clip if necessary.

(6) Install dash brace rod, if equipped.

(7) Install instrument panel trim and air conditioning duct if removed.

(8) 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. 1).

(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 (Fig. 1). Thread switch into place or rock it up/down until switch plunger touches brake pedal.

(2) Connect brakelight switch wires.

(3) Check brakelight switch operation. Adjust switch position if necessary. Refer to procedures in this section.

(4) Install trim panels (if removed).

BRAKELIGHT SWITCH ADJUSTMENT

(1) Check switch adjustment. Move brake pedal forward by hand and note operation of switch plunger. Plunger should be fully extended when pedal free play is taken up and brake application begins. Clearance of approximately 1.5 to 3.0 mm (1/16 to 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. Pedal should contact switch barrel, push it rearward in retaining clip and stop at correct position.

(3) Verify brakelight switch operation and proper clearance between switch 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.)
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

CONTENTS

CLUTCH COMPONENTS

MECHANICAL COMPONENTS

The clutch mechanism in Grand Cherokee 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 remote reservoir, clutch master cylinder, clutch slave cylinder and interconnecting fluid lines.

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 drivers' side of the dash panel adjacent to the brake master cylinder.

CLUTCH LINKAGE FLUID

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 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 DIAGNOSIS

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GENERAL DIAGNOSIS INFORMATION

Unless the cause of a clutch problem is obvious, a road test and component inspection will be required for accurate diagnosis.

A road test will help determine the type of fault while component inspection will identify the problem component.

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 is needed. The transmission or another driveline component may actually be at fault.

Careful observation during a road test will help narrow the problem area.

CLUTCH PROBLEM CAUSES

CONTAMINATION

Fluid contamination is a common cause of clutch malfunction. Oil, water, or clutch fluid on the clutch contact surfaces will result in chatter, slip, or 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 heavy duty operation, or 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 and water are entering the clutch housing due to loose bolts, housing cracks, vent openings, or through the slave cylinder opening. Driving through deep water puddles can force water/road splash into the housing through such openings.

An additional problem caused by water contamination and especially by steam cleaning, involves clutch disc sticking and poor release.

Water and steam vapors can be absorbed by the clutch facing material. If the vehicle is idle for long periods after water contamination, the force exerted by the pressure plate may cause the disc to bond itself to the flywheel or pressure plate.

Frequently, the only remedy for the above condition is component replacement. To avoid this problem, a vehicle should be driven as soon as possible to heat and dry the clutch components.

Clutch fluid leaks are from a loose or damaged slave cylinder line or connection. 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 release.

Flywheel Runout

Common causes of runout are heat warping, improper machining, mounting the flywheel on a dirty crankshaft flange, incorrect bolt tightening, or improper seating on the crankshaft flange shoulder.

Very light scratches or surface roughness on the flywheel face can be cleaned up by scuff sanding with 180 grit emery cloth. However, if the surface is warped or severely scored, replace the flywheel.

Do not machine the flywheel. The flywheel face is manufactured with a unique surface contour. Machining would negate this feature and could result in unsatisfactory operation.

Clean the crankshaft flange before mounting the flywheel. Dirt and grease on the flange surface may cock the flywheel causing runout.

Use new bolts when remounting a flywheel and secure the bolts with Mopar Lock And Seal, or Loctite 242. Tighten flywheel bolts to specified torque only. Overtightening could 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 0.5 mm (0.020 in.). Measure runout about 6 mm (1/4 in.) from the outer edge of the disc facing. Obtain another disc if runout is excessive.

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, tighten the bolts alternately (in a 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 bore maintains alignment between the crankshaft and transmission input shaft.

Misalignment can cause noise, incomplete clutch 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 the shaft bearing.

Housing face 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 parallel.

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.

Improperly seated flywheels and clutch housings are other causes of clutch failure. Improper seating will produce misalignment and clutch problems.

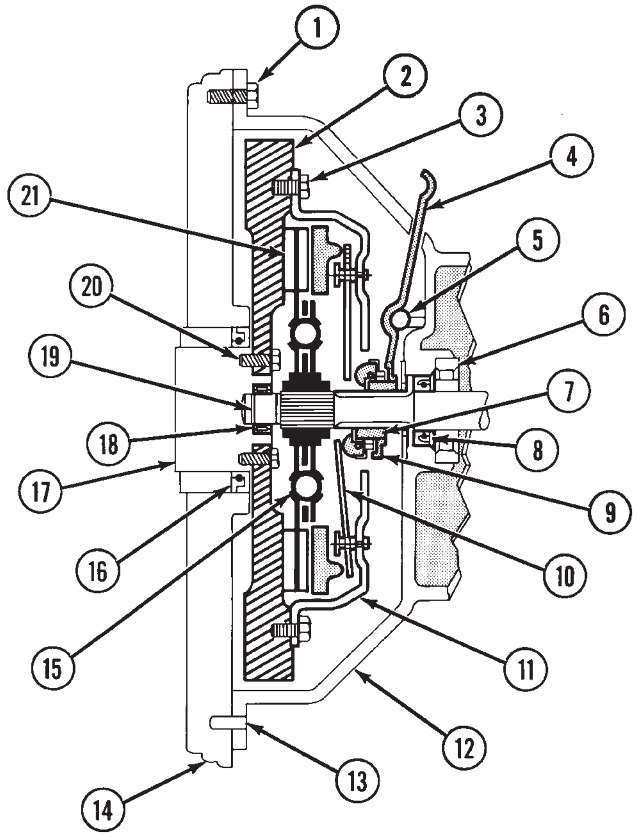
Tighten all the clutch housing bolts to proper torque before installing any struts. Also be sure alignment dowels are in place and seated in the block and housing before bolt tightening.

The use of non-standard or low quality parts can also lead to problems and wear. Use the 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. Use the charts as a guide 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 condition. Scuff sand flywheel face to remove glaze. Clean surface with a wax and grease remover afterward. Replace flywheel if severely scored, worn or cracked. Secure flywheel with new bolts (if removed). Do not reuse old bolts. Use Lock and 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 distorted or worn. Make sure ball stud and release bearing contact surfaces are lubricated.

5 Check release fork pivot. Be sure pivot is tight 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 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.

8 Check input shaft seal if clutch cover and disc were oil covered. Replace seal if worn, or cut.

9 Do not replace release bearing unless actually faulty. Replace bearing only if seized, noisy, or damaged.

10 Check clutch cover diaphragm spring and release fingers. Replace cover if spring or fingers are bent, warped, broken, cracked. Do not tamper with factory clutch spring setting. Clutch problems will result.

11 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.

12 Inspect clutch housing. Be sure alignment dowels are in position and bolts are tight. Replace housing if cracked, or damaged. If clutch problems ocurred, check runout, to be sure housing is square with flywheel and transmission input shaft.

13 Verify that housing alignment dowels are in position before installing housing.

14 Clean engine block surface before installing clutch housing. Dirt, grime can produce misalignment.

15 Make sure side of clutch disc marked "flywheel side" is toward flywheel.

16 Check rear main seal if clutch disc and cover were oil covered. Replace seal if necessary.

17 Check crankshaft flange (if flywheel is removed). Be sure flange is clean and flywheel bolt threads are in good condition.

18 Check pilot bearing. Replace bearing if damaged. Lube with high temp. Grease before installation.

19 Check transmission input shaft. Clutch disc must slide freely on shaft splines. Lightly grease splines before installation. Replace shaft if splines or pilot bearing hub are damaged.

20 Check flywheel bolt torque. If bolts are loose, replace them. Use Mopar Lock and Seal to secure new bolts.

21 Check clutch disc facing. Replace disc if facing is charred, scored, flaking off, or worn. Also check runout of new disc. Runout should not exceed 0.5 mm (0.02 in.).

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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.

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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.

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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. b) Too much grease applied to splines or disc and input shaft.	a) Correct leak and replace disc (do not clean and reuse the disc). 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. b) Engine related problem.	a) Further diagnosis required. Check engine/transmission mounts, propeller shafts and U-joints, tires, suspension attaching parts and other driveline components as needed. 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. b) Clutch cover, spring, or release fingers bent, distorted (rough handling, improper assembly). c) Clutch disc damaged or distorted. d) Clutch misalignment.	a) Replace clutch cover and disc. b) Replace clutch cover and disc. c) Replace disc. d) Check alignment and runout of flywheel, disc, or cover and/or clutch housing. Correct as necessary.

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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.

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CLUTCH SERVICE

INDEX

CLUTCH COVER AND DISC REMOVAL

(1) Raise vehicle.

(2) Remove transmission and clutch housing as assembly (Fig. 2). Refer to Group 21 for procedures.

(3) If clutch cover will be reused, mark position of cover on flywheel with scriber, chalk, or center punch (Fig. 2).

(4) Loosen clutch cover bolts evenly and in rotation to relieve spring tension. Loosen bolts a few threads at a time only to avoid warping cover. This is especially important if cover will be reused.

(5) Remove cover bolts and remove cover and disc.

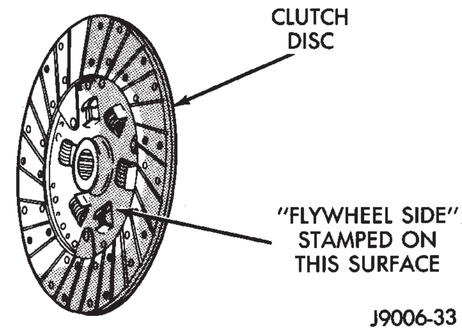


Fig. 2 Clutch Disc Position

CLUTCH COVER AND DISC INSTALLATION

(1) Reduce minor scratches or surface glazing on flywheel face with 120/180 grit emery cloth. Clean flywheel surface with Mopar brake cleaner or wax and grease remover afterward.

(2) Check runout and free operation of new clutch disc. Install disc on transmission input shaft splines. Disc should slide freely on splines. Leave disc on shaft and check runout with dial indicator. Position indicator plunger about 6 mm (1/4 in.) from outer edge of facing. Runout should not exceed 0.5 mm (0.020 inch). Obtain another disc if runout exceeds this limit.

(3) Lubricate crankshaft pilot bearing with Mopar high temperature grease, or equivalent.

(4) Insert clutch alignment tool in disc and position disc on flywheel.

(5) Verify that disc hub is positioned correctly. Side of hub marked “Flywheel Side” should face flywheel (Fig. 2).

(6) Insert alignment tool or spare input shaft in pilot bushing and position disc on flywheel (Fig. 3).

(7) Position clutch cover over disc and on flywheel. Verify that disc and cover are aligned before proceeding.

(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.** Cover bolt torques are:

• Tighten 5/16 in. diameter bolts to 23 N●m (17 ft. lbs.).

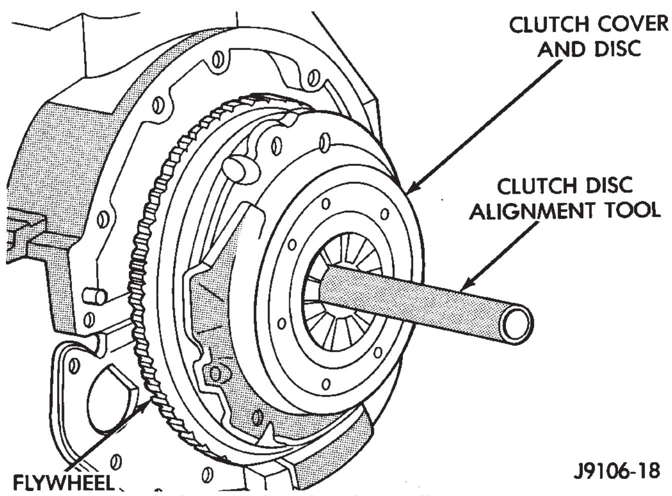


Fig. 3 Clutch Disc Alignment

• Tighten 3/8 in. diameter bolts to 41 N●m (30 ft. lbs.).

(10) Apply light coating of Mopar high temperature grease to input shaft splines and to release bearing slide surface of front bearing retainer. **Do not overlubricate shaft splines. This could result in grease contamination of disc.**

(11) Install transmission and clutch housing as assembly. Refer to Figure 4 for attaching bolt torques.

CLUTCH HOUSING REMOVAL

(1) Raise vehicle and remove transmission and clutch housing as assembly.

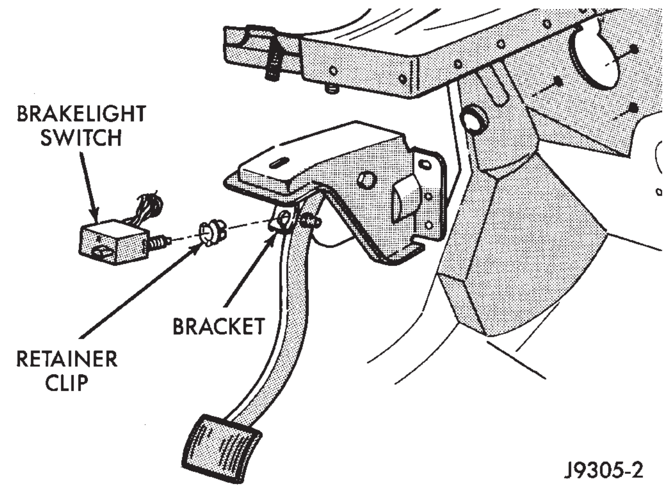


Fig. 4 Transmission And Clutch Housing Installation

(2) Remove release bearing, release lever and boot and lever pivot ball stud from clutch housing (Fig. 5).

(3) Remove clutch housing attaching bolts and remove housing from transmission (Fig. 5).

CLUTCH HOUSING INSTALLATION

(1) Clean housing mounting surface of engine block with solvent.

(2) Check alignment dowels in engine block. Be sure dowels are in good condition and properly seated.

(3) Lubricate release bearing bore, release fork and pivot ball contact surfaces with Mopar high temperature grease.

(4) Transfer pivot ball stud, release fork and boot and release bearing to new housing.

(5) Align and install clutch housing on transmission. Tighten housing bolts to 33-43 N•m (24-32 ft. lbs.) torque.

(6) Install transmission as described in Group 21. Install transmission-to-engine struts **after** clutch housing has been installed. Tighten bolts attaching struts to clutch housing first and strut-to-engine bolts last.

RELEASE BEARING REPLACEMENT

(1) Remove transmission and clutch housing as an assembly.

(2) Disconnect release bearing from the fork 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) Lightly lubricate crankshaft pilot bushing, input shaft splines, bearing retainer slide surface, fork pivot and release fork pivot surface with Mopar high temperature grease.

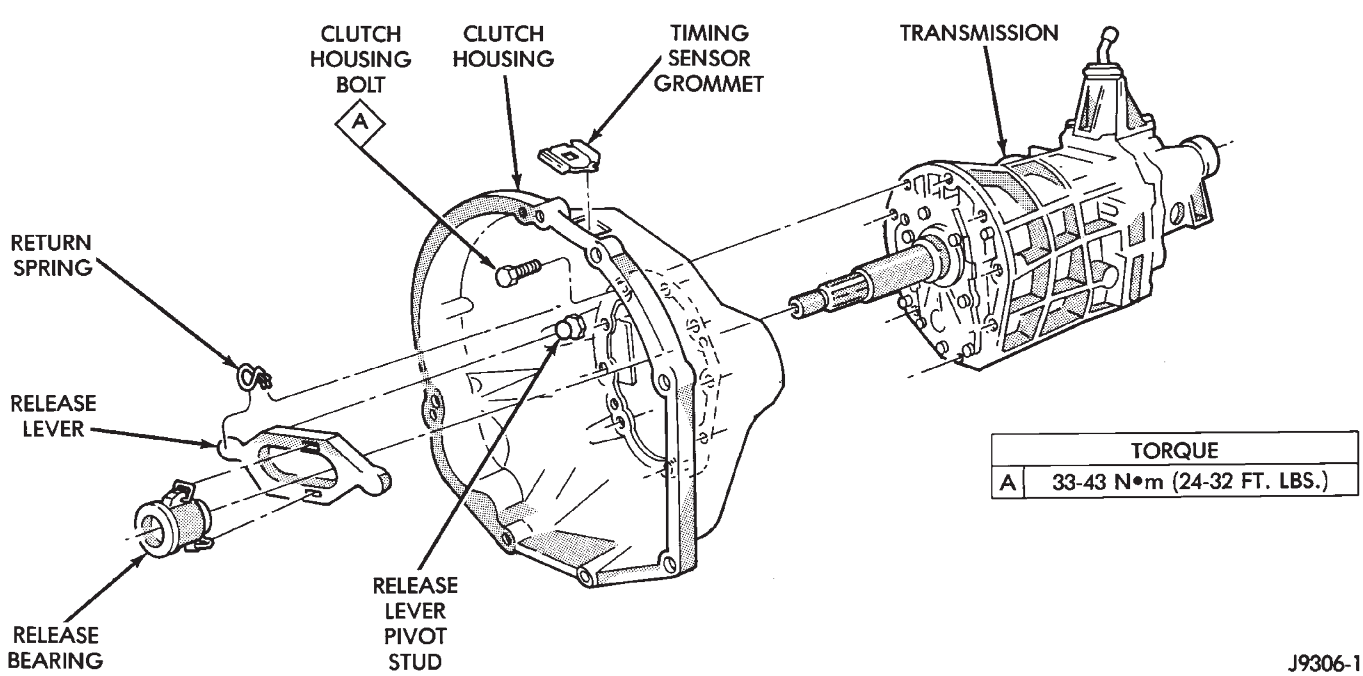
(6) Install release fork and new release bearing. Be sure fork and bearing are properly secured.

(7) Install transmission and clutch housing as assembly.

PILOT BEARING REPLACEMENT

(1) Remove transmission and clutch housing.

(2) Remove clutch cover and disc.



TORQUE	
A	33-43 N•m (24-32 FT. LBS.)

Fig. 5 Clutch Housing And Release Bearing Attachment

(3) Remove pilot bearing. Use blind hole puller tools such as those included in Snap-On set CG40CB to remove bearing.

(4) Clean bearing bore with solvent and wipe dry with shop towel.

(5) Lubricate new pilot bearing with Mopar high temperature grease.

(6) Position and start new bearing in bearing bore by hand. **Note that pilot bearing has seal at one end. Install bearing so seal is facing out and toward transmission.**

(7) Seat pilot bearing with clutch alignment tool (Fig. 6). **Keep bearing straight during installation. Do not allow bearing to become cocked. Tap bearing into place until flush with edge of bearing bore. Do not recess bearing.**

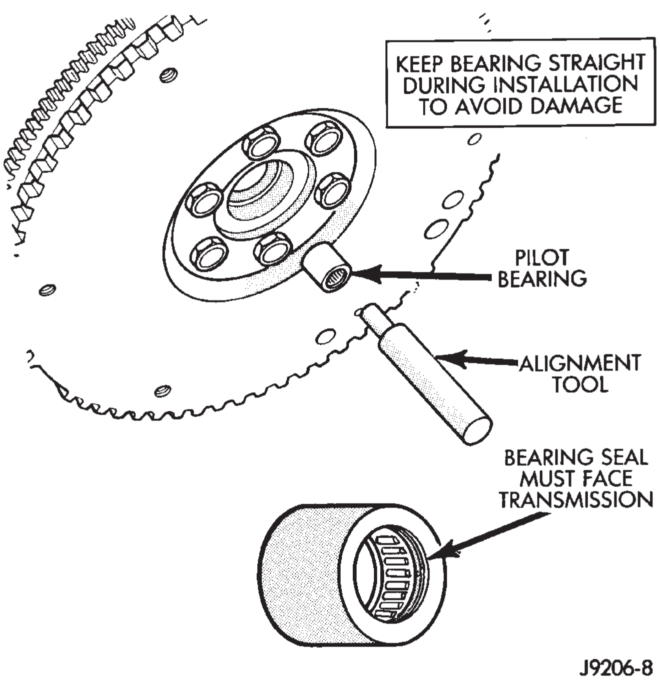


Fig. 6 Typical Method Of Installing Pilot Bearing

(8) Install clutch cover and disc.

(9) Install clutch housing and transmission as assembly.

(10) Install transfer case, propeller shafts, wire harnesses, vacuum hoses, crossmembers, shift linkage and remaining components removed during service.

CLUTCH HYDRAULIC LINKAGE REMOVAL

The clutch master cylinder, remote reservoir, slave cylinder and connecting lines are serviced as an assembly only. The linkage components cannot be overhauled or serviced separately. The cylinders and connecting lines are sealed units.

(1) Raise vehicle.

(2) Remove nuts attaching slave cylinder to clutch housing.

(3) Remove slave cylinder and clip from housing.

(4) Disengage hydraulic fluid line from body clips.

(5) Lower vehicle.

(6) Remove retaining ring, flat washer and wave washer that attach clutch master cylinder push rod to clutch pedal (Fig. 7).

(7) Slide clutch master cylinder push rod off clutch pedal pin.

(8) Inspect condition of bushing on clutch pedal pin. Remove and replace bushing if worn or damaged.

(9) Verify that cap on clutch master cylinder reservoir is tight. This is necessary to avoid undue spillage during removal.

(10) Remove screws attaching clutch fluid reservoir to dash panel.

(11) Remove nuts attaching clutch master cylinder to stud nuts (Fig. 7).

(12) Remove both clutch cylinders, reservoir and connecting lines from vehicle.

CLUTCH HYDRAULIC LINKAGE INSTALLATION

(1) Tighten cap on clutch fluid reservoir to avoid spillage during installation.

(2) Position cylinders, connecting lines and reservoir in vehicle.

(3) Install clutch master cylinder on mounting studs extending through dash panel (Fig. 7). Tighten attaching nuts to 23-34 N•m (200-300 in. lbs.) torque.

(4) Position reservoir on dash panel and install reservoir screws. Tighten screws to 5 N•m (40 in. lbs.) torque.

(5) Install replacement bushing on clutch pedal pin if necessary.

(6) Install clutch master cylinder push rod on clutch pedal pin. Secure rod with wave washer, flat washer and retainer ring.

(7) Raise vehicle.

(8) 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.

(9) Install and tighten slave cylinder attaching nuts to 23-34 N•m (200-300 in. lbs.) torque.

(10) Insert clutch fluid line in body clips and lower vehicle.

CLUTCH PEDAL REMOVAL

(1) Remove retaining ring, flat washer and wave washer that secure clutch master cylinder push rod to clutch pedal pin (Fig. 8).

(2) Remove fastener that secures pedal shaft to pedal support.

(3) Slide pedal shaft out left side of pedal support and out of clutch pedal.

(4) Slide push rod off clutch pedal pin and remove clutch pedal.

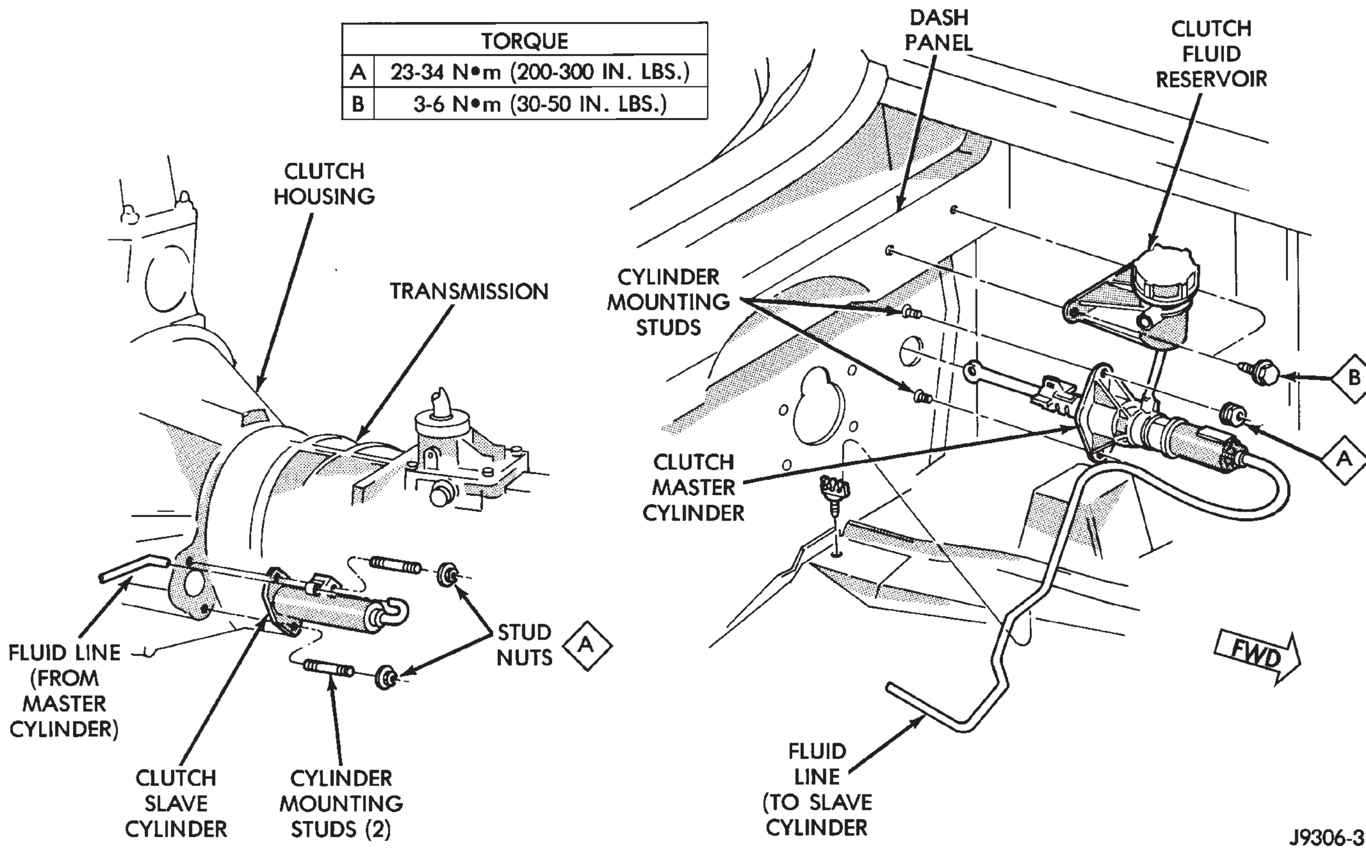


Fig. 7 Clutch Hydraulic Linkage Components

(5) Remove and inspect bushings in clutch pedal shaft bore and on bushing on pedal pin. Replace any bushing that is worn or damaged.

CLUTCH PEDAL INSTALLATION

(1) Lubricate pedal shaft, pedal shaft bore and all bushings with Mopar multi-mileage grease, silicone grease, or lubriplate.

(2) Insert pedal pin into cylinder push rod. Then position clutch pedal in support.

(3) Slide pedal shaft through clutch pedal bore and bushings.

(4) Install bolt that retains pedal shaft in support.

(5) Secure push rod to pedal pin with wave washer, flat washer and retaining ring.

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 scuff sanded with 120/180 grit emery cloth. However, the flywheel should be replaced if the disc contact surface is severely scored, heat checked, cracked, or obviously worn.

Cleanup of minor flywheel scoring should be performed with surface grinding equipment. Remove only enough material to reduce scoring (approximately 0.001 - 0.003 in. maximum).

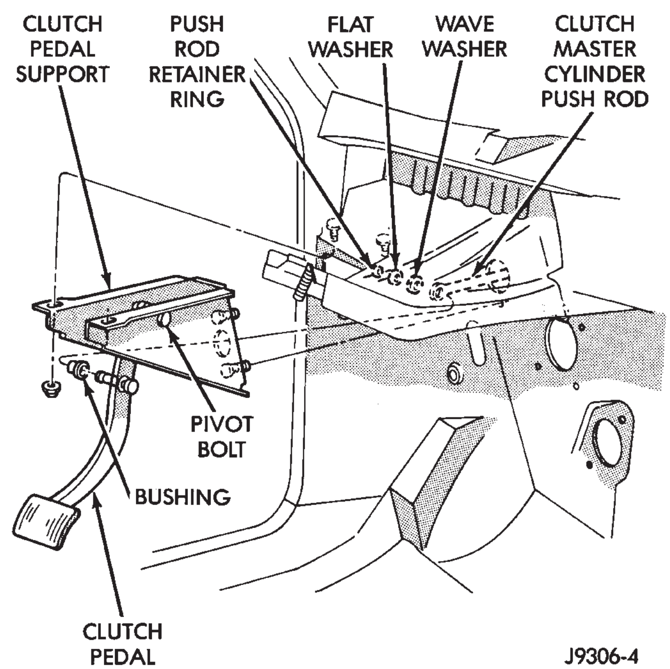


Fig. 8 Clutch Pedal Mounting

Heavy stock removal from the flywheel face 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.

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 replacement bolt threads.

Recommended bolt torque for 6-cylinder flywheel is 142 N●m (105 ft. lbs.).

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 cut-off 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 325-350° F.

CAUTION: Never 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 will cause localized heating and damage the flywheel. In addition, using the torch to heat a replacement gear will cause uneven heating and expansion. The torch flame will 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.

COOLING SYSTEM

CONTENTS

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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 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. It also maintains normal operating temperature and prevents overheating.

The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid (if equipped). The cooling system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system.

An optional factory installed maximum duty cooling package is available on most models. This package will provide additional cooling capacity for vehicles used under extreme conditions such as trailer towing in high ambient temperatures.

COOLING SYSTEM COMPONENTS

The cooling system consists of:

- A radiator
- Cooling fan
- 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 routings refer to (Figs. 1 or 2).

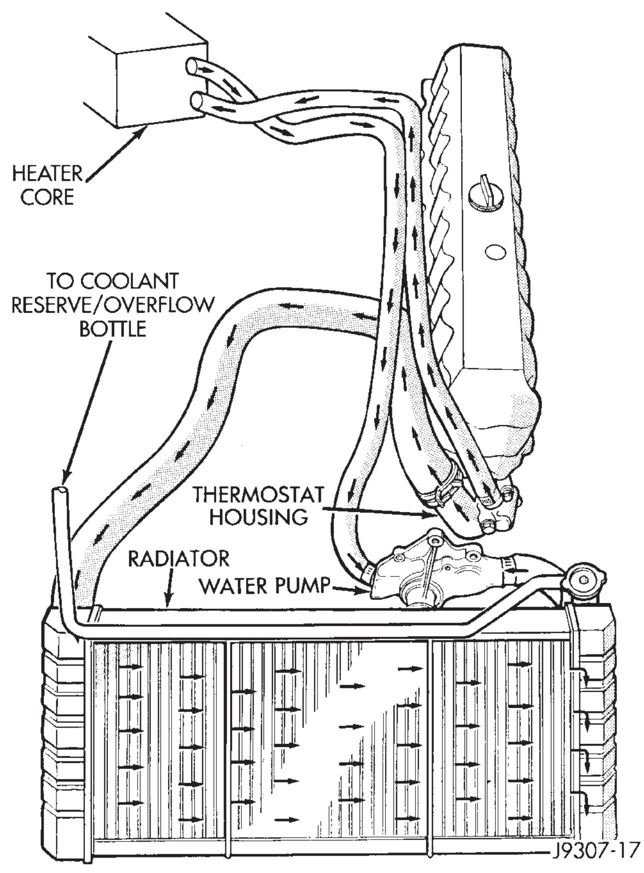

Fig. 1 Engine Cooling System—4.0L Engine—Typical

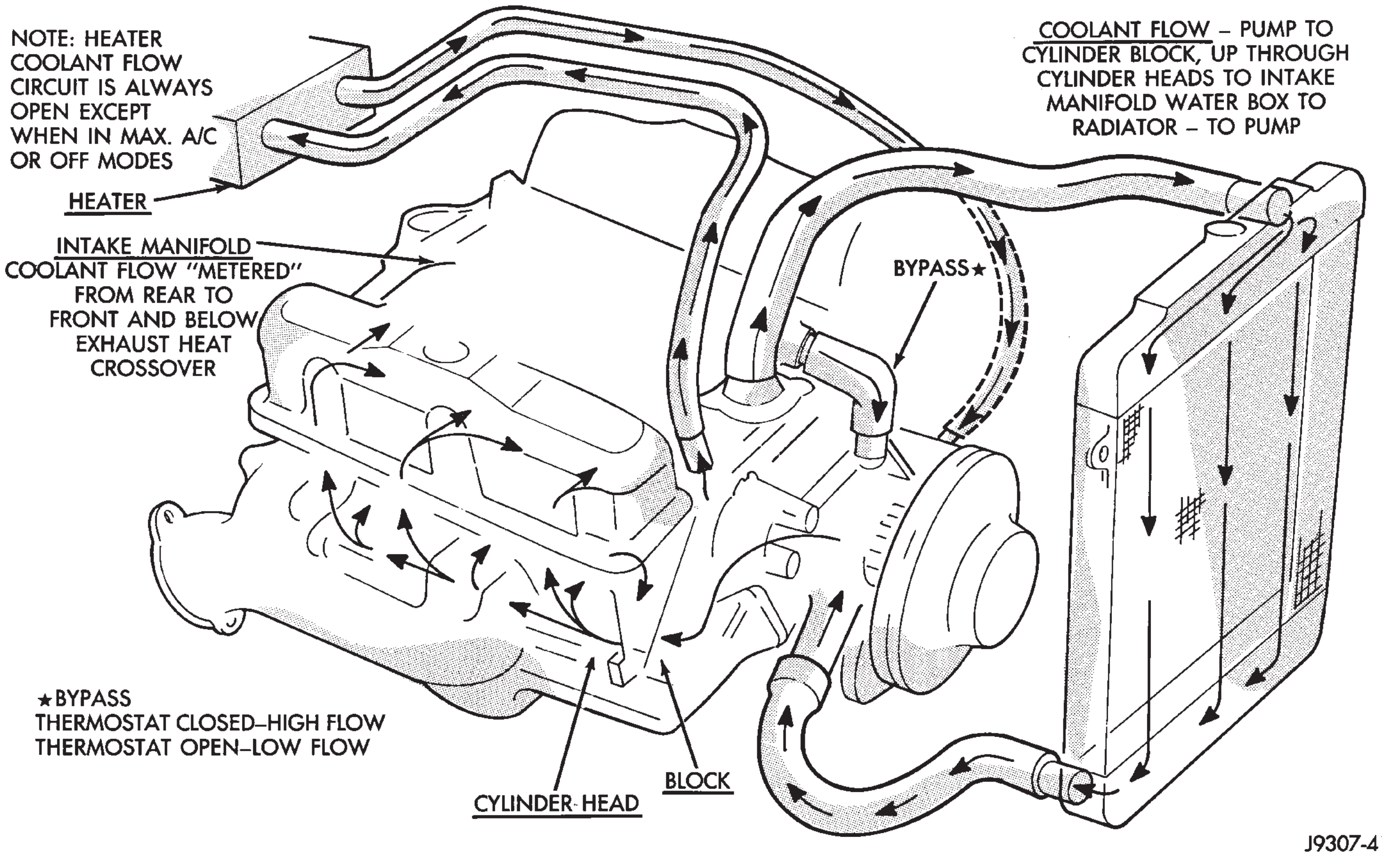

Fig. 2 Engine Cooling System—5.2L Engine—Typical

DIAGNOSIS

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).
• Rubber and foam air seals not properly installed to radiator or A/C condenser after a repair.

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 deaerate the cooling system. A low coolant level will then result in the Coolant Reserve/Overflow Bottle. 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 Bottle: **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/overflow bottle may increase above the FULL level indicated on the bottle. If the level in the bottle 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 bottle for vacuum leak only. Coolant return failure will be evident by a low level in the radiator. Reserve bottle level should increase during heat-up.

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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).

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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 single serpentine 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 two small holes to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant mixture. No additional lubrication is necessary.

CAUTION: All 4.0L 6 cylinder engines are equipped with a reverse (counterclockwise) rotating water pump and thermal 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). 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 or viscous fan drive will cause engine over heating.

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.

5.2L ENGINE: One of the heater hoses is connected to the water pump with a metal coolant return tube (Fig. 2). A rubber O-ring forms a seal at the water pump end of the tube.

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.

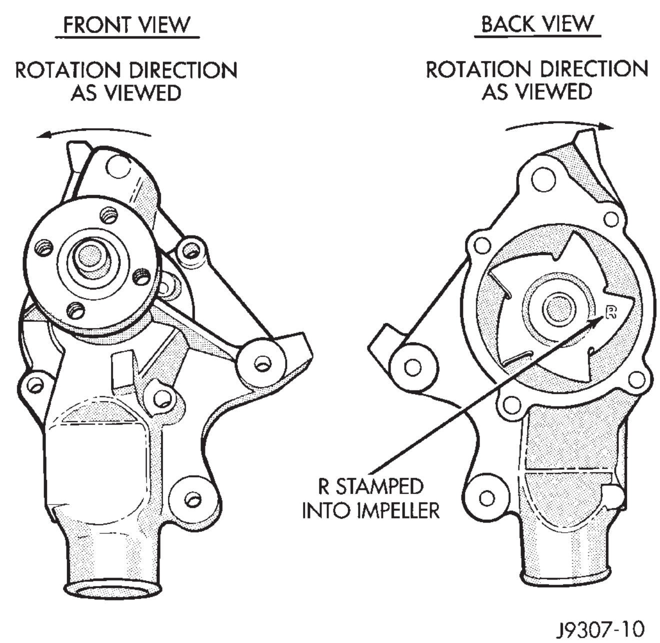

Fig. 1 Reverse Rotating Water Pump—4.0L 6 Cylinder

(1) Drain the cooling system. Refer to Draining Cooling System in this group.

(2) Loosen the fan belt. Refer to Belt Service in the Engine Accessory Drive Belt section of this group.

(3) Disconnect the lower radiator hose from the water pump.

(4) Bend a stiff welding rod or similar device as shown in (Fig. 3). To prevent breakage of rod, minimum thickness should be 3/16 inch (.187 inches).

(5) Position the rod in the water pump inlet and attempt to hold the impeller while turning the fan pulley. If equipped with a thermal viscous fan drive, rotate the water pump shaft with a wrench attached to one of the fan pulley mounting nuts. If the impeller is loose and can be held with the rod while the fan blades are turning, the pump is defective. Do not

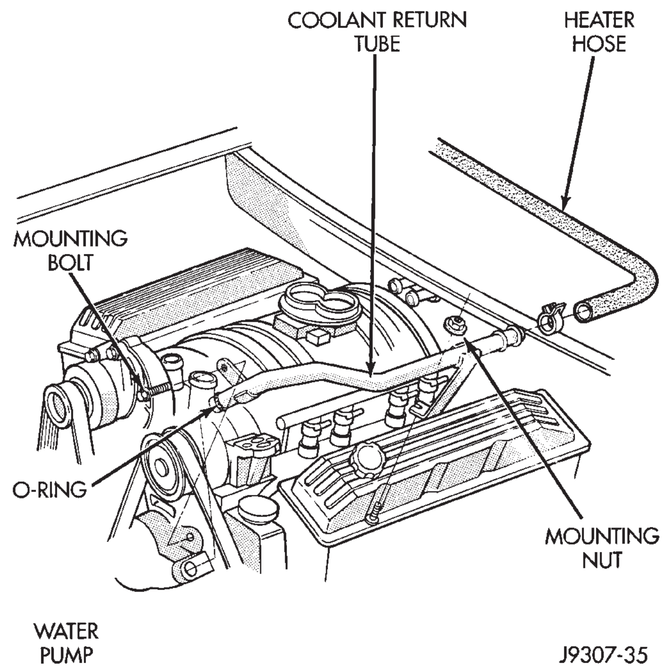

Fig. 2 Coolant Return Tube—5.2L Engine

use excessive force when rotating pump shaft. If the impeller turns, the pump is OK.

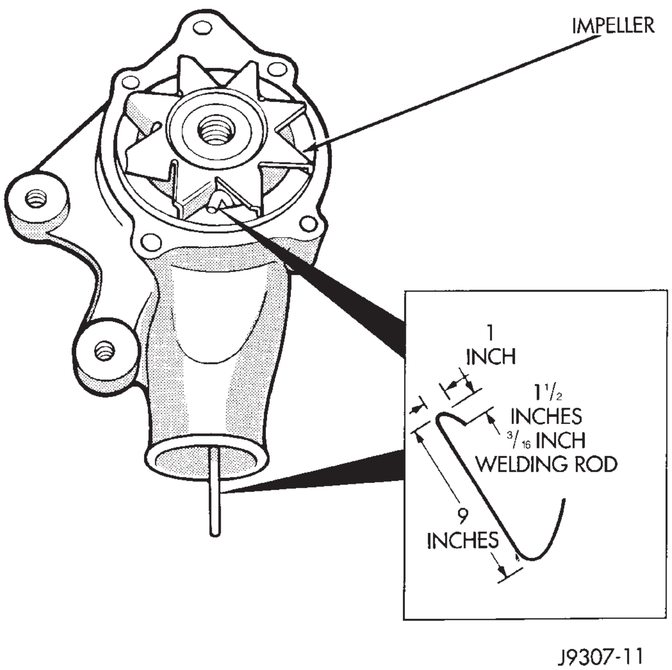

Fig. 3 Impeller Test—Typical

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.

DO NOT WASTE reusable coolant. If solution is clean, drain the coolant into a clean container for reuse.

WARNING: DO NOT 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 the engine before removing restriction to prevent contamination of the coolant with debris. Refer to Water Pump Removal in this group.

WATER PUMPS—REMOVAL/INSTALLATION

4.0L 6 CYLINDER ENGINE

REMOVAL

The water pump on all models can be removed without discharging the air conditioning system (if equipped).

CAUTION: All 4.0L 6 cylinder engines have a reverse (counter-clockwise) 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 Cooling System Draining in this group.

(3) Loosen (but do not remove at this time) the four fan hub-to-water pump pulley mounting nuts.

The engine accessory drive belt must be removed prior to removing the fan.

(4) Remove engine drive belt as follows:

(a) Loosen two rear power steering pump mounting bolts A (Fig. 4).

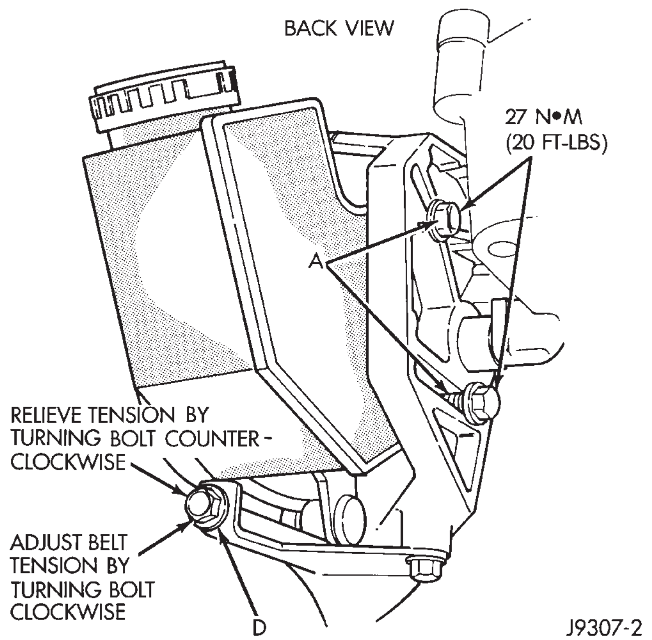

Fig. 4 P.S. Pump Rear Mounting Bolts—4.0L Engine

(b) Loosen upper pump pivot bolt B and lower lock nut C (Figs. 5 or 6).

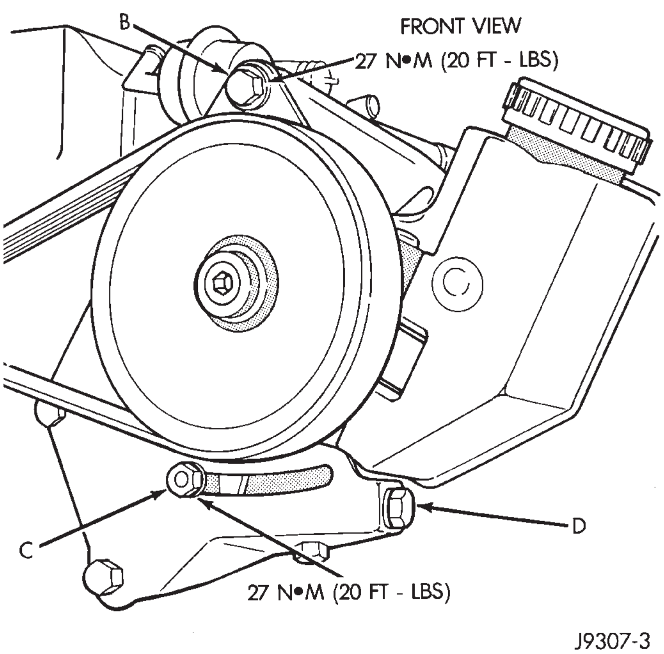

Fig. 5 P.S. Pump Front Mounting Bolt/Locknut—4.0L Engine

(c) Loosen pump adjusting bolt D (Fig. 4) until belt can be removed.

(d) Remove belt.

(5) Check condition of all pulleys.

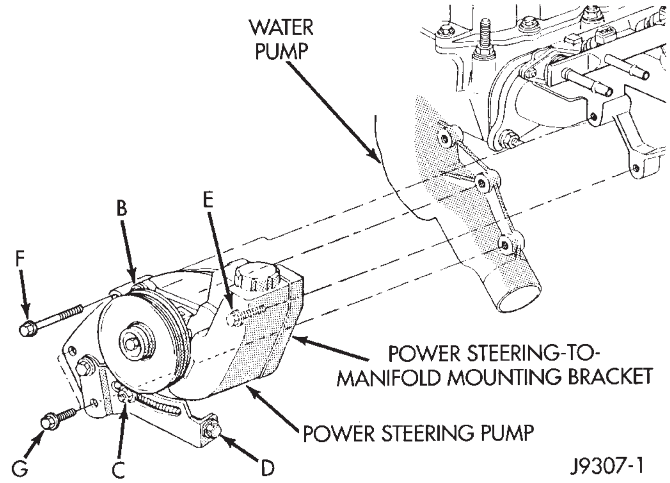

Fig. 6 Bracket Mounting Bolts—4.0L Engine

(6) The power steering pump must be removed from its cast mounting bracket to gain access to bolt E. Bracket mounting bolt E is located behind the power steering pump (Fig. 6).

(7) Remove two bolts A (Fig. 4).

(8) Remove locknut C and belt adjustment bolt D (Figs. 5 or 6).

(9) Remove bolt B (Fig. 5). 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. 6) and remove pump mounting bracket.

(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.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING THIS TYPE OF CLAMP, ONLY USE TOOLS DESIGNED FOR SERVICING THIS CLAMP.

(12) Remove lower radiator hose from water pump. Remove heater hose from water pump fitting. Miller Clamp Tool number 6094 (Fig. 7) may be used to remove the constant tension clamps.

(13) Remove the four fan hub-to-water pump pulley mounting nuts.

(14) Remove the two fan shroud-to-upper radiator crossmember attaching nuts (Fig. 8).

(15) Remove the fan assembly and fan shroud (together as one unit) from the vehicle.

(16) 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.

(17) If pump is to be replaced, the heater hose fitting must be removed. Note position of fitting before removal.

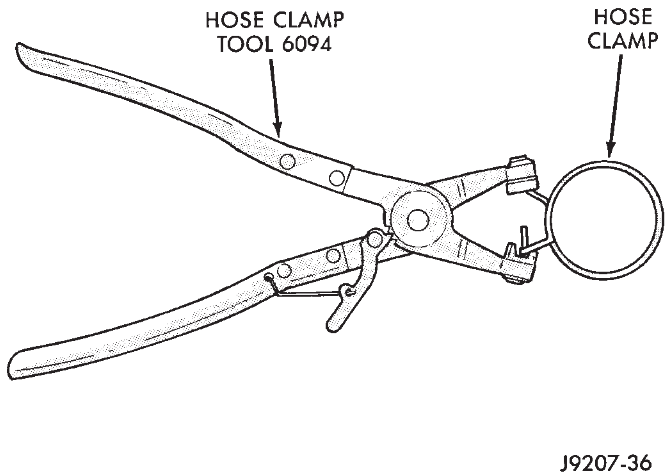

Fig. 7 Hose Clamp Tool

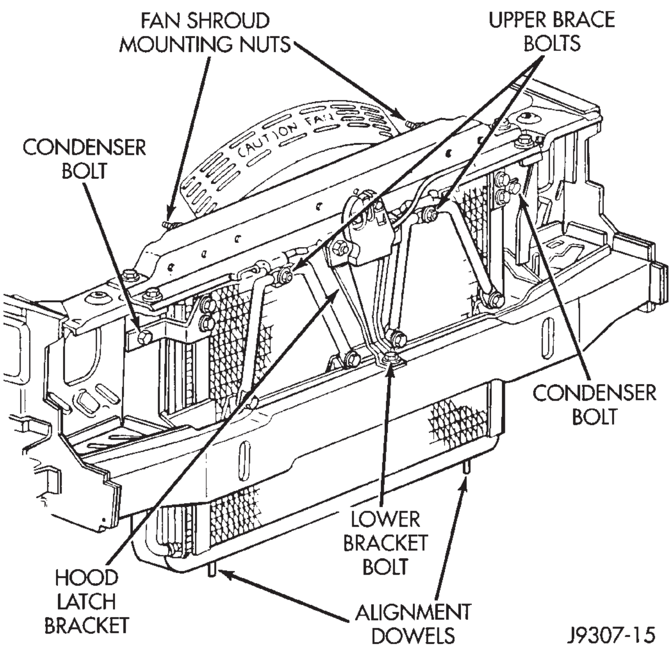

Fig. 8 Fan Shroud Mounting

INSTALLATION

(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.

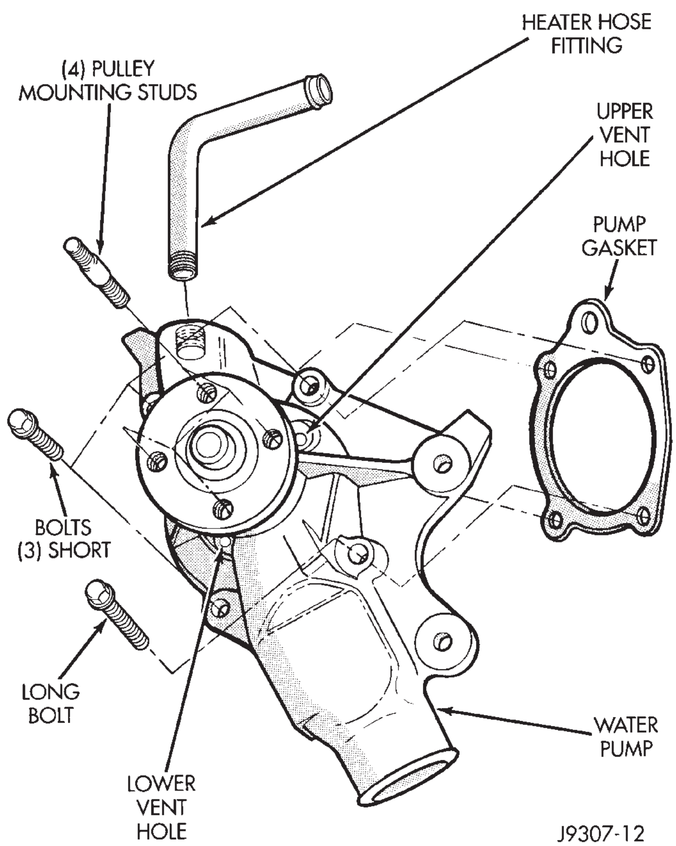

Fig. 9 Water Pump Remove/Install—4.0L 6 Cylinder Engine

(5) Position the fan assembly and fan shroud (together as one unit) to the engine.

(6) Position fan shroud to radiator. Be sure the alignment tabs at the lower part of shroud are placed into the slots near lower part of radiator. Install and tighten the two fan shroud mounting nuts.

(7) Install fan assembly to water pump hub. Tighten fan drive mounting nuts to 24 N●m (18 ft. lbs.) torque. Be sure of at least 25 mm (1.0 inches) between tips of fan blades and fan shroud.

(8) Position power steering pump bracket to engine. Install bolts E, F and G (Fig. 6). Tighten bolts F and G to 38 N●m (28 ft. lbs.) torque. Tighten bolt E to 27 N●m (20 ft. lbs.) torque.

(9) Position power steering pump to mounting bracket. Install pivot bolt B (Fig. 5) finger tight. Install locknut C and adjustment bolt D (Figs. 5 or 6) finger tight.

(10) Install two adjustment bolts A (Fig. 4) finger tight.

(11) 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 Fig. 10 for appropriate belt routing.

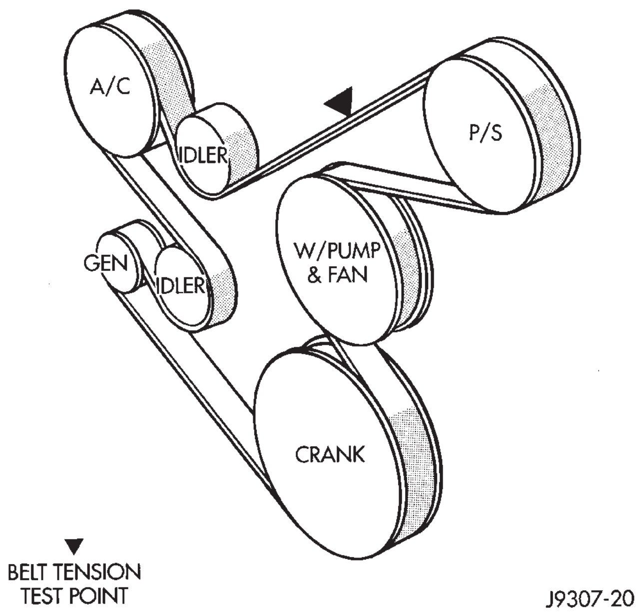

Fig. 10 Belt Routing—4.0L 6 Cylinder Engine

(12) Position drive belt to pulleys.

(13) Tighten belt adjustment bolt D (Fig. 4) to the proper tension. Refer to the Specifications section at the end of this group for belt tension.

(14) Tighten bolts A (Fig. 4) to 27 N●m (20 ft. lbs.) torque.

(15) Tighten pivot bolt B (Fig. 5) to 27 N●m (20 ft. lbs.) torque.

(16) Tighten locknut C (Fig. 5) to 27 N●m (20 ft. lbs.) torque.

(17) After the power steering pump has been tightened, recheck belt tension.

(18) Fill cooling system with coolant and check for leaks. Refer to Refilling Cooling System in this group.

(19) Connect battery cable to battery.

(20) Start and warm the engine. Check for leaks.

5.2L V-8 ENGINE

REMOVAL

The water pump on 5.2L engines is bolted directly to the engine timing chain case/cover.

A gasket is used as a seal between the water pump and timing chain case/cover.

If water pump is replaced because of bearing/shaft damage, or leaking shaft seal, the mechanical cooling fan assembly should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan if any of these conditions are found. Also check condition of the thermal Viscous Fan Drive. Refer to Viscous Fan Drive in this group.

The water pump on all models can be removed without discharging the air conditioning system (if equipped).

(1) Disconnect negative battery cable from battery.

(2) Drain cooling system. Refer to Draining Cooling System in this group.

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(3) The thermal Viscous Fan Drive is attached (threaded) to the water pump hub shaft (Fig. 11). Remove fan/viscous fan drive assembly from water pump by turning mounting nut counterclockwise as viewed from front. Threads on viscous fan drive are **RIGHT HAND**. A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) can be used. Place a bar or screwdriver between water pump pulley bolts (Fig. 11) to prevent pulley from rotating. Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES.

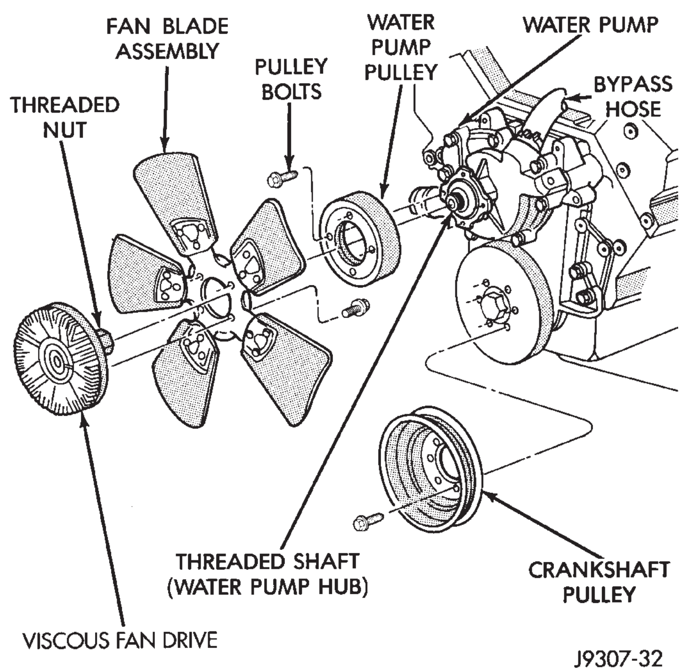

Fig. 11 Fan Blade and Viscous Fan Drive—5.2L Engine

WHEN REMOVING OR INSTALLING THIS TYPE OF CLAMP, ONLY USE TOOLS DESIGNED FOR SERVICING THIS CLAMP, SUCH AS MILLER TOOL 6094 (FIG. 12).

(4) If water pump is being replaced, do not unbolt fan blade assembly (Fig. 11) from thermal viscous fan drive.

(5) Remove two fan shroud-to-radiator nuts (Fig. 13). Do not attempt to remove fan shroud at this time.

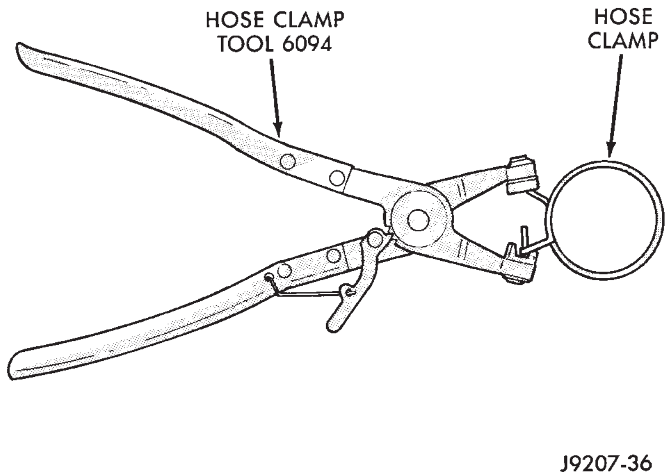

Fig. 12 Hose Clamp Tool

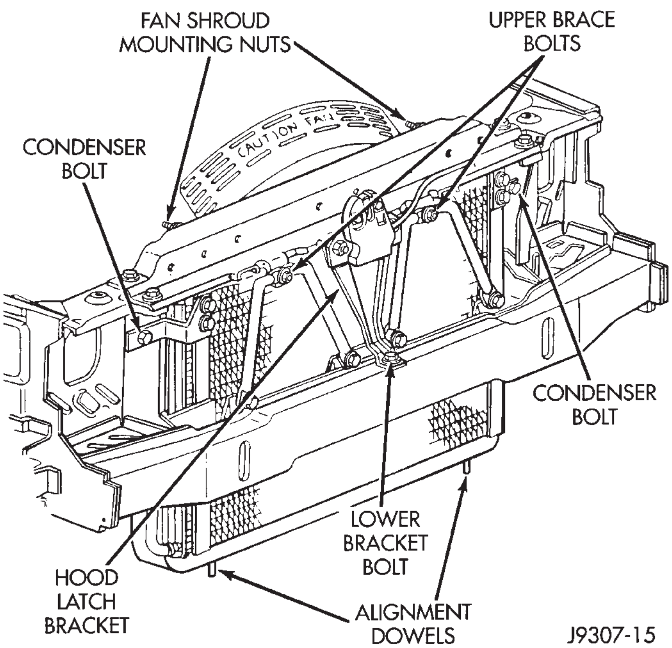

Fig. 13 Fan Shroud Nuts

(6) Remove fan shroud and fan blade/viscous fan drive assembly from vehicle as a complete unit.

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.

Do not remove water pump pulley bolts at this time.

(7) Remove accessory drive belt as follows: The drive belt is equipped with a spring loaded automatic belt tensioner (Fig. 14). Relax tension from belt by rotating tensioner clockwise (as viewed from front) (Fig. 14). When all belt tension has been relaxed, remove accessory drive belt.

(8) Remove four water pump pulley-to-water pump hub bolts (Fig. 11) and remove pulley from vehicle.

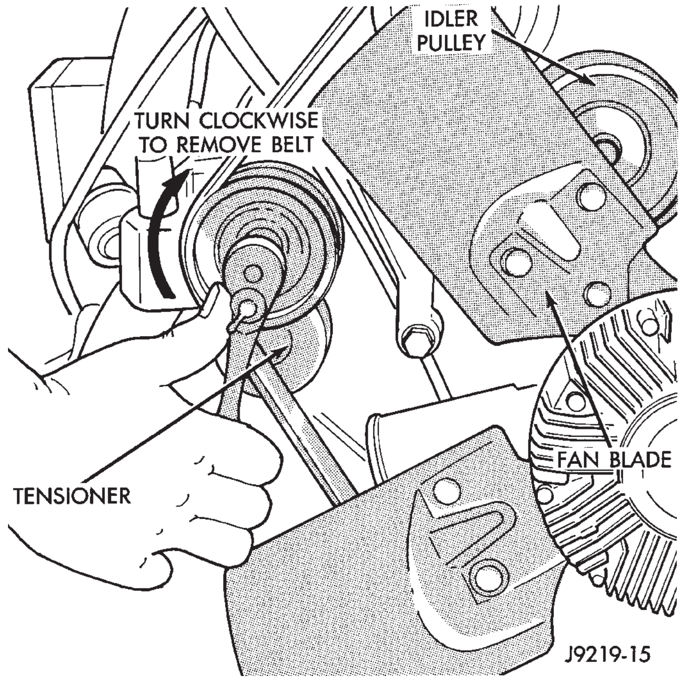

Fig. 14 Belt Tensioner Assembly—5.2L Engine

(9) Remove lower radiator hose clamp and remove lower hose at water pump.

(10) Remove heater hose clamp (Fig. 15) and heater hose from heater hose coolant return tube.

(11) Loosen heater hose coolant return tube mounting bolt and nut (Fig. 15) and remove tube from water pump. Discard the old tube O-ring.

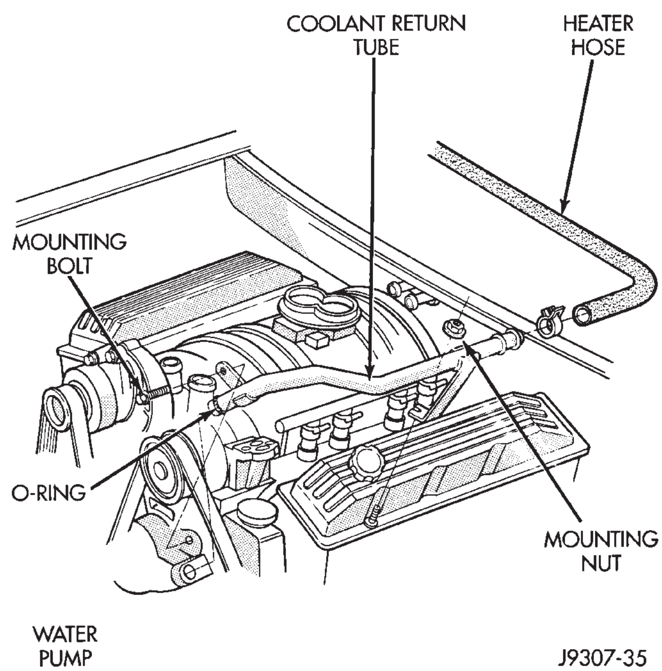

Fig. 15 Coolant Return Tube—5.2L Engine

(12) Remove seven water pump mounting bolts (Fig. 16).

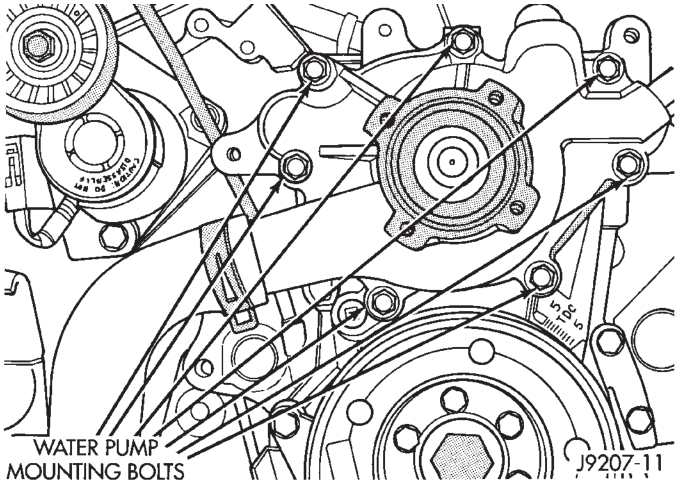

Fig. 16 Water Pump Bolts—5.2L Engine—Typical

(13) Loosen clamp at water pump end of bypass hose (Fig. 11). Slip bypass hose from water pump while removing pump from vehicle. Discard old gasket.

CAUTION: Do not pry water pump at timing chain case/cover. The machined surfaces may be damaged resulting in leaks.

INSPECTION

Replace water pump assembly if it has any of the following conditions:

- The body is cracked or damaged
- Water leaks from shaft seal. This is evident by traces of coolant below vent hole
- Loose or rough turning bearing. Also inspect viscous fan drive
- Impeller rubs either the pump body or timing chain case/cover

INSTALLATION

(1) Clean gasket mating surfaces.

(2) Using a new gasket, install water pump to engine as follows: Guide water pump nipple into bypass hose as pump is being installed. Install water pump bolts (Fig. 16). Tighten water pump mounting bolts to 40 N●m (30 ft. lbs.) torque.

(3) Spin water pump to be sure that pump impeller does not rub against timing chain case/cover.

(4) Install a new O-ring to the heater hose coolant return tube (Fig. 15). Coat the new O-ring with antifreeze before installation.

(5) Install coolant return tube to engine (Fig. 15). Be sure the slot in tube bracket is bottomed to the mounting bolt. This will properly position return tube.

(6) Connect radiator lower hose to water pump.

(7) Connect heater hose and hose clamp to coolant return tube.

(8) Install water pump pulley. Tighten bolts to 27 N●m (20 ft. lbs.) torque. Place a bar or screwdriver between water pump pulley bolts (Fig. 11) to prevent pulley from rotating.

(9) Relax tension from belt tensioner (Fig. 14). Install drive belt.

CAUTION: When installing the serpentine accessory drive belt, belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 17) for correct belt routing. The correct belt with correct length must be used.

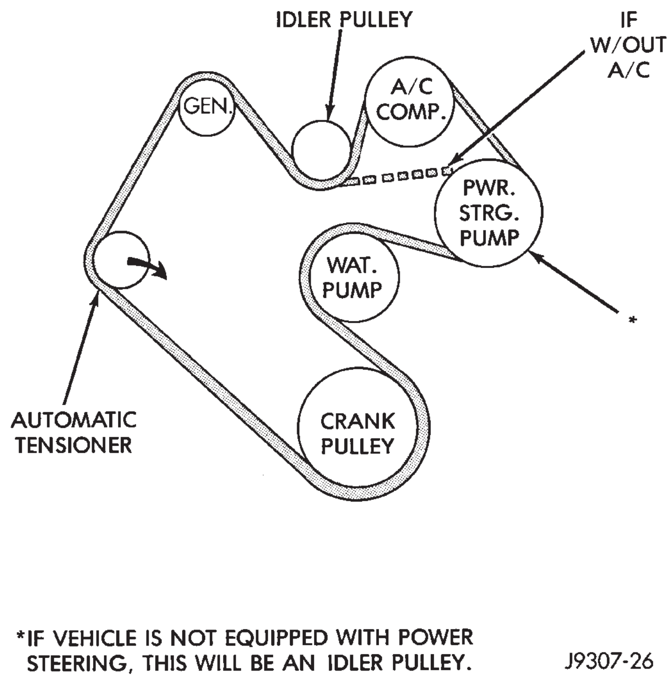

Fig. 17 Belt Routing—5.2L Engine

(10) Position fan shroud and fan blade/viscous fan drive assembly to vehicle as a complete unit.

(11) Install two fan shroud-to-radiator nuts (Fig. 13).

Be sure of at least 25 mm (1.0 inches) between tips of fan blades and fan shroud.

(12) Install fan blade/viscous fan drive assembly to water pump shaft.

(13) Fill cooling system. Refer to Refilling the Cooling System in this group.

(14) Connect negative battery cable.

(15) Start and warm the engine. Check for leaks.

WATER PUMP BYPASS HOSE—5.2L ENGINE

A water pump bypass hose (Fig. 18) is used between the intake manifold and water pump on all 5.2L V-8 engines. To test for leaks, refer to Testing Cooling System for Leaks in this group.

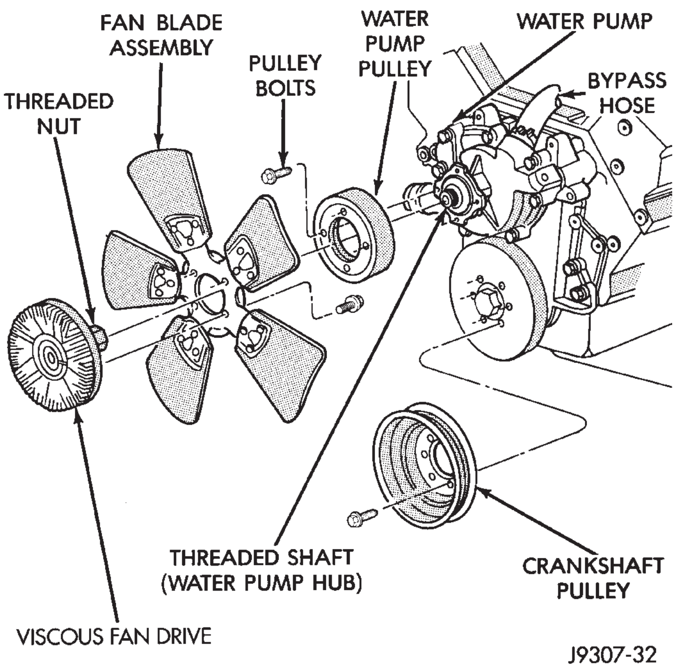

Fig. 18 Water Pump Bypass Hose—5.2L Engine

WITHOUT AIR CONDITIONING (A/C)

REMOVAL

(1) Partially drain cooling system. Refer to Draining Cooling System in this group.

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON ALL COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING THIS TYPE OF CLAMP, ONLY USE TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP SUCH AS MILLER CLAMP TOOL 6094 (FIG. 19).

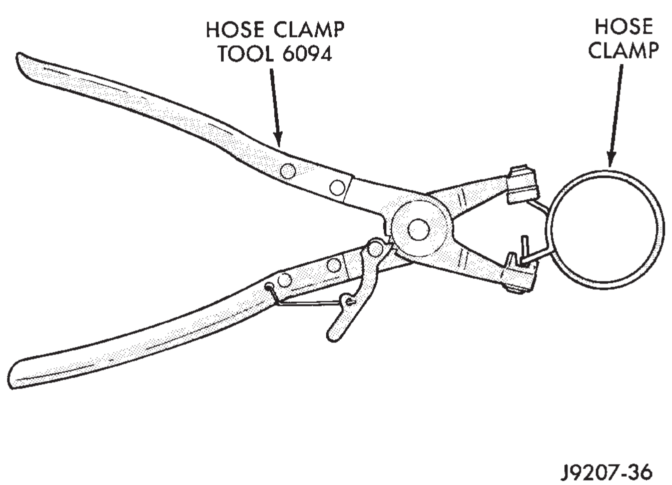

Fig. 19 Hose Clamp Tool

(2) Loosen both bypass hose clamps (Fig. 19) and position to center of hose. Remove hose from vehicle.

INSTALLATION

(1) Position bypass hose clamps (Fig. 19) to center of hose.

(2) Install bypass hose to engine.

(3) Secure both hose clamps (Fig. 19).

(4) Fill cooling system. Refer to Refilling the Cooling System in this group.

(5) Start and warm the engine. Check for leaks.

WITH AIR CONDITIONING (A/C)

REMOVAL

If equipped with A/C, the generator and A/C compressor along with their common mounting bracket (Fig. 20) must be partially removed. Removing generator or A/C compressor from their mounting bracket is not necessary. Also, discharging A/C system is not necessary. **Do not** remove any refrigerant lines from A/C compressor.

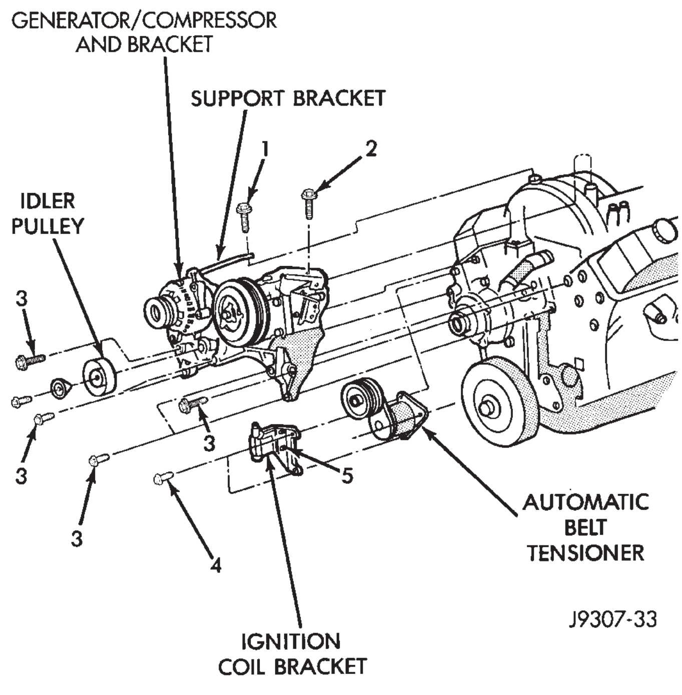

Fig. 20 Generator—A/C Compressor Mounting Bracket—5.2L Engine

WARNING: THE A/C SYSTEM IS UNDER PRESSURE EVEN WITH ENGINE OFF. REFER TO REFRIGERANT WARNINGS IN GROUP 24, HEATING AND AIR CONDITIONING.

(1) Disconnect negative battery cable from battery.

(2) Partially drain cooling system. Refer to Draining Cooling System in this group.

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(3) Remove upper radiator hose clamp (Fig. 19) and hose at radiator.

(4) Unplug wiring harness from A/C compressor.

(5) Remove air duct at throttle body.

(6) Disconnect A/C lines from clip at intake manifold.

(7) Remove heater hose coolant return tube mounting bolt and nut (Fig. 21). Remove tube from engine and discard the old tube O-ring.

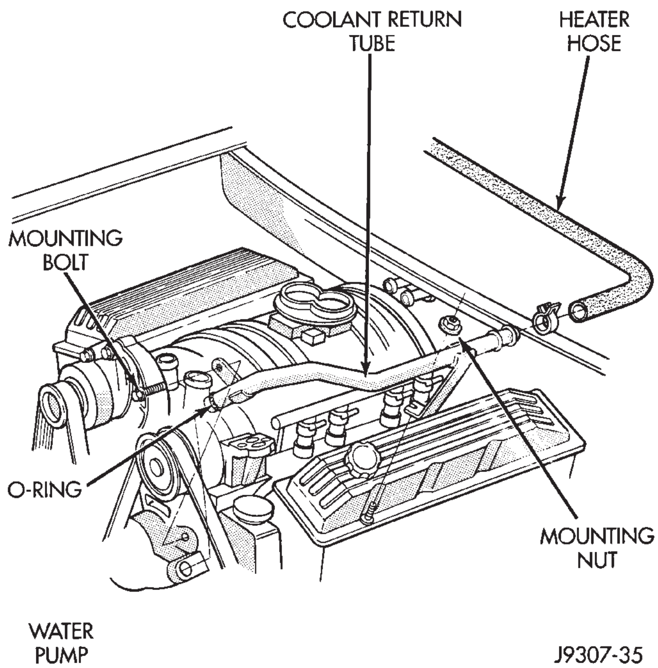

Fig. 21 Coolant Return Tube—5.2L Engine

(8) Remove accessory drive belt as follows: The drive belt is equipped with a spring loaded automatic belt tensioner (Fig. 22). Relax tension from belt by rotating tensioner clockwise (as viewed from front) (Fig. 22). When all belt tension has been relaxed, remove accessory drive belt.

(9) The drive belt idler pulley must be removed to gain access to one of A/C compressor/generator bracket mounting bolts. Remove idler pulley bolt and remove idler pulley (Fig. 20).

(10) Remove oil dipstick tube mounting bolt at side of A/C-generator mounting bracket.

(11) Disconnect speed control cable and throttle cable at throttle body. Refer to Accelerator Pedal and Throttle Cable in Group 14, Fuel System for throttle cable removal and installation. Refer to Group 8H for removal and installation of speed control cable.

(12) Remove bracket-to-intake manifold bolts (number 1 and 2—Fig. 20).

(13) Remove six bracket bolts (number 3—Fig. 20).

(14) Lift and position generator and A/C compressor (along with their common mounting bracket) to gain access to bypass hose. A block of wood may be used to hold assembly in position.

(15) Loosen and position both hose clamps to center of bypass hose. Remove hose from vehicle.

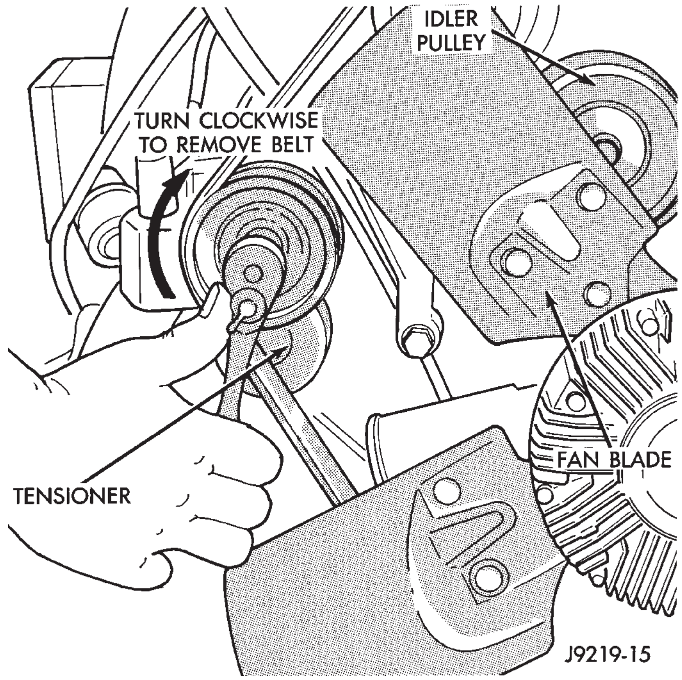

Fig. 22 Belt Tensioner Assembly—5.2L Engine

INSTALLATION

(1) Position bypass hose clamps to center of hose.

(2) Install bypass hose to engine.

(3) Secure both hose clamps (Fig. 19).

(4) Install generator-A/C mounting bracket assembly to engine. Tighten bolts (number 1 and 2—Fig. 20) to 54 N●m (40 ft. lbs.) torque. Tighten bolts (number 3—Fig. 20) to 40 N●m (30 ft. lbs.) torque.

(5) Install a new O-ring to the heater hose coolant return tube (Fig. 21). Coat the new O-ring with antifreeze before installation.

(6) Install coolant return tube to engine (Fig. 21).

Be sure the slot in tube bracket is bottomed to the mounting bolt. This will properly position return tube.

(7) Connect throttle body control cables.

(8) Install oil dipstick mounting bolt.

(9) Install idler pulley. Tighten pulley bolt to 54 N●m (40 ft. lbs.) torque.

(10) Relax tension from belt tensioner (Fig. 22). Install drive belt.

CAUTION: When installing serpentine accessory drive belt, belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 23) for correct belt routing. The correct belt with correct length must be used.

(11) Install air duct to throttle body.

(12) Install upper radiator hose to radiator.

(13) Connect wiring harness to A/C compressor.

(14) Connect A/C lines to clip at intake manifold.

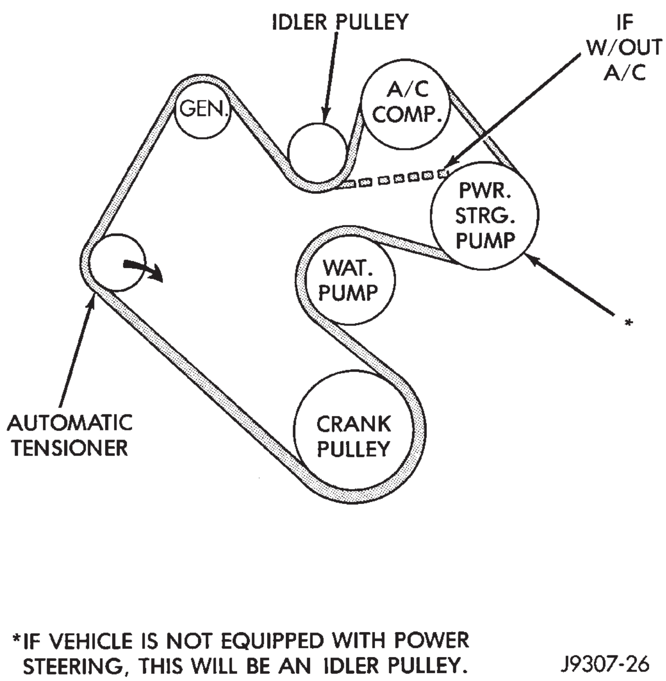

Fig. 23 Belt Routing—5.2L Engine

(15) Fill cooling system. Refer to Refilling the Cooling System in this group.

(16) Start and warm the engine. Check for leaks.

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 warm up 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.

The more common type of thermostat failure, usually found on high milage vehicles, is a thermostat failed in the shut position. The temperature gauge (if equipped) will give an indication of this condition. Depending upon length of time that vehicle is operated, pressure cap may vent. This will expel steam and coolant to coolant reserve/overflow tank and to surface below vehicle. Refer to the Diagnosis section of this group.

ON-BOARD DIAGNOSTICS

All models are equipped with On-Board Diagnostics. If the Powertrain Control Module (PCM) computer detects low engine coolant temperature, it will record a Diagnostic Trouble Code (DTC). The code number for low coolant temperature is 17. For other DTC numbers, refer to On-Board Diagnostics in the General Diagnosis section of Group 14, Fuel Systems.

REMOVAL—4.0L 6 CYLINDER ENGINE

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 THIS TYPE OF CLAMP, ONLY USE TOOLS DESIGNED FOR SERVICING THIS CLAMP.

(2) Remove radiator upper hose and heater hose at thermostat housing. Miller Clamp Tool number 6094 (Fig. 24) may be used to remove the constant tension clamps.

(3) Disconnect wiring connector at engine coolant temperature sensor.

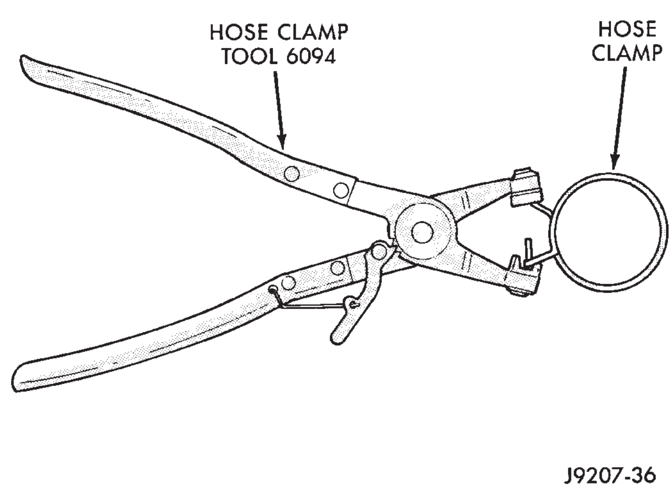

Fig. 24 Hose Clamp Tool

(4) Remove thermostat housing mounting bolts, thermostat housing, gasket and thermostat (Fig. 25). Discard old gasket.

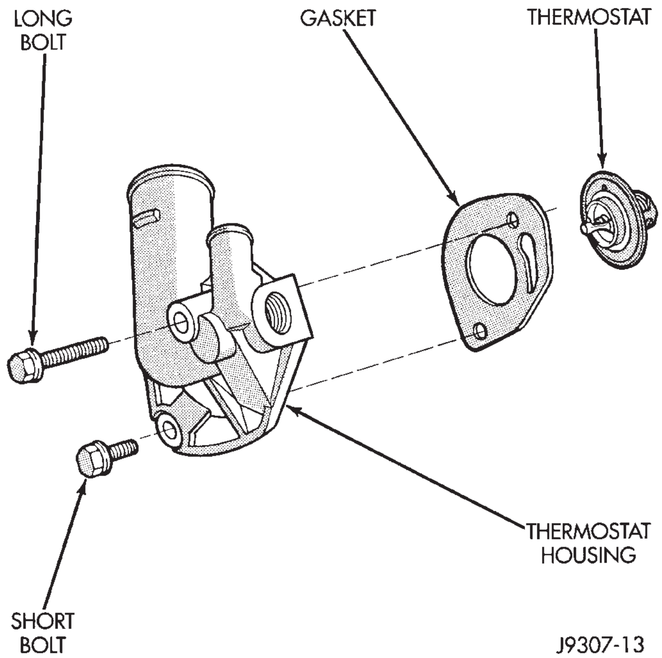

Fig. 25 Thermostat Removal/Installation—4.0L Engine

(5) Clean the gasket mating surfaces.

INSTALLATION—4.0L 6 CYLINDER ENGINE

(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. 26).

(b) Position thermostat in groove with arrow and air bleed hole on outer flange pointing up.

(2) Install replacement gasket and thermostat housing.

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 22 N●m (16 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.

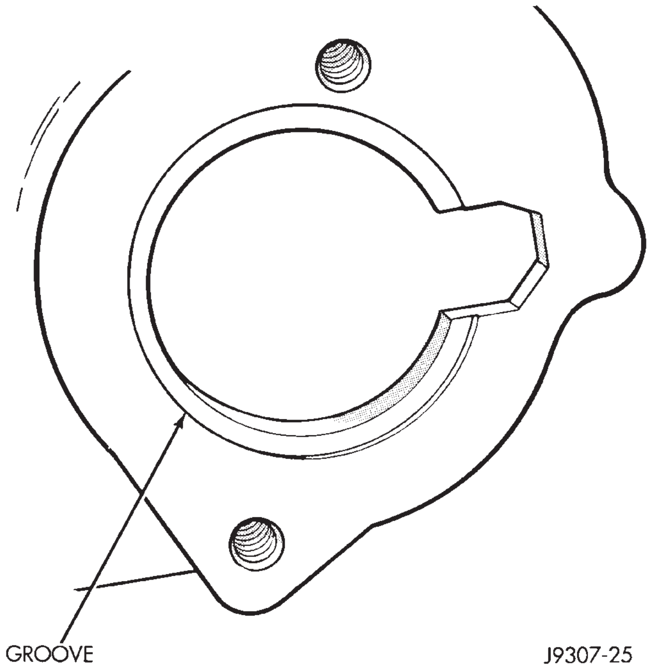

Fig. 26 Thermostat Recess—4.0L Engine

REMOVAL—5.2L V-8 ENGINE

WARNING: DO NOT LOOSEN RADIATOR DRAINCOCK WITH SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM COOLANT CAN OCCUR.

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

If thermostat is being replaced, be sure that replacement is specified thermostat for vehicle model and engine type.

Factory installed thermostat housings on 5.2L engines are installed on a gasket with an anti-stick coating. This will aid in gasket removal and clean-up.

(1) Disconnect negative battery cable at battery.

(2) Drain cooling system until coolant level is below thermostat. Refer to Draining Cooling System in this group.

(3) Air Conditioned vehicles: Remove support bracket (generator mounting bracket-to-intake manifold) located near rear of generator (Fig. 27).

(4) On Air Conditioning equipped vehicles, the generator must be partially removed.

(a) Remove generator drive belt as follows: Drive belts on the 5.2L engine are equipped with a spring loaded automatic belt tensioner (Fig. 28).

(b) Attach a socket/wrench to pulley mounting bolt of automatic belt tensioner (Fig. 28).

(c) Rotate tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(d) Remove belt from vehicle.

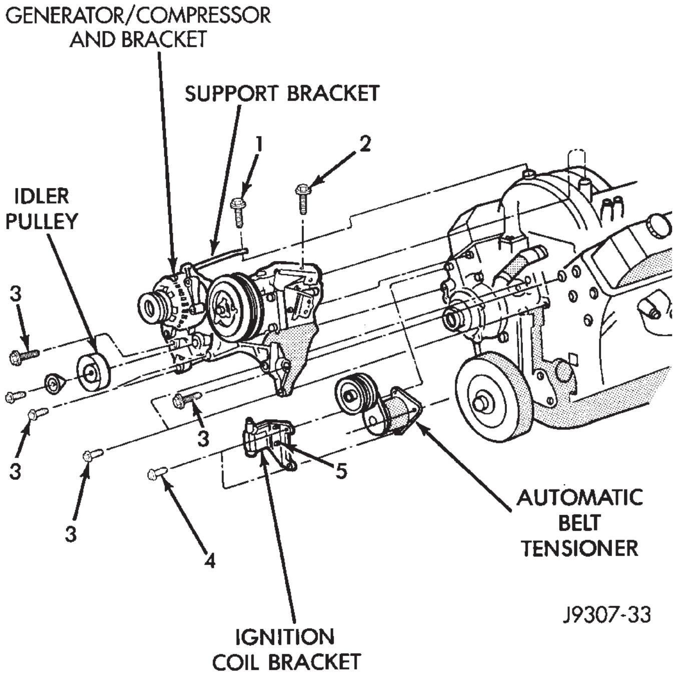

Fig. 27 Generator Support Bracket—5.2L Engine

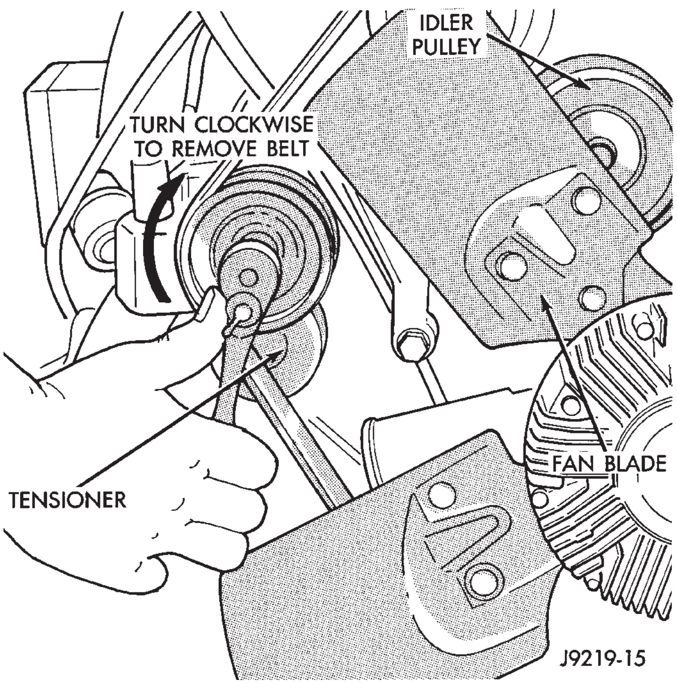

Fig. 28 Automatic Belt Tensioner—5.2L Engine

(e) Remove two generator mounting bolts. Do not remove any wiring at generator. If equipped with 4WD, unplug 4WD indicator lamp wiring harness (located near rear of generator).

(f) Remove generator. Position generator to gain access for thermostat gasket removal.

(5) Remove upper radiator hose clamp (Fig. 24) and upper radiator hose at thermostat housing.

(6) Position wiring harness (behind thermostat housing) to gain access to thermostat housing.

(7) Remove thermostat housing mounting bolts, thermostat housing, gasket and thermostat (Fig. 29). Discard old gasket.

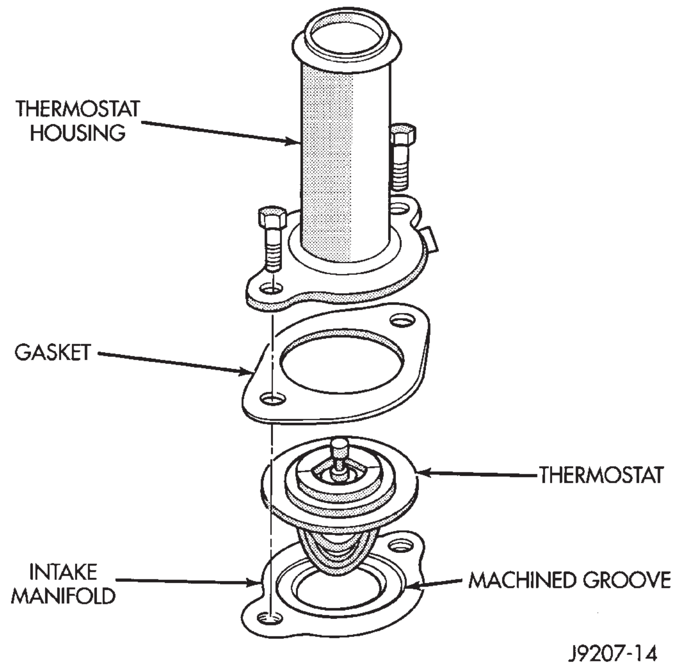

Fig. 29 Thermostat—5.2L Engine

INSTALLATION—5.2L V-8 ENGINE

(1) Clean mating areas of intake manifold and thermostat housing.

(2) Install thermostat (spring side down) into recessed machined groove on intake manifold (Fig. 29).

(3) Install gasket on intake manifold and over thermostat (Fig. 29).

(4) Position thermostat housing to intake manifold. Note the word FRONT stamped on housing (Fig. 30). For adequate clearance, this **must** be placed towards front of vehicle. The housing is slightly angled forward after installation to intake manifold.

(5) Install two housing-to-intake manifold bolts. Tighten bolts to 23 N●m (200 in. lbs.) torque.

CAUTION: Housing must be tightened evenly and thermostat must be centered into recessed groove in intake manifold. If not, it may result in a cracked housing, damaged intake manifold threads or coolant leak.

(6) Install upper radiator hose to thermostat housing.

(7) Air Conditioned vehicles:

(a) Install generator. Tighten bolts to 41 N●m (30 ft. lbs.).

(b) Install support bracket (generator mounting bracket-to-intake manifold) (Fig. 27). Tighten bolts to 54 N●m (40 ft. lbs.) torque.

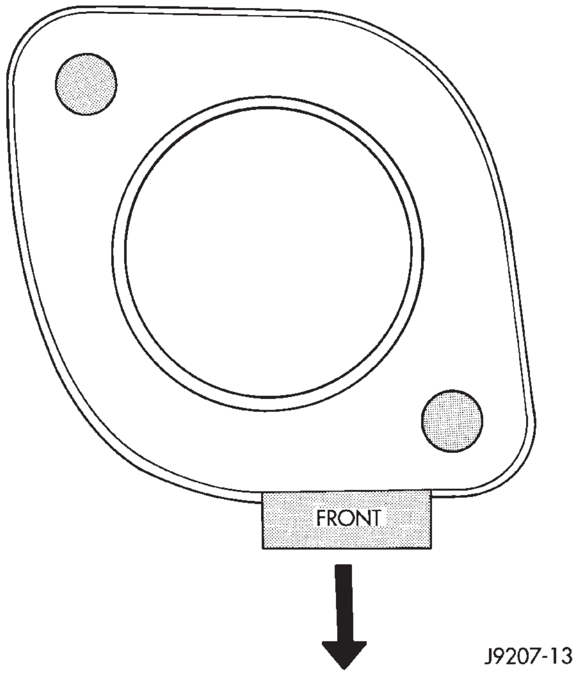

Fig. 30 Thermostat Position—5.2L Engine

CAUTION: When installing the serpentine accessory drive belt, belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 31) for correct 5.2L engine belt routing. The correct belt with correct length must be used.

(c) Position drive belt over all pulleys **except** idler pulley (located between generator and A/C compressor).

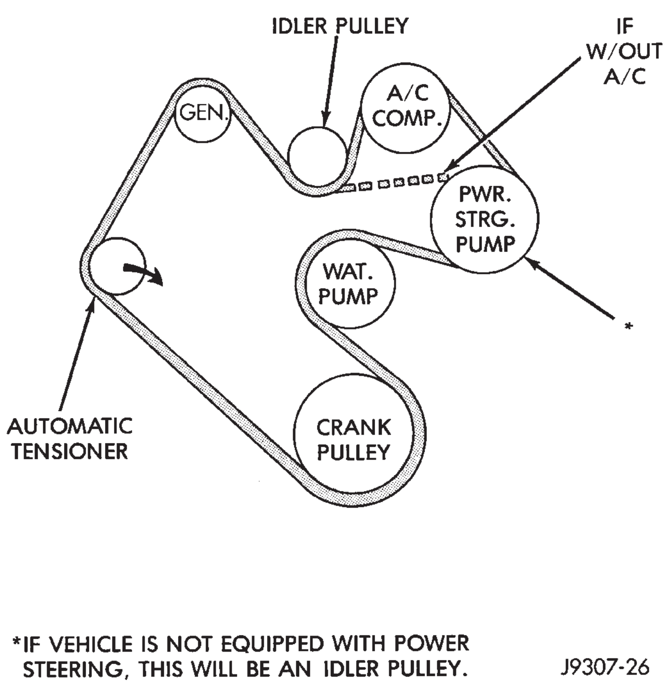

Fig. 31 Belt Routing—5.2L Engine

(d) Attach a socket/wrench to pulley mounting bolt of automatic belt tensioner (Fig. 28).

(e) Rotate socket/wrench clockwise. Place belt over idler pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated on all pulleys.

(8) Fill cooling system. Refer to Refilling Cooling System in this group.

(9) Connect negative battery cable to battery.

(10) 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 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% 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

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.

DRAINING ENTIRE SYSTEM

Use this procedure if the entire cooling system is to be drained, such as for engine removal.

(1) DO NOT remove radiator cap first. With engine cold, raise vehicle on a hoist and locate radiator draincock.

- 4.0L Engine: Radiator draincock is located on the right/lower side of radiator facing to rear of vehicle.
- 5.2L Engine: Radiator draincock is located on the left/lower side of radiator facing to rear of vehicle.

(2) Attach one end of a hose to the draincock. Put the other end into a clean container. Open draincock and drain coolant from radiator. This will empty the coolant reserve/overflow tank. The coolant does not have to be removed from the tank unless the system

is being refilled with a fresh mixture. When tank is empty, remove radiator cap and continue draining cooling system.

To drain the 4.0L 6 cylinder engine of coolant, remove the cylinder block drain plug located on the side of cylinder block (Fig. 32).

To drain the 5.2L V-8 engine of coolant, remove the cylinder block drain plugs located on the sides of cylinder block above the oil pan rail (Fig. 33).

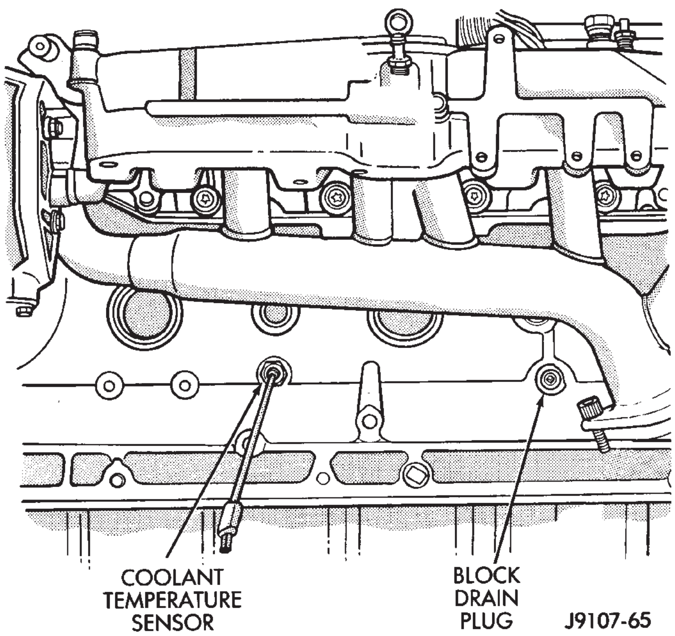

Fig. 32 Drain Plug—4.0L 6 Cylinder Engine

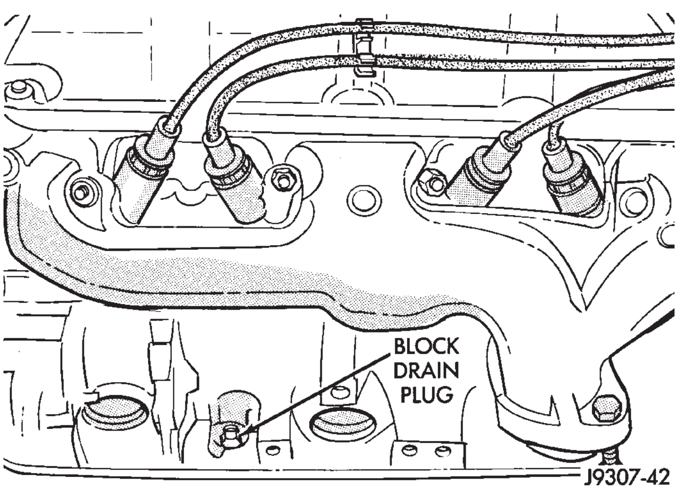

Fig. 33 Drain Plugs—5.2L V-8 Engine

PARTIAL DRAINING

Use this procedure if the coolant is to be partially drained, such as for engine thermostat removal.

(1) With engine cold, slowly remove the radiator cap. Raise vehicle on a hoist and locate radiator draincock.

- 4.0L Engine: Radiator draincock is located on the right/lower side of radiator facing to rear of vehicle.
- 5.2L Engine: Radiator draincock is located on the left/lower side of radiator facing to rear of vehicle.

(2) Attach one end of a hose to the draincock. Put the other end into a clean container.

(3) Open draincock and drain desired amount of coolant from radiator.

REFILLING COOLING SYSTEM

(1) Tighten the radiator draincock and the cylinder block drain plug(s) (if removed).

(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 the 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. When engine is cooling down, coolant will be drawn into the radiator from the reserve/overflow tank.

(5) Add coolant to reserve/overflow tank as necessary. **Only add coolant to the reserve/overflow tank when the engine is cold. Coolant level in a warm engine will be higher due to thermal expansion.** To purge the cooling system of all air, this heat up/cool down cycle (adding coolant to cold engine) must be performed three times. Add necessary coolant to raise tank level to the FULL mark after each cool down period.

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.

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. 34).

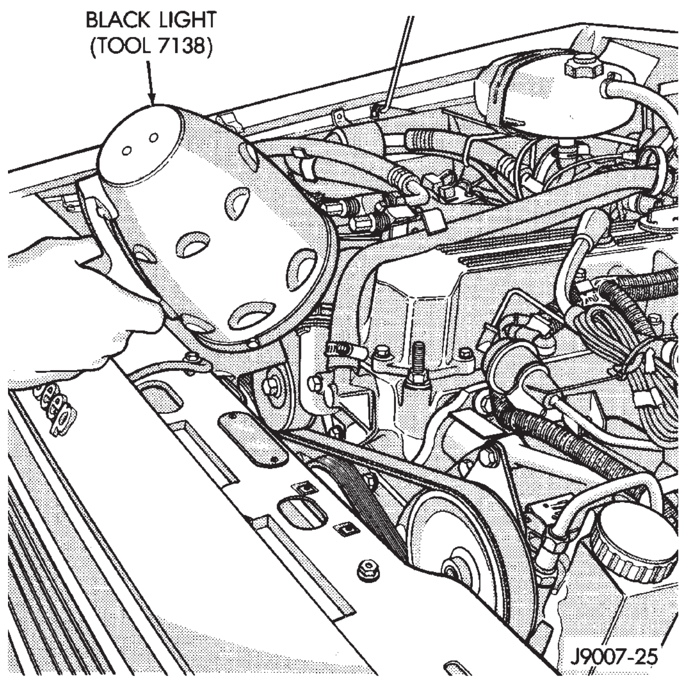

Fig. 34 Leak Detection Using Black Light—Typical

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. 35).

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.

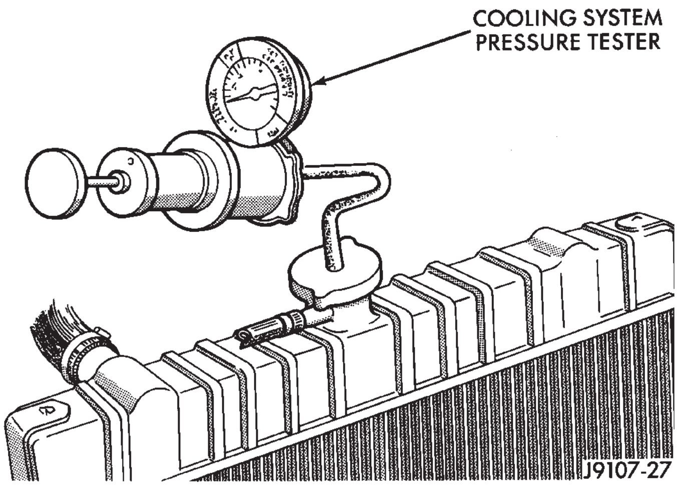

Fig. 35 Pressurizing System—Typical

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 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

This system works along with the radiator pressure cap. This is done by using thermal expansion and contraction of the coolant to keep the coolant free of trapped air. It provides:

- A volume for coolant expansion and contraction.
- A convenient and safe method for checking/adjusting coolant level at atmospheric pressure. This is done without removing the radiator pressure cap.
- Some reserve coolant to cover minor leaks and evaporation or boiling losses.

The coolant reserve/overflow system has a radiator mounted pressurized cap, an overflow tube and a plastic coolant reserve/overflow tank (Fig. 36)

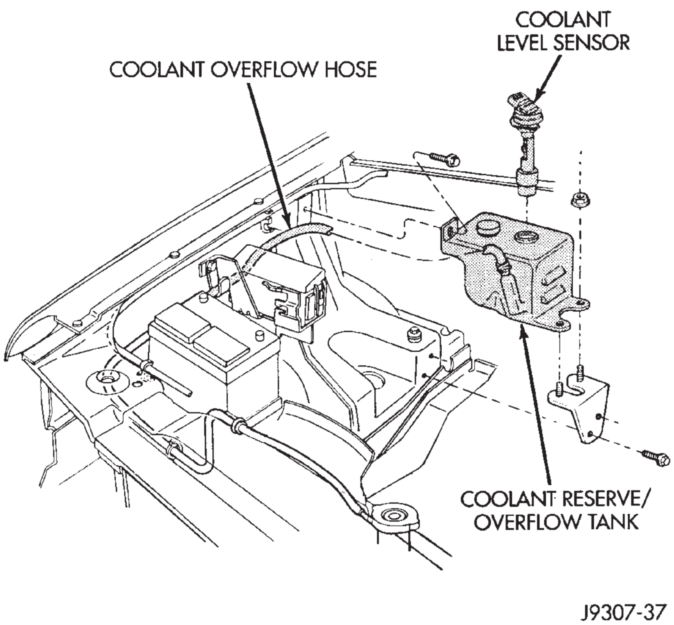

Fig. 36 Coolant Reserve/Overflow Tank—Typical

mounted to the right inner fender.

RADIATOR PRESSURE CAP

All radiators are equipped with a pressure cap. This cap releases pressure at some point within a range of 97-to-124 kPa (14-to-18 psi). The pressure relief point (in pounds) is engraved on top of the cap (Fig. 37).

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. 37) contains a spring-loaded pressure relief valve. This valve opens when system pressure reaches the release range of 97-to-124 kPa (14-to-18 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 the coolant cools, it contracts and creates a vacuum in cooling system. This causes the vacuum valve to open and coolant in

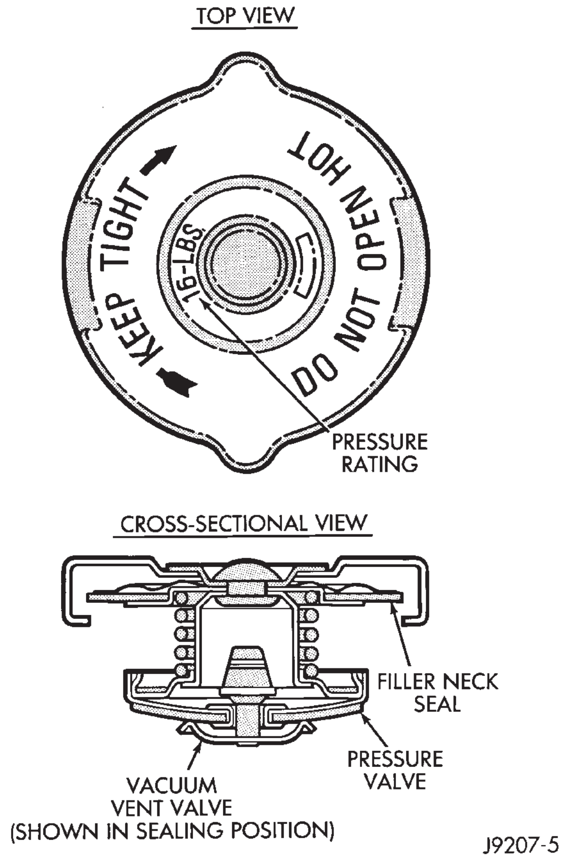

Fig. 37 Radiator Pressure Cap—Typical

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.

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. 37) 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:

- To check and adjust antifreeze freeze point.
- To refill system with new antifreeze.
- For conducting service procedures.
- 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. 38).

Operate the tester pump and observe the gauge pointer at its highest point. The cap release pressure should be 97-to-124 kPa (14-to-18 psi). The cap is satisfactory when the pressure holds steady. It is also good if it holds pressure within the 97-to-124 kPa (14-to-18 psi) range for 30 seconds or more. If the pointer drops quickly, replace the cap.

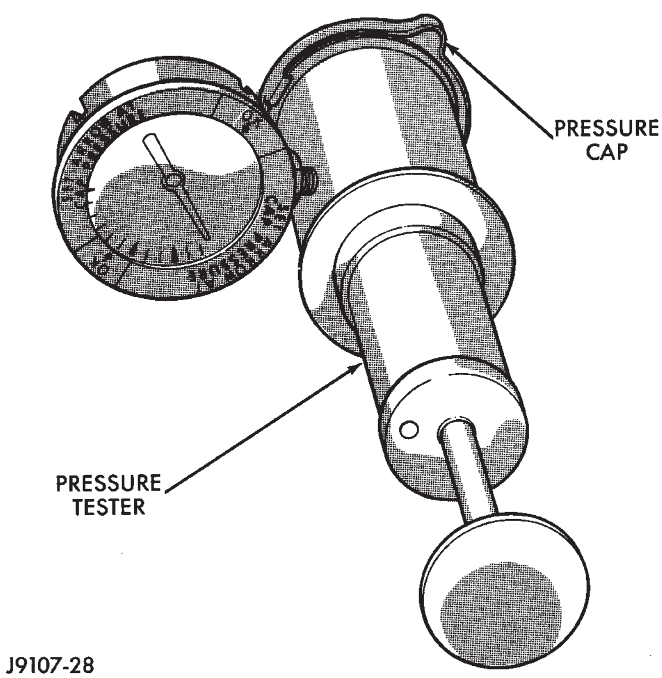

Fig. 38 Pressure Testing Radiator Pressure Cap

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.

RADIATOR

GENERAL INFORMATION

All vehicles are equipped with a cross flow type radiator with plastic side tanks.

Plastic tanks, while stronger than brass, are subject to damage by impact, such as from tools or wrenches. Handle radiator with care.

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.

REMOVAL

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR. REFER TO COOLING SYSTEM DRAINING IN THIS GROUP.

Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING THIS TYPE OF CLAMP, ONLY USE TOOLS DESIGNED FOR SERVICING THIS CLAMP, SUCH AS MILLER TOOL 6094 (FIG. 39)

CAUTION: When removing the radiator or A/C condenser for any reason, note the location of all radiator-to-body and radiator-to-A/C condenser rubber air seals. To prevent overheating, these seals must be installed to their original positions.

(1) Disconnect the negative battery cable at battery.

(2) Observe the previous WARNINGS and CAUTIONS.

(3) Drain coolant from radiator. Refer to Draining Cooling System in this group.

(4) **4.0L Engine:** Remove the four fan hub-to-water pump pulley mounting nuts (Fig. 40). Carefully remove the fan assembly from the water pump pulley

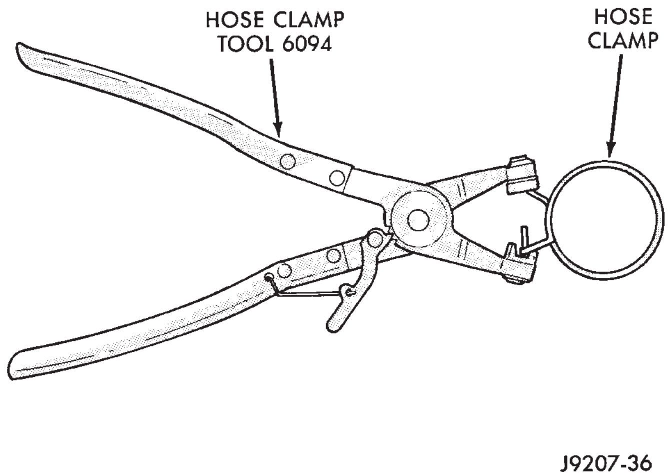

Fig. 39 Hose Clamp Tool

and position to center of fan shroud. Fan belt removal is not necessary as the water pump studs will hold the pump pulley in position.

Do not remove fan/viscous fan drive assembly from vehicle at this time.

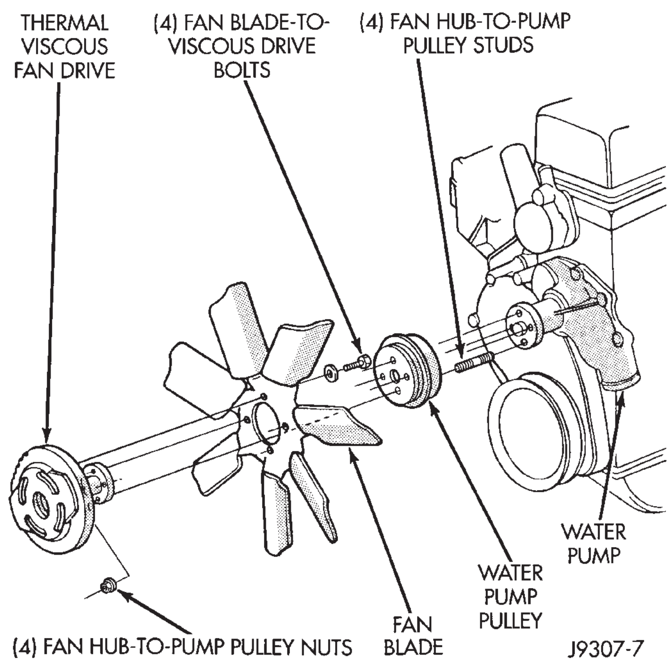

Fig. 40 Fan Mounting Nuts—4.0L Engine

5.2L Engine: The thermal Viscous Fan Drive is attached (threaded) to the water pump hub shaft (Fig. 41). Remove fan/viscous fan drive assembly from water pump by turning mounting nut counterclockwise as viewed from front. Threads on viscous fan drive are **RIGHT HAND**. A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) can be used. Place a bar or screwdriver between water pump pulley bolts (Fig. 41) to prevent pulley from rotating. Drive belt removal is not necessary for removal of fan drive.

Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

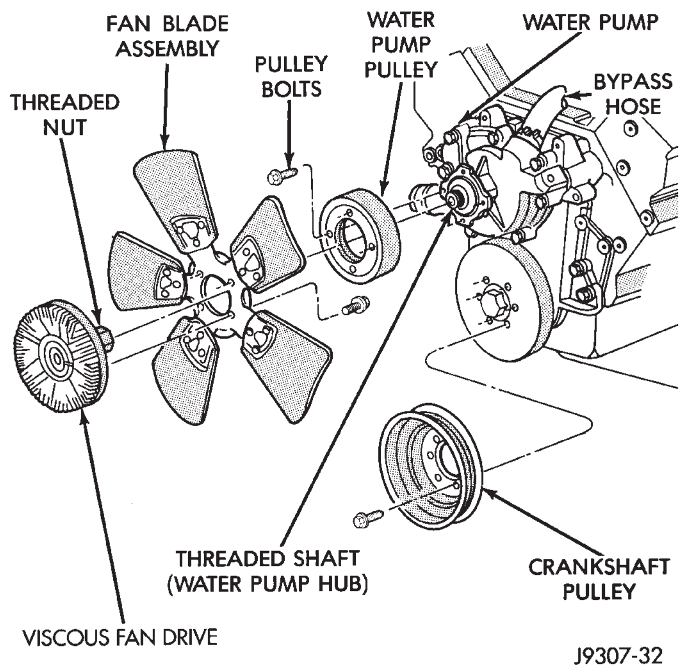

Fig. 41 Fan Blade and Viscous Fan Drive—5.2L Engine

(5) Remove the two fan shroud-to-upper radiator crossmember mounting nuts (Fig. 42).

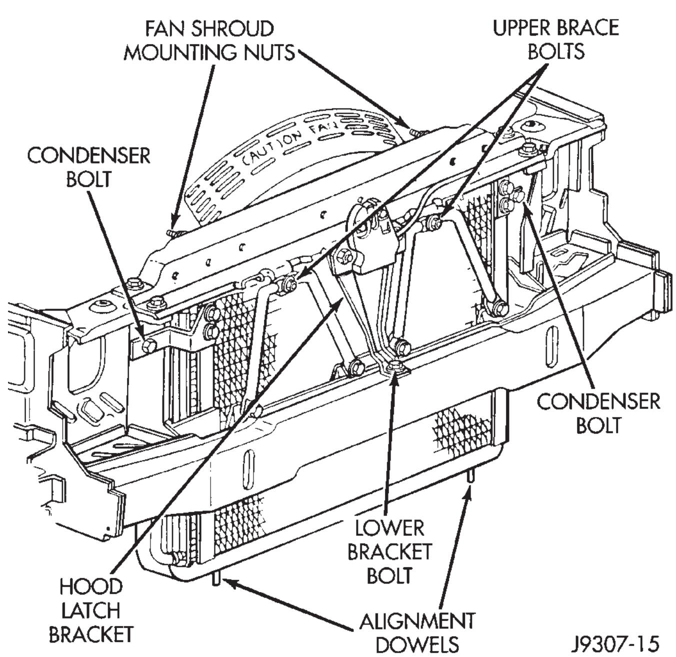

Fig. 42 Radiator—A/C Condenser Mounting

(6) Remove the fan assembly and fan shroud (as one unit) from vehicle.

(7) Special quick-connect fittings are used to join the transmission cooling lines to the radiator. Removal procedures are different between the 4.0L and 5.2L engine. Disconnect the cooling lines from the ra-

diator. Refer to Group 21 for transmission cooling line removal and installation.

(8) The radiator upper crossmember (Fig. 43) can be adjusted left or right through the use of slotted holes. Before removal, mark the original position of the crossmember.

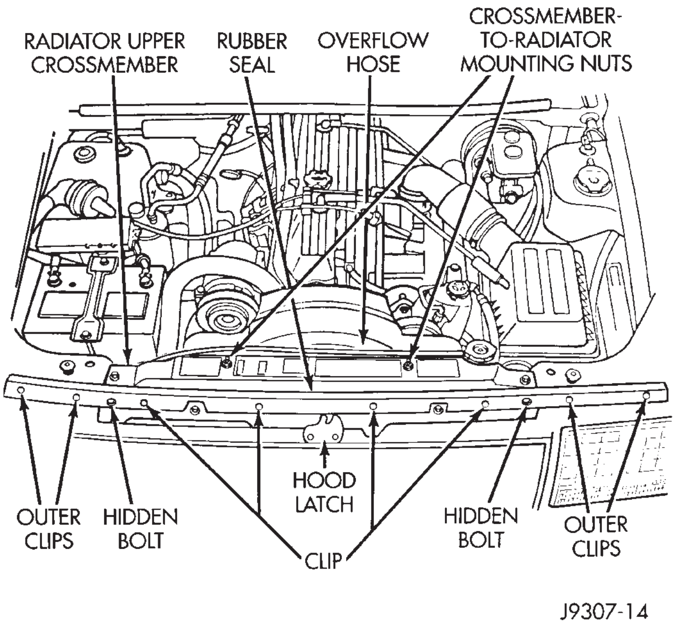

Fig. 43 Radiator Upper Crossmember—Typical

(9) Eight clips are used to retain a rubber seal (Fig. 43) to the body. Gently pry up the outboard clips (two per side) until rubber seal can be removed. Do not remove the clips entirely. Fold back the seal on both sides for access to (the hidden) grille opening reinforcement mounting bolts (Fig. 43). Remove these two bolts.

(10) Remove the grill. Refer to group 23, Body.

(11) Remove the upper brace bolt from each of the two radiator braces (Fig. 42).

(12) Remove the two crossmember-to-radiator mounting nuts (Fig. 43).

(13) Working through grill opening, remove the lower bracket bolt securing lower part of hood latch support bracket to lower frame crossmember (Fig. 42).

(14) Remove the remaining four bolts securing the radiator upper crossmember to the body. Do not remove the hood latch or hood latch cable from the crossmember. Lift the crossmember straight up and lay to the side.

(15) Equipped with air conditioning: Remove the two A/C condenser-to-radiator mounting bolts (Fig. 42). These two bolts are also used to retain the side mounted rubber air seals. These seals are compressed between the A/C condenser and the radiator. The lower part of the air seals are compressed between the radiator and the A/C condenser mounting brackets (Fig. 44).

Not equipped with air conditioning: Remove the two bolts retaining the side mounted rubber air seals to the radiator. The lower part of the air seals are compressed between the radiator and the radiator lower crossmember.

CAUTION: Note the location of all rubber air seals. To prevent overheating, they must be installed back to their original positions.

(16) Disconnect the coolant reserve/overflow tank hose (Fig. 43) at radiator.

(17) Remove upper radiator hose at radiator. Miller Clamp Tool number 6094 (Fig. 39) may be used to remove the constant tension hose clamps.

(18) 4.0L Engine Only: Remove the lower radiator hose at the water pump end.

(19) To gain access to lower radiator hose clamp at radiator, gently lift the radiator a slight amount. Remove hose clamp and hose.

The lower part of radiator is equipped with two alignment dowel pins (Figs. 42 or 44). They are located on the bottom of radiator tank and fit into rubber grommets. These rubber grommets are pressed into the radiator lower crossmember.

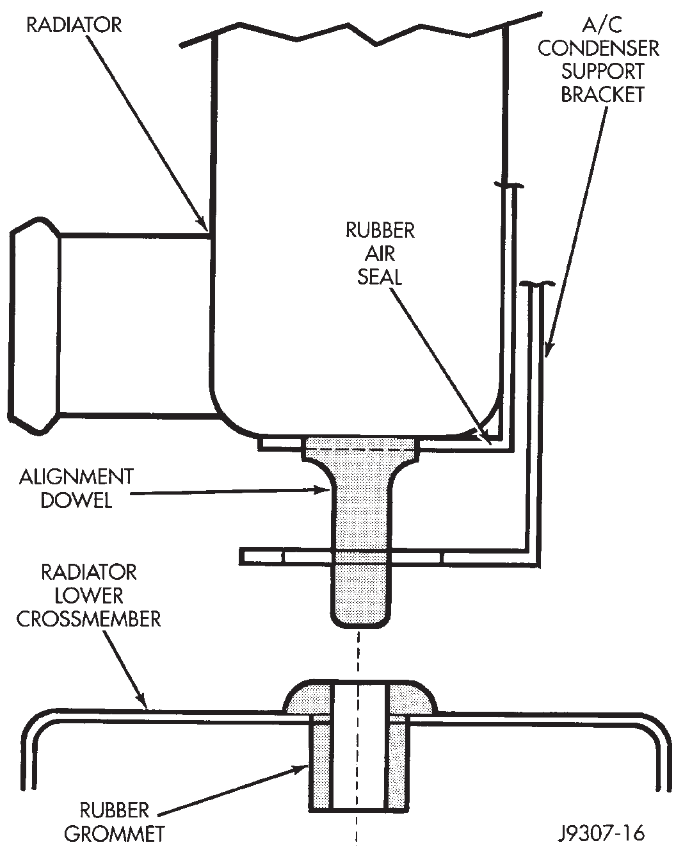

Fig. 44 Radiator Alignment Dowels

WARNING: THE AIR CONDITIONING SYSTEM (IF EQUIPPED) IS UNDER A CONSTANT PRESSURE EVEN WITH THE ENGINE OFF. REFER TO REFRIGERANT WARNINGS IN GROUP 24, HEATING AND AIR CONDITIONING BEFORE HANDLING ANY AIR CONDITIONING COMPONENT.

(20) If equipped with an auxiliary automatic transmission oil cooler, use caution when removing radiator. The oil cooler lines are routed through a rubber air seal on the left side of radiator. Do not cut or tear this seal.

(21) Gently lift up and remove radiator from vehicle. Be careful not to scrape the radiator fins against any other component. Also be careful not to disturb the air conditioning condenser (if equipped).

INSTALLATION

(1) Equipped with air conditioning: Gently lower the radiator into the vehicle. Guide the two radiator alignment dowels through the holes in the rubber air seals first and then through the A/C support brackets (Fig. 44). Continue to guide the alignment dowels into the rubber grommets located in lower radiator crossmember (Fig. 44). The holes in the L-shaped brackets (located on bottom of A/C condenser) must be positioned between bottom of rubber air seals and top of rubber grommets.

Not equipped with air conditioning: Gently lower the radiator into the vehicle. Guide the two radiator alignment dowels through the holes in the rubber air seals. Continue to guide the alignment dowels into the rubber grommets located in lower radiator crossmember.

(2) Connect the lower radiator hose and hose clamp to radiator.

CAUTION: The tangs on the hose clamp must be positioned straight down.

(3) 4.0L Engine: Connect the lower radiator hose at the water pump.

(4) Connect the upper radiator hose at the radiator.

(5) Equipped with air conditioning: Install the two A/C condenser-to-radiator mounting bolts (Fig. 42). These two bolts are also used to retain the rubber air seal to the sides of radiator.

Not equipped with A/C: Install the two bolts retaining the rubber air seal to sides of radiator.

(6) Install coolant reserve/overflow tank hose at radiator.

(7) If radiator-to-upper crossmember rubber isolators were removed from radiator, install them. Tighten mounting nuts to 3 N●m (24-36 in. lbs.) torque. Position upper radiator crossmember to radiator.

(8) Working through grill opening, install and tighten the hood latch support bracket-to-lower frame crossmember bolt (Fig. 42).

(9) Install the four bolts securing the radiator upper crossmember to the body (Fig. 43).

(10) Install two nuts securing the radiator to the upper radiator crossmember (Fig. 43). Tighten nuts to 2 N●m (18-21 in. lbs.) torque.

(11) Install the upper bolt to each radiator brace (Fig. 42).

(12) Install the grill. Refer to group 23, Body.

(13) Install the rubber seal (Fig. 43) to the four (outer) seal mounting clips on vehicle body. Press down on clips until seated.

(14) Install the transmission cooler lines to radiator. Refer to Group 21 for installation.

(15) Position the fan assembly and fan shroud (as one unit) to the vehicle.

(16) Position fan shroud to radiator. Be sure the alignment tabs at the lower part of shroud are placed into the slots near lower part of radiator.

(17) Install the two nuts securing the fan shroud to the upper radiator crossmember (Fig. 42).

(18) 4.0L Engine: Install the four nuts securing the fan assembly to the water pump (Fig. 40). Tighten nuts to 27 N●m (20 ft. lbs.) torque.

5.2L Engine: Install the fan/viscous fan drive assembly to the water pump.

(19) Rotate the fan blades (by hand) and check for interference at fan shroud.

Be sure of at least 25 mm (1.0 inches) between tips of fan blades and fan shroud.

(20) Fill cooling system. Refer to Refilling Cooling System in this group.

(21) Connect battery cable at battery.

(22) Start and warm engine. Check for leaks.

COOLING SYSTEM HOSES

Rubber hoses route coolant to and from the radiator, intake manifold and heater core.

The lower radiator hose is spring-reinforced to prevent collapse from water pump suction at moderate and high engine speeds.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON ALL COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING THIS TYPE OF CLAMP, ONLY USE TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP SUCH AS MILLER CLAMP TOOL 6094 (FIG. 45)

Inspect the hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed, or swell excessively when the system is pressurized.

Be sure that the hoses are positioned with sufficient clearance from the exhaust system, fan blades, drive belts and sway bars. This should be done in areas where specific routing clamps are not provided. If

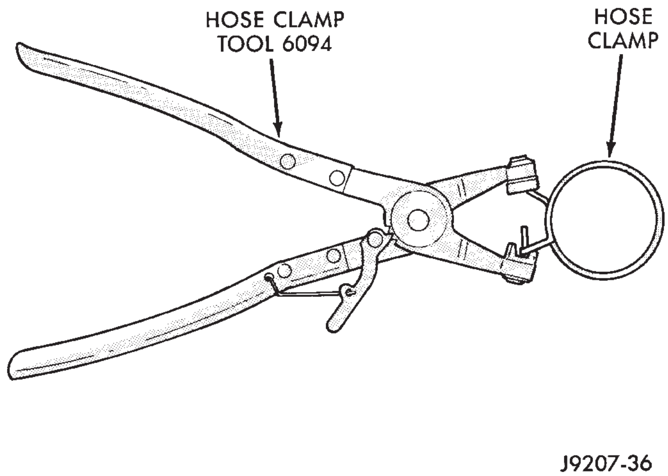

Fig. 45 Hose Clamp Tool

improperly positioned, the hoses will be damaged, resulting in coolant loss and overheating.

When performing a hose inspection, inspect the radiator lower hose for proper position and condition of the internal spring.

COOLING SYSTEM FAN

VISCOUS FAN DRIVE OPERATION

All models are equipped with a temperature controlled fan. The thermal Viscous Fan Drive is a torque-and-temperature sensitive clutch unit. It automatically increases or decreases fan speed to provide proper engine cooling.

The thermal Viscous Fan Drive is a silicone-fluid-filled coupling. It connects the fan assembly to the fan/water pump pulley (Figs. 46 or 47). 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 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 radiator discharge air. It engages the viscous fan drive for higher fan speed if air temperature from 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 clutch 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: 4.0L 6 cylinder engines equipped with serpentine accessory 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 fan drive can result in engine overheating.

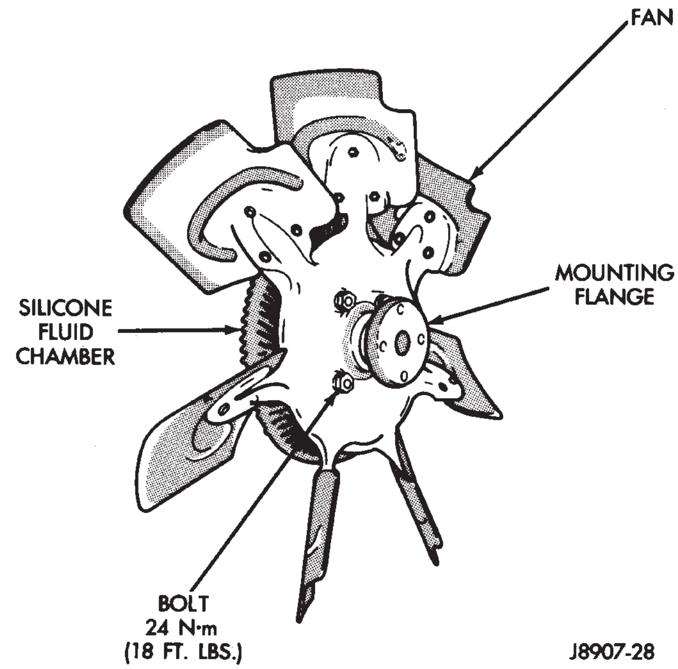

Fig. 46 Viscous Fan Drive—4.0L Engine—Typical

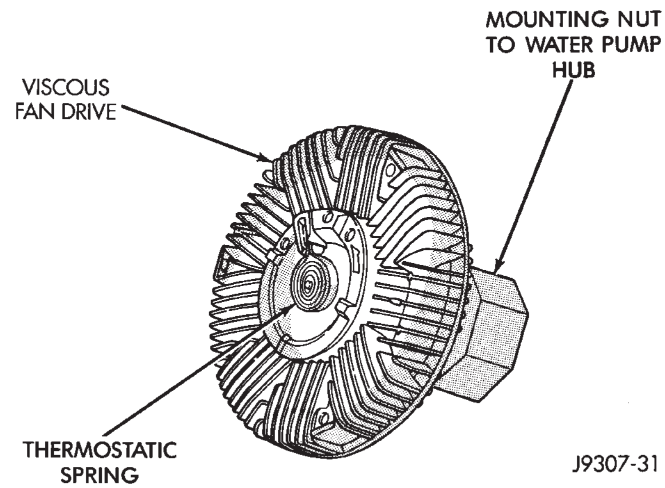

Fig. 47 Viscous Fan Drive—5.2L Engine—Typical

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.

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 ensure that the air flow is blocked.

(5) Be sure that the air conditioner 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 drive 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

4.0L 6 CYLINDER ENGINE

REMOVAL

(1) Remove the four fan hub-to-water pump pulley mounting nuts (Fig. 48). Carefully remove the fan assembly from the water pump pulley and position to center of fan shroud. Fan belt removal is not necessary as the water pump studs will hold the pump pulley in position. Do not remove fan assembly from vehicle at this time.

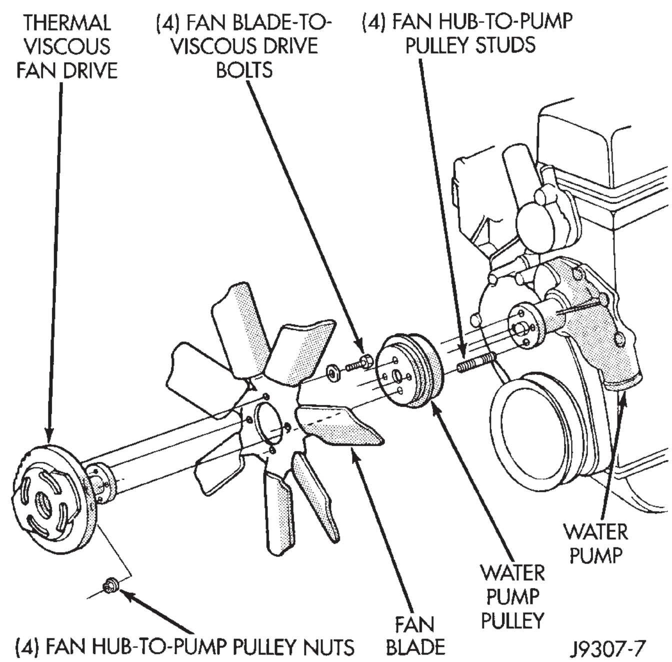

Fig. 48 Fan Mounting Nuts

(2) Remove the two fan shroud-to-upper radiator crossmember mounting nuts (Fig. 49).

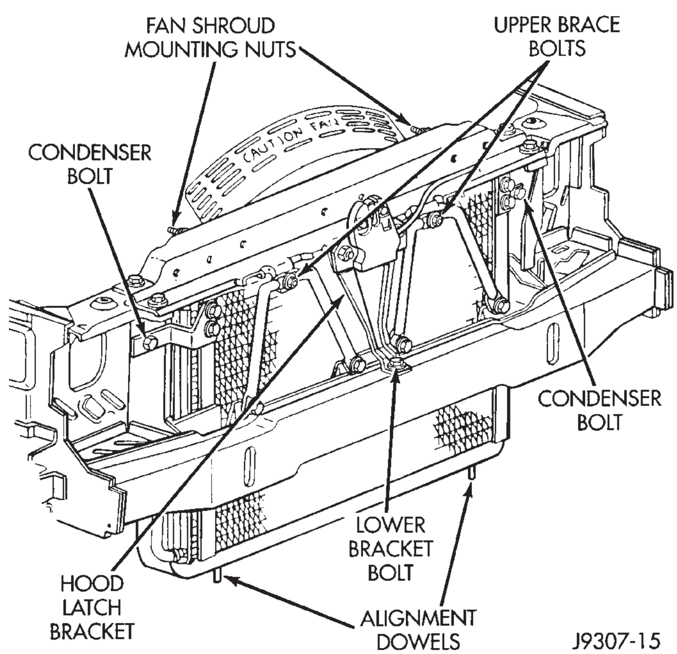

Fig. 49 Fan Shroud Mounting Nuts

(3) Remove fan, viscous fan drive and fan shroud as an assembly from the vehicle.

(4) Remove the four fan blade-to-viscous fan drive mounting bolts. Remove viscous fan drive from fan blades.

After removing fan blade/fan drive assembly **do not** place the thermal viscous fan drive in the horizontal position. If stored horizontally, the silicone fluid in the viscous fan drive could drain into the bearing assembly and contaminate the lubricant.

INSTALLATION

(1) Assemble fan blades to viscous fan drive. Tighten mounting bolts to 24 N●m (18 ft. lbs.) torque.

(2) Position fan, viscous fan drive and fan shroud to the engine as one assembly.

(3) Position fan shroud to radiator. Be sure the alignment tabs at the lower part of shroud are placed into the slots near lower part of radiator.

(4) Position mounting flange of fan/viscous fan drive assembly onto water pump pulley. Install four nuts and tighten to 24 N●m (18 ft. lbs.) torque.

(5) Install two fan shroud mounting nuts.

Be sure of at least 25 mm (1.0 inches) between tips of fan blades and fan shroud.

5.2 L V-8 ENGINE

REMOVAL

(1) Disconnect negative battery cable from battery.

(2) The thermal Viscous Fan Drive/Fan Blade Assembly is attached (threaded) to water pump hub shaft (Fig. 50). Remove fan blade/viscous fan drive assembly from water pump by turning mounting nut counterclockwise as viewed from front. Threads on viscous fan drive are **RIGHT HAND**. A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) can be used. Place a bar or screwdriver between water pump pulley bolts (Fig. 50) to prevent pulley from rotating.

Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

Do not unbolt fan blade assembly (Fig. 50) from viscous fan drive at this time.

(3) Remove two fan shroud-to-upper crossmember nuts (Fig. 49).

(4) Remove fan shroud and fan blade/viscous fan drive assembly as a complete unit from vehicle.

After removing fan blade/viscous fan drive assembly, **do not** place Viscous Fan Drive in horizontal position. If stored horizontally, silicone fluid in the viscous fan drive could drain into its bearing assembly and contaminate lubricant.

CAUTION: Do not remove water pump pulley-to-water pump bolts (Fig. 50). This pulley is under spring tension.

(5) Remove four bolts securing fan blade assembly to viscous fan drive (Fig. 50).

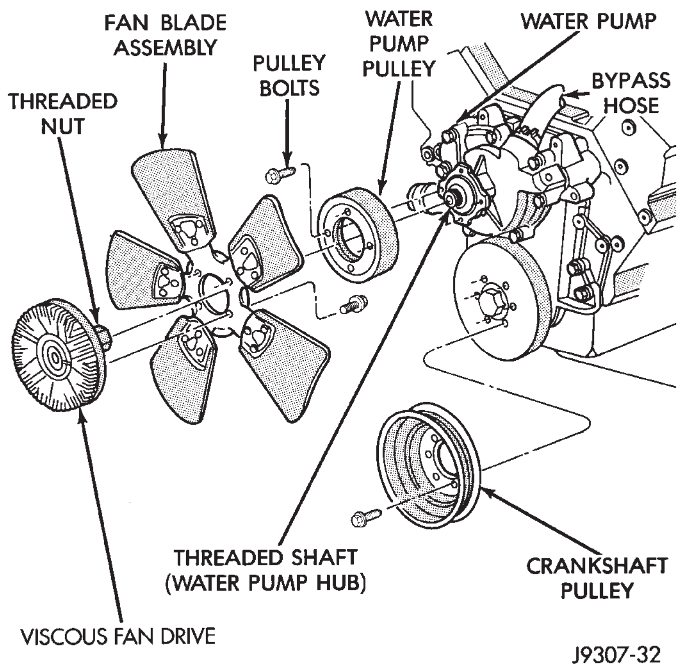

Fig. 50 Fan Blade/Viscous Fan Drive—5.2L Engine

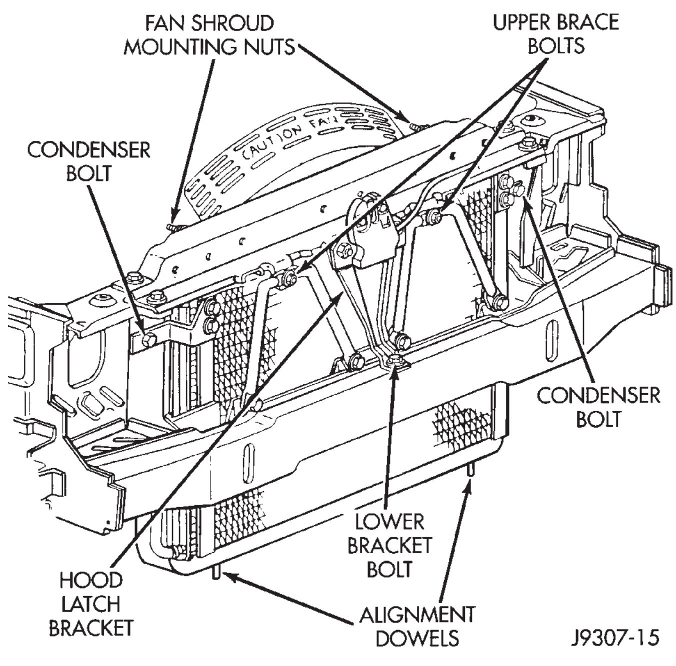

Fig. 51 Fan Shroud Mounting Nuts

INSTALLATION

(1) Install fan blade assembly to viscous fan drive. Tighten bolts (Fig. 50) to 23 N●m (17 ft. lbs.) torque.

(2) Position fan shroud and fan blade/viscous fan drive assembly to vehicle as a complete unit.

(3) Position fan shroud to radiator. Be sure the alignment tabs at the lower part of shroud are placed into the slots near lower part of radiator. Install and tighten the two fan shroud-to-upper crossmember mounting nuts.

Be sure of at least 25 mm (1.0 inches) between tips of fan blades and fan shroud.

(4) Install fan blade/viscous fan drive assembly to water pump shaft.

(5) Connect negative battery cable.

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: IF FAN IS NOT WITHIN SPECIFICATIONS, DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN.

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.

AUTOMATIC TRANSMISSION OIL COOLERS

There are two types of automatic transmission oil coolers:

- An oil-to-coolant type. This is supplied as standard equipment on vehicles with an automatic transmission. It is mounted in the radiator outlet tank.
- An external auxiliary oil-to-air cooler. This is supplied as optional equipment. It is mounted in front of the radiator and air conditioning condenser and behind the grille (Fig. 52).

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Remove the grill. Refer to Group 23, Body.

(3) Remove the bumper fascia. Refer to Group 23, Body.

(4) Remove the grill opening reinforcement panel. Refer to Group 23, Body.

(5) Remove two bracket bolts and three brace bolts (Fig. 52).

(6) Remove the retaining clip from the cooler lines (Fig. 52).

(7) Place a drain pan under the cooler.

(8) Disconnect the upper hose clamp at cooler line (Fig. 53). Separate the line from the rubber hose.

(9) Position the cooler to gain access to lower hose. The cooler lines are routed through a rubber seal located on the side of radiator. Be careful not to cut or tear this seal when positioning cooler for lower hose removal.

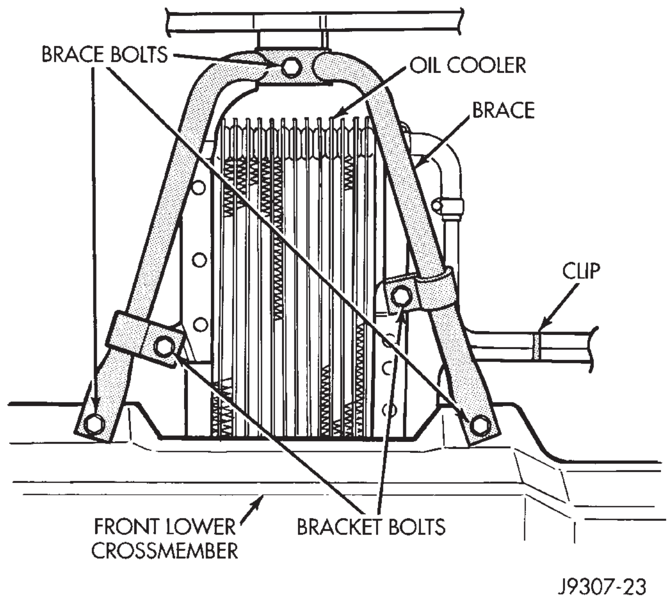

Fig. 52 Oil Cooler Mounting Brackets—Typical

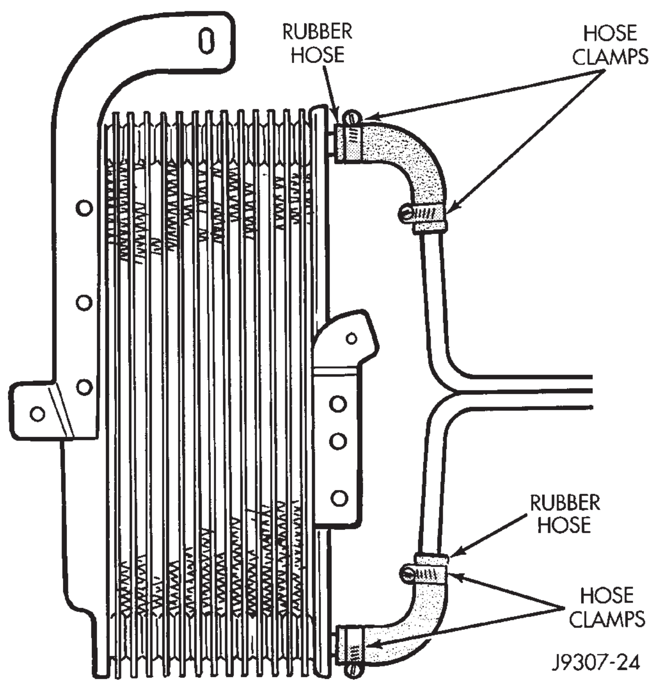

Fig. 53 Oil Cooler Hoses—Typical

(10) Remove lower hose clamp and hose from cooler.

(11) Remove cooler from vehicle.

INSTALLATION

(1) Position cooler to vehicle.

(2) Install lower hose and hose clamp to cooler. Hose clamp screws must be facing towards rear of vehicle. Tighten clamp to 2 N•m (18 in. lbs.) torque.

(3) Install upper hose and hose clamp at cooler. Hose clamp screws must be facing towards rear of vehicle. Tighten clamp to 2 N●m (18 in. lbs.) torque.

(4) Install brace and mounting bracket bolts (Fig. 52).

(5) Connect negative battery cable to battery.

(6) Add necessary transmission fluid. Refer to Group 21, Transmissions. Start engine and check for leaks.

(7) Install grill opening reinforcement panel, bumper fascia and grill. Refer to Group 23, Body.

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.

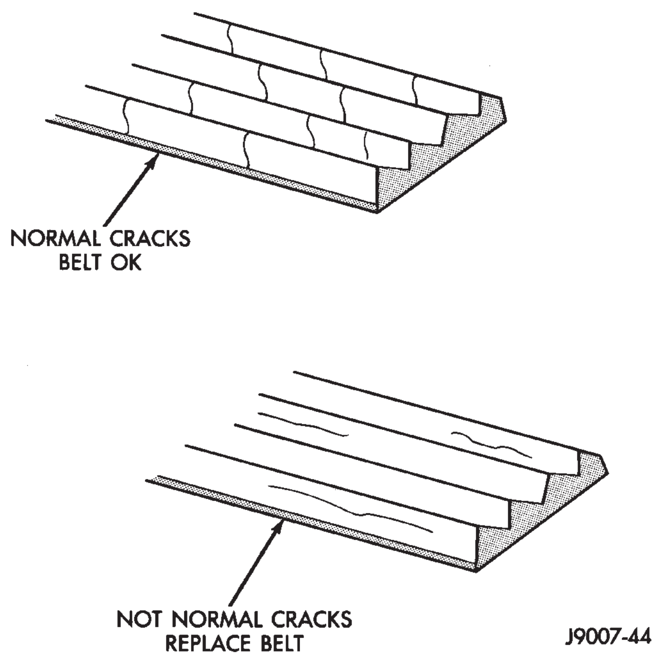

Fig. 1 Serpentine Belt Wear Patterns

SERPENTINE ACCESSORY 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. (2) Installation damage.	(1) Remove foreign objects from pulley grooves. Replace belt. (2) Replace belt.
RIB OR BELT WEAR	(1) Pulley(s) misaligned. (2) Abrasive environment. (3) Rusted pulley(s). (4) Sharp or jagged pulley groove tips. (5) Rubber deteriorated.	(1) Align pulley(s). (2) Clean pulley(s). Replace belt if necessary. (3) Clean rust from pulley(s). (4) Replace pulley. (5) Replace belt.
LONGITUDINAL BELT CRACKING (CRACKS BETWEEN TWO RIBS)	(1) Belt has mistracked from pulley groove. (2) Pulley groove tip has worn away rubber to tensile member.	(1) Replace belt. (2) Replace belt.
BELT SLIPS	(1) Belt slipping because of insufficient tension. (2) Belt or pulley subjected to substance (belt dressing, oil, ethylene glycol) that has reduced friction. (3) Driven component bearing failure. (4) Belt glazed and hardened from heat and excessive slippage.	(1) Adjust tension (4.0L). (1A) Check belt tensioner (5.2L). (2) Replace belt and clean pulleys. (3) Replace faulty component bearing. (4) Replace belt.
"GROOVE JUMPING" (BELT DOES NOT MAINTAIN CORRECT POSITION ON PULLEY)	(1) Belt tension either too high or too low. (2) Pulley(s) not within design tolerance. (3) Foreign object(s) in grooves. (4) Pulley misalignment. (5) Belt cordline is broken.	(1) Adjust belt tension (4.0L). (1A) Check belt tensioner (5.2L). (2) Replace pulley(s). (3) Remove foreign objects from grooves. (4) Align pulley(s). (5) Replace belt.
BELT BROKEN (NOTE: IDENTIFY AND CORRECT PROBLEM BEFORE NEW BELT IS INSTALLED)	(1) Excessive tension. (2) Tensile members damaged during belt installation. (3) Severe misalignment. (4) Bracket, pulley, or bearing failure.	(1) Replace belt. Adjust tension (4.0L). (1A) Check bent tensioner (5.2L). (2) Replace belt. (3) Align pulley(s). (4) Replace defective component and belt.

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SERPENTINE ACCESSORY DRIVE BELT DIAGNOSIS—CONTINUED

CONDITION	POSSIBLE CAUSE	CORRECTION
NOISE (OBJECTIONABLE SQUEAL, SQUEAK, OR RUMBLE IS HEARD OR FELT WHILE DRIVE BELT IS IN OPERATION)	(1) Belt slippage. (2) Bearing noise. (3) Belt misalignment. (4) Belt-to-pulley mismatch. (5) Driven component induced vibration. (6) System resonant frequency induced vibration.	(1) Adjust belt (4.0L). (1A) Check belt tensioner (5.2L). (2) Locate and repair. (3) Align belt/pulley(s). (4) Install correct belt. (5) Locate defective driven component and repair. (6) Vary the belt tension within specs (4.0L). (6A) Check belt tensioner (5.2L).
TENSION SHEETING FABRIC FAILURE (WOVEN FABRIC ON OUTSIDE CIRCUMFERENCE OF BELT HAS CRACKED OR SEPARATED FROM BODY OF BELT)	(1) Tension sheeting contacting stationary object. (2) Excessive heat causing woven fabric to age. (3) Tension sheeting splice has fractured.	(1) Correct rubbing condition. (2) Replace belt. (3) Replace belt.
CORD EDGE FAILURE (TENSILE MEMBER EXPOSED AT EDGES OF BELT OR SEPARATED FROM BELT BODY)	(1) Excessive tension. (2) Belt contacting stationary object. (3) Pulley(s) out of tolerance. (4) Insufficient adhesion between tensile member and rubber matrix.	(1) Adjust belt tension (4.0L). (1A) Check belt tensioner (5.2L). (2) Correct as necessary. (3) Replace pulley (4) Replace belt and adjust tension to specifications.

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BELT TENSION—4.0L ENGINE

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 (Fig. 2). Do not allow the gauge (or gauge adapter) to contact anything but the belt.

BELT TENSION—5.2L ENGINE

It is not necessary to adjust belt tension on the 5.2L (V-8) engine. The engine is equipped with an automatic belt tensioner (Fig. 3). The tensioner maintains correct belt tension at all times. For other tensioner information and removal/installation procedures, refer to Automatic Belt Tensioner—5.2L En-

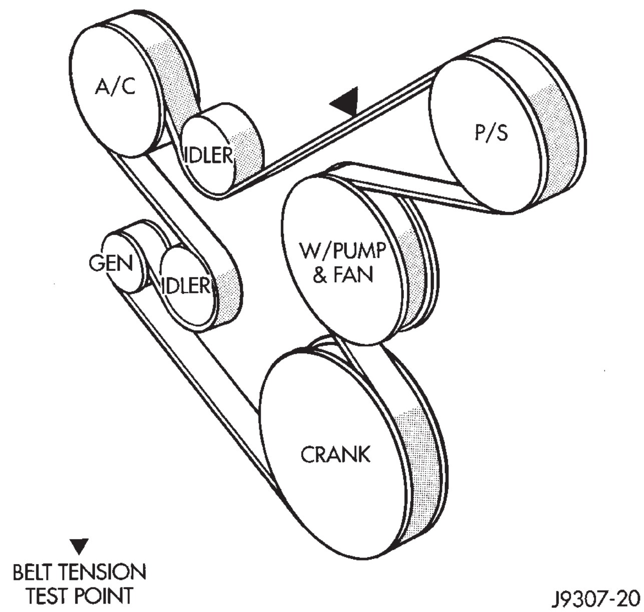

Fig. 2 Belt Routing—4.0L 6 Cylinder Engine

gine proceeding in this group. Due to use of this belt tensioner, do not attempt to use a belt tension gauge on 5.2L (V-8) engines.

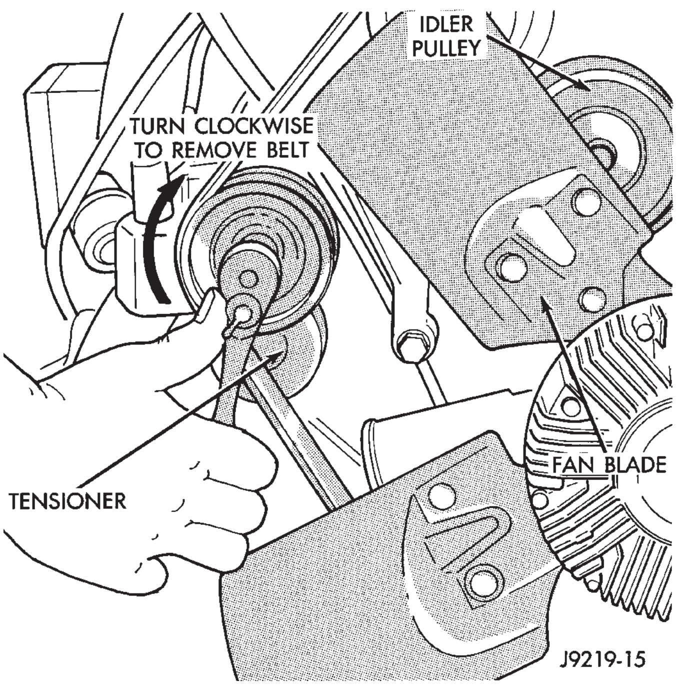

Fig. 3 Automatic Belt Tensioner—5.2L Engine

BELT TENSION SPECIFICATIONS

4.0L ENGINE

Proper belt tension for a new serpentine accessory drive belt is 800-900 N (180-200 lbs. force). For a used belt, the belt tension is 623-712 N (140-160 lbs. force). Belt tension is not adjustable on the 5.2L engine.

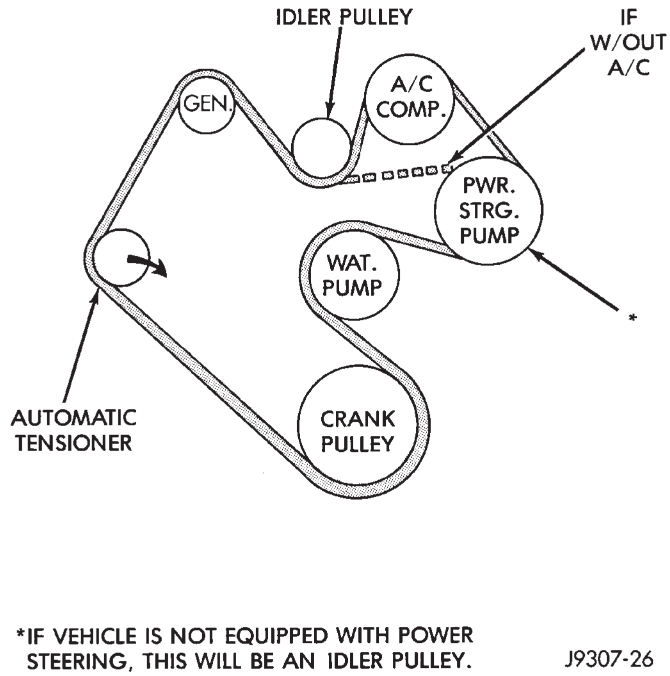

Fig. 4 Belt Routing—5.2 Engine

BELT SCHEMATICS

Refer to figures 2 or 4 for proper belt routing. Or, refer to the Belt Routing Label located in the vehicle engine compartment.

BELT SERVICE

REPLACEMENT/ADJUSTMENT—4.0L ENGINE

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. 5).

(2) Loosen upper pump pivot bolt B and lower lock nut C (Fig. 6).

(3) Loosen pump adjusting bolt D (Fig. 5).

(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.

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. 4) 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. 5) to attain proper belt tension.

(8) Tighten rear pump mounting bolts, pivot bolt and lock nut to 27 N•m (20 ft. lbs.) torque.

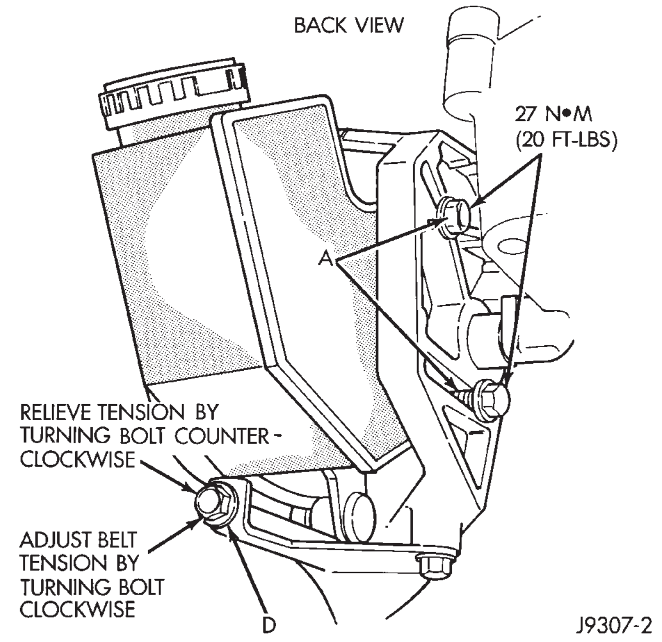

Fig. 5 P.S. Pump Rear Mounting Bolts—4.0L Engine

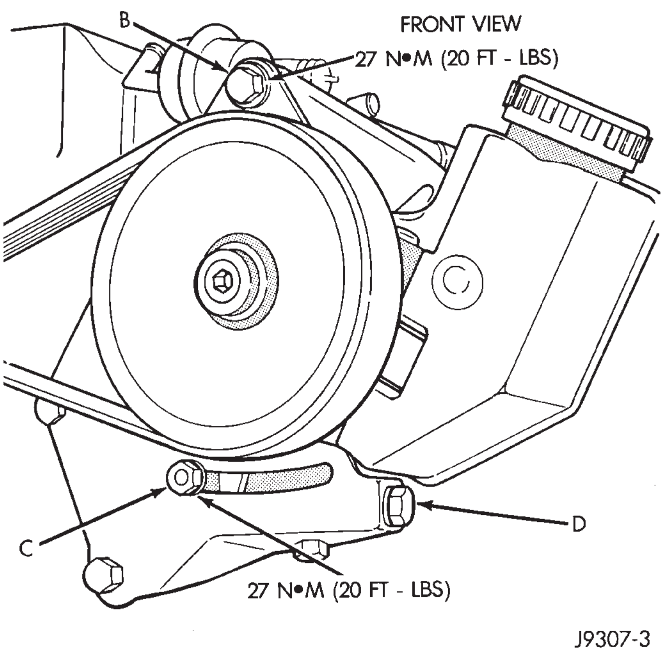

Fig. 6 P.S. Pump Front Mounting Bolt/Locknut—4.0L Engine

(9) After power steering pump has been tightened into position, recheck belt tension. Adjust if necessary.

REPLACEMENT—5.2L V-8 ENGINE

REMOVAL

Drive belts on the 5.2L V-8 engine are equipped with a spring loaded automatic belt tensioner (Fig. 7). This belt tensioner will be used on all belt configurations, such as with or without power steering or air conditioning. For more information, refer to Automatic Belt Tensioner—5.2L Engines, proceeding in this group.

(1) Attach a socket/wrench to pulley mounting bolt of automatic belt tensioner (Fig. 7).

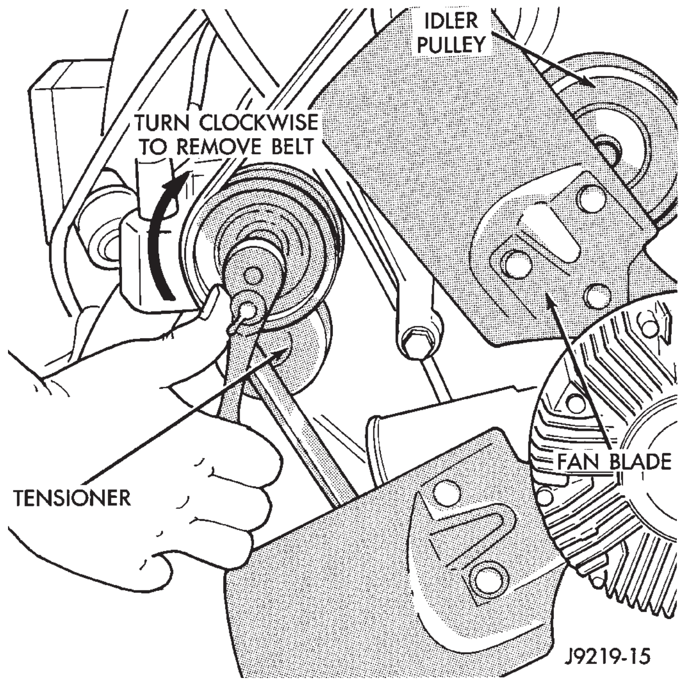

Fig. 7 Belt Tensioner—Belt Removal/Installation—5.2L Engine

(2) Rotate tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(3) Remove belt from idler pulley first.

(4) Remove belt from vehicle.

INSTALLATION

CAUTION: When installing serpentine accessory drive belt, belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 4) for correct 5.2L V-8 engine belt routing. The correct belt with correct length must be used.

(1) Position drive belt over all pulleys **except** idler pulley. This pulley is located between generator and A/C compressor.

(2) Attach a socket/wrench to pulley mounting bolt of automatic belt tensioner (Fig. 7).

(3) Rotate socket/wrench clockwise. Place belt over idler pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated on all pulleys.

(4) Check belt indexing marks. Refer to the proceeding Automatic Belt Tensioner—5.2L Engine for more belt information.

AUTOMATIC BELT TENSIONER—5.2L ENGINE

Drive belts on the 5.2L engine are equipped with a spring loaded automatic belt tensioner (Figs. 7 and 8). This belt tensioner will be used with all belt configurations. Such as with or without power steering or air conditioning.

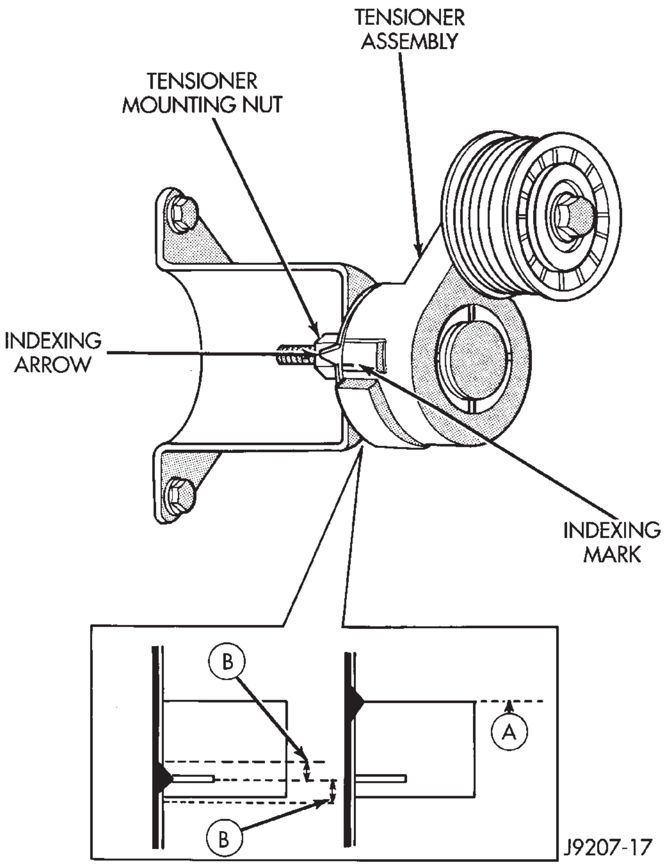

Fig. 8 Belt Tensioner/Pulley Assembly—5.2L Engine

The tensioner is equipped with an indexing arrow (Fig. 8) on back of tensioner and an indexing mark on tensioner housing. If a new belt is being installed, arrow must be within approximately 3 mm (1/8 in.) of indexing mark (Point B—Fig. 8). Belt is considered new if it has been used 15 minutes or less. If this specification cannot be met, check for:

- The wrong belt being installed (incorrect length/width)
- Worn bearings on an engine accessory (A/C compressor, power steering pump, water pump, idler pulley or generator)
- A pulley on an engine accessory being loose
- Misalignment of an engine accessory
- Belt incorrectly routed. Refer to (Fig. 4)

A used belt should be replaced if tensioner indexing arrow has moved beyond point A (Fig. 8).

REMOVAL

(1) Attach a socket/wrench to mounting bolt of automatic belt tensioner pulley bolt (Fig. 7).

(2) Rotate tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(3) Remove belt from idler pulley first.

(4) Remove belt from other pulleys.

(5) Disconnect wiring and secondary cable from ignition coil.

(6) Remove ignition coil from coil mounting bracket (two bolts). Do not remove coil mounting bracket from cylinder head.

(7) Remove tensioner assembly from mounting bracket (one nut) (Fig. 8).

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC BELT TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY (EXCEPT FOR PULLEY).

(8) Remove pulley bolt. Remove pulley from tensioner.

INSTALLATION

(1) Install pulley and pulley bolt to tensioner. Tighten bolt to 61 N●m (45 ft. lbs.).

(2) Install tensioner assembly to mounting bracket. An indexing tab is located on back of tensioner. Align this tab to slot in mounting bracket. Tighten nut to 67 N●m (50 ft. lbs.).

(3) Connect all wiring to ignition coil.

(4) Install coil to coil bracket. If nuts and bolts are used to secure coil to coil bracket, tighten to 11 N●m (100 in. lbs.) torque. If coil mounting bracket has been tapped for coil mounting bolts, tighten bolts to 5 N●m (50 in. lbs.) torque.

CAUTION: To prevent damage to coil case, coil mounting bolts must be torqued.

(5) Position drive belt over all pulleys **except** idler pulley (located between generator and A/C compressor).

CAUTION: When installing serpentine accessory drive belt, belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 4) for correct 5.2L engine belt routing. The correct belt with correct length must be used

(6) Attach a socket/wrench to pulley mounting bolt of automatic belt tensioner (Fig. 7).

(7) Rotate socket/wrench clockwise. Place belt over idler pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated on all pulleys.

(8) Check belt indexing marks.

ENGINE BLOCK HEATER

DESCRIPTION AND OPERATION

An optional engine block heater (Figs. 1 or 2) is available with 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 power cord to a grounded 110-120 volt AC electrical outlet with a grounded, three wire extension cord.

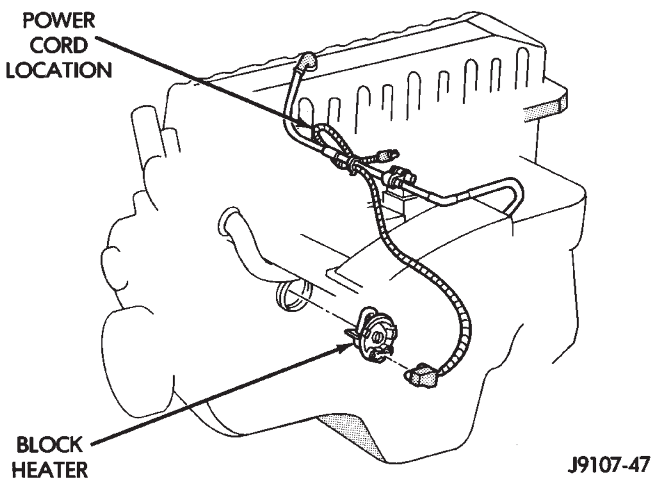

Fig. 1 Block Heater—4.0L Engine

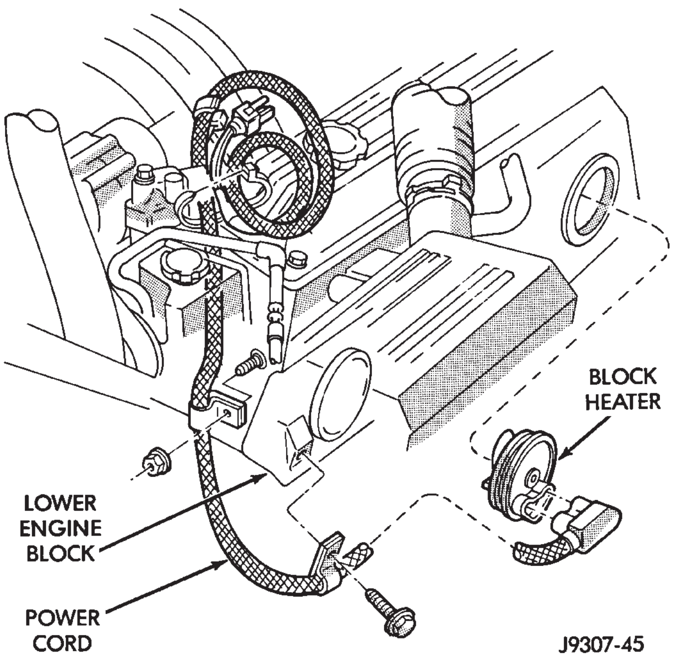

Fig. 2 Block Heater—5.2L Engine

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE. THE POWER CORD MUST BE SECURED IN ITS RETAINING CLIPS AND ROUTED AWAY FROM EXHAUST MANIFOLDS AND MOVING PARTS.

REMOVAL

(1) Disconnect negative battery cable from battery.

(2) Drain coolant from radiator. Refer to Draining Cooling System in this group.

(3) Raise vehicle.

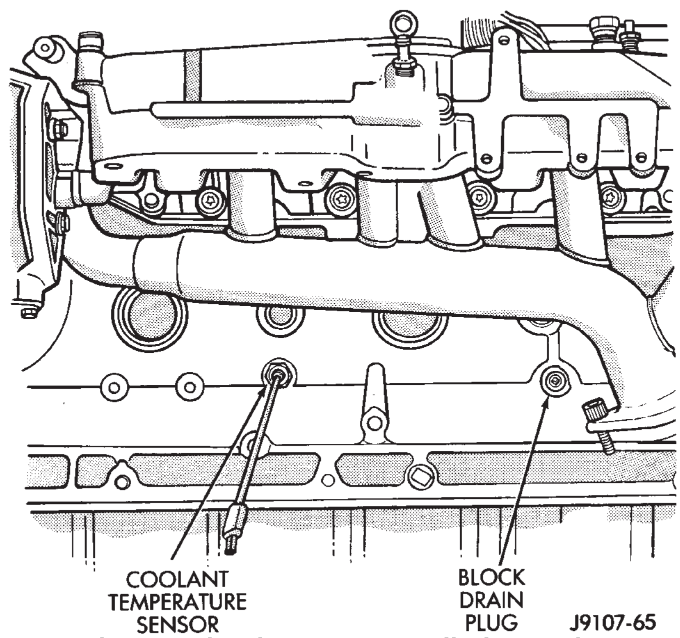

Fig. 3 Drain Plug—4.0L 6 Cylinder Engine

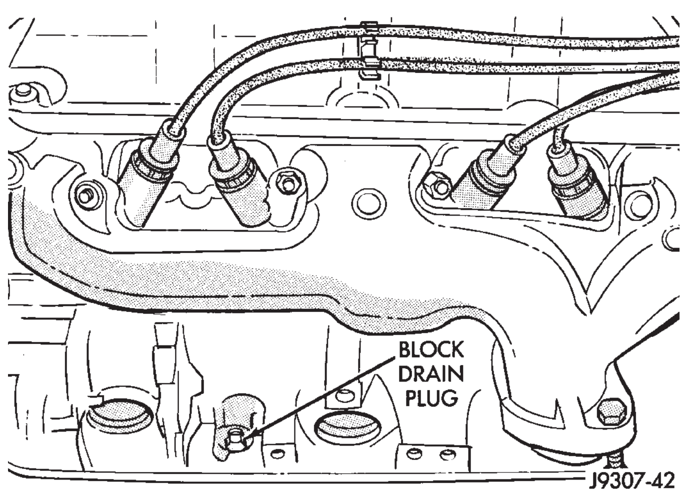

Fig. 4 Drain Plugs—5.2L V-8 Engine

(4) Remove engine cylinder block drain plug(s) located on the sides of cylinder block above the oil pan rail (Figs. 3 or 4).

(5) Remove power cord from block heater (Figs. 1 or 2).

(6) Loosen screw at center of block heater. Remove heater assembly.

INSTALLATION

(1) Thoroughly clean cylinder block core hole and block heater seat.

(2) Insert block heater assembly with element loop pointing down.

(3) With block heater fully seated, tighten center screw to 2 N●m (17 in. lbs.) torque.

(4) Fill cooling system with recommended coolant. Refer to Refilling Cooling System section in this group.

(5) Start and warm the engine. Check for leaks.

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. Refer to Group 25, Emission System for more information on the VECI label.

COOLING SYSTEM CAPACITIES

4.0L (6 cylinder engine)—
(a) with standard cooling system
8.5L (9.0 qts.)

4.0L (6 cylinder engine)—
(a) (b) with heavy duty cooling system
9.5L (10.0 qts.)

5.2L (V-8) engine
(a) All systems
14.1L (14.9 qts.)

(a) Nominal refill capacities are shown. A variation may be observed due to manufacturing tolerances and refill procedures.

(b) The heavy duty cooling system can be identified by the use of an auxiliary transmission oil cooler located in front of the radiator.

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DRIVE BELT TENSION

4.0L (6 cylinder) engine—
* (With new serpentine belt)
800-900 N (180-200 lbs. force)

4.0L (6 cylinder) engine—
* (With used serpentine belt)
623-712 N (140-160 lbs. force)

5.2L (V-8) engine—
Do not attempt to check belt tension with a tension gauge. Belt is equipped with an automatic tensioner. Refer to Automatic Belt Tensioner in Group 7, Cooling System.

* Specifications for use with a belt tension gauge. Refer to operating instructions supplied with gauge.

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TORQUE

DESCRIPTION	TORQUE
Generator Pivot Bolt (4.0L)	27 N•m (20 ft. lbs.)
Generator Rear Adj. Bolt (4.0L Engine)	27 N•m (20 ft. lbs.)
Automatic Belt Tensioner-To Mounting Bracket (5.2L)	67 N•m (50 ft. lbs.)
Automatic Belt Tensioner Pulley Bolt (5.2L)	61 N•m (45 ft. lbs.)
Auto. Trans. Auxiliary Oil Cooler Mtg. Screws	10 N•m (90 in. lbs.)
Block Htr. Mounting Screw	4 N•m (32 in. lbs.)
Fan Blade Assy.-to-Viscous Drive	24 N•m (18 ft. lbs.)
Fan/Drive Assy.-to-Water Pump (4.0L Engine)	27 N•m (20 ft. lbs.)
Fan Shroud Mtg. Bolts	3 N•m (20 in. lbs.)
Radiator Upper Isolator-to-Crossmember Mounting Nuts	3 N•m (20 in. lbs.)
Radiator Upper Isolator-to-Radiator Mounting Nuts	4 N•m (36 in. lbs.)
Radiator Brace Bolts	10 N•m (90 in. lbs.)
Thermostat Housing	22 N•m (16 ft. lbs.)
Upper Radiator Crossmember-to-Body Mounting Bolts	10 N•m (90 in. lbs.)
Water Pump Bolts (4.0L)	30 N•m (22 ft. lbs.)
Water Pump Bolts (5.2L)	40 N•m (30 ft. lbs.)
Water Pump Pulley (5.2L)	27 N•m (20 ft. lbs.)

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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 light 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.

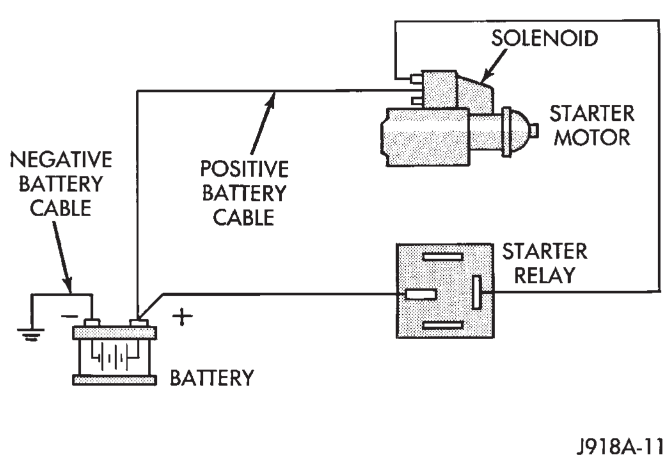

Fig. 1 Starting System Components (Typical)

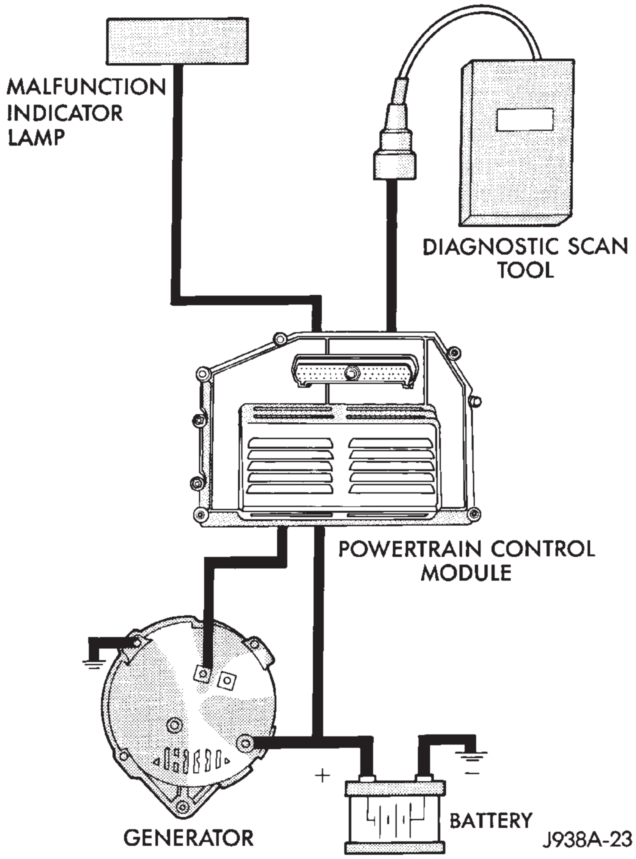

Fig. 2 Charging System Components

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 over an extended period. A chemical reaction takes place between sulfuric acid solution (electrolyte) and lead+/-plates in each cell of the battery. As the battery discharges, the plates collect 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. A factory installed battery has a built-in test indicator to help determine state-of-charge. Specific gravity can also be measured with a hand held 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 (Fig. 3).

WARNING: DO NOT ATTEMPT TO ASSIST BOOST, CHARGE, OR TEST BATTERY WHEN ELECTROLYTE LEVEL IS BELOW THE TOP OF THE PLATES (YELLOW OR BRIGHT COLOR IS VISIBLE). PERSONAL INJURY MAY OCCUR.

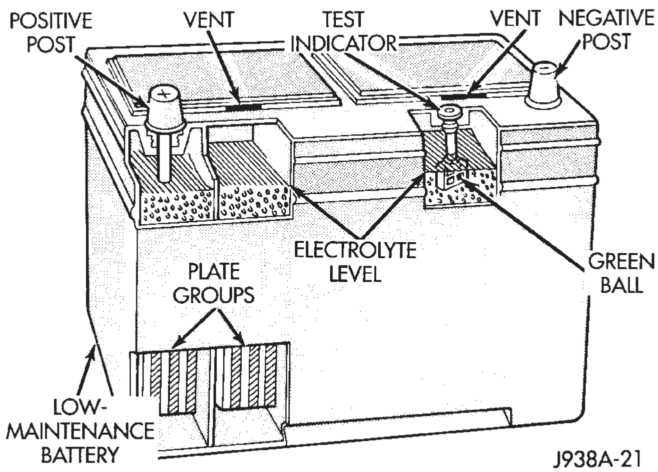

Fig. 3 Battery Construction and Test Indicator

When electrolyte level is below top of the plates (yellow or bright indicator), distilled water should be added. The battery must be completely charged (green indicator) and the top, posts, and terminals should be properly cleaned before diagnostic procedures are performed. Refer to Group 8B - Battery/Starter Service, for additional information.

All batteries are protected from high underhood temperatures by a thermal shield. Always install shield after removing the battery.

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% by weight or 24% by volume.

The condition of a battery may be determined from the results of 3 tests:

- state of charge, using test indicator
- hydrometer test
- ability to supply current (battery load test).

Use test indicator first. If battery condition is not certain then perform the Hydrometer test. If the specific gravity is less than 1.225, (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 A 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.

TEST INDICATOR

A test indicator (hydrometer) built into the top of battery case, provides visual information for battery testing (Fig. 4). It is important when using test indicator that the battery be level and have a clean top to see correct indications. A light may be required to view indicator.

WARNING: DO NOT USE OPEN FLAME. EXPLOSIVE GASES FORM ABOVE BATTERY.

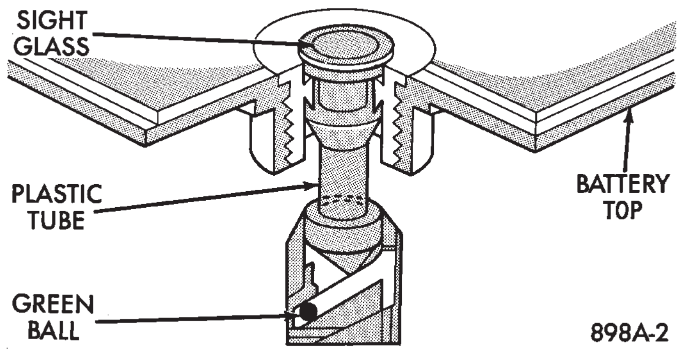

Fig. 4 Built in Test Indicator

STATE OF CHARGE TEST USING TEST INDICATOR

The built-in test indicator (hydrometer) measures the specific gravity of the electrolyte. Specific gravity (SG) will indicate state-of-charge (voltage); although, the test indicator will not indicate cranking capacity of the battery. Refer to Battery Load Test for more information. Look into the sight glass and note the color of the indicator (Fig. 5), refer to the following description as color indicates:

GREEN—75 to 100% state-of-charge

The battery is adequately charged for further testing or return to use. If the vehicle will not crank for a maximum 15 seconds, refer to Battery Load Test for more information.

BLACK OR DARK—0 to 75% state-of-charge

The battery is inadequately charged and must be charged until green indicator is visible (12.4 volts or more) before the battery is tested or returned to use. Refer to Causes of Battery Discharging for more information.

YELLOW OR BRIGHT COLOR

WARNING: DO NOT ATTEMPT TO CHARGE, TEST, OR ASSIST BOOST BATTERY WHEN YELLOW OR BRIGHT COLOR IS VISIBLE. PERSONAL INJURY MAY OCCUR.

A yellow or bright color indicates electrolyte level in the battery is below test indicator (Fig. 5). Water can be added to a low maintenance battery. A low electrolyte level may be caused by an over charging condition. Refer to Generator Test Procedures On Vehicle in this group.

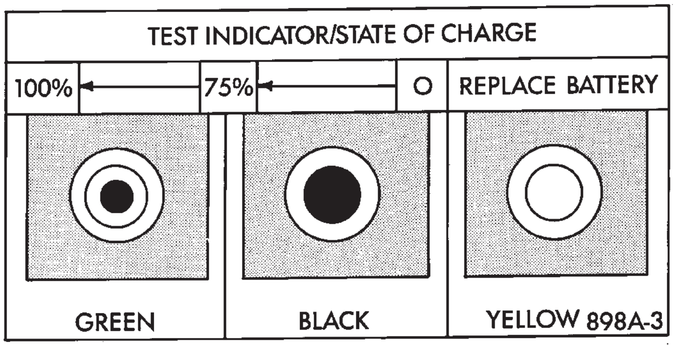

Fig. 5 Test Indicator Sight Glass

HYDROMETER TEST

Before performing a hydrometer test, remove the battery caps and check the electrolyte level. Add distilled water as required.

Before testing, visually inspect the battery for 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, but variation between cells is more than 50 points (0.050), it is a sign that the battery should be replaced.

If the specific gravity of one or more cells is less than 1.235, recharge the battery at a rate of approximately 5 amperes. Continue charging until 3 consecutive specific gravity tests, taken at one-hour intervals, are constant.

If the cell specific gravity variation is more than 50 points (0.050) at the end of the charge period, replace the battery.

When the specific gravity of all cells is above 1.235 and variation between cells is less than 50 points (0.050), the battery may be tested under heavy load.

CAUSES OF BATTERY DISCHARGING

It is normal to have a 5 to 20 milliamperes Ignition Off Draw (IOD) from the battery with all lamps OFF. Electronic features or accessories that have a memory circuit cause IOD. When a vehicle is not used for 20 days or more, remove IOD fuse in the Power Distribution Center to reduce battery discharging.

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 in this Group.

(6) Defective charging system.

(7) Defective battery.

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 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 head lights on for 15 seconds then allow up to 5 minutes for voltage to stablize.

(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. 6).

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%

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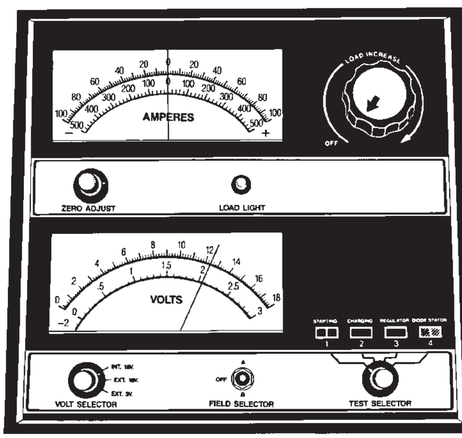

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Fig. 6 Testing Open Circuit Voltage

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 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. If indicator is not green, charge the battery. See Battery Charging Procedures in this section.

(2) Connect a suitable Volt-Ammeter-Load tester (Fig. 7) to the battery posts (Fig. 8). 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. 7) with a green test indicator.

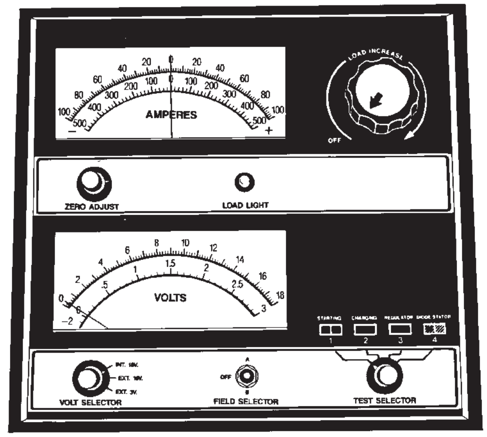

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Fig. 7 Volt-Amps-Load Tester (Typical)

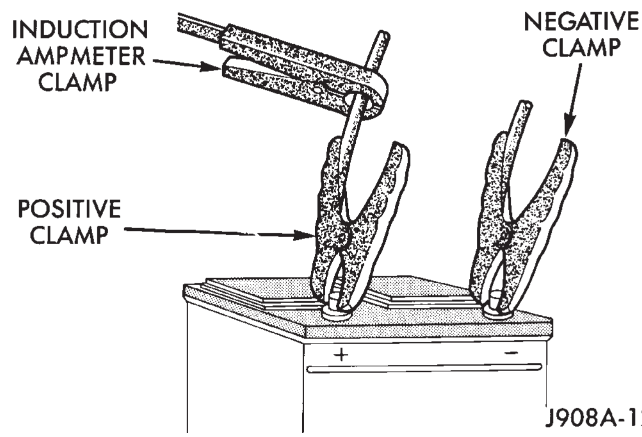

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Fig. 8 Volt-Ammeter-Load Tester Connections

(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. 9). This will remove the surface charge from the battery.

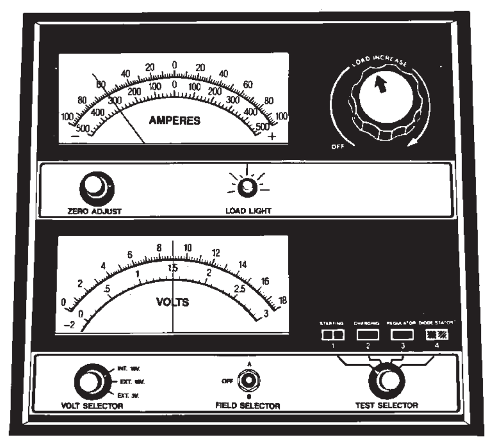

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Fig. 9 Remove Surface Charge from Battery

(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 rating—see Specifications) for a

minimum of 15 seconds (Fig. 10). After 15 seconds, record the (loaded) voltage reading and return the load control to off.

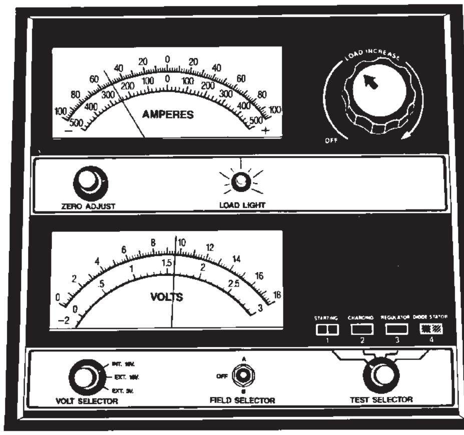

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Fig. 10 Load 50% Cold Crank Rating Note Voltage

(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.

(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

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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 cranking amperage rating at 21°C/70°F).

A green test indicator on the top of the battery, indicates the battery is charged enough for further testing. A black indicator means the battery state of charge is below 75%. A yellow or bright indicator means the battery has low electrolyte level. Add distilled water as required.

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: Disconnect the vehicle's 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. Determine 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.

CAUTION: Charge battery until test indicator appears green. Do not overcharge.

It may be necessary to jostle the battery or vehicle to bring green ball into view in the test indicator when state-of-charge has reached 75%.

After the battery has been charged, green indicator, 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 hold

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		

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downs, 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.

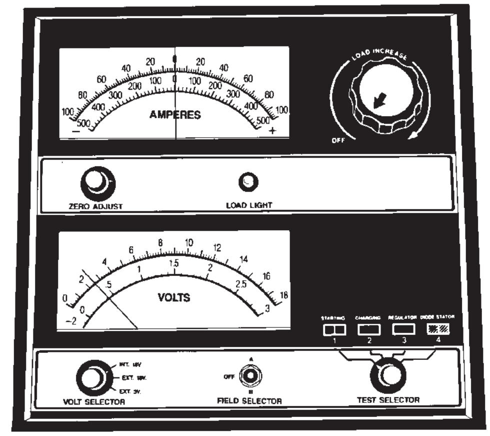
(3) **Charger Capacity—** A charger, that supplies only 5 amperes, will require a much longer charging time than a charger that supplies 20 amperes or more.

(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. 11). 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.



898A-12

Fig. 11 Voltmeter Accurate to 1/10 Volt Connected

(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.

(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.

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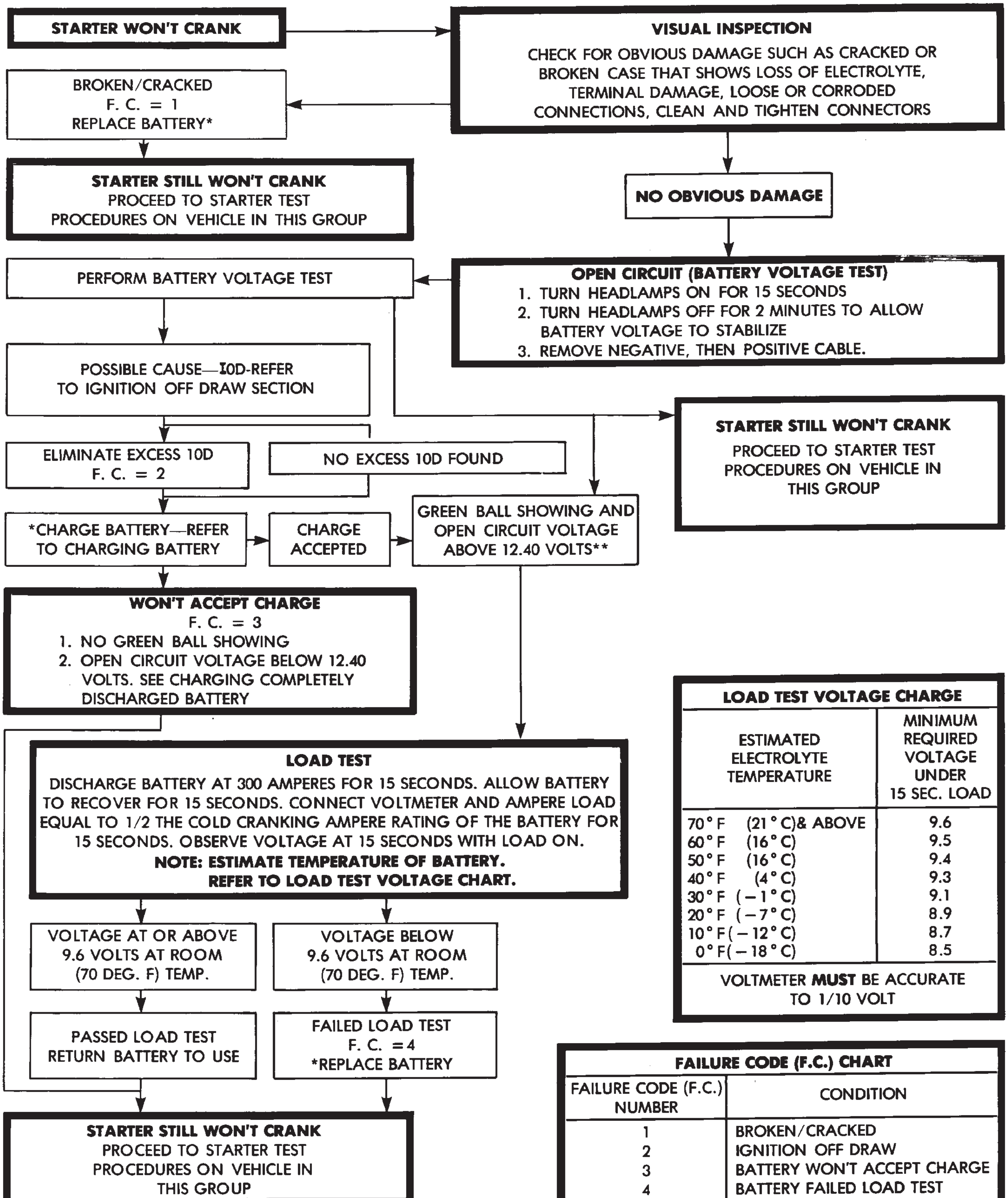
BATTERY DIAGNOSTICS CHART



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	IGNITION OFF DRAW
3	BATTERY WON'T ACCEPT CHARGE
4	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.**

J928A-8

IGNITION OFF DRAW (IOD)

Ignition off draw refers to power being drained from the battery with the ignition turned off. A normal vehicle electrical system will draw from 5 to 20 milliamps. This is with the ignition 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, ETR (electronically tuned radio) and Security Alarm memory.

Excessive battery drain is caused by items left turned on, internally shorted generator, or intermittent short in wiring.

If 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. See BATTERY CHARGING in this section.

TEST PROCEDURE

Testing for higher amperage IOD must be performed first to prevent damage to most milliamp meters.

(1) If the vehicle is equipped with a Security Alarm disconnect the Security Alarm relay that is located in the relay center under the glove box.

(2) Verify that all electrical accessories are OFF. Turn off all lights, 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.

(3) After determining that the underhood lamp is operating properly then disconnect bulb.

(4) Disconnect negative cable from battery.

(5) Connect a typical 12 volt test light (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 light 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 light will be the same as if it were connected across the battery.

The test light must be securely clamped to the negative cable and battery terminal. If the test light becomes disconnected during any 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.

(6) After 3 minutes, the test light should turn OFF or be DIMLY lit (depending on the electrical equipment). If the test light remains brightly lit do not disconnect it. Remove each fuse or circuit breaker (refer to Group 8 - Wiring Diagrams) until test light is either OFF or DIMLY lit. This will eliminate the higher amperage draw.

If test light is still bright after disconnecting each fuse and circuit breaker, disconnect the wiring harness from the generator. Refer to Generator Testing in this group. Do not disconnect the test light.

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.

(7) With test light still connected securely clamp an ammeter between battery negative terminal and negative battery cable.

If the test light or the milliamp meter circuit is broken the Security alarm module will turn on parking lamps. Do not open any doors or turn on any electrical accessories with the test light disconnected or the meter may be damaged.

(8) Disconnect test light. 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

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 (Fig. 1).

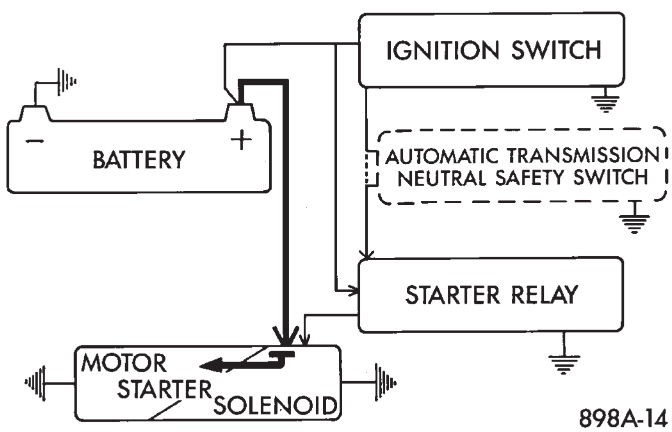


Fig. 1 Starting System Components

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 the Battery Section.

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/start switch, and battery (including all ground connections). Clean and tighten all connections as required.

SOLENOID, RELAY AND IGNITION/START 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.

If the following components are working properly remove the starter motor and follow procedures in the Testing Section.

- battery
- wiring
- switch
- solenoid
- relay
- park/neutral position switch

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. 2). 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 lights and accessories are OFF.

(5) Remove coil secondary cable from distributor and connect to ground.

(6) Rotate and hold the ignition switch (key) 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 amperate reads 0 to 10 amps, go to Starter Control Circuit Tests.

A cold engine will increase starter motor current.

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 volt-

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 ALTERNATOR 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 IGNITION SWITCH FAULTY PARK/NEUTRAL POSITION SWITCH (AUTO TRANS.) FAULTY OR MISADJUSTED STARTER RELAY FAULTY STARTER ASSEMBLY FAULTY	RESISTANCE TOO HIGH IN STARTER FEED CIRCUIT STARTER CONTROL CIRCUIT FAULTY STARTER SOLENOID FAULTY STARTER ASSEMBLY FAULTY	RESISTANCE TOO HIGH IN STARTER FEED CIRCUIT STARTER ASSEMBLY FAULTY ENGINE SEIZED REFER TO APPROPRIATE GROUP AND SECTION OF THIS MANUAL FOR PROPER SERVICE AND TEST PROCEDURES FOR THE COMPONENTS INVOLVED	DRIVE CLUTCH FAULTY BROKEN TEETH ON RING GEAR STARTER ASSEMBLY FAULTY	IGNITION SWITCH FAULTY STARTER RELAY FAULTY STARTER ASSEMBLY FAULTY STARTER IMPROPERLY MOUNTED

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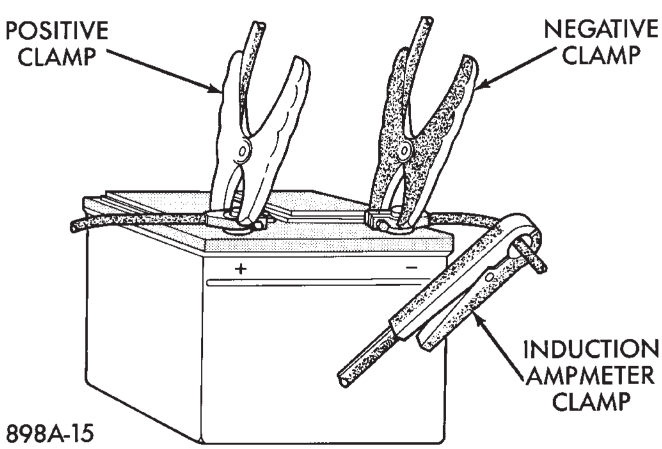


Fig. 2 Volt-Amps Tester Connections (Typical)

meter 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).

(1) Connect positive lead of the voltmeter to the battery negative post. Connect negative lead to the battery negative cable clamp (Fig. 3). Rotate and hold the ignition switch (key) in the START position. Observe the voltmeter. If voltage is detected, correct poor contact between the cable clamp and post.

(2) Connect positive lead of voltmeter to the battery positive post. Connect negative lead to the battery cable positive clamp (Fig. 3). Rotate and hold the ignition switch (key) in the START position. Observe the voltmeter. If voltage is detected, correct poor contact between the cable clamp and post.

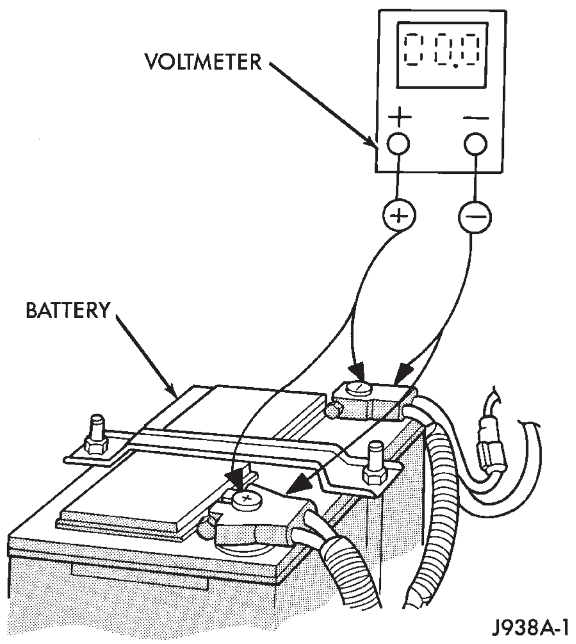


Fig. 3 Test Battery Connection Resistance

(3) Connect a voltmeter to measure between the battery positive post and the center of the B+ starter solenoid stud (Fig. 4).

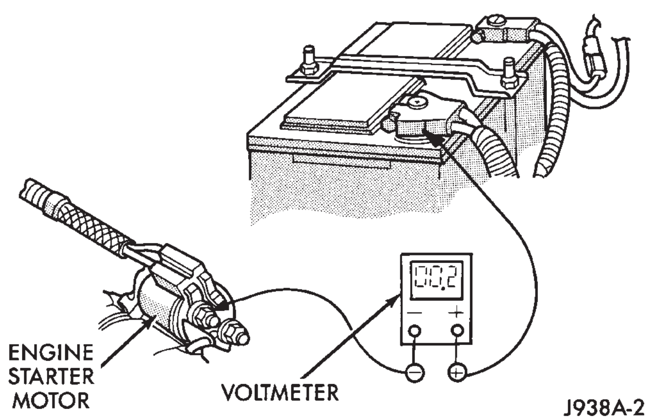


Fig. 4 Test Positive Battery Cable Resistance (Typical)

(4) Rotate and hold the ignition with (key) in the START position. If voltage reads above 0.2 volt, correct poor contact at battery cable to solenoid connection. If reading is still above 0.2 volt, replace positive battery cable.

(5) Connect the voltmeter to measure between the battery negative post and the engine block (Fig. 5).

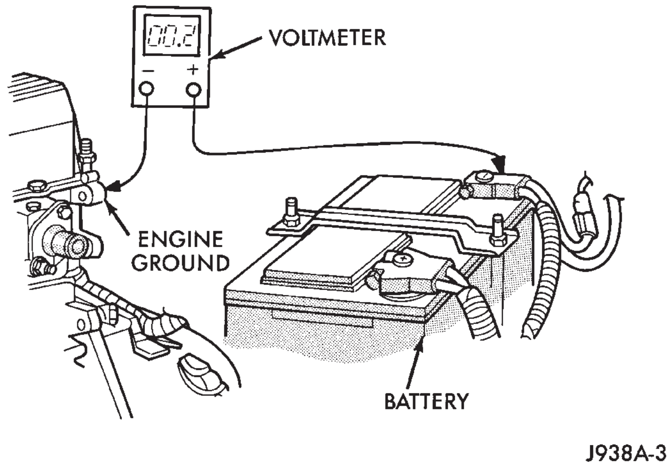


Fig. 5 Test Ground Circuit Resistance

(6) Rotate and hold the ignition with (key) 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 the starter motor housing and the negative lead to the battery negative terminal (Fig. 6).

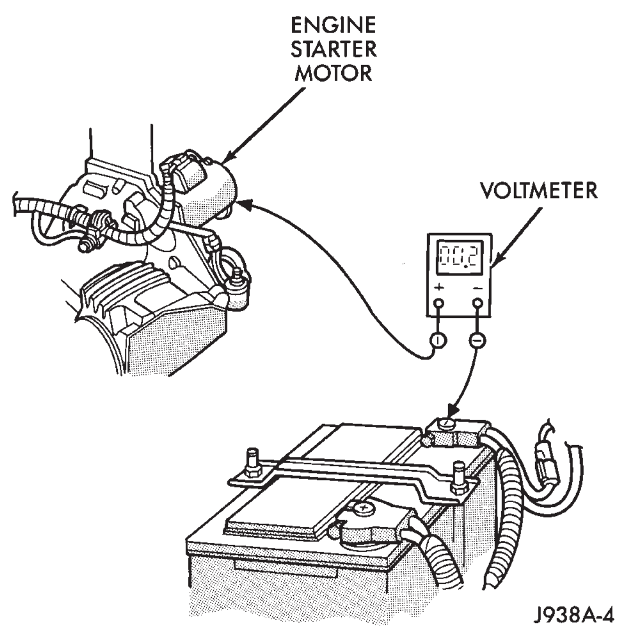


Fig. 6 Test Starter Motor Ground (Typical)

(8) Rotate and hold the ignition switch (key) 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 Bench Testing Starter Solenoid.

STARTER CONTROL CIRCUIT TESTS

The starter control circuit consists of a:

- starter solenoid
- starter relay
- ignition switch
- park/neutral position switch (automatic transmission)
- 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 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. 7).

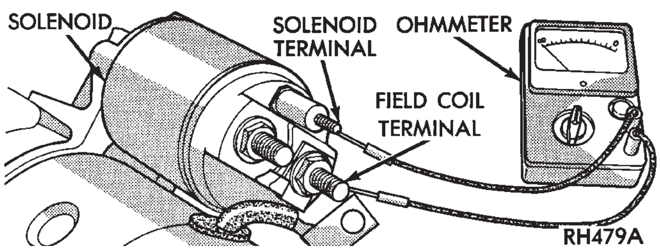


Fig. 7 Continuity Test Between Solenoid Terminal and Field Coil Terminal

(3) Check for continuity between solenoid terminal and solenoid housing. There should be continuity (Fig. 8).

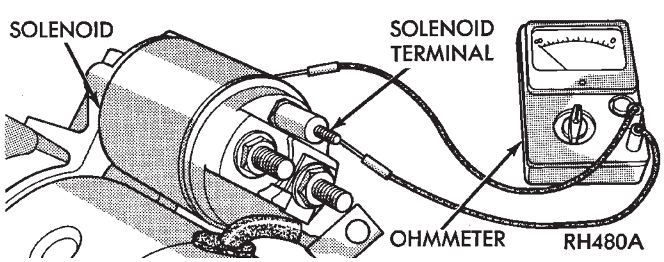


Fig. 8 Continuity Test Between Solenoid Terminal and Solenoid Case

(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 - Battery/Starter/Generator Service.

(6) Connect field coil wire to field coil terminal.

STARTER RELAY OPERATION/TESTING

The starter relay is in the Power Distribution Center (Fig. 9). Refer to the underside of the Power Distribution Cover for relay location.

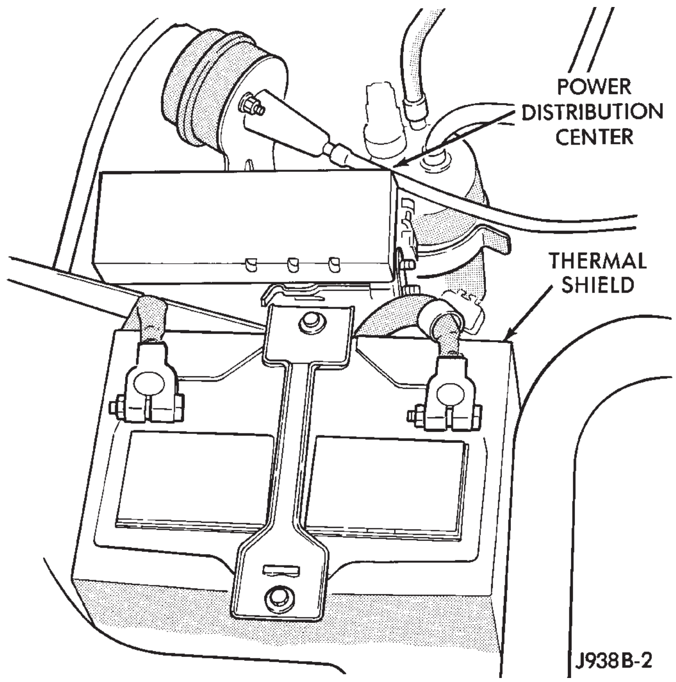
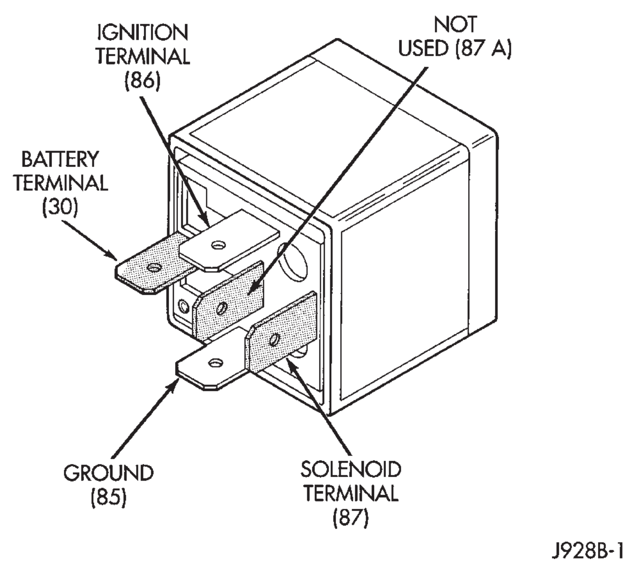


Fig. 9 Power Distribution Center

ENGINE STARTER RELAY CONNECTIONS



OPERATION

- The battery terminal (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.
- The solenoid terminal (87) is connected to the battery terminal (30) in the energized position which supplies battery voltage to the operated device.
- The ignition terminal (86) is connected to the electromagnet and usually connected to a switched power source.
- The ground terminal (85) is connected to the electromagnet and is usually grounded by a switch or the PCM.

TESTING

Remove relay from the 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 okay, 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.

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).

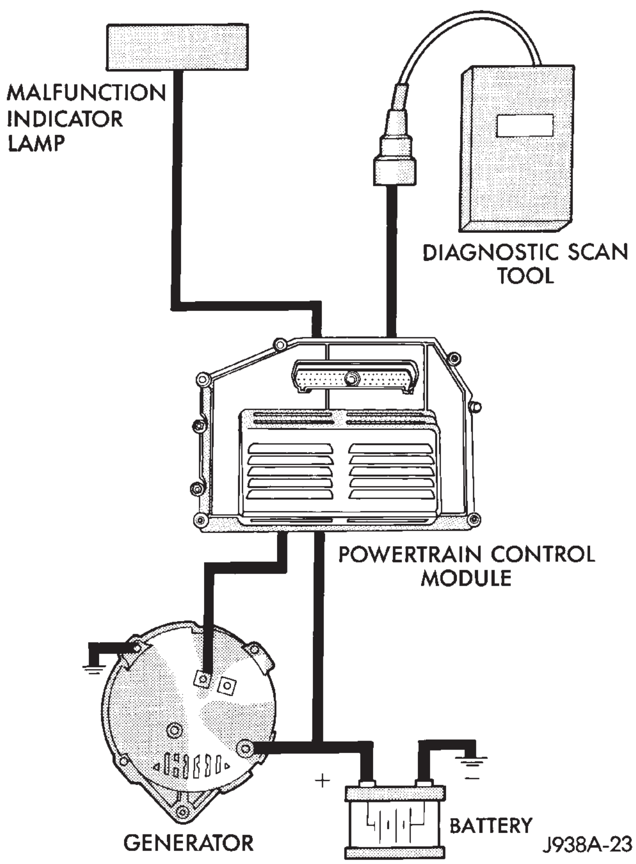


Fig. 1 Charging System Components (Typical)

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 RUN 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).

OPERATIONAL CHECK WITH VOLTMETER

When the ignition switch is turned to the RUN 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 RUN) should register.

DIAGNOSTIC PROCEDURES

If the indicator does not operate properly, 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 trunk or glove box light, to stay on (refer to Ignition Off Draw).

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).
- Inspect generator drive belt condition and tension. Tension or replace belt as required. Refer to Belt Tension Specifications.

• Inspect connection at generator B+ output. It should be clean and tight. Repair as required.

OUTPUT WIRE RESISTANCE TEST

Generator output wire resistance test will show amount of Voltage Drop across generator output wire between generator BAT 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 section of this Group.

(2) Turn OFF ignition switch.

(3) Disconnect negative cable from the battery.

(4) Disconnect generator output wire from generator output Battery terminal.

(5) Connect a 0-150 ampere scale D.C. ammeter in series between generator BAT terminal and disconnected generator output wire (Fig. 2). Connect Positive lead to generator BAT 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 dark green/black A61 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 Battery Section, Load Testing 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 BAT 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 BAT terminal post. Tighten to 5 to 6 N•m (45 to 75 in. lbs.).

(5) Connect negative cable to battery.

(6) Use DRB II scan tool to erase DTC.

CURRENT 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 section of this Group.

(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 BAT terminal and disconnected generator output wire (Fig. 3). Connect Positive lead to generator BAT terminal and negative lead to disconnected generator output wire.

(5) Connect positive lead of a test voltmeter (range 0-18 volts minimum) to generator BAT 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 Battery section, Load Testing for instructions.

(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 dark green/black A61 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.

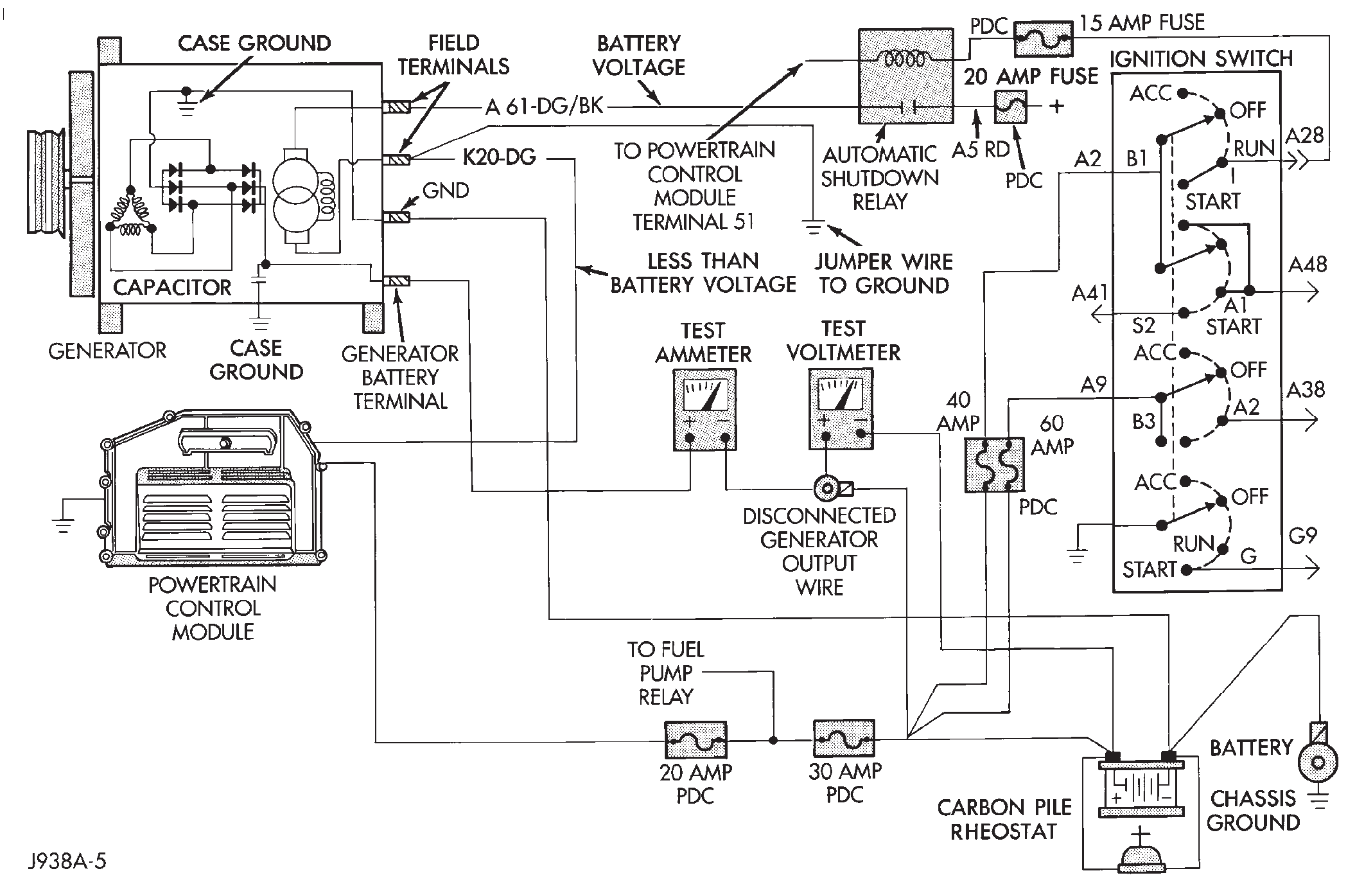


Fig. 2 Generator Output Wire Resistance Test (Typical)

(3) The ammeter reading must be within limits shown in generator specifications in back of this group.

RESULTS

(1) If reading is less than specified and generator output wire resistance is not excessive, generator should be replaced; refer to Group 8C - Generator Service for information.

(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.

(5) Remove Jumper Wire (Fig. 3).

(6) Connect generator output wire to generator BAT terminal post. Tighten nut to 8.5±1.5 N•m (75±15 in. lbs.).

(7) Connect negative cable to battery.

(8) Use DRB II scan tool to erase DTC.

USING ON-BOARD DIAGNOSTIC SYSTEM

OPERATION OF ON-BOARD DIAGNOSTIC (OBD) SYSTEM

The Powertrain Control Module monitors critical input and output circuits of the charging system making sure they are okay. Some are checked continuously and some are checked only under certain conditions.

If the OBD system senses that one critical circuit is bad, it will consider this a real problem and put a DTC into memory. Each input and output circuit monitored by the OBD system has its own DTC. The DTC will stay in memory as long as the circuit continues to be bad. If the problem does not happen again after the DTC is put into memory, the Powertrain Control Module will clear the memory after 50 to 100 engine starts.

DIAGNOSTIC TROUBLE CODES

Diagnostic trouble codes are two-digit numbers flashed on Malfunction Indicator lamp that identify which circuit is bad. In most cases they do not identify which component in a circuit is bad. A DTC description can be read using the DRB II scan tool. Refer to Group 14 - Fuel Systems for more information. Therefore, a DTC is only a result, not necessarily the reason 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 the DTC of the on-board diagnostic system are trying to tell.

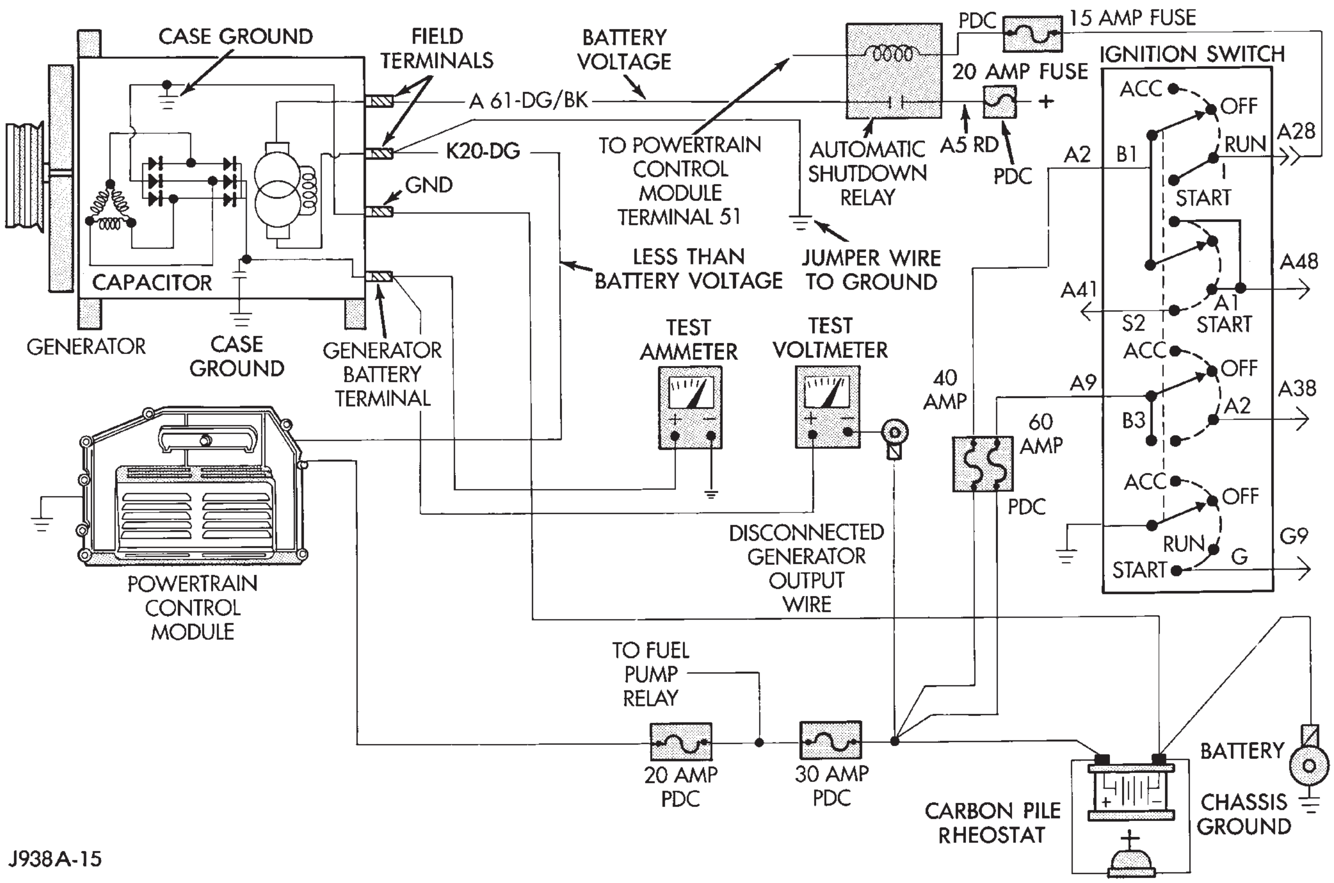


Fig. 3 Generator Current Output Test (Typical)

HOW TO USE MALFUNCTION INDICATOR LAMP FOR DIAGNOSTIC TROUBLE CODES

To start this function, cycle the ignition switch on-off-on-off-on within 5 seconds. This will allow any fault stored in the Powertrain Control Module to be displayed. The Malfunction Indicator 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 four 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.

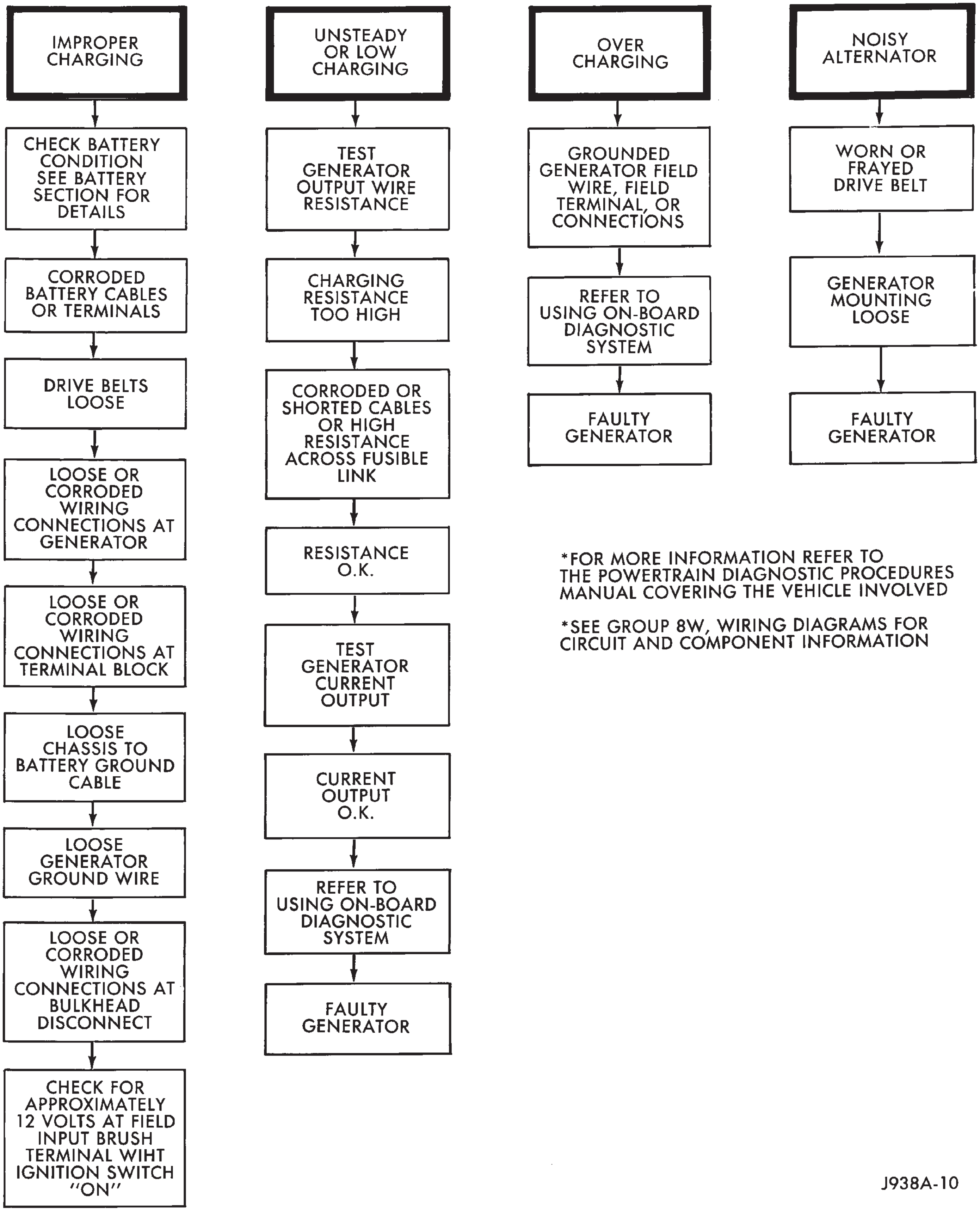
(3) Lamp pauses for 4 seconds, flashes 4 times, pauses and then flashes 7 times.

The two 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 DTC which apply to the charging system. Refer to the Powertrain Diagnostic Procedures Manual to diagnose an On-Board Diagnostic System, Diagnostic Trouble Code.

CHARGING SYSTEM DIAGNOSTICS



J938A-10

GENERATOR DIAGNOSTIC TROUBLE CODE (DTC)

DTC	Type	Malfunction Indicator Lamp	Circuit	When Monitored By the Logic Module	When Put Into Memory	Actuator Test	Sensor Read Test
41	Fault	Yes	Generator Field Control (Charging System)	All the time when the ignition switch is on.	An open or shorted condition in the generator field control circuit.	Yes	None
46	Fault	Yes	Charging System Voltage	All the time when the engine is running.	If the battery sense voltage is more than 1 volt above the desired control voltage for more than 20 seconds.	None	Yes
47	Fault	Yes	Charging System Voltage	Engine rpm above 1,500 rpm	Battery voltage 1 volt less than set point during engine operation and no change in voltage during internal PCM test performed on generator field.	None	Yes

J938A-20

SPECIFICATIONS

BATTERY CLASSIFICATIONS AND RATINGS

Group Size	Cold Crank AMPS	Reserve Capacity (Min.)	Engine
34	600	120	ALL

J938A-11

GENERATOR OUTPUT VOLTAGE SPECIFICATIONS

Ambient 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

J918C-13

Type	Part Number	Engine	Rating
Nippondenso	56005685	4.0L,5.2L	90 Amps

J938B-17

4.0L ENGINE

TORQUE SPECIFICATIONS

COMPONENT	TORQUE	
Generator Mounting Bolts	38 N•m (28 ft. lbs.)	
Power Steering Pump (or Idler Pulley) Mounting Bolts	27 N•m (30 ft. lbs.)	
Belt Tension	New Belt 800-900	N (lbs-f) (180-200)
	Used Belt 623-712	N (lbs-f) (140-160)

J938B-11

TORQUE SPECIFICATIONS

Description	Torque
Battery Strap Screw	10 N•m (90 in. lbs.)
Battery Tray Screw	10 N•m (90 in. lbs.)

J938A-14

ENGINE STARTER MOTOR AND SOLENOID TESTING SPECIFICATIONS

Description	Specifications @ 20 °C (68 °F)
No Load Test With 11.2 volts Max. Amps Min. RPM	 90 2500
Solenoid Hold-in Winding Voltage	3.5 Min.
Pull-in Winding Voltage	7.8 Max.

J928B-25

ENGINE STARTER MOTOR COLD CRANKING SPECIFICATIONS

Battery Test Voltage	12.5 Volts
Cold Cranking Voltage (Minimum)	9.6 Volts
Cold Cranking Amps	130 Amps

J918B-17

5.2L ENGINE

REDUCTION GEAR STARTER

Manufacturer	Nippondenso
Engine Application	5.2L
Part Number and Power Rating	56004934 1.4 Kw
Voltage	12
No. of Fields	4
No. of Poles	4
Brushes	4
Drive	Reduction Gear Train
Free Running Test Voltage Amperage Draw Minimum Speed RPM	 11 73 Amps 3601 RPM
Solenoid Closing Voltage	7.5 Volts
Cranking Amperage Draw Test	125-200 Amps*

*Engine should be up to operating temperature. Extremely heavy oil or tight engine will increase starter amperage draw.

J938B-21

BATTERY/STARTER MOTOR/GENERATOR SERVICE

CONTENTS

BATTERY SERVICE PROCEDURES

GENERAL INFORMATION

This section covers Battery rermoval and installation procedures only. For diagnostic procedures. refer to Group 8A - Battery/Starting/Charging Systems Diagnostics.

The Low Maintenance Battery (Fig. 1) has removable battery cell caps. Water can be added to this battery. The battery is not sealed and also has small vent holes in the top. The chemical composition inside of the battery produces an extremely small amount of gases at normal charging voltages. The battery is equipped with a test indicator (Fig. 1) that displays a colored ball to indicate battery state-of-charge.

Green Indicator = Full charge
Black Indicator = Discharged
Yellow Indicator = Battery replacement required

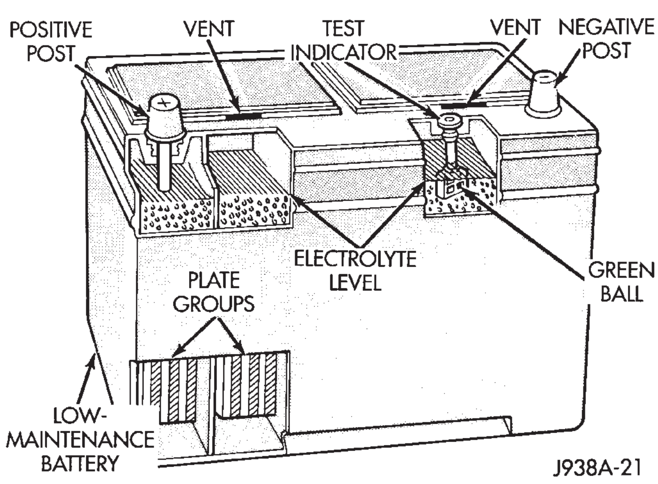


Fig. 1 Low Maintenance Battery

BATTERY MAINTENANCE

(1) Inspect the cable terminal 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 vents are installed when washing battery to prevent solution from entering battery.

(2) Clean the outside of the battery case if the original battery is to be installed. Clean the top cover with diluted ammonia or a sodium bicarbonate/water solution to remove the acid film (Fig. 2). Flush with clean water. Ensure that the cleaning solution does not enter the cells.

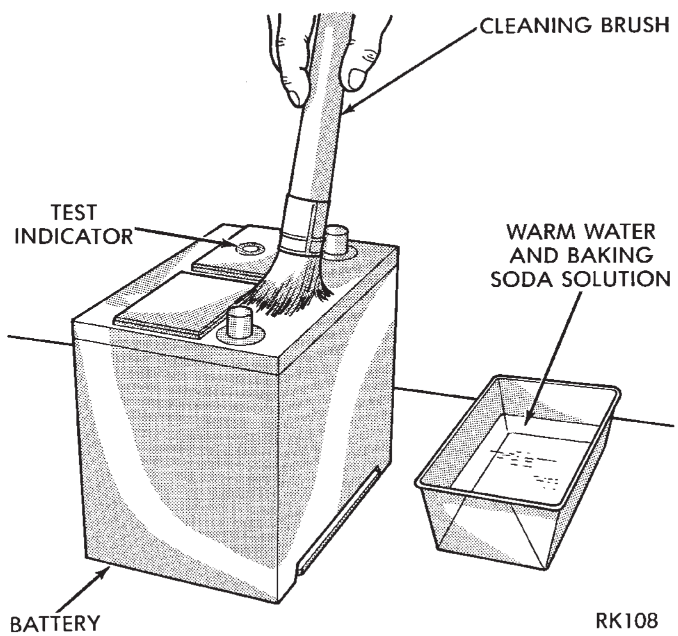


Fig. 2 Cleaning Battery

(3) Remove corrosion from the terminals with a wire brush or post and terminal cleaner (Figs. 3 and 4). Inspect the case for cracks or other damage that would result in leakage of electrolyte.

Check electrolyte level in the battery. Use a putty knife or other suitable wide tool to pry filler caps off low maintenance battery (Fig. 5). Do not use a screwdriver. Add distilled water to each cell until the liquid reaches the bottom of the vent well. DO NOT OVERFILL.

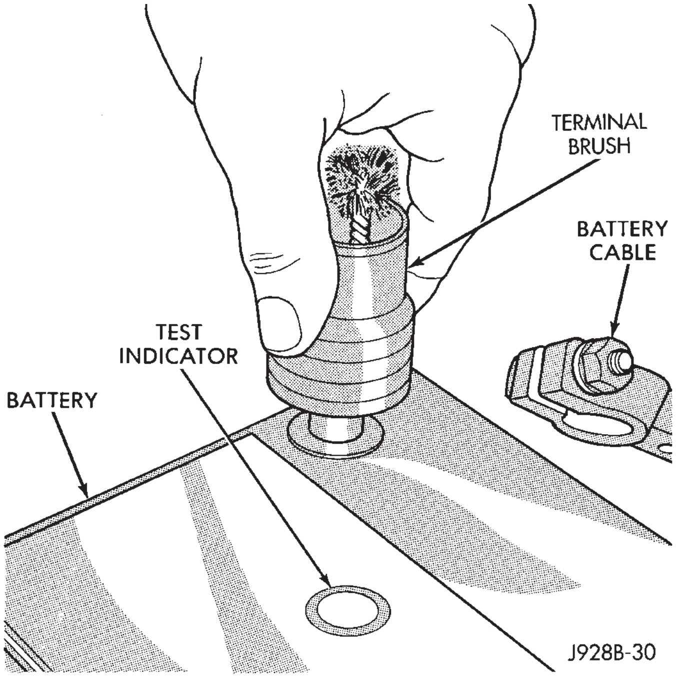


Fig. 3 Cleaning Battery Post

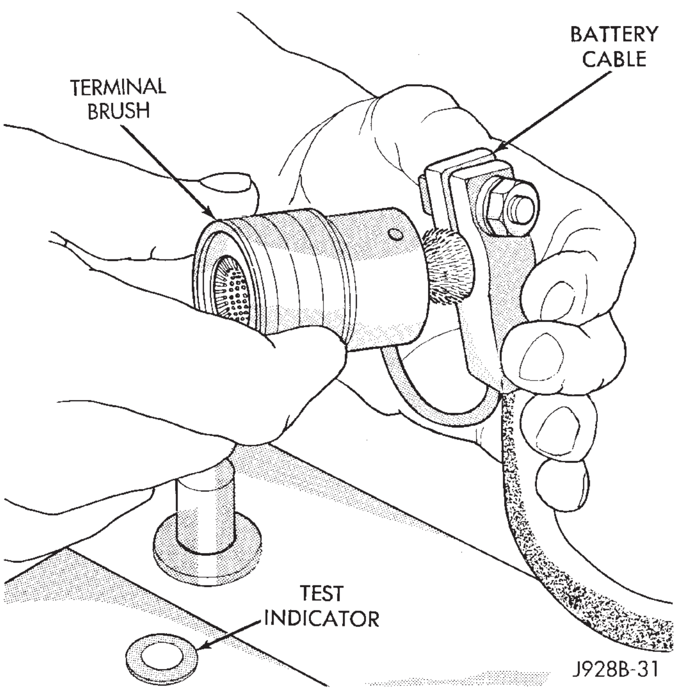


Fig. 4 Cleaning Battery Terminals

Operate the engine immediately after adding water (particularly in cold weather) to assure proper mixing of the water and acid.

BATTERY REPLACEMENT

REMOVAL

(1) Make sure ignition switch is in OFF position and all electrical accessories are OFF.

(2) Loosen the cable terminal clamps.

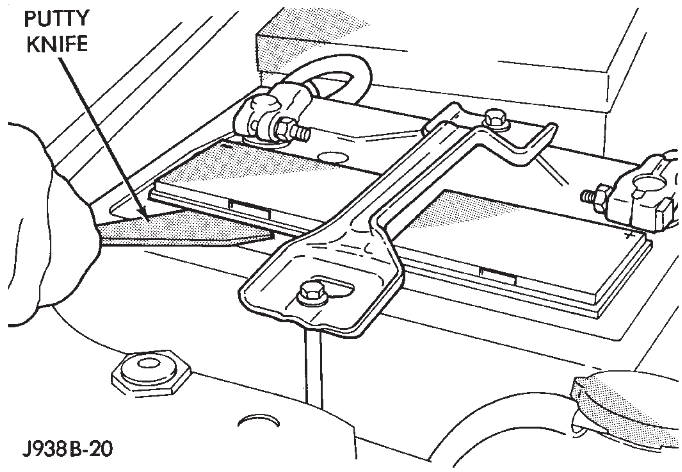


Fig. 5 Removing Filler Cap

(3) If necessary, use a puller to remove the cable terminal clamps, and remove the negative cable terminal clamp first.

WARNING: WEAR A SUITABLE PAIR OF RUBBER GLOVES (NOT THE HOUSEHOLD TYPE) WHEN REMOVING A BATTERY BY HAND. IF THE BATTERY IS CRACKED OR LEAKING THE ELECTROLYTE CAN BURN THE SKIN.

(4) Remove battery holddowns and remove battery from vehicle (Fig. 6).

(5) Inspect the 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 (Fig. 6).

If the battery tray needs to be replaced, disconnect the hoses from the vacuum reservoir to remove the tray. Remove the vacuum reservoir from the bottom to the battery tray.

INSTALLATION

(1) Refer to Specifications to determine if the battery has the correct classification and rating for the vehicle.

(2) Use a hydrometer to test the battery electrolyte. Charge the battery if necessary.

(3) Position the battery in the tray. Ensure that the positive and negative terminals (posts) are correctly located. The cables must reach their respective terminals (posts) without stretching (Fig. 7).

(4) Ensure that the tang at the battery base is positioned in the tray properly before tightening the 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).

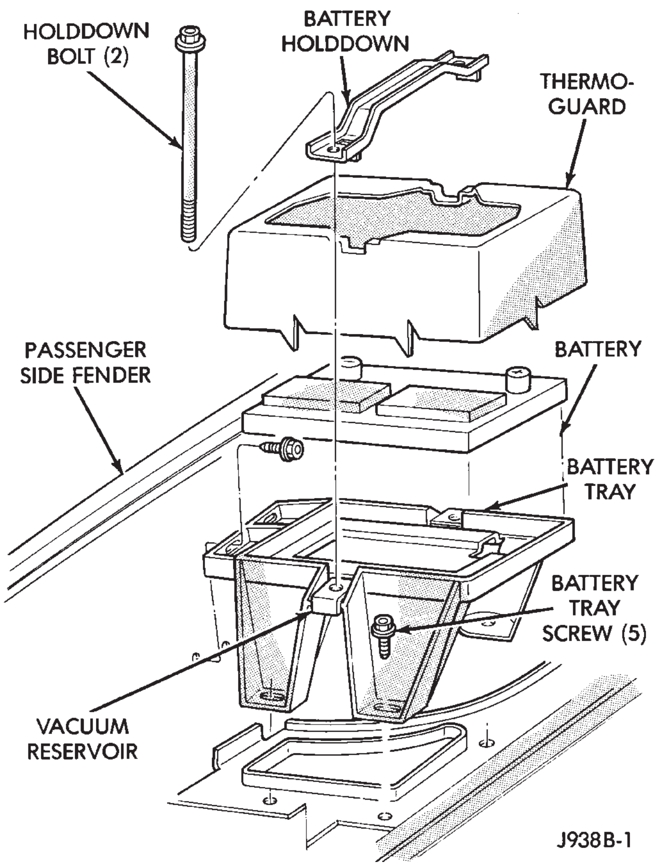


Fig. 6 Battery Tray and Holddown

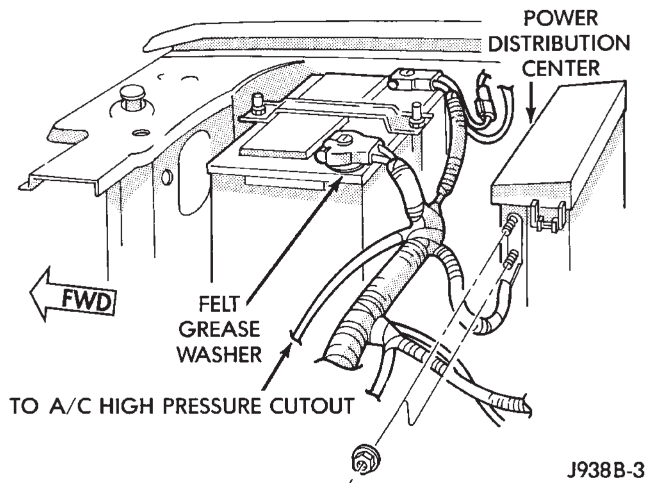


Fig. 7 Battery Cable Connections

(5) Place the felt washer on the positive battery terminal.

(6) Connect the positive cable first. Then connect the negative cable. Tighten both cable terminal bolts to 8.5 N●m (75 in. lbs.).

(7) Apply a thin coating of petroleum jelly or chassis grease to the cable terminals and the battery posts.

(8) Inspect the negative cable connections on the engine and the vehicle body for condition, security and electrical continuity.

ENGINE STARTER MOTOR SERVICE PROCEDURES

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.

The starter system circuits consist of:

- a battery
- starter motor and solenoid
- starter relay
- ignition switch
- park/neutral positon switch (automatic transmission)
- connecting wires and battery cables.

STARTER RELAY REPLACEMENT

The starter relay is located in the Power Distribution Center (Fig. 1). Refer to the underside of the Power Distribution Cover for relay location.

(1) Disconnect negative cable from battery.
(2) Replace the relay.
(3) Connect battery cable.
(4) Test relay operation.

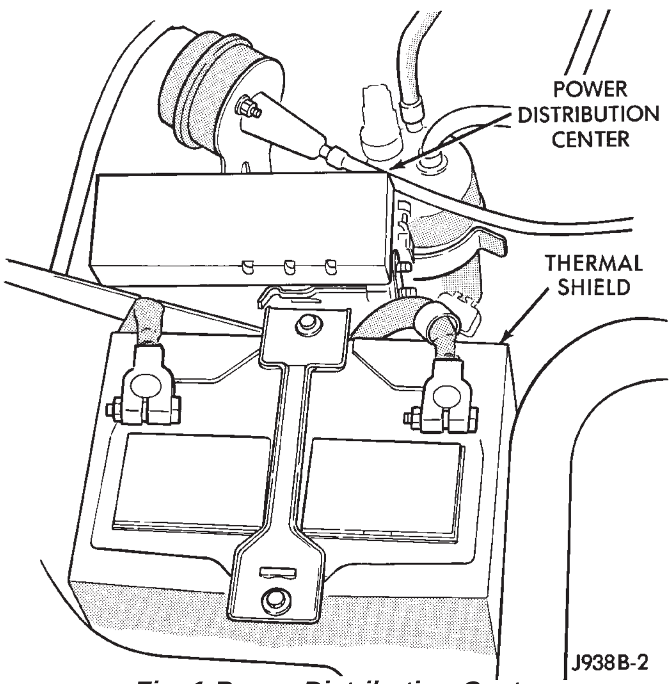


Fig. 1 Power Distribution Center

STARTER MOTOR GENERAL INFORMATION—4.0L

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 armature 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 stator 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 electrical 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 stator frame. Chips in the ring gear can lead to failure of the starter.

STARTER MOTOR REMOVAL/INSTALLATION—4.0L

(1) Disconnect negative cable from battery.
(2) Raise and support vehicle.
(3) Disconnect the battery wire and solenoid feed wire connector (Fig. 2).

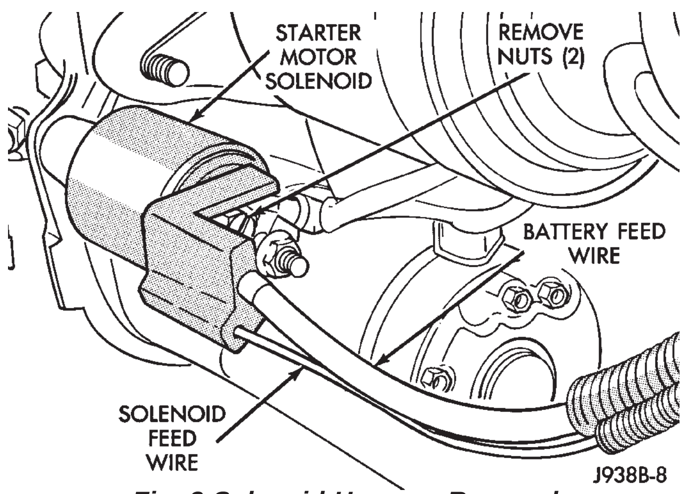


Fig. 2 Solenoid Harness Removal

(4) Remove starter front mounting bolt (Fig. 3).
(5) Remove starter rear mounting bolt and remove starter.
(6) To install the starter motor, reverse the removal procedures and torque the mounting hardware as follows:

- Tighten starter mounting bolts to 45 N•m (33 ft. lbs.).

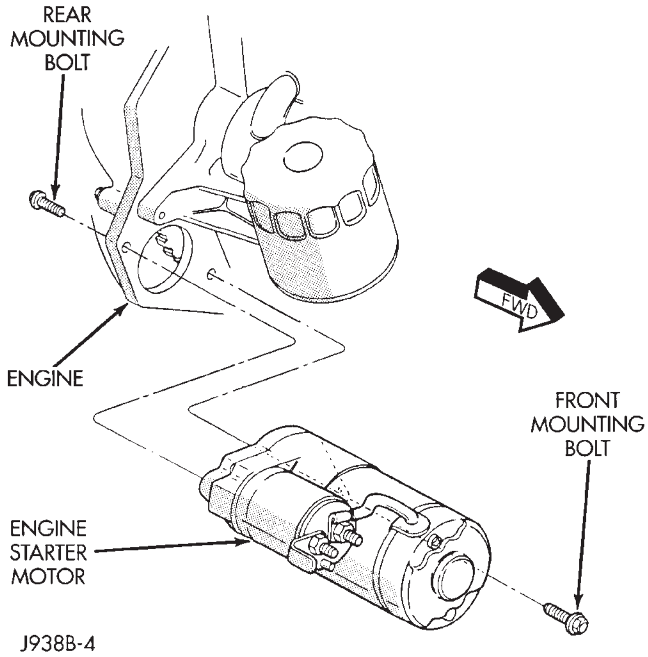


Fig. 3 Starter Motor Removal/Installation—Typical

• Tighten the terminal adapter solenoid nut to 6 N●m (55 in. lbs.).

• Tighten the terminal adapter battery cable nut to 10 N●m (90 in. lbs.).

(7) Remove vehicle support and lower vehicle.

(8) Install negative cable to battery.

STARTER MOTOR GENERAL INFORMATION—5.2L

A Nippondenso reduction gear field coil starter motor is used on the 5.2L engine. This starter motor features compact design and is lightweight as compared with those having the same output. Structure is different from that of direct drive and permanent magnet type, but electrical wiring is common for all engines. The reduction gear sets and solenoid shift devices are enclosed in an aluminum die cast housing which is part of starter assembly.

STARTER MOTOR REMOVAL/INSTALLATION—5.2L

(1) Disconnect negative cable from battery.

(2) Raise and support vehicle.

(3) Disconnect the battery wire and solenoid feed wire connector (Fig. 4).

(4) Remove lower mounting nut (Fig. 5).

(5) Remove transmission line clip from stud.

(6) Remove upper mounting bolt.

(7) Pull starter forward and remove from vehicle.

(8) To install the starter motor, reverse the removal procedures and torque the mounting hardware as follows:

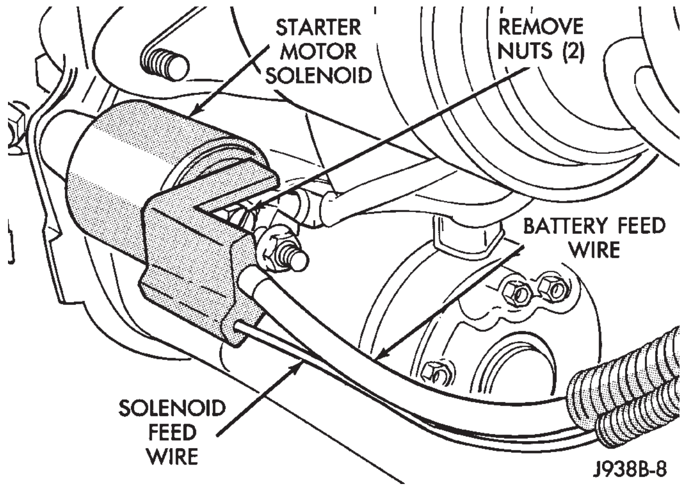


Fig. 4 Solenoid Harness Removal—Typical

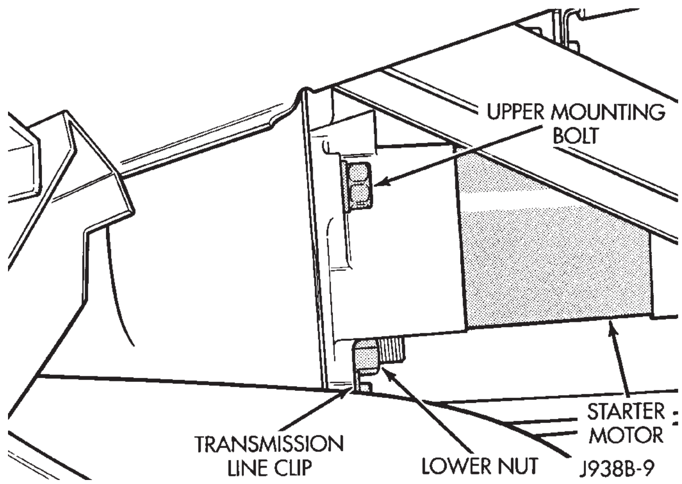


Fig. 5 Starter Motor Removal/Installation (Typical)

• Tighten starter upper mounting bolt and stud nut to 68 N●m (50 ft. lbs.).

• Tighten the terminal adapter solenoid nut to 6 N●m (55 in. lbs.).

• Tighten the terminal adapter battery cable nut to 10 N●m (90 in. lbs.).

(9) Remove vehicle support and lower vehicle.

(10) 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. 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 REMOVAL AND INSTALLATION—4.0L

WARNING: FAILURE TO DISCONNECT THE NEGATIVE CABLE FROM THE BATTERY BEFORE DISCONNECTING THE RED (OUTPUT) WIRE CONNECTOR FROM THE GENERATOR CAN RESULT IN INJURY.

Belt tension is adjusted at the power steering pump.

(1) Disconnect negative cable from battery.

(2) Loosen rear mounting bolts (Fig. 1).

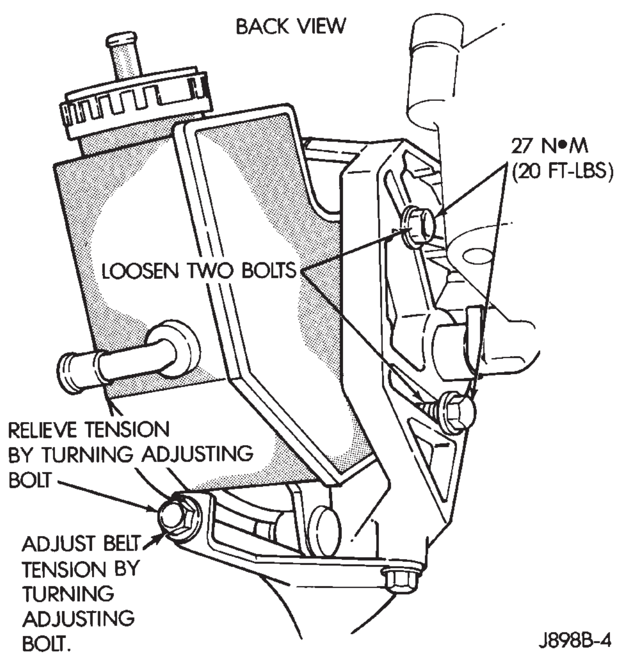


Fig. 1 P.S Pump Rear Mounting Bolts

(3) Loosen power steering pump pivot bolt and lock nut (Fig. 2).

(4) Loosen adjusting bolt to remove belt.

(5) Raise and support vehicle.

(6) Remove B+ terminal nut, 2 field terminal nuts, ground and harness hold down nuts (Fig. 3). 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.

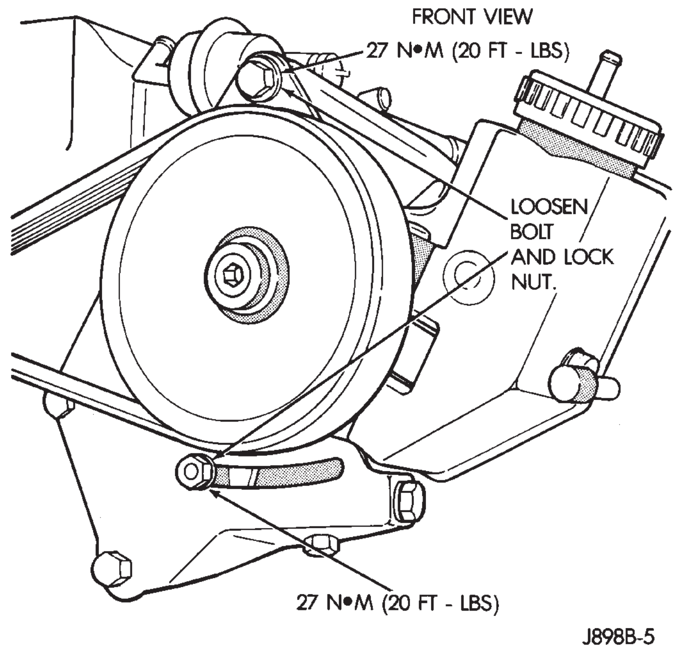


Fig. 2 P.S Pump Front Mounting Bolts

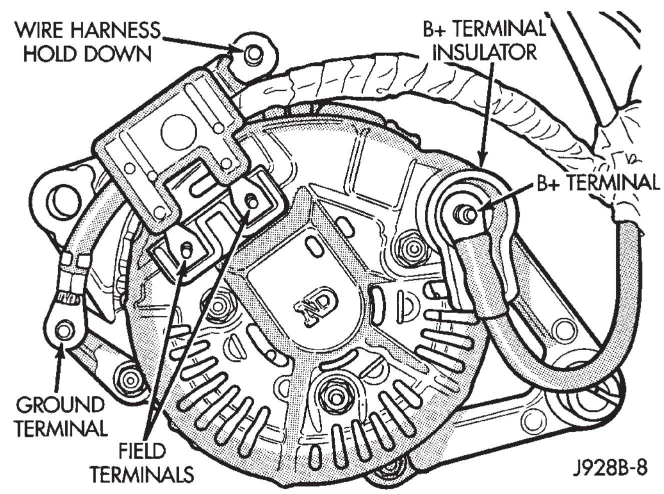


Fig. 3 Remove or Install Connector Assembly

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 appropriate accessory drive belt schematic for the correct belt routing (Group 7).

(10) Place serpentine belt over pulley.

(11) The 2 rear mounting bolts and the power steering pump pivot bolt should be finger tight.

(12) Turn adjusting bolt until the belt has the correct tension as given 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) Attach negative cable to the battery.

GENERATOR REMOVAL AND INSTALLATION—5.2L ENGINE

WARNING: FAILURE TO DISCONNECT THE NEGATIVE CABLE FROM THE BATTERY BEFORE DISCONNECTING THE RED (OUTPUT) WIRE CONNECTOR FROM THE GENERATOR CAN RESULT IN INJURY.

REMOVAL

Drive belts on the 5.2L engine are equipped with a spring loaded automatic belt tensioner (Fig. 4). This belt tensioner is used on all belt configurations. For more information, refer to Group 7 - Cooling, Automatic Belt Tensioner—5.2L Engines.

(1) Disconnect negative cable from battery.

(2) Attach a socket/wrench to the pulley mounting bolt of the automatic tensioner (Fig. 4).

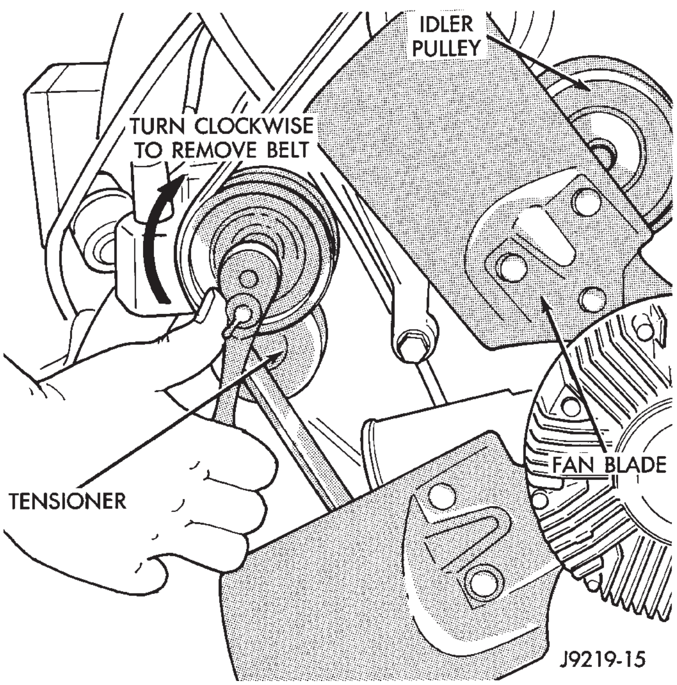


Fig. 4 Automatic Belt Tensioner—Belt Removal/ Installation

(3) Rotate the tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(4) Remove belt from vehicle.

(5) Remove lower generator mounting bolt and nut (Fig. 5).

(6) Remove upper generator mounting bolt and remove generator from bracket.

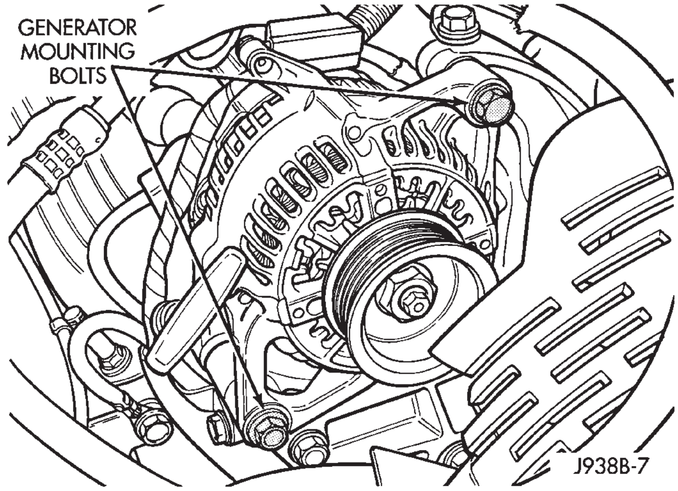


Fig. 5 Generator Mounting Bolts

(7) Remove the B+ terminal nut, 2 field terminal nuts, ground, and harness hold down nuts (Fig. 6). Remove wire connectors.

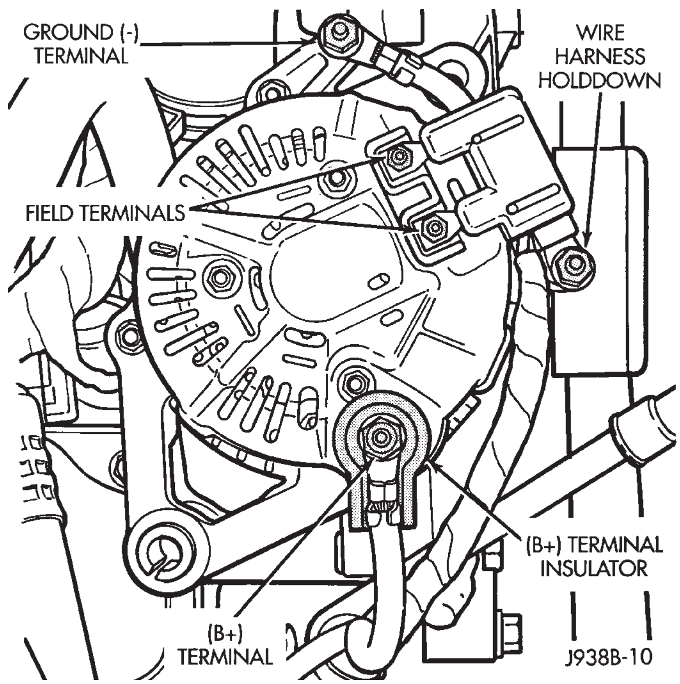


Fig. 6 Remove or Install Wire Connector Assembly

INSTALLATION

(1) Install generator. Tighten both bolts to 41 N●m (30 ft. lbs.).

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. 7) for correct 5.2L engine belt routing. The correct belt with the correct length must be used

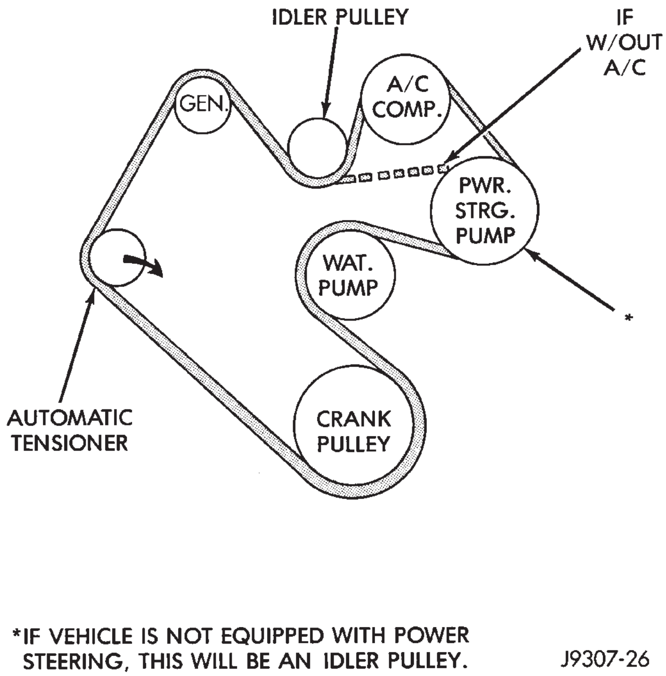


Fig. 7 Belt Routing—5.2L Engine

(2) Position the drive belt over all pulleys **except** the idler pulley. This pulley is located between the generator and A/C compressor.

(3) Attach a socket/wrench to the pulley mounting bolt of the automatic tensioner (Fig. 4).

(4) Rotate the socket/wrench clockwise. Place the belt over the idler pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated on all pulleys.

(5) Check belt indexing marks. Refer to Group 7 - Cooling, Automatic Belt Tensioner—5.2L Engine for more belt information.

SPECIFICATIONS

BATTERY CLASSIFICATIONS AND RATINGS

Group Size	Cold Crank AMPS	Reserve Capacity (Min.)	Engine
34	600	120	ALL

J938A-11

GENERATOR OUTPUT VOLTAGE SPECIFICATIONS

Ambient 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

J918C-13

Type	Part Number	Engine	Rating
Nippondenso	56005685	4.0L,5.2L	90 Amps

J938B-17

4.0L ENGINE

TORQUE SPECIFICATIONS

COMPONENT	TORQUE	
Generator Mounting Bolts	38 N•m (28 ft. lbs.)	
Power Steering Pump (or Idler Pulley) Mounting Bolts	27 N•m (30 ft. lbs.)	
Belt Tension	New Belt 800-900	N (lbs-f) (180-200)
	Used Belt 623-712	N (lbs-f) (140-160)

J938B-11

TORQUE SPECIFICATIONS

Description	Torque
Battery Strap Screw	10 N•m (90 in. lbs.)
Battery Tray Screw	10 N•m (90 in. lbs.)

J938A-14

ENGINE STARTER MOTOR AND SOLENOID TESTING SPECIFICATIONS

Description	Specifications @ 20°C (68°F)
No Load Test With 11.2 volts Max. Amps Min. RPM	 90 2500
Solenoid Hold-in Winding Voltage	3.5 Min.
Pull-in Winding Voltage	7.8 Max.

J928B-25

ENGINE STARTER MOTOR COLD CRANKING SPECIFICATIONS

Battery Test Voltage	12.5 Volts
Cold Cranking Voltage (Minimum)	9.6 Volts
Cold Cranking Amps	130 Amps

J918B-17

5.2L ENGINE

REDUCTION GEAR STARTER

Manufacturer	Nippondenso
Engine Application	5.2L
Part Number and Power Rating	56004934 1.4 Kw
Voltage	12
No. of Fields	4
No. of Poles	4
Brushes	4
Drive	Reduction Gear Train
Free Running Test Voltage Amperage Draw Minimum Speed RPM	 11 73 Amps 3601 RPM
Solenoid Closing Voltage	7.5 Volts
Cranking Amperage Draw Test	125-200 Amps*

*Engine should be up to operating temperature. Extremely heavy oil or tight engine will increase starter amperage draw.

J938B-21

OVERHEAD CONSOLE

CONTENTS

DESCRIPTION

The overhead console includes:

- 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 compartments sun glasses.

A compass/thermometer mini trip computer that displays 6 conditions:

- Compass/Temperature
- Trip odometer (ODO)
- Average miles per gallon (ECO)
- Instant miles per gallon (ECO)
- Distance to empty (DTE)
- Elapsed time (ET)
- Blank Display

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.

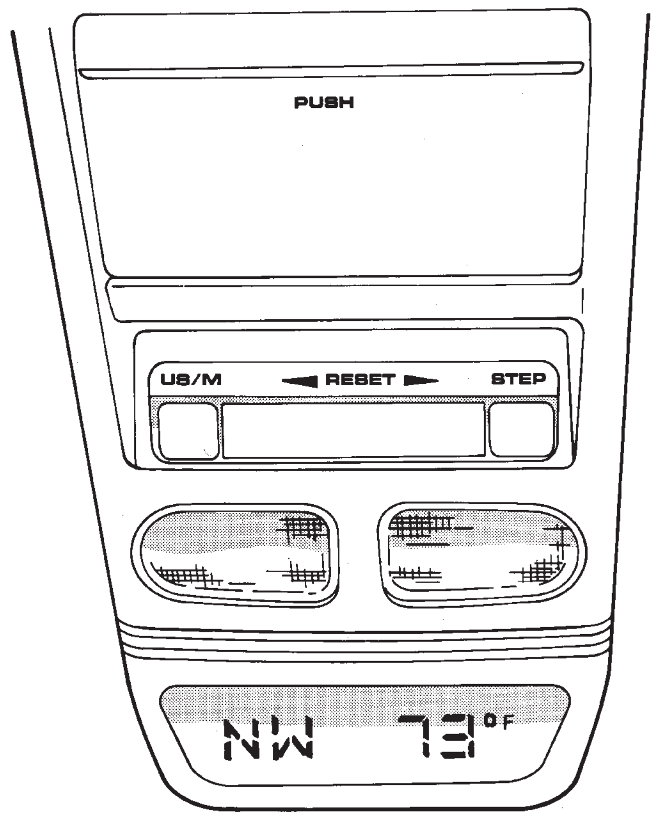
TRIP COMPUTER

Actuating the STEP switch will cause the trip computer to change mode of operation when ignition is ON. Traveler data is obtained from the Powertrain Control Module and HEVAC on the CCD lines. If the data displayed is wrong, run self diagnostics before replacing the computer. The DRB II is recommended for checking the CCD lines.

COMPASS

The compass will display the direction the vehicle is pointed in using the 8 major compass headings (Examples: North is “N”, Northeast is “NE”). It does not display the headings in actual degrees.

The compass is a self calibrating unit that requires no adjusting. 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 will also 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.



J938C-10

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 demagnetizing and calibration procedures may be required to restore proper operation.

If the front console attaching screw is replaced, the new screw must be a #10 stainless.

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, demagnetizing may be necessary to remove residual magnetic fields.

THERMOMETER

The ambient temperature display can be changed from Fahrenheit to Celsius using the US/Metric button. 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.

If the temperature is more than 55°C (131°F) or the circuit is shorted to ground, the temperature display should read SC. If the temperature message received is less than -40°C (-40°F), or an open circuit exists, the display should read OC.

DIAGNOSTIC PROCEDURES

Follow the appropriate diagnostic flow chart:

- Chart 1 Describes the procedures for compass and display problems.
- Chart 2 Describes the procedures for outside temperature measuring problems.
- Chart 3 Describes the procedures for illumination lamp problems.

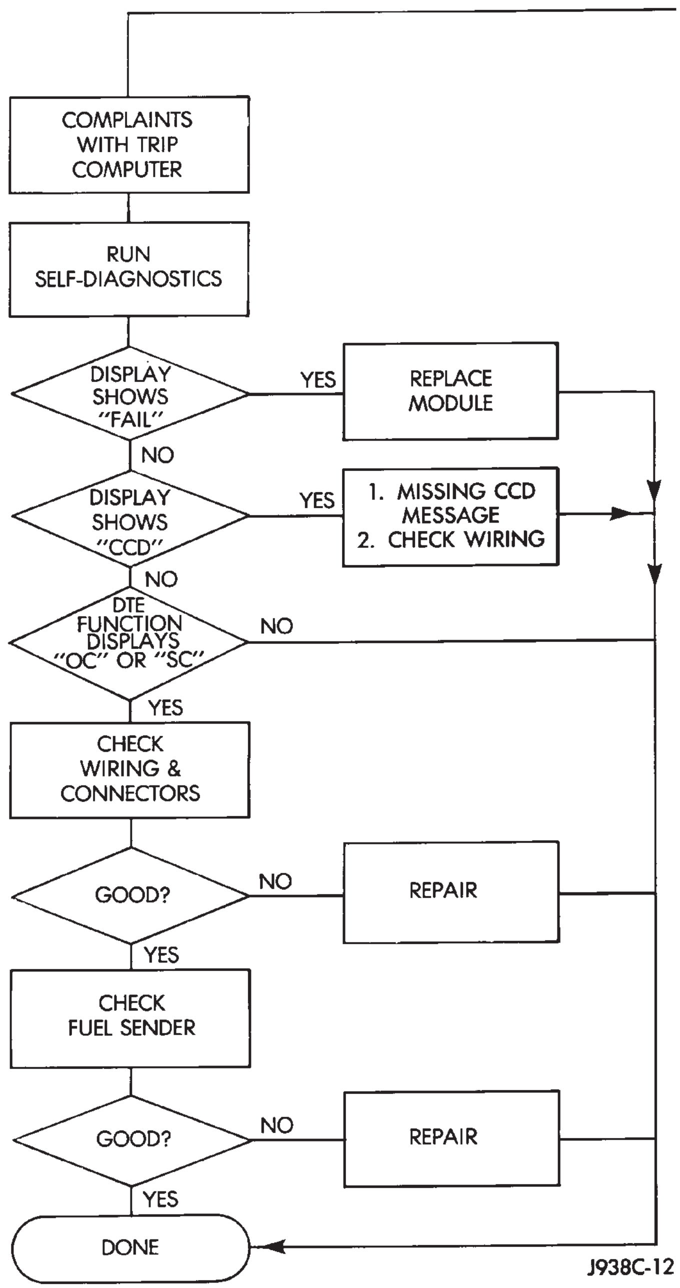


Chart 1

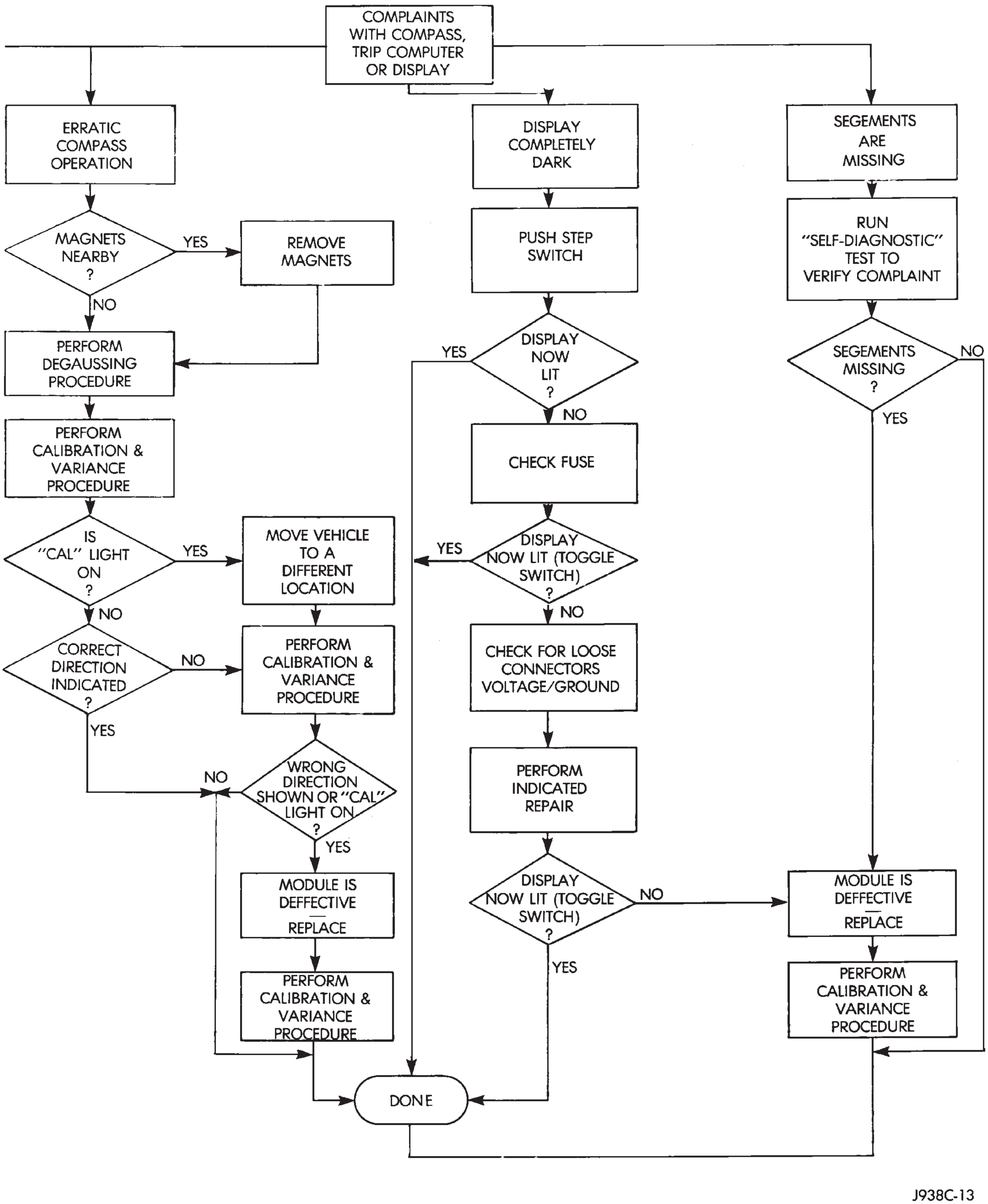


Chart 1 Continued

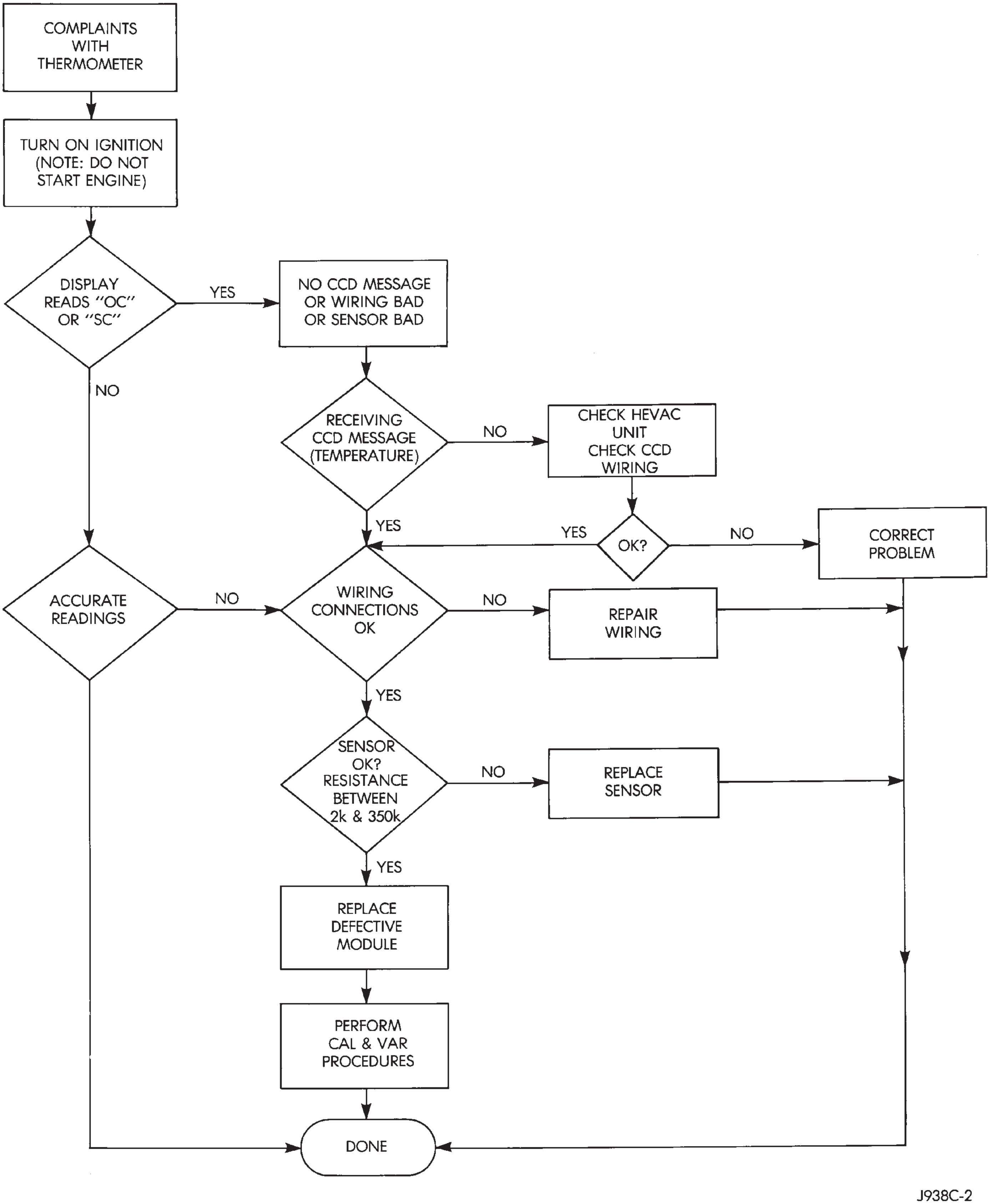

COMPLAINTS WITH THERMOMETER
TURN ON IGNITION (NOTE: DO NOT START ENGINE)
DISPLAY READS "OC" OR "SC"
YES
NO CCD MESSAGE OR WIRING BAD OR SENSOR BAD
NO
RECEIVING CCD MESSAGE (TEMPERATURE)
NO
CHECK HEVAC UNIT CHECK CCD WIRING
YES
YES
OK?
NO
CORRECT PROBLEM
ACCURATE READINGS
NO
WIRING CONNECTIONS OK
NO
REPAIR WIRING
YES
SENSOR OK? RESISTANCE BETWEEN 2k & 350k
NO
REPLACE SENSOR
YES
REPLACE DEFECTIVE MODULE
PERFORM CAL & VAR PROCEDURES
DONE
J938C-2

Chart 2

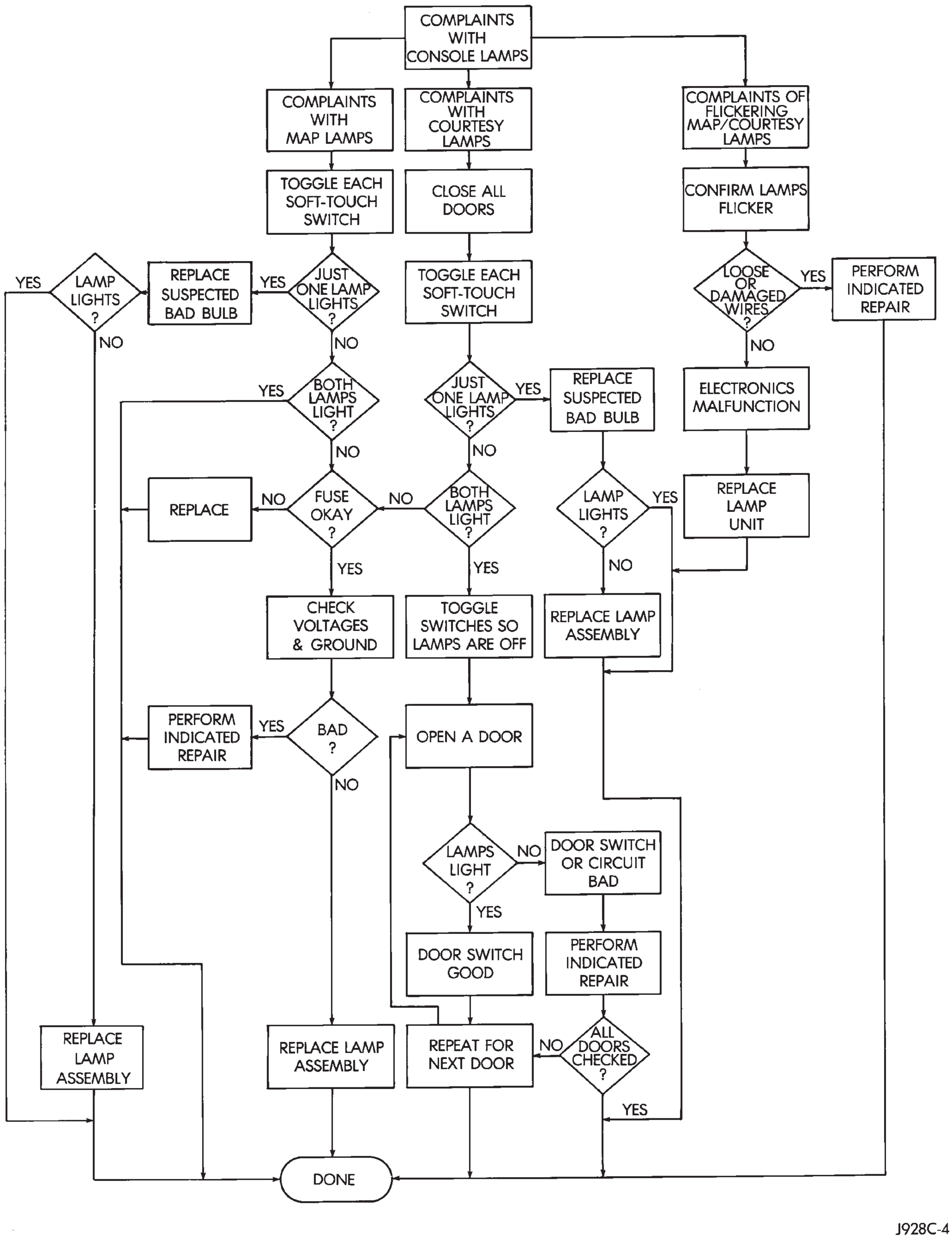

COMPLAINTS WITH CONSOLE LAMPS
COMPLAINTS WITH MAP LAMPS
COMPLAINTS WITH COURTESY LAMPS
COMPLAINTS OF FLICKERING MAP/COURTESY LAMPS
TOGGLE EACH SOFT-TOUCH SWITCH
CLOSE ALL DOORS
CONFIRM LAMPS FLICKER
LAMP LIGHTS ?
REPLACE SUSPECTED BAD BULB
JUST ONE LAMP LIGHTS ?
TOGGLE EACH SOFT-TOUCH SWITCH
LOOSE OR DAMAGED WIRES ?
PERFORM INDICATED REPAIR
BOTH LAMPS LIGHT ?
JUST ONE LAMP LIGHTS ?
REPLACE SUSPECTED BAD BULB
ELECTRONICS MALFUNCTION
REPLACE
FUSE OKAY ?
BOTH LAMPS LIGHT ?
LAMP LIGHTS ?
REPLACE LAMP UNIT
CHECK VOLTAGES & GROUND
TOGGLE SWITCHES SO LAMPS ARE OFF
REPLACE LAMP ASSEMBLY
PERFORM INDICATED REPAIR
BAD ?
OPEN A DOOR
LAMPS LIGHT ?
DOOR SWITCH OR CIRCUIT BAD
DOOR SWITCH GOOD
PERFORM INDICATED REPAIR
REPLACE LAMP ASSEMBLY
REPLACE LAMP ASSEMBLY
REPEAT FOR NEXT DOOR
ALL DOORS CHECKED ?
DONE
YES
NO
J928C-4

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: turn key to the ON position. Depress both buttons and hold down until VAR light appears. This takes about 5 seconds.

Release both buttons.

Using the map (Fig. 1) find your geographic location and note the Zone Number.

Press the U.S./Metric button to sequentially go through the numbers until the zone number for your area appears in the display.

Press the STEP button to enter this zone number.

Confirm correct directions are indicated.

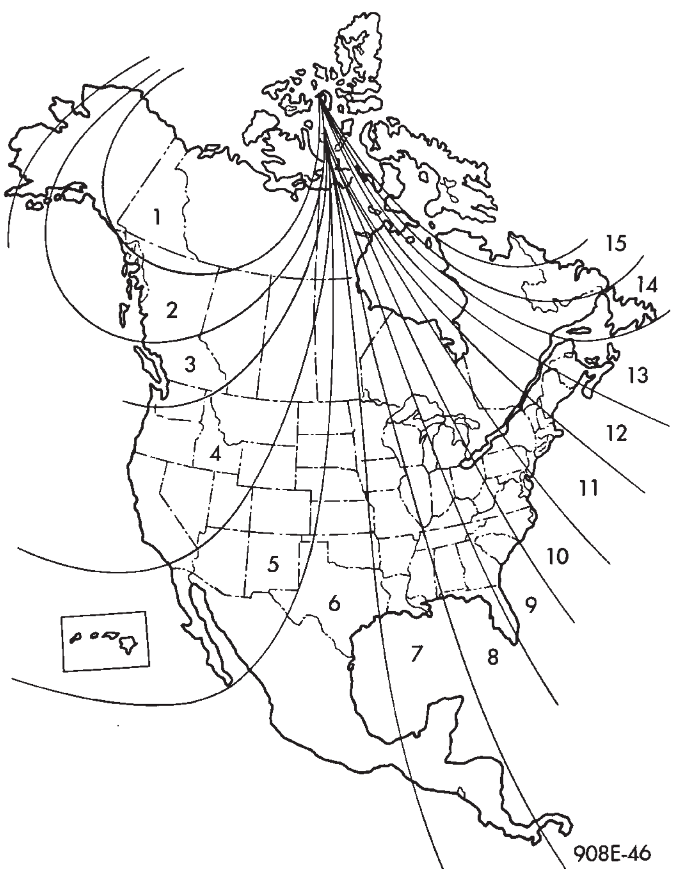


Fig. 1 Variance Settings

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 small changes in magnetism the vehicle may see over its life time.

Calibrate the compass manually as follows:

(1) Start the engine.

(2) Depress both buttons 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 3 or more complete circles, in not less than 48 seconds. The CAL light will go off and the compass is now calibrated.

If CAL light does not go off, either there is excessive magnetism near the compass or the unit is defective. Repeat the demagnetizing 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.

DEMAGNETIZING PROCEDURE

The tool used to 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 and 60Hz. They must also have a field strength of over 350 gauss at 1/4 inch beyond the tip of the probe.

In this procedure the demagnetizing 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 demagnetizing procedures.

(2) Plug the demagnetizing tool into a 110/115 volt outlet while keeping the tool at least 2 inches away from the compass area.

CONSOLE FORWARD MOUNTING SCREW

(3) Slowly approach the head of the forward mounting screw with the plastic coated tip of the demagnetizing tool. Contact the head of the screw for about 2 seconds.

(4) With the demagnetizing tool still energized, slowly back it away from the screw until the tool is at least 2 inches from the screw head. 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 to 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.

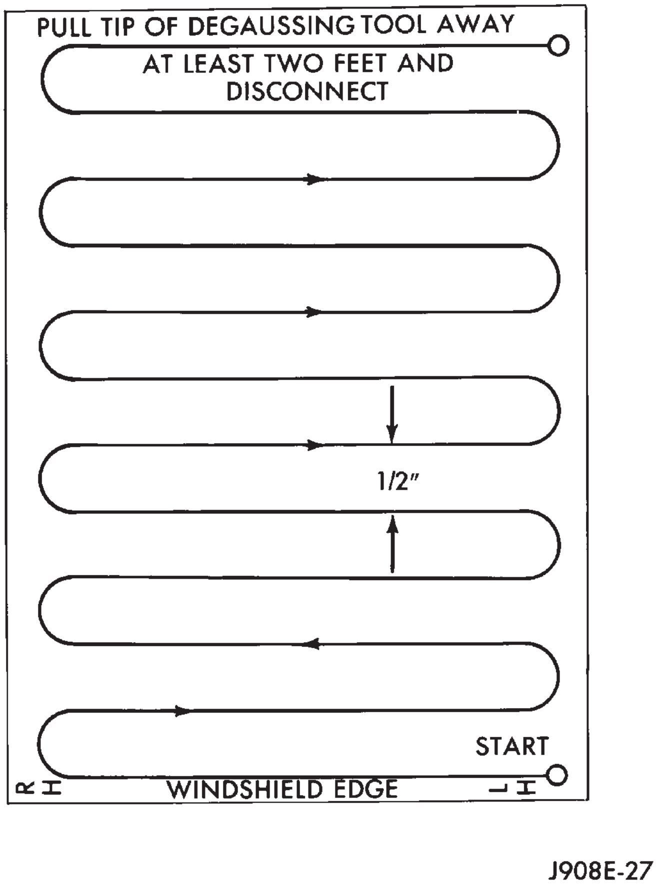


Fig. 2 Roof Demagnetizing Pattern

(6) Plug in the demagnetizing 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 demagnetizing 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). Use slow sweeping motions of 1/2 inch between sweeps. Move the tool approximately 4 inches either side of the centerline and at least 11 inches back from the windshield.

(9) With the demagnetizing tool still energized, slowly back it away from the roof panel until the tip is at least 2 inches from the roof. Unplug the tool.

(10) Calibrate the compass and set the variance as described.

SELF-DIAGNOSTIC TEST

The Self-Diagnostic test is used to verify compass electrical operation and that all CCD messages required are being received. 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 STEP button and the US/METRIC button.

(2) Turn ignition switch to ON.

(3) Continue to hold both buttons until all segments on the display light. The module is now in self diagnostic test. The test will:

(a) Display all segments

(b) Check internal circuitry

(c) Check if all CCD messages needed are being received.

(4) If tests (a) and (b) pass, the module will automatically return to normal operation.

(5) If test (b) fails, the module will display “FAIL”. To return to normal operation press either button. Replace module.

(6) If test (c) fails, the module is not receiving all the CCD messages required for operation. The failure message on the display will be “CCD”. Check CCD buss for missing messages. Press either button to return to normal operation.

Should any segment in any of the digit positions fail to light, the unit is defective and should be replaced.

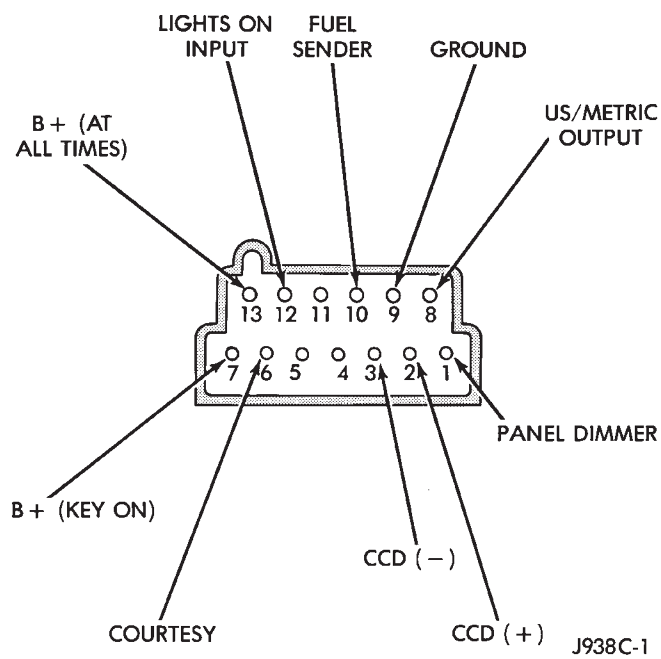


Fig. 3 Compass/Temperature Harness Connector

THERMOMETER SENSOR REPLACEMENT

The sensor is mounted to the radiator support in the center just behind the grille (Fig. 1).

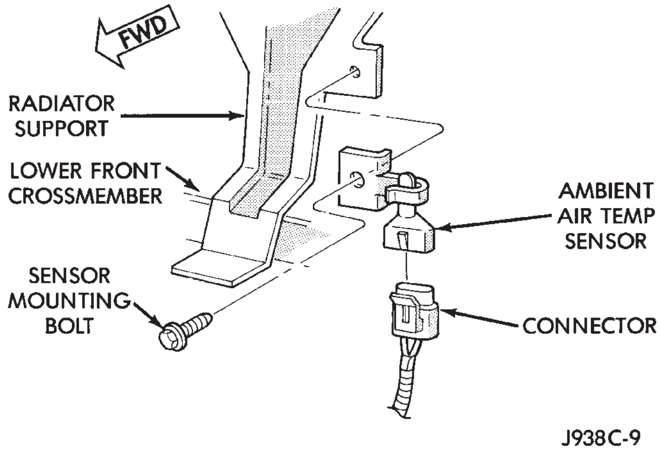


Fig. 1 Ambient Temperature Sensor.

Remove the grille to access the sensor (Fig. 2).

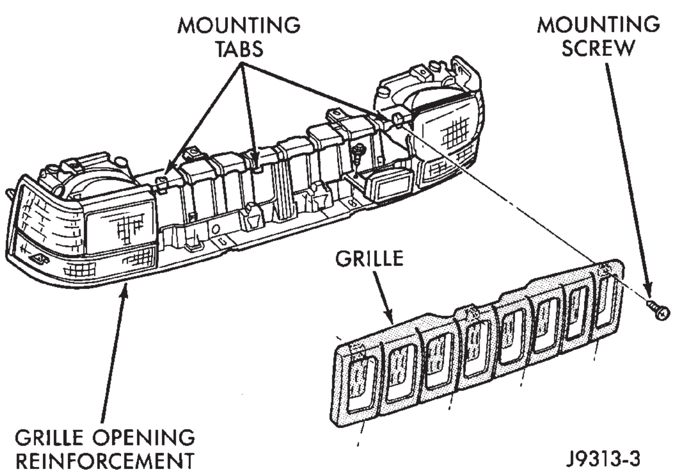


Fig. 2 Grille Removal

CONSOLE REPAIR PROCEDURES

(1) Remove console forward mounting screw (Fig. 3).

(2) Slide console forward until the console detaches from the rear mounting bracket.

(3) Disconnect wire harnesses from keyless entry and compass (Fig. 4).

(4) To install overhead console, reverse the removal procedures.

TRIP COMPUTER REPLACEMENT

(1) Remove overhead console and disconnect wiring. Refer to Console Repair Procedures.

(2) Unplug harness connectors from Trip Computer.

(3) Remove 2 screws holding trip computer to console (Fig. 5).

(4) Spread retaining tabs on the sides to remove trip computer from the console.

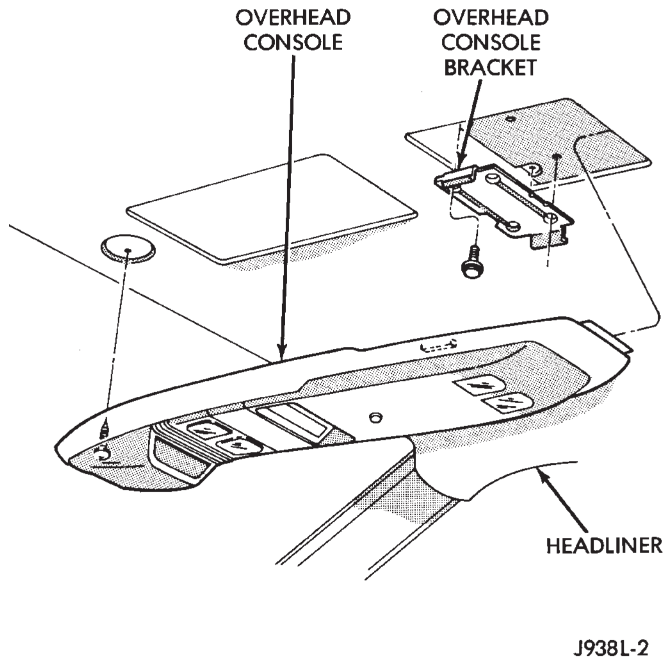


Fig. 3 Remove/Install Overhead Console

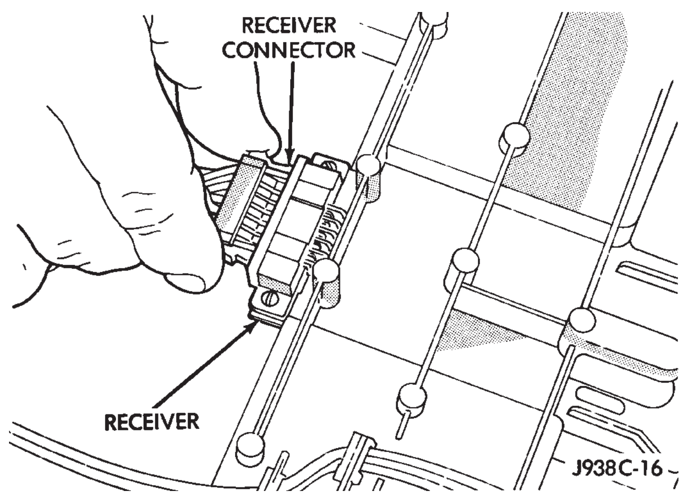


Fig. 4 Keyless Entry Harness Connector

(5) For installation, reverse the removal procedures.

PUSH BUTTON MODULE REPLACEMENT

(1) Remove overhead console and disconnect wiring. Refer to Console Repair Procedures.

(2) Unplug harness connectors from Push Button Module.

(3) Remove 4 screws holding module to console (Fig. 5).

(4) Remove module from console.

(5) For installation, reverse the removal procedures.

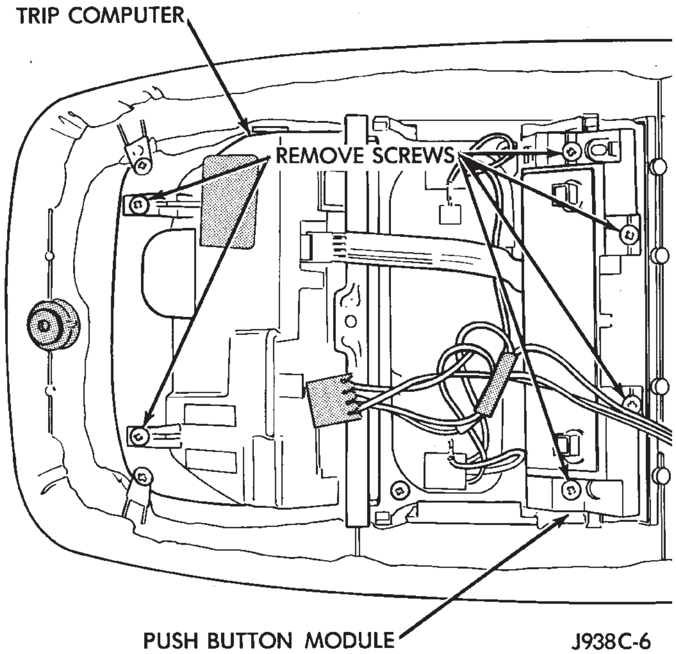


Fig. 5 Trip Computer Removal/Installation

LENS/LAMP REPLACEMENT

(1) Insert a long flat blade tool at the notch on the curved edge of the lens. Carefully pry the lens from the housing and pivot the lens down. It may be necessary to move the tool along the edge to free the lens.

(2) Remove bulb by pulling straight down.

(3) Install new bulb by pushing firmly into socket.

(4) Pivot lens up into position and snap in. Test by pressing lens for proper operation and lighting.

KEYLESS ENTRY RECEIVER

Refer to Group 8P - Power Locks.

IGNITION SYSTEMS

CONTENTS

COMPONENT IDENTIFICATION/SYSTEM OPERATION

INDEX

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 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 II Diagnostic 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

Two different ignition operating systems are used. One system is used on the 4.0L 6 cylinder engine. The other is used on the 5.2L V-8 engine. Similarities and differences between the two systems will be discussed.

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 RELAY (ASD) RELAY

The automatic shut down (ASD) relay is located in the Power Distribution Center (PDC) near the battery (Fig. 1). 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.

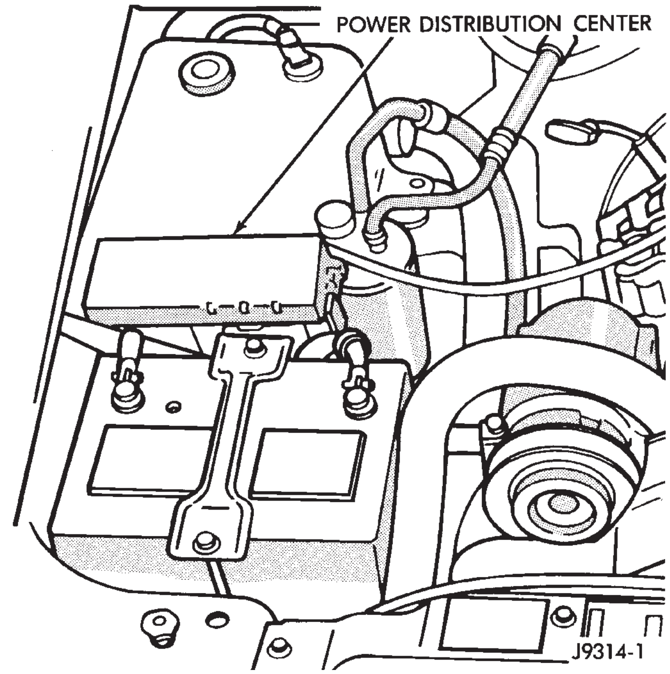


Fig. 1 Power Distribution Center

CAMSHAFT POSITION SENSOR

The camshaft position sensor is located in the ignition distributor (Figs. 2 or 3) on all engines.

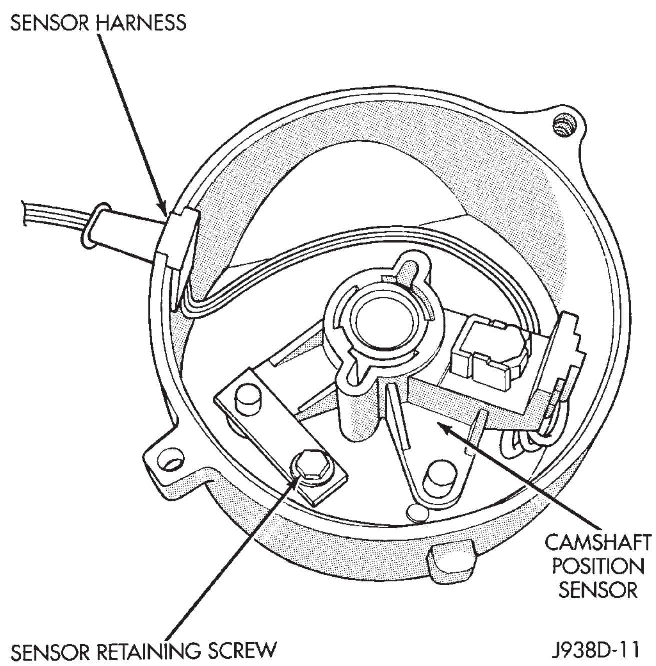


Fig. 2 Camshaft Position Sensor—4.0L Engine

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 rotating pulse ring (shutter) on the distributor shaft. The pulse ring rotates 180 degrees through the sync signal generator. Its signal is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

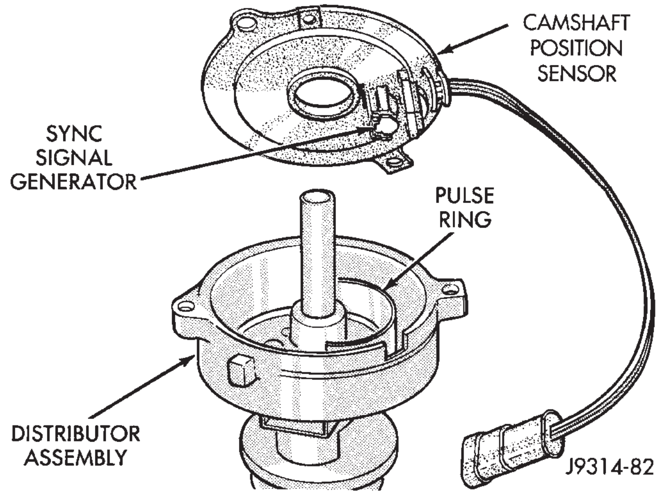


Fig. 3 Camshaft Position Sensor—5.2L Engine

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.

CRANKSHAFT POSITION SENSOR

On 4.0L engines, the crankshaft position sensor is mounted to the transmission bellhousing at the left/rear side of the engine block (Fig. 4).

On 5.2L engines, the sensor is bolted to the top of cylinder block near the rear of the right cylinder head (Fig. 5).

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.

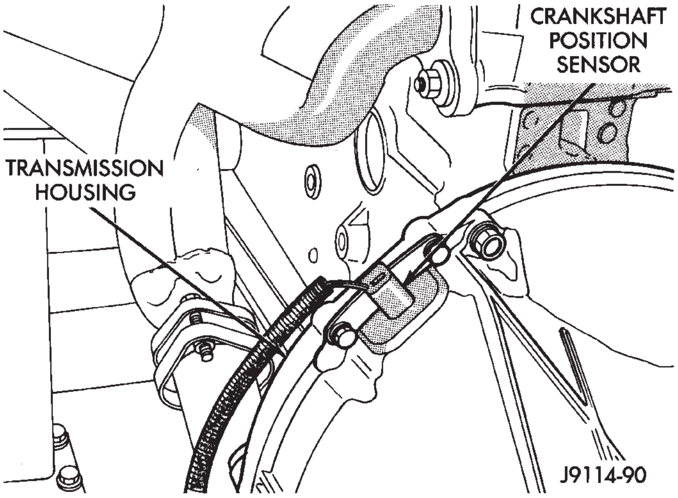


Fig. 4 Crankshaft Position Sensor—4.0L Engine

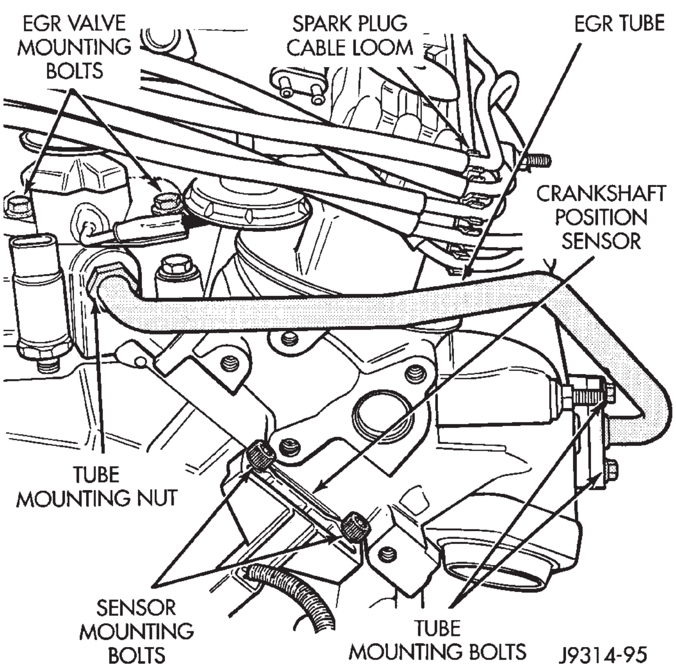


Fig. 5 Crankshaft Position Sensor—5.2L Engine—Typical

SENSOR OPERATION—4.0L ENGINE

The flywheel/drive plate has groups of four notches at its outer edge. On 4.0L engines there are three sets of notches (Fig. 6).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM. For each engine revolution there are 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.

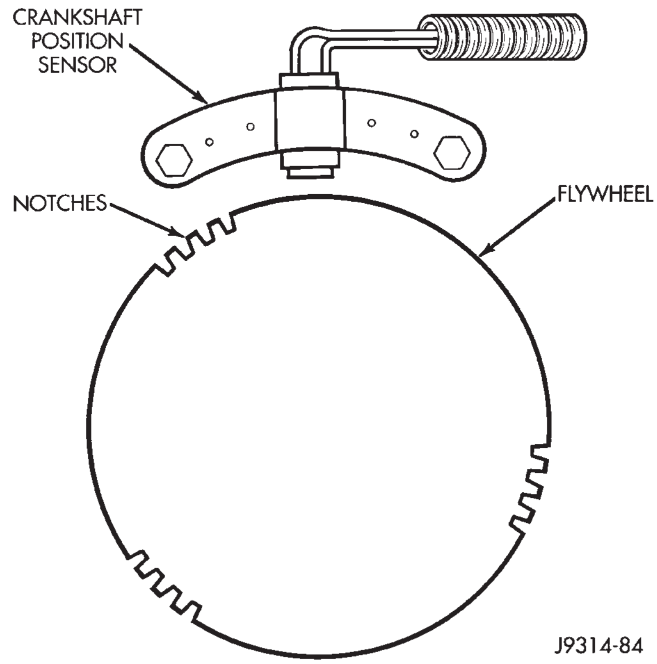


Fig. 6 Sensor Operation—4.0L Engine

SENSOR OPERATION—5.2L ENGINE

On 5.2L engines, the flywheel/drive plate has 8 single notches, spaced every 45 degrees, at its outer edge (Fig. 7).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM. For each engine revolution, there are 8 pulses generated on 5.2L V-8 engines.

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 component, 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 4.0L and 5.2L 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

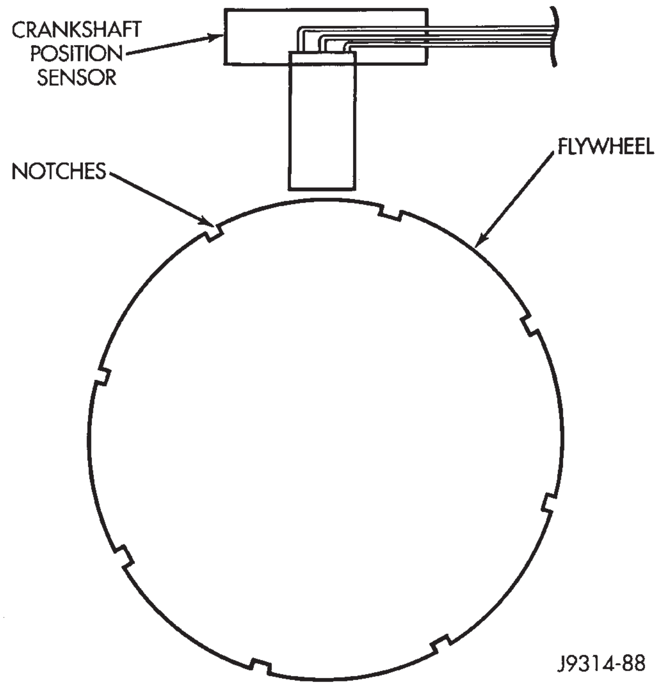


Fig. 7 Sensor Operation—5.2L Engine

(PCM). Because ignition timing is controlled by the PCM, **base ignition timing is not adjustable on any of these engines.**

On the 4.0L 6 cylinder engine, 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 installed, 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.**

On the 5.2L V-8 engine, the distributor is held to the engine in the conventional method using a holddown clamp and bolt. **Although the distributor on the 5.2L engine can be rotated, it will have no effect on ignition timing.**

All distributors contain an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

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.

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.

On 4.0L 6 cylinder engines, the ignition coil is mounted to a bracket on the side of the engine (Fig. 8).

On 5.2L V-8 engines, the ignition coil is mounted to a bracket at the front of the right cylinder head (Fig. 9). This bracket is also used to mount the automatic belt tensioner.

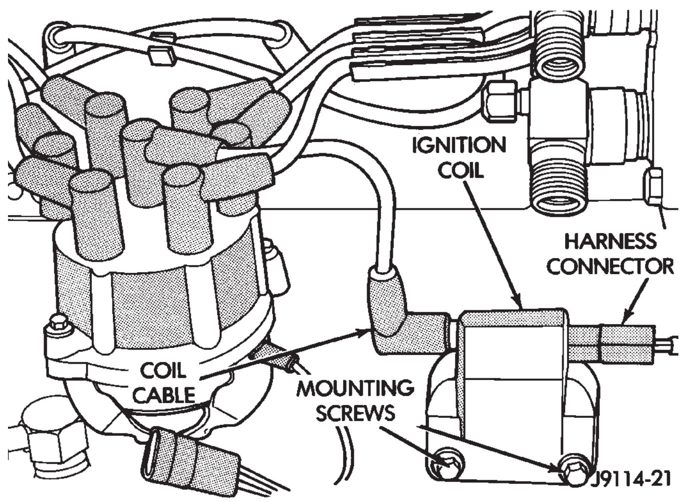


Fig. 8 Ignition Coil—4.0L Engine

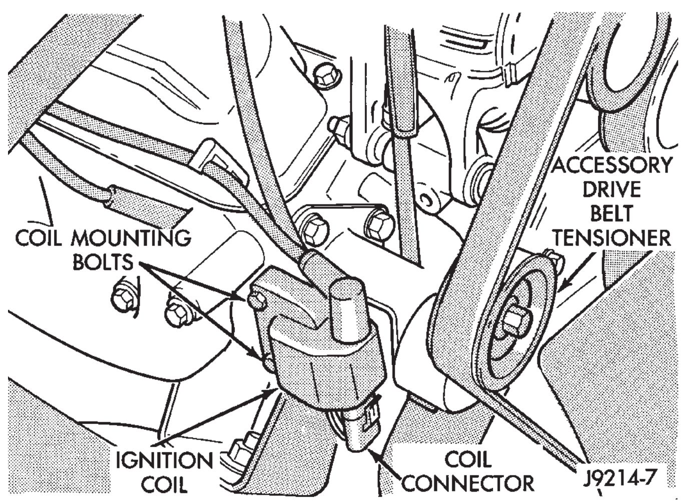


Fig. 9 Ignition Coil—5.2L Engine—Typical

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.

ENGINE COOLANT TEMPERATURE SENSOR

The sensor provides an input voltage to the Powertrain Control Module (PCM) relating coolant temperature. The PCM uses this input, along with inputs from other sensors, to determine injector pulse width and ignition timing. As coolant temperature varies, the coolant temperature sensor resistance will change, 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 on 4.0L 6 cylinder engines (Fig. 10).

This sensor is installed in the intake manifold near the thermostat housing on 5.2L V-8 engines (Fig. 11).

For component testing, refer to the

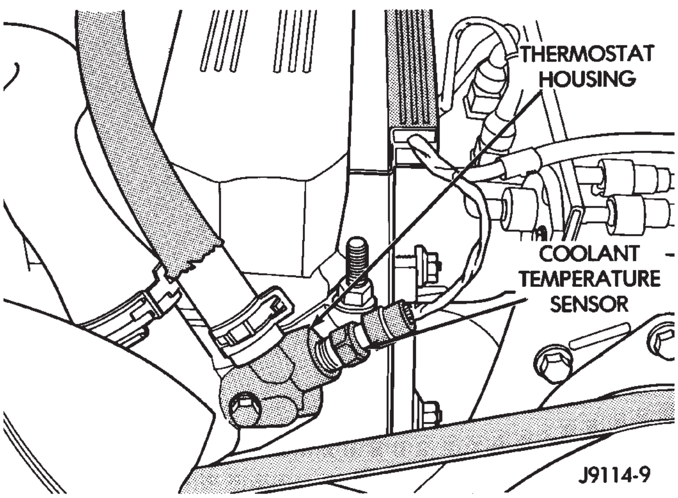


Fig. 10 Coolant Temperature Sensor—4.0L Engine

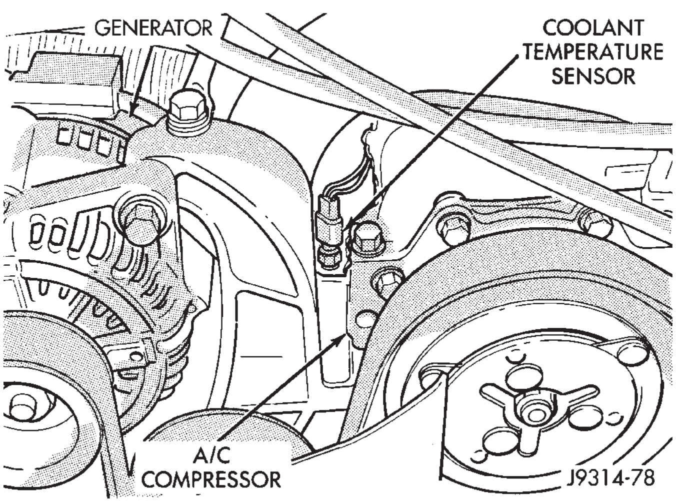


Fig. 11 Coolant Temperature Sensor—5.2L Engine

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 CHARGE 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. 12, 4.0L engine or Fig. 13, 5.2L engine).

For component testing, refer to the

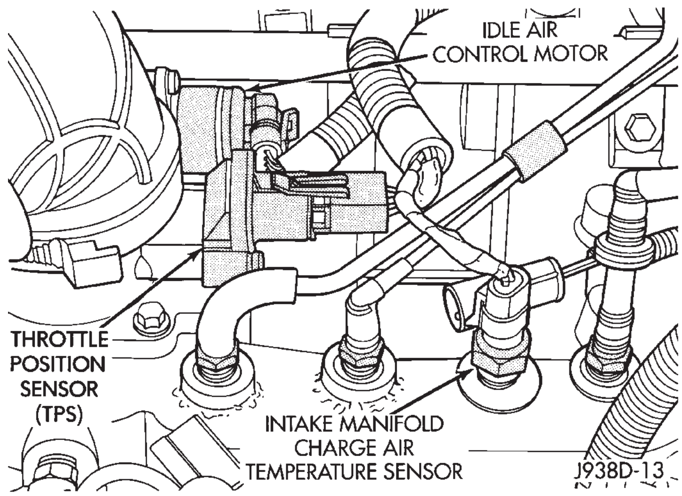


Fig. 12 Sensor Location—4.0L Engine

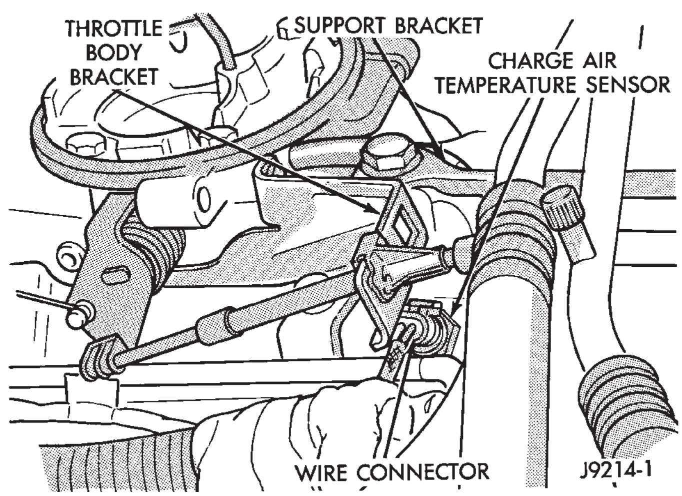


Fig. 13 Sensor Location—5.2L Engine—Typical

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.

On 4.0L 6 cylinder engines, the MAP sensor is mounted on the dash panel (Fig. 14). It is connected to the throttle body with a vacuum hose and to the PCM electrically.

On 5.2L V-8 engines, the MAP sensor is mounted to the throttle body (Fig. 15). It is connected to the throttle body with an L-shaped rubber fitting and to the PCM electrically.

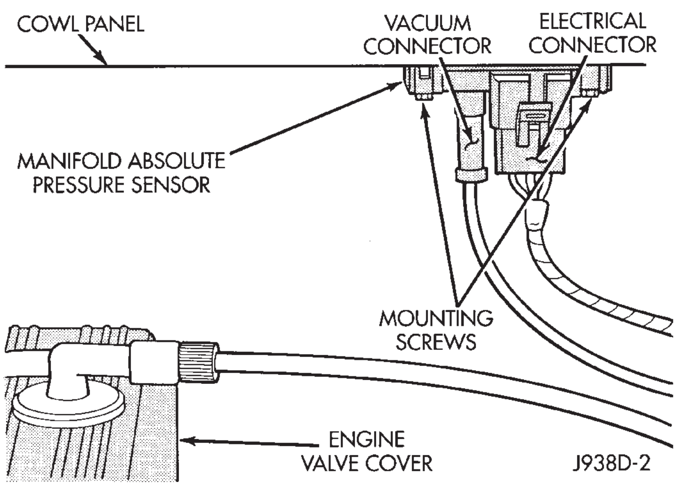


Fig. 14 MAP Sensor—4.0L Engine

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.

POWERTRAIN CONTROL MODULE (PCM)

The PCM (formerly called the SBEC or engine controller) is located in the right/rear side of the engine compartment (Fig. 16).

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.

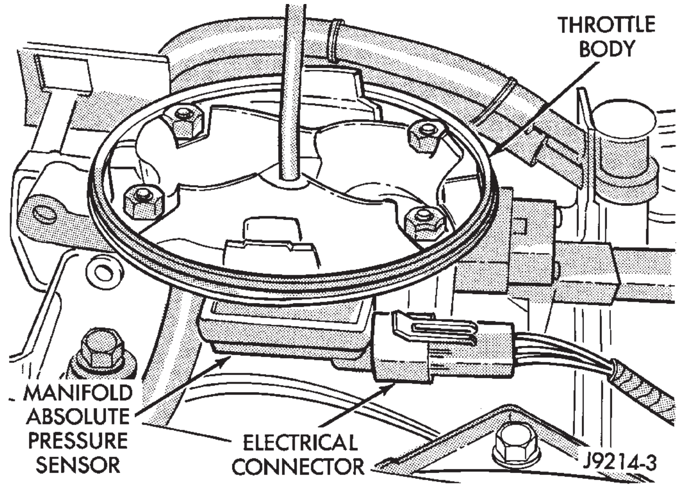


Fig. 15 MAP Sensor—5.2L Engine

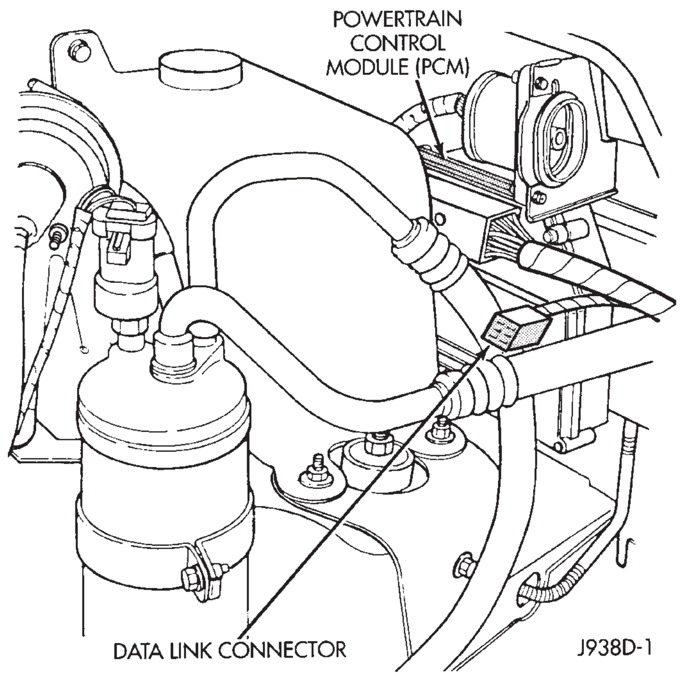


Fig. 16 PCM Location

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: Coolant temperature, engine rpm, intake manifold air temperature, manifold absolute pressure and throttle position.

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 II scan tool.

THROTTLE POSITION SENSOR

The sensor is mounted on the throttle body (Figs. 17 or 18). 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.

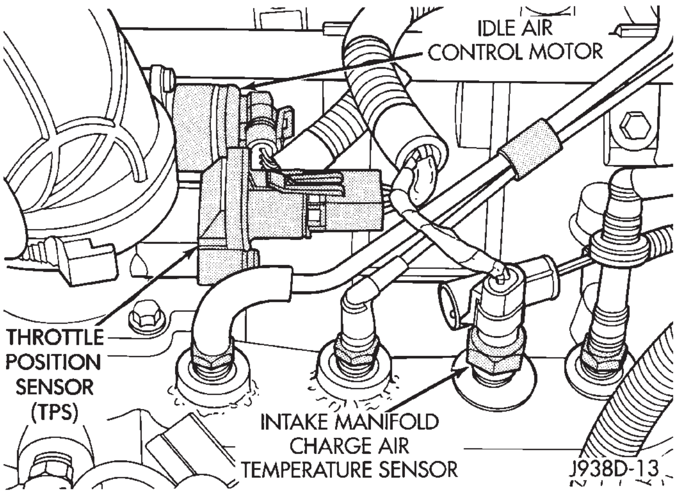


Fig. 17 Throttle Position Sensor—4.0L Engine

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 current engine operating conditions. It also will adjust fuel injector pulse width and ignition timing.

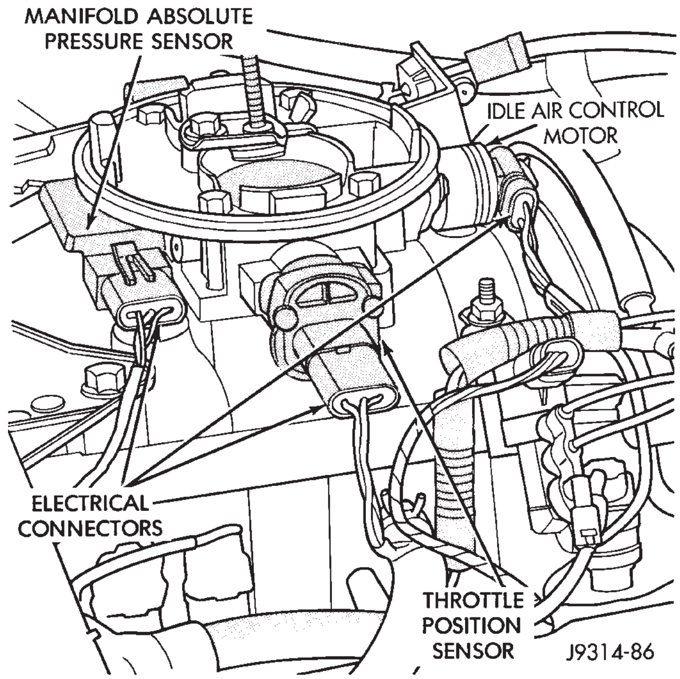


Fig. 18 Throttle Position Sensor—5.2L Engine—Typical

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.

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 II Diagnostic 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 II diagnostic scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

4.0L OR 5.2L 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.

4.0L Engines: 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.

5.2L Engines: Remove coil high-tension cable and all spark plug cables at distributor cap. Note and mark position of cables before removal (Fig. 2). Remove distributor cap from distributor (two screws). Rotate (crank) the engine until the distributor rotor is pointed towards the rear of vehicle. The movable pulse ring should now be within the sensor pickup.

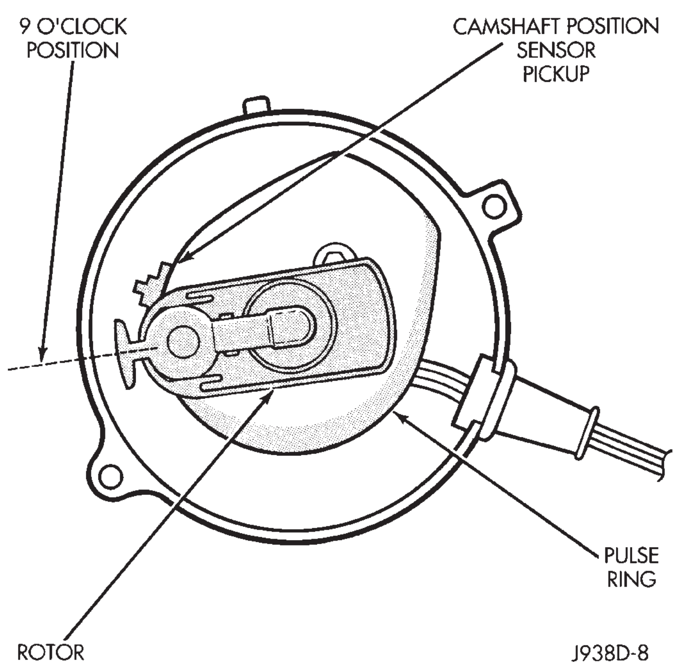


Fig. 1 Pulse Ring/Rotor Position—4.0L Engine

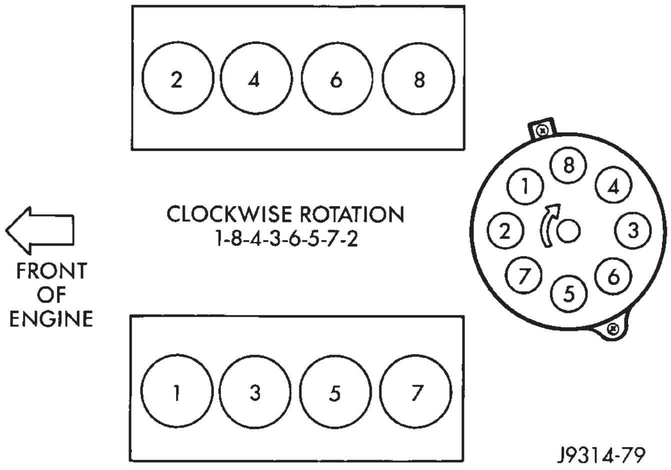


Fig. 2 Engine Firing Order—5.2L Engine

(4) Turn ignition key to ON position. Voltmeter should read approximately 5.0 volts.

(5) If voltage is not present, check the voltmeter leads for a good connection.

(6) If voltage is still not present, check for voltage at the supply wire. For wire identification, refer to Group 8W, Wiring Diagrams.

(7) 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.

(8) If voltage is still not present, perform vehicle test using the DRB II diagnostic scan tool.

(9) 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.

(10) 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 II diagnostic scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

On the 4.0L engine, the sensor is located on the transmission bellhousing at the left/rear side of the engine block (Fig. 3).

On the 5.2L engine, the sensor is located on the top of cylinder block near the rear of right cylinder head (Fig. 4).

(1) Near the rear of intake manifold, disconnect sensor pigtail harness connector from main wiring harness.

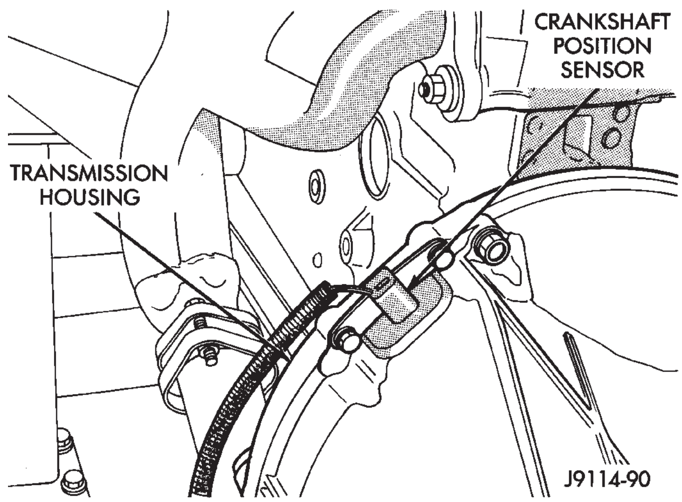


Fig. 3 Crankshaft Position Sensor—4.0L Engine

(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.

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.

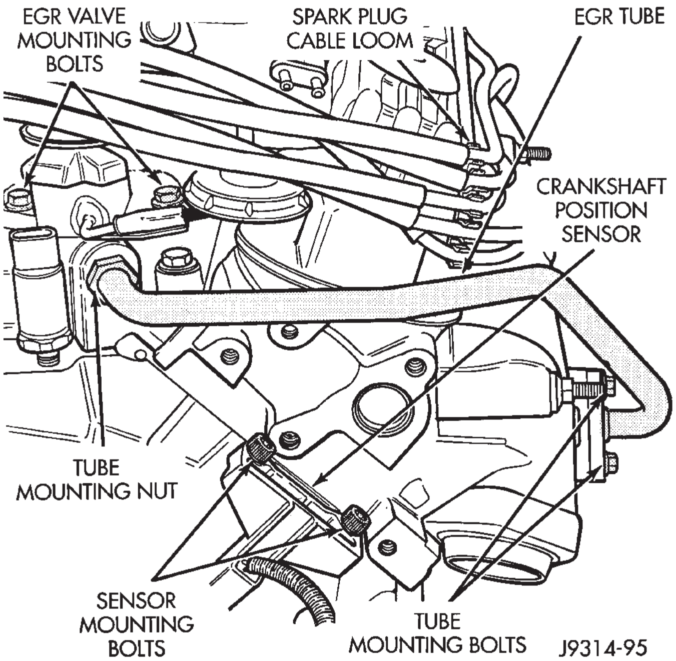


Fig. 4 Crankshaft Position Sensor—5.2L Engine—Typical

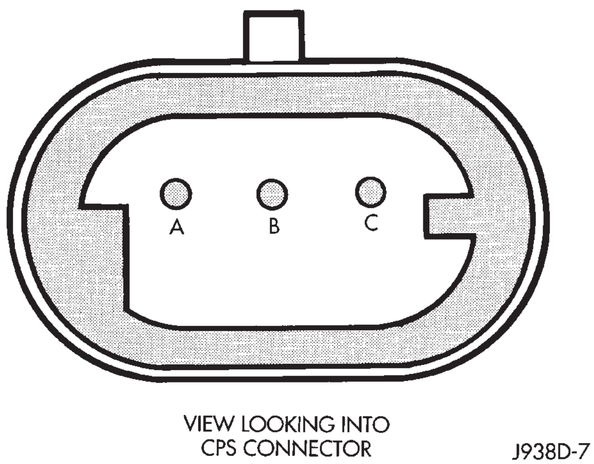


Fig. 5 Crankshaft Position Sensor Connector

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 necessary, refer to the Engine Firing Order diagrams (Figs. 8 or 9).

DISTRIBUTOR ROTOR

Visually inspect the rotor (Figs. 10 or 11) 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**

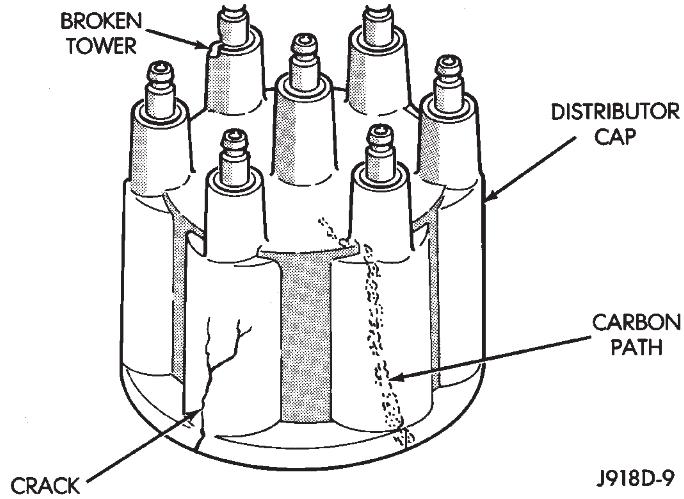


Fig. 6 Cap Inspection—External—Typical

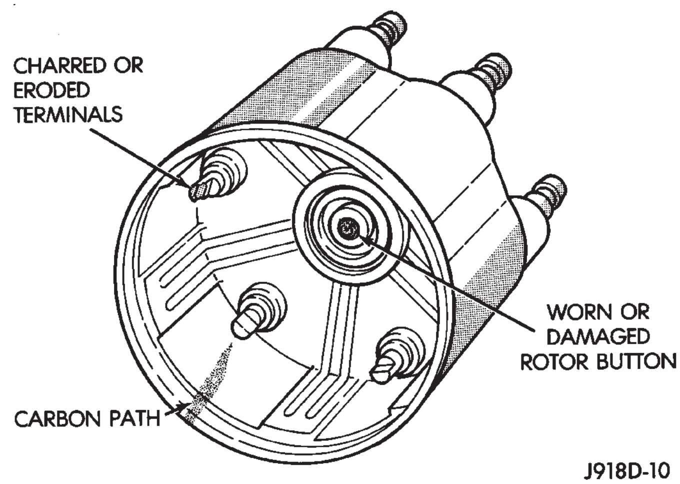


Fig. 7 Cap Inspection—Internal—Typical

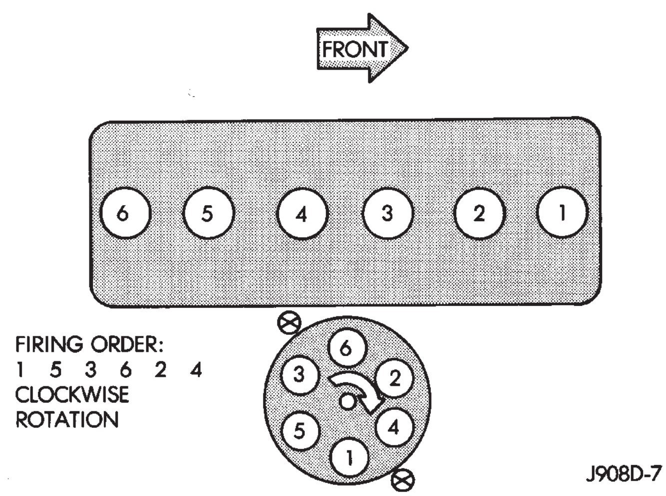


Fig. 8 Engine Firing Order—4.0L Engine

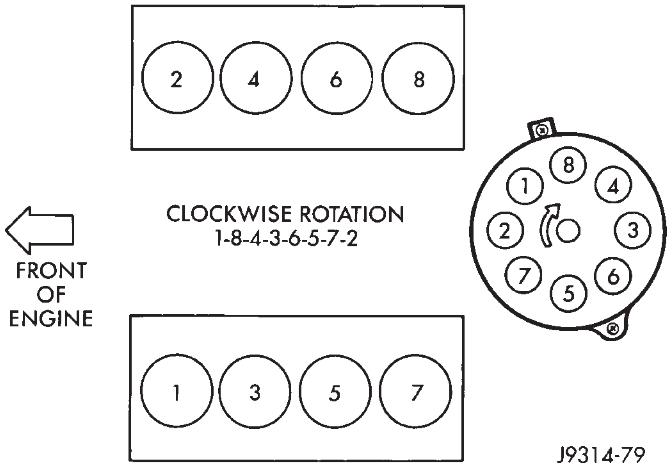


Fig. 9 Engine Firing Order—5.2L Engine

charred compound. Test the spring for insufficient tension. Replace a rotor that displays any of these adverse conditions.

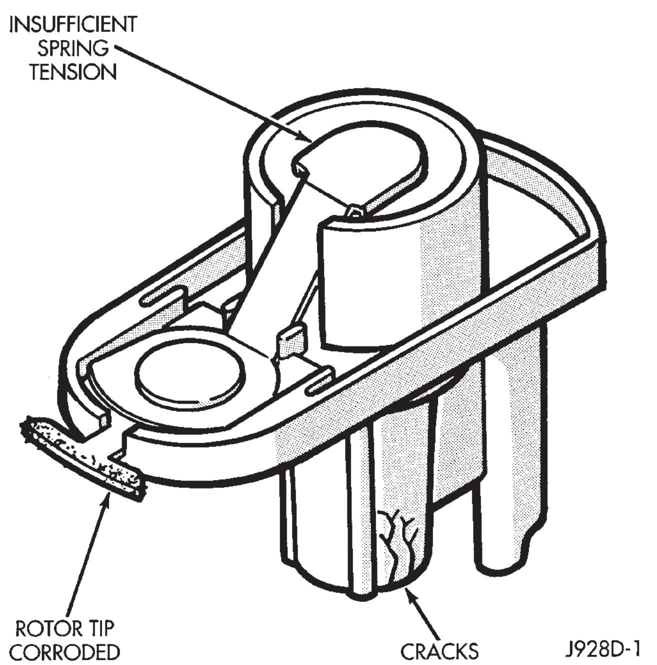


Fig. 10 Rotor Inspection—4.0L Engine—Typical

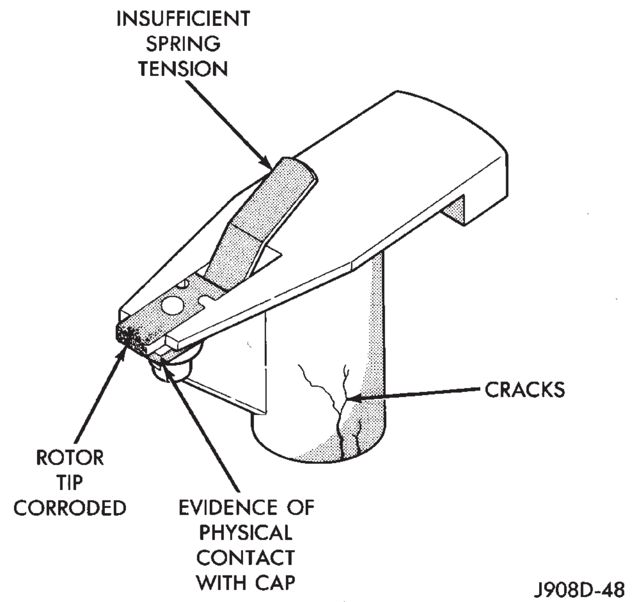


Fig. 11 Rotor Inspection—5.2L Engine—Typical

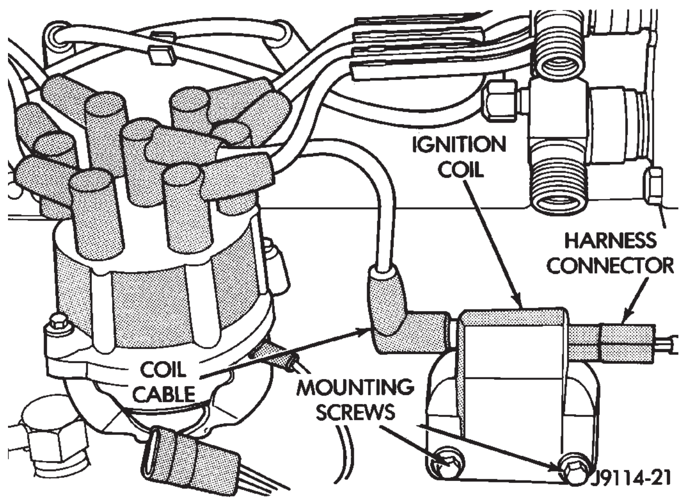


Fig. 12 Ignition Coil—4.0L Engine

IGNITION COIL

To perform a complete test of the ignition coil and its circuitry, refer to the DRB II diagnostic scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the coil only, refer to the following:

The ignition coil (Figs. 12 or 13) is designed to operate without an external ballast resistor.

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.

ENGINE COOLANT TEMPERATURE SENSOR TEST

To perform a complete test of this sensor and its circuitry, refer to the DRB II diagnostic scan tool.

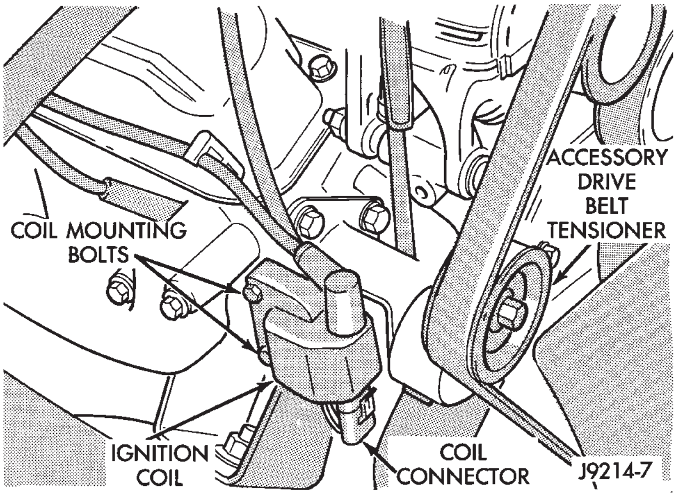


Fig. 13 Ignition Coil—5.2L Engine

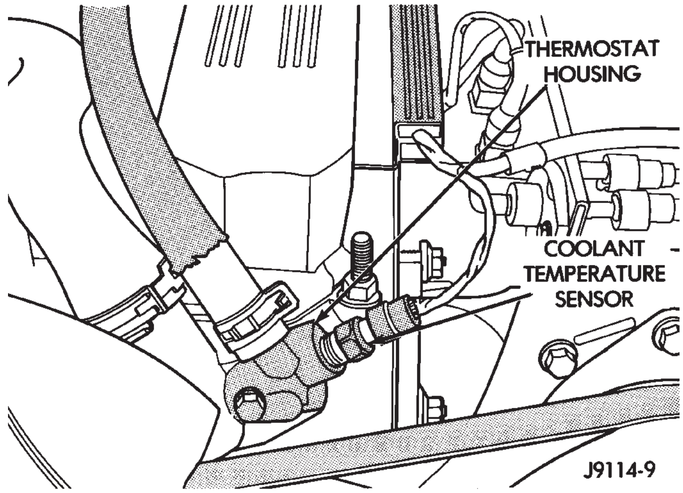


Fig. 14 Coolant Temperature Sensor—4.0L Engine

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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Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

4.0L Engines: The sensor is installed in the thermostat housing (Fig. 14).

5.2L Engines: The sensor is located in a water passage of the intake manifold next to the thermostat housing (Fig. 15).

(1) Disconnect wire harness connector from sensor (Figs. 14 or 15). On 5.2L engines with air conditioning, do not pull directly on wiring harness. Fabricate an L-shaped hook tool from a coat hanger (approximately eight inches long). Place the hook part of tool under the connector for removal. The connector is snapped onto the sensor. It is not equipped with a lock type tab.

(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.

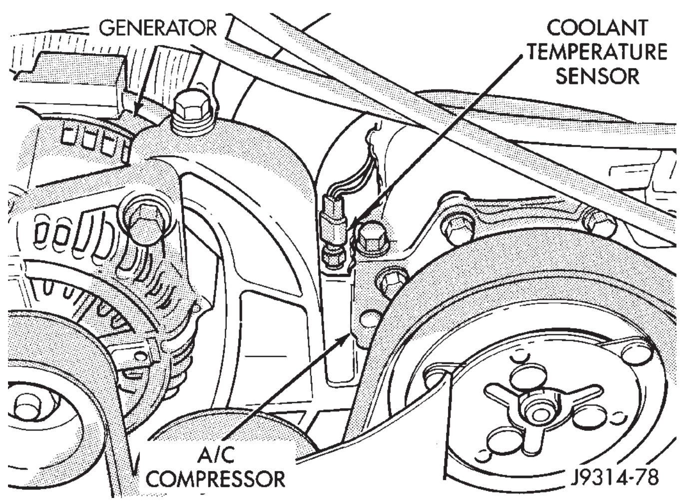

Fig. 15 Coolant Temperature Sensor—5.2L Engine

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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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. 16).

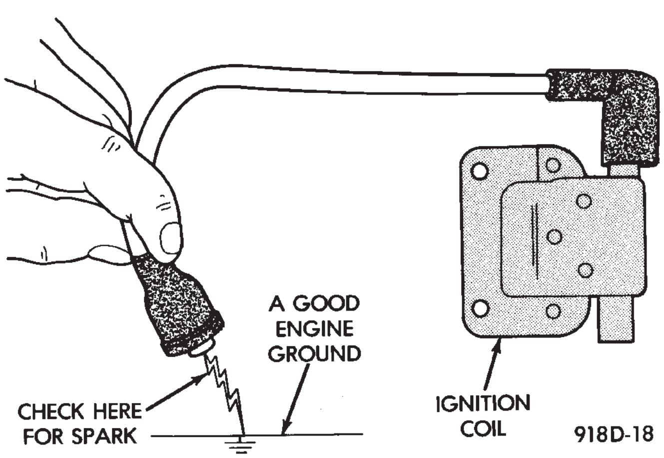

Fig. 16 Checking for Spark—Typical

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 II diagnostic scan tool. Refer to the Powertrain Diagnostic Procedures service manual.

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 (Figs. 17 or 18).

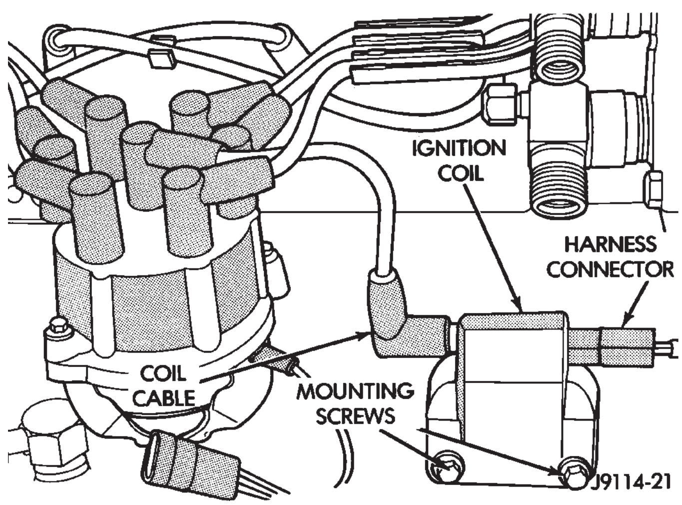

Fig. 17 Coil Harness Connector—4.0L Engine—Typical

(2) Connect a set of small jumper wires (18 gauge or smaller) between the ignition coil and coil electrical connector (Fig. 19).

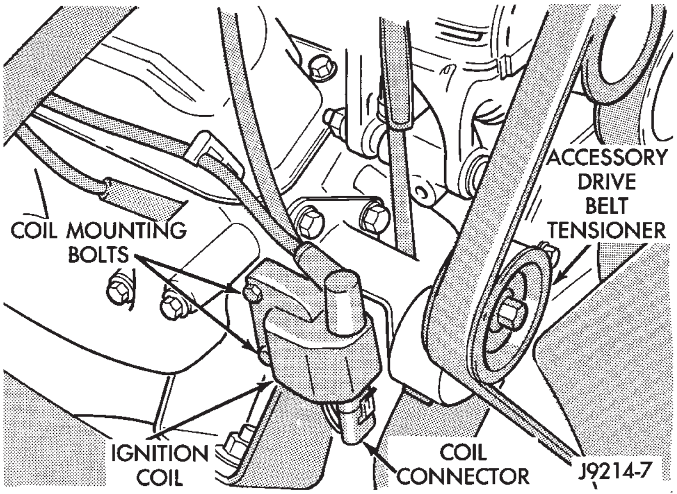

Fig. 18 Coil Harness Connector—5.2L Engine—Typical

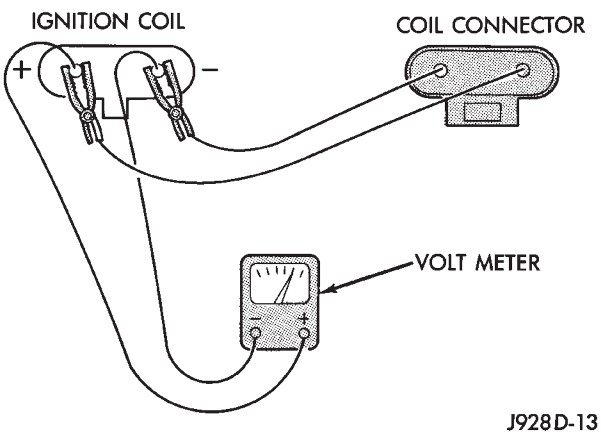

Fig. 19 Coil Terminals—Typical

(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 (Fig. 19):

• 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 and auto shutdown relay.

• If voltage is at near battery voltage and drops to zero after 1-2 seconds of cranking, check the camshaft position sensor-to-powertrain control module 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 60-way connector (Fig. 20) from the powertrain control module (PCM). Check 60-way connector for any spread terminals.

(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.

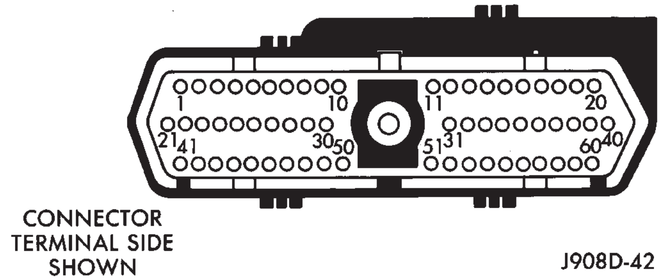

Fig. 20 PCM 60-Way Connector

(6) Make the special jumper shown in Figure 21. 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.

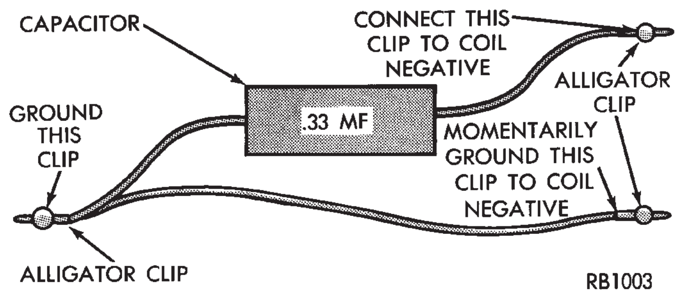

Fig. 21 Special Jumper Ground-to-Coil Negative Terminal

(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 4.0L 6 cylinder or 5.2L V-8 engines. Do not attempt to adjust ignition timing by rotating the distributor.

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 II Scan Tool.

INTAKE MANIFOLD CHARGE AIR TEMPERATURE SENSOR TEST

To perform a complete test of this sensor and its circuitry, refer to the DRB II diagnostic 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. 22 or 23).

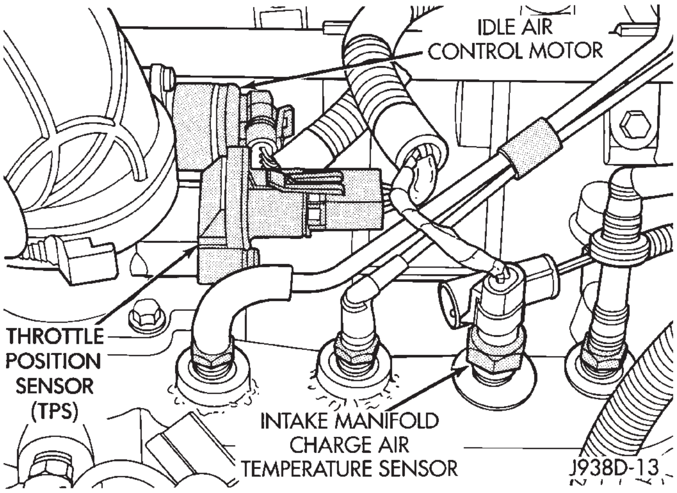

Fig. 22 Air Temperature Sensor—4.0L Engine

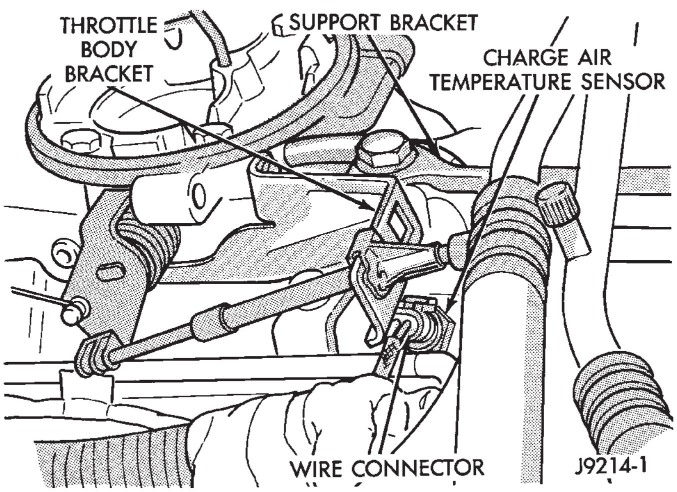

Fig. 23 Air Temperature Sensor—5.2L Engine—Typical

(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-2 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.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST

To perform a complete test of this sensor and its circuitry, refer to the DRB II diagnostic scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

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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4.0L Engines: The MAP sensor is located on the cowl panel near the rear of the engine valve cover (Fig. 24).

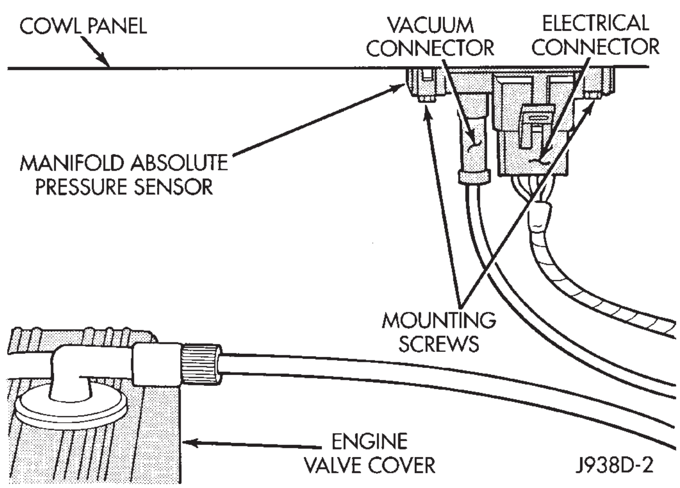


Fig. 24 MAP Sensor—4.0L Engine

5.2L Engine: The MAP sensor is located on the front of the throttle body (Fig. 25).

(1) 4.0L Engine: Inspect the sensor vacuum hose connections at the throttle body and sensor (Fig. 25). Repair as necessary.

5.2L Engines: Inspect the L-shaped rubber fitting located between the MAP sensor and throttle body (Fig. 26).

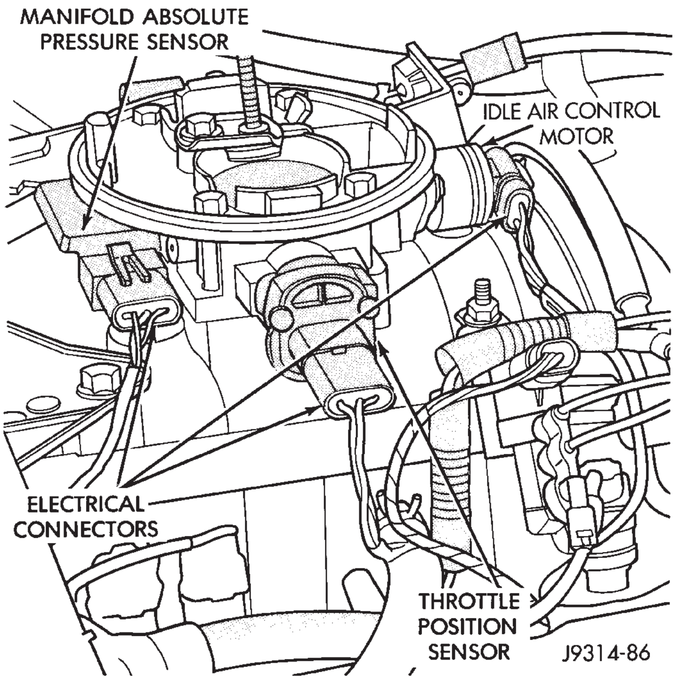


Fig. 25 MAP Sensor—5.2L Engine

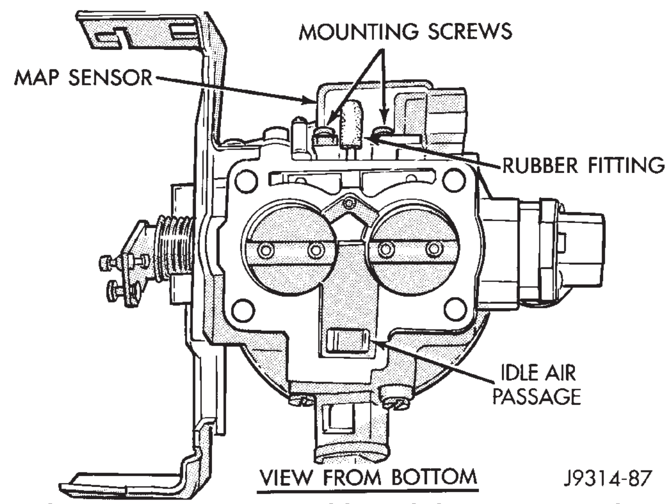


Fig. 26 MAP Sensor Rubber Fitting—5.2L Engine

CAUTION: When testing the sensor, be sure that the harness wires are not damaged by the test meter probes.

(2) Test the sensor output voltage at the sensor connector between terminals A and B as marked on the sensor body (Fig. 27). 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.**

(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

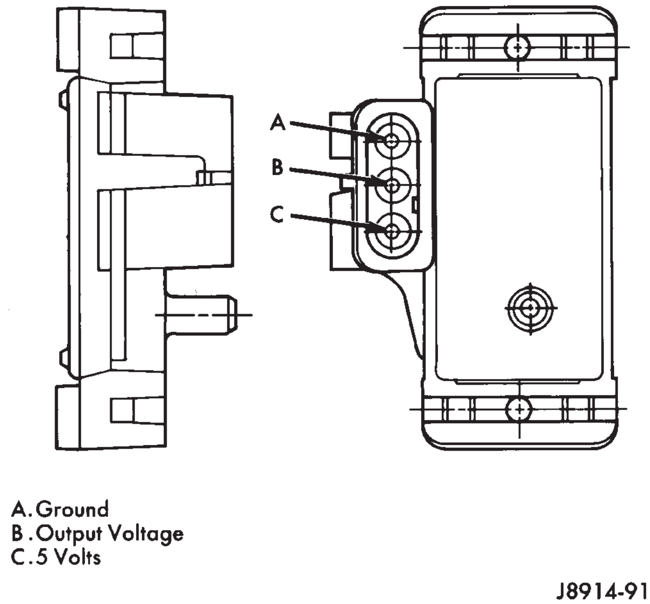


Fig. 27 MAP Sensor Test—Typical

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 right/rear side of the engine compartment.

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 II scan tool.

SPARK PLUGS

For spark plug removal, cleaning, gap adjustment and installation, refer to the Component Removal/Installation section of this group.

5.2L Engine: Spark plug heat shields are pressed into the cylinder head to surround each spark plug cable boot and spark plug (Fig. 28). These shields protect the spark plug boots from damage (due to intense engine heat generated by the exhaust manifolds) and should not be removed. After the spark plug cable has been installed, the lip of the cable boot should have a small air gap to the top of the heat shield (Fig. 28).

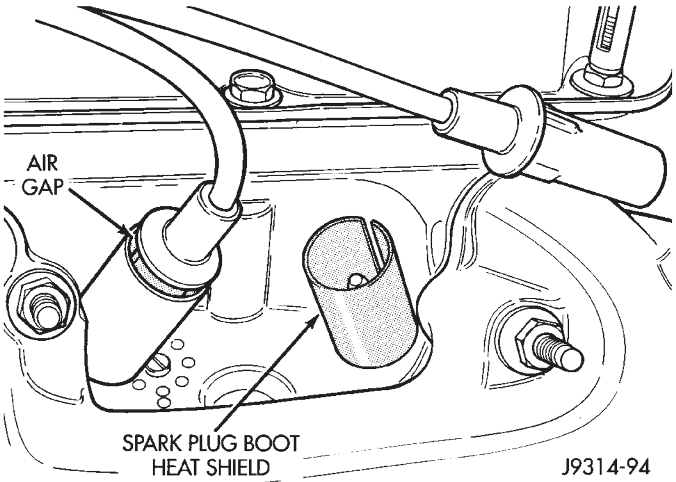


Fig. 28 Heat Shields—5.2L Engine

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. 29). 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.

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.

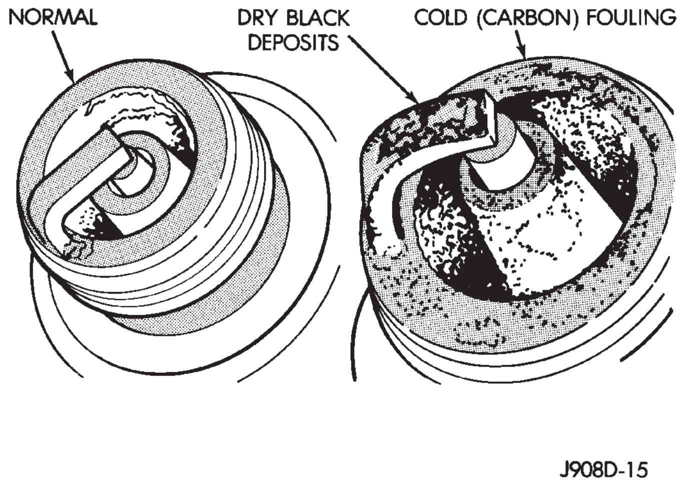


Fig. 29 Normal Operation and Cold (Carbon) Fouling

COLD FOULING/CARBON FOULING

Cold fouling is sometimes referred to as carbon fouling. The deposits that cause cold fouling are basically carbon (Fig. 29). 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. 30). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 31). They may appear to be harmful, but this is a normal condition caused by chemical additives in certain fuels. These additives are designed to change the chemical nature of deposits and decrease spark plug misfire tendencies. Notice that accumulation on the ground electrode and shell area may be heavy, but the deposits are easily removed. Spark plugs with scavenger deposits can be considered normal in condition and can be cleaned using standard procedures.

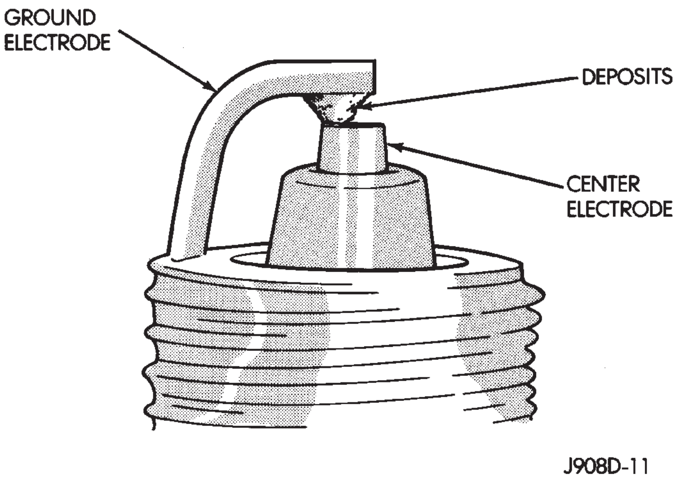


Fig. 30 Electrode Gap Bridging

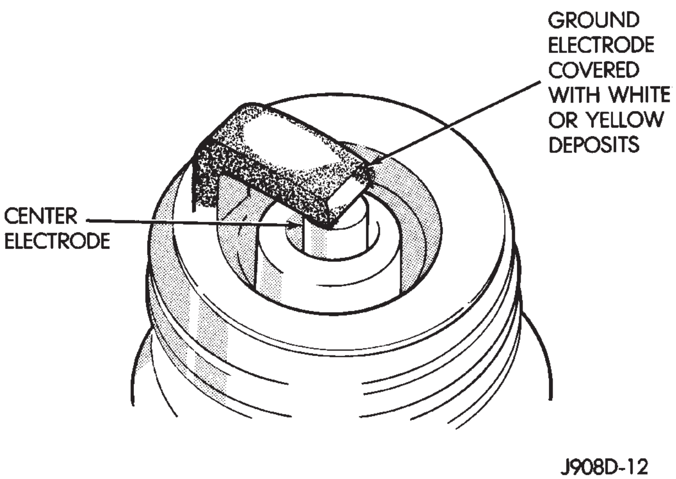


Fig. 31 Scavenger Deposits

CHIPPED ELECTRODE INSULATOR

A chipped electrode insulator usually results from bending the center electrode while adjusting the spark plug electrode gap. Under certain conditions, severe detonation can also separate the insulator from the center electrode (Fig. 32). Spark plugs with this condition must be replaced.

PREIGNITION DAMAGE

Preignition damage is usually caused by excessive combustion chamber temperature. The center electrode dissolves first and the ground electrode dissolves somewhat latter (Fig. 33). Insulators appear relatively deposit free. Determine if the spark plug has the correct heat range rating for the engine. Determine if ignition timing is over advanced, or if other operating conditions are causing engine overheating. (The heat range rating refers to the operating temperature of a particular type spark plug. Spark plugs are designed to operate within specific temperature ranges. This depends upon the thickness and length of the center electrodes porcelain insulator.)

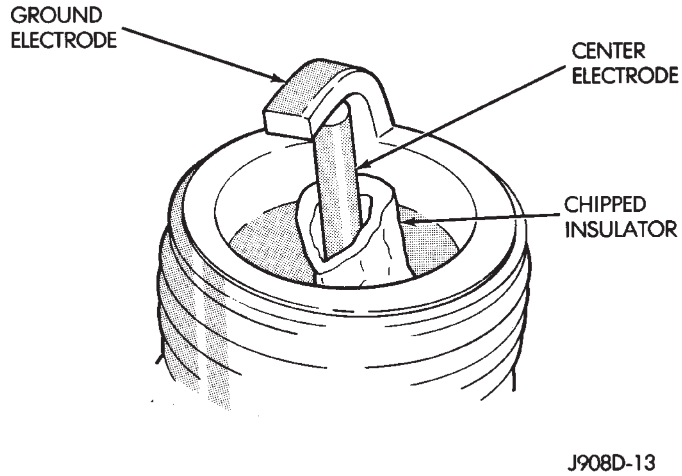


Fig. 32 Chipped Electrode Insulator

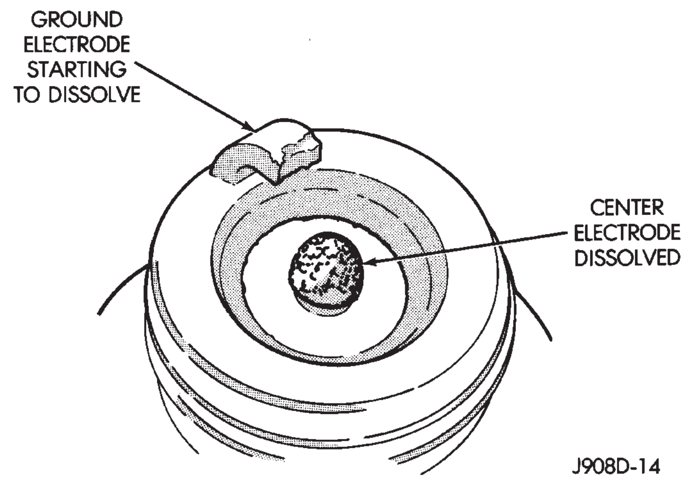


Fig. 33 Preignition Damage

SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 34). The increase in electrode gap will be considerably in excess of 0.001 inch per 1000 miles of operation. This suggests that a plug with a cooler heat range rating should be used. Over advanced ignition timing, detonation and cooling system malfunctions can also cause spark plug overheating.

SPARK PLUG SECONDARY CABLES

5.2L Engine: Spark plug heat shields are pressed into the cylinder head to surround each spark plug cable boot and spark plug (Fig. 35). These shields protect the spark plug boots from damage (due to intense engine heat generated by the exhaust manifolds) and should not be removed. After the spark plug cable has been installed, the lip of the cable boot should have a small air gap to the top of the heat shield (Fig. 35).

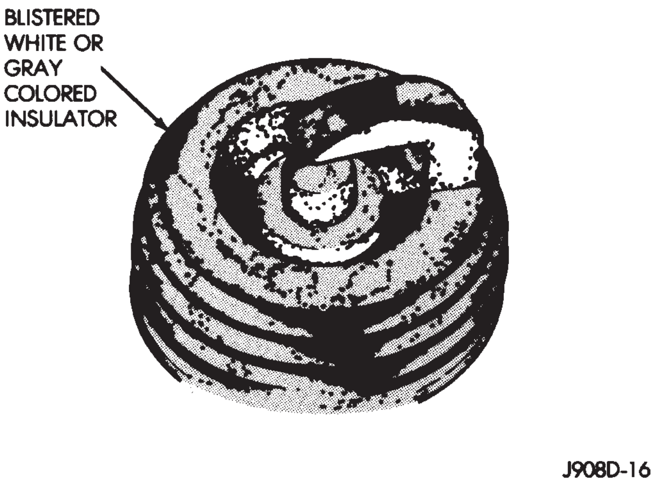


Fig. 34 Spark Plug Overheating

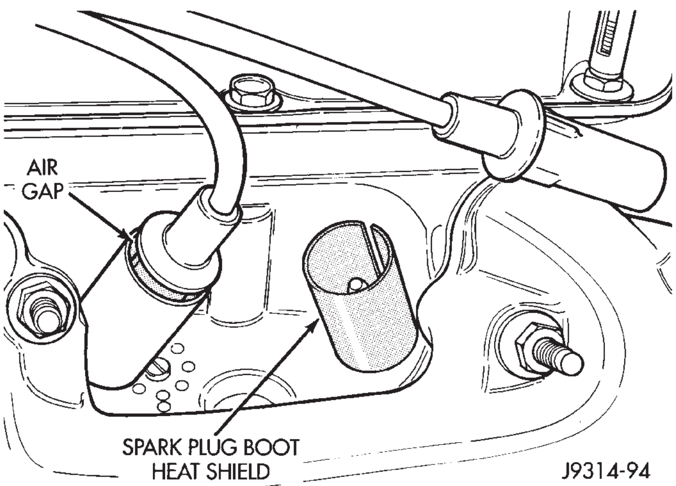


Fig. 35 Heat Shields—5.2L Engine

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.

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.

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

J908D-43

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 II diagnostic 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. 36 or 37).

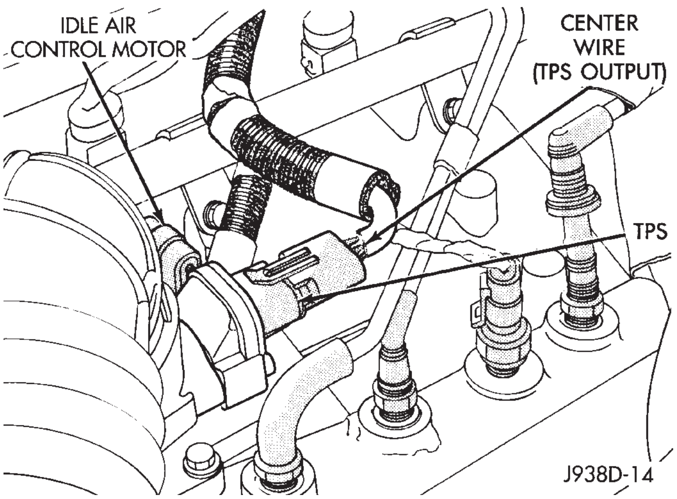


Fig. 36 Sensor Testing—4.0L Engine

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.

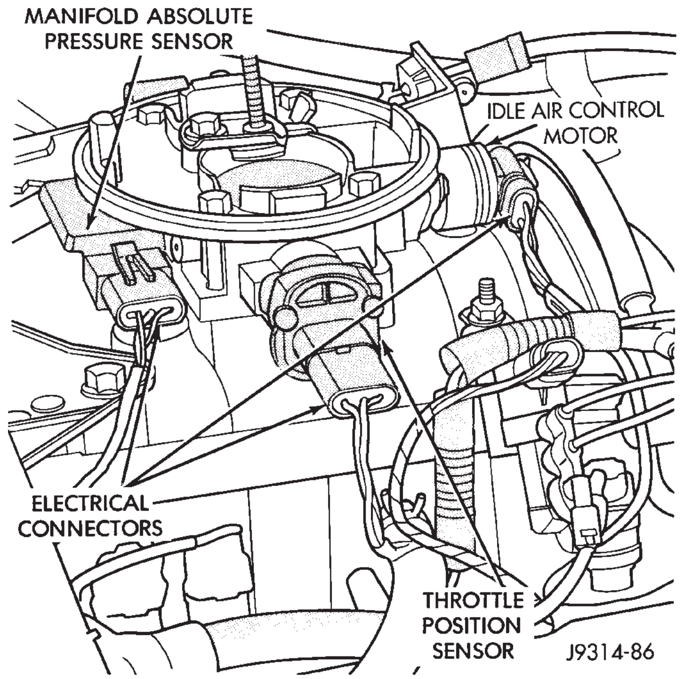


Fig. 37 Sensor Testing—5.2L Engine

OXYGEN SENSOR TESTS

For diagnosis, removal or installation, refer to Group 14, Fuel Systems in this manual.

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.

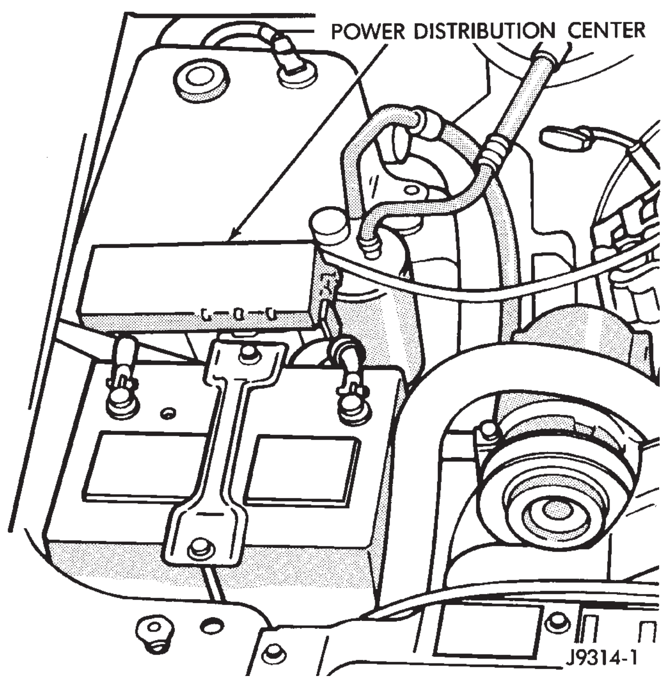


Fig. 1 Power Distribution Center

REMOVAL

(1) Remove the Power Distribution Center cover.

(2) Remove the relay by lifting straight up.

INSTALLATION

(1) Push the relay into the connector.

(2) Install the relay cover.

CAMSHAFT POSITION SENSOR

The camshaft position sensor is located in the distributor.

REMOVAL—4.0L ENGINE

(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. 2).

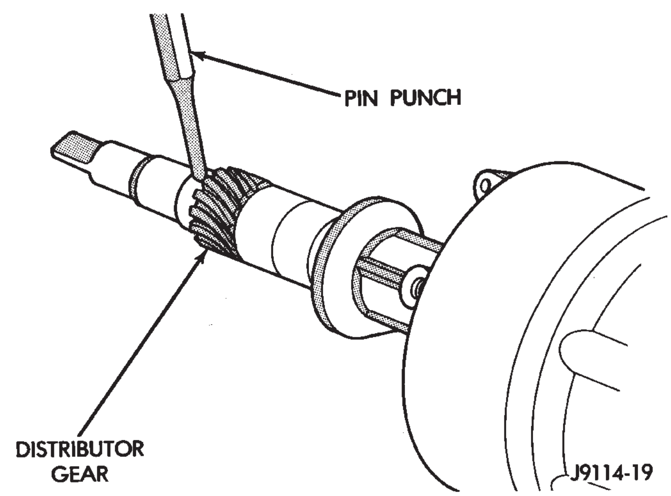


Fig. 2 Distributor Gear—Removal/Installation—4.0L Engine

(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. 3).

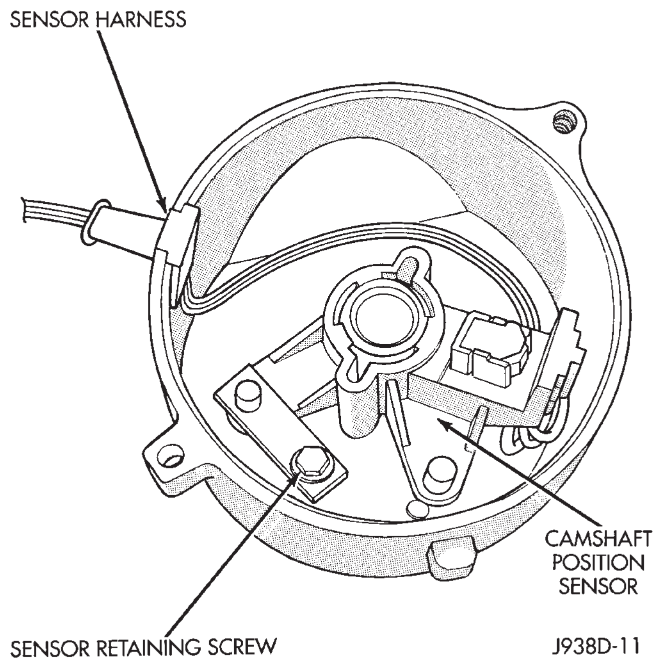


Fig. 3 Camshaft Position Sensor—4.0L Engine

(8) Slide the wire harness grommet out of the distributor housing. Remove the camshaft position sensor.

INSTALLATION—4.0L ENGINE

(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.

REMOVAL—5.2L ENGINE

Distributor removal is not necessary to remove camshaft position sensor.

(1) Disconnect negative battery cable at battery.

(2) Remove coil high-tension cable and all spark plug cables at distributor cap. Note and mark position of cables (Fig. 4) before removal.

(3) Remove distributor cap from distributor (two screws).

(4) Disconnect camshaft position sensor wiring harness from main engine wiring harness.

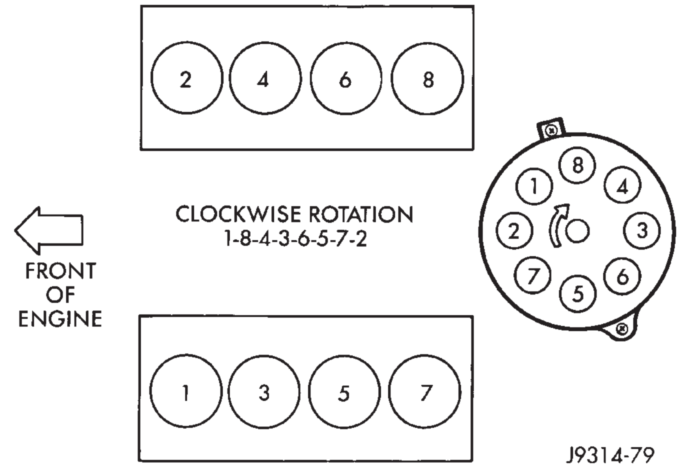


Fig. 4 Engine Firing Order—5.2L Engine

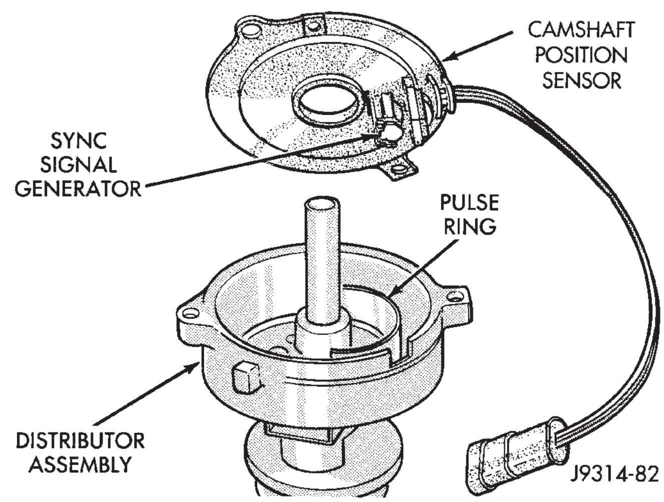


Fig. 5 Camshaft Position Sensor—5.2L Engine

(5) Remove distributor rotor from distributor shaft.

(6) Lift the camshaft position sensor assembly from the distributor housing (Fig. 5).

INSTALLATION—5.2L ENGINE

(1) Install camshaft position sensor to distributor. Align sensor into notch on distributor housing.

(2) Connect wiring harness.

(3) Install rotor.

(4) Install distributor cap. Tighten mounting screws.

(5) Install spark plug cables in correct firing order (Fig. 4) to distributor cap. Be sure all spark plug cables are firmly connected into distributor cap towers.

CRANKSHAFT POSITION SENSOR

REMOVAL—4.0L ENGINE

The crankshaft position sensor is mounted to the transmission bellhousing at the left/rear side of the engine block (Fig. 6).

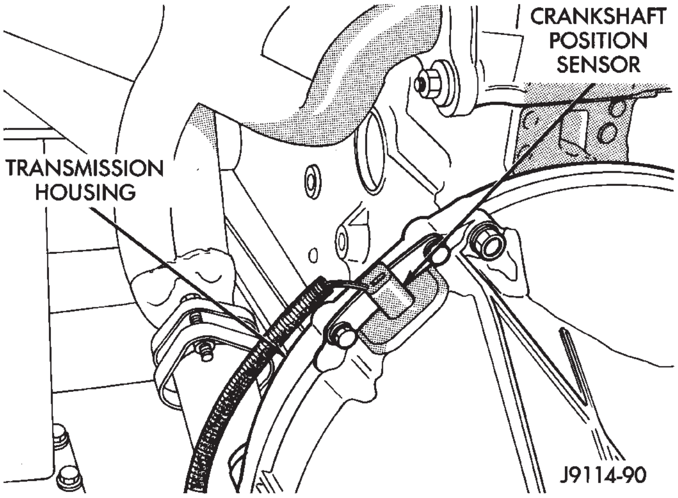


Fig. 6 Crankshaft Position Sensor—4.0L Engine

(1) Near the rear of the intake manifold, disconnect the pigtail harness on the sensor from the main electrical harness.

(2) Raise and support the vehicle.

(3) Remove the two sensor mounting bolts (Fig. 6).

(4) Remove the sensor.

(5) Remove clip from sensor wire harness.

INSTALLATION—4.0L ENGINE

(1) Install the sensor flush against the opening in the transmission housing.

(2) Install and tighten the two sensor mounting bolts to 19 N●m (14 ft. lbs.) torque.

CAUTION: The two bolts used to secure the sensor to the transmission are specially machined to correctly space the unit to the flywheel. Do not attempt to install any other bolts.

(3) Lower the vehicle.

(4) Connect the electrical connector to the sensor.

(5) Install clip on sensor wire harness.

REMOVAL—5.2L ENGINE

The sensor is bolted to the top of the cylinder block near the rear of right cylinder head (Fig. 7).

(1) Remove the spark plug cable loom and spark plug cables from valve cover mounting stud at rear of right valve cover (Fig. 7). Position spark plug cables to top of valve cover.

(2) Remove the right exhaust manifold heat shield nuts/bolts and remove heat shield (Fig. 8).

(3) Disconnect 2 hoses at Exhaust Gas Recirculation (EGR) valve. Note position of hoses at EGR valve before removal.

(4) Disconnect electrical connector and hoses at electric EGR transducer (EET). Note position of hoses at EET before removal.

(5) Remove 2 EGR valve mounting bolts (Fig. 7) and remove EGR valve. Discard old EGR gasket.

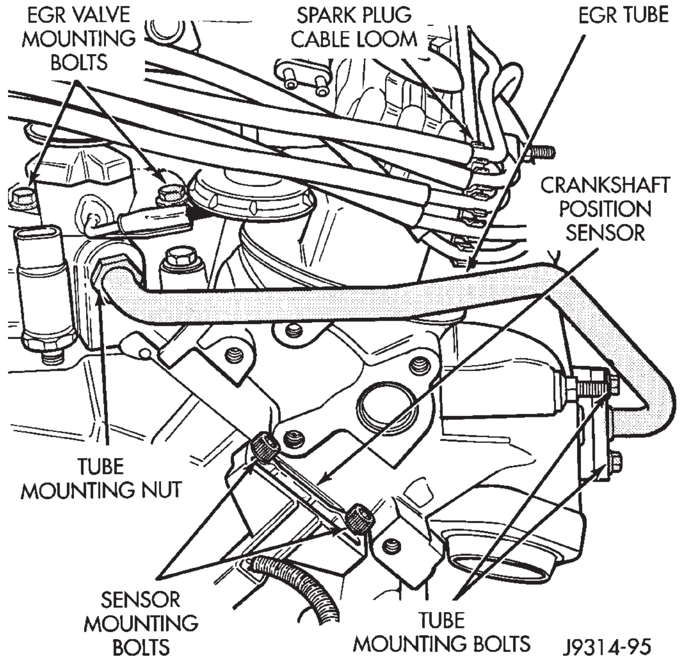


Fig. 7 Crankshaft Position Sensor—5.2L Engine

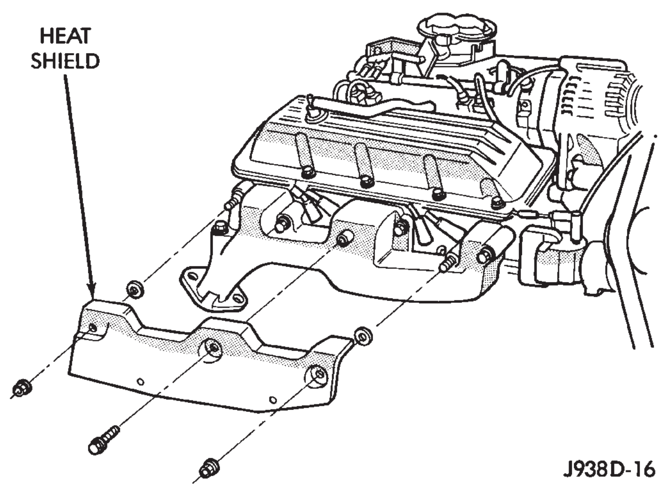


Fig. 8 Exhaust Manifold Heat Shield—5.2L Engine

(6) Disconnect electrical connector at engine oil pressure sending unit.

(7) To prevent damage to oil pressure sending unit, a special tool, such as number C-4597 must be used (Fig. 9). Remove sending unit from engine.

(8) Loosen EGR tube mounting nut at intake manifold (Fig. 7).

(9) Remove 2 EGR tube mounting bolts at exhaust manifold (Fig. 7) and remove EGR tube. Discard old gasket at exhaust manifold.

(10) Disconnect crankshaft position sensor pigtail harness from main wiring harness.

(11) Remove 2 sensor (recessed hex head) mounting bolts (Fig. 7) and remove sensor.

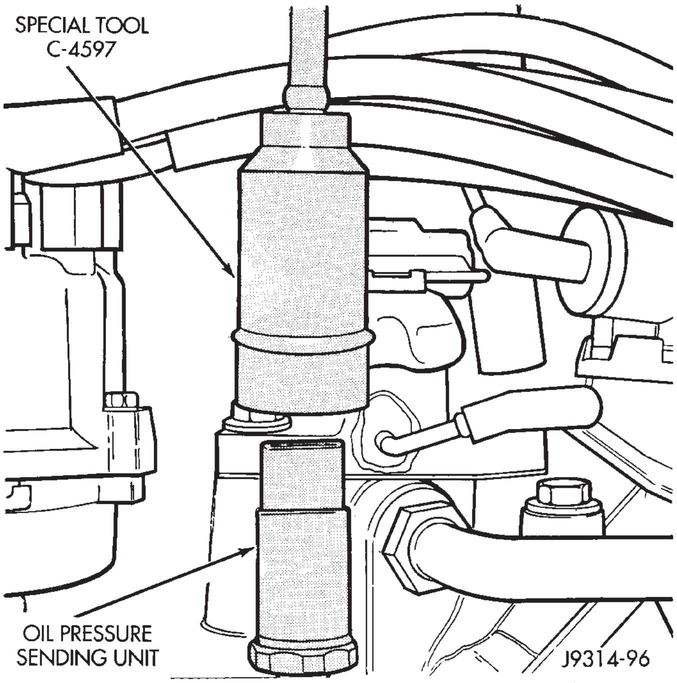


Fig. 9 Oil Pressure Sending Unit—Removal/Installation

INSTALLATION—5.2L ENGINE

(1) Position crankshaft position sensor to engine and install mounting bolts. Tighten bolts to 8 N●m (70 in. lbs.) torque.

(2) Connect main harness electrical connector to sensor.

(3) Clean the EGR tube and exhaust manifold (at EGR tube mounting point) of any old gasket material.

(4) Install a new gasket to exhaust manifold end of EGR tube and install EGR tube to both manifolds. Tighten tube mounting nut at intake manifold. Tighten 2 mounting bolts at exhaust manifold to 23 N●m (204 in. lbs.) torque.

(5) Coat the threads of the oil pressure sending unit with thread sealant. Do not allow any of the thread sealant to get into the sending unit opening, or the opening at the engine. Install sending unit to engine and tighten to 14 N●m (130 in. lbs.) torque. Install electrical connector to sending unit.

(6) Clean the intake manifold and EGR valve of any old gasket material.

(7) Install a new EGR valve gasket at intake manifold.

(8) Install EGR valve to intake manifold. Tighten 2 EGR bolts to 23 N●m (200 in. lbs.) torque.

(9) Position EET and install its electrical connector. Connect hoses between EGR valve and EET. Connect hose between main vacuum harness and EET.

(10) Install spark plug cable loom and spark plug cables to valve cover mounting stud.

(11) Install heat shield at right exhaust manifold.

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—4.0L ENGINE

The sensor is installed in the thermostat housing (Fig. 10) on 4.0L engines.

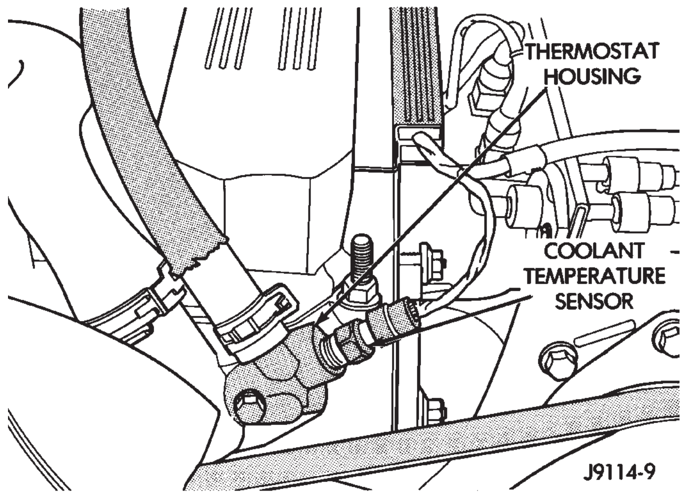


Fig. 10 Coolant Temperature Sensor—4.0L Engine

(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. 10).

INSTALLATION—4.0L ENGINE

(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.

REMOVAL—5.2L ENGINE

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.

The engine coolant temperature sensor on the 5.2L engine is located in a water passage of the intake manifold next to the thermostat housing (Fig. 11).

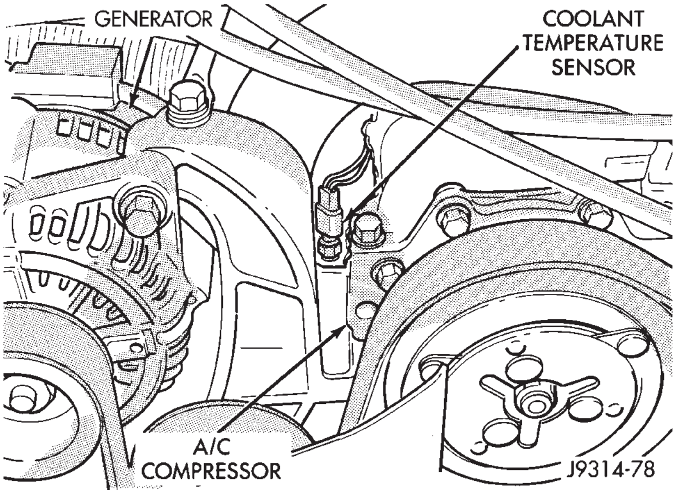


Fig. 11 Coolant Temperature Sensor—5.2L Engines

(1) Partially drain cooling system. Refer to Group 7, Cooling.

(2) Disconnect electrical connector from sensor (Fig. 11).

(3) Engines with air conditioning: When removing the connector from sensor, do not pull directly on wiring harness. Fabricate an L-shaped hook tool from a coat hanger (approximately eight inches long). Place the hook part of tool under the connector for removal. The connector is snapped onto the sensor. It is not equipped with a lock type tab.

(4) Remove sensor from intake manifold.

INSTALLATION—5.2L ENGINE

(1) Install sensor.

(2) Tighten to 7 N●m (5.5 ft. lbs.) torque.

(3) Connect electrical connector to sensor.

The sensor connector is symmetrical (not indexed). It can be installed to the sensor in either direction.

(4) Replace any lost engine coolant. 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.

REMOVAL—4.0L ENGINE

(1) Disconnect the negative battery cable at the battery.

(2) 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 number 1 cylinder firing position (Fig. 13).

(3) Remove the distributor cap.

(4) Turn the engine crankshaft in a clockwise direction until rotor is approaching scribe mark on distributor housing. Then slowly turn engine until timing mark on crankshaft vibration damper lines up with zero on front cover timing scale (Fig. 14).

The timing mark is on the edge of vibration damper closest to engine timing chain cover.

(5) Align the trailing edge of the rotor blade with the scribe mark on the distributor housing (Fig. 15).

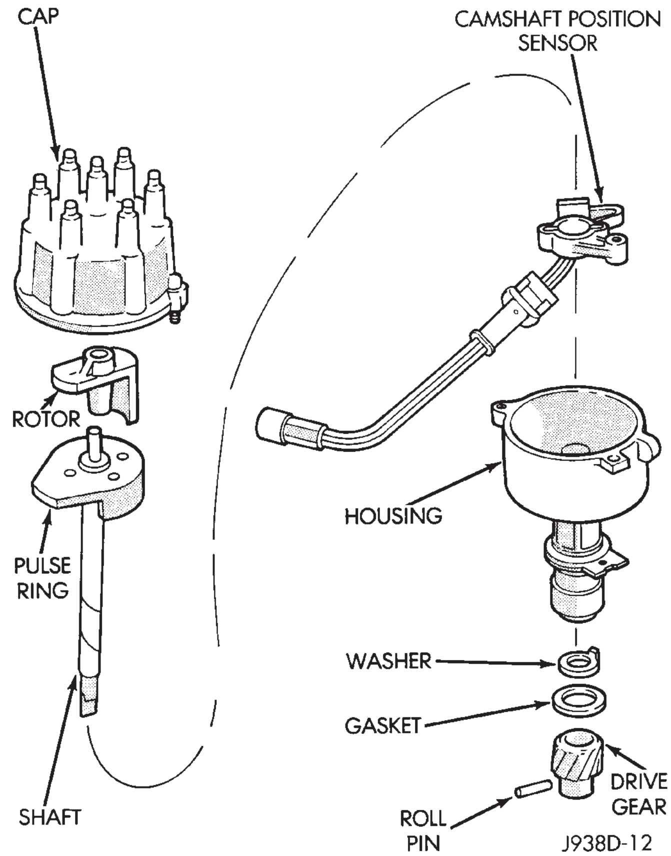


Fig. 12 Distributor—4.0L Engine—Typical

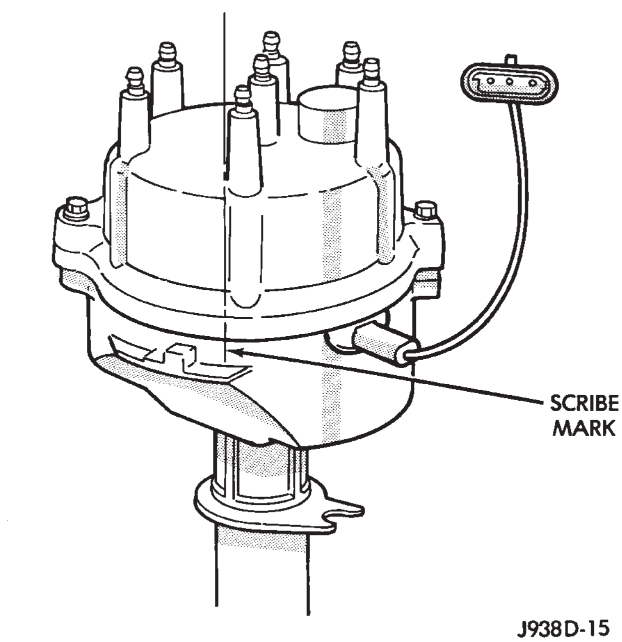


Fig. 13 Mark Distributor Housing—4.0L Engine

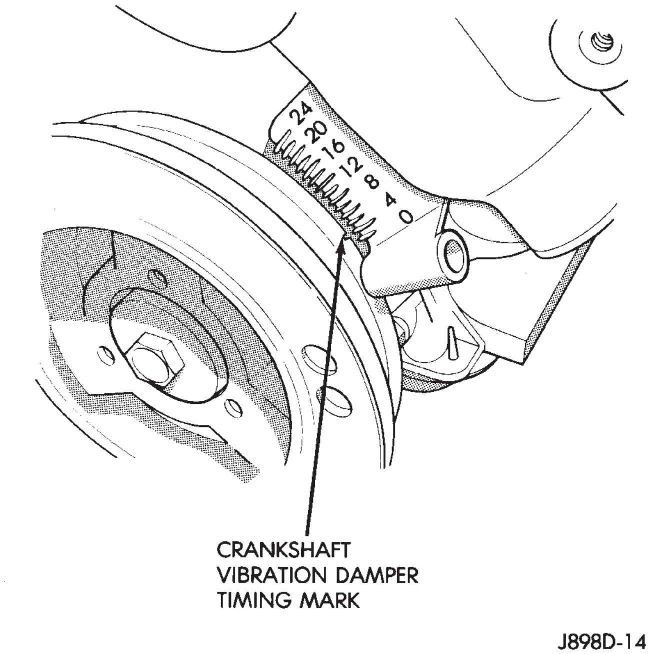


Fig. 14 Align Timing Marks—4.0L Engine

(6) Remove the distributor holddown bolt and clamp.

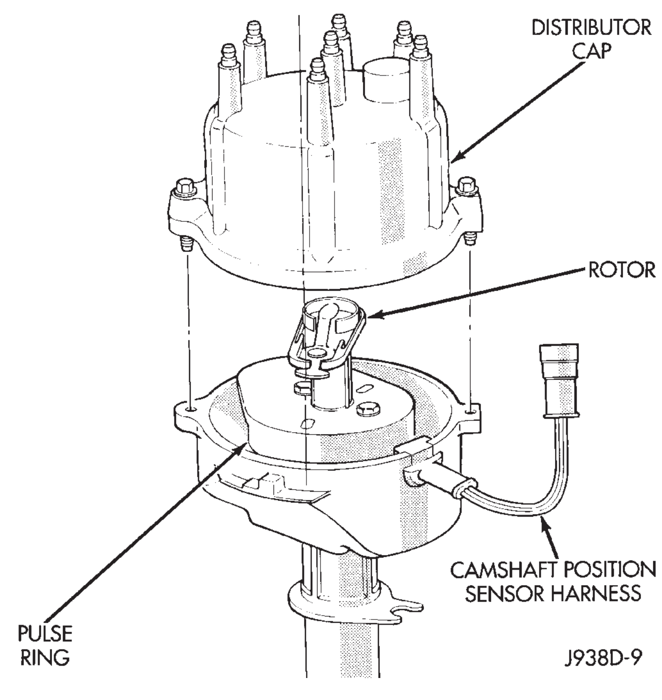


Fig. 15 Align Rotor Trailing Edge With Scribe Mark—4.0L Engine

(7) Remove the distributor from the engine.

INSTALLATION—4.0L ENGINE

(1) 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. 16).

The oil pump shaft is located down in the distributor hole.

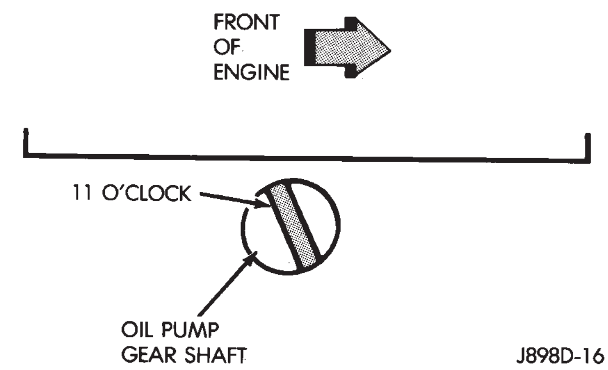


Fig. 16 Align Oil Pump Gear Shaft—4.0L Engine

(2) Install the rotor.

(3) 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.

(4) Visually line up the holddown ear of the distributor housing with the holddown clamp hole (Fig. 17).

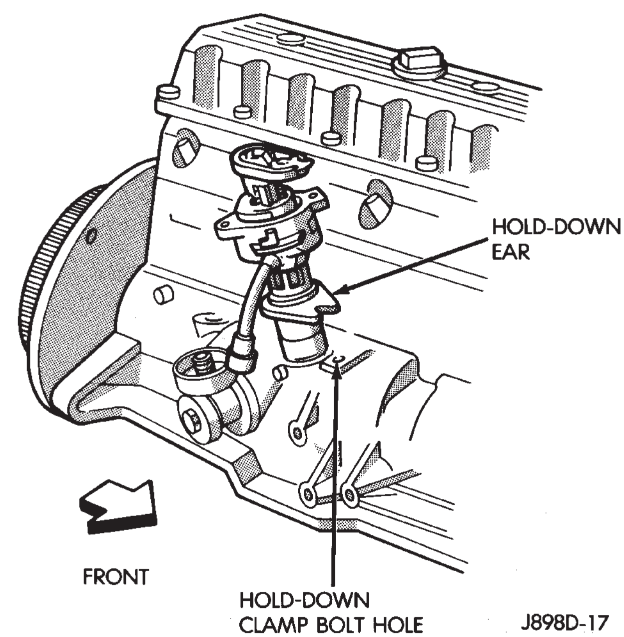


Fig. 17 Distributor Installation—4.0L Engine

(5) Turn the rotor to the 4 o'clock position (Fig. 18).

(6) Slide the distributor down into the block until it seats. Keep the holddown ear aligned to the hole in the block.

(7) 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).

(8) Install the distributor holddown clamp bolt and tighten to 23 N•m (17 ft. lbs.) torque.

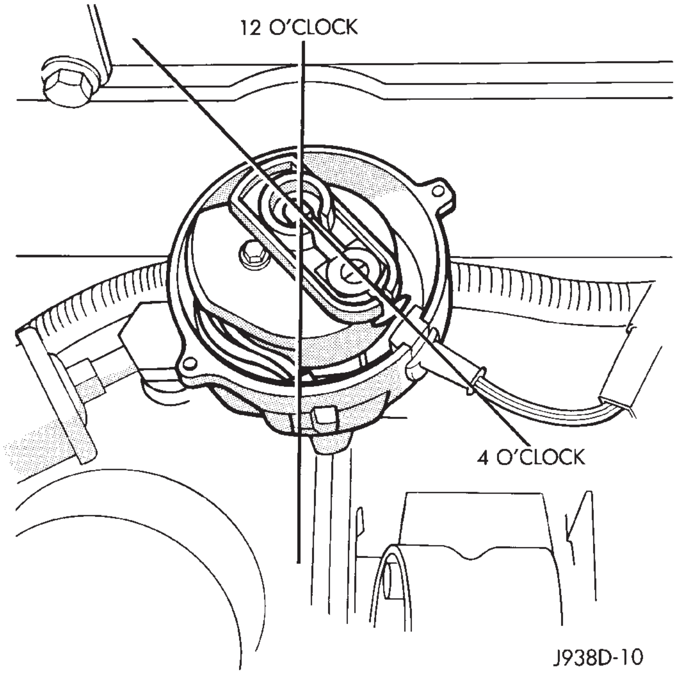


Fig. 18 Rotor Alignment—4.0L Engine

(9) Install the distributor cap and connect the distributor electrical connector.

(10) Connect battery cable to battery.

REMOVAL—5.2L ENGINE

CAUTION: Base ignition timing is not adjustable on the 5.2L V-8 engine. Distributors do not have built in centrifugal or vacuum assisted advance. Base ignition timing and timing advance are controlled by the Powertrain Control Module (PCM). Because a conventional timing light can not be used to adjust distributor position after installation, note position of distributor before removal.

(1) Disconnect negative battery cable at battery.

(2) Remove coil high-tension cable and all spark plug cables at distributor cap. Note and mark position of cables (Fig. 19) before removal.

(3) Remove distributor cap from distributor (two screws).

(4) Mark the position of distributor housing in relationship to engine or dash panel. This is done to aid in installation.

Before distributor is removed, the number one cylinder must be brought to the top dead center (TDC) firing position.

(5) Attach a socket to the Crankshaft Vibration Damper mounting bolt.

(6) Slowly rotate engine clockwise, as viewed from front, until indicating mark on crankshaft vibration damper is aligned to 0 degree (TDC) mark on timing chain cover (Fig. 20).

(7) The distributor rotor should now be aligned to the CYL. NO. 1 alignment mark (stamped) into the camshaft position sensor (Fig. 21). If not, rotate the crankshaft through another complete 360 degree turn. Note the position of the number one cylinder spark plug cable (on the cap) in relation to rotor. Rotor should now be aligned to this position.

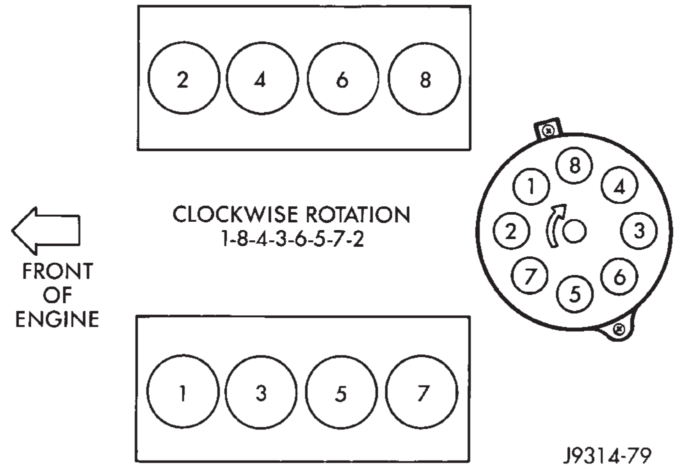


Fig. 19 Engine Firing Order—5.2L Engine

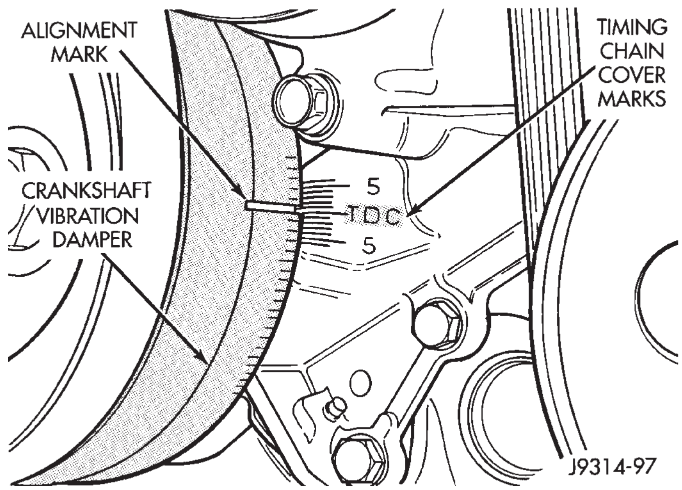


Fig. 20 Damper-To-Timing Chain Cover Alignment Marks—5.2L Engine

(8) Disconnect camshaft position sensor wiring harness from main engine wiring harness.

(9) Remove distributor rotor from distributor shaft.

(10) Remove distributor holddown clamp bolt and clamp (Fig. 22). Remove distributor from vehicle.

CAUTION: Do not crank engine with distributor removed. Distributor/crankshaft relationship will be lost.

INSTALLATION—5.2L ENGINE

If engine has been cranked while distributor is removed, establish the relationship between distributor shaft and number one piston position as follows:

Rotate crankshaft in a clockwise direction, as viewed from front, until number one cylinder piston

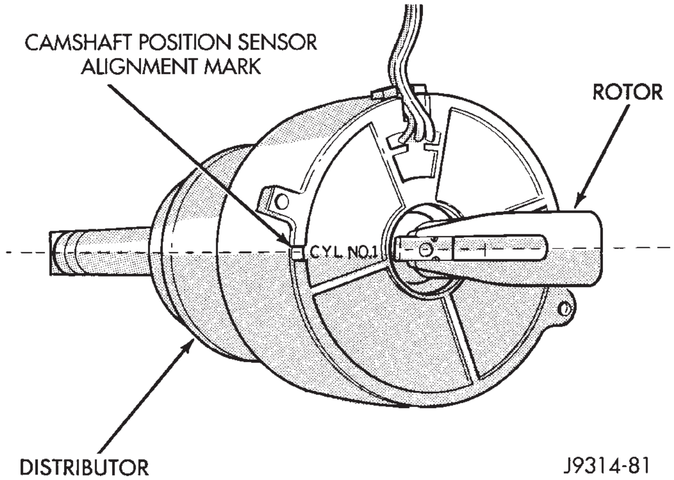


Fig. 21 Rotor Alignment Mark—5.2L Engine

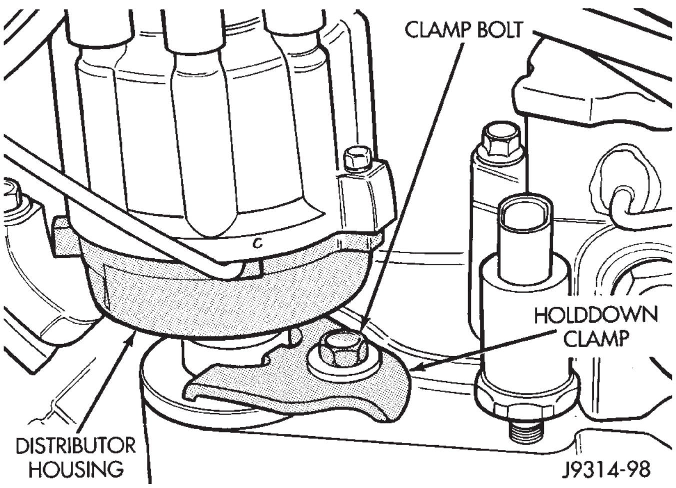


Fig. 22 Distributor Holddown Clamp—5.2L Engine

is at top of compression stroke (compression should be felt on finger with number one spark removed). Then continue to slowly rotate engine clockwise until indicating mark (Fig. 20) is aligned to 0 degree (TDC) mark on timing chain cover.

(1) Clean top of cylinder block for a good seal between distributor base and block.

(2) Lightly oil the rubber O-ring seal on the distributor housing.

(3) Install rotor to distributor shaft.

(4) Position distributor into engine to its original position. Engage tongue of distributor shaft with slot in distributor oil pump drive gear. Position rotor to the number one spark plug cable position.

(5) Install distributor holddown clamp and clamp bolt. Do not tighten bolt at this time.

(6) Rotate the distributor housing until rotor is aligned to CYL. NO. 1 alignment mark on the camshaft position sensor (Fig. 21).

(7) Tighten clamp holddown bolt (Fig. 22) to 22.5 N●m (200 in. lbs.) torque.

(8) Connect camshaft position sensor wiring harness to main engine harness.

(9) Install distributor cap. Tighten mounting screws.

(10) Install spark plug cables in correct firing order (Fig. 19) to distributor cap. Be sure all spark plug cables are firmly connected into distributor cap towers.

IGNITION COIL

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

REMOVAL—4.0L ENGINE

The ignition coil is mounted to the right side of the 4.0L engine block next to the distributor (Fig. 23).

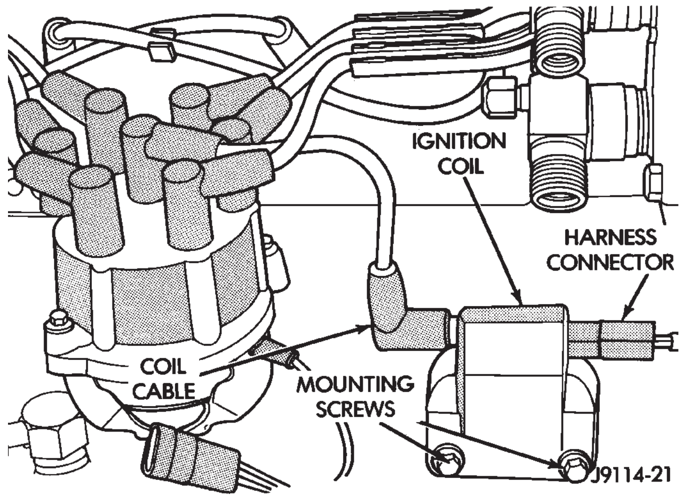


Fig. 23 Ignition Coil—4.0L Engine

(1) Disconnect the ignition coil secondary cable from ignition coil (Fig. 23).

(2) Disconnect engine harness connector from ignition coil.

(3) Remove ignition coil mounting screws. Remove coil.

INSTALLATION—4.0L ENGINE

(1) Install ignition coil to bracket on cylinder block with mounting screws.

(2) Connect engine harness connector to coil.

(3) Connect ignition coil cable to ignition coil.

REMOVAL—5.2L ENGINE

The ignition coil is mounted to a bracket near the front of the right engine cylinder head on 5.2L engines (Fig. 24).

(1) Disconnect the wiring and secondary cable from the ignition coil (Fig. 24).

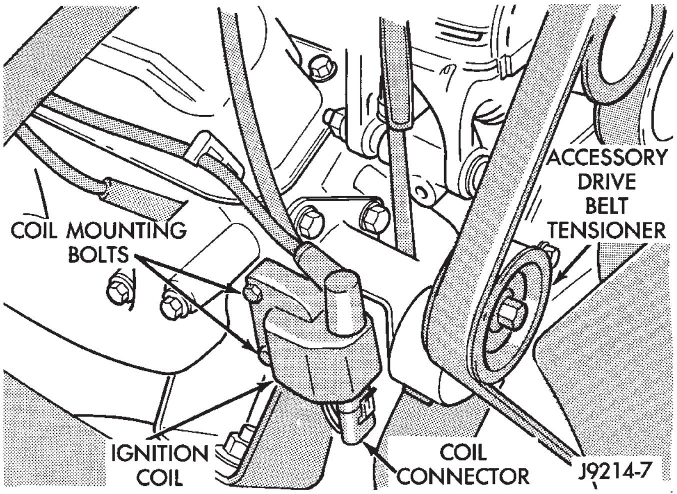


Fig. 24 Ignition Coil—5.2L Engine—Typical

WARNING: DO NOT REMOVE THE COIL MOUNTING BRACKET-TO-CYLINDER HEAD MOUNTING BOLTS. THE COIL MOUNTING BRACKET IS UNDER ACCESSORY DRIVE BELT TENSION. IF THIS BRACKET IS TO BE REMOVED FOR ANY REASON, ALL BELT TENSION MUST FIRST BE RELIEVED. REFER TO THE BELT SECTION OF GROUP 7, COOLING SYSTEM.

(2) Remove ignition coil from coil mounting bracket (two bolts).

INSTALLATION—5.2L ENGINE

(1) Install the ignition coil to coil bracket. If nuts and bolts are used to secure coil to coil bracket, tighten to 11 N●m (100 in. lbs.) torque. If the coil mounting bracket has been tapped for coil mounting bolts, tighten bolts to 5 N●m (50 in. lbs.) torque.

(2) Connect all wiring to ignition coil.

INTAKE MANIFOLD CHARGE AIR TEMPERATURE SENSOR

REMOVAL—4.0L ENGINE

The intake manifold charge air temperature sensor is installed into the intake manifold plenum (Fig. 25) on the 4.0L engine.

(1) Disconnect the electrical connector from the sensor.

(2) Remove the sensor from the intake manifold.

INSTALLATION—4.0L ENGINE

(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.

REMOVAL—5.2L ENGINE

The charge air temperature sensor is located in right-front side of intake manifold (Fig. 26) on the 5.2L engine.

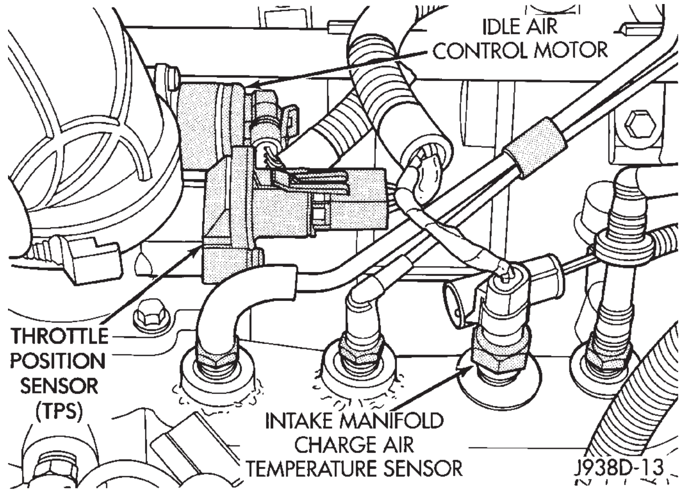


Fig. 25 Air Temperature Sensor—4.0L Engine

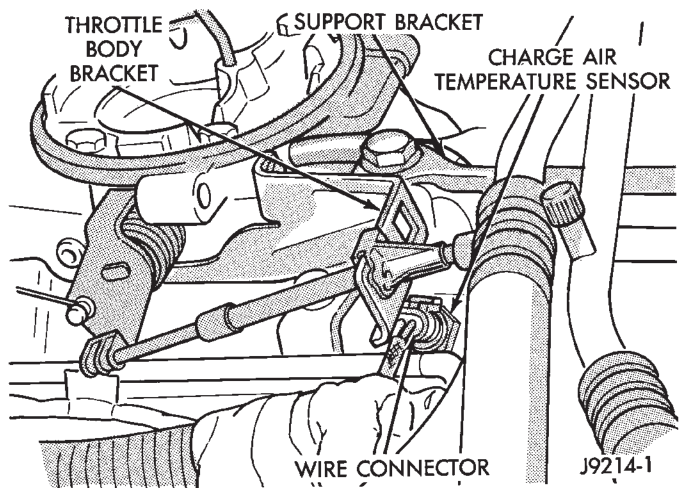


Fig. 26 Air Temperature Sensor—5.2L Engine—Typical

(1) Disconnect electrical connector at sensor (Fig. 26).

(2) Remove sensor from intake manifold.

INSTALLATION—5.2L ENGINE

(1) Install sensor to intake manifold. Tighten the sensor to 13 N●m (10 ft. lbs.) torque.

(2) Install electrical connector.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

REMOVAL—4.0L ENGINE

The sensor is located on the cowl panel near the rear of the engine valve cover (Fig. 27) if equipped with the 4.0L engine.

(1) Disconnect the sensor electrical connector (Fig. 27).

(2) Disconnect the sensor vacuum supply hose.

(3) Remove the two sensor mounting screws and remove sensor from vehicle.

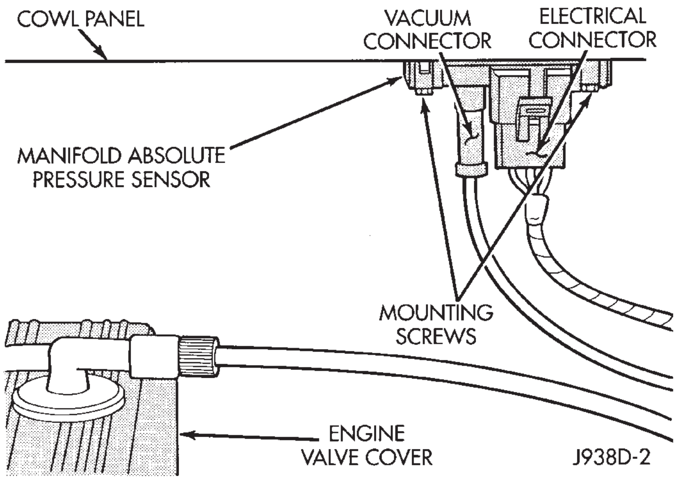


Fig. 27 MAP Sensor—4.0L Engine

INSTALLATION—4.0L ENGINE

(1) Install sensor to cowl panel. Install 2 screws and tighten to 3 N●m (25 in. lbs.) torque.

(2) Install the sensor vacuum supply hose.

(3) Connect the sensor electrical connector.

REMOVAL—5.2L ENGINE

The MAP sensor is located on the front of the throttle body (Fig. 28) if equipped with the 5.2L engine.

An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 29).

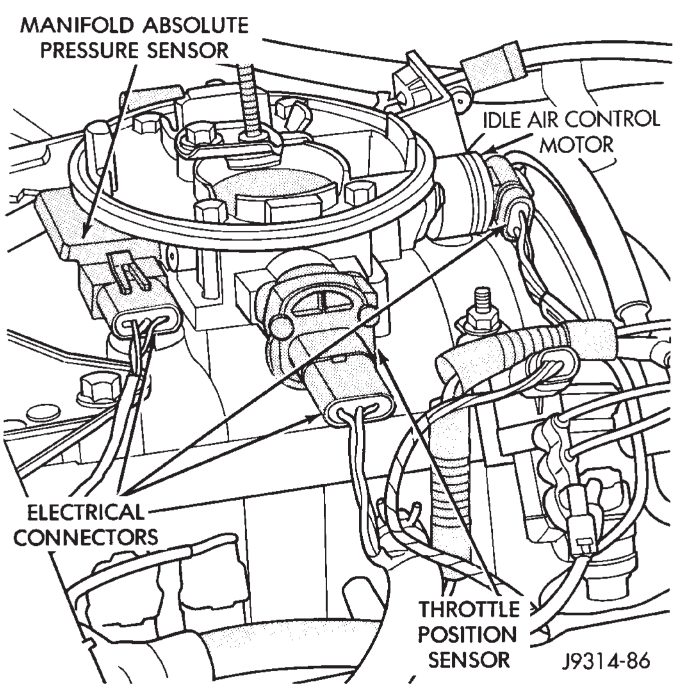


Fig. 28 MAP Sensor—5.2L Engine

The throttle body must be removed from the intake manifold for MAP sensor removal.

(1) Remove air intake tube at throttle body.

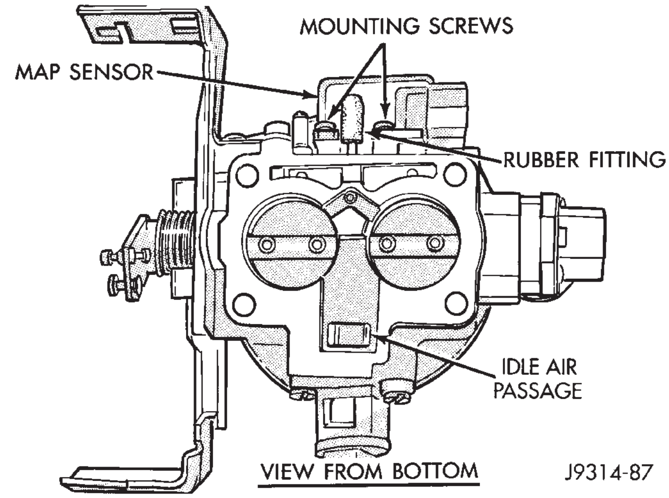


Fig. 29 MAP Sensor Rubber Fitting—5.2L Engine

(2) Remove throttle body. Refer to Throttle Body removal in the Group 14, Fuel System section of this manual.

(3) Remove two MAP sensor mounting screws (Fig. 29).

(4) While removing MAP sensor, slide the L-shaped rubber vacuum fitting (Fig. 29) from the throttle body.

(5) Remove rubber fitting from MAP sensor.

INSTALLATION—5.2L ENGINE

(1) Install L-shaped rubber fitting to MAP sensor.

(2) Position MAP sensor to throttle body while guiding L-shaped rubber fitting over throttle body fitting.

(3) Install MAP sensor mounting screws. Tighten screws to 3 N●m (25 in. lbs.) torque.

(4) Install throttle body. Refer to Throttle Body installation in the Group 14, Fuel System section of this manual.

(5) Install air intake tube.

OXYGEN (O_2) SENSOR

For diagnostics and removal/installation procedures, refer to Group 14, Fuel Systems, in this manual.

POWERTRAIN CONTROL MODULE (PCM)

The PCM is located on the cowl panel in the right/rear side of the engine compartment (Fig. 30).

REMOVAL

(1) Disconnect the negative battery cable at the battery.

(2) Remove the coolant reserve/overflow bottle (one bolt and two nuts) (Fig. 31)

(3) Loosen the 60-Way connector mounting bolt (Fig. 32).

(4) Remove the electrical connector by pulling straight back.

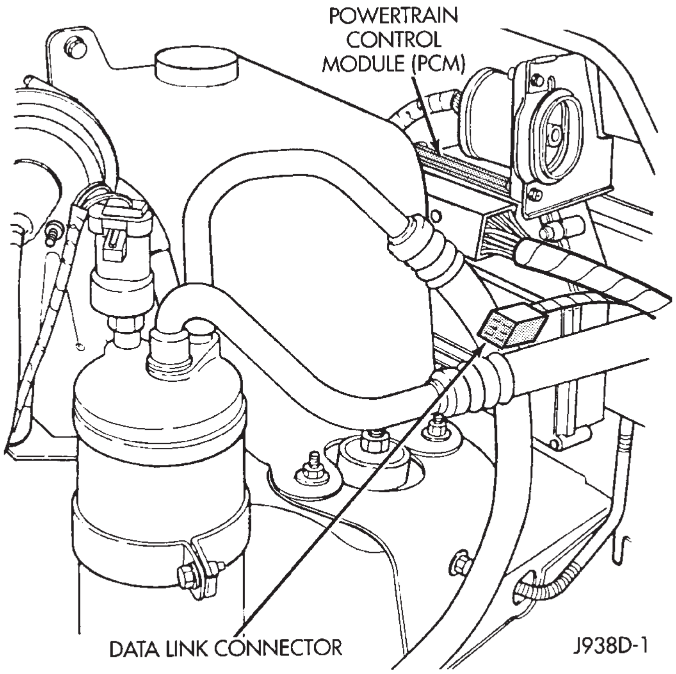


Fig. 30 PCM Location

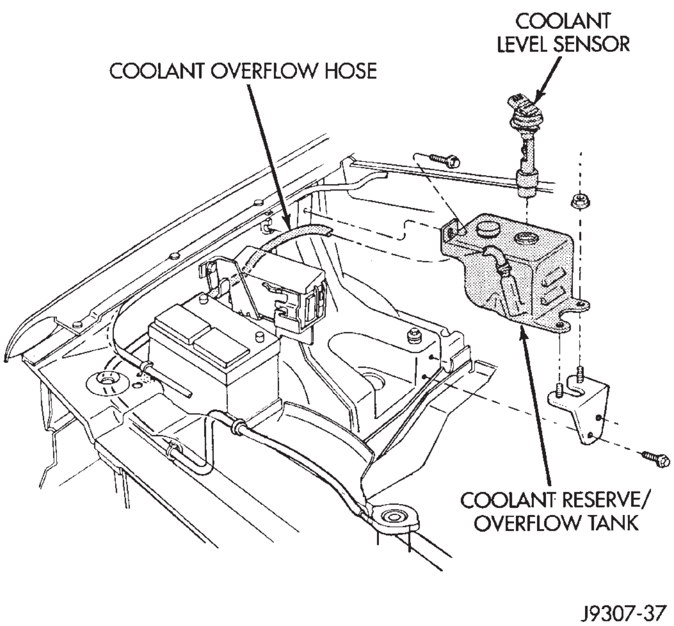


Fig. 31 Coolant Reserve/Overflow Bottle Mounting

(5) Remove the three PCM mounting bolts (Fig. 32).

(6) Remove PCM.

INSTALLATION

(1) Check the pins in the PCM 60-way electrical connector for damage. 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) Install coolant reserve/overflow bottle (Fig. 31).

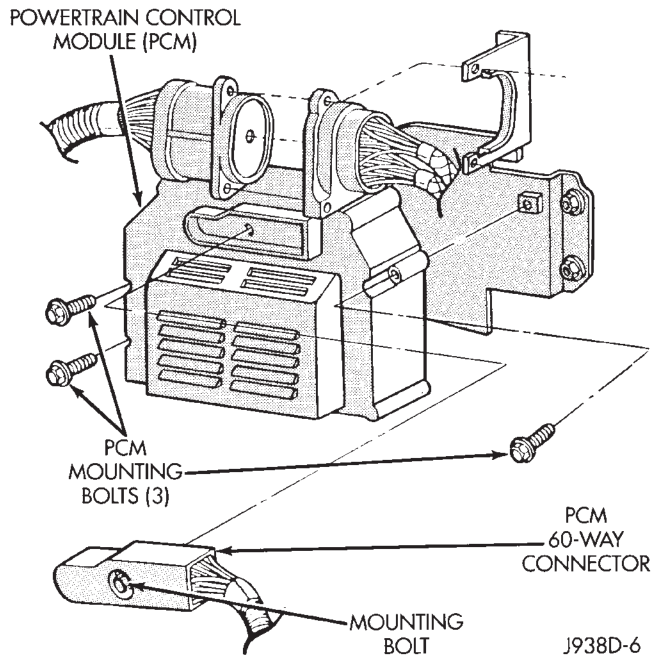


Fig. 32 PCM Mounting

(5) Connect negative cable to battery.

SPARK PLUGS

5.2L ENGINE. Spark plug cable heat shields are pressed into the cylinder head to surround each cable boot and spark plug (Fig. 33). These shields protect the spark plug boots from damage (due to intense engine heat generated by the exhaust manifolds) and should not be removed. After the spark plug cable has been installed, the lip of the cable boot should have a small air gap to the top of the heat shield (Fig. 33).

If removal of the heat shield(s) is necessary, remove the spark plug cable and compress the sides of shield for removal. Each shield is slotted to allow for

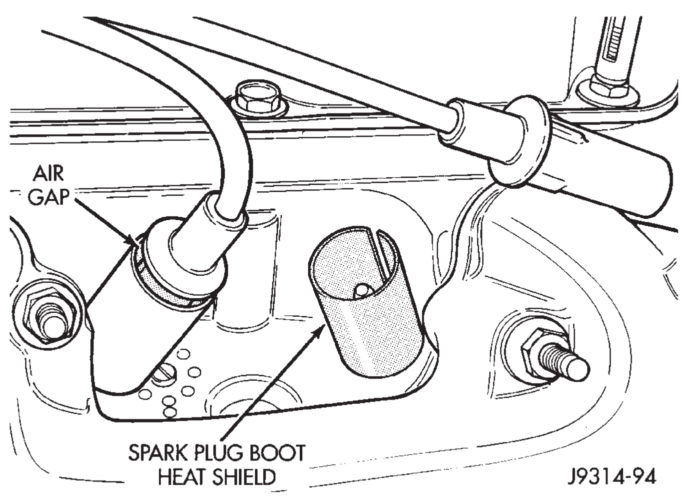


Fig. 33 Heat Shields—5.2L Engine

compression and removal. To install the shields, align shield to machined opening in cylinder head and tap into place with a block of wood.

PLUG REMOVAL

(1) Always remove spark plug or ignition coil cables by grasping at the cable boot. 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. 34). **Never attempt to adjust the gap by bending the center electrode.**

SPARK PLUG GAP

- 4.0L Engine Spark Plug Gap: .89 mm (.035 in).
- 5.2L Engine Spark Plug Gap: .89 mm (.035 in).

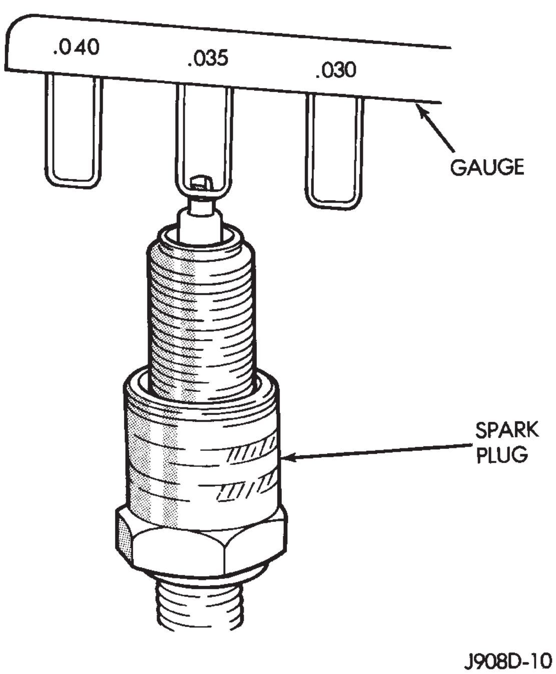


Fig. 34 Setting Spark Plug Gap—Typical

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. 35 or 36).

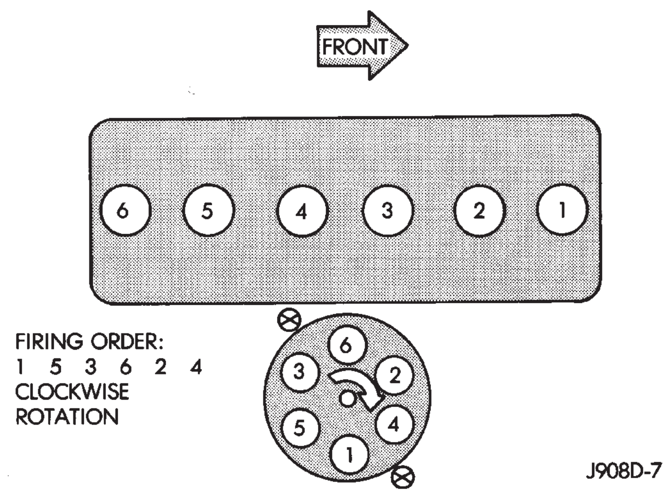


Fig. 35 Engine Firing Order—4.0L Engine

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.

5.2L Engine: Spark plug cable boot heat shields are pressed into the cylinder head to surround each cable boot and spark plug (Fig. 37). These shields protect the spark plug boots from damage (due to in-

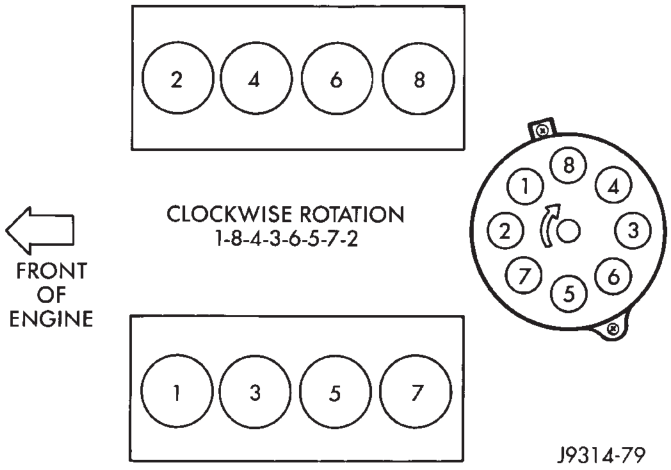


Fig. 36 Engine Firing Order—5.2L Engine

tense engine heat generated by the exhaust manifolds) and should not be removed. After the spark plug cable has been installed, the lip of the cable boot should have a small air gap to the top of the heat shield (Fig. 37).

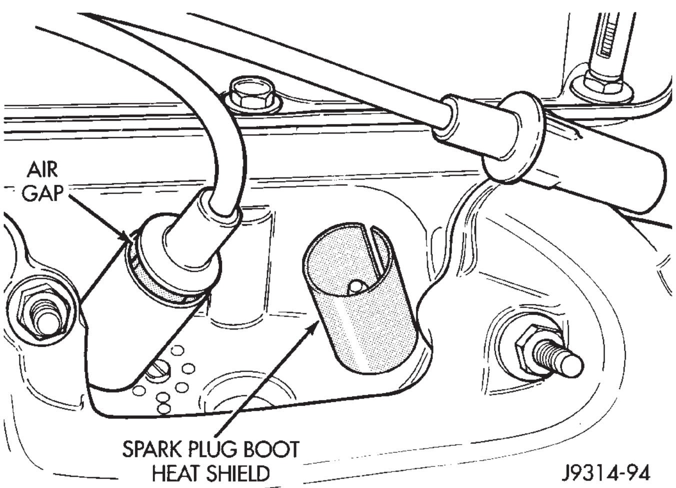


Fig. 37 Heat Shields—5.2L Engine

THROTTLE POSITION SENSOR (TPS)

REMOVAL—4.0L ENGINE

The throttle position sensor is mounted to the throttle body (Fig. 38) on the 4.0L engine.

(1) Disconnect sensor electrical connector.

(2) Remove the two sensor mounting screws.

(3) Remove sensor.

INSTALLATION—4.0L ENGINE

The throttle shaft end slides into a socket in the sensor (Fig. 39). The sensor must be installed so that it can be rotated a few degrees. (If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs). The sensor will be under slight tension when rotated.

(1) Install the throttle position sensor and two retaining screws.

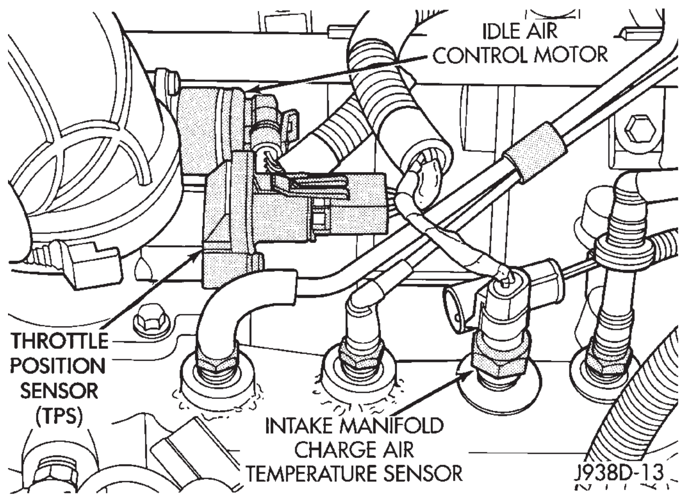


Fig. 38 TPS—4.0L Engine

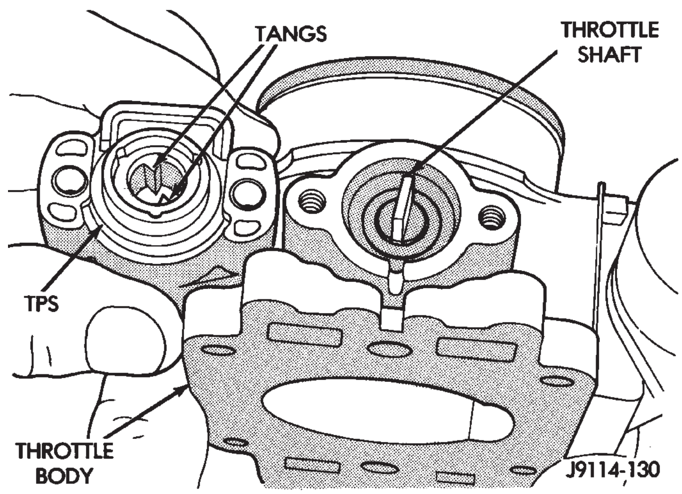


Fig. 39 TPS Installation—4.0L Engine

(2) Connect sensor electrical connector to sensor.

(3) Operate the throttle by hand to check for binding.

REMOVAL—5.2L ENGINE

The TPS is located on the side of the throttle body (Fig. 40) on the 5.2L engine.

(1) Remove air intake tube at throttle body.

(2) Disconnect TPS electrical connector (Fig. 40).

(3) Remove two TPS mounting screws (Fig. 41).

(4) Remove TPS from throttle body.

INSTALLATION—5.2L ENGINE

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 42). The TPS must be installed so that it can be rotated a few degrees. If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs. The TPS will be under slight tension when rotated.

(1) Install the TPS and two retaining screws.

(2) Tighten screws to 7 N•m (60 in. lbs.) torque.

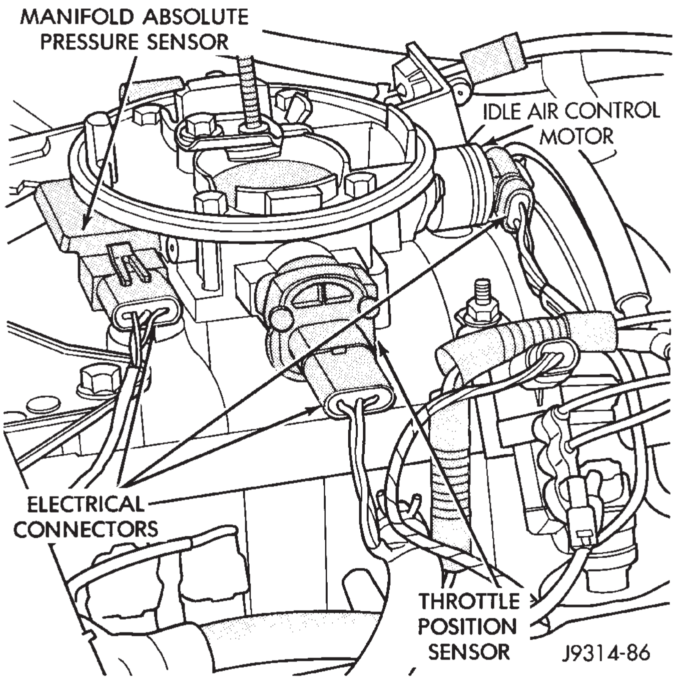


Fig. 40 TPS—5.2L Engine

(3) Manually operate the throttle control lever by hand to check for any binding of the TPS.

(4) Connect TPS electrical connector to TPS.

(5) Install air intake tube.

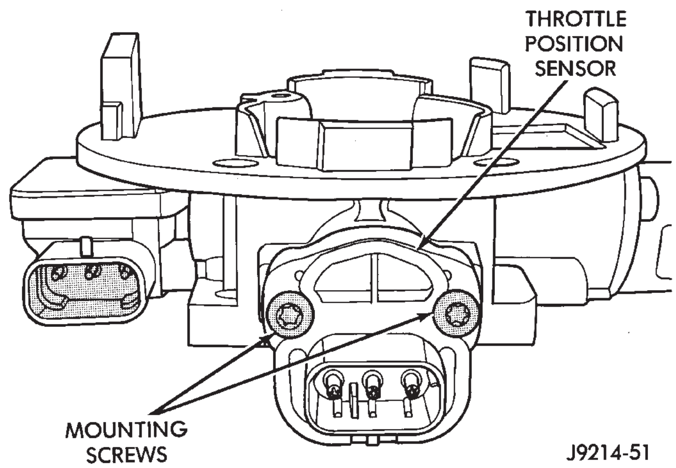


Fig. 41 TPS Mounting Screws—5.2L Engine

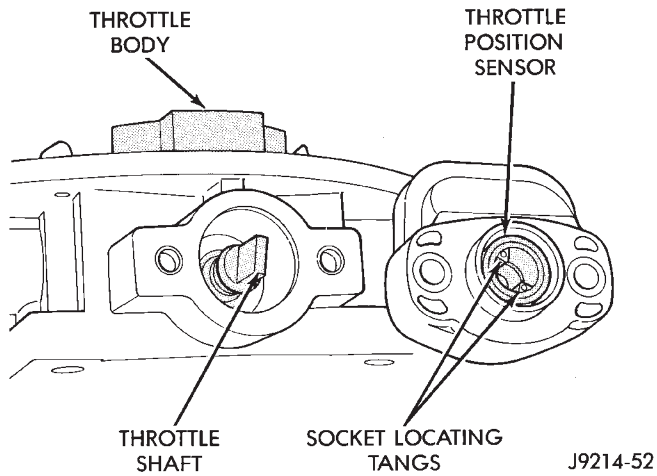


Fig. 42 TPS Installation—5.2L Engine

IGNITION SWITCH

INDEX

GENERAL INFORMATION

The ignition switch is located in the steering column. The Key-In-Switch and Halo Light are integral with the ignition switch. Refer to Group 8M for Key-In-Switch and Halo Light diagnosis.

IGNITION SWITCH AND KEY CYLINDER SERVICE

REMOVAL

(1) Disconnect negative battery cable.

(2) Tilt column: Remove tilt lever (counterclockwise).

(3) Remove upper and lower covers (three screws).

(4) Remove ignition switch mounting screws (Snap-on torx bit tool TTXR20B0 or equivalent required—Fig. 1).

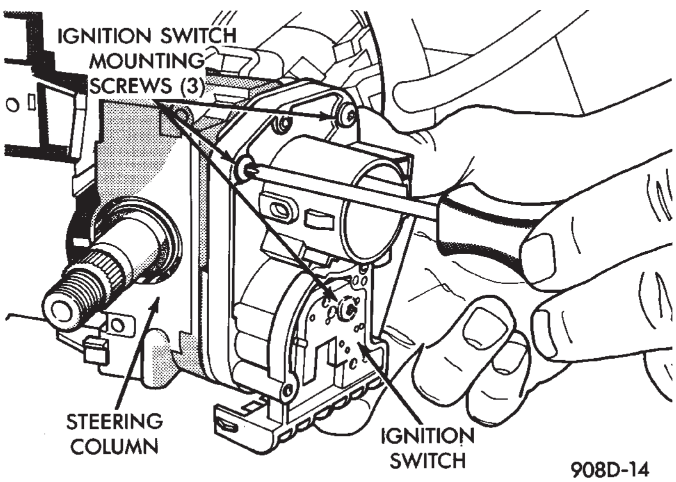


Fig. 1 Ignition Switch Screw Removal

(5) Gently pull switch away from the column. Release two connector locks on the 7-terminal wiring connector. Remove the connector from the ignition switch.

(6) Release connector lock on the Key-In-Switch and Halo Light 4-terminal connector. Remove the connector from the ignition switch (Fig. 2).

(7) Remove the key cylinder from the ignition switch as follows:

(a) With the key inserted and the ignition switch in the lock position, proceed as follows: Use a small screwdriver to depress the key cylinder retaining pin flush with the key cylinder surface (Fig. 3).

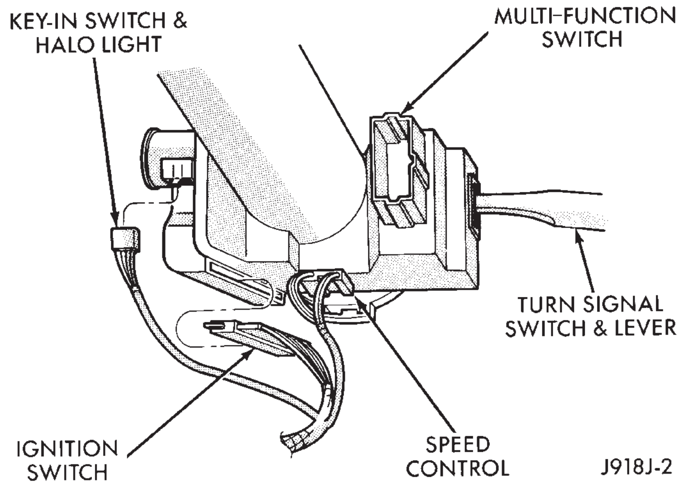


Fig. 2 Key in Switch and Halo Lamp Connector

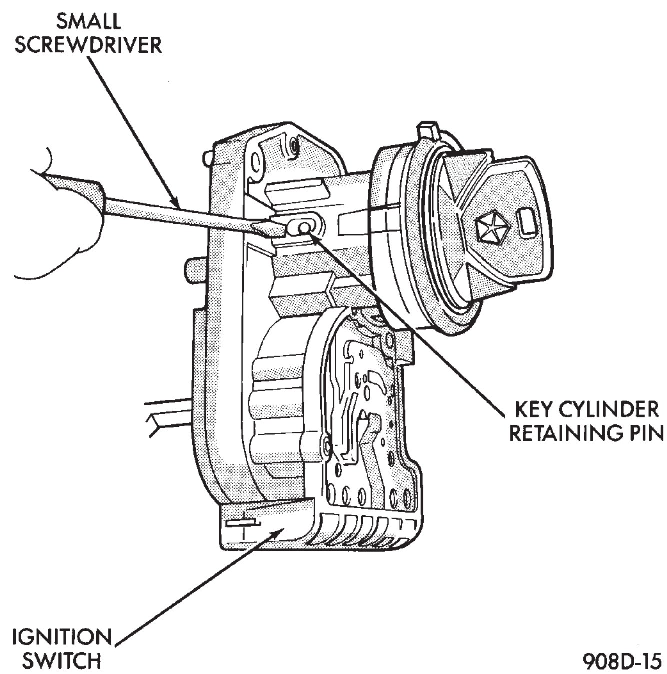


Fig. 3 Key Cylinder Retaining Pin

(b) Rotate the key clockwise to the OFF position. The key cylinder should now be unseated from the ignition switch assembly (Fig. 4).

CAUTION: Do not remove key cylinder at this time.

(c) With key cylinder in unseated position (key cylinder bezel about 1/8 inch above ignition switch

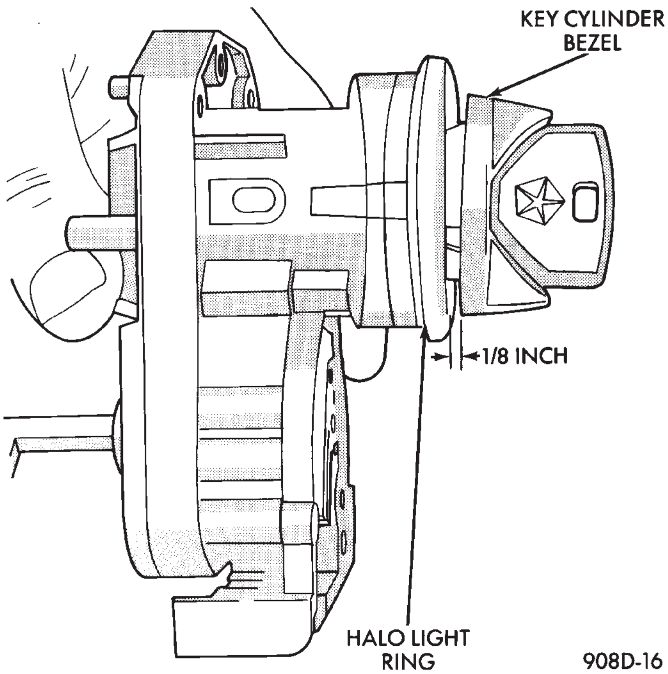


Fig. 4 Unseated Key Cylinder

halo light ring), proceed as follows: Rotate the key counterclockwise to the Lock position and remove the key.

(d) Remove key cylinder (Fig. 5).

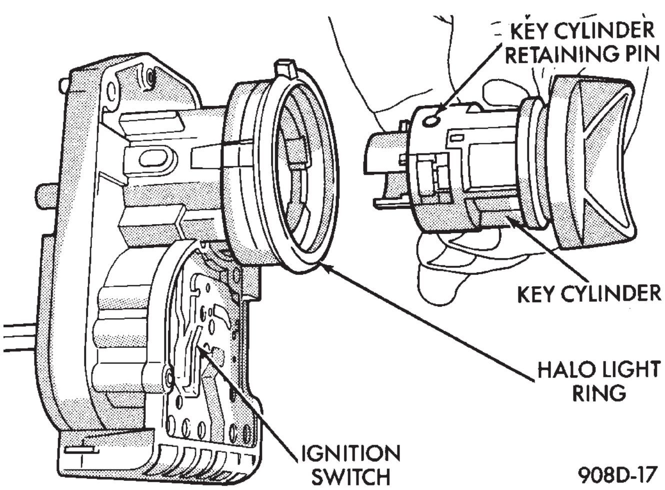


Fig. 5 Key Cylinder Removal

INSTALLATION

(1) Install electrical connectors to switch. Make sure that the switch locking tabs are fully seated in the wiring connectors.

(2) Mount ignition switch to the column (Fig. 6).

Park-lock dowel pin on ignition switch assembly must engage with column park-lock slider linkage (Fig. 7). Verify ignition switch is in lock position (flag is parallel with the ignition switch terminals) (Fig. 6). Apply a dab of grease to flag and pin. Position park-lock link and slider to mid-travel. Position ignition switch against lock housing face. Be sure pin is inserted into park-lock link contour slot. Tighten retaining screws to 2 N●m (17 in. lbs.) torque.

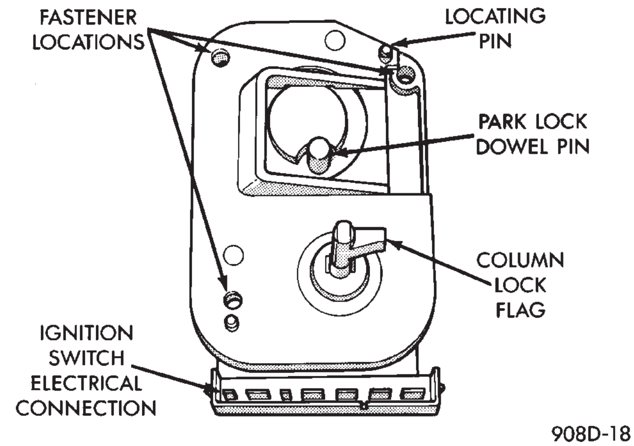


Fig. 6 Ignition Switch View From Column

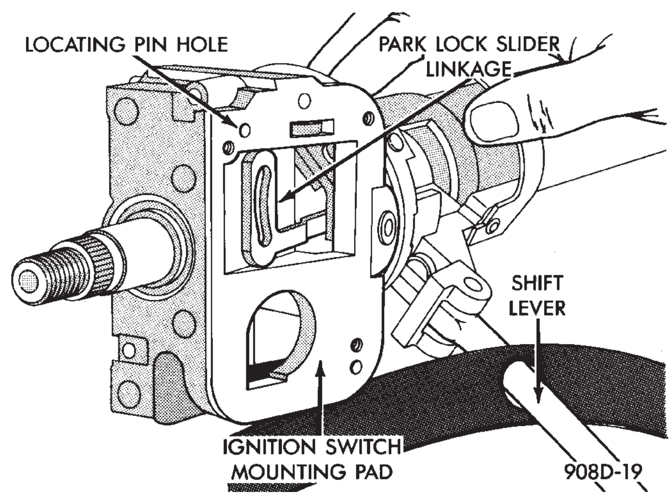


Fig. 7 Ignition Switch Mounting Pad

(3) Assemble cover to the column (3 screws). Tighten retaining screws to 2 N●m (17 in. lbs.) torque.

(4) Tilt column: Install tilt lever (clockwise).

(5) Install negative battery cable.

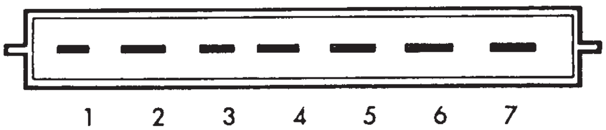
(6) Install key cylinder.

(a) With key cylinder and ignition in lock position, gently insert key cylinder into ignition switch assembly until it bottoms.

(b) Insert key. While gently pushing on the key cylinder (inward) toward the ignition switch, rotate key clockwise to end of travel.

(7) Check for proper operation of push-to-lock, halo lighting, Accessory, Lock, Off, Run, Start, column lock and shift lock (if applicable).

IGNITION SWITCH CIRCUITS



IGNITION SWITCH CONNECTOR
LOOKING INTO SWITCH

WIRE CAVITY	WIRE COLOR	APPLICATION
1	YELLOW/DRK. BLUE	STARTER RELAY
2	YELLOW	IGNITION RUN/START
3	GRAY/BLACK	BRAKE WARNING LAMP
4	RED/WHITE	IGNITION SWITCH BATTERY FEED
5	ORANGE/BLACK	RUN ACCESSORY
6	VIOLET	ACCESSORY
7	PINK/BLACK	IGNITION SWITCH BATTERY FEED

J938D-5

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
4.0L 6 Cylinder	RC12LYC	0.089mm (0.035 in.)
5.2L V-8	RC12YC	0.089 mm (0.035 in.)

J9314-90

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

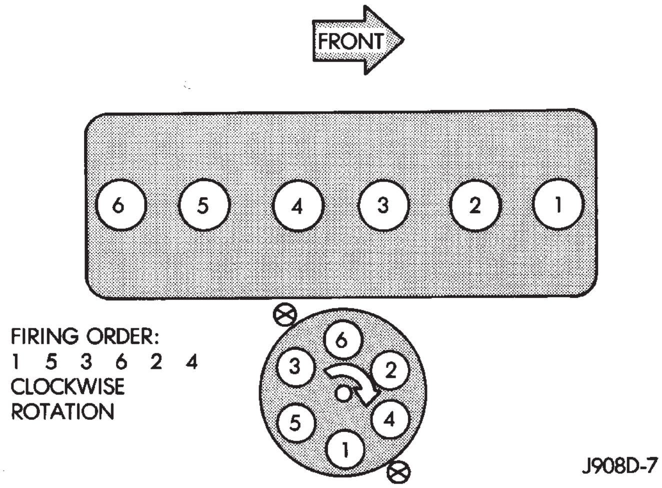
J908D-43

IGNITION COIL RESISTANCE

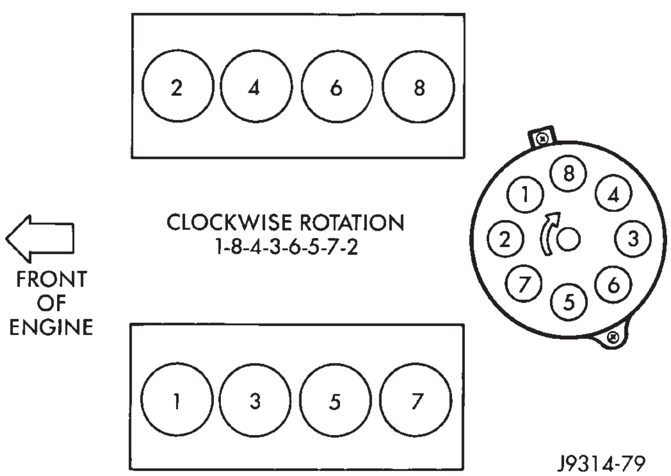
COIL (MANUFACTURER)	PRIMARY RESISTANCE 21–27°C (70–80°F)	SECONDARY RESISTANCE 21–27°C (70–80°F)
Diamond	0.97 - 1.18 Ohms	11,300 - 15,300 Ohms
Toyodenso	0.95 - 1.20 Ohms	11,300 - 13,300 Ohms

J918D-2

ENGINE FIRING ORDER—4.0L ENGINE



ENGINE FIRING ORDER—5.2L ENGINE



TORQUE

DESCRIPTION	TORQUE
Coolant Temperature Sensor (6 Cylinder)	28 N·m (21 ft. lbs.)
Coolant Temperature Sensor (V-8)	7 N·m (5 ft. lbs.)
Crankshaft Position Sensor Mounting Bolts (6 Cyl.)	19 N·m (14 ft. lbs.)
Crankshaft Position Sensor Mounting Bolts (V-8)	8 N·m (70 in. lbs.)
Distributor Hold Down Bolt	23 N·m (17 ft. lbs.)
Intake Manifold Charge Air Temp. Sensor	13 N·m (10 ft. lbs.)
Oxygen Sensor	30 N·m (22 ft. lbs.)
Powertrain Control Module (PCM) Mounting Screws	1 N·m (9 in. lbs.)
Powertrain Control Module (PCM) Elect. Connector	4 N·m (35 in. lbs.)
Spark Plugs 6 or 8 Cylinder	35-41 N·m (26-30 ft. lbs.)

J9314-91

INSTRUMENT PANEL AND GAUGES

CONTENTS

INSTRUMENT CLUSTER GENERAL INFORMATION

With the ignition switch in the RUN or START position, voltage applied to the instrument cluster is limited by the gauges fuse. The voltage applied to the instrument cluster is applied to all the gauges and indicators through the instrument cluster printed circuit.

With the ignition switch in the OFF position, voltage is not applied to the instrument cluster and the gauges do not indicate any vehicle condition.

VOLTMETER

The voltmeter measures the output of the generator when the engine is running. When the engine is not running the voltmeter measures battery voltage.

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 the amount of current flow will change the magnetic field which changes the pointer position. The oil pressure sender is a variable resistor that changes resistance with a change in oil pressure (calibration values shown in Specifications chart).

COOLANT TEMPERATURE GAUGE

The coolant temperature gauge pointer position is controlled by a magnetic field. This field is created by electrical current flowing through the coils within the gauge. A change in the amount of current flow will change the magnetic field which changes the pointer position. The coolant temperature sensor is a thermistor that provides a different electrical resistance for different temperatures of the coolant. As the resistance changes, the current changes and the pointer moves to a new position (calibration values shown in Specifications chart).

TACHOMETER

The tachometer displays the engine speed, (RPM). With the engine running, the tachometer receives an engine speed signal from the PCM pin 43 (calibration values shown in Specifications chart).

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 the amount of current flow will change the magnetic field which changes the pointer position. The fuel level sender is a variable resistor that changes electrical resistance depending on the level of fuel in the tank. As the resistance changes, the current changes and the pointer moves to a new position (calibration values shown in Specifications chart).

LOW FUEL WARNING

The low fuel warning indicator glows when the fuel tank holds approximately 4 gallons. A low fuel warning module controls when the indicator will light. When the module senses 66.5 ohms or less from the fuel level sender for 10 continuous seconds, the indicator will light. The indicator will remain on until the module senses 63.5 ohms or more from the fuel sender for 20 continuous seconds.

UPSHIFT INDICATOR

Vehicles equipped with manual transmissions have an optional Up-Shift indicator lamp. The lamp is controlled by the PCM. The lamp illuminates to indicate when the driver should shift to the next highest gear for best fuel economy. The engine controller will turn the lamp OFF after 3 to 5 seconds if the shift of gears is not performed. The shift light will remain off until the vehicle stops accelerating and is brought back to the range of shift light operation or 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. The lamp will be illuminated during engine operation according to engine speed and load.

BRAKE INDICATOR

The brake indicator warns the driver that the parking brake is on or that the pressure in the brake system is unequal.

Voltage is applied through the brake indicator bulb to three switches. A path to ground for the current is available if:

- The brake warning switch is closed (with unequal brake system pressures), or
- The ignition switch is in START (to test the bulb), or
- The park brake switch is closed (with the park brake on).

MALFUNCTION INDICATOR (CHECK ENGINE LAMP)

The Check Engine Lamp illuminates at the bottom of the instrument cluster each time the ignition key is turned on. It will stay 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 can also be used to display diagnostic trouble codes. Cycle the ignition switch on, off, on, off, on within 5 seconds. This will allow any trouble codes stored in the control module memory to be displayed in a series of flashes representing digits.

SECURITY LAMP

The Security Lamp illuminates when the Security system has been properly armed. The lamp will flash for 15 seconds, indicating that arming is in progress. Note that this 15 second arming will start after the Illuminated Entry has timed out (courtesy lamps out). Refer to Group 8Q - Vehicle Theft Security System.

CHECK ANTI-LOCK LAMP

This light monitors the Anti-Lock Brake System. This light will come on when the ignition key is turned to the ON position and may stay on for as long as thirty seconds. If the Anti-Lock light remains on or comes on during driving, it indicates that the Anti-Lock portion of the brake system is not functioning. Refer to Group 5 - Brakes for further information.

AIR BAG

This red light monitors the Air Bag system. This light will come on when the ignition key is turned to the ON position and should light for 6 to 8 seconds. If the Air Bag light remains on or comes on during driving, it indicates that the Air Bag system is not functioning.

If air bag warning lamp either fails to light, or goes on and stays on, there is a system malfunction. Refer to the Passive Restraint Diagnostic Test Manual to diagnose the problem.

HAZARD FLASHER INDICATOR (CANADA)

Illuminates when the hazard switch on top of the steering column is depressed.

MASTER LIGHTING INDICATOR (CANADA)

Illuminates when the headlamps are turned ON.

INSTRUMENT CLUSTER DIAGNOSIS

If the entire cluster is inoperative check fuse 22 in the fuse panel. Replace as required.

SPEEDOMETER/OIL PRESSURE GAUGE/AIR BAG LAMP

UPSHIFT INDICATOR
MALFUNCTION INDICATOR (CHECK ENGINE)
BRAKE INDICATOR
CHECK ANTI-LOCK (ABS)

If all these are inoperative check for an open in the IGN line to cluster connector terminal C12.

If C12 has ignition voltage continue with the diagnostics of the appropriate item.

SPEEDOMETER

(1) Raise the 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 key to the RUN position.
(5) Check for approximately 5 volts. If OK, perform vehicle speed sensor test. Refer to the appropriate Vehicle Diagnostics Test Procedures Manual. If not OK, continue with step 6.
(6) Turn ignition key to OFF position.
(7) Check continuity between distance (speed) sensor connector and cluster connector terminal C7. If OK, replace speedometer. If not OK, repair open circuit.

OIL PRESSURE GAUGE INOPERATIVE

(1) Turn ignition switch to RUN.
(2) Disconnect Oil Pressure Sender connector. Needle goes to High. If not, go to step 2.

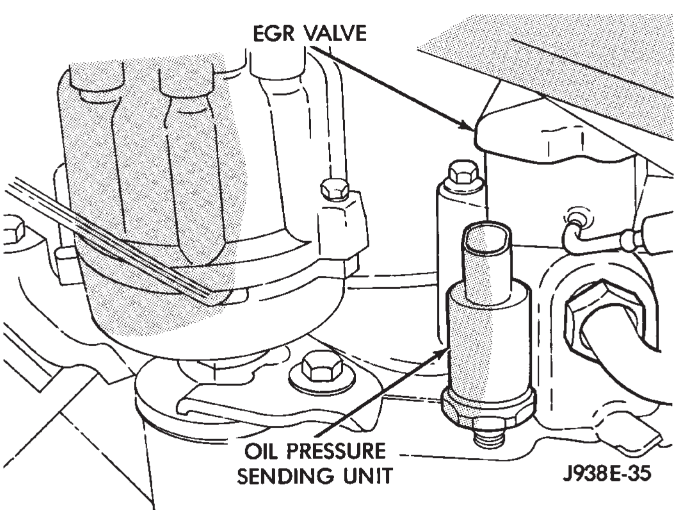


Fig. 1 Oil Pressure Sending Unit—5.2L

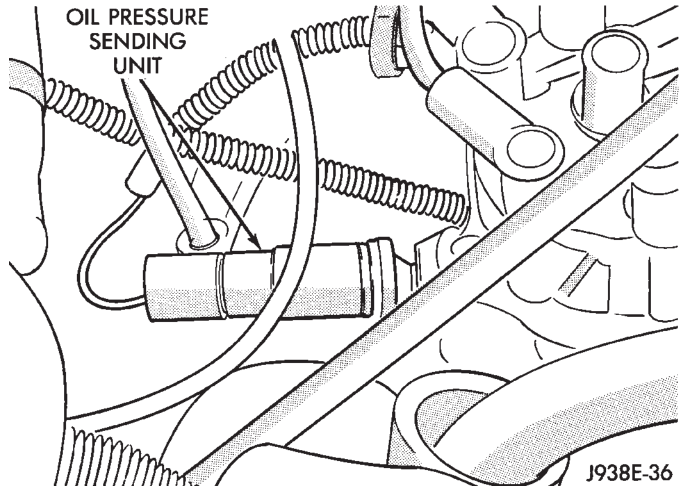


Fig. 2 Oil Pressure Sending Unit—4.0L

(3) Touch Oil Pressure Sender connector to ground. Needle goes to Low.
(4) If OK, replace sender. If not, check for an open to gauge (instrument cluster connector terminal C9). Repair open as required. If no open is found, replace gauge.

AIR BAG LAMP

(1) Turn ignition switch to RUN.
(2) Ground instrument cluster connector pin C11. Lamp should light. If not, replace bulb. If OK, continue with step 3.
(3) Turn key to OFF. Disconnect and isolate the battery negative (ground) cable. Check for continuity between connector pin C11 and pin 3 of the air bag diagnostic module connector. If OK, replace ASDM (refer to Group 8M- Restraint Systems).

UPSHIFT INDICATOR

(1) Turn ignition switch to RUN.
(2) Ground instrument cluster connector pin C8. Lamp should light. If not, replace bulb. If OK, continue with step 3.
(3) Turn Key to OFF. Check for continuity between connector pin C8 and pin 54 of the PCM. If OK, replace PCM. If not, repair open.

MALFUNCTION INDICATOR (CHECK ENGINE)

(1) Turn ignition switch to RUN.
(2) Jumper cluster connector terminal C5 to ground. Lamp should light. If bulb is OK, check for open circuit between C5 and powertrain control module pin 32. If OK, replace PCM.

BRAKE INDICATOR

Jumper cluster connector terminal C4 to ground. Lamp should light. If bulb is OK, check for continuity to brake pressure warning switch and park brake switch.

CHECK ANTI-LOCK (ABS)

(1) Turn ignition switch to RUN.

(2) Jumper instrument cluster connector terminal C3 to ground. Lamp should light. If bulb is OK, check for continuity between C3 and pin 53 of the ABS module. Refer to Group 5 - Brakes.

VOLTMETER/TACHOMETER/FUEL GAUGE/LOW FUEL INOPERATIVE

If all these are inoperative check for an open in the B+ line to cluster connector terminal D4.

If D4 has battery voltage continue with the diagnostics of the appropriate item.

VOLTMETER

If cluster connector terminal D4 has battery voltage, replace meter.

TACHOMETER INOPERATIVE

Tachometer input is from the powertrain control module (PCM) pin 43 to cluster connector terminal D5.

(1) Check for continuity between D5 and PCM pin 43.

(2) Use the DRB II Scan Tool to test pin 43.

FUEL GAUGE

(1) Turn ignition switch to RUN.

(2) Unplug Fuel Gauge sender connector at tank. Needle should go to E.

(3) Connect a jumper between terminals 1 and 2 (PK/BK and BK/OR wires) on 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 terminal 1 and cluster connector terminal D6. If OK, replace gauge. If not, repair open to gauge. **If there is an open in the line to D6 the Low Fuel will be illuminated.**

LOW FUEL WARNING INOPERATIVE

(1) Perform Fuel Gauge test. **The Fuel Gauge and Low Fuel use the same line. If one is not working properly the other must also be incorrect.**

(2) If the Low Fuel is still inoperative, replace bulb.

To replace the Low Fuel Module, replace the Tachometer.

COOLANT TEMPERATURE GAUGE INOPERATIVE

(1) Check for an open in the B+ line to cluster connector terminal D9. If D9 has battery voltage continue with the next step. If D9 has no voltage repair as required.

(2) Turn ignition switch to RUN.

(3) Disconnect Coolant Temperature Sender connector. Needle goes to Low. If not, go to step 3.

(4) Touch Coolant Temperature Sender connector to ground. Needle goes to High. If OK, replace sender. If not, check for an open between sender and gauge. If OK, replace gauge.

SECURITY INDICATOR

(1) Jumper cluster connector terminal D16 to ground. Lamp should light. If OK, test Security Alarm Module (refer to Group 8Q - Vehicle Theft Security System). If not, go to step 2.

(2) Measure voltage at cluster connector terminal D15. Meter should read battery voltage with ignition OFF. If OK, test Security Alarm Module. If not, replace bulb.

SEAT BELT INDICATOR

Jumper instrument cluster connector terminal C14 to 12 volts. Lamp should light. If not, replace bulb. If OK, check wiring for an open to Convenience Center. Refer to Group 8U - Chime/Buzzer Warning Systems.

INSTRUMENT CLUSTER SERVICE PROCEDURES

INDEX

INSTRUMENT CLUSTER REPLACEMENT

(1) Disconnect negative cable from battery.

(2) Remove ash tray.

(3) Remove 6 screws holding center cluster bezel (Fig. 1).

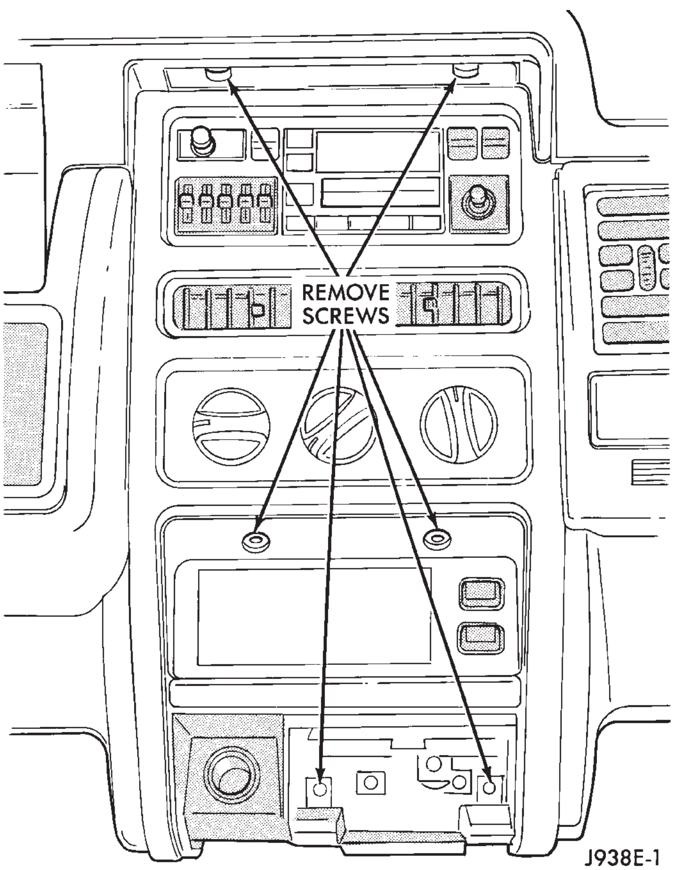


Fig. 1 Remove Center Bezel Retaining Screws

(4) Remove center bezel.

(5) Remove 2 screws holding dash pad.

(6) Gently pry defroster grille out of dash pad.

(7) Unplug sensors (if equipped) and set defroster grille aside.

(8) Remove 4 screws in defroster duct opening holding dash pad (Fig. 2).

(9) Remove 3 screws above instrument panel cluster holding dash pad (Fig. 3).

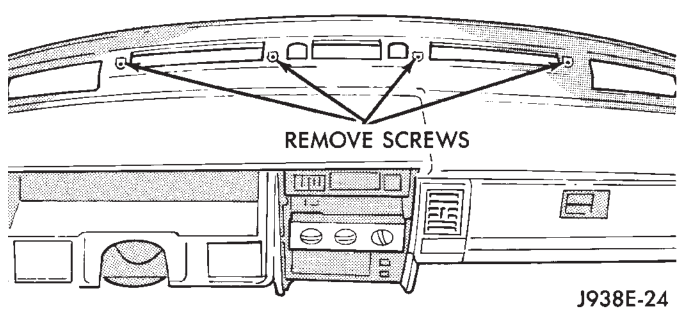


Fig. 2 Upper Dash Pad Attaching Screws

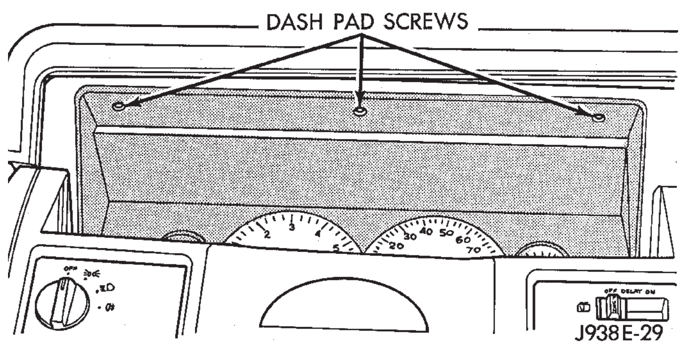


Fig. 3 Remove Screws Holding Dash Pad

(10) Open glove box and remove 2 screws holding dash pad.

(11) Remove dash pad pulling up to unsnap end clips.

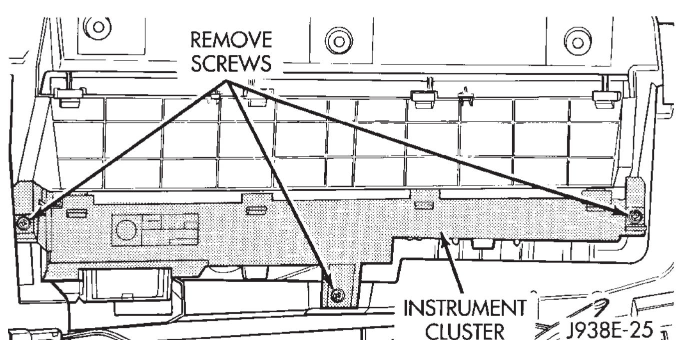


Fig. 4 Instrument Cluster Attaching Screws

(12) Remove 3 screws from the top of the cluster (Fig. 4).

(13) Lift cluster straight up far enough to allow access to connector. Unplug connector and remove cluster.

GAUGE REPLACEMENT—INSTRUMENT CLUSTER REMOVED

(1) Remove 4 screws from bottom of lens.
(2) Lift lens off from bottom.
(3) Pull trip reset knob off.
(4) Remove mask by lifting from bottom. Mask is snapped in along the top.

CAUTION: Do not touch the face of a gauge or the back of the lens with your finger. It will leave a permanent finger print.

(5) Remove the required gauge set attaching screws from the rear of mounting bezel. Remove gauge set from front.
(6) Install the gauge set. Install the attaching screws.
(7) Install the mask.
(8) Install lens with 4 screws.
(9) Install knob on trip odometer push pin.

SPEEDOMETER REPLACEMENT—INSTRUMENT CLUSTER REMOVED

(1) Remove 4 screws from bottom of lens (Fig. 5).
(2) Lift lens off from bottom.
(3) Pull trip reset knob off.
(4) Remove mask by lifting from bottom. Mask is snapped in along the top.

CAUTION: Do not touch the face of a gauge or the back of the lens with your finger. It will leave a permanent finger print.

(5) Remove 3 attaching screws from the rear of the mounting bezel (Fig. 6).
(6) Remove the speedometer assembly including the circuit board.
(7) Install the speedometer. Install the attaching screws.
(8) Install the mask.
(9) Install lens with four screws.
(10) Install knob on trip odometer push pin.

TACHOMETER REPLACEMENT—INSTRUMENT CLUSTER REMOVED

(1) Remove 4 screws from bottom of lens.
(2) Lift lens off from bottom.
(3) Pull trip reset knob off.
(4) Remove mask by lifting from bottom. Mask is snapped in along the top.

CAUTION: Do not touch the face of a gauge or the back of the lens with your finger. It will leave a permanent finger print.

(5) Remove 6 silver colored attaching screws from the rear of the mounting bezel (Fig. 6).
(6) Remove the tachometer assembly including the circuit board.
(7) Install the tachometer. Install the attaching screws.
(8) Install the mask.
(9) Install lens with 4 screws.
(10) Install knob on trip odometer push pin.

PRINTED CIRCUIT REPLACEMENT—INSTRUMENT CLUSTER REMOVED

DISASSEMBLY

(1) Remove 4 screws from bottom of lens.
(2) Lift lens off from bottom.
(3) Pull trip reset knob off.
(4) Remove mask by lifting from bottom. Mask is snapped in along the top.

CAUTION: Do not touch the face of a gauge or the back of the lens with your finger. It will leave a permanent finger print.

(5) Remove all attaching screws for gauges, tachometer, and speedometer that are contacting the printed circuit (Fig. 6).
(6) Remove 2 screws holding the cluster connector to the bezel (Fig. 7).
(7) Remove the lamp sockets from the circuit board.
(8) Lift the connector up to unfold the printed circuit (Fig. 8). Remove the printed circuit including the connector.

ASSEMBLY

(1) Position the printed circuit, including connector, on the back of the instrument panel cluster.
(2) Hold the components in place and install the screws.
(3) Install the lamp sockets.
(4) Pivot the connector into place and install two screws.
(5) Install the mask.
(6) Install lens with four screws.
(7) Install knob on trip odometer push pin.

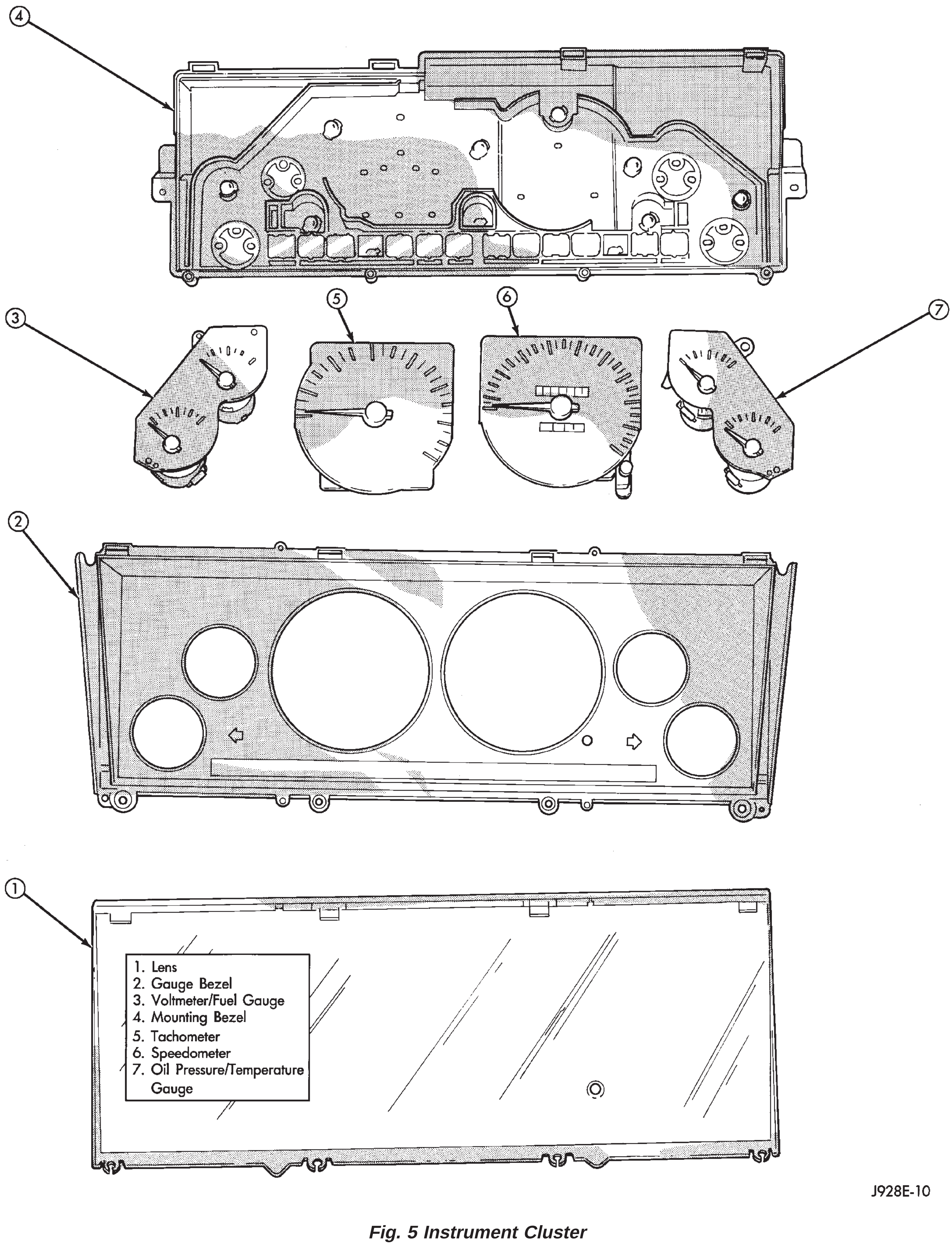


Fig. 5 Instrument Cluster

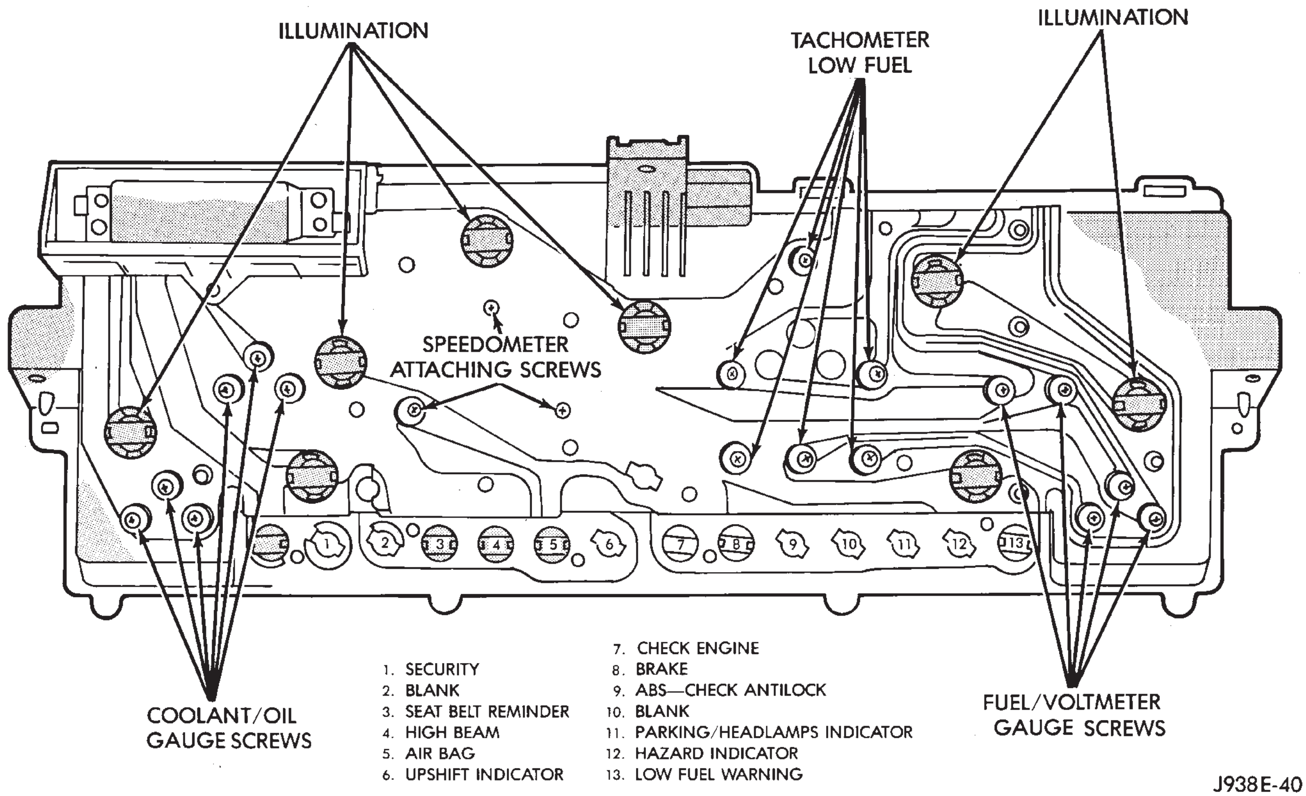


Fig. 6 Printed Circuit Removal/Installation

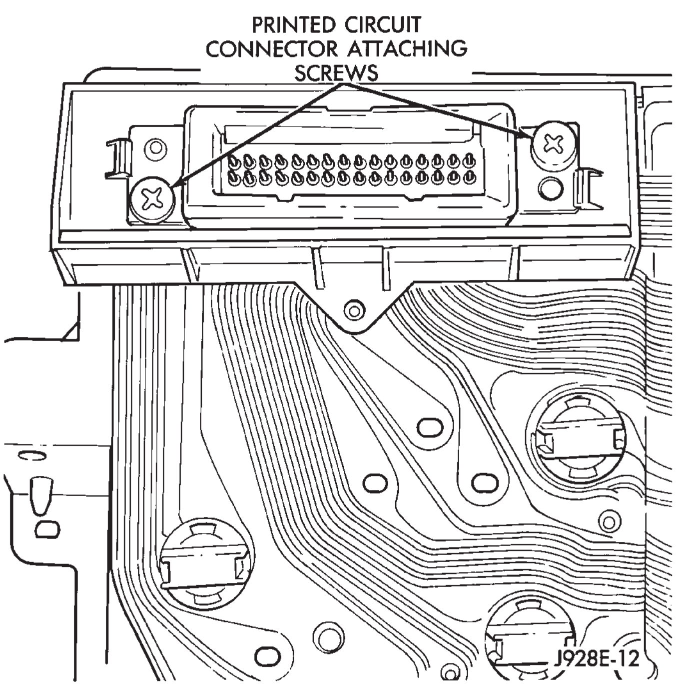


Fig. 7 Cluster Connector Retaining Screws

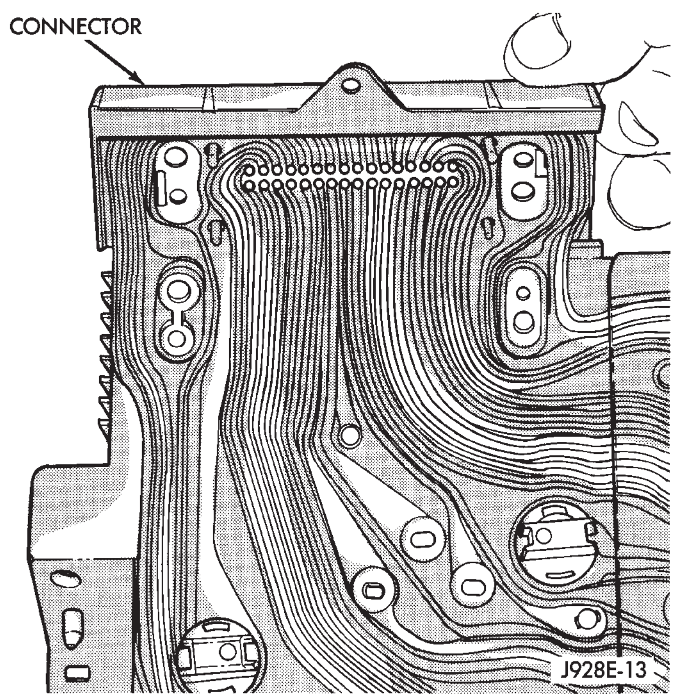
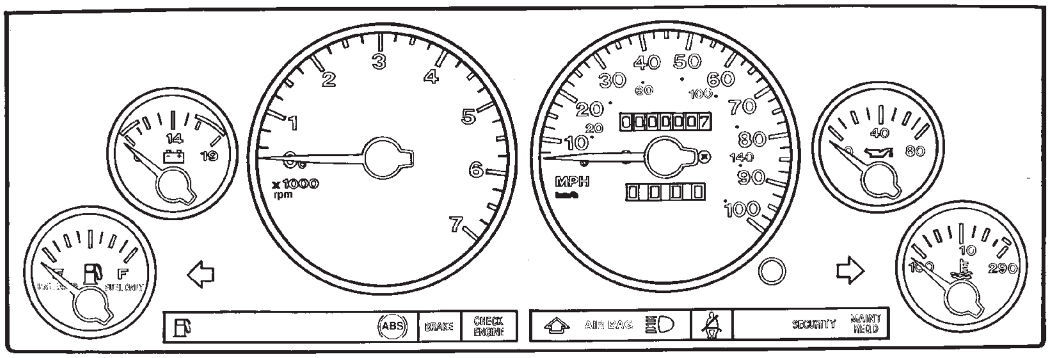
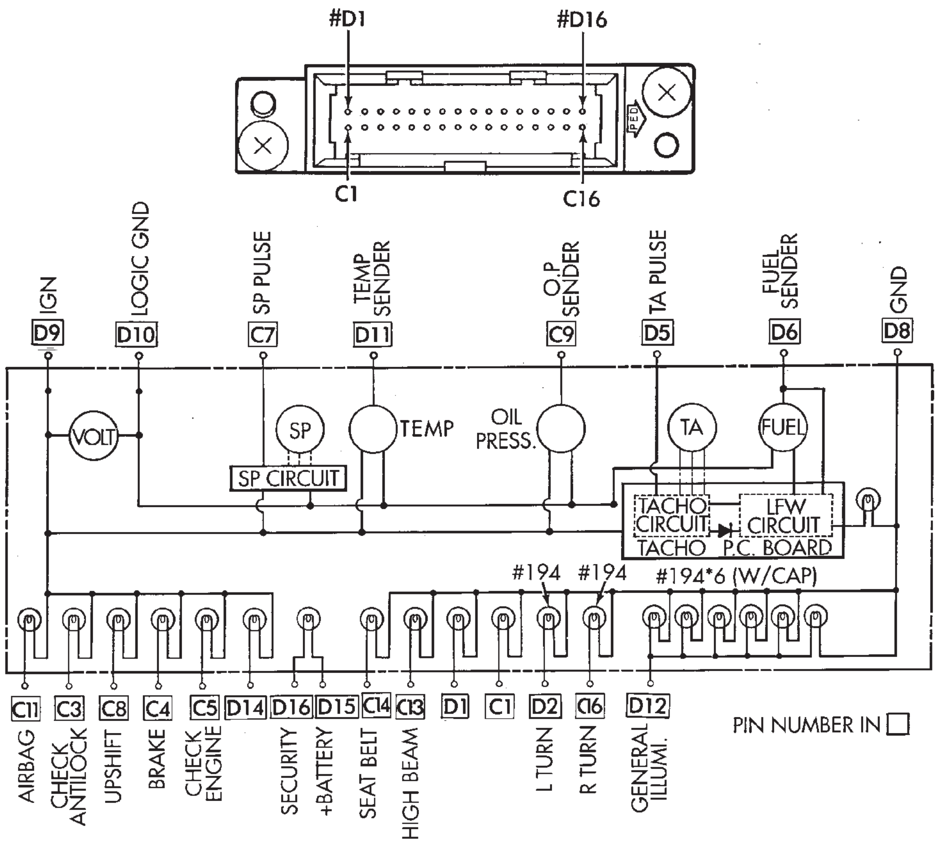


Fig. 8 Printed Circuit And Cluster Connector

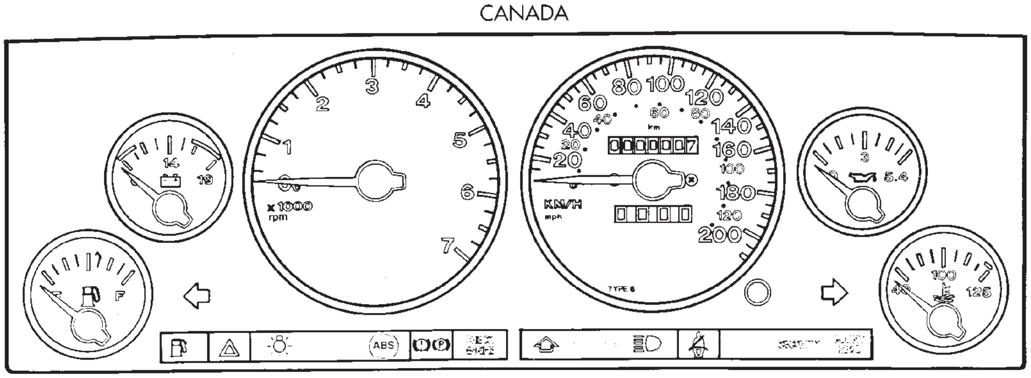
INSTRUMENT CLUSTER

U.S.A.





CANADA



J938E-45

SPECIFICATIONS

INSTRUMENT CLUSTER GAUGES

OIL PRESSURE GAUGE CALIBRATION

POINTER POSITION	RESISTANCE
0 psi Grad. ± 2°	1 ohm
40 psi Grad. ± 3½°	46.5 ohms
80 psi Grad. ± 3°	87 ohms

TEMPERATURE GAUGE CALIBRATION

POINTER POSITION	RESISTANCE
100°F Grad. ± 3½°	1365 ohms
210°F Grad. ± 2½°	115 ohms
260°F Grad. ± 2½°	55.1 ohms

FUEL GAUGE CALIBRATION

POINTER POSITION	RESISTANCE
Empty Grad. +0° −5°	105 ohm
1/2 Full Grad. ± 5°	32.5 ohms
Full Grad. + 5° −0°	5 ohms

VOLTMETER CALIBRATION

VOLTAGE INPUT	POINTER POSITION
12V	12V Grad. ± 6°
16V	16V Grad. ± 3°

TACHOMETER CALIBRATION

FREQUENCY	INDICATION
66.7 HZ	2000 RPM ± 140
166.7 HZ	5000 RPM ± 140

SPEEDOMETER CALIBRATION

FREQUENCY	INDICATION
44.4 HZ	20 mph −1.5 +4.5
88.8 HZ	40 mph −1 +4
122.2 HZ	55 mph −.3 +3.3

J928E-7

VEHICLE INFORMATION CENTER (VIC)

INDEX

GENERAL INFORMATION

A multi-colored vacuum fluorescent (VF) display screen and vehicle outline. The VIC will perform four functions with the use of the Select and Set buttons.

- Display time and date (clock/calendar feature)
- Monitor specific vehicle operating systems
- Display service reminder or distance to service
- Display 4wd transfer case modes of operation.

CLOCK/CALENDAR DISPLAY

The clock/calendar display consists of:

- Time (hours and minutes with AM and PM
- Day of the week (Monday through Sunday)
- Date (Month and Day)

MONITORED SYSTEMS

The vehicle systems monitored by the Vehicle Information Center are:

- Right front door ajar
- Left front door ajar
- Right rear door ajar
- Left rear door ajar
- Liftgate open
- Tail lamps
- Engine oil level/sensor
- Windshield washer fluid level/sensor
- Engine coolant fluid level/sensor
- Turn Signal On
- Electrical system voltage
- Four/two wheel drive states

SERVICE REMINDERS

There are two service reminders:

- PERFORM SERVICE
- MILES (KM) TO SERVICE

FOUR WHEEL DRIVE DISPLAY

The VIC will illuminate the vehicle outline and telltale indicator lights exactly the same as the 4WD Graphic Display Module.

- Rear wheels illuminated (2WD)
- Front wheels illuminated (4WD)
- PART TIME (Part Time 4WD)
- FULL TIME (Full Time 4WD)
- LO (Lo Range 4WD)

When the ignition key is turned ON, the module will display the distance-to service message for 6 seconds. If the distance remaining to service is zero, the module will instead display the 0 MILES TO SERVICE message for 11 seconds. Then the TONE-OUT line will pulse low for 6 sequences of warning beeps. The 0 MILES TO SERVICE message will continue for an additional 2 seconds.

Next, if no monitored system faults exist and the time/date has been previously set, the module will display the current time and date. If a service fault exists, the module will begin to display the fault message. If more than one message has to be displayed, the module will display up to 2 messages. Then the clock function will pulse (unless a door is open and vehicle is at critical speed) in a continuous sequence at 3 second interval.

CONTROLS

- The SET button when depressed for 2 seconds initiates the time-setting mode. Once in the time-setting mode, pressing the SELECT button will cause the VIC to step to the next time/day function.
- Pressing the SELECT then the SET button for 2 seconds, will reset the service reminder back to service interval selected in set up mode.

At ignition ON, the module will display the distance to service message. If the distance to service is 0, 11 seconds after the display turns on, the module will beep a set of 6 beeps. Pressing SELECT then SET will reset the service reminder back to the service interval.

- If the time/date has been set, pressing the SELECT displays the service reminder.
- After ignition ON and the service reminder has been displayed, pressing SET for 2 seconds initiates the time/date setting mode.
- If the module has lost battery power, the clock/calendar display will flash the next time the ignition switch is turned ON or a button is pressed with the ignition off. The time display will continue to flash until the time is set.
- If both SELECT and SET buttons are depressed at ignition ON, the VIC will enter the Self-Test Mode.

If SET and/or SELECT is pressed with ignition OFF, the module will display the clock/calendar. This display will remain for the time the button(s) is/are pressed plus 6 seconds.

CLOCK/CALENDAR

Clock/Calendar function will be displayed during normal vehicle operation unless a warning or service system fault is detected. The clock/calendar display will include the following:

- Time (hours and minutes with AM and PM, except 24 hour clock mode)
- Day of Week (Monday through Sunday)
- Date (month and day)

OPERATING SYSTEM MESSAGES

The VIC monitors 11 vehicle operating systems. If a fault is detected, an area of the vehicle display outline will light-up and a message will appear. To alert the driver, an audio signal warning (Beeps) will occur the first time the message appears as indicated in the following paragraphs.

WARNING MESSAGES

The following warning messages will be displayed if detected:

- Driver door ajar
- Passenger door ajar
- Left rear door ajar
- Right rear door ajar
- Liftgate open
- Rear Lamp Failure
- Turn Signal On
- Check battery

DOOR AJAR/LIFTGATE OPEN

These messages are displayed when the switch is grounded. For the driver door only, whenever the door is open and the vehicle speed is greater that 10 MPH, the TONE-OUT will sound. This same warning will be enabled whenever the passenger doors are opened and the vehicle speed is greater that 2 MPH.

REAR LAMP FAILURE (LAMP OUTAGE MODULE)

Message is displayed when Lamp Out input is open for 1/2 second. This display is latched on until the ignition turns OFF. **If a bulb is replaced the ignition must be turned OFF to make the message clear.**

TURN SIGNAL ON

Message is turned on if 1 mile has elapsed with turn signal on.

CHECK BATTERY

Message is turned on when the ignition voltage is not between 11.5 and 15.1 volts. The reading is checked every 15 seconds for an over or under battery voltage. It takes 2 consecutive 15 second average readings to turn the message on and 1 to remove it. **The message can be turned on anywhere between 15 and 30 seconds and removed within 15 seconds.**

LEVEL MESSAGES

The module monitors the following 3 fluid levels:

- Check oil level
- Washer fluid low
- Coolant level low

CHECK OIL LEVEL/OIL LEVEL SENSOR BAD

The module will test the oil sensor input immediately after ignition ON. If low oil is detected during the test or the oil level sensor is bad, the VIC will display this message. The engine on the vehicle outline will also be illuminated. Ignition must be OFF for 1 minute before the oil is checked. If the fault is found, the message will stay on until the ignition turns OFF. Unless the ignition has been off for one minute or longer and the oil fault fixed, the fault will appear again on the next ignition ON.

WASHER FLUID LOW/COOLANT LEVEL LOW

The module will test the washer and coolant input immediately after ignition ON and determine if there is a fault. Thereafter the inputs are checked every 1 second. It takes 30 consecutive low averaged samples to determine the washer or coolant is low. It takes 15 consecutive low averaged samples to determine the sensor is bad. The washer and coolant messages are latched until the ignition turns OFF.

SERVICE MESSAGES

The VIC system includes a distance-to-service counter and detects faulty sensors. The following service messages will be displayed if a fault is determined:

- Perform Service
- xxxxx Miles (KM) to Service
- Coolant sensor bad
- Oil level sensor bad
- Washer sensor bad

PERFORM SERVICE

The 0 Miles To Service message is displayed at ignition ON any time the distance-to-service counter is equal to zero. The distance-to-service counter is reset by pressing SELECT then SET buttons depressed. Refer to SETUP for information on changing the service interval.

XXX MILES (KM) TO SERVICE

The distance-to-service message is displayed at ignition ON or when SELECT is pressed after the time/date has been set. The distance-to-service counter must not equal zero for the message to display. The distance is expressed in MILES or KILOMETERS (km) depending on the state of the US/M (in overhead console) input.

After the ignition turns ON and while the service reminder is being displayed, pressing SELECT and the SET for 2 seconds resets the service reminder. **Even though the service reminder is being displayed, SELECT needs to be pressed before SET to reset the service reminder.**

There will be 6 beeps every time the service miles are reset. Refer to Setup.

SENSOR FAULTS

The module displays a message as part of the warning message when it detects an open circuit to the oil, washer or coolant sensor. Refer back to Level Messages.

4WD SYSTEM MODE DISPLAYS

The VIC System Display will also monitor 4WD transfer case modes of operation. The VIC will illuminate the vehicle outline and telltale indicator lights exactly the same as the 4WD Graphic Display Module.

- Rear wheels illuminated (2WD)
- Front wheels illuminated (4WD)
- PART TIME (Part Time 4WD)
- FULL TIME (Full Time 4WD)
- LO (Lo Range 4WD)

VIC DIAGNOSTICS

The module will perform certain self-tests without the use of special tools. To start the test mode, press the SELECT and SET switches simultaneously while turning the key to ON. The program will stay in diagnostics mode until all the tests pass or the ignition is turned off.

When the diagnostic routine begins the module will perform the following:

MICROCOMPUTER RAM/ROM/TIMER TEST - Failure in any of these tests causes the message MODULE FAILURE to be displayed until the ignition turns OFF.

DISPLAY TEST - Activate all display segments and beep 6 times. Pressing SET or SELECT will stop the beeps if they are going and the program will advance to monitor the inputs.

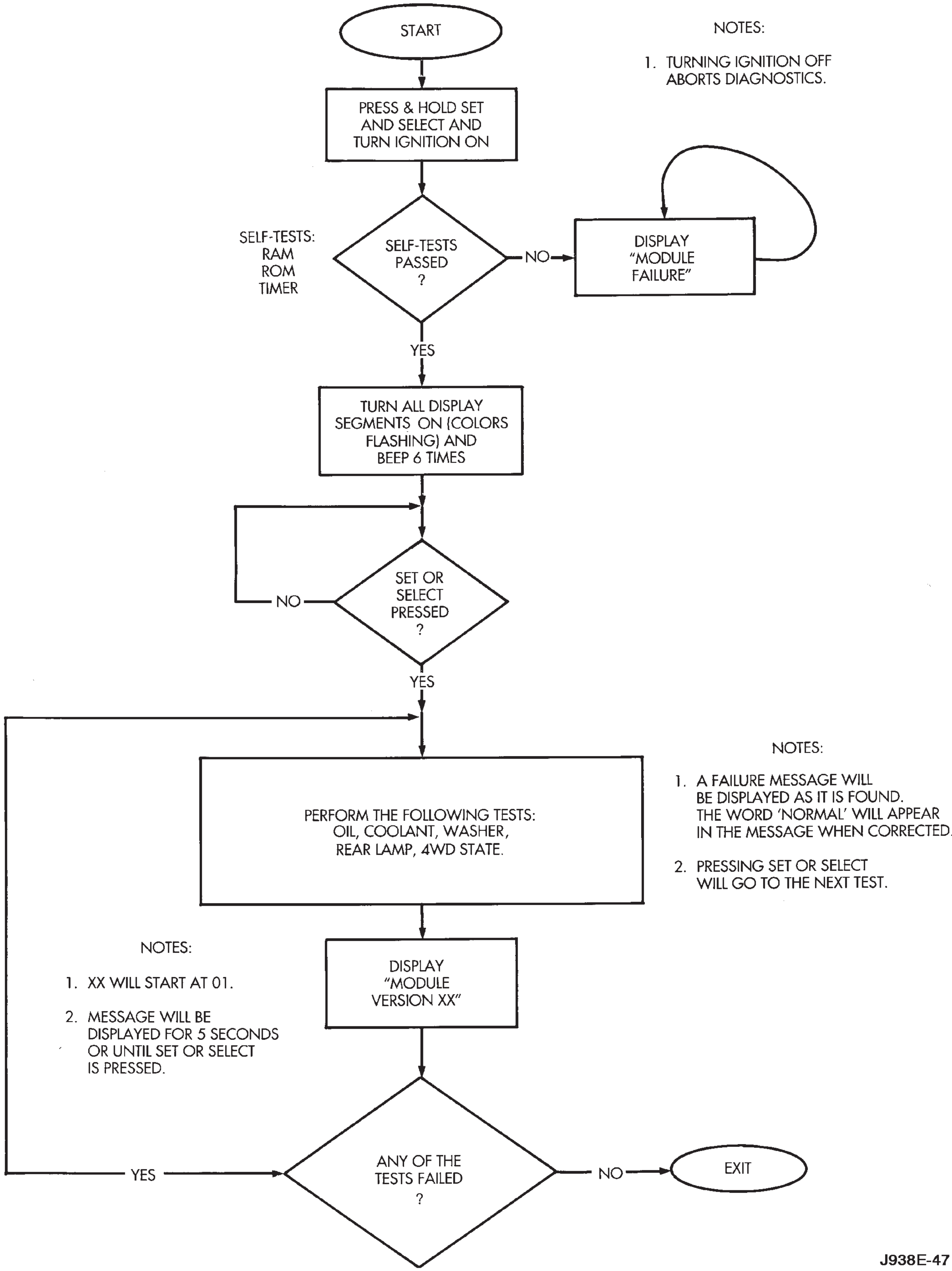
If a failure is detected, a corresponding error message will be displayed. The input will be monitored until SET or SELECT is pressed going on to the next step.

If the error is corrected while the error message is on the display, the word NORMAL will appear in the new message. Pressing SET or SELECT will continue to the next test.

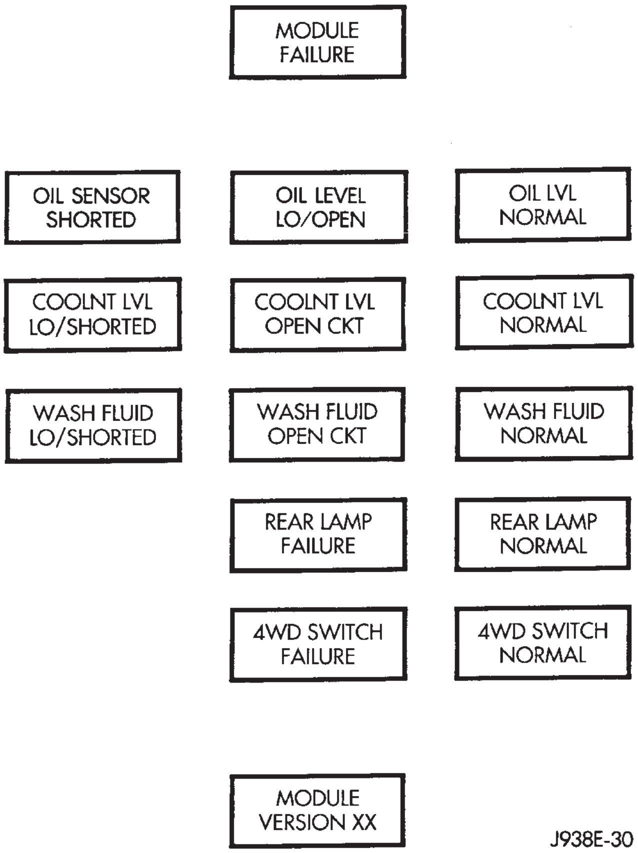
OIL/COOLANT/WASHER/REAR LAMP/FOUR WHEEL DRIVE - These inputs are monitored. Refer to Diagnostic Messages.

If the tests are successful, the message MODULE VERSION XX will be displayed for 5 seconds. XX represents the module software revision level. Pressing the SELECT switch causes the diagnostics to continue to Clock Display Select.

VIC DIAGNOSTICS CHART



VIC DIAGNOSTIC MESSAGES



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If part of the module will not light or is not operating properly, use the schematic and Group 8 - Wiring Diagrams to check for continuity to the appropriate device. If there is continuity and the sending device is operating properly replace the Vehicle Information Center.

SETUP

LANGUAGE SELECT

This function allows the selection of an alternate language for the module message displays.

Pressing the SELECT switch will cause the module to toggle between the available languages. Pressing the SET switch will set the module to the chosen language and continue to the Sensor Test.

CLOCK DISPLAY SELECT

Allows the selection of either 12 hour or 24 hour clock display. The module will display:

- 12 HOUR CLOCK MODE
- 24 HR CLOCK MODE

Pressing the SELECT switch will cause the module to toggle between the 12 and 24 hour modes. Pressing the SET switch will set the module to the chosen clock display and continue into Language Select.

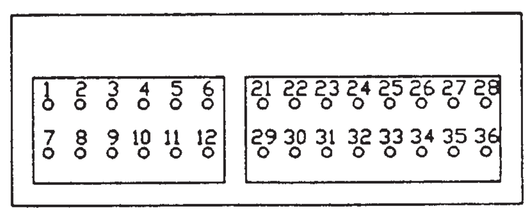
SERVICE INTERVAL

Controls the mileage of the service interval. The service interval can be set to a mileage between 2000 and 7500 miles in increments of 500 miles. Kilometers are displayed if US/M (in overhead console) is set to metric.

The miles to service displayed are always recalculated from whatever the interval is set to. For example:

- Service interval is set at 7500 miles and 3000 miles have elapsed. Service Reminder will show 4500 MILES TO SERVICE.
- If interval is reset to 5000 miles, the service reminder will show 2000 MILES TO SERVICE (5000-3000).

CONNECTOR IDENTIFICATION



PIN #	SIGNAL	PIN #	SIGNAL
1	BATTERY	7	GROUND
2	GROUND	8	NOT CONNECTED
3	DRIVER DOOR	9	NOT CONNECTED
4	PASSENGER DOOR	10	NOT CONNECTED
5	RIGHT REAR DOOR	11	TONE
6	TURN SIGNAL	12	SPEED
21	PARK LAMP	29	LIFT-GATE
22	COOLANT	30	WASHER
23	LAMP OUT	31	PART-TIME
24	US / M	32	FULL-TIME
25	LEFT REAR DOOR	33	IGNITION
26	OIL LEVEL	34	LO
27	ILLUMINATION	35	ALL-TIME
28	GROUND (GND)	36	2 WHEEL DRIVE (2WD)

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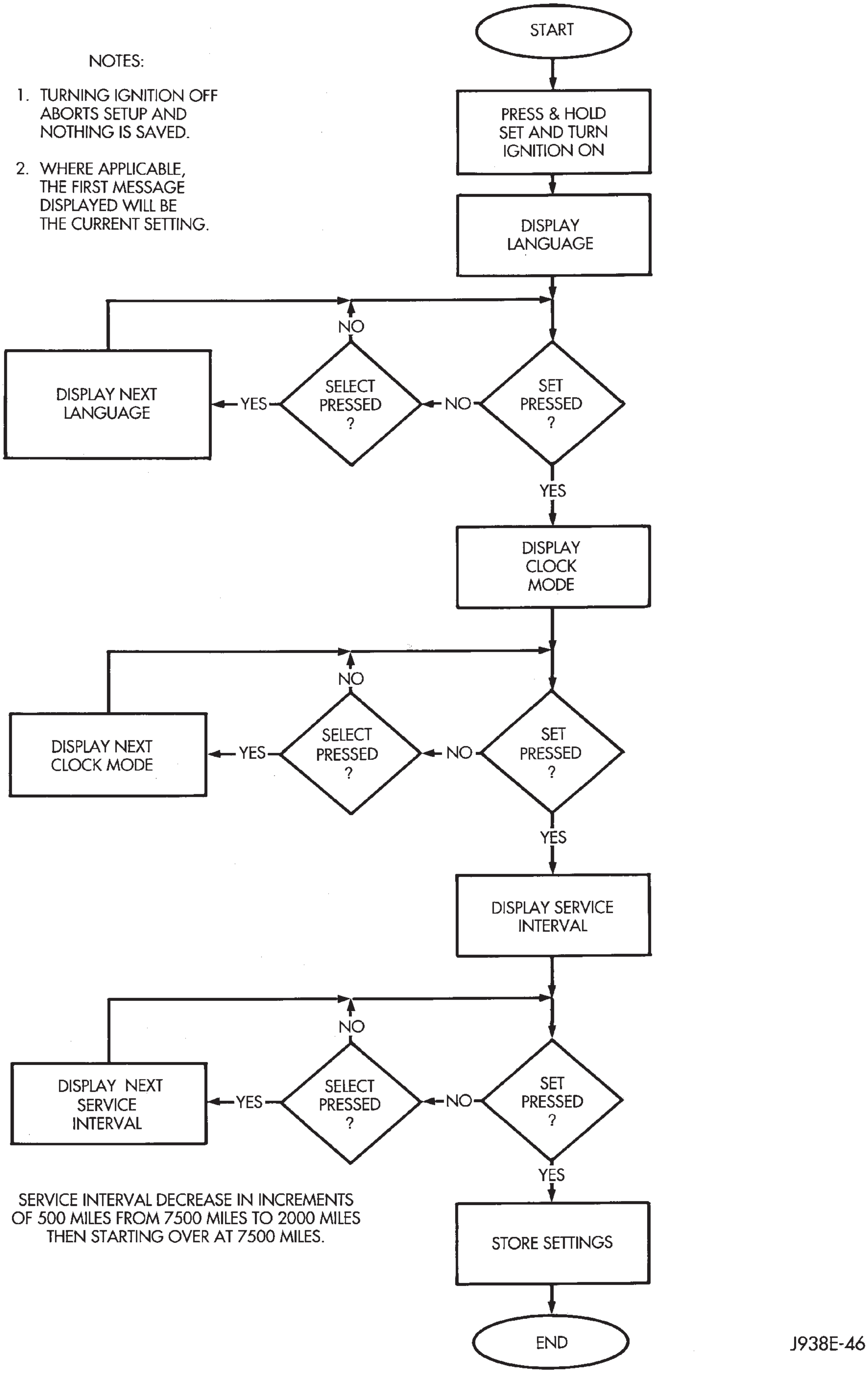
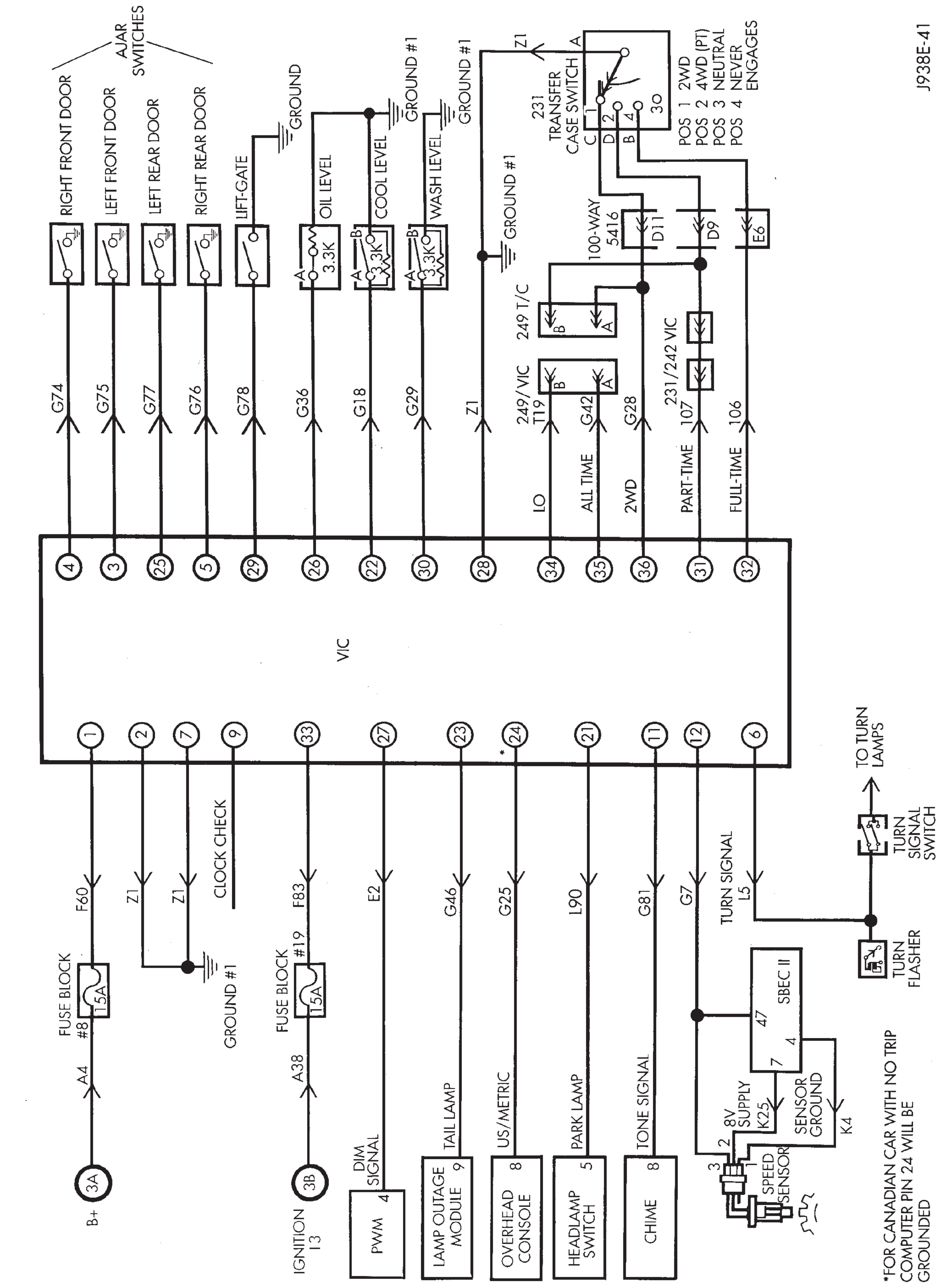
VIC INITIAL SETUP CHART





VIC SYSTEM SCHEMATIC

SERVICE PROCEDURES

(1) Disconnect negative cable from the battery.

(2) Remove ash tray.

(3) Remove 6 screws holding center cluster bezel (Fig. 1).

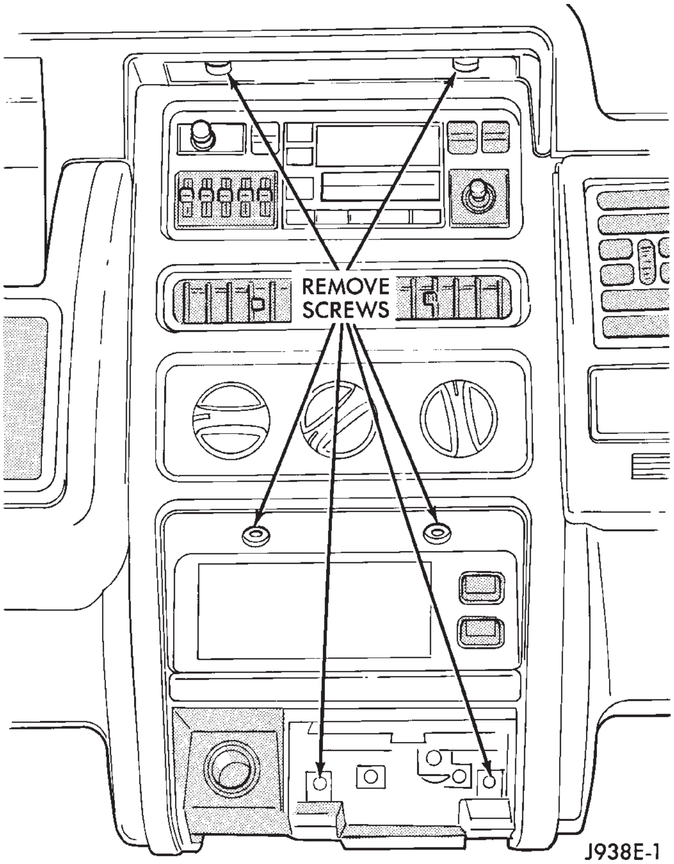


Fig. 1 Remove Center Bezel Retaining Screws

(4) Remove center bezel.

(5) Remove 3 screws holding VIC (Fig. 2).

(6) Pull module out far enough to unplug connector. Remove module.

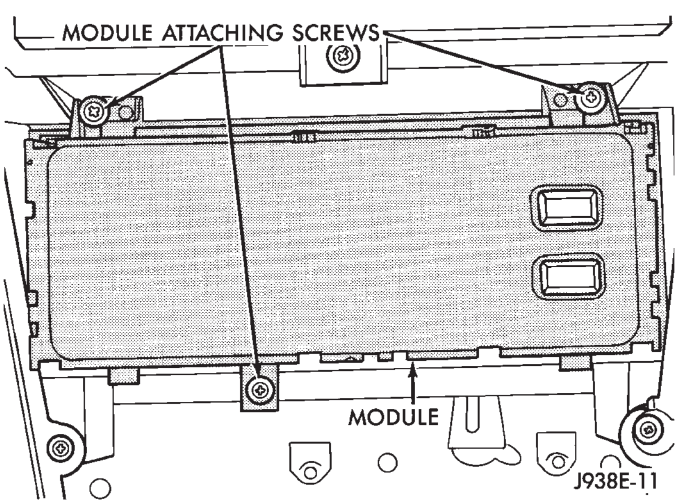


Fig. 2 Module Attaching Screws

ENGINE OIL LEVEL SENSOR

CAUTION: If the oil pan is being replaced, do NOT reuse the original engine oil sensor. Install a new sensor. The washer may not seal and is not serviced.

(1) Raise vehicle on hoist and drain engine oil.

CAUTION: Do not break connector locking tab. The tab is needed to maintain circuit continuity. This is a 0.75 milliamp circuit.

(2) Using a thin flat blade screwdriver or equivalent, release connector locking tab.

(3) Remove sensor from engine oil pan (Fig. 3) and discard.

(4) Install new sensor into oil pan. Torque to 41 N●m (30 ft. lbs.).

(5) Attach sensor connector.

(6) Lower vehicle and fill with specified amount of oil.

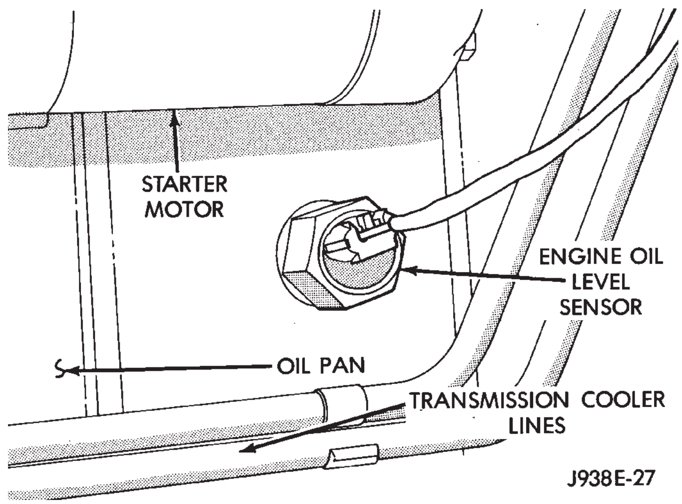
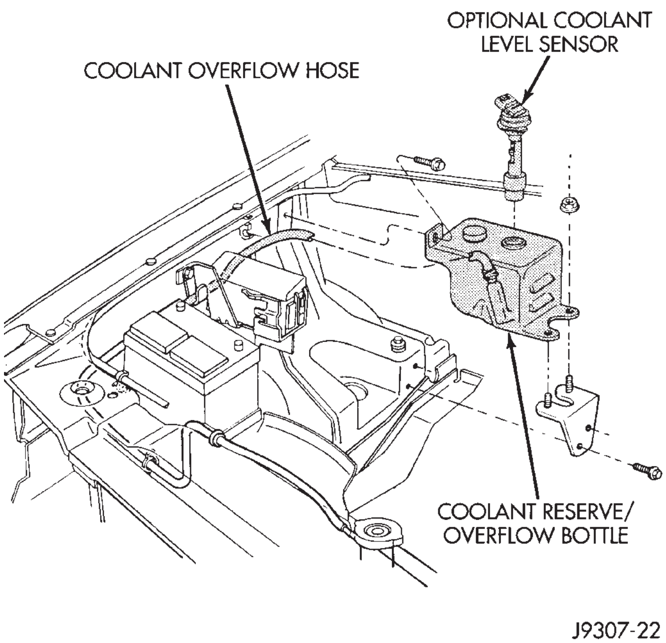
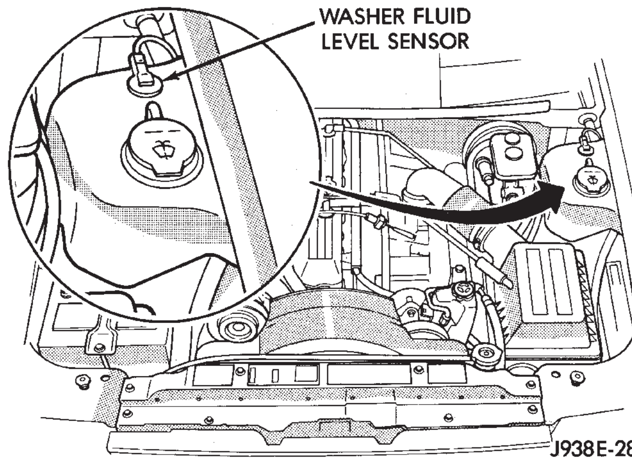


Fig. 3 Engine Oil Level Sensor

COOLANT LEVEL SENSOR

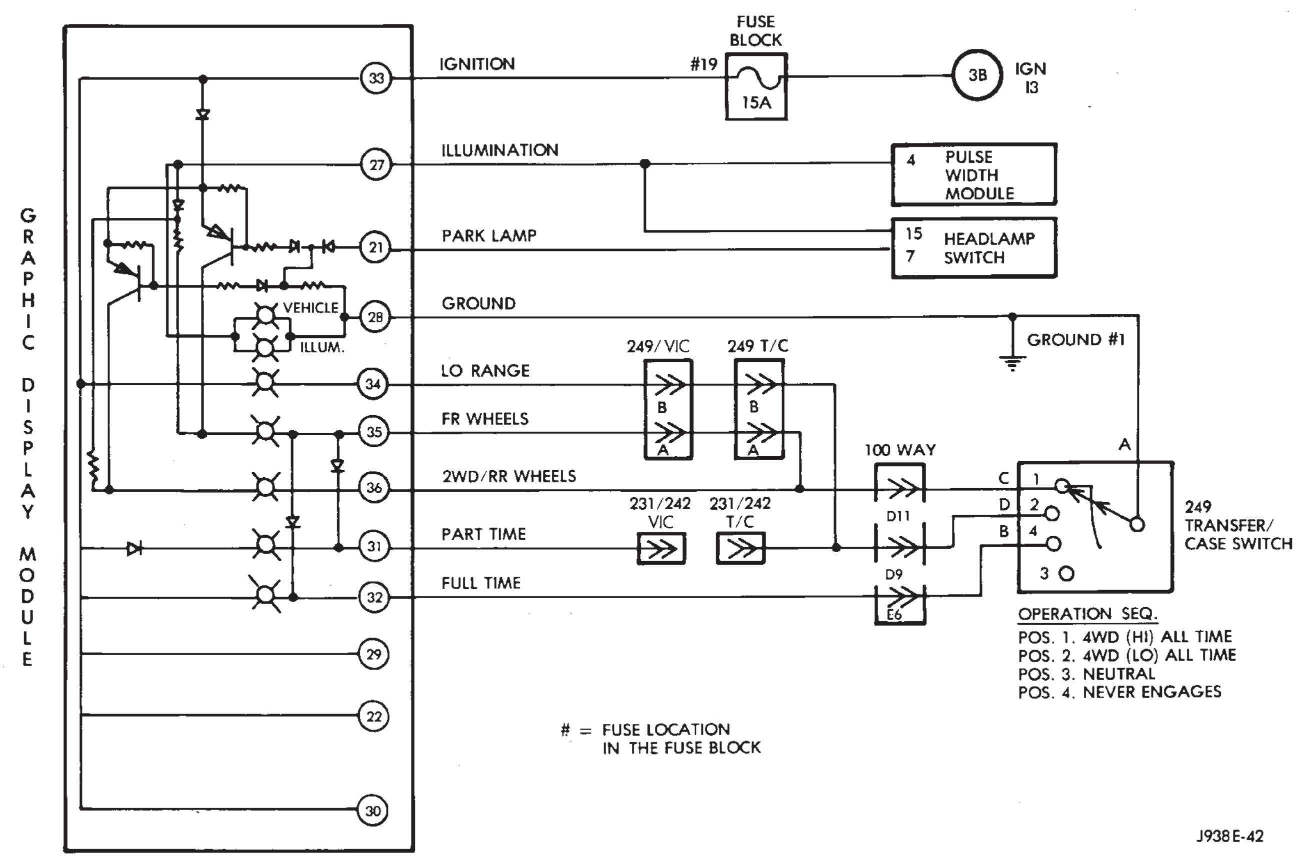


WASHER FLUID LEVEL SENSOR

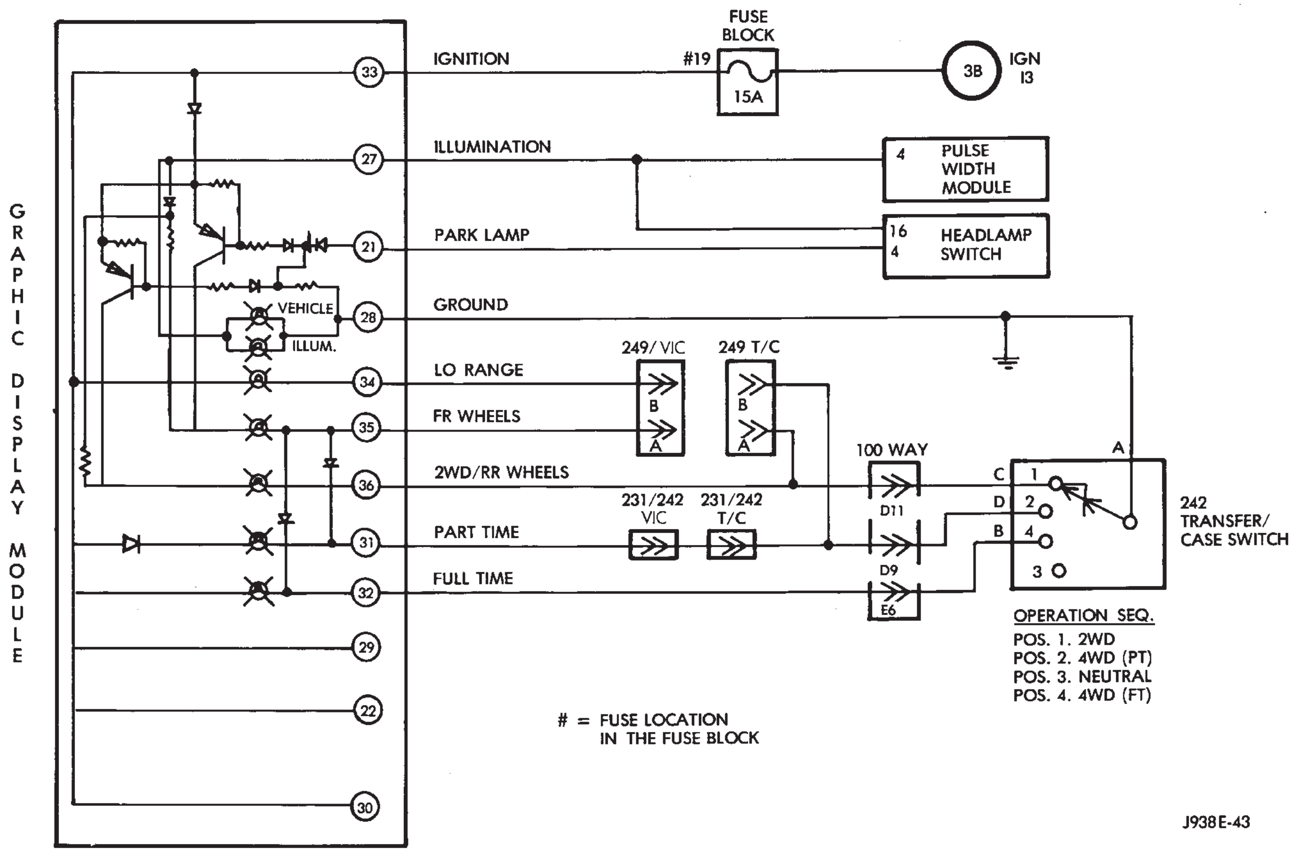


GRAPHIC DISPLAY MODULE

WIRING SCHEMATIC—249 TRANSFER CASE



WIRING SCHEMATIC—242 TRANSFER CASE



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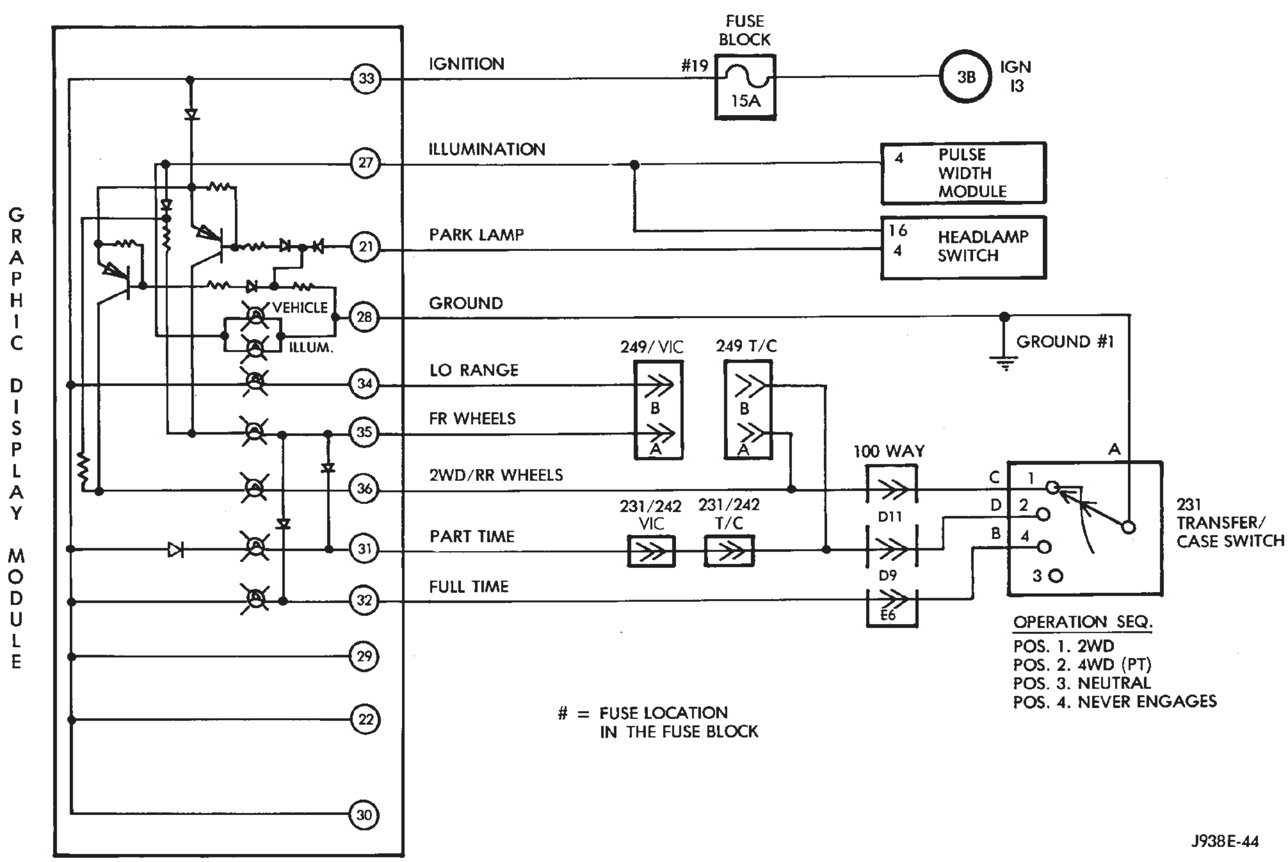
WIRING SCHEMATIC—231 TRANSFER CASE



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DIAGNOSIS

If part of the module will not light or is not operating properly, use the schematics and Group 8 - Wiring Diagrams to check for continuity to the appropriate device. If there is continuity and the sending device is operating properly replace the Graphic Display Module.

SERVICE PROCEDURES

(1) Disconnect negative cable from the battery.

(2) Remove ash tray.

(3) Remove 6 screws holding center cluster bezel (Fig. 1).

(4) Remove center bezel.

(5) Remove 3 screws holding GDM (Fig. 2).

(6) Pull module out far enough to unplug connector. Remove module.

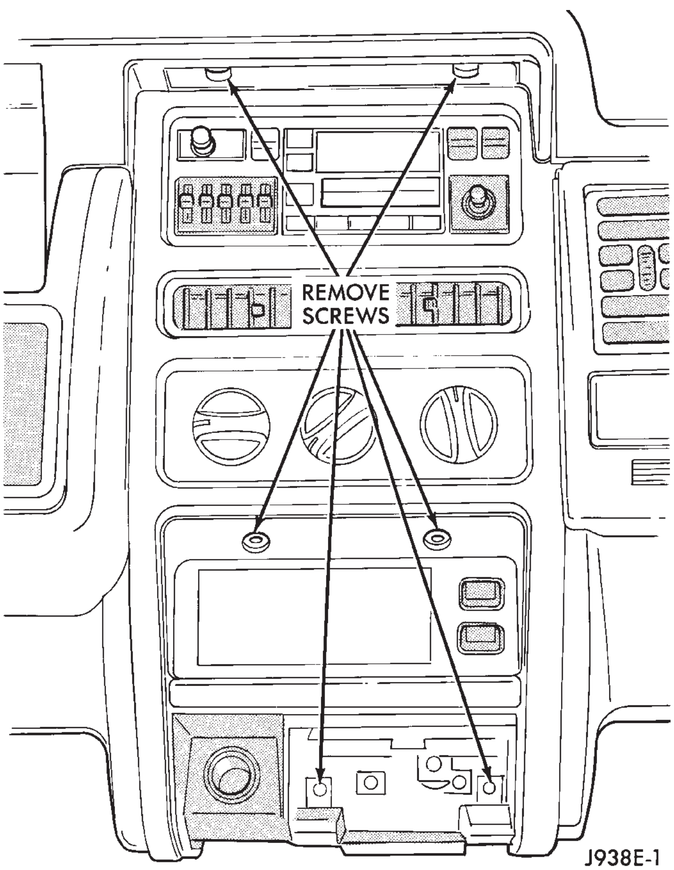


Fig. 1 Remove Center Bezel Retaining Screws

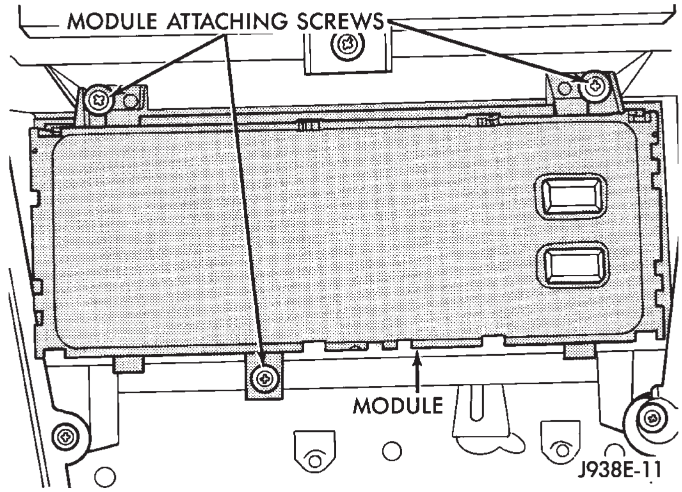


Fig. 2 Module Attaching Screws

INSTRUMENT PANEL SERVICE PROCEDURES

SWITCH POD REPLACEMENT

(1) Disconnect negative cable from the battery.

(2) Remove ash tray.

(3) Remove 6 screws holding center cluster bezel (Fig. 1).

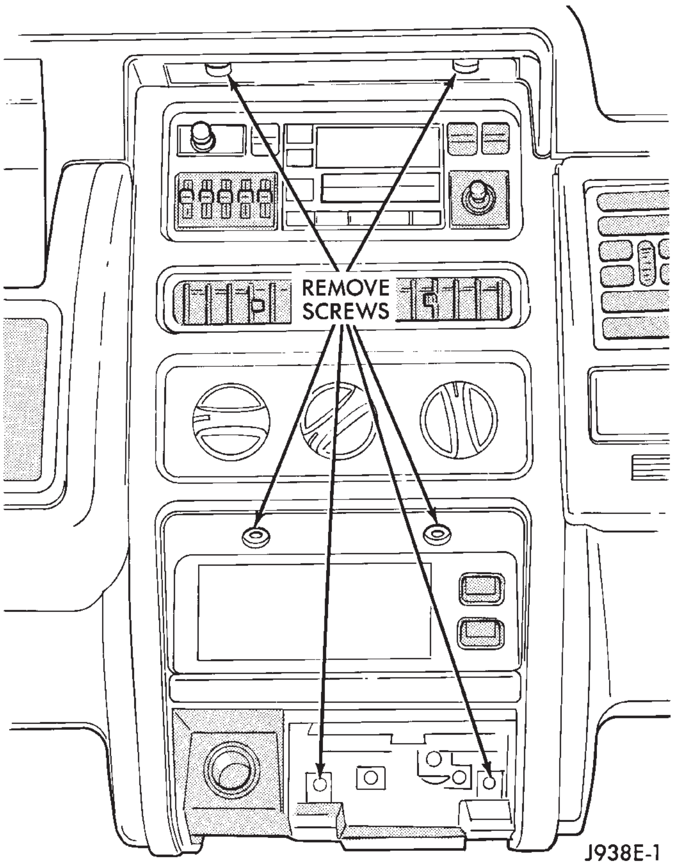


Fig. 1 Remove Center Bezel Retaining Screws

(4) Remove center bezel.

(5) Remove 2 screws holding dash pad located behind top of center bezel.

(6) Gently pry defroster grille out of dash pad.

(7) Unplug sensors (if equipped) and set defroster grille aside.

(8) Remove 4 screws in defroster duct opening holding dash pad (Fig. 2).

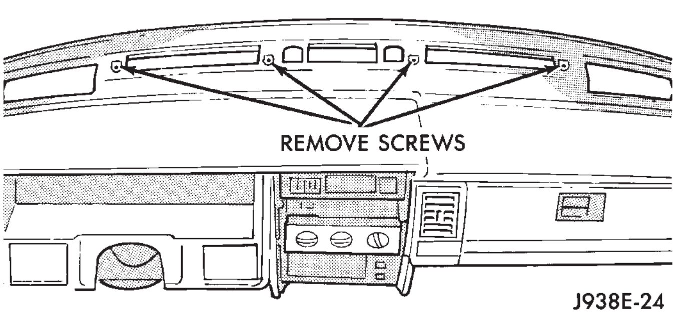


Fig. 2 Upper Dash Pad Attaching Screws

(9) Remove 3 screws above instrument panel cluster holding dash pad (Fig. 3).

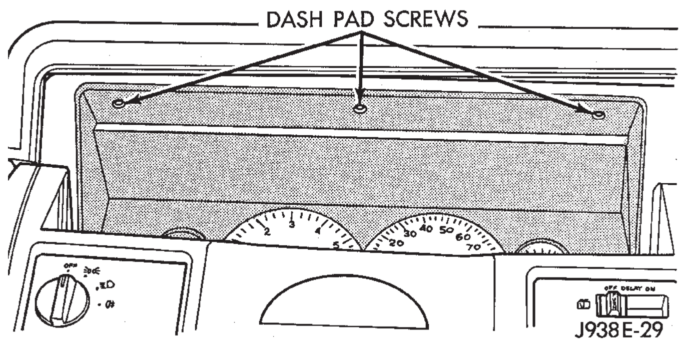


Fig. 3 Remove Screws Holding Dash Pad

(10) Open glove box and remove 2 screws holding dash pad.

(11) Remove dash pad pulling up to unsnap end clips.

(12) With driver's door open remove 1 screw from the side of the lower trim panel (Fig. 4).

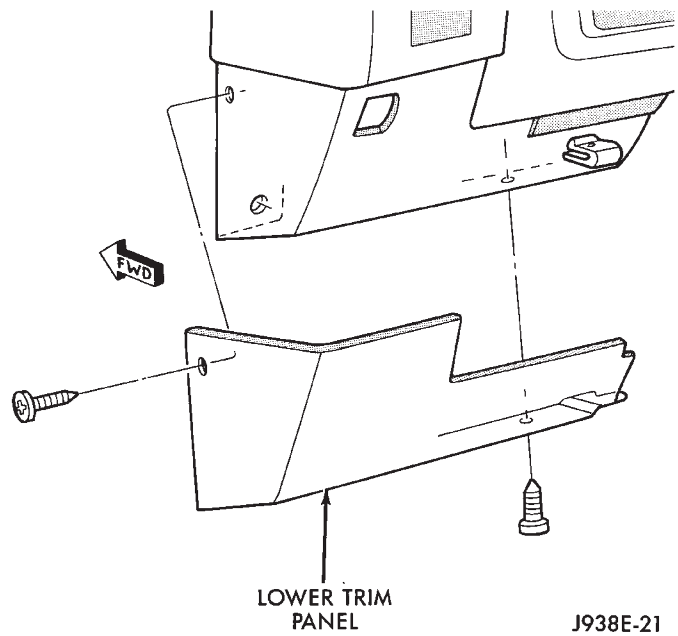


Fig. 4 Lower Trim Panel

(13) Remove 4 screws holding the steering column cover (Fig. 5).

(14) Remove 1 screw from bottom of lower trim panel and pull panel off. There is also a clip holding the panel to the instrument panel.

(15) Remove 6 screws holding knee blocker.

(16) Remove steering column retaining nuts.

(17) Remove 3 screws holding bottom of bezels (Fig. 6).

(18) Remove 2 screws holding top of end and switch pod bezels (Fig. 7). The end bezel can now be removed.

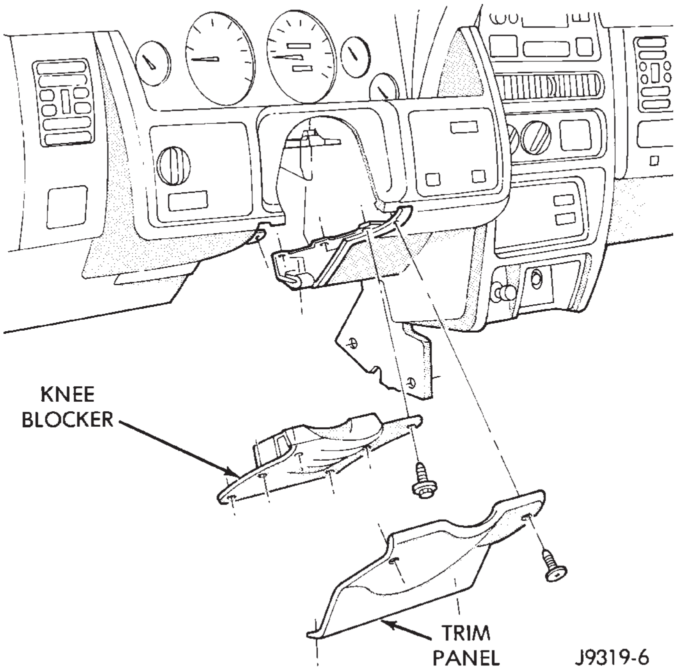


Fig. 5 Steering Column Cover and Knee Blocker

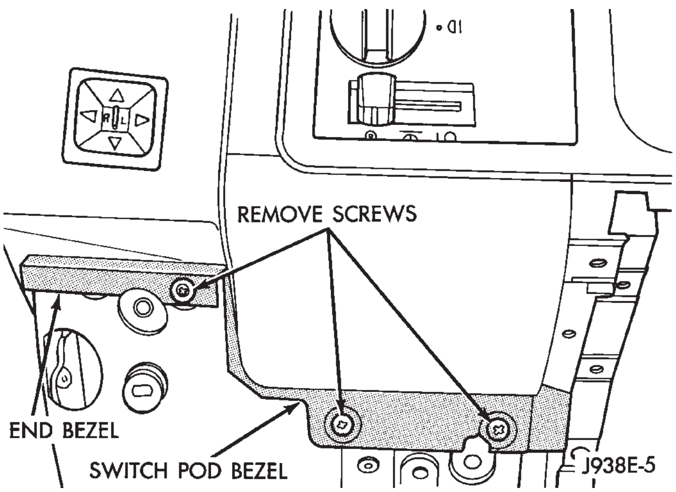


Fig. 6 Remove Screws Holding Bottom Of Bezels

(19) Remove 2 screws holding left side of switch pod bezel (Fig. 8).

(20) Remove 3 screws holding right hand side of switch pod bezel (Fig. 9).

(21) Pull switch pod bezel out far enough to remove switch connectors. Disconnect connectors from each switch pod and remove bezel (Fig. 10).

(22) Remove required switch attaching screws and switch.

(23) Reverse the removal procedures to install a new switch. Tighten steering column retaining nuts to 105 in. lbs.

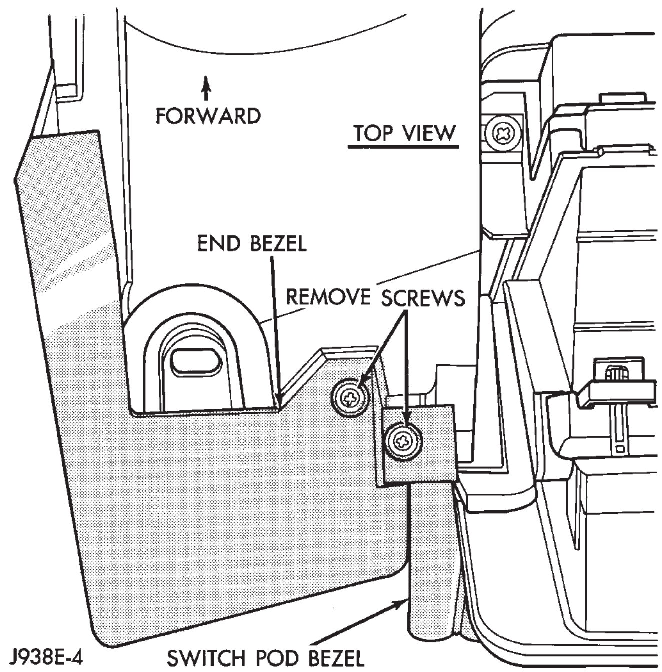


Fig. 7 Remove Screws Holding Top Of Bezels

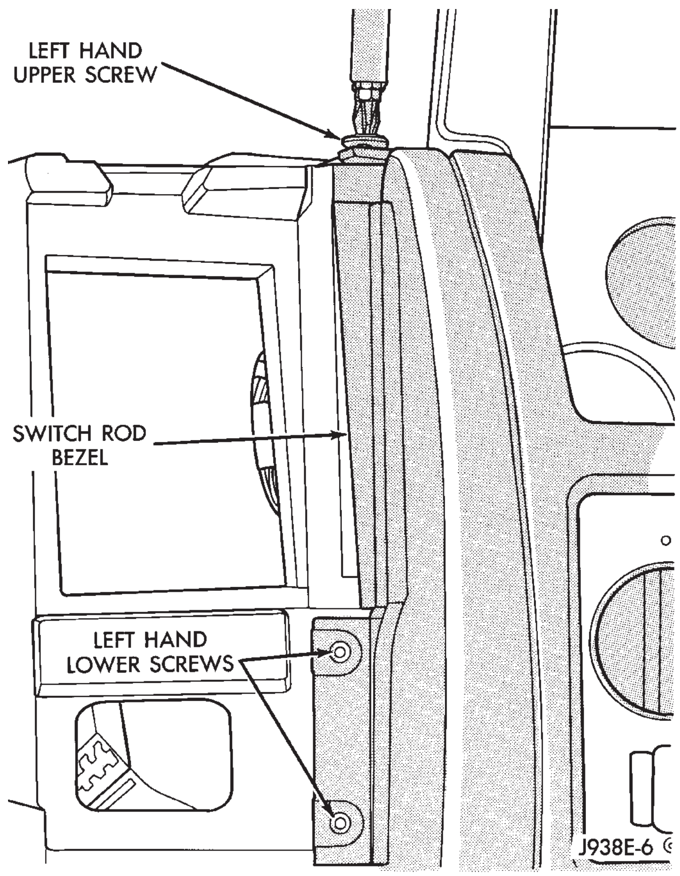


Fig. 8 Left Hand Switch Pod Bezel Screws

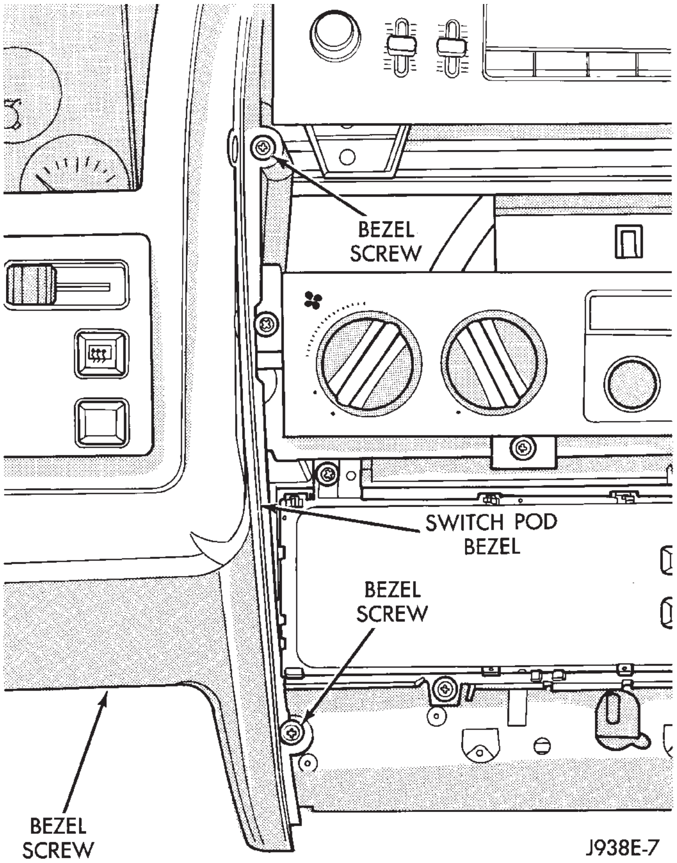


Fig. 9 Right Hand Switch Pod Bezel Screws

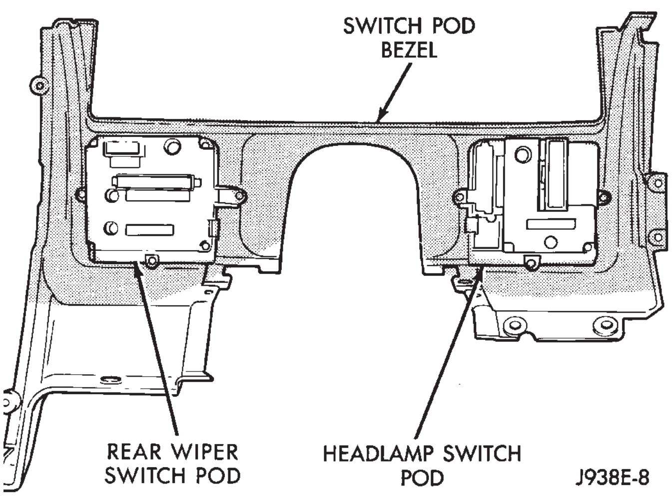


Fig. 10 Rear View of Switch Pod Bezel

LEFT HAND POD

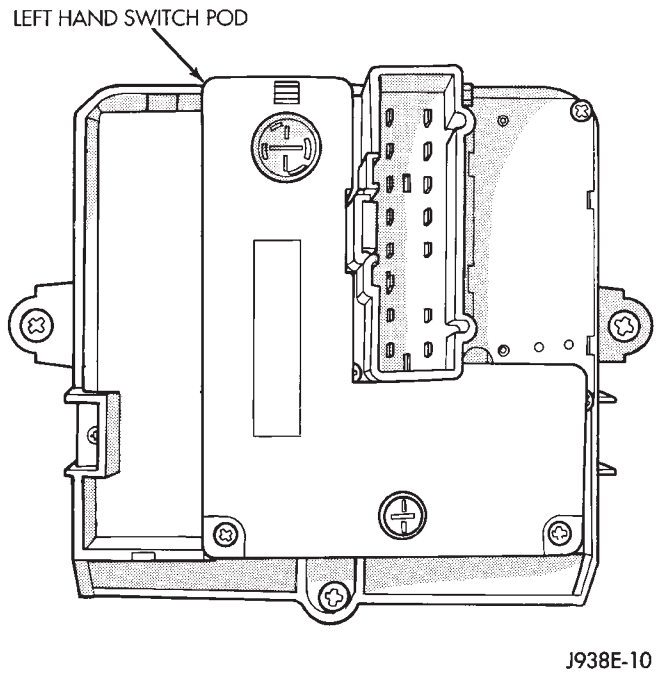


Fig. 11 Rear View of Left Hand Switch Pod

RIGHT HAND POD

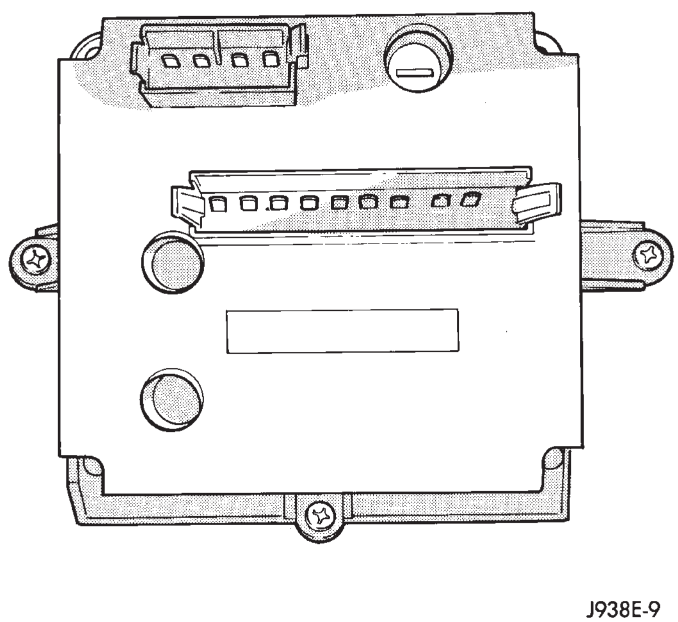


Fig. 12 Rear View of Right Hand Switch Pod

AUDIO SYSTEMS

CONTENTS

GENERAL INFORMATION

DESCRIPTION

For operation of the factory installed radios refer to the Owners Manual supplied with the vehicle.

All radios receive IGN feed from the 10 amp #10 RADIO fuse.

All vehicles are equipped with an Ignition-Off Draw (IOD) fuse which is used when the vehicles are originally shipped from the factory. This fuse #F1, which is located in the Power Distribution Center, helps to prevent battery discharge during storage. For specific location refer to Group 8W - Wiring Diagrams.

The IOD fuse includes the radio memory circuitry and should be checked if the memory (time or radio station programming) is inoperative.

The radio is connected to fuse #8 in order to retain the radio's memory when the ignition switch is turned to OFF.

The electronically tuned (ETR) radio is self compensating. A radio trimmer adjustment is not required.

INTERFERENCE ELIMINATION

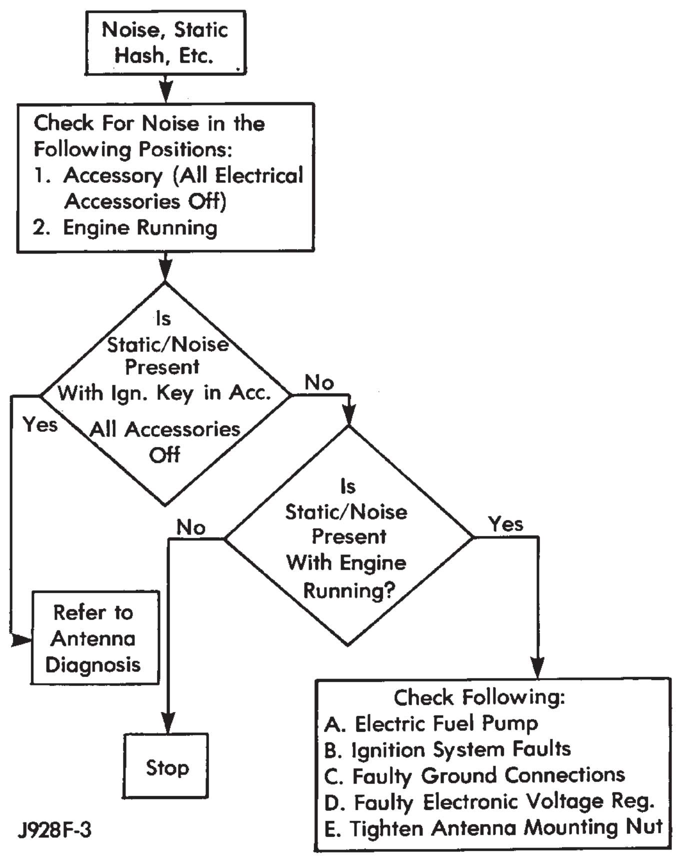
A number of components are used on vehicles equipped with a radio, to suppress radio frequency interference (static).

Capacitors are mounted in the generator and power mirror motors.

Radio resistance type spark plugs in the high tension circuit of the ignition system complete the interference suppression.

If radio noises are evident, isolate circuits with capacitors to be sure they are the cause. Faulty or deteriorated spark plug wires should be replaced.

RADIO NOISE DIAGNOSIS



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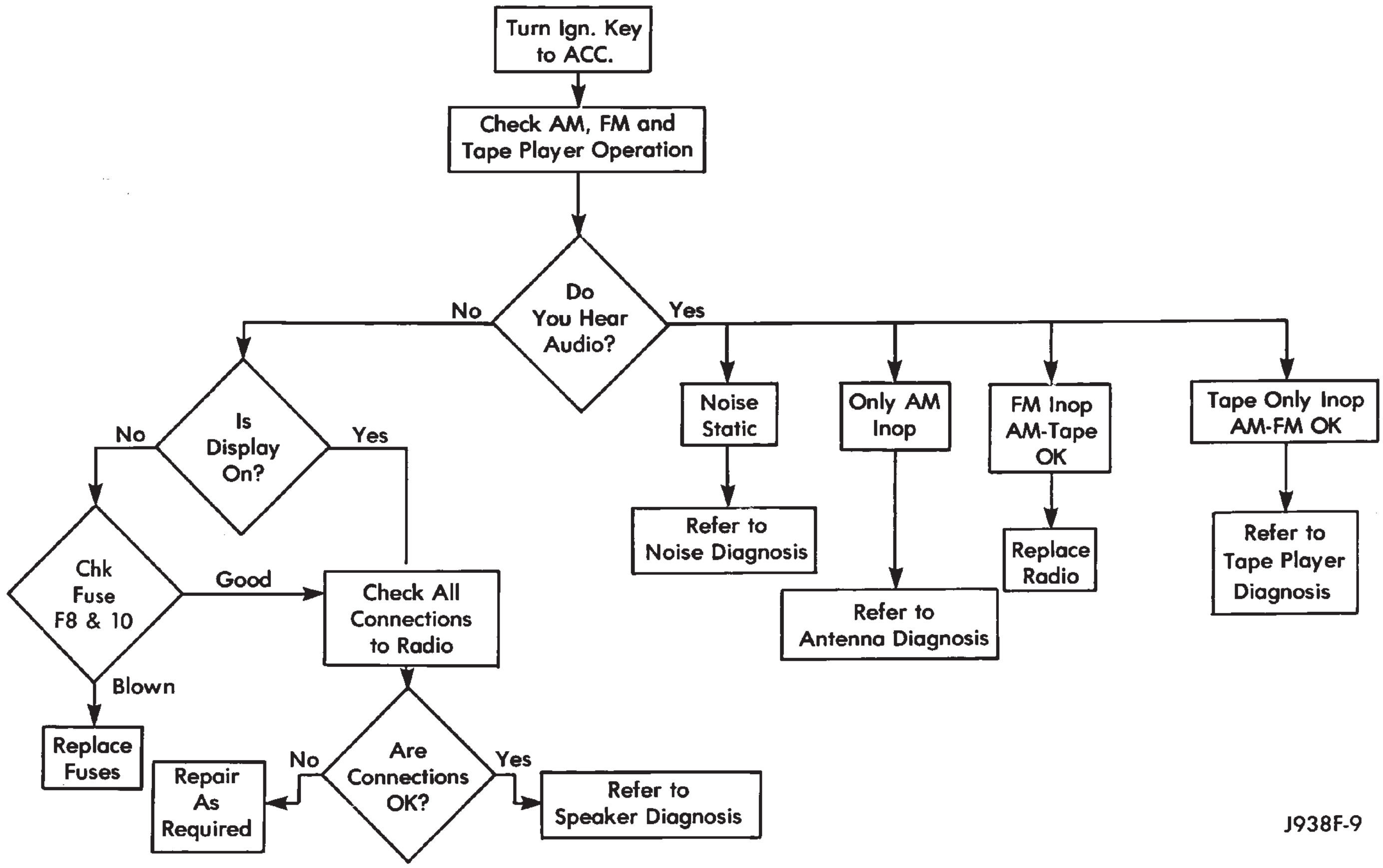
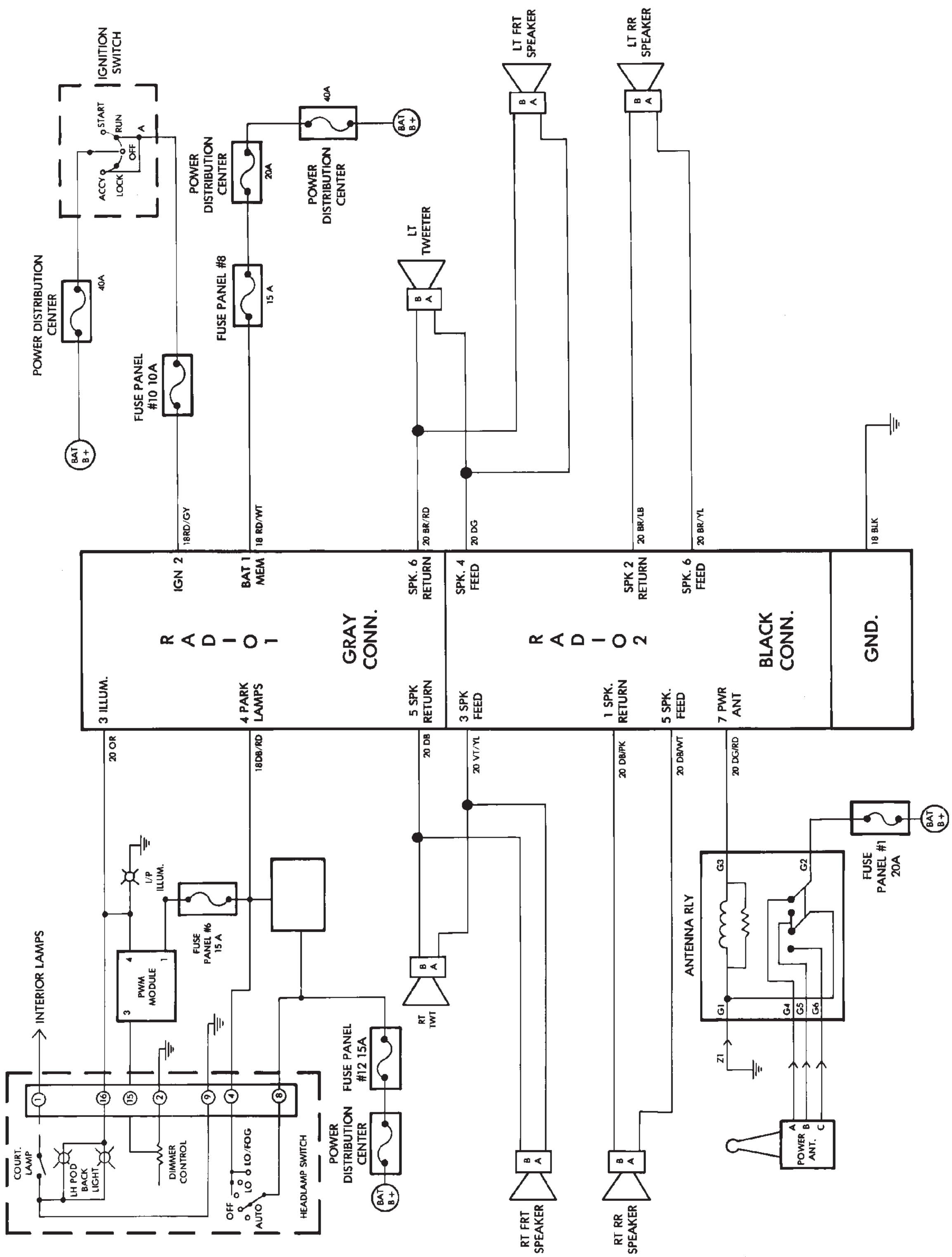
TEST PROCEDURES

RADIO DIAGNOSIS

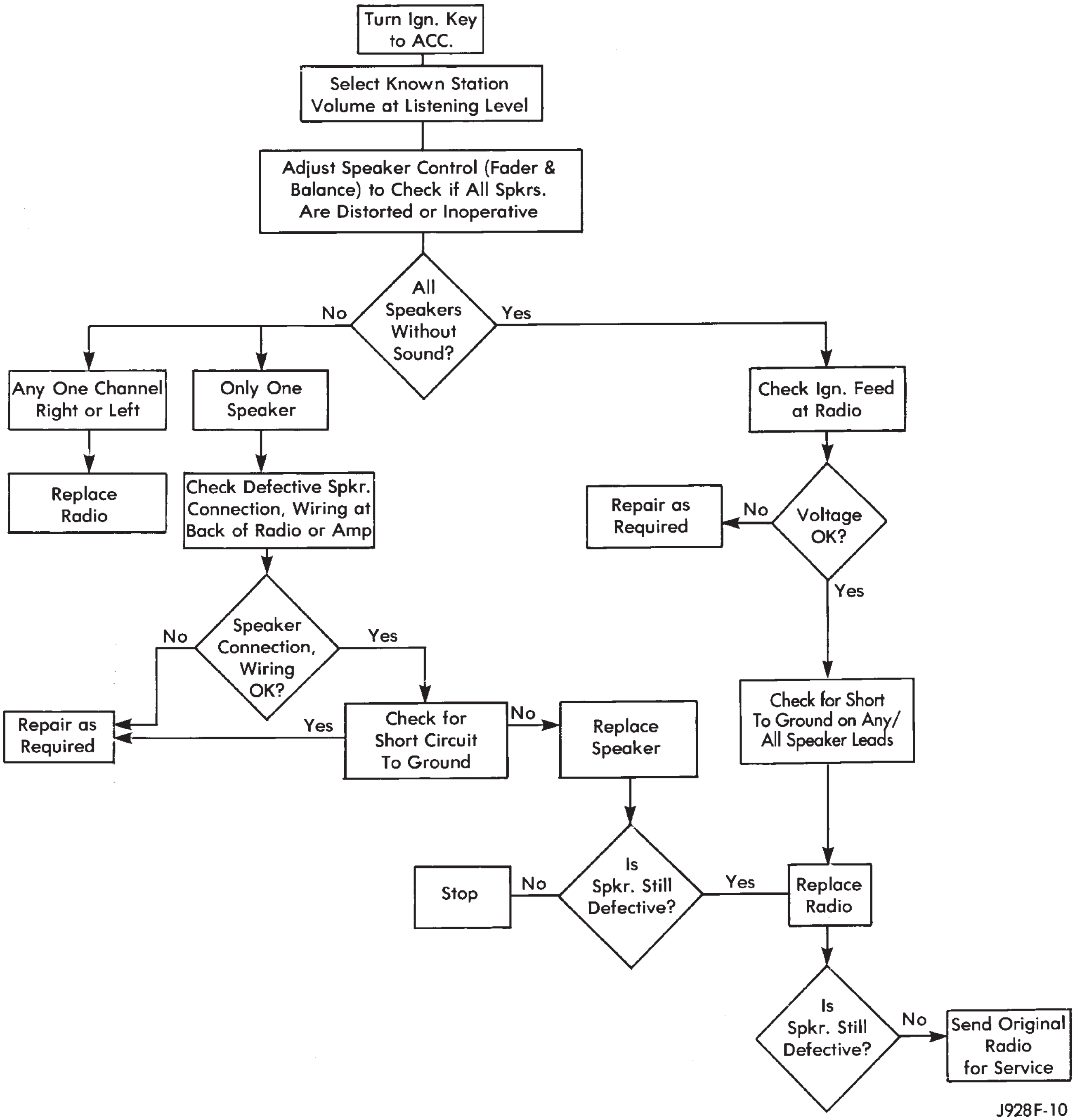


RADIO SCHEMATIC

J938F-10



SPEAKER DIAGNOSIS



J928F-10

AM/FM/STEREO—STEREO CASSETTE

Short Circuits

On some radios, if a speaker wire is shorted the audio output will automatically shut down. Turn fader and balance controls to mid position and volume at mid position. If display operates and there is no volume from any speaker proceed to the Short test.

Short Circuit Test

(1) Turn radio on to mid volume.

(2) Move balance and fader control to Left Front, Right Front, Right Rear, and Left Rear. If sound is heard from any speaker during any of these positions there is a short in one of the speaker feed wires.

(a) If front speakers have normal sound; one rear speaker has low sound and the other has no sound, then the speaker with low sound has a short in its feed line. Check wires to BLACK connector pins 5 and 6 for shorts to vehicle chassis.

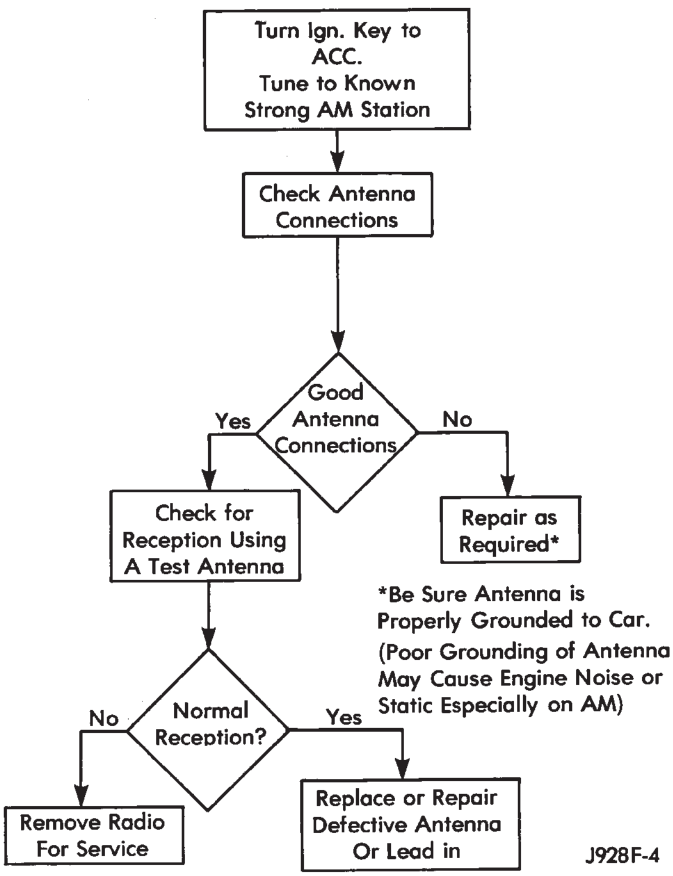
(b) If rear speakers have normal sound; one front speaker has low sound and the other has no sound, then the speaker with low sound has a short in its feed line. Check wires to BLACK connector pins 3 and 4 for shorts to vehicle chassis.

(3) If no sound is heard while adjusting the balance and fader controls there still may be a short in one of the 4 speaker return lines. Check speaker wires connected to GRAY connector pins 5 and 6 for shorts to vehicle chassis.

(4) If all the tests show no problem, replace radio.

ANTENNA TESTING

ANTENNA DIAGNOSIS



Antenna performance may be tested by substituting a known good antenna. Check short or open circuits with an ohmmeter or continuity light once the antenna cable is disconnected from the radio as follows:

(1) Continuity should be observed between the tip of the mast and radio end pin (Fig. 1).

(2) No continuity or a very high resistance of several megohms should be observed between the ground shell of the connector and radio end pin.

(3) Continuity should be observed between the ground shell of the connector and the mounting hardware on the fender.

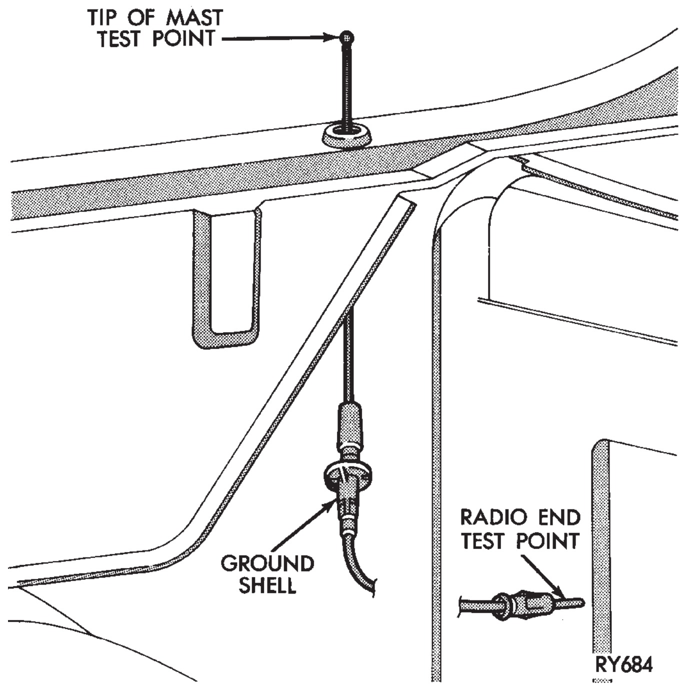
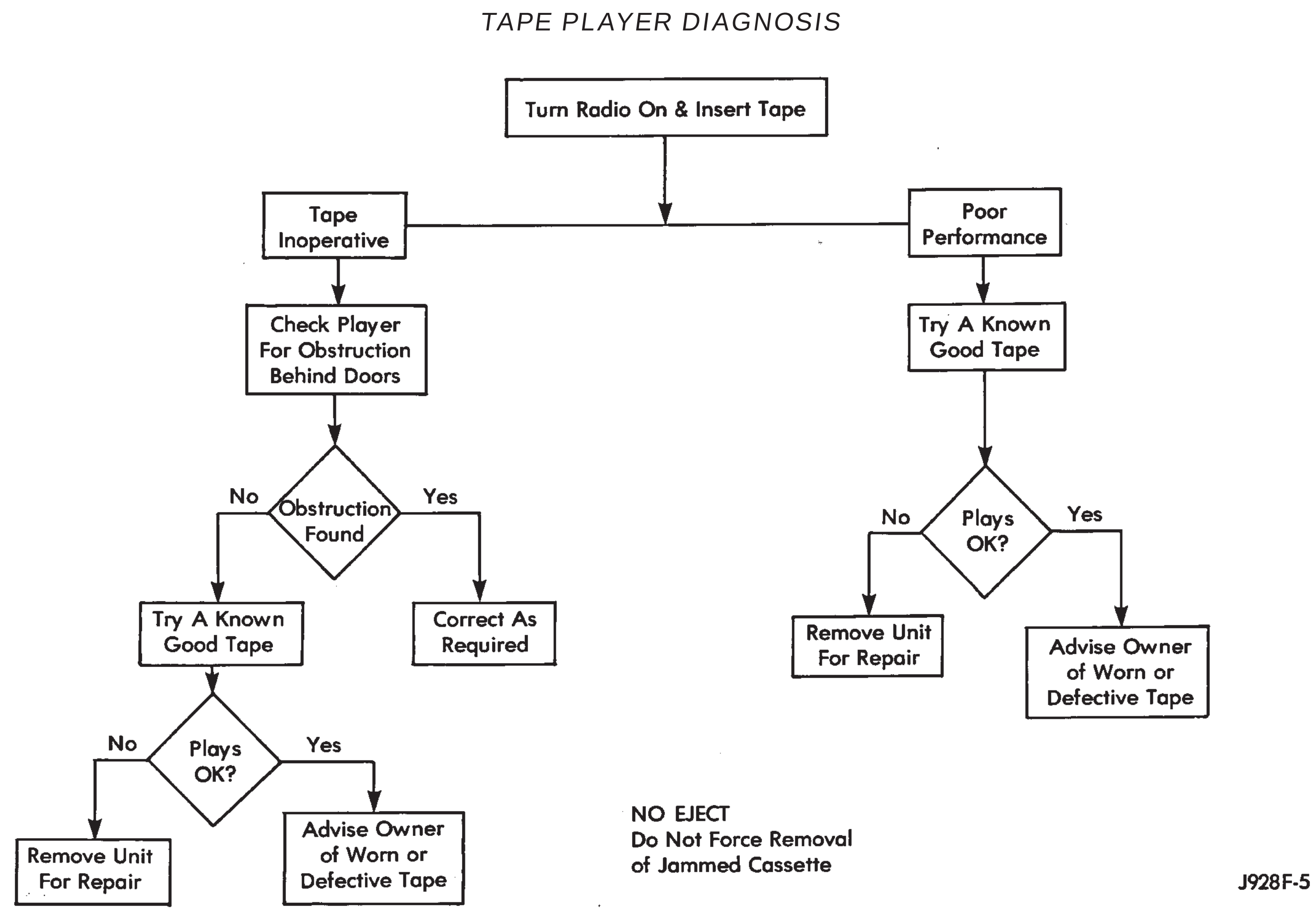


Fig. 1 Antenna Test Points

CASSETTE TAPE PLAYER DIAGNOSIS



COMPACT DISC PLAYER DIAGNOSIS

WARNING: USE OF THE CONTROLS, ADJUSTMENTS, OR SERVICE PROCEDURES NOT SPECIFIED HERE OR IN THE OWNER MANUAL MAY RESULT IN HAZARDOUS RADIATION EXPOSURE. REPAIR PROCEDURES SHOULD ONLY BE PERFORMED BY A TRAINED TECHNICIAN.

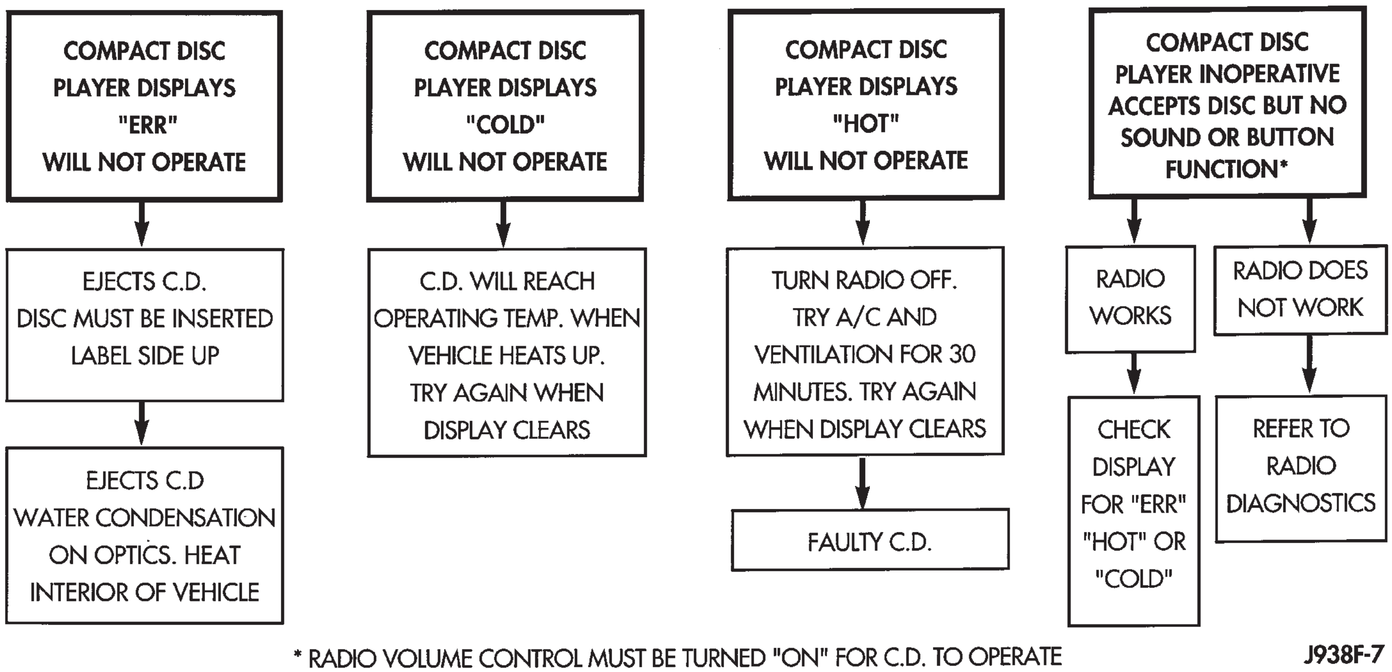
The CD player may eject the disc with a display of “ERR” under the following conditions:

- The surface of the disc is dirty or wet (moisture).
- The disc was inserted with the label side facing down.
- Damaged disc.
- Water condensation.
- The disc is defective.
- The CD player may skip or mute while playing a disc under severe vibration conditions, example: pot holes, railroad tracks.
- The CD player may skip or mute while playing due to dirt or skin oils on disc.
- If the CD player becomes too hot. At temperatures above 60°C (140°F) the CD player will shut down with a display of HOT until it cools down. Refer to the Compact Disc Player diagnosis chart.

COMPACT DISC PLAYER REPLACEMENT

The compact disc player is part of the radio. Perform Radio Replacement in this group.

COMPACT DISC PLAYER DIAGNOSIS



SERVICE PROCEDURES

RADIO REPLACEMENT

(1) Disconnect negative cable from the battery.

(2) Remove ash tray.

(3) Remove 6 screws holding center cluster bezel (Fig. 1).

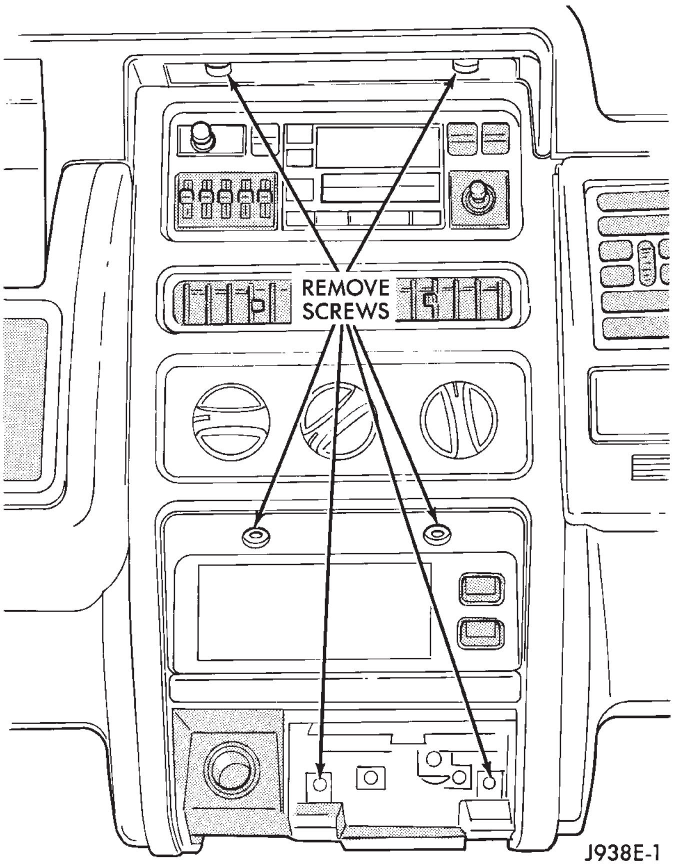


Fig. 1 Remove Center Bezel Retaining Screws

(4) Remove center bezel.

(5) Remove 2 screws from radio (Fig. 2).

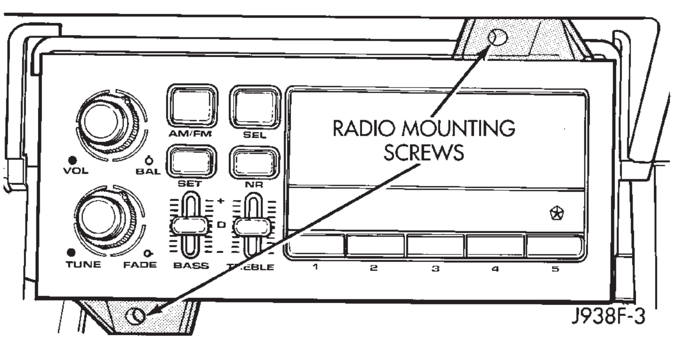


Fig. 2 Radio Removal

(6) Pull radio out far enough to gain access to the ground terminal on the rear of the radio.

(7) Remove ground clip from terminal on rear of radio and remove radio.

DOOR MOUNTED SPEAKERS

(1) Remove screw from demister opening at front of door (front door).

(2) Remove screw at top of trim panel near mirror (Fig. 3).

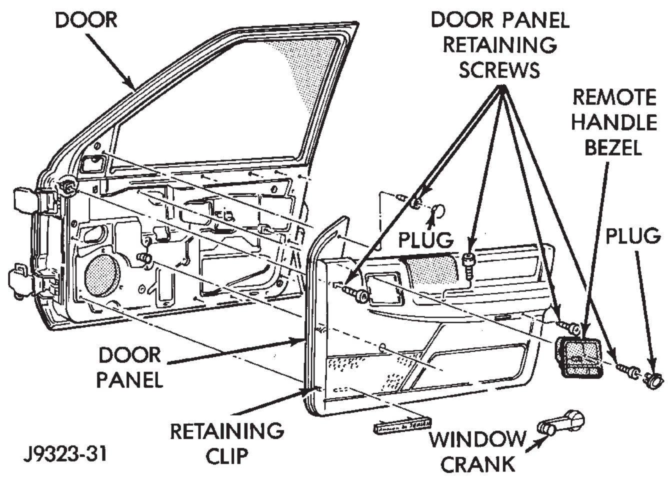


Fig. 3 Door Panel Removal

(3) Remove screw and door handle cover.

(4) Remove screw from under armrest.

(5) Remove screw from bottom of hand hold in armrest.

(6) 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.

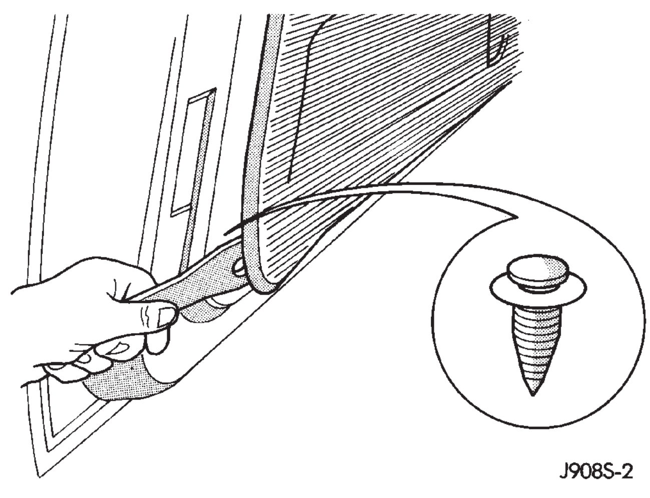


Fig. 4 Trim Panel Removal

(7) Remove screws holding speaker in door.

(8) Pull speaker out far enough to unplug connector.

(9) Install a new speaker.

(10) Install door trim panel by reversing the removal procedures.

INSTRUMENT PANEL MOUNTED TWEETERS

(1) Disconnect negative cable from the battery.

(2) Remove ash tray.

(3) Remove 6 screws holding center cluster bezel (Fig. 5).

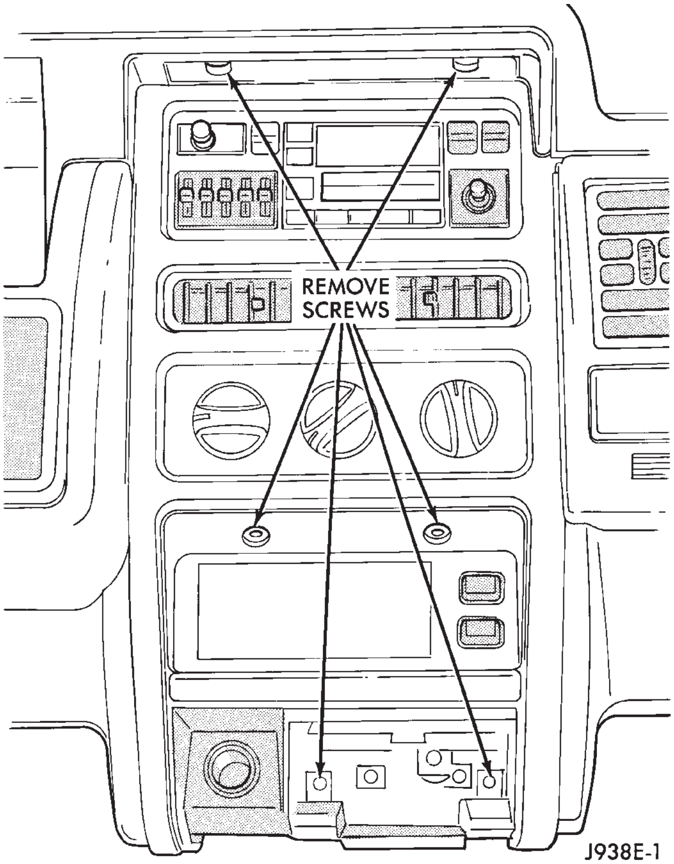


Fig. 5 Remove Center Bezel Upper Screws

(4) Remove center bezel.

(5) Remove 2 screws holding dash pad located behind top of center bezel.

(6) Gently pry defroster grille out of dash pad.

(7) Unplug sensors (if equipped) and set defroster grille aside.

(8) Remove 4 screws in defroster duct opening holding dash pad (Fig. 6).

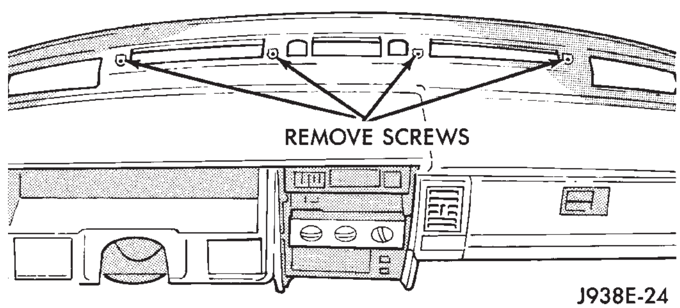


Fig. 6 Upper Dash Pad Attaching Screws

(9) Remove 3 screws above instrument panel cluster holding dash pad (Fig. 7).

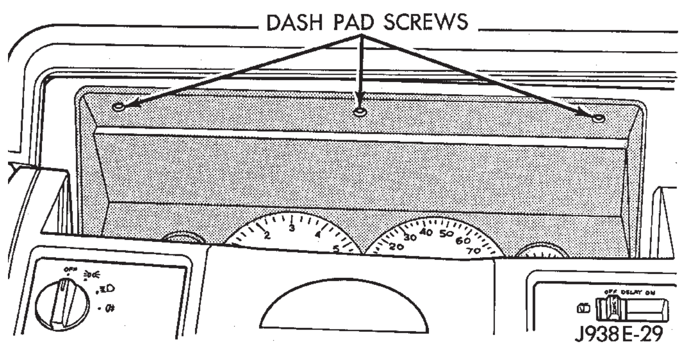


Fig. 7 Remove Screws Holding Dash Pad

(10) Open glove box and remove 2 screws holding dash pad.

(11) Remove dash pad.

(12) Remove 2 screws holding tweeter (Fig. 8).

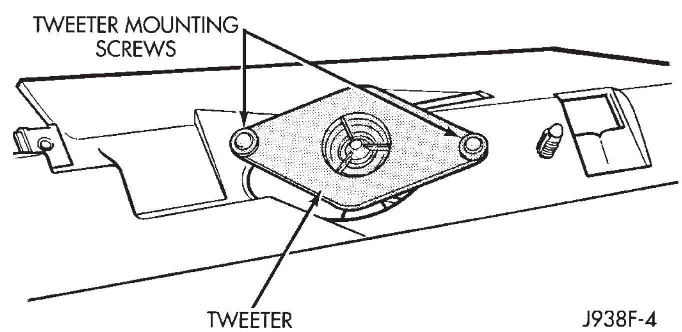


Fig. 8 Tweeter Removal

(13) Unplug tweeter connection and remove tweeter.

STANDARD RADIO ANTENNA

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 co-axial 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

(1) Remove the fender inner splash panel to gain access to the antenna base and cable.
(2) Remove the antenna mast, cap nut and escutcheon from the top of the fender (Fig. 1).
(3) Remove the passenger side kick panel.
(4) Disconnect the antenna lead (Fig. 2) by pulling apart while twisting the metal connectors. DO NOT PULL ON THE COAX CABLE.
(5) Pull the rubber grommet out of the kick panel.
(6) Remove the antenna assembly from the inside of the wheel well.
(7) To install the antenna, reverse the removal procedure.
(8) Verify antenna and radio operation.

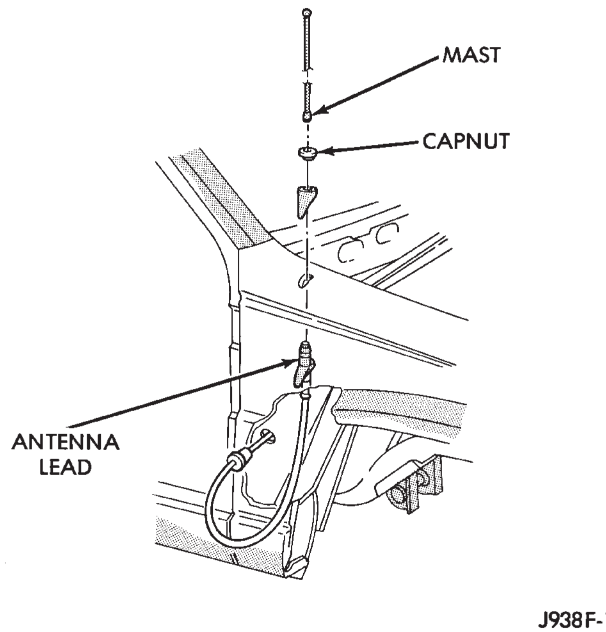


Fig. 1 Remove/Install Nut and Escutcheon

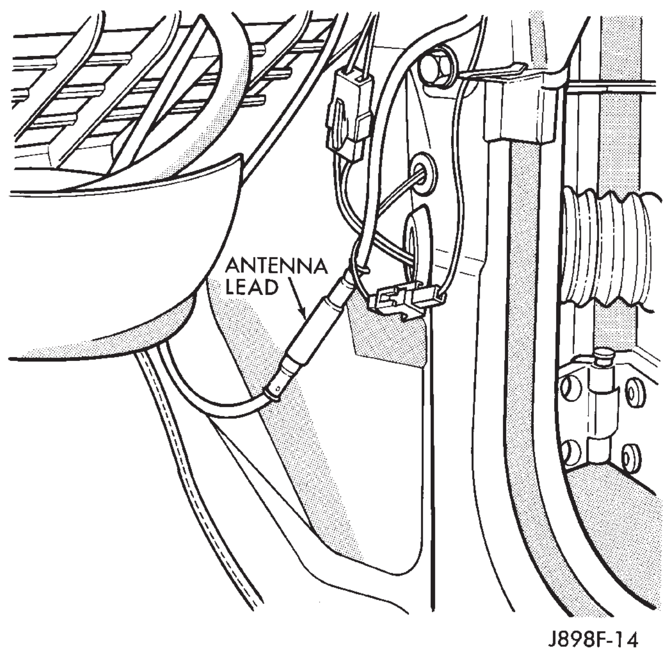


Fig. 2 Disconnect Antenna Lead—Typical

POWER RADIO ANTENNA

GENERAL INFORMATION

The power antenna is designed to raise automatically when both the ignition switch and the radio are turned ON. When the ignition is turned ON and the radio is turned OFF, the antenna will return to, or remain in, the retracted position.

The power antenna is a telescoping type antenna, extended and retracted by a reversible electric motor.

The antenna is controlled by a combination of an external relay and two limit switches that are built into the antenna motor housing. There is a gear-operated cam system to activate the switches. The limit switches are used to open the motor circuits when the antenna mast reaches the full UP position.

The antenna cannot be adjusted to an intermediate position. It must be fully extended or retracted.

When the radio or ignition is turned OFF, the relay coil is de-energized. With the coil de-energized battery voltage switches to the motor through the closed lower limit switch. The antenna then retracts until the lower limit switch opens.

DESCRIPTION

When the radio is turned ON battery voltage is applied to the antenna relay coil pin 3. The antenna relay contacts close, and battery voltage is applied from the Power Antenna/Trailer Tow fuse #1 to the relay contacts to pin 4; and then to the antenna motor. The other motor pin is grounded through the up switch and the relay contacts. The motor drives the antenna up. At the end of its travel the up switch opens and the motor stops.

When the radio or ignition is turned OFF, the circuit through the power antenna relay coil relay is opened. The contacts open applying battery voltage to pin 5. Pin 4 is now grounded. The voltage to the motor has reversed polarity. At the end of its travel the down switch opens and the motor stops.

REPLACEMENT

(1) Remove the fender inner splash panel to gain access to the antenna mounting screws.

(2) Remove the cap nut and escutcheon from the top of the fender (Fig. 1).

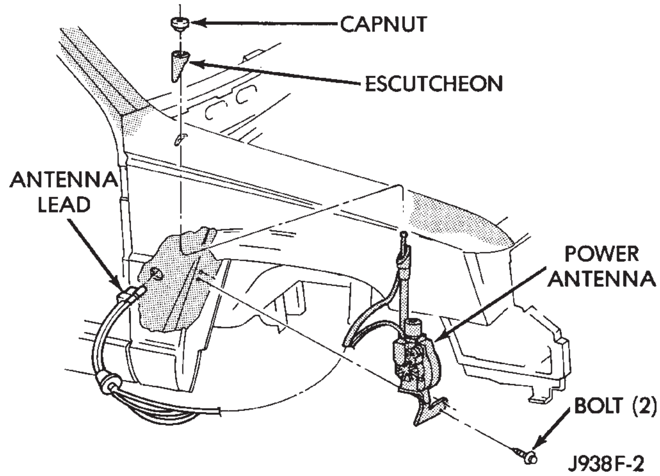


Fig. 1 Remove/Install Escutcheon and Antenna Pad

(3) Remove the passenger side kick panel.

(4) Disconnect the antenna lead.

(5) Disconnect the antenna harness connector.

(6) Remove the antenna mounting bolts and washers (Fig. 1).

(7) Pull the rubber grommet out of the kick panel.

(8) Pull the antenna motor harness through the hole in the kick panel.

(9) Remove the antenna assembly from the inside of the wheel well.

(10) To install the antenna, reverse the removal procedure.

(11) Verify antenna and radio operation.

POWER ANTENNA RELAY

REPLACEMENT

(1) Open glove box and remove 3 screws holding relay center cover (Fig. 1).

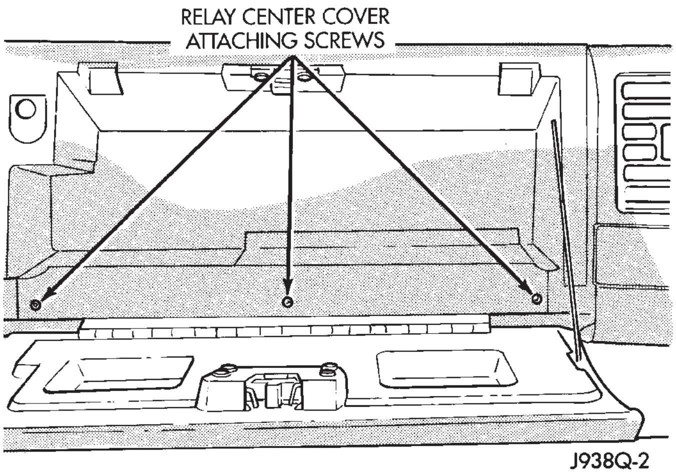


Fig. 1 Relay Center Cover

(2) Replace power antenna relay (Fig. 2)

DIAGNOSIS

POWER ANTENNA RELAY

The relay is located in the relay center located under the glove box.

RADIO ON—RELAY REMOVED

(1) Measure the voltage at connector pin 2. There should be 12 volts. If not, repair open to fuse #1.

(2) Measure the voltage at connector pin 3. There should be 12 volts. If not, repair open to radio.

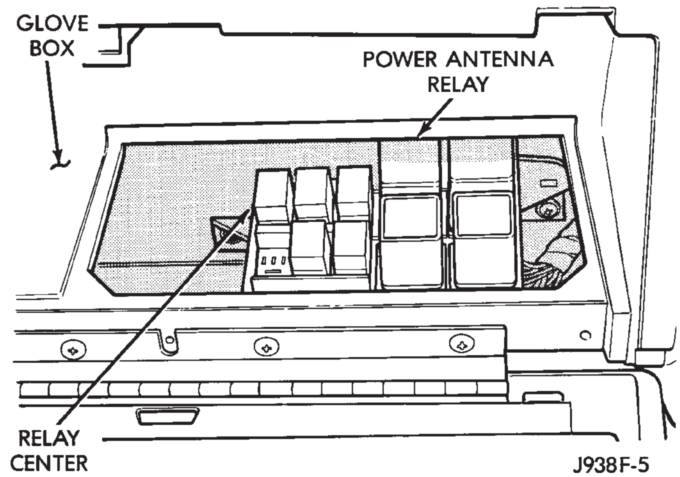


Fig. 2 Power Antenna Relay

(3) TURN RADIO OFF. Measure the resistance at connector pin 1. Meter should read zero ohms. If not, repair open to ground.

POWER ANTENNA

RELAY REMOVED

(1) Connect a jumper wire between the connector pins 2 and 4. Continue with next step.

(2) Connect a jumper wire between the connector pins 6 and 1. The antenna should go up. If not, replace power antenna.

(3) Move the jumper wire between pins 2 and 4 to pin 5. Continue with next step.

(4) Move the jumper wire between pins 6 and 1 to pin 4. The antenna should go down. If not, replace power antenna. If antenna went up and down, replace the antenna relay.

HORNS

CONTENTS

GENERAL INFORMATION

WARNING: ON VEHICLES EQUIPPED WITH AN AIR BAG, SEE GROUP 8M - RESTRAINT SYSTEMS FOR STEERING WHEEL REMOVAL PROCEDURES.

The horn circuit consists of a horn switch, horn relay and horns. The relay plugs into the relay center located under the glove box.

Battery voltage is applied to the horn relay at all times through fuse #13, located in the fuse block. The fuse block is located in the passenger end of the instrument panel.

When the horn switch is depressed, the horn relay is grounded, pulling the contact closed and providing battery voltage to the horns.

The horn is also activated by the security alarm system. When the alarm is triggered, the security alarm module grounds the horn relay for a specified cycle time. Refer to Group 8Q - Theft Security System.

HORNS WILL NOT SOUND

Refer to Group 8W - Wiring Diagrams for a complete circuit diagram.

If the horn functions properly except for the security alarm system, refer Group 8Q - Theft Security System.

HORN RELAY

- Inspect 20 amp fuse, #13, located in the Fuse block. Replace fuse as required.
- Depress Horn Switch. The relay contacts should click. If ok, go to HORNS. If not, go to next step.
- Remove relay (BLACK) from the relay center located under the glove box (Fig. 5). There should be battery voltage at cavity 1. If not, repair open in circuit to relay.
- Depress horn switch. Measure resistance between relay cavity 2 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.

HORN

- Measure the resistance between the horn connector pin B (black) and chassis ground. The meter should read zero ohms. If not, repair open to ground.

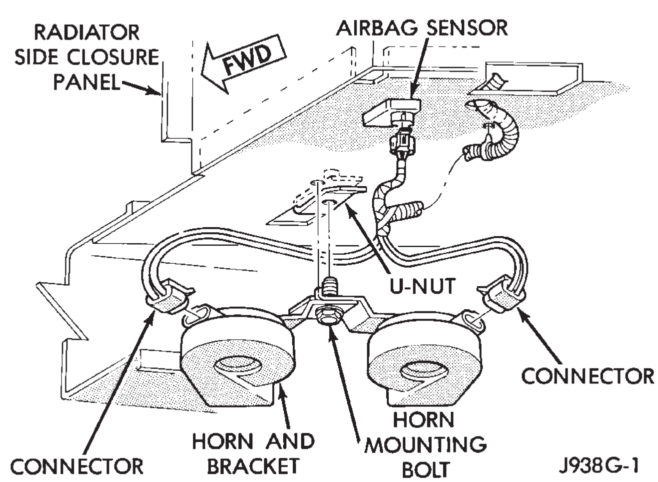


Fig. 1 Horn Removal/Installation

- Disconnect horn connector. Depress Horn Switch. There should be battery voltage at the horn connector pin A (dark green). If OK, replace horn assembly. If not, repair open to relay.

HORNS SOUND CONTINUOUSLY

CAUTION: Continuous sounding of horns may cause relay to fail.

(1) Unplug the horn relay from the relay center underneath the glove box (Fig. 5). Plug in a known good relay. If the horns stop blowing, the relay is defective and must be replaced. Should the horns still sound, replace original relay and proceed as follows:

(a) Connect one lead of test lamp to relay terminal 1 (battery) on the relay bank.

(b) Connect the other lead to relay terminal 2 (switch) on the relay bank. Should the lamp illuminate, either the wire from the horn switch is shorted to ground or the horn switch is defective. Continue to next step.

WARNING: BEFORE BEGINNING ANY AIR BAG SYSTEM COMPONENT REMOVAL OR INSTALLATION, REMOVE AND ISOLATE THE NEGATIVE (-) CABLE FROM THE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIR BAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIR BAG DEPLOYMENT AND POSSIBLE INJURY.

(2) Disconnect and isolate the battery negative cable.

(3) Remove 4 retaining nuts from back of steering wheel. Remove air bag module (Fig. 2).

(4) Disconnect wire from rear of air bag module.

(5) Place air bag module on a clean level surface with pad facing upward.

(6) Pry out 2 trim cover buttons on back of steering wheel to access retaining screws for the horn switch.

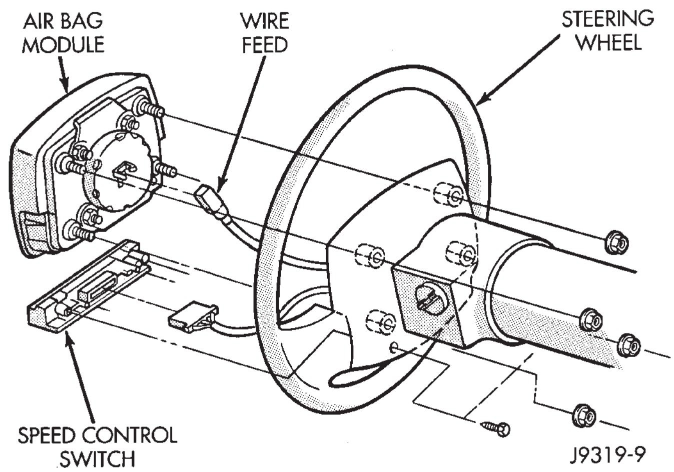


Fig. 2 Horn Switch Removal/Installation

(7) Remove 2 screws and disconnect horn wires located in the lower portion of steering wheel.

(8) Repeat the previous test and if the test lamp still illuminates, wire is shorted and should be repaired. If test lamp does not illuminate, horn switch is defective and must be replaced.

HORN SWITCH REPLACEMENT

WARNING: BEFORE BEGINNING ANY AIR BAG SYSTEM COMPONENT REMOVAL OR INSTALLATION, REMOVE AND ISOLATE THE NEGATIVE (-) CABLE FROM THE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIR BAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIR BAG DEPLOYMENT AND POSSIBLE INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove 4 retaining nuts from back of steering wheel. Remove air bag module.

(3) Disconnect wire from rear of air bag module.

(4) Place air bag module on a clean level surface with pad facing upward.

(5) Pry out 2 trim cover buttons on back of steering wheel to access retaining screws for the horn switch.

(6) Remove 2 screws and disconnect horn wires located in the lower portion of steering wheel. Push wires through the access holes and remove horn switch.

(7) To install, reverse the previous procedures. Use caution not to pinch wires.

HORN REPLACEMENT

(1) Raise and support the vehicle.

(2) Remove the splash shield from passenger side of vehicle.

(3) Disconnect wire harness connector from the horn (Fig. 3).

(4) Remove horn mounting bolt and horns. Horn and bracket are removed as an assembly.

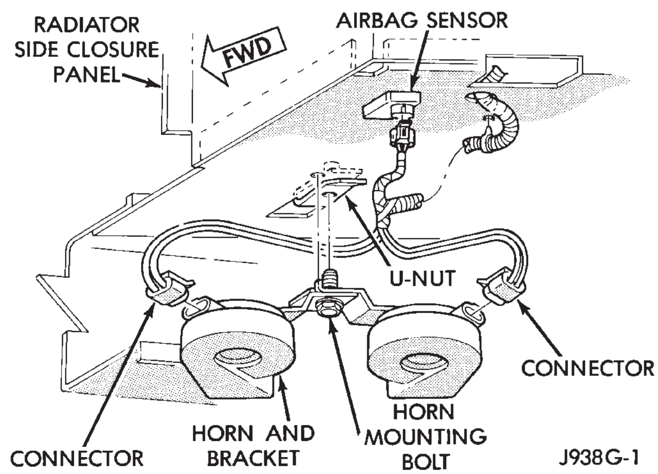


Fig. 3 Horn Removal/Installation

RELAY REPLACEMENT

(1) Open glove box and remove 3 screws holding relay center cover (Fig. 4).

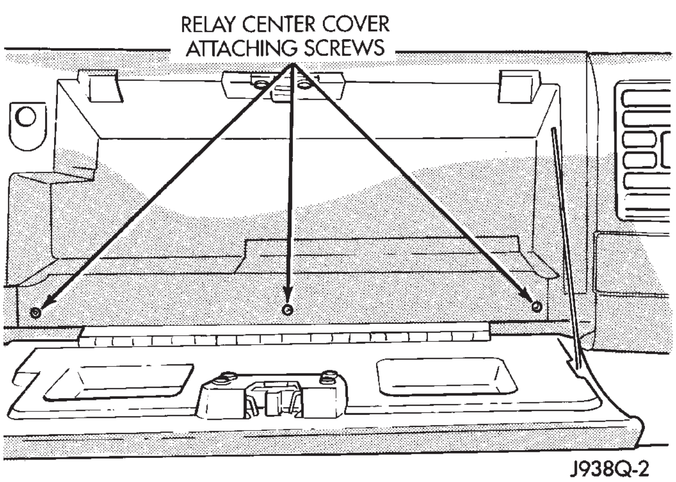


Fig. 4 Relay Center Cover

(2) Remove horn relay (Fig. 5)

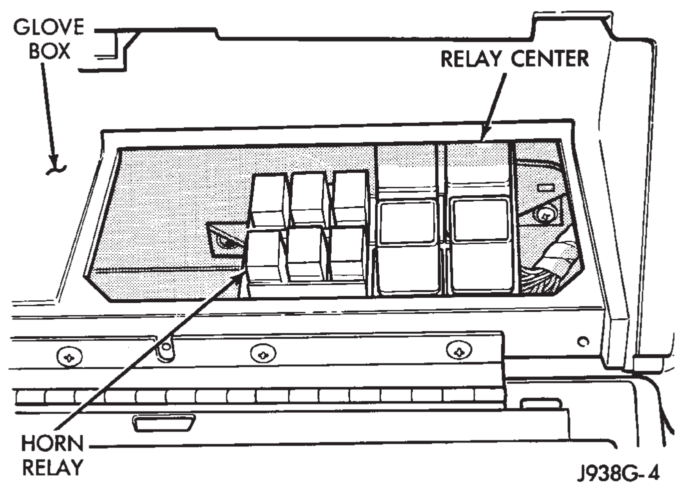


Fig. 5 Horn Relay

VEHICLE SPEED CONTROL SYSTEM

CONTENTS

GENERAL INFORMATION

The vehicle speed control system (Fig. 1) is electrically controlled and vacuum operated. The electronic control is integrated into the Powertrain Control Module (PCM). The PCM is located in the engine compartment on the passenger side dash panel. The controls are located on the steering wheel and consist of the ON/OFF, RESUME/ACCEL and SET/DECEL buttons. The system is designed to operate at speeds between 35 mph (50 km/h) and 85 mph (142 km/h).

WARNING: THE USE OF VEHICLE SPEED CONTROL IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT MAINTAINING A CONSTANT SPEED, SUCH AS IN HEAVY TRAFFIC OR ON ROADS THAT ARE WINDING, ICY, SNOW COVERED, OR SLIPPERY.

TO ACTIVATE: By pushing the ON/OFF button to the depressed latched position, ON, the speed control function is now ready for use.

TO DEACTIVATE: A soft tap of the brake pedal, normal brake use or clutch pedal use while the system is engaged will disengage speed control without erasing memory. A sudden increase in engine R.P.M. may be experienced if the clutch pedal is depressed while the speed control system is engaged. Pushing the ON/OFF button to the unlatched position or turning off the ignition erases the memory.

TO SET SPEED: When the vehicle has reached the desired speed push the SET/DECEL button to engage system which will then automatically maintain the desired speed.

TO DECELERATE: When speed control is engaged, holding the SET/DECEL button depressed allows the vehicle to coast to a lower speed setting.

TO RESUME: After disengaging the speed control system by tapping the brake or clutch pedal, push the RESUME/ACCEL button to return vehicle to the previously set speed.

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 continuously accelerate and set at a higher speed setting.

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 for PASSING: Depress the accelerator as you would normally. When the pedal is released the vehicle will return to the speed setting in memory.

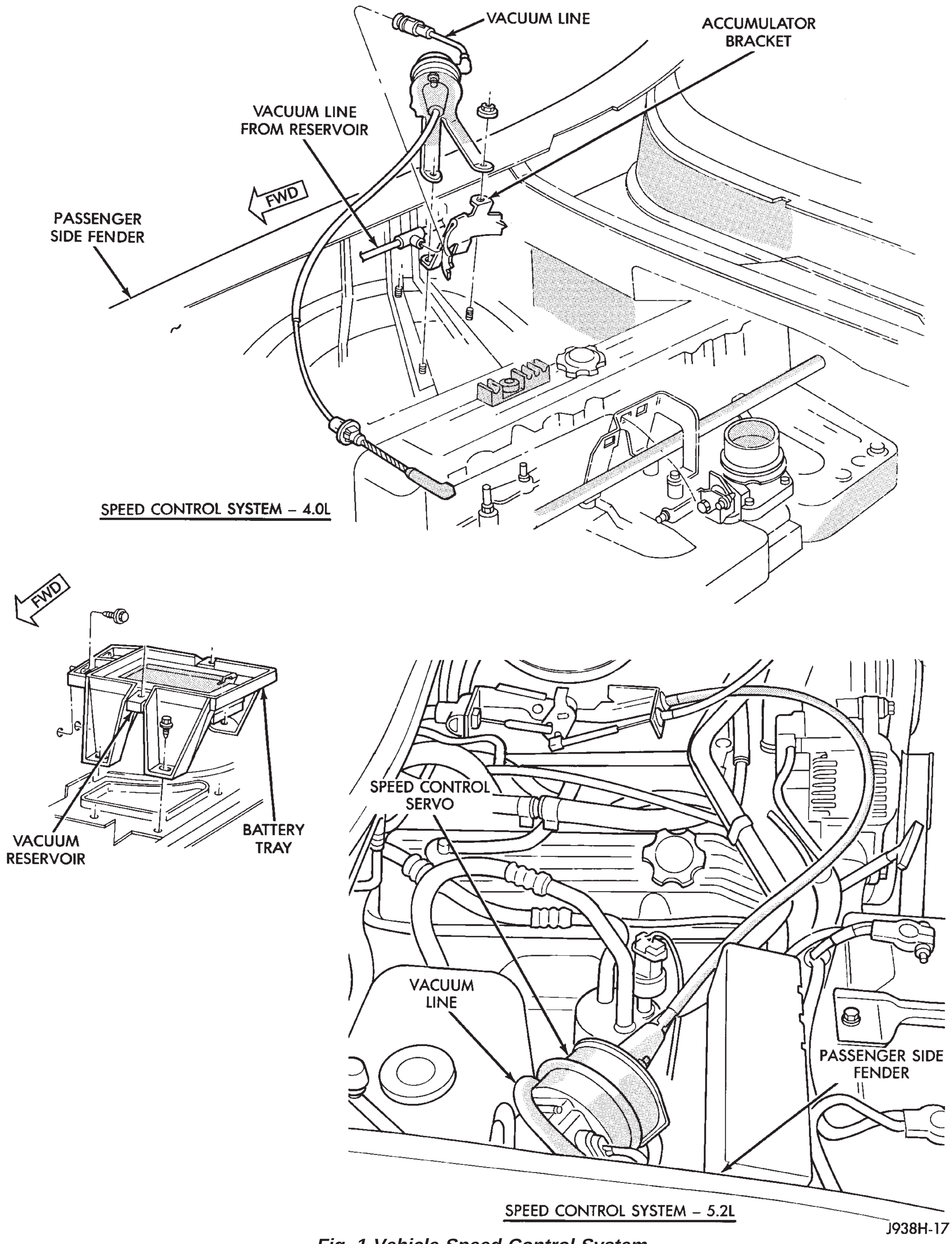
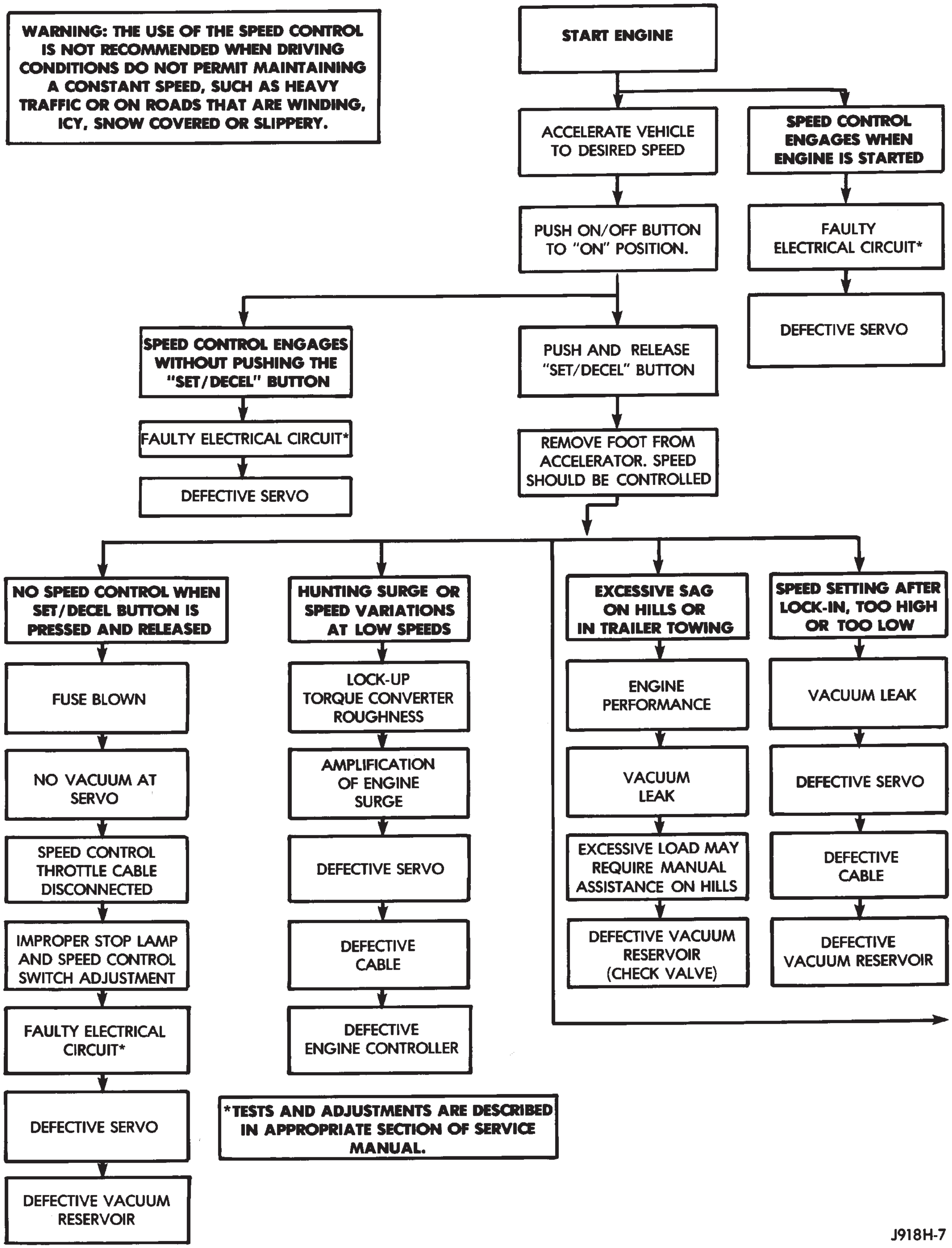


Fig. 1 Vehicle Speed Control System


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
PUSH ON/OFF BUTTON TO "ON" POSITION.
FAULTY ELECTRICAL CIRCUIT*
DEFECTIVE SERVO
SPEED CONTROL ENGAGES WITHOUT PUSHING THE "SET/DECEL" BUTTON
PUSH AND RELEASE "SET/DECEL" BUTTON
FAULTY ELECTRICAL CIRCUIT*
DEFECTIVE SERVO
REMOVE FOOT FROM ACCELERATOR. SPEED SHOULD BE CONTROLLED
NO SPEED CONTROL WHEN SET/DECEL 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
LOCK-UP TORQUE CONVERTER ROUGHNESS
AMPLIFICATION OF ENGINE SURGE
DEFECTIVE SERVO
DEFECTIVE CABLE
DEFECTIVE ENGINE CONTROLLER
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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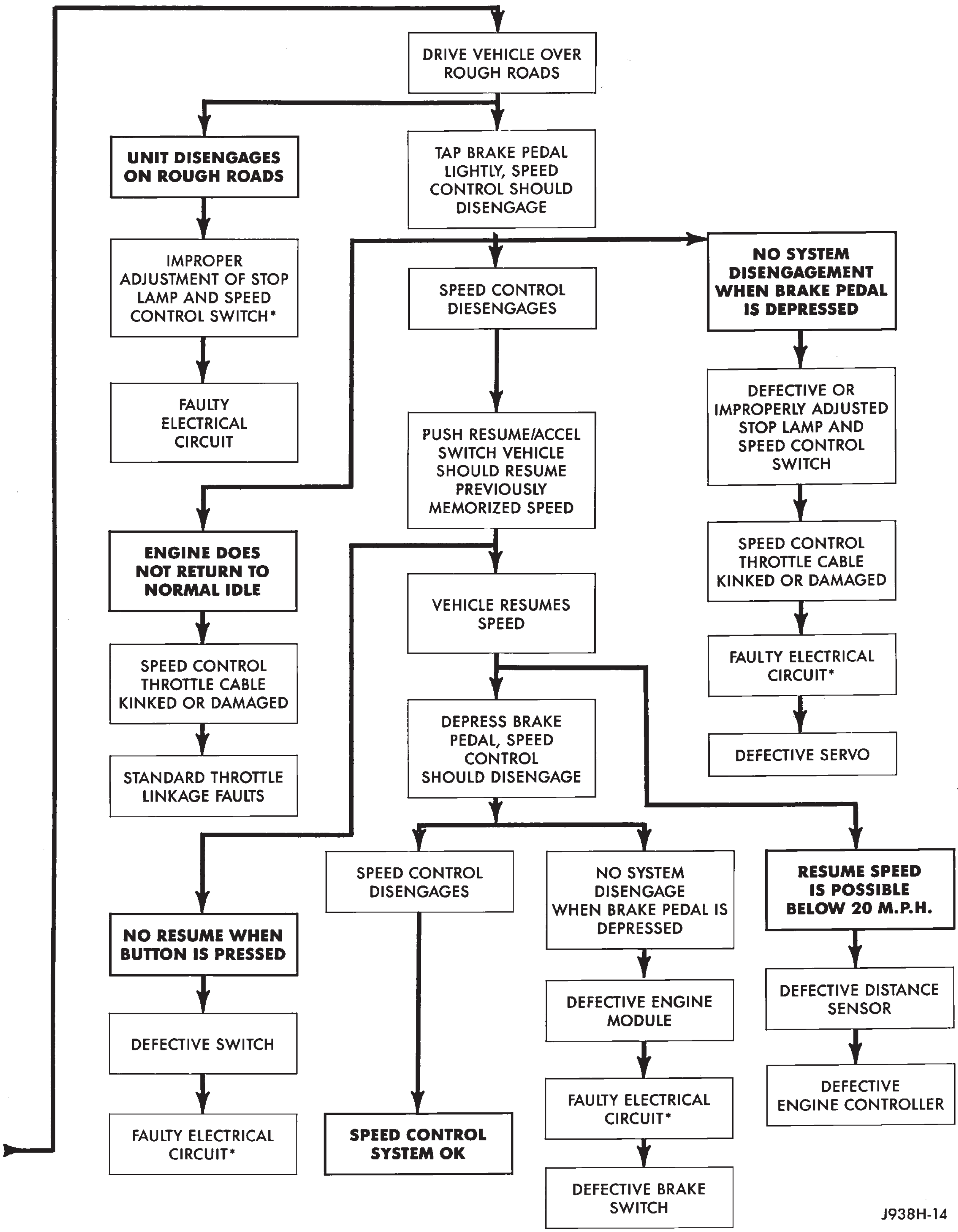

DRIVE VEHICLE OVER ROUGH ROADS
UNIT DISENGAGES ON ROUGH ROADS
IMPROPER ADJUSTMENT OF STOP LAMP AND SPEED CONTROL SWITCH*
FAULTY ELECTRICAL CIRCUIT
TAP BRAKE PEDAL LIGHTLY, SPEED CONTROL SHOULD DISENGAGE
SPEED CONTROL DIESENGAGES
NO SYSTEM DISENGAGEMENT WHEN BRAKE PEDAL IS DEPRESSED
DEFECTIVE OR IMPROPERLY ADJUSTED STOP LAMP AND SPEED CONTROL SWITCH
SPEED CONTROL THROTTLE CABLE KINKED OR DAMAGED
FAULTY ELECTRICAL CIRCUIT*
DEFECTIVE SERVO
PUSH RESUME/ACCEL SWITCH VEHICLE SHOULD RESUME PREVIOUSLY MEMORIZED SPEED
ENGINE DOES NOT RETURN TO NORMAL IDLE
SPEED CONTROL THROTTLE CABLE KINKED OR DAMAGED
STANDARD THROTTLE LINKAGE FAULTS
VEHICLE RESUMES SPEED
DEPRESS BRAKE PEDAL, SPEED CONTROL SHOULD DISENGAGE
SPEED CONTROL DISENGAGES
SPEED CONTROL SYSTEM OK
NO SYSTEM DISENGAGE WHEN BRAKE PEDAL IS DEPRESSED
DEFECTIVE ENGINE MODULE
FAULTY ELECTRICAL CIRCUIT*
DEFECTIVE BRAKE SWITCH
RESUME SPEED IS POSSIBLE BELOW 20 M.P.H.
DEFECTIVE DISTANCE SENSOR
DEFECTIVE ENGINE CONTROLLER
NO RESUME WHEN BUTTON IS PRESSED
DEFECTIVE SWITCH
FAULTY ELECTRICAL CIRCUIT*
J938H-14

TEST PROCEDURES

INDEX

GENERAL INFORMATION

Before starting diagnosis and repair procedures for a speed control malfunction, verify that the speed control wire harness is properly connected to all connectors. Refer to Diagnosis Chart.

ROAD TEST

Road test vehicle to verify reports of speed control system malfunction. The road test should include attention to the speedometer. Speedometer operation should be smooth and without flutter at all speeds.

Flutter in the speedometer indicates a problem which might cause surging in the speed control system. The cause of any speedometer deficiencies should be corrected before proceeding.

INOPERATIVE SYSTEM

If a road test verifies a system problem and the speedometer operates properly, check for:

- loose electrical and vacuum connections at the servo
- 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 that should be removed from electrical terminals and a light coating of Mopar MultiPurpose Grease, or equivalent, applied
- secure attachment of both ends of the speed control cable.

CHECKING FOR DIAGNOSTIC TROUBLE CODE

(1) When trying to verify a speed control system electrical problem, use a DRB II Scan Tool to find the cause. Refer to Powertrain Diagnostic Procedures manual.

If the DRB II 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 the 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 the tests in the sections Electrical Tests at Servo and Electrical Tests at Powertrain Control Module.

If a DTC 15 is observed, perform the 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 the 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 II Scan Tool. If this test method is desired, refer to the 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 the 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.

(2) Push the speed control switch to the ON position.

(3) Connect the negative lead of a voltmeter to a good chassis ground near the servo.

(4) Disconnect the 4-way connector going to the servo (Fig. 2). The blue wire with the green tracer of the main harness 4-way connector should read ap-

proximately battery voltage. If not, check for loose connections, brake switch adjustment or, repair the main harness as necessary.

(5) Connect a jumper wire between the male and female terminals of the blue wire with green tracer. The other 3 male terminals from the servo should show battery voltage. If not, replace the servo.

(6) Turn ignition OFF. Using an ohmmeter, connect one lead to a good body ground. Touch the other lead to the black (BK) wire terminal in the 4-way connector of the main harness. The meter should show continuity. If not, repair the ground circuit as necessary.

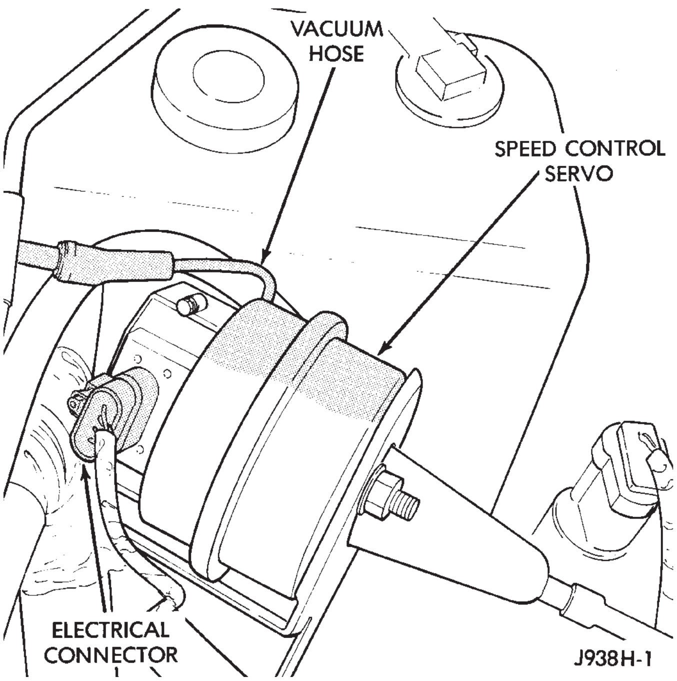


Fig. 2 Servo And Harness Connector

ELECTRICAL TESTS AT POWERTRAIN CONTROL MODULE

(1) Unplug 60-way connector from the Powertrain Control Module, located on the passenger side dash panel in the engine compartment (Fig. 3).

(2) Connect negative lead of voltmeter to a good body ground near the module.

(3) For the following tests, the ignition switch must be in the ON position. Refer to Fig. 4 for control module terminal locations. Touch the positive lead of the voltmeter to the terminal in cavity number 33. With the speed control switch in the OFF position, the voltmeter should read 0 volts. With the speed control switch in the ON position, the voltmeter should read battery voltage. If not, repair the main harness as necessary.

(4) Touch the positive lead of the voltmeter to the terminal in cavity number 53. As in step (3), the voltmeter should read 0 volts with the switch in the OFF position and battery voltage with the switch in the ON position.

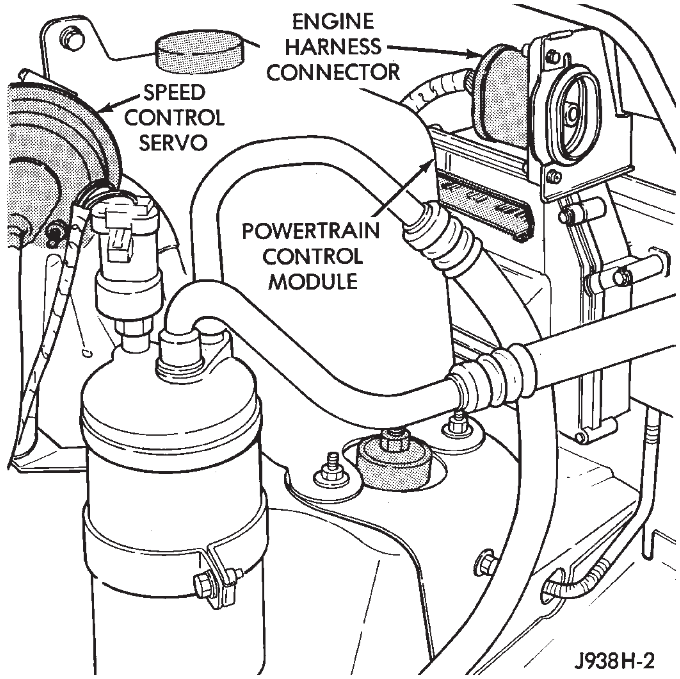


Fig. 3 Powertrain Control Module and Connector Location

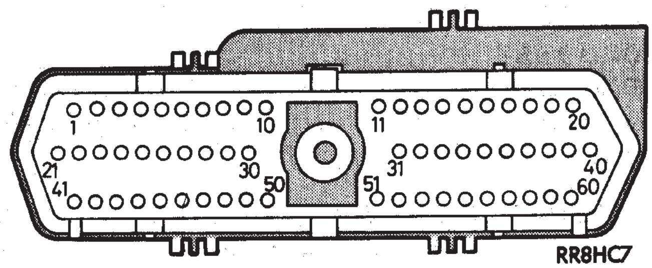


Fig. 4 Powertrain Control Module 60-Way Connector Shown from Terminal End

(5) Touch the positive lead of the voltmeter to the terminal in cavity number 48. With the speed control switch in the OFF position, the voltmeter should read 0 volts. With the switch in the ON position, the voltmeter should read battery voltage. Pressing the SET button should cause the 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 the main harness and repair as necessary.

(6) Touch the positive lead of the voltmeter to the terminal in cavity number 50. The voltmeter should read 0 volts with the speed control switch in either the OFF or ON position. With switch in either RESUME or SET position, the voltmeter should read battery voltage. If not, perform the speed control switch test. If the switch is not at fault, then check the main harness and repair as necessary.

(7) Touch the positive lead of the voltmeter to the terminal in cavity number 49. The voltmeter should read 0 volts with the switch in the OFF position. With the switch in the ON position, the 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 the switch is not at fault, then check the main harness and repair as necessary.

(8) Turn key OFF. Using an ohmmeter, connect one lead to a good body ground and touch the other lead to the terminal in cavity number 29. With the brake pedal released, the meter should show continuity. When the pedal is depressed, the meter should show open circuit.

VEHICLE SPEED CONTROL SWITCH TEST

WARNING: BEFORE BEGINNING ANY AIR BAG SYSTEM COMPONENT REMOVAL OR INSTALLATION, REMOVE AND ISOLATE THE NEGATIVE (-) CABLE FROM THE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIR BAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIR BAG DEPLOYMENT AND POSSIBLE INJURY.

To check the switch, remove the switch from its mounting position, refer to Service Procedures - Speed Control Switch. Use an ohmmeter and refer to the Switch Continuity Chart to determine if continuity is correct. If there is no continuity at any one of the switch positions, replace the switch.

STOP LAMP SPEED CONTROL SWITCH TEST

(1) Disconnect the connector at the stop lamp switch. Using an ohmmeter, continuity may be checked at the switch side of the connector as follows (Fig. 5):

(a) With the brake pedal at rest (plunger of switch pushed in by brake pedal) there should be:

- continuity between the black (BK) and white with pink tracer (WT/PK) wires
- continuity between the yellow with red tracer (YL/RD) and dark blue with red tracer (DB/RD) wires.
- NO continuity between the pink (PK) and white (WT) wires.

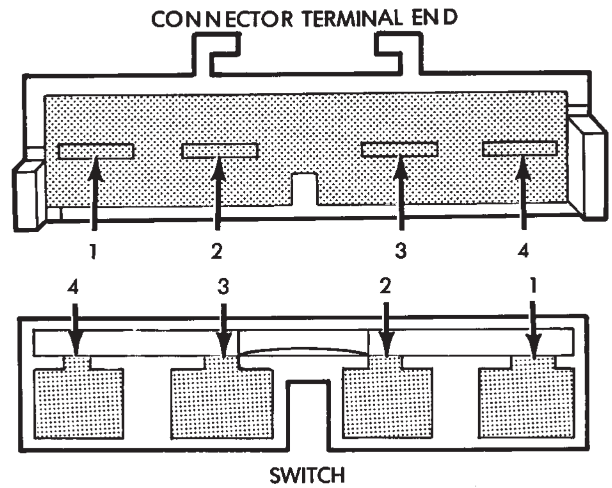
(b) With brake pedal depressed, there should be:

- continuity between pink (PK) and white (WT) wires
- NO continuity between black (BK) and white with pink tracer (WT/PK) wires
- NO continuity between the yellow with red tracer (YL/RD) and dark blue with red tracer (DB/RD) wires.

(2) If the above results are not obtained, the stop lamp switch is defective or out of adjustment.

Stop lamp switch adjustment is detailed in Group 5 - Brakes.

SPEED CONTROL SWITCH CONTINUITY CHART



SPEED CONTROL SWITCH CONTINUITY	
SWITCH POSITION	**CONTINUITY BETWEEN**
OFF	PIN 1 AND PIN 4
ON	PIN 1 AND PIN 4 PIN 1 AND PIN 2 PIN 2 AND PIN 4
ON AND SET	PIN 1 AND PIN 2
ON AND RESUME	PIN 1 AND PIN 3

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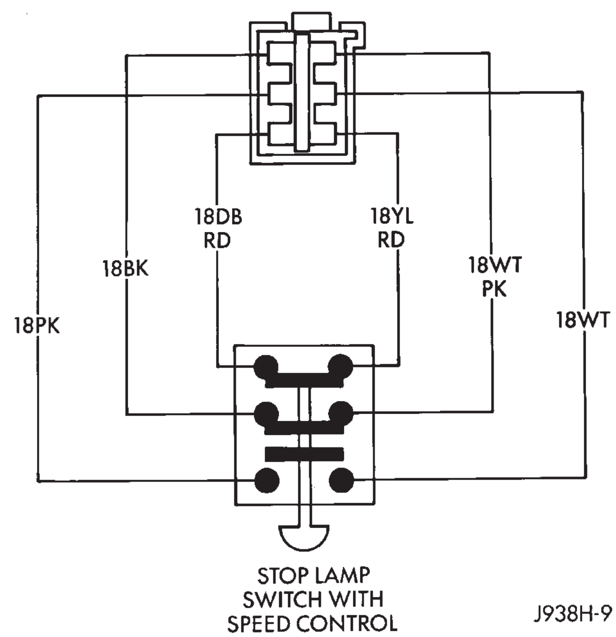


Fig. 5 Stop Lamp Switch Connector

VACUUM SUPPLY TEST

(1) Disconnect vacuum hose at the servo or vacuum receiver and install a vacuum gauge in the hose (Fig. 6).

(2) Start engine and observe gauge at idle. Vacuum gauge should read at least 10 inches of mercury.

(3) If vacuum does not meet this requirement, check for vacuum leaks or poor engine performance.

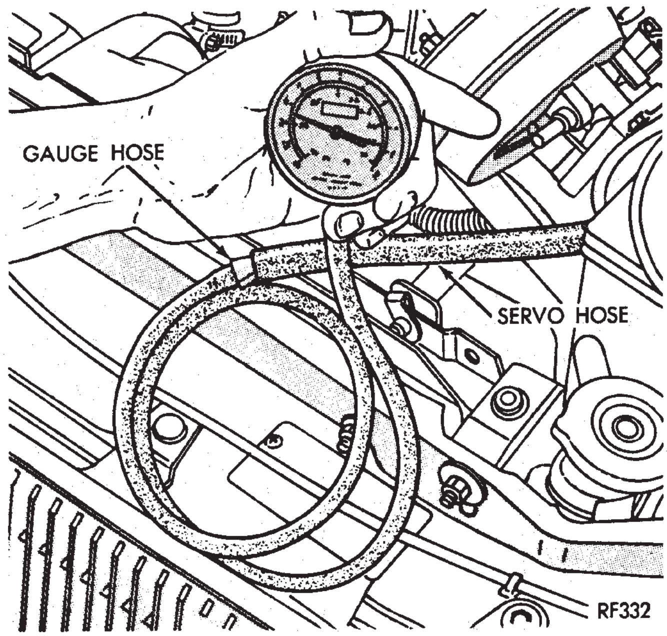
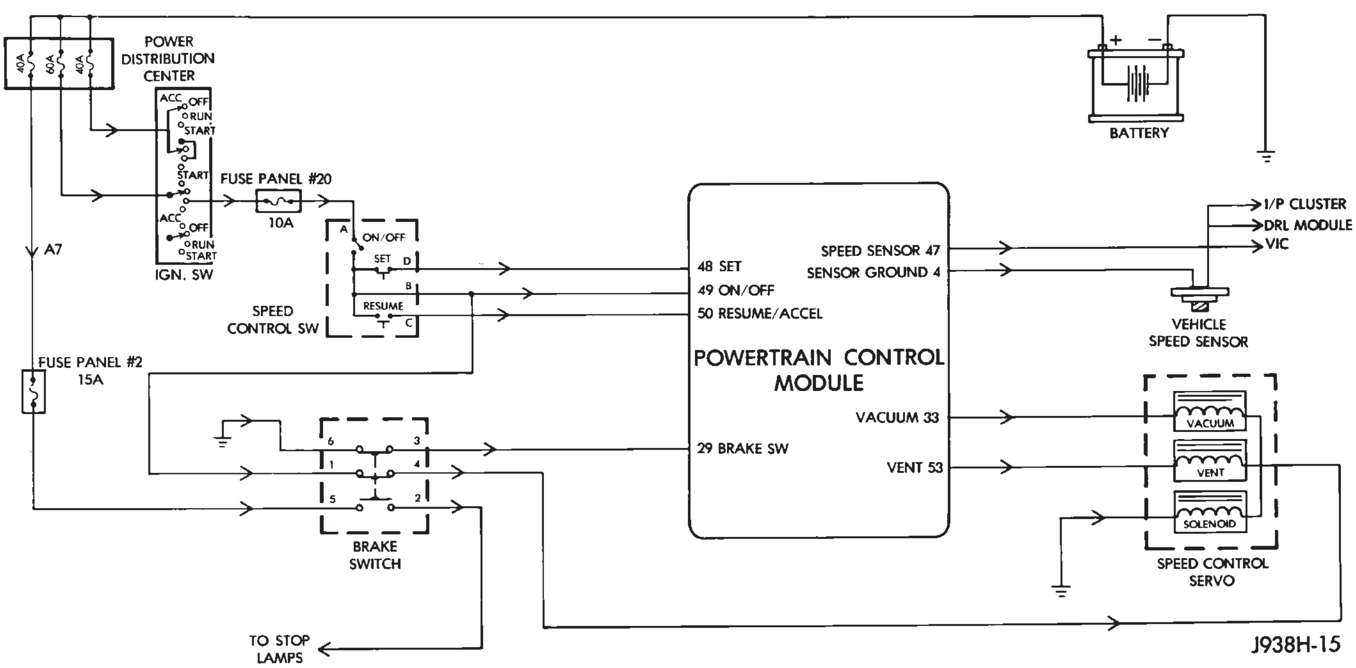


Fig. 6 Vacuum Gauge Test

VEHICLE SPEED CONTROL SYSTEM SCHEMATIC



SERVICE PROCEDURES

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SERVO UNIT

REMOVAL

(1) Disconnect vacuum hose at servo.
(2) Unplug electrical connector at servo.
(3) Remove 2 nuts from servo mounting bracket.
(4) Remove and discard push nuts on servo studs.
(5) Pull servo away from mounting bracket.
(6) Pull speed control cable away from servo to expose cable retaining clip.
(7) Remove clip attaching cable to servo.

INSTALLATION

(1) With throttle blocked to full open position, align hole in cable sleeve with hole in servo pin and install retaining clip.
(2) Insert servo studs through holes in the cable.
(3) Insert servo studs through holes in servo mounting bracket.
(4) Install new push nuts on the servo studs.
(5) Install the 2 attaching nuts and tighten to 8.5 N●m (75 in. lbs.).
(6) Connect vacuum hose to servo.
(7) Connect the electrical connector to servo terminals.

SPEED CONTROL SWITCH

WARNING: BEFORE BEGINNING ANY AIR BAG SYSTEM COMPONENT REMOVAL OR INSTALLATION, REMOVE AND ISOLATE THE NEGATIVE (-) CABLE FROM THE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIR BAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIR BAG DEPLOYMENT AND POSSIBLE INJURY.

REMOVAL

(1) Disconnect negative cable from the battery.
(2) Remove 2 screws from back side of steering wheel (Fig. 1).
(3) Rock switch away from horn pad while lifting switch out of steering wheel.
(4) Disconnect 4-way electrical connector from clockspring.

INSTALLATION

(1) Connect 4-way electrical connector from clockspring to switch.

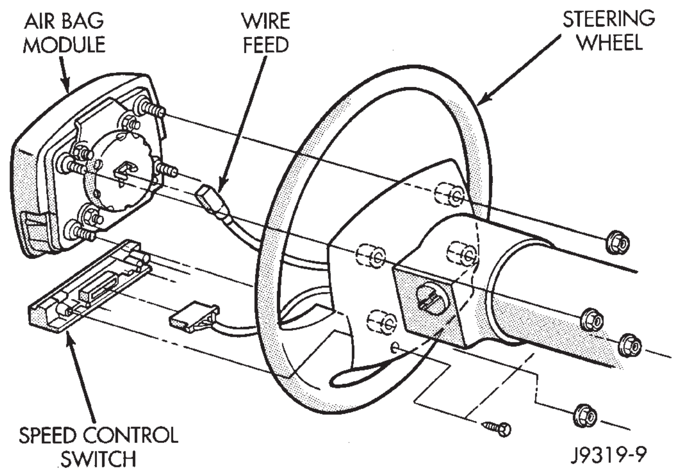


Fig. 1 Speed Control Switch Removal

(2) Place switch in steering wheel, sliding the forward edge of switch under horn pad. Line up locating pins on switch with holes in steering wheel frame.
(3) Attach switch to wheel with 2 screws starting with the screw at the left end of the switch.
(4) Connect negative cable to battery.

SERVO CABLE REPLACEMENT

CAUTION: Use finger pressure only to remove the speed control cable connector at the bell crank. Pliers or screwdriver can break the connector requiring the complete cable replacement.

(1) Using finger pressure only, remove speed control cable connector at bell crank by PUSHING connector off the bell crank (Fig. 2). 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. 3).
(3) Pull cable out of cable guide.
(4) Remove 2 nuts, 2 pushnuts, and cable housing from the servo.
(5) Release the cable clip from the servo cable and remove the servo cable.
(6) To install, reverse the removal procedure.

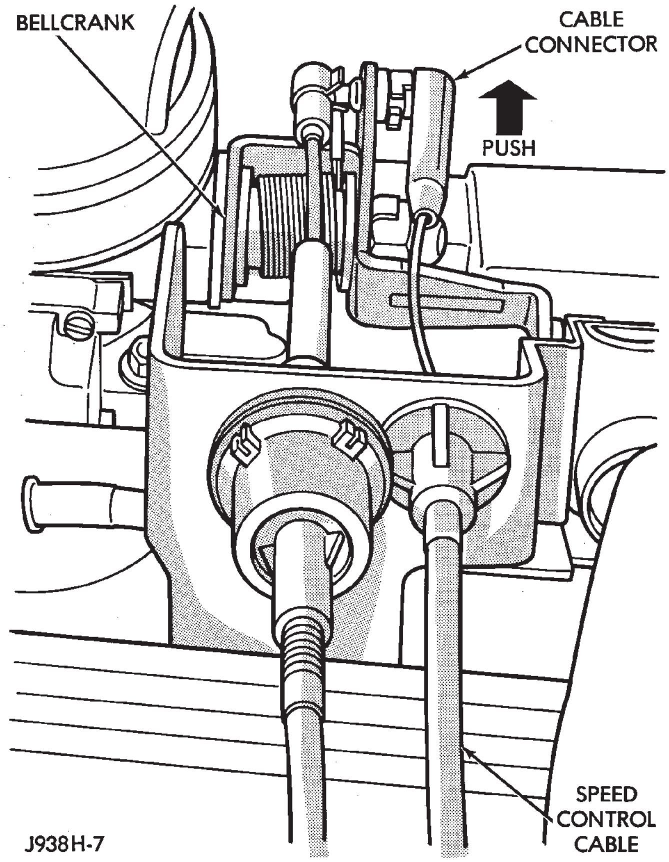


Fig. 2 Remove Bell Crank Connector

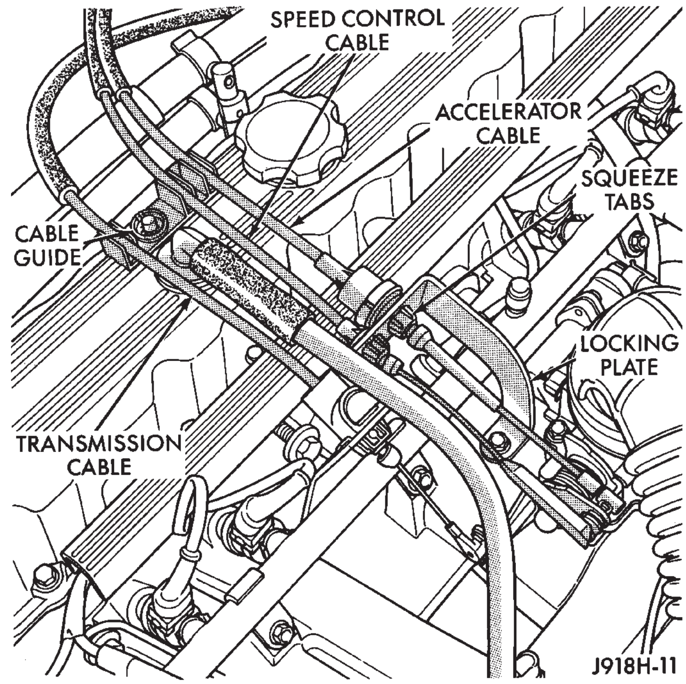


Fig. 3 Remove/Install Speed Control Cable to Locking Plate

VACUUM RESERVOIR

REMOVAL

(1) Disconnect battery cables, negative cable first.
(2) Remove both battery holddown bolts.
(3) Remove battery from vehicle.
(4) Remove 5 screws holding battery tray.
(5) Pull up battery tray and remove vacuum line from reservoir (Fig. 4).
(6) Remove 2 screws holding reservoir to battery tray.

INSTALLATION

(1) Install vacuum reservoir to battery tray.
(2) Connect vacuum line to reservoir.
(3) Install battery tray. Tighten screws to 10 N●m (90 in. lbs.).
(4) Install battery.
(5) Install battery strap and holddown bolts. Tighten bolts to 10 N●m (90 in. lbs.).
(6) Install battery cables, positive cable first. Tighten clamps to 8.5 N●m (75 in. lbs.).

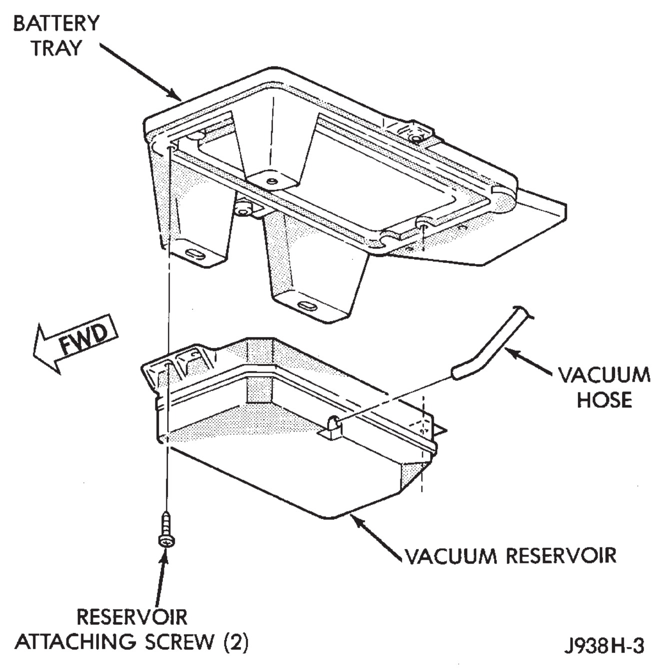


Fig. 4 Vacuum Reservoir

TURN SIGNALS AND HAZARD WARNING FLASHER

CONTENTS

WARNING: BEFORE SERVICING A STEERING COLUMN EQUIPPED WITH AN AIR BAG, REFER TO GROUP 8M - RESTRAINT SYSTEMS FOR PROPER AND SAFE SERVICE PROCEDURES.

GENERAL INFORMATION

TURN SIGNAL AND HAZARD WARNING FLASHER LOCATION

The turn signal and hazard warning flasher are both located on the Convenience Center (Figs. 1 and 2), which is located up under the driver's end of the instrument panel. Remove chime module from the Convenience Center to gain access to the Turn Signal and Hazard flashers.

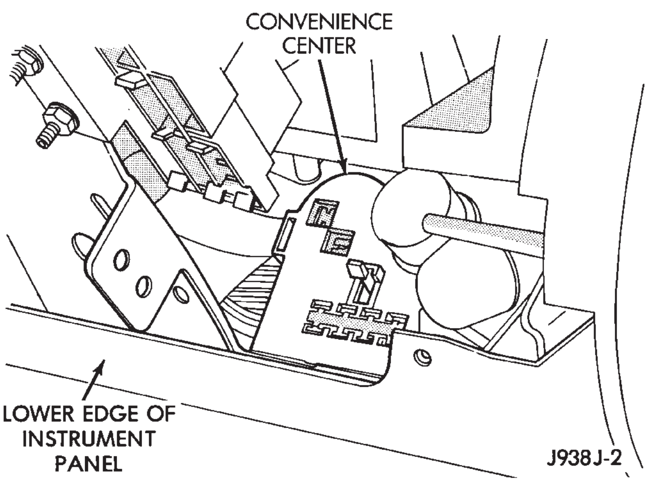


Fig. 1 Convenience Center Location

TURN SIGNALS

DESCRIPTION

The turn signals are actuated with a lever on the left side of the steering column just behind the steering wheel. The signals are turned off by a canceling cam (two lobes molded to the clockspring mechanism). The cam comes in contact with the cancel actuator on the turn signal (multi-function) switch assembly. Either cam lobe, pushing on the cancel actuator, returns the switch to the off position.

If only momentary signaling such as indication of a lane change is desired, the switch is actuated to a left or right intermediate detent position. In this position the signal lamps flash as described above, but the switch returns to the OFF position as soon as the lever is released.

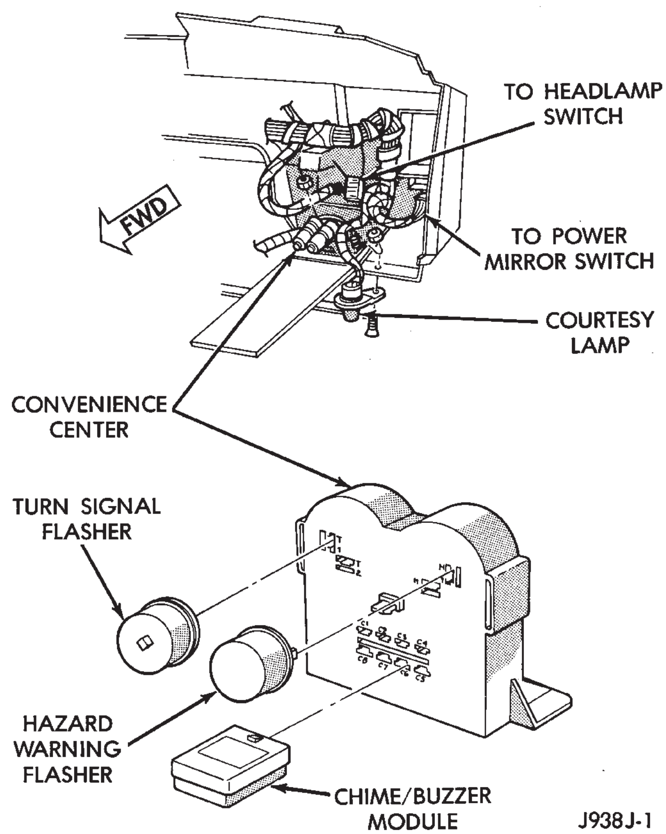


Fig. 2 Turn Signal and Hazard Warning Flashers

With the ignition key ON and the multi-function lever in its UP or DOWN position, current flows through the:

- turn signal flasher canister
- multi-function
- turn indicator lamp
- front and rear bulbs.

The selected turn signal indicator with front and rear turn signal bulbs will flash.

The chime will sound after the vehicle has traveled a distance of approximately 0.5 mile with the turn signal ON.

DIAGNOSIS—TURN SIGNAL INOPERATIVE

High generator output voltage can burn out lamps rapidly.

(1) Turn ignition key to RUN position. Place turn stalk in up or down position. Observe the turn indicator arrow on instrument cluster. If the arrow stays lit, check for burned out exterior turn signal bulb. Replace bulb as required. Turn indicator should now flash, if not go to next step.

(2) Open front passenger door. Locate the fuse panel at the passenger end of the instrument panel. Inspect 20 amp Turn fuse in cavity #16. Replace if necessary.

(3) Locate turn signal flasher in convenience center and remove it. There should be battery voltage at the fuse side of the flasher (top terminal) (Fig. 3). If not, repair open circuit in wiring between turn fuse and flasher.

(4) Replace flasher with a known good flasher. The lamps should flash. If not, install original flasher, put electrical tape over flashers and go to next step.

(5) Locate multi-function as described in Multi-Function Switch Testing Procedures. Measure voltage at the multi-function switch connector cavity #17. Meter should read battery voltage. If OK, replace multi-function switch assembly. If not, repair open circuit in wiring between turn flasher and multi-function switch.

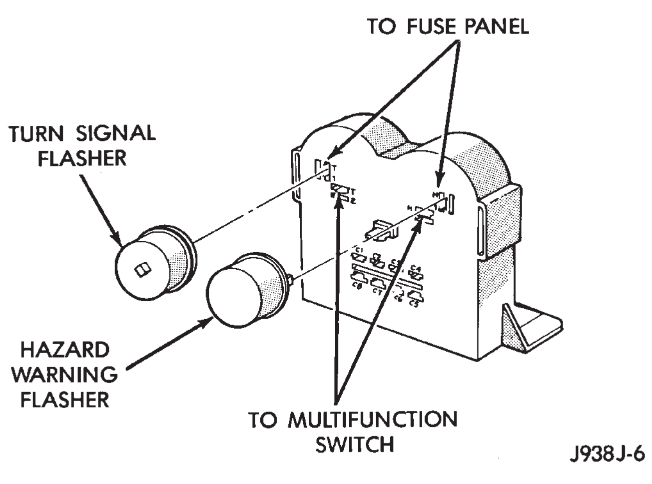


Fig. 3 Flasher Wiring

HAZARD WARNING SYSTEM

DESCRIPTION

The hazard warning system is actuated by a push button located on the top of the steering column between the steering wheel and the instrument panel. The hazard switch is identified with a double triangle. Push and release the button to turn the hazard function on and off. The button will move out from the steering column in the ON position and will remain in toward the column in the OFF position.

With the hazard switch OUT, current flows through the

- hazard flasher canister
- multi-function switch
- front turn signal bulbs
- rear turn signal bulbs
- both indicator bulbs.

All of the turn lamps and both indicators will flash.

DIAGNOSIS—HAZARD FLASHER INOPERATIVE

Hazard switch in ON. The lamps should flash. If not proceed as follows:

(1) Open front passenger door. Locate the fuse panel at the passenger end of the instrument panel. Inspect the 20 amp Haz. Lamps fuse #3. Replace if necessary.

(2) Measure voltage at the fuse side of the flasher (top terminal) (Fig. 3). Meter should read battery voltage. If not, repair open circuit in wiring between fuse and Hazard flasher.

(3) Replace Hazard flasher with known good flasher. Lamps should flash. If not, install original flasher and go to next step.

(4) Locate multi-function as described in Multi-Function Switch Testing Procedures. Measure voltage at the multi-function switch connector cavity #13. Meter should read battery voltage. If OK, replace multi-function switch. If not, repair open circuit in wiring between hazard flasher and multi-function switch connector cavity #13.

MULTI-FUNCTION SWITCH TESTING PROCEDURES

The multi-function switch contains electrical circuitry for

- turn signal
- hazard warning
- headlamp beam select
- headlamp optical horn
- windshield wiper
- pulse wipe
- windshield washer switching.

This integrated switch assembly is mounted to the left-hand side of the steering column. Should any function of the switch fail, the entire switch assembly must be replaced.

To test the switch:

(1) Disconnect negative cable from the battery.

(2) Remove tilt lever (tilt column only).

(3) Remove both upper and lower steering column covers. Requires removal of 3 screws (Torx T-20).

(4) Remove 4 screws holding steering column trim panel (Fig. 4).

(5) Remove 6 screws holding knee blocker.

(6) Remove steering column retaining nuts.

(7) Lower steering column to gain access to rear of multi-function switch.

(8) Remove switch connector (Figs. 5 and 6).

(9) Using an ohmmeter, test for continuity (no resistance) between the terminals of the switch as shown in the following continuity chart (Fig. 7).

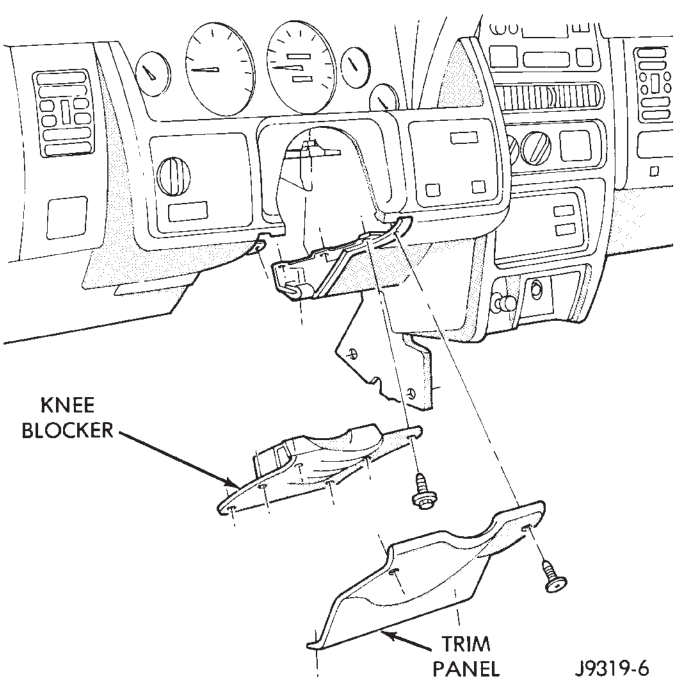


Fig. 4 Steering Column Trim And Knee Blocker

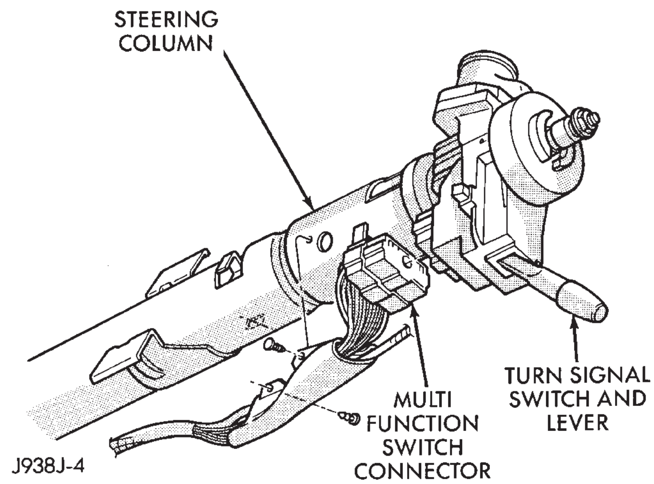


Fig. 5 Multi-Function Switch Connector

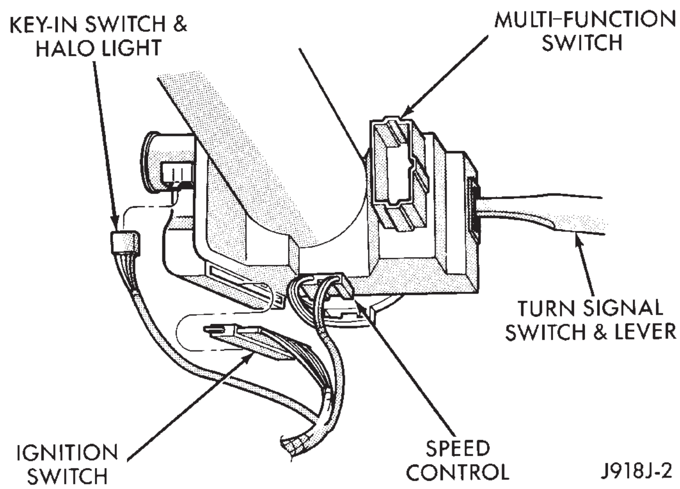
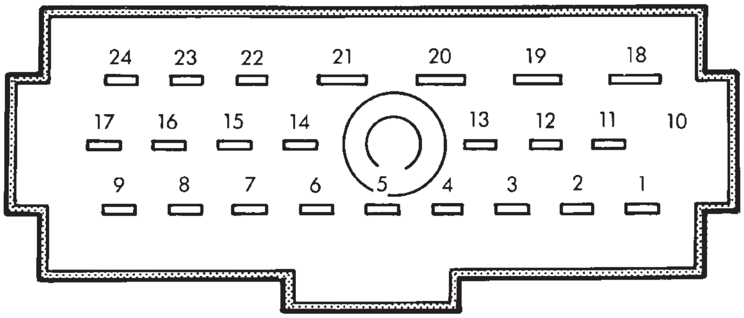


Fig. 6 Steering Column Connectors



SWITCH POSITIONS TURN SIGNAL	HAZARD WARNING	CONTINUITY BETWEEN
NEUTRAL	OFF	12 AND 14 AND 15
LEFT	OFF	15 AND 16 AND 17
LEFT	OFF	12 AND 14
LEFT	OFF	22 AND 23 WITH OPTIONAL CORNER LAMPS
RIGHT	OFF	11 AND 12 AND 17
RIGHT	OFF	14 AND 15
RIGHT	OFF	23 AND 24 WITH OPTIONAL CORNER LAMPS
NEUTRAL	ON	11 AND 12 AND 13 AND 15 AND 16

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Fig. 7 Turn Signal and Hazard Switch Continuity Chart

MULTI-FUNCTION SWITCH SERVICE PROCEDURES

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove tilt lever (tilt column only).

(3) Remove both upper and lower steering column covers. Requires removal of 3 screws (Torx T-20).

(4) Remove 4 screws holding steering column trim panel (Fig. 3).

(5) Remove 6 screws holding knee blocker.

(6) Remove steering column retaining nuts.

(7) Lower steering column.

(8) Remove multi-function switch tamper proof mounting screws (tamper proof Torx bit Snap-On TTXR20B2 or equivalent required).

(9) Gently pull switch away from column. Loosen connector screw. The screw will remain in the connector.

(10) Remove wiring connector from multi-function switch (Fig. 8).

INSTALLATION

(1) Install wiring connector to switch and tighten connector retaining screw to 17 in. lbs.

(2) Mount multi-function switch to column and torque retaining screws to 17 in. lbs.

(3) Install steering column. Tighten nuts to (105 in. lbs.).

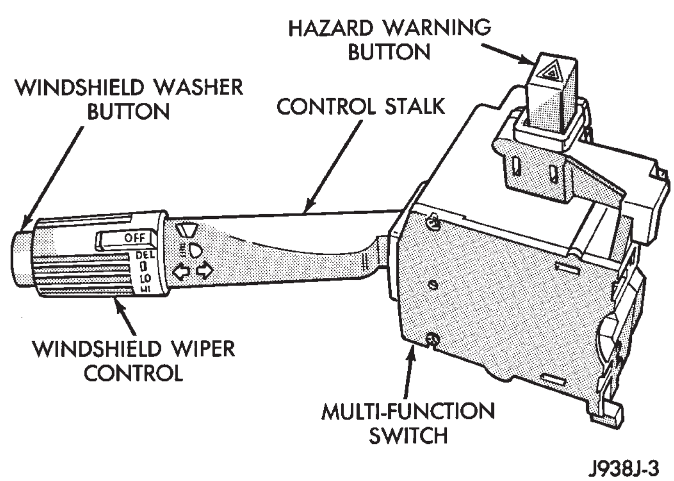


Fig. 8 Multi-Function Switch

(4) Install knee bolster and trim panel.

(5) Install steering column covers. Torque retaining screws to 17 in. lbs.

(6) Install tilt lever (tilt column only).

(7) Install negative cable to the battery.

(8) Check all functions of switch for proper operation.

WINDSHIELD WIPER AND WASHER SYSTEMS

CONTENTS

FRONT WIPERS/WASHERS

INDEX

GENERAL INFORMATION

An intermittent windshield wiper system and electric washers are standard equipment. The 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 ACCESSORY or RUN position. A fuse located in the fuse block protects the circuitry of the wiper system and the vehicle.

The wiper motor has permanent magnet fields. The speeds are determined by current flow to the appropriate set of brushes.

The intermittent wipe system in addition to low and high speed, has a delay mode. The delay mode has a range of 2 to 20 seconds. This is performed by a variable resistor in the wiper switch and is controlled electrically by the intermittent wiper control unit.

The wiper system completes the wipe cycle when the switch is turned OFF. The blades park in the lowest portion of the wipe pattern.

If the washer knob is depressed while in the OFF position, the wiper control will operate for approximately 3 wipes and automatically turn OFF.

WIPERS

The windshield wiper circuit contains three components; wiper/washer switch, motor, and front washer pump, module and delay resistance in the wiper switch. The circuit receives battery feed from, and is protected by a 10 amp circuit breaker.

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/washer switch is turned to OFF, current flows through the contact and the module to the motor until the wipers reach the park position.

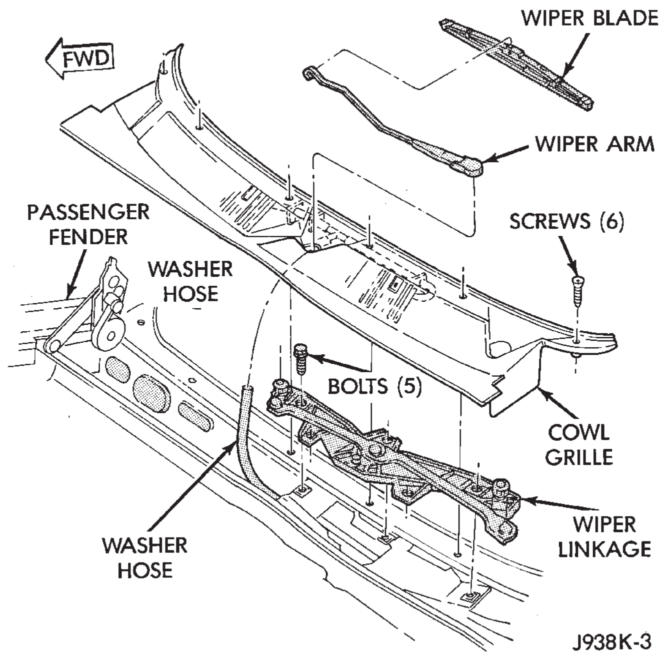
CAUTION: The wiper arms and blades must not be moved manually from side to side or damage may result.

WASHERS

With the washer switch in ON, current flows through the washer pump to ground. The front washer pump runs as long as the driver holds the switch in ON. The wiper module runs the wiper motor on LO. Turning the switch to OFF stops the wipers.

If the washer knob is depressed while in the OFF position, the wiper control will operate for approximately 3 wipes and automatically turn OFF.

WINDSHIELD WIPER AND WASHER SYSTEM



DIAGNOSING WINDSHIELD WIPERS

(1) Remove circuit breaker.

(2) Measure voltage battery side of the circuit breaker. Meter should read battery voltage. If not, repair open to splice.

(3) Measure resistance across circuit breaker terminals. Meter should read zero ohms. If not, replace circuit breaker.

(4) Disconnect harness side Intermittent Wiper Module connector.

(5) Measure the resistance from harness side connector terminal G to ground. Meter should read zero ohms. If not, repair open to ground.

(6) Turn ignition switch to ACCY.

(7) **Turn wiper switch to LO or HI.**

CAUTION: DO NOT move the switch to intermittent. If the switch is moved to the intermittent position during the next step the rheostat will be damaged.

(8) Remove intermittent wiper module and plug connectors together from the module. The Wipers should operate in LO and HI speed modes and Mist (washer) should work. If wipers and Mist now operate, replace intermittent wiper module. If not, go to step 10.

(9) Measure voltage at harness connector terminal E with wiper switch in LO and mist/intermittent. Meter should read battery voltage. If not, test switch.

(10) Measure voltage at harness connector terminal C with wiper switch in HI. Meter should read battery voltage. If not, test switch.

(11) Measure voltage at harness connector terminal F and move wiper switch to OFF. Meter should read battery voltage until wipers park and then zero volts. If not, replace switch.

(12) Disconnect switch side of connector of intermittent wiper module.

(13) Measure resistance across terminals A and D while rotating switch from minimum delay to maximum delay. Meter should read 0-500K ohms. If not, test switch.

(14) Measure resistance across terminals A and G while rotating switch from minimum delay to maximum delay. Meter should read 0-500K ohms. If OK, replace wiper module. If not, test switch.

(15) Measure resistance at terminal 4. Meter should read zero ohms. If not, repair open to ground.

(16) To test the wiper motor turn the ignition switch to ACCY. Position the wiper and probe the motor connector as indicated Figure 1.

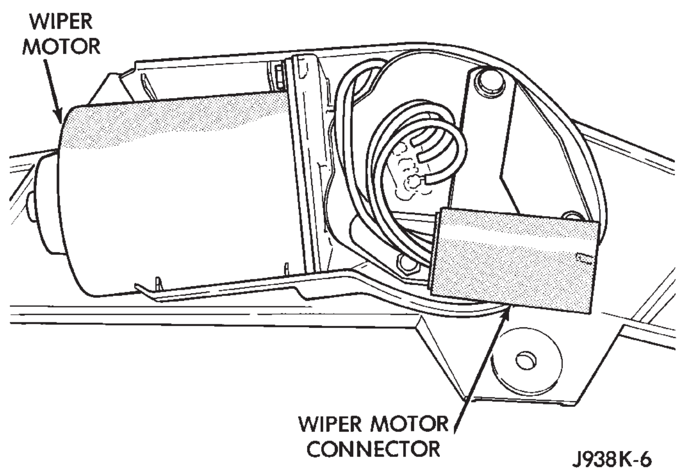


Fig. 1 Wiper Motor Connector

(17) Measure voltage at terminal 1,-wiper switch in any position. Meter should read battery voltage. If OK, replace motor. If not, repair open from fuse panel.

(18) Measure voltage at terminal 5,-wiper switch in LO. Meter should read battery voltage. If OK, replace motor. If not, repair open from wiper switch.

(19) Measure voltage at terminal 6,-wiper switch in HI. Meter should read battery voltage. If OK, replace motor. If not, repair open from wiper switch.

(20) Measure voltage at terminal 2-wiper switch to OFF with voltmeter connected. Meter should read battery voltage until wipers park and then zero volts. If OK, replace motor. If not, repair open from wiper switch.

INTERMITTENT WIPER FUNCTION TESTING PROCEDURES

The multifunction switch contains circuitry for:

- turn signal
- hazard warning
- headlamp beam select
- headlamp optical horn

- windshield wiper
- pulse wipe
- and windshield washer switching.

This integrated switch assembly is mounted to the left-hand side of the steering column. Should any function of the switch fail, the entire switch assembly must be replaced.

Using an ohmmeter, test for continuity between the terminals of the switch as shown in Intermittent Wipe Switch Continuity Chart.

To test the switch:

(1) Disconnect negative cable from the battery.

(2) Remove tilt lever (tilt column only).

(3) Remove both upper and lower steering column covers. Requires removal of 3 screws (Torx T-20).

(4) Remove 4 screws holding steering column trim panel (Fig. 2).

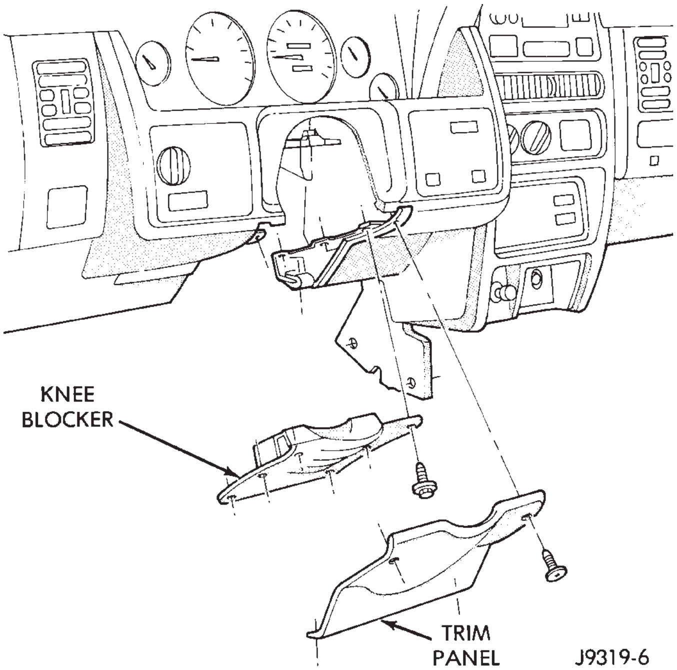


Fig. 2 Steering Column Trim And Knee Blocker

(5) Remove 6 screws holding knee blocker.

(6) Remove steering column retaining nuts.

(7) Lower steering column to gain access to rear of multifunction switch.

(8) Remove switch connector (Figs. 3 and 4).

If the problem occurs only in the DELAY mode, the following tests are to be performed. These tests involve disconnecting the intermittent wipe control unit which can be found on a bracket located on the driver's side kick panel.

CONDITION

Excessive delay (more than 30 seconds) or inadequate variation in delay.

PROCEDURE

Variations in delay should be as follows:

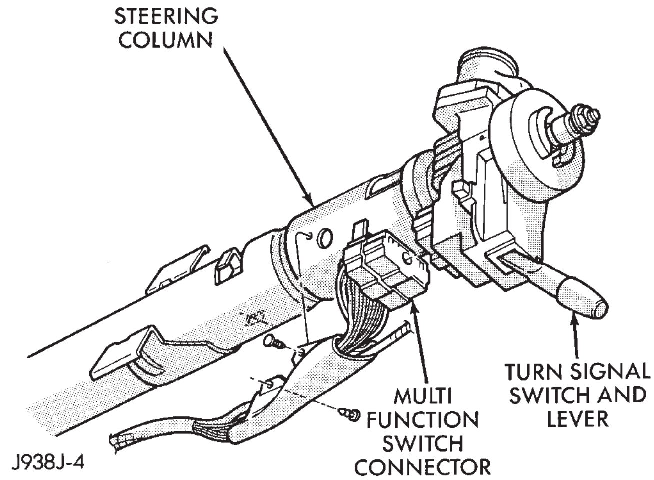


Fig. 3 Multifunction Switch Connector

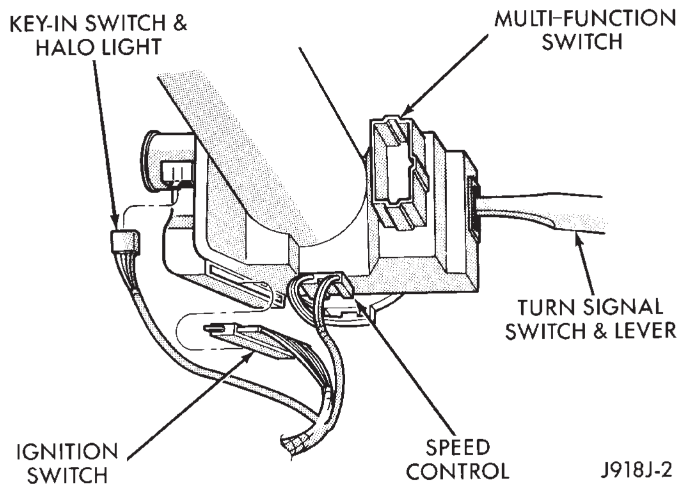


Fig. 4 Steering Column Connectors

(1) Minimum delay (delay control to extreme counterclockwise position before first detent) 1/2 to 2 seconds.

(2) Maximum delay (delay control to extreme clockwise position before off detent) 10 to 30 seconds.

(3) If there is excessive delay or no variations in delay proceed to intermittent wipe switch test.

CONDITION

In DELAY mode wipers run continually when wash is operated but do not provide an extra wipe when the wash control is released.

PROCEDURE

Replace the control unit.

CONDITION

Wipers start erratically during DELAY mode.

PROCEDURE

(1) Verify that the ground connection at the instrument panel is making good connection (free from paint) and is tight.

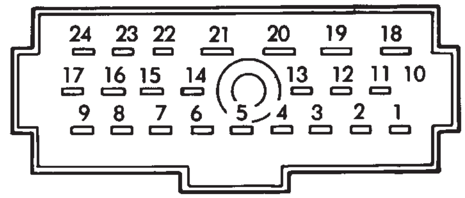
(2) Verify that the wiring ground connections are tight and have good contact.

(3) Verify that the wiring ground connections for the intermittent wipe control unit and the wiper switch are tight.

(4) If condition is not corrected, replace control unit.

MULTIFUNCTION (INTERMITTENT WIPER) SWITCH TESTING PROCEDURES

INTERMITTENT WIPE SWITCH CONTINUITY CHART



MULTIFUNCTION SWITCH PINS

SWITCH POSITION	CONTINUITY BETWEEN
OFF	PIN 6 AND PIN 7
DELAY	PIN 8 AND PIN 9 PIN 2 AND PIN 4 PIN 1 AND PIN 2 PIN 1 AND PIN 4
LOW	PIN 4 AND PIN 6
HIGH	PIN 4 AND PIN 5
WASH	PIN 3 AND PIN 4

*RESISTANCE AT MAXIMUM DELAY POSITION SHOULD BE BETWEEN 270,000 OHMS AND 330,000 OHMS.

*RESISTANCE AT MINIMUM DELAY POSITION SHOULD BE ZERO WITH OHMMETER SET ON HIGH OHM SCALE.

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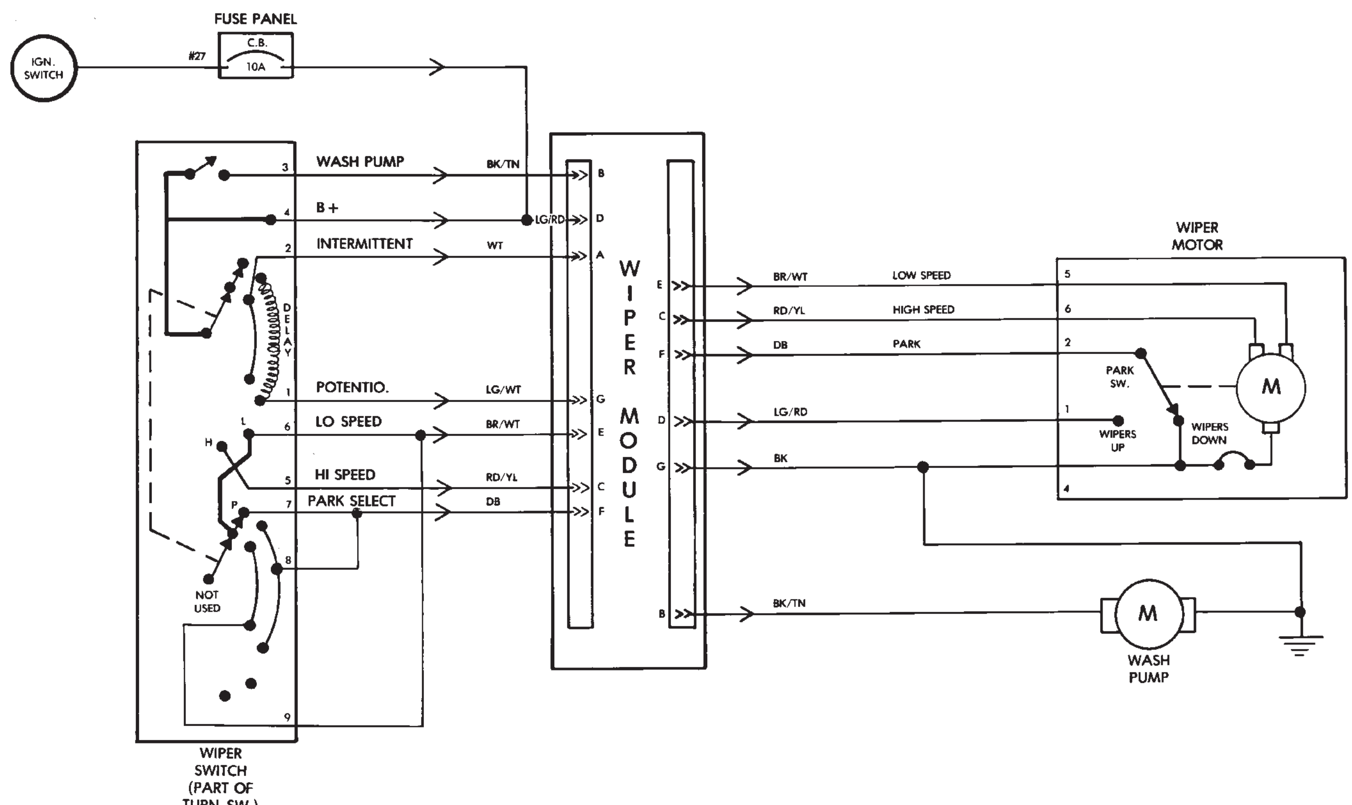
INTERMITTENT WIPER SYSTEM SCHEMATIC



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WIPER SWITCH REPLACEMENT

REMOVAL

(1) Disconnect negative cable from the battery.

(2) Remove tilt lever (tilt column only).

(3) Remove both upper and lower steering column covers. Requires removal of 3 screws (Torx T-20).

(4) Remove 4 screws holding steering column trim panel (Fig. 2).

(5) Remove 6 screws holding knee blocker.

(6) Remove steering column retaining nuts.

(7) Lower steering column to gain access to rear of multifunction switch.

(8) Remove multifunction switch tamper proof mounting screws (tamper proof torx bit Snap-On TTXR20B2 or equivalent required).

(9) Gently pull switch away from column. Loosen connector screw. The screw will remain in the connector.

(10) Remove wiring connector from multifunction switch (Fig. 5).

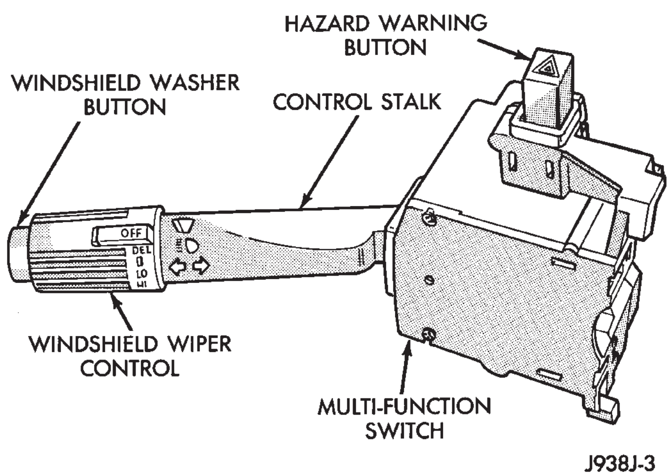

Fig. 5 Multifunction Switch

INSTALLATION

(1) Install wiring connector to switch and tighten connector retaining screw to 2 N●m (17 in. lbs.).

(2) Mount multifunction switch to column and torque retaining screws to 2 N●m (17 in. lbs.).

(3) Install steering column. Tighten nuts to (105 in. lbs.).

(4) Install knee blocker and trim panel.

(5) Install steering column covers. Torque screws to 2 N●m (17 in. lbs.).

(6) Install tilt lever (tilt column only).

(7) Install battery negative cable.

(8) Check all functions of switch for proper operation.

WASHER PUMP REPLACEMENT

(1) Remove 3 screws holding reservoir to driver's fender (Fig. 6)

(2) Disconnect hose from pump(s) (Fig. 6).

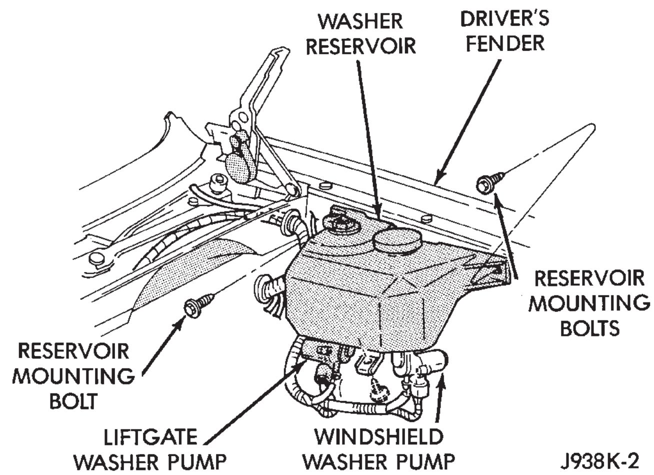

Fig. 6 Washer Reservoir Mounting

(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).

WIPER MOTOR REPLACEMENT

REMOVAL

(1) Remove wiper arms by lifting up wiper arm and slide tap out.

(2) Remove 6 screws holding the cowl grille (Fig. 7).

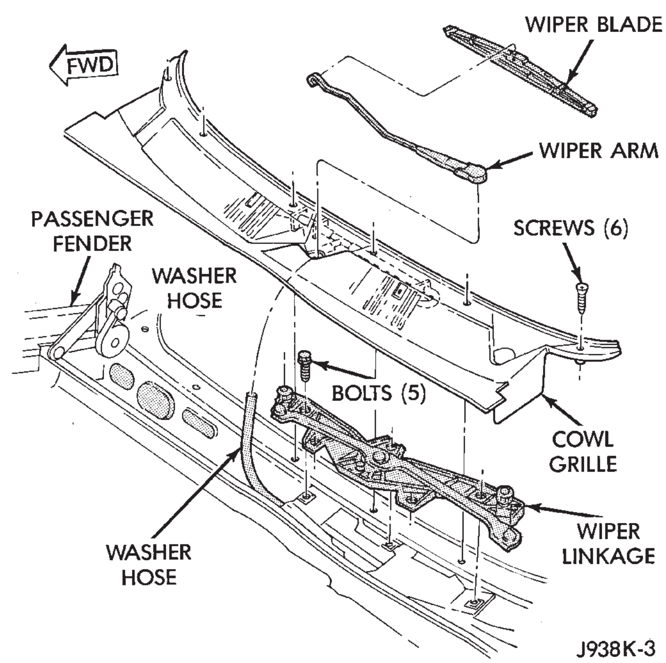

Fig. 7 Wiper Linkage Removal

(3) Disconnect washer hose and set cowl grille aside.

(4) Remove 5 bolts holding wiper linkage assembly.

(5) Turn linkage over and remove the nut holding the crank arm to the motor.

(6) Remove 3 screws holding motor to linkage (Fig. 8) and remove motor.

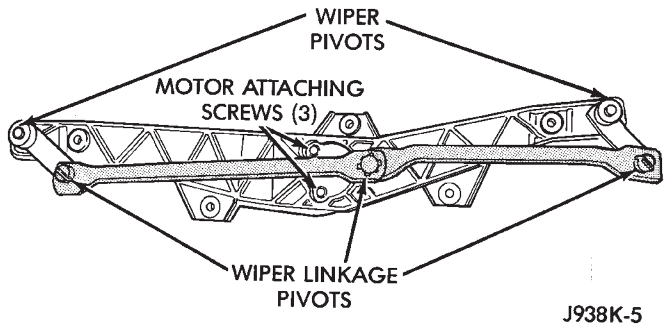

Fig. 8 Wiper Motor Removal

INSTALLATION

(1) Install motor and tighten screws to 5-7 N●m (44-62 in. lbs.).

(2) Install crank arm to motor and tighten nut to 10-12 N●m (88-106 in. lbs.)

(3) Install linkage assembly and tighten screws to 8 N●m (72 in. lbs.).

(4) Connect washer hose to cowl grille and install grille.

(5) Install wiper arms on pivot as shown in Figure 9 and release tabs.

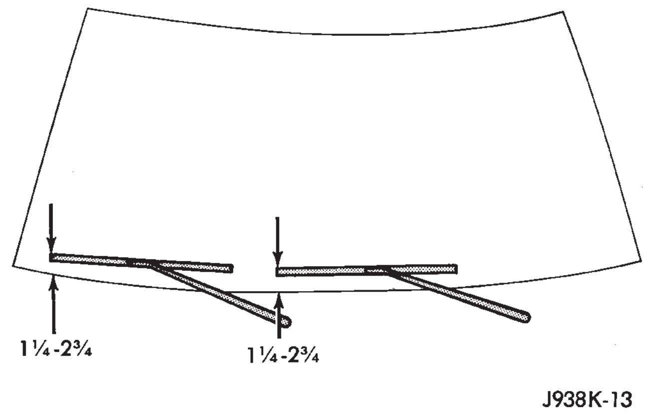

Fig. 9 Front Wiper Arm Positioning

REAR WINDOW WIPER/WASHER

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GENERAL INFORMATION

The rear wiper system provides four operating modes:

- Intermittent wipe with a 5 to 8 second delay between sweeps.
- Continuous wipe.
- Park mode which operates when the rear wiper switch is turned off.
- Rear washer with 2-3 sweeps in any of the other operating modes.

The rear wiper motor contains electronic controls to provide four operating modes. It receives signal currents from the rear wiper switch for these four modes.

The rear wiper switch is located in the right hand switch pod and is supplied current when the ignition switch is in the ON position. When the switch is placed in the ON position current is supplied to the electronic motor controls. When the switch is placed in the DELAY position it provides current to the rear wiper motor electronic controls and timer to control the pulse. When the switch is PUSHED to the wash position it provides current to both the motor electronics and the rear washer pump. The switch is spring loaded in the wash position.

The rear washer reservoir and pump are located on the left inner fender in the engine compartment. The pump is fed current from the rear wiper switch. Washer fluid is routed from the pump through a rubber hose which is run in the electrical harness to the right of the quarter panel.

DIAGNOSING REAR WIPER

(1) Remove and inspect 20 amp fuse #9 in the fuse panel. Replace as required.

(2) Remove liftgate cover, refer to Rear Wiper Motor Replacement.

(3) Measure resistance between Rear Wiper motor connector terminal 3 and ground. Meter should read zero ohms. If not, repair open to splice in body harness.

(4) Turn ignition switch to RUN and place wiper switch in WASH. Measure voltage at Rear Wiper motor connector terminal 5. Meter should read battery voltage. If not, go to step 6.

(5) Place wiper switch in ON. Measure voltage at Rear Wiper motor connector terminal 2. Meter should read battery voltage. If not, go to step 6.

(6) Remove switch and reconnect below Instrument panel; back probe switch connector, with ignition key in RUN position.

(7) Measure voltage at switch connector terminal 1. Meter should read battery voltage. If not, repair open to fuse #9.

(8) Push switch to WASH. Measure voltage at switch connector terminal 4. Meter should read battery voltage. If OK, repair open to Rear Wiper Motor terminal 5. If not, replace switch.

(9) Move switch to ON. Measure voltage at switch connector terminal 3. Meter should read battery voltage. If OK, repair open to Rear Wiper motor terminal 2. If not, replace switch.

(10) Move switch to DELAY. Measure voltage at switch connector terminal 2. Meter should read battery voltage. If OK, repair open to Rear Wiper motor terminal 4. If not, replace switch.

DIAGNOSING REAR WASHER

Refer to Rear Wiper/Washer Circuitry

(1) Turn ignition switch to RUN and place rear wiper/washer switch to ON. If motor does not operate check fuse #9 in the fuse panel.

(2) Unplug Rear Washer Pump connector.

(3) Measure resistance at pump connector terminal B (ignition switch off). Meter should read zero ohms. If not, repair open to ground.

(4) Turn ignition switch to RUN.

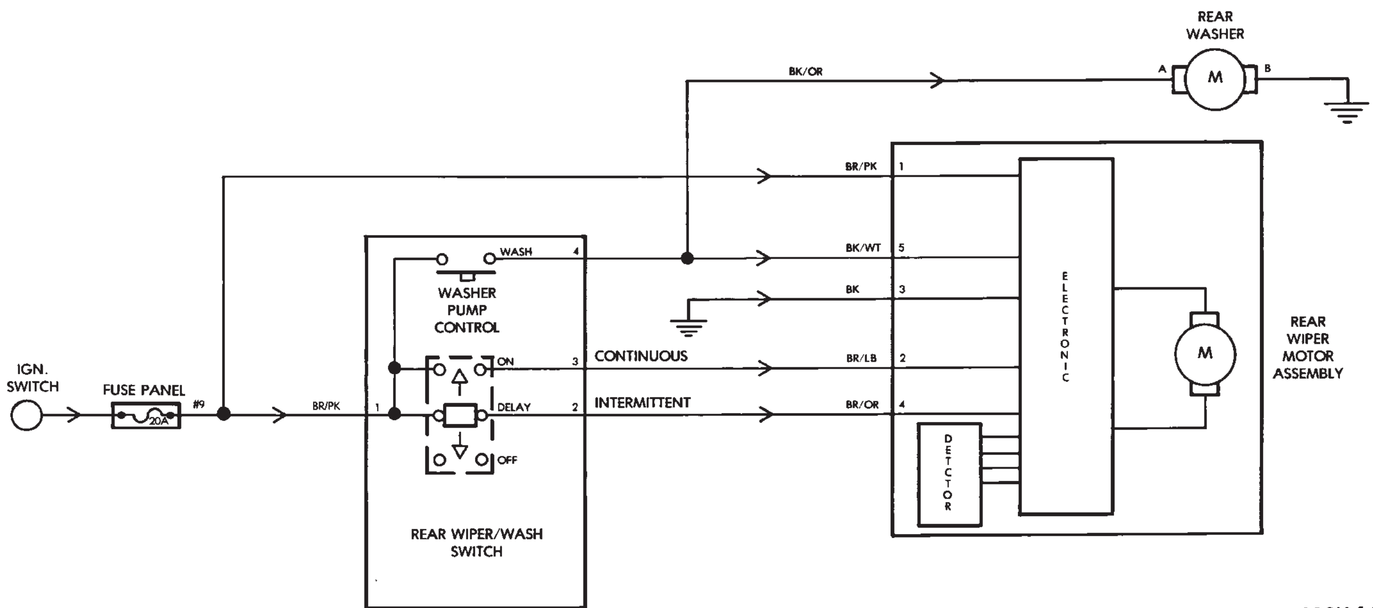
(5) Measure voltage at pump connector terminal A, switch in WASH. Meter should read battery voltage. If OK, replace pump. If not, go to step 6.

(6) Remove switch and reconnect below instrument panel. Backprobe switch connector with ignition switch in RUN.

(7) Measure voltage at switch connector terminal 1. Meter should read battery voltage. If not, repair open to fuse #9.

(8) Measure voltage at switch connector terminal 4, switch in WASH. Meter should read battery voltage. If not, replace switch.

REAR WIPER/WASHER CIRCUITRY



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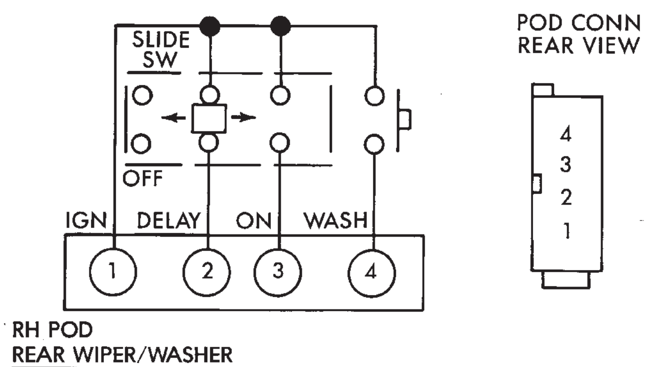
REAR WIPER/WASHER SWITCH TESTING



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WIPER BLADE REPLACEMENT

(1) Lift the wiper arm and place a 1/8 inch pin into the arm pin hole (Fig. 1).

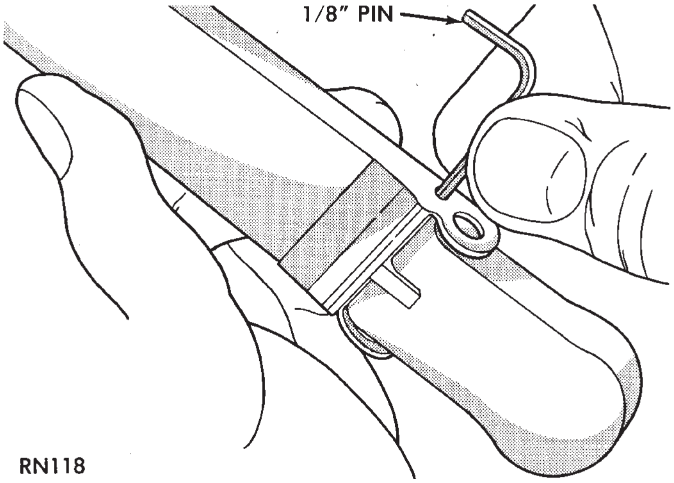


Fig. 1 Removing Wiper Arm

(2) Turn the release lever (Fig. 2), then pull blade from wiper arm pin.

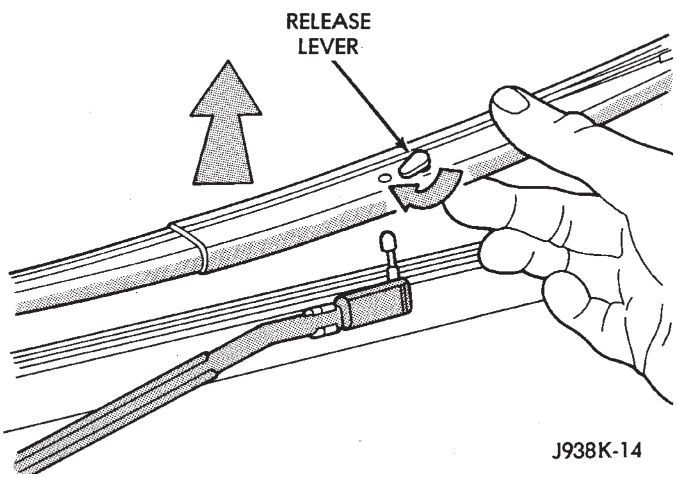


Fig. 2 Wiper Blade Removal

(3) When installing the blade, make sure the release lever is not between the blade and arm.

REAR WIPER MOTOR REPLACEMENT

REMOVAL

(1) Lift the wiper arm and place a 1/8 inch pin into the arm pin hole (Fig. 1).

(2) Remove the wiper arm assembly from the pivot pin by depressing the tab (Fig. 3) and pulling straight out on wiper arm.

(3) Remove motor retaining nut (Fig. 4).

(4) Remove external bezel.

(5) Remove 5 screws holding liftgate interior trim panel.

(6) Remove the trim panel with a wide flat blade tool (Fig. 5).

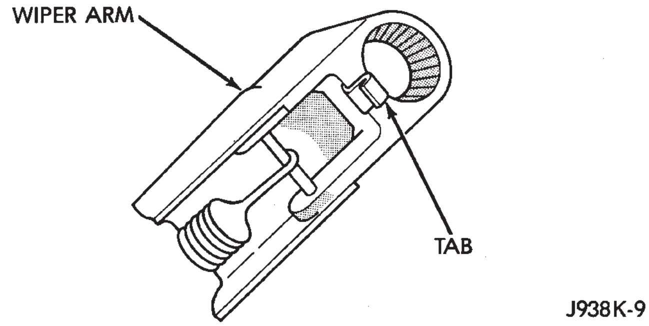


Fig. 3 Rear Wiper Arm Removal

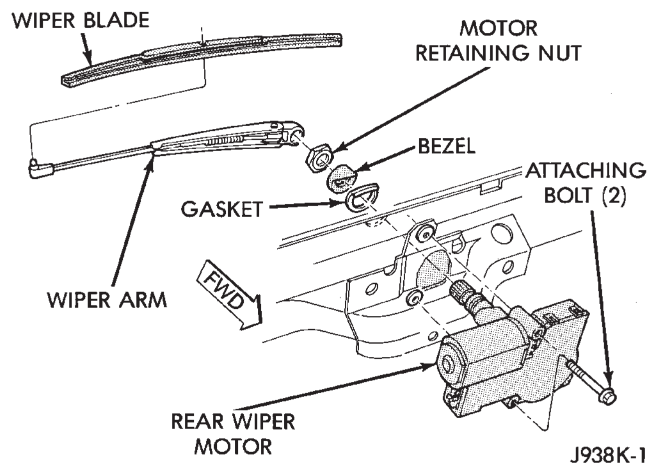


Fig. 4 Rear Wiper Motor Removal/Installation

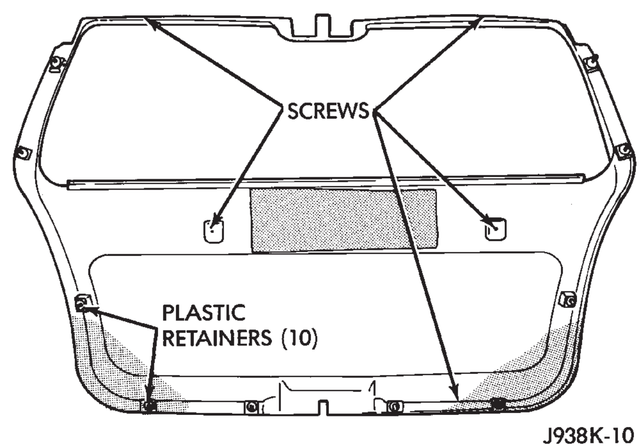


Fig. 5 Liftgate Trim Panel Removal

To aid in removal of the trim panel, start at the bottom of the panel.

(7) Unplug the harness connector from the motor.

(8) Remove 2 wiper motor mounting bolts.

(9) Remove the wiper motor.

INSTALLATION

(1) Position the motor (Fig. 4) in the liftgate cavity with the knurled driver protruding through the hole in the liftgate and the gasket.

(2) Install the mounting bolts. Tighten bolts to 1-1.7 N●m (10-15 in. lbs.).

(3) Connect the wiring harness.

(4) Install the bezel and motor retaining nut (Fig. 3). Torque nut to 4-5.6 N●m (35-50 in. lbs.).

(5) Install the liftgate trim panel.

(6) Install the wiper arm assembly.

The blade should be positioned as shown in Figure 6.

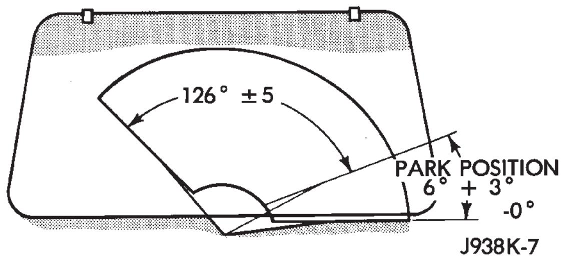


Fig. 6 Rear Wiper Arm Positioning

REAR WASHER NOZZLE

To remove the rear washer nozzle push up on the nozzle (Fig. 7). There is a small tang that will release.

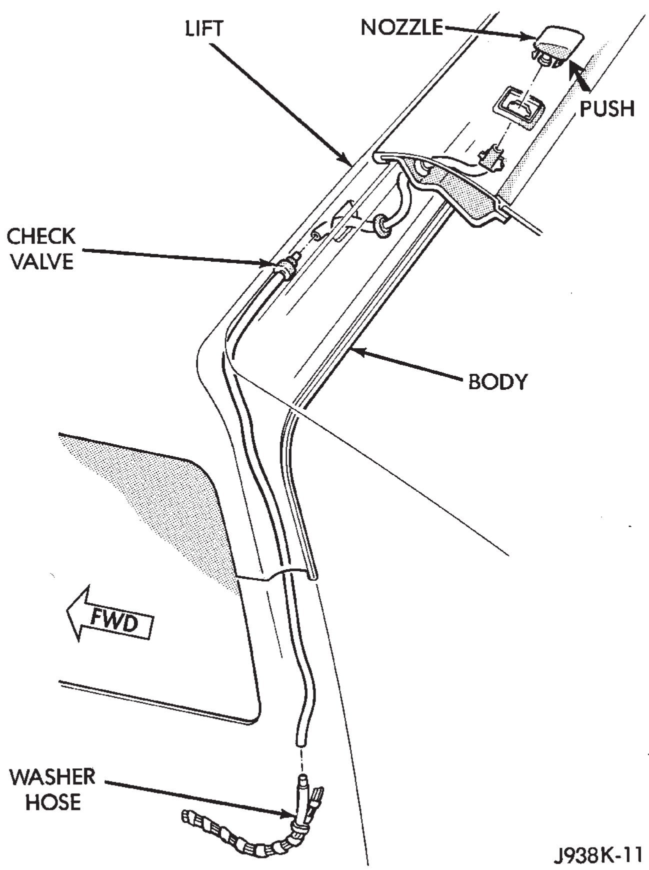


Fig. 7 Rear Washer Nozzle And Hose

REAR WIPER SWITCH REPLACEMENT

(1) Disconnect negative cable from the battery.

(2) Remove ash tray.

(3) Remove 6 screws holding center cluster bezel (Fig. 8).

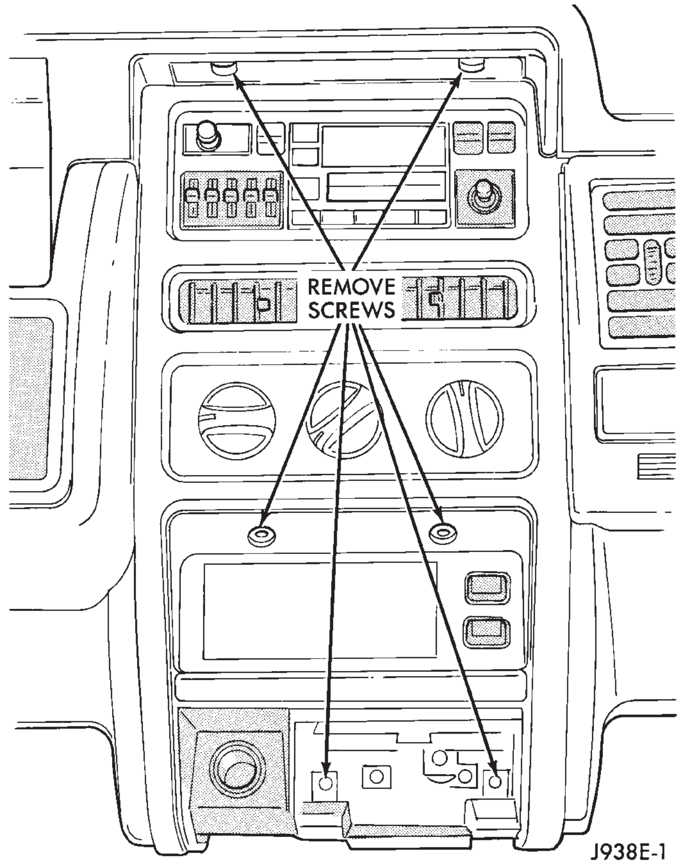


Fig. 8 Remove Center Bezel Upper Screws

(4) Remove center bezel.

(5) Remove 2 screws holding dash pad located behind top of center bezel.

(6) Gently pry defroster grille out of dash pad.

(7) Unplug sensors (if equipped) and set defroster grille aside.

(8) Remove 4 screws in defroster duct opening holding dash pad (Fig. 9).

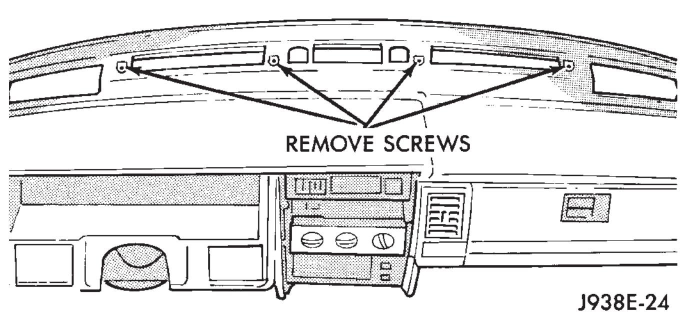


Fig. 9 Upper Dash Pad Attaching Screws

(9) Remove 3 screws above Instrument Panel cluster holding dash pad (Fig. 10).

(10) Open glove box and remove 2 screws holding dash pad.

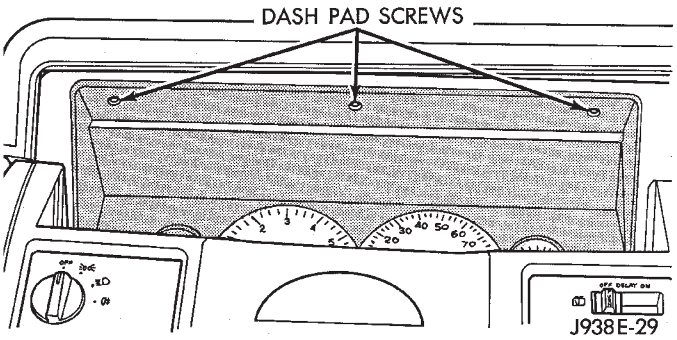


Fig. 10 Remove Screws Holding Dash Pad

(11) Remove dash pad pulling up to unsnap end clips.

(12) With driver's door open remove 1 screw from the side of the lower trim panel (Fig. 11).

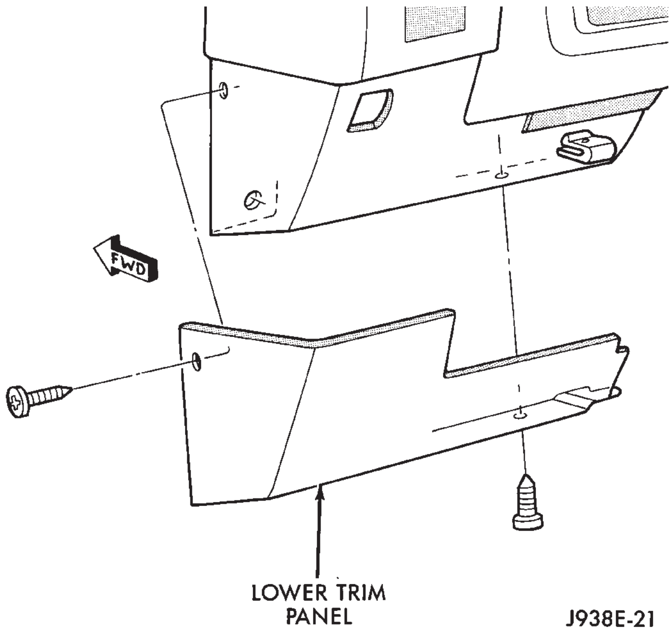


Fig. 11 Lower Trim Panel

(13) Remove 4 screws holding the steering column cover (Fig. 12).

(14) Remove 1 screw from bottom of lower trim panel and pull panel off. There is also a clip holding the panel to the instrument panel.

(15) Remove 6 screws holding knee blocker.

(16) Remove steering column retaining nuts.

(17) Remove 3 screws holding bottom of bezels (Fig. 13).

(18) Remove 2 screws holding top of end and switch pod bezels (Fig. 14). The end bezel can now be removed.

(19) Remove 2 screws holding left side of switch pod bezel (Fig. 15).

(20) Remove 3 screws holding right hand side of switch pod bezel (Fig. 16).

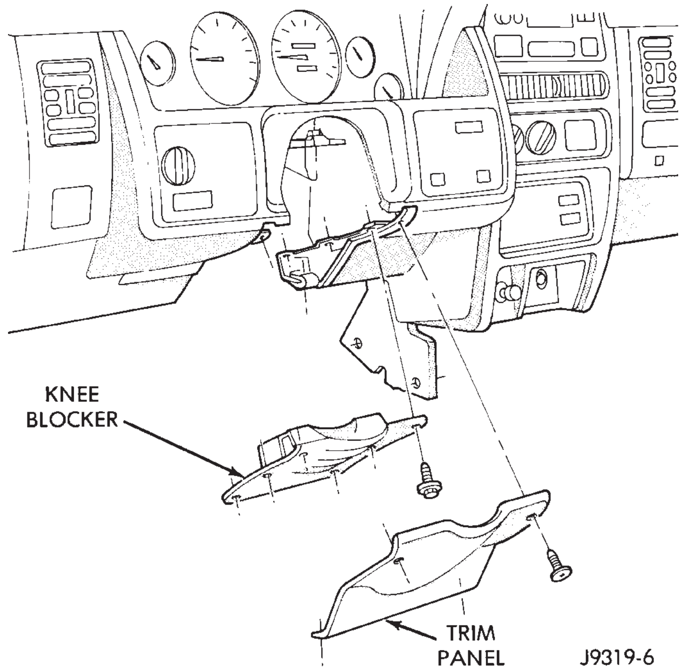


Fig. 12 Steering Column Cover and Knee Blocker

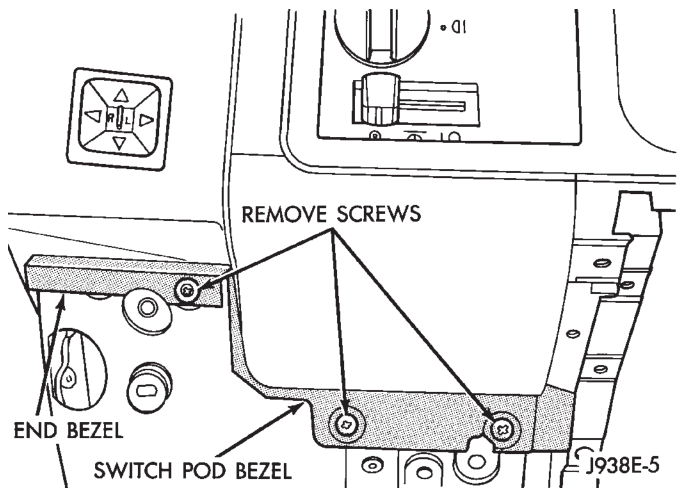


Fig. 13 Remove Screws Holding Bottom Of Bezels

(21) Pull switch pod bezel out far enough to remove switch connectors. Disconnect connectors from each switch pod and remove bezel (Fig. 17).

(22) Remove required switch attaching screws and switch.

(23) Reverse the removal procedures to install a new switch. Tighten steering column retaining nuts to 105 in. lbs.

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. For replacement refer to the front washer pump replacement procedure.

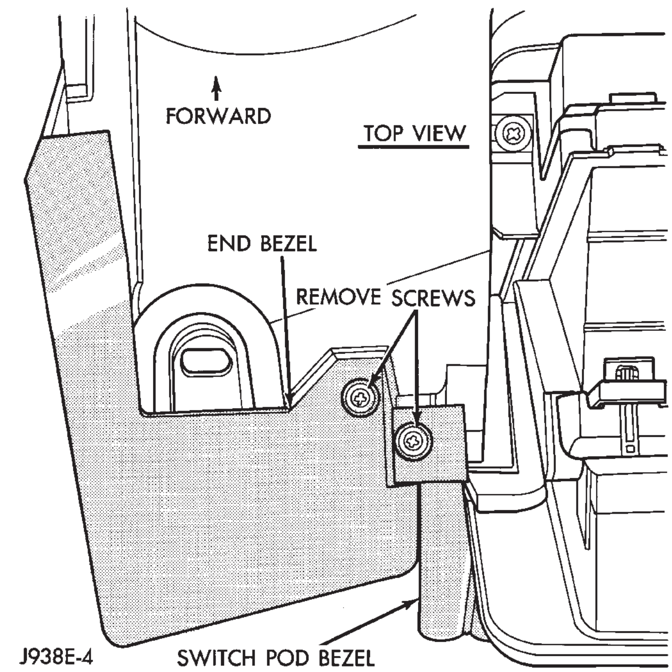


Fig. 14 Remove Screws Holding Top Of Bezels

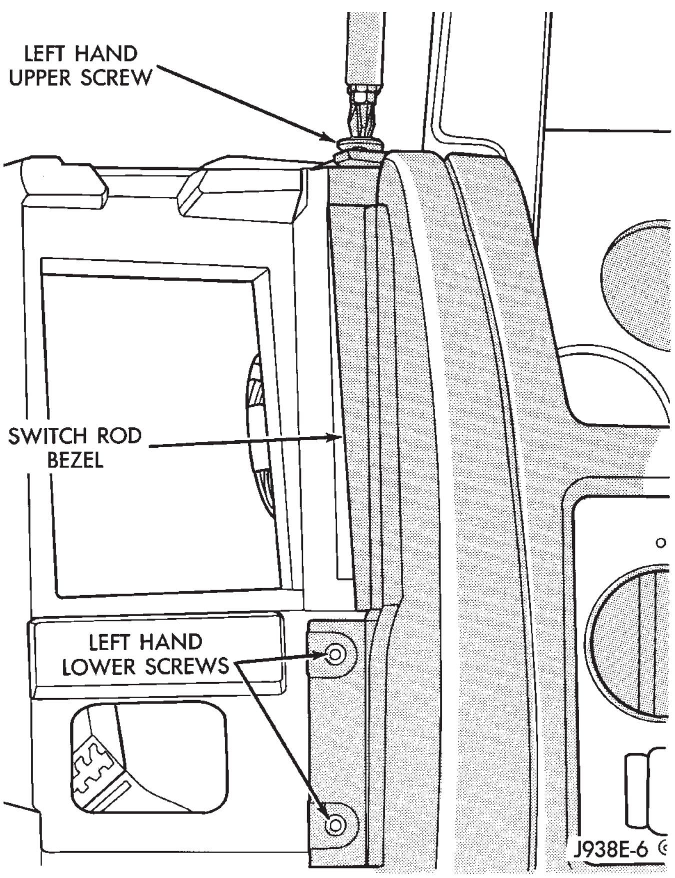


Fig. 15 Left Hand Switch Pod Bezel Screws

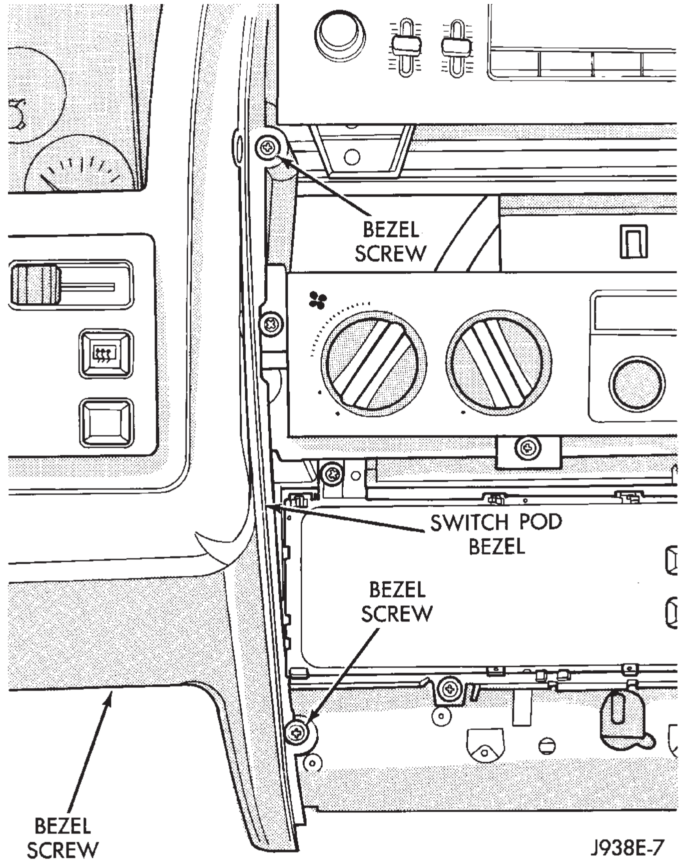


Fig. 16 Right Hand Switch Pod Bezel Screws

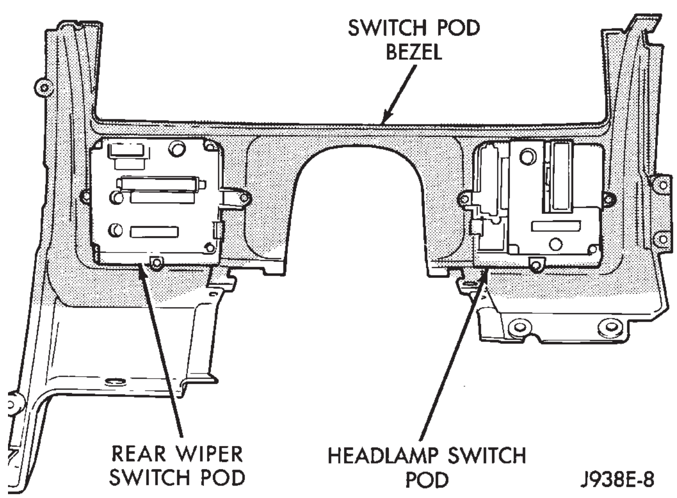


Fig. 17 Rear View of Switch Pod Bezel

LAMPS

CONTENTS

GENERAL INFORMATION

Each vehicle is equipped with various lamp assemblies. A good ground is necessary for proper lighting operation. Grounding is provided by the lamp socket when it comes in contact with the metal body, or through a separate ground wire.

When changing lamp bulbs check the socket for corrosion. If corrosion is present, clean it with a wire brush. Coat the inside of the socket lightly with Mopar® Multi-Purpose Grease or equivalent.

Aero headlamps use a replaceable bulb that is mounted in a molded plastic lens.

DIAGNOSTIC PROCEDURES

Always begin any diagnosis by testing all of the fuses and circuit breakers in the system. Refer to Group 8W, Wiring Diagrams.

LEFT HAND SWITCH POD

The multi-function switch pod contains electrical circuitry for:

- Auto Headlamps
- Park Lamps
- Headlamps
- Low Beam/Fog Lamp
- Instrument Lamp Intensity
- Dome Lamp

This multi-function switch pod is mounted to the left hand side of the instrument panel. Should any function of the switch fail, other than illumination bulbs, the entire switch pod must be replaced.

The multi-function switch also serves as a fog lamp lock-out circuit. The circuit to the fog lamp switch is completed only when the dimmer switch is in the low beam position.

TURN SIGNAL/DIMMER SWITCH

This integrated switch is mounted to the left of the steering column. Should any function of this switch fail, the entire switch must be replaced. Refer to Group 8J, Turn Signals And Hazard Warning Flasher for service procedures.

DIMMER SWITCH TEST

(1) Disconnect battery negative cable.

(2) Remove tilt lever.

(3) Remove screws along bottom edge of steering column.

(4) Remove upper and lower shrouds to gain access to the switch connector (Fig. 1).

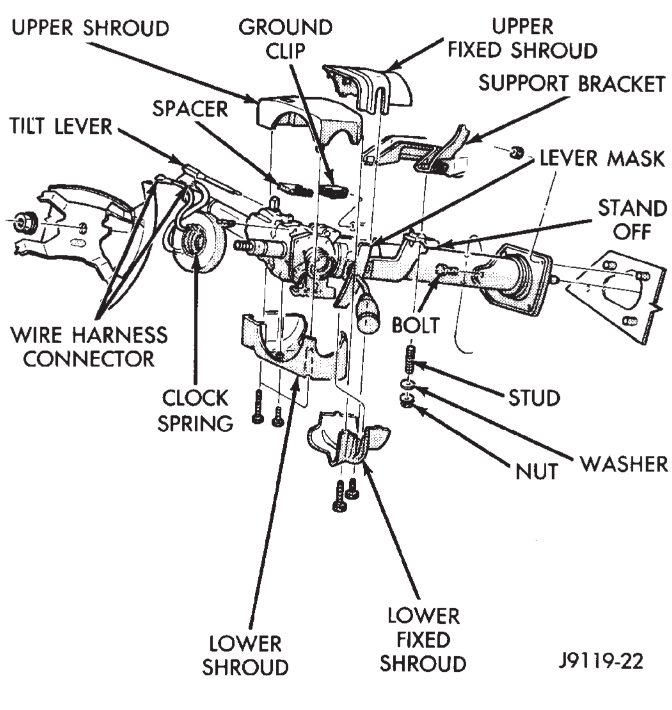


Fig. 1 Steering Column Covers

(5) Remove switch connector (Figs. 2 and 3).

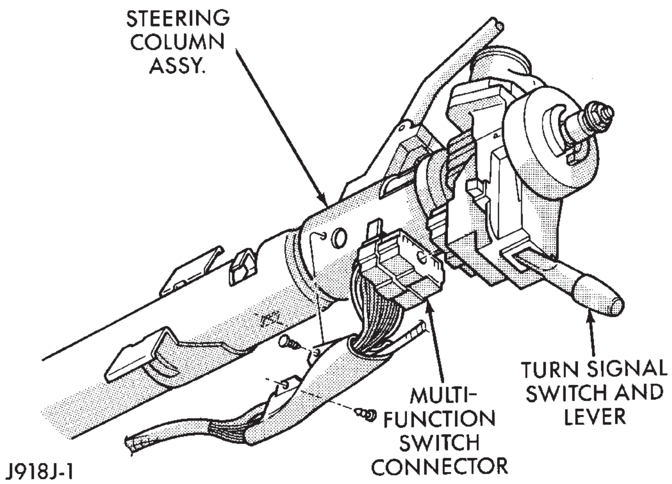


Fig. 2 Multi-function Switch Connector

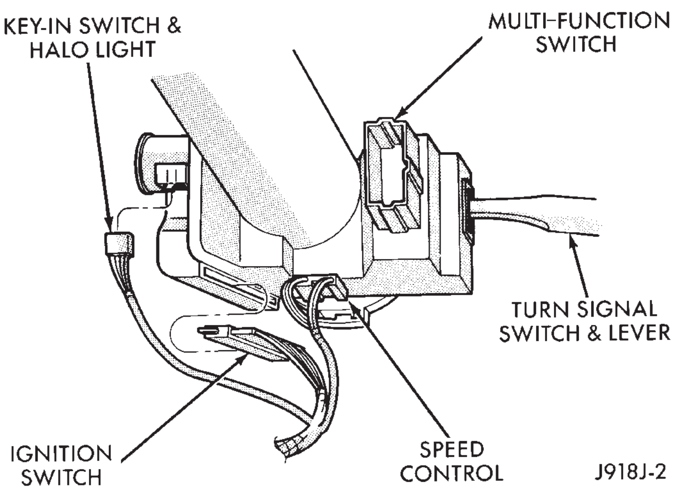
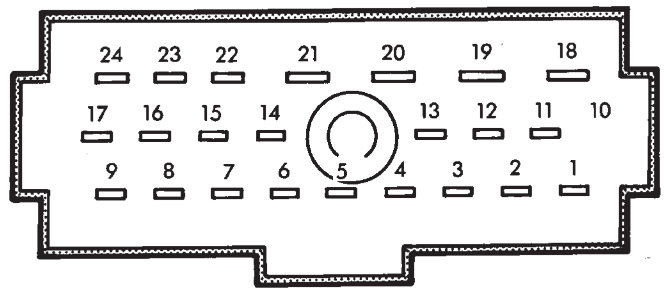


Fig. 3 Steering Column Connectors

(6) Use an ohmmeter to test for continuity between the terminals of the switch as shown in the chart (Fig. 4).

(7) Refer to Service Procedures for assembly.



SWITCH POSITION	CONTINUITY BETWEEN
LOW BEAM	18 AND 19
HIGH BEAM	19 AND 20
OPTICAL HORN	20 AND 21

908J-5

Fig. 4 Dimmer Switch Continuity Chart

SERVICE PROCEDURES

INDEX

HEADLAMP ALIGNMENT

Headlamps can be aligned using the screen method provided in this section. Alignment Tool C4466-A or equivalent can also be used. Refer to instructions provided with the tool for proper procedures. **The preferred headlamp alignment setting is 0 for the left/right adjustment and 1″ down for the up/down adjustment.**

HEADLAMP ALIGNMENT PREPARATION

(1) Verify headlamp dimmer switch and high beam indicator operation.

(2) Correct defective components that could hinder proper headlamp alignment.

(3) Verify proper tire inflation.

(4) Clean headlamp lenses.

(5) Verify that luggage area is not heavily loaded.

(6) Fuel tank should be FULL. Add 2.94 kg (6.5 lbs.) of weight over the fuel tank for each estimated gallon of missing fuel.

HEADLAMP/FOG LAMP ADJUSTMENT USING ALIGNMENT SCREEN

ALIGNMENT SCREEN PREPARATION

(1) Position vehicle on a level surface. Perpendicular to a flat wall 7.62 meters (25 ft) away from front of headlamp lens.

(2) If necessary, tape a line on the floor 7.62 meters (25 ft) away from and parallel to the wall (Fig. 1).

(3) From the floor up 1.27 meters (5 ft), tape a line on the wall at the centerline of the vehicle. Sight along the centerline of the vehicle to verify accuracy of line placement.

(4) Rock vehicle side-to-side three times to allow suspension to stabilize.

(5) Jounce front suspension three times by pushing downward on front bumper and releasing.

(6) Measure the distance from the center of headlamp lens to the floor. Transfer measurement to the alignment screen (with tape). Use this line for up/down adjustment reference.

(7) Measure distance from the centerline of the vehicle to the center of each headlamp being aligned. Transfer measurements to screen (with tape) to each side of vehicle centerline. Use these lines for left/right adjustment reference.

HEADLAMP ADJUSTMENT

A properly aimed low beam will project the top edge of high intensity pattern on the screen from 50 mm (2 in.) above to 50 mm (2 in.) below headlamp centerline. The side-to-side left edge of high intensity pattern should be from 50 mm (2 in.) left to 50 mm (2 in.) right of headlamp centerline (Fig. 1). **The preferred headlamp alignment is 0 for the left/right adjustment and 1″ down for the up/down adjustment.** The high beams on a vehicle with aero headlamps cannot be aligned. The high beam pattern should be correct when the low beams are aligned properly.

To adjust headlamp aim, rotate alignment screws.

FOG LAMP ADJUSTMENT

Prepare an alignment screen. A properly aligned fog lamp will project a pattern on the alignment screen 100 mm (4 in.) below the fog lamp centerline and straight ahead (Fig. 3).

AERO HEADLAMP REPLACEMENT

CAUTION: Do not touch the bulb glass with fingers or other oily surfaces. Reduced bulb life will result.

(1) Grasp lower edge of headlamp lens. Pull straight back (away) from grille opening reinforcement (GOR). Disengage lower adjuster pivots from lens assembly (Fig. 4).

(2) Grasp upper edge of headlamp lens. Pull straight back from grille opening reinforcement (GOR). Disengage upper adjuster pivot from lens assembly.

(3) Locate and disconnect the 3 wire connector behind the headlamp.

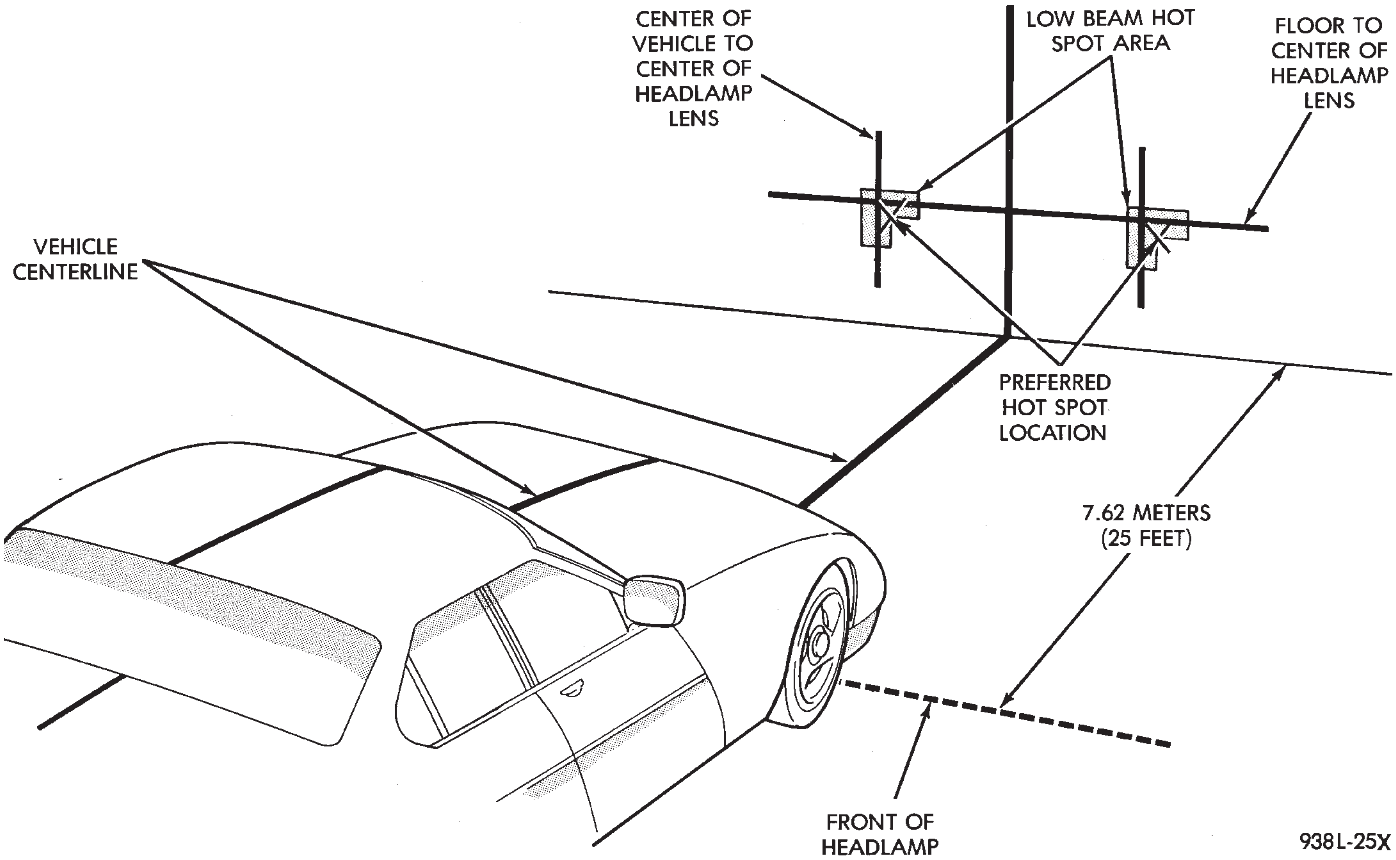


Fig. 1 Headlamp Alignment Screen —Typical

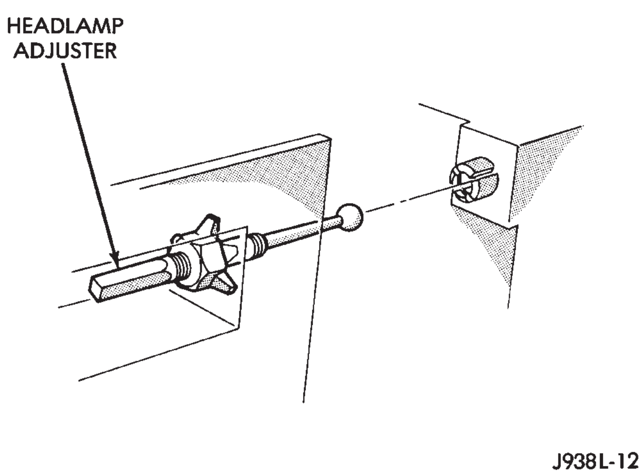


Fig. 2 Aero Headlamp Alignment

HEADLAMP BULB REMOVAL

(1) Lift hood to access lamps.

(2) Reach into engine compartment and locate lock ring supporting the headlamp bulb assembly.

(3) Rotate the lock ring 1/8 turn counterclockwise (Fig. 5).

(4) Pull the bulb (9004) straight out from the housing. This is a halogen bulb, take care not to touch it with your fingers.

(5) Replace by seating the assembly in the lamp housing and turning the lock ring 1/8 turn clockwise to secure.

PARKING LAMP BULB/LENS REPLACEMENT

The parking lamp is mounted on the side of the GOR next to headlamp assembly.

(1) Open hood.

(2) Remove two screws which hold the parking lamp in position (Fig. 6).

(3) Disengage lamp and grasp and pull bulb (194 NA) to remove.

To install, reverse the removal procedure.

TURN SIGNAL AND SIDE MARKER LAMP

(1) The parking lamp must be removed to get to attaching screws for this lamp.

(2) Remove the two screws and slide lamp outboard to expose the bulb (Fig. 7).

(3) To replace turn signal bulb, press in on bulb (1295na) and rotate 1/4 turn to remove.

(4) To replace sidemarker bulb (194na) grasp and pull from lamp.

(5) After replacing bulb, slide lamp into slot provided on inboard side of headlamp assembly. Replace two screws and replace parking lamp.

FOG LAMPS

Fog lamps are turned OFF by the circuit relay

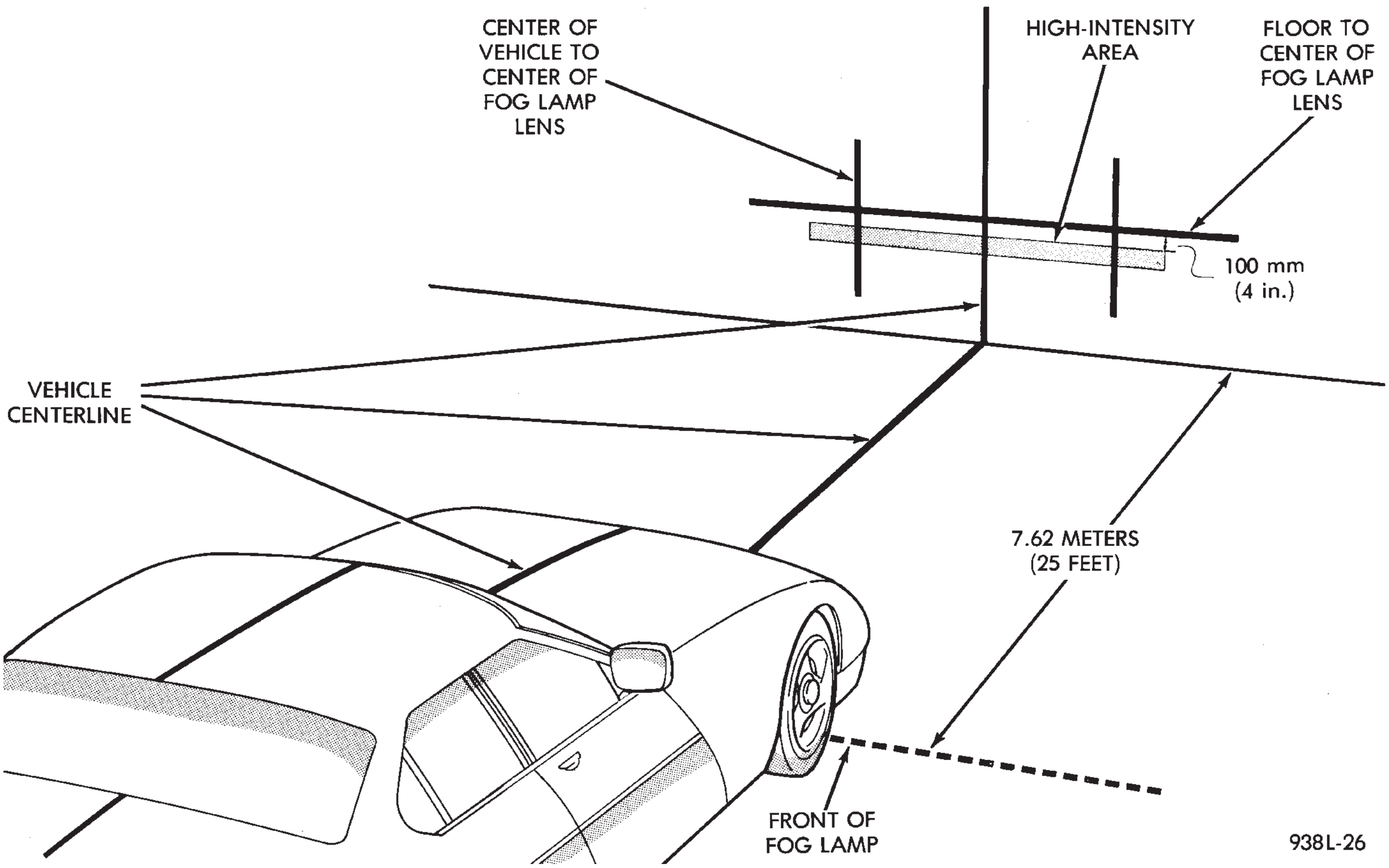


Fig. 3 Fog Lamp Alignment —Typical

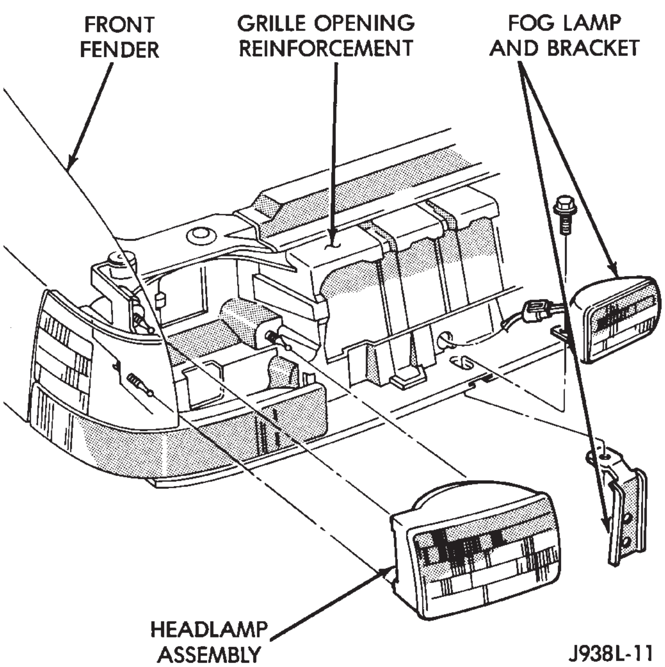


Fig. 4 Headamp Removal

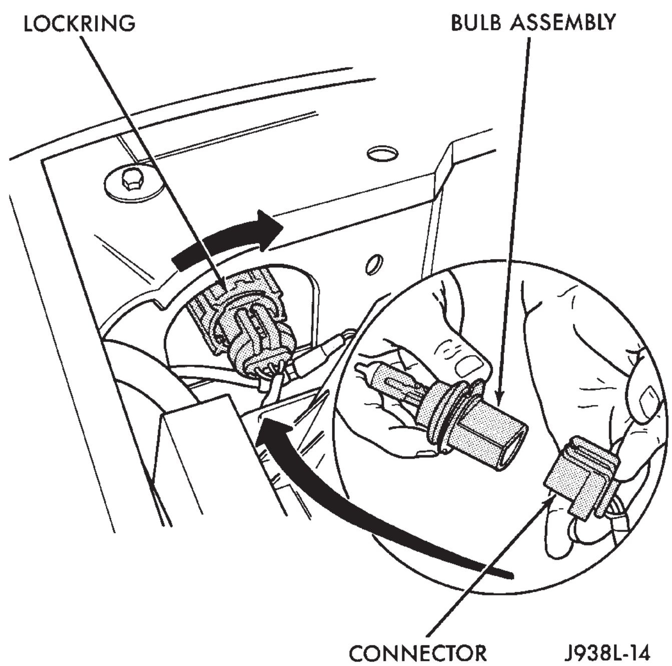


Fig. 5 Headlamp Bulb Removal

when high beam driving lamps are turned ON.

Fog lamps may be operated ONLY when low beam headlamps are ON. If the headlamps are switched to high beam, the fog lamps will turn OFF. The fog lamps will go back on when the high beams are switched OFF.

FOG LAMP BULB/LENS REPLACEMENT

CAUTION: Do not touch the bulb glass with fingers or other oily surfaces. Reduced bulb life will result.

(1) Remove center pivot bolt and disconnect wire

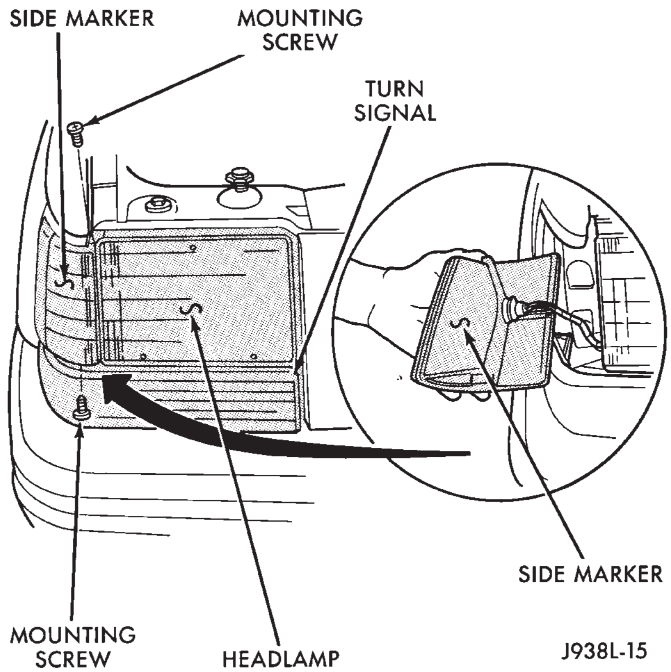


Fig. 6 Parking Lamp Removal

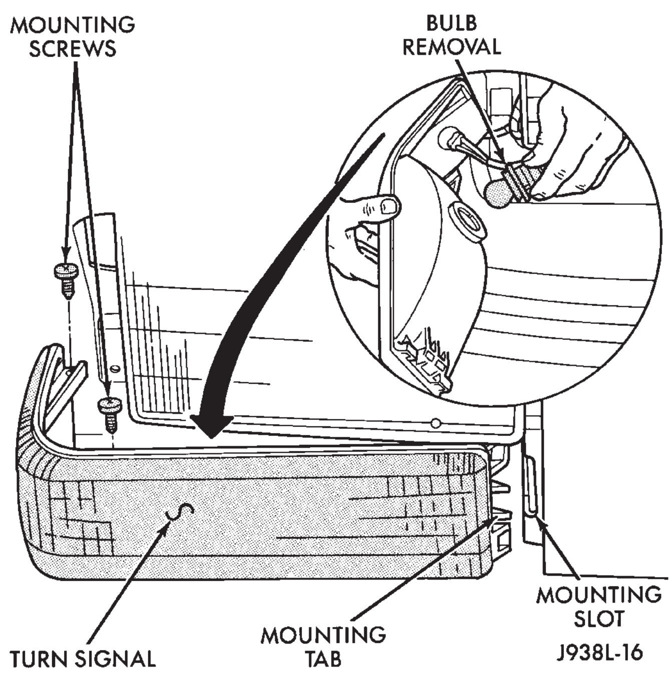


Fig. 7 Turn Signal And Side Marker

connector.

(2) Remove the 2 screws attaching the lens to the lamp housing. Remove lens from lamp housing.

(3) Remove spring clip holding bulb to lens.

(4) Disconnect 2 wire connectors at bulb.

(5) Remove bulb element from lens.

(6) To install, reverse the removal procedure.

HEADLAMP SWITCH

To remove or replace headlamp switch. Refer to Group 8E, Instrument Panel and Gauges.

TURN SIGNAL/DIMMER SWITCH

To remove or replace dimmer switch, Refer to Group 8J, Turn Signals and Hazard Flasher.

FOG LAMP SWITCH REPLACEMENT

The fog lamp switch is integrated into the headlamp switch. The switch is located on the left hand side of instrument panel.

TAIL AND STOP LAMPS

To remove or replace bulbs.

(1) Remove three lamp screws and separate lamp from body (Fig. 8).

(2) Grip top bulb socket and rotate counterclockwise. Separate socket and bulb from lens (Fig. 9).

(3) Rotate bulb in socket counterclockwise. Remove bulb from socket.

To install, reverse the removal procedures.

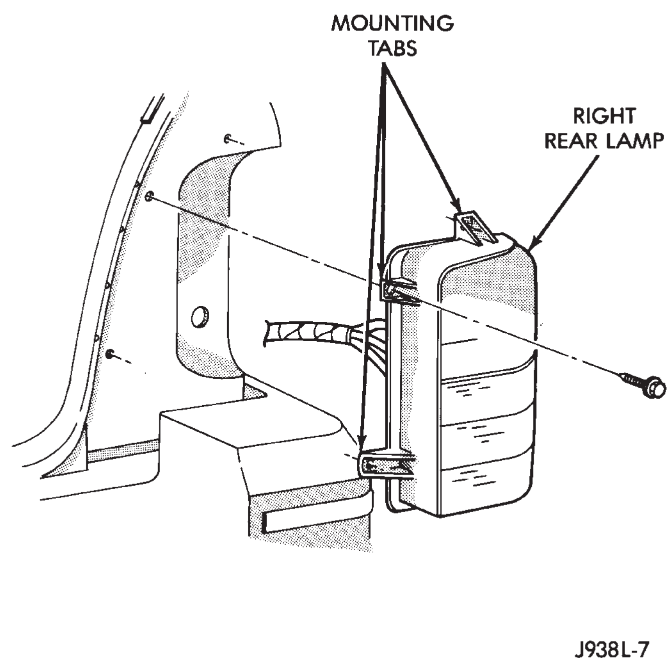


Fig. 8 Rear Lamps

BACKUP LAMPS

To remove or replace backup lamp bulbs:

(1) Remove three lamp screws and separate lamp from the body (Fig. 8).

(2) Grip second bulb socket from top and rotate counterclockwise. Separate socket from lamp (Fig. 9).

(3) Rotate bulb in the socket counterclockwise. Remove bulb from socket.

To install reverse the removal procedures.

BACKUP LAMP SWITCH

The backup lamp switch service instructions can be found in Group 21, Transmission.

TURN SIGNAL LAMP

(1) Remove three lamp screws and separate the lamp from body (Fig. 8).

(2) Grip bottom bulb socket and rotate counterclockwise. Separate socket from lamp (Fig 9).

(3) Rotate bulb in socket counterclockwise. Remove bulb from socket.

To install, reverse the removal procedure.

REAR SIDE MARKER LAMP

The rear side marker lamp is incorporated into the tail lamp.

(1) Remove three lamp screws and separate lamp from body (Fig. 8).

(2) Grip bulb socket located on the side of lens. Rotate counterclockwise. Separate socket from lamp (Fig. 9).

(3) Rotate bulb in the socket counterclockwise. Remove bulb from socket (Fig. 9).

To install, reverse the removal procedure.

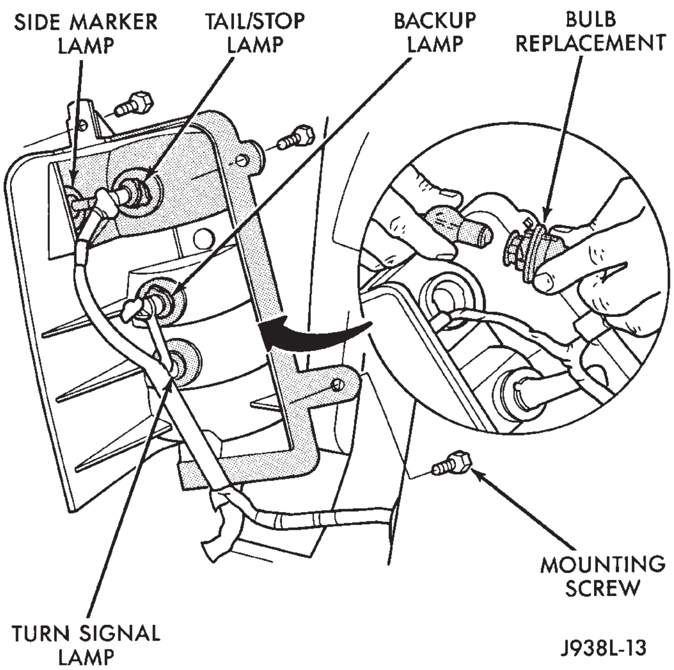


Fig. 9 Bulb Replacement/Rear Lamps

LICENSE PLATE LAMP

REMOVAL

(1) Remove screws and license plate lamp visor from liftgate (Fig. 10).

(2) Remove bulb from lamp socket.

INSTALLATION

(1) Install a bulb in lamp socket.

(2) Position license plate lamp visor on liftgate and install screws (Fig 10).

CENTER HIGH MOUNTED STOP LAMP (CHMSL)

The CHMSL is mounted at the top of the rear window (Fig. 11).

(1) Raise liftgate.

(2) Remove CHMSL access door.

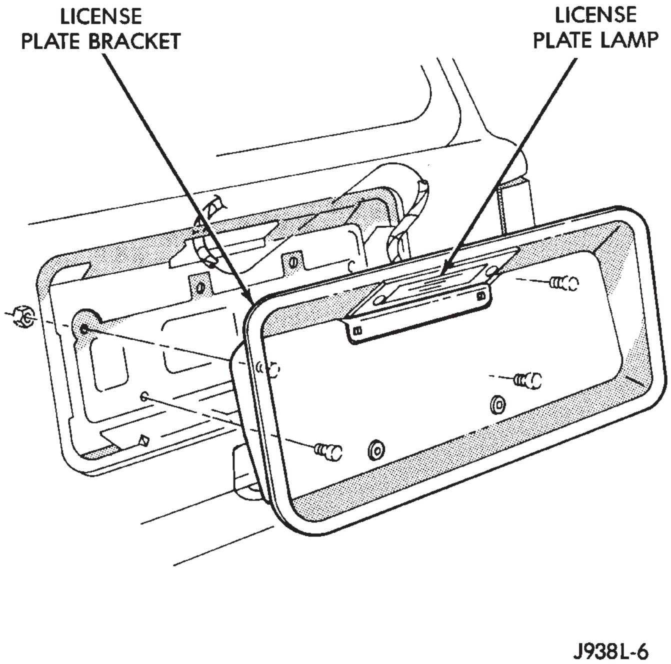


Fig. 10 License Plate Lamp Visor

(3) Remove CHMSL lamp mounting screws.

(4) Remove CHMSL lamp.

(5) Replace bulbs if necessary.

To install, reverse removal procedure.

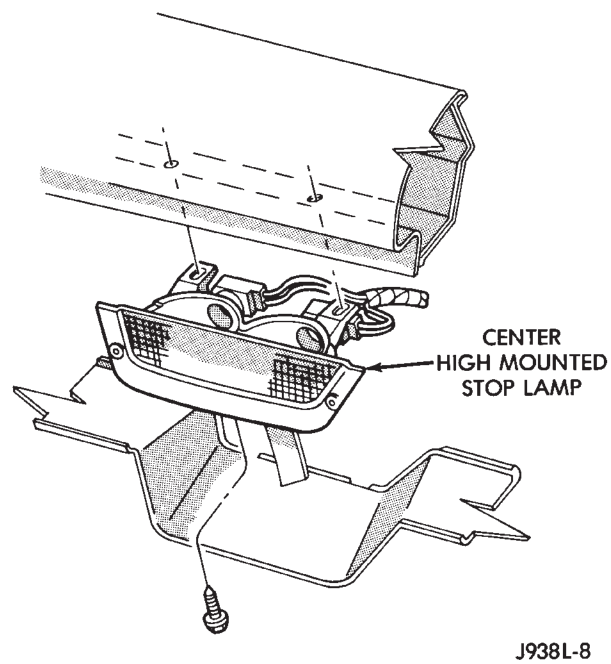


Fig. 11 Center High Mounted Stop Lamp

UNDERHOOD LAMP

When equipped, the underhood lamp is installed on the hood right, rear panel. The lamp is on when hood is opened by way of liquid ON/OFF switch that is integral with lamp base (Fig. 13).

BULB REMOVAL

(1) Disconnect wire harness connector from underhood lamp (Fig. 12).

(2) Rotate bulb counterclockwise. Remove it from lamp base socket.

BULB INSTALLATION

(1) Insert replacement bulb in lamp base socket. Rotate it clockwise.

(2) Connect wire harness connector to lamp.

HOUSING REMOVAL

(1) Disconnect wire harness connector from lamp.

(2) Rotate bulb counterclockwise. Remove it from lamp base socket.

(3) Remove screw that attaches lamp reflector bracket to hood inner panel (Fig. 12).

(4) Remove lamp from hood inner panel.

HOUSING INSTALLATION

(1) Position underhood lamp on the hood inner panel.

(2) Install screw through lamp and into the hood panel.

(3) Insert bulb in lamp base socket and rotate it clockwise.

(4) Connect wire harness connector to lamp.

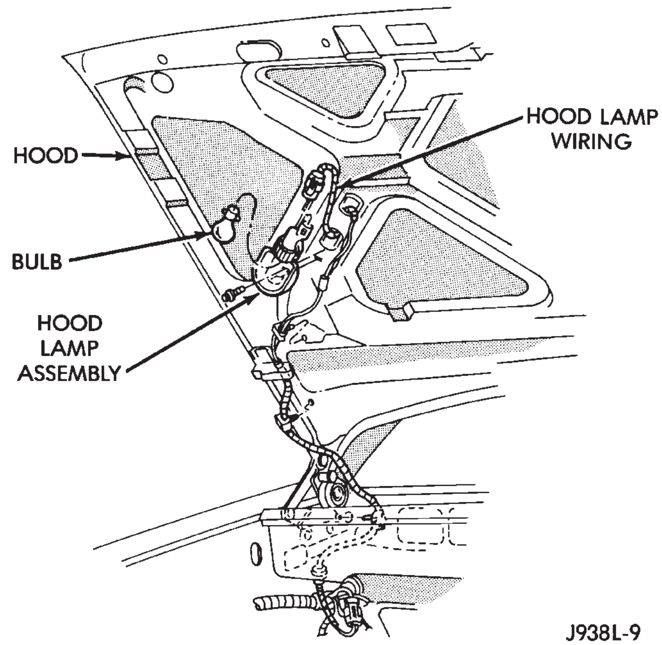


Fig. 12 Underhood Lamp

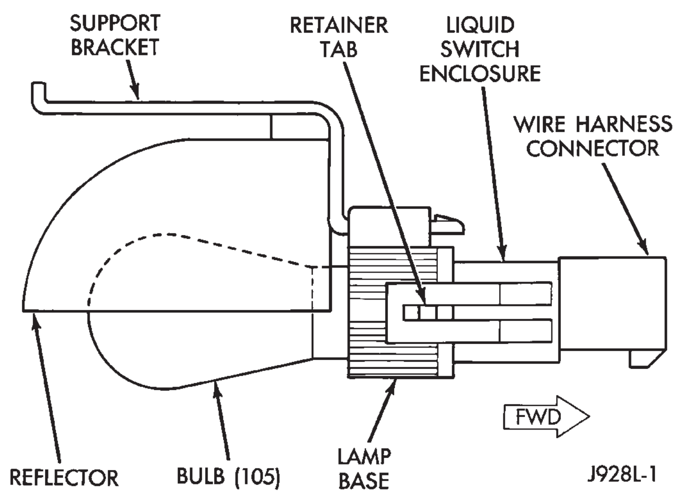


Fig. 13 Underhood Lamp Components

INTERIOR LAMPS

INDEX

DOME/COURTESY LAMP SERVICE INFORMATION

The interior lamp bulbs illuminate when they are connected to vehicle body ground. By way of applicable switch:

- Dome lamp switch
- Glove box switch
- Door pillar switch
- Liftgate switch (if the cargo lamp is ON.)

If equipped with Security Alarm Module, refer to Group 8Q—Vehicle Theft Security System.

DOME/COURTESY LAMP TROUBLE DIAGNOSIS

ALL LAMPS INOPERATIVE

(1) Slide the I/P illumination rheostat to the right. The lamps should light. If not, remove, inspect and test the dome lamp fuse.

(2) If fuse is OK, repair open circuit in the wire harness to vehicle body ground.

(3) Replace left hand pod switch if dome lamp switch fails.

ONE LAMP INOPERATIVE

(1) Measure the resistance across the bulb holder terminals. The ohmmeter should indicate approximately zero ohms. If not, replace bulb.

(2) Measure voltage between 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 faulty switch from the door pillar and connect switch wire directly to ground. The lamp should light.

(2) If not, check for an open circuit in ground wire. Repair as necessary. If lamps still do not light, replace switch.

LIGHTED VANITY MIRROR

SERVICE INFORMATION

Both the driver and the front passenger sunvisor can be equipped with a lighted vanity mirror. A lamp is located at each side of the vanity mirror. The lamps are switched ON automatically when the mirror cover is lifted (Fig. 1).

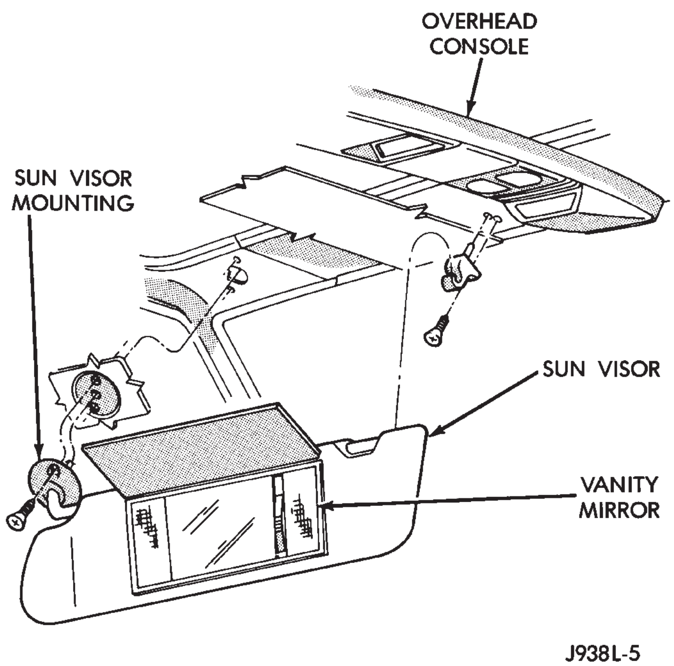


Fig. 1 Lighted Vanity Mirror

Voltage is applied directly to the vanity lamp bulbs by way of the dome lamp fuse.

LIGHTED VANITY MIRROR TROUBLE DIAGNOSIS

VANITY LAMPS INOPERATIVE

(1) Remove, inspect and test dome lamp fuse. Replace if defective.

(2) Test dome lamp operation. If OK, go to 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 switch connector and vehicle body ground. The voltmeter should indicate battery voltage. If not OK, repair the open circuit in wire harness from 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 approximately zero ohms. If not, repair the open circuit in the wire harness to vehicle body ground.

DOME/READING LAMP

REMOVAL

(1) Insert a flat blade screwdriver in slot at the center of the lamp housing. Rotate screwdriver upward and unsnap dome lamp lens.

(2) Pull lens downward. Remove it from lamp housing.

(3) Remove the lamp housing retaining screws (Fig. 2).

(4) Push housing forward and release housing from bracket.

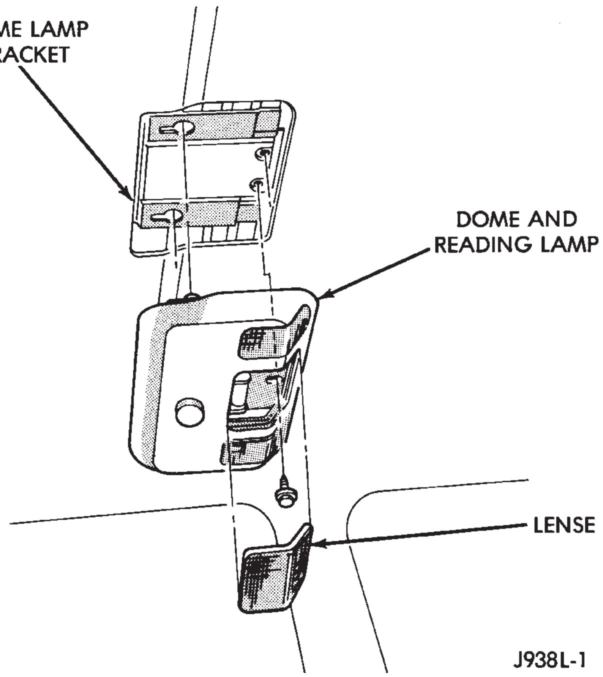


Fig. 2 Dome/Reading Lamp

(5) Disconnect wire harness connectors.

(6) Remove lamp housing from headliner cavity.

INSTALLATION

(1) Position dome/reading lamp housing at headliner cavity.

(2) Connect wire harness connectors.

(3) Locate rear pods of the lamp in the slots of the dome lamp bracket. Push lamp housing up and to rear.

(4) Install the lamp housing screws (Fig. 2).

(5) Position dome lamp lens at lamp housing. Snap lens into housing.

DOME LAMP BULB

REMOVAL

(1) Insert a flat blade screwdriver in slot at front of lens.

(2) Rotate the screwdriver until lens snaps out of the housing.

(3) Remove lens from housing.

(4) Remove bulb from terminals.

INSTALLATION

(1) Insert bulb into reding lamp terminals.

(2) Replace lens by holding lens level and pushing rearward into housing.

(3) Push lens up to snap into housing.

CARGO LAMP/BULB

The cargo lamp bulb housing is integral with the upper rear headliner trim moulding. To replace bulb housing the trim moulding must be replaced.

REMOVAL

(1) Insert a flat blade screwdriver in slots provided at lower portion of lens.

(2) Rotate screwdriver upward until lens snaps out of housing.

(3) Remove lens from housing (Fig. 3).

(4) Remove bulb from bulb holder.

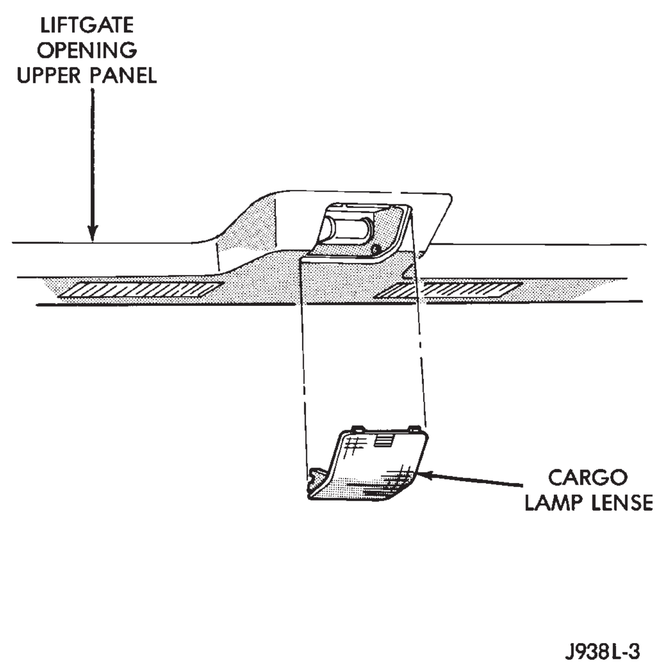


Fig. 3 Cargo Lamp

INSTALLATION

(1) Install bulb in holder.

(2) Insert upper tabs of lens into lens housing.

(3) Snap lower portion of lens into slots at lens housing (Fig. 3).

DOOR COURTESY LAMP

REMOVAL

(1) Remove door panel. Refer to Group 23—Body Components for service procedure.

(2) Disconnect wiring harness connector (Fig. 4).

(3) Carefully insert a thin flat blade screwdriver between lens and door trim panel.

(4) Rotate screwdriver to remove lens.

(5) Push door courtesy lamp housing through door trim panel.

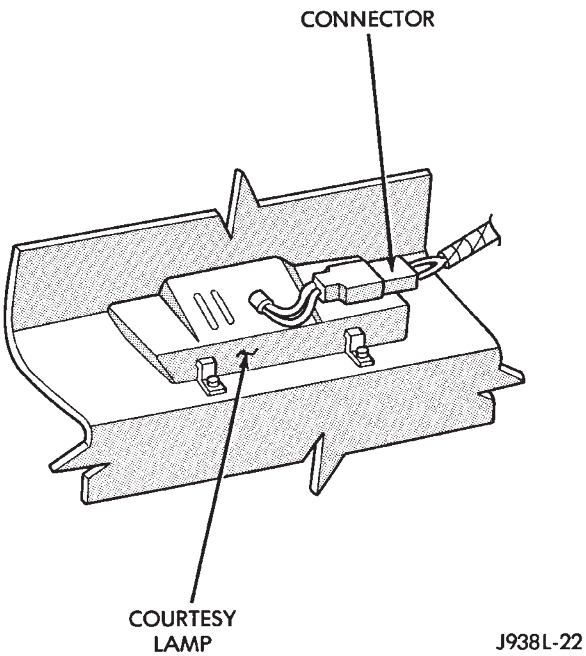


Fig. 4 Door Courtesy Lamp

INSTALLATION

(1) Connect wiring harness.

(2) Insert door courtesy lamp into door trim panel.

(3) Install door trim panel.

UNDER PANEL LAMP

REMOVAL

(1) Remove 1 mounting screw (Fig. 5).

(2) Disconnect wiring harness connector.

INSTALLATION

For installation, reverse removal procedure.

OVERHEAD CONSOLE

To remove or repair overhead console refer to Group 8C, Overhead Console.

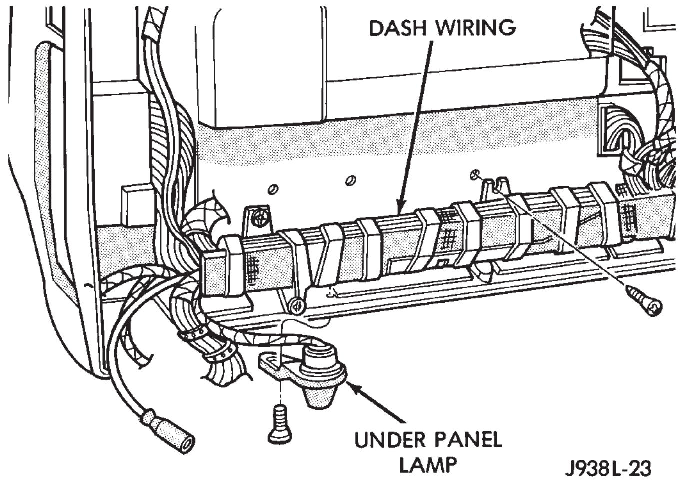


Fig. 5 Under Panel Lamp—Rear View

ILLUMINATED ENTRY SYSTEM SERVICE INFORMATION

The Illuminated Entry System is activated by the system relay. The relay is located in the relay center behind instrument panel. The relay receives input from door pillar switches, the keyless entry system, and the ignition switch (when in the RUN position). When input is received, the timer in the relay immediately begins the timing-out process. The timing-out process requires approximately 30 seconds. Interior lamps are turned off either when the 30 second time-out is completed or when the ignition switch is turned ON. If a door remains open for more than 30 seconds, the interior lamps will stay on until the door is closed.

The illuminated entry system also operates when a door is opened to exit vehicle. When door is closed the lamps will stay on for remaining portion of the 30 seconds.

ILLUMINATED ENTRY RELAY

To remove or replace relay, refer to Auto Headlamp Module procedure located in this section.

EXTERIOR LAMP SYSTEMS

INDEX

DAYTIME RUNNING LIGHT MODULE

The headlamps on vehicles sold in Canada, will go ON when the ignition is turned ON. The module must also receive a movement signal from distance sensor. This provides a constant Lights On condition while the vehicle is rolling. The lamps illuminate at less than 50% of normal intensity.

The Daytime Running Light Module is located on right inner fender below power distribution center.

(1) Remove bolts holding module and bracket to vehicle (Fig. 1).

(2) Disconnect electrical connector.

To install module, reverse the removal procedures.

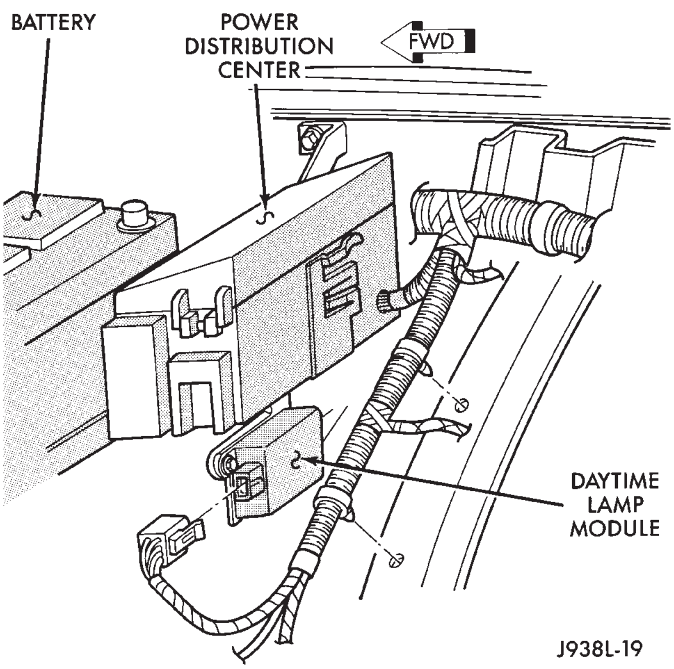


Fig. 1 Daytime Running Light Module

AUTO HEADLAMPS

This system automatically turns the lamps on and off according to light conditions. The system also keeps the lights on for a selected amount of time after driver has parked and left vehicle. The system can be turned off to give driver manual control of headlamps.

AUTO HEADLAMP SYSTEM DIAGNOSIS

Perform the system check in the order shown. When a fault is found, refer to the Body Diagnostic Manual. If a normal result is found at each and every step of the System Check, the fault may be intermittent.

To find an intermittent fault, check the mating terminals at each component and connector for a poor connection. Also check that each terminal of mating connectors is properly seated. If the connections appear to be reliable, try the System Check again while moving the wire harness from side to side at each component. Once a fault has been corrected, perform the System Check to verify the diagnosis.

AUTO HEADLAMP MODULE

The module receives inputs from the auto headlamp switch and auto headlamp sensor. Based on these inputs the module will control the lamps. The auto headlamp module is located behind the glove box to the right of the security alarm module.

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove two screws holding top of center cluster bezel (Fig. 2).

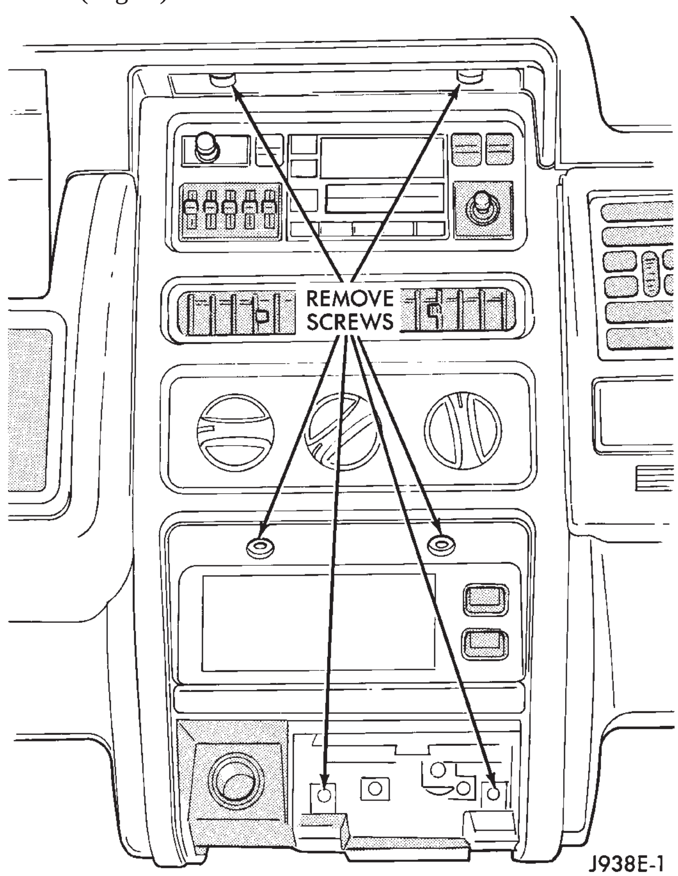


Fig. 2 Center Bezel Upper Screws

AUTO HEADLAMP SYSTEM CHECK

ACTION	NORMAL RESULTS
• Headlamp switch to OFF position. • Apply a bright light to the Photocell Light Sensor. • Ignition switch to RUN.	Tail and license lamps OFF. Front park and headlights OFF.
• Headlamp switch to AUTO position. • Cover Photocell Light Sensor. • Wait 30 seconds.	Tail and license lamps ON. Front park and headlights ON.
• Apply a bright light to the Photocell Light Sensor. • Wait 30 seconds.	Tail, license, front park and headlights OFF.
• Cover the Photocell Light Sensor and wait for lights to turn ON. • Wait 15 seconds, turn ignition switch OFF.	Lights turn OFF after a time delay.

J938L-21

(3) Remove ash tray.

(4) Remove two screws holding center of bezel.

(5) Remove two screws holding bottom of bezel (Fig. 3).

(6) Remove center bezel.

(7) Remove two screws holding dash pad located behind center bezel.

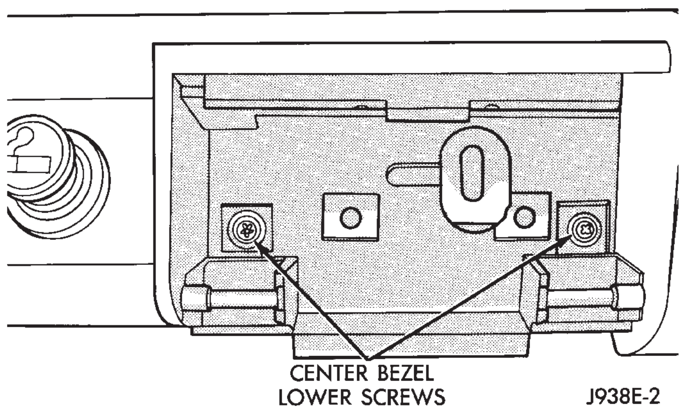


Fig. 3 Center Bezel Lower Screws

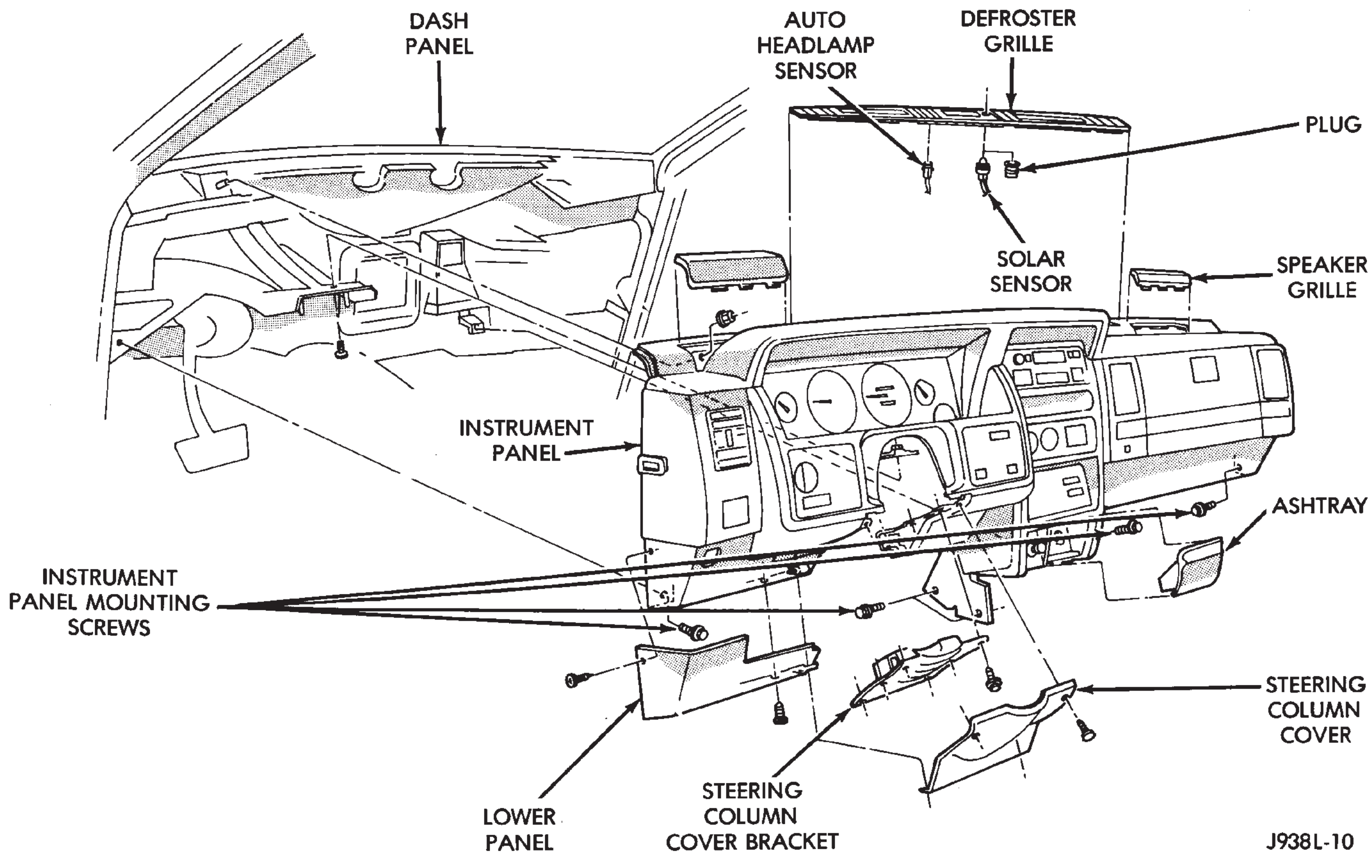


Fig. 4 Instrument Panel

(8) Gently pry defroster bezel out of dash pad (Fig. 4).

(9) Unplug sensor(s) and set defroster bezel aside.

(10) Remove screws in defroster duct opening holding dash pad.

(11) Remove speaker grilles. Remove screws behind speaker grilles.

(12) Remove three screws above IP cluster holding dash pad (Fig. 5).

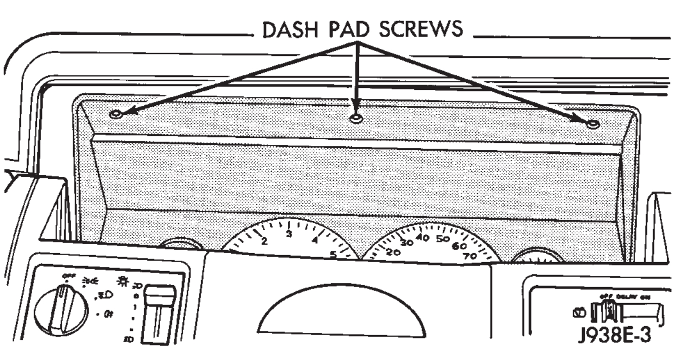


Fig. 5 Dash Pad Screws

(13) Open glove box and remove 2 screws holding dash pad.

(14) Pull up on dash pad to unsnap clips and then remove dash pad.

(15) Remove four screws holding glove box bottom (Fig. 6).

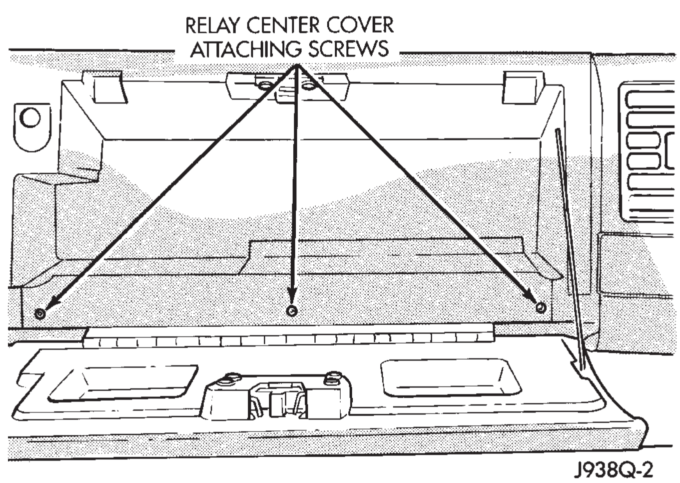


Fig. 6 Glove Box

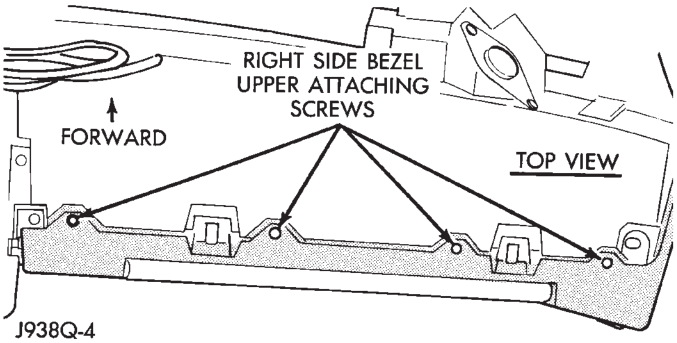


Fig. 7 Right Side Bezel

(16) Remove four screws from top of glove box bezel (Fig. 7).

(17) Remove one screw holding the bezel to the center armature (Fig. 8).

(18) Remove bezel from instrument panel. Disconnect glove box light switch.

(19) Remove 2 screws holding auto headlamp module (Fig. 9).

(20) Remove connector from module.

For installation, reverse removal procedure.

AUTO HEADLAMP SENSOR

The auto headlamp sensor is the key sensor for the auto headlamp system. The module utilizes the sensor input to determine when to turn the headlamps on or off. The sensor is located in the center of the defroster grille at the base of the windshield.

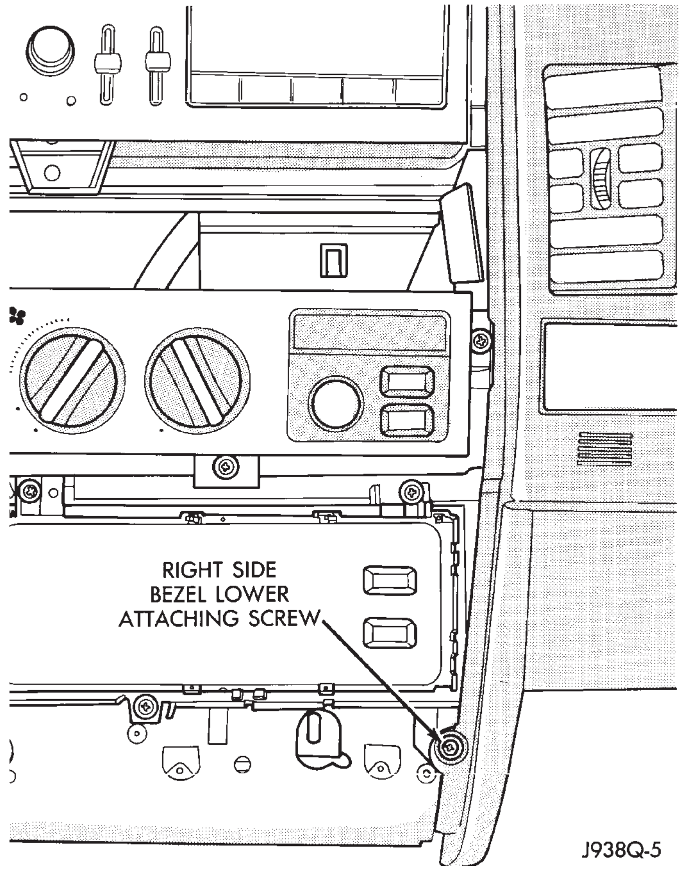


Fig. 8 Right Side Lower Screw

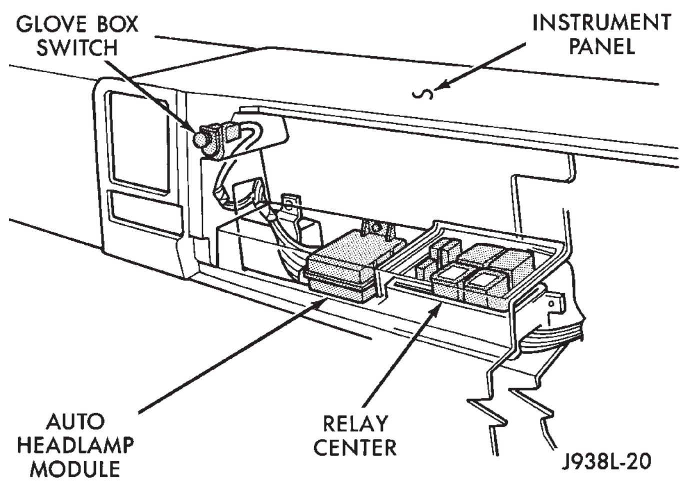


Fig. 9 Auto Headlamp Module

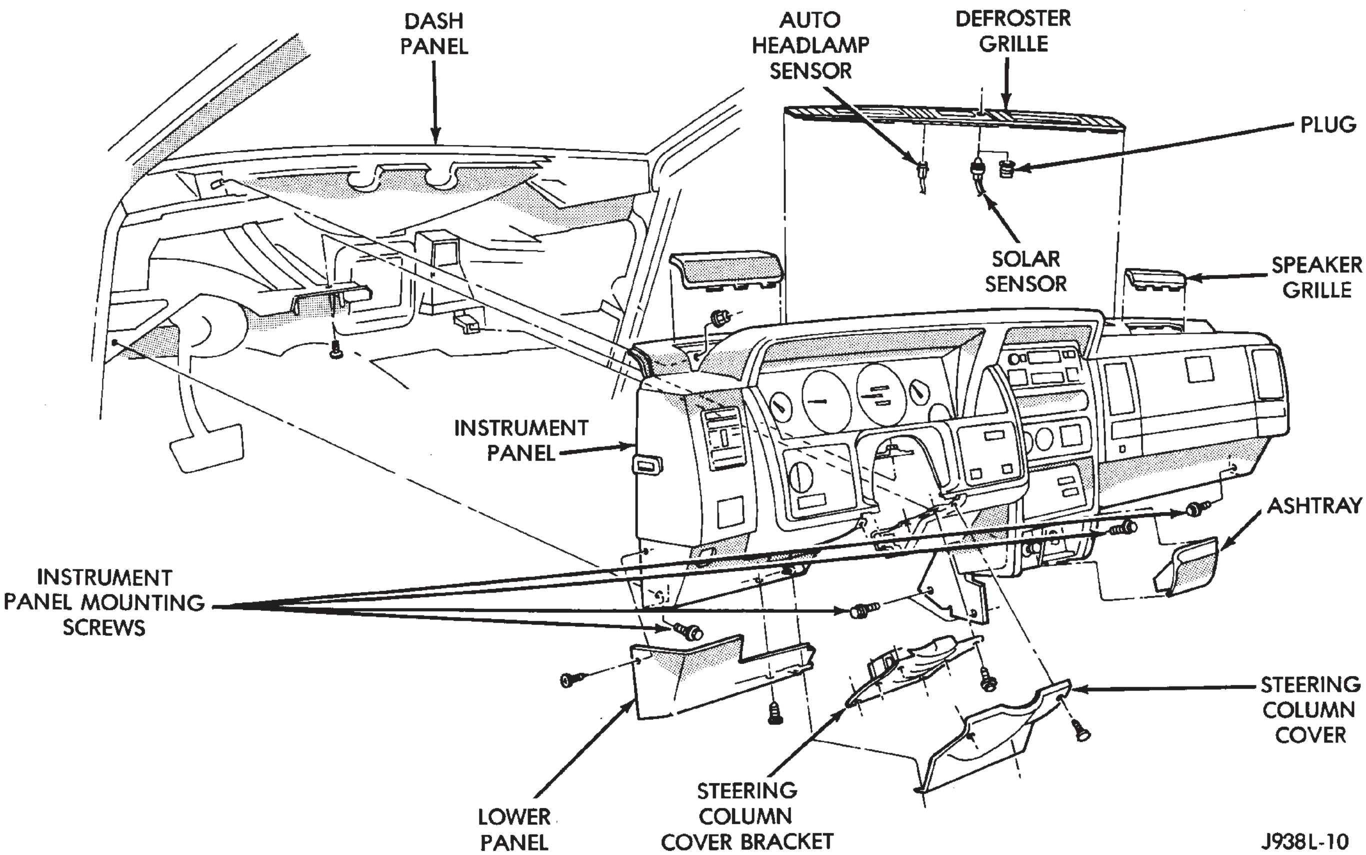


Fig. 10 Instrument Panel

REMOVAL (FIG. 10)

(1) Gently pry defroster bezel out of dash pad.
(2) Unplug auto headlamp sensor connector.
(3) Snap out sensor from bezel.
For installation, reverse the removal procedure.

LAMP OUTAGE MODULE

Details for the lamp outage module can be found in Group 8E, Vehicle Information Center. For circuit location refer to the Wiring Diagrams.

REMOVAL

(1) Remove battery negative cable.
(2) Remove spare tire from carrier.
(3) Remove access door (Fig. 11).
(4) Remove wiring connectors at top of module.
(5) Remove 1 screw holding module to inner quarter panel.
(6) Remove lamp outage module.
For installation, reverse the removal procedure.

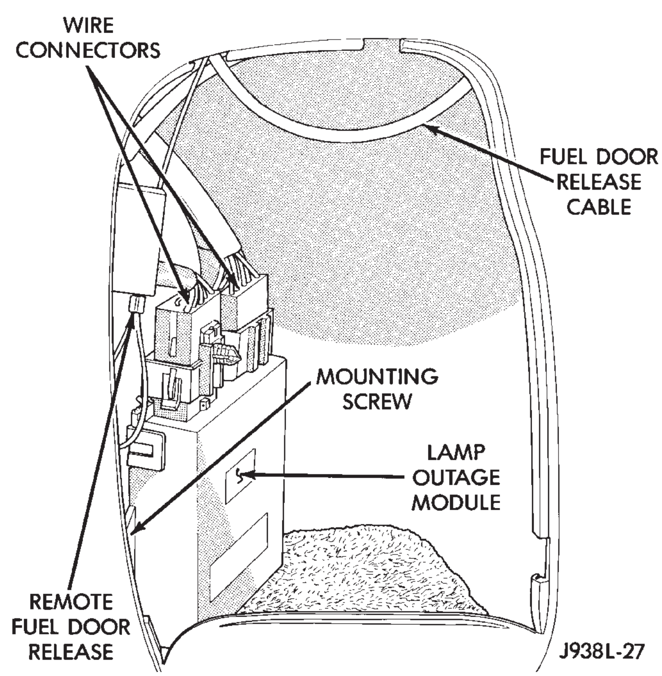


Fig. 11 Lamp Outage Module

BULB APPLICATION

GENERAL INFORMATION

The following Bulb Application Table lists the lamp title on the left side of the column and trade number or part number on the right.

CAUTION: Do not use bulbs that have a higher candle power than bulb listed in the Bulb Application Table. Damage to lamp can result. Do not touch halogen bulbs with fingers or other oily surfaces. Bulb life will be reduced.

EXTERIOR LAMPS

Back-up 1156
Center High Mounted Stop Lamp 921
Fog...H3
Front Turn Signal 1295NA
Front Side Marker 194NA
Headlamp/Aero...H6054
License Plate 168
Rear/Stop/Tail...2057
Rear Turn Signal...1156
Underhood Lamp...105

INTERIOR LAMPS

Service procedures for most of the lamps in the instrument panel, are located in Group 8E. Some components have lamps that can only be serviced by an Authorized Service Center (ASC) after the component is removed from the vehicle. Contact local dealer for location of nearest ASC.

Ash Receiver 1891
Cargo Lamp 212-2
Cigarette Lighter...53
Climate Control 74
Console Floor Shifter PC194
Dome/Reading ....561 and 906
Door Courtesy..168
Glove Compartment PC194
Overhead Console 212-2
Radio ....ASC
Rocker Switch 37
Transfer Case Shifter.......................................PC194
Under Panel Courtesy 89
*Vanity Mirror..P/N6501966
*Available only at Chrysler Dealers.

RESTRAINT SYSTEMS

CONTENTS

AIR BAG SYSTEM

WARNING: THIS SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE, REMOVE OR INSTALL THE AIR BAG SYSTEM COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WHEN AN UNDEPLOYED AIR BAG ASSEMBLY IS TO BE REMOVED FROM THE STEERING WHEEL, DISCONNECT BATTERY NEGATIVE CABLE AND ISOLATE. ALLOW SYSTEM CAPACITOR TO DISCHARGE FOR 2 MINUTES THEN BEGIN AIR BAG REMOVAL.

To inspect system use Passive Restraint System Diagnostic Procedures Manual.

If the Air Bag Module Assembly is defective and non-deployed, refer to Chrysler Motors current return list for proper handling procedures.

WARNING: REPLACE AIR BAG SYSTEM COMPONENTS WITH CHRYSLER MOPAR® SPECIFIED REPLACEMENT PARTS ONLY. SUBSTITUTE PARTS MAY APPEAR INTERCHANGEABLE, BUT INTERNAL DIFFERENCES MAY RESULT IN INFERIOR OCCUPANT PROTECTION.

THE FASTENERS, SCREWS, AND BOLTS, ORIGINALLY USED FOR THE AIR BAG COMPONENTS, HAVE SPECIAL COATINGS AND ARE SPECIFICALLY DESIGNED FOR THE AIR BAG SYSTEM. THEY MUST NEVER BE REPLACED WITH ANY SUBSTITUTES. ANYTIME A NEW FASTENER IS NEEDED, REPLACE WITH THE CORRECT FASTENERS PROVIDED IN THE SERVICE PACKAGE OR FASTENERS LISTED IN THE PARTS BOOK.

AIR BAG SYSTEM GENERAL INFORMATION

INDEX

AIR BAG MODULE The air bag module is the most visible part of the system. It contains the air bag cushion and its supporting components. The air bag module contains a housing to which the cushion and inflator are attached and sealed.

The inflator assembly is mounted to the back of the module. It seals the hole so it can discharge the gas it produces directly into the cushion when supplied with the proper electrical signal. A protective cover is fitted to the front of the air bag module and forms a decorative cover in the center of the steering wheel. The air bag module is mounted directly to the steering wheel.

FRONT IMPACT SENSORS

The passive restraint air bag system is a safety device designed to protect the driver from serious injury, caused by a frontal impact of the vehicle.

The impact sensors provide verification of the direction and severity of the impact. Three impact sensors are used. One is called a safeing sensor. It is located inside the diagnostic module which is under the center console or park brake cover. The other two sensors are mounted on the radiator closure panel on the left and right side of the vehicle.

The impact sensors are threshold sensitive switches that complete an electrical circuit when an impact provides a sufficient G force to close the switch. The sensors are calibrated for the specific vehicle and react to the severity and direction of the impact.

CLOCKSPRING

The clockspring is mounted on the steering column behind the steering wheel. It is used to maintain a continuous electrical circuit between the wiring harness and the driver's air bag module. This assembly consists of a flat, ribbon-like electrically conductive tape which winds and unwinds with the steering wheel rotation.

DIAGNOSTIC MODULE

The Air Bag System Diagnostic Module (ASDM), contains the safeing sensor, and monitors the system to determine the readiness of the system. The ASDM contains on-board diagnostics, and will illuminate the Air bag warning light in the cluster when a fault occurs.

STORAGE

The air bag module must be stored in its original special container until used for service. Additionally, it must be stored in a clean, dry environment, away from sources of extreme heat, sparks, and sources of high electrical energy. Always place or store the module on a surface with the trim cover facing up to minimize movement in case of accidental deployment.

HANDLING UNDEPLOYED MODULE

At no time should any source of electricity be permitted near the inflator on the back of the module. When carrying an undeployed module, the trim cover should be pointed away from the body to minimize injury in the event of accidental deployment. In addition, if the module is placed on a bench or other surface, the plastic trim cover should be face up to minimize movement in case of accidental deployment.

WARNING: WHEN A STEERING COLUMN HAS AN AIR BAG MODULE ATTACHED, NEVER PLACE THE COLUMN ON THE FLOOR OR OTHER SURFACE WITH THE STEERING WHEEL OR MODULE FACE DOWN.

DEPLOYED MODULE

The vehicle interior will contain sodium hydroxide power, a byproduct of air bag deployment. Since this powder can irritate the skin, eyes, nose or throat, be sure to wear safety glasses, rubber gloves and long sleeve shirt during clean up (Fig. 1).

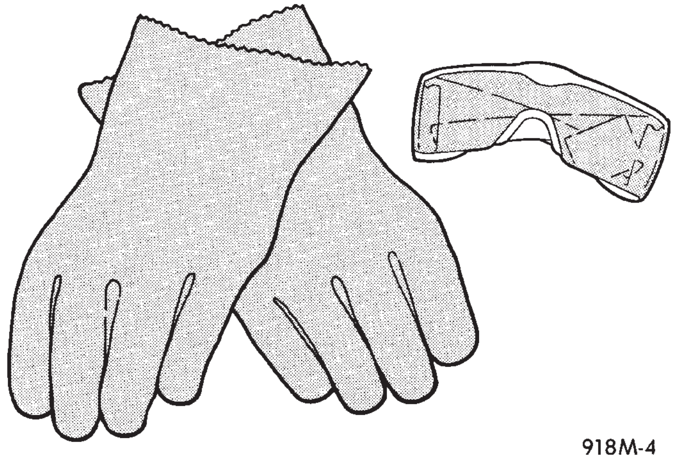


Fig. 1 Wear Safety Glasses and Rubber Gloves

If you find that the clean up is irritating your skin, run cool water over the affected area. Also, if you experience nasal or throat irritation, exit the vehicle for fresh air until the irritation ceases. If irritation continues, see a physician.

CLEAN UP PROCEDURE

Begin the clean up by putting tape over the air bag exhaust vent (Fig. 2) so that no additional powder will find its way into the vehicle interior. Then remove the air bag and air bag module from the vehicle.

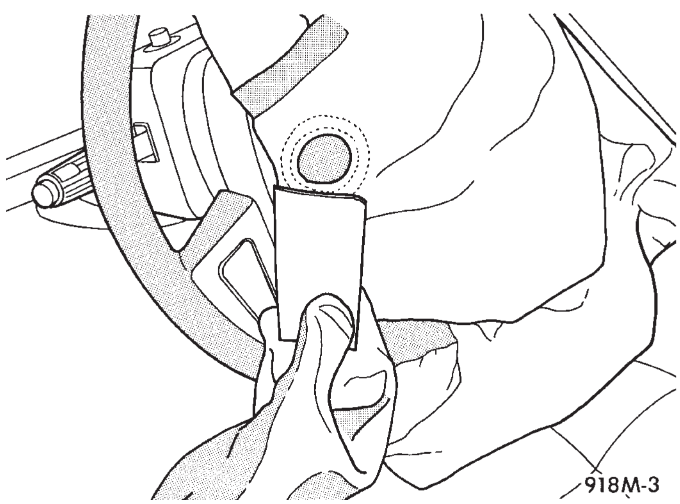


Fig. 2 Seal the Air Bag Exhaust Vents

Use a vacuum cleaner to remove any residual powder from the vehicle interior. Work from the outside in as you do, so that you avoid kneeling or sitting on uncleaned area.

Be sure to vacuum the heater and A/C outlets as well (Fig. 3). In fact it's a good idea to run the blower on low and to vacuum up any powder expelled from the plenum. You may need to vacuum the interior of the car a second time to recover all of the powder.

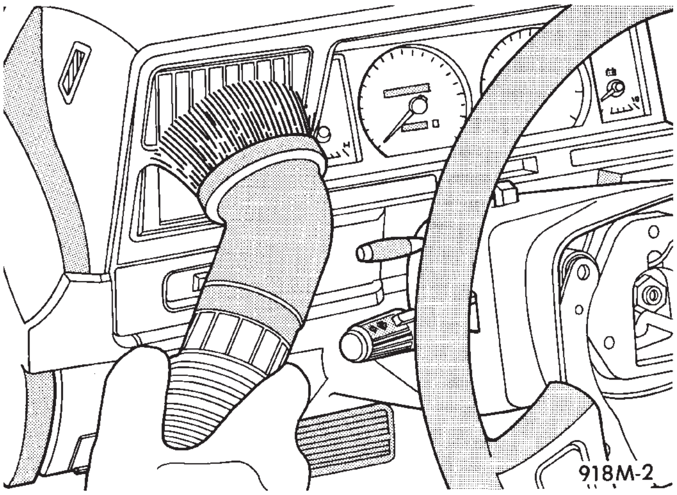


Fig. 3 Vacuum Heated and A/C Outlets

Place the deployed bag and module in your vehicular scrap pile.

SERVICE OF DEPLOYED AIR BAG

Any vehicle which is to be returned to use after an air bag deployment, must have the air bag module and clockspring replaced. These are one-time components and cannot be reused. Other air bag system components are replaced as required by extent of damage.

AIR BAG SYSTEM SCHEMATIC

AIR BAG SYSTEM CHECK

(1) Be sure battery negative cable is disconnected.

(2) Connect DRB II to ASDM diagnostic 6-way connector. Located under the right front seat at the forward left corner of the seat riser, under the carpet.

(3) From passenger side of vehicle, turn the ignition key to ON position. Exit vehicle with DRB II. Use the latest version of the proper cartridge.

(4) After checking that no one is inside the vehicle, reconnect the negative battery terminal.

(5) Using the DRB II, read and record active fault data.

(6) Read and record any stored faults.

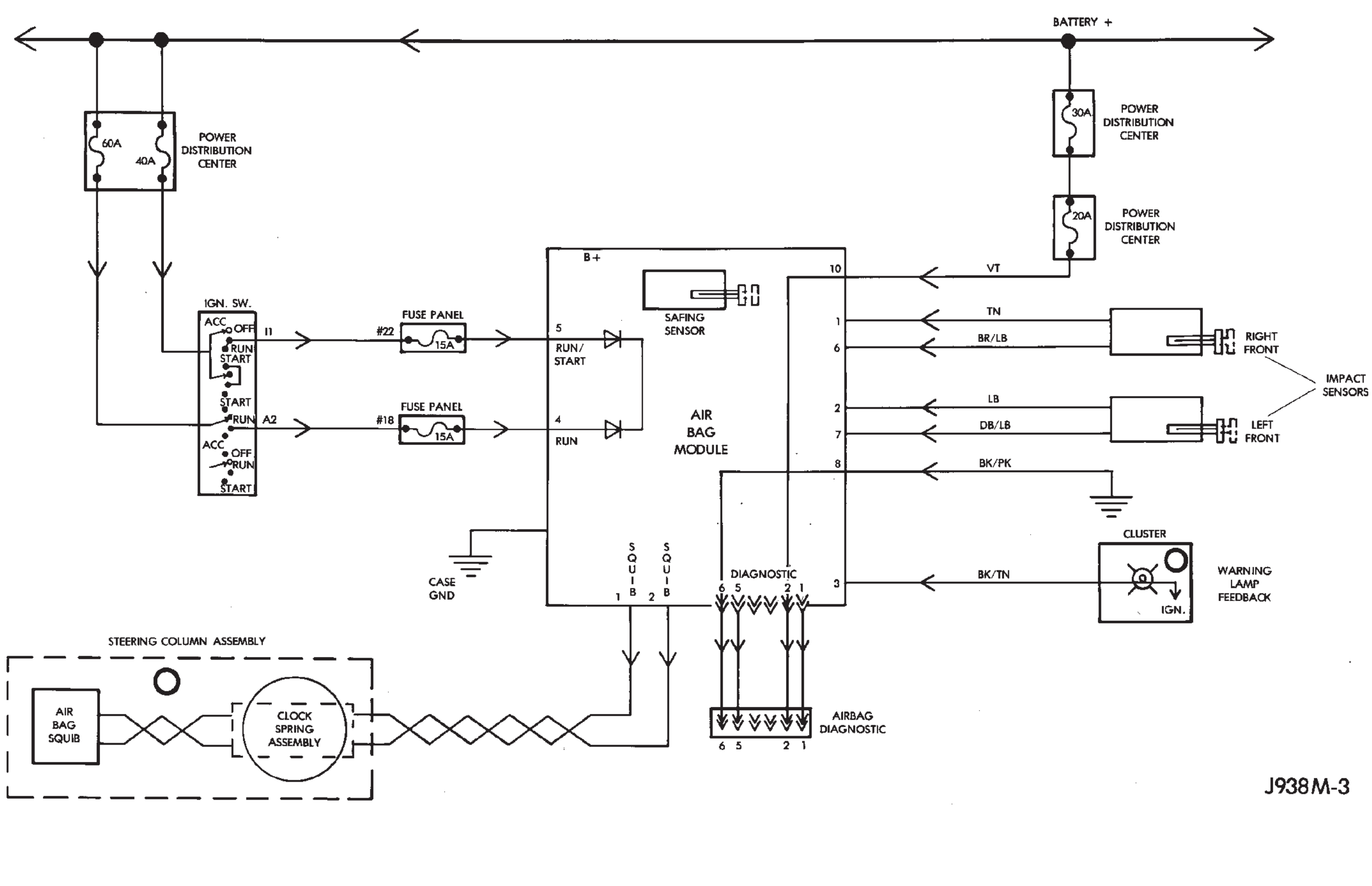
(7) Refer to the Diagnostic Test Manual if any faults are found in steps 5 or 6.

(8) Erase stored faults if there are no active fault codes. If problems remain, fault codes will not erase.

(9) With the ignition key in the ON position, make sure no one is in the vehicle.

(10) From the passenger side of vehicle, turn the ignition key to OFF then ON and observe the instrument cluster air bag light. It should go on for 6 to 8 seconds, then go out; indicating system is functioning normal.

If air bag warning light either fails to light, or goes on and stays on, there is a system malfunction. Refer to the Passive Restraint Diagnostic Test Manual to diagnose the problem.



AIR BAG SYSTEM SERVICE PROCEDURES

INDEX

AIR BAG MODULE

WARNING: BEFORE BEGINNING ANY AIR BAG SYSTEM REMOVAL OR INSTALLATION PROCEDURES, REMOVE AND ISOLATE THE BATTERY NEGATIVE (-) CABLE FROM THE VEHICLE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIR BAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIR BAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

When removing a deployed module, rubber gloves, eye protection and long sleeve shirt should be worn. There may be deposits on the surface which could irritate the skin and eyes in large doses.

(1) Disconnect battery negative cable and isolate.

(2) Remove 4 nuts attaching air bag module from the back side of steering wheel (Fig. 1).

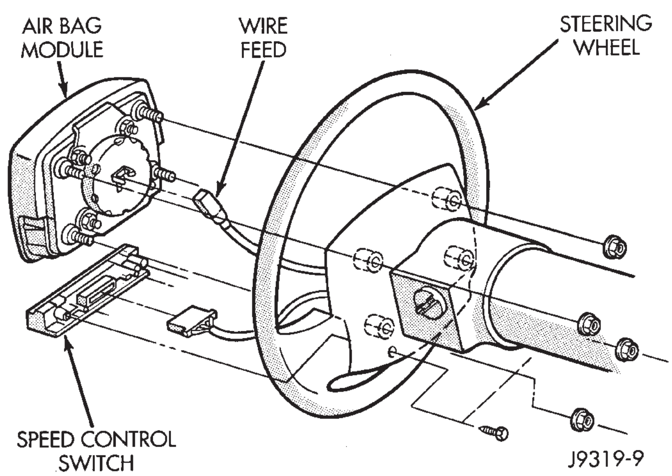


Fig. 1 Air Bag Module

(3) Lift module, and disconnect electrical connector by spreading apart the external latching arms and prying upward on the connector.

(4) Remove module.

(5) If replacing a deployed module, the clockspring must also be replaced. Refer to clockspring Removal and Installation for proper procedure.

INSTALLATION

(1) Connect clockspring wiring connector to the module, by pressing straight in on the connector. The connector should latch securely beneath module locking clip to assure positive connection.

(2) Install 4 nuts and torque to 9 to 11 N●m (80 to 100 in. lbs.).

(3) Do not connect negative battery cable. Refer to Air Bag System Check for proper procedure.

IMPACT SENSORS

WARNING: BEFORE BEGINNING ANY AIR BAG SYSTEM REMOVAL OR INSTALLATION PROCEDURES, REMOVE AND ISOLATE THE BATTERY NEGATIVE (-) CABLE FROM THE VEHICLE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIR BAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIR BAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The impact sensors are located on the front wheelhouse extensions behind the grille opening reinforcement.

REMOVAL

(1) Disconnect battery negative cable and isolate.

(2) Remove the 3 screws and the grille (Fig. 2) from the grille opening reinforcement (GOR).

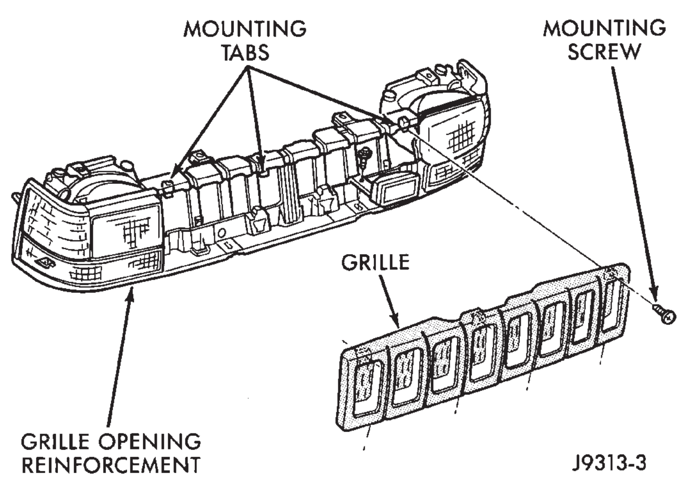


Fig. 2 Grille Removal

(3) Remove turn signals, side markers and headlamps. Refer to Group 8L - Lamps for procedures.

(4) Remove 6 retainers at front fascia (Fig. 3).

(5) Remove 3 push-in retainers at each front wheel well (Fig. 4).

(6) Slide fascia off retainer pegs at side of lower crossmember. Using a small screwdriver, pull up on locating tangs under turn signal mounting location.

(7) Remove fascia from lower crossmember (Fig. 3).

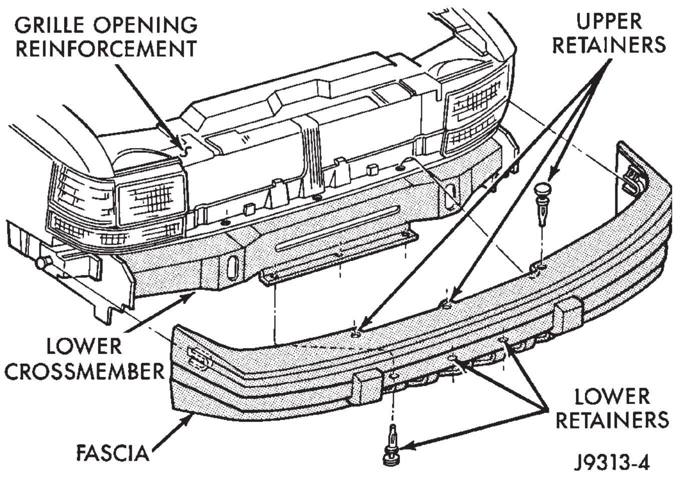


Fig. 3 Lower Fascia Removal

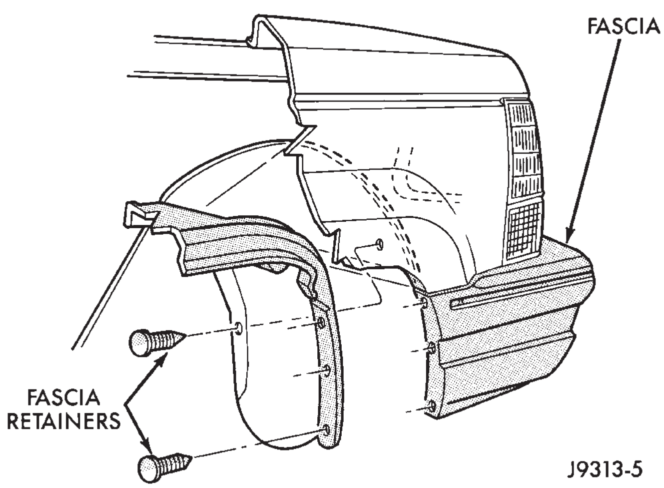


Fig. 4 Wheel Well Retainers

(8) Disconnect impact sensor electrical connector.

(9) Remove 3 screws holding sensor to front wheelhouse extension. Remove sensor (Fig. 5).

(10) Unplug connector from sensor and remove sensor (Fig. 6).

INSTALLATION

(1) Mount sensor (arrow pointed forward) using 3 screws provided with new sensor. Torque screws to 4 to 5 N●m (35 - 45 in. lbs.).

(2) Connect sensor wiring lead from harness to connector on body of sensor.

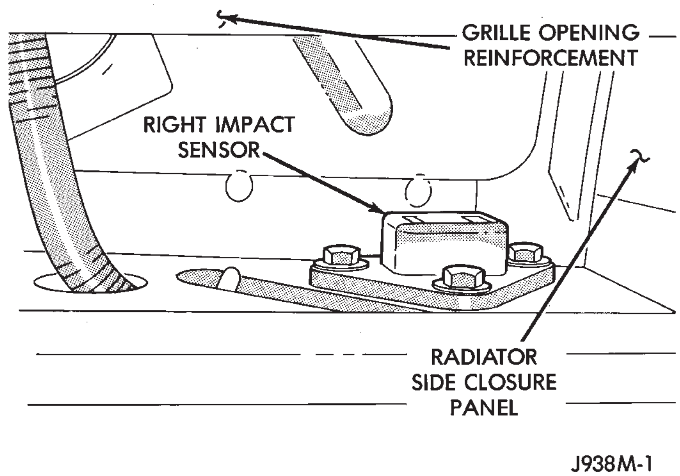


Fig. 5 Impact Sensor (Typical)

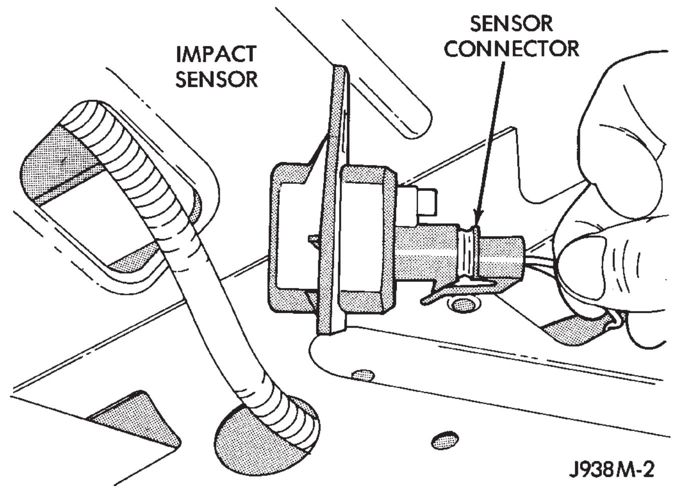


Fig. 6 Impact Sensor Connector

(3) Install fascia and grille by reversing the removal procedures.

(4) Do not connect negative battery cable. Refer to Air Bag Systems Check for proper procedure.

AIR BAG SYSTEM DIAGNOSTIC MODULE (ASDM)

WARNING: THE ASDM CONTAINS ONE OF THE IMPACT SENSORS WHICH ENABLE THE SYSTEM TO FIRE THE AIR BAG. TO AVOID ACCIDENTAL DEPLOYMENT, NEVER CONNECT ASDM ELECTRICALLY TO THE SYSTEM UNLESS IT IS BOLTED TO VEHICLE. BEFORE BEGINNING ANY AIR BAG SYSTEM REMOVAL OR INSTALLATION PROCEDURES, REMOVE AND ISOLATE THE BATTERY NEGATIVE (-) CABLE FROM THE VEHICLE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIR BAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIR BAG DEPLOYMENT, AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove 2 screws from bottom of center console storage bin (Figs. 7, 8 and 9).

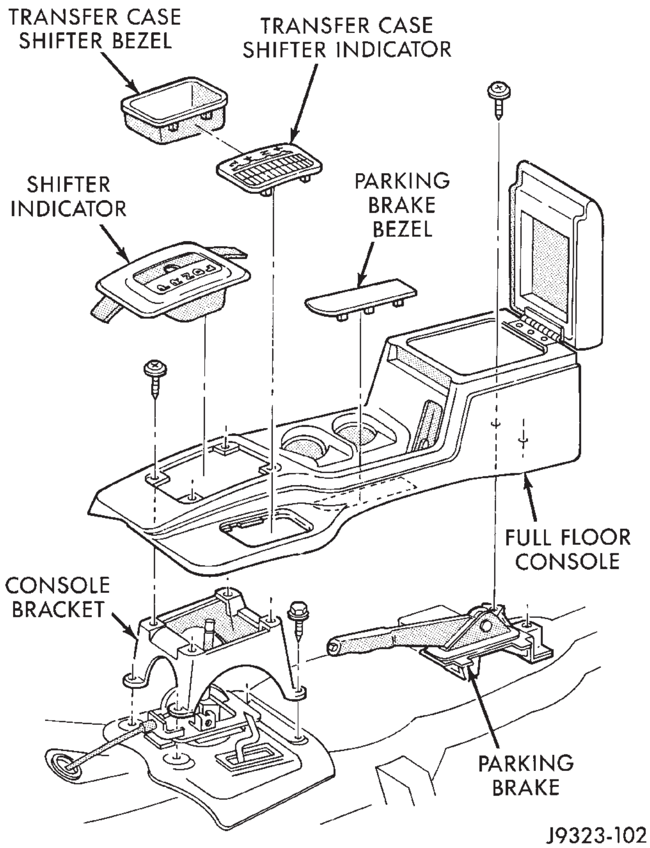


Fig. 7 Full Console Removal

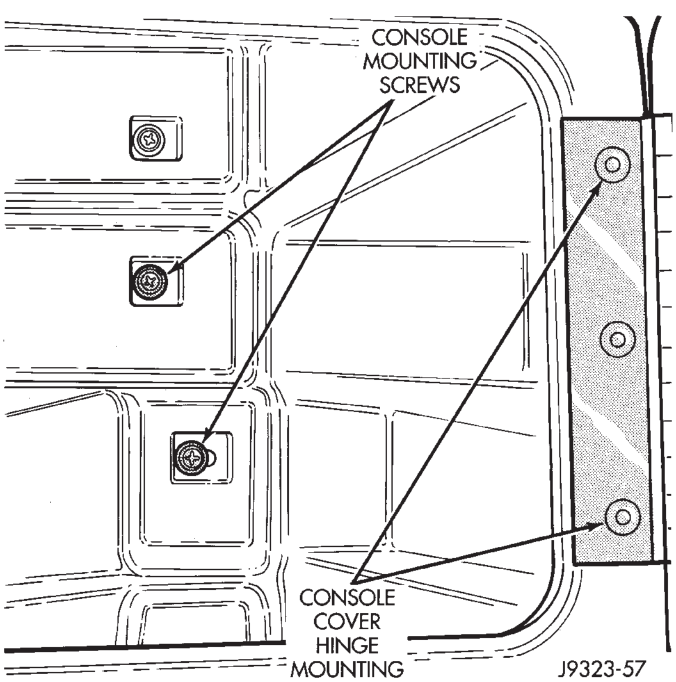


Fig. 8 Console Removal

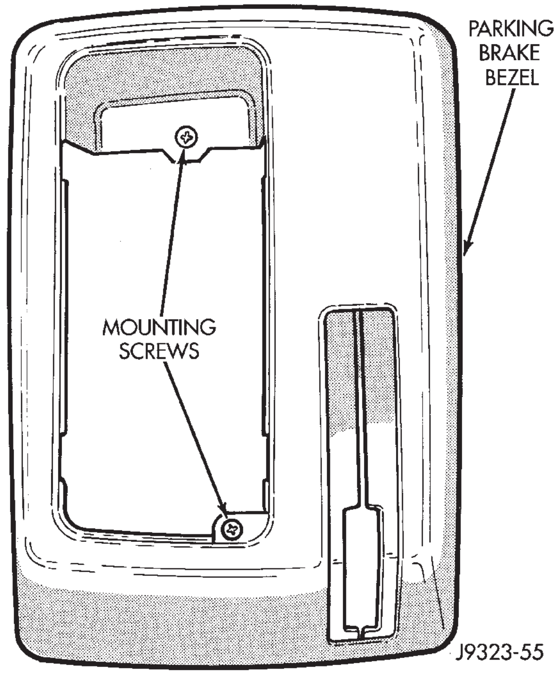


Fig. 9 Parking Brake Bezel

(3) Remove transmission shift handle by pulling it up sharply.

(4) Remove transmission shift bezel, there are 2 snap clips on each side.

(5) Remove bulb from bezel.

(6) Remove 4 screws under transmission shift bezel (Fig. 10).

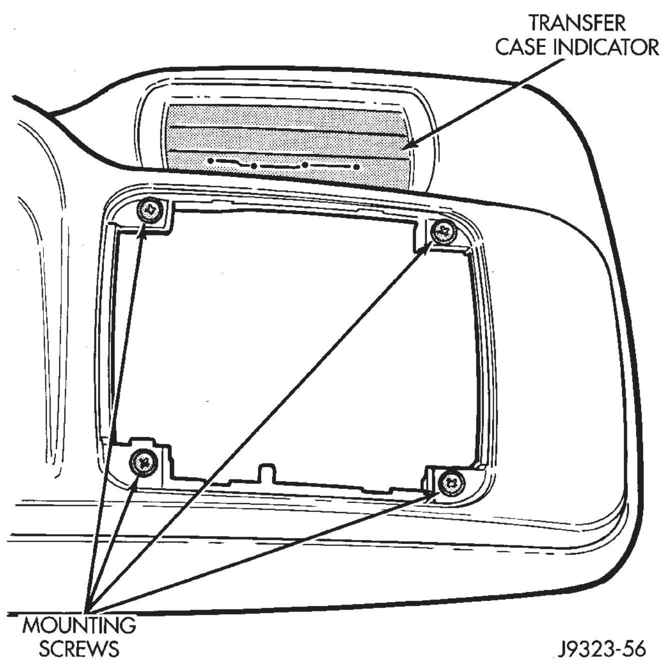


Fig. 10 Console Forward Mounting Screws

(7) Remove bezel under parking brake handle.

(8) Move transfer case and transmission shift levers rearward.

(9) Lift console up to remove it. There is a bulb at the rear end of the transfer case bezel.

(10) Disconnect wiring at ASDM (Fig. 11).

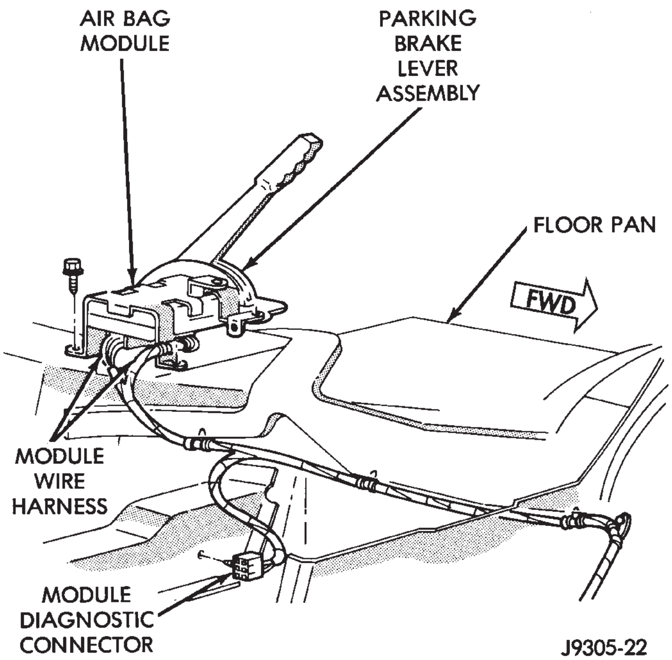


Fig. 11 Air Bag System Diagnostic Module

(11) Remove 4 screws holding the ASDM.

(12) Remove ASDM.

INSTALLATION

(1) Position the ASDM with the arrow pointing forward.

(2) Attach the ASDM to the Park Brake bracket and floor pan with the 4 screws supplied. Torque to 5.5 to 7 N●m (50-60 in. lbs.).

(3) Connect wiring at ASDM, making sure both connectors are seated and locking tabs engaged.

(4) Install center floor console.

(5) Do not connect negative battery cable. Refer to Air Bag System Check for proper procedure.

CLOCKSPRING

WARNING: BEFORE BEGINNING ANY AIR BAG SYSTEM REMOVAL OR INSTALLATION PROCEDURES, REMOVE AND ISOLATE THE BATTERY NEGATIVE (-) CABLE FROM THE VEHICLE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIR BAG SYSTEM. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL AIR BAG DEPLOYMENT, AND POSSIBLE INJURY.

REMOVAL

(1) Place the front wheels in the straight ahead position before starting the repair.

(2) Disconnect battery negative cable and isolate.

(3) Wait 2 minutes for the reserve capacitor to discharge before removing undeployed module.

(4) Remove the air bag module. Refer to Air Bag Module Removal.

(5) Remove Speed Control switch and connector if equipped.

(6) Remove the steering wheel and vibration dampener.

(7) Disconnect horn terminals.

(8) Remove upper and lower steering column shrouds to gain access to clockspring wiring (Fig. 12).

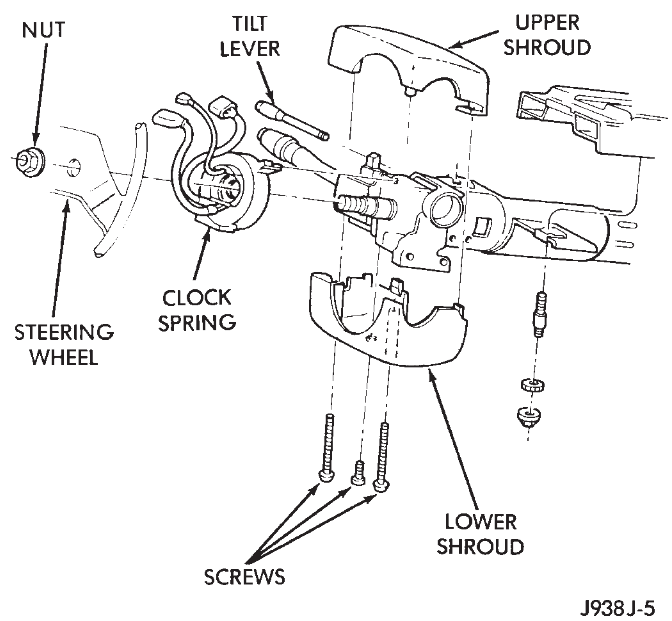


Fig. 12 Steering Column Shrouds

(9) Disconnect the 2-way connector between the clockspring and the instrument panel wiring harness at the base of the steering column.

(10) To remove, pull clockspring assembly from steering column by lifting locating fingers as necessary. The clockspring cannot be repaired, and must be replaced if faulty.

INSTALLATION

(1) Snap clockspring onto the steering column. If the clockspring is not properly positioned, follow the clockspring centering procedure before installing steering wheel.

(2) Connect the clockspring assembly to the instrument panel wiring harness. Make sure wiring locator clips are properly seated on the outside of the wiring trough and locking tabs are engaged.

(3) Reinstall steering column shrouds. Be sure air bag wire is inside of shrouds.

(4) Road wheels should still be in the straight-ahead position. Install steering wheel making sure to fit the flats on the hub of the steering wheel with the formations on the inside of clockspring. Pull the horn lead through the upper smaller hole. The air bag and

speed control leads through the bottom larger hole in the steering wheel. Making sure not to pinch them between the steering wheel and nut.

(5) Connect the horn lead wire, then the air bag lead wire to the air bag module. To assure complete connection, latching arms must be visibly on top of connector housing.

(6) Install the air bag module, and torque nuts to 9 to 11 N●m (80 to 100 in. lb.).

(7) Do not connect negative battery cable. Refer to Air Bag System Check for proper procedure.

CLOCKSPRING CENTERING PROCEDURE

If the rotating tape within the clockspring is not positioned properly with the steering wheel and the front wheels, the clockspring may fail during use. The following procedure MUST BE USED to center the clockspring if it is not known to be properly positioned, or if the front wheels were moved from the straight ahead position.

WARNING: BEFORE BEGINNING ANY AIR BAG SYSTEM REMOVAL OR INSTALLATION PROCEDURES, REMOVE AND ISOLATE THE BATTERY NEGATIVE (-) CABLE FROM THE VEHICLE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIR BAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIR BAG DEPLOYMENT AND POSSIBLE INJURY.

(1) Place front wheels in the straight ahead position.

(2) Remove air bag module, vibration damper (if equipped), and steering wheel.

(3) Depress the two plastic locking pins (Fig. 13).

(4) Keeping locking mechanism disengaged, rotate the clockspring rotor in the CLOCKWISE DIRECTION to the end of travel. Do not apply excessive torque.

(5) From the end of travel, rotate the rotor two full turns and a half in the counterclockwise direction. The horn wire should end up at the top and the squib wire at the bottom.

(6) Reinstall steering wheel.

(7) Reinstall vibration damper (if equipped).

(8) Install air bag module. Torque nuts to 9 to 11 N●m (80 to 100 in. lbs.).

(9) Do not connect battery negative cable. Refer to Air Bag System Check for proper procedure.

STEERING WHEEL

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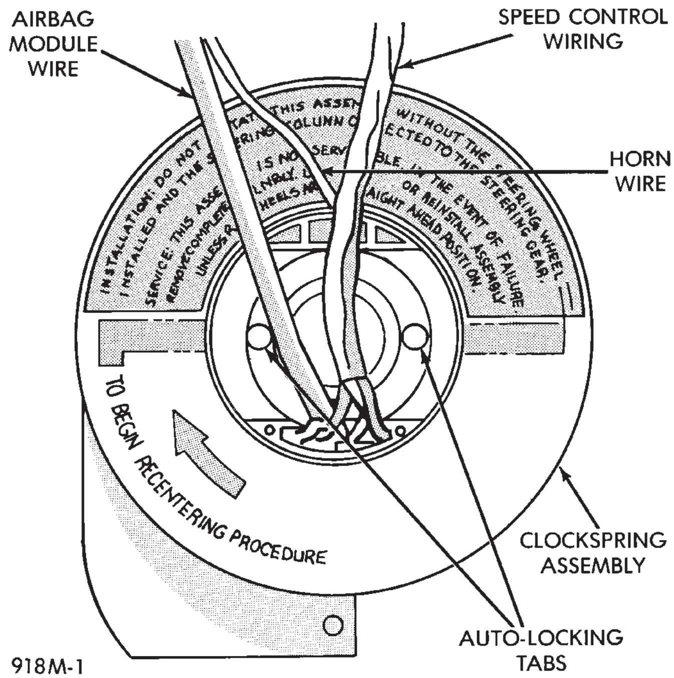


Fig. 13 Clockspring (Auto-Locking)

REMOVAL

(1) Make sure road wheels are straight, and steering column is locked in place.

(2) Disconnect battery negative cable and isolate.

(3) Wait 2 minutes for the reserve capacitor to discharge before removing undeployed module.

(4) Remove four nuts attaching air bag module from the back side of steering wheel.

(5) Lift module, and disconnect connector by spreading apart the external latching arms and prying upward on the connector.

(6) Remove speed control switch.

(7) Remove steering wheel retaining nut.

(8) On vehicles so equipped, remove damper assembly.

(9) Remove steering wheel with steering wheel puller Tool C-3428B.

INSTALLATION

(1) If the clockspring is not properly positioned or if road wheels were moved, follow the clockspring centering procedure before installing steering wheel. With the road wheels in the straight ahead position. Position the steering wheel on the steering column. Making sure to fit the flats on the hub of the steering wheel with the formations on the inside of the clockspring. Pull the air bag and speed control wires through the lower, larger hole in the steering wheel; and the horn wire through smaller hole at the top. Make sure not to pinch wires (Fig. 14).

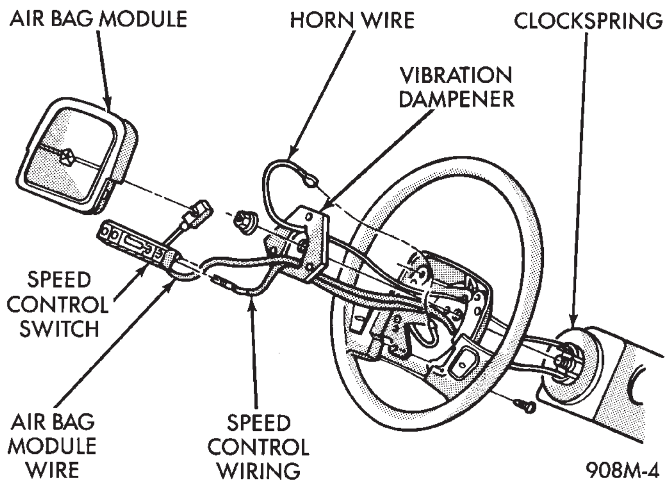


Fig. 14 Steering Wheel Wiring

(2) Install damper assembly on vehicles equipped with automatic transmissions.

(3) Install retaining nut, and torque it to 5 N●m (45 ft. lbs.).

(4) Connect horn wiring lead.

(5) Connect 4-way connector to speed control switch and attach switch to steering wheel.

(6) Connect air bag lead wire to air bag module, and secure module to steering wheel.

(7) Do not connect battery negative cable. Refer to Air Bag System Check for proper procedure.

REAR WINDOW DEFOGGER

CONTENTS

GENERAL

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 rear window glass comprise an electrical circuit. The electrically conductive lines are composed of a silver-ceramic material. When this material is baked on glass it 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.

The power circuit to the grid is protected by the 30 amp Circuit Breaker #28 located in the fuse box. Power for the relay is protected by the 15 amp #19 fuse located in the fuse box. There is another fuse, #23, located in the fuse box that controls the power to the switch and the side mirrors.

To defog the rear window, momentarily depress the push button switch. An amber light above the push button 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.

DIAGNOSIS

Refer to Group 8W - Wiring Diagrams for a complete circuit diagram.

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/or until it is cleared by the adjacent grids.

With the engine running, push the rear window defogger switch to the ON position and release. The pilot lamp above the push button 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 the positive voltmeter lead to the left or right along the grid. An abrupt change in the voltage reading will be noticed. The break is at that point in the grid.

SWITCH TESTING

BATTERY, IGNITION & FUSES

- Check fuses #19, #23 and circuit breaker #28. Replace as required.
- If the fuses are not blown, check the battery side of fuse #28 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 #19, 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.

(1) Using a jumper wire, apply 12 volts to terminal 1 of switch.

(2) Using another jumper wire connect terminal 3 of switch to ground.

The indicator should light. If not replace switch. If OK, proceed to next step.

(3) Remove jumper wires and connect an ohmmeter to terminals 2 and 3 of switch.

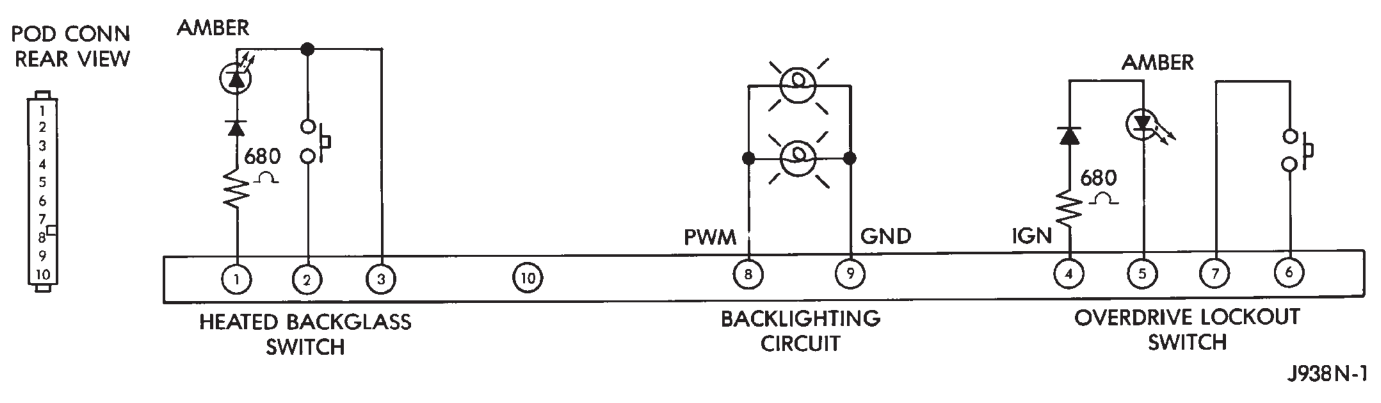
(4) Push the switch. Ohmmeter should read less than 1 ohm. If not replace switch. If OK, check for an open circuit between:

- terminal 1 and fuse #23
- terminal 3 and ground
- terminal 2 and terminal 3 of the relay.

REAR DEFOGGER RELAY

Defogger relay connector separated from defogger relay; turn ignition switch to RUN for voltage tests; turn ignition switch to OFF for resistance tests

- Measure voltage at relay connector terminal 5. The meter should read battery voltage. If not, repair open to fuse #19.
- Measure voltage at relay connector terminal 4. The meter should read battery voltage. If not, repair open to Circuit Breaker #28.

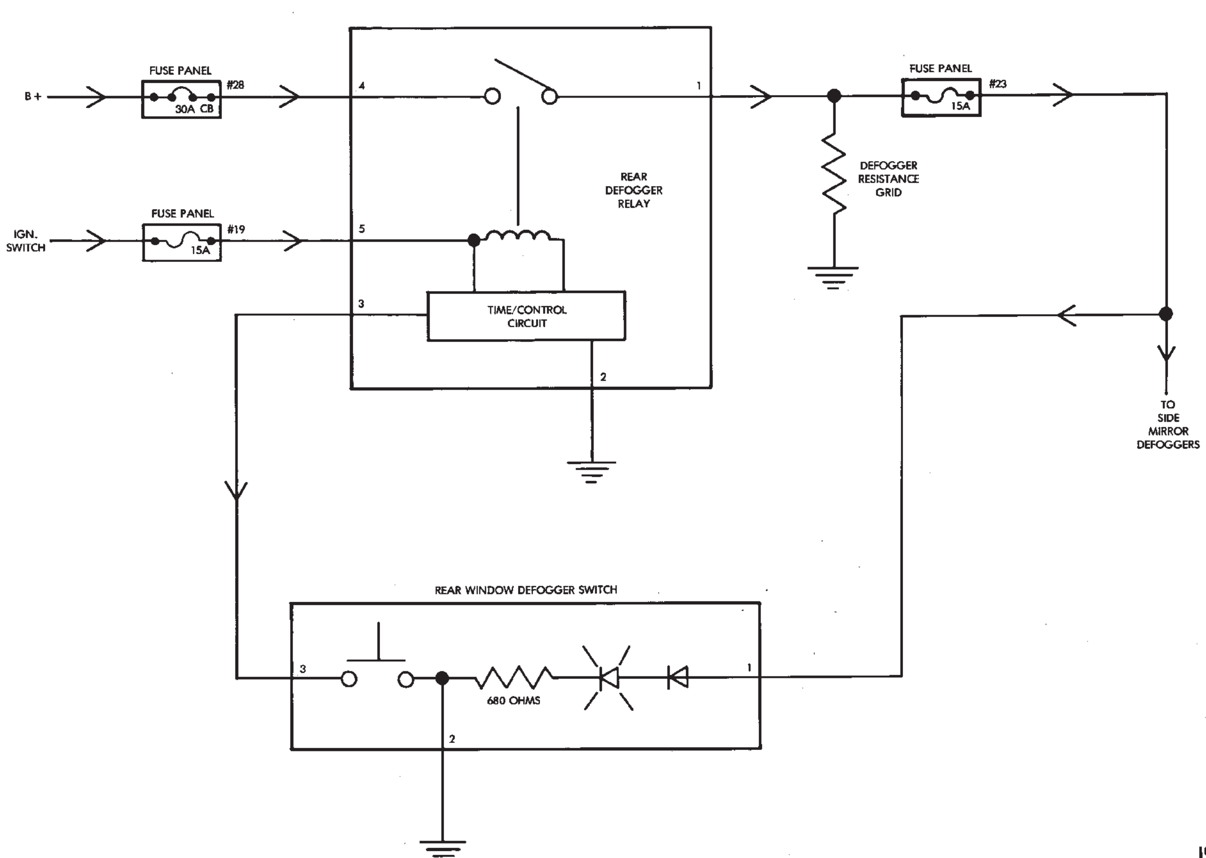


• Measure resistance between relay connector terminal 1 and Left Hand side (driver's side) of defogger grid. The meter should read zero ohms. If not, repair open between relay connector and Left Hand side of defogger grid.
• Measure resistance between relay connector terminal 2 and a clean chassis ground. 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.

DEFOGGER GRID

Turn defogger switch to ON; turn ignition switch to RUN for voltage tests; turn ignition switch to OFF for resistance tests
• Measure voltage at Right Hand side (passengers side) of Defogger Grid. The meter should read battery voltage. If not, repair open from defogger relay.
• Measure resistance for LH side of Defogger Grid to a clean chassis ground. The meter should read zero ohms. If not, repair open between RH side of Defogger Grid and ground.

REAR WINDOW DEFOGGER SYSTEM SCHEMATIC



J938N-3

SERVICE PROCEDURES

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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).

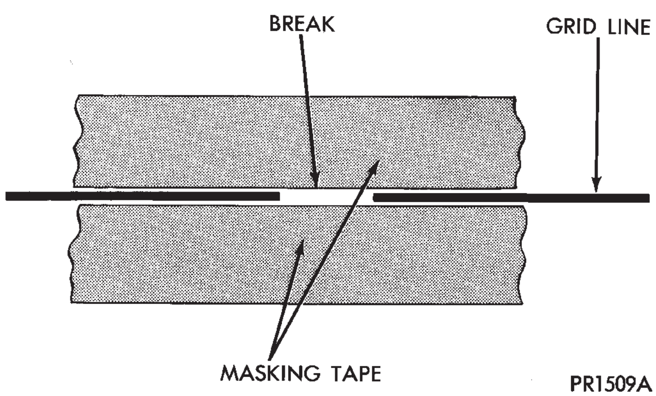

Fig. 1 Grid Line Repair (Typical)

(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.

REAR WINDOW DEFOGGER SWITCH REPLACEMENT

(1) Disconnect negative cable from the battery.

(2) Remove ash tray.

(3) Remove 6 screws holding center cluster bezel (Fig. 2).

(4) Remove center bezel.

(5) Remove 2 screws holding dash pad located behind top of center bezel.

(6) Gently pry defroster grille out of dash pad.

(7) Unplug sensors (if equipped) and set defroster grille aside.

(8) Remove 4 screws in defroster duct opening holding dash pad (Fig. 3).

(9) Remove 3 screws above Instrument Panel cluster holding dash pad (Fig. 4).

(10) Open glove box and remove 2 screws holding dash pad.

(11) Remove dash pad pulling up to unsnap end clips.

(12) With driver's door open remove 1 screw from the side of the lower trim panel (Fig. 5).

(13) Remove 4 screws holding the steering column cover (Fig. 6).

(14) Remove 1 screw from bottom of lower trim panel and pull panel off. There is also a clip holding the panel to the instrument panel.

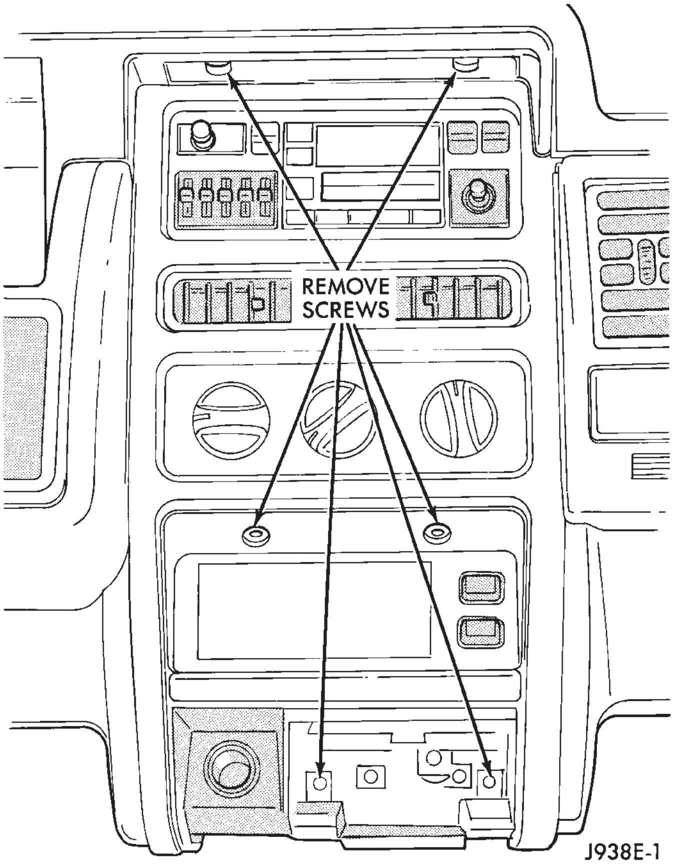

Fig. 2 Remove Center Bezel Screws

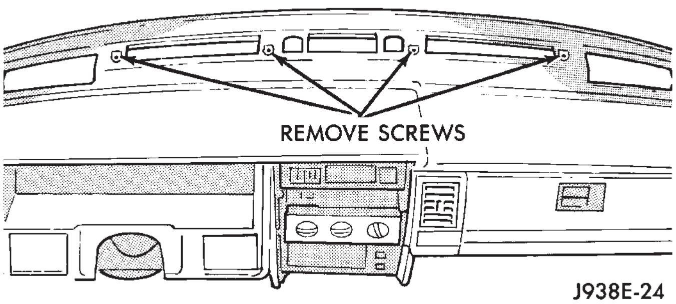

Fig. 3 Upper Dash Pad Attaching Screws

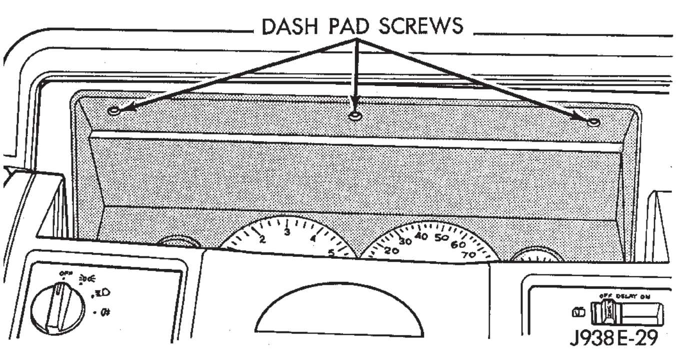

Fig. 4 Remove Screws Holding Dash Pad

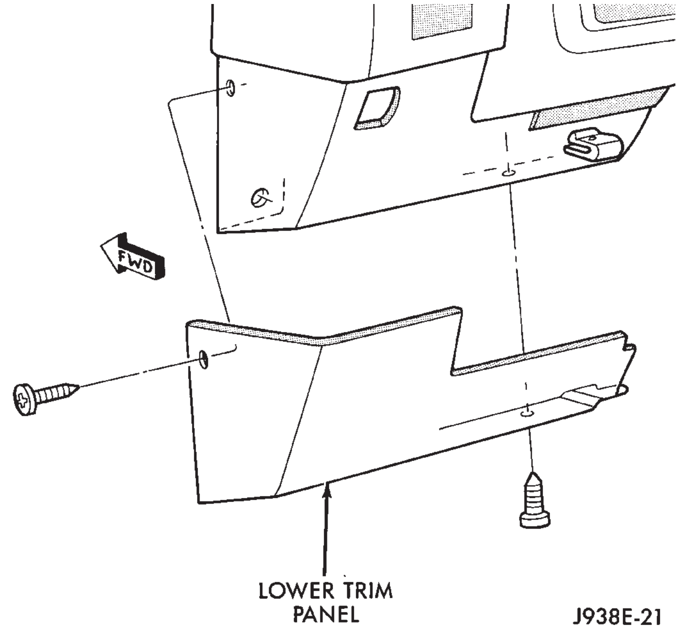

Fig. 5 Lower Trim Panel

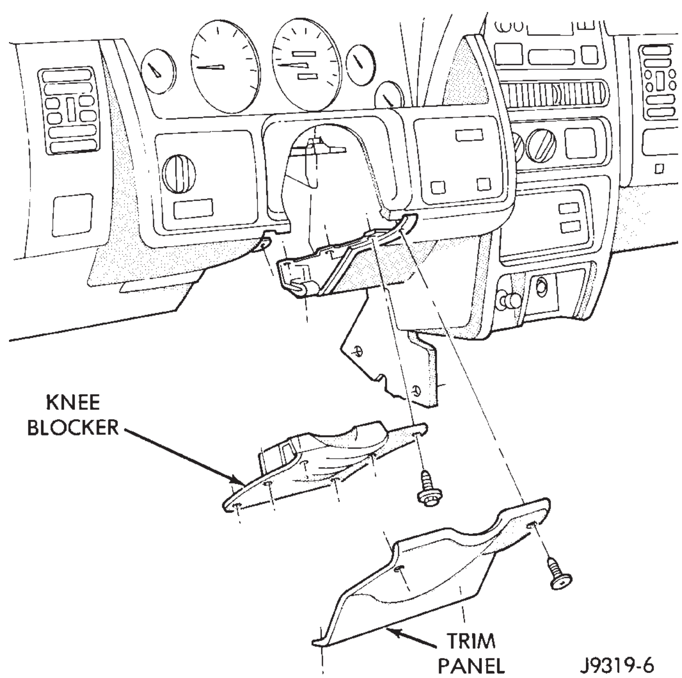

Fig. 6 Steering Column Cover And Knee Blocker

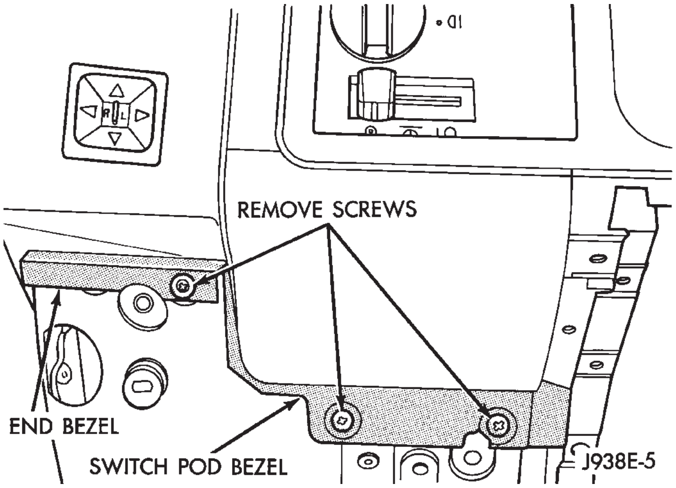

Fig. 7 Remove Screws Holding Bottom Of Bezels

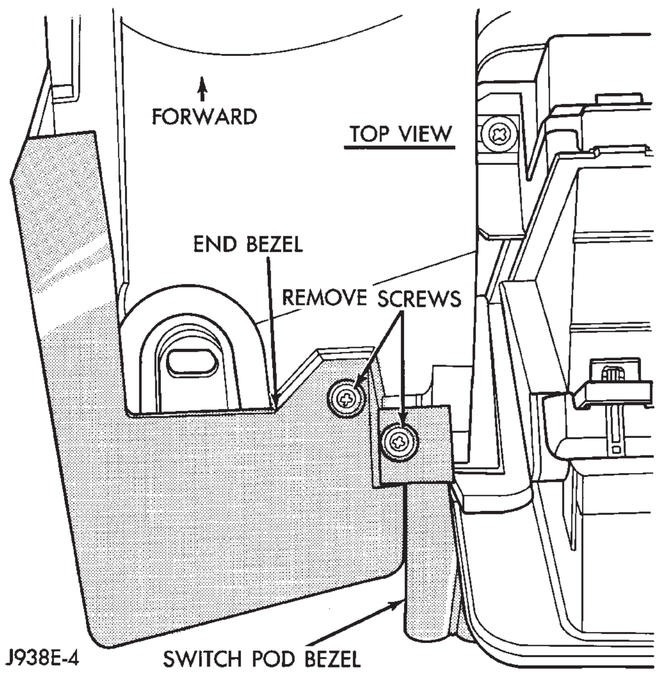

Fig. 8 Remove Screws Holding Top Of Bezels

(15) Remove 6 screws holding knee blocker.
(16) Remove steering column retaining nuts.
(17) Remove 3 screws holding bottom of bezels (Fig. 7).
(18) Remove 2 screws holding top of end and switch pod bezels (Fig. 8). The end bezel can now be removed.
(19) Remove 2 screws holding left side of switch pod bezel (Fig. 9).
(20) Remove 3 screws holding right hand side of switch pod bezel (Fig. 10).

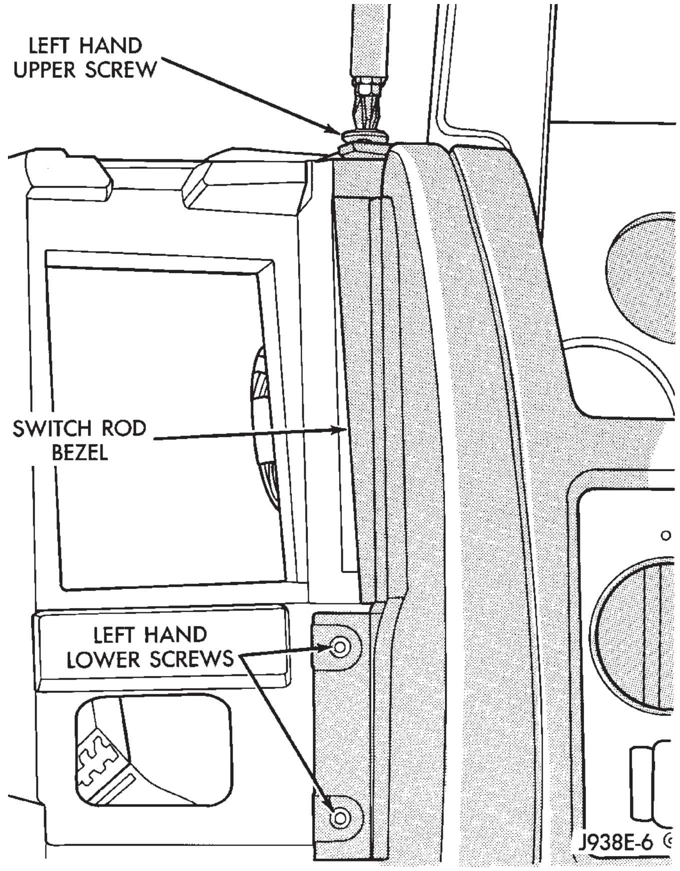

Fig. 9 Left Hand Switch Pod Bezel Screws

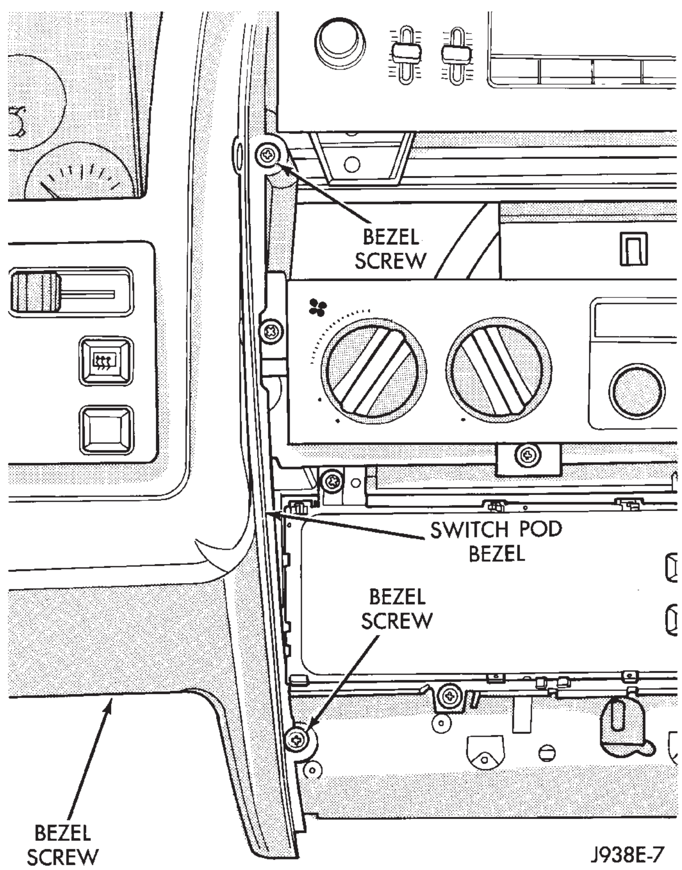

Fig. 10 Right Hand Switch Pod Bezel Screws

(21) Pull switch pod bezel out far enough to remove switch connectors. Disconnect connectors from each switch pod and remove bezel (Fig. 11).

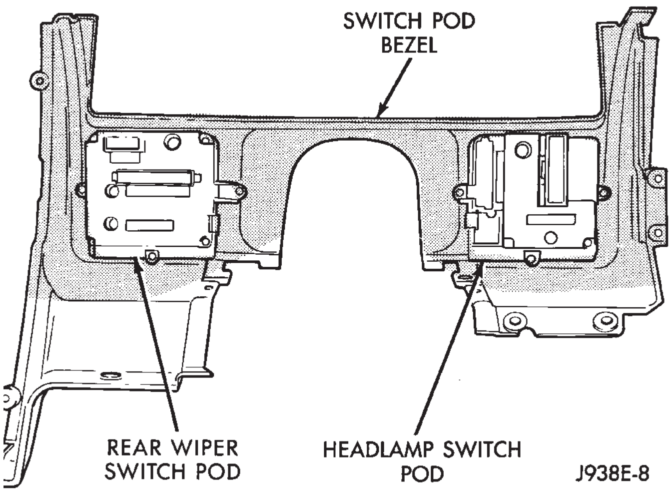

Fig. 11 Rear View of Switch Pod Bezel

(22) Remove required switch pod attaching screws and switch pod.

(23) Reverse the removal procedures to install a new switch pod. Tighten steering column retaining nuts to 105 in. lbs.

REAR DEFOGGER RELAY

(1) Open glove box and remove 3 screws holding relay center cover (Fig. 12).

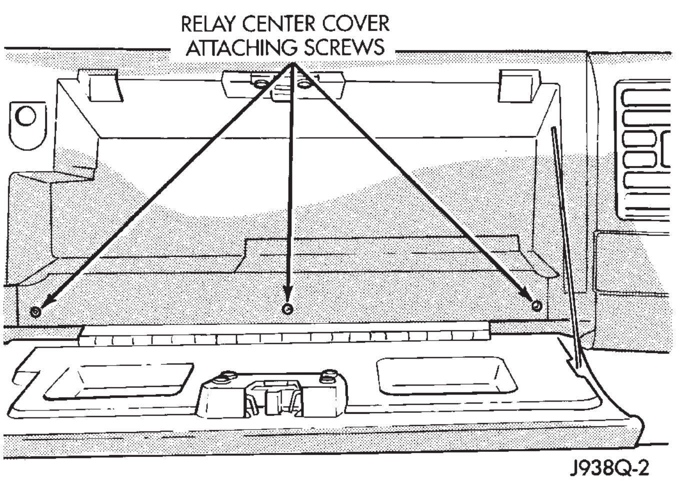

Fig. 12 Relay Center Cover

(2) Remove the RED relay from the relay center (Fig. 13).

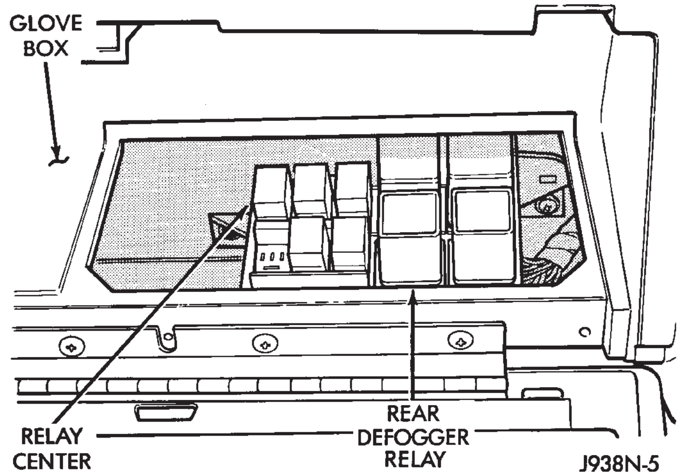

Fig. 13 Rear Defogger Relay

POWER DOOR LOCKS

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POWER LOCKS

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GENERAL

The door lock actuators, including liftgate, are controlled by two-way switches. To lock the doors, push either switch to the right. To unlock doors from inside the vehicle push either switch to the left.

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 or use the keyless entry transmitter.

DESCRIPTION

The door locks are operated by reversible motors. The voltage supply comes from the 20 amp mini fuse F1 in the Power Distribution Center (PDC) to the 15 amp #8 fuse located in the fuse panel. Power then goes to the left hand door lock switch. With the left hand 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 F14 20 amp fuse to the lock motor. Fuse 14 is supplied by a 40 amp maxi fuse in the PDC labeled Fuse Block Feed. The motor is grounded by the unlock relay.

The LOCK function will not operate if:
- The chime module is not plugged in.
- The key is in the ignition, or the lights are ON, while the driver's door is open.
- The door lock inhibit feature of the chime module is inoperable due to defective electronics in the chime. In this case the operation is unpredictable.

The RH 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 the vehicle has Keyless Entry and the door locks operate properly using the door switches but do not work with the transmitter, refer to Keyless Entry in this group.

DOOR LOCKS DO NOT OPERATE USING DOOR LOCK SWITCHES

For complete circuit diagrams refer to Group 8W - Wiring Diagrams.

Check fuses #8 and #14 in the fuse panel. Replace as required.

(1) Measure voltage at output side of fuses. Meter should read battery voltage. If not, repair open in circuit to fuse.

(2) Remove door switch and measure voltage at terminal 4. Meter should read battery voltage. If not, repair open circuit between fuse #8 and switch.

(3) Remove glove box bottom to access the relay center.

(4) Measure resistance between Lock and Unlock relay terminal 4 and ground. Meter should read zero ohms. If not, repair open to ground.

(5) Measure voltage at terminal 2 of both the Lock and Unlock relays. Meter should read battery voltage. If OK, next step. If not, repair open to fuse #14.

(6) Measure resistance at terminal 5 of both the Lock and Unlock relays. Meter should read zero ohms. If not, repair open to ground.

(7) Hold left hand switch in LOCK position. Measure voltage at lock relay terminal 1. Meter should read battery voltage. If OK, next step. If not, repair open to left hand switch.

(8) Hold left hand switch in UNLOCK position. Measure voltage at Unlock relay terminal 1. Meter should read battery voltage. If OK, next step. If not, repair open to left hand switch.

(9) Hold left hand switch in LOCK position. Measure voltage at Lock relay terminal 4. Meter should read battery voltage. If OK, next step. If not, replace Lock relay.

(10) Hold left hand switch in UNLOCK position. Measure voltage at Unlock relay terminal 4. Meter should read battery voltage. If OK, check connections and door motor. If not, replace Unlock relay.

(11) Repeat procedures for RH switch.

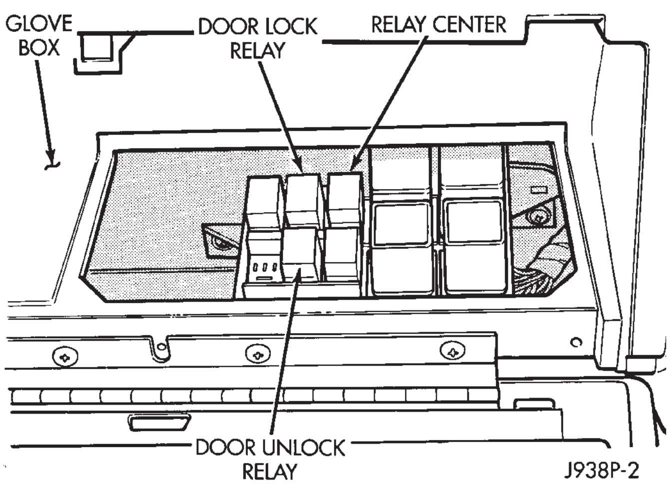


Fig. 1 Door Lock/Unlock Relays

ACTUATOR MOTOR STALL TEST

To test the actuator motor, attach 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 Removal procedures.

SWITCH REPLACEMENT—FRONT DOOR

(1) Remove screw at top of trim panel near mirror (Fig. 2).

(2) Remove screw from demister opening at front of door.

(3) Remove screw and door handle cover.

(4) Remove screw from under armrest.

(5) Remove screw from bottom of hand hold in armrest.

CAUTION: The wiring harness to the door switches is just long enough to allow installation. If trim panel is pulled off by hand the switch may be pulled apart. Use a door clip tool to prevent damaging the switches.

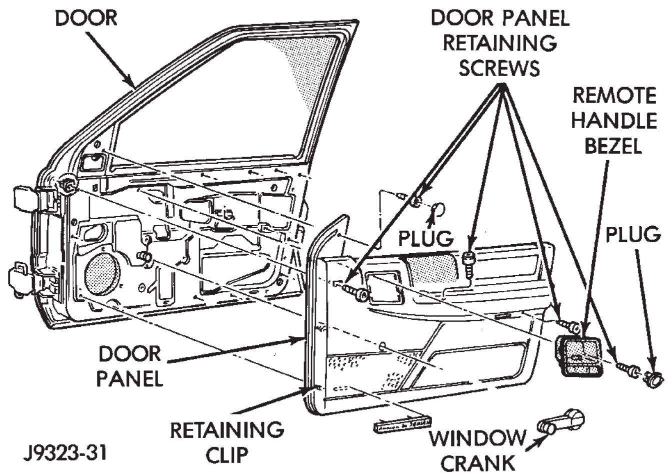


Fig. 2 Door Panel Removal

(6) Remove the trim panel with a wide flat blade tool (Fig. 3).

To aid in removal of the trim panel, start at the bottom of the panel.

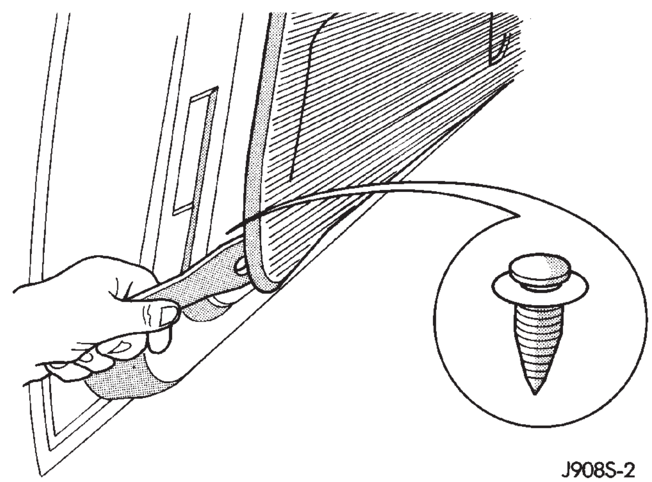


Fig. 3 Trim Panel Removal

(7) Unplug electrical connector from switch.

(8) Remove switch from door panel.

(9) Install a new switch.

(10) Install door trim panel by reversing the removal procedures.

SWITCH REPLACEMENT—REAR DOOR

(1) Remove screw and door handle cover (Fig. 4).

(2) Remove screw from under armrest.

(3) Remove screw from bottom of hand hold in armrest.

CAUTION: The wiring harness to the door switches is just long enough to allow installation. If trim panel is pulled off by hand the switch may be pulled apart. Use a door clip tool to prevent damaging the switches.

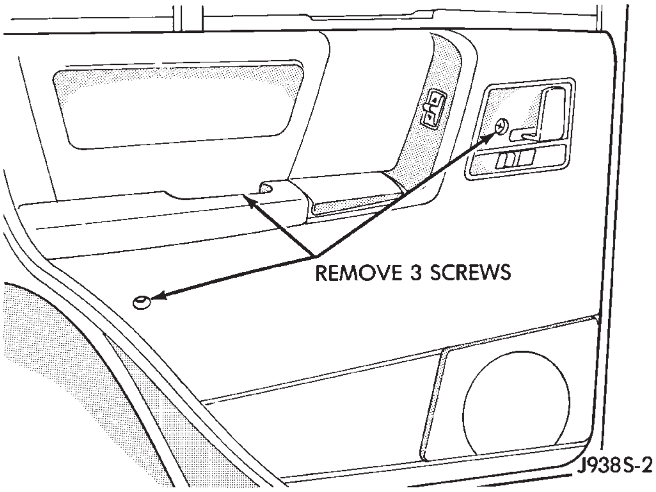


Fig. 4 Trim Panel Attachment

(4) Remove the trim panel with a wide flat blade tool (Fig. 3).

To aid in removal of the trim panel, start at the bottom of the panel.

(5) Remove switch from door panel.

(6) Install a new switch.

(7) Install door trim panel by reversing the removal procedures.

SOLENOID AND LATCH ASSEMBLY REPLACEMENT

(1) Remove door panel as described in Switch Replacement.

(2) Remove 1 bolt holding bottom of window track to door (Figs. 5 and 6).

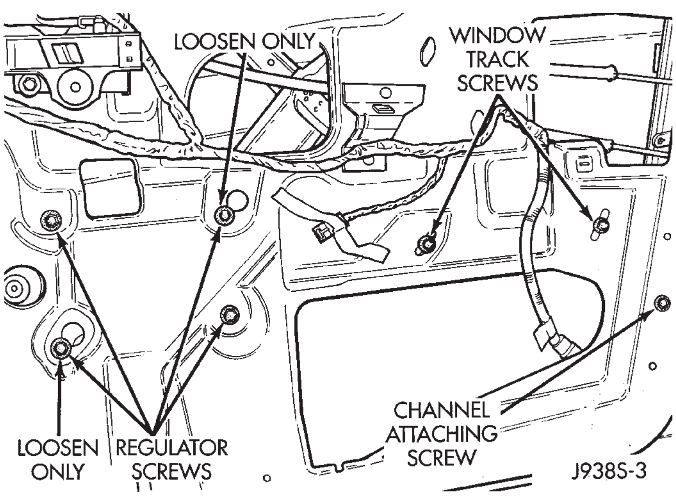


Fig. 5 Window Track Attaching Bolts—Front Door

(3) Disconnect 4 linkage rods from their clips (Figs. 7 and 8).

(4) Unplug wire harness connector from lock motor.

(5) Remove 3 torx head screws retaining the latch (Figs. 9 and 10).

(6) Place the lock solenoid, latch and remote control rods in the door.

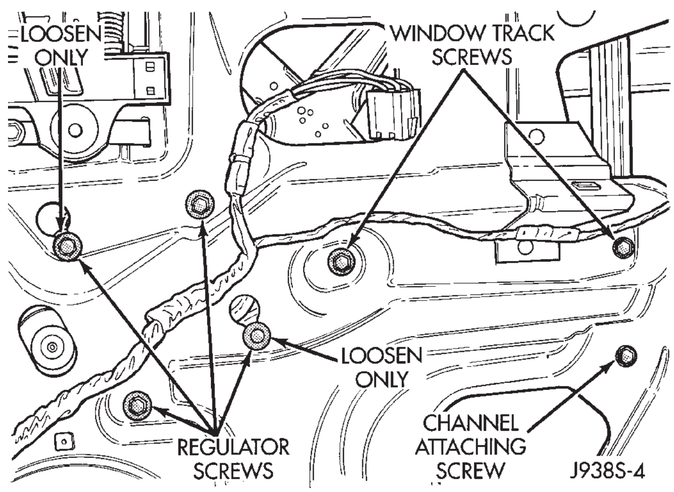


Fig. 6 Window Track Attaching Bolts—Rear Door

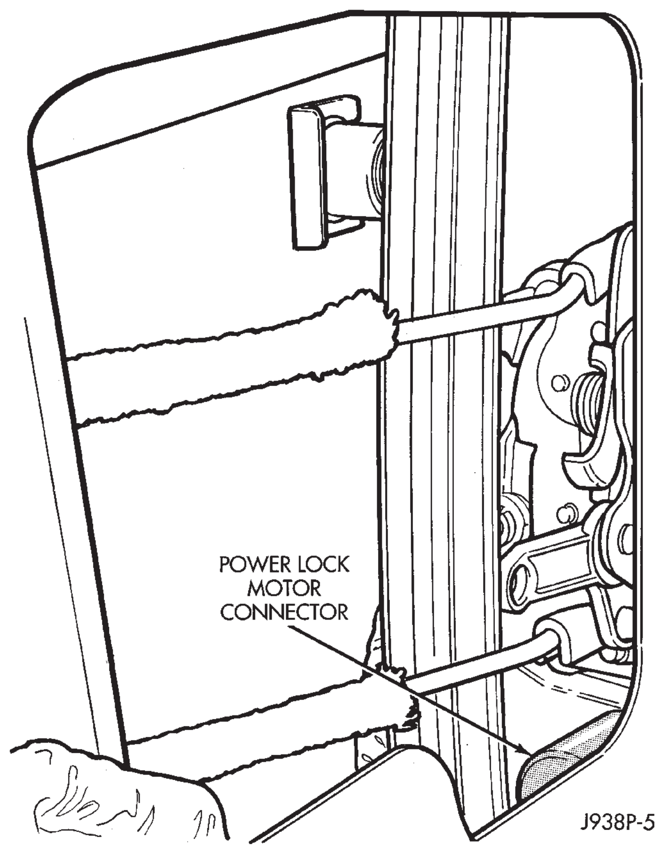


Fig. 7 Power Lock Motor—Front Door

(7) Attach the lock solenoid to the door panel with 3 torx head screws. Tighten screws to 11 N●m (95 in. lbs.).

(8) Install 4 linkage rods.

(9) Using 3M 08044 or 3M 08041 adhesive/sealant, install the plastic water dam sheet.

(10) Place the trim panel in the installation position and press in the nylon retainers.

(11) Install the door panel attaching screws.

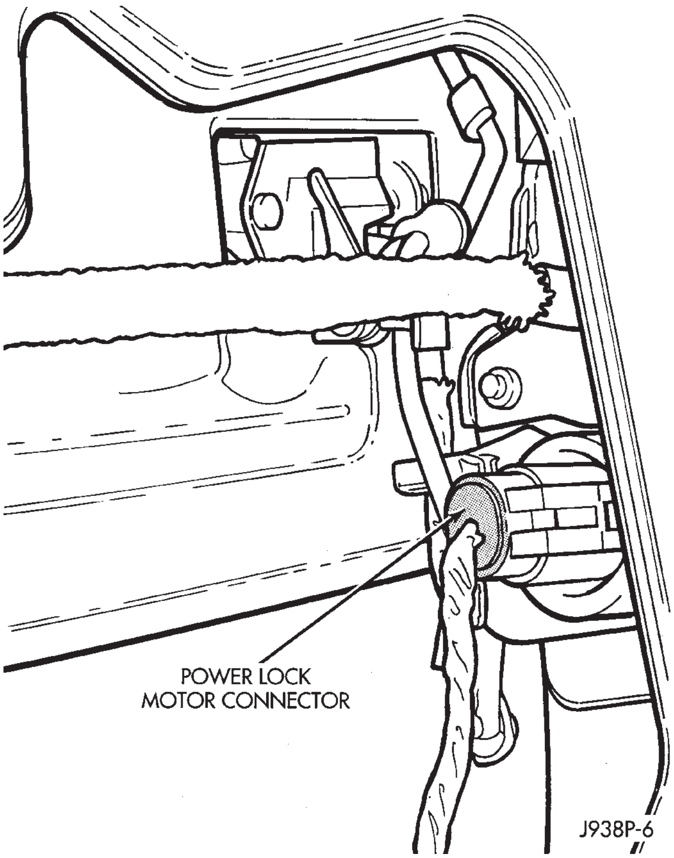


Fig. 8 Power Lock Motor—Rear Door

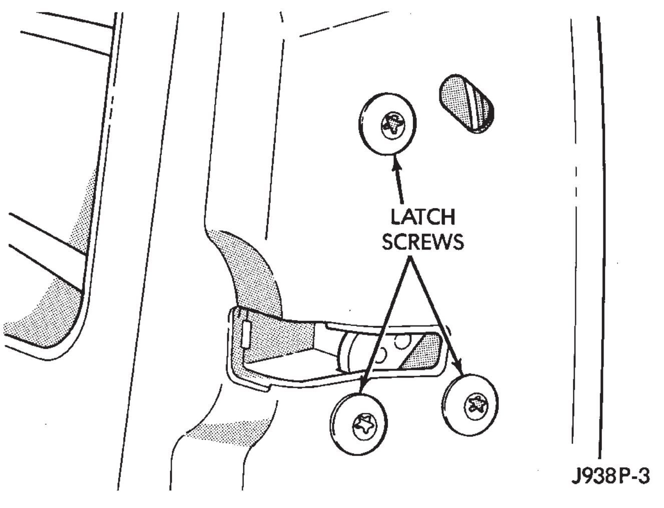


Fig. 9 Latch Removal/Installation—Front Door

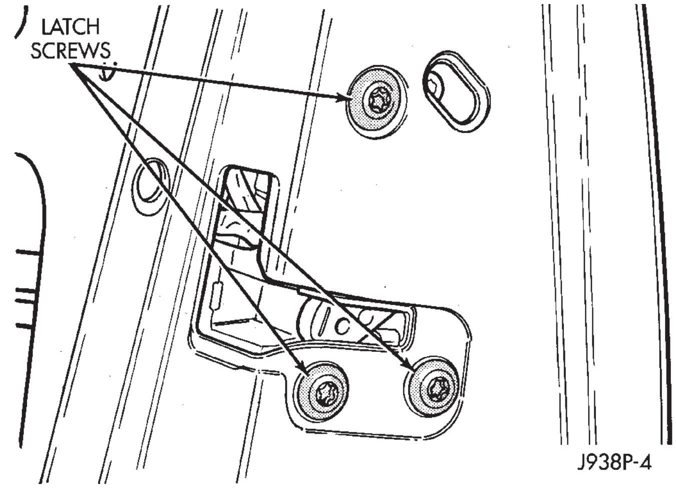


Fig. 10 Latch Removal/Installation—Rear Door

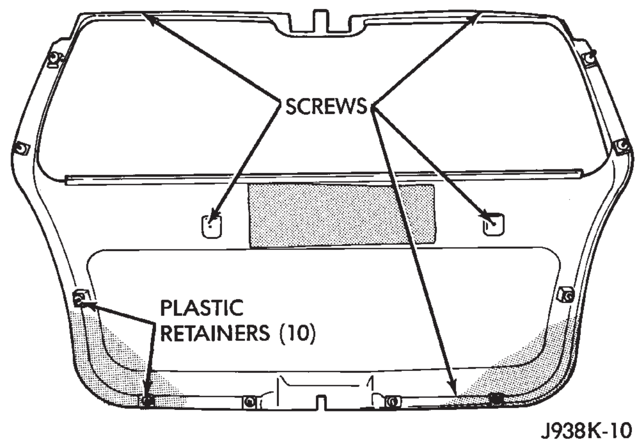


Fig. 11 Liftgate Trim Panel Removal

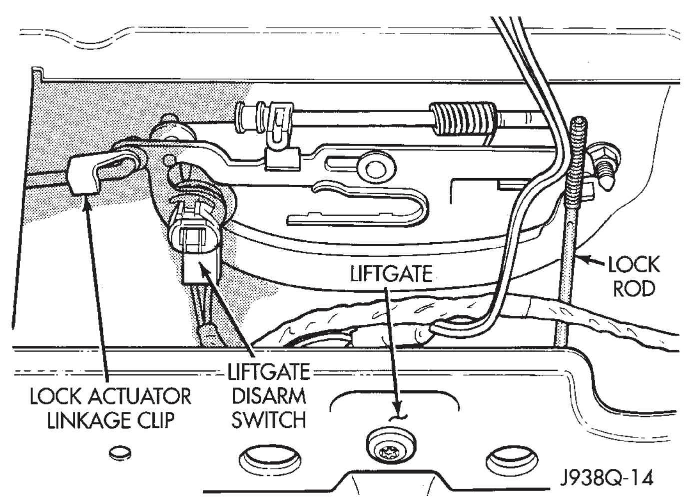


Fig. 12 Lock Actuator Linkage Clip

LIFTGATE LOCK ACTUATOR REPLACEMENT

(1) Remove 5 screws holding liftgate interior trim panel.

To aid in removal of the trim panel, start at the bottom of the panel.

(2) Remove the trim panel with a wide flat blade tool (Fig. 11).

(3) Disconnect the lock actuator linkage clip at the handle (Fig. 12).

(4) Remove 2 actuator retaining screws (Fig. 13).

(5) Remove the actuator.

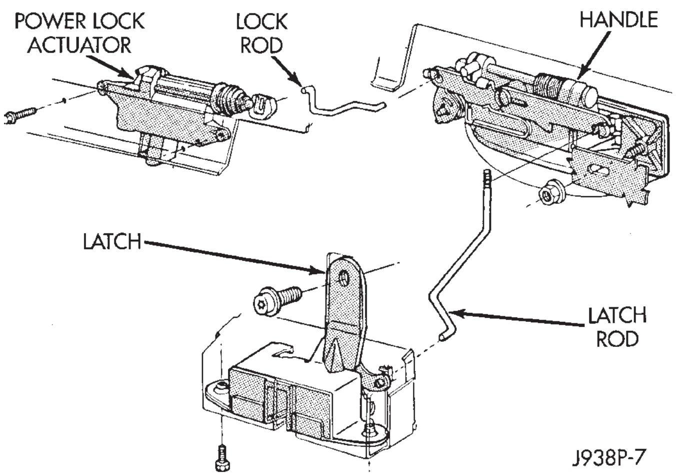


Fig. 13 Power Lock Actuator Removal/Installation

(6) To install the actuator, reverse the removal procedures.

(7) Tighten the actuator screws to 3 N●m (28 in. 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 in the dome-lamp housing. 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 place 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

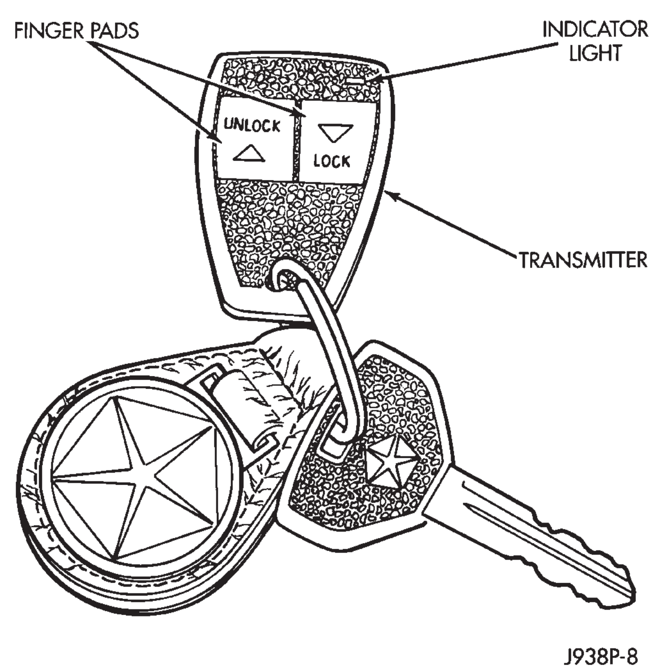


Fig. 1 Keyless Entry Transmitter

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 case 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 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) Insert the ignition key and turn it to the RUN position.

(4) Turn the ignition to the RUN position. 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 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

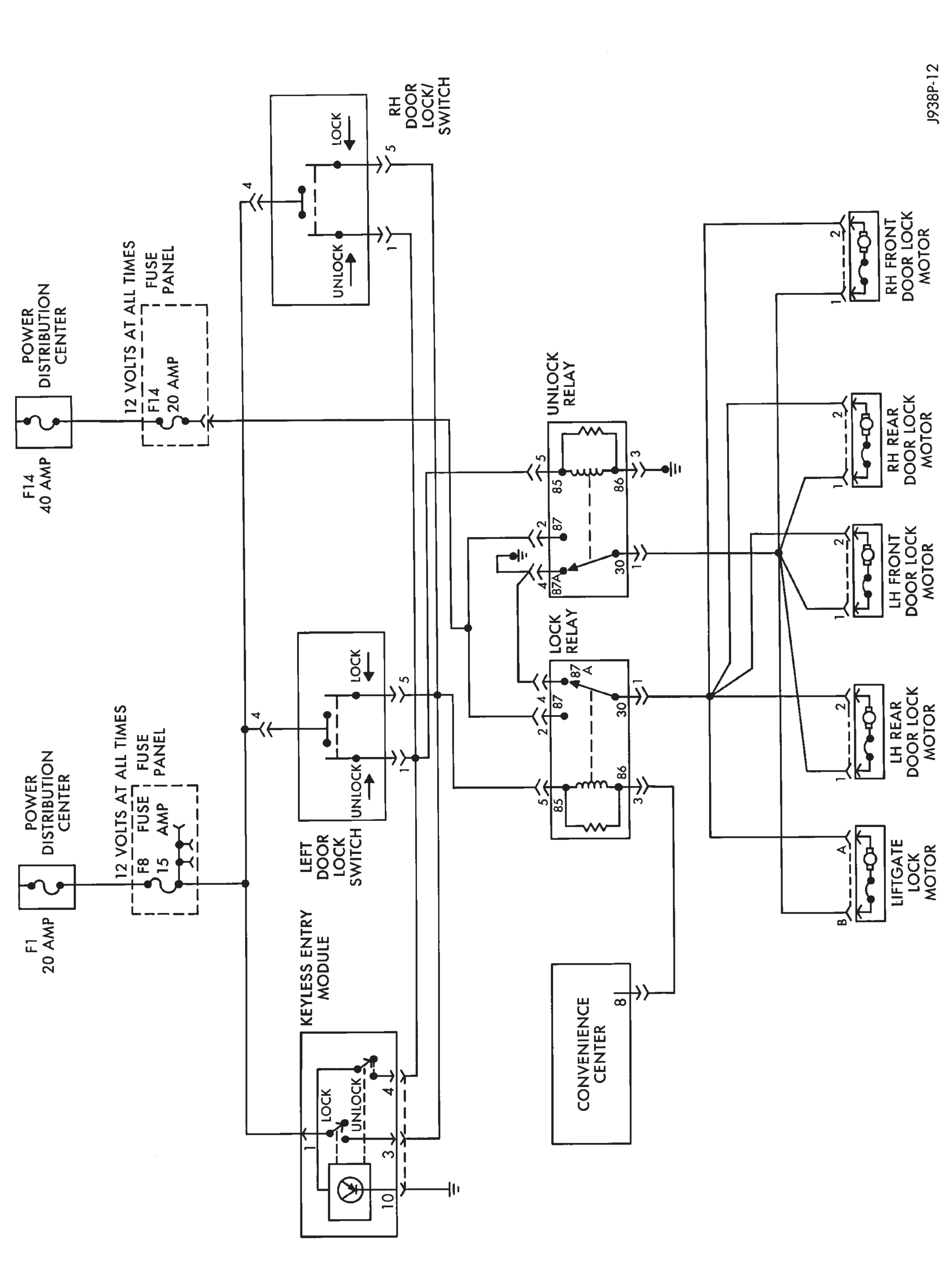
NO DOOR LOCKS OPERATE, USING TRANSMITTER

(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 Dome 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 5.

(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 5.



POWER DOOR LOCKS

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 the transmitter at the middle seam (Fig. 2).

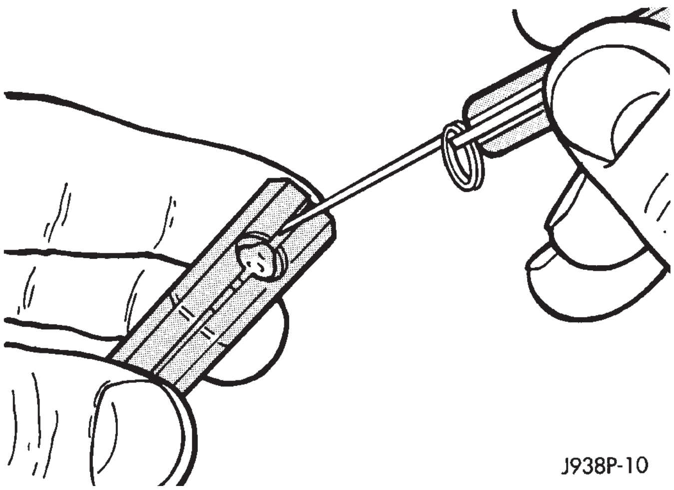


Fig. 2 Separate Transmitter Halves

(2) Remove and discard the old batteries (Figs. 3, 4).

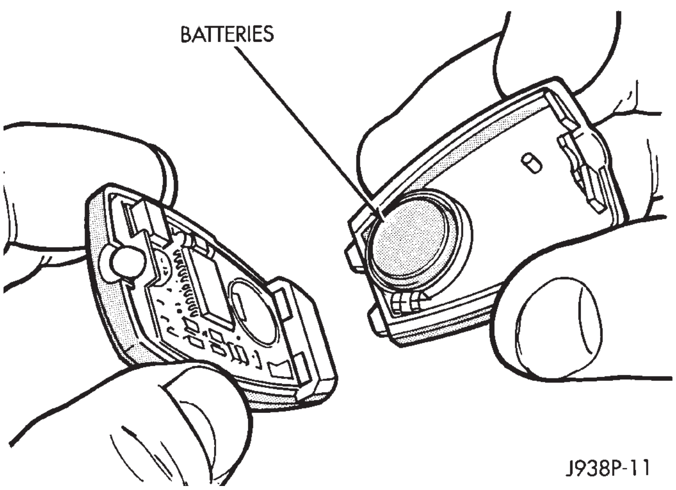


Fig. 3 Battery Removal

(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.

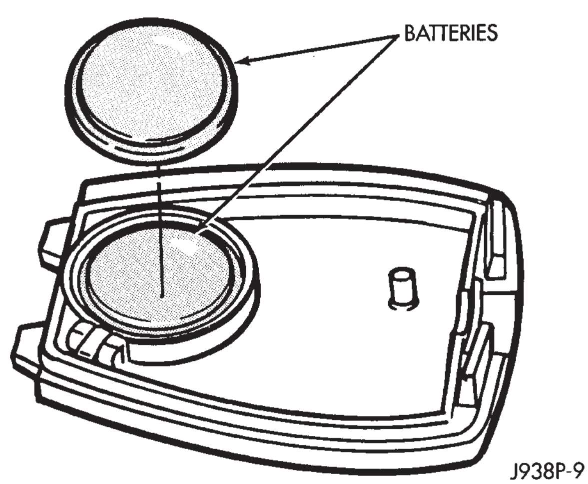


Fig. 4 Battery Installation

RECEIVER SERVICE

WITH OVERHEAD CONSOLE

(1) Remove console forward mounting screw (Fig. 5).

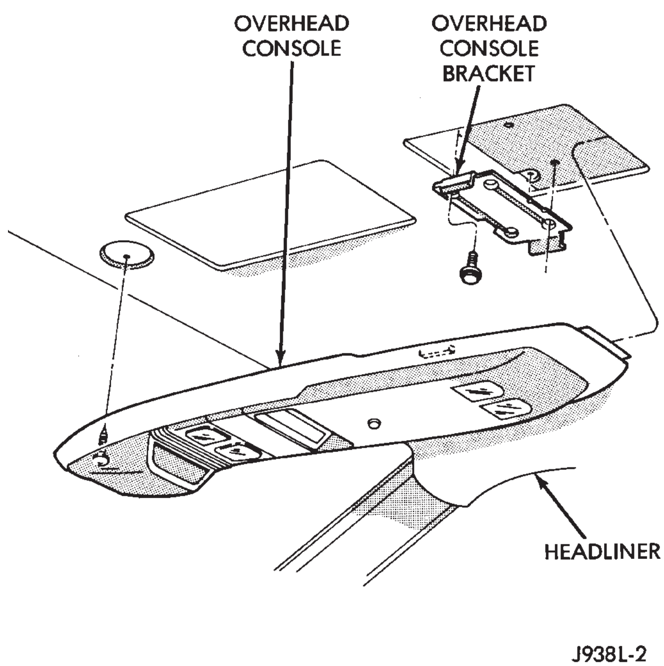


Fig. 5 Remove/Install Overhead Console

(2) Unplug Trip Computer harness connector.

(3) Slide console forward until the console detaches from the rear mounting bracket.

(4) Unplug keyless entry harness connector (Fig. 6).

(5) Remove 6 screws holding rear half of console (Fig. 7).

(6) Release 4 clips, 2 front and 2 rear, and separate cover out from console.

(7) Remove the screw and the printed circuit board can be removed (Fig. 8).

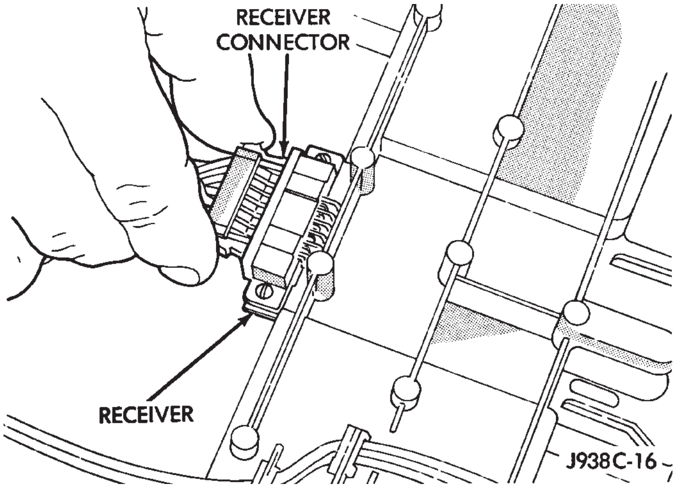


Fig. 6 Keyless Entry Harness Connector

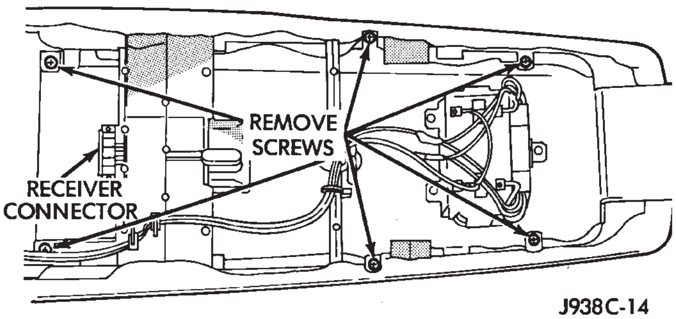


Fig. 7 Rear Overhead Console Panel Removal

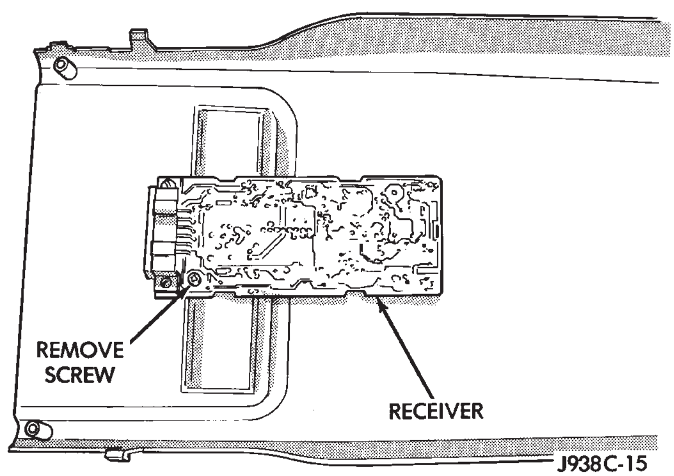


Fig. 8 Receiver Removal/Installation

(8) To install the overhead console, reverse the removal procedures.

WITHOUT OVERHEAD CONSOLE

(1) Remove 1 screw attaching the dome lamp housing to the roof (Fig. 9).

(2) Push the housing toward the front of the vehicle to disengage retainers.

(3) Unplug the harness connectors.

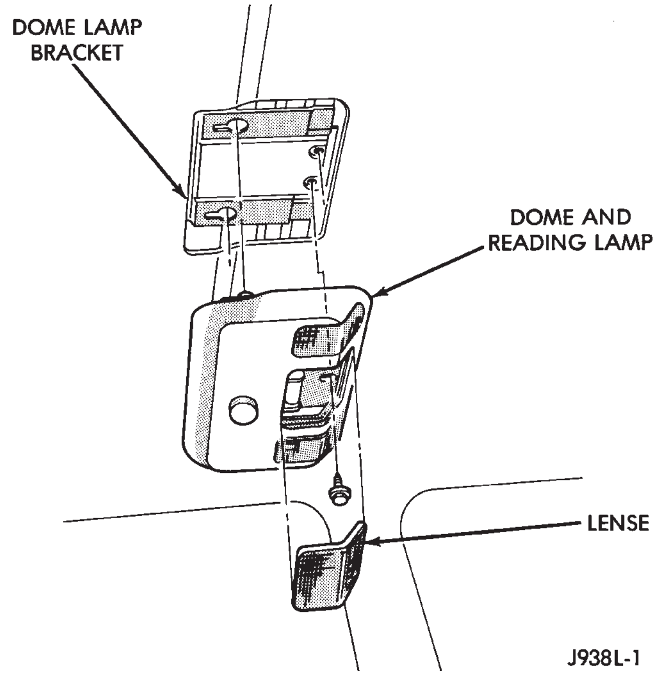


Fig. 9 Remove/Install Dome Lamp Housing

(4) Release the circuit board connector from its mounting location.

(5) Remove circuit board from housing.

(6) Reverse the removal procedures to install the receiver.

DOOR LOCK/UNLOCK RELAY REPLACEMENT

(1) Open glove box and remove 3 screws holding relay center cover (Fig. 10).

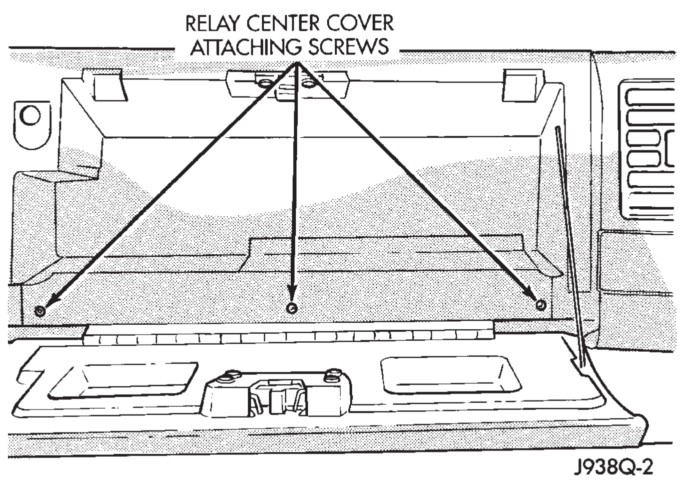


Fig. 10 Relay Center Cover

(2) Remove lock or unlock relay as required (Fig. 11).

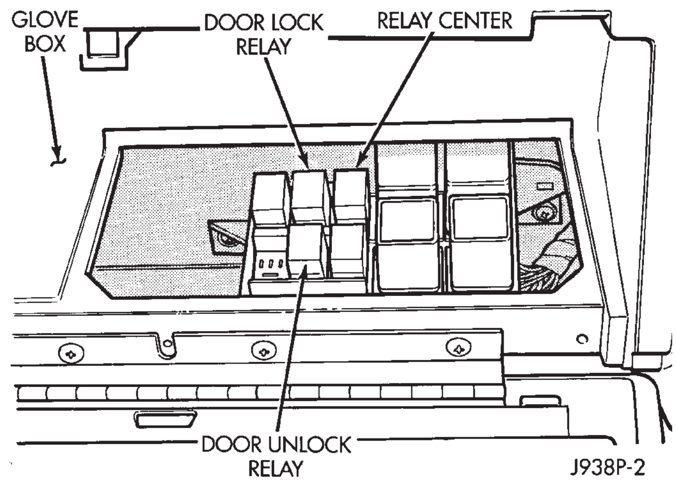


Fig. 11 Door Lock/Unlock Relays

VEHICLE THEFT SECURITY SYSTEM

CONTENTS

GENERAL INFORMATION

This passive system is designed to protect against vehicle theft. The Security Alarm Module (SAM) is a logic controlled device that monitors vehicle doors, hood, liftgate and ignition action for unauthorized operation. The alarm activates by sounding the horn, flashing the headlamps, park and tail lamps and providing an engine no run feature.

Passive arming occurs upon normal vehicle exit (ignition OFF, open door, lock with power locks, close door). The Security lamp in the panel will flash for 15 seconds, showing that arming is in progress. Note that this 15 second arming period will start after the Illuminated Entry has timed out (courtesy lamps off). If no monitored systems are activated during this period, the system will arm. If the hood switch is not seen by the system, the Security lamp will remain steadily lit during the arming process, although the system will still arm.

The engine compartment will not be protected from entry while the security lamp remains lit.

Active arming occurs when the Remote Keyless Entry transmitter is used to lock the vehicle doors, whether the doors are open or closed. If one or more doors are open, the arming sequence is completed only after all doors and liftgate are closed.

Passive disarming occurs upon normal vehicle entry (unlocking either front door or liftgate, with the key). This disarming also will halt the alarm once it has been activated.

Active disarming occurs when the Remote Keyless Entry transmitter is used to unlock the vehicle doors. This disarming also will halt the alarm once it has been activated.

When the battery is connected the Vehicle Theft Security System enters its power up alarm mode which:

- flashes the headlamps
- flashes the park and tail lamps
- prevents the engine from running.

To exit this mode, the system must be disarmed as mentioned previously.

A tamper alert exists to notify the driver that the alarm had been activated, and has since timed-out (alarmed for more than 18 minutes). This alert gives 3 horn pulses when the vehicle is disarmed.

The alarm system will not arm if the doors are manually locked, providing a manual override of alarm.

SYSTEM SELF-TESTS

A diagnostics mode is available in the system to verify operation of all monitored switches or circuits. To enter diagnostics, cycle the ignition key to the accessory position 3 times, leaving the key in this position.

Upon entering diagnostics, the headlamps, park and tail lamps will begin flashing to verify their operation. In addition, the horn will sound twice. Returning the ignition to the OFF position will stop the lamps from flashing while keeping the system in diagnostics.

While in diagnostics mode, a horn pulse should occur at each of the following events indicating proper operation:

Note that vehicles equipped with the Vehicle Theft Security System are also equipped with Illuminated Entry. When in diagnostic mode it is recommended that the Illuminated Entry Relay be removed. Otherwise it is necessary to wait for the 30 seconds delay after each door opening or closure.

(1) Beginning with all doors closed, open then close each door. The horn will sound when the door jamb switch closes, and then again when the switch opens. There must be a 1 second delay between closing and opening the switch.

(2) Open, then close the hood. The horn will sound when the hood is opened, and again when it is closed.

(3) Activate the power door locks in both the Lock and Unlock directions. The horn will sound after each activation.

(4) Rotate the key in each door lock cylinder to the unlock position. The horn will sound as the switch closes, and again when it opens. There must be a 1 second delay between changing switch states, or the horn will not sound.

(5) Cycle the key to the ignition RUN position. A single horn pulse will indicate proper operation of the ignition input. This also will take the module out of the diagnostics mode.

(6) Activate the Remote Keyless Entry in both the Lock and Unlock directions. The horn will sound after each activation.

For any of these tests, if the switch does not remain open or closed for at least 1 second, the horn will only sound once.

The lack of a horn pulse, during any operation, indicates:

- a switch failure
- the lack of that input to the Vehicle Theft Security System module
- or a failure internal to the module.

Check for continuity at the switch. If this is good, check for an open or shorted wire between the switch and alarm module. Also, check if the Powertrain Control Module (PCM) has been replaced recently. For the first 20 engine starts with a new PCM, the Vehicle Theft Security System will function normally except it will not prevent the engine from running.

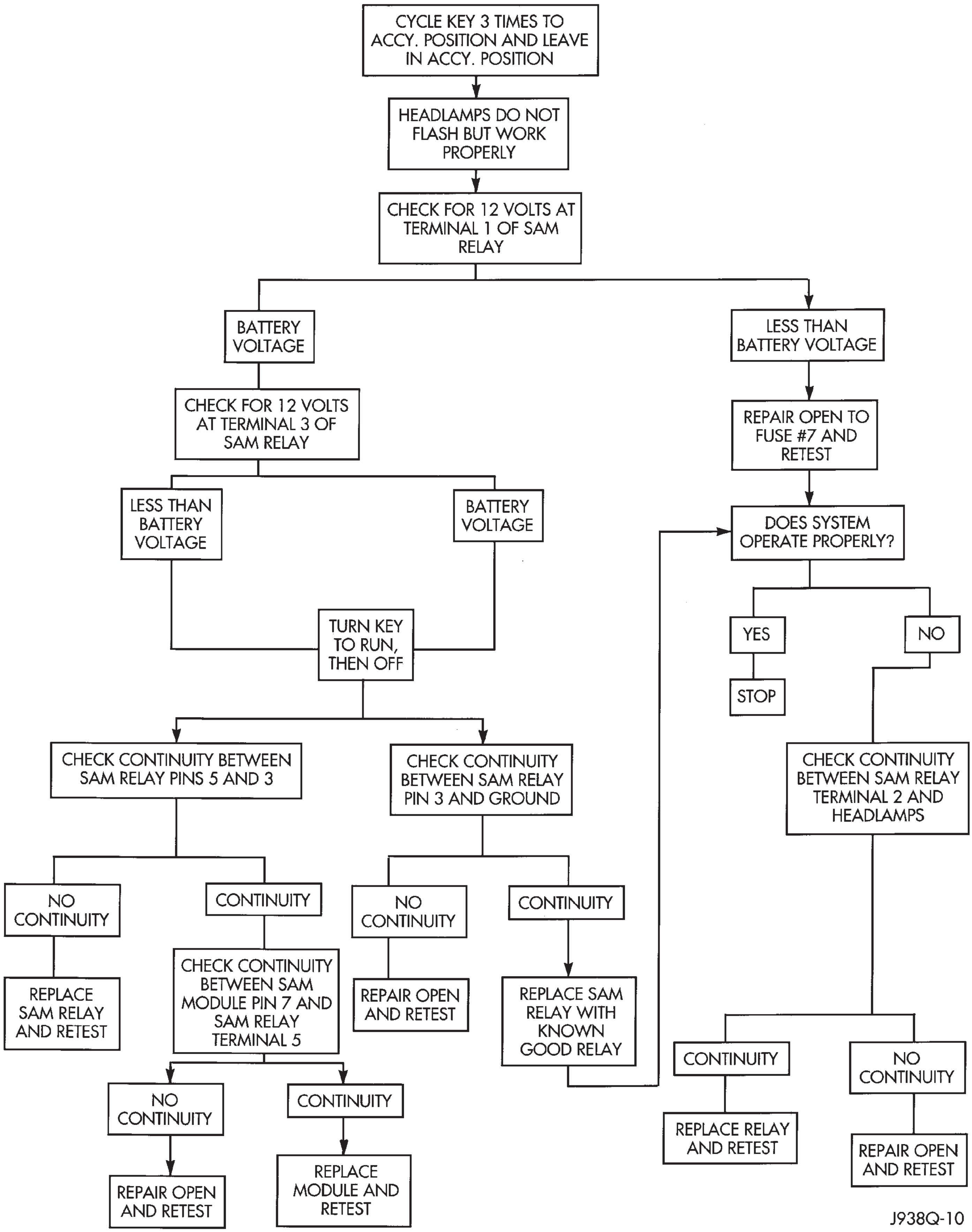
A PCM from a vehicle equipped with Vehicle Theft Security System cannot be used in a vehicle that is not equipped with Vehicle Theft Security System.

If the Security Lamp comes on after ignition ON and stays on, the CCD bus communication with the PCM has been lost.

ON-BOARD DIAGNOSTIC SYSTEM

The DRB II Scan tool also may be used to test the Security System. Refer to the appropriate Diagnostic Procedures Manual.

VEHICLE THEFT SECURITY SYSTEM DIAGNOSIS



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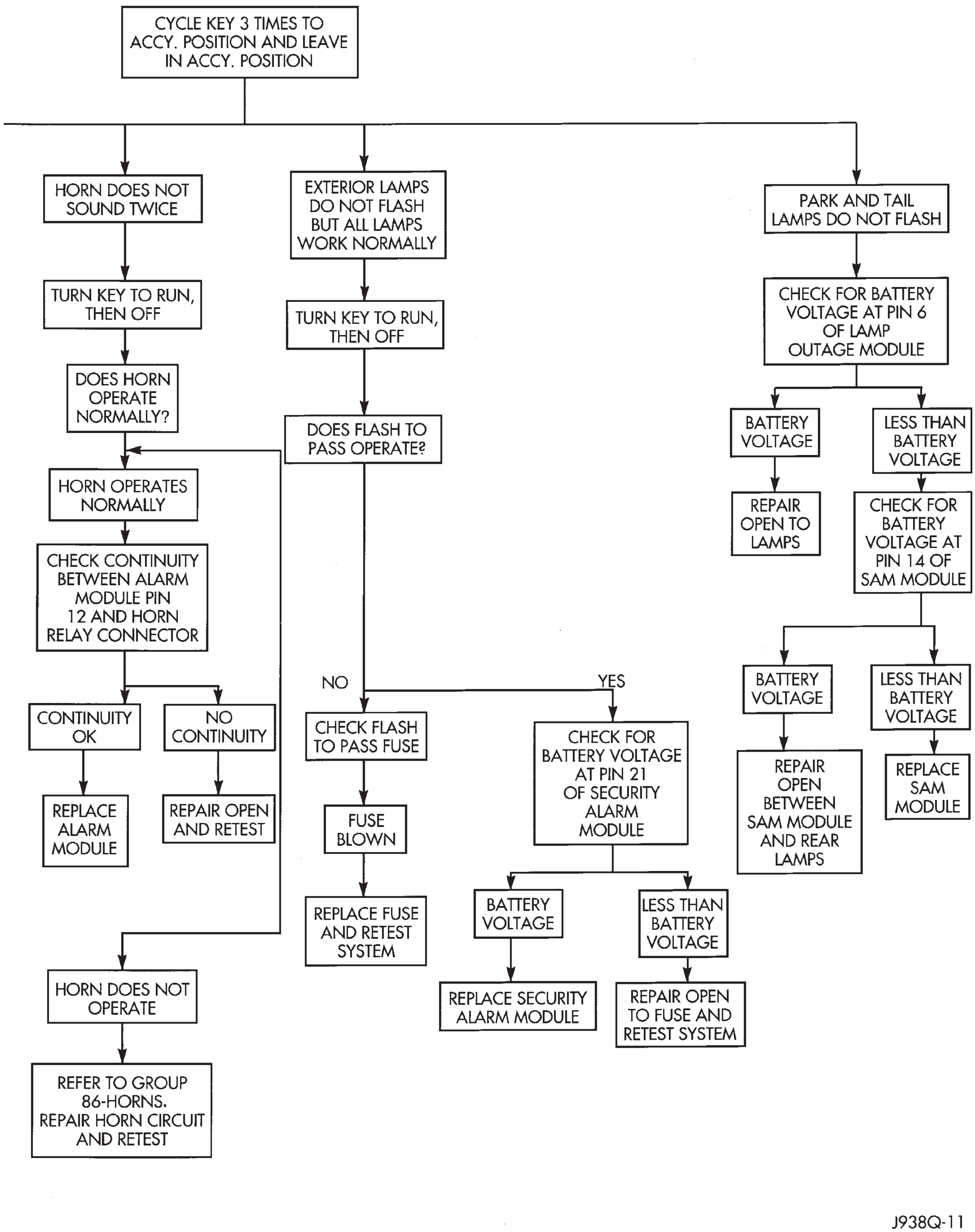
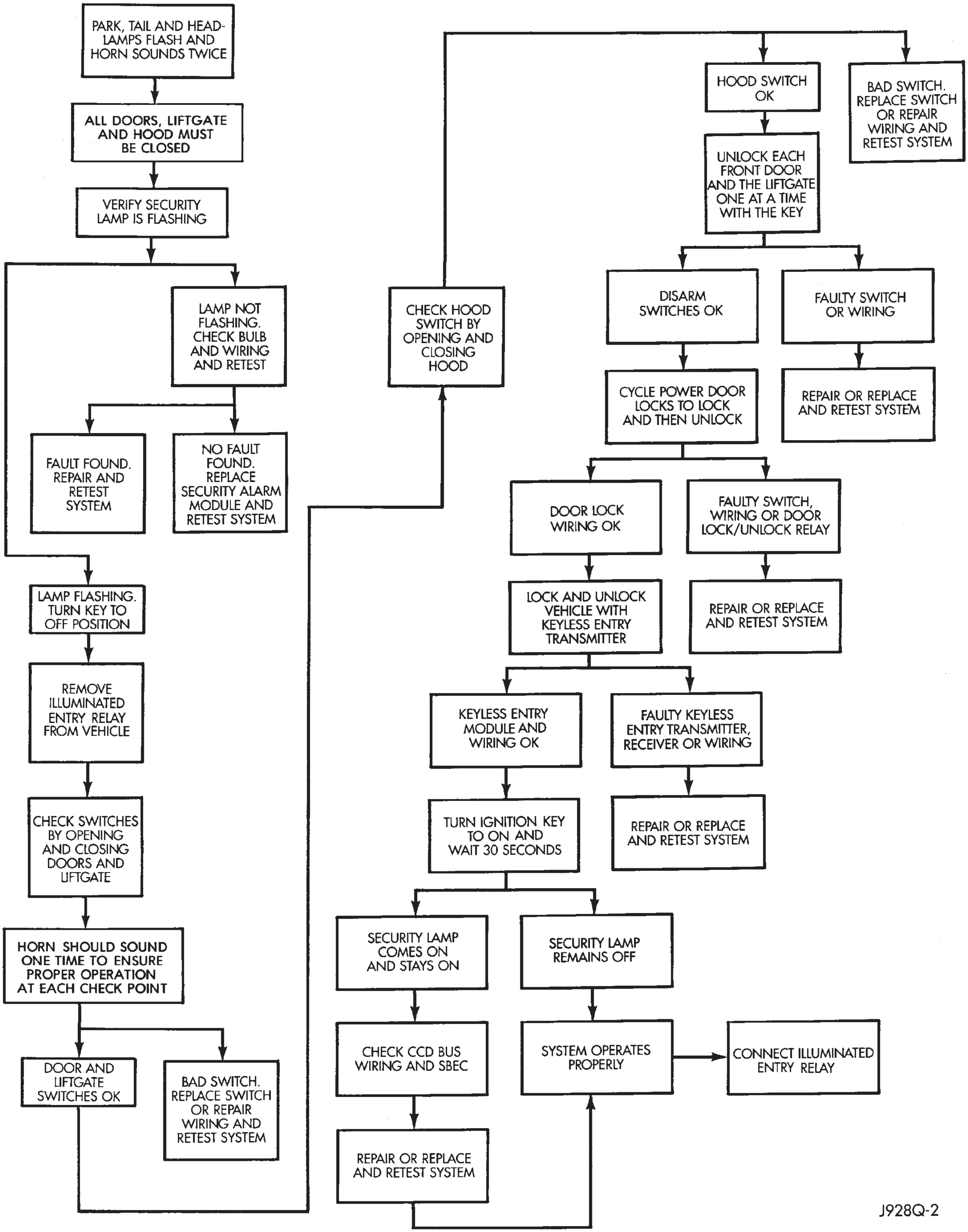
VEHICLE THEFT SECURITY SYSTEM DIAGNOSIS CONTINUED



VEHICLE THEFT SECURITY SYSTEM DIAGNOSIS CONTINUED



SECURITY SYSTEM MODULE REPLACEMENT

(1) Disconnect negative cable from the battery.

(2) Remove ash tray.

(3) Remove 6 screws holding center cluster bezel (Fig. 1).

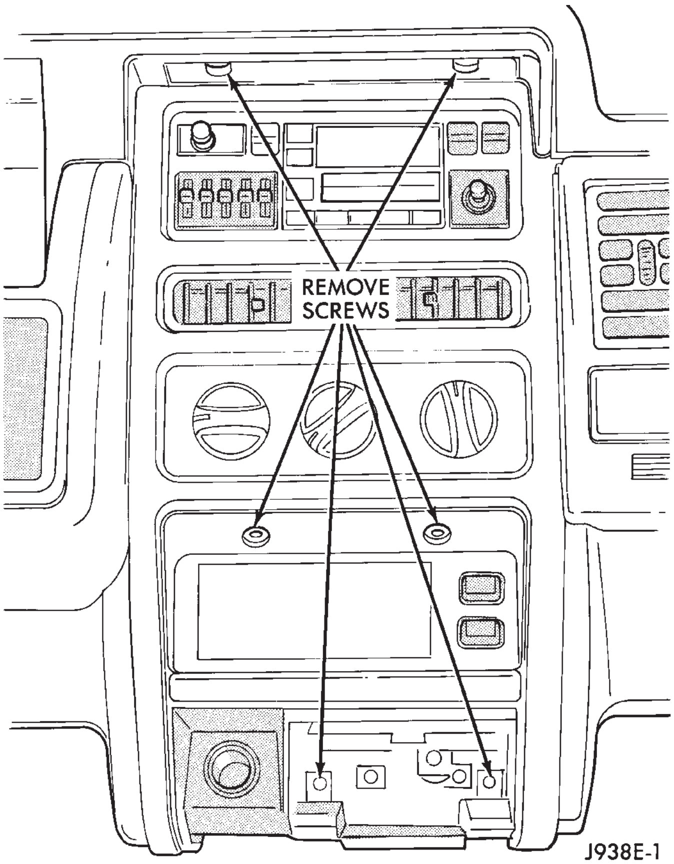


Fig. 1 Remove Center Bezel Retaining Screws

(4) Remove center bezel.

(5) Remove 2 screws holding dash pad located behind top of center bezel.

(6) Gently pry defroster bezel out of dash pad.

(7) Unplug sensors (if equipped) and set defroster bezel aside.

(8) Remove 4 screws in defroster duct opening holding dash pad (Fig. 2).

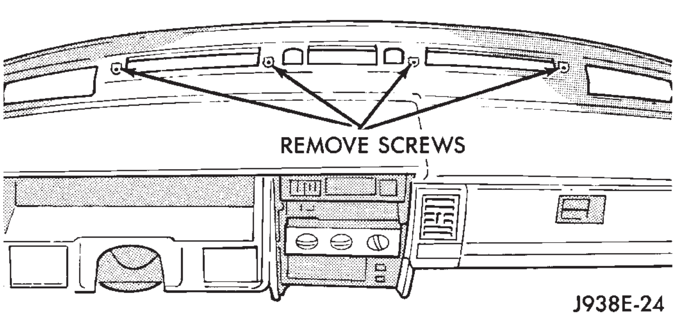


Fig. 2 Upper Dash Pad Attaching Screws

(9) Remove 3 screws above instrument panel cluster holding dash pad (Fig. 3).

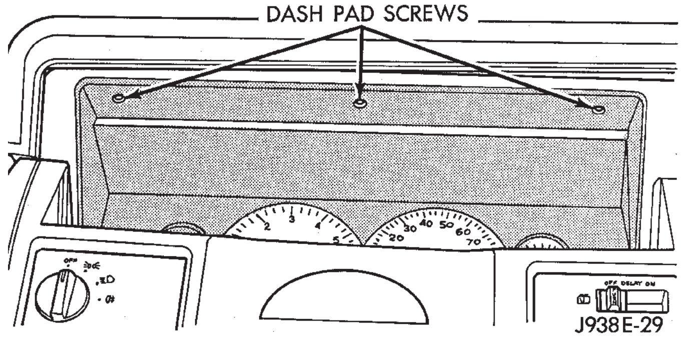


Fig. 3 Remove Screws Holding Dash Pad

(10) Open glove box and remove 2 screws holding dash pad (Fig. 4).

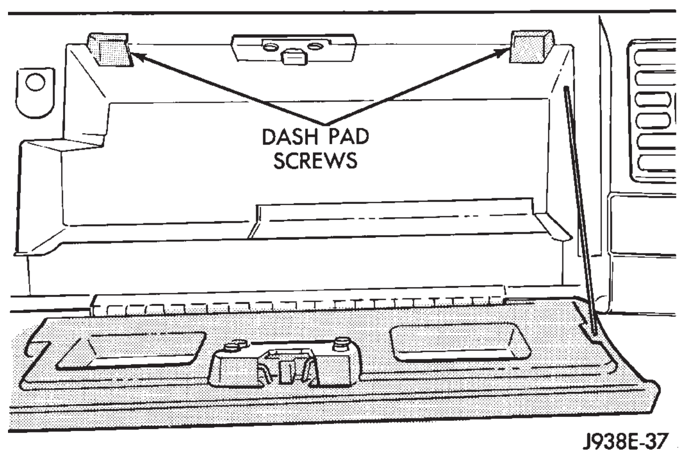


Fig. 4 Remove Screws Holding Dash Pad

(11) Remove dash pad prying gently on each end to unsnap end clips.

(12) Remove 4 screws from bottom of glove box bezel (Fig. 5).

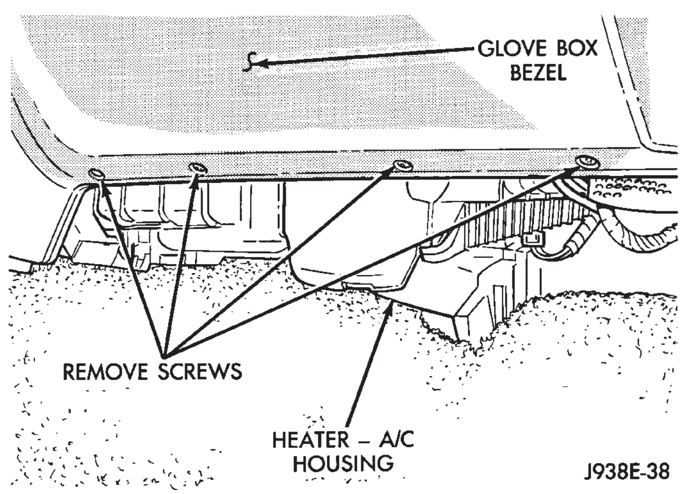


Fig. 5 Right Side Bezel Attaching Screws

(13) Remove 4 screws from top of glove box bezel (Fig. 6).

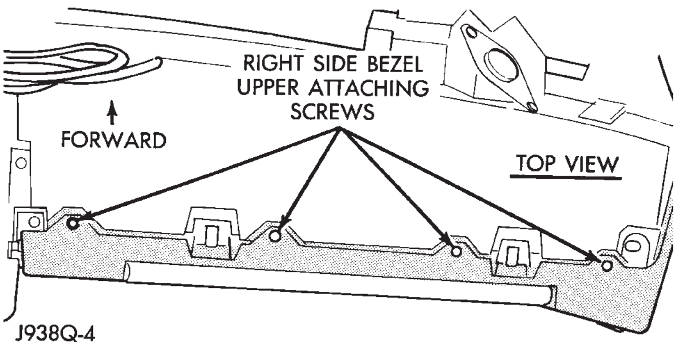


Fig. 6 Right Side Bezel Upper Screws

(14) Remove 1 screw holding the bezel to the center console (Fig. 7).

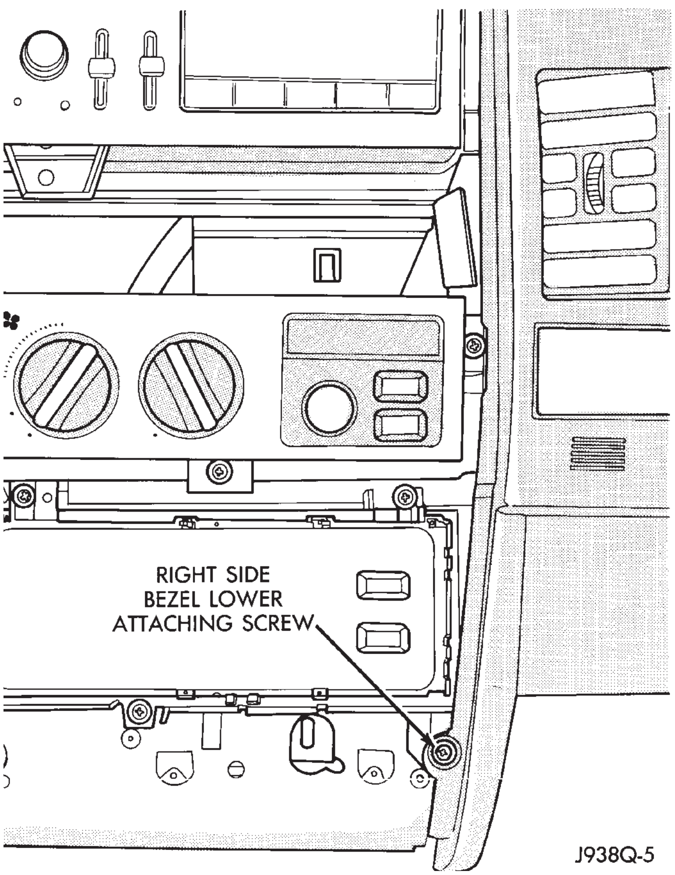


Fig. 7 Right Side Lower Screw

(15) Remove side window demister boot from glove box bezel.

(16) Remove right side bezel from instrument panel.

(17) Unplug glove box light and switch connector.

(18) Remove 2 screws holding SAM module to instrument panel (Fig. 8).

(19) Pull module out and unplug connector.

(20) For installation, reverse the removal procedures.

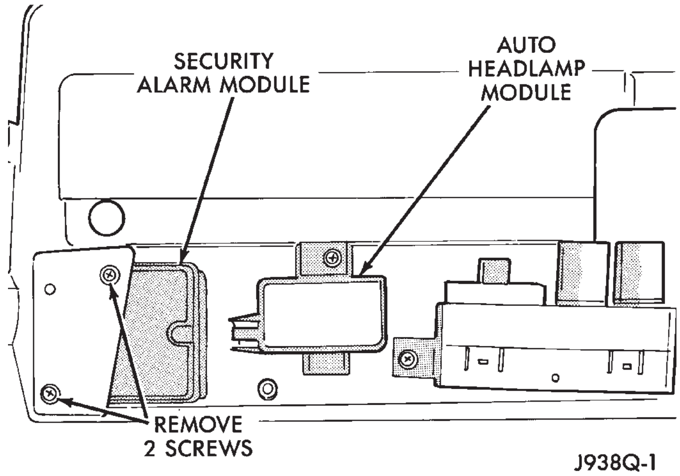


Fig. 8 SAM Module Removal/Installation

SECURITY ALARM MODULE RELAY

The Security Alarm Module Relay is in the relay center located under the glove box (Fig. 9).

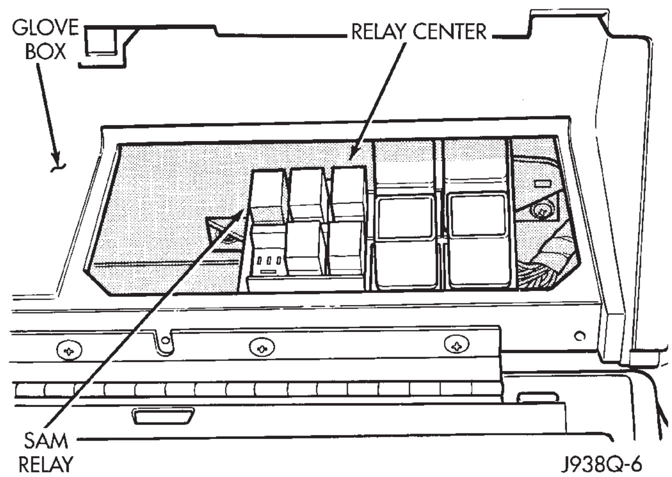


Fig. 9 Security Alarm Module Relay

SECURITY SYSTEM HOOD SWITCH REPLACEMENT

(1) Disconnect battery negative cable.

(2) Remove sheet metal screw securing switch to right inner fender (Fig. 10).

(3) Disconnect wire from switch.

(4) Remove switch.

For Installation, reverse Removal procedure.

SECURITY SYSTEM DOOR DISARM SWITCH

REMOVAL

(1) Remove screw from demister opening at front of door.

(2) Remove screw and door handle cover.

(3) Remove screw from under armrest.

(4) Remove screw from bottom of hand hold in armrest.

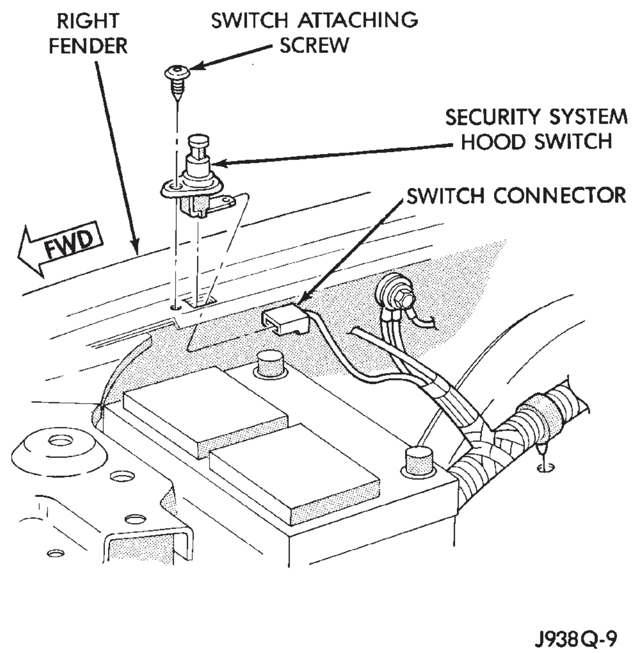


Fig. 10 Security System Hood Switch

To aid in removal of the trim panel, start at the bottom of the panel.

(5) Remove the trim panel with a wide flat blade tool (Fig. 11).

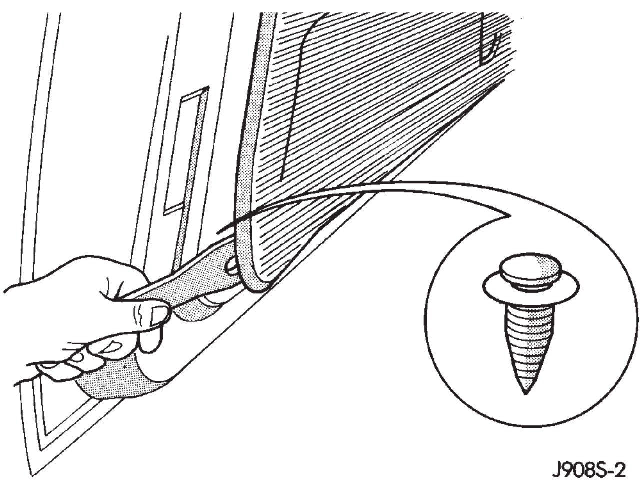


Fig. 11 Trim Panel Removal

(6) Remove the plastic water dam sheet.

(7) Remove the U-clip holding the lock cylinder and disarm switch (Figs. 12 and 13).

(8) Pull the lock cylinder out of the door.

(9) Pry the door disarm switch off the back of the lock cylinder.

(10) Remove harness clip from door sheet metal.

(11) Unplug the harness connector and remove the switch.

INSTALLATION

(1) Push the door disarm switch onto the lock cylinder.

(2) Install lock cylinder in door with U-shaped clip.

(3) Connect harness and fasten clip to door.

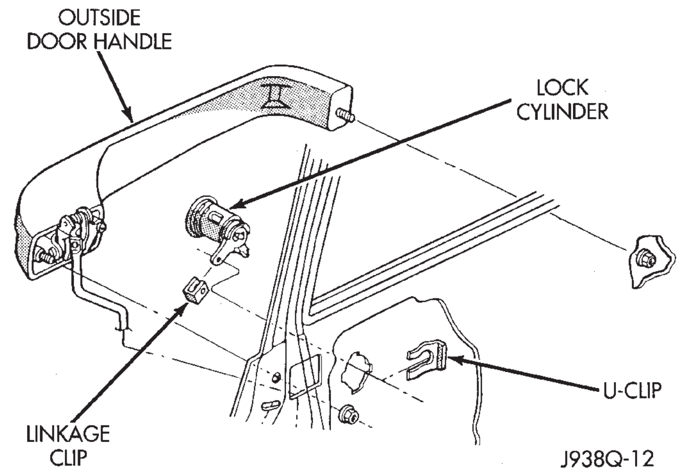


Fig. 12 Lock Cylinder Removal

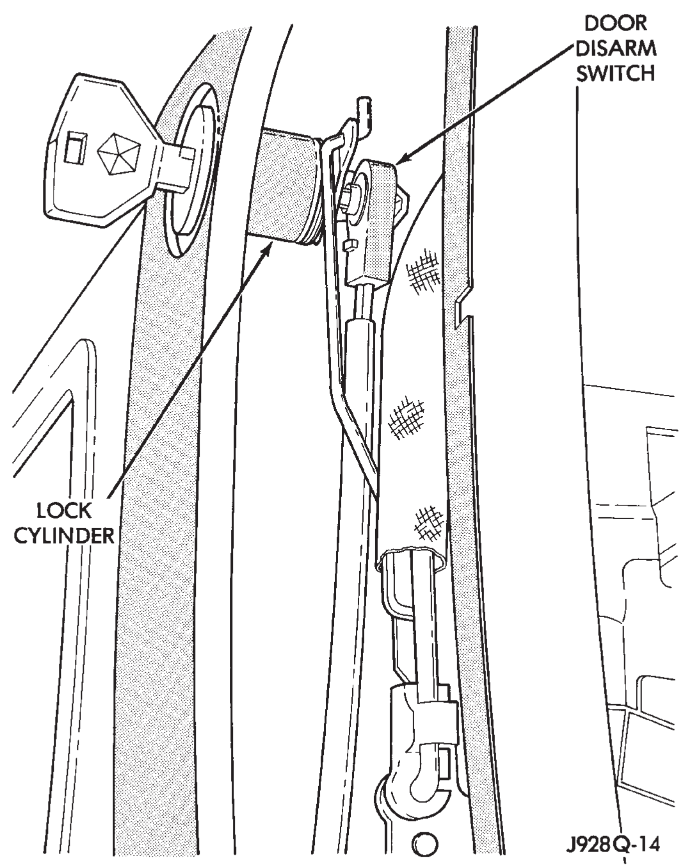


Fig. 13 Door Disarm Switch (Typical)

(4) Install door trim panel.

(5) Install linkage and control panel.

SECURITY SYSTEM LIFTGATE DISARM SWITCH

(1) Remove 5 screws holding liftgate interior trim panel.

(2) Remove the trim panel with a wide flat blade tool (Fig. 14).

To aid in removal of the trim panel, start at the bottom of the panel.

(3) Remove the disarm switch from the liftgate lock cylinder (Fig. 15).

(4) Unplug the harness connector and remove the switch.

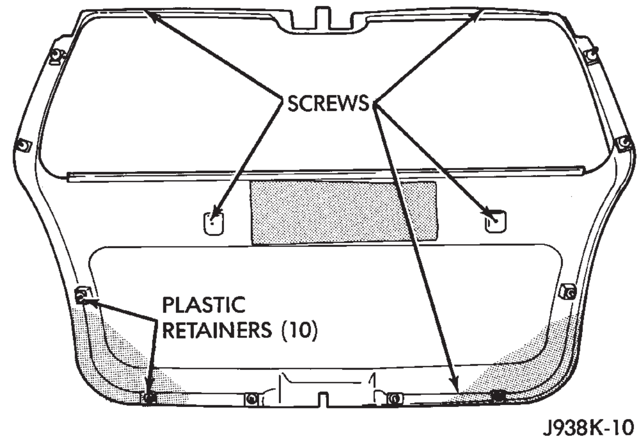


Fig. 14 Liftgate Trim Panel Removal

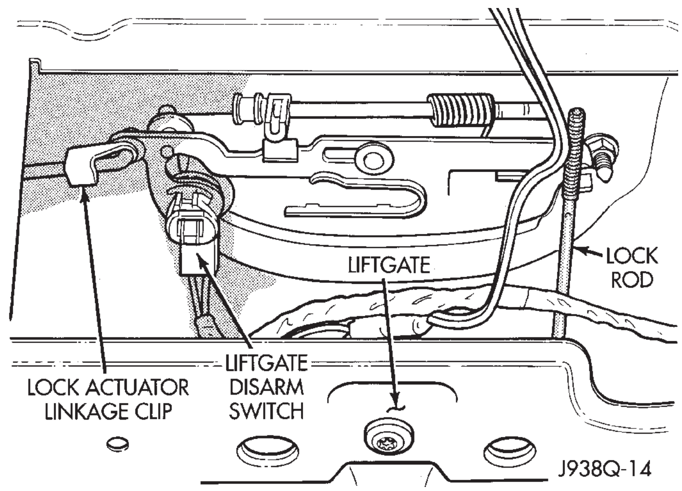
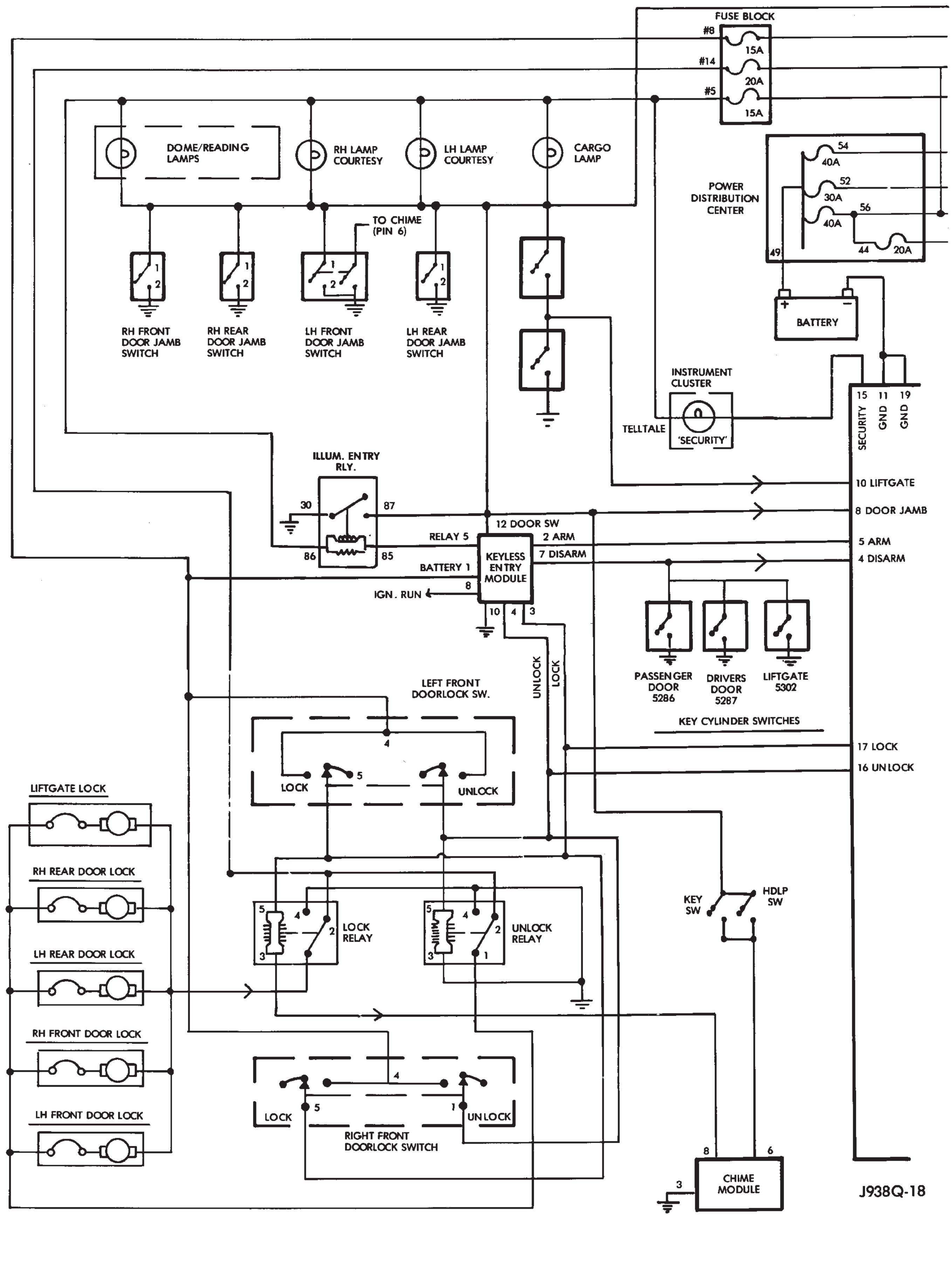
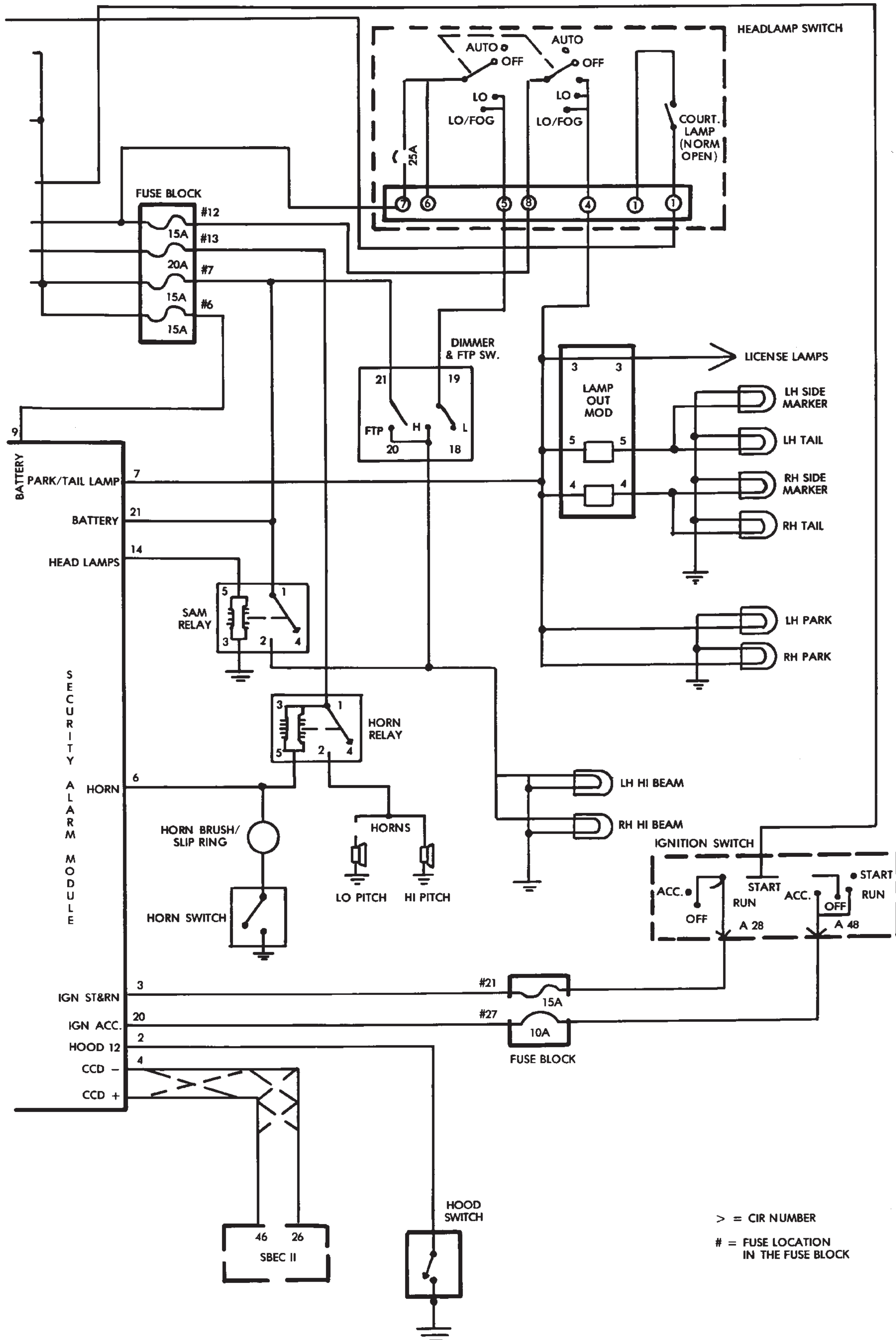


Fig. 15 Liftgate Disarm Switch

SECURITY SYSTEM SCHEMATIC




HEADLAMP SWITCH
AUTO
OFF
LO
LO/FOG
COURT. LAMP (NORM OPEN)
25A
FUSE BLOCK
#12
#13
#7
#6
15A
20A
DIMMER & FTP SW.
21
19
FTP
H
L
20
18
LAMP OUT MOD
LICENSE LAMPS
LH SIDE MARKER
LH TAIL
RH SIDE MARKER
RH TAIL
LH PARK
RH PARK
BATTERY
PARK/TAIL LAMP
HEAD LAMPS
SAM RELAY
HORN RELAY
SECURITY ALARM MODULE
HORN
HORN BRUSH/ SLIP RING
HORNS
LO PITCH
HI PITCH
HORN SWITCH
LH HI BEAM
RH HI BEAM
IGNITION SWITCH
ACC.
START
RUN
A 28
A 48
IGN ST&RN
IGN ACC.
HOOD 12
CCD −
CCD +
#21
#27
10A
SBEC II
46
26
HOOD SWITCH
> = CIR NUMBER
= FUSE LOCATION IN THE FUSE BLOCK

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POWER SEATS

CONTENTS

GENERAL

The power seats can be adjusted in six different directions (Fig. 1). The control switch is located on the lower outboard side of the seat.

The front lever on the switch raises or lowers (tilts) the front of the seat; the center lever raises or lowers the complete seat by moving the switch up or down. It also moves it forward or rearward by moving the switch forward or rearward. The rear lever raises or lowers (tilts) the back of the seat.

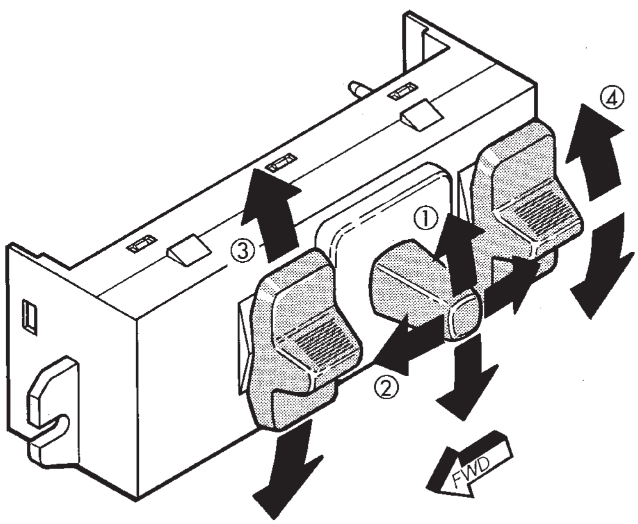


Fig. 1 Power Seat Switch

There are three reversible motors that operate the power seats. The front and rear of a seat are operated by different motors. They can be raised or lowered independently of each other. When the center seat switch is pushed to the UP or DOWN position, both rear and front motors run, moving the entire seat up or down.

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 the forward-rearward motor. The motor is grounded and the motor runs to drive the seat forward until the switch is released.

With the switch in the REAR position, the polarity is reversed and 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 the front and rear motors. 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 ensure 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 three 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

Power Seats circuit breaker #25 installed.

• Probe Power Seats 30 amp circuit breaker, #25 on fuse panel. If battery voltage is present, replace circuit breaker.

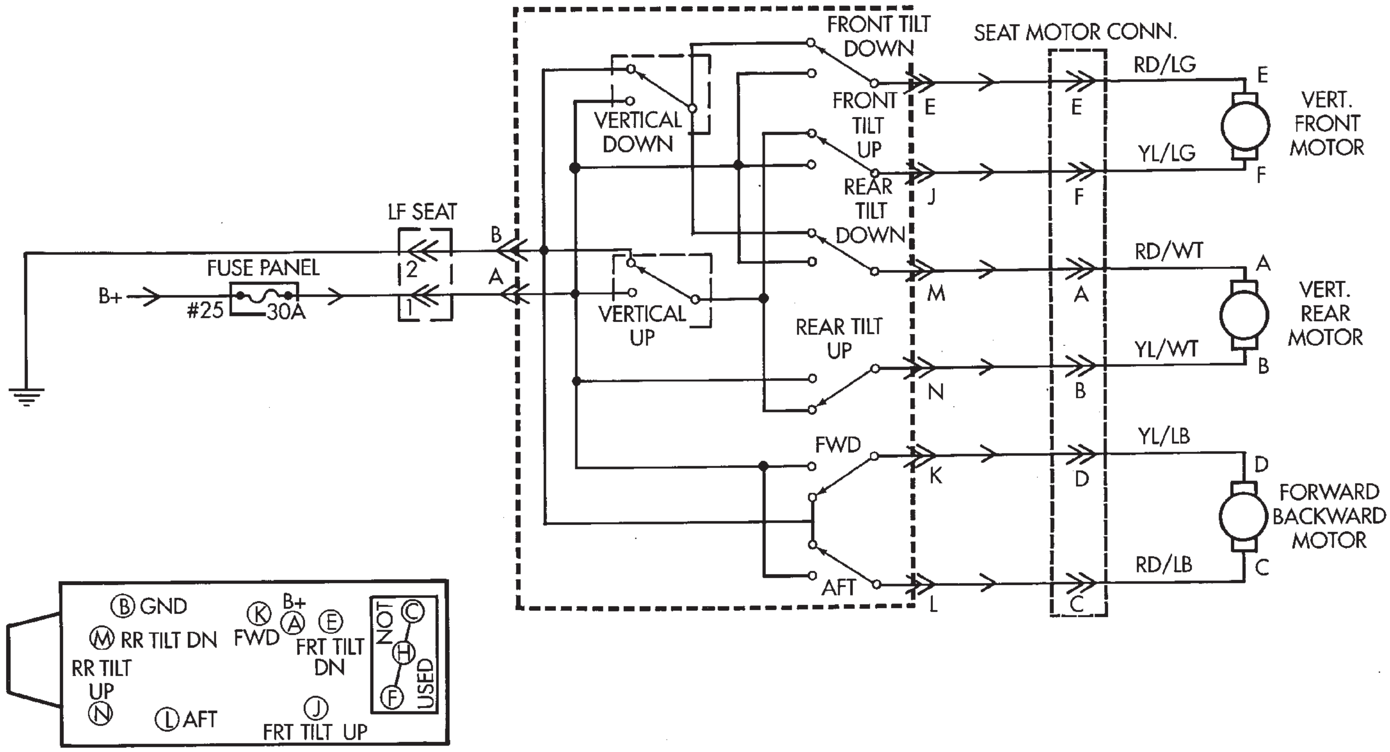
• Remove switch mounting screws and measure voltage at Red wire at switch. Meter should read battery voltage. If not, repair open to power.

• Measure resistance at black wire at switch. Meter should read zero ohms. If OK, replace switch. If not, repair open to ground.

SWITCH TEST

To check the switch, remove the switch from its mounting position. Using an ohmmeter, and referring to the schematic, determine if continuity is correct. If there is not continuity at any one of the switch positions, replace the switch.

DRIVER'S POWER SEAT



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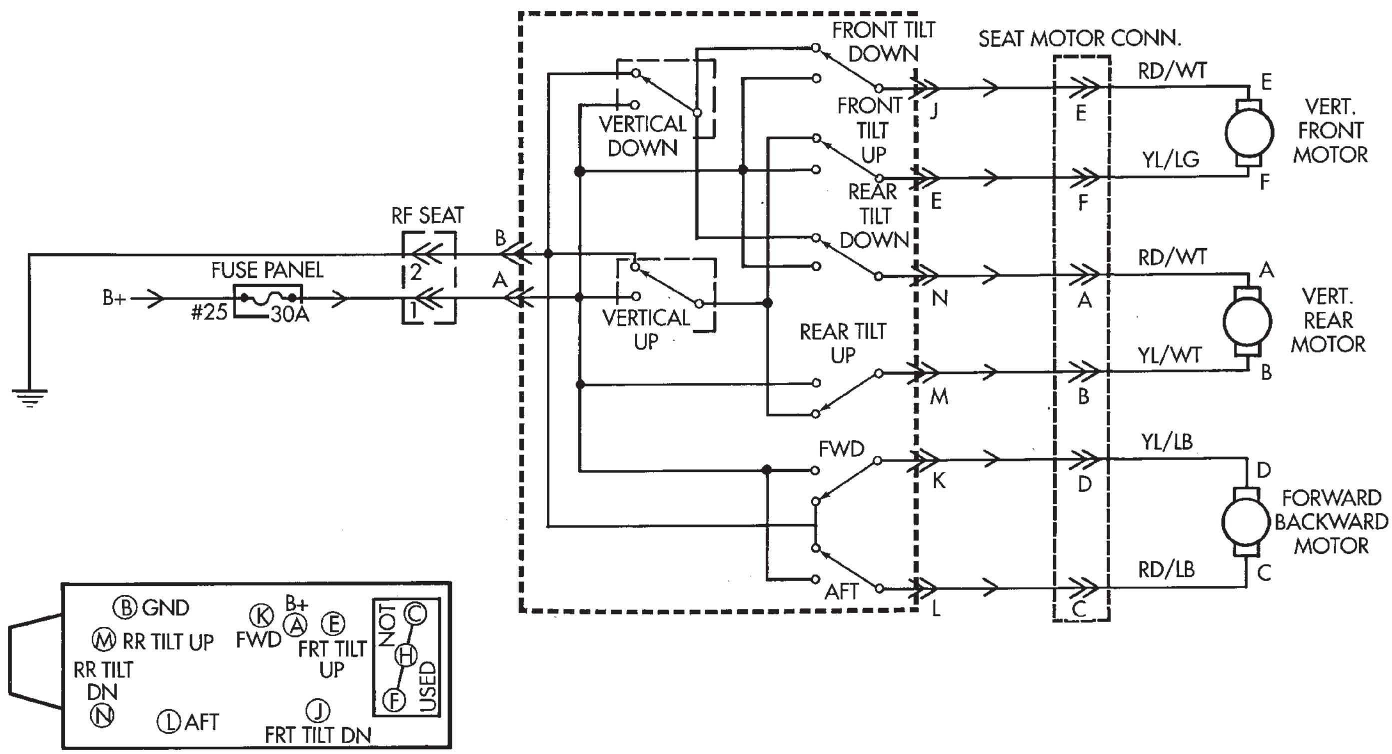
PASSENGER'S POWER SEAT



J938R-6

SEAT REMOVAL/INSTALLATION

REMOVAL

(1) Remove 2 screws and the rear track covers.

(2) Remove 4 screws holding seat to floor pan (Fig. 2). Move adjuster as required for access.

Fig. 2 Power Seat Removal—Right Side Shown

(3) Disconnect wiring harness power lead at carpet.

(4) Remove seat assembly from vehicle.

INSTALLATION

(1) Position seat assembly in vehicle.

(2) Connect wiring harness.

(3) Install and tighten mounting bolts to 20 N●m (15 ft. lbs.).

(4) Install rear track covers.

(5) Check seat operation.

POWER SEAT MOTOR REPLACEMENT

(1) Remove seat as described in Seat Removal/Installation.

CAUTION: Take care to avoid excessive bending of the three drive cables when removing/installing the motor assembly.

(2) Remove screws attaching motor assembly to seat frame and remove motor assembly and mounting spacers (Figs. 3 and 4).

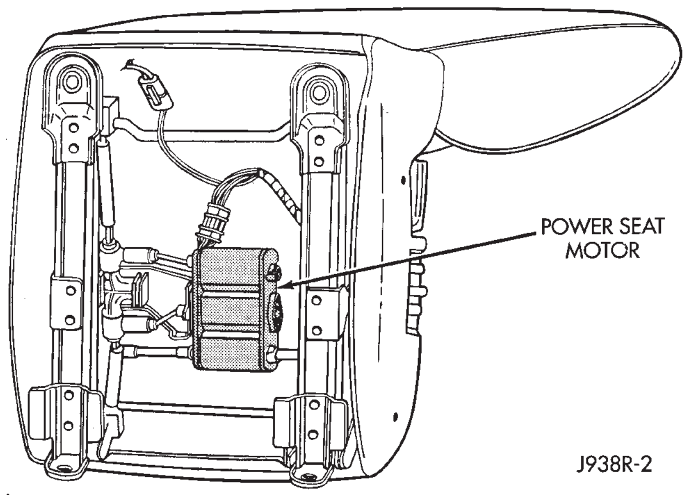


Fig. 3 Power Seat Motor Installation—Right Side Shown

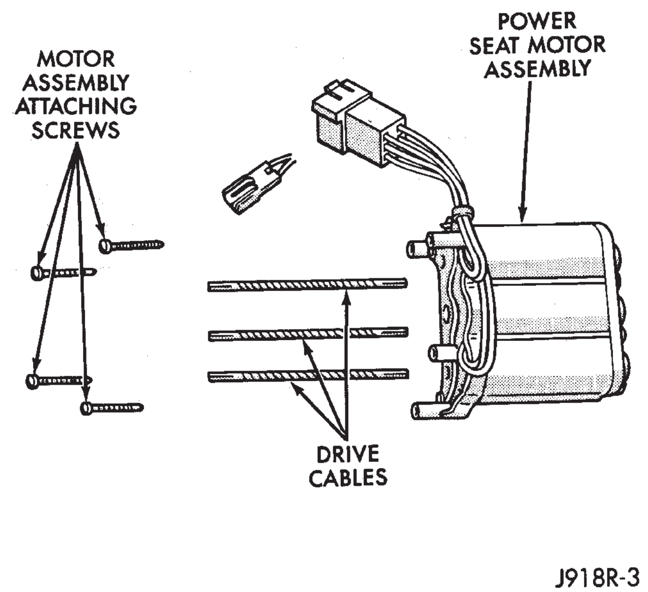


Fig. 4 Power Seat Motor Assembly

(3) To install the power seat motor, reverse the removal procedures. Tighten seat mounting bolts to 20 N●m (15 ft. lbs.).

POWER WINDOWS

DESCRIPTION

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 ignition in RUN, voltage from the #13 fuse, 60 amp, in the PDC is applied to the #26 circuit breaker, 30 amp, in the Fuse Panel. Power then goes to the master switch terminal 5 and to the passenger's window switches.

When the driver's window switch is moved UP, the contacts close a current path to:

- terminal 4
- the Left Hand front window motor
- terminal 3
- terminal 1 of the Left Hand front window switch 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 (Fig. 1)

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 key to OFF and measure resistance from ground lug on driver's side kick panel to ground. Meter should read zero ohms. If not, repair open to ground.
- Remove Master Door Lock/Power Window Switch assembly (refer to service procedures). Measure resistance at BLK wire (terminal 1). Meter should read zero ohms. If not, repair open to ground.
- Turn key to ON and measure voltage at terminal 5 at LH switch. Meter should read battery voltage. If not, repair open circuit to breaker.
- Operate Window switch. If the windows move up and down go to Switch Testing.
- Perform Drivers Door Switch test. 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 2 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 LH motor), refer to Switch Testing.
- Measure resistance at terminal 1 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 LH motor), refer to Switch Testing. If both tests are OK, replace regulator.

WINDOW REGULATOR REPLACEMENT

FRONT DOOR REMOVAL

(1) Lower window half way.

(2) Remove screw at top of trim panel near mirror (Fig. 2).

(3) Remove screw from demister opening.

(4) Remove screw and door handle cover.

(5) Remove screw from under armrest.

(6) Remove screw from bottom of hand hold in armrest.

CAUTION: The wiring harness to the door switches is just long enough to allow installation. If trim panel is pulled off by hand the switch may be pulled apart. Use a door clip tool to prevent damaging the switches.

(7) Remove the trim panel with a wide flat blade tool (Fig. 3).

To aid in removal of the trim panel, start at the bottom of the panel.

(8) Unplug electrical connector from switches.

(9) Loosen 2 nuts holding glass to window regulator (Fig. 4).

(10) Slide glass rearward to remove from nuts.

(11) Pull the glass to the full up position and tape the glass to the door.

(12) Unplug the wire harness connector from the window regulator.

(13) Remove 4 window regulator screws (Fig. 5).

(14) Loosen the last 2 window track screws (Fig. 5).

(15) Remove the window regulator.

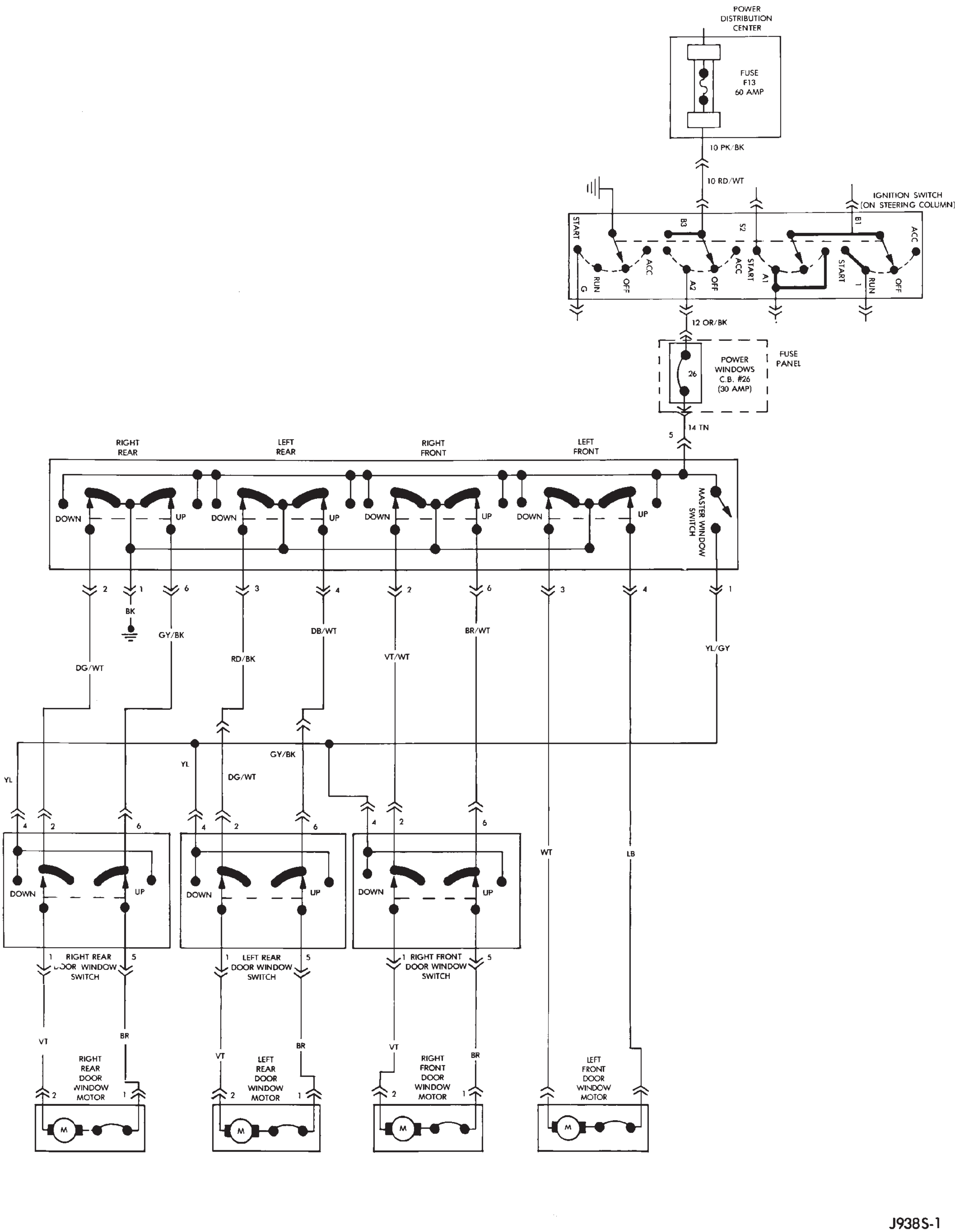


Fig. 1 Power Windows

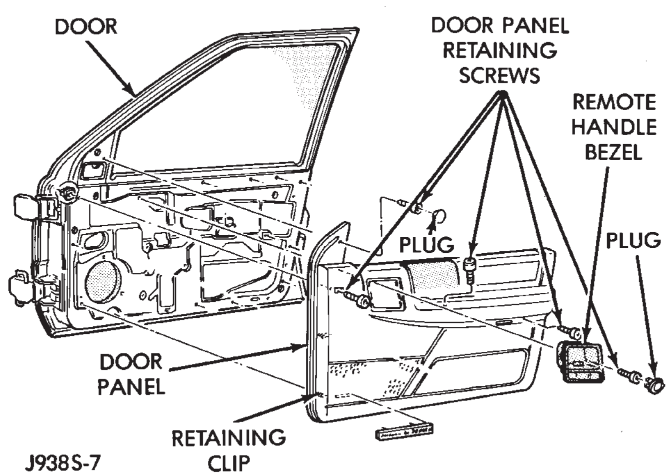


Fig. 2 Door Panel Removal

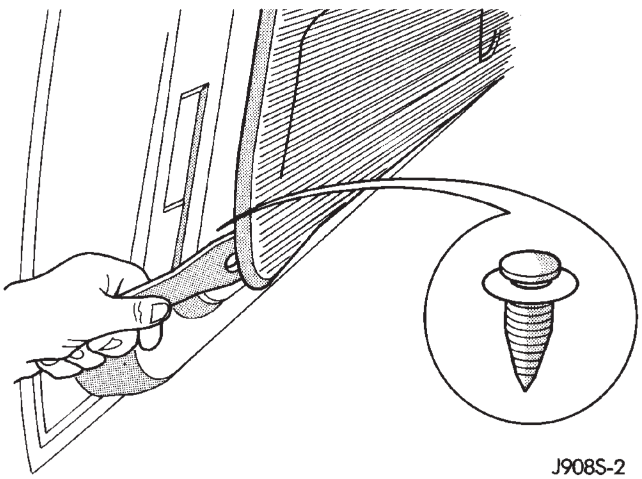


Fig. 3 Trim Panel Removal

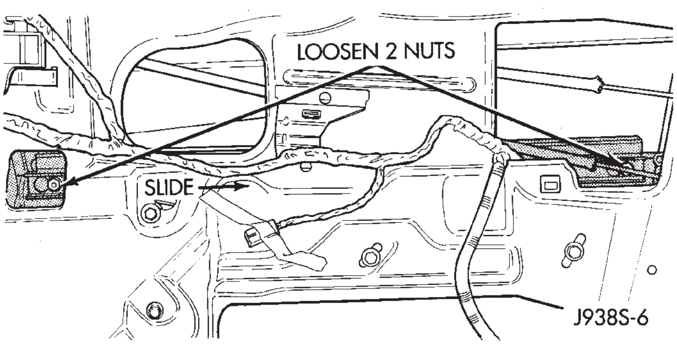


Fig. 4 Remove/Install Glass Attaching Nuts

INSTALLATION

(1) Place the regulator inside the door by sliding 2 loose screws in slots in door.

(2) Install the remaining 4 screws.

(3) Tighten the 4 regulator screws to 12 N●m (105 in. lbs.) torque.

(4) Move the glass as far rearward into the channel as possible and pushed down. Tighten the 2 window track screws to 12 N●m (105 in. lbs.) torque.

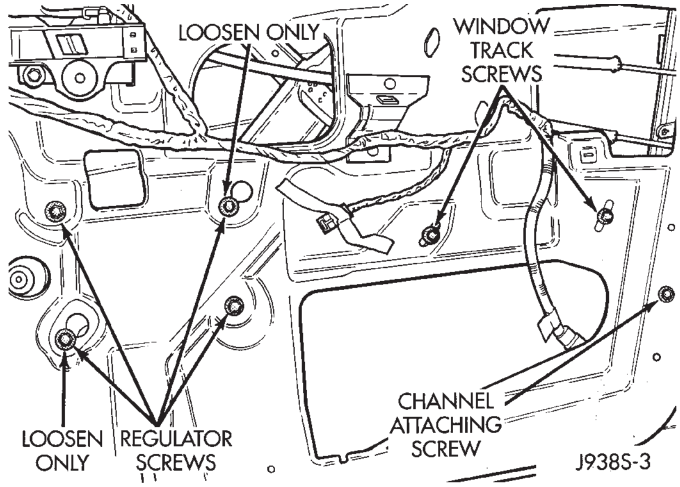


Fig. 5 Window Regulator Removal—Front Door

(5) Attach the door glass by sliding the 2 nuts into the slots on the regulator (Fig. 4). Tighten the door glass nuts to 12 N●m (105 in. lbs.) torque.

(6) Connect the wire harness connector to the regulator.

(7) Using 3M 08044 or 3M 08041 adhesive/sealant, install the plastic water dam sheet.

(8) Place the trim panel in the installation position and press in the nylon retainers.

(9) Install the door panel attaching screws.

REAR DOOR REMOVAL

(1) Remove screw and door handle cover (Fig. 6).

(2) Remove screw from under armrest.

(3) Remove screw from bottom of hand hold in armrest.

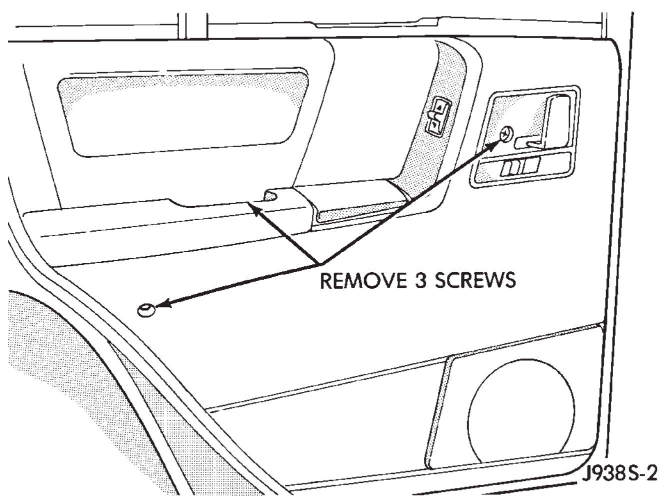


Fig. 6 Trim Panel Attachment

(4) Remove the trim panel with a wide flat blade tool (Fig. 3).

To aid in removal of the trim panel, start at the bottom of the panel.

(5) Lower window until the 2 nuts holding the glass to the regulator are visible (Fig. 7).

(6) Unplug electrical connector from switch.

(7) Remove screws holding speaker.

(8) Pull speaker from door and unplug connector.

(9) Loosen 2 nuts holding glass to window regulator (Fig. 7).

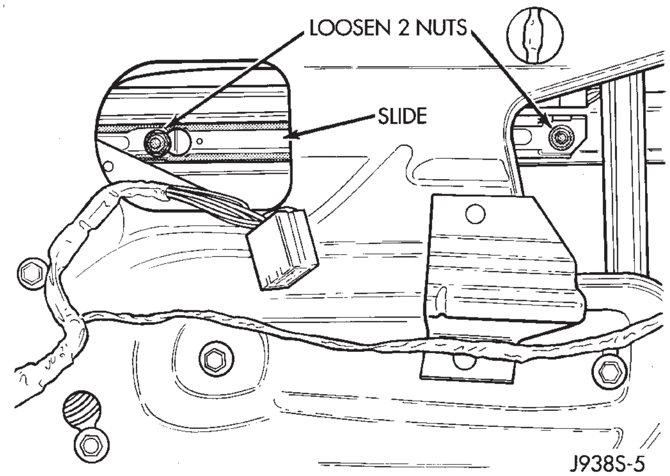


Fig. 7 Remove/Install Glass Attaching Screw

(10) Slide glass forward to remove from nuts.

(11) Pull the glass to the full up position and tape the glass to the door.

(12) Unplug the wire harness connector from the window regulator.

(13) Remove 4 window regulator screws (Fig. 8).

(14) Loosen the last 2 window track screws (Fig. 8).

(15) Remove the window regulator.

INSTALLATION

(1) Place the regulator inside the door by sliding 2 loose screws in slots in door.

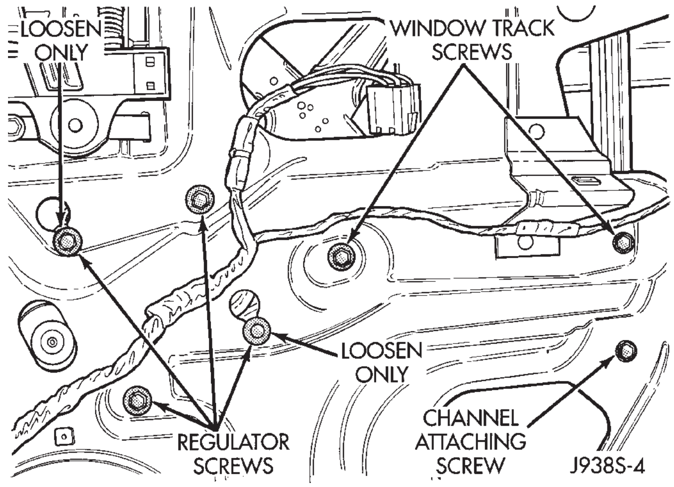


Fig. 8 Window Regulator Removal

(2) Install the remaining 4 screws.

(3) Tighten the 4 regulator screws to 12 N●m (105 in. lbs.) torque.

(4) Move the glass as far rearward into the channel as possible and pushed down. Tighten the 2 window track screws to 12 N●m (105 in. lbs.) torque.

(5) Attach the door glass by sliding the 2 nuts into the slots on the regulator (Fig. 7). Tighten the door glass nuts to 12 N●m (105 in. lbs.) torque.

(6) Connect the wire harness connector to the regulator.

(7) Install the speaker.

(8) Using 3M 08044 or 3M 08041 adhesive/sealant, install the plastic water dam sheet.

(9) Place the trim panel in the installation position and press in the nylon retainers.

(10) Install the door panel attaching screws.

POWER MIRRORS

CONTENTS

POWER SIDE MIRRORS

INDEX

GENERAL INFORMATION

For information concerning wiring or connectors, refer to Group 8W - Wiring Diagrams.

The mirror control switch uses a paddle which is moved Left or Right for mirror selection and 4 buttons for mirror movement direction (Fig. 1).

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 the switch that controls the polarity of the voltage to the motors. The mirror select switch directs these control voltages to either the RH or LH mirror.

The mirror select switch must be set to L or R to direct current flow.

HEATED MIRROR

The heated mirror is controlled by the rear window defogger switch. The mirror heater is on only when the rear window defogger switch is on.

Refer to Group 8N - Rear Window Defogger.

MIRROR TEST PROCEDURE

CAUTION: The wiring harness to the door switches is just long enough to allow installation. If trim panel is pulled off by hand the switch may be pulled apart. Use a door clip tool to prevent damaging the switches.

(1) Remove the door trim panel with a wide flat blade tool (Fig. 2).

To aid in removal of the trim panel, start at the bottom of the panel.

(2) Unplug door wiring harness connector.

(3) Connect a jumper wire to a 12 volt source.

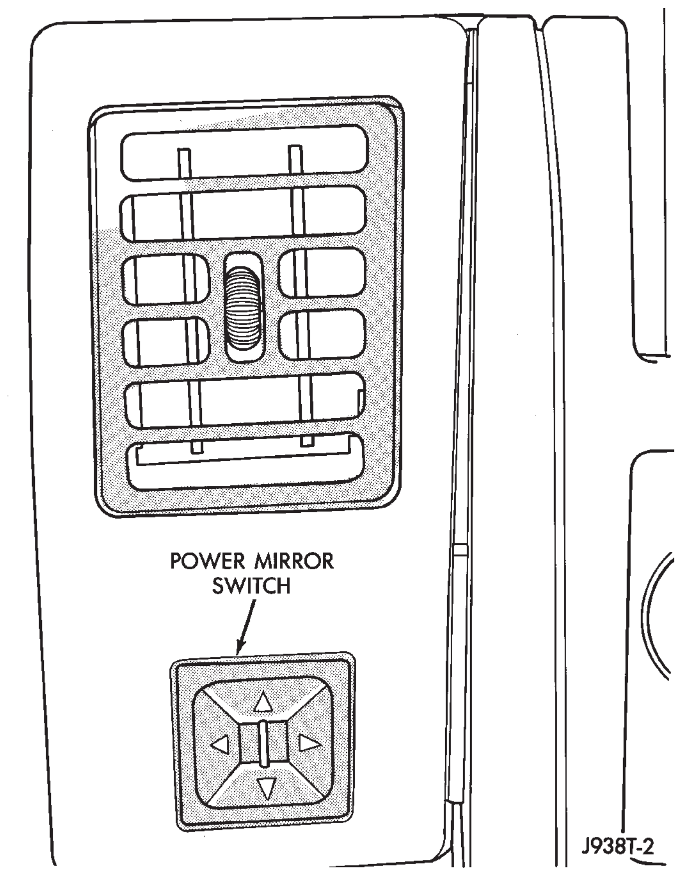


Fig. 1 Power Mirror Switch

(4) Connect another jumper wire to a good body ground.

(5) Refer to Mirror Motor Test for appropriate pin numbers (Fig. 3).

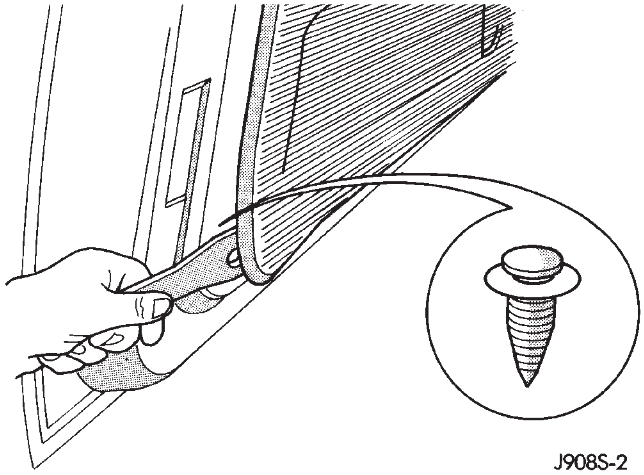
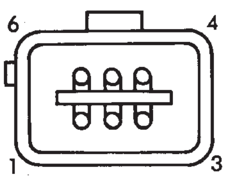


Fig. 2 Trim Panel Removal



DOOR CONNECTOR		
12 Volts	Ground	MIRROR REACTION
PIN 3	PIN1	UP
PIN 1	PIN 3	DOWN
PIN 3	PIN 2	RIGHT
PIN 2	PIN 3	LEFT
PIN 4	PIN 5	HEATER

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Fig. 3 Mirror Motor Test

MIRROR SWITCH TEST PROCEDURE

(1) Remove power mirror switch from mounting position.

(2) Unplug wiring harness connector.

(3) Using an ohmmeter, test for continuity between the terminals of the switch as shown in the Mirror Switch Test (Fig. 4).

MIRROR SWITCH REPLACEMENT

(1) Disconnect negative cable from the battery.

(2) Remove ash tray.

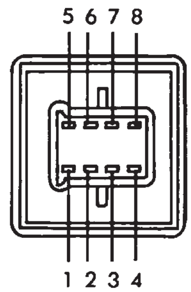
(3) Remove 6 screws holding center cluster bezel (Fig. 5).

(4) Remove center bezel.

(5) Remove 2 screws holding dash pad located behind top of center bezel.

(6) Gently pry defroster grille out of dash pad.

(7) Unplug sensors (if equipped) and set defroster grille aside.



MIRROR SWITCH CONTINUITY TYPE III	
Mirror Switch Knob in "L" Position	
MOVE LEVER	CONTINUITY BETWEEN
▲	PINS 6 AND 8 PINS 5 TO 1 AND 4
▶	PINS 6 AND 1 PINS 5 AND 4
▼	PINS 6 AND 1 PINS 5 AND 8
◀	PINS 6 AND 4 PINS 5 TO 1 AND 8
Mirror Selector Knob in "R" Position	
MOVE LEVER	CONTINUITY BETWEEN
▲	PINS 6 AND 7 PINS 5 TO 1 AND 3
▶	PINS 6 AND 1 PINS 5 AND 3
▼	PINS 5 AND 7 PINS 6 AND 1
◀	PINS 6 AND 3 PINS 5 TO 1 AND 7

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Fig. 4 Mirror Switch Test

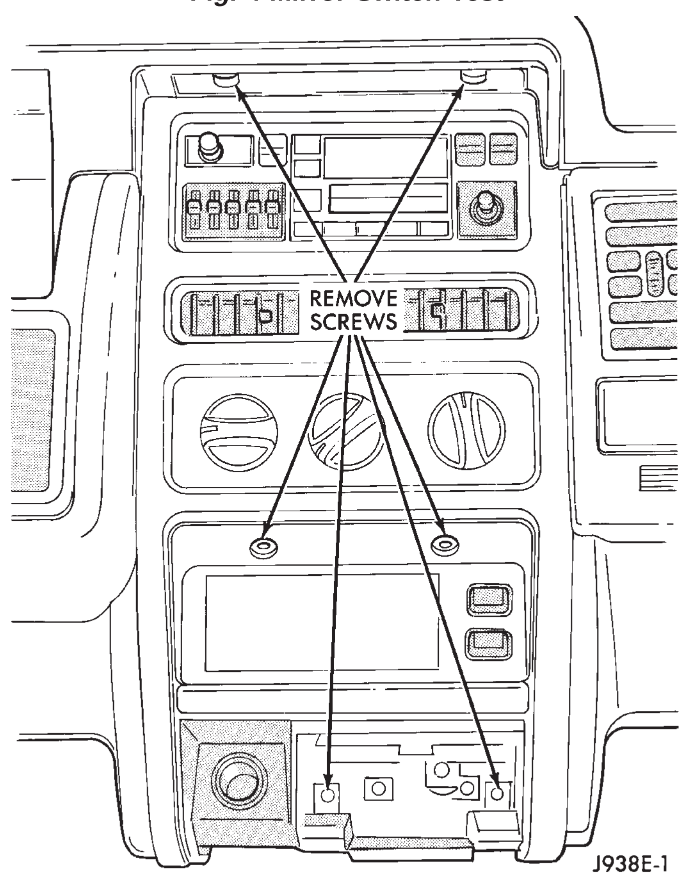
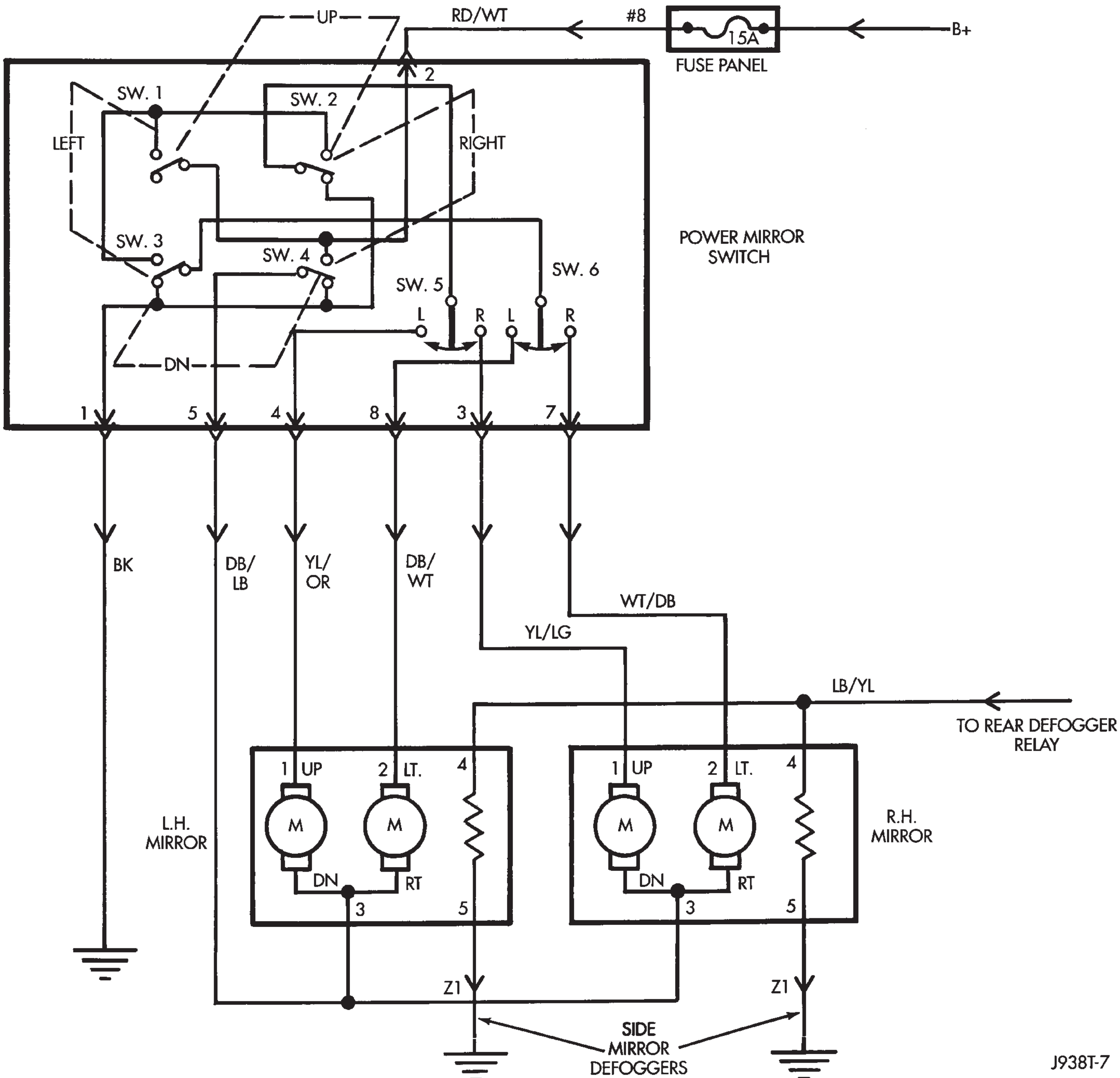


Fig. 5 Remove Center Bezel Screws

POWER MIRROR SCHEMATIC



(8) Remove 4 screws in defroster duct opening holding dash pad (Fig. 6).

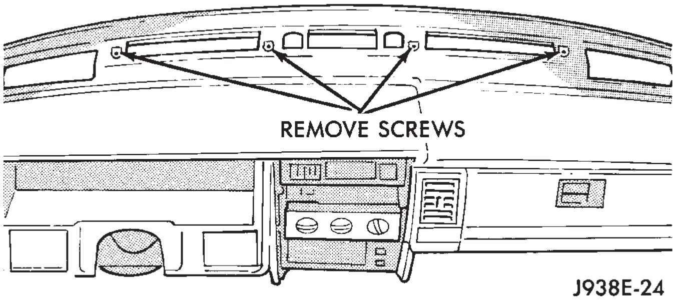


Fig. 6 Upper Dash Pad Attaching Screws

(9) Remove 3 screws above Instrument Panel cluster holding dash pad (Fig. 7).

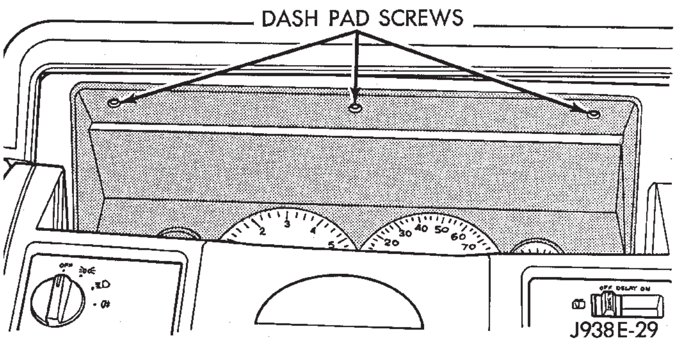


Fig. 7 Remove Screws Holding Dash Pad

(10) Open glove box and remove 2 screws holding dash pad.

(11) Remove dash pad pulling up to unsnap end clips.

(12) Remove 4 screws holding the steering column cover (Fig. 8).

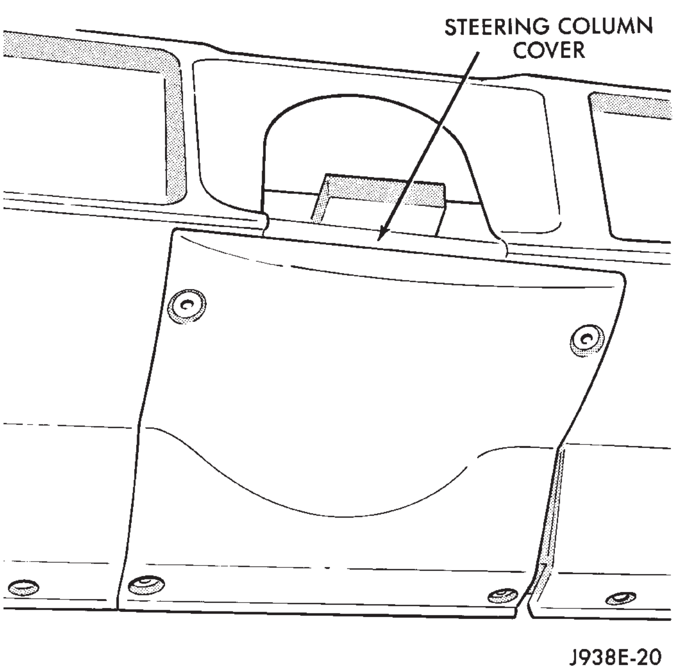


Fig. 8 Steering Column Cover

(13) With driver's door open remove 1 screw from the side of the lower trim panel (Fig. 9).

(14) Remove 1 screw from bottom of lower trim panel and pull panel off. There is also a clip holding the panel to the instrument panel.

(15) Remove 1 screw holding top of mirror switch bezel (Fig. 10).

(16) Remove 1 screw holding bottom of bezel (Fig. 11). Remove the mirror switch bezel far enough to unplug connector.

(17) Depress locking tabs and remove switch from bezel (Fig. 12).

(18) To install the switch, reverse the removal procedures.

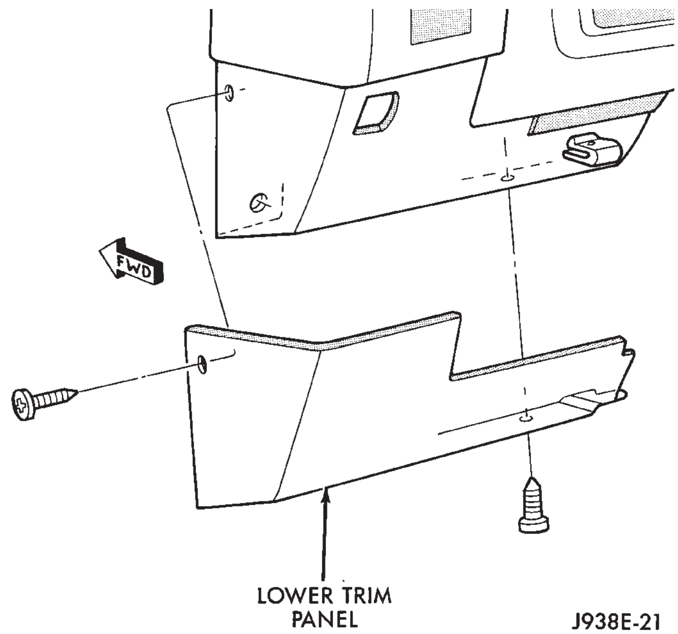


Fig. 9 Lower Trim Panel

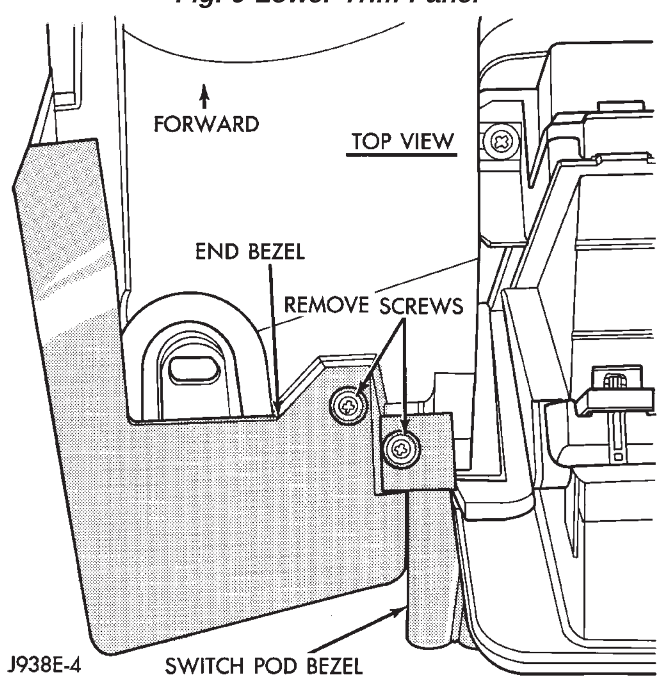


Fig. 10 Remove Screw Holding Top Of Bezel

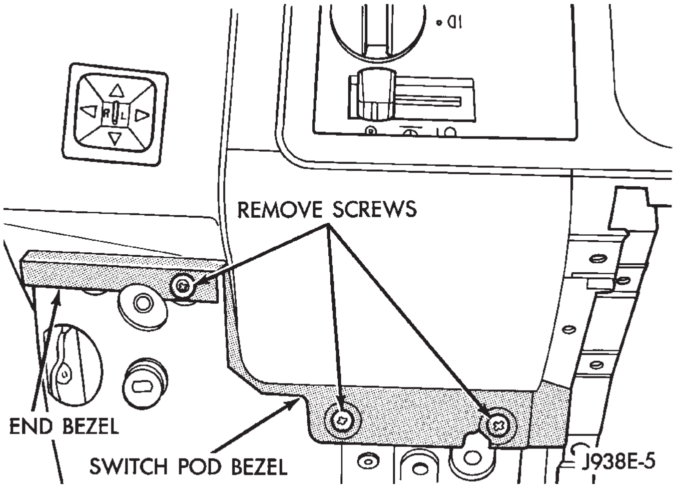


Fig. 11 Remove Screw Holding Bottom Of Bezel

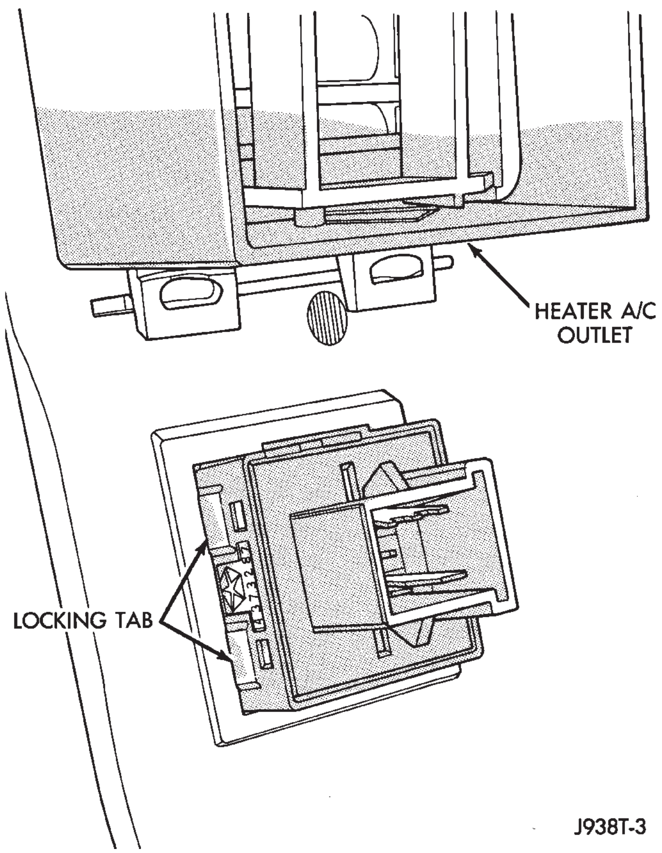


Fig. 12 Power Mirror Switch Removal

MIRROR ASSEMBLY REPLACEMENT

(1) Remove screw at top of trim panel near mirror (Fig. 13).

(2) Remove screw from demister opening.

(3) Remove screw and door handle cover.

(4) Remove screw from under armrest.

(5) Remove screw from bottom of hand hold in armrest.

(6) Remove the trim panel with a wide flat blade tool (Fig. 14).

To aid in removal of the trim panel, start at the bottom of the panel.

(7) Unplug mirror wiring from door harness at connector (Fig. 15).

(8) Remove 3 nuts holding mirror and remove mirror.

(9) To install the mirror, reverse the removal procedures.

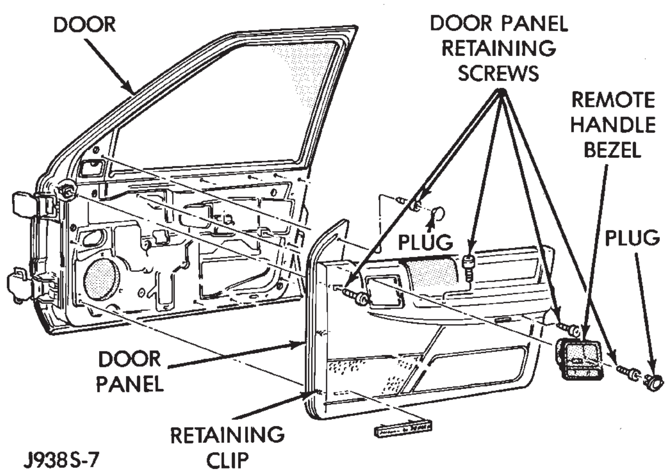


Fig. 13 Door Panel Removal

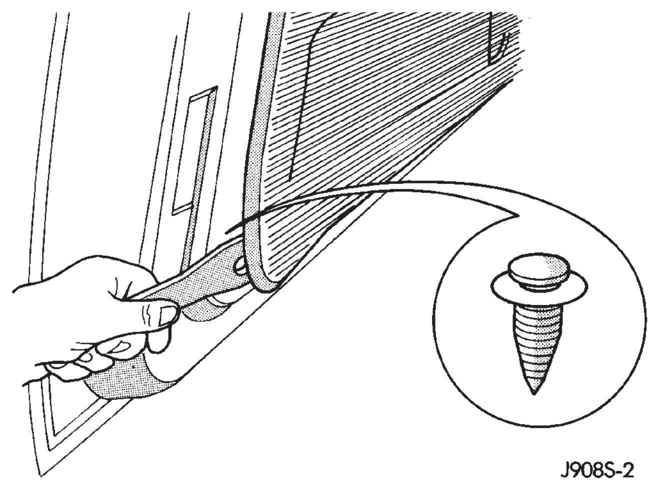


Fig. 14 Trim Panel Removal

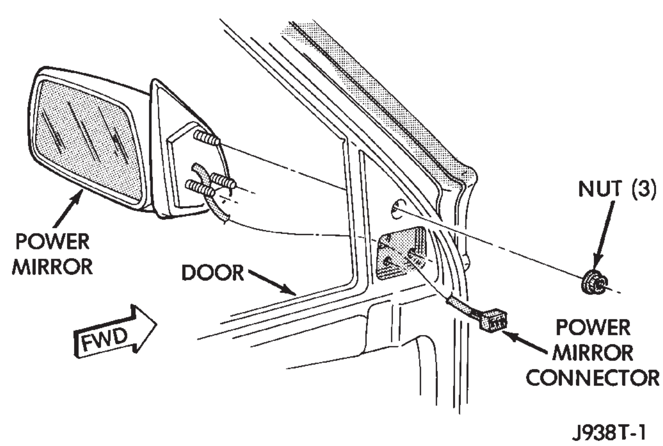


Fig. 15 Power Mirror Removal/Installation

AUTOMATIC DAY/NIGHT REAR VIEW MIRROR

GENERAL

The Automatic Day/Night Mirror automatically changes its reflectance to reduce glare in all types of driving conditions. A thin layer of electrochromic material between two pieces of conductive glass make up the face of the mirror. As light conditions change, two photocell sensors adjust the reflectance while reducing glare from headlamps approaching from the rear.

SENSORS

The mirror incorporates 2 sensors. The Ambient sensor (forward facing) detects normal outside light levels. The Headlamp sensor (rear facing) detects light levels received at the rear window side of the mirror. When the difference between the two levels becomes too great (light level received at rear of mirror is much higher than front of mirror), the mirror begins to darken. The level of light required to darken the mirror is controlled by the Mirror Switch.

SWITCH

The mirror switch allows the driver to adjust the sensitivity of the mirror. In the LOW position, the mirror is less sensitive to change while the HIGH position causes the mirror to darken at a lower glare level.

To test the operation:

• Turn ignition switch to the ON position with the vehicle in park.
• Place mirror switch in either the low or high position (Fig. 1).

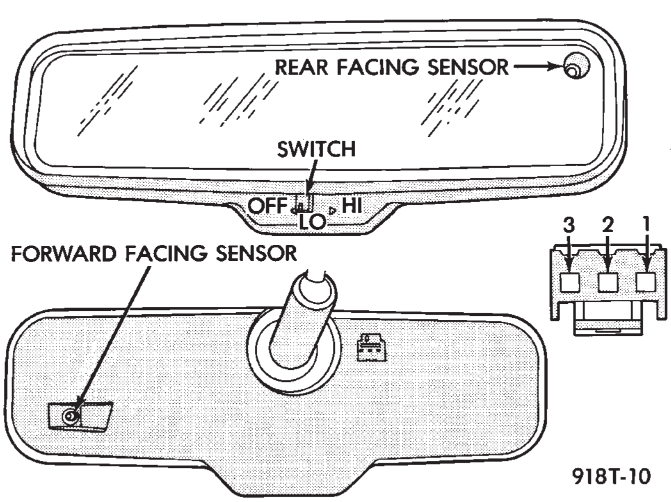


Fig. 1 Automatic Day/Night Mirror

• Cover the forward facing sensor with your hand to keep out any ambient light.
• Shine a light into the rear facing sensor. Watch to see if the mirror darkens.

With the mirror darkened, place the vehicle in reverse, the mirror should return to its normal condition.

If the above conditions are met the mirror is operating properly.

If the above conditions are not met, perform the following voltage tests (Fig. 1).

Test 3 way connector harness.

(1) Pin 1 - Ignition Switch in RUN position, should have battery voltage.

(2) Pin 2 - Should have continuity to ground.

(3) Pin 3 - When the transmission is in reverse, should have battery voltage.

(4) If test is OK, replace Mirror.

(5) If not, refer to 8W - Wiring Diagrams to test the circuits.

REPLACEMENT

(1) Remove wire cover by grasping lower portion of wire cover and sliding into upper portion and off of mirror base (Fig. 2).

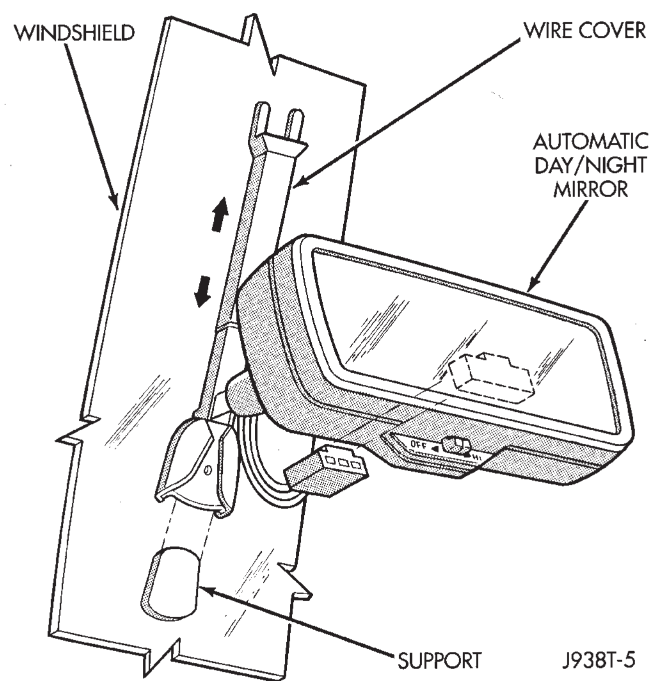


Fig. 2 Automatic Mirror Removal

(2) Unplug connector behind mirror.

(3) Remove screw holding mirror to windshield.

(4) Push mirror up far enough to clear the support and remove mirror.

(5) To install mirror, reverse removal procedures

CHIME/BUZZER WARNING SYSTEMS

SEAT BELT WARNING SYSTEM

INDEX

GENERAL INFORMATION

The buzzer or optional chime module is located on the convenience center. The convenience center is located under the driver's end of the instrument panel (Figs. 1 and 2). The buzzer or chime sounds an audible warning tone in any of the following conditions:

- Vehicle lights are ON when the ignition is switched OFF, the key is removed and driver's door opened.
- Key is in the ignition and driver's door is open. (On some vehicles, the buzzer will not sound if the ignition switch is in the RUN position).
- Ignition is switched ON and driver's seat belt is not buckled. Sound will quit after 4 to 8 seconds. Besides the sound, a seat belt light indicator turns on as a reminder to fasten seat belt.
- An input from the Driver's Information Center is received.

There is also a door lock inhibit feature. If the key is in the ignition or the lights are ON, while the driver's door is open, the power locks/keyless entry will not operate.

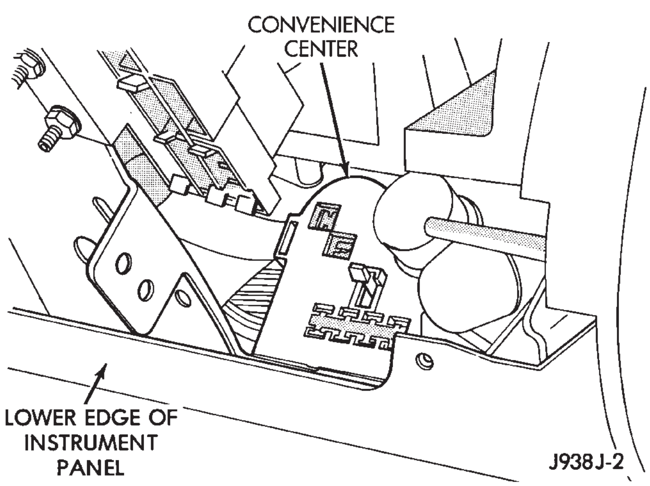


Fig. 1 Convenience Center Location

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 RUN or START position.

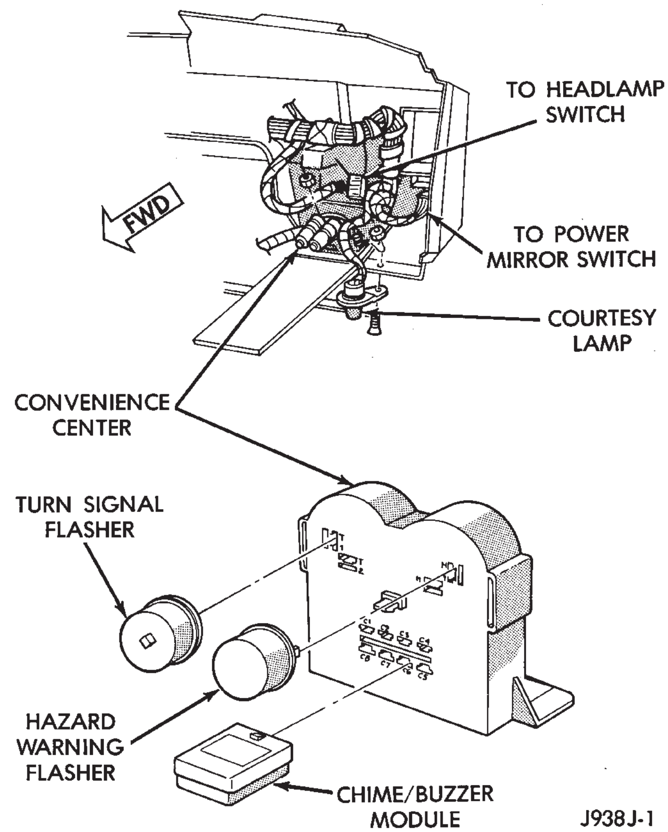


Fig. 2 Turn Signal and Hazard Warning Flashers

LIGHTS ON

To sound the lights on warning, the module needs:

- 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.

SEAT BELT WARNING

To sound the seat belt warning, the module needs:

- battery voltage at pin (7)
- battery voltage at the ignition switch input (Pin 1)
- a ground at the seat belt switch.
- a ground at Pin 3.

This occurs when the seat belt switch is closed because the driver's seat belt is not buckled. The "fasten belt" light also will turn on along with the warning sound.

KEY IN IGNITION

To sound the key in ignition alarm, the module needs:

- 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.

VEHILCE INFORMATION CENTER

There will be 6 beeps (3 beeps, pause, 3 beeps) unless the fault goes away or SET/SELECT is pressed in diagnostics mode. There should be no beeping for the first 8 seconds after the ignition turns ON. Beeping will only occur for two messages in a row if the second message has higher priority over the first message.

DOOR LOCK INHIBIT

Pin 8 of the chime module provides the ground for the coil side of the power door lock relay.

The LOCK function will not operate if:

- The chime module is not plugged in.
- The key is in the ignition, or the lights are ON, while the driver's door is open.
- The door lock inhibit feature of the chime module is inoperable due to defective electronics in the chime. In this case the operation is unpredictable.

DIAGNOSIS

If the buzzer/chime unit does not operate as described, check the two fuses for pins 1 and 7 (Figs. 3, 4) 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. Remove the module from the fuse block. 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:

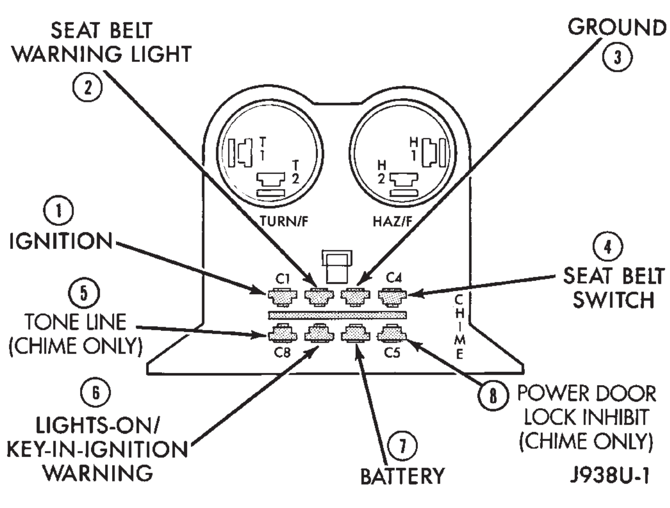


Fig. 3 Convenience Center Terminal Identification

VOLTAGE TESTS

Ignition in RUN position, measure between the following pins and vehicle ground.

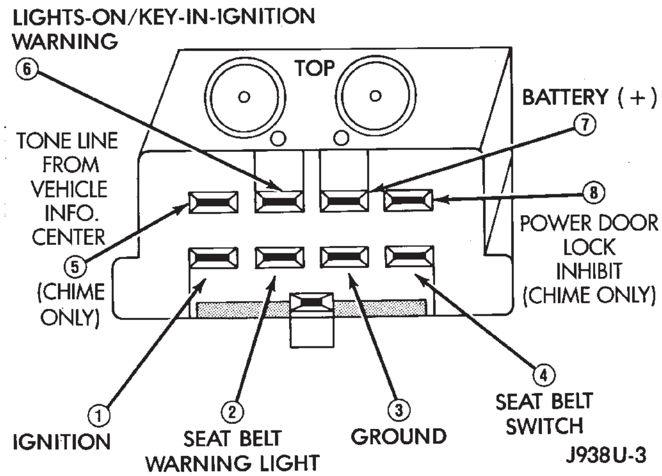


Fig. 4 Buzzer Module Terminal Identification

- Measure voltage at buzzer/chime module connector pin 1. Meter should read battery voltage. If not, repair open circuit to ignition switch.

Turn ignition off and remove the key from the ignition.

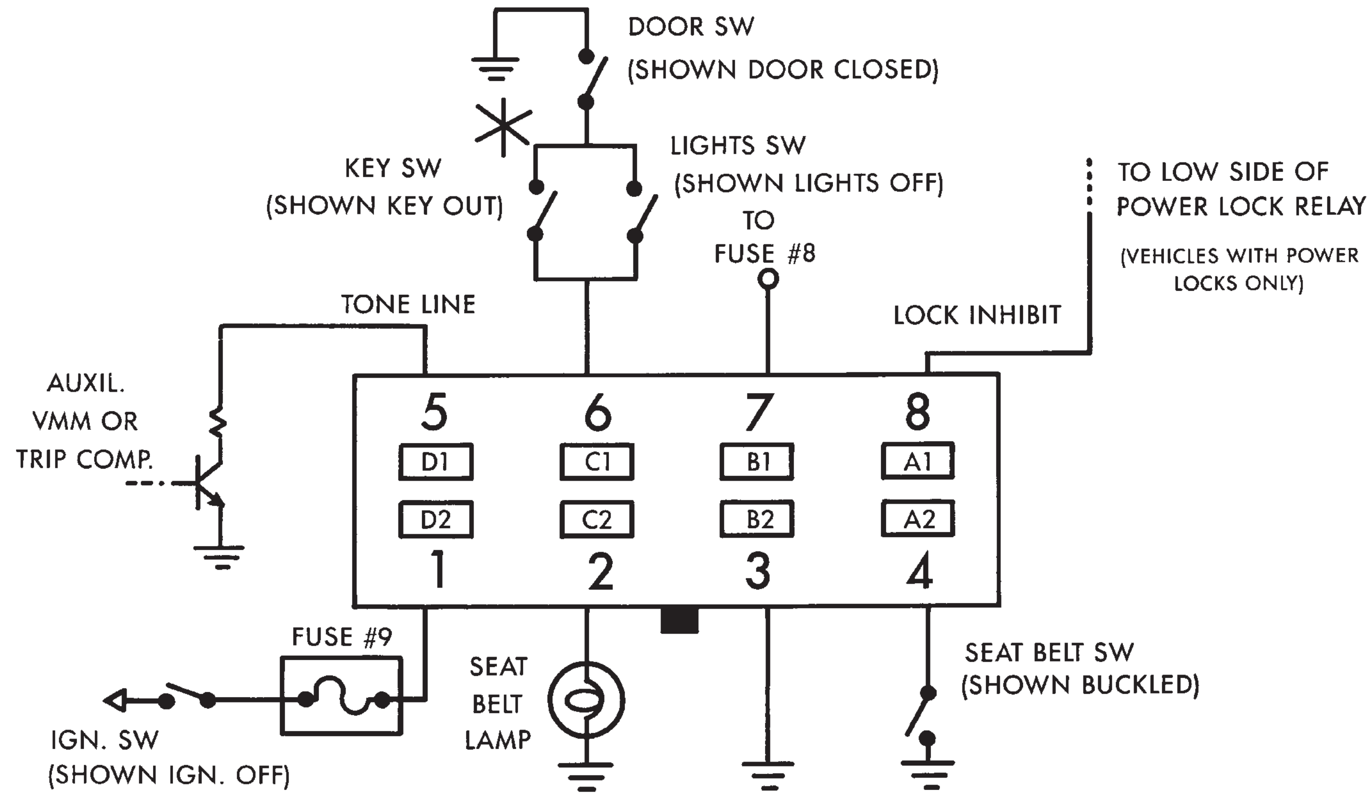
- Measure voltage at buzzer/chime module connector pin 7. Meter should read battery voltage. If not, repair open circuit to fuse.

RESISTANCE TESTS

CAUTION: Before making resistance measurements, turn ignition switch OFF and disconnect the battery negative cable. This will avoid damaging the ohmmeter.

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 circuit to ground.
- Buzzer/chime module connector pin 4. Driver's seat belt not buckled. Meter should read zero ohms. If not, repair open circuit 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 circuit to ground (or key-in-ignition switch may be defective).
- Buzzer/chime module connector pin 6. Remove key from ignition. Open driver's door, headlamp switch on, meter should read zero ohms. If not, repair open circuit to ground.



PIN 8 (POWER LOCKS INHIBIT): LOW WHEN PIN 6 IS HI. AND OPEN WHEN PIN 6 IS LOW.

N/A = NOT APPLICABLE. X = DON'T CARE.

FUNCTION	DESCRIPTION	IGN.	SEAT BELT	TRIP COMP	DRIVER'S DOOR	KEY	HEAD LAMPS
SEAT BELT REMINDER	4 TO 8 SEC. CHIME AND LAMP OUTPUT	OFF → ON	NOT BCKLD	X	X	X	X
	4 TO 8 SEC. LAMP OUTPUT ONLY	OFF → ON	BCKLD	X	X	X	X
TRIP COMPUTER	CONTINUOUS. STEADY TONE	ON	X	LOW	X	X	X
KEY & HEAD LAMP REMINDER	PULSD. FAST-RATE CHIMES	OFF	X	X	OPEN	IN	X
						X	ON
DOOR LOCK INHIBIT	POWER LOCKS INHIBITED	OFF	X	X	OPEN	IN	X
						X	ON

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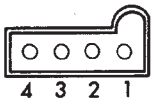
Fig. 5 Buzzer Module Schematic



WIRE CAVITY	APPLICATION	CONTINUITY BETWEEN
1 2	Halo lamp Halo lamp	1 & 2 Almost zero ohms (bulb filament)
3 4	Key-in warning switch Key-in warning switch	3 & 4 with key in ignition

J918M-3

Fig. 6 Halo Lamp And Key-In Warning Switch Continuity Chart

KEY-IN SWITCH REPLACEMENT

REMOVAL

(1) Disconnect battery negative cable.

(2) Tilt column only—remove tilt lever (counterclockwise).

(3) Carefully remove both upper and lower steering column covers. Requires removal of 3 screws (Torx T-20).

(4) Remove 3 ignition switch mounting screws (tamper proof Torx bit Snap-On TTXR20B2 or equivalent required) (Fig. 7).

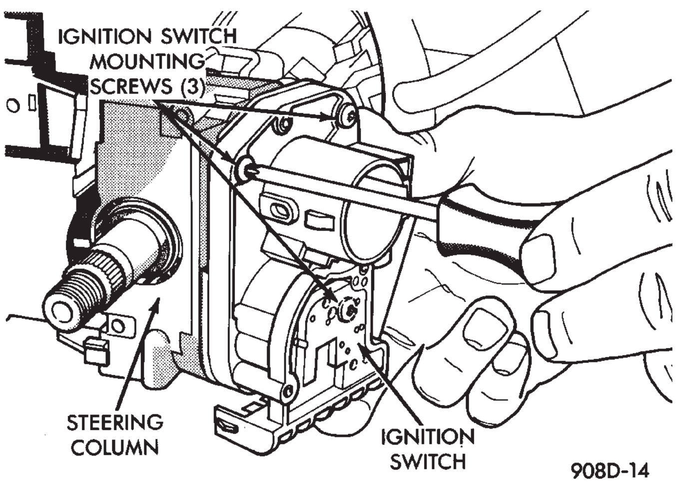


Fig. 7 Ignition Switch Screw Removal

(5) Gently pull switch away from the column. Release 2 connector locks on the 7 terminal wiring connector, then remove the connector from the ignition switch.

(6) Release connector lock on the 4 terminal Key In and Halo light connector then remove the connector from the ignition switch (Fig. 8).

(7) Remove the key cylinder from the ignition switch as follows:

(a) Place the key in the ignition switch in the Lock position. Use a small screw driver to depress the key cylinder retaining pin flush with the key cylinder surface (Fig. 9).

(b) Rotate the key clockwise to the Off position. The key cylinder should now be unseated from the

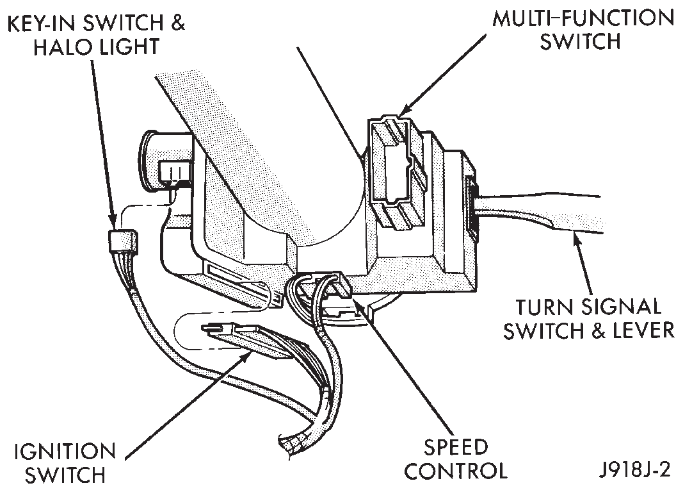
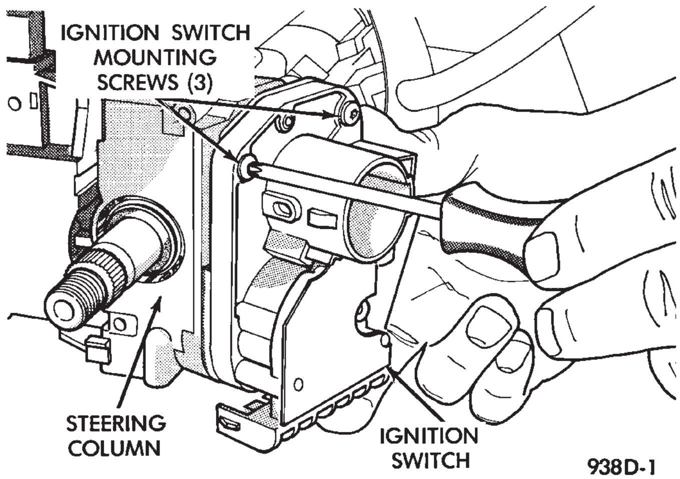


Fig. 8 Key In Switch And Halo Lamp Connector



Key Cylinder Pin

ignition switch assembly and about 1/8 inch above the ignition switch halo light ring (Fig. 10).

CAUTION: Do not try to remove the key cylinder at this time.

(c) Rotate the key counterclockwise to the Lock position and remove the key.

(d) Remove key cylinder (Fig. 11).

INSTALLATION

(1) Install 2 wiring connectors to the switch. Make sure that the switch locking tabs are fully seated in the wiring connectors.

(2) Mount ignition switch to the column with 3 screws. When equipped with column shift:

- the shifter must be in the Park position

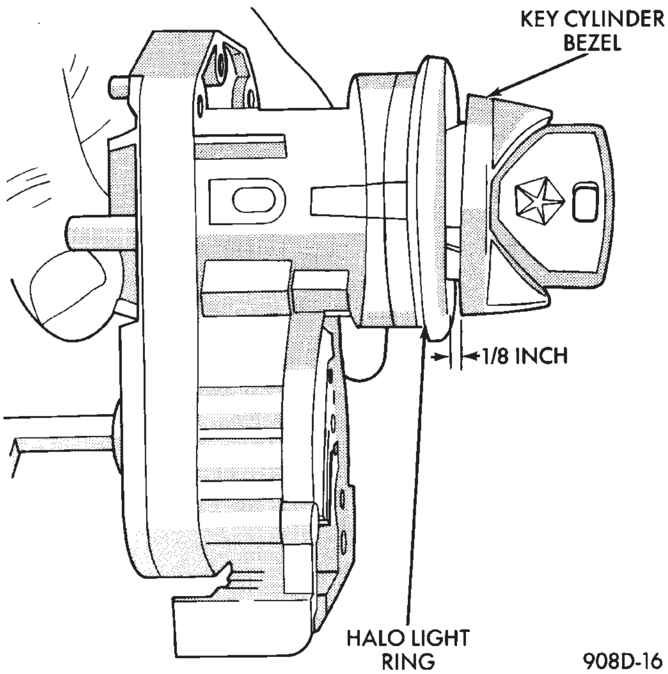


Fig. 10 Unseated Key Cylinder

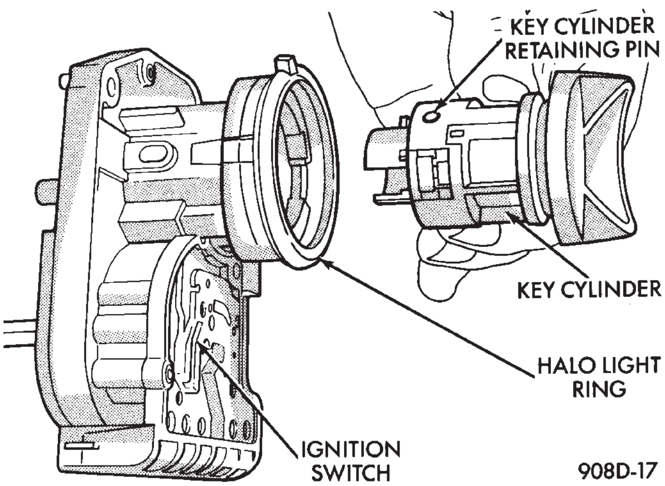


Fig. 11 Key Cylinder Removal

• the park lock dowel pin on the ignition switch assembly must engage with the column park lock slider linkage (Figs. 12 and 13).

Verify ignition switch is in lock position (flag is parallel with the ignition switch terminals). Apply a daub of grease to flag and pin. Position park lock link and slider to mid-travel. Position ignition switch against lock housing face, making sure pin is inserted into park lock link contour slot. Torque retaining screws to 2 N●m (17 in. lbs.).

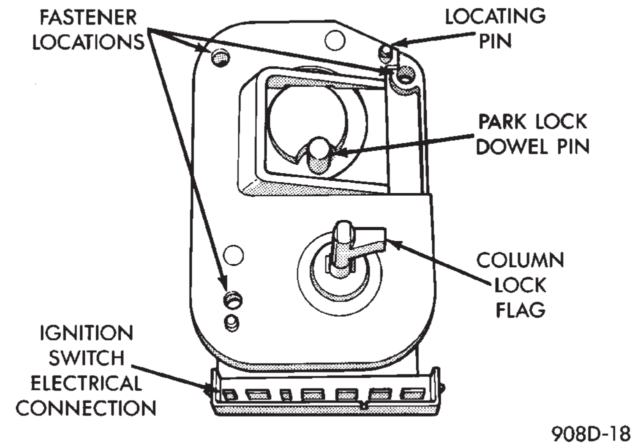


Fig. 12 Ignition Switch—View From Column

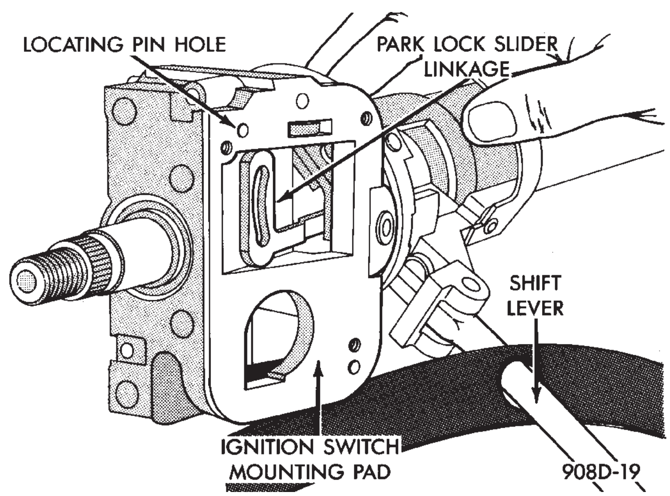


Fig. 13 Ignition Switch Mounting Pad—Typical

(3) Assemble cover to the column with 3 screws. Torque screws to 2 N●m (17 in. lbs.).

(4) Tilt column only—install tilt lever (clockwise).

(5) Install battery negative cable.

(6) Install key cylinder as follows:

(a) With the key cylinder and the ignition in the Lock position, gently insert the key cylinder into the ignition switch assembly until it bottoms.

(b) Insert key, while gently pushing on the key cylinder inward toward the ignition switch, rotate the key clockwise to the Run position.

(7) Check for proper operation of push-to-lock, halo lighting, Accessory, Lock, Off, Run, Start, Column Lock and Shift Lock (if applicable).

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 Figs 1 and 2. For additional information on ignition systems or distributor operation refer to Group 8D Ignition Systems.

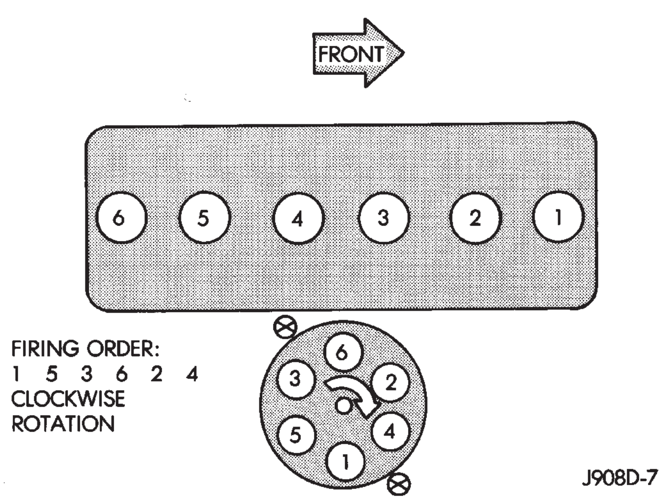


Fig. 1 Secondary Ignition Wiring 4.0L

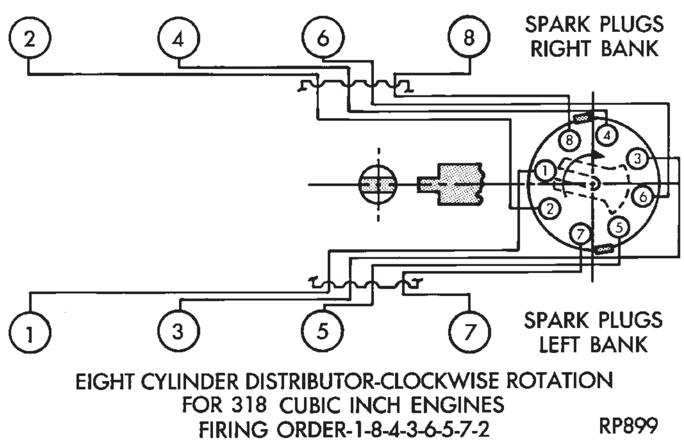


Fig. 3 Secondary Ignition Wiring 5.2L Engine

WIRING DIAGRAM SHEETS AND INDEXES

The wiring diagram sheets are organized to show systems relating to the basic vehicle and all of its options. Add-on or non-factory options are not covered. 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.

In certain instances a wire may be referenced to another sheet. When this happens, the wire will be identified as to what it is ie: feed, ground etc, and where it is going (Fig. 3). This has been done to aid in the diagnosis of wiring and component problems.

The index for the diagrams is located at the beginning. It covers all systems shown in the diagrams and is in alphabetical order. The main system and all related components are covered.

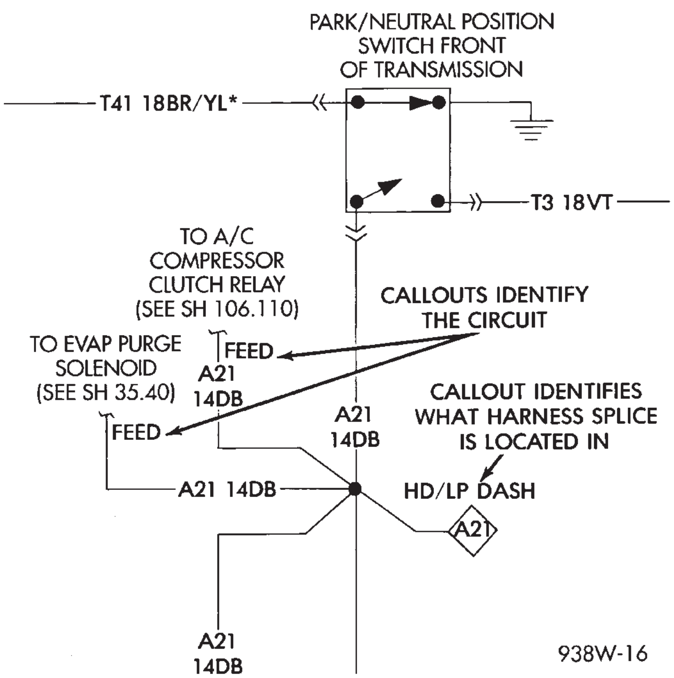


Fig. 3 Wiring Diagram Page Example

WIRE CODE IDENTIFICATION

Each wire shown in the diagrams contains a code (Fig. 4) 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. 5). 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.

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.**

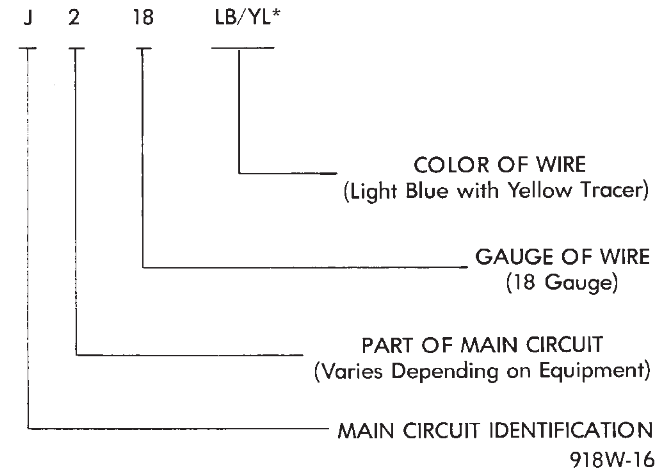


Fig. 4 Wire Color Code Identification

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	

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Fig. 5 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 of the vehicle. The diagrams end with connector identification pages.

COMPONENT IDENTIFICATION

When looking for a components location on the vehicle refer to the wiring and components section.

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

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This section shows the wire harness routing and the components location in the vehicle. To use 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. 6 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. 6 example 2).

To locate a splice in the wiring harness determine the splice number from the diagrams then refer to the splice location index. This section shows the general location of the splice in the harness.

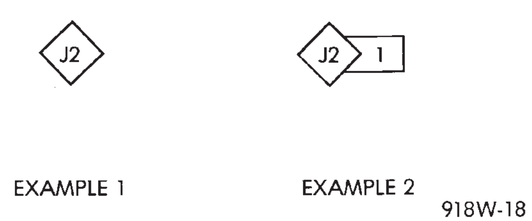


Fig. 6 Wiring Splice Examples

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.

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. Refer to the wiring diagrams fuse application chart.

(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.

HARNESS REPAIR

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 the wire.

(3) Place a piece of heat shrink tubing over one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.

(4) Spread the strands of the wire apart on each part of the exposed 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 all affected systems.

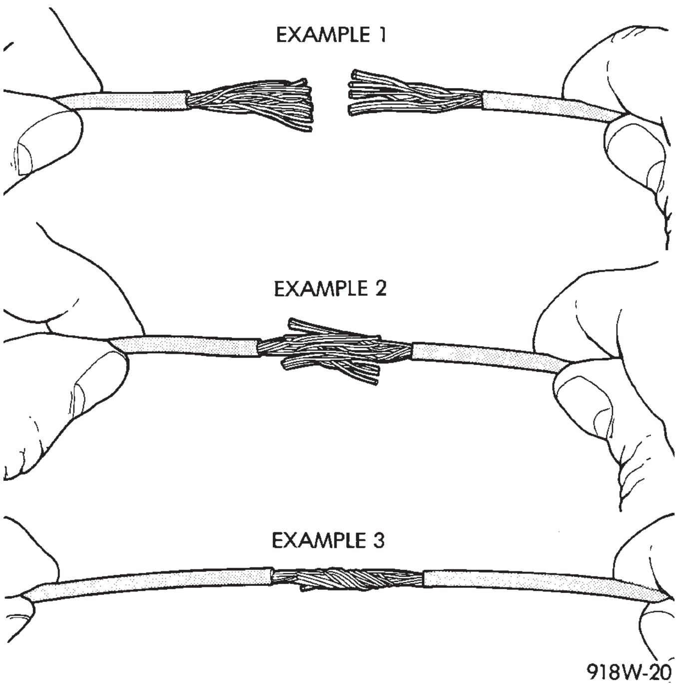


Fig. 7 Wire Repair

CONNECTOR REPLACEMENT

(1) Disconnect battery.

(2) Disconnect the connector that is to be repaired from its mating half.

(3) Remove connector locking wedge (Fig. 8).

(4) Position the connector locking finger away from the terminal. Pull 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 thru 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.

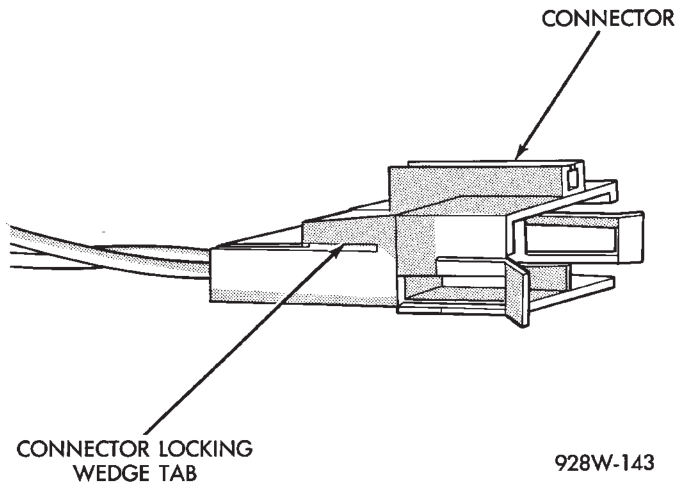


Fig. 8 Connector Locking Wedge Tab

(10) Connect battery and test all affected systems.

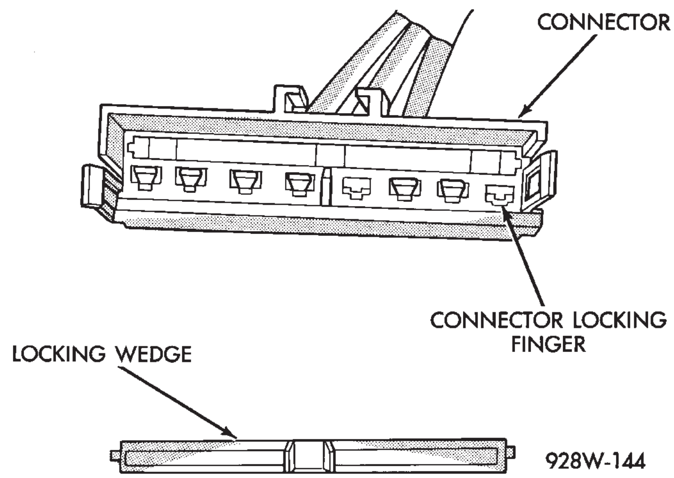


Fig. 9 Connector Locking Finger and Locking Wedge

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. 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.

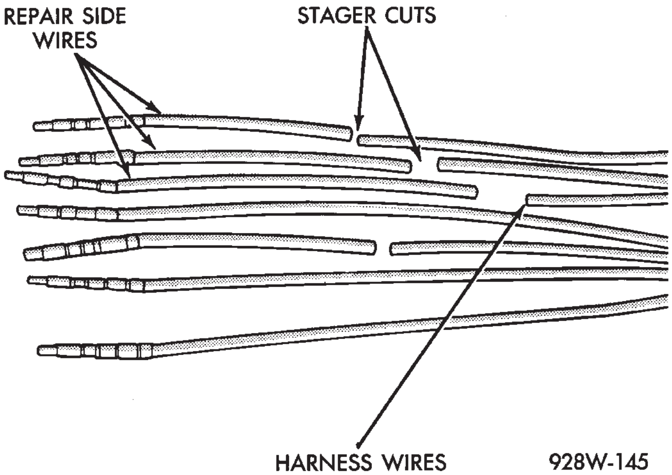


Fig. 10 Stagger Cutting Wires

(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 part 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 thru 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 all 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. Pull 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 part 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 all affected systems.

SYMBOLS, FUSES, AND RELAYS

Various symbols are used throughout the wiring diagrams. These symbols can be identified by referring to the symbol identification chart (Fig. 11).

For fuse block information refer to (Fig. 12). For convince center information refer to (Fig. 13). For relay bank information refer to (Fig. 14). And for power distribution center information refer to (Fig. 15).

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.

MODULES AND CONTROLLERS

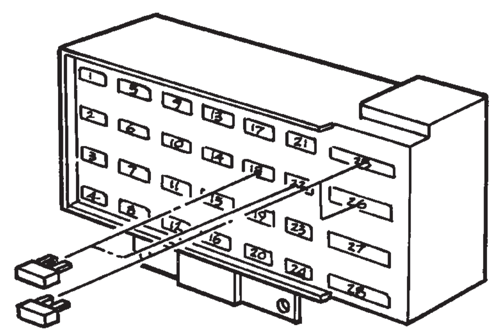
Modules and connectors are shown in (Fig. 16). This is intended to show the general location of all modules and controllers. For additional information on component location refer to the component identification section.

	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		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

CAVITY	FUSE	ITEMS FUSED
1	20 AMP	POWER ANTENNA RELAY/TRAILER TOW RELAY
2	15 AMP	STOP LAMPS
3	20 AMP	HAZARD LAMPS
4	15 AMP	SECURITY LAMP
5	15 AMP	COURTESY LAMPS
6	15 AMP	SECURITY ALARM MODULE
7	15 AMP	SECURITY ALARM MODULE RELAY
8	15 AMP	FUSED BATTERY—MEMORY CIRCUITS
9	20 AMP	REAR WIPER
10	15 AMP	RADIO ACCESSORY
11	10 AMP	CIGAR LIGHTER
12	15 AMP	PARK LAMPS/ULTRA LIGHT MODULE
13	20 AMP	HORN RELAY
14	20 AMP	POWER DOOR LOCKS RELAY
15	3 AMP	ABS MODULE
16	20 AMP	TURN SIGNAL FLASHER

CAVITY	FUSE	ITEMS FUSED
17	7.5 AMP	HEVAC MODULE
18	15 AMP	AIR BAG MODULE
19	15 AMP	CONVENIENCE ITEMS
20	10 AMP	HEATED REAR WINDOW/OVERDRIVE MODULE/ VEHICLE SPEED CONTROL SYSTEM
21	15 AMP	CLUSTER/LAMP OUTAGE MODULE
22	15 AMP	AIR BAG MODULE
23	15 AMP	POWER MIRRORS-HEATED
24	7.5 AMP	POWER MIRRORS
25	30A C/BRKR	POWER SEATS
26	30 AMP C/BRKR	POWER WINDOWS
27	10 AMP C/BRKR	WINDSHIELD WIPER
28	30 AMP	HEATED REAR WINDOW



AMPS	FUSE	COLOR CODE
2	WT	WHITE
4	PK	PINK
5	TN	TAN
10	RD	RED
20	YL	YELLOW
25	NAT	NATURAL
30	LG	LIGHT GREEN

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Fig. 12 Fuse Block Identification

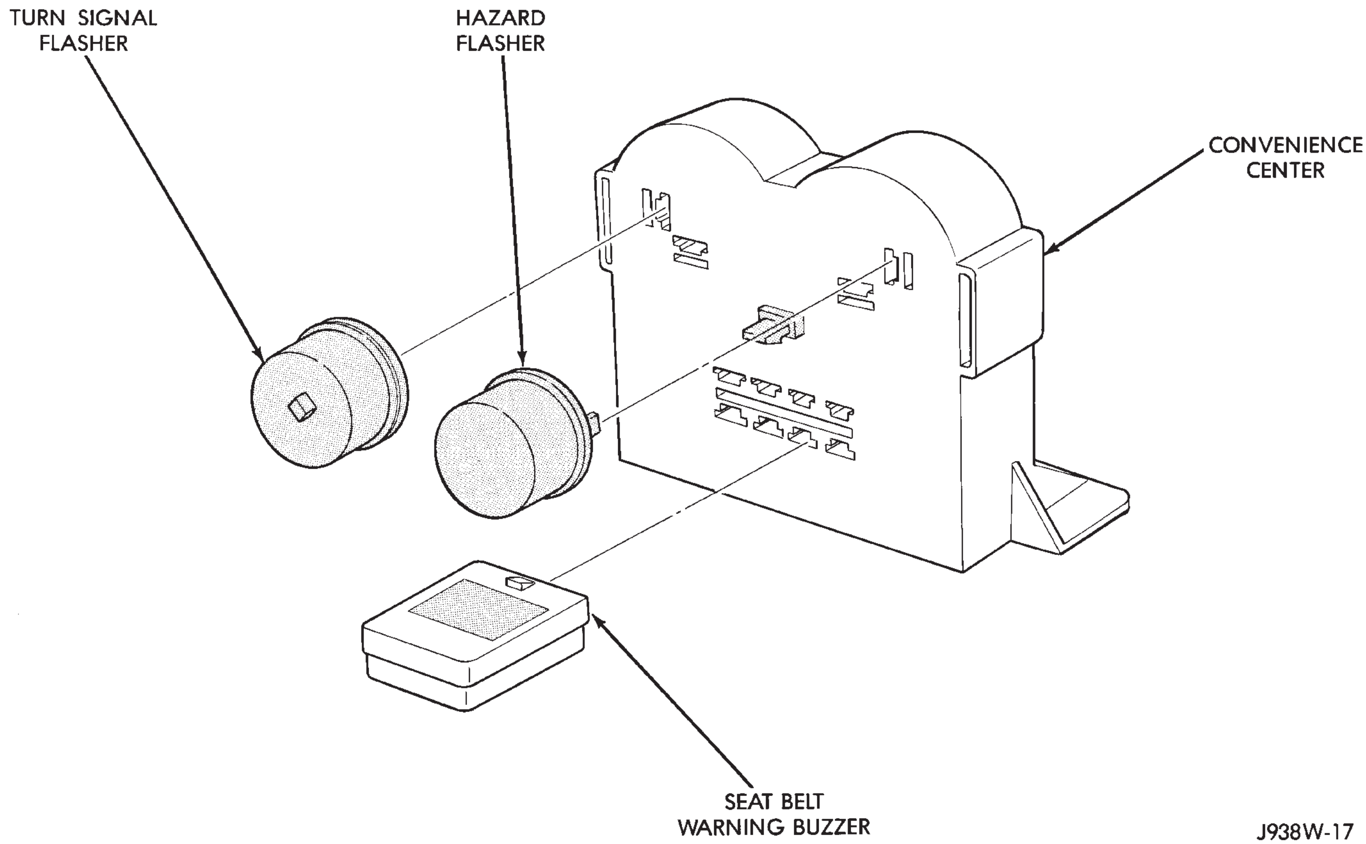

Fig. 13 Convince Center

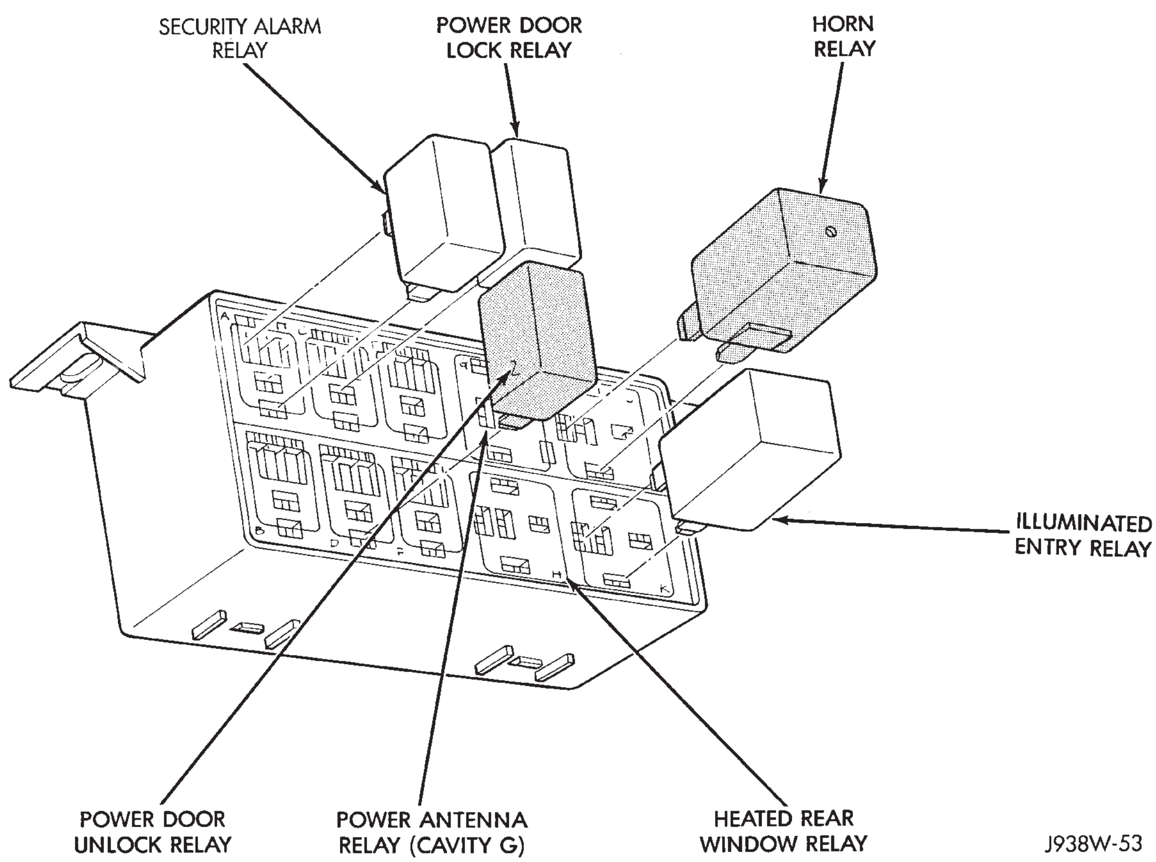

Fig. 14 Relay Center

RELAYS	
CAV	**DESCRIPTION**
A	FOG LAMP
B	FUEL PUMP
C	ABS PUMP MOTOR
D	A/C
E	AUTOMATIC SHUTDOWN
F	ENGINE STARTER
G	ABS SYSTEM

MINI FUSES	
CAV	**DESCRIPTION**
1	IGNITION-OFF DRAW
2	AUXILIARY LAMPS
3	POWERTRAIN CONTROL MODULE
4	A/C COMPRESSOR CLUTCH
5	AIRBAG SYSTEM DIAGNOSTIC MODULE
6	TRANSMISSION CONTROL

MAXI FUSES	
CAV	**DESCRIPTION**
A1	ABS PUMP MOTOR
A2	GENERATOR
A3	ABS SYSTEM
A4	EXTERIOR LIGHTING
A5	BLOWER MOTOR
A6	IGNITION SWITCH
A7	IGNITION SWITCH
A8	FUSE BLOCK
A9	POWERTRAIN CONTROL MODULE
A10	GENERATOR

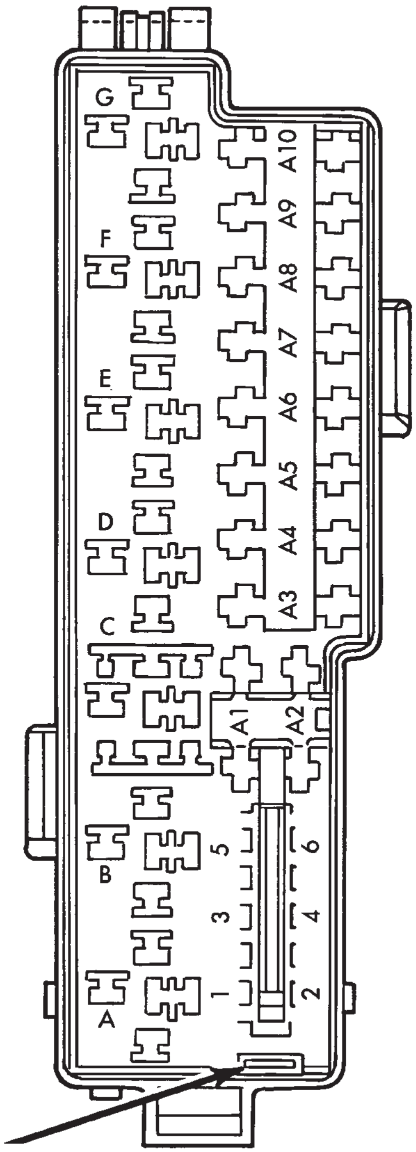

Fig. 15 Power Distribution Center

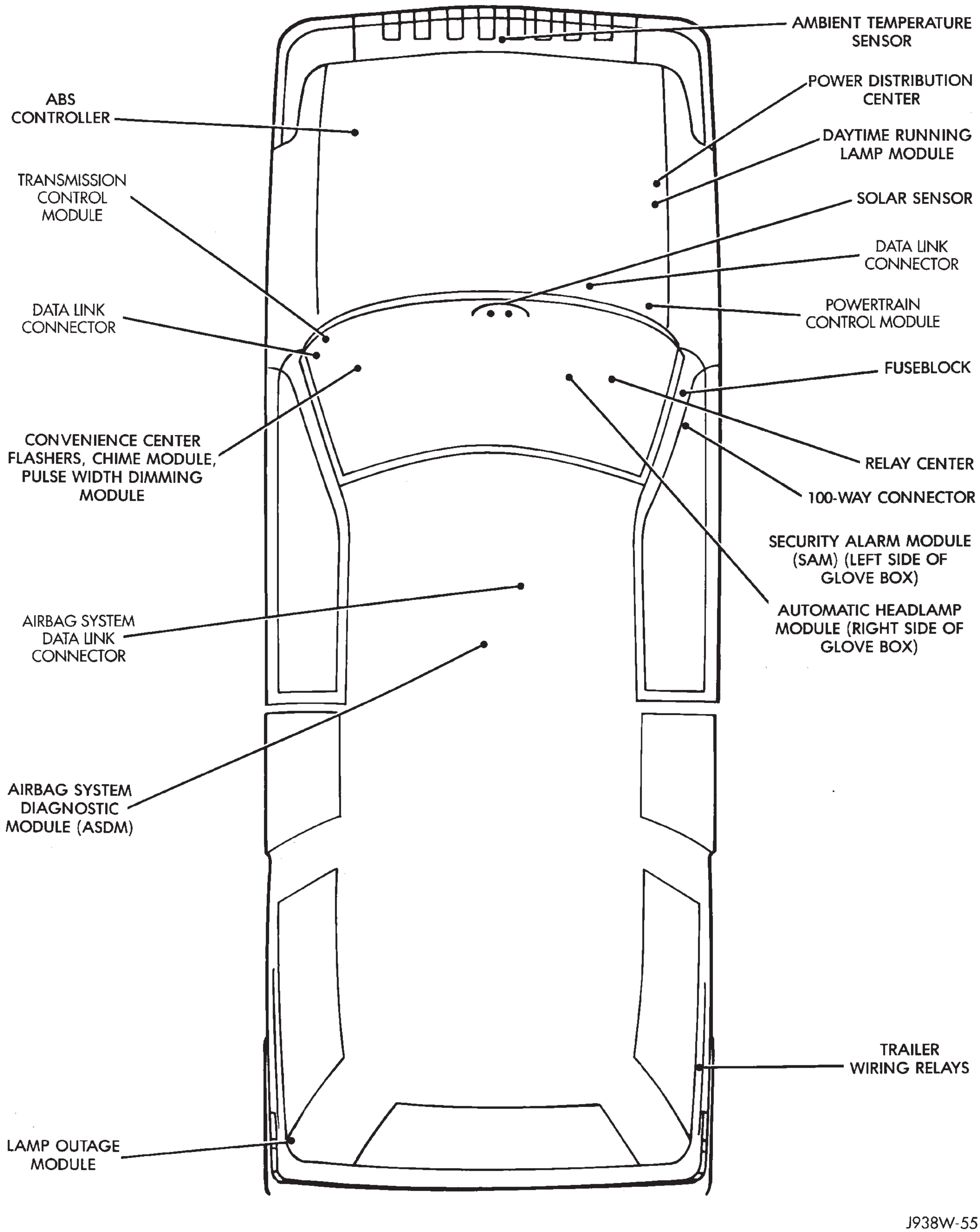

Fig. 16 Module and Component Location

COMPONENT IDENTIFICATION

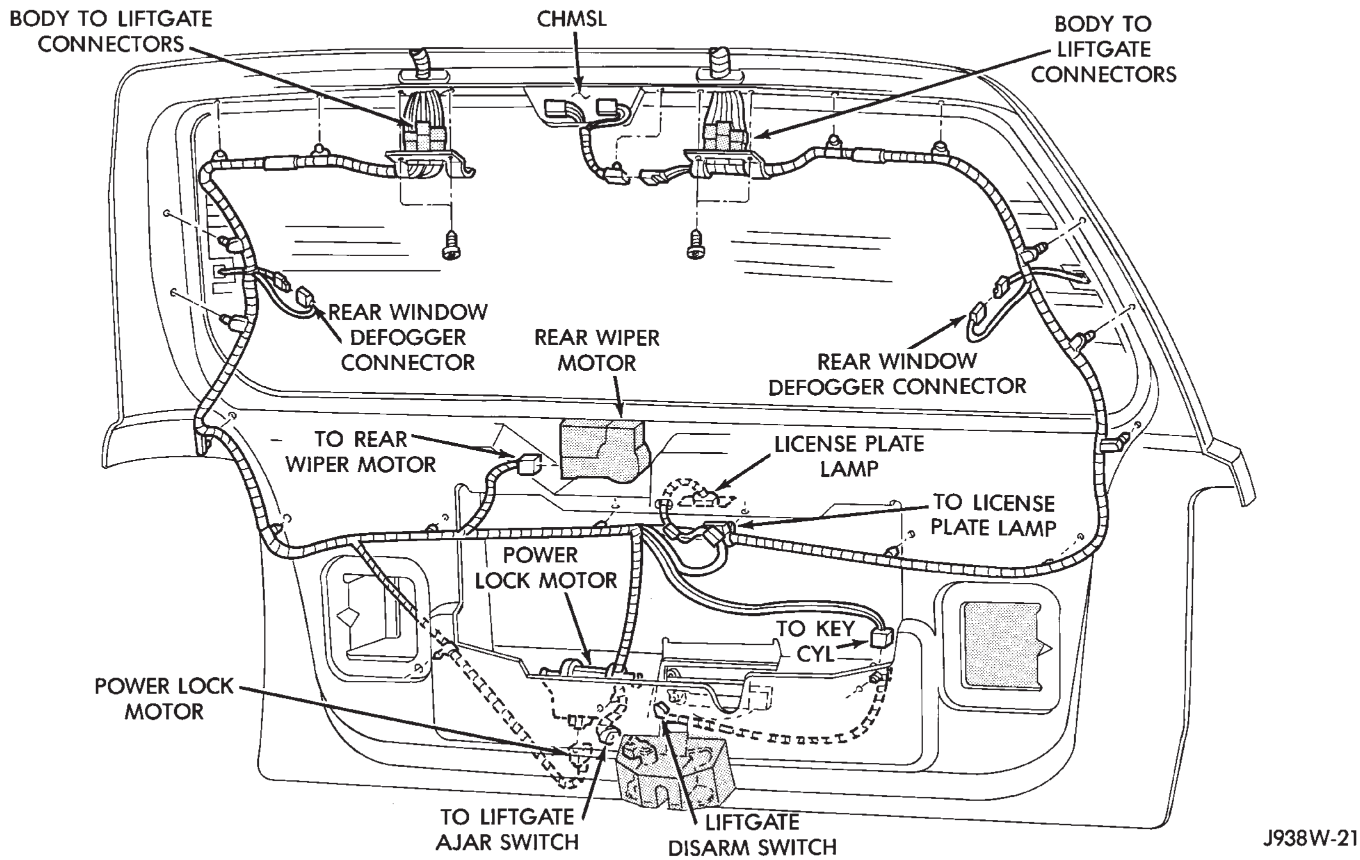

Fig. 1 Liftgate Wiring

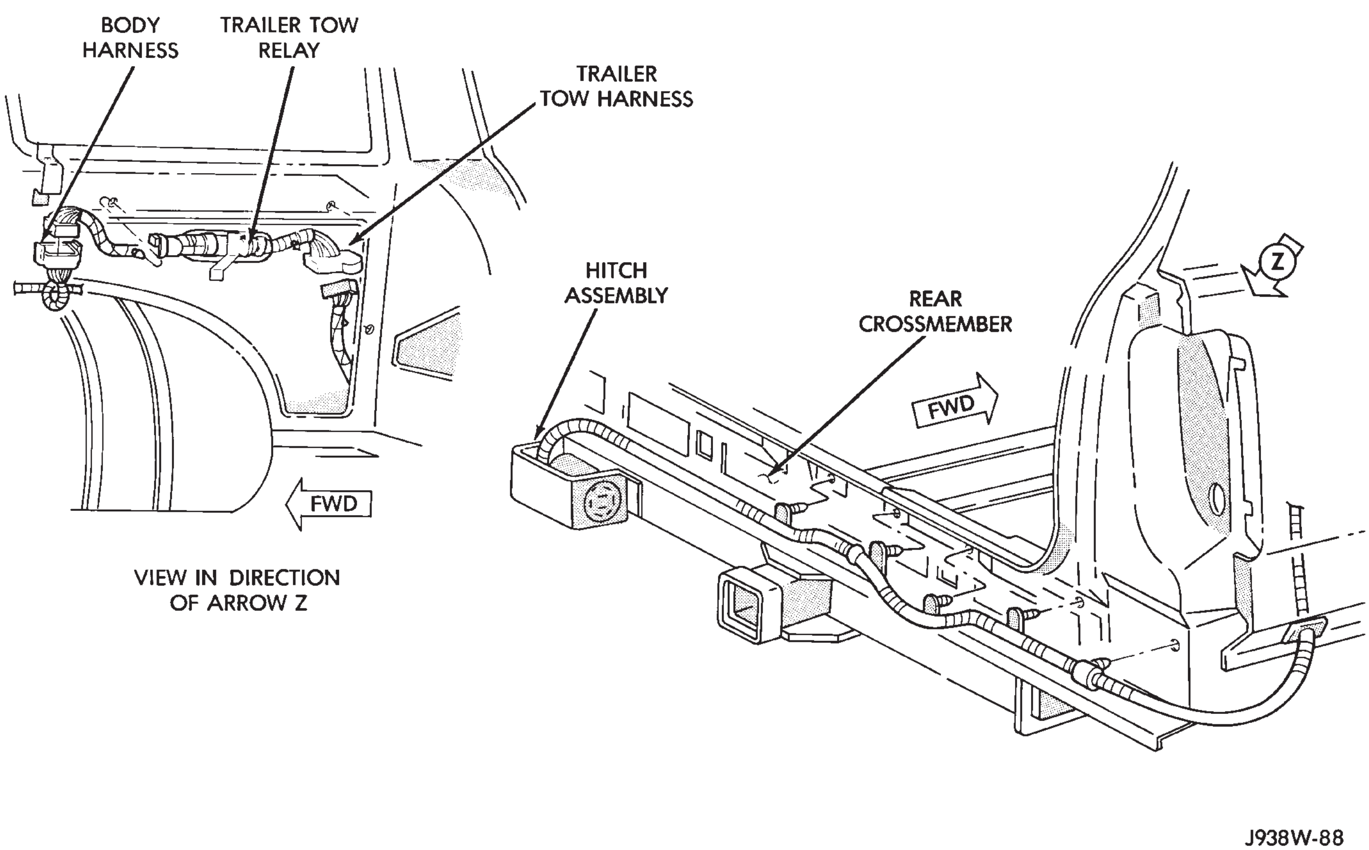

Fig. 2 Trailer Tow Wiring

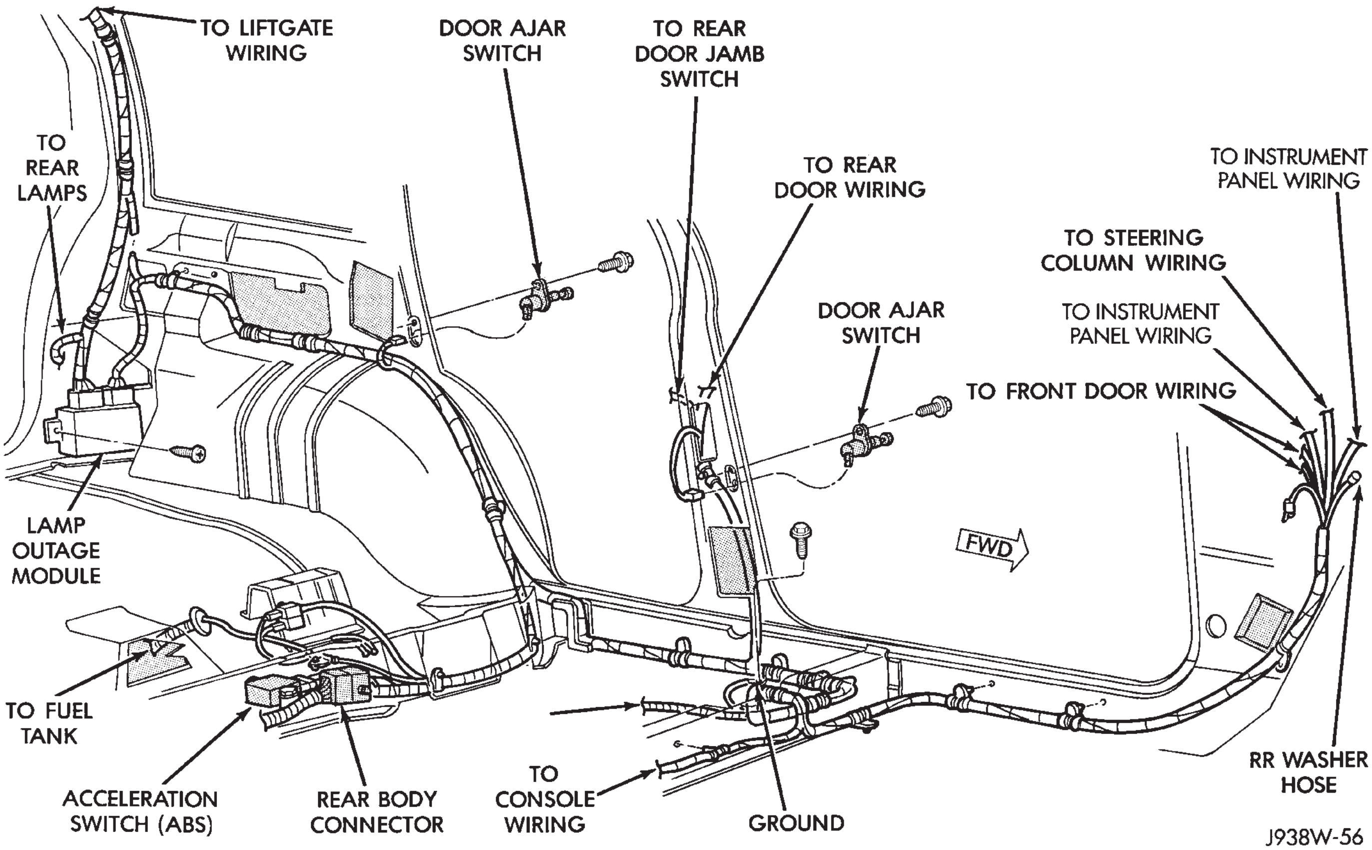

Fig. 3 Body Wiring (Left Side)

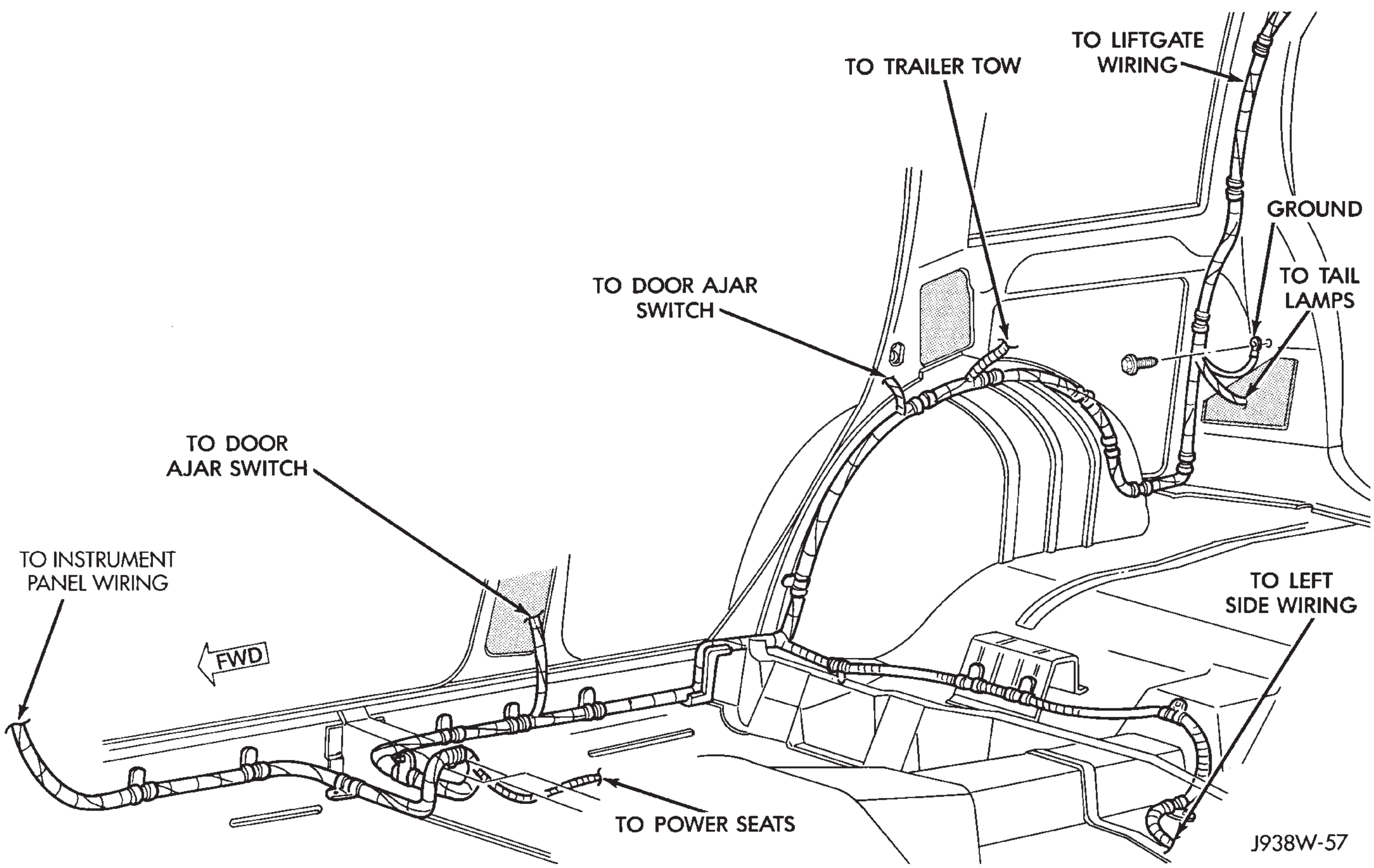

Fig. 4 Body Wiring (Right Side)

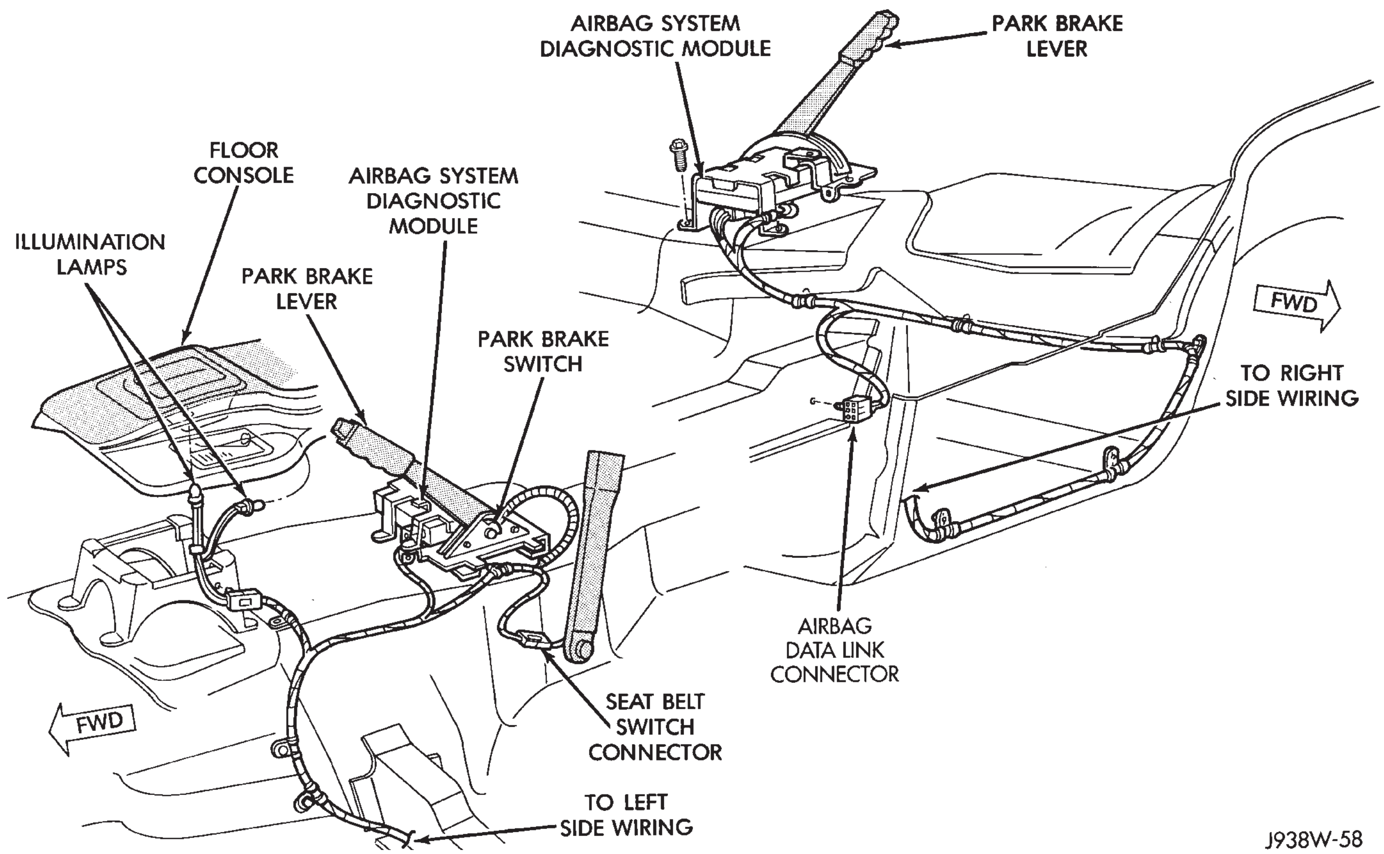

Fig. 5 Body Wiring (Floor and Console)

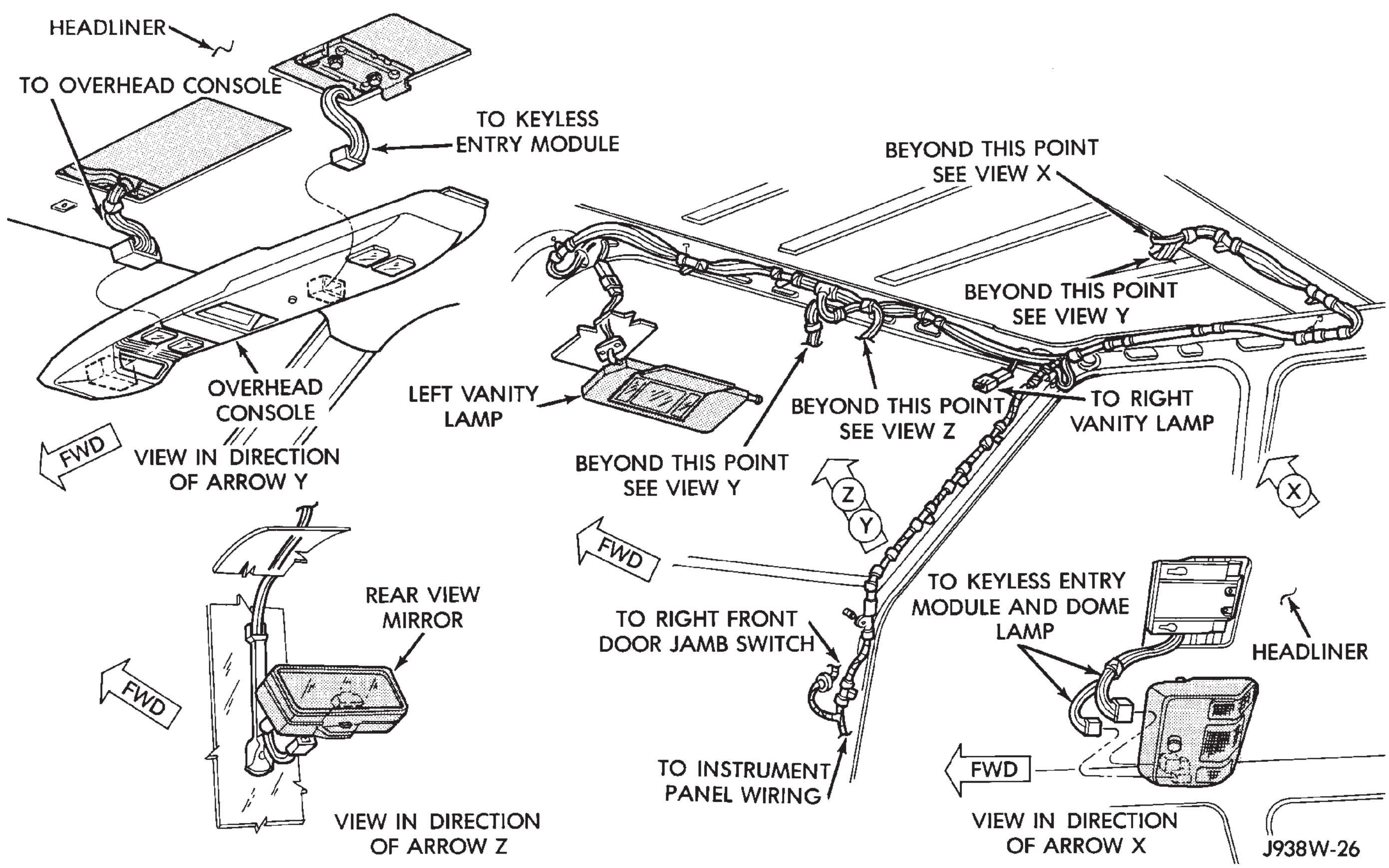

Fig. 6 Overhead Lamps Wiring

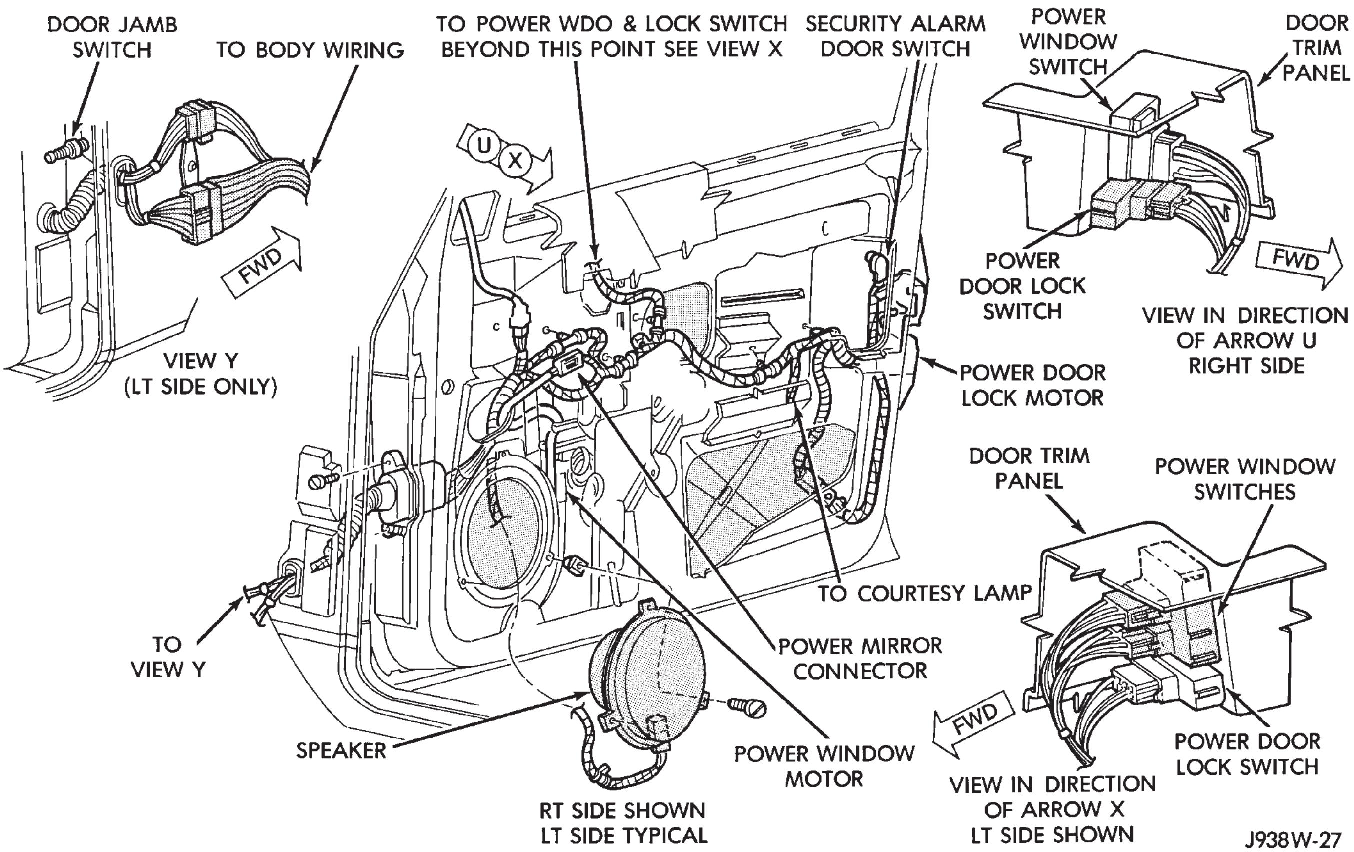

Fig. 7 Door Wiring (Front)

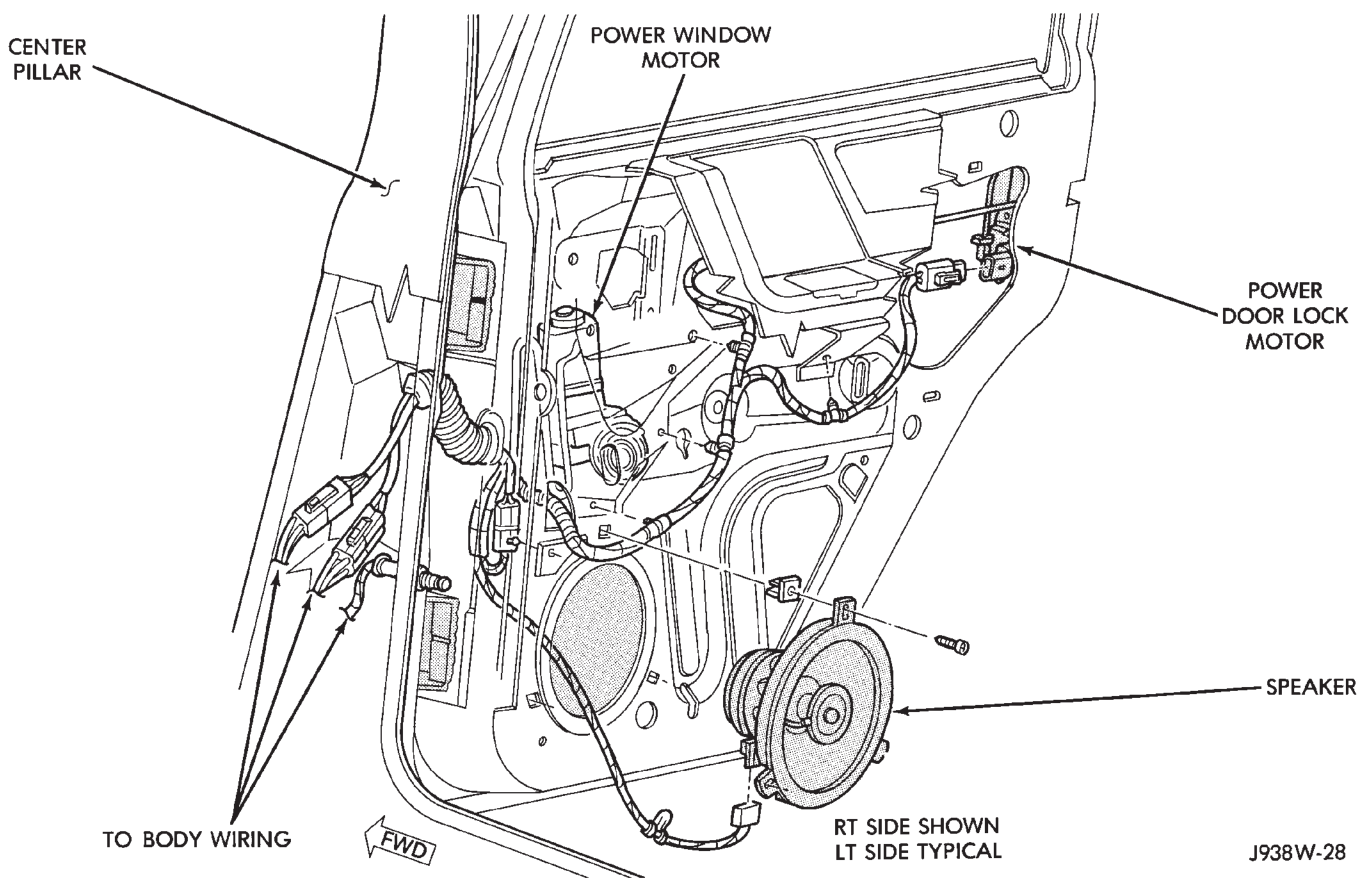

Fig. 8 Door Wiring (Rear)

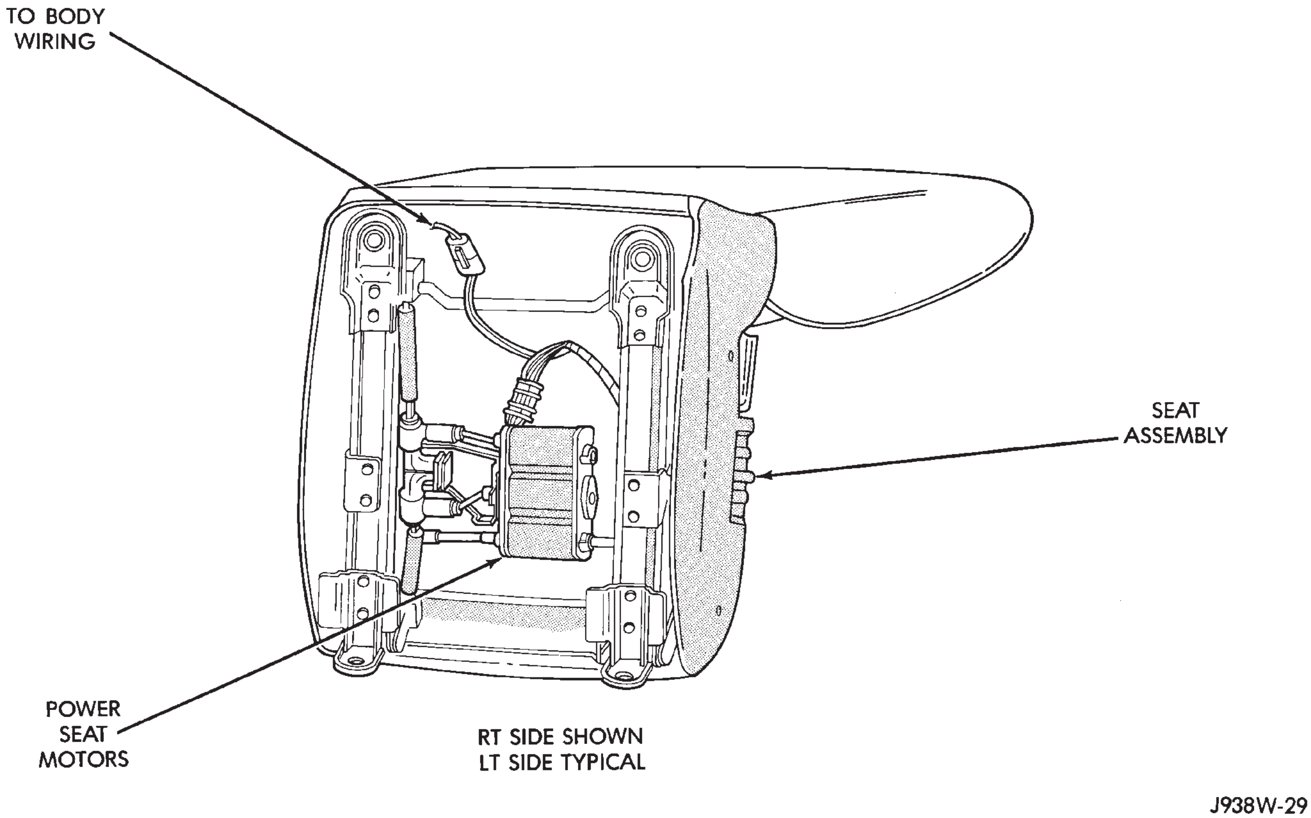

Fig. 9 Power Seat Wiring

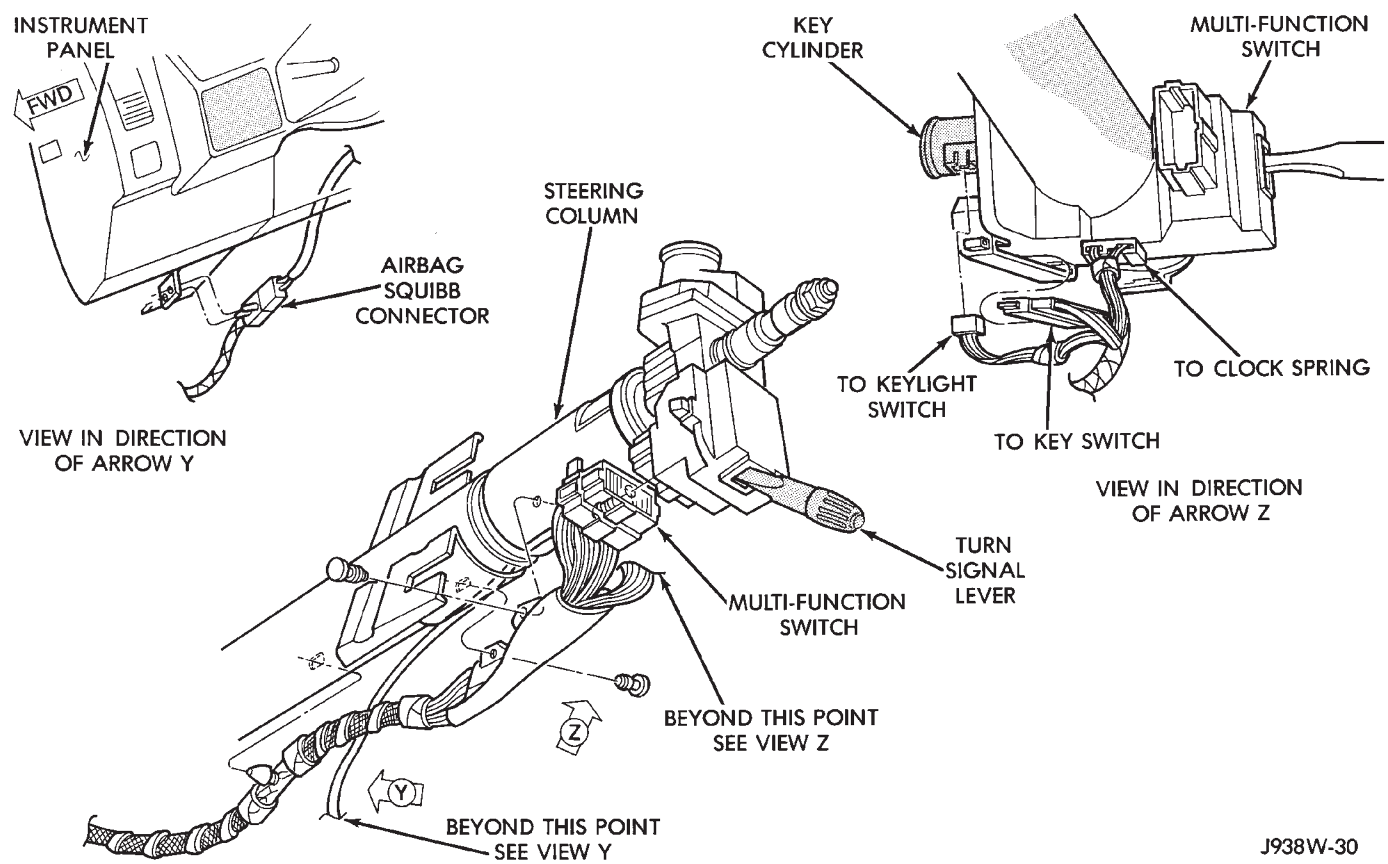

Fig. 10 Steering Column Wiring

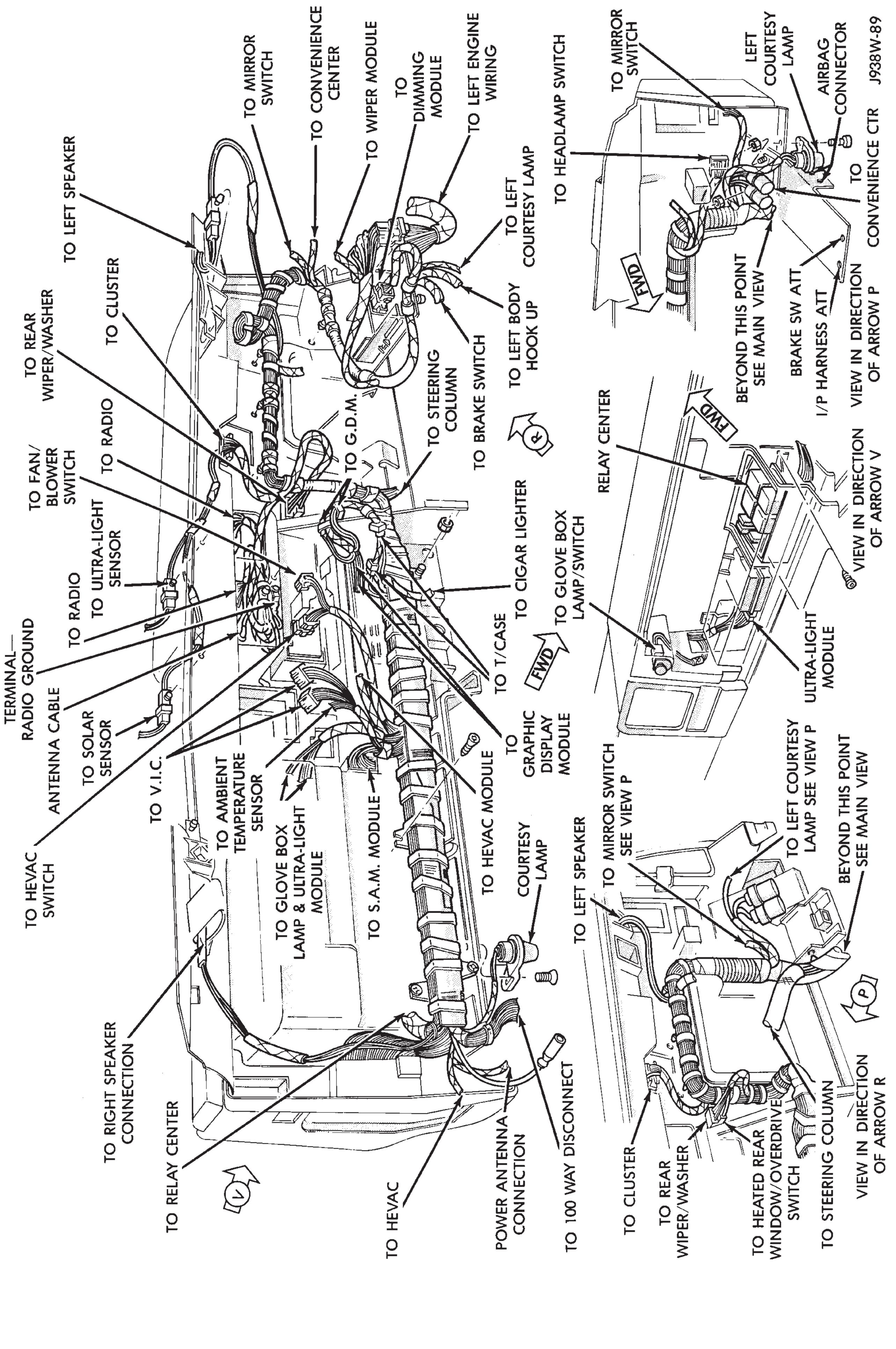

Fig. 11 Instrument Panel Wiring

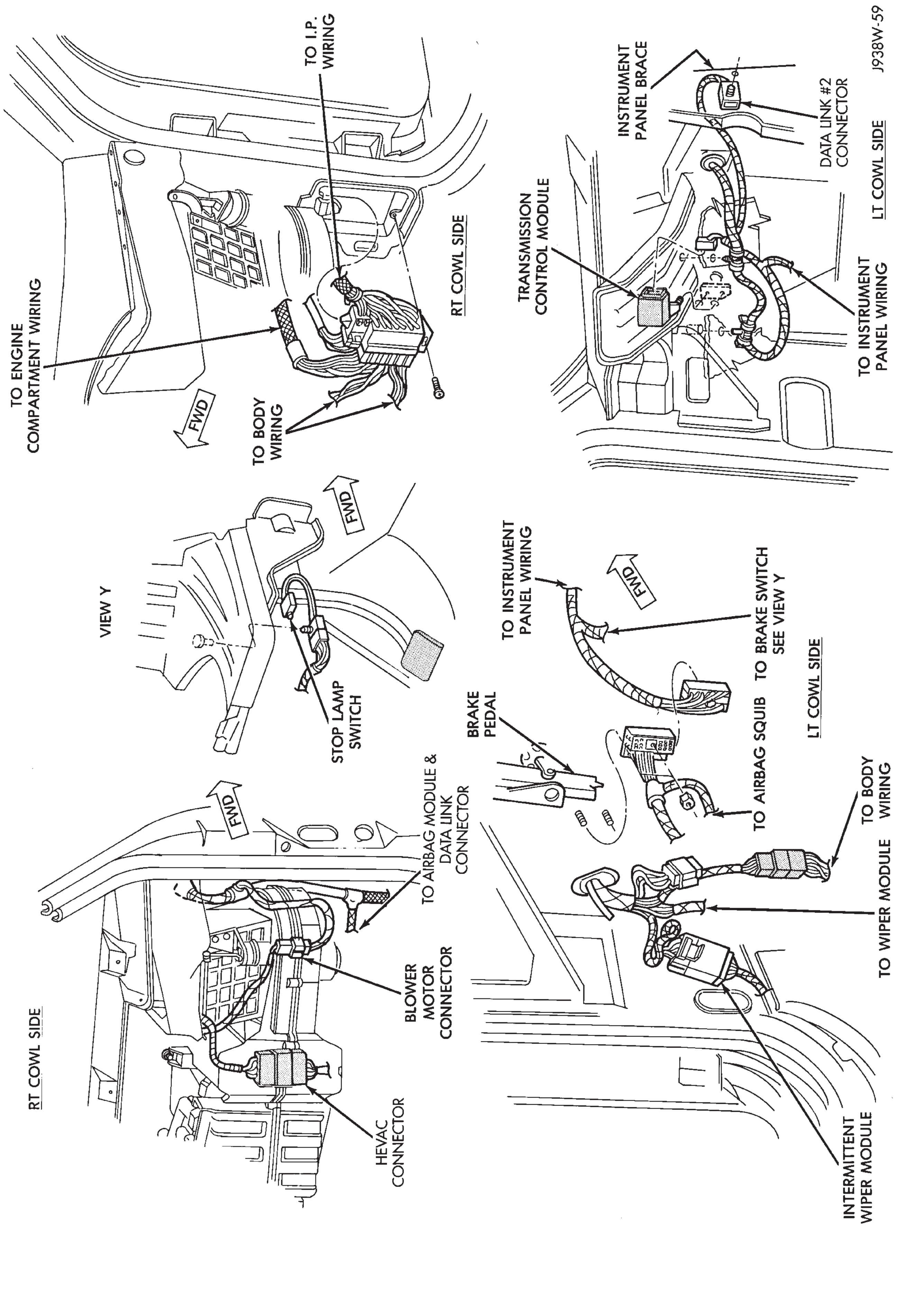

Fig. 12 Instrument Panel to Body Wiring

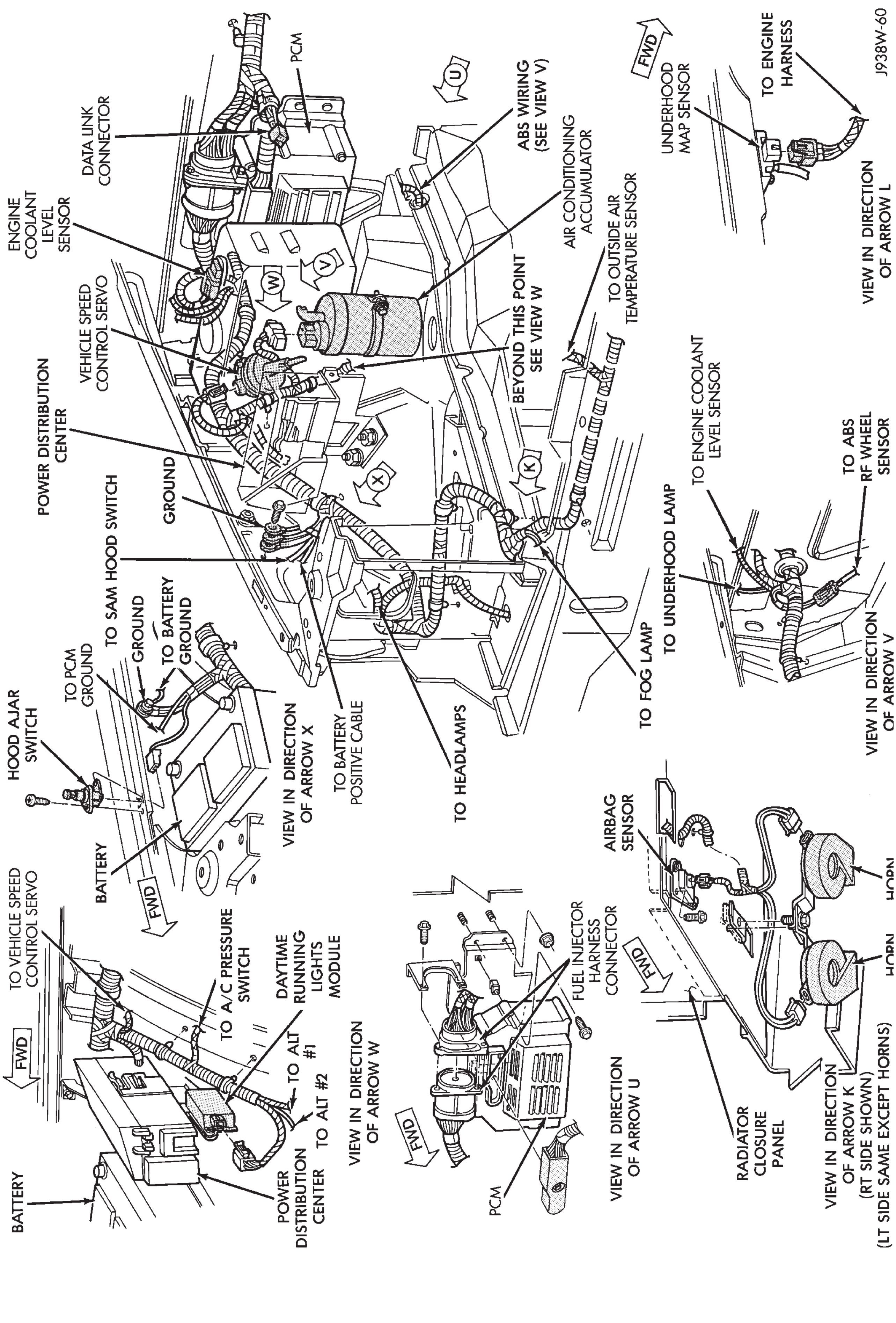

Fig. 13 Engine Compartment Wiring (Right Side)

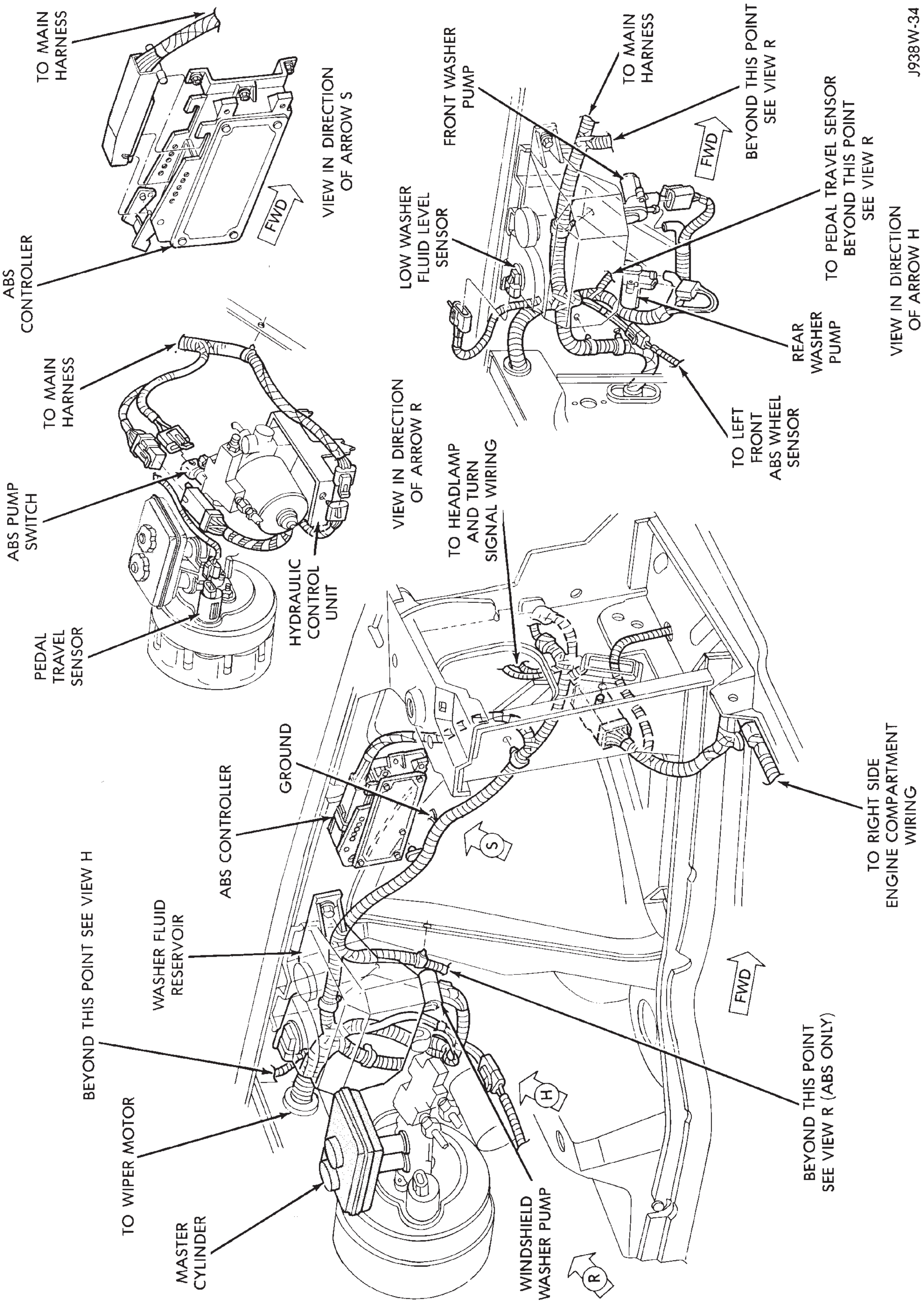

Fig. 14 Engine Compartment Wiring (Left Side)

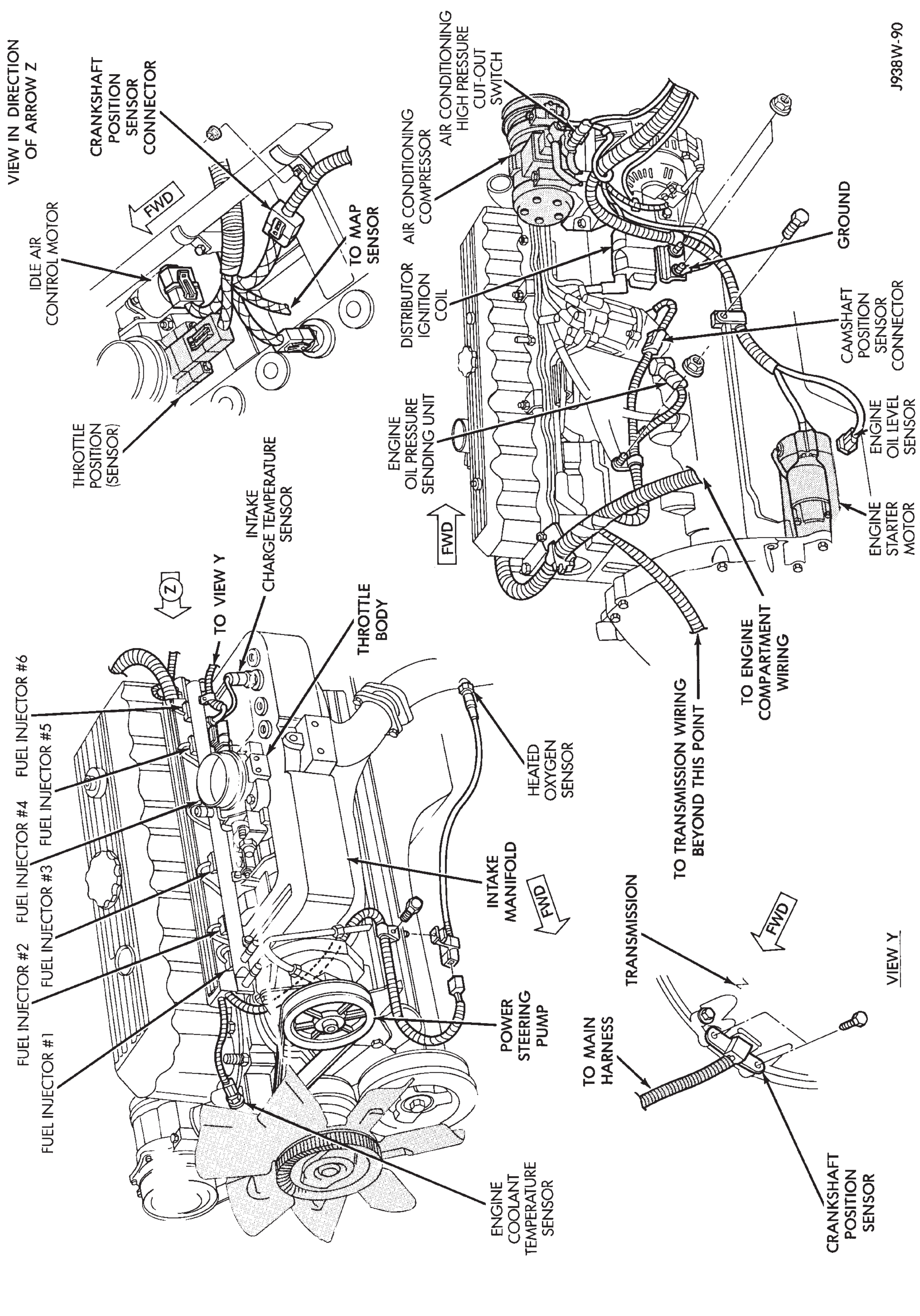

Fig. 15 Engine Wiring 4.0L

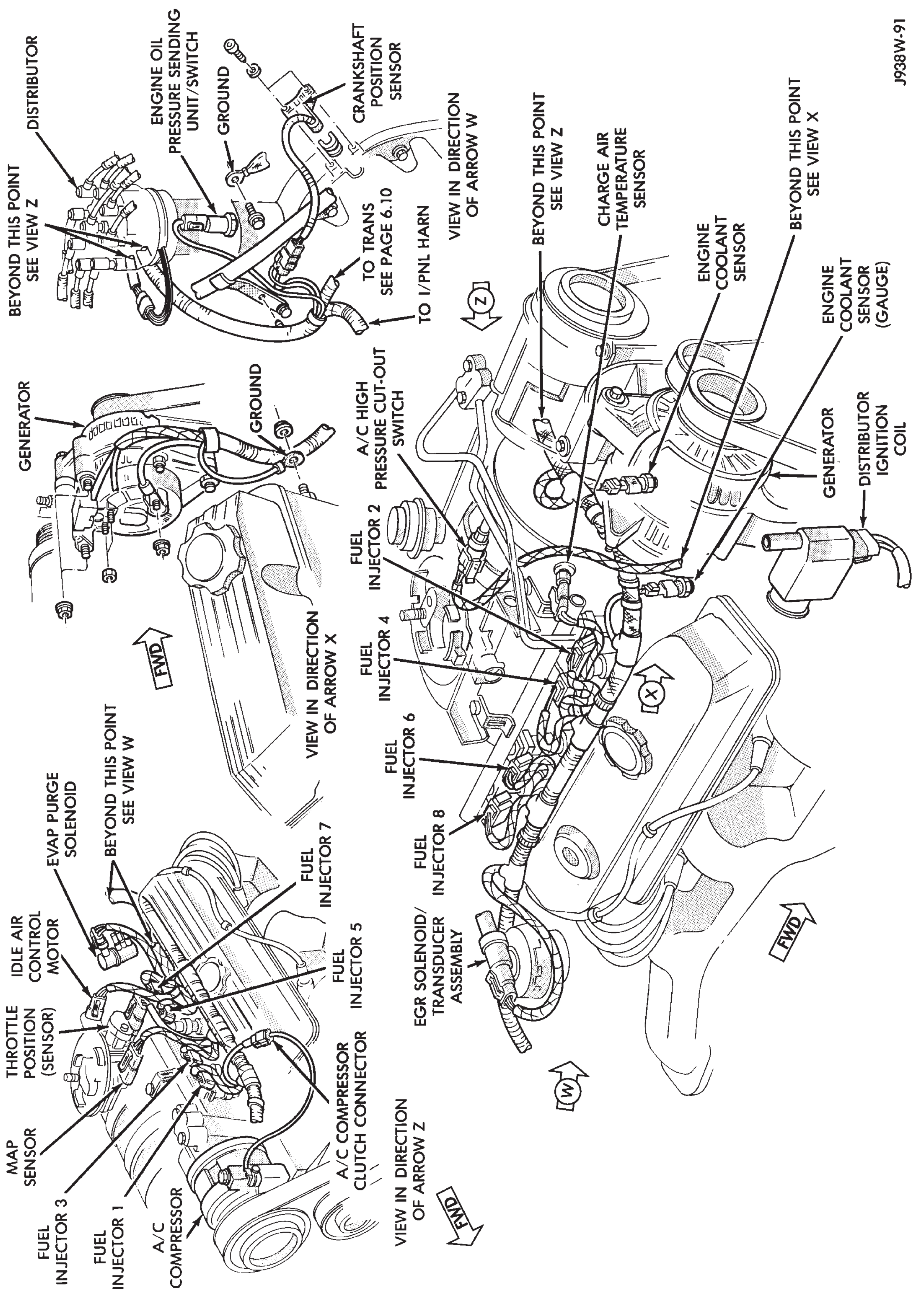

Fig. 16 Engine Wiring 5.2L

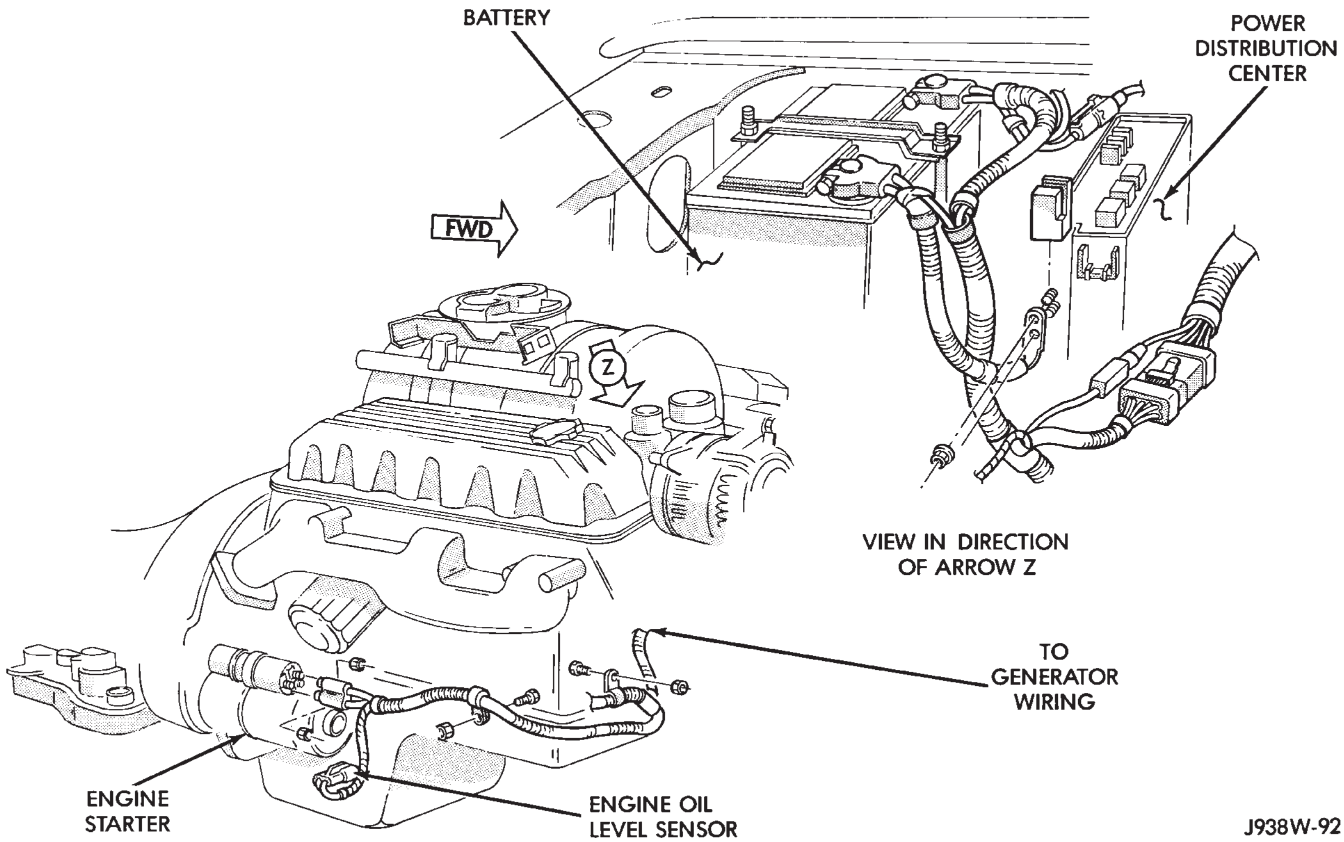

Fig. 17 Battery and Starter Wiring 5.2L

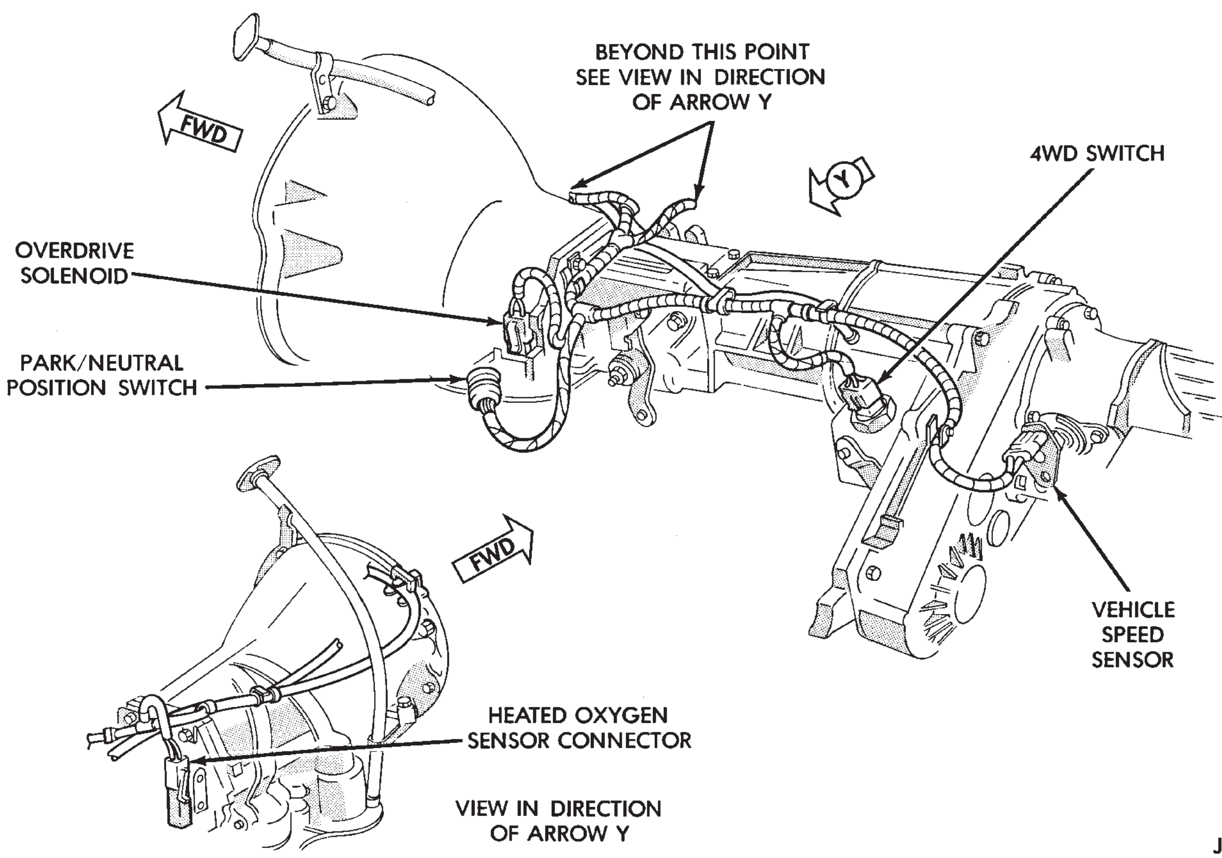

Fig. 18 Transmission Wiring 5.2L

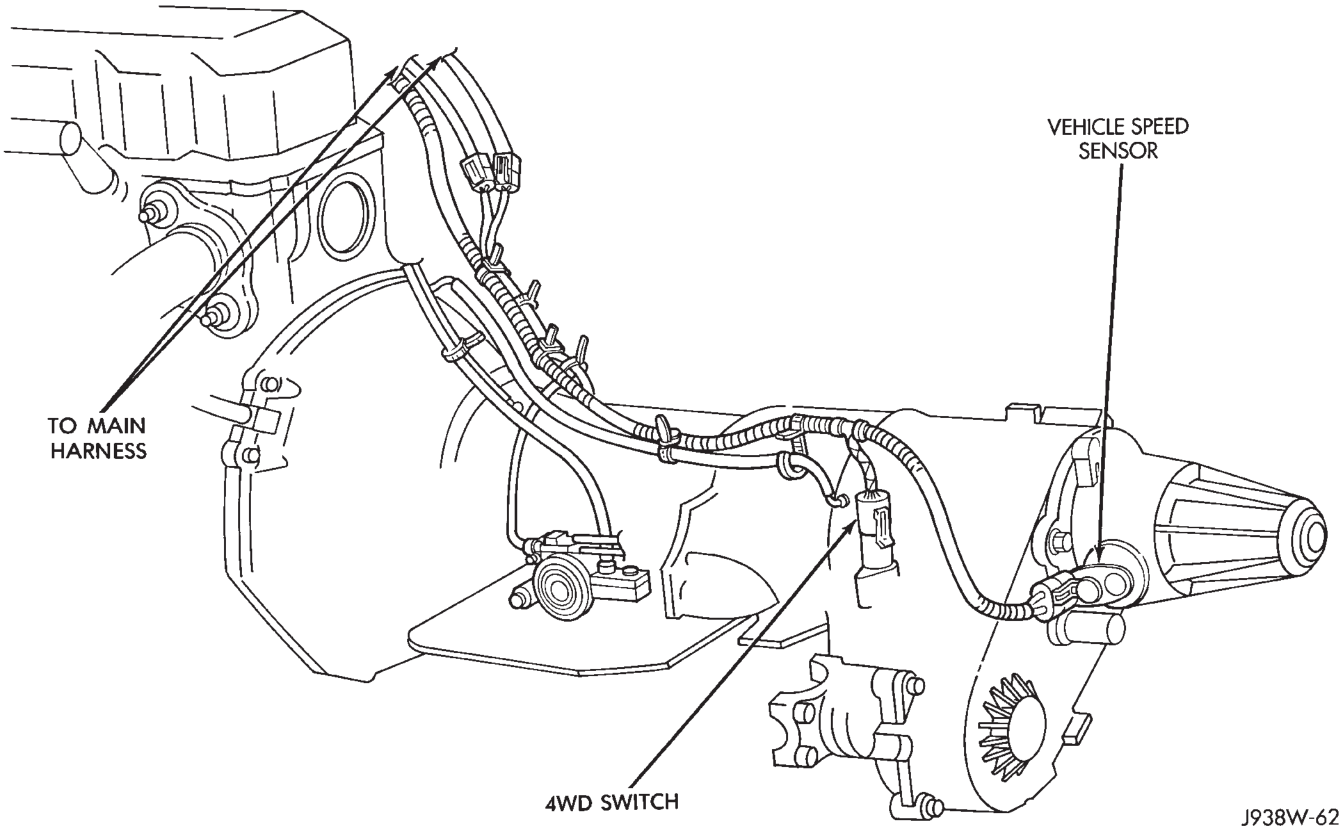

Fig. 19 Transmission Wiring 4.0L

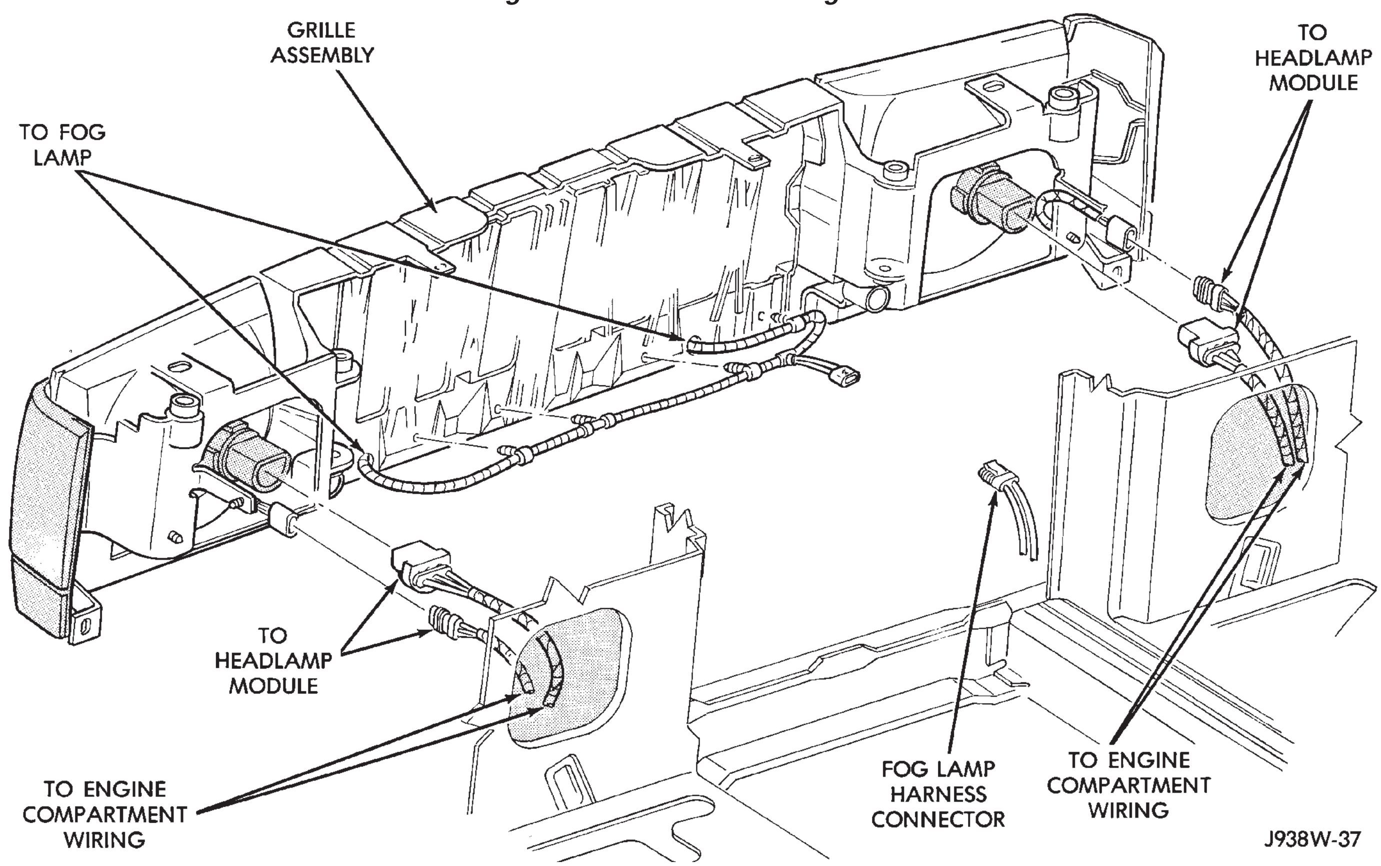

Fig. 20 Front End Wiring

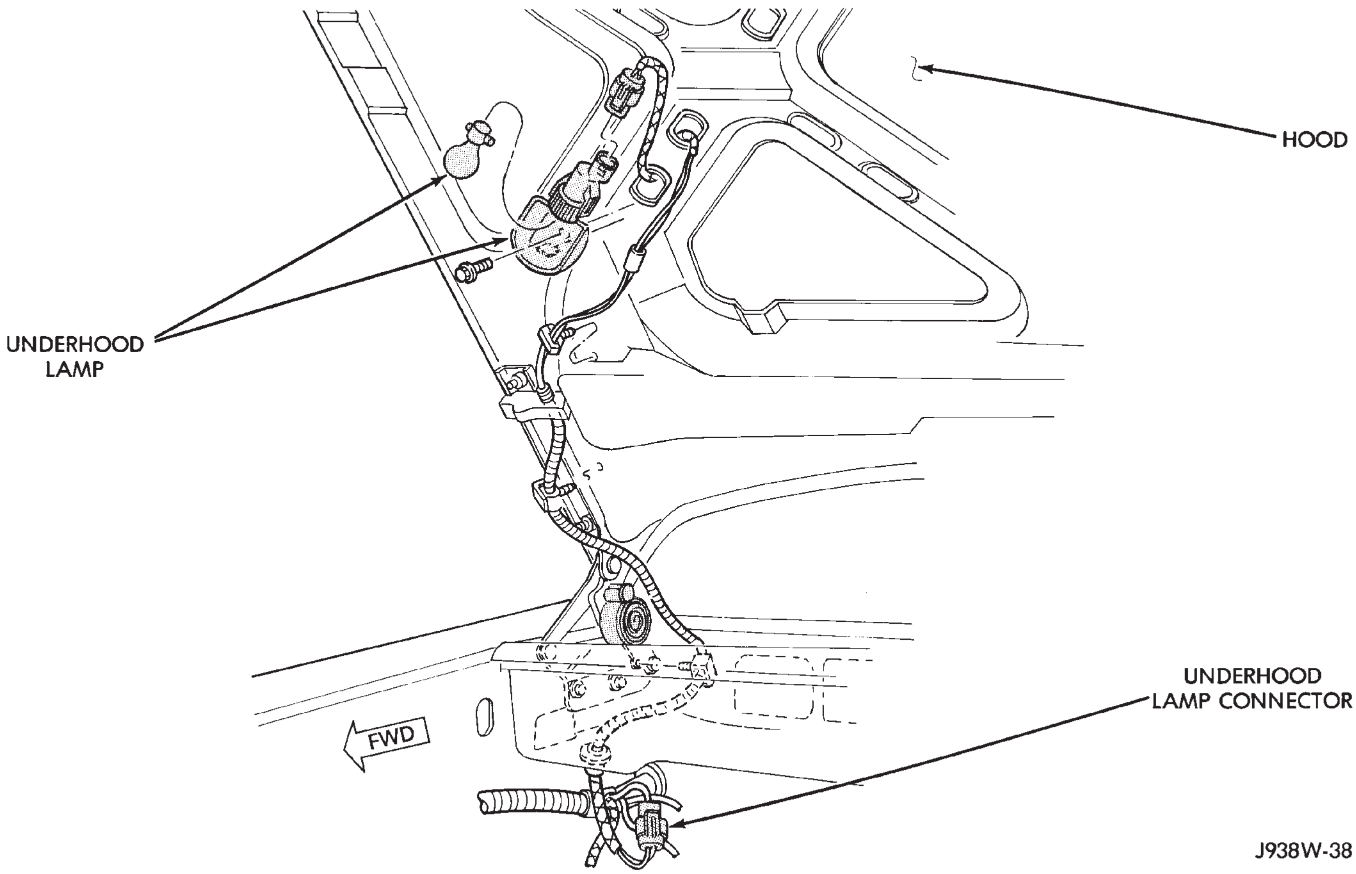

Fig. 21 Underhood Lamp Wiring

SPLICE LOCATIONS

Splice Number	Figure
107	7
235	8
A5	8
A6	7
A6-1	8
A11	8
A18	1
A21	8
A21-1	7
A61 4.0L	9
A61 5.2L	8
A61-1 4.0L	9
A61-1 5.2L	10
C7	6
C15	7
C34	7
C40	6
C42	6
D1	8
D2	8
D41	7
D41-1	6
E2	7
F35	3
F60	7
F60-1	4
F81	4
F83	7
F83-1	4
F86	8
F87	7
G7 4.0L	9
G7 5.2L	10
G7-1 4.0L	9
G7-1 5.2L	10
G7-2	8
G28	7
K4 4.0L	9
K4 5.2L	10
K6 4.0L	9
K6 5.2L	10
K22	8
K25 4.0L	9
K25 5.2L	10
L3	11

Splice Number	Figure
L4	11
L10	2
L22-1	2
L22-2	3
L39	11
L64	11
L64-1	11
L64-2	7
L90	11
L90-1	11
L90-2	7
M1	7
M1-1	4
M2	7
M2-1	4
M2-2	3
Q1	3
Q1-1	2
T41	8
X2	8
X53	7
X55	7
Z1	11
Z1-1	11
Z1-2	11
Z1-3	8
Z1-4	3
Z1-6	2
Z1-7	2
Z1-8	2
Z1-9	7
Z1-10	7
Z1-11	5
Z1-12	8
Z1-13	7
Z1-14	3
Z1-15 4.0L	9
Z1-15 5.2L	10
Z1-17	4
Z1-18	1
Z1-19	3
Z1-20	6
Z2	7
Z4	6
Z12	8

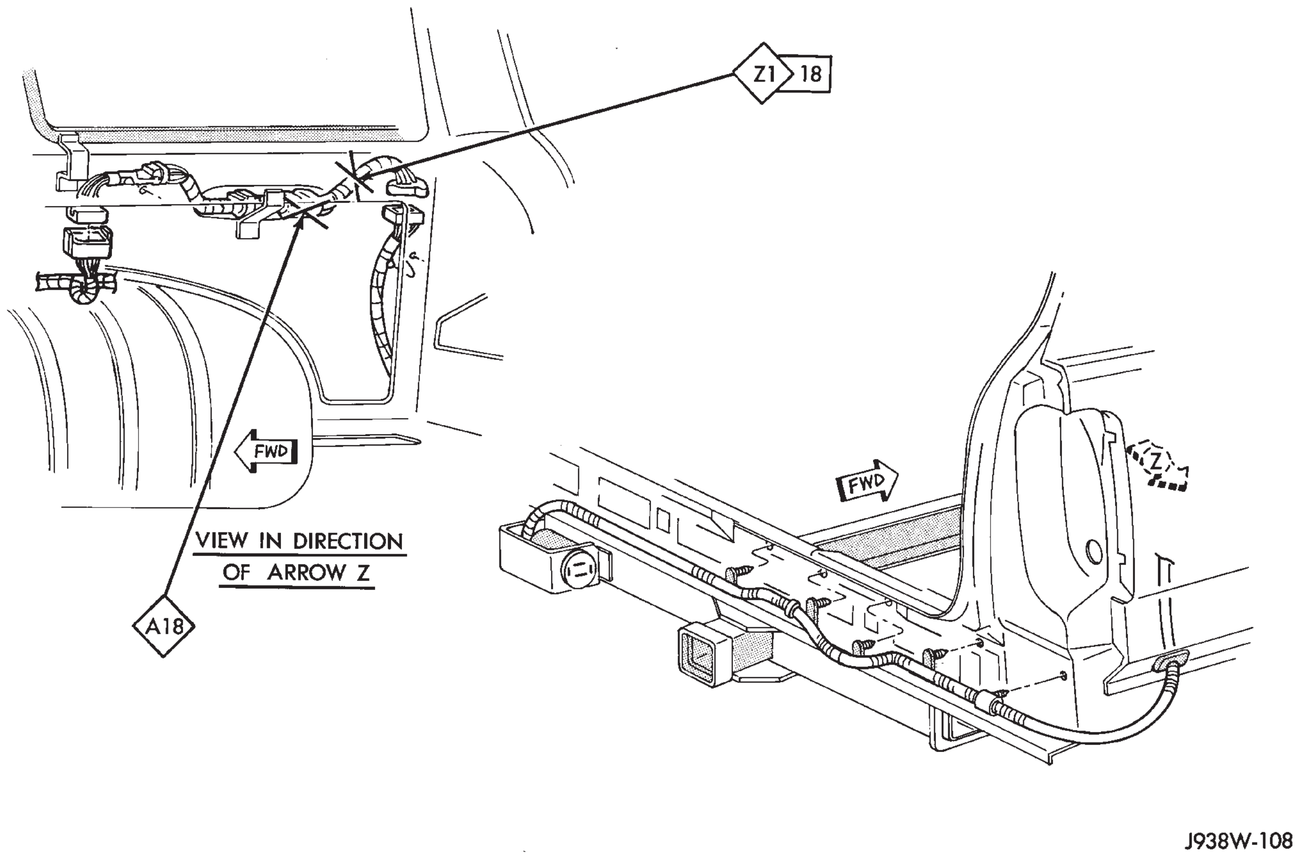

Fig. 1 Trailer Tow Splices

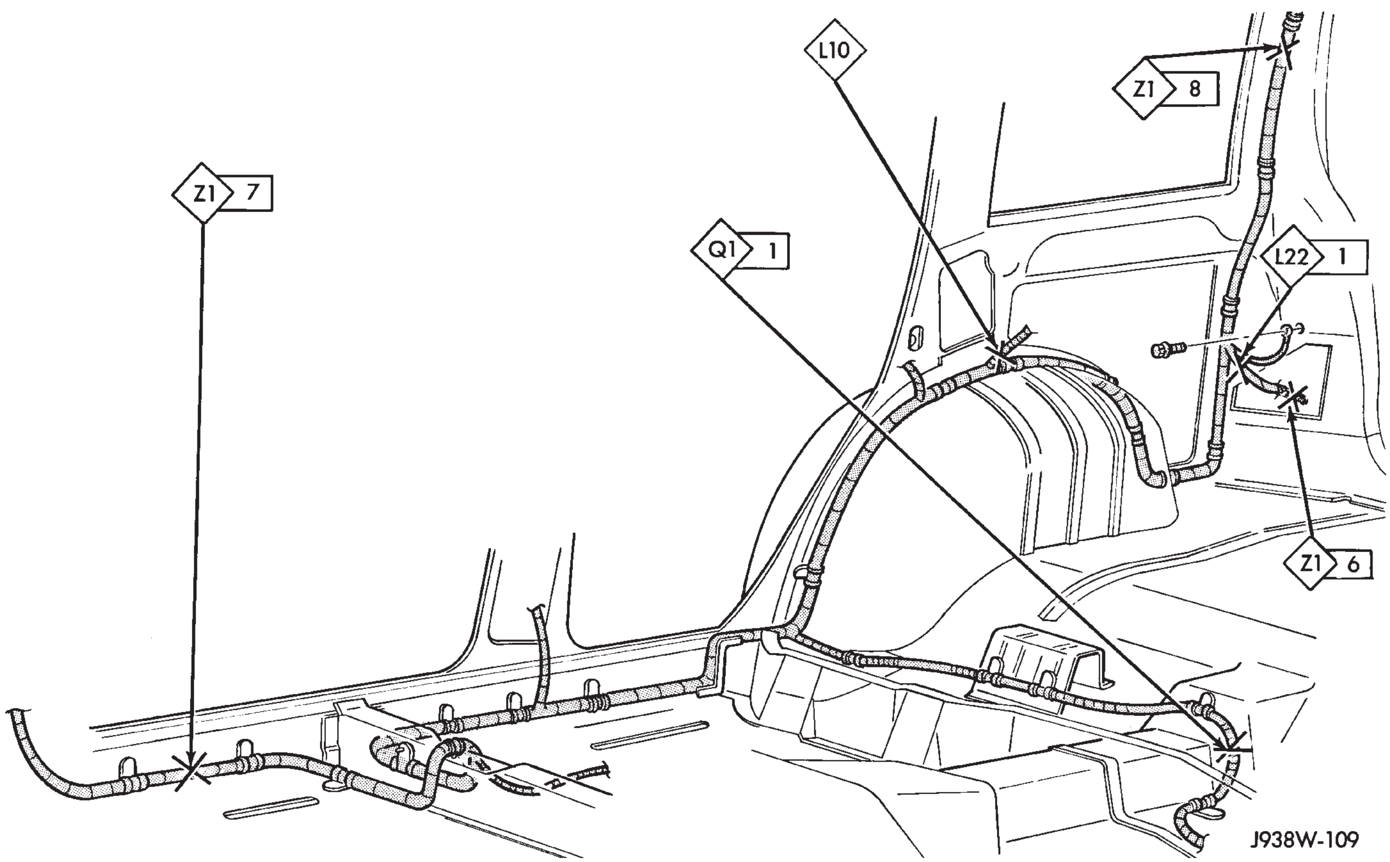

Fig. 2 Body Splices (Right Side)

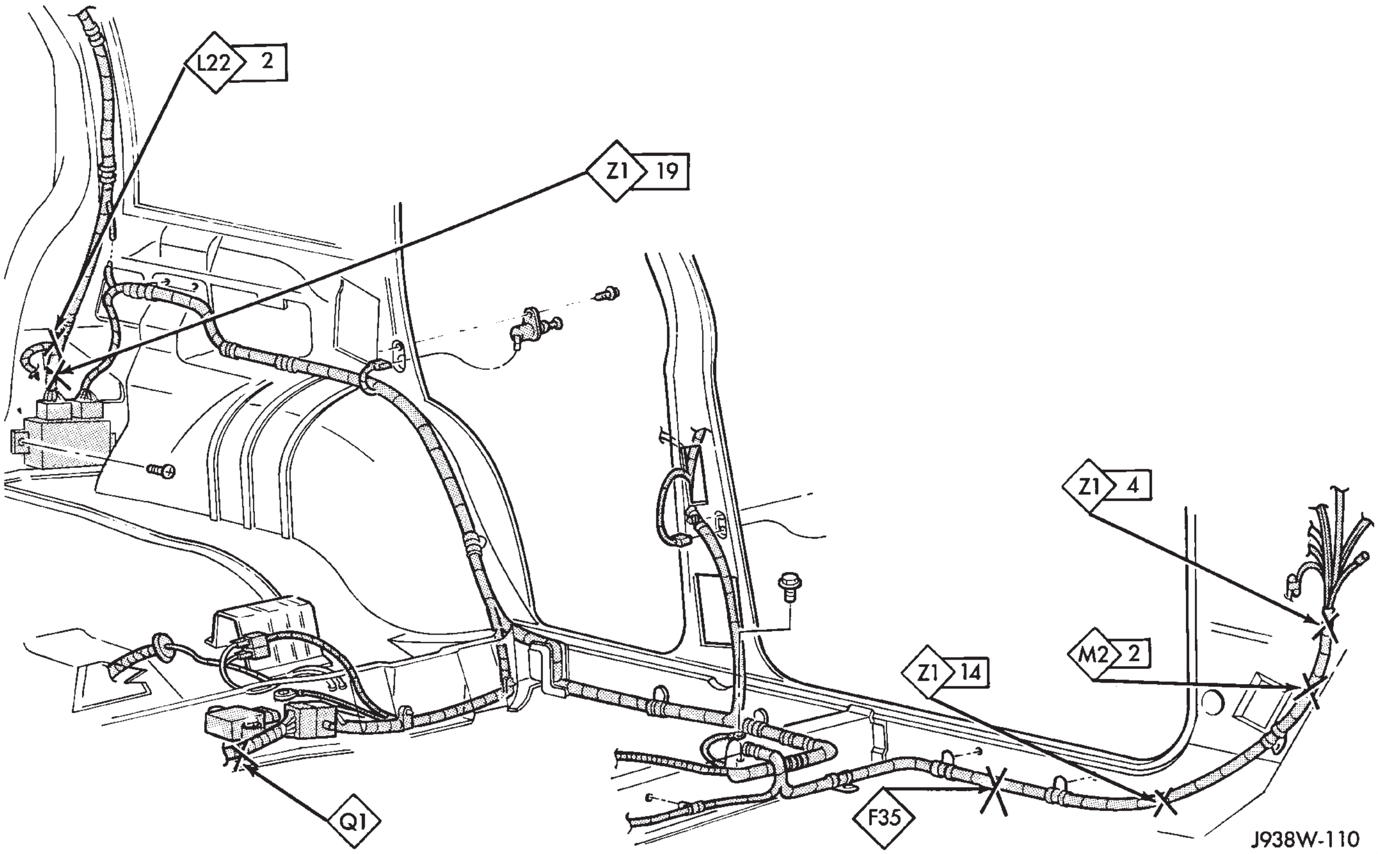

Fig. 3 Body Splices (Left Side)

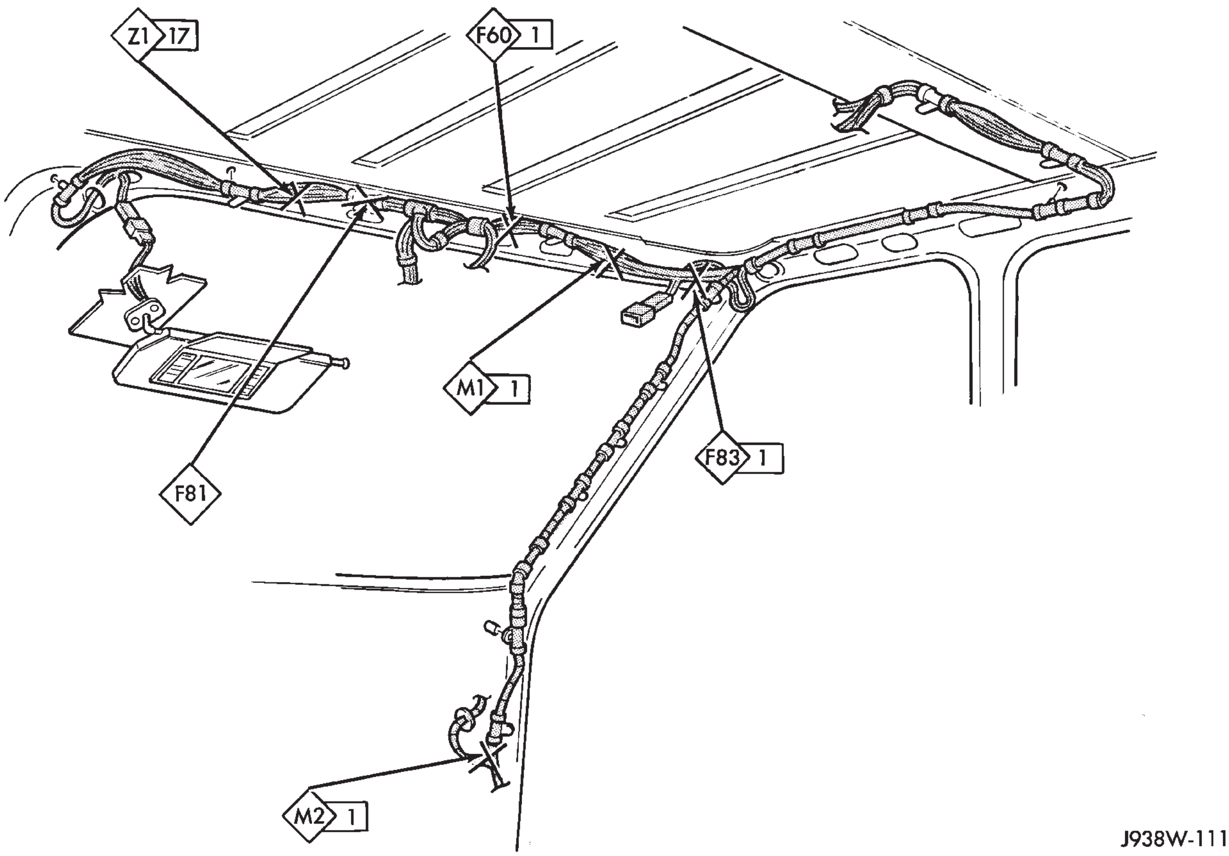

Fig. 4 Roof Splices

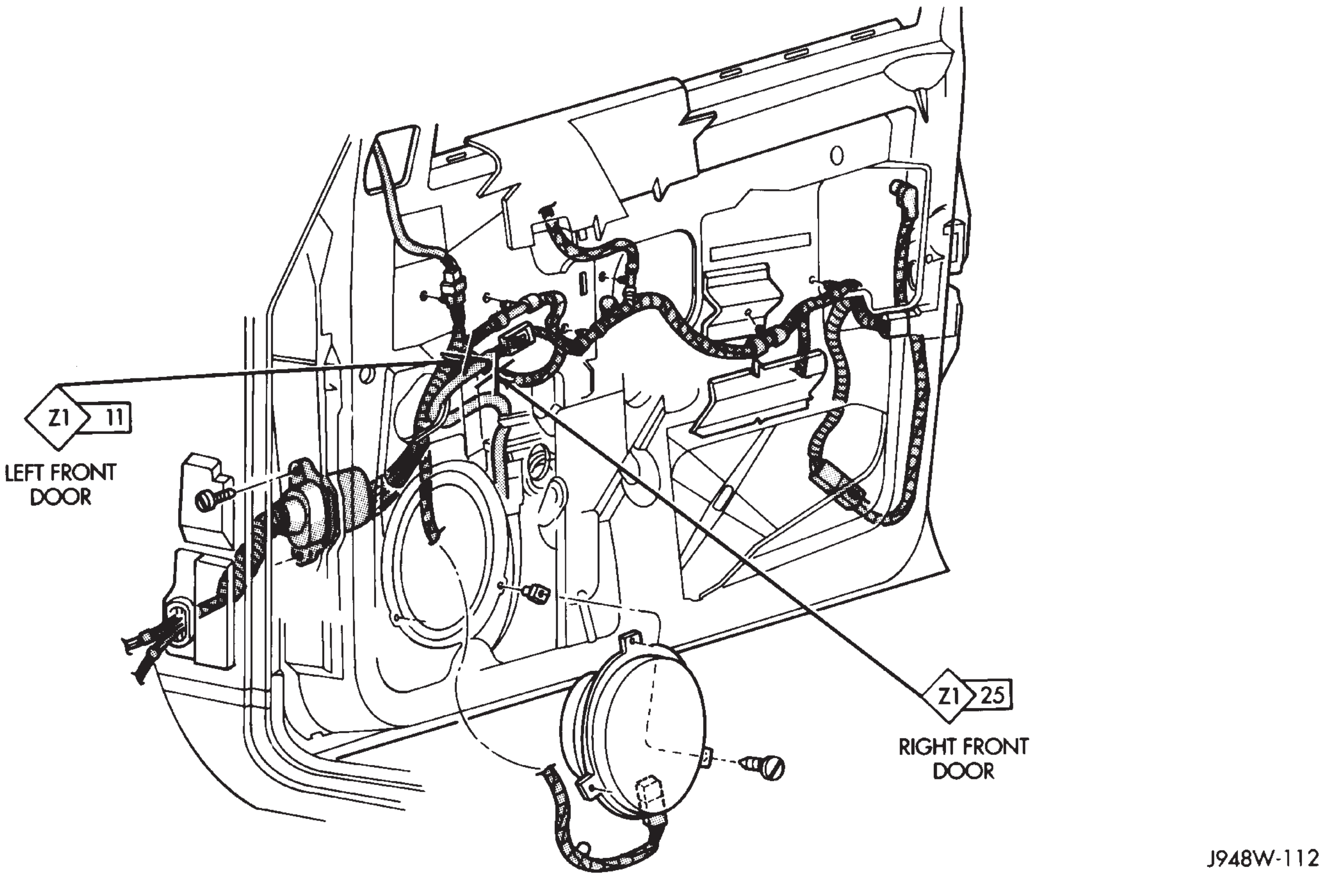

Fig. 5 Door Splices

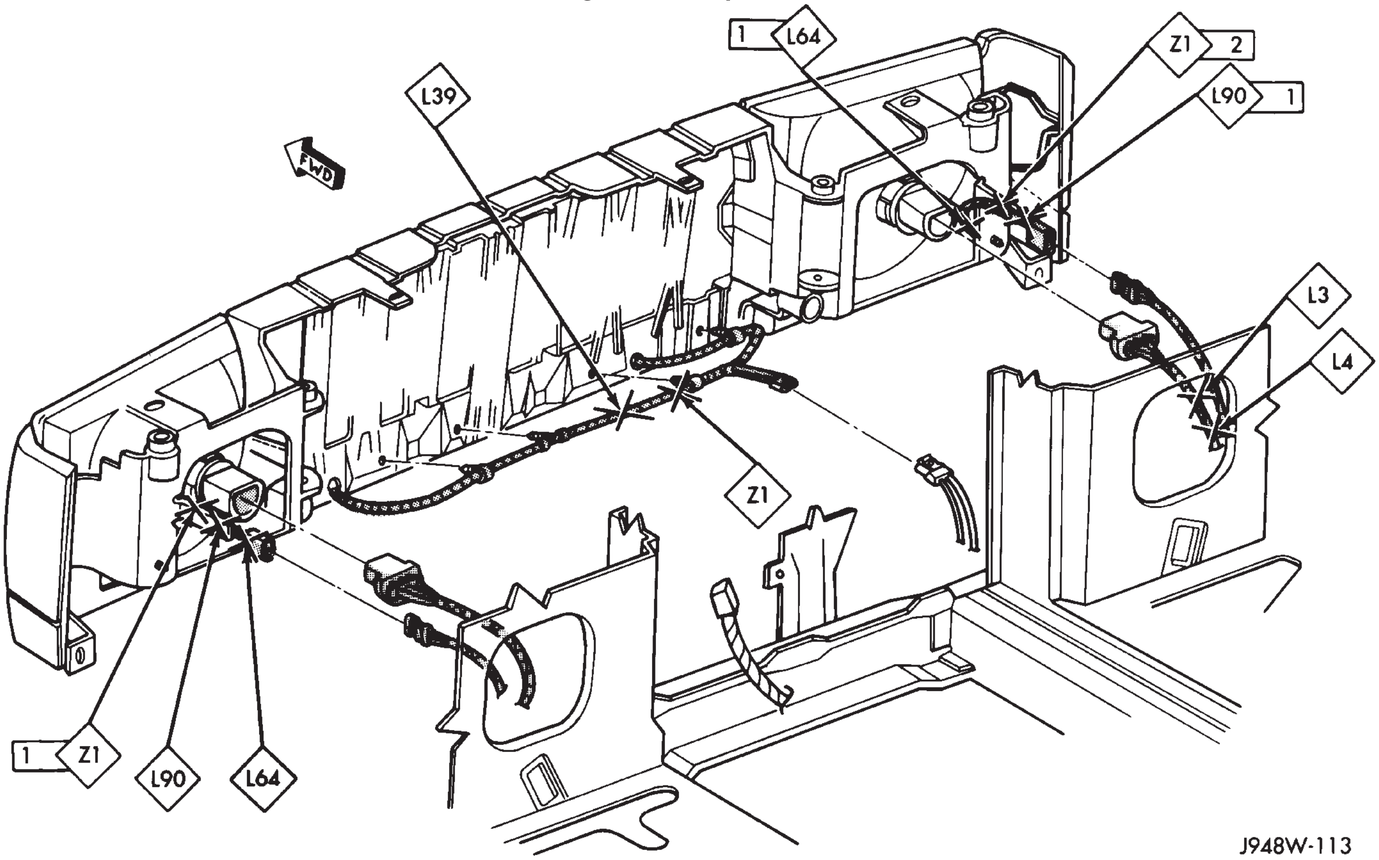

Fig. 6 HEVAC Splices

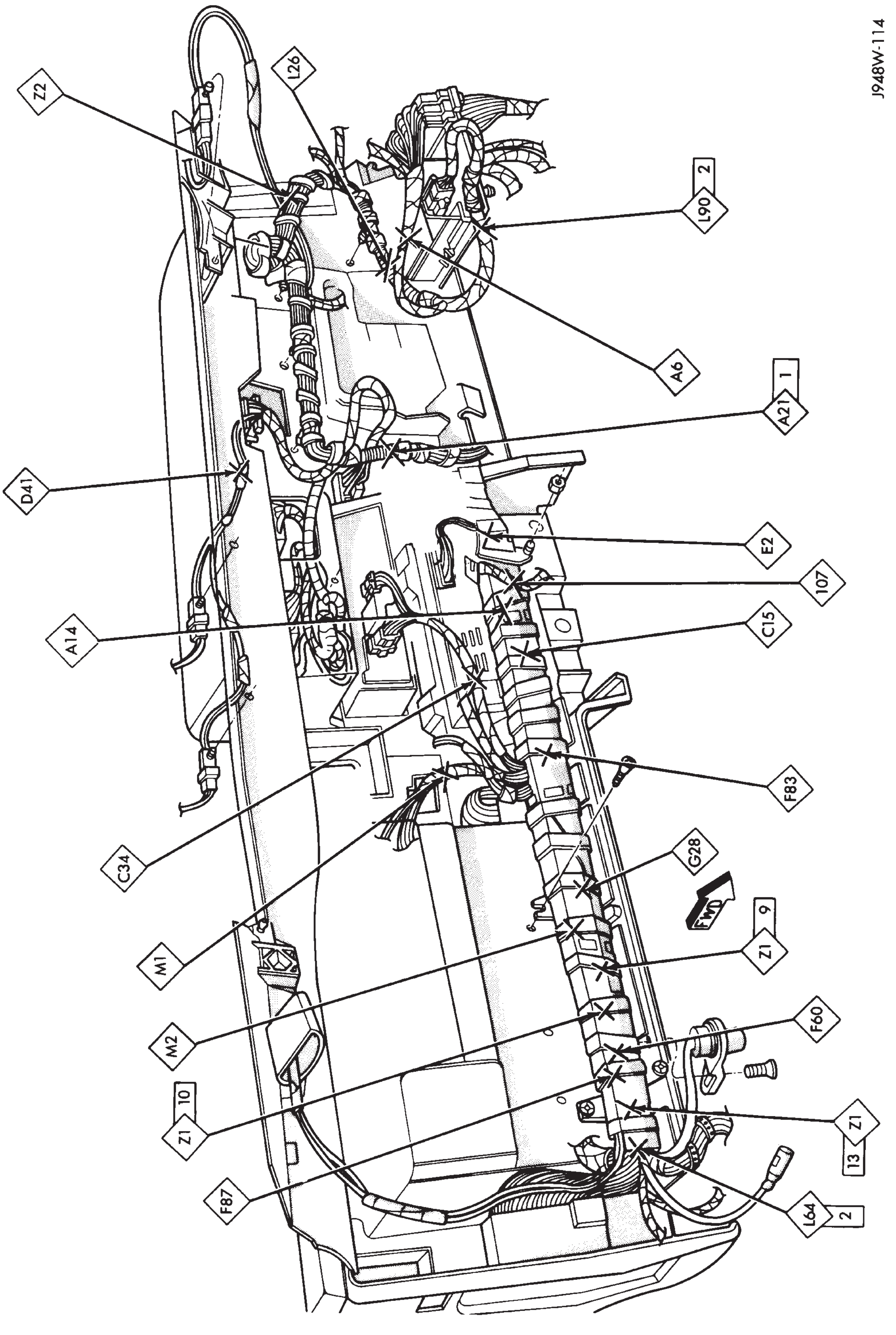

Fig. 7 Instrument Panel Splices

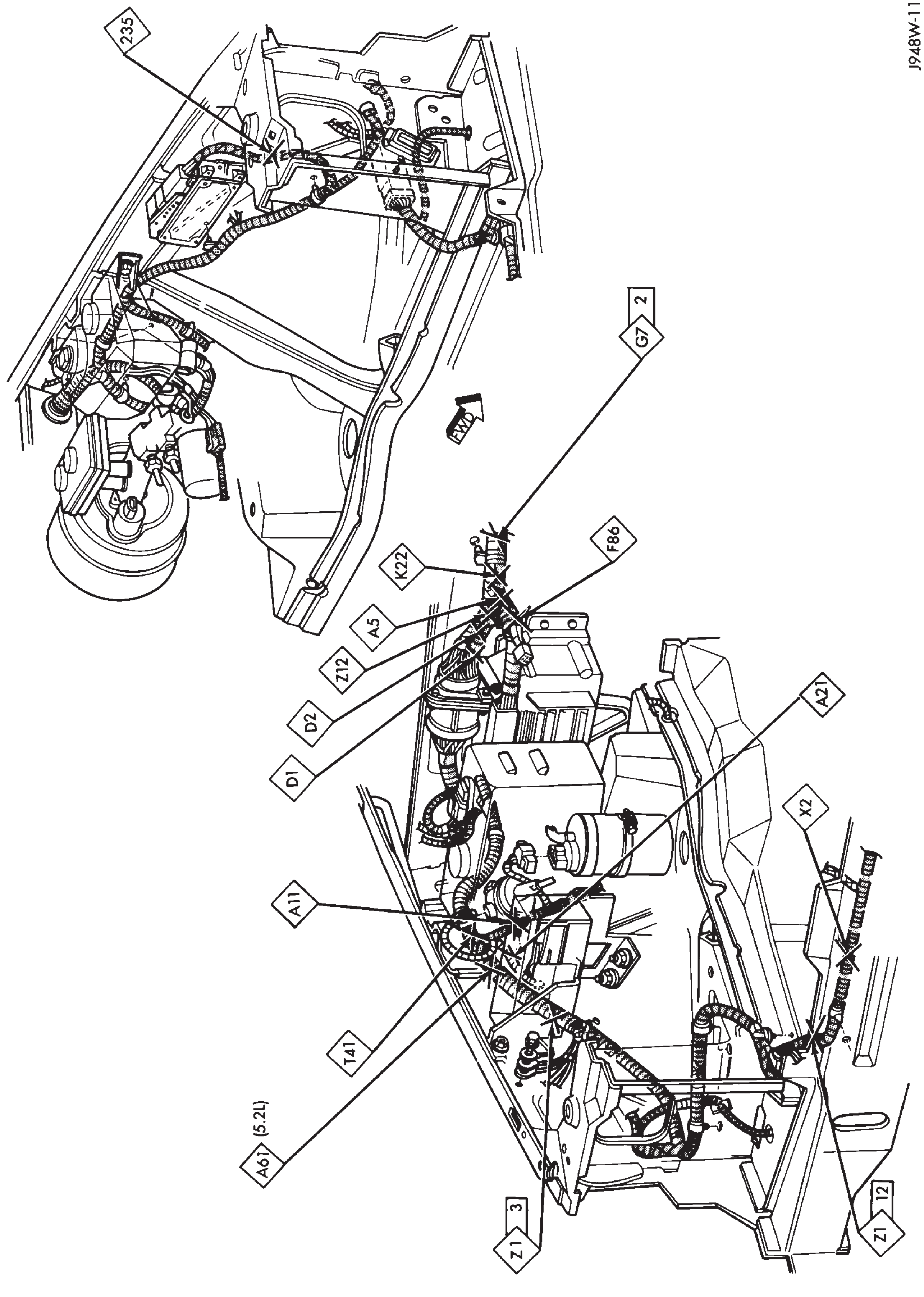

Fig. 8 Engine Compartment Splices

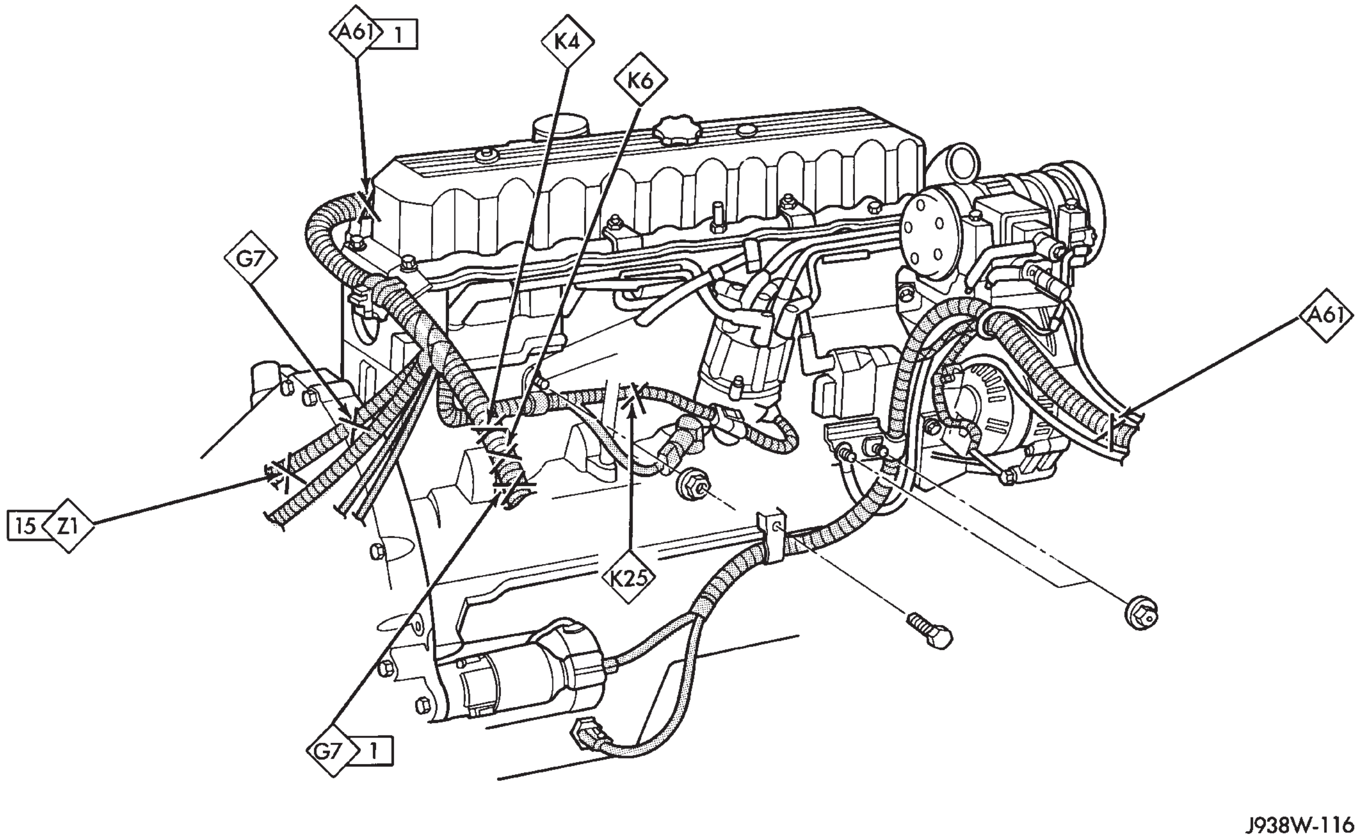

Fig. 9 Engine Splices 4.0L

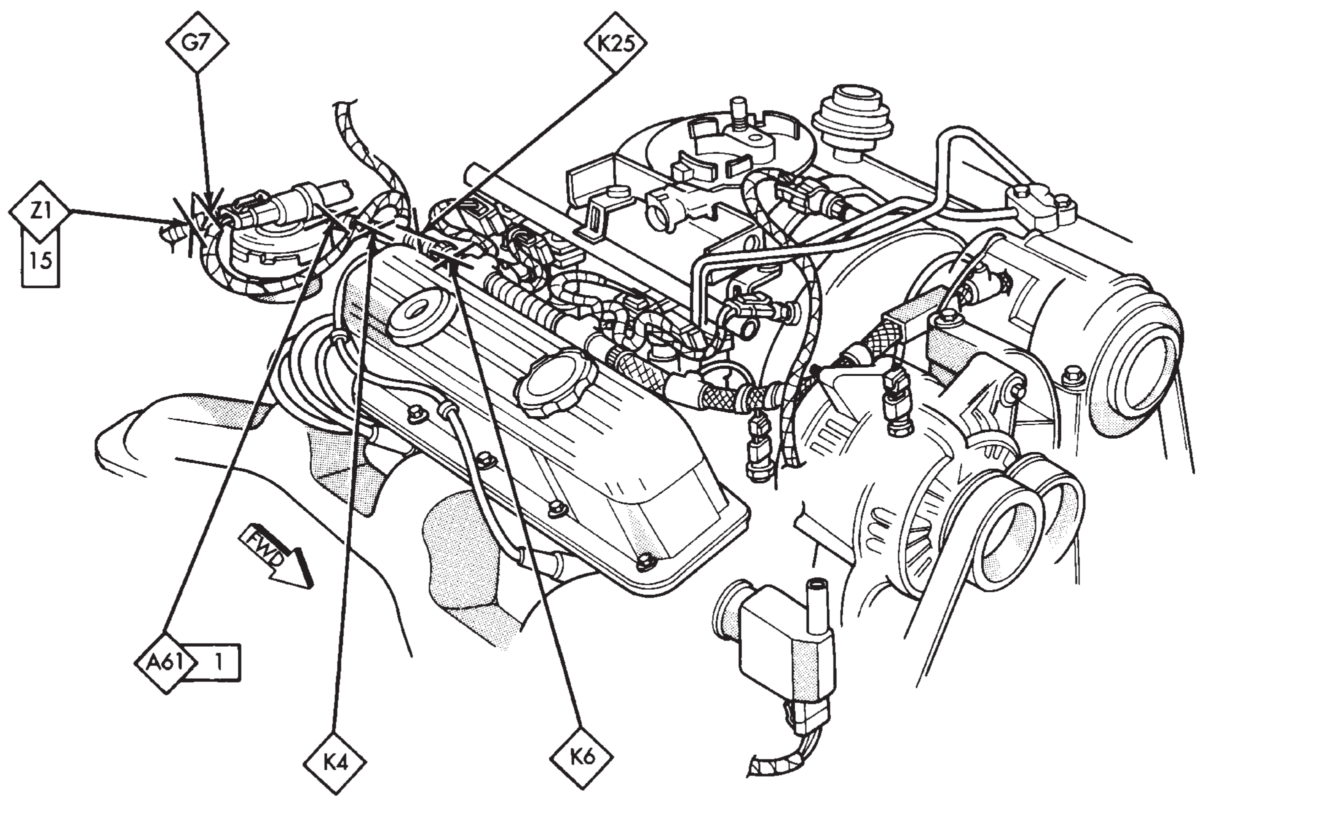

Fig. 10 Engine Splices 5.2L

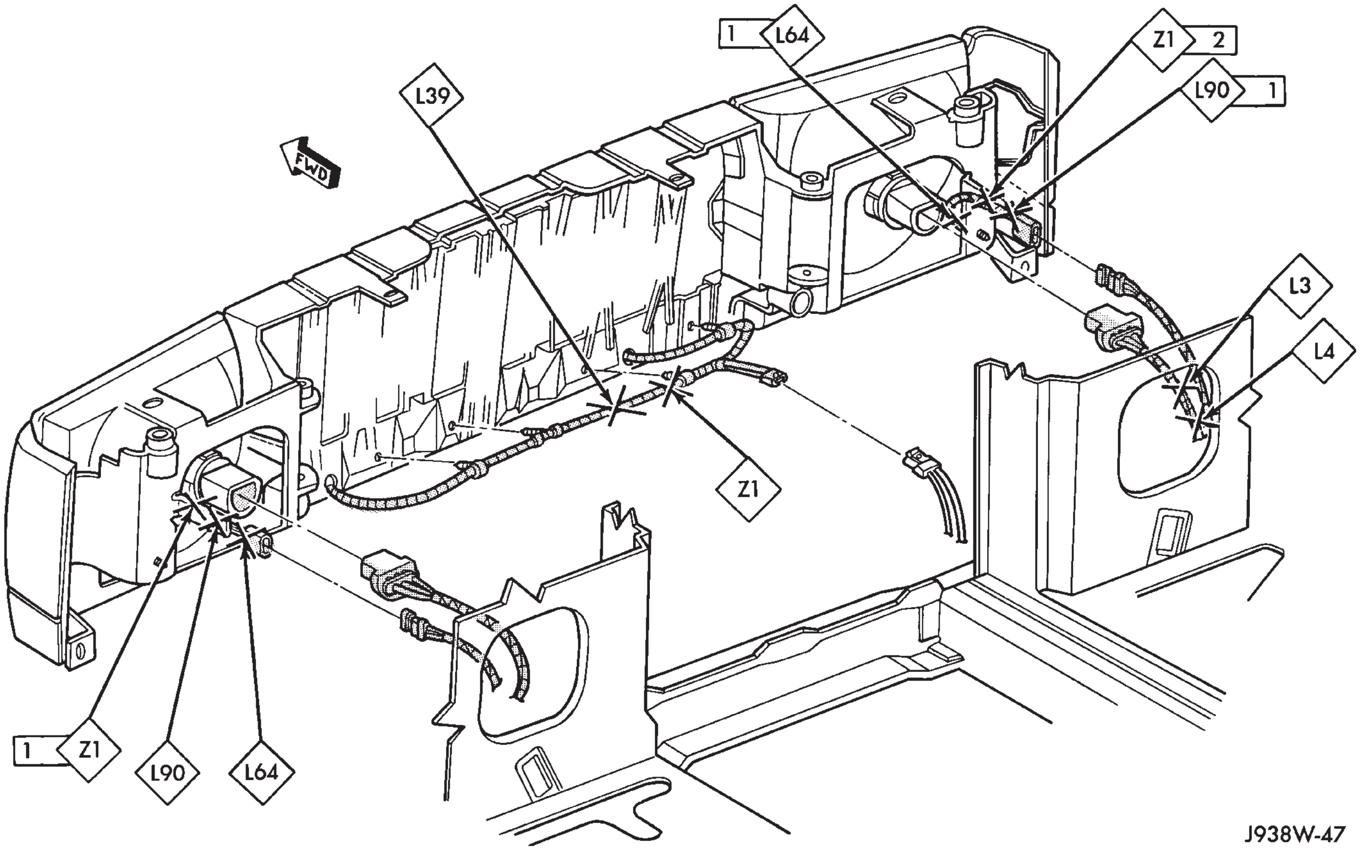

Fig. 11 Front End Splices

WIRING DIAGRAMS

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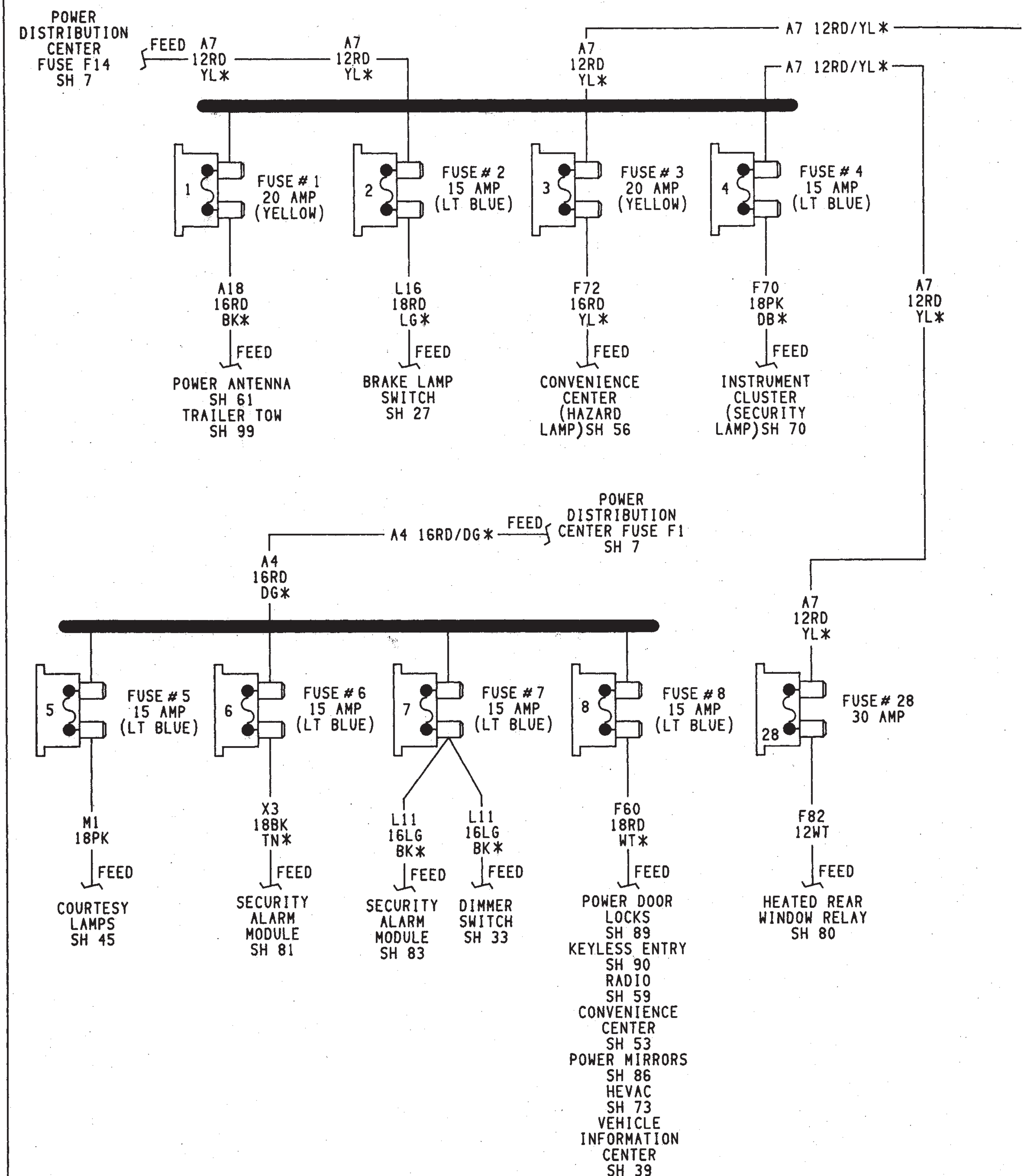
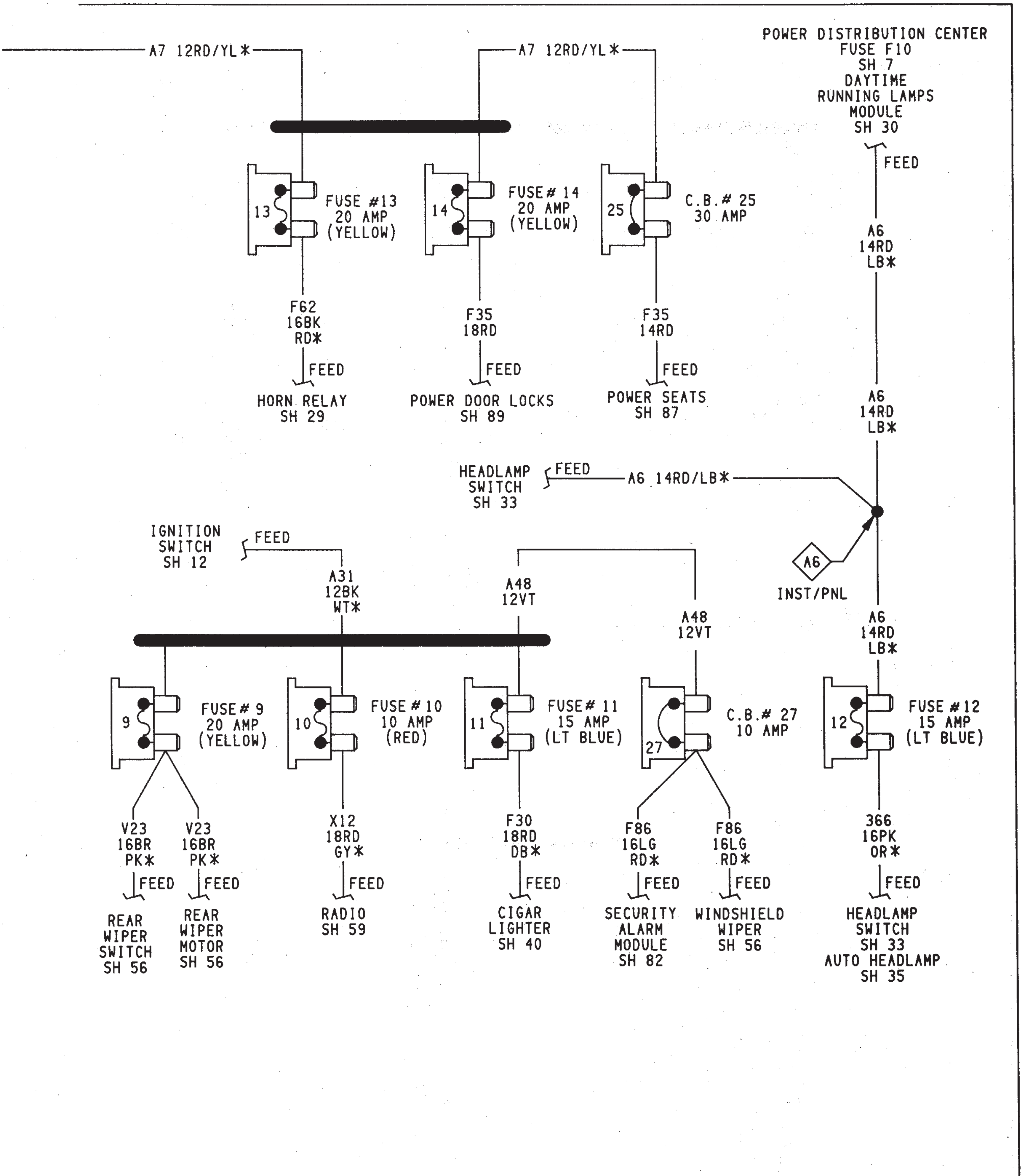
NOTES



ZJ 1

FUSE APPLICATION CHART

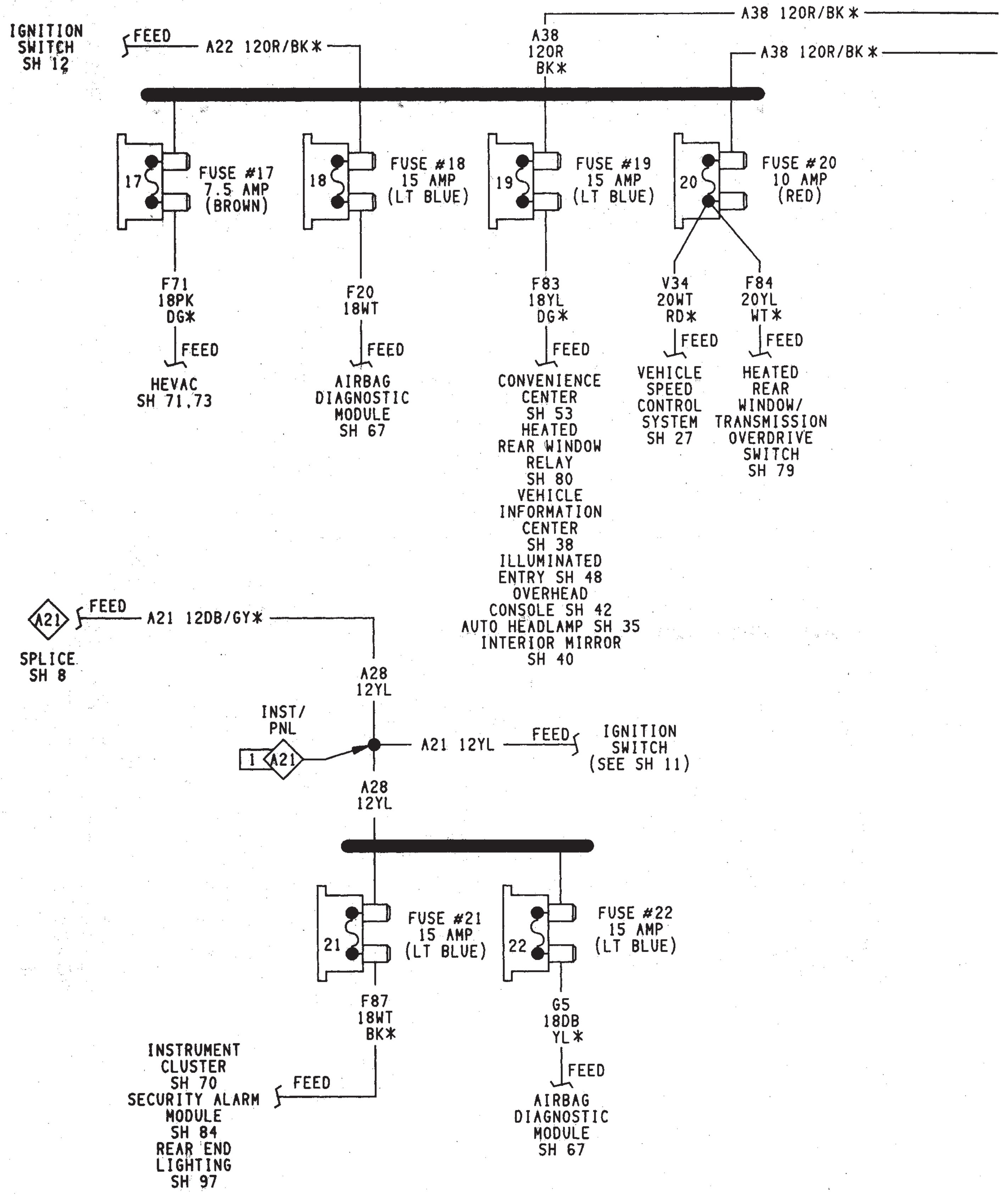
J938W-1



J938W-1

FUSE APPLICATION CHART

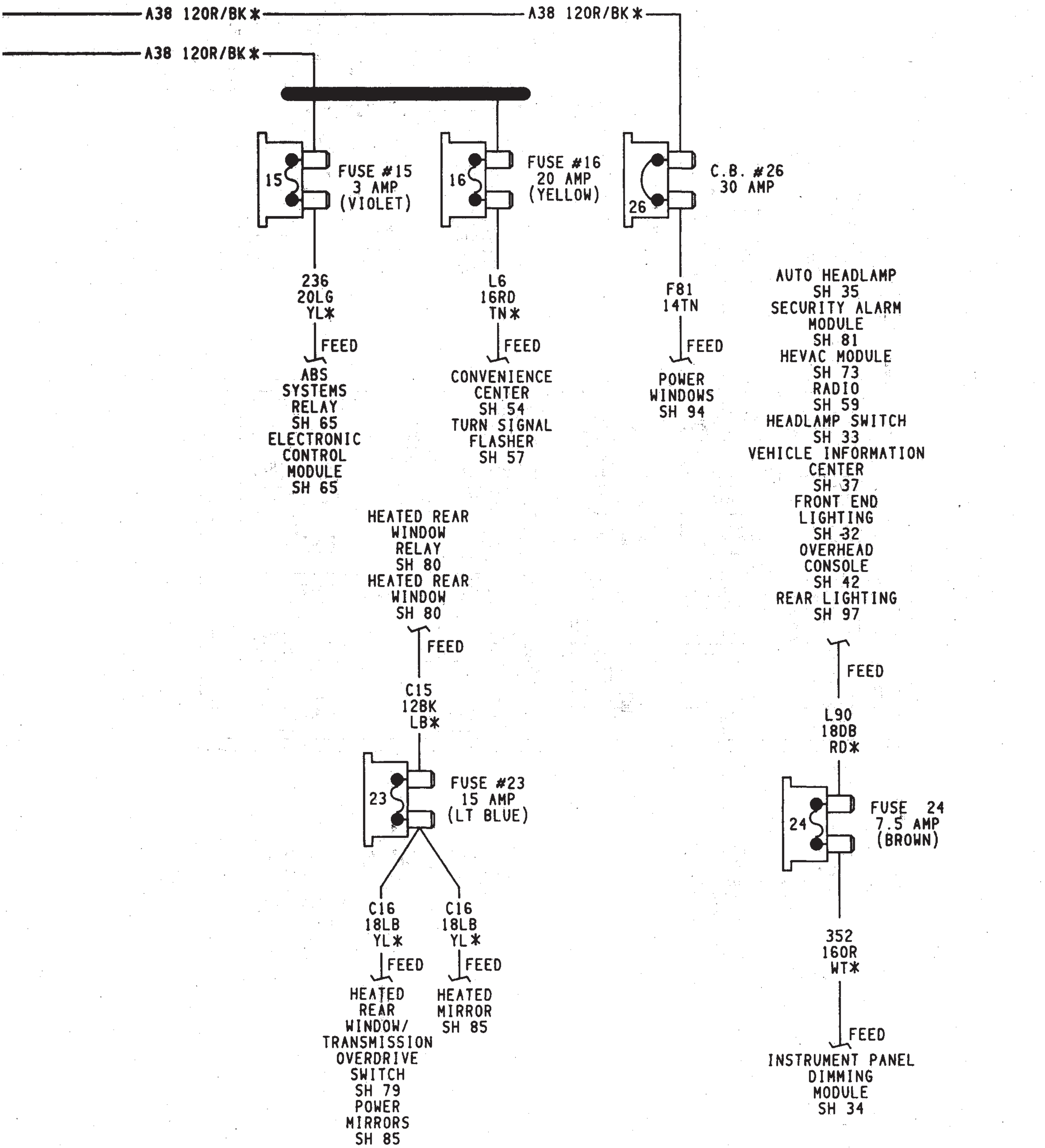
ZJ 2



ZJ 3

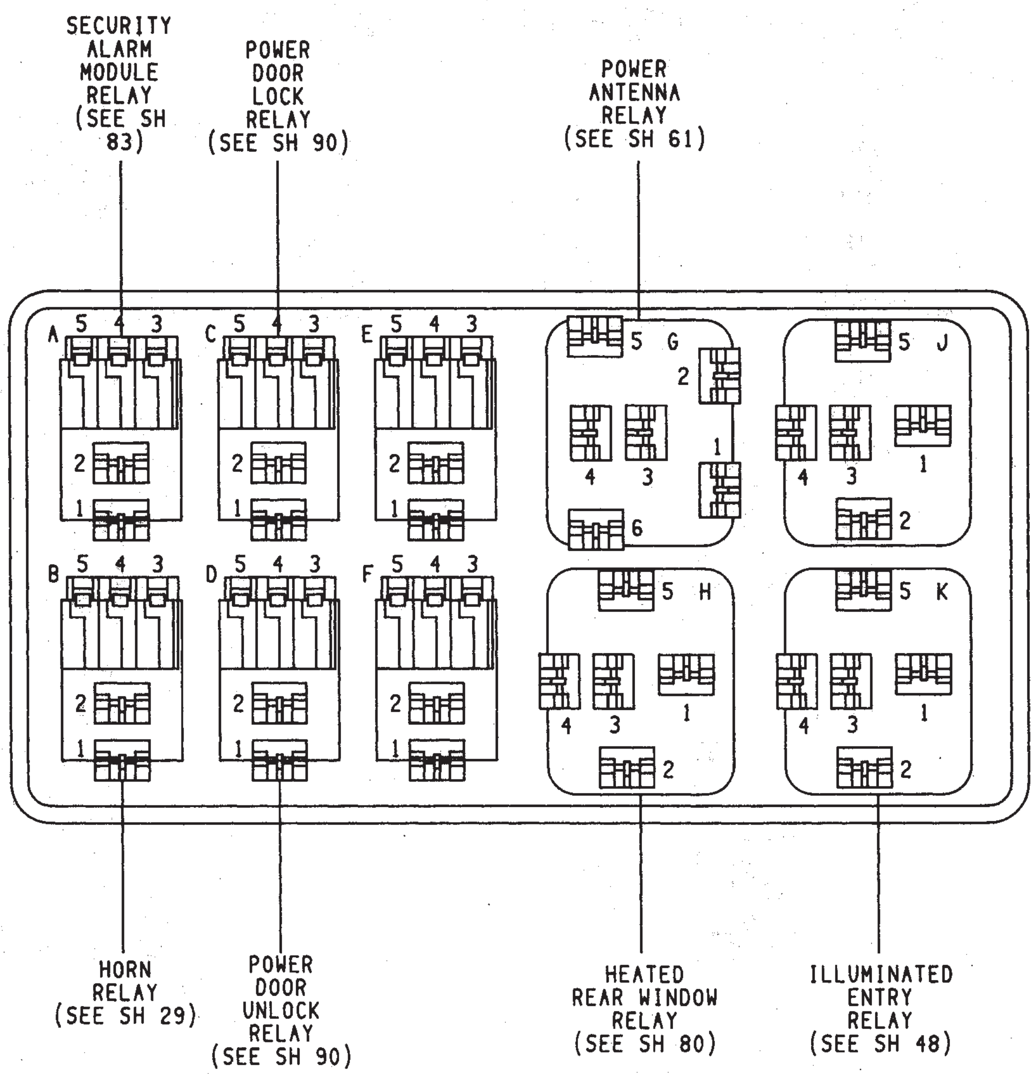
FUSE APPLICATION CHART

J938W-1

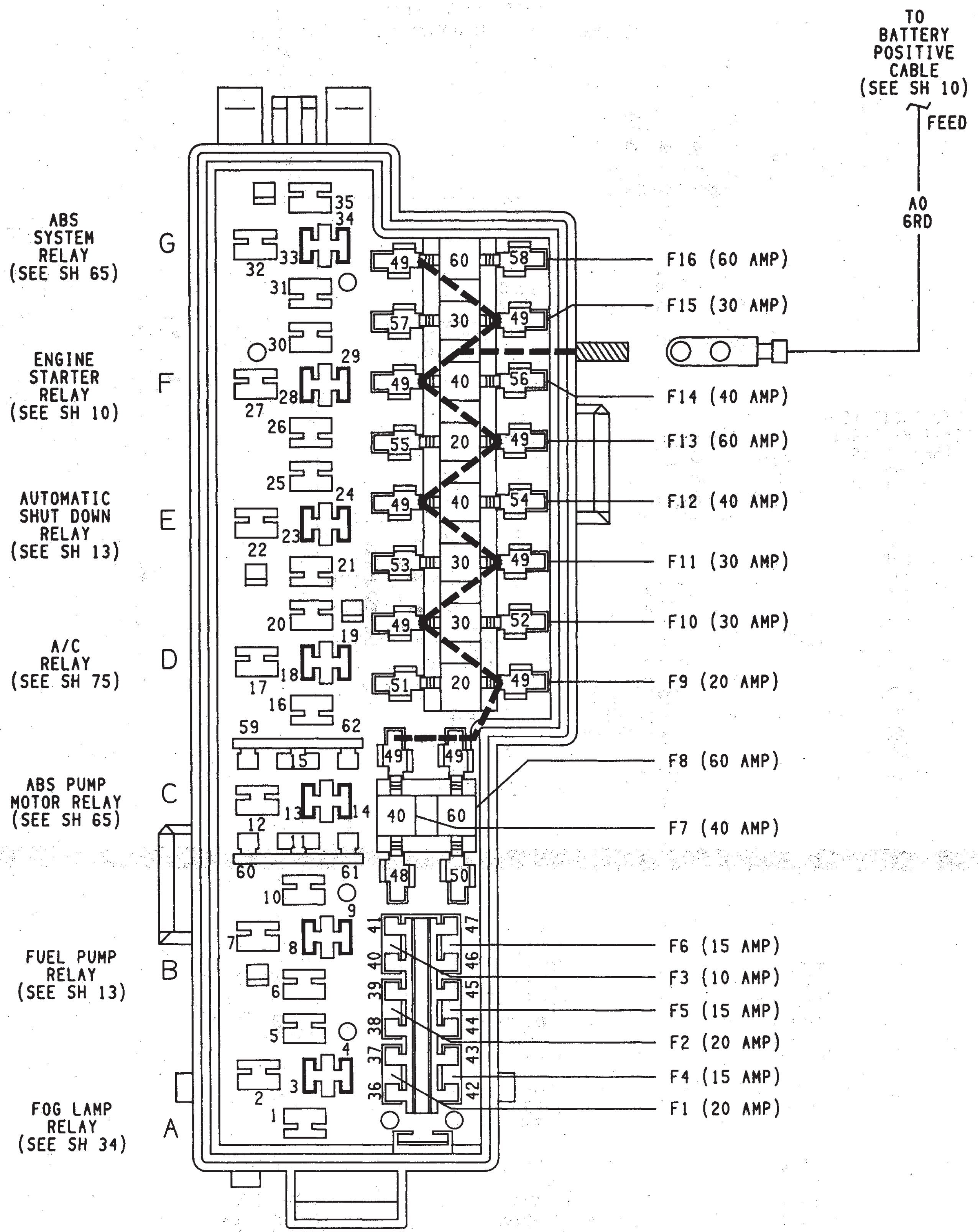


J938W-1

FUSE APPLICATION CHART



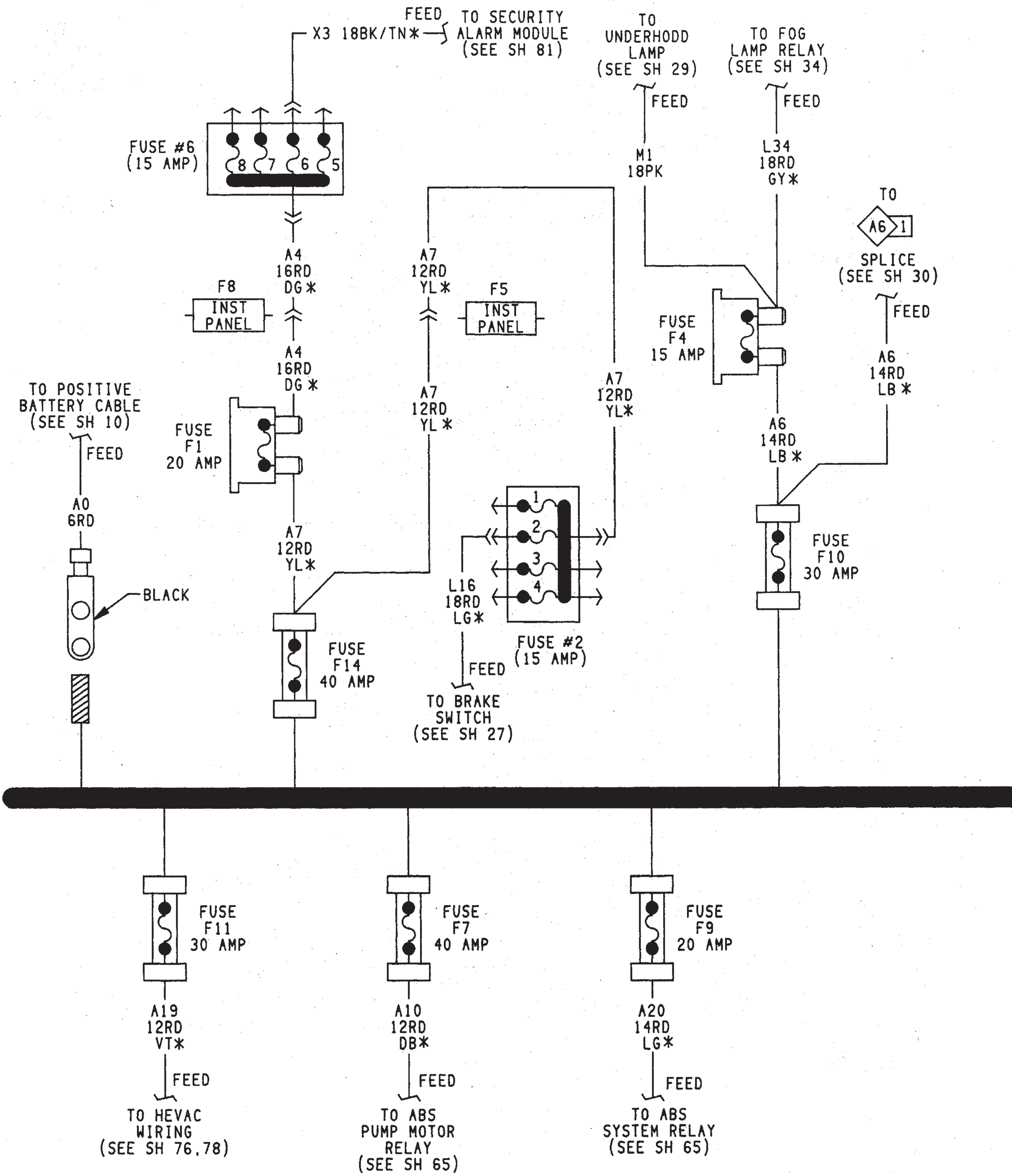
ZJ 5 RELAY CENTER IDENTIFICATION J938W-1



POWER DISTRIBUTION
CENTER IDENTIFICATION

J938W-1

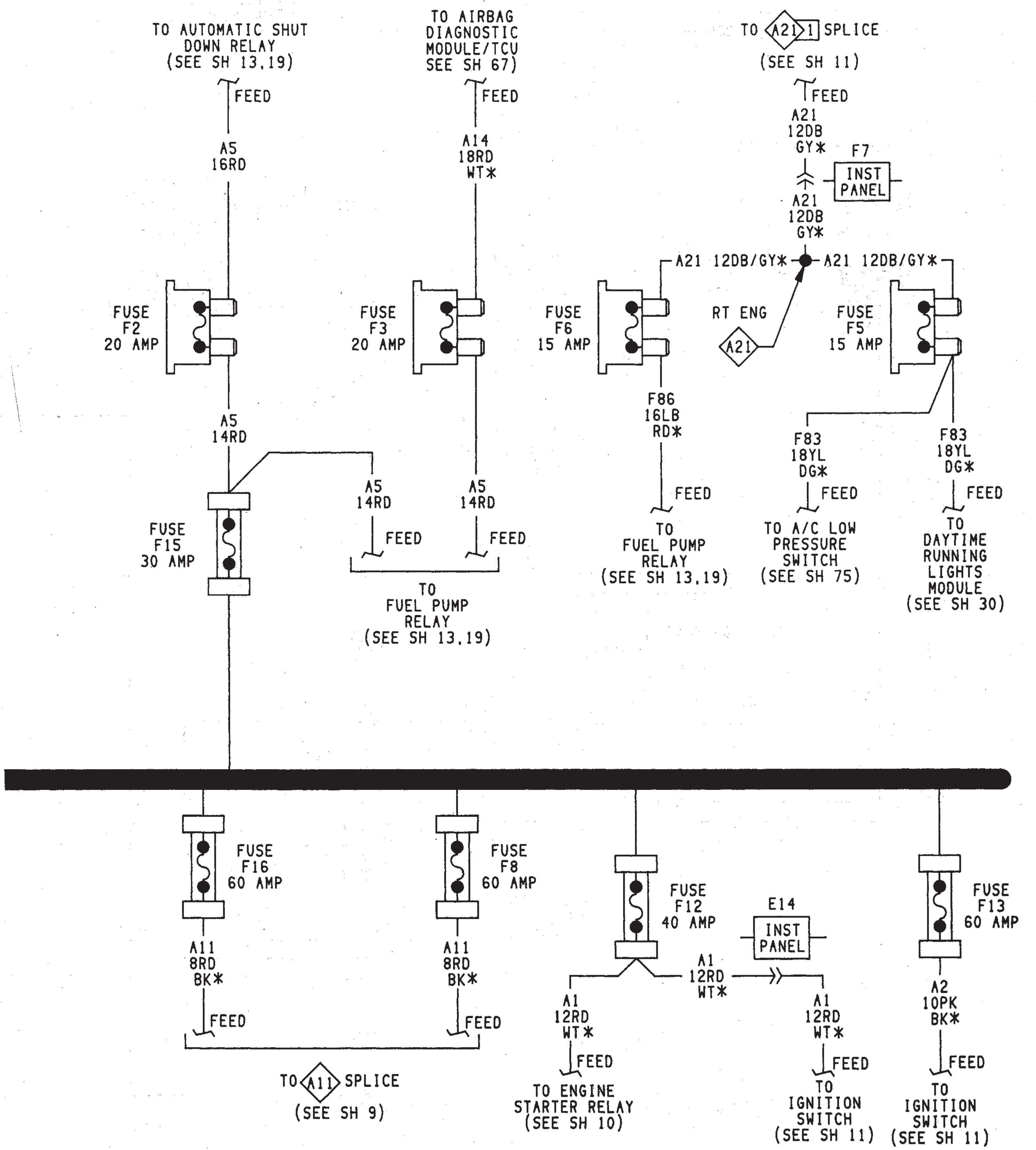
ZJ 6



ZJ 7

POWER DISTRIBUTION CENTER
APPLICATION CHART

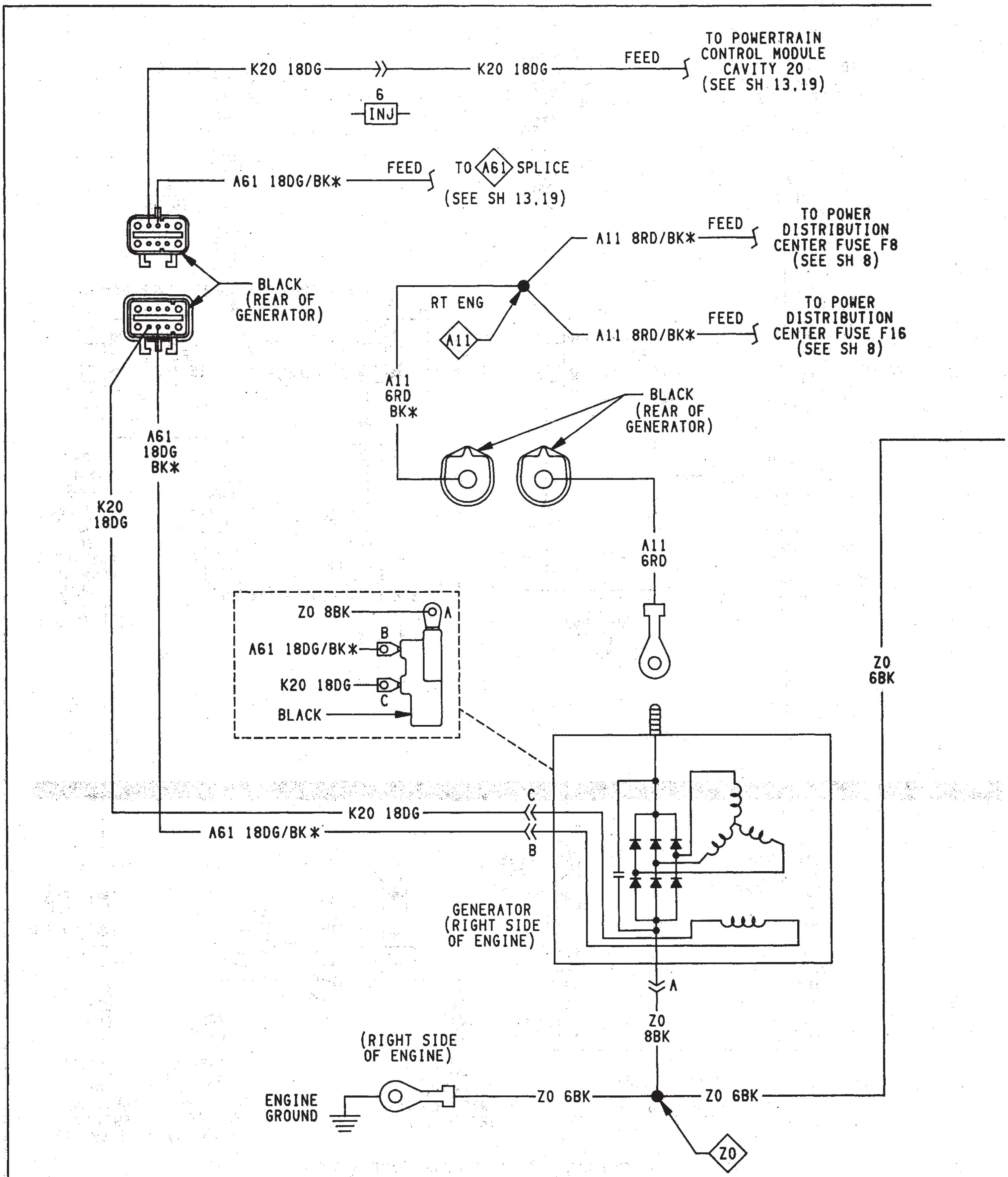
J938W-1



POWER DISTRIBUTION CENTER
APPLICATION CHART

J938W-1

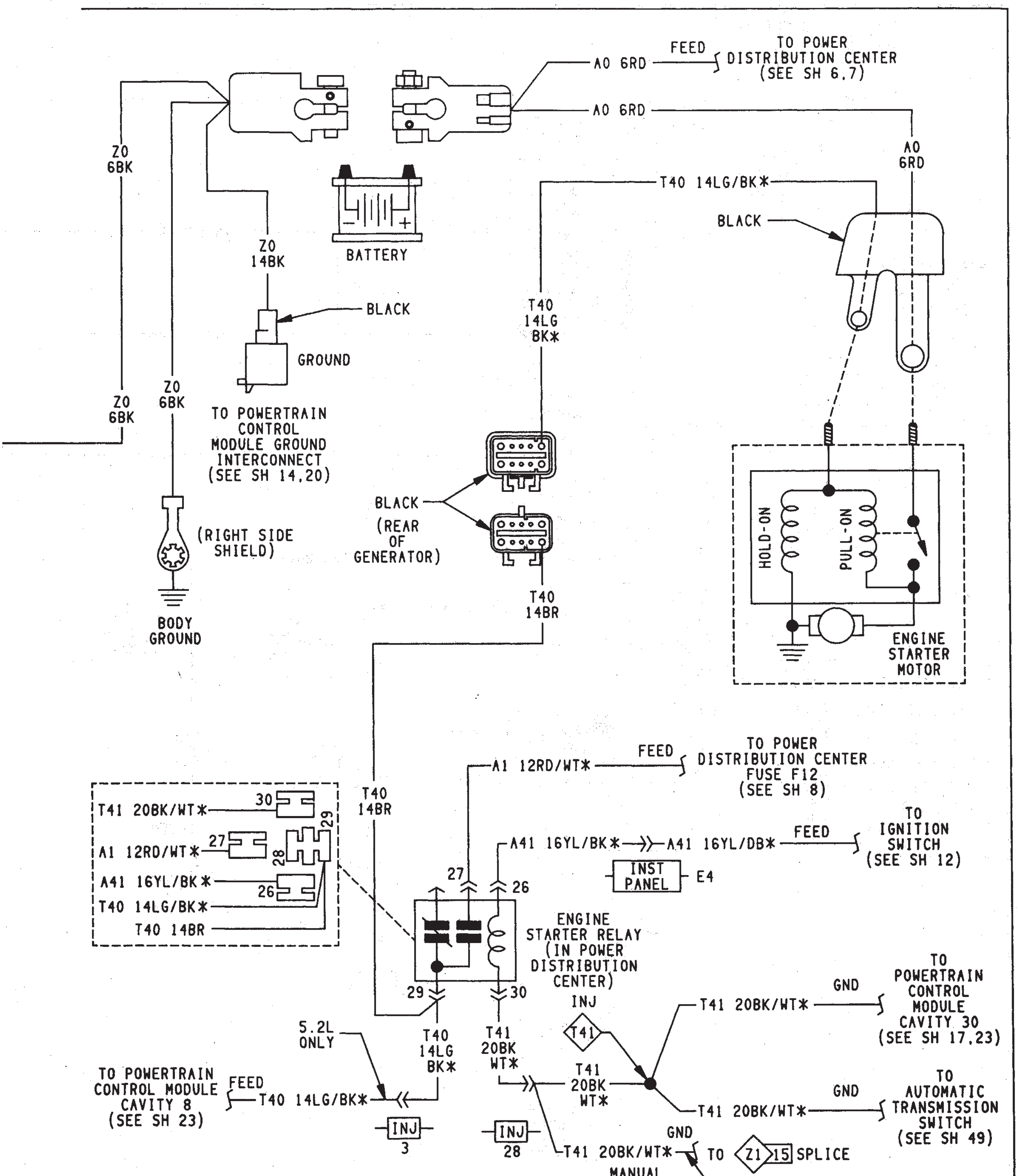
ZJ 8



ZJ 9

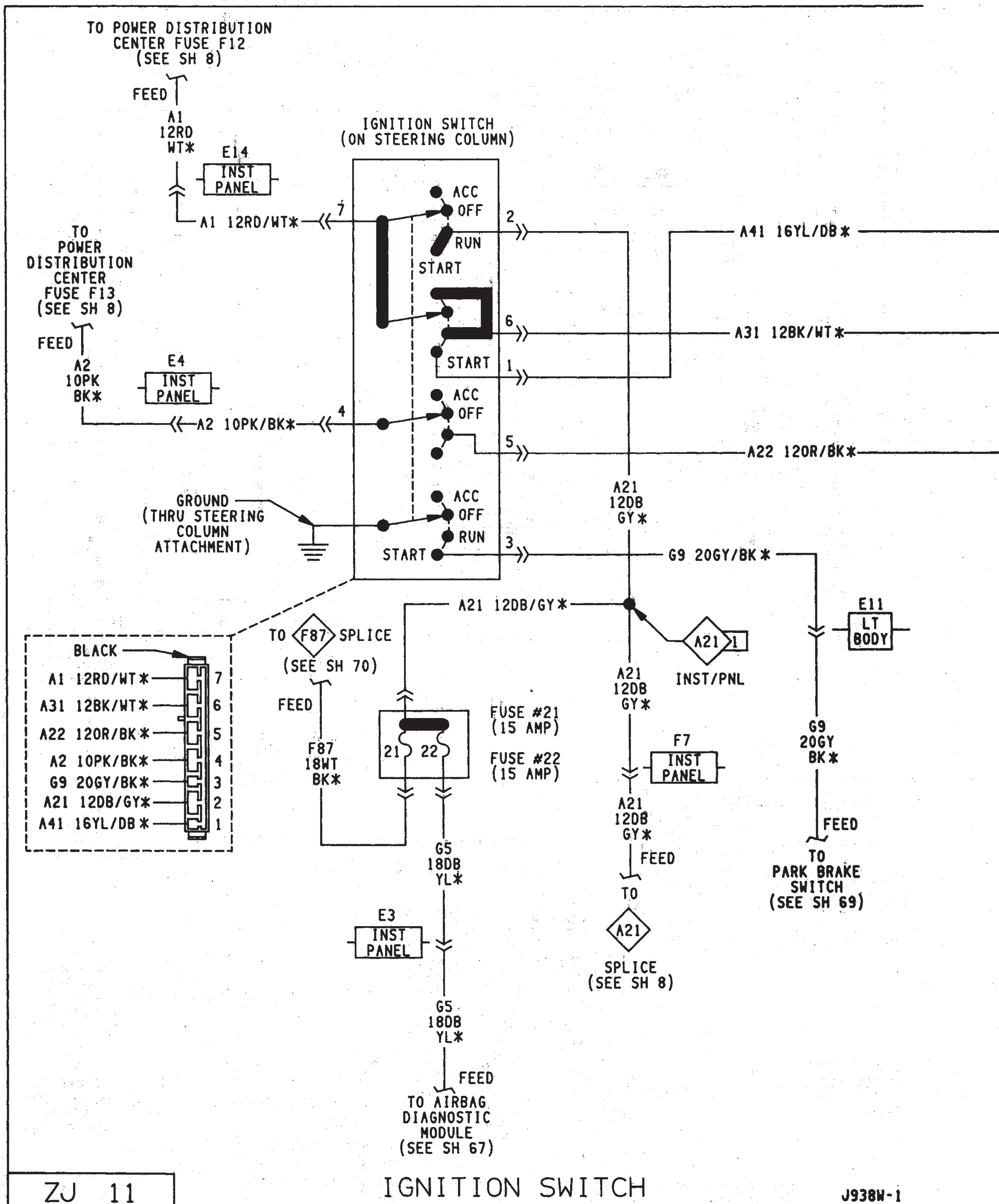
CHARGING SYSTEM

J938W-1



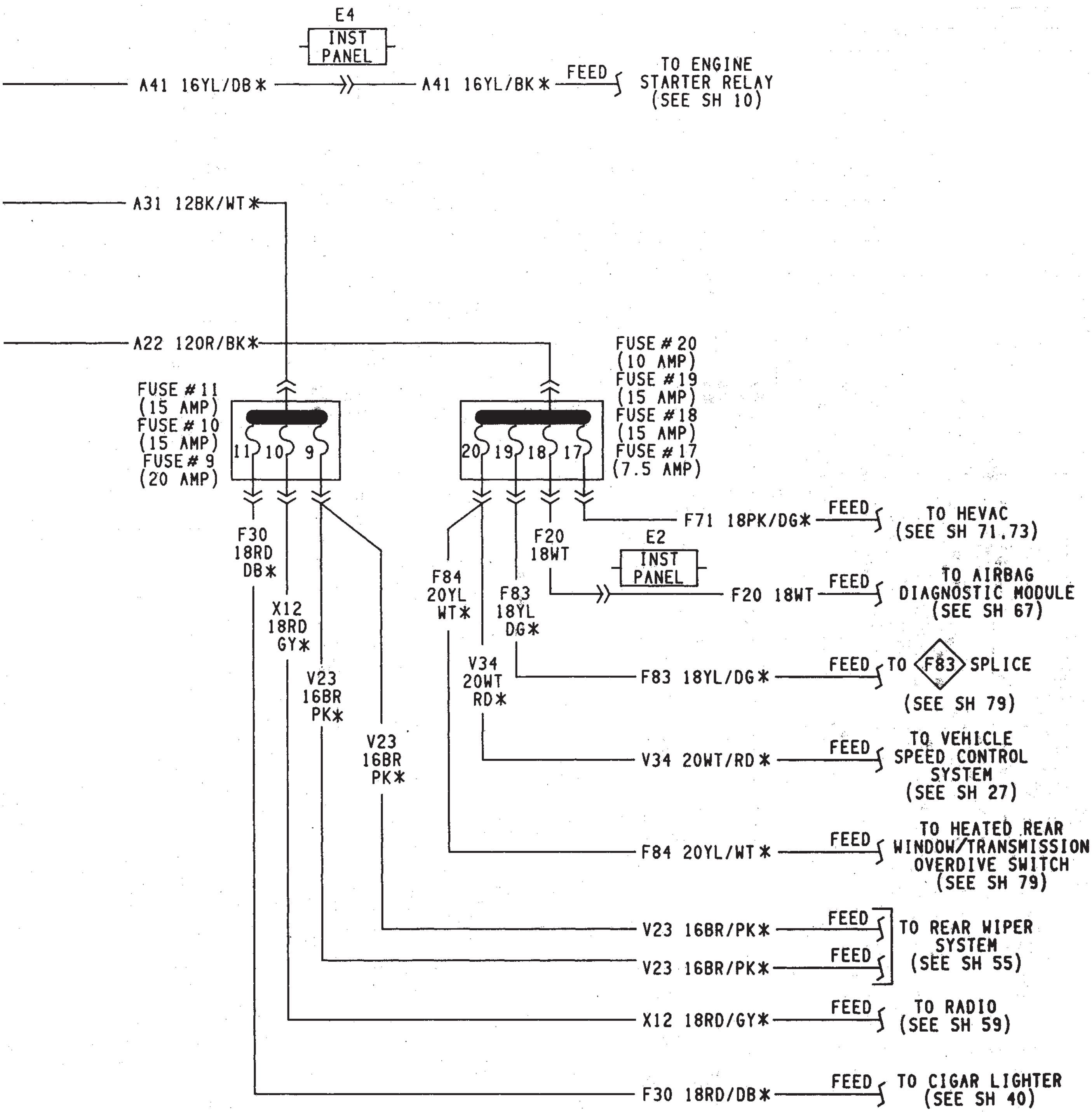
J938W-1 ENGINE STARTER SYSTEM

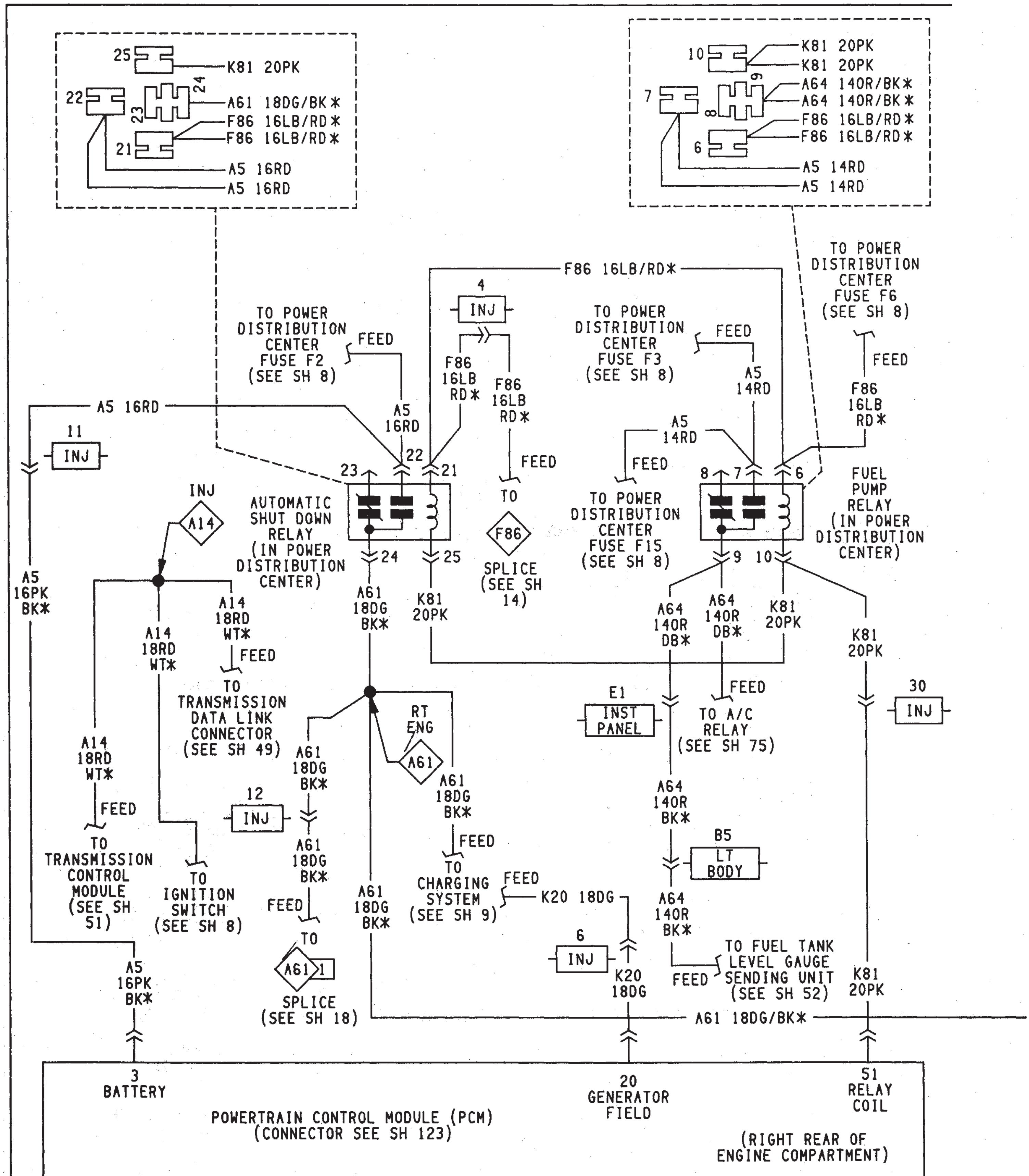
ZJ 10



IGNITION SWITCH

J938W-1

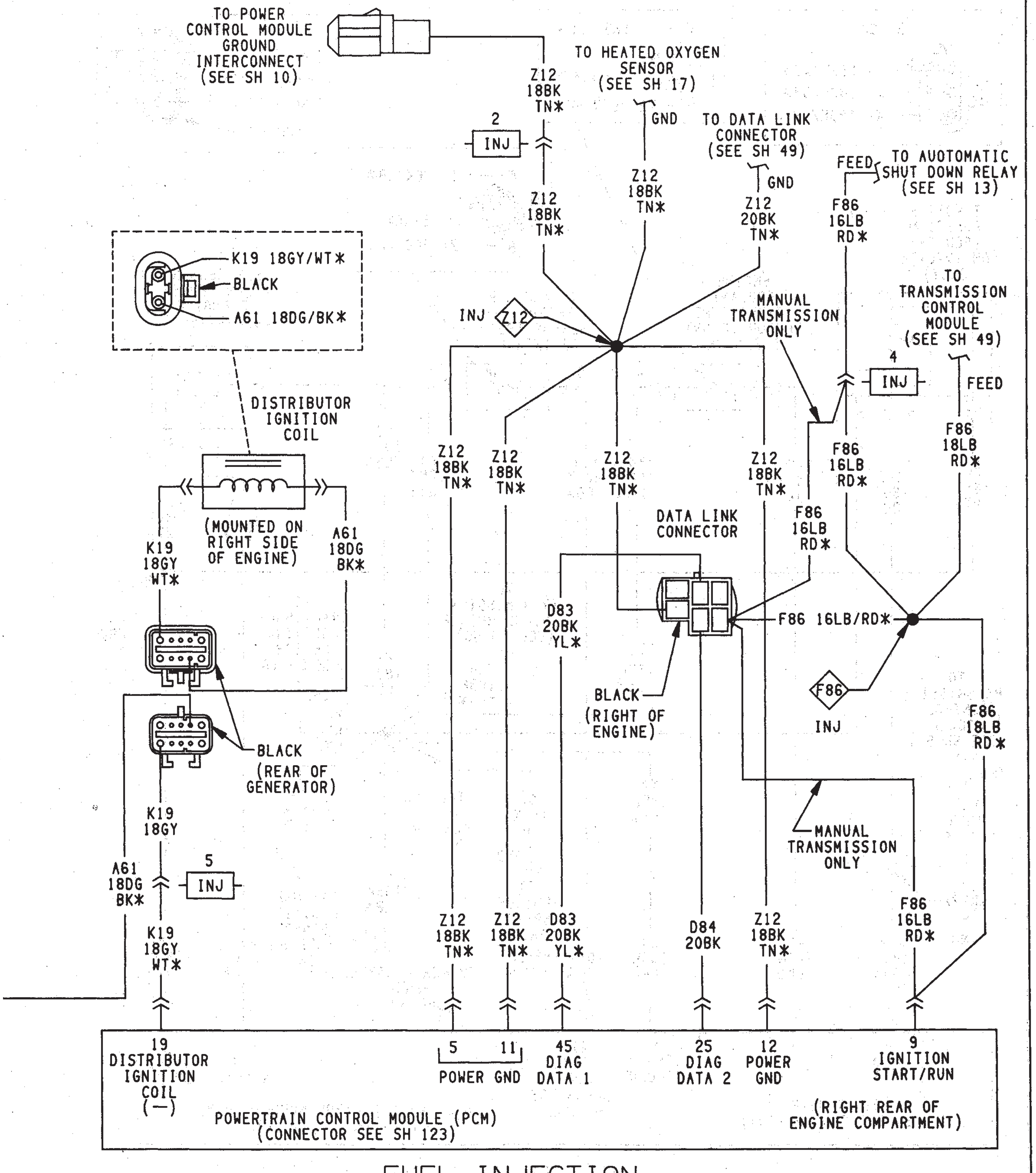

E4
INST PANEL
A41 16YL/DB*
A41 16YL/BK*
FEED
TO ENGINE STARTER RELAY (SEE SH 10)
A31 12BK/WT*
A22 12OR/BK*
FUSE #11 (15 AMP) FUSE #10 (15 AMP) FUSE #9 (20 AMP)
11 10 9
FUSE #20 (10 AMP) FUSE #19 (15 AMP) FUSE #18 (15 AMP) FUSE #17 (7.5 AMP)
20 19 18 17
F71 18PK/DG*
FEED
TO HEVAC (SEE SH 71,73)
F30 18RD DB*
F20 18WT
E2
INST PANEL
F20 18WT
FEED
TO AIRBAG DIAGNOSTIC MODULE (SEE SH 67)
X12 18RD GY*
F84 20YL WT*
F83 18YL DG*
F83 18YL/DG*
FEED
TO F83 SPLICE
(SEE SH 79)
V23 16BR PK*
V34 20WT RD*
V23 16BR PK*
V34 20WT/RD*
FEED
TO VEHICLE SPEED CONTROL SYSTEM (SEE SH 27)
F84 20YL/WT*
FEED
TO HEATED REAR WINDOW/TRANSMISSION OVERDIVE SWITCH (SEE SH 79)
V23 16BR/PK*
FEED
V23 16BR/PK*
FEED
TO REAR WIPER SYSTEM (SEE SH 55)
X12 18RD/GY*
FEED
TO RADIO (SEE SH 59)
F30 18RD/DB*
FEED
TO CIGAR LIGHTER (SEE SH 40)



ZJ 13

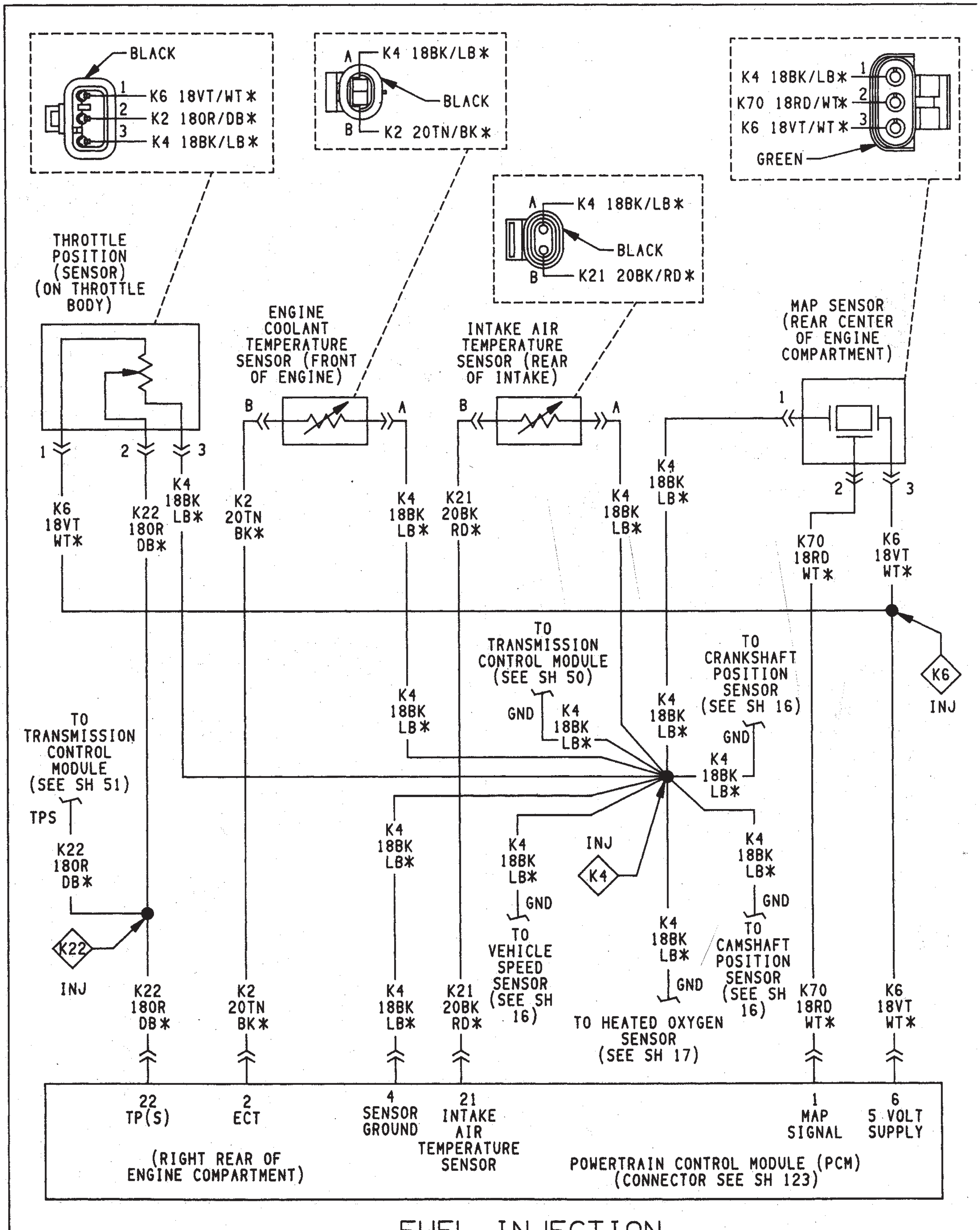
FUEL INJECTION
IGNITION SYSTEM (4.0L ENGINE)

J938W-1



FUEL INJECTION
IGNITION SYSTEM (4.0L ENGINE)

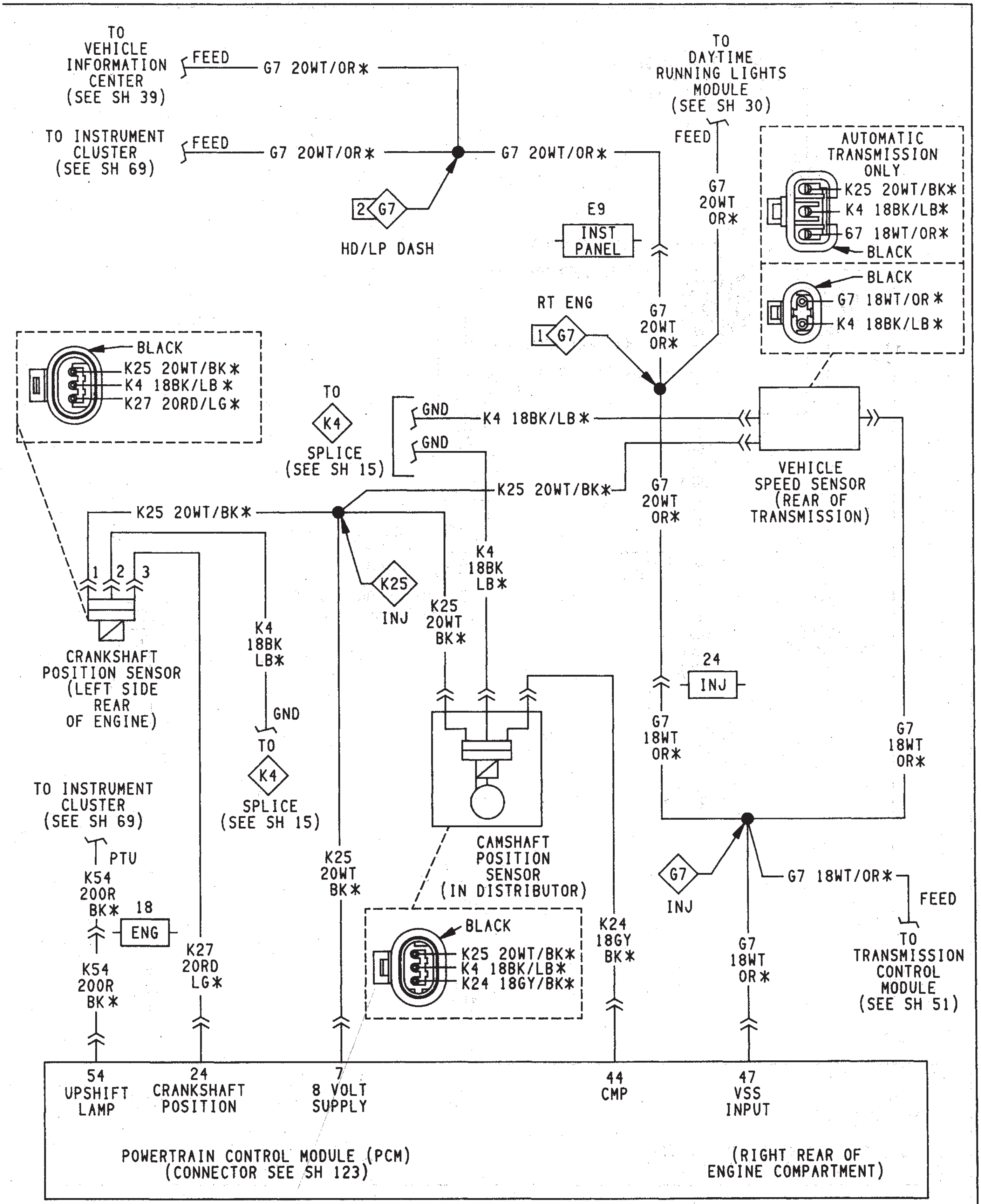
J938W-1



ZJ 15

FUEL INJECTION
IGNITION SYSTEM (4.0L ENGINE)

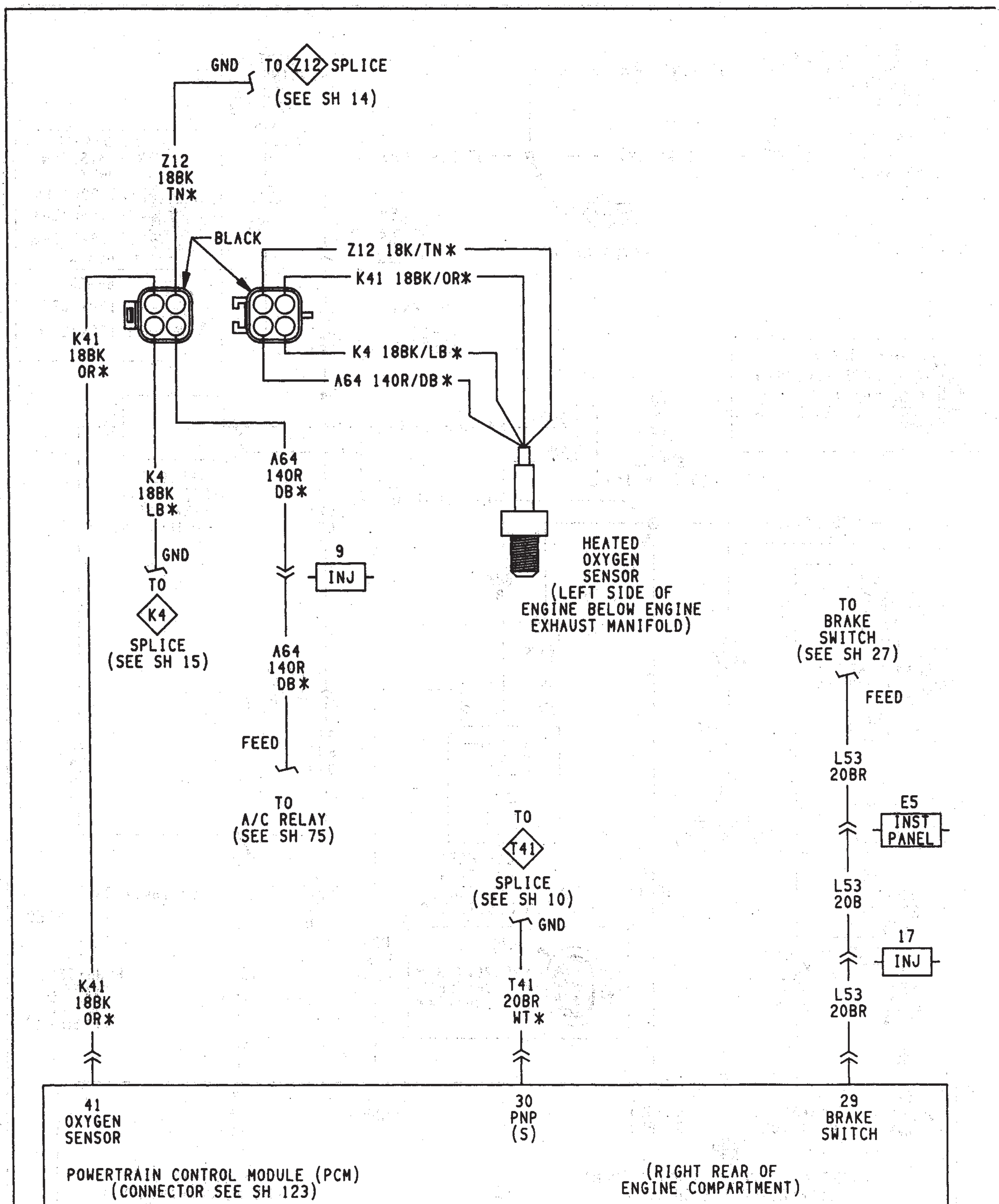
J938W-1



FUEL INJECTION
IGNITION SYSTEM (4.0L ENGINE)

J938W-1

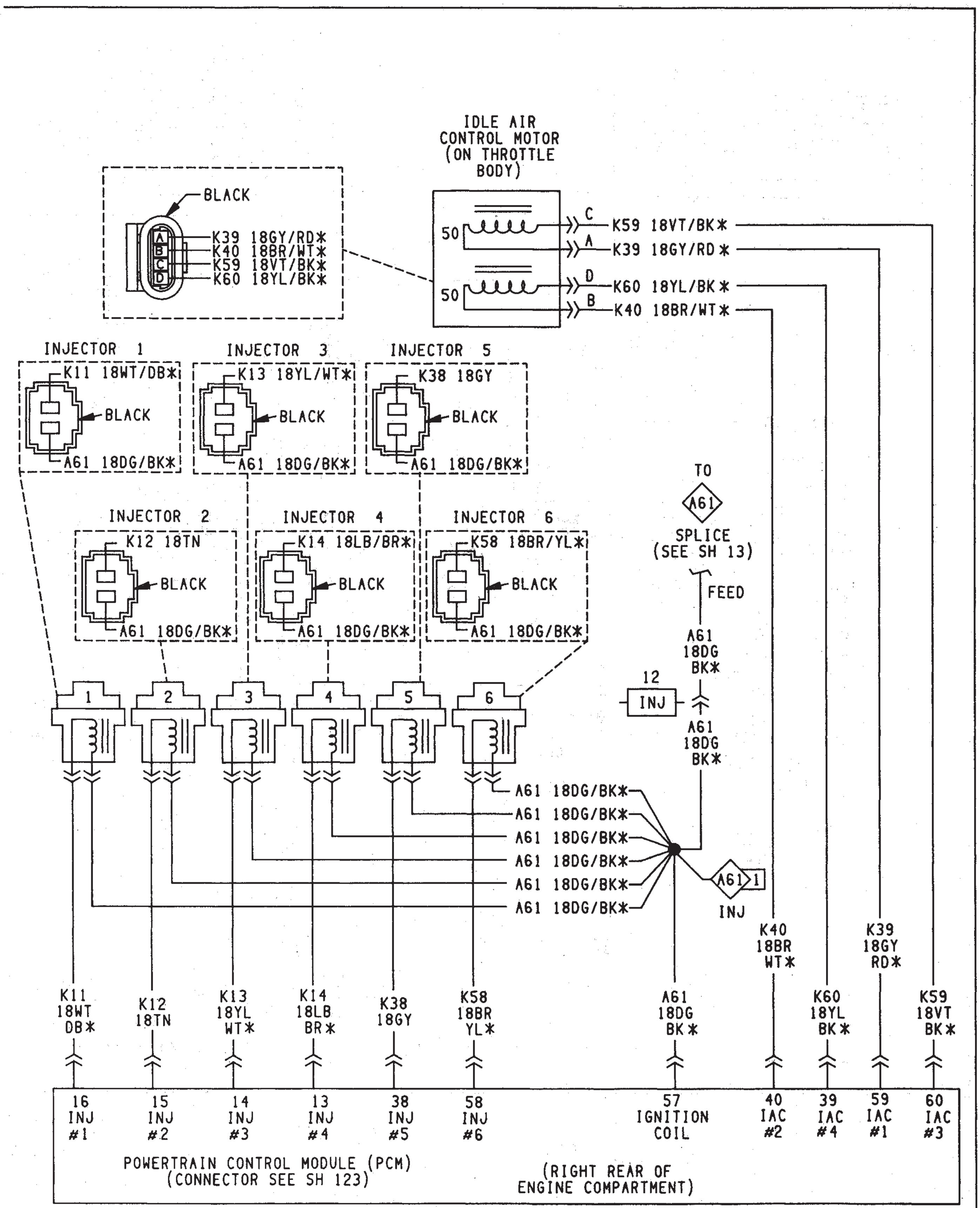
ZJ 16



FUEL INJECTION
IGNITION SYSTEM (4.0L ENGINE)

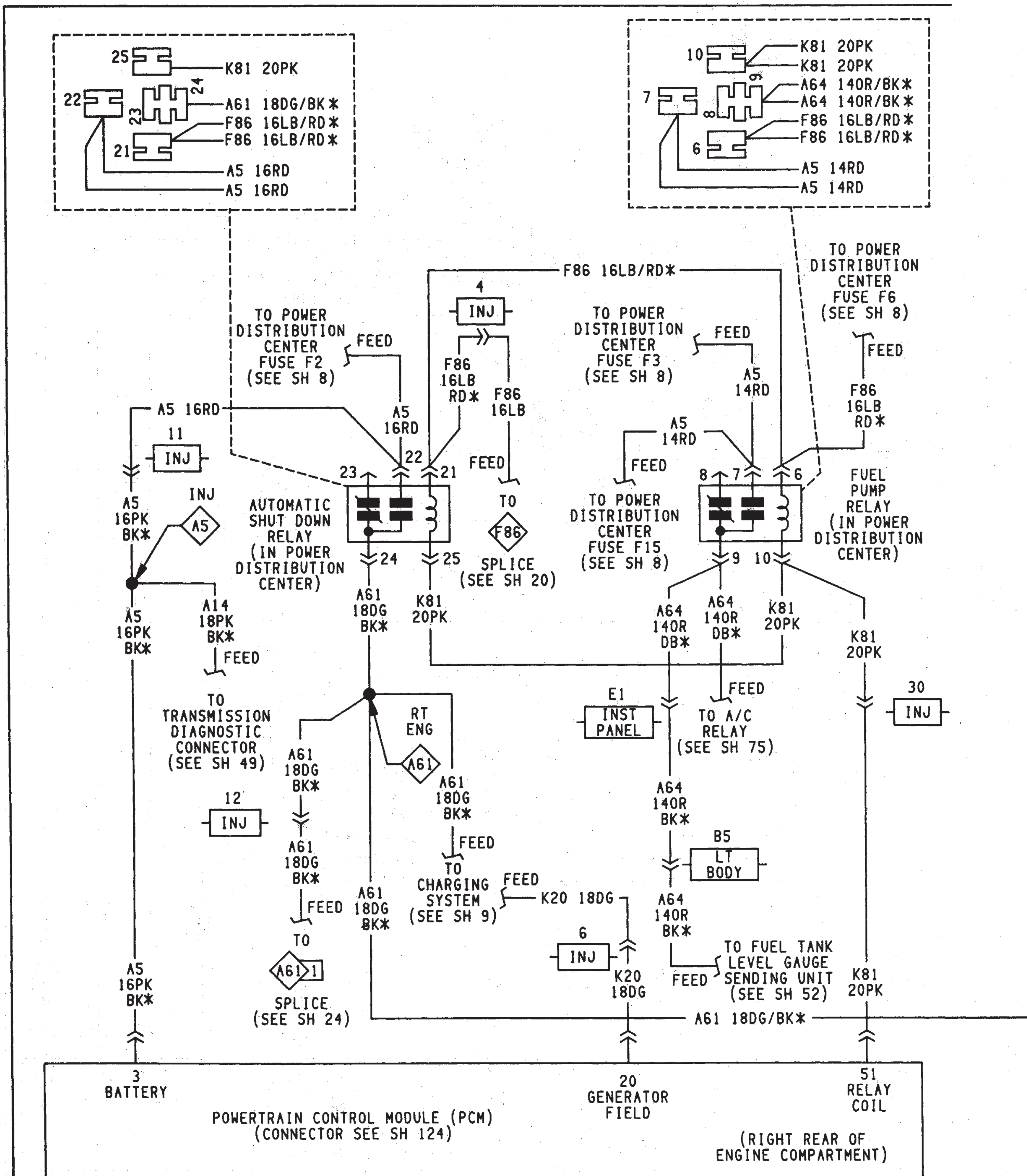
ZJ 17

J938W-1



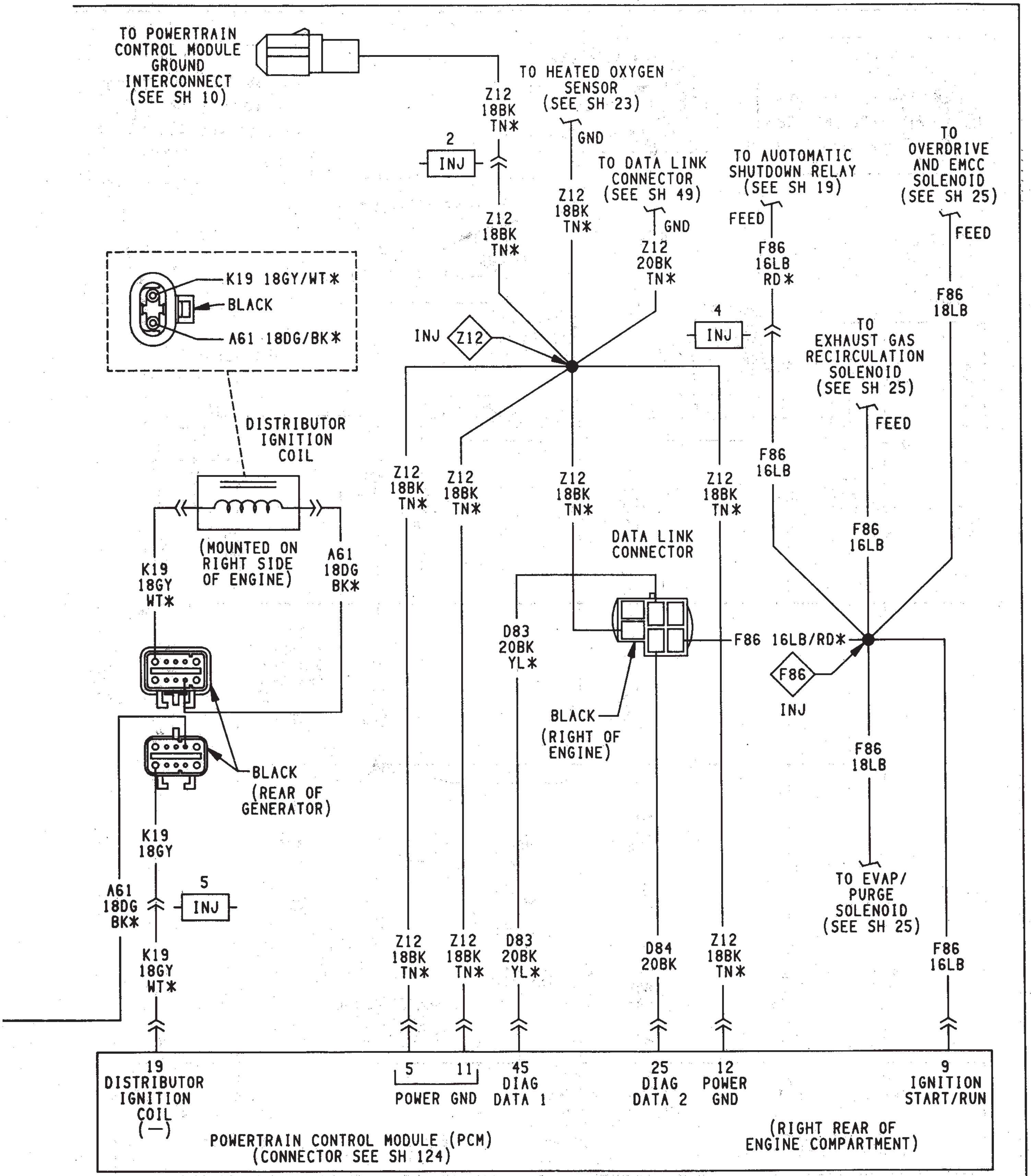
FUEL INJECTION
IGNITION SYSTEM (4.0L ENGINE)

J938W-1

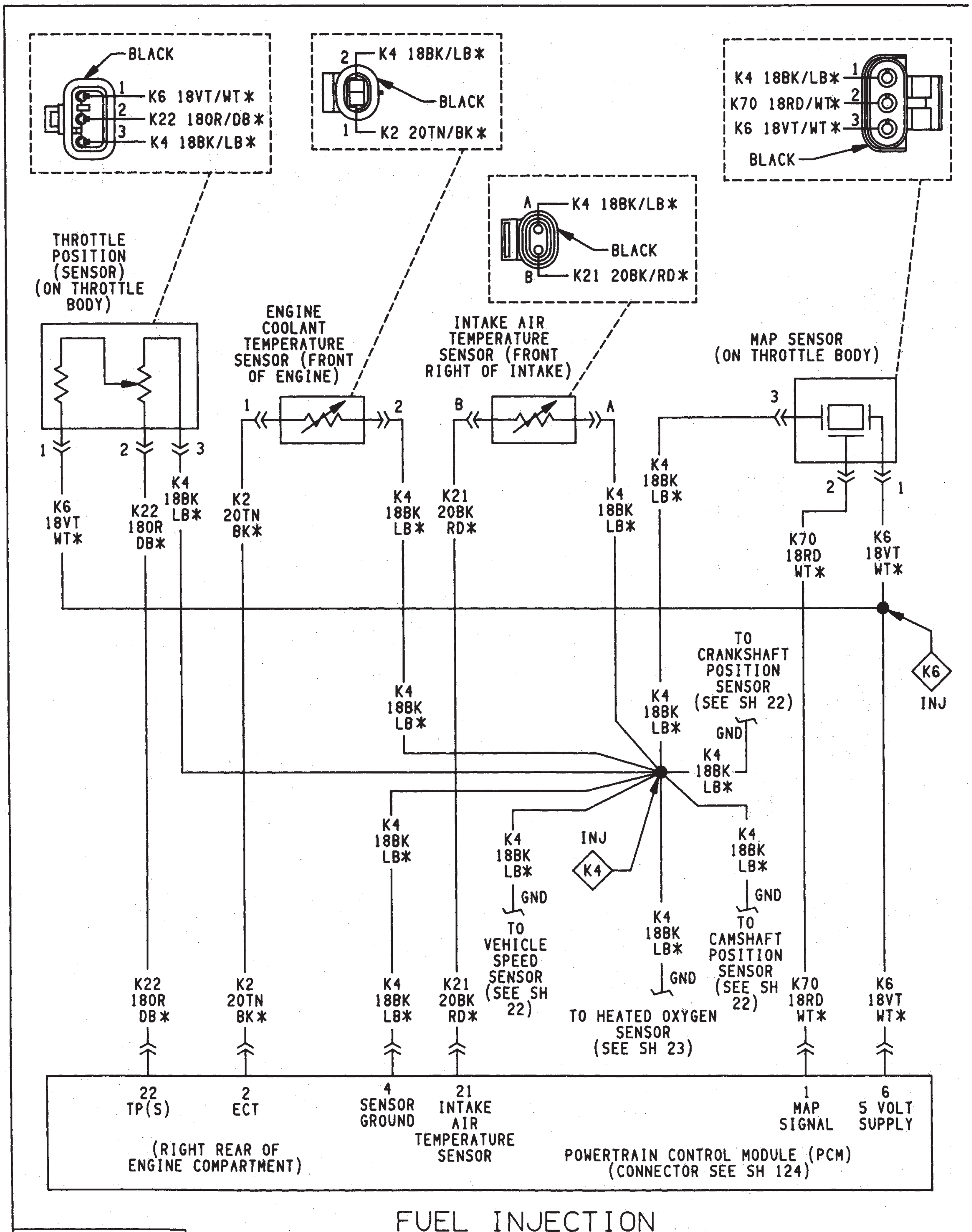


FUEL INJECTION
IGNITION SYSTEM (5.2L ENGINE)

J938W-1



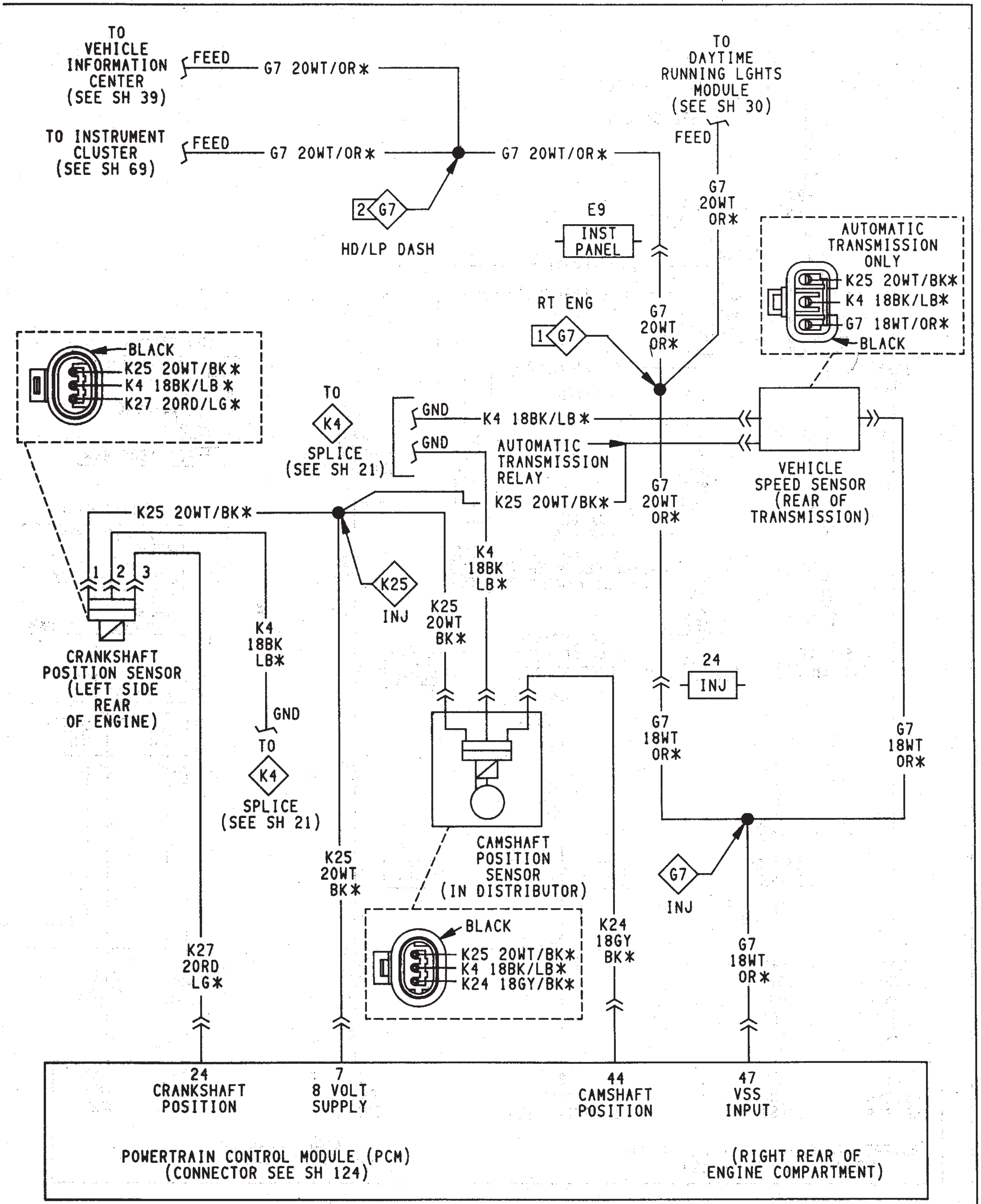
FUEL INJECTION
IGNITION SYSTEM (5.2L ENGINE)



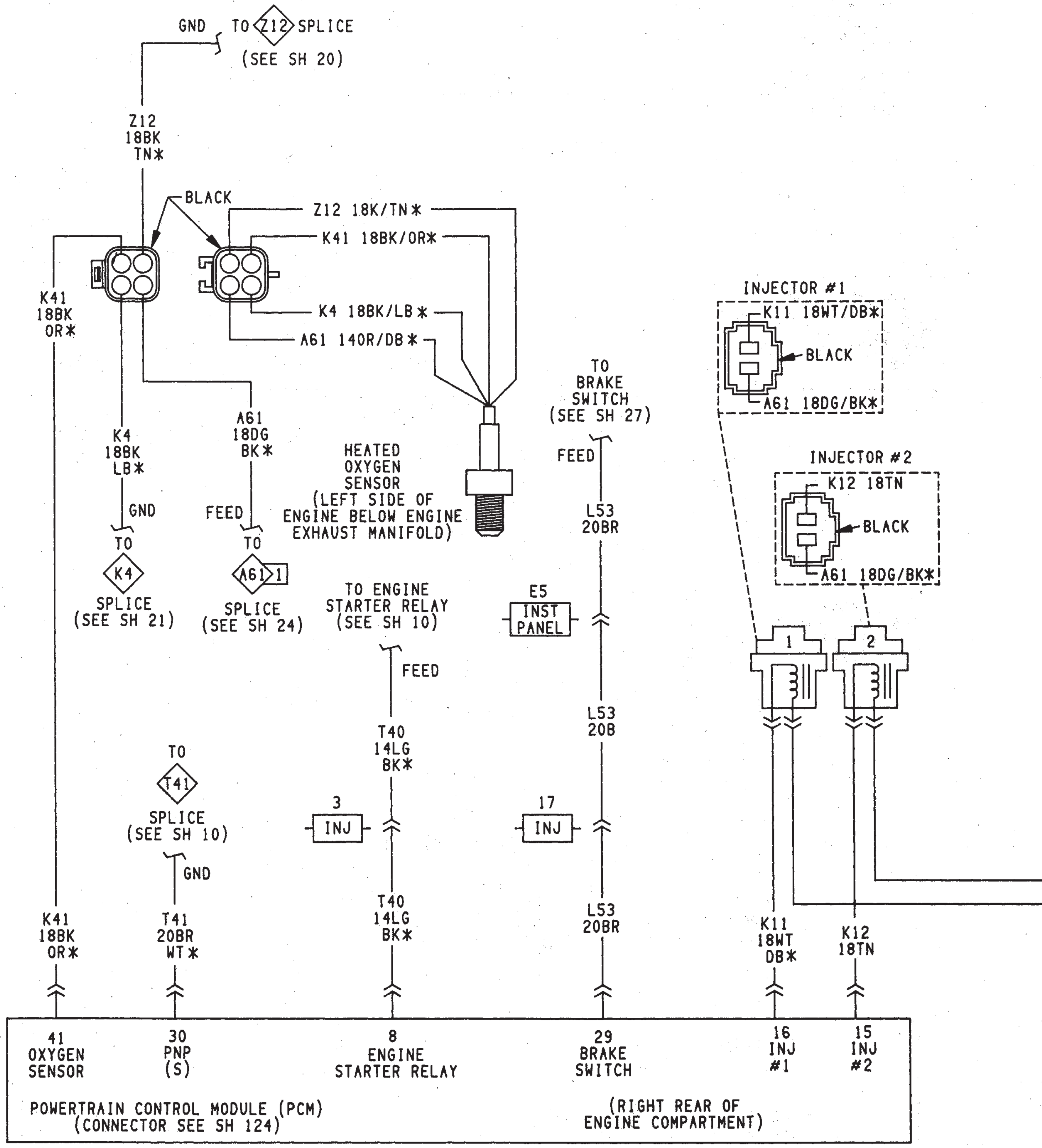
ZJ 21

FUEL INJECTION
IGNITION SYSTEM (5.2L ENGINE)

J938W-1

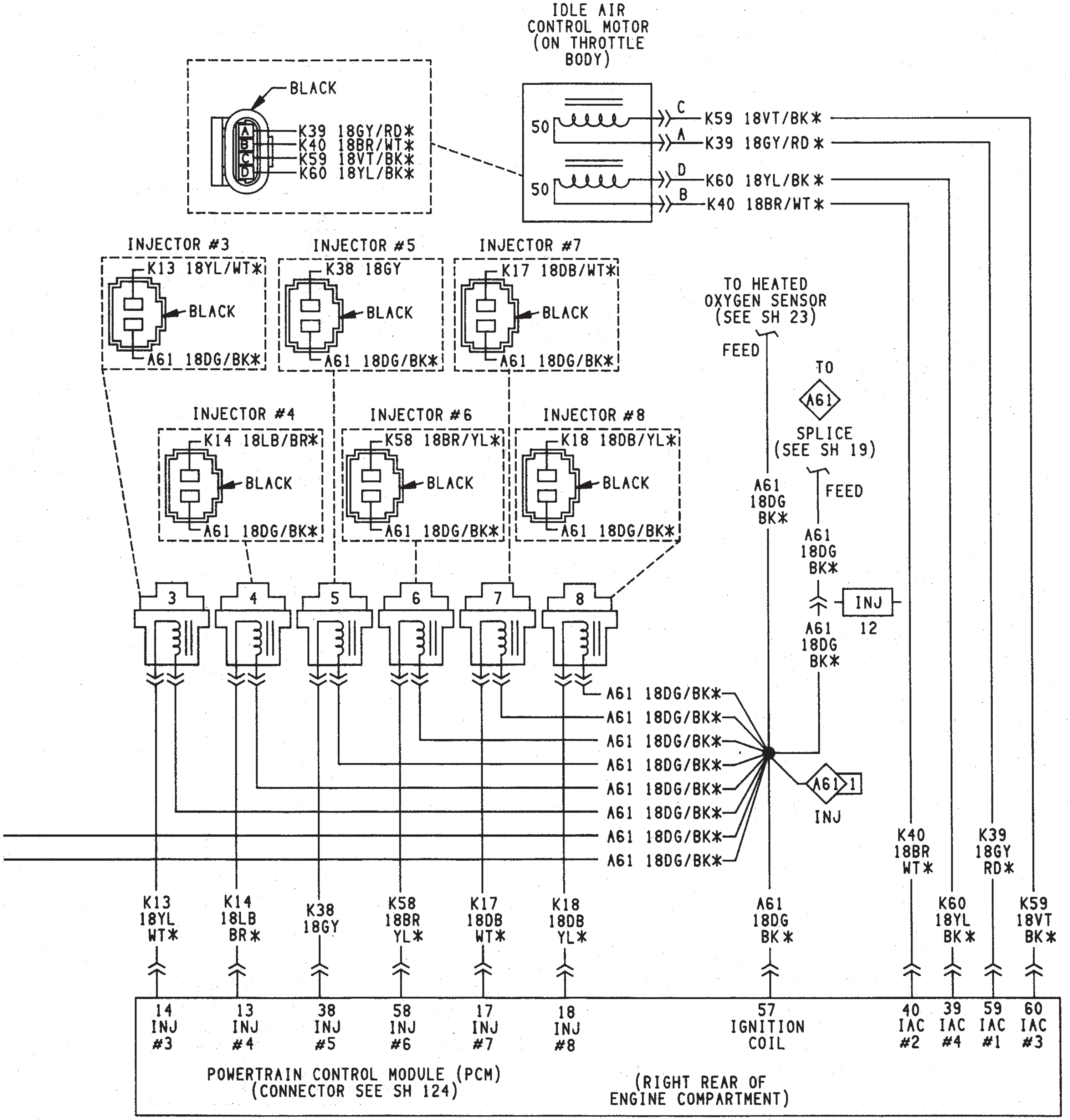


FUEL INJECTION
IGNITION SYSTEM (5.2L ENGINE)

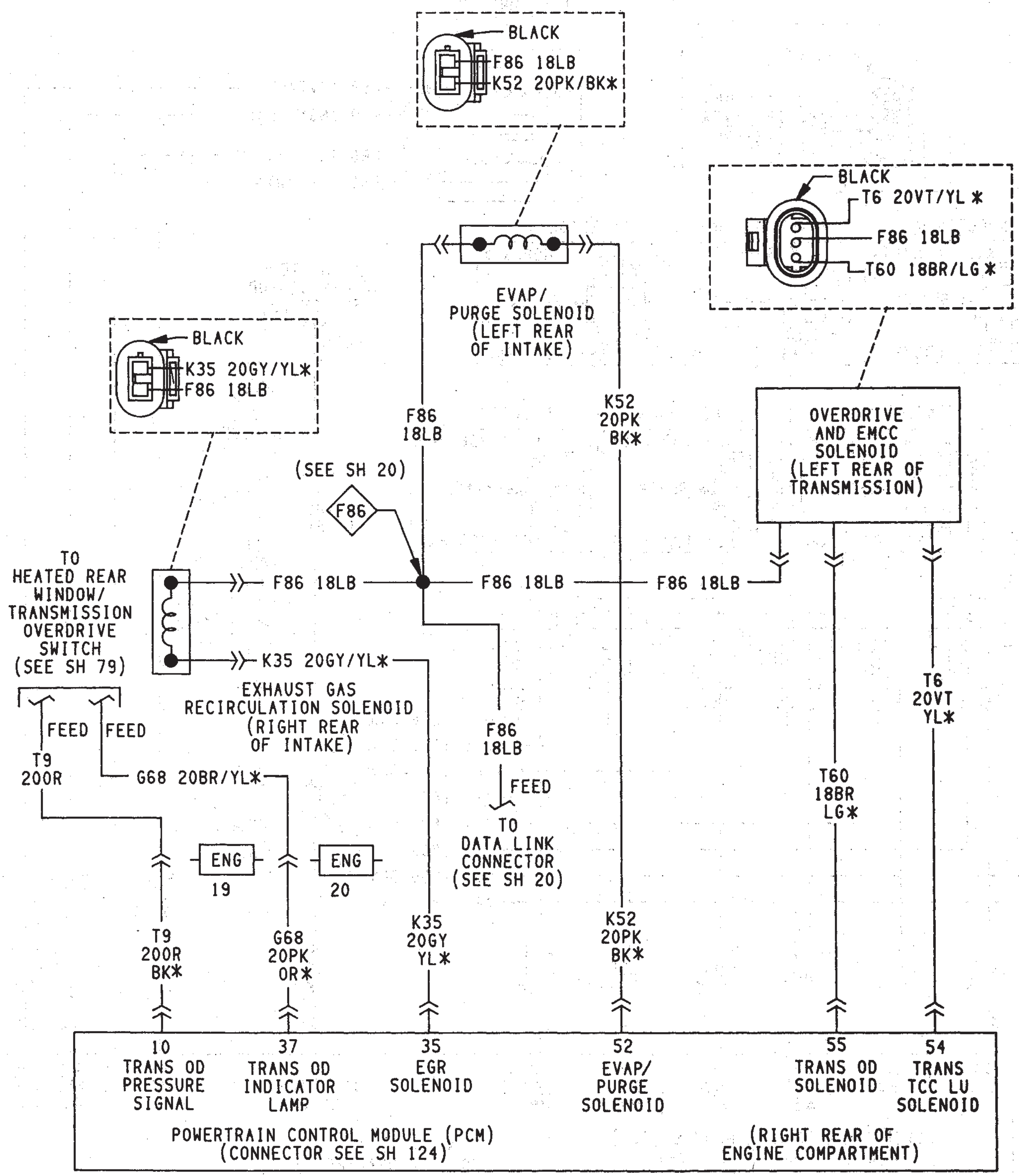


FUEL INJECTION
IGNITION SYSTEM (5.2L ENGINE)

J938W-1

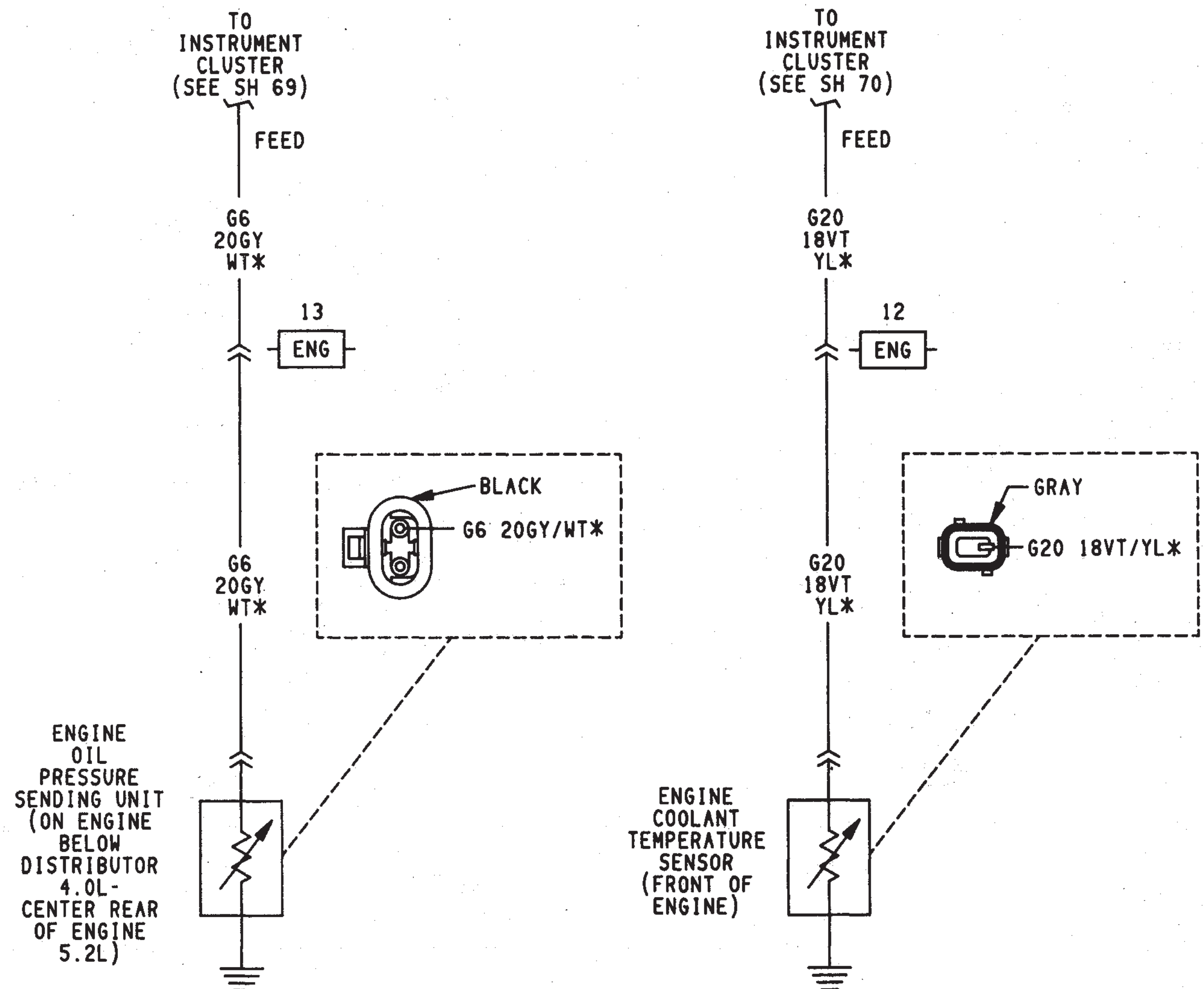


FUEL INJECTION
IGNITION SYSTEM (5.2L ENGINE)



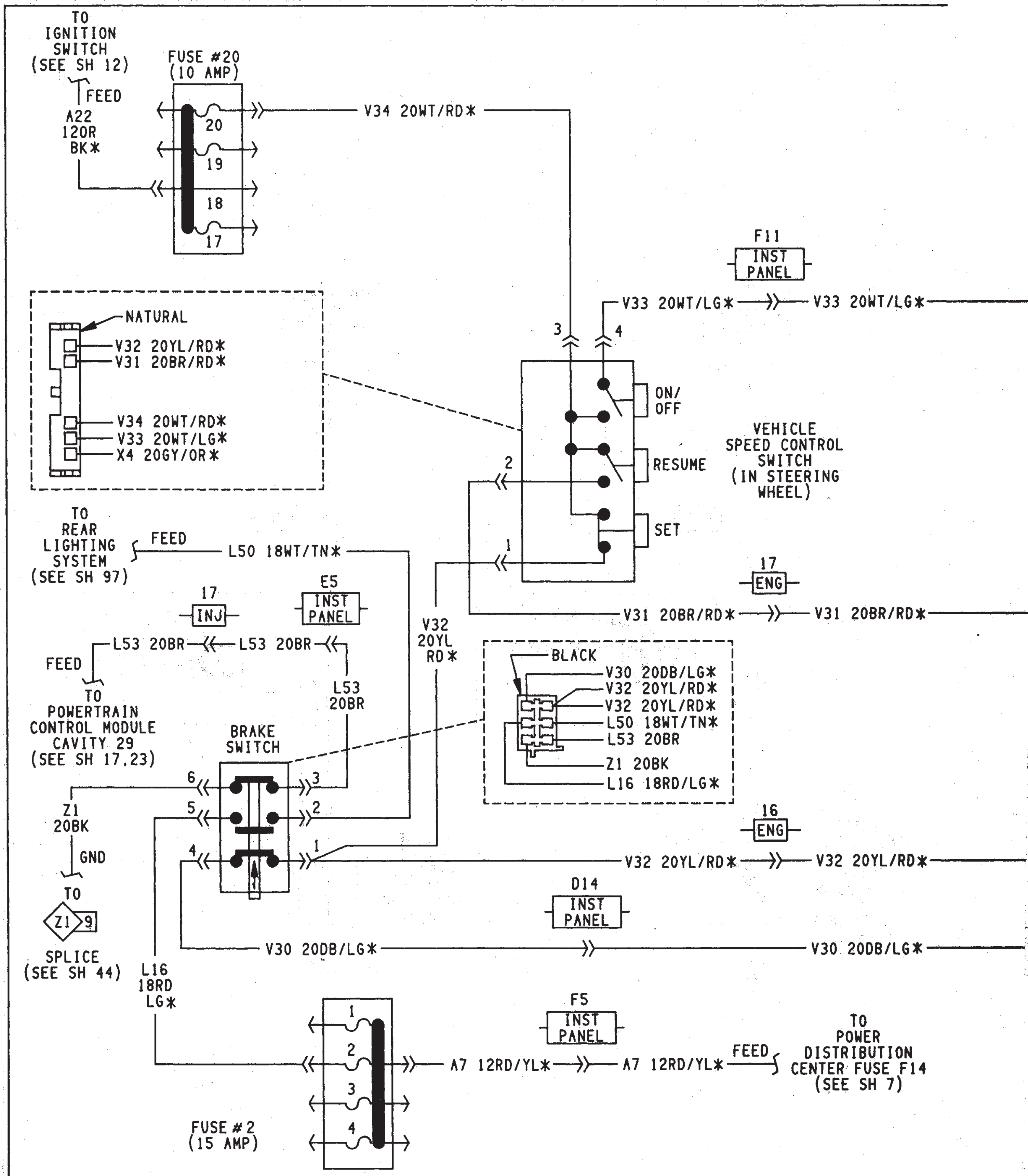
FUEL INJECTION
IGNITION SYSTEM (5.2L ENGINE)

J938W-1



J938W-1

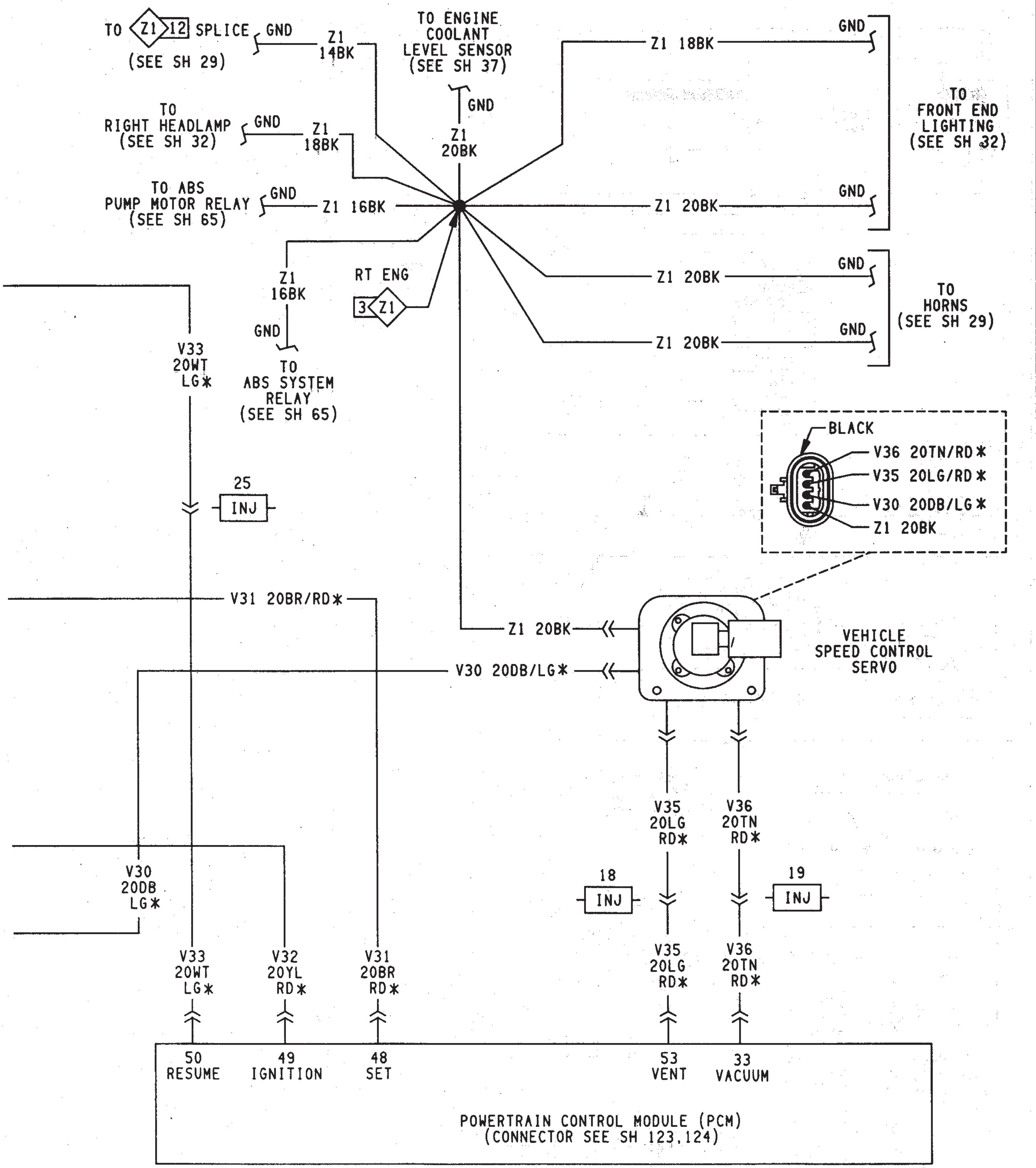
ENGINE OIL PRESSURE
AND TEMPERATURE SYSTEM



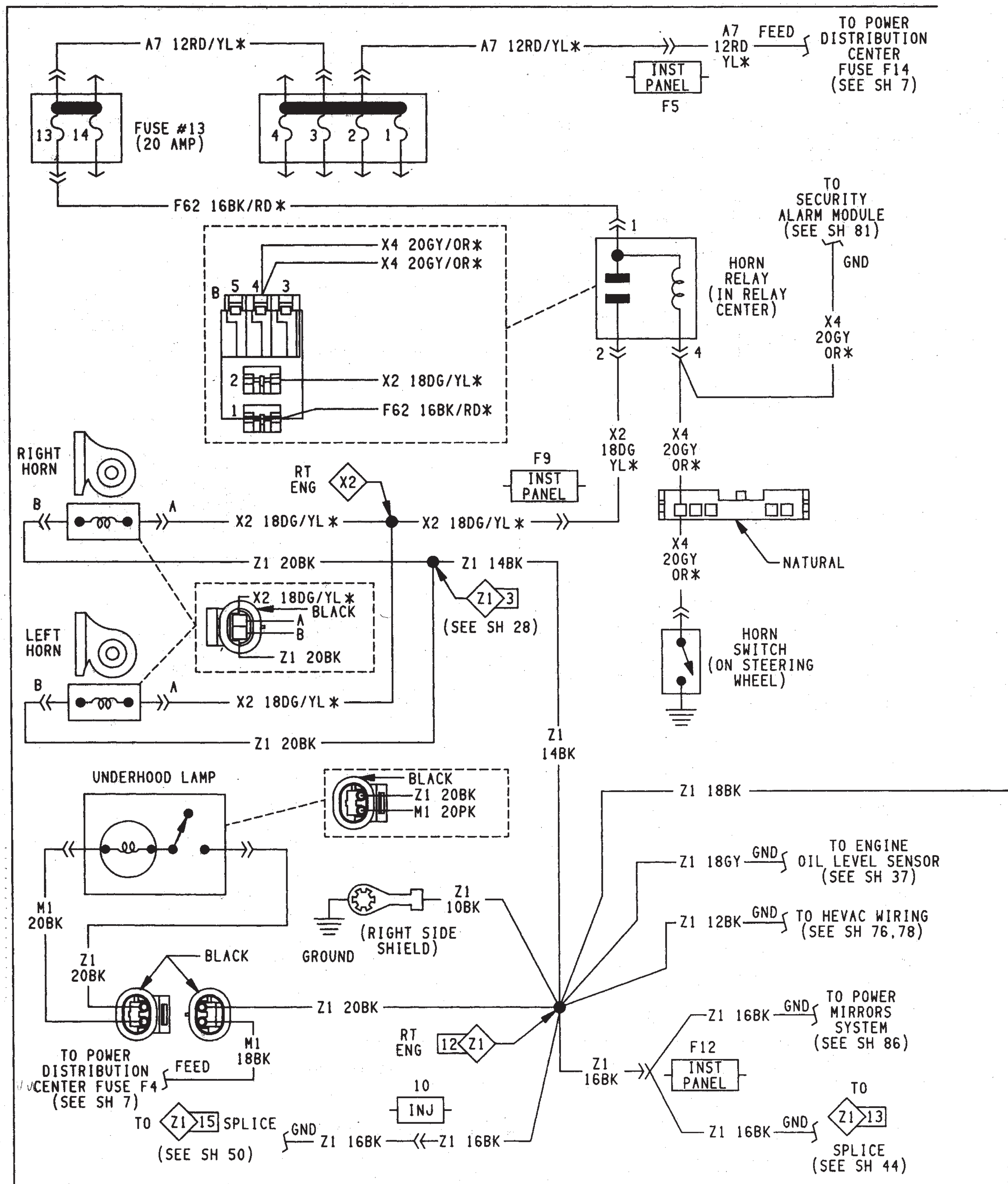
VEHICLE SPEED CONTROL SYSTEM AND BRAKE SYSTEM

ZJ 27

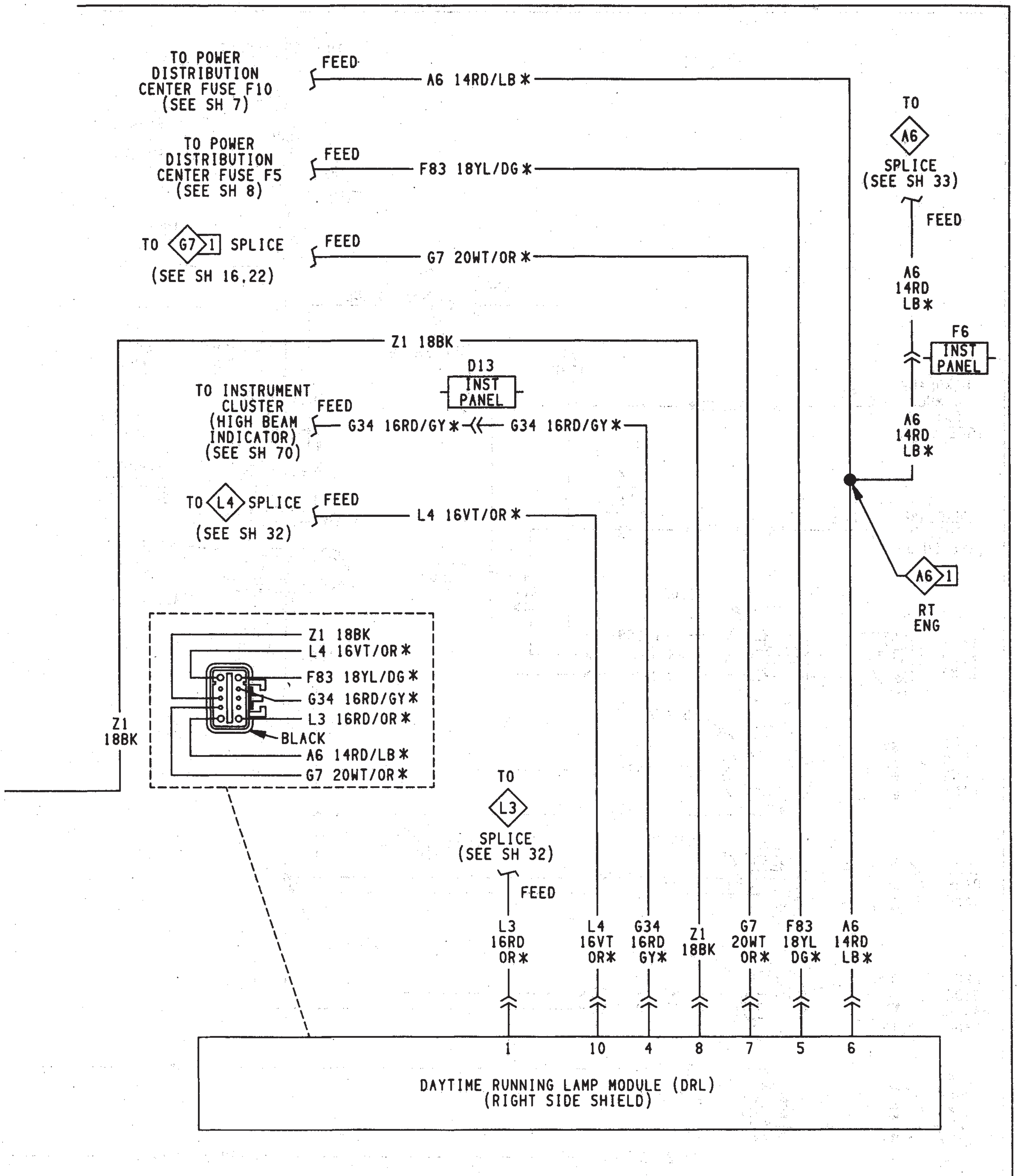
J938W-1

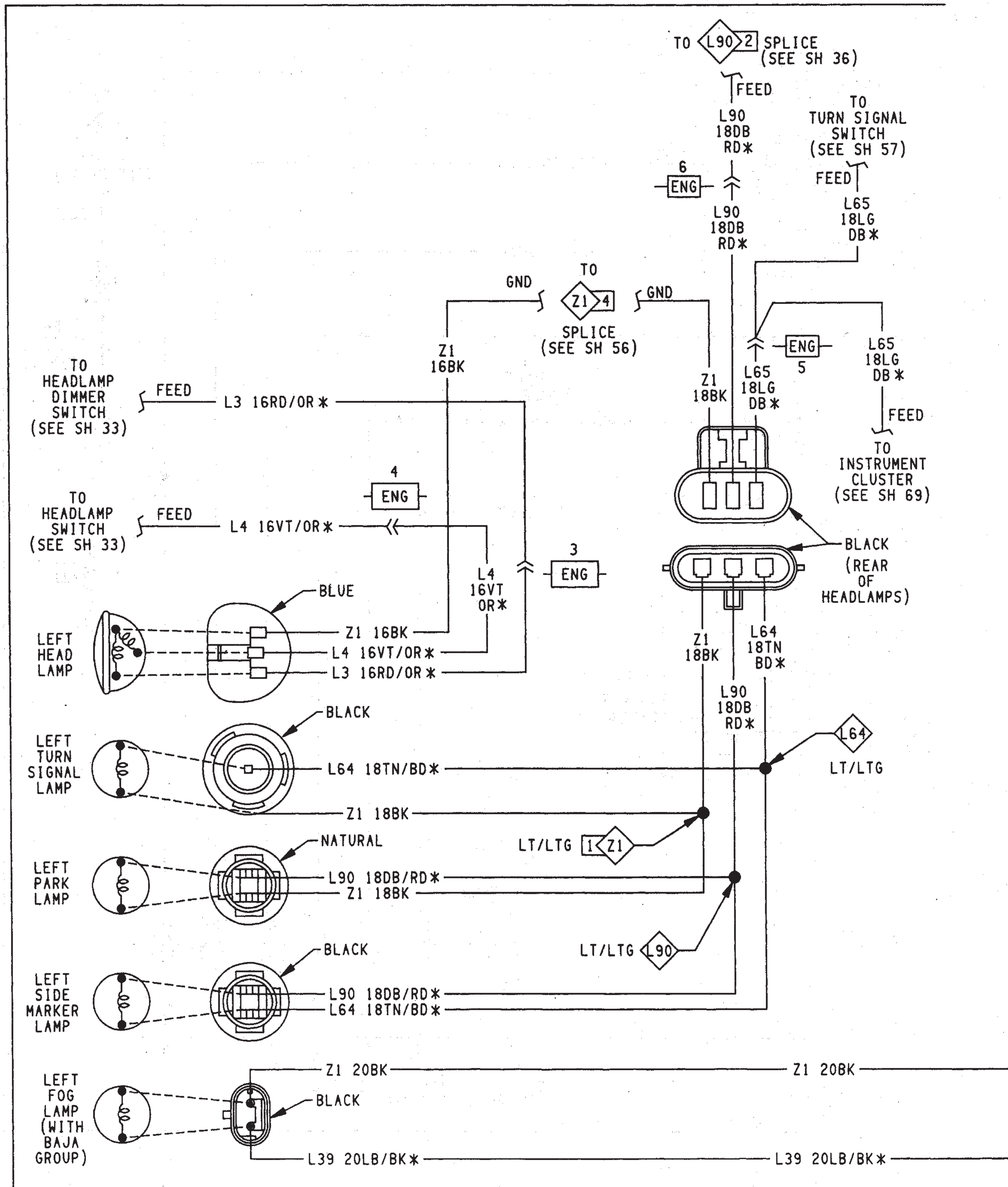


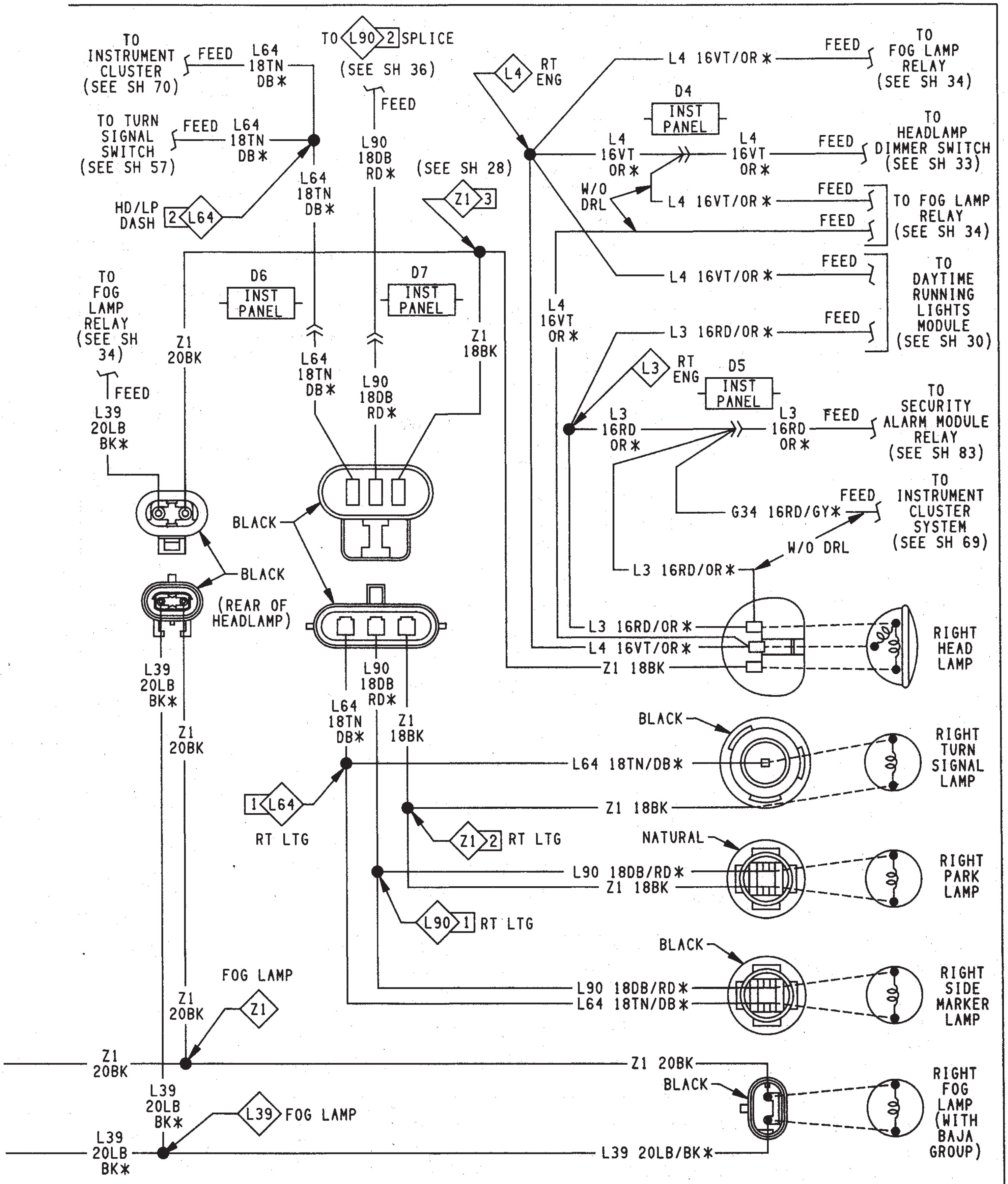
VEHICLE SPEED CONTROL SYSTEM AND BRAKE SYSTEM



ZJ 29 UNDERHOOD LAMP/HORN SYSTEM J938W-1

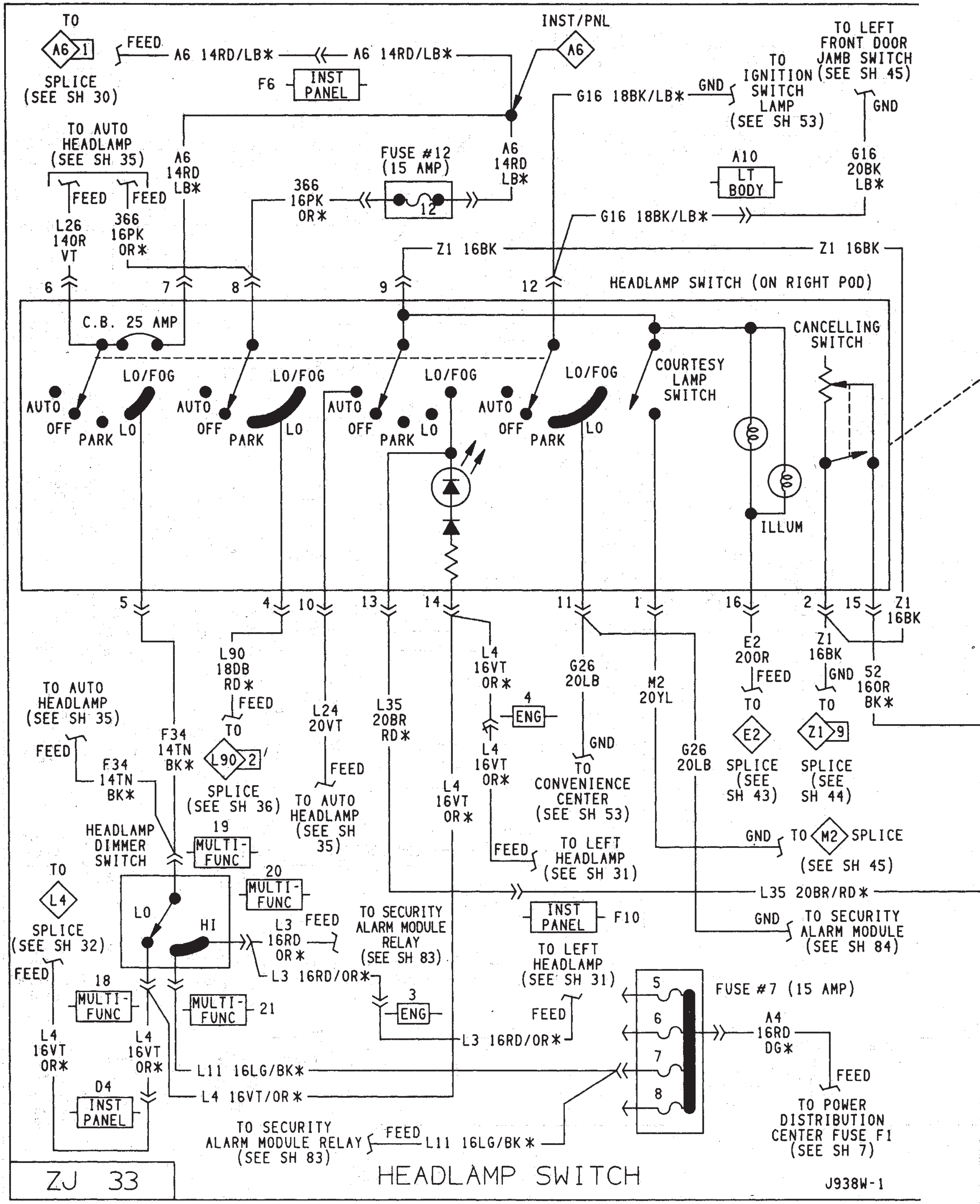

TO POWER DISTRIBUTION CENTER FUSE F10 (SEE SH 7)
FEED
A6 14RD/LB*
TO POWER DISTRIBUTION CENTER FUSE F5 (SEE SH 8)
FEED
F83 18YL/DG*
TO G7 1 SPLICE (SEE SH 16,22)
FEED
G7 20WT/OR*
TO A6 SPLICE (SEE SH 33)
FEED
A6 14RD LB*
F6 INST PANEL
A6 14RD LB*
A6 1 RT ENG
Z1 18BK
D13 INST PANEL
TO INSTRUMENT CLUSTER (HIGH BEAM INDICATOR) (SEE SH 70)
FEED
G34 16RD/GY*
G34 16RD/GY*
TO L4 SPLICE (SEE SH 32)
FEED
L4 16VT/OR*
Z1 18BK
L4 16VT/OR*
F83 18YL/DG*
G34 16RD/GY*
L3 16RD/OR*
BLACK
A6 14RD/LB*
G7 20WT/OR*
Z1 18BK
TO L3 SPLICE (SEE SH 32)
FEED
L3 16RD OR*
L4 16VT OR*
G34 16RD GY*
Z1 18BK
G7 20WT OR*
F83 18YL DG*
A6 14RD LB*
1
10
4
8
7
5
6
DAYTIME RUNNING LAMP MODULE (DRL) (RIGHT SIDE SHIELD)


TO L90 2 SPLICE (SEE SH 36)
FEED
L90 18DB RD*
TO TURN SIGNAL SWITCH (SEE SH 57)
FEED
6 ENG
L90 18DB RD*
L65 18LG DB*
TO Z1 4 SPLICE (SEE SH 56)
GND
GND
Z1 16BK
Z1 18BK
L65 18LG DB*
ENG 5
L65 18LG DB*
FEED
TO INSTRUMENT CLUSTER (SEE SH 69)
TO HEADLAMP DIMMER SWITCH (SEE SH 33)
FEED
L3 16RD/OR*
4 ENG
TO HEADLAMP SWITCH (SEE SH 33)
FEED
L4 16VT/OR*
3 ENG
L4 16VT OR*
BLACK (REAR OF HEADLAMPS)
BLUE
LEFT HEAD LAMP
Z1 16BK
L4 16VT/OR*
L3 16RD/OR*
Z1 18BK
L64 18TN BD*
L90 18DB RD*
BLACK
LEFT TURN SIGNAL LAMP
L64 18TN/BD*
Z1 18BK
L64 LT/LTG
NATURAL
LT/LTG 1 Z1
LEFT PARK LAMP
L90 18DB/RD*
Z1 18BK
LT/LTG L90
BLACK
LEFT SIDE MARKER LAMP
L90 18DB/RD*
L64 18TN/BD*
LEFT FOG LAMP (WITH BAJA GROUP)
Z1 20BK
Z1 20BK
BLACK
L39 20LB/BK*
L39 20LB/BK*



J938W-1

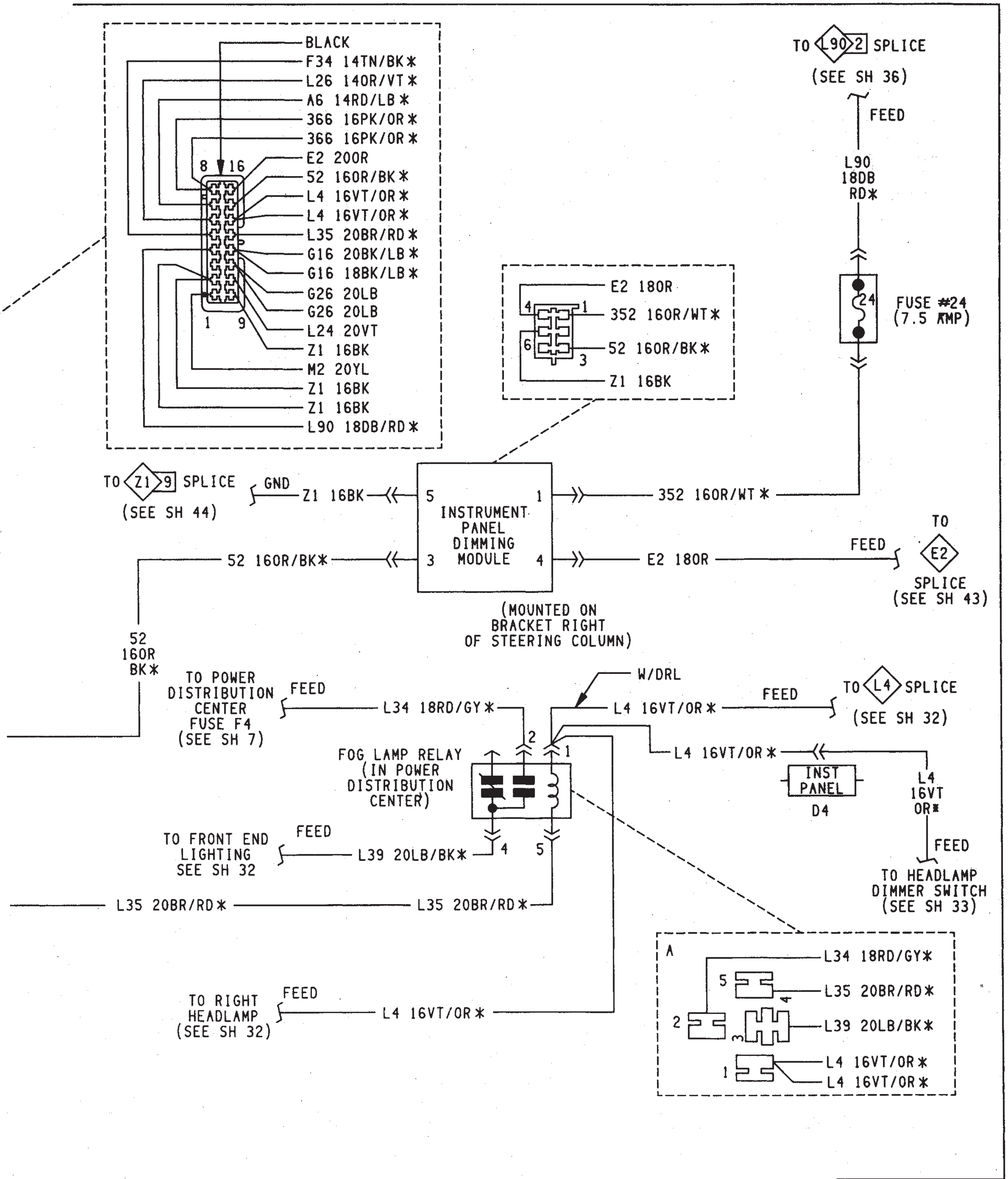
FRONT END LIGHTING

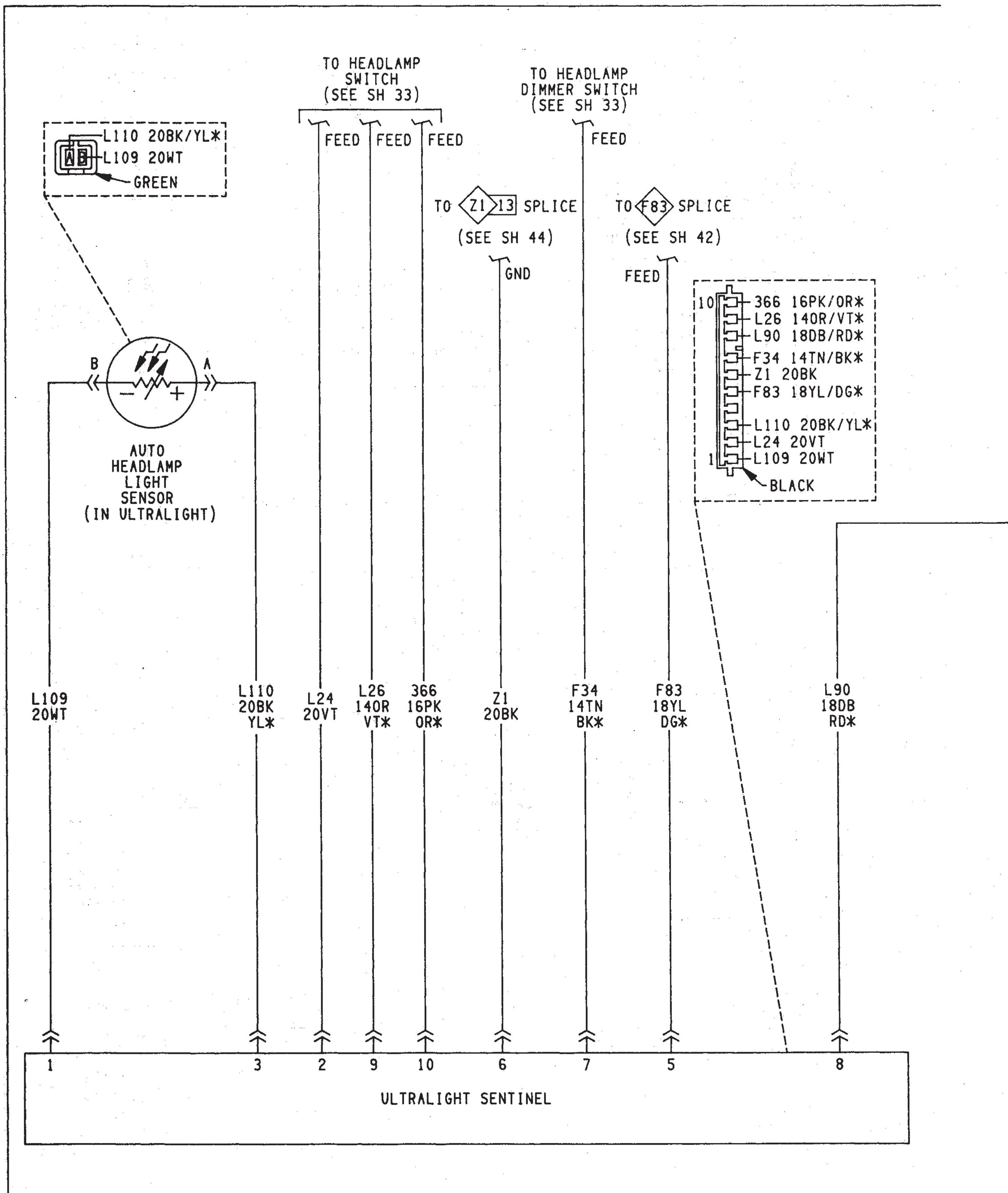


ZJ 33

HEADLAMP SWITCH

J938W-1

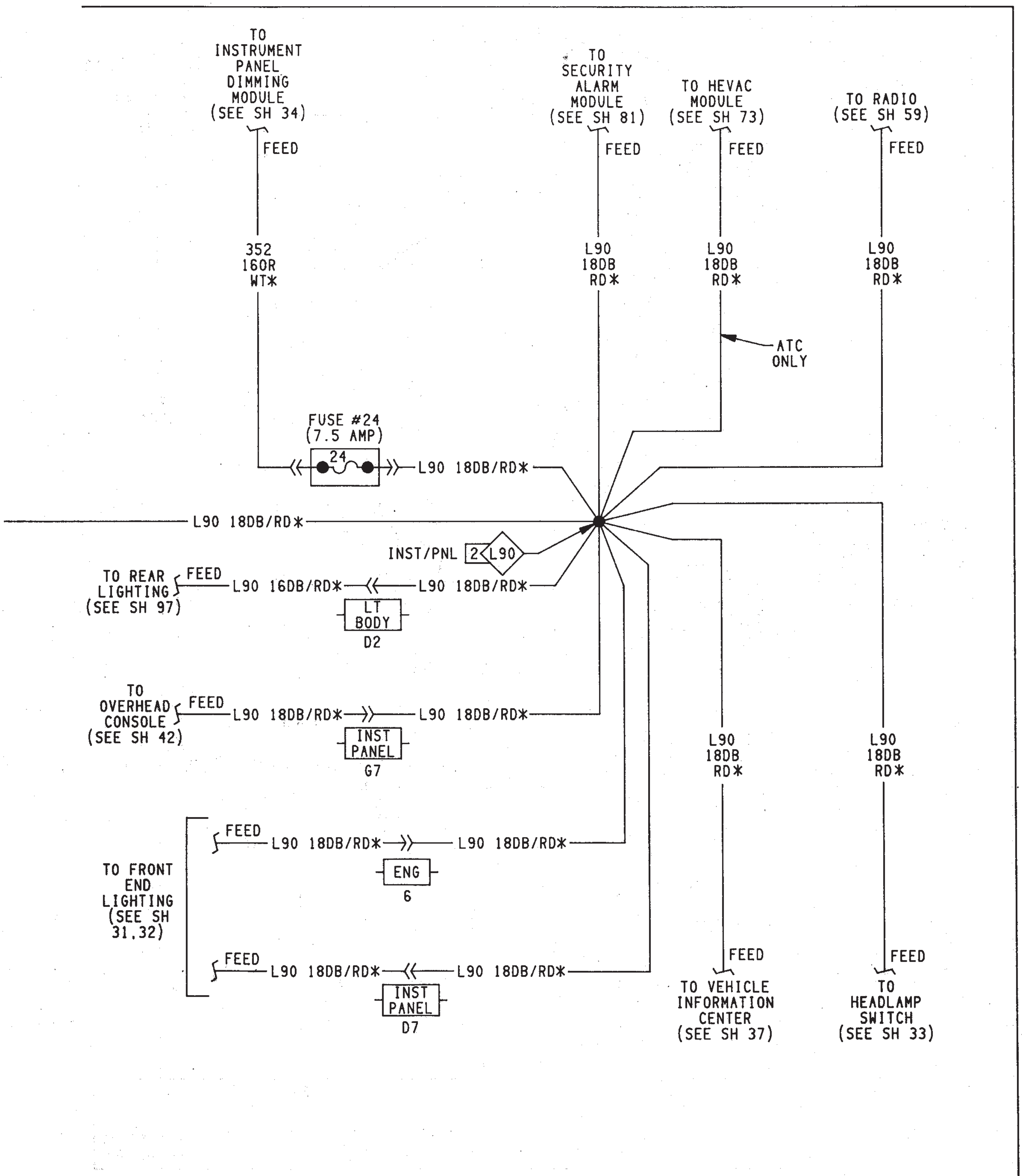

BLACK
F34 14TN/BK*
L26 14OR/VT*
A6 14RD/LB*
366 16PK/OR*
366 16PK/OR*
E2 20OR
52 16OR/BK*
L4 16VT/OR*
L4 16VT/OR*
L35 20BR/RD*
G16 20BK/LB*
G16 18BK/LB*
G26 20LB
G26 20LB
L24 20VT
Z1 16BK
M2 20YL
Z1 16BK
Z1 16BK
L90 18DB/RD*
8 16
1 9
TO L90 2 SPLICE
(SEE SH 36)
FEED
L90
18DB
RD*
FUSE #24
(7.5 AMP)
24
E2 18OR
352 16OR/WT*
52 16OR/BK*
Z1 16BK
4 1
6 3
TO Z1 9 SPLICE
(SEE SH 44)
GND
Z1 16BK
INSTRUMENT
PANEL
DIMMING
MODULE
5 1 3 4
352 16OR/WT*
52 16OR/BK*
E2 18OR
FEED
TO
E2
SPLICE
(SEE SH 43)
(MOUNTED ON
BRACKET RIGHT
OF STEERING COLUMN)
52
16OR
BK*
TO POWER
DISTRIBUTION
CENTER
FUSE F4
(SEE SH 7)
FEED
L34 18RD/GY*
W/DRL
L4 16VT/OR*
FEED
TO L4 SPLICE
(SEE SH 32)
L4 16VT/OR*
INST
PANEL
D4
L4
16VT
OR*
FEED
TO HEADLAMP
DIMMER SWITCH
(SEE SH 33)
FOG LAMP RELAY
(IN POWER
DISTRIBUTION
CENTER)
2 1 4 5
TO FRONT END
LIGHTING
SEE SH 32
FEED
L39 20LB/BK*
L35 20BR/RD*
L35 20BR/RD*
TO RIGHT
HEADLAMP
(SEE SH 32)
FEED
L4 16VT/OR*
A
L34 18RD/GY*
5
L35 20BR/RD*
4
2
L39 20LB/BK*
3
1
L4 16VT/OR*
L4 16VT/OR*

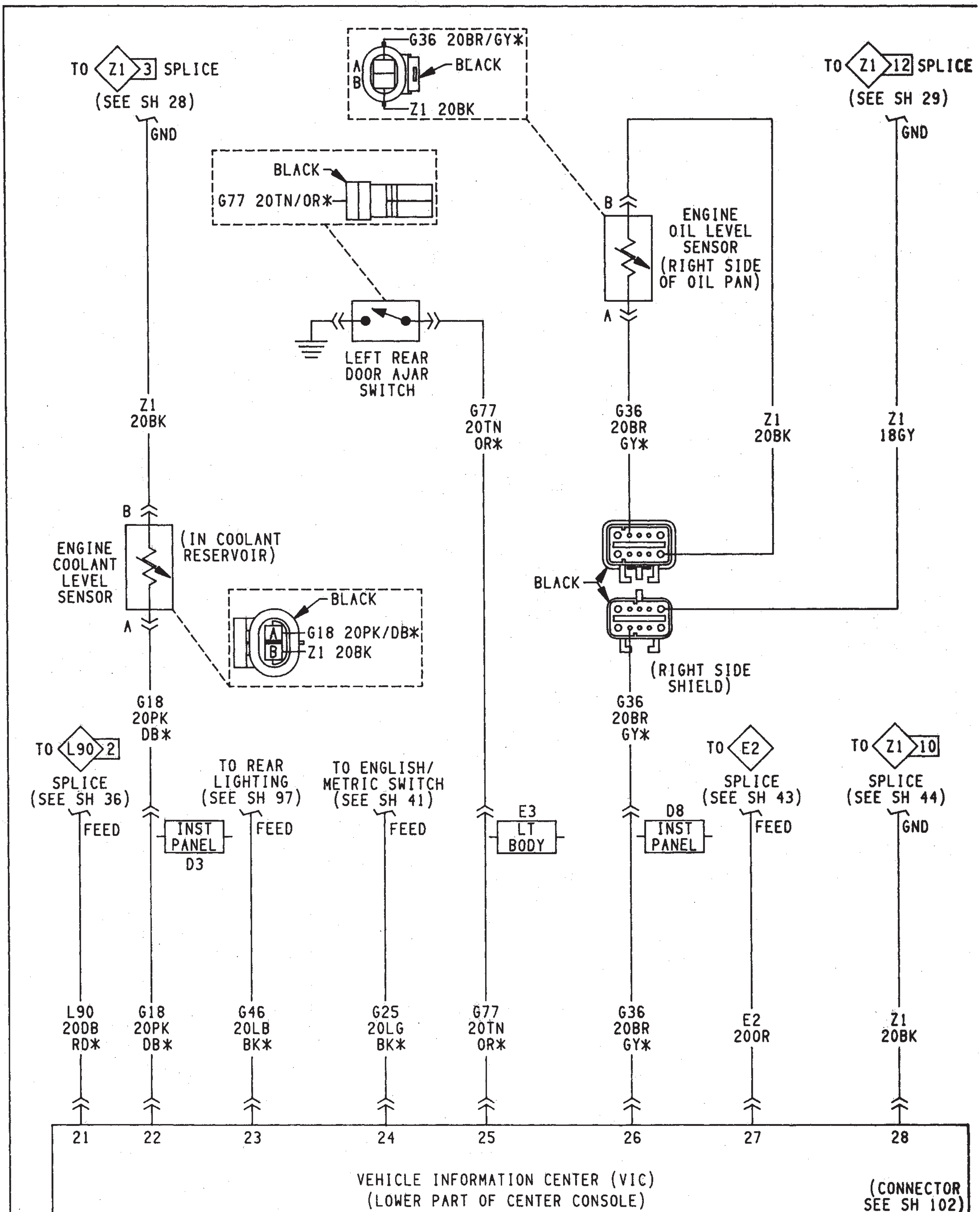


ZJ 35

AUTO HEADLAMP

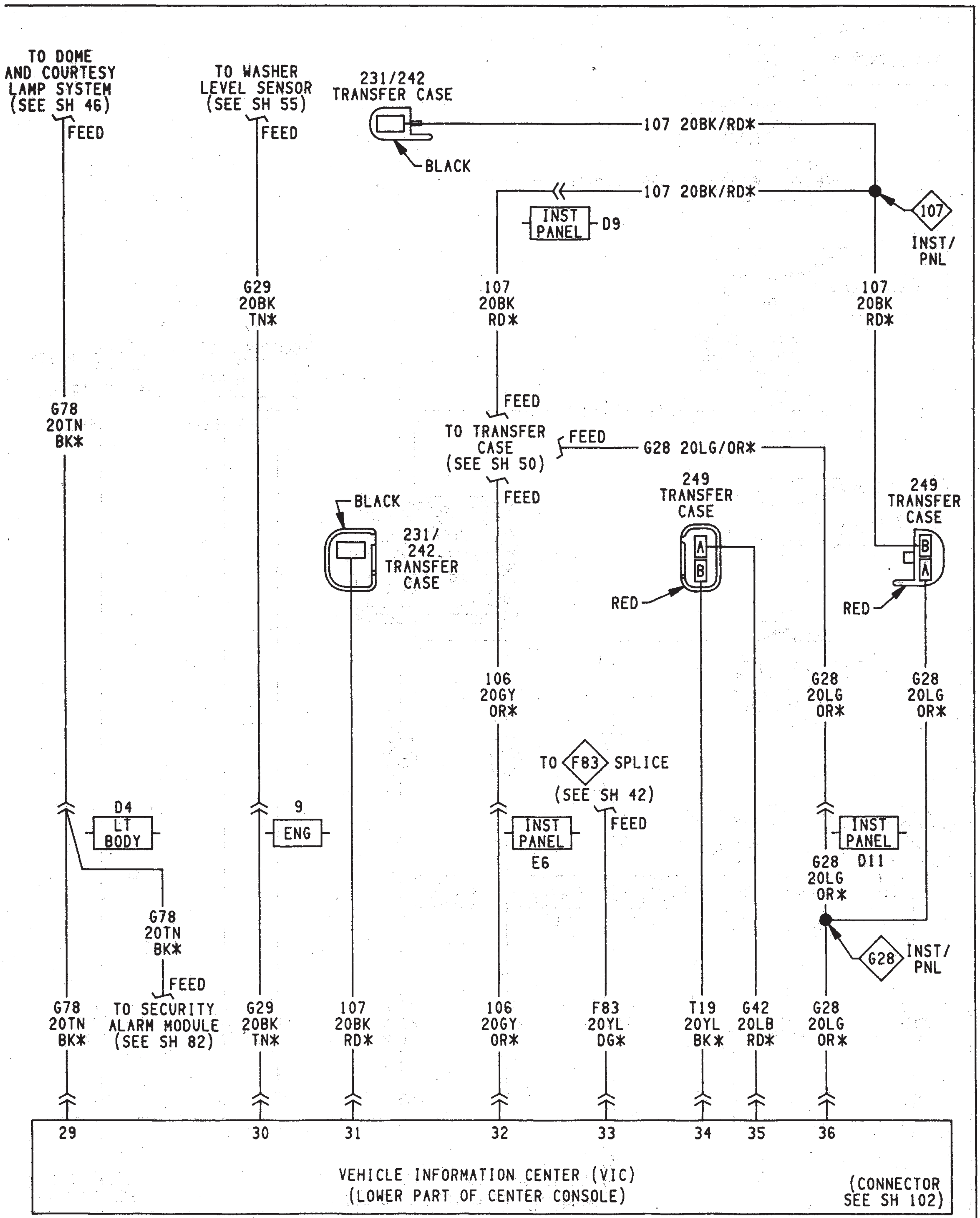
J938W-1


TO INSTRUMENT PANEL DIMMING MODULE (SEE SH 34)
FEED
352 16OR WT*
TO SECURITY ALARM MODULE (SEE SH 81)
FEED
L90 18DB RD*
TO HEVAC MODULE (SEE SH 73)
FEED
L90 18DB RD*
ATC ONLY
TO RADIO (SEE SH 59)
FEED
L90 18DB RD*
FUSE #24 (7.5 AMP)
24
L90 18DB/RD*
L90 18DB/RD*
INST/PNL 2 L90
TO REAR LIGHTING (SEE SH 97)
FEED
L90 16DB/RD*
L90 18DB/RD*
LT BODY
D2
TO OVERHEAD CONSOLE (SEE SH 42)
FEED
L90 18DB/RD*
L90 18DB/RD*
INST PANEL
G7
TO FRONT END LIGHTING (SEE SH 31,32)
FEED
L90 18DB/RD*
L90 18DB/RD*
ENG
6
FEED
L90 18DB/RD*
L90 18DB/RD*
INST PANEL
D7
L90 18DB RD*
FEED
TO VEHICLE INFORMATION CENTER (SEE SH 37)
L90 18DB RD*
FEED
TO HEADLAMP SWITCH (SEE SH 33)

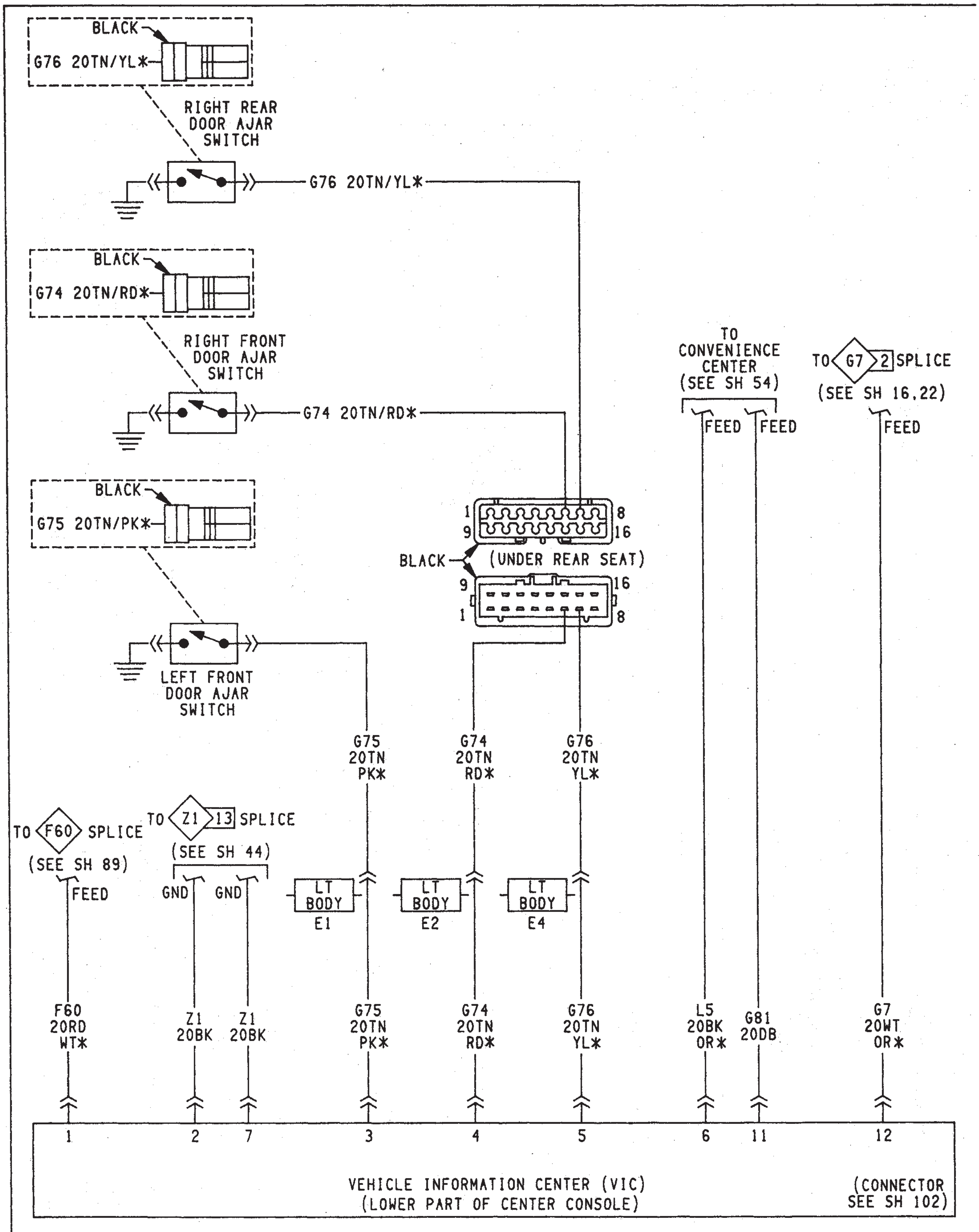


VEHICLE INFORMATION CENTER

J938W-1

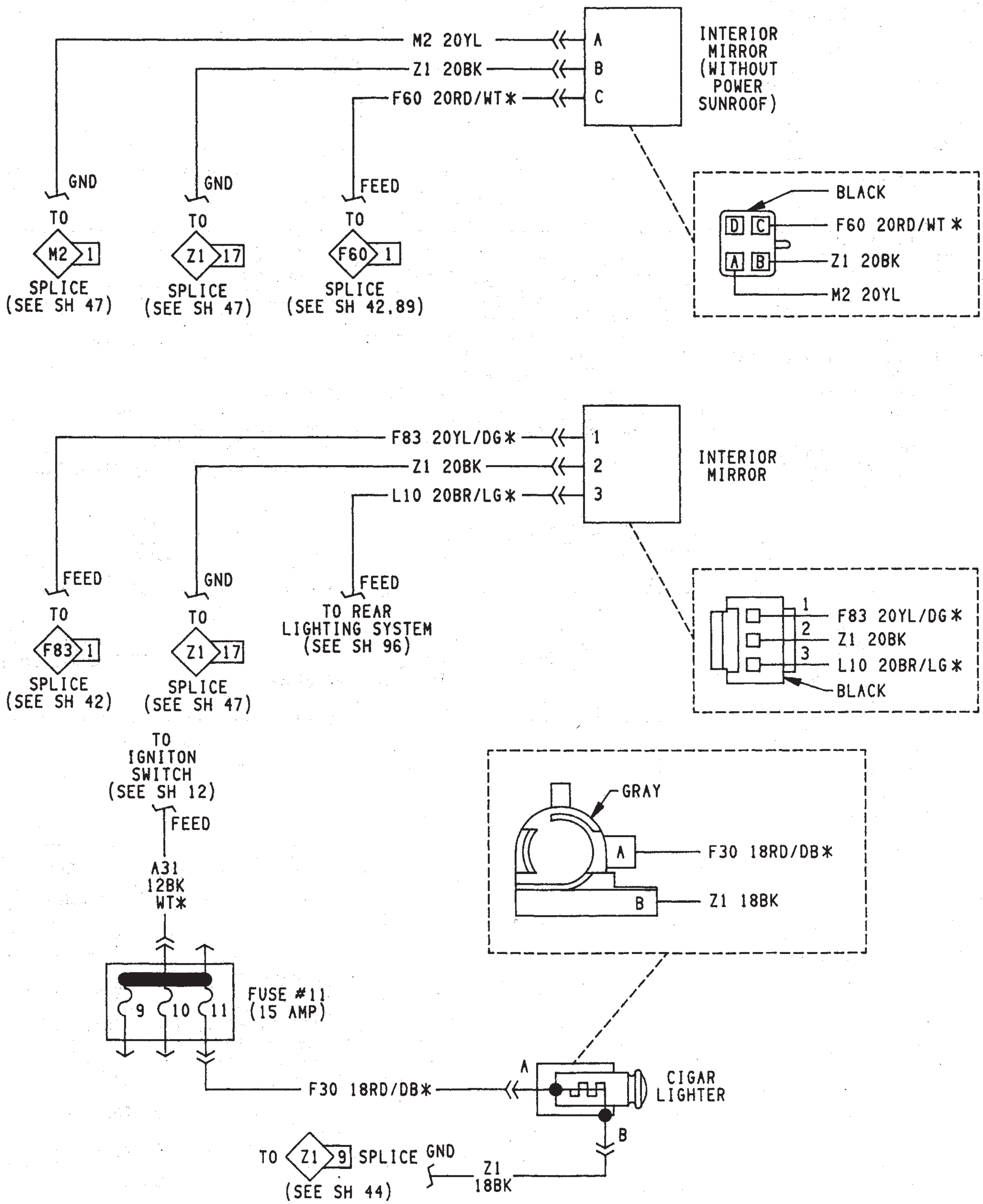


TO DOME AND COURTESY LAMP SYSTEM (SEE SH 46)
FEED
TO WASHER LEVEL SENSOR (SEE SH 55)
FEED
231/242 TRANSFER CASE
BLACK
107 20BK/RD*
107 20BK/RD*
INST PANEL
D9
107
INST/PNL
G29 20BK TN*
107 20BK RD*
107 20BK RD*
G78 20TN BK*
FEED
TO TRANSFER CASE (SEE SH 50)
FEED
G28 20LG/OR*
FEED
249 TRANSFER CASE
249 TRANSFER CASE
BLACK
231/242 TRANSFER CASE
A
B
B
A
RED
RED
106 20GY OR*
G28 20LG OR*
G28 20LG OR*
TO F83 SPLICE (SEE SH 42)
FEED
D4
LT BODY
9
ENG
INST PANEL
E6
INST PANEL
D11
G28 20LG OR*
G78 20TN BK*
G28
INST/PNL
FEED
G78 20TN BK*
TO SECURITY ALARM MODULE (SEE SH 82)
G29 20BK TN*
107 20BK RD*
106 20GY OR*
F83 20YL DG*
T19 20YL BK*
G42 20LB RD*
G28 20LG OR*
29
30
31
32
33
34
35
36
VEHICLE INFORMATION CENTER (VIC) (LOWER PART OF CENTER CONSOLE)
(CONNECTOR SEE SH 102)



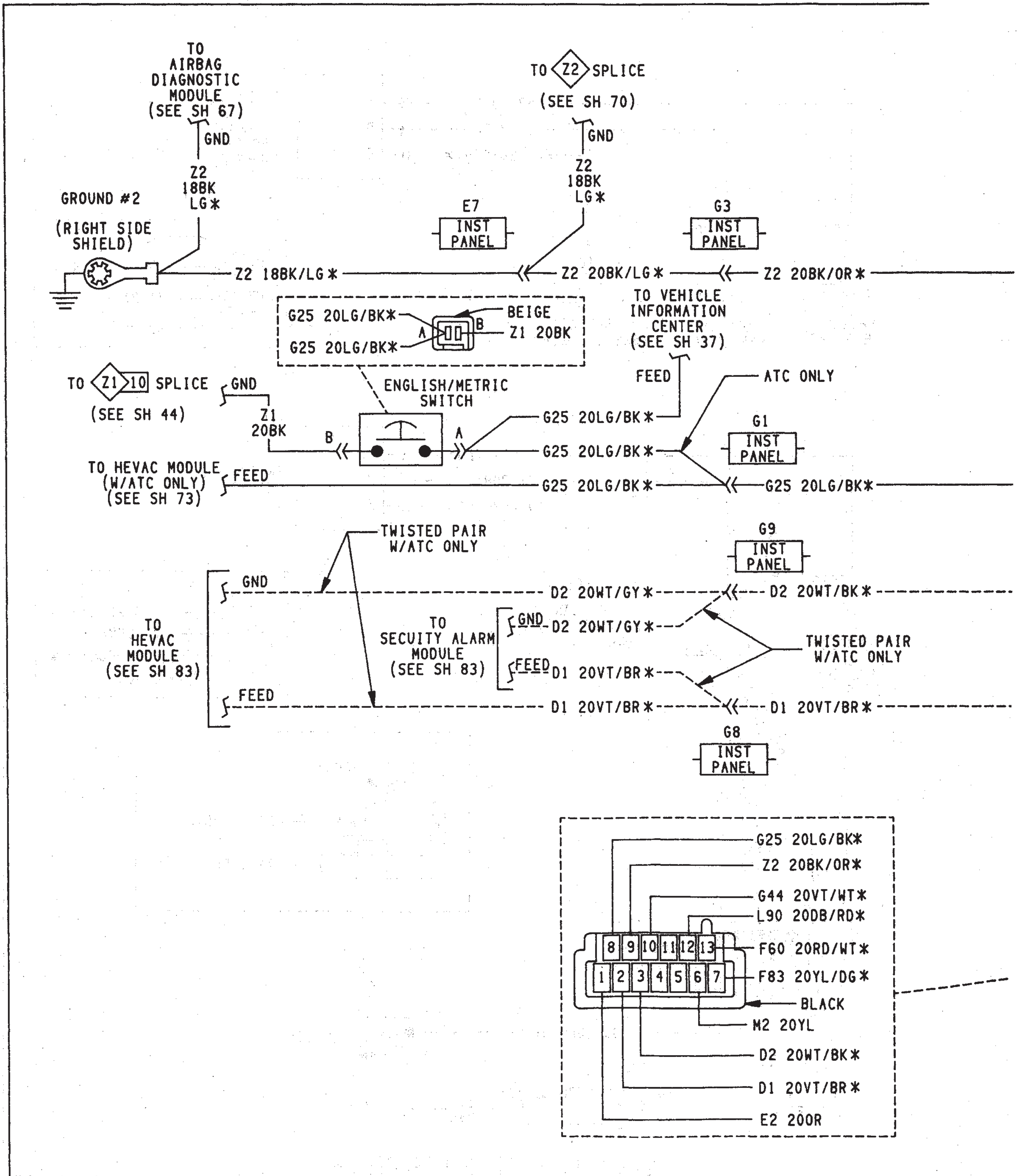
VEHICLE INFORMATION SYSTEM

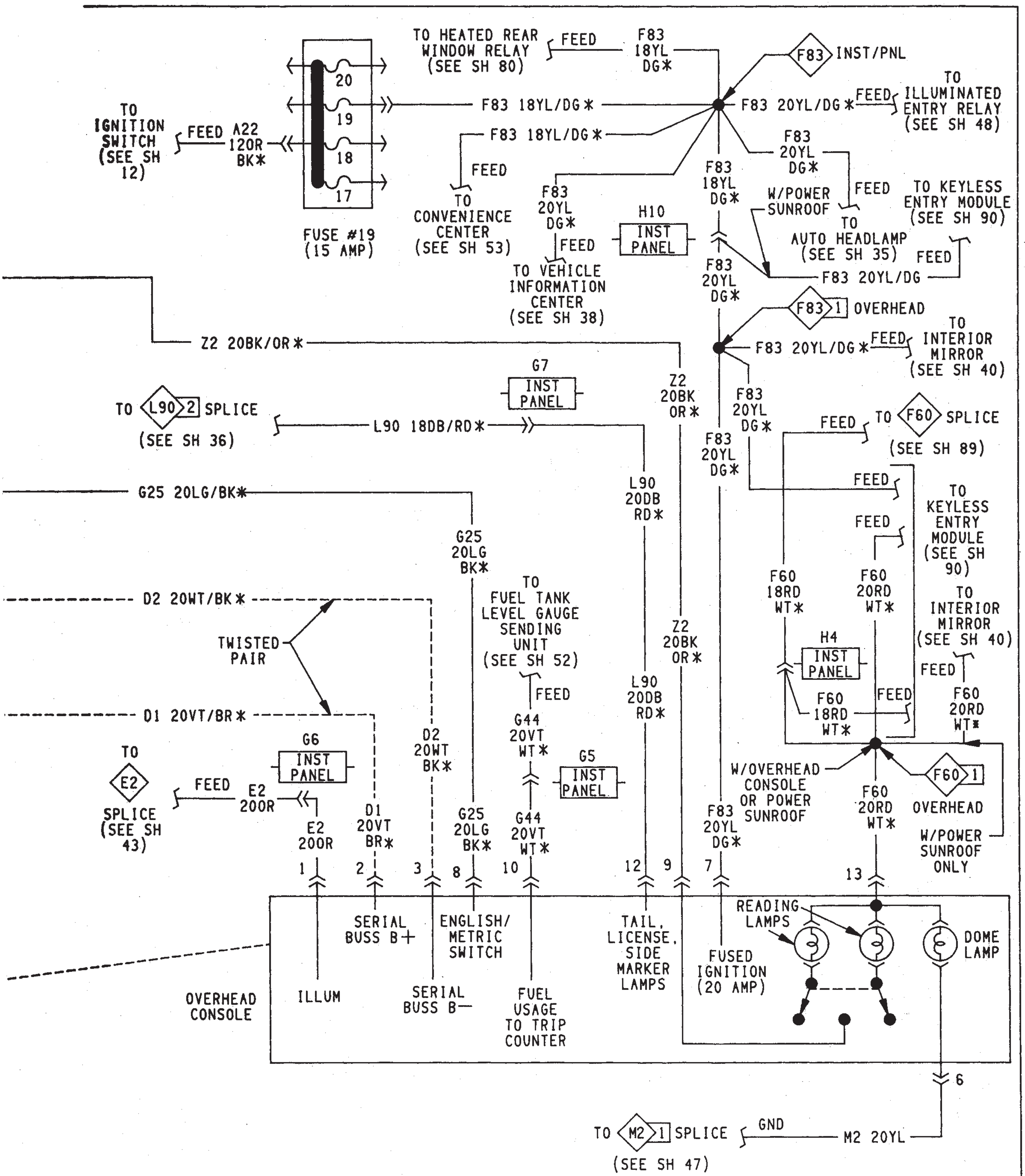
J938W-1



DAY/NIGHT MIRROR AND CIGAR LIGHTER

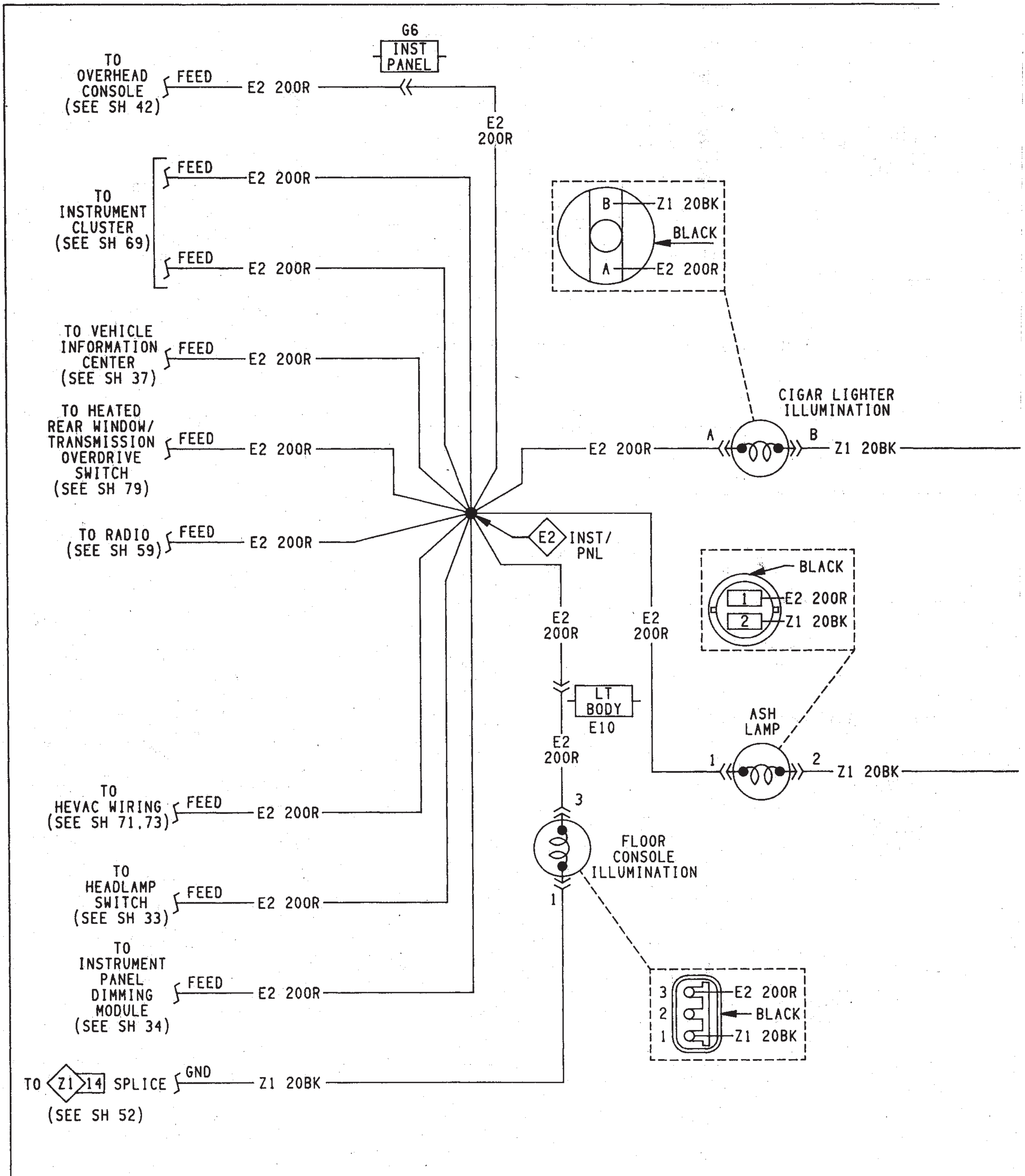
J938W-1


TO AIRBAG DIAGNOSTIC MODULE (SEE SH 67)
GND
Z2 18BK LG*
GROUND #2
(RIGHT SIDE SHIELD)
Z2 18BK/LG*
E7 INST PANEL
TO Z2 SPLICE (SEE SH 70)
GND
Z2 18BK LG*
Z2 20BK/LG*
G3 INST PANEL
Z2 20BK/OR*
G25 20LG/BK*
G25 20LG/BK*
A
B
BEIGE
Z1 20BK
TO VEHICLE INFORMATION CENTER (SEE SH 37)
FEED
ATC ONLY
TO Z1 10 SPLICE (SEE SH 44)
GND
Z1 20BK
ENGLISH/METRIC SWITCH
G25 20LG/BK*
G25 20LG/BK*
G1 INST PANEL
TO HEVAC MODULE (W/ATC ONLY) (SEE SH 73)
FEED
G25 20LG/BK*
G25 20LG/BK*
TWISTED PAIR W/ATC ONLY
G9 INST PANEL
GND
D2 20WT/GY*
D2 20WT/BK*
TO HEVAC MODULE (SEE SH 83)
TO SECUITY ALARM MODULE (SEE SH 83)
GND D2 20WT/GY*
FEED D1 20VT/BR*
TWISTED PAIR W/ATC ONLY
FEED
D1 20VT/BR*
D1 20VT/BR*
G8 INST PANEL
G25 20LG/BK*
Z2 20BK/OR*
G44 20VT/WT*
L90 20DB/RD*
8 9 10 11 12 13
1 2 3 4 5 6 7
F60 20RD/WT*
F83 20YL/DG*
BLACK
M2 20YL
D2 20WT/BK*
D1 20VT/BR*
E2 20OR

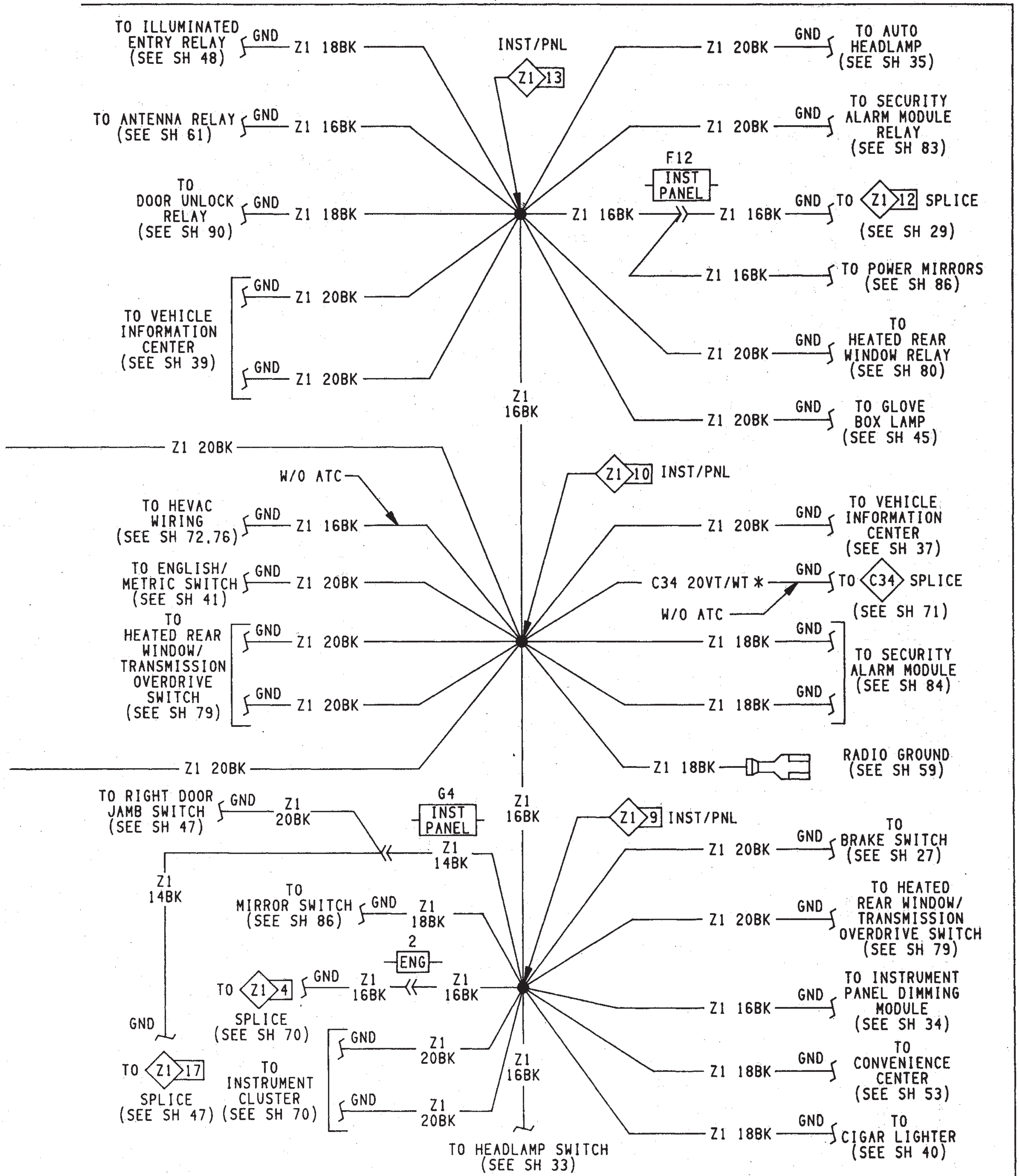


J938W-1

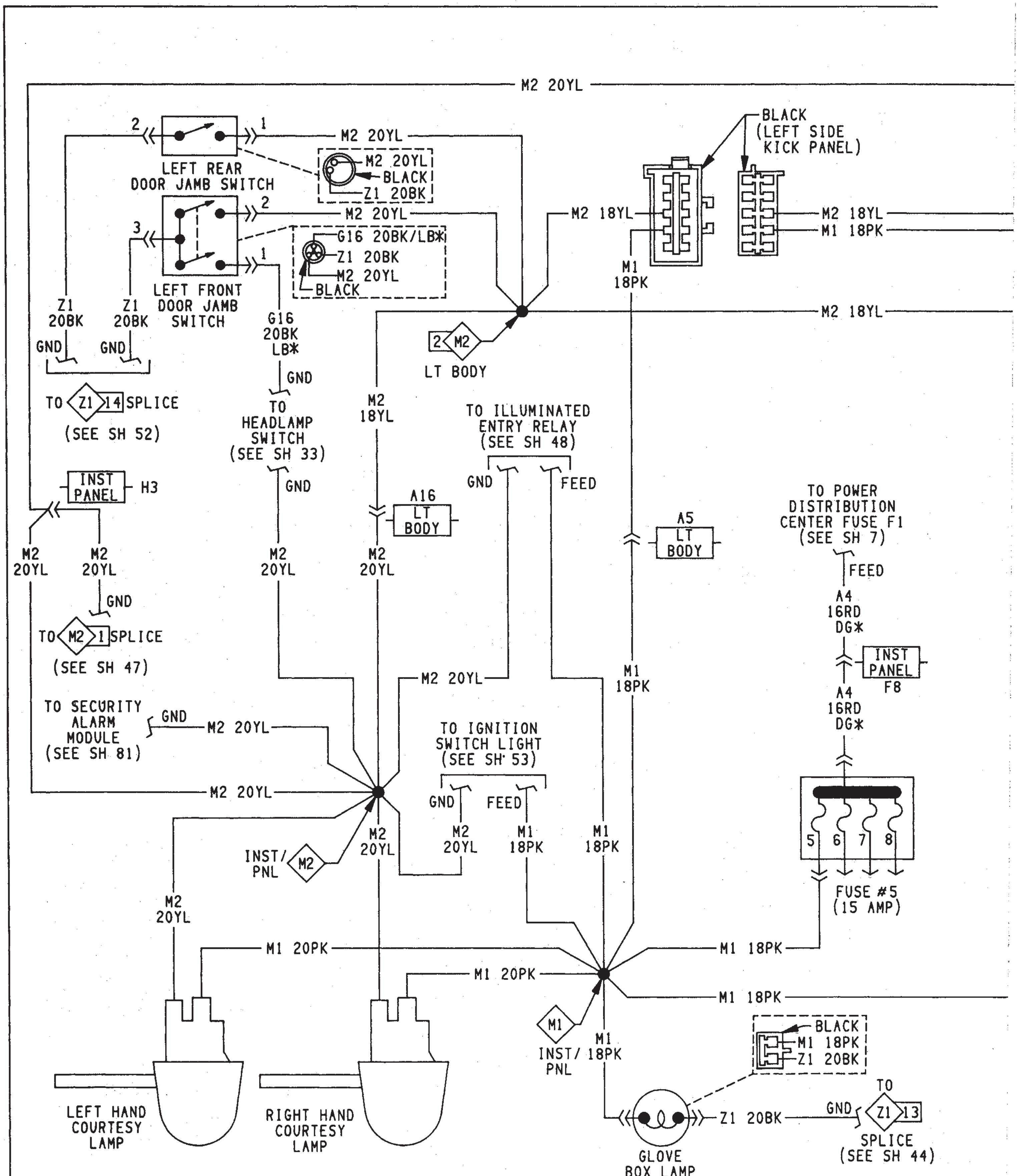
OVERHEAD CONSOLE



ZJ 43 INSTRUMENT PANEL ILLUMINATION J938W-1



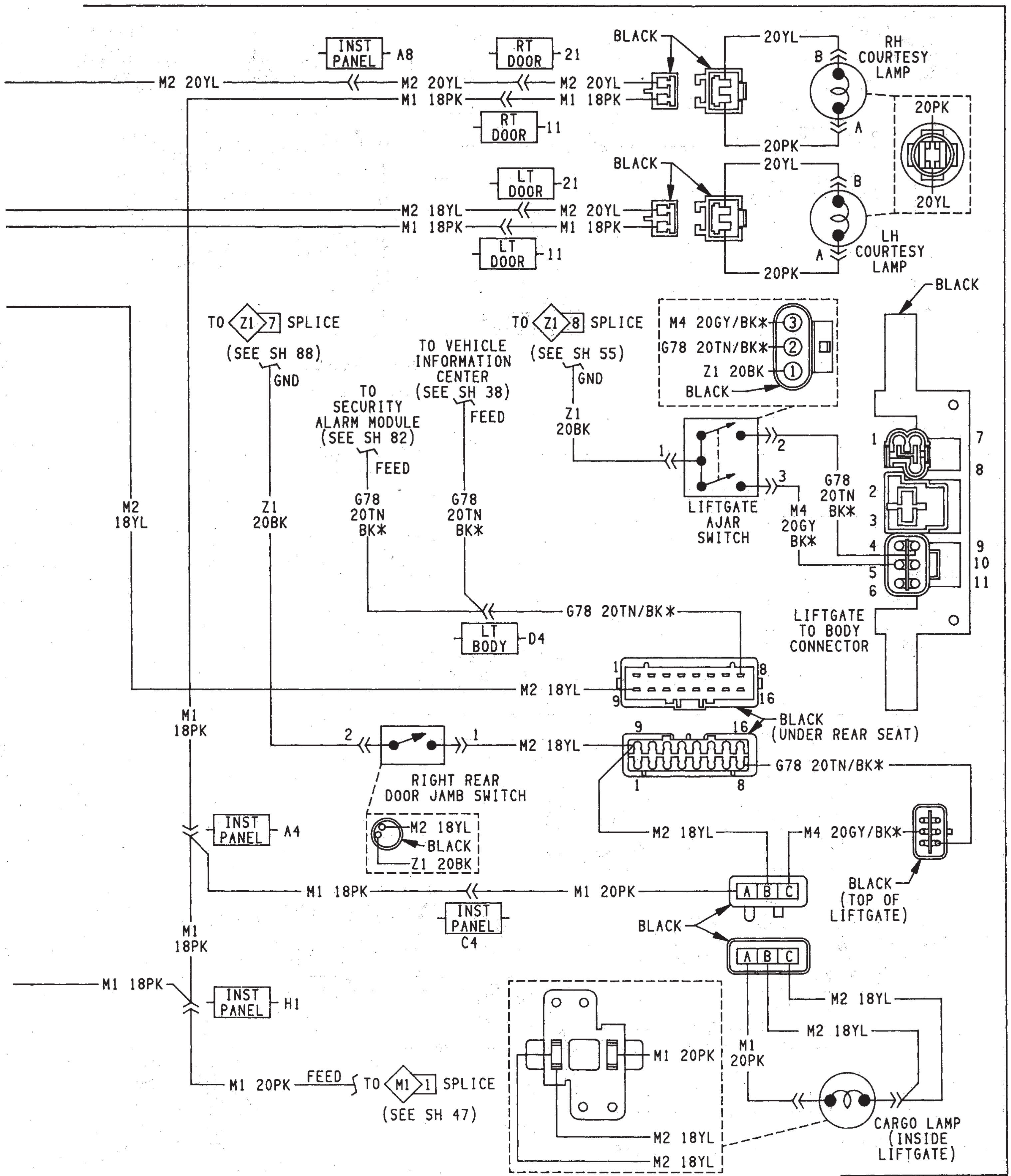
J938W-1 INSTRUMENT PANEL GROUND SYSTEM



ZJ 45

DOME AND COURTESY LAMPS

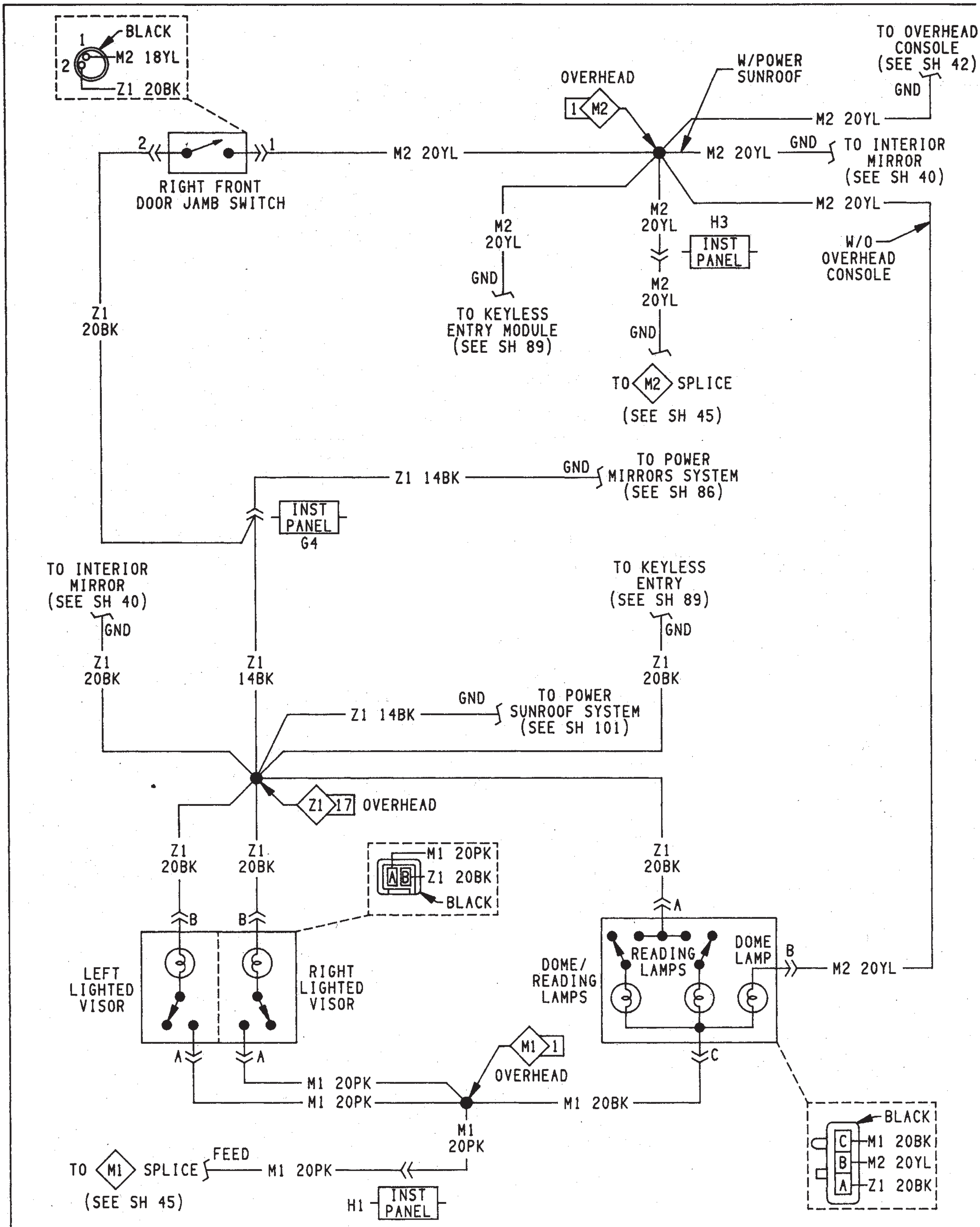
J938W-1



J938W-1

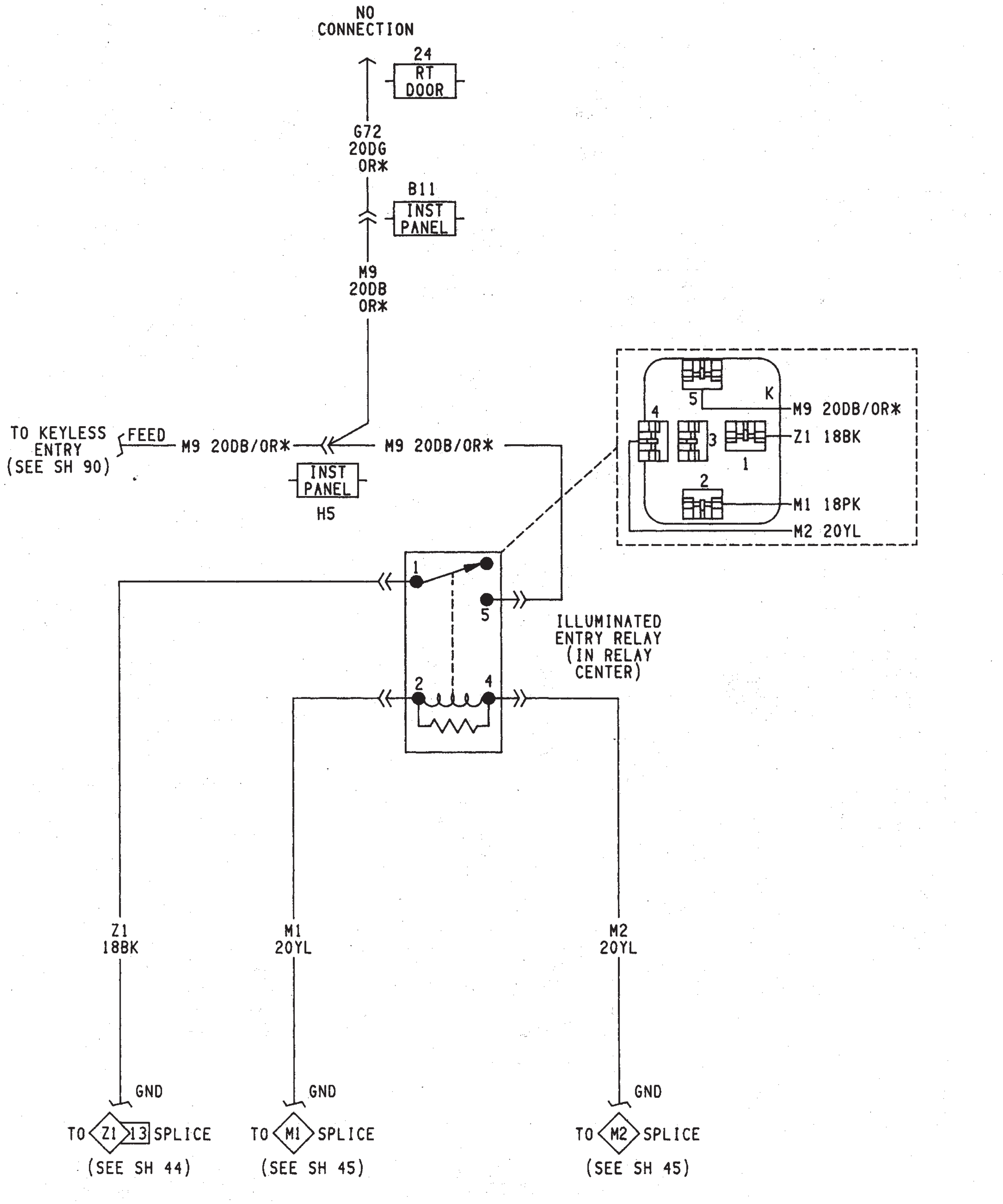
DOME AND COURTESY LAMPS

ZJ 46

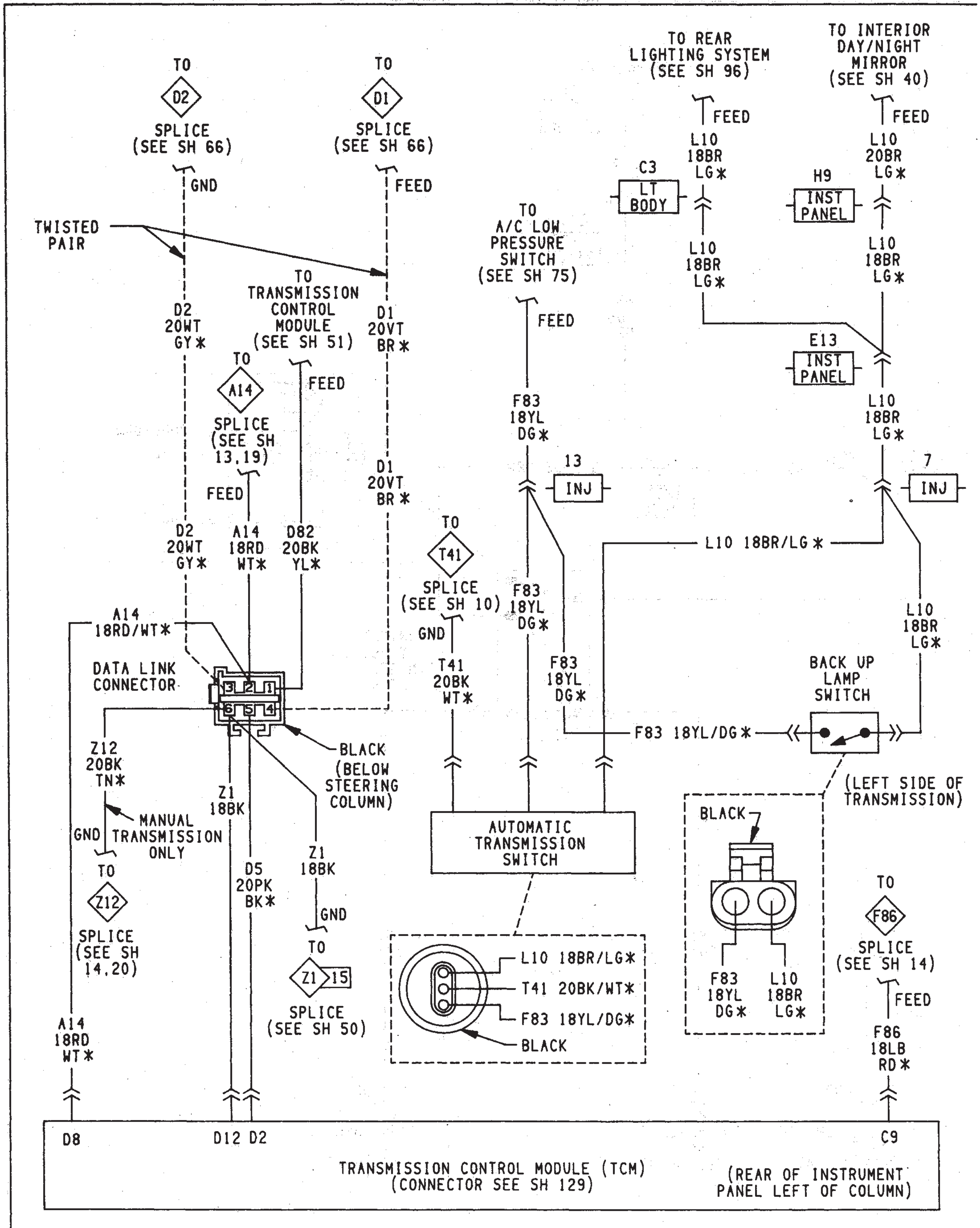


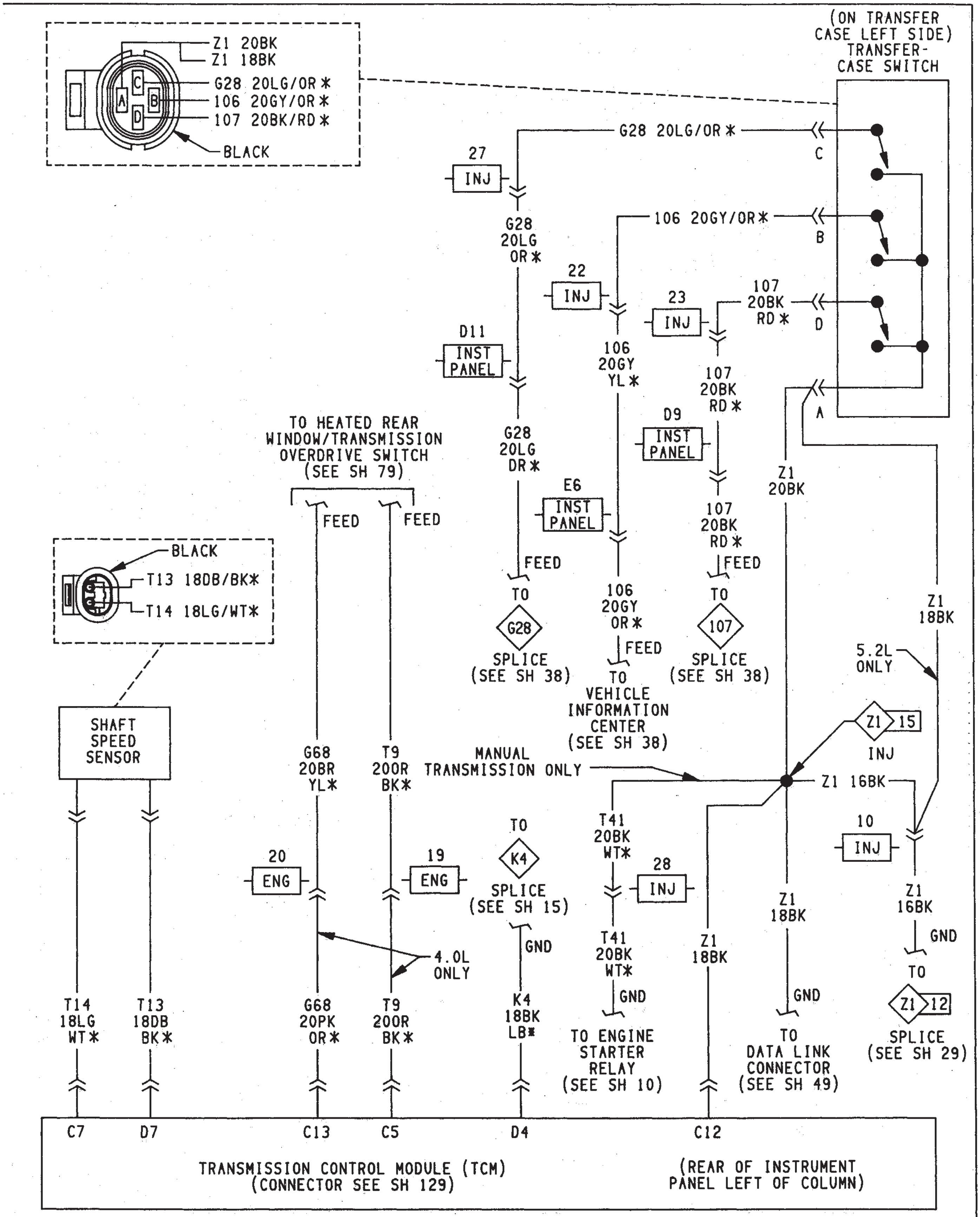
DOME AND COURTESY LAMPS

J938W-1

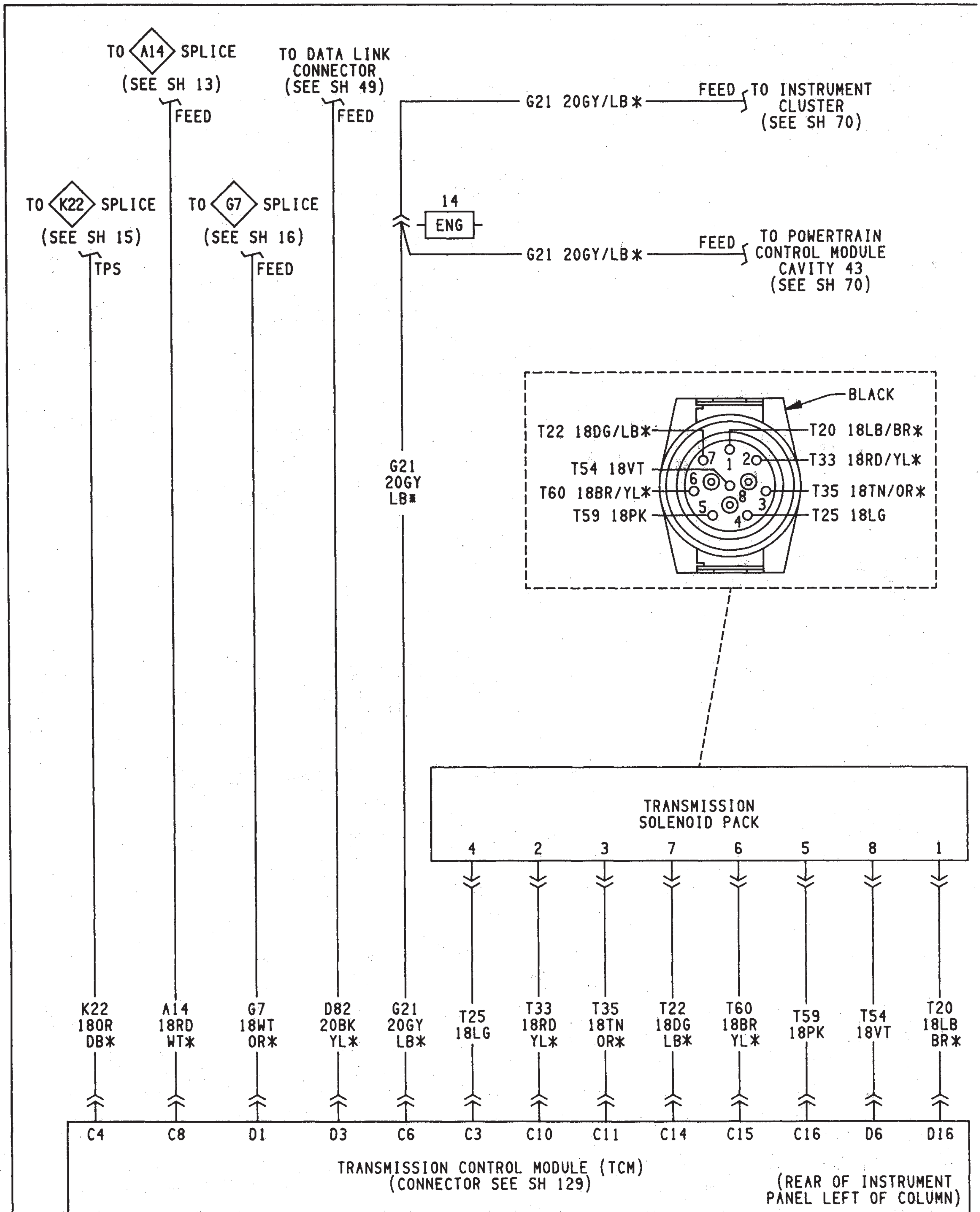


NO CONNECTION
24
RT DOOR
G72
20DG
OR*
B11
INST PANEL
M9
20DB
OR*
TO KEYLESS ENTRY (SEE SH 90)
FEED
M9 20DB/OR*
INST PANEL
H5
M9 20DB/OR*
5
K
M9 20DB/OR*
4
3
Z1 18BK
1
2
M1 18PK
M2 20YL
1
5
ILLUMINATED ENTRY RELAY (IN RELAY CENTER)
2
4
Z1
18BK
M1
20YL
M2
20YL
GND
TO Z1 13 SPLICE
(SEE SH 44)
GND
TO M1 SPLICE
(SEE SH 45)
GND
TO M2 SPLICE
(SEE SH 45)


TO
D2
SPLICE
(SEE SH 66)
GND
TO
D1
SPLICE
(SEE SH 66)
FEED
TWISTED PAIR
TO REAR LIGHTING SYSTEM (SEE SH 96)
FEED
L10 18BR LG*
C3
LT BODY
L10 18BR LG*
TO INTERIOR DAY/NIGHT MIRROR (SEE SH 40)
FEED
L10 20BR LG*
H9
INST PANEL
L10 18BR LG*
E13
INST PANEL
L10 18BR LG*
7
INJ
TO A/C LOW PRESSURE SWITCH (SEE SH 75)
FEED
F83 18YL DG*
13
INJ
TO TRANSMISSION CONTROL MODULE (SEE SH 51)
FEED
D2 20WT GY*
D1 20VT BR*
TO
A14
SPLICE (SEE SH 13,19)
FEED
D1 20VT BR*
D2 20WT GY*
A14 18RD WT*
D82 20BK YL*
TO
T41
SPLICE (SEE SH 10)
GND
F83 18YL DG*
L10 18BR/LG*
L10 18BR LG*
A14 18RD/WT*
DATA LINK CONNECTOR
3 2 1
6 5 4
BLACK (BELOW STEERING COLUMN)
T41 20BK WT*
F83 18YL DG*
BACK UP LAMP SWITCH
F83 18YL/DG*
Z12 20BK TN*
MANUAL TRANSMISSION ONLY
GND
TO
Z12
SPLICE (SEE SH 14,20)
Z1 18BK
D5 20PK BK*
Z1 18BK
GND
TO
Z1 15
SPLICE (SEE SH 50)
AUTOMATIC TRANSMISSION SWITCH
(LEFT SIDE OF TRANSMISSION)
BLACK
L10 18BR/LG*
T41 20BK/WT*
F83 18YL/DG*
BLACK
F83 18YL DG*
L10 18BR LG*
TO
F86
SPLICE (SEE SH 14)
FEED
F86 18LB RD*
A14 18RD WT*
D8
D12 D2
C9
TRANSMISSION CONTROL MODULE (TCM) (CONNECTOR SEE SH 129)
(REAR OF INSTRUMENT PANEL LEFT OF COLUMN)

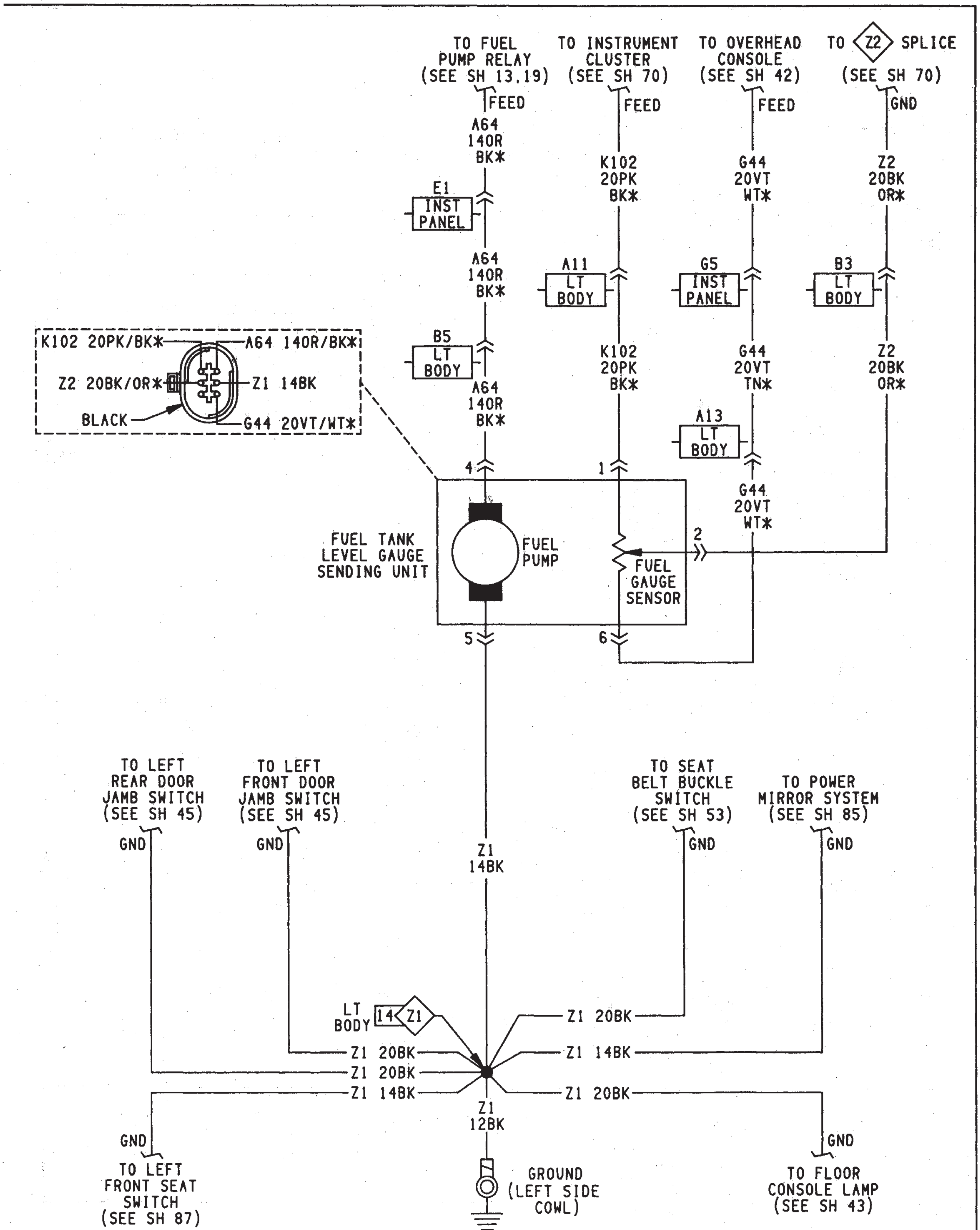


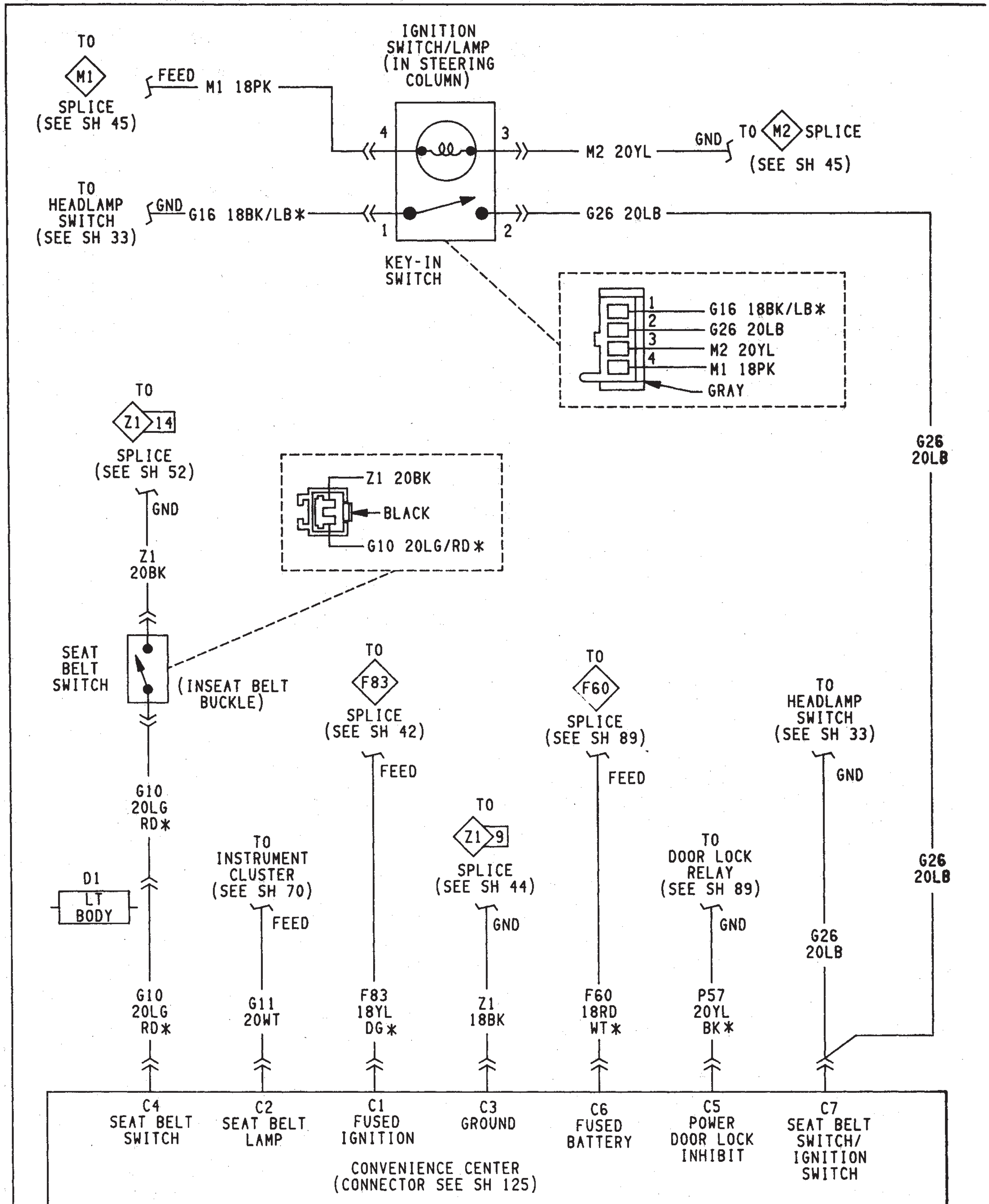
J938W-1 TRANSMISSION CONTROL SYSTEM



TRANSMISSION CONTROL SYSTEM

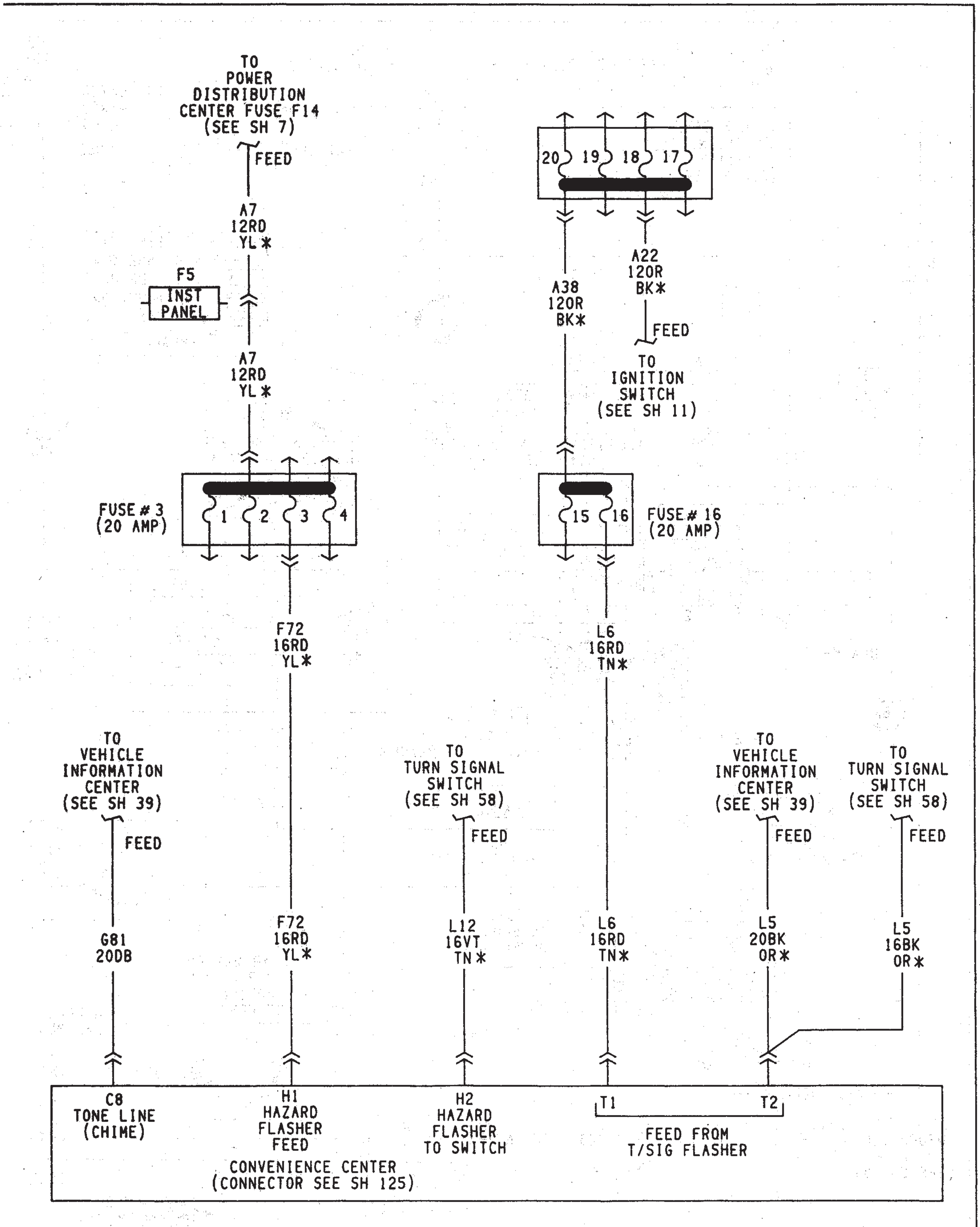
J938W-1


TO FUEL PUMP RELAY (SEE SH 13,19)
FEED
A64 14OR BK*
E1 INST PANEL
A64 14OR BK*
B5 LT BODY
A64 14OR BK*
TO INSTRUMENT CLUSTER (SEE SH 70)
FEED
K102 20PK BK*
A11 LT BODY
K102 20PK BK*
TO OVERHEAD CONSOLE (SEE SH 42)
FEED
G44 20VT WT*
G5 INST PANEL
G44 20VT TN*
A13 LT BODY
G44 20VT WT*
TO Z2 SPLICE (SEE SH 70)
GND
Z2 20BK OR*
B3 LT BODY
Z2 20BK OR*
K102 20PK/BK*
A64 14OR/BK*
Z2 20BK/OR*
Z1 14BK
BLACK
G44 20VT/WT*
4
1
2
5
6
FUEL TANK LEVEL GAUGE SENDING UNIT
FUEL PUMP
FUEL GAUGE SENSOR
TO LEFT REAR DOOR JAMB SWITCH (SEE SH 45)
GND
TO LEFT FRONT DOOR JAMB SWITCH (SEE SH 45)
GND
Z1 14BK
TO SEAT BELT BUCKLE SWITCH (SEE SH 53)
GND
TO POWER MIRROR SYSTEM (SEE SH 85)
GND
LT BODY 14 Z1
Z1 20BK
Z1 20BK
Z1 14BK
Z1 20BK
Z1 14BK
Z1 20BK
Z1 12BK
GND
TO LEFT FRONT SEAT SWITCH (SEE SH 87)
GROUND (LEFT SIDE COWL)
GND
TO FLOOR CONSOLE LAMP (SEE SH 43)

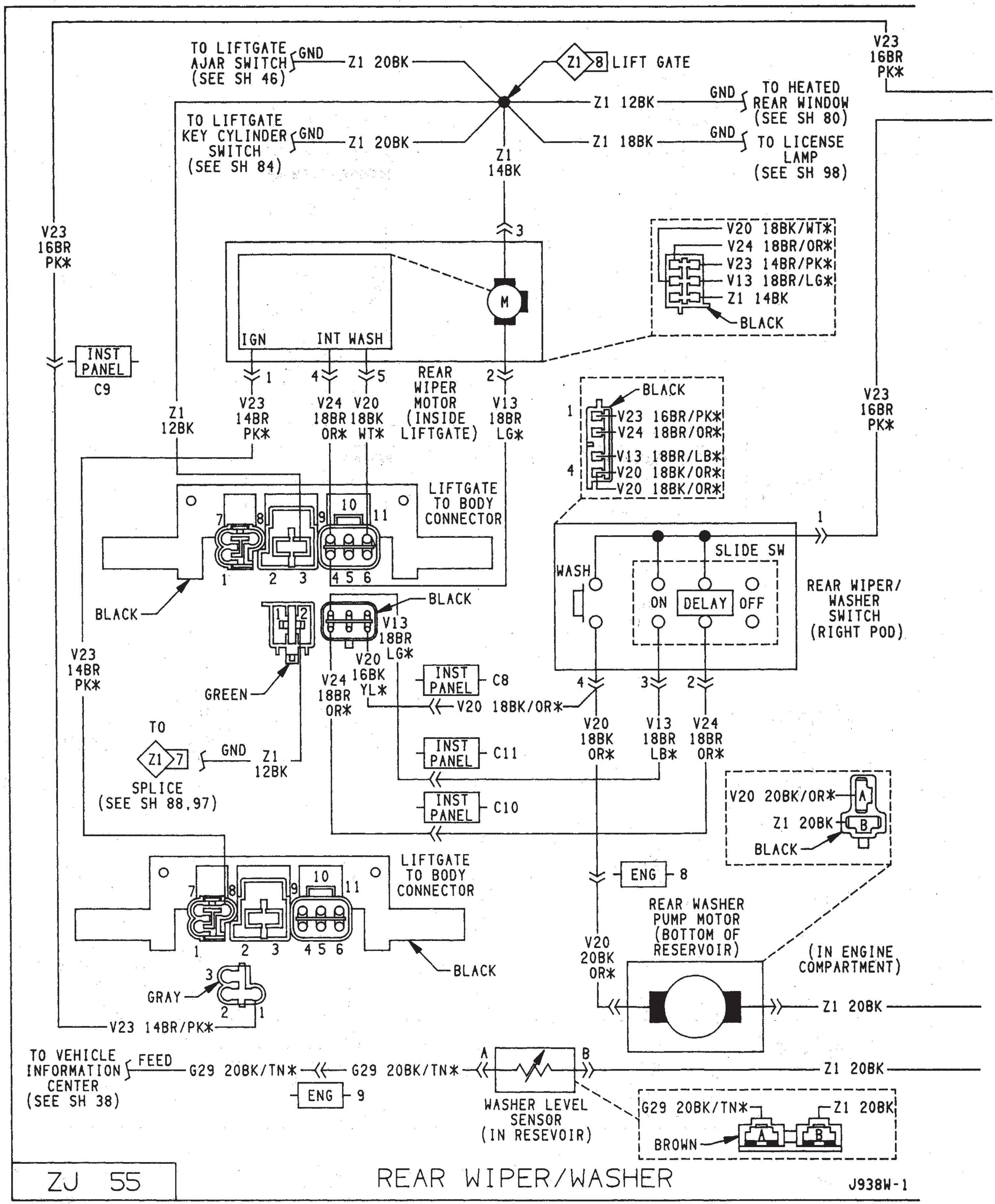


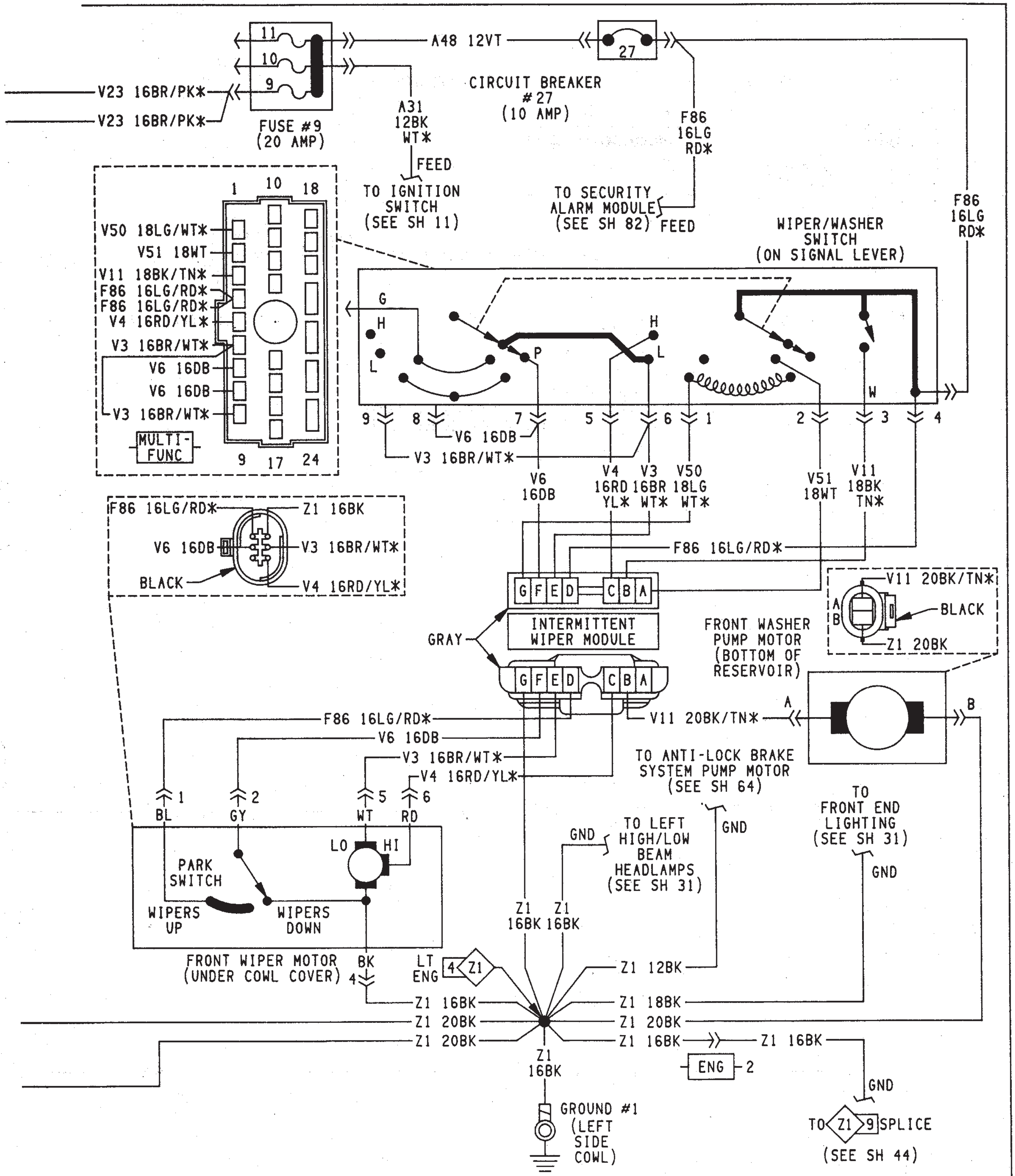
CONVENIENCE CENTER

J938W-1

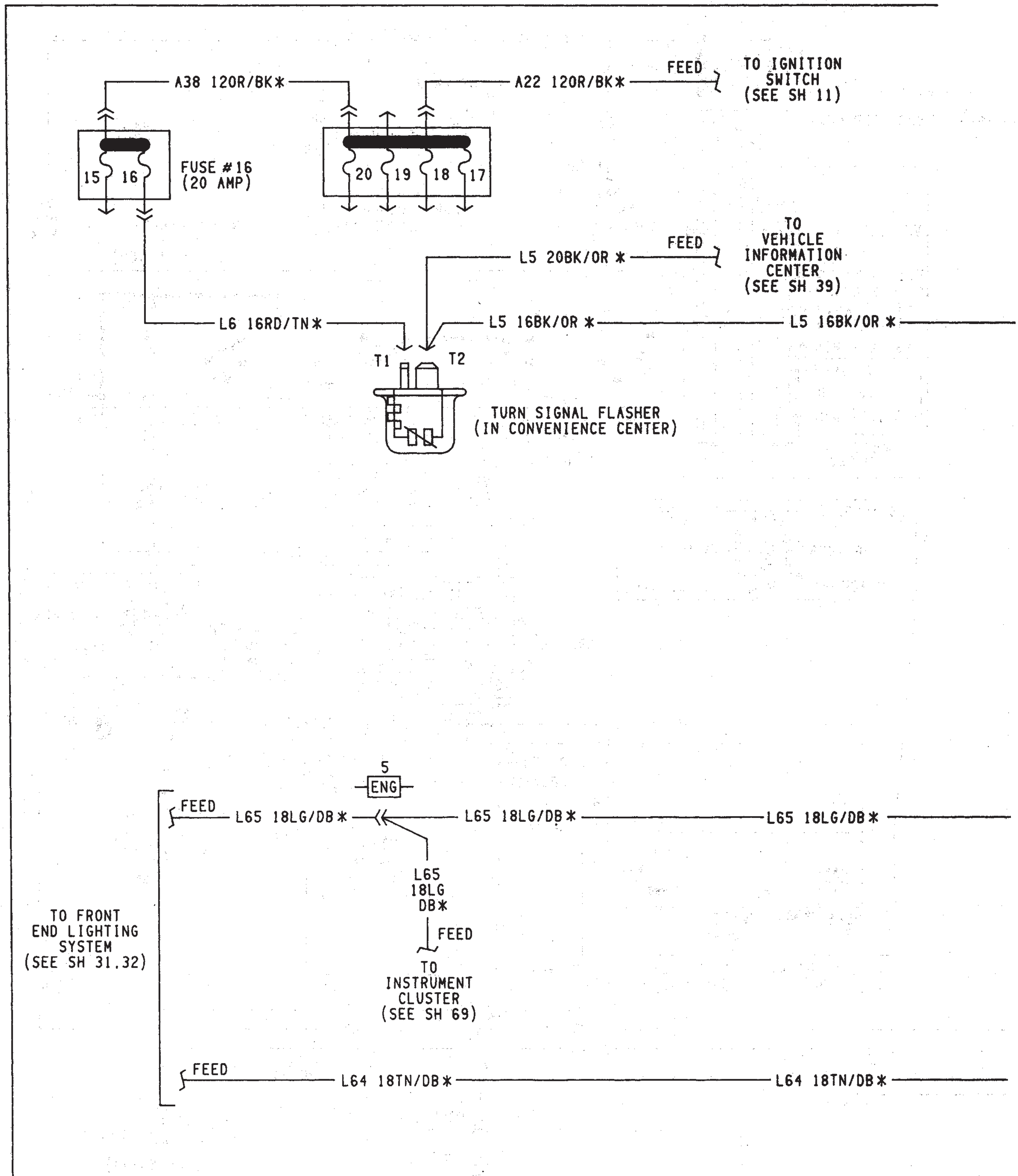


TO POWER DISTRIBUTION CENTER FUSE F14 (SEE SH 7)
FEED
A7 12RD YL*
F5 INST PANEL
A7 12RD YL*
FUSE # 3 (20 AMP)
1 2 3 4
20 19 18 17
A38 12OR BK*
A22 12OR BK*
FEED
TO IGNITION SWITCH (SEE SH 11)
15 16
FUSE # 16 (20 AMP)
F72 16RD YL*
L6 16RD TN*
TO VEHICLE INFORMATION CENTER (SEE SH 39)
FEED
G81 20DB
TO TURN SIGNAL SWITCH (SEE SH 58)
FEED
F72 16RD YL*
L12 16VT TN*
L6 16RD TN*
TO VEHICLE INFORMATION CENTER (SEE SH 39)
FEED
L5 20BK OR*
TO TURN SIGNAL SWITCH (SEE SH 58)
FEED
L5 16BK OR*
C8 TONE LINE (CHIME)
H1 HAZARD FLASHER FEED
H2 HAZARD FLASHER TO SWITCH
T1 T2
FEED FROM T/SIG FLASHER
CONVENIENCE CENTER (CONNECTOR SEE SH 125)


TO LIFTGATE AJAR SWITCH (SEE SH 46)
GND
Z1 20BK
Z1 8 LIFT GATE
Z1 12BK
GND
TO HEATED REAR WINDOW (SEE SH 80)
TO LIFTGATE KEY CYLINDER SWITCH (SEE SH 84)
Z1 20BK
Z1 18BK
TO LICENSE LAMP (SEE SH 98)
Z1 14BK
V23 16BR PK*
INST PANEL
C9
M
IGN
INT WASH
REAR WIPER MOTOR (INSIDE LIFTGATE)
V23 14BR PK*
V24 18BR OR*
V20 18BK WT*
V13 18BR LG*
Z1 12BK
V20 18BK/WT*
V24 18BR/OR*
V23 14BR/PK*
V13 18BR/LG*
Z1 14BK
BLACK
V23 16BR/PK*
V24 18BR/OR*
V13 18BR/LB*
V20 18BK/OR*
V20 18BK/OR*
LIFTGATE TO BODY CONNECTOR
SLIDE SW
WASH
ON
DELAY
OFF
REAR WIPER/ WASHER SWITCH (RIGHT POD)
BLACK
V13 18BR LG*
V20 16BK YL*
V24 18BR OR*
GREEN
INST PANEL C8
V20 18BK/OR*
V20 18BK OR*
V13 18BR LB*
V24 18BR OR*
TO
Z1 7
SPLICE (SEE SH 88,97)
GND
Z1 12BK
INST PANEL C11
INST PANEL C10
V20 20BK/OR*
Z1 20BK
BLACK
ENG 8
LIFTGATE TO BODY CONNECTOR
BLACK
GRAY
REAR WASHER PUMP MOTOR (BOTTOM OF RESERVOIR)
V20 20BK OR*
(IN ENGINE COMPARTMENT)
Z1 20BK
V23 14BR/PK*
TO VEHICLE INFORMATION CENTER (SEE SH 38)
FEED
G29 20BK/TN*
G29 20BK/TN*
ENG 9
WASHER LEVEL SENSOR (IN RESEVOIR)
Z1 20BK
G29 20BK/TN*
Z1 20BK
BROWN
ZJ 55
REAR WIPER/WASHER
J938W-1

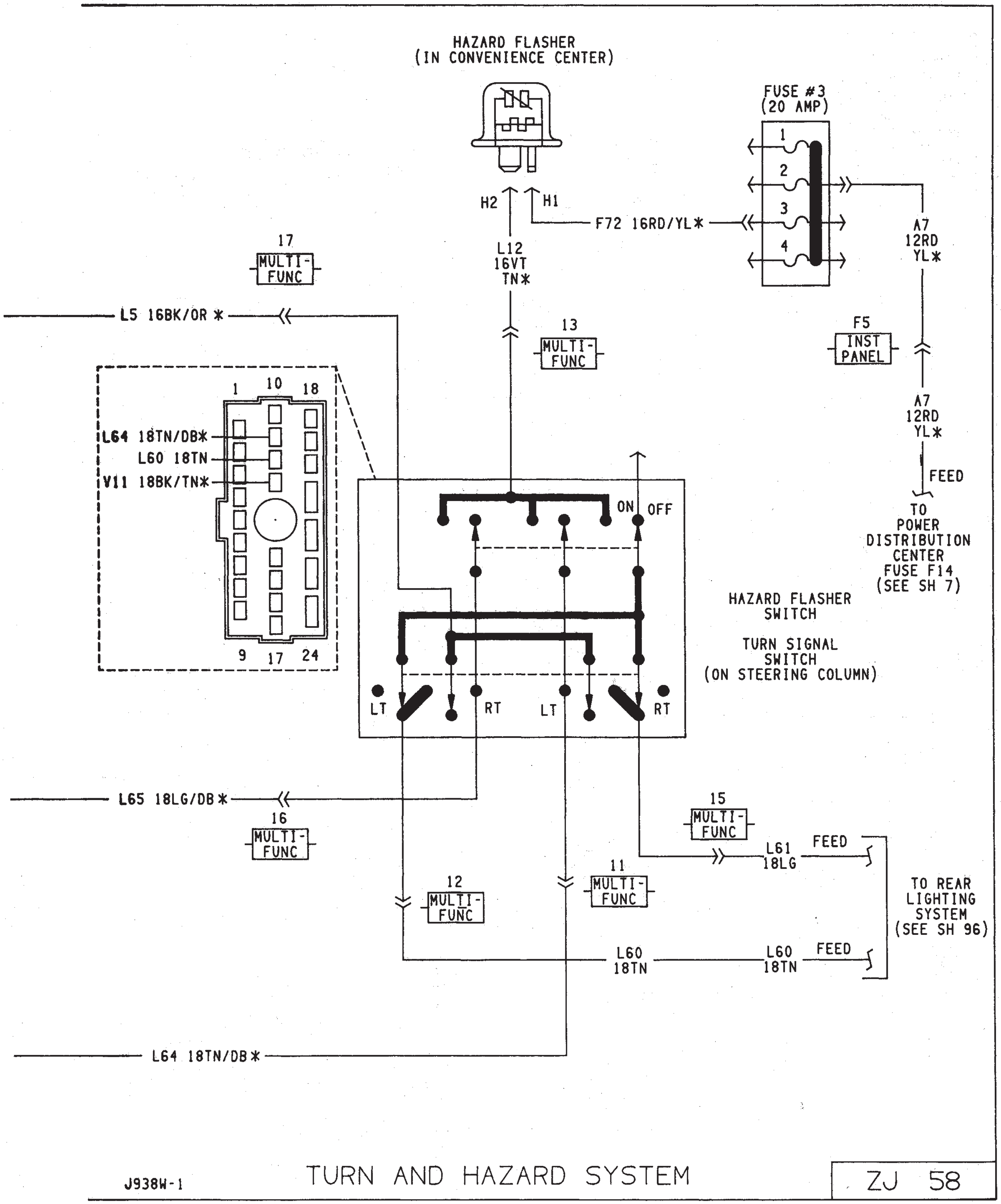


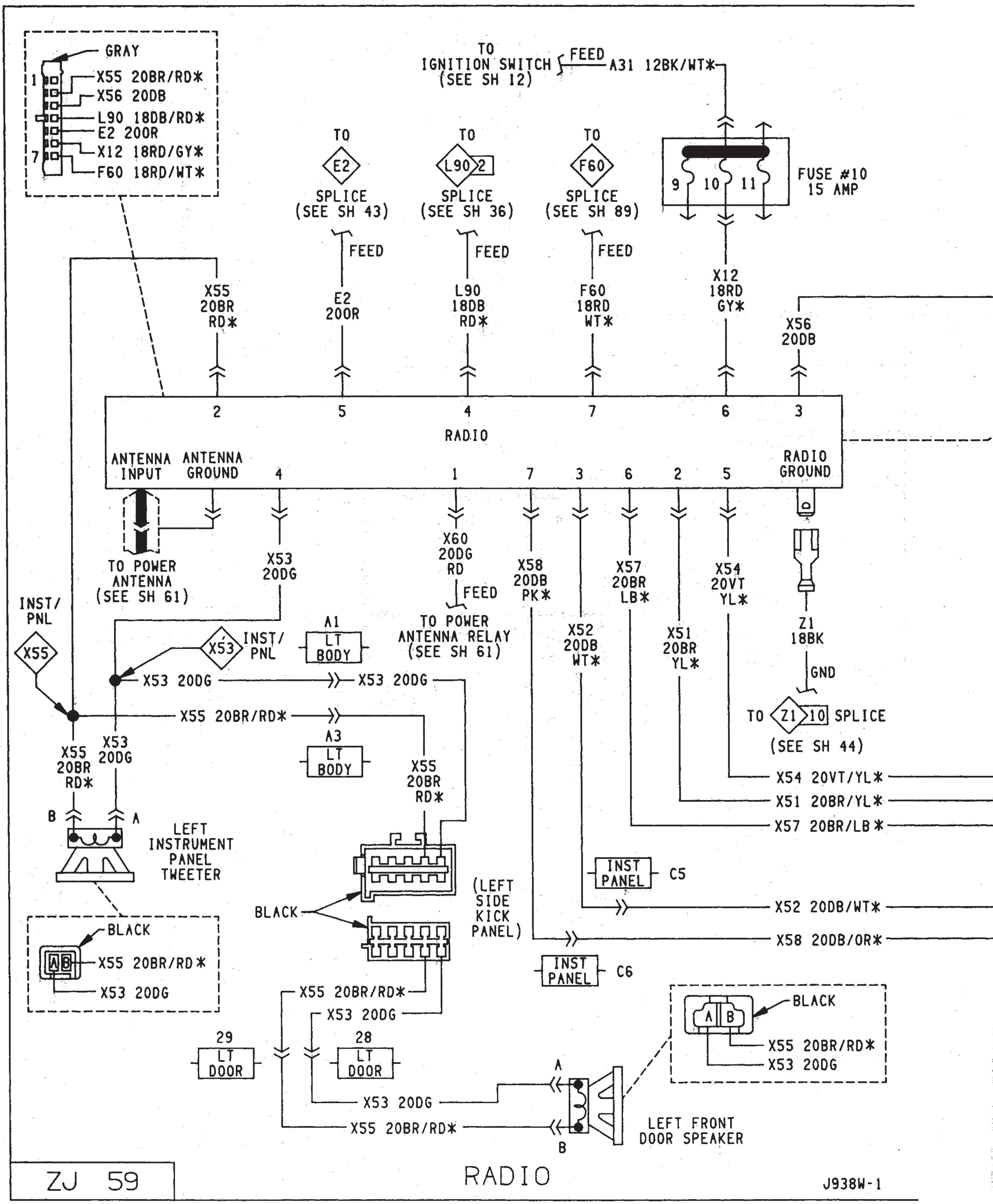
V23 16BR/PK*
V23 16BR/PK*
FUSE #9 (20 AMP)
A48 12VT
CIRCUIT BREAKER #27 (10 AMP)
A31 12BK WT*
FEED
TO IGNITION SWITCH (SEE SH 11)
F86 16LG RD*
TO SECURITY ALARM MODULE (SEE SH 82) FEED
F86 16LG RD*
WIPER/WASHER SWITCH (ON SIGNAL LEVER)
V50 18LG/WT*
V51 18WT
V11 18BK/TN*
F86 16LG/RD*
F86 16LG/RD*
V4 16RD/YL*
V3 16BR/WT*
V6 16DB
V6 16DB
V3 16BR/WT*
MULTI-FUNC
V6 16DB
V3 16BR/WT*
V6 16DB
V4 16RD YL*
V3 16BR WT*
V50 18LG WT*
V51 18WT
V11 18BK TN*
F86 16LG/RD*
Z1 16BK
V6 16DB
V3 16BR/WT*
BLACK
V4 16RD/YL*
F86 16LG/RD*
INTERMITTENT WIPER MODULE
GRAY
V11 20BK/TN*
BLACK
Z1 20BK
FRONT WASHER PUMP MOTOR (BOTTOM OF RESERVOIR)
F86 16LG/RD*
V6 16DB
V3 16BR/WT*
V4 16RD/YL*
V11 20BK/TN*
TO ANTI-LOCK BRAKE SYSTEM PUMP MOTOR (SEE SH 64)
GND
TO FRONT END LIGHTING (SEE SH 31)
GND
GND
TO LEFT HIGH/LOW BEAM HEADLAMPS (SEE SH 31)
PARK SWITCH
LO HI
WIPERS UP
WIPERS DOWN
FRONT WIPER MOTOR (UNDER COWL COVER)
BK
LT ENG
Z1 16BK Z1 16BK
Z1 12BK
Z1 16BK
Z1 18BK
Z1 20BK
Z1 20BK
Z1 20BK
Z1 16BK
Z1 16BK
Z1 16BK
ENG 2
GROUND #1 (LEFT SIDE COWL)
GND
TO Z1 9 SPLICE (SEE SH 44)



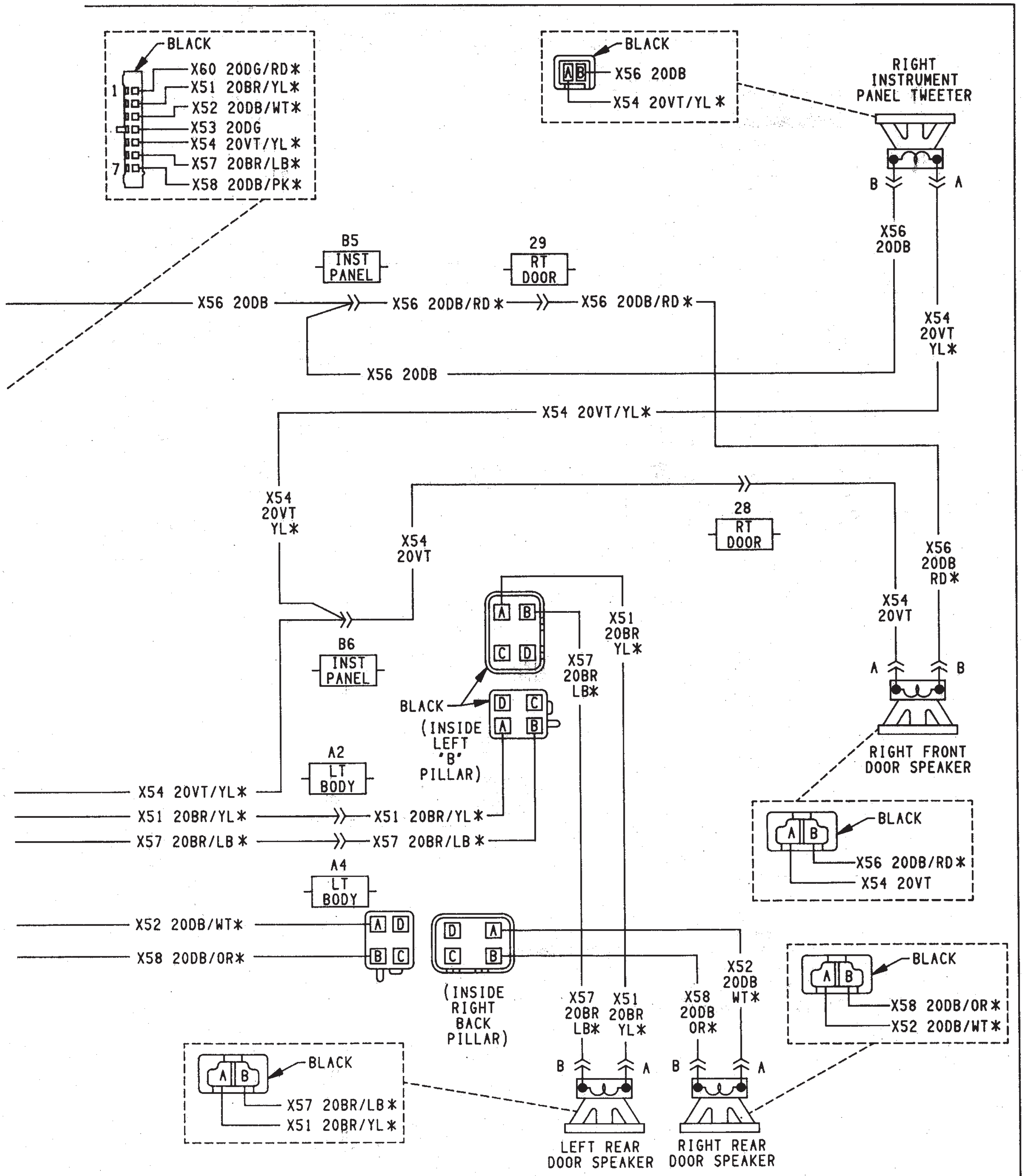
TURN AND HAZARD SYSTEM

J938W-1


HAZARD FLASHER
(IN CONVENIENCE CENTER)
FUSE #3
(20 AMP)
1
2
3
4
H2
H1
F72 16RD/YL*
A7
12RD
YL*
L12
16VT
TN*
17
MULTI-
FUNC
L5 16BK/OR *
13
MULTI-
FUNC
F5
INST
PANEL
1 10 18
L64 18TN/DB*
L60 18TN
V11 18BK/TN*
9 17 24
A7
12RD
YL*
FEED
TO
POWER
DISTRIBUTION
CENTER
FUSE F14
(SEE SH 7)
ON OFF
HAZARD FLASHER
SWITCH
TURN SIGNAL
SWITCH
(ON STEERING COLUMN)
LT RT LT RT
L65 18LG/DB*
16
MULTI-
FUNC
15
MULTI-
FUNC
L61
18LG
FEED
11
MULTI-
FUNC
12
MULTI-
FUNC
TO REAR
LIGHTING
SYSTEM
(SEE SH 96)
L60
18TN
L60
18TN
FEED
L64 18TN/DB*

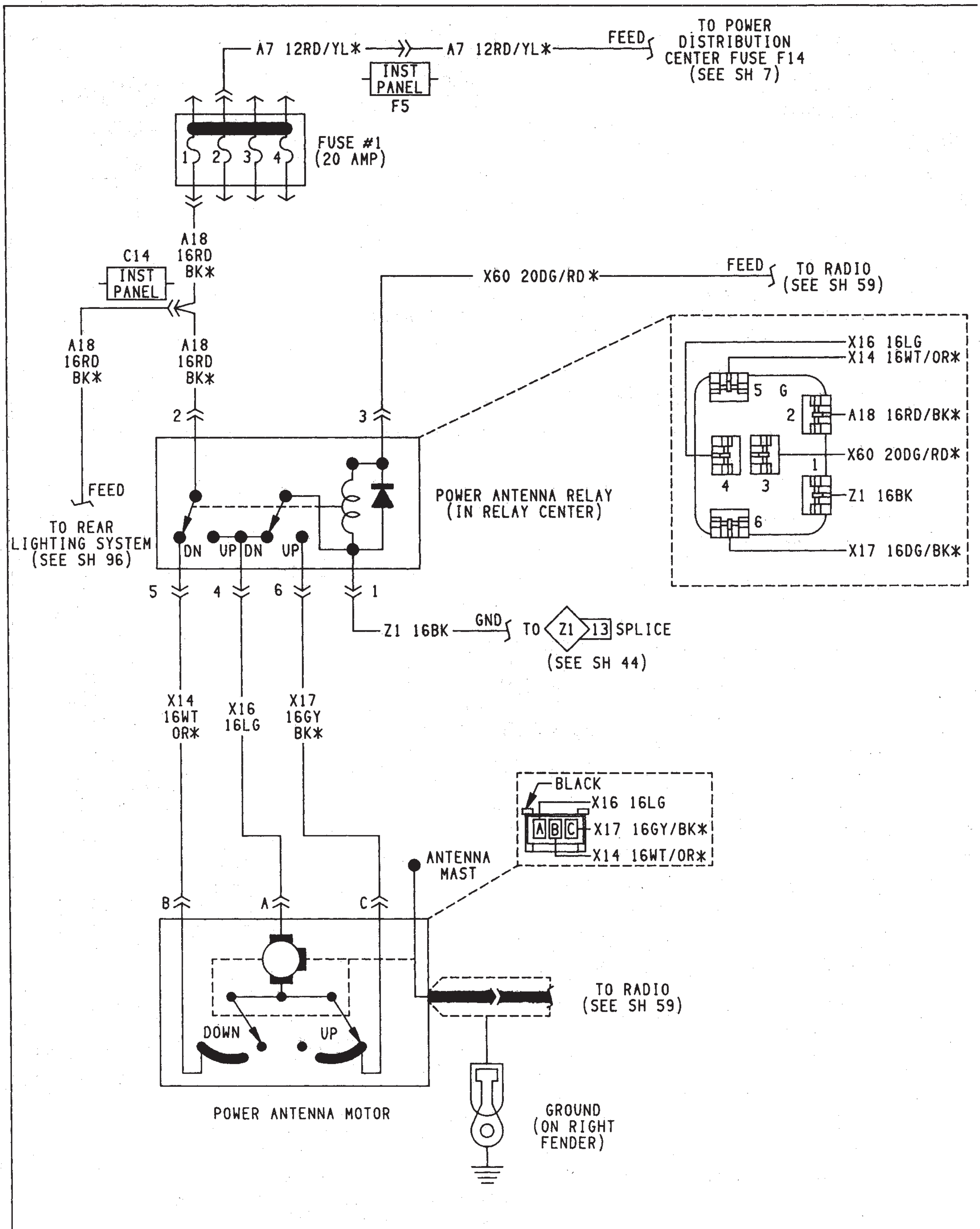


GRAY
X55 20BR/RD*
X56 20DB
L90 18DB/RD*
E2 20OR
X12 18RD/GY*
F60 18RD/WT*
TO IGNITION SWITCH (SEE SH 12)
FEED
A31 12BK/WT*
TO E2 SPLICE (SEE SH 43)
TO L90 2 SPLICE (SEE SH 36)
TO F60 SPLICE (SEE SH 89)
FUSE #10 15 AMP
9 10 11
FEED
X55 20BR RD*
E2 20OR
L90 18DB RD*
F60 18RD WT*
X12 18RD GY*
X56 20DB
2 5 4 7 6 3
RADIO
ANTENNA INPUT
ANTENNA GROUND
4 1 7 3 6 2 5
RADIO GROUND
TO POWER ANTENNA (SEE SH 61)
X53 20DG
X60 20DG RD
FEED
TO POWER ANTENNA RELAY (SEE SH 61)
X58 20DB PK*
X52 20DB WT*
X57 20BR LB*
X51 20BR YL*
X54 20VT YL*
Z1 18BK
GND
TO Z1 10 SPLICE (SEE SH 44)
INST/ PNL
X55
X53
INST/ PNL
A1 LT BODY
X53 20DG
X53 20DG
X55 20BR/RD*
A3 LT BODY
X55 20BR RD*
X53 20DG
X55 20BR RD*
B A
LEFT INSTRUMENT PANEL TWEETER
X54 20VT/YL*
X51 20BR/YL*
X57 20BR/LB*
INST PANEL C5
X52 20DB/WT*
X58 20DB/OR*
INST PANEL C6
(LEFT SIDE KICK PANEL)
BLACK
BLACK
A B
X55 20BR/RD*
X53 20DG
X55 20BR/RD*
X53 20DG
29 LT DOOR
28 LT DOOR
X53 20DG
X55 20BR/RD*
A
B
LEFT FRONT DOOR SPEAKER
BLACK
A B
X55 20BR/RD*
X53 20DG
ZJ 59
RADIO
J938W-1



J938W-1

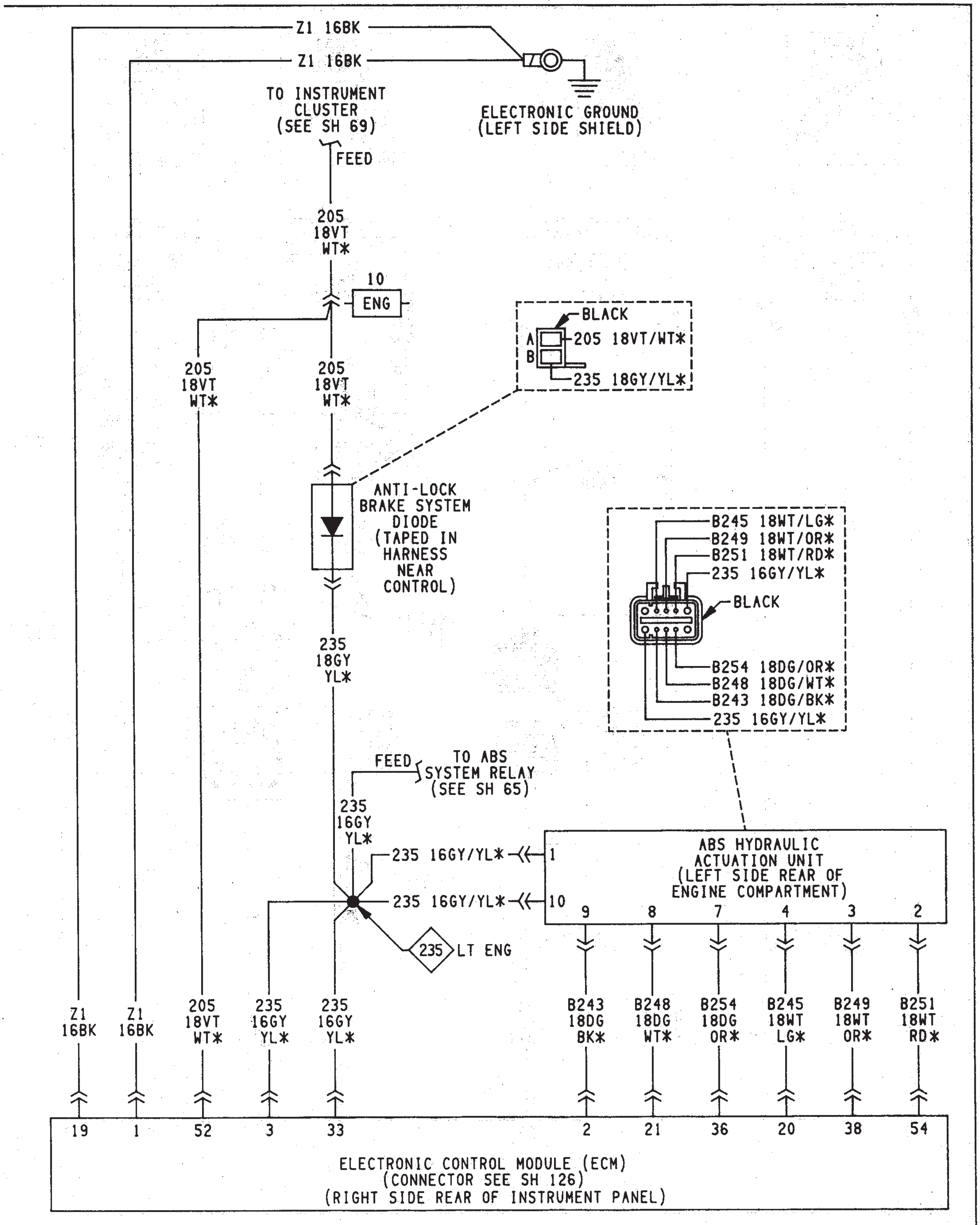
RADIO

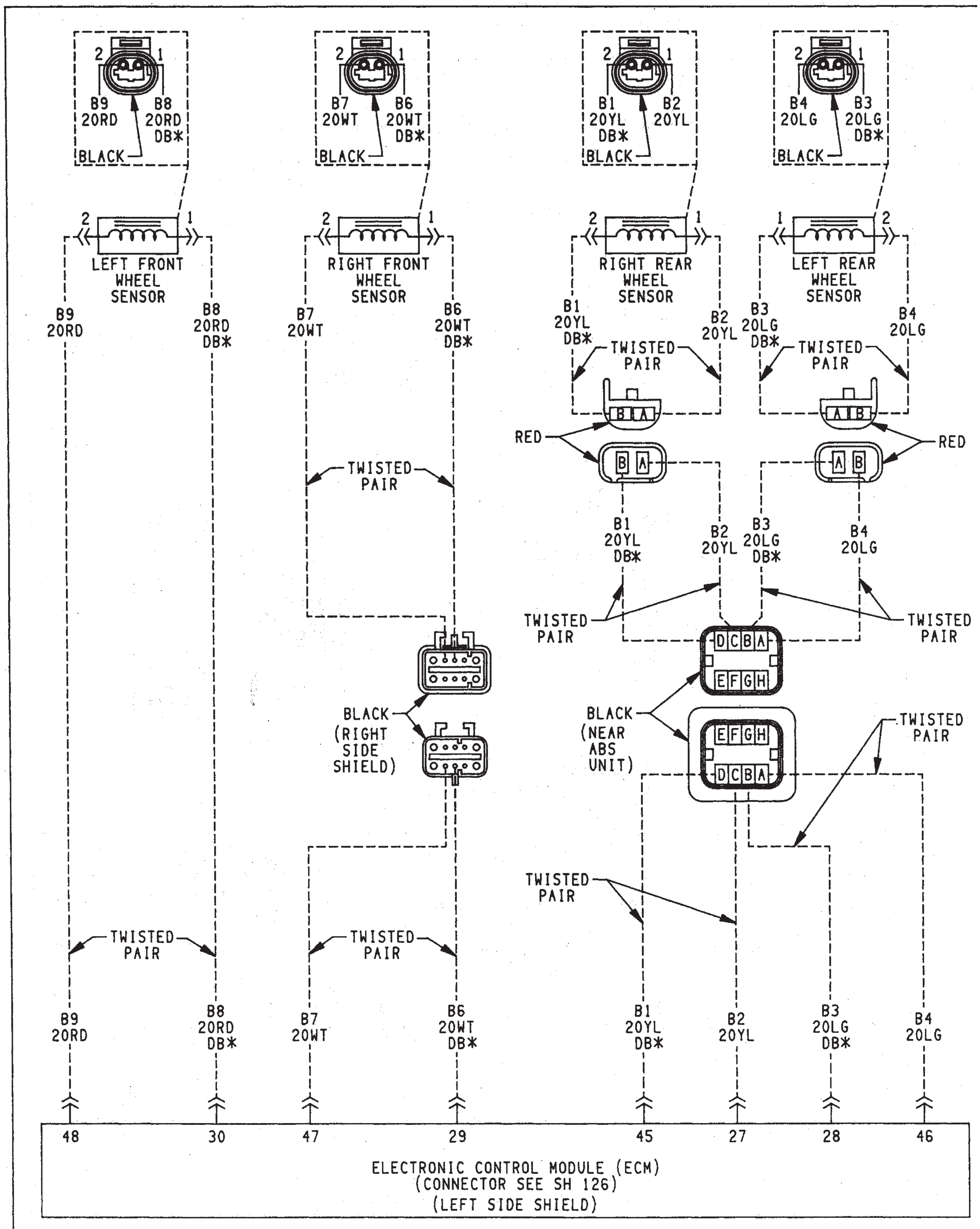


ZJ 61

POWER ANTENNA

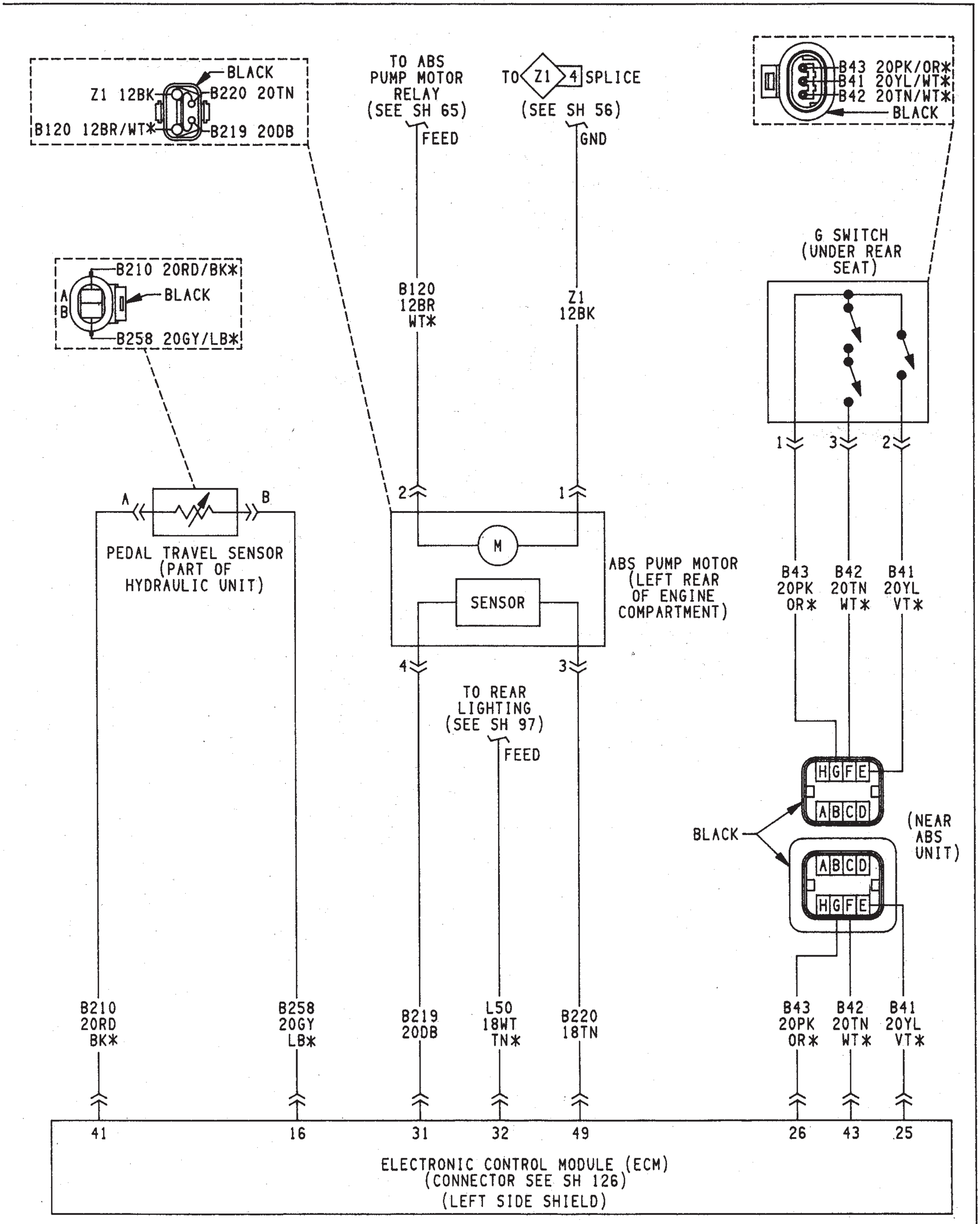
J938W-1

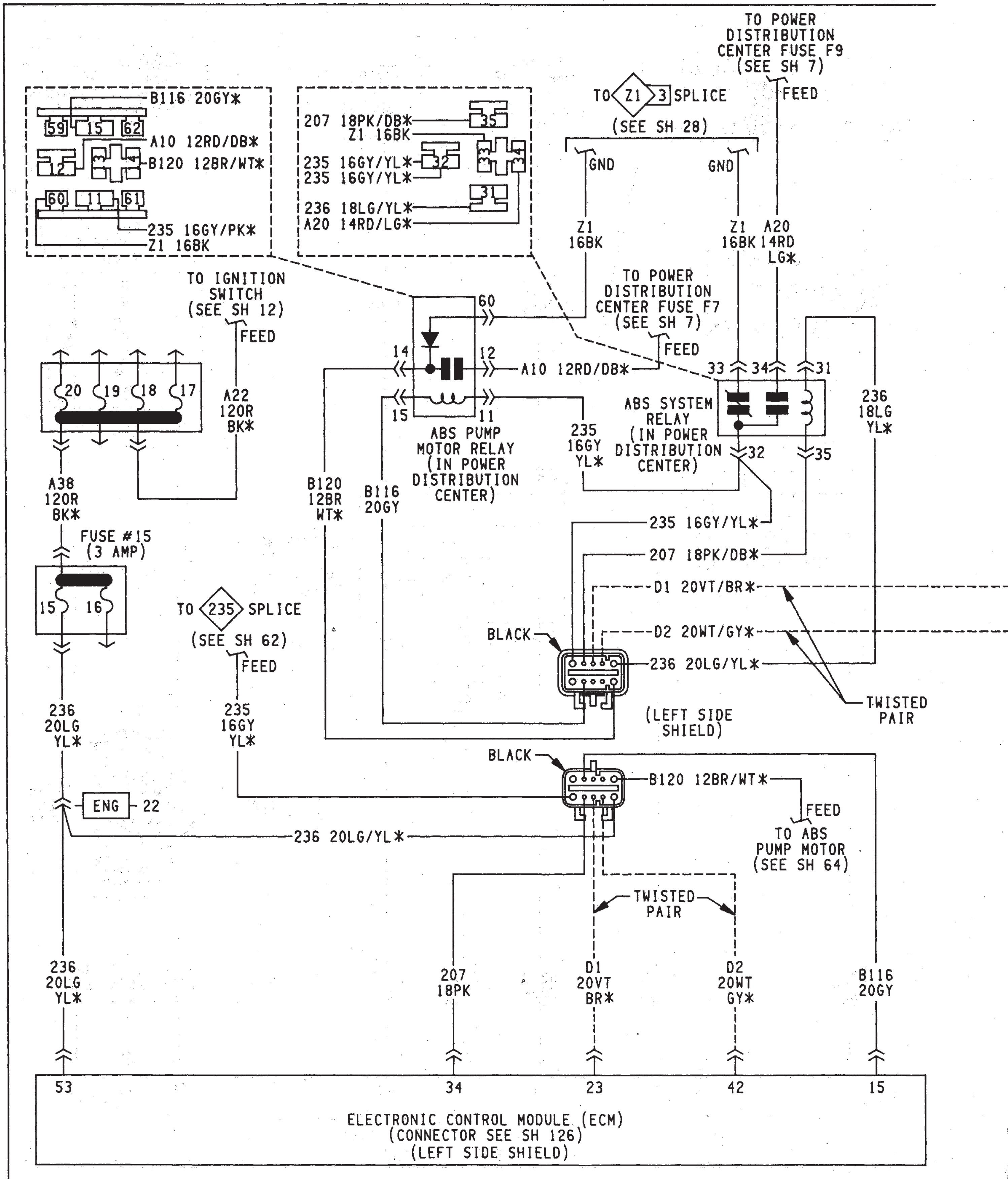

Z1 16BK
Z1 16BK
TO INSTRUMENT CLUSTER (SEE SH 69)
FEED
ELECTRONIC GROUND (LEFT SIDE SHIELD)
205 18VT WT*
10 ENG
BLACK
A 205 18VT/WT*
B 235 18GY/YL*
205 18VT WT*
205 18VT WT*
ANTI-LOCK BRAKE SYSTEM DIODE (TAPED IN HARNESS NEAR CONTROL)
B245 18WT/LG*
B249 18WT/OR*
B251 18WT/RD*
235 16GY/YL*
BLACK
B254 18DG/OR*
B248 18DG/WT*
B243 18DG/BK*
235 16GY/YL*
235 18GY YL*
FEED
TO ABS SYSTEM RELAY (SEE SH 65)
235 16GY YL*
235 16GY/YL* 1
235 16GY/YL* 10
ABS HYDRAULIC ACTUATION UNIT (LEFT SIDE REAR OF ENGINE COMPARTMENT)
9 8 7 4 3 2
235 LT ENG
Z1 16BK
Z1 16BK
205 18VT WT*
235 16GY YL*
235 16GY YL*
B243 18DG BK*
B248 18DG WT*
B254 18DG OR*
B245 18WT LG*
B249 18WT OR*
B251 18WT RD*
19 1 52 3 33 2 21 36 20 38 54
ELECTRONIC CONTROL MODULE (ECM) (CONNECTOR SEE SH 126) (RIGHT SIDE REAR OF INSTRUMENT PANEL)



ANTI-LOCK BRAKE SYSTEM

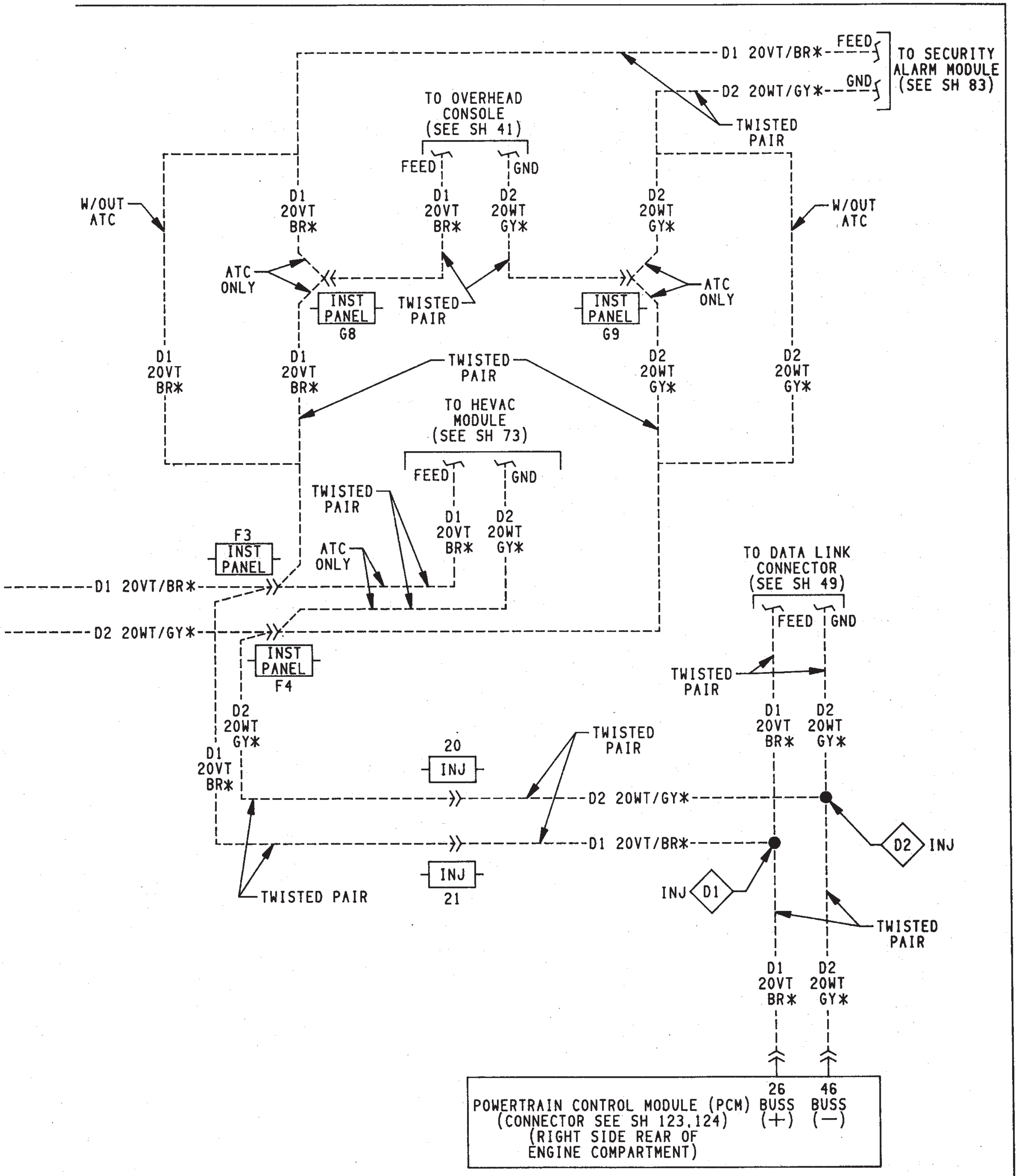
J938W-1

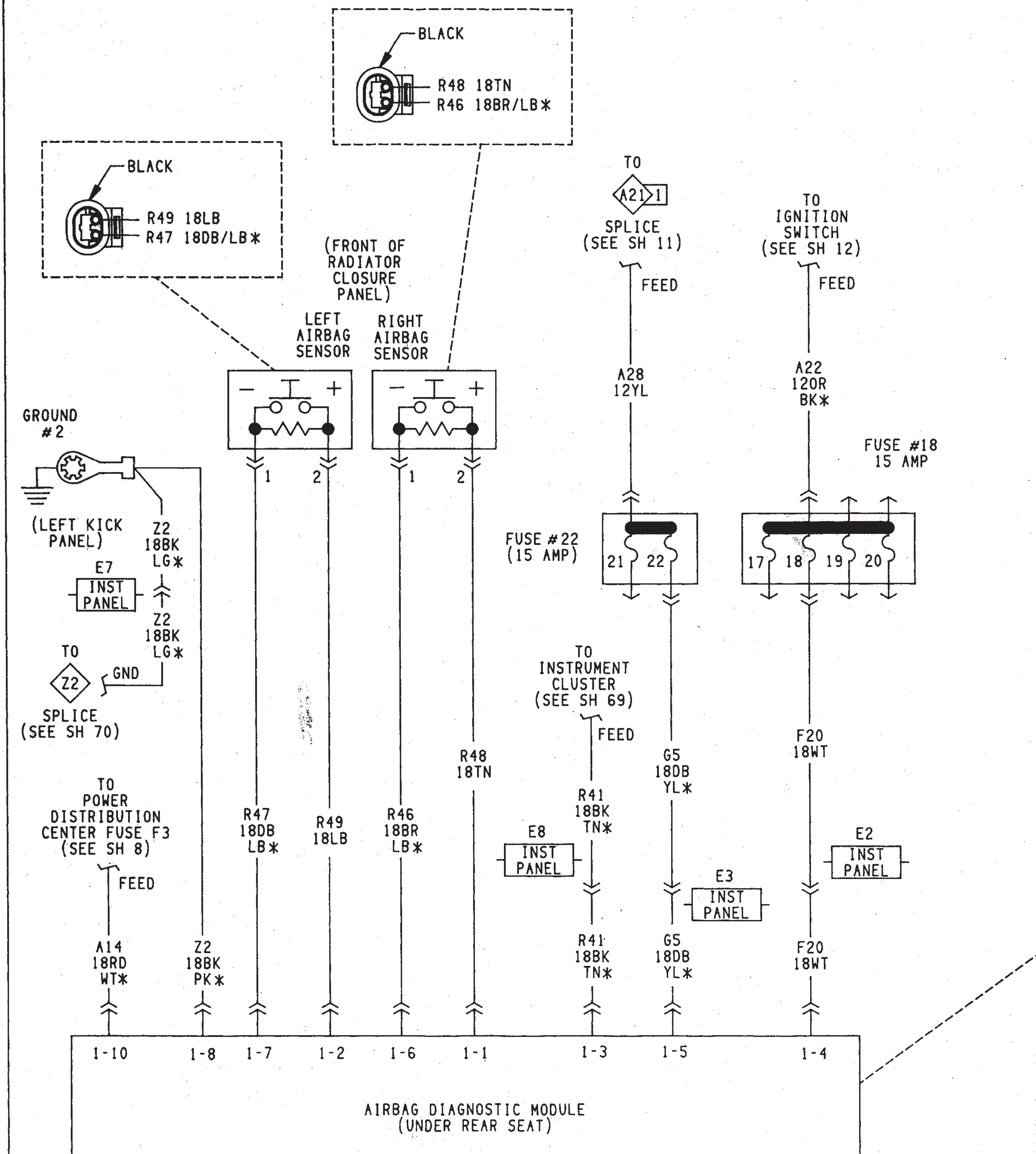

BLACK
Z1 12BK
B220 20TN
B120 12BR/WT*
B219 20DB
TO ABS PUMP MOTOR RELAY (SEE SH 65)
FEED
TO Z1 4 SPLICE (SEE SH 56)
GND
B43 20PK/OR*
B41 20YL/WT*
B42 20TN/WT*
BLACK
B210 20RD/BK*
A
B
BLACK
B258 20GY/LB*
B120 12BR WT*
Z1 12BK
G SWITCH (UNDER REAR SEAT)
1
3
2
A
B
2
1
PEDAL TRAVEL SENSOR (PART OF HYDRAULIC UNIT)
M
SENSOR
ABS PUMP MOTOR (LEFT REAR OF ENGINE COMPARTMENT)
B43 20PK OR*
B42 20TN WT*
B41 20YL VT*
4
3
TO REAR LIGHTING (SEE SH 97)
FEED
H G F E
A B C D
BLACK
(NEAR ABS UNIT)
A B C D
H G F E
B210 20RD BK*
B258 20GY LB*
B219 20DB
L50 18WT TN*
B220 18TN
B43 20PK OR*
B42 20TN WT*
B41 20YL VT*
41
16
31
32
49
26
43
25
ELECTRONIC CONTROL MODULE (ECM) (CONNECTOR SEE SH 126) (LEFT SIDE SHIELD)



ANTI-LOCK BRAKE SYSTEM

J938W-1

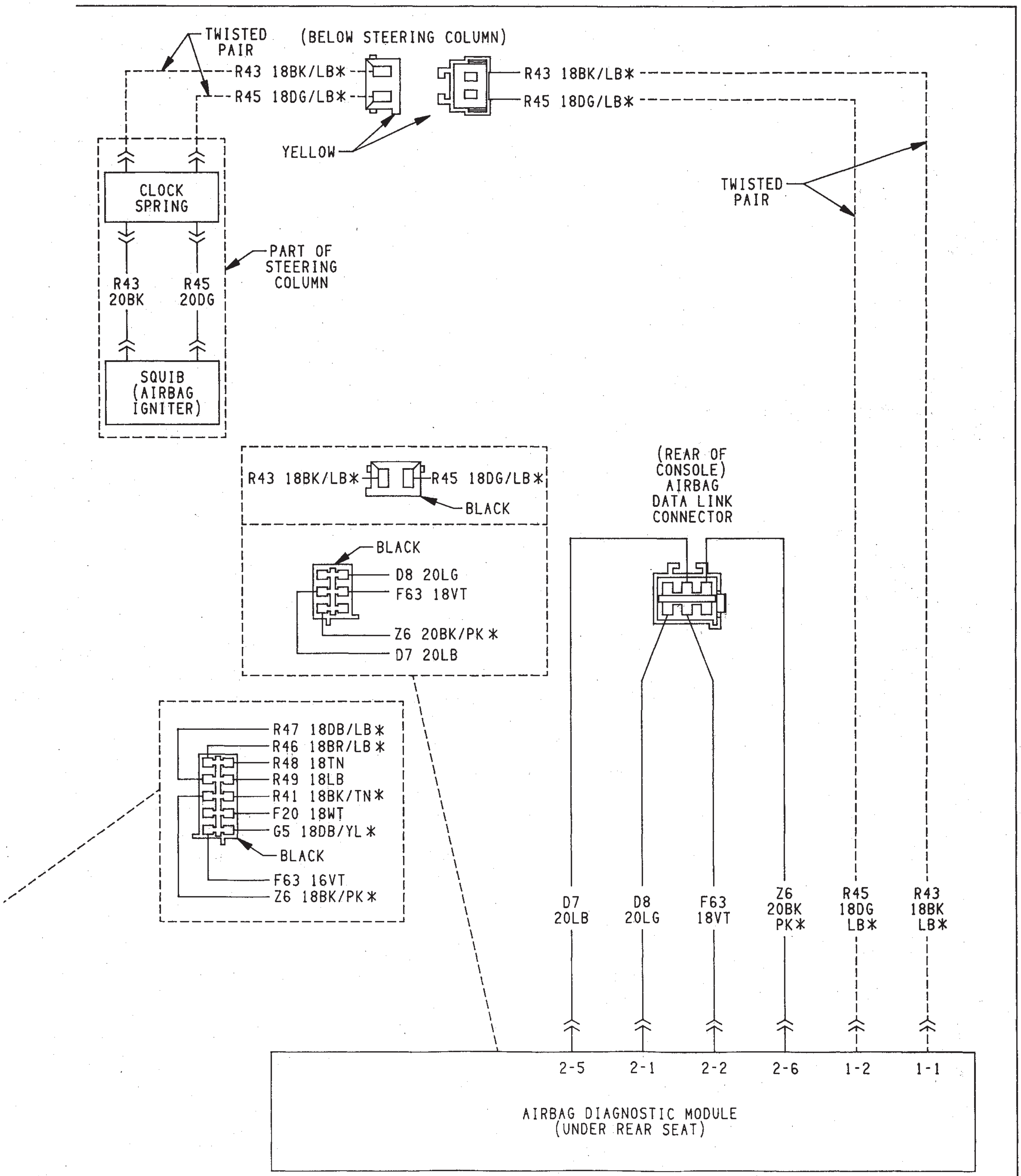

D1 20VT/BR*
FEED
TO SECURITY ALARM MODULE (SEE SH 83)
D2 20WT/GY*
GND
TWISTED PAIR
TO OVERHEAD CONSOLE (SEE SH 41)
FEED
GND
W/OUT ATC
D1 20VT BR*
D2 20WT GY*
ATC ONLY
INST PANEL G8
INST PANEL G9
TWISTED PAIR
TO HEVAC MODULE (SEE SH 73)
F3 INST PANEL
INST PANEL F4
D1 20VT/BR*
D2 20WT/GY*
TO DATA LINK CONNECTOR (SEE SH 49)
20 INJ
INJ 21
D2 INJ
INJ D1
26 BUSS (+)
46 BUSS (−)
POWERTRAIN CONTROL MODULE (PCM) (CONNECTOR SEE SH 123,124) (RIGHT SIDE REAR OF ENGINE COMPARTMENT)

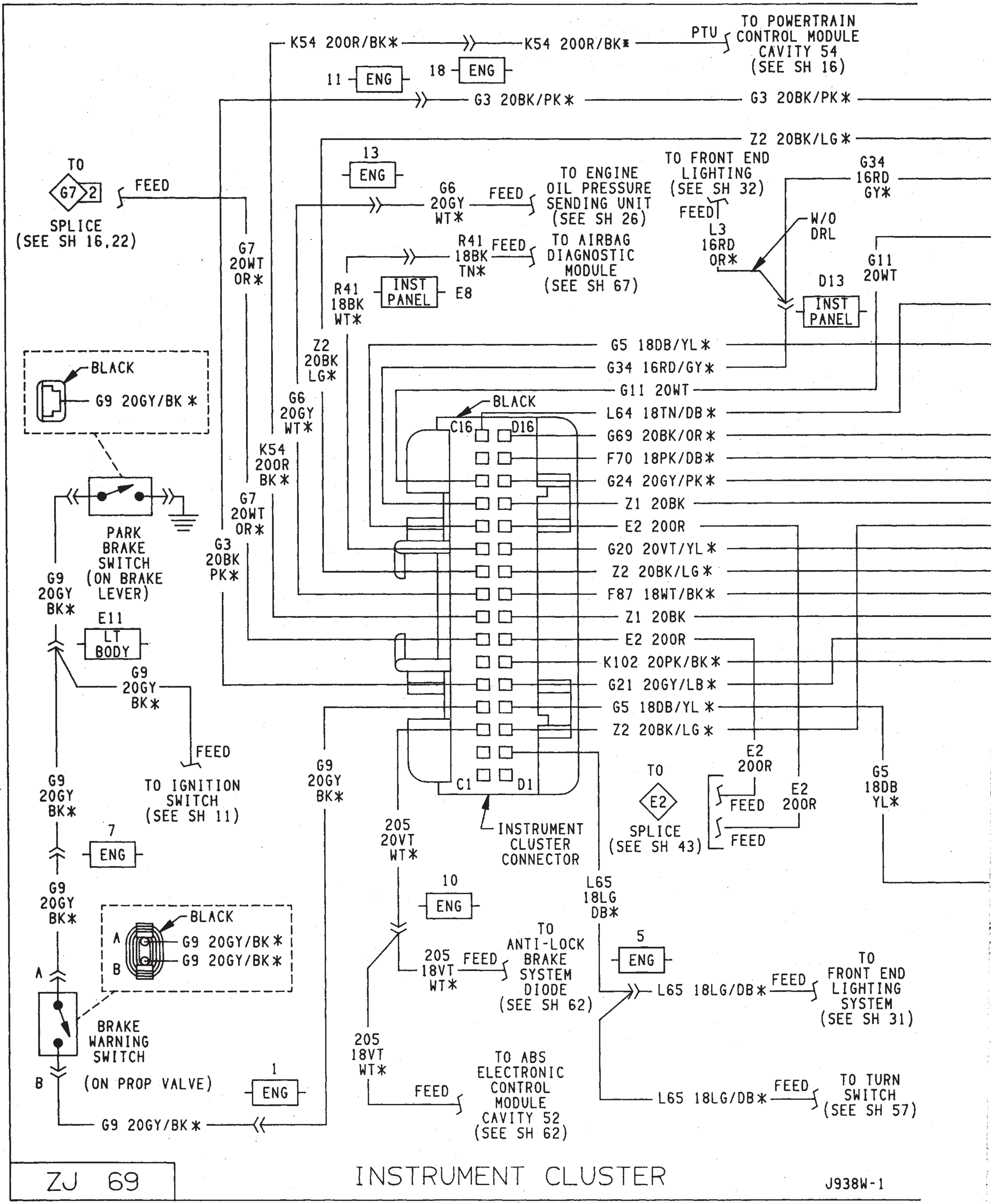


ZJ 67

AIRBAG SYSTEM

J938W-1

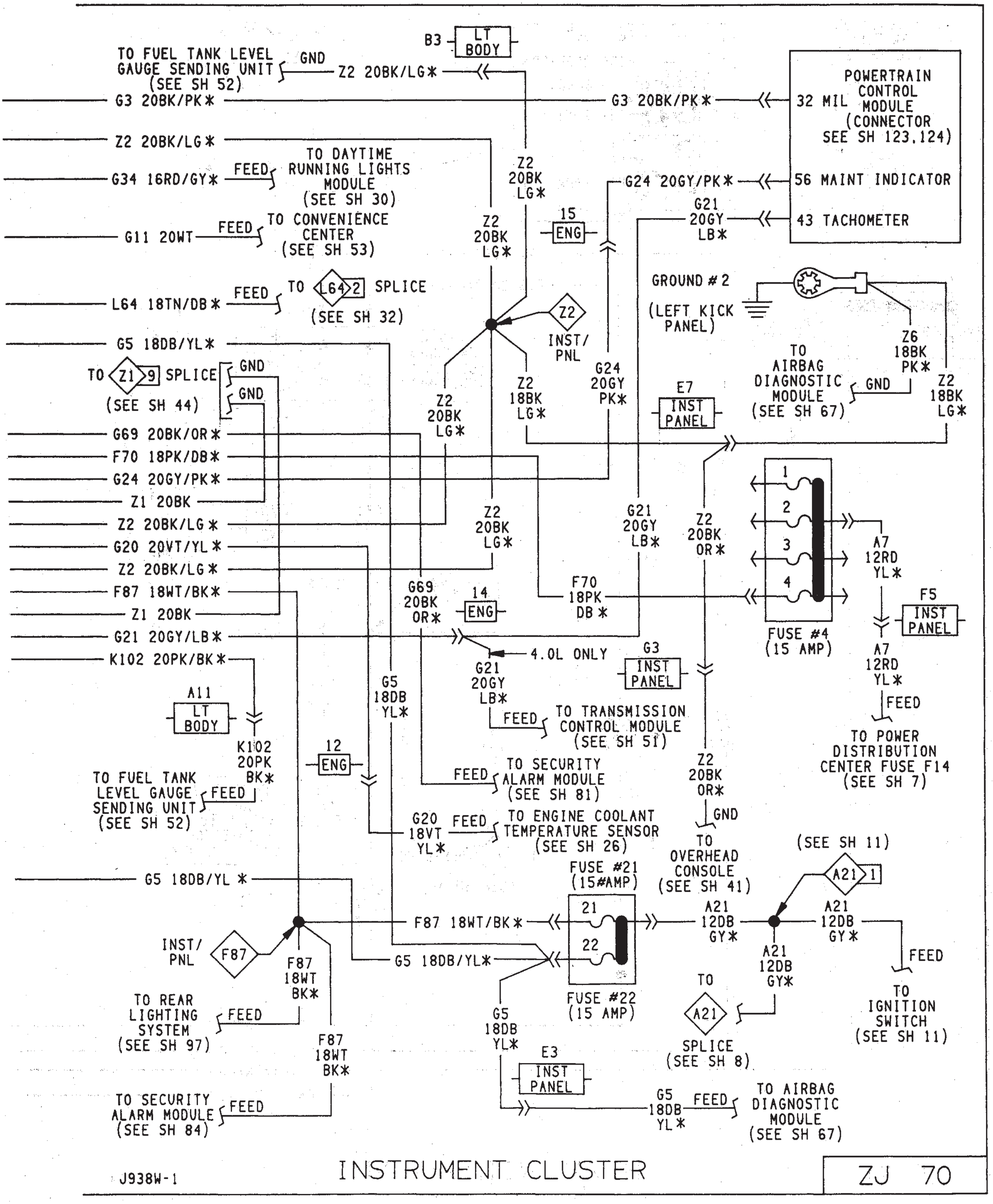

TWISTED PAIR
(BELOW STEERING COLUMN)
R43 18BK/LB*
R45 18DG/LB*
R43 18BK/LB*
R45 18DG/LB*
YELLOW
CLOCK SPRING
PART OF STEERING COLUMN
R43 20BK
R45 20DG
SQUIB (AIRBAG IGNITER)
TWISTED PAIR
R43 18BK/LB*
R45 18DG/LB*
BLACK
BLACK
D8 20LG
F63 18VT
Z6 20BK/PK*
D7 20LB
(REAR OF CONSOLE) AIRBAG DATA LINK CONNECTOR
R47 18DB/LB*
R46 18BR/LB*
R48 18TN
R49 18LB
R41 18BK/TN*
F20 18WT
G5 18DB/YL*
BLACK
F63 16VT
Z6 18BK/PK*
D7 20LB
D8 20LG
F63 18VT
Z6 20BK PK*
R45 18DG LB*
R43 18BK LB*
2-5
2-1
2-2
2-6
1-2
1-1
AIRBAG DIAGNOSTIC MODULE (UNDER REAR SEAT)

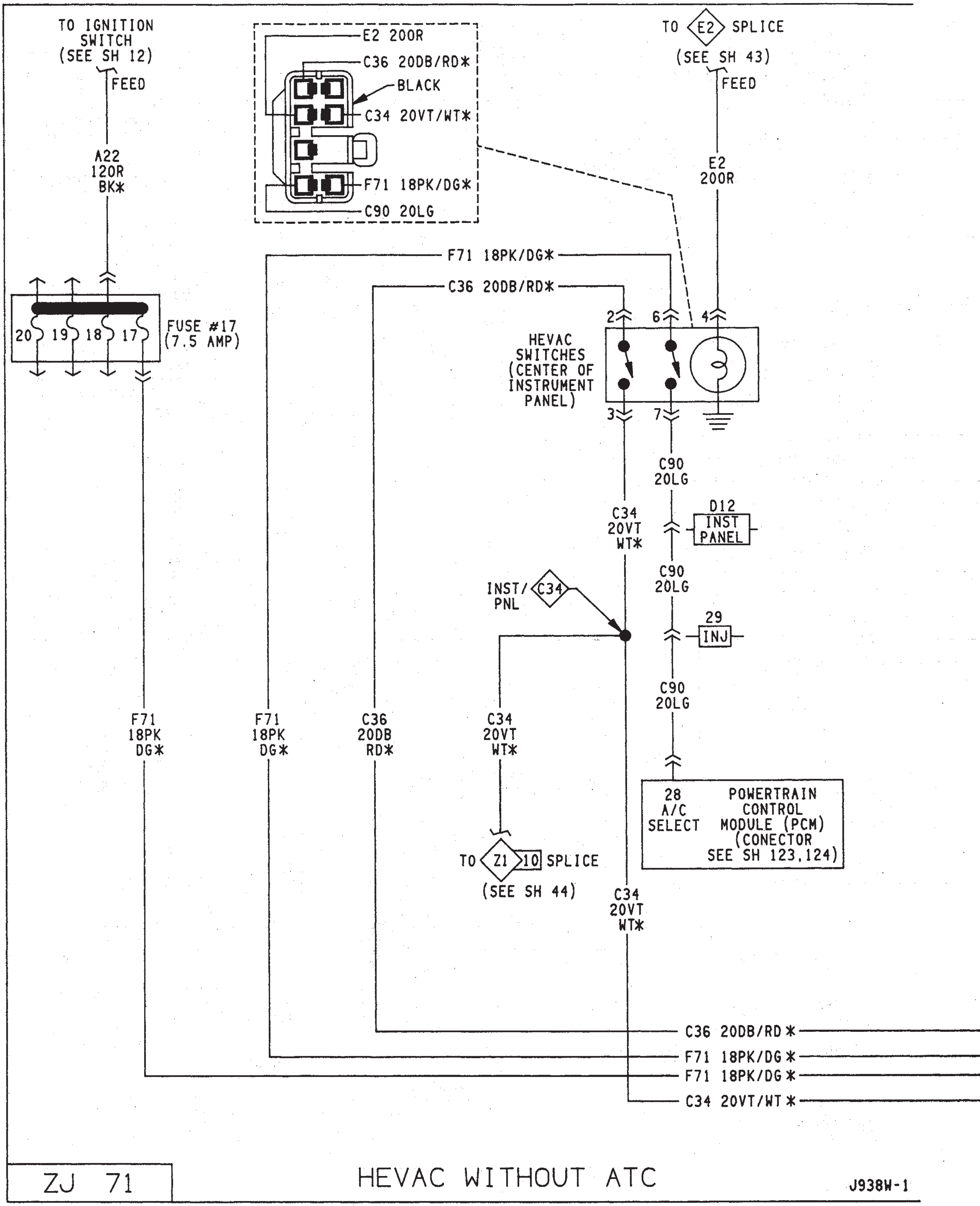


ZJ 69

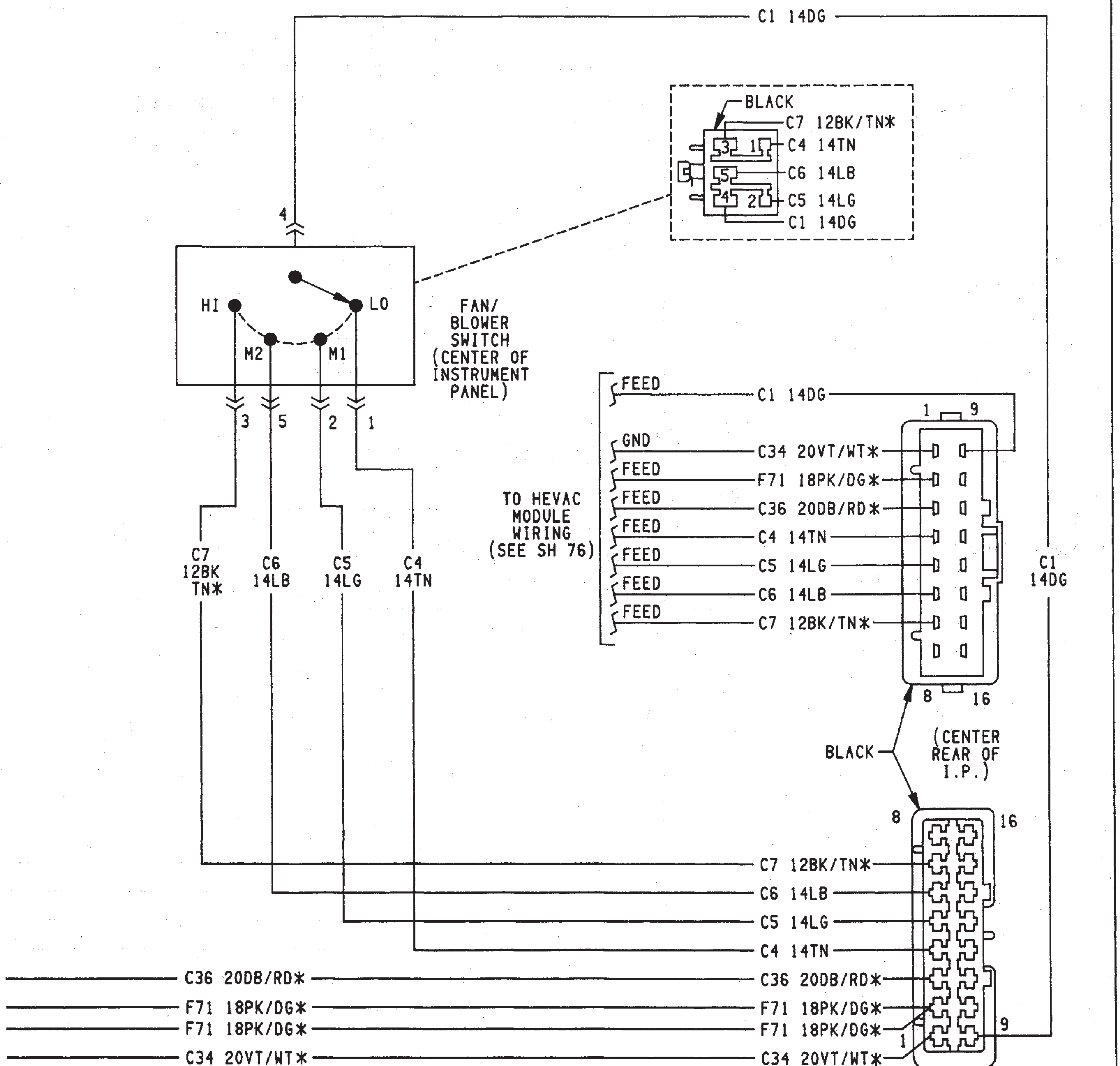
INSTRUMENT CLUSTER

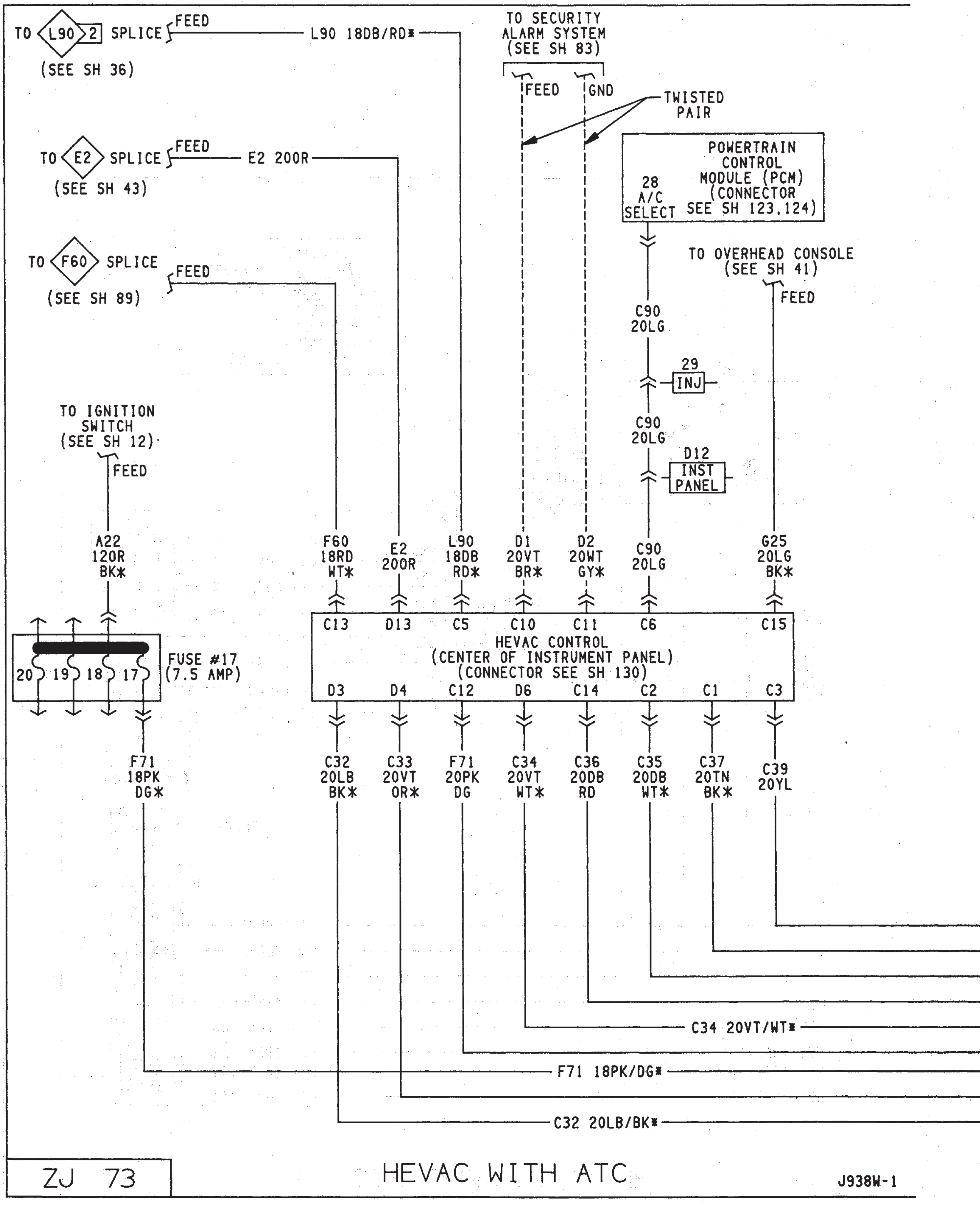
J938W-1


TO FUEL TANK LEVEL GAUGE SENDING UNIT (SEE SH 52)
GND
Z2 20BK/LG*
B3 LT BODY
G3 20BK/PK*
POWERTRAIN CONTROL MODULE (CONNECTOR SEE SH 123,124)
32 MIL
56 MAINT INDICATOR
43 TACHOMETER
Z2 20BK/LG*
G34 16RD/GY*
FEED
TO DAYTIME RUNNING LIGHTS MODULE (SEE SH 30)
G11 20WT
TO CONVENIENCE CENTER (SEE SH 53)
L64 18TN/DB*
TO L64 2 SPLICE (SEE SH 32)
G24 20GY/PK*
G21 20GY LB*
15 ENG
GROUND #2 (LEFT KICK PANEL)
Z2 INST/ PNL
G5 18DB/YL*
TO Z1 9 SPLICE (SEE SH 44)
TO AIRBAG DIAGNOSTIC MODULE (SEE SH 67)
Z6 18BK PK*
Z2 18BK LG*
E7 INST PANEL
G69 20BK/OR*
F70 18PK/DB*
G24 20GY/PK*
Z1 20BK
Z2 20BK/LG*
G20 20VT/YL*
Z2 20BK/LG*
F87 18WT/BK*
Z1 20BK
G21 20GY/LB*
K102 20PK/BK*
FUSE #4 (15 AMP)
A7 12RD YL*
F5 INST PANEL
Z2 20BK OR*
G69 20BK OR*
14 ENG
F70 18PK DB*
4.0L ONLY
G3 INST PANEL
A11 LT BODY
K102 20PK BK*
TO FUEL TANK LEVEL GAUGE SENDING UNIT (SEE SH 52)
12 ENG
G5 18DB YL*
TO TRANSMISSION CONTROL MODULE (SEE SH 51)
TO POWER DISTRIBUTION CENTER FUSE F14 (SEE SH 7)
TO SECURITY ALARM MODULE (SEE SH 81)
G20 18VT YL*
TO ENGINE COOLANT TEMPERATURE SENSOR (SEE SH 26)
TO OVERHEAD CONSOLE (SEE SH 41)
(SEE SH 11)
A21 1
FUSE #21 (15 AMP)
F87 18WT/BK*
A21 12DB GY*
INST/ PNL F87
F87 18WT BK*
G5 18DB/YL*
FUSE #22 (15 AMP)
TO REAR LIGHTING SYSTEM (SEE SH 97)
TO A21 SPLICE (SEE SH 8)
TO IGNITION SWITCH (SEE SH 11)
E3 INST PANEL
TO AIRBAG DIAGNOSTIC MODULE (SEE SH 67)
TO SECURITY ALARM MODULE (SEE SH 84)
J938W-1
INSTRUMENT CLUSTER
ZJ 70

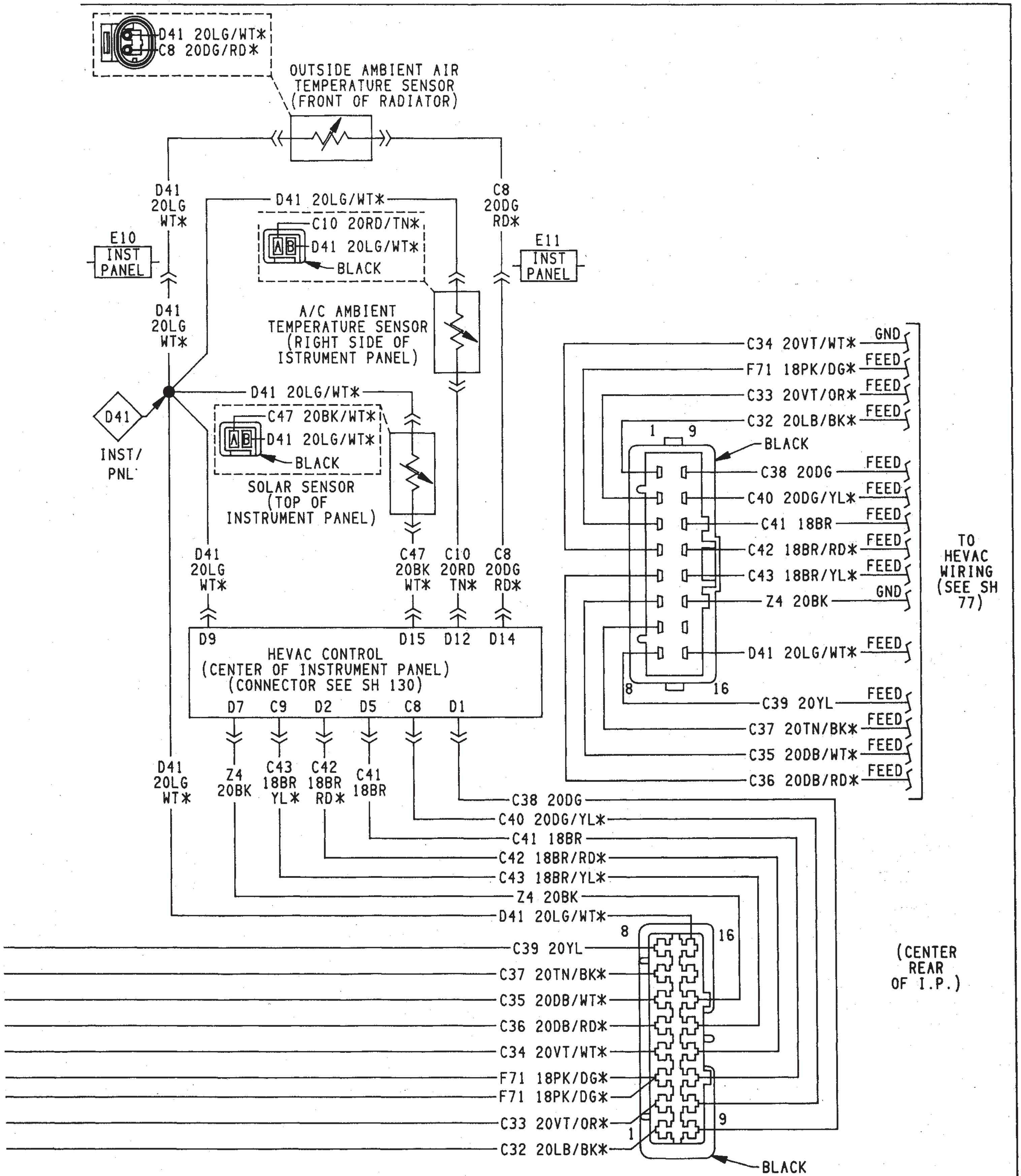


TO IGNITION SWITCH (SEE SH 12)
FEED
A22 120R BK*
FUSE #17 (7.5 AMP)
20 19 18 17
E2 20OR
C36 20DB/RD*
BLACK
C34 20VT/WT*
F71 18PK/DG*
C90 20LG
TO E2 SPLICE (SEE SH 43)
FEED
E2 20OR
F71 18PK/DG*
C36 20DB/RD*
HEVAC SWITCHES (CENTER OF INSTRUMENT PANEL)
2 6 4 3 7
C90 20LG
C34 20VT WT*
D12 INST PANEL
INST/ C34 PNL
29 INJ
F71 18PK DG*
F71 18PK DG*
C36 20DB RD*
C34 20VT WT*
TO Z1 10 SPLICE (SEE SH 44)
28 A/C SELECT
POWERTRAIN CONTROL MODULE (PCM) (CONECTOR SEE SH 123,124)
C34 20VT WT*
C36 20DB/RD*
F71 18PK/DG*
F71 18PK/DG*
C34 20VT/WT*
ZJ 71
HEVAC WITHOUT ATC
J938W-1


C1 14DG
BLACK
C7 12BK/TN*
C4 14TN
C6 14LB
C5 14LG
C1 14DG
4
HI
LO
M2
M1
FAN/
BLOWER
SWITCH
(CENTER OF
INSTRUMENT
PANEL)
3
5
2
1
C7
12BK
TN*
C6
14LB
C5
14LG
C4
14TN
TO HEVAC
MODULE
WIRING
(SEE SH 76)
FEED
GND
FEED
FEED
FEED
FEED
FEED
FEED
C1 14DG
C34 20VT/WT*
F71 18PK/DG*
C36 20DB/RD*
C4 14TN
C5 14LG
C6 14LB
C7 12BK/TN*
1
9
8
16
C1
14DG
BLACK
(CENTER
REAR OF
I.P.)
8
16
C7 12BK/TN*
C6 14LB
C5 14LG
C4 14TN
C36 20DB/RD*
F71 18PK/DG*
F71 18PK/DG*
C34 20VT/WT*
C36 20DB/RD*
F71 18PK/DG*
F71 18PK/DG*
C34 20VT/WT*
1
9

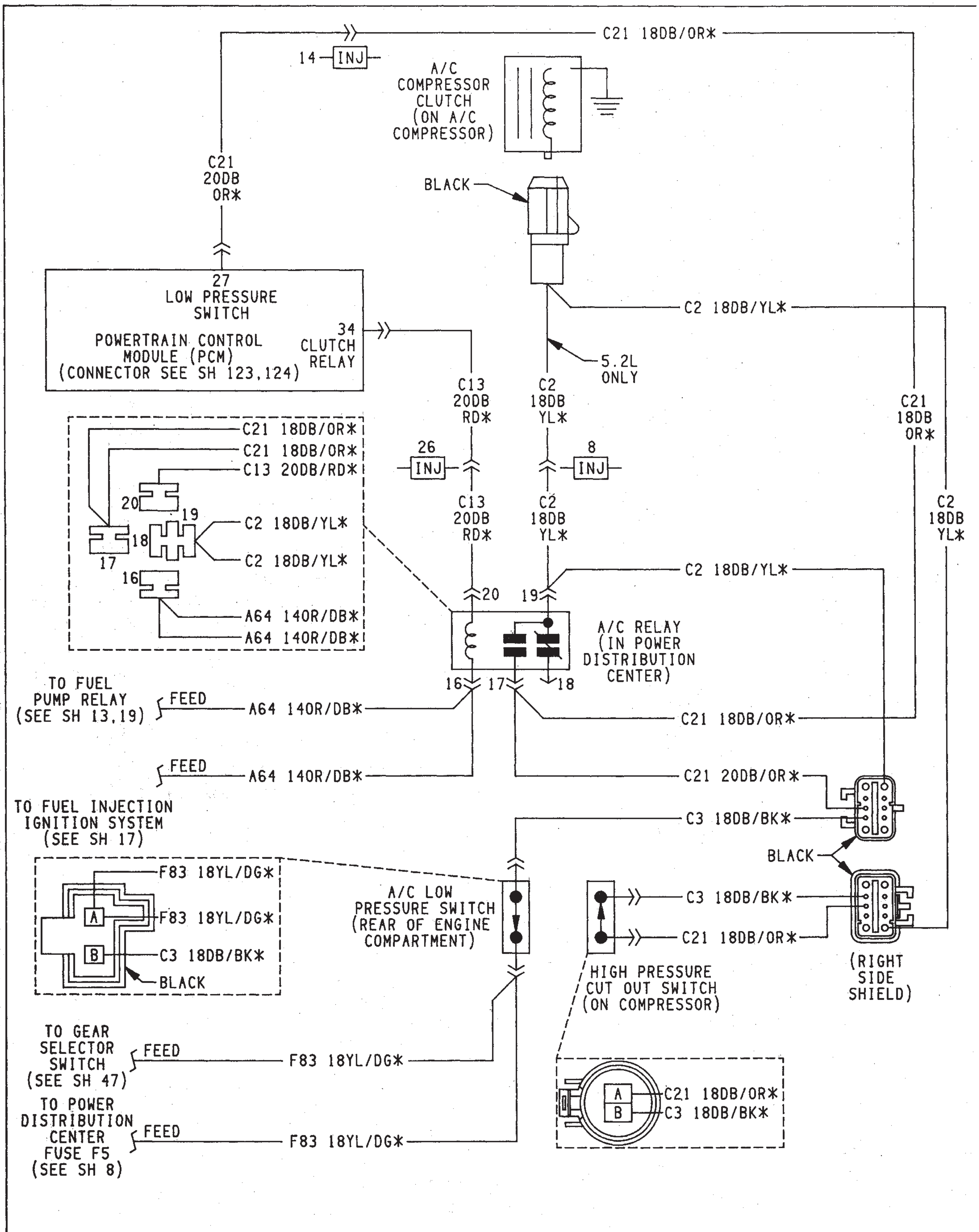


HEVAC WITH ATC



J938W-1

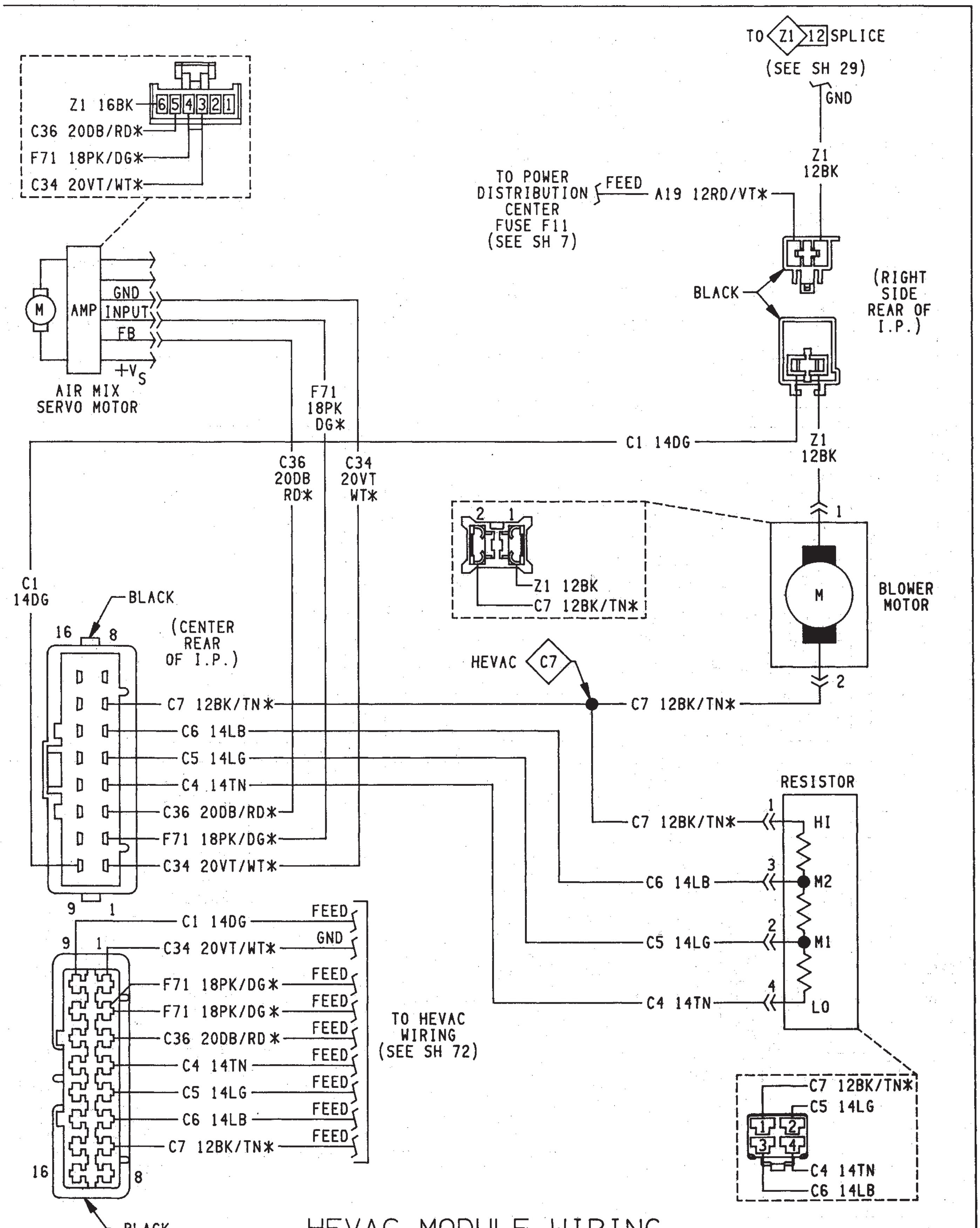
HEVAC WITHOUT ATC



ZJ 75

AIR CONDITIONER RELAY

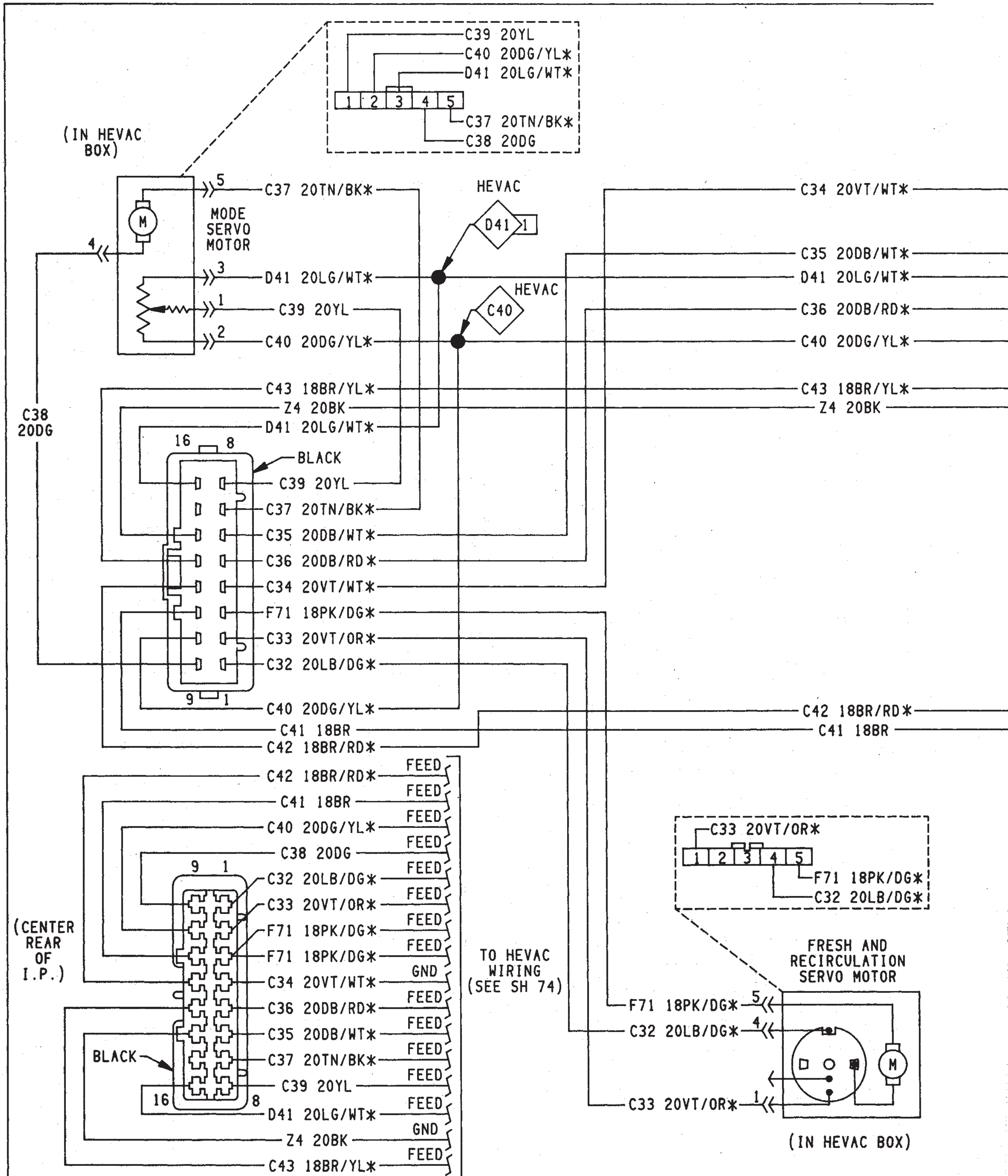
J938W-1



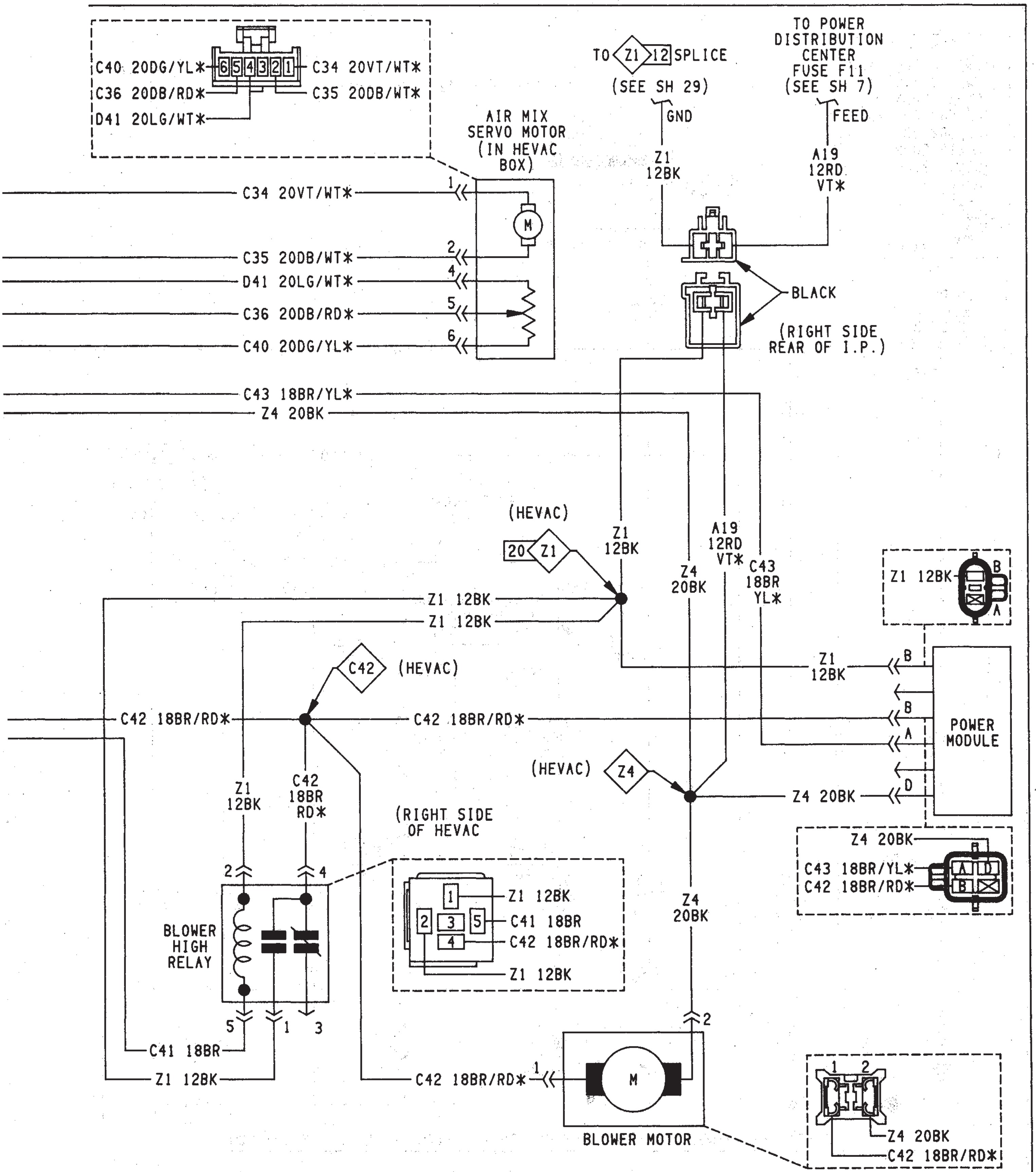
HEVAC MODULE WIRING
WITHOUT ATC

J938W-1

ZJ 76



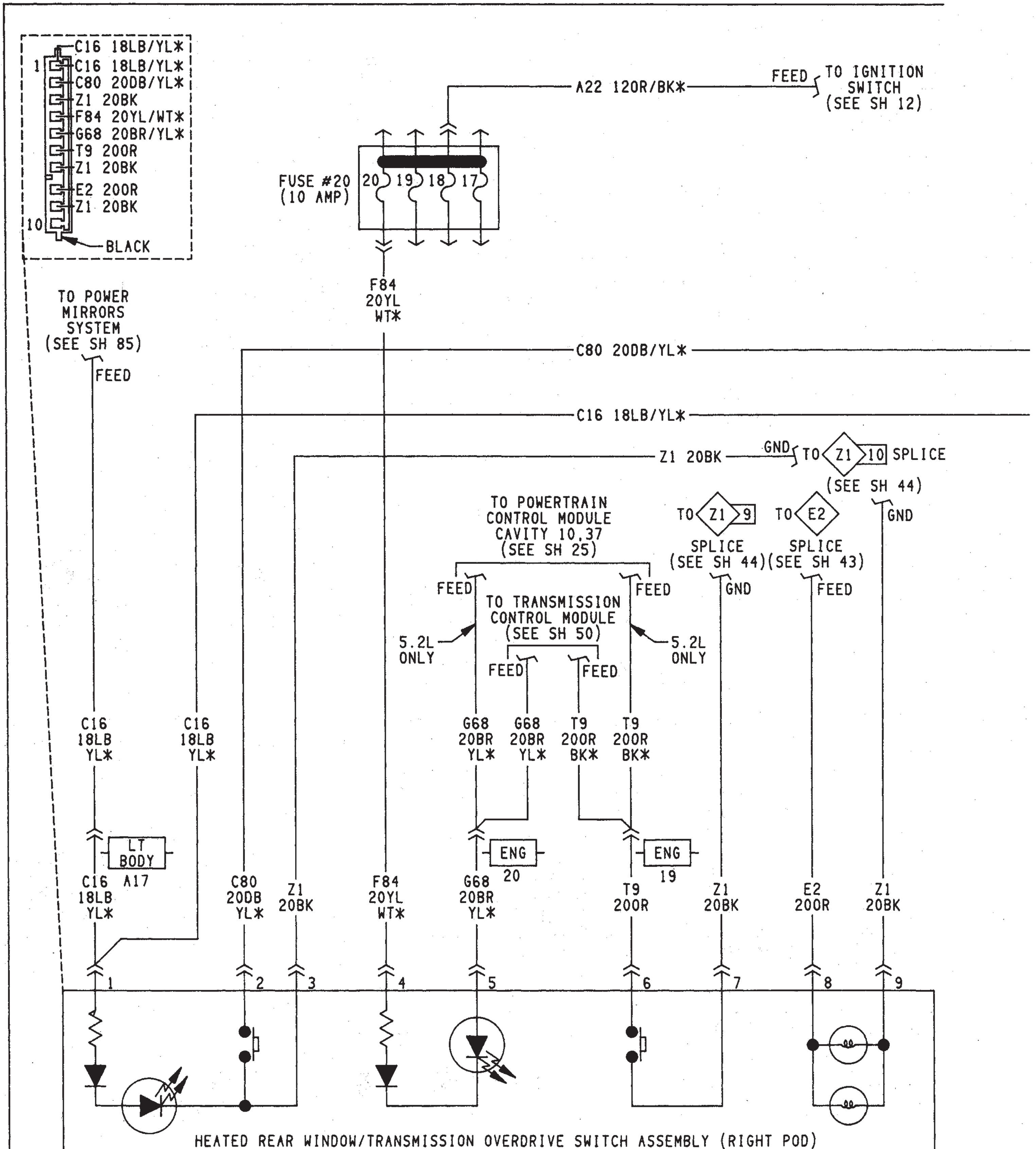
ZJ 77 HEVAC MODULE WIRING WITH ATC J938W-1



HEVAC MODULE WIRING WITH ATC

J938W-1

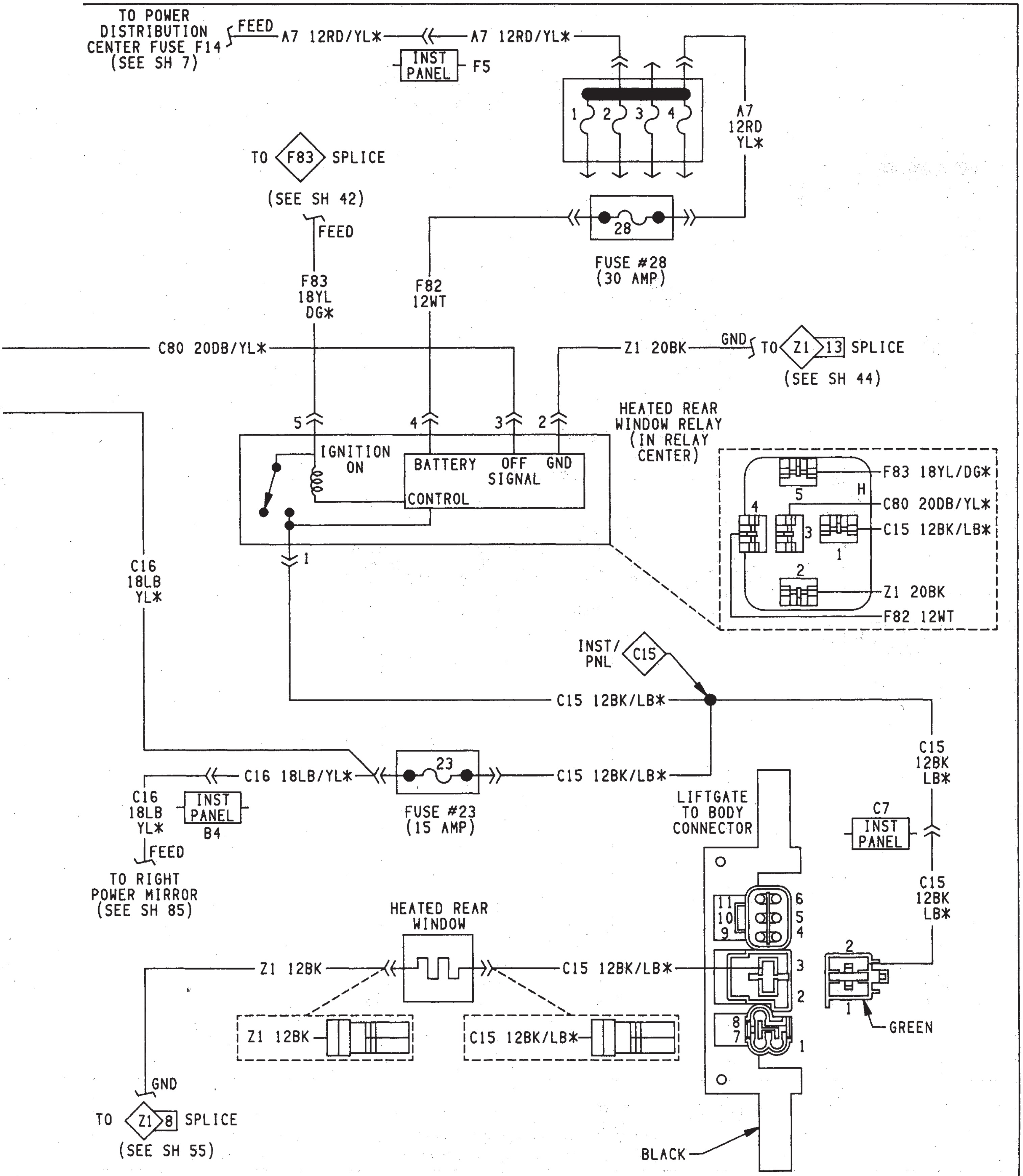
ZJ 78



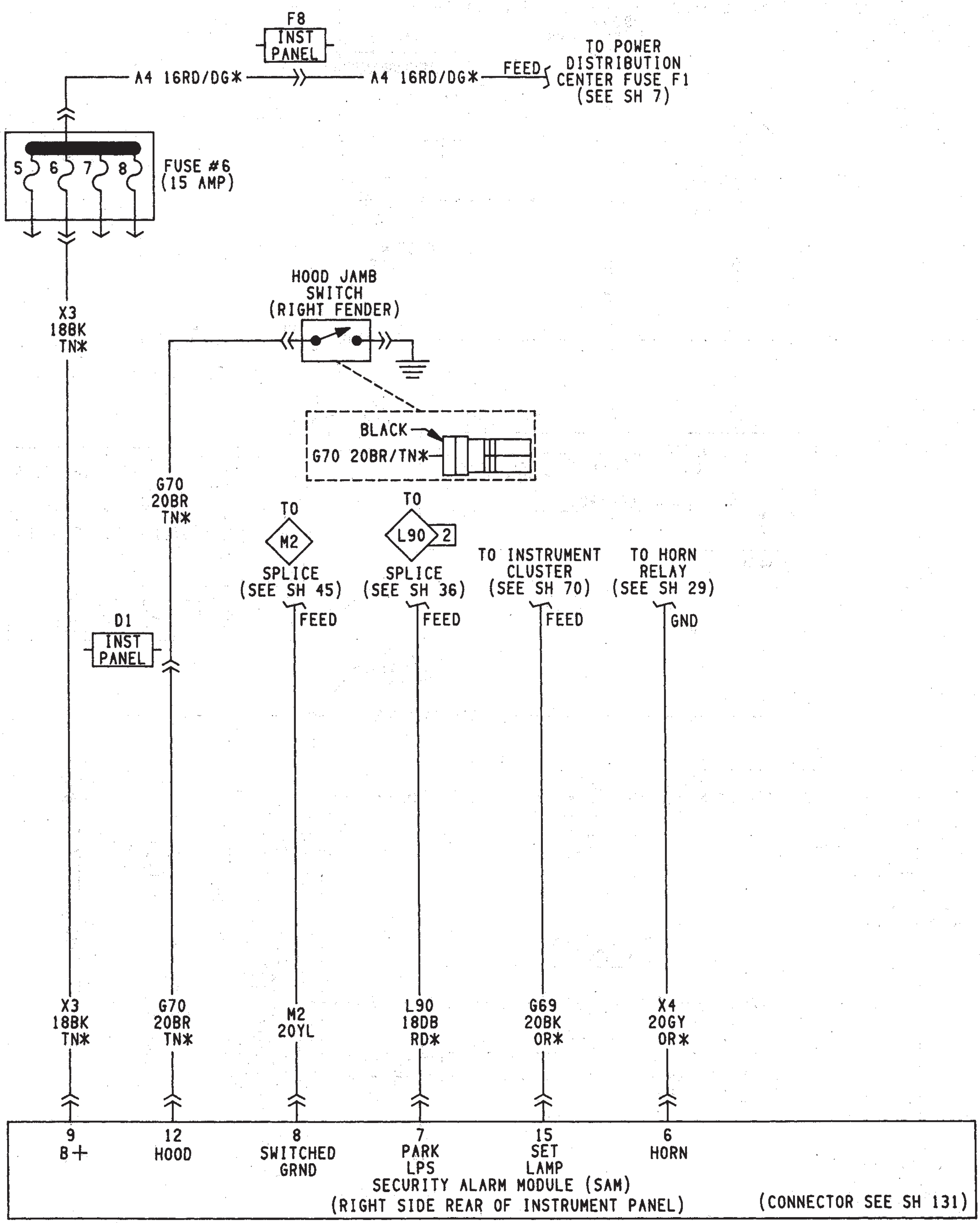
HEATED REAR WINDOW/TRANSMISSION OVERDRIVE SWITCH

ZJ 79

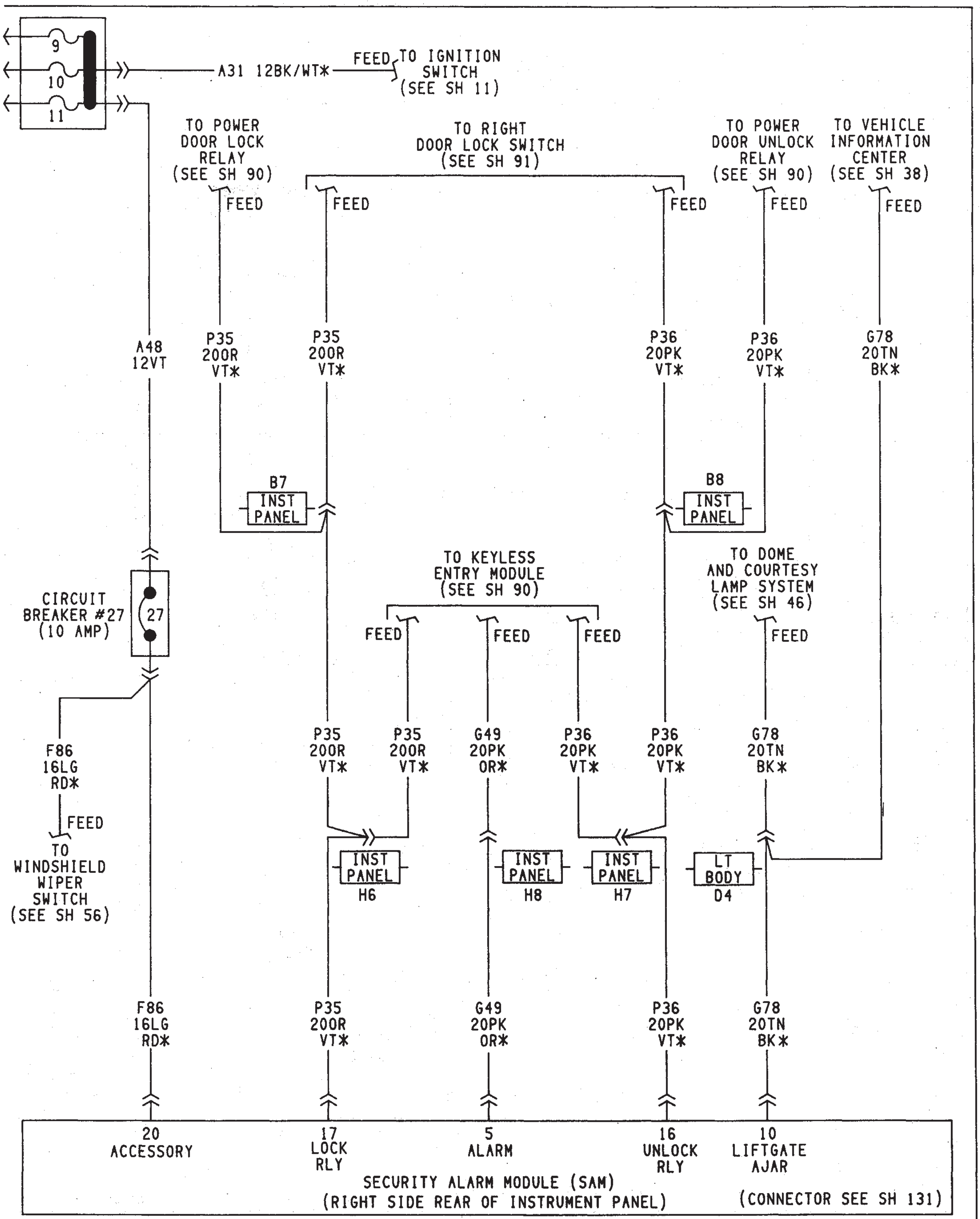
J938W-1

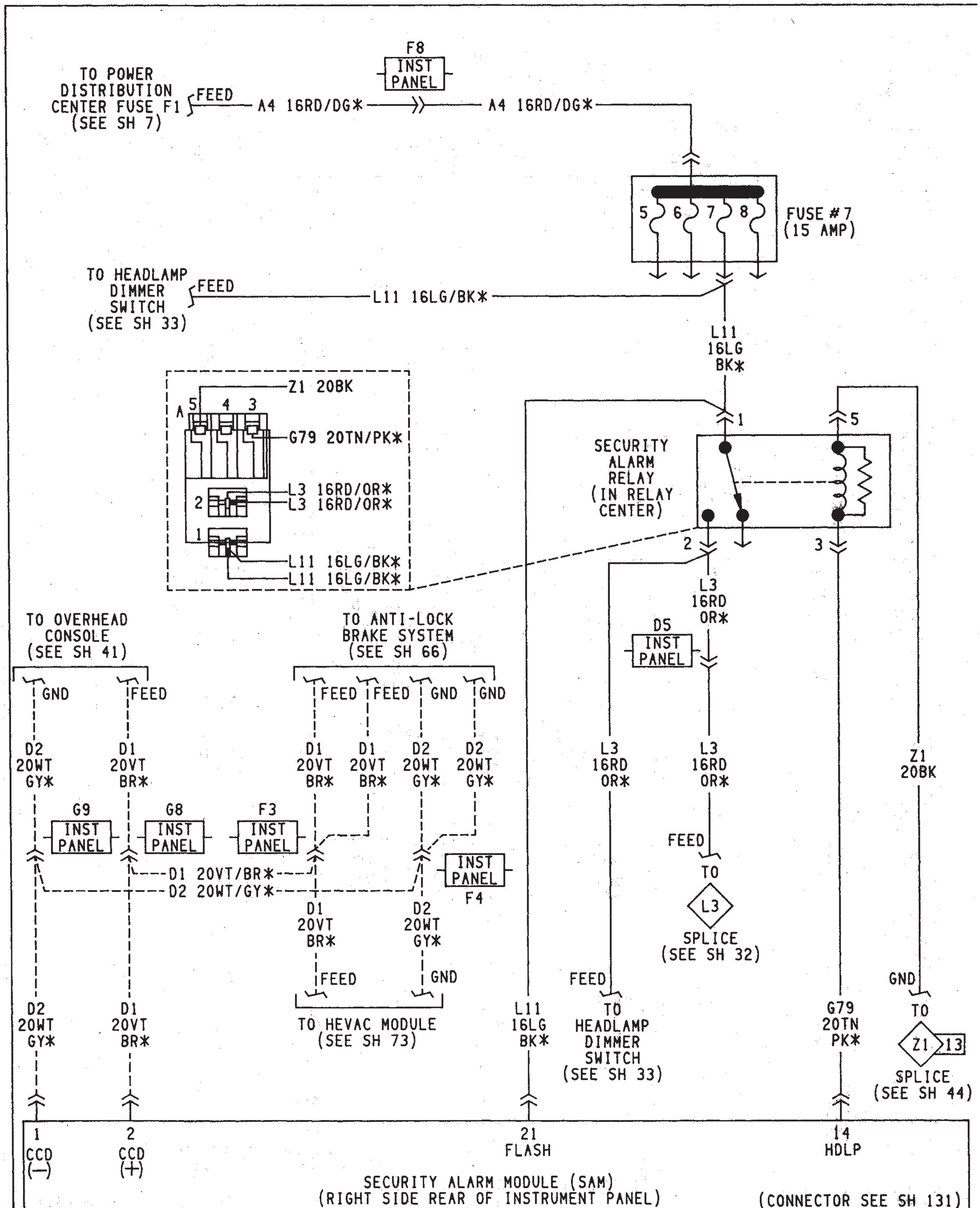


TO POWER DISTRIBUTION CENTER FUSE F14 (SEE SH 7)
FEED
A7 12RD/YL*
A7 12RD/YL*
INST PANEL
F5
1 2 3 4
A7 12RD YL*
TO F83 SPLICE
(SEE SH 42)
FEED
28
FUSE #28 (30 AMP)
F83 18YL DG*
F82 12WT
C80 20DB/YL*
Z1 20BK
GND
TO Z1 13 SPLICE
(SEE SH 44)
5 4 3 2
HEATED REAR WINDOW RELAY (IN RELAY CENTER)
IGNITION ON
BATTERY
OFF SIGNAL
GND
CONTROL
1
F83 18YL/DG*
5
H
C80 20DB/YL*
4
3
C15 12BK/LB*
1
2
Z1 20BK
F82 12WT
C16 18LB YL*
INST/ PNL
C15
C15 12BK/LB*
C15 12BK LB*
C16 18LB/YL*
23
C15 12BK/LB*
C16 18LB YL*
INST PANEL
B4
FUSE #23 (15 AMP)
LIFTGATE TO BODY CONNECTOR
C7
INST PANEL
FEED
TO RIGHT POWER MIRROR (SEE SH 85)
C15 12BK LB*
HEATED REAR WINDOW
11 10 9
6 5 4
3
2
8 7
1
2
1
GREEN
Z1 12BK
C15 12BK/LB*
Z1 12BK
C15 12BK/LB*
GND
TO Z1 8 SPLICE
(SEE SH 55)
BLACK



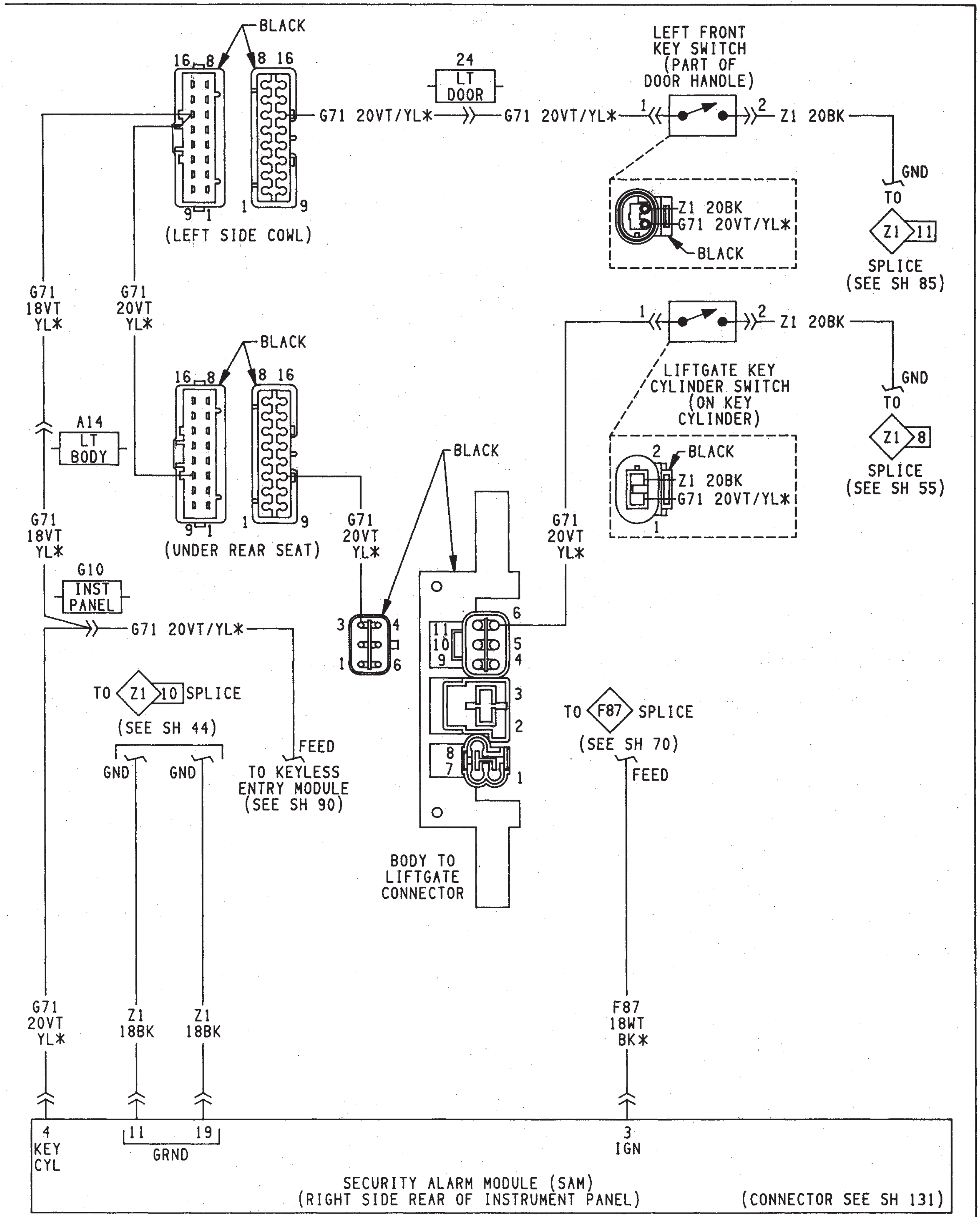
ZJ 81 SECURITY ALARM SYSTEM J938W-1

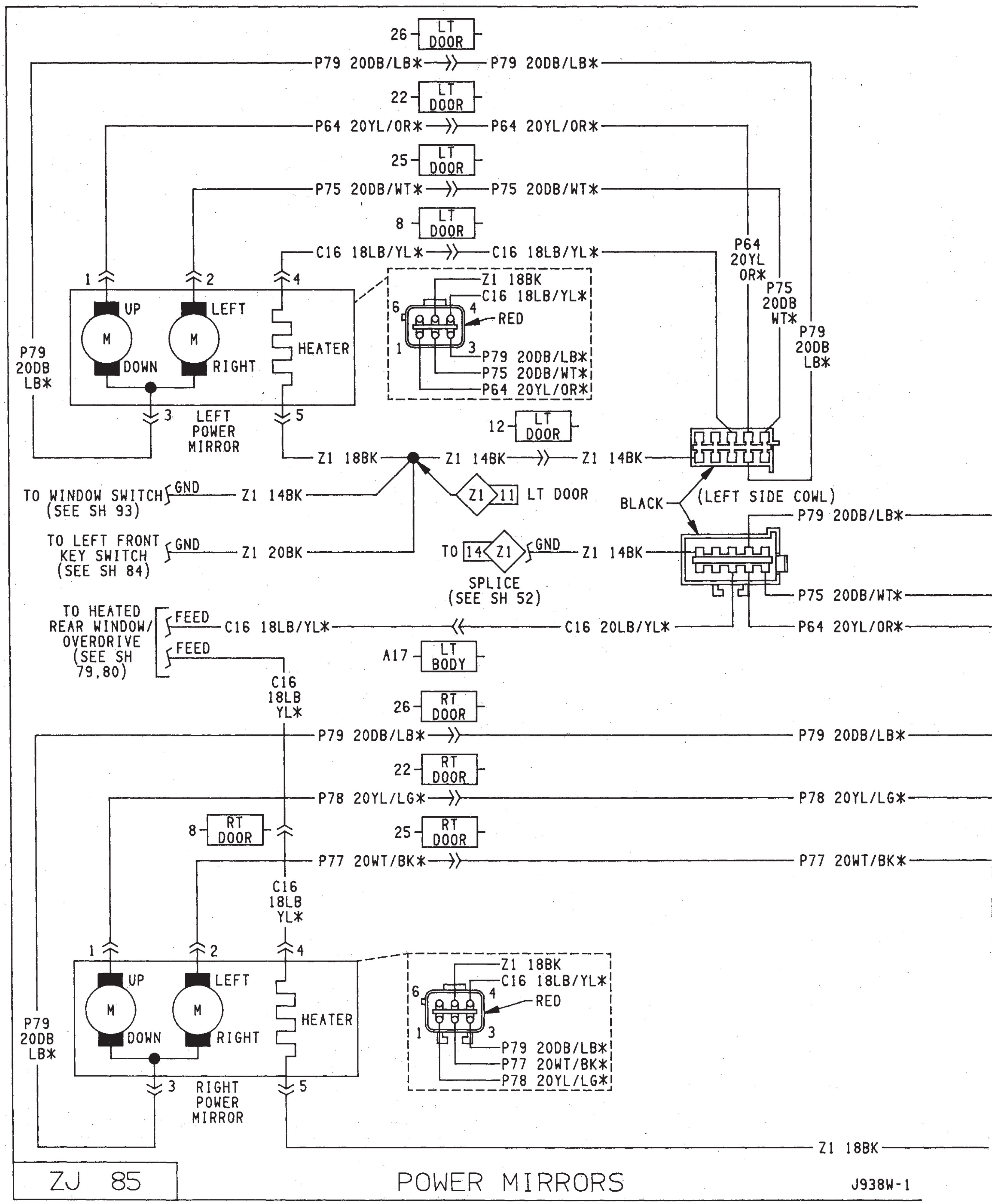

9
10
11
A31 12BK/WT*
FEED
TO IGNITION SWITCH (SEE SH 11)
TO POWER DOOR LOCK RELAY (SEE SH 90)
FEED
TO RIGHT DOOR LOCK SWITCH (SEE SH 91)
FEED
FEED
TO POWER DOOR UNLOCK RELAY (SEE SH 90)
FEED
TO VEHICLE INFORMATION CENTER (SEE SH 38)
FEED
A48 12VT
P35 20OR VT*
P35 20OR VT*
P36 20PK VT*
P36 20PK VT*
G78 20TN BK*
B7 INST PANEL
B8 INST PANEL
CIRCUIT BREAKER #27 (10 AMP)
27
TO KEYLESS ENTRY MODULE (SEE SH 90)
FEED
FEED
FEED
TO DOME AND COURTESY LAMP SYSTEM (SEE SH 46)
FEED
F86 16LG RD*
FEED
TO WINDSHIELD WIPER SWITCH (SEE SH 56)
P35 20OR VT*
P35 20OR VT*
G49 20PK OR*
P36 20PK VT*
P36 20PK VT*
G78 20TN BK*
INST PANEL H6
INST PANEL H8
INST PANEL H7
LT BODY D4
F86 16LG RD*
P35 20OR VT*
G49 20PK OR*
P36 20PK VT*
G78 20TN BK*
20 ACCESSORY
17 LOCK RLY
5 ALARM
16 UNLOCK RLY
10 LIFTGATE AJAR
SECURITY ALARM MODULE (SAM) (RIGHT SIDE REAR OF INSTRUMENT PANEL)
(CONNECTOR SEE SH 131)

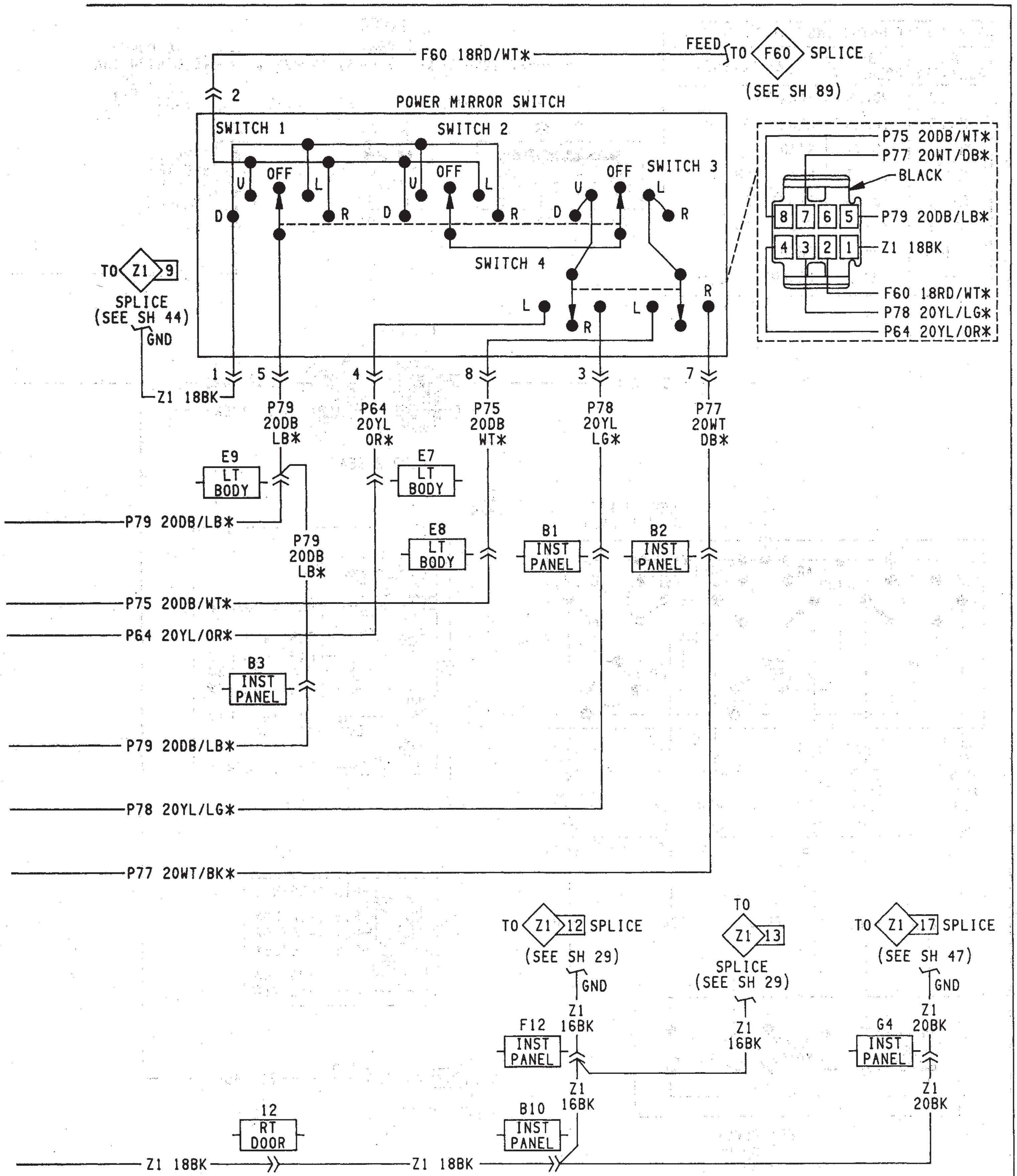


SECURITY ALARM SYSTEM

J938W-1


BLACK
16 8 8 16
9 1 1 9
(LEFT SIDE COWL)
24
LT DOOR
G71 20VT/YL*
G71 20VT/YL*
LEFT FRONT KEY SWITCH (PART OF DOOR HANDLE)
Z1 20BK
GND
TO
Z1 11
SPLICE (SEE SH 85)
Z1 20BK
G71 20VT/YL*
BLACK
G71 18VT YL*
G71 20VT YL*
BLACK
(UNDER REAR SEAT)
A14
LT BODY
LIFTGATE KEY CYLINDER SWITCH (ON KEY CYLINDER)
Z1 20BK
GND
TO
Z1 8
SPLICE (SEE SH 55)
BLACK
Z1 20BK
G71 20VT/YL*
BLACK
G71 18VT YL*
G71 20VT YL*
G71 20VT YL*
G10
INST PANEL
G71 20VT/YL*
TO Z1 10 SPLICE
(SEE SH 44)
GND GND
FEED
TO KEYLESS ENTRY MODULE (SEE SH 90)
TO F87 SPLICE
(SEE SH 70)
FEED
BODY TO LIFTGATE CONNECTOR
G71 20VT YL*
Z1 18BK
Z1 18BK
F87 18WT BK*
4 KEY CYL
11 19 GRND
3 IGN
SECURITY ALARM MODULE (SAM) (RIGHT SIDE REAR OF INSTRUMENT PANEL)
(CONNECTOR SEE SH 131)

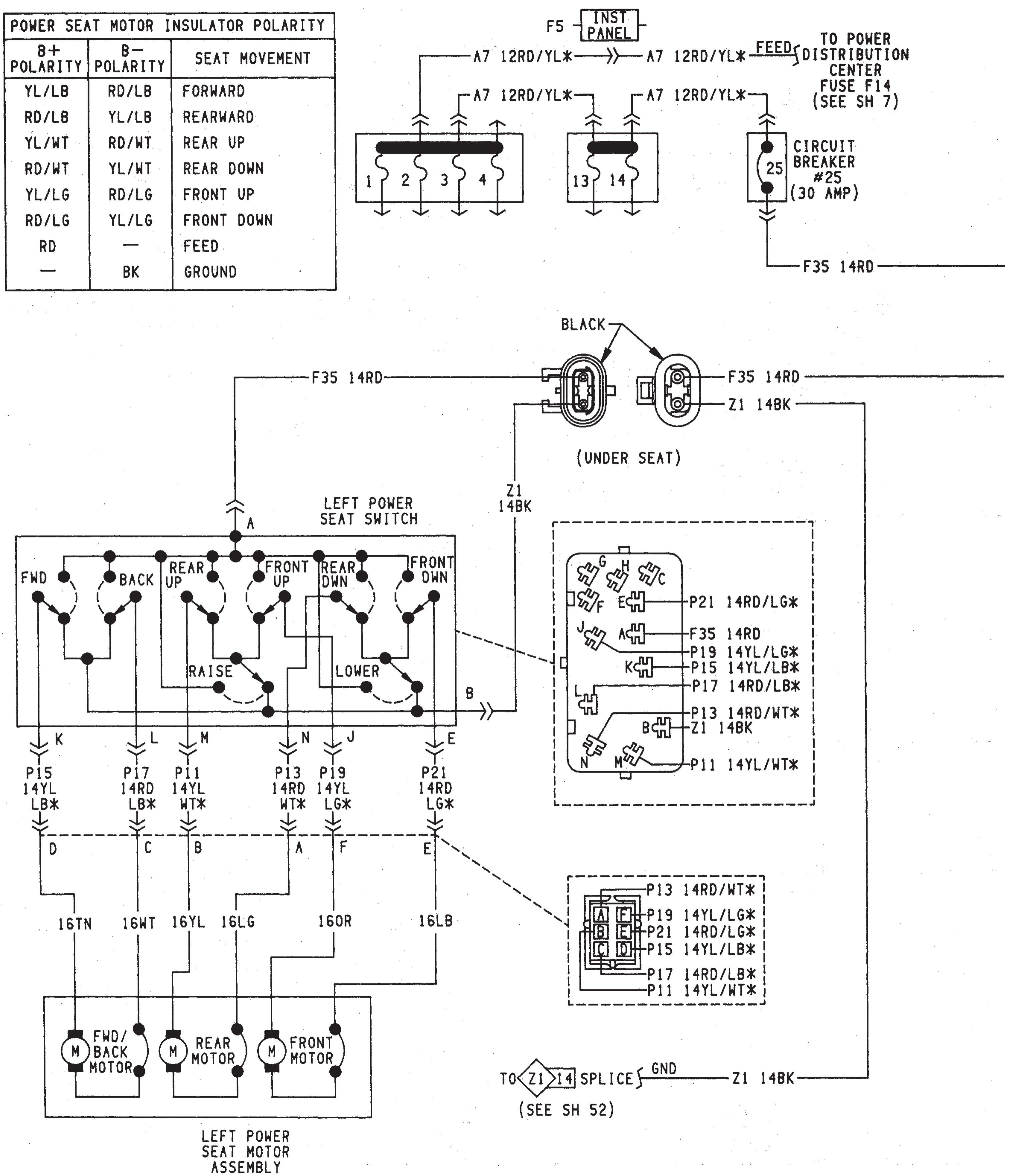

26 LT DOOR
P79 20DB/LB*
P79 20DB/LB*
22 LT DOOR
P64 20YL/OR*
P64 20YL/OR*
25 LT DOOR
P75 20DB/WT*
P75 20DB/WT*
8 LT DOOR
C16 18LB/YL*
C16 18LB/YL*
P64 20YL OR*
P75 20DB WT*
P79 20DB LB*
UP
LEFT
DOWN
RIGHT
HEATER
P79 20DB LB*
LEFT POWER MIRROR
Z1 18BK
C16 18LB/YL*
RED
P79 20DB/LB*
P75 20DB/WT*
P64 20YL/OR*
12 LT DOOR
Z1 18BK
Z1 14BK
Z1 14BK
TO WINDOW SWITCH (SEE SH 93)
GND
Z1 14BK
Z1 11 LT DOOR
BLACK
(LEFT SIDE COWL)
P79 20DB/LB*
TO LEFT FRONT KEY SWITCH (SEE SH 84)
GND
Z1 20BK
TO 14 Z1
GND
Z1 14BK
SPLICE (SEE SH 52)
P75 20DB/WT*
TO HEATED REAR WINDOW/ OVERDRIVE (SEE SH 79,80)
FEED
C16 18LB/YL*
C16 20LB/YL*
P64 20YL/OR*
FEED
A17 LT BODY
C16 18LB YL*
26 RT DOOR
P79 20DB/LB*
P79 20DB/LB*
22 RT DOOR
P78 20YL/LG*
P78 20YL/LG*
8 RT DOOR
25 RT DOOR
P77 20WT/BK*
P77 20WT/BK*
C16 18LB YL*
UP
LEFT
DOWN
RIGHT
HEATER
P79 20DB LB*
Z1 18BK
C16 18LB/YL*
RED
P79 20DB/LB*
P77 20WT/BK*
P78 20YL/LG*
RIGHT POWER MIRROR
Z1 18BK
ZJ 85
POWER MIRRORS
J938W-1

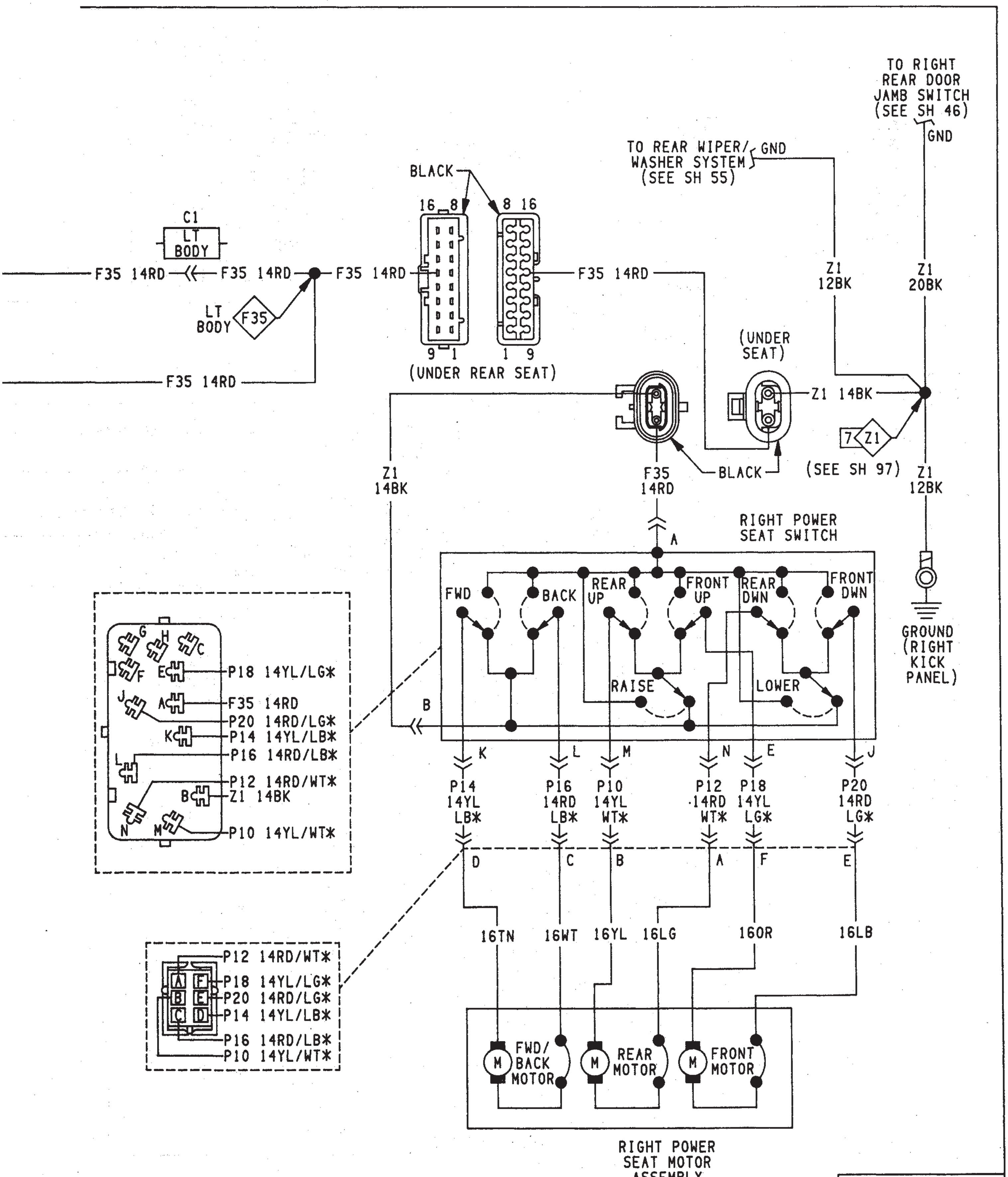


J938W-1

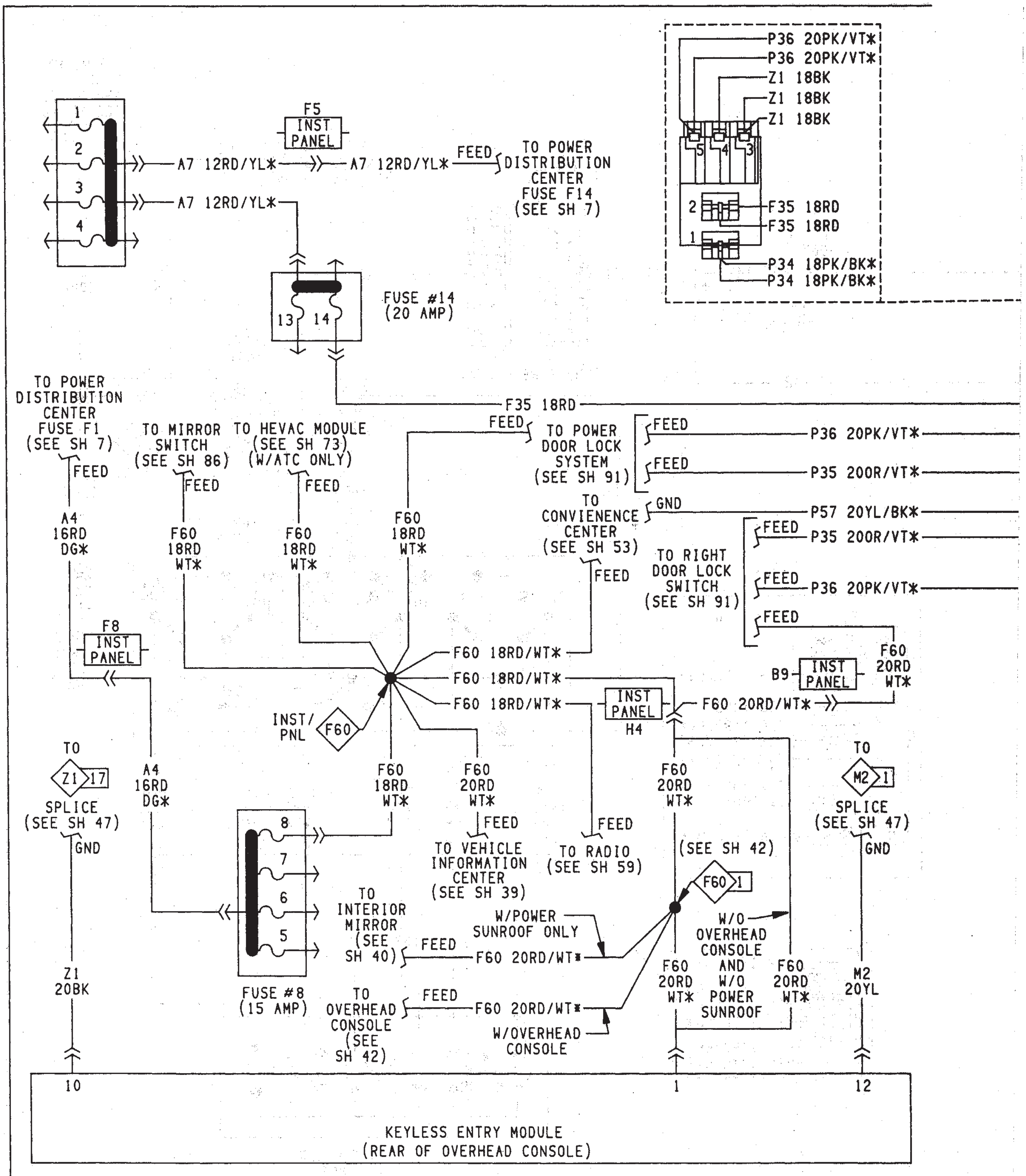
POWER MIRRORS

POWER SEAT MOTOR INSULATOR POLARITY		
B+ POLARITY	B− POLARITY	SEAT MOVEMENT
YL/LB	RD/LB	FORWARD
RD/LB	YL/LB	REARWARD
YL/WT	RD/WT	REAR UP
RD/WT	YL/WT	REAR DOWN
YL/LG	RD/LG	FRONT UP
RD/LG	YL/LG	FRONT DOWN
RD	—	FEED
—	BK	GROUND





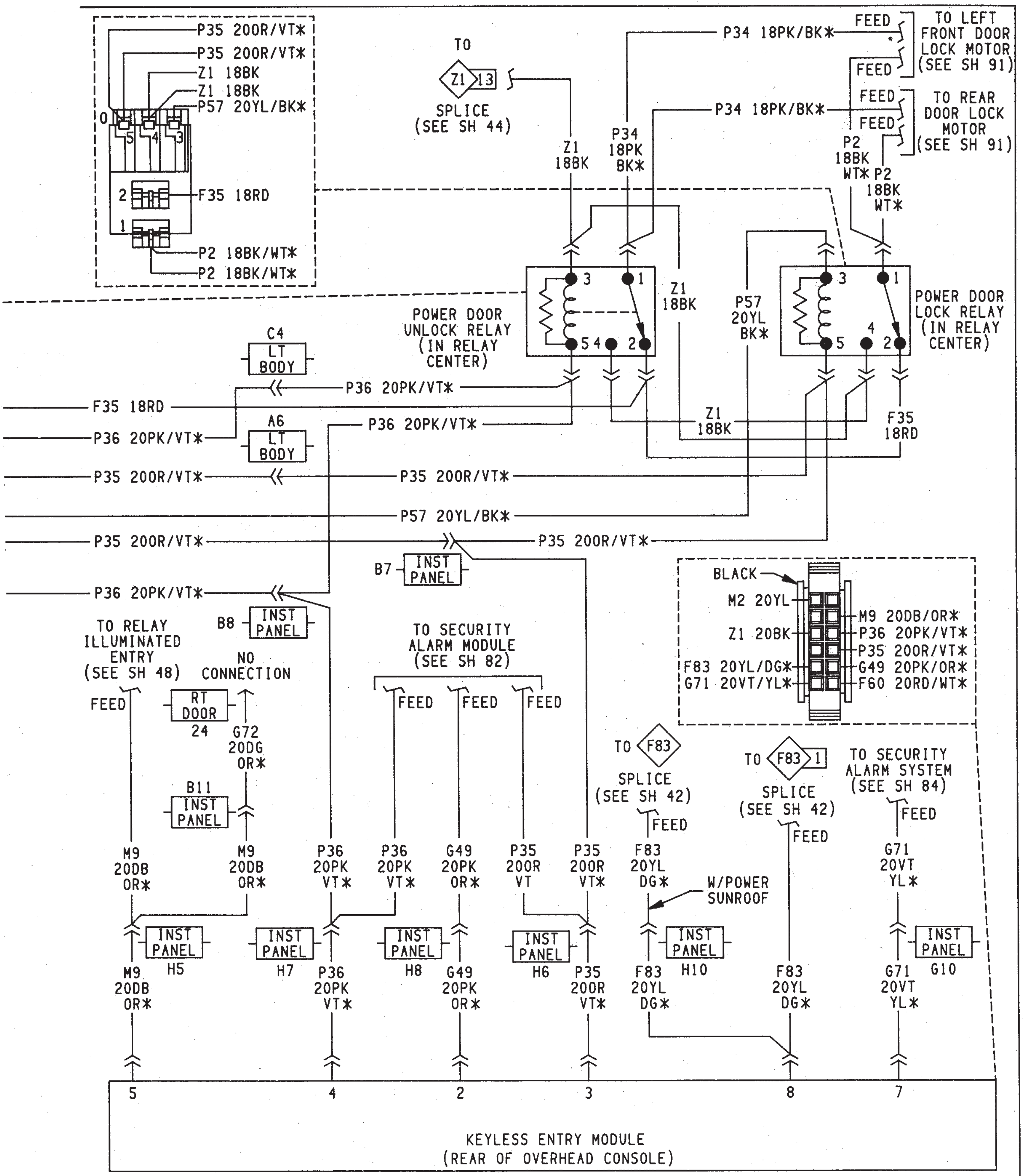
TO RIGHT REAR DOOR JAMB SWITCH (SEE SH 46)
GND
TO REAR WIPER/ WASHER SYSTEM (SEE SH 55)
GND
BLACK
16 8
8 16
C1
LT BODY
F35 14RD
F35 14RD
F35 14RD
F35 14RD
LT BODY
F35
Z1 12BK
Z1 20BK
9 1
1 9
(UNDER REAR SEAT)
F35 14RD
(UNDER SEAT)
Z1 14BK
7 Z1
(SEE SH 97)
Z1 14BK
F35 14RD
BLACK
Z1 12BK
RIGHT POWER SEAT SWITCH
A
FWD
BACK
REAR UP
FRONT UP
REAR DWN
FRONT DWN
RAISE
LOWER
B
GROUND (RIGHT KICK PANEL)
P18 14YL/LG*
F35 14RD
P20 14RD/LG*
P14 14YL/LB*
P16 14RD/LB*
P12 14RD/WT*
Z1 14BK
P10 14YL/WT*
K L M N E J
P14 14YL LB*
P16 14RD LB*
P10 14YL WT*
P12 14RD WT*
P18 14YL LG*
P20 14RD LG*
D C B A F E
16TN 16WT 16YL 16LG 16OR 16LB
P12 14RD/WT*
P18 14YL/LG*
P20 14RD/LG*
P14 14YL/LB*
P16 14RD/LB*
P10 14YL/WT*
FWD/ BACK MOTOR
REAR MOTOR
FRONT MOTOR
RIGHT POWER SEAT MOTOR ASSEMBLY

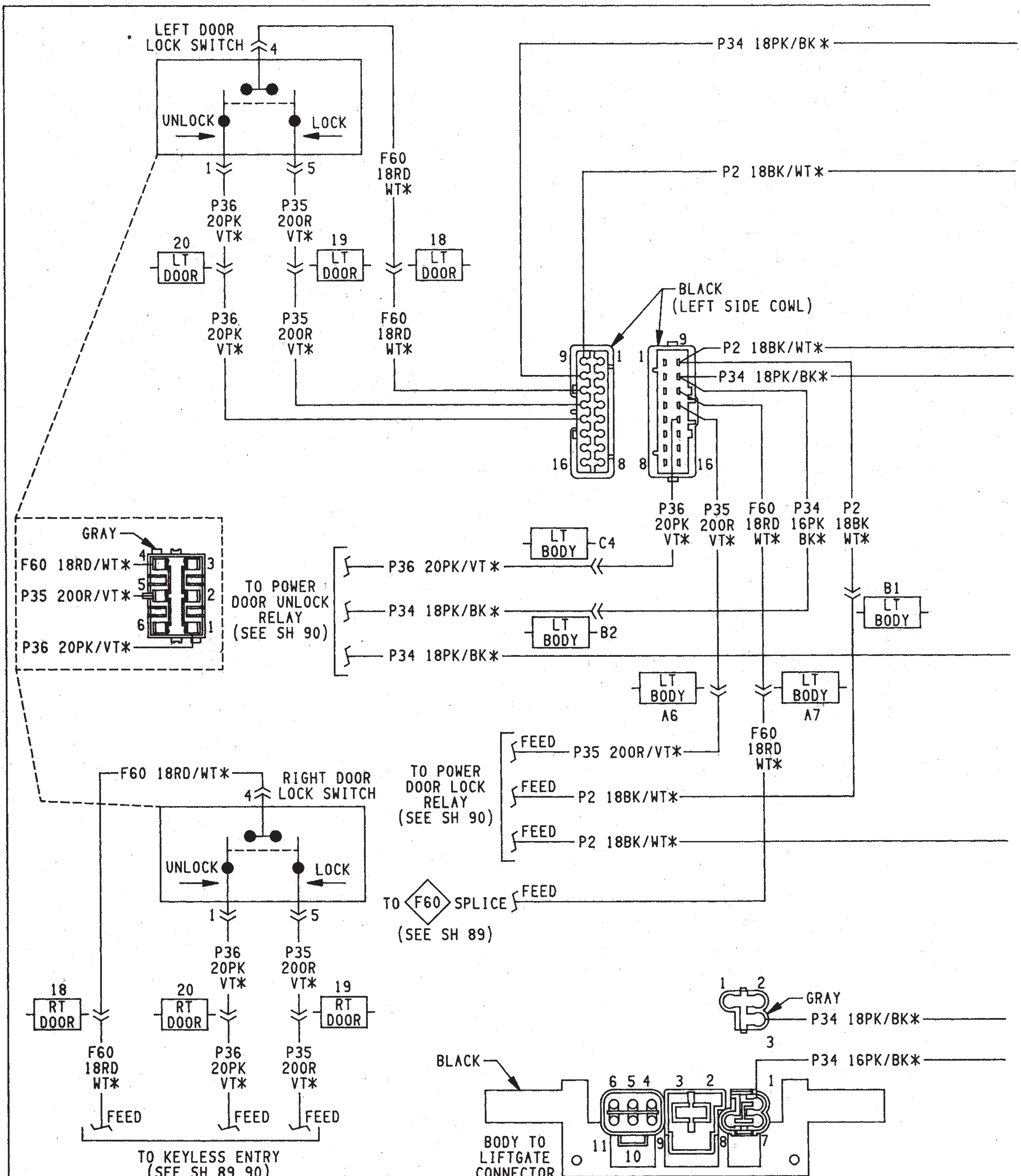


ZJ 89

POWER DOOR LOCKS

J938W-1

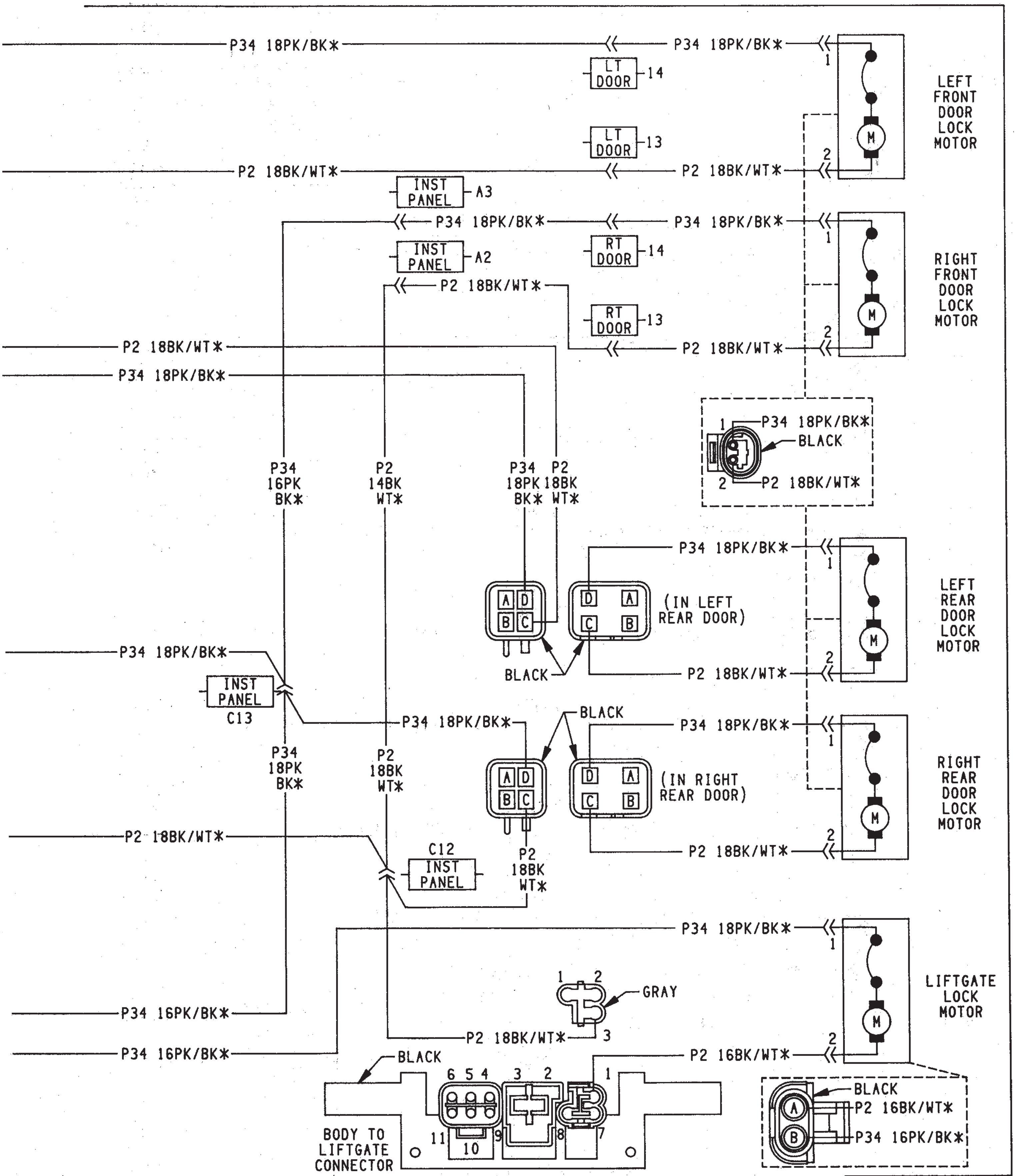

P35 20OR/VT*
P35 20OR/VT*
Z1 18BK
Z1 18BK
P57 20YL/BK*
F35 18RD
P2 18BK/WT*
P2 18BK/WT*
TO
Z1 13
SPLICE (SEE SH 44)
P34 18PK/BK*
FEED
TO LEFT FRONT DOOR LOCK MOTOR (SEE SH 91)
FEED
P34 18PK/BK*
FEED
TO REAR DOOR LOCK MOTOR (SEE SH 91)
FEED
Z1 18BK
P34 18PK BK*
P2 18BK WT*
P2 18BK WT*
Z1 18BK
P57 20YL BK*
POWER DOOR UNLOCK RELAY (IN RELAY CENTER)
POWER DOOR LOCK RELAY (IN RELAY CENTER)
C4 LT BODY
P36 20PK/VT*
F35 18RD
P36 20PK/VT*
A6 LT BODY
P36 20PK/VT*
Z1 18BK
F35 18RD
P35 20OR/VT*
P35 20OR/VT*
P57 20YL/BK*
P57 20YL/BK*
P35 20OR/VT*
P35 20OR/VT*
B7 INST PANEL
P36 20PK/VT*
B8 INST PANEL
BLACK
M2 20YL
Z1 20BK
F83 20YL/DG*
G71 20VT/YL*
M9 20DB/OR*
P36 20PK/VT*
P35 20OR/VT*
G49 20PK/OR*
F60 20RD/WT*
TO RELAY ILLUMINATED ENTRY (SEE SH 48)
FEED
NO CONNECTION
RT DOOR 24
G72 20DG OR*
B11 INST PANEL
TO SECURITY ALARM MODULE (SEE SH 82)
FEED
FEED
FEED
TO F83 SPLICE (SEE SH 42)
FEED
TO F83 1 SPLICE (SEE SH 42)
FEED
TO SECURITY ALARM SYSTEM (SEE SH 84)
FEED
M9 20DB OR*
M9 20DB OR*
P36 20PK VT*
P36 20PK VT*
G49 20PK OR*
P35 20OR VT
P35 20OR VT*
F83 20YL DG*
W/POWER SUNROOF
G71 20VT YL*
INST PANEL H5
INST PANEL H7
INST PANEL H8
INST PANEL H6
INST PANEL H10
INST PANEL G10
M9 20DB OR*
P36 20PK VT*
G49 20PK OR*
P35 20OR VT*
F83 20YL DG*
F83 20YL DG*
G71 20VT YL*
5
4
2
3
8
7
KEYLESS ENTRY MODULE (REAR OF OVERHEAD CONSOLE)



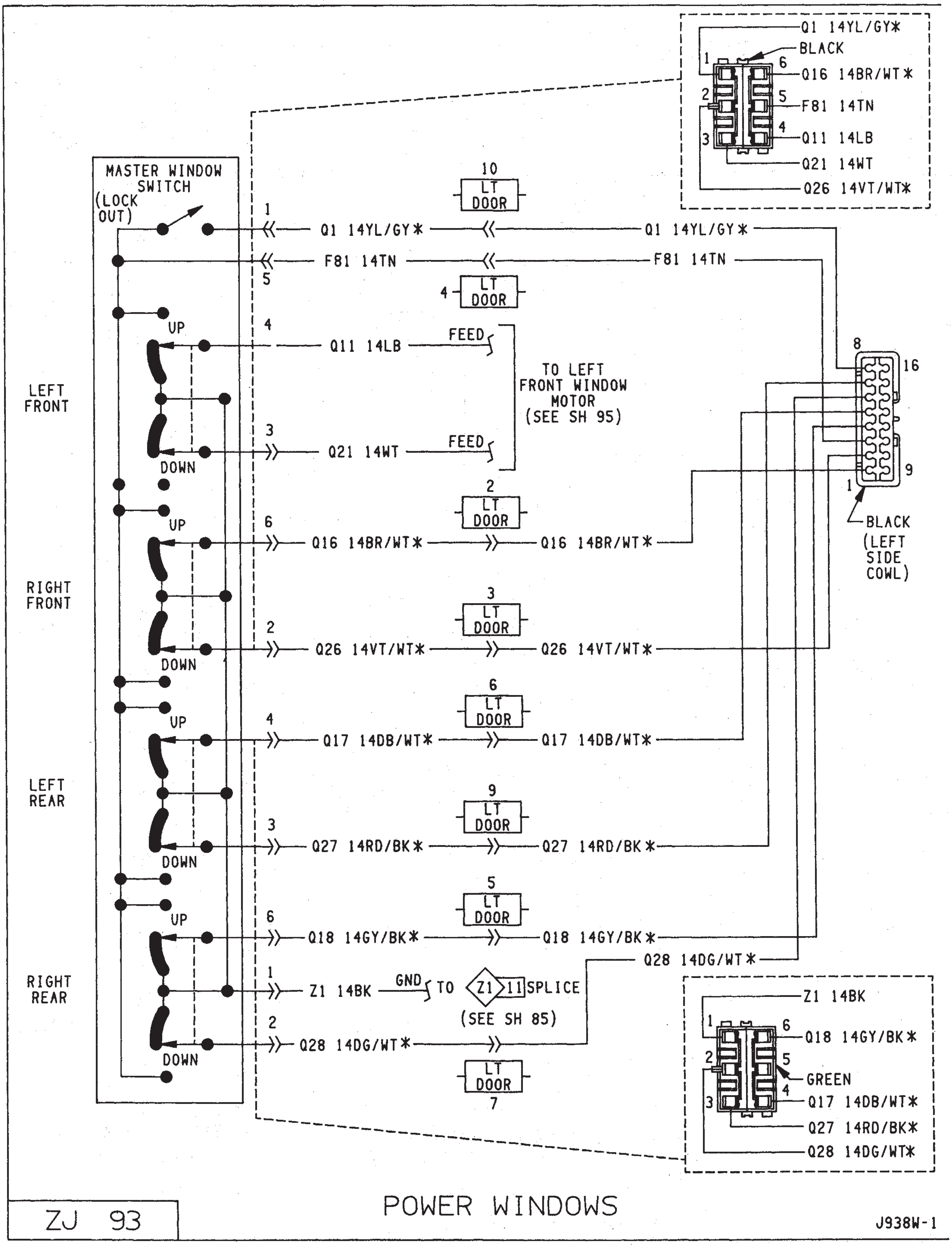
ZJ 91

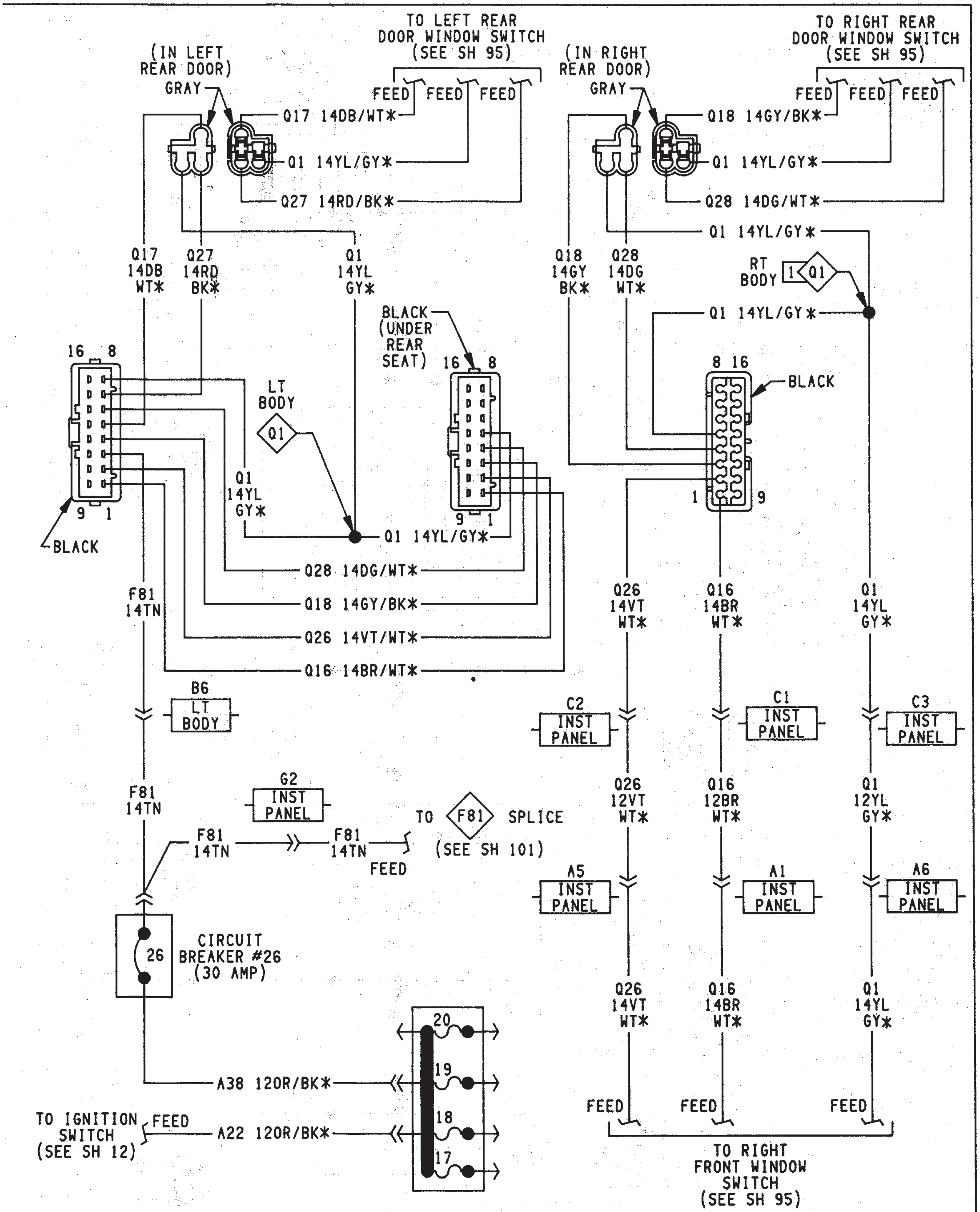
POWER DOOR LOCKS

J938W-1

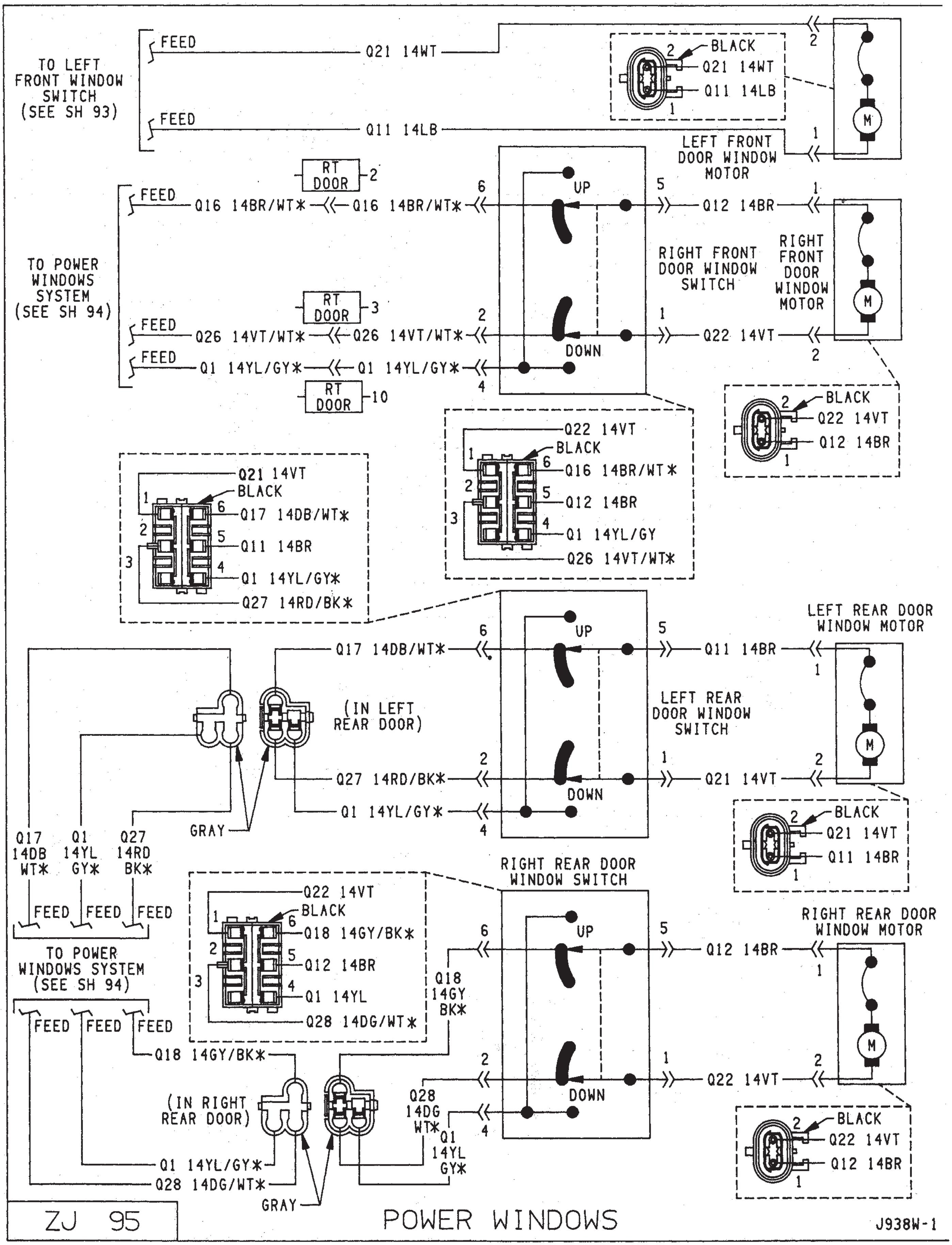


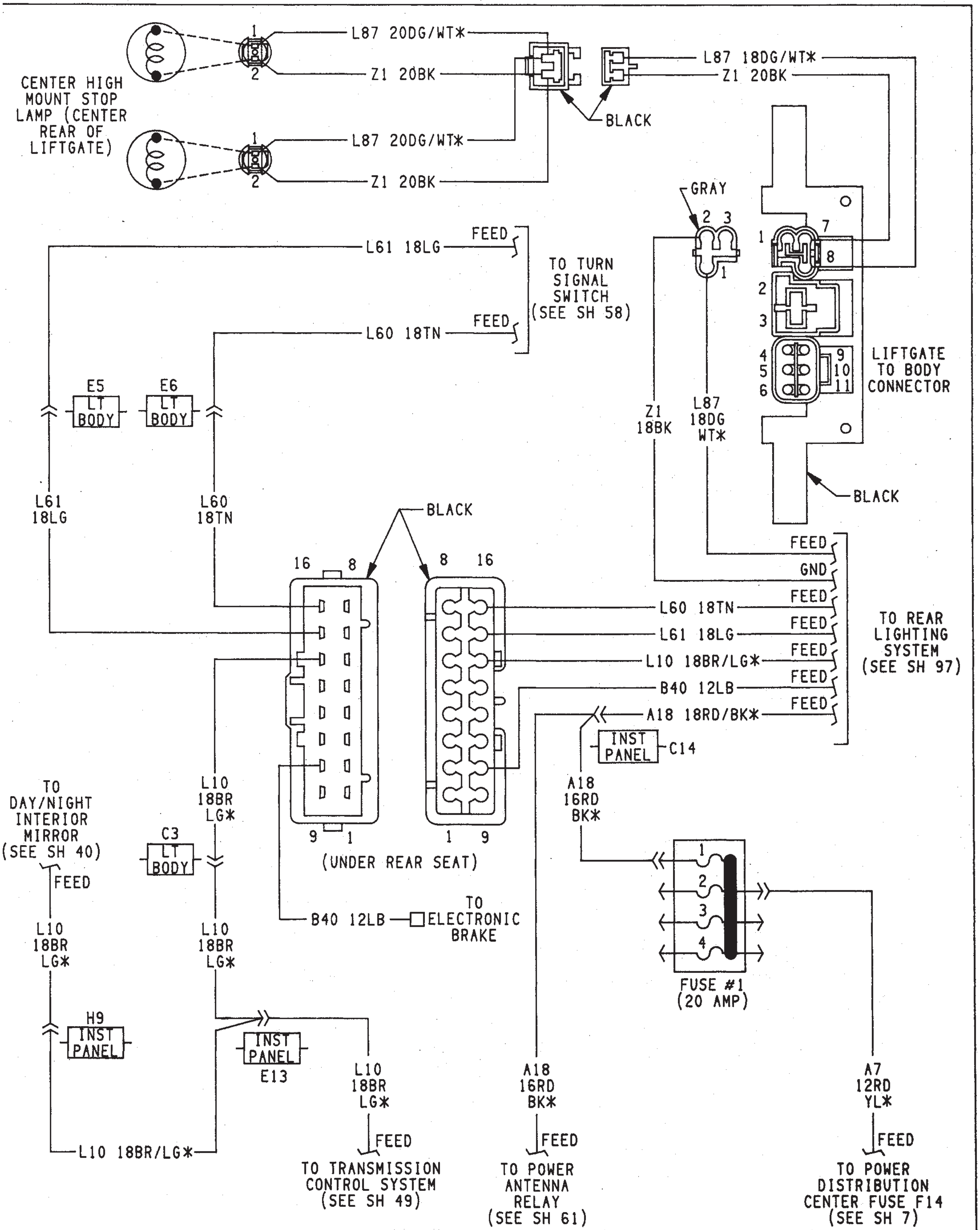
P34 18PK/BK*
LT DOOR 14
LT DOOR 13
P2 18BK/WT*
LEFT FRONT DOOR LOCK MOTOR
INST PANEL A3
INST PANEL A2
RT DOOR 14
RT DOOR 13
RIGHT FRONT DOOR LOCK MOTOR
BLACK
P34 16PK BK*
P2 14BK WT*
P34 18PK BK*
P2 18BK WT*
(IN LEFT REAR DOOR)
LEFT REAR DOOR LOCK MOTOR
INST PANEL C13
(IN RIGHT REAR DOOR)
RIGHT REAR DOOR LOCK MOTOR
C12 INST PANEL
GRAY
LIFTGATE LOCK MOTOR
P34 16PK/BK*
P2 16BK/WT*
BODY TO LIFTGATE CONNECTOR


Q1 14YL/GY*
BLACK
Q16 14BR/WT*
F81 14TN
Q11 14LB
Q21 14WT
Q26 14VT/WT*
MASTER WINDOW SWITCH
(LOCK OUT)
LEFT FRONT
RIGHT FRONT
LEFT REAR
RIGHT REAR
UP
DOWN
LT DOOR
FEED
TO LEFT FRONT WINDOW MOTOR (SEE SH 95)
Q17 14DB/WT*
Q27 14RD/BK*
Q18 14GY/BK*
Q28 14DG/WT*
Z1 14BK
GND
TO Z1 11 SPLICE
(SEE SH 85)
BLACK (LEFT SIDE COWL)
GREEN
POWER WINDOWS
J938W-1

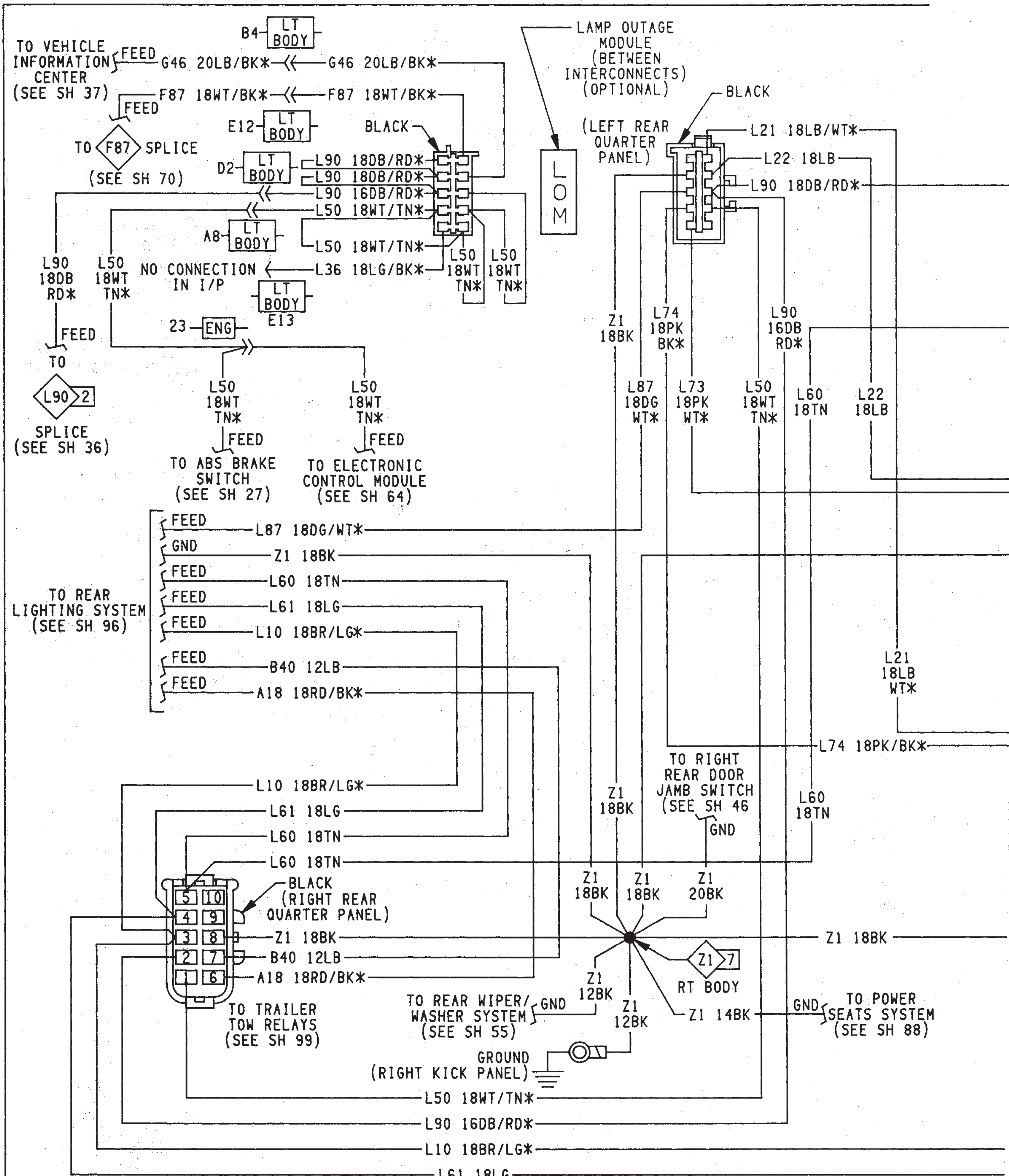


POWER WINDOWS

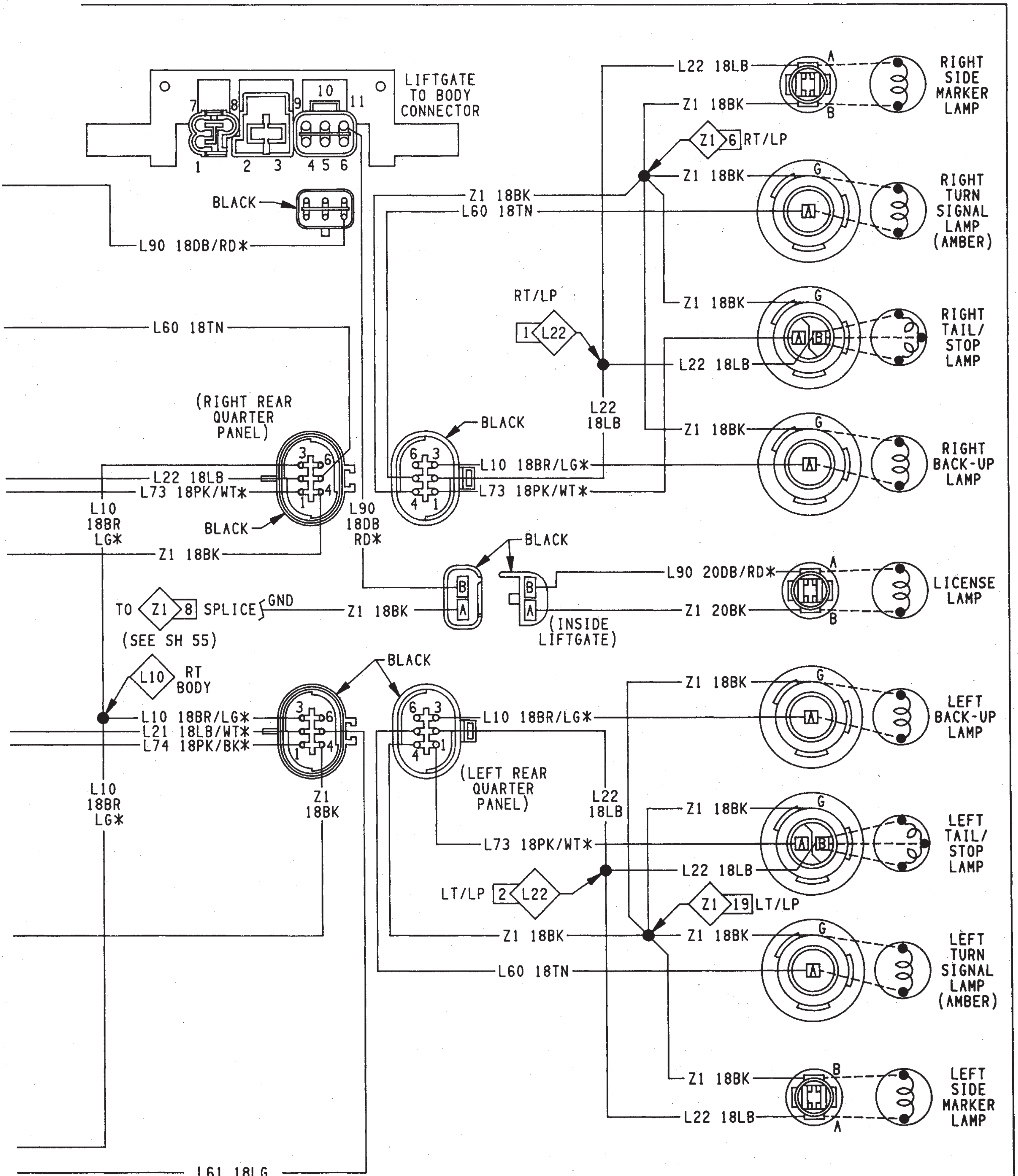

TO LEFT FRONT WINDOW SWITCH (SEE SH 93)
FEED
Q21 14WT
FEED
Q11 14LB
BLACK
Q21 14WT
Q11 14LB
LEFT FRONT DOOR WINDOW MOTOR
TO POWER WINDOWS SYSTEM (SEE SH 94)
FEED
Q16 14BR/WT*
RT DOOR
Q16 14BR/WT*
UP
Q12 14BR
RIGHT FRONT DOOR WINDOW SWITCH
RIGHT FRONT DOOR WINDOW MOTOR
FEED
Q26 14VT/WT*
Q26 14VT/WT*
Q22 14VT
DOWN
FEED
Q1 14YL/GY*
Q1 14YL/GY*
BLACK
Q22 14VT
Q12 14BR
Q22 14VT
BLACK
Q16 14BR/WT*
Q12 14BR
Q1 14YL/GY
Q26 14VT/WT*
Q21 14VT
BLACK
Q17 14DB/WT*
Q11 14BR
Q1 14YL/GY*
Q27 14RD/BK*
LEFT REAR DOOR WINDOW MOTOR
Q17 14DB/WT*
UP
Q11 14BR
(IN LEFT REAR DOOR)
LEFT REAR DOOR WINDOW SWITCH
Q27 14RD/BK*
Q21 14VT
DOWN
Q1 14YL/GY*
GRAY
Q17 14DB WT*
Q1 14YL GY*
Q27 14RD BK*
BLACK
Q21 14VT
Q11 14BR
RIGHT REAR DOOR WINDOW SWITCH
FEED FEED FEED
Q22 14VT
BLACK
Q18 14GY/BK*
Q12 14BR
Q1 14YL
Q28 14DG/WT*
RIGHT REAR DOOR WINDOW MOTOR
TO POWER WINDOWS SYSTEM (SEE SH 94)
UP
Q12 14BR
Q18 14GY BK*
FEED FEED FEED
Q18 14GY/BK*
Q22 14VT
DOWN
(IN RIGHT REAR DOOR)
Q28 14DG WT*
Q1 14YL GY*
Q1 14YL/GY*
Q28 14DG/WT*
GRAY
BLACK
Q22 14VT
Q12 14BR
ZJ 95
POWER WINDOWS
J938W-1



J938W-1 REAR LIGHTING



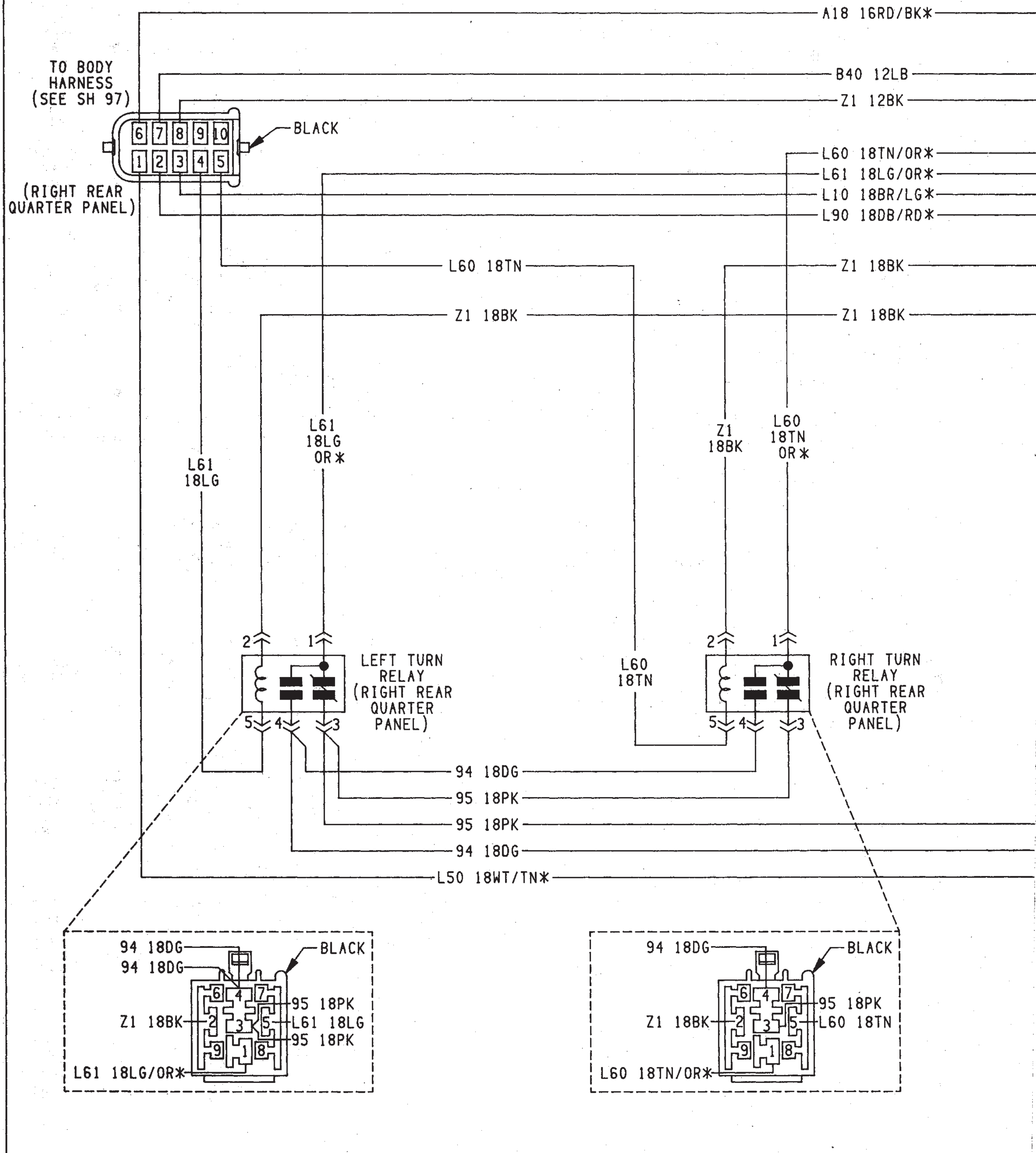
ZJ 97 REAR LIGHTING J938W-1



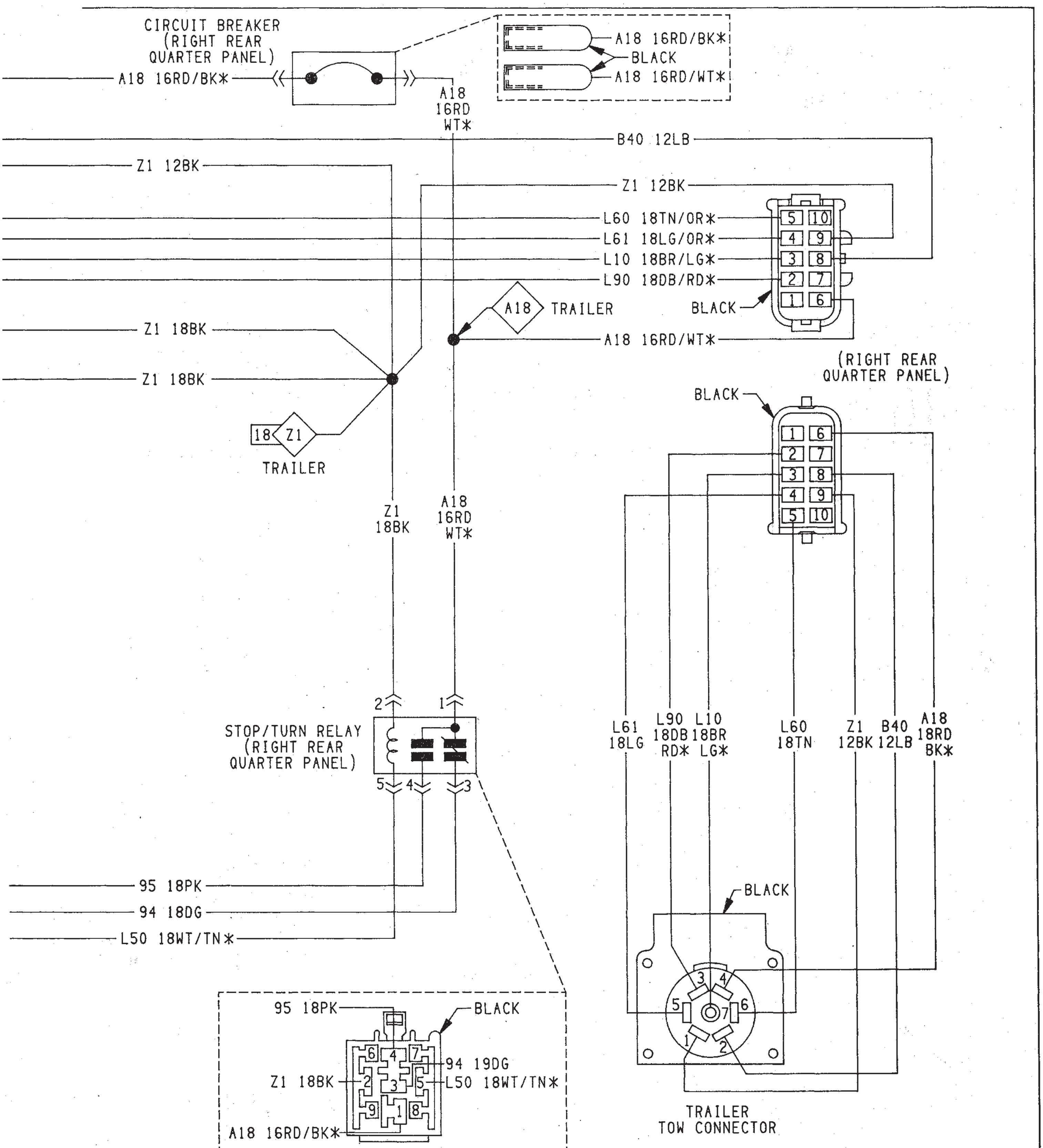
J938W-1

REAR LIGHTING

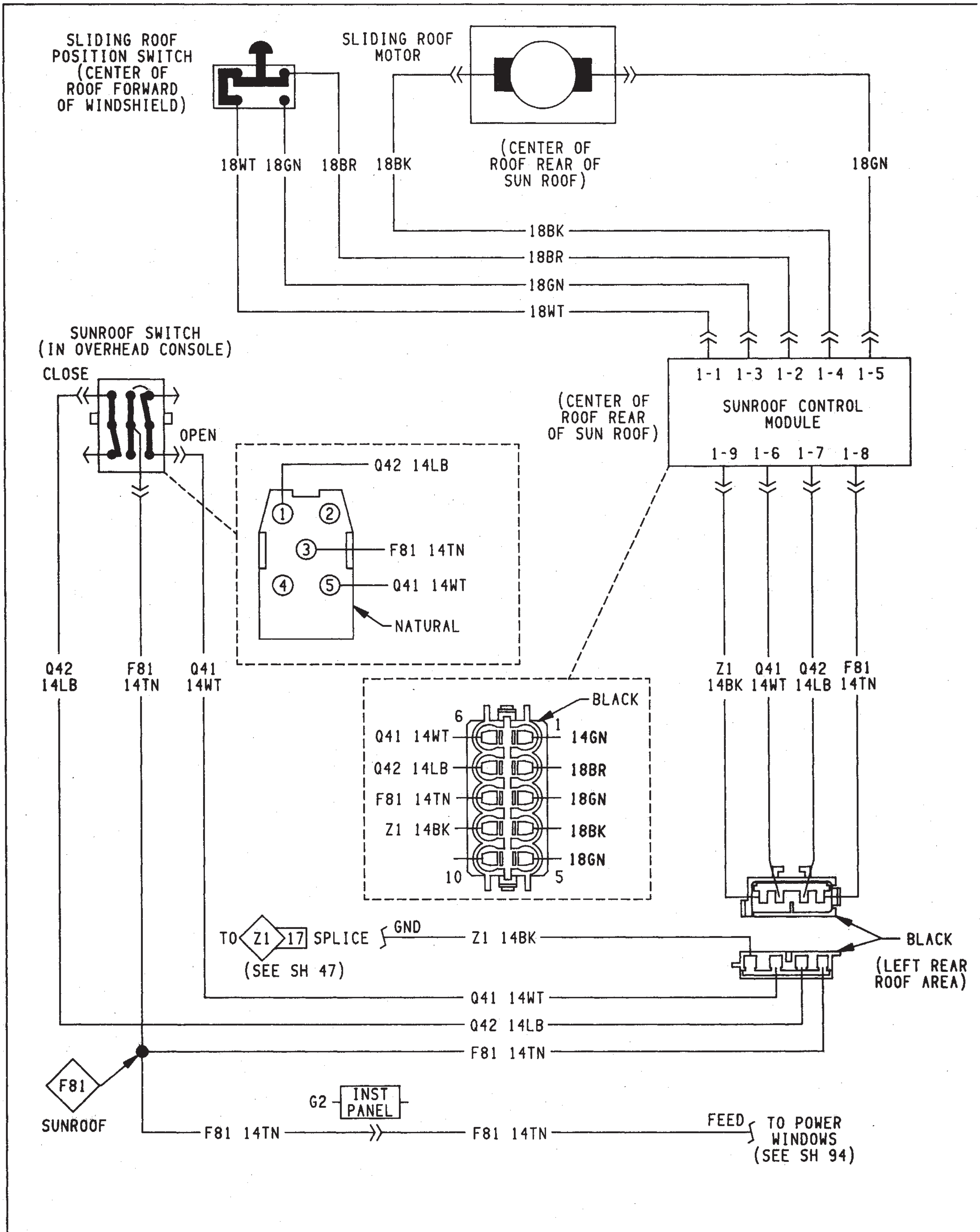
ZJ 98



A18 16RD/BK*
TO BODY HARNESS (SEE SH 97)
B40 12LB
Z1 12BK
BLACK
6 7 8 9 10
1 2 3 4 5
L60 18TN/OR*
L61 18LG/OR*
L10 18BR/LG*
L90 18DB/RD*
(RIGHT REAR QUARTER PANEL)
L60 18TN
Z1 18BK
Z1 18BK
Z1 18BK
L61 18LG OR*
L61 18LG
Z1 18BK
L60 18TN OR*
LEFT TURN RELAY (RIGHT REAR QUARTER PANEL)
L60 18TN
RIGHT TURN RELAY (RIGHT REAR QUARTER PANEL)
94 18DG
95 18PK
95 18PK
94 18DG
L50 18WT/TN*
94 18DG
94 18DG
BLACK
95 18PK
Z1 18BK
L61 18LG
95 18PK
L61 18LG/OR*
94 18DG
BLACK
95 18PK
Z1 18BK
L60 18TN
L60 18TN/OR*



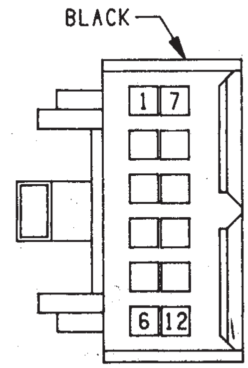
CIRCUIT BREAKER (RIGHT REAR QUARTER PANEL)
A18 16RD/BK*
A18 16RD WT*
A18 16RD/BK*
BLACK
A18 16RD/WT*
B40 12LB
Z1 12BK
Z1 12BK
L60 18TN/OR*
L61 18LG/OR*
L10 18BR/LG*
L90 18DB/RD*
A18 TRAILER
BLACK
Z1 18BK
A18 16RD/WT*
Z1 18BK
(RIGHT REAR QUARTER PANEL)
BLACK
18 Z1 TRAILER
Z1 18BK
A18 16RD WT*
STOP/TURN RELAY (RIGHT REAR QUARTER PANEL)
L61 18LG
L90 18DB RD*
L10 18BR LG*
L60 18TN
Z1 12BK
B40 12LB
A18 18RD BK*
95 18PK
94 18DG
L50 18WT/TN*
BLACK
95 18PK
BLACK
94 19DG
Z1 18BK
L50 18WT/TN*
A18 16RD/BK*
TRAILER TOW CONNECTOR



POWER SUNROOF SYSTEM

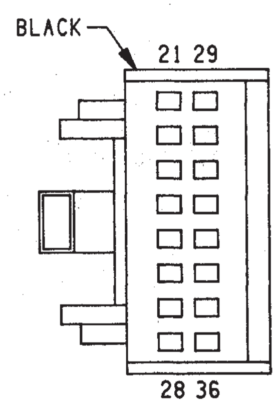
J938W-1

CAV	CIRCUIT	FUNCTION	SHEET
1	F60 20RD/WT ✱	FUSED BATTERY 'A' MEMORY CIRCUITS	39
2	Z1 20BK	GROUND	39
3	G75 20TN/PK ✱	LEFT FRONT DOOR AJAR LIGHT	39
4	G74 20TN/RD ✱	RIGHT FRONT DOOR AJAR LIGHT	39
5	G76 20TN/YL ✱	RIGHT REAR DOOR AJAR LIGHT	39
6	L5 20BK/OR ✱	TURN SIGNAL FLASHER UNIT FEED	39
7	Z1 20BK	GROUND	39
8	—	—	—
9	—	—	—
10	—	—	—
11	G81 20DB	TONE LINE (CHIME)	39
12	G7 20WT/OR ✱	VEHICLE SPEED SENSOR	39



VIEWED FROM TERMINAL END

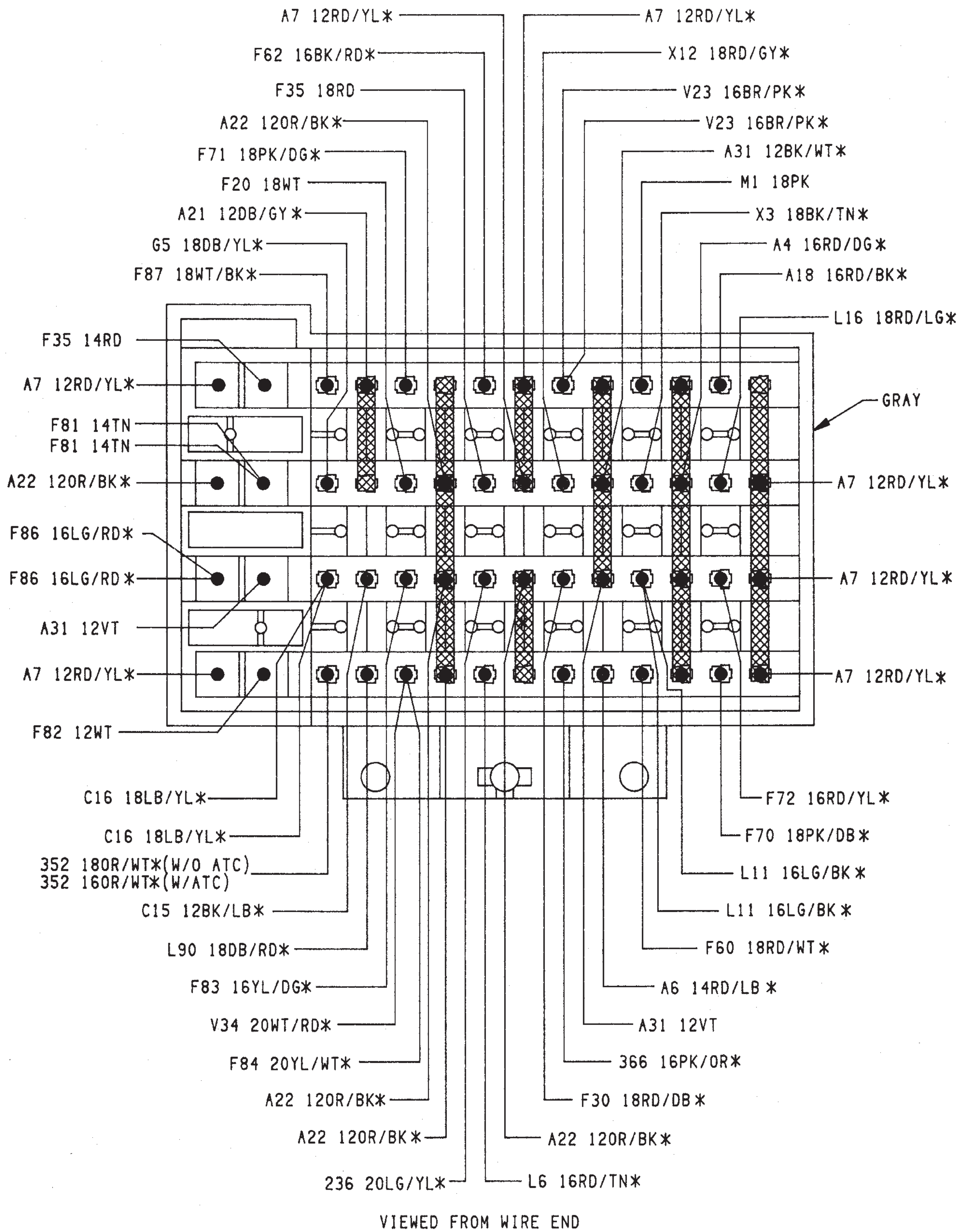
CAV	CIRCUIT	FUNCTION	SHEET
21	L90 20DB/RD ✱	PARK LAMP FEED	37
22	G18 20PK/DB ✱	LOW ENGINE COOLANT	37
23	G46 20LB/BK ✱	LAMP OUTAGE-REAR	37
24	G25 20LG/BK ✱	ENGLISH/METRIC SWITCH	37
25	G77 20TN/OR ✱	LEFT REAR DOOR AJAR LIGHT	37
26	G36 20BR/GY ✱	ENGINE OIL LEVEL SENSOR	37
27	E2 20OR	I/P ILLUMINATION	37
28	Z1 20BK	GROUND	37
29	G78 20TN/BK ✱	LIFTGATE/DECK LID AJAR SWITCH	38
30	G29 20BK/TN ✱	LOW WASHER FLUID	38
31	107 20BK/RD ✱	PART TIME LAMP/ALL TIME LAMP	38
32	106 20GY/OR ✱	4WD FULL TIME	38
33	F83 20YL/DG ✱	FUSED IGNITION	38
34	T19 20YL/BK ✱	LOW RANGE	38
35	G42 20LB/RD ✱	ALL TIME/FRONT WHEELS	38
36	G28 20LG/OR ✱	2WD/REAR WHEEL AND ALL TIME	38



VIEWED FROM TERMINAL END

VEHICLE INFORMATION CENTER CONNECTOR

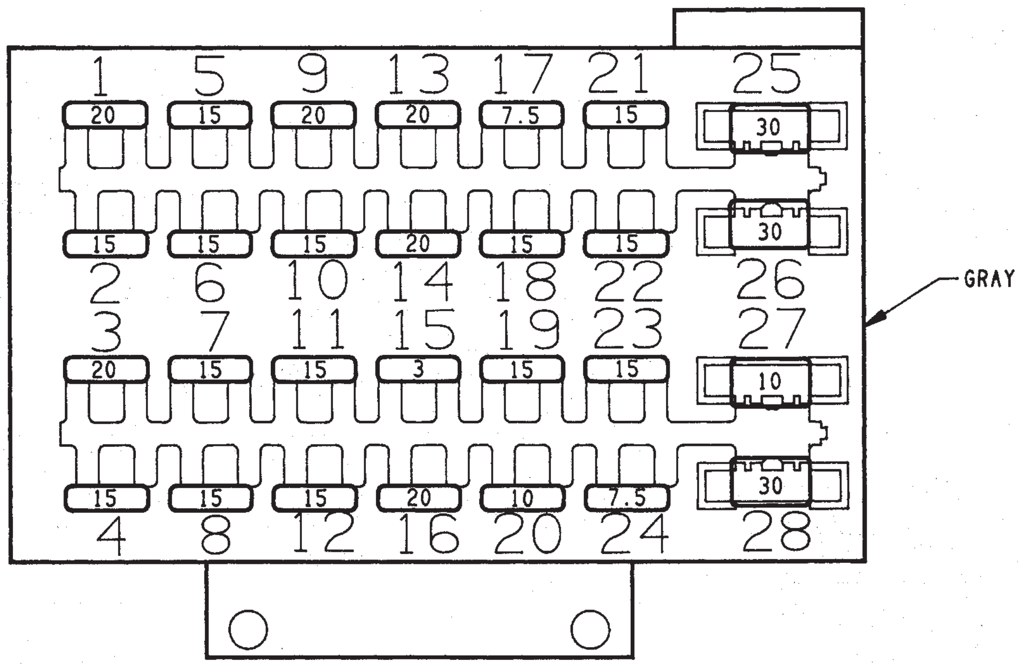
J938W-1



ZJ 103

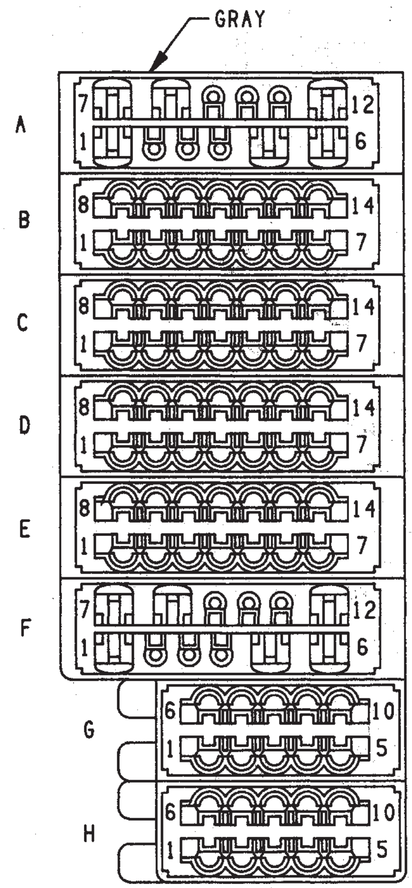
FUSE BLOCK

J938W-1



VIEWED FROM TERMINAL END

FUSE NUMBER	AMPS	COLOR	SHEET
1	20	YELLOW	1,61,96
2	15	LIGHT BLUE	1,7,27
3	20	YELLOW	1,54,58
4	15	LIGHT BLUE	1,70
5	15	LIGHT BLUE	1,45
6	15	LIGHT BLUE	1,7,81
7	15	LIGHT BLUE	1,33,83
8	15	LIGHT BLUE	1,89
9	20	YELLOW	2,12,56
10	10	RED	2,12,59
11	15	LIGHT BLUE	2,12,40
12	15	LIGHT BLUE	2,33
13	20	YELLOW	2,29
14	20	YELLOW	2,89
15	3	VIOLET	4,65
16	20	YELLOW	4,54,57
17	7.5	BROWN	3,12,71,73
18	15	LIGHT BLUE	3,12,67
19	15	LIGHT BLUE	3,12,42
20	10	RED	3,12,27,79
21	15	LIGHT BLUE	3,11,70
22	15	LIGHT BLUE	3,11,67,70
23	15	LIGHT BLUE	4,80
24	7.5	BROWN	4,34,36
25	30	C.B.	2,87
26	30	C.B.	4,94
27	10	C.B.	2,56,82
28	30	GREEN	1,80



CONNECTOR A

CAV	CIRCUIT	FUNCTION	SHEET
1	Q16 12BR/WT*	WINDOW SWITCH TO RT FRONT MOTOR UP	94
2	P2 18BK/WT*	RELAY FEED (LOCK)	92
3	P34 18PK/BK*	RELAY FEED (UNLOCK)	92
4	M1 18PK	COURTESY LAMPS	46
	M1 18PK	COURTESY LAMPS	
5	Q26 12VT/WT*	WINDOW SWITCH TO RT FRONT MOTOR DOWN	94
6	Q1 12YL/GY*	POWER WINDOW MASTER SWITCH FEED OUT	94
7	—	—	
8	M2 20YL	SWITCHED GROUND	46
9	—	—	—
10	—	—	—
11	—	—	—
12	—	—	—

CONNECTOR B

CAV	CIRCUIT	FUNCTION	SHEET
1	P78 20YL/LG*	MIRROR UP/DOWN MOTOR - RIGHT	86
2	P77 20WT/DB*	MIRROR RIGHT/LEFT MOTOR - RIGHT	86
3	P79 20DB/LB*	MIRROR RETURN (—) LEFT	86
4	C16 18LB/YL*	HEATED MIRROR FEED	80
5	X56 20DB	SPEAKER RETURN - RIGHT FRONT	60
	X56 20DB	SPEAKER RETURN - RIGHT FRONT	
6	X54 20VT/YL*	SPEAKER FEED - RIGHT FRONT	60
	X54 20VT/YL*	SPEAKER FEED - RIGHT FRONT	
7	P35 20OR/VT*	SWITCH TO RELAY (LOCK)	82,90
	P35 20OR/VT*	SWITCH TO RELAY (LOCK)	
8	P36 20PK/VT*	SWITCH TO RELAY (UNLOCK)	82,90
	P36 20PK/VT*	SWITCH TO RELAY (UNLOCK)	
9	F60 18RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUITS	89
10	Z1 20BK	GROUND	86
	Z1 16BK	GROUND	
11	M9 20DB/OR*	SECURITY ALARM DISARM SIGNAL	48,90
12	—	—	—
13	—	—	—
14	—	—	—

100 WAY
INSTRUMENT PANEL CONNECTOR

ZJ 105

J938W-1

CONNECTOR C

CAV	CIRCUIT	FUNCTION	SHEET
1	Q16 12BR/WT*	WINDOW SWITCH TO RT FRONT MOTOR UP	94
2	Q26 12VT/WT*	WINDOW SWITCH TO RT FRONT MOTOR DOWN	94
3	Q1 12YL/GY*	POWER WINDOW MASTER SWITCH FEED OUT	94
4	M1 18PK	COURTESY LAMPS	46
5	X52 20DB/WT*	SPEAKER FEED - RIGHT REAR	59
6	X58 20DB/PK*	SPEAKER RETURN - RIGHT REAR	59
7	C15 12BK/LB*	HEATED REAR WINDOW RELAY	80
8	V20 18BK/OR*	REAR WASHER FEED	55
9	V23 16BR/PK* V23 16BR/PK*	REAR WIPER - PARK REAR WIPER - PARK	55
10	V24 18BR/OR*	INTERMITTENT WIPER - REAR	55
11	V13 18BR/LB*	CONTINUOUS WIPER - REAR	55
12	P2 18BK/WT* P2 18BK/WT*	RELAY FEED (LOCK) RELAY FEED (LOCK)	92
13	P34 18PK/BK* P34 18PK/BK*	RELAY FEED (UNLOCK) RELAY FEED (UNLOCK)	92
14	A18 16RD/BK* A18 16RD/BK*	TRAILER TOW & POWER ANTENNA FEED TRAILER TOW & POWER ANTENNA FEED	61,96

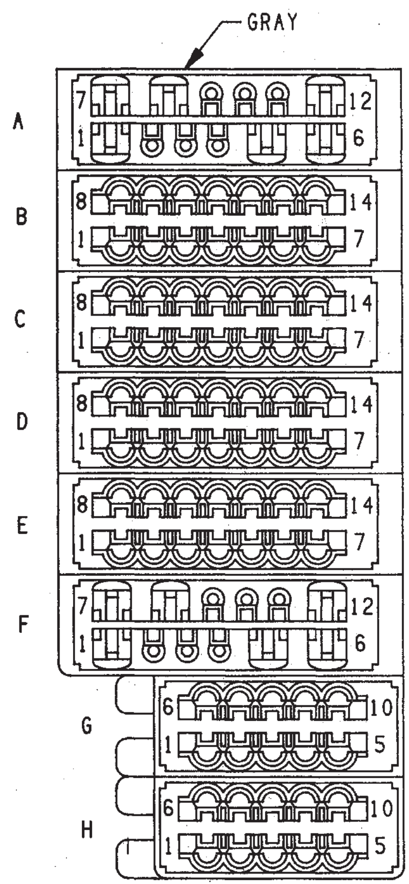
CONNECTOR D

CAV	CIRCUIT	FUNCTION	SHEET
1	G70 20BR/TN*	SECURITY ALARM (HOOD OPEN)	81
2	—	—	—
3	G18 20PK/DB*	LOW ENGINE COOLANT	37
4	L4 16VT/OR *	LOW BEAM (FEED)	32,33,34
5	L3 16RD/OR*	HIGH BEAM FEED	32,83
6	L64 18TN/DB*	RIGHT FRONT TURN SIGNAL	32
7	L90 18DB/RD*	PARK LAMP FEED	32,36
8	G36 20BR/GY*	ENGINE OIL LEVEL SENSOR	37
9	107 20BK/RD*	4WD PART TIME/LOW RANGE	38,50
10	—	—	—
11	G28 20LG/OR*	2WD/REAR WHEEL AND ALL TIME	38,50
12	C90 20LG	A/C SELECT SIGNAL	71.73
13	G34 16RD/GY*	HIGH BEAM INDICATOR LAMP	30,69
14	V30 20DB/LG*	STOP LAMP SWITCH TO VEHICLE SPEED CONTROL	27

100 WAY
INSTRUMENT PANEL CONNECTOR

CONNECTOR E

CAV	CIRCUIT	FUNCTION	SHEET
1	A64 14OR/DB*	FUEL PUMP FEED	13,19,52
2	F20 18WT	AIRBAG FEED	12,67
3	G5 18DB/YL*	IGNITION RUN/START FEED	11,67,70
	G5 18DB/YL*	IGNITION RUN/START FEED	
4	A41 16YL/DB*	ENGINE STARTER RELAY	10,12
5	L53 20BR	TCU BRAKE (–)	17,23,27
6	106 20GY/OR*	4WD FULL TIME	38,50
7	Z2 20BK/LG*	ELECTRONIC GROUND	41,67,70
	Z2 18BK/LG*	ELECTRONIC GROUND	
8	R41 18BK/TN*	AIRBAG SYSTEM WARNING LAMP	67,69
9	G7 20WT/OR*	VEHICLE SPEED SIGNAL	16,22
10	D41 20LG/WT*	HEVAC SENSOR RETURN	73
11	C8 20DG/RD*	A/C AMBIENT TEMP SENSOR (HEVAC)	73
12	—	—	—
13	L10 18BR/LG*	BACK-UP LAMP FEED	49,96
	L10 18BR/LG*	BACK-UP LAMP FEED	
14	A1 12RD/WT*	IGNITION SWITCH FEED	8,11



VIEWED FROM TERMINAL END

CONNECTOR F

	CAV	CIRCUIT	FUNCTION	SHEET
	1	A2 10PK/BK*	IGNITION SWITCH FEED	11
	2	—	—	—
*	3	D1 20VT/BR*	CCD(+)	66,83
		D1 20VT/BR*	CCD(+)	
*	4	D2 20WT/GY*	CCD(–)	66,83
		D2 20WT/GY*	CCD(–)	
	5	A7 12RD/YL*	FUSE BLOCK FEED	7,27,29, 54,58,61, 70,80,87, 89
	6	A6 14RD/LB*	EXTERIOR LAMPS FEED	30,33
	7	A21 12DB/GY	IGNITION RUN/START FEED	8,11
	8	A4 16RD/DG*	IOD FEED	7,45, 81,83,89
	9	X2 18DG/YL*	HORN RELAY TO HORN	29
	10	L35 20BR/RD*	FOG LAMP SWITCH TO RELAY	33
	11	V33 20WT/LG*	VEHICLE SPEED CONTROL SWITCH (RESUME)	27
	12	Z1 16BK	GROUND	29,44,86
		Z1 16BK	GROUND	

*—INDICATES TWISTED PAIR

100 WAY
INSTRUMENT PANEL CONNECTOR

ZJ 107

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CONNECTOR G

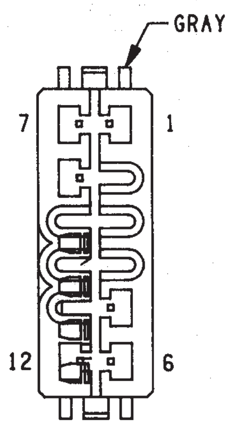
	CAV	CIRCUIT	FUNCTION	SHEET
	1	G25 20LG/BK*	ENGLISH/METRIC SWITCH	41
		G25 20LG/BK*	ENGLISH/METRIC SWITCH	
	2	F81 14TN	POWER SUNROOF FEED	94,101
	3	Z2 20BK/LG*	ELECTRONIC GROUND	41,70
	4	Z1 14BK	GROUND	44,47,86
	5	G44 20VT/TN*	FUEL USAGE MONITOR	42,52
	6	E2 20OR	I/P ILLUMINATION	42,43
	7	L90 18DB/RD*	PARK LAMP FEED	36,42
*	8	D1 20VT/BR*	CCD(+)	41,66,83
		D1 20VT/BR*	CCD(+)	
*	9	D2 20WT/GY*	CCD(—)	41,66,83
		D2 20WT/GY*	CCD(—)	
	10	G71 20VT/YL	SECURITY ALARM DECKLID KEY CYLINDER	84,90
		G71 20VT/YL	SECURITY ALARM DECKLID KEY CYLINDER	

* —INDICATES TWISTED PAIR

CONNECTOR H

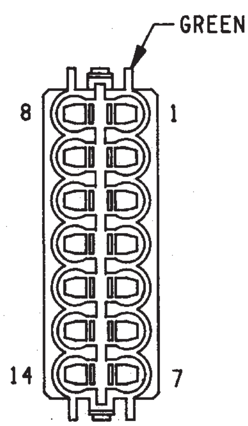
CAV	CIRCUIT	FUNCTION	SHEET
1	M1 18PK	COURTESY LAMPS	46,47
	M1 18PK	COURTESY LAMPS	
2			
3	M2 20YL	SWITCHED GROUND	45,47
	M2 20YL	SWITCHED GROUND	
4	F60 18RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUITS	42,89
	F60 18RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUITS	
5	M9 20DB/OR*	ILLUMINATED ENTRY SIGNAL	48,90
6	P35 20OR/VT*	SWITCH TO RELAY (LOCK)	82,90
	P35 20OR/VT*	SWITCH TO RELAY (LOCK)	
7	P36 20PK/WT*	SWITCH TO RELAY (UNLOCK)	82,90
	P36 20PK/WT*	SWITCH TO RELAY (UNLOCK)	
8	G49 20PK/OR*	SECURITY ALARM TO SAM	82,90
9	L10 18BR/LG*	BACK-UP LAMP FEED	49,96
10	F83 18YL/DG*	FUSED IGNITION 'B' CONV ITEMS	42,90

100 WAY
INSTRUMENT PANEL CONNECTOR



CONNECTOR A
VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	Q16 14BR/WT*	WINDOW SWITCH TO RT FRONT MOTOR UP	94
2	P2 18BK/WT*	RELAY FEED (LOCK)	92
3	P34 18PK/BK*	RELAY FEED (UNLOCK)	92
4	M1 18PK	COURTESY LAMPS	46
5	Q26 14VT/WT*	WINDOW SWITCH TO RT FRONT MOTOR DOWN	94
6	Q1 14YL/GY*	POWER WINDOW MASTER SWITCH FEED OUT	94
7	—	—	—
8	M2 20YL	SWITCHED GROUND	46
9	—	—	—
10	—	—	—
11	—	—	—
12	—	—	—



CONNECTOR B
VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	P78 20YL/LG*	MIRROR UP/DOWN MOTOR - RIGHT	86
2	P77 20WT/BK*	MIRROR RIGHT/DOWN MOTOR - RIGHT	86
3	P79 20DB/LB*	MIRROR RETURN (—) LEFT	86
4	C16 18LB/YL*	HEATED MIRROR FEED	80
5	X56 20DB/RD*	SPEAKER RETURN — RIGHT FRONT	60
6	X54 20VT	SPEAKER FEED — RIGHT FRONT	60
7	P35 20OR/VT*	POWER DOOR LOCK B+LOCK (SWITCH)	82,90
8	P36 20PK/VT*	POWER DOOR LOCK B+UNLOCK (SWITCH)	82,90
9	F60 18RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUITS	89
10	Z1 18BK	GROUND	86
11	G72 20DG/OR*	ILLUMINATED ENTRY SIGNAL	48,90
12	—	—	—
13	—	—	—
14	—	—	—

ZJ 109

CONNECTORS TO 100 WAY
INSTRUMENT PANEL WIRING

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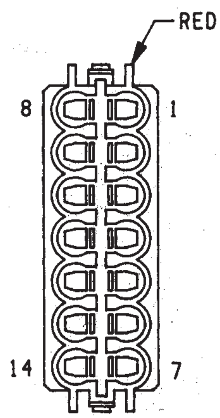
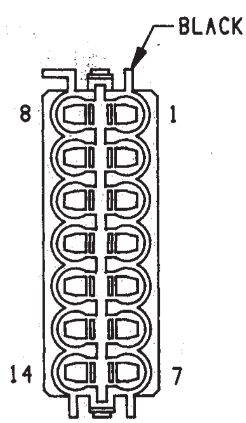
CAV	CIRCUIT	FUNCTION	SHEET
1	Q16 14BR/WT*	WINDOW SWITCH TO RT FRONT MOTOR UP	94
2	Q26 14VT/WT*	WINDOW SWITCH TO RT FRONT MOTOR DOWN	94
3	Q1 14YL/GY*	POWER WINDOW MASTER SWITCH FEED OUT	94
4	M1 20PK	COURTESY LAMPS	46
5	X52 20DB/WT*	SPEAKER FEED — RIGHT REAR	59
6	X58 20DB/OR*	SPEAKER RETURN — RIGHT REAR	59
7	C15 12BK/LB*	HEATED REAR WINDOW RELAY	80
8	V20 16BK/YL*	REAR WASHER FEED	55
9	V23 14BR/PK*	REAR WIPER — PARK	55
10	V24 18BR/OR*	INTERMITTENT WIPER — REAR	55
11	V13 18BR/LG*	CONTINUOUS WIPER — REAR	55
12	P2 18BK/WT*	RELAY FEED (LOCK)	92
	P2 18BK/WT*	RELAY FEED (LOCK)	
13	P34 18PK/BK*	RELAY FEED (UNLOCK)	92
	P34 18PK/BK*	RELAY FEED (UNLOCK)	
14	A18 18RD/BK*	TRAILER TOW & POWER ANTENNA FEED	61,96



CONNECTOR C
VIEWED FROM TERMINAL END

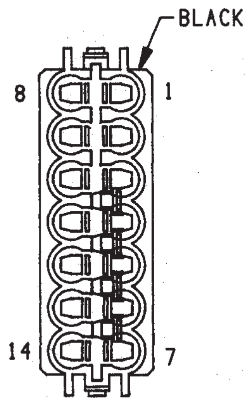
CAV	CIRCUIT	FUNCTION	SHEET
1	G70 20BR/TN*	SECURITY ALARM (HOOD OPEN)	81
2	—	—	—
3	G18 20PK/DB*	LOW ENGINE COOLANT	37
4	L4 16VT/OR*	LOW BEAM FEED	32 33,34
5	L3 16RD/OR*	HIGH BEAM FEED	32,83
	G34 16RD/GY*	HIGH BEAM INDICATOR LAMP	
6	L64 18TN/DB*	RIGHT FRONT TURN SIGNAL	32
7	L90 18DB/RD*	PARK LAMP FEED	32,36
8	G36 20BR/GY*	ENGINE OIL LEVEL SENSOR	37
9	107 20BK/RD*	4WD PART TIME/LOW RANGE	38,50
10	—	—	—
11	G28 20LG/OR*	2WD/REAR WHEEL AND ALL TIME	38,50
12	C90 20LG	A/C SELECT SIGNAL	71,73
13	G34 16RD/GY*	HIGH BEAM INDICATOR LAMP	30,69
14	V30 20DB/LG*	STOP LAMP SWITCH TO VEHICLE SPEED CONTROL	27



CONNECTOR D
VIEWED FROM TERMINAL END

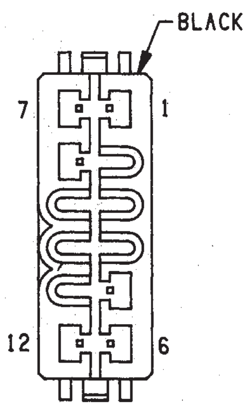
J938W-1

CONNECTORS TO 100 WAY
INSTRUMENT PANEL WIRING



CONNECTOR E
VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	A64 14OR/DB*	FUEL PUMP FEED	13,19,52
2	F20 18WT	AIRBAG FEED	12,67
3	G5 18DB/YL*	IGNITION RUN/START FEED	11,67,70
4	A41 16YL/BK*	ENGINE STARTER RELAY	10,12
5	L53 20BR	TCU BRAKE (−)	17,23,27
6	106 20GY/YL*	4WD FULL TIME	38,50
7	Z2 18BK/LG*	ELECTRONIC GROUND	41,67,70
8	R41 18BK/TN*	AIRBAG SYSTEM WARNING LAMP	67,69
9	G7 20WT/OR*	VEHICLE SPEED SIGNAL	16,22
10	D41 20LG/WT*	HEVAC SENSOR RETURN	73
11	C8 20DG/RD*	AMBIENT TEMP SENSOR (HEVAC)	73
12	—	—	—
13	L10 18BR/LG*	BACK-UP LAMP SIGNAL	49,96
14	A1 12RD/WT*	IGNITION SWITCH FEED	8,11



CONNECTOR F
VIEWED FROM TERMINAL END

	CAV	CIRCUIT	FUNCTION	SHEET
	1	A2 10PK/BK*	IGNITION SWITCH FEED	11
	2	—	—	—
*	3	D1 20VT/BR*	CCD(+)	66,83
		D1 20VT/BR*	CCD(+)	
*	4	D2 20WT/GY*	CCD(−)	66,83
		D2 20WT/GY*	CCD(−)	
	5	A7 12RD/YL*	FUSE BLOCK FEED	7,27 29,54,58, 61,70,80, 87,89
	6	A6 14RD/LB*	EXTERIOR LAMPS FEED	30,33
	7	A21 12DB/GY*	IGNITION RUN/START FEED	8,11
	8	A4 16RD/DG*	IOD FEED	7,45, 81,83,89
	9	X2 18DG/YL*	HORN RELAY TO HORN	29
	10	L35 20BR/RD*	FOG LAMP SWITCH TO RELAY	33
	11	V33 20WT/LG*	VEHICLE SPEED CONTROL SWITCH (RESUME)	27
	12	Z1 16BK	GROUND	29,44,86

*—INDICATES TWISTED PAIR

CONNECTORS TO 100 WAY
INSTRUMENT PANEL WIRING

ZJ 111

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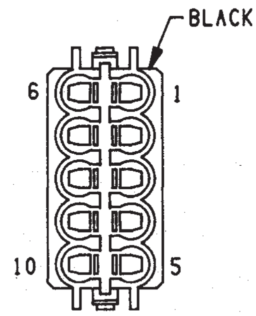
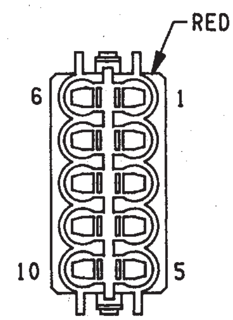
	CAV	CIRCUIT	FUNCTION	SHEET
	1	G25 20LG/BK*	ENGLISH/METRIC SWITCH	41
	2	F81 14TN	POWER SUNROOF FEED	94,101
	3	Z2 20BK/OR*	ELECTRONIC GROUND	41,70
	4	Z1 14BK	GROUND	44,47,86
		Z1 20BK	GROUND	44,47,86
	5	G44 20VT/WT*	FUEL USAGE MONITOR	42,52
	6	E2 20OR	I/P ILLUMINATION	42,43
	7	L90 20DB/RD*	PARK LAMP FEED	36,42
*	8	D1 20VT/BR*	CCD(+)	41,66,83
*	9	D2 20WT/BK*	CCD(−)	41,66,83
	10	G71 20VT/YL*	SECURITY ALARM DECKLID KEY CYLINDER	84,90

*—INDICATES TWISTED PAIR



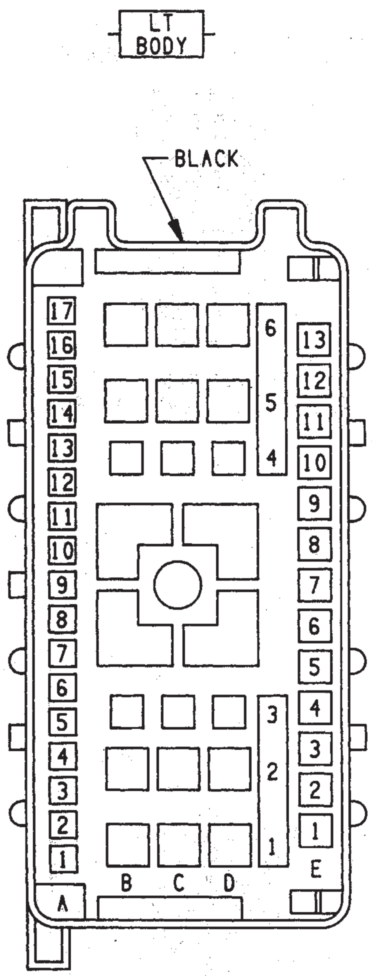
CONNECTOR G
VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	M1 20PK	COURTESY LAMPS	46,47
2	—	—	—
3	M2 20YL	SWITCHED GROUND	45,47
4	F60 20RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUITS	42,89
5	M9 20DB/OR *	ILLUMINATED ENTRY SIGNAL	48,90
6	P35 20OR/VT*	SWITCH TO RELAY (LOCK)	82,90
7	P36 20PK/VT*	SWITCH TO RELAY (UNLOCK)	82,90
8	G49 20PK/OR*	SECURITY ALARM TO SAM	82,90
9	L10 20BR/LG*	BACK—UP LAMP FEED	49,96
10	F83 20YL/DG*	FUSED IGNITION 'B' CONV ITEMS	42,90



CONNECTOR H
VIEWED FROM TERMINAL END

CONNECTORS TO 100 WAY
INSTRUMENT PANEL WIRING



VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
A1	X53 20DG	SPEAKER FEED-LEFT FRONT	59
A2	X51 20BR/YL*	SPEAKER FEED-LEFT REAR	60
A3	X55 20BR/RD*	SPEAKER RETURN-LEFT FRONT	59
A4	X57 20BR/LB*	SPEAKER RETURN-LEFT REAR	60
A5	M1 18PK	COURTESY LAMPS	45
A6	P35 20OR/VT*	SWITCH TO RELAY (LOCK)	90,91
A7	F60 18RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUITS	91
A8	L50 18WT/TN*	STOP LAMP SIGNAL	97
A9	—	—	—
A10	G16 20BK/LB*	BUZZER/CHIME SWITCHED GROUND	33
A11	K102 20PK/BK*	FUEL PUMP GAUGE	52,70
A12	—	—	—
A13	G44 20VT/WT*	FUEL USAGE MONITOR	52
A14	G71 18VT/YL*	SECURITY ALARM DECK LID KEY CYLINDER	84
A15	—	—	—
A16	M2 18YL	SWITCHED GROUND	45
A17	C16 20LB/YL*	HEATED MIRROR FEED	79,85

CAV	CIRCUIT	FUNCTION	SHEET
B1	P2 18BK/WT*	RELAY FEED (LOCK)	91
B2	P34 18PK/BK*	RELAY FEED (UNLOCK)	91
B3	Z2 20BK/OR*	ELECTRONIC GROUND	52,70
B4	G46 20LB/BK*	LAMP OUTAGE-REAR	97
B5	A64 14OR/BK*	FUEL PUMP FEED	13,19,52
B6	F81 14TN	POWER WINDOW FEED	94

CAV	CIRCUIT	FUNCTION	SHEET
C1	F35 14RD	POWER SEATS FEED	88
C2	—	—	—
C3	L10 18BR/LG*	BACK-UP LAMP FEED	49,96
C4	P36 20PK/VT*	SWITCH TO RELAY (UNLOCK)	90,91
C5	—	—	—
C6	—	—	—
D1	G10 20LG/RD*	SEAT BELT SWITCH	53
D2	L90 16DB/RD*	PARK LAMP FEED	36,97
D3	—	—	—
D4	G78 20TN/BK*	LIFTGATE/DECK LID AJAR SWITCH	38,46,82
D5	—	—	—
D6	—	—	—

CAV	CIRCUIT	FUNCTION	SHEET
E1	G75 20TN/PK*	LEFT FRONT DOOR AJAR LIGHT	39
E2	G74 20TN/RD*	RIGHT FRONT DOOR AJAR LIGHT	39
E3	G77 20TN/OR*	LEFT REAR DOOR AJAR LIGHT	37
E4	G76 20TN/YL*	RIGHT REAR DOOR AJAR LIGHT	39
E5	L61 18LG	LEFT TURN SIGNAL	96
E6	L60 18TN	RIGHT TURN SIGNAL	96
E7	P64 20YL/OR*	MIRROR UP/DOWN MOTOR - LEFT	86
E8	P75 20DB/WT*	MIRROR RIGHT/LEFT MOTOR - LEFT	86
E9	P79 20DB/LB*	MIRROR RETURN (-) LEFT	86
E10	E2 20OR	I/P ILLUMINATION	43
E11	G9 20GY/BK*	BRAKE BULB CHECK	11,69
E12	F87 18WT/BK*	FUSED IGNITION 'C' CLUSTER/SAM	97
E13	L36 18LG/BK*	REAR FOG LAMP LOAD (BUX)	97

ZJ 113

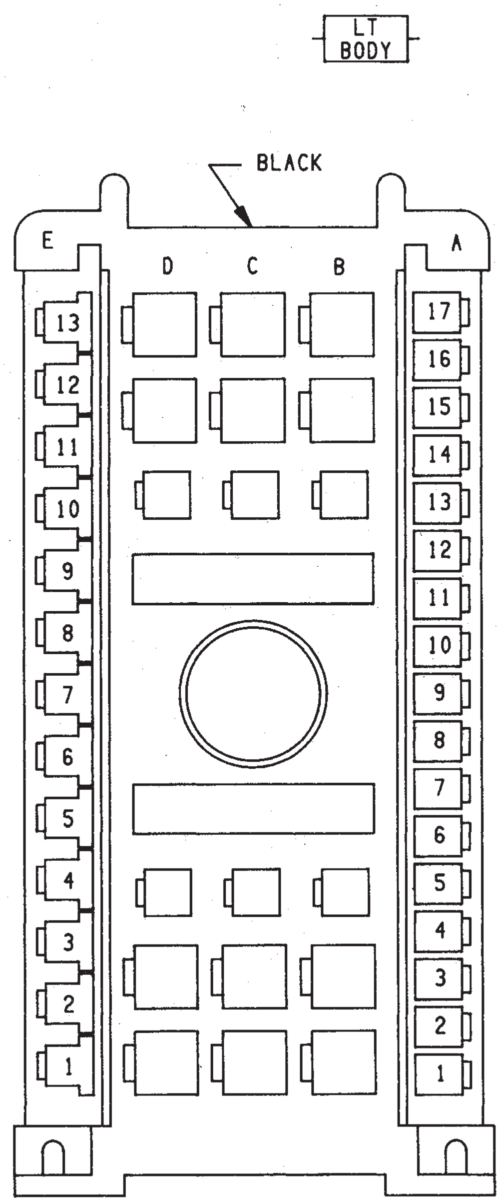
LEFT BODY TO 48 WAY
INSTRUMENT PANEL WIRING

J938W-1

CAV	CIRCUIT	FUNCTION	SHEET
A1	X53 20DG	SPEAKER FEED-LEFT FRONT	59
A2	X51 20BR/YL*	SPEAKER FEED-LEFT REAR	60
A3	X55 20BR/RD*	SPEAKER RETURN-LEFT FRONT	59
A4	X57 20BR/LB*	SPEAKER RETURN-LEFT REAR	60
A5	M1 18PK	COURTESY LAMPS	45
A6	P35 20OR/VT*	SWITCH TO RELAY (LOCK)	90,91
A7	F60 18RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUITS	91
A8	L50 18WT/TN*	STOP LAMP SIGNAL	97
A9	—	—	—
A10	G16 18BK/LB*	BUZZER/CHIME SWITCHED GROUND	33
A11	K102 20PK/BK*	FUEL PUMP GAUGE	52,70
A12	—	—	—
A13	G44 20VT/TN*	FUEL USAGE MONITOR	52
A14	G71 20VT/YL*	SECURITY ALARM DISARM SIG	84
A15	—	—	—
A16	M2 20YL	SWITCHED GROUND	45
A17	C16 18LB/YL*	HEATED MIRROR FEED	79,85

CAV	CIRCUIT	FUNCTION	SHEET
B1	P2 18BK/WT*	RELAY FEED (LOCK)	91
B2	P34 18PK/BK*	RELAY FEED (UNLOCK)	91
B3	Z2 20BK/LG*	ELECTRONIC GROUND	52,70
B4	G46 20LB/BK*	LAMP OUTAGE-REAR	97
B5	A64 14OR/DB*	FUEL PUMP FEED	13,19,52
B6	F81 14TN	POWER WINDOW FEED	94
C1	F35 14RD	POWER SEATS FEED	88
C2	—	—	—
C3	L10 18BR/LG*	BACK-UP LAMP FEED	49,96
C4	P36 20PK/VT*	SWITCH TO RELAY (UNLOCK)	90,91
C5	—	—	—
C6	—	—	—
D1	G10 20LB/RD*	SEAT BELT SWITCH	53
D2	L90 18DB/RD*	PARK LAMP FEED	36,97
D3	—	—	—
D4	G78 20TN/BK* G78 20TN/BK*	LIFTGATE/DECKLID AJAR SWITCH LIFTGATE/DECKLID AJAR SWITCH	38,46,82
D5	—	—	—
D6	—	—	—

CAV	CIRCUIT	FUNCTION	SHEET
E1	G75 20TN/PK*	LEFT FRONT DOOR AJAR LIGHT	39
E2	G74 20TN/RD*	RIGHT FRONT DOOR AJAR LIGHT	39
E3	G77 20TN/OR*	LEFT REAR DOOR AJAR LIGHT	37
E4	G76 20TN/YL*	RIGHT REAR DOOR AJAR LIGHT	39
E5	L61 18LG	LEFT TURN SIGNAL	96
E6	L60 18TN	RIGHT TURN SIGNAL	96
E7	P64 20YL/OR*	MIRROR UP/DOWN MOTOR - LEFT	86
E8	P75 20DB/WT*	MIRROR RIGHT/LEFT MOTOR-LEFT	86
E9	P79 20DB/LB* P79 20DB/LB*	MIRROR RETURN (-) LEFT MIRROR RETURN (-) LEFT	86
E10	E2 20OR	I/P ILLUMINATION	43
E11	G9 20GY/BK* G9 20GY/BK*	BRAKE BULB CHECK PARK BRAKE	11,69
E12	F87 18WT/BK*	FUSED IGNITION 'C' CLUSTER/SAM	97
E13	—	—	—



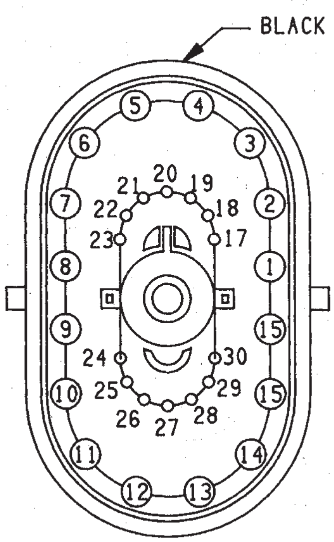
VIEWED FROM TERMINAL END

INSTRUMENT PANEL TO 48 WAY LEFT BODY WIRING

J938W-1

ZJ 114

INJ



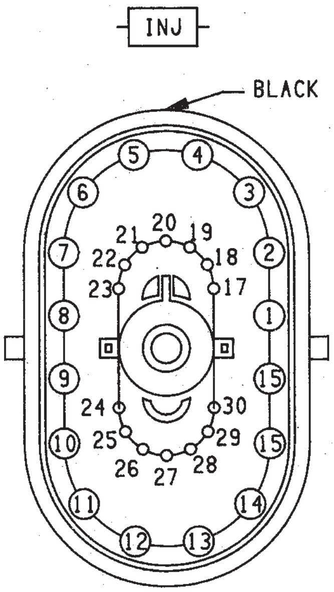
CAV	CIRCUIT	FUNCTION	SHEET
1	—	—	—
2	Z12 18BK/TN*	POWER GROUND	14
3	—	—	—
4	F86 16LB/RD*	IGNITION ACCESSORY FEED	13,14
5	K19 18GY/WT*	DISTRIBUTOR IGNITION COIL (—)	14
6	K20 18DG	GENERATOR FIELD	9,13
7	L10 18BR/LG*	BACK-UP LAMP FEED	49
8	—	—	—
9	A64 14OR/DB*	HEATER FEED	17
10	Z1 16BK	GROUND	50
11	A5 16PK/BK*	BATTERY	13
12	A61 18DG/BK*	IGN COIL; FUEL INJECTOR; FUEL PUMP	13,18
13	F83 18YL/DG*	FUSED IGNITION	49
14	C21 20DB/OR *	A/C LOW PRESSURE SWITCH	75
15	—	—	—
16	—	—	—
17	L53 20BR	TCU BRAKE (—)	17,27
18	V35 20LG/RD*	VEHICLE SPEED CONTROL (VENT)	28
19	V36 20TN/RD*	VEHICLE SPEED CONTROL (VACUUM)	28
* 20	D2 20WT/GY*	CCD (—)	66
* 21	D1 20VT/BR *	CCD (+)	66
22	106 20GY/OR*	4WD FULL TIME	50
23	107 20BK/RD*	PART TIME LAMP/ALL TIME	50
24	G7 18WT/OR*	VEHICLE SPEED CONTROL	16
25	V33 20WT/LG*	VEHICLE SPEED CONTROL (RESUME)	28
26	C13 20DB/RD *	A/C COMPRESSOR CLUTCH RELAY	75
27	G28 20LG/OR*	2WD/REAR WHEEL AND ALL TIME	50
28	T41 20BK/WT*	PARK/NEUTRAL POSITION SWITCH	10,50
29	C90 20LG	A/C SELECT SIGNAL	71,73
30	K81 20PK	FUEL PUMP RELAY COIL	13

* - INDICATES TWISTED PAIR

INJECTOR (4.0L) TO
ENGINE INTERCONNECT WIRING

ZJ 115

J938W-1



VIEWED FROM
TERMINAL END

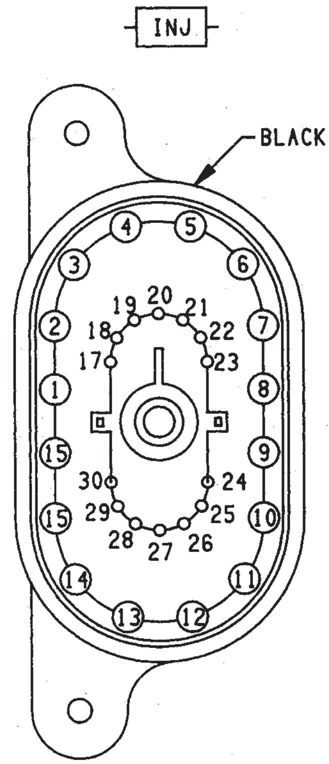
	CAV	CIRCUIT	FUNCTION	SHEET
	1	—	—	—
	2	Z12 18BK/TN*	POWER GROUND	20
	3	T40 14LG/BK*	ENGINE STARTER RELAY	10,23
	4	F86 16LB	IGNITION ACCESSORY FEED	19,20
	5	K19 18GY/WT*	DISTRIBUTOR IGNITION COIL (–)	20
	6	K20 18DG	GENERATOR FIELD	9,19
	7	L10 18BR/LG*	BACK-UP LAMP FEED	49
	8	C2 18DB/YL*	A/C COMPRESSOR CLUTCH	75
	9	—	—	—
	10	Z1 18BK	GROUND	29,50
	11	A5 16RD	BATTERY	19
	12	A61 18DG/BK*	IGN COIL; FUEL INJECTOR; FUEL PUMP	19,24
	13	F83 18YL/DG*	FUSED IGNITION	49
	14	C21 18DB/OR*	A/C LOW PRESSURE SWITCH	75
	15	—	—	—
	16	—	—	—
	17	L53 20BR	TCU BRAKE (–)	23,27
	18	V35 20LG/RD*	VEHICLE SPEED CONTROL (VENT)	28
	19	V36 20TN/RD*	VEHICLE SPEED CONTROL (VACUUM)	28
*	20	D2 20WT/BK*	CCD (–)	66
*	21	D1 20VT/BR*	CCD (+)	66
	22	106 20GY/YL*	4WD FULL TIME	50
	23	107 20BK/RD*	PART TIME LAMP/ALL TIME	50
	24	G7 18WT/OR*	VEHICLE SPEED SIGNAL	22
	25	V33 20WT/LG*	VEHICLE SPEED CONTROL (RESUME)	28
	26	C13 20DB/RD*	A/C COMPRESSOR CLUTCH RELAY	75
	27	G28 20LG	2WD/REAR WHEEL AND ALL TIME	50
	28	T41 20BK/WT*	PARK/NEUTRAL POSITION SWITCH	10
	29	C90 20LG	A/C SELECT SIGNAL	71,73
	30	K81 20PK	FUEL PUMP RELAY COIL	19

* - INDICATES TWISTED PAIR

J938W-1

INJECTOR (5.2L) TO
ENGINE INTERCONNECT WIRING

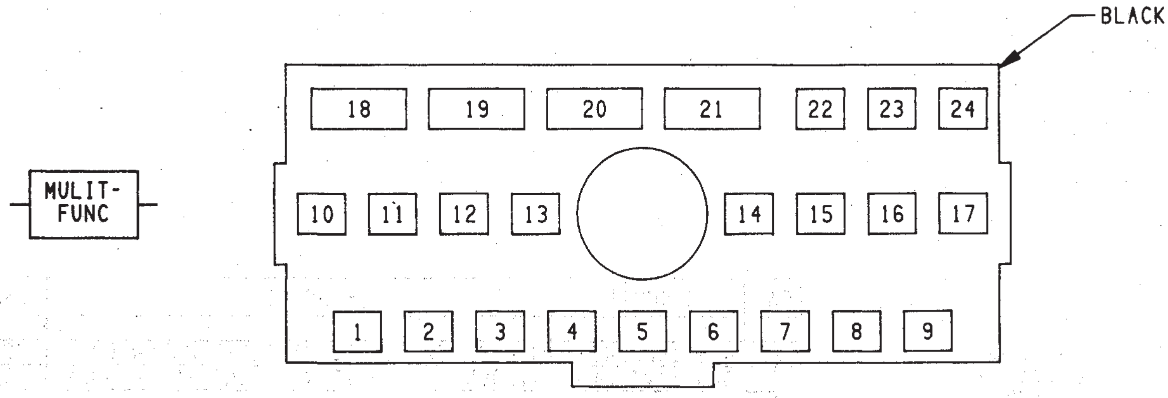
CAV	CIRCUIT	FUNCTION	SHEET
1	—	—	—
2	Z12 18BK/TN*	POWER GROUND	14,20
3	T40 14LG/BK*	ENGINE STARTER RELAY	10,23
4	F86 16LB/RD*	IGNITION ACC FEED	13,14,19,20
5	K19 18GY	DISTRIBUTOR IGNITION COIL (−)	14,20
6	K20 18DG	GENERATOR FIELD	9,13,19
7	L10 18BR/LG*	BACK-UP LAMP FEED	49
8	C2 18DB/YL*	A/C COMPRESSOR CLUTCH	75
9	A64 140R/DB*	HEATER FEED	17
10	Z1 16BK	GROUND	29,50
11	A5 16RD	BATTERY	13,19
12	A61 18DG/BK*	IGN COIL; FUEL INJECTION; FUEL PUMP	13,18,19,24
13	F83 18YL/DG*	FUSED IGNITION	49
14	C21 18DB/OR*	A/C LOW PRESSURE SWITCH	75
15	—	—	—
16	—	—	—
17	L53 20BR	TCU BRAKE (−)	17,23,27
18	V35 20LG/RD*	VEHICLE SPEED CONTROL (VENT)	28
19	V36 20TN/RD*	VEHICLE SPEED CONTROL (VACUUM)	28
20	D2 20WT/GY*	CCD (−)	66
21	D1 20VT/BR*	CCD (+)	66
22	106 20GY/YL*	4WD FULL TIME	50
23	107 20BK/RD*	PART TIME LAMP/ALL TIME	50
24	G7 20WT/OR*	VEHICLE SPEED SIGNAL	16,22
25	V33 20WT/LG*	VEHICLE SPEED CONTROL (RESUME)	28
26	C13 20DB/RD*	A/C COMPRESSOR CLUTCH RELAY	75
27	G28 20LG/OR*	2WD/REAR WHEEL AND ALL TIME	50
28	T41 20BK/WT*	PARK/NEUTRAL POSITION SWITCH	10,50
29	C90 20LG	A/C SELECT SIGNAL	71,73
30	K81 20PK	FUEL PUMP RELAY COIL	13,19



VIEWED FROM TERMINAL END

ENGINE TO INJECTOR WIRING

J938W-1

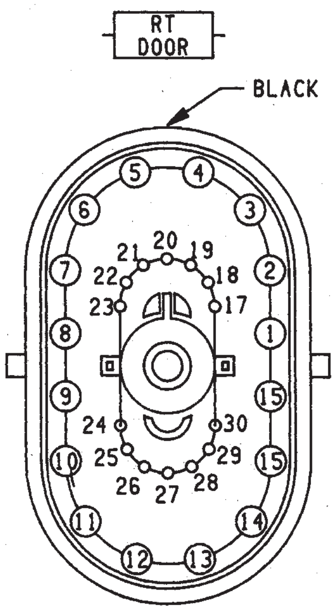


VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	V50 18LG/WT*	INTERMITTENT WIPER SWITCH TO MODULE	56
2	V51 18WT	INTERMITTENT WIPER MODULE TO SWITCH	56
3	V11 18BK/TN*	WINDSHIELD WASH	56
4	F86 16LG/RD* F86 16LG/RD*	IGNITION ACCESSORY FEED IGNITION ACCESSORY FEED	56
5	V4 16RD/YL*	WIPER - HIGH SPEED	56
6	V3 16BR/WT* V3 16BR/WT*	WIPER - LOW SPEED WIPER - LOW SPEED	56
7	V6 16DB	WIPER - PARK FEED	56
8	V6 16DB	WIPER - PARK FEED	56
9	V3 16BR/WT*	WIPER - LOW SPEED	56
10	—	—	—
11	L64 18TN/DB*	RIGHT FRONT TURN SIGNAL	58
12	L60 18TN	RIGHT TURN TO TAIL LAMP	58
13	L12 16VT/TN*	HAZARD FLASHER TO SWITCH	58
14	—	—	—
15	L61 18LG	LEFT TURN TO TAIL LAMP	58
16	L65 18LG/DB*	LEFT FRONT TURN SIGNAL	58
17	L5 16BK/OR *	TURN SIGNAL FLASHER UNIT FEED	58
18	L4 16VT/OR * L4 16VT/OR *	LOW BEAM FEED LOW BEAM FEED	33
19	F34 14TN/BK* F34 14TN/BK*	HEADLAMP SWITCH BREAKER TO STRG COL HEADLAMP SWITCH BREAKER TO STRG COL	33
20	L3 16RD/OR * L3 16RD/OR *	HIGH BEAM FEED HIGH BEAM FEED	33
21	L11 16LG/BK* L11 16LG/BK*	FLASH TO PASS/SAM FLASH TO PASS/SAM	33
22	—	—	—
23	—	—	—
24	—	—	—

J938W-1

MULTI-FUNCTION SWITCH CONNECTOR



VIEWED FROM TERMINAL END

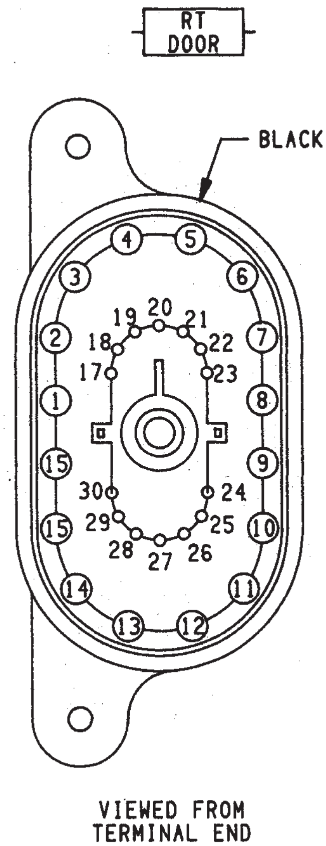
CAV	CIRCUIT	FUNCTION	SHEET
1	—	—	—
2	Q16 14BR/WT*	WINDOW SWITCH TO RT FRONT MOTOR UP	95
3	Q26 14VT/WT*	WINDOW SWITCH TO RT FRONT MOTOR DOWN	95
4	—	—	—
5	—	—	—
6	—	—	—
7	—	—	—
8	C16 18LB/YL*	HEATED MIRROR FEED	85
9	—	—	—
10	Q1 14YL/GY*	POWER WINDOW MASTER SWITCH FEED OUT	95
11	M1 18PK	COURTESY LAMPS	46
12	Z1 18BK	GROUND	86
13	P2 18BK/WT*	RELAY FEED (LOCK)	92
14	P34 18PK/BK*	RELAY FEED (UNLOCK)	92
15	—	—	—
16	—	—	—
17	—	—	—
18	F60 18RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUITS	91
19	P35 20OR/VT*	SWITCH TO RELAY (LOCK)	91
20	P36 20PK/VT*	SWITCH TO RELAY (UNLOCK)	91
21	M2 20YL	SWITCHED GROUND	46
22	P78 20YL/LG*	MIRROR UP/DOWN MOTOR - RIGHT	85
23	—	—	—
24	G72 20DG/OR*	ILLUMINATED ENTRY SIGNAL	48,90
25	P77 20WT/BK*	MIRROR RIGHT/LEFT MOTOR-RIGHT	85
26	P79 20DB/LB*	MIRROR RETURN (—) LEFT	85
27	—	—	—
28	X54 20VT	SPEAKER FEED - RIGHT FRONT	60
29	X56 20DB/RD*	SPEAKER RETURN - RIGHT FRONT	60
30	—	—	—

RIGHT DOOR JUMPER TO
RIGHT FRONT DOOR WIRING

ZJ 119

J938W-1

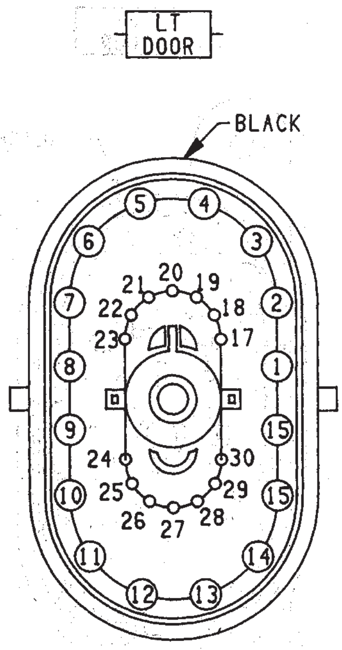
CAV	CIRCUIT	FUNCTION	SHEET
1	—	—	—
2	Q16 14BR/WT*	WINDOW SWITCH TO RT FRONT MOTOR UP	95
3	Q26 14VT/WT*	WINDOW SWITCH TO RT FRONT MOTOR DOWN	95
4	—	—	—
5	—	—	—
6	—	—	—
7	—	—	—
8	C16 18LB/YL*	HEATED MIRROR FEED	85
9	—	—	—
10	Q1 14YL/GY*	POWER WINDOW MASTER SWITCH FEED OUT	95
11	—	—	—
12	Z1 18BK	GROUND	86
13	P2 18BK/WT*	RELAY FEED (LOCK)	92
14	P34 18PK/BK*	RELAY FEED (UNLOCK)	92
15	—	—	—
16	—	—	—
17	—	—	—
18	F60 18RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUIT	91
19	P35 20OR/VT*	SWITCH TO RELAY (LOCK)	91
20	P36 20PK/VT*	SWITCH TO RELAY (UNLOCK)	91
21	—	—	—
22	P78 20YL/LG*	MIRROR UP/DOWN MOTOR - RIGHT	85
23	—	—	—
24	—	—	—
25	P77 20WT/BK*	MIRROR RIGHT/LEFT MOTOR RIGHT	85
26	P79 20DB/LB*	MIRROR RETURN (—) LEFT	85
27	—	—	—
28	X54 20VT	SPEAKER FEED - RIGHT FRONT	60
29	X56 20DB/RD*	SPEAKER RETURN - RIGHT FRONT	60
30	—	—	—



RIGHT FRONT DOOR TO
RIGHT FRONT DOOR JUMPER WIRING

J938W-1

ZJ 120



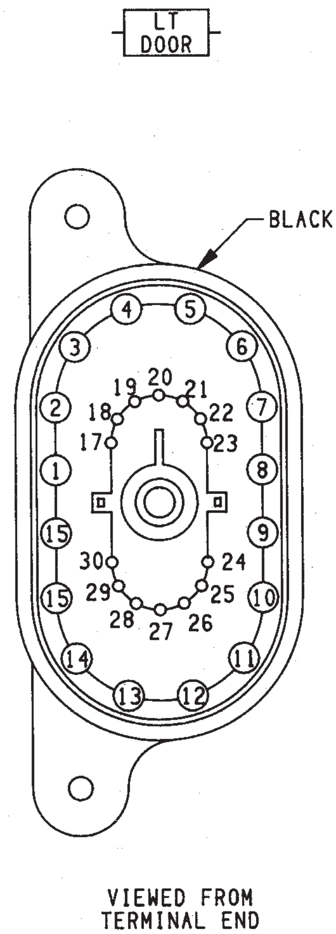
CAV	CIRCUIT	FUNCTION	SHEET
1	—	—	—
2	Q16 14BR/WT*	WINDOW SWITCH TO RT FRONT MOTOR UP	93
3	Q26 14VT/WT*	WINDOW SWITCH TO RT FRONT MOTOR DOWN	93
4	F81 14TN	POWER WINDOW FEED	93
5	Q18 14GY/BK*	WINDOW SWITCH TO RT REAR MOTOR UP	93
6	Q17 14DB/WT*	WINDOW SWITCH TO LT REAR MOTOR UP	93
7	Q28 14DG/WT*	WINDOW SWITCH TO RT REAR MOTOR DOWN	93
8	C16 18LB/YL*	HEATED MIRROR FEED	85
9	Q27 14RD/BK*	WINDOW SWITCH TO LT REAR MOTOR DOWN	93
10	Q1 14YL/GY*	POWER WINDOW MASTER SWITCH FEED OUT	93
11	M1 18PK	COURTESY LAMPS	46
12	Z1 14BK	GROUND	85
13	P2 18BK/WT*	RELAY FEED (LOCK)	92
14	P34 18PK/BK*	RELAY FEED (UNLOCK)	92
15	—	—	—
16	—	—	—
17	—	—	—
18	F60 18RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUITS	91
19	P35 20OR/VT*	SWITCH TO RELAY (LOCK)	91
20	P36 20PK/VT*	SWITCH TO RELAY (UNLOCK)	91
21	M2 18YL	SWITCHED GROUND	46
22	P64 20YL/OR*	MIRROR UP/DOWN - LEFT	85
23	—	—	—
24	G71 20VT/YL*	SECURITY ALARM DECK LID KEY CYLINDER	84
25	P75 20DB/WT*	MIRROR RIGHT/LEFT MOTOR - LEFT	85
26	P79 20DB/LB*	MIRROR RETURN (-) LEFT	85
27	—	—	—
28	X53 20DG	SPEAKER FEED - LEFT FRONT	59
29	X55 20BR/RD*	SPEAKER RETURN - LEFT FRONT	59
30	—	—	—

LEFT FRONT DOOR JUMPER TO
LEFT FRONT DOOR WIRING

ZJ 121

J938W-1

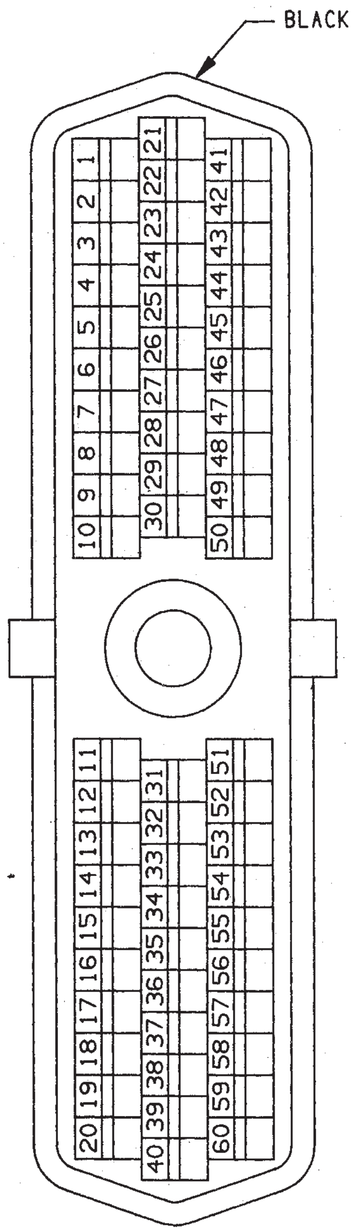
CAV	CIRCUIT	FUNCTION	SHEET
1	—	—	—
2	Q16 14BR/WT*	WINDOW SWITCH TO RT FRONT MOTOR UP	93
3	Q26 14VT/WT*	WINDOW SWITCH TO RT FRONT MOTOR DOWN	93
4	F81 14TN	POWER WINDOW FEED	93
5	Q18 14GY/BK*	WINDOW SWITCH TO RT REAR MOTOR UP	93
6	Q17 14DB/WT*	WINDOW SWITCH TO LT REAR MOTOR UP	93
7	Q28 14DG/WT*	WINDOW SWITCH TO RT REAR MOTOR DOWN	93
8	C16 18LB/YL*	HEATED MIRROR FEED	85
9	Q27 14RD/BK*	WINDOW SWITCH TO LT REAR MOTOR DOWN	93
10	Q1 14YL/GY*	POWER WINDOW MASTER SWITCH FEED OUT	93
11	M1 18PK	COURTESY LAMPS	46
12	Z1 14BK	GROUND	85
13	P2 18BK/WT*	RELAY FEED (LOCK)	92
14	P34 18PK/BK*	RELAY FEED (UNLOCK)	92
15	—	—	—
16	—	—	—
17	—	—	—
18	F60 18RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUITS	91
19	P35 20OR/VT*	SWITCH TO RELAY (LOCK)	91
20	P36 20PK/VT*	SWITCH TO RELAY (UNLOCK)	91
21	M2 18YL	SWITCHED GROUND	46
22	P64 20YL/OR*	MIRROR UP/DOWN - LEFT	85
23	—	—	—
24	G71 20VT/YL*	SECURITY ALARM DECK LID KEY CYLINDER	84
25	P75 20DB/WT*	MIRROR RIGHT/LEFT MOTOR - LEFT	85
26	P79 20DB/LB*	MIRROR RETURN (-) LEFT	85
27	—	—	—
28	X53 20DG	SPEAKER FEED - LEFT FRONT	59
29	X55 20BR/RD*	SPEAKER RETURN - LEFT FRONT	59
30	—	—	—



LEFT FRONT DOOR TO
LEFT FRONT DOOR JUMPER WIRING

J938W-1

ZJ 122



VIEWED FROM WIRE END

* - INDICATES TWISTED PAIR

CAV	CIRCUIT	FUNCTION	SHEET
1	K70 18RD/WT*	MAP SIGNAL	15
2	K2 20TN/BK*	ENGINE COOLANT TEMPERATURE SENSOR	15
3	A5 16PK/BK*	BATTERY	13
4	K4 18BK/LB*	SENSOR GROUND	15
5	Z12 18BK/TN*	POWER GROUND (LOGIC MODULE)	14
6	K6 18VT/WT*	5 VOLT SUPPLY	15
7	K25 20WT/BK*	8 VOLT SUPPLY	16
8	—	—	—
9	F86 16LB/RD*	IGNITION ACCESSORY FEED	14
10	—	—	—
11	Z12 18BK/TN*	POWER GROUND	14
12	Z12 18BK/TN*	POWER GROUND	14
13	K14 18LB/BR*	INJECTOR 4	18
14	K13 18YL/WT*	INJECTOR 3	18
15	K12 18TN	INJECTOR 2	18
16	K11 18WT/DB*	INJECTOR 1	18
17	—	—	—
18	—	—	—
19	K19 18GY/WT*	DISTRIBUTOR IGNITION COIL (−)	14
20	K20 18DG	GENERATOR FIELD	13
21	K21 20BK/RD*	INTAKE AIR TEMPERATURE SENSOR	15
22	K22 18OR/DB*	THROTTLE POSITION (SENSOR)	15
23	—	—	—
24	K27 20RD/LG*	CRANKSHAFT POSITION SENSOR	16
25	D84 20BK	DIAGNOSTIC (DATA 2)	14
* 26	D1 20VT/BR*	CCD (+)	66
27	C21 18DB/OR*	A/C LOW PRESSURE SWITCH	75
28	C90 20LG	A/C SELECT SIGNAL	71,73
29	L53 20BR	TCU BRAKE (−)	17
30	T41 20BK/WT*	PARK/NEUT POS SW (AUTO TRANS ONLY)	17
31	—	—	—
32	G3 20BK/PK*	MALFUNCTION INDICATOR LAMP	70
33	V36 20TN/RD*	VEHICLE SPEED CONTROL (VACUUM)	28
34	C13 20DB/RD*	A/C COMPRESSOR CLUTCH RELAY	75
35	—	—	—
36	—	—	—
37	—	—	—
38	K38 18GY	INJECTOR 5	18
39	K60 18YL/BK*	IDLE AIR CONTROL (4)	18
40	K40 18BR/WT*	IDLE AIR CONTROL (2)	18
41	K41 18BK/OR*	HEATED OXYGEN SENSOR	17
42	—	—	—
43	G21 20GY/LB*	BUFFERED TACHOMETER SIGNAL	70
44	K24 18GY/BK*	CAMSHAFT POSITION SENSOR SIGNAL	16
45	D83 20BK/YL*	DIAGNOSTIC (DATA 1)	14
* 46	D2 20WT/GY*	CCD (−)	66
47	G7 18WT/OR*	VEHICLE SPEED SIGNAL	16
48	V31 20BR/RD*	VEHICLE SPEED CONTROL SWITCH(SET)	28
49	V32 20YL/RD*	VEHICLE SPEED CONTR SWITCH (IGNITION)	28
50	V33 20WT/LG*	VEHICLE SPEED CONTROL SWITCH (RESUME)	28
51	K81 20PK	FUEL PUMP RELAY COIL	13
52	—	—	—
53	V35 20LG/RD*	VEHICLE SPEED CONTROL (VENT)	28
54	K54 20OR/BK*	UPSHIFT LAMP	16
55	—	—	—
56	G24 20GY/PK*	MAINTENANCE INDICATOR	70
57	A61 18DG/BK*	IGNITION COIL: FUEL INJ: FUEL PUMP	18
58	K58 18BR/YL*	INJECTOR 6	18
59	K39 18GY/RD*	IDLE AIR CONTROL (1)	18
60	K59 18VT/BK*	IDLE AIR CONTROL (3)	18

ZJ 123

POWERTRAIN CONTROL MODULE (PCM) CONNECTOR (4.0L)

J938W-1

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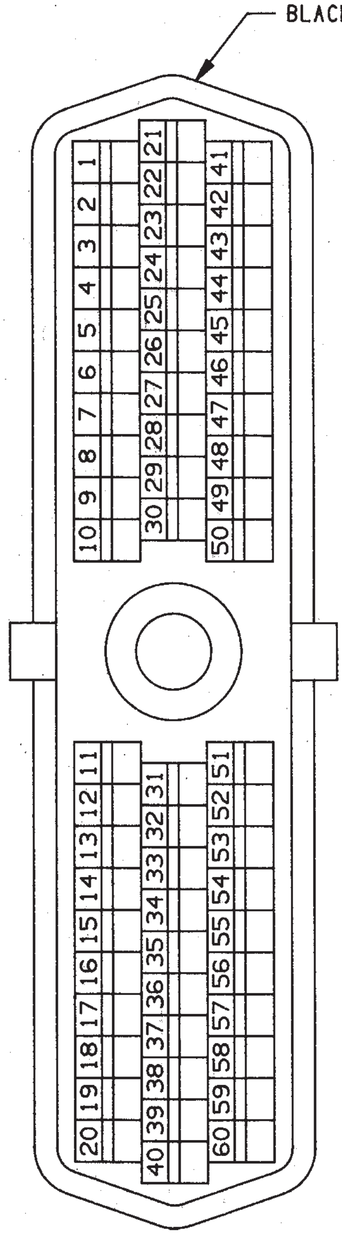


VIEWED FROM WIRE END

* - INDICATES TWISTED PAIR

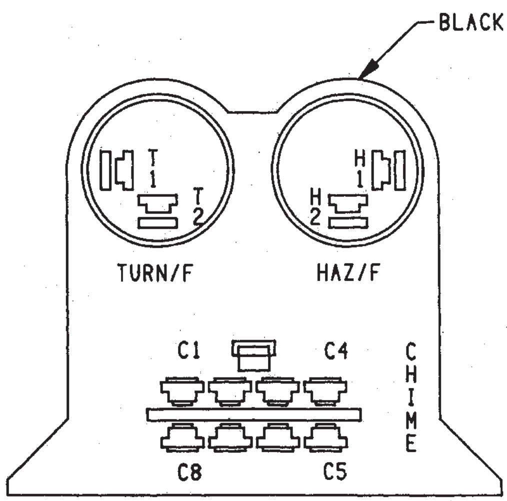
CAV	CIRCUIT	FUNCTION	SHEET
1	K70 18RD/WT*	MAP SIGNAL	21
2	K2 20TN/BK*	ENGINE COOLANT TEMPERATURE SENSOR	21
3	A5 16PK/BK*	BATTERY	19
4	K4 18BK/LB*	SENSOR GROUND	21
5	Z12 18BK/TN*	POWER GROUND	20
6	K6 18VT/WT*	5 VOLTS	21
7	K25 20WT/BK*	8 VOLT SUPPLY	22
8	T40 14LG/BK*	ENGINE STARTER RELAY	23
9	F86 16LB	IGNITION ACCESSORY FEED	20
10	T9 20OR/BK*	TRANSMISSION OVERDRIVE PRESSURE SIGNAL	25
11	Z12 18BK/TN*	POWER GROUND	20
12	Z12 18BK/TN*	POWER GROUND	20
13	K14 18LB/BR*	INJECTOR 4	24
14	K13 18YL/WT*	INJECTOR 3	24
15	K12 18TN	INJECTOR 2	23
16	K11 18WT/DB*	INJECTOR 1	23
17	K17 18DB/WT*	INJECTOR 7	24
18	K18 18DB/YL*	INJECTOR 8	24
19	K19 18GY/WT*	DISTRIBUTOR IGNITION COIL (−)	20
20	K20 18DG	GENERATOR FIELD	19
21	K21 20BK/RD*	INTAKE AIR TEMPERATURE SENSOR	21
22	K22 18OR/DB*	THROTTLE POSITION (SENSOR)	21
23	—	—	—
24	K27 20RD/LG*	CRANKSHAFT POSITION SENSOR	22
25	D84 20BK	DIAGNOSTIC (DATA 2)	20
* 26	D1 20VT/BR*	CCD (+)	66
27	C21 18DB/OR*	A/C LOW PRESSURE SWITCH	75
28	C90 20LG	A/C SELECT SIGNAL	71,73
29	L53 20BR	TCU BRAKE (−)	23
30	T41 20BK/WT*	PARK/NEUTRAL SWITCH	23
31	—	—	—
32	G3 20BK/PK*	MALFUNCTION INDICATOR LAMP	70
33	V36 20TN/RD*	VEHICLE SPEED CONTROL (VACUUM)	28
34	C13 20DB/RD*	A/C COMPRESSOR CLUTCH RELAY	75
35	K35 20GY/YL*	EXHAUST GAS RECIRCULATION SOLENOID	25
36	—	—	—
37	G68 20PK/OR*	TRANSMISSION OVERDRIVE LAMP	25
38	K38 18GY	INJECTOR 5	24
39	K60 18YL/BK*	IDLE AIR CONTROL (4)	24
40	K40 18BR/WT*	IDLE AIR CONTROL (2)	24
41	K41 18BK/OR*	OXYGEN SENSOR	23
42	—	—	—
43	G21 20GY/LB*	BUFFERED TACHOMETER SIGNAL	70
44	K24 18GY/BK*	CAMSHAFT POSITION SENSOR SIGNAL	22
45	D83 20BK/YL*	DIAGNOSTIC (DATA 1)	20
* 46	D2 20WT/GY*	CCD (−)	66
47	G7 18WT/OR*	VEHICLE SPEED SIGNAL	22
48	V31 20BR/RD*	VEHICLE SPEED CONTROL SWITCH(SET)	28
49	V32 20YL/RD*	VEHICLE SPEED CONTR SWITCH (IGNITION)	28
50	V33 20WT/LG*	VEHICLE SPEED CONTROL SWITCH (RESUME)	28
51	K81 20PK	FUEL PUMP RELAY COIL	19
52	K52 20PK/BK*	EVAP/PURGE SOLENOID	25
53	V35 20LG/RD*	VEHICLE SPEED CONTROL (VENT)	28
54	T6 20VT/YL*	TRANSMISSION TCC LU SOLENOID	25
55	T60 18BR/LG*	TRANSMISSION OVERDRIVE SOLENOID	25
56	G24 20GY/PK*	MAINTENANCE INDICATOR	70
57	A61 18DG/BK*	IGNITION COIL: FUEL INJ: FUEL PUMP	24
58	K58 18BR/YL*	INJECTOR 6	24
59	K39 18GY/RD*	IDLE AIR CONTROL (1)	24
60	K59 18VT/BK*	IDLE AIR CONTROL (3)	24

POWERTRAIN CONTROL MODULE (PCM) CONNECTOR (5.2L)

J938W-1

ZJ 124

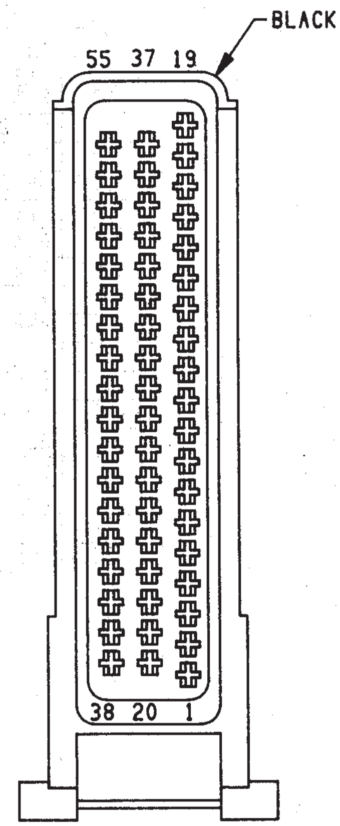
CAV	CIRCUIT	FUNCTION	SHEET
C1	F83 18YL/DG*	FUSED IGNITION 'B' CONV ITEMS	53
C2	G11 20WT	SEAT BELT LAMP	53
C3	Z1 18BK	GROUND	53
C4	G10 20LG/RD*	SEAT BELT SWITCH	53
C5	P57 20YL/BK*	POWER DOOR LOCK INHIBIT	53
C6	F60 18RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUITS	53
C7	G26 20LB	SEAT BELT SWITCH	53
	G26 20LB	IGNITION SWITCH RETURN	
C8	G81 20DB	TONE LINE (CHIME)	54
H1	F72 16RD/YL*	HAZARD FLASHER FEED	54
H2	L12 16VT/TN*	HAZARD FLASHER TO SWITCH	54
T1	L6 16RD/TN*	FEED FROM TURN SIGNAL FLASHER	54
T2	L5 20BK/OR *	TURN SIGNAL FLASHER UNIT FEED	54
	L5 16BK/OR *	TURN SIGNAL FLASHER UNIT FEED	



VIEWED FROM TERMINAL END

ZJ 125 CONVENIENCE CENTER CONNECTOR J938W-1

	CAV	CIRCUIT	FUNCTION	SHEET
	1	Z1 16BK	GROUND	62
	2	B243 18DG/BK*	LEFT FRONT DECAY VALVE	62
	3	235 16GY/YL*	SOLENOID (12 VOLTS)	62
	4	—	—	—
	5	—	—	—
	6	—	—	—
	7	—	—	—
	8	—	—	—
	9	—	—	—
	10	—	—	—
	11	—	—	—
	12	—	—	—
	13	—	—	—
	14	—	—	—
	15	B116 20GY	PUMP RELAY COIL B (—)	65
	16	B258 20GY/LB*	PEDAL TRAVEL SENSOR	64
	17	—	—	—
	18	—	—	—
	19	Z1 16BK	GROUND	62
	20	B245 18WT/LG*	LEFT FRONT ISOLATE VALVE	62
	21	B248 18DG/WT*	RIGHT FRONT DECAY VALVE	62
	22	—	—	—
*	23	D1 20VT/BR *	CCD (+)	65
	24	—	—	—
	25	B41 20YL/VT *	ACCELERATOR SWITCH 1	64
	26	B43 20PK/OR *	ACCELERATOR SENSOR	64
*	27	B2 20YL	RIGHT REAR SENSOR (+)	63
*	28	B3 20LG/DB *	LEFT REAR SENSOR (—)	63
*	29	B6 20WT/DB *	RIGHT FRONT SENSOR (—)	63
*	30	B8 20RD/DB *	LEFT FRONT SENSOR (—)	63
	31	B219 20DB	BOOST PRESSURE	64
	32	L50 18WT/TN *	STOP LAMP SIGNAL	64
	33	235 16GY/YL *	SOLENOID (12 VOLTS)	62
	34	207 18PK	RELAY	65
	35	—	—	—
	36	B254 18DG/DR*	DECAY MODULATOR VALVE	62
	37	—	—	—
	38	B249 18WT/OR*	RIGHT FRONT ISOLATE VALVE	62
	39	—	—	—
	40	—	—	—
	41	B210 20RD/BK*	PEDAL TRAVEL SENSOR	64
*	42	D2 20WT/GY *	CCD (—)	65
	43	B42 20TN/WT *	ACCELERATOR SENSOR 2	64
	44	—	—	—
*	45	B1 20YL/DB *	RIGHT REAR SENSOR (—)	63
*	46	B4 20LG	LEFT REAR SENSOR (+)	63
*	47	B7 20WT	RIGHT FRONT SENSOR (+)	63
*	48	B9 20RD	LEFT FRONT SENSOR (+)	63
	49	B220 20TN	BOOST PRESSURE RETURN	64
	50	—	—	—
	51	—	—	—
	52	205 18VT/WT*	YELLOW LIGHT	62
	53	236 20LG/YL *	IGNITION (12 VOLTS)	65
	54	B251 18WT/RD*	REAR ISOLATE VALVE	62
	55	—	—	—



VIEWED FROM
TERMINAL END

* INDICATES TWISTED
PAIRS D1+D2, B1+B2,
B3+B4, B6+B7 AND B8+B9

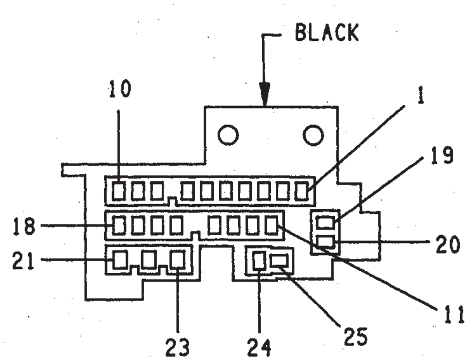
ANTI-LOCK BRAKE SYSTEM
ELECTRONIC CONTROL MODULE CONNECTOR

J938W-1

ZJ 126

ENG

CAV	CIRCUIT	FUNCTION	SHEET
1	G9 20GY/BK*	BRAKE PRESSURE	69
2	Z1 16BK	GROUND	44,56
3	L3 16RD/OR*	HIGH BEAM FEED	31,33
4	L4 16VT/OR*	LOW BEAM FEED	31,33
5	L65 18LG/DB*	LEFT FRONT TURN SIGNAL	31,57,69
	L65 18LG/DB*	LEFT FRONT TURN SIGNAL	
6	L90 18DB/RD*	PARK LAMP FEED	31,36
7	G9 20GY/BK*	PARK BRAKE	69
8	V20 18BK/OR*	REAR WASHER FEED	55
9	G29 20BK/TN*	LOW WASHER FLUID	38,55
10	205 20VT/WT*	ABS YELLOW LIGHT RELAY	62,69
11	G3 20BK/PK*	MALFUNCTION INDICATOR LAMP	69
12	G20 20VT/YL*	ENGINE COOLANT TEMPERATURE SENSOR	26,70
13	G6 20GY/WT*	ENGINE OIL PRESSURE SIGNAL	26,69
14	G21 20GY/LB*	BUFFERED TACHOMETER SIGNAL	51,70
15	G24 20GY/PK*	MAINTENANCE INDICATOR	70
16	V32 20YL/RD*	VEHICLE SPEED CONTR SWITCH (IGNITION)	27
17	V31 20BR/RD*	VEHICLE SPEED CONTROL SWITCH (SET)	27
18	K54 20OR/BK*	UPSHIFT LAMP	16,69
19	T9 20OR	TRANSMISSION OVERDRIVE PRESSURE SIGNAL	25,50,79
20	G68 20BR/YL*	TRANSMISSION OVERDRIVE LAMP	25,50,79
21	—	—	—
22	236 20LG/YL*	ABS IGNITION (12 VOLTS)	65
23	L50 18WT/TN*	STOP LAMP SIGNAL	97
	L50 18WT/TN*	STOP LAMP SIGNAL	
24	—	—	—
25	—	—	—



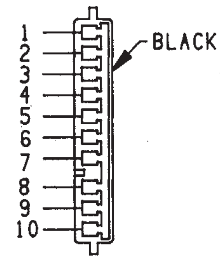
VIEWED FROM TERMINAL END

ENGINE TO 25 WAY INTERCONNECT WIRING

J938W-1

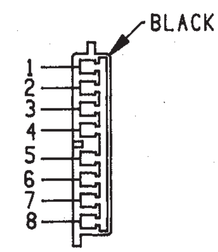
ENG

CAV	CIRCUIT	FUNCTION	SHEET
1	G9 20GY/BK*	BRAKE PRESSURE	69
2	Z1 16BK	GROUND	44,56
3	L3 16RD/OR*	HIGH BEAM FEED	31,33
4	L4 16VT/OR*	LOW BEAM FEED	31,33
5	L65 18LG/DB*	RIGHT FRONT TURN SIGNAL	31,57,69
6	L90 18DB/RD*	PARK LAMP FEED	31,36
7	G9 20GY/BK*	PARK BRAKE	69
8	V20 20BK/OR*	REAR WASHER FEED	55
9	G29 20BK/TN*	LOW WASHER FLUID	38,55
10	205 18VT/WT*	YELLOW LIGHT	62,69
	205 18VT/WT*	YELLOW LIGHT	



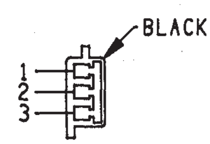
VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	G3 20BK/PK*	MALFUNCTION INDICATOR LAMP	69
2	G20 18VT/YL*	ENGINE COOLANT TEMPERATURE SENSOR	26,70
3	G6 20GY/WT*	ENGINE OIL PRESSURE SIGNAL	26,69
4	G21 20GY/LB*	BUFFERED TACHOMETER SIGNAL	51,70
5	G24 20GY/PK*	MAINTENANCE INDICATOR	70
6	V32 20YL/RD*	VEHICLE SPEED CONTR SWITCH (IGNITION)	27
7	V31 20BR/RD*	VEHICLE SPEED CONTROL SWITCH (SET)	27
8	K54 20OR/BK*	UPSHIFT LAMP	16,69



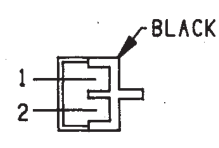
VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	L50 18WT/TN*	STOP LAMP SIGNAL	97
2	236 20LG/YL*	IGNITION (12 VOLTS)	65
	236 20LG/YL*	IGNITION (12 VOLTS)	
3	—	—	—



VIEWED FROM TERMINAL END

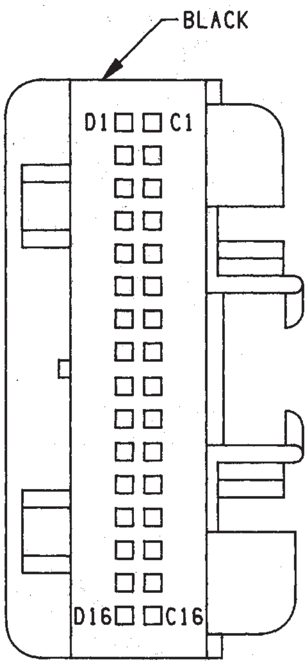
CAV	CIRCUIT	FUNCTION	SHEET
1	G68 20PK/OR*	TRANSMISSION OVERDRIVE LAMP	25,50,79
2	T9 20OR/BK*	TRANSMISSION OVERDRIVE PRESSURE SIGNAL	25,50,79



VIEWED FROM TERMINAL END

INTERCONNECT TO 25 WAY
ENGINE WIRING

J938W-1

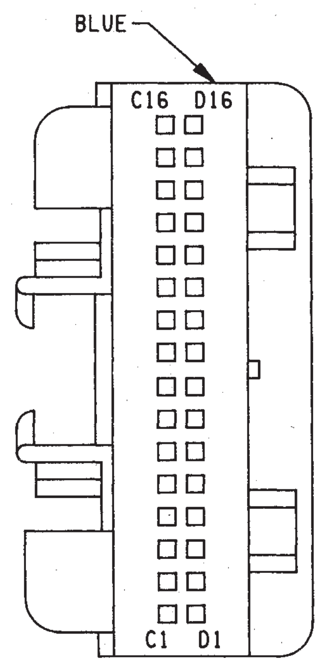


VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
C1	—	—	—
C2	—	—	—
C3	T25 18LG	TRANSMISSION GOVERNOR PRESSURE	51
C4	K22 18OR/DB*	THROTTLE POSITION (SENSOR)	51
C5	T9 20OR/BK*	TRANSMISSION OVERDRIVE SWITCH	50
C6	G21 20GY/LB*	BUFFERED TACHOMETER SIGNAL	51
C7	T14 18LG/WT*	TRANSMISSION OUTPUT SPEED SENSOR (+)	50
C8	A14 18RD/WT	TCU BATTERY/DIAGNOSTIC FEED	51
C9	F86 18LB/RD*	IGNITION ACCESORY FEED	49
C10	T33 18RD/YL*	SENSOR FEED (+5V)	51
C11	T35 18TN/OR*	SENSOR GROUND	51
C12	Z1 18BK	GROUND	50
C13	G68 20BK/OR*	TRANSMISSION OVERDRIVE LAMP	50
C14	T22 18DG/LB*	TRANSMISSION SOLENOID	51
C15	T60 18BR/YL*	TRANSMISSION SOLENOID (3-4 SHIFT)	51
C16	T59 18PK	TRANSMISSION SOLENOID (VAR FORCE)	51
D1	G7 18WT/OR*	VEHICLE SPEED SENSOR	51
D2	D5 20PK/BK*	DATA LINK (TX)	51
D3	D82 20BK/YL*	DATA LINK (RX)	49
D4	K4 18BK/LB*	THROTTLE POSITION (SENSOR) GROUND	50
D5	—	—	—
D6	T54 18VT	TRANSMISSION FLUID TEMPERATURE	51
D7	T13 18DB/BK*	TRANSMISSION OUTPUT SPEED SENSOR (-)	50
D8	A14 18RD/WT	TCU BATTERY/DIAGNOSTIC FEED	49
D9	—	—	—
D10	—	—	—
D11	—	—	—
D12	Z1 18BK	GROUND	49
D13	—	—	—
D14	—	—	—
D15	—	—	—
D16	T20 18LB/BR*	TRANSMISSION SOLENOID (FEED)	51

TRANSMISSION CONTROL MODULE
(TCM) CONNECTOR

	CAV	CIRCUIT	FUNCTION	SHEET
	C1	C37 20TN/BK*	MODE MOTOR (−)	73
	C2	C35 20DB/WT*	MIX MOTOR (+)	73
	C3	C39 20YL	MODE MOTOR POSITION	73
	C4	—	—	—
	C5	L90 18DB/RD*	PARK LAMP FEED	73
	C6	C90 20LG	A/C SELECTOR SIGNAL	73
	C7	—	—	—
	C8	C40 20DG/YL*	5 VOLT REFERANCE	74
	C9	C43 18BR/YL*	BLOWER DRIVE	74
*	C10	D1 20VT/BR*	CCD (+)	73
*	C11	D2 20WT/GY*	CCD (−)	73
	C12	F71 20PK/DG*	HEVAC IGNITION FEED	73
	C13	F60 18RD/WT*	FUSED BATTERY 'A' MEMORY CIRCUITS	73
	C14	C36 20DB/RD*	MIX MOTOR POSITION	73
	C15	G25 20LG/BK*	ENGLISH/METRIC SWITCH	73
	C16	—	—	—
	D1	C38 20DG	MODE MOTOR (+)	74
	D2	C42 18BR/RD*	BLOWER FEEDBACK	74
	D3	C32 20LB/BK*	RECIRCULATION MOTOR POSITION	73
	D4	C33 20VT/OR*	FRESH MOTOR POSITION	73
	D5	C41 18BR	HIGH BLOWER RELAY	74
	D6	C34 20VT/WT*	MIX MOTOR (−)	73
	D7	Z4 20BK	HEVAC REFERENCE GROUND	74
	D8	—	—	—
	D9	D41 20LG/WT*	HEVAC SENSOR RETURN	74
	D10	—	—	—
	D11	—	—	—
	D12	C10 20RD/TN*	INTERIOR AMBIENT TEMPERATURE SENSOR FEED	74
	D13	E2 20OR	I/P ILLUMINATION	73
	D14	C8 20DG/RD*	HEVAC AMBIENT TEMPERATURE SENSOR	74
	D15	C47 20BK/WT*	SOLAR SENSOR	74
	D16	—	—	—



VIEWED FROM TERMINAL END

* - INDICATES TWISTED PAIR

J938W-1

HEVAC MODULE CONNECTOR

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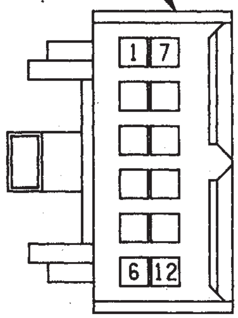


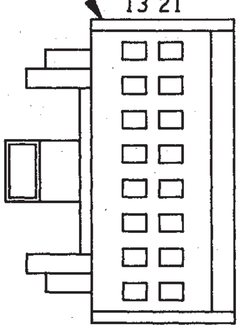
VIEWED FROM
TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
* 1	D2 20WT/GY*	CCD (−)	83
* 2	D1 20VT/BR*	CCD (+)	83
3	F87 18WT/BK*	FUSE IGNITION 'C' CLUSTER/SAM	84
4	G71 20VT/YL*	SECURITY ALARM KEY CYLINDER	84
5	G49 20PK/OR*	SECURITY ALARM	82
6	X4 20GY/OR*	HORN SWITCH	81
7	L90 18DB/RD*	PARK LAMP FEED	81
8	M2 20YL	SWITCHED GROUND	81
9	X3 18BK/TN*	SECURITY ALARM FEED (B+)	81
10	G78 20TN/BK*	LIFTGATE AJAR	82
11	Z1 18BK	GROUND	84
12	G70 20BR/TN*	SECURITY ALARM (HOOD OPEN)	81

* INDICATES TWISTED PAIR

BLACK

13 21



20 28

VIEWED FROM
TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
13	—	—	—
14	G79 20TN/PK*	HEADLAMP OUTPUT	83
15	G69 20BK/OR*	SET TELLTALE	81
16	P36 20PK/VT*	SWITCH TO RELAY (UNLOCK)	82
17	P35 20OR/VT	SWITCH TO RELAY (LOCK)	82
18	—	—	—
19	Z1 18BK	GROUND	84
20	F86 16LG/RD*	IGNITION ACCESSORY FEED	82
21	L11 16LG/BK*	FLASH TO PASS	83
22	—	—	—
23	—	—	—
24	—	—	—
25	—	—	—
26	—	—	—
27	—	—	—
28	—	—	—

ZJ 131 SECURITY ALARM MODULE CONNECTOR J938W-1

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).

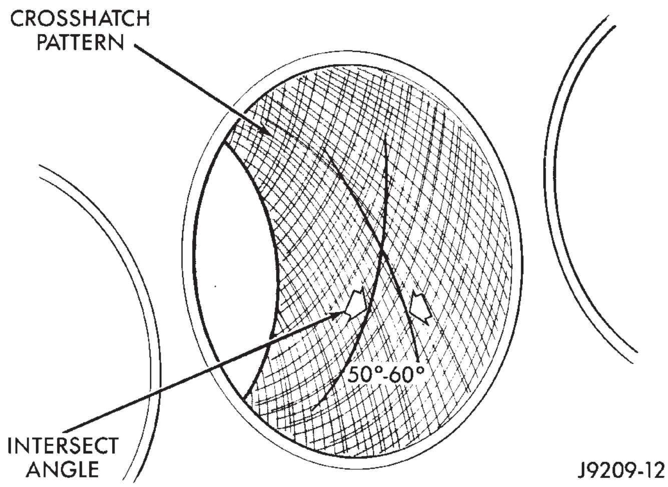


Fig. 1 Cylinder Bore Crosshatch Pattern

(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.

- **4.0L & 5.2L ENGINES**—When checking No.1 main bearing; shim No.2 main bearing.
- **4.0L & 5.2L ENGINES**—When checking No.2 main bearing; shim No.1 and No.3 main bearing.
- **4.0L & 5.2L ENGINES**—When checking No.3 main bearing; shim No.2 and No.4 main bearing.
- **4.0L & 5.2L ENGINES**—When checking No.4 main bearing; shim No.3 and No.5 main bearing.
- **5.2L 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 (4.0L Engine). Tighten the bearing cap bolts of the bearing being checked to 115 N•m (85 ft. lbs.) torque (5.2L Engine). **DO NOT rotate the crankshaft or the Plastigage may be smeared, giving inaccurate results.**

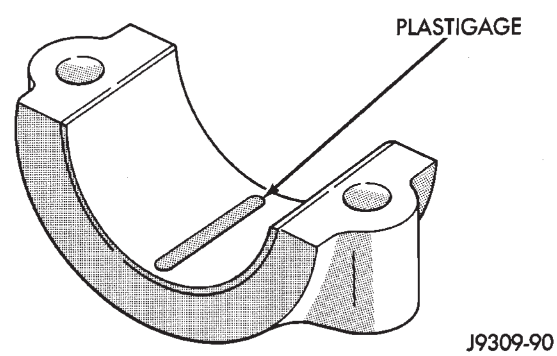


Fig. 2 Placement of Plastigage in Bearing Shell

(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.

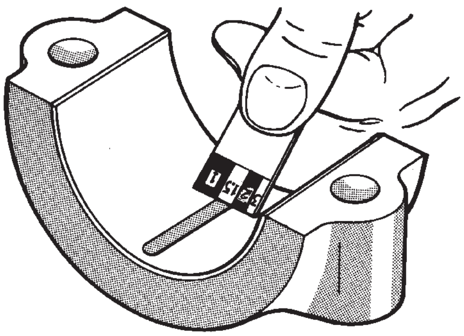


Fig. 3 Clearance Measurement

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 4.0L rod cap nut to 45 N•m (33 ft. lbs.) torque. Tighten the 5.2L rod cap nut to 61 N•m (45 ft. lbs.) torque. **DO NOT rotate the crankshaft or the Plastigage may be smeared, giving inaccurate results.**

(4) Remove the bearing cap and compare the width of the flattened Plastigage with the scale provided on the package (Fig. 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)—4.0L ENGINE

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) Preform 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 4.0L engine spark plugs to 37 N•m (27 ft. lbs.) torque. Tighten the 5.2L engine spark plugs to 41 N•m (30 ft. lbs.) torque.

(11) Drain engine oil. Remove and discard the oil filter.

(12) Install the drain plug. Tighten 4.0L engine the drain plug to 41 N•m (30 ft. lbs.) torque. Tighten the 5.2L engine drain 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

SERVICE 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.

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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.

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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

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 x 87.4 mm (3.88 x 3.44 in.)
Displacement	4.0L (242 cu. in.)
Compression Ratio	8.8:1
Torque	305 N•m (225 ft. lbs.) @ 4,000 RPM
Firing Order	1-5-3-6-2-4
Lubrication	Pressure Feed - Full Flow Filtration
Engine Oil Capacity	5.7L (6.0 Qts.) with Filter
Cooling System	Liquid Cooled - Forced Circulation
Cooling Capacity	11.4L (12.0 Qts.)
Cylinder Block	Cast Iron
Crankshaft	Cast Nodular Iron
Cylinder Head	Cast Iron
Camshaft	Cast Iron
Pistons	Aluminum Alloy (with Strut)
Piston Combustion Cavity	Double Quench
Connecting Rods	Cast Iron

J9309-8

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).

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.

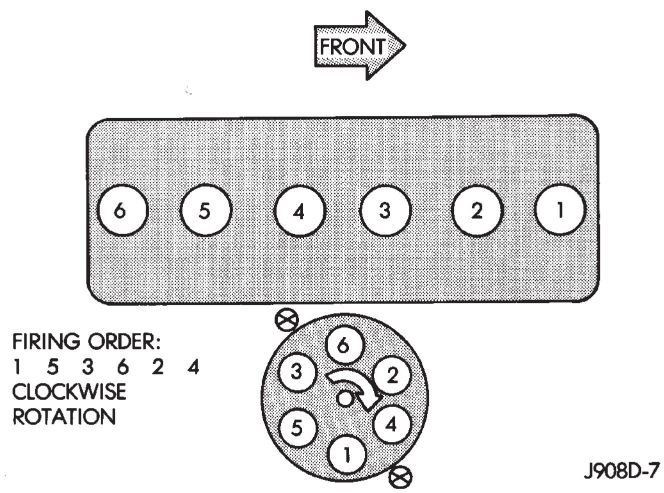

Fig. 2 Engine Firing Order

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.2 and No.3 cylinders (Fig. 3).

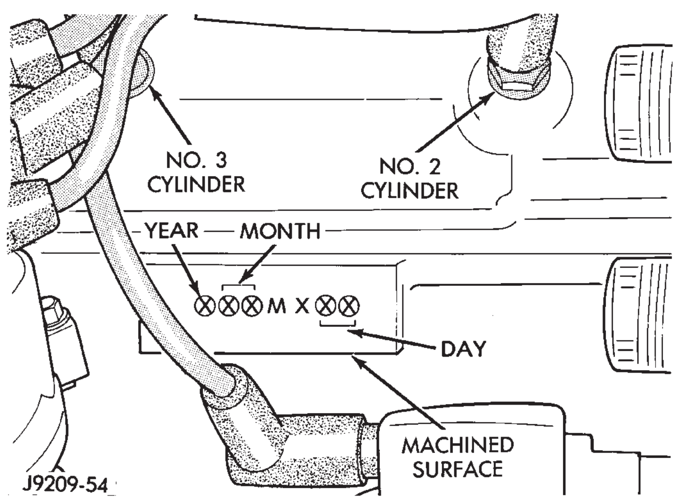

Fig. 3 Build Date Code Location

The digits of the code identify:

(1) 1st Digit—The year (2 = 1992).

(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) 8.8:1 compression ratio engine with a multi-point fuel injection system).

(4) 6th & 7th Digits—The day of engine build (01 - 31).

FOR EXAMPLE: Code * 201MX12 * Identifies a 4.0 Liter (242 CID) engine with a multi-point fuel injection system, 8.8:1 compression ratio and built on January 12, 1992.

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)

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Fig. 4 Oversize and Undersize Component Codes

ENGINE MOUNTS—FRONT

Resilient rubber insulator assemblies support the engine at each side (Figs. 6 and 7).

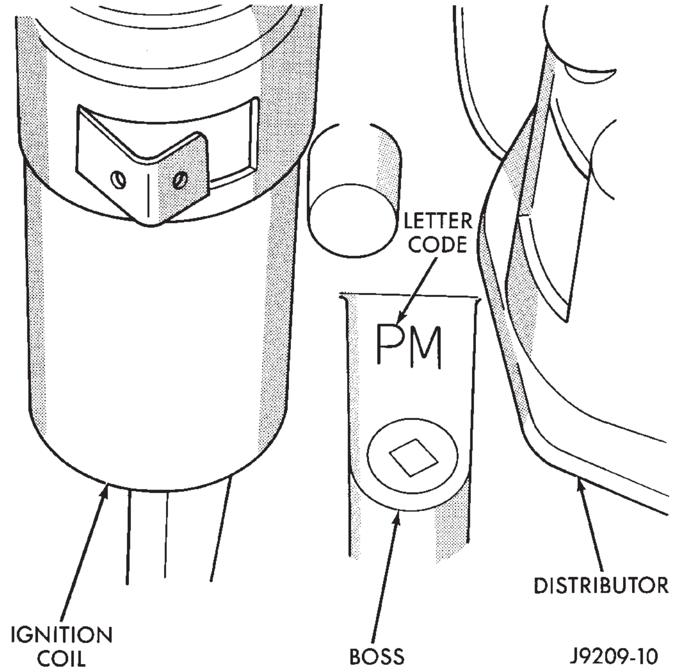

Fig. 5 Oversize and Undersize Component Code Location

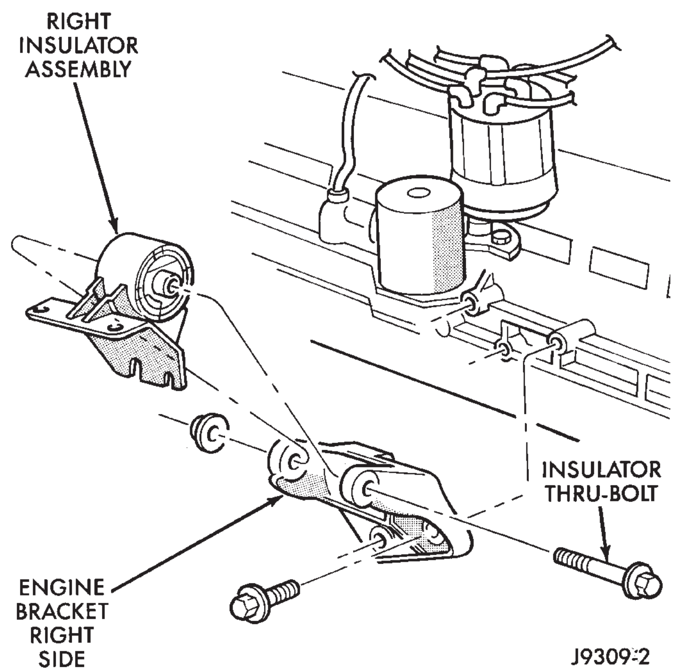

Fig. 6 Engine Mounts—Front (Right Side)

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise the vehicle.

(3) Support and raise the engine slightly.

(4) Remove the nut from the through bolt (Fig. 6 or 7). DO NOT remove the through bolt.

(5) Remove the insulator assembly retaining bolts (Fig. 6 or 7).

(6) Remove the engine bracket attaching bolts (Fig. 6 or 7).

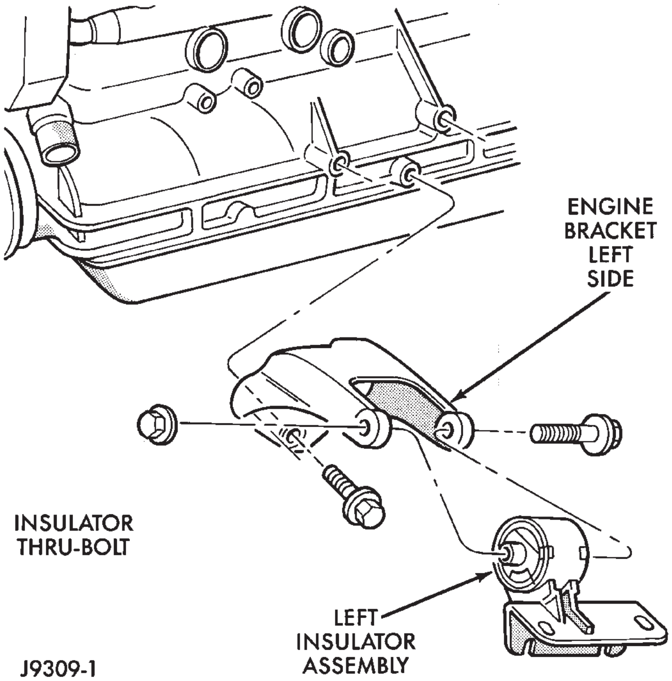

Fig. 7 Engine Mounts—Front (Left Side)

(7) Remove the through bolt.
(8) Remove the engine bracket.
(9) Remove the engine insulator assembly.

INSTALLATION

(1) With the engine insulator assembly and engine bracket in position, install the through bolt and the retaining nut (Fig. 6 or 7).

(2) Install the engine bracket attaching bolts (Fig. 6 or 7). Tighten the bolts to 61 N●m (45 ft. lbs.) torque.

(3) Install the insulator assembly retaining bolts. Tighten the retaining bolts to 54 N●m (40 ft. lbs.) torque.

(4) Lower and remove the engine support.

(5) Tighten the through bolt nut to 65 N●m (48 ft. lbs.) torque.

(6) Lower the vehicle.

(7) Connect the negative cable to the battery.

ENGINE MOUNT—REAR

A resilient rubber cushion bracket assembly supports the transmission at the rear. This bracket is attached to the crossmember (Fig. 8).

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle and support the transmission.
(3) Remove the nuts holding the clevis bracket to the crossmember (Fig. 8).
(4) Raise the transmission SLIGHTLY.
(5) Remove the through bolt and nut (Fig. 8).
(6) Set the rear mount bracket clevis aside.
(7) Remove the bolts holding the rear mount bracket assembly to the transmission (Fig. 8).

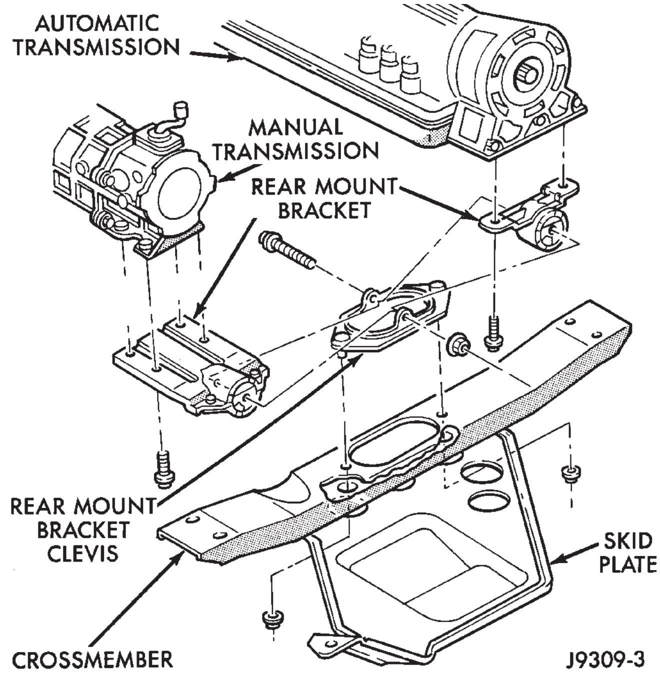

Fig. 8 Engine Mount—Rear

(8) Remove the mount bracket assembly from the exhaust pipe hanger.

INSTALLATION

(1) Position the rear mount bracket assembly onto the exhaust hanger.

(2) Position the rear mount bracket assembly onto the transmission (Fig. 8). Install the bolts and tighten to 46 N●m (34 ft. lbs.) torque.

(3) Install the through bolt into the rear mount bracket and clevis (Fig. 8). Finger tighten the nut at this time.

(4) Lower the transmission until the clevis bracket studs are in position on the crossmember (Fig. 8).

(5) Install the clevis bracket stud nuts. Tighten the nuts to 41 N●m (30 ft. lbs) torque.

(6) Tighten the through bolt to 65 N●m (48 ft. lbs.) torque.

(7) Remove the transmission support.

(8) Lower the vehicle.

(9) Connect the negative cable to the battery.

ENGINE ASSEMBLY

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 upper radiator hose and coolant recovery hose (Fig. 9).

(5) Remove the lower radiator hose.

(6) Remove upper radiator support retaining bolts and remove radiator support.

(7) Remove the fan assembly from the water pump.

(8) Remove the fan shroud (Fig. 9).

(9) Disconnect the transmission fluid cooler tubing (automatic transmission).

(10) **Vehicles with Air Conditioning:**

(a) Discharge the A/C system (refer to Group 24, Heating and Air Conditioning).

(b) Remove the service valves and cap the compressor ports.

(11) Remove the radiator or radiator/condenser (if equipped with A/C).

(12) Disconnect the heater hoses at the engine thermostat housing and water pump (Fig. 9).

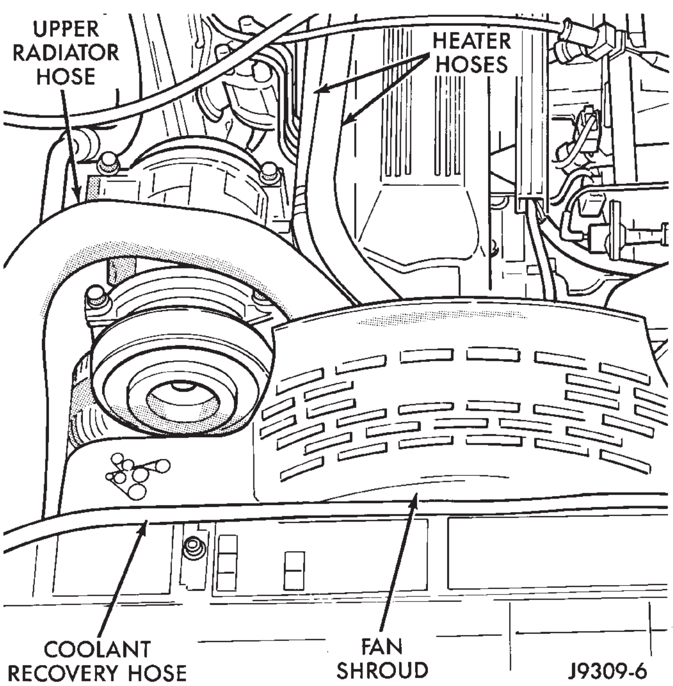

Fig. 9 Upper Radiator Hose, Coolant Recovery Hose, Fan Shroud & Heater hoses

(13) Disconnect the throttle linkages (Fig. 10).

(14) Disconnect the vehicle speed control cable (if equipped)—(Fig. 10).

(15) Disconnect the line pressure cable (if equipped with automatic transmission).

(16) Disconnect injection system wire harness connector at each injector. Mark the wires for proper installation.

(17) Disconnect the distributor electrical connection and the oil pressure switch connector.

(18) Disconnect the quick-connect fuel lines at the fuel rail and return line by squeezing the two retaining tabs against the fuel tube (Fig. 10). Pull the fuel tube and retainer from the quick-connect fitting (refer to Group 14, Fuel System for the proper procedure).

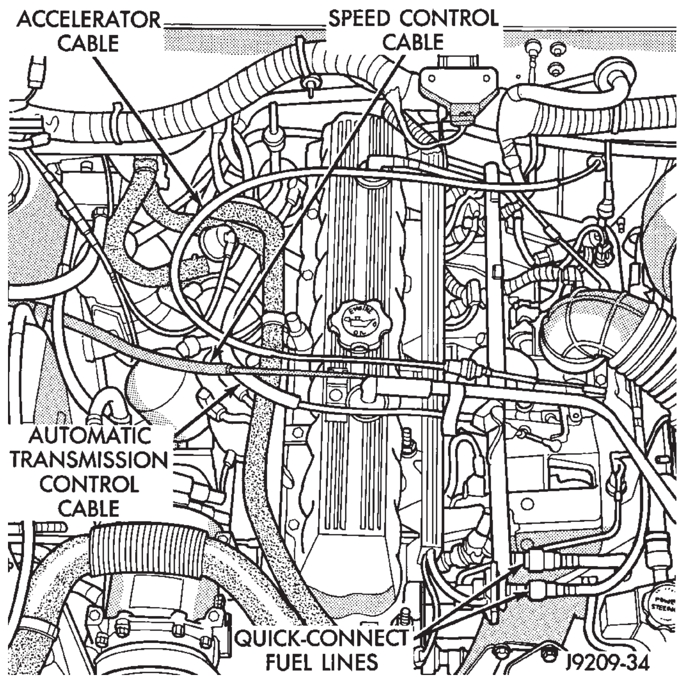

Fig. 10 Accelerator Cable, Vehicle Speed Control Cable, Automatic Transmission Control Cable & Quick-Connect Fuel Lines

(19) Remove the fuel line bracket from the intake manifold.

(20) Remove the air cleaner assembly (Fig. 11).

(21) Remove the power brake vacuum check valve from the booster, if equipped.

(22) **Vehicles with Power Steering (Fig. 11):**

(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.

(23) Identify, tag and disconnect all necessary wire connectors and vacuum hoses.

(24) Raise and support the vehicle.

(25) Disconnect the wires from the engine starter motor solenoid.

(26) Remove the engine starter motor.

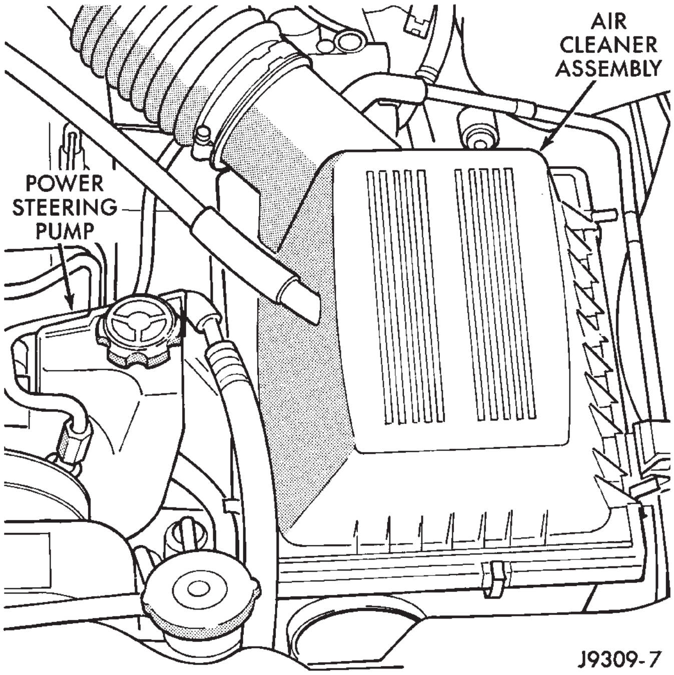

Fig. 11 Air Cleaner Assembly & Power Steering Pump

(27) Disconnect the oxygen sensor from the exhaust pipe.

(28) Disconnect the exhaust pipe from the manifold.

(29) Disconnect the vehicle speed sensor wire connection.

(30) Remove the exhaust pipe support.

(31) Remove the engine 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 engine 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 engine flywheel) housing.

(39) Remove the remaining converter (or engine 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 engine 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 bracket as an aid 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 engine flywheel housing with the engine.

(c) Install and tighten the engine 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 brackets (if removed).

(5) Lower the engine and engine mount brackets onto the engine compartment cushions. Install the bolts and finger tighten the nuts.

(6) Remove the engine lifting device.

(7) Raise and support the vehicle.

(8) Install the remaining engine 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 engine 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 vehicle speed sensor wire connections and tighten the screws.

(14) Connect the exhaust pipe to the manifold.

(15) Install the engine starter motor and connect the cable.

(16) Connect the wires to the engine starter motor solenoid.

(17) Lower the vehicle.

(18) Connect all the vacuum hoses and wire connectors identified during engine removal.

(19) **Vehicles 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 from 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 wires to the injectors.

(25) Connect the line pressure cable (if equipped with automatic transmission).

(26) Connect the vehicle 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 water pump.

(30) Place the fan shroud in position over the fan.

(31) Install the radiator or radiator/condenser (if equipped with A/C).

(32) Connect the service valves to the A/C compressor ports, if equipped with A/C.

(33) Charge the air conditioner system (refer to Group 24, Heating and Air Conditioning).

(34) Connect the radiator hoses and automatic transmission fluid cooler pipes, if equipped.

(35) Install the fan shroud to the radiator or 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 (refer to Group 7, Cooling System).

(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 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. 12).

(3) Disconnect the fresh air inlet hose from the engine cylinder head cover (Fig. 12).

(4) Remove the engine cylinder head cover mounting bolts.

(5) Remove the engine cylinder head cover.

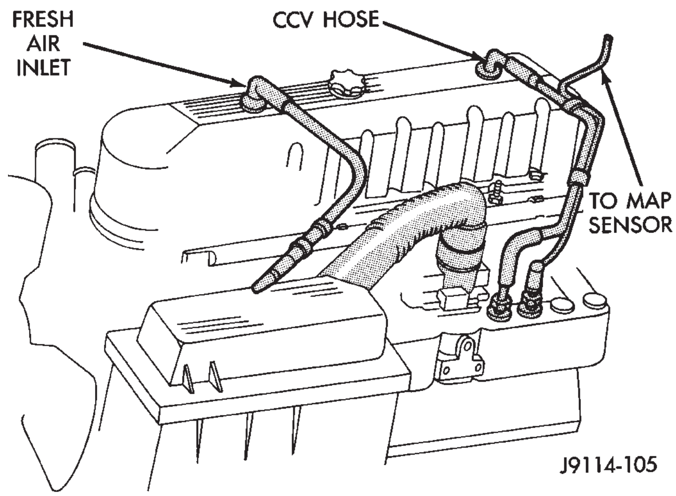

Fig. 12 Engine Cylinder Head Cover

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 9 N●m (75 in. lbs.) torque.

(3) Connect the CCV hoses (Fig. 12).

(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. 13). 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. 13). 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.

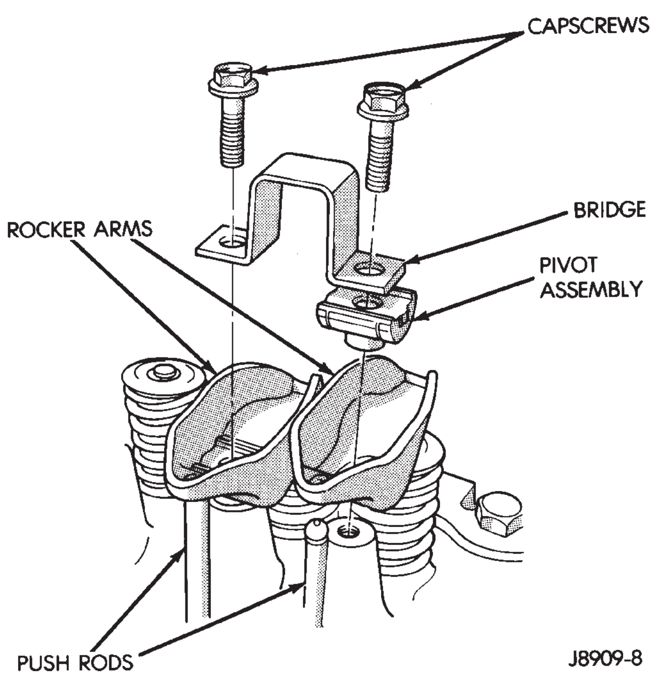

Fig. 13 Rocker Arm Assembly

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. 13).

(6) Remove the push rods (Fig. 13). **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. 14). 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. 14).

(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.

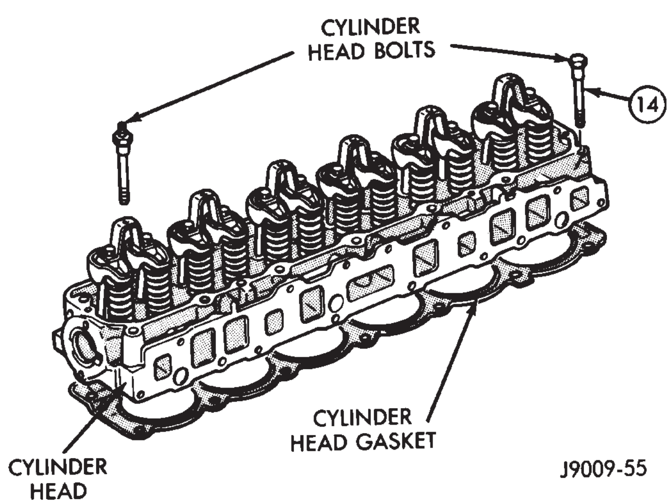

Fig. 14 Engine Cylinder Head Assembly

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. 15):

(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.

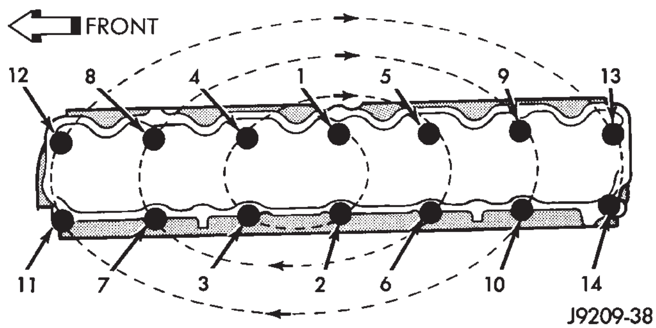

Fig. 15 Engine Cylinder Head Bolt Tightening Sequence

(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.

(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 6138 to compress the spring and remove the locks (Fig. 16). Use an old rocker arm pivot and the supplied bolt to attach the tool.

(9) Remove valve spring and retainer (Fig. 16).

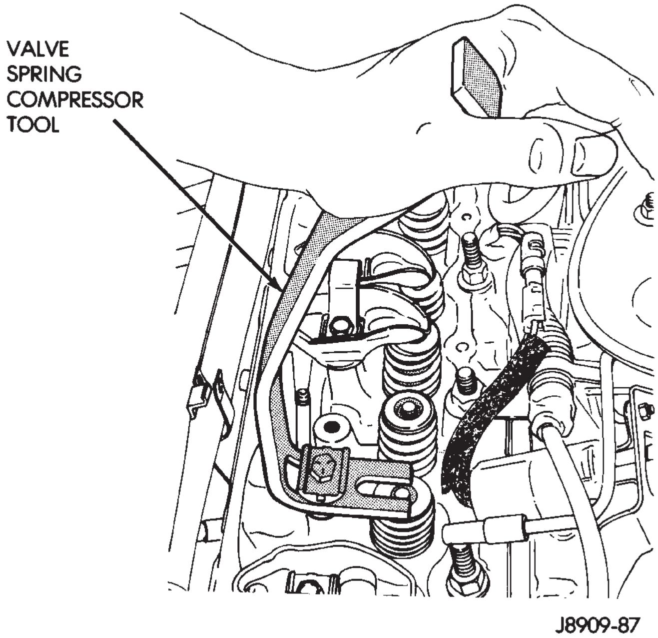

Fig. 16 Remove Valve Spring and Retainer

(10) Remove valve stem oil seals (Fig. 17). 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.

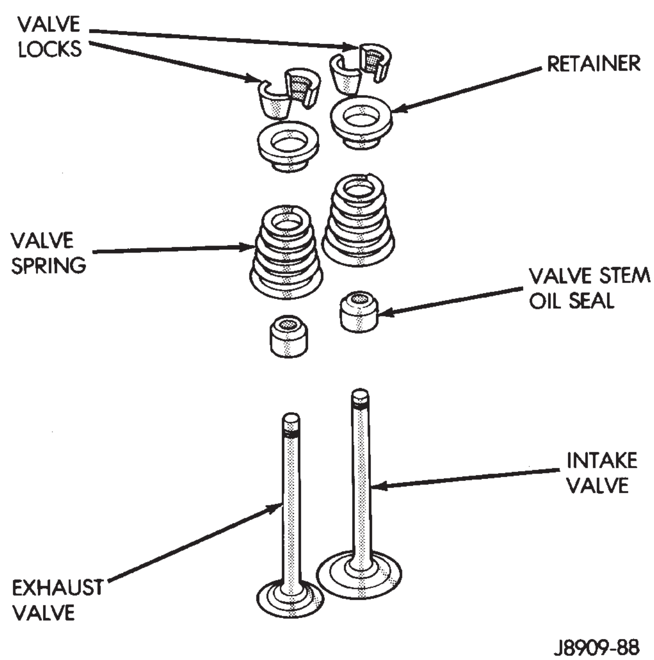

Fig. 17 Valve and Valve Components

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 6138 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 the Valve Compressor Tool C-3422-B (J-8062 or 8014) and compress each valve spring (Fig. 18).

(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.

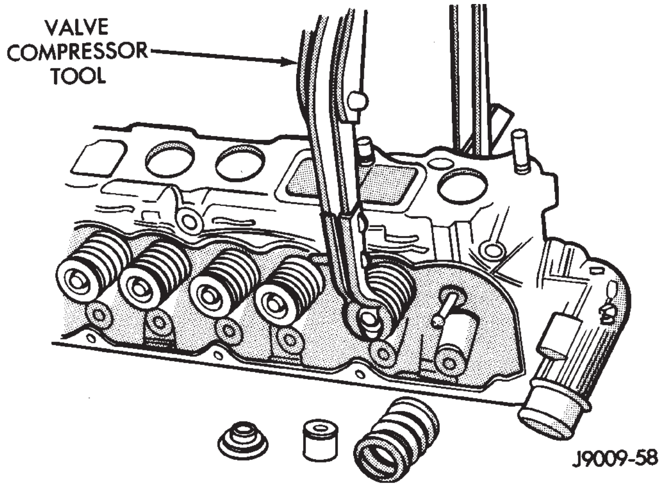

Fig. 18 Valve Compressor Tool C-3422-B (J-8062 or 8014)

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. 19). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

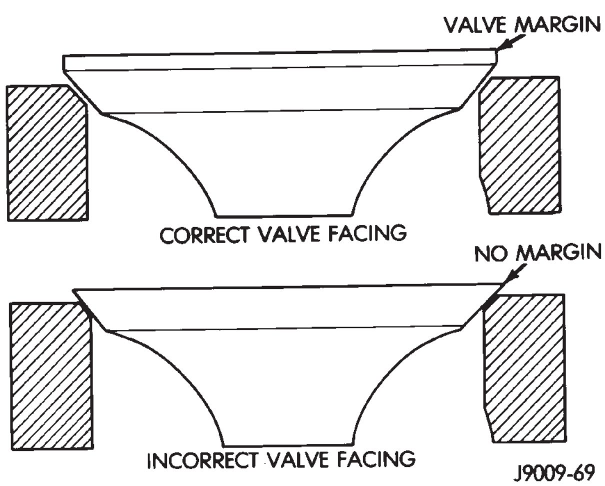

Fig. 19 Valve Facing Margin

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.

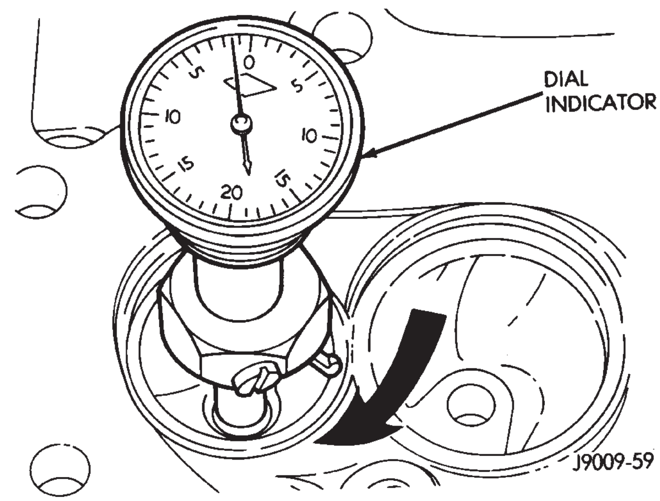

Fig. 20 Measurement of Valve Seat Runout

(3) Control valve seat runout to a maximum of 0.0635 mm (0.0025 in.)—(Fig. 20).

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. 21).

(4) Remove and measure telescoping gauge with a micrometer.

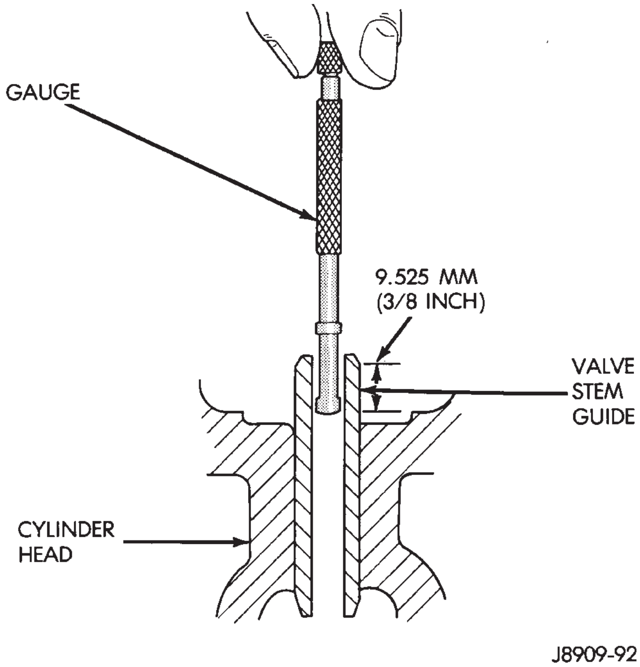

Fig. 21 Measurement of Valve Guide Bore Diameter

(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. 22).

(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 (J-22738-02) and a torque wrench to test each valve spring for the specified tension value (Fig. 23).

Replace valve springs that are not within specifications.

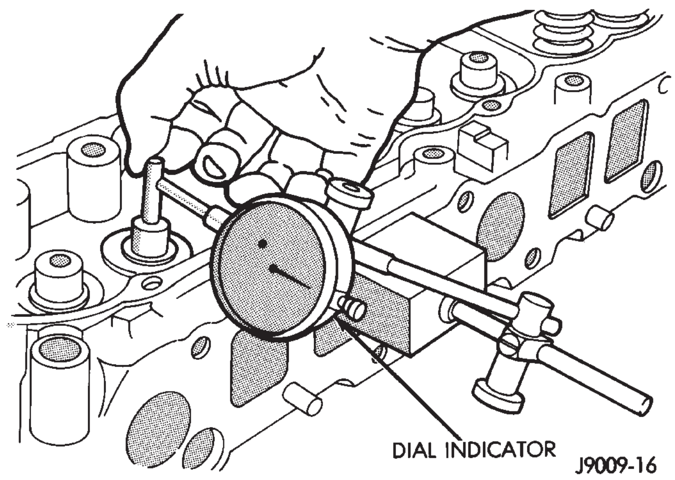

Fig. 22 Measurement of Lateral Movement of Valve Stem

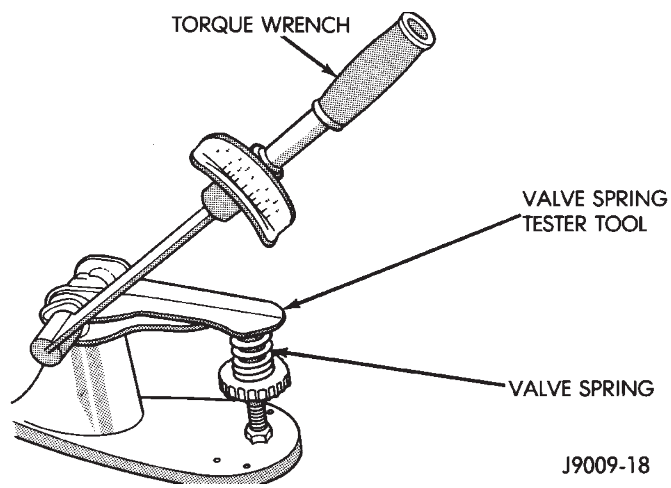

Fig. 23 Valve Spring Tester C-647 (J-22738-02)

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. 24).

(4) Install the replacement valve stem oil seals on the valve stem (Fig. 24). 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 C-3422-B (J-8062 or 8014).

(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.

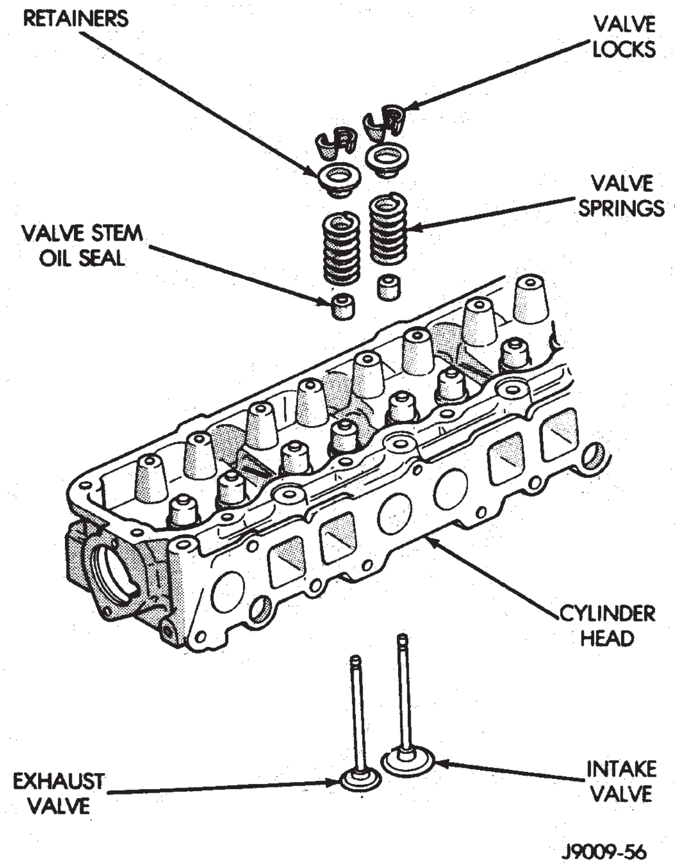

Fig. 24 Valve Components

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.

DISASSEMBLE

Place the components of each tappet in a separate location. This will greatly assist in the installation operation.

(1) Release the snap ring.

(2) Remove the following from the tappet body (Fig. 25):

(a) The plunger cap.

(b) The metering valve.

(c) The plunger.

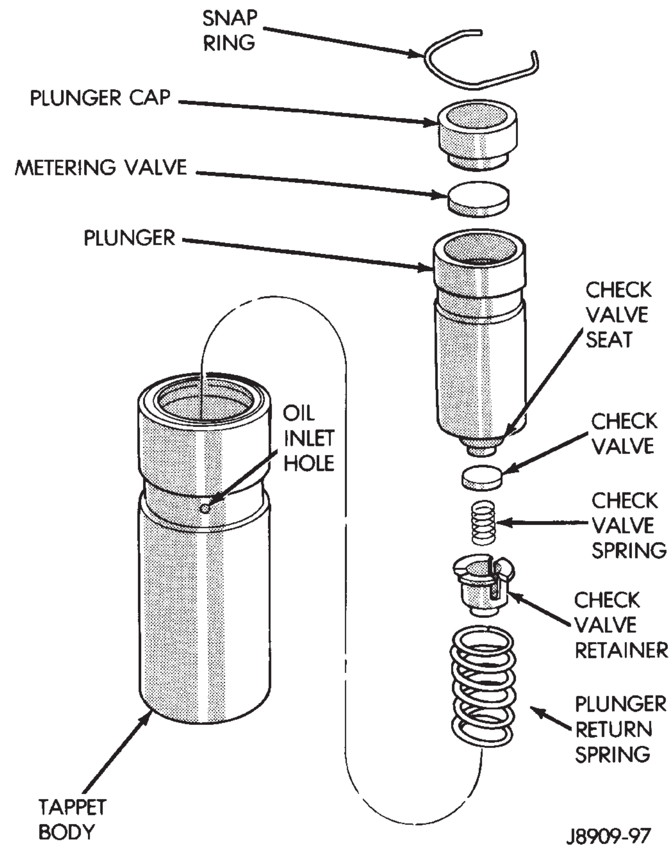

Fig. 25 Hydraulic Tappet Assembly

(d) The check valve assembly.

(e) The plunger return spring.

CLEANING

Clean the components of 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.

ASSEMBLY

(1) Install the plunger return spring, check valve assembly, plunger, metering valve and the plunger cap in tappet body.

(2) Compress the plunger assembly by exerting force on the plunger cap with the push rod and install snap ring.

LEAK-DOWN TEST

After cleaning, inspection and assembly, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 26).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Leak-Down Tester 7980 (J-5790-B).

(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.

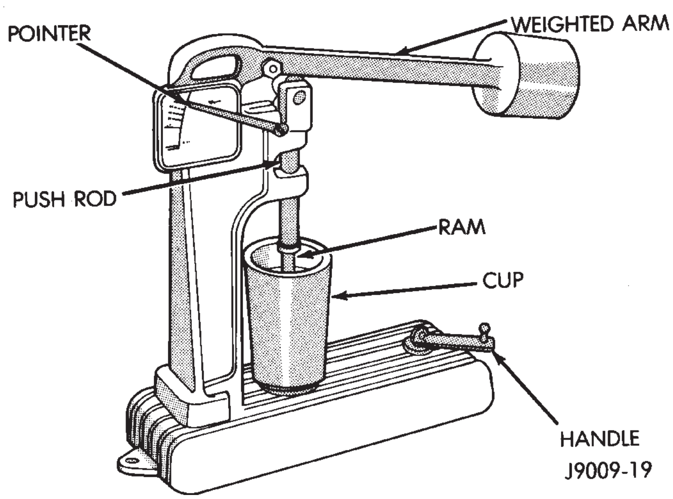

Fig. 26 Leak-Down Tester 7980 (J-5790-B)

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) 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 (J-21791-01) to remove the damper from the crankshaft (Fig. 1).

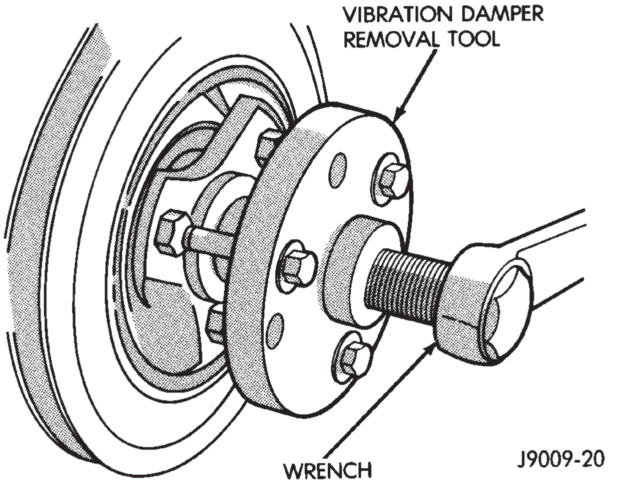

Fig. 1 Vibration Damper Removal Tool 8068 (J-21791-01)

INSTALLATION

(1) With the key in position, align the key slot of 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) Remove the oil seal (Fig. 2).

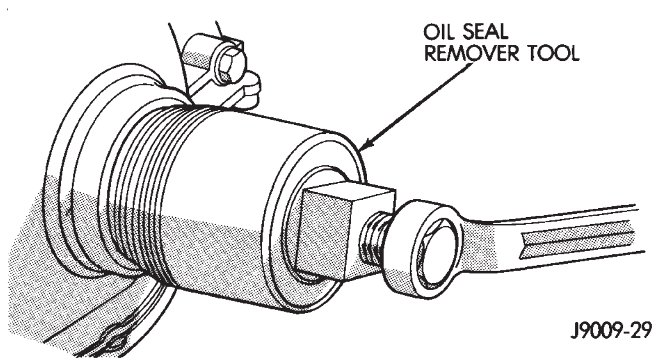

Fig. 2 Timing Case Cover Oil Seal Removal

(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.

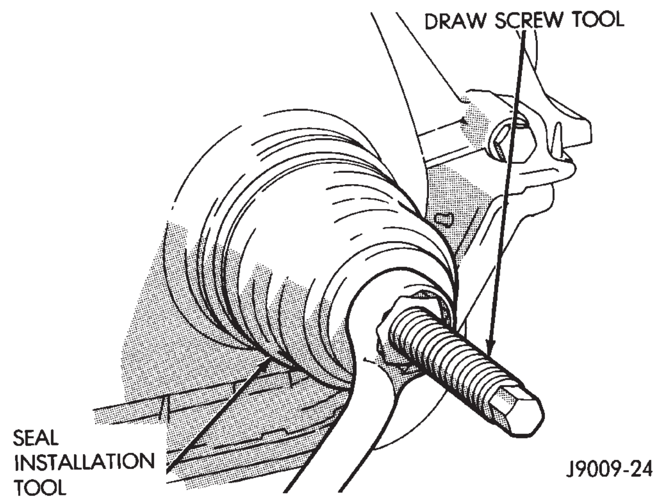

Fig. 3 Timing Case Cover Oil Seal Installation

(8) Remove the tools. Apply a light film of engine oil on the vibration damper hub contact surface of the seal.

(9) 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).

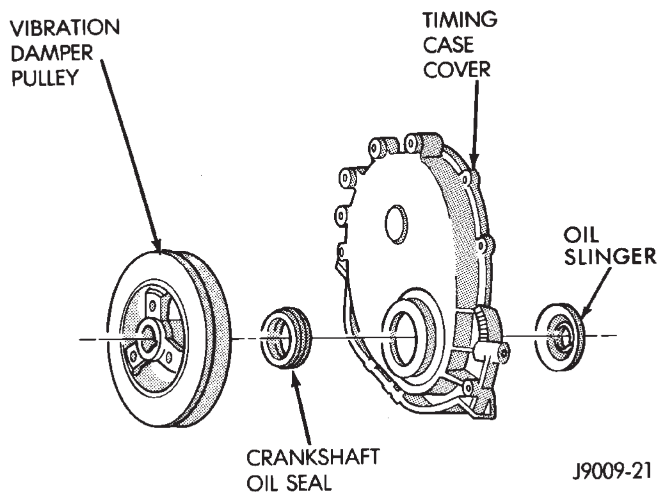

Fig. 4 Timing Case Cover Components

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).

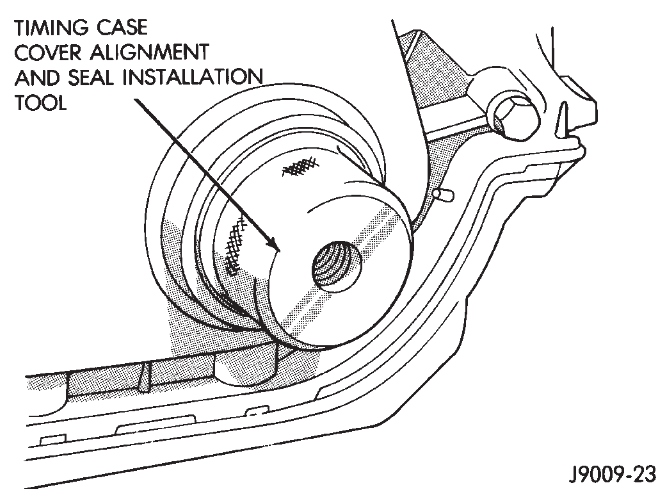

Fig. 5 Timing Case Cover Alignment and Seal Installation Tool 6139

(5) Install the timing case cover-to-cylinder block and the oil pan-to-timing case cover bolts.

(6) Tighten the cover-to-block bolts to 7 N●m (60 in. lbs.) torque. Tighten the oil pan-to-cover 1/4 inch bolts to 13 N●m (114 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) 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).

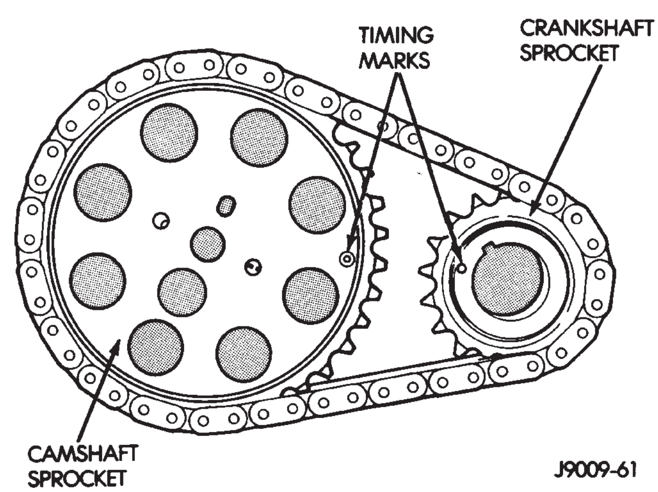

Fig. 6 Crankshaft/Camshaft Alignment

(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.

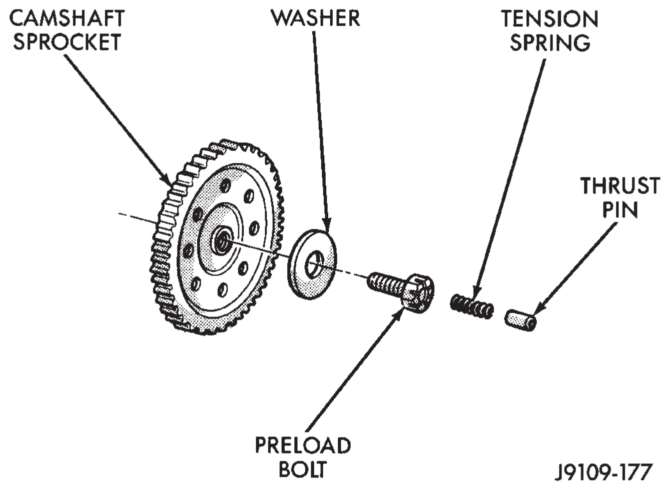

Fig. 7 Camshaft Sprocket Preload Bolt

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 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) 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.

(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 in the keyway on the crankshaft, 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.

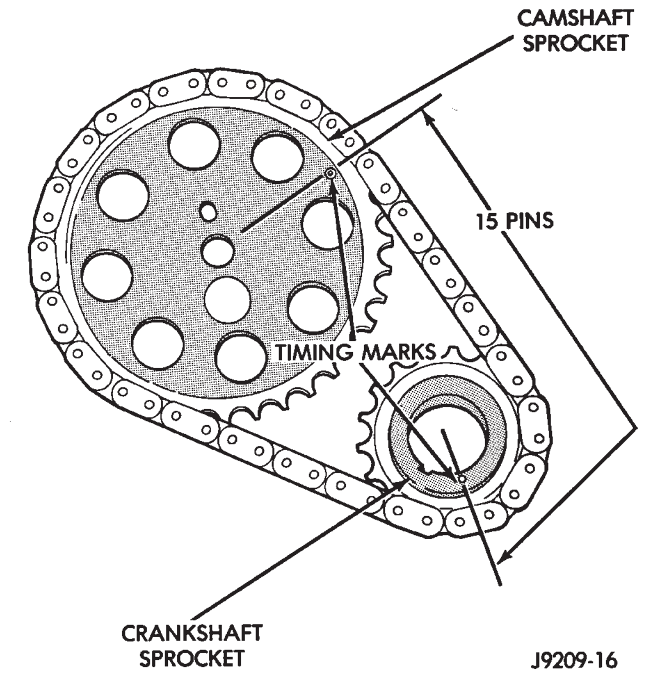

Fig. 8 Verify Sprocket/Chain Installation

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).

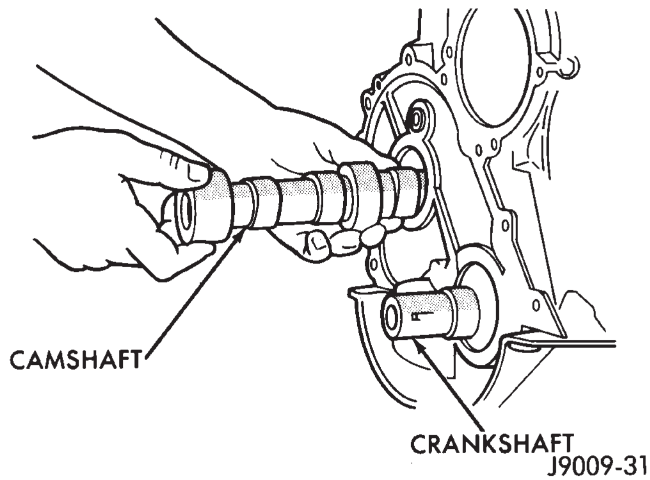

Fig. 9 Camshaft

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).

(7) Install the vibration damper (Fig. 10).

(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).

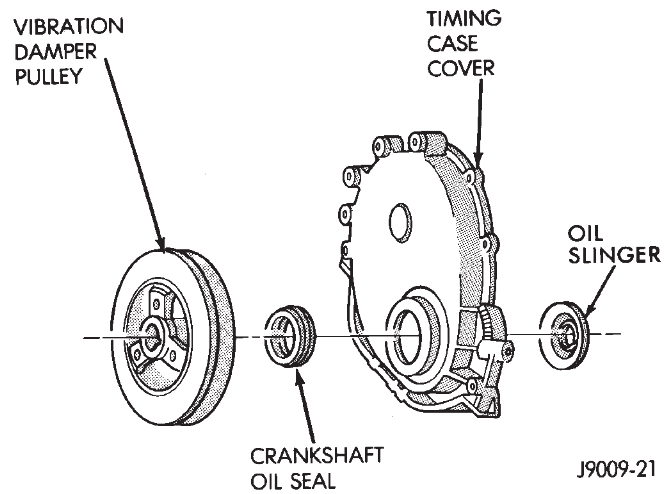

Fig. 10 Timing Case Cover Components

(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).

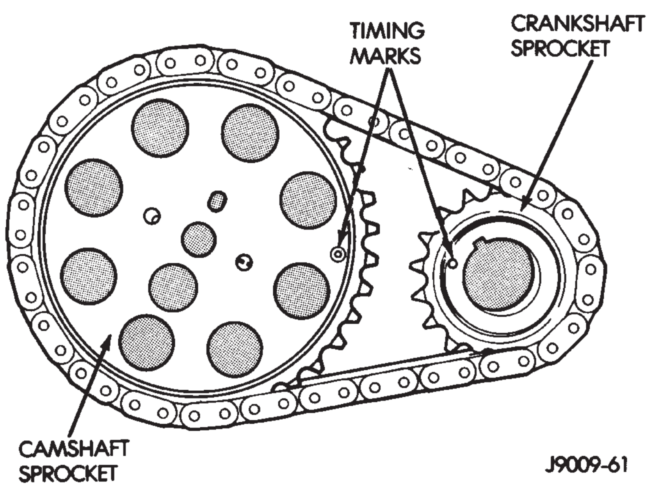

Fig. 11 Timing Chain Alignment

(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.
(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.
(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.

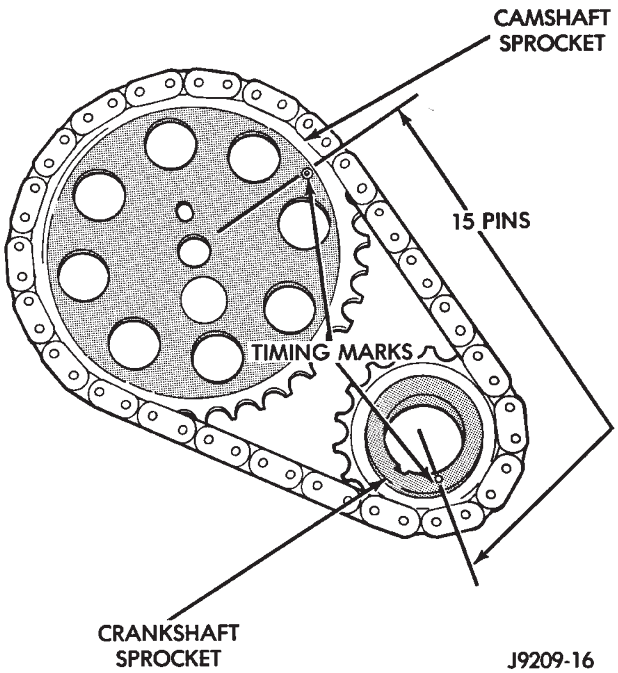

Fig. 12 Verify Crankshaft/Camshaft Installation

(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 (J-22248) in the crankshaft opening in the cover (Fig. 13).

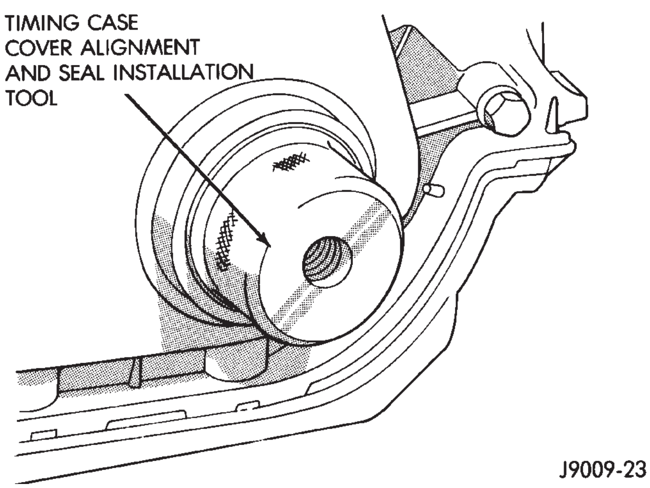

Fig. 13 Timing Case Cover Alignment and Seal Installation Tool 6139 (J-22248)

(13) Install the timing case cover-to-cylinder block bolts. Install the oil pan-to-timing case cover bolts.

(14) Tighten the cover-to-block bolts to 7 N•m (60 in. lbs.) torque. Tighten the oil pan-to-cover 1/4 inch bolts to 13 N•m (114 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.

(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 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 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. The one-piece gasket is reusable.

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).

(2) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 2).

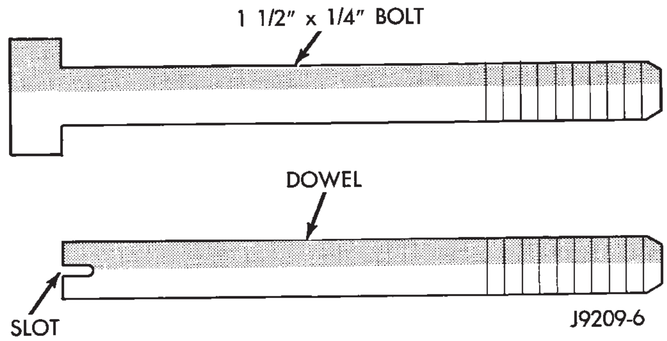

Fig. 1 Fabrication of Alignment Dowels

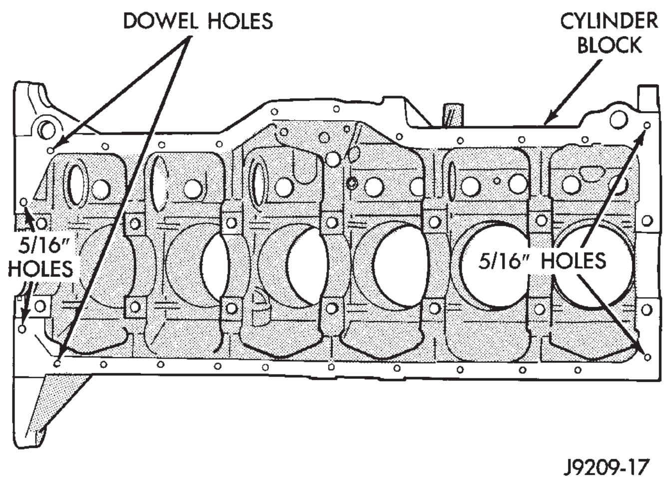

Fig. 2 Position of Dowels in Cylinder Block

(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 13 N•m (114 in. lbs.) torque. Install the 5/16 inch oil pan bolts (Fig. 3). Tighten these bolts to 18 N•m (156 in. lbs.) torque.

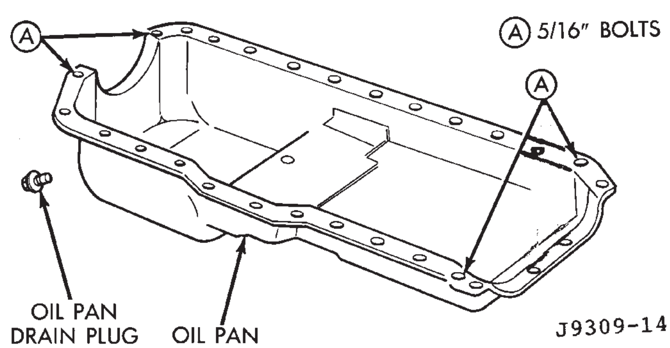

Fig. 3 Position of 5/16 inch Oil Pan Bolts

(6) Remove the dowels. Install the remaining 1/4 inch oil pan bolts. Tighten these bolts to 13 N•m (114 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 to 65 N•m (48 ft. lbs.) torque.

(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 41 N•m (30 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.

DISASSEMBLE

(1) Remove the cover from the pump body.

(2) Check the following clearances:

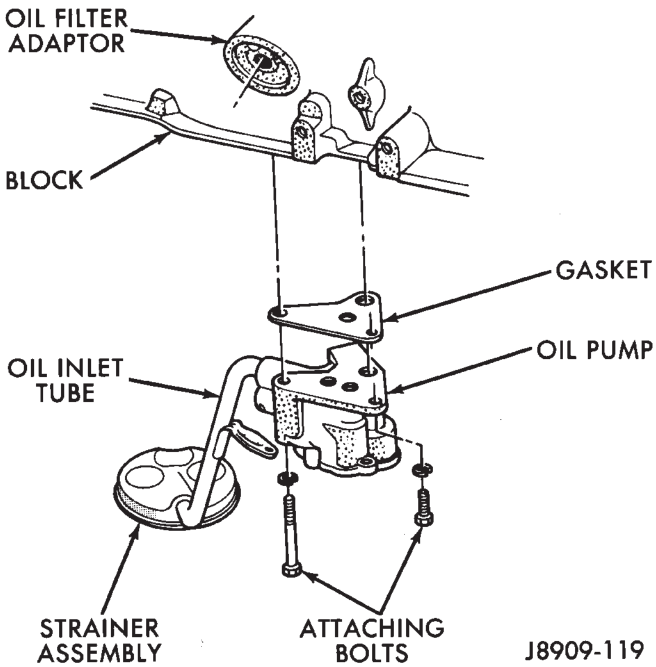

Fig. 4 Oil Pump Assembly

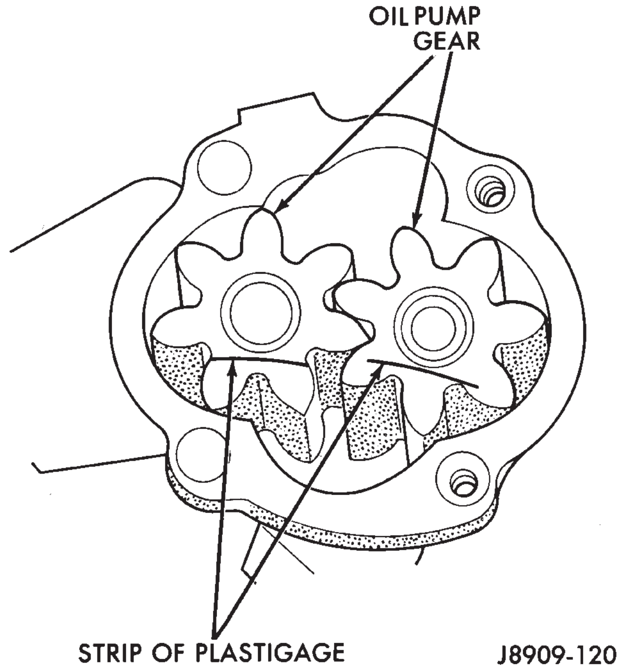

Fig. 5 Gear End Clearance Measurement—Preferred Method

GEAR END CLEARANCE MEASUREMENT

PREFERRED METHOD:

(a) Place a strip of Plastigage across the full width of each gear.

(b) Install the pump cover and tighten the bolts to 8 N•m (70 in. lbs.) torque.

(c) Remove the pump cover and determine the amount of clearance by measuring the width of compressed Plastigage with scale on the Plastigage envelope (Fig. 5).

(d) Correct clearance by this method is 0.051-0.152 mm with 0.051 mm preferred (0.002-0.006 inch with 0.002 inch preferred).

(e) If gear end clearance is excessive, replace the oil pump assembly.

ALTERNATIVE METHOD:

(a) Place a straightedge across the ends of the gears and the pump body.

(b) Select a feeler gauge that fits snugly but freely between the straightedge and the pump body (Fig. 6).

(c) Correct clearance by this method is 0.051-0.152 mm with 0.051 mm preferred (0.002-0.006 inch with 0.002 inch preferred).

(d) If gear end clearance is excessive, replace the oil pump assembly.

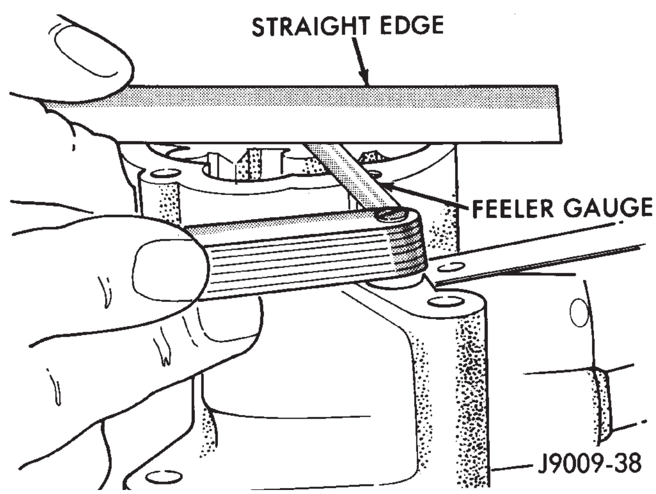

Fig. 6 Gear End Clearance Measurement—Alternative Method

GEAR-TO-BODY CLEARANCE MEASUREMENT

(a) Measure the gear-to-body clearance with both gears in place. Insert a feeler gauge between the gear tooth and the inner wall of the pump body directly opposite the point of gear mesh. Select a feeler gauge which fits snugly but freely. Rotate gears to measure each tooth-to-body clearance in this manner (Fig. 7).

(b) Correct clearance is 0.051-0.102 mm with 0.051 mm preferred (0.002-0.004 inch with 0.002 inch preferred).

(c) If the gear-to-body clearance is more than specified, replace oil pump.

DISASSEMBLE (CONT.)

(3) Remove the cotter pin and slide the spring retainer, spring and oil pressure relief valve plunger out of the pump body.

(4) Inspect for binding condition during disassembly. Clean or replace as necessary.

(5) The oil inlet tube and strainer assembly must be moved to allow removal of the relief valve.

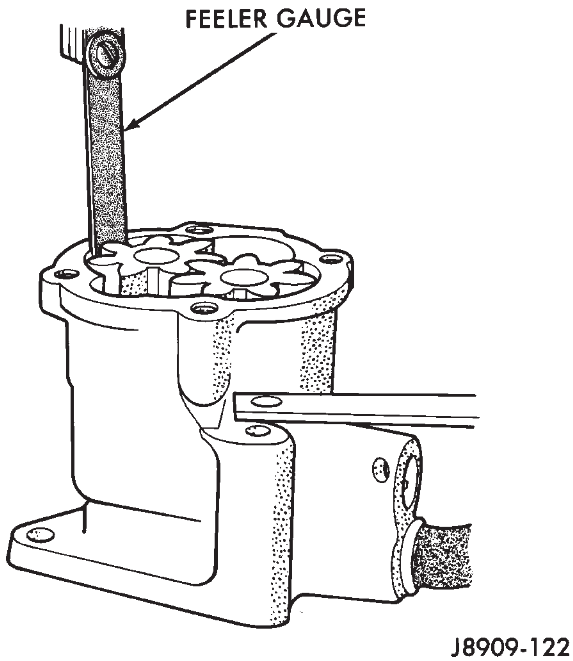

Fig. 7 Gear-to-Body Clearance Measurement

ASSEMBLY

Two relief valve plunger sizes (standard and oversize) are available. The oversize plunger diameter is 0.254 mm (0.010 inch).

(1) Install the oil pressure relief valve plunger, spring, retainer, and cotter pin.

(2) If the position of the inlet tube in the pump body has been disturbed, install a replacement inlet tube and strainer assembly. Apply a light film of Permatex No.2 sealant, or equivalent, around the end of the tube. Use Oil Pump Inlet Tube Installation Tool 7624 (J-21882) to drive the inlet tube into the body (Fig. 8). BE sure the support bracket is properly aligned.

(3) Install the idler gear and drive gear assembly.

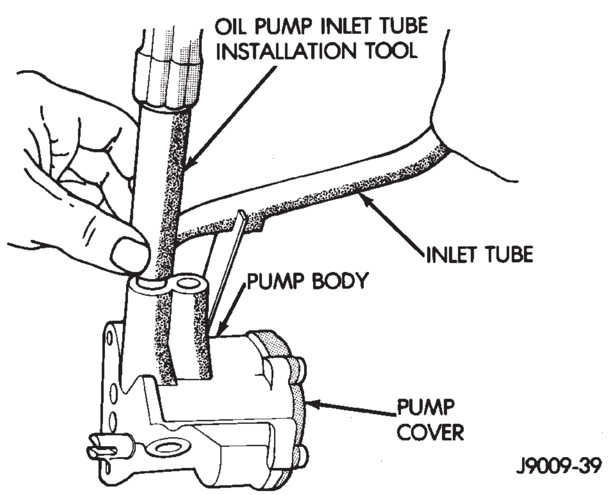

Fig. 8 Inlet Tube Installation Tool 7624 (J-21882)

(4) Spin the drive gear shaft to ensure a binding condition does not exist before installing the oil pump.

(5) To self-prime the oil pump, fill pump with petroleum jelly before installing the oil pump cover. **DO NOT use grease.**

(6) Apply a thin bead of Mopar Gasket Maker, or equivalent, to the top of the pump housing.

(7) Install the oil pump cover. Tighten the cover bolts to 8 N●m (70 in. lbs.) torque.

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. Retain in the same order as removed. The connecting rods and caps are stamped with the corresponding cylinder number (Fig. 9).

(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. 10).

INSPECTION—CONNECTING ROD

CONNECTING ROD BEARINGS

Inspect the connecting rod bearings for scoring and bent alignment tabs (Figs. 11 and 12). Check the

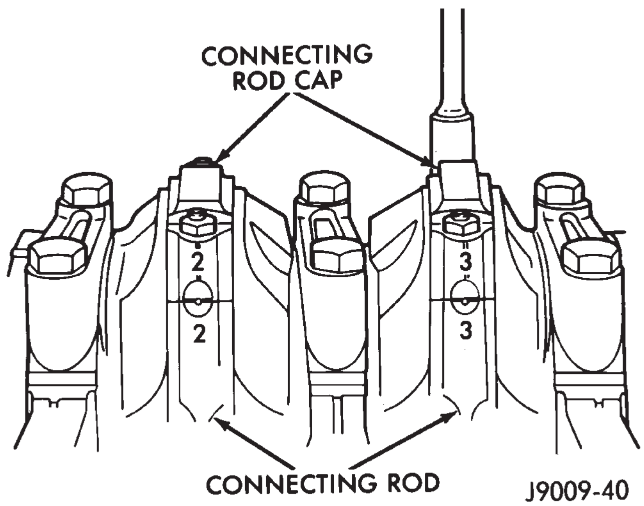

Fig. 9 Stamped Connecting Rods and Caps

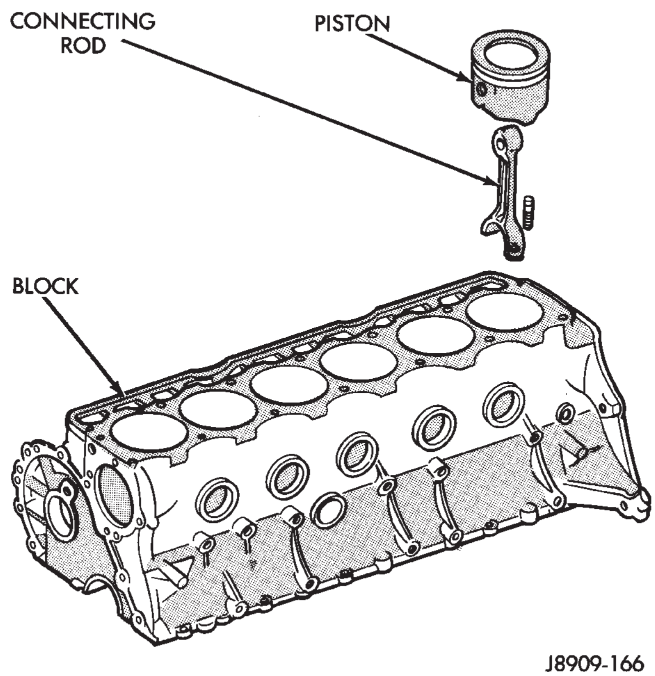

Fig. 10 Removal of Connecting Rod and Piston Assembly

bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 13). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

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.

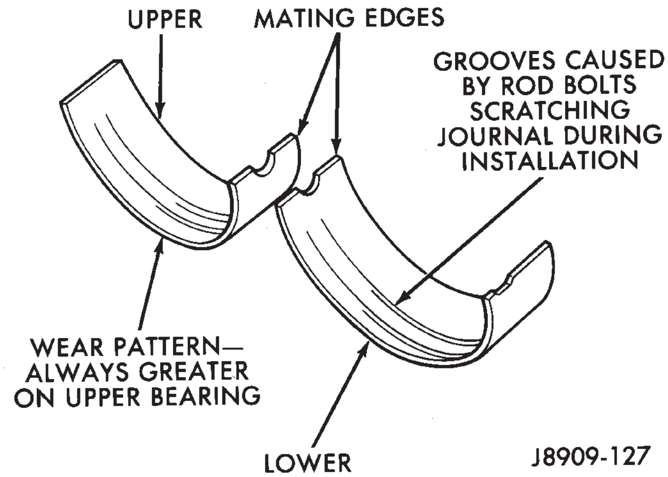

Fig. 11 Connecting Rod Bearing Inspection

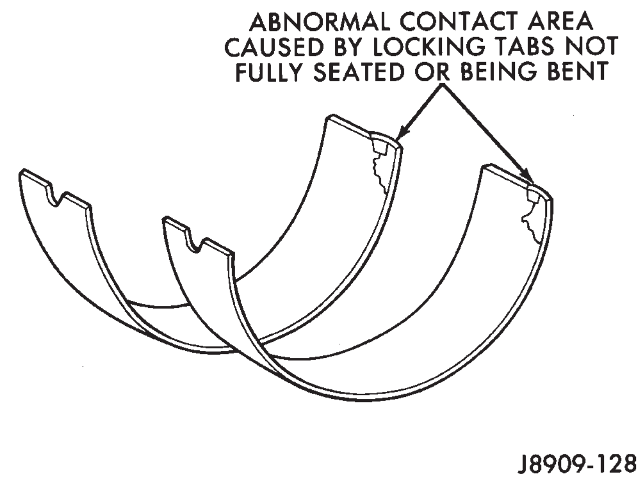

Fig. 12 Locking Tab Inspection

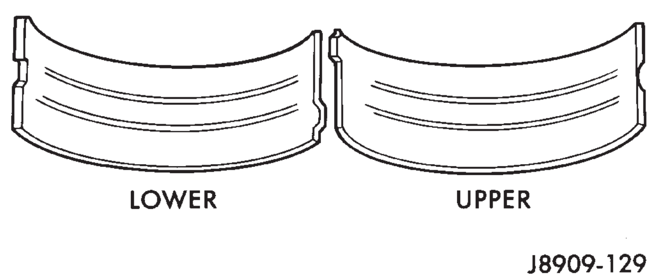

Fig. 13 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

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.

14). 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.

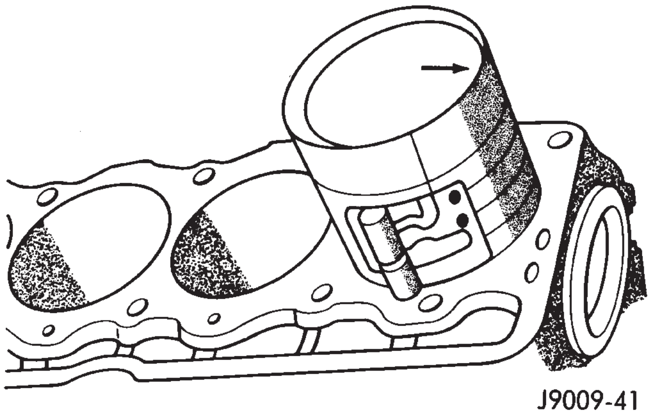

Fig. 14 Rod and Piston Assembly Installation

(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. 15). 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.**

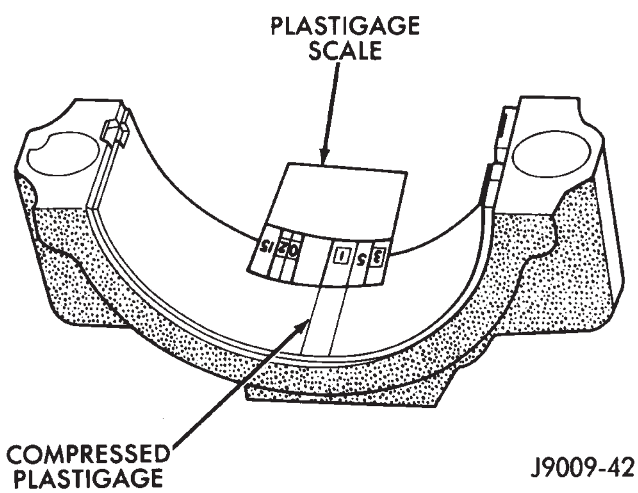

Fig. 15 Measuring Bearing Clearance with Plastigage

(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. 16).

The difference between cylinder bore diameter and piston diameter is piston-to-bore clearance.

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.

CONNECTING ROD BEARING FITTING CHART

Crankshaft Main Bearing Journal Color Code and Diameter	Corresponding Connecting Rod Bearing Insert Color Code	
	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.)
Black—53.1901-53.1723 mm (2.0941-2.0933 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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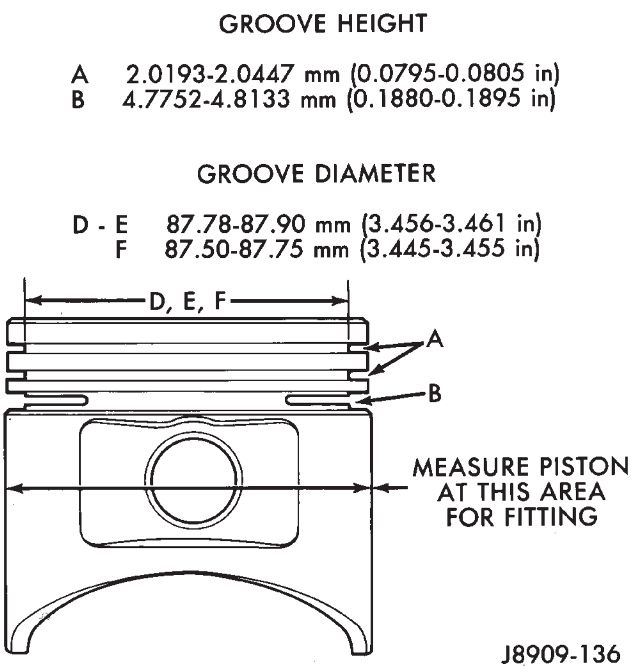

Fig. 16 Piston Dimensions

(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. 17). Note position of the pin through the gauge window of removal support tool.

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. 18).

(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. 18).

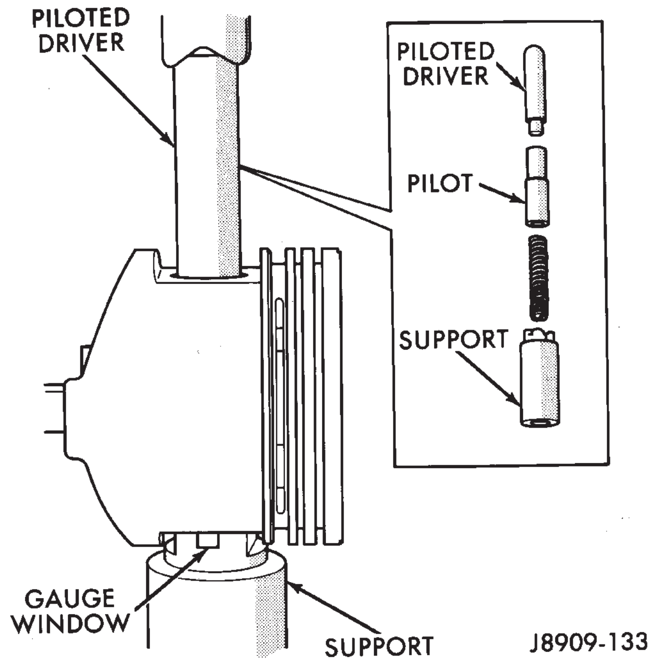

Fig. 17 Piston Pin Removal/Installation

(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. 17).

(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.

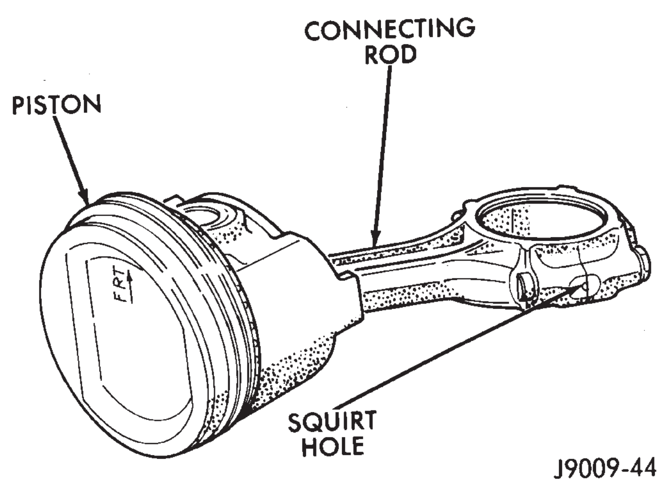

Fig. 18 Correct Alignment—Piston and Connecting Rod

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) Measure the ring side clearance with a feeler gauge fitted snugly between the ring land and ring (Fig. 19). Rotate the ring in the groove. It must move freely around circumference of the groove.

	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)

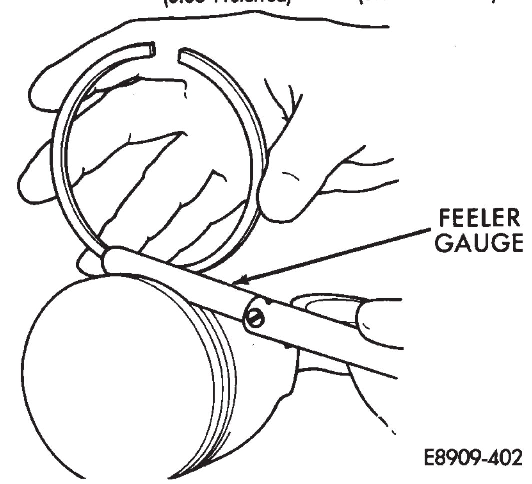

Fig. 19 Ring Side Clearance Measurement

(3) 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. 20). 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).

(4) Position the ring gaps and install piston rings (Fig. 21).

(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 expander ring first, then side rails

(6) The two compression rings are different and cannot be interchanged (Fig. 22). The top ring is a moly ring (the scraping edge is gray in color). The second ring is a black cast iron ring (the scraping edge is black in color when new).

(7) The compression rings can be identified by a chamfer of either the top or bottom inside edge (Fig. 22). The rings may also be identified by 1 or 2 dots on the top surface of the ring.

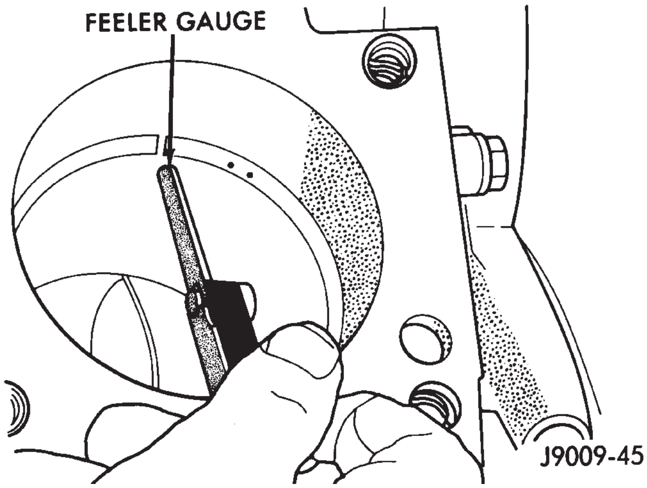

Fig. 20 Ring Gap Measurement

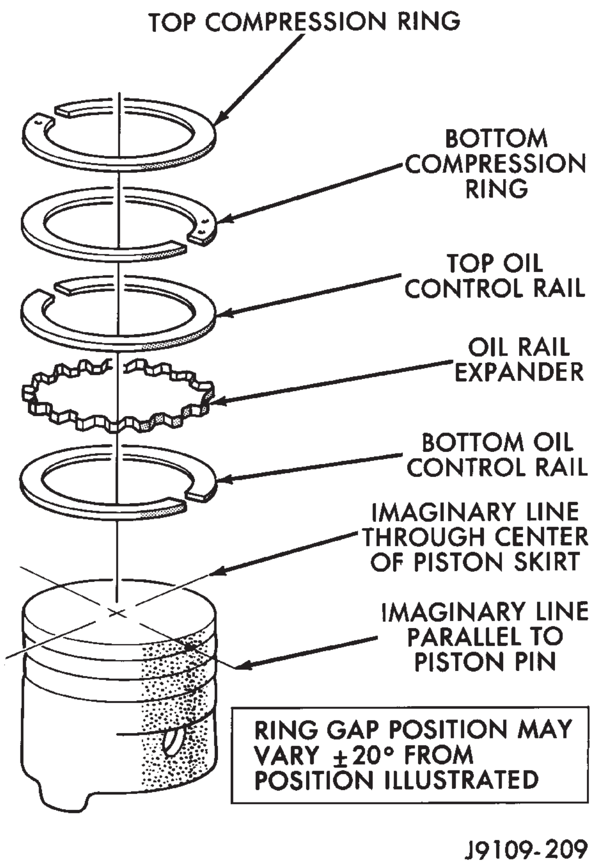

Fig. 21 Ring Gap Position

(8) The second compression ring (black cast iron) has a chamfer on the BOTTOM of the inside edge (Fig. 23). This ring may also have 2 dots located on the top surface.

(9) Using a ring installer, install the second compression ring with the chamfer facing down (Fig. 24). The dots will be facing up.

(10) The top compression ring (the scraping edge is gray in color) has a chamfer on the TOP of the inside edge. This ring has one dot located on the top surface.

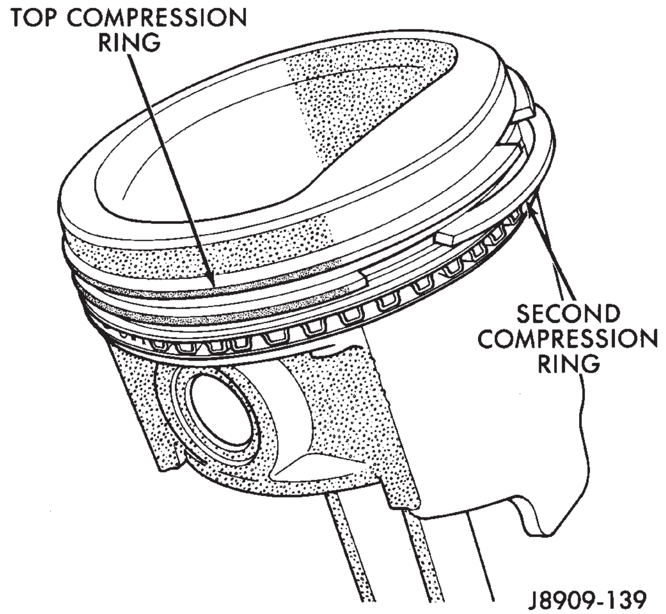

Fig. 22 Compression Ring Location

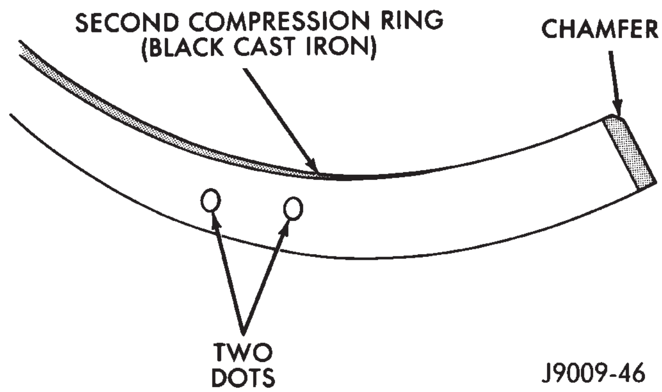

Fig. 23 Second Compression Ring Identification

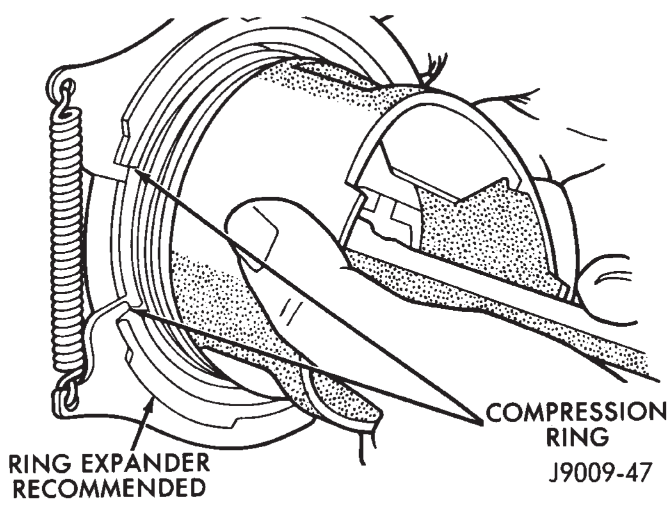

Fig. 24 Compression Ring Installation

(11) Using a ring installer, install the top ring with the chamfer facing up. The dot will be facing up.

(12) Position the ring end gaps on the piston.

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. 25).

(4) Ensure the arrow on the piston top points to the front of the engine (Fig. 25).

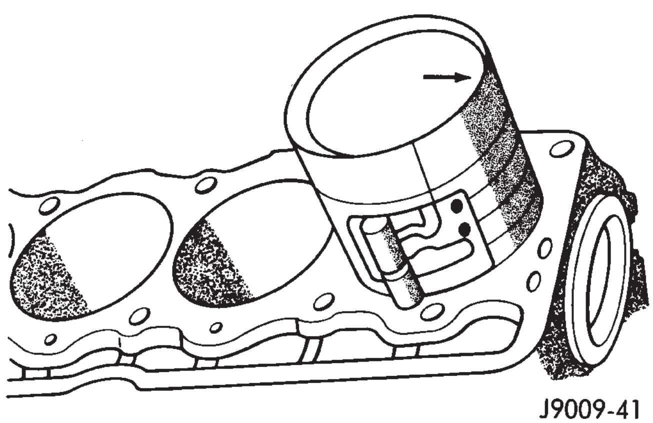

Fig. 25 Rod and Piston Assembly Installation

(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).

(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.

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).

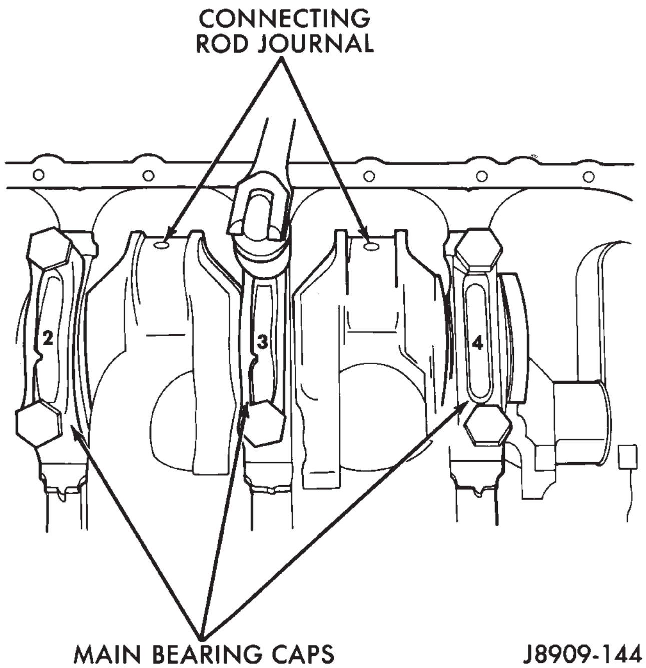

Fig. 1 Removing Main Bearing Caps and Lower Inserts

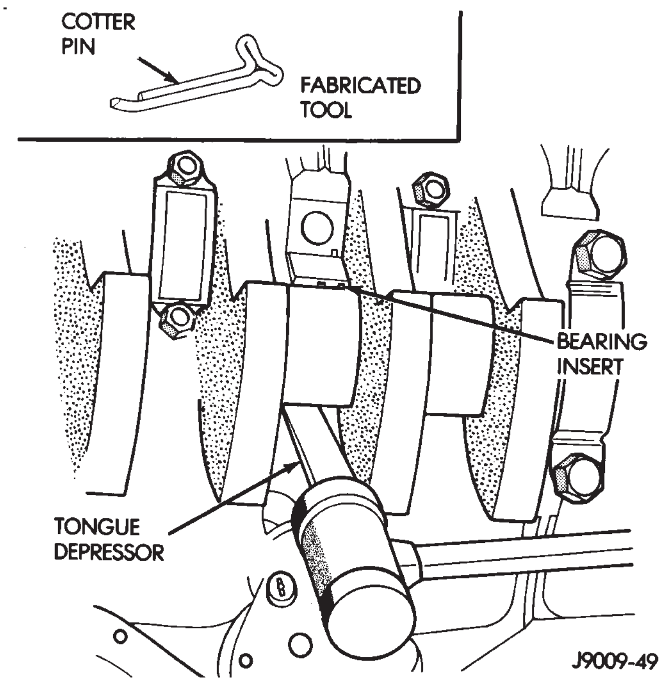

Fig. 2 Removing Upper Inserts

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.

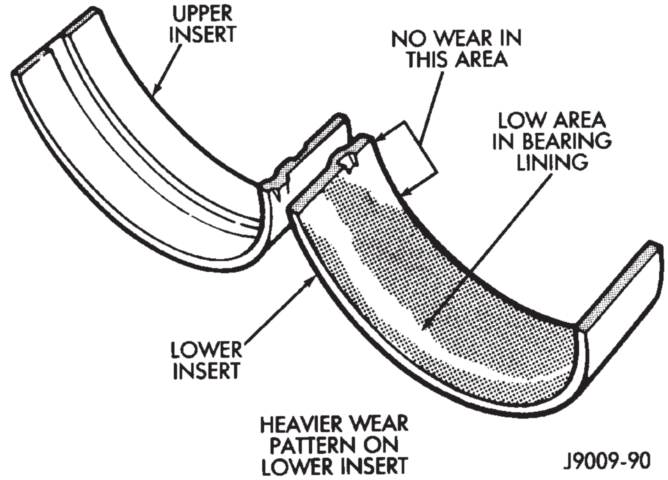

Fig. 3 Main Bearing Wear Patterns

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.

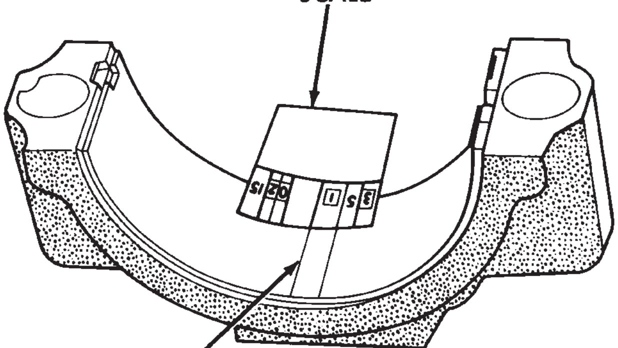

Fig. 5 Measuring Bearing Clearance with Plastigage

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.

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.

MAIN BEARING FITTING CHART

Crankshaft Color Code and Diameter (Journal Size)	Bearing Insert Color Code	
	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	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Black - 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 (2.4901-2.4966 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 Main Bearing Journal 7 Color Code and Diameter (Journal Size)	Bearing Insert Color Code	
	Upper Insert Size	Lower Insert Size
Yellow - 63.4873-63.4746 mm (2.499-2.4990 in.)	Yellow - Standard	Yellow - Standard
Orange - 63.4746-63.4619 mm (2.4990-2.4985 in.) 0.0127 mm (0.0005 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Black - 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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(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.

(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).

(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.

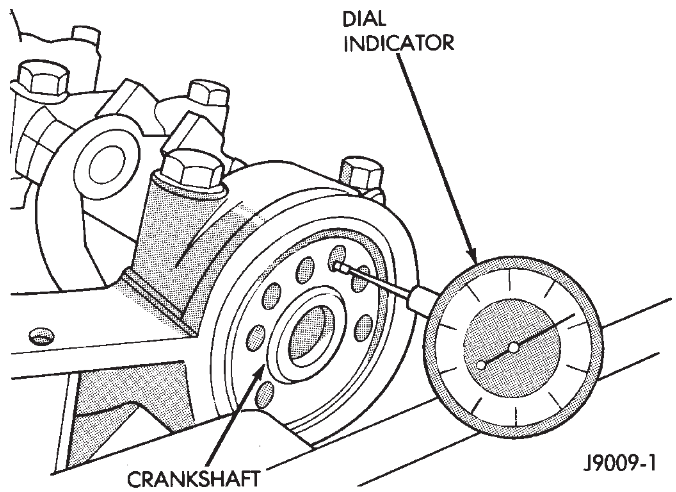

Fig. 6 Crankshaft End Play Measurement

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 41 N•m (30 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).

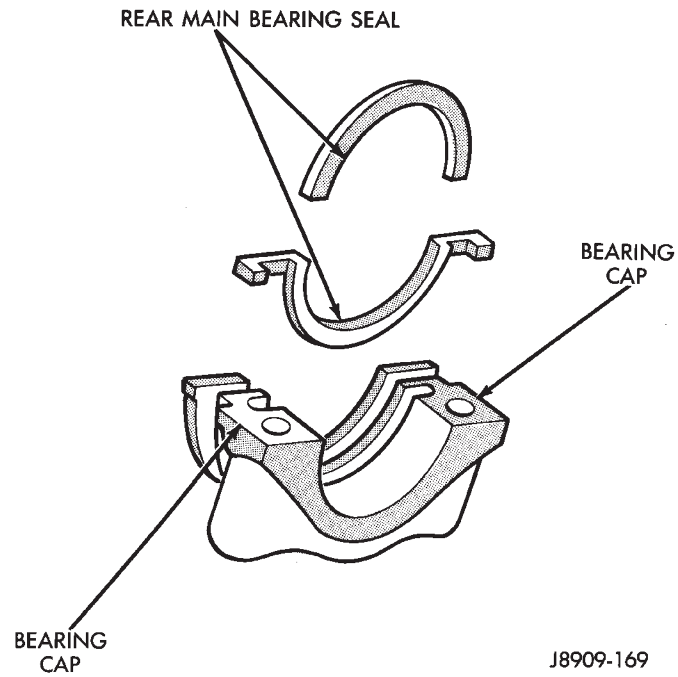

Fig. 7 Rear Main Bearing Oil Seal

(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.

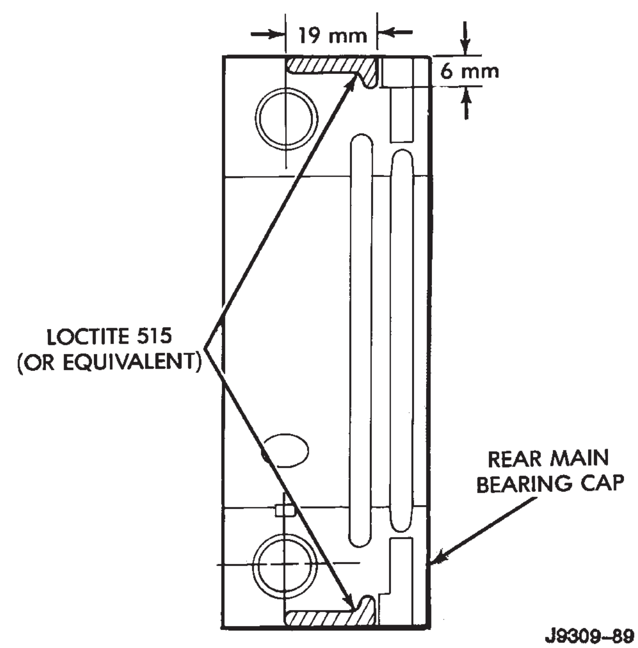

Fig. 8 Location of Loctite 515 (or equivalent)

(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.

(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.

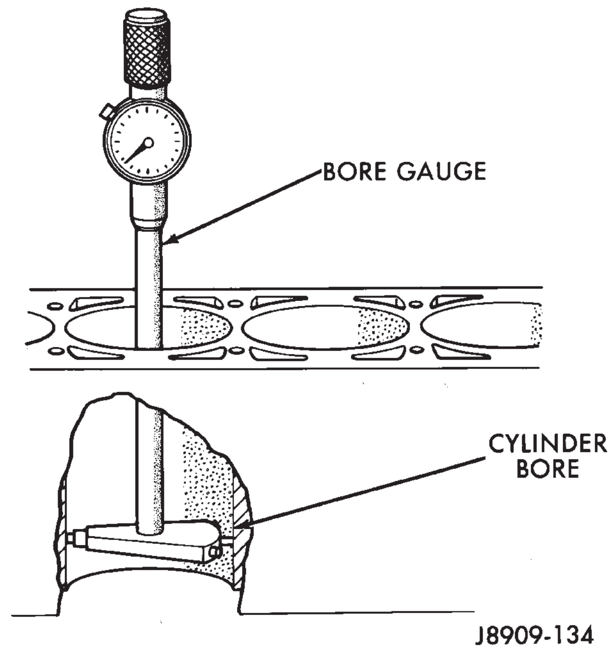

Fig. 9 Cylinder Bore Measurement

(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.

(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 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.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
Preferred	0.051 mm
	(0.001 - 0.0025 in)
Preferred.	(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.	98.42 - 98.48 mm (3.875 - 3.877 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
Preferred	0.044 - 0.050 mm
	(0.001 - 0.003 in)
Preferred	(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	8.8:1
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 ....64.45 - 67.45 cc
(3.93 - 4.12 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.) ....46.22 mm
(1.82 in)
Spring Tension
Valve Closed ....293 - 329 N @ 41.275 mm
(66 - 74 lbf @ 1.625 in)
Valve Open...............................911 - 978 N @ 30.48 mm
(205 - 220 lbf @ 1.20 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
Preferred........0.033 - 0.038 mm
(0.0013 - 0.0021 in)
Preferred.....(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
Preferred...................0.025 mm
(0.001 - 0.0032 in)
Preferred................... (0.001 in)
Oil Control Ring ....0.025 - 0.241 mm
Preferred.....................0.08 mm
(0.001 - 0.0095 in)
Preferred................... (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
Preferred . . . . 0.013 mm
(0.0003 - 0.0007 in - Loose)
Preferred................. (0.0005 in)
Piston-to-Pin Connecting Rod (Press Fit).........................8.9 kN
(2000 lb f)

J9209-53

ENGINE SPECIFICATIONS (CONT.)

Oil Pump

Gear-to-Body Clearance (Radial) ....0.051 - 0.102 mm
Preferred...............0.051 mm
(0.002 - 0.004 in)
Preferred................(0.002 in)

Gear End Clearance
Plastigage...0.051 - 0.152 mm
Preferred...............0.051 mm
(0.002 - 0.006 in)
Preferred............. (0.002 in)
Feeler Gauge....................................0.1016 - 0.2032 mm
Preferred.............0.1778 mm
(0.004 - 0.008 in)
Preferred................(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)

J9209-28

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.)
Camshaft Sprocket Bolt	108 N•m (80 ft. lbs.)
Connecting Rod Nuts	45 N•m (33 ft. lbs.)
Crossmember-to-Sill Bolts	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	9 N•m (75 in. lbs.)
Engine Support Bracket Bolts	61 N•m (45 ft. lbs.)
Exhaust Manifold-to-Exhaust Pipe Nuts	27 N•m (20 ft. lbs.)
Flywheel/Converter Housing Bolts	38 N•m (28 ft. lbs.)
Front Cover-to-Block Bolts	7 N•m (60 in. lbs.)
Front Support Bracket-to-Cylinder Block Bolts	61 N•m (45 ft. lbs.)
Front Support Cushion-to-Mount Thru-Bolt	65 N•m (48 ft. lbs.)
Front Support Cushion-to-Sill Bracket	41 N•m (30 ft. 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.)

Description	Torque
Oil Filter	18 N•m (13 ft. lbs.)
Oil Filter Adaptor Bolt	65 N•m (48 ft. lbs.)
Oil Filter Connector	47 N•m (35 ft. lbs.)
Oil Galley Plug	41 N•m (30 ft. lbs.)
Oil Pan Bolts (1/4 - 20)	13 N•m (114 in. lbs.)
(5/16 - 18)	18 N•m (156 in. lbs.)
Oil Pan Cover Bolts	8 N•m (70 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.)
Power Steering Pump Pressure Hose Nut	52 N•m (38 ft. lbs.)
Rear Support Bracket Stud Nuts (Automatic Transmission)	75 N•m (55 ft. lbs.)
Rear Support Bracket Stud Nuts (Manual Transmission)	46 N•m (34 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.)
Timing Case Cover-to-Block Bolts	7 N•m (60 in. lbs.)
Vibration Damper Bolts	108 N•m (80 ft. lbs.)
Water Pump-to-Block Bolts	34 N•m (25 ft. lbs.)

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5.2L ENGINE SERVICE PROCEDURES

INDEX

GENERAL INFORMATION

The 5.2 Liter (318 CID) eight-cylinder engine is a V-Type lightweight, single cam, overhead valve engine with hydraulic roller tappets (Fig. 1).

Engine Type	90° V-8 OHV
Bore and Stroke	99.3 × 84.0 mm (3.91 × 3.31 in.)
Displacement	5.2L (318 cu. in.)
Compression Ratio	9.1:1
Torque	386 N·m (285 ft. lbs.) @ 3,600 rpm
Firing Order	1-8-4-3-6-5-7-2
Lubrication	Pressure Feed — Full Flow Filtration
Engine Oil Capacity	4.7L (5.0 qts) w/filter
Cooling System	Liquid Cooled — Forced Circulation
Cooling Capacity	15.6L (16.5 qts)
Cylinder Block	Cast Iron
Crankshaft	Nodular Iron
Cylinder Head	Cast Iron
Combustion Chambers	Wedge-High Swirl Valve Shrouding
Camshaft	Nodular Cast Iron
Pistons	Aluminum Alloy w/Strut
Connectiong Rods	Forged Steel

J9309-16

Fig. 1 Engine Description

This engine is designed for unleaded fuel.

Engine lubrication system consists of a rotor type oil pump and a full flow oil filter.

The cylinders are numbered from front to rear; 1, 3, 5, 7 on the left bank and 2, 4, 6, 8 on the right bank. The firing order is 1-8-4-3-6-5-7-2 (Fig. 2).

The engine serial number is stamped into a machined pad located on the left, front corner of the cylinder block. When component part replacement is necessary, use the engine type and serial number for reference (Fig. 3).

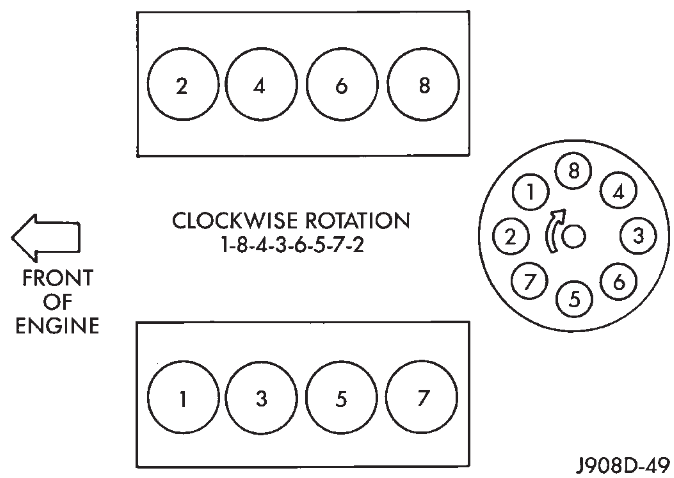

Fig. 2 Firing Order

X M 5.2L T XXXX XXXXXXXX

X = Last Digit of Model Year
M = Plant - M Mound Road
S Saltillo
T Trenton
K Toluca
5.2L = Engine Displacement
T = Usage - T Truck
XXXX = Month/Day
XXXXXXXX = Serial Code - Last 8 Digits of VIN No.

J9209-73

Fig. 3 Engine Identification Number

ENGINE FRONT MOUNTS

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Position fan to assure clearance for radiator top tank and hose.

CAUTION: DO NOT lift the engine by the intake manifold.

(3) Install engine lifting fixture.
(4) Raise vehicle on hoist.
(5) Remove the engine support bracket through-bolts (Figs. 4 and 5).
(6) Raise engine with lifting fixture SLIGHTLY. Remove the engine support insulator assembly bolts. Remove the engine support insulator assembly.

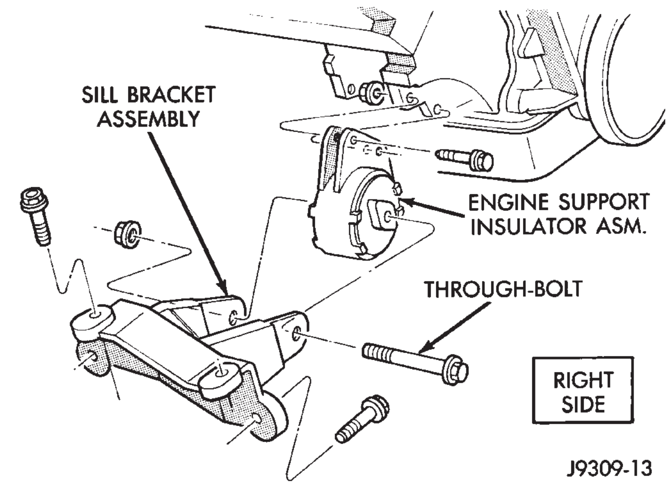

Fig. 4 Engine Front Mount (Right Side)

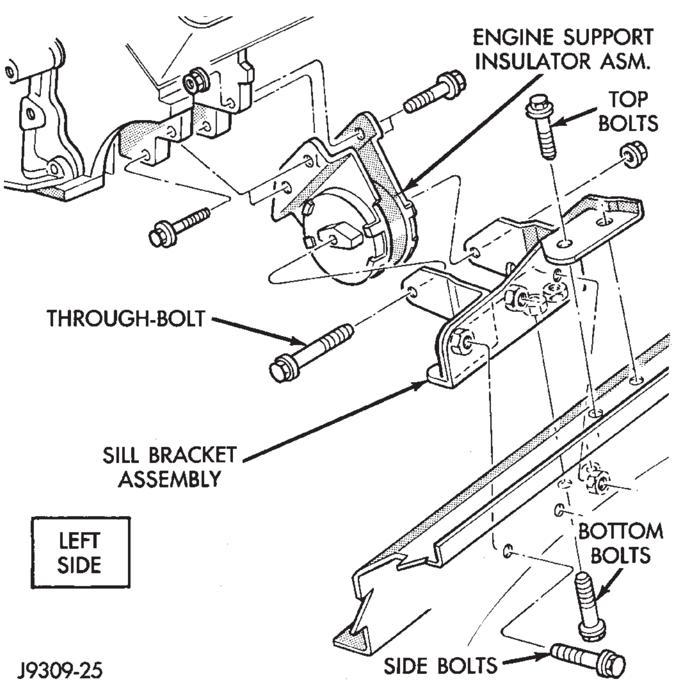

Fig. 5 Engine Front Mount (Left Side)

INSTALLATION

(1) If the sill bracket assembly was removed, install the bracket to the sill assembly.

(a) RIGHT SIDE—Install the sill bracket assembly onto the sill assembly (Fig. 4). Install and tighten the bolts to 54 N●m (40 ft. lbs.) torque.

(b) LEFT SIDE—Install the sill bracket assembly onto the sill assembly (Fig. 5). Install and tighten the 2 top bolts to 54 N●m (40 ft. lbs.) torque. Install and tighten the 2 side bolts to 95 N●m (70 ft. lbs.) torque. Install and tighten the 2 bottom bolts to 121 N●m (89 ft. lbs.) torque.

(2) With the engine raised SLIGHTLY, position engine support insulator assembly onto the engine block (Figs. 4 and 5). Install bolts and tighten to 88 N●m (65 ft. lbs.) torque.
(3) Lower engine with lifting fixture while aligning engine support insulator assembly into sill bracket assembly.
(4) Install the through-bolt and tighten the nut to 65 N●m (48 ft. lbs.) torque.
(5) Lower the vehicle.
(6) Remove lifting fixture.
(7) Connect the negative cable to the battery.

ENGINE REAR SUPPORT

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle on a hoist.
(3) Support the transmission with a jack.
(4) Remove engine mount bracket through-bolt (Fig. 6).
(5) Raise the transmission and engine SLIGHTLY.
(6) Remove stud nuts attaching engine mount clevis bracket to crossmember (Fig. 6). Remove bracket.

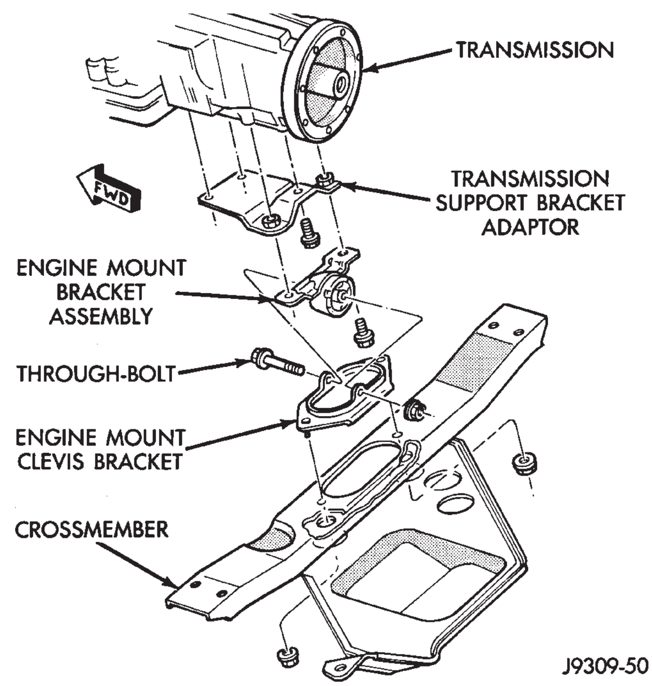

Fig. 6 Engine Rear Support Assembly

INSTALLATION

(1) If the transmission support bracket adaptor was removed, position the adaptor to the transmission (Fig. 6). Tighten the bolts to 95 N●m (70 ft. lbs.) torque.

(2) Install the engine mount clevis bracket onto crossmember. Tighten the stud nuts to 41 N●m (30 ft. lbs) torque.

(3) Install the engine mount bracket assembly to the adaptor. Install the 3 bolts and tighten to 75 N●m (55 ft. lbs.) torque.

(4) Lower the transmission and engine while aligning the engine mount bracket assembly to the engine mount clevis bracket.

(5) Install through-bolt and tighten the nut to 65 N●m (48 ft. lbs.) torque.

(6) Remove transmission jack.

(7) Lower the vehicle.

(8) Connect the negative cable to the battery.

ENGINE ASSEMBLY

REMOVAL

(1) Scribe hood hinge outlines on hood and remove the hood.

(2) Remove the battery.

(3) Drain cooling system.

(4) Remove the air cleaner and tube.

(5) Set fan shroud aside.

(6) Remove radiator and heater hoses. Remove the radiator (refer to Group 7, Cooling System).

(7) Remove the vacuum lines.

(8) Remove the distributor cap and wiring.

(9) Disconnect the accelerator linkage.

(10) Remove MPI throttle body.

(11) Remove the starter wires.

(12) Remove the oil pressure wire.

(13) Discharge the air conditioning system, if equipped (refer to Group 24, Heating and Air Conditioning for service procedures).

(14) Remove air conditioning hoses.

(15) Disconnect the power steering hoses, if equipped.

(16) Remove starter motor (refer to Group 8B, Battery/Starter Service).

(17) Remove the generator (refer to Group 8C, Generator Service).

(18) Raise and support the vehicle on a hoist.

(19) Disconnect exhaust pipe at manifold.

(20) Support automatic transmission with a transmission stand. This will assure that the torque converter will remain in proper position in the transmission housing.

(21) Remove bell housing bolts and inspection plate. Attach C-clamp on front bottom of transmission torque converter housing to prevent torque converter from coming out.

(22) Remove torque converter drive plate bolts from torque converter drive plate. Mark converter and drive plate to aid in assembly.

(23) Disconnect the engine from the torque converter drive plate.

CAUTION: DO NOT lift the engine by the intake manifold.

(24) Install an engine lifting fixture.

(25) Remove the engine front mount through-bolts.

(26) Lower the vehicle.

(27) Remove engine from engine compartment.

(28) Install on engine repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment.

(2) Install engine support fixture.

(3) Raise and support the vehicle on a hoist.

(4) Position the torque converter and drive plate. Install torque converter drive plate bolts. Tighten the bolts to 31 N●m (270 in. lbs.) torque.

(5) Install the engine front mount through-bolts.

(6) Install bell housing bolts. Tighten the bolts to 41 N●m (30 ft. lbs.) torque.

(7) Remove C-clamp and install inspection plate.

(8) Remove stand from transmission.

(9) Install exhaust pipe to manifold.

(10) Lower the vehicle.

(11) Remove engine lifting fixture.

(12) Install the generator (refer to Group 8C, Generator Service).

(13) Install starter motor (refer to Group 8B, Battery/Starter Service).

(14) Install power steering hoses, if equipped.

(15) Install air conditioning hoses.

(16) Charge the air conditioner, if equipped (refer to Group 24, Heater and Air Conditioning for service procedures).

(17) Using a new gasket, install MPI throttle body. Tighten the throttle body bolts to 23 N●m (200 in. lbs.) torque.

(18) Connect the accelerator linkage.

(19) Connect the starter wires.

(20) Connect the oil pressure wire.

(21) Install the distributor cap and wiring.

(22) Install vacuum lines.

(23) Install radiator, radiator hoses and heater hoses (refer to Group 7, Cooling System).

(24) Install fan shroud in position.

(25) Install the battery

(26) Fill cooling system (refer to Group 7, Cooling System for the proper procedure).

(27) Install the air cleaner.

(28) Warm engine and adjust.

(29) Install hood and line up.

(30) Road test vehicle.

CYLINDER HEAD COVER

A steel backed silicon gasket is used with the cylinder head cover (Fig. 7). This gasket can be used again.

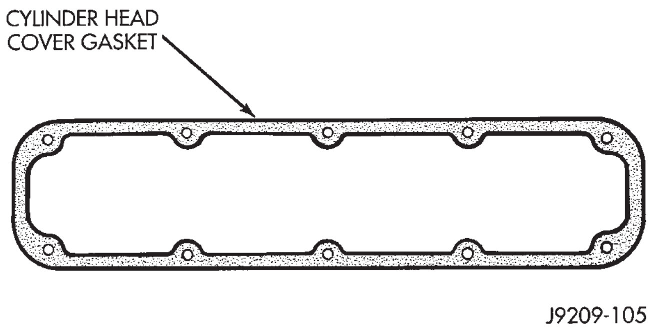

Fig. 7 Cylinder Head Cover Gasket

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Disconnect closed ventilation system and evaporation control system from cylinder head cover.
(3) On the left cover, remove the coolant tube bracket.
(4) Remove the ignition wires from the holders.
(5) Remove cylinder head cover and gasket. The gasket may be used again.

CLEANING

Clean cylinder head cover gasket surface.
Clean head rail, if necessary.

INSPECTION

Inspect cover for distortion and straighten, if necessary.
Check the gasket for use in head cover installation. If damaged, use a new gasket.

INSTALLATION

(1) The cylinder head cover gasket can be used again. Install the gasket onto the head rail.
(2) Position the cylinder head cover onto the gasket. On the left cover, install the coolant tube bracket (refer to Group 7, Cooling System). Tighten the bolts to 11 N●m (95 in. lbs.) torque.
(3) Install the ignition wires onto the holders.
(4) Install closed crankcase ventilation system and evaporation control system.
(5) Connect the negative cable to the battery.

ROCKER ARMS

REMOVAL

(1) Disconnect spark plug wires by pulling on the boot straight out in line with plug.
(2) Remove cylinder head cover and gasket.
(3) Remove the rocker arm bolts and pivots (Fig. 8). Place them on a bench in the same order as removed.
(4) Remove the push rods and place them on a bench in the same order as removed.

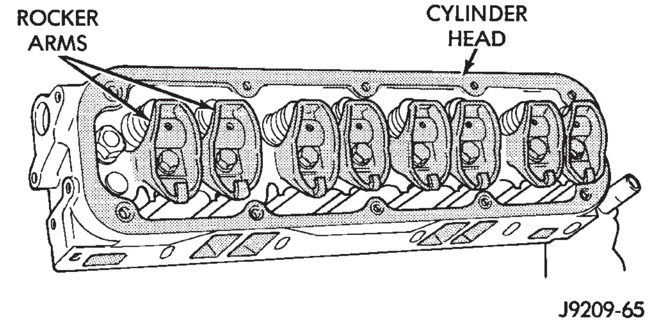

Fig. 8 Rocker Arms

INSTALLATION

(1) Install the push rods in the same order as removed.

CAUTION: When tightening the rocker arm bolts, make sure the piston in that cylinder is NOT at TDC. Contact between the valves and piston could occur.

(2) Install rocker arm and pivot assemblies in the same order as removed. Tighten the rocker arm bolts to 28 N●m (21 ft. lbs.) torque.
(3) Install cylinder head cover.
(4) Connect spark plug wires.

CYLINDER HEADS

The alloy cast iron cylinder heads (Fig. 9) are held in place by 10 bolts. The spark plugs are located in the peak of the wedge between the valves.

The 5.2L cylinder head is identified by the foundry mark NH.

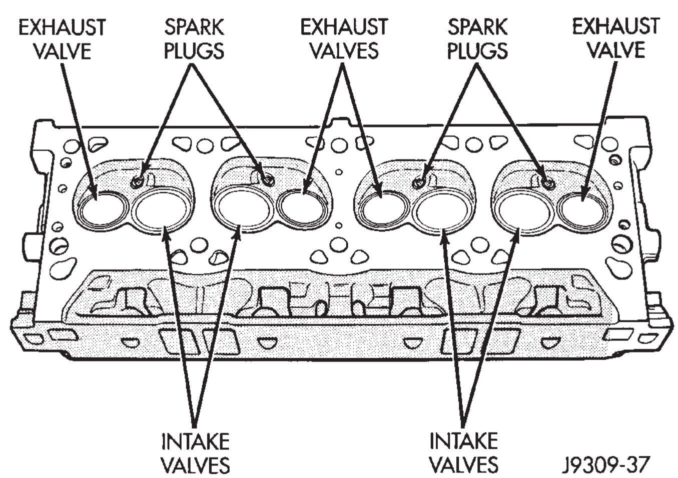

Fig. 9 Cylinder Head Assembly

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Drain cooling system (refer to Group 7, Cooling System for the proper procedures).
(3) Remove the generator.

(4) Remove closed crankcase ventilation system.
(5) Disconnect the evaporation control system.
(6) Remove the air cleaner.
(7) Disconnect the fuel lines.
(8) Disconnect accelerator linkage and if so equipped, the speed control and transmission kick-down cables.
(9) Remove the return spring.
(10) Remove distributor cap and wires.
(11) Disconnect the coil wires.
(12) Disconnect heat indicator sending unit wire.
(13) Disconnect heater hoses and bypass hose.
(14) Remove cylinder head covers and gaskets.
(15) Remove intake manifold and throttle body as an assembly. Discard the flange side gaskets and the front and rear cross-over gaskets.
(16) Remove exhaust manifolds.
(17) Remove rocker arm assemblies and push rods. Identify to ensure installation in original locations.
(18) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.
(19) Remove spark plugs.

CLEANING

Clean all surfaces of cylinder block and cylinder heads.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

INSPECTION

Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out-of-flatness exceeds 0.00075 mm/mm (0.00075 inch/inch) times the span length in inches in any direction, either replace head or lightly machine the head surface.

FOR EXAMPLE: A 305 mm (12 inch) span is 0.102 mm (0.004 inch) out-of-flat. The allowable out-of-flat is 305 X 0.00075 (12 X 0.00075) equals 0.23 mm (0.009 inch). This amount of out-of-flat is acceptable.

The cylinder head surface finish should be 1.78-3.00 microns (70-125 microinches).

Inspect push rods. Replace worn or bent rods.

INSTALLATION

(1) Apply Perfect Sealant No.5, or equivalent, to both sides of the gasket (Fig. 10),
(2) Position the new cylinder head gaskets onto the cylinder block.
(3) Position the cylinder heads onto head gaskets and cylinder block.
(4) Starting at top center, tighten all cylinder head bolts, in sequence, to 68 N•m (50 ft. lbs.) torque (Fig. 11). Repeat procedure, tighten all cylinder head bolts to 143 N•m (105 ft. lbs.) torque. Repeat procedure to confirm that all bolts are at 143 N•m (105 ft. lbs.) torque.

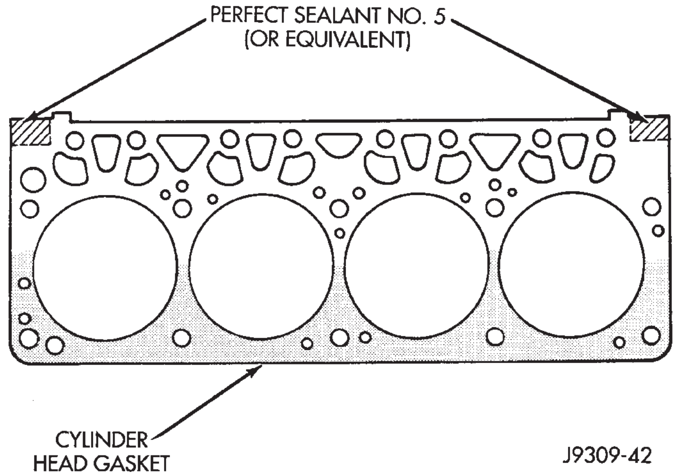

Fig. 10 Sealant Location on Cylinder Head Gasket

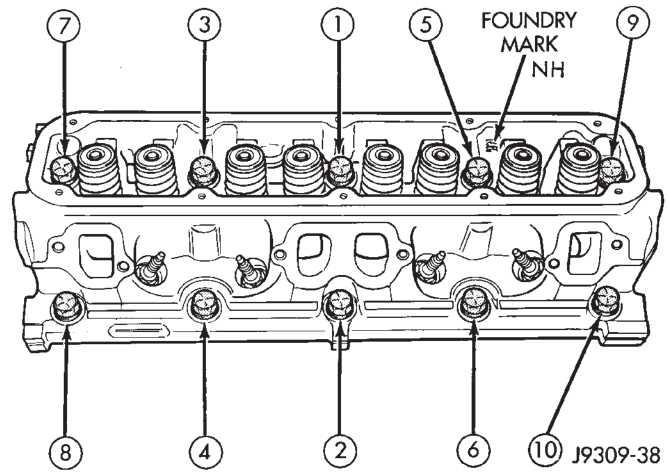

Fig. 11 Cylinder Head Bolt Tightening Sequence

CAUTION: When tightening the rocker arm bolts, make sure the piston in that cylinder is NOT at TDC. Contact between the valves and piston could occur.

(5) Install push rods and rocker arm assemblies in their original position. Tighten the bolts to 28 N•m (21 ft. lbs.) torque.
(6) Place the 4 plastic locator dowels into the holes in the block Fig. 12).
(7) Apply Mopar Silicone Rubber Adhesive Sealant, or equivalent, to the four corner joints. An excessive amount of sealant is not required to ensure a leak proof seal. However, an excessive amount of sealant may reduce the effectiveness of the flange gasket. The sealant should be slightly higher than the cross-over gaskets, approx. 5 mm (0.2 in).
(8) Install the front and rear cross-over gaskets onto the dowels (Fig. 12).
(9) Install the flange gaskets. Be sure that the vertical port alignment tab is resting on the deck face of the block. Also the horizontal alignment tabs must be in position with the mating cylinder head gasket

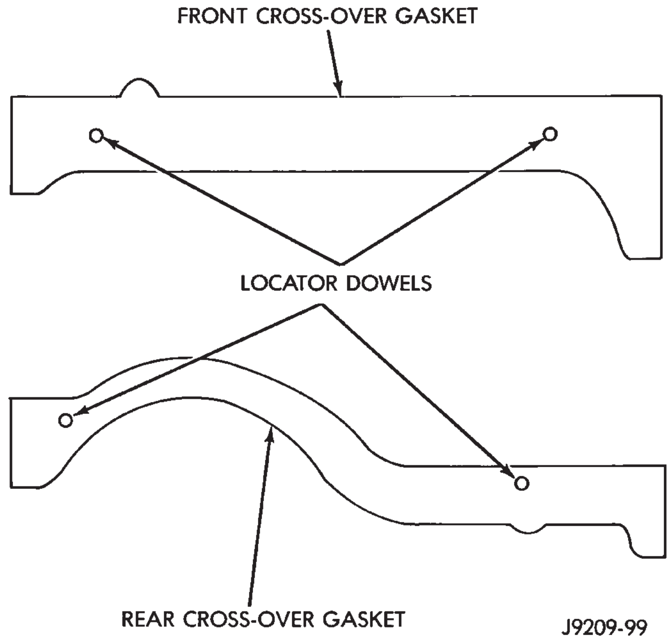

Fig. 12 Cross-Over Gaskets and Locator Dowels

tabs (Fig. 13). The words MANIFOLD SIDE should be visible on the center of each flange gasket.

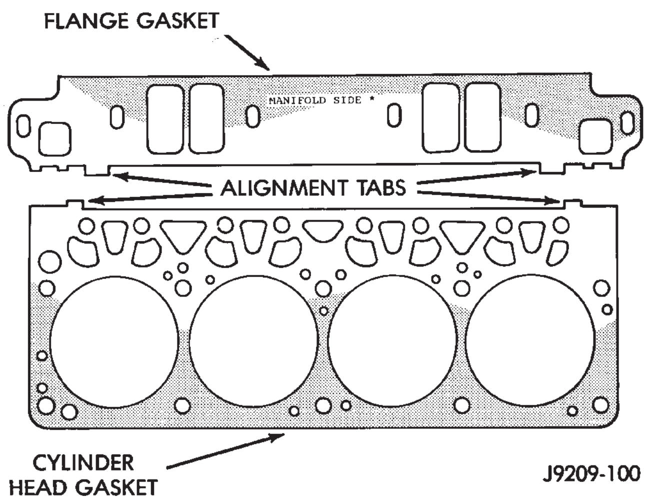

Fig. 13 Intake Manifold Flange Gasket Alignment

(10) Carefully lower intake manifold into position on the cylinder block and cylinder heads. Use the alignment dowels in the cross-over gaskets to position the intake manifold. After intake manifold is in place, inspect to make sure seals are in place.

(11) The following torque sequence duplicates the expected results of the automated assembly system (Fig. 14).

- Step 1—Tighten bolts 1 through 4, in sequence, to 8 N•m (72 in. lbs.) torque. Tighten in alternating steps 1.4 N•m (12 in. lbs.) torque at a time.
- Step 2—Tighten bolts 5 through 12, in sequence, to 8 N•m (72 in. lbs.) torque.
- Step 3—Check that all bolts are tighten to 8 N•m (72 in. lbs.) torque.

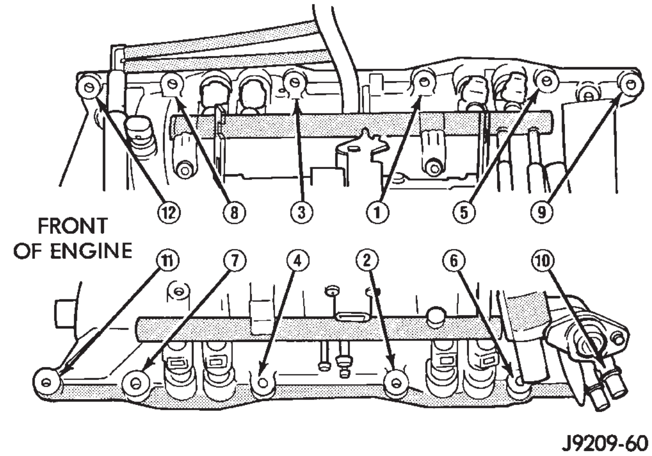

Fig. 14 Intake Manifold Bolt Tightening Sequence

- Step 4—Tighten all bolts, in sequence, to 16 N•m (12 ft. lbs.) torque.
- Step 5—Check that all bolts are tighten to 16 N•m (12 ft. lbs.) torque.

(12) Install exhaust manifolds. Tighten the bolts and nuts to 34 N•m (25 ft. lbs.) torque.

(13) Adjust spark plugs to specifications (refer to Group 8D, Ignition System). Install the plugs and tighten to 41 N•m (30 ft. lbs.) torque.

(14) Install coil wires.

(15) Connect heat indicator sending unit wire.

(16) Connect the heater hoses and bypass hose.

(17) Install distributor cap and wires.

(18) Hook up the return spring.

(19) Connect the accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(20) Install the fuel lines.

(21) Install the generator and drive belt. Tighten generator mounting bolt to 41 N•m (30 ft. lbs.) torque. Tighten the adjusting strap bolt to 23 N•m (200 in. lbs.) torque. Refer to Group 7, Cooling System for adjusting the belt tension.

(22) Install the intake manifold-to-generator bracket support rod. Tighten the bolts.

(23) Place the cylinder head cover gaskets in position and install cylinder head covers. Tighten the bolts to 11 N•m (95 in. lbs.) torque.

(24) Install closed crankcase ventilation system.

(25) Connect the evaporation control system.

(26) Install the air cleaner.

(27) Fill cooling system (refer to Group 7, Cooling System for proper procedure).

(28) Connect the negative cable to the battery.

VALVES / VALVE SPRINGS

The valves are arranged in-line and inclined 18°. The rocker pivot support and the valve guides are cast integral with the heads.

This procedure requires the removal of the cylinder head.

REMOVAL

(1) Remove the cylinder head.

(2) Compress valve springs using Valve Spring Compressor Tool C-3422-B.

(3) Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.

(4) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original location.

VALVE CLEANING

Clean valves thoroughly. Discard burned, warped and cracked valves.

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

VALVE INSPECTION

Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

Measure valve stem guide clearance as follows:

(a) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 15). The special sleeve places the valve at the correct height for checking with a dial indicator.

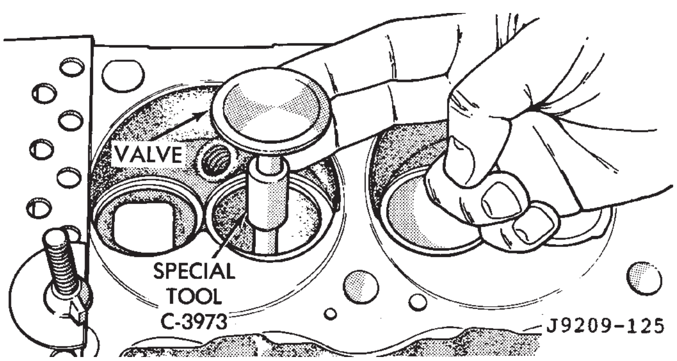

Fig. 15 Positioning Valve with Tool C-3973

(b) Attach Dial Indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 16).

(c) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 inch). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

Service valves with oversize stems are available (Fig. 17):

Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Ream the valve guides from standard to 0.381 mm (0.015 inch). Use a 2 step procedure so the valve guides are reamed true in relation to the valve seat:**

- Step 1—Ream to 0.0763 mm (0.003 inch).
- Step 2—Ream to 0.381 mm (0.015 inch).

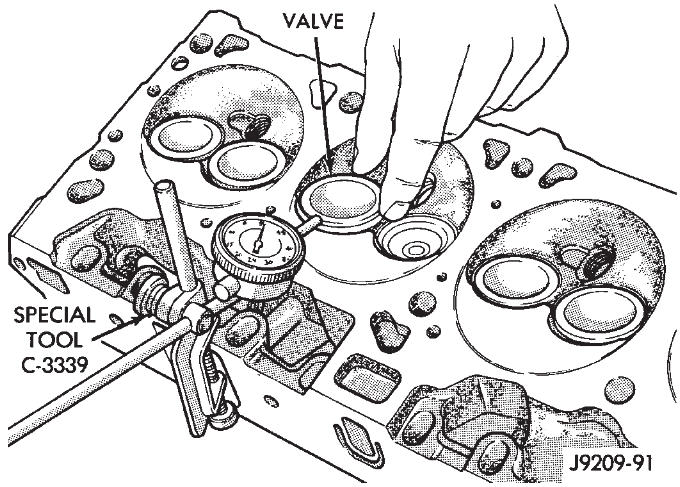

Fig. 16 Measuring Valve Guide Wear

Reamer O/S	Valve Guide Size
0.076 mm (0.003 in.)	8.026 – 8.052 mm (0.316 – 0.317 in.)
0.381 mm (0.015 in.)	8.331 – 8.357 mm (0.328 – 0.329 in.)

J9309-30

Fig. 17 Reamer Sizes

REFACING VALVES / VALVE SEATS

The intake and exhaust valves have a 43-1/4° to 43-3/4° face angle and a 44-1/4° to 44-3/4° seat angle (Fig. 18).

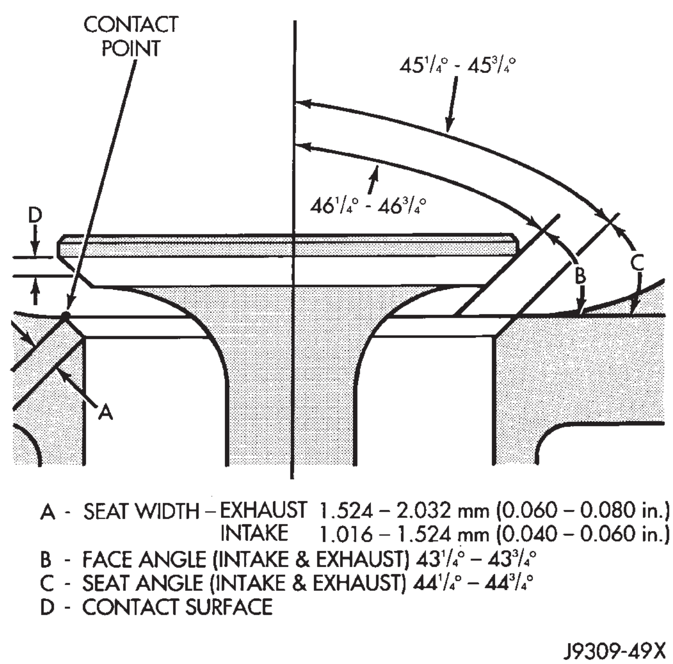

Fig. 18 Valve Face and Seat Angles

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 19). Valves with less than 1.190 mm (0.047 inch) margin should be discarded.

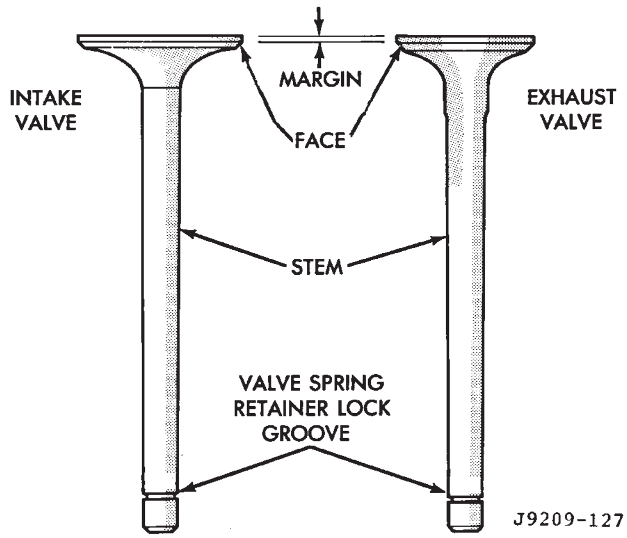

Fig. 19 Intake and Exhaust Valves

VALVE SEATS

CAUTION: DO NOT un-shroud valves during valve seat refacing (Fig. 20).

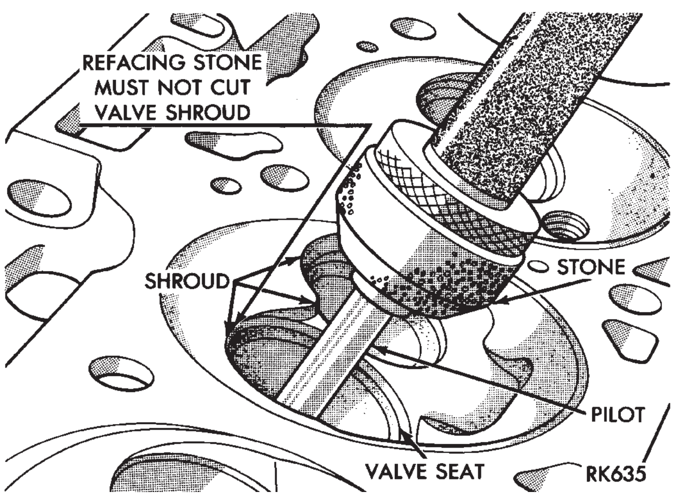

Fig. 20 Refacing Valve Seats

(1) When refacing valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.

(2) Measure the concentricity of valve seat using a dial indicator. Total runout should not exceed 0.051 mm (0.002 inch) total indicator reading.

(3) Inspect the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat LIGHTLY with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to the top edge of valve face, lower valve seat with a 15° stone. If the blue is transferred to bottom edge of valve face raise valve seat with a 60° stone.

(4) When seat is properly positioned the width of exhaust seats should be 1.524-2.032 mm (0.060-0.080 inch). The width of the intake seats should be 1.016-1.524 mm (0.040-0.060 inch).

VALVE SPRING INSPECTION

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example the compression length of the spring to be tested is 1-5/16 inch. Turn table of Valve Spring Tester Tool C-647 (Fig. 21) until surface is in line with the 1-5/16 inch mark on the threaded stud. Be sure the zero mark is to the front. Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

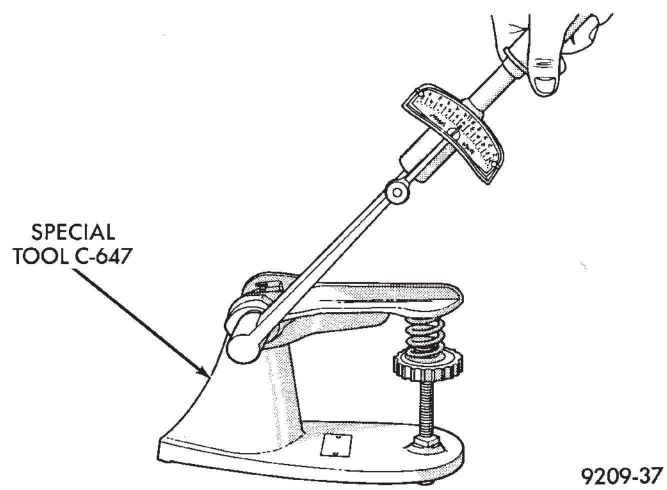

Fig. 21 Testing Valve Spring for Compressed Length with Tool C-647

INSTALLATION

(1) Coat valve stems with lubrication oil and insert them in cylinder head.

(2) If valves or seats are reground, check valve stem height. If valve is too long, replace cylinder head.

(3) Install new seals on all valve guides. Install valve springs and valve retainers.

(4) Compress valve springs with Valve Spring Compressor Tool C-3422-B, install locks and release tool. If valves and/or seats are ground, measure the installed height of springs. Make sure the measurement is taken from bottom of spring seat in cylinder

head to the bottom surface of spring retainer. If spacers are installed, measure from the top of spacer. If height is greater than 42.86 mm (1-11/16 inches), install a 1.587 mm (1/16 inch) spacer in head counterbore. This should bring spring height back to normal 41.27 to 42.86 mm (1-5/8 to 1-11/16 inch).

VALVE STEM SHIELD / SPRING REPLACEMENT

This procedure is done with the cylinder head installed.

(1) Set engine basic timing to TDC and remove Air Cleaner.

(2) Remove cylinder head covers and spark plugs.

(3) Remove coil wire from distributor and secure to good ground to prevent engine from starting.

(4) Using suitable socket and flex handle at crankshaft retaining bolt, turn engine so the No.1 piston is at Top Dead Center on the compression stroke.

(5) Remove rocker arms.

(6) With air hose attached to an adapter installed in No.1 spark plug hole, apply 620-689 kPa (90-100 psi) air pressure.

(7) Using Valve Spring Compressor Tool C-4682-A, compress valve spring and remove retainer valve locks and valve spring.

(8) Install seals on the exhaust valve stem and position down against valve guides.

(9) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. DO NOT force seal against top of guide. When installing the valve retainer locks, compress the spring only enough to install the locks.

(10) Follow the same procedure on the remaining 7 cylinders using the firing sequence 1-8-4-3-6-5-7-2. Make sure piston in cylinder is at TDC on the valve spring that is being removed.

(11) Remove adapter from the No.1 spark plug hole.

(12) Install rocker arms.

(13) Install covers and coil wire to distributor.

(14) Install air cleaner.

(15) Road test vehicle.

HYDRAULIC TAPPETS

Before disassembling any part of the engine to correct tappet noise, check the oil pressure. If vehicle has no oil pressure gauge, install a reliable gauge at the pressure sending unit. The pressure should be between 207-552 kPa (30-80 psi) at 3,000 RPM.

Check the oil level after the engine reaches normal operating temperature. Allow 5 minutes to stabilize oil level, check dipstick.

The oil level in the pan should never be above the FULL mark or below the ADD OIL mark on dipstick. Either of these 2 conditions could be responsible for noisy tappets.

OIL LEVEL

HIGH

If oil level is above the FULL mark, it is possible for the connecting rods to dip into the oil. With the engine running this condition could create foam in the oil pan. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

LOW

Low oil level may allow oil pump to take in air. When air is fed to the tappets, they lose length which allows valves to seat noisily. Any leaks on intake side of oil pump through which air can be drawn will create the same tappet action. Check the lubrication system from the intake strainer to the pump cover, including the relief valve retainer cap. When tappet noise is due to aeration, it may be intermittent or constant, and usually more than 1 tappet will be noisy. When oil level and leaks have been corrected, operate the engine at fast idle. Run engine for a sufficient time to allow all of the air inside the tappets to be bled out.

TAPPET NOISE DIAGNOSIS

(1) To determine source of tappet noise, operate engine at idle with cylinder head covers removed.

(2) Feel each valve spring or rocker arm to detect noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on the valve spring. If noise is not appreciably reduced, it can be assumed the noise is in the tappet. Inspect the rocker arm push rod sockets and push rod ends for wear.

(3) Valve tappet noise ranges from light noise to a heavy click. A light noise is usually caused by excessive leak-down around the unit plunger or by the plunger partially sticking in the tappet body cylinder. The tappet should be replaced. A heavy click is caused by a tappet check valve not seating or by foreign particles becoming wedged between the plunger and the tappet body. This will cause the plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between the valve stem and rocker arm as valve closes. In either case, tappet assembly should be removed for inspection and cleaning.

The valve train generates a noise very much like a light tappet noise during normal operation. Care must be taken to ensure that tappets are making the noise. In general, if more than one tappet seems to be noisy, its probably not the tappets.

REMOVAL

(1) Remove the air cleaner.

(2) Remove cylinder head cover, rocker assembly and push rods. Identify push rods to ensure installation in original location.

(3) Remove intake manifold, yoke retainer and aligning yokes.

(4) Slide Hydraulic Tappet Remover/Installer Tool C-4129-A through opening in cylinder head and seat tool firmly in the head of tappet.

(5) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

(6) If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize. Replace with oversize tappet.

CAUTION: The plunger and tappet bodies are not interchangeable. The plunger and valve must always be fitted to the original body. It is advisable to work on one tappet at a time to avoid mixing of parts. Mixed parts are not compatible. DO NOT disassemble a tappet on a dirty work bench.

DISASSEMBLE

(1) Pry out plunger retainer spring clip (Fig. 22).

(2) Clean varnish deposits from inside of tappet body above plunger cap.

(3) Invert tappet body and remove plunger cap, plunger, check valve, check valve spring, check valve retainer and plunger spring (Fig. 22). Check valve could be flat or ball.

ASSEMBLE

(1) Clean all tappet parts in a solvent that will remove all varnish and carbon.

(2) Replace tappets that are unfit for further service with new assemblies.

(3) If plunger shows signs of scoring or wear, install a new tappet assembly. If valve is pitted, or valve seat on end of plunger is prevented from seating, install a new tappet assembly.

(4) Assemble tappets (Fig. 22).

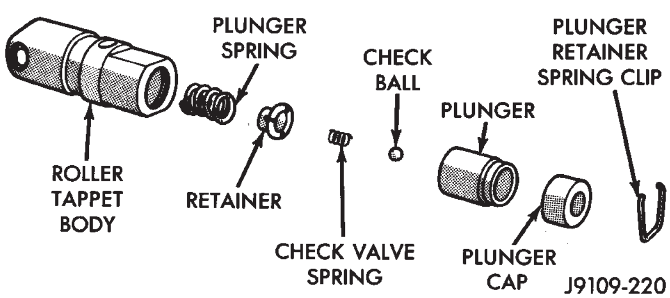

Fig. 22 Hydraulic Tappet Assembly

INSTALLATION

(1) Lubricate tappets.

(2) Install tappets and push rods in their original positions. Ensure that the oil feed hole in the side of the tappet body faces up (away from the crankshaft).

(3) Install aligning yokes with ARROW toward camshaft.

(4) Install yoke retainer. Tighten the bolts to 23 N●m (200 in. lbs.) torque. Install intake manifold.

(5) Install push rods in original positions.

(6) Install rocker arm.

(7) Install cylinder head cover.

(8) Start and operate engine. Warm up to normal operating temperature.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

VALVE TIMING

(1) Turn crankshaft until the No.6 exhaust valve is closing and No.6 intake valve is opening.

(2) Insert a 6.350 mm (1/4 inch) spacer between rocker arm pad and stem tip of No.1 intake valve. Allow spring load to bleed tappet down giving in effect a solid tappet.

(3) Install a dial indicator so plunger contacts valve spring retainer as nearly perpendicular as possible. Zero the indicator.

(4) Rotate the crankshaft clockwise (normal running direction) until the valve has lifted 0.254 mm (0.010 inch). The timing of the crankshaft should now read from 10° before top dead center to 2° after top dead center. Remove spacer.

CAUTION: Do not turn crankshaft any further clockwise as valve spring might bottom and result in serious damage.

(5) If reading is not within specified limits:

(a) Check sprocket index marks.

(b) Inspect timing chain for wear.

(c) Check accuracy of DC mark on timing indicator.

VIBRATION DAMPER

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove fan shroud retainer bolts and set shroud back over engine.

(3) Remove the cooling system fan.

(4) Remove the serpentine belt (refer to Group 7, Cooling System).

(5) Remove the vibration damper pulley.

(6) Remove vibration damper bolt and washer from end of crankshaft.

(7) Install bar and screw from Puller Tool Set C-3688. Install 2 bolts with washers through the puller tool and into the vibration damper (Fig. 1).

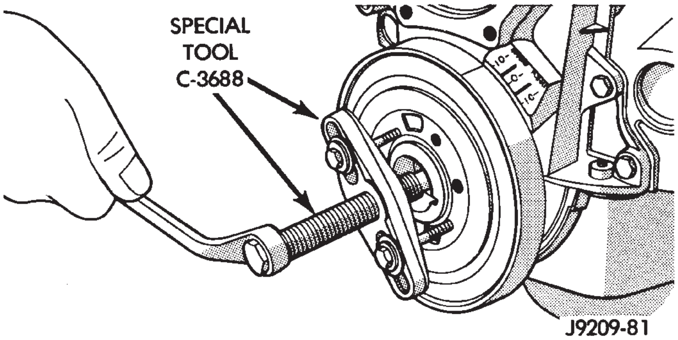

Fig. 1 Vibration Damper Assembly

(8) Pull vibration damper off of the crankshaft.

INSTALLATION

(1) Position the vibration damper onto the crankshaft.

(2) Place installing tool, part of Puller Tool Set C-3688 in position and press the vibration damper onto the crankshaft (Fig. 2).

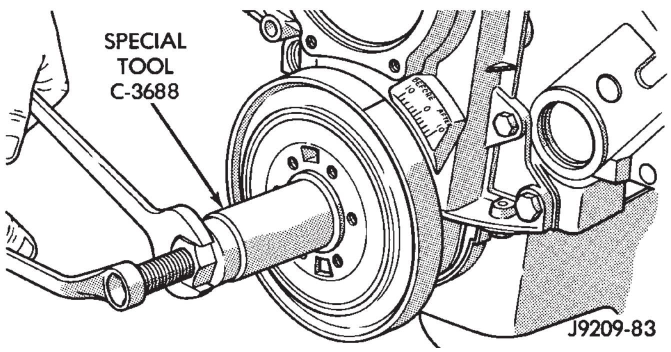

Fig. 2 Installing Vibration Damper

(3) Install the crankshaft bolt and washer. Tighten the bolt to 183 N●m (135 ft. lbs.) torque.

(4) Install the crankshaft pulley. Tighten the pulley bolts to 23 N●m (200 in. lbs.) torque.

(5) Install the serpentine belt (refer to Group 7, Cooling System).

(6) Install the cooling system fan. Tighten the bolts to 23 N●m (17 ft. lbs.) torque.

(7) Position the fan shroud and install the bolts. Tighten the retainer bolts to 11 N●m (95 in. lbs.) torque.

(8) Connect the negative cable to the battery.

TIMING CHAIN COVER

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain cooling system (refer to Group 7, Cooling System).

(3) Remove the serpentine belt (refer to Group 7, Cooling System).

(4) Remove water pump (refer to Group 7, Cooling System).

(5) Remove power steering pump (refer to Group 19, Steering).

(6) Remove vibration damper.

(7) Remove fuel lines (refer to Group 14, Fuel System).

(8) Loosen oil pan bolts and remove the front bolt at each side.

(9) Remove the cover bolts.

(10) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

(11) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal surface of cover (Fig. 3).

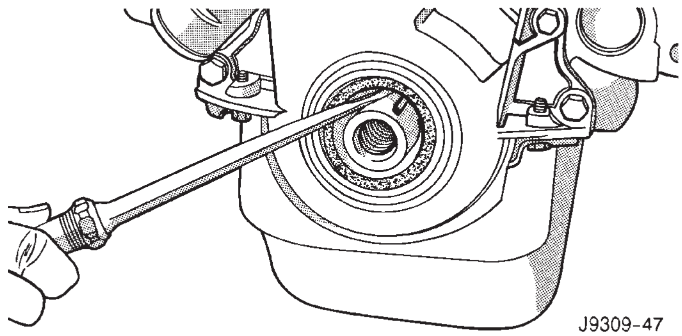

Fig. 3 Removal of Front Crankshaft Oil Seal

TIMING CHAIN STRETCH

(1) Place a scale next to the timing chain so that any movement of the chain may be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt. Apply torque in the direction of crankshaft rotation to take up slack; 41 N●m (30 ft. lbs.) torque with cylinder head installed or 20 N●m (15 ft. lbs.) torque with cylinder head removed. With a torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block the crankshaft to prevent rotation.

(3) Hold a scale with dimensional reading even with the edge of a chain link. With cylinder heads installed, apply 14 N●m (30 ft. lbs.) torque in the reverse direction. With the cylinder heads removed, apply 20 N●m (15 ft. lbs.) torque in the reverse direction. Note the amount of chain movement (Fig. 4).

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

(5) If chain is not satisfactory, remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

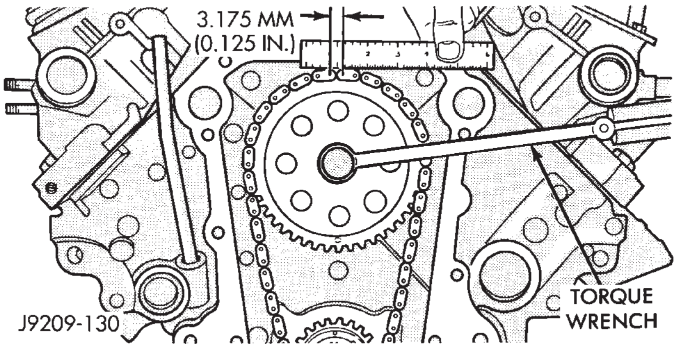

Fig. 4 Measuring Timing Chain Wear and Stretch

(6) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(7) Place timing chain around both sprockets.

(8) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(9) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(10) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 5).

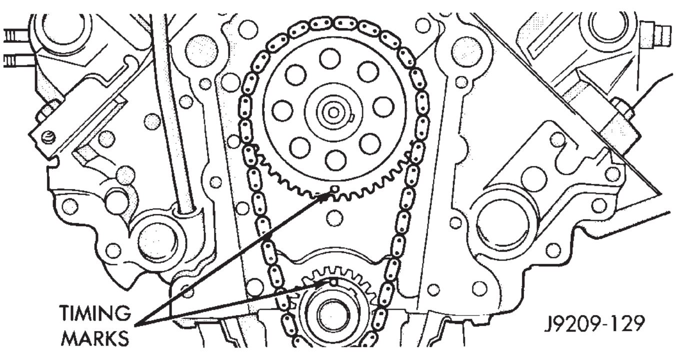

Fig. 5 Alignment of Timing Marks

(11) Install the camshaft bolt. Tighten the bolt to 68 N●m (50 ft. lbs.) torque.

(12) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

CLEANING

Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs.

INSTALLATION

(1) Using a new cover gasket, carefully install chain case cover to avoid damaging oil pan gasket. Use a small amount of Mopar Silicone Rubber Adhesive Sealant, or equivalent, at the joint between timing chain cover gasket and the oil pan gasket. Finger tighten the timing chain cover bolts at this time.

(2) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 6). Seat the oil seal in the groove of the tool.

(3) Position the seal and tool onto the crankshaft (Fig. 7).

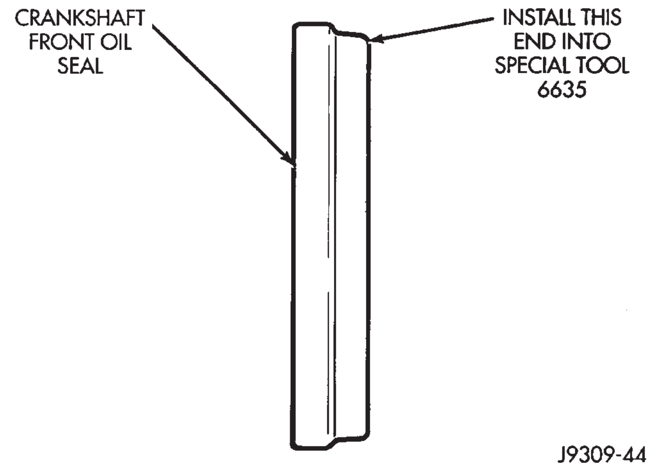

Fig. 6 Placing Oil Seal on Installation Tool 6635

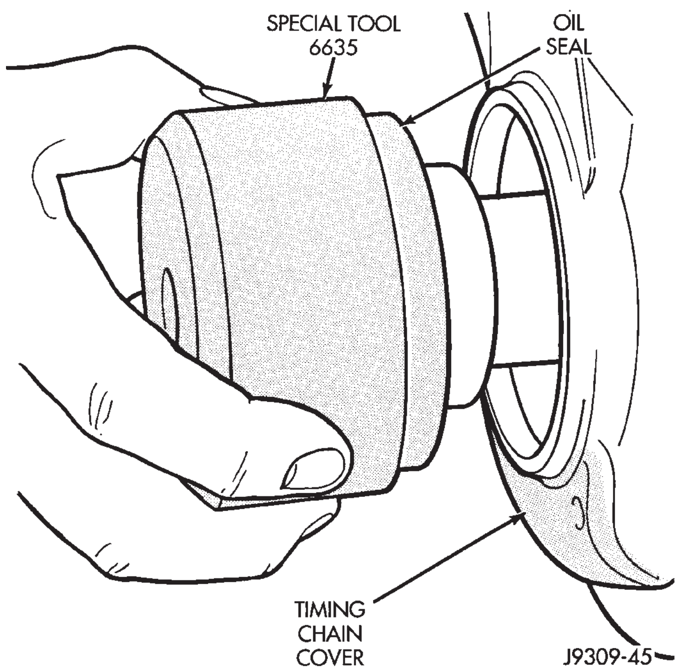

Fig. 7 Position Tool and Seal onto Crankshaft

(4) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 8).

(5) Tighten chain case cover bolts to 41 N●m (30 ft. lbs.) torque. Tighten oil pan bolts to 24 N●m (215 in. lbs.) torque.

(6) Remove the vibration damper bolt and seal installation tool.

(7) Install vibration damper.

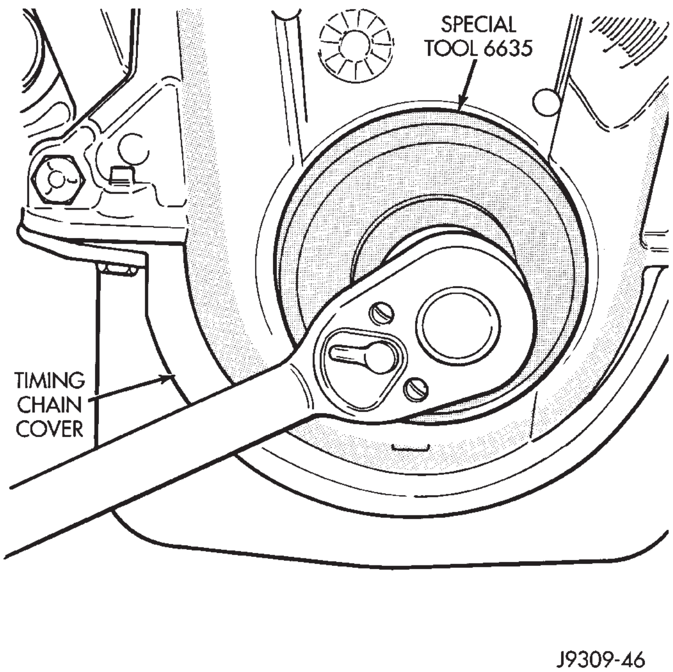

Fig. 8 Installing Oil Seal

(8) Install fuel lines (refer to Group 14, Fuel System).

(9) Install water pump and housing assembly using new gaskets (refer to Group 7, Cooling System). Tighten bolts to 41 N●m (30 ft. lbs.) torque.

(10) Install power steering pump (refer to Group 19, Steering).

(11) Install the serpentine belt (refer to Group 7, Cooling System).

(12) Install the cooling system fan. Tighten the bolts to 23 N●m (17 ft. lbs.) torque.

(13) Position the fan shroud and install the bolts. Tighten the bolts to 11 N●m (95 in. lbs.) torque.

(14) Fill cooling system (refer to Group 7, Cooling System for the proper procedure).

(15) Connect the negative cable to the battery.

FRONT CRANKSHAFT OIL SEAL REPLACEMENT

The oil seal can be replaced without removing the timing chain cover provided the cover is not misaligned.

(1) Disconnect the negative cable from the battery.

(2) Remove vibration damper.

(3) If front seal is suspected of leaking, check front oil seal alignment to crankshaft. The seal installation/alignment tool 6635, should fit with minimum interference. If tool does not fit, the cover must be removed and installed properly.

(4) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal surface of cover.

(5) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 6). Seat the oil seal in the groove of the tool.

(6) Position the seal and tool onto the crankshaft (Fig. 7).

(7) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 8).

(8) Remove the vibration damper bolt and seal installation tool.

(9) Install the vibration damper.

(10) Connect the negative cable to the battery.

CAMSHAFT

This procedure requires that the engine is removed from the vehicle.

The camshaft has an integral oil pump and distributor drive gear (Fig. 9).

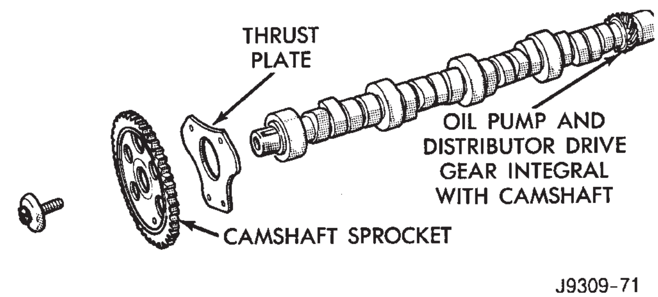

Fig. 9 Camshaft and Sprocket Assembly

REMOVAL

(1) Remove intake manifold.

(2) Remove cylinder head covers.

(3) Remove timing case cover and timing chain.

(4) Remove rocker arms.

(5) Remove push rods and tappets. Identify each part so it can be installed in its original location.

(6) Remove distributor and lift out the oil pump and distributor drive shaft.

(7) Remove camshaft thrust plate; note location of oil tab (Fig. 10).

(8) Install a long bolt into front of camshaft to facilitate removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

REMOVAL—BEARING

(1) With engine completely disassembled, drive out rear cam bearing core hole plug.

(2) Install proper size adapters and horseshoe washers (part of Camshaft Bearing Remover/Installer Tool C-3132-A) at back of each bearing shell. Drive out bearing shells (Fig. 11).

INSTALLATION—BEARING

(1) Install new camshaft bearings with Camshaft Bearing Remover/Installer Tool C-3132-A by sliding the new camshaft bearing shell over proper adapter.

(2) Position rear bearing in the tool. Install horseshoe lock and by reversing removal procedure, carefully drive bearing shell into place.

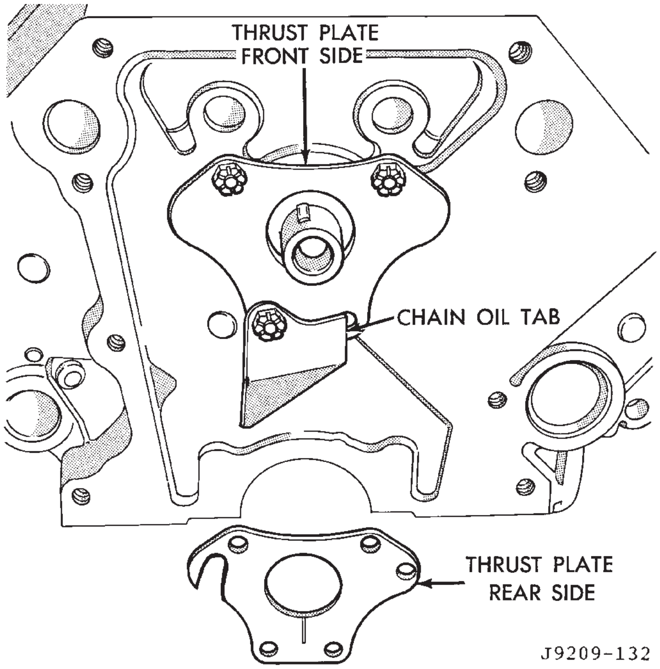

Fig. 10 Timing Chain Oil Tab Installation

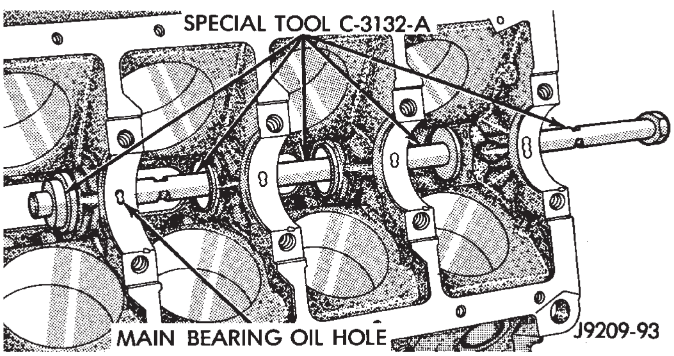

Fig. 11 Camshaft Bearings Removal and Installation with Tool C-3132-A

(3) Install remaining bearings in the same manner. Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearing. If the camshaft bearing shell oil holes are not in exact alignment, remove and install them correctly. Install a new core hole plug at the rear of camshaft. **Be sure this plug does not leak.**

INSTALLATION

(1) Lubricate camshaft lobes and camshaft bearing journals and insert the camshaft to within 51 mm (2 inches) of its final position in cylinder block.

Whenever an engine has been rebuilt, a new camshaft and/or new tappets installed, add 1 pint of Mopar Crankcase Conditioner, or equivalent. The oil mixture should be left in engine for a minimum of 805 km (500 miles). Drain at the next normal oil change.

(2) Install Camshaft Gear Installer Tool C-3509 with tongue back of distributor drive gear (Fig. 12).

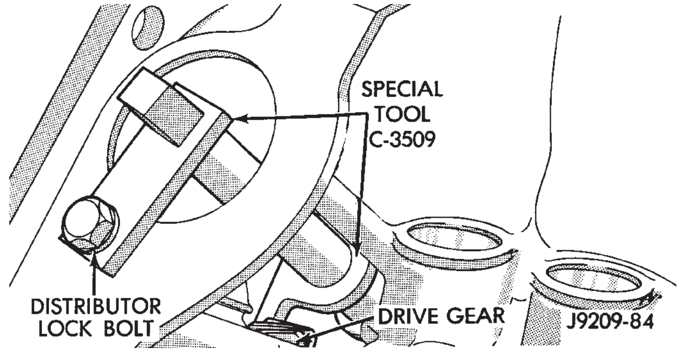

Fig. 12 Camshaft Holding Tool C-3509 (Installed Position)

(3) Hold tool in position with a distributor lockplate bolt. This tool will restrict camshaft from being pushed in too far and prevent knocking out the welch plug in rear of cylinder block. **Tool should remain installed until the camshaft and crankshaft sprockets and timing chain have been installed.**

(4) Install camshaft thrust plate and chain oil tab. **Make sure tang enters lower right hole in thrust plate.** Tighten bolts to 24 N●m (210 in. lbs.) torque. Top edge of tab should be flat against thrust plate in order to catch oil for chain lubrication.

(5) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(6) Place timing chain around both sprockets.

(7) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(8) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(9) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 13).

(10) Install the camshaft bolt/cup washer. Tighten bolt to 68 N●m (50 ft. lbs.) torque.

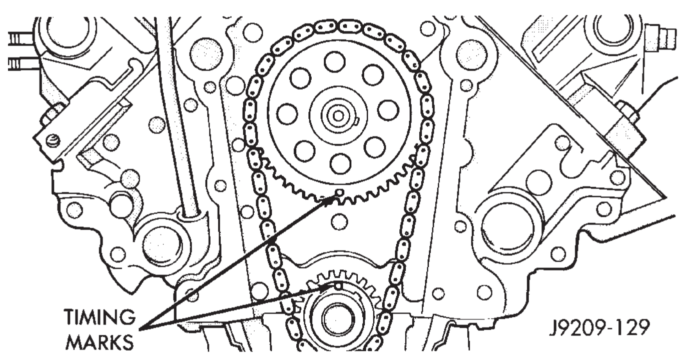

Fig. 13 Alignment of Timing Marks

(11) Measure camshaft end play. Refer to Specifications for proper clearance. If not within limits install a new thrust plate.

(12) Each tappet reused must be installed in the same position from which it was removed. **When camshaft is replaced, all of the tappets must be replaced.**

DISTRIBUTOR

REMOVAL

Refer to Group 8D, Ignition Systems for the proper procedure.

REMOVAL—DRIVE SHAFT BUSHING

(1) Insert Distributor Drive Shaft Bushing Puller Tool C-3052 into old bushing and thread down until a tight fit is obtained (Fig. 14).

(2) Hold puller screw and tighten puller nut until bushing is removed.

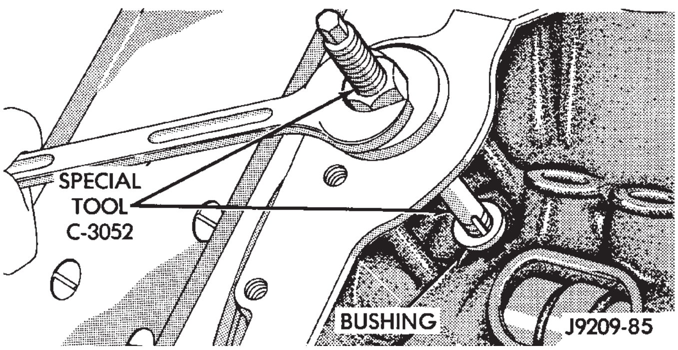

Fig. 14 Distributor Driveshaft Bushing Removal

INSTALLATION—DRIVE SHAFT BUSHING

(1) Slide new bushing over burnishing end of Distributor Drive Shaft Bushing Driver/Burnisher Tool C-3053. Insert the tool and bushing into the bore.

(2) Drive bushing and tool into position, using a hammer (Fig. 15).

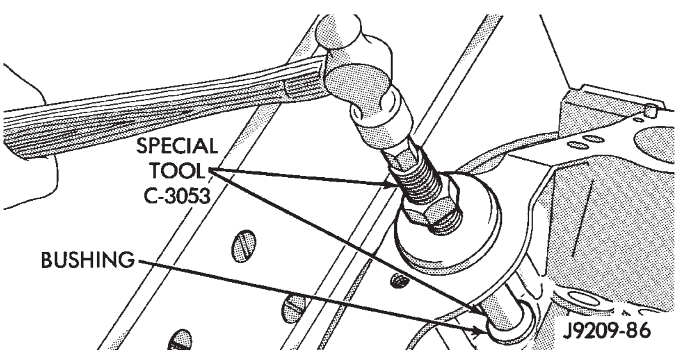

Fig. 15 Distributor Driveshaft Bushing Installation

(3) As the burnisher is pulled through the bushing, the bushing is expanded tight in the block and burnished to correct size (Fig. 16). **DO NOT ream this bushing.**

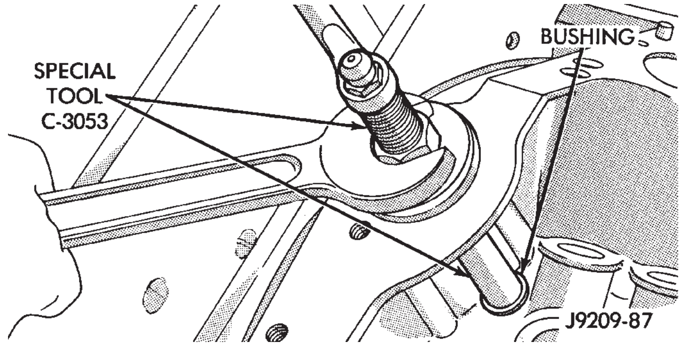

Fig. 16 Burnishing Distributor Driveshaft Bushing

DISTRIBUTOR TIMING

Before installing the distributor and oil pump drive shaft, time engine as follows:

(1) Rotate crankshaft until No.1 cylinder is at top dead center on the firing stroke.

(2) When in this position, the timing mark on vibration damper should be under "0" on the timing indicator.

(3) Coat shaft and drive gear with engine oil. Install the shaft so that after the gear spirals into place, it will index with the oil pump shaft. The slot in top of drive gear should be aligned towards left front intake manifold attaching bolt hole (Fig. 17).

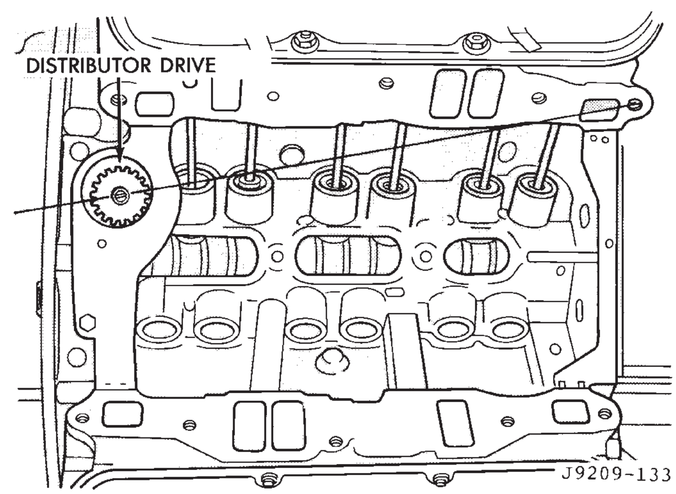

Fig. 17 Position of Installed Distributor Drive Gear

INSTALLATION

Refer to Group 8D, Ignition Systems for the proper procedure.

OIL PAN

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise the vehicle.

(3) Remove the oil pan drain plug and drain the engine oil.

(4) Remove the oil filter.

(5) Remove the starter (refer to Group 8B, Battery / Starter / Generator Service).

(6) If equipped with an oil level sensor, disconnect the sensor.

(7) Position the cooler lines out of the way.

(8) Disconnect the oxygen sensor.

(9) Remove exhaust pipe.

(10) 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. The one-piece gasket is reusable.

CLEANING

Clean the block and pan gasket surfaces.

Trim or remove excess sealant film in the rear main cap oil pan gasket groove. **DO NOT remove the sealant inside the rear main cap slots.**

If present, trim excess sealant from inside the engine.

Clean oil pan in solvent and wipe dry with a clean cloth.

Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSPECTION

Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

INSTALLATION

(1) Fabricate 4 alignment dowels from 1 1/2 x 5/16 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).

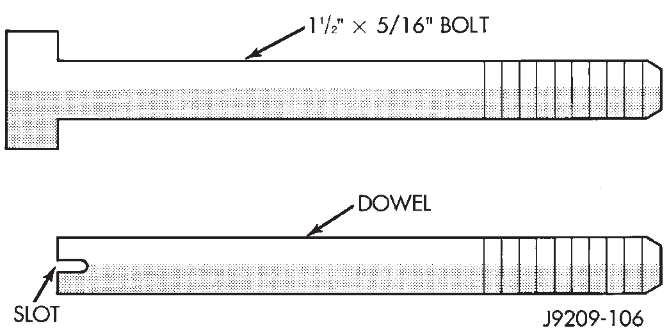

Fig. 1 Fabrication of Alignment Dowels

(2) Install the dowels in the cylinder block (Fig. 2).

(3) Apply small amount of Mopar Silicone Rubber Adhesive Sealant, or equivalent in the corner of the cap and the cylinder block.

(4) Slide the one-piece gasket over the dowels and onto the block.

(5) Position the oil pan over the dowels and onto the gasket. If equipped with an oil level sensor, take care not to damage the sensor.

(6) Install the oil pan bolts. Tighten the bolts to 24 N●m (215 in. lbs.) torque.

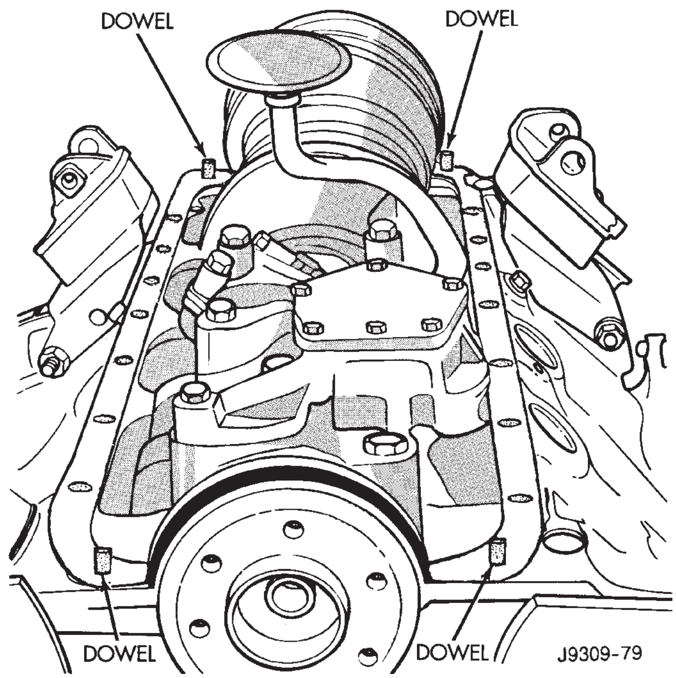

Fig. 2 Position of Dowels in Cylinder Block

(7) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N●m (215 in. lbs.) torque.

(8) Install the drain plug. Tighten drain plug to 34 N●m (25 ft. lbs.) torque.

(9) Install exhaust pipe.

(10) Connect the oxygen sensor.

(11) Install the oil filter.

(12) If equipped with an oil level sensor, connect the sensor.

(13) Install the starter (refer to Group 8B, Battery / Starter / Generator Service).

(14) Move the cooler lines back into position.

(15) Lower vehicle.

(16) Connect the negative cable to the 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

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from rear main bearing cap.

DISASSEMBLE

(1) Remove the relief valve as follows:

(a) Remove cotter pin. Drill a 3.175 mm (1/8 inch) hole into the relief valve retainer cap and insert a self-threading sheet metal screw.

(b) Clamp screw into a vise and while supporting oil pump, remove cap by tapping pump body using a soft hammer. Discard retainer cap and remove spring and relief valve (Fig. 3).

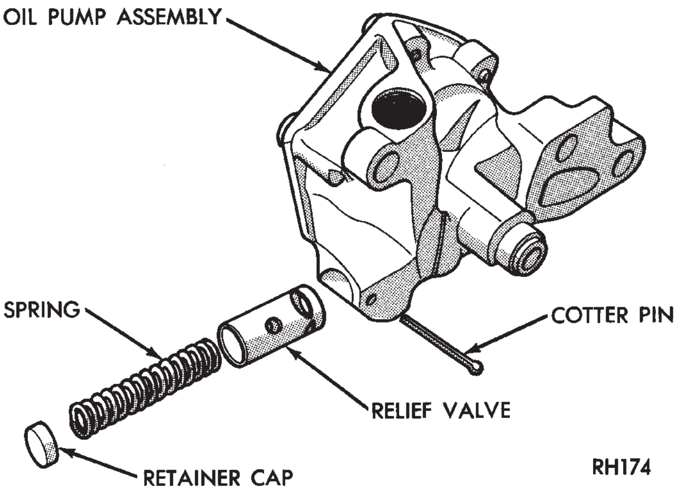

Fig. 3 Oil Pressure Relief Valve

(2) Remove oil pump cover (Fig. 4).

(3) Remove pump outer rotor and inner rotor with shaft (Fig. 4).

(4) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

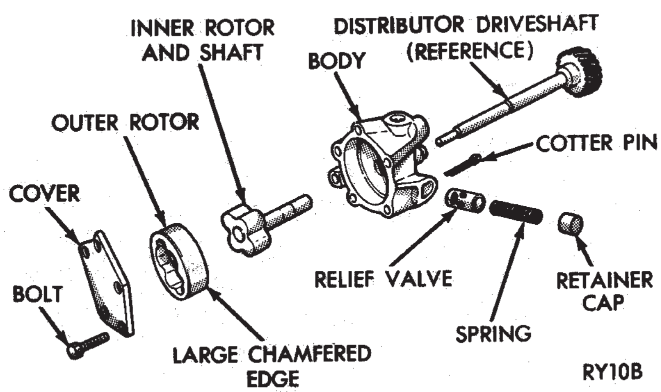

Fig. 4 Oil Pump

INSPECTION

Mating surface of the oil pump cover should be smooth. Replace pump assembly if cover is scratched or grooved.

Lay a straightedge across the pump cover surface (Fig. 5). If a 0.038 mm (0.0015 inch) feeler gauge can be inserted between cover and straightedge, pump assembly should be replaced.

Measure thickness and diameter of OUTER rotor. If outer rotor thickness measures 20.9 mm (0.825 inch) or less or if the diameter is 62.7 mm (2.469 inches) or less, replace outer rotor (Fig. 6).

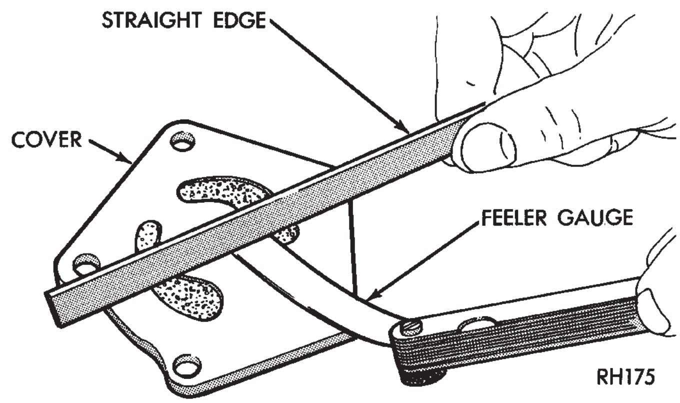

Fig. 5 Checking Oil Pump Cover Flatness

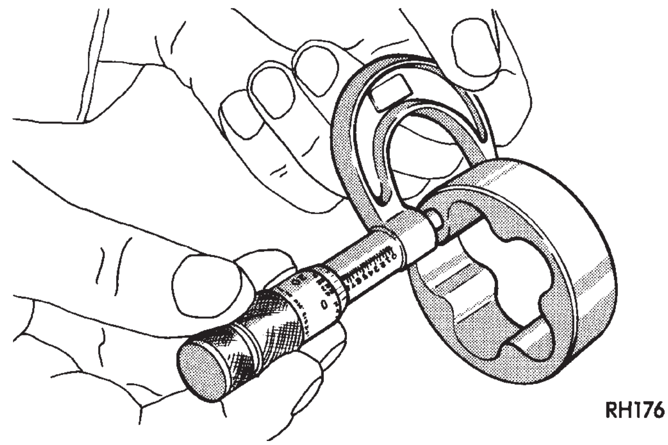

Fig. 6 Measuring Outer Rotor Thickness

If inner rotor measures 20.9 mm (0.825 inch) or less, replace inner rotor and shaft assembly (Fig. 7).

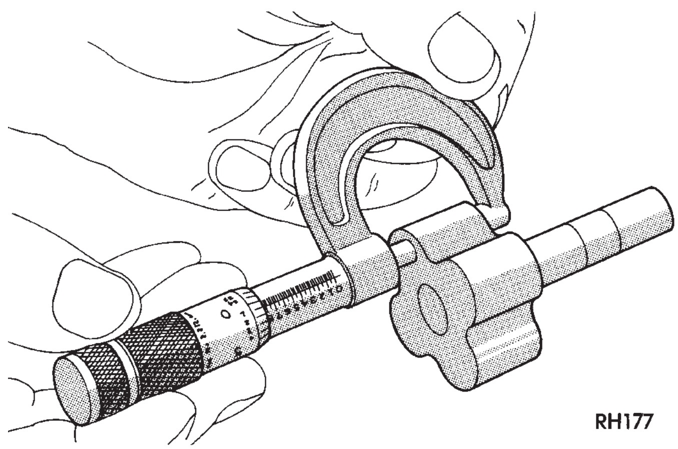

Fig. 7 Measuring Inner Rotor Thickness

Slide outer rotor into pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 8). If clearance is 0.356 mm (0.014 inch) or more, replace oil pump assembly.

Install inner rotor and shaft into pump body. If clearance between inner and outer rotors is 0.203 mm (0.008 inch) or more, replace shaft and both rotors (Fig. 9).

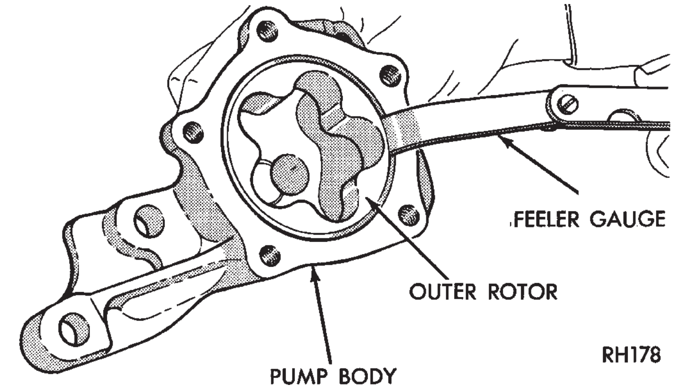

Fig. 8 Measuring Outer Rotor Clearance in Housing

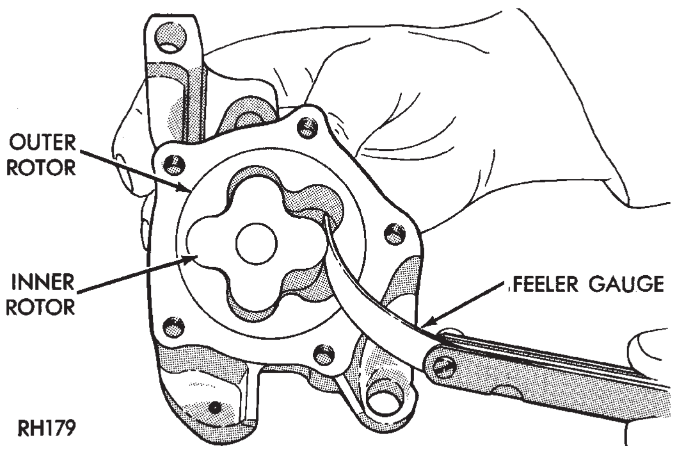

Fig. 9 Measuring Clearance Between Rotors

Place a straightedge across the face of the pump, between bolt holes. If a feeler gauge of 0.102 mm (0.004 inch) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 10).

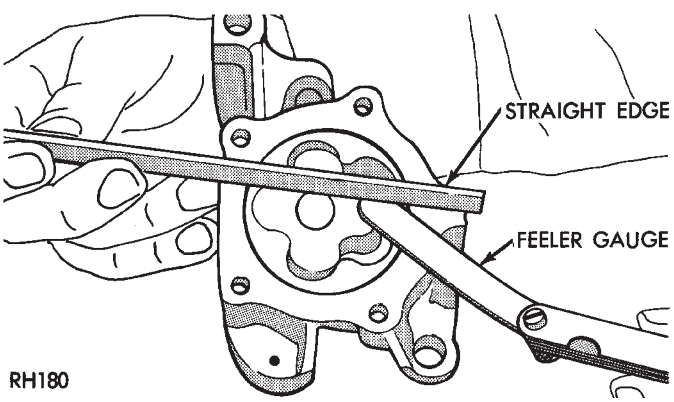

Fig. 10 Measuring Clearance Over Rotors

Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

The relief valve spring has a free length of approximately 49.5 mm (1.95 inches). The spring should test between 19.5 and 20.5 pounds when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet these specifications (Fig. 11).

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

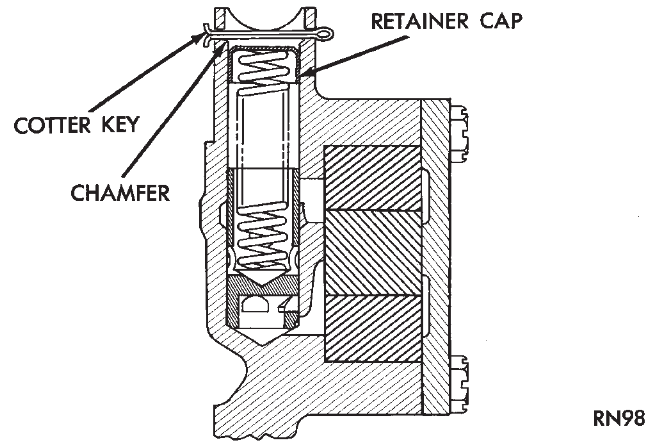

Fig. 11 Proper Installation of Retainer Cap

ASSEMBLE

(1) Install pump rotors and shaft, using new parts as required.

(2) Position the oil pump cover onto the pump body. Tighten cover bolts to 11 N•m (95 in. lbs.) torque.

(3) Install the relief valve and spring. Insert the cotter pin.

(4) Tap on a new retainer cap.

(5) Prime oil pump before installation by filling rotor cavity with engine oil.

INSTALLATION

(1) Install oil pump. During installation slowly rotate pump body to ensure driveshaft-to-pump rotor shaft engagement.

(2) Hold the oil pump base flush against mating surface on No.4 main bearing cap. Finger tighten pump attaching bolts. Tighten attaching bolts to 41 N•m (30 ft. lbs.) torque.

(3) Install the oil pan.

PISTON / CONNECTING ROD ASSEMBLY

The pistons are elliptically turned so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, causing the piston to assume a more nearly round shape.

All pistons are machined to the same weight, regardless of size, to maintain piston balance.

The piston pin rotates in the piston only and is retained by the press interference fit of the piston pin in the connecting rod.

REMOVAL

(1) Remove the engine from the vehicle.

(2) Remove the cylinder head.

(3) Remove the oil pan.

(4) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. Be sure to keep tops of pistons covered during this operation.

(5) Be sure the connecting rod and connecting rod cap are identified with the cylinder number. Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts.

(6) Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies, rotate crankshaft so that the connecting rod is centered in cylinder bore and at BDC. **Be careful not to nick crankshaft journals.**

(7) After removal, install bearing cap on the mating rod.

INSPECTION

Check the crankshaft connecting rod journal for excessive wear, taper and scoring.

Check the cylinder block bore for out-of-round, taper, scoring and scuffing.

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 12).

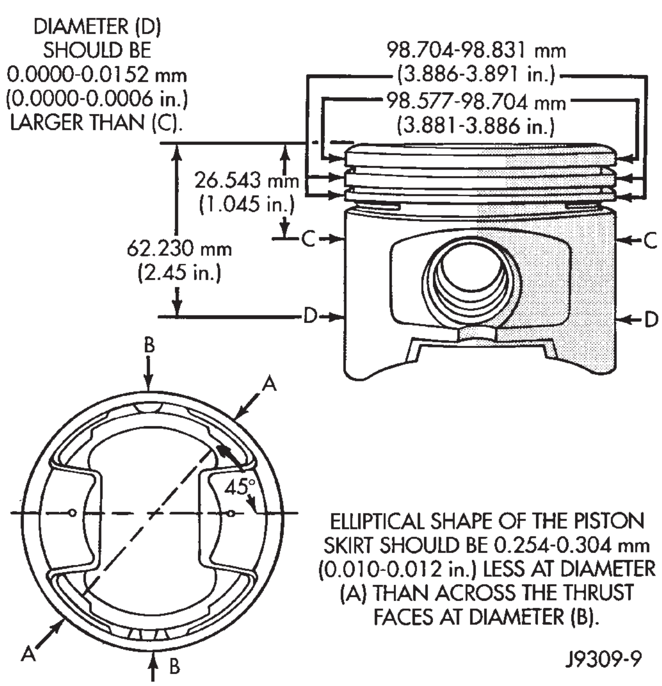

Fig. 12 Piston Measurements

FITTING PISTONS

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.013-0.038 mm (0.0005-0.0015 inch).

Piston diameter should be measured at the top of skirt, 90° to piston pin axis. Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).

FITTING RINGS

(1) Measurement of end gaps:

(a) Measure piston ring gap 2 inches from bottom of cylinder bore. An inverted piston can be used to push the rings down to ensure positioning rings squarely in the cylinder bore before measuring.

(b) Insert feeler gauge in the gap. The top compression ring gap should be between 0.254-0.508 mm (0.010-0.020 inch). The second compression ring gap should be between 0.508-0.762 mm (0.020-0.030 inch). The oil ring gap should be 0.254-1.270 mm (0.010-0.050 inch).

(c) Rings with insufficient end gap may be properly filled to the correct dimension. Rings with excess gaps should not be used.

(2) Install rings and confirm ring side clearance:

(a) Install oil rings being careful not to nick or scratch the piston.

(b) Install the compression rings using Installation Tool C-4184. The top compression may be installed with either side up. The second compression ring must be installed with the identification mark face up (toward top of piston) and the chamfer should face down. An identification mark on the ring is a drill point, a stamped letter “O”, an oval depression or the word TOP.

(c) Measure side clearance between piston ring and ring land (Fig. 13). Clearance should be 0.038-0.076 mm (0.0015-0.0030 inch) for the compression rings. The steel rail oil ring should be free in groove, but should not exceed 0.203 mm (0.0080 inch) side clearance.

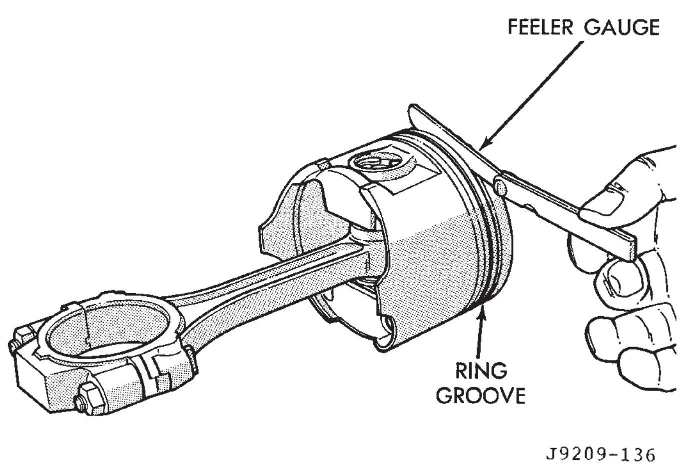

Fig. 13 Measuring Piston Ring Side Clearance

(d) Pistons with insufficient or excessive side clearance should be replaced.

(3) Arrange ring gaps 90° apart as shown in Fig. 14.

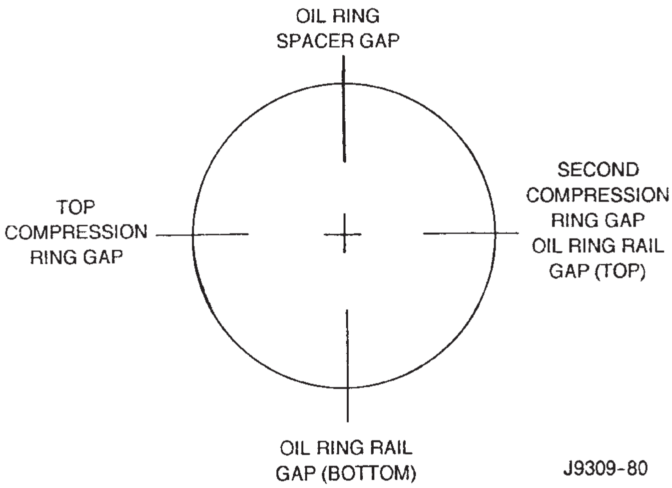

Fig. 14 Proper Ring Installation

CONNECTING ROD BEARINGS

Fit all rods on a bank until completed. DO NOT alternate from one bank to another, because connecting rods and pistons are not interchangeable from one bank to another.

The bearing caps are not interchangeable and should be marked at removal to ensure correct assembly.

Each bearing cap has a small V-groove across the parting face. When installing the lower bearing shell, make certain that the V-groove in the shell is in line with the V-groove in the cap. This provides lubrication of the cylinder wall in the opposite bank.

The bearing shells must be installed so that the tangs are in the machined grooves in the rods and caps.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 inch). Bearings are available in 0.025 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch) undersize. **Install the bearings in pairs. DO NOT use a new bearing half with an old bearing half. DO NOT file the rods or bearing caps.**

INSTALLATION

(1) Be sure that compression ring gaps are staggered so that neither is in-line with oil ring rail gap.

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 14).

(3) Immerse the piston head and rings in clean engine oil. Slide Piston Ring Compressor Tool C-385 over the piston and tighten with the special wrench (part of Tool C-385). **Be sure position of rings does not change during this operation.**

(4) Install connecting rod bolt protectors on rod bolts, the long protector should be installed on the numbered side of the connecting rod.

(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Be sure connecting rod and cylinder bore number are the same. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

(6) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on crankshaft journal.

(7) The notch or groove on top of piston must be pointing toward front of engine. The larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(8) Install rod caps. Be sure connecting rod, connecting rod cap and cylinder bore number are the same. Install nuts on cleaned and oiled rod bolts and tighten nuts to 61 N●m (45 ft. lbs.) torque.

(9) Install the oil pan.

(10) Install the cylinder head.

(11) Install the engine into the vehicle.

CRANKSHAFT

A crankshaft which has undersize journals will be stamped with 1/4 inch letters on the milled flat on the No.8 crankshaft counterweight (Fig. 15).

FOR EXAMPLE: R2 stamped on the No.6 crankshaft counterweight indicates that the No.2 rod journal is 0.025 mm (0.001 in) undersize. M4 indicates that the No.4 main journal is 0.025 mm (0.001 in) undersize. R3 M2 indicates that the No.3 rod journal and the No.2 main journal are 0.025 mm (0.001 in) undersize.

Undersize Journal	Identification Stamp
0.025 mm (0.001 in.) (Rod)	R1-R2-R3 or R4
0.025 mm (0.001 in.) (Main)	M1-M2-M3-M4 or M5

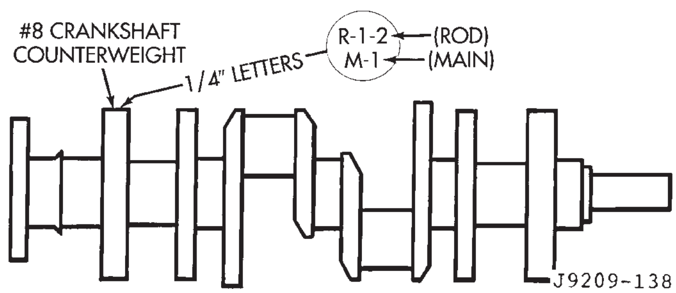

Fig. 15 Location of Crankshaft Identification

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Identify bearing caps before removal. Remove bearing caps and bearings one at a time.

(4) Lift the crankshaft out of the block.

(5) Remove and discard the crankshaft rear oil seals.

(6) Remove and discard the front crankshaft oil seal.

INSPECTION OF JOURNALS

The crankshaft connecting rod and main journals should be checked for excessive wear, taper and scoring. The maximum taper or out-of-round on any crankshaft journal is 0.025 mm (0.001 inch).

Journal grinding should not exceed 0.305 mm (0.012 inch) under the standard journal diameter. DO NOT grind thrust faces of No.3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

CAUTION: After any journal grind, it is important that the final paper or cloth polish be in the same direction as the engine rotates.

INSTALLATION

Refer to Crankshaft Rear Oil Seals - Upper Seal Replacement (Crankshaft Removed) and Lower Seal Replacement.

CRANKSHAFT MAIN BEARINGS

Bearing caps are not interchangeable and should be marked at removal to ensure correct assembly. Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of No.2 and 4 are interchangeable.

Upper and lower No.3 bearing halves are flanged to carry the crankshaft thrust loads. They are NOT interchangeable with any other bearing halves in the engine (Fig. 16). Bearing shells are available in standard and the following undersizes: 0.25 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch). Never install an undersize bearing that will reduce clearance below specifications.

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Identify bearing caps before removal. Remove bearing caps one at a time.

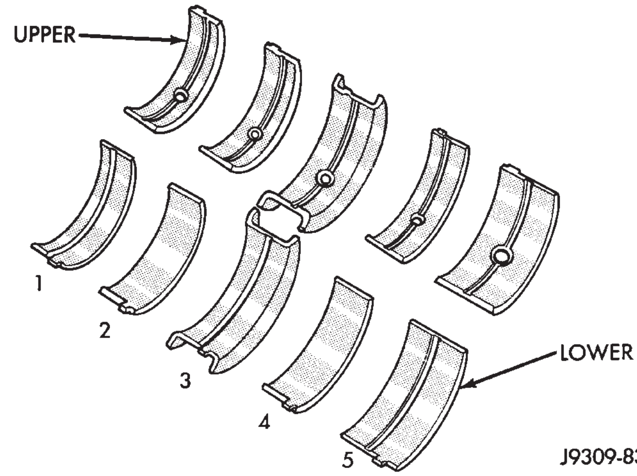

Fig. 16 Main Bearing Identification

(4) Remove upper half of bearing by inserting Crankshaft Main Bearing Remover/Installer Tool C-3059 into the oil hole of crankshaft (Fig. 17).

(5) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

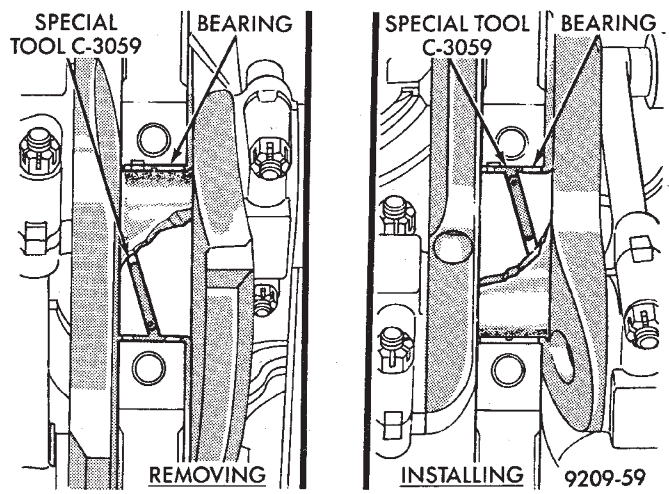

Fig. 17 Upper Main Bearing Removal and Installation with Tool C-3059

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened. All bearing capbolts removed during service procedures are to be cleaned and oiled before installation.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Crankshaft Main Bearing Remover/Installer Tool C-3059 into oil hole of crankshaft (Fig. 17).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.

(3) Install the bearing caps. Clean and oil the bolts. Tighten the capbolts to 115 N•m (85 ft. lbs.) torque.

(4) Install the oil pump.
(5) Install the oil pan.

CRANKSHAFT REAR OIL SEALS

The service seal is a 2 piece, viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new lower seal. The lower seal half can only be installed with the rear main bearing cap removed.

UPPER SEAL REPLACEMENT (CRANKSHAFT REMOVED)

(1) Remove the crankshaft.
(2) Lightly oil the new upper seal lips with engine oil.
(3) Install the new upper rear bearing oil seal with the yellow paint facing towards the rear of the engine.
(4) Position the crankshaft into the cylinder block.
(5) Lightly oil the new lower seal lips with engine oil.
(6) Install the new lower rear bearing oil seal into the bearing cap with the yellow paint facing towards the rear of the engine.
(7) Apply 5 mm (0.20 in) drop of Loctite 515, or equivalent, on each side of the rear main bearing cap (Fig. 18). Do not over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

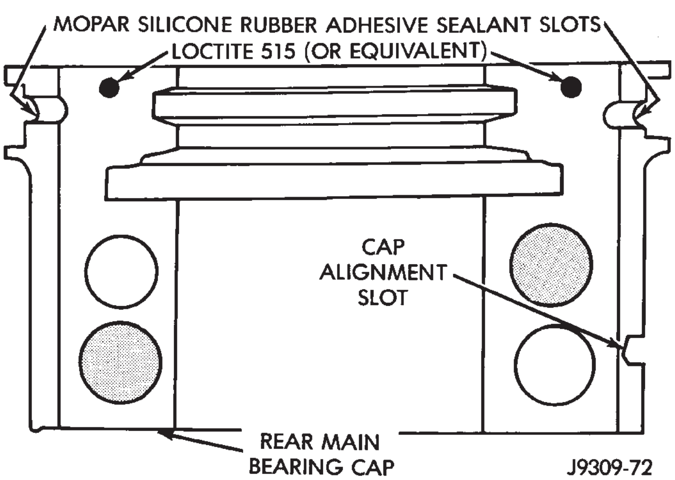

Fig. 18 Sealant Application to Bearing Cap

(8) To align the bearing cap, use cap slot, alignment dowel and cap bolts. Do not remove excess material after assembly. Do not strike rear cap more than 2 times for proper engagement.
(9) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N•m (85 ft. lbs.) torque.
(10) Install oil pump.
(11) Apply Mopar Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 19). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.
(12) Install new front crankshaft oil seal.
(13) Immediately install the oil pan.

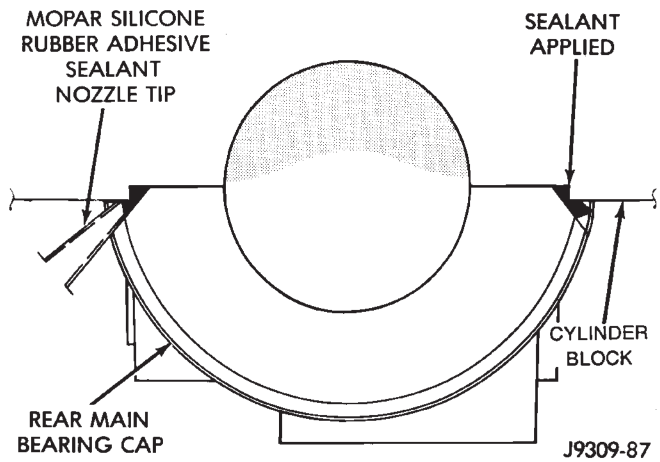

Fig. 19 Apply Sealant to Bearing Cap to Block Joint

UPPER SEAL REPLACEMENT (CRANKSHAFT INSTALLED)

(1) Remove the oil pan.
(2) Remove the oil pump from the rear main bearing cap.
(3) Remove the rear main bearing cap. Remove and discard the old lower oil seal.
(4) Carefully remove and discard the old upper oil seal.
(5) Lightly oil the new upper seal lips with engine oil. To allow ease of installation of the seal, loosen at least the 2 main bearing caps forward of the rear bearing cap.
(6) Rotate the new upper seal into the cylinder block being careful not to shave or cut the outer surface of the seal. To assure proper installation, use the installation tool provided with the kit. Install the new seal with the yellow paint facing towards the rear of the engine.
(7) Install the new lower rear bearing oil seal into the bearing cap with the yellow paint facing towards the rear of the engine.
(8) Apply 5 mm (0.20 in) drop of Loctite 515, or equivalent, on each side of the rear main bearing cap (Fig. 18). Do not over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application. Be sure the yellow paint faces toward the rear of the engine.
(9) To align the bearing cap, use cap slot, alignment dowel and cap bolts. Do not remove excess ma-

terial after assembly. Do not strike rear cap more than 2 times for proper engagement.

(10) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten ALL cap bolts to 115 N•m (85 ft. lbs.) torque.

(11) Install oil pump.

(12) Apply Mopar Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 19). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(13) Immediately install the oil pan.

LOWER SEAL REPLACEMENT

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Remove the rear main bearing cap and discard the old lower seal.

(4) Carefully install a new upper seal (refer to Upper Seal Replacement - Crankshaft Installed procedure above).

(5) Lightly oil the new lower seal lips with engine oil.

(6) Install a new lower seal in bearing cap with yellow paint facing the rear of engine.

(7) Apply 5 mm (0.20 in) drop of Loctite 515, or equivalent, on each side of the rear main bearing cap (Fig. 18). Do not over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(8) To align the bearing cap, use cap slot, alignment dowel and cap bolts. Do not remove excess material after assembly. Do not strike rear cap more than 2 times for proper engagement.

(9) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten the cap bolts to 115 N•m (85 ft. lbs.) torque.

(10) Install oil pump.

(11) Apply Mopar Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 19). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(12) Immediately install the oil pan.

CYLINDER BLOCK

Remove the engine assembly from the vehicle.

DISASSEMBLE

(1) Remove the cylinder head.

(2) Remove the oil pan.

(3) Remove the piston/connecting rod assembly.

CLEANING

Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

INSPECTION

Examine block for cracks or fractures.

The cylinder walls should be checked for out-of-round and taper with Cylinder Bore Indicator Tool C-119. The cylinder block should be bored and honed with new pistons and rings fitted if:

- The cylinder bores show more than 0.127 mm (0.005 inch) out-of-round.
- The cylinder bores show a taper of more than 0.254 mm (0.010 inch).
- The cylinder walls are badly scuffed or scored.

Boring and honing operation should be closely coordinated with the fitting of pistons and rings so specified clearances may be maintained.

Refer to Standard Service Procedures in the beginning of this Group for the proper honing of cylinder bores.

OIL LINE PLUG

The oil line plug is located in the vertical passage at the rear of the block between the Oil-To-Filter and Oil-From-Filter passages (Fig. 20). Improper installation or plug missing could cause erratic, low or no oil pressure.

(1) Remove oil pressure sending unit from back of block.

(2) Insert a 3.175 mm (1/8 inch) finish wire or equivalent into passage.

(3) Plug should be 190.0 to 195.2 mm (7-1/2 to 7-11/16 inches) from machined surface of block (Fig. 20). If plug is too high, use a suitable flat dowel drift to position properly.

(4) If plug is off location, remove oil pan and rear main bearing cap. Use suitable flat dowel to remove plug. Coat outside diameter of new plug with Mopar (Stud and Bearing Mount Adhesive), or equivalent. Plug should be 54.0 to 57.7 mm (2-1/8 to 2-5/16 inches) from bottom of the block.

(5) Assemble engine and check oil pressure.

ENGINE CORE, OIL AND CAMSHAFT PLUGS

Engine core plugs have been pressed into the oil galleries behind the camshaft thrust plate (Fig. 21). This will reduce internal leakage and help maintain higher oil pressure at idle.

REMOVAL

(1) Using a blunt tool such as a drift or a screwdriver and a hammer, strike the bottom edge of the cup plug (Fig. 22).

(2) With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 22).

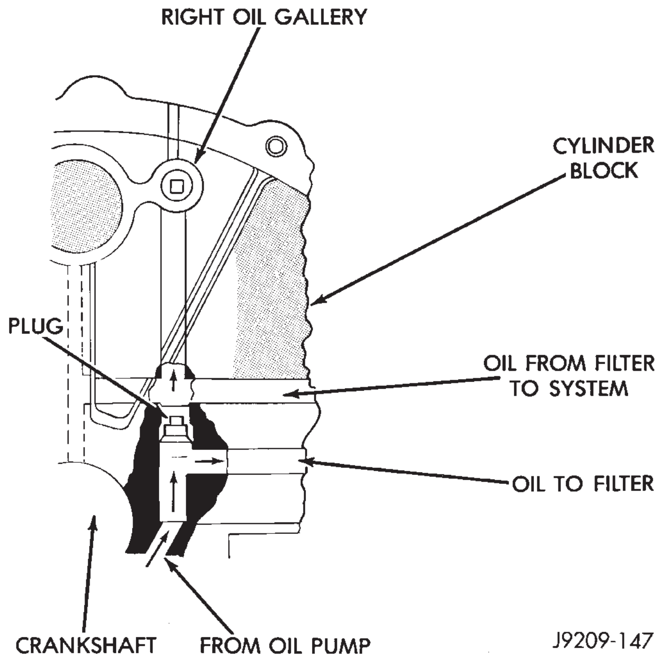

Fig. 20 Oil Line Plug

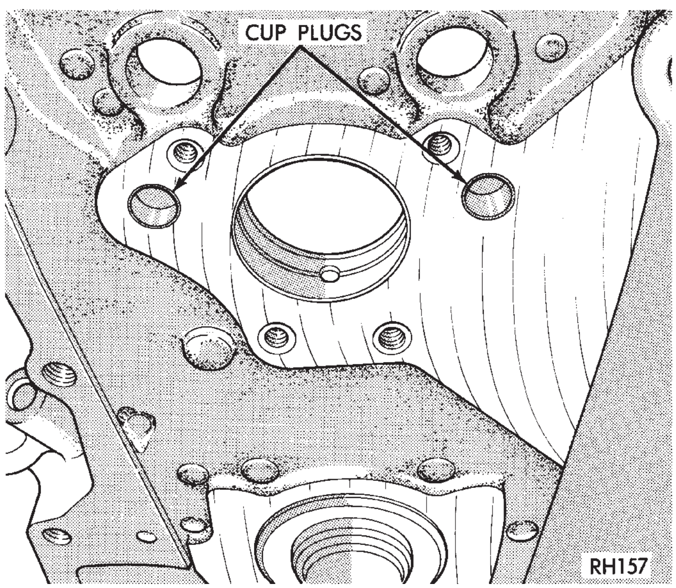

Fig. 21 Location of Cup Plugs in Oil Galleries

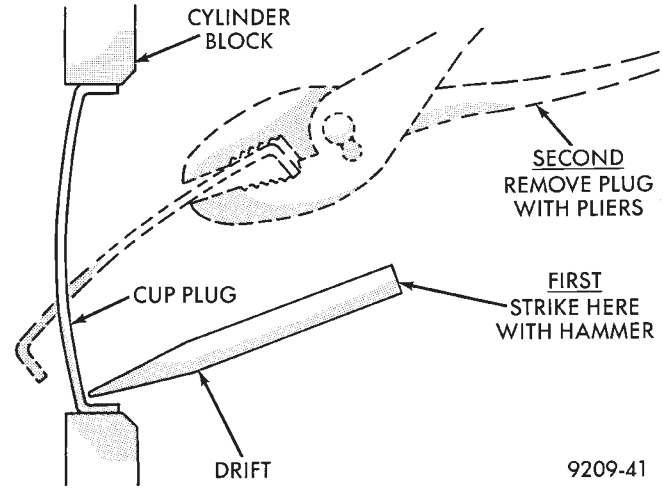

Fig. 22 Core Hole Plug Removal

CLEANING

Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer.

Make certain the new plug is cleaned of all oil or grease.

INSTALLATION

(1) Coat edges of plug and core hole with Mopar Gasket Maker, or equivalent.

CAUTION: DO NOT drive cup plug into the casting as restricted coolant flow can result and cause serious engine problems.

(2) Using proper drive plug, drive plug into hole. The sharp edge of the plug should be at least 0.50 mm (0.020 inch) inside the lead-in chamfer.

It is not necessary to wait for curing of the sealant. The cooling system can be filled and the vehicle placed in service immediately.

ASSEMBLE

(1) Install the piston/connecting rod assembly.
(2) Install the oil pan.
(3) Install the cylinder head.
(4) Install the engine into the vehicle.

1993 Grand Cherokee/Grand Wagoneer
Publication No. 81-370-3147
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SPECIFICATIONS—5.2L ENGINE

ENGINE SPECIFICATIONS

Camshaft

Bearing Diameter	
No. 1	50.800-50.825 mm (2.000-2.001 in)
No. 2	50.394-50.419 mm (1.984-1.985 in)
No. 3	50.013-50.038 mm (1.969-1.970 in)
No. 4	49.606-49.632 mm (1.953-1.954 in)
No. 5	39.688-39.713 mm (1.5625-1.5635 in)
Diametrical Clearance	0.0254-0.0762 mm (0.001-0.003 in)
Max. Allowable	0.127 mm (0.005 in)
End Play	0.051-0.254 mm (0.002-0.010 in)
Bearing Journal Diameter	
No. 1	50.749-50.775 mm (1.998-1.999 in)
No. 2	50.343-50.368 mm (1.982-1.983 in)
No. 3	49.962-49.987 mm (1.967-1.968 in)
No. 4	49.555-49.581 mm (1.951-1.952 in)
No. 5	39.637-39.662 mm (1.5605-1.5615 in)

Connecting Rods

Bearing Clearance	0.0127-0.0559 mm (0.0005-0.0022 in)
Piston Pin Bore Diameter	24.966-24.978 mm (0.9829-0.9834 in)
Side Clearance (Two Rods)	0.152-0.356 mm (0.006-0.014 in)
Total Weight (Less Bearing)	726 grams (25.61 oz)

Crankshaft

Connect Rod Journal	
Diameter	53.950-53.975 mm (2.124-2.125 in)
Out-of-Round (Max.)	0.0254 mm (0.001 in)
Taper (Max.)	0.0254 mm (0.001 in)
Diametrical Clearance	
No. 1	0.0127-0.0381 mm (0.0005-0.0015 in)
Nos. 2, 3, 4 and 5	0.0127-0.0508 mm (0.0005-0.0020 in)
Max. Allowable (Nos. 2, 3, 4 & 5)	0.0635 mm (0.0025 in)
End Play	0.051-0.178 mm (0.002-0.007 in)
Max. Allowable	0.254 mm (0.010 in)
Main Bearing Journals	
Diameter	63.487-63.513 mm (2.4995-2.5005 in)
Out-of-Round (Max.)	0.0254 mm (0.001 in)
Taper (Max.)	0.0254 mm (0.001 in)

Cylinder Block

Cylinder Bore	
Diameter	99.314-99.365 mm (3.910-3.912 in)
Out-of-Round (Max.)	0.127 mm (0.005 in)
Taper (Max.)	0.254 mm (0.010 in)
Oversize (Max.)	1.016 mm (0.040 in)
Distributor Lower Drive Shaft	
Bushing (Press Fit in Block)	0.0127-0.3556 mm (0.0005-0.0140 in)
Shaft-to-Bushing Clearance	0.0178-0.0686 mm (0.0007-0.0027 in)
Tappet Bore Diameter	22.99-23.01 mm (0.9051-0.9059 in)

Cylinder Head

Compression Pressure	689 kPa (100 psi)
Gasket Thickness (Compressed)	1.2065 mm (0.0475 in)
Valve Seat	
Angle	44.25° - 44.75°
Runout (Max.)	0.0762 mm (0.003 in)
Width (Finish) – Intake	1.016-1.524 mm (0.040-0.060 in)
Width (Finish) – Exhaust	1.524-2.032 mm (0.060-0.080 in)

Hydraulic Tappets

Body Diameter	22.949-22.962 mm (0.9035-0.9040 in)
Clearance in Block	0.0279-0.0610 mm (0.0011-0.0024 in)
Dry Lash	1.524-5.334 mm (0.060-0.210 in)
Push Rod Length	175.64–176.15 mm (6.915–6.935 in)

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ENGINE SPECIFICATIONS (CONT.)

Oil Pump

Clearance Over Rotors (Max.)	0.1016 mm (0.004 in)
Cover Out-of-Flat (Max.)	0.0381 mm (0.0015 in)
Inner Rotor Thickness (Min.)	20.955 mm (0.825 in)
Outer Rotor	
Clearance (Max.)	0.3556 mm (0.014 in)
Diameter (Min.)	62.7126 mm (2.469 in)
Thickness (Min.)	20.955 mm (0.825 in)
Tip Clearance Between Rotors (Max)	0.2032 mm (0.008 in)

Oil Pressure

At Curb Idle Speed*	41.4 kPa (6 psi)
At 3000 rpm	207-552 kPa (30-80 psi)
Oil Pressure Switch	
Actuating Pressure (Min.)	34.5-48.3 kPa (5-7 psi)

*CAUTION: If pressure is ZERO at curb idle, DO NOT run engine at 3,000 rpm.

Oil Filter

Bypass Valve Setting	62-103 kPa (9-15 psi)

Pistons

Clearance at Top of Skirt	0.0127-0.0381 mm (0.0005-0.0015 in)
Land Clearance (Diametrical)	0.635-1.016 mm (0.025-0.040 in)
Piston Length	86.360 mm (3.40 in)
Piston Ring Groove Depth	
Nos. 1 and 2	4.572-4.826 mm (0.180-0.190 in)
No. 3	3.810-4.064 mm (0.150-0.160 in)
Weight	592.6-596.6 grams (20.90-21.04 oz)

Piston Pins

Clearance	
In Piston	0.00635-0.01905 mm (0.00025-0.00075 in)
In Rod (Interference)	0.0178-0.0356 mm (0.0007-0.0014 in)
Diameter	24.996-25.001 mm (0.9841-0.9843 in)
End Play	NONE
Length	75.946-76.454 mm (2.990-3.010 in)

Piston Rings

Ring Gap	
Compression Rings	0.254-0.508 mm (0.010-0.020 in)
Oil Control (Steel Rails)	0.254-1.270 mm (0.010-0.050 in)
Ring Side Clearance	
Compression Rings	0.038-0.076 mm (0.0015-0.0030 in)
Oil Ring (Steel Rails)	0.06-0.21 mm (0.002-0.008 in)
Ring Width	
Compression Rings	1.971-1.989 mm (0.0776-0.0783 in)
Oil Ring (Steel Rails)	3.848-3.975 mm (0.1515-0.1565 in)

Valves

Face Angle	43.25°-43.75°
Head Diameter	
Intake	48.666 mm (1.916 in)
Exhaust	41.250 mm (1.624 in)
Length (Overall)	
Intake	124.28-125.92 mm (4.893-4.918 in)
Exhaust	124.64-125.27 mm (4.907-4.932 in)
Lift (Zero Lash)	10.973 mm (0.432 in)
Stem Diameter	7.899-7.925 mm (0.311-0.312 in)
Stem-to-Guide Clearance	0.0254-0.0762 mm (0.001-0.003 in)
Max. Allowable (Rocking Method)	0.4318 mm (0.017 in)
Guide Bore Diameter (Std)	7.950-7.976 mm (0.313-0.314 in)

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ENGINE SPECIFICATIONS (CONT.)

Valve Springs

Free Length (Approx.)	49.962 mm (1.967 in)
Spring Tension (Valve Closed)	@ 41.66 mm = 378 N (@ 1.64 in = 85 lbs)
Spring Tension (Valve Open)	@ 30.89 mm = 890 N (@ 1.212 in = 200 lbs)
Number of Coils	6.8
Installed Height (Spring Seat to Retainer)	41.66 mm (1.64 in)
Wire Diameter	4.50 mm (0.177 in)

Valve Timing

Exhaust Valve	
Closes (ATC)	16°
Opens (BBC)	52°
Duration	248°
Intake Valve	
Closes (ABC)	50°
Opens (BTC)	10°
Duration	240°
Valve Overlap	26°

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OVERSIZE AND UNDERSIZE ENGINE COMPONENT MARKINGS

CONDITION	IDENTIFICATION	LOCATION OF IDENTIFICATION
CRANKSHAFT JOURNALS (UNDERSIZE) 0.0254 mm (0.001 in.)	R or M M-2-3 etc. (indicating no. 2 and 3 main bearing journal) and/or R-1-4 etc. (indicating no. 1 and 4 connecting rod journal)	Milled flat on no. 8 crankshaft counterweight.
HYDRAULIC TAPPETS (OVERSIZE) 0.2032 mm (0.008 in.)	♦	Diamond-shaped stamp top pad – front of engine and flat ground on outside surface of each O/S tappet bore.
VALVE STEMS (OVERSIZE) 0.127 mm (0.005 in.)	X	Milled pad adjacent to two tapped holes (3/8 in.) on each end of cylinder head.

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TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Adjusting Strap Bolt	23 N·m (200 in. lbs.)
Bell Housing Bolts	41 N·m (30 ft. lbs.)
Camshaft Bolt	68 N·m (50 ft. lbs.)
Camshaft Thrust Plate Bolts	24 N·m (210 in. lbs.)
Chain Case Cover Bolts	41 N·m (30 ft. lbs.)
Connecting Rod Cap Bolts	61 N·m (45 ft. lbs.)
Crankshaft Main Bearing Cap Bolts	115 N·m (85 ft. lbs.)
Cylinder Head Bolts	
1st Step	68 N·m (50 ft. lbs.)
2nd Step	143 N·m (105 ft. lbs.)
Cylinder Head Collar Studs	13 N·m (115 in. lbs.)
Cylinder Head Cover Bolts	11 N·m (95 in. lbs.)
Exhaust Manifold Bolts	27 N·m (20 ft. lbs.)
Exhaust Manifold Nuts	20 N·m (15 ft. lbs.)
Front Left Sill Bracket	
Top Bolts	54 N·m (40 ft. lbs.)
Side Nuts	95 N·m (70 ft. lbs.)
Side and Bottom Bolts	121 N·m (89 ft. lbs.)
Front Right Inner Sill Bracket Stud-Nut	65 N·m (48 ft. lbs.)
Front Right Sill Bracket Bolts	54 N·m (40 ft. lbs.)
Front Support Bracket Through-Bolt Nuts	68 N·m (50 ft. lbs.)
Front Support Bracket-to-Engine Block Bolts	88 N·m (65 ft. lbs.)
Generator Mounting Bolt	41 N·m (30 ft. lbs.)
Intake Manifold Bolts	Refer to Procedure in Service Manual
Oil Pan Bolts	24 N·m (215 in. lbs.)
Oil Pan Drain Plug	27 N·m (20 ft. lbs.)
Oil Pump Attaching Bolts	41 N·m (30 ft. lbs.)
Oil Pump Cover Bolts	11 N·m (95 in. lbs.)
Rear Mount Bracket Through-Bolt Nut	65 N·m (48 ft. lbs.)
Rear Mount Bracket Assembly Bolts	75 N·m (55 ft. lbs.)
Rear Mount Clevis Bracket-to-Crossmember Stud-Nuts	41 N·m (30 ft. lbs.)
Rocker Arm Bolts	28 N·m (21 ft. lbs.)
Spark Plugs	41 N·m (30 ft. lbs.)
Starter Mounting Bolts	68 N·m (50 ft. lbs.)
Throttle Body Bolts (MPI)	23 N·m (20o in. lbs.)
Torque Converter Drive Plate Bolts	31 N·m (270 in. lbs.)
Transmission Support Bracket Adaptor Bolts	95 N·m (70 ft. lbs.)
Transmission-to-Clutch Bolts	68 N·m (50 ft. lbs.)
Vibration Damper Retainer Bolt	183 N·m (135 ft. lbs.)
Water Pump-to-Chain Case Cover Bolt	41 N·m (30 ft. lbs.)

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EXHAUST SYSTEM AND INTAKE MANIFOLD

CONTENTS

EXHAUST SYSTEM

GENERAL INFORMATION

The basic exhaust system consists of exhaust manifold(s), exhaust pipe with oxygen sensor, catalytic converter, heat shield(s), muffler and tailpipe (Fig. 1 or 2).

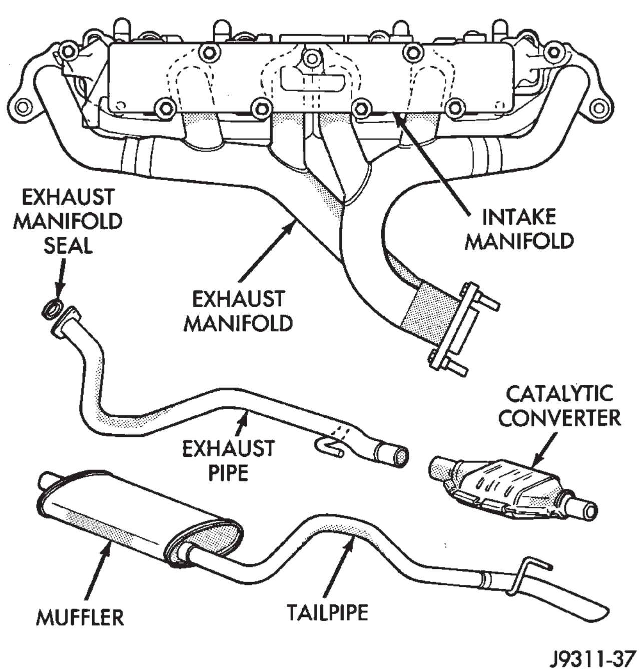

Fig. 1 Exhaust System (4.0L Engine)

The exhaust system uses a single muffler with a single monolithic-type catalytic converter.

The 4.0L engines use a seal between the exhaust manifold and exhaust pipe to assure a tight seal and strain free connections.

The 5.2L exhaust manifolds are equipped with ball flange outlets to assure a tight seal and strain free connections.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. If the system contacts any body panel, it may amplify objectionable noises originating from the engine or body.

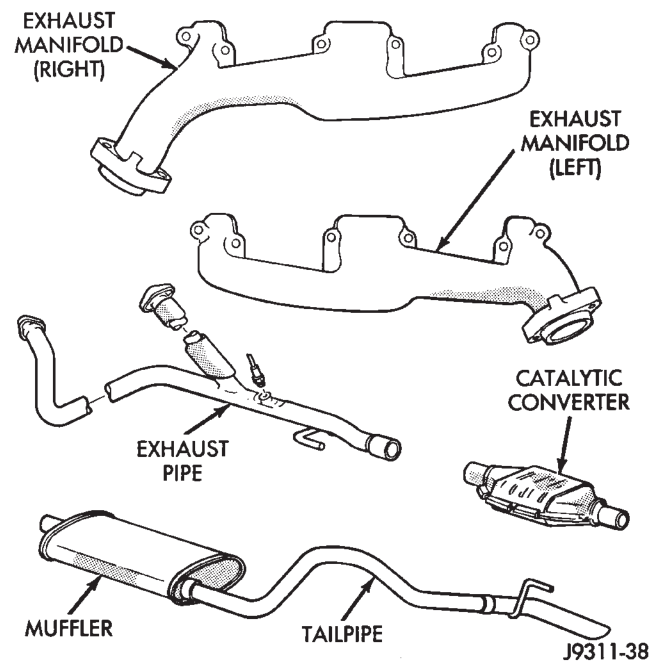

Fig. 2 Exhaust System (5.2L Engine)

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 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.

HEAT SHIELDS

Heat shields are needed to protect both the vehicle and the environment from the high temperatures developed by the catalytic converter (Fig. 3 or 4). The catalytic converter releases additional heat into the exhaust system. Under severe operating conditions, the temperature increases in the area of the converter. Such conditions can exist when the engine misfires or otherwise does not operate at peak efficiency.

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 GAS RECIRCULATION (EGR)

To assist in the control of oxides of nitrogen (NOx) in engine exhaust, all engines are equipped with an exhaust gas recirculation system. The use of exhaust gas to dilute incoming air/fuel mixtures lowers peak flame temperatures during combustion, thus limiting the formation of NOx.

Exhaust gases are piped from the exhaust manifold to the intake manifold through an EGR tube. Refer to Group 25, Emission Control Systems for complete description, diagnosis and service procedures of the exhaust gas recirculation system and components.

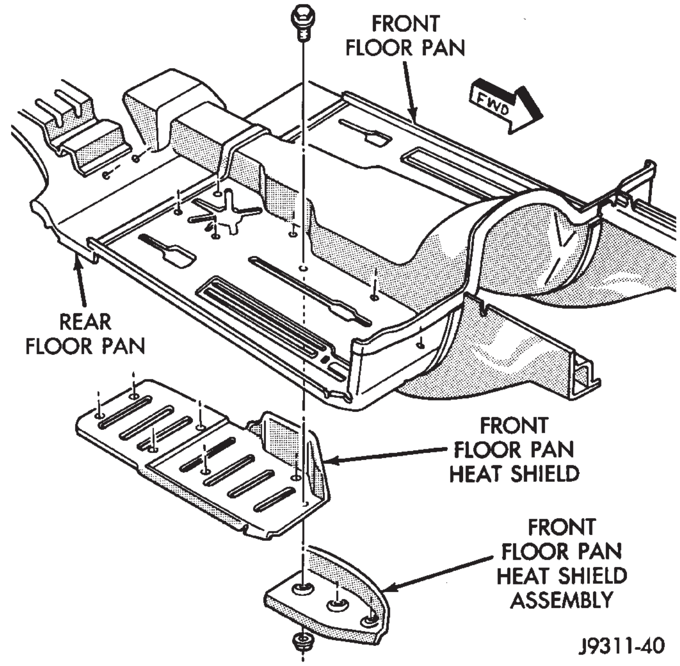

Fig. 3 Front Floor Pan Heat Shield

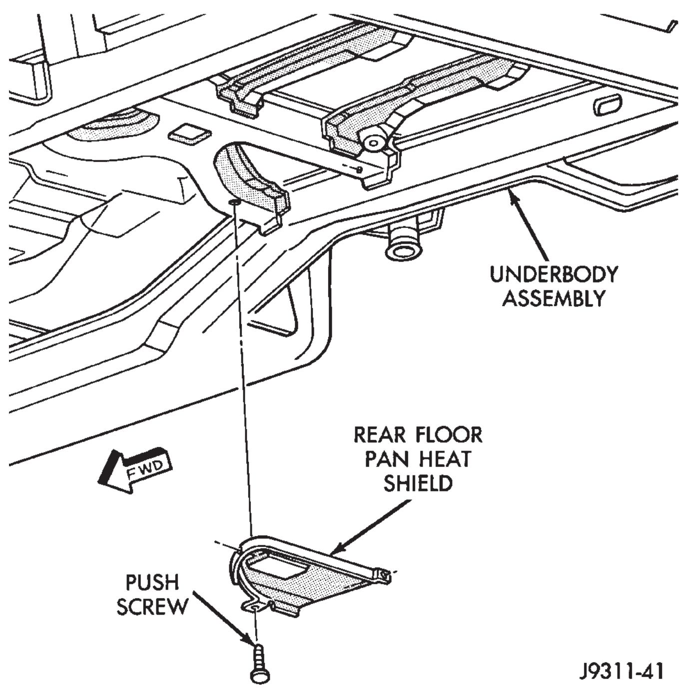

Fig. 4 Rear Floor Pan Heat Shield

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.

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SERVICE PROCEDURES

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EXHAUST PIPE

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. Allow 5 minutes for penetration.

(3) Remove the oxygen sensor from the exhaust pipe (Fig. 1 or 2).

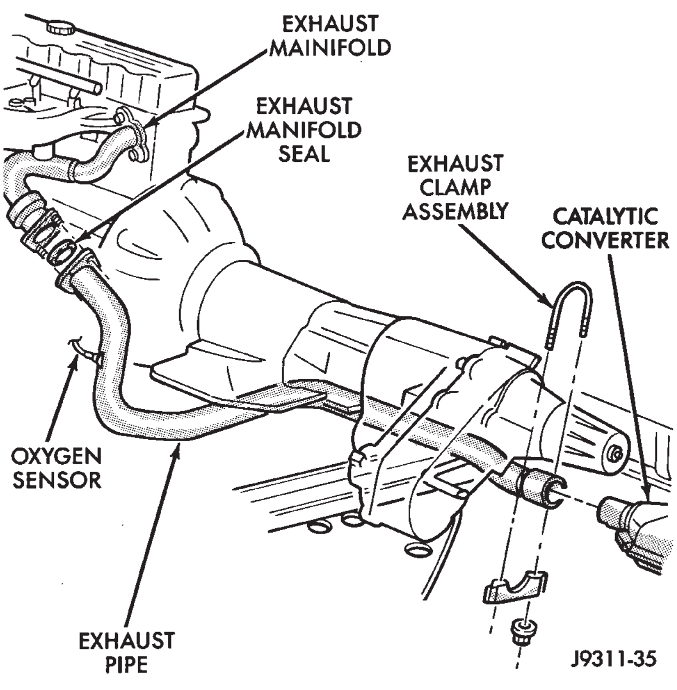

Fig. 1 Exhaust Pipe (4.0L Engine)

(4) Disconnect the exhaust pipe from the engine exhaust manifold. On 4.0L engines, discard the exhaust manifold seal (Fig. 1).

(5) Remove the exhaust clamp and nuts from the exhaust pipe and catalytic converter connection (Fig. 1 or 2). Disconnect the exhaust pipe from the catalytic converter. If needed:

(a) Heat the exhaust pipe and catalytic converter connection with an torch until the metal becomes cherry red.

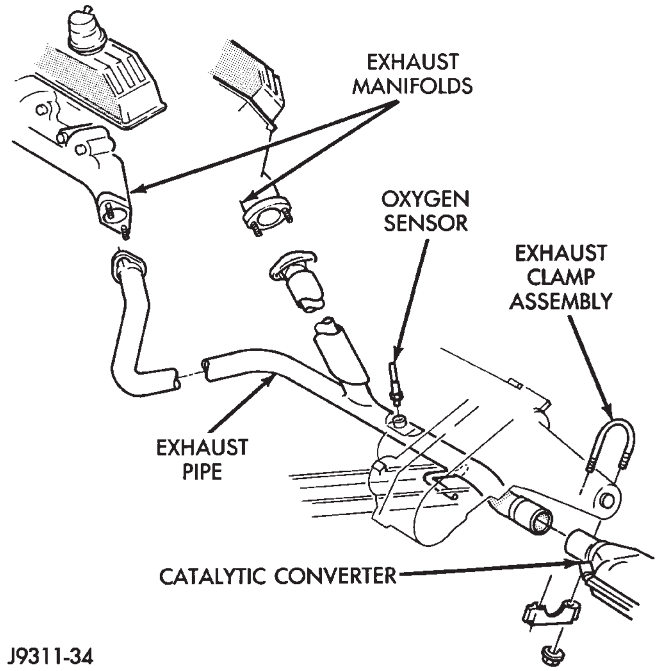

Fig. 2 Exhaust Pipe (5.2L Engine)

(b) While the metal is still cherry red, twist the exhaust pipe back and forth to separate it from the catalytic converter.

(6) Disconnect the exhaust pipe hanger from the rear mount bracket insulator (Fig. 3).

(7) Remove the exhaust pipe.

INSTALLATION

(1) Position the exhaust pipe onto the catalytic converter.

(2) Connect the exhaust pipe hanger to the rear mount bracket insulator.

(3) On 4.0L engines, install a new seal between the exhaust pipe and the engine exhaust manifold (Fig. 1). Connect the exhaust pipe to the engine exhaust manifold. Tighten the nuts to 31 N●m (23 ft. lbs.) torque.

(4) Position the exhaust clamp assembly over the exhaust pipe/catalytic converter connection (Fig. 1 or 2). Tighten the nuts to 34 N●m (25 ft. lbs.) torque.

(5) Coat the oxygen sensor with anti-seize compound. Install the sensor and tighten the nut to 48 N●m (35 ft. lbs.) torque.

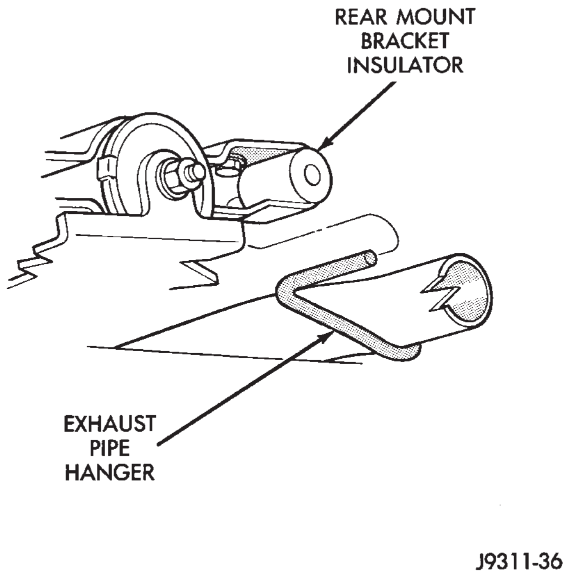

Fig. 3 Rear Mount Bracket Insulator

(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.

(8) After initial start-up, check the engine exhaust manifold to exhaust pipe nuts for proper torque.

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) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.

(3) Remove the clamp and nuts from the catalytic converter and exhaust pipe connection (Fig. 4).

(4) Remove the clamp and nuts from the catalytic converter and muffler connection (Fig. 4).

(5) Heat the exhaust pipe, catalytic converter and muffler connections with an torch until the metal becomes cherry red.

(6) While the metal is still cherry red, twist the catalytic converter back and forth to separate it from the exhaust pipe and the muffler.

INSTALLATION

(1) Position the exhaust clamp assembly over the exhaust pipe/catalytic converter connection (Fig. 4). Tighten the nuts to 34 N●m (25 ft. lbs.) torque.

(2) Install the muffler onto the catalytic converter until the alignment tab is inserted into the alignment slot.

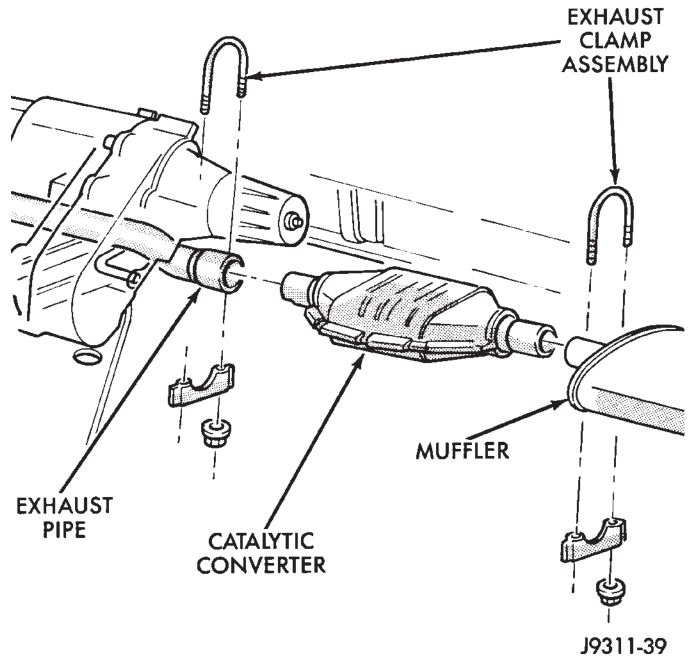

Fig. 4 Exhaust Pipe-to-Catalytic Converter-to-Muffler Connection

(3) Install the exhaust clamp assembly at the muffler and catalytic converter connection (Fig. 4). Tighten the clamp nuts to 34 N●m (25 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 TAILPIPE

All original equipment exhaust systems are manufactured with the tailpipe welded to a stamped muffler. Service replacement mufflers and 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) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.

(3) Remove the exhaust clamp and nuts from the catalytic converter and muffler connection (Fig. 4).

(4) Heat the catalytic converter-to-muffler connection with an torch until the metal becomes cherry red.

(5) While the metal is still cherry red, remove the tail pipe/muffler assembly from the catalytic converter.

(6) Remove the tailpipe from the tailpipe hanger (Fig. 5).

(7) Remove the tailpipe/muffler assembly.

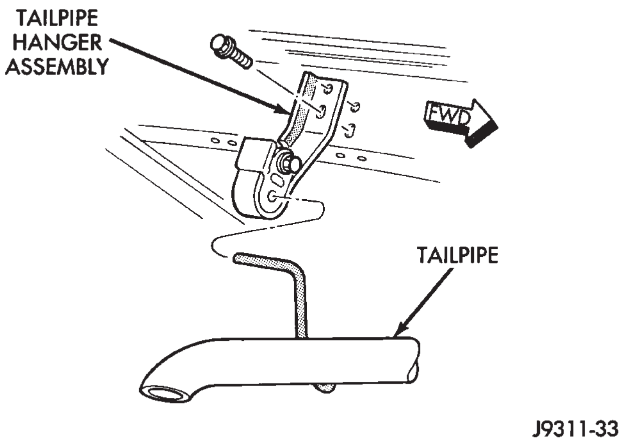

Fig. 5 Tailpipe Hanger

INSTALLATION

(1) If the tailpipe hanger assembly was removed, install the hanger to the frame. Tighten the bolts to 22 N●m (192 in. lbs.) torque.

(2) Position the tailpipe and muffler onto the tailpipe hanger (Fig. 5).

(3) Install the muffler onto the catalytic converter. Make sure that the tailpipe has sufficient clearance from the floor pan. Install the exhaust clamp assembly and tighten the nuts to 34 N●m (25 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.

EXHAUST MANIFOLD—4.0L ENGINE

The intake and engine exhaust manifold must be removed and installed together. The manifolds use a common gasket at the cylinder head.

Refer to Intake Manifold in this section for the proper removal and installation procedures.

INTAKE MANIFOLD—4.0L ENGINE

The intake and engine exhaust manifold must be removed and installed together. The manifolds use a common gasket at the cylinder head.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove air cleaner inlet hose from throttle plate assembly.

(3) Remove the air cleaner assembly.

(4) Remove the throttle cable, vehicle speed 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 system 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.

INSTALLATION

If the manifold is being replaced, ensure all the fitting, etc. are transferred to the replacement manifold.

(1) Install a new engine 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. 6).

(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. 6).

(5) Install washers and fasteners Nos.6 and 7 (Fig. 6).

(6) Tighten the fasteners in sequence and to the specified torque (Fig. 6).

- Fasteners Nos.1 through 5—Tighten to 33 N●m (24 ft. lbs.) torque.
- Fasteners Nos.6 and 7—Tighten to 23 N●m (17 ft. lbs.) torque.
- Fasteners Nos.8 through 11—Tighten to 33 N●m (24 ft. lbs.) torque.

(7) Install the fuel rail and injectors (refer to Group 14, Fuel System).

(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 system supply and return lines to the fuel rail assembly. **Before connecting the fuel system 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.

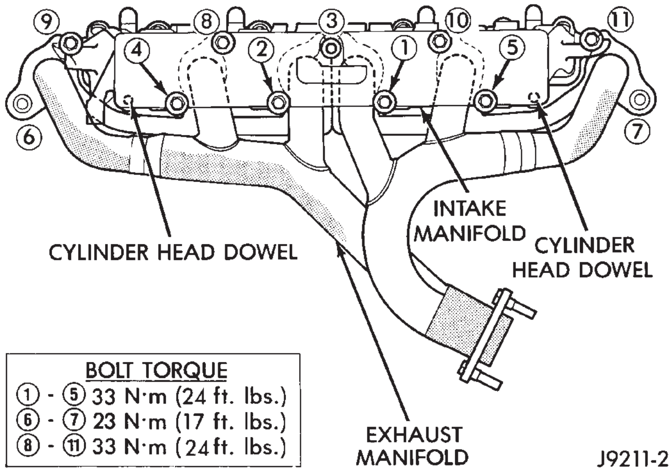

Fig. 6 Engine Exhaust/Intake Manifold

(12) Install throttle cable, vehicle speed 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) Use a new engine exhaust manifold seal. Connect the exhaust pipe to the engine exhaust manifold.

(18) Lower the vehicle.

(19) Connect the negative cable to the battery.

(20) Start the engine and check for leaks.

INTAKE MANIFOLD—5.2L ENGINE

The aluminum intake manifold is a single plane design with equal length runners. The manifold is sealed by flange side gaskets with front and rear cross-over gaskets. The intake manifold has internal EGR.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain the cooling system (refer to Group 7, Cooling System for the proper procedures).

(3) Remove the generator (refer to Group 8B Battery/Starting/Charging Systems).

(4) Remove the air cleaner.

(5) Remove the fuel lines and fuel rail (refer to Group 14, Fuel System).

(6) Disconnect the accelerator linkage and, if so equipped, the speed control and transmission kick-down cables.

(7) Remove the return spring.

(8) Remove the distributor cap and wires.

(9) Disconnect the coil wires.

(10) Disconnect the heat indicator sending unit wire.

(11) Disconnect the heater hoses and bypass hose.

(12) Remove the closed crankcase ventilation and evaporation control systems.

(13) Remove the A/C compressor bolts and set the compressor on the fan shroud.

(14) Remove the support bracket from the intake manifold and the mounting bracket.

(15) Remove intake manifold bolts.

(16) Lift the intake manifold and throttle body out of the engine compartment as an assembly.

(17) Remove and discard the flange side gaskets and the front and rear cross-over gaskets.

(18) Remove the throttle body bolts and lift the throttle body off the intake manifold (Fig. 7). Discard the throttle body gasket.

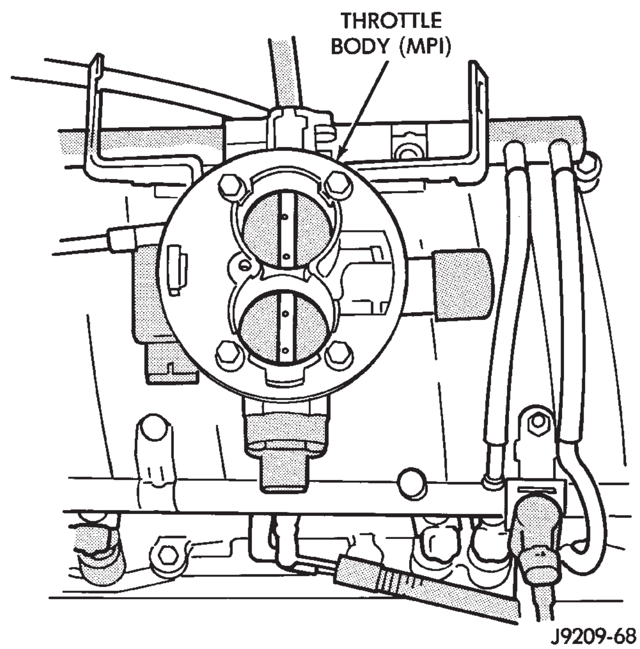

Fig. 7 Throttle Body Assembly (MPI)

(19) Remove the plenum pan as follows:

(a) Turn the intake manifold upside down. Support the manifold.

(b) Remove the bolts and lift the pan off the manifold. Discard the gasket.

CLEANING

Clean manifold in solvent and blow dry with compressed air.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

The plenum pan rail must be clean and dry (free of all foreign material).

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straightedge.

INSTALLATION

(1) Install the plenum pan, if removed, as follows:

(a) Turn the intake manifold upside down. Support the manifold.

(b) Place a new plenum pan gasket onto the seal rail of the intake manifold. Position the pan over the gasket. Align all the gasket and pan holes with the intake manifold.

(c) Hand start all bolts.

(d) Tighten the bolts, in sequence (Fig. 8), as follows:

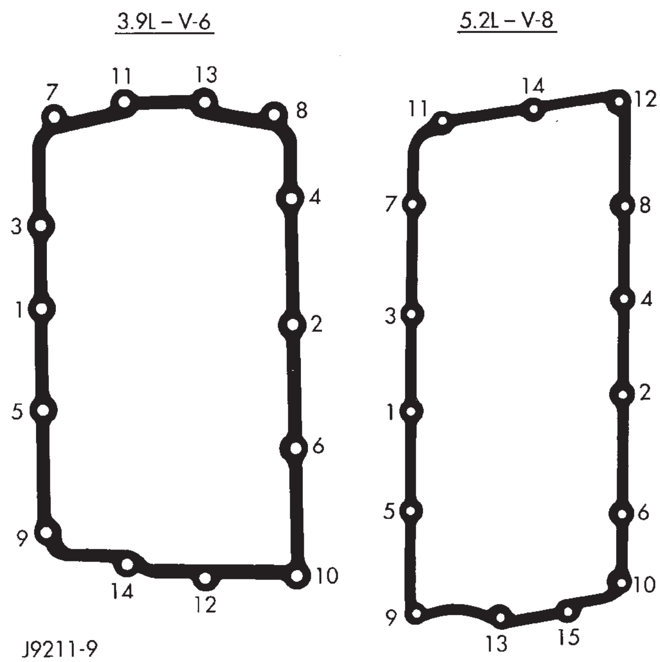

Fig. 8 Plenum Pan Bolt Tightening Sequence

• Step 1—Tighten bolts to 2.7 N•m (24 in. lbs.) torque.

• Step 2—Tighten bolts to 5.4 N•m (48 in. lbs.) torque.

• Step 3—Tighten bolts to 9.5 N•m (84 in. lbs.) torque.

• Step 4—Check that all bolts are tighten to 9.5 N•m (84 in. lbs.) torque.

(2) Using a new gasket, install the throttle body onto the intake manifold. Tighten the bolts to 23 N•m (200 in. lbs.) torque.

(3) Place the 4 plastic locator dowels into the holes in the block Fig. 9).

(4) Apply Mopar Silicone Rubber Adhesive Sealant, or equivalent, to the four corner joints. An excessive amount of sealant is not required to ensure a leak proof seal. However, an excessive amount of sealant may reduce the effectiveness of the flange gasket. The sealant should be slightly higher than the cross-over gaskets, approx. 5 mm (0.2 in).

(5) Install the front and rear cross-over gaskets onto the dowels (Fig. 9).

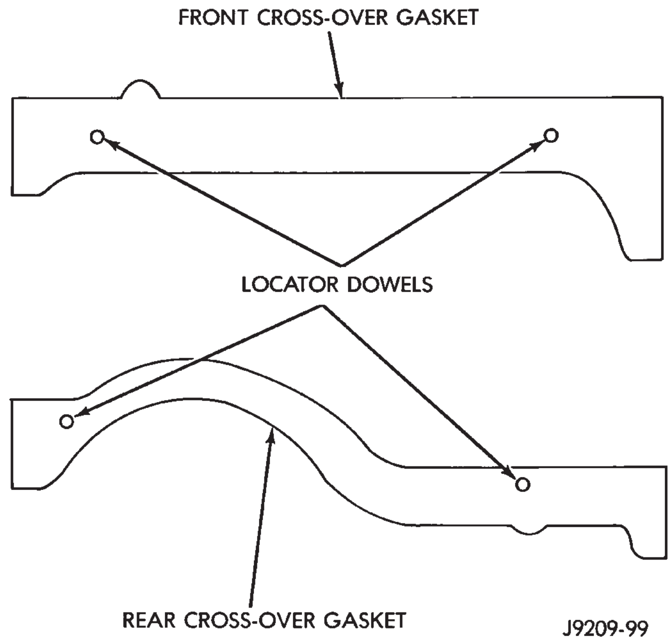

Fig. 9 Cross-Over Gaskets and Locator Dowels

(6) Install the flange gaskets. Ensure that the vertical port alignment tab is resting on the deck face of the block. Also the horizontal alignment tabs must be in position with the mating cylinder head gasket tabs (Fig. 10). The words MANIFOLD SIDE should be visible on the center of each flange gasket.

(7) Carefully lower intake manifold into position on the cylinder block and cylinder heads. Use the alignment dowels in the cross-over gaskets to position the intake manifold. After intake manifold is in place, inspect to make sure seals are in place.

(8) The following torque sequence duplicates the expected results of the automated assembly system (Fig. 11).

• Step 1—Tighten bolts 1 through 4, in sequence, to 8 N•m (72 in. lbs.) torque. Tighten in alternating steps 1.4 N•m (12 in. lbs.) torque at a time.

• Step 2—Tighten bolts 5 through 12, in sequence, to 8 N•m (72 in. lbs.) torque.

• Step 3—Check that all bolts are tighten to 8 N•m (72 in. lbs.) torque.

• Step 4—Tighten all bolts, in sequence, to 16 N•m (12 ft. lbs.) torque.

• Step 5—Check that all bolts are tighten to 16 N•m (12 ft. lbs.) torque.

(9) Install closed crankcase ventilation and evaporation control systems.

(10) Install the coil wires.

(11) Connect the heat indicator sending unit wire.

(12) Connect the heater hoses and bypass hose.

(13) Install distributor cap and wires.

(14) Hook up the return spring.

(15) Connect the accelerator linkage and, if so equipped, the speed control and transmission kick-down cables.

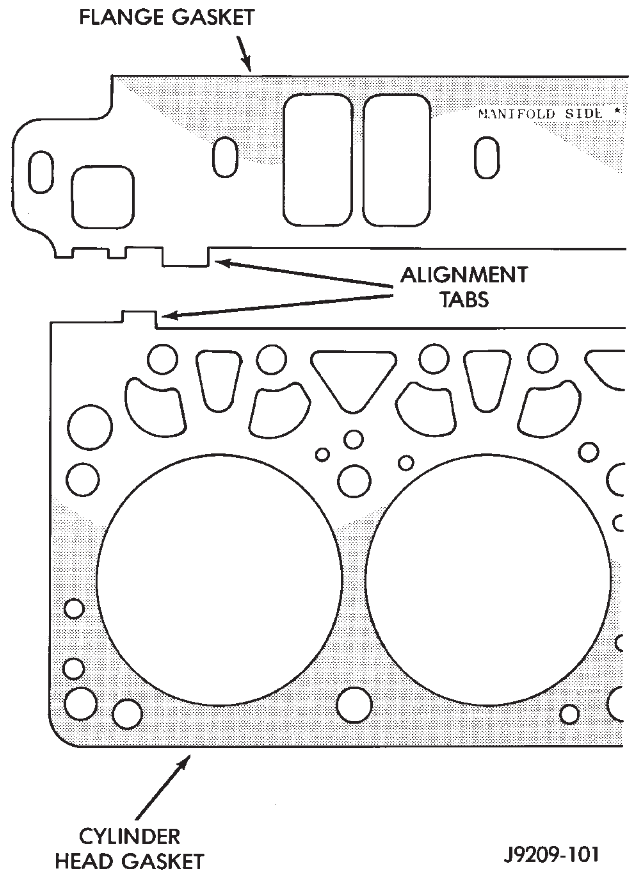

Fig. 10 Intake Manifold Flange Gasket Alignment

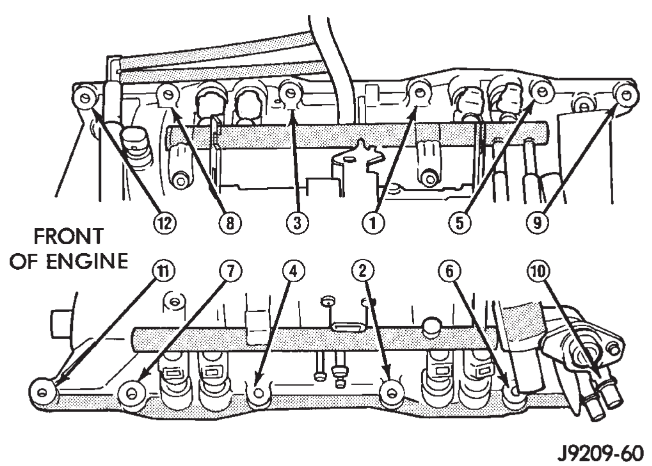

Fig. 11 Intake Manifold Bolt Tightening Sequence

(16) Install the fuel lines and fuel rail (refer to Group 14, Fuel System).

(17) Install the support bracket to the intake manifold and the mounting bracket.

(18) Install the generator and drive belt. Tighten generator mounting bolt to 41 N•m (30 ft. lbs.) torque. Tighten the adjusting strap bolt to 23 N•m (200 in. lbs.) torque. Refer to Group 7, Cooling System for the proper adjusting of belt tension.

(19) Install the A/C compressor on the mounting bracket (refer to Group 24, Heating and Air Conditioning).

(20) Install the air cleaner.

(21) Fill cooling system (refer to Group 7, Cooling System for the proper procedure).

(22) Connect the negative cable to the battery.

EXHAUST MANIFOLD—5.2L ENGINE

Exhaust manifolds are LOG type with balanced flow.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove the exhaust manifold heat shields (Fig. 12).

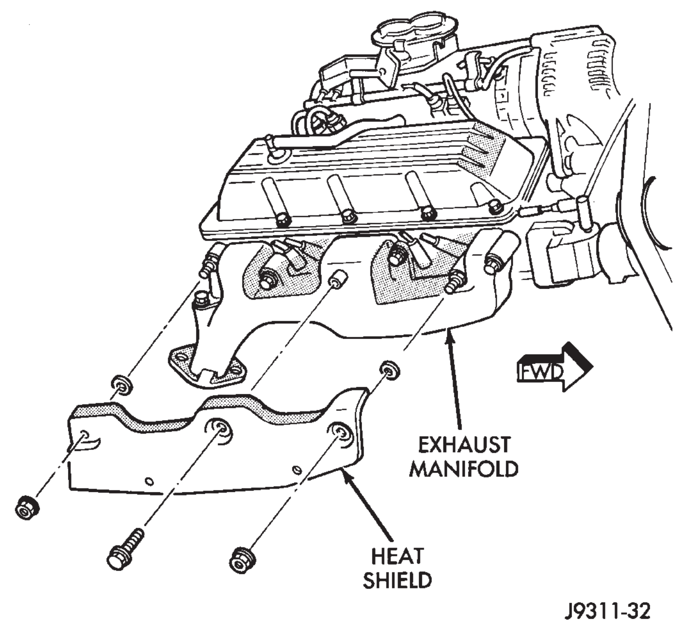

Fig. 12 Exhaust Manifold Heat Shields (Left Shield Shown)

(3) Remove the ERG tube (refer to Group 25, Emission Control Systems).

(4) Raise the vehicle.

(5) Remove the bolts and nuts attaching the exhaust pipe to the exhaust manifold.

(6) Lower the vehicle.

(7) Remove bolts, nuts and washers attaching manifold to cylinder head.

(8) Remove manifold from the cylinder head.

CLEANING

Clean mating surfaces on cylinder head and manifold, wash with solvent and blow dry with compressed air. Inspect manifold for cracks.

INSPECTION

Inspect mating surfaces of manifold for flatness with a straight edge. Seal surfaces must be flat within 0.1 mm (0.004 inch) overall.

INSTALLATION

CAUTION: If the studs came out with the nuts when removing the exhaust manifold, install new studs.

(1) Position the exhaust manifolds on the two studs located on the cylinder head. Install conical washers and nuts on these studs (Fig. 13).

(2) Install new bolt and washer assemblies in the remaining holes (Fig. 13). Start at the center arm and work outward. Tighten the bolts and nuts to 34 N●m (25 ft. lbs.) torque.

(3) Raise the vehicle.

(4) Assemble the exhaust pipe to the exhaust manifold and secure with bolts, nuts and washers. Tighten these nuts to 31 N●m (23 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Install the EGR tube (refer to Group 25, Emission Control Systems).

CAUTION: The exhaust manifold heat shields MUST be installed to protect the underhood components.

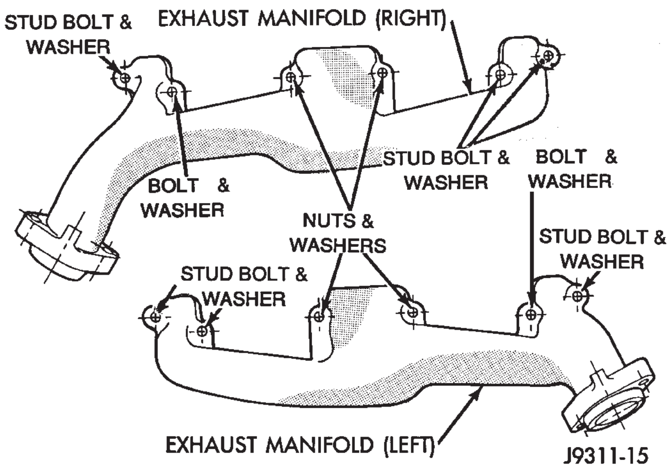

Fig. 13 Exhaust Manifold

(7) Install the exhaust manifold heat shields. Tighten the nuts to 27 N●m (20 ft. lbs.) torque.

(8) Connect the negative cable to the battery.

TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Adjusting Strap Bolt	23 N·m (200 in. lbs.)
Catalytic Converter-to-Exhaust Pipe Clamp Nuts	34 N·m (25 ft. lbs.)
Exhaust Pipe-to-Manifold Nuts	31 N·m (23 ft. lbs.)
Exhaust/Intake Manifold Nut/ Bolts #1-5 & #8-11 (4.0L)	33 N·m (24 ft. lbs.)
Exhaust Manifold Heat Shield Nuts (5.2L)	27 N·m (20 ft. lbs.)
Exhaust Manifold Nuts #6 & 7 (4.0L Engine)	23 N·m (17 ft. lbs.)
Exhaust Manifold Nuts/Bolts (5.2L Engine)	34 N·m (25 ft. lbs.)
Generator Mounting Bolts	41 N·m (30 ft. lbs.)

DESCRIPTION	TORQUE
Intake Manifold Bolts (5.2L)	Refer to Procedure in Service Manual
Muffler-to-Catalytic Converter Clamp Nuts	34 N·m (25 ft. lbs.)
Oxygen Sensor	48 N·m (35 ft. lbs.)
Plenum Pan Bolts (5.2L)	Refer to Procedure in Service Manual
Rear Tailpipe Hanger Assembly	22 N·m (192 in. lbs.)
Throttle Body (5.2L)	23 N·m (200 in. lbs.)

J9311-42

FRAME AND BUMPERS

CONTENTS

FRAME

GENERAL INFORMATION

Jeep® Grand Cherokee vehicles do not have a conventional frame (Fig. 1). They are constructed as a unitized body and frame. Jeep® unibodies are constructed from special high-strength steel and coated metals. This process reduces weight and provides strength to withstand the forces applied against structural members. The structural members provide a unibody that has great structural strength.

A vehicle is designed within a three dimensional grid partitioned into 100 mm (3.92 in.) cubes. The lines that make the grid run in three planes defined as X, Y and Z (Fig 1.). The X-plane extends from the front to the rear of the vehicle. The Y-plane extends from 50 mm (2.00 in.) below the frame rails upward (Datum). The Z-plane extends from the center line (C/L) of the vehicle outward. The Zero point of the grid is located 50 mm (2.00 in.) below the front Principle Location Points (PLPs) at the center line of the vehicle. Most Z-plane dimensions are symmetrical to the center line.

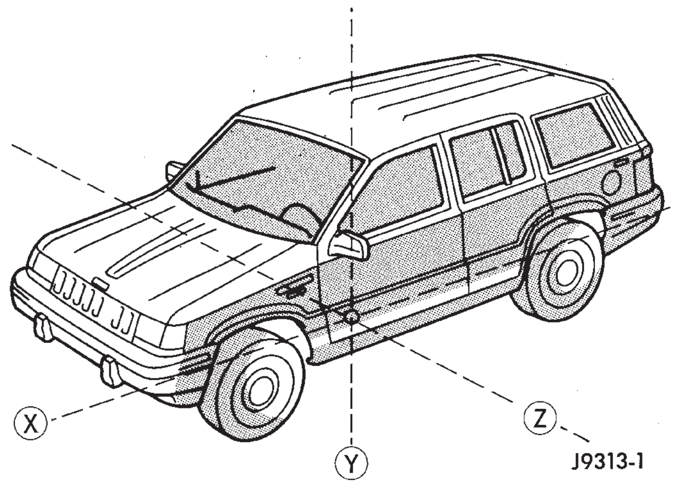

Fig. 1 Grand Cherokee

COLLISION DAMAGE

DAMAGE DIAGNOSIS

A unibody reacts differently to impact than a vehicle with a conventional frame. While damage at the point of impact is noticed, the extent of hidden damage must be diagnosed to expose it.

With unibody construction, there are five logical areas to examine to expose damage.

- (1) Damage at immediate point of impact—primary damage.
- (2) Other body damage—secondary damage.
- (3) Damage to exterior trim and other attached components.
- (4) Damage to mechanical components.
- (5) Interior trim and accessory damage.

DAMAGE REPAIR

A logical approach to damage repair must be used. Usually, the repairs are done in the reverse order of consequence.

Also, when there is damage to a unibody, the critical alignment points must be returned to the manufacturer's specifications (Figs. 2 and 3). This entails:

- Accurate measurement
- Repetitive measurement
- Re-check of measurements.

Collision damage repair can be done right the first time:

- If the fundamental steps for damage repair are correctly followed
- If the basic structural details of unibody construction are correctly considered.

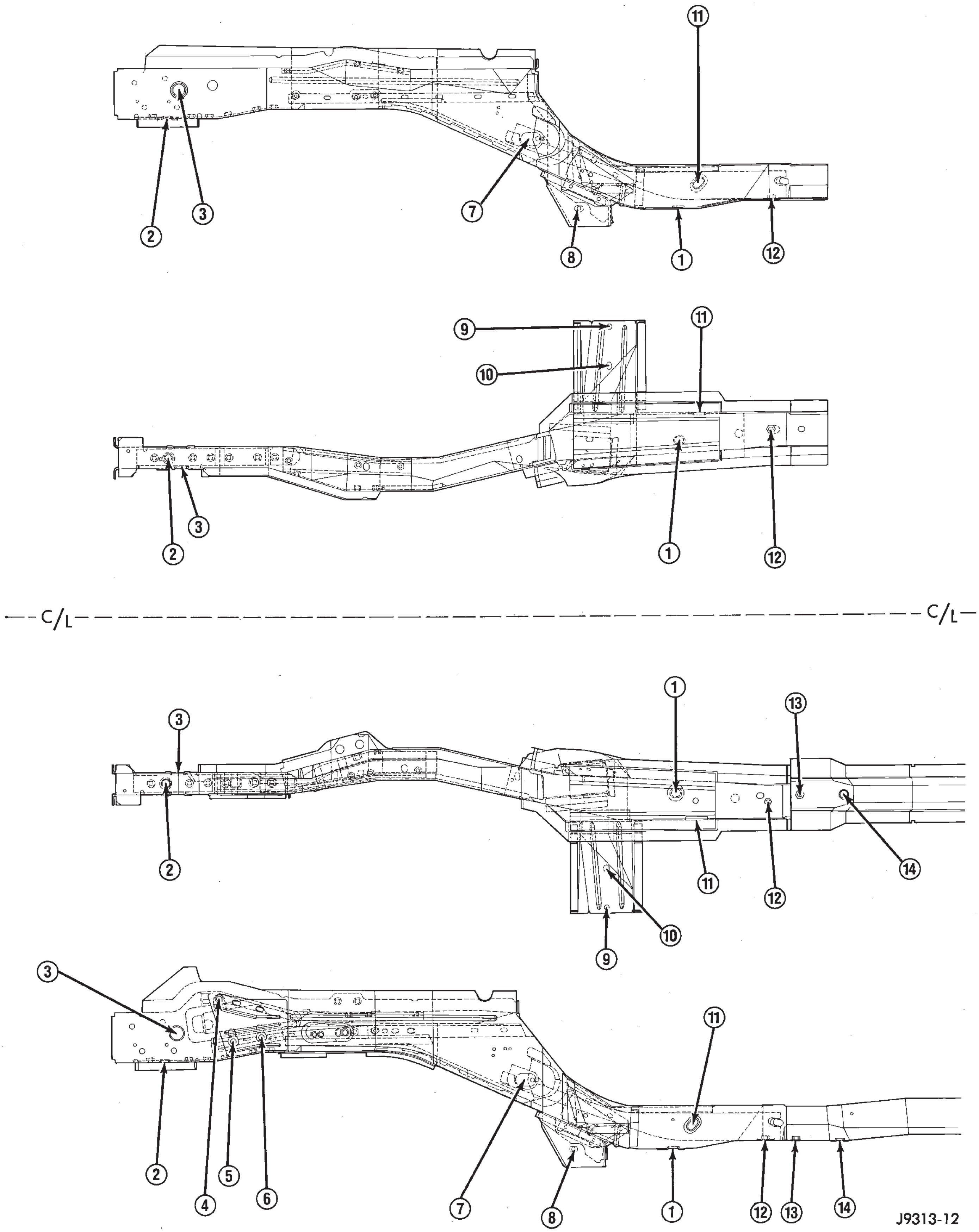

Fig. 2 Frame Dimension Locations—Front

Location	X from ZERO	Y from DATUM	Z from C/L ♦
1	0	50 mm (2.00 in.)	420 mm (16.8 in.)
2	-1280 mm (-51.2 in.)	280 mm (11.2 in.)	385 mm (15.4 in.)
3	-1250 mm (-50.0 in.)	350 mm (14.0 in.)	413 mm (16.5 in.)
4	-1144 mm (-45.8 in.)	434 mm (17.4 in.)	N/A
5	-1107 mm (-44.3 in.)	326 mm (13.0 in.)	N/A
6	-1037 mm (-41.5 in.)	337 mm (13.5 in.)	N/A
7	- 370 mm (-14.8 in.)	222 mm (8.9 in.)	N/A
8	- 249 mm (- 9.9 in.)	49 mm (1.9 in.)	N/A
9	- 190 mm (- 7.6 in.)	110 mm (4.4 in.)	706 mm (28.2 in.)
10	- 190 mm (- 7.6 in.)	110 mm (4.4 in.)	606 mm (24.2 in.)
11	50 mm (2.0 in.)	108 mm (4.3 in.)	489 mm (19.6 in.)
12	232 mm (9.3 in.)	70 mm (2.8 in.)	444 mm (17.8 in.)
13	308 mm (12.3 in.)	70 mm (2.8 in.)	444 mm (17.8 in.)
14	420 mm (16.8 in.)	70 mm (2.8 in.)	444 mm (17.8 in.)
15	900 mm (36.0 in.)	84 mm (3.4 in.)	444 mm (17.8 in.)
16	1128 mm (45.1 in.)	129 mm (5.1 in.)	N/A
17	1350 mm (54.0 in.)	82 mm (3.3 in.)	444 mm (17.8 in.)
18	1505 mm (60.2 in.)	50 mm (2.0 in.)	444 mm (17.8 in.)
19	1635 mm (65.4 in.)	189 mm (7.6 in.)	N/A
20	1933 mm (77.3 in.)	280 mm (11.2 in.)	518 mm (20.7 in.)
21	2064 mm (82.6 in.)	230 mm (9.2 in.)	444 mm (17.8 in.)
22	2272 mm (90.9 in.)	340 mm (13.6 in.)	570 mm (22.8 in.)
23	2314 mm (92.6 in.)	267 mm (10.7 in.)	464 mm (18.6 in.)
24	2463 mm (98.5 in.)	295 mm (11.8 in.)	495 mm (19.8 in.)
25	2515 mm (100.6 in.)	267 mm (10.7 in.)	464 mm (18.6 in.)
26	2250 mm (90.0 in.)	N/A	200 mm (8.0 in.)
27	2597 mm (103.9 in.)	N/A	200 mm (8.0 in.)
28	2710 mm (108.4 in.)	N/A	170 mm (6.8 in.)

N/A = Not Applicable
C/L = Center Line
* = Measure to C/L of rail.
Locations 1, 2, 3, 14, 15, and 25 are Principal Location Points (PLP).

Zero = Point of X, Y and Z origin.
Datum = 50 mm below frame rails.
♦ = Measures symmetrical to C/L

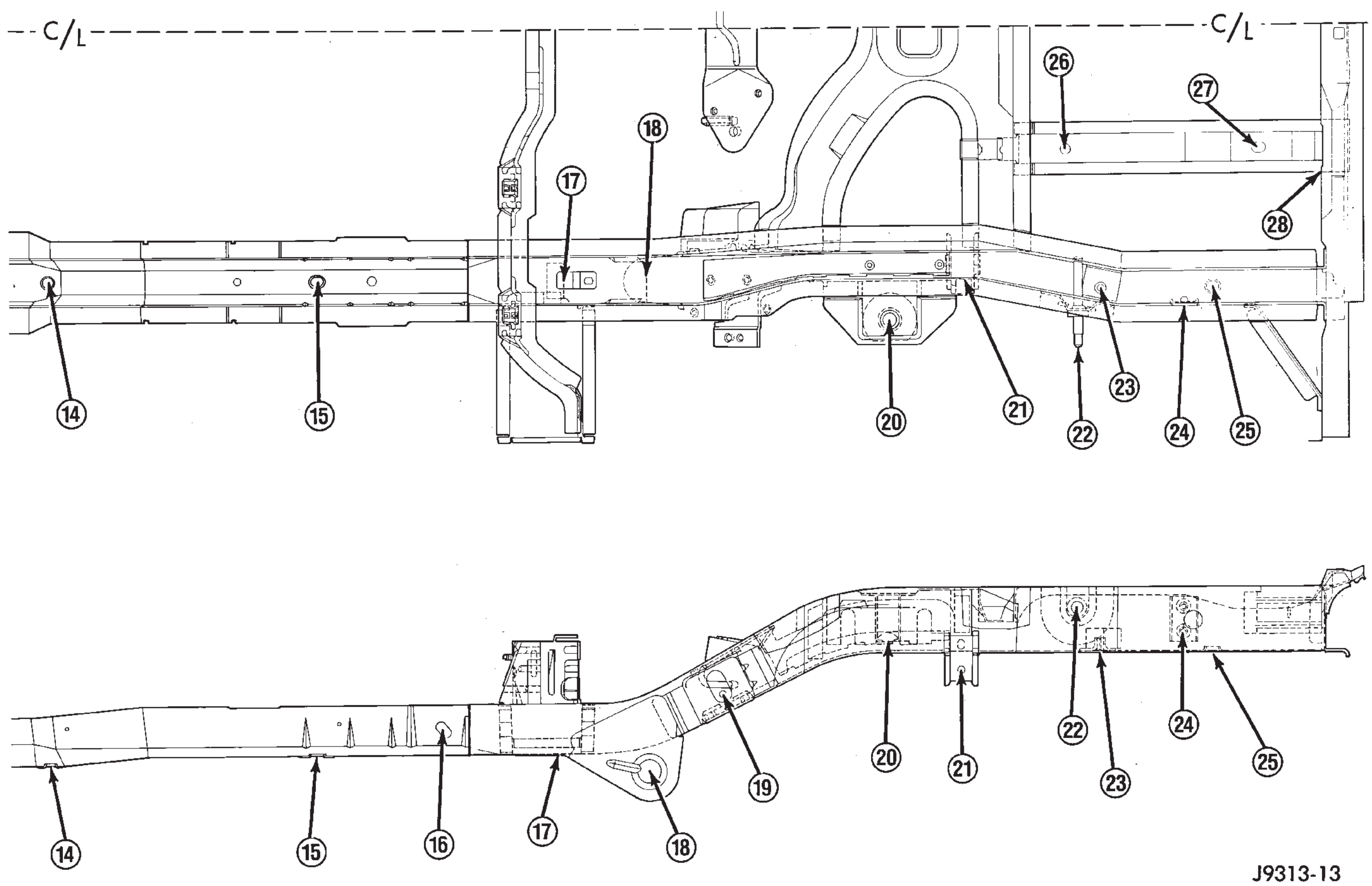

Fig. 3 Frame Dimension Locations—Rear

BUMPERS

INDEX

FRONT BUMPER/FASCIA

GENERAL INFORMATION

The Grand Cherokee front bumper is actually a bumper fascia incorporated with a lower welded crossmember. The lower crossmember is a fixed welded structure. To replace the crossmember a frame machine should be used to correctly align the crossmember to the unibody.

REMOVAL

(1) Remove 3 grille screws at grille opening reinforcement (GOR) (Fig. 1).

(2) Unsnap lower clips at grille. Remove grille from (GOR).

(3) Remove turn signals, side markers and headlamps. Refer to Group 8L, Lamps for service information.

(4) Remove the 6 retainers at the front fascia (Fig. 2).

(5) Remove the 3 plastic rivets at each front wheel well (Fig. 3).

(6) Slide the fascia off of the retainer pegs at the side of the fender attach brackets. Using a small screwdriver, pull up on locating tangs under turn signal mounting location.

(7) Remove the fascia from the vehicle (Fig. 2).

Reverse removal procedure for installation.

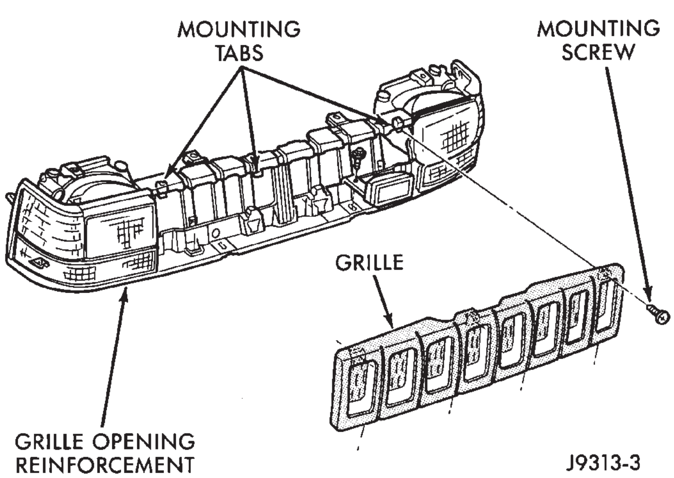

Fig. 1 Grille Removal

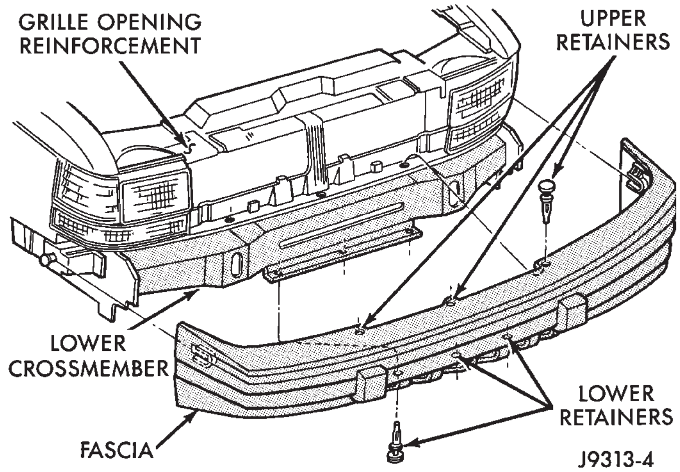

Fig. 2 Lower Fascia Removal

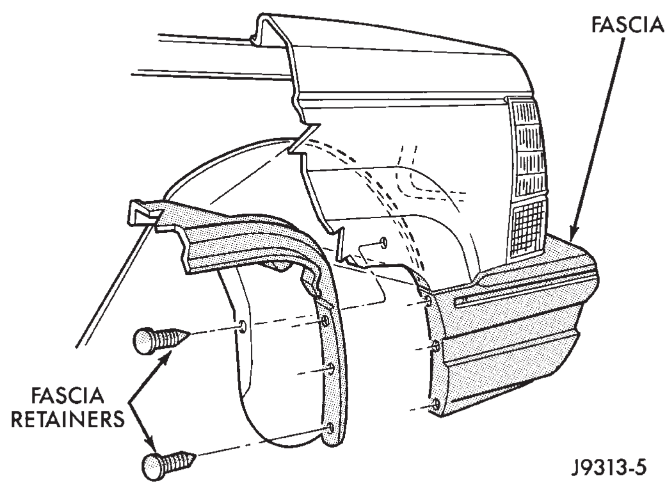

Fig. 3 Wheel Well Retainers

FRONT TOW HOOKS

REMOVAL

(1) Remove the nuts and bolts that attach the tow hooks to the lower crossmember (Fig. 4).

(2) Remove the tow hooks from the lower crossmember (Fig. 4).

INSTALLATION

(1) Position the tow hooks at the lower crossmember. Install the bolts and nuts that attach tow hooks (Fig. 4). Tighten the retaining nuts to 100 N●m (74 ft-lbs) torque.

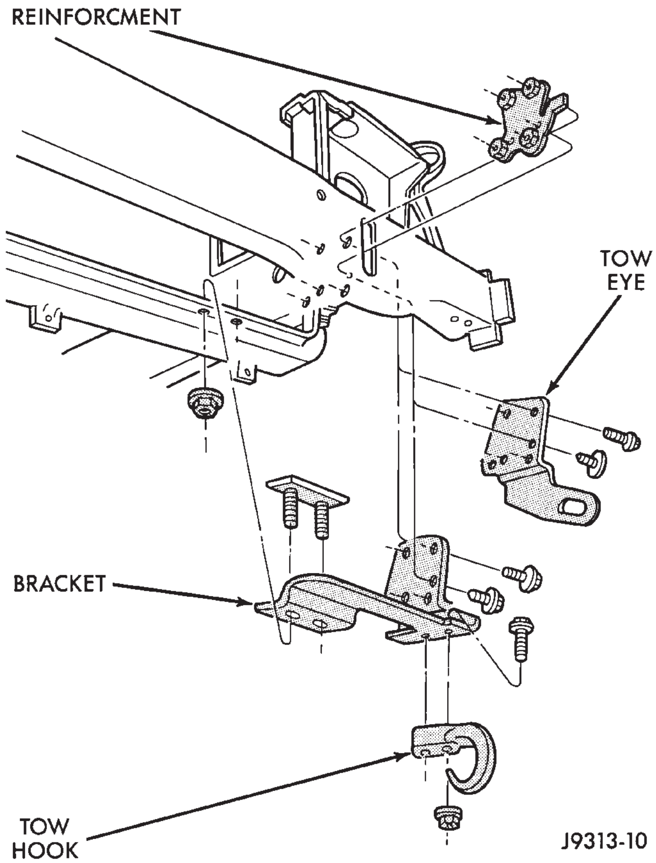

Fig. 4 Tow Hook Removal

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 2 push-in retainers at each side rear wheel well.

(5) Remove the bolts that attach the bumper support brackets to the rear rails (Fig. 5).

(6) Slide the bumper beam/fascia off of the retainer pegs on the side of the lower quarter panel.

(7) Remove the beam/fascia from the vehicle.

(8) Remove the bumper support brackets from the bumper (Fig. 6).

(9) Remove the upper scuff pad from the bumper fascia by squeezing fasteners and pushing through slots.(Fig. 6).

(10) Remove the 4 lower retainers from the bumper fascia (Fig. 6).

(11) Remove the bumper fascia from the bumper.

INSTALLATION

(1) Install brackets onto bumper beam.

(2) Install beam/brackets onto vehicle rails finger-tight (Fig. 6).

(3) Install fascia onto bumper assembly (Fig. 6).

(4) Check gaps and fit. Adjust as necessary. Tighten bolts to 56 N●m (41 ft-lbs).

(5) Install scuff pad (Fig. 6).

(6) If removed, install the trailer hitch. If necessary, refer to the installation procedure within Group 23—Body Components.

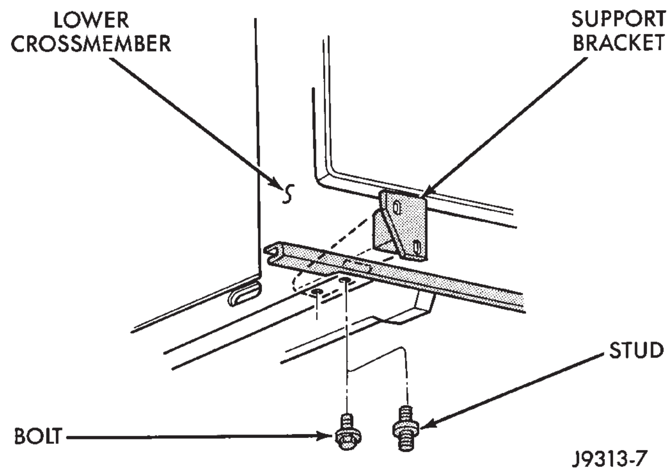

Fig. 5 Bumper Support Bracket

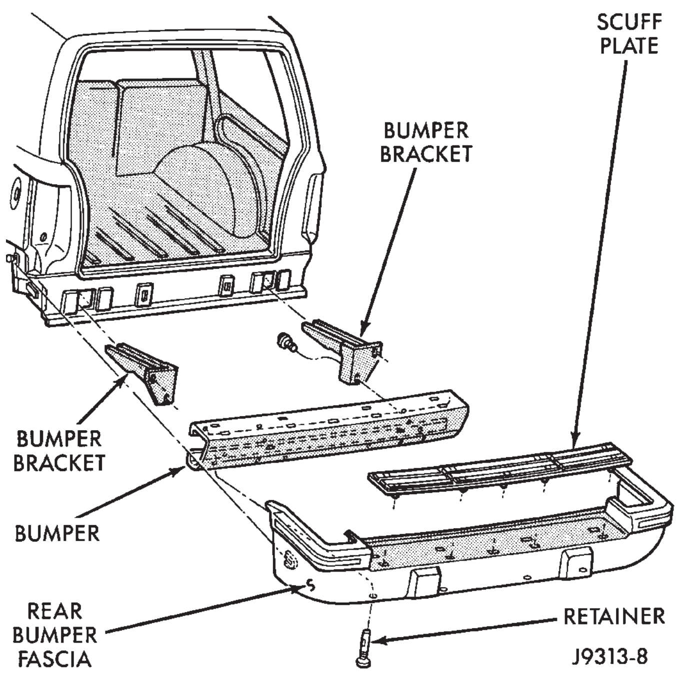

Fig. 6 Bumper Removal

REAR BUMPER FASCIA

REMOVAL

(1) For vehicles equipped with a trailer hitch, remove the hitch before removing the bumper fascia. If necessary, refer to the removal procedure within Group 23—Body Components.

(2) Raise and support the rear of the vehicle.

(3) Remove the upper scuff pad from fascia (Fig. 6).

(4) Remove the 4 lower retainers from fascia (Fig. 6).

(5) Remove the 2 push-in retainers located at the rear wheel well on each side.

(6) Remove the fascia from the bumper.

For installation, reverse removal procedure.

REAR TOW HOOK

REMOVAL

(1) Remove the nuts and bolts that attach the tow hook to the lower crossmember (Fig. 7).

(2) Remove the tow hook from the lower crossmember (Fig. 7).

INSTALLATION

(1) Position the tow hook at the lower crossmember. Install the bolts and nuts that attach tow hook (Fig. 7). Tighten the retaining nuts to 100 N●m (74 ft-lbs) torque.

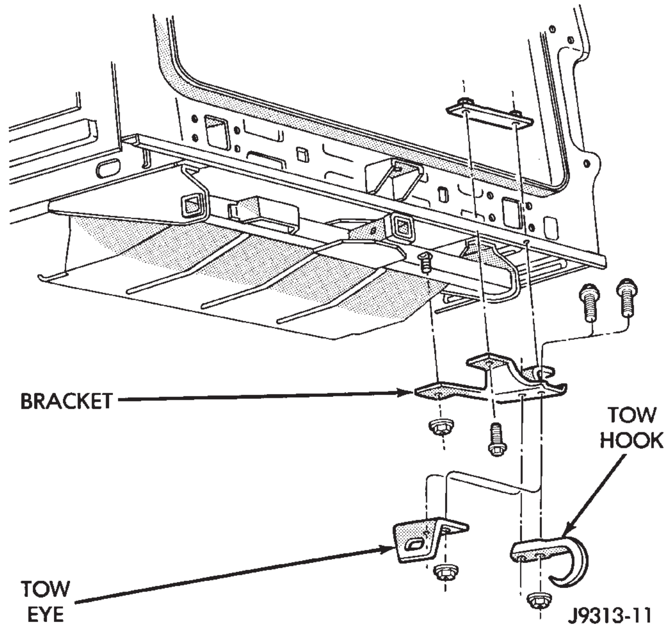

Fig. 7 Tow Hook Removal

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 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 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 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 (Fig. 1) 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

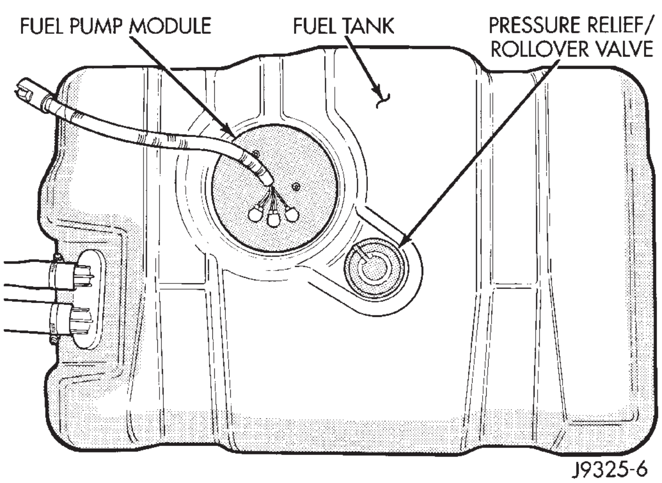

Fig. 1 Fuel Pump Module

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

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.

(1) Drain and remove the fuel tank. Refer to Fuel Tank removal and installation in the Fuel Tank section of this group.

(2) The fuel pump module locknut is threaded onto the fuel tank. Remove the fuel pump module locknut (Fig. 2). The fuel pump module will spring up from the fuel tank after the locknut has been removed.

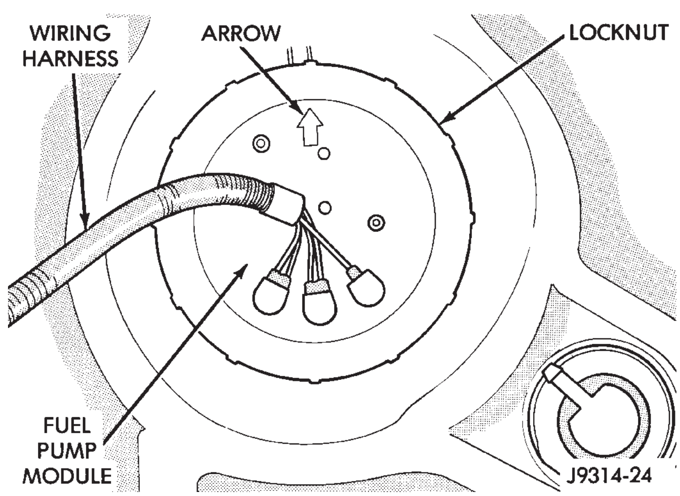

Fig. 2 Top View of Fuel Pump Module

(3) Remove module from fuel tank.

INSTALLATION

CAUTION: Whenever the fuel pump module is serviced, the rubber gasket must be replaced.

(1) Clean the fuel tank at the module opening.

(2) Using a new gasket on the fuel tank (Fig. 3), position fuel pump module into opening in fuel tank.

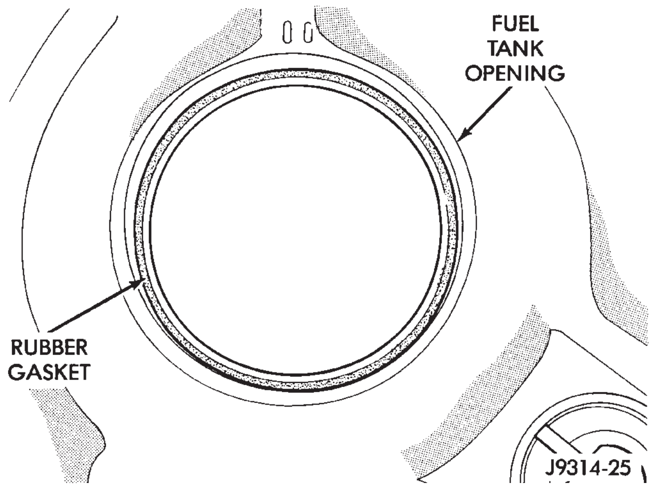

Fig. 3 Rubber Gasket

CAUTION: The arrow on the top of the fuel pump module must be facing in the direction shown in Figure 2.

(3) Tighten locknut.

(4) Install fuel tank. Refer to Fuel Tank Installation in this group.

FUEL PUMP REPLACEMENT

The electric fuel pump is not serviceable. If the fuel pump needs replacement, the complete fuel pump module must be replaced. Refer to the previous procedure.

FUEL GAUGE SENDING UNIT REPLACEMENT

The fuel gauge sending unit is not serviceable. If the unit needs replacement, the complete fuel pump module must be replaced.

FUEL PUMP CONTROL

The Powertrain Control Module (PCM) computer energizes the fuel pump through the Fuel Pump Relay. Battery voltage is applied to the relay from the ignition switch. The coil in the relay is energized when a ground is provided by the PCM. The relay is located in the Power Distribution Center (PDC) next to the battery (Fig. 4). For location of relay within the PDC, refer to label under PDC cover. The ballast resistor and ballast resistor bypass relay (as used with 4.0L engines of previous years), is no longer used to control fuel pump operation.

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.

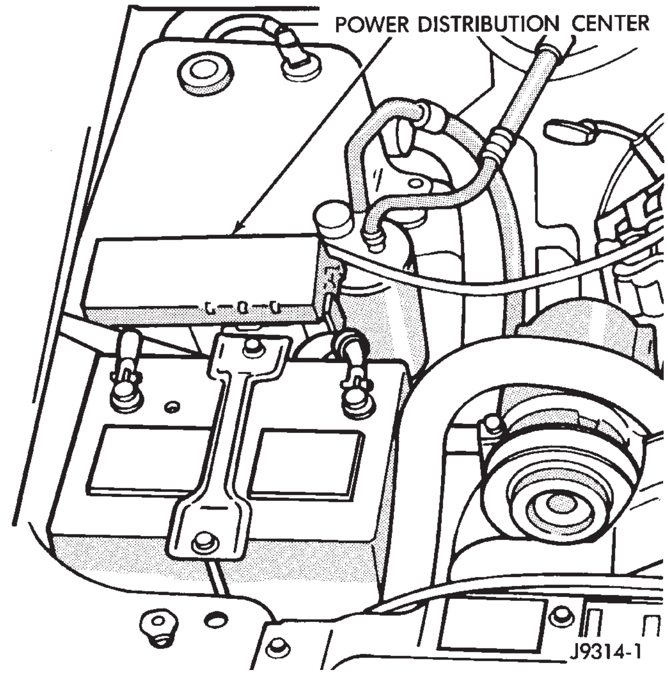

Fig. 4 Power Distribution Center

(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 (Figs. 5 or 6).

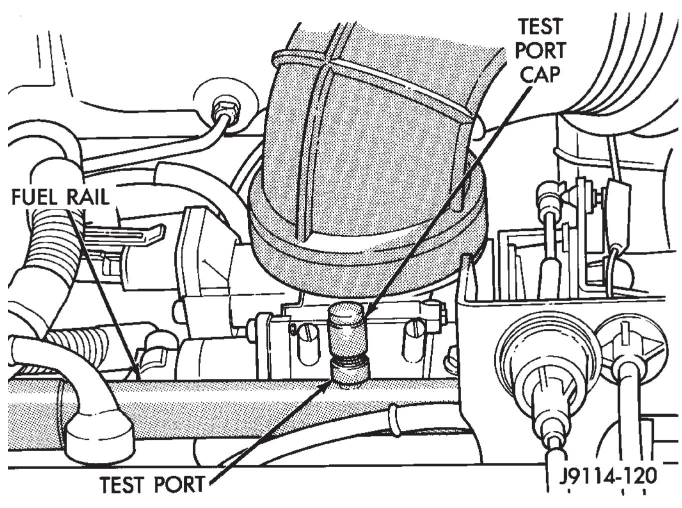

Fig. 5 Pressure Test Port—4.0L Engine

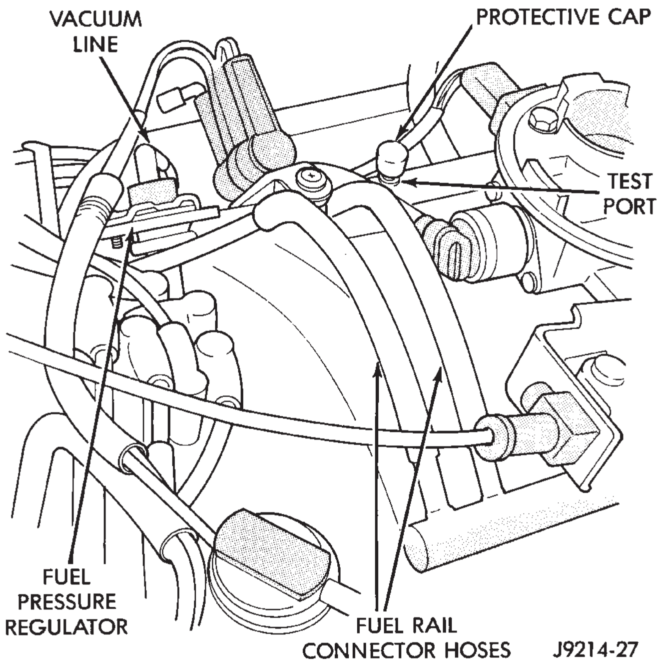

Fig. 6 Pressure Test Port—5.2L Engine

(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.

(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 (Figs. 7 or 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 (Figs. 5 or 6). Connect the 0-414 kPa (0-60 psi) fuel pressure gauge (from Gauge Set 5069) to test port pressure fitting on fuel rail (Figs. 9 or 10).

(2) Note pressure gauge reading. Fuel pressure should be approximately 214 kPa (31 psi) at idle.

(3) Disconnect vacuum line at fuel pressure regulator (Figs. 7 or 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

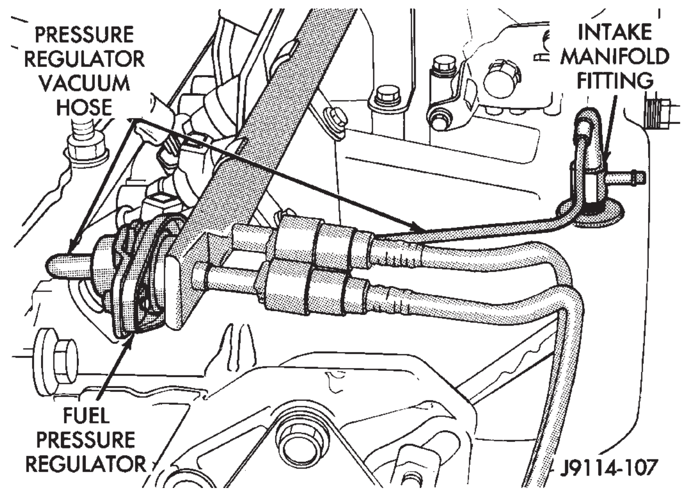

Fig. 7 Fuel Pressure Regulator—4.0L Engine

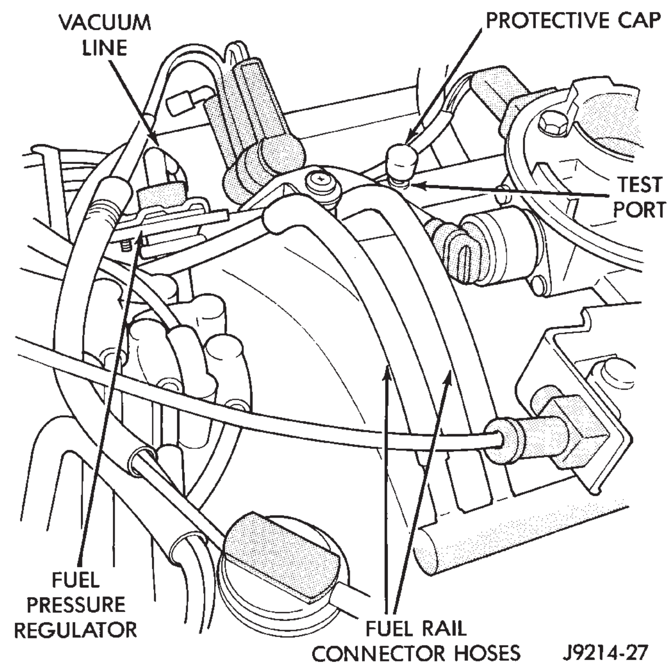

Fig. 8 Fuel Pressure Regulator—5.2L Engine

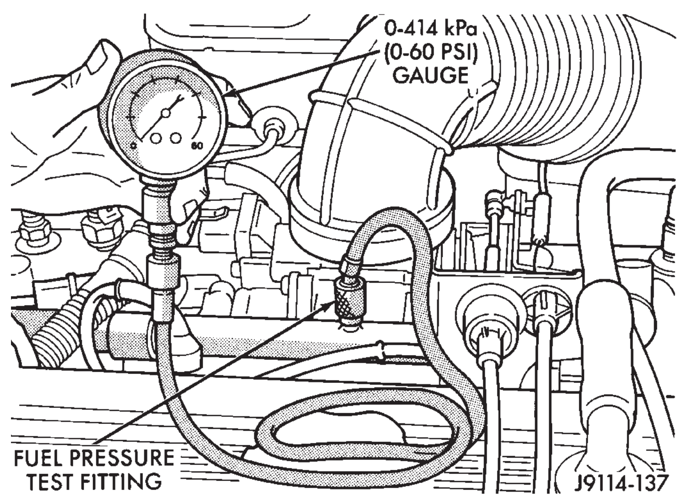

Fig. 9 Fuel Pressure Test Connection—4.0L Engine

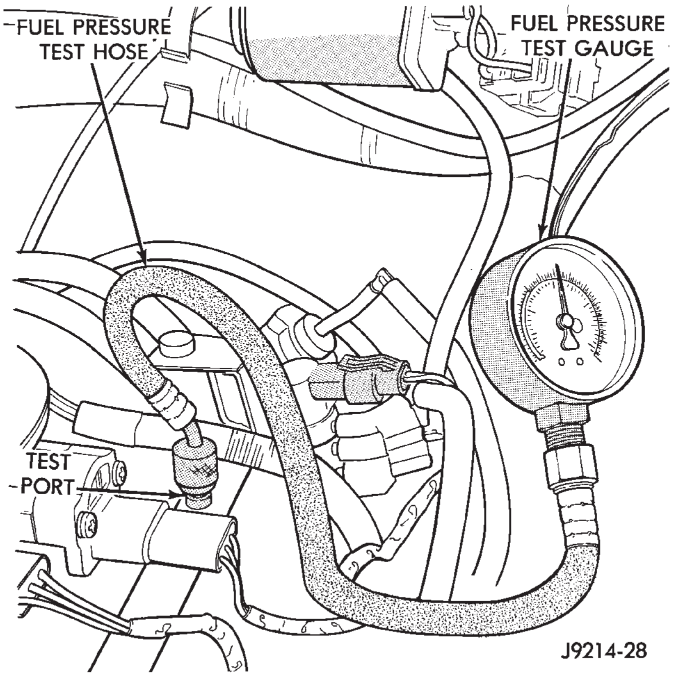

Fig. 10 Fuel Pressure Test Connection—5.2L Engine

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 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 as follows:

(a) 4.0L Engine: To disconnect quick-connect fitting from fuel rail, press on both tabs located on sides of fitting (Fig. 11) and remove fitting at fuel rail.

(b) 5.2L Engine: To disconnect the quick-connect fitting from the fuel rail, push in the spring loaded plastic retainer ring into the fitting (Fig. 12). With the plastic ring depressed, pull the fitting from fuel rail. After disconnection, the plastic retainer ring will remain on the fitting.

Connect Fuel Line Pressure Test Adapter Tool number 6539 (5/16 in.) between the disconnected fuel return line and fuel rail (Fig. 13).

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.

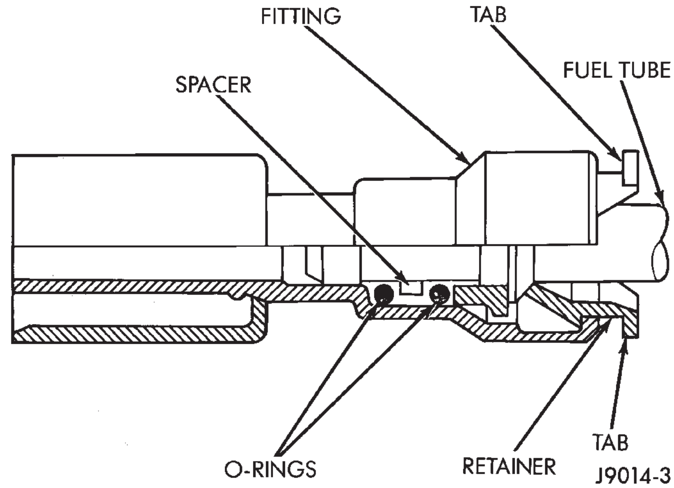

Fig. 11 Removing Quick-Connect Fitting—4.0L Engine

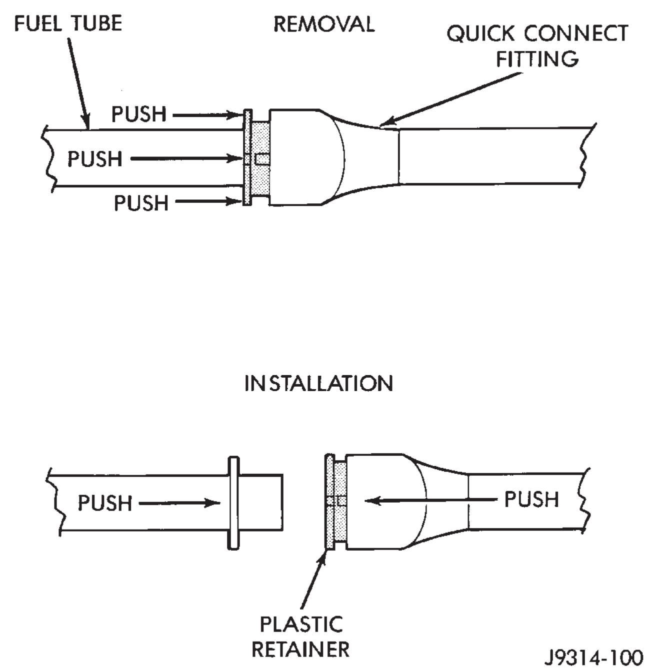

Fig. 12 Removing Quick-Connect Fitting—5.2L Engine

(7) To activate the fuel pump and pressurize the system, obtain the DRB II scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual for DRB II 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:

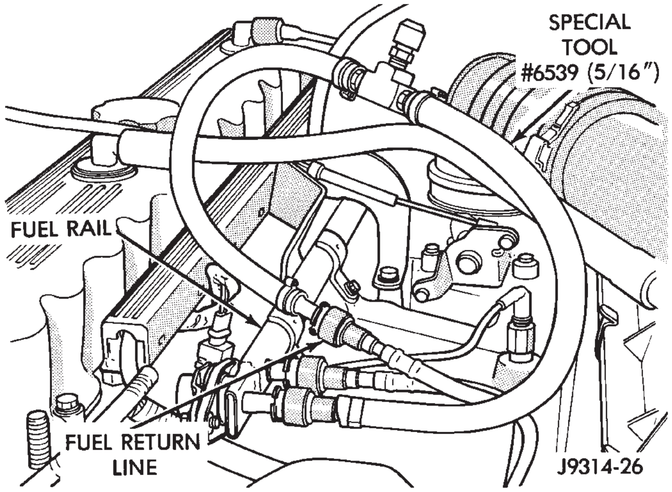

Fig. 13 Adapter Tool—Typical Connection

(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 II scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual for DRB II 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.

(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 II scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual for DRB II operation.

(5) 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 (Figs. 14 or 15). 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.

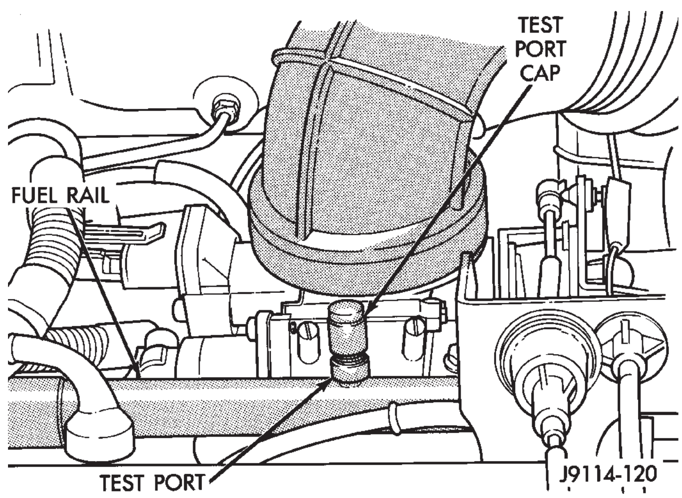

Fig. 14 Fuel Pressure Test Port—4.0L Engine

(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.

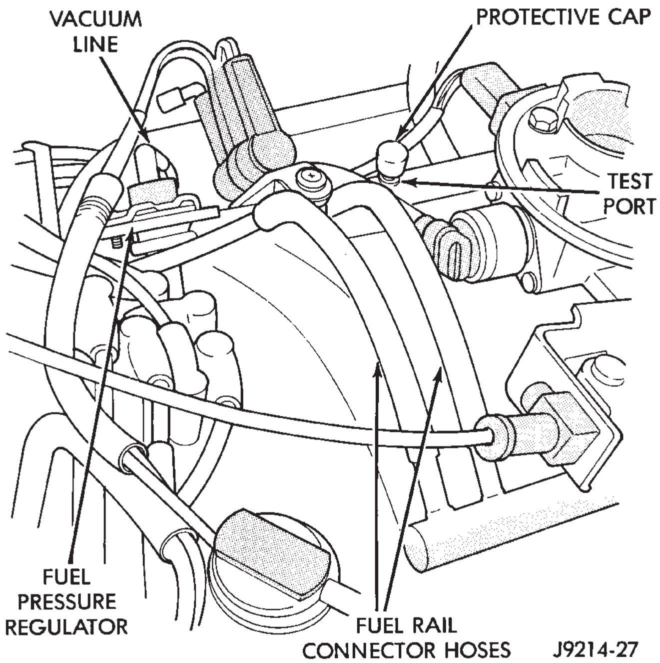

Fig. 15 Fuel Pressure Test Port—5.2L Engine

(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.

(8) Connect Fuel Line Pressure Test Adapter Tool number 6631 (3/8 in.) between the disconnected fuel supply line and fuel rail (Fig. 16).

(9) Connect Fuel Line Pressure Test Adapter Tool number 6539 (5/16 in.) between the disconnected fuel return line and fuel rail (Fig. 16).

(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,

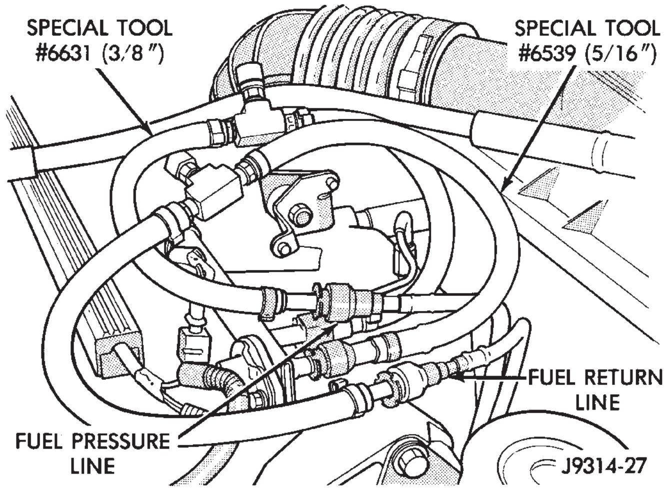

Fig. 16 Adapter Tools—Typical Connections

pressure is bleeding past the fuel pressure regulator. Replace fuel pressure regulator. Refer to Fuel Pressure Regulator 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 near front of fuel tank (Fig. 17). Replace fuel filter at intervals specified in the Lubrication and Maintenance Schedule chart found in Group 0, Lubrication and Maintenance.

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.

(2) Release fuel system pressure. Refer to the previous Fuel Pressure Release Procedure in this section.

(3) Raise and support vehicle.

(4) Place shop towels under fuel filter.

(5) Disconnect fuel lines at filter by pressing on two tabs located on fuel line (Fig. 18).

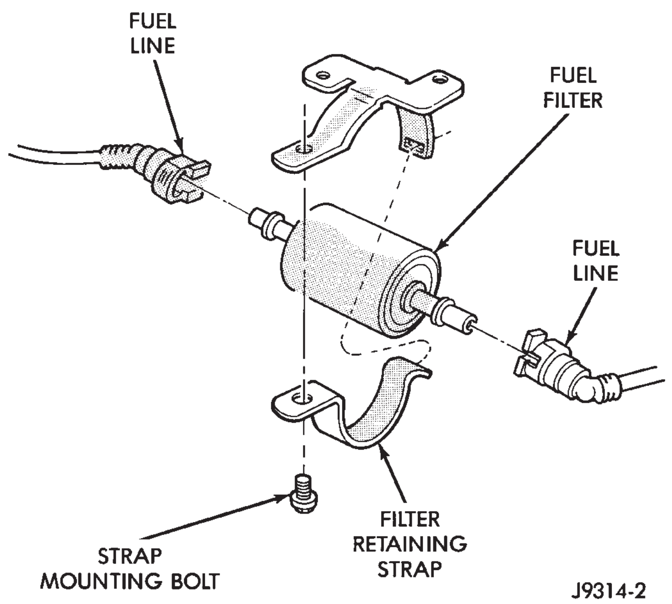

Fig. 17 Fuel Filter

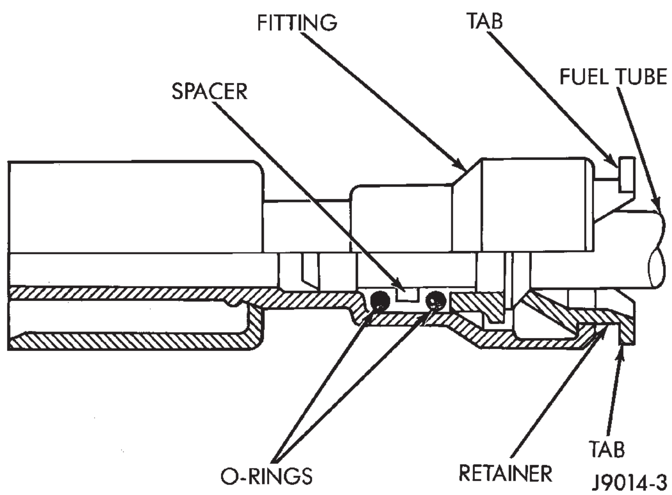

Fig. 18 Quick-Connect Fitting Removal

(6) Remove retaining strap mounting bolt (Fig. 17).
(7) Remove filter retaining strap (Fig. 17).
(8) Remove filter from mounting bracket.

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. Tighten to 7 N•m (66 in. lbs.) torque.
(3) Install fuel lines to filter. Refer to Fuel Tubes/Lines/Hoses and Clamps in this group.
(4) Lower vehicle.
(5) Connect negative battery cable.
(6) Start engine and check for leaks.

FUEL TUBES/LINES/HOSES AND CLAMPS

Also refer to Quick-Connect Fittings in this section.

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.

Avoid contact of any fuel tubes/hoses with other vehicle components that could cause abrasions or scuffing. Be sure that the plastic fuel tubes are properly routed to prevent pinching and to avoid heat sources.

CAUTION: The 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 tubes/hoses, only tubes/hoses marked EFM/EFI may be used.

CAUTION: 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 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 (10 in. lbs.) torque.

QUICK-CONNECT FITTINGS

Also refer to the previous Fuel Tubes/Lines/Hoses and Clamps.

Two different types of Quick-Connect fittings are used at several fuel system connections. One type of fitting will be referred to as a Tab Type Fitting. The other will be referred to as a Plastic Ring Type Fitting.

CAUTION: The Plastic Ring Type Fittings are not serviced separately. Do not attempt to repair damaged Plastic Ring Type quick-connect fittings or fuel tubes. Replace the complete fuel tube/quick-connect fitting assembly.

PLASTIC RING TYPE FITTING

WARNING: RELEASE FUEL SYSTEM PRESSURE BEFORE DISCONNECTING A QUICK-CONNECT FITTING. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE.

This type of fitting contains non-serviceable sealed O-rings.

(1) Disconnect negative cable from the battery.

(2) Perform the Fuel Pressure Release Procedure. Refer to the Fuel Pressure Release Procedure in this section.

(3) To release the fuel tube from the fitting, push in on the tube while pushing the spring loaded plastic retainer ring into the fitting (Fig. 19). With the plastic ring depressed, pull the tube from fitting. After disconnection, the plastic retainer ring will remain on the fitting.

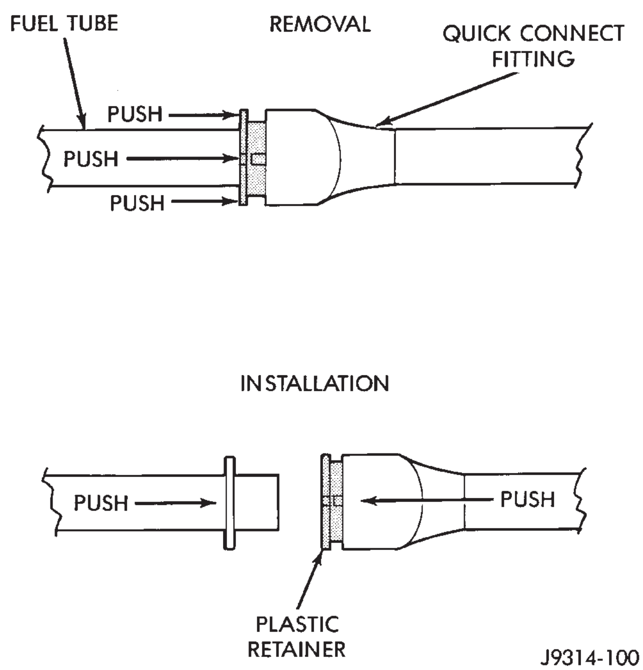

Fig. 19 Plastic Ring Type Fitting

(4) Inspect fitting connector body and plastic retainer ring (Fig. 19) for damage. Replace as necessary.

(5) Prior to connecting fuel tube to quick-connect fitting, check condition of tube and clean the fuel tube nipple and fitting with a lint-free cloth. Lubricate it with clean engine oil.

(6) Insert the fuel tube into quick-connect fitting (Fig. 19) until a click is felt. Pull back on fuel tube and fitting to be sure of a complete connection.

(7) Connect negative cable to battery.

TAB TYPE FITTING

CAUTION: The O-ring and spacer assembly must be replaced when ever the tab type quick-connect fittings are disassembled.

Tab type fittings consist of two O-rings, a spacer (installed between O-rings) and an O-ring retainer (Fig. 20).

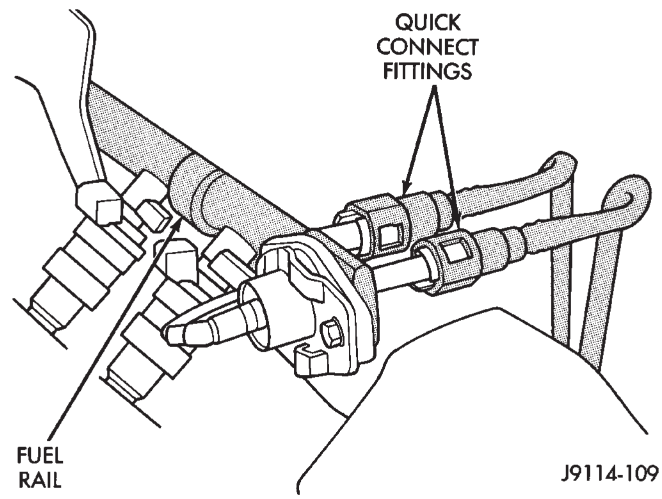

Fig. 20 Tab Type Quick-Connect Fittings—Typical

DISASSEMBLY

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.

The retainer has two tabs. To disconnect the fitting, squeeze the tabs against the fuel tube. Pull the fitting off of the quick-connect fitting/tube assembly. The retainer will stay on the fuel tube when the tube is disconnected. The O-rings and spacer will remain in the connector.

CAUTION: When ever a tab type quick-connect fitting is disconnected, the O-rings, spacer and retainer MUST be replaced.

The O-rings and spacer must be removed with the bent end of an L-shaped paper clip.

O-RING REPLACEMENT

A repair kit consisting of replacement O-rings, spacer and retainer is available through the parts department. The replacement parts are installed on a disposable plastic plug. Install the replacement kit as follows:

(1) Push the kit/disposable plug assembly into the fitting until an audible click sound is heard (Fig. 21).

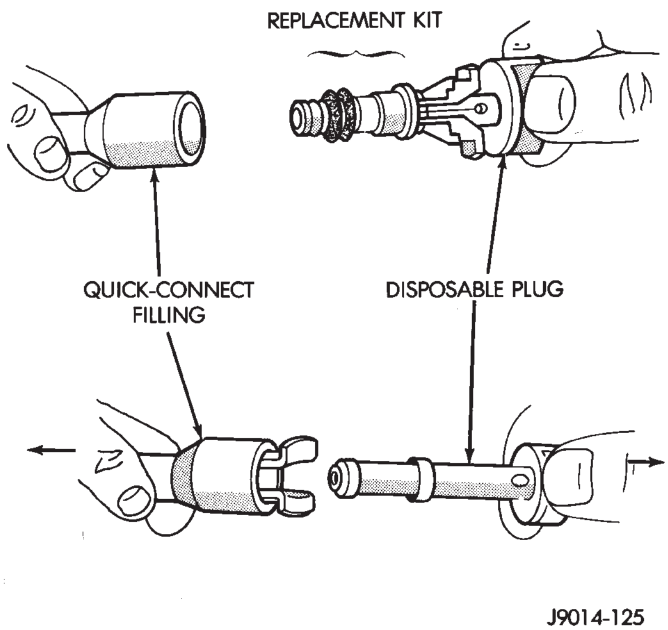

Fig. 21 Repair Kit Installation

(2) Grasp end of disposable plug and pull outward to remove it from fitting.

ASSEMBLY

(1) Push fuel tube into quick-connect fitting until an audible click is heard (Fig. 22).

(2) Verify that connection is secure by firmly pulling back on fuel tube (Fig. 22). The tube should be locked in place.

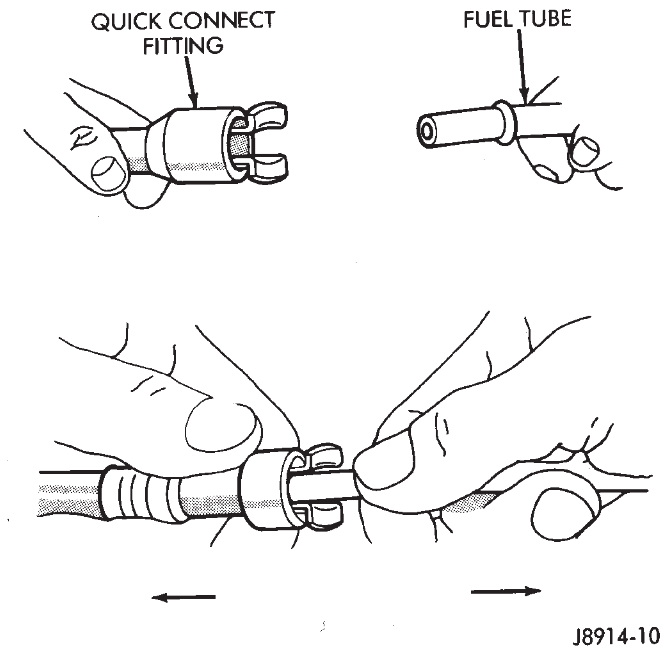

Fig. 22 Fuel Tube-to-Fitting Connection

FUEL TANKS

INDEX

GENERAL INFORMATION

These 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.

NO-LEAD FUEL TANK FILLER TUBE

These 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 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

(1) Disconnect negative battery cable at battery.

(2) Release fuel system pressure. Refer to the Fuel Pressure Release Procedure in the Fuel Delivery section of this Group.

(3) Raise and support vehicle.

(4) Remove the fuel tank filler hose and vent hose retaining clamps (Fig. 1). Remove both tubes at fuel filler tube (Fig. 1).

(5) Remove the rear tow hooks (if equipped).

(6) Remove the fuel tank skid plate mounting nuts/bolts and remove skid plate (Fig. 2) (if equipped).

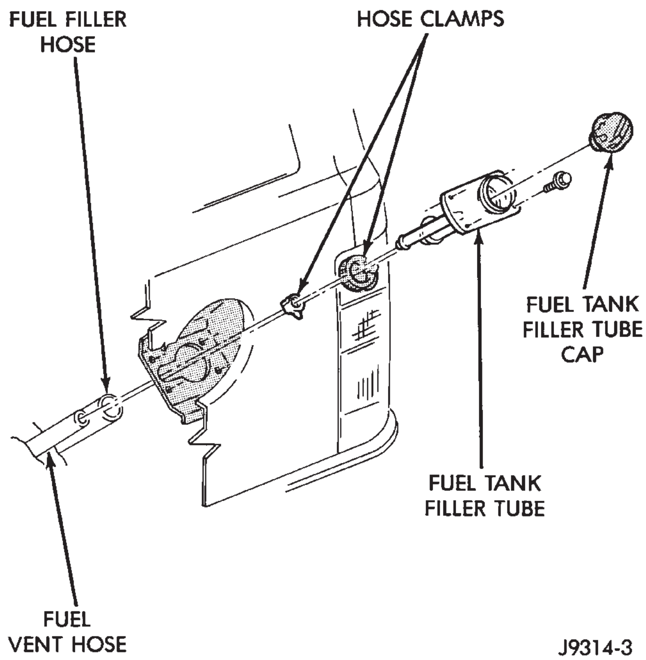

Fig. 1 Fuel Filler Tube and Hoses

(7) Remove the optional trailer hitch (if equipped).

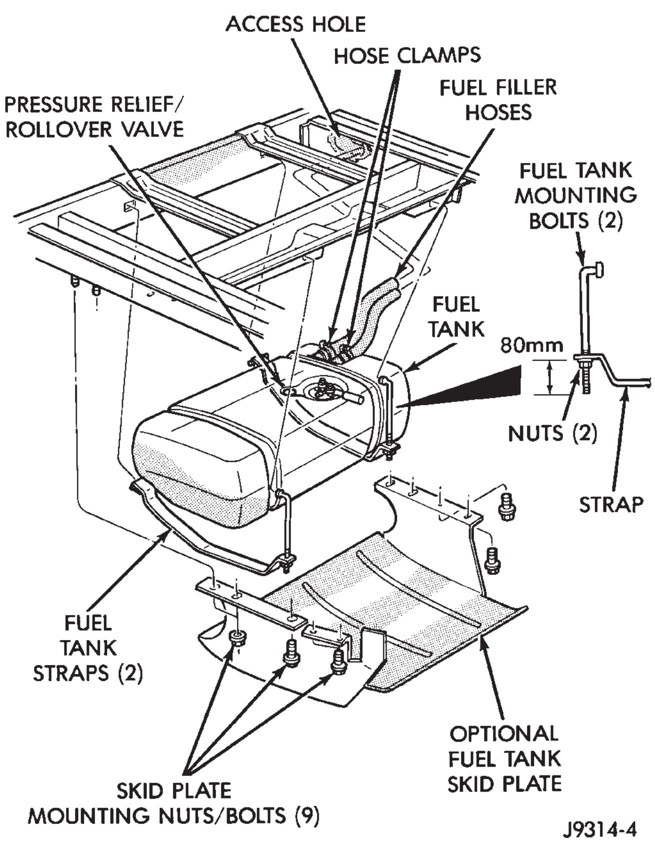

Fig. 2 Fuel Tank Mounting

(8) Remove the exhaust tailpipe heat shield mounting bolts and remove shield.

CAUTION: To protect the fuel tank from exhaust heat, this shield must reinstalled after tank installation.

(9) Place a hydraulic jack to bottom of fuel tank.

WARNING: PLACE A SHOP TOWEL AROUND FUEL LINES TO CATCH ANY EXCESS FUEL. REFER TO FUEL TUBES/LINES/HOSES AND CLAMPS IN THIS GROUP.

(10) Disconnect fuel supply line at fuel filter. Disconnect fuel return line and fuel vent line near front of tank.

(11) Disconnect fuel pump module electrical connector near front of tank.

CAUTION: The right (passenger side) of the fuel tank must be lowered first to gain access to the two fuel filler hose clamps located on the left side of tank (Fig. 2).

(12) Remove the two fuel tank strap nuts (Fig. 2). Position both tank support straps away from tank.

(13) Carefully lower right side of tank while feeding fuel hoses through access hole in body (Fig. 2) until fuel tank filler hose clamps can be removed.

(14) Before removing fuel filler hoses (Fig. 2) from tank, mark their rotational position in relation to tank. Remove both hose clamps and hoses at tank (Fig. 2). Insert the drain hose (from an approved gasoline draining station) into either of the hose openings. Drain tank until empty.

(15) Continue lowering tank and remove from vehicle.

(16) If tank is to be replaced, disconnect fuel tank pressure relief/rollover valve (Fig. 2) from tank. For valve removal, refer to Fuel Tank Pressure Relief/Rollover Valve in this section. Remove fuel pump module from tank. Refer to Fuel Pump Module Removal/Installation in the Fuel Delivery section of this group.

INSTALLATION

(1) Install fuel filler hoses and hose clamps (Fig. 2) to tank noting their previously marked position.

(2) Position fuel tank to hydraulic jack.

(3) Raise tank into position while guiding the fuel filler hoses into and through the access hole (Fig. 2) in body.

(4) Continue raising tank until positioned to body.

(5) Attach two fuel tank mounting straps and mounting nuts.

CAUTION: The two mounting nuts must be tightened until 80 mm (3.149 in.) is attained between the end of the mounting bolt and bottom of strap. See insert (Fig. 2). Do not over tighten nuts.

(6) Connect pump module electrical connector and three fuel lines near front of tank.

(7) Install exhaust tailpipe heat shield.

(8) Install the fuel tank skid plate (Fig. 2) and trailer hitch (if equipped).

(9) Install the rear tow hooks (if equipped).

(10) Install the fuel tank filler hose and vent hose to tank necks. Tighten both retaining clamps (Fig. 1).

(11) Lower vehicle and connect battery cable to battery.

FUEL PUMP—REMOVAL/INSTALLATION

The fuel pump is not serviceable. If the fuel pump needs replacement, the complete fuel pump module must be replaced. Refer to Fuel Pump Module in the Fuel Delivery System section of this group.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit is attached to the fuel pump module. Refer to Fuel Delivery System in this group for fuel gauge sending unit service.

FUEL TANK PRESSURE RELIEF/ROLLOVER VALVE

The fuel tank is equipped with a pressure relief/rollover valve (Fig. 3). 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.

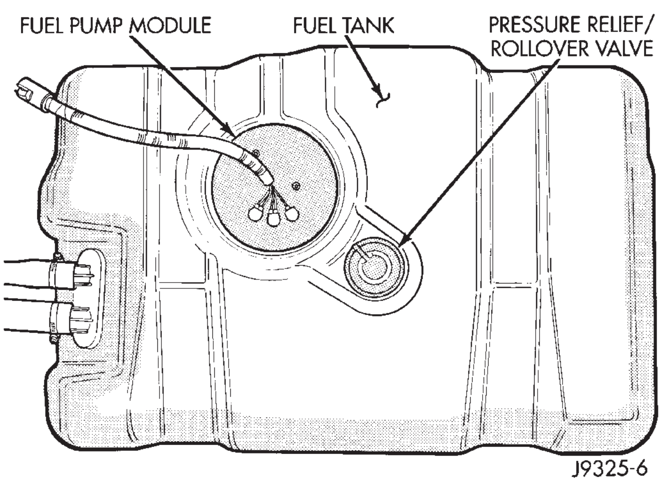

Fig. 3 Pressure Relief/Rollover Valve Location

The valve consists of a plunger, spring and orifice/guide plate (Fig. 4). 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.

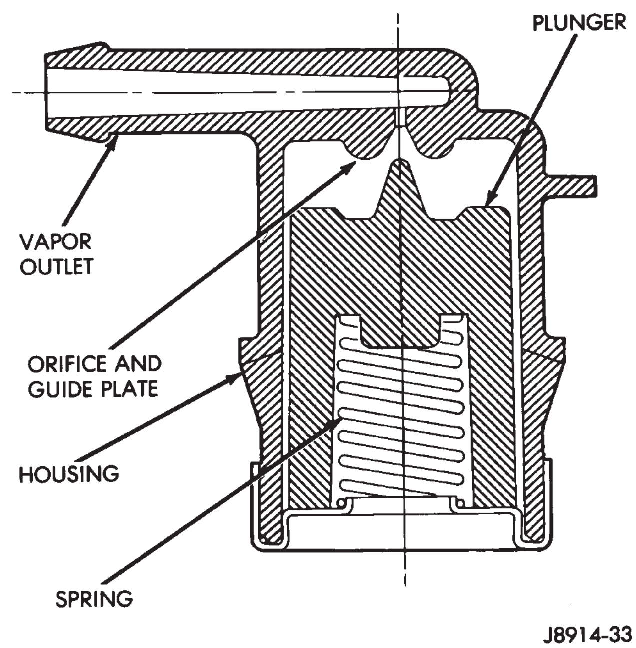

Fig. 4 Pressure Relief/Rollover Valve Operation

REMOVAL

(1) Disconnect negative battery cable.

(2) Drain and remove the fuel tank. Refer to Fuel Tank removal and installation in the Fuel Tank section of this group.

(3) The valve is seated in a grommet. Remove by prying one side upward and then roll the grommet out of tank.

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

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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 accelerator pedal arm by a plastic retainer (clip) (Fig. 1). This retainer (clip) snaps into the top of the accelerator pedal arm. Retainer tabs (built into the cable sheathing) (Fig. 1) fasten the cable to the dash panel.

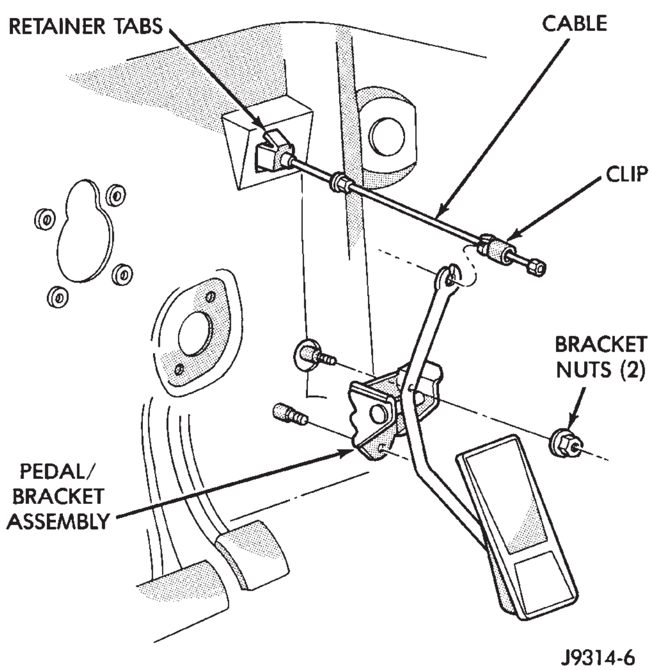

Fig. 1 Accelerator Pedal Mounting—Typical

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 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 pedal arm (Fig. 1). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove accelerator pedal bracket nuts. Remove accelerator pedal assembly (Fig. 1).

INSTALLATION

(1) Place accelerator pedal assembly over studs protruding from floor pan. Tighten mounting nuts to 10 N●m (92 in. lbs.) torque.

(2) Slide throttle cable into opening in top of pedal arm. Push plastic cable retainer (clip) into pedal arm opening until it snaps into place.

(3) Before starting engine, operate accelerator pedal to check for any binding.

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 pedal arm (Fig. 1). 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. 1) at the dash panel. Remove cable housing from dash panel and pull into the engine compartment.

(4) 4.0L Engine: Remove cable from clip on engine valve cover (Fig. 2) and clip at dash panel.

(5) Remove the throttle cable ball end socket at throttle body linkage (Figs. 2 or 3) (snaps off).

(6) 4.0L Engine: Remove throttle cable from throttle body mounting bracket by compressing retainer tabs and pushing cable through hole in bracket. Remove throttle cable from vehicle.

(7) 5.2L Engine: Remove cable housing at throttle body mounting bracket by pressing forward on release tab with a small screwdriver (Fig. 4). **To prevent cable housing breakage, press on the tab only enough to release the cable from the bracket.** Lift the cable housing straight up from bracket while pressing on release tab. Remove throttle cable from vehicle.

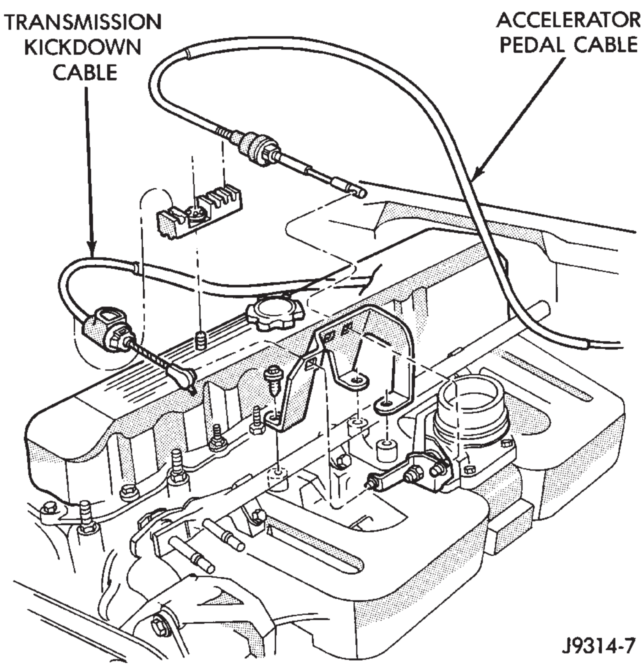

Fig. 2 Throttle Cable—4.0L Engine

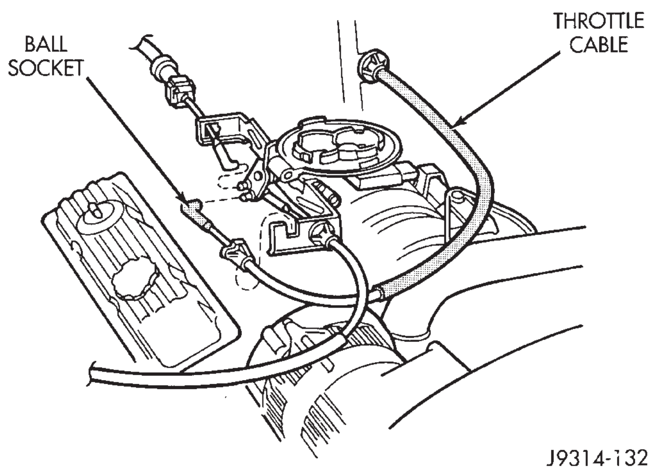

Fig. 3 Throttle Cable—5.2L Engine

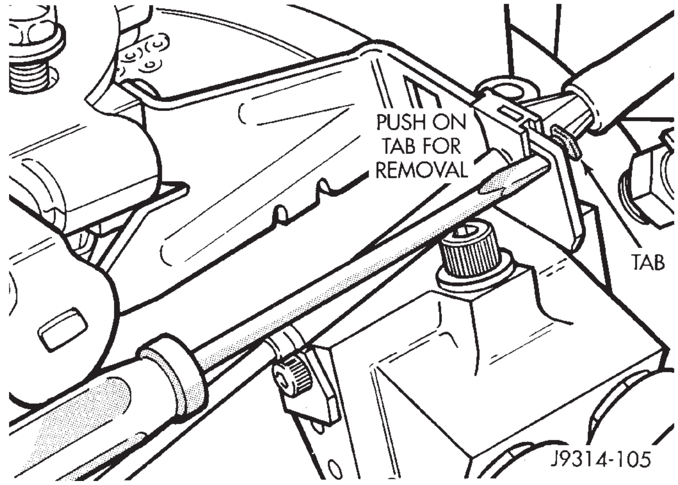

Fig. 4 Cable Release Tab—5.2L Engines—Typical

INSTALLATION

(1) 4.0L Engine: 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) 5.2L Engine: Connect cable end to throttle body linkage ball (snaps on). Connect cable to throttle body bracket (push down and lock).

(3) 4.0L Engine: Snap cable into clip on engine valve cover and clip at dash panel.

(4) Push other end of cable through opening in dash panel until retaining tabs lock into panel.

(5) From inside drivers compartment, slide throttle cable core wire into opening in top of pedal arm. Push cable retainer (clip) into pedal arm opening until it snaps in place.

(6) Before starting engine, operate accelerator pedal to check for any binding.

MPI SYSTEM—4.0L ENGINE—COMPONENT DESCRIPTION/SYSTEM OPERATION

INDEX

GENERAL INFORMATION

All 4.0L engines are equipped with sequential Multi-Port Fuel Injection (MPI). The MPI system (Fig. 1) 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 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.

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 pre-programmed 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
- 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 discharges 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).

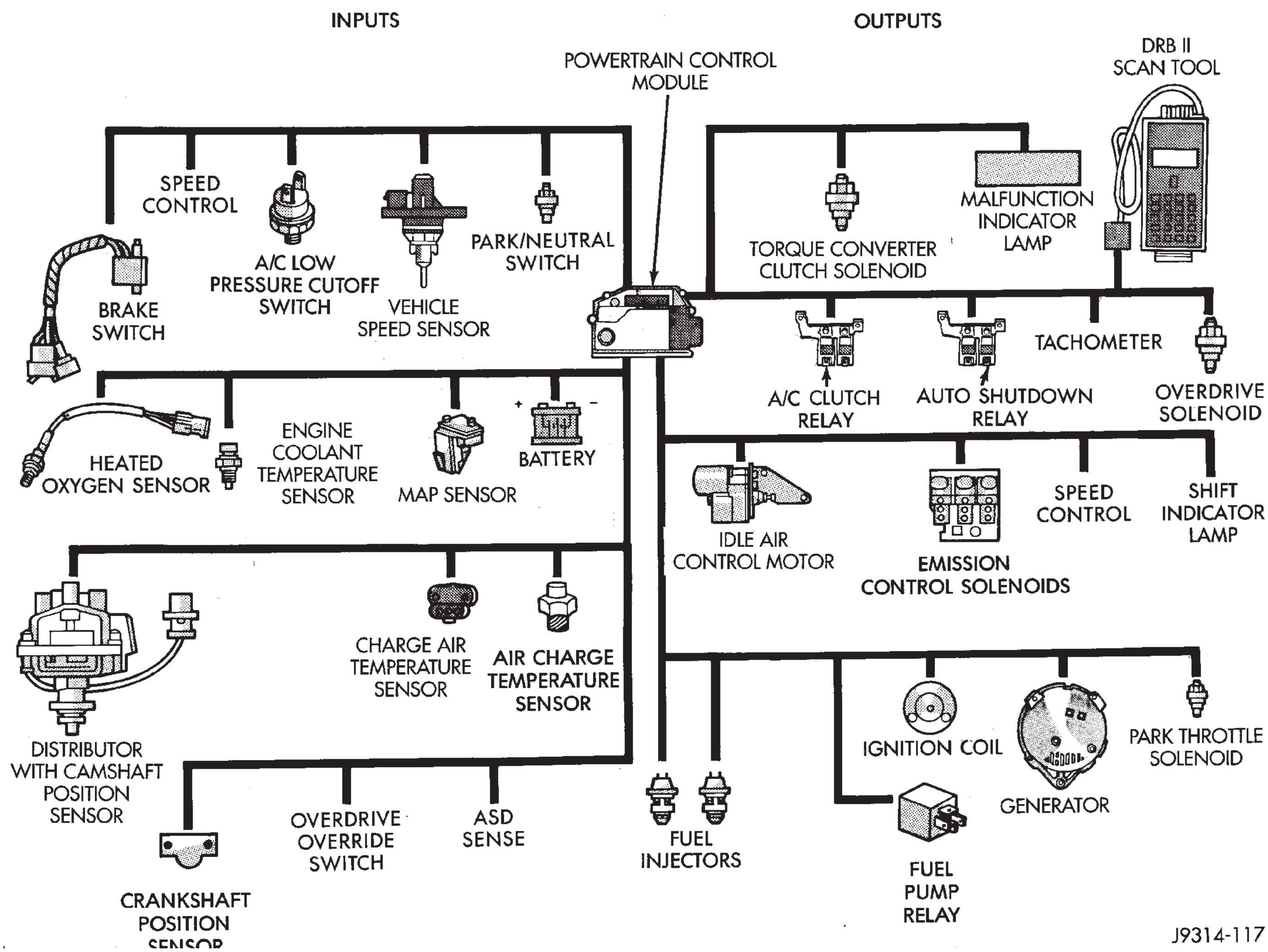

Fig. 1 Multi-Port Fuel Injection Components—4.0L Engine

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 MPI System—4.0L Engine—General Diagnosis section of this group for DTC information.

POWERTRAIN CONTROL MODULE (PCM)

The Powertrain Control Module (PCM) (Fig. 2) 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.

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as Powertrain Control Module (PCM) Outputs. The sensors and switches that provide inputs to the PCM are considered Powertrain Control Module (PCM) Inputs.

The PCM adjusts ignition timing based upon inputs it receives from sensors that react to: engine rpm, manifold absolute pressure, 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

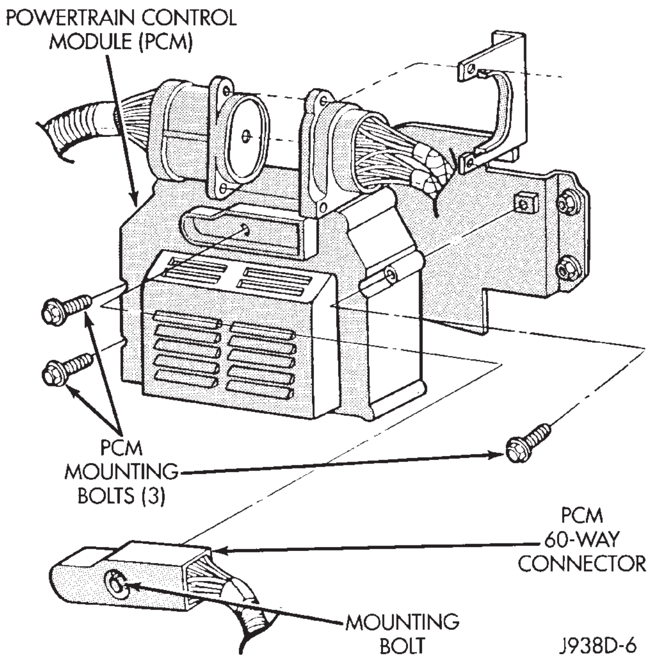

Fig. 2 Powertrain Control Module (PCM)

- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Auto shut down (ASD) sense
- Charge air temperature sensor
- Battery voltage
- Brake switch
- 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 II 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 II connection)
- Shift indicator lamp (manual transmission only)
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (on instrument panel, if equipped)

The powertrain control module (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.

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 powertrain control module (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 idle air control (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. It is used to connect oxygen sensor heater element, ignition coil, generator field winding and fuel injectors to 12 volt + power supply.

This input is used only to sense that the ASD relay is energized. If the powertrain control module (PCM) does not see 12 volts at this input when the ASD should be activated, it will set a Diagnostic Trouble Code (DTC).

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. 3). The sync signal from this sensor works in conjunction with the crankshaft position sensor to provide the powertrain control module (PCM) with inputs. This is done to establish and maintain correct injector firing order.

Refer to Camshaft Position Sensor in Group 8D, Ignition System for more information.

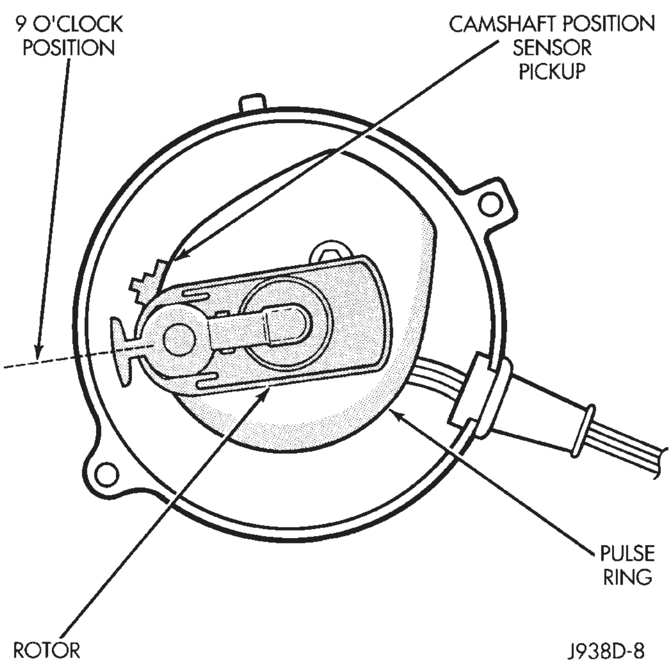

Fig. 3 Camshaft Position Sensor

CHARGE AIR TEMPERATURE SENSOR—PCM INPUT

The intake manifold charge air temperature sensor is installed in the intake manifold with the sensor element extending into the air stream (Fig. 4). The sensor provides an input voltage to the powertrain control module (PCM) indicating intake manifold air temperature. The input is used along with inputs from other sensors to determine injector pulse width. As the temperature of the air-fuel stream in the manifold varies, the sensor resistance changes. This results in a different input voltage to the PCM.

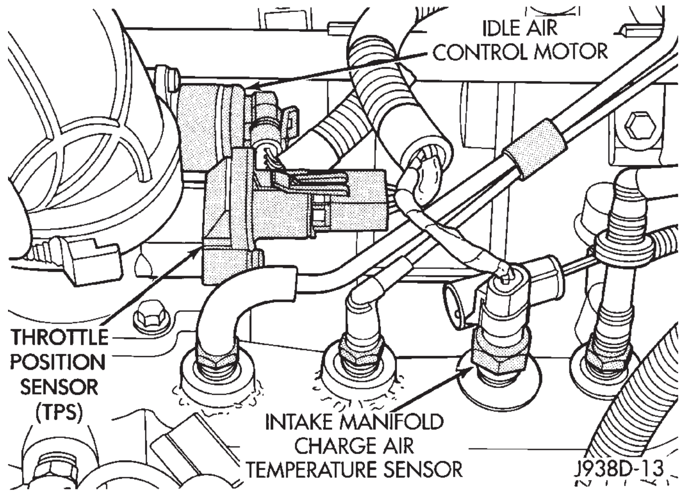

Fig. 4 Charge Air Temperature Sensor

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.

The sensor is bolted to the transmission housing near the rear of the cylinder head (Fig. 5).

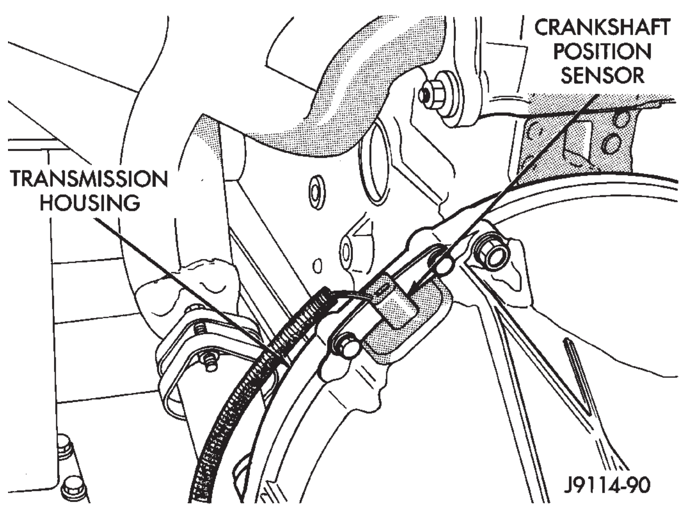

Fig. 5 Crankshaft Position Sensor

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. 6) 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.

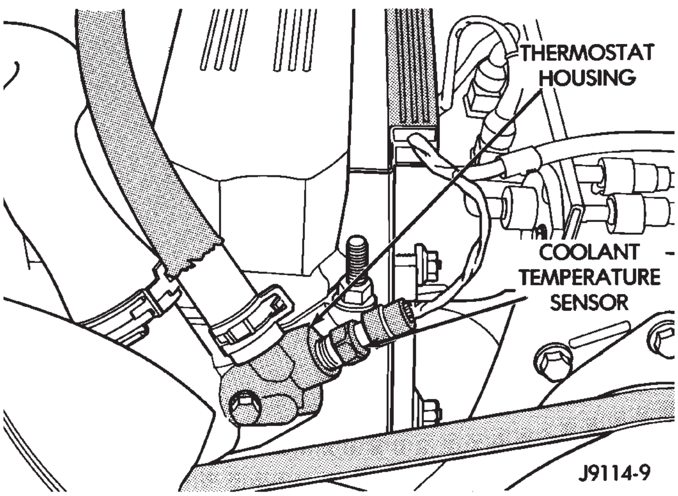

Fig. 6 Coolant Temperature Sensor

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 (Fig. 7). The sensor is connected to the throttle body with a vacuum hose and to the PCM electrically.

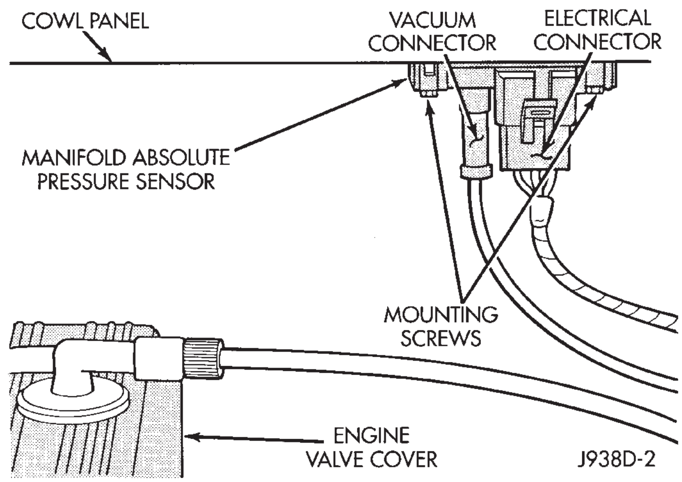

Fig. 7 Manifold Absolute Pressure (MAP) Sensor

OXYGEN (O_2) SENSOR—PCM INPUT

The O_2 sensor is located in the exhaust down pipe (Fig. 8). 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 O_2 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 O_2 sensor input (along with other inputs). It then adjusts the injector pulse width accordingly. During Open Loop operation, the PCM ignores the O_2 sensor input and adjusts injector pulse width to a preprogrammed value (based on other sensor inputs).

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.

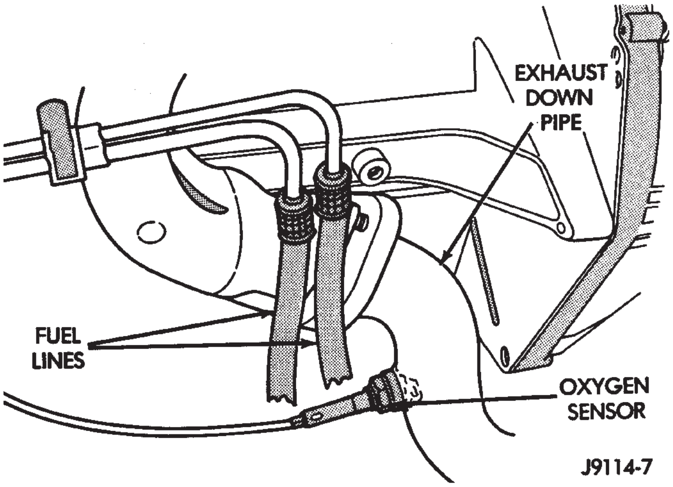

Fig. 8 Heated Oxygen Sensor Location

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

SCI RECEIVE—PCM INPUT

SCI Receive is the serial data communication receive circuit for the DRB II scan tool. The powertrain control module (PCM) receives data from the DRB II through the SCI Receive circuit.

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 (Fig. 9). 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.

VEHICLE SPEED SENSOR—PCM INPUT

The speed sensor (Fig. 10) is located in the extension housing of the transmission (2WD) or on the transfer case extension housing (4WD). 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

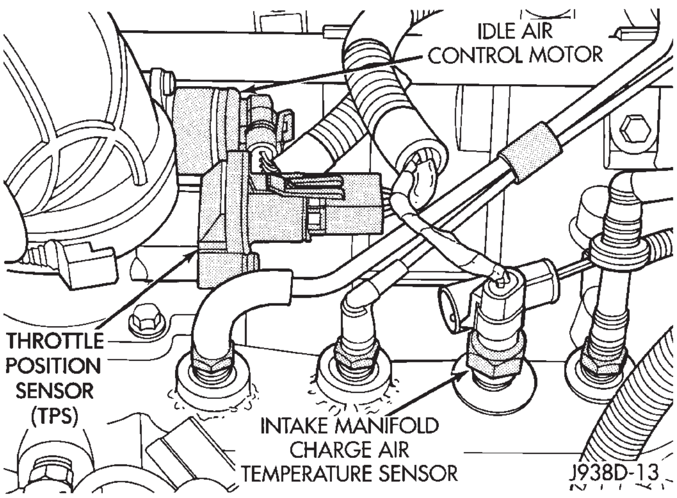

Fig. 9 Throttle Position Sensor

MAP value. Under idle conditions, the PCM adjusts the IAC motor to maintain a desired engine speed.

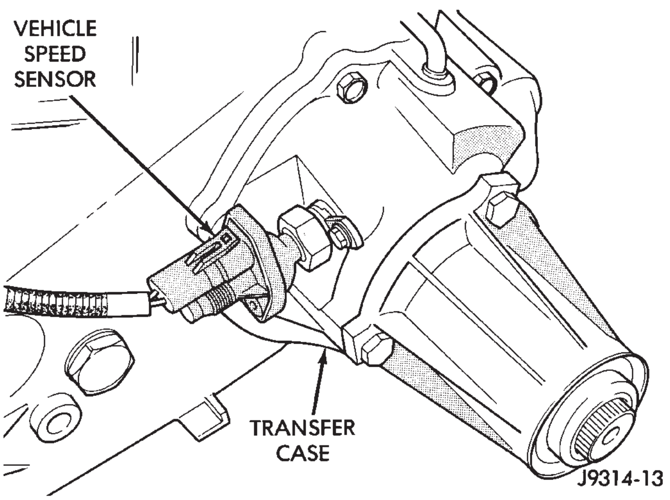

Fig. 10 Vehicle Speed Sensor—Typical

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) (Fig. 11). For the location of the relay within the PDC, refer to label under PDC cover.

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).

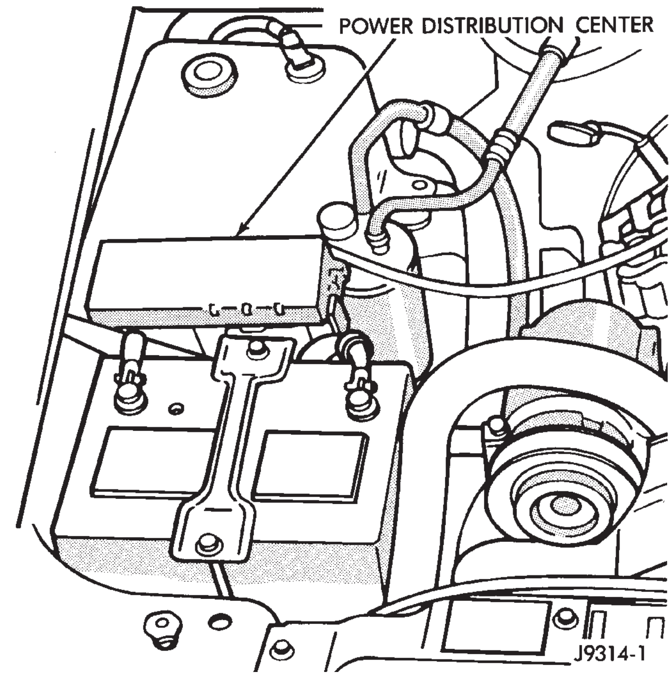

Fig. 11 Power Distribution Center (PDC)

IDLE AIR CONTROL (IAC) MOTOR—PCM OUTPUT

The IAC motor is mounted on the throttle body (Fig. 12) and is controlled by the powertrain control module (PCM).

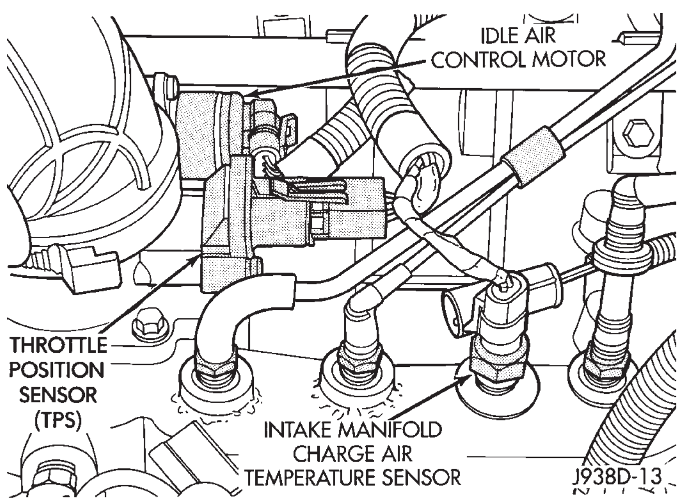

Fig. 12 IAC Motor

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 moving the IAC motor pintle in and out of the air control passage. The IAC motor is positioned when the ignition key is turned to the On position.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

AUTO SHUT DOWN (ASD) RELAY—PCM OUTPUT

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 11). For the location of this relay within the PDC, refer to label under PDC cover.

The ASD supplies battery voltage to the fuel pump, fuel injector, ignition coil, generator field winding and oxygen (O_2) 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.

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 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 for charging system information.

EMR LAMP—PCM OUTPUT

The EMR lamp is not used for the 1993 model year.

FUEL INJECTORS—PCM OUTPUT

Six fuel injectors are attached to the fuel rail (Fig. 13).

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.

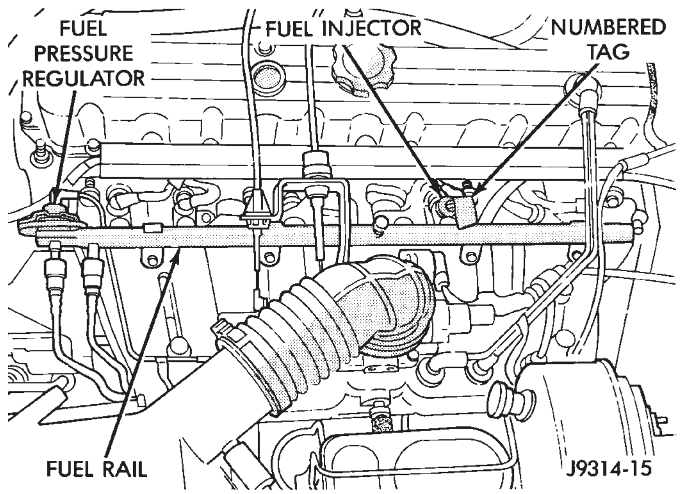

Fig. 13 Fuel Injectors—Typical

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.

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. 14).

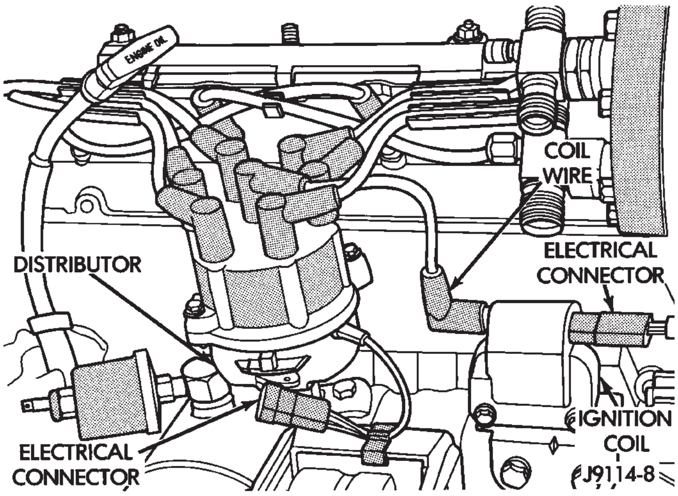

Fig. 14 Ignition Coil

SCI TRANSMIT—PCM OUTPUT

SCI Transmit is the serial data communication transmit circuit for the DRB II scan tool. The powertrain control module (PCM) transmits data to the DRB II 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. Refer to Group 8E for tachometer information.

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 (O_2) sensor is not monitored during Open Loop modes.

During Closed Loop modes, the PCM will monitor the oxygen (O_2) 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 O_2 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 charge 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 O_2 sensor heater element is energized through the fuel pump relay. The O_2 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 charge 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 charge 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 O_2 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 charge 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 O_2 sensor input and adjusts air-fuel ratio by varying injector pulse width. It also adjusts engine idle speed through the idle air control (IAC) motor.
• The PCM adjusts ignition timing by increasing and decreasing spark advance.
• The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

CRUISE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At cruising speed, the powertrain control module (PCM) receives inputs from:
• Air conditioning select signal (if equipped)
• Air conditioning request signal (if equipped)
• Battery voltage

- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold charge 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 (O_2) 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 O_2 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 charge 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 charge 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. 15). Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors. The throttle body is mounted on the intake manifold. It contains an air control passage controlled by an Idle Air Control (IAC) motor. The air control passage is used to supply air for idle conditions. A throttle valve (plate) is used to supply air for above idle conditions.

The throttle position sensor (TPS) 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.

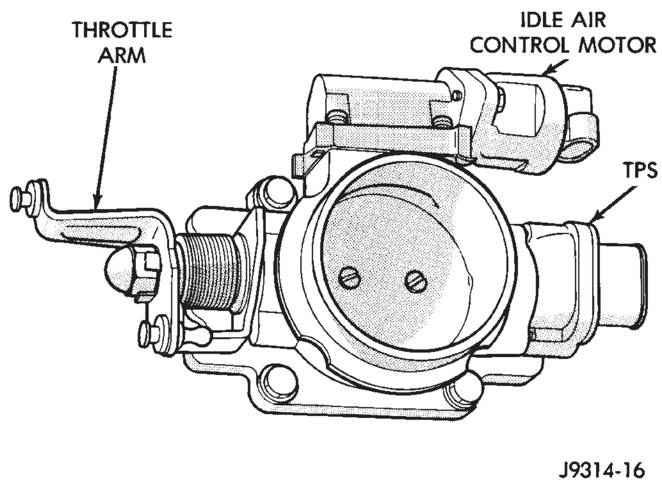

Fig. 15 Throttle Body—Typical

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. 16). 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.

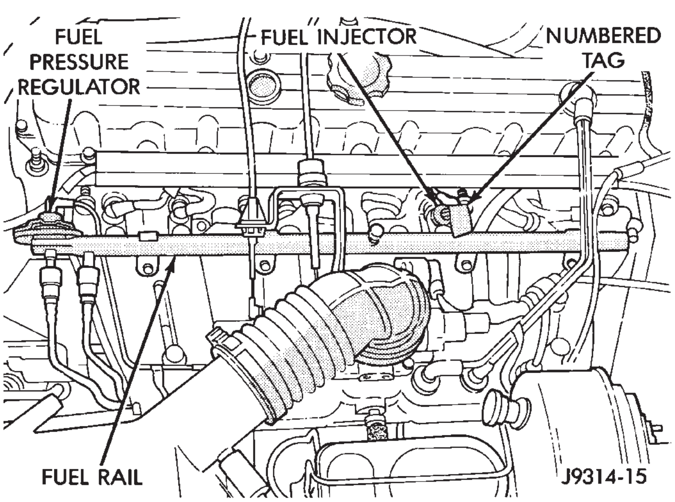

Fig. 16 Fuel Rail—Typical

FUEL PRESSURE REGULATOR

The fuel pressure regulator (Fig. 17) is a mechanical device that is not controlled by the powertrain control module (PCM).

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.

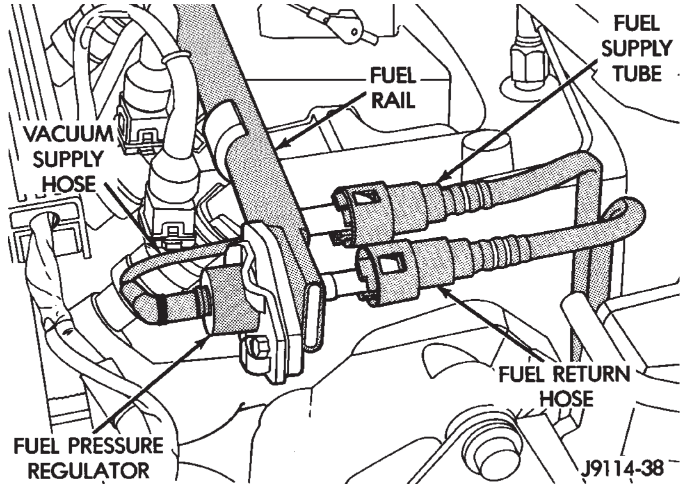

Fig. 17 Fuel Pressure Regulator—Typical

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. 18). 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.

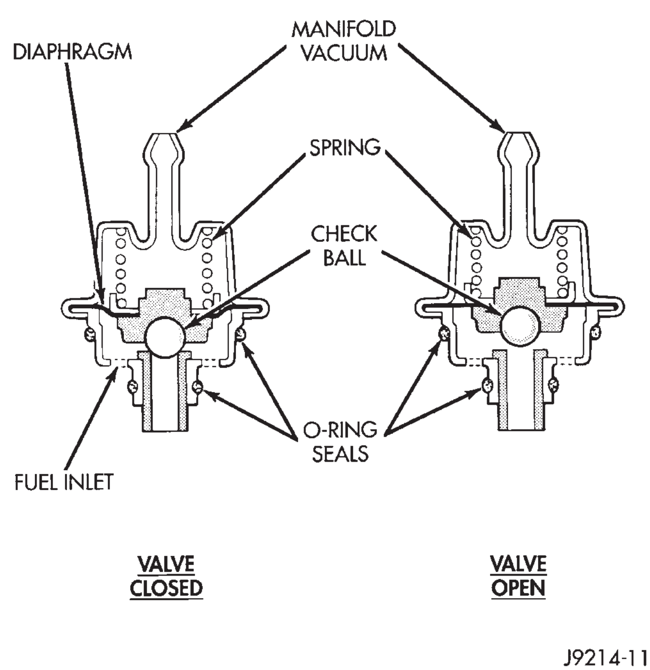

Fig. 18 Fuel Pressure Regulator Operation—Typical

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.

MPI SYSTEM—4.0L ENGINE—GENERAL DIAGNOSIS

INDEX

GENERAL INFORMATION

All 4.0L engines are equipped with sequential Multi-Port Fuel Injection (MPI). The MPI 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) (Fig. 1). Verify that the connector mounting screw is tightened to 4 N●m (35 in. lbs.) torque.

(2) Inspect the battery cable connections. Be sure that they are clean and tight.

(3) Inspect fuel pump relay, air conditioning compressor clutch relay (if equipped) and ASD relay. These are located in the Power Distribution Center (Fig. 2). Inspect starter motor relay connections. Inspect relays for signs of physical damage and corrosion.

(4) Inspect ignition coil connections. Look for bent or spread pins in the connector. Verify that coil secondary cable is firmly connected to coil (Fig. 3).

(5) Verify that distributor cap is correctly attached to distributor. Be sure that spark plug cables are firmly connected to the distributor cap and the spark plugs are in their correct firing order. Be sure that coil cable is firmly connected to distributor cap and coil. Be sure that camshaft position sensor wire connector (from in the distributor) is firmly connected to main harness connector (Fig. 4). 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.

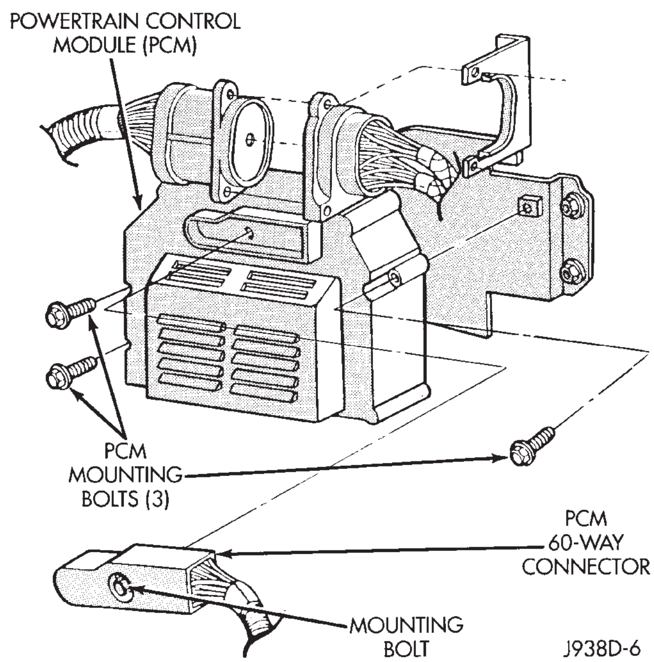

Fig. 1 Powertrain Control Module (PCM) Connector

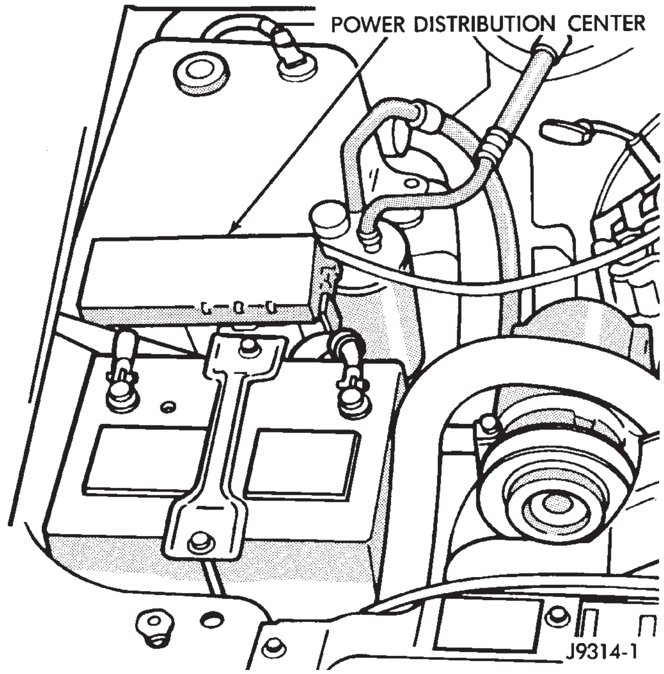

Fig. 2 Power Distribution Center

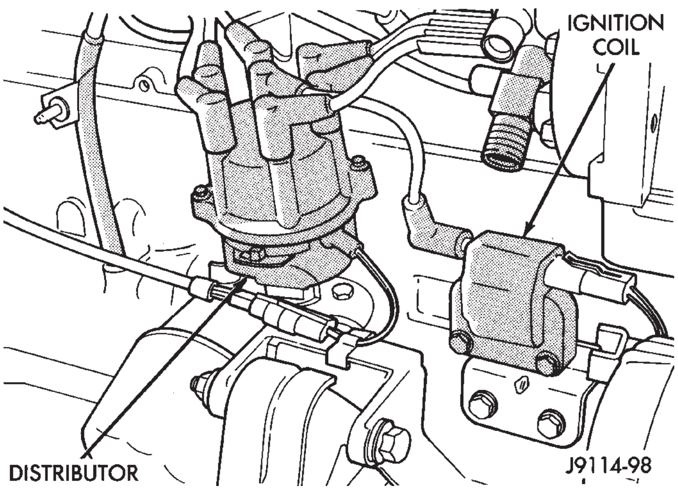

Fig. 3 Ignition Coil—Typical

(6) Verify that generator output wire, generator connector and ground wire are firmly connected to the generator (Fig. 5).

(7) Inspect the system ground connections at the right inner fender next to the battery. Be sure the bolt is tight and the ground terminals are clean. The Powertrain Control Module (PCM) is grounded directly (and plugged individually) to the negative battery cable with a small jumper harness.

(8) Verify that crankcase ventilation (CCV) fresh air hose is firmly connected to cylinder head and air cleaner covers. Refer to Group 25, Emission Control System for information.

(9) Verify that vacuum hose is firmly connected to fuel pressure regulator and manifold fitting (Fig. 6).

(10) Inspect fuel tube quick-connect fitting-to-fuel rail connections (Fig. 7).

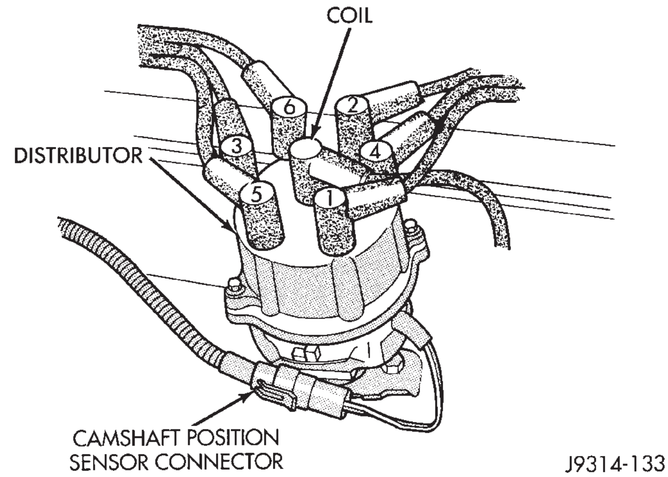

Fig. 4 Distributor Cap, Spark Plug Cables and Camshaft Position Sensor Connector

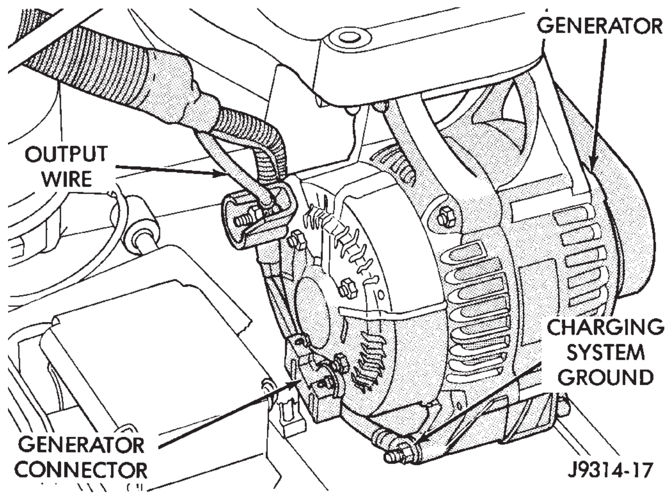

Fig. 5 Generator Connector and Output Wire Connections—Typical

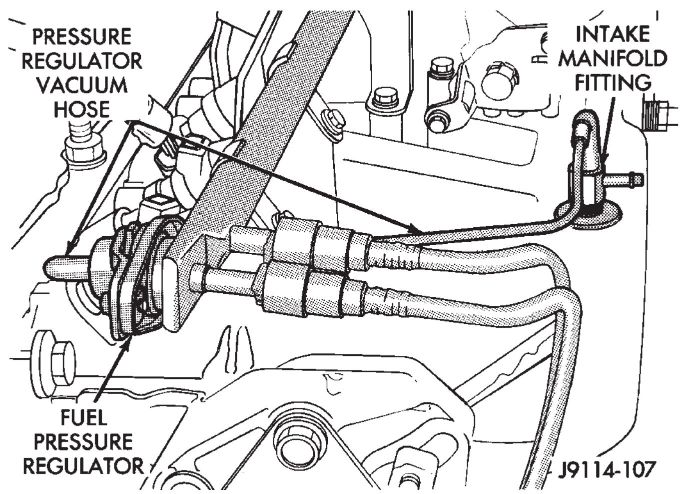

Fig. 6 Fuel Pressure Regulator Vacuum Hose—Typical

(11) Verify that hose connections to all ports of vacuum fittings on intake manifold are tight and not leaking.

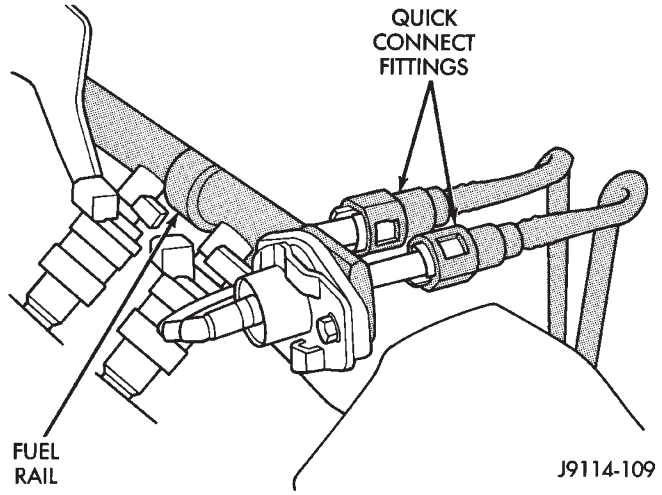

Fig. 7 Fuel Supply Tube—Typical

(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. 8).

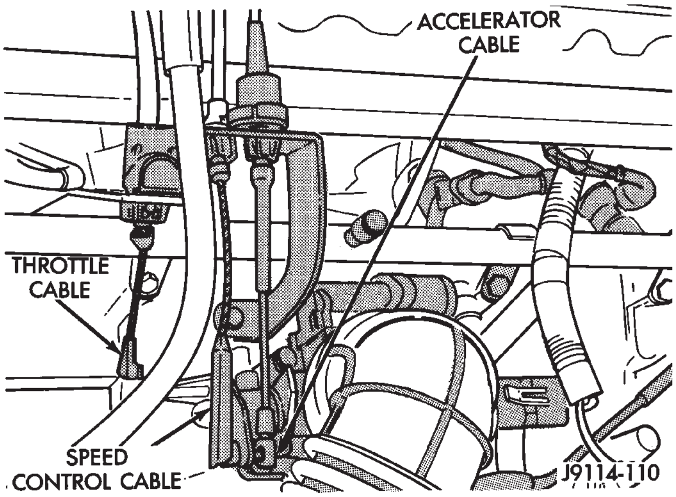

Fig. 8 Accelerator Cable, Throttle Cable and Speed Control Cable

(13) Verify that brake vacuum booster hose is firmly connected to fitting on intake manifold. Also check connection to brake vacuum booster.

(14) Inspect the air cleaner inlet and air filter element for restrictions.

(15) Inspect radiator grille area, radiator fins and air conditioning condenser for restrictions.

(16) Verify that intake manifold air temperature sensor wire connector is firmly connected to harness connector (Fig. 9).

(17) Verify that MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 10). Verify that vacuum hose is firmly connected to MAP sensor and to the intake manifold.

(18) Verify that fuel injector wire harness connectors are firmly connected to the fuel injectors in the correct firing order. Each harness connector is tagged with the number of its corresponding fuel injector (Fig. 11).

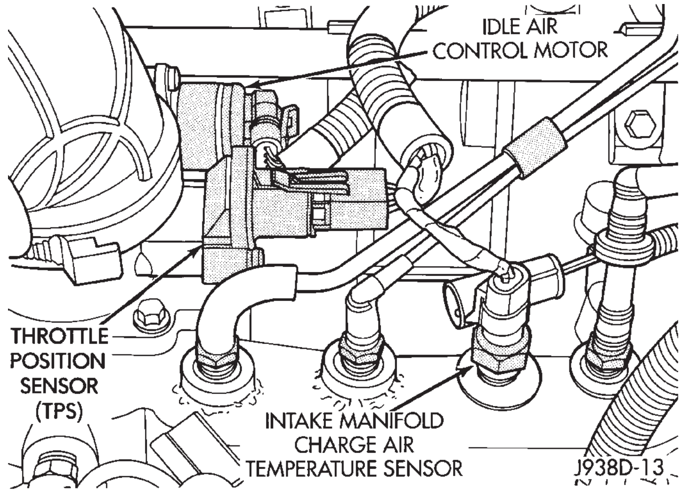

Fig. 9 Sensor Connectors

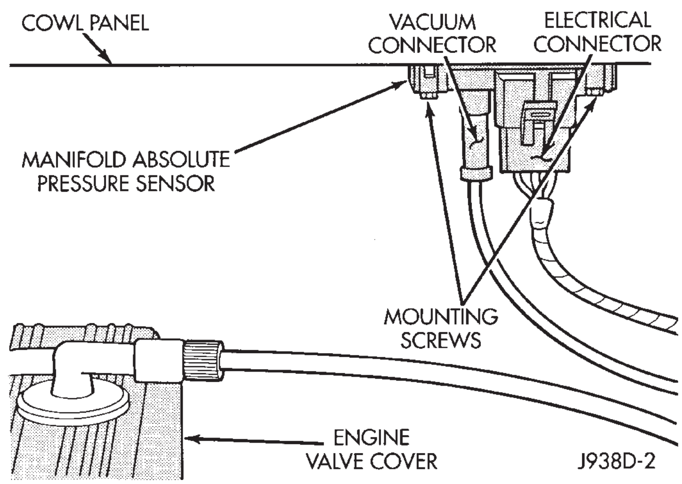

Fig. 10 Manifold Absolute Pressure (MAP) Sensor

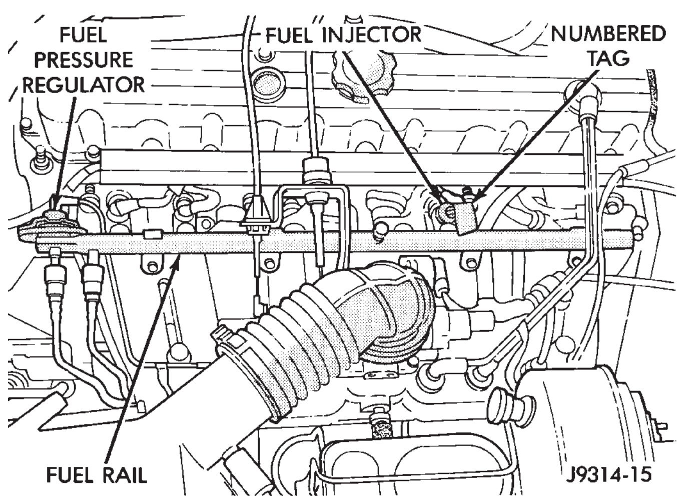

Fig. 11 Fuel Injector Wire Harness—Typical

(19) Verify that harness connectors are firmly connected to idle air control motor and throttle position sensor.

(20) Verify that wire harness connector is firmly connected to the engine coolant temperature sensor (Fig. 12).

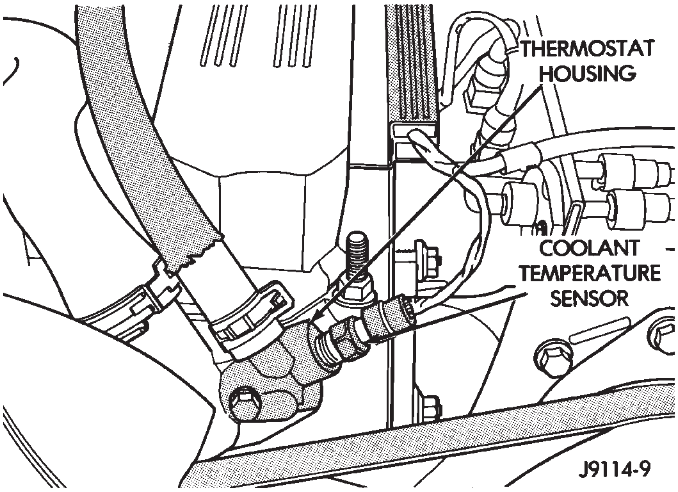

Fig. 12 Engine Coolant Temperature Sensor—Typical

(21) Verify that Oxygen Sensor wire connector is firmly connected to the sensor. Inspect sensor and connector for damage (Fig. 13).

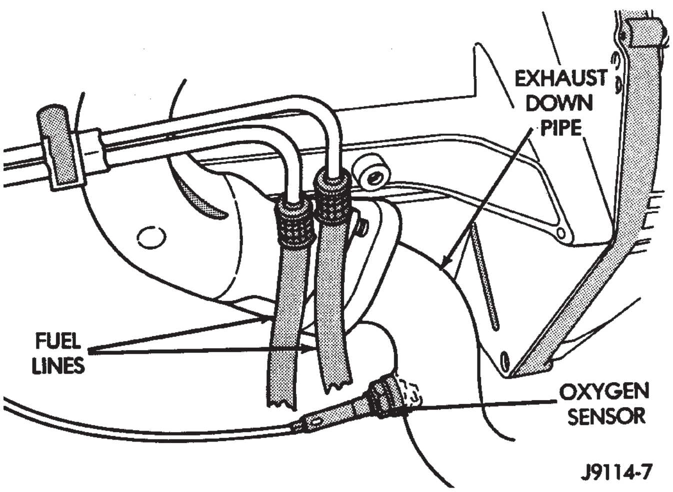

Fig. 13 Oxygen Sensor Location—Typical

(22) Raise and support the vehicle.

(23) Inspect for pinched or leaking fuel tubes. Inspect for pinched cracked or leaking fuel lines.

(24) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(25) If equipped with automatic transmission, verify that electrical harness is firmly connected to neutral safety switch. Refer to the Automatic Transmission section of Group 21.

(26) Verify that the harness connector is firmly connected to the vehicle speed sensor (Fig. 14).

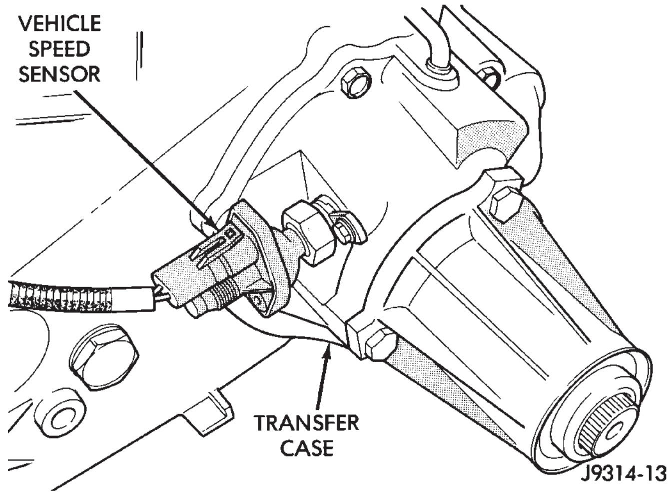

Fig. 14 Vehicle Speed Sensor—Typical

(27) Verify that fuel pump/gauge sender unit wire connector (located near front of fuel tank) is firmly connected to harness connector.

(28) Inspect fuel lines at front of fuel tank for cracks or leaks.

(29) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

(30) 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. 15).

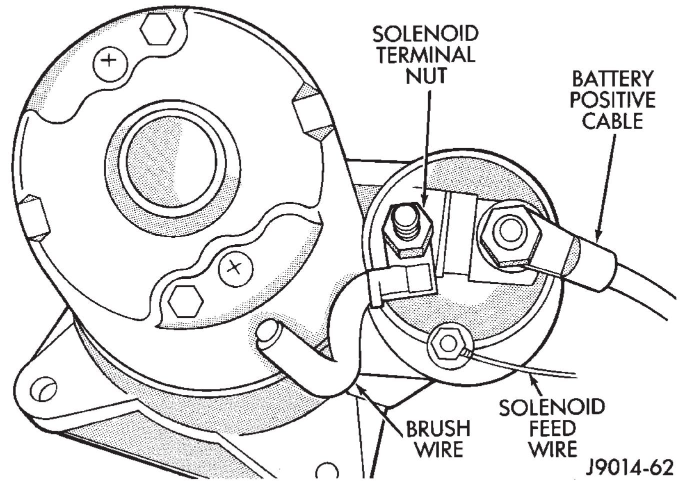

Fig. 15 Starter Solenoid Connection—Typical

POWERTRAIN CONTROL MODULE (PCM) 60-WAY CONNECTOR

Terminal identification and specific circuit applications for the 4.0L six-cylinder engine are detailed in the PCM connector chart (Fig. 16).

SYSTEM SCHEMATICS

Fuel system schematics for fuel injected 4.0L engines are shown in figure 17.

CAV	WIRE COLOR	DESCRIPTION
1	RD/WT	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
2	TN/BK*	ENGINE COOLANT TEMPERATURE SENSOR
3	RD	DIRECT BATTERY VOLTAGE
4	BK/LB*	SENSOR GROUND (PCM II)
5	BK/TN	POWER GROUND
6	VT/WT	+ 5 VOLT OUTPUT
7	WT/BK	+ 8 VOLT OUTPUT
8		
9	LB/RD	IGNITION (START AND RUN)
10		
11	BK/TN*	POWER GROUND
12	BK/TN*	POWER GROUND
13	LB/BR*	INJECTOR NO. 4
14	YL/WT*	INJECTOR NO. 3
15	TN	INJECTOR NO. 2
16	WT/LB	INJECTOR NO. 1
17		
18		
19	GY/WT	DISTRIBUTOR IGNITION COIL (-)
20	DG	GENERATOR FIELD CONTROL
21	BK/RD*	INTAKE (MANIFOLD) AIR TEMPERATURE SENSOR
22	OR/DB*	THROTTLE POSITION SENSOR
23		
24	RD/LG	CRANKSHAFT POSITION SENSOR (CPS)
25	BK	DIAGNOSTIC CONNECTOR
26	VT/BR*	CHRYSLER COLLISION DETECTION BUS (+)
27	DB/OR	A/C LOW PRESSURE SWITCH
28	LG	A/C SELECT
29	BR	BRAKE SWITCH (-)
30	BK/WT	PARK/NEUTRAL SWITCH (AUTO TRANS. ONLY)
31		
32	BK/PK*	CHECK ENGINE LAMP
33	TN/RD*	SPEED CONTROL VACUUM SOLENOID
34	DB/RD	A/C CLUTCH RELAY
35		
36		

CAV	WIRE COLOR	DESCRIPTION
37		
38	GY	INJECTOR NO. 5
39	YL/BK	IDLE AIR CONTROL MOTOR (4)
40	BR/WT*	IDLE AIR CONTROL MOTOR (2)
41	BK/OR	OXYGEN SENSOR
42		
43	GY/LB*	TACH SIGNAL OUTPUT (VEHICLE W/TACHOMETER)
44	GY/BL	CAMSHAFT POSITION SENSOR (FUEL SYNC)
45	BK/YL	DIAGNOSTIC CONNECTOR
46	WT/GY	CHRYSLER COLLISION DETECTION BUS (-)
47	WT/OR*	VEHICLE SPEED (DISTANCE) SENSOR
48	BR/RD*	SPEED CONTROL COAST/SET
49	YL/RD*	SPEED CONTROL ON/OFF
50	WT/LG*	SPEED CONTROL RESUME/ACCEL
51	PK	FUEL PUMP RELAY
52		
53	LG/RD*	SPEED CONTROL VENT SOLENOID
54		
55		
56	GY/PK*	SERVICE REMINDER INDICATOR
57	DG/BK	AUTOMATIC SHUTDOWN RELAY (SENSE)
58	BR/YL	INJECTOR NO. 6
59	GY/RD	IDLE AIR CONTROL MOTOR (1)
60	VT/BK	IDLE AIR CONTROL MOTOR (3)

WIRE COLOR CODES					
BK	BLACK	LB	LIGHT BLUE	VT	VIOLET
BR	BROWN	LG	LIGHT GREEN	WT	WHITE
DB	DARK BLUE	OR	ORANGE	YL	YELLOW
DG	DARK GREEN	PK	PINK	*	WITH TRACER
GY	GRAY	RD	RED		
		TN	TAN		

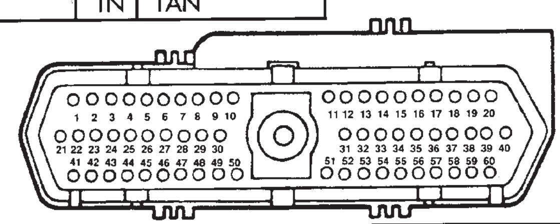

Fig. 16 PCM Connector—4.0L Engine

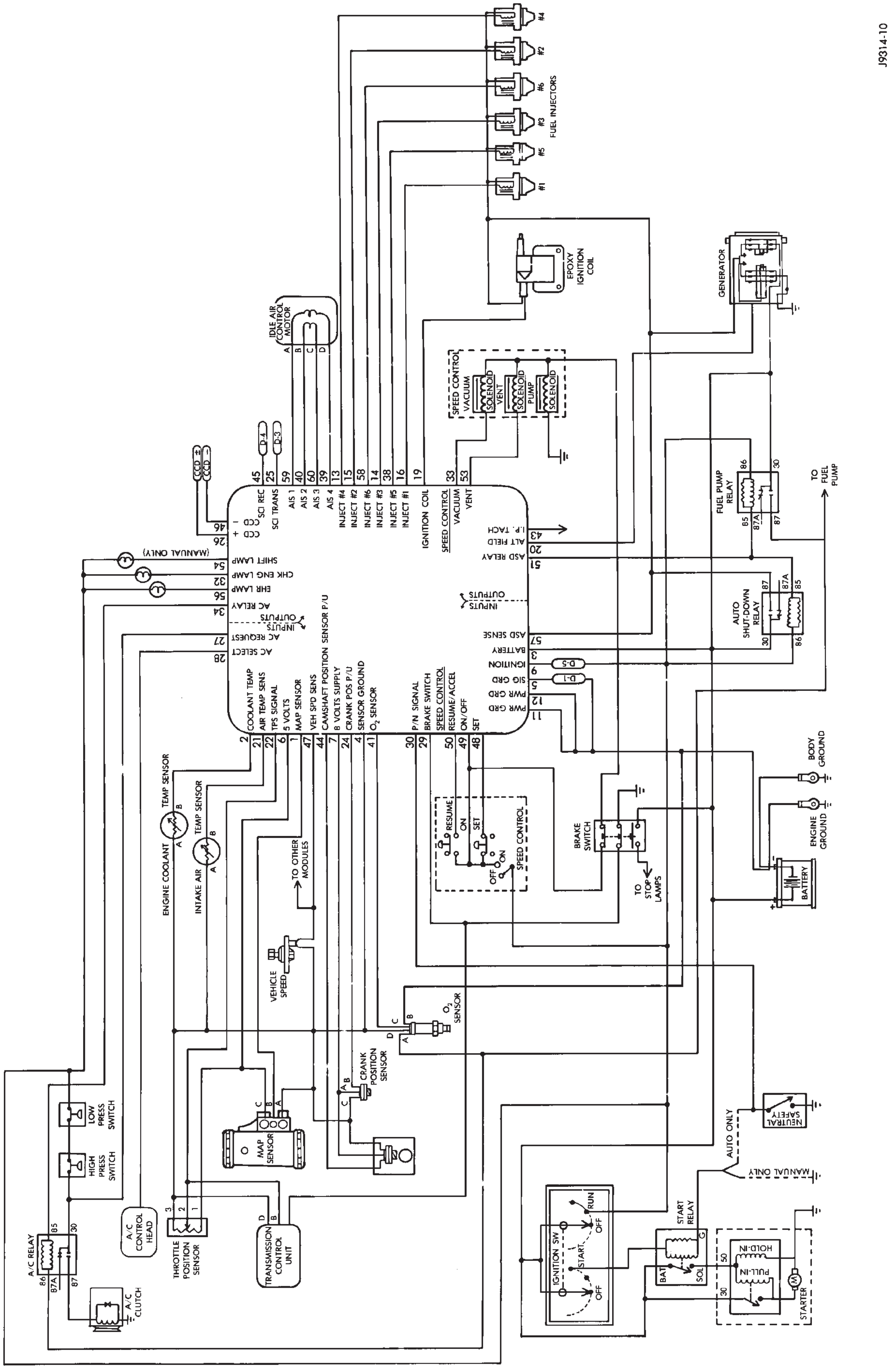

Fig. 17 System Schematic—4.0L Engine

CAMSHAFT POSITION SENSOR TEST

Refer to Group 8D, Ignition Systems, for Camshaft Position Sensor testing.

COOLANT TEMPERATURE SENSOR TEST

Disconnect wire harness connector from engine coolant temperature sensor (Fig. 18).

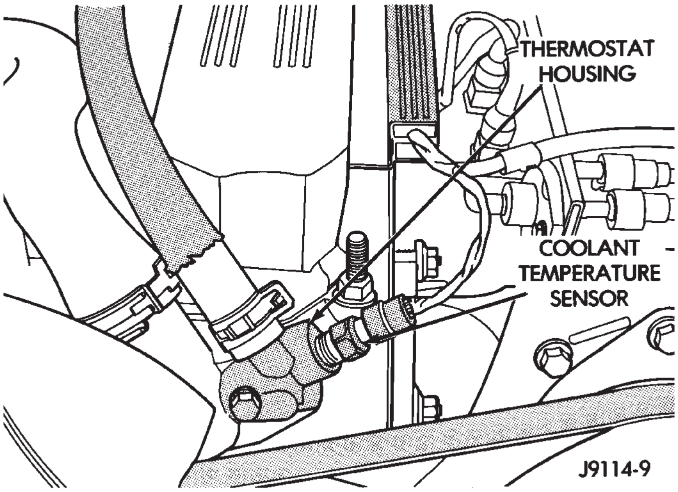

Fig. 18 Coolant Temperature Sensor—Typical

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.

CHARGE AIR TEMPERATURE SENSOR TEST

Disconnect the wire harness connector from the intake manifold charge air temperature sensor (Fig. 19).

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 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.

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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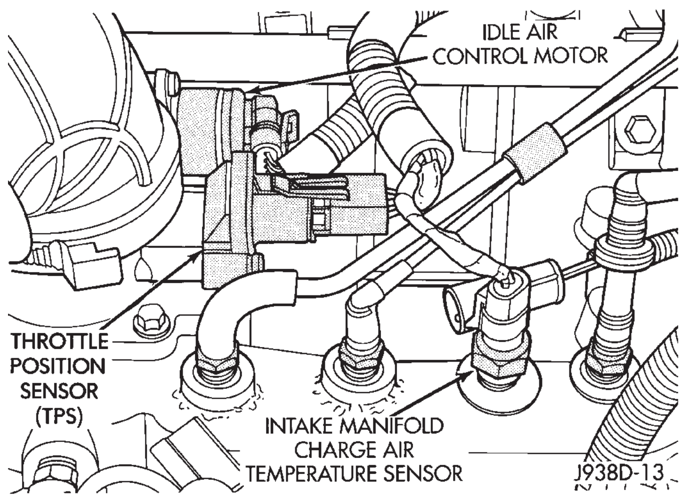


Fig. 19 Air Temperature Sensor

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST

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. 20). Be sure that the MAP sensor harness wires are not damaged by the test meter probes.

Test the MAP sensor output voltage at the MAP sensor connector between terminals A and B (as marked on the sensor body) (Fig. 21). With the ignition switch ON and the engine OFF, output voltage

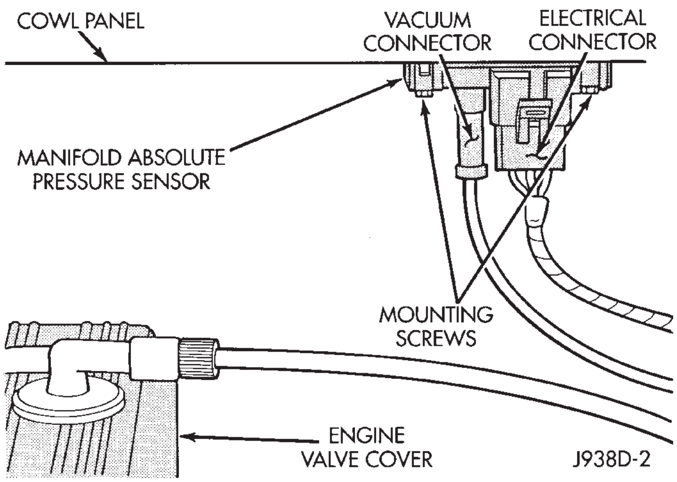


Fig. 20 MAP Sensor Location

should be 4-to-5 volts. The voltage should drop to 1.5-to-2.1 volts with a neutral-hot idle speed condition.

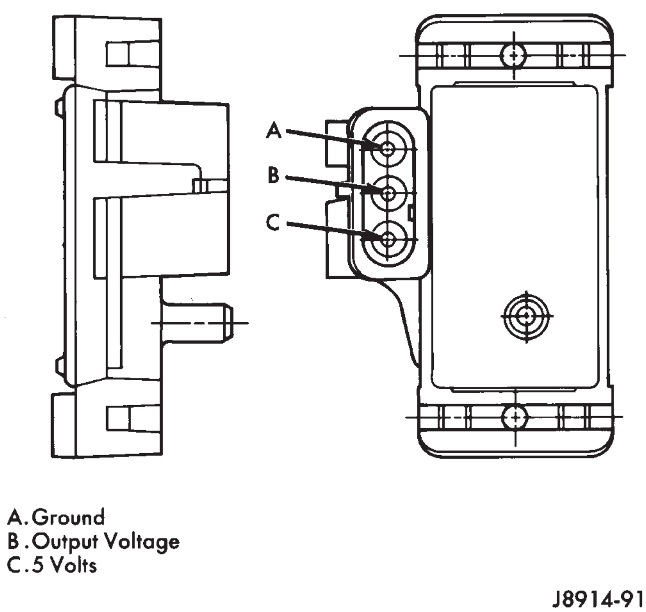


Fig. 21 MAP Sensor Connector Terminals—Typical

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. 21) 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. 21) 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.

THROTTLE POSITION SENSOR (TPS) TEST

The throttle position sensor (TPS) can be tested with a digital voltmeter. The center terminal of the TPS is the output terminal (Fig. 22).

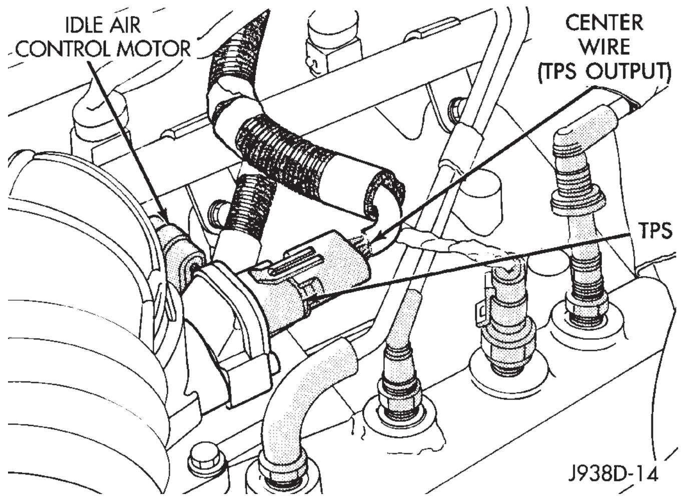


Fig. 22 Throttle Position Sensor (TPS) Testing—Typical

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.

OXYGEN SENSOR (O_2) HEATING ELEMENT TEST

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 O_2 sensor connector (Fig. 23). 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.

IDLE AIR CONTROL MOTOR TEST

Idle Air Control Motor operation can be tested using special exerciser tool number 7558 (Fig. 24).

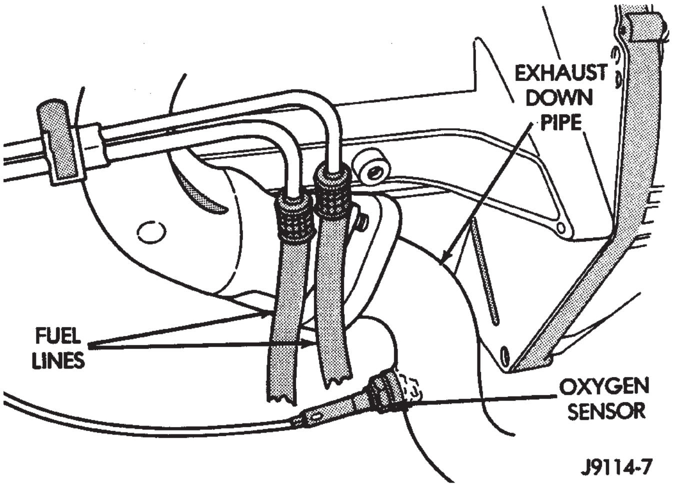


Fig. 23 Oxygen Sensor—Typical

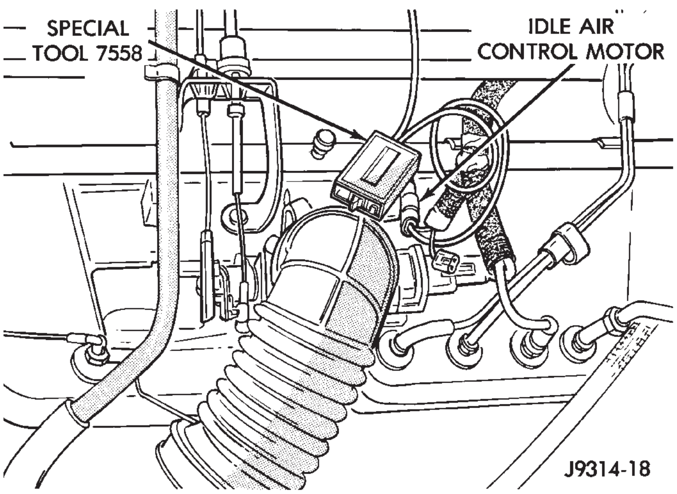


Fig. 24 Idle Air Control Motor Testing

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 Idle Air Control Motor wire connector at throttle body (Fig. 24).

(2) Plug the exerciser tool number 7558 harness connector into the Idle Air Control 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 Idle Air Control 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 Idle Air Control Motor is functioning properly. Disconnect the exerciser tool and connect the Idle Air Control 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 Idle Air Control Motor.

(6) Remove the Idle Air Control Motor from the throttle body. Do not remove Idle speed motor housing from throttle body.

CAUTION: When checking Idle Air Control Motor operation with the motor removed from the throttle body, do not extend the pintle (Fig. 25) more than 6.35 mm (.250 in). If the pintle is extended more than this amount, it may separate from the Idle Air Control Motor. The Idle Air Control Motor must be replaced if the pintle separates from the motor.

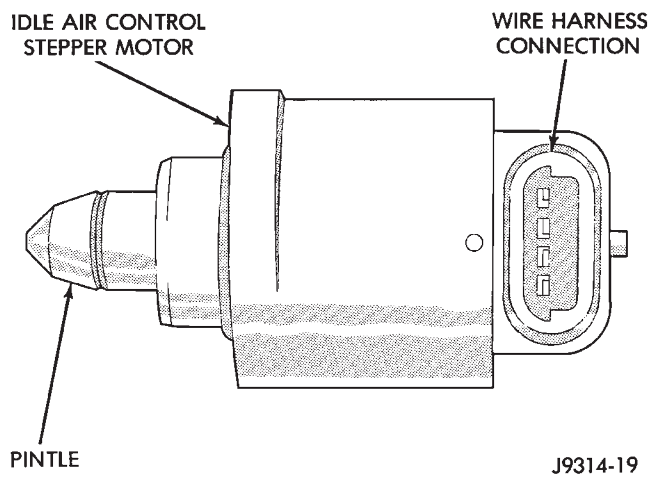


Fig. 25 Idle Air Control Motor Pintle

(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 II Scan Tool and the appropriate Powertrain Diagnostics Procedures service manual.

RELAYS—OPERATION/TESTING

OPERATION

The following operations/tests apply to these relays only: Automatic Shutdown (ASD) and Fuel Pump. For operations/tests on all other relays, refer to the appropriate section of this service manual.

The relay terminal numbers from (Fig. 26) can be found on the bottom of the relay:

- Terminal number 30 is connected to battery voltage and can be switched or B+ (hot) at all times.
- 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).

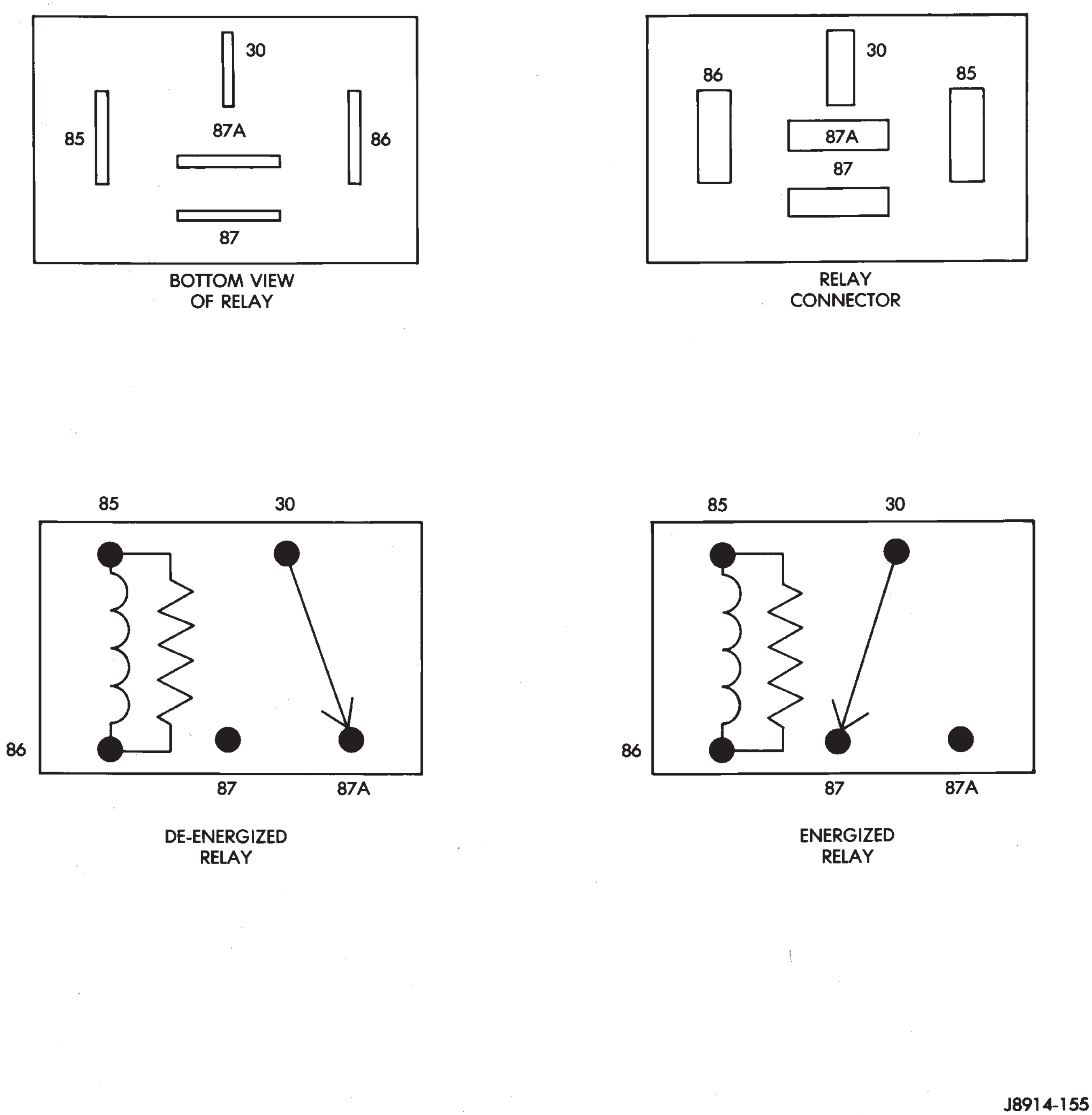


Fig. 26 Relay Terminals

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 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 (Fig. 17) for (fuel system) relay wiring schematics. Also refer to Group 8W, Wiring Diagrams for additional circuit information.

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.

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.

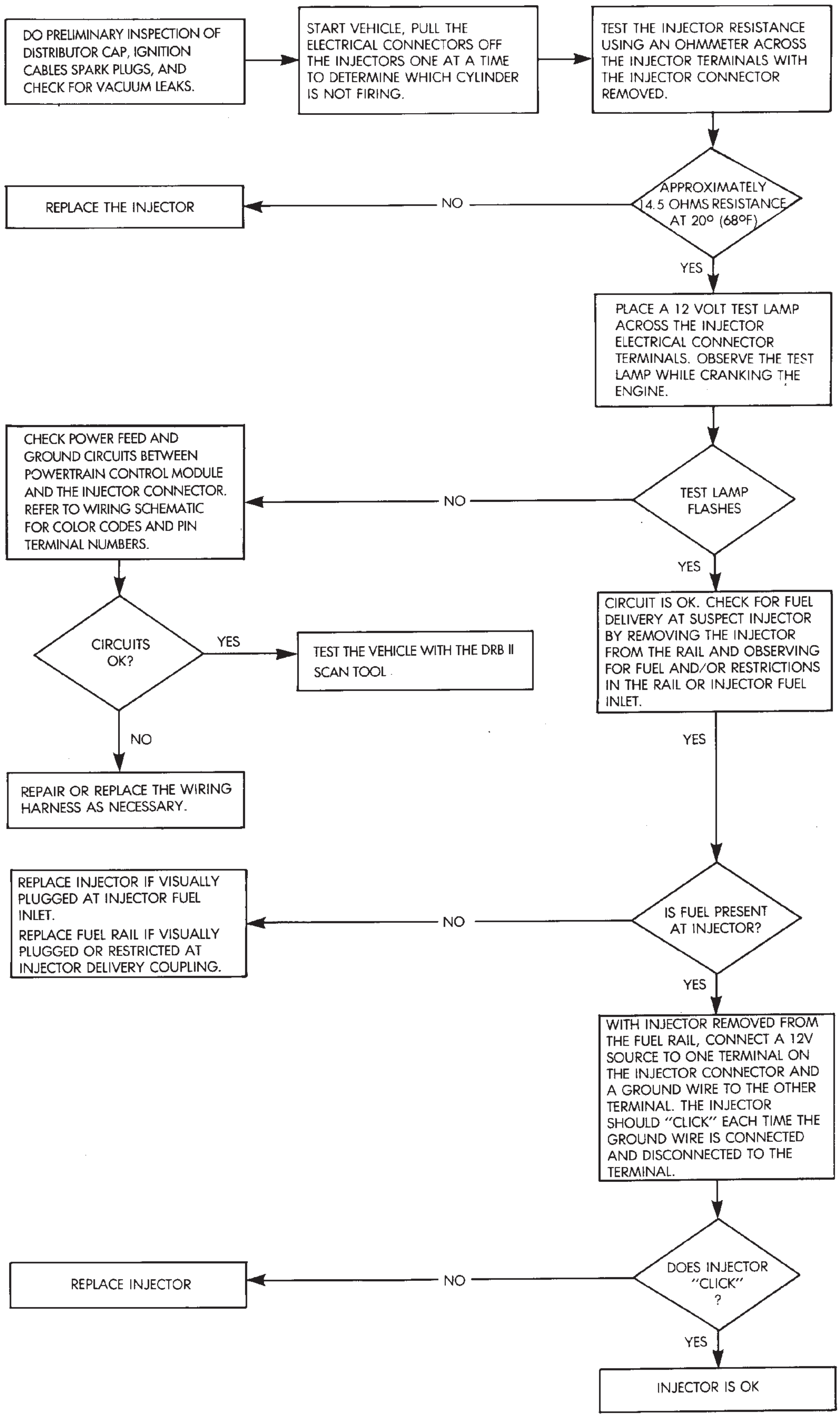
Oxygen Sensor - The PCM can determine if the oxygen sensor is switching between rich and lean. This is, once the system has entered Closed Loop. Refer to Open Loop/Closed Loop Modes Of Operation in the Component Description/System Operation section for an explanation of Closed (or Open) Loop operation.

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

INJECTOR DIAGNOSIS—VEHICLE RUNS ROUGH AND/OR HAS A MISS



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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.

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 II (DRB II scan tool). The DRB II connects to the data link connector in the vehicle (Fig. 27). For operation of the DRB II, refer to the appropriate Powertrain Diagnostic Procedures service manual.

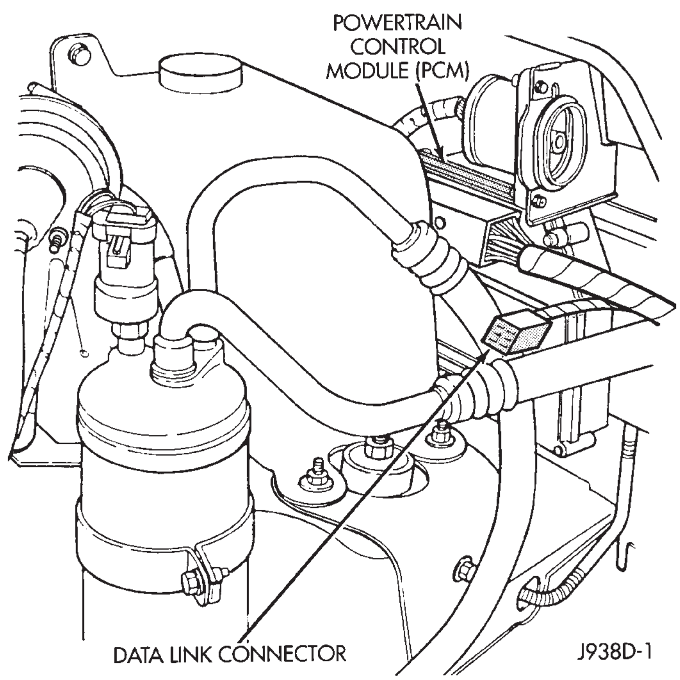

Fig. 27 Data Link Connector—Typical

EXAMPLES

- If the lamp flashes 4 times, pauses and flashes 1 more time, a Diagnostic Trouble Code (DTC) number 41 is indicated.
- If the lamp flashes 4 times, pauses and flashes 6 more times, a Diagnostic Trouble Code (DTC) number 46 is indicated.

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. 28).

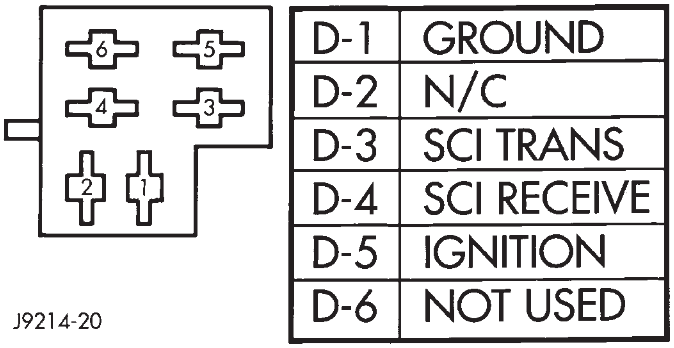

Fig. 28 Data Link Connector Schematic

ERASING TROUBLE CODES

The DRB II scan tool must be used to erase a Diagnostic Trouble Code (DTC). Refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB II scan tool.

DRB II SCAN TOOL

For operation of the DRB II 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 4.0L six-cylinder engine. 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 DESCRIPTION

DIAGNOSTIC TROUBLE CODE	DRBII DISPLAY	DESCRIPTION OF CONDITION
11	No Reference (Crank) Signal at PCM	No distributor reference signal detected during engine cranking from the crankshaft position sensor.
13+**	No change in MAP from Start to Run	No difference is recognized between the engine MAP reading and the barometric pressure reading at engine start-up.
14+**	MAP Voltage too Low MAP Voltage too high	MAP sensor input below minimum acceptable voltage.
15	No vehicle speed sensor signal.	No 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**	O_2S Shorted to Voltage	Neither rich nor lean condition is detected from the oxygen sensor input. Oxygen sensor input voltage maintained above normal operating range.
22+**	ECT Voltage too High or ECT Voltage too Low	Coolant temperature sensor input below the minimum acceptable voltage. Coolant temperature sensor input above the maximum acceptable voltage.
23+**	Intake Air Temp Sensor Voltage High or Intake Air Temp Sensor Voltage Low	Intake Manifold Air Temperature Sensor input above the maximum acceptable voltage. Intake Manifold Air Temperature Sensor input below the minimum acceptable voltage.
24+**	Throttle Position Sensor Voltage High or Throttle Position Sensor Voltage Low	Throttle position sensor (TPS) input below the minimum acceptable voltage. Throttle position sensor (TPS) input above the maximum acceptable voltage.

+ Check Engine Lamp On
* * Check Engine Lamp On (California Only)

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DIAGNOSTIC TROUBLE CODE DESCRIPTION—CONTINUED

DIAGNOSTIC TROUBLE CODE	DRBII DISPLAY	DESCRIPTION OF CONDITION
25**	Idle Air Control Motor Circuits	A shorted or open circuit detected in one or more of the Idle Air Control motor circuits.
27+**	Injector #1, #2, #3, #4, #5 or #6 Circuits	Injector 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.
41+**	Generator Field Not Switching Properly	Generator field not switching properly.
42	Auto Shutdown Relay Control Circuit or No ASD Relay Voltage Sense at PCM	An open or shorted condition detected in the ASD relay control circuit. No ASD voltage sensed at PCM.
44	Battery Temp Sensor Voltage out of limit	Battery temperature sensor voltage out of limit.
46+**	Charging System Voltage too High	Charging system voltage too high.
47+**	Charging System Voltage too Low	Charging system voltage too low.
51**	O_2S stays below center (lean)	O_2 sensor signal stays lean.
52**	O_2S stays above center (rich)	O_2 sensor signal stays rich.
53	Internal PCM Failure or PCM Failure SPI Communication	Internal Powertrain Control Module (PCM) fault condition detected. No internal communication between co-processors.
54	No Cam Sync Signal at PCM	No sync pickup signal from camshaft position sensor.
62	PCM Failure SRI miles not stored	Powertrain Control Module (PCM) failure—Service Reminder Indicator (SRI) miles not stored.

+ Check Engine Lamp On
* * Check Engine Lamp On (California Only)

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DIAGNOSTIC TROUBLE CODE DESCRIPTION—CONTINUED

DIAGNOSTIC TROUBLE CODE	DRBII DISPLAY	DESCRIPTION OF CONDITION
63	PCM Failure EEPROM Write Denied	Powertrain Control Module (PCM) failure—EEPROM write denied.
76		
55	NA	Completion of diagnostic trouble code display on the Malfunction Indicator Lamp (Check Engine Lamp).

+ Check Engine Lamp On

* * Check Engine Lamp On (California Only)

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MPI SYSTEM—4.0L ENGINE—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) (Fig. 1). For location of this relay within the PDC, refer to label attached to bottom of PDC cover.

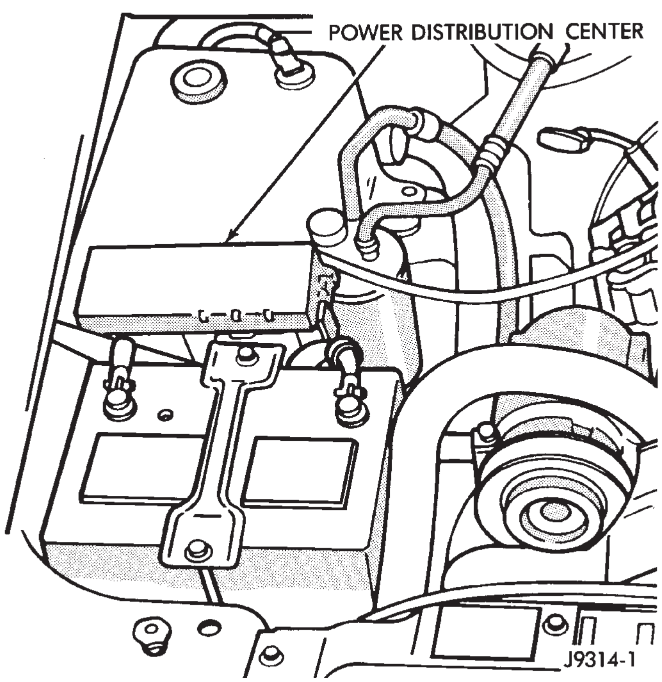


Fig. 1 Power Distribution Center (PDC)

AIR CLEANER HOUSING

Refer to Group 25, Emission Control System.

AIR FILTER

Refer to Group 25, Emission Control System.

AUTOMATIC SHUT DOWN (ASD) RELAY

The ASD relay is located in the Power Distribution Center (Fig. 1) (PDC). For location of this relay within the PDC, refer to label attached to bottom of 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.

CHARGE AIR TEMPERATURE SENSOR

The intake manifold charge air temperature sensor is installed into the intake manifold plenum (Fig. 2).

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

The crankshaft position sensor is mounted in the transmission bellhousing at the left/rear side of the engine block (Fig. 3).

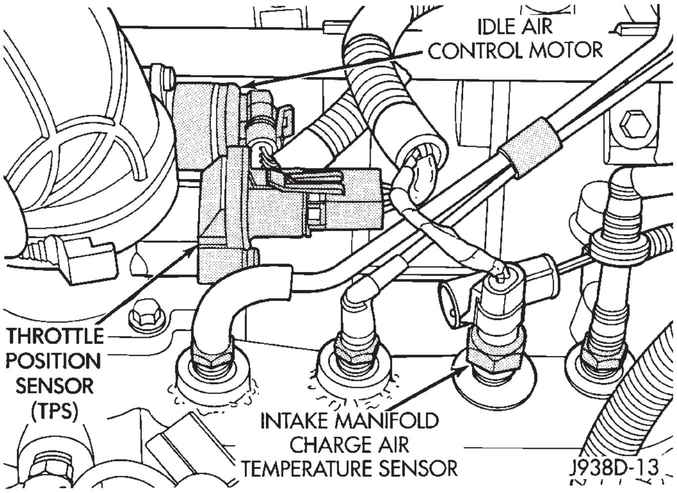


Fig. 2 Sensor Location

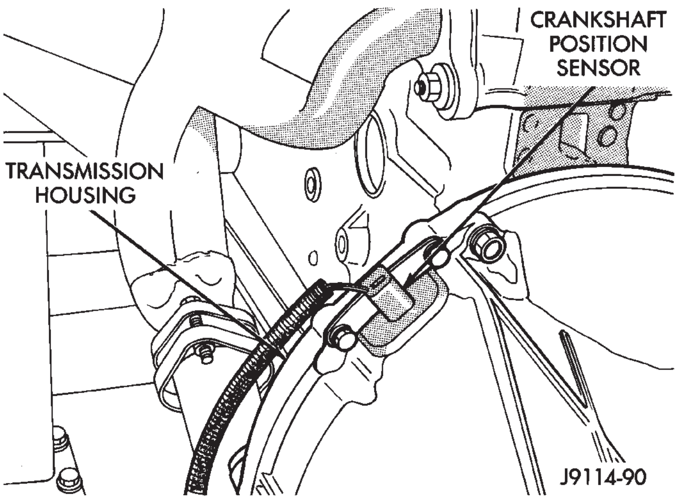


Fig. 3 Crankshaft Position Sensor

REMOVAL

(1) Near the rear of the intake manifold, disconnect the pigtail harness (on the sensor) from the main electrical harness.

(2) Remove the two sensor mounting bolts (Fig. 3).

(3) Remove the sensor.

(4) Remove clip from sensor wire harness.

INSTALLATION

(1) Install the sensor flush against the opening in the transmission housing.

(2) Install and tighten the two sensor mounting bolts to 17-to-21 N●m (13-to-16 ft. lbs.) torque.

CAUTION: The two bolts used to secure the sensor to the transmission 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.

ENGINE COOLANT TEMPERATURE SENSOR

The coolant temperature sensor is installed in the thermostat housing (Fig. 4).

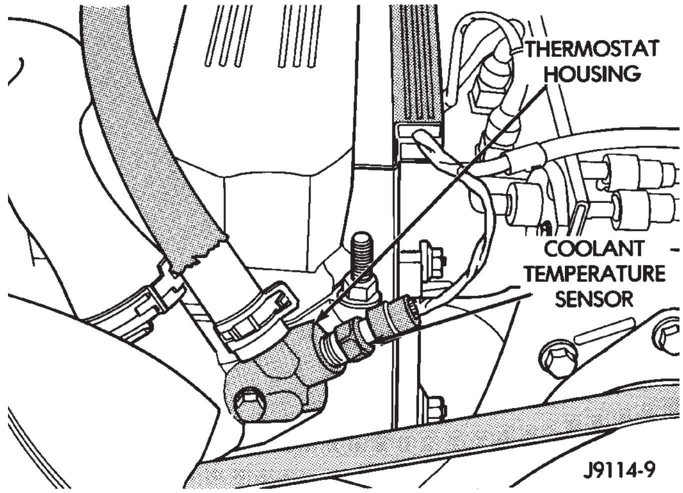


Fig. 4 Engine Coolant Temperature Sensor—Typical

REMOVAL

(1) Drain cooling system until the coolant level is below the cylinder head. Observe the **WARNINGS** in Group 7, Cooling.

(2) Disconnect the coolant temperature sensor wire connector.

(3) Remove the sensor from the thermostat housing (Fig. 4).

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.

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. 5).

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.

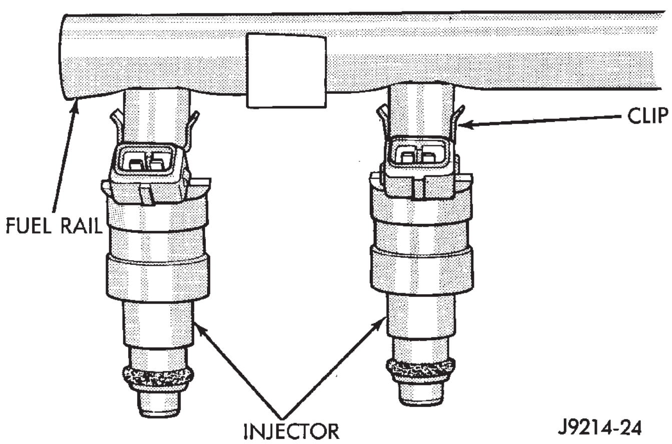


Fig. 5 Injector Retaining Clips

FUEL PUMP RELAY

The Fuel Pump relay is located in the Power Distribution Center (PDC) (Fig. 6). For location of this relay within the PDC, refer to label attached to bottom of PDC cover.

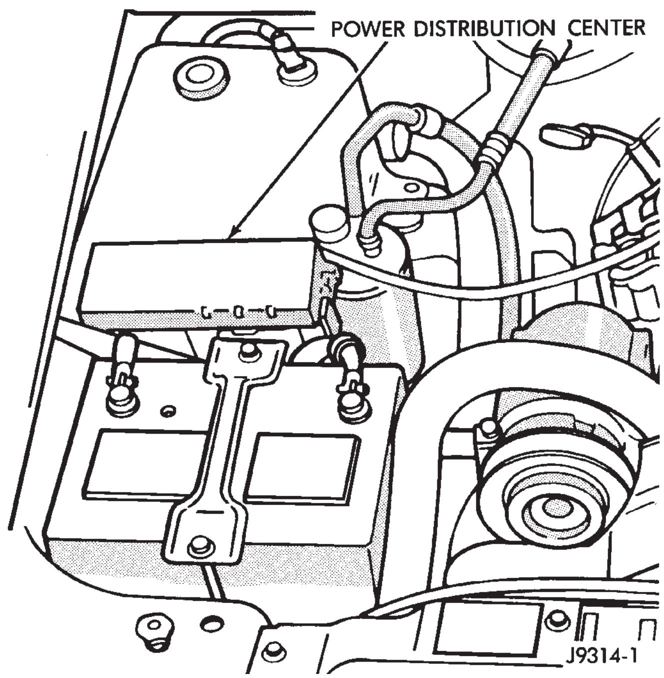


Fig. 6 Power Distribution Center (PDC)

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).

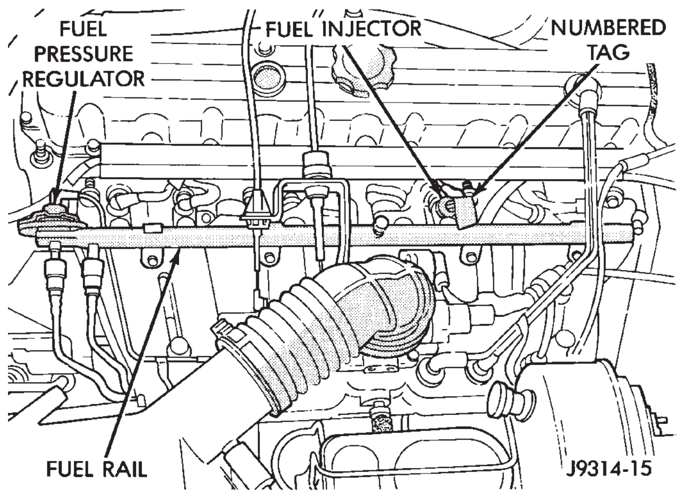


Fig. 7 Fuel Injector Harness—Typical

(5) Disconnect vacuum line from fuel pressure regulator (Fig. 7).

(6) Disconnect fuel supply tube from fuel rail and the fuel return tube 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, THROTTLE BODY 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 Idle Air Control Motor is mounted to the throttle body adjacent to the throttle position sensor (Fig. 8).

REMOVAL

(1) Disconnect the electrical connector from the Idle Air Control Motor.

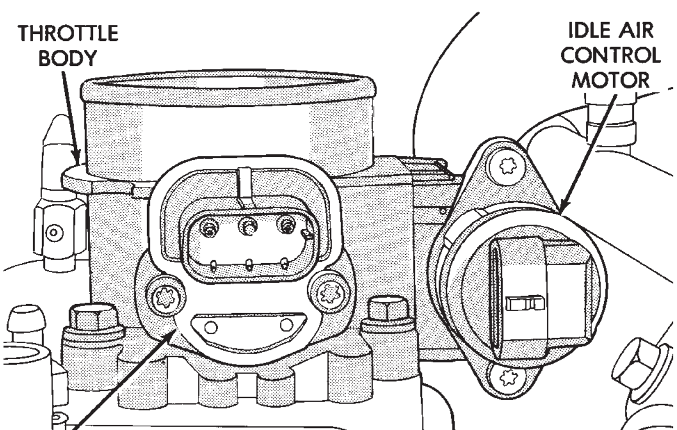


Fig. 8 Idle Air Control Motor—Removal/Installation

(2) Remove Idle Air Control Motor torx head mounting screws.
(3) Remove Idle Air Control Motor.

INSTALLATION

(1) Install Idle Air Control Motor into throttle body and tighten retaining screws.
(2) Connect electrical connector to Idle Air Control 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 cover (Fig. 9).

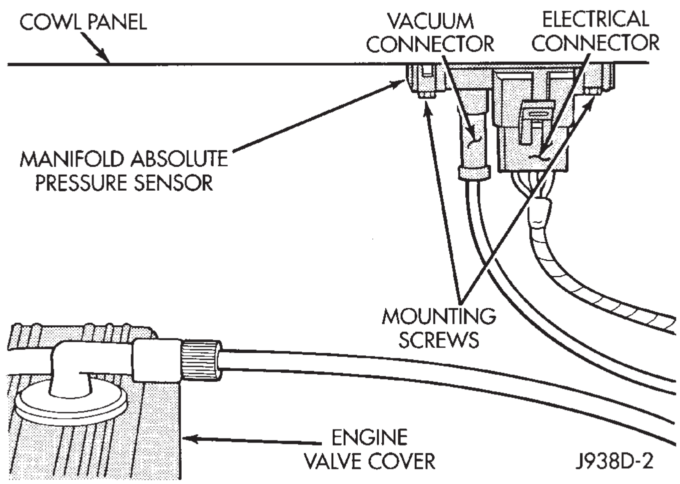


Fig. 9 MAP Sensor

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 screws and remove MAP sensor.

INSTALLATION

(1) Install MAP sensor to dash panel and secure with mounting screws.
(2) Install the MAP sensor vacuum supply hose.
(3) Connect the MAP sensor electrical connector.

OXYGEN (O_2) SENSOR

The O_2 sensor is installed in the exhaust down pipe just below the exhaust manifold flange (Fig. 10).

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) The sensors electrical connector clip is pushed over an oil pan mounting stud. Pull the connector clip from the mounting stud.

(3) Separate the electrical connectors.

(4) Remove the O_2 sensor from the exhaust manifold.

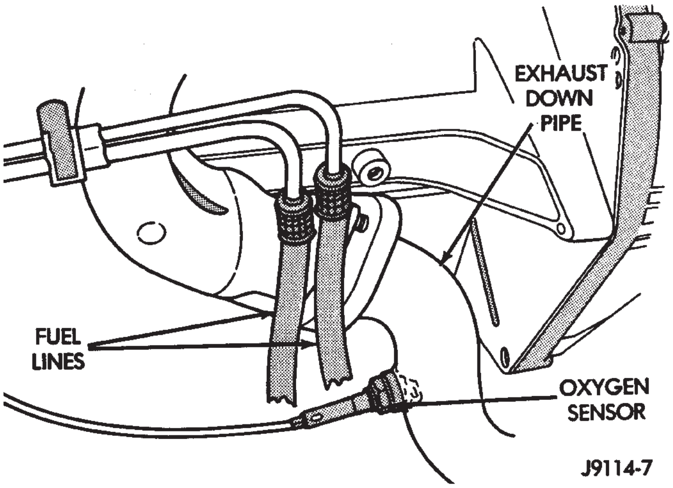


Fig. 10 Oxygen Sensor—Typical

INSTALLATION

Threads of new factory oxygen sensors are coated with anti-seize compound to aid in removal.

(1) Install the O_2 sensor into the exhaust manifold and tighten to 30 N●m (22 ft. lbs.) torque.

(2) Connect the O_2 sensor wire connector to the main harness.

(3) Push the sensor clip on firmly at the oil pan stud.

(4) Lower the vehicle.

PARK NEUTRAL SWITCH

Refer to Group 21, Transmissions for park neutral switch service.

POWERTRAIN CONTROL MODULE (PCM)

The PCM is located on the cowl panel in the right/rear side of the engine compartment (Fig. 11).

REMOVAL

(1) Disconnect the negative battery cable at the battery.

(2) Remove the coolant reserve/overflow bottle (one bolt and two nuts) (Fig. 12)

(3) Loosen the 60-Way connector mounting bolt (Fig. 13).

(4) Remove the electrical connector by pulling straight back.

(5) Remove the three PCM mounting bolts (Fig. 13).

(6) Remove PCM.

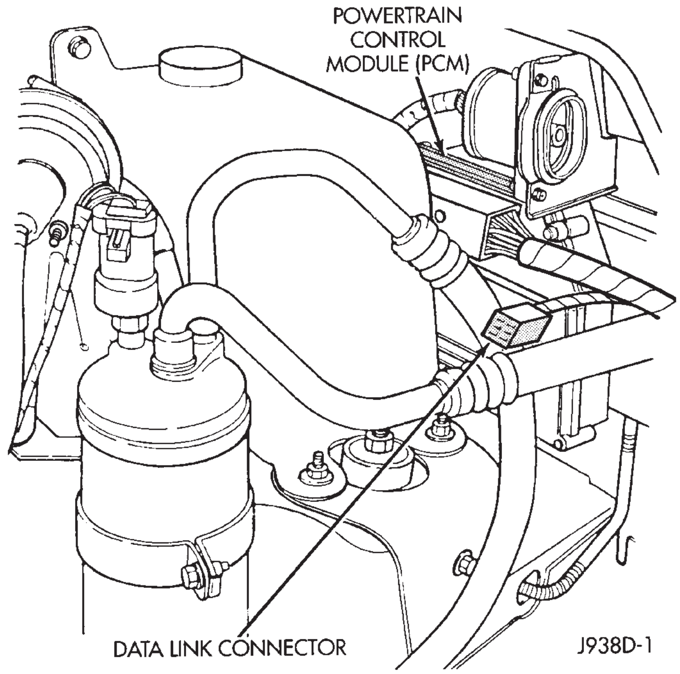


Fig. 11 Powertrain Control Module (PCM) Location

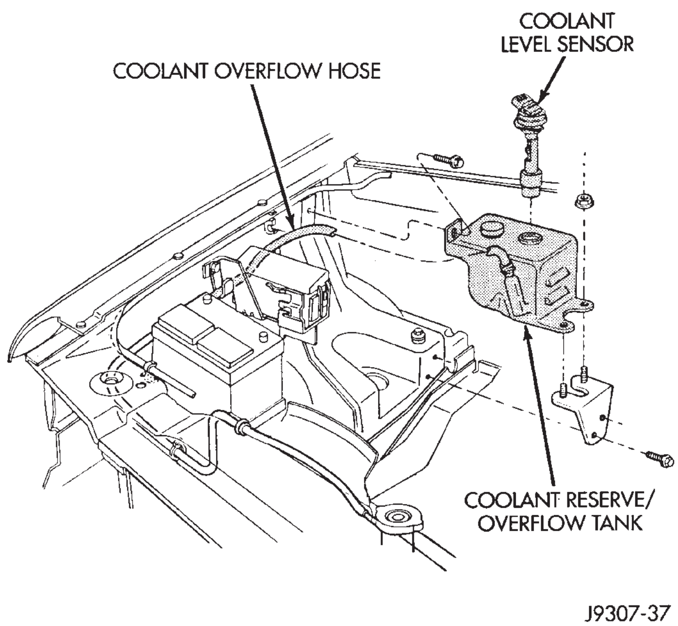


Fig. 12 Coolant Reserve/Overflow Bottle Mounting

INSTALLATION

(1) Check the pins in 60-way electrical connector for damage. 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) Install coolant reserve/overflow bottle.

(5) Connect negative cable to battery.

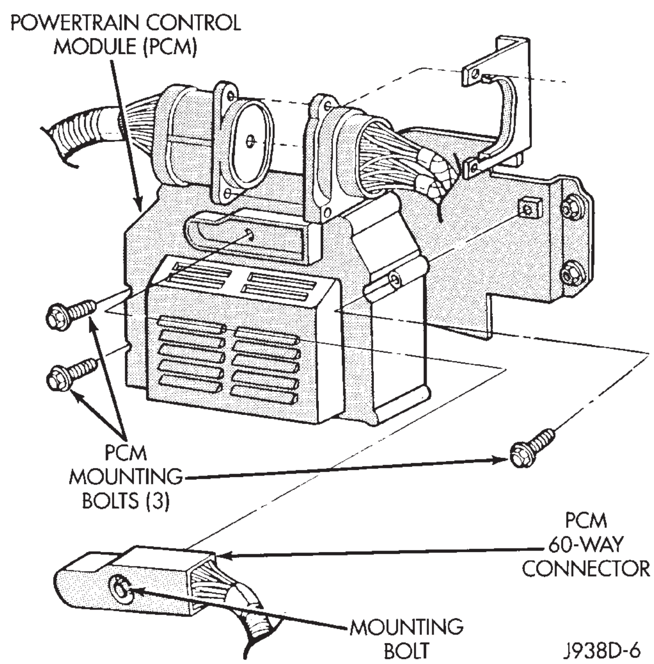


Fig. 13 Powertrain Control Module (PCM) Mounting

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. 14).

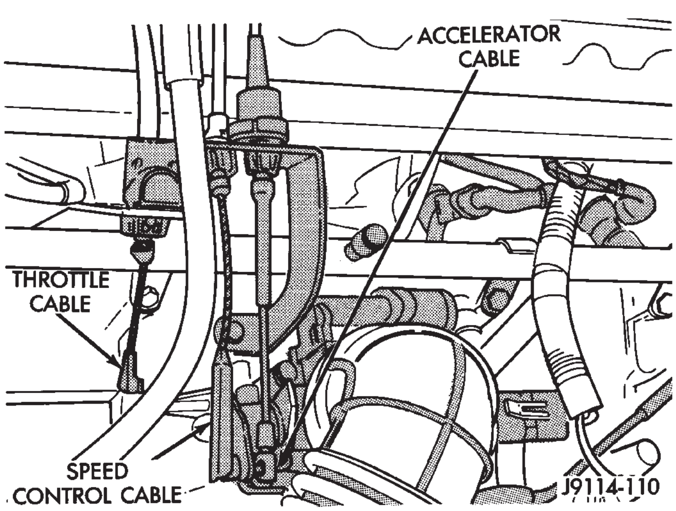


Fig. 14 Accelerator, Throttle and Speed Control Cables

(5) Remove throttle body mounting bolts, throttle body and gasket. Discard old gasket (Fig. 15).

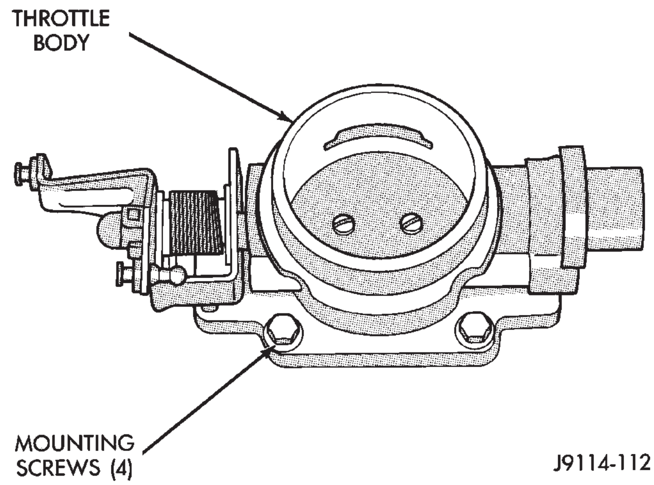


Fig. 15 Throttle Body—Removal/Installation

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.

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)

REMOVAL

(1) Disconnect TPS electrical connector.

(2) Remove TPS mounting screws.

(3) Remove TPS.

INSTALLATION

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 16). The TPS must be installed so that it can be rotated a few degrees. (If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs). The TPS will be under slight tension when rotated.

(1) Install the TPS and retaining screws.

(2) Connect TPS electrical connector to TPS.

(3) Manually operate the throttle (by hand) to check for any TPS binding before starting the engine.

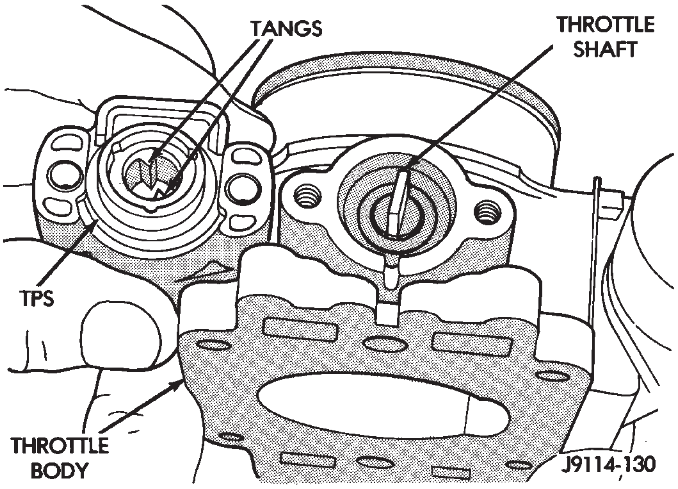


Fig. 16 Throttle Position Sensor—Installation

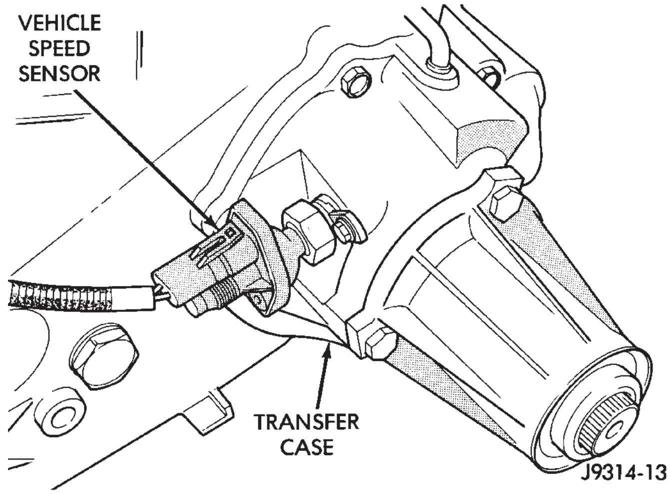


Fig. 17 Vehicle Speed Sensor—Typical

VEHICLE SPEED SENSOR

The vehicle speed sensor (Fig. 17) is located on the extension housing of the transmission on 2WD models. It is located on the transfer case on 4WD models.

REMOVAL

(1) Raise and support vehicle.

(2) Disconnect the electrical connector from the sensor.

(3) Remove (unscrew) the speedometer cable from the sensor (Fig. 18).

(4) Loosen the sensor mounting nut (Fig. 18).

(5) Remove the sensor.

INSTALLATION

(1) Install new sensor into speedometer adapter.

(2) Tighten sensor mounting nut.

(3) Connect electrical connector to sensor.

(4) Connect the speedometer cable.

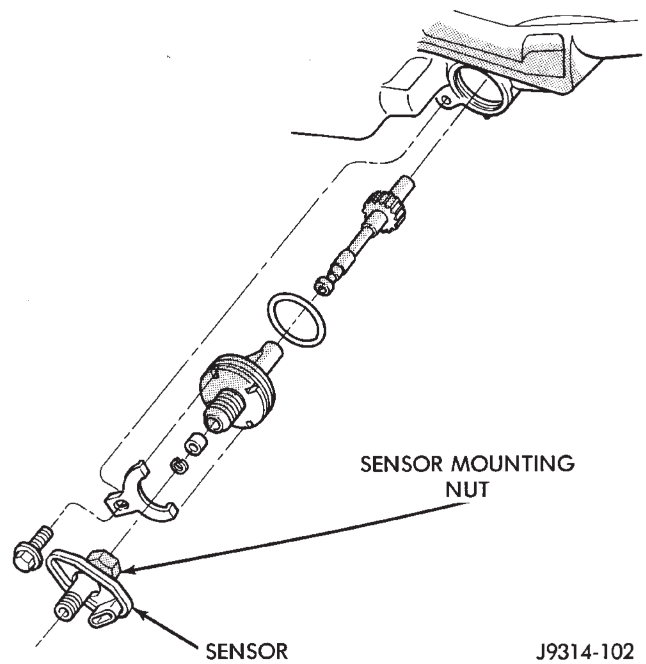


Fig. 18 Sensor and Components

MPI SYSTEM—5.2L ENGINE—COMPONENT DESCRIPTION/SYSTEM OPERATION

INDEX

GENERAL INFORMATION

All 5.2L engines are equipped with sequential Multi-Port Fuel Injection (MPI). The MPI system (Fig. 1) 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 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.

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 pre-programmed 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
- 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 discharges 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 En-

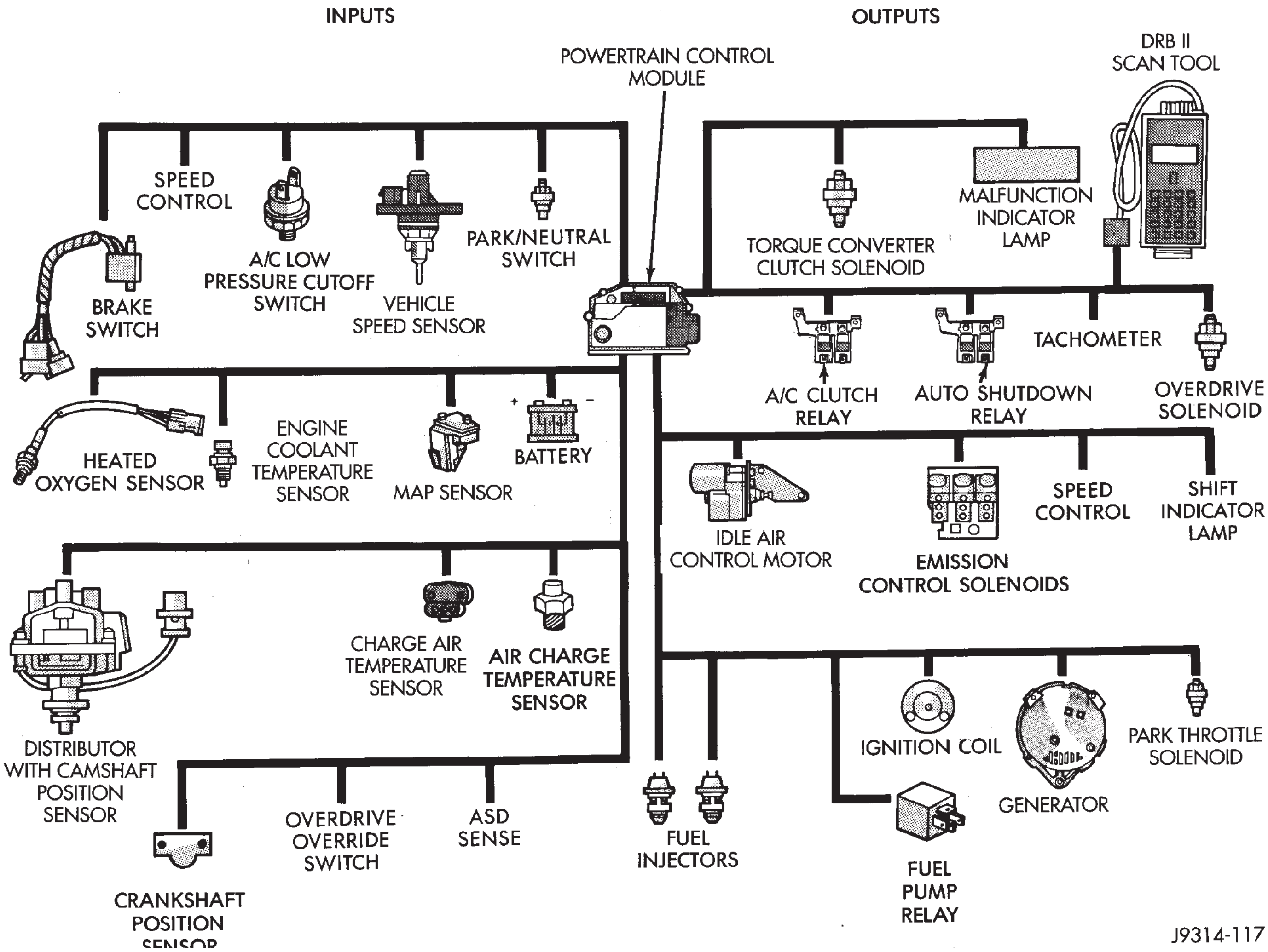


Fig. 1 Multi-Port Fuel Injection Components—5.2L Engine

gine 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 Multi-Port Fuel Injection—General Diagnosis—5.2L Engine section of this group for DTC information.

POWERTRAIN CONTROL MODULE (PCM)

The Powertrain Control Module (PCM) (Fig. 2) 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.

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as Powertrain Control Module (PCM) Outputs. The sensors and switches that provide inputs to the PCM are considered Powertrain Control Module (PCM) Inputs.

The PCM adjusts ignition timing based upon inputs it receives from sensors that react to: engine rpm, manifold absolute pressure, 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.

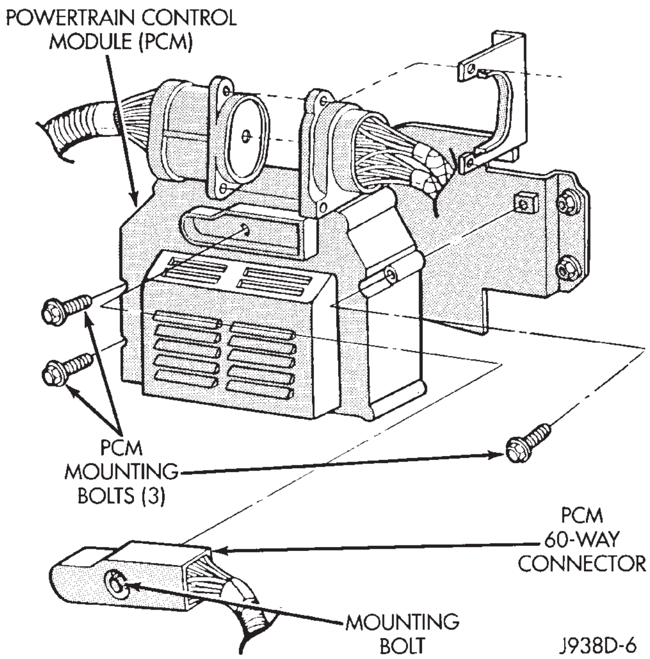


Fig. 2 Powertrain Control Module (PCM) Location

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
- Charge air temperature sensor
- Battery voltage
- Brake switch
- 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 II 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
- EGR valve control solenoid
- Fuel injectors
- Fuel pump relay
- Ignition coil
- EVAP canister purge solenoid
- SCI transmit (DRB II connection)
- Shift indicator lamp (manual transmission only)
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (on instrument panel, if equipped)

The powertrain control module (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.

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 powertrain control module (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 idle air control (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. It is used to connect oxygen winding and fuel injectors to 12 volt + power supply.

This input is used only to sense that the ASD relay is energized. If the powertrain control module (PCM) does not see 12 volts at this input when the ASD should be activated, it will set a Diagnostic Trouble Code (DTC).

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. 3). The sync signal from this sensor works in conjunction with the crankshaft position sensor to provide the powertrain control module (PCM) with inputs. This is done to establish and maintain correct injector firing order.

Refer to Camshaft Position Sensor in Group 8D, Ignition System for more information.

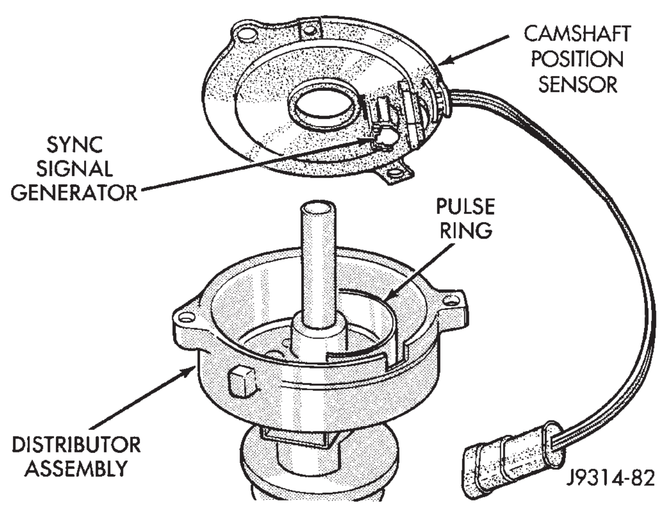


Fig. 3 Camshaft Position Sensor

CHARGE AIR TEMPERATURE SENSOR—PCM INPUT

The intake manifold charge air temperature sensor is installed in the intake manifold with the sensor element extending into the air stream (Fig. 4). The sensor provides an input voltage to the powertrain control module (PCM) indicating intake manifold air temperature. The input is used along with inputs from other sensors to determine injector pulse width. As the temperature of the air-fuel stream in the manifold varies, the sensor resistance changes. This results in a different input voltage to the PCM.

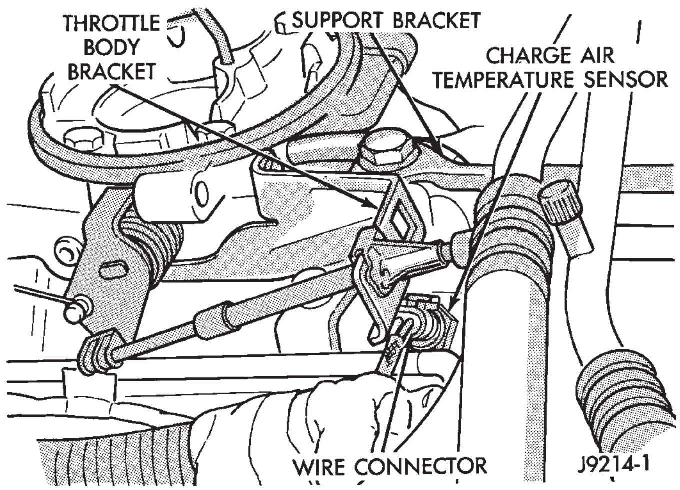


Fig. 4 Charge Air Temperature Sensor—Typical

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.

The sensor is bolted to the cylinder block near the rear of the right cylinder head (Fig. 5).

Refer to Group 8D, Ignition System for more crankshaft position sensor information.

The engine will not operate if the PCM does not receive a crankshaft position sensor input.

ENGINE COOLANT TEMPERATURE SENSOR—PCM INPUT

The coolant temperature sensor is installed next to the thermostat housing (Fig. 6) 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-

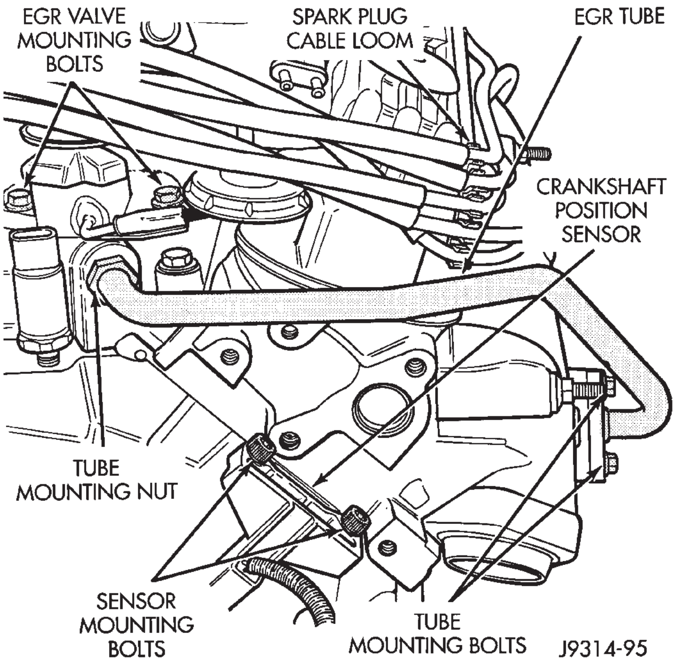


Fig. 5 Crankshaft Position Sensor

fuel mixtures and higher idle speeds. This is done until normal operating temperatures are reached.

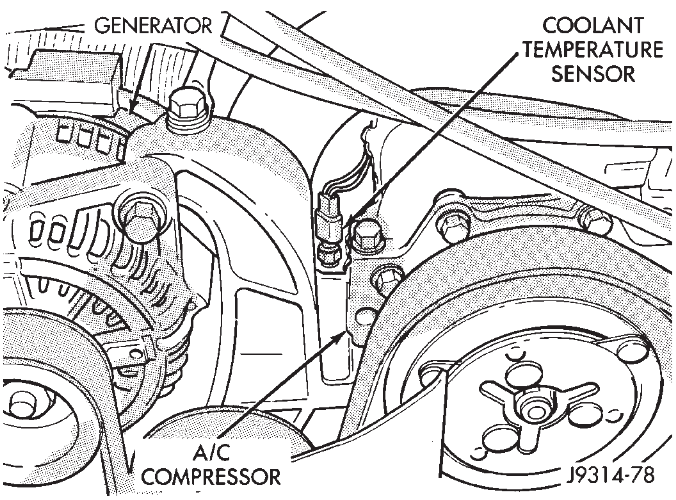


Fig. 6 Coolant Temperature Sensor—Typical

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 side of the engine throttle body (Fig. 7). The sensor is connected to the throttle body with a rubber L-shaped fitting.

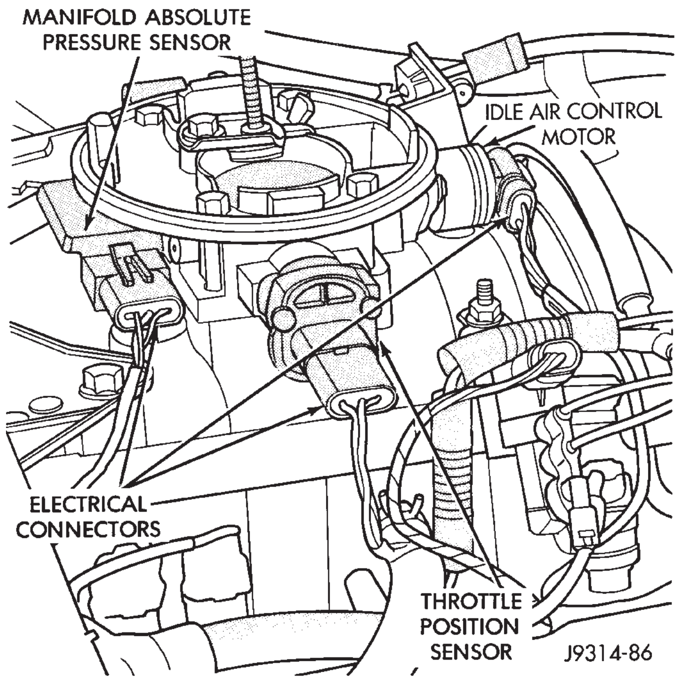


Fig. 7 Manifold Absolute Pressure (MAP) Sensor

OXYGEN (O_2) SENSOR—PCM INPUT

The O_2 sensor is located in the right exhaust down pipe (Fig. 8). 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 O_2 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 O_2 sensor input (along with other inputs). It then adjusts the injector pulse width accordingly. During Open Loop operation, the

PCM ignores the O_2 sensor input and adjusts injector pulse width to a preprogrammed value (based on other sensor inputs).

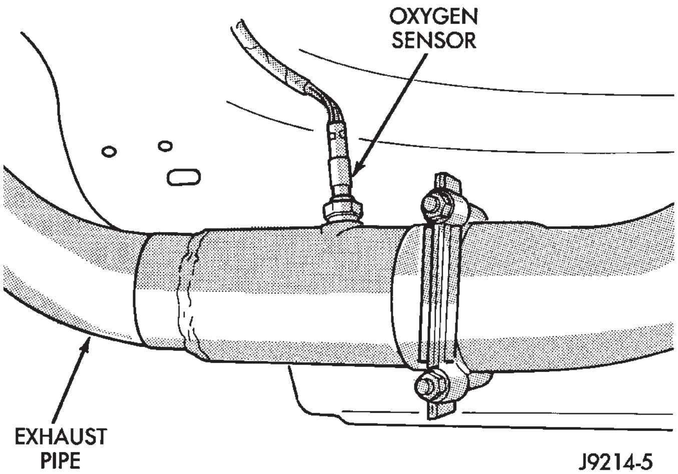


Fig. 8 Heated Oxygen Sensor—Typical

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. An override switch is located on the instrument panel.

The overdrive/override switch is normally closed. It opens when the operator presses the switch. The transmission will not enter overdrive when the operator presses the override switch. The transmission downshifts if the operator presses the override switch while in overdrive.

The overdrive switch circuit contains two other switches: A transmission thermo-switch and a coolant temperature switch. When either switch opens, the transmission will not shift into overdrive, or downshift (if already in overdrive).

Refer to Group 21 for more information.

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

SCI RECEIVE—PCM INPUT

SCI Receive is the serial data communication receive circuit for the DRB II scan tool. The powertrain control module (PCM) receives data from the DRB II through the SCI Receive circuit.

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 (Fig. 9). 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.

VEHICLE SPEED SENSOR—PCM INPUT

The speed sensor (Fig. 10) is located in the extension housing of the transmission (2WD) or on the transfer case extension housing (4WD). The sensor input is used by the powertrain control module (PCM) to determine vehicle speed and distance traveled.

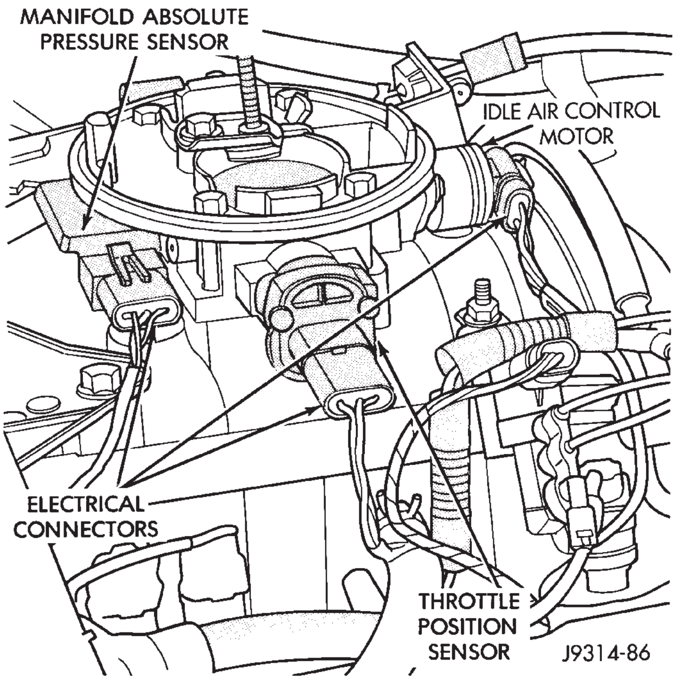


Fig. 9 Throttle Position Sensor

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.

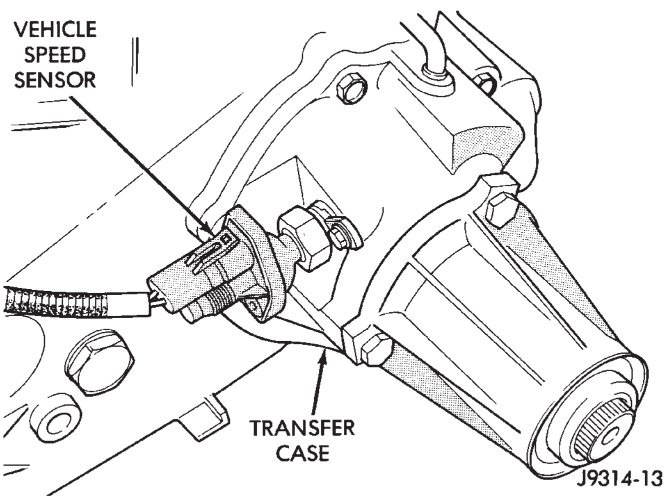


Fig. 10 Vehicle Speed Sensor—Typical

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) (Fig. 11). For the location of the relay within the PDC, refer to label under PDC cover.

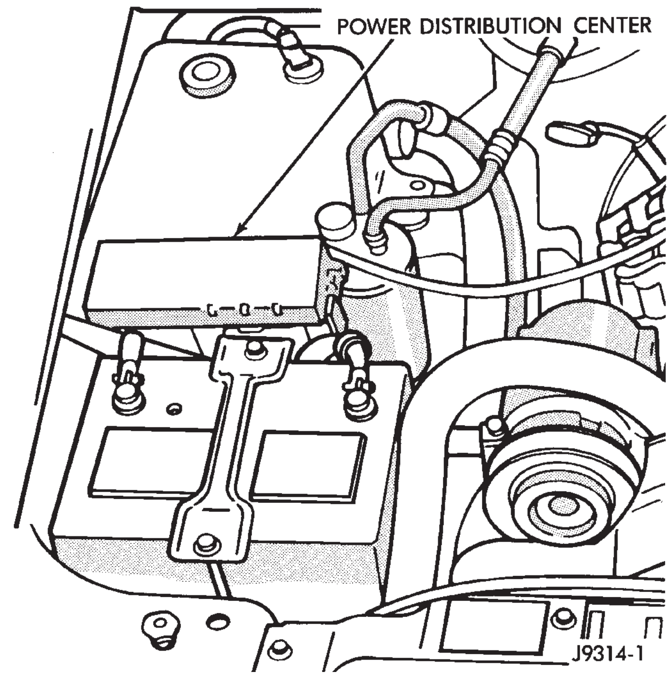


Fig. 11 Power Distribution Center (PDC)

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).

IDLE AIR CONTROL (IAC) MOTOR—PCM OUTPUT

The IAC motor is mounted to the back of the throttle body (Fig. 12) and is controlled by the powertrain control module (PCM).

The throttle body has an air control passage that provides air for the engine at idle (the throttle plate is closed). The IAC motor pintle protrudes into the air control passage (Fig. 13) and regulates air flow through it. Based on various sensor inputs, the powertrain control module (PCM) adjusts engine idle

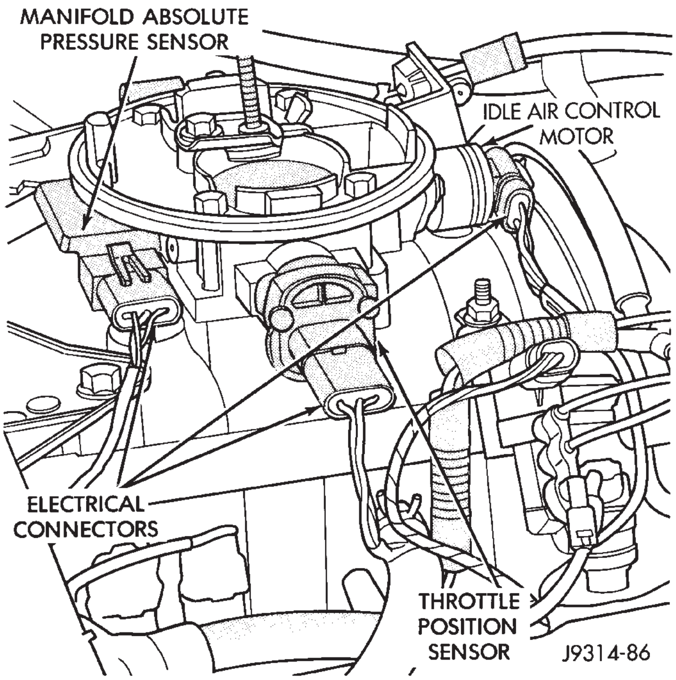


Fig. 12 IAC Motor

speed by moving the IAC motor pintle in and out of the air control passage. The IAC motor is positioned when the ignition key is turned to the On position.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

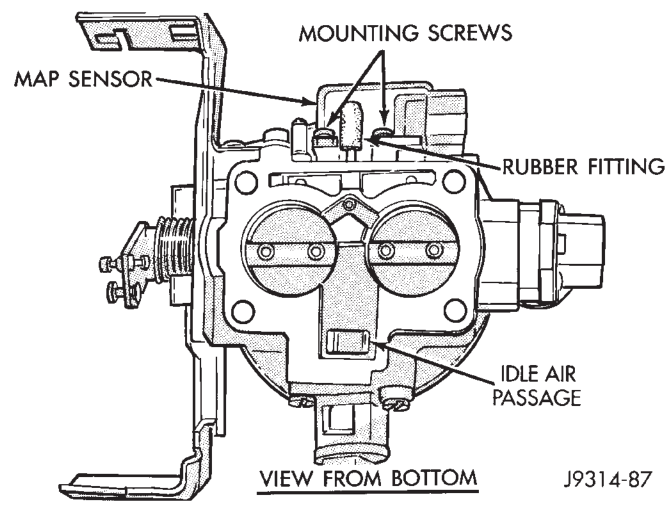


Fig. 13 Throttle Body Air Control Passage

AUTO SHUT DOWN (ASD) RELAY—PCM OUTPUT

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 11). For the location of this relay within the PDC, refer to label under PDC cover.

The ASD supplies battery voltage to the fuel pump, fuel injector, ignition coil, generator field winding and oxygen (O_2) 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.

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 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 for charging system information.

ELECTRIC EXHAUST GAS RECIRCULATION TRANSDUCER (EET) SOLENOID—PCM OUTPUT

Refer to Group 25, Emission Control System for information. See Electric Exhaust Gas Recirculation Transducer (EET) Solenoid.

EMR LAMP—PCM OUTPUT

The EMR lamp is not used for the 1993 model year.

EVAP CANISTER PURGE SOLENOID—PCM OUTPUT

Refer to Group 25, Emission Control System. See EVAP Canister Purge Solenoid.

FUEL INJECTORS—PCM OUTPUT

The fuel injectors are attached to the fuel rail (Fig. 14). 5.2L engines use eight individual injectors for each cylinder.

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.

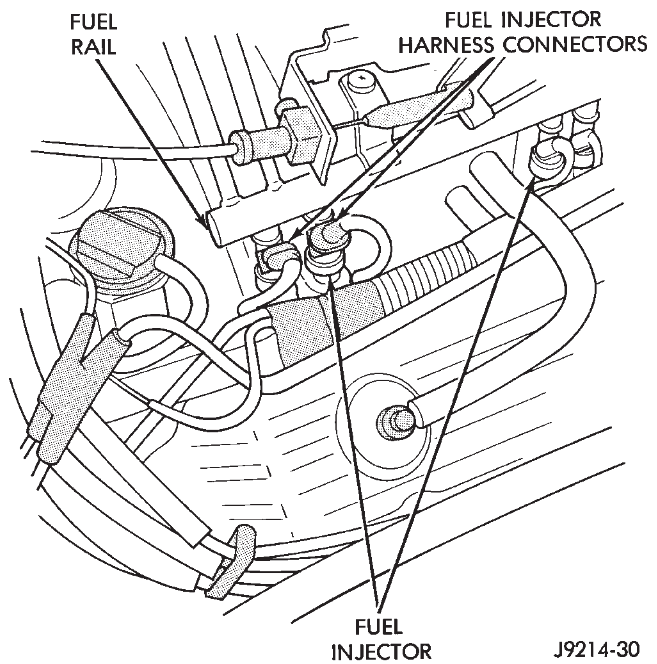


Fig. 14 Fuel Injectors—Typical

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.

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 front of the right cylinder head (Fig. 15).

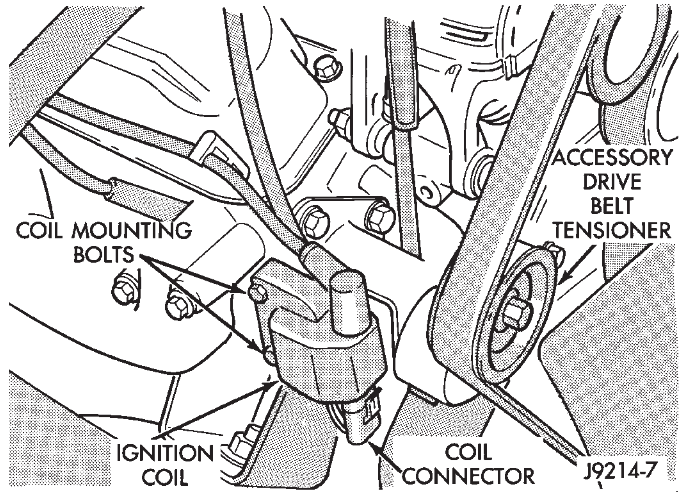


Fig. 15 Ignition Coil

SCI TRANSMIT—PCM OUTPUT

SCI Transmit is the serial data communication transmit circuit for the DRB II scan tool. The powertrain control module (PCM) transmits data to the DRB II 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. Refer to Group 8E for tachometer information.

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 (O_2) sensor is not monitored during Open Loop modes.

During Closed Loop modes, the PCM will monitor the oxygen (O_2) 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 O_2 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 charge 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 O_2 sensor heater element is energized through the fuel pump relay. The O_2 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 charge 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 charge 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 upshift light is operated by the PCM.
• When engine has reached operating temperature, the PCM will begin monitoring O_2 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 charge 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 O_2 sensor input and adjusts air-fuel ratio by varying injector pulse width. It also adjusts engine idle speed through the idle air control (IAC) motor.
- The PCM adjusts ignition timing by increasing and decreasing spark advance.
- The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

CRUISE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At cruising speed, the powertrain control module (PCM) receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold charge 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 (O_2) 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 O_2 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 charge 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 charge 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 up-shift light is operated by the PCM.

When the PCM senses wide open throttle condition through the throttle position sensor (TPS), it will provide a ground for the EGR solenoid. This will prevent any EGR functions.

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. 16). Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors. The throttle body is mounted on the intake manifold. It contains an air control passage (Fig. 17) 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.

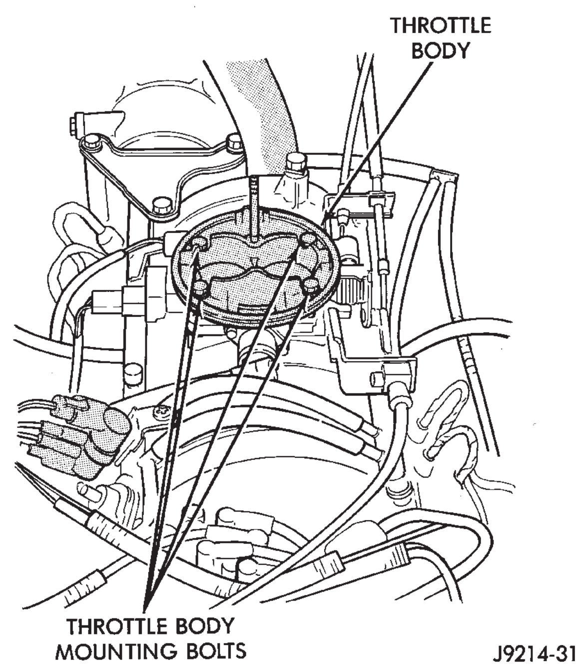


Fig. 16 Throttle Body

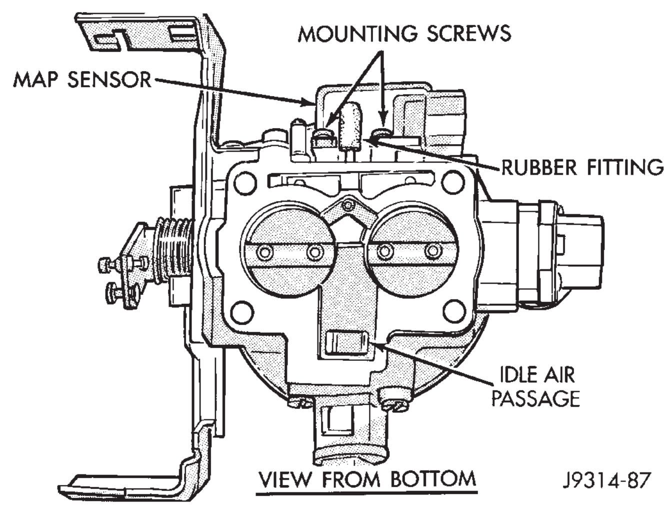


Fig. 17 Air Control Passage

The throttle position sensor (TPS), idle air control (IAC) motor and manifold absolute pressure sensor (MAP) are attached to the throttle body. The accelerator pedal cable, speed control cable and transmission control cable (when equipped) are connected to the throttle arm.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

FUEL RAIL

The fuel rail supplies fuel to the injectors and is mounted to the intake manifold (Fig. 18). 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.

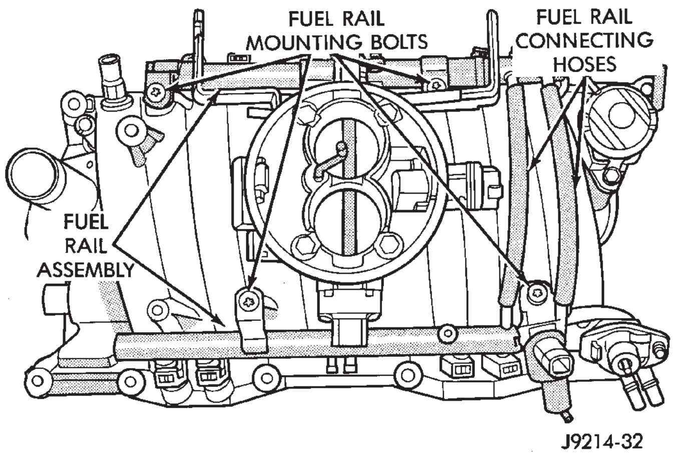


Fig. 18 Fuel Rail—Typical

FUEL PRESSURE REGULATOR

The fuel pressure regulator is a mechanical device that is not controlled by the powertrain control module (PCM).

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 (Fig. 19). 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. 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.

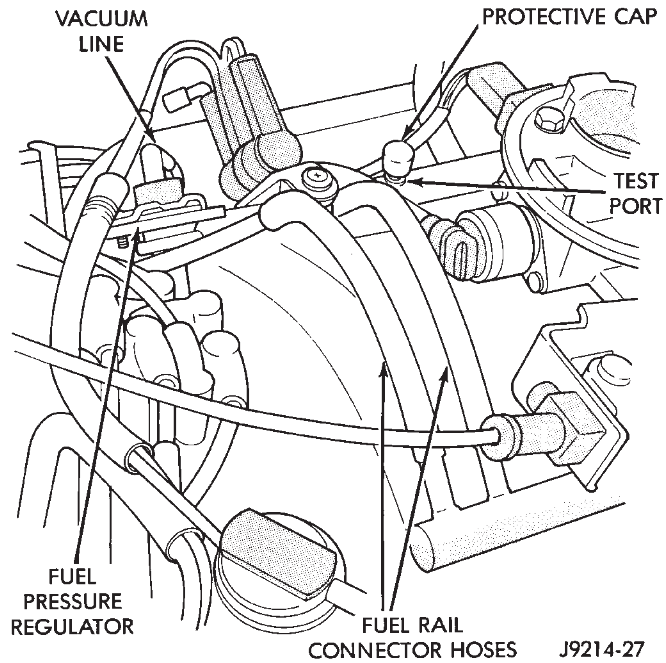


Fig. 19 Fuel Pressure Regulator

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.

MPI SYSTEM—5.2L ENGINE—GENERAL DIAGNOSIS

INDEX

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) (Fig. 1). Verify that the connector mounting screw is tightened to 4 N•m (35 in. lbs.) torque.

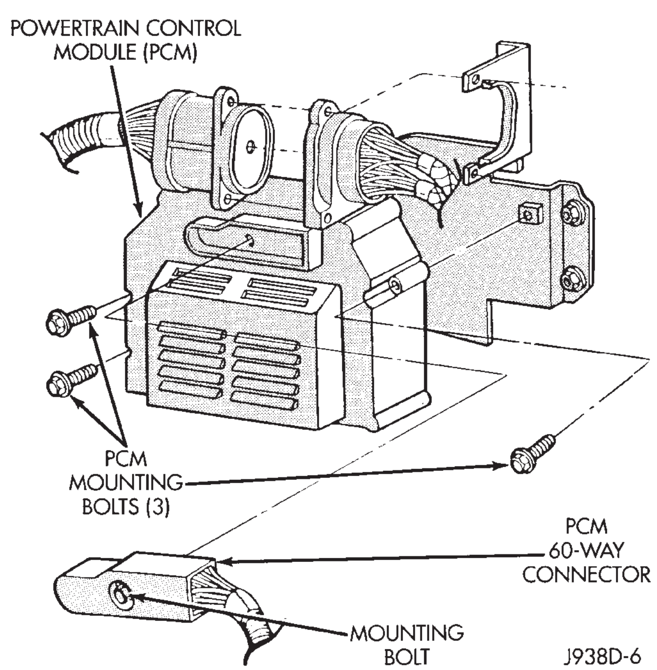


Fig. 1 Powertrain Control Module (PCM)

(2) Inspect the battery cable connections. Be sure that they are clean and tight.

(3) Inspect fuel pump relay and air conditioning compressor clutch relay (if equipped). Inspect the ASD relay connections. Inspect starter motor relay connections. Inspect relays for signs of physical damage and corrosion. The relays are located in the Power Distribution Center (PDC) (Fig. 2). For the location of the relays within the PDC, refer to label under PDC cover.

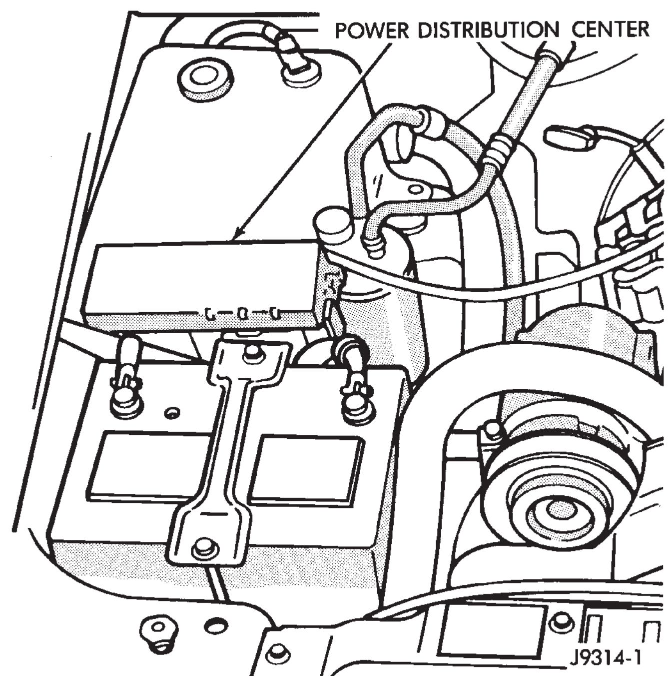


Fig. 2 Power Distribution Center (PDC)

(4) Inspect ignition coil connections. Verify that coil secondary cable is firmly connected to coil (Fig. 3).

(5) Verify that distributor cap is correctly attached to distributor. Be sure that spark plug cables are firmly connected to the distributor cap and the spark plugs are in their correct firing order. Be sure that coil cable is firmly connected to distributor cap and coil. Be sure that camshaft position sensor wire connector (at the distributor) is firmly connected to harness connector. Inspect spark plug condition. Refer to

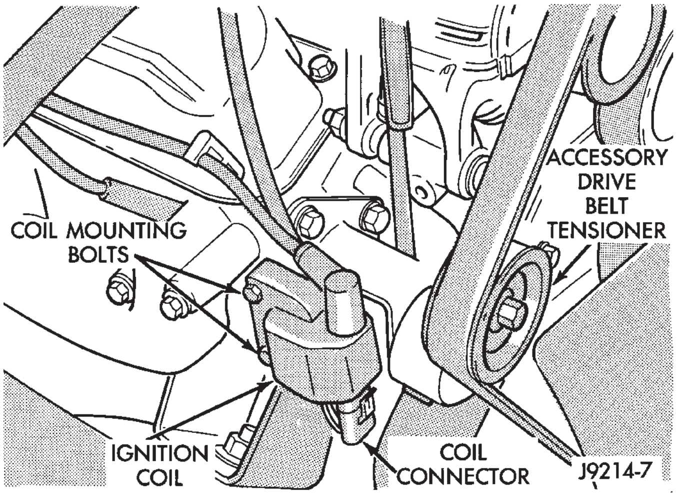


Fig. 3 Ignition Coil

Group 8D, Ignition. Connect vehicle to an oscilloscope and inspect spark events for fouled or damaged spark plugs or cables.

(6) Verify that generator output wire, generator connector and ground wire are firmly connected to the generator.

(7) Inspect the system body grounds for loose or dirty connections. Refer to Group 8W, Wiring for location of body ground connections.

(8) Verify Positive Crankcase Ventilation (PCV) valve operation. Refer to Group 25, Emission Control System for additional information. Verify PCV valve hose is firmly connected to PCV valve and manifold (Fig. 4).

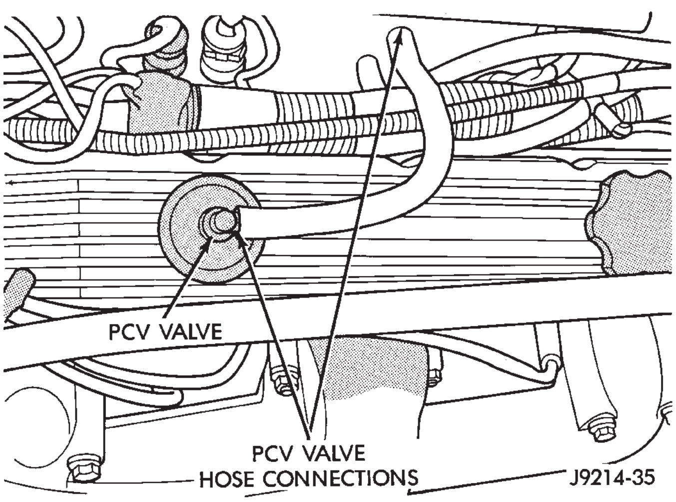


Fig. 4 PCV Valve Hose Connections

(9) Verify that vacuum line is firmly connected to fuel pressure regulator and manifold fitting (Fig. 5).

(10) Inspect fuel tube quick-connect fitting-to-fuel rail connections.

(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

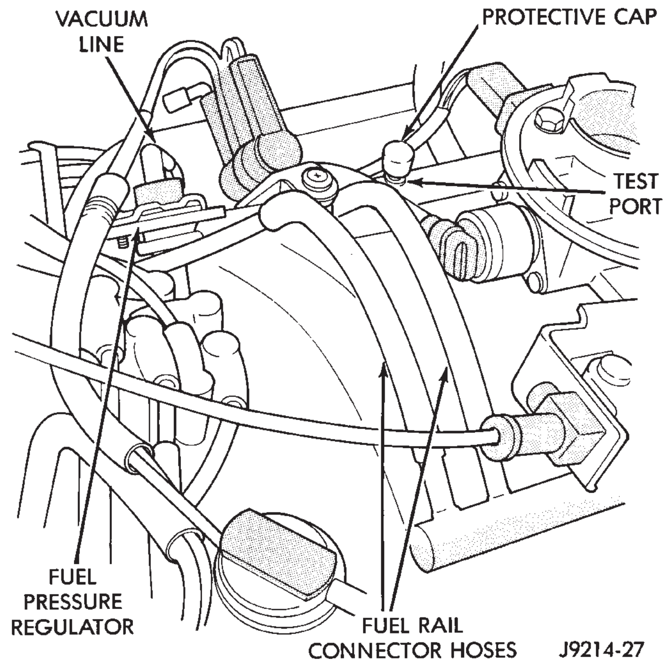


Fig. 5 Pressure Regulator Vacuum Hose

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.

(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.

(14) Inspect the air cleaner inlet and air filter element for dirt or restrictions.

(15) Inspect radiator grille area, radiator fins and air conditioning condenser for restrictions.

(16) Verify that the intake manifold charge air temperature sensor wire connector is firmly connected to harness connector (Fig. 6).

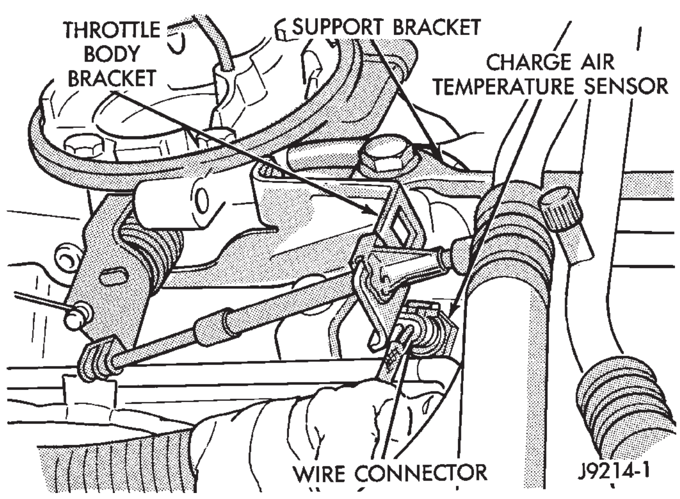


Fig. 6 Charge Air Temperature Sensor—Typical

(17) Verify that MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 7). Also verify that rubber L-shaped fitting from MAP sensor to the throttle body is firmly connected (Fig. 8).

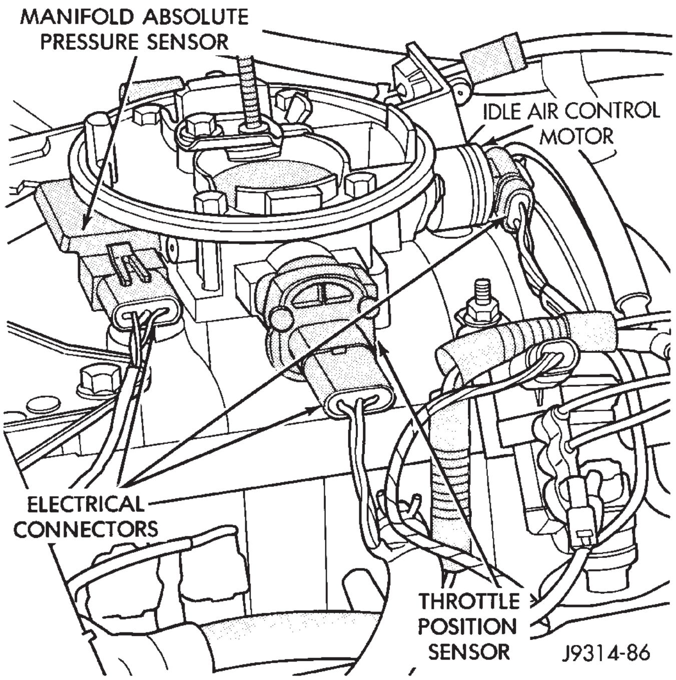


Fig. 7 Manifold Absolute Pressure (MAP) Sensor

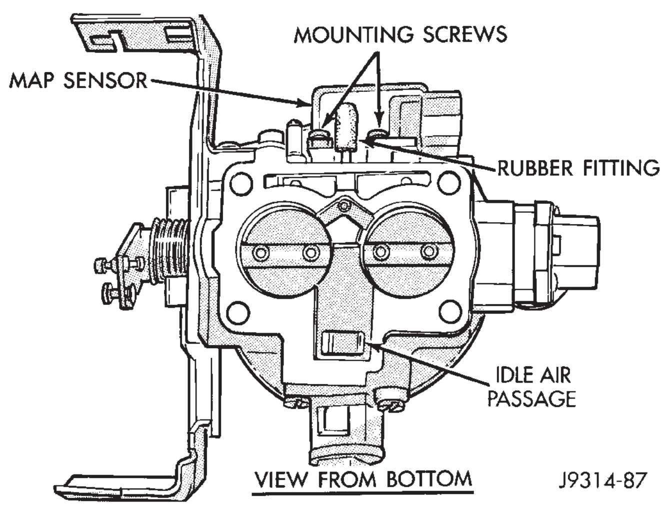


Fig. 8 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

(18) Verify that fuel injector wire harness connectors are firmly connected to injectors in the correct firing order. Each harness connector is numerically tagged with the injector number (INJ 1, INJ 2 etc.) of its corresponding fuel injector and cylinder number.

(19) Verify harness connectors are firmly connected to idle air control (IAC) motor, throttle position sensor (TPS) and manifold absolute pressure (MAP) sensor.

(20) Verify that wire harness connector is firmly connected to the engine coolant temperature sensor (Fig. 9).

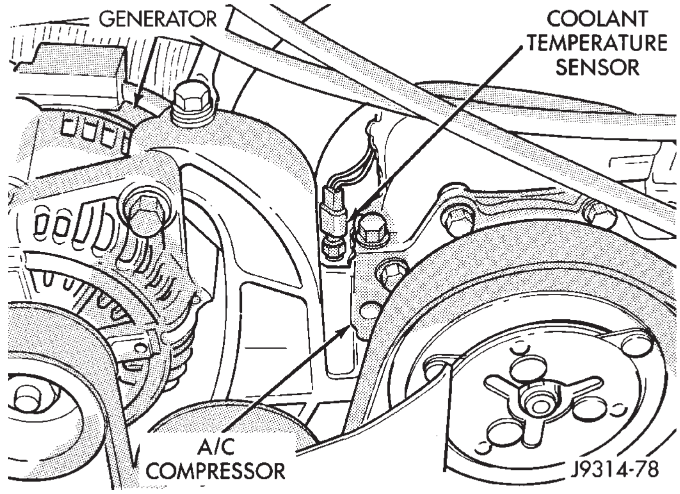


Fig. 9 Engine Coolant Temperature Sensor—Typical

(21) Raise and support the vehicle.

(22) Verify that oxygen sensor wire connector is firmly connected to the sensor. Inspect sensor and connector for damage (Fig. 10).

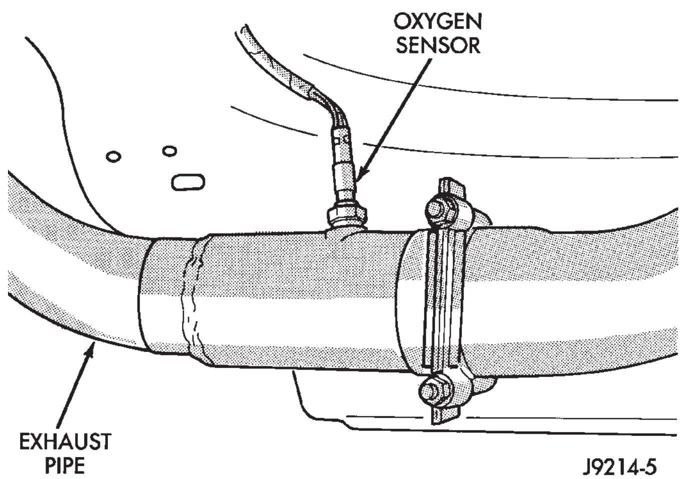


Fig. 10 Oxygen Sensor—Typical

(23) Inspect for pinched or leaking fuel tubes. Inspect for pinched, cracked or leaking fuel hoses.

(24) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(25) If equipped with automatic transmission, verify that electrical harness is firmly connected to park/neutral switch. Refer to Automatic Transmission section of Group 21.

(26) Verify that the harness connector is firmly connected to the vehicle speed sensor (Fig. 11).

(27) Verify that fuel pump/gauge sender unit wire connector is firmly connected to harness connector.

(28) Inspect fuel hoses at fuel pump/gauge sender unit for cracks or leaks.

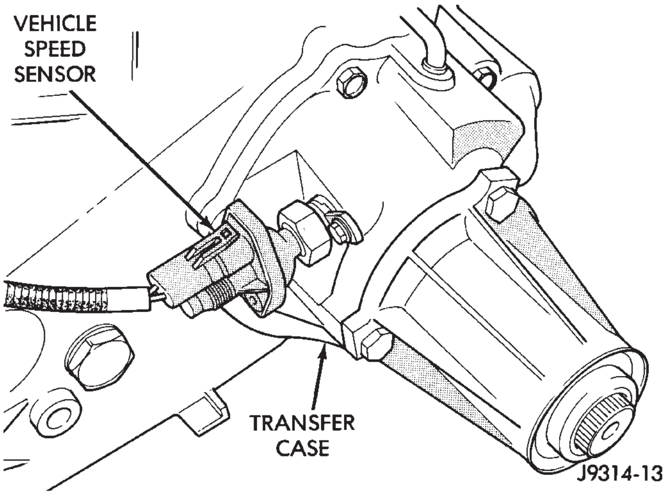


Fig. 11 Vehicle Speed Sensor—Typical

(29) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

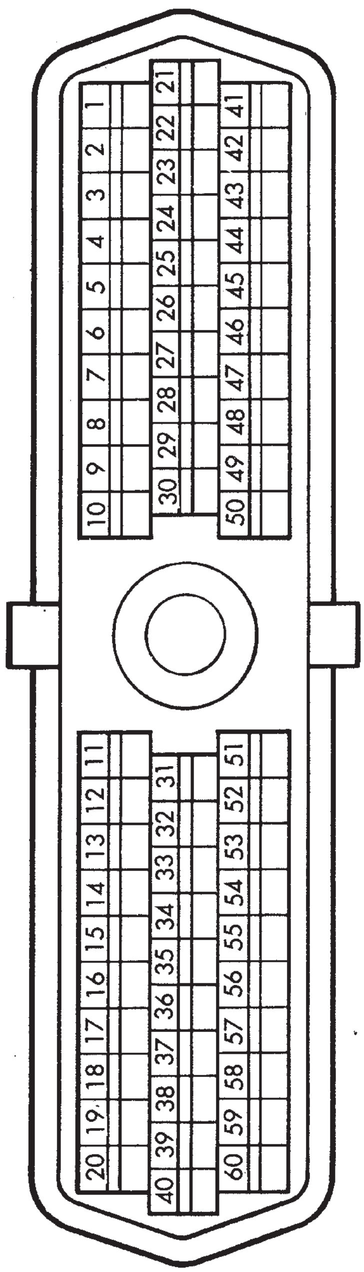
(30) Verify that battery cable and solenoid feed wire connections to the starter solenoid are tight and clean. Inspect for chaffed wires or wires rubbing up against other components.

POWERTRAIN CONTROL MODULE (PCM) 60-WAY CONNECTOR

Terminal identification and specific circuit applications for the 5.2L (V-8) engine are shown in the PCM connector charts (Fig. 12). Also refer to Group 8W, Wiring Diagrams.

SYSTEM SCHEMATICS

Fuel system schematics for the 5.2L (V-8) engine are shown in figure 13.



CAV	CIRCUIT	FUNCTION
1	K70 18RD/WT*	MAP SIGNAL
2	K2 20TN/BK*	ENGINE COOLANT TEMPERATURE SENSOR
3	A5 16PK/BK*	BATTERY
4	K4 18BK/LB*	SENSOR GROUND
5	Z12 18BK/TN*	POWER GROUND
6	K6 18VT/WT*	5 VOLTS
7	K25 20WT/BK*	8 VOLT SUPPLY
8	T40 14LG/BK*	ENGINE STARTER RELAY
9	F86 16LB	IGNITION ACCESSORY FEED
10	T9 20OR/BK*	TRANSMISSION OVERDRIVE PRESSURE SIGNAL
11	Z12 18BK/TN*	POWER GROUND
12	Z12 18BK/TN*	POWER GROUND
13	K14 18LB/BR*	INJECTOR 4
14	K13 18YL/WT*	INJECTOR 3
15	K12 18TN	INJECTOR 2
16	K11 18WT/DB*	INJECTOR 1
17	K17 18DB/WT*	INJECTOR 7
18	K18 18DB/YL*	INJECTOR 8
19	K19 18GY/WT*	DISTRIBUTOR IGNITION COIL (-)
20	K20 18DG	GENERATOR FIELD
21	K21 20BK/RD*	INTAKE AIR TEMPERATURE SENSOR
22	K22 18OR/DB*	THROTTLE POSITION (SENSOR)
23	—	—
24	K27 20ORD/LG*	CRANKSHAFT POSITION SENSOR
25	D84 20BK	DIAGNOSTIC (DATA 2)
* 26	D1 20VT/BR*	CCD (+)
27	C21 18DB/OR*	A/C LOW PRESSURE SWITCH
28	C90 20LG	A/C SELECT SIGNAL
29	L53 20BR	TCU BRAKE (—)
30	T41 20BK/WT*	PARK/NEUTRAL SWITCH
31	—	—
32	G3 20BK/PK*	MALFUNCTION INDICATOR LAMP
33	V36 20TN/RD*	VEHICLE SPEED CONTROL (VACUUM)
34	C13 20DB/RD*	A/C COMPRESSOR CLUTCH RELAY
35	K35 20GY/YL*	EXHAUST GAS RECIRCULATION SOLENOID
36	—	—
37	G68 20PK/OR*	TRANSMISSION OVERDRIVE LAMP
38	K38 18GY	INJECTOR 5
39	K60 18YL/BK*	STEPPER IDLE AIR CONTROL (4)
40	K40 18BR/WT*	STEPPER IDLE AIR CONTROL (2)
41	K41 18BK/OR*	OXYGEN SENSOR
42	—	—
43	G21 20GY/LB*	BUFFERED TACHOMETER SIGNAL
44	K24 18GY/BK*	CAMSHAFT POSITION SENSOR SIGNAL
45	D83 20BK/YL*	DIAGNOSTIC (DATA 1)
* 46	D2 20WT/GY*	CCD (—)
47	G7 18WT/OR*	VEHICLE SPEED SIGNAL
48	V31 20BR/RD*	VEHICLE SPEED CONTROL SWITCH (SET)
49	V32 20YL/RD*	VEHICLE SPEED CONTROL SWITCH (IGNITION)
50	V33 20WT/LG*	VEHICLE SPEED CONTROL SWITCH (RESUME)
51	K81 20PK	FUEL PUMP RELAY COIL
52	K52 20PK/BK*	EVAP/PURGE SOLENOID
53	V35 20LG/RD*	VEHICLE SPEED CONTROL (VENT)
54	T6 20VT/YL*	TRANSMISSION TCC LU SOLENOID
55	T60 18BR/LG*	TRANSMISSION OVERDRIVE SOLENOID
56	G24 20GY/PK*	MAINTENANCE INDICATOR
57	A61 18DG/BK*	IGNITION COIL: FUEL INJ: FUEL PUMP
58	K58 18BR/YL*	INJECTOR 6
59	K39 18GY/RD*	STEPPER IDLE AIR CONTROL (1)
60	K59 18VT/BK*	STEPPER IDLE AIR CONTROL (3)

* - INDICATES TWISTED PAIR

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Fig. 12 PCM Connector—5.2L Engine

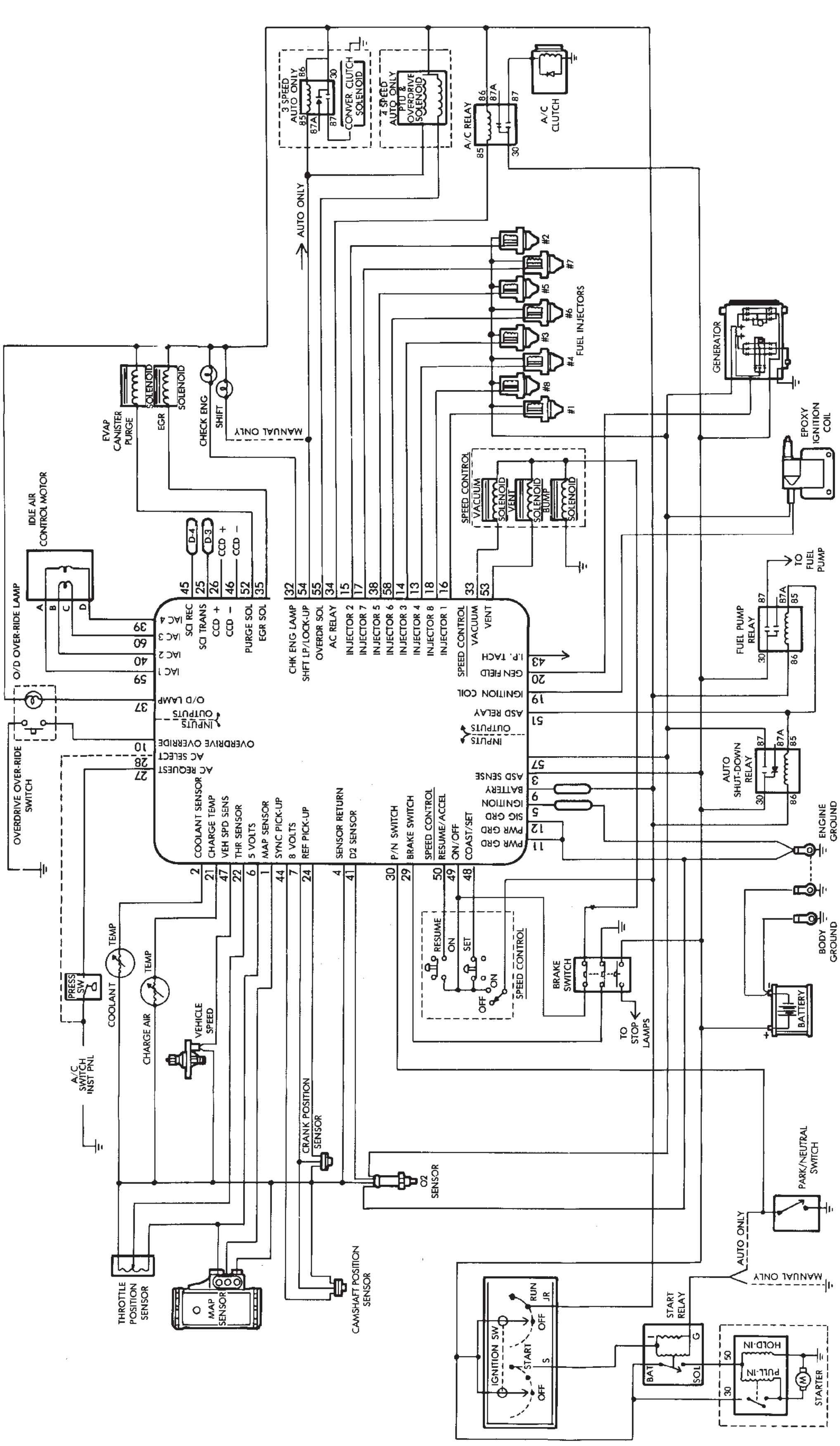

Fig. 13 System Schematic—5.2L Engine

CAMSHAFT POSITION SENSOR TESTING

Refer to Group 8D, Ignition Systems for testing.

COOLANT TEMPERATURE SENSOR TEST

To perform a complete test of the Engine Coolant Temperature Sensor and its circuitry, refer to DRB II tester and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect wire harness connector from coolant temperature sensor (Fig. 14).

Engines with air conditioning: When removing the connector from sensor, do not pull directly on wiring harness. Fabricate an L-shaped hook tool from a coat hanger (approximately eight inches long). Place the hook part of tool under the connector for removal. The connector is snapped onto the sensor. It is not equipped with a lock type tab.

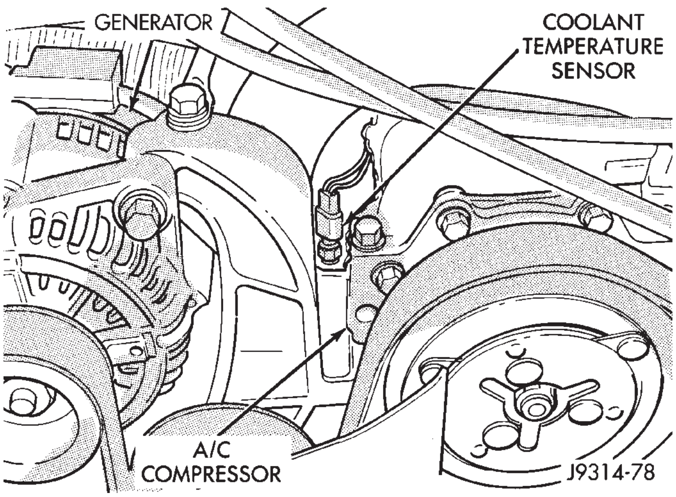

Fig. 14 Coolant Temperature Sensor—Typical

(2) Test the resistance of the sensor with a high input impedance (digital) volt-ohmmeter. The resistance (as measured across the sensor terminals) should be less than 1340 ohms with the engine warm. Refer to the Coolant Temperature sensor/Charge Air Temperature 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. 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.

(4) After tests are completed, connect electrical connector to sensor. The sensor connector is symmetrical (not indexed). It can be installed to the sensor in either direction.

CHARGE AIR TEMPERATURE SENSOR TEST

To perform a complete test of the Intake Manifold Charge Air Temperature sensor and its circuitry, refer

SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/CHARGE AIR TEMPERATURE SENSOR

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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to DRB II tester and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect the wire harness connector from the Charge Air Temperature sensor (Fig. 15).

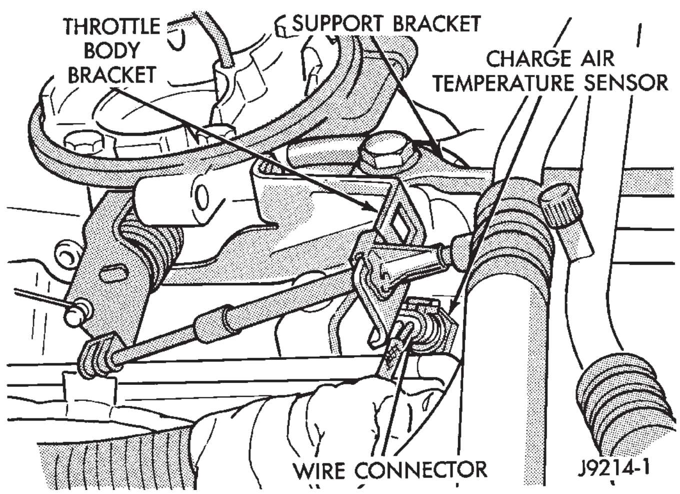


Fig. 15 Charge Air Temperature Sensor—Typical

(2) Test the resistance of the sensor with an input impedance (digital) volt-ohmmeter. The resistance (as measured across the sensor terminals) should be less than 1340 ohms with the engine warm. Refer to the Coolant Temperature sensor/Charge Air Temperature 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. Do this between the powertrain control module (PCM) wire harness connector terminal 21 and the sensor connector terminal. Also check between terminal 4 to the sensor connector terminal. Repair the wire harness as necessary if the resistance is greater than 1 ohm.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST

To perform a complete test of MAP sensor (Fig. 16) and its circuitry, refer to DRB II tester and appropriate Powertrain Diagnostics Procedures manual. To test the MAP sensor only, refer to the following:

(1) Inspect the rubber L-shaped fitting from the MAP sensor to the throttle body (Fig. 17). Repair as necessary.

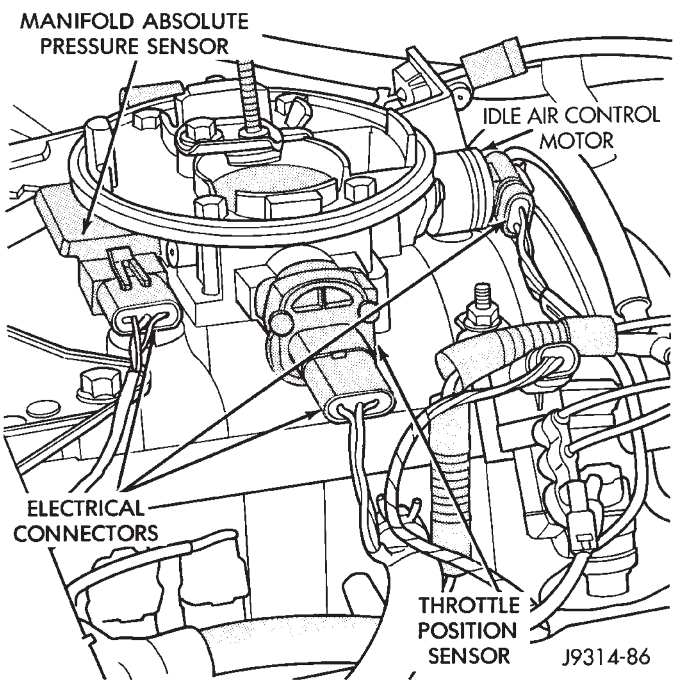


Fig. 16 Manifold Absolute Pressure (MAP) Sensor

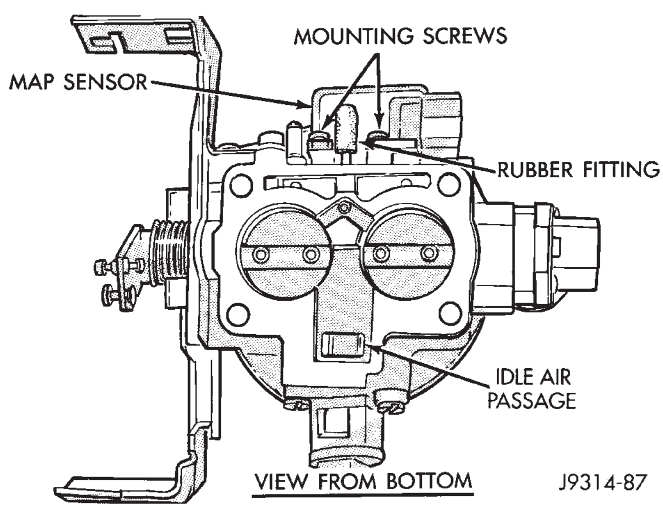


Fig. 17 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

CAUTION: When testing the MAP sensor, be sure that the harness wires are not damaged by the test meter probes.

(2) Test the MAP sensor output voltage at the MAP sensor connector between terminals A and B (Fig. 18). 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.

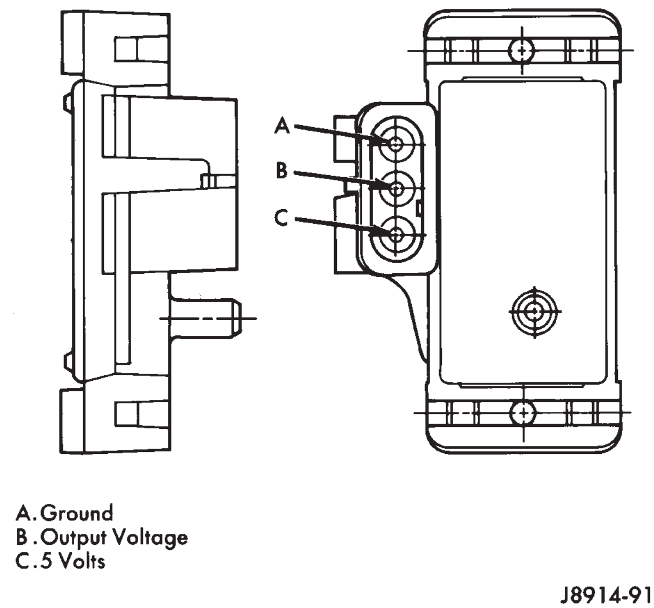


Fig. 18 MAP Sensor Connector Terminals—Typical

(3) Test powertrain control module (PCM) pin-1 for the same voltage described above to verify the wire harness condition. Repair as necessary.

(4) Test MAP sensor supply voltage at sensor connector between terminals A and C (Fig. 18) 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 powertrain control module (PCM) wire harness connector. Repair or replace the wire harness as necessary.

(5) Test the MAP sensor ground circuit at sensor connector terminal A (Fig. 18) and PCM connector terminal/pin-4. Repair the wire harness if necessary.

(6) Test the MAP sensor ground circuit at the PCM connector between terminal/pin-4 and terminal/pin-11 with an ohmmeter. If the ohmmeter indicates an open circuit, inspect for a defective sensor ground connection. Refer to Group 8W, Wiring Diagrams for location of this connection. If the ground connection is good, replace the PCM. If terminal/pin-4 has a short circuit to 12 volts +, correct this condition before replacing the PCM.

CRANKSHAFT POSITION SENSOR TEST

To perform a complete test of this sensor (Fig. 19) and its circuitry, refer to the DRB II tester and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Near the rear of the right cylinder head, disconnect the sensor pigtail harness connector from the main wiring harness.

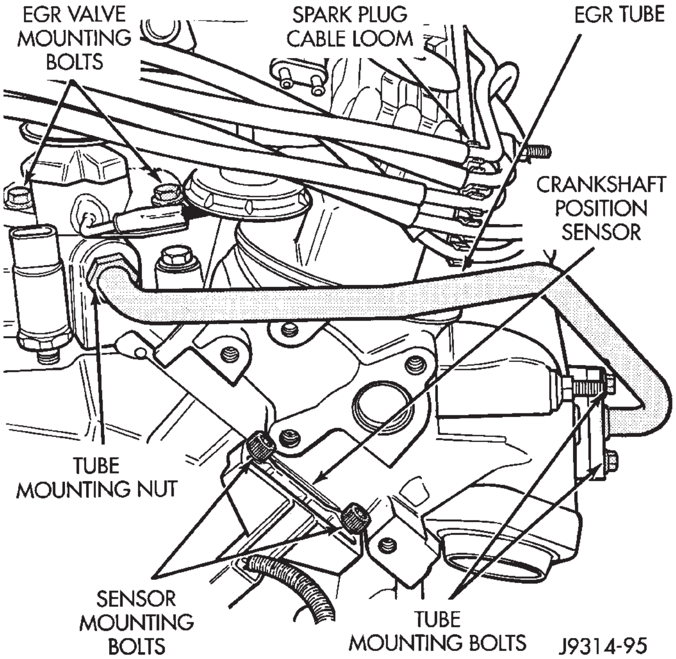


Fig. 19 Crankshaft Position Sensor

(2) Place an ohmmeter across terminals B and C (Fig. 20). Ohmmeter should be set to 1K-to-10K scale for this test. The meter reading should be open (no resistance). Replace sensor if a low resistance is indicated.

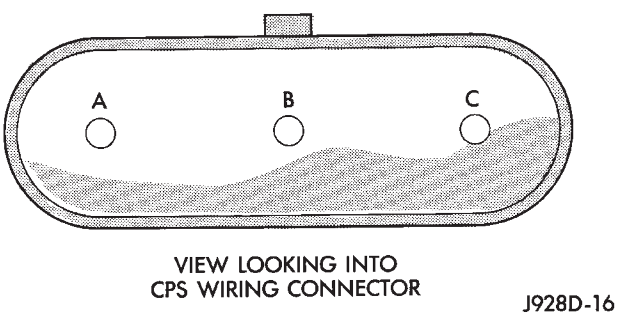


Fig. 20 Sensor Wiring Connector

THROTTLE POSITION SENSOR (TPS) TEST

To perform a complete test of the TPS and its circuitry, refer to the DRB II tester and appropriate Powertrain Diagnostics Procedures manual. To test the TPS only, refer to the following:

The TPS can be tested with a digital voltmeter. The center terminal of the TPS is the output terminal (Fig. 21).

With the ignition key in the ON position, check the TPS output voltage at the center terminal wire of the connector. Check this at idle (throttle plate closed)

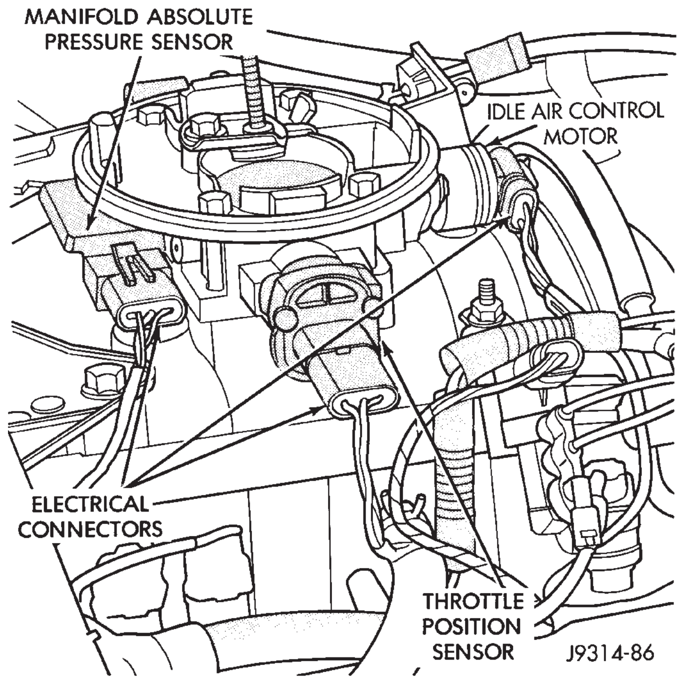


Fig. 21 Throttle Position Sensor (TPS) Connector

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.

OXYGEN (O_2) SENSOR HEATING ELEMENT TEST

To perform a complete test of O_2 sensor and its circuitry, refer to DRB II tester and appropriate Powertrain Diagnostics Procedures manual. To test the O_2 only, refer to the following:

The O_2 sensor is located on the right exhaust down pipe (Fig. 22). The O_2 heating element can be tested with an ohmmeter as follows:

Disconnect the O_2 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.

IDLE AIR CONTROL (IAC) MOTOR TEST

To perform a complete test of IAC motor (Fig. 23) and its circuitry, refer to DRB II scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the IAC motor only, special IAC motor exerciser tool number 7558 (Fig. 24) may be used.

CAUTION: Proper safety precautions must be taken when testing the IAC 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

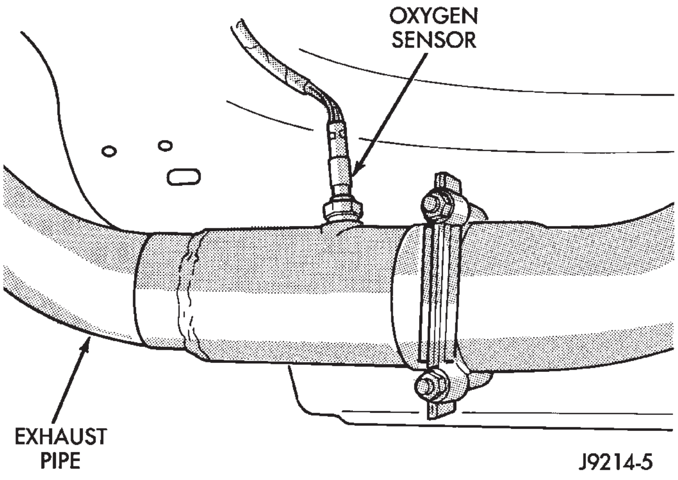


Fig. 22 Oxygen Sensor—Typical

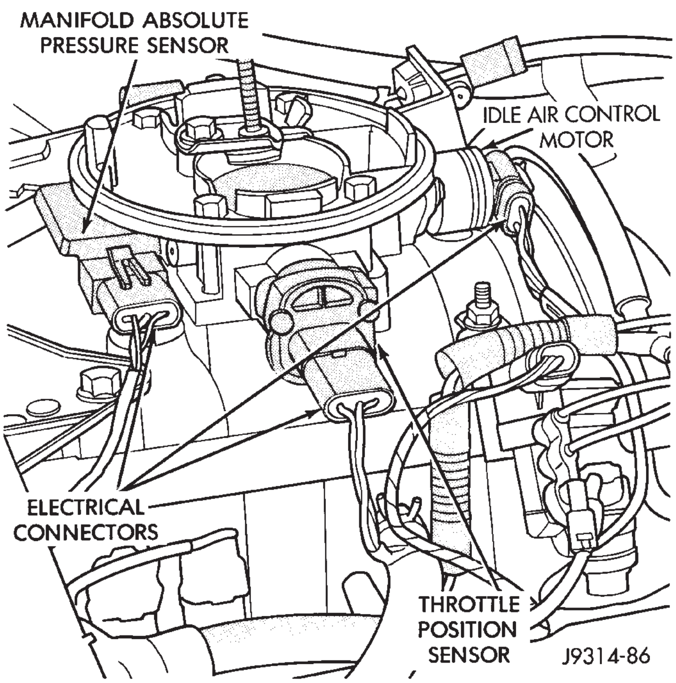


Fig. 23 IAC Motor

• 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. 24).

(2) Plug the exerciser tool (7558) harness connector into the IAC motor (Fig. 24).

(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 be illuminated when the exerciser is properly connected to battery.

(4) Start engine.

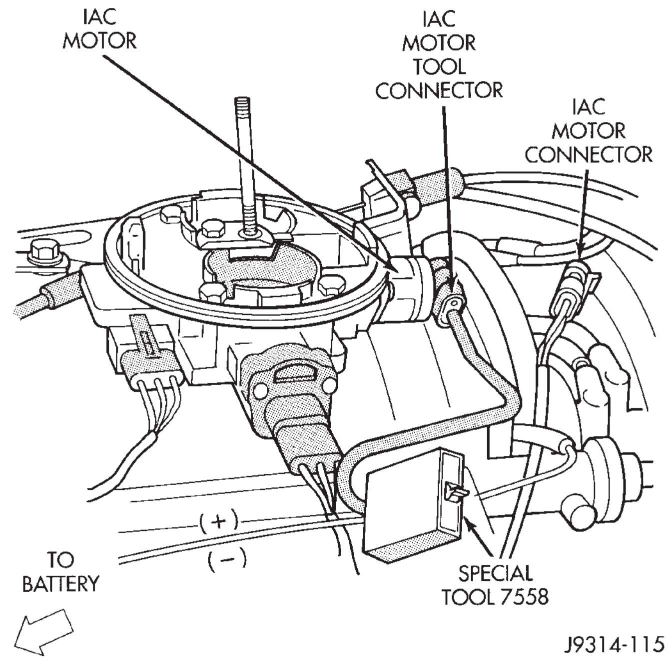


Fig. 24 IAC Motor Testing

When the switch is in the HIGH or LOW position, the light on the exerciser 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 stepper 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 from the IAC stepper motor.

(6) Remove the IAC stepper motor from the throttle body.

CAUTION: When checking IAC motor operation with the motor removed from the throttle body, do not extend the pintle (Fig. 25) more than 6.35 mm (.250 in). If the pintle is extended more than this amount, it may separate from the IAC stepper motor. The IAC motor must be replaced if the pintle separates from the motor.

(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 IAC motor. Start the engine and test the replacement motor operation as described in step (5).

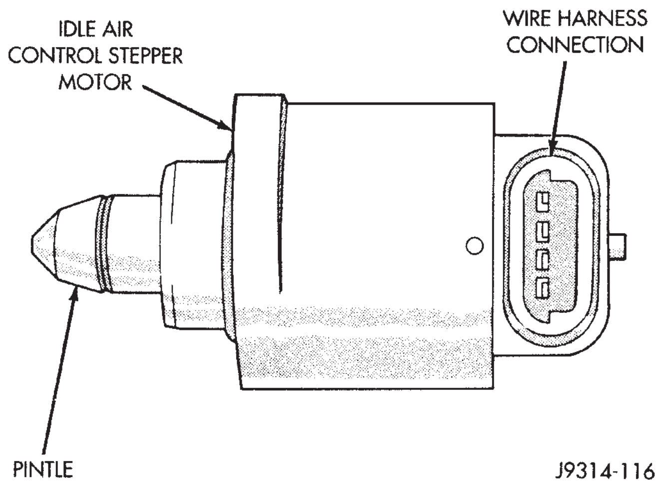


Fig. 25 IAC Stepper Motor Pintle—Typical

(b) If the pintle operates properly, check the IAC motor bore in the throttle body bore for blockage and clean as necessary. Install the IAC motor and retest. If blockage is not found, refer to the DRB II 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) and Fuel Pump. For operations/tests on all other relays, refer to the appropriate section of this service manual.

These relays are located in the Power Distribution Center (PDC) (Fig. 26). For the location of the relay within the PDC, refer to label under PDC cover.

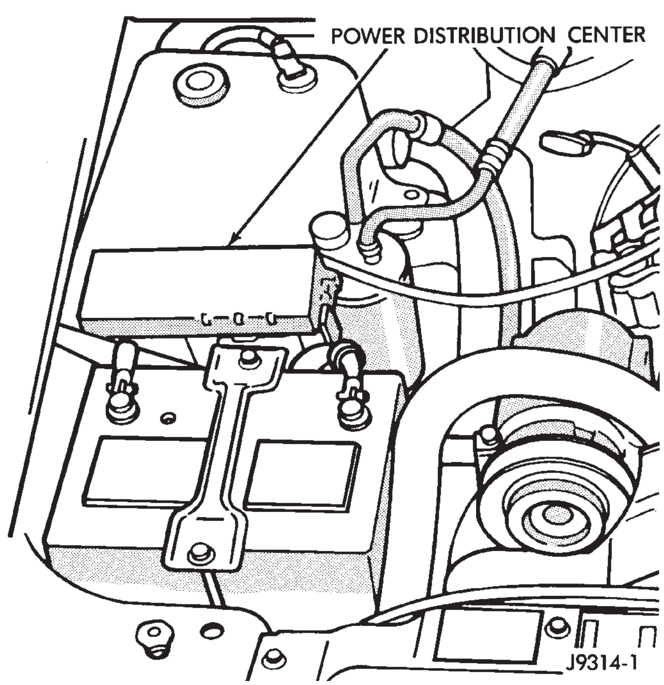


Fig. 26 Power Distribution Center (PDC)

The relay terminal numbers from (Fig. 27) can be found on the bottom of the relay.

- Terminal number 30 is connected to battery voltage and can be switched or B+ (hot) at all times.
- The center terminal number 87A is connected (a circuit is formed) to terminal 30 in the de-energized (normally OFF) position.
- Terminal number 87 is connected (a circuit is formed) to terminal 30 in the energized (ON) position. Terminal number 87 then supplies battery voltage to the component being operated.
- Terminal number 86 is connected to a switched (+) power source.
- Terminal number 85 is grounded by the powertrain control module (PCM).

TESTING

(1) Remove relay before testing.

(2) Using an ohmmeter, perform a resistance test between terminals 85 and 86. Resistance value (ohms) should be 75 ±5 ohms for resistor equipped relays.

(3) Connect the ohmmeter between terminals number 87A and 30. Continuity should be present at this time.

(4) Connect the ohmmeter between terminals number 87 and 30. Continuity should not be present at this time.

(5) Use a set of jumper wires (16 gauge or smaller). Connect one jumper wire between terminal number 85 (on the relay) to the ground side (-) of a 12 Volt power source.

(6) Attach the other jumper wire to the positive side (+) of a 12V power source. Do not connect this jumper wire to relay at this time.

CAUTION: DO NOT ALLOW THE OHMMETER TO CONTACT TERMINALS 85 OR 86 DURING THESE TESTS. DAMAGE TO OHMMETER MAY RESULT.

(7) Attach the other jumper wire (12V +) to terminal number 86. This will activate the relay. Continuity should now be present between terminals number 87 and 30. Continuity should not be present between terminals number 87A and 30.

(8) Disconnect jumper wires from relay and 12 Volt power source.

If continuity or resistance tests did not pass, replace relay. If tests passed, refer to Group 8W, Wiring Diagrams for (fuel system) relay wiring schematics and for additional circuit information.

STARTER MOTOR RELAY TEST

Refer to Group 8A, Battery/Starting/Charging System Diagnostics, for starter motor relay testing.

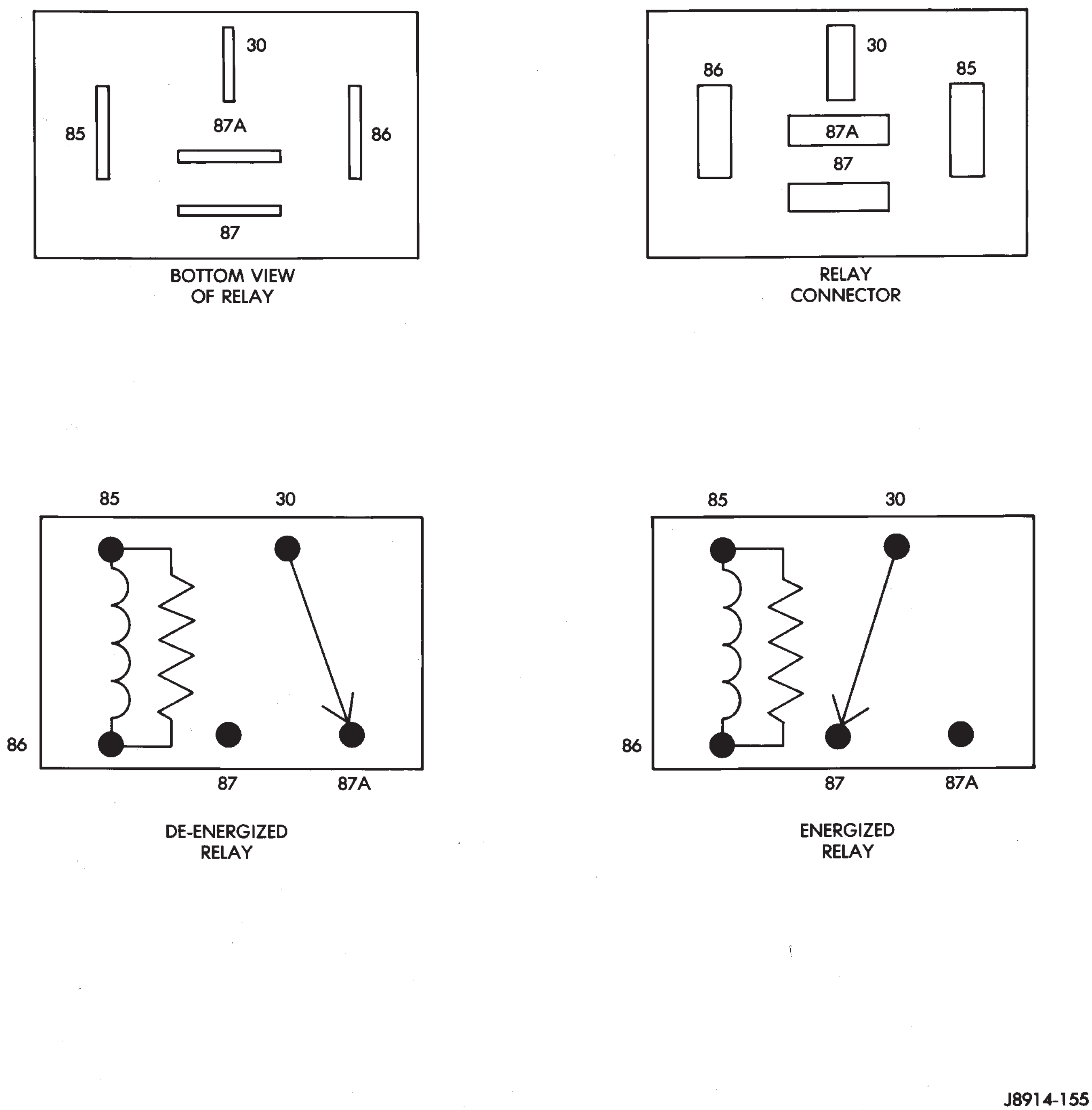


Fig. 27 Relay Terminals

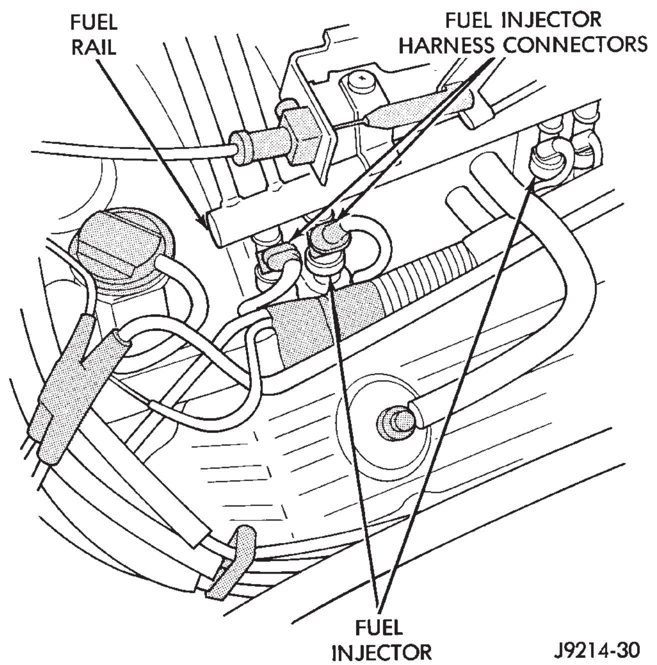


Fig. 28 Fuel Injector Wiring Connector

FUEL INJECTOR TEST

Disconnect the fuel injector wire harness connector from the injector (Fig. 28). Place an ohmmeter across the injector terminals. Resistance reading should be approximately 14.5 ohms ±1.2 ohms at 20°C (68°F). Proceed to following Fuel Injector diagnosis chart.

FUEL PUMP PRESSURE TEST

Refer to Fuel Pump Pressure Test in the Fuel Delivery System section of this group.

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

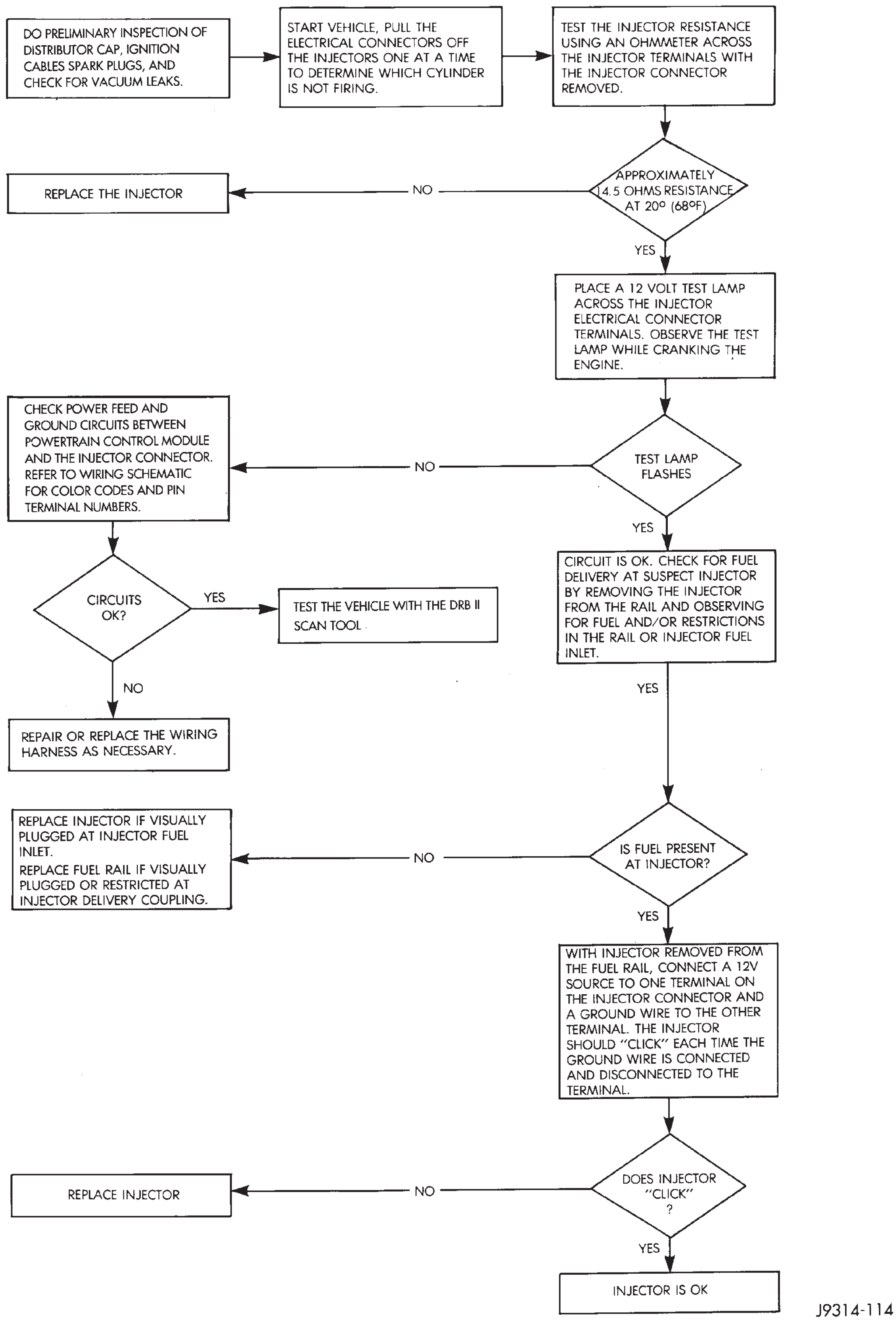
The PCM does not monitor the following circuits, systems or conditions that could have malfunctions that result in driveability problems. A Diagnostic Trouble Code (DTC) may not be displayed for these conditions.

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.

INJECTOR DIAGNOSIS—VEHICLE RUNS ROUGH AND/OR HAS A MISS



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.

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 II (DRB II scan tool). The DRB II connects to the data link connector in the vehicle (Fig. 29). For operation of the DRB II, refer to the appropriate Powertrain Diagnostic Procedures service manual.

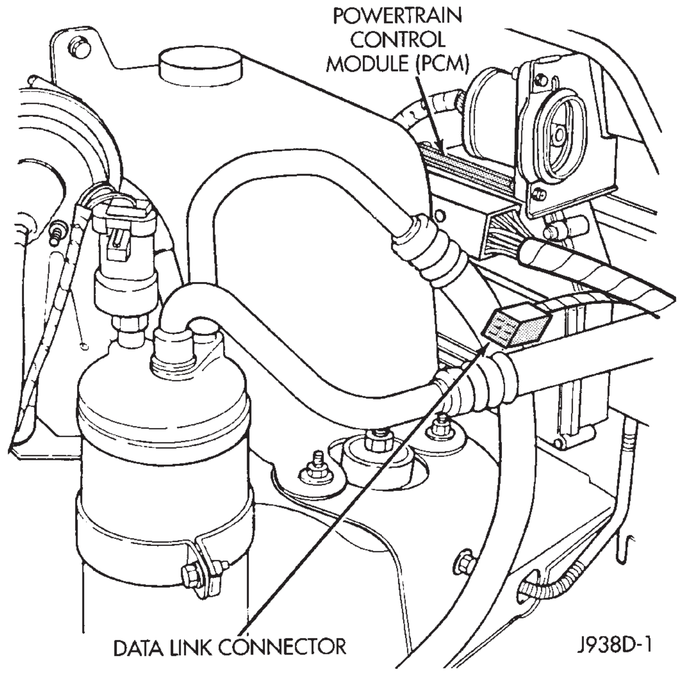


Fig. 29 Data Link Connector—Typical

EXAMPLES

• If the lamp flashes 4 times, pauses and flashes 1 more time, a Diagnostic Trouble Code (DTC) number 41 is indicated.

• If the lamp flashes 4 times, pauses and flashes 6 more times, a Diagnostic Trouble Code (DTC) number 46 is indicated.

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. 30).

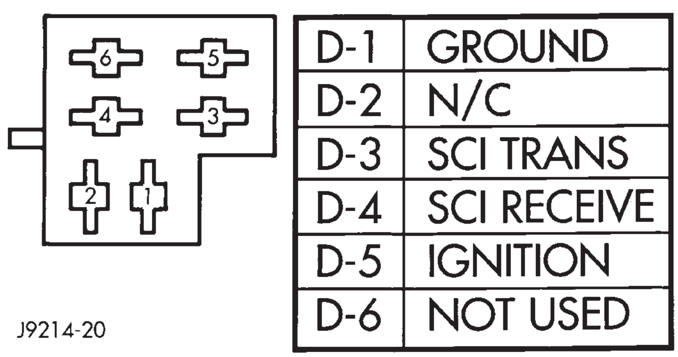


Fig. 30 Data Link Connector Schematic

ERASING TROUBLE CODES

The DRB II scan tool must be used to erase a Diagnostic Trouble Code (DTC). Refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB II scan tool.

DRB II SCAN TOOL

For operation of the DRB II 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 5.2L (V-8) engine. 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 (DTC) DESCRIPTION

Diagnostic Trouble Code	DRB II Display	Description of Trouble Code Condition
11	No Crank Reference Signal at PCM	No distributor reference signal detected during engine cranking.
13+**	No Change in MAP From Start to Run	No variation in MAP sensor signal is detected. No difference is recognized between the engine MAP reading and the barometric pressure reading at start up.
14+**	MAP Voltage Too Low or MAP Voltage Too High	MAP sensor input below minimum acceptable voltage. MAP sensor input above maximum acceptable voltage.
15**	No Vehicle Speed Sensor Signal	No 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**	O_2 Signal Stays at Center or O_2 Signal Shorted to Voltage	Neither rich or lean condition is detected from the oxygen sensor input. Oxygen sensor input voltage maintained above normal operating range.
22+**	ECT Sensor Voltage Too Low or ECT Sensor Voltage Too High	Coolant temperature sensor input below the minimum acceptable voltage. Coolant temperature sensor input above the maximum acceptable voltage.
23	Charge Air Temperature Sensor Voltage High or Charge Air Temperature Sensor Voltage Low	Charge Air Temperature Sensor input above/below acceptable minimum.
24+**	Throttle Position Sensor Voltage High or Throttle Position Sensor Voltage Low	Throttle position sensor (TPS) input above the maximum acceptable voltage. Throttle position sensor (TPS) input below the minimum acceptable voltage.

** Check Engine Lamp ON (California only)
+ Check Engine Lamp ON

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DIAGNOSTIC TROUBLE CODE (DTC) DESCRIPTION—CONTINUED

Diagnostic Trouble Code	DRB II Display	Description of Trouble Code Condition
25**	Idle Air Control Motor Circuits (ISC Actuator)	A shorted condition detected in one or more of the idle air control actuator circuits.
27+**	Control Circuit	Injector output driver does not respond properly to the control signal.
31**	EVAP Purge Solenoid Circuit	An open or shorted condition detected in the purge solenoid circuit.
32**	EGR System Failure	An open or shorted condition detected in the EGR solenoid circuit. Required change in air-fuel ratio not detected during diagnostic test (California emissions packages only).
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.
37	Torque Converter Clutch Solenoid Circuit (CKT)	An open or shorted condition detected in the torque converter clutch solenoid circuit (vehicles with automatic transmissions only).
41+**	Generator Field Not Switching Properly	Generator field not switching properly.
42	Auto Shutdown Relay Control Circuit or No ASD Relay Voltage Sense at Controller	An open or short condition detected in the auto shutdown relay circuit. No ASD voltage sensed at PCM.

** Check Engine Lamp ON (California only)
+ Check Engine Lamp ON

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DIAGNOSTIC TROUBLE CODE (DTC) DESCRIPTION—CONTINUED

Diagnostic Trouble Code	DRB II Display	Description of Trouble Code Condition
45	Overdrive Solenoid	An open or shorted condition detected in overdrive solenoid circuit.
46+**	Charging system voltage too high.	Charging system voltage too high.
47+**	Charging system voltage too low.	Charging system voltage too low.
51**	O_2 Signal Stays Below Center (Lean) or Additive Adaptive Memory at Rich Limit	O_2 sensor signal stays lean. Additive adaptive memory at rich limit.
52**	O_2 Signal Stays Above Center (Rich) or Additive Adaptive Memory at Lean Limit	O_2 sensor signal stays rich. Additive adaptive memory at lean limit.
53	Internal PCM Failure	Internal failure in the PCM (Powertrain Control Module).
62	PCM Failure SRI Miles not Stored	PCM (Powertrain Control Module) failure - SRI miles not stored.
63	PCM Failure EEprom Write Denied	PCM (Powertrain Control Module) failure - EEprom write denied.
54	Sync Pick-up Signal	No fuel sync signal detected during crankshaft rotation.
55	NA	Completion of trouble code display on the Malfunction Indicator (MIL) lamp.

+ Check Engine Lamp ON ** Check Engine Lamp ON (California only)

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MPI SYSTEM—5.2L ENGINE—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) (Fig. 1). For location of this relay within the PDC, refer to label attached to bottom of PDC cover.

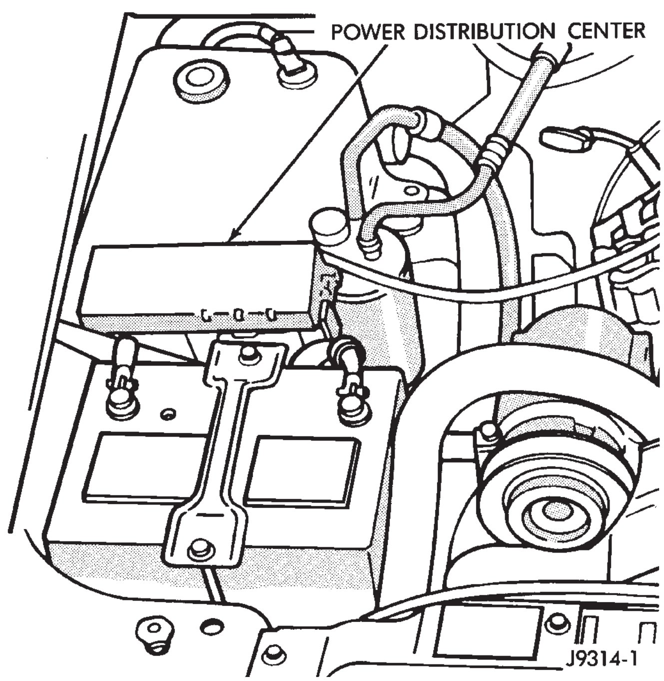

Fig. 1 Power Distribution Center (PDC)

AIR CLEANER HOUSING

Refer to Group 25, Emission Control System.

AIR FILTER

Refer to Group 25, Emission Control System.

AUTOMATIC SHUT DOWN (ASD) RELAY

The ASD relay is located in the Power Distribution Center (Fig. 1) (PDC). For location of this relay within the PDC, refer to label attached to bottom of 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.

CHARGE AIR TEMPERATURE SENSOR

The intake manifold charge air temperature sensor is located in the front/side of the intake manifold (Fig. 2).

REMOVAL

(1) Remove air cleaner assembly.
(2) Disconnect electrical connector at sensor (Fig. 2).
(3) Remove sensor from intake manifold.

INSTALLATION

(1) Install sensor to intake manifold. Tighten to 28 N•m (20 ft. lbs.) torque.
(2) Install electrical connector.
(3) Install air cleaner.

CRANKSHAFT POSITION SENSOR

For removal and installation procedures, refer to Group 8D, Ignition System.

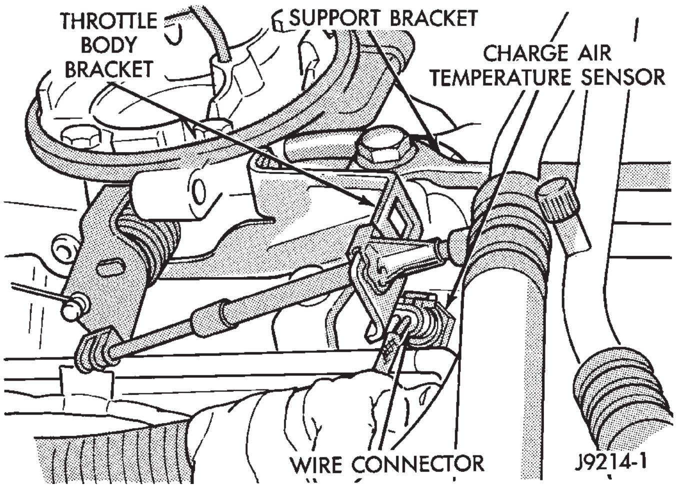

Fig. 2 Charge Air Temperature Sensor—Typical

ENGINE COOLANT TEMPERATURE SENSOR

REMOVAL

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR. REFER TO GROUP 7, COOLING.

(1) Partially drain cooling system. Refer to Group 7, Cooling.

(2) Disconnect electrical connector from sensor (Fig. 3).

Engines with air conditioning: When removing the connector from sensor, do not pull directly on wiring harness. Fabricate an L-shaped hook tool from a coat hanger (approximately eight inches long). Place the hook part of tool under the connector for removal. The connector is snapped onto the sensor. It is not equipped with a lock type tab.

(3) Remove sensor from intake manifold.

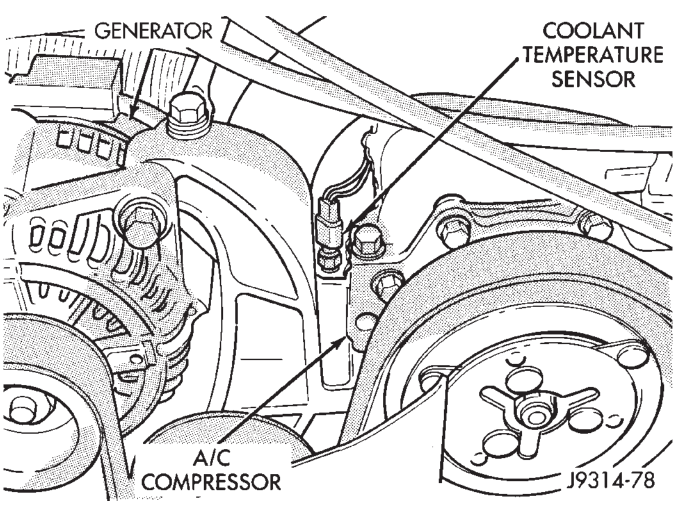

Fig. 3 Coolant Temperature Sensor—Typical

INSTALLATION

(1) Install sensor.

(2) Tighten to 11 N●m (8 ft. lbs.) torque.

(3) Connect electrical connector to sensor.

The sensor connector is symmetrical (not indexed). It can be installed to the sensor in either direction.

(4) Replace any lost engine coolant. Refer to Group 7, Cooling System.

EVAP CANISTER PURGE SOLENOID

Refer to Group 25, Emission Control System for removal/installation procedures.

FUEL FILTER

Refer to the Fuel Delivery System section of this group for removal/installation procedures.

FUEL INJECTOR(S)

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE TURNED OFF). BEFORE SERVICING THE FUEL INJECTOR(S), THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to the Fuel Delivery System section of this group. See Fuel System Pressure Release.

To remove one or more fuel injectors, the fuel rail assembly must be removed from engine.

REMOVAL

(1) Remove air duct at throttle body.

(2) Remove fuel rail assembly. Refer to Fuel Rail removal in this section.

(3) Remove the clip(s) retaining the injector(s) to fuel rail (Fig. 4).

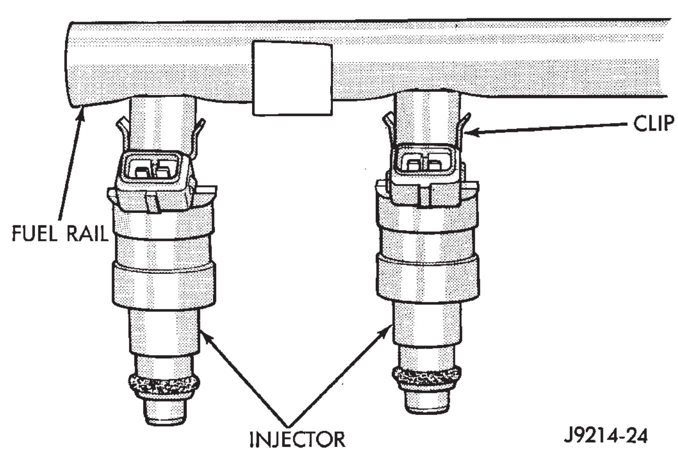

Fig. 4 Fuel Injector and Retaining Clip

(4) Remove injector(s) from fuel rail.

INSTALLATION

(1) Apply a small amount of engine oil to each fuel injector O-ring. This will help in fuel rail installation.

(2) Install injector(s) and injector clip(s) to fuel rail.

(3) Install fuel rail assembly. Refer to Fuel Rail installation.

(4) Install air duct to throttle body.

(5) Start engine and check for leaks.

FUEL PRESSURE REGULATOR

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE TURNED OFF). BEFORE SERVICING THE FUEL PRESSURE REGULATOR, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to the Fuel Delivery System section of this group. See Fuel System Pressure Release.

REMOVAL

The pressure regulator is located (mounted vertically) in the fuel rail assembly near the dash panel (Fig. 5). It is held to the fuel rail with a clamp and bolt (Fig. 6).

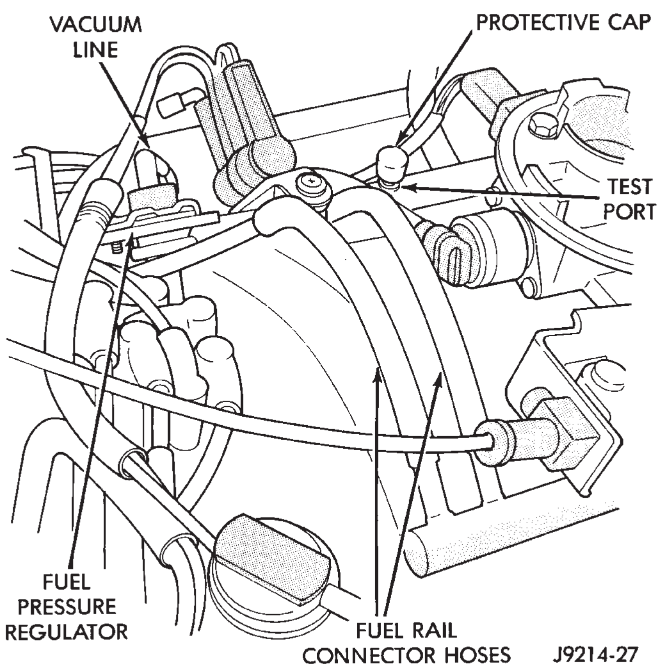

Fig. 5 Fuel Pressure Regulator

(1) Perform the fuel pressure release procedure.

(2) Remove the vacuum line from the pressure regulator.

(3) Remove the clamp bolt and regulator retaining clamp from fuel rail.

(4) Remove pressure regulator from fuel rail.

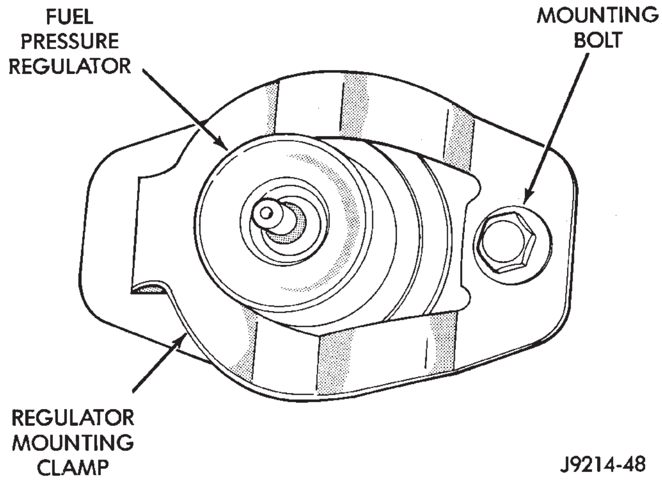

Fig. 6 Pressure Regulator Mounting

INSTALLATION

(1) Install new O-ring seals to pressure regulator.

(2) Install pressure regulator to fuel rail.

(3) Install retaining clamp and clamp bolt.

(4) Install vacuum line to pressure regulator.

(5) Start engine and check for 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) (Fig. 1). For location of this relay within the PDC, refer to label attached to bottom of PDC cover.

FUEL RAIL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE TURNED OFF). BEFORE SERVICING THE FUEL RAIL ASSEMBLY, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to the Fuel Delivery System section of this group. See Fuel System Pressure Release.

CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate the rail halves at the connecting hoses (Fig. 7). Due to the design of these connecting hoses, they do not use any clamps. Never attempt to install a clamping device of any kind to the hoses. When removing the fuel rail assembly for any reason, be careful not to bend or kink the connecting hoses.

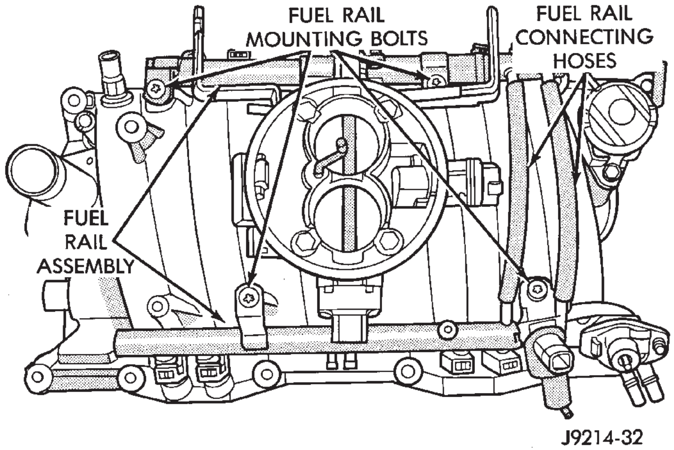

Fig. 7 Fuel Rail Assembly—Typical

REMOVAL

(1) Remove negative battery cable at battery.

(2) Remove air duct at throttle body.

(3) Perform the fuel pressure release procedure. Refer to the Fuel Delivery System section of this group.

(4) Remove throttle body from intake manifold. Refer to Throttle Body removal in this group.

(5) If equipped with air conditioning, remove the A/C compressor-to-intake manifold support bracket (three bolts) (Fig. 8).

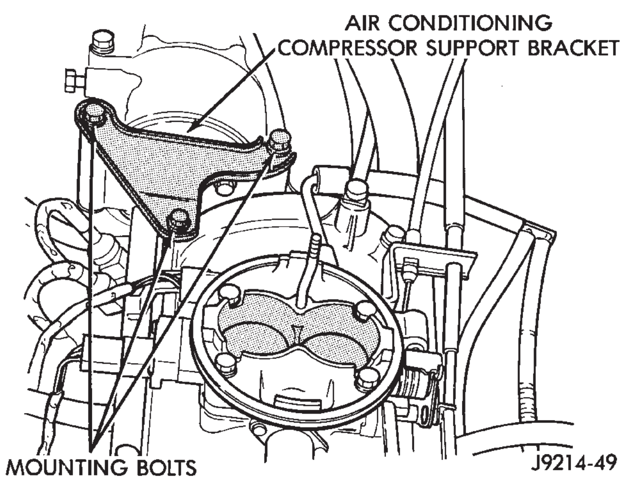

Fig. 8 A/C Compressor Support Bracket—Typical

(6) Disconnect electrical connectors at all fuel injectors (Fig. 9). The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification.

(7) Remove vacuum line at fuel pressure regulator (Fig. 10).

(8) Remove EVAP canister purge solenoid/bracket assembly (Fig. 11) from intake manifold.

(9) Disconnect two fuel lines at rear of fuel rail. Refer to Fuel Tubes/Lines/Hoses and Clamps in the Fuel Delivery System section of this group.

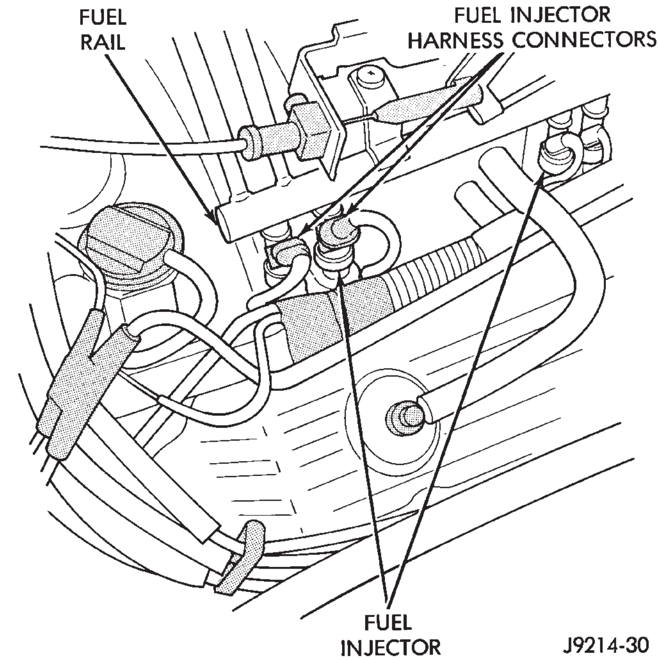

Fig. 9 Fuel Injector Connectors

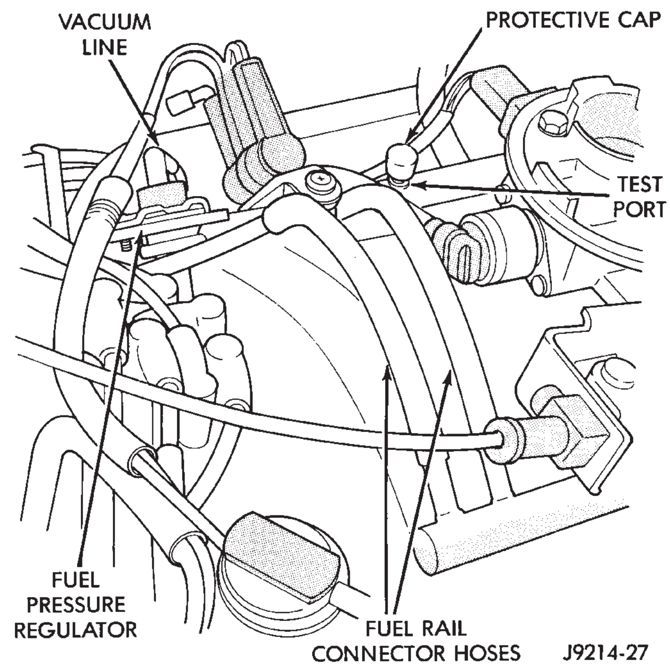

Fig. 10 Pressure Regulator Vacuum Line—Typical

(10) Remove the remaining fuel rail mounting bolts (Fig. 12).

(11) Gently rock and pull the **left** fuel rail until the fuel injectors just start to clear the intake manifold. Gently rock and pull the **right** fuel rail until the fuel injectors just start to clear the intake manifold. Repeat this procedure (left/right) until all fuel injectors have cleared the intake manifold.

(12) Remove fuel rail (with injectors attached) from engine.

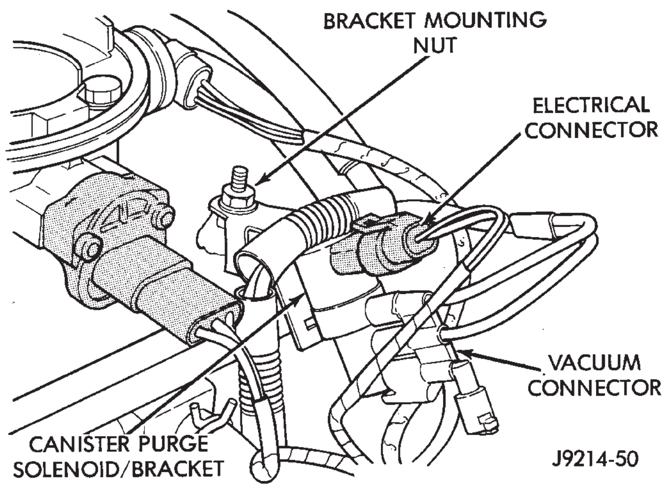

Fig. 11 EVAP Canister Purge Solenoid

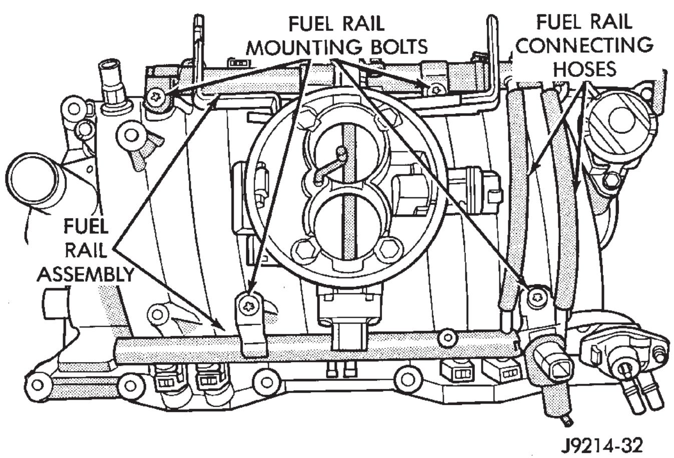

Fig. 12 Fuel Rail Mounting Bolts—Typical

(13) Remove the clip(s) retaining the injector(s) to fuel rail (Fig. 13).

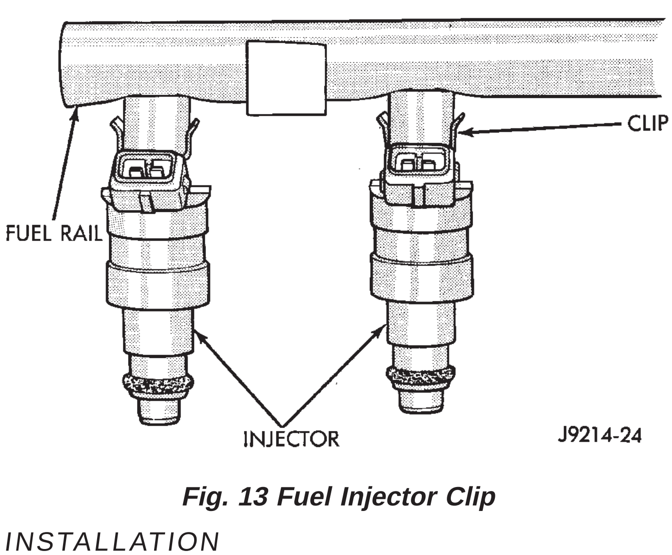

Fig. 13 Fuel Injector Clip

INSTALLATION

(1) Apply a small amount of engine oil to each fuel injector O-ring. This will help in fuel rail installation.

(2) Install injector(s) and injector clip(s) to fuel rail.

(3) Position the fuel rail/fuel injector assembly to the injector openings on the intake manifold.

(4) Guide each injector into the intake manifold. Be careful not to tear the injector O-ring.

(5) Push the **right** fuel rail down until fuel injectors have bottomed on injector shoulder. Push the **left** fuel rail down until fuel injectors have bottomed on injector shoulder.

(6) Install fuel rail mounting bolts.

(7) Install EVAP canister purge solenoid to intake manifold.

(8) Connect electrical connector to intake manifold charge air temperature sensor.

(9) Connect wiring to all fuel injectors. The injector wiring harness is numerically tagged.

(10) Install the A/C support bracket (if equipped).

(11) Install throttle body to intake manifold. Refer to Throttle Body installation in this section of the group.

(12) Install vacuum line to fuel pressure regulator.

(13) Install two fuel lines at rear of fuel rail. Refer to Fuel Tubes/Lines/Hoses and Clamps in the Fuel Delivery System section of this group.

(14) Install air duct at throttle body.

(15) Connect battery cable to battery.

(16) Start engine and check for leaks.

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE TURNED OFF). BEFORE SERVICING THE FUEL PUMP, FUEL LINES, FUEL FILTER, OR FUEL INJECTOR(S), THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to the Fuel Delivery System section of this group. See Fuel System 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 Fuel Tubes/Lines/Hoses and Clamps in the Fuel Delivery System section of this group for removal/installation procedures.

Also refer to Quick-Connect Fittings in the Fuel Delivery System section of this group for removal/installation procedures.

IDLE AIR CONTROL (IAC) MOTOR

The IAC motor is located on the back of the throttle body (Fig. 14).

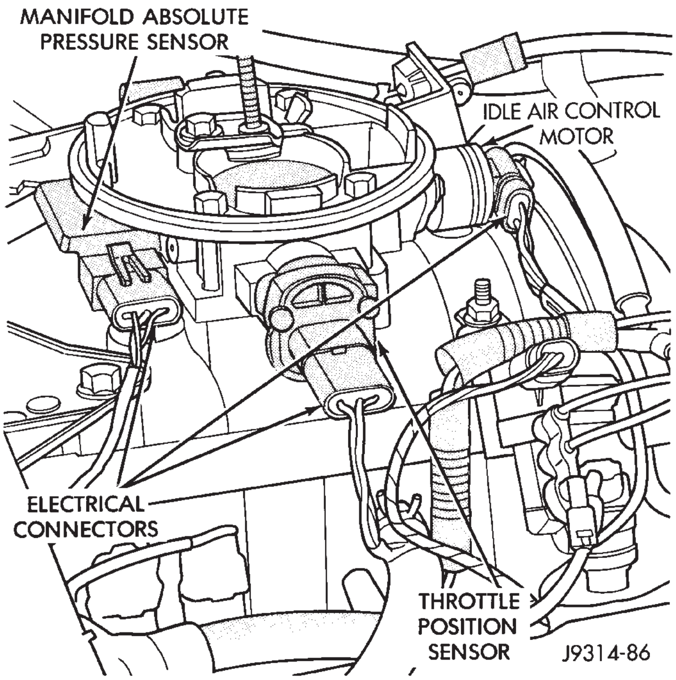

Fig. 14 Idle Air Control Motor

REMOVAL

(1) Remove air duct at throttle body.

(2) Disconnect electrical connector from IAC motor.

(3) Remove two mounting screws (Fig. 15).

(4) Remove IAC motor from throttle body.

INSTALLATION

(1) Install IAC motor to throttle body.

(2) Install and tighten two mounting screws to 7 N●m (60 in. lbs.) torque.

(3) Install electrical connector.

(4) Install air duct to throttle body.

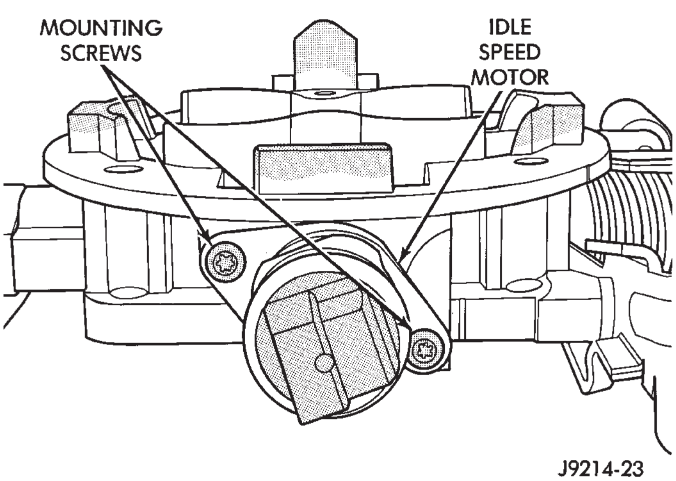

Fig. 15 Mounting Screws—IAC Motor

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 front of the throttle body (Fig. 16). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 17).

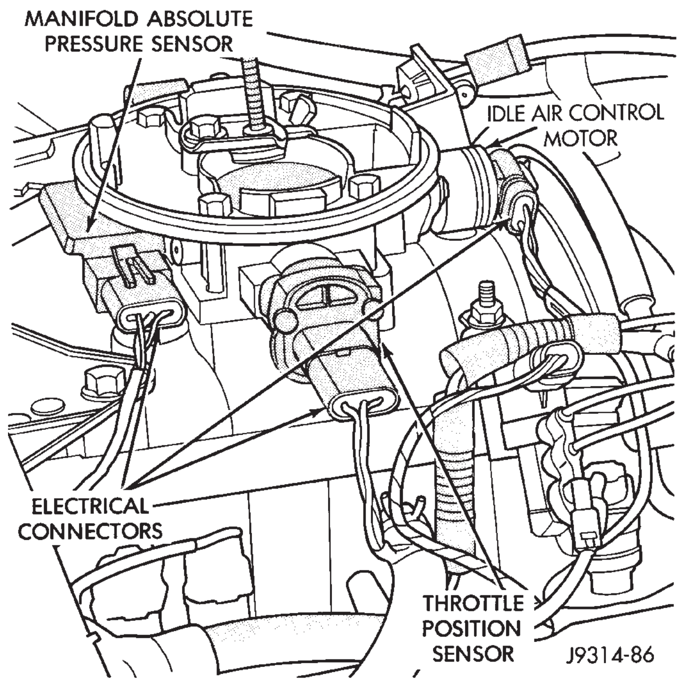

Fig. 16 MAP Sensor

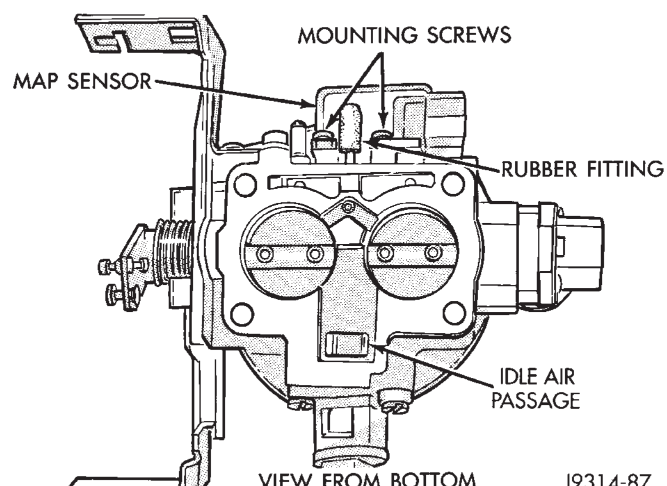

Fig. 17 MAP Sensor L-Shaped Rubber Fitting

REMOVAL

The throttle body must be removed from the intake manifold for MAP sensor removal.

(1) Remove air duct at throttle body.

(2) Remove throttle body. Refer to Throttle Body removal in this section.

(3) Remove two MAP sensor mounting screws (Fig. 17).

(4) While removing MAP sensor, slide the vacuum rubber L-shaped fitting (Fig. 17) from the throttle body.

(5) Remove rubber L-shaped fitting from MAP sensor.

INSTALLATION

(1) Install rubber L-shaped fitting to MAP sensor.

(2) Position sensor to throttle body while guiding rubber fitting over throttle body vacuum nipple.

(3) Install MAP sensor mounting screws. Tighten screws to 3 N●m (25 in. lbs.) torque.

(4) Install throttle body. Refer to Throttle Body installation in this section.

(5) Install air duct to throttle body.

OXYGEN (O_2) SENSOR

The O_2 sensor is located in the right exhaust downpipe below the exhaust manifold flange (Fig. 18).

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) Disconnect the wire connector from the O_2 sensor.

CAUTION: When disconnecting the sensor electrical connector, do not pull directly on wire going into sensor.

(3) Remove the O_2 sensor from the exhaust manifold.

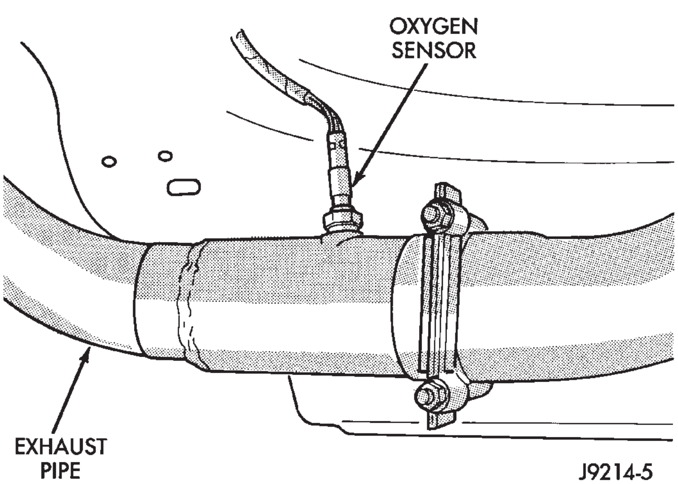

Fig. 18 Oxygen Sensor

INSTALLATION

Threads of new oxygen sensors are factory coated with anti-seize compound to aid in removal. **DO NOT add any additional anti-seize compound to the threads of a new oxygen sensor.**

(1) Install the O_2 sensor into the exhaust manifold. Tighten to 30 N●m (22 ft. lbs.) torque.

(2) Connect the O_2 sensor wire connector.

(3) Lower the vehicle.

PARK/NEUTRAL SWITCH

Refer to Group 21, Transmission and Transfer Case for removal/installation procedures.

POWERTRAIN CONTROL MODULE (PCM)

The PCM is located on the cowl panel in the right/rear side of the engine compartment (Fig. 19).

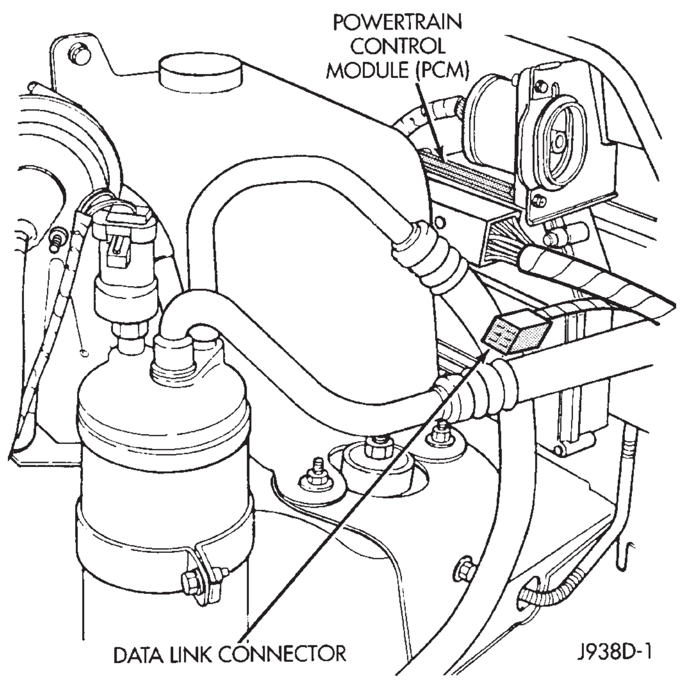

Fig. 19 Powertrain Control Module (PCM) Location

REMOVAL

(1) Disconnect the negative battery cable at the battery.

(2) Remove the coolant reserve/overflow bottle (one bolt and two nuts) (Fig. 20)

(3) Loosen the 60-Way connector mounting bolt (Fig. 21).

(4) Remove the electrical connector by pulling straight back.

(5) Remove the three PCM mounting bolts (Fig. 21).

(6) Remove PCM.

INSTALLATION

(1) Check the pins in 60-way electrical connector for damage. Repair as necessary.

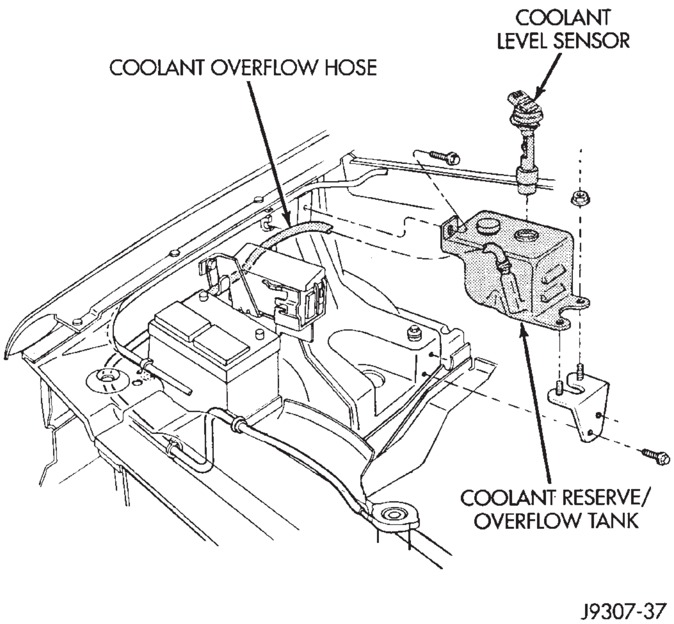

Fig. 20 Coolant Reserve/Overflow Bottle Mounting

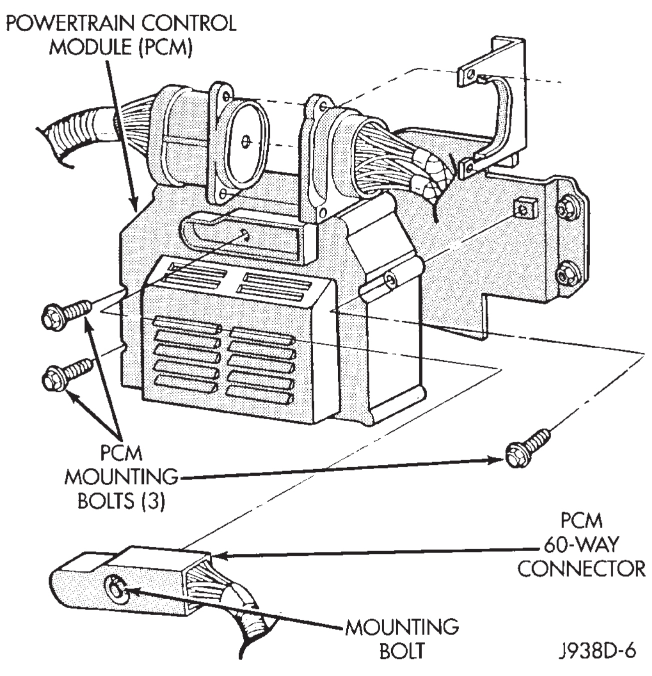

Fig. 21 Powertrain Control Module (PCM) Mounting

(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) Install coolant reserve/overflow bottle.

(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

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the powertrain control module (PCM).

REMOVAL

(1) Remove the air duct at throttle body.

(2) Disconnect throttle body electrical connectors at MAP sensor, IAC motor and TPS (Fig. 22).

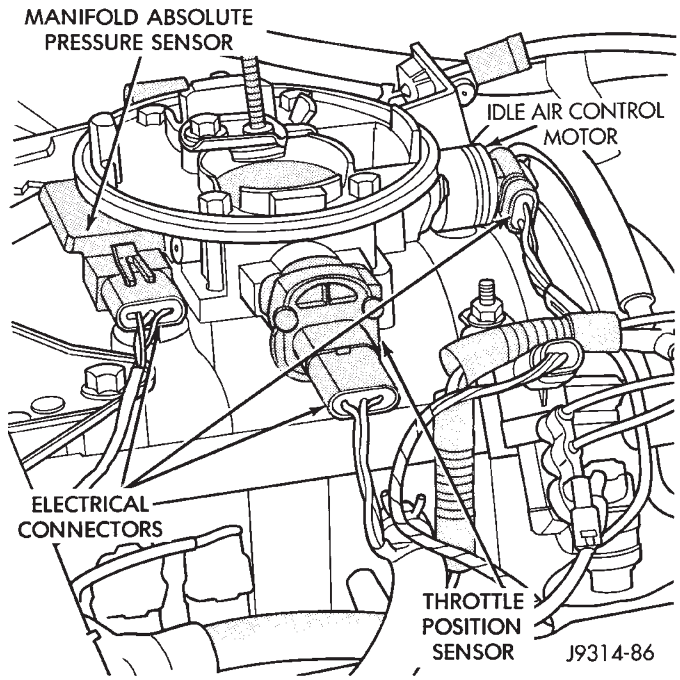

Fig. 22 Sensor Electrical Connectors

(3) Remove vacuum line at throttle body.

(4) Remove (unsnap) all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section of this group for additional information.

(5) Remove four throttle body mounting bolts (Fig. 23).

(6) Remove throttle body from intake manifold.

(7) Discard old throttle body-to-intake manifold gasket.

INSTALLATION

(1) Clean the mating surfaces of the throttle body and the intake manifold.

(2) Install new throttle body-to-intake manifold gasket.

(3) Install throttle body to intake manifold.

(4) Install four mounting bolts. Tighten bolts to 23 N●m (200 in. lbs.) torque.

(5) Install control cables.

CAUTION: When the automatic transmission throttle cable is connected, it MUST be adjusted.

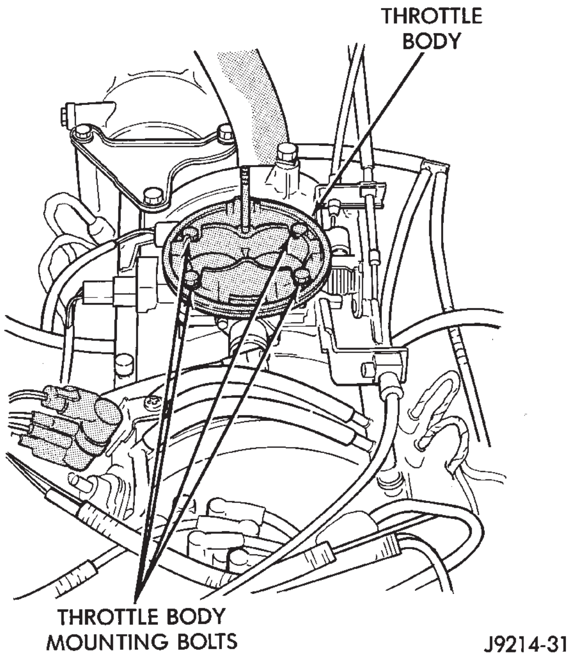

Fig. 23 Throttle Body Mounting Bolts—Typical

(6) If equipped with an automatic transmission, connect and adjust the transmission line pressure cable. Refer to Group 21, Transmissions for adjustment procedure.

(7) Install vacuum line to throttle body.

(8) Install electrical connectors.

(9) Install air duct to throttle body.

THROTTLE POSITION SENSOR (TPS)

REMOVAL

The TPS is located on the side of the throttle body (Fig. 24).

(1) Remove air intake tube at throttle body.

(2) Disconnect TPS electrical connector.

(3) Remove two TPS mounting screws (Fig. 25).

(4) Remove TPS from throttle body.

INSTALLATION

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 26). The TPS must be installed so that it can be rotated a few degrees. If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs. The TPS will be under slight tension when rotated.

(1) Install the TPS and two retaining screws.

(2) Tighten screws to 7 N●m (60 in. lbs.) torque.

(3) Manually operate the throttle control lever by hand to check for any binding of the TPS.

(4) Connect TPS electrical connector to TPS.

(5) Install air intake tube.

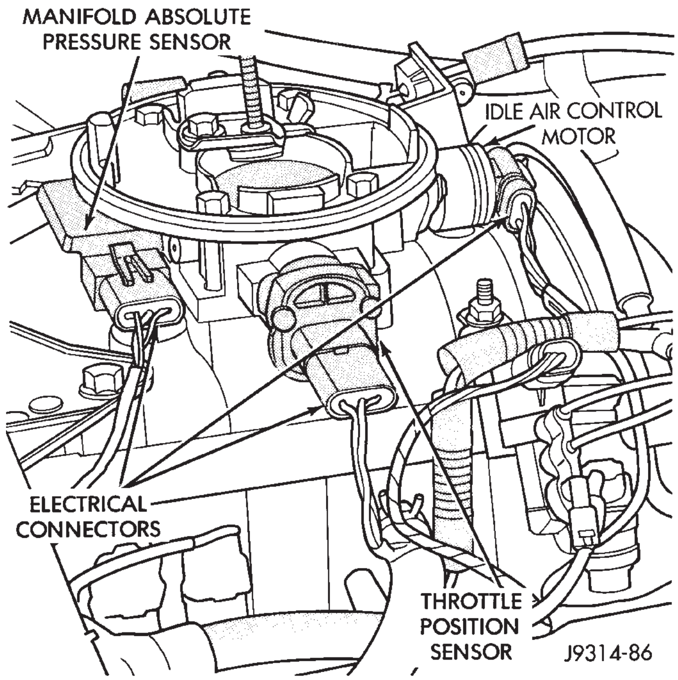

Fig. 24 TPS—Typical

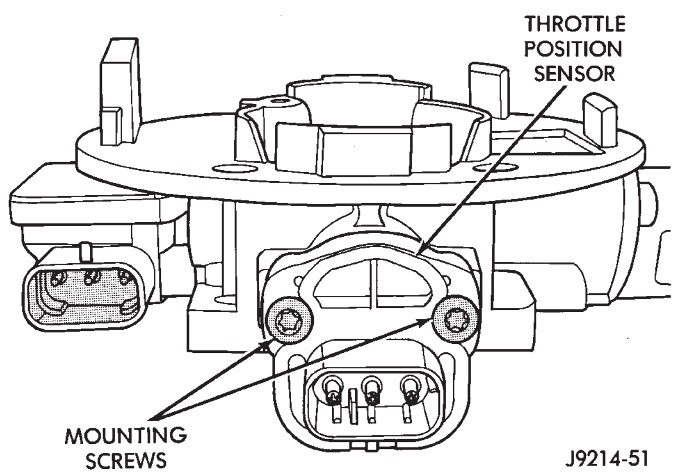

Fig. 25 TPS Mounting Screws

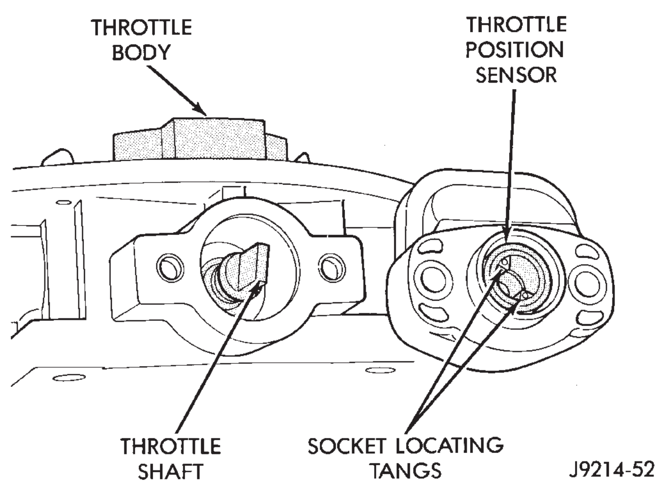

Fig. 26 TPS Installation

(3) Connect electrical connector to sensor.

(4) Connect the speedometer cable.

VEHICLE SPEED SENSOR

The vehicle speed sensor (Fig. 27) is located on the extension housing of the transmission on 2WD models. It is located on the transfer case on 4WD models.

REMOVAL

(1) Raise and support vehicle.

(2) Disconnect the electrical connector from the sensor.

(3) Remove (unscrew) the speedometer cable from the sensor (Fig. 28).

(4) Loosen the sensor mounting nut (Fig. 28).

(5) Remove the sensor.

INSTALLATION

(1) Install new sensor into speedometer adapter.

(2) Tighten sensor mounting nut.

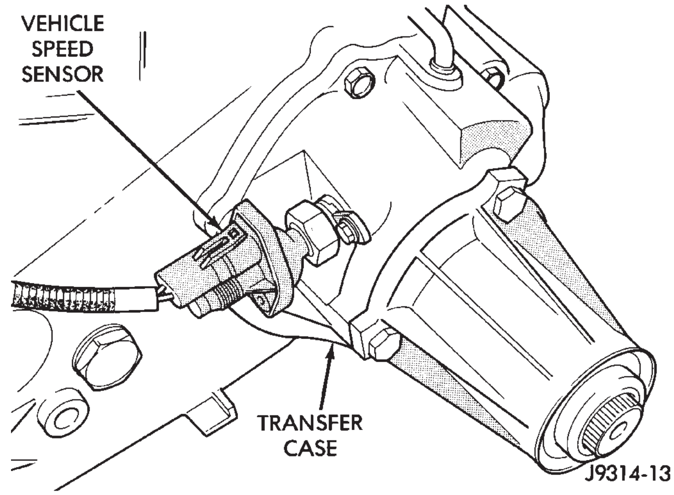

Fig. 27 Vehicle Speed Sensor—Typical

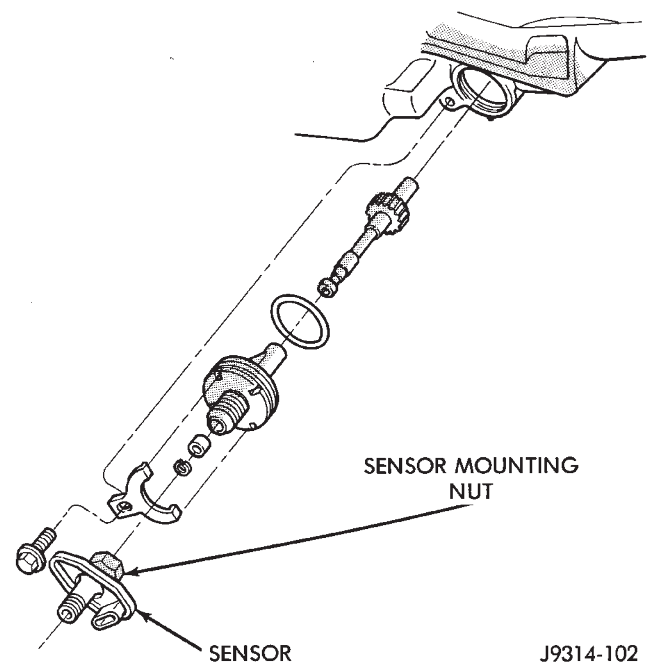

Fig. 28 Sensor and Components

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	LITERS*	GALLONS*
ALL MODELS	87	23.0

*Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerances, ambient temperature and refill procedures.

J9314-5

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

J9314-8

TORQUE

DESCRIPTION	TORQUE
Accelerator Pedal Mounting Nuts	10 N·m (92 in. lbs.)
Coolant Temperature Sensor 4.0L	28 N·m (21 ft. lbs.)
Coolant Temperature Sensor 5.2L	11 N·m (8 ft. lbs.)
Crankshaft Position Sensor 4.0L...................	18 N·m (15 ft. lbs.)
Fuel Filter Retaining Strap Bolt	7 N·m (66 in. lbs.)
Fuel Rail Mounting Bolts	27 N·m (20 ft. lbs.)
Idle Air Control Motor Mounting Screws	7 N·m (60 in. lbs.)
Intake Manifold Charge Air Temperature Sensor	28 N·m (20 ft. lbs.)
MAP Sensor Mounting Screws 5.2L	3 N·m (25 in. lbs.)
Oxygen Sensor	30 N·m (22 ft. lbs.)
PCM 60-Way Connector Mounting Screw	4 N·m (35 in. lbs.)
PCM Mounting Bolts	1 N·m (9 in. lbs.)
Throttle Body Mounting Bolts (4.0L)	12 N·m (9 ft. lbs.)
Throttle Body Mounting Bolts (5.2L)	23 N·m (200 in. lbs.)
TPS Screws	7 N·m (60 in. lbs.)

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PROPELLER SHAFTS

CONTENTS

GENERAL INFORMATION

PROPELLER SHAFTS

The function of a prop shaft is to transmit power from one point to another in a smooth action. The shaft is designed to send torque through an angle from the transmission (transfer case on 4WD vehicles) to the axle (Fig. 1).

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

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

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. This will ensure safe operation. The specified torque must always be applied when tightening the fasteners.

UNIVERSAL JOINTS

The front and rear prop shafts use the 1310 series universal joint.

Two different types of U-joints systems are used:
- Single cardan U-joint (Fig. 2)
- Double cardan U-joint (Fig. 3)

LUBRICATION

The slip yoke on the front shaft is equipped with a zerk type lubrication fitting. Use a multi-purpose NLGI Grade 2 EP lubricant, refer to Group 0, Lubrication and Maintenance for additional information. The factory installed U-joints are lubricated for the

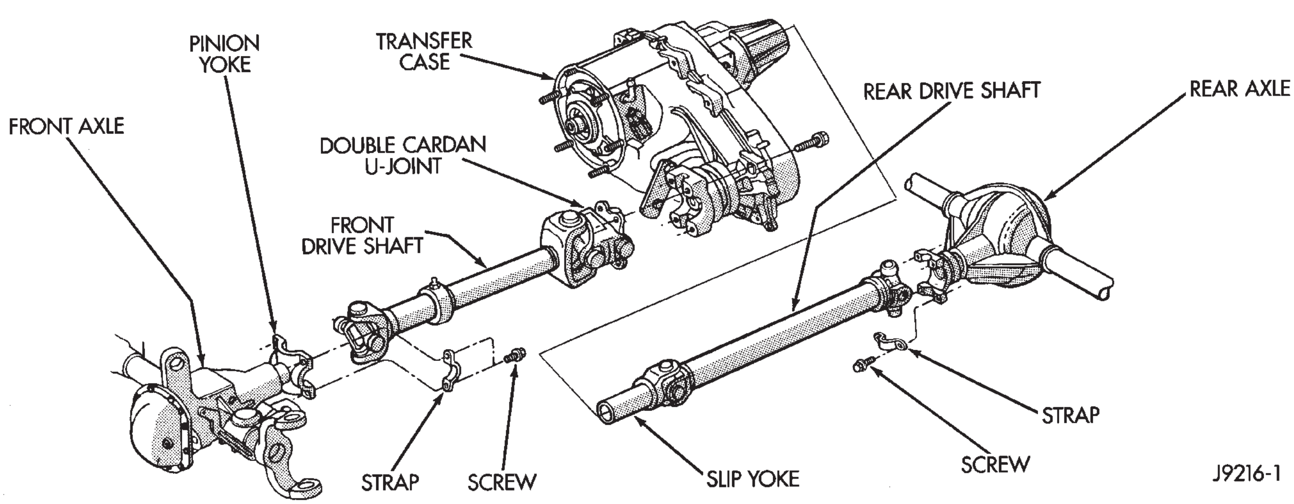

Fig. 1 Front & Rear Propeller Shafts (4WD)

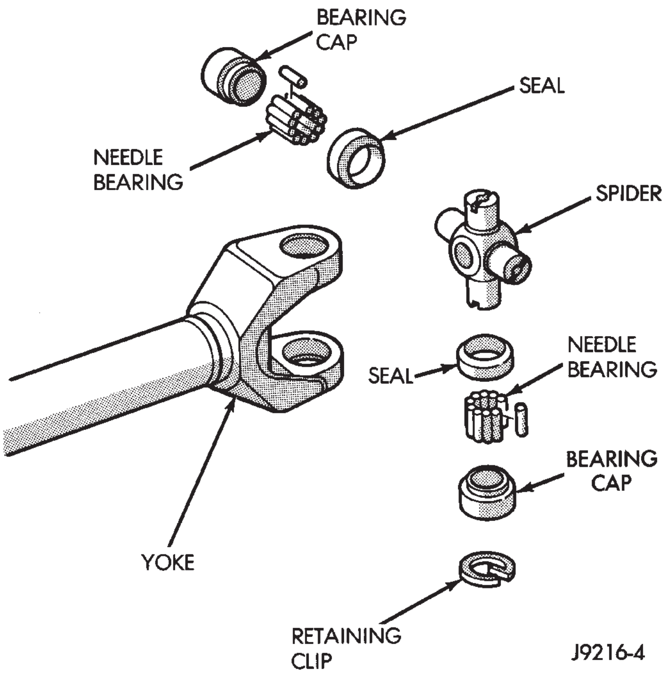

Fig. 2 Single Cardan U-Joint (Typical)

life of the vehicle and do not need re-lubrication. 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.

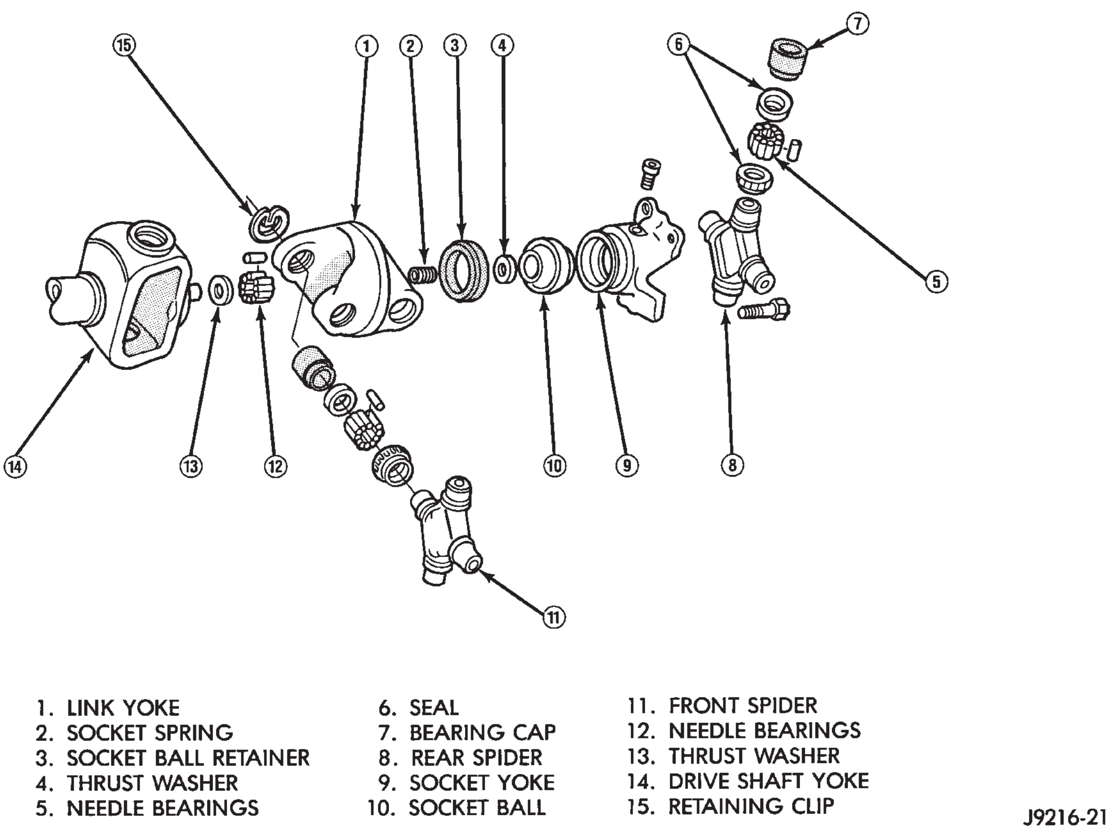

Fig. 3 Double Cardan (CV) U-Joint

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, Tires And Wheels for additional information.

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

Driveline vibration can also result from loose or damaged engine mounts. Refer to Group 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 (mud, undercoating, etc.).
- 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. Install the wheel lug nuts to retain the brake drums.

(3) Mark and number the prop shaft tube 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 change in vibration, the vibration may not be caused by prop shaft unbalance.

(8) If the vibration decreased, install a second clamp (Fig. 2). Repeat the vibration test.

(9) If the clamps cause an additional unbalanced

DRIVELINE VIBRATION

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

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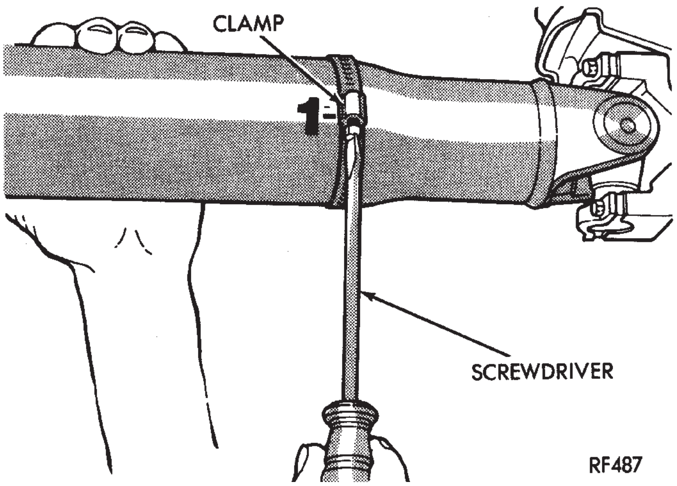

Fig. 1 Clamp Screw At Position 1

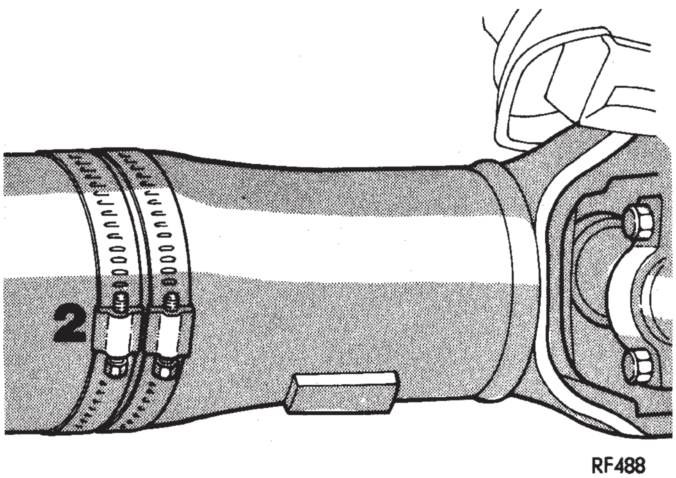

Fig. 2 Two Clamp Screws At The Same Position

condition. Separate the clamp screws (1/4 inch above and 1/4 inch below the mark). Repeat the vibration test (Fig. 3).

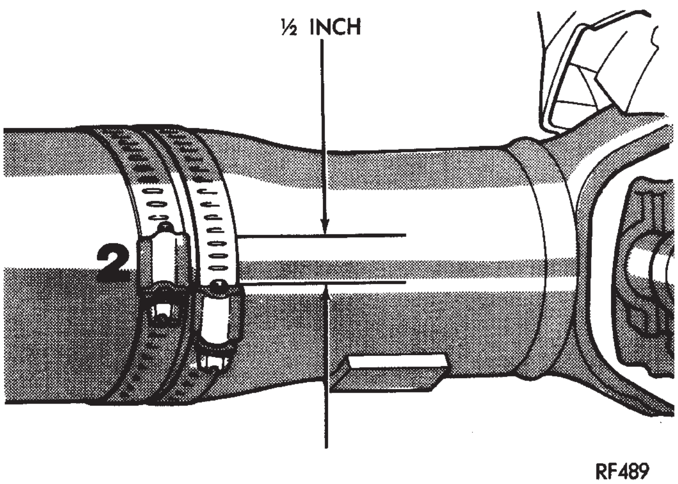

Fig. 3 Clamp Screws Separated

(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.

J9116-15

UNIVERSAL JOINT ANGLE MEASUREMENT

INFORMATION

When two shafts intersect at a common universal joint, the angle is called the operating angle. The larger the operating angle, the larger the amount of acceleration and deceleration of the joint. For every revolution there are two accelerations and decelerations of the universal 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 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 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°

J9316-4

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. Prop shaft 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 springs and verify all fasteners are torqued to specifications.

• Check the condition of the engine and transmission mounts. 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 snap rings from universal joint so Inclinometer 7663 (J-23498A) base sits flat on cap.

(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 will give you the PROPELLER SHAFT ANGLE (C).

(4) Subtract smaller figure from larger (C minus A) to obtain transmission OUTPUT OPERATING ANGLE.

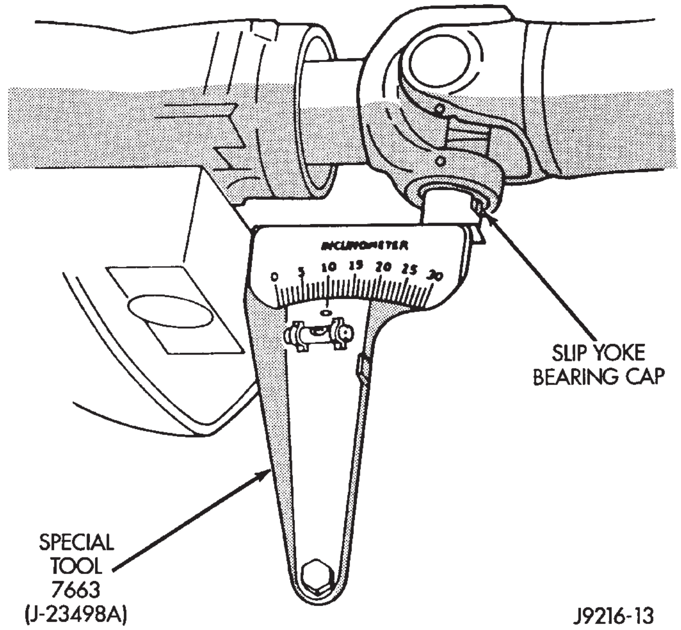

Fig. 5 Front (Output) Angle Measurement (A)

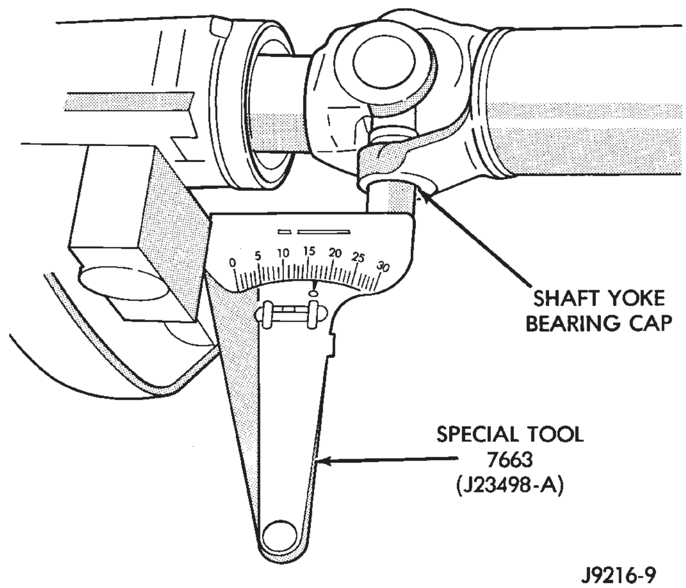

Fig. 6 Propeller Shaft Angle Measurement (C)

(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.

• 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

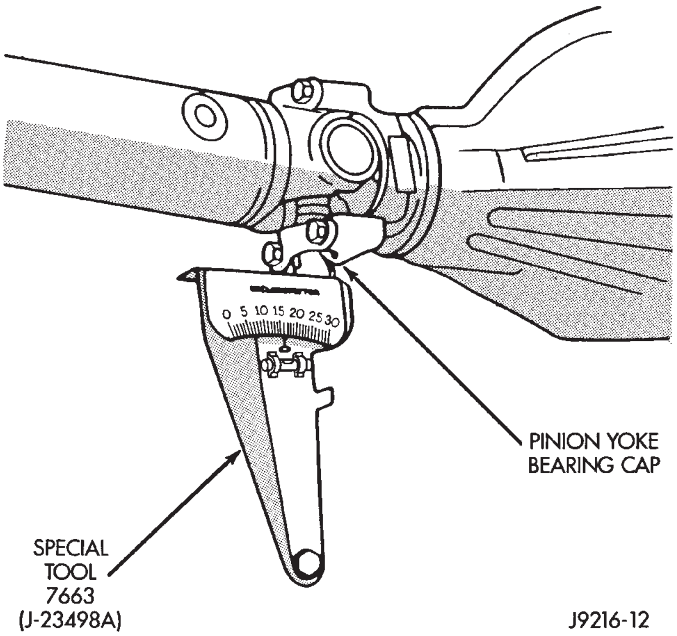

Fig. 7 Rear (Input) Angle Measurement (B)

ADJUSTMENT WITH CAMS

Adjust the angle by rotating cams on the upper suspension arms (Fig. 9). On 4WD vehicles, the front shaft input (pinion shaft) angle has priority over the caster angle.

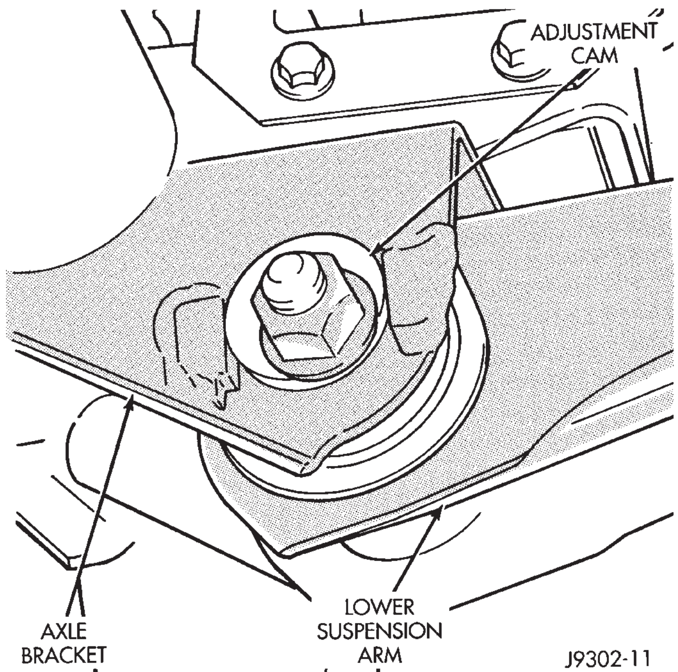

Fig. 9 Angle Adjustment With Cams

A cam service kit is available to adjust the rear propeller shaft angle. The cam kit is installed in the upper suspension arms at the axle.

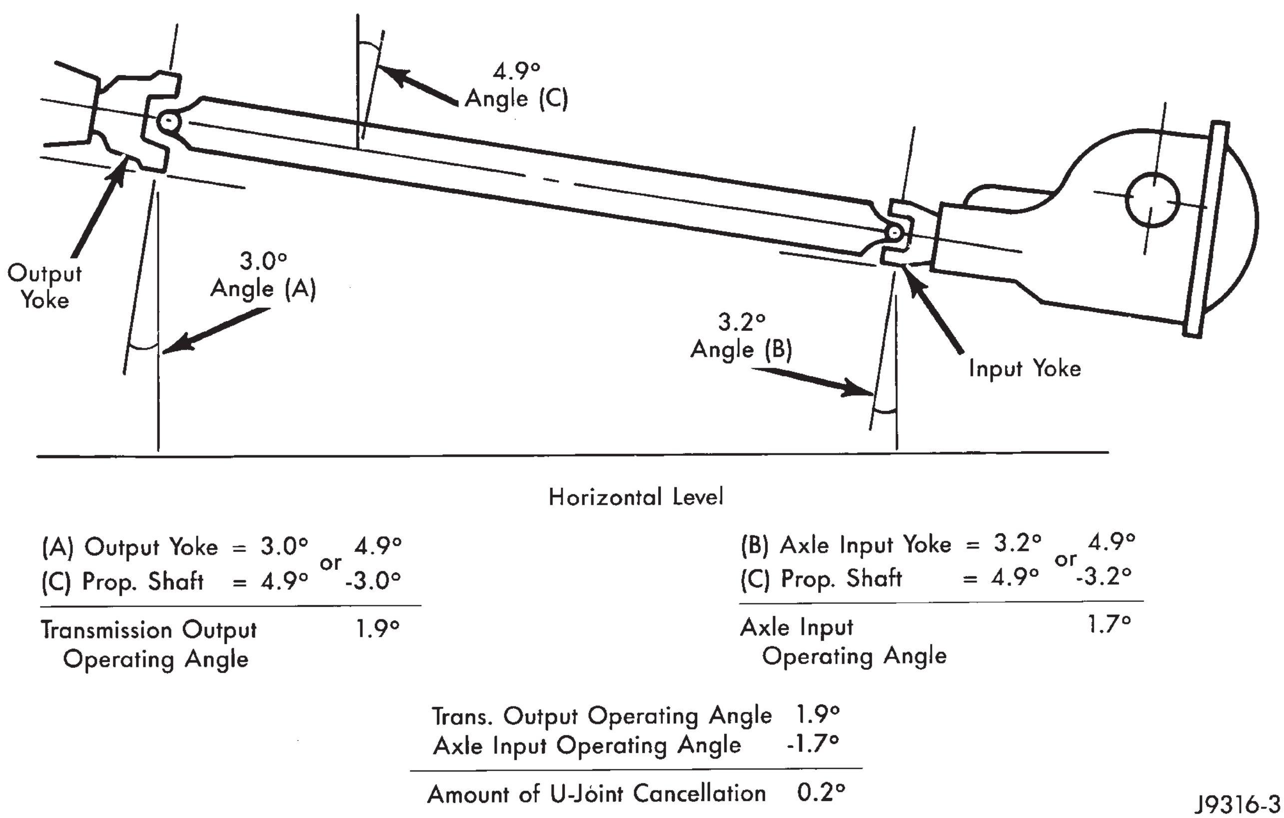

Fig. 8 Universal Joint Angle Example

PROPELLER SHAFT REPLACEMENT

PRECAUTIONS

Use exact replacement hardware for attaching the propeller shafts. This will ensure safe operation. The specified torque must always be applied when tightening the fasteners.

It is important to mark the propeller shaft yoke and axle or transmission yoke before removal (Fig. 1). This will assure correct phasing and eliminate possible vibration.

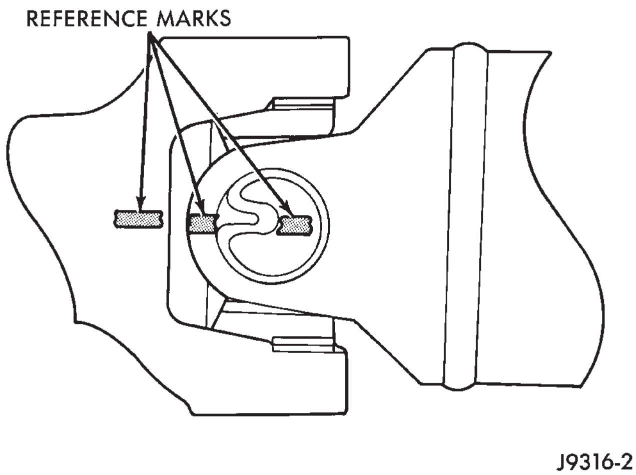

Fig. 1 Reference Marks on Yokes

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

REMOVAL

(1) Shift the transmission and transfer case (if applicable) to Neutral position. Raise the vehicle. Remove skid plates (if equipped) from frame, refer to Group 13, Frames.

(2) Scribe alignment marks on the yokes at the transfer case and axle pinion. 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) Remove bolts from transfer case yoke and remove the propeller shaft.

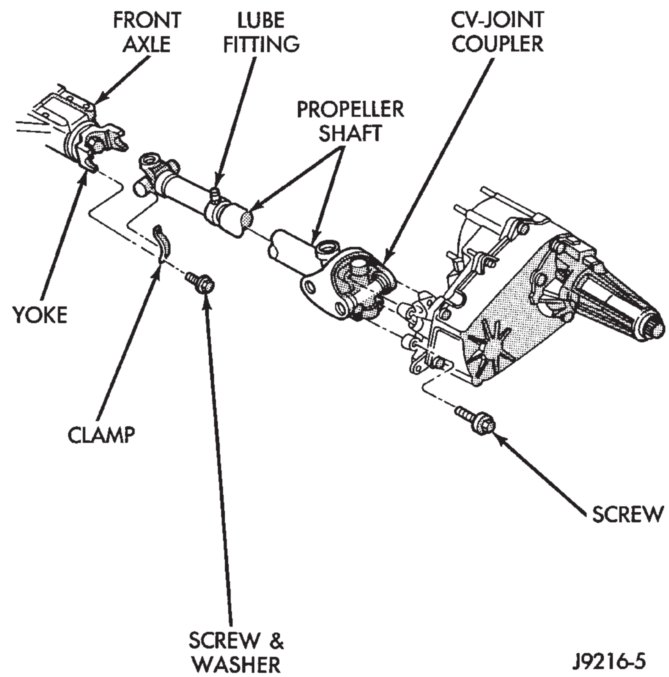

Fig. 2 Front Propeller Shaft

INSTALLATION

(1) Position the propeller shaft with the yoke reference marks aligned. Install the propeller shaft (Fig. 2).

Replacement U-joint straps and bolts must be installed.

(2) Tighten the U-joint strap bolts at the pinion shaft to 19 N●m (14 ft. lbs.) torque. Tighten the transfer case yoke bolts to 27 N●m (19.5 ft. lbs.) torque.

(3) Install skid plates (if equipped), refer to Group 13, Frames. Lower the vehicle.

REAR

REMOVAL

(1) Shift the transmission and transfer case (if applicable) to Neutral position. Raise the vehicle.

(2) Scribe alignment marks at the pinion yoke and at each end of the propeller shaft.

(3) Remove the U-joint strap bolts at the pinion shaft yoke.

(4) Slide the slip yoke off transmission/transfer case output shaft. 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 pinion yoke. Install the propeller shaft (Fig. 3).

Replacement U-joint straps and bolts must be installed.

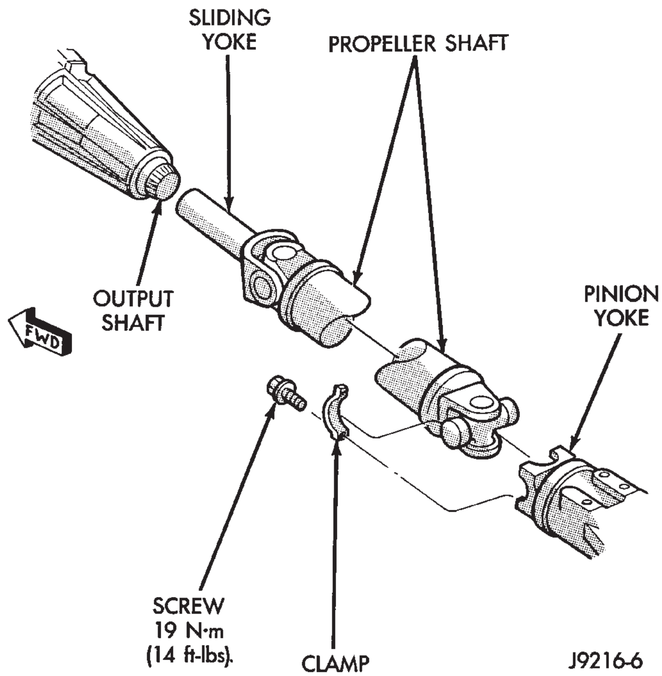

Fig. 3 Rear Propeller Shaft

(2) Tighten the U-joint strap bolts to 19 N●m (14 ft. lbs.) torque.

(3) 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.

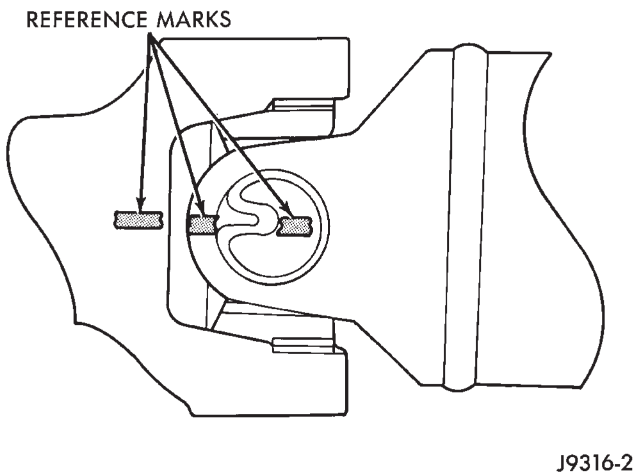

Fig. 1 Reference Marks on Yokes

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).

(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).

(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.

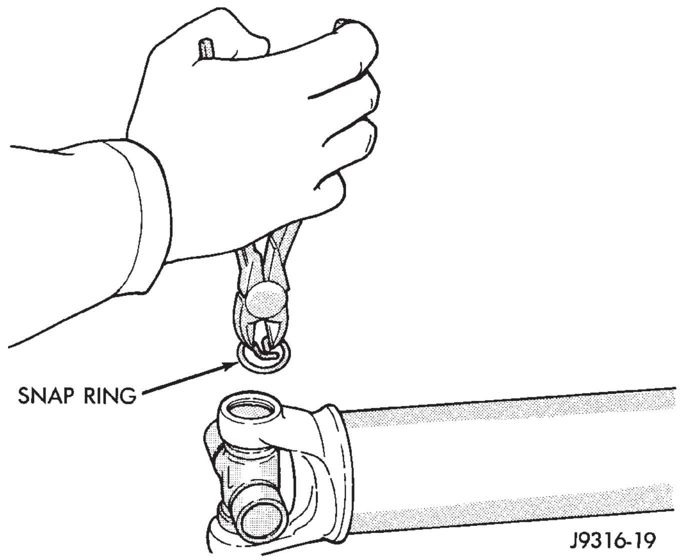

Fig. 2 Remove Snap Ring

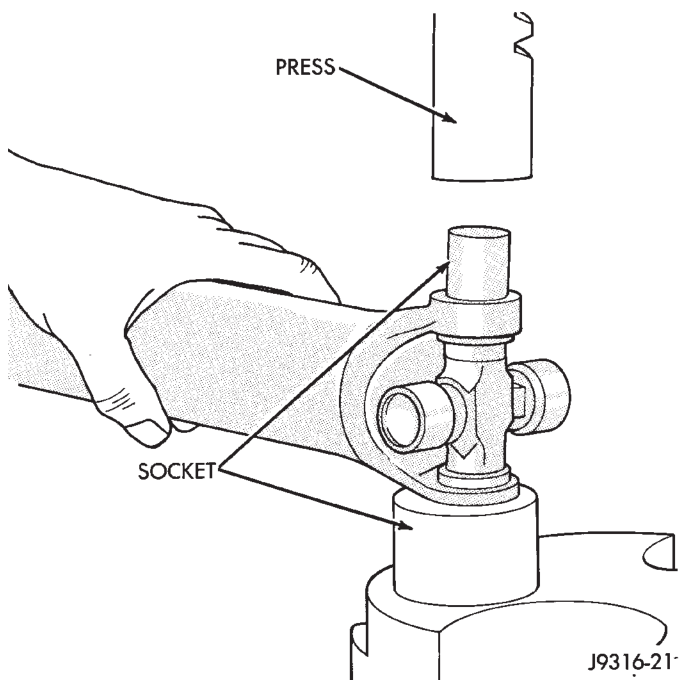

Fig. 3 Press Out Bearing

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.

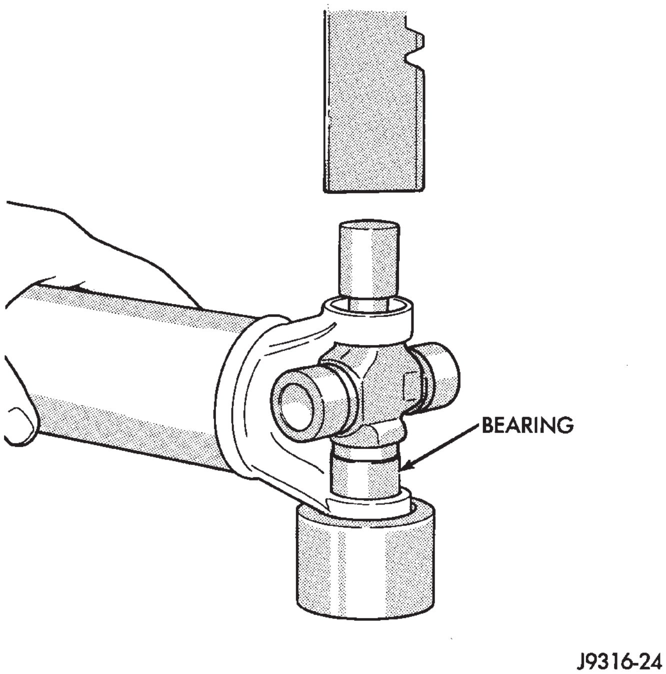

Fig. 4 Press Out Remaining Bearing

(2) Position the cross in the yoke with its lube fitting (if equipped) pointing up (Fig. 5).

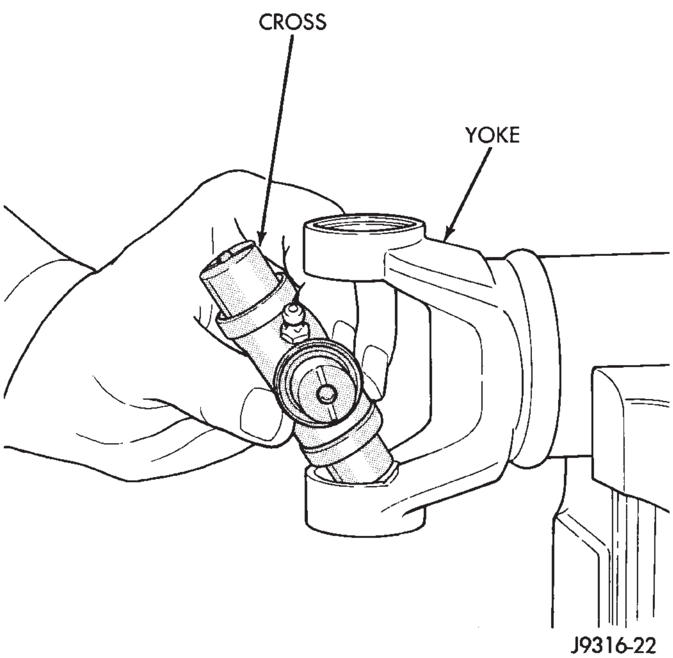

Fig. 5 Install Cross In Yoke

(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.

(4) Press the bearing assembly into the cross hole enough to install a snap ring. Install a snap ring.

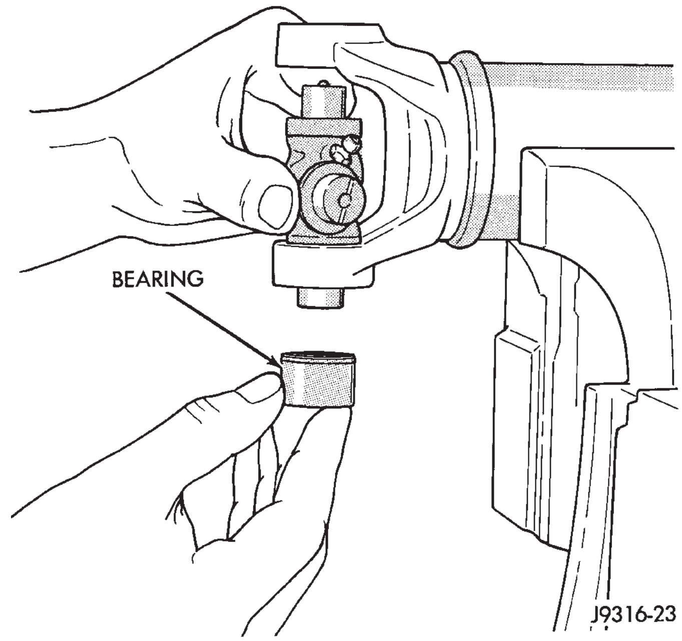

Fig. 6 Install Bearing On Trunnion

(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.

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).

(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.

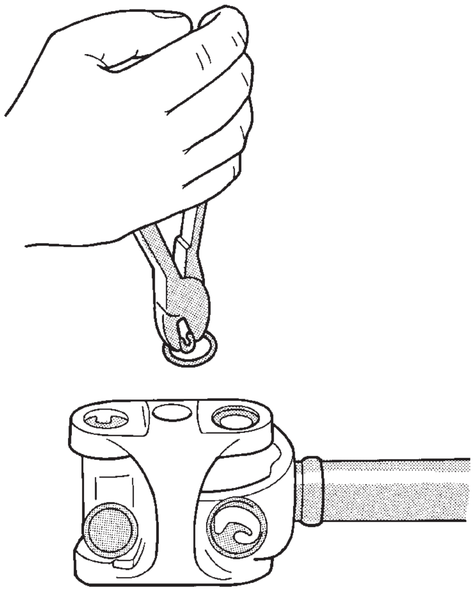

Fig. 7 Remove Snap Rings

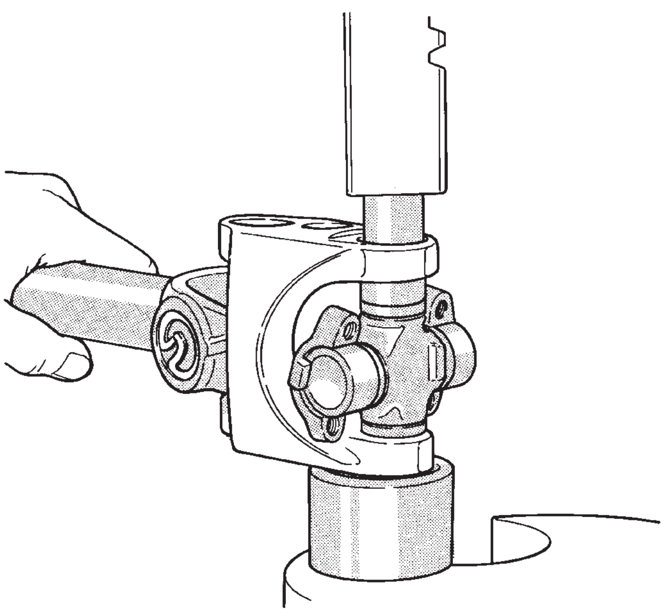

Fig. 8 Press Out Bearing

(5) Grasp the protruding bearing by vise jaws. Tap the tube yoke with a mallet and drift to dislodge from the yoke (Fig. 9).

(6) Flip assembly and repeat steps 4 and 5 for removing the opposite side bearing. This will allow removal of the cross centering kit assembly and spring (Fig. 10).

(7) Press the remaining bearing assemblies out the other cross as described above to complete the disassembly.

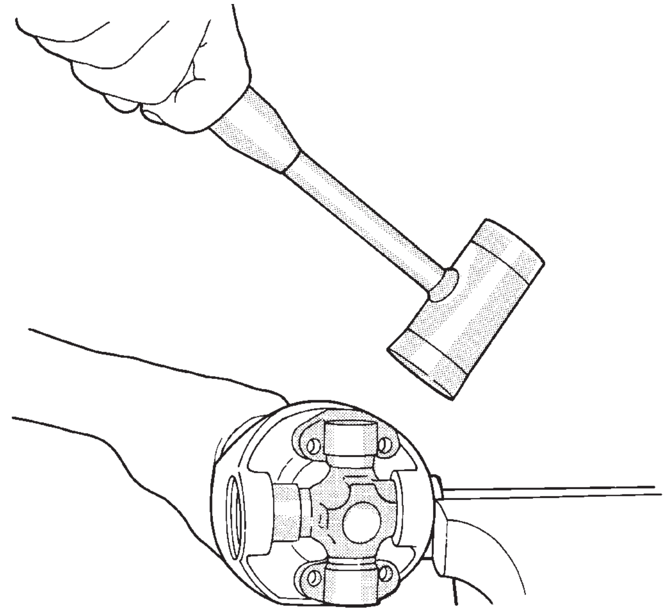

Fig. 9 Remove Bearing From Yoke

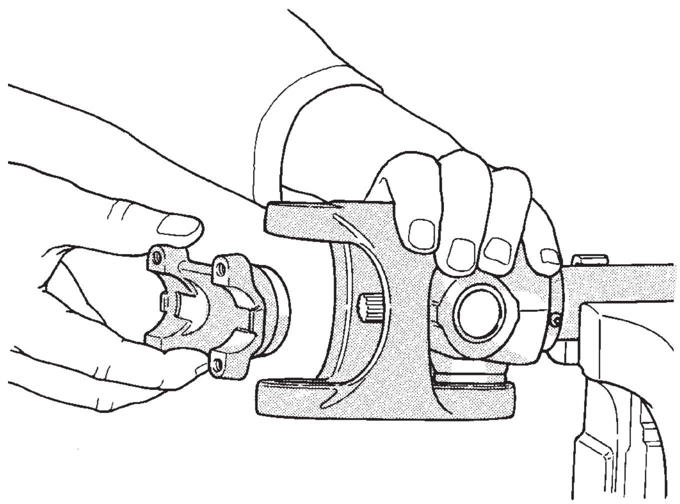

Fig. 10 Remove Centering Kit

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).

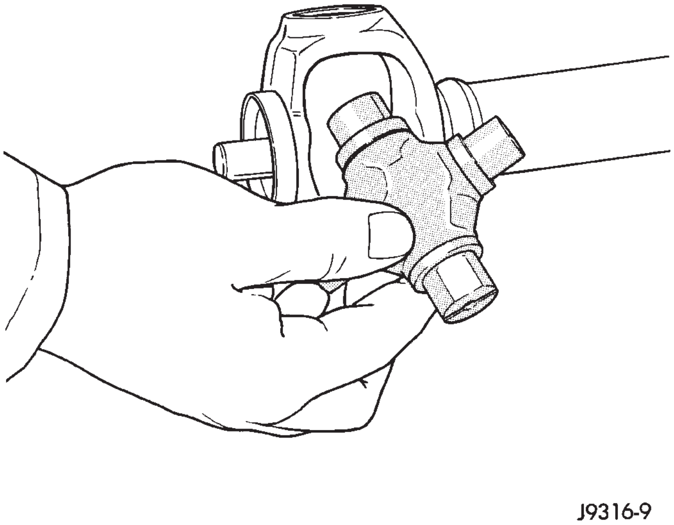

Fig. 11 Install Cross In Yoke

(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.

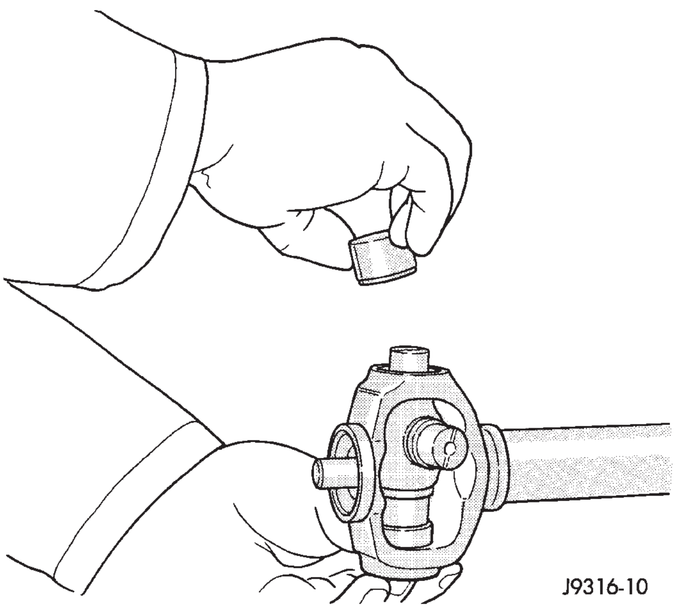

Fig. 12 Install Bearing Assembly

(3) Press the bearing assembly in place and install a snap ring (Fig. 13).

(4) Flip the tube yoke and bearing assembly installation on the opposite trunnion. Install a snap ring (Fig. 14).

(5) Fit the center yoke on the remaining two trunnions and press bearing assemblies in place, both sides (Fig. 15). Install a snap ring.

(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

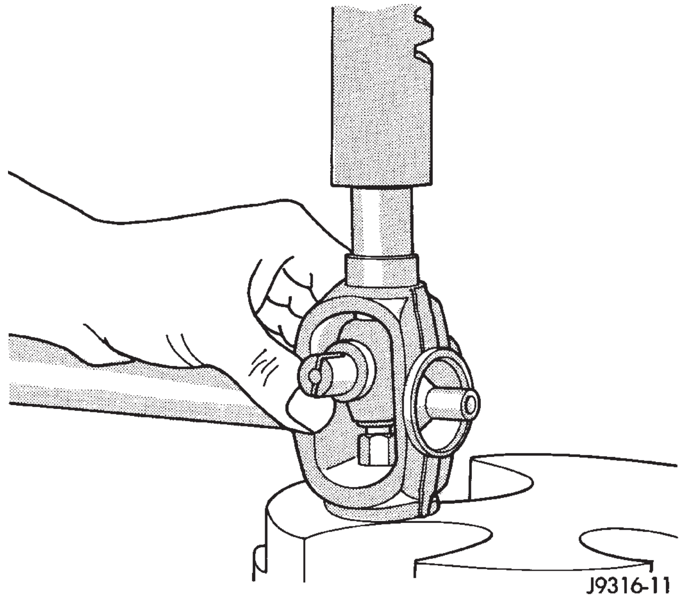

Fig. 13 Press In Bearing Assembly

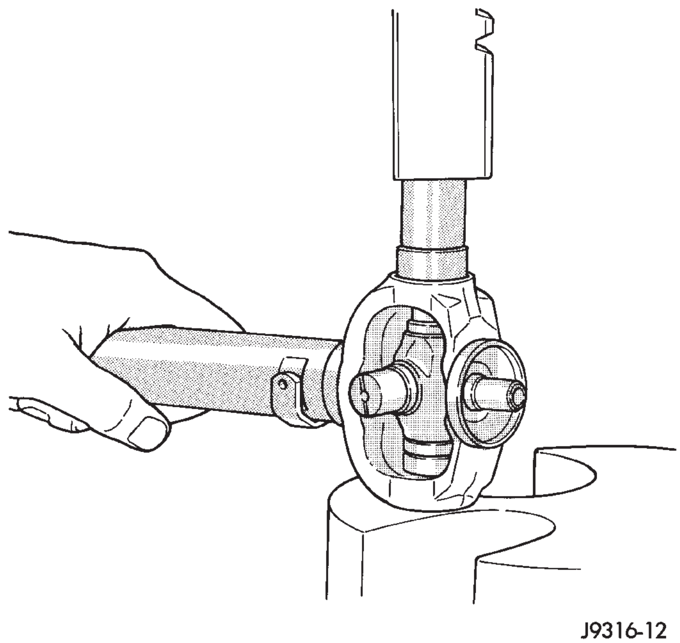

Fig. 14 Press In Bearing Assembly

the lube fitting on the installed cross.

(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.

(8) Press the remaining two bearing assemblies into place and install snap rings (Fig. 18).

(9) Tap the snap rings to allow them to seat into the grooves (Fig. 19).

(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.

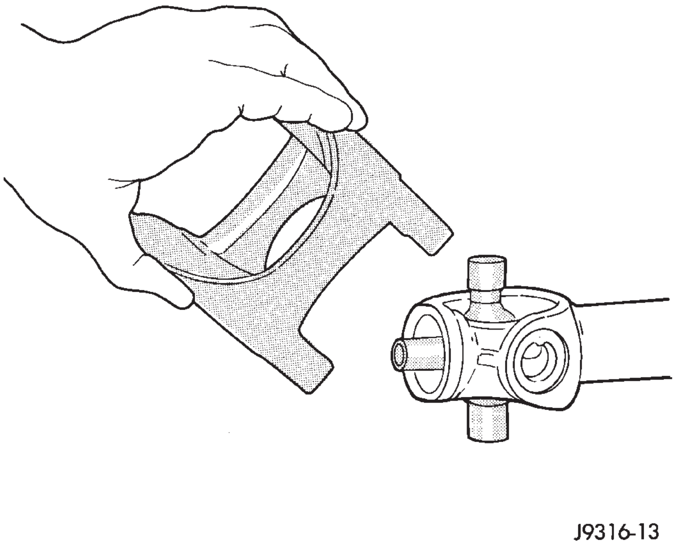

Fig. 15 Install Center Yoke

(12) Install the propeller shaft. Refer to Propeller Shaft Replacement in this Group.

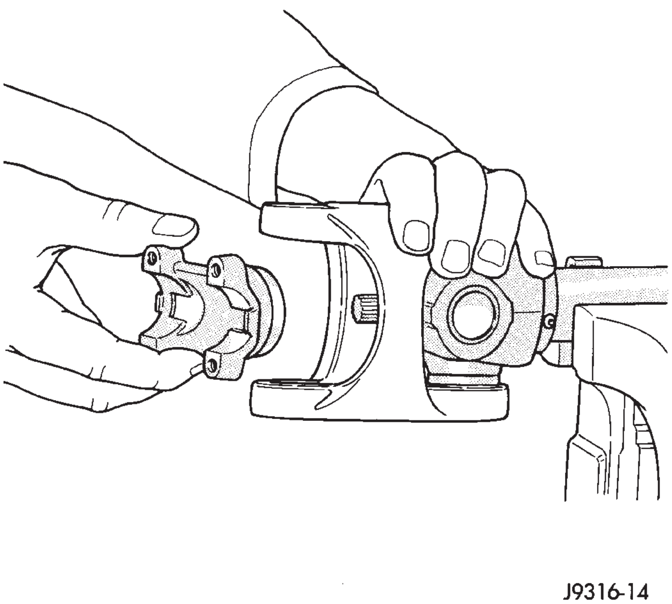

Fig. 16 Install Centering Kit

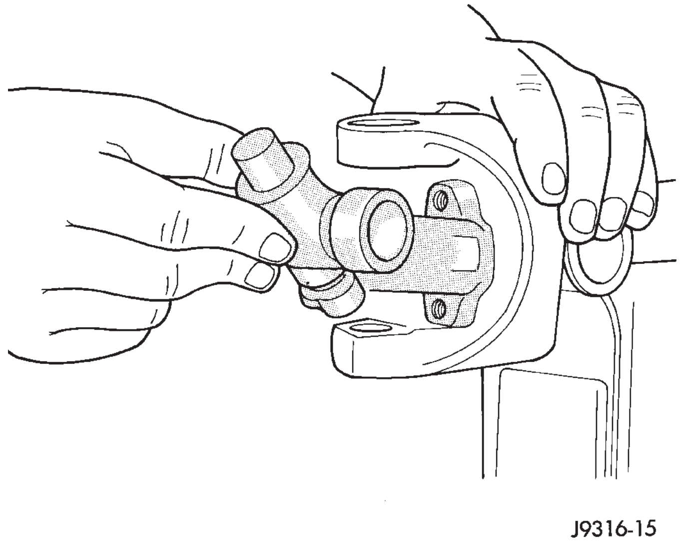

Fig. 17 Install Remaining Cross

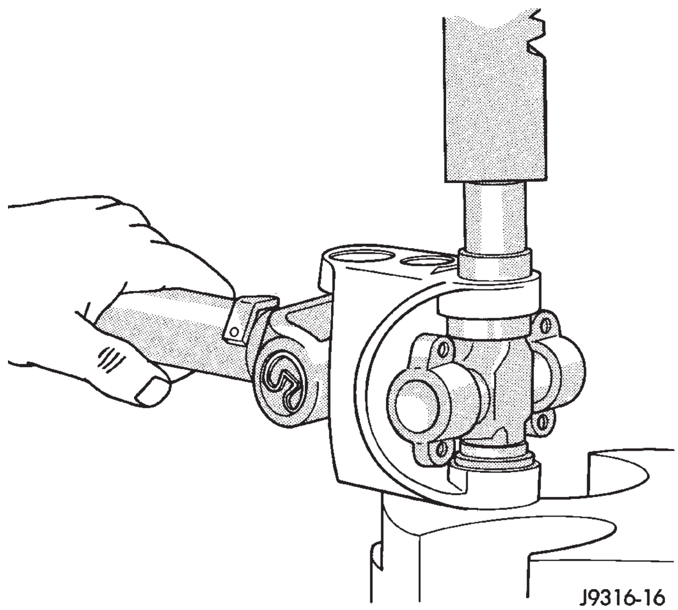

Fig. 18 Press In Bearing Assembly

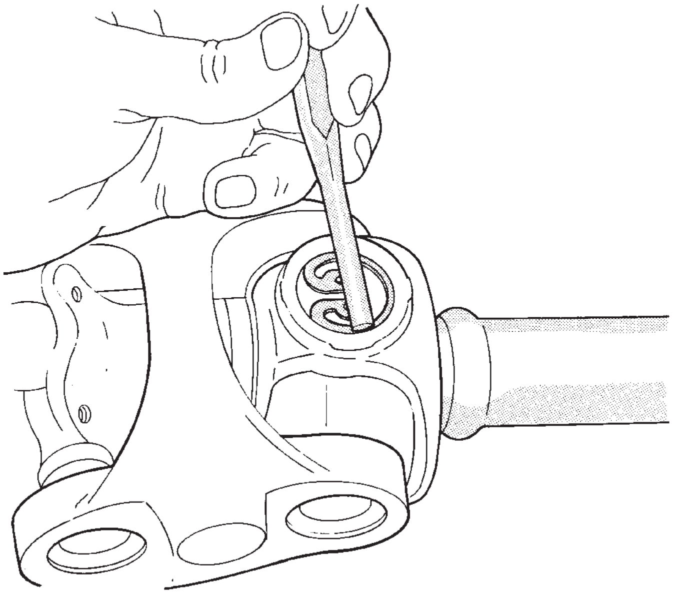

Fig. 19 Seat Snap Rings In Groove

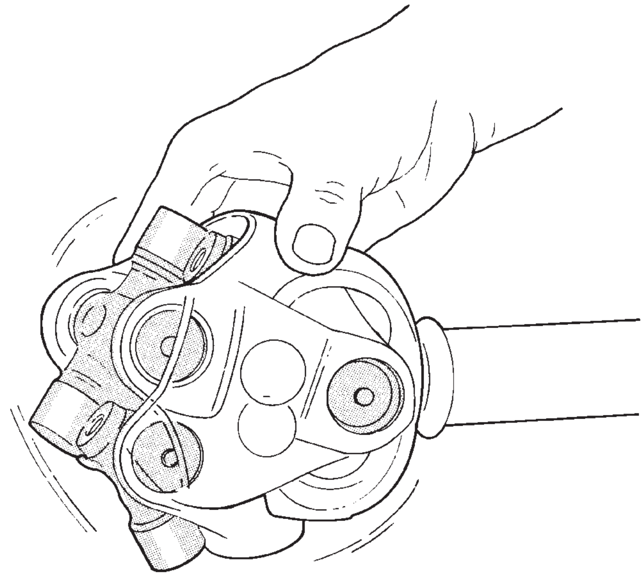

Fig. 20 Check Assembly

TORQUE SPECIFICATIONS

PROPELLER SHAFTS AND U-JOINTS

DESCRIPTION	TORQUE
Double Cardan to Transfer Case Yoke Bolts	27 N·m (19.5 ft. lbs.)
Prop Shaft to Axle Yoke Screws	19 N·m (14 ft. lbs.)

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STEERING

CONTENTS

GENERAL INFORMATION

STEERING SYSTEM COMPONENTS

Power steering systems use the following (Fig. 1);

- Recirculating-ball steering gear
- Steering linkage
- Belt driven hydraulic steering pump with fluid reservoir
- Pump pressure and return hoses and fittings
- Steering column with shifter interlock
- Intermediate shaft between column and gear

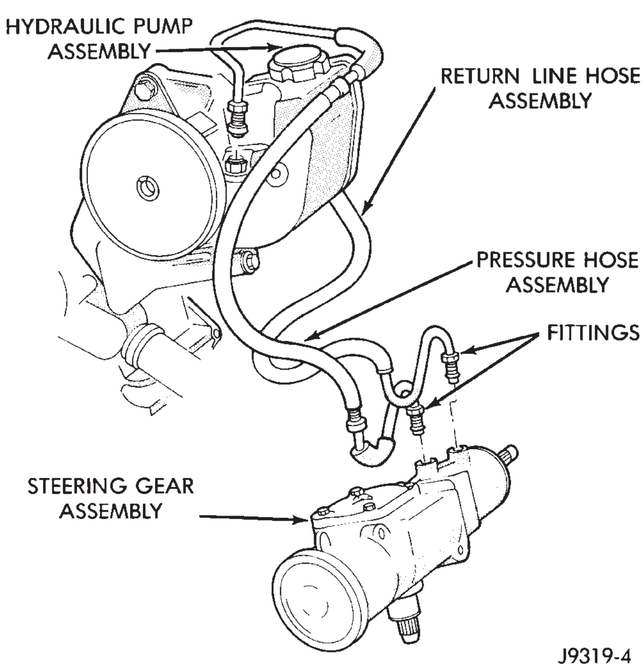

Fig. 1 Power Steering Systems

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. All oil passages are internal within the gear housing except for the pressure and return hoses between the gear and the 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 AL designates 12.7:1 ratio without Trailer Tow
- Code MN designates 12.7:1 ratio with Trailer Tow

Trailer Tow gears have higher temperature resistant seals. Otherwise gears are interchangeable.

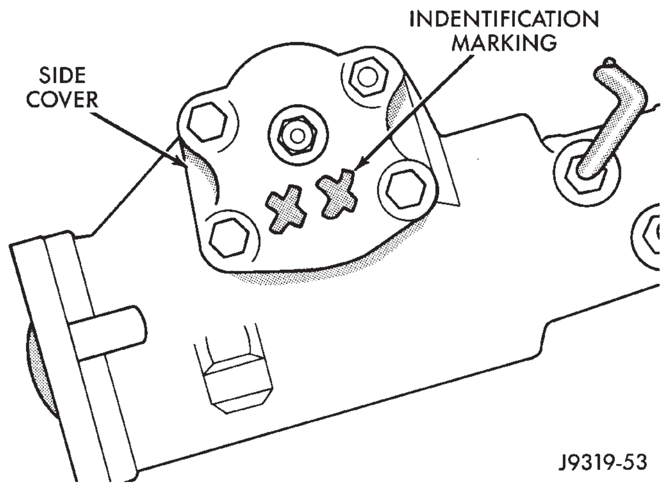

Fig. 2 Ratio Code Location

CAUTION: Vehicles equipped with H.D. Trailer Tow Package use high temperature seals in the power steering gear. The gears are identified with a YELLOW paint mark. The mark is on the pitman shaft side of the housing below the side cover. Use ONLY the correct seal kit when servicing the steering gear with this identification.

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.

STEERING LINKAGE

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. Refer to Group 2, Front Suspension and Axles for wheel alignment information.

POWER STEERING PUMP

Hydraulic pressure is provided for operation of the power steering gear by a belt driven power steering 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 discharge fitting. The pressure relief valve inside the flow control valve limits the pump pressure.

Power steering pumps have different pressure and flow rates. They are not interchangeable with pumps installed in other vehicles.

The power steering pump is connected to the steering gear via high pressure and return hoses. The pump shaft has a pressed-on drive pulley that is belt driven by the crankshaft pulley (Fig. 3).

CAUTION: Vehicles equipped with H.D. Trailer Tow Package use high temperature seals in the power steering pump. The pumps are identified with a YELLOW label attached to the back of the reservoir. Use ONLY the correct seal kit when servicing the steering pump with this identification.

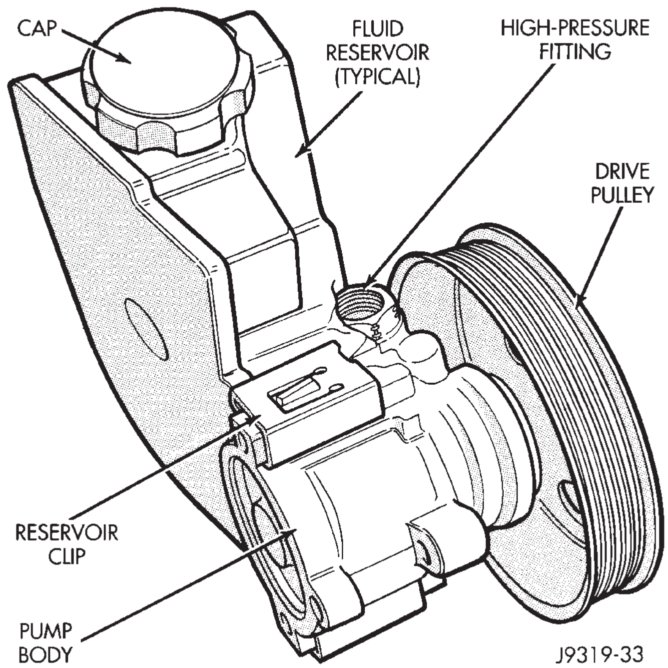

Fig. 3 TC-Series Pump

STEERING COLUMNS

Two general types of steering columns are installed on Grand Cherokee vehicles: a fixed, non-tilt column and a tilt column. The multi-position, tilt column is optionally available.

The column to gear intermediate shaft is equipped with universal joints. Rubber isolators are built into the shaft to absorb noise and vibration from the steering system.

Both types of steering columns have anti-theft provisions. They are energy-absorbing (collapse from impact in the event of a front end collision).

POWER STEERING SYSTEM DIAGNOSIS

HISS NOISE COMPLAINT

There is some noise in all power steering systems. One of the most common is a hissing sound most evident at stand still parking. Hiss is a high frequency noise similar to that experienced while slowly closing a water tap. The noise is present in every steering gear valve and results from high velocity fluid passing valve orifice edges. There is no relationship between this noise and performance of the steering. HISS MAY BE EXPECTED WHEN SLOWLY TURNING AT STANDSTILL. The noise transmission of this into the passenger compartment is controlled by the use of the universal joint coupling. There is a rubber isolator in the steering coupling (intermediate) shaft to muffle hiss. If hiss is extremely objectional, replace the shaft. If hiss is persistent, service the steering gear.

POWER STEERING 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.

(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.**

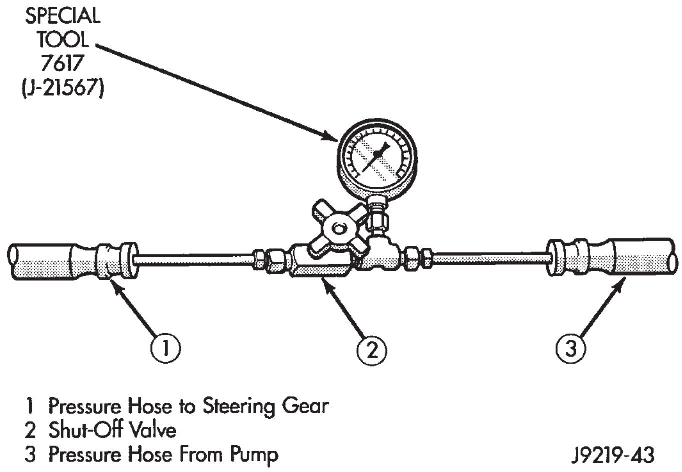

Fig. 1 Pressure Test Gauge

• 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 or 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.

The steering pump relief pressure is 1400 p.s.i. ± 50.

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.

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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.

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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.

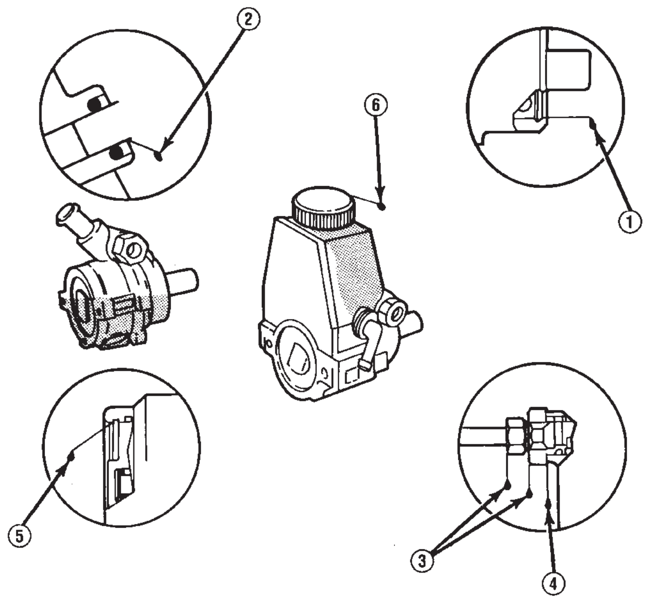
J9319-14

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

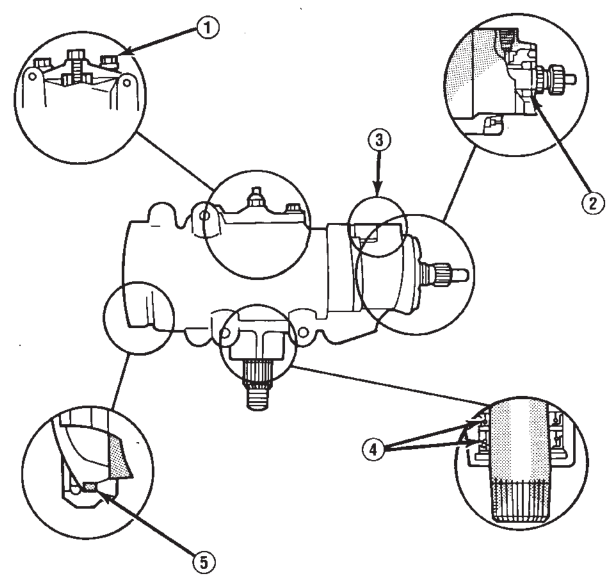
PUMP LEAKAGE DIAGNOSIS



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

CAUTION: Vehicles equipped with H.D. Trailer Tow Package use high temperature seals in the power steering pump. The pumps are identified with a YELLOW label attached to the back of the reservoir. Use ONLY the correct seal kit when servicing the steering pump with this identification.

The power steering pump internal components are not be 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.

REMOVAL

(1) Place a drain pan under the pump and gear.
(2) Disconnect the pressure and return hose from the steering gear.
(3) Disconnect the pressure and return hose from the pump (Fig. 1). Drain the fluid from pump and reservoir (Fig. 1).

INSTALLATION

(1) Wipe hose ends, pump and gear unions clean.
(2) Install the pressure hose on the pump and gear. Rotate the pressure hose CLOCKWISE so the rubber insulators on the tube contacts the reservoir and gear side cover. Tighten the fittings at the pump and gear to 28 N●m (21 ft. lbs.) torque.
(3) Install the return hose on the pump and gear. Rotate the return hose CLOCKWISE so the tube contacts the pressure hose insulator. Tighten the fitting at the gear to 28 N●m (21 ft. lbs.) torque.

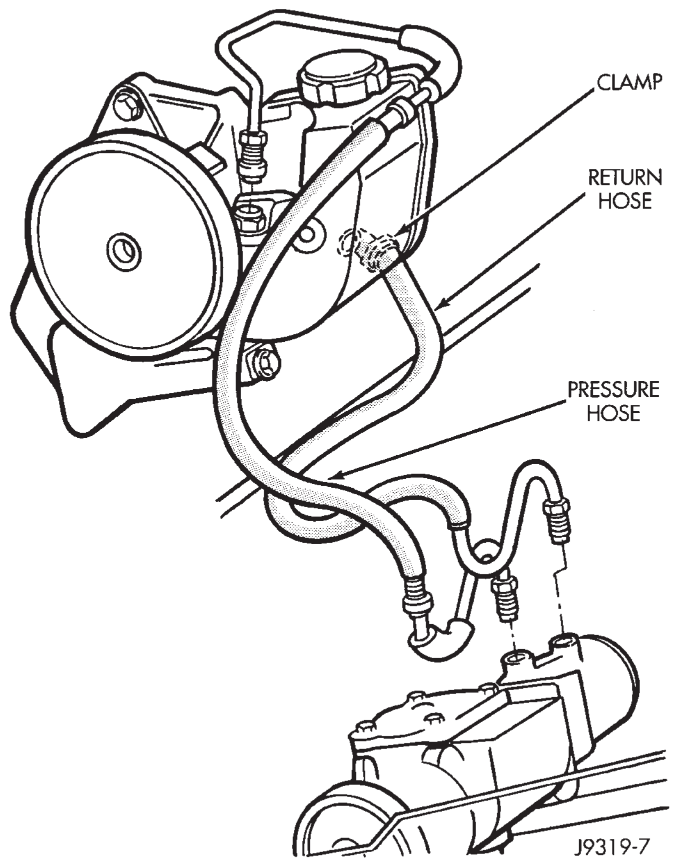


Fig. 1 Power Steering Lines

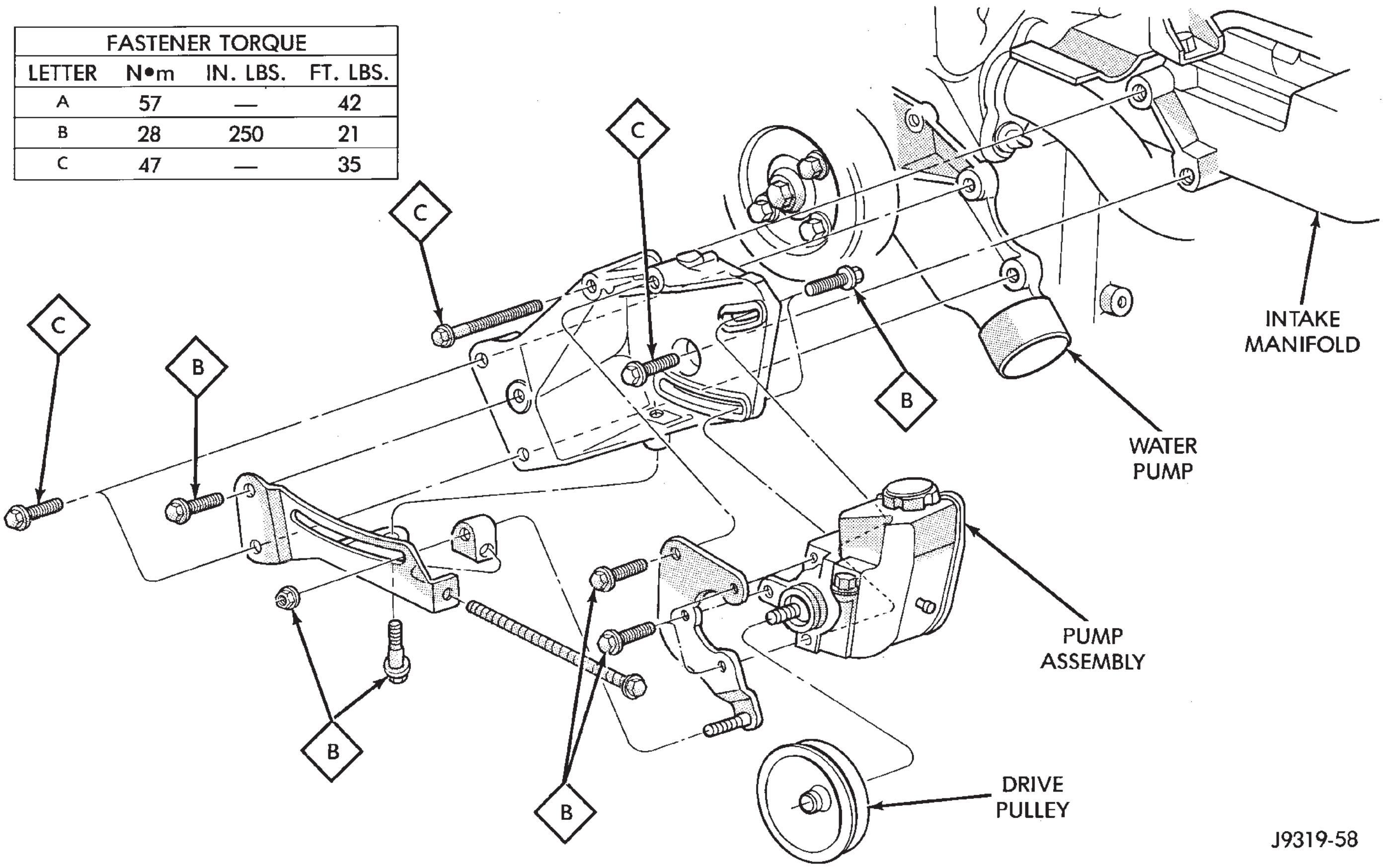
(4) Install a clamp on the return hose at the pump reservoir fitting.
(5) Add power steering fluid. Refer to Power Steering Pump Initial Operation in this section.

PUMP REPLACEMENT— 4.0L

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.



FASTENER TORQUE			
LETTER	N•m	IN. LBS.	FT. LBS.
A	57	—	42
B	28	250	21
C	47	—	35

Fig. 2 Pump Mounting (4.0L I-6)

(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. 2).

(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. 4).

(11) Remove 3 adjustment bracket-to-pump bolts.

INSTALLATION

(1) Install 3 adjustment 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. 5).

(3) Install lower adjuster collar on adjuster bracket stud (Fig. 2).

(4) Tilt pump rearward 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.

PUMP REPLACEMENT— 5.2L V/8

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 the serpentine drive belt. Refer to Group 7, Cooling for additional information.

(2) Place a drain pan under the pump.

(3) Remove the pressure and return hoses from pump. Refer to Pressure and Return Hose Replacement in this section.

(4) Remove the bolts that attach the pump to the bracket on the engine block (Fig. 3).

(5) If necessary, remove the bracket to engine block bolts (Fig. 3).

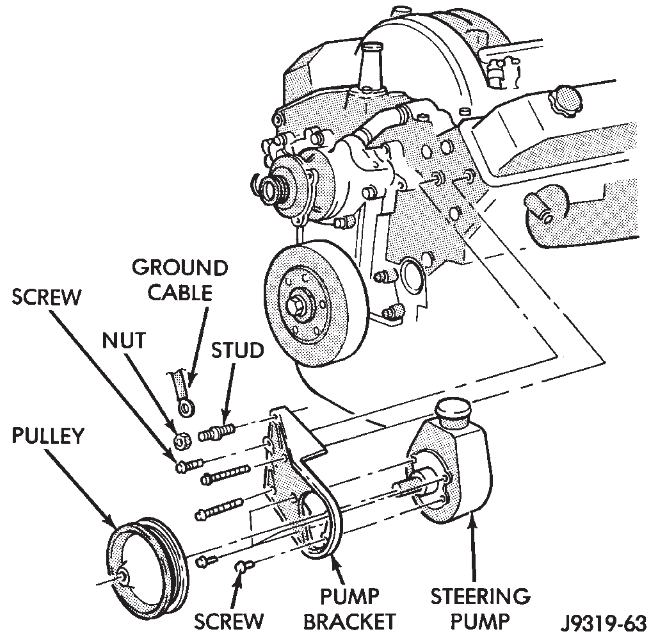


Fig. 3 Pump Mounting (5.2L V/8)

INSTALLATION

(1) Install the bracket to the engine block. Tighten the bolts to 41 N●m (30 ft. lbs.) torque.

(2) Mount the pump on the bracket.

(3) Install the bolts through the pump and into the bracket. Tighten the bolts to 27 N●m (20 ft. lbs.) torque.

(4) Install the serpentine drive belt. Refer to Group 7, Cooling for additional information.

(5) Install the pressure and return hoses to pump. Refer to Pressure and Return Hose Replacement in this section.

(6) 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. 4).

Do not hammer on any part of drive pulley, damage will occur to the pump and pulley.

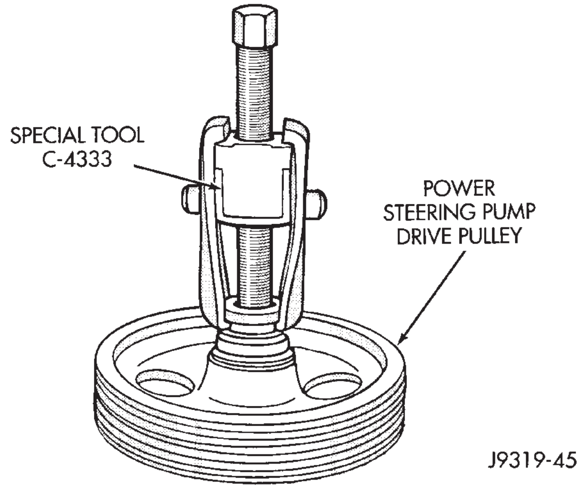


Fig. 4 Remove Drive Pulley (Typical)

INSTALLATION

(1) Install pulley with Installer C-4063 (J-25033-B) (Fig. 5). Do not use the tool adapters.

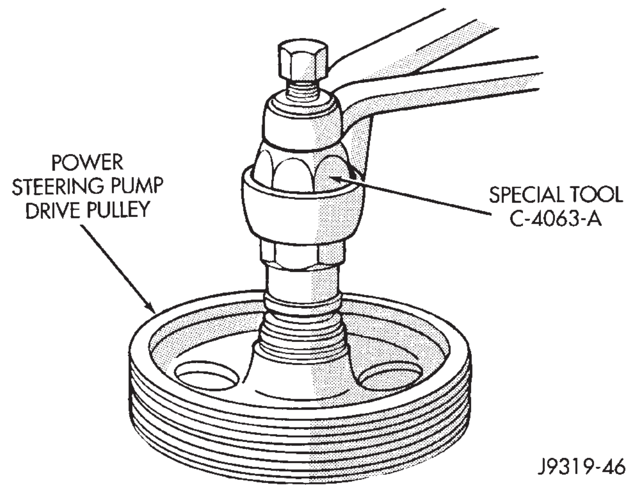


Fig. 5 Install Drive Pulley (Typical)

(2) Be sure tool and pulley remain aligned and NOT cocked with the pump shaft.

(3) Press the pulley flush with the end of the pump shaft (Fig. 6).

(4) Install power steering pump. Refer to Pump Replacement in this section.

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. 7).

(5) Remove fluid reservoir from pump body. Remove and discard O-ring seal (Fig. 8).

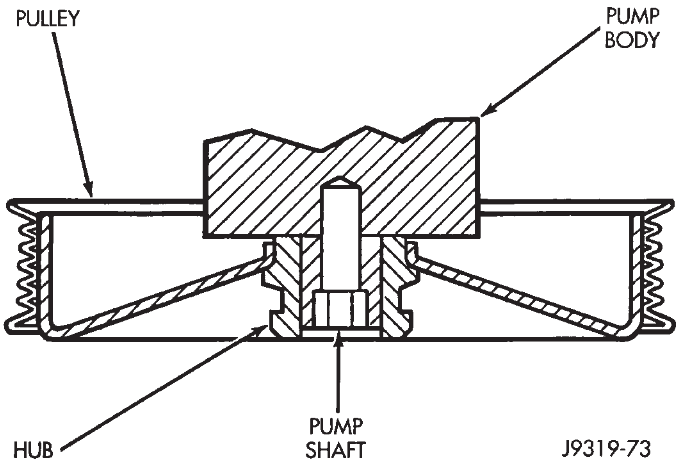


Fig. 6 Pump Shaft Location

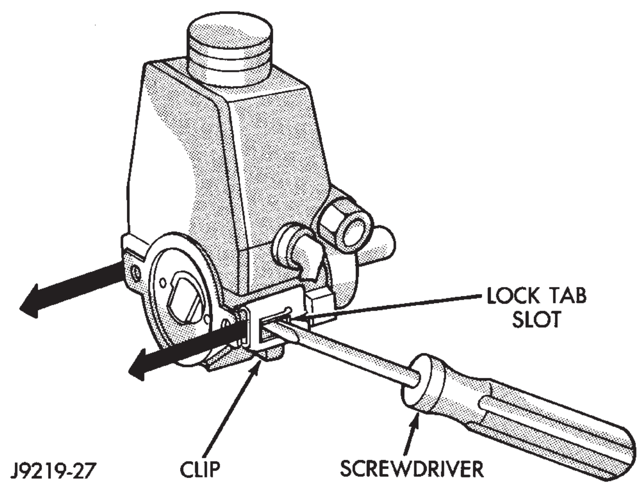


Fig. 7 Remove Reservoir Clips (Typical)

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. 9). **Prevent flow control valve and spring from sliding out of housing bore.**

(3) Remove and discard O-ring seal.

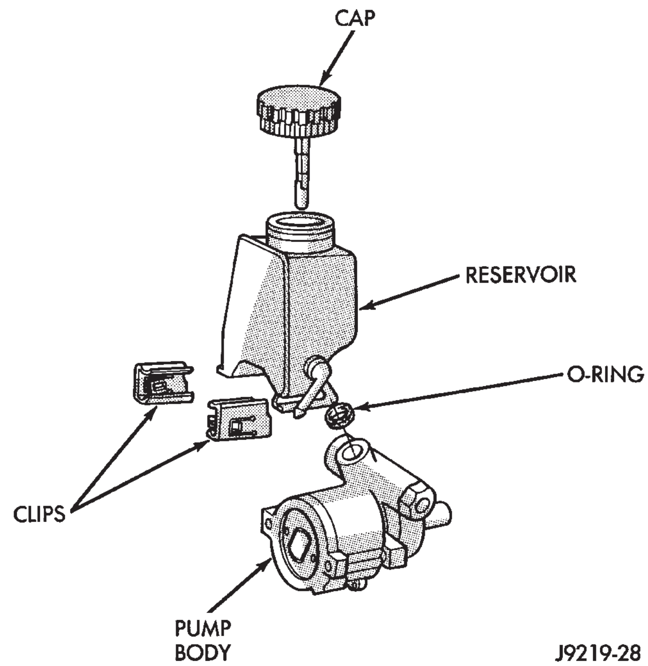


Fig. 8 Remove Reservoir (Typical)

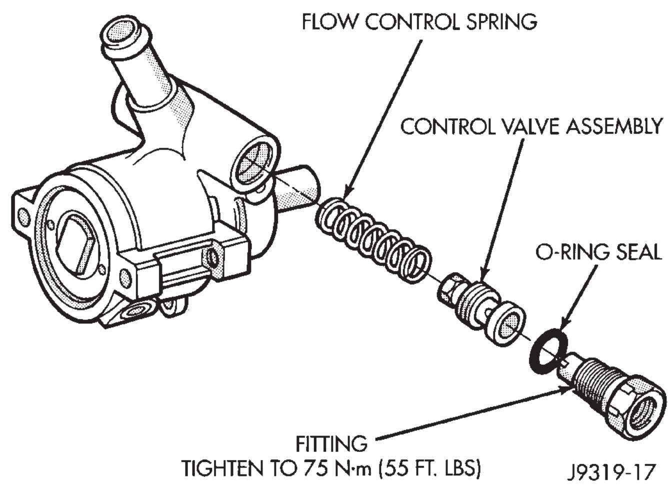


Fig. 9 Flow Control Valve Fitting

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 the pump.**

(2) Install O-ring seal onto fitting (Fig. 9).

(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

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).

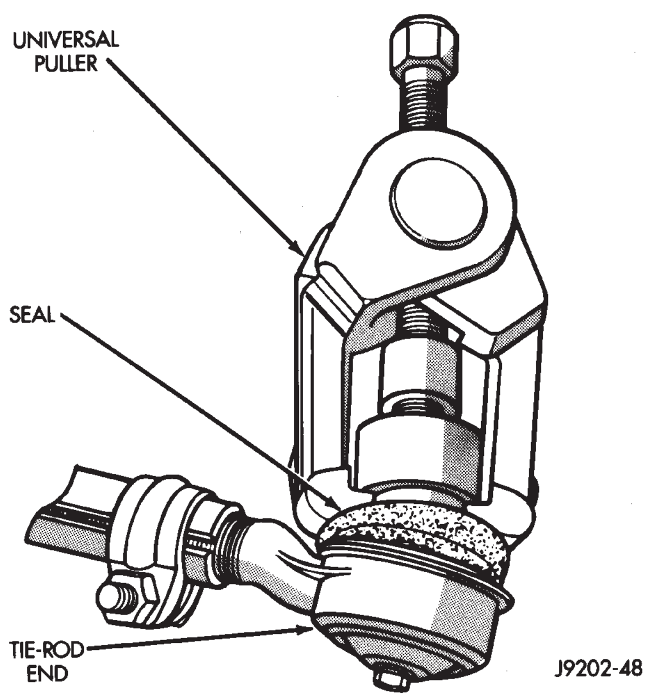


Fig. 1 Ball Stud Removal

TIE ROD

REMOVAL

(1) Remove the cotter pins and nuts at the steering knuckle 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). 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 74 N●m (55 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

(1) Remove the cotter pins and nuts at the steering knuckle and drag link (Fig. 2).

(2) Remove the steering dampener ball stud from the drag link with a puller tool.

(3) Remove the drag link from the steering knuckle with a puller tool. Remove the same for tie rod and pitman arm.

(4) 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 drag link to the steering knuckle nut. Do the same for the tie rod and pitman arm.

(3) Tighten the nut at the steering knuckle to 74 N●m (55 ft. lbs.) torque. Tighten the pitman and tie rod ball stud nuts to 74 N●m (55 ft. lbs.) torque. Install new cotter pins.

(4) Install the steering dampener onto the drag link. Tighten the nut to 74 N●m (55 ft. lbs.) torque. Install a new cotter pin.

FASTENER TORQUE			
LETTER	N•m	IN. LBS.	FT. LBS.
A	251	—	185
B			
C	74	—	55
D			
E	49	—	36
F	27	—	20

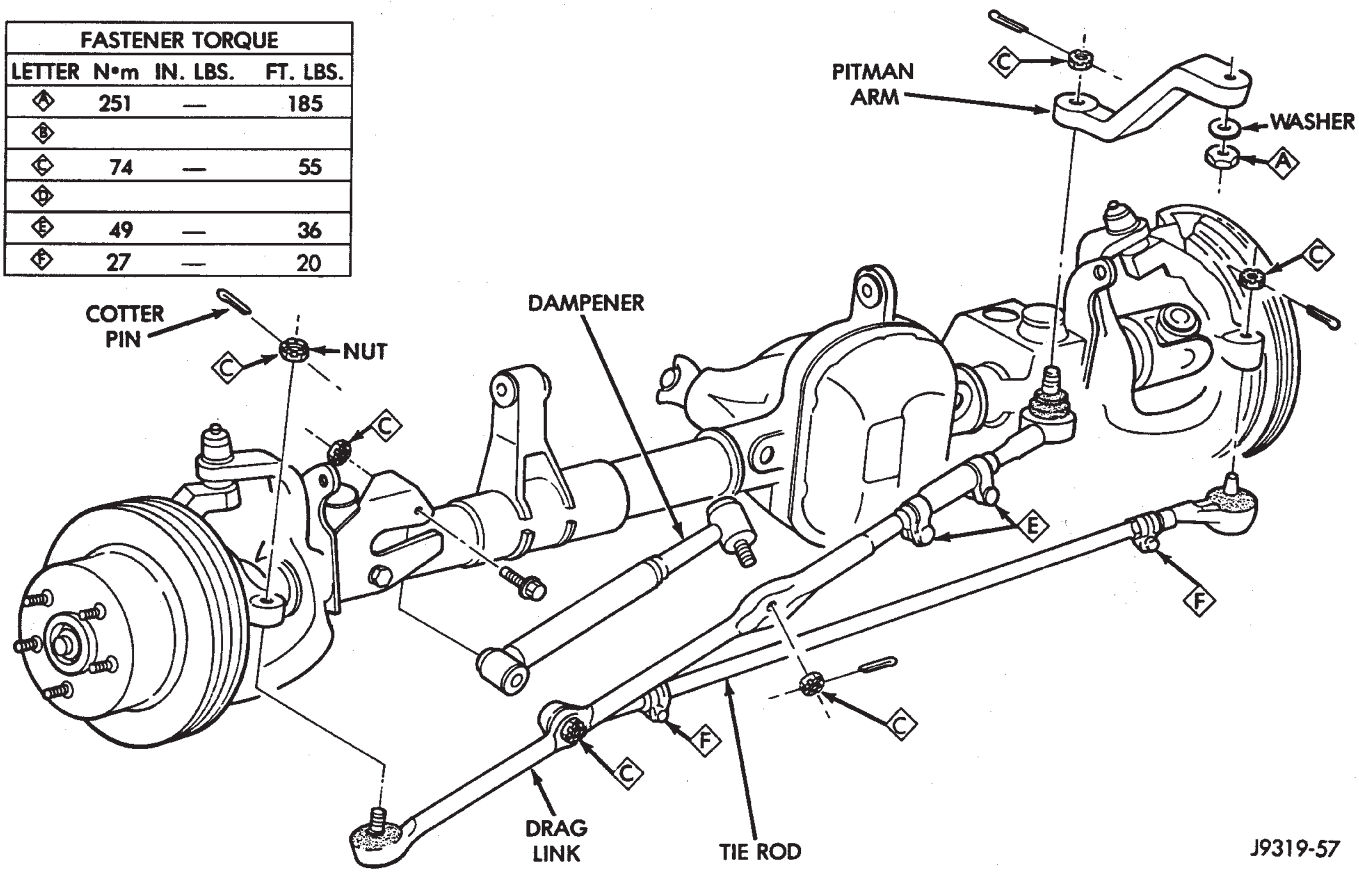


Fig. 2 Steering Linkage

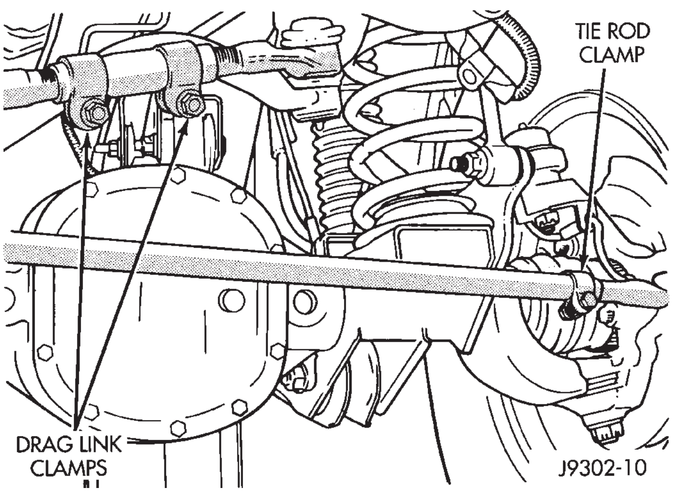


Fig. 3 Tie Rod/Drag Link Clamp Bolt

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 74 N●m (55 ft. lbs.) torque.

(3) Install the ball stud nut at the drag link. 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).

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.

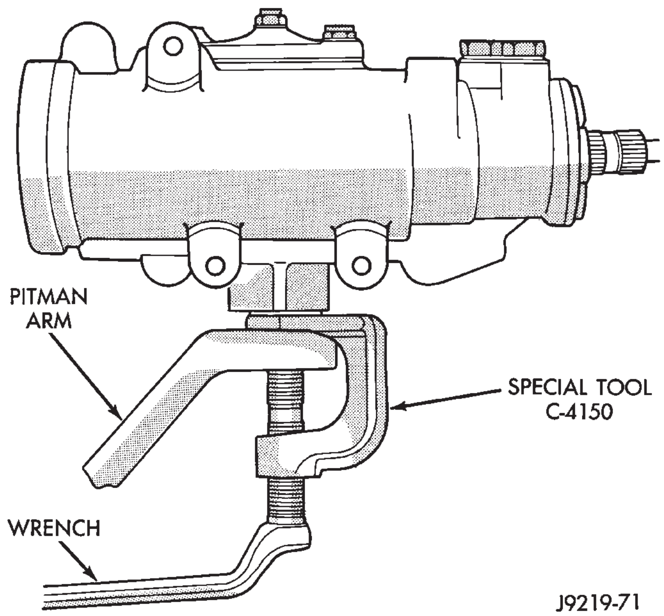


Fig. 4 Pitman Arm Removal

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

CAUTION: Vehicles equipped with H.D. Trailer Tow Package use high temperature seals in the power steering gear. The gears are identified with a YELLOW paint mark. The mark is on the pitman shaft side of the housing below the side cover. Use ONLY the correct seal kit when servicing the steering gear with this identification.

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.

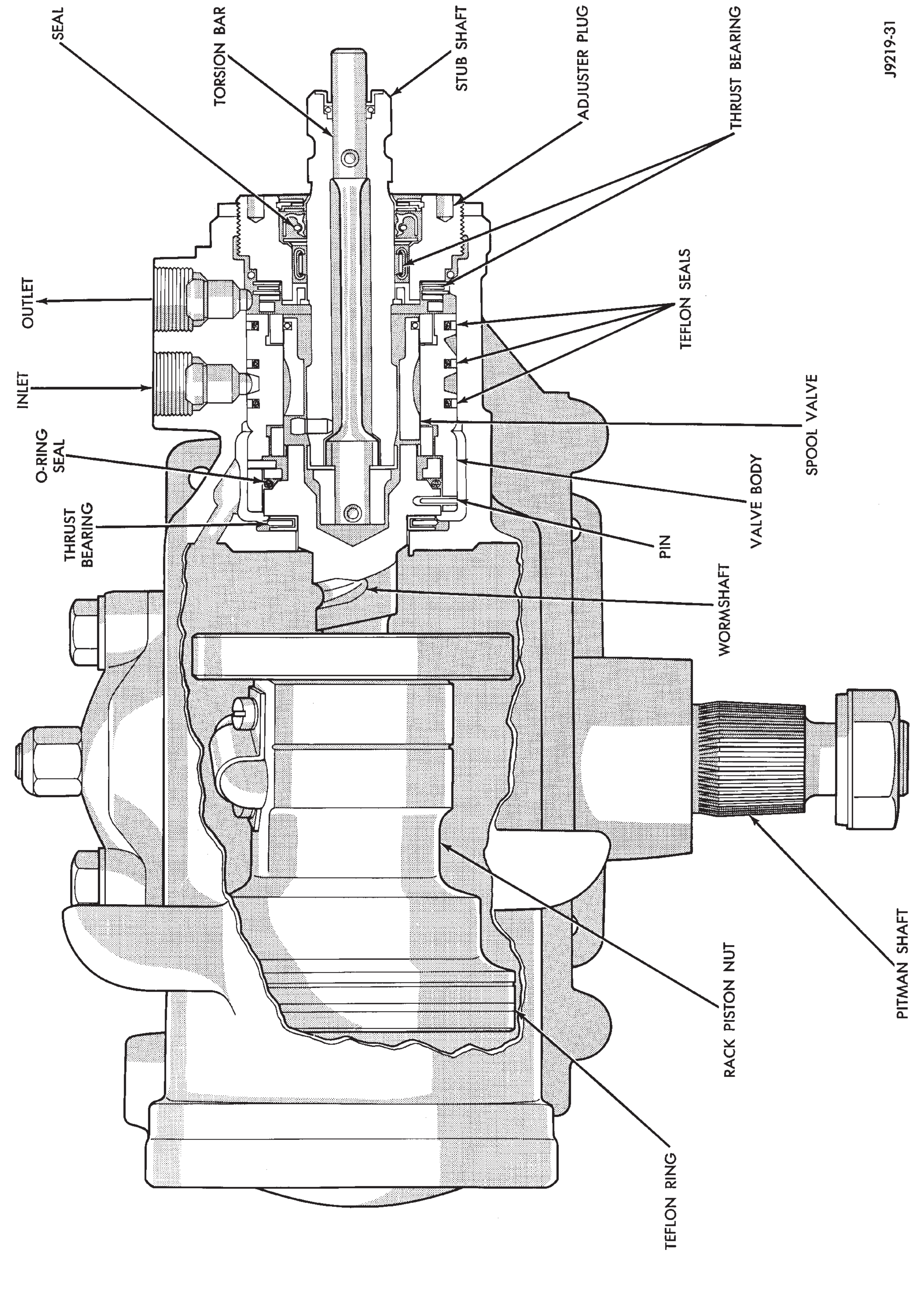


Fig. 1 Power Steering Gear

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).

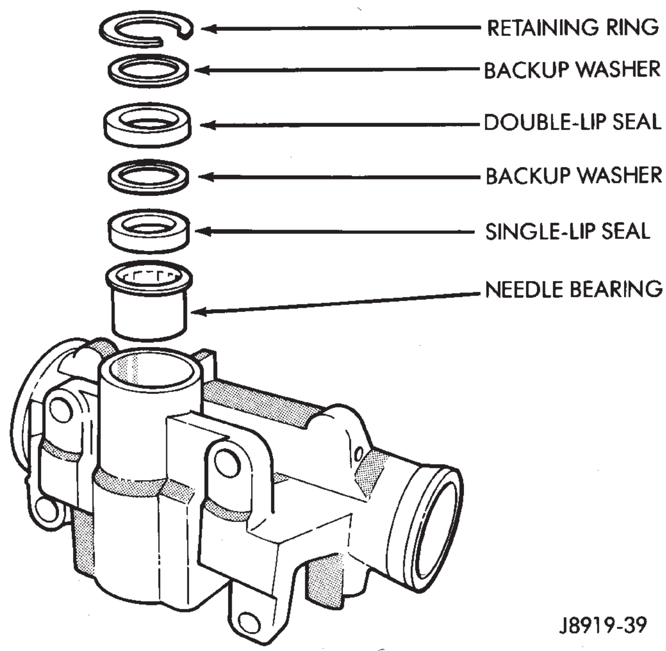


Fig. 2 Pitman Shaft Seals

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.

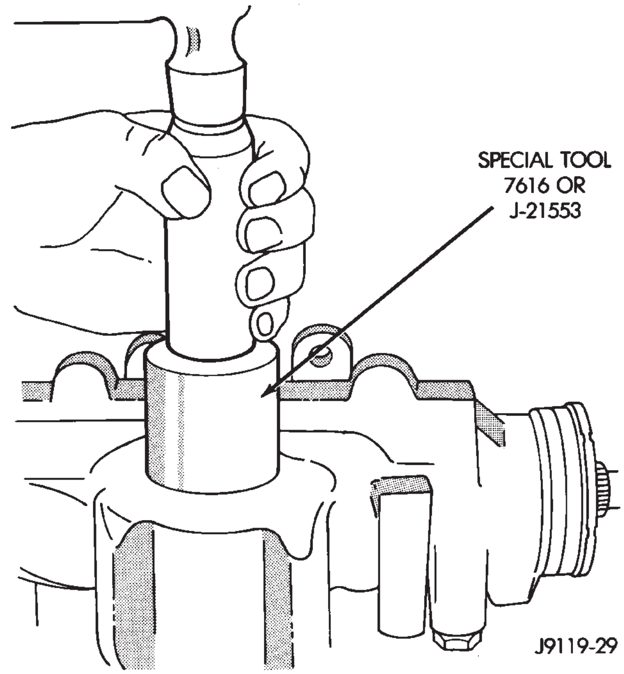


Fig. 3 Pitman Shaft Seal Installation

(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 column intermediate (coupling) shaft stone shield (Fig. 4).

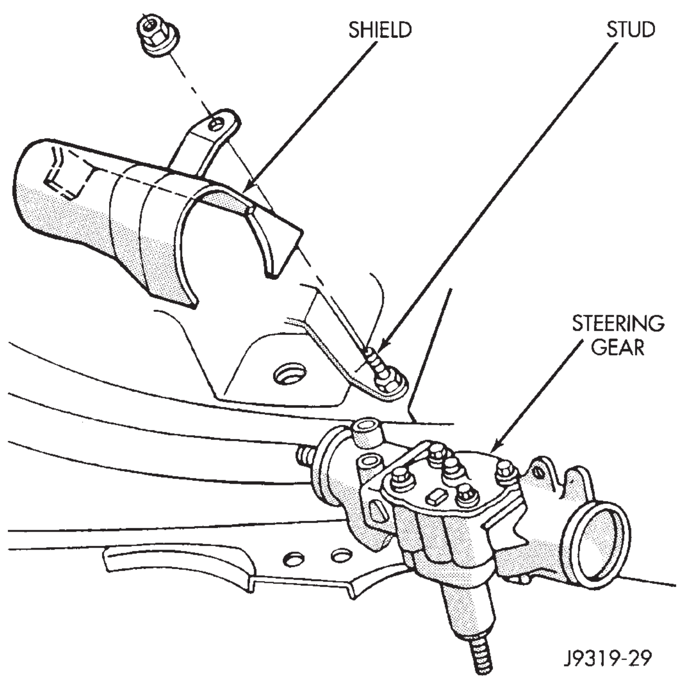


Fig. 4 Shaft Stone Shield

(3) Remove the shaft pinch bolt at the steering gear and column (Fig. 5). Unbolt steering gear from frame rail to remove shaft. Refer to Steering Gear Replacement in this section.

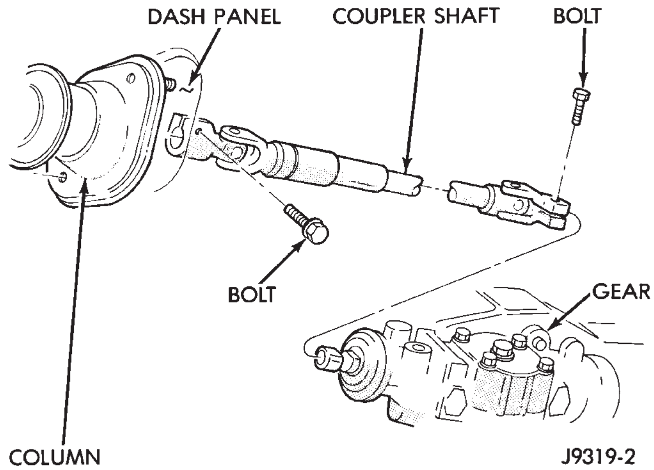


Fig. 5 Coupling Shaft

INSTALLATION

(1) Align the intermediate (coupling) 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 45 N•m (33 ft. lbs.) torque.

(4) Install the intermediate (coupling) shaft stone shield.

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.

(5) Remove the steering gear retaining bolts and nuts. Remove the steering gear from the vehicle (Fig. 6).

INSTALLATION

(1) Align the column coupler shaft to steering gear. Refer to Column Coupler installation in this section.

(2) Position the steering gear on the frame rail and install the bolts. Tighten the bolts to 88 N•m (65 ft. lbs.) torque.

(3) Align and install the pitman arm. Refer to Pitman Arm Installation in the Steering Linkage section.

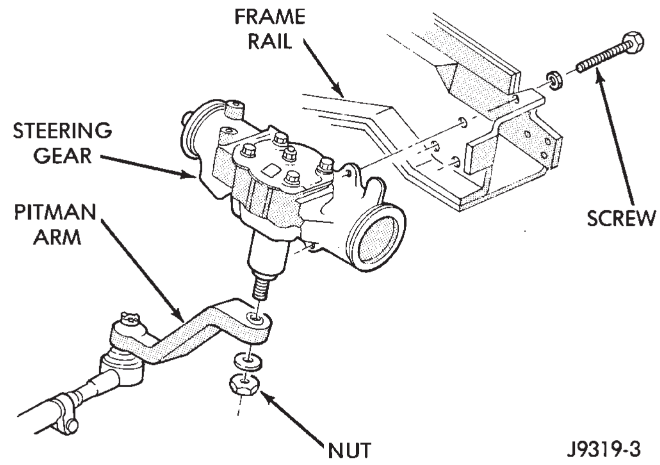


Fig. 6 Steering Gear Mounting

(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. 7).

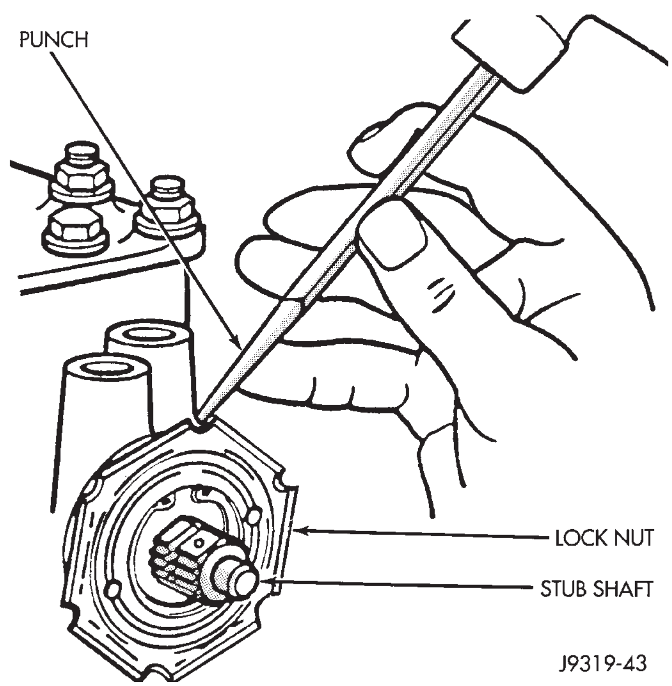


Fig. 7 Loosening the Adjuster Plug Locknut

(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. 8).

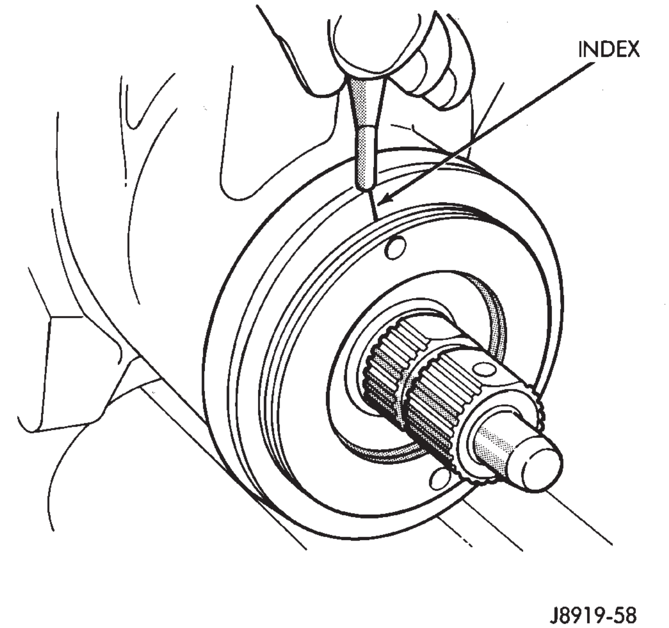


Fig. 8 Alignment Marking On Housing

(4) Measure back (counterclockwise) 13 mm (0.50 in) and mark housing (Fig. 9).

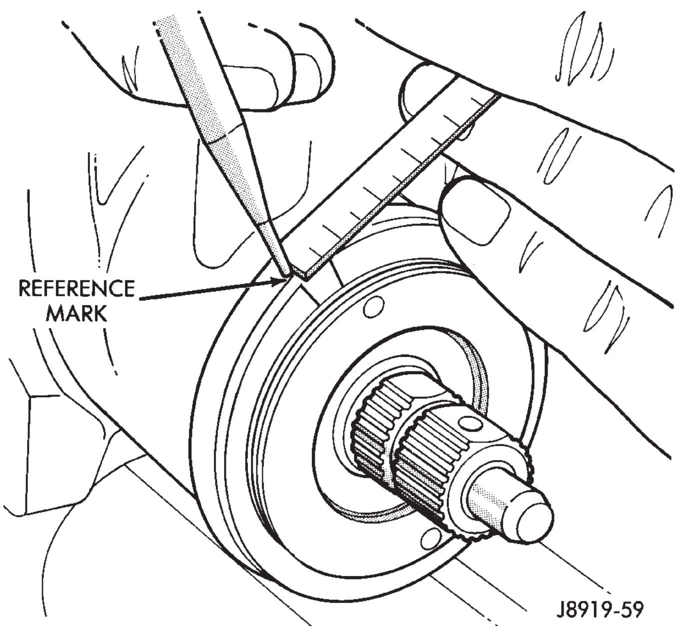


Fig. 9 Remarking The Housing

(5) Rotate adjustment cap back (counterclockwise) with spanner wrench until hole is aligned with the second mark (Fig. 10).

(6) Install and tighten locknut to 109 N●m (80 ft. lbs.) torque. Be sure adjustment cap does not turn while tightening the locknut.

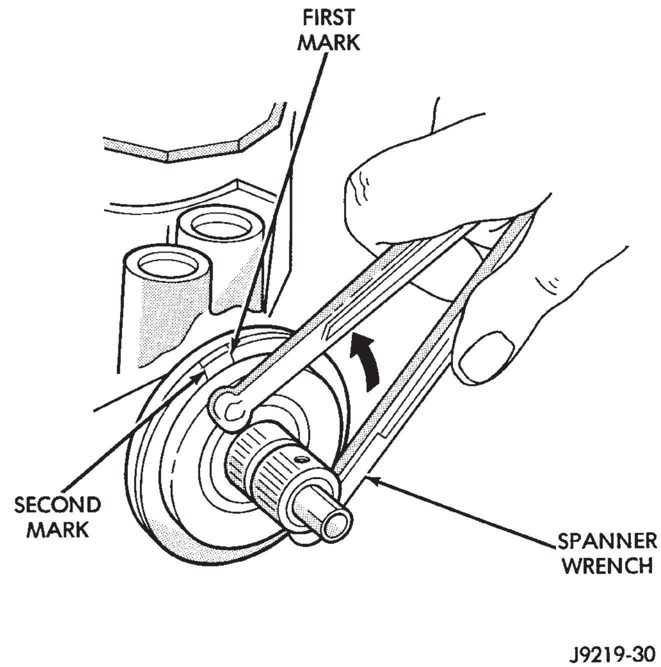


Fig. 10 Aligning To The Second Mark

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. 11).

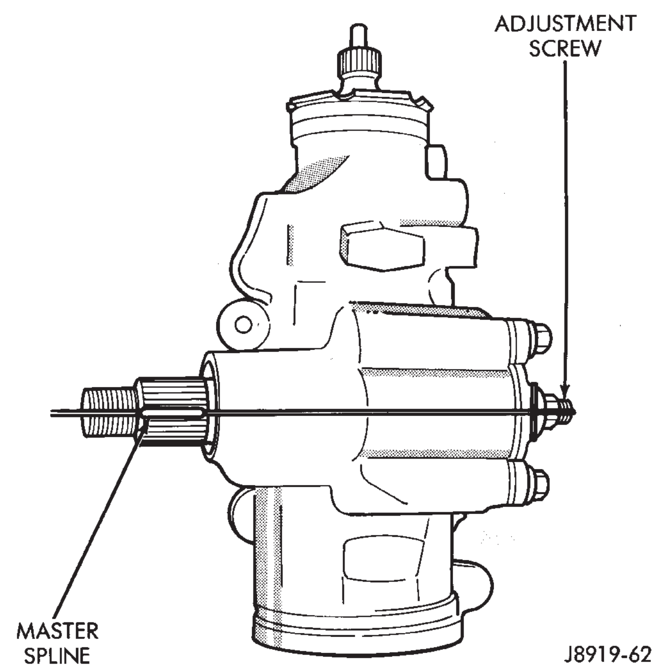


Fig. 11 Steering Gear Centered

(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. 12).

(5) Turn the adjuster in until torque to turn stub shaft is 0.6 to 1.2 N●m (6 to 10 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 when instructed otherwise (Fig. 13).

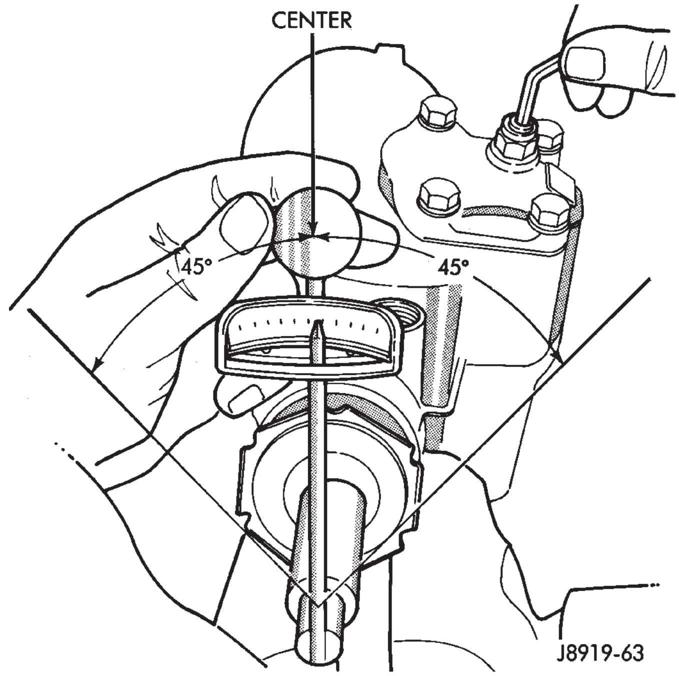


Fig. 12 Checking Over-center Rotation Torque

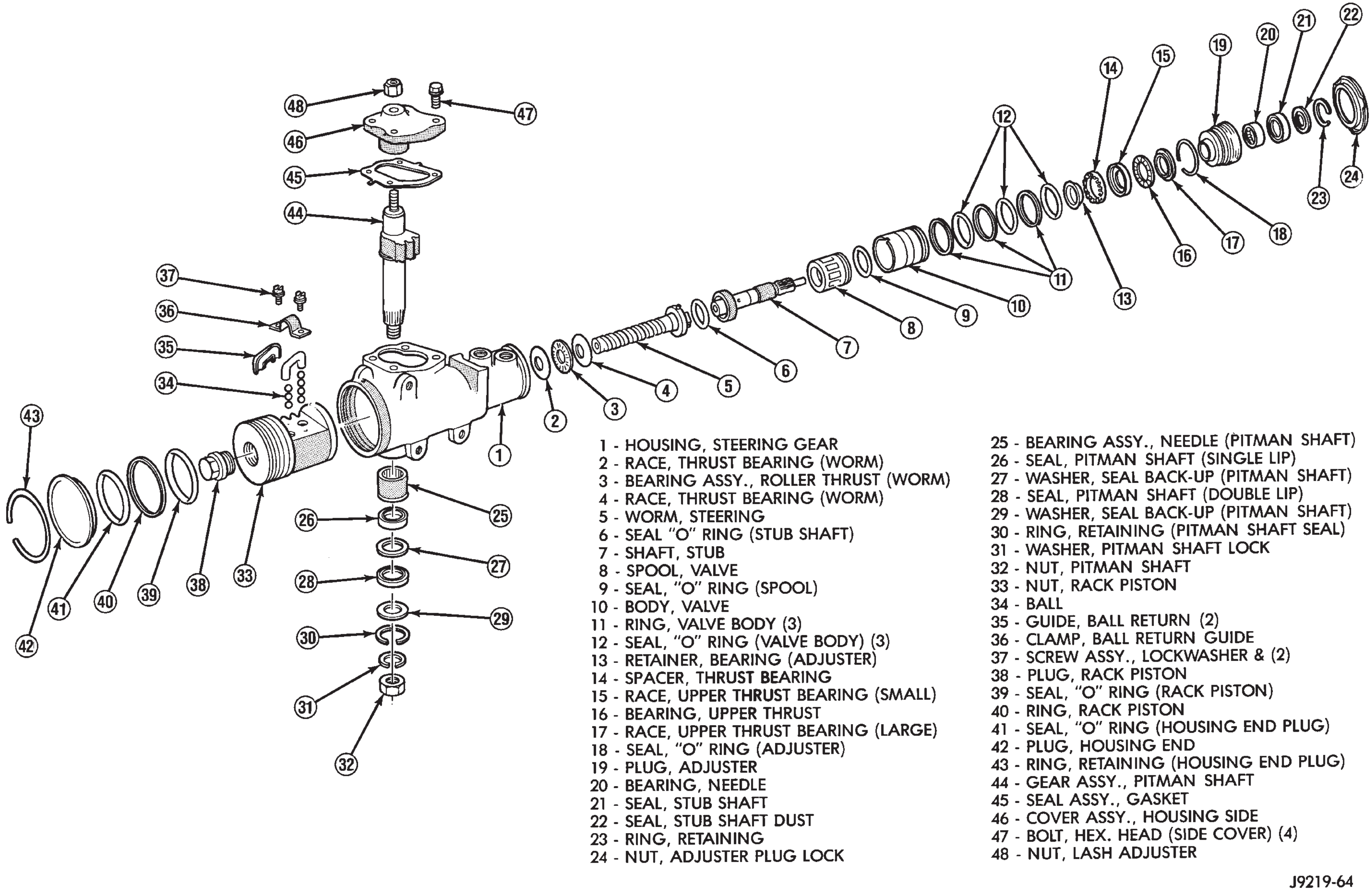


Fig. 13 Power Steering Gear

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) Remove side cover bolts. Rotate stub shaft with socket to center gear.

(3) Remove side cover, gasket and pitman shaft as an assembly.

(4) Remove pitman shaft from the side cover (Fig. 14).

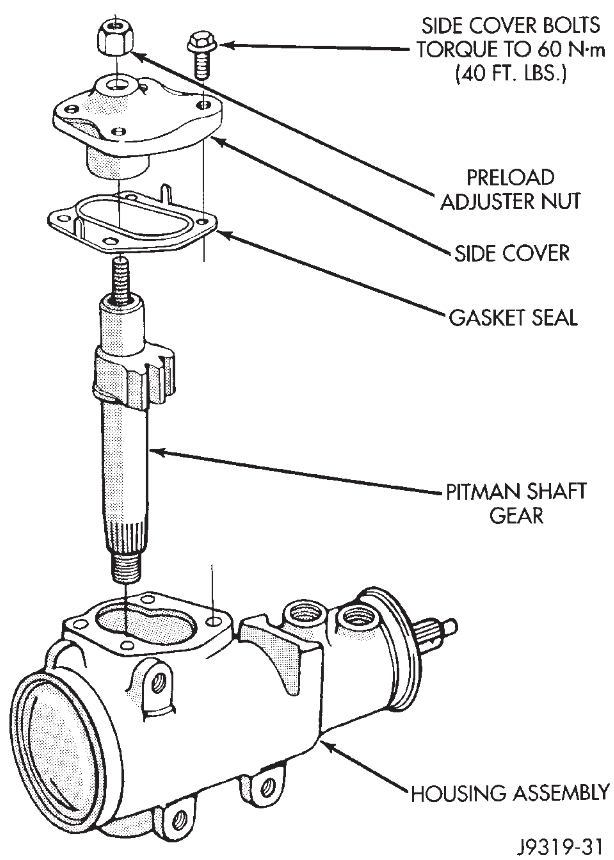


Fig. 14 Side Cover and Pitman Shaft

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. 15).

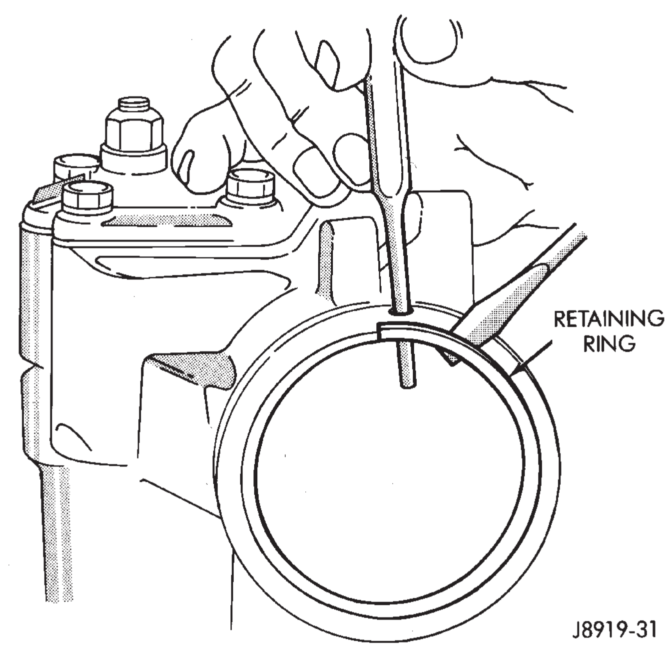


Fig. 15 End Plug Retaining Ring

(2) Rotate stub shaft slowly COUNTER-CLOCKWISE to remove end plug out from housing (Fig. 16).

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. 16).

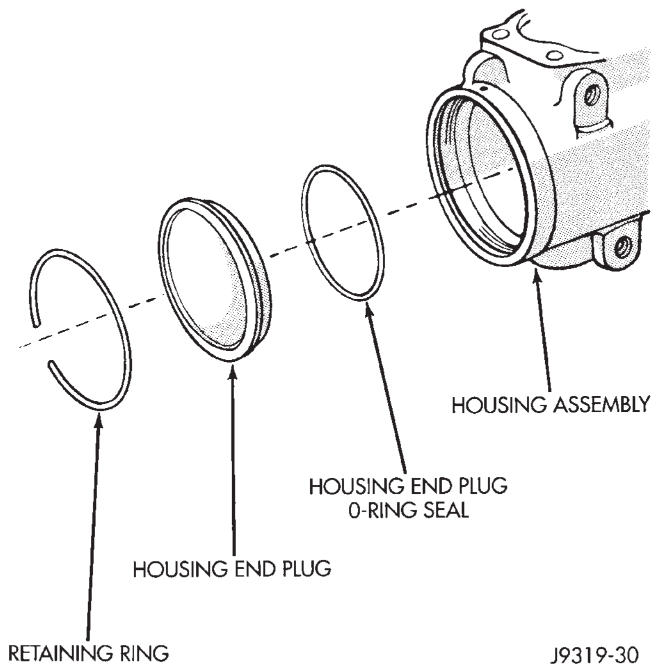


Fig. 16 End Plug Components

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. 17).

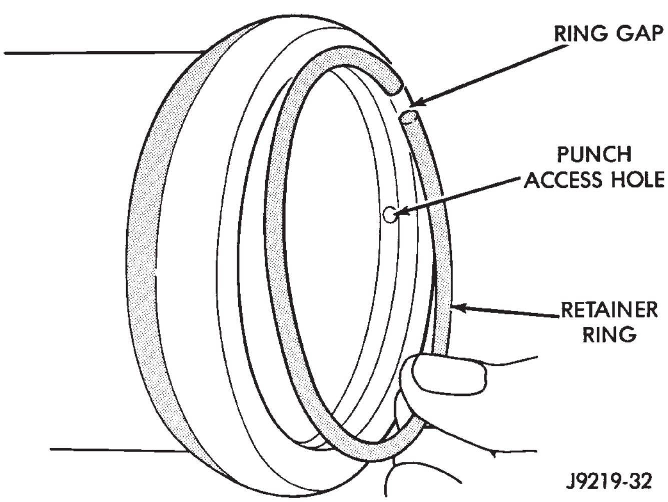


Fig. 17 Installing The Retaining Ring

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. 18).

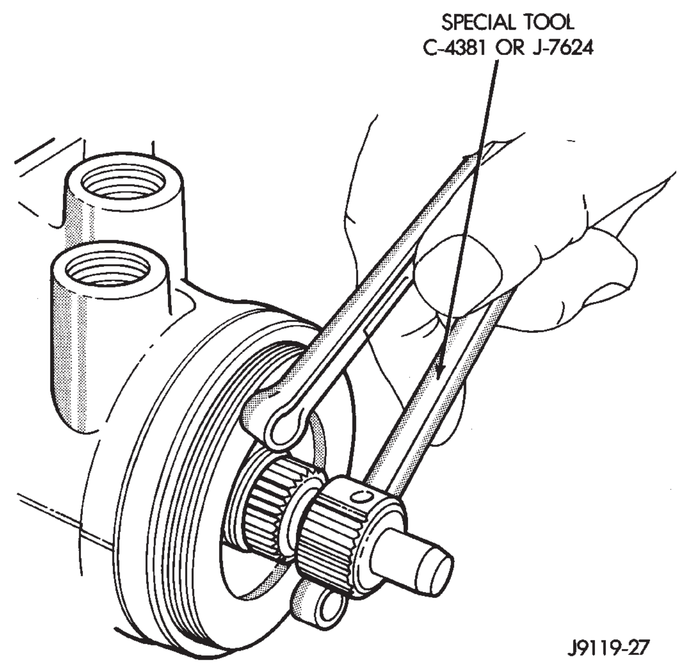


Fig. 18 Remove/Install Adjustment Plug

(3) Remove thrust washer bearing retainer from adjuster plug with screwdriver (Fig. 19).

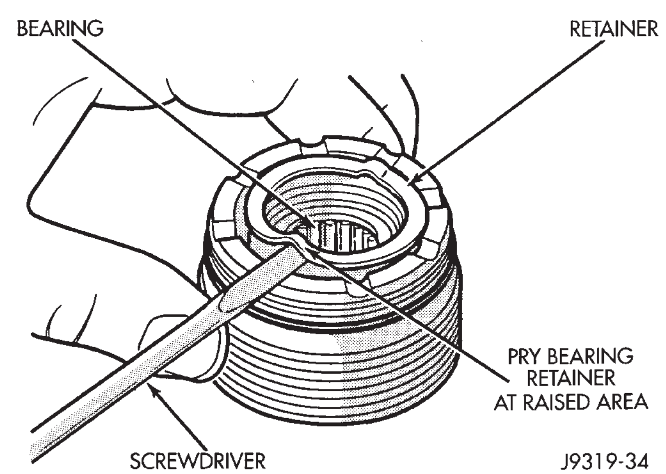


Fig. 19 Remove Retainer

(4) Remove bearing spacer, races and thrust bearing (Fig. 20).

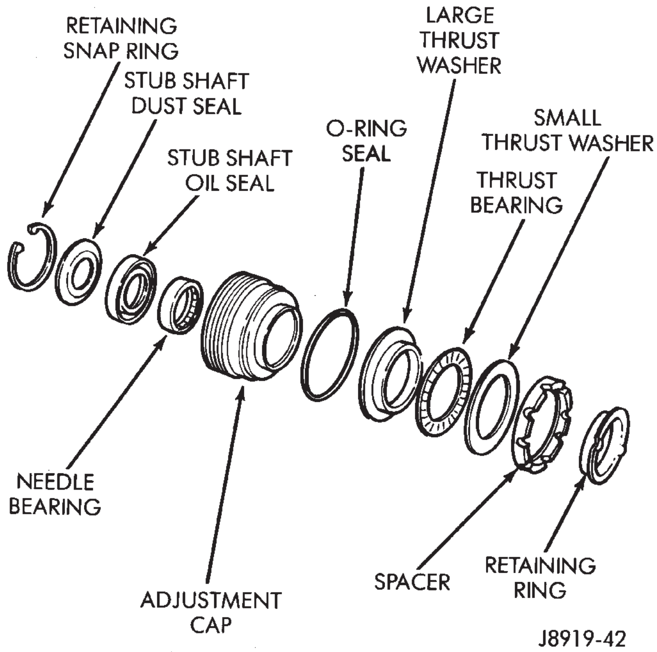


Fig. 20 Adjustment Plug (Cap) Components

(5) Remove O-ring seal.

(6) Remove retaining snap ring.

(7) Remove needle bearing, dust seal and lip seal with an appropriate tool (Fig. 21).

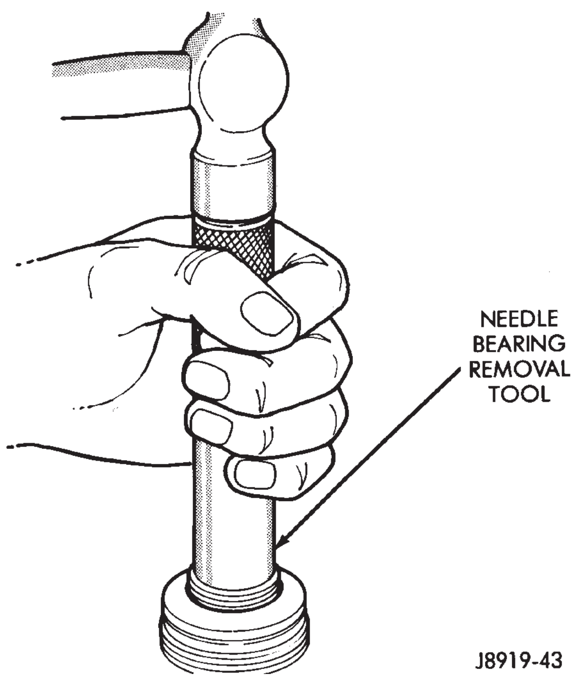


Fig. 21 Needle Bearing Removal

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. 22).

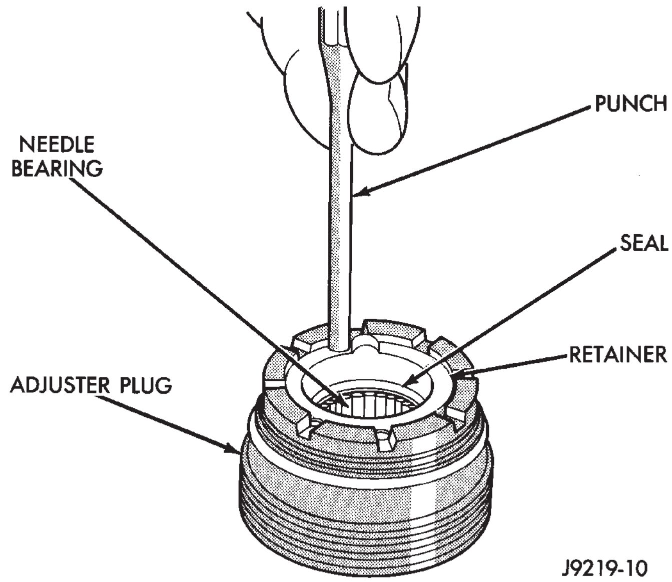


Fig. 22 Install Retainer

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. 23). **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.

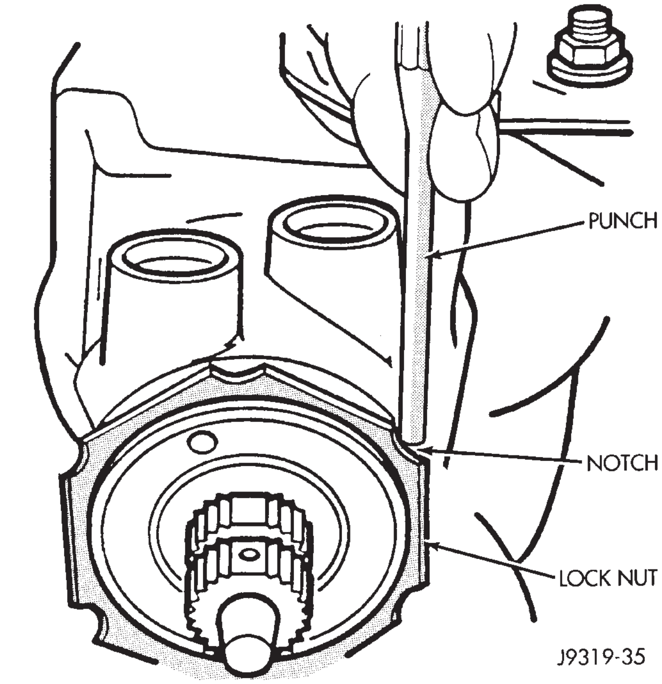


Fig. 23 Tighten Lock Nut

(2) Remove stub shaft and valve assembly (Fig. 24).

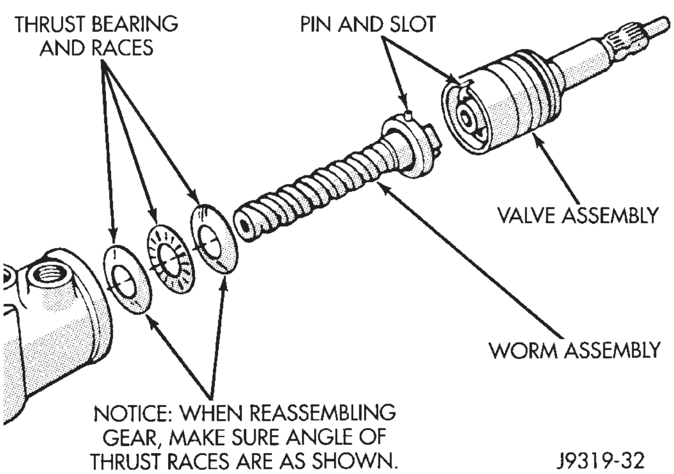


Fig. 24 Bearing, Worm and Valve Assembly

(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. 25).

(4) Remove valve assembly if necessary.

• Remove valve spool by pulling and rotating from valve body (Fig. 26).

• Remove valve spool O-ring seal

• Remove valve body teflon rings and O-ring seals (Fig. 27).

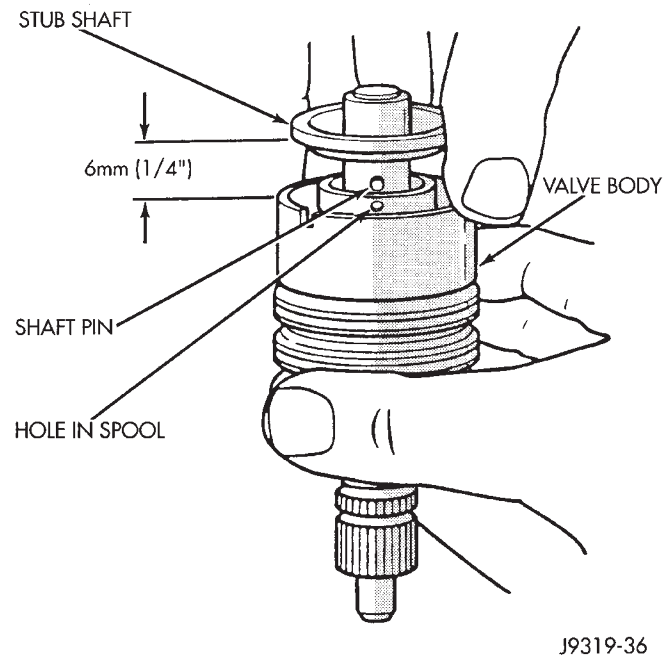


Fig. 25 Remove and Install Stub Shaft

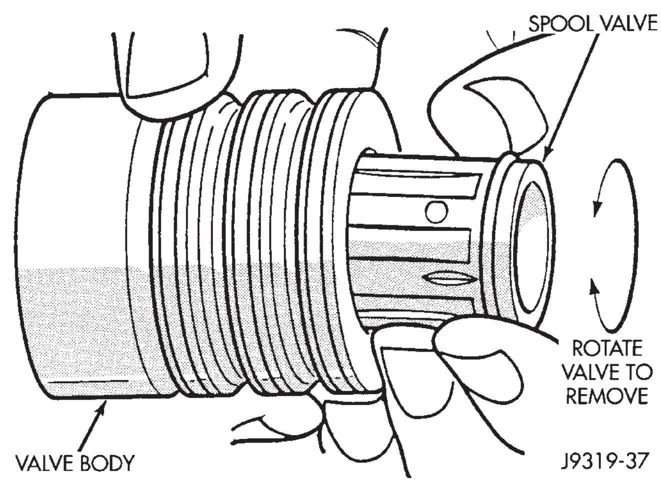


Fig. 26 Remove and Install Spool

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. 28).

• 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.

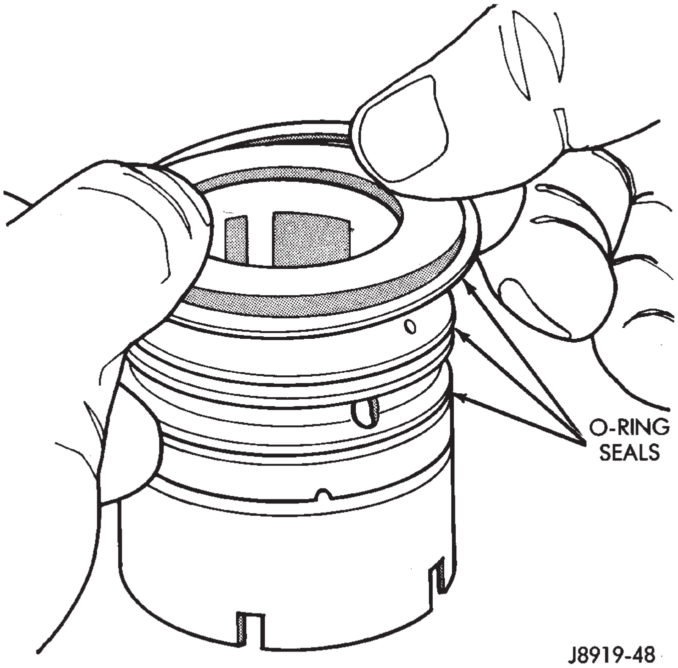


Fig. 27 Remove and Install Valve Seals

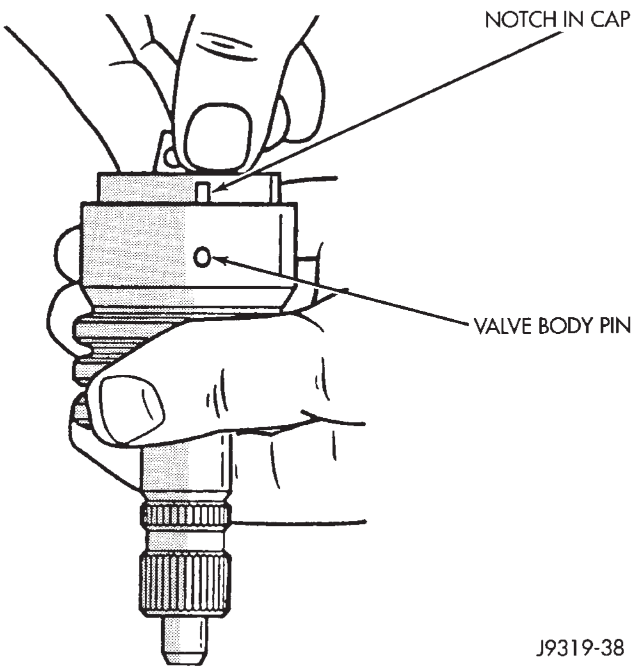


Fig. 28 Stub Shaft Installation

(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. 29).

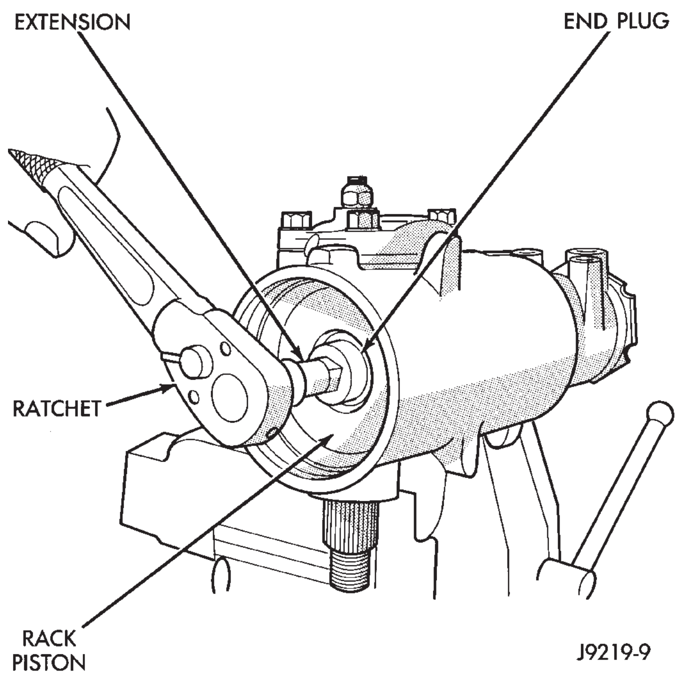


Fig. 29 Remove and Install Rack Piston End Plug

(5) Insert Arbor C-4175 (J-21552) into bore of rack piston (Fig. 30). 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. 31).

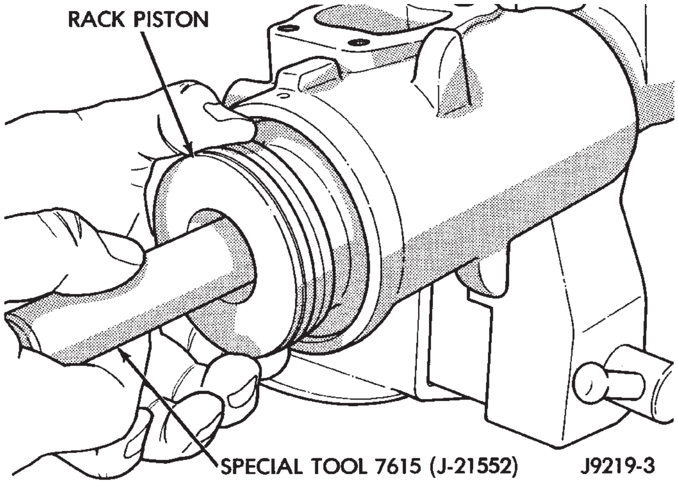


Fig. 30 Remove and Install Rack Piston

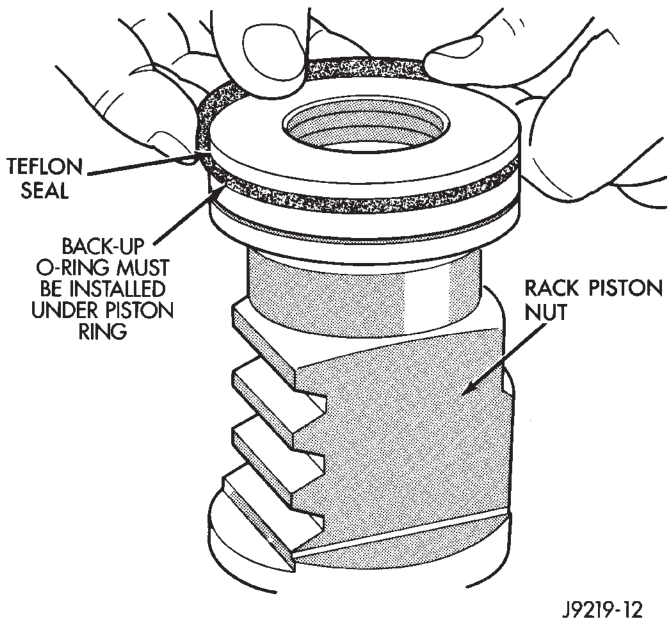


Fig. 31 Remove and Install Seal on Rack Piston

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. 32).

WARNING: MAKE SURE ALL RACK PISTON BALLS ARE REINSTALLED IN THE RACK PISTON. IMPROPER INSTALLATION MAY RESULT IN PERSONAL INJURY.

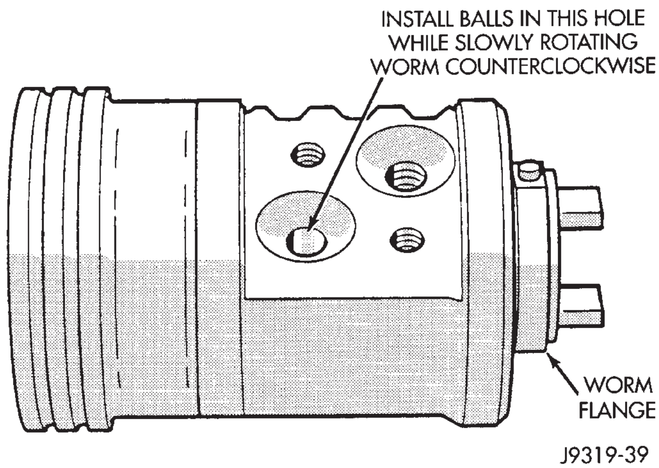


Fig. 32 Installing Balls in Rack Piston

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. 33).

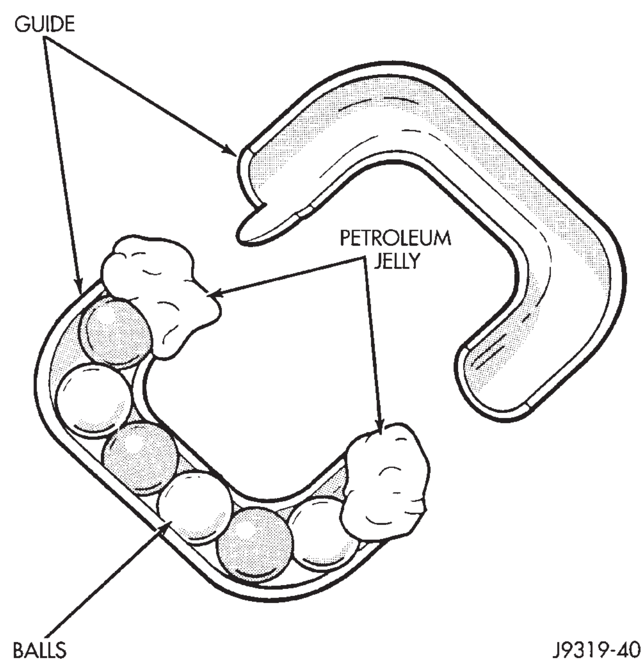


Fig. 33 Balls in the Return Guide

(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. 34).

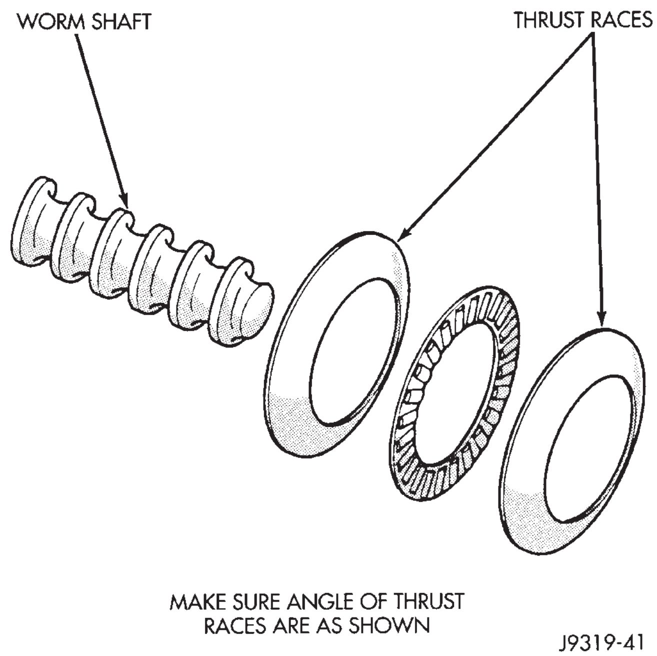


Fig. 34 Worm Shaft and Bearing

(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. 35).

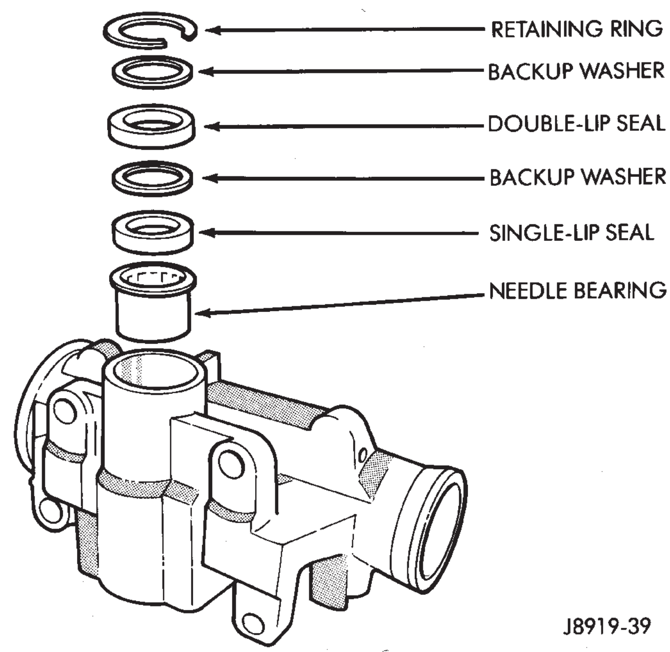


Fig. 35 Pitman Shaft Seals

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. 36).

ASSEMBLE

(1) Install needle bearing into housing (Fig. 37).

(2) Install single lip seal with Installer or a suitable size socket (Fig. 38).

(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.

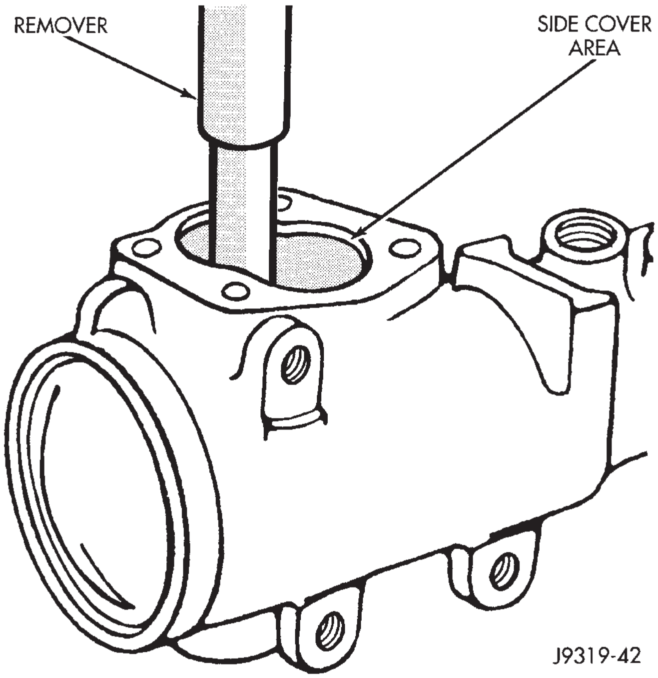


Fig. 36 Needle Bearing Removal

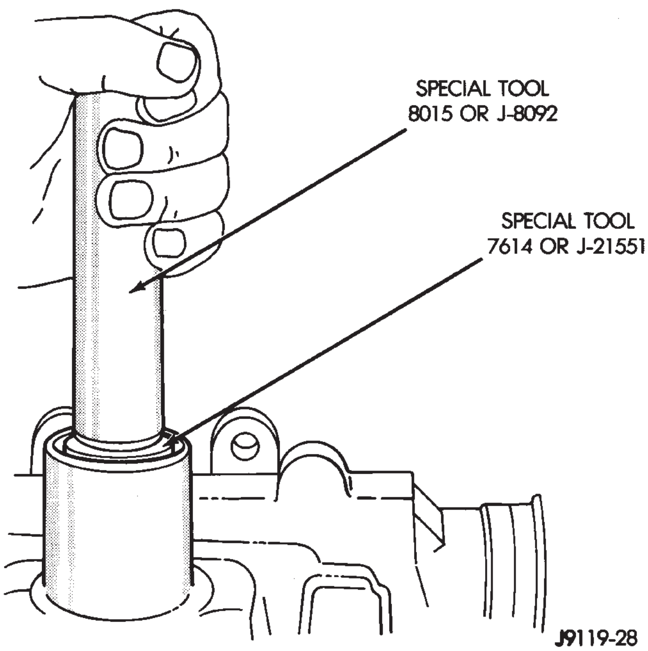


Fig. 37 Pitman Shaft Bearing Installation

(7) Install the retainer ring with snap ring pliers.

(8) Install the pitman shaft and side cover. Refer to Side Cover and Pitman Shaft Replacement in this section.

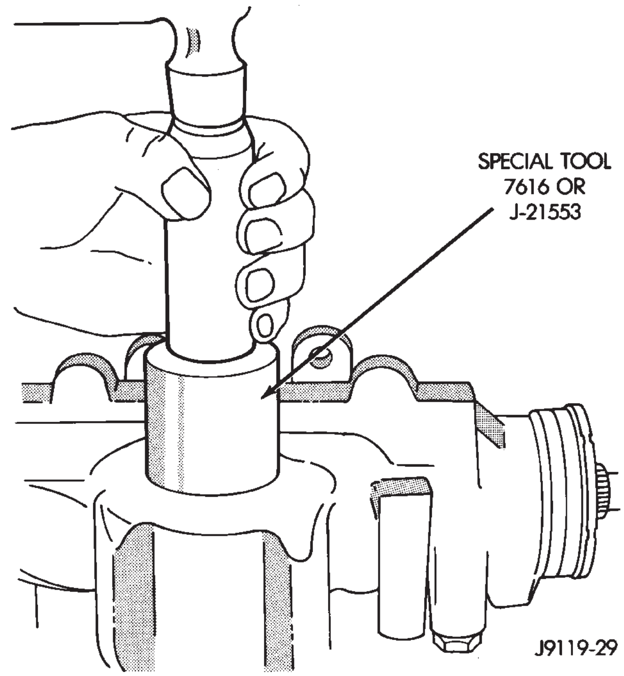


Fig. 38 Pitman Shaft Seal Installation

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

STEERING COLUMN

INDEX

SERVICE INFORMATION

WARNING: THE AIR BAG SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT. BEFORE ATTEMPTING TO SERVICE THE AIR BAG SYSTEM COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIR BAG AND POSSIBLE PERSONAL INJURY.

THE FASTENERS, SCREWS, AND BOLTS, ORIGINALLY USED FOR THE AIR BAG COMPONENTS, HAVE SPECIAL COATINGS. THIS HARDWARE IS SPECIFICALLY DESIGNED FOR THE AIR BAG SYSTEM. THEY MUST NEVER BE REPLACED WITH ANY SUBSTITUTES. REPLACE WITH THE CORRECT FASTENERS PROVIDED IN THE SERVICE PACKAGE OR FASTENERS IN THE PARTS BOOK.

BEFORE SERVICING A COLUMN EQUIPPED WITH AIR BAG, REFER TO GROUP 8M, ELECTRICAL FOR PROPER AND SAFE PROCEDURES.

The Acustar columns (Fig.1) have been designed to be serviced as an assembly; less wiring, switches, shrouds, steering wheel, etc. Most steering column components can be serviced without removing the column from the vehicle. For additional information on electrical components refer to Group 8, Electrical.

CAUTION: Bumping, jolting and hammering on the steering column shaft 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.

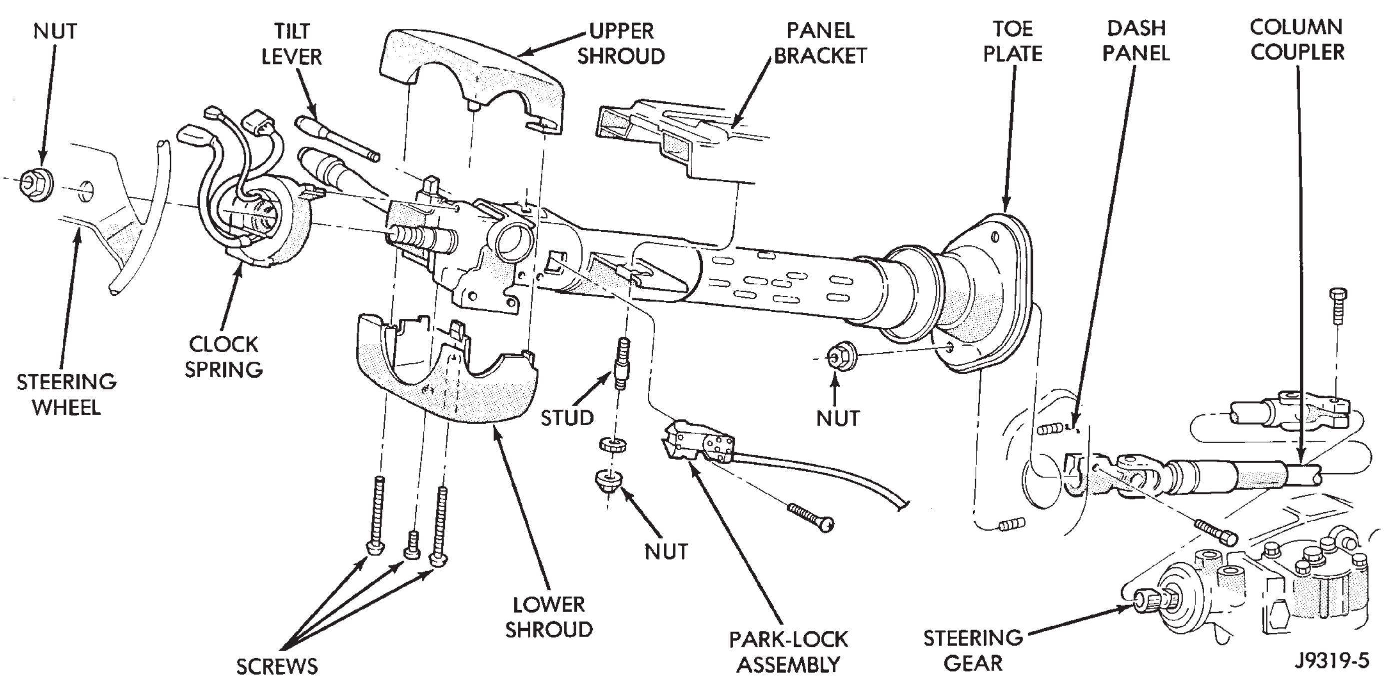


Fig. 1 Acustar Steering Column

STEERING WHEEL

WARNING: BEFORE SERVICING AIR BAG SYSTEM, REMOVE AND ISOLATE THE BATTERY NEGATIVE (-) CABLE (GROUND) FROM THE VEHICLE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIR BAG SYSTEM. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL AIR BAG DEPLOYMENT AND POSSIBLE INJURY. WHEN AN UNDEPLOYED AIR BAG ASSEMBLY IS TO BE REMOVED FROM THE STEERING WHEEL, DISCONNECT THE BATTERY GROUND CABLE AND ISOLATE. ALLOW SYSTEM CAPACITOR TO DISCHARGE FOR 2 MINUTES, THEN BEGIN AIR BAG REMOVAL.

REMOVAL

(1) Make sure the front wheels are in the **straight ahead** position and steering column locked in place.

(2) Disconnect the battery negative (ground) cable and isolate.

(3) Wait 2 minutes for the reserve capacitor to discharge before removing undeployed air bag module.

(4) Remove the air bag module and speed control switch (if equipped) and disconnect the wire feeds (Fig. 2).

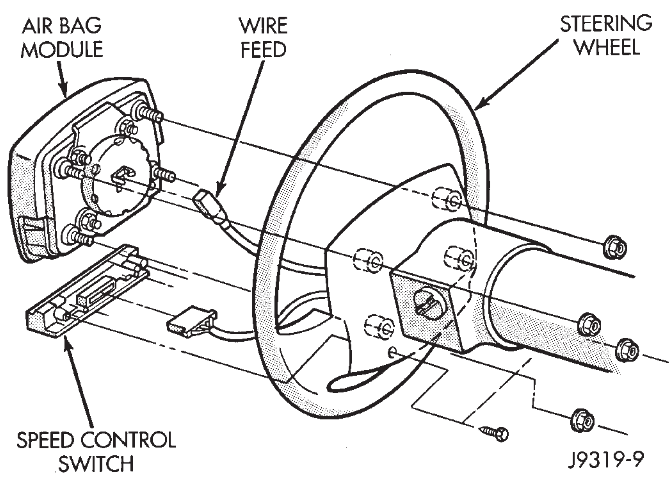


Fig. 2 Air Bag Module and Speed Control

(5) Disconnect the wire feed to the horn buttons.

(6) Remove the steering wheel retaining nut. Score or paint alignment marks on the column shaft and steering wheel (if none exist) for installation reference.

(7) Remove the steering wheel with a universal puller (Fig. 3). **Do not hammer or jolt the steering column or shaft during removal of the wheel.**

INSTALLATION

(1) Install the steering wheel on column with the scored marks or master splines aligned. Ensure the wheel compresses the 2 lock tabs on the clockspring.

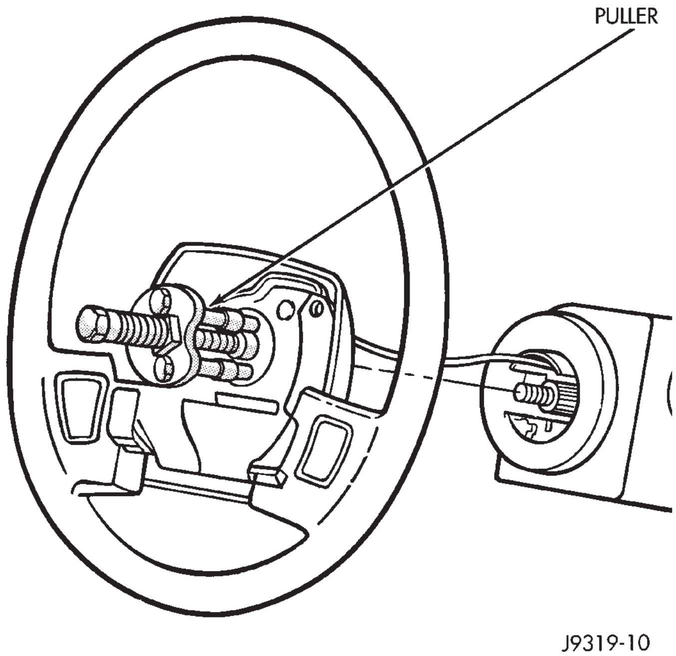


Fig. 3 Steering Wheel Removal

(2) Pull the air bag and speed control wires through the lower, larger hole in the steering wheel. Pull the horn wire through the smaller hole at the top.

WARNING: ENSURE THE AIR BAG WIRES ARE NOT PINCHED.

(3) Install the retaining nut and tighten to 61 N●m (45 ft. lbs.) torque. **Force the steering wheel down on the shaft with the retaining nut only. Do not hammer or shock the column with sudden impact to install the wheel.**

(4) Connect the wire feed to the horn buttons.

(5) Connect the wire feeds to the air bag module and speed control switch (Fig. 2). Tighten the air bag module nuts to 10 N●m (90 in. lbs.) torque.

WARNING: ENSURE THE AIR BAG WIRE CONNECTION IS COMPLETELY SEATED. THE LATCHING CLIP ARMS MUST BE VISIBLE ON TOP OF THE CONNECTOR HOUSING ON THE MODULE.

(6) Do not connect the battery ground (negative) cable. Refer to Air Bag System Check within Group 8M for additional information.

CLOCKSPRING

WARNING: BEFORE SERVICING AIR BAG SYSTEM, REMOVE AND ISOLATE BATTERY NEGATIVE (-) CABLE (GROUND) FROM VEHICLE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIR BAG SYSTEM. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL AIR BAG DEPLOYMENT, AND POSSIBLE INJURY. WHEN AN UNDEPLOYED AIR BAG ASSEMBLY IS TO BE REMOVED FROM THE STEERING WHEEL, DISCONNECT THE BATTERY GROUND CABLE AND ISOLATE. ALLOW SYSTEM CAPACITOR TO DISCHARGE FOR 2 MINUTES, THEN BEGIN AIR BAG REMOVAL.

REMOVAL

(1) Place the front wheels in the straight ahead position before starting the repair.

(2) Disconnect battery negative cable and isolate.

(3) Wait 2 minutes for the reserve capacitor to discharge before removing undeployed module.

(4) Remove the steering wheel and air bag, refer to Steering Wheel Removal.

(5) Remove upper and lower steering column shrouds to gain access to the clockspring wiring.

(6) Release wire connector at clockspring.

(7) Pull clockspring assembly from column by lifting locking fingers as necessary. The clockspring cannot be repaired, and must be replaced if faulty.

INSTALLATION

(1) Snap clockspring assembly onto column. If clockspring is not properly positioned, follow the centering procedures before installing steering wheel.

(2) Connect the wire connector to the clockspring.

WARNING: ENSURE CLOCKSPRING WIRE CONNECTION IS COMPLETELY SEATED. THE LATCHING CLIP ARMS MUST BE PROPERLY ENGAGED ON THE MODULE.

(3) Install upper and lower steering column shrouds. Be sure wiring is inside of shrouds and not pinched.

(4) Install the steering wheel and air bag module, refer to Steering Wheel Installation.

CENTERING PROCEDURE

If the rotating tape within the clockspring is not positioned properly, the clockspring may fail during use. The following procedures MUST BE USED to center the clockspring;

- If it is not known to be properly positioned
- If the front wheels were moved from the straight ahead position

(1) Place the front wheels in the straight ahead position before starting the procedure.

(2) Depress the 2 locking tabs to disengage the locking mechanism (Fig. 4).

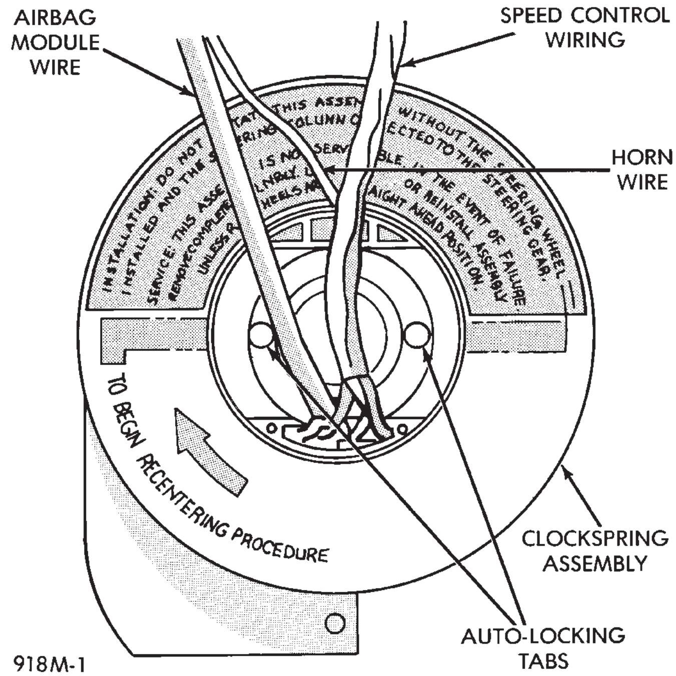


Fig. 4 Clockspring (Auto-Locking)

(3) Keeping the mechanism disengaged, rotate the clockspring rotor in the CLOCKWISE DIRECTION to the end of the travel. Do not apply excessive torque.

(4) From the end of travel, rotate the rotor 2 1/2 full turns in the COUNTER CLOCKWISE direction. The horn wire should end up at the top and the squib wire at the bottom (Fig. 4).

(5) Install the steering wheel and air bag module, refer to Steering Wheel Installation.

COLUMN ASSEMBLY REPLACEMENT

CAUTION: Bumping, jolting and hammering on the steering column shaft and gear shift tube must be avoided during all service procedures.

REMOVAL

(1) Make sure the front wheels are in the **straight ahead** position.

(2) Observe Cautions and disconnect the negative (ground) cable from the battery.

(3) Remove steering wheel from column, refer to Steering Wheel-Removal and observe Cautions/Warnings.

(4) Remove column coupler upper pinch bolt (Fig. 5).

(5) Remove the trim panel column cover and support plate (Fig. 6).

(6) Remove tilt lever (if equipped) from column.

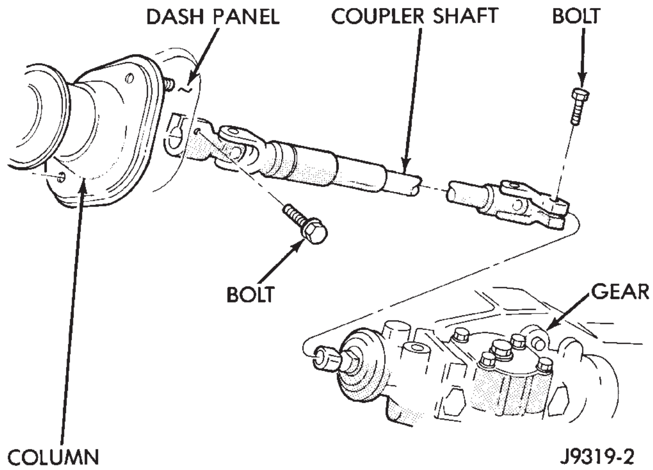


Fig. 5 Column Coupler Shaft

(7) Remove the upper and lower lock housing shrouds (Fig. 1).

(8) Remove the heater cross over tube from under the column.

(9) Loosen the panel bracket nuts/studs to allow the column to drop.

(10) Remove the wiring harness from steering column (Fig. 7).

(11) Remove the Interlock cable from the steering column. Refer to Automatic Transmission Shifter/Ignition Interlock in this group.

(12) Remove the toe plate to dash panel nuts (Fig. 1).

(13) Remove the panel bracket nuts/studs and remove the column. Use care to avoid damaging the paint or trim.

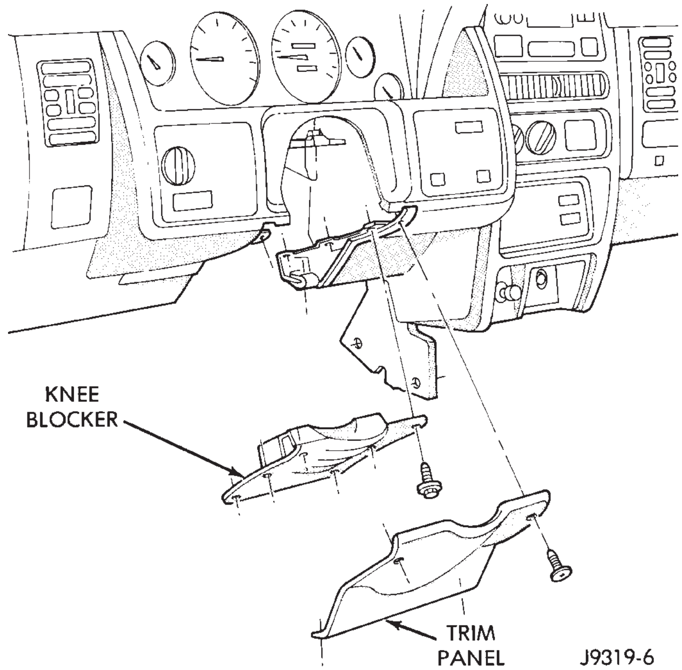


Fig. 6 Trim Panel Column Cover

INSTALLATION

CAUTION: Bumping, jolting and hammering on the steering column shaft and gear shift tube must be avoided during all service procedures.

(1) With the front wheels in the straight ahead position. Align and install the column to coupler. **Do not apply force at the top of the steering column shaft.**

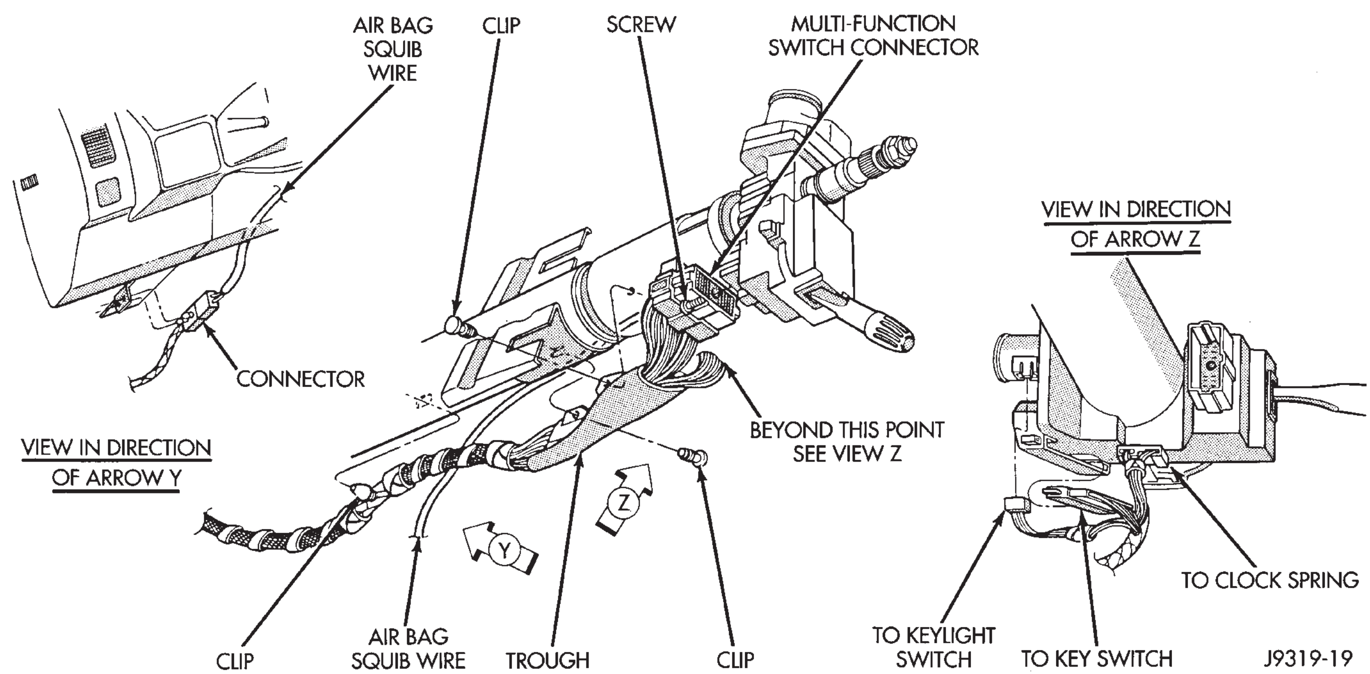


Fig. 7 Steering Column Wiring Harness

(2) Ensure the ground clip is on the left spacer slot (Fig. 8).

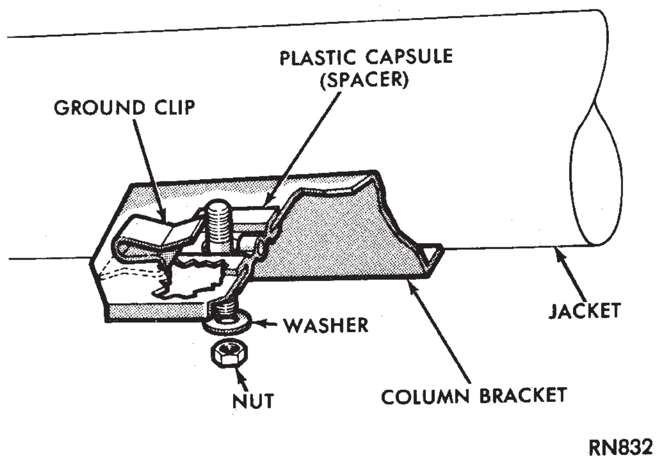


Fig. 8 Ground Clip & Spacer Installation

(3) Install the Interlock cable from the steering column. Refer to Automatic Transmission Shifter/Ignition Interlock in this group.

(4) Install wiring harness connections to steering column (Fig. 7).**Ensure the wiring is not pinched and all connections are correctly locked in place.**

(5) Install shaft coupler pinch bolt loose, load column up to panel bracket.

(6) Be sure both spacers are fully seated in the column support bracket. Tighten the column panel bracket support nuts/studs to 12 N●m (105 in. lbs.) torque. **Ensure the nut is installed on the SHORT threaded side of the stud (Fig. 1).**

(7) Tighten the toe plate attaching nuts (Fig. 1) to 12 N●m (105 in. lbs.) torque.

(8) Tighten the coupler pinch bolt to 47 N●m (35 ft. lbs.) torque.

(9) Install the heater cross over tube under the column.

(10) Install the upper and lower shrouds. Install the tilt lever (if equipped).

(11) Install the trim panel column cover and support plate.

(12) Install the steering wheel, refer to Steering Wheel Installation and observe cautions.

(13) Remove the column shaft shipping lock pin (installed in service column).

(14) Connect the battery ground (negative) cable.

COLUMN COMPONENT SERVICE

The Acustar columns have been designed to be serviced as an assembly; less wiring, switches, shrouds, steering wheel, etc. Also most steering column components can be serviced without removing the column from the vehicle. For additional information on electrical components refer to Group 8, Electrical.

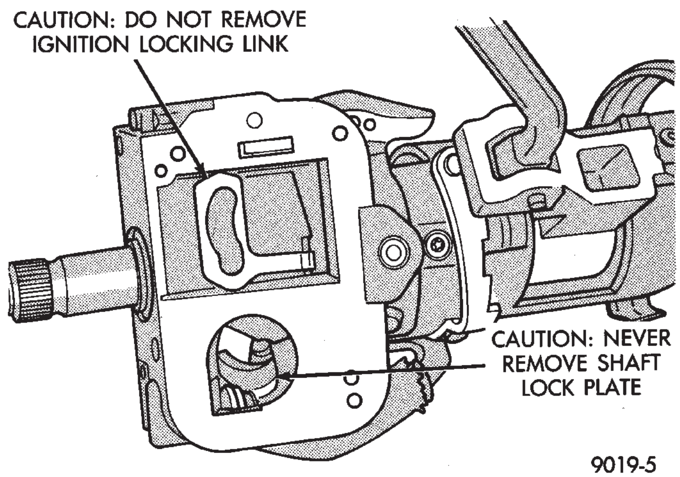


Fig. 9 Observe Cautions

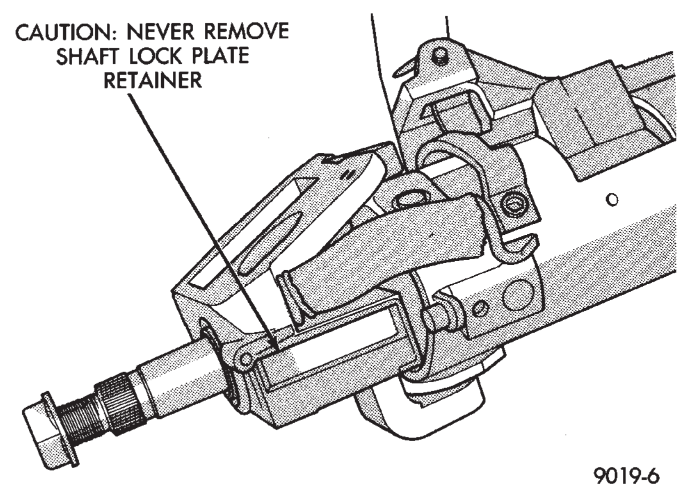


Fig. 10 Observe Cautions

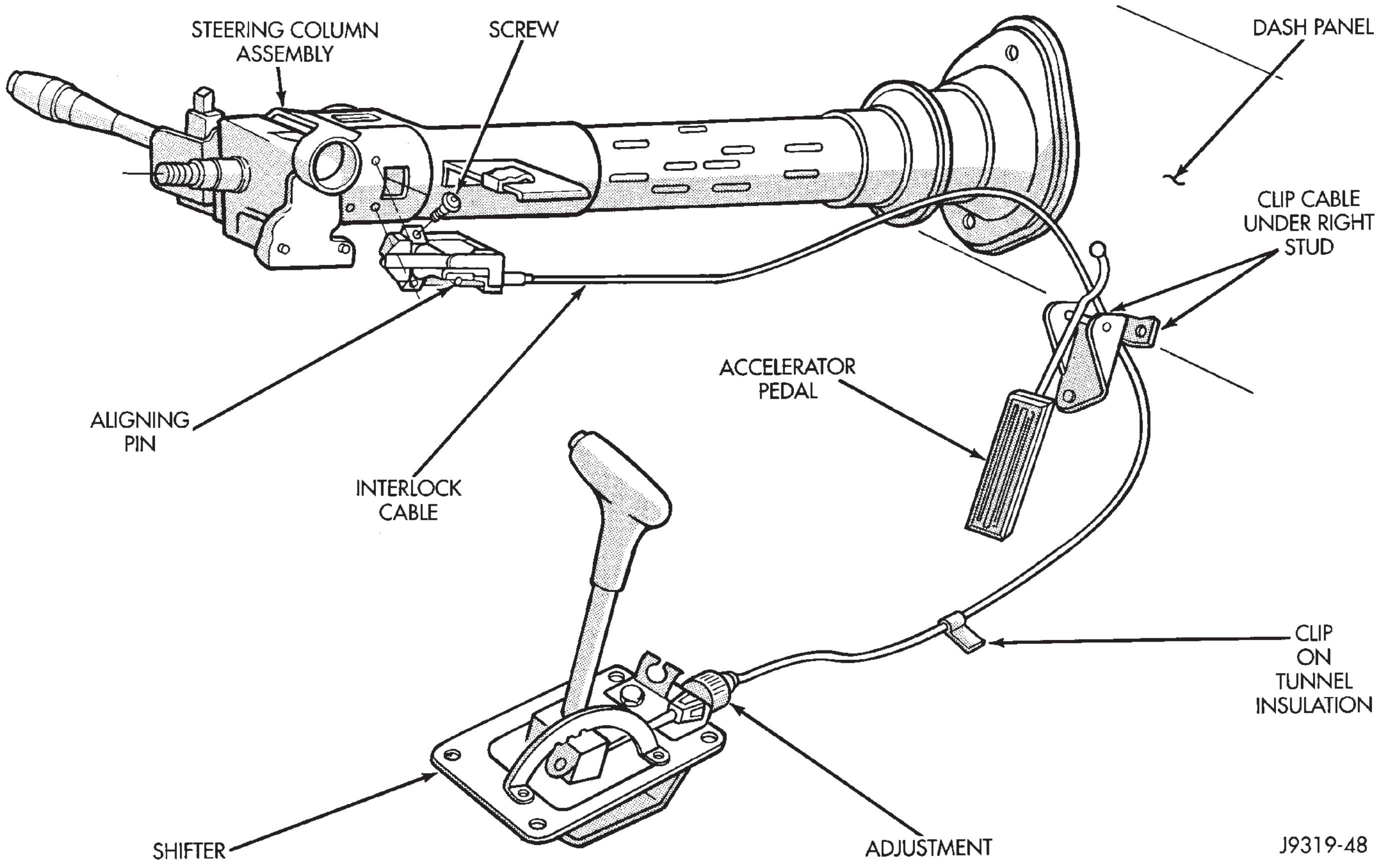


Fig. 1 Ignition Interlock Cable Routing

AUTOMATIC TRANSMISSION SHIFTER/IGNITION INTERLOCK MECHANISM

The automatic transmission Shifter/Ignition Interlock, is a cable operated system. It interconnects the automatic transmission floor mounted shifter to the steering column ignition switch (Fig. 1). The system locks the shifter into the PARK position. The Interlock system is engaged whenever the ignition switch is in the LOCK or ACCESSORY position. When the key is in the OFF or RUN position the shifter is unlocked and will move into any position. The interlock system also prevents the ignition switch from being turned to the LOCK or ACCESSORY position (Fig. 2). Unless the shifter is fully locked into the PARK position.

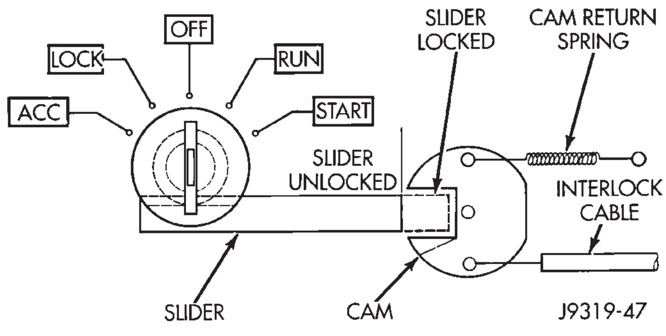


Fig. 2 Ignition Key Cylinder Actuation

INTERLOCK CABLE REPLACEMENT

REMOVAL

(1) Lower the steering column. Refer to Column Assembly Replacement in this group.

(2) Remove two screws retaining the interlock mechanism to the column (Fig. 3). Unsnap the mechanism from column.

(3) Remove the center console and related trim. Refer to Group 23, Body.

(4) Disconnect the cable eyelet from the bellcrank (Fig. 4).

(5) Disconnect and remove the cable from the shift bracket.

(6) Remove the accelerator pedal (the cable routes under the pedal), refer to Group 14, Fuel Systems. Release the cable from the accelerator pedal clip. Move the carpet as necessary to remove the cable.

INSTALLATION/ADJUSTMENT

(1) Snap the cable base assembly into the large square opening in the steering column.

(2) Secure the plastic base with two (2) self tapping screws (Fig. 3).

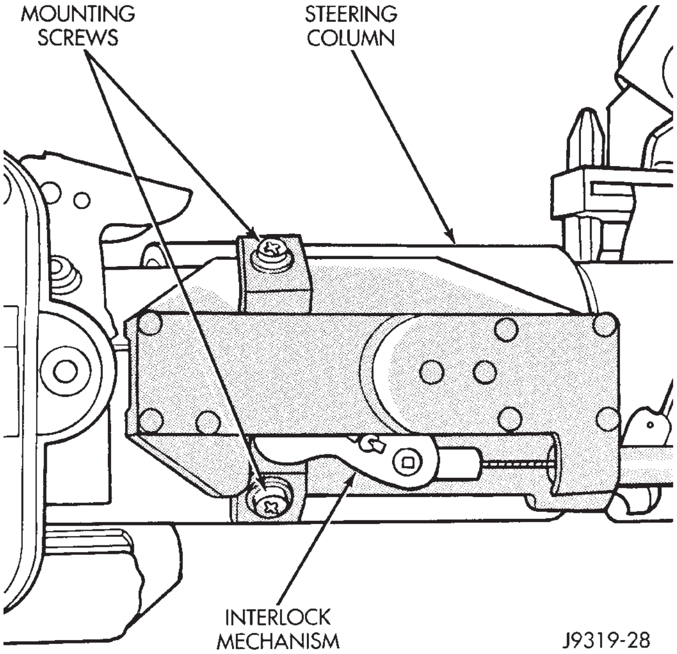


Fig. 3 Interlock Mechanism on Column

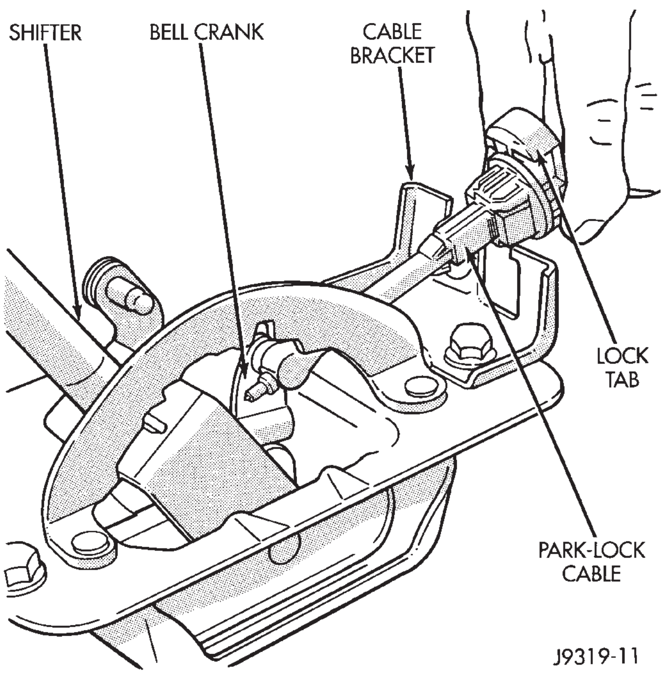


Fig. 4 Cable and Shifter

CAUTION: Interlock cable must be clipped to the RIGHT HAND STUD under the throttle pedal. This is to prevent interference with the throttle pedal.

(3) Route the cable between the accelerator pedal mounting studs and secure with clip (Fig. 1). Be sure clip is on right hand stud.

(4) Place the ignition key cylinder in the ACCESSORY position.

(5) Remove shipping pin from plastic base.

(6) Connect the cable eyelet to the bellcrank pin (Fig. 10).

(7) Place gear selector in PARK.

(8) Push the spring-loaded cable adjuster forward and snap cable into bracket (Fig. 3).

(9) Push the cable adjuster lock clamp downward to lock it.

(10) Install the center console and related trim. Refer to Group 23, Body.

(11) Test the park-lock cable operation.

(12) Load the steering column up to the bracket. Refer to Column Assembly Replacement in this group.

TEST/INSPECTION

(1) Turn the ignition switch key to the LOCK position.

(2) Press inward on the gear selector handle release button, the button should not move.

(3) Turn the ignition switch key to the ON position.

(4) Press inward on the gear selector handle release button.

(5) Move the gear selector handle to the DRIVE or NEUTRAL position.

(6) Attempt to turn the ignition switch key to the LOCK position.

(7) If the park-lock cable is correctly adjusted, the key will not turn to the LOCK position.

(8) Press inward on the gear selector handle release button and move the gear selector handle to the PARK position.

(9) 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 required, slide the adjuster forward or rearward to obtain the correct position. Refer to Group 21, Transmission for additional information involving shift cable adjustment.

TORQUE SPECIFICATIONS

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	44 N•m (33 ft. lbs.)
Gear to Frame Bolts	88 N•m (65 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.)

J9319-76

STEERING LINKAGE

DESCRIPTION	TORQUE
Drag Link to Steering Knuckle Nut	74 N•m (55 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.)

J9319-77

STEERING PUMP

DESCRIPTION	TORQUE
Adjustment Bracket Bolts	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.)
5.2L Pump Bracket to Block	41 N•m (30 ft. lbs.)
5.2L Pump Body to Bracket	27 N•m (20 ft. lbs.)

J9319-78

STEERING COLUMN

DESCRIPTION	TORQUE
Air Bag Module Nuts	10 N·m (90 in. lbs.)
Steering Wheel to Column Shaft Nut	61 N·m (45 ft. lbs.)
Toe Plate Bolts/Nuts	12 N·m (105 in. lbs.)
Upper Bracket Support Stud/Nuts	12 N·m (105 in. lbs.)

J9319-52

TRANSMISSION AND TRANSFER CASE

CONTENTS

AX 15 MANUAL TRANSMISSION

INDEX

GENERAL INFORMATION

The AX 15 is a five 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).

TRANSMISSION IDENTIFICATION

The AX 15 identification code numbers are on the bottom surface of the transmission gear case (Fig. 2).

The first number represents year of manufacture. For example, 3 would represent 1993. The second and third numbers indicate month of manufacture.

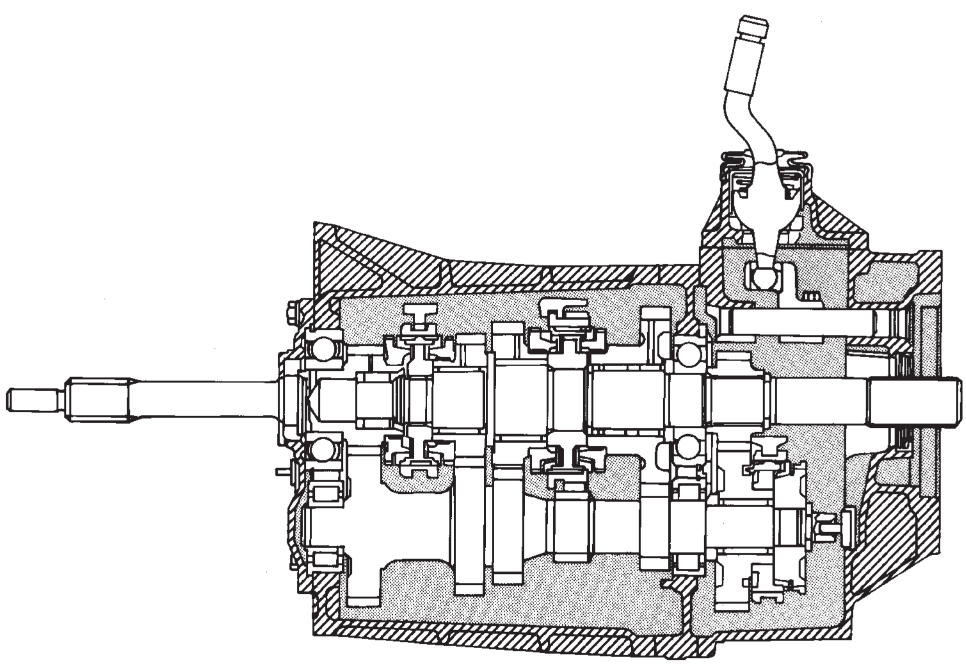


Fig. 1 AX 15 Manual Transmission

For example, 11 would represent November. The last series of numbers is the transmission serial number.

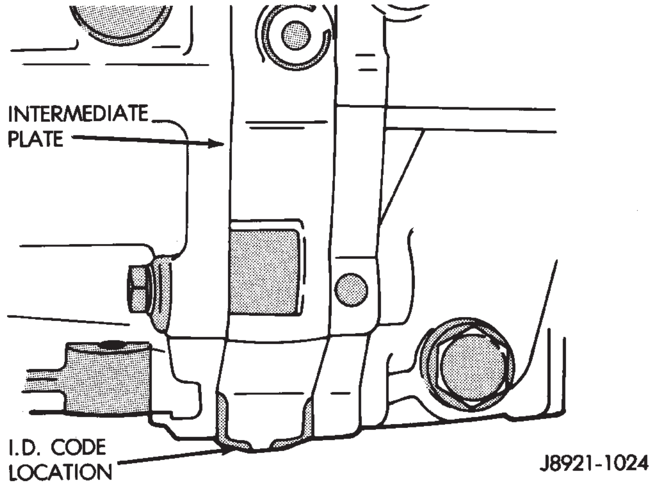


Fig. 2 Transmission Identification Code Location

TRANSMISSION SHIFT PATTERN

The AX 15 shift pattern is shown in Figure 3. First and second and third and fourth gear ranges are in an H pattern. Fifth and reverse gear ranges are also in line at the right of the H 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.

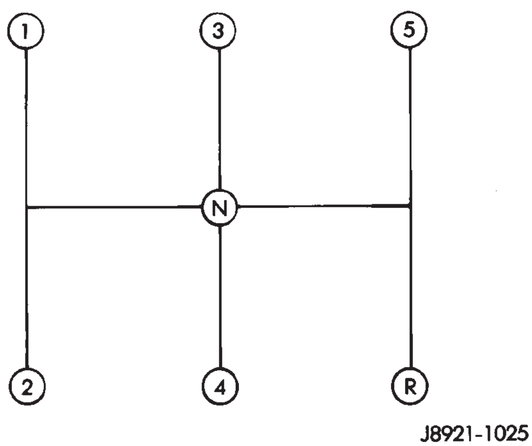


Fig. 3 AX 15 Shift Pattern

TRANSMISSION LUBRICANT

Recommended lubricant for AX 15 transmissions is Mopar SAE 75W-90, API Grade GL-5 gear lubricant.

Correct lubricant refill or top-off level is to the bottom edge of the fill plug hole.

Lubricant capacity is approximately 3.10 liters (3.27 qts.).

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).

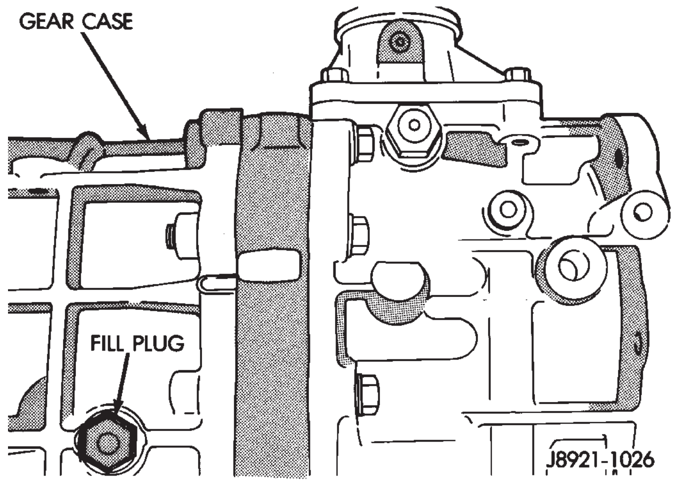


Fig. 4 Fill Plug Location

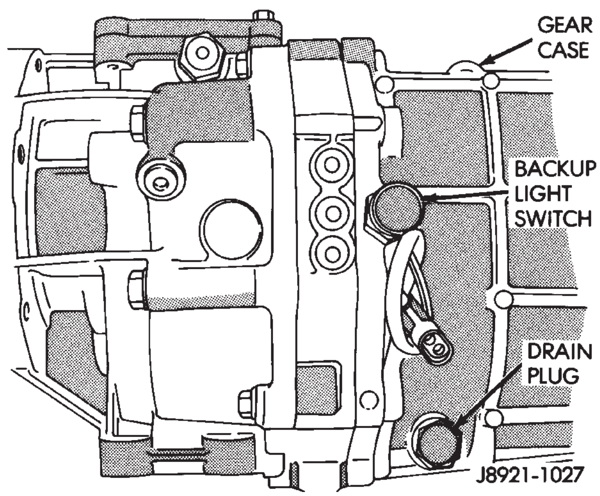


Fig. 5 Drain Plug And Backup Light Switch Location

TRANSMISSION GEAR RATIOS

AX 15 transmission gear ratios are:

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

TRANSMISSION 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 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 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 are from 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 the result of 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 hard shifting and noise.

Incorrect or contaminated lubricants 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 transmission noise is generally the result of a lubricant problem, or internal component damage. 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 Neutral.

(2) Raise vehicle on hoist.

(3) Remove skid plate.

(4) Mark front and rear propeller shafts for installation alignment (Fig. 1). Then remove shafts.

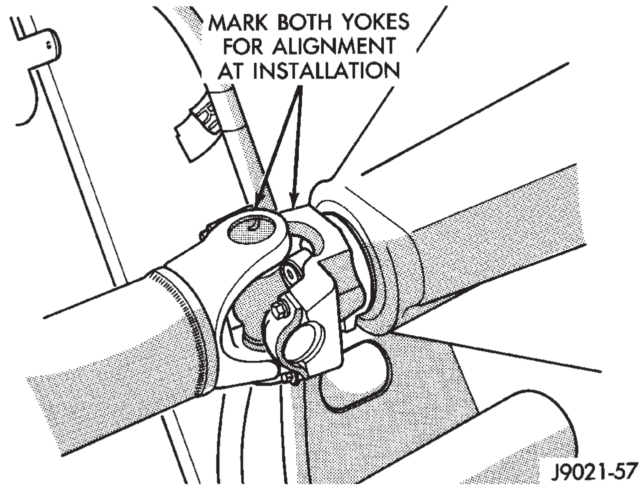


Fig. 1 Marking Propeller Shaft And Axle Yoke

(5) Disconnect transfer case shift linkage from shift lever, or range lever.

(6) Disconnect wire harness from distance sensor.

(7) Remove harness wires from clips on transmission case.

(8) Disconnect transmission and transfer case vent hoses.

(9) Disconnect wires at transfer case electrical switch.

(10) Support transmission with transmission jack. Secure transmission on jack with safety chains.

(11) Support engine with jack positioned under clutch housing or oil pan flange.

(12) Remove bolts/nuts attaching rear mount to crossmember (Fig. 2).

(13) Remove rear crossmember.

(14) Remove transfer case attaching nuts and remove transfer case from transmission.

(15) Lower transmission enough to provide access to shift lever.

(16) Reach up and around transmission case and unseat shift lever dust boot from transmission shift tower (Fig. 3). Move boot upward on shift lever for access to lever retainer.

(17) Disengage transmission 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. 3). **It is not necessary to remove shift lever from floorpan boot. Simply leave lever in place for later installation.**

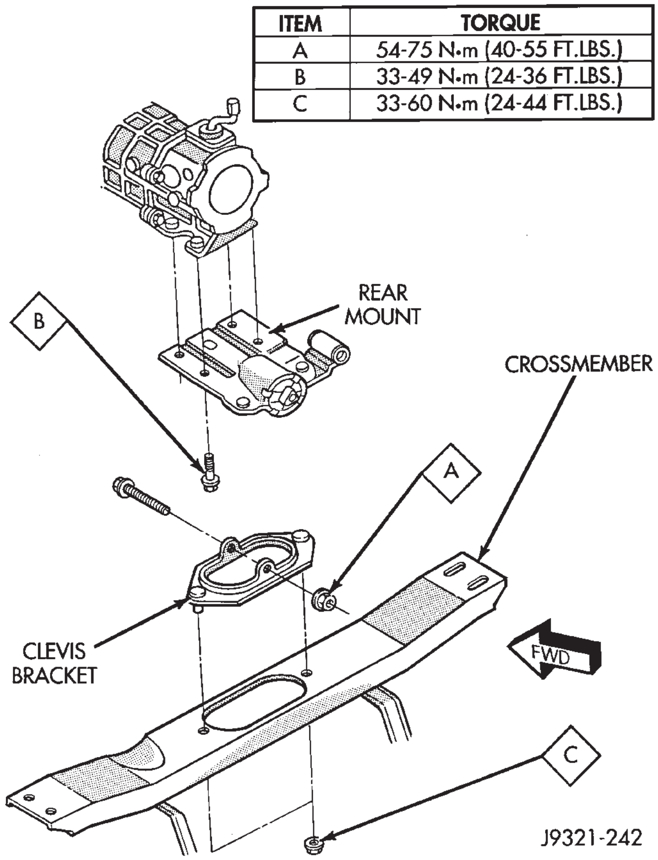


Fig. 2 Transmission Rear Mounting

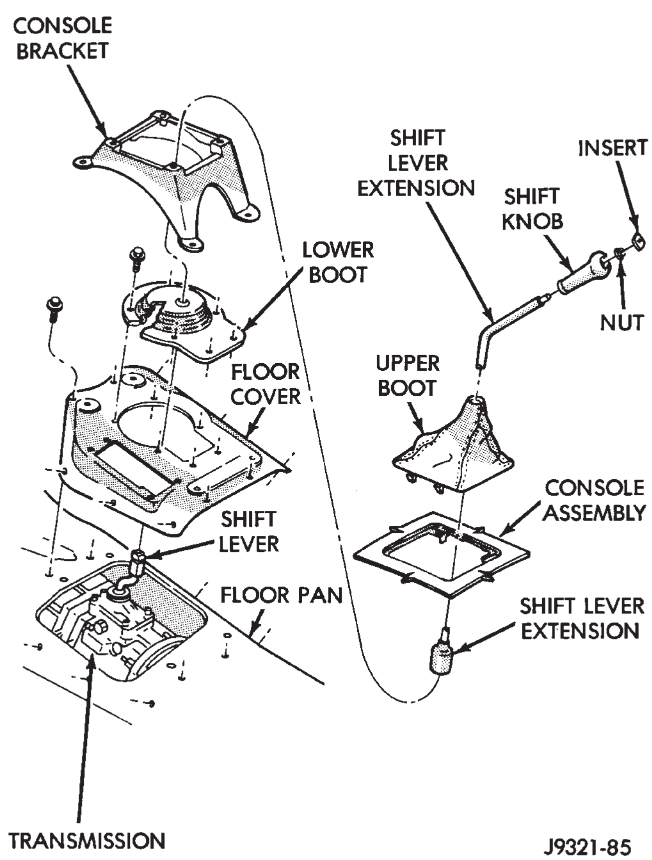


Fig. 3 Shift Lever Attachment

(18) Disconnect and remove engine timing sensor. Retain sensor attaching screws.

(19) Remove clutch slave cylinder from clutch housing. Move cylinder aside for working clearance and access to other components.

(20) Remove bolts attaching clutch housing to engine.

(21) Pull transmission rearward until clutch housing is clear of engine. Then remove transmission from under vehicle.

TRANSMISSION INSTALLATION

(1) Mount transmission and clutch housing assembly on transmission jack. Secure assembly with safety chains.

(2) Lubricate pilot bearing and transmission input shaft splines with Mopar high temperature grease.

(3) Align transmission input shaft and clutch disc splines and seat clutch housing on engine.

(4) Install and tighten bolts that clutch housing to engine. Tighten bolts to 61 N●m (45 ft. lbs.) torque.

(5) Lower transmission for access to transmission shift tower.

(6) 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.

(7) Align transfer case and transmission shafts and install transfer case. Tighten transfer attaching nuts to 35 N●m (26 ft. lbs.) torque.

(8) Move adjustable support stand from under engine and reposition it under transmission. Then remove transmission jack.

(9) Install rear crossmember. Tighten crossmember-to-frame bolts to 41 N●m (30 ft. lbs.) torque. Tighten transmission-to-rear support bolts/nuts to 45 N●m (33 ft. lbs.) torque.

(10) Install slave cylinder in clutch housing. Tighten cylinder attaching nuts securely.

(11) Connect or install engine timing sensor, if removed.

(12) Connect transfer case electrical switch wires.

(13) Connect transfer case shift rod to range lever.

(14) Connect transmission and transfer case vent hoses.

(15) Connect backup light switch wires.

(16) Connect distance sensor and sensor wires.

(17) Align and install front/rear propeller shafts. Tighten shaft U-joint clamp bolts to 19 N●m (170 in. lbs.) torque.

(18) 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.

(19) Top off transmission and transfer lubricant levels.

(20) Lower vehicle.

TRANSMISSION DISASSEMBLY AND OVERHAUL

ADAPTER HOUSING REMOVAL

(1) Remove release bearing, release lever and release fork from clutch housing. Then remove clutch housing from transmission.

(2) Remove backup light switch. Then remove drain plug (Fig. 1) and drain transmission lubricant into pan.

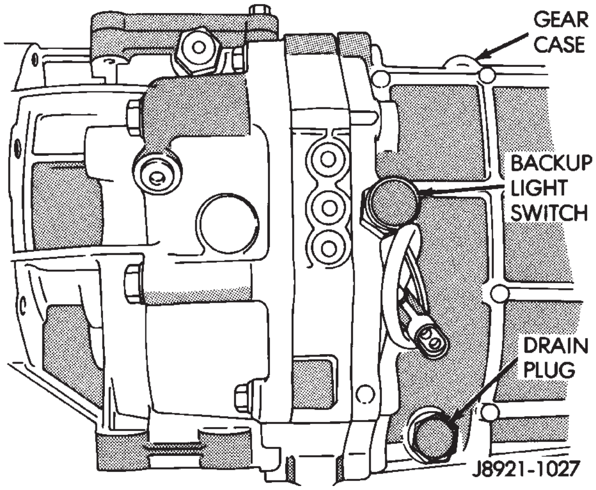


Fig. 1 Drain Plug And Backup Light Switch Location

(3) Remove shift tower bolts and remove tower from adapter or extension housing (Fig. 2).

(4) Remove gasket from shift tower (Fig. 3).

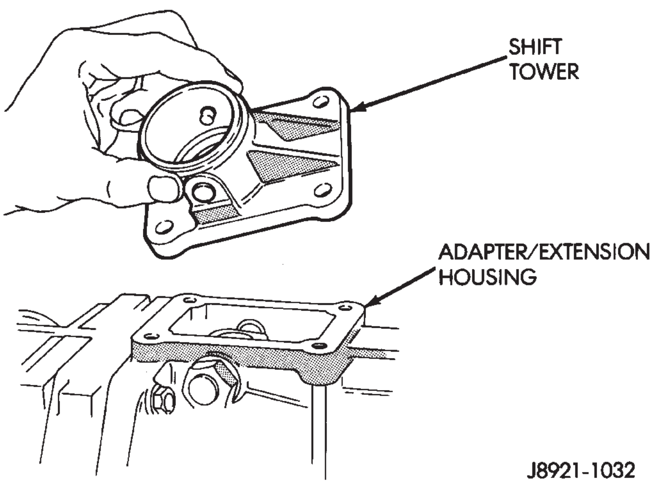


Fig. 2 Shift Tower Removal/Installation

(5) Remove shift arm retainer bolt (Fig. 4).

(6) Loosen and remove restrictor pins (Fig. 5).

(7) Remove shift arm shaft plug (Fig. 6).

(8) Remove shift arm shaft with large magnet (Fig. 7).

(9) Remove shift arm (Fig. 8).

(10) Remove plug for reverse shift head lock ball. Plug is at right side of adapter housing near backup light switch (Fig. 9).

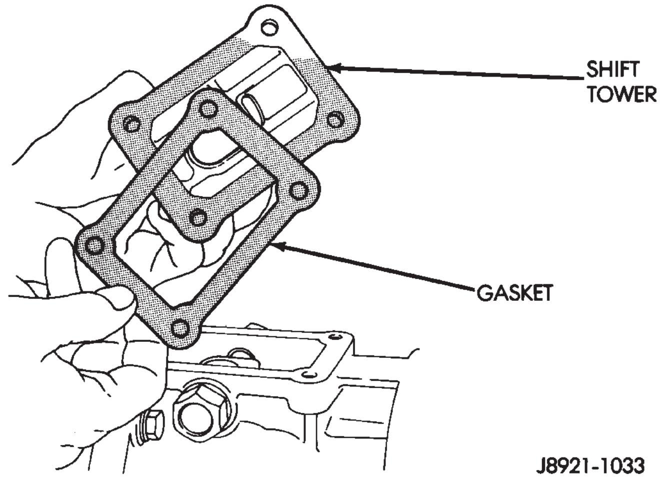


Fig. 3 Shift Tower Gasket Removal/Installation

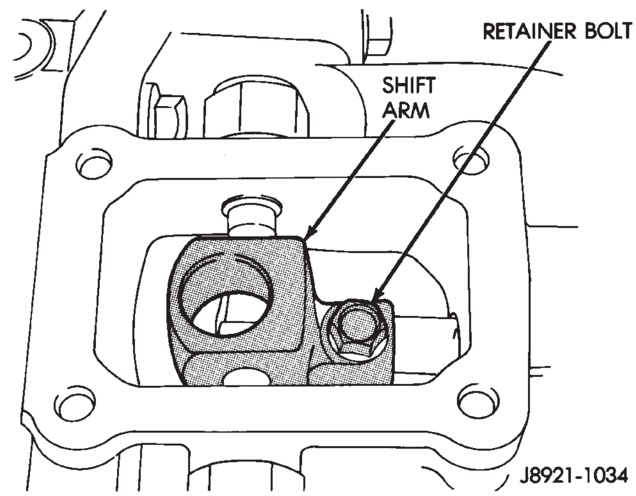


Fig. 4 Shift Arm Retainer Bolt Removal/Installation

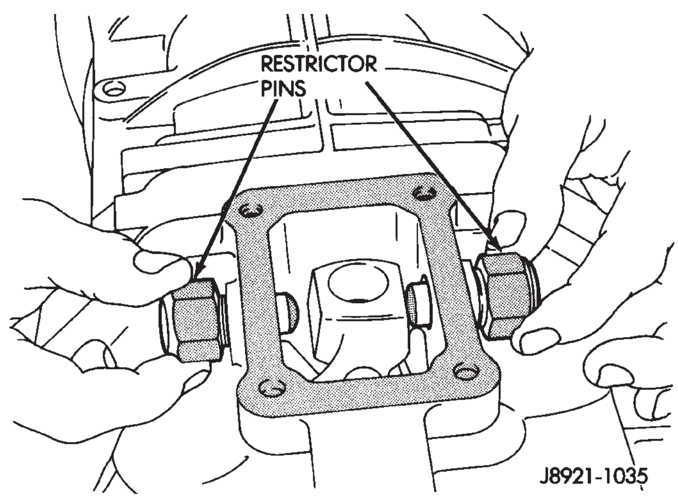


Fig. 5 Removing/Installing Restrictor Pins

(11) Remove lock ball spring with pencil magnet (Fig. 10).

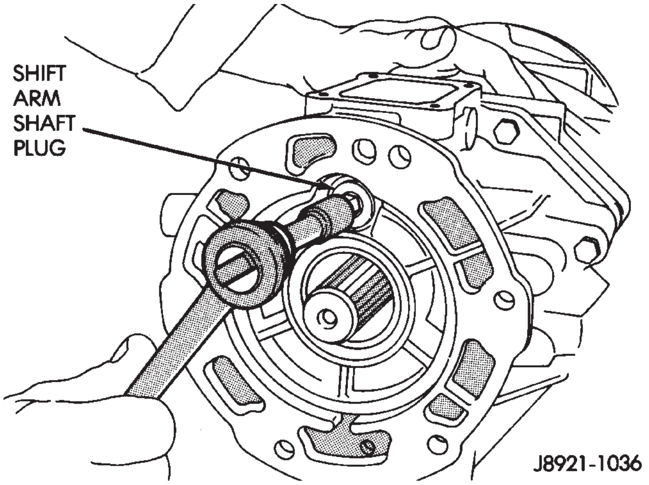


Fig. 6 Removing/Installing Shift Lever Shaft Plug

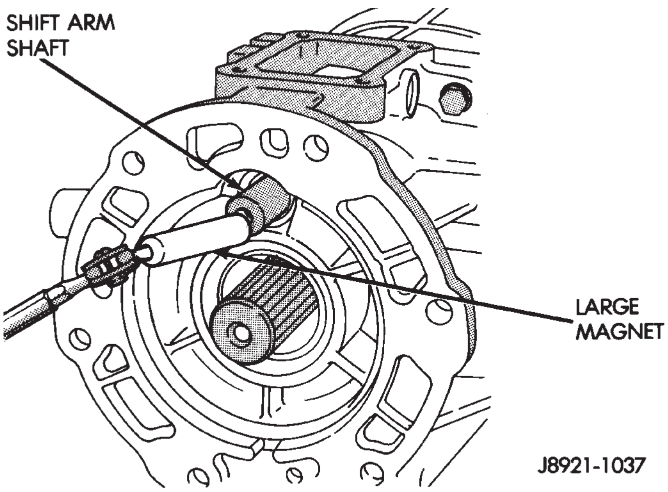


Fig. 7 Removing/Installing Shift Lever Shaft

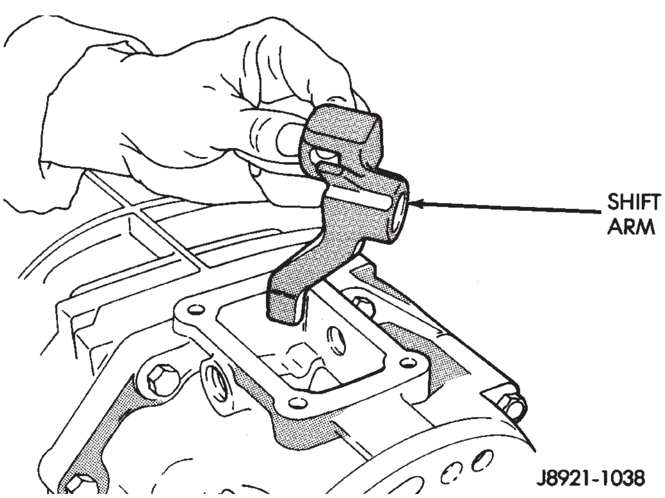


Fig. 8 Shift Arm Removal/Installation

(12) Remove shift head lock ball with pencil magnet (Fig. 11).

(13) Remove adapter housing bolts (Fig. 12).

(14) Loosen adapter/extension housing with rubber mallet (Fig. 13).

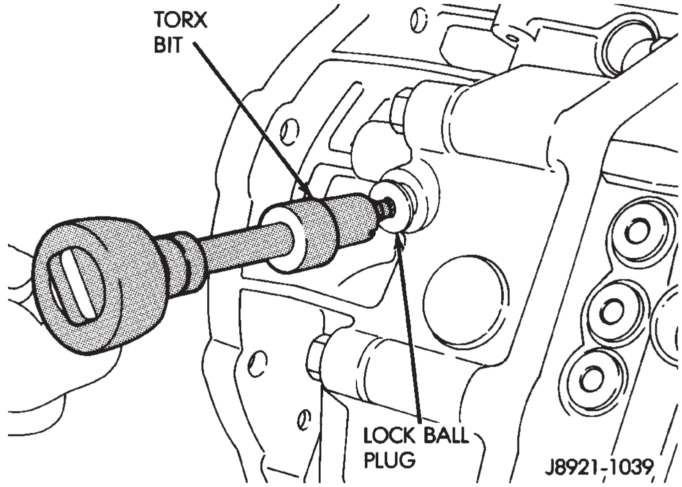


Fig. 9 Removing/Installing Lock Ball Plug

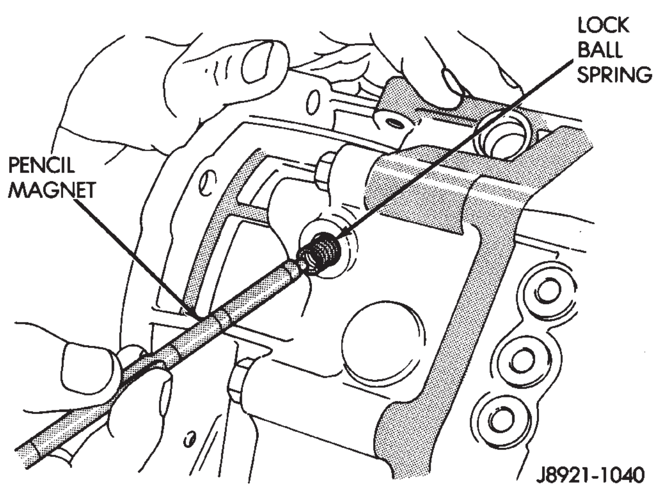


Fig. 10 Removing/Installing Lock Ball Spring

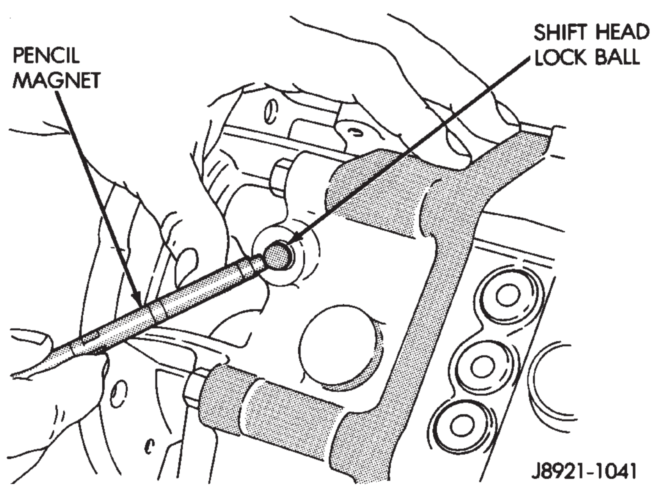


Fig. 11 Removing/Installing Shift Head Lock Ball

(15) Remove housing after loosening it (Fig. 14)

(16) Remove adapter housing oil seal with a pry tool (Fig. 15).

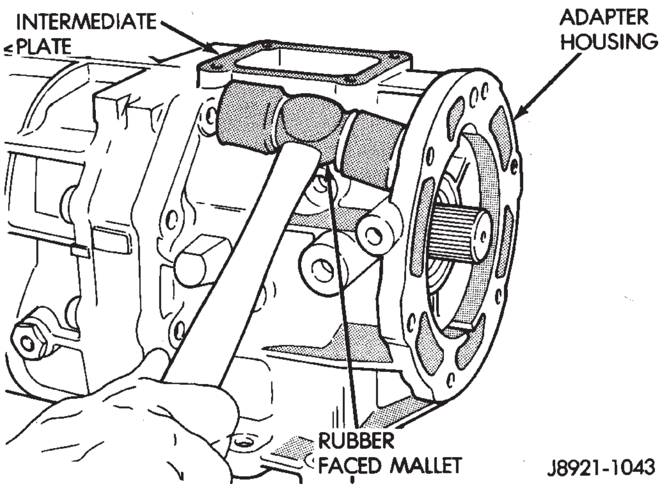


Fig. 13 Loosening Adapter Housing

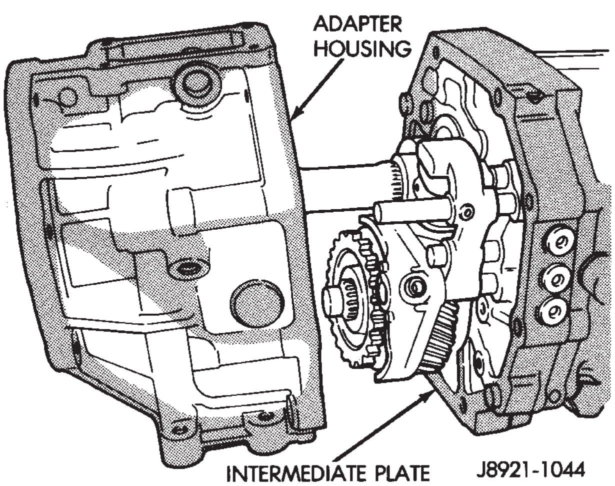


Fig. 14 Adapter Housing Removal

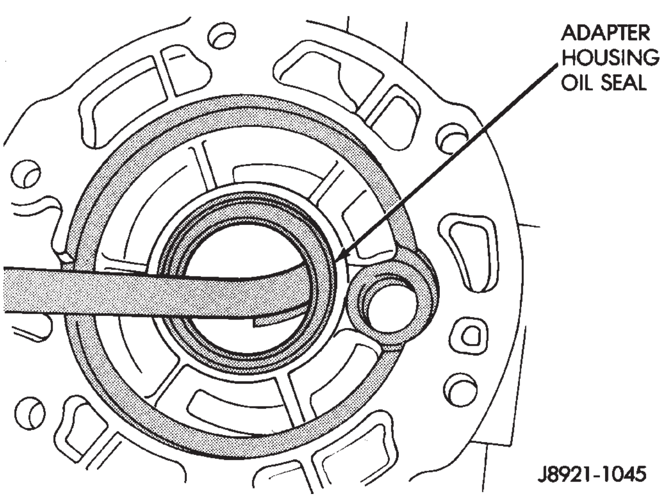
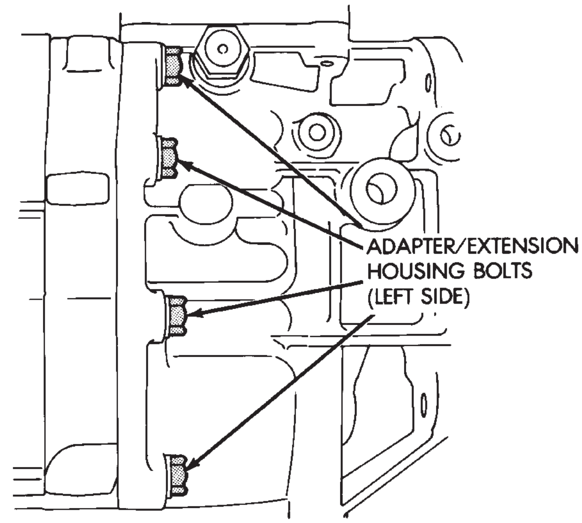
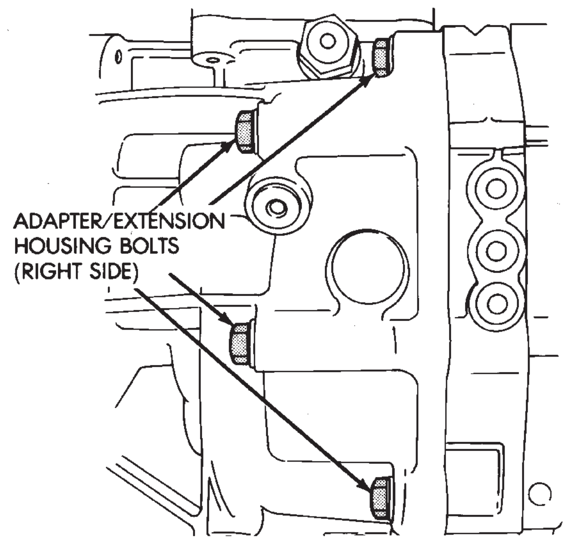


Fig. 15 Removing Adapter Housing Seal





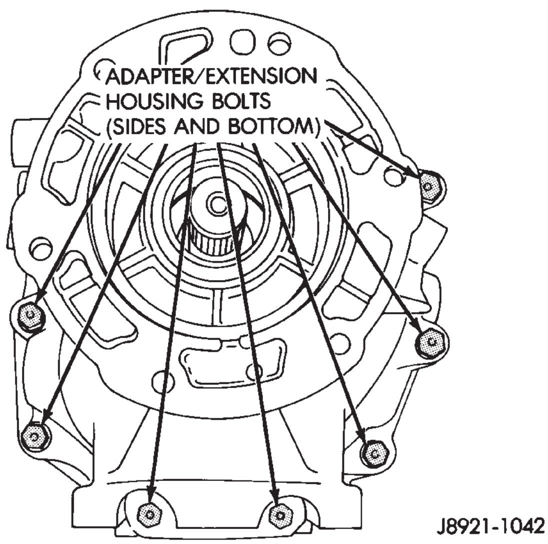


Fig. 12 Adapter Housing Bolt Locations

GEAR CASE REMOVAL

(1) Remove bearing retainer bolts and remove retainer (Fig. 16).

(2) Remove retainer oil seal with pry tool (Fig. 17).

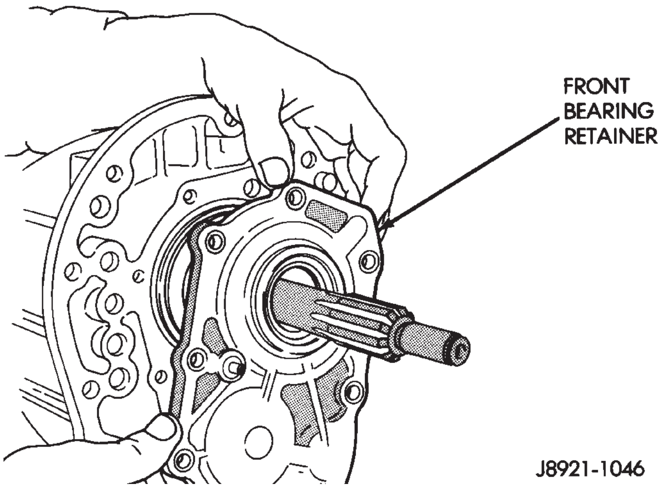


Fig. 16 Front Bearing Retainer Removal

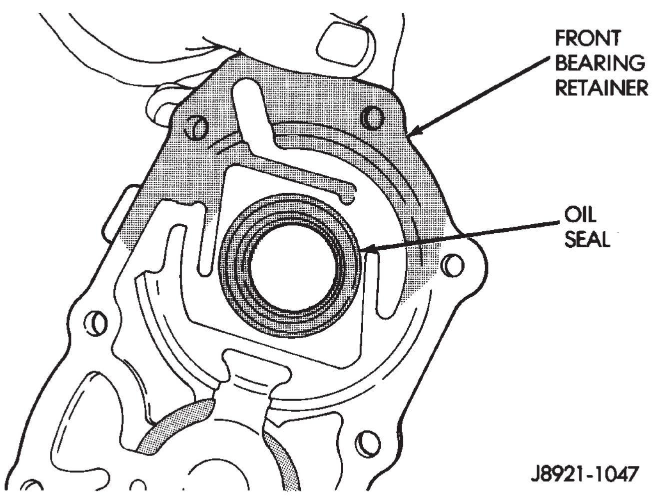


Fig. 17 Front Bearing Retainer Seal Location

(3) Remove input shaft bearing snap ring (Fig. 18).

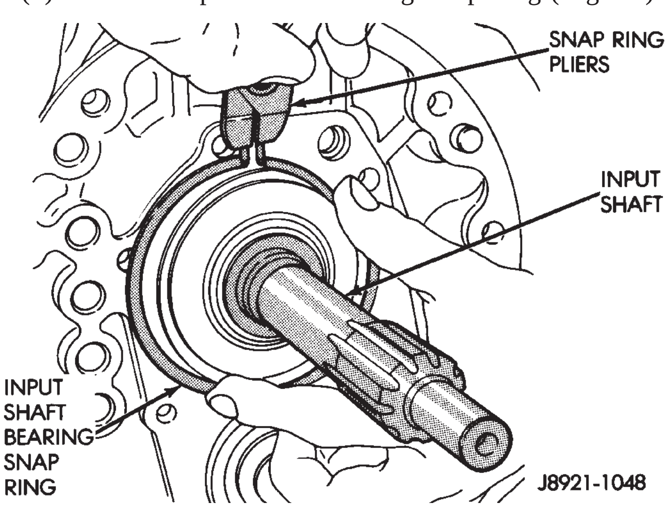


Fig. 18 Removing Input Shaft Bearing Snap Ring

(4) Remove cluster gear front bearing snap ring (Fig. 19).

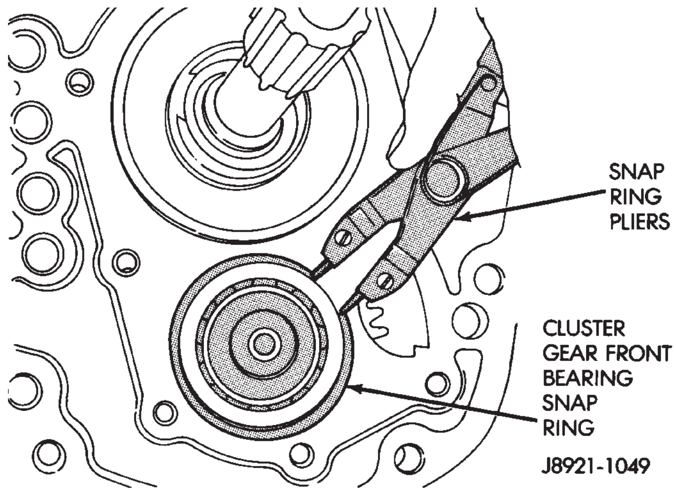


Fig. 19 Removing Cluster Gear Front Bearing Snap Ring

(5) Loosen gear case by tapping it away from intermediate plate with rubber mallet (Fig. 20).

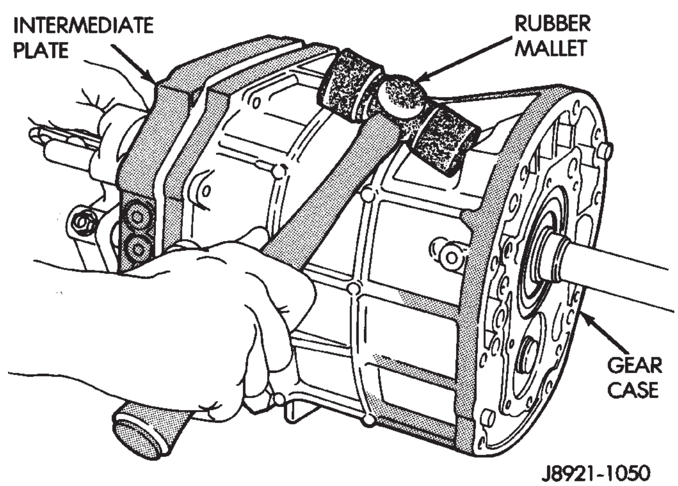


Fig. 20 Loosening Gear Case

(6) Remove gear case from geartrain and intermediate plate (Fig. 21).

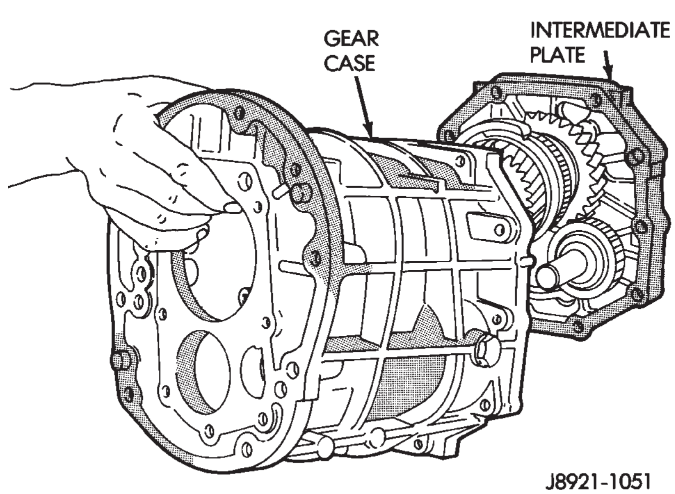


Fig. 21 Gear Case Removal

(7) 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).

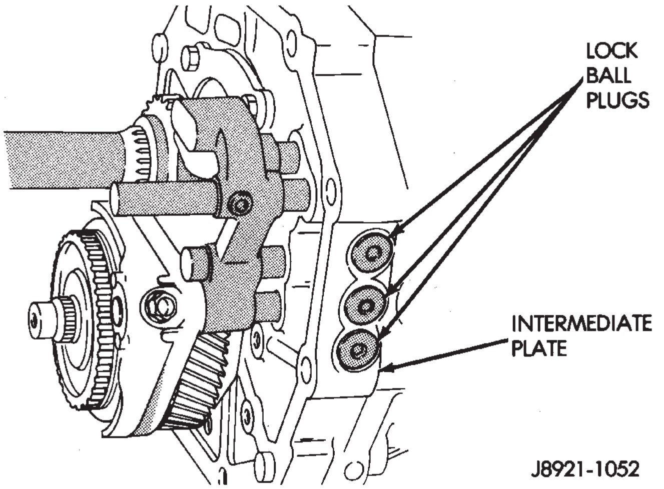


Fig. 22 Lock Ball Plug Locations

(2) Remove three lock ball springs and lock balls from intermediate plate with pencil magnet (Fig. 23).

(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).

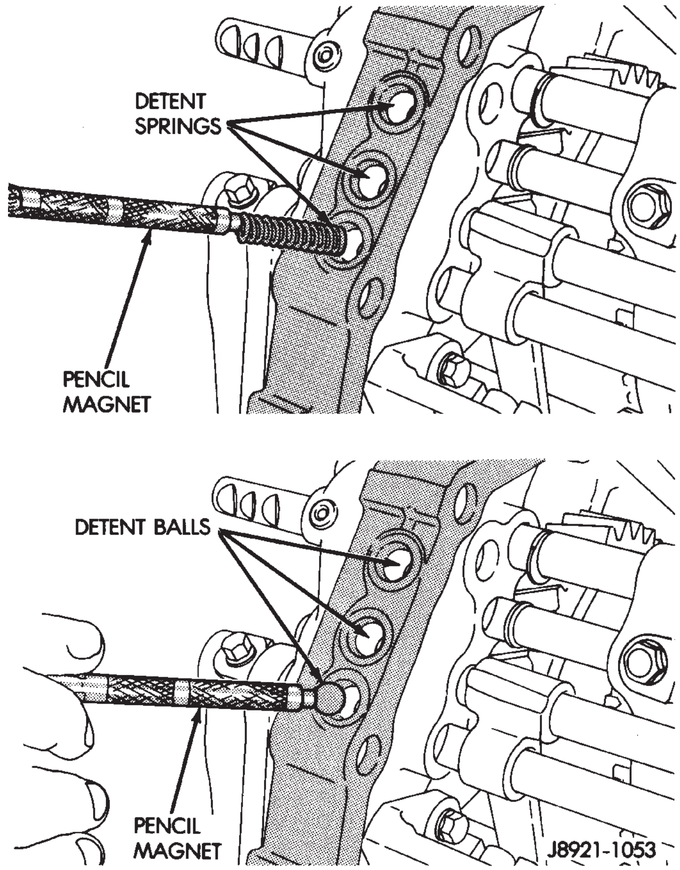


Fig. 23 Removing/Installing Lock Ball And Spring

(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.**

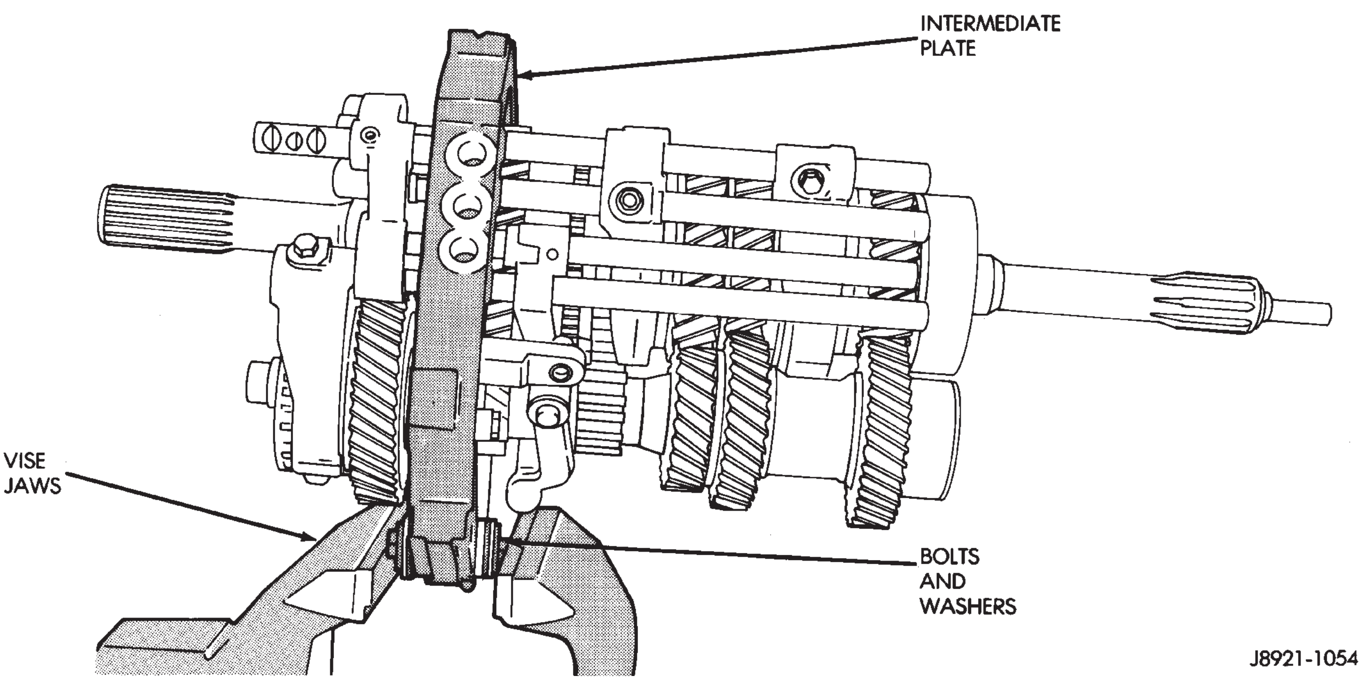


Fig. 24 Mounting Intermediate Plate And Geartrain In Vise

(4) Remove fifth gear snap ring (Fig. 25). Retain snap ring for assembly reference. It is a select fit component.

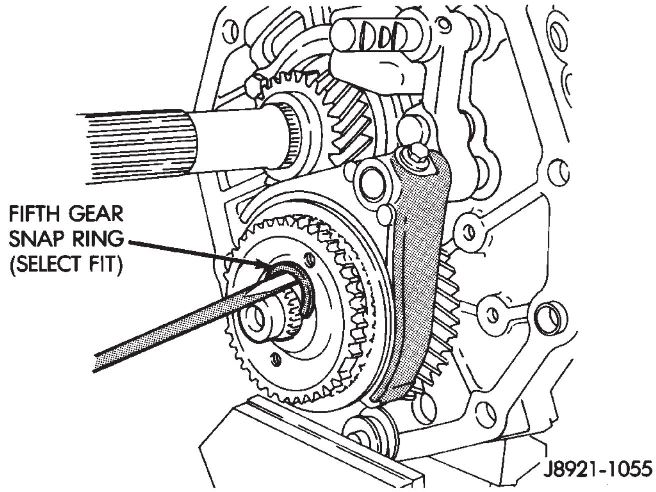


Fig. 25 Fifth Gear Snap Ring Removal

(5) Remove E-ring that secures reverse shift arm to fork (Fig. 26).

(6) Remove bolts attaching reverse shift arm bracket to intermediate plate. Then remove bracket (Fig. 27).

(7) Remove reverse shift arm and shoe (Fig. 28).

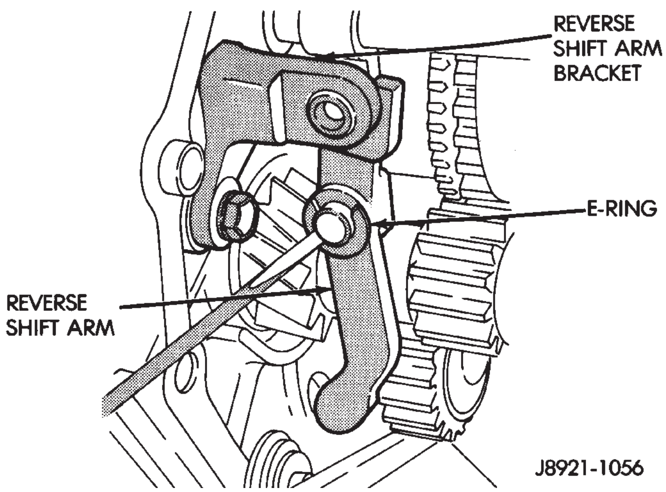


Fig. 26 Removing Reverse Shift Arm E-Ring

(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 to 0.40 mm (0.003 to 0.019 in.). If clearance exceeds limits, gear and/or ring will have to be replaced.

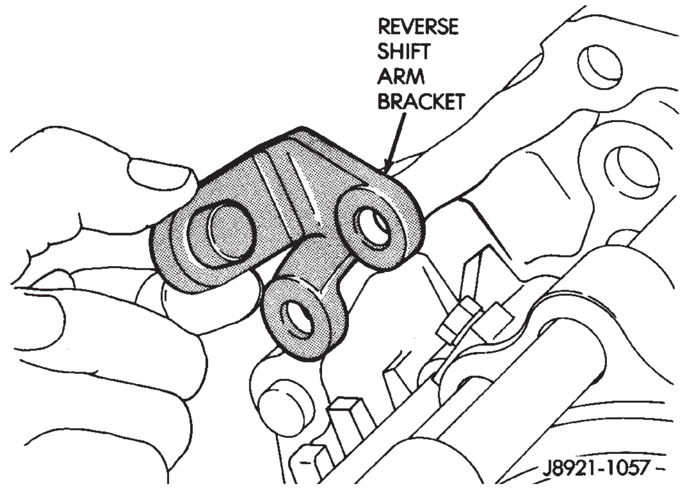


Fig. 27 Removing Reverse Shift Arm Bracket

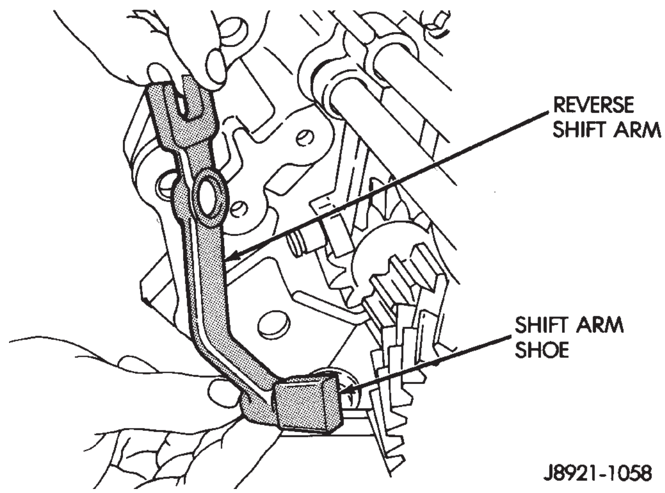


Fig. 28 Removing Reverse Shift Arm And Shoe

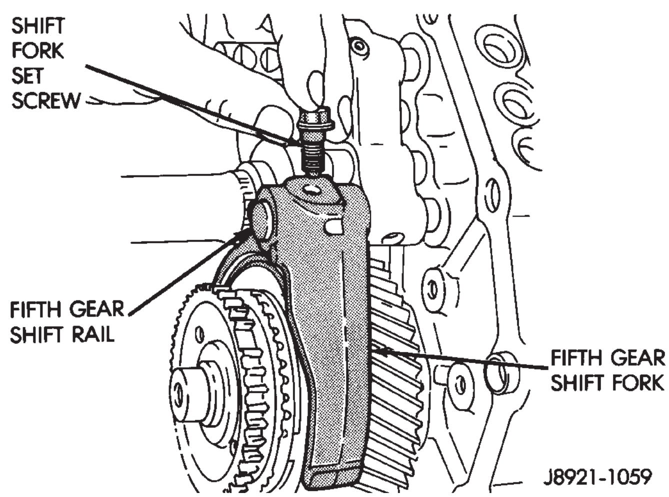


Fig. 29 Removing Fifth Gear Fork Set Screw

(13) Loosen fifth spline gear with standard two-jaw puller (Fig. 32). **Position puller jaws behind fifth counter gear as shown.**

(14) Remove fifth spline gear (Fig. 33).

(15) Remove fifth gear synchro ring (Fig. 34).

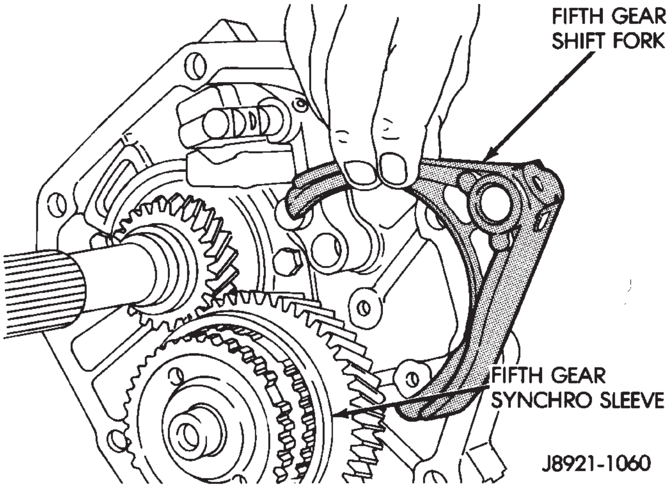


Fig. 30 Removing Fifth Gear Shift Fork

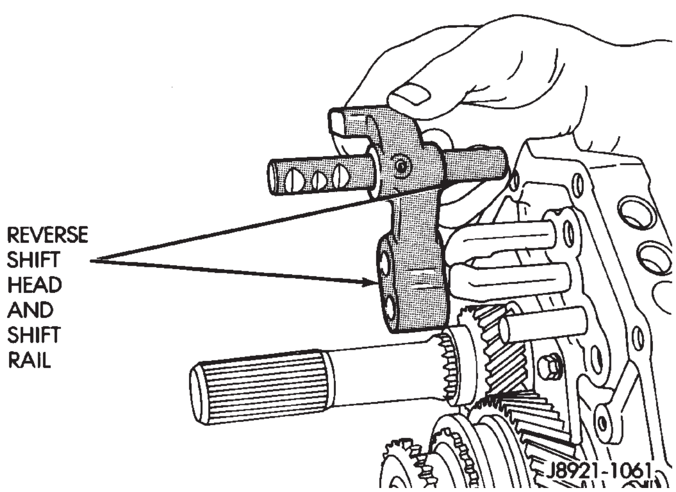


Fig. 31 Removing Reverse Shift Head And Rail

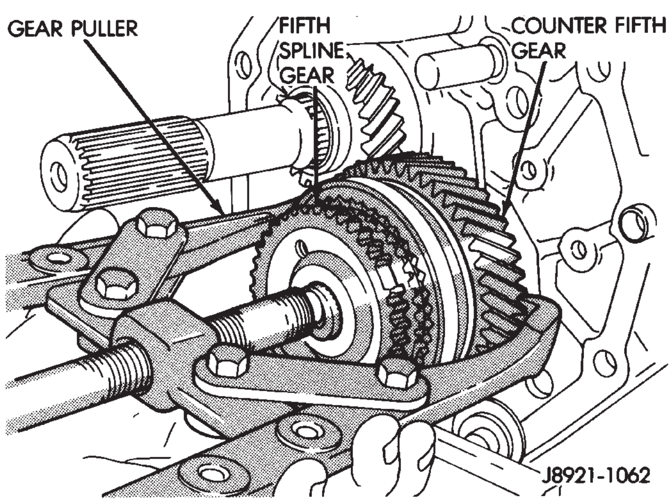


Fig. 32 Loosening Fifth Spline Gear

(16) Remove fifth gear synchro and sleeve assembly (Fig. 35).

(17) Remove counter fifth gear thrust ring (Fig. 36).

(18) Remove thrust ring lock ball with pencil magnet (Fig. 37).

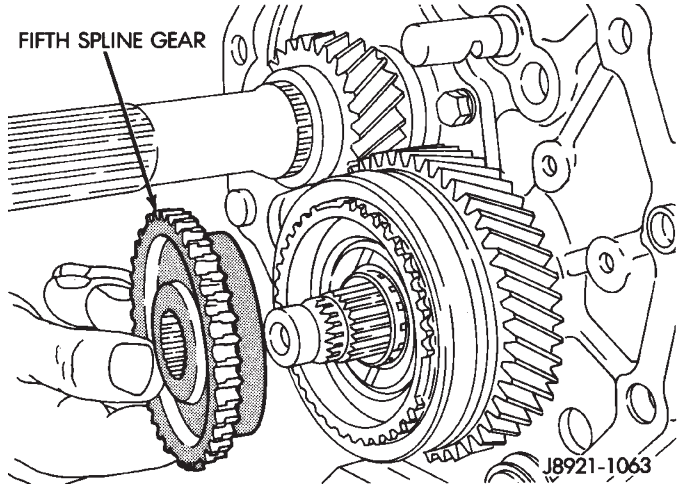


Fig. 33 Removing Fifth Spline Gear

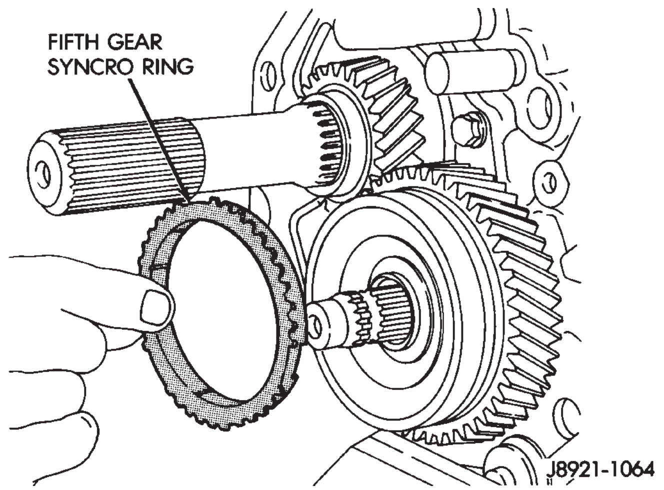


Fig. 34 Removing Fifth Gear Synchro Ring

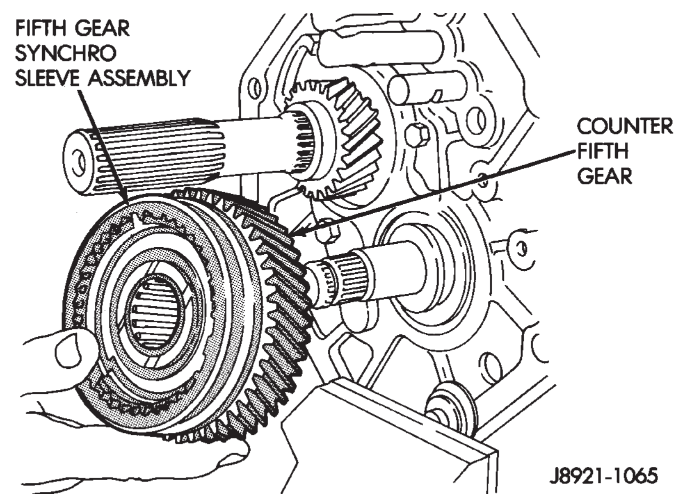


Fig. 35 Removing Counter Fifth Gear And Synchro Assembly

(19) Remove bolts attaching output shaft rear bearing retainer to intermediate plate (Fig. 38).

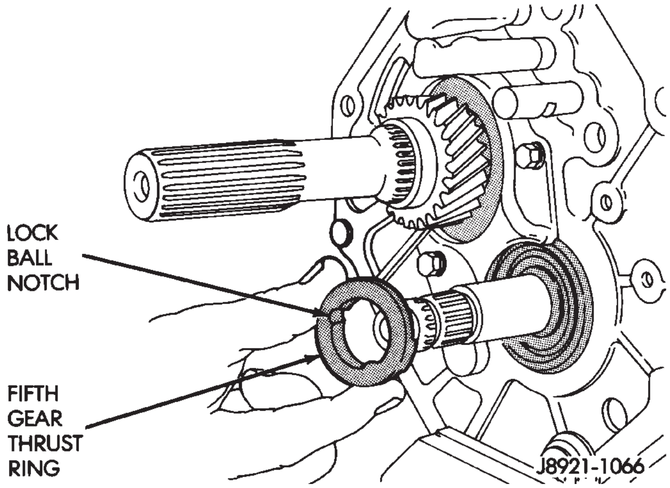


Fig. 36 Removing Fifth Gear Thrust Ring

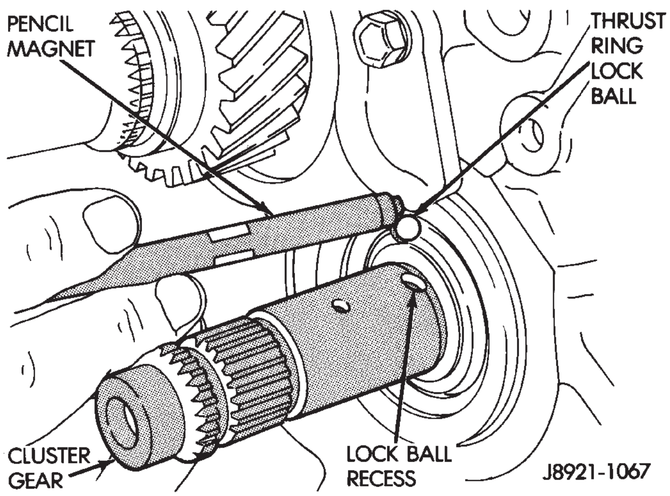


Fig. 37 Removing Thrust Ring Lock Ball

(20) Remove rear bearing retainer (Fig. 39).
(21) Remove reverse gear and shaft (Fig. 40).

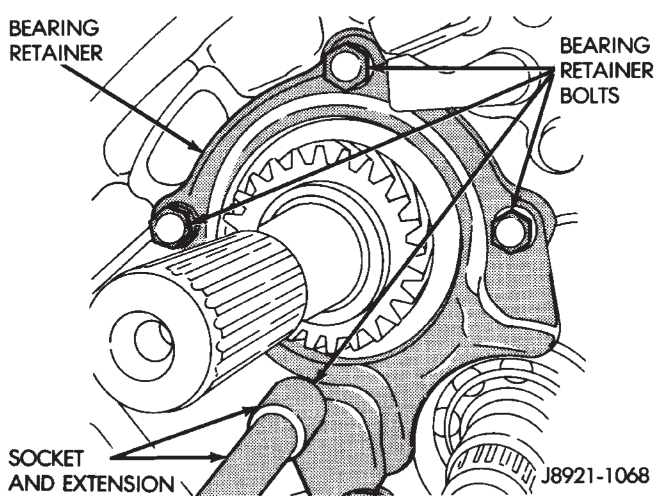


Fig. 38 Removing Output Shaft Rear Bearing Retainer Bolts

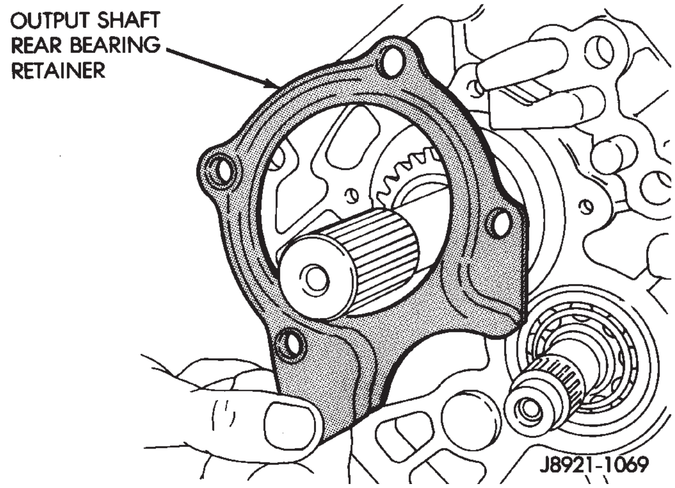


Fig. 39 Removing Output Shaft Rear Bearing Retainer

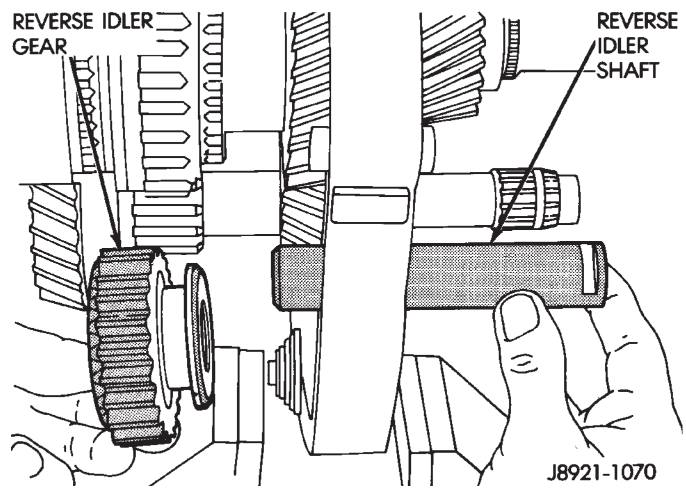


Fig. 40 Removing Reverse Idler Gear And Shaft

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 are in good condition. Only the shift forks need be removed for access to the 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).

(3) Remove shift fork set screws (Fig. 43).

(4) Remove 3-4 shift rail from shift fork and intermediate plate (Fig. 44).

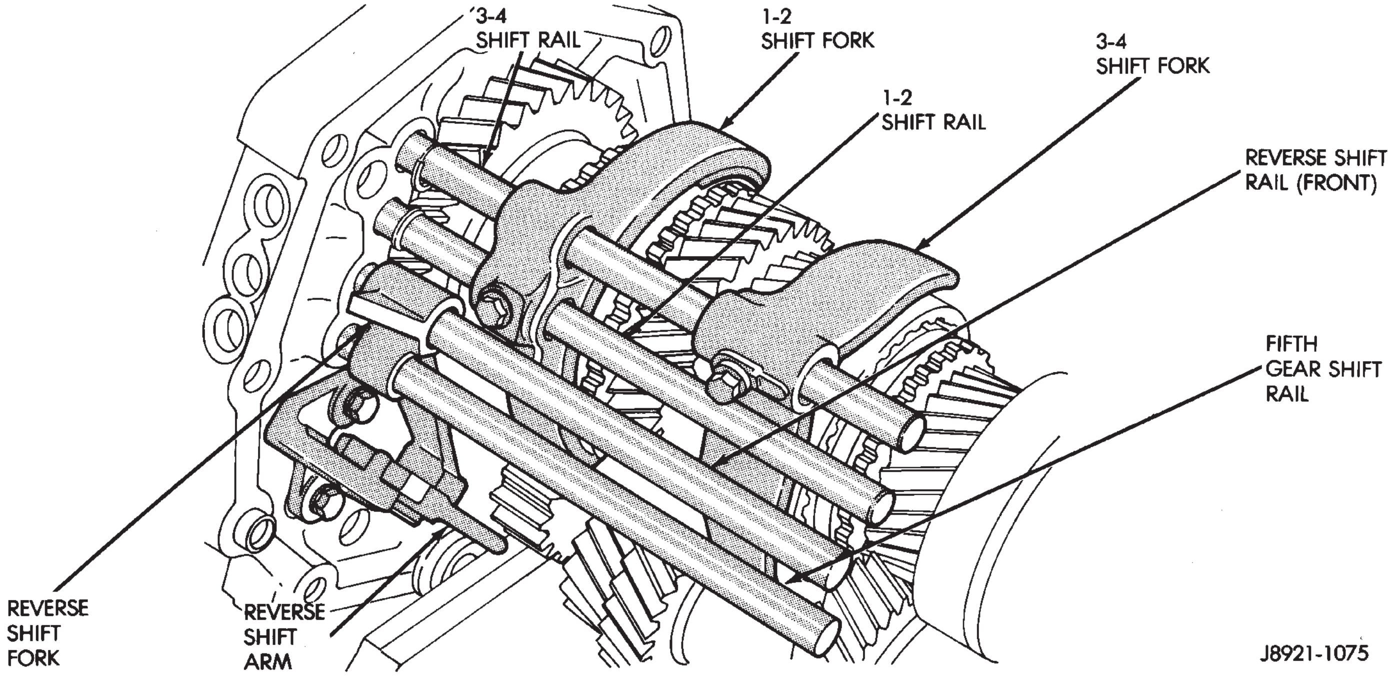


Fig. 41 Shift Rail Identification

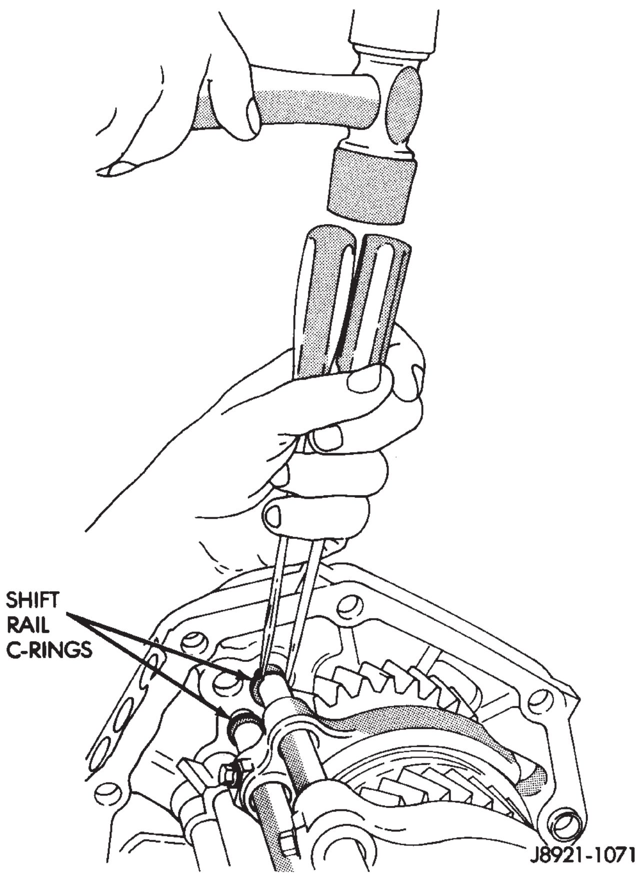


Fig. 42 Removing Shift Rail C-Rings

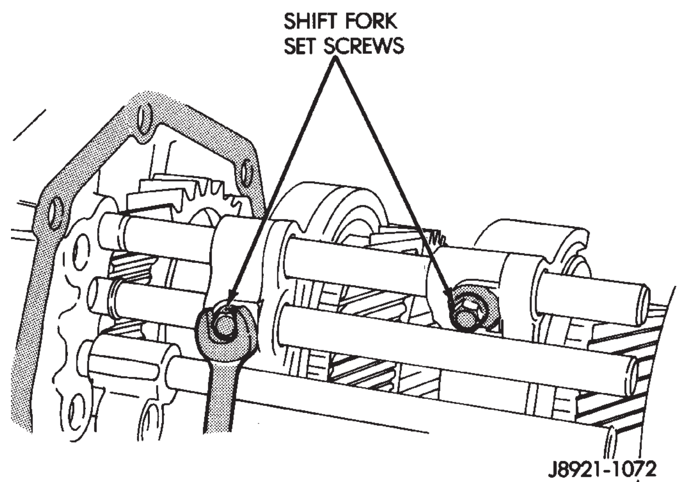


Fig. 43 Removing Shift Fork Set Screws

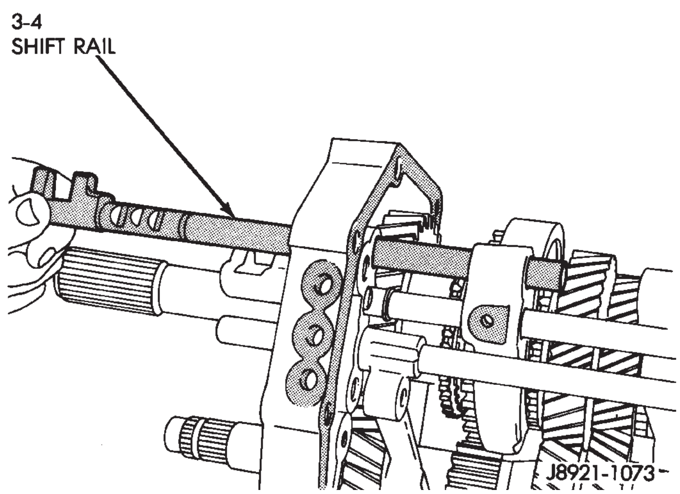


Fig. 44 Removing 3-4 Shift Rail

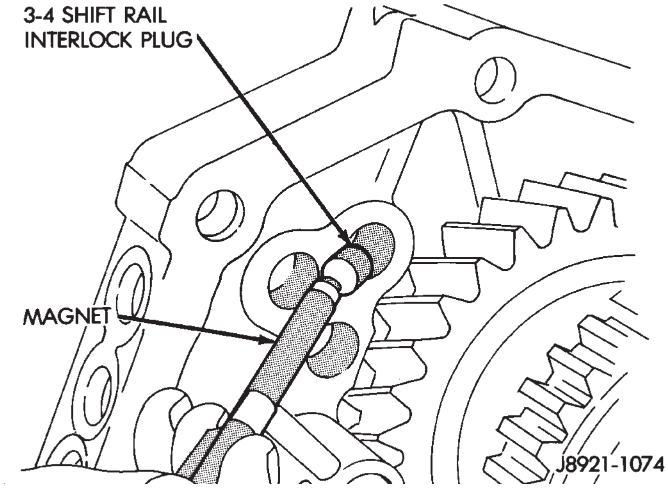


Fig. 45 Removing 3-4 Shift Rail Interlock Plug

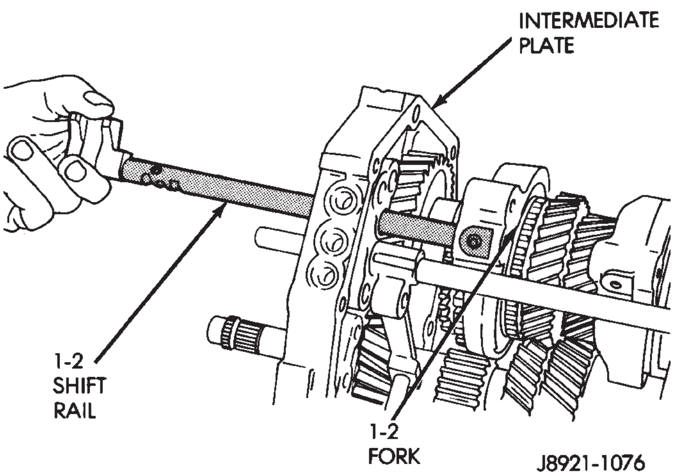


Fig. 46 Removing 1-2 Shift Rail

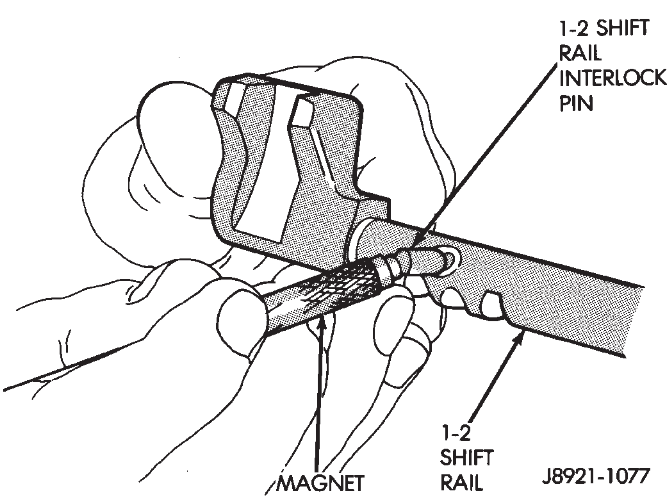


Fig. 47 Removing 1-2 Shift Rail Interlock Pin

(5) Remove 3-4 shift rail interlock plug from intermediate plate with magnet (Fig. 45).

(6) Remove 1-2 shift rail from shift fork and intermediate plate (Fig. 46).

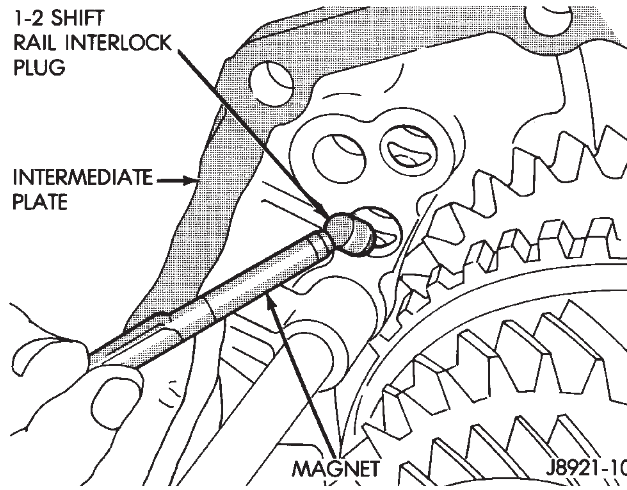


Fig. 48 Removing 1-2 Shift Rail Interlock Plug

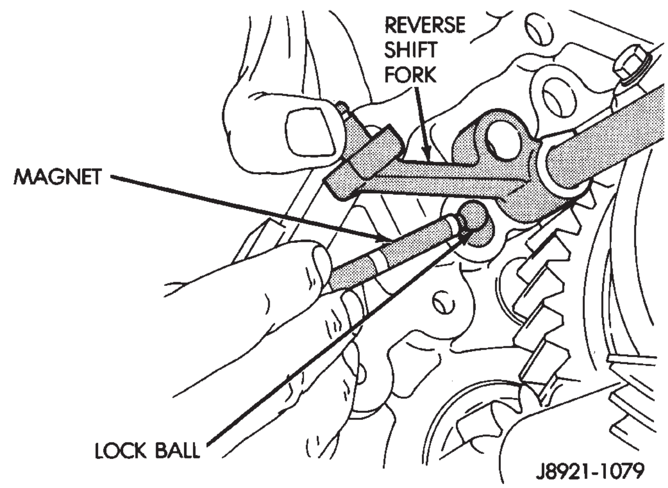


Fig. 49 Removing Fifth Gear Shift Rail Lock Ball

(7) Remove 1-2 shift rail interlock pin from shift rail (Fig. 47).

(8) Remove 1-2 shift rail interlock plug from intermediate plate (Fig. 48).

(9) Lift reverse shift fork upward and remove fifth gear shift rail lock ball (Fig. 49).

(10) Remove 3-4 shift fork (Fig. 50).

(11) Remove 1-2 shift fork (Fig. 50).

(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.

OUTPUT SHAFT AND CLUSTER GEAR REMOVAL

(1) Remove output shaft rear bearing snap ring (Fig. 54).

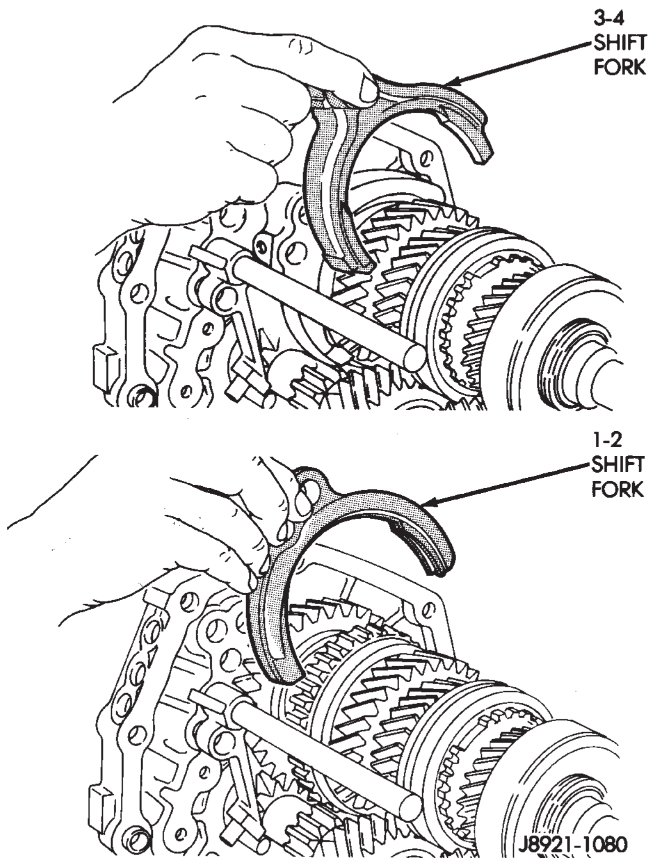


Fig. 50 Shift Fork Removal

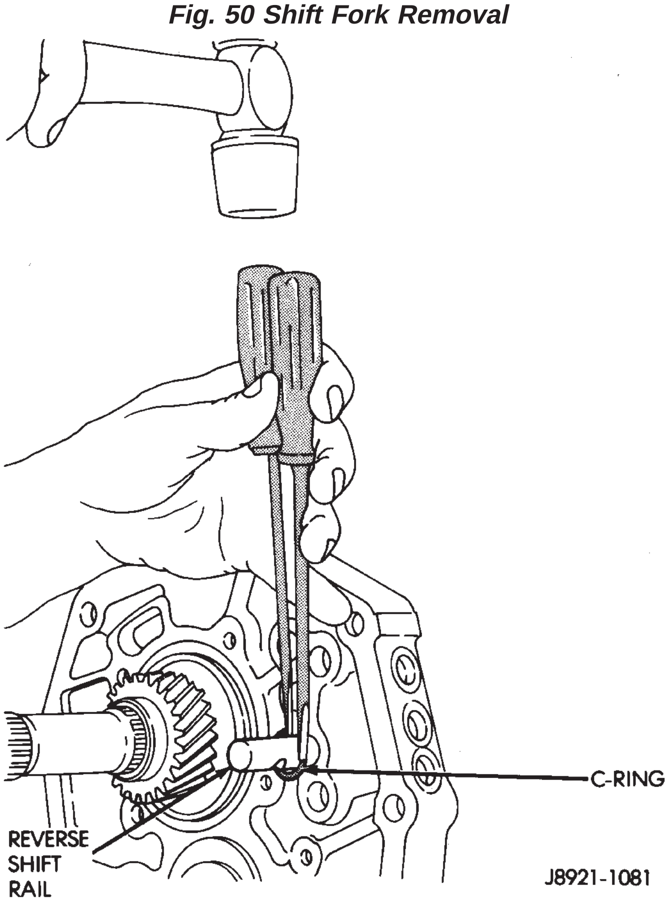


Fig. 51 Removing Reverse Shift Rail C-Ring

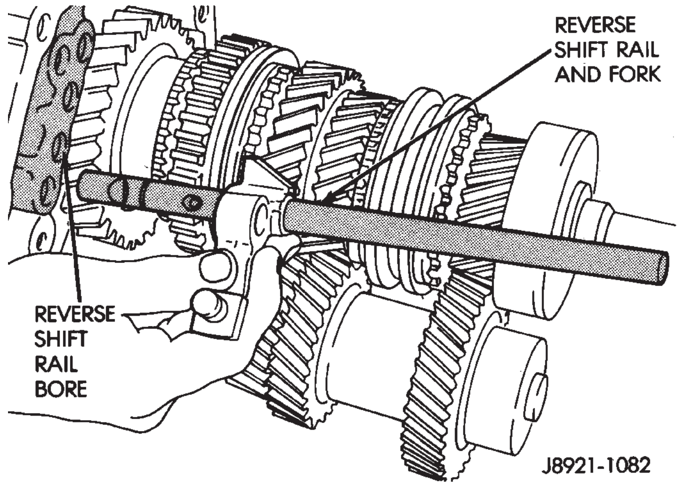


Fig. 52 Removing Reverse Shift Rail And Fork

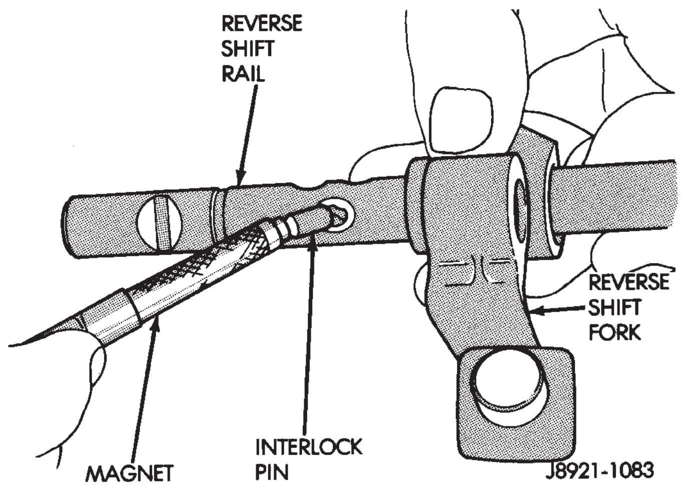


Fig. 53 Removing Reverse Shift Rail Interlock Pin

(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).

(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).

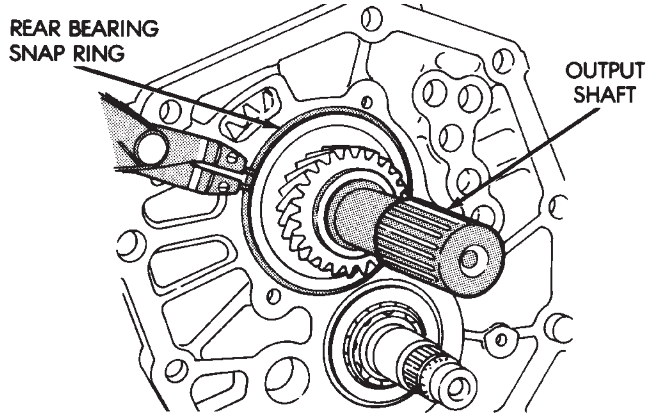
(8) Remove output shaft pilot bearing from input shaft (Fig. 60).

(9) Remove synchro ring from input shaft (Fig. 61).

(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).



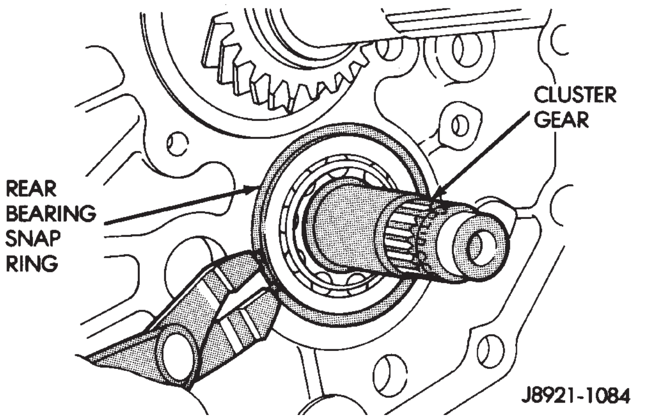


Fig. 54 Removing Bearing Snap Rings

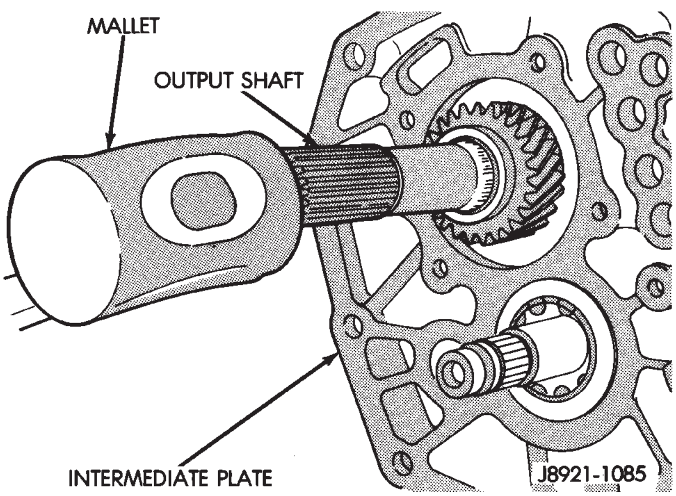


Fig. 55 Unseating Output Shaft Rear Bearing

• 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 output shaft flange is worn. Refer to output shaft inspection in Cleaning and Inspection section.**

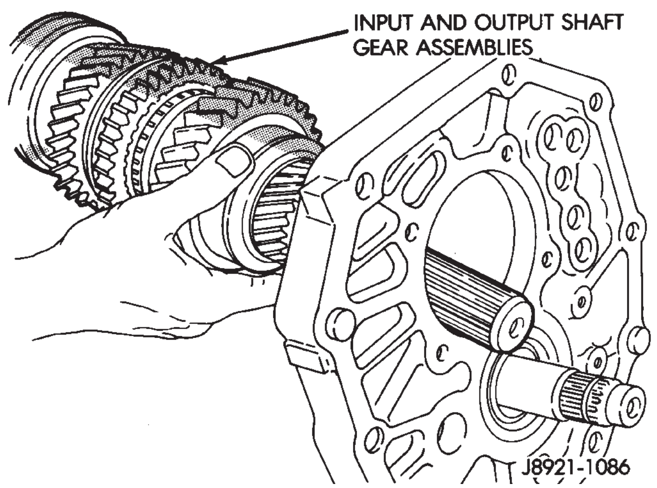


Fig. 56 Removing Assembled Input And Output Shaft

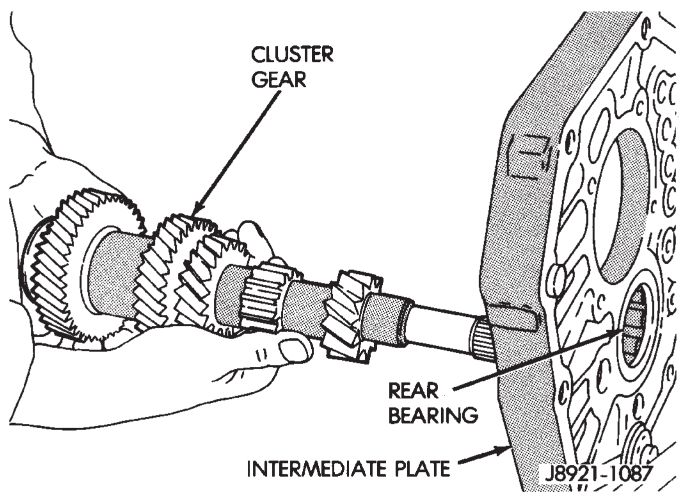


Fig. 57 Cluster Gear Removal

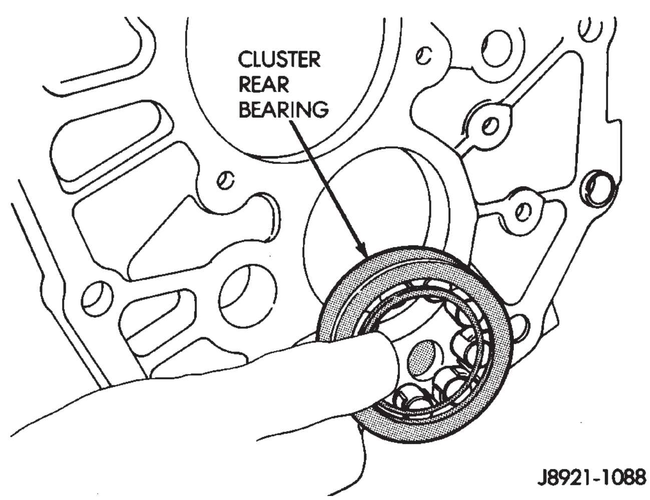


Fig. 58 Removing Cluster Gear Rear Bearing

(3) Press fifth gear and rear bearing off rear of output shaft.

(4) Remove thrust washer, pin, and first gear and bearing (Fig. 62).

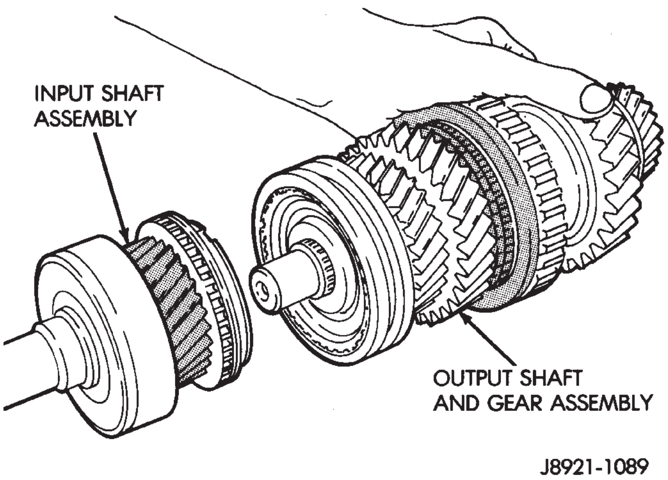


Fig. 59 Input Shaft Removal

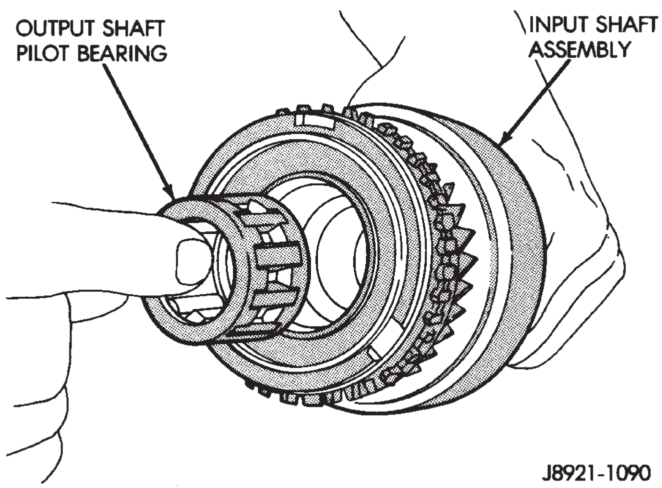


Fig. 60 Removing Input Shaft Pilot Bearing

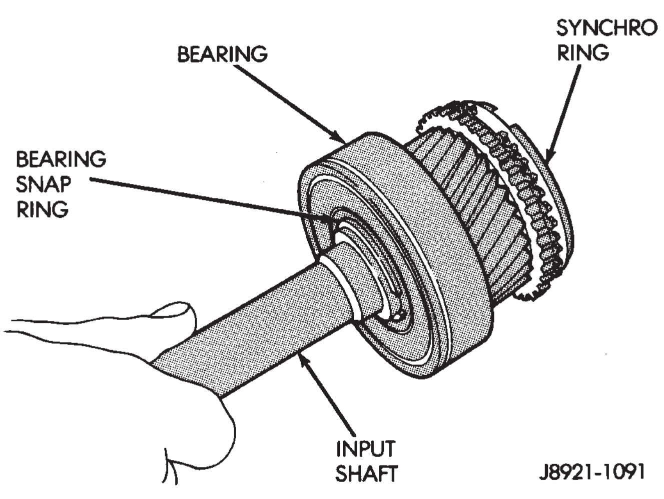


Fig. 61 Input Shaft Components

(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.

(8) Remove remaining synchro ring and second gear and bearing (Fig. 63).

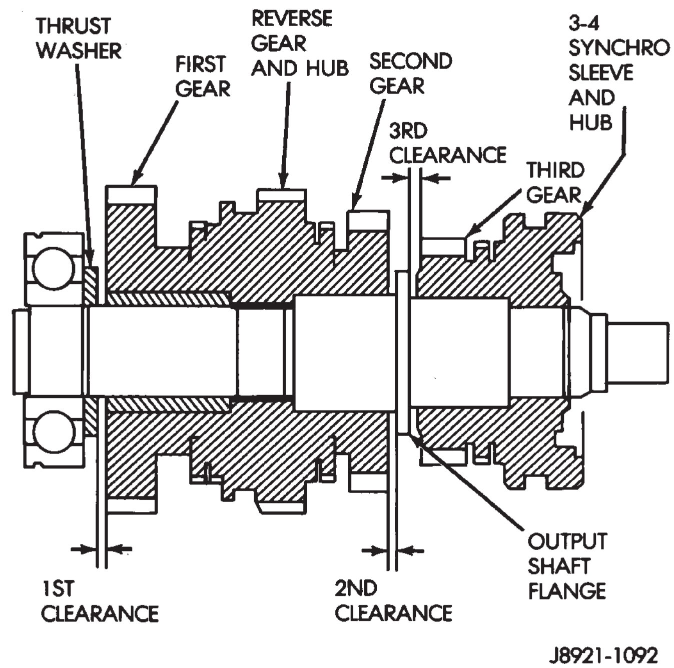


Fig. 62 Checking Output Shaft Gear Thrust Clearance

(9) Remove snap ring at front of output shaft (Fig. 63).

(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. Then 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

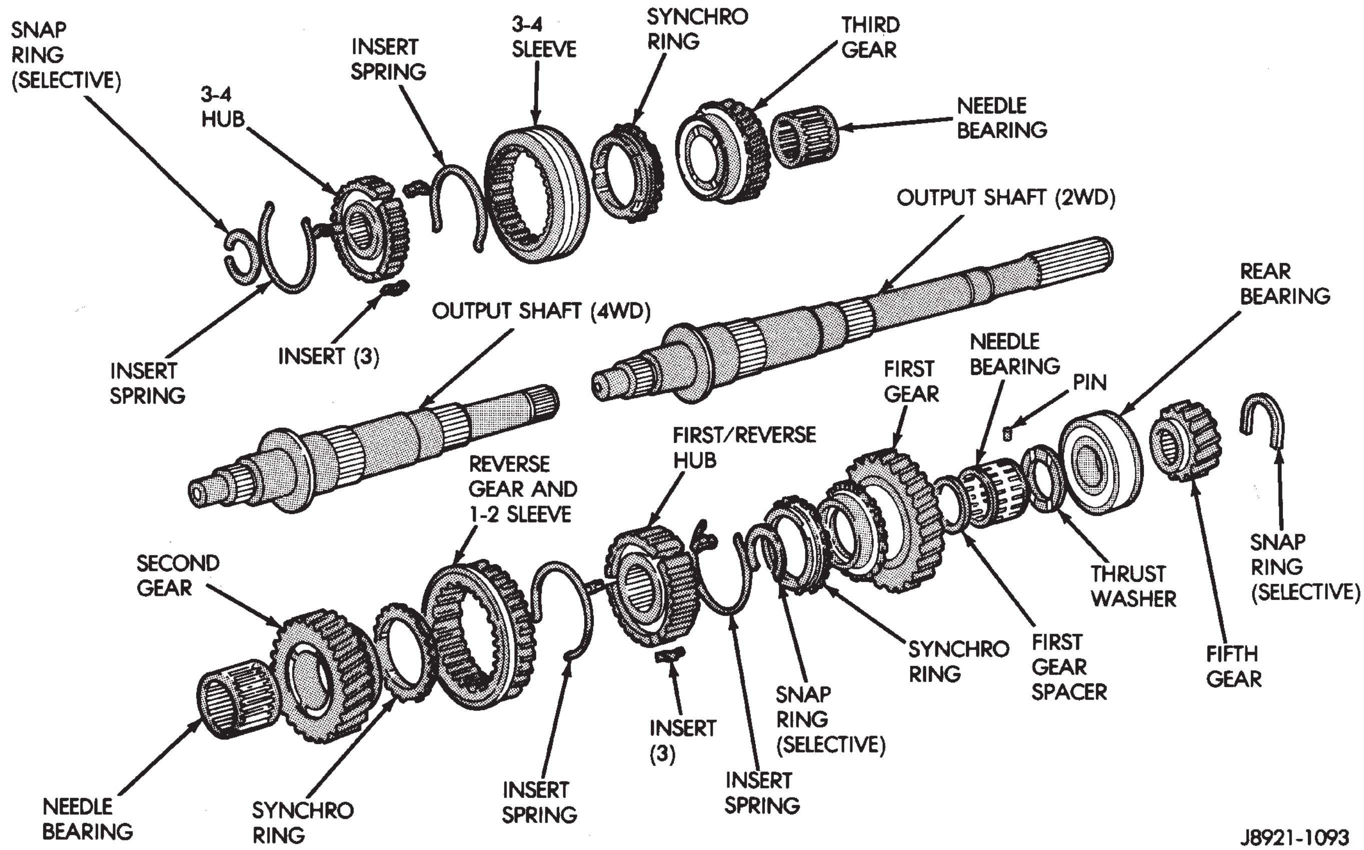


Fig. 63 Output Shaft And Gears

- 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 to 1.6 mm (0.024 to 0.063 in.).

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).

Maximum allowable clearance is 0.16 mm (0.0063 in.). If any gear exhibits excessive clearance, replace the gear and needle bearing.

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 scored or worn.

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.

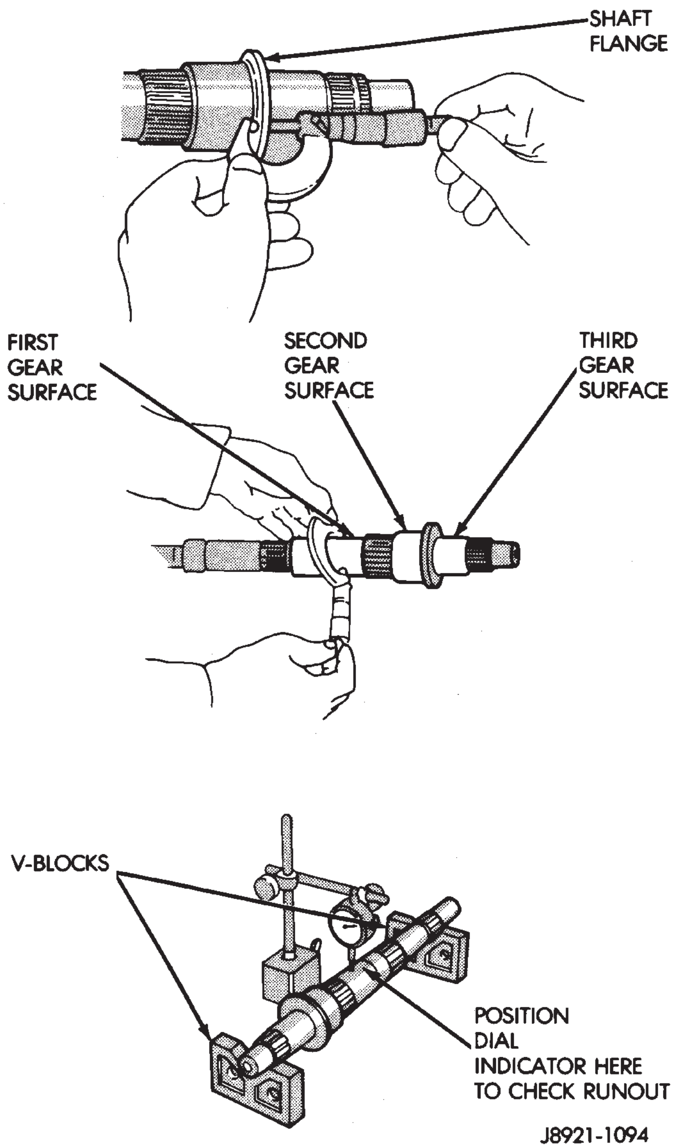


Fig. 64 Checking Output Shaft Tolerances

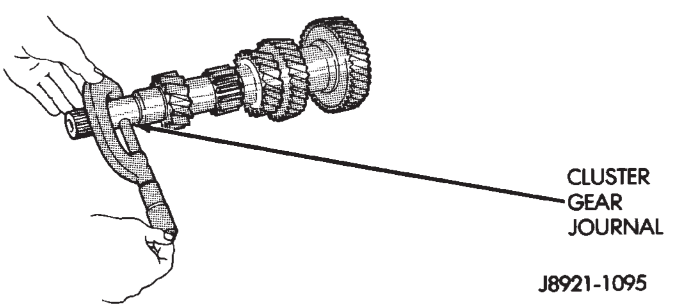


Fig. 65 Checking Cluster Gear Journal Diameter

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 gear lubricant during assembly. Use petroleum jelly to lubricate seal lips and/or hold parts in place during installation.

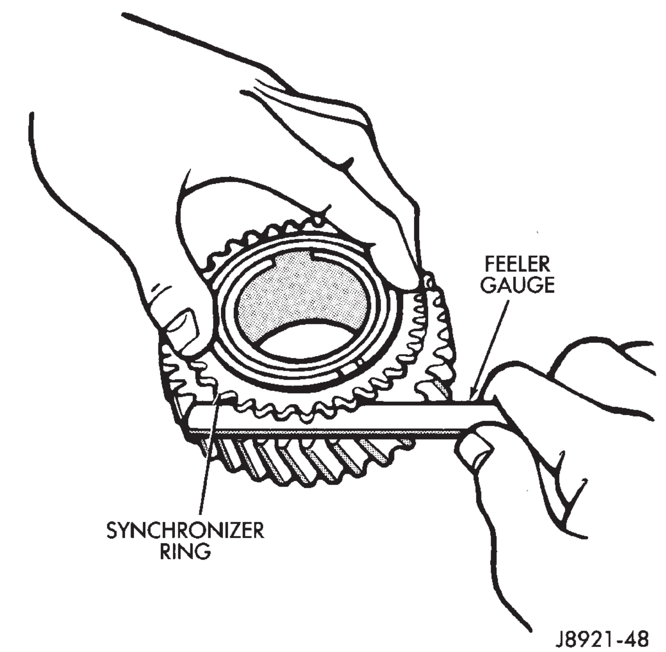


Fig. 66 Checking Synchro Ring End Clearance

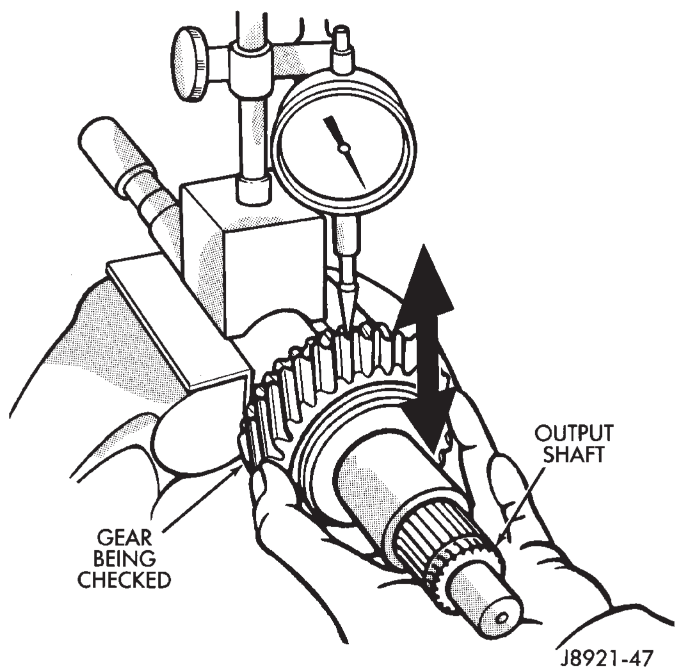


Fig. 67 Checking Gear-To-Shaft Clearance

FRONT BEARING/BEARING SEAL/REVERSE SHAFT PIN INSTALLATION

(1) Press front bearing on input shaft. Then secure bearing with thickest snap ring that will fit in shaft groove (Fig. 70).

(2) Press front bearing on cluster gear. Then secure bearing with thickest snap ring that will fit in ring groove on gear (Fig. 71).

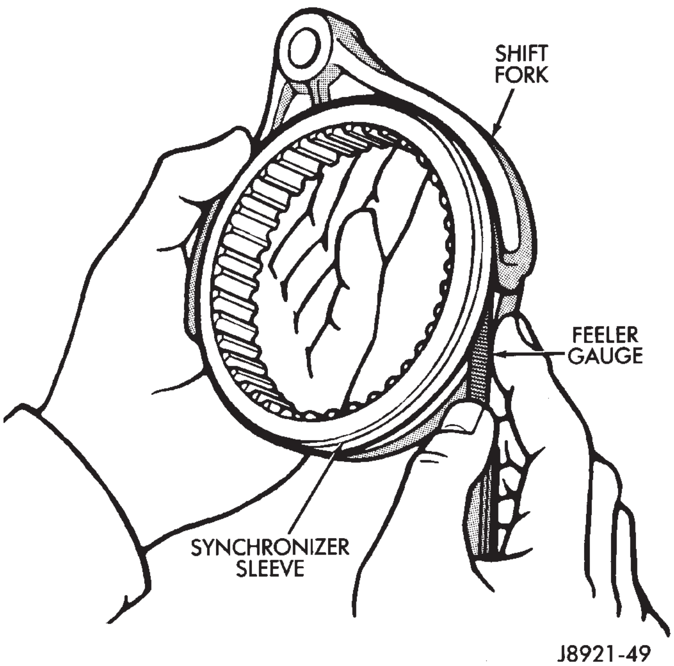


Fig. 68 Checking Shift Fork-To-Sleeve Clearance

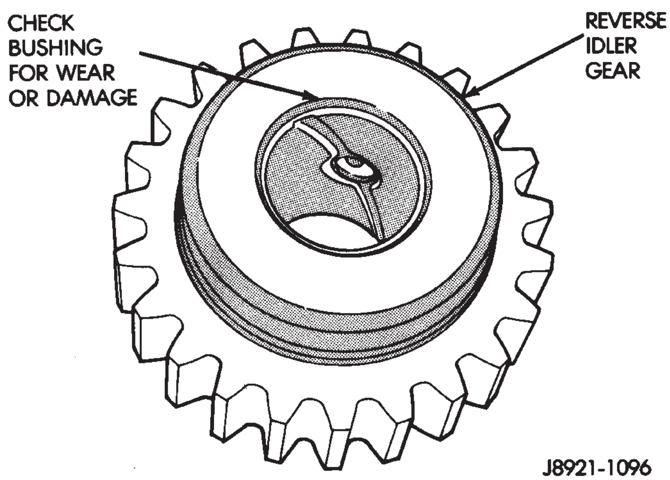


Fig. 69 Reverse Idler Gear Bushing

(3) Install new oil seals in front bearing retainer and adapter housing (Fig. 72). Installation depth for bearing retainer seal is 10.5 to 11.5 mm (0.414 to 0.453 in.).

(4) Install reverse shaft and shaft retaining pin in adapter housing. Then install access hole plug with torx bit (Fig. 73).

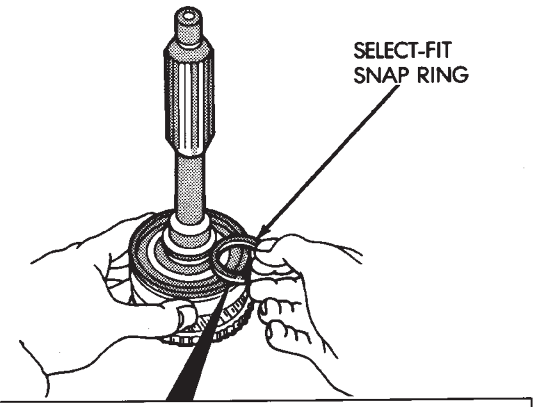
(5) Lubricate reverse shaft and gear components with Mopar 75W-90 gear lubricant.

OUTPUT SHAFT ASSEMBLY

(1) Lubricate output shaft journals, gears and needle bearings with recommended gear lubricant.

(2) Install third gear and needle bearing on shaft (Fig. 63)

(3) Install synchro ring on third gear (Fig. 63).



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)

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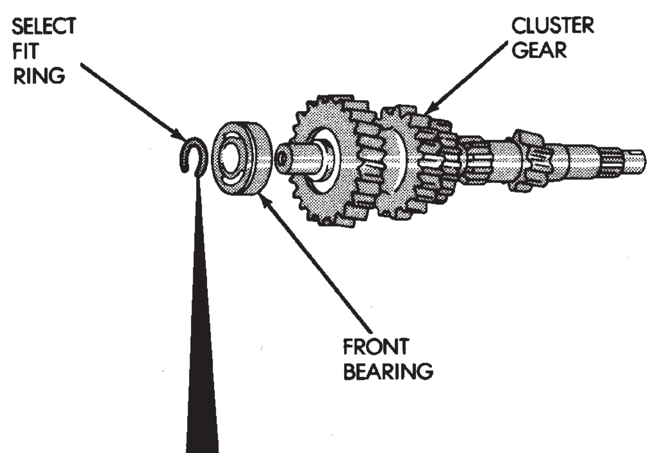
Fig. 70 Selecting Input Shaft Front Bearing Snap Ring



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

(4) Assemble 1-2 and 3-4 synchro hubs and sleeves (Fig.74).

(5) Install inserts and springs in synchro sleeves. Position open ends of springs 180° apart as shown (Fig. 75).

(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.

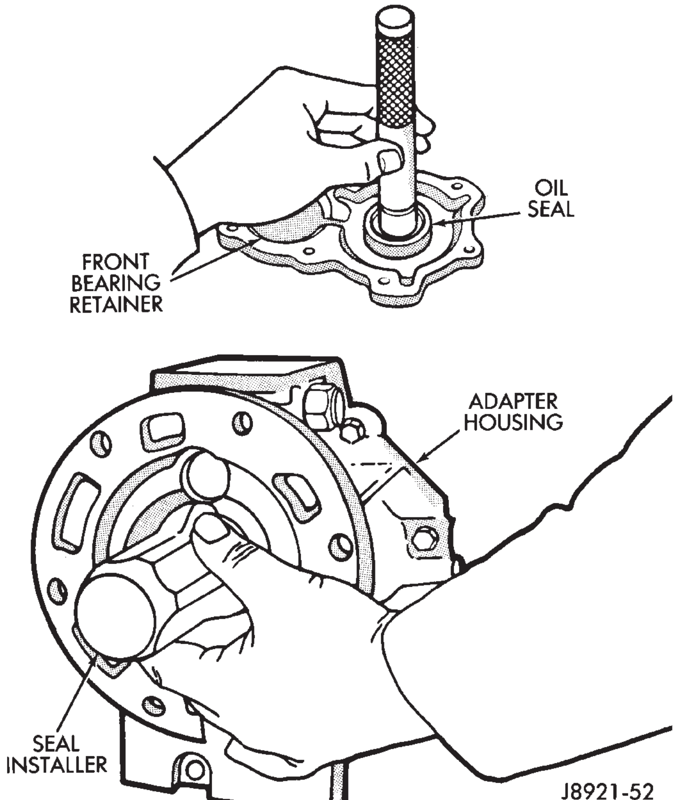


Fig. 72 Oil Seal Installation

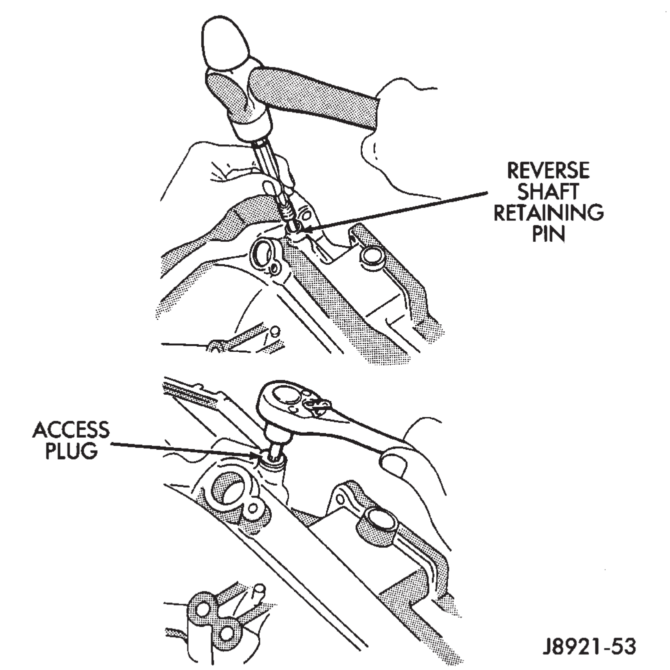


Fig. 73 Installing Reverse Shaft Pin

(8) Verify third gear thrust clearance with feeler gauge (Fig. 56). Clearance should be 0.10 to 0.25 mm (0.004 to 0.010 in.).

(9) Lubricate remaining output shaft gears and bearings with gear lubricant.

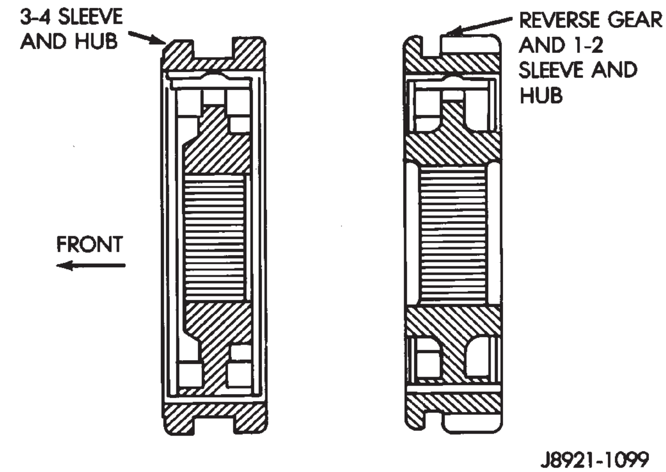


Fig. 74 Synchro Sleeve And Hub Identification

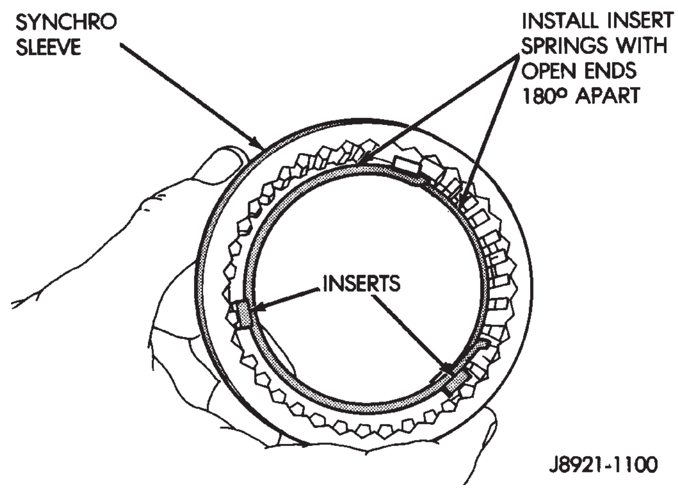
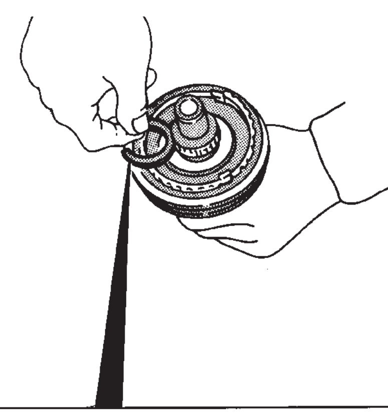


Fig. 75 Insert Spring Position



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

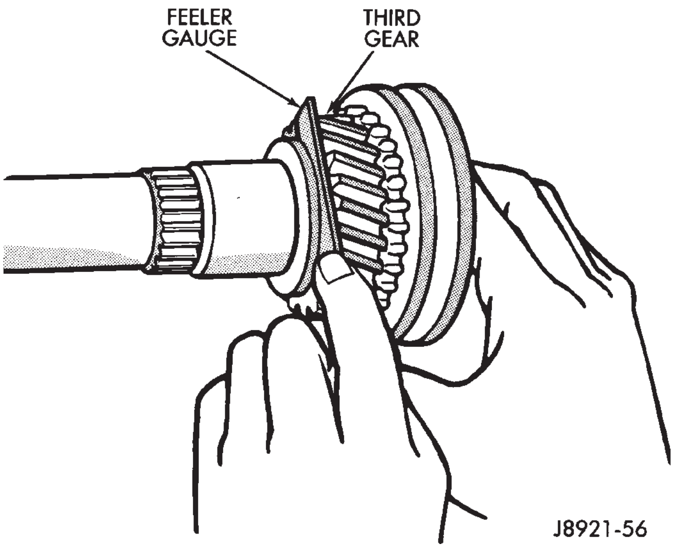


Fig. 77 Checking Third Gear Clearance

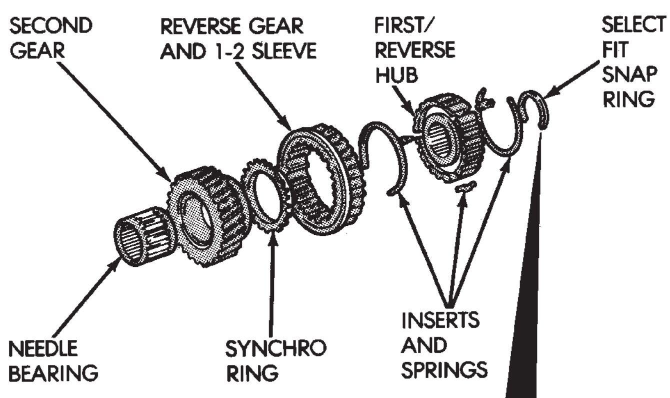
(10) Install second gear and needle bearing on shaft (Fig. 78).

(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.



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

(15) Install synchro ring on first gear (Fig. 79).

(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).

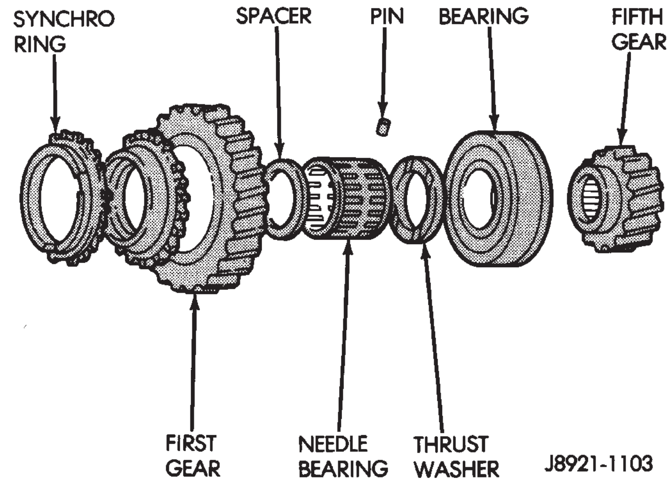


Fig. 79 First And Fifth Gear Components

(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 to 0.40 mm (0.003 to 0.0197 in.)

• Second gear clearance should be 0.10 to 0.30 mm (0.003 to 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.

(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

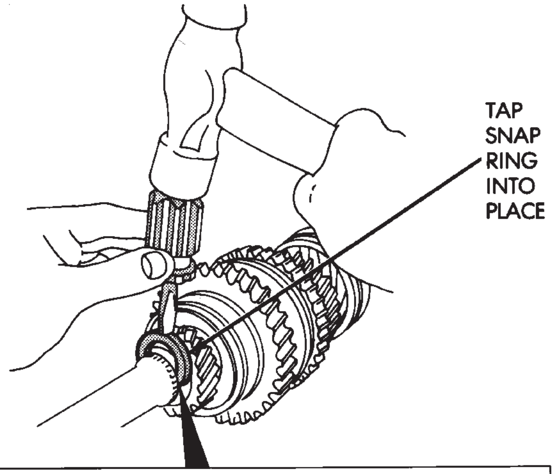
(1) Mount intermediate plate in vise (Fig. 24).

(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.



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)

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Fig. 80 Selecting Fifth Gear Snap Ring

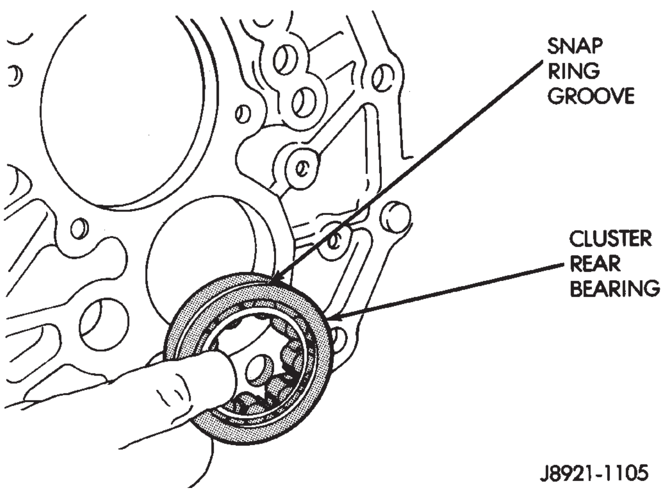


Fig. 81 Installing Cluster Gear Rear Bearing

(6) Install snap rings on cluster and output shaft **rear** bearings only (Fig. 82). Do not install front bearing snap rings at this time.

(7) Install reverse idler gear and shaft (Fig. 83).

(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).

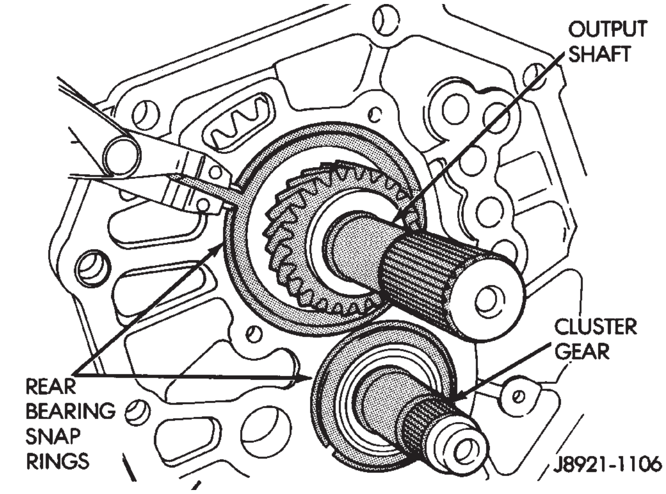


Fig. 82 Installing Rear Bearing Snap Rings

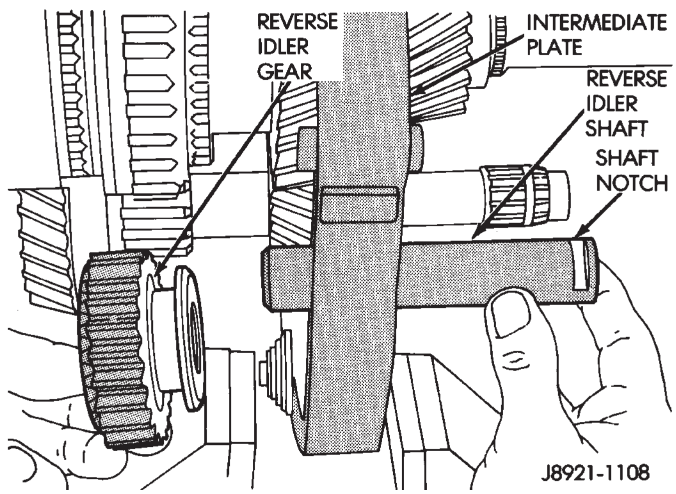


Fig. 83 Installing Reverse Idler Gear And Shaft

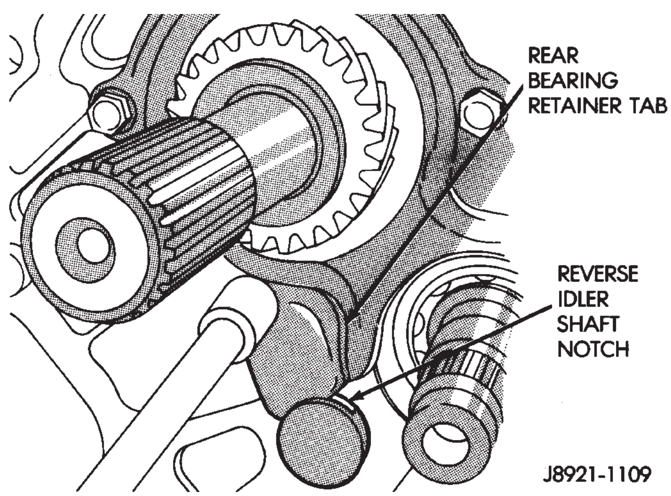


Fig. 84 Installing Rear Bearing Retainer

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.

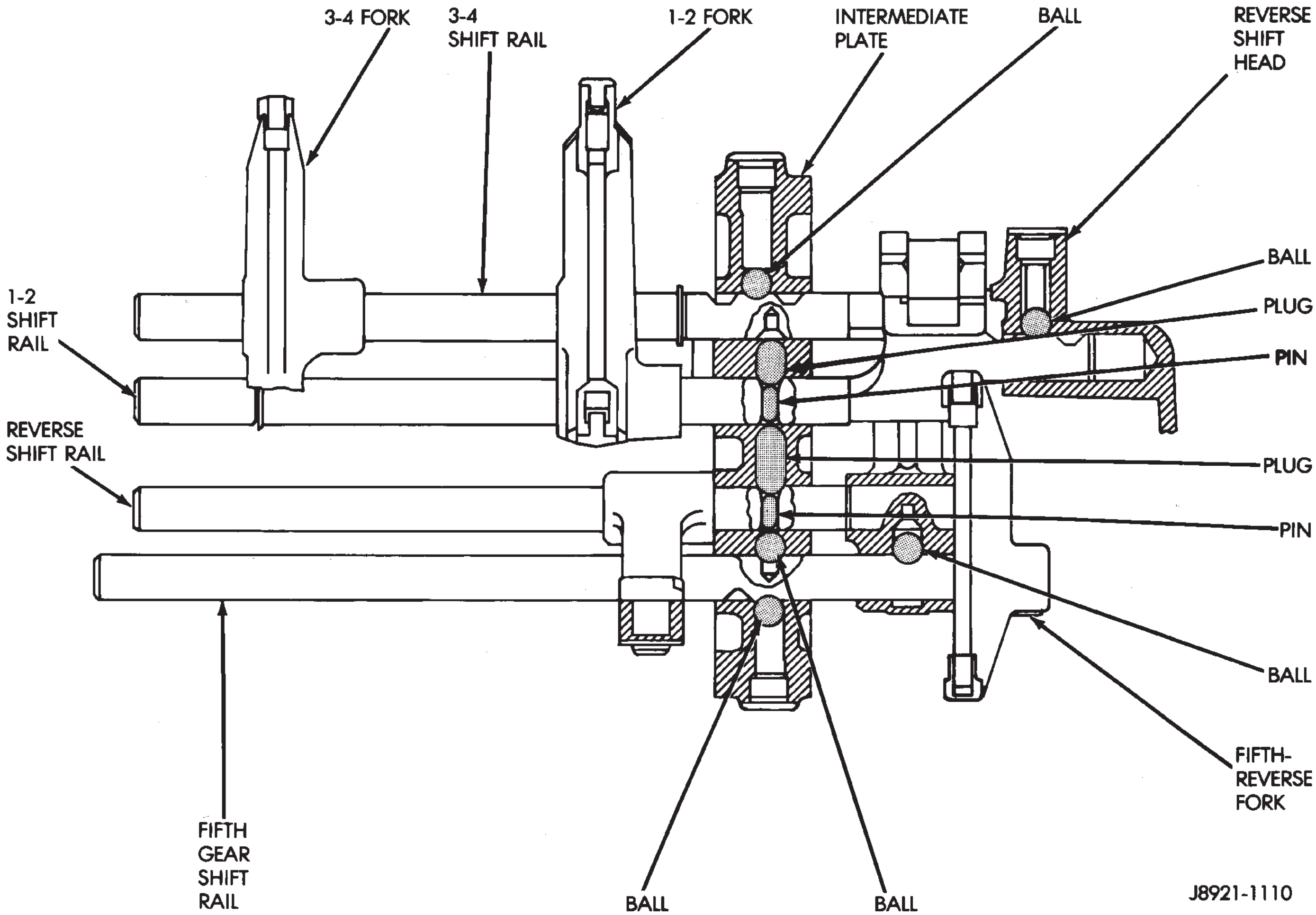


Fig. 85 Shift Rail Ball-Plug-Pin Position

Coat the intermediate plate shift rail bores and the interlock balls, pins and plugs with a thick covering 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).

(2) Install reverse shift rail in intermediate plate (Fig. 87).

(3) Install reverse shift rail C-ring (Fig. 51).

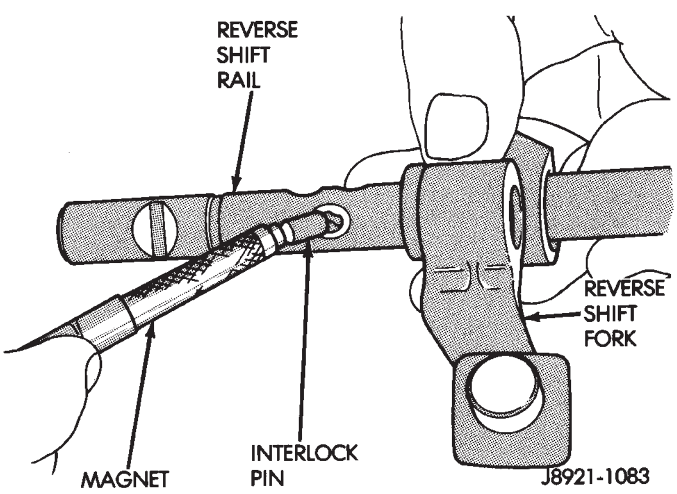


Fig. 86 Installing Reverse Shift Rail Interlock Pin

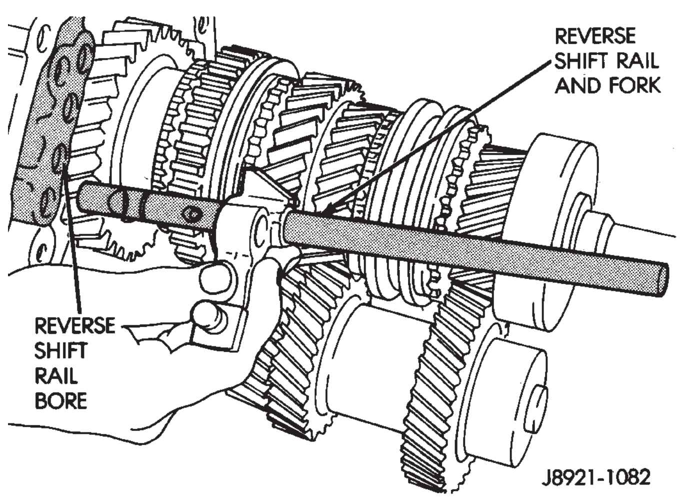


Fig. 87 Installing Reverse Shift Rail And Fork

(4) Position 1-2 and 3-4 shift forks in synchro sleeves (Fig. 88). (5) Coat reverse rail lock ball with petroleum jelly. Then tilt reverse shift fork upward and insert ball in intermediate plate (Fig. 89).

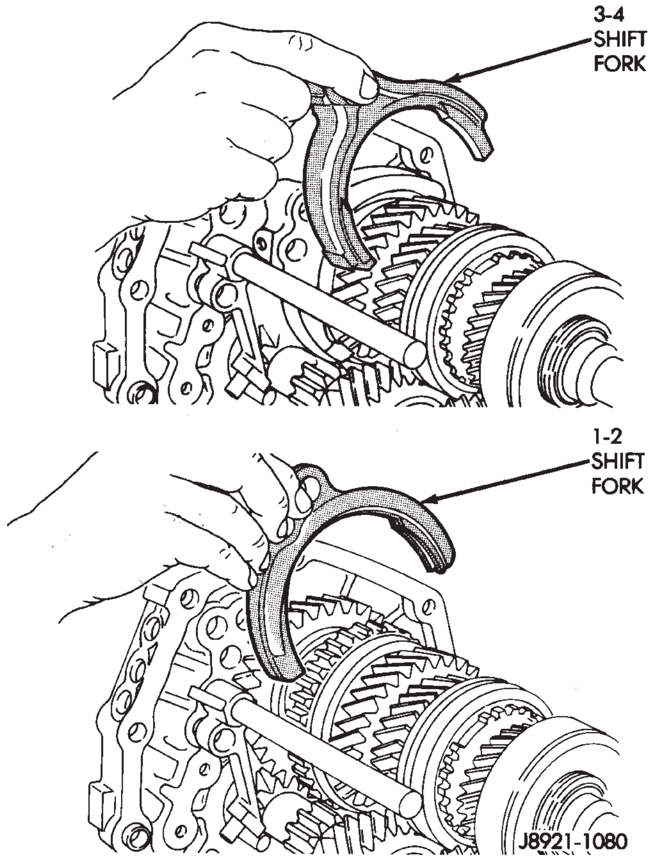


Fig. 88 Shift Fork Installation

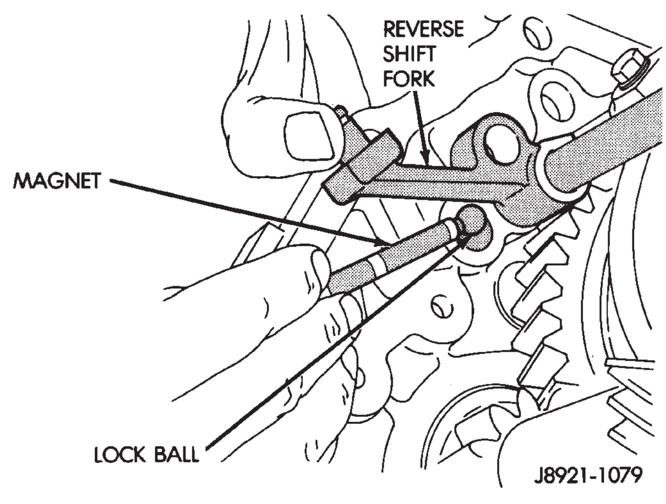


Fig. 89 Installing Reverse Shift Rail Lock Ball

(6) Coat 1-2 shift rail interlock plug with petroleum jelly and install it in intermediate plate bore (Fig. 90).

(7) Coat 1-2 shift rail interlock pin with petroleum jelly and insert it in shift rail (Fig. 91).

(8) Install 1-2 shift rail in intermediate plate and 1-2 fork (Fig. 92).

(9) Coat 3-4 shift rail interlock plug with petroleum

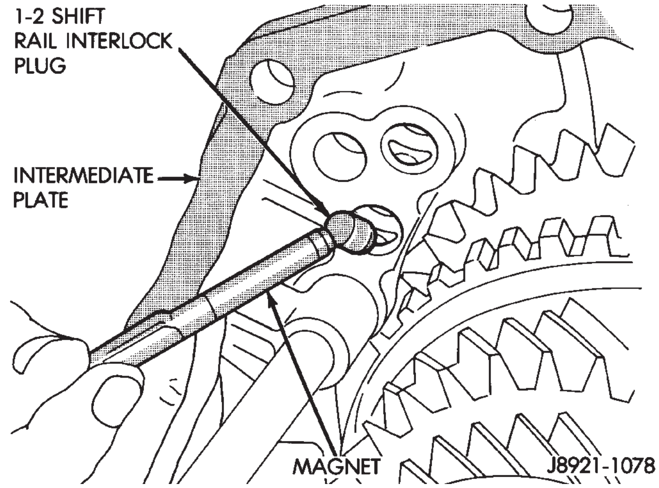


Fig. 90 Installing 1-2 Shift Rail Interlock Plug

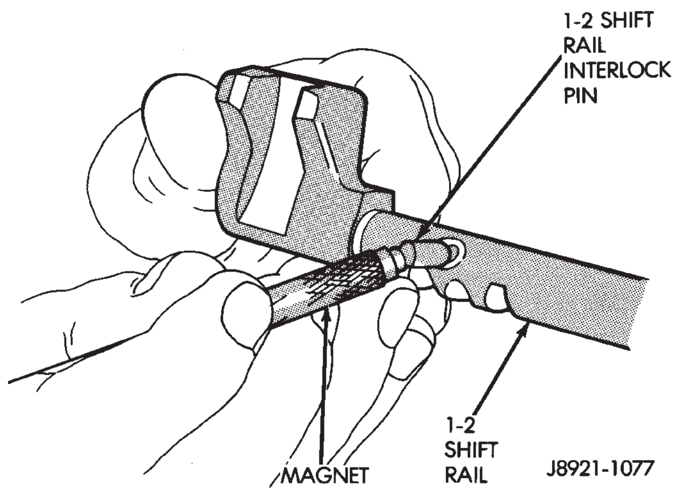


Fig. 91 Installing 1-2 Shift Rail Interlock Pin

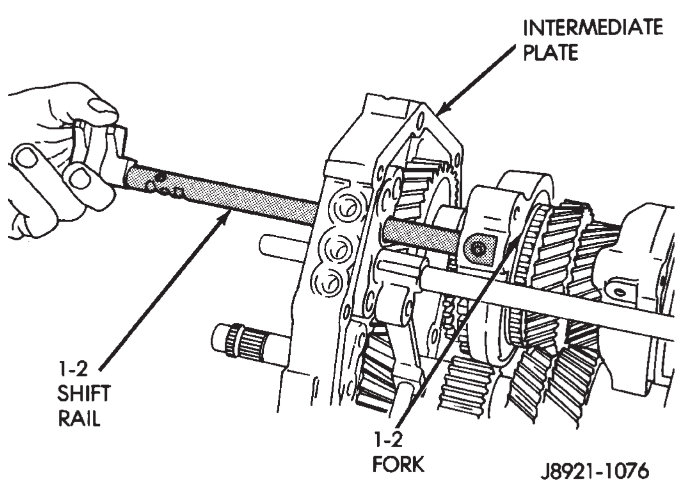


Fig. 92 Installing 1-2 Shift Rail

jelly and install plug in intermediate plate (Fig. 93).

(10) Install 3-4 shift rail in intermediate plate and in both shift forks (Fig. 94).

(11) Verify that none of the interlock balls, plugs,

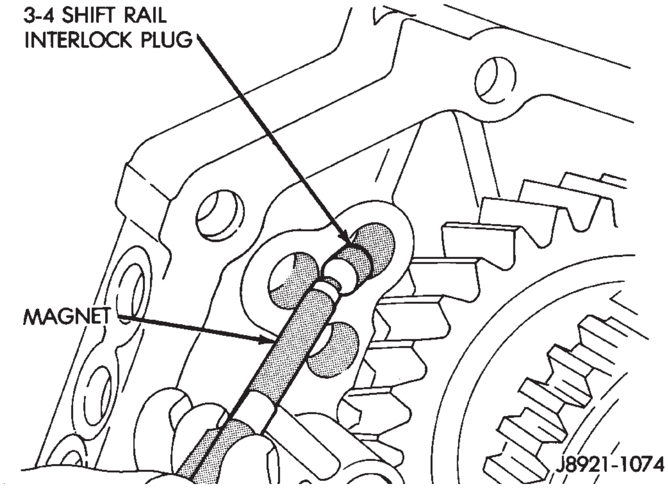


Fig. 93 Installing 3-4 Shift Rail Interlock Plug

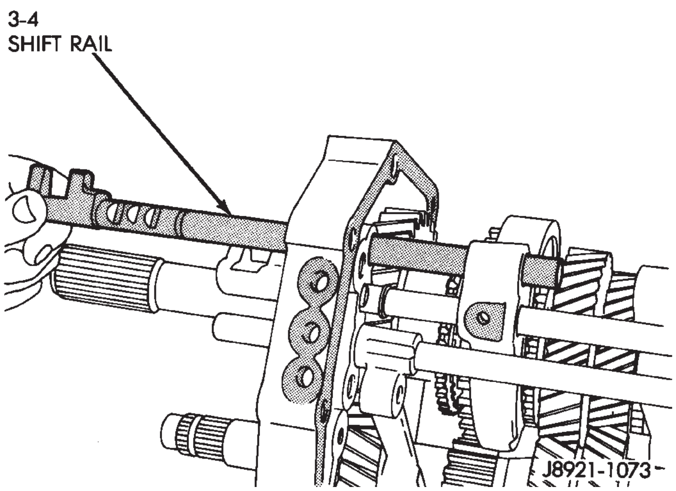


Fig. 94 Installing 3-4 Shift Rail

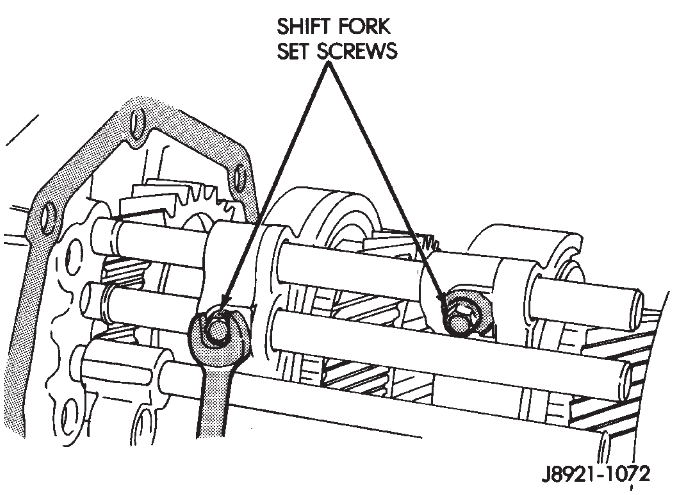


Fig. 95 Installing Shift Fork Set Screws

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).

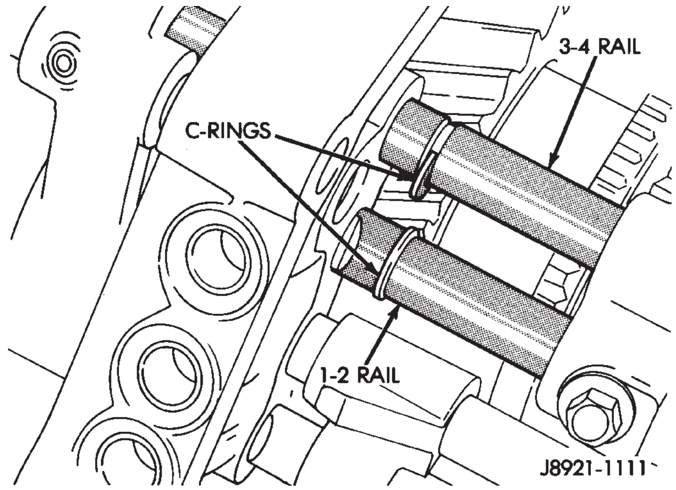


Fig. 96 Installing Shift Rail C-Rings

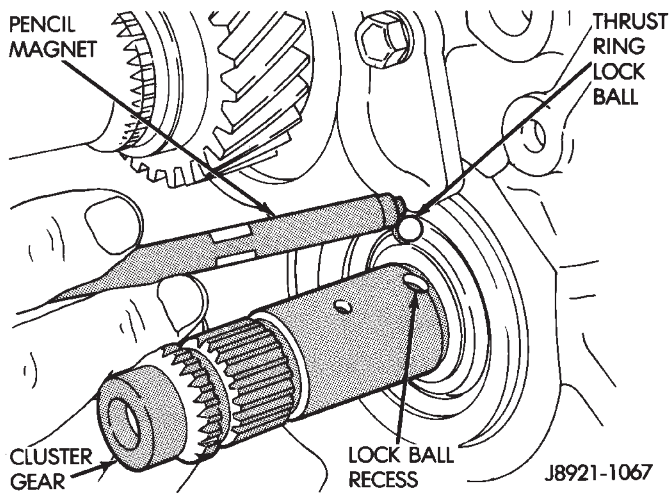


Fig. 97 Installing Thrust Ring Lock Ball

(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.**

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.

(2) Install fifth gear thrust ring (Fig. 98). Be sure thrust ring notch fits over lock ball.

(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).

(6) Install synchro ring in synchro sleeve (Fig. 102).

(7) Install fifth spline gear on cluster journal (Fig. 103). Tap spline gear into place with plastic mallet if necessary.

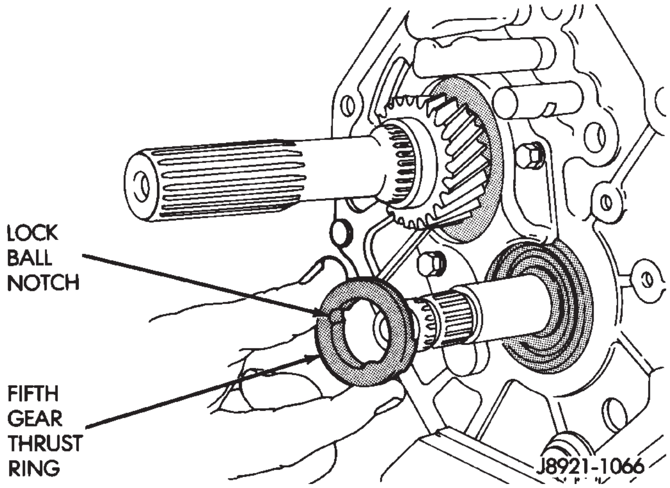


Fig. 98 Installing Fifth Gear Thrust Ring

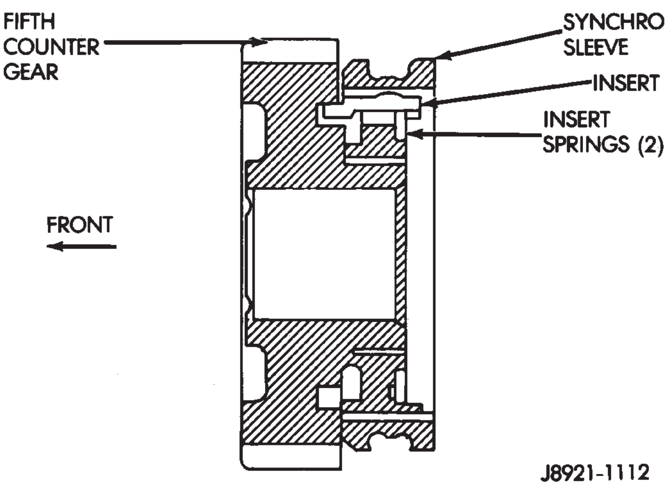


Fig. 99 Assembling Fifth Gear And Synchro Assembly

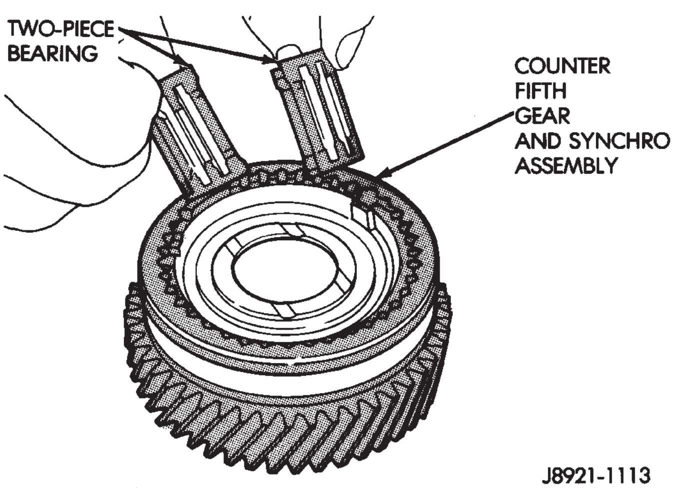


Fig. 100 Installing Counter Fifth Gear Bearing

(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.

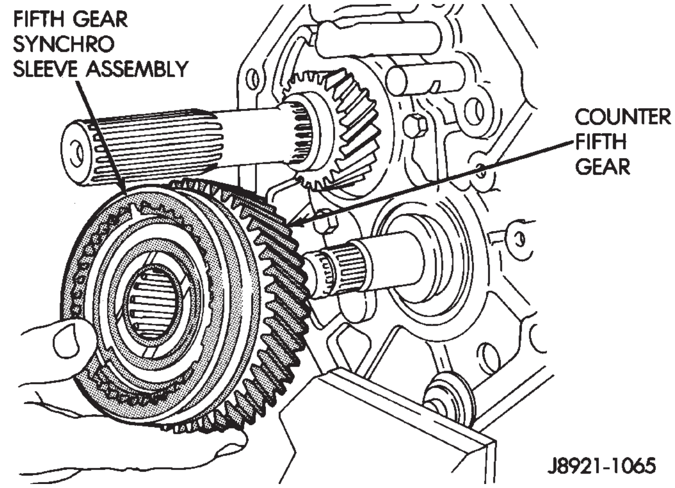


Fig. 101 Installing Counter Fifth Gear And Sleeve

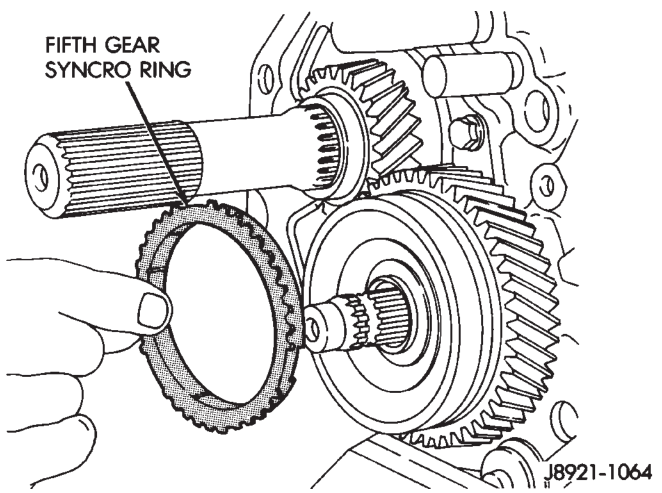


Fig. 102 Installing Fifth Gear Synchro Ring

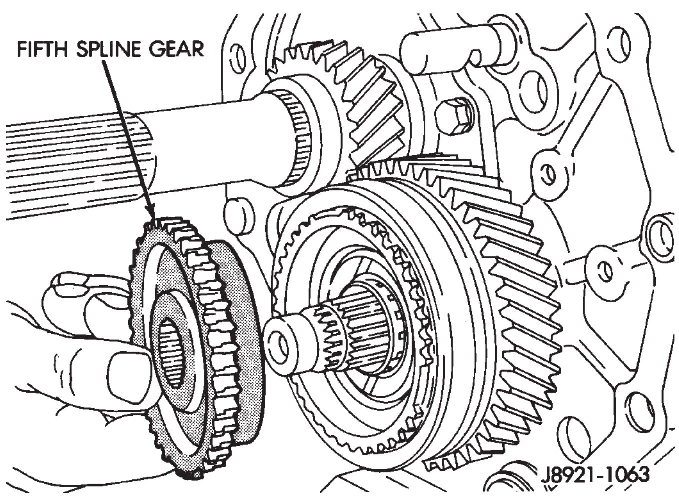
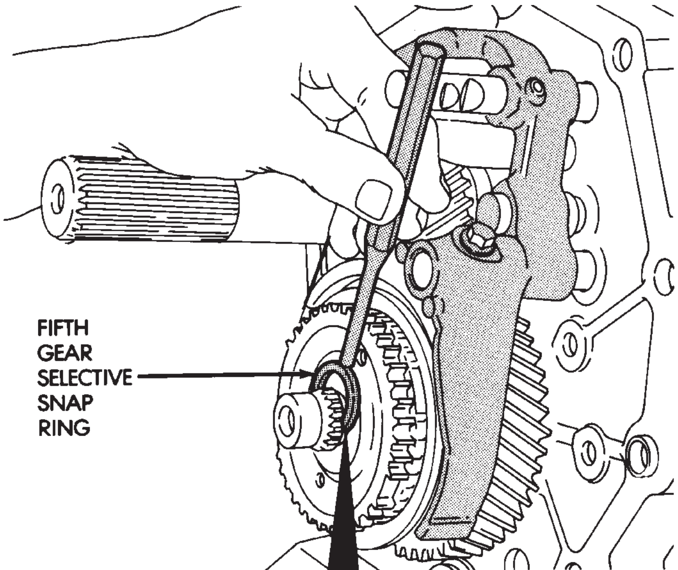


Fig. 103 Installing Fifth Spline Gear

(10) Position fifth gear shift fork in synchro sleeve (Fig. 106).



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

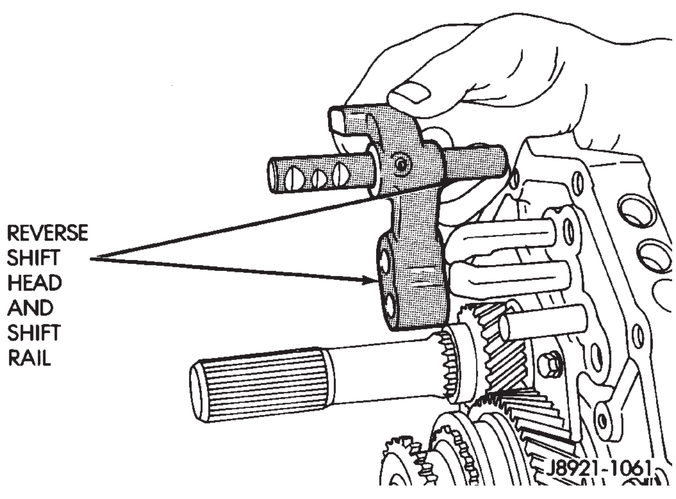

Fig. 105 Installing Reverse Shift Head And Rail

(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.

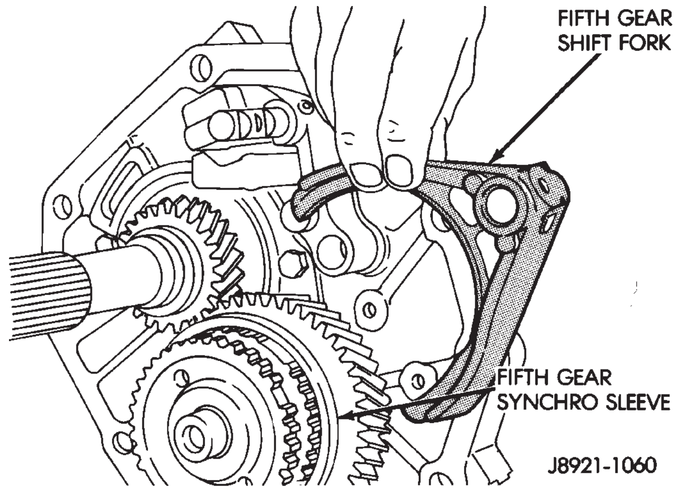

Fig. 106 Installing Fifth Gear Shift Fork

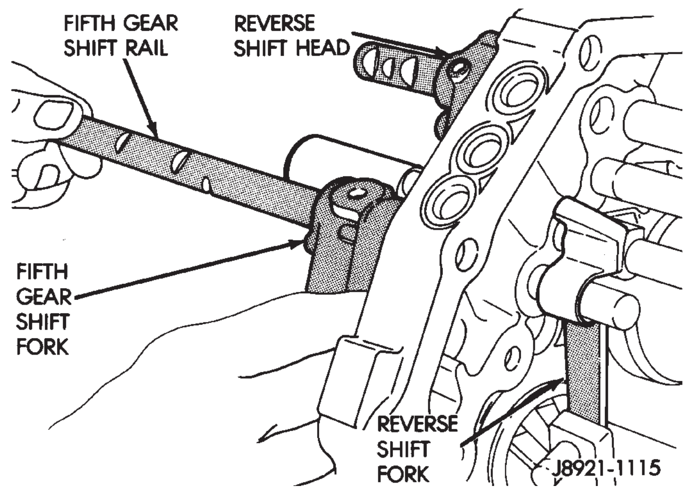

Fig. 107 Installing Fifth Gear Shift Rail

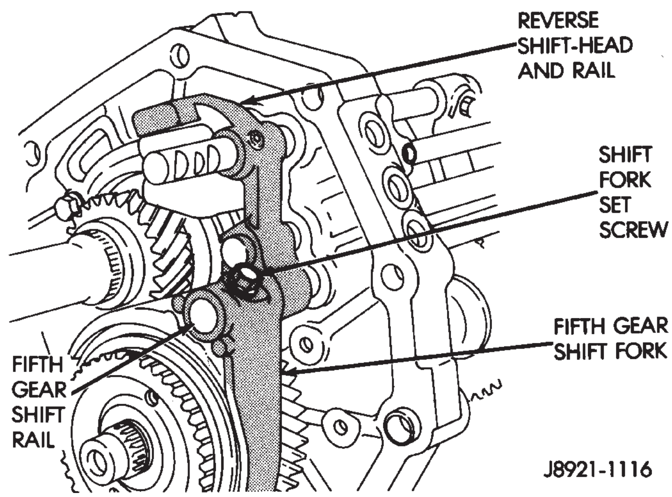

Fig. 108 Shift Fork Set Screw Installation

(14) Install reverse shift arm bracket (Fig. 110). Tighten bracket bolts to 18 N•m (13 ft. lbs.) torque.

(15) Install reverse shift arm (Fig. 110). Position arm on reverse fork pin and engage it with pin on shift arm bracket.

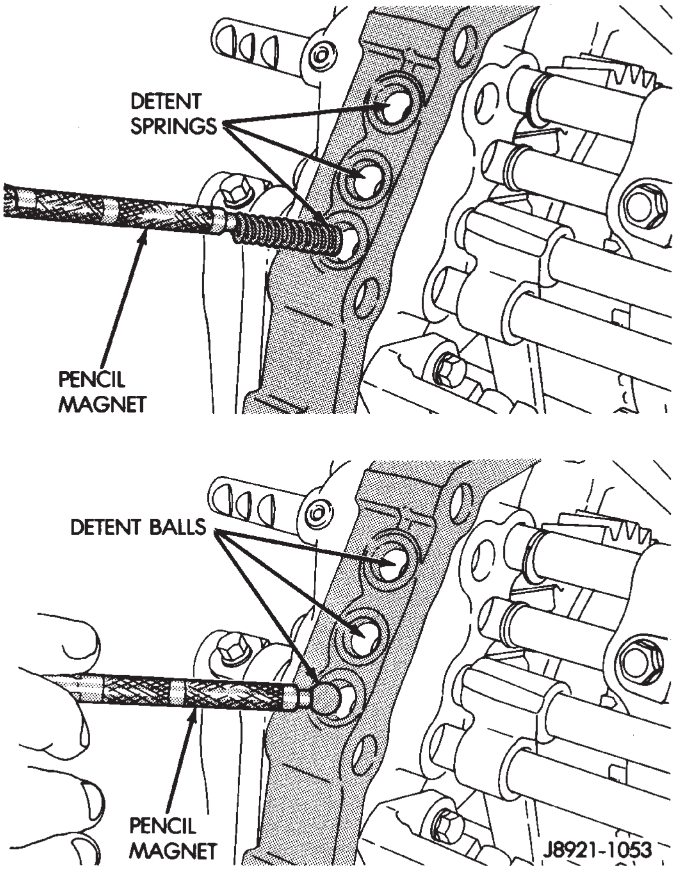

Fig. 109 Detent Ball And Spring Installation

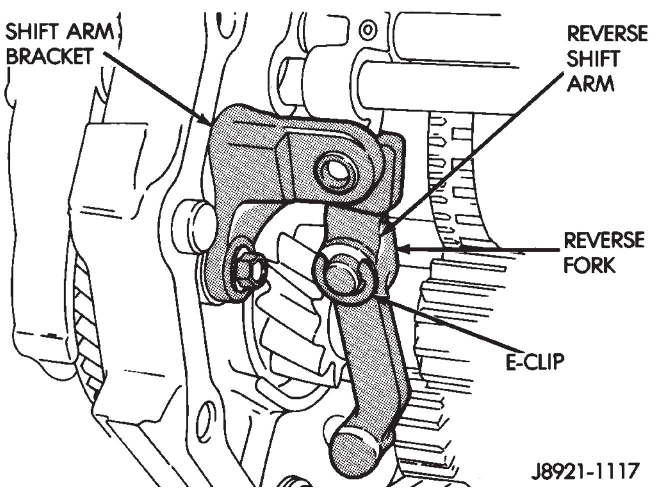

Fig. 110 Reverse Shift Arm And Bracket Installation

(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 plate and gear assemblies from vise.

(2) Clean mating surfaces of intermediate plate and transmission gear case with wax and grease remover. Then wipe dry with a clean cloth.

(3) Apply 3 mm (1/8 in.) wide bead of Mopar Gasket Maker, or Loctite 518 to mating surface of gear case. Keep sealer bead inside bolt holes as shown (Fig. 111).

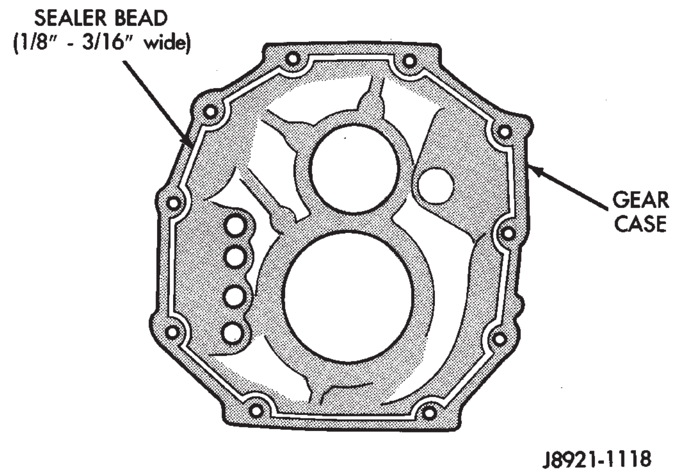

Fig. 111 Applying Sealer To Gear Case

(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.

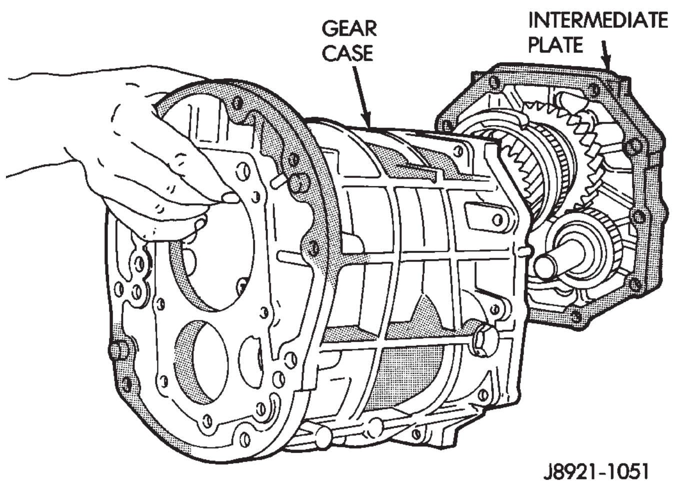

Fig. 112 Installing Gear Case

(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 to 11.5 mm (0.413 to 0.453 in.).**

(9) Apply a 3 mm (1/8 in.) wide bead of Mopar Gasket Maker, or Loctite 518 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.

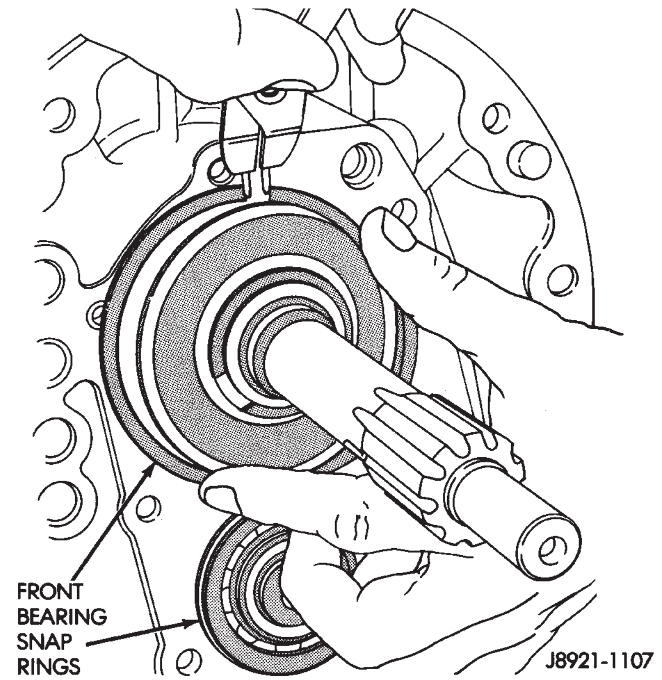

Fig. 113 Installing Front Bearing Snap Rings

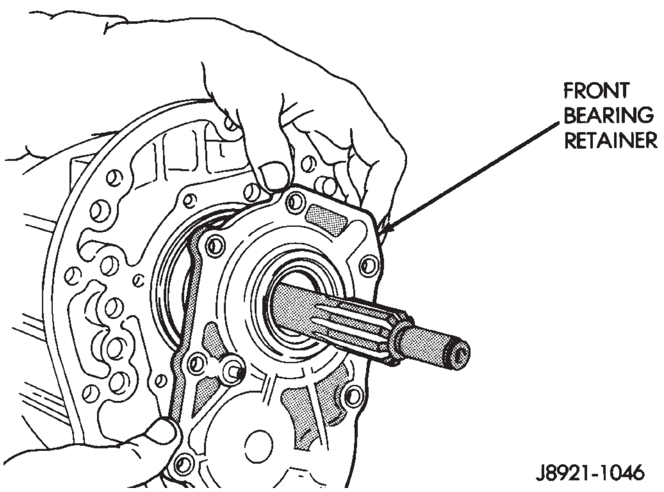

Fig. 114 Installing Front Bearing Retainer

(11) Install and tighten front bearing retainer bolts to 17 N●m (12 ft. lbs.) torque.

(12) On models with extension housing, install speedometer gear, lock ball and retaining rings (Fig. 115). Be sure lock ball is engaged in gear.

(13) Inspect condition of 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.

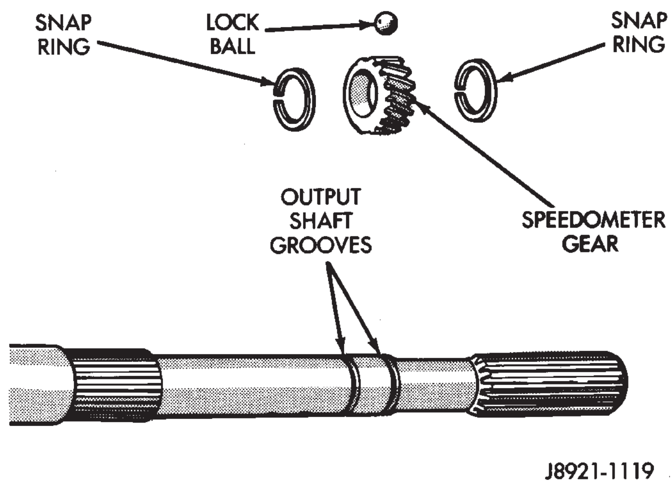

Fig. 115 Speedometer Gear Installation (2WD Models)

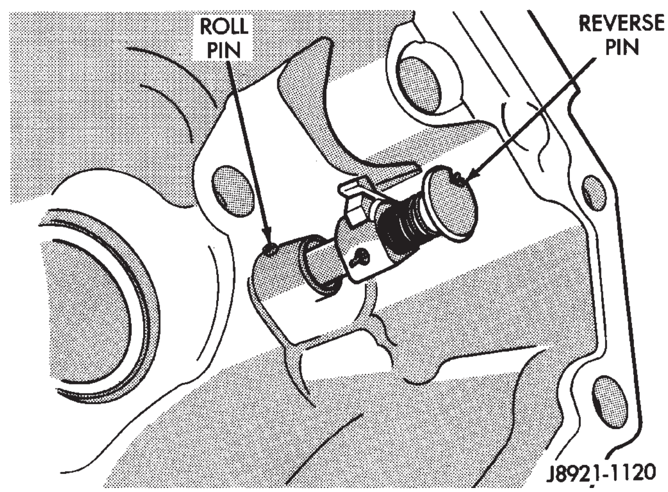

Fig. 116 Reverse Pin Position

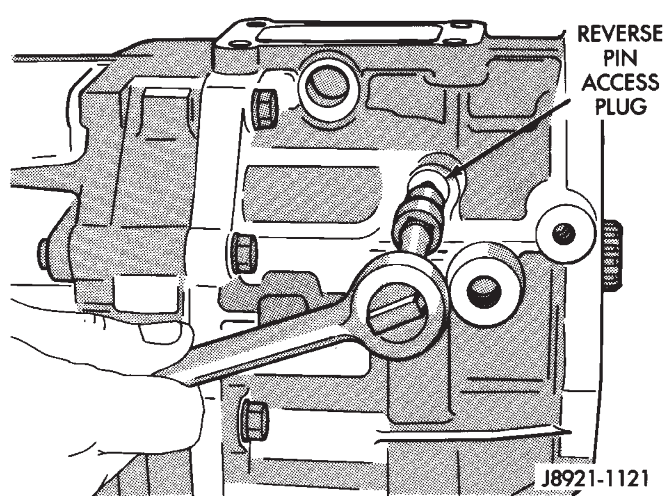

Fig. 117 Access Plug Removal/Installation

(15) Apply 3 mm (1/8 in.) wide bead of Mopar Gasket Maker, or Loctite 518 to sealing surface of adapter or extension housing. Keep sealer bead inside bolt holes as shown in Figure 111.

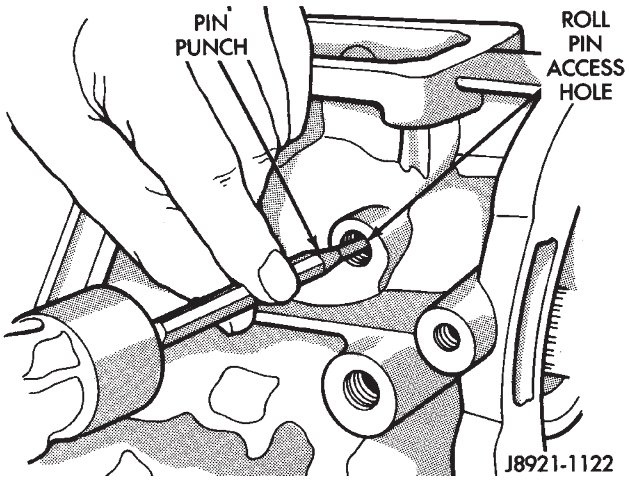

Fig. 118 Roll Pin Removal/Installation

(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 Mopar silicone sealer. Then install and tighten bolts to 37 N●m (27 ft. lbs.) torque.

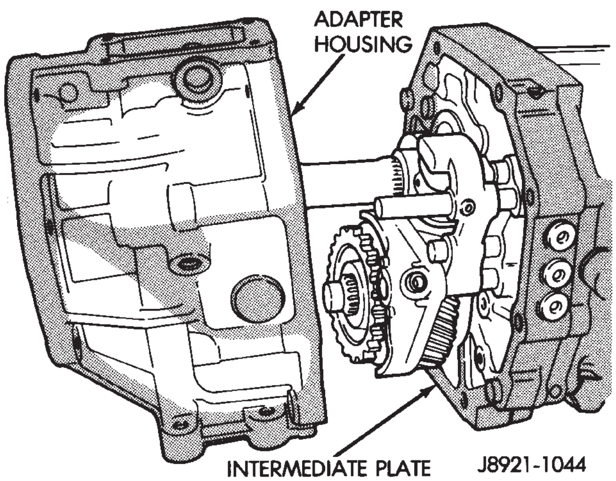

Fig. 119 Adapter/Extension Housing Installation

(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).

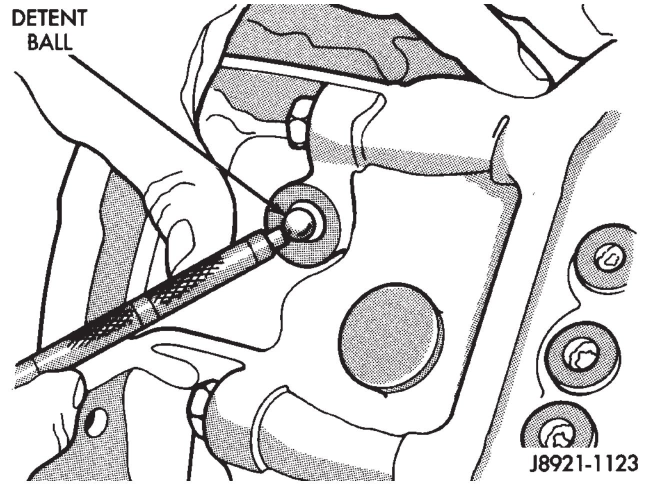

Fig. 120 Installing Detent Ball

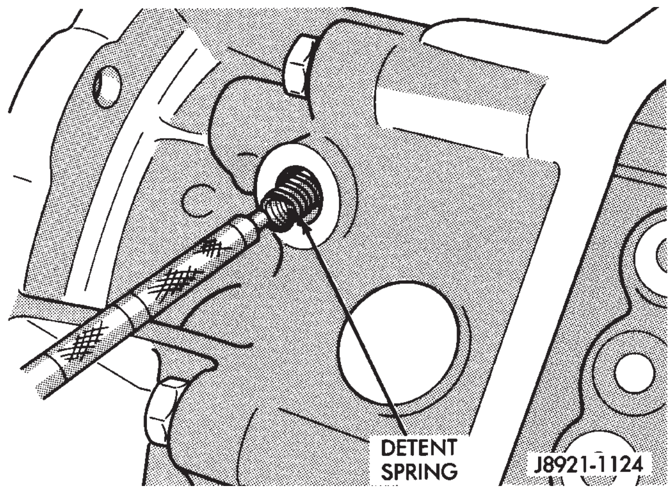

Fig. 121 Installing Detent Spring

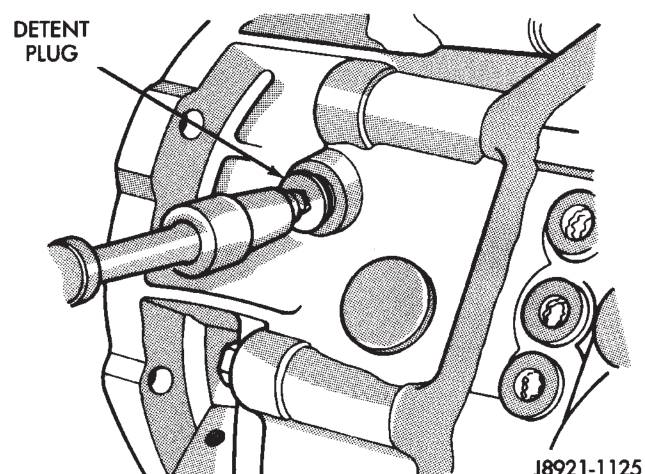

Fig. 122 Installing Detent Access Plug

(27) Install and tighten shift arm shaft access plug to 19 N●m (14 ft. lbs.) torque (Fig. 126).

(28) Position new shift tower gasket on adapter housing (Fig 127).

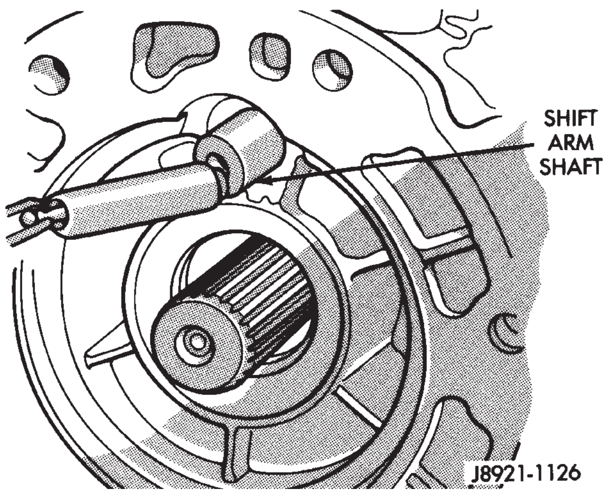

Fig. 123 Installing Shift Arm Shaft

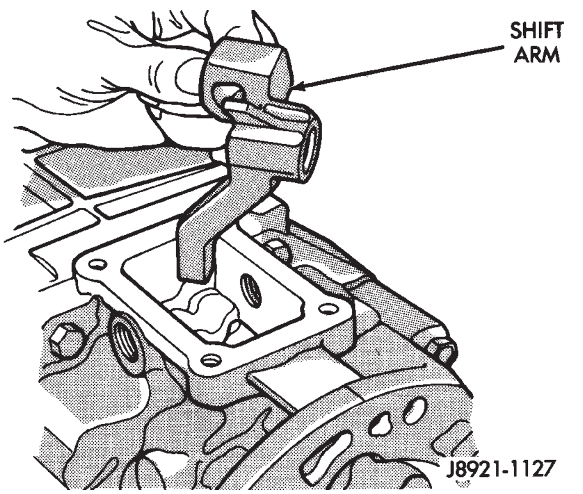

Fig. 124 Shift Arm Installation

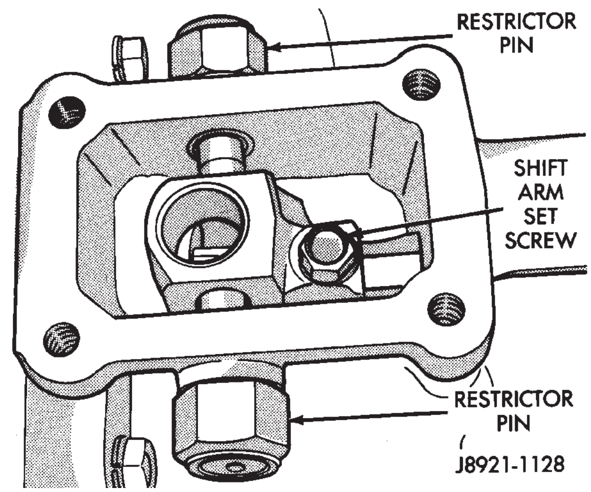

Fig. 125 Set Screw And Restrictor Pin Installation

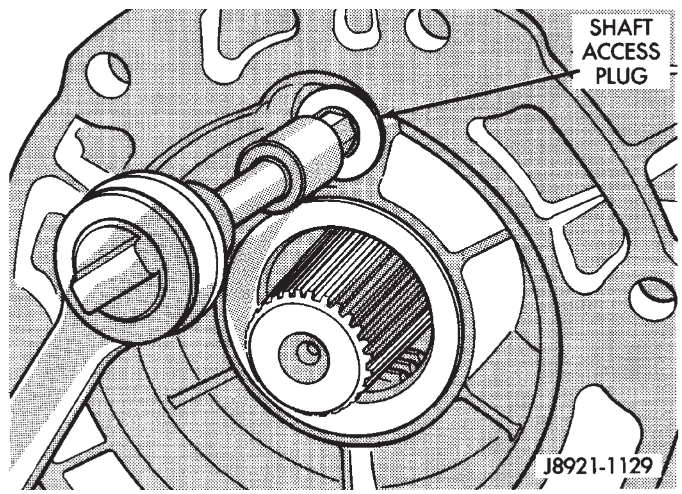

Fig. 126 Access Plug Installation

(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.

(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 hydraulic concentric bearing.

(35) On models with extension housing, install new seal in housing with suitable size installer tool (Fig. 129). Lubricate seal lips with petroleum jelly before installation.

(36) On models with extension housing, install speedometer driven gear, speedometer adapter and speed sensor.

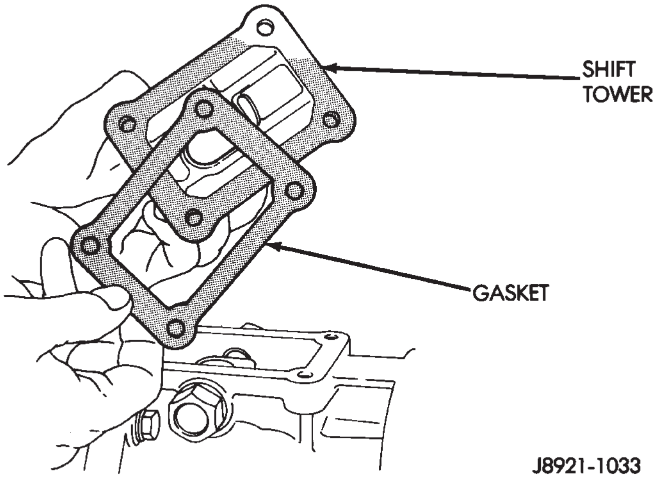

Fig. 127 Shift Tower Gasket Installation

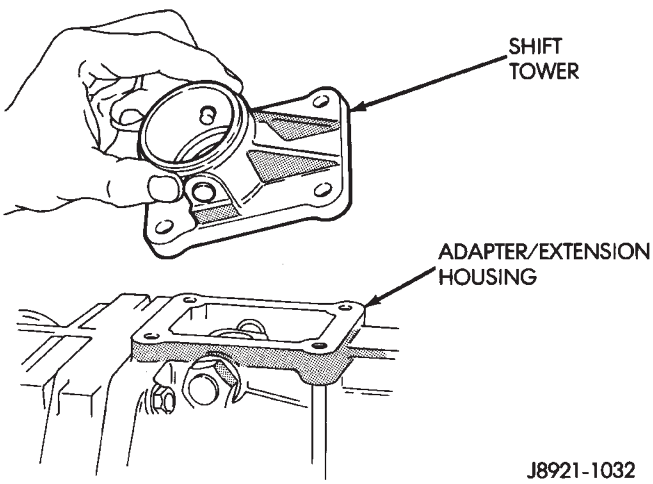

Fig. 128 Shift Tower Installation

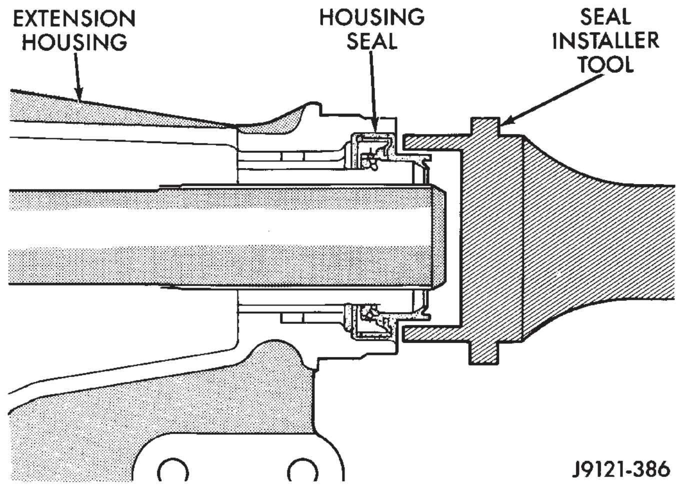

Fig. 129 Installing Extension Housing Seal

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).

Cables are used for shifting and transmission throttle pressure control. A park/neutral position switch permits engine starting in Park and Neutral range only.

The valve body solenoids are controlled by signals from a transmission control module (TCM). Signal sequence is determined by vehicle speed and throttle position.

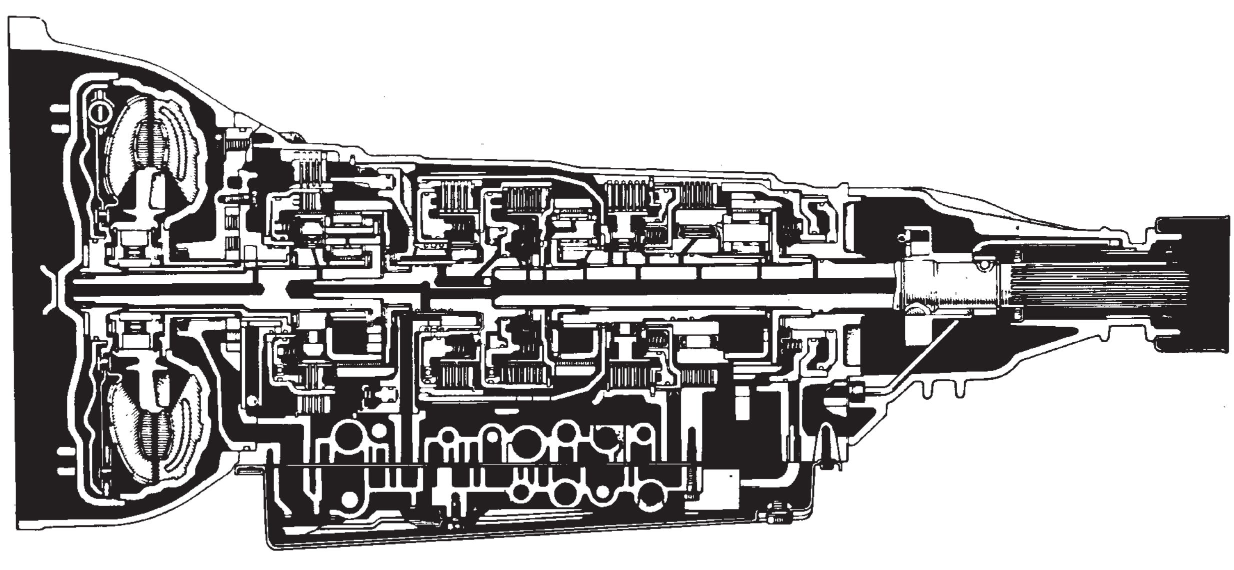

Fig. 1 AW-4 Automatic Transmission

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 with the shift lever in D position (Fig. 2).

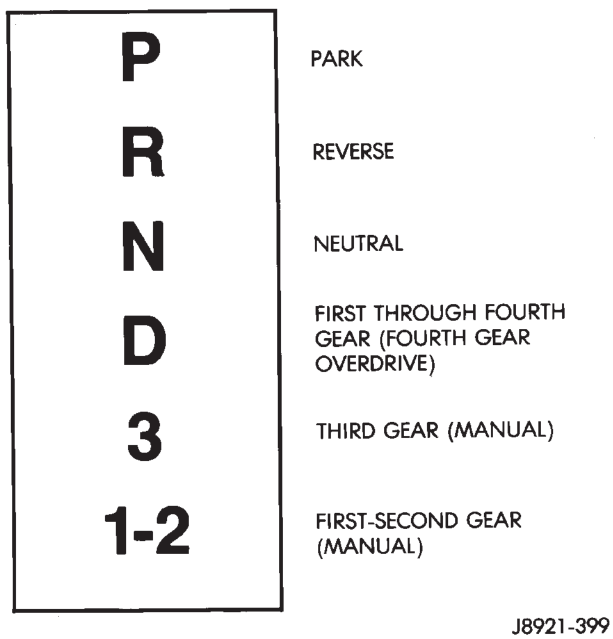

Fig. 2 AW-4 Shift Lever Positions And Transmission Ranges

TRANSMISSION IDENTIFICATION

The transmission identification 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.

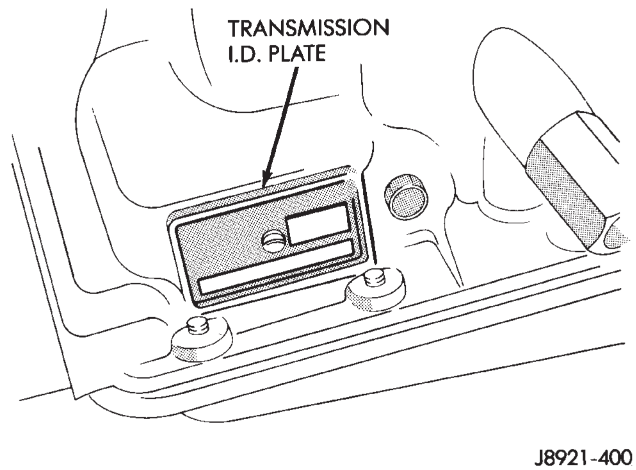

Fig. 3 Transmission Identification

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 magnet 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 har-

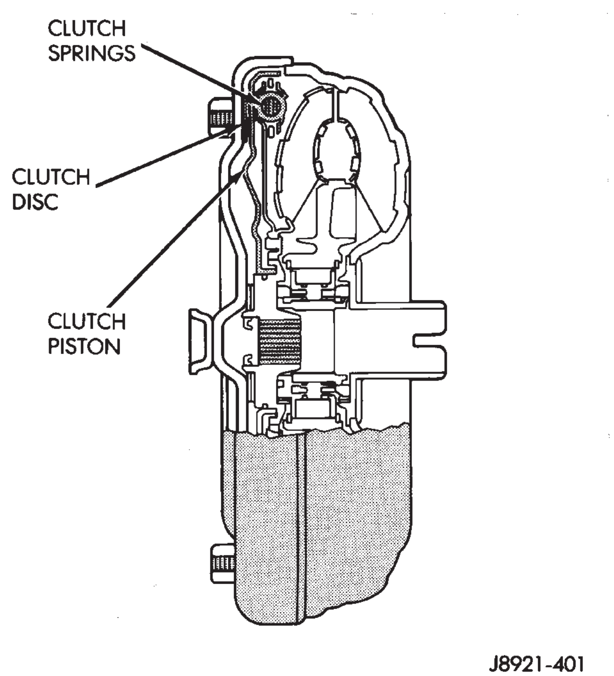

Fig. 4 Torque Converter With Modulated Clutch

ness. 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 three element torque converter is used for all applications. The converter consists of an impeller, stator, and turbine. The converter also contains an electronic modulated converter clutch mechanism and an overrunning clutch in the stator hub.

The converter modulated clutch mechanism consists of a sliding clutch piston, clutch springs and the clutch disc friction material (Fig. 4). The clutch provides optimum torque transfer and fuel 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.

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.

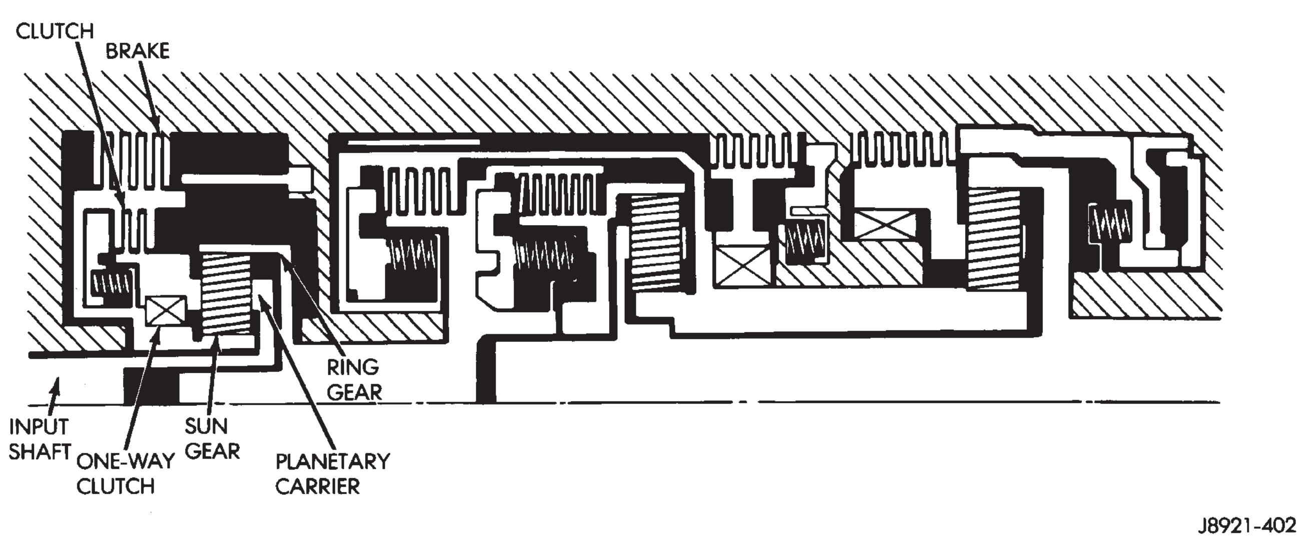

Fig. 5 Fourth Gear Overdrive Components

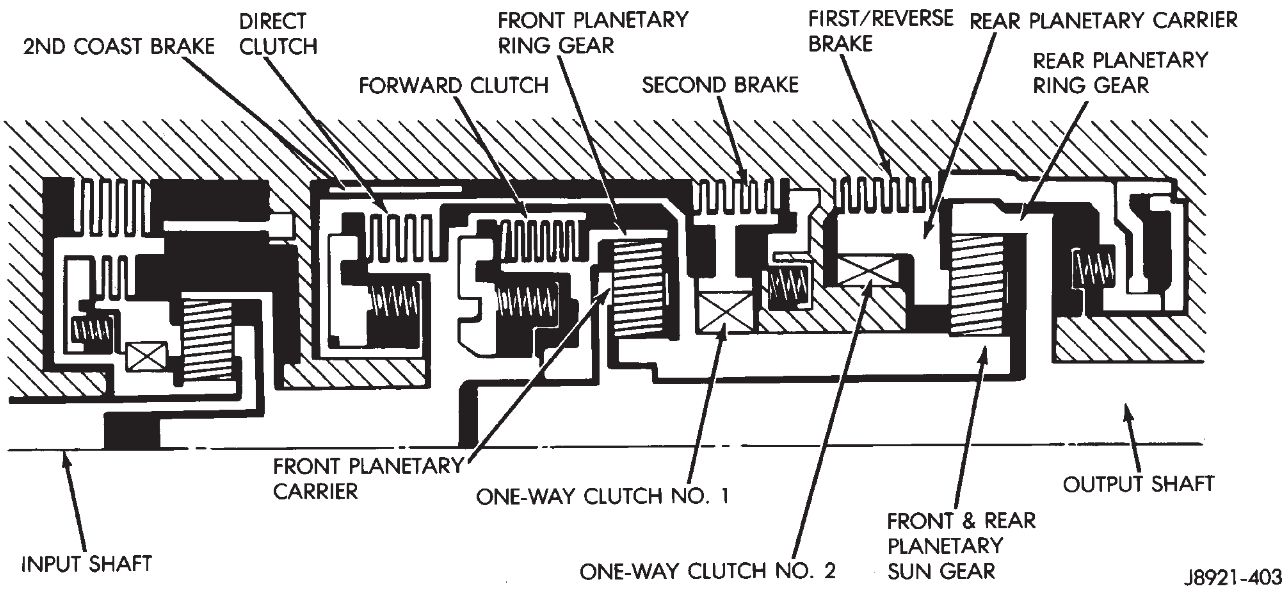

Fig. 6 First-Third-Reverse Gear Components

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.

The Component Function Chart (Fig. 7), describes basic function of various geartrain elements. The Component Application Chart (Fig. 8), indicates

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

J8921-404

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

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 valve body. The valve body consists of an upper body, lower body, separator plate and upper and lower gaskets (Fig. 9). The shift valves, sleeves, plugs and springs are located within the two body sections.

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).

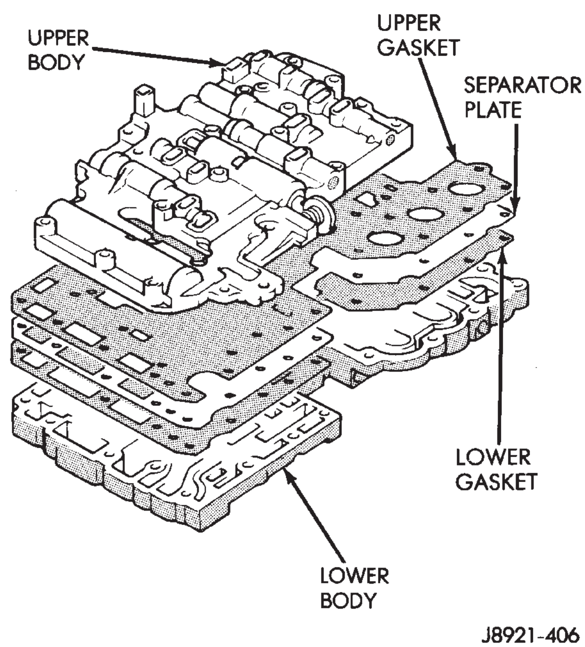

Fig. 9 Two-Section Transmission Valve Body

Manual Valve

The manual valve is operated by the gearshift linkage. The valve diverts fluid to the apply circuits according to shift lever position.

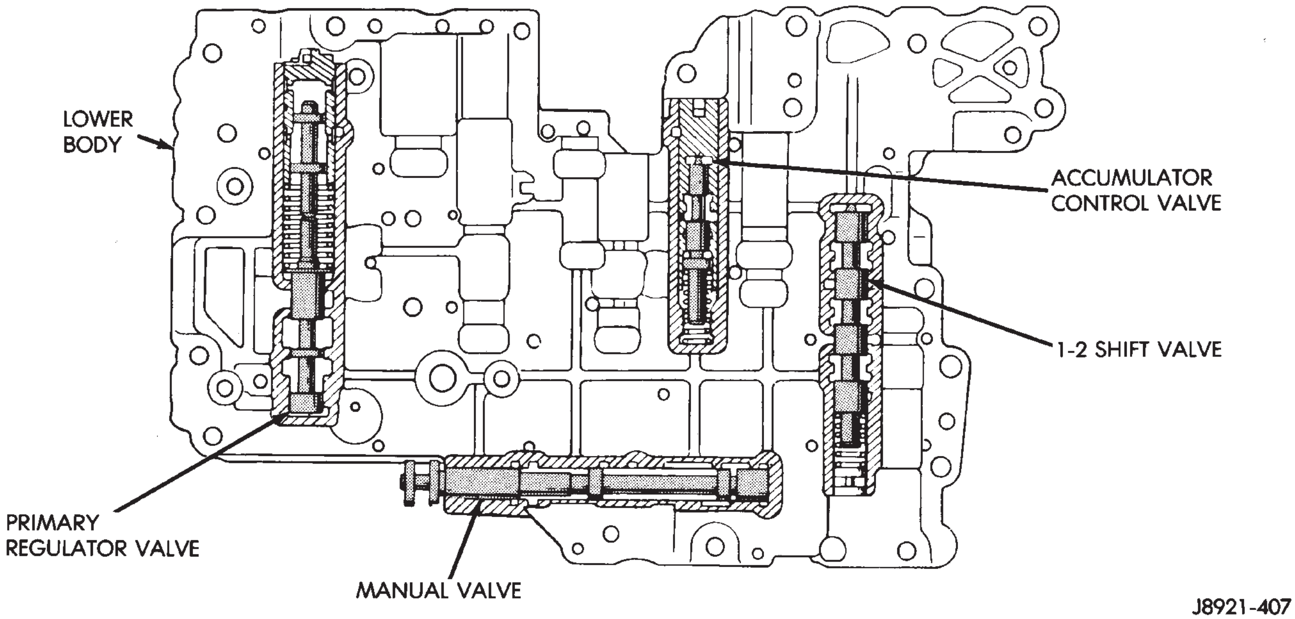

Fig. 10 Upper Body Components

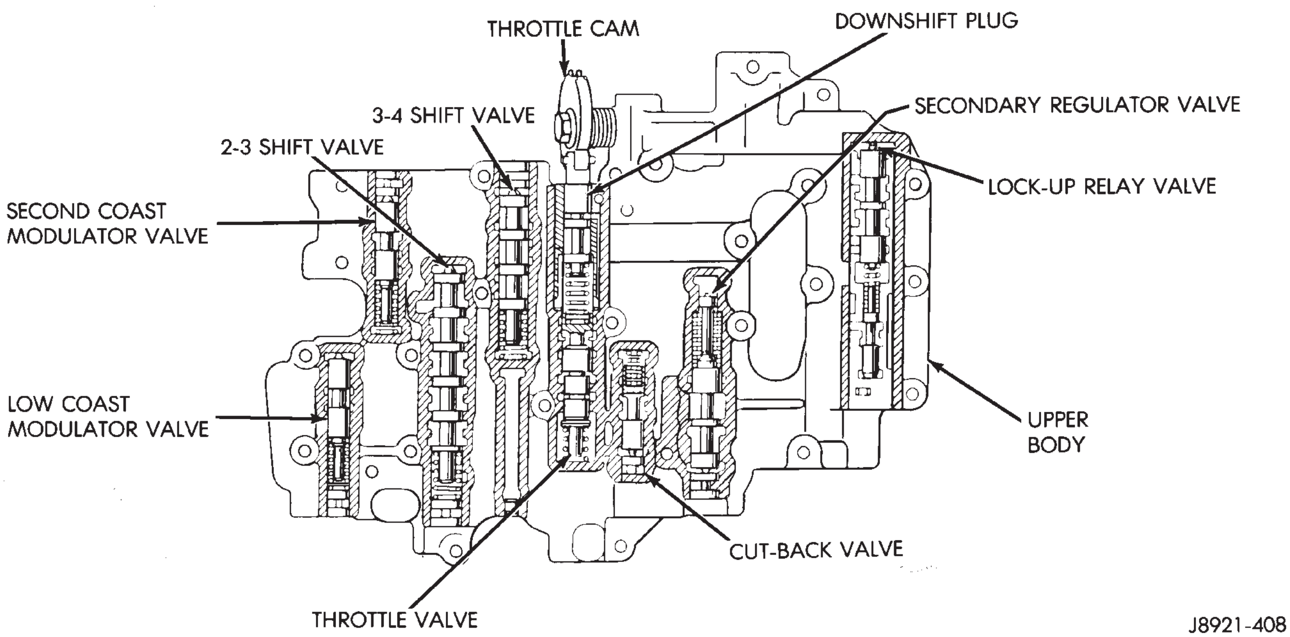

Fig. 11 Lower Body Components

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.

Cut-Back Valve

The cut-back valve (Fig. 15) helps prevent excessive pump pressure buildup in second, third and

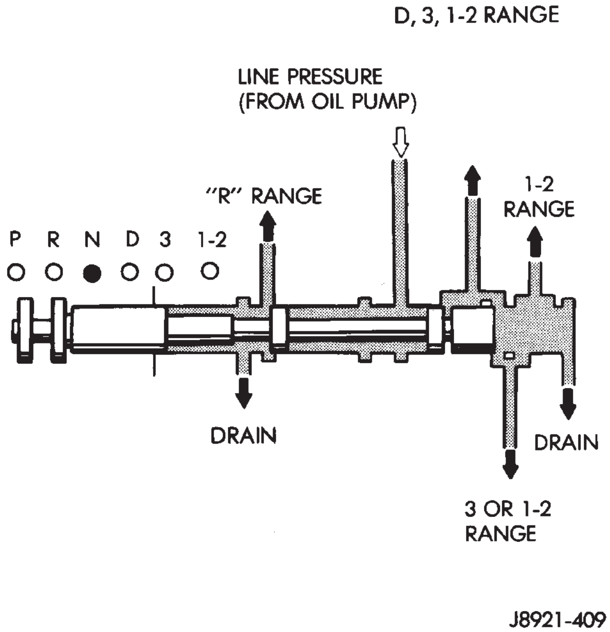

Fig. 12 Manual Valve

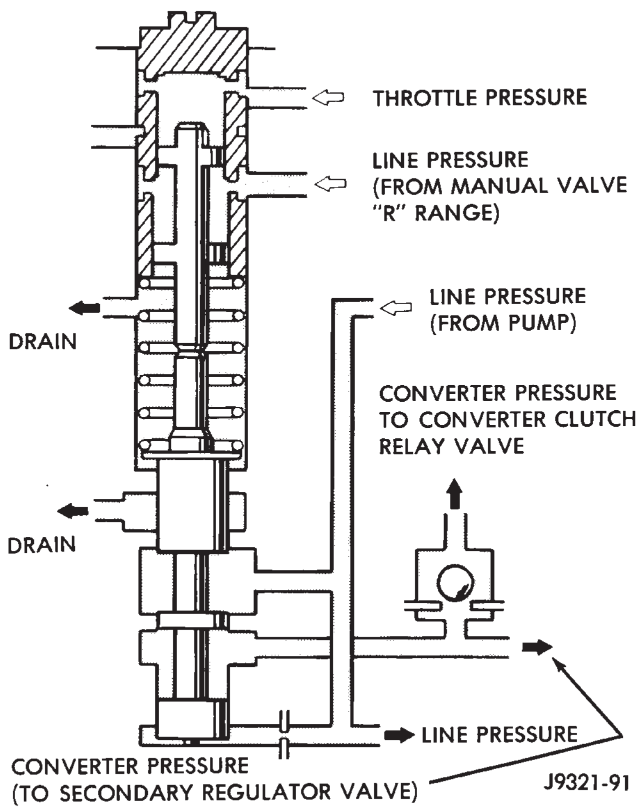

Fig. 13 Primary Regulator Valve

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.

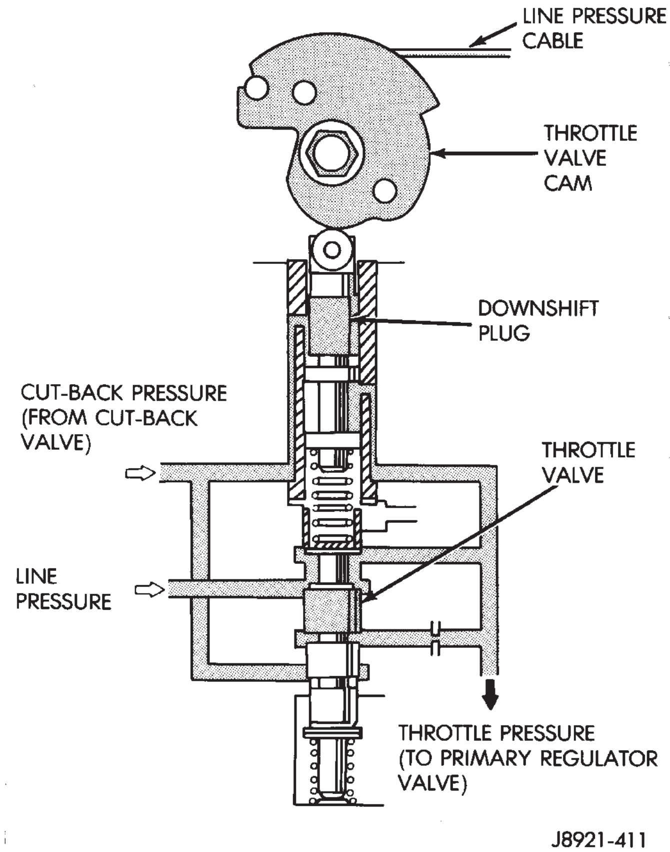

Fig. 14 Throttle Valve And Downshift Plug

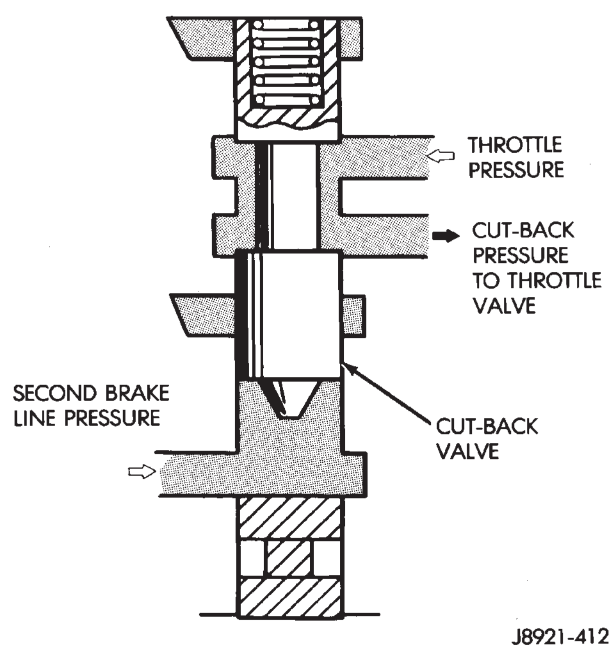

Fig. 15 Cut-Back Valve

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

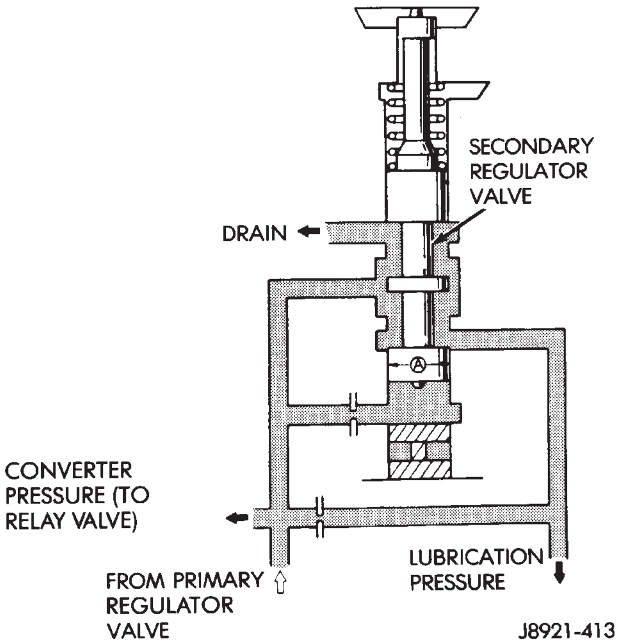

Fig. 16 Secondary Regulator Valve

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.

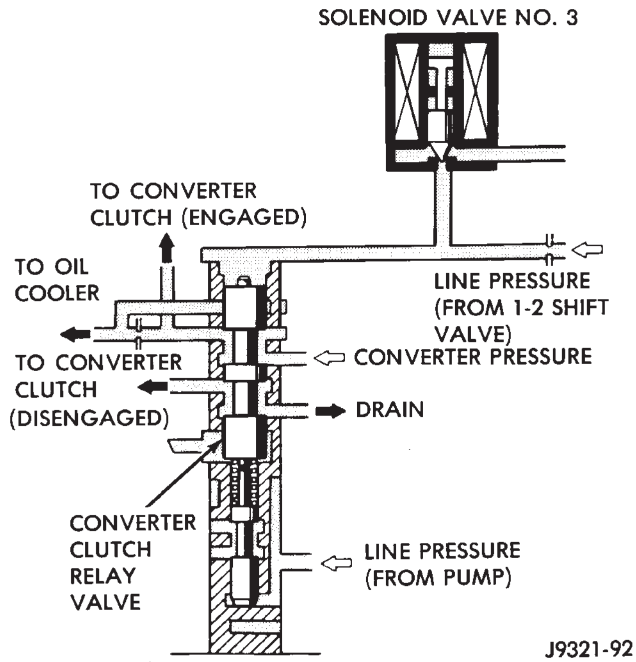

Fig. 17 Converter Clutch Relay Valve

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

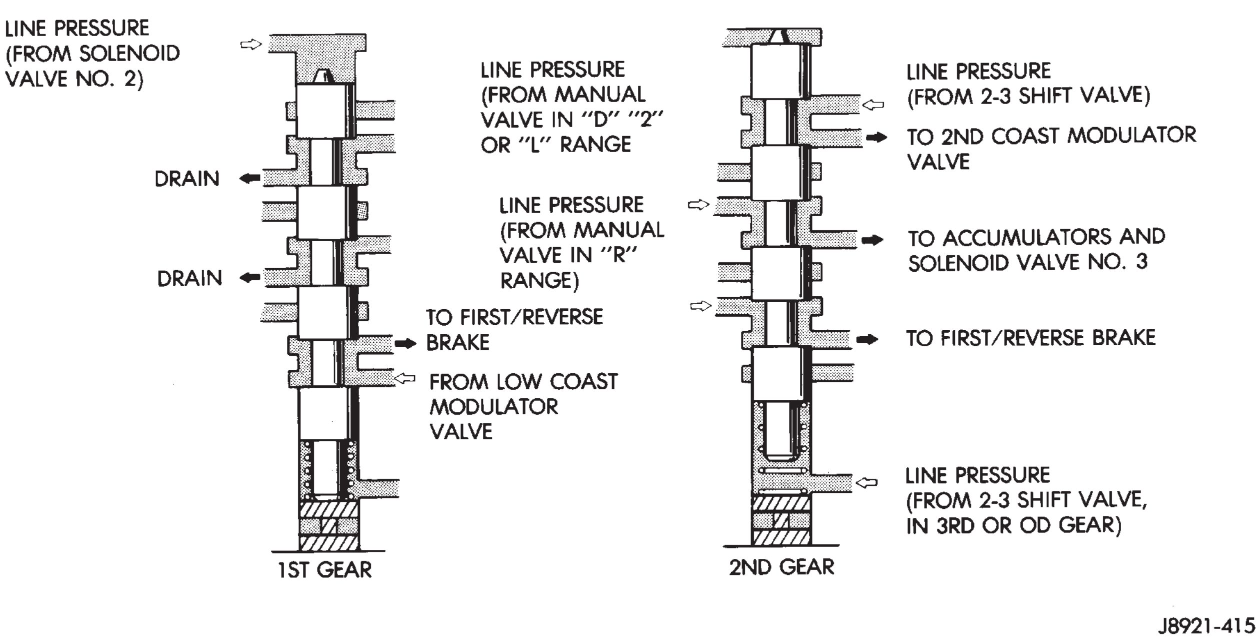

Fig. 18 1-2 Shift Valve

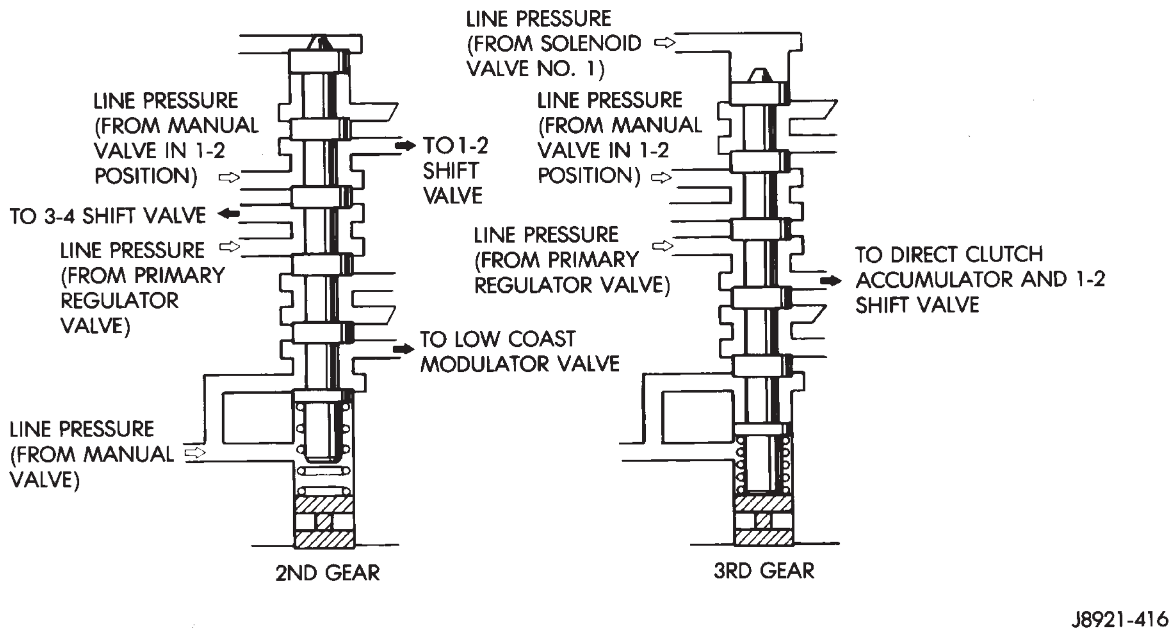

Fig. 19 2-3 Shift Valve

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.

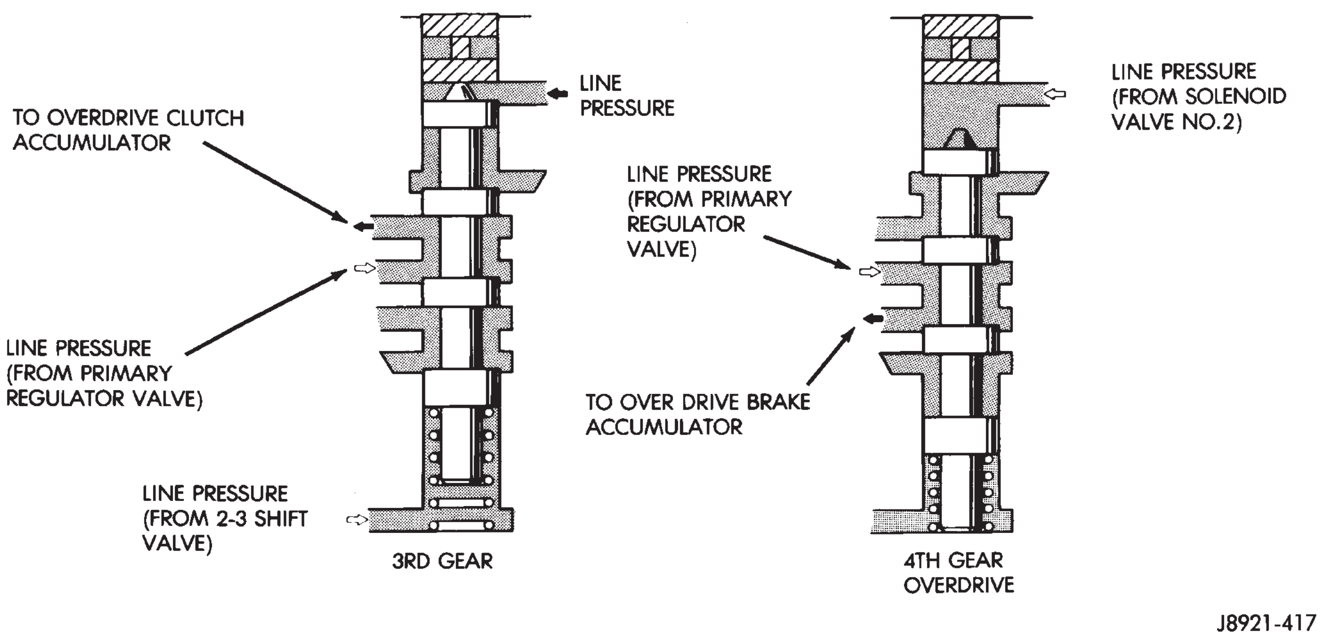

Fig. 20 3-4 Shift Valve

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.

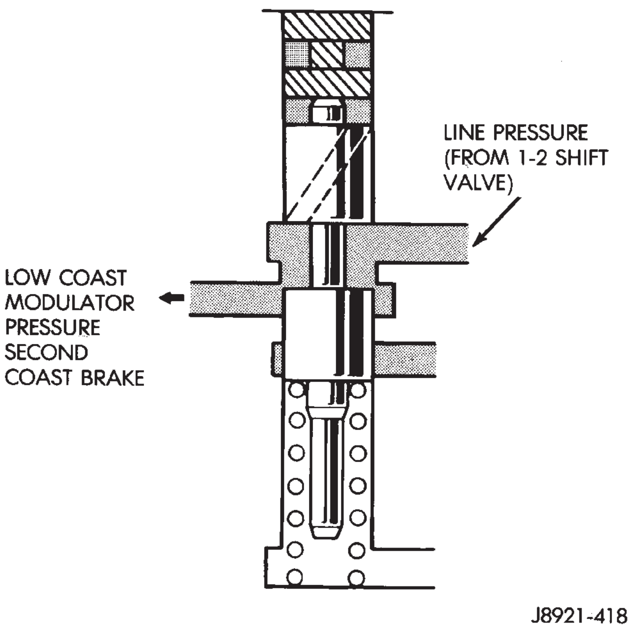

Fig. 21 Second Coast Modulator Valve

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.

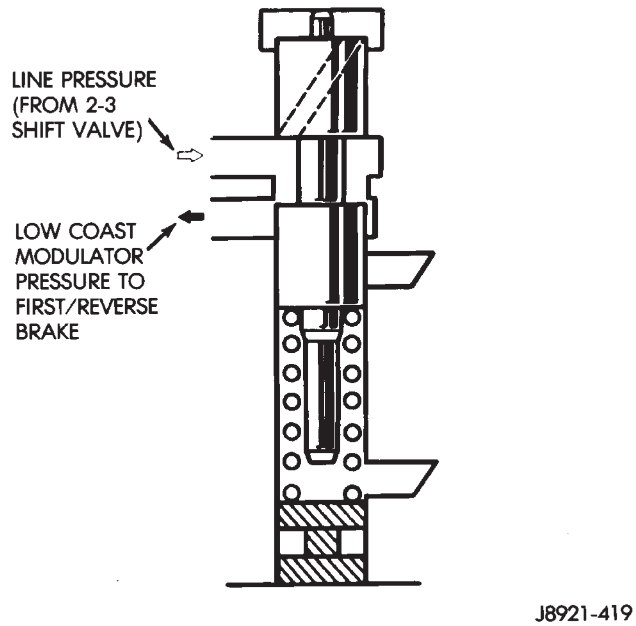

Fig. 22 Low Coast Modulator Valve

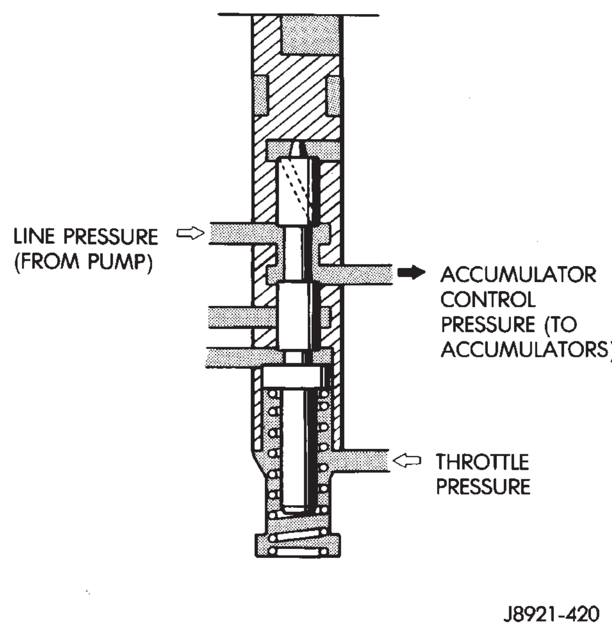

Fig. 23 Accumulator Control Valve

Control pressure from the accumulator control valve is constantly 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).

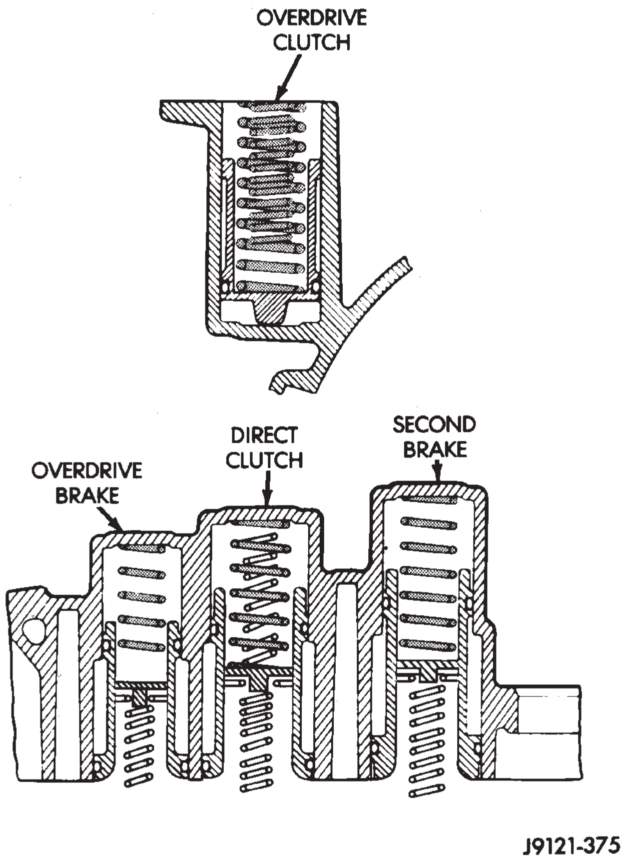

Fig. 24 Accumulators

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.

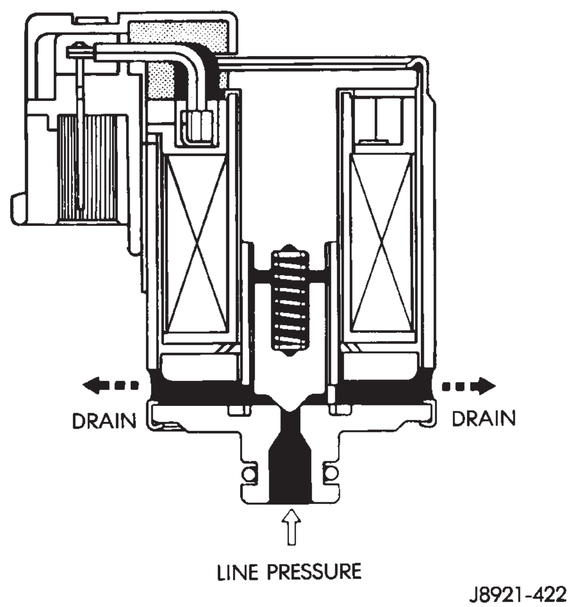

Fig. 25 Transmission Valve Body Solenoids

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.

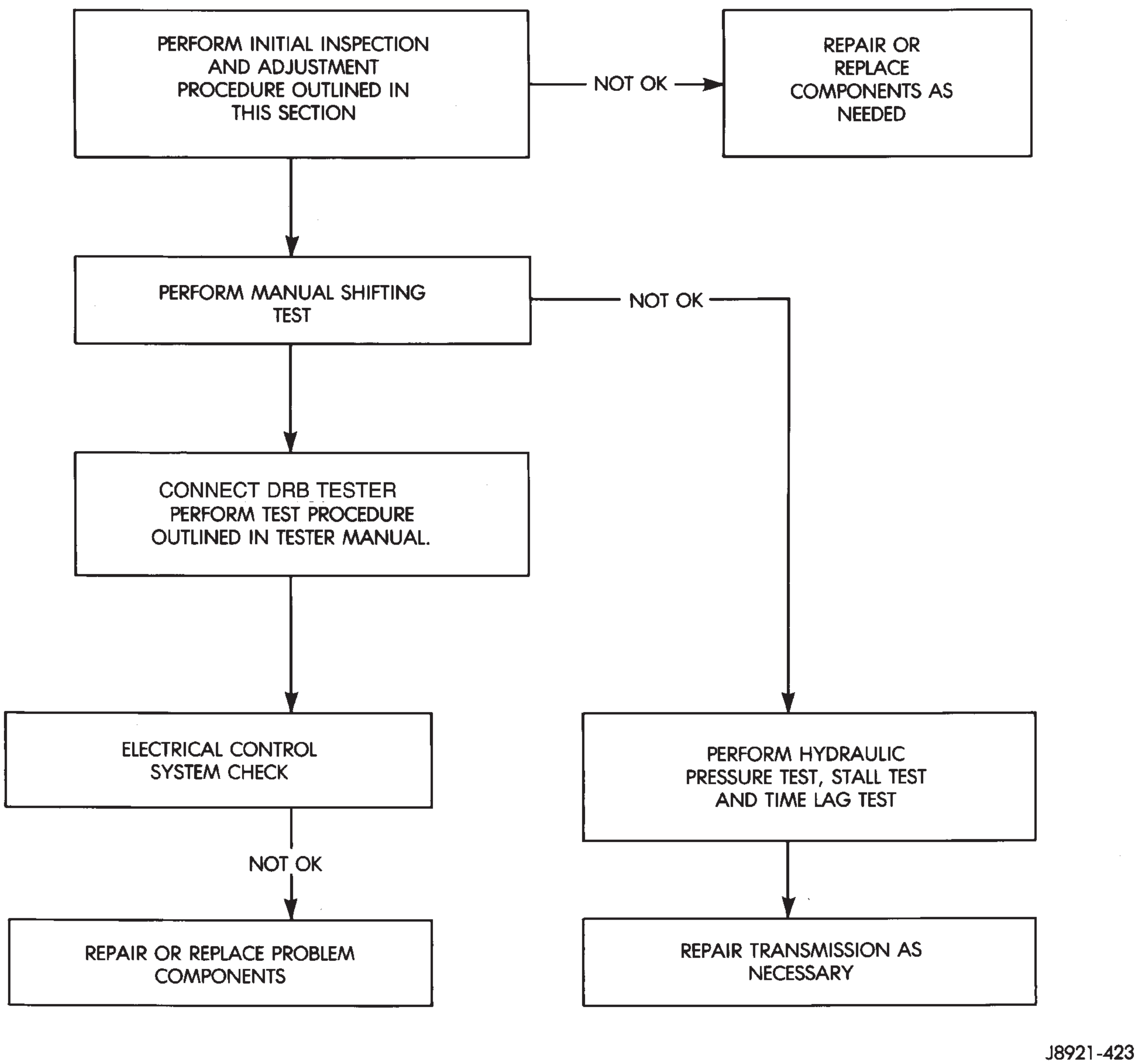

Fig. 26 Preliminary Diagnosis Check Procedure

PRELIMINARY INSPECTION AND ADJUSTMENT

(1) Check and adjust transmission shift cable if necessary.

(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 2100 kPa (300 psi).

(2) Be sure transmission fluid is at normal operating temperature.

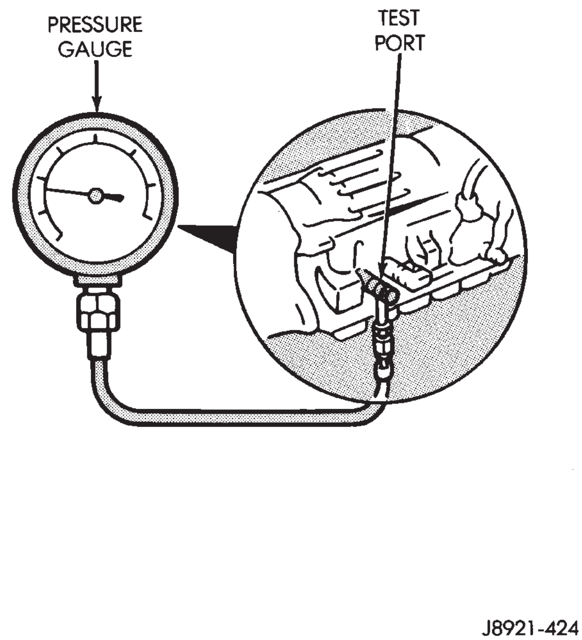

Fig. 27 Pressure Test Gauge Connection

(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 421-481 kPa (61-70 psi) .

(7) Press accelerator pedal to wide open throttle position and note line pressure. Pressure should be 1196-1442 kPa (173-209 psi).

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 519-618 kPa (75-90 psi).

(9) Press accelerator to wide open throttle position and note line pressure in Reverse. Pressure should be 1471-1814 kPa (213-263 psi).

CAUTION: Do not maintain wide open throttle for more than 3-4 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 2100-2400 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

AW-4 TRANSMISSION 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 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 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 Tester

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AW-4 TRANSMISSION 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 Tester
NO 4-3, 3-2 OR 2-1 KICKDOWN	Solenoid faulty Electronic control problem Valve body faulty	Replace solenoid Locate problem with DRB 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 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 TRANSMISSION FLUID LEVEL AND CONDITION

Recommended fluid for AW-4 transmissions is Mopar Mercon automatic transmission fluid. 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 25 km (15 miles) 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 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.**

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.

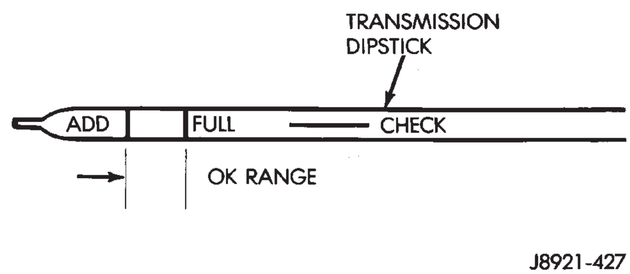


Fig. 1 Transmission Fluid Level

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 under the driver side of the instrument panel. It is bolted to the dash panel at the upper left side of the steering column support (Fig. 2).

A nut plate is used to secure the module to the dash panel. The plate is next to the power brake booster on the driver side of the dash. The module attaching nuts are accessible from the engine compartment side.

To remove the module, remove the attaching nuts and nut plate from the engine compartment side of the dash. Then work the module out from under the instrument, disconnect the module wire harness and remove the module.

To install the module, work the module into position on the dash panel and connect the module harness wires. Then slip the nut plate over the module studs and install the attaching nuts.

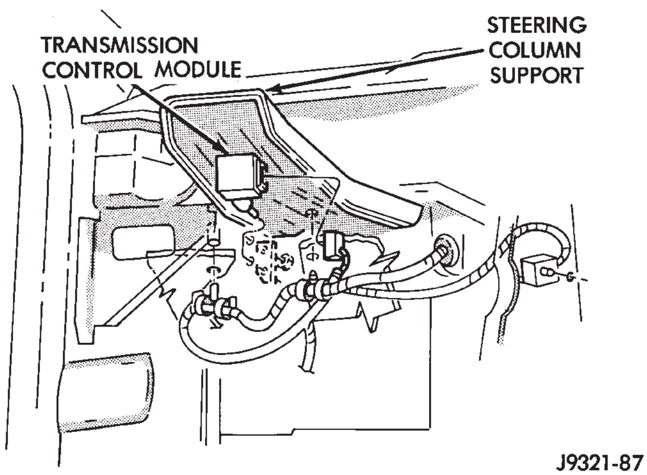


Fig. 2 Transmission Control Module

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:

- Continuity should exist between terminals B and C with the transmission in Park and Neutral only (Fig. 3).
- Continuity should exist between terminals A and E with the transmission in Reverse (Fig. 3).
- Continuity should exist between terminals A and G with the transmission in third gear (Fig. 3).
- Continuity should exist between terminals A and H with the transmission in first and/or second gear (Fig. 3).
- Continuity should not exist in D position.

PARK/NEUTRAL POSITION SWITCH REMOVAL

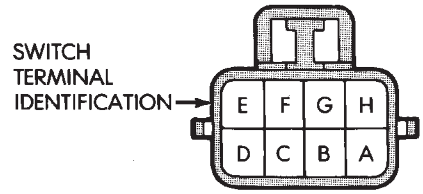
(1) Raise vehicle.

(2) Disconnect switch wire harness connector.

(3) Pry washer lock tabs upward and remove switch attaching nut and tabbed washer (Fig. 4).

(4) Remove switch adjusting bolt (Fig. 4).

(5) Slide switch off manual valve shaft.



	B	C	A	E	G	H
P	○	○				
R			○	○		
N	○	○				
D						
3			○		○	
1-2			○			○

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Fig. 3 Park/Neutral Position Switch Terminals And Testing

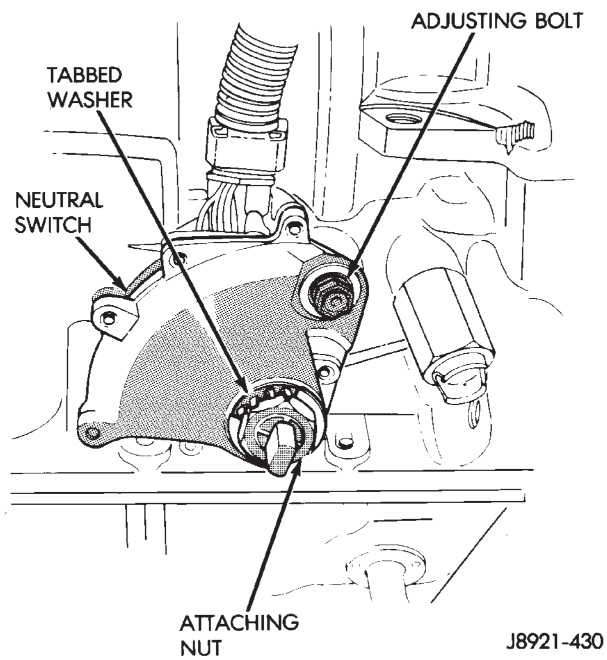


Fig. 4 Park/Neutral Position Switch Removal/Installation

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.

(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. 5).

(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.

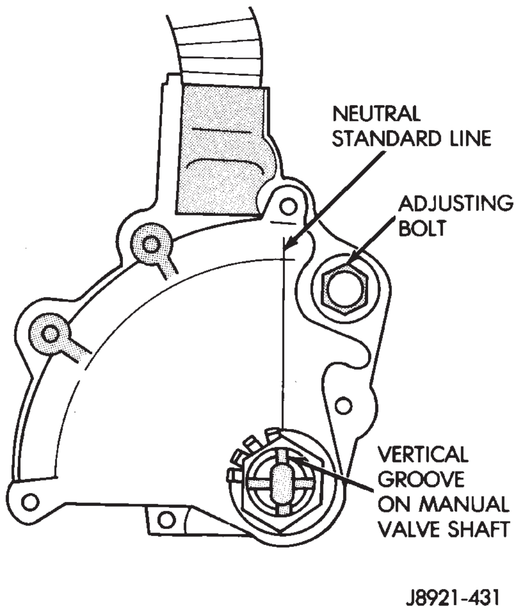


Fig. 5 Park/Neutral Position Switch Adjustment

VALVE BODY SOLENOID REPLACEMENT

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. 6) and gasket. Discard the gasket.

(4) Disconnect solenoid wire connector (Fig. 7).

(5) If all solenoids are being removed, mark or tag wires for assembly reference before disconnecting them.

(6) Remove bolt attaching solenoids to valve body and remove solenoids (Fig. 8). Do not allow any valve body components to fall out when solenoids are removed.

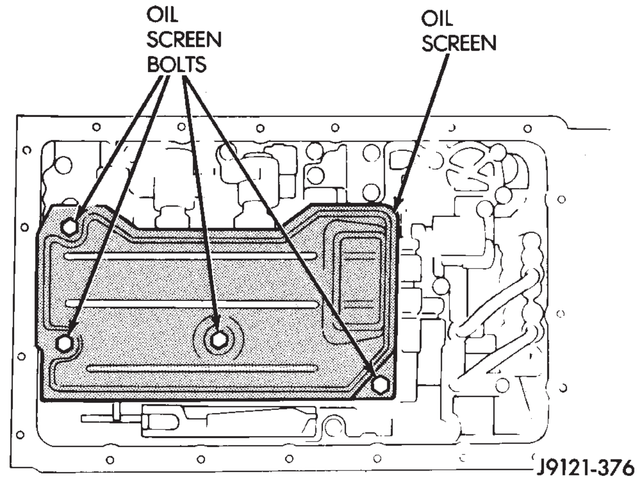


Fig. 6 Oil Screen Removal/Installation

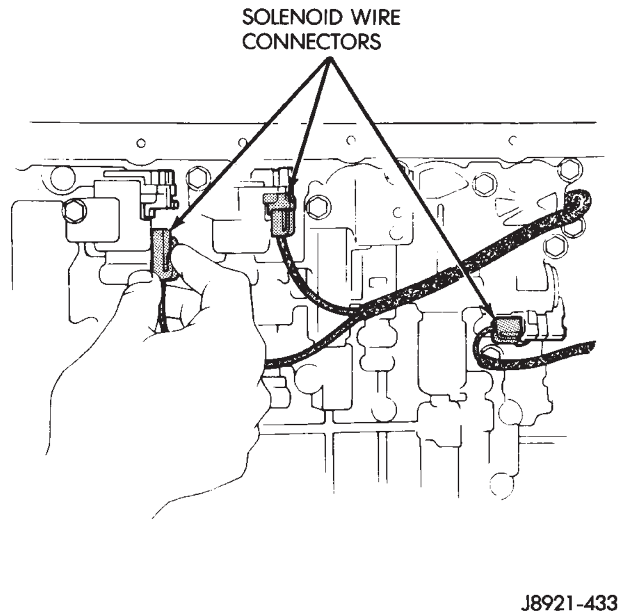


Fig. 7 Solenoid Wire Connectors

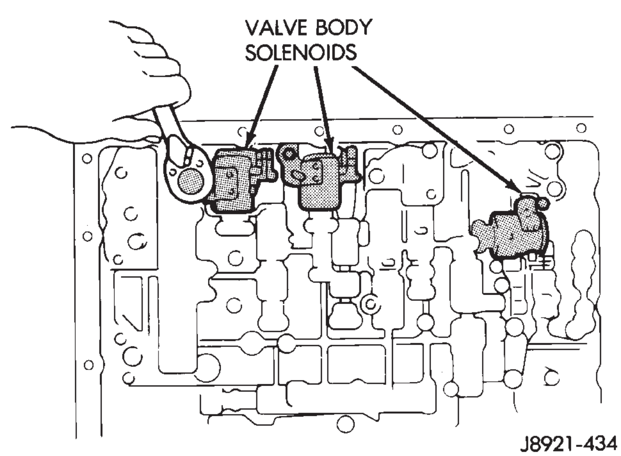


Fig. 8 Transmission Valve Body Solenoids

(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. 9).

Solenoid resistance should be 11-15 ohms. Replace the solenoid if resistance is above or below the specified range.

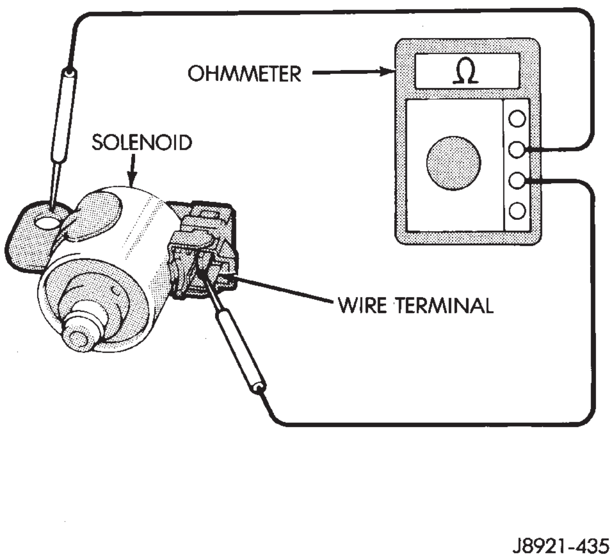


Fig. 9 Testing Transmission Valve Body Solenoid

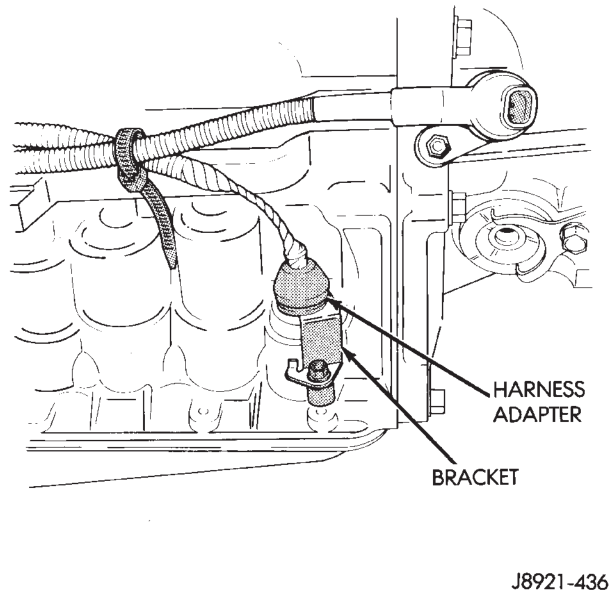


Fig. 10 Harness Adapter Removal/Installation

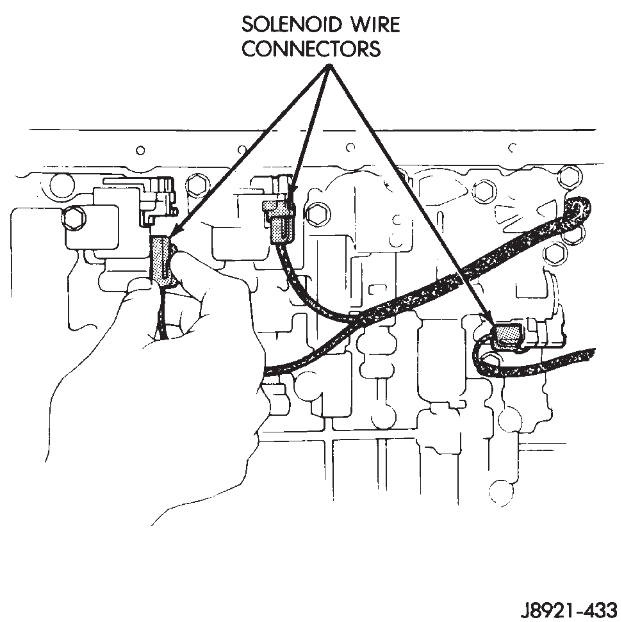


Fig. 11 Solenoid Wire Connections

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 Mopar or Loctite 599 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. 7).

(3) Remove bracket securing solenoid harness adaptor (Fig. 10) 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 and install oil screen.

(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 N●m (65 in. lbs.) torque.

(11) Install new gasket on oil pan drain plug and install plug. Tighten plug to 20 N●m (15 ft. lbs.) torque.

(12) Fill transmission with Mopar Mercon fluid.

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. 7). Mark wires for assembly reference.

(4) Remove valve body oil tubes (Fig. 12). Carefully pry tubes out of valve body with screwdriver.

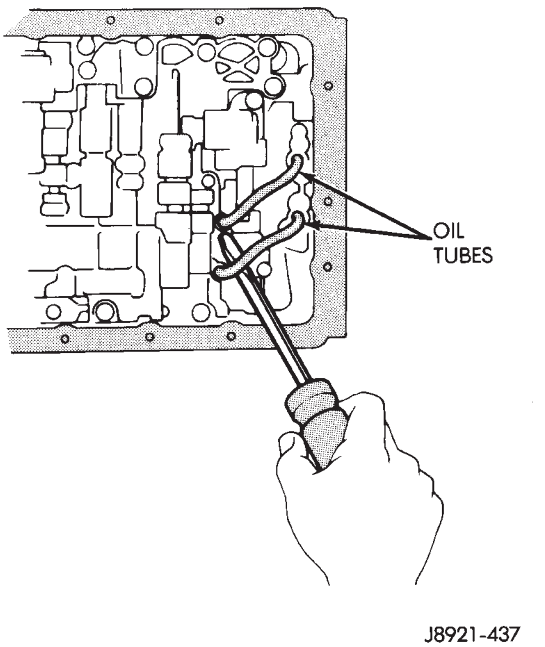


Fig. 12 Removing Transmission Valve Body Oil Tubes

(5) Disconnect throttle cable from throttle cam (Fig. 13).

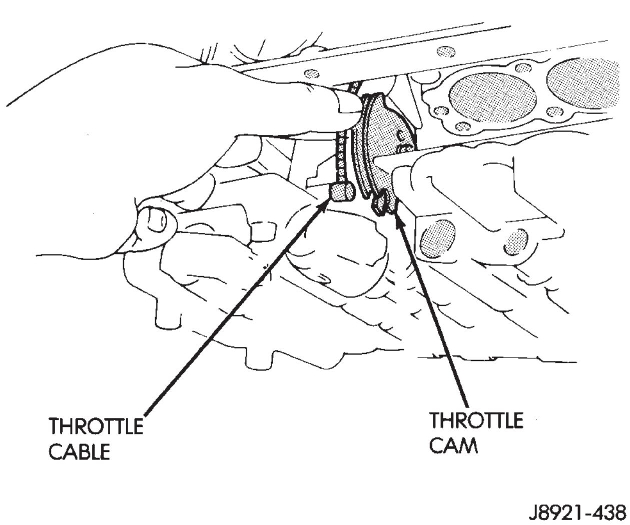


Fig. 13 Removing/Installing Throttle Cable

(6) Remove valve body bolts. Bolt locations are outlined in Figure 14.

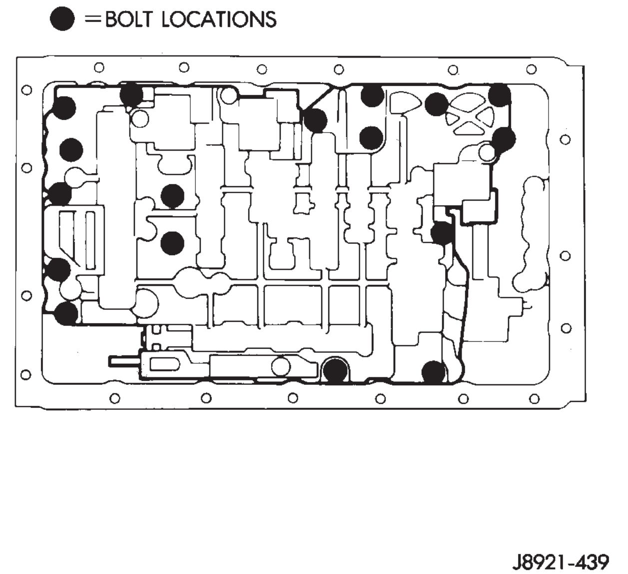


Fig. 14 Transmission Valve Body Bolt Locations

(7) Lower valve body and remove overdrive clutch accumulator springs, direct clutch accumulator springs and second brake accumulator spring (Fig. 15).

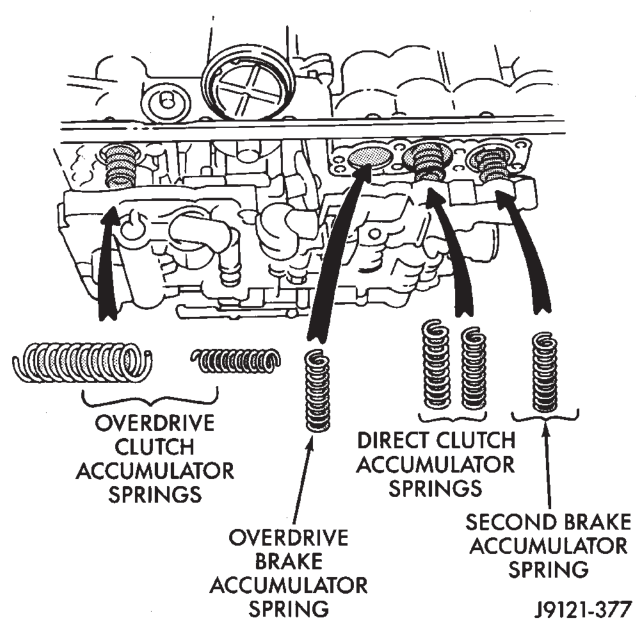


Fig. 15 Accumulator Springs

(8) Remove valve body and check ball and spring (Fig. 16).

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.

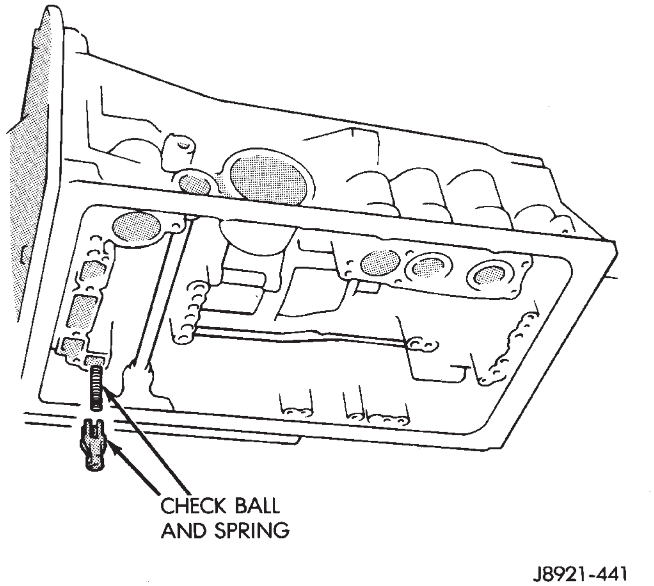


Fig. 16 Removing/Installing Check Ball And Spring

(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.

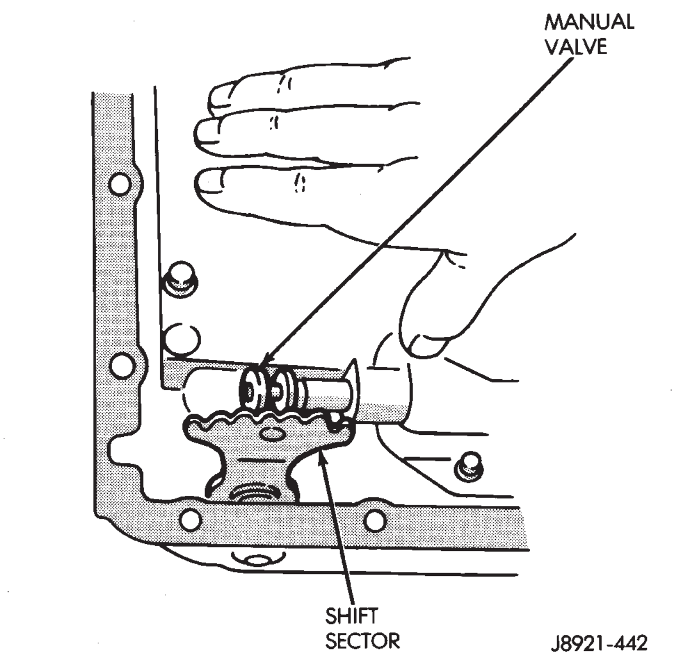


Fig. 17 Shift Sector And Manual Valve Alignment

(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.

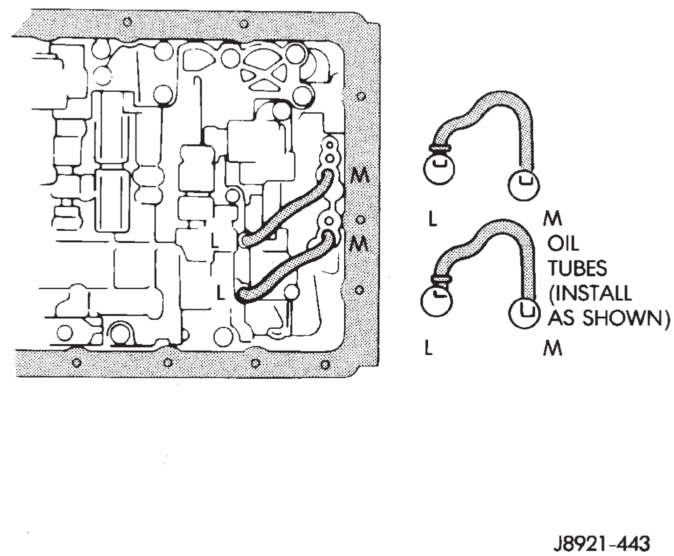


Fig. 18 Installing Transmission Valve Body Oil Tubes

(9) Install new gaskets on oil screen and install screen on case. Tighten screen attaching bolts to 10 N●m (7 ft. lbs.) torque.

(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.

(3) Remove bolts attaching park rod bracket to case (Fig. 20).

(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.

(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.

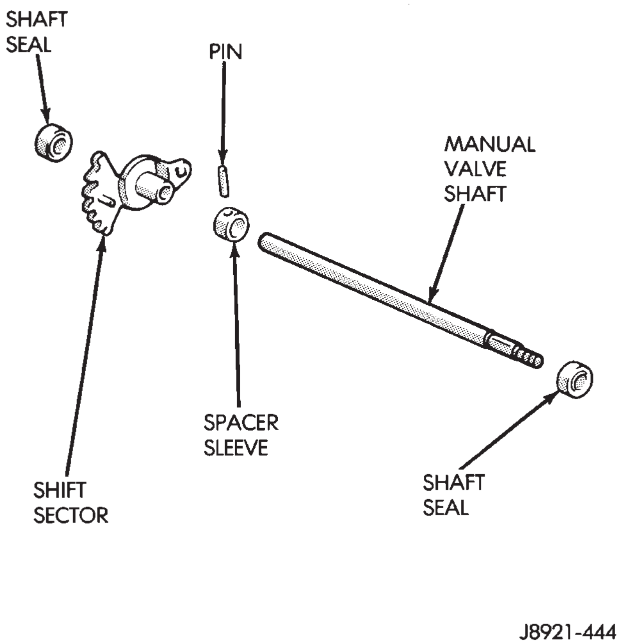


Fig. 19 Manual Valve Shaft And Seals

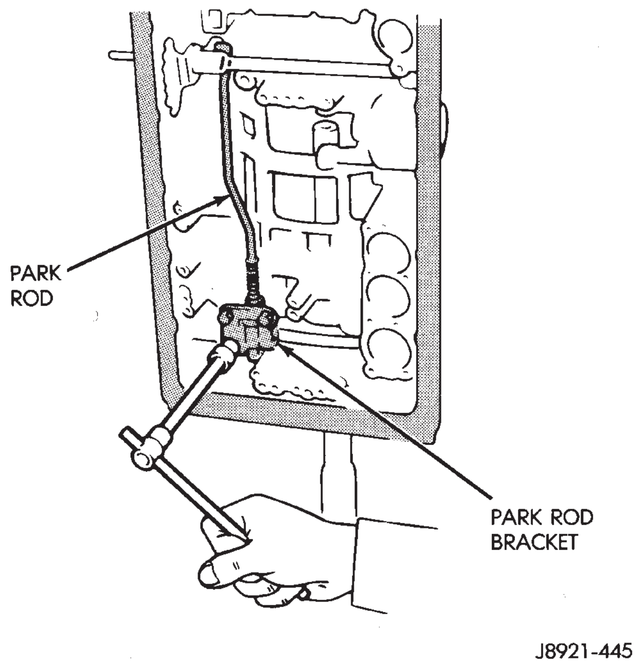


Fig. 20 Removing/Installing Park Rod Bracket

(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.

(17) Install valve body and oil screen.

(18) Apply Loctite 599 to oil pan seal surface and install pan and drain plug. Use new gasket on drain plug if necessary.

(19) Install park/neutral position switch.

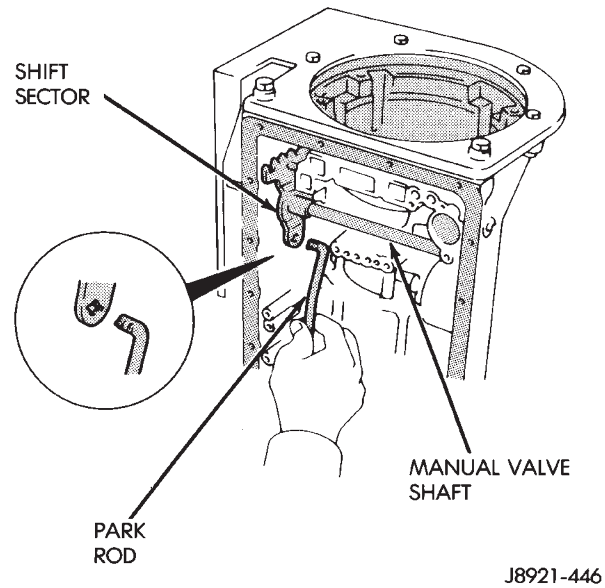


Fig. 21 Removing/Installing Park Rod

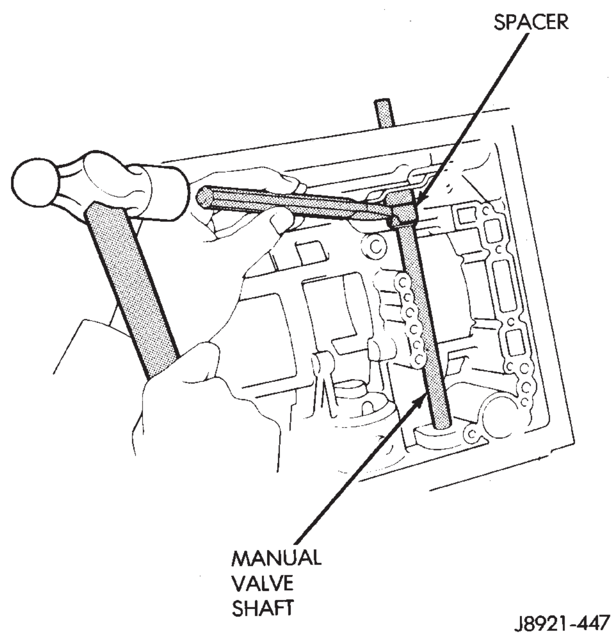


Fig. 22 Cutting Spacer Sleeve

(20) Fill transmission with Mopar Mercon fluid.

ACCUMULATOR PISTONS AND SPRINGS

ACCUMULATOR PISTON AND SPRING REMOVAL

(1) Remove valve body. Refer to procedure in this section.

(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.

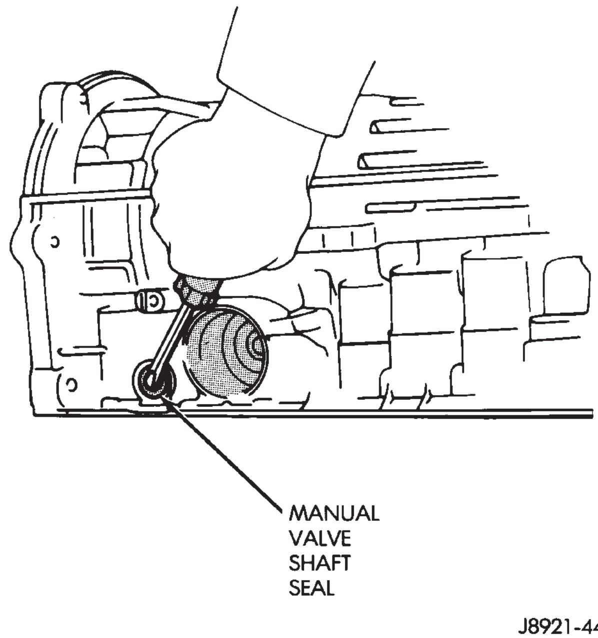


Fig. 23 Removing Manual Valve Shaft Seals

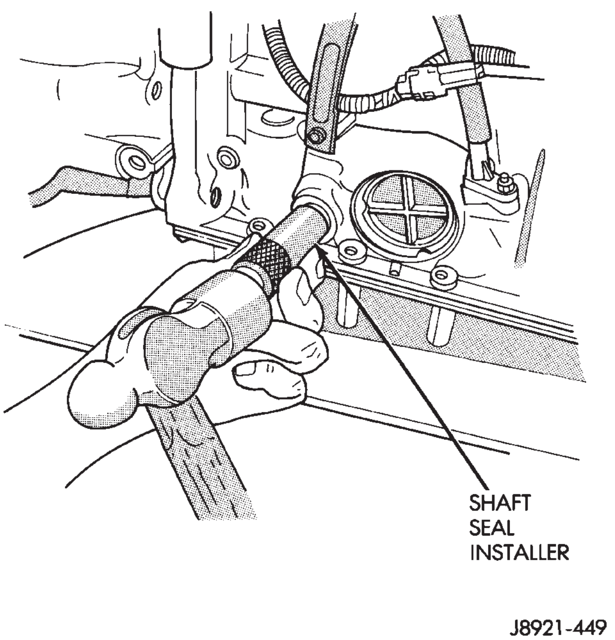


Fig. 24 Installing Manual Valve Shaft Seals

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.

(4) Inspect pistons, springs and piston bores. Replace worn damaged pistons. Replace broken, collapsed or distorted springs. Replace case if piston bores are damaged.

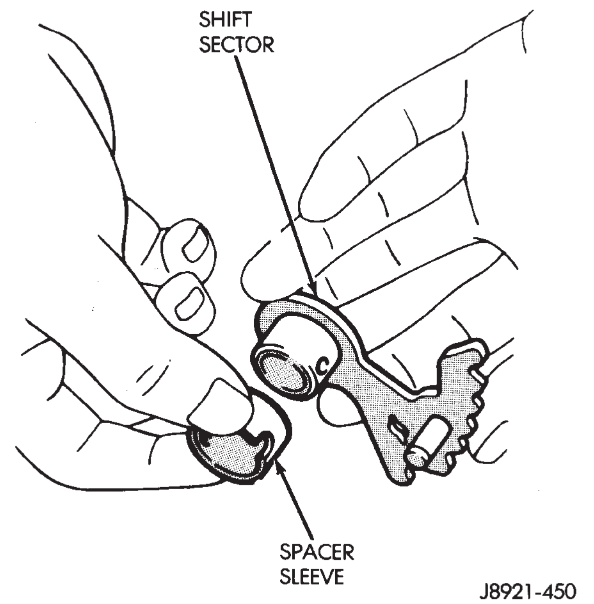


Fig. 25 Installing Spacer Sleeve On Sector

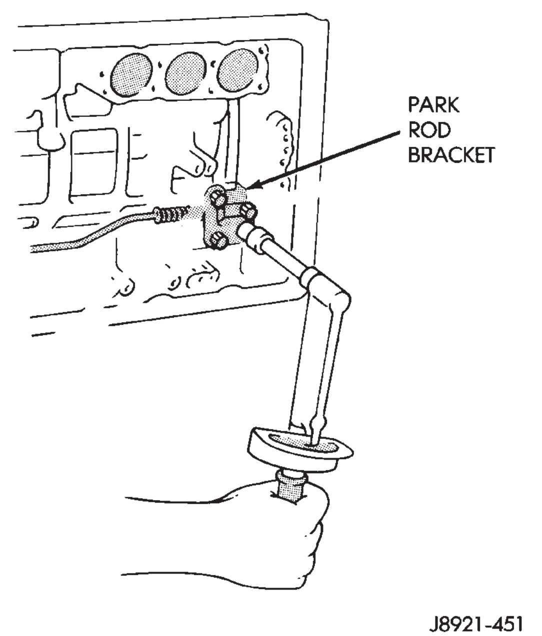


Fig. 26 Installing Park Rod Bracket

(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.

(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 and oil screen.

(9) Apply bead of Loctite 599 to oil pan seal surface and install pan and drain plug.

(10) Fill transmission with Mopar Mercon fluid.

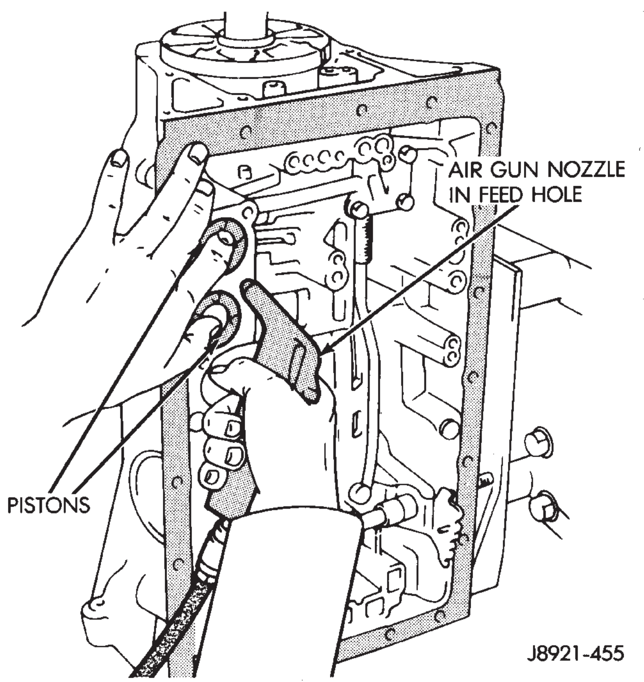


Fig. 27 Accumulator Piston Removal

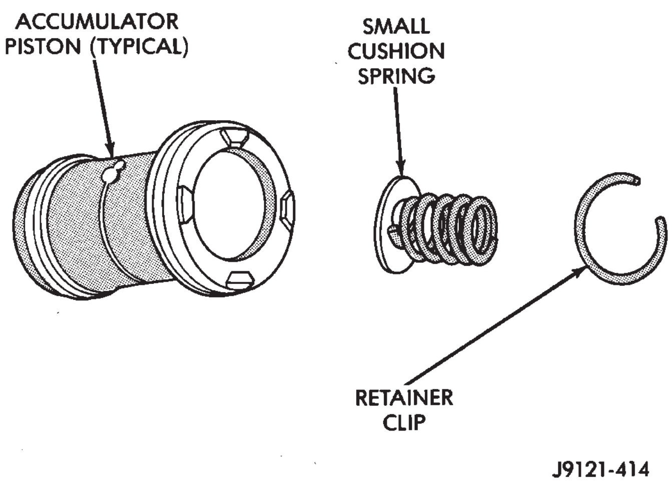


Fig. 28 Small Cushion Spring Retention

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.

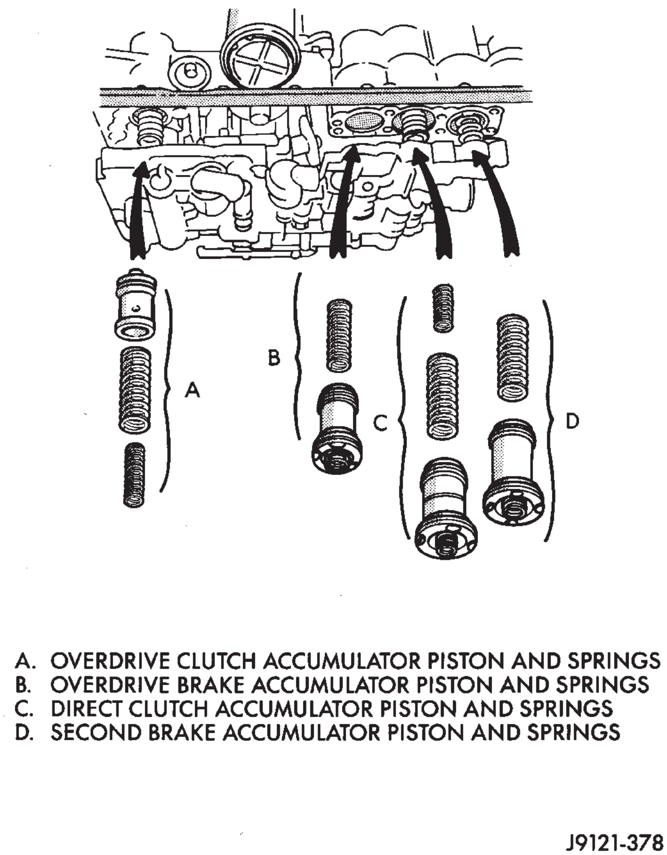


Fig. 29 Accumulator Pistons, Springs And Spacers

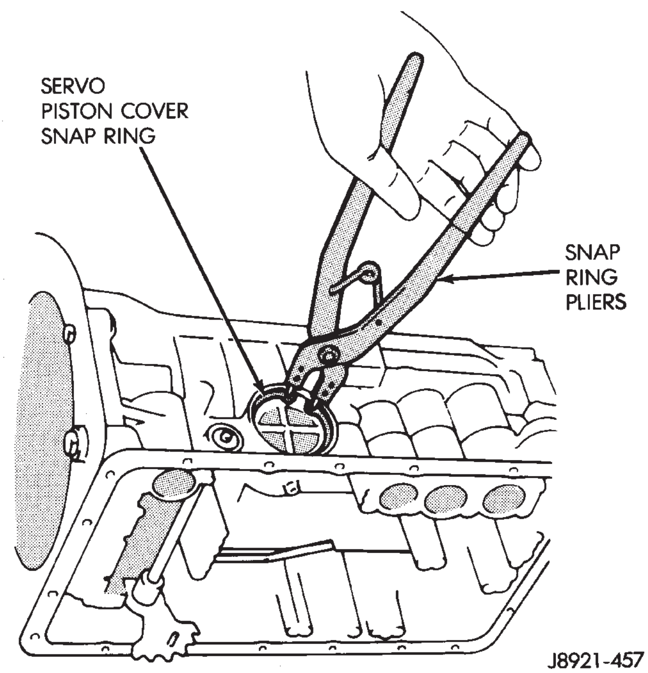


Fig. 30 Removing/Installing Servo Piston Cover Snap Ring

(7) Assemble and install servo components in case. Be sure servo piston rod is properly engaged in the second coast brake band.

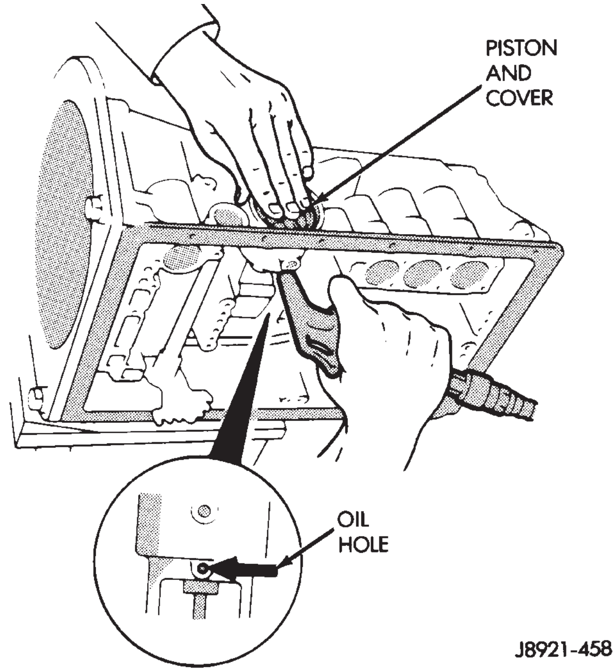


Fig. 31 Removing Servo Cover And Piston

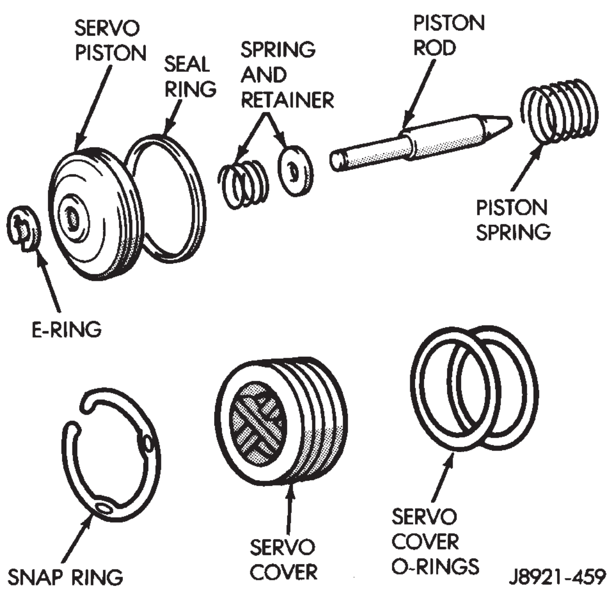


Fig. 32 Second Coast Brake Servo Components

(8) Compress cover and piston and install cover snap ring.

(9) Install valve body, oil screen and oil pan.

PARK ROD AND PAWL SERVICE

PARK ROD AND PAWL REMOVAL

(1) Remove valve body as outlined in this section.

(2) Remove bolts attaching park rod bracket to case (Fig. 33).

(3) Remove park rod from manual valve shaft sector (Fig. 34).

(4) Remove park rod.

(5) Remove park pawl, pin and spring (Fig. 35).

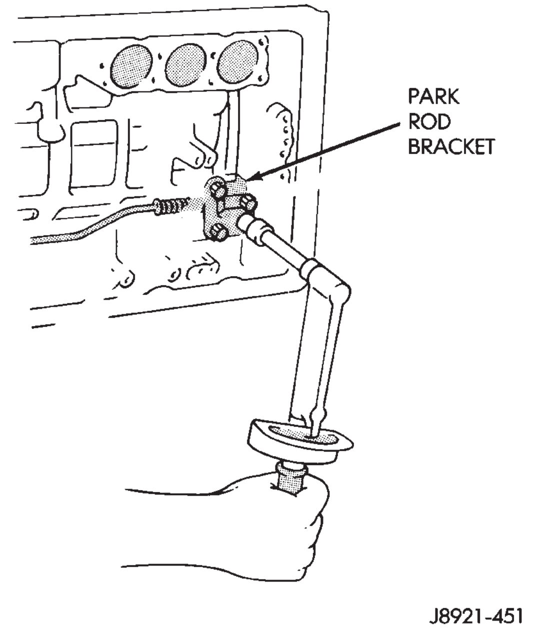


Fig. 33 Removing/Installing Park Rod Bracket

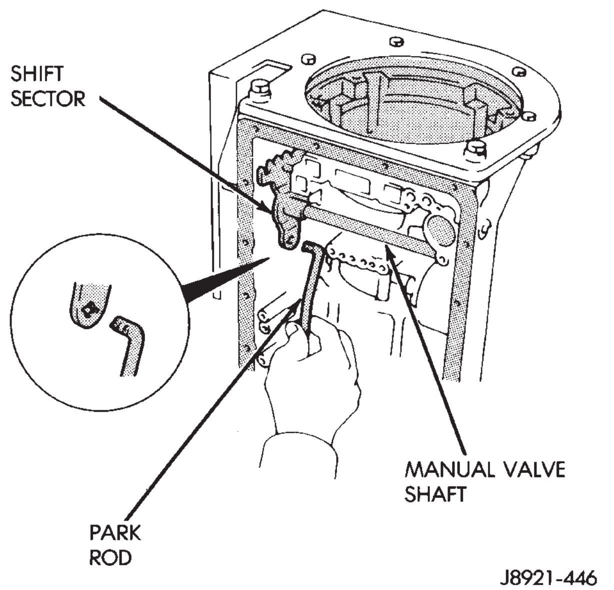


Fig. 34 Removing/Installing Park Rod

(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.

(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.

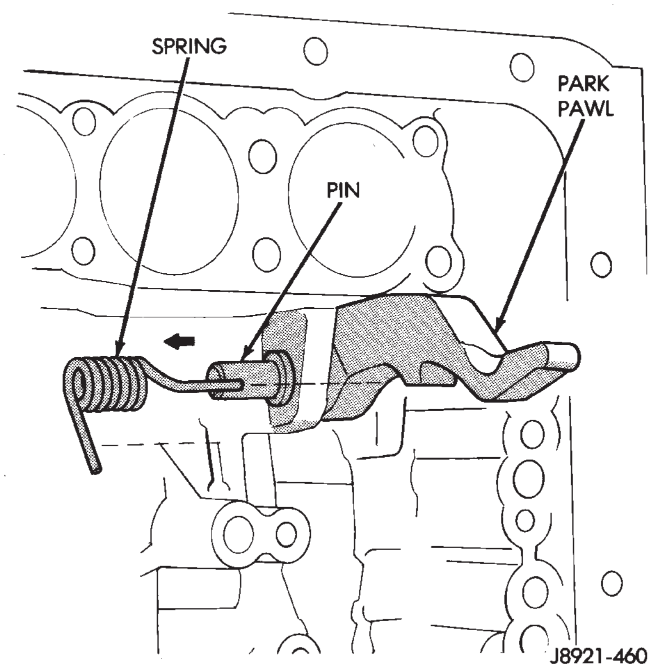


Fig. 35 Removing/Installing Park Pawl, Pin And Spring

(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).

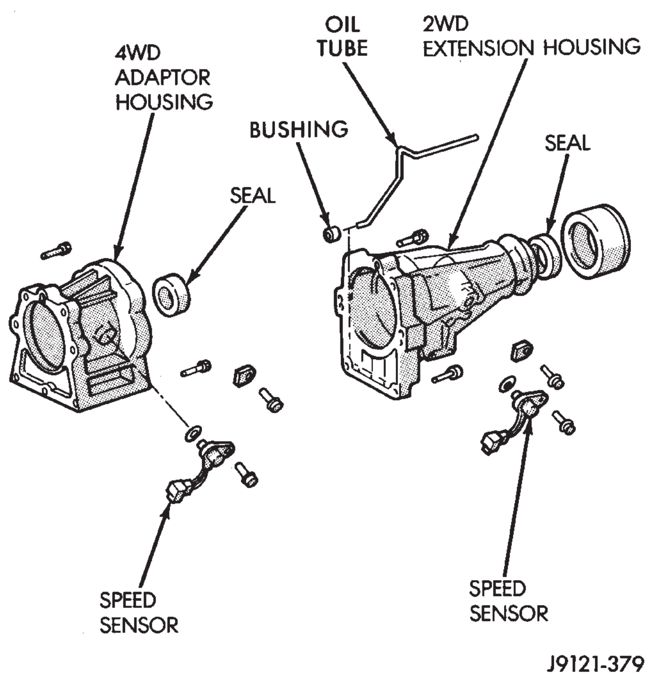


Fig. 36 Adapter Housing Seals

(4) Install new seal with appropriate size seal installer and install dust shield.

(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 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.

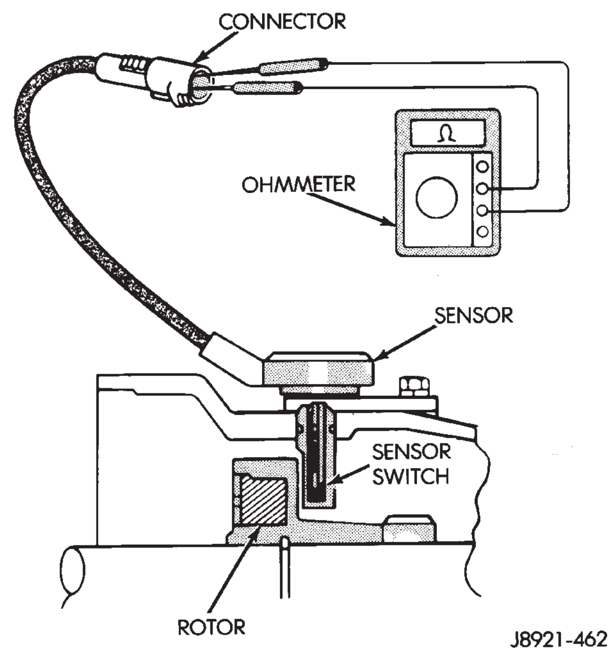


Fig. 37 Speed Sensor Testing

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.

(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.

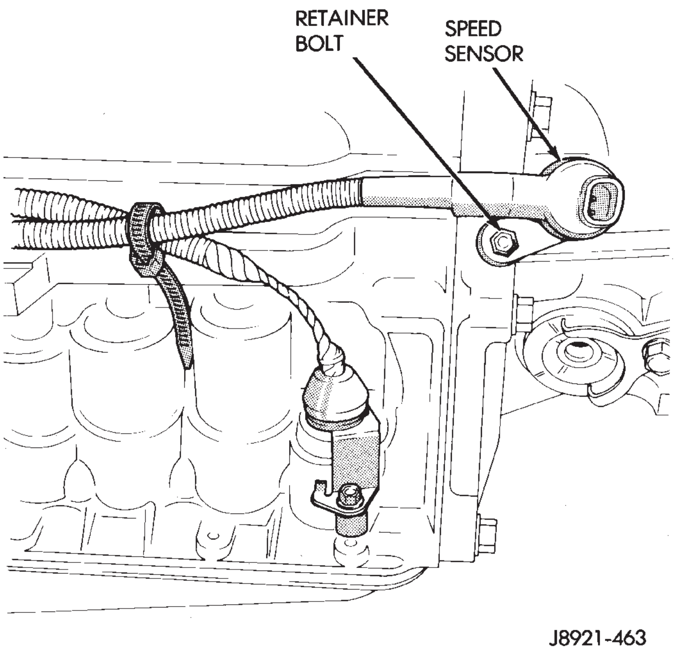


Fig. 38 Transmission Speed Sensor Removal/Installation

(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).

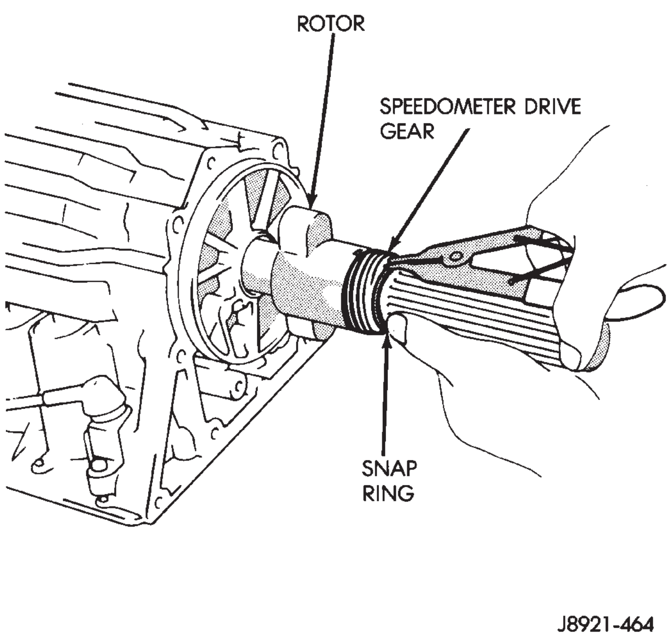


Fig. 39 Removing/Installation Speedometer Drive Gear

(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.

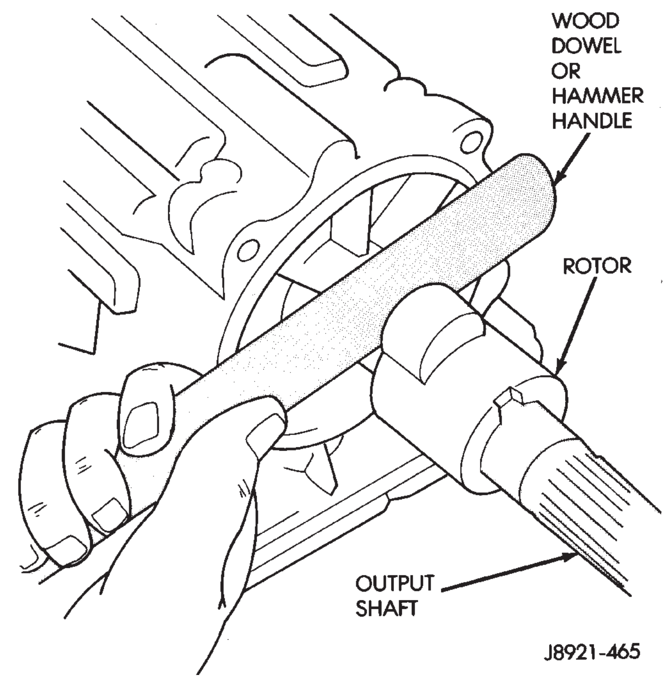


Fig. 40 Removing Speed Sensor Rotor

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/adaptor housing on case.

(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.

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).

(5) Remove cable bracket bolt and remove cable and bracket from case (Fig. 43).

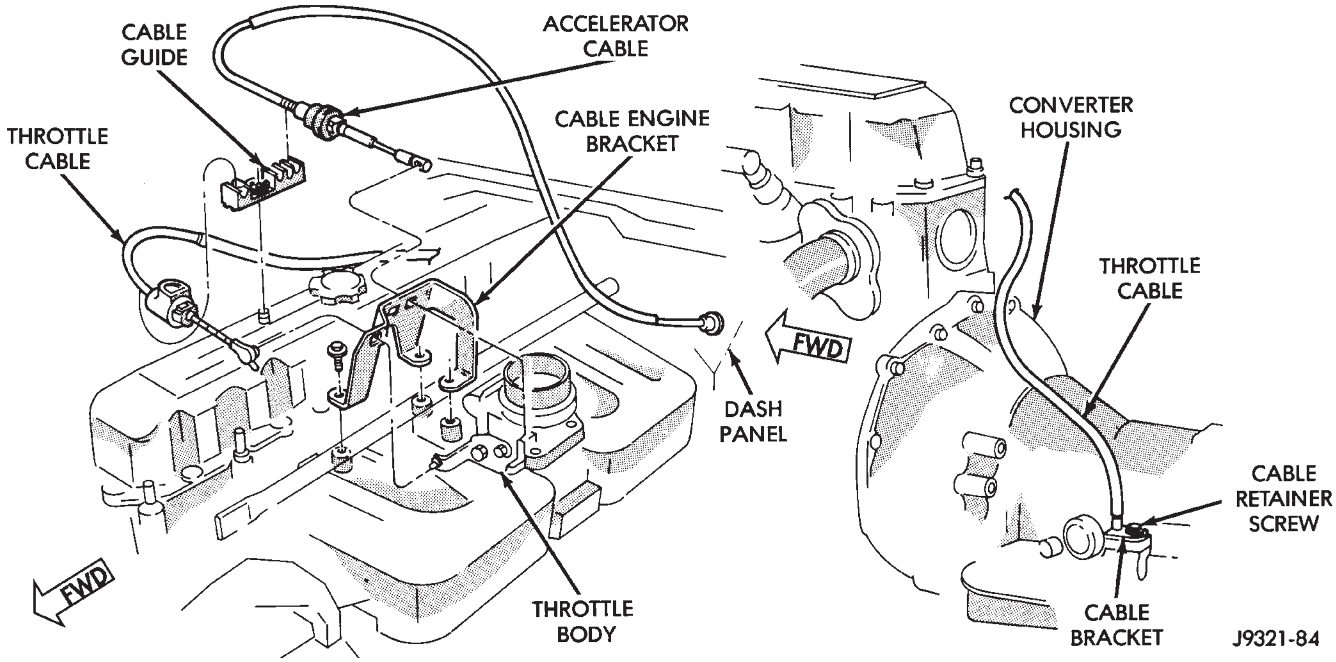


Fig. 41 Transmission Throttle Cable Attachment

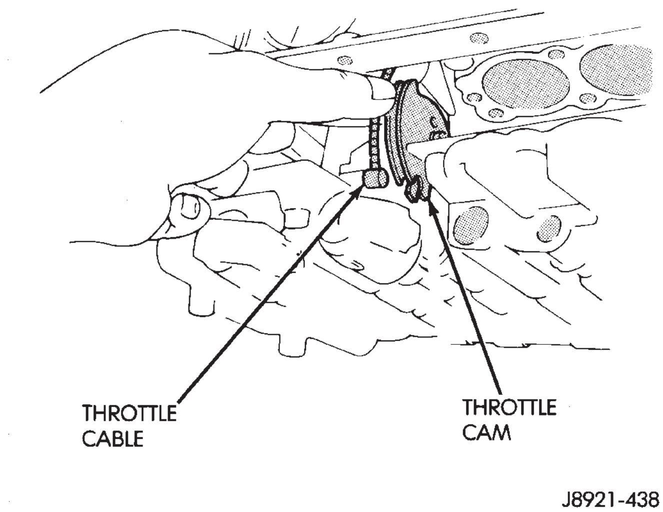


Fig. 42 Removing/Installing Transmission Throttle Cable

(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 7.4 N•m (65 in. lbs.) torque.

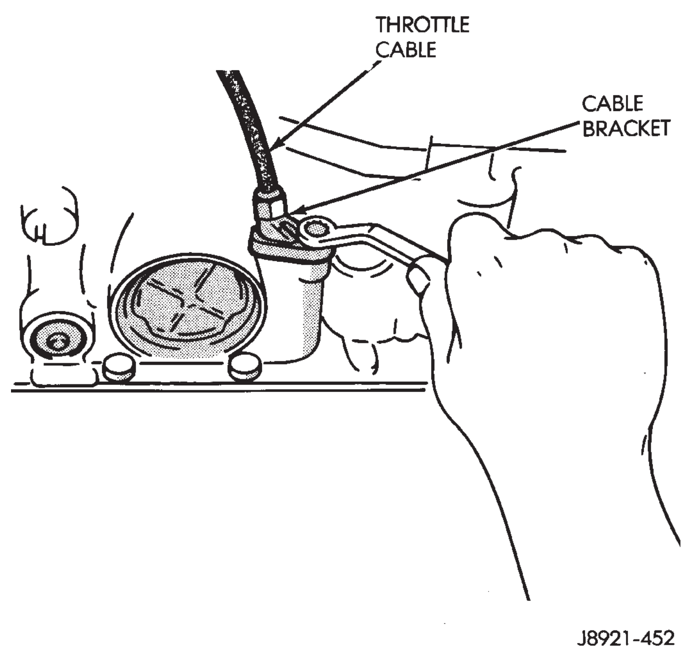


Fig. 43 Removing/Installing Transmission Throttle Cable And Bracket

(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).

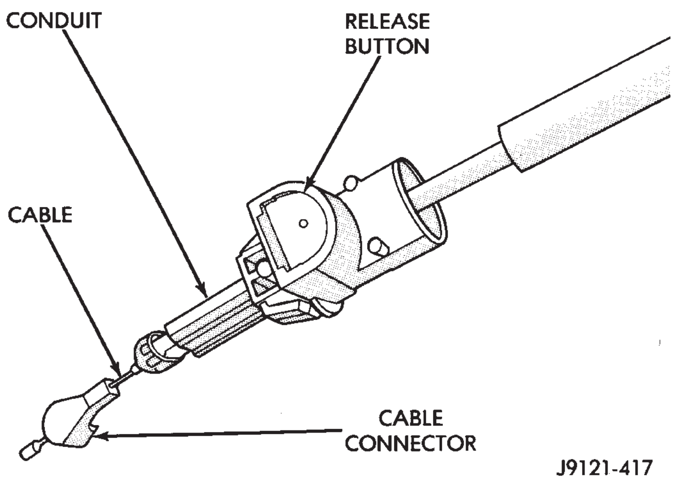


Fig. 44 Throttle Cable Components

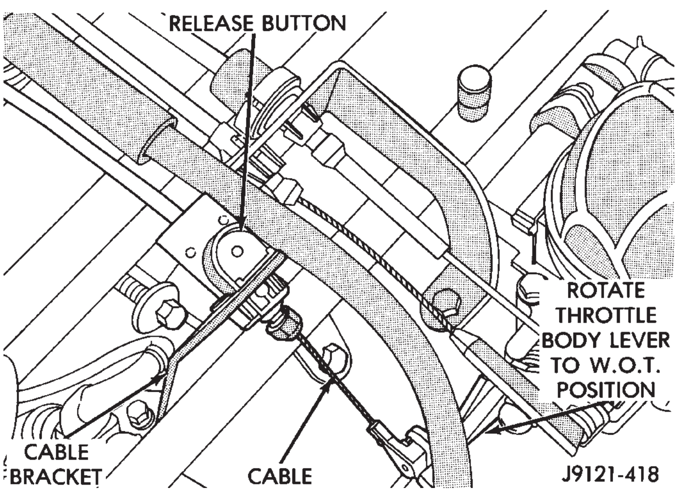


Fig. 45 Throttle Cable Adjustment

SHIFT LEVER ASSEMBLY REMOVAL—WITH FULL CONSOLE

(1) Disconnect battery negative cable.

(2) Remove screws at bottom of console storage bin.

(3) Remove handle from transmission shift lever. Grasp handle and pull up sharply to remove handle from lever.

(4) Unsnap and remove shift lever bezel (Fig. 46). Bezel has two retainer tabs on each side.

(5) Remove light bulb from shift lever bezel.

(6) Remove screws attaching front of console (Fig. 47). Screws are under shift lever bezel and are accessible once bezel has been removed.

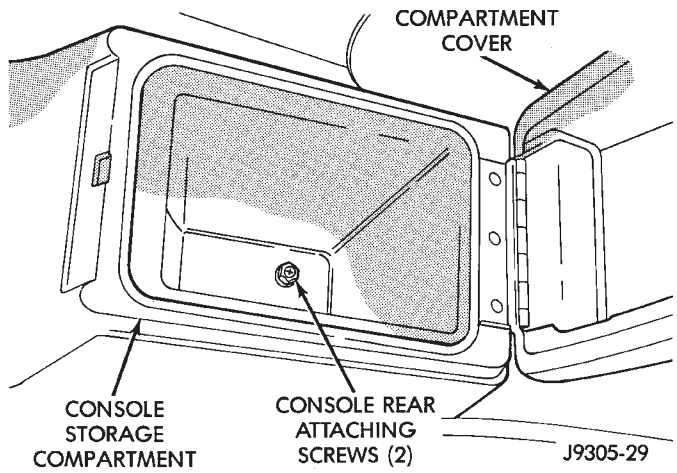


Fig. 46 Full Console Rear Attaching Screw Location

(7) Remove bezel under parking brake lever.

(8) Move transmission and transfer case shift levers rearward.

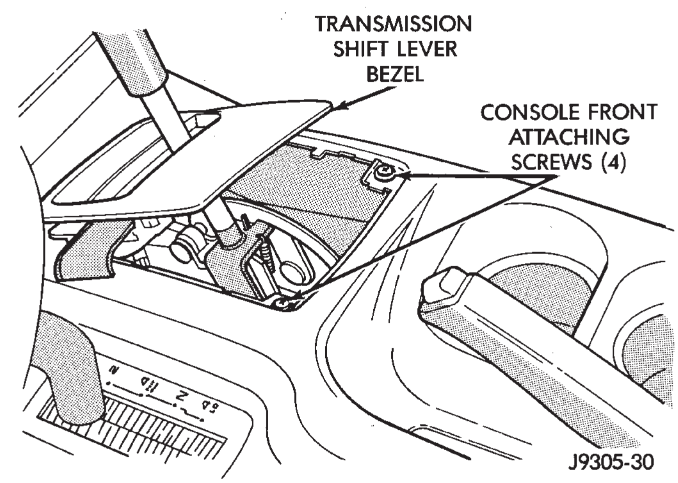


Fig. 47 Full Console Front Attaching Screw Location

(9) Raise front of console and remove bulb at rear of transfer case shift lever bezel.

(10) Remove console by lifting it upward and off shift levers.

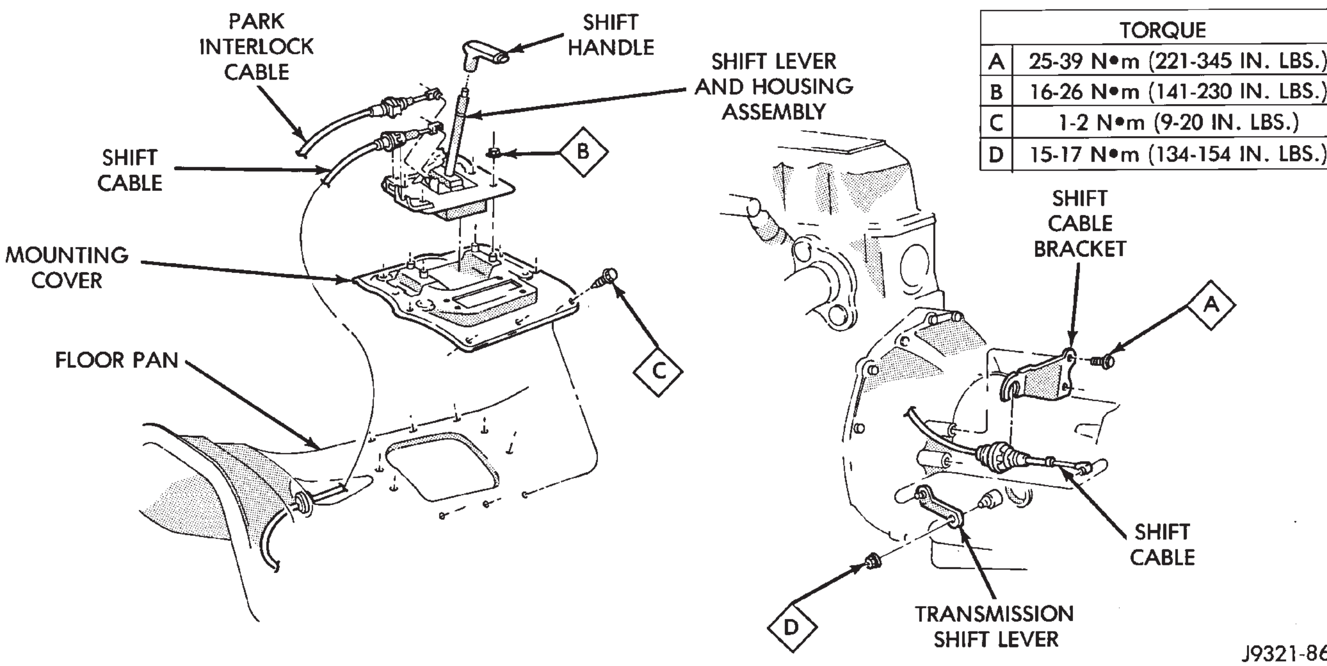
(11) Remove console bracket. Remove screws attaching bracket to floorpan mounting cover and remove bracket.

(12) Remove nuts attaching shift lever assembly to floorpan mounting cover (Fig. 48).

(13) Lift shift lever assembly upward for access to cables.

(14) Disengage shift and interlock cables.

(15) Remove shift lever assembly.



	TORQUE
A	25-39 N•m (221-345 IN. LBS.)
B	16-26 N•m (141-230 IN. LBS.)
C	1-2 N•m (9-20 IN. LBS.)
D	15-17 N•m (134-154 IN. LBS.)

Fig. 48 Automatic Transmission Shift Components

SHIFT LEVER ASSEMBLY INSTALLATION—WITH FULL CONSOLE

(1) Attach shift and interlock cables to shift lever assembly.

(2) Install shift lever assembly on floorpan mounting cover. Tighten lever assembly attaching nuts to 16-26 N●m (141-230 in. lbs.) torque.

(3) Install console front bracket over shift lever and onto mounting cover. Tighten bracket screws to 2-4 N●m (17-32 in. lbs.) torque.

(4) Install console over shift levers and onto console brackets.

(5) Install screws attaching console to brackets at front and rear of console.

(6) Install bulbs in transmission and transfer case shift lever bezels.

(7) Install transmission shift lever bezel.

(8) Install bezel under parking brake lever.

(9) Align and install shift handle on transmission shift lever.

(10) Connect battery negative cable.

(11) Check and adjust transmission throttle cable if necessary.

SHIFT LEVER ASSEMBLY REMOVAL—WITH MINI CONSOLE

(1) Disconnect battery negative cable.

(2) Remove transmission shift lever handle. Grasp handle and pull upward sharply to remove it from lever.

(3) Unsnap and remove shift lever bezel (Fig. 46).

(4) Remove light bulb from shift lever bezel.

(5) Remove screws attaching console to bracket and lift console upward and off lever and bracket (Fig. 49).

(6) Remove screws attaching console bracket to mounting cover and remove bracket (Fig. 49).

(7) Remove nuts attaching shift lever assembly to floorpan mounting cover.

(8) Disconnect shift and interlock cables from shift lever assembly.

(9) Remove shift lever assembly.

SHIFT LEVER ASSEMBLY INSTALLATION—WITH MINI CONSOLE

(1) Connect shift and interlock cables to shift lever assembly.

(2) Install shift lever assembly on floorpan mounting cover. Tighten lever attaching nuts to 16-26 N●m (141-230 in. lbs.) torque.

(3) Install console bracket on floorpan mounting cover. Tighten bracket screws to 2-4 N●m (17-32 in. lbs.) torque.

(4) Install console on bracket. Tighten console attaching screws 2-4 N●m (17-32 in. lbs.) torque.

(5) Install light bulb in shift lever bezel.

(6) Install shift lever bezel.

(7) Align and install shift lever handle on lever.

(8) Connect battery negative cable.

(9) Check and adjust shift and park interlock cables if necessary.

SHIFT CABLE ADJUSTMENT

(1) Shift transmission into Park.

(2) Raise vehicle.

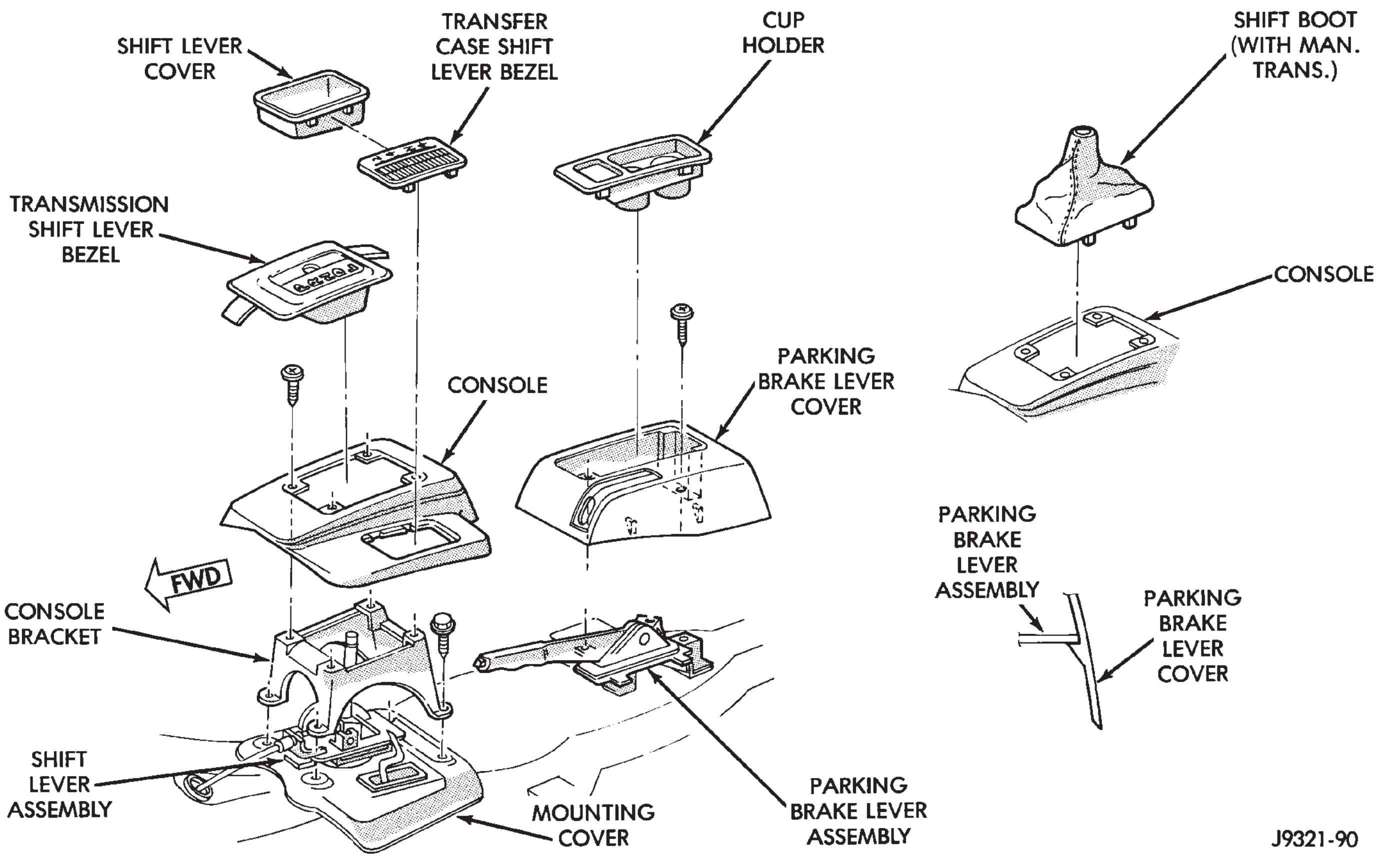


Fig. 49 Mini Console Components

(3) Release cable adjuster clamp to unlock cable (Fig. 50).

(4) Unsnap cable from cable bracket (Fig. 50).

(5) Move transmission shift lever all the way rearward into Park detent. Lever is on manual valve shaft at left 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 shaft 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. 50).

(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.

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. 51). The cooler can be flushed when necessary, while mounted

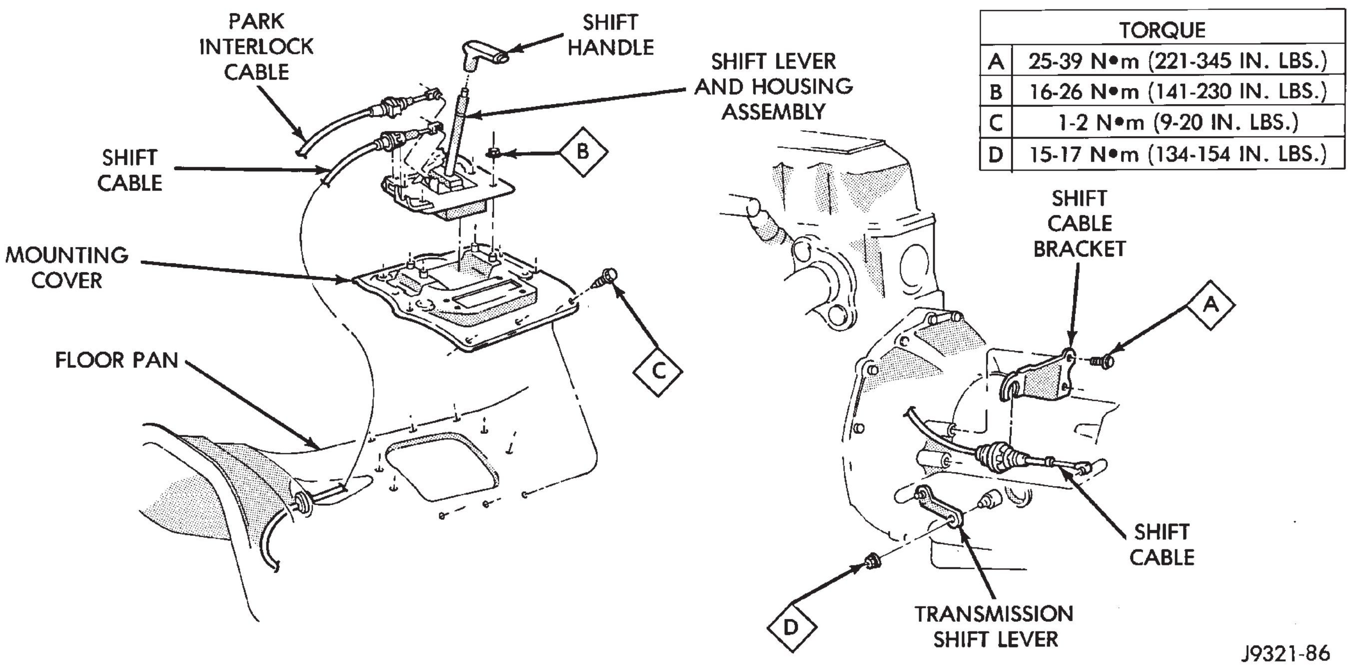


Fig. 50 Shift And Park Interlock Cables

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. Refer to Figure 51 for cooler line identification.

(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 cooler fittings, seals and guides are serviceable.

Replace the seals and guides whenever the fittings indicate leakage, or will no longer snap securely into place.

TORQUE	
A	2-4 N•m (18-35 IN. LBS.)
B	5-11 N•m (48-96 IN. LBS.)
C	18-23 N•m (159-203 IN. LBS.)
D	18-23 N•m (160-200 IN. LBS.)

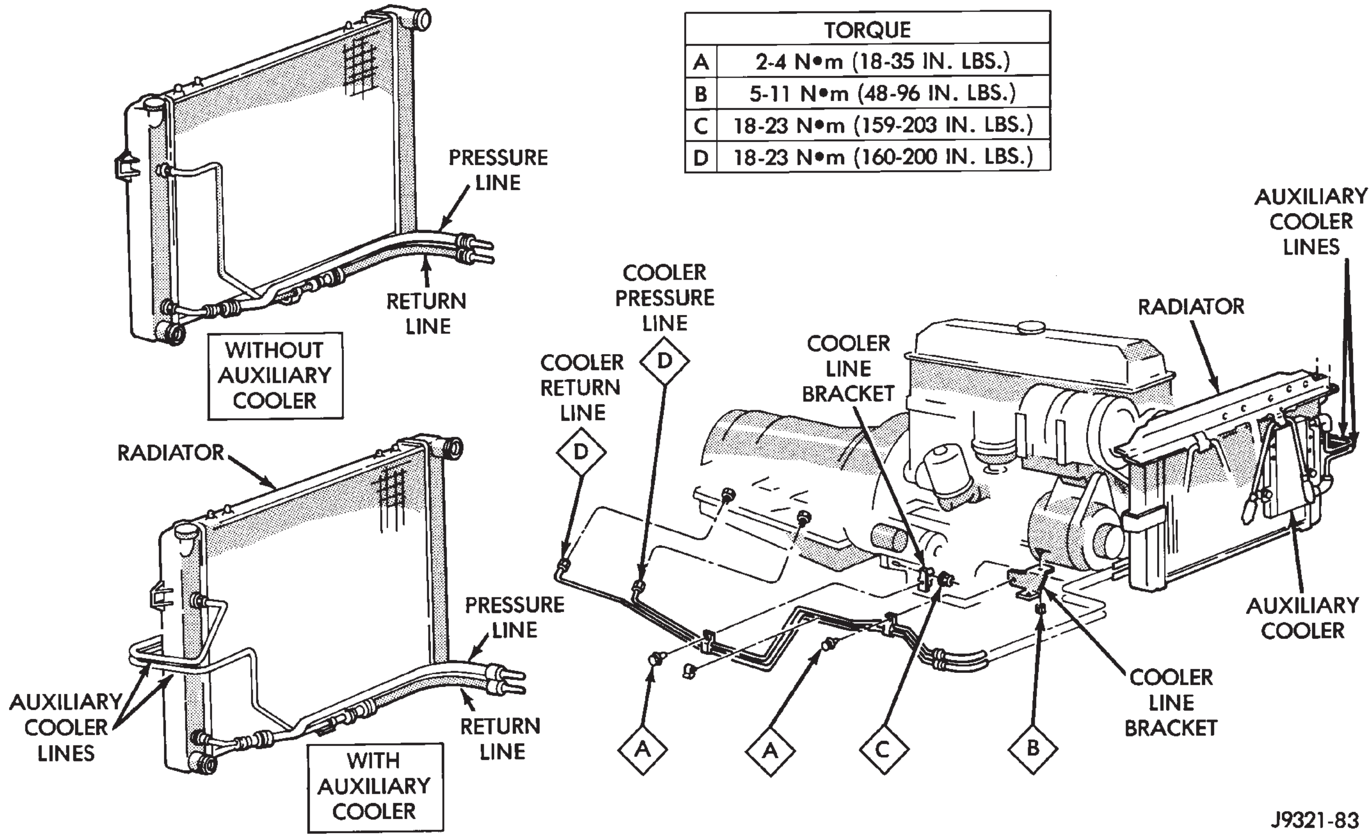


Fig. 51 Transmission Auxiliary Cooler Mounting

AW-4 TRANSMISSION/CONVERTER 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. 52).

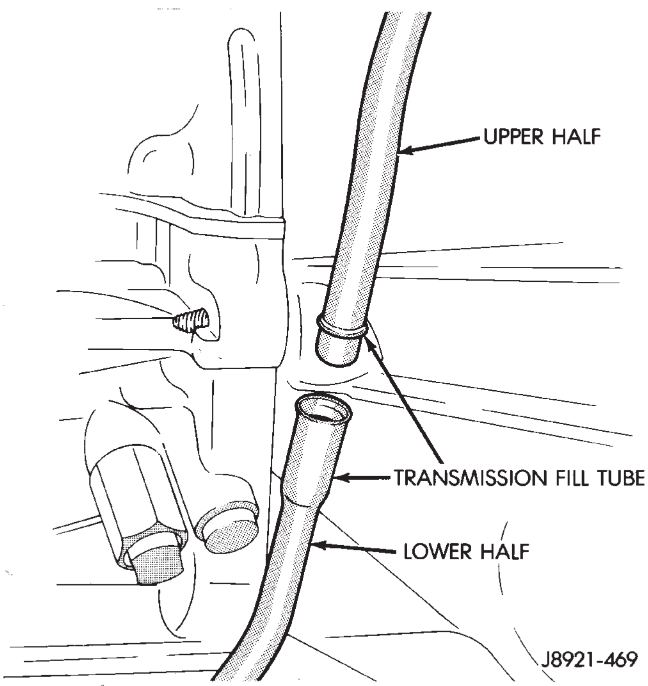


Fig. 52 Two-Piece Transmission Fill Tube

(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 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 throttle 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 OVERRUNNING CLUTCH INSPECTION

(1) Insert Rotating Tool 7547 into converter hub and seat tool in one-way clutch (Fig. 53).

(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. 54).

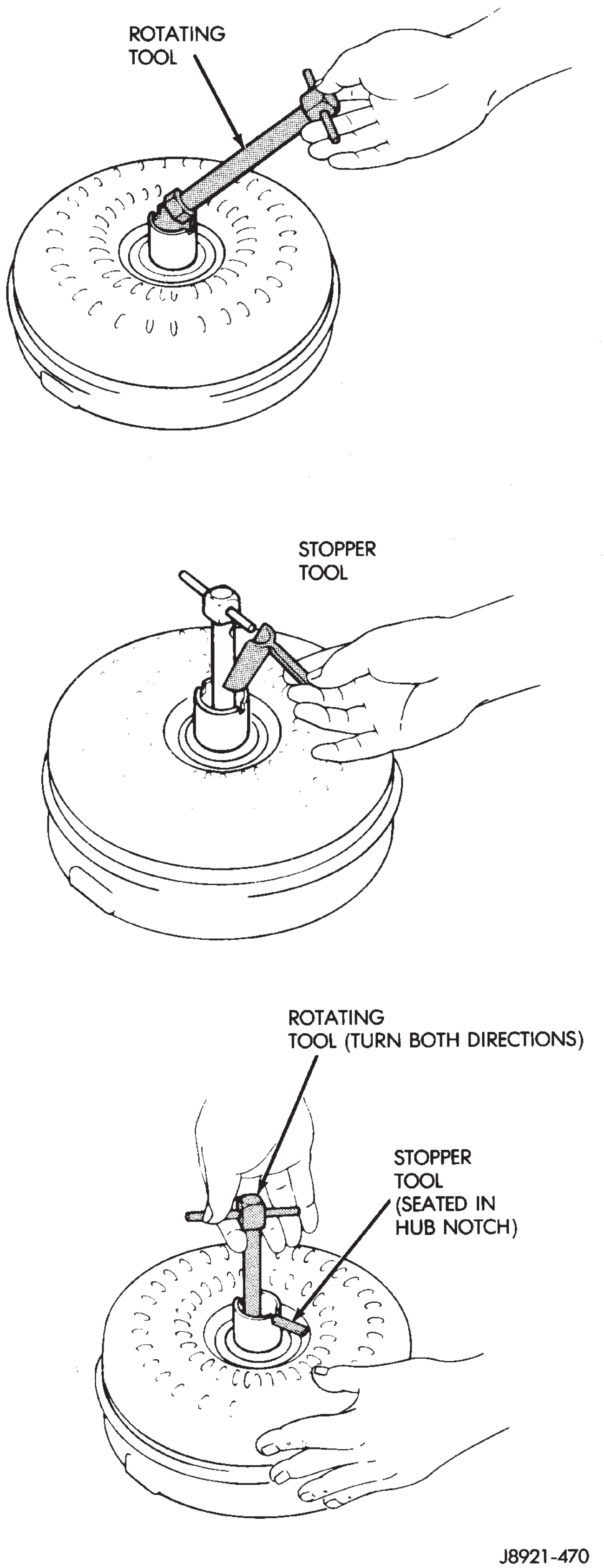


Fig. 53 Checking Operation Of Torque Converter Stator Overrunning Clutch

(4) Lubricate torque converter hub with Mopar Mercon transmission fluid.

(5) Align and install converter.

(6) Secure converter with strap or C-clamp until transmission is ready for installation in vehicle.

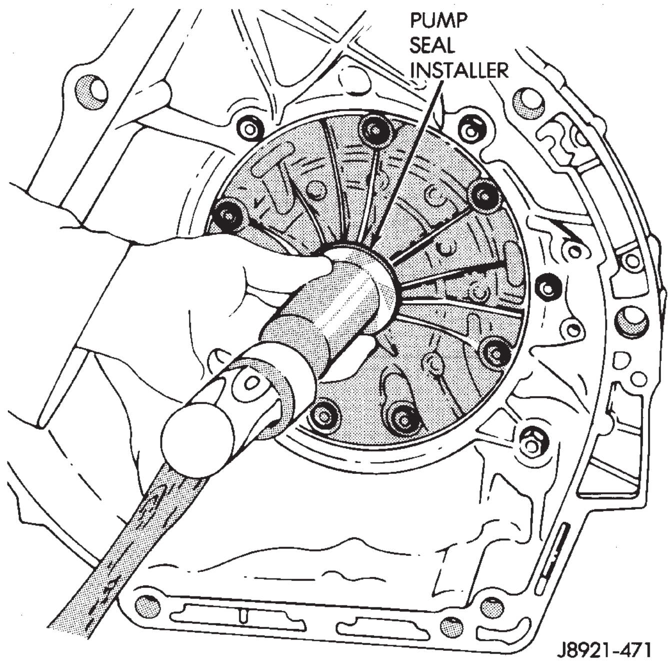


Fig. 54 Installing Oil Pump Seal

TRANSMISSION AND TORQUE CONVERTER INSTALLATION

(1) Mount transmission on transmission jack. Then secure transmission to jack with safety chains.

(2) Install torque converter. Be sure converter is fully seated in oil pump drive 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. 55).

(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

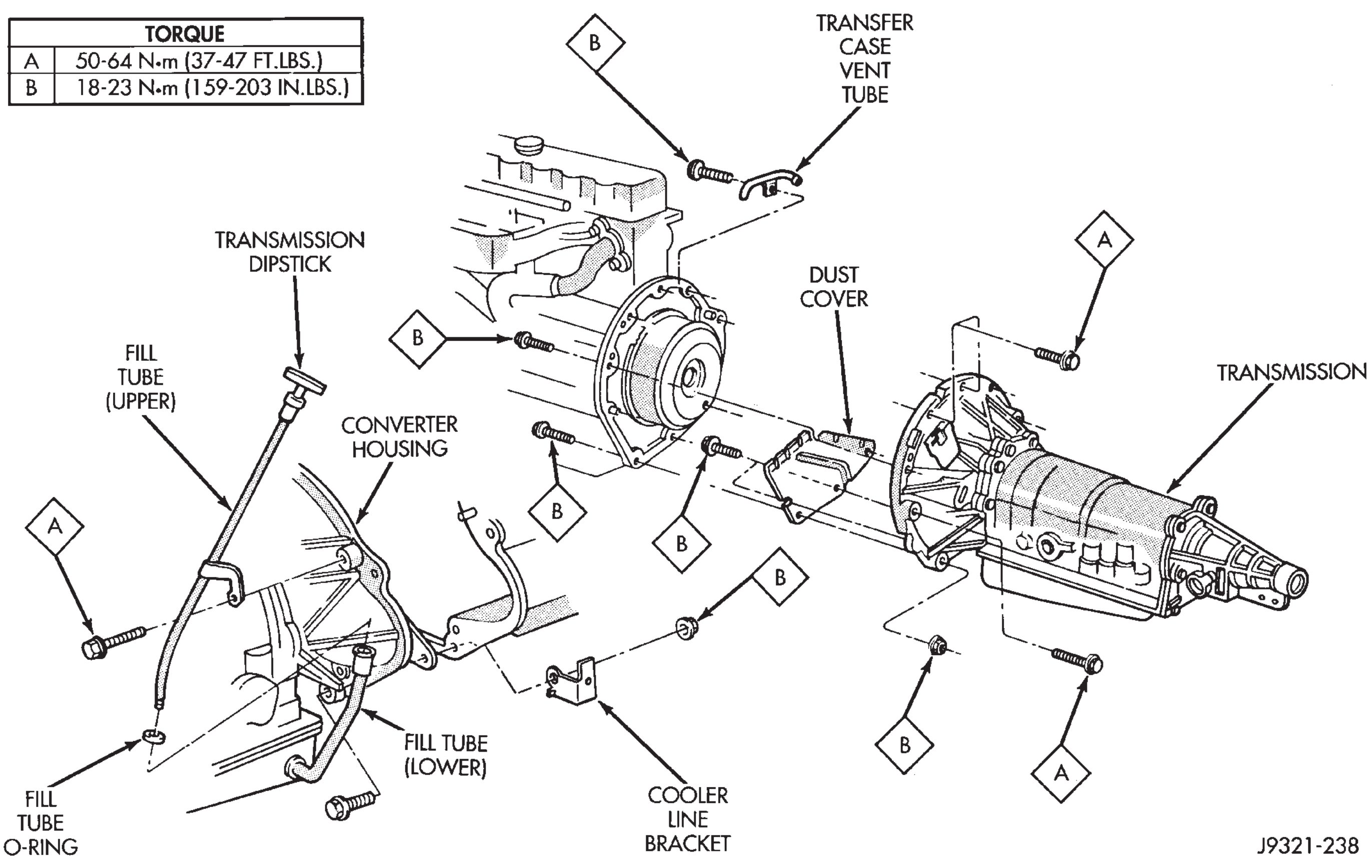
(11) Connect transfer case shift linkage and vacuum hoses.

(12) Connect exhaust components.

(13) Install rear mount and crossmember (Fig. 56). Then remove jack used to support transmission assembly.

(14) Connect speed sensor wire harness to sensor.

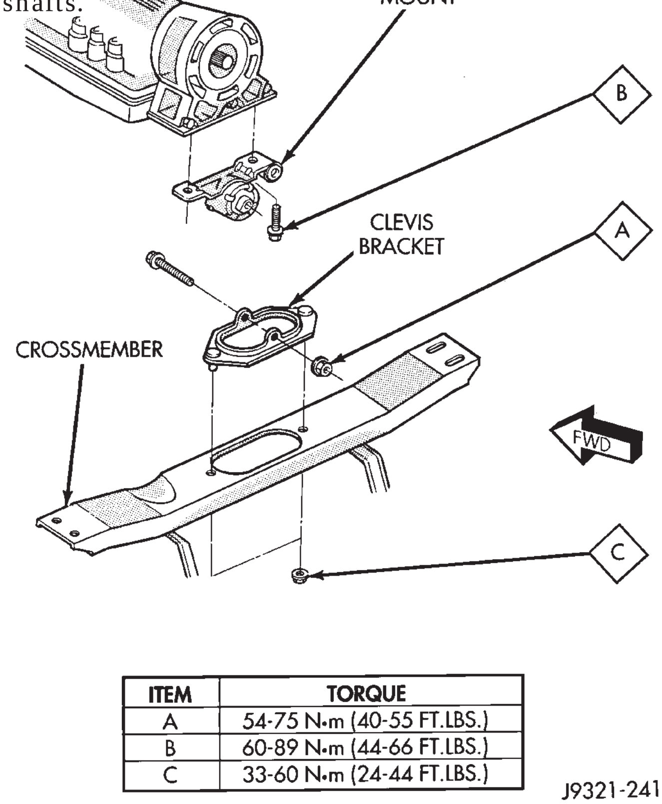
(15) Connect wire harness to park/neutral position switch.



TORQUE	
A	50-64 N•m (37-47 FT.LBS.)
B	18-23 N•m (159-203 IN.LBS.)

Fig. 55 AW-4 Transmission Attachment

(16) Align and connect front and rear propeller shafts.



ITEM	TORQUE
A	54-75 N•m (40-55 FT.LBS.)
B	60-89 N•m (44-66 FT.LBS.)
C	33-60 N•m (24-44 FT.LBS.)

Fig. 56 AW-4 Transmission Rear Mounting

(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.

AW-4 TRANSMISSION OVERHAUL

INDEX

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 will have to be ordered separately. The overhaul tool kit and test port adapter are available through the parts division and dealer special tool program. An additional tool recommended for proper overhaul is a high quality dial caliper. Dial calipers are locally available and recommended for the many component measurements required during overhaul.

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.

(4) Remove shift lever from manual valve shaft at left side of transmission.

(5) Remove park/neutral position switch.

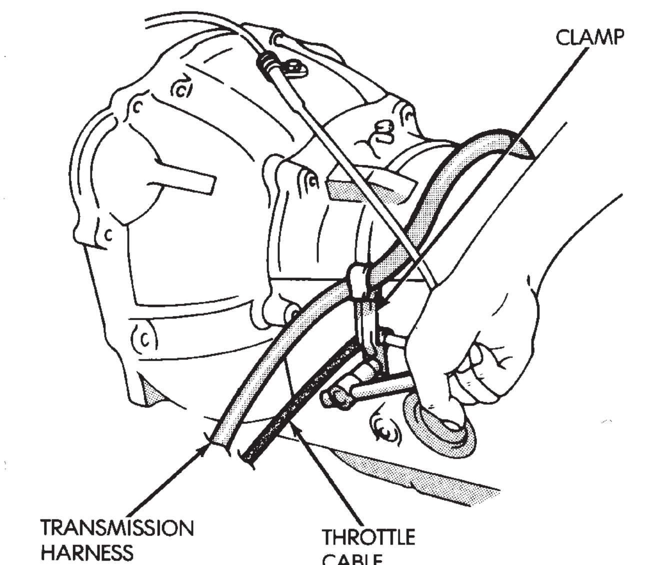


Fig. 1 Typical Harness And Cable Clamp Attachment

(6) Remove speed sensor (Fig. 2).

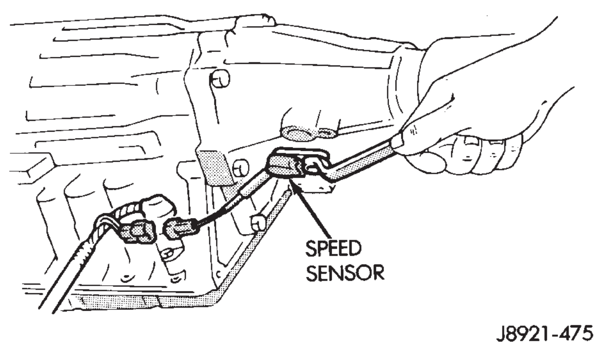


Fig. 2 Speed Sensor Removal

(7) Remove converter housing bolts and remove housing (Fig. 3) from case.

(8) Remove adapter housing.

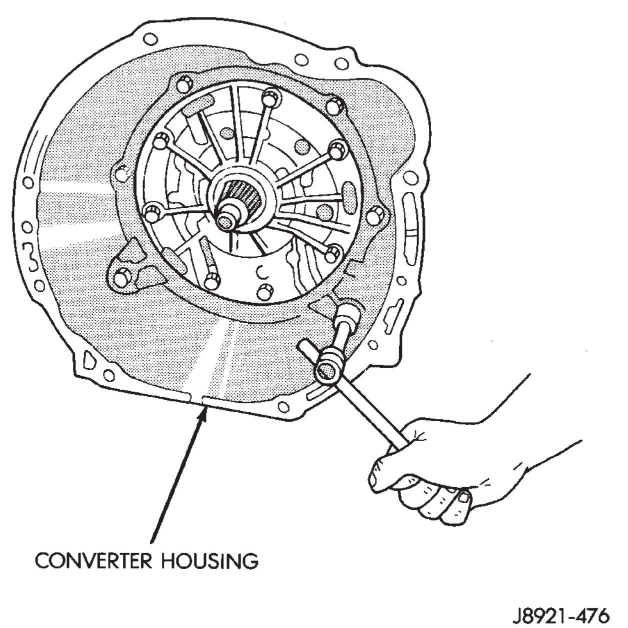


Fig. 3 Removing/Installing Converter Housing

(9) Remove speedometer drive gear snap ring and remove gear and gear spacer if equipped (Fig. 4).

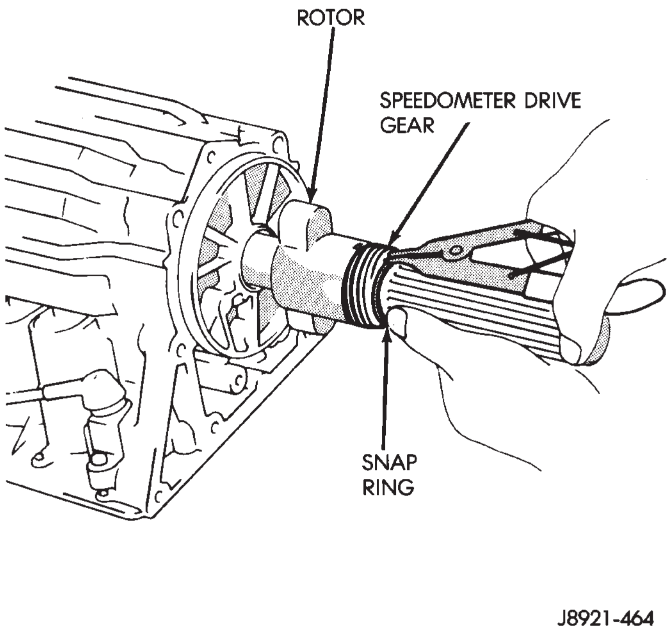


Fig. 4 Removing Speed Sensor And Speedometer Drive Gear

(10) Remove speed sensor rotor and key. Use wood dowel or hammer handle to loosen and remove rotor (Fig. 5).

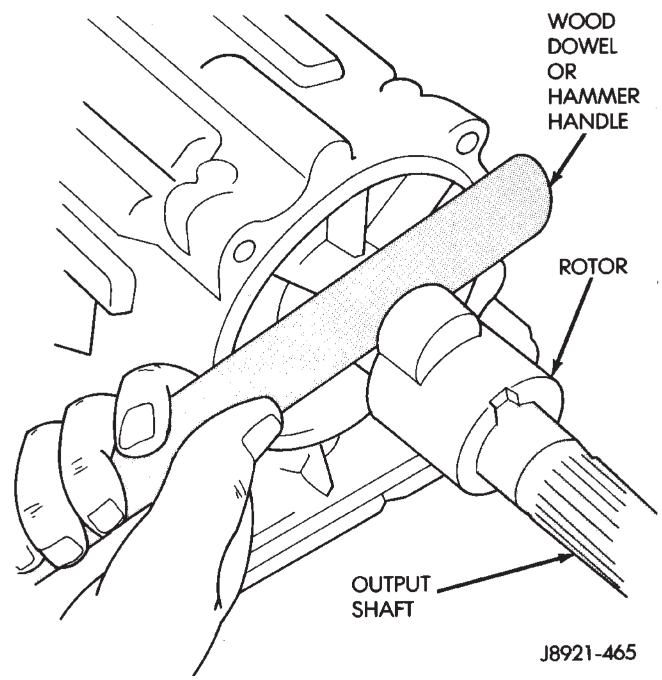


Fig. 5 Removing Transmission Speed Sensor Rotor

(11) Remove transmission oil pan, oil screen and screen gaskets (Fig. 6). Then mount transmission in holding fixture.

(12) Remove valve body oil feed tubes (Fig. 7).

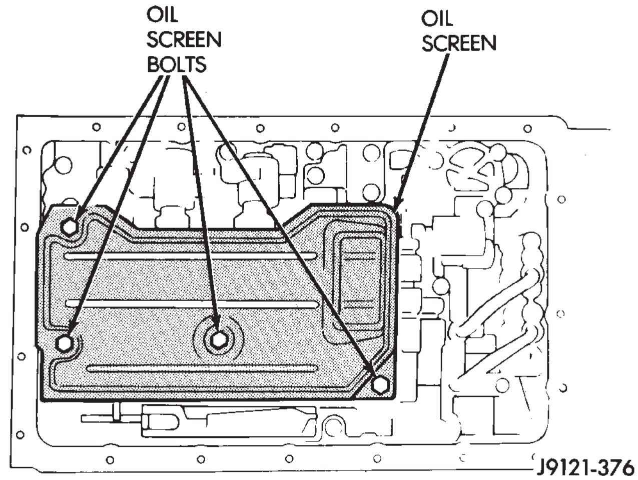


Fig. 6 Removing Oil Screen

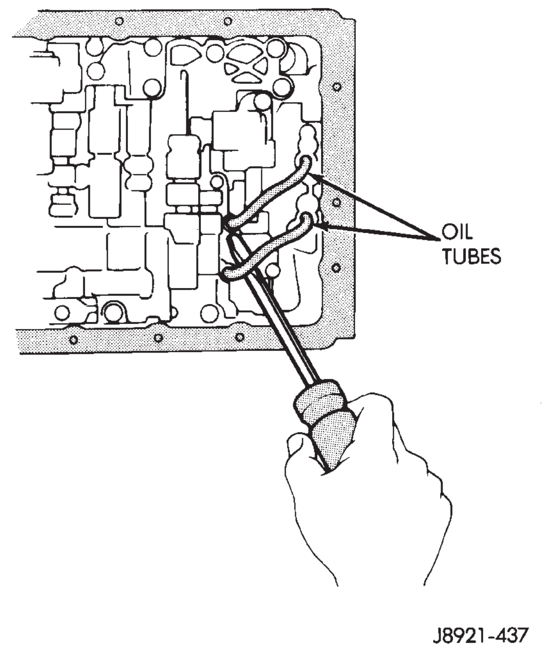


Fig. 7 Removing Valve Body Oil Tubes

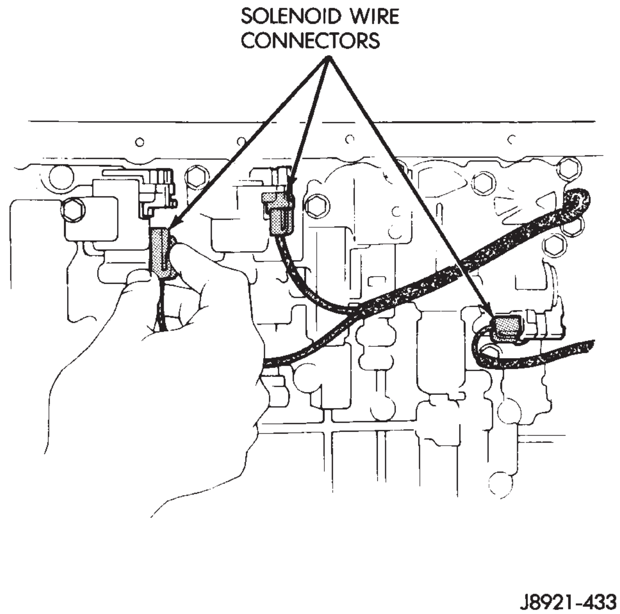


Fig. 8 Solenoid Wire Location

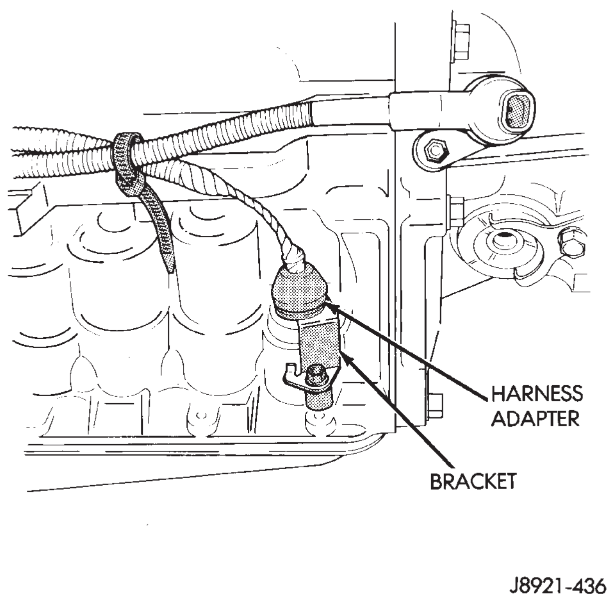


Fig. 9 Removing Bracket And Harness

(13) Disconnect valve body solenoid wires (Fig. 8).

(14) Remove harness bracket bolt and remove harness and bracket Fig. 9).

(15) Remove valve body bolts (Fig. 10).

(16) Disconnect throttle cable from throttle cam (Fig. 11).

(17) Remove valve body from case. Then remove accumulator springs, spacers and check ball and spring (Fig. 12).

(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.

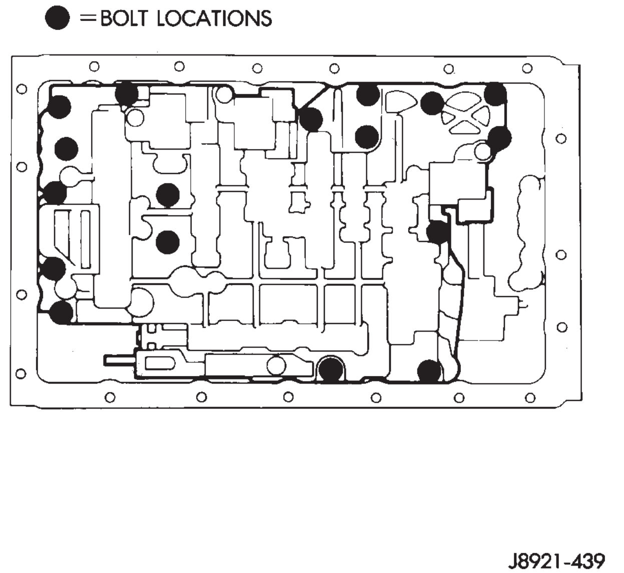


Fig. 10 Valve Body Bolt Locations

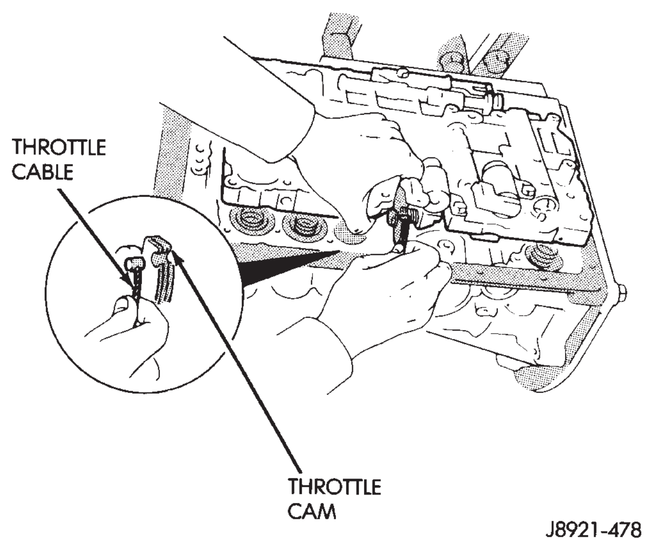


Fig. 11 Disconnecting Throttle Cable

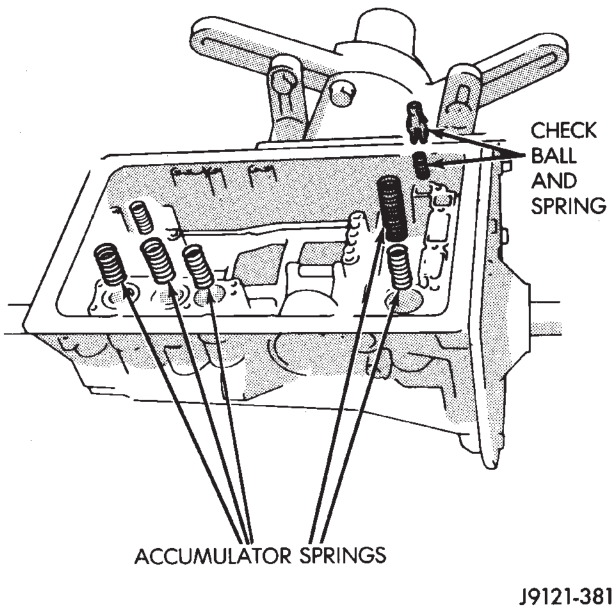


Fig. 12 Removing Accumulator Springs, Spacers And Check Ball

(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.

(22) Remove oil pump bolts and remove pump with bridge-type Puller 7536 (Fig. 14).

(23) Remove race from oil pump (Fig. 15).

(24) Remove fourth gear overdrive planetary gear and overdrive direct clutch assembly (Fig. 16).

(25) Remove race from fourth gear overdrive planetary (Fig. 17).

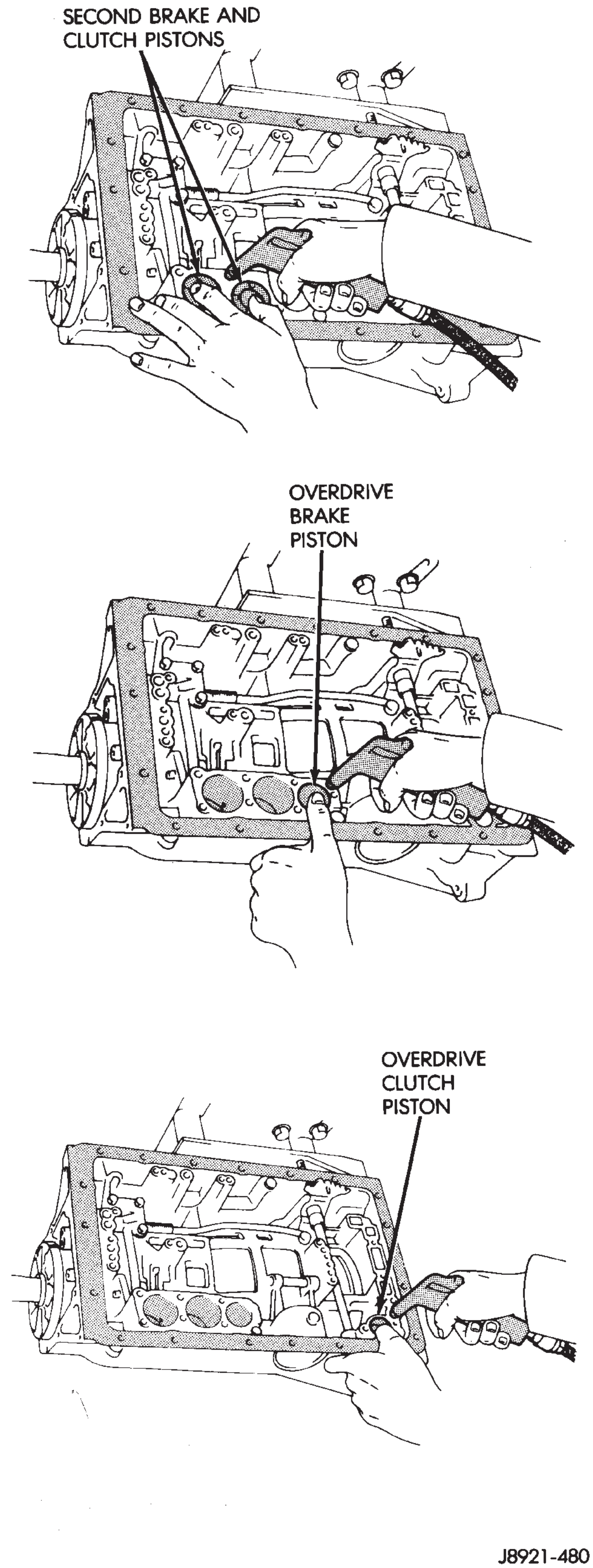


Fig. 13 Removing Accumulator Pistons

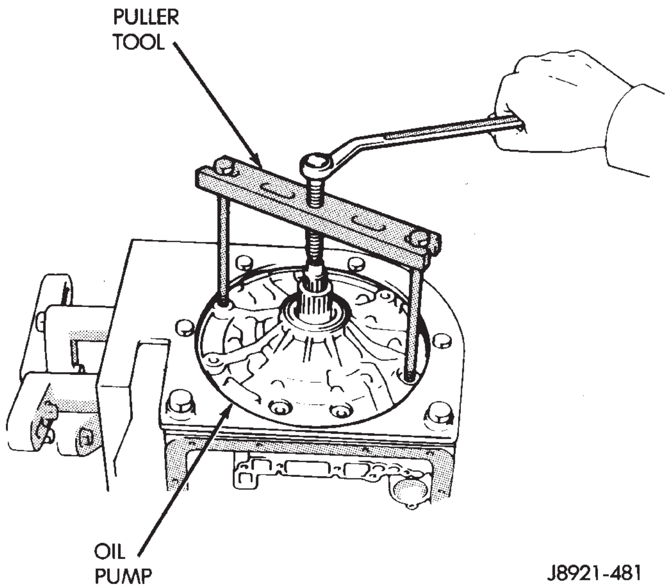


Fig. 14 Oil Pump Removal

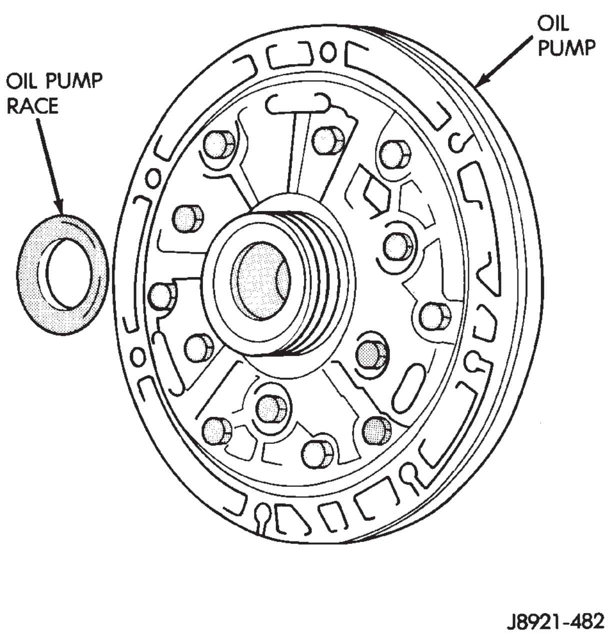


Fig. 15 Oil Pump Race Removal

(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) Position Gauge Tool 7546 so it contacts piston (Fig. 19).

(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.).

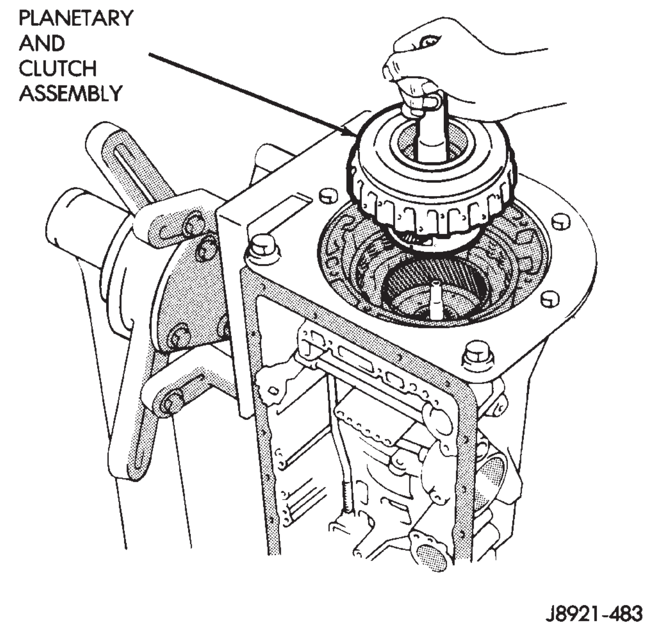


Fig. 16 Removing Fourth Gear Planetary And Direct Clutch Assembly

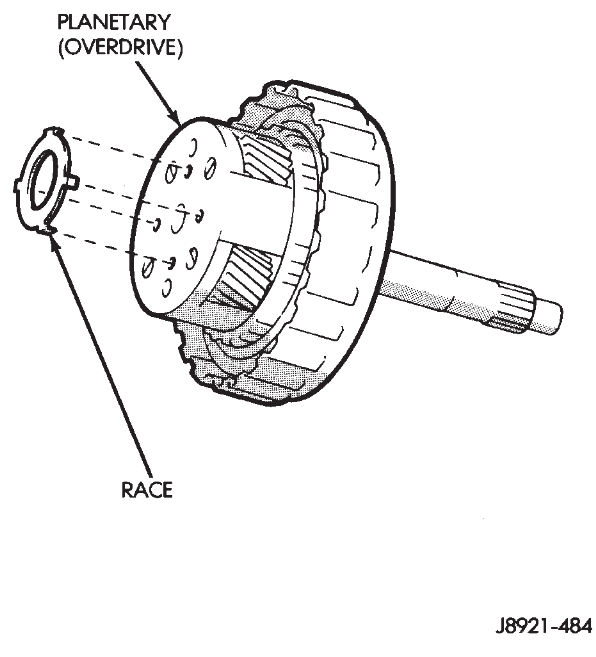


Fig. 17 Fourth Gear Planetary Race Removal

(d) If stroke is not within limits, replace brake pack retainer. Select required retainer from Overdrive Brake Retainer Selection chart in Specifications section.

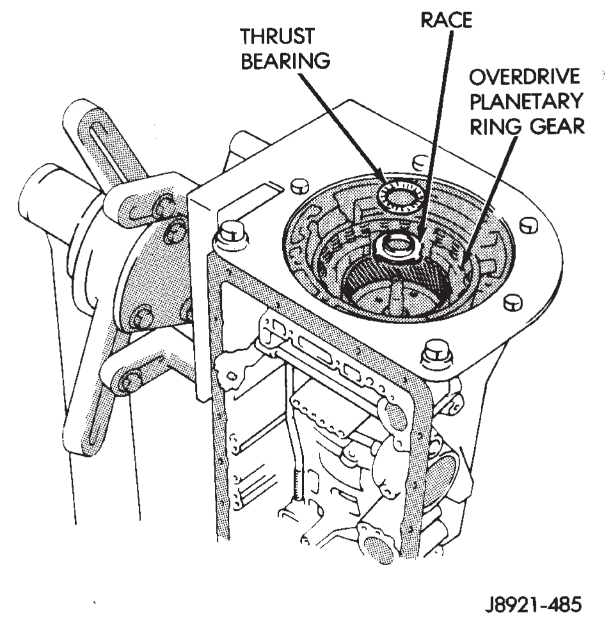


Fig. 18 Removing Bearing, Race And Planetary Ring Gear

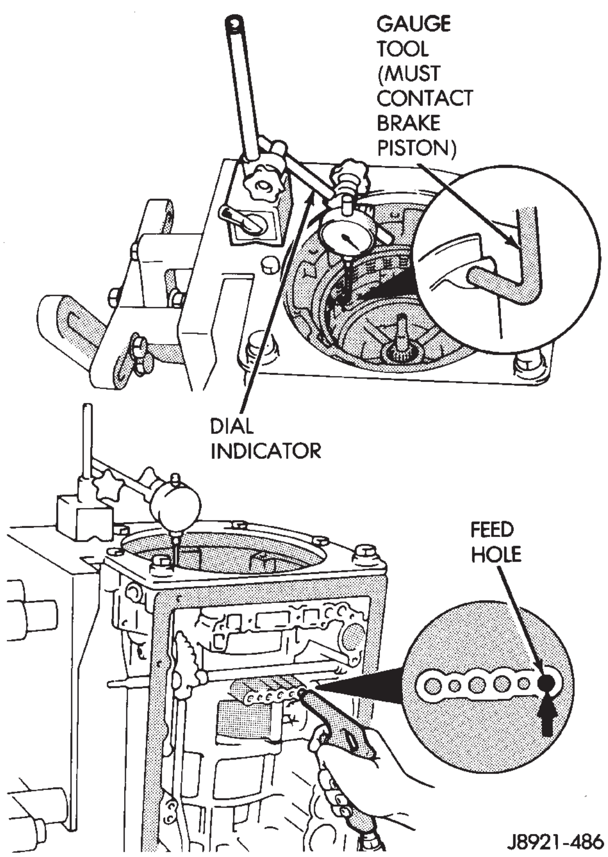


Fig. 19 Measuring Overdrive Brake Piston Stroke

(28) Remove overdrive brake snap ring (Fig. 20).

(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.

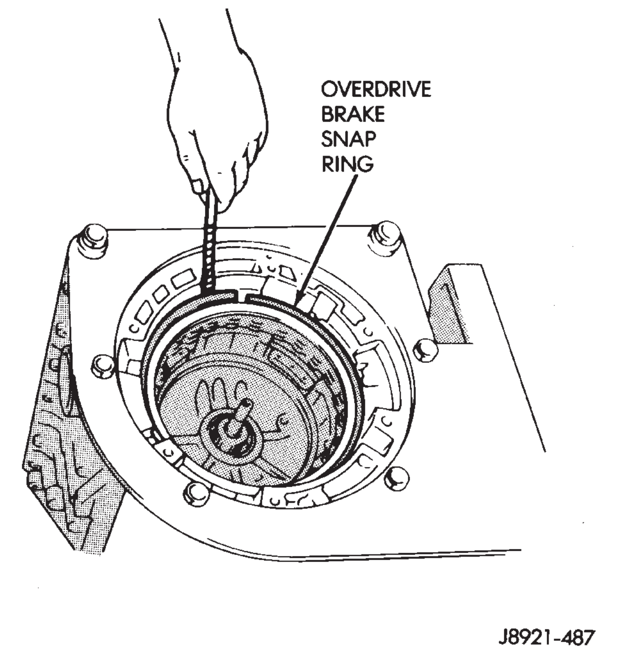


Fig. 20 Removing Overdrive Brake Snap Ring

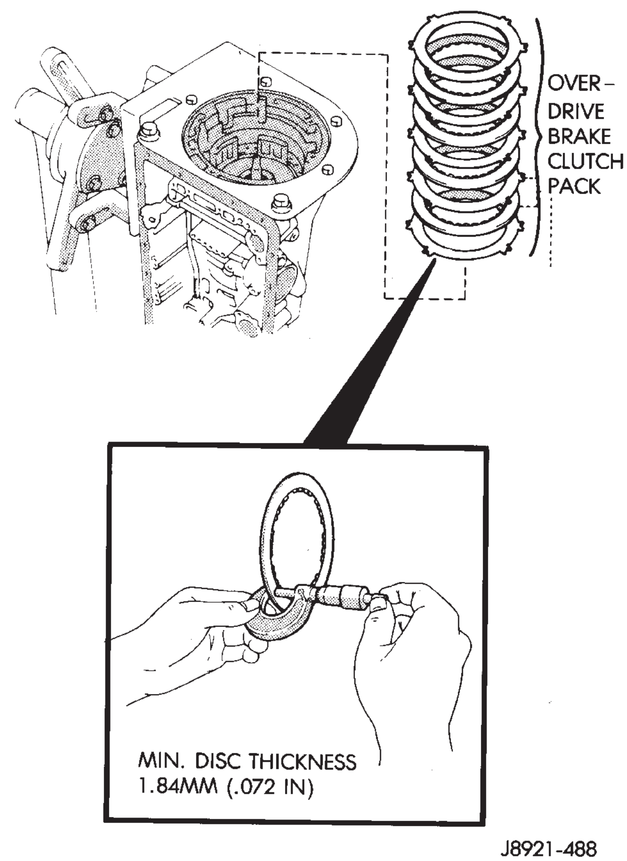


Fig. 21 Removing/Measuring Overdrive Brake Disc Thickness

(30) Remove overdrive support lower race and upper bearing and race assembly (Fig. 22).

(31) Remove overdrive support bolts (Fig. 23).

(32) Remove overdrive support snap ring with Snap Ring Plier Tool 7540 (Fig. 24).

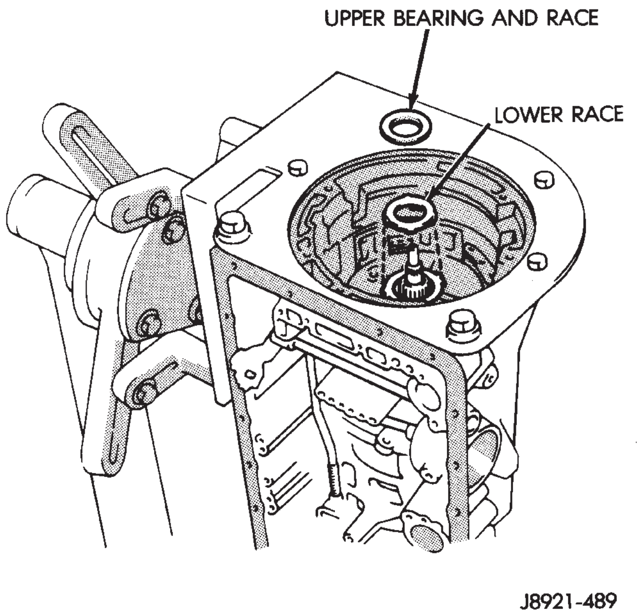


Fig. 22 Overdrive Support Bearing/Race Removal

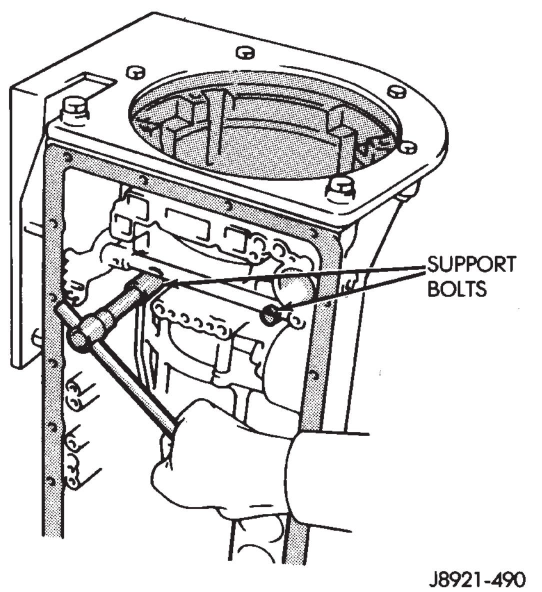


Fig. 23 Overdrive Support Bolt Removal

(33) Remove overdrive support (Fig. 25) with bridge-type Puller 7536.

(34) Remove race from hub of overdrive support (Fig. 26).

(35) Measure stroke length of second coast brake piston rod as follows:

(a) Make reference mark on piston rod (Fig. 27) as shown.

(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.).

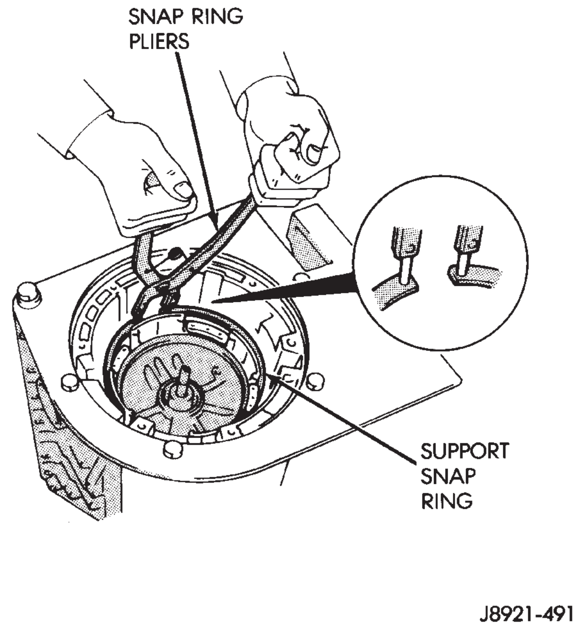


Fig. 24 Removing/Installing Overdrive Support Snap Ring

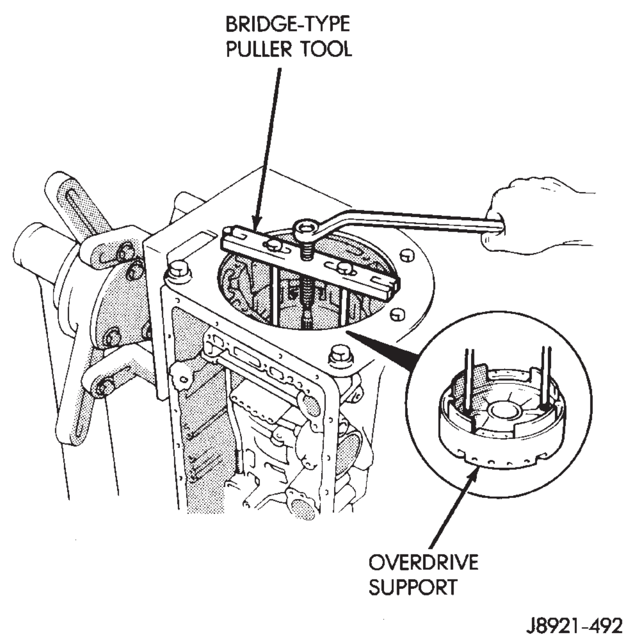


Fig. 25 Removing Overdrive Support

(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.).

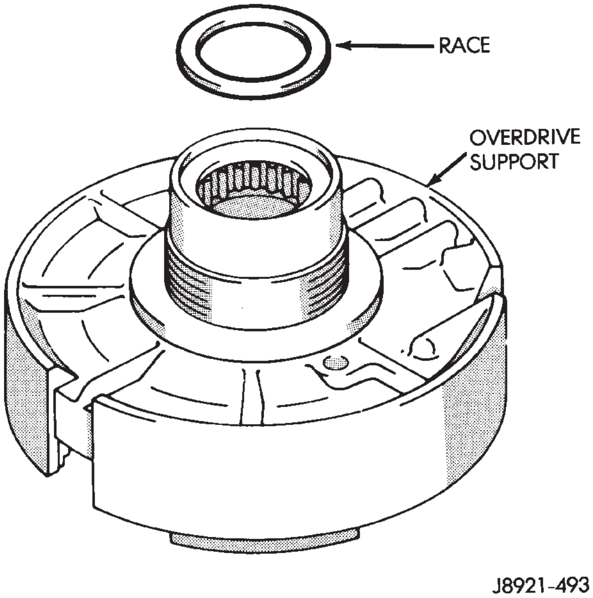


Fig. 26 Remove Overdrive Support Race

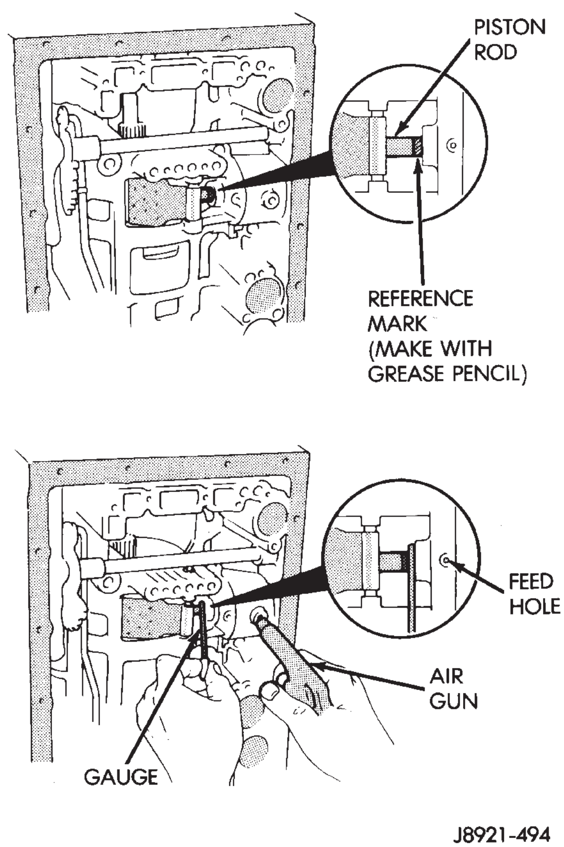


Fig. 27 Measuring Second Coast Brake Piston Rod Stroke

(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).

(37) Disassemble second coast brake piston (Fig. 29).

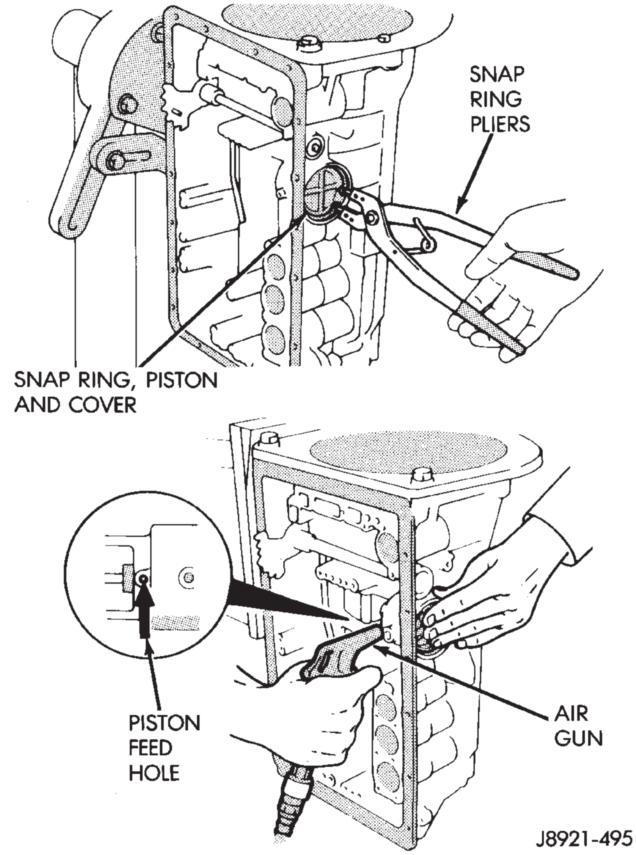


Fig. 28 Removing Second Coast Brake Cover And Piston

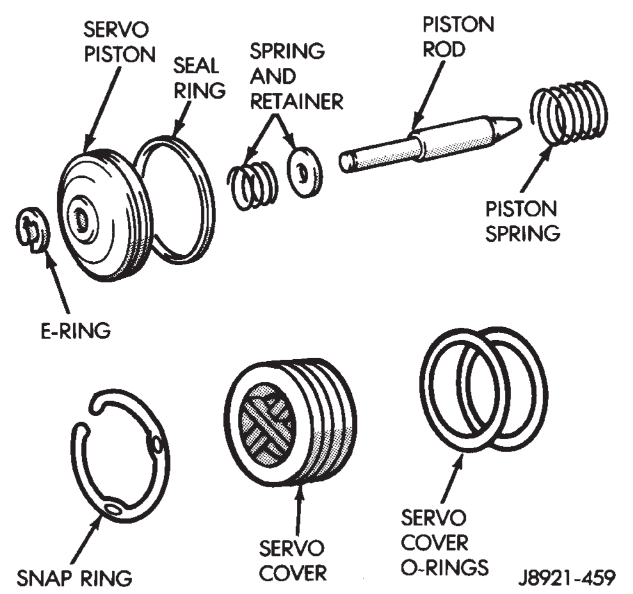


Fig. 29 Second Coast Brake Piston Components

(38) Remove direct and forward clutch assembly (Fig. 30).

(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).

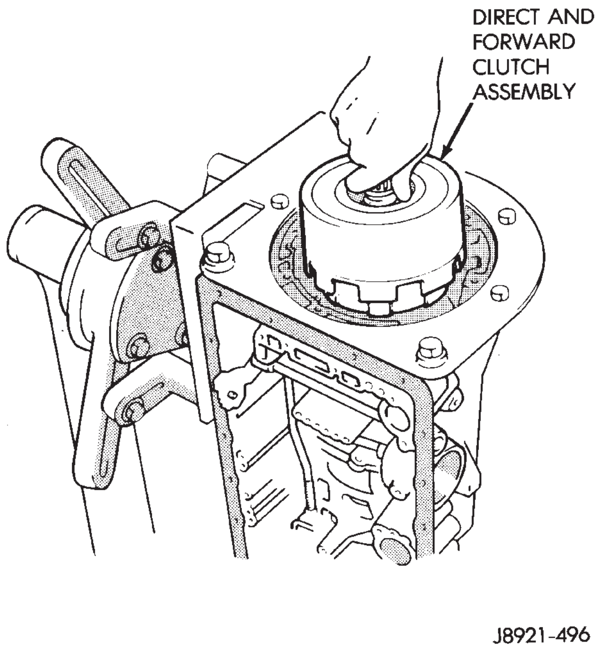


Fig. 30 Removing Direct And Forward Clutch Assembly

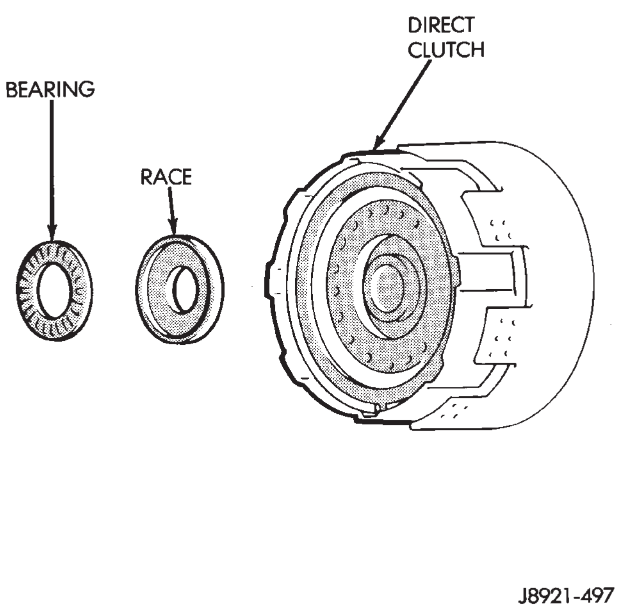


Fig. 31 Remove Bearing And Race From Clutch Hub

(41) Remove front planetary ring gear front bearing race and remove front planetary ring gear (Fig. 33).

(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 transmission over and allow output shaft to support transmission weight. Then place wood blocks under shaft to protect splines (Fig. 35).

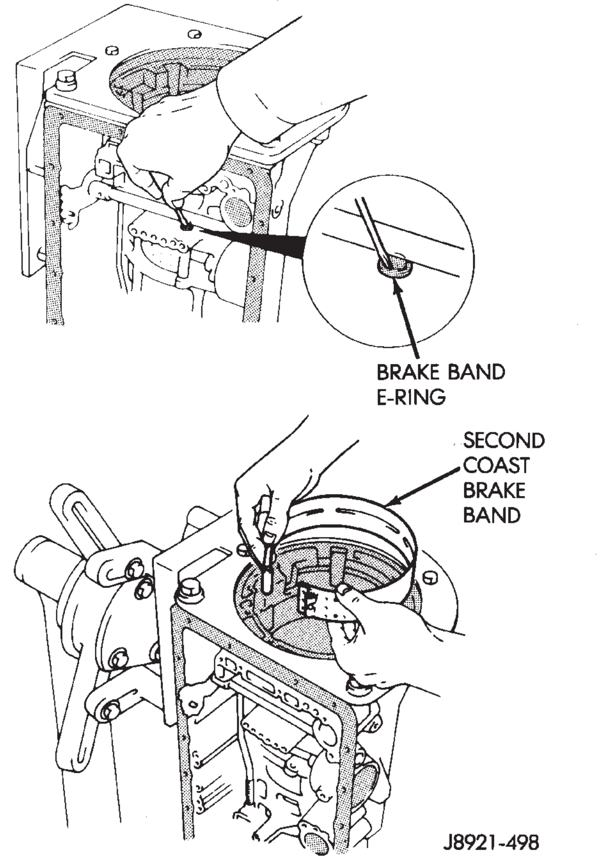


Fig. 32 Removing Second Coast Brake Band

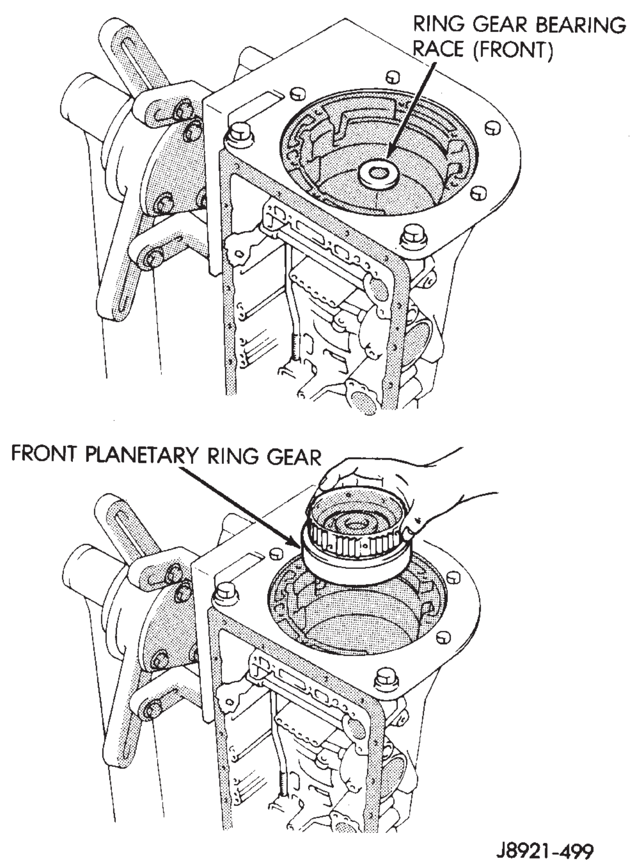


Fig. 33 Removing Front Planetary Ring Gear

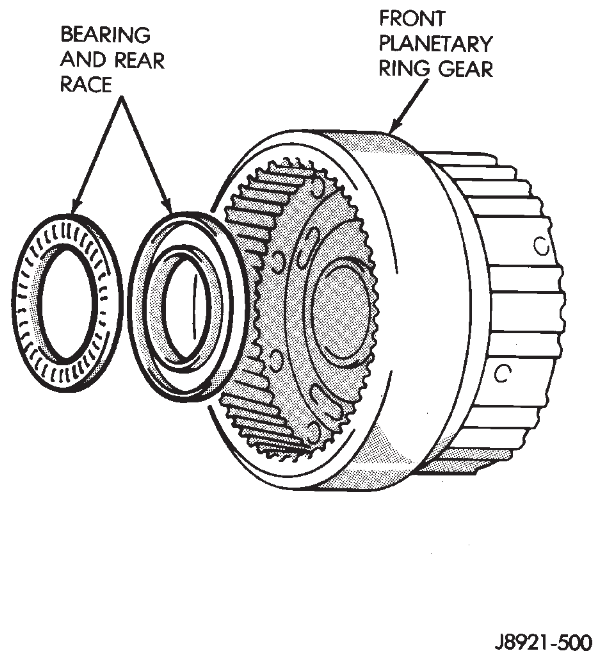


Fig. 34 Removing Ring Gear Bearing And Rear Race

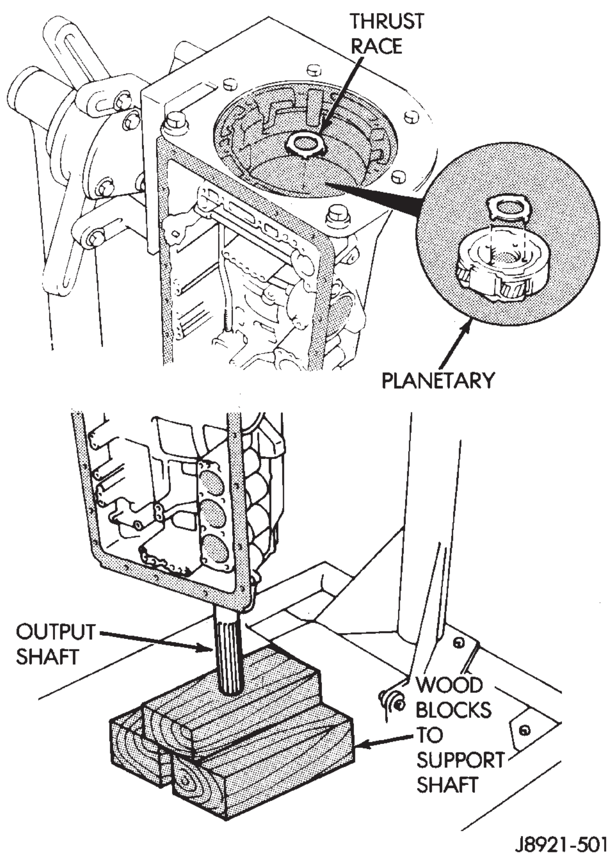


Fig. 35 Relieving Load On Planetary Snap Ring

(45) Remove planetary snap ring and remove planetary gear (Fig. 36).

(46) Remove sun gear, input drum and one-way clutch as assembly (Fig. 37).

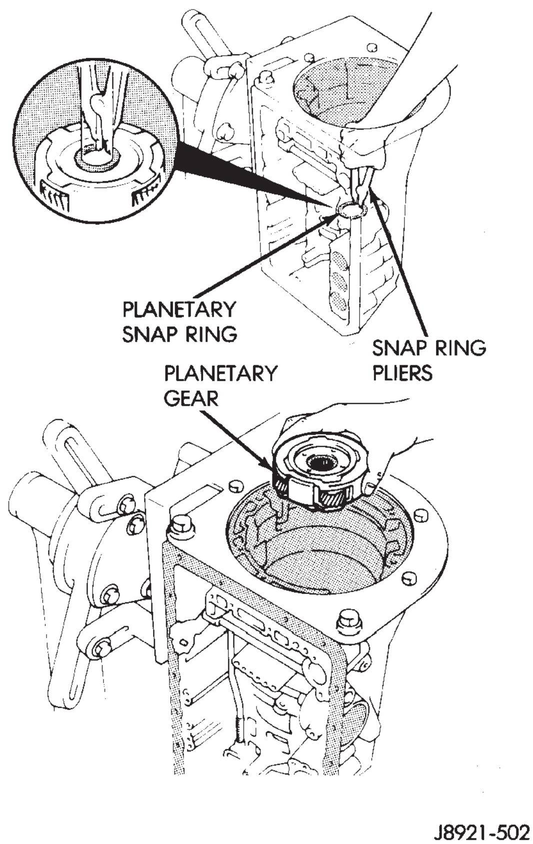


Fig. 36 Removing Planetary Snap Ring And Gear

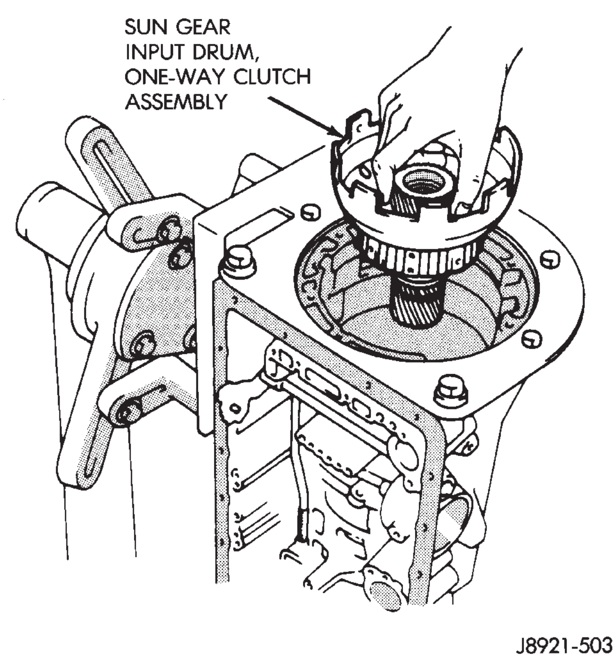


Fig. 37 Removing Sun Gear, Input Drum And One-Way Clutch

(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.

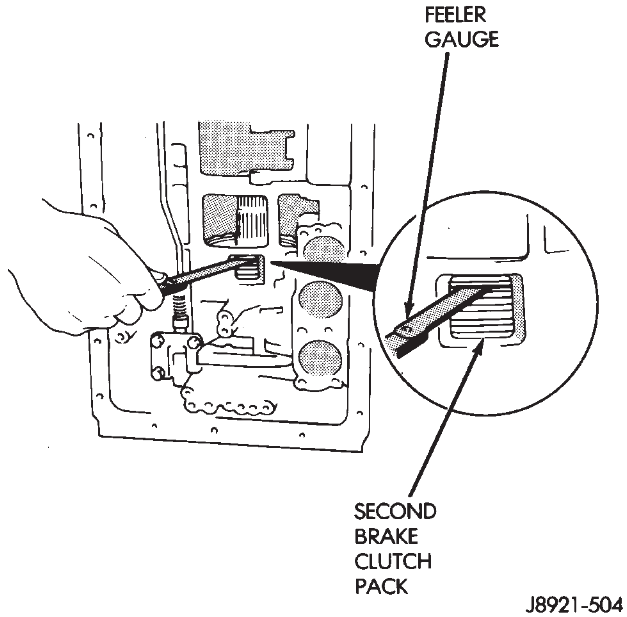


Fig. 38 Checking Second Brake Clutch Pack Clearance

(48) Remove second brake clutch pack snap ring (Fig. 39).

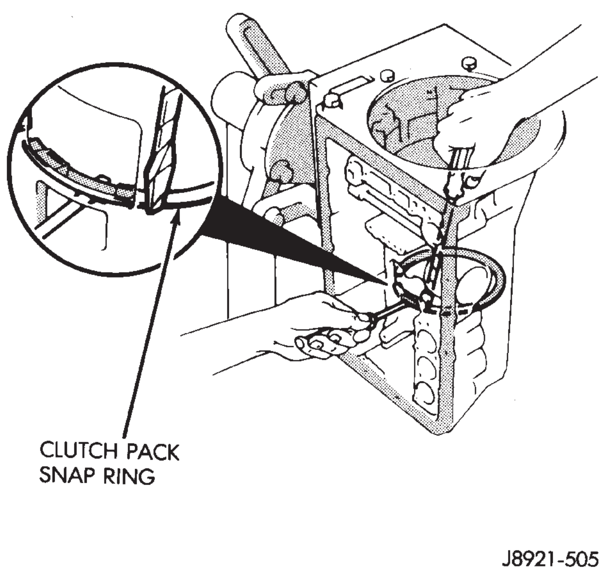


Fig. 39 Removing Second Brake Clutch Pack Snap Ring

(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.

(50) Remove bolts attaching park rod bracket to case. Then disconnect park rod from manual shaft lever and remove rod and bracket (Fig. 41).

(51) Remove park pawl spring, pin and pawl (Fig. 42).

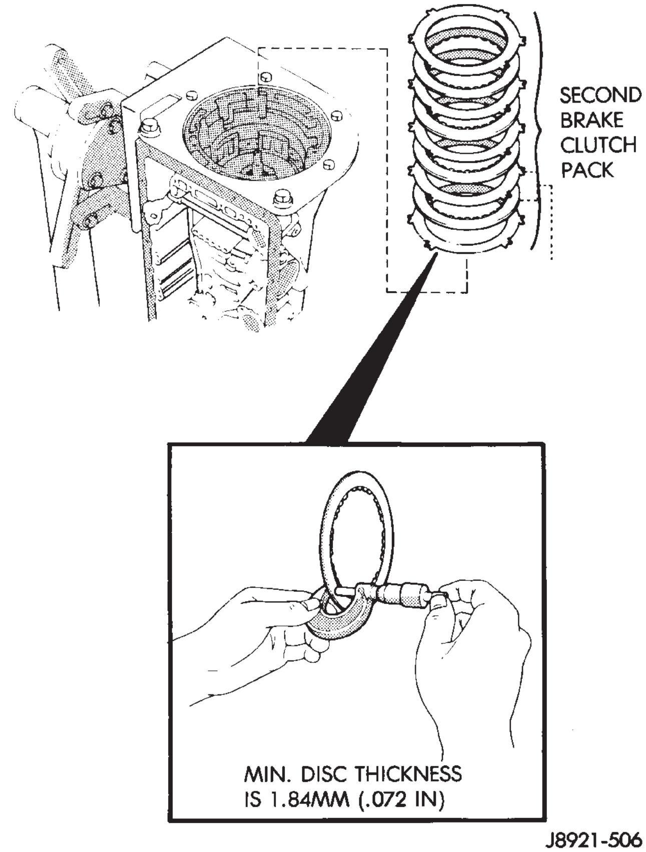


Fig. 40 Remove/Measure Second Brake Clutch Disc Thickness

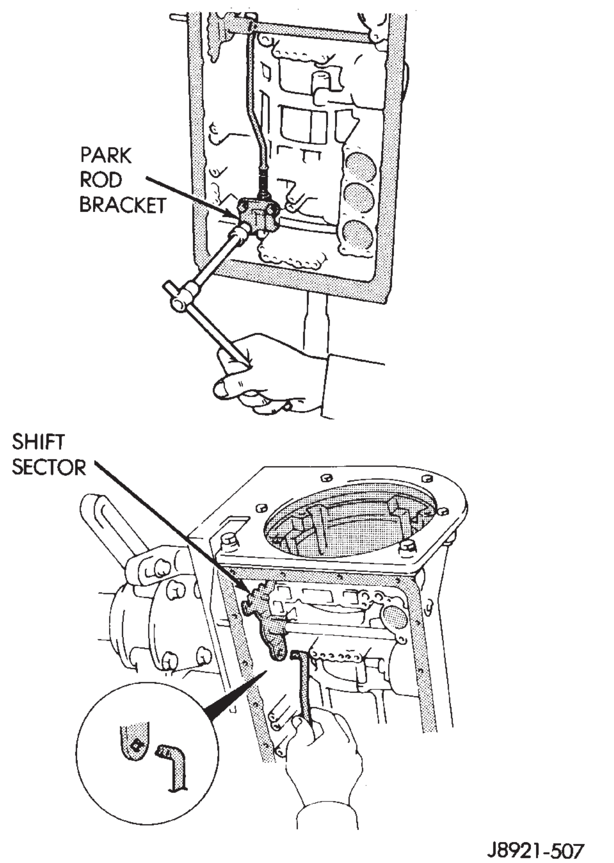


Fig. 41 Removing Park Rod And Bracket

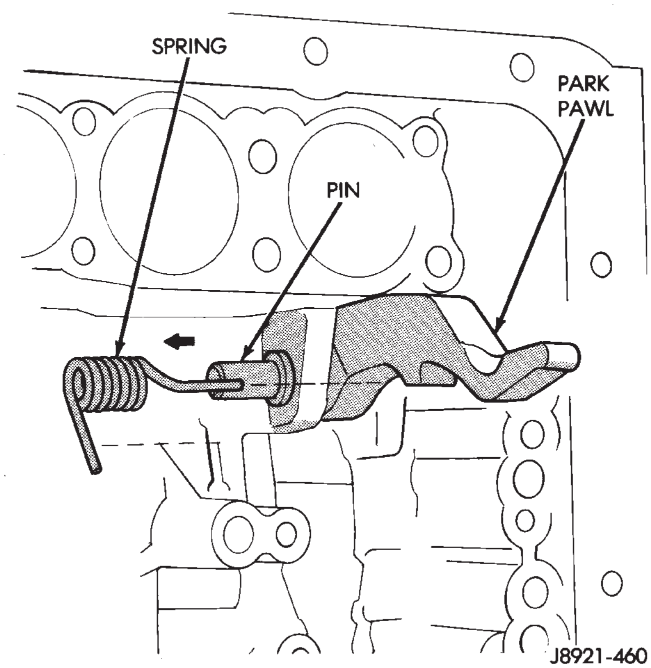


Fig. 42 Removing Park Pawl, Pin And Spring

(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.

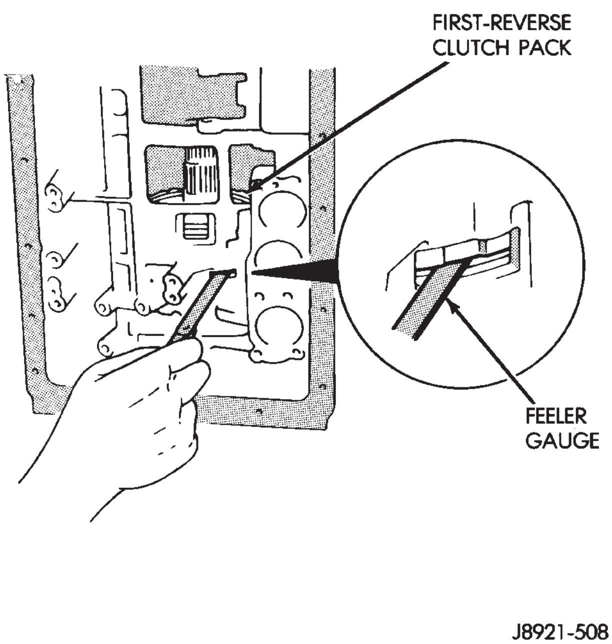


Fig. 43 Checking First-Reverse Brake Clutch Pack Clearance

(53) Remove second brake piston sleeve (Fig. 44). Cover remover tool with tape to avoid damaging case.

(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).

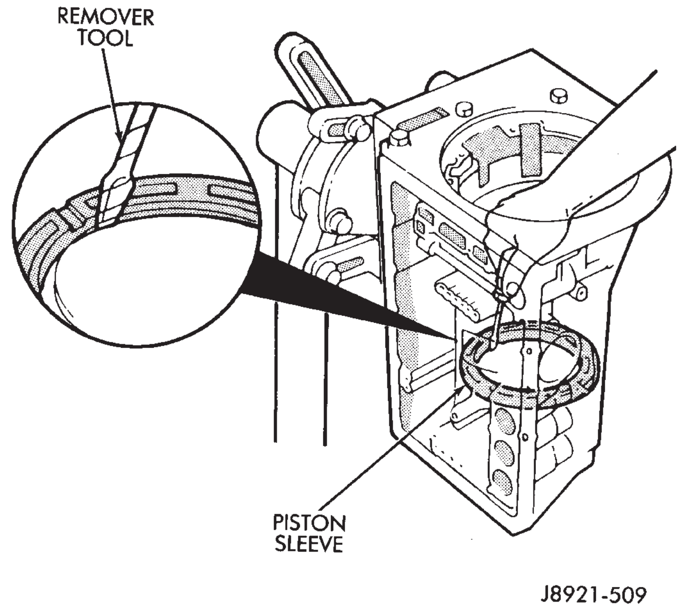


Fig. 44 Removing Second Brake Piston Sleeve

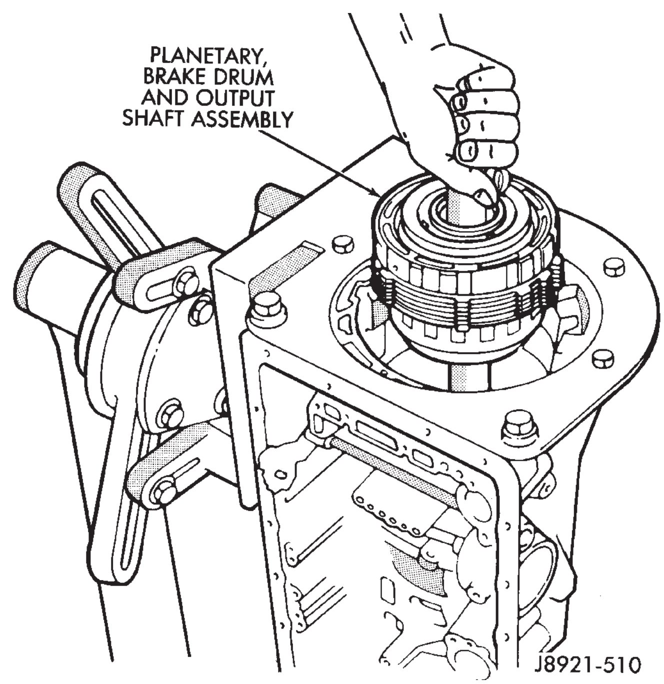


Fig. 45 Removing Rear Planetary, Second Brake Drum And Output Shaft

(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.**

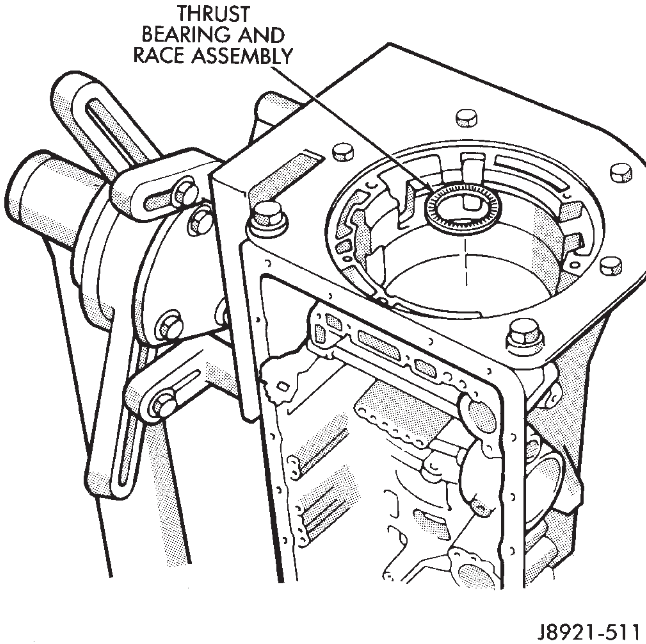


Fig. 46 Removing Planetary And Brake Drum Thrust Bearing And Race Assembly

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.

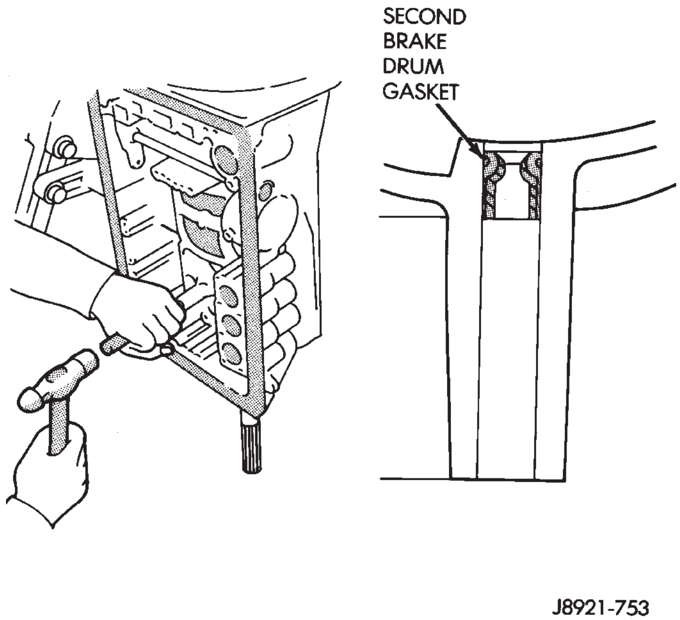


Fig. 47 Removing Brake Drum Gasket

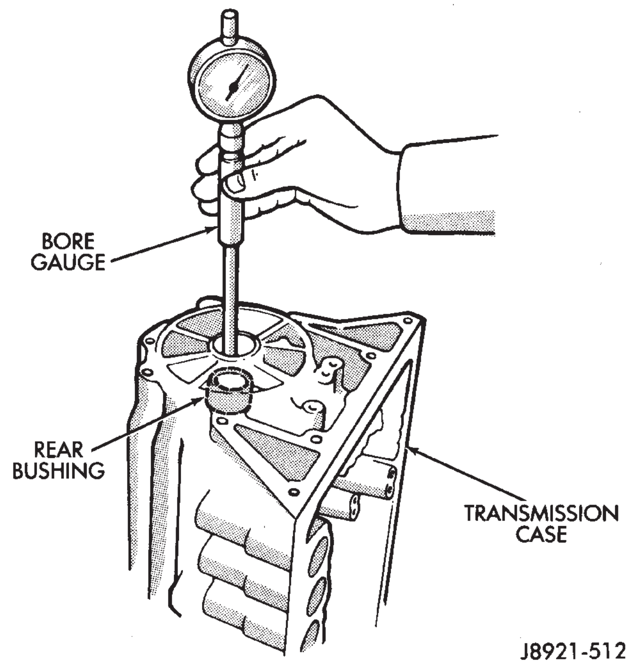


Fig. 48 Checking Rear Bushing Inside Diameter

MANUAL VALVE SHAFT OVERHAUL

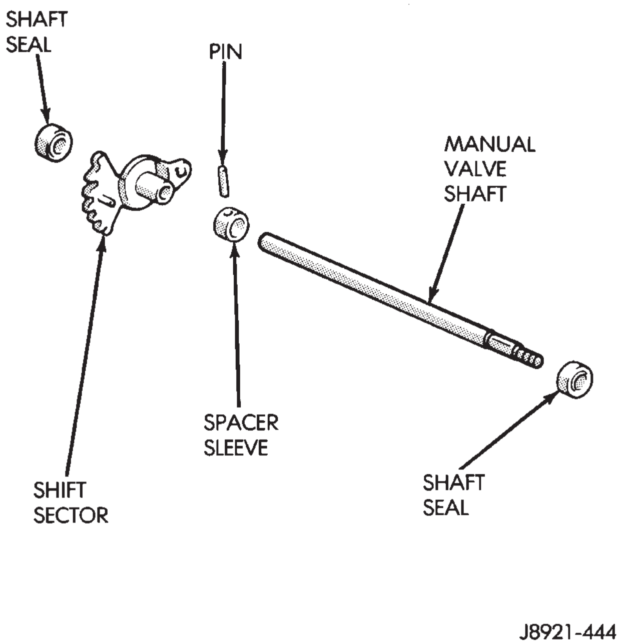


Fig. 1 Manual Valve Shaft Components

(1) Cut shaft spacer sleeve in half with chisel and remove it from lever and shaft (Fig. 2).

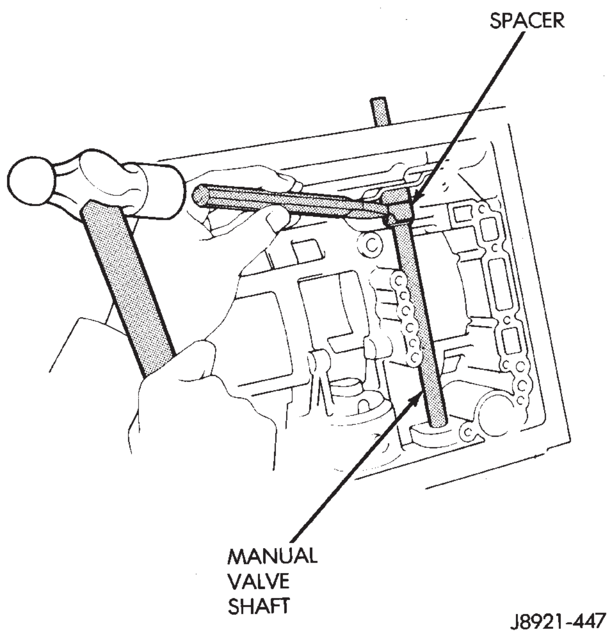


Fig. 2 Cutting Shaft Spacer Sleeve

(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.

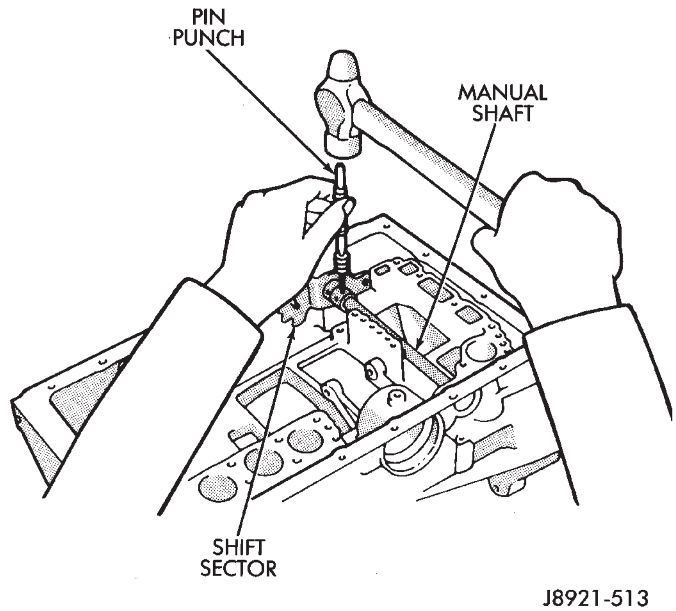


Fig. 3 Removing/Installing Sector Retaining Pin

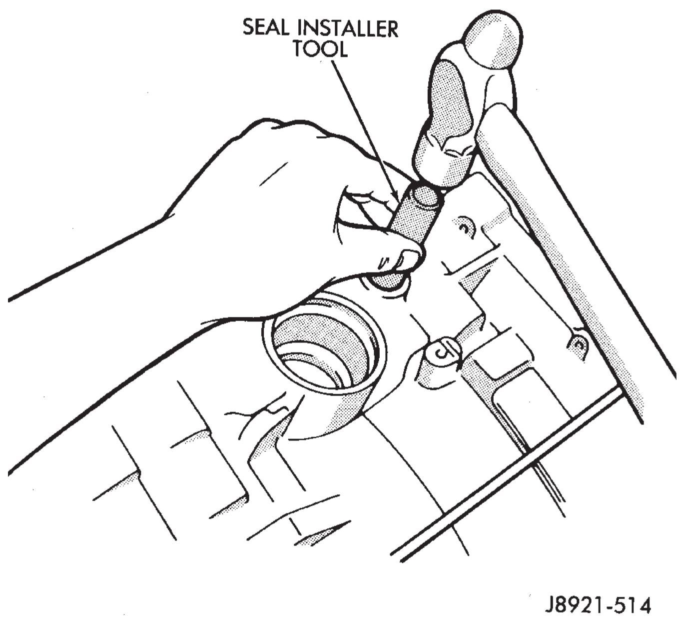


Fig. 4 Installing Manual Shaft Seals

(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.

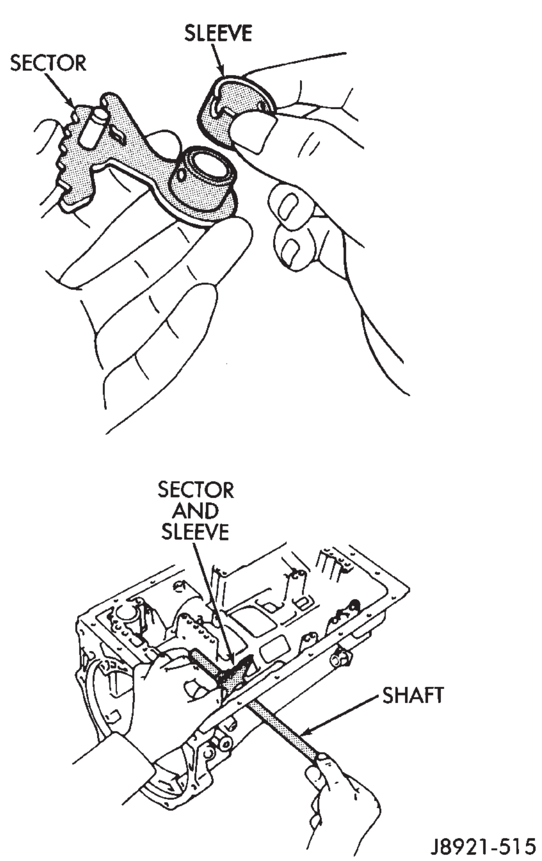


Fig. 5 Installing Manual Shaft And Sector

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).

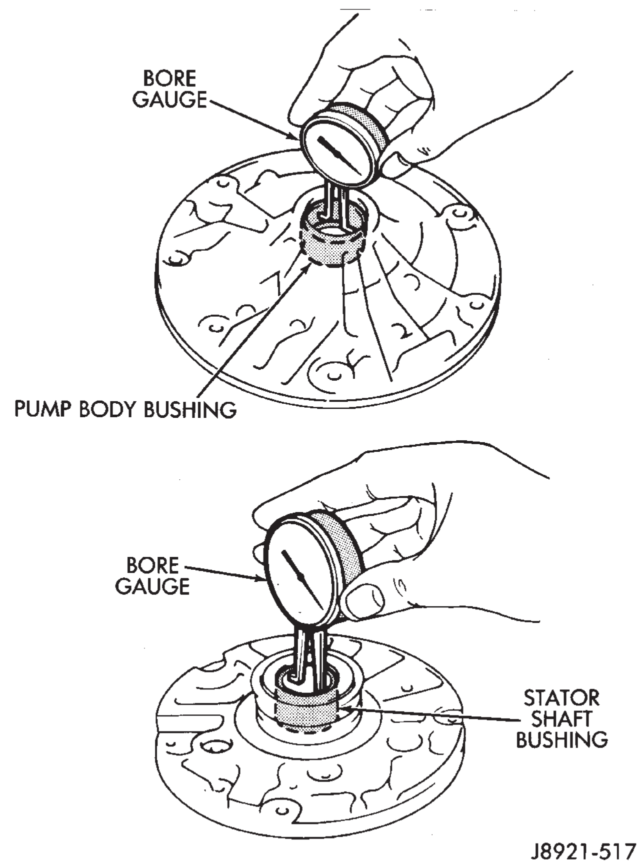


Fig. 2 Checking Pump/Stator Shaft Bushings

(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 inside diameter is greater than specified.

(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

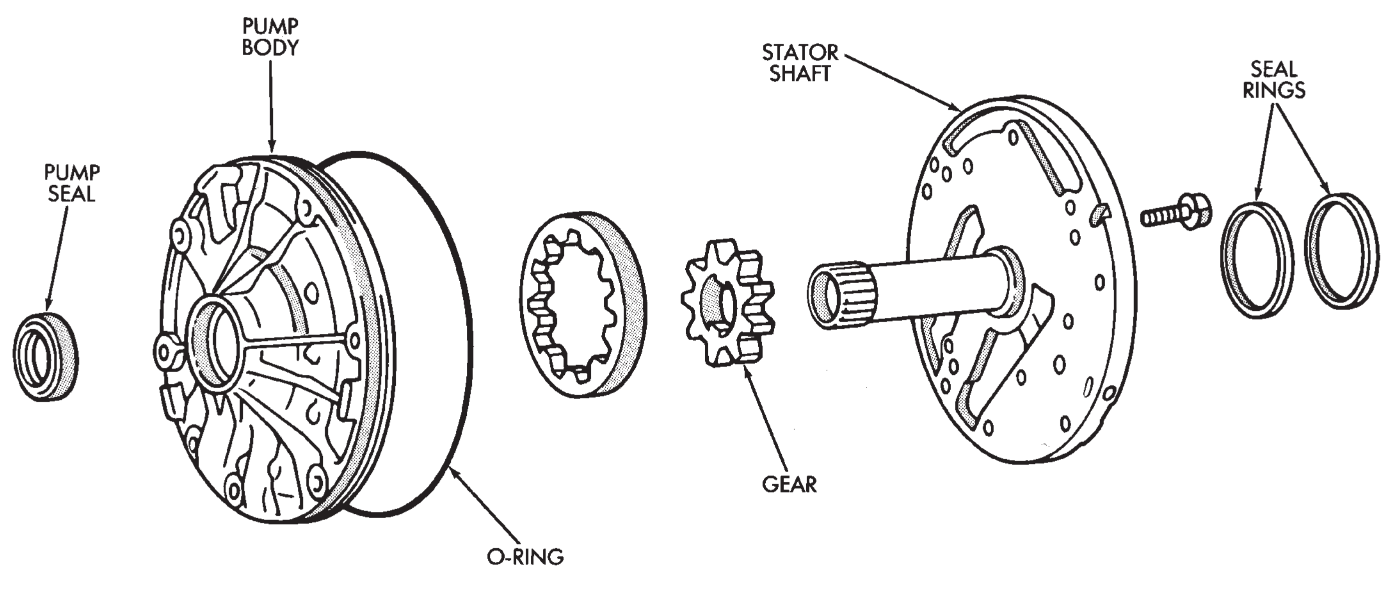


Fig. 1 Oil Pump Components

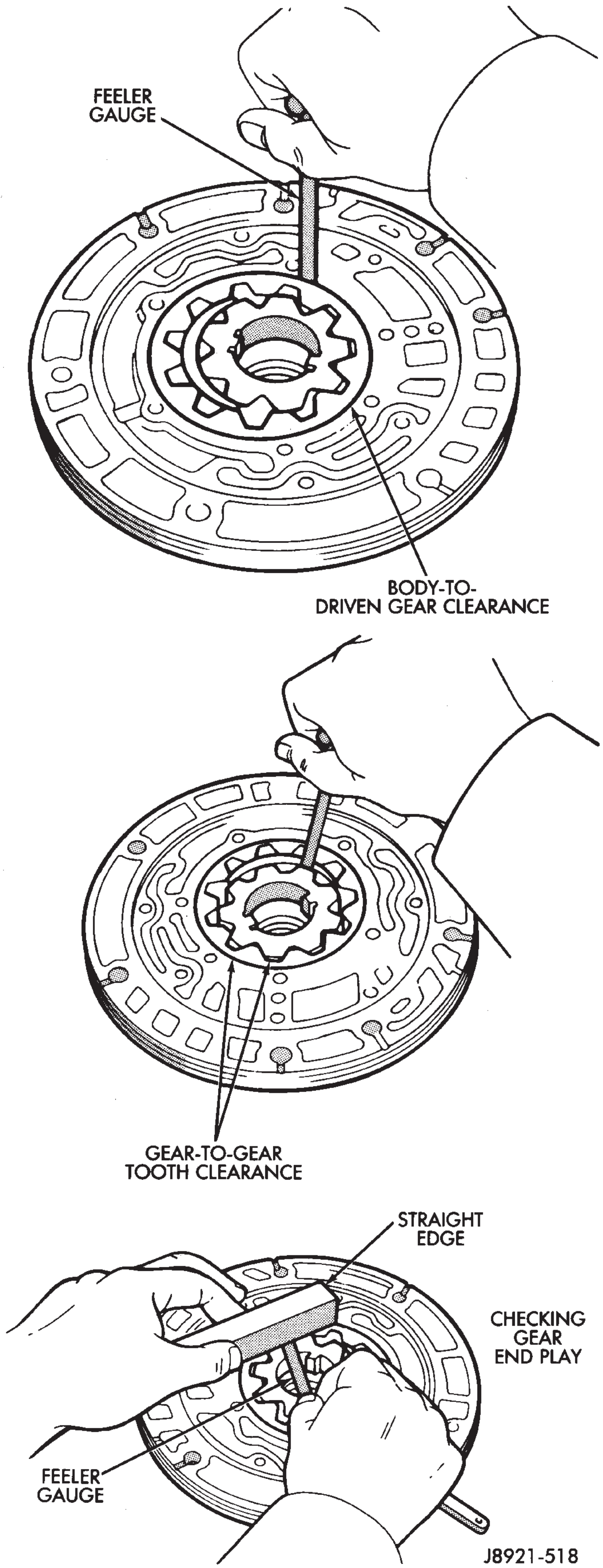


Fig. 3 Checking Pump Gear Clearances

(0.08496 in.) at front and 27.08 mm (1.0661 in.) at rear.

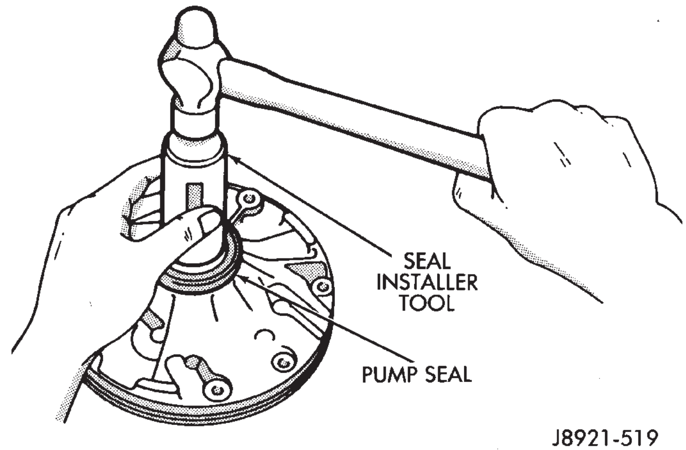


Fig. 4 Installing Pump Seal

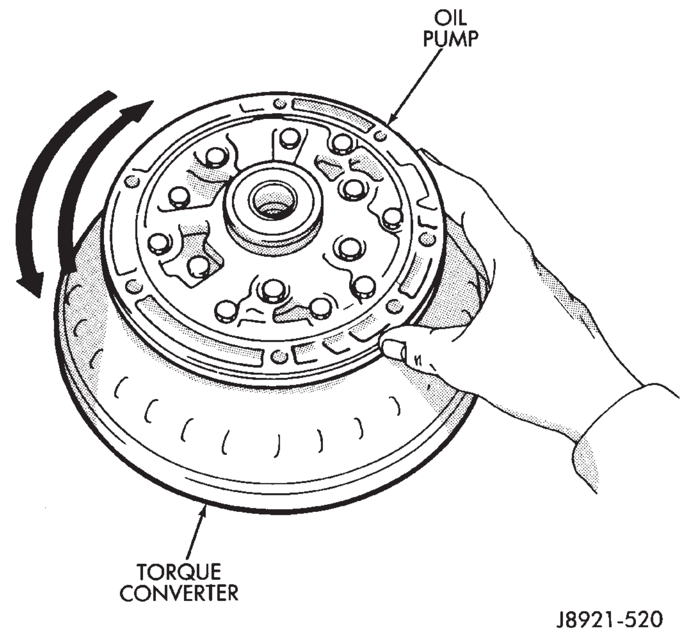


Fig. 5 Checking Pump Gear Rotation

Replace stator shaft if bushing diameter is greater than specified.

(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.

(9) Remove old pump seal. Install new seal with Seal Installer 7549 (Fig. 4).

(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.

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.

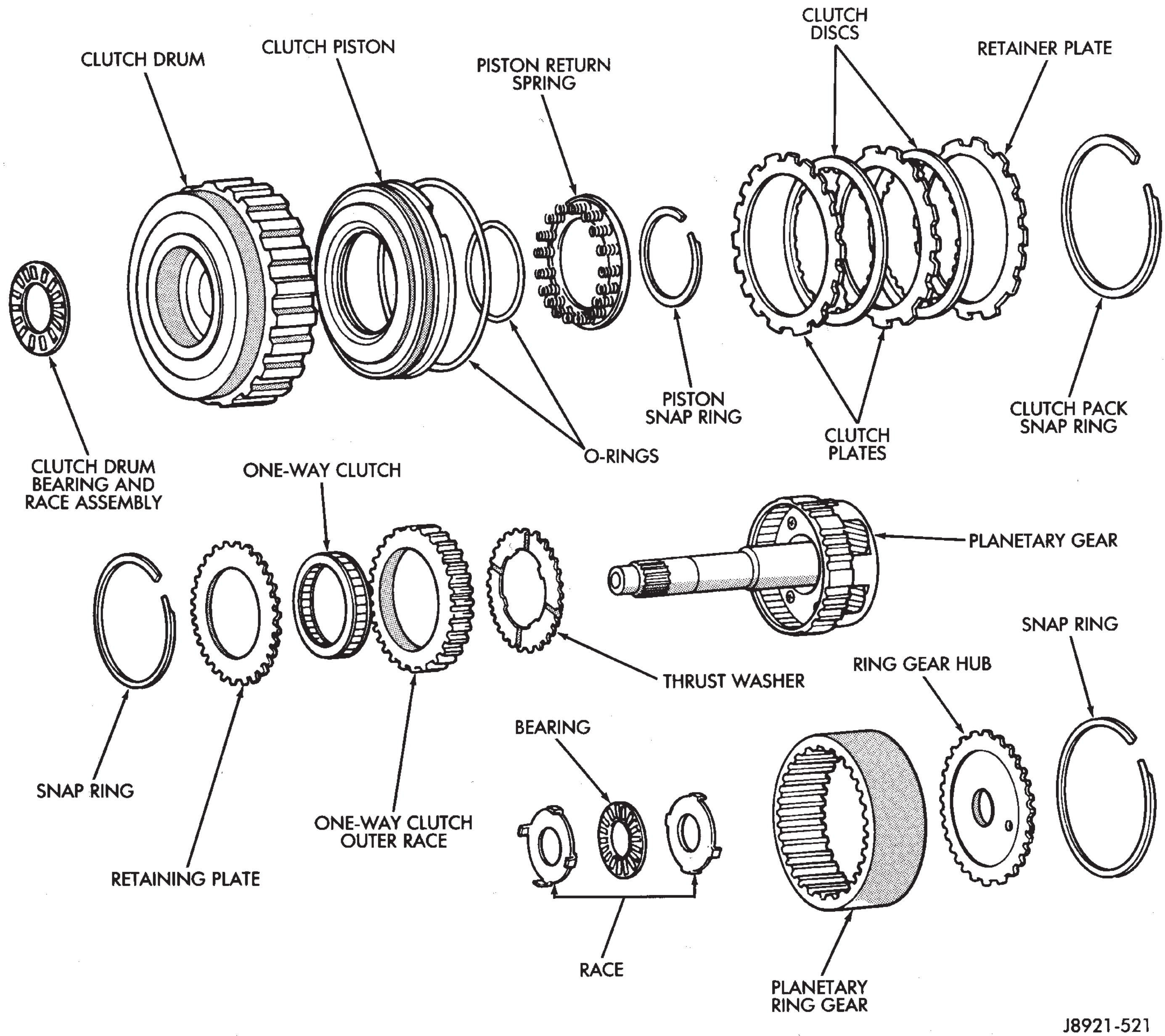


Fig. 1 Overdrive Planetary Gear And Clutch Components

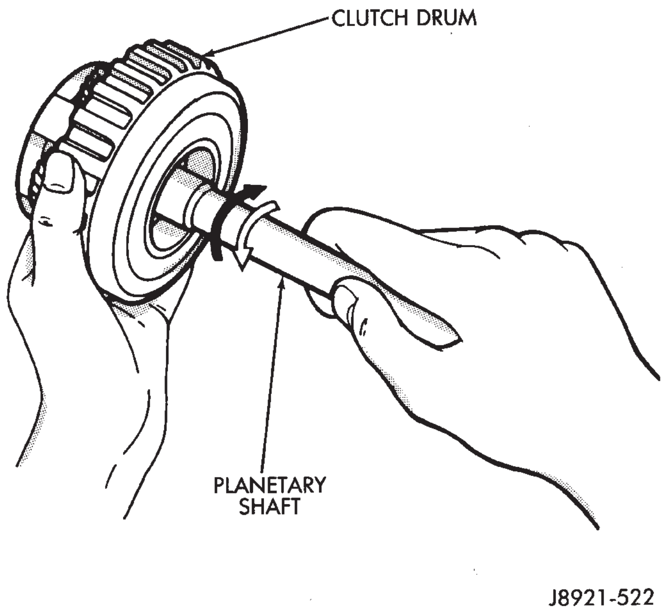


Fig. 2 Checking One-Way Clutch

(2) Remove overdrive clutch from planetary gear (Fig. 3).

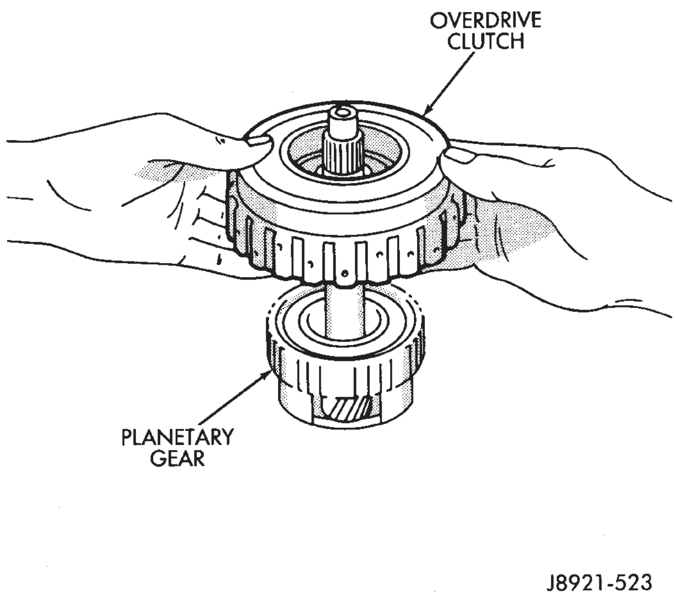


Fig. 3 Removing Overdrive Clutch From Gear

(3) Remove thrust bearing and race assembly from clutch drum (Fig. 4).

(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.).

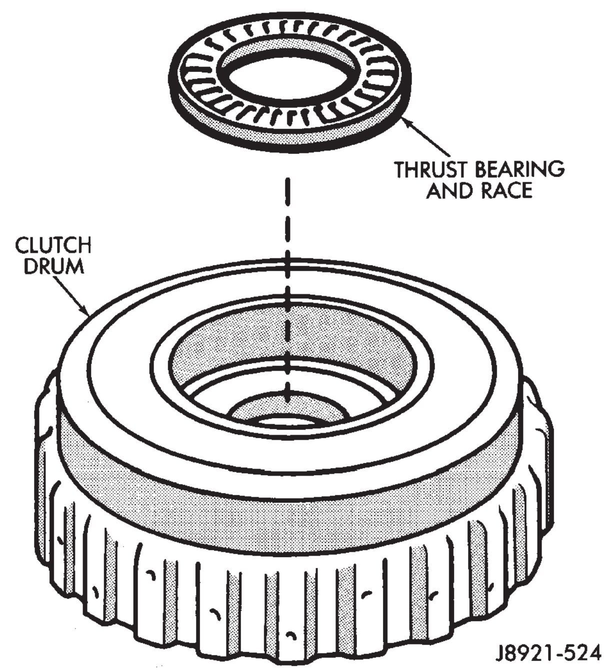


Fig. 4 Removing Clutch Drum Bearing And Race

(5) Replace clutch pack retainer if stroke length is incorrect. Refer to chart in Specifications section for replacement retainer thicknesses.

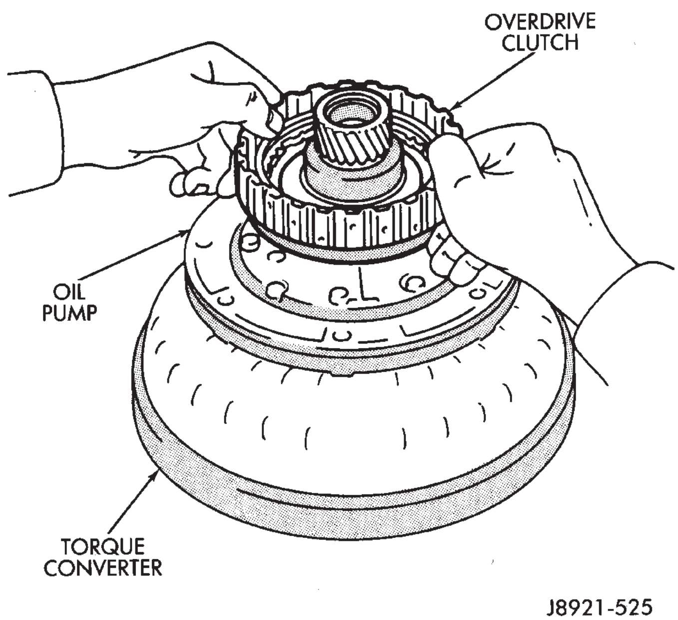


Fig. 5 Assembling Converter, Pump And Clutch For Test

(6) Remove clutch pack snap ring and remove the clutch pack.

(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.

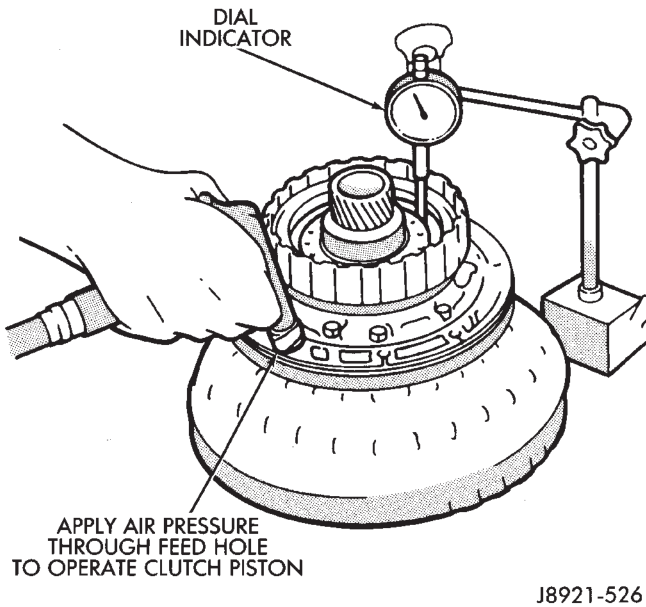


Fig. 6 Checking Overdrive Clutch Piston Stroke

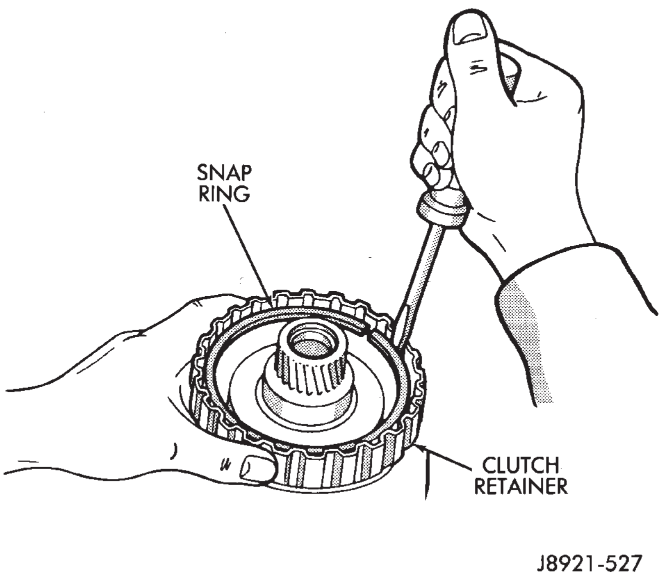


Fig. 7 Removing Clutch Pack Snap Ring

(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.

(11) Remove bearing and race from ring gear (Fig. 10).

(12) Remove snap ring from ring gear and remove ring gear hub (Fig. 11).

(13) Remove race from planetary gear (Fig. 12).

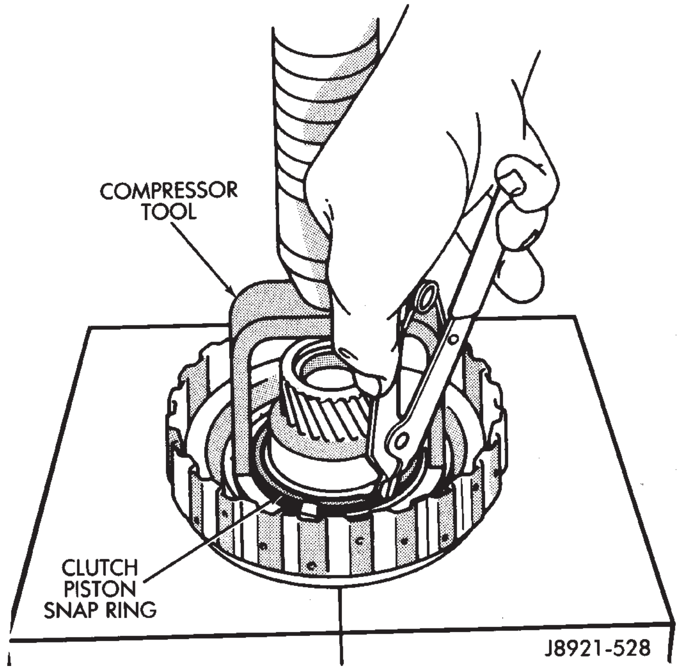


Fig. 8 Removing Clutch Piston Snap Ring

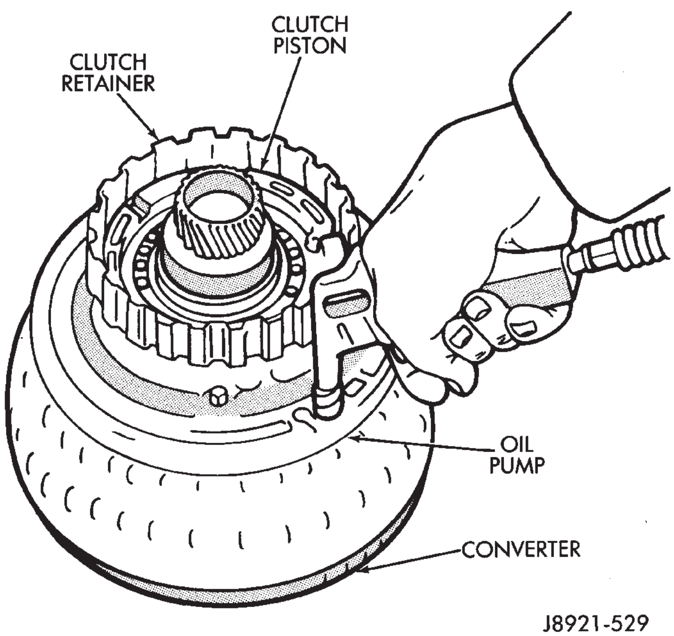


Fig. 9 Removing Overdrive Clutch Piston

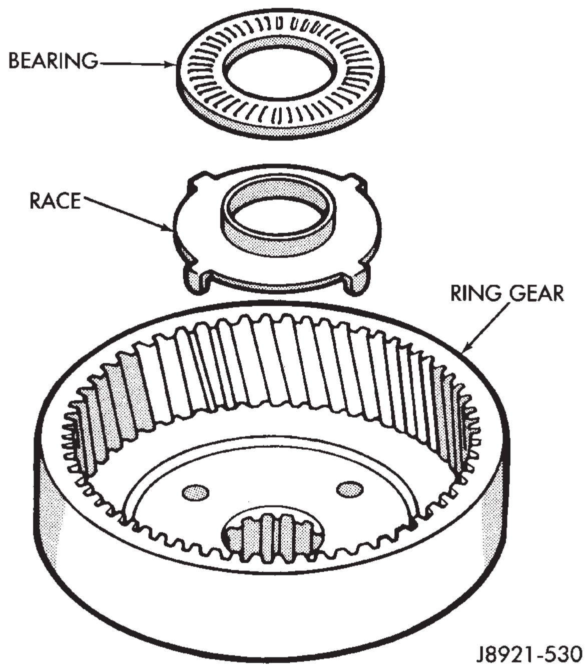


Fig. 10 Removing Ring Gear Bearing And Race

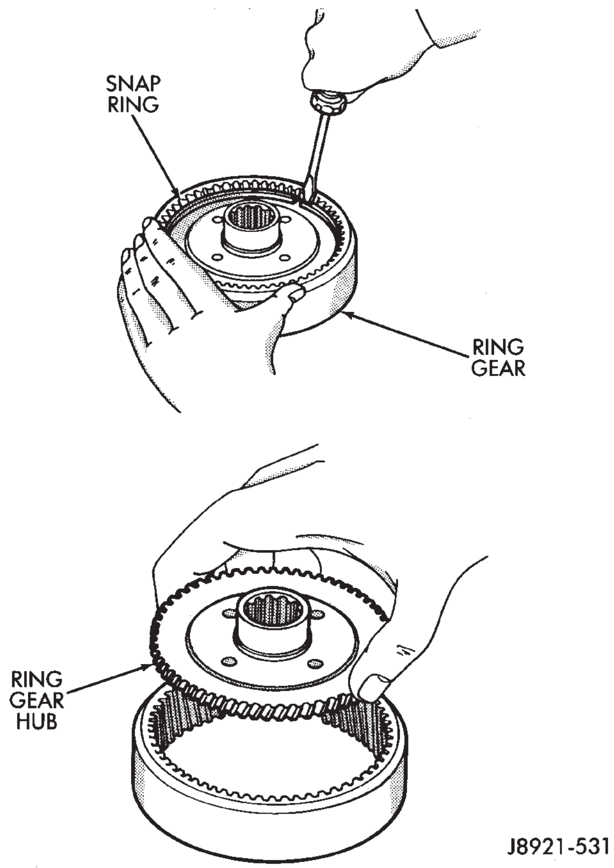


Fig. 11 Removing Ring Gear Hub

(14) Remove snap ring and remove retaining plate (Fig. 13).

(15) Remove one-way clutch and outer race as assembly. Then separate race from clutch (Fig. 14).

(16) Remove thrust washer (Fig. 15).

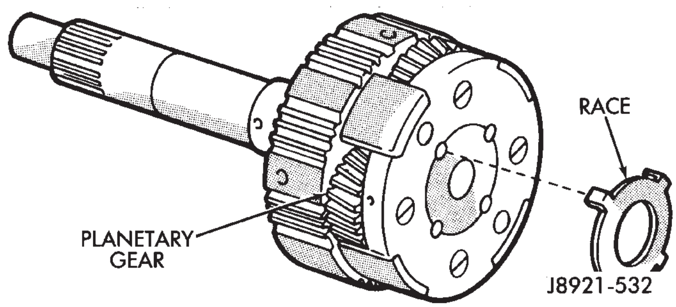


Fig. 12 Remove Planetary Gear Race

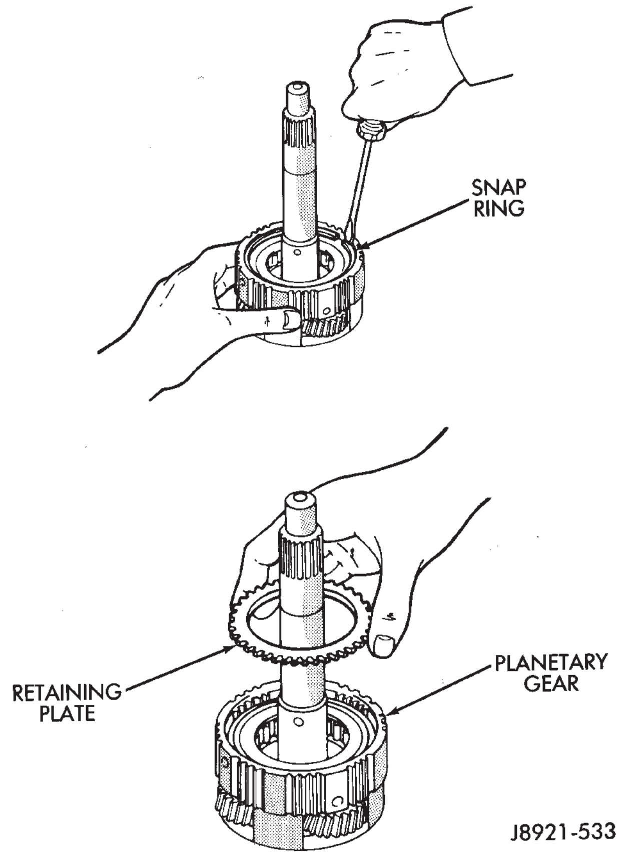


Fig. 13 Removing Snap Ring And Retaining Plate

(17) Measure clutch disc thickness. Minimum allowable thickness is 1.84 mm (0.0724 in.).

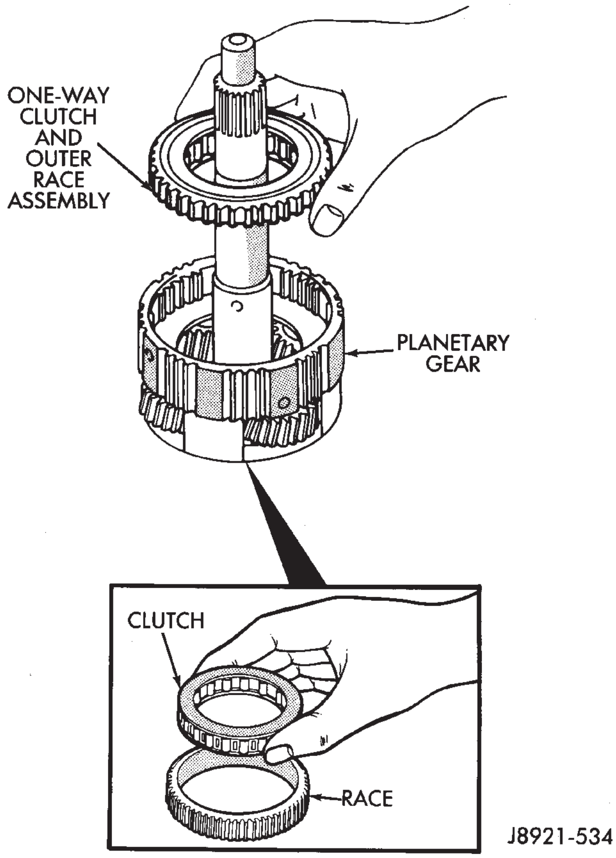


Fig. 14 Removing One-Way Clutch

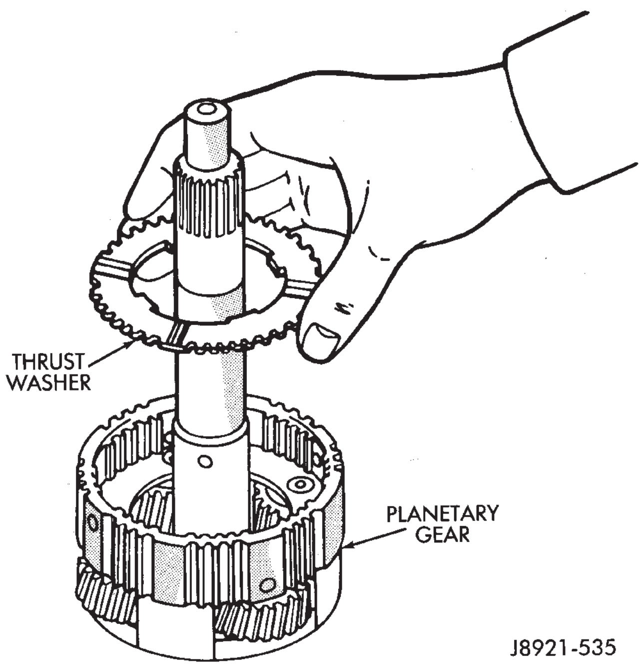


Fig. 15 Removing Planetary Thrust Washer

(18) Measure free length of piston return springs with springs in retainer (Fig. 16). Length should be 16.8 mm (0.661 in.).

(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.

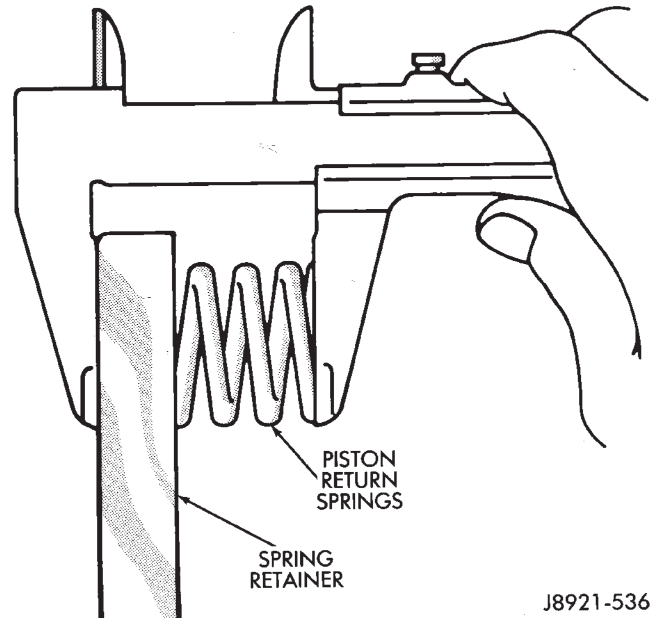


Fig. 16 Checking Piston Return Spring Length

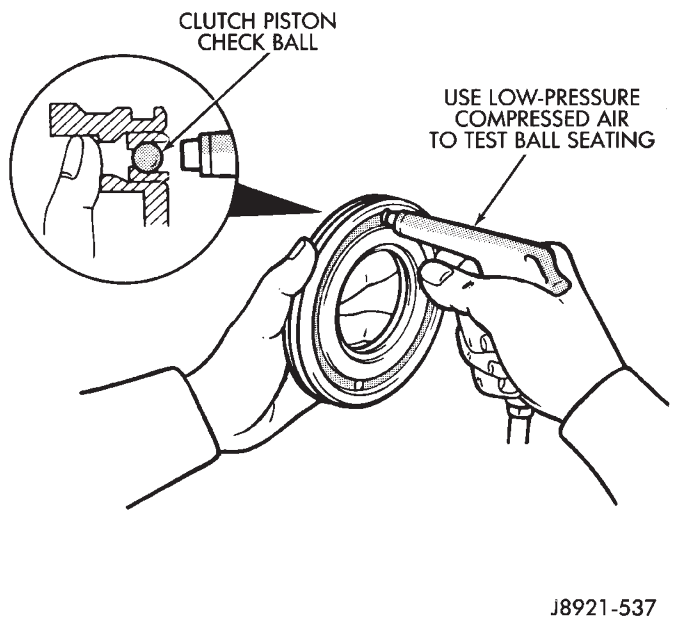


Fig. 17 Testing Clutch Piston Check Ball

(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.

(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.

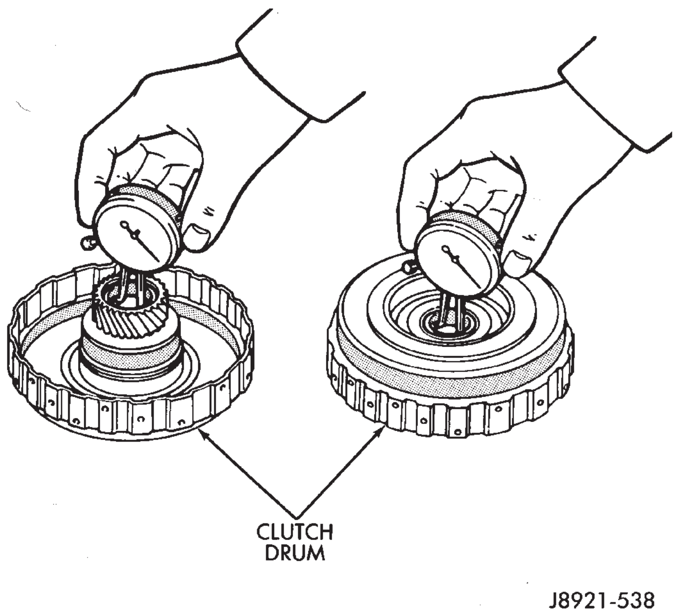


Fig. 18 Checking Clutch Drum Bushings

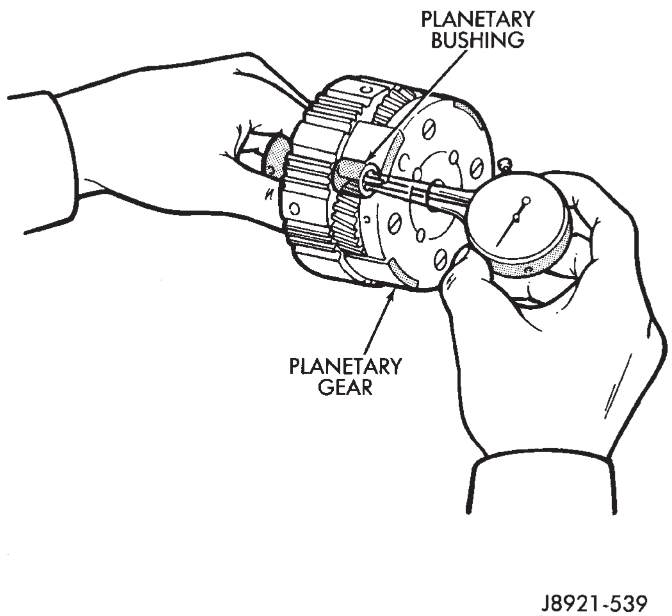


Fig. 19 Checking Planetary Bushing

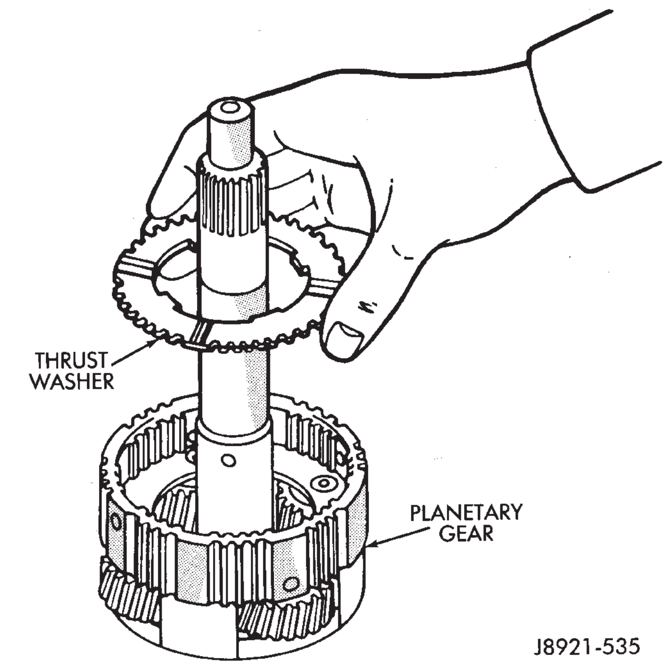


Fig. 20 Planetary Thrust Washer Installation

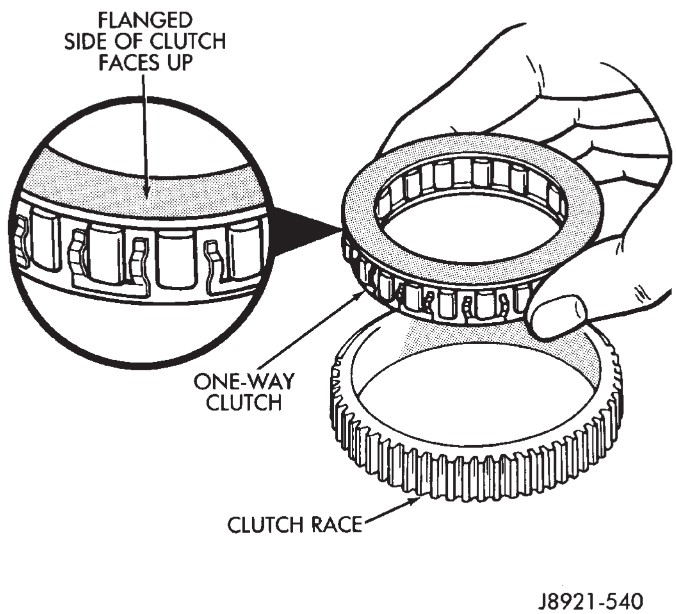


Fig. 21 Assembling One-Way Clutch And Race

Assembling Gear And Clutch

(1) Install thrust washer in planetary gear (Fig. 20). **Grooved side of washer faces up and toward front.**

(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.

(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.) and 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.).

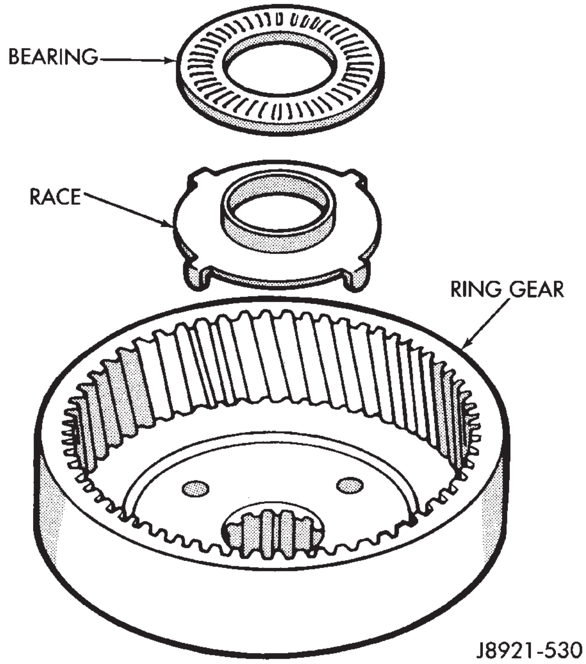


Fig. 22 Install Ring Gear Bearing And Race

(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).

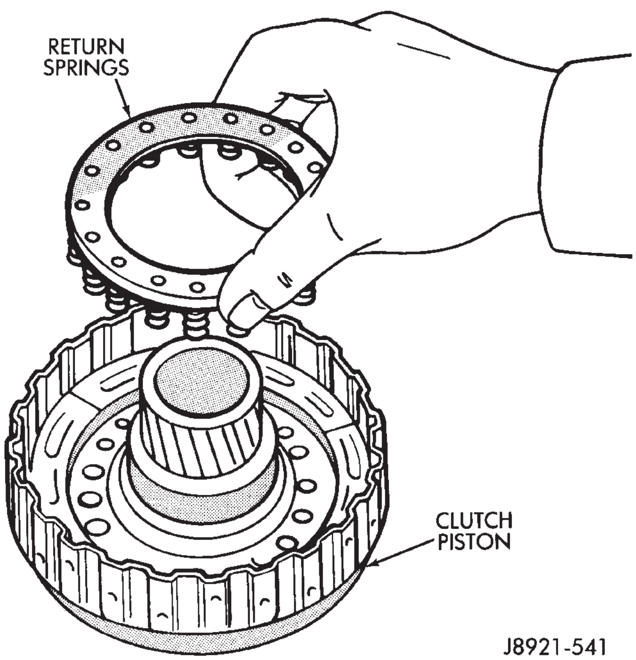


Fig. 23 Installing Piston Return Springs

(11) Install piston snap ring. Compress piston return springs with Tool 7538 and shop press (Fig. 24).

(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.

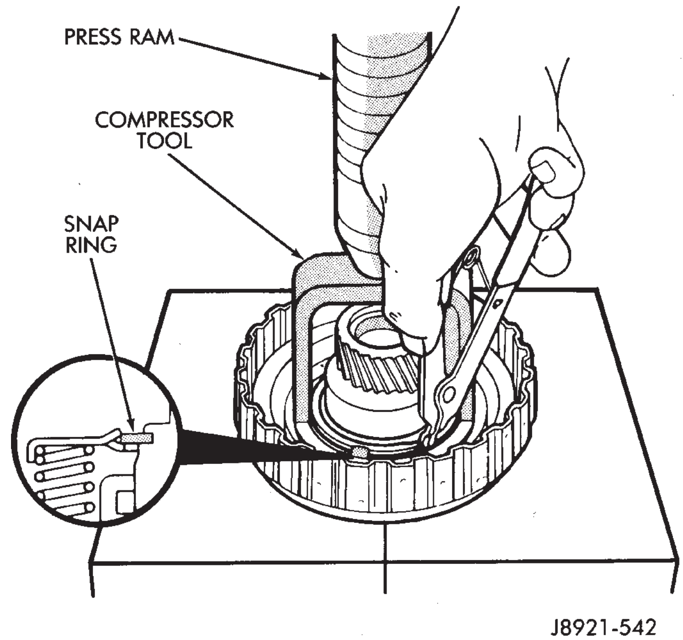


Fig. 24 Installing Clutch Piston Snap Ring

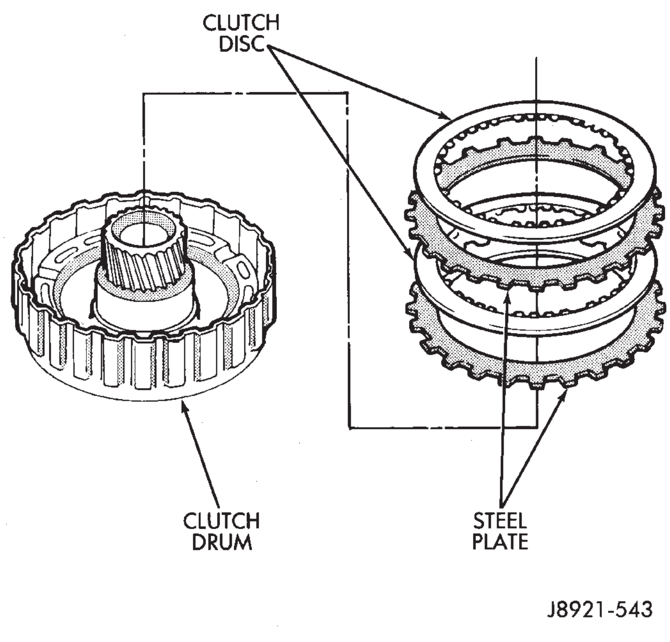


Fig. 25 Installing Clutch Discs And Plates

(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 transmission disassembly). 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 mm (1.976 in.). Inside diameter is 28.9 mm (1.138 in.).

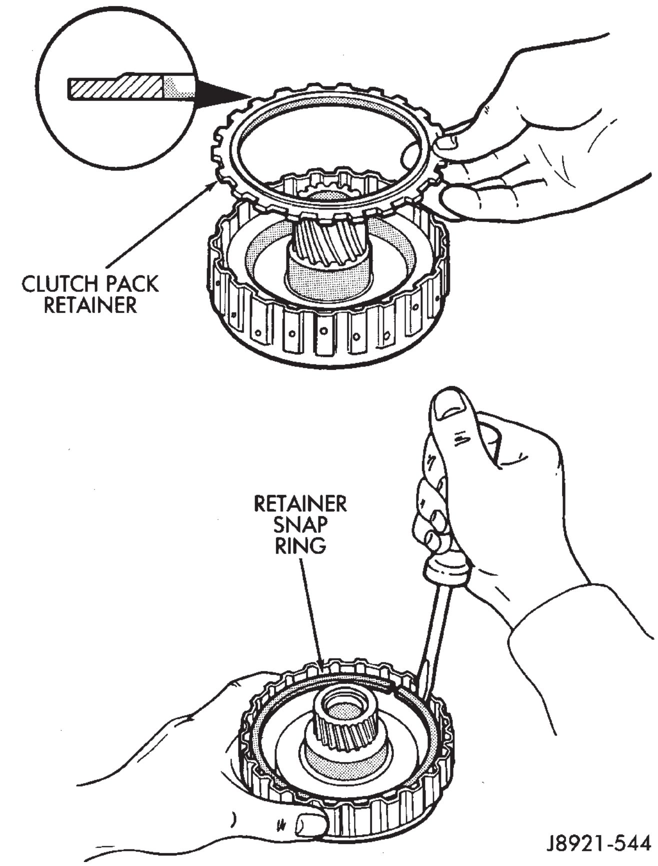


Fig. 26 Installing Retainer And Snap Ring

(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.

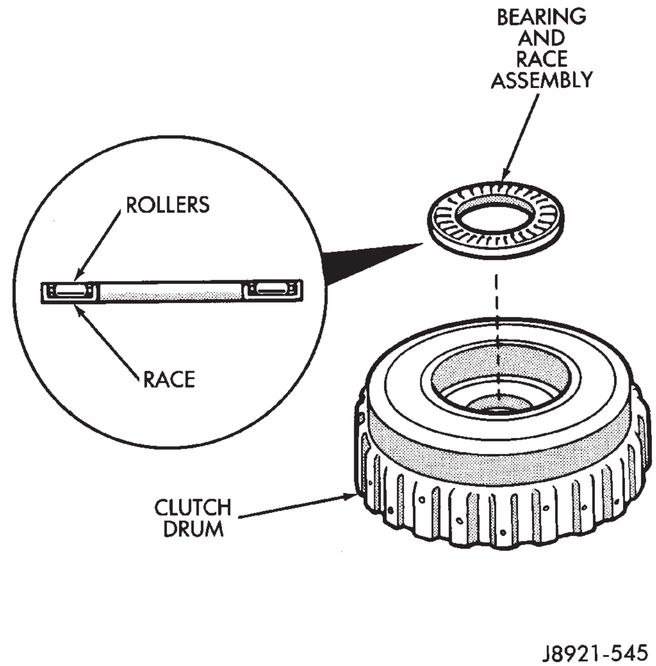


Fig. 27 Installing Clutch Drum Bearing And Race Assembly

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 should move smoothly and not bind or stick. If operation is incorrect, replace piston and support.

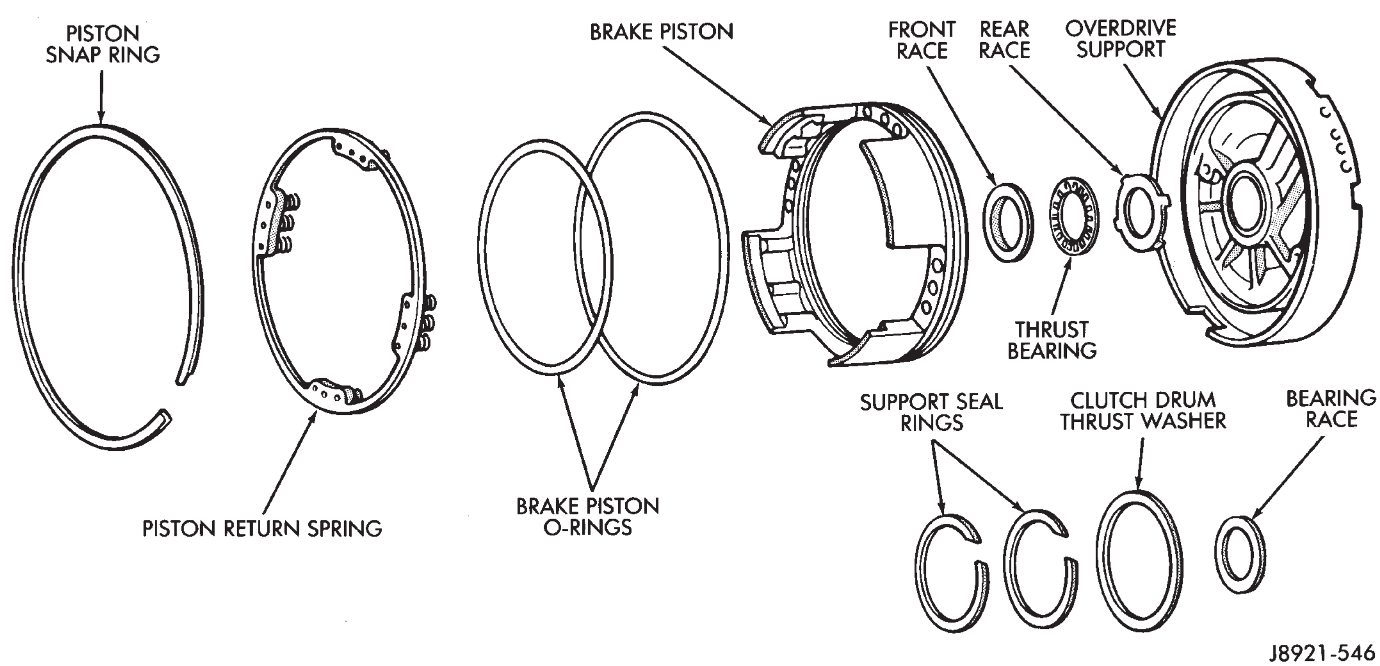


Fig. 1 Overdrive Support Components

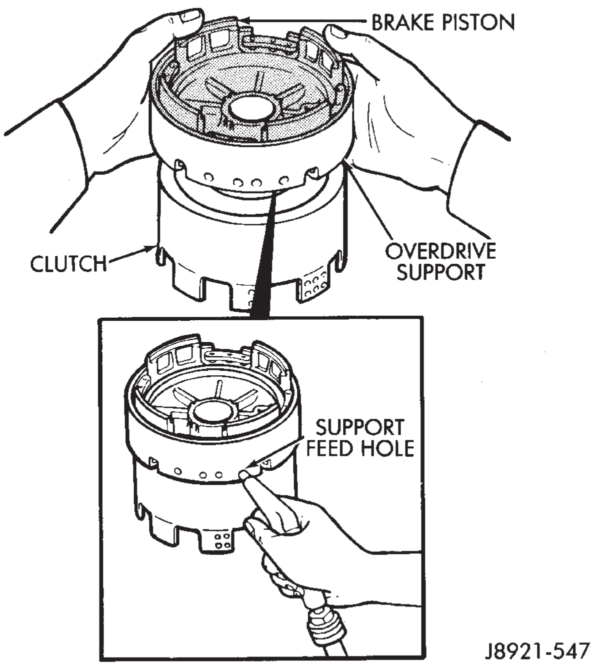


Fig. 2 Checking Brake Piston Movement

(3) Remove thrust bearing front race, thrust bearing and rear race (Fig. 3).

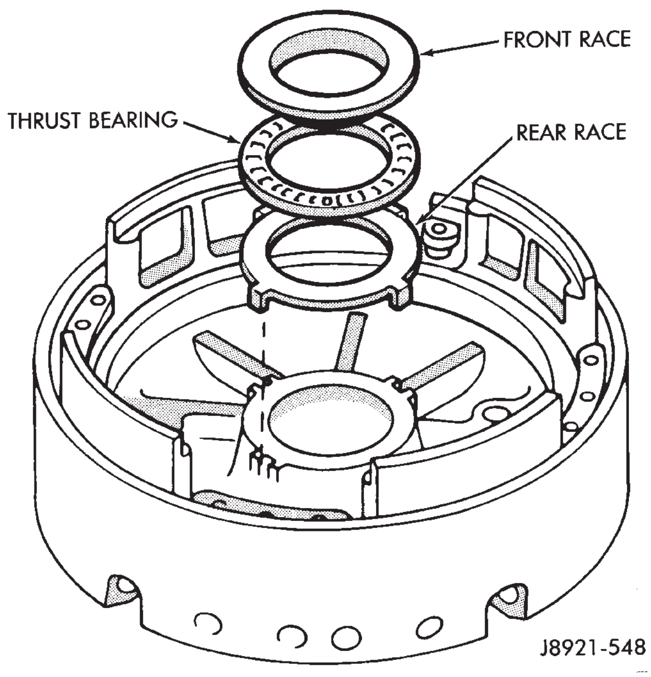


Fig. 3 Removing Support Thrust Bearing And Races

(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).

(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).

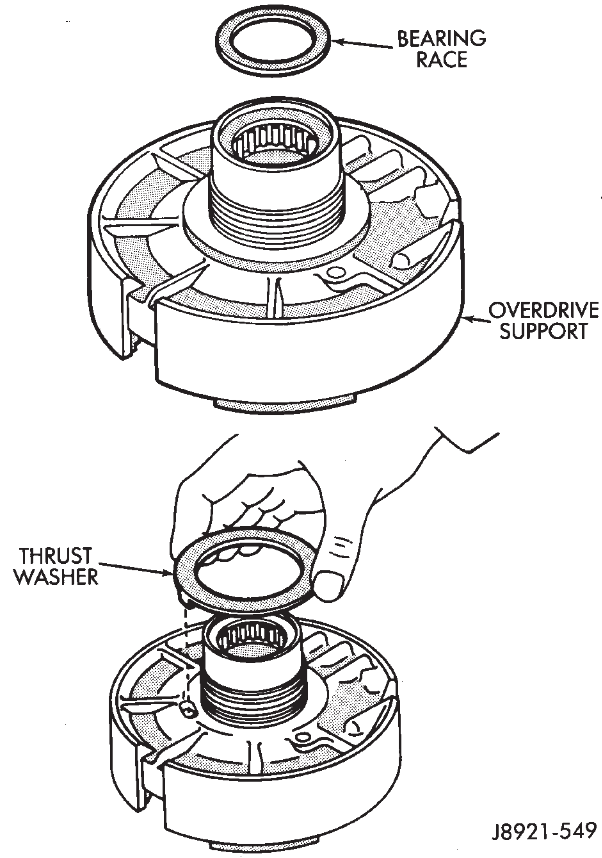


Fig. 4 Removing Clutch Drum Thrust Washer And Race

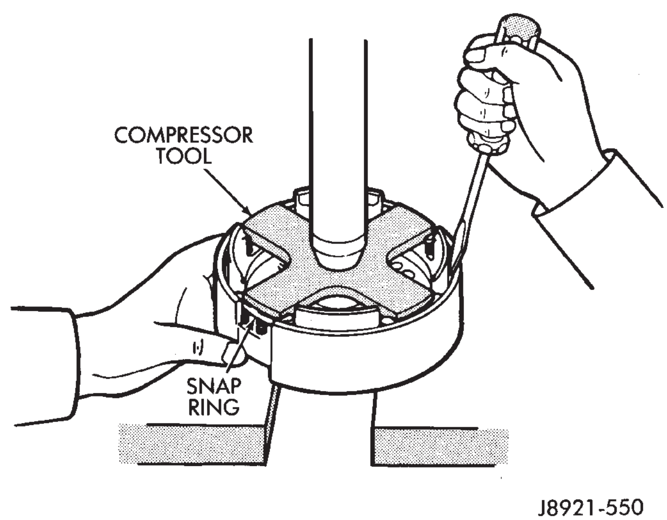


Fig. 5 Removing/Installing Piston Snap Ring

(8) Remove support seal rings (Fig. 6).

(9) Measure free length of piston return springs with springs mounted in retainer (Fig. 7). Length should be 17.23 mm (0.678 in.).

(10) Clean support components and dry them with compressed air.

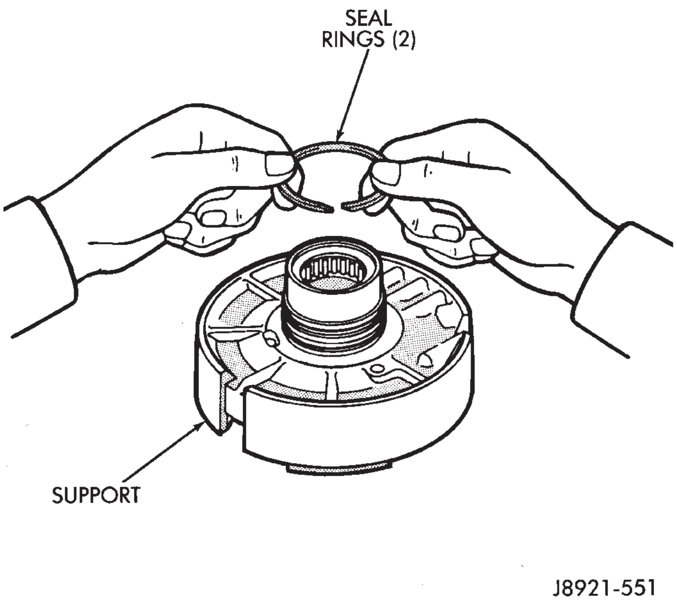


Fig. 6 Removing Support Seal Rings

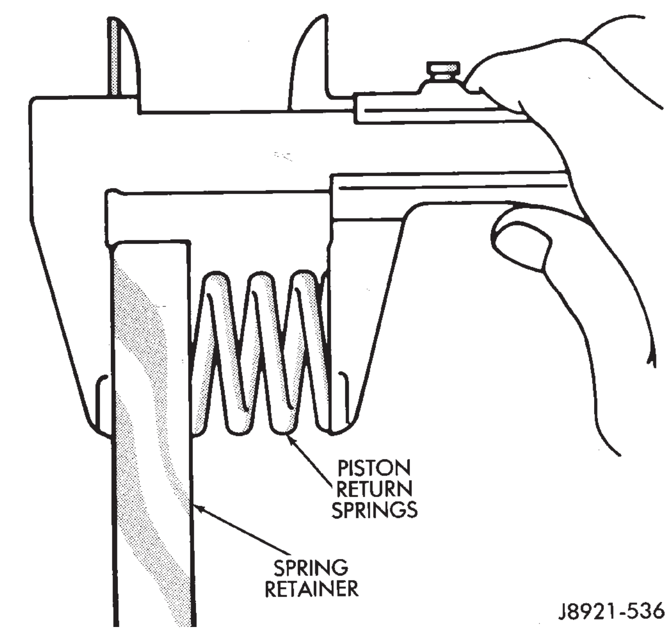


Fig. 7 Checking Piston Return Spring Length

(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.

(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).

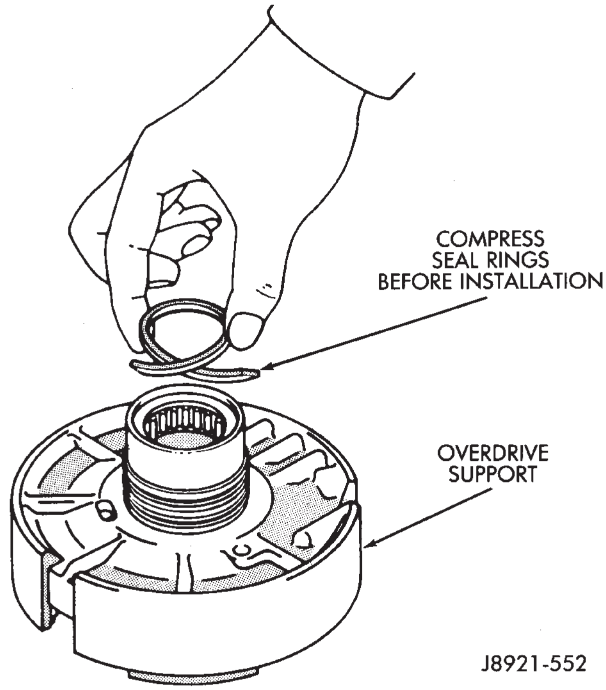


Fig. 8 Installing Support Seal Rings

(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.).

• 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.).

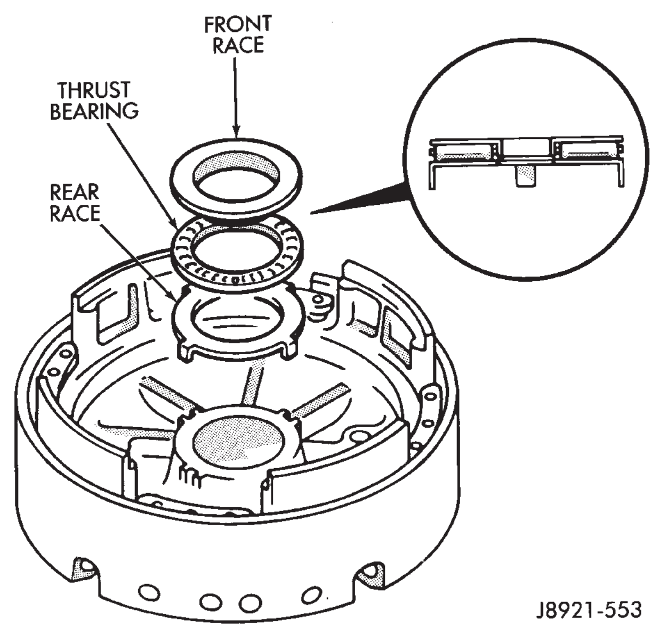


Fig. 9 Installing Support Thrust Bearing And Races

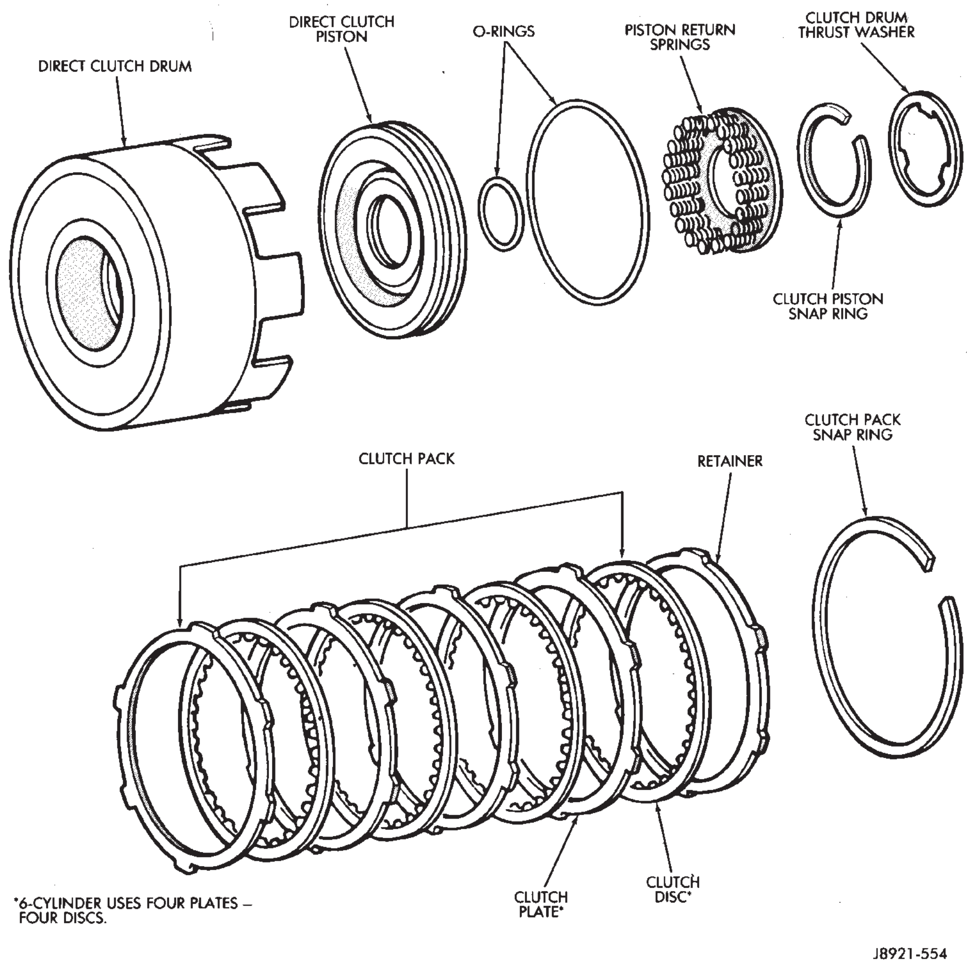


Fig. 1 Direct Clutch Components

(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. 2).

(2) Remove clutch drum thrust washer (Fig. 3).

(3) Check clutch piston stroke length as outlined in following steps.

(4) Mount direct clutch on overdrive support assembly (Fig. 4).

(5) Mount dial indicator on clutch and position indicator plunger on clutch piston (Fig. 4).

(6) Apply 57-114 psi air pressure through feed hole in overdrive support and note piston stroke length (Fig. 5). Check stroke at least twice.

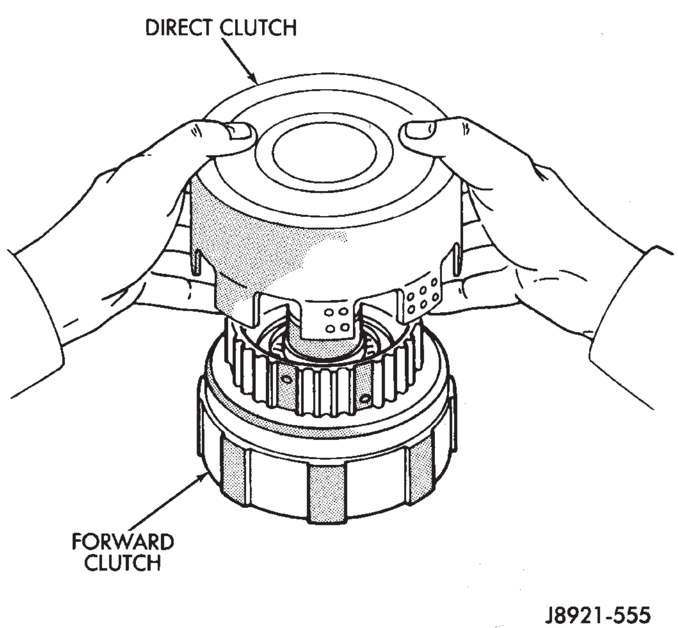


Fig. 2 Separate Direct Clutch From Forward Clutch

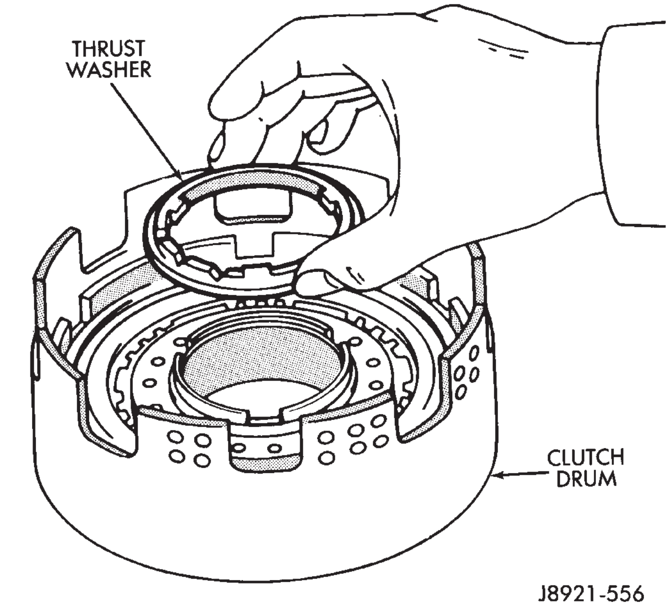


Fig. 3 Removing Clutch Drum Thrust Washer

(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.

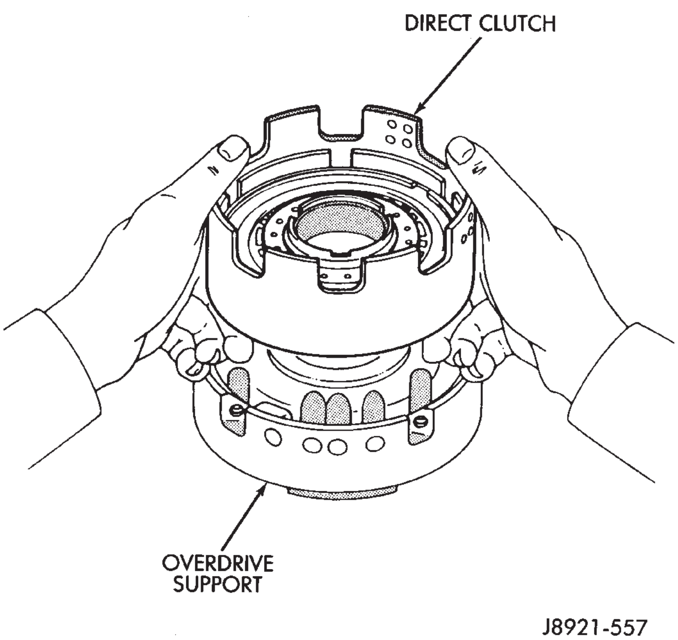


Fig. 4 Mount Direct Clutch On Overdrive Support

(8) Remove clutch pack snap ring and remove retainer and clutch pack from drum (Fig. 6).

(9) Compress clutch piston return springs with Compressor Tool 7538 and remove clutch piston snap ring (Fig. 7).

(10) Remove compressor tool and return spring.

(11) Remove clutch piston. Remount clutch on overdrive support (Fig. 8). Apply compressed air through

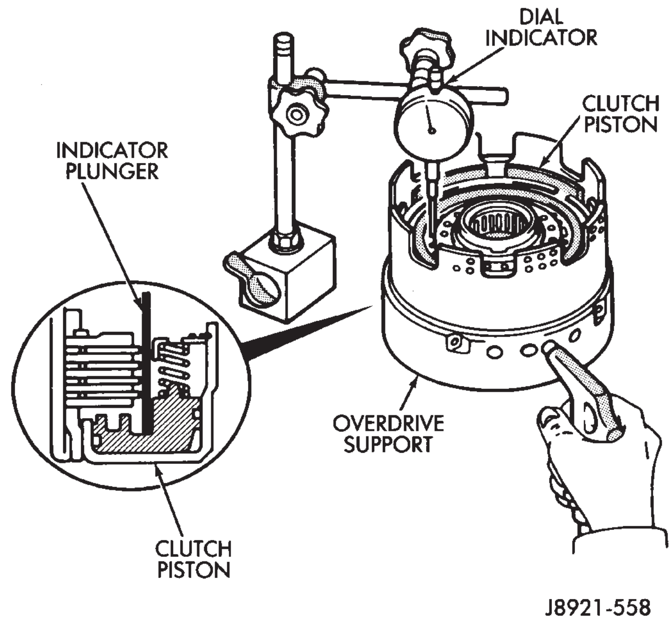


Fig. 5 Checking Direct Clutch Piston Stroke Length

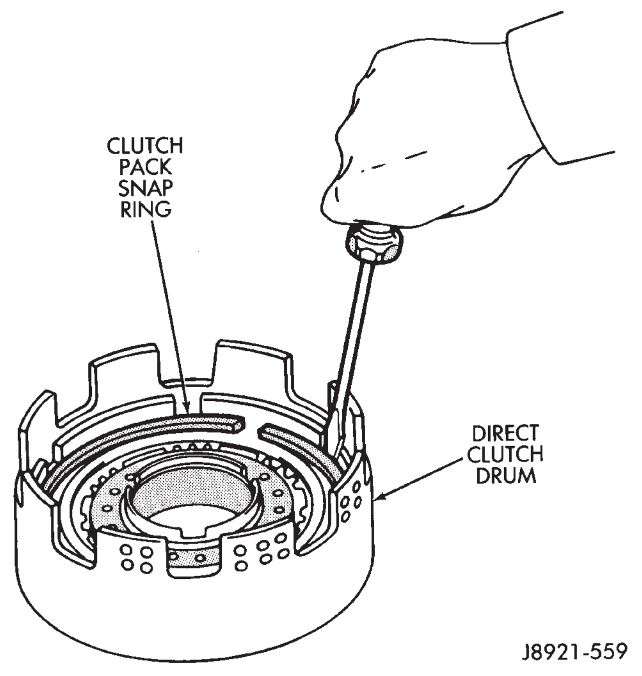


Fig. 6 Removing Clutch Pack Snap Ring

piston feed hole in support to remove piston. Use only enough air to ease piston out.

(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.

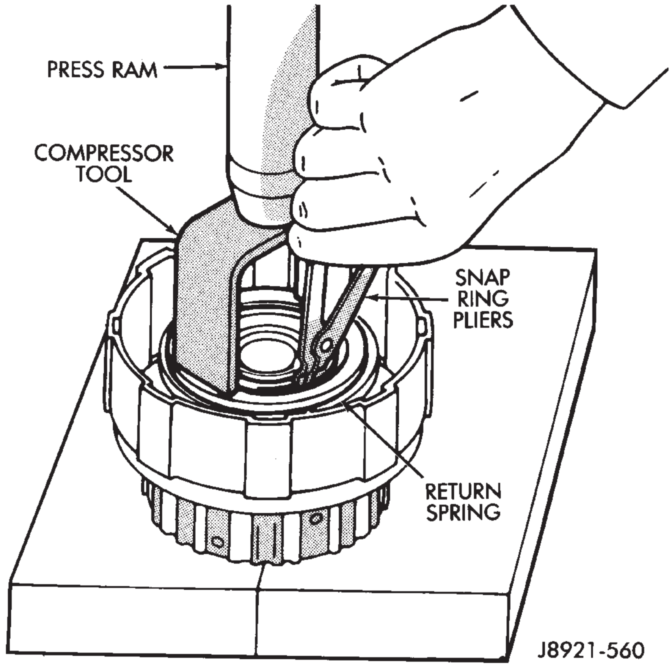


Fig. 7 Removing Piston Return Spring

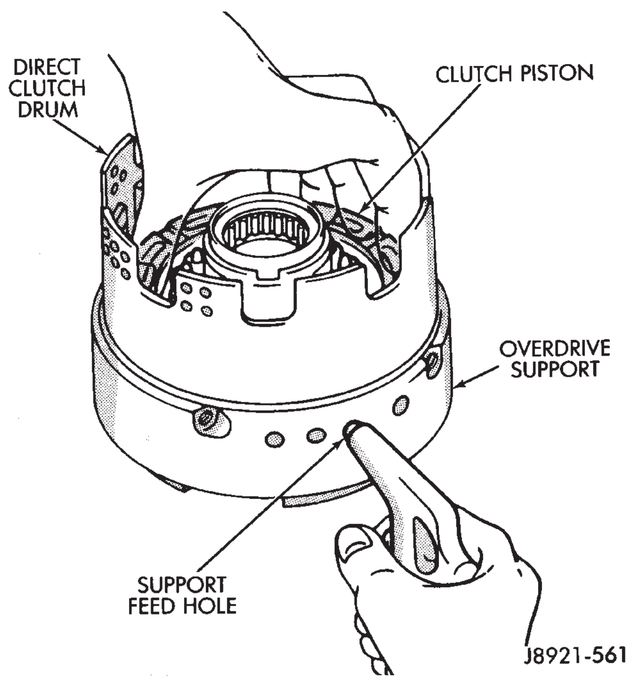


Fig. 8 Removing Direct Clutch Piston

(14) Measure free length of piston return springs with springs in retainer (Fig. 9). Length should be 21.32 mm (0.839 in.). Replace return springs if not within specification.

(15) Check clutch piston check ball (Fig. 10). 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.

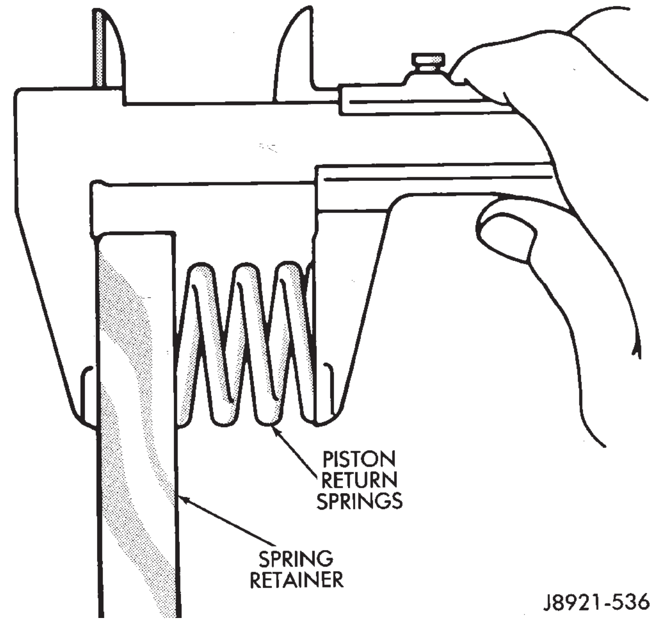


Fig. 9 Checking Piston Return Spring Length

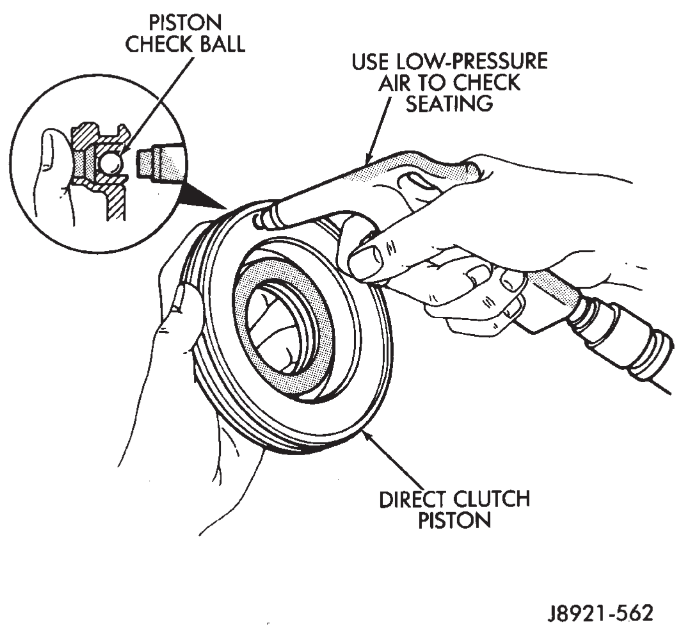


Fig. 10 Testing Piston Check Ball Seating

DIRECT CLUTCH ASSEMBLY

(1) Lubricate and install replacement O-rings on clutch piston.

(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. 7). 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.

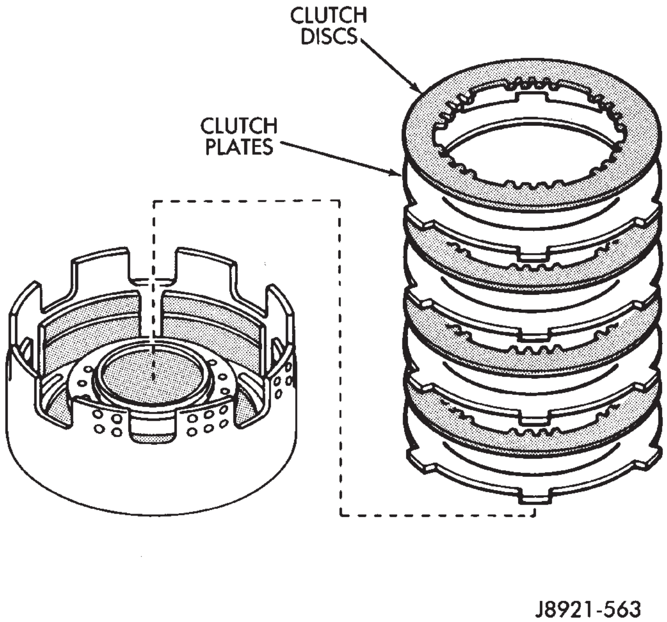


Fig. 11 Installing Direct Clutch Discs And Plates

(5) Install clutch pack retainer in drum (Fig. 12).

(6) Install clutch pack snap ring (Fig. 12).

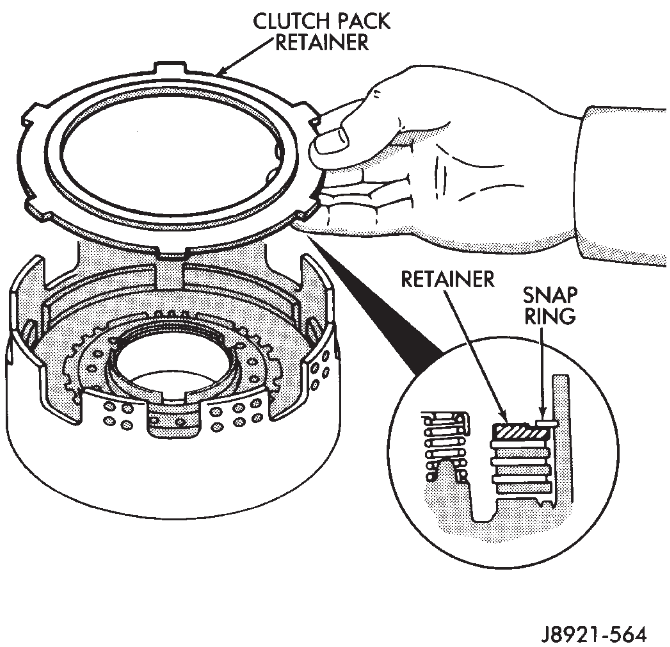


Fig. 12 Install Clutch Pack Retainer

(7) Check snap ring position. If necessary, shift snap ring until end gap is **not** aligned with any notches in clutch drum (Fig. 12).

(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).

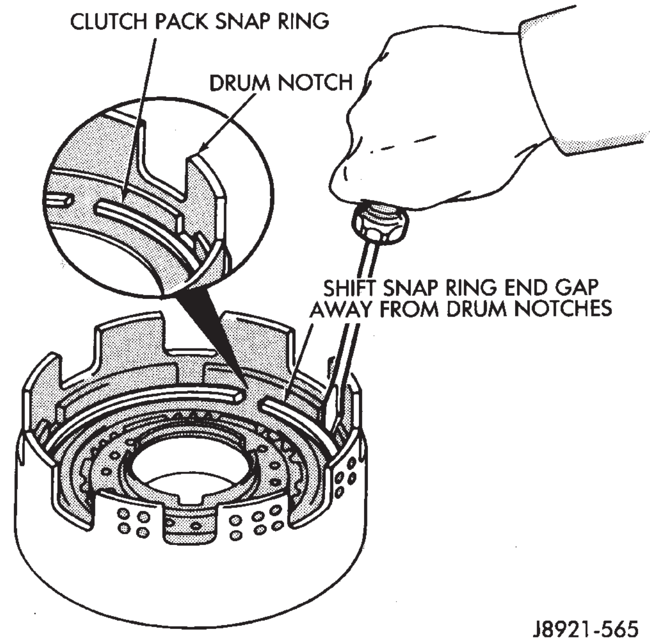


Fig. 13 Adjusting Clutch Pack Snap Ring Position

(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.

(12) If clutch height is OK, remove direct clutch from forward clutch and proceed to forward clutch overhaul.

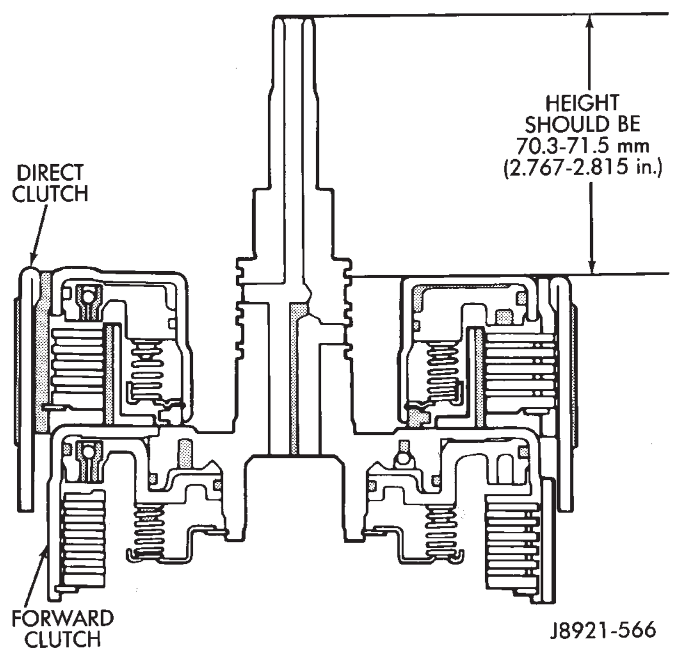


Fig. 14 Checking Direct Clutch Assembled Height

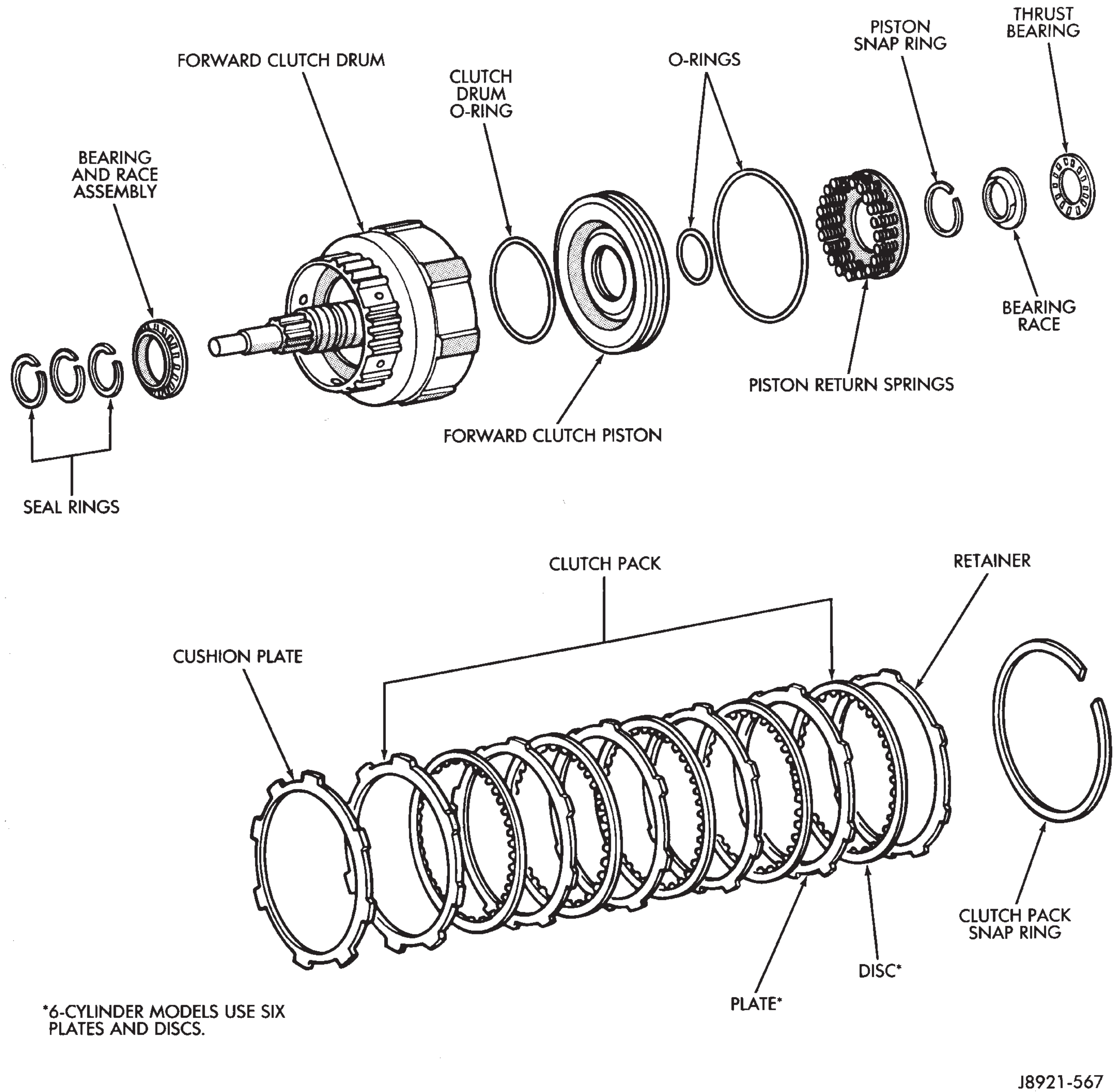


Fig. 1 Forward Clutch Components

FORWARD CLUTCH OVERHAUL

FORWARD CLUTCH DISASSEMBLY

(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.

(8) Remove clutch pack snap ring and remove retainer and clutch pack (Fig. 4).

(9) Remove clutch pack cushion plate (Fig. 5).

(10) Compress clutch springs with Tool 7538 and remove piston snap ring.

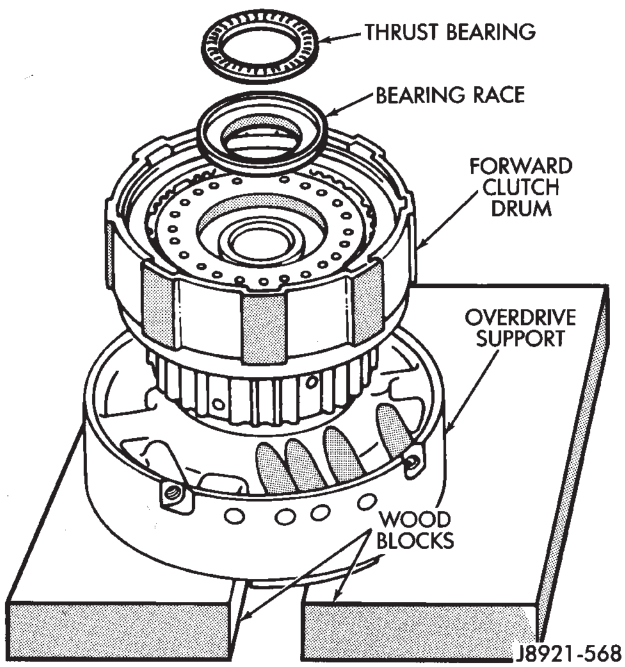


Fig. 2 Positioning Drum And Support On Wood Blocks

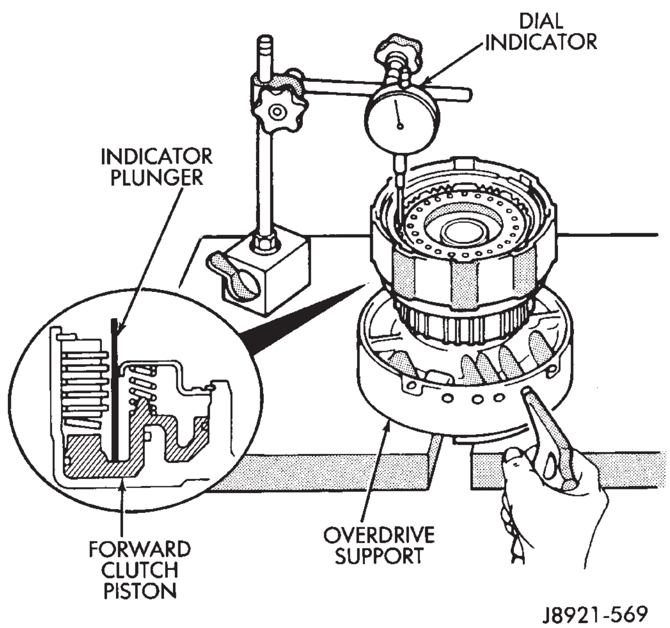


Fig. 3 Checking Forward Clutch Piston Stroke Length

(11) Remove spring compressor tool and piston return springs.

(12) Remount forward clutch drum on overdrive support (Fig. 6).

(13) Remove forward clutch piston. Apply compressed air through feed hole in support to remove piston (Fig. 6). Use only enough air pressure to ease piston out of drum.

(14) Remove and discard clutch piston O-rings.

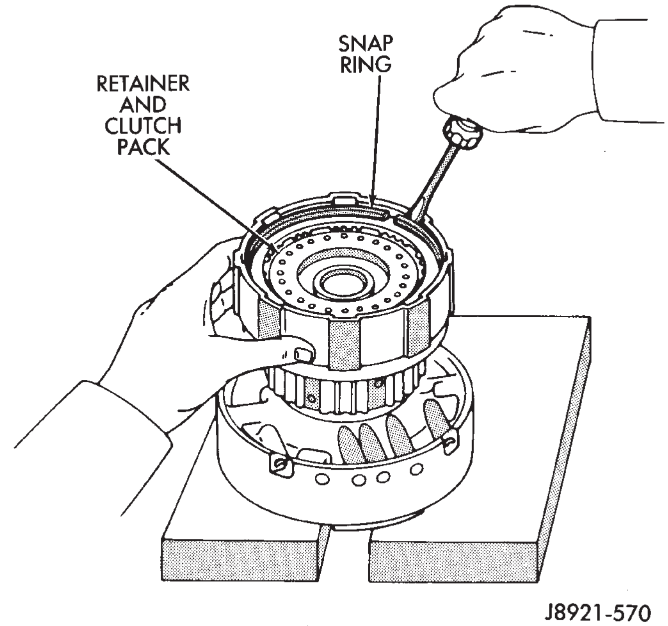


Fig. 4 Removing Retainer And Clutch Pack

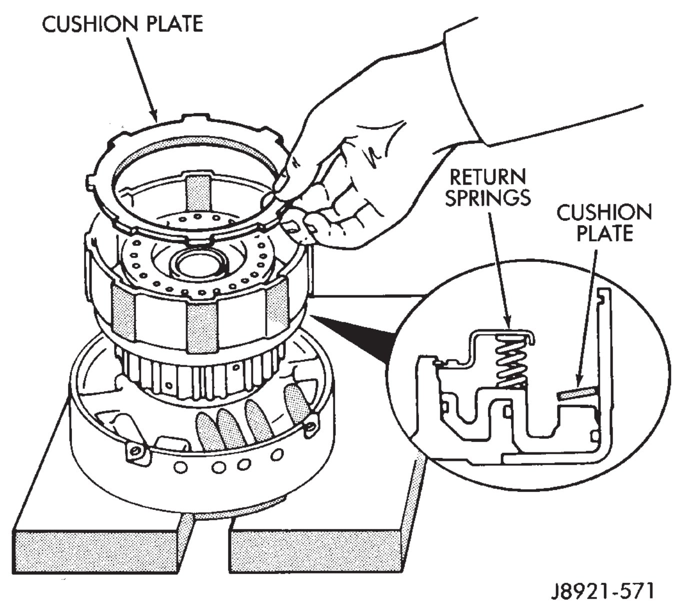


Fig. 5 Removing Cushion Plate

(15) Remove clutch drum O-ring from rear hub of drum.

(16) Remove three seal rings from clutch drum shaft (Fig. 8).

(17) Remove thrust bearing and race assembly from clutch drum (Fig. 9).

(18) Measure clutch disc thickness (Fig. 10). Minimum allowable thickness is 1.51 mm (0.0595 in.).

(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.

(20) Inspect clutch piston check ball (Fig. 12). Ball should move freely within piston. Check ball seating

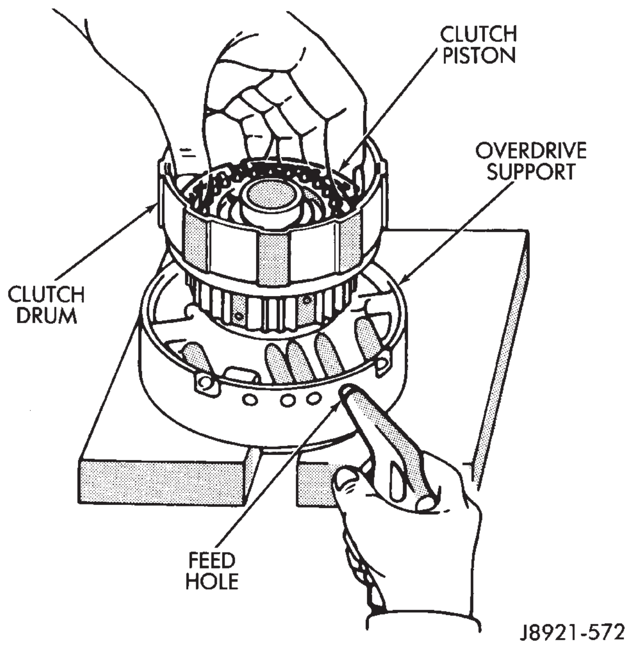


Fig. 6 Removing Forward Clutch Piston

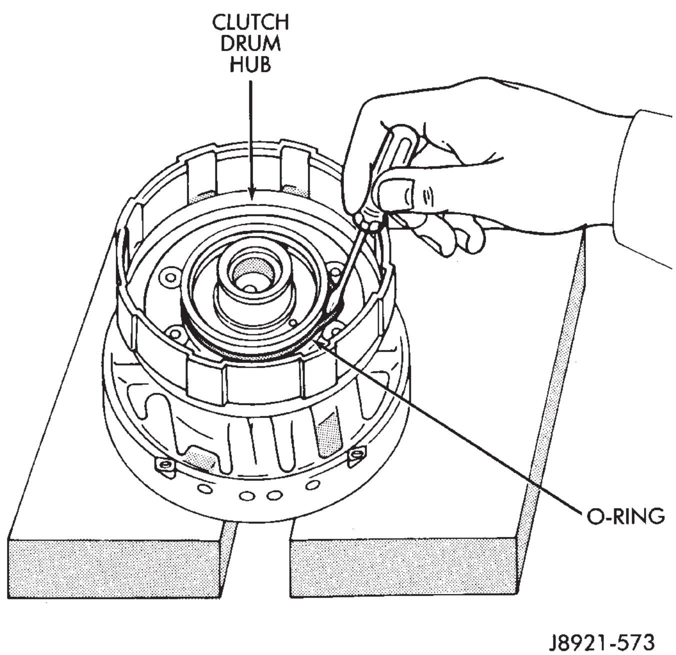


Fig. 7 Removing/Installing Clutch Drum O-Ring

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.

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)

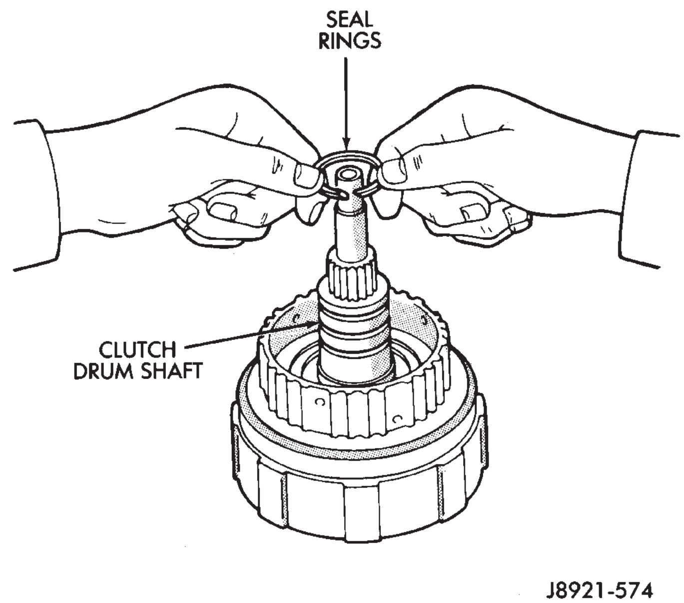


Fig. 8 Removing Clutch Drum Seal Rings

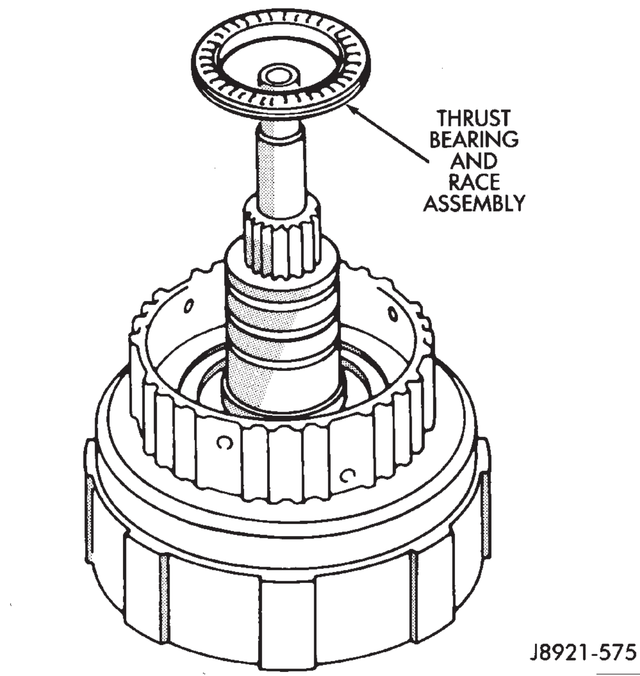


Fig. 9 Removing Clutch Drum Thrust Bearing Assembly

(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.

(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.

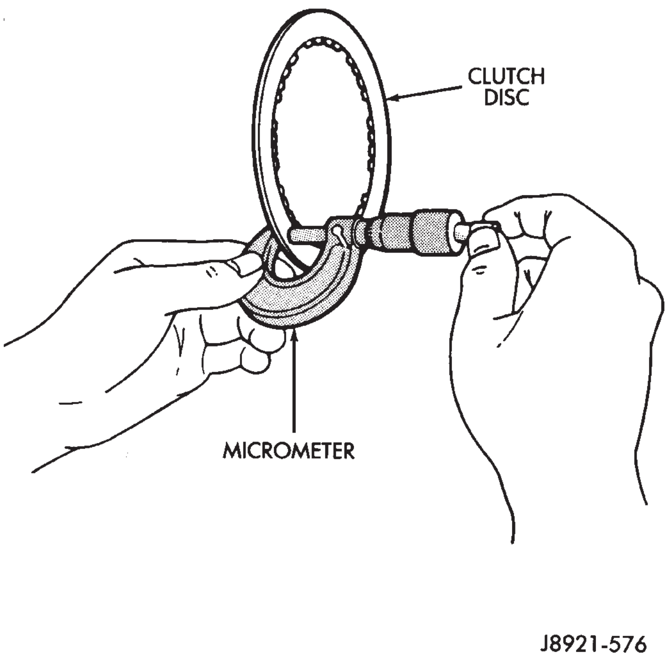


Fig. 10 Measuring Clutch Disc Thickness

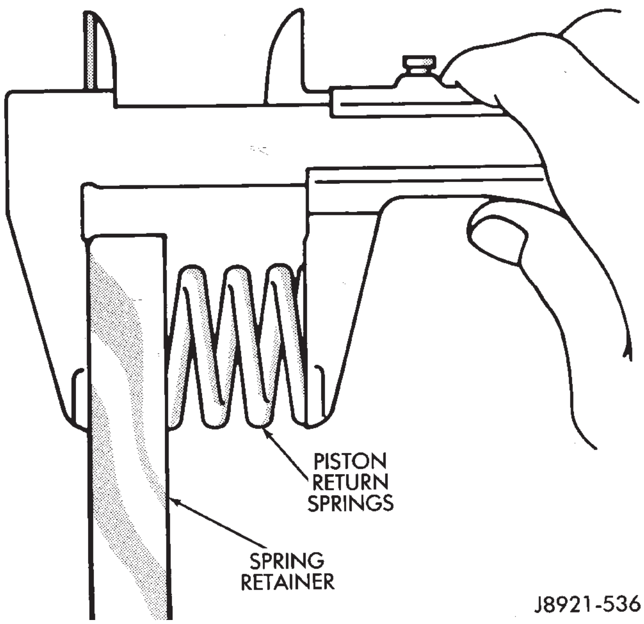


Fig. 11 Checking Return Spring Length

(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.

(11) Install clutch pack snap ring.

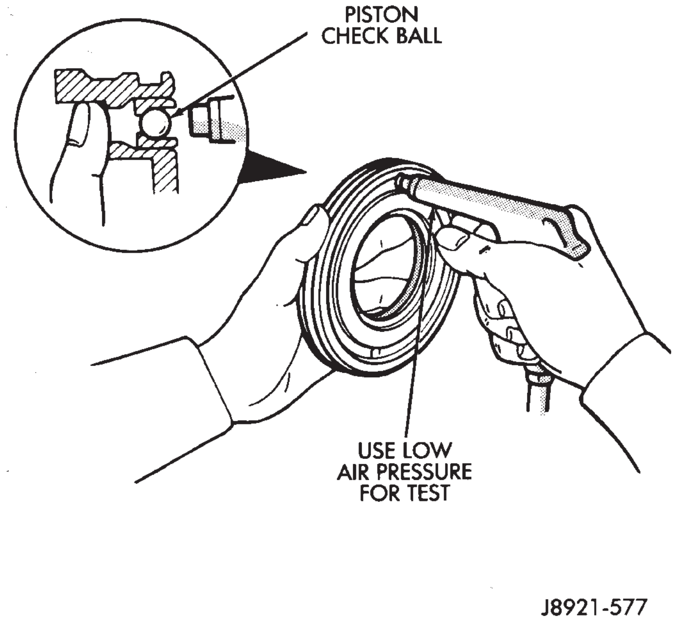


Fig. 12 Testing Piston Check Ball

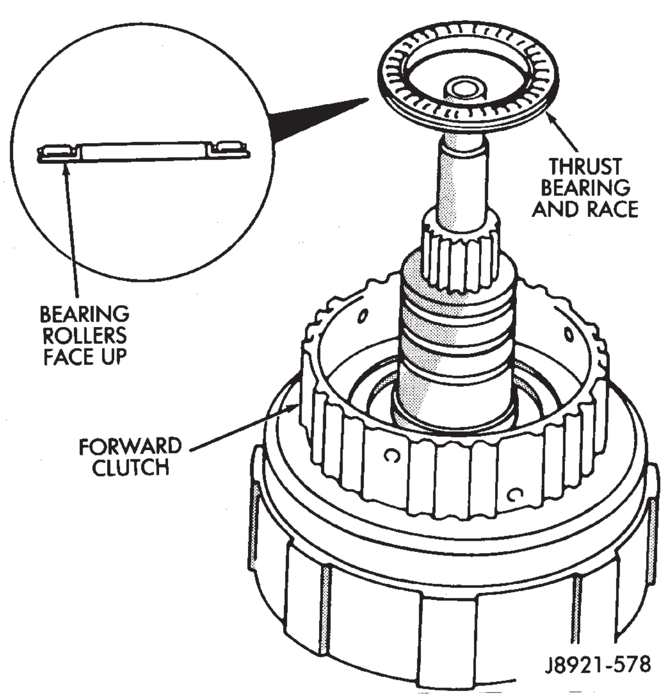


Fig. 13 Installing Thrust Bearing And Race

(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.).

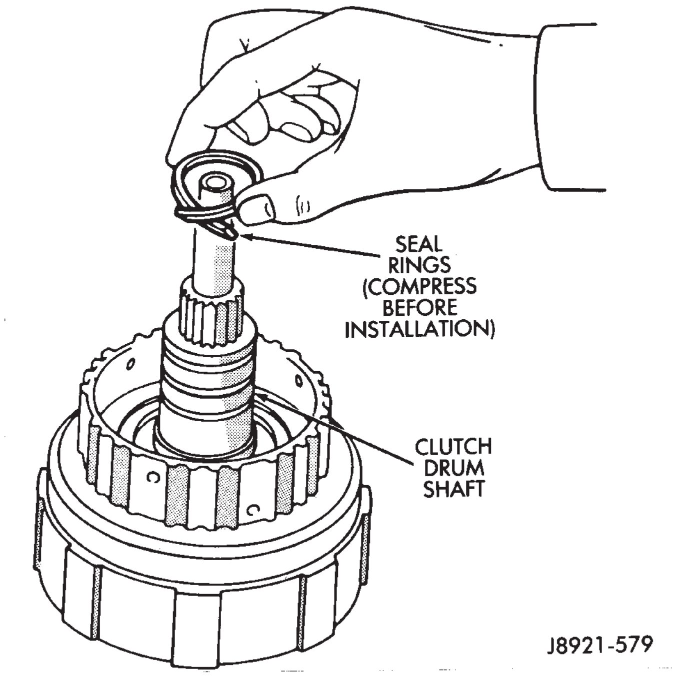


Fig. 14 Installing Clutch Drum Shaft Seal Rings

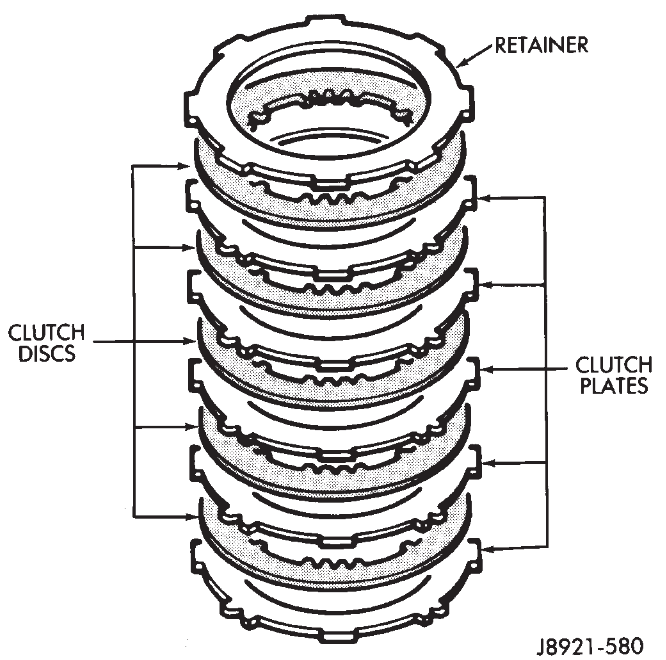


Fig. 15 Installing Forward Clutch Discs And Plates

• 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.).

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).

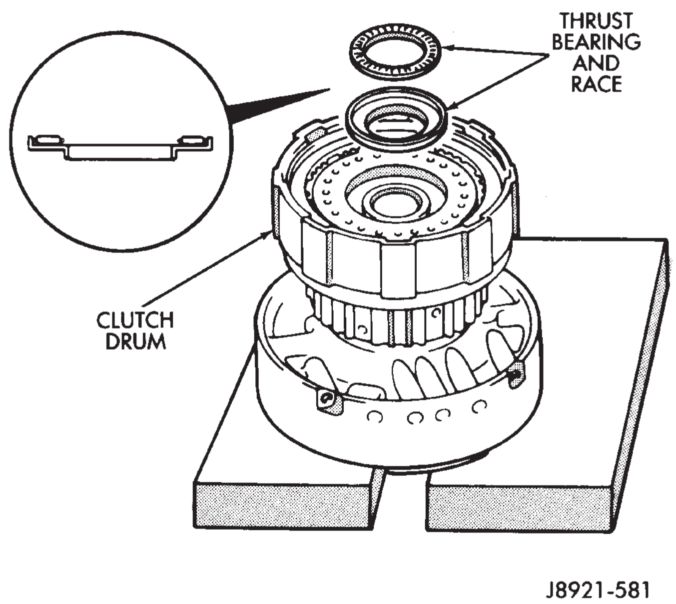


Fig. 16 Installing Thrust Bearing And Race

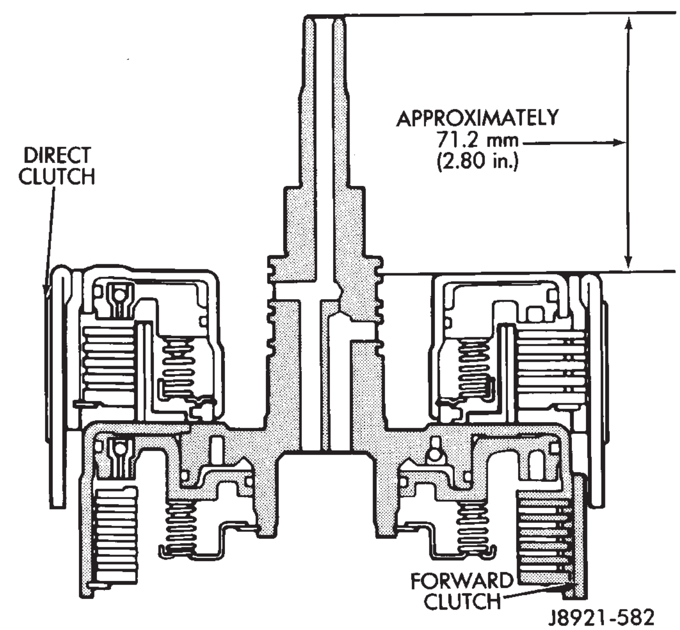


Fig. 17 Checking Forward Clutch Assembled Height

(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.

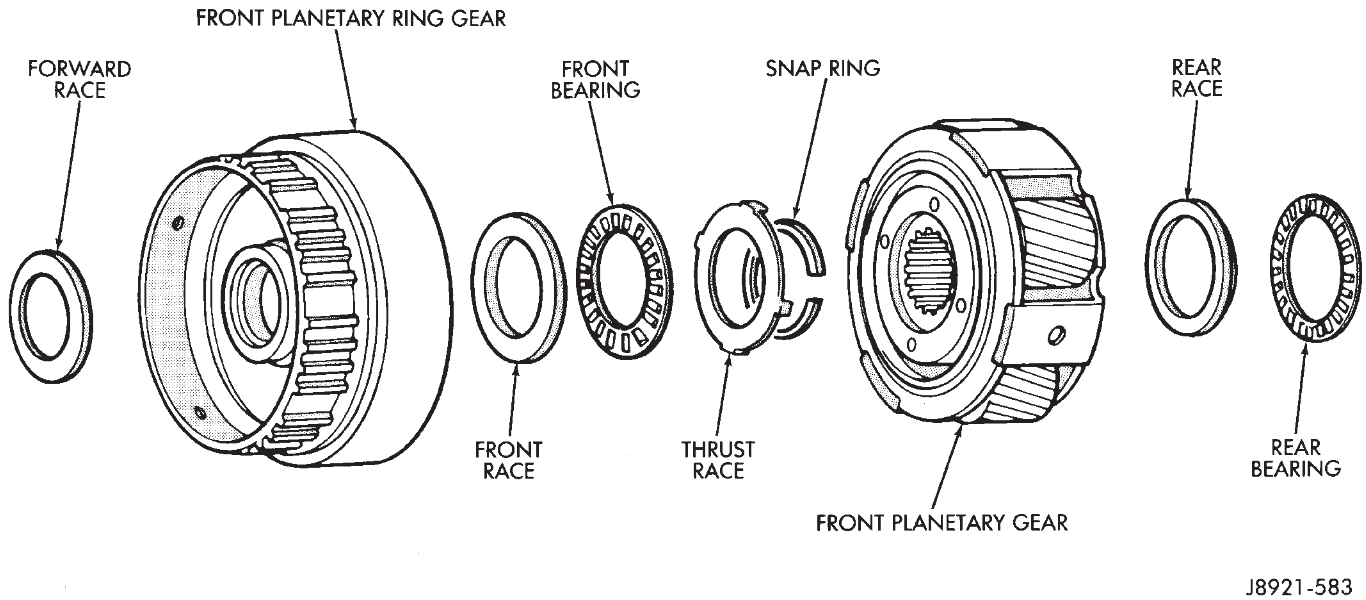


Fig. 1 Front Planetary Gear Components

(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.).

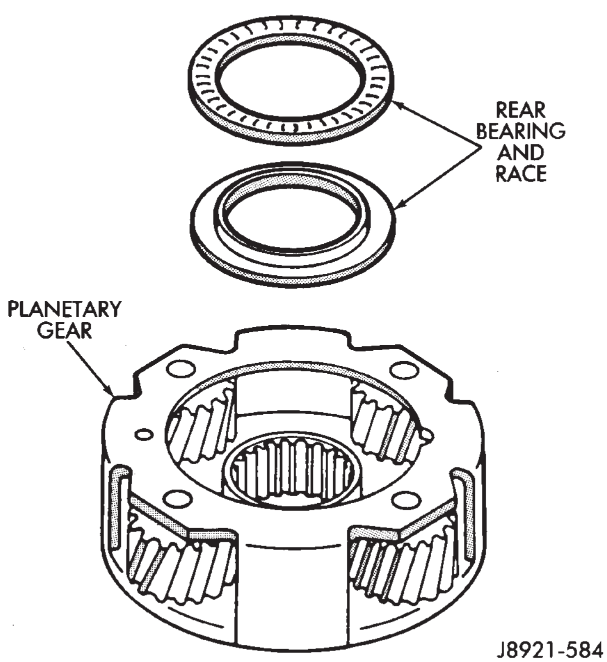


Fig. 2 Installing Front Planetary Rear Bearing and Race

• 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).

(4) Turn planetary over and install race thrust race (Fig. 3).

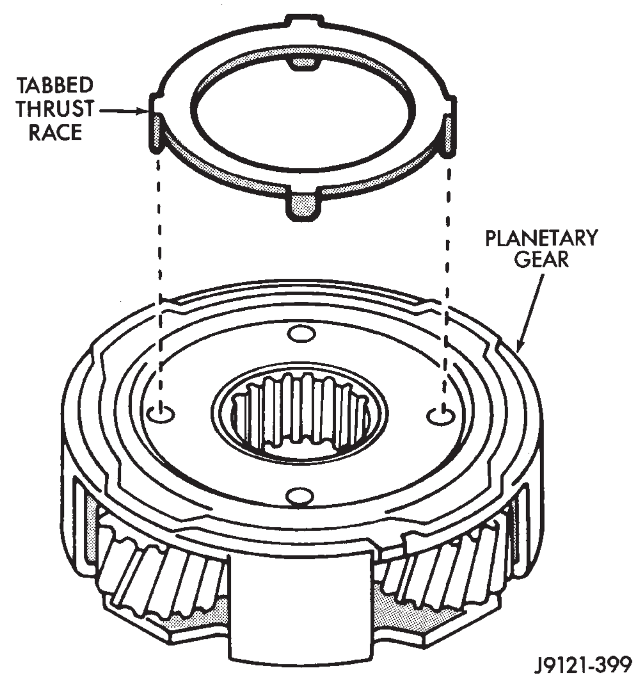


Fig. 3 Installing Front Planetary Thrust Race

(5) Install front race and bearing and forward race in ring gear (Fig. 4).

(6) Set planetary gear assembly aside for final assembly.

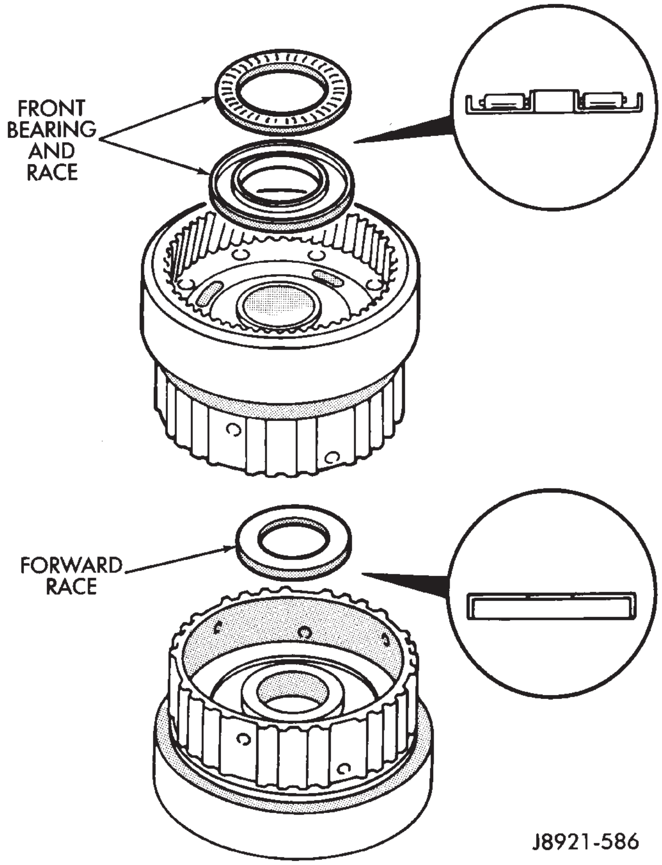


Fig. 4 Installing Front Planetary Front Bearing And Races

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.

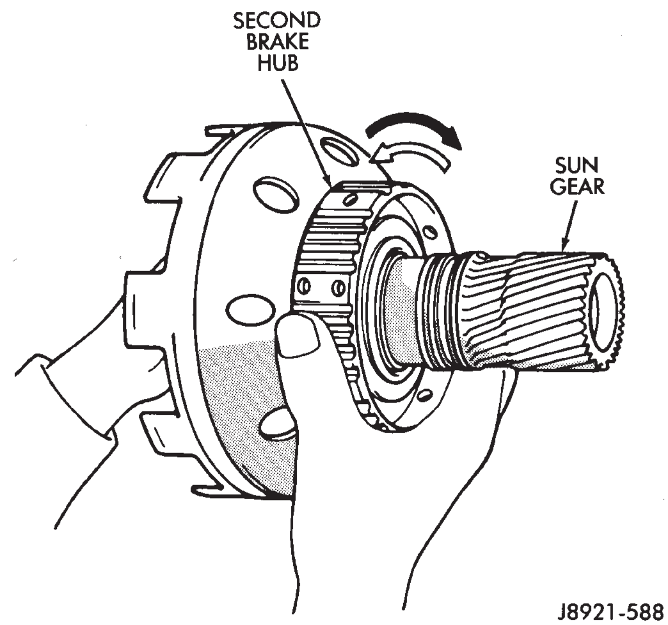


Fig. 2 Checking One-Way Clutch Operation

(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).

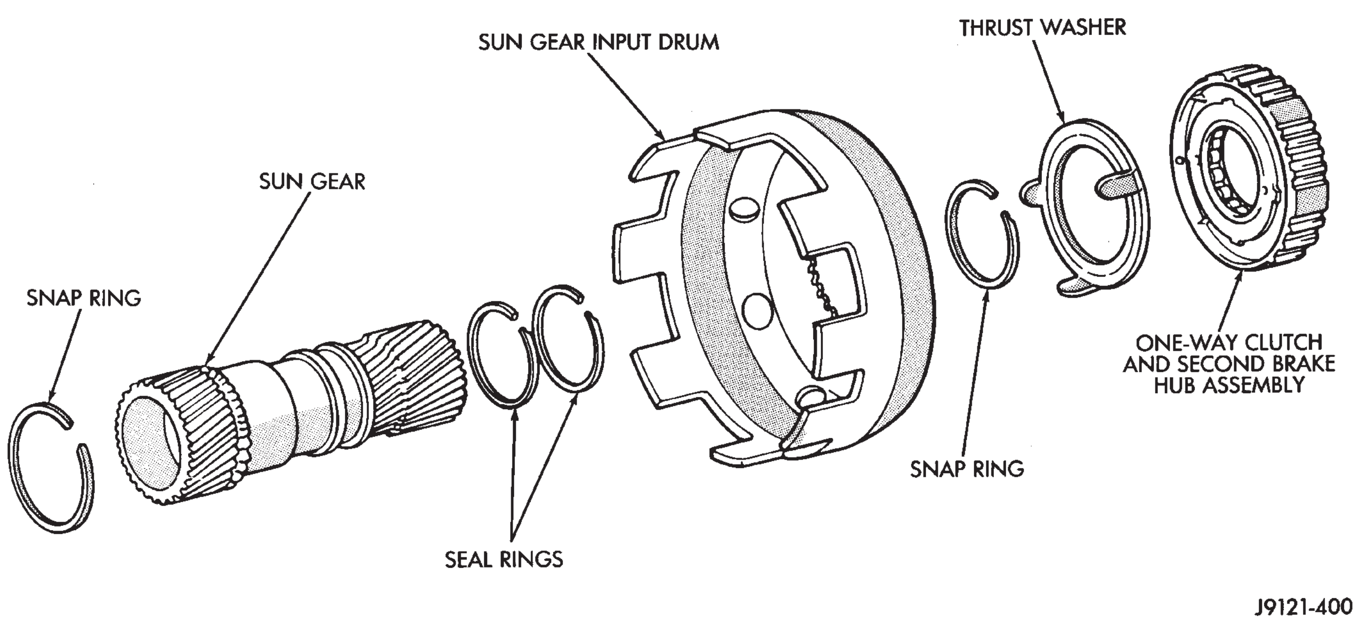


Fig. 1 Sun Gear And One-Way Clutch Components

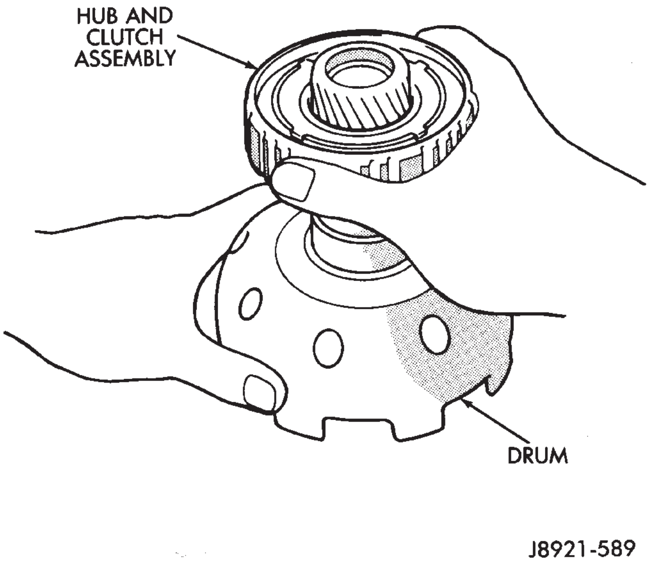


Fig. 3 Removing/Installing Brake Hub And Clutch Assembly

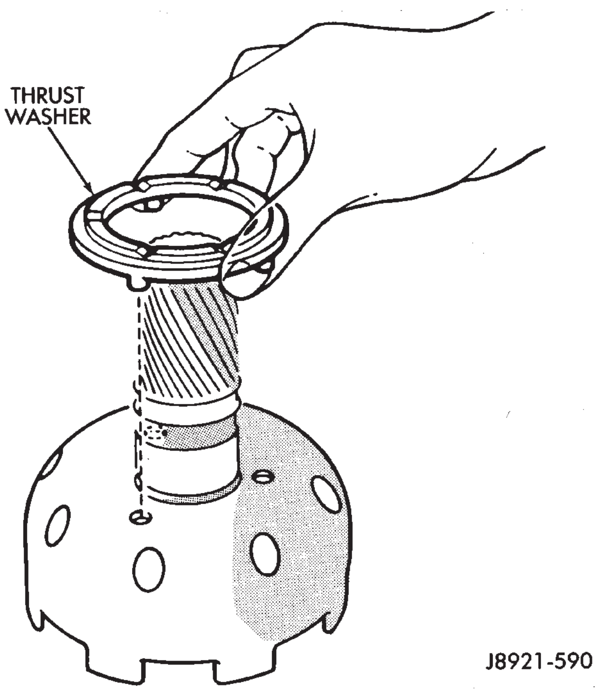


Fig. 4 Removing/Installing Thrust Washer

(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.

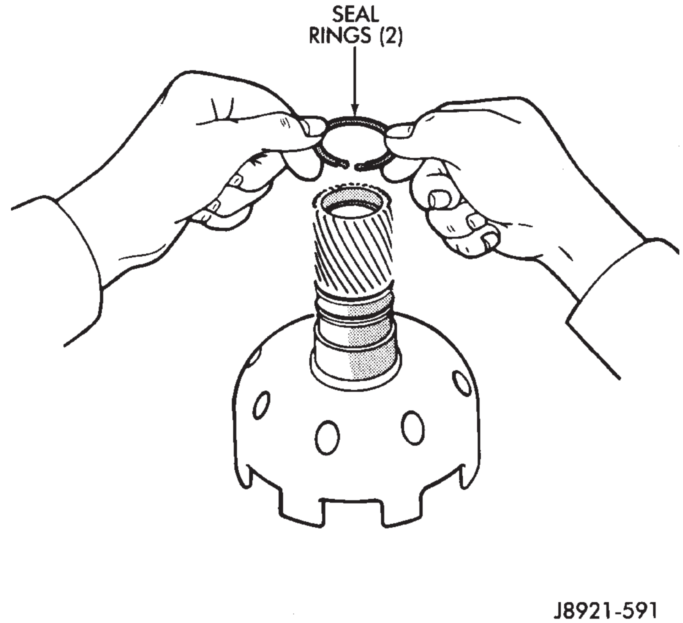


Fig. 5 Removing/Installing Sun Gear Seal Rings

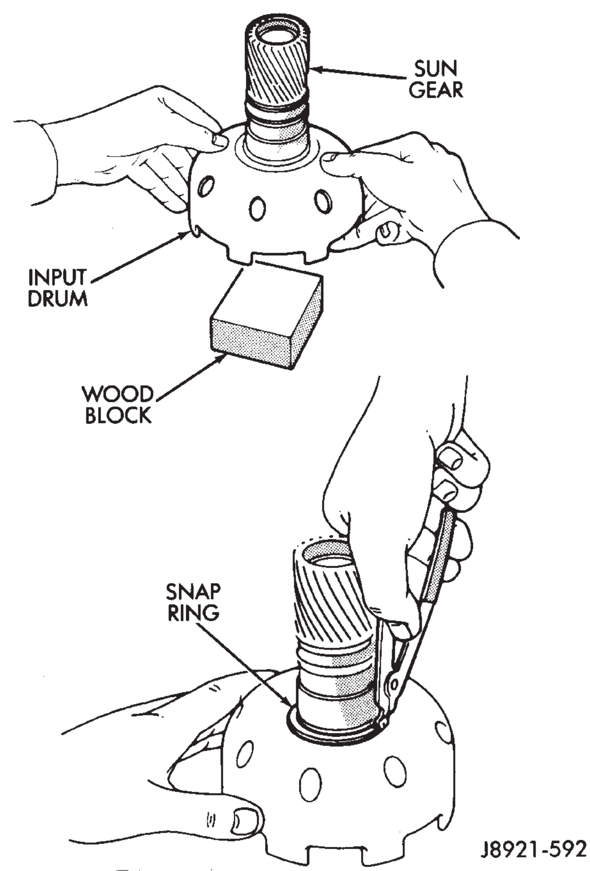


Fig. 6 Removing/Installing Sun Gear

(2) Install sun gear in drum and install remaining snap ring.

(3) Coat replacement seal rings with petroleum jelly and install them on sun gear. **Be sure seal ring ends are interlocked.**

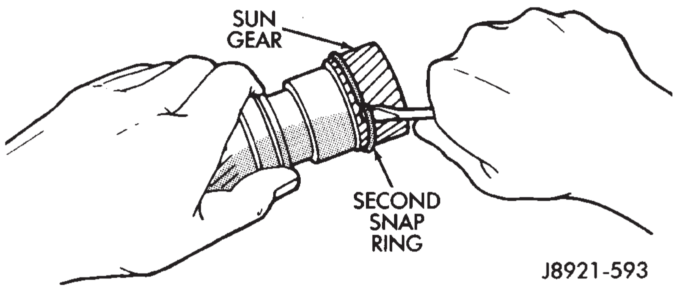


Fig. 7 Removing/Installing Second Snap Ring

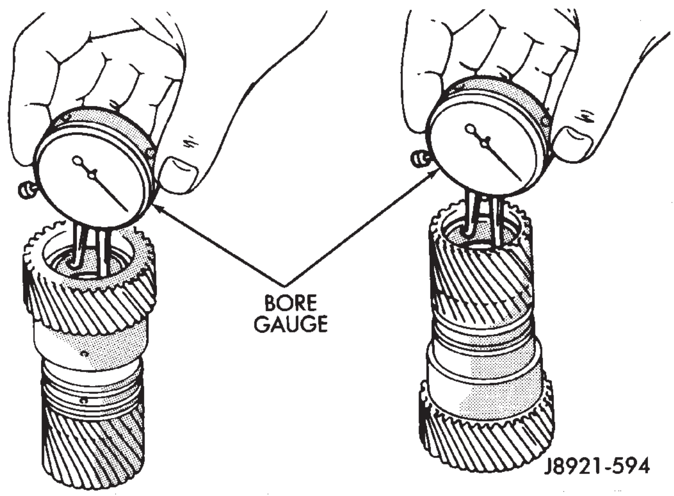


Fig. 8 Checking Sun Gear Bushings

(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).

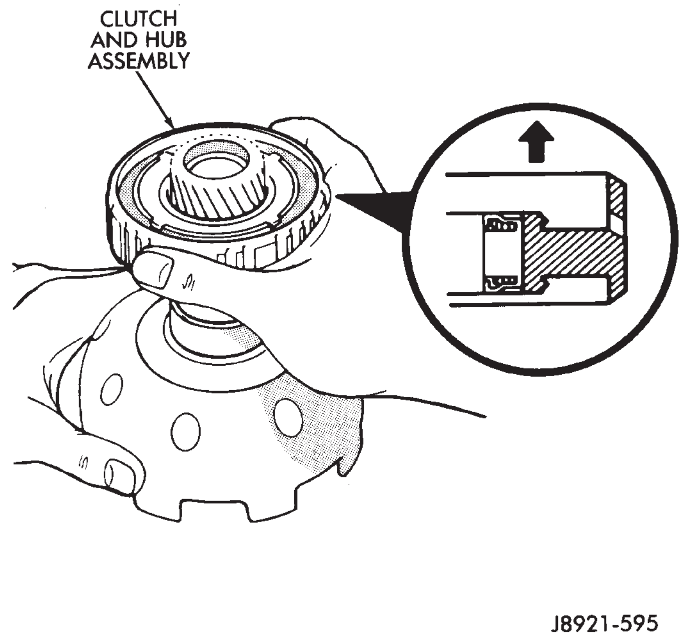


Fig. 9 Installing Clutch And Hub Assembly On Sun Gear

(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.

(7) Set sun gear/clutch assembly aside for final assembly.

SECOND BRAKE OVERHAUL

BRAKE DISASSEMBLY

(1) Remove second brake drum from output shaft (Fig. 2).

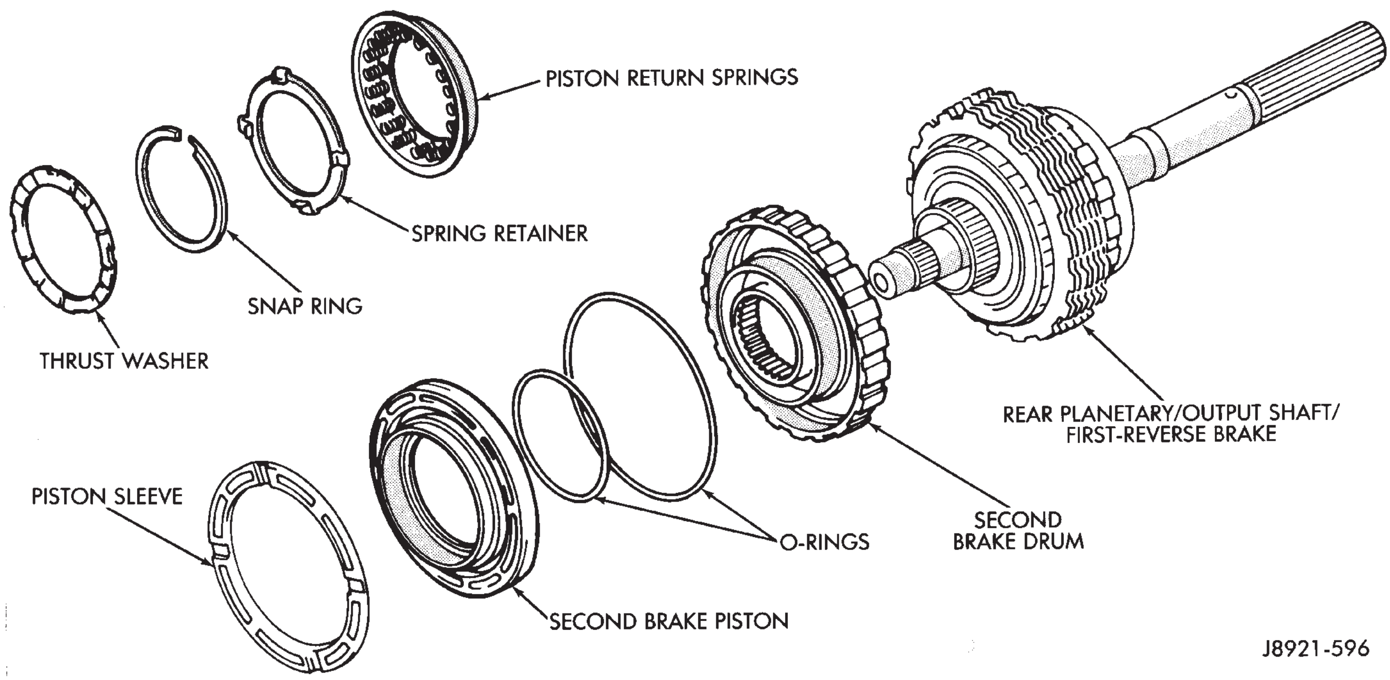


Fig. 1 Second Brake Components

(2) Set output shaft assembly aside for overhaul. Refer to Rear Planetary Gear and Output Shaft Overhaul procedures.

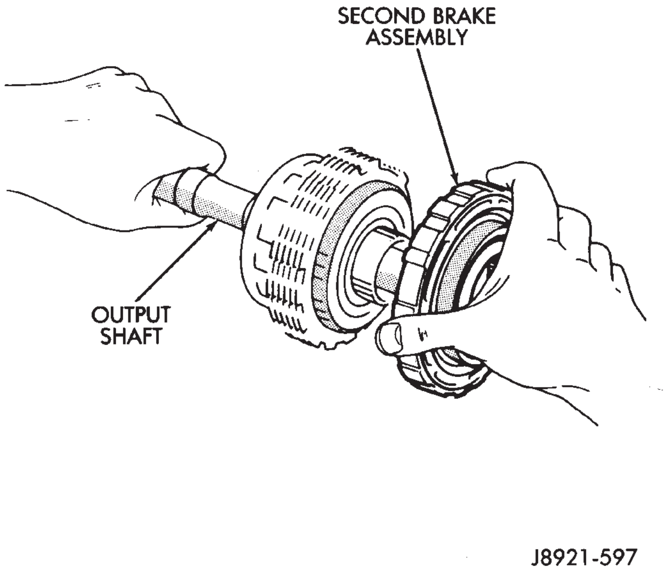


Fig. 2 Removing/Installing Second Brake Assembly

(3) Remove thrust washer from second brake drum (Fig. 3).

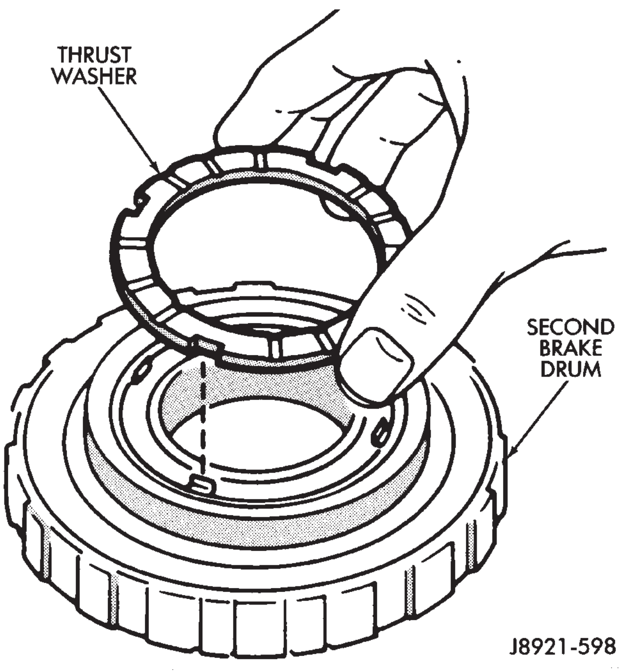


Fig. 3 Removing/Installing Second Brake Drum Thrust Washer

(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.

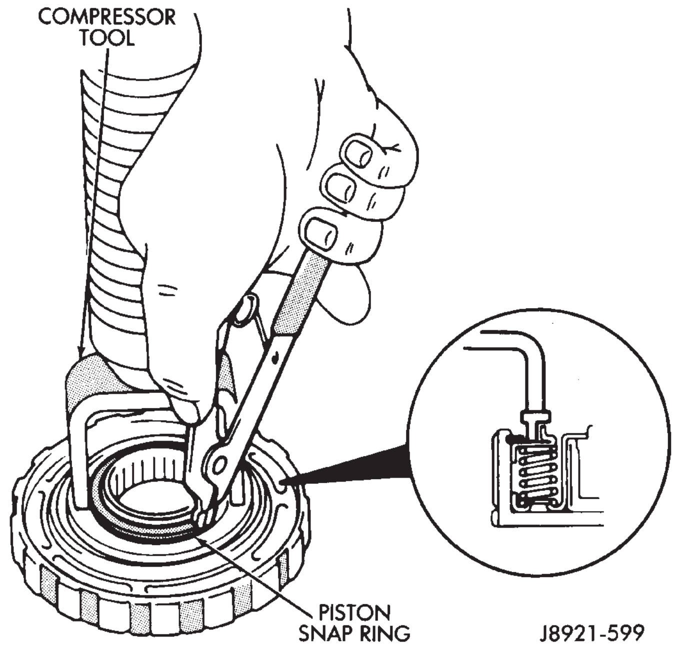


Fig. 4 Removing/Installing Second Brake Piston Snap Ring

(7) Remove and discard brake piston O-rings.

(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.

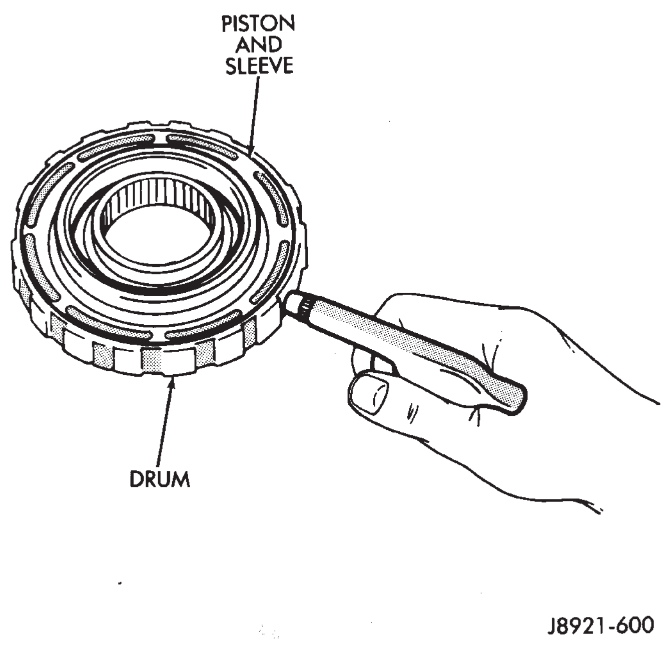


Fig. 5 Removing/Installing Piston And Sleeve

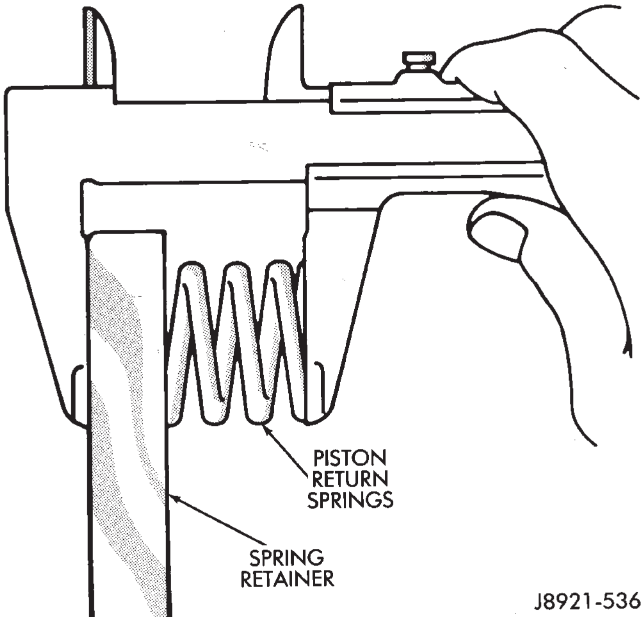


Fig. 6 Measuring Second Brake Piston Return Springs

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.

(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 and releasing air pressure.

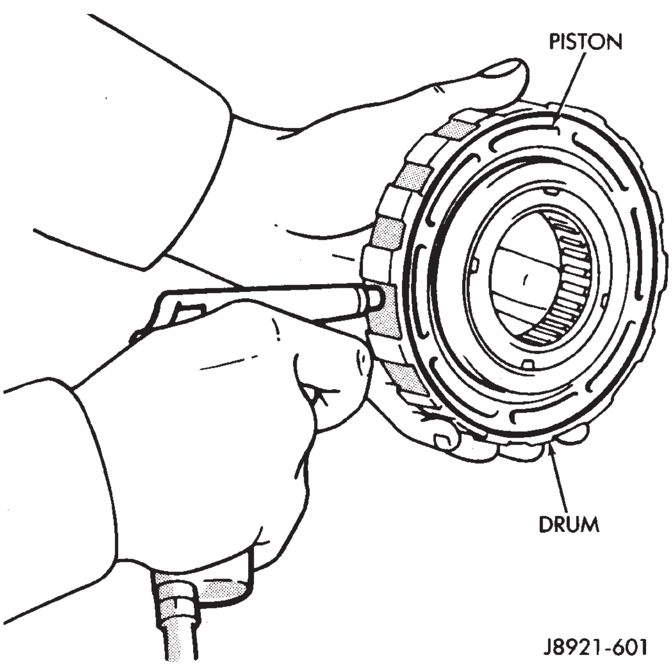


Fig. 7 Checking Second Brake Piston Operation

(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.

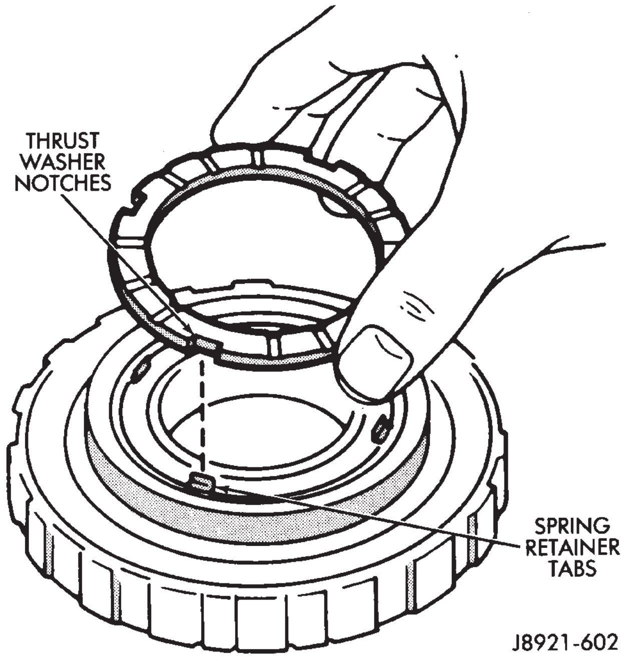


Fig. 8 Installing Second Brake Thrust Washer

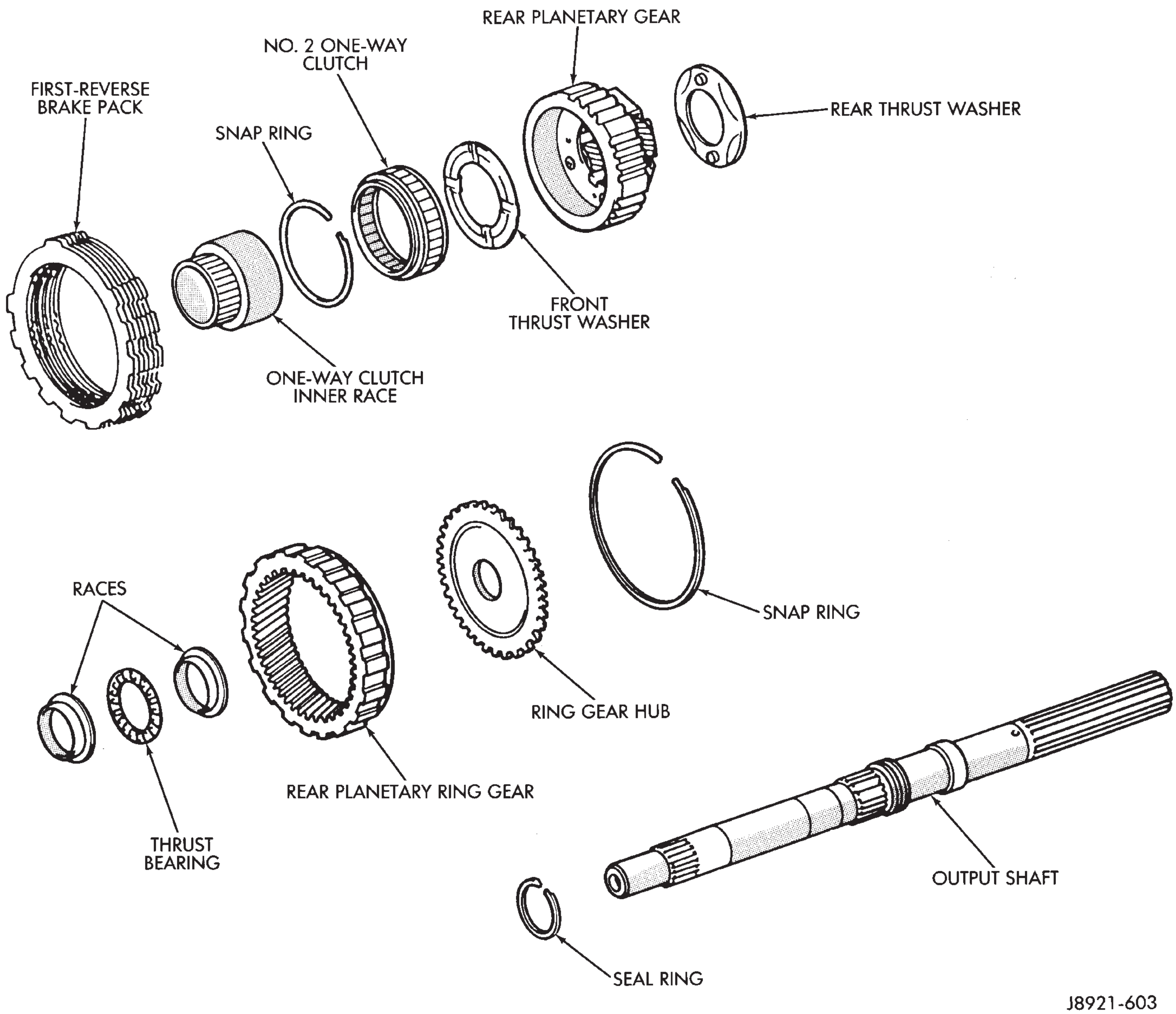


Fig. 1 Rear Planetary, Brake Pack, Clutch And Output Shaft Components

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. Race should turn freely counterclockwise, but lock when turned clockwise. Replace one-way clutch if necessary.

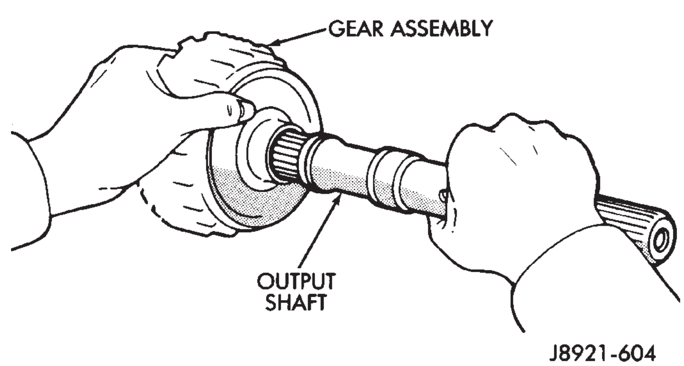


Fig. 2 Removing/Installing Output Shaft

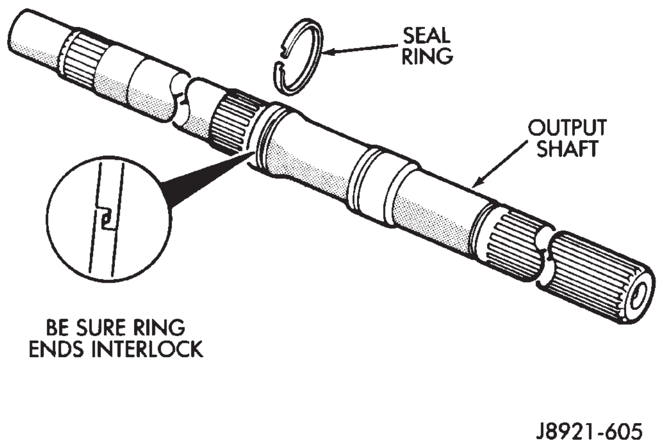


Fig. 3 Removing/Installing Shaft Seal Ring

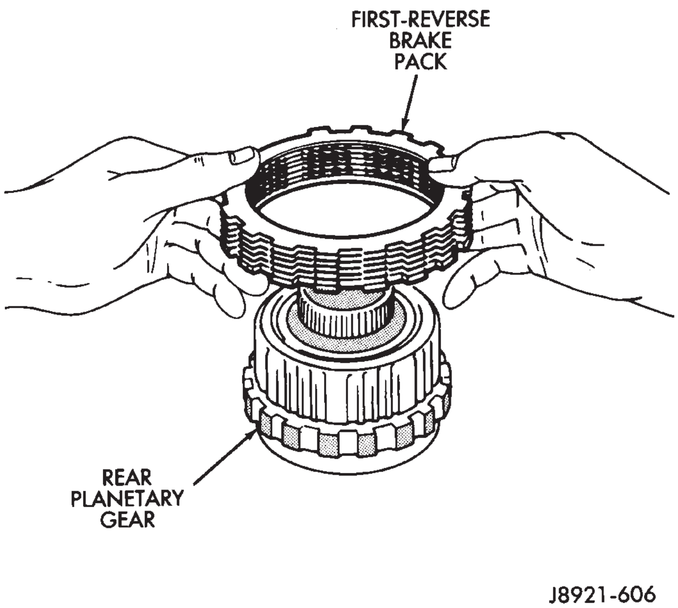


Fig. 4 Removing/Installing First-Reverse Brake Pack

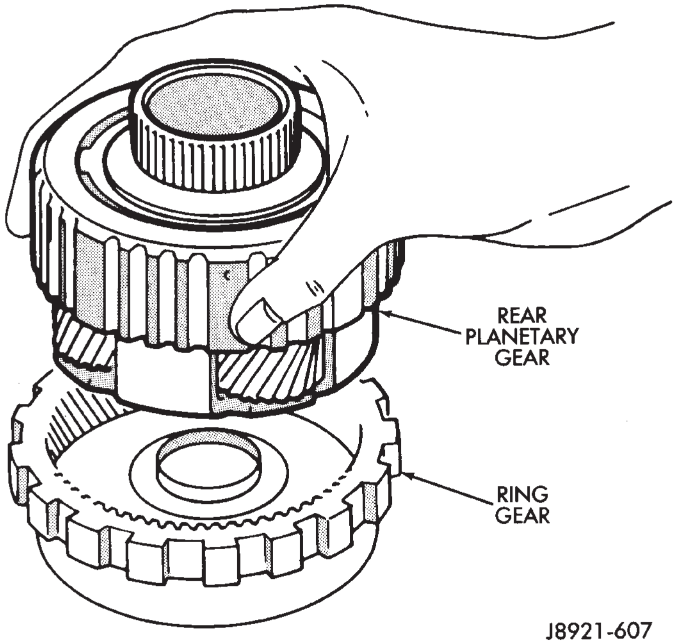


Fig. 5 Removing/Installing Rear Planetary

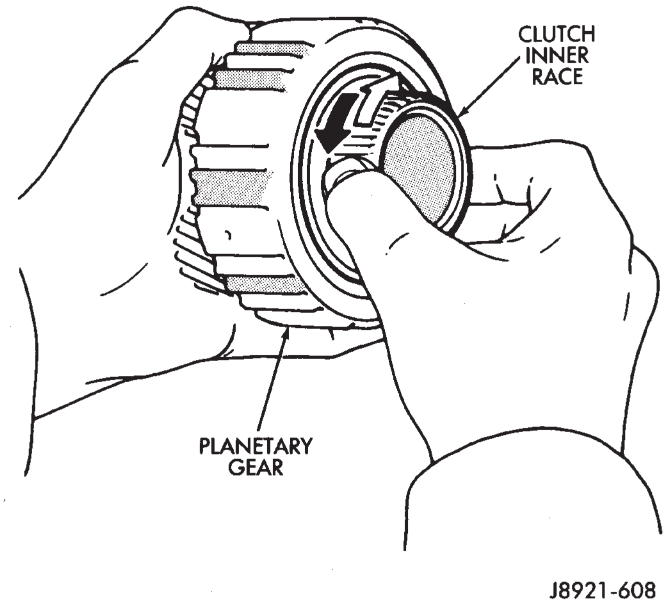


Fig. 6 Checking No. 2 One-Way Clutch Operation

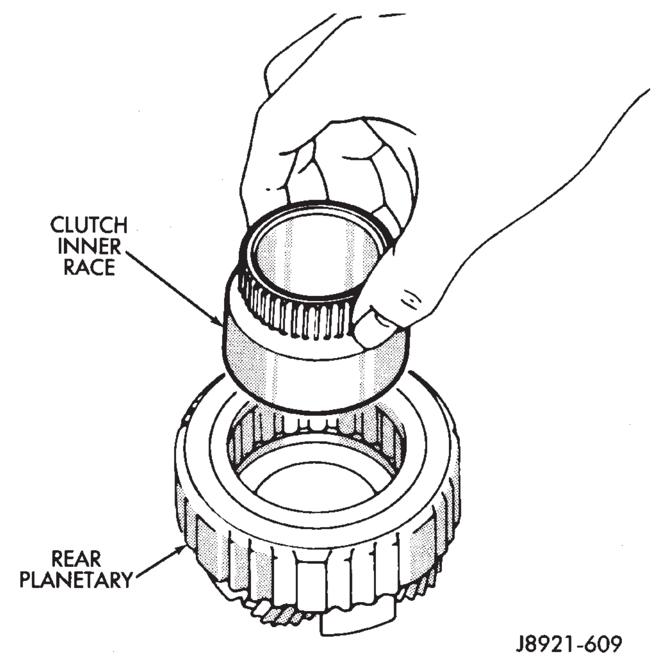


Fig. 7 Removing/Installing Clutch Inner Race

(7) Remove clutch inner race from planetary gear (Fig. 7).

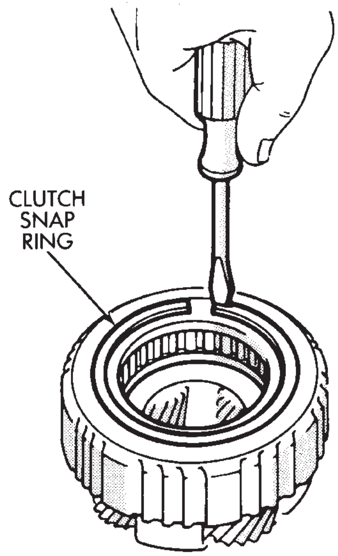
(8) Remove clutch snap ring and remove No. 2 one-way clutch from planetary (Fig. 8).

(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 worn or damaged planetary gear components.



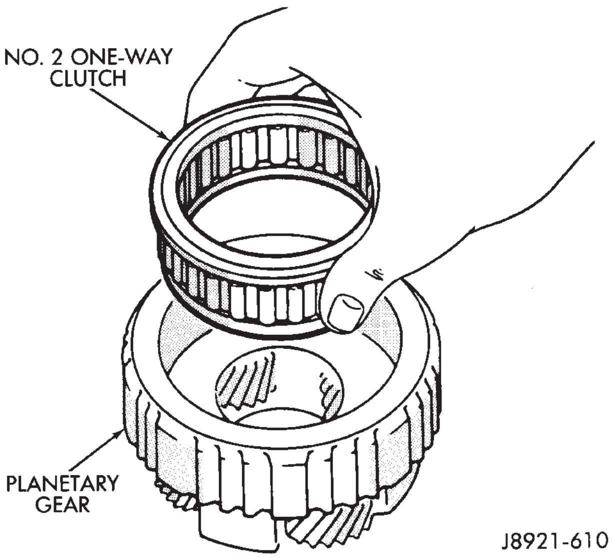


Fig. 8 Removing.Installing One-Way Clutch

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).

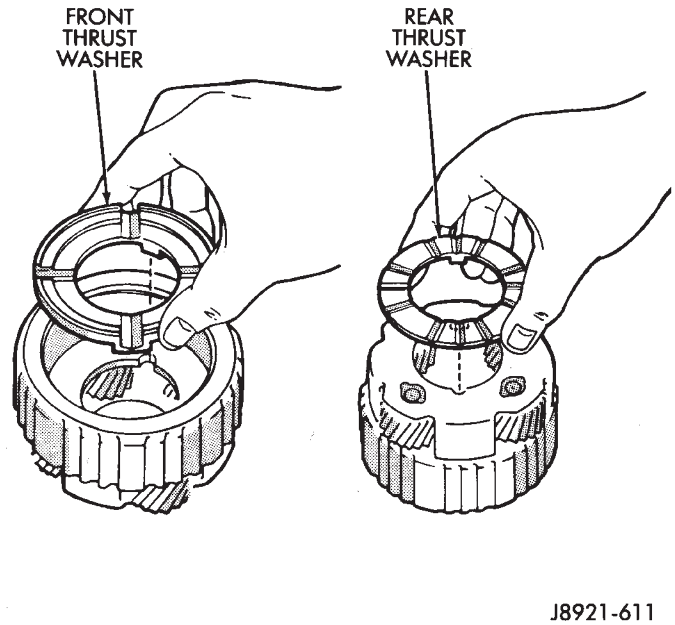


Fig. 9 Removing/Installing Rear Planetary Thrust Washers

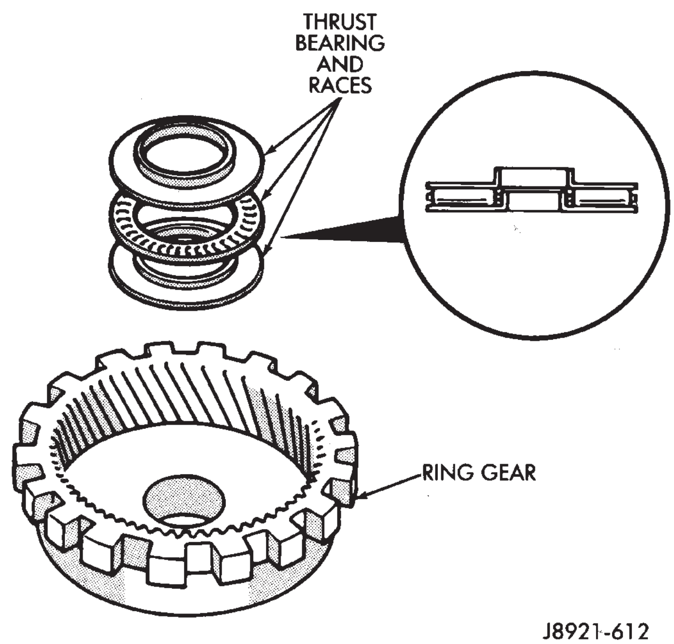


Fig. 10 Removing/Installing Ring Gear Thrust Bearing And Races

(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.

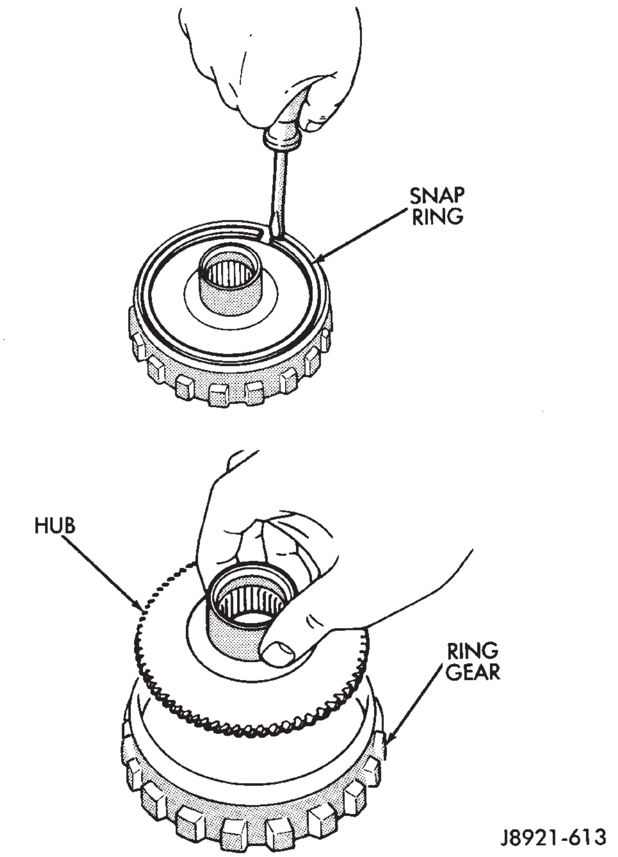


Fig. 11 Removing/Installing Ring Gear Hub

(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.

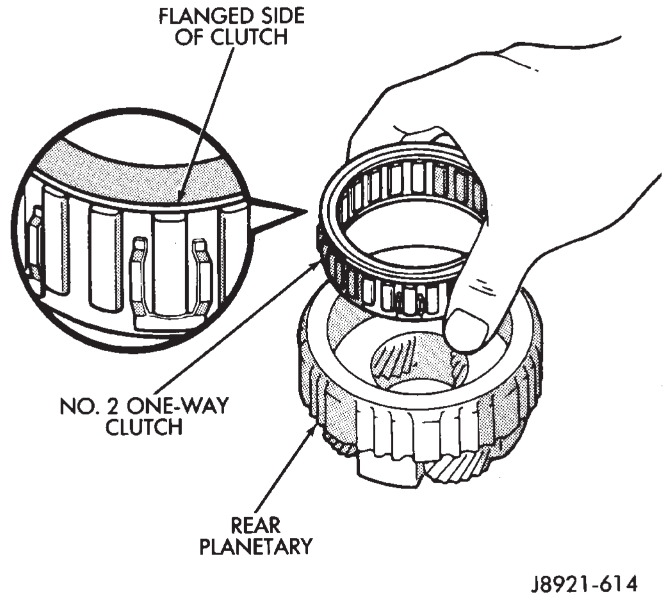


Fig. 12 Installing No. 2 One-Way Clutch

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

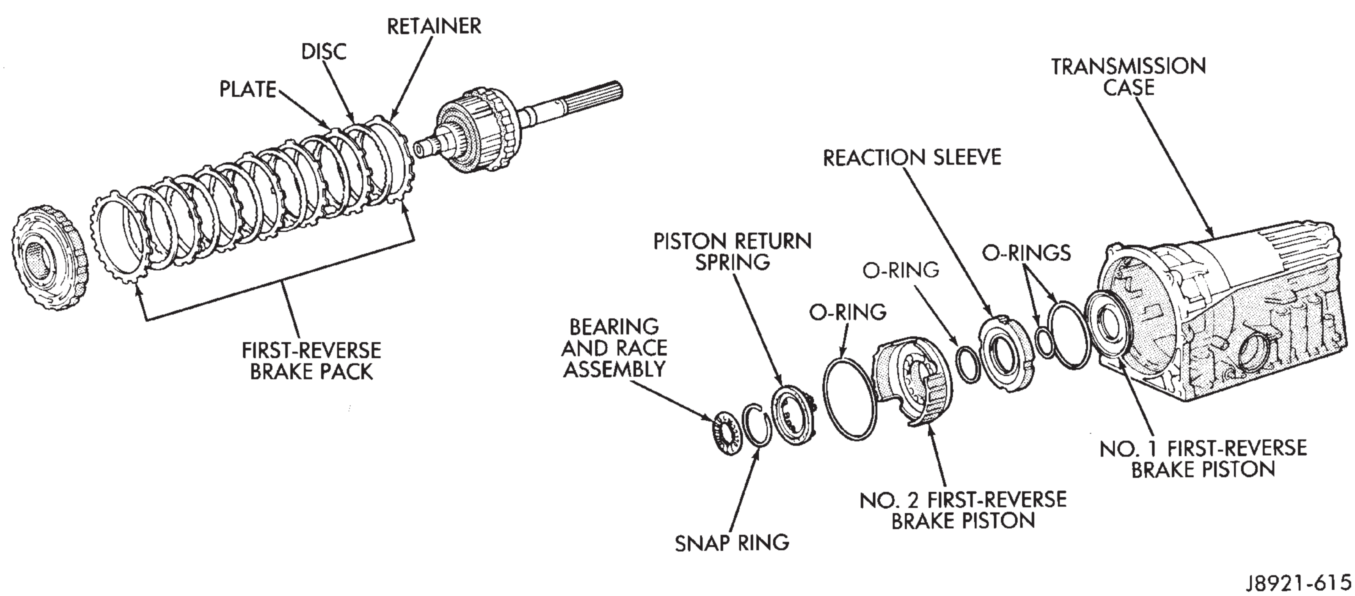


Fig. 1 First-Reverse Brake Pistons And Transmission Case

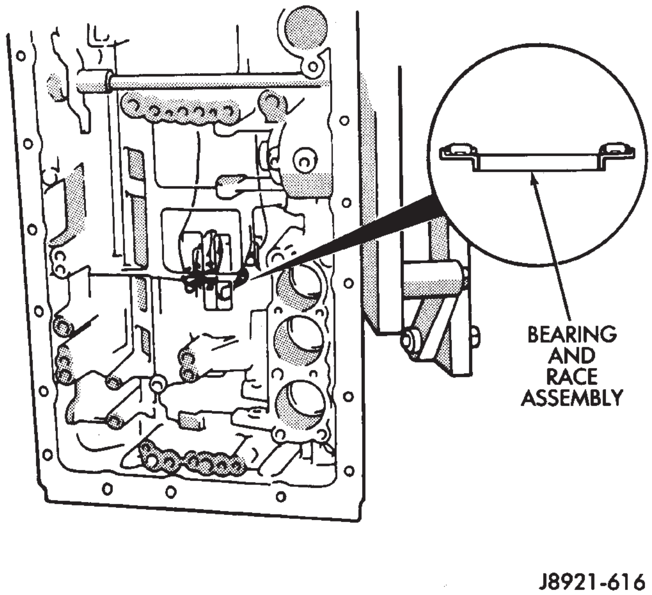


Fig. 2 Removing/Installing Bearing And Race Assembly

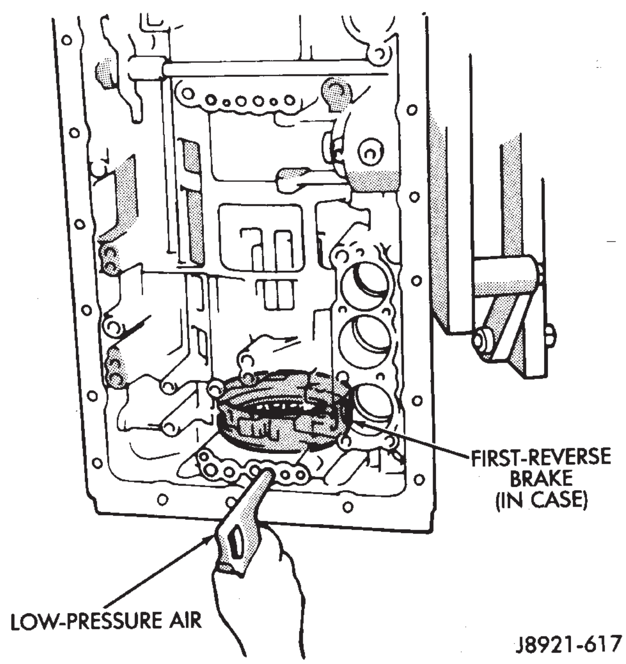


Fig. 3 Checking First-Reverse Brake Piston Operation

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 minimum of 18.382 mm (0.724 in.). Replace springs if length is less than this.

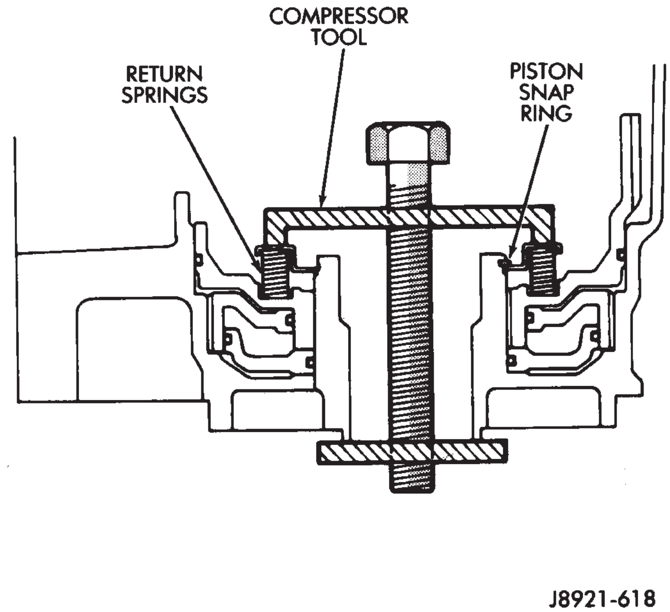


Fig. 4 Removing/Installing Piston Snap Ring

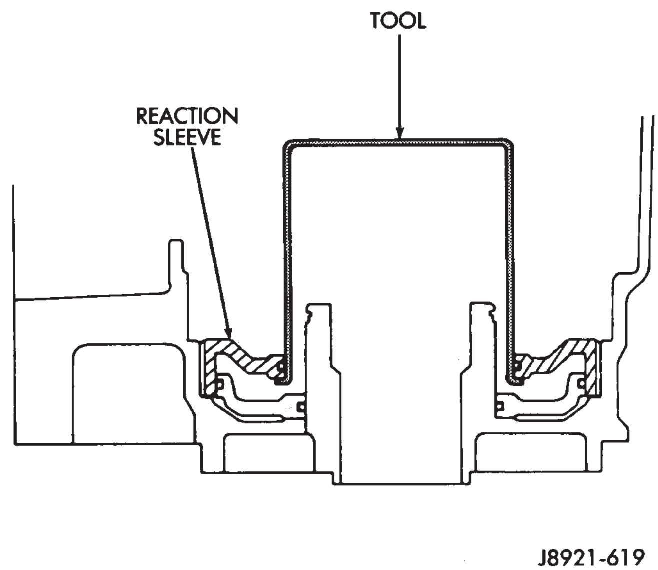


Fig. 5 Removing/Installing Reaction Sleeve

(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).

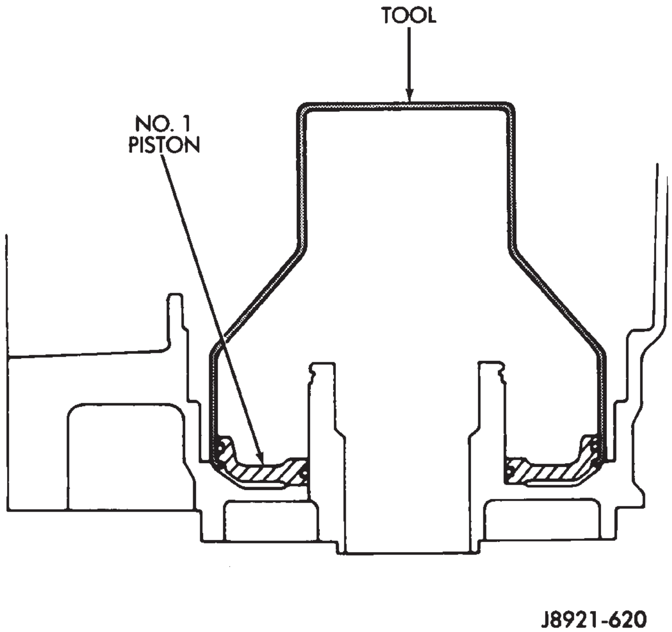


Fig. 6 Removing/Installing First-Reverse Brake No.1 Piston

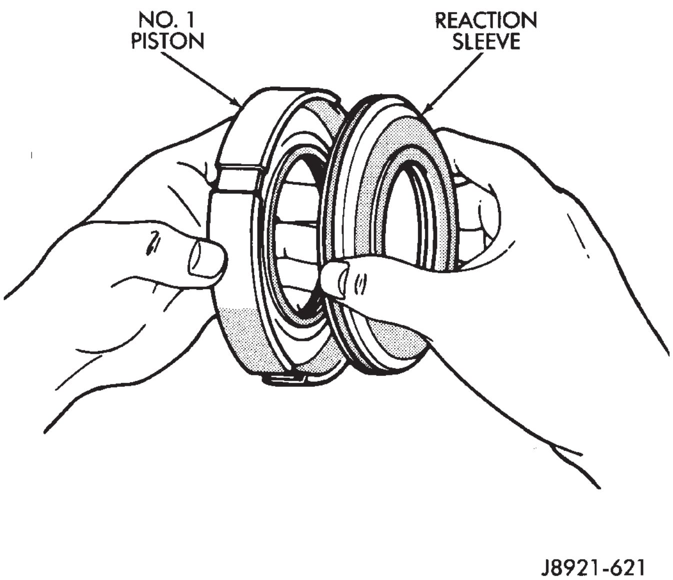


Fig. 7 Assembling No. 1 Piston And Sleeve

(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.).

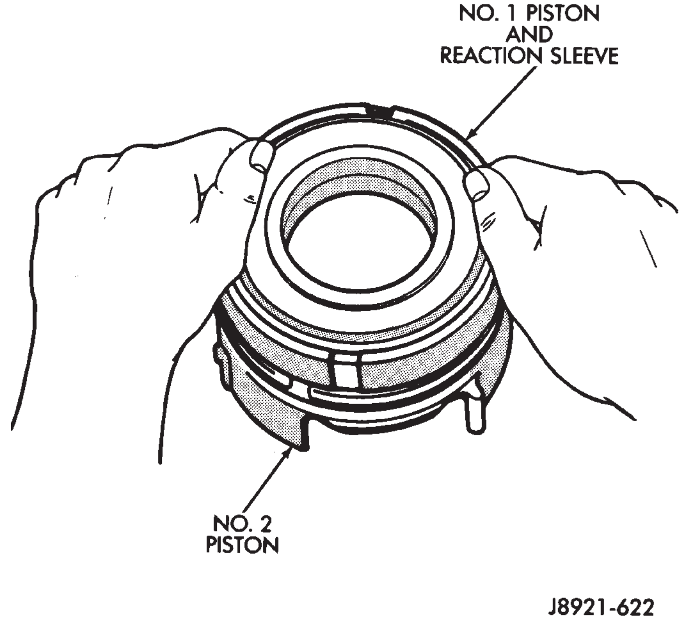


Fig. 8 Assembling First-Reverse Brake Pistons

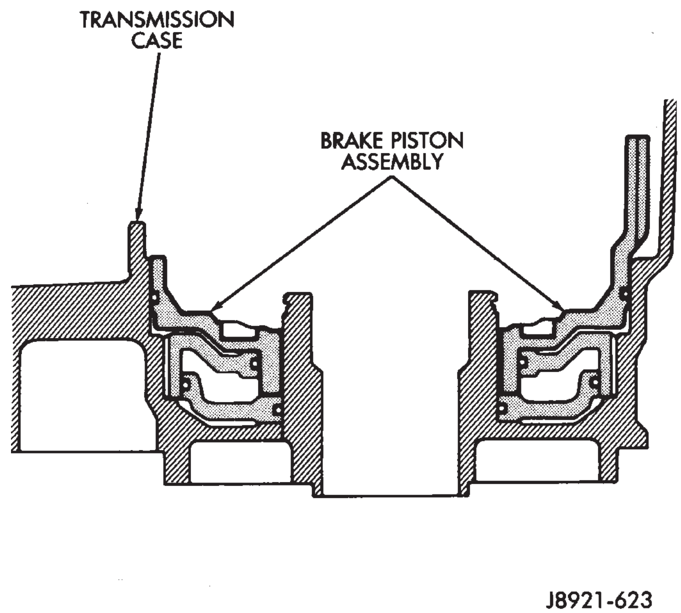


Fig. 9 Installing First-Reverse Brake Piston Assembly

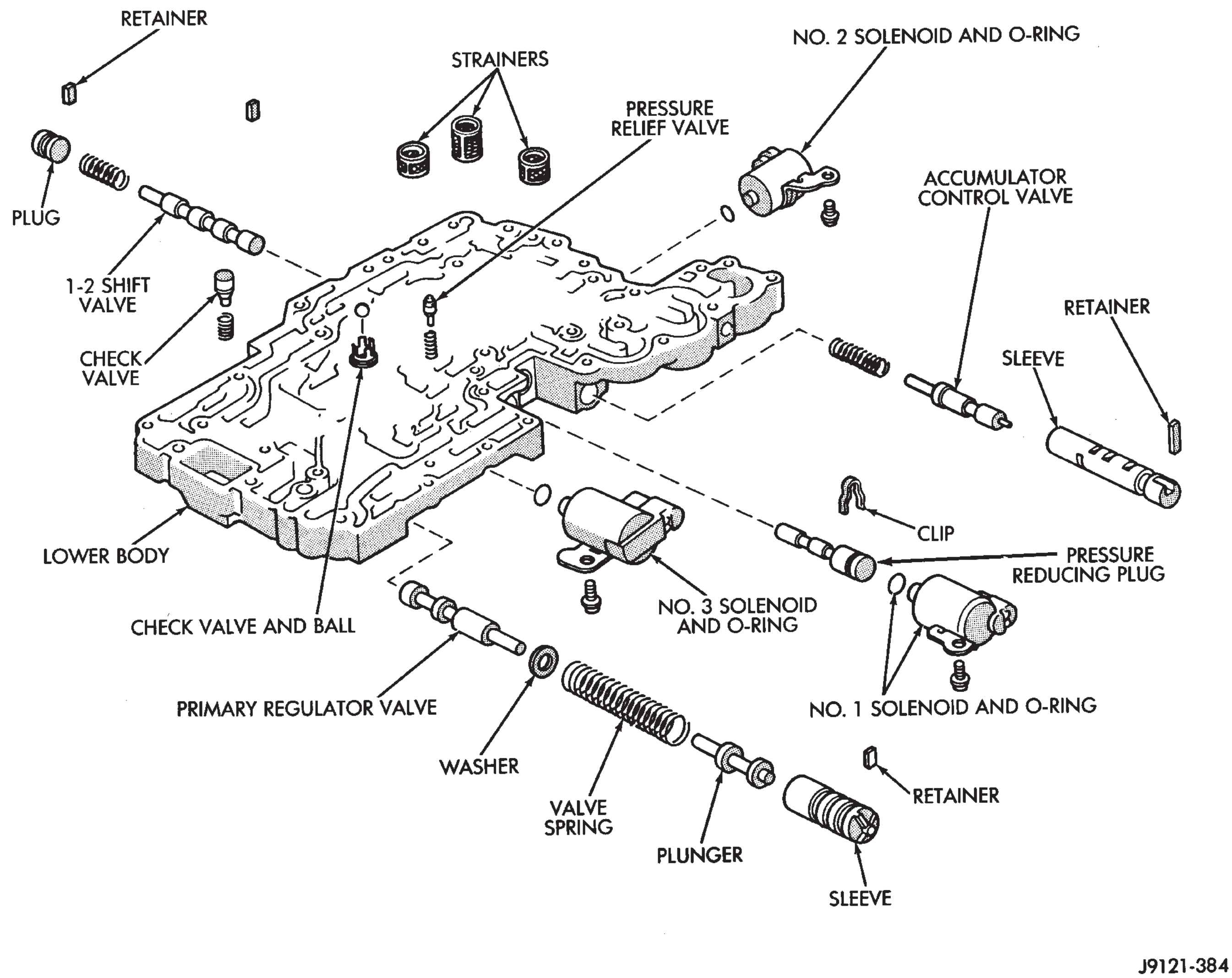


Fig. 1 Lower Body Components

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.

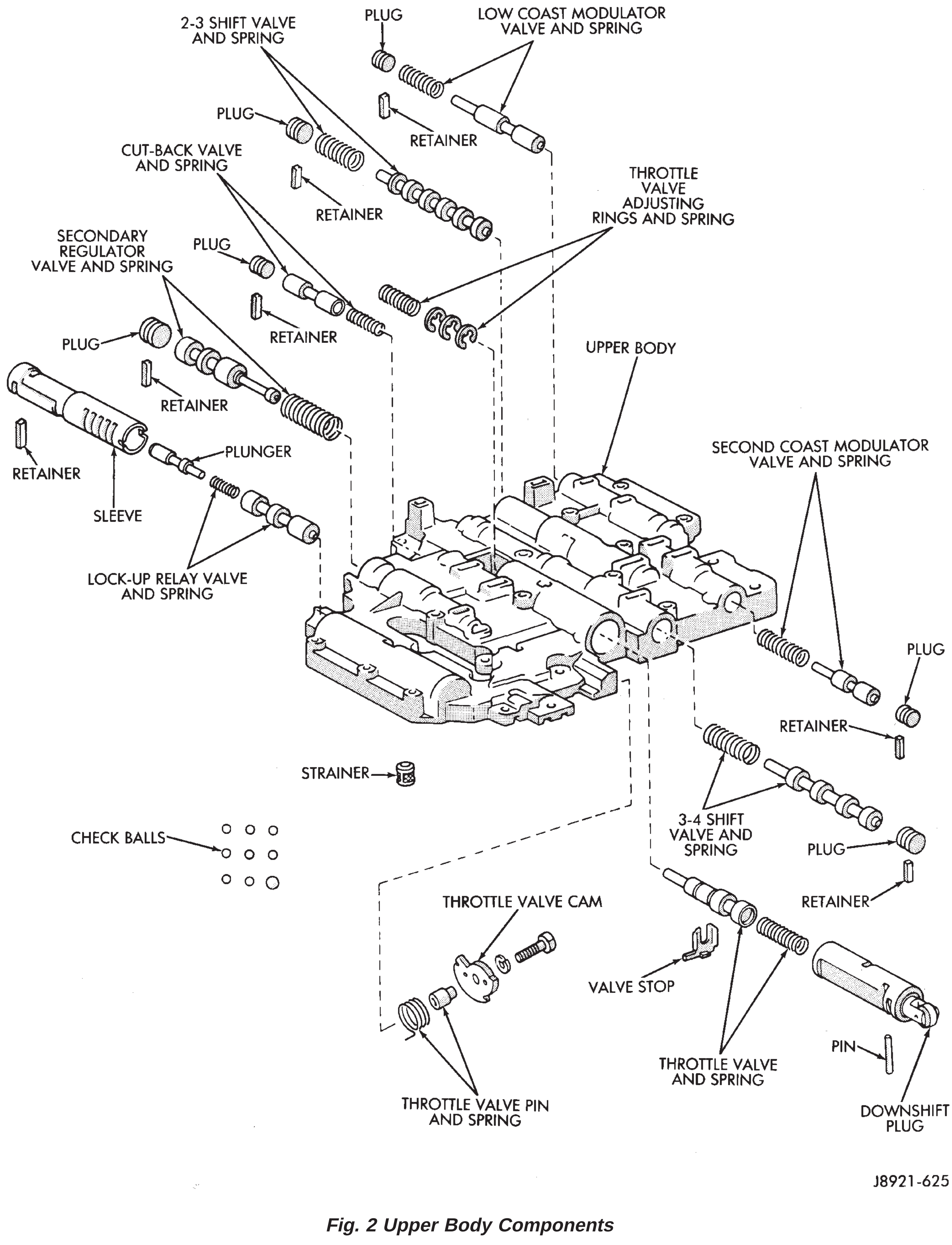


Fig. 2 Upper Body Components

REMOVING UPPER BODY FROM LOWER BODY

(1) Remove two-piece detent spring (Fig. 3). Note position of spring sections for assembly reference.

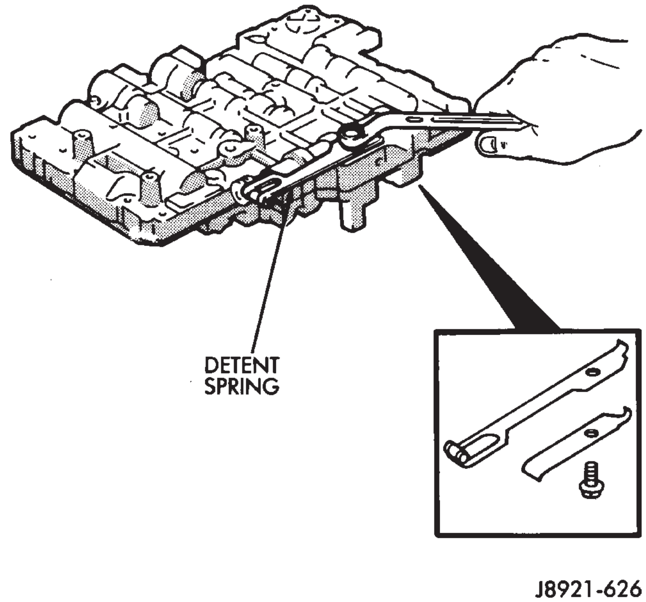


Fig. 3 Removing/Installing Detent Spring

(2) Remove manual valve from lower body (Fig. 4).

(3) Remove bolts attaching upper body to lower body (Fig. 5).

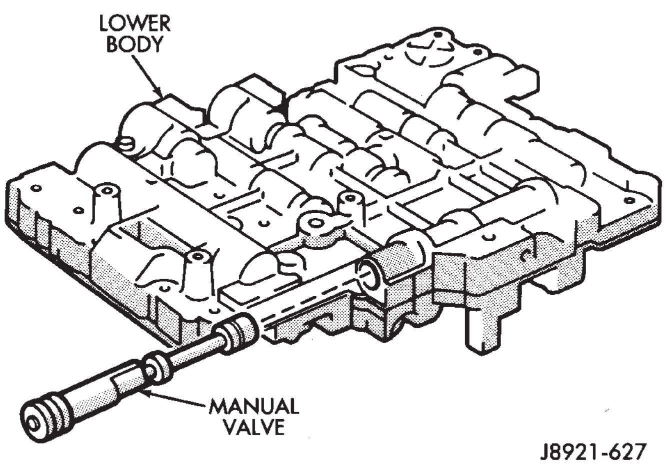


Fig. 4 Removing/Installing Manual Valve

(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.

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).

(2) Remove oil strainers (Fig. 2).

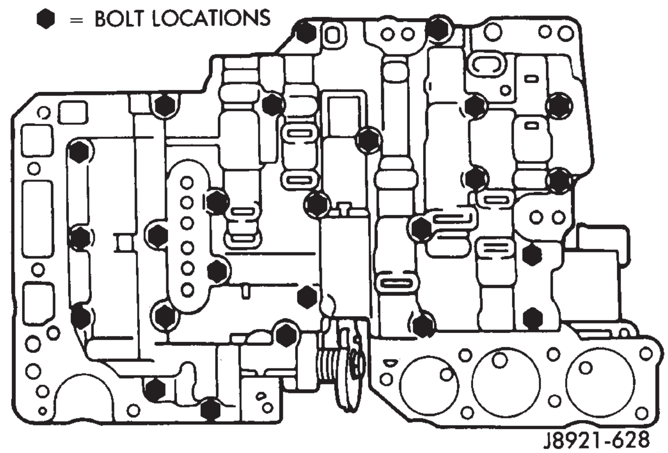


Fig. 5 Valve Body Bolt Locations

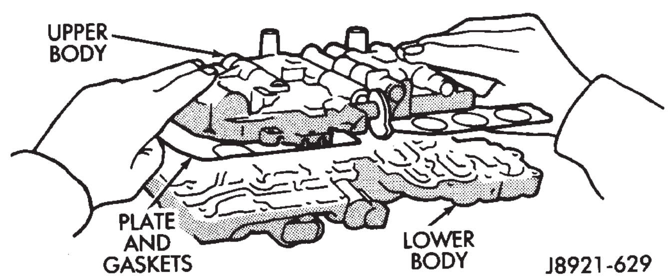


Fig. 6 Upper Body, Plate And Gaskets

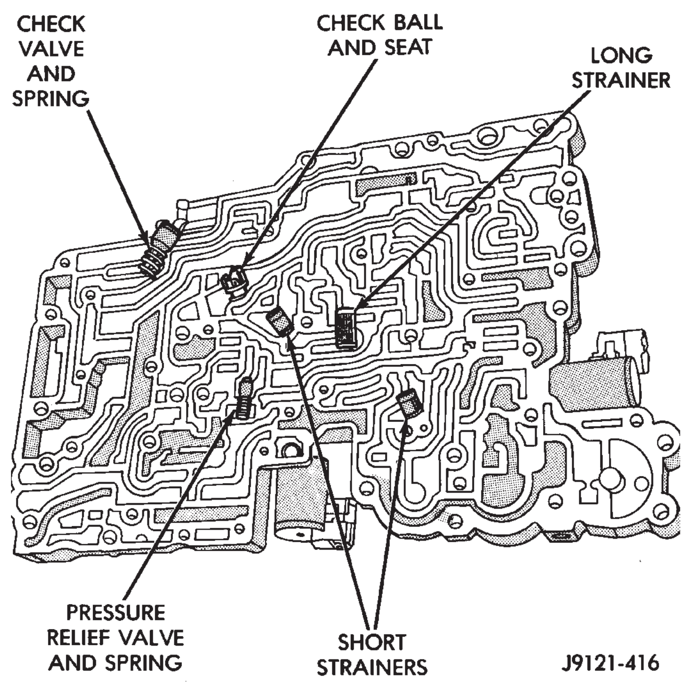


Fig. 1 Lower Body Check Valve And Strainer Location

(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.

(4) Remove solenoid No. 1, 2 and 3. Discard solenoid O-rings.

(5) Remove 1-2 shift valve retainer (Fig. 3).

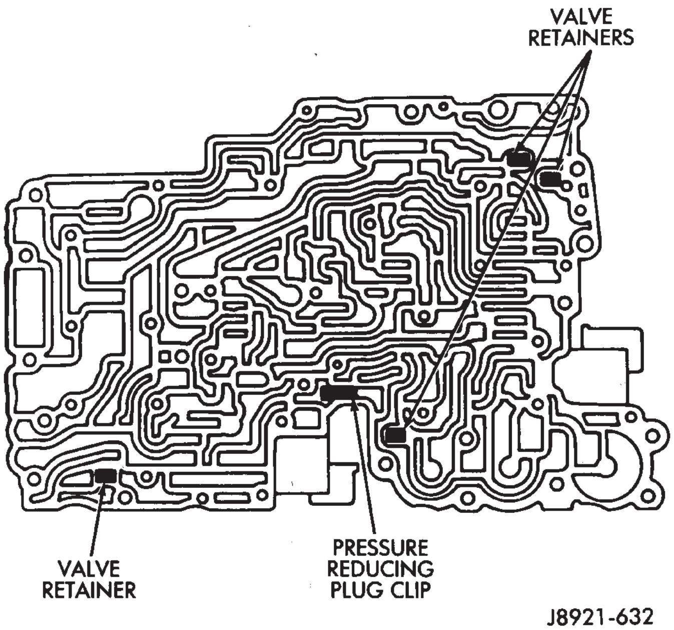


Fig. 2 Valve Retainer And Clip Location

(6) Remove 1-2 shift valve plug, valve spring and valve (Fig. 4).

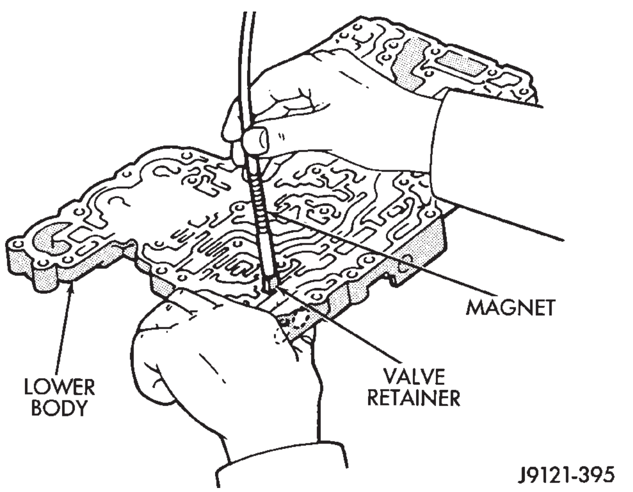


Fig. 3 Removing 1-2 Shift Valve Retainer

(7) Remove primary regulator valve as follows:

WARNING: THE PRIMARY REGULATOR VALVE SLEEVE AND PLUNGER ARE UNDER TENSION FROM THE VALVE SPRING. EXERT COUNTERPRESSURE ON THE SPRING WHILE REMOVING THE VALVE RETAINER TO PREVENT COMPONENTS FROM FLYING OUT.

(a) Note position of valve retainer for assembly reference (Fig. 5). Then press valve sleeve inward with your thumb and remove retainer with magnet.

(b) Slowly release thumb pressure on sleeve and remove sleeve, spring and washer and valve (Fig. 6). Use magnet to remove valve if necessary.

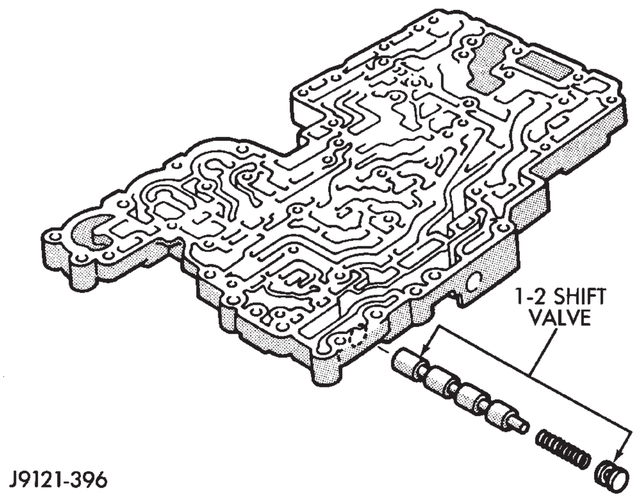


Fig. 4 Removing/Installing 1-2 Shift Valve

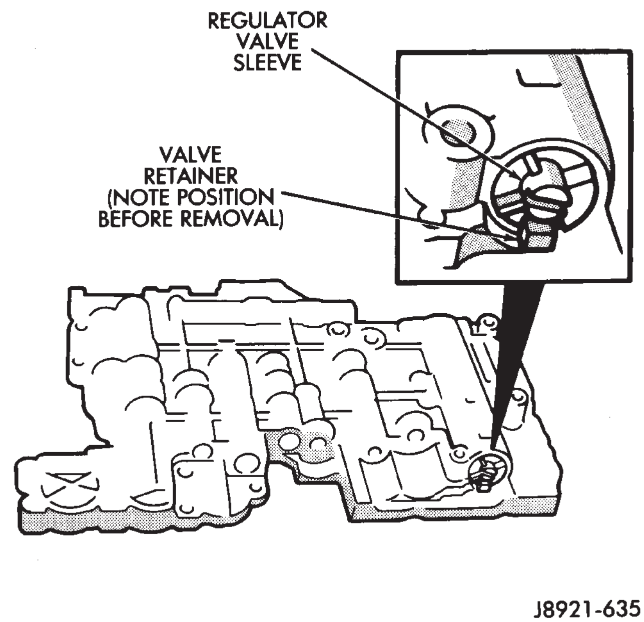


Fig. 5 Regulator Valve Retainer Position

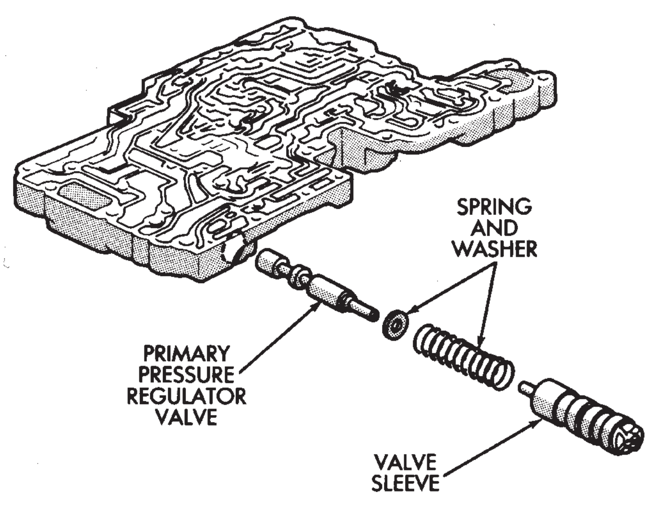


Fig. 6 Removing/Installing Primary Pressure Regulator Valve

(8) Remove regulator valve plunger from sleeve (Fig. 7).

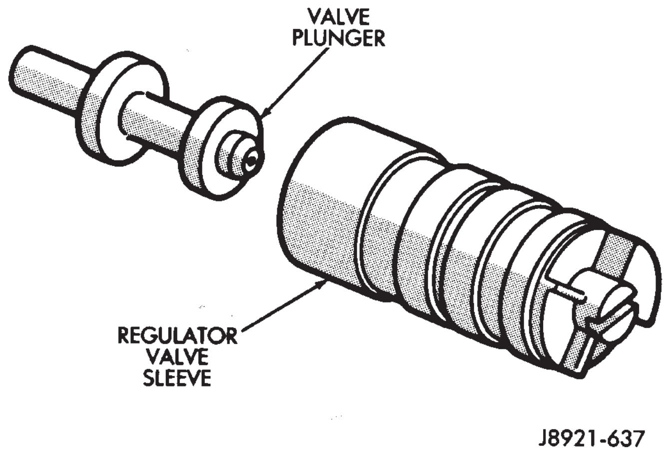


Fig. 7 Removing/Installing Regulator Valve Plunger

(9) Remove retaining clip and remove pressure reducing plug (Fig. 8). Cover screwdriver blade with tape to avoid scratching valve body surface.

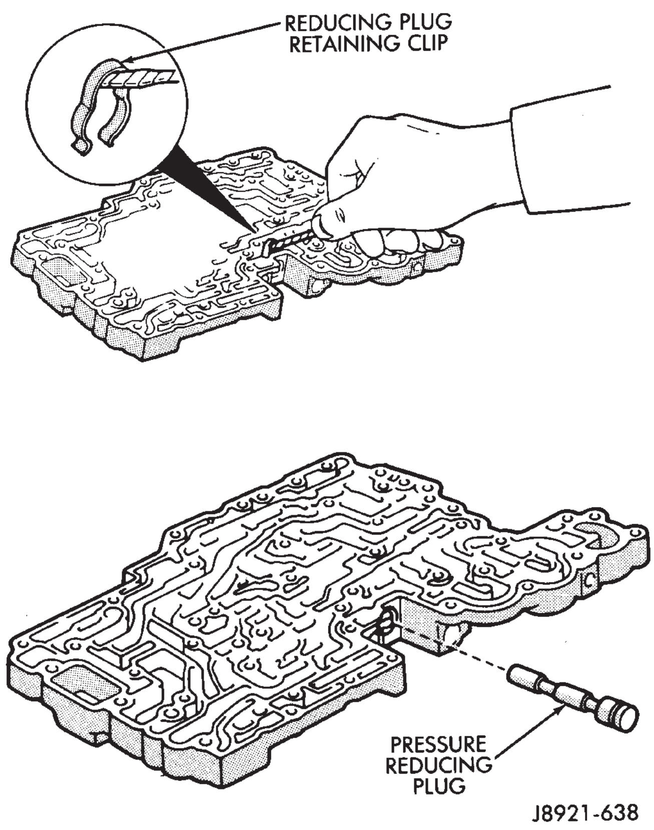


Fig. 8 Removing/Installing Pressure Reducing Plug

(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.

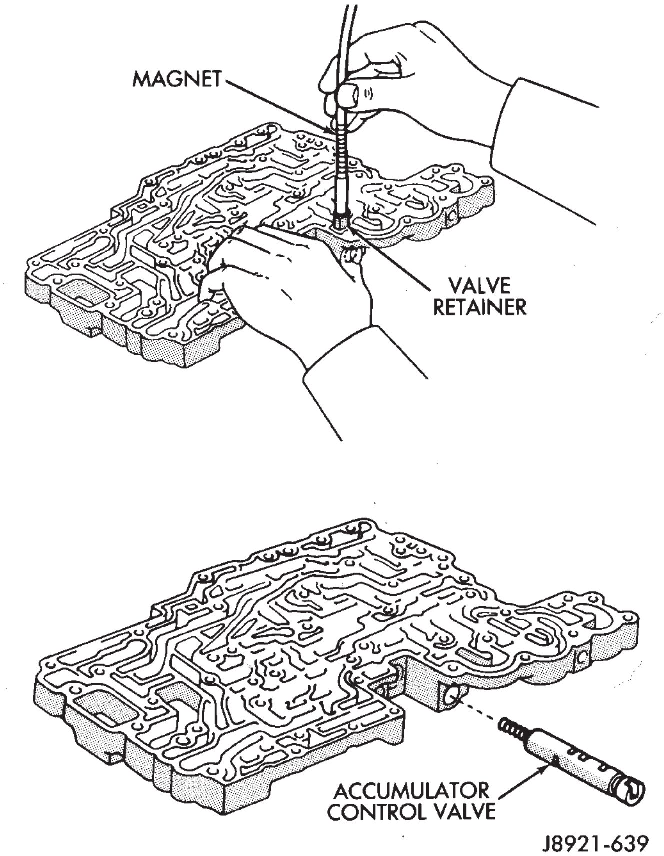


Fig. 9 Removing/Installing Accumulator Control Valve Assembly

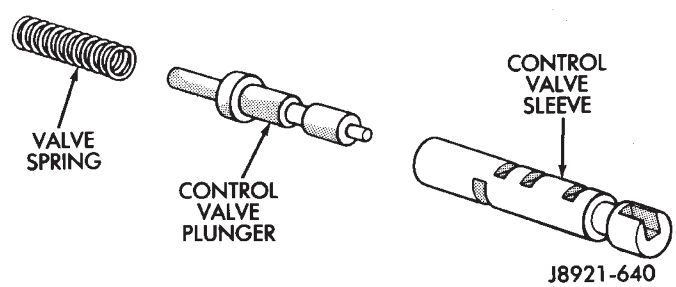
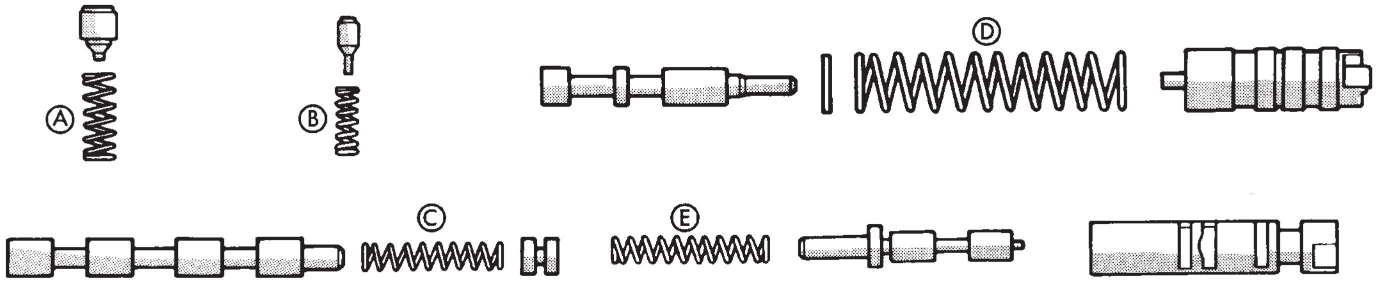


Fig. 10 Accumulator Control Valve Components

(13) Inspect condition of lower body components. Replace lower body if any bores are scored or corroded. 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).



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

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).

(7) Install valve spring and regulator valve sleeve and plunger.

(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).

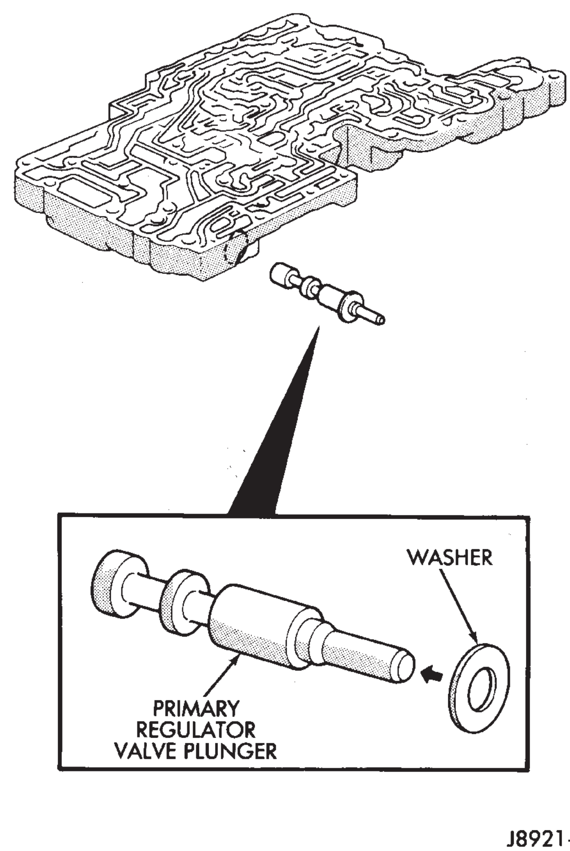


Fig. 12 Installing Washer On Regulator Valve Plunger

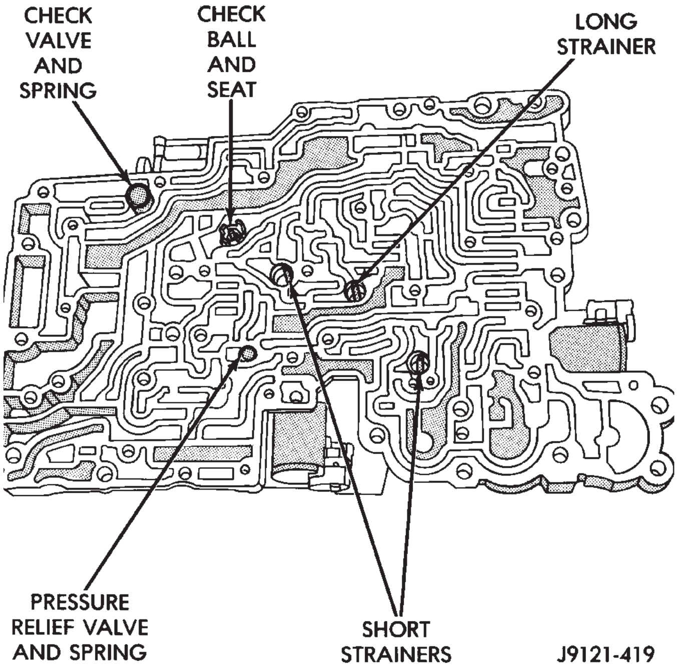


Fig. 13 Oil Strainer And Check Valve Installation

UPPER BODY DISASSEMBLY AND INSPECTION

(1) Remove valve body plate and gaskets (Fig. 1). Discard gaskets.

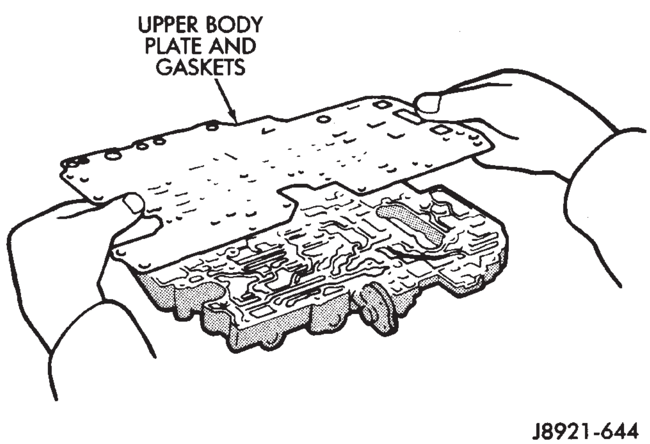


Fig. 1 Removing/Installing Upper Body Plate And Gaskets

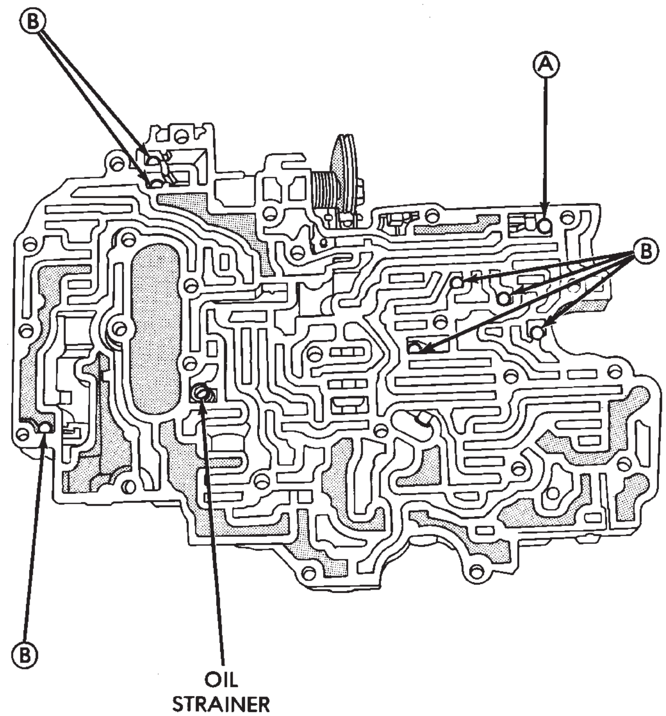
(2) Remove strainer and eight check balls (Fig. 2). Note check ball and strainer position for assembly reference.

(3) Remove valve stop and throttle cam (Fig. 3).

(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.

(6) Remove 3-4 shift valve retainer with magnet and remove valve plug, spring and 3-4 shift valve (Fig. 6).



CHECK BALL	DIAMETER
A	6.35 mm (.250 in.)
B	5.535 mm (.218 in.)

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Fig. 2 Check Ball And Strainer Location/Identification

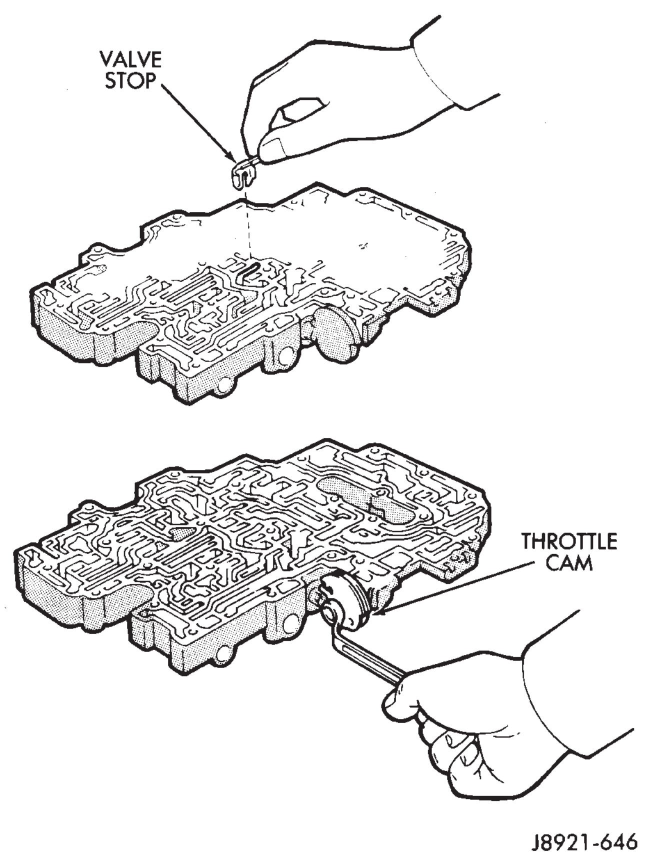


Fig. 3 Removing/Installing Valve Stop And Throttle Cam

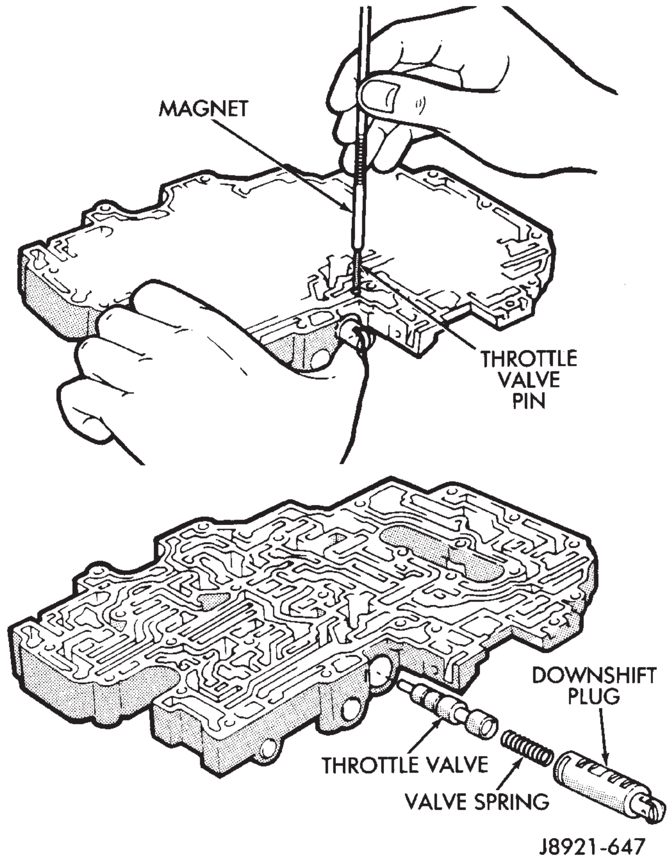


Fig. 4 Removing/Installing Throttle Valve

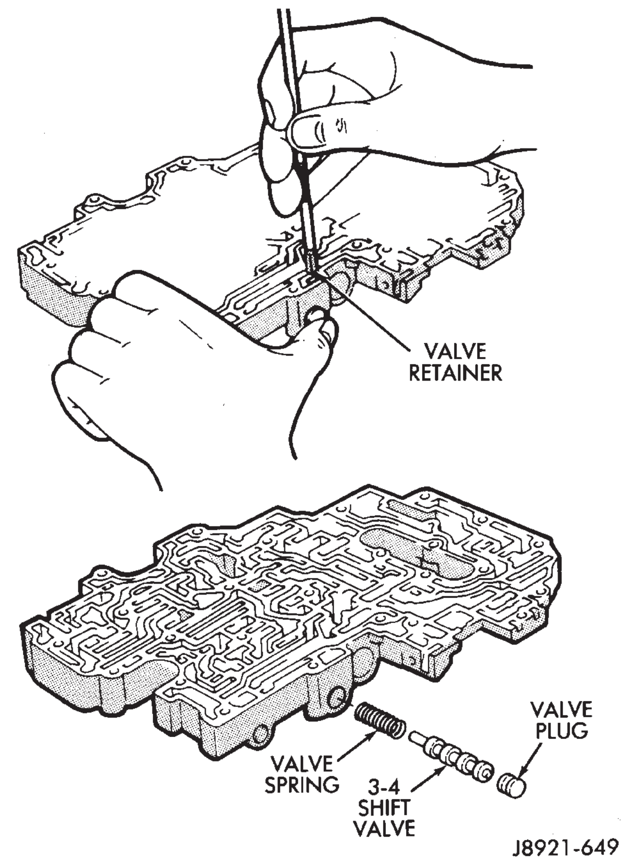


Fig. 6 Removing/Installing 3-4 Shift Valve

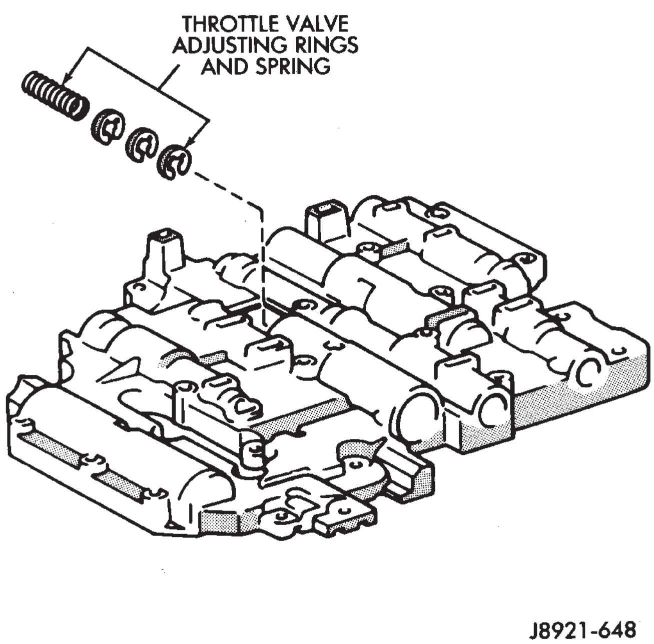


Fig. 5 Throttle Valve Adjusting Ring Location (If Equipped)

(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).

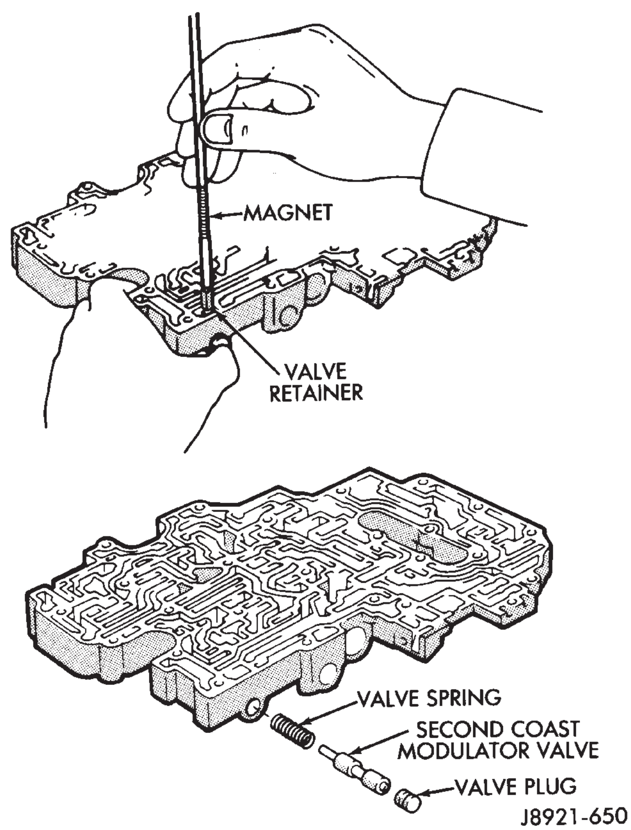


Fig. 7 Removing/Installing Second Coast Modulator Valve

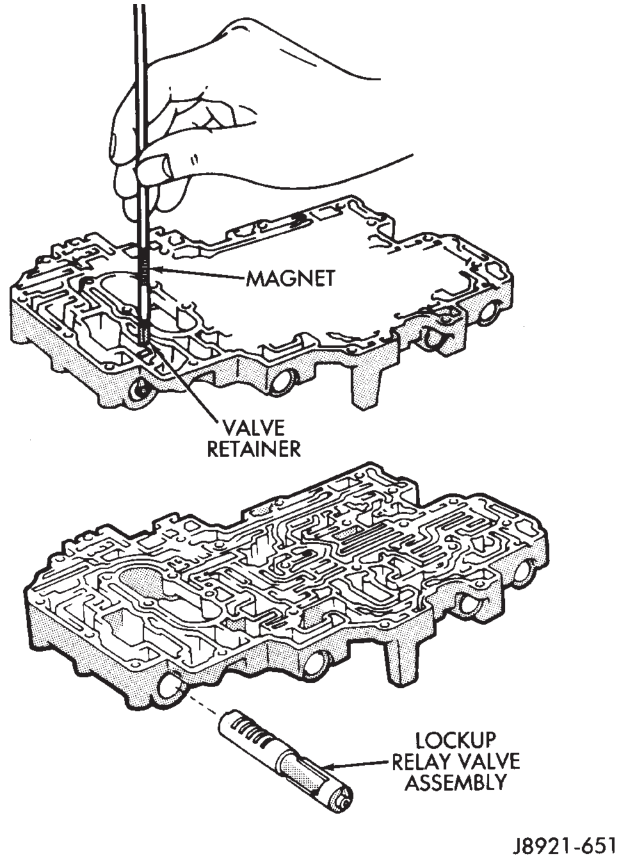


Fig. 8 Removing/Installing Converter Clutch Relay Valve

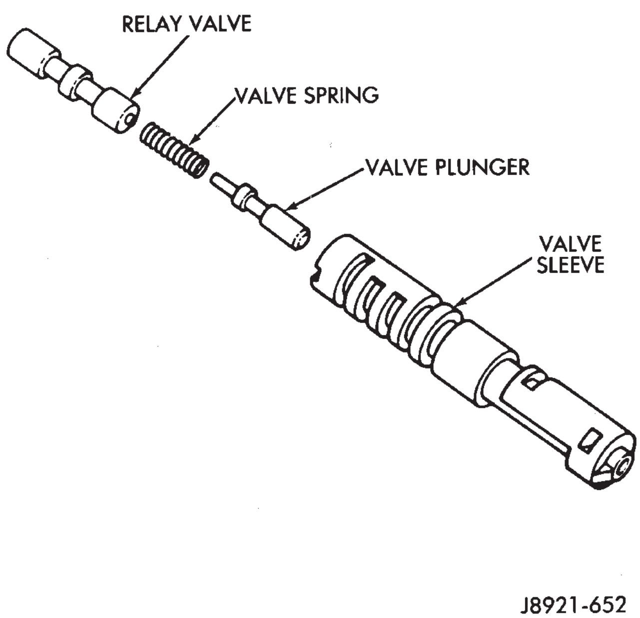


Fig. 9 Relay Valve Components

(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).

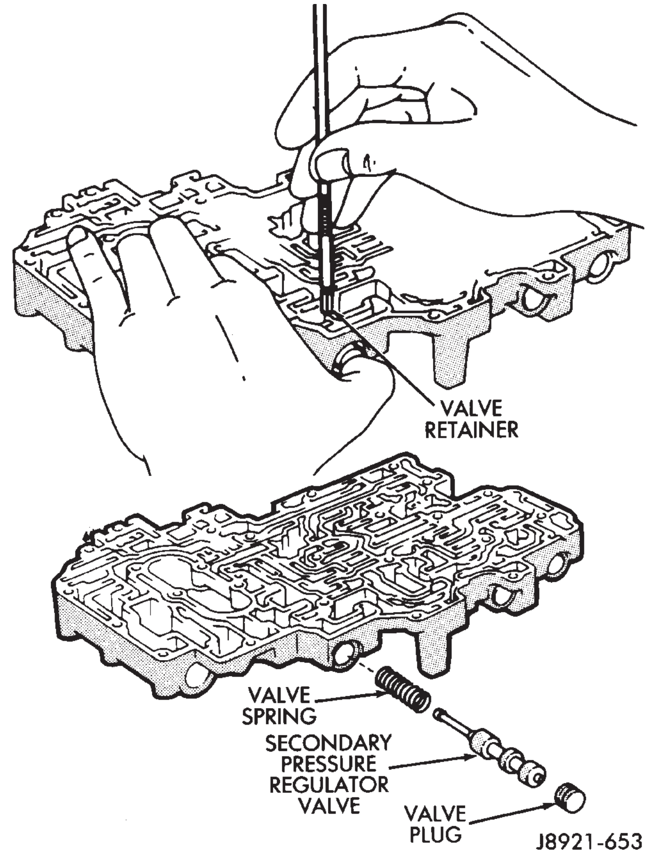


Fig. 10 Removing/Installing Secondary Pressure Regulator Valve

(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.

(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.

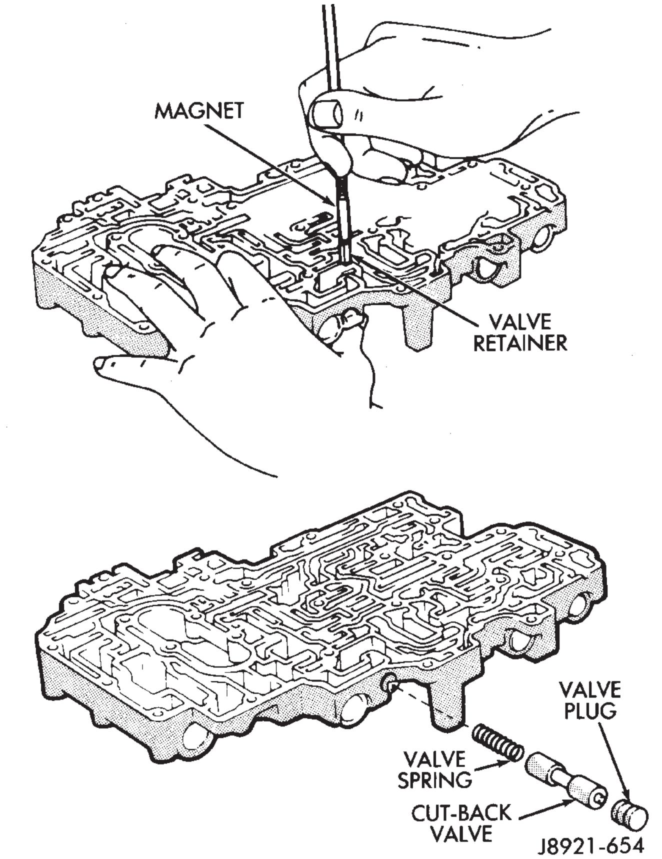


Fig. 11 Removing/Installing Cut-Back Valve

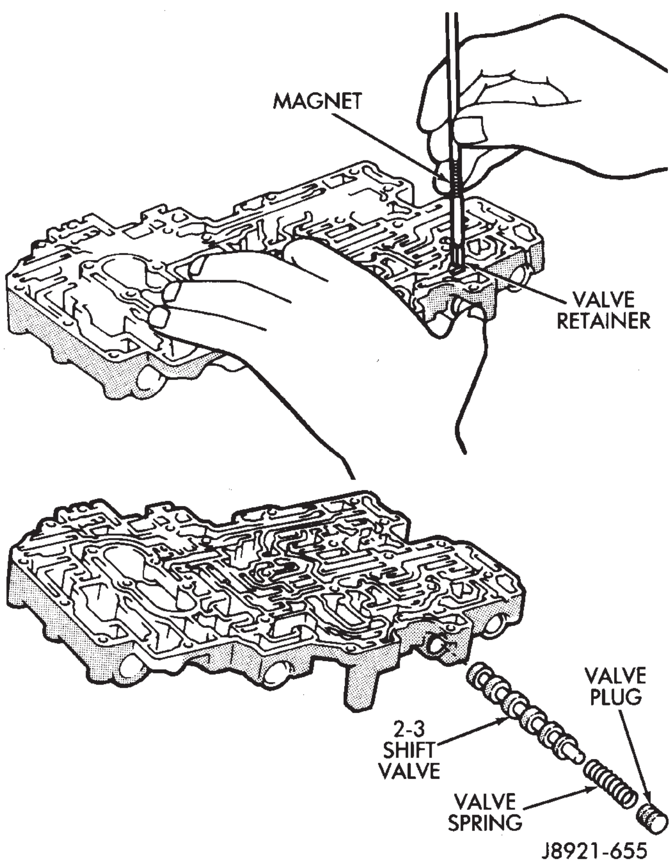


Fig. 12 Removing/Installing 2-3 Shift Valve

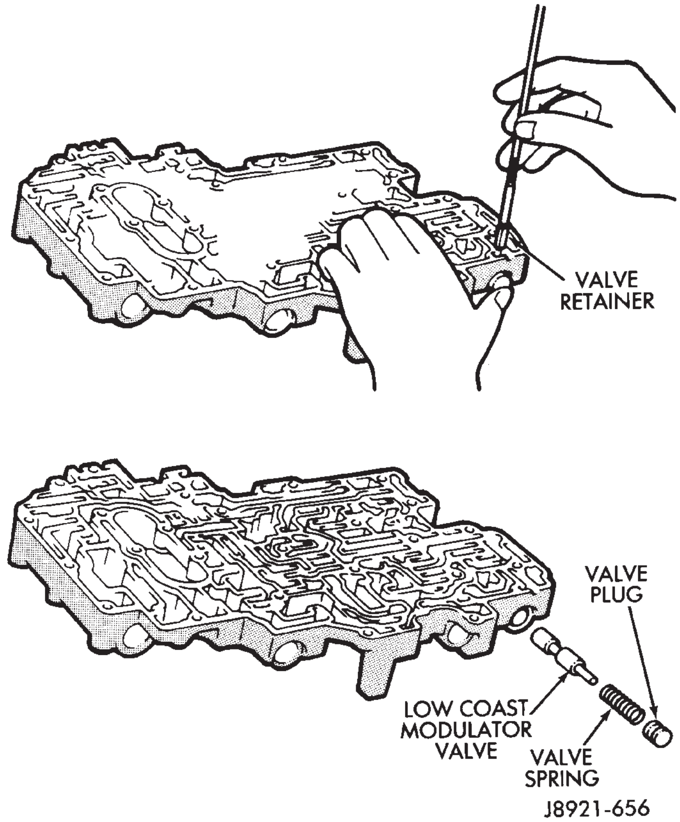


Fig. 13 Removing/Installing Low Coast Modulator Valve

(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.

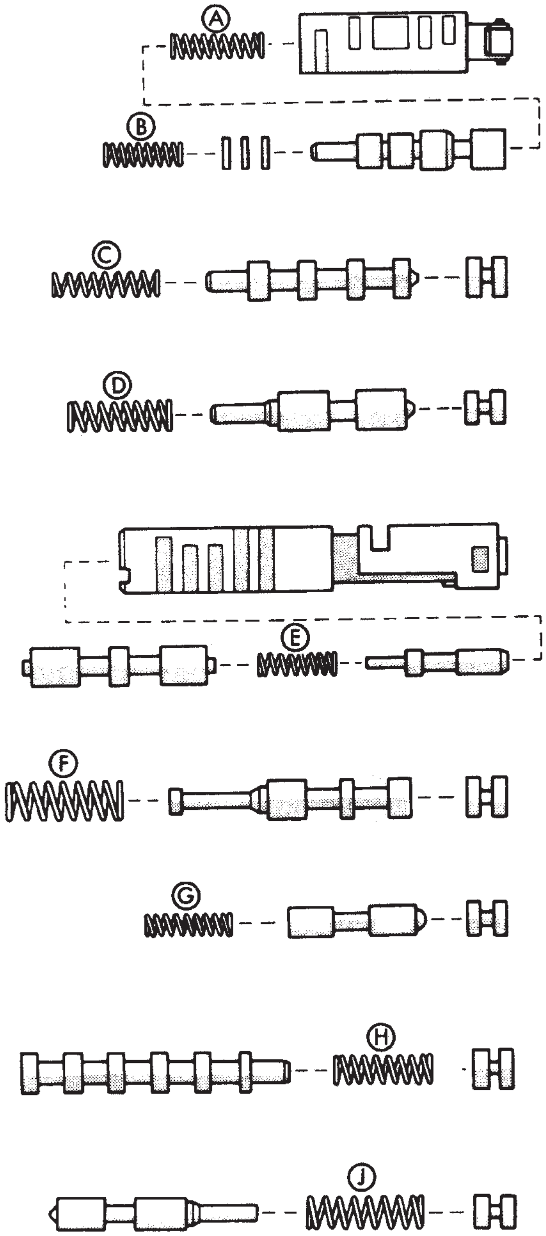
(6) Install secondary regulator valve spring, valve and plug in valve bore. Press plug inward and install retainer (Fig. 10).

(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.)

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Fig. 14 Upper Body Spring/Valve Identification

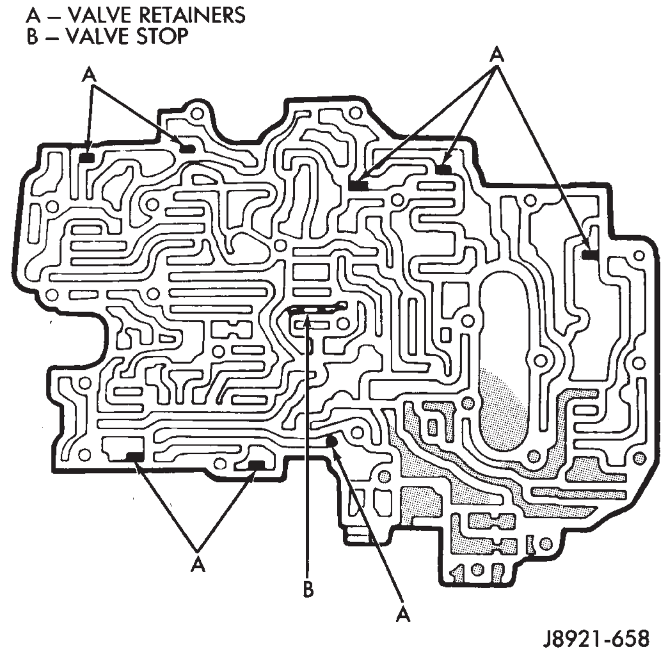

Fig. 15 Valve Retainer And Stop Locations

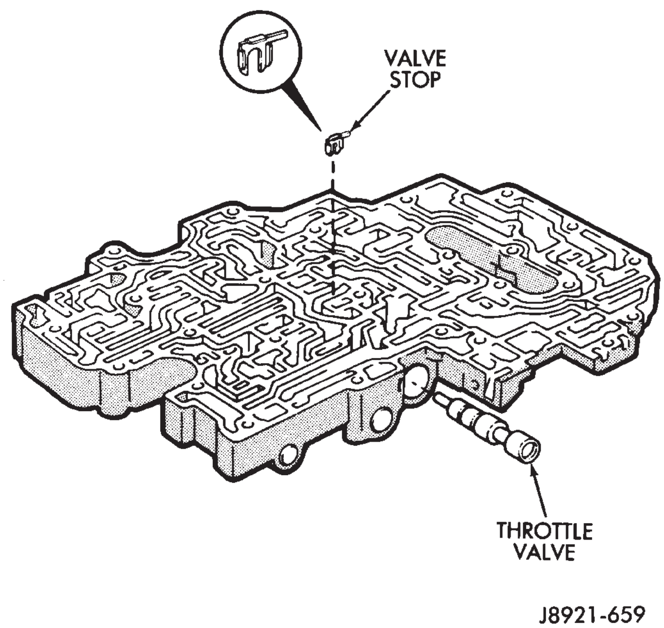

Fig. 16 Installing Throttle Valve And Stop

(11) Install throttle valve in valve bore. Push valve into place and install valve stop (Fig. 16).

(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).

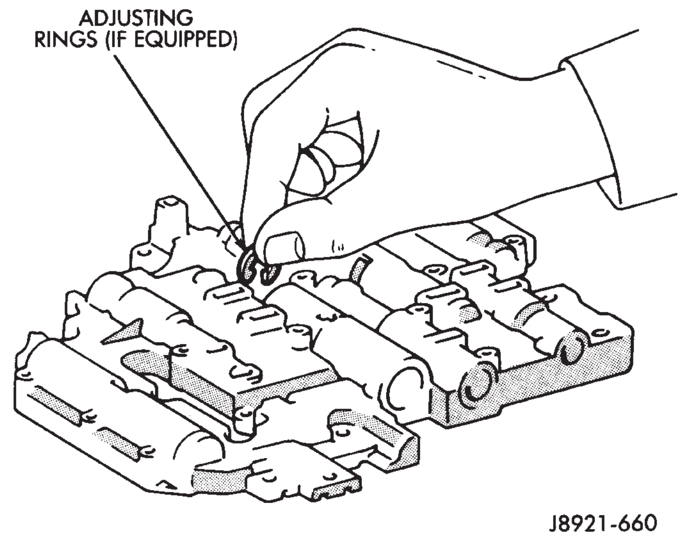

Fig. 17 Install Throttle Valve Adjusting Rings (If Equipped)

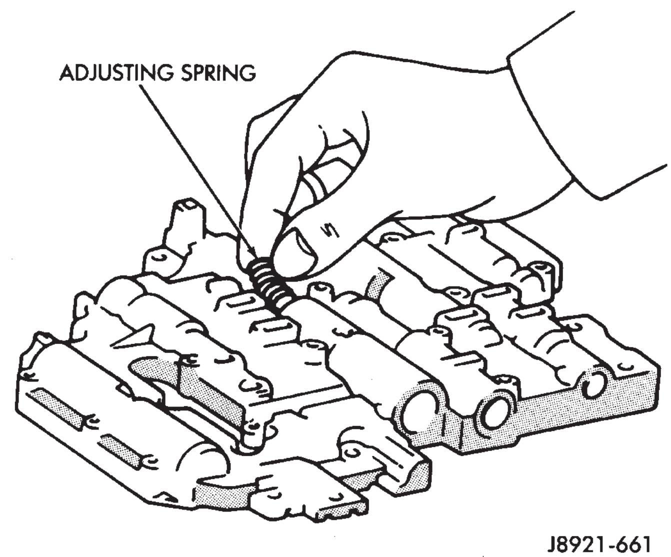

Fig. 18 Installing Throttle Valve Adjusting Spring

(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).

(19) Install check balls in upper body (Fig. 2).

(20) Install oil strainer (Fig. 2).

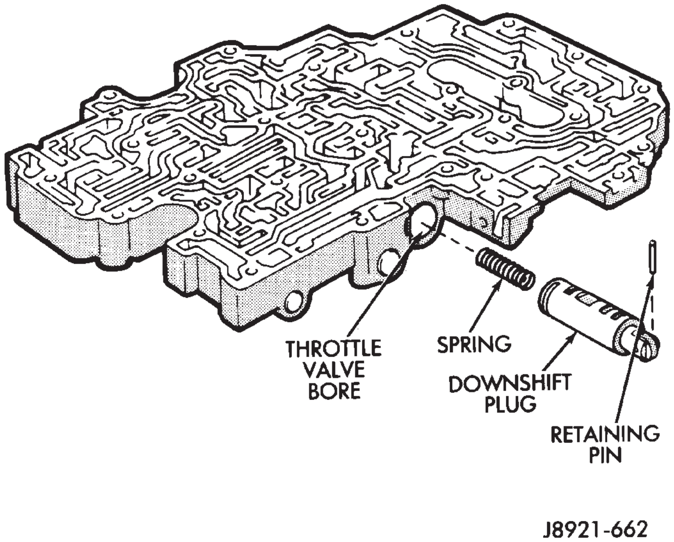

Fig. 19 Installing Downshift Plug

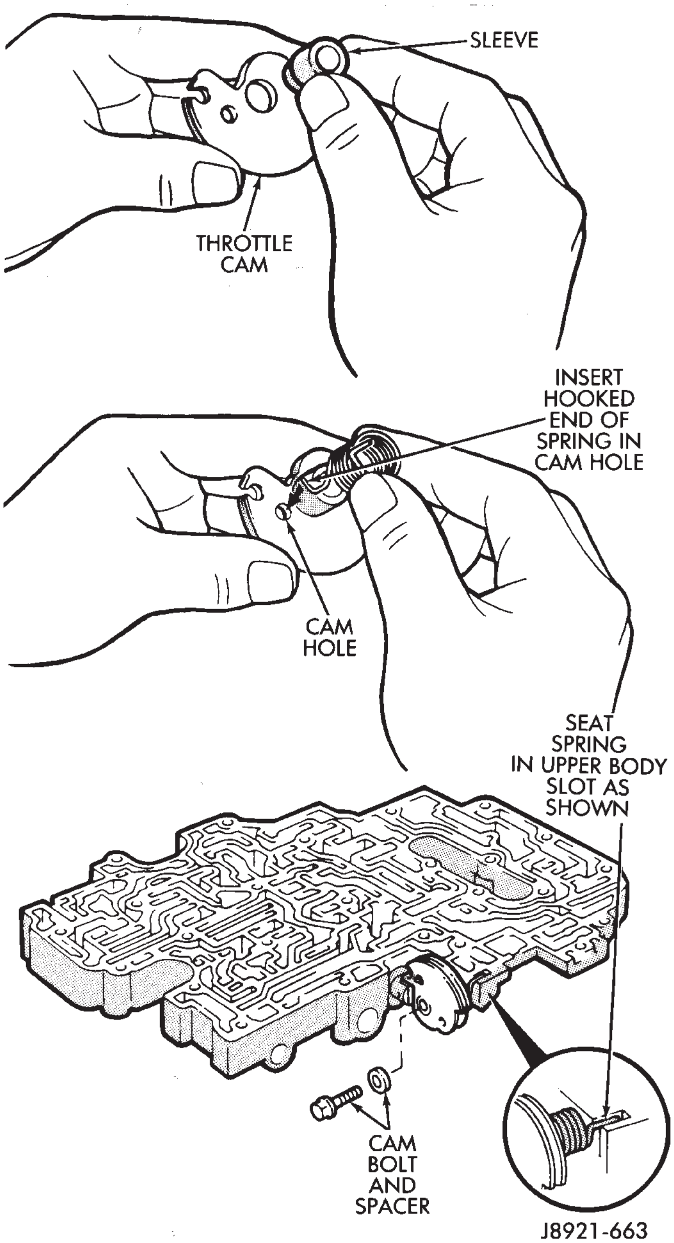

Fig. 20 Installing Throttle Cam

INSTALLING UPPER BODY ON LOWER BODY

If valve body was equipped with gaskets, start at step (1). However, if valve body was 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.

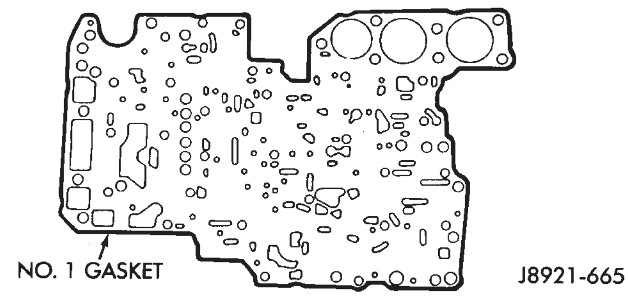

Fig. 1 Valve Body Gasket No. 1

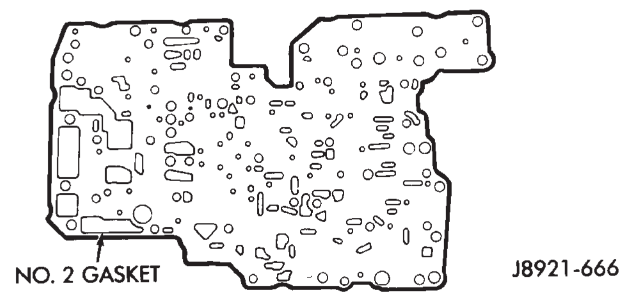

Fig. 2 Valve Body Gasket No. 2

(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.**

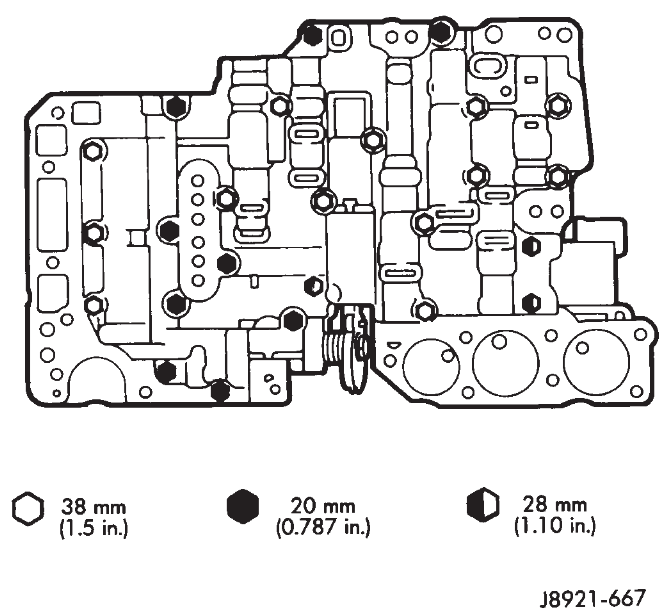

Fig. 3 Valve Body Bolt Location/Size

(5) Tighten valve body bolts to 6.4 N●m (56 in. lbs.) torque.

(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.

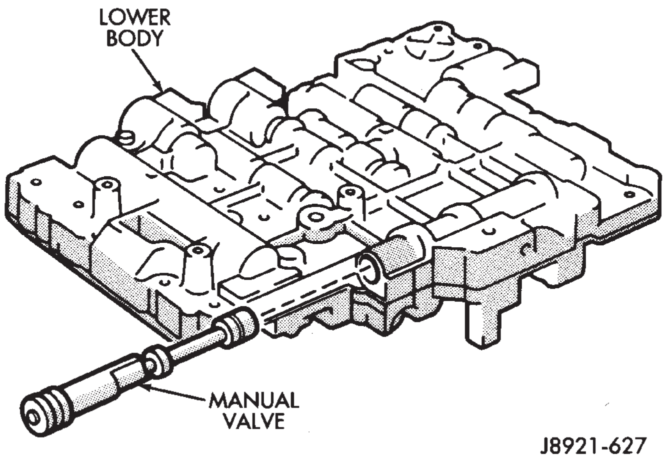

Fig. 4 Installing Manual Valve

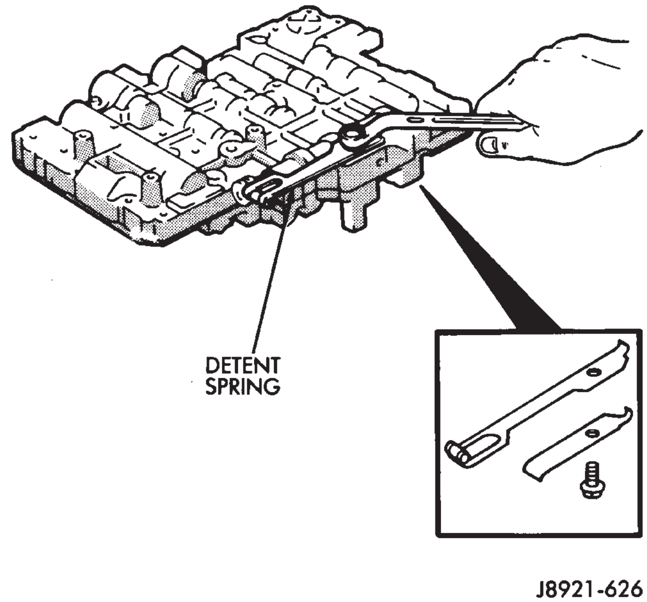

Fig. 5 Installing Detent Spring

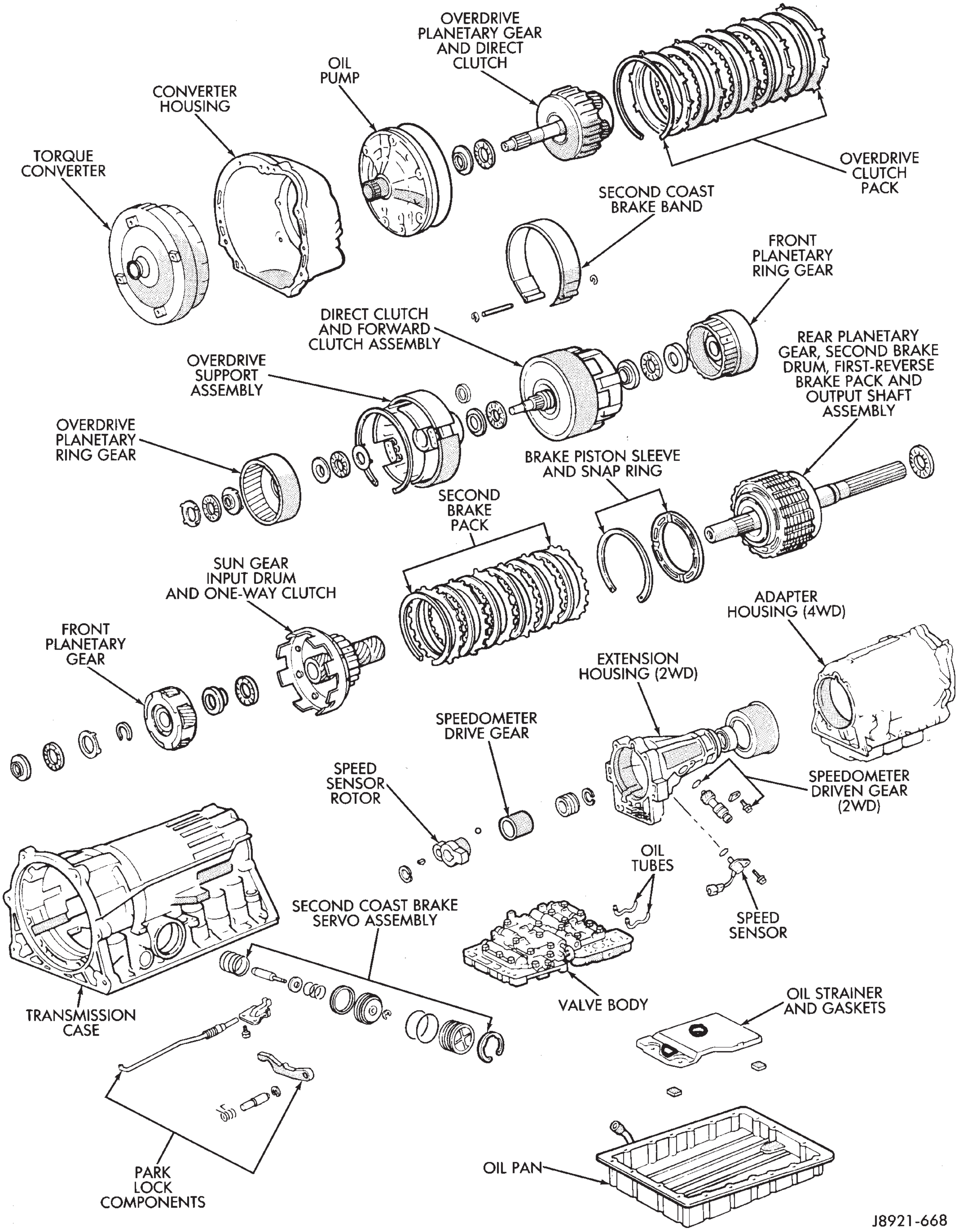

Fig. 1 AW-4 Transmission Components

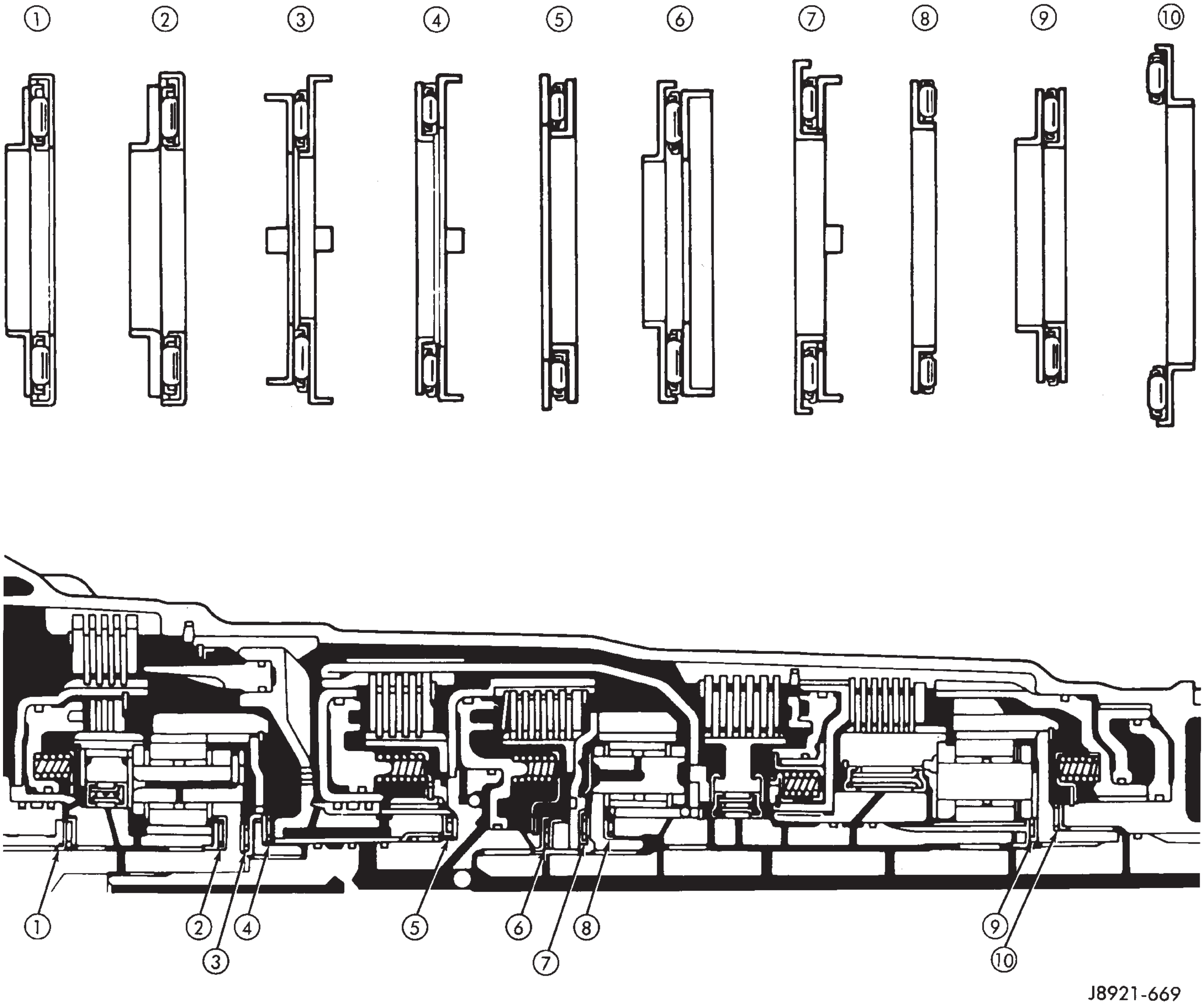

Fig. 2 Thrust Bearing Chart

TRANSMISSION ASSEMBLY AND ADJUSTMENT

(1) Lubricate components with transmission fluid or petroleum jelly as indicated during reassembly.

(2) Separate any transmission sub-assemblies that are still temporarily assembled for overhaul testing/checking procedures.

(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.

(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.

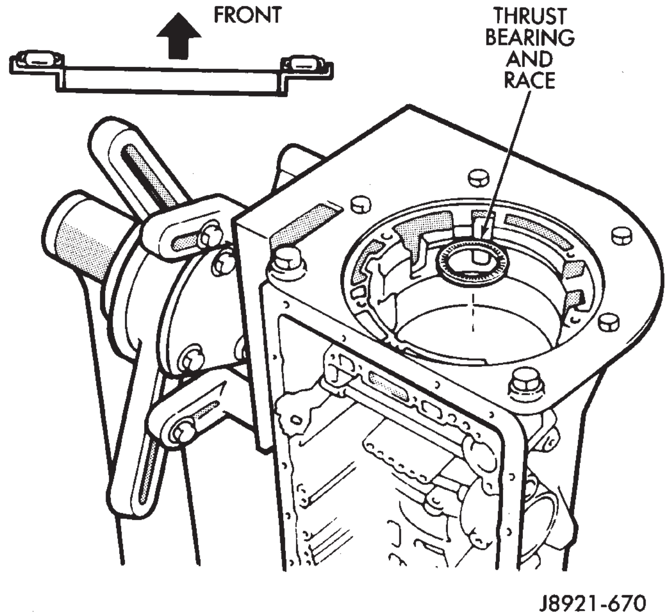

Fig. 3 Installing Thrust Bearing And Race (No. 10)

(7) Align teeth of second brake drum and clutch pack (Fig. 4).

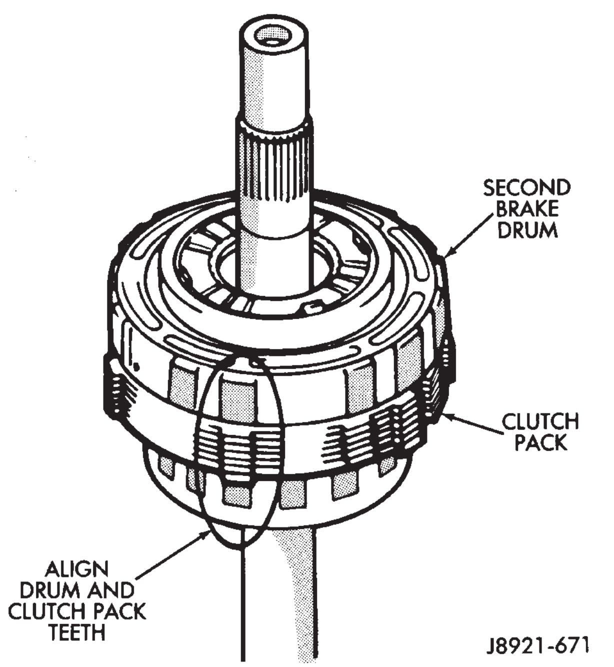

Fig. 4 Aligning Second Brake Drum And Clutch Pack Teeth

(8) Align rear planetary-output shaft assembly teeth with case slots and install assembly in case (Fig. 5).

(9) Install rear planetary snap ring with snap ring pliers. Chamfered side of snap ring faces up and toward case front (Fig. 6).

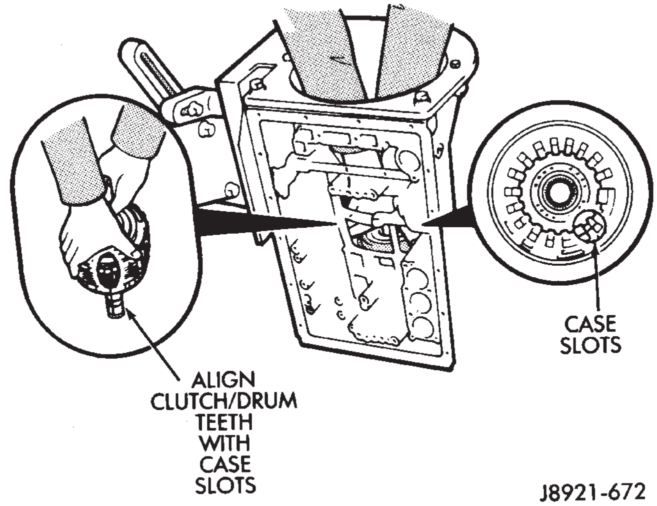

Fig. 5 Installing Output Shaft And Rear Planetary Assembly

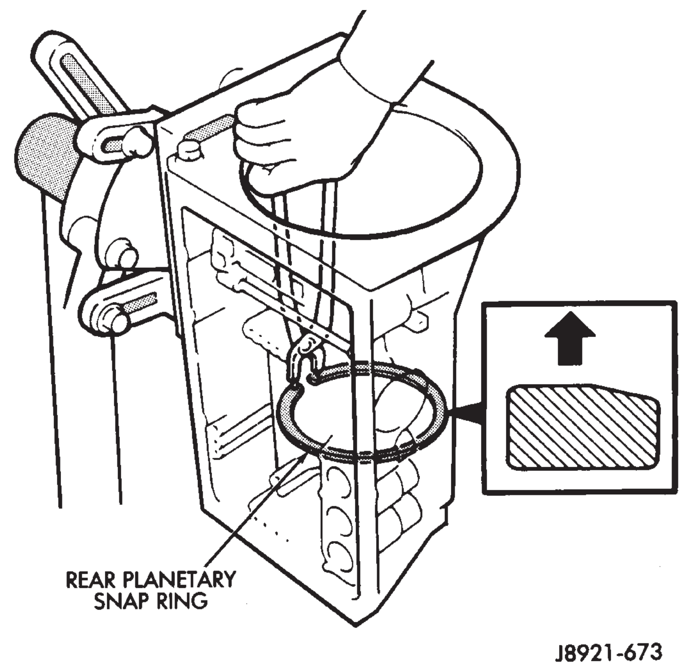

Fig. 6 Installing Planetary Snap Ring

(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.

(12) Install second brake drum gasket with Installer Tool 7544 (Fig. 9). Gasket depth is 43.7 mm (1.720 in.).

(13) Install park lock pawl, spring and pin (Fig. 10).

(14) Connect park lock rod to manual valve shift sector (Fig. 11).

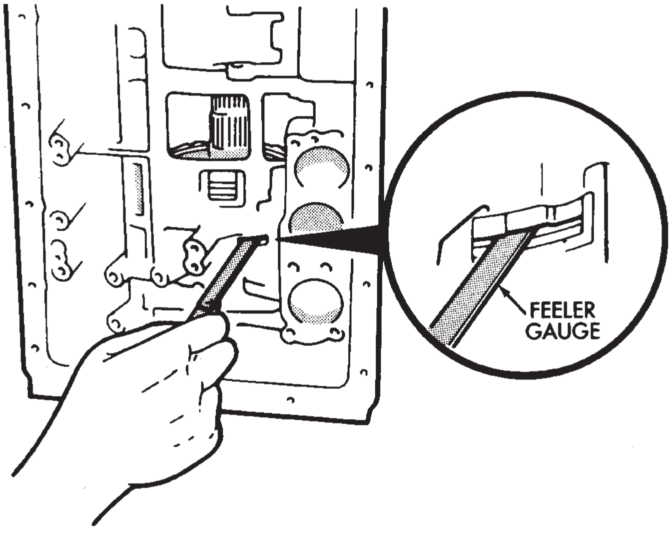

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Fig. 7 Checking First-Reverse Brake Pack Clearance

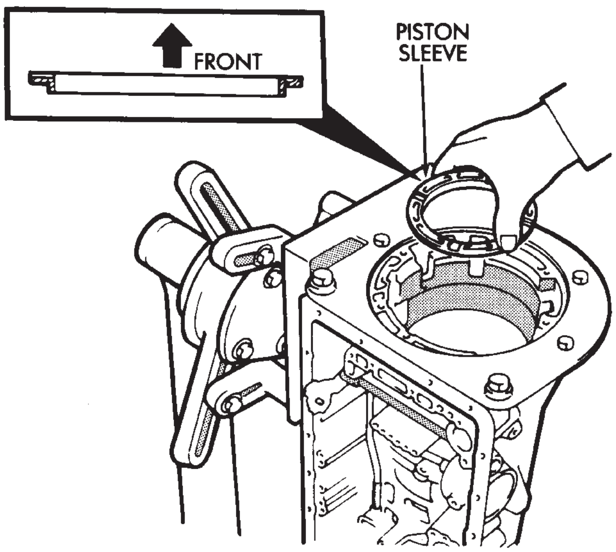

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Fig. 8 Installing Second Brake piston Sleeve

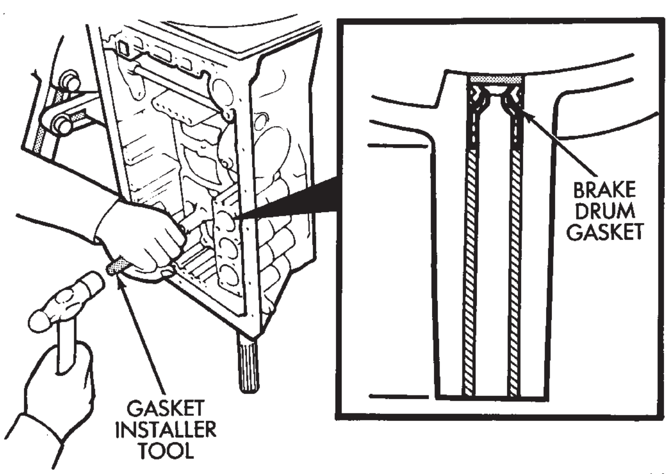

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Fig. 9 Installing Second Brake Drum Gasket

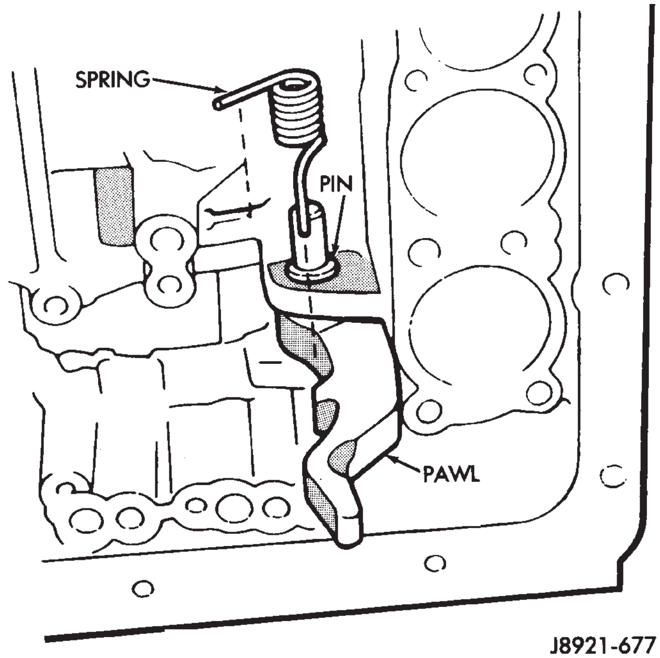

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Fig. 10 Installing Park Lock Pin, Spring And Pawl

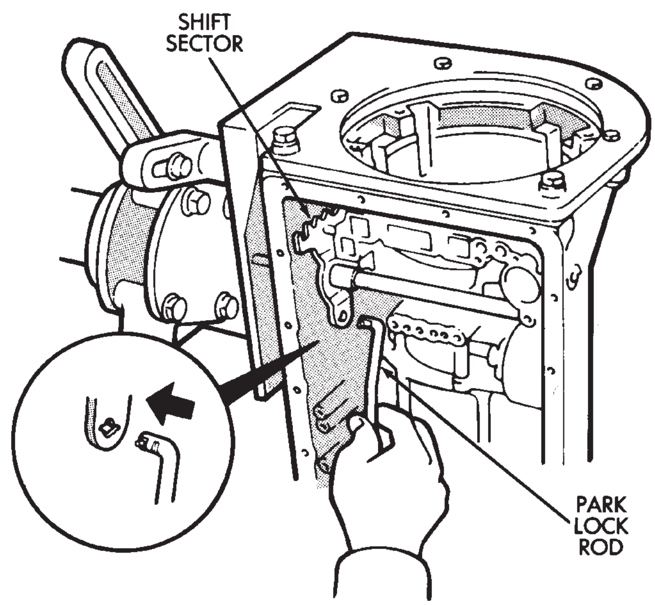

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Fig. 11 Installing Park Lock Rod

(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).

(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.

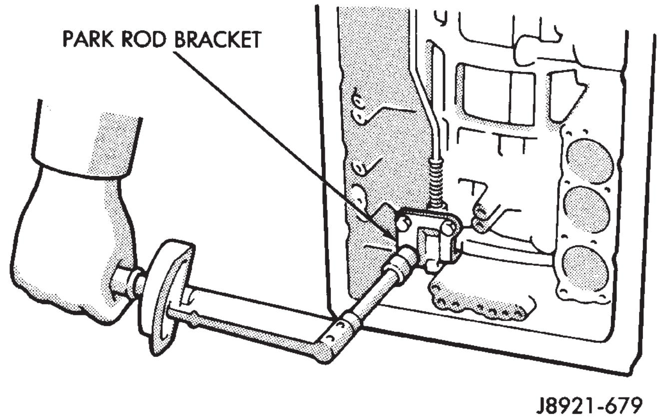


Fig. 12 Installing Park Rod Bracket

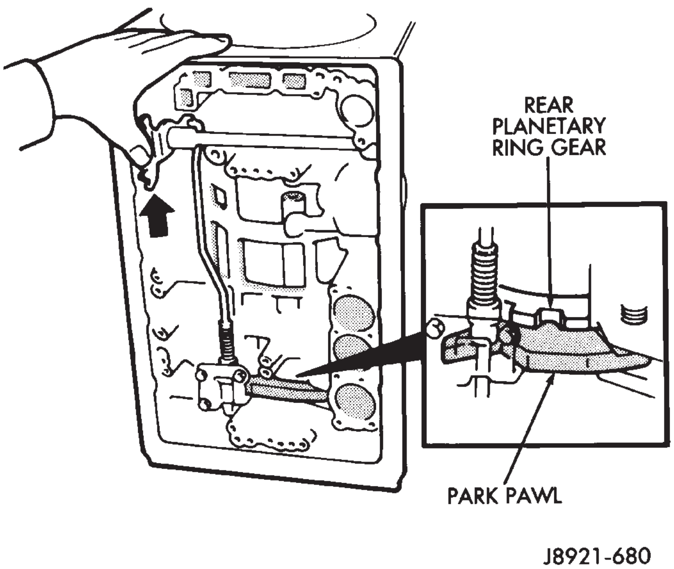


Fig. 13 Checking Park Pawl Engagement

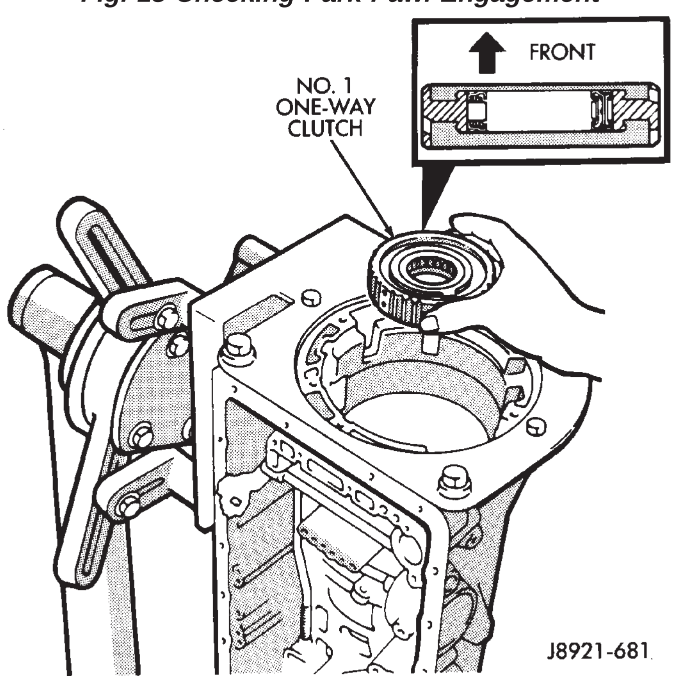


Fig. 14 Installing No. 1 One-Way Clutch

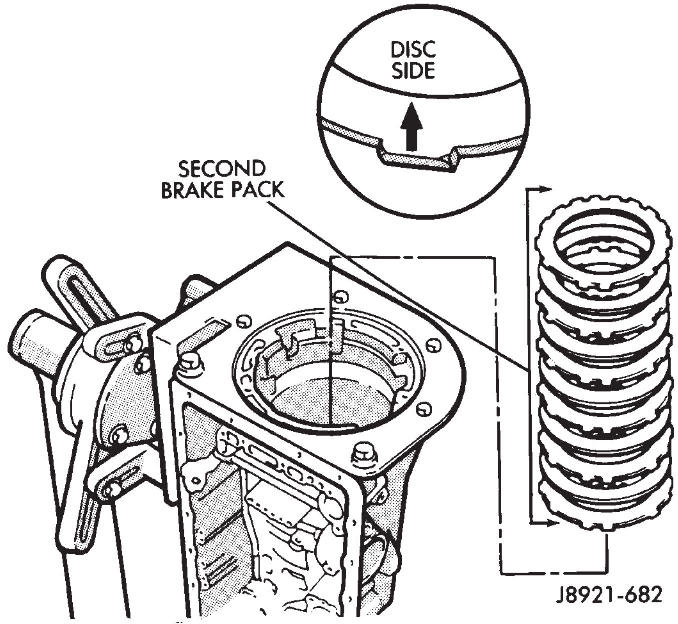


Fig. 15 Installing Second Brake Pack

(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.

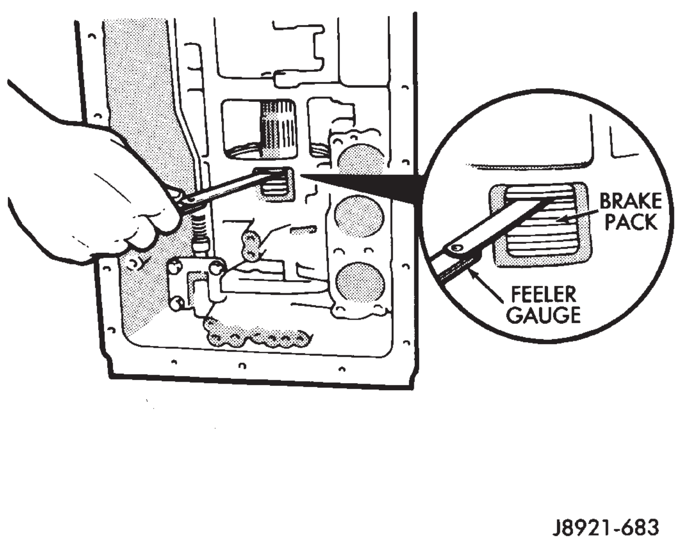


Fig. 16 Checking Second Brake Pack Clearance

(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.

(23) Install front planetary gear on sun gear (Fig. 18).

(24) Support output shaft with wood blocks (Fig. 19).

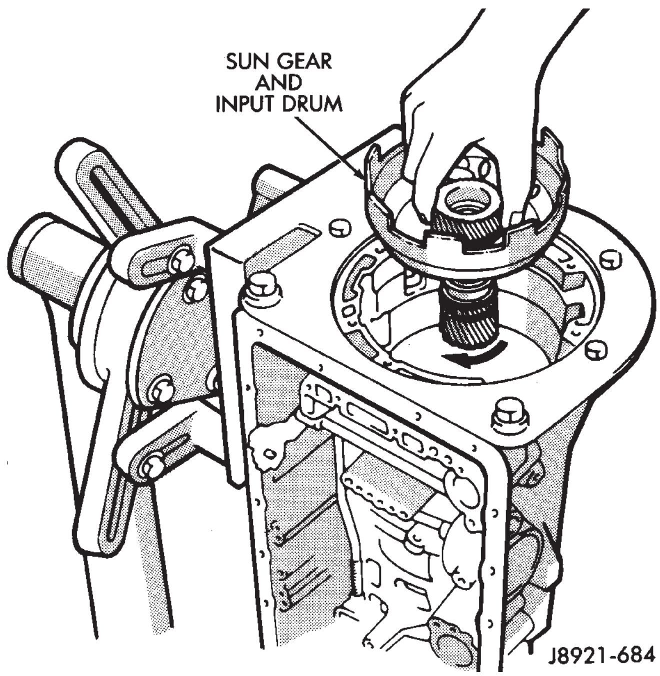


Fig. 17 Installing Sun Gear And Input Drum

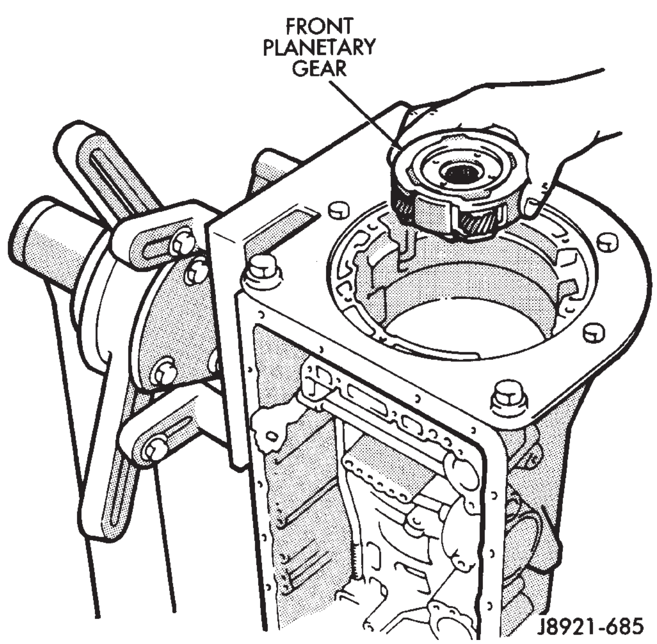


Fig. 18 Installing Front Planetary Gear

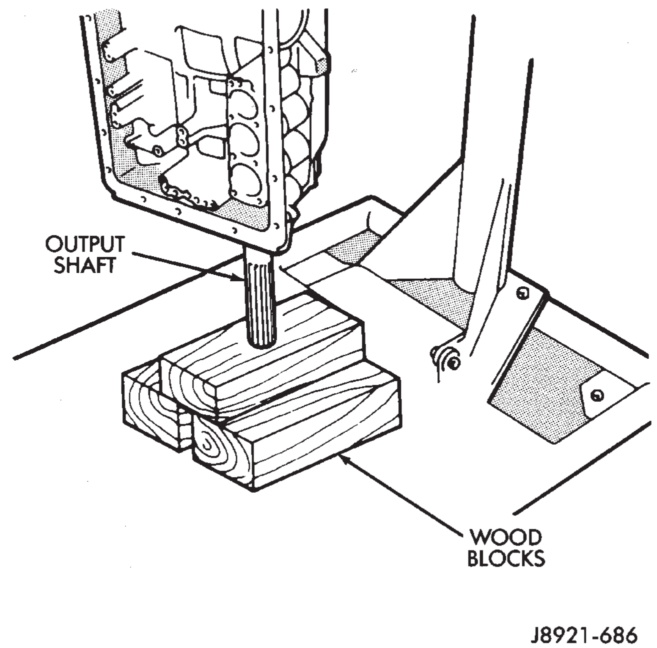


Fig. 19 Supporting Output Shaft

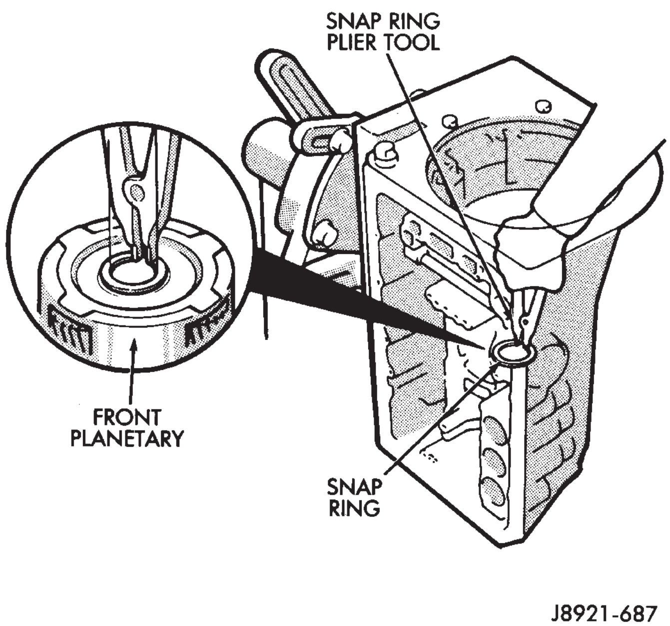


Fig. 20 Installing Front Planetary Snap Ring

(25) Install planetary snap ring on sun gear with snap ring plier tool 7541 (Fig. 20).

(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.

- 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).

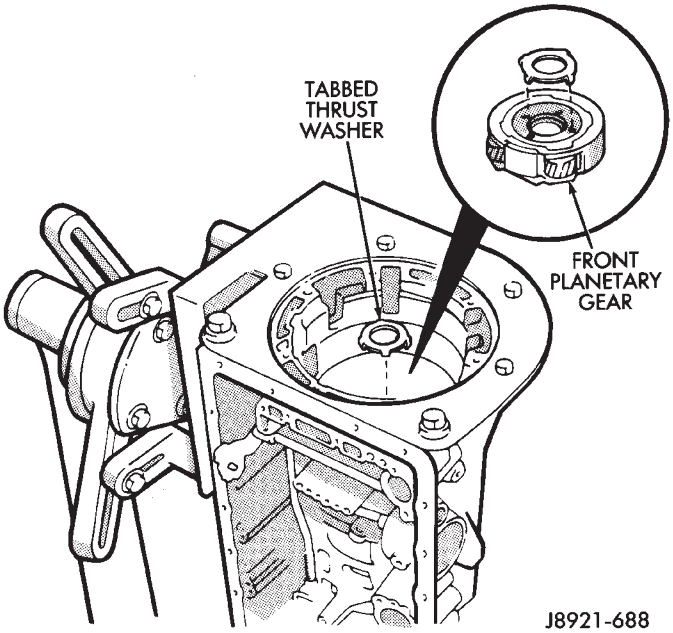


Fig. 21 Installing Planetary Thrust Race

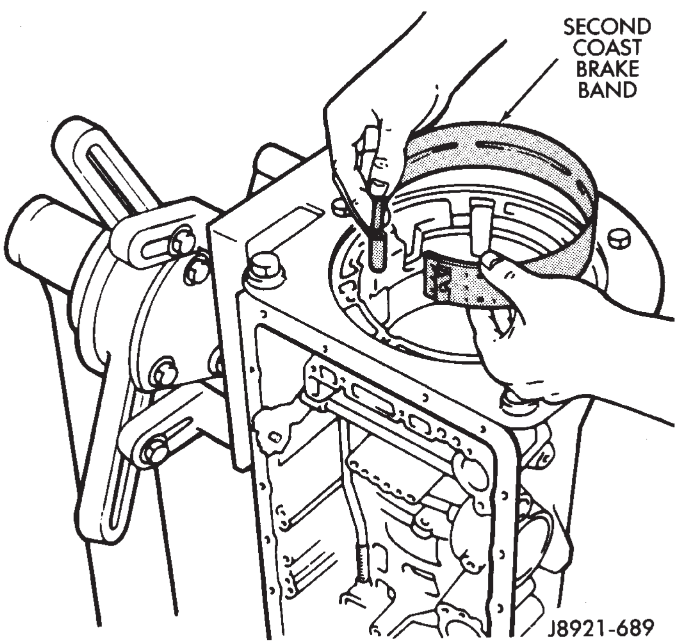


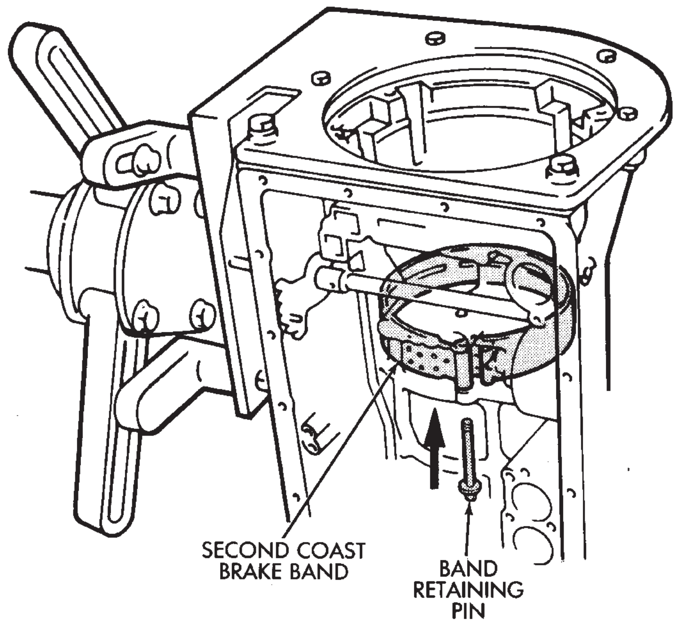
Fig. 22 Installing Second Coast Brake Band

(34) Align and install front planetary ring gear in forward-direct clutch (Fig. 27).

(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.).

(36) Rotate front of transmission case downward and install assembled planetary gear/forward-direct clutch (Fig. 29).



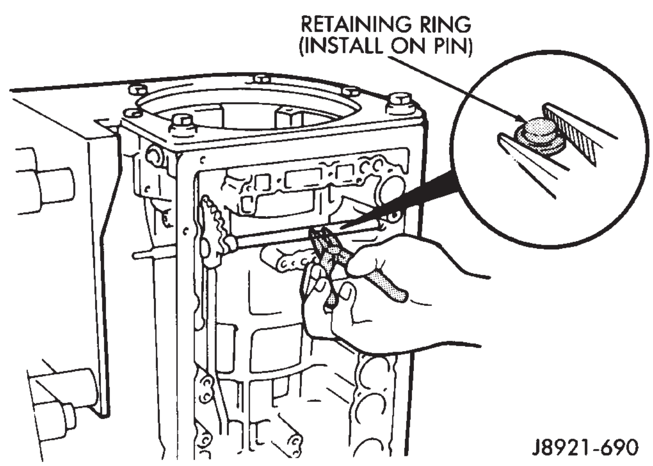


Fig. 23 Installing Second Coast Brake Band Retaining Pin

(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.

(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.).

(39) Assemble second coast brake piston components (Fig. 32).

(40) Install assembled second coast brake piston in case.

(41) Install replacement seals on second coast brake piston cover and install cover in case.

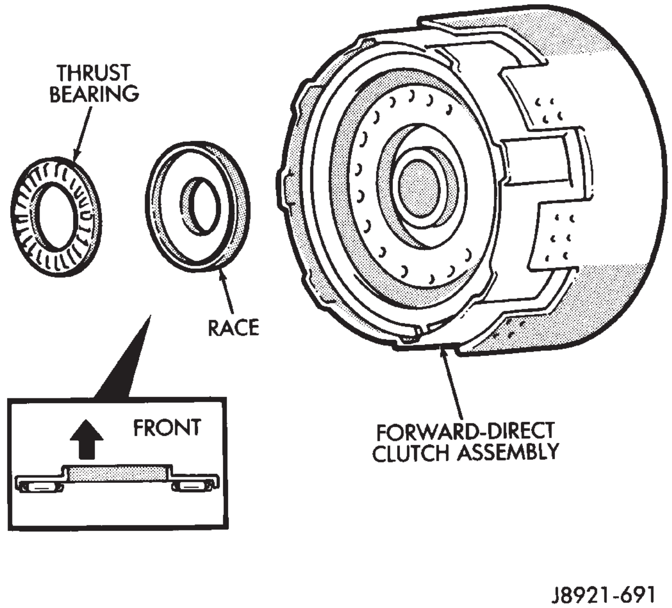


Fig. 24 Installing Forward-Direct Clutch Thrust Bearing And Race

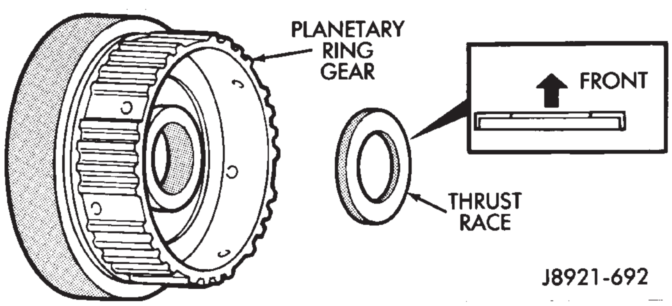


Fig. 25 Installing Planetary Ring Gear Race

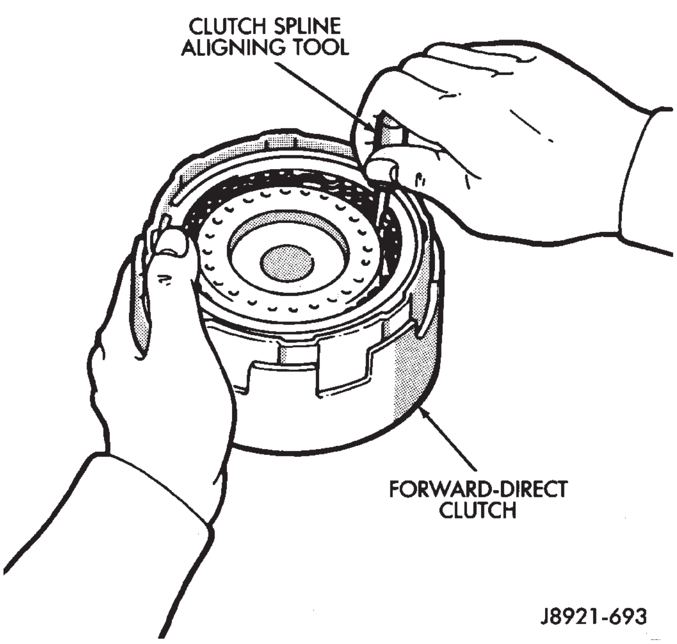


Fig. 26 Aligning Forward-Direct Clutch Splines

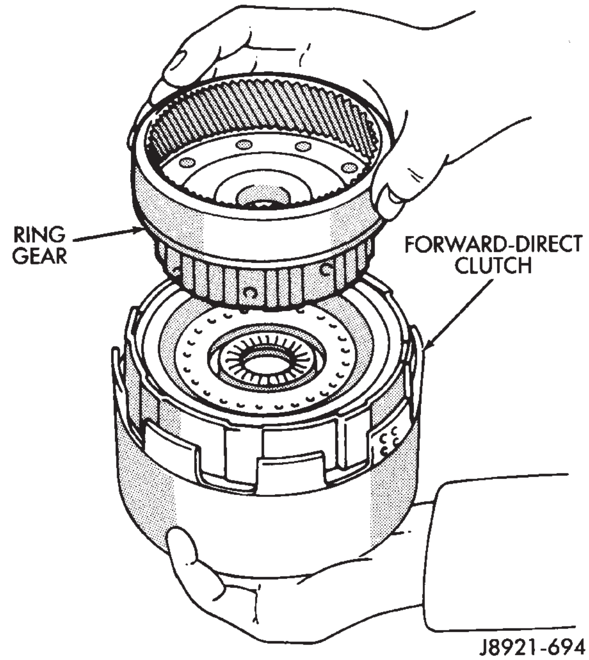


Fig. 27 Installing Front Planetary Ring Gear

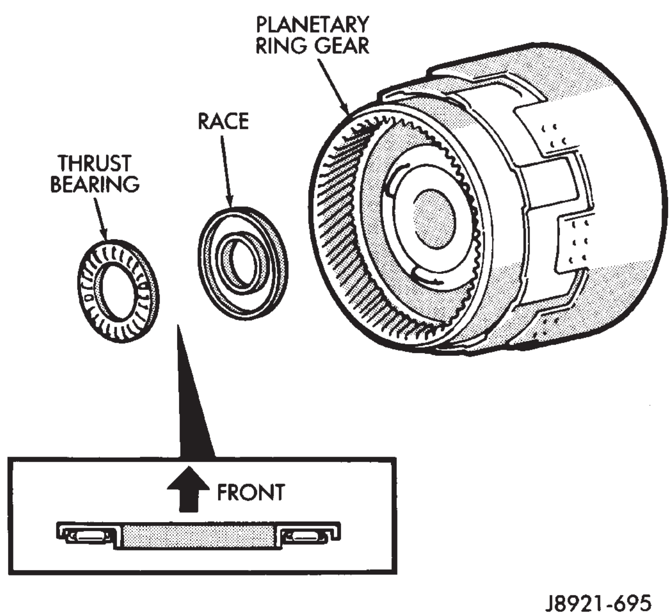


Fig. 28 Installing Ring Gear Bearing And Race

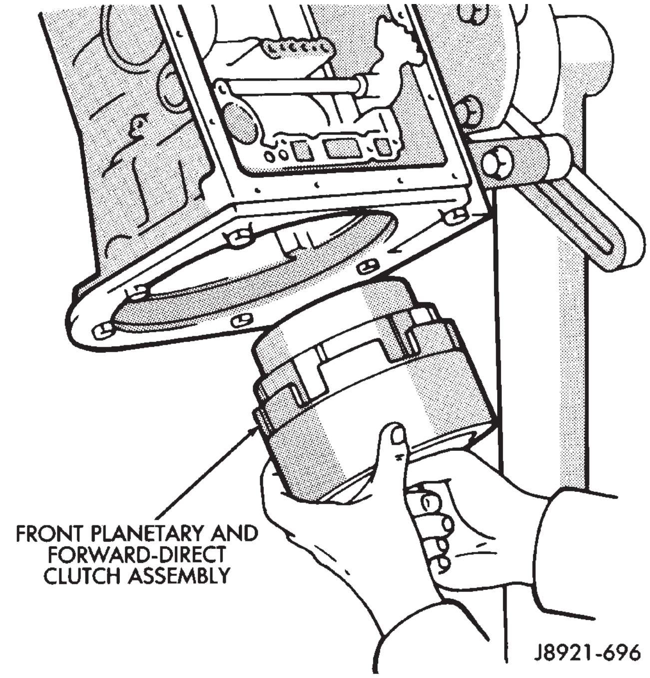


Fig. 29 Installing Front Planetary And Forward-Direct Clutch Assembly

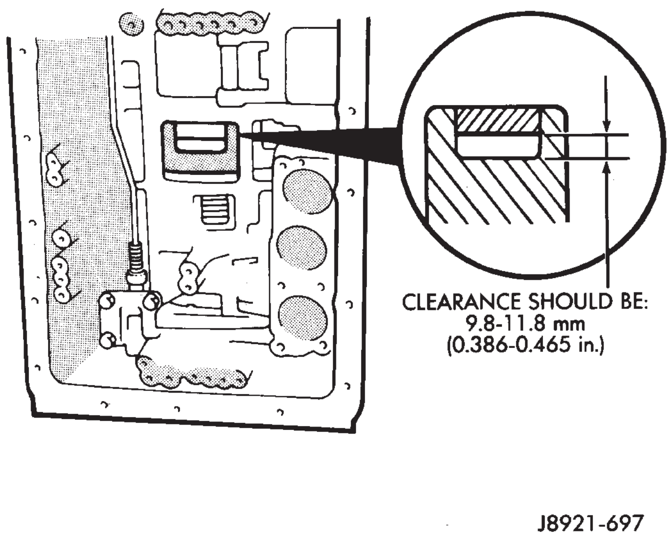


Fig. 30 Checking Input Drum-To-Direct Clutch Drum Clearance

(42) Install second coast brake piston snap ring with snap ring plier tool (Fig. 33).

(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 Tool 7552 (Fig. 35).

(d) If stroke length is incorrect, piston, cover or snap ring is not seated. Reassemble and check stroke again if necessary.

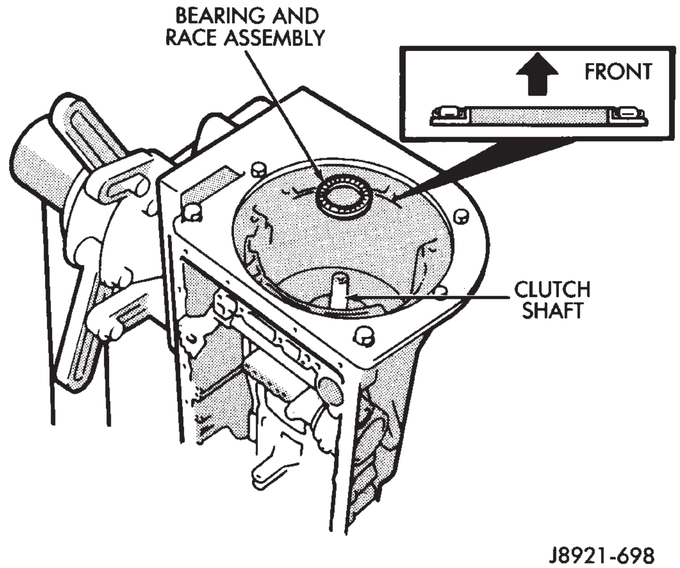


Fig. 31 Installing Clutch Shaft Thrust Bearing And Race Assembly

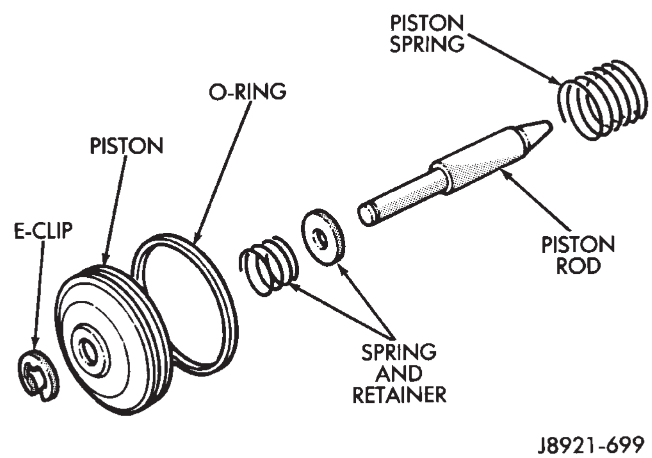


Fig. 32 Assembling Second Coast Brake Piston

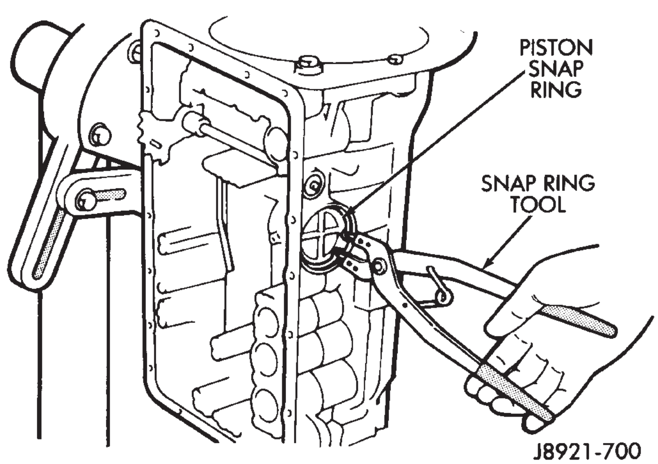


Fig. 33 Installing Second Coast Brake Piston Snap Ring

(44) Coat thrust race and tabbed washer with petroleum jelly and install them on overdrive support

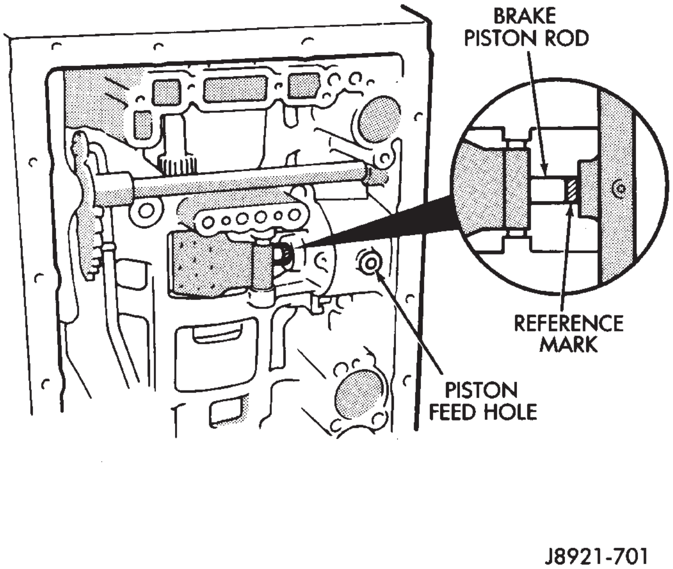


Fig. 34 Marking Brake Piston Rod

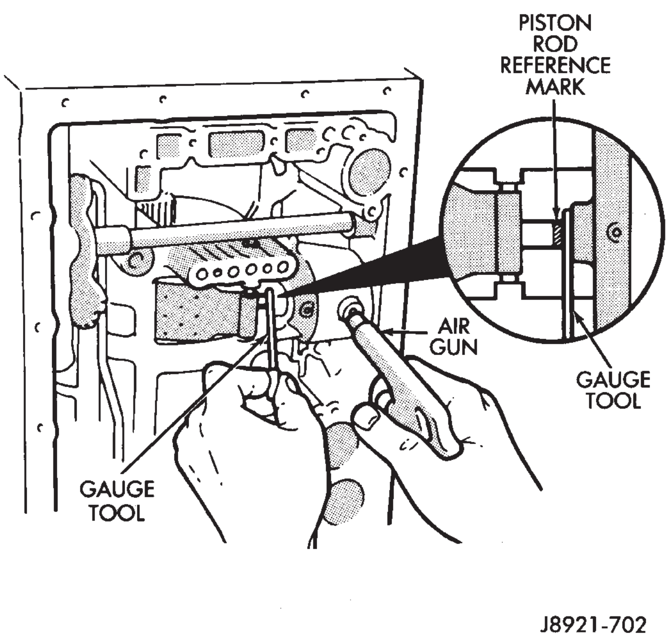


Fig. 35 Checking Second Coast Brake Piston Stroke

(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.).

(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).

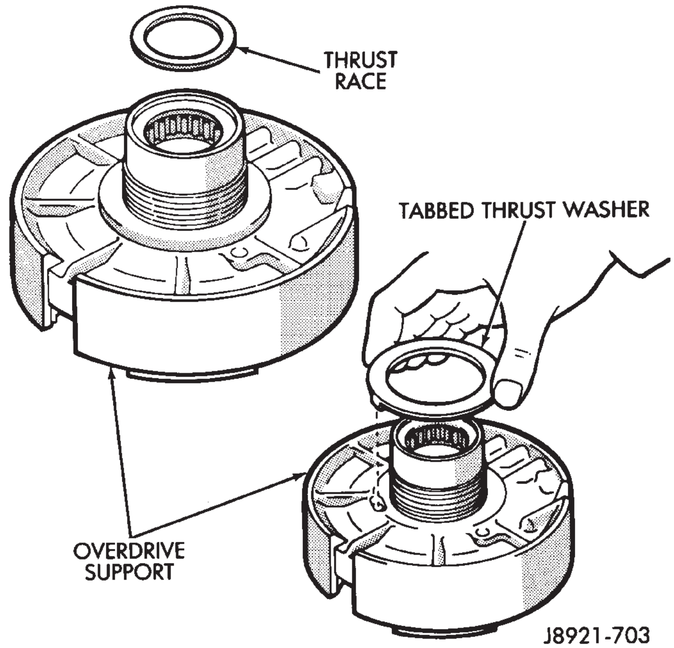


Fig. 36 Installing Overdrive Support Thrust Race And Washer

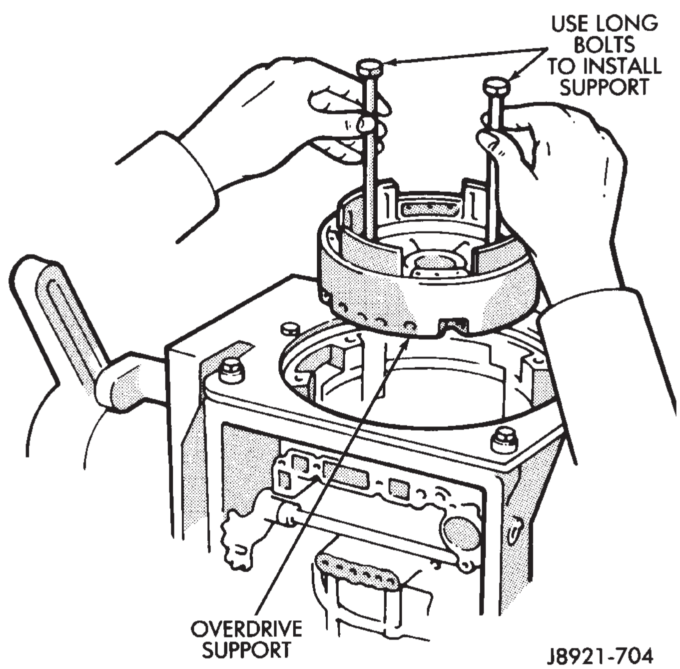


Fig. 37 Installing Overdrive Support

(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.).

(49) If output shaft end play is incorrect, one or more installed components are 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.

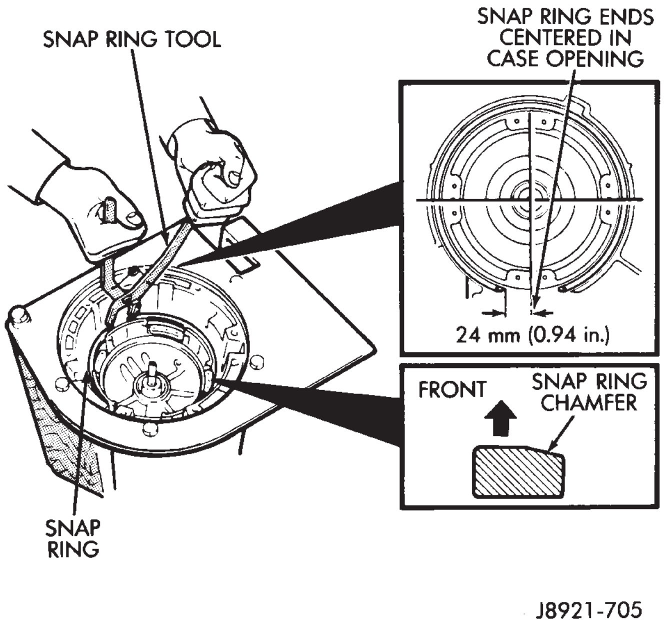


Fig. 38 Installing Overdrive Support Snap Ring

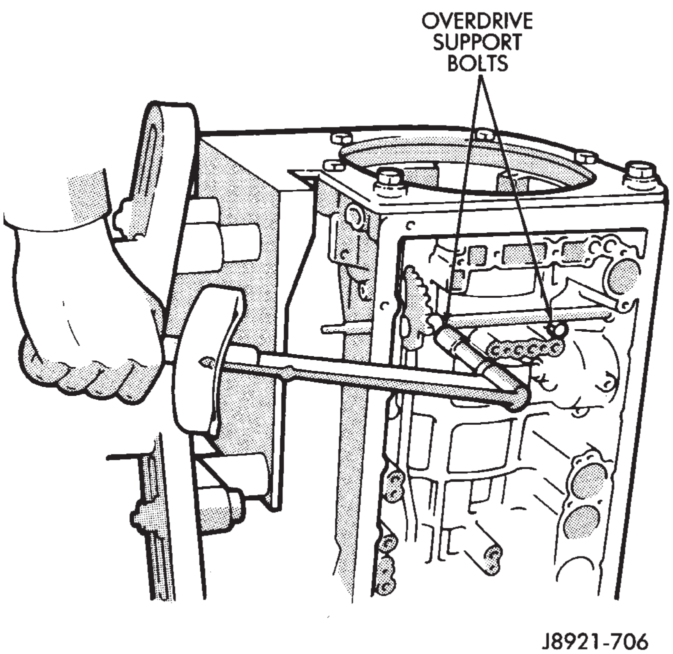


Fig. 39 Installing Overdrive Support Bolts

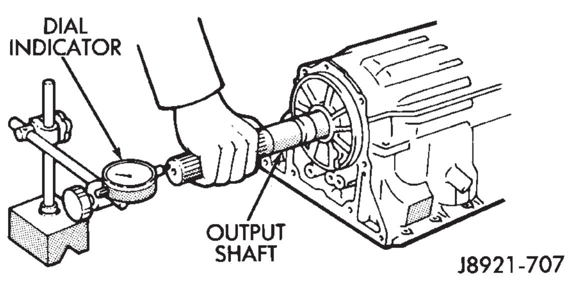


Fig. 40 Checking Output Shaft End Play

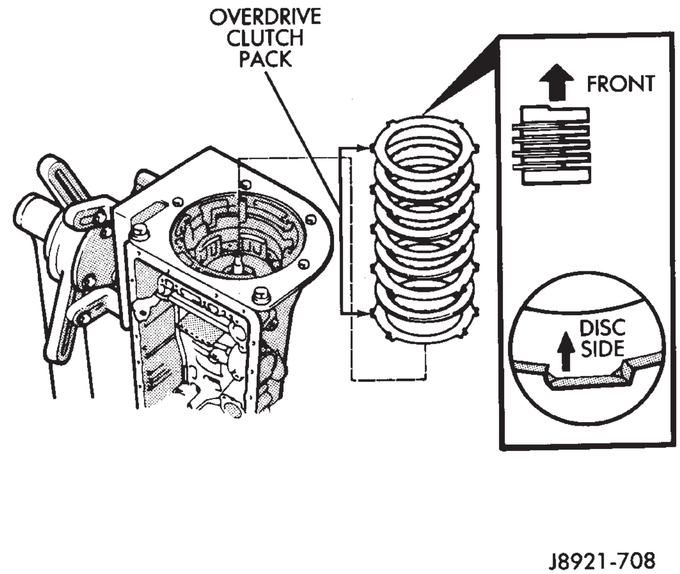


Fig. 41 Install Overdrive Clutch Pack

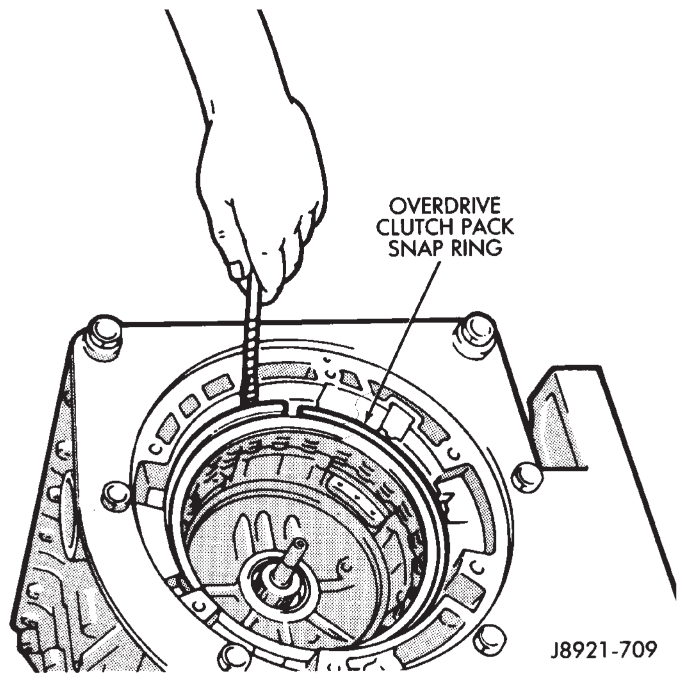


Fig. 42 installing Overdrive Brake Snap Ring

(51) Install stepped ring retainer plate with flat side facing disc. Then install brake pack snap ring (Fig. 42).

(52) Check overdrive brake piston stroke as follows:

(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.).

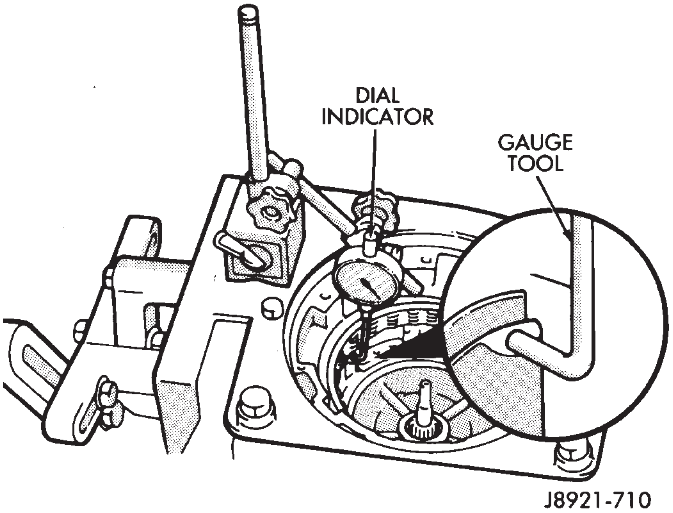


Fig. 43 Positioning Gauge Tool And Dial Indicator

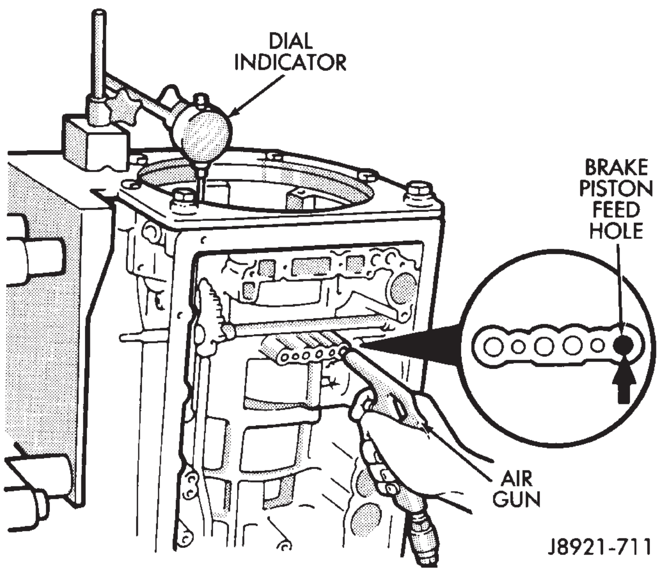


Fig. 44 Checking Overdrive Brake Piston Stroke

(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.

(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.).

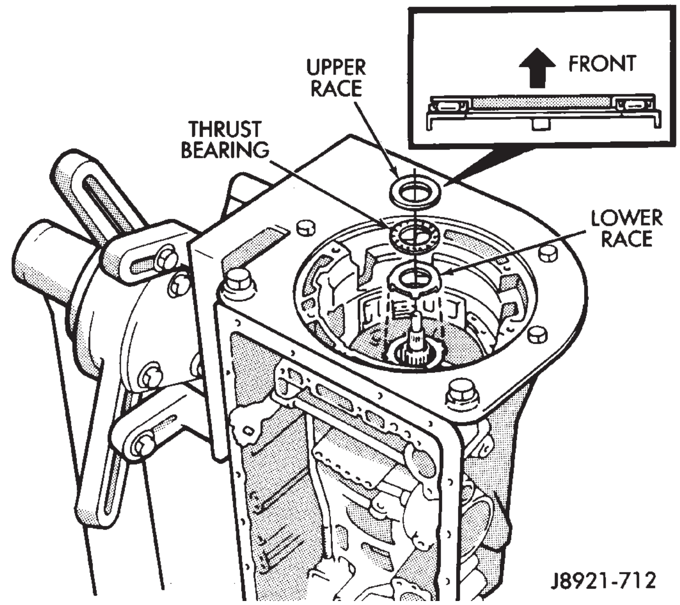


Fig. 45 Installing Overdrive Support Thrust Bearing And Races

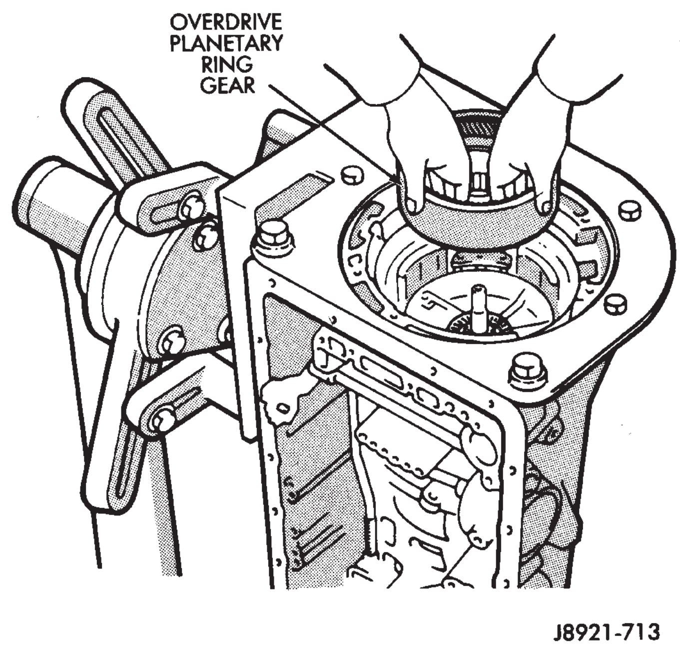


Fig. 46 Installing Overdrive Planetary Ring Gear

(57) Install overdrive planetary ring gear in support (Fig. 46).

(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.).

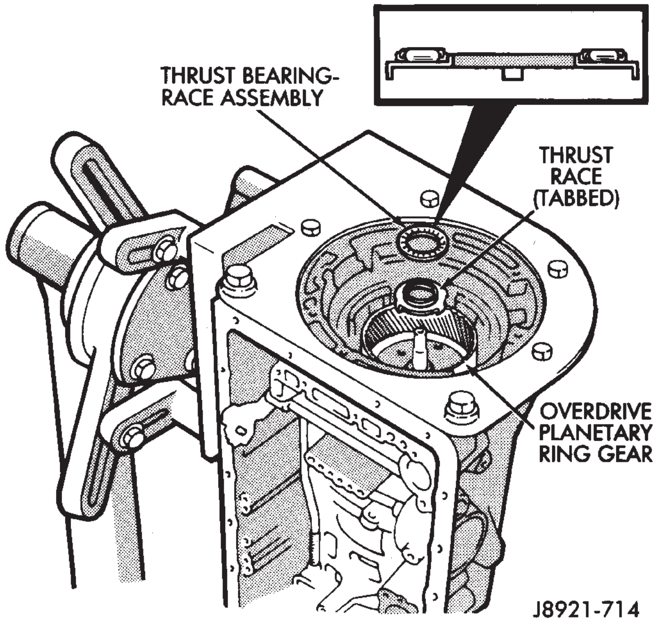


Fig. 47 Installing Ring Gear Thrust Bearing And Race

(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.).

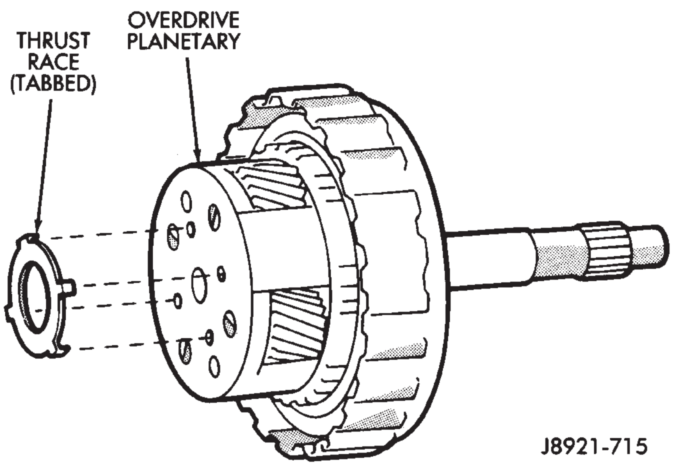


Fig. 48 Installing Planetary thrust Race

(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.

(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).

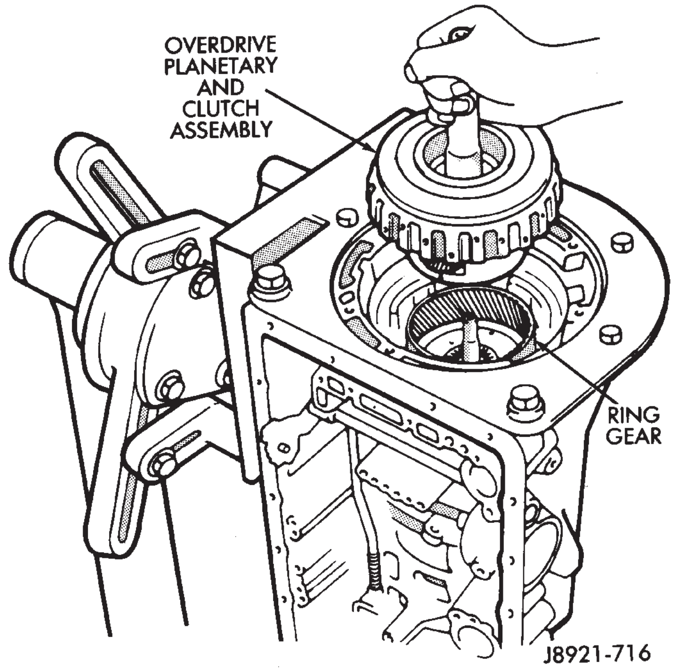


Fig. 49 Installing Overdrive Planetary And Clutch Assembly

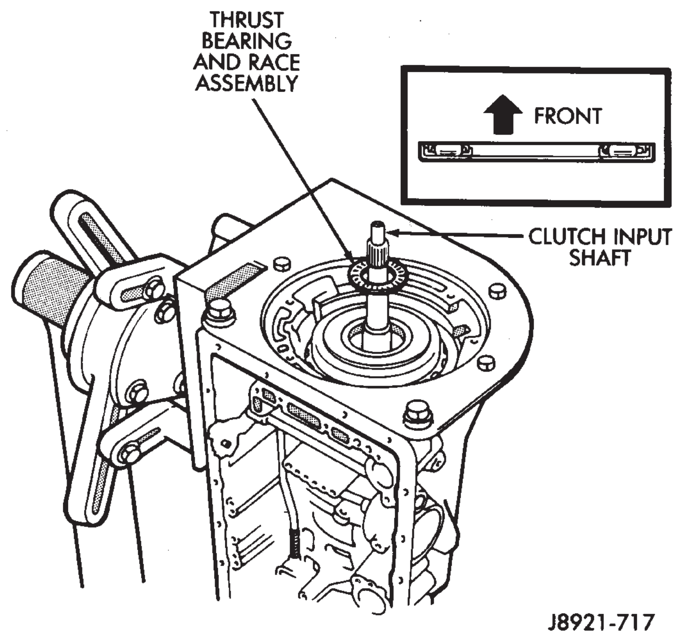


Fig. 50 Installing Input Shaft Thrust Bearing And Race Assembly

(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 outer diameter is 47.2 mm (1.858 in.) and inside diameter is 28.1 mm (1.106 in.).

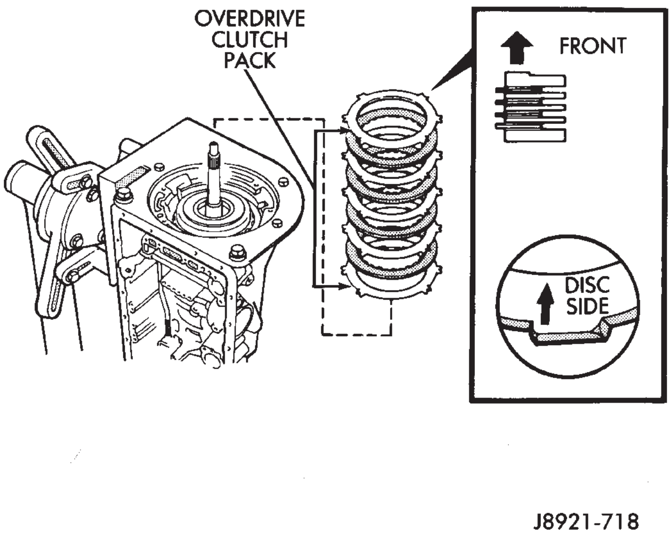


Fig. 51 Installing Overdrive Clutch Pack

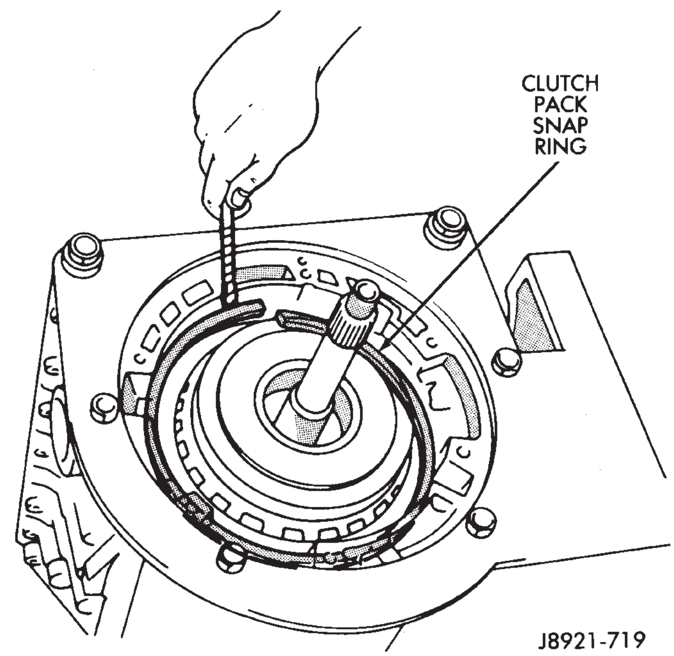


Fig. 52 Installing Clutch Pack Snap Ring

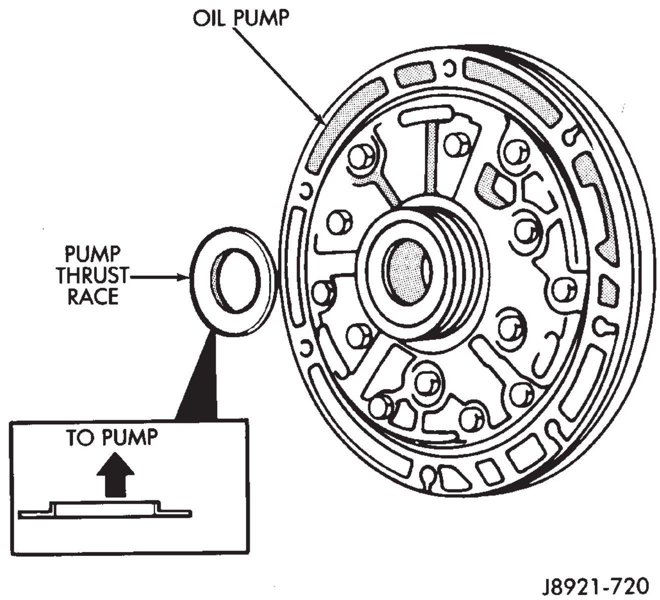


Fig. 53 Installing Oil Pump Thrust Race

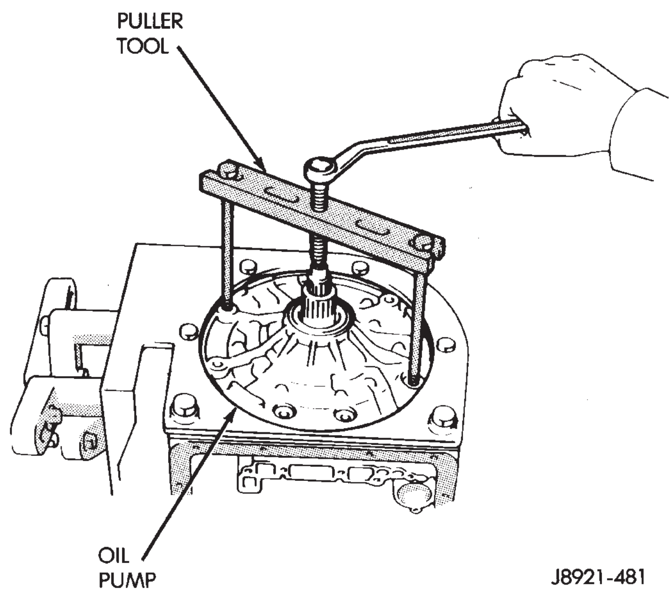


Fig. 54 Installing Oil Pump

(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).

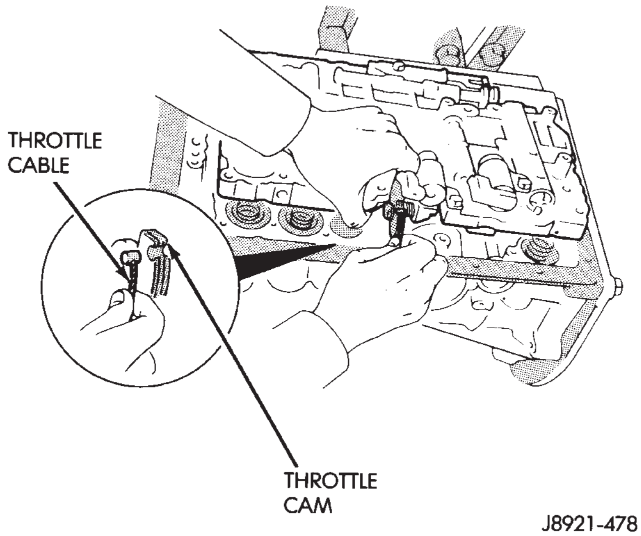


Fig. 55 Installing Transmission Throttle Cable

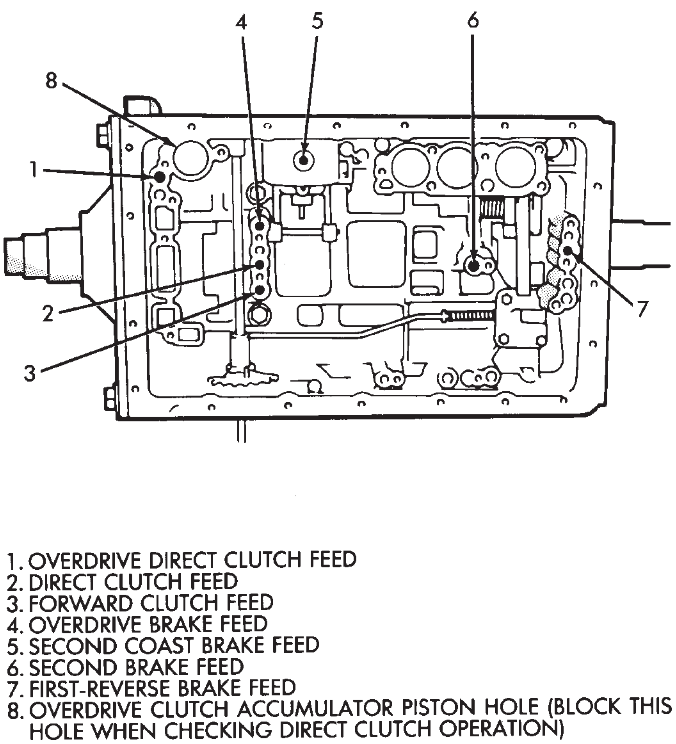


Fig. 56 Clutch And Brake Feed Hole Locations

(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.

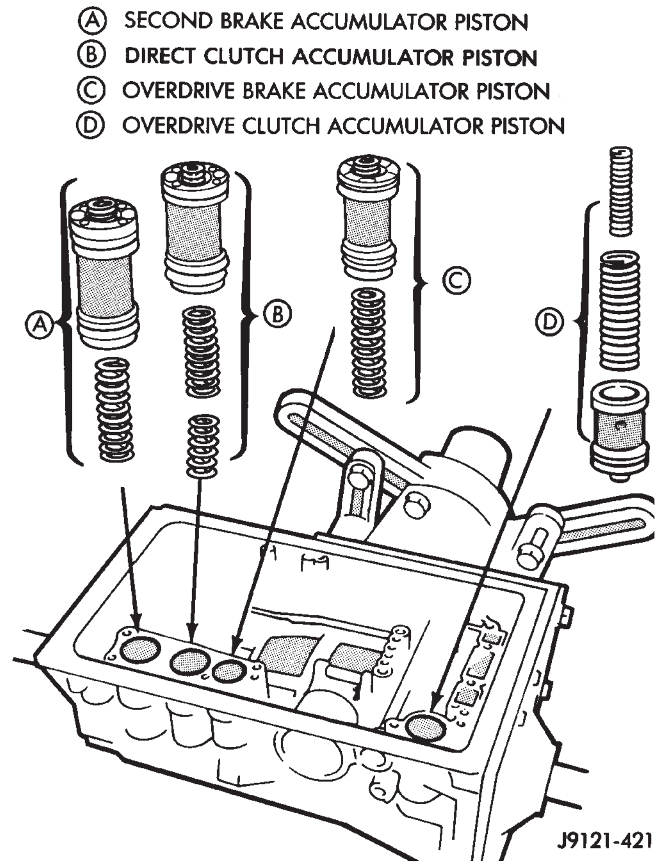


Fig. 57 Accumulator Piston And Spring Installation

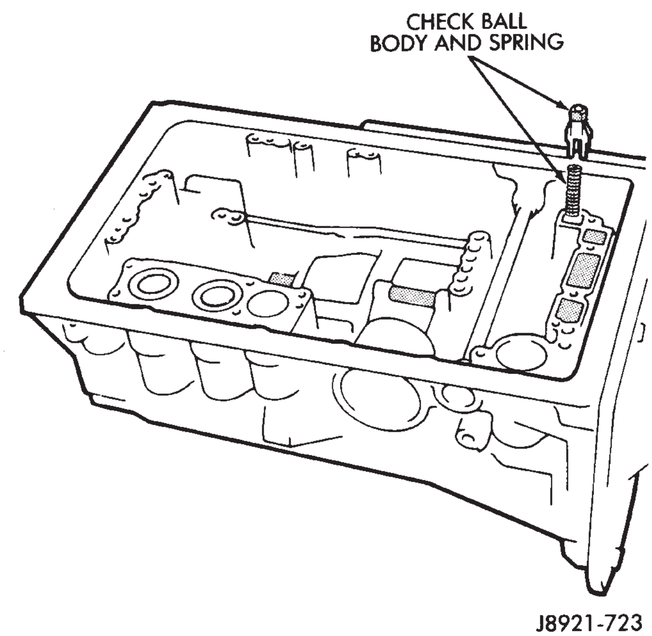


Fig. 58 Installing Check Ball Body And Spring

(80) Connect valve body solenoid wires to solenoids (Fig. 61).

(81) Install new O-ring on solenoid harness adapter and secure adapter to case.

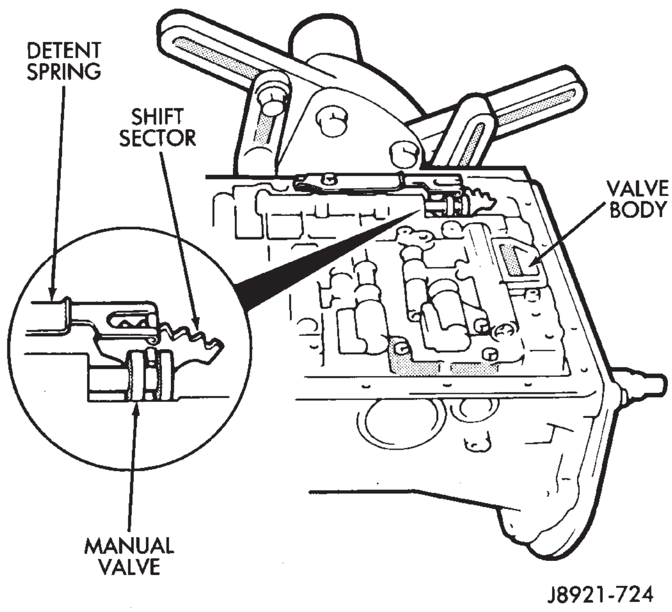


Fig. 59 Aligning Manual Valve, Shift Sector And Detent Spring

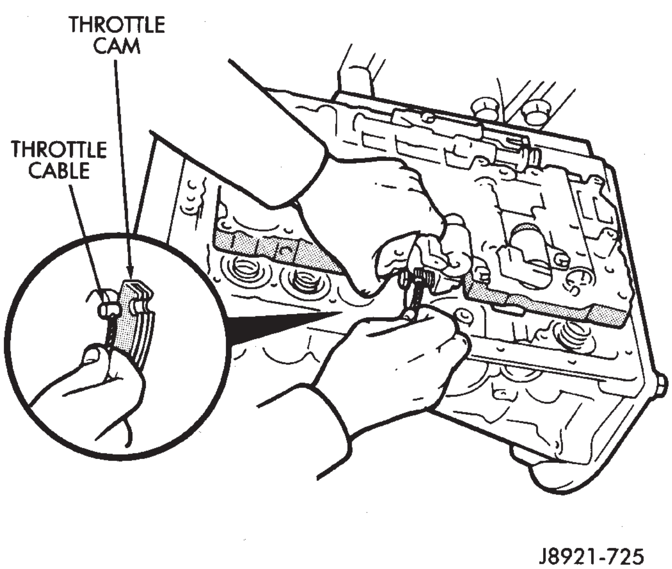


Fig. 60 Connecting Transmission Throttle Cable

(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).

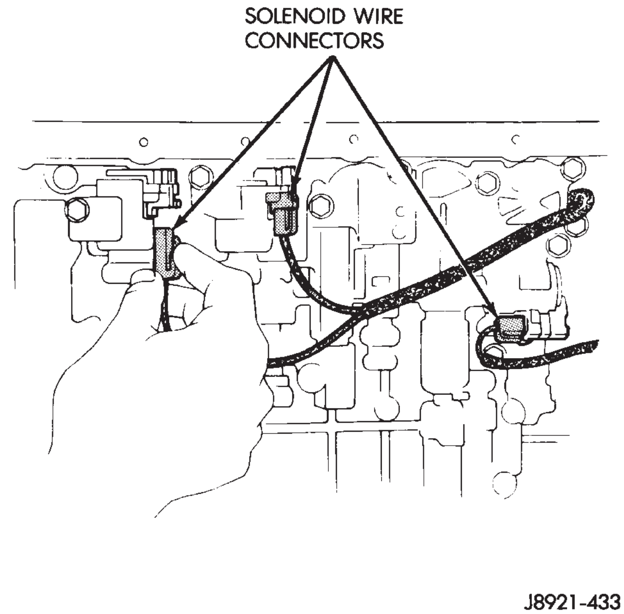


Fig. 61 Connecting Valve Body Solenoid Wires

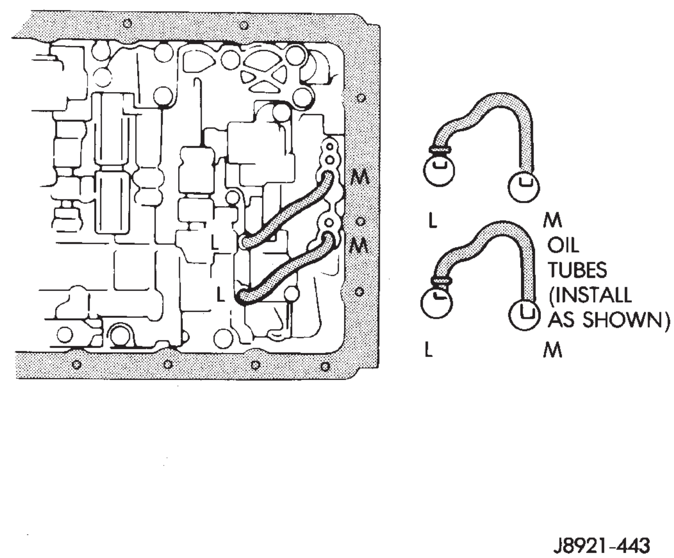


Fig. 62 Installing Valve Body Oil Tubes

(87) Install spacer and speedometer drive gear on output shaft. Then install retaining snap ring (Fig. 64).

(88) Apply bead of Mopar or Loctite 599 sealer to sealing surface at rear of case (Fig. 65).

(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.

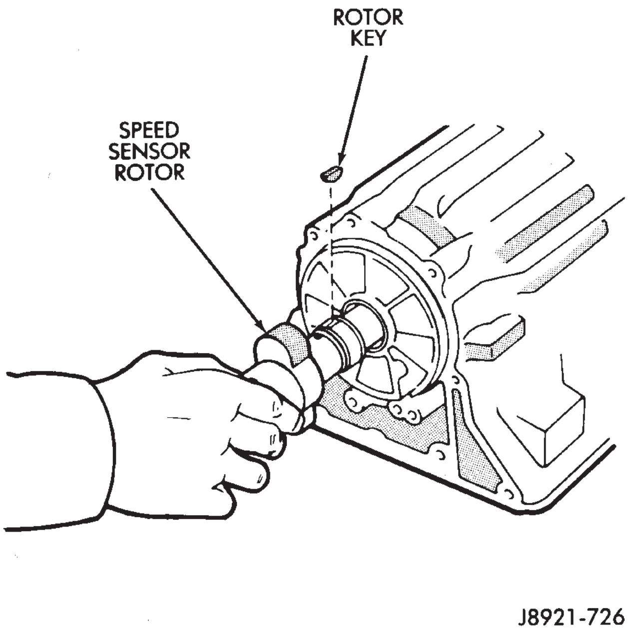


Fig. 63 Installing Transmission Speed Sensor Rotor And Key

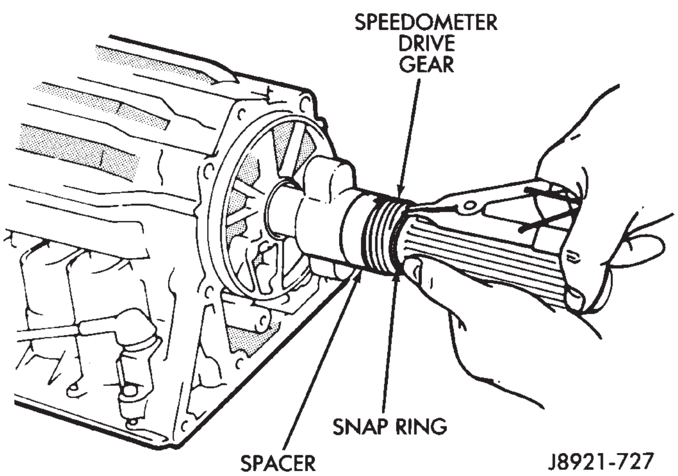


Fig. 64 Installing Spacer And Speedometer Drive Gear

(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).

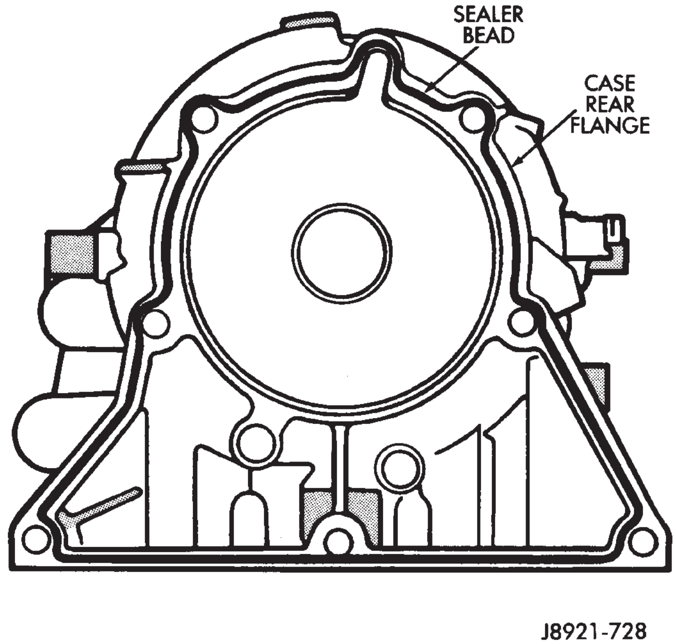


Fig. 65 Applying Sealer To Case Rear Flange

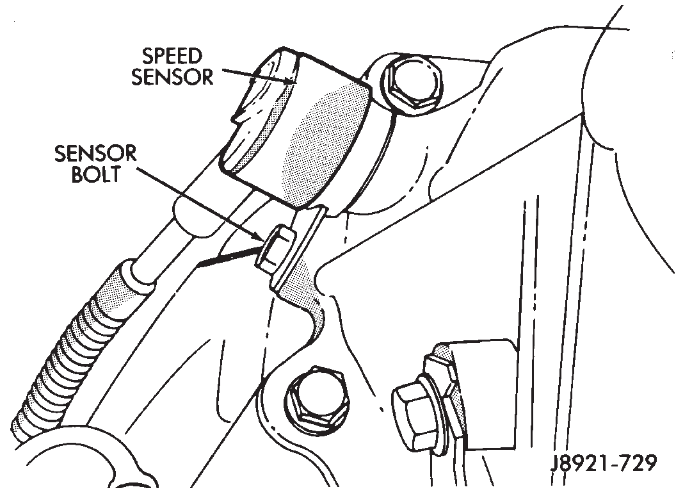


Fig. 66 Installing Transmission Speed Sensor

(97) Tighten park/neutral position switch adjusting bolt to 13 N•m (9 ft. lbs.) torque.

(98) Install transmission shift lever on manual 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. 70).

(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. 71). Use straight-edge and vernier calipers to measure distance. On 6-cyl. transmissions, distance should be 16.5 mm (0.650 in.).

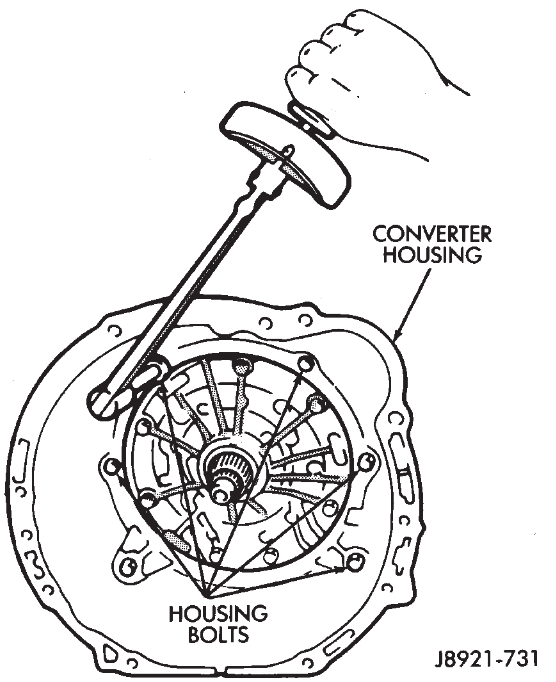


Fig. 67 Installing Converter Housing

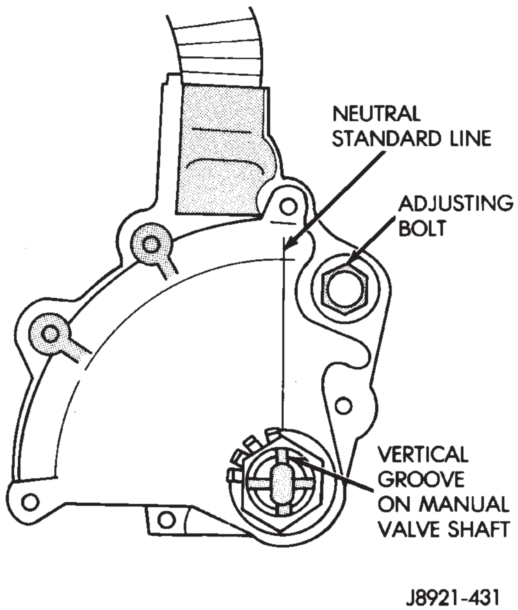


Fig. 68 Park/Neutral Position Switch Installation/ Adjustment

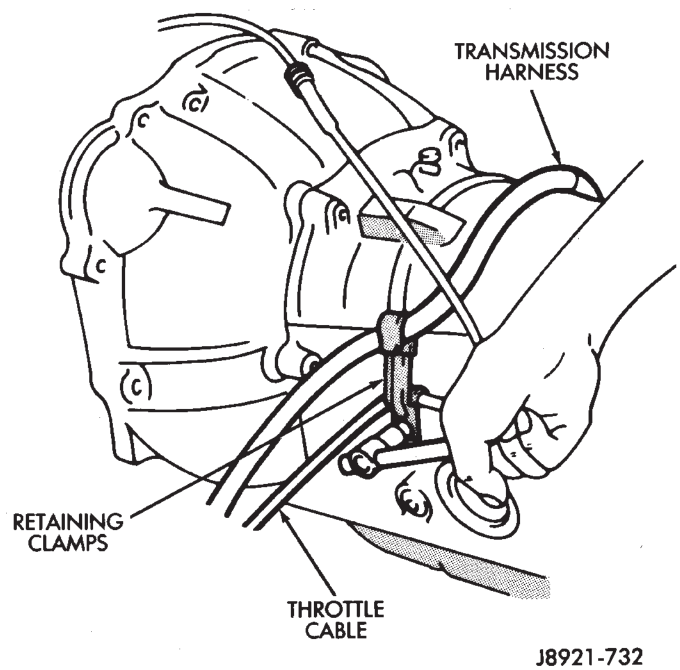


Fig. 70 Installing Cable/Harness Clamps

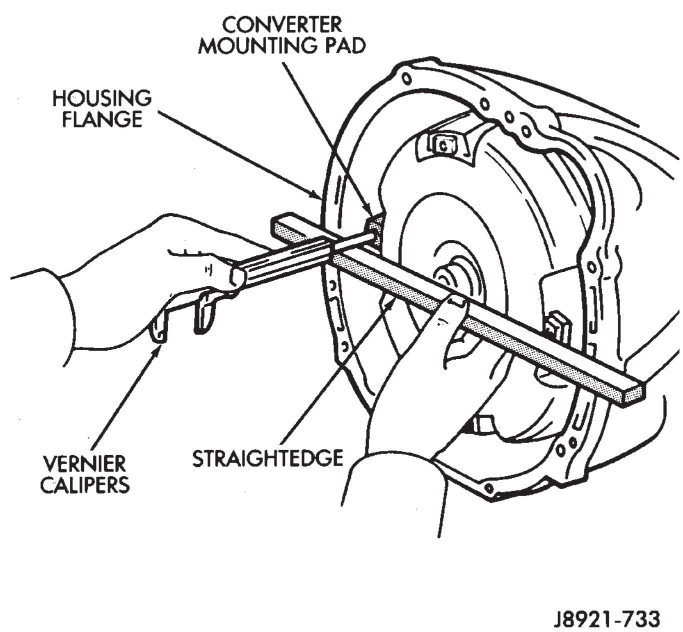


Fig. 71 Checking Converter Installation

46RH AUTOMATIC TRANSMISSION

CONTENTS

GENERAL INFORMATION

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TRANSMISSION DESCRIPTION

The Chrysler 46RH is 4-speed automatic transmission. Fourth gear is an overdrive range providing a ratio of 0.69:1. The 46RH is used for 5.2L engine applications.

The 46RH is a dual unit design. The assembly consists of a three speed automatic transmission with an overdrive unit attached at the rear (Figs. 1 and 2). First through third gear ranges are provided by the clutches, bands, overrunning clutch and planetary gear set in the transmission. Fourth gear range is provided by the overdrive unit.

The overdrive unit contains an overdrive clutch, direct clutch, compound planetary gear set and overrunning clutch. The overdrive clutch is applied in fourth gear only. The direct clutch is applied in all ranges except fourth gear.

The governor and park lock assemblies are located inside the overdrive unit. The unit must be removed and disassembled for service access to the park lock and governor components.

Fourth gear is controlled by a manually operated switch in the instrument panel. The switch is in circuit with the overdrive solenoid (on the valve body) and the powertrain control module. In the On position, current flows through the switch to the solenoid for the 3-4 shift sequence. The transmission must be in third gear before a 3-4 upshift will occur.

The overdrive solenoid will not be energized and a 3-4 upshift will not occur when the control switch is in the OFF position.

TORQUE CONVERTER

A three element torque converter is used for all applications. The converter consists of the impeller, stator and turbine. The converter also contains an overrunning clutch and a modulated converter clutch mechanism.

The converter modulated clutch consists of a sliding clutch piston, clutch springs and the clutch disc friction material. 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 the converter clutch valve and solenoid. Both are located on the transmission valve body. Clutch engagement occurs in drive range at speeds above approximately 30-35 mph.

The clutch provides reduced engine speed and greater fuel economy when engaged. Clutch engagement also provides reduced transmission fluid temperatures.

GEAR RATIOS

46RH forward gear ratios are:

- First gear = 2.45:1
- Second gear = 1.45:1
- Third gear = 1.00:1
- Fourth gear = 0.69:1.

FOURTH GEAR OVERDRIVE COMPONENTS

The 46RH model has three transmission shafts. An intermediate shaft is positioned between the input and output shafts. The output shaft is in the overdrive unit. The intermediate shaft is supported by the overdrive piston retainer and piloted in the output shaft (Fig. 1).

The overdrive piston and retainer are located at the rear of the transmission case. The retainer serves as both the rear support and pressure chamber for the overdrive piston. The intermediate shaft is splined to the overdrive direct clutch sliding hub, planetary assembly and overrunning clutch (Fig. 1).

The governor components and speedometer drive are located on the output shaft in the overdrive unit. Two bearings are used to support the output shaft. A longer park rod assembly is also required.

There are no rotating seal rings or pressurized oil for the direct clutch. The clutch is applied by spring pressure and released by movement of the overdrive clutch piston during the 3-4 upshift.

The governor is operated by fluid pressure supplied through pressure tubes. The tubes are permanently attached to the governor support. Governor fluid pressure is transmitted through the intermediate shaft to the tubes.

Governor pressure and overdrive clutch pressure taps are provided in the transmission case for pressure testing purposes.

The overdrive unit contains a direct clutch, an overdrive clutch and an overrunning clutch. Fourth gear range is provided by an additional planetary gear set In the overdrive unit.

The direct clutch is applied by spring pressure. A high pressure spring rated at approximately 830 pounds (5530 kPa) tension, holds the clutch in engagement. The sun gear, direct clutch sliding hub and drum are splined to the annulus gear for direct drive. For coasting or reverse gear, power flows only through the direct clutch.

A timing valve disengages the torque converter clutch prior to a 4-3 downshift. The clutch solenoid, engagement valve, and timing valve are actuated in fourth gear range.

The fourth gear shift valves and plugs are located in the valve body lower housing (Fig. 2). The components include:

- a separate housing for the overdrive valves and plugs
- an overdrive solenoid
- a converter clutch solenoid
- a 3-4 shift valve
- a 3-4 timing valve
- a 3-4 accumulator
- a 3-4 shuttle valve
- an overdrive separator plate.

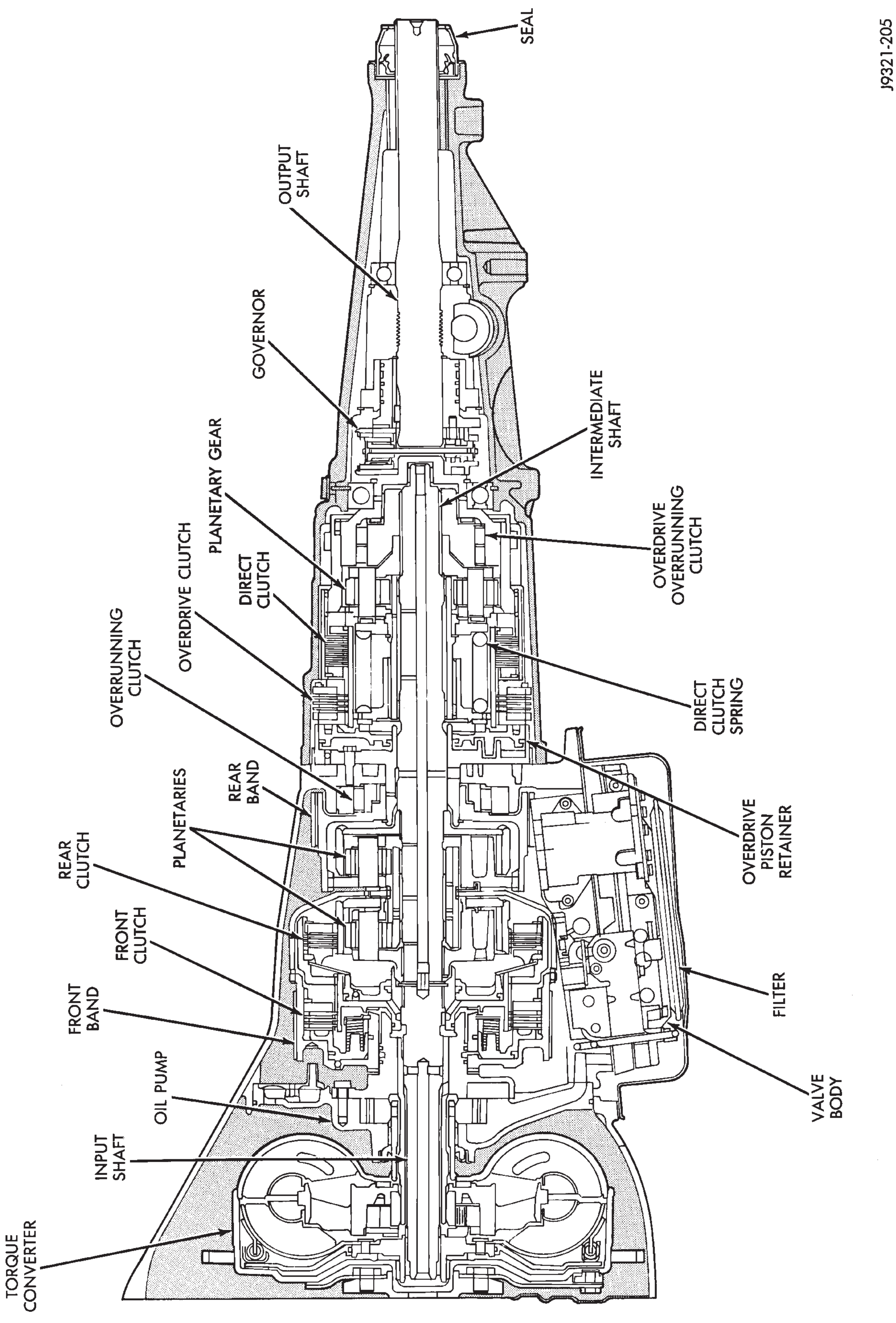

Fig. 1 46RH Transmission And Overdrive Unit

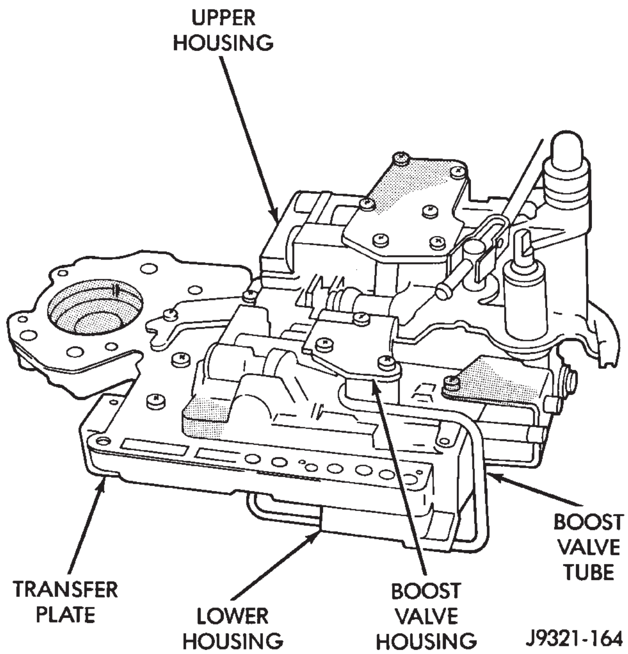

Fig. 2 46RH Valve Body

RECOMMENDED FLUID

The recommended (and preferred) fluid for 46RH transmissions is Mopar ATF Plus, type 7176. Mopar Dexron II fluid can be used for topping off the transmission fluid level during normal maintenance checks. Dexron II can also be used for refill after overhaul if ATF Plus is not readily available.

TRANSMISSION IDENTIFICATION

The transmission part/identification numbers and codes are stamped on the left side of the case just above the oil pan gasket surface (Fig. 3).

The first letter/number group is the assembly part number. The next number group the transmission build date. The last number group is the transmission serial number. Refer to this information when ordering replacement parts.

FOURTH GEAR OVERDRIVE CONTROLS

Shift Sequence

Fourth gear overdrive range is electronically controlled and hydraulically activated. Various sensor inputs are supplied to the powertrain control module to operate the overdrive solenoid on the valve body. The solenoid contains a check ball that opens and closes a vent port in the 3-4 shift valve feed passage.

The overdrive solenoid (and check ball) are not energized in first, second, third or reverse gear. The vent port remains open diverting line pressure from the 2-3 shift valve away from the 3-4 shift valve.

The overdrive switch must be in the On position to transmit signals to the solenoid. A 3-4 upshift occurs only when the overdrive solenoid is energized by an electrical signal from the powertrain control module.

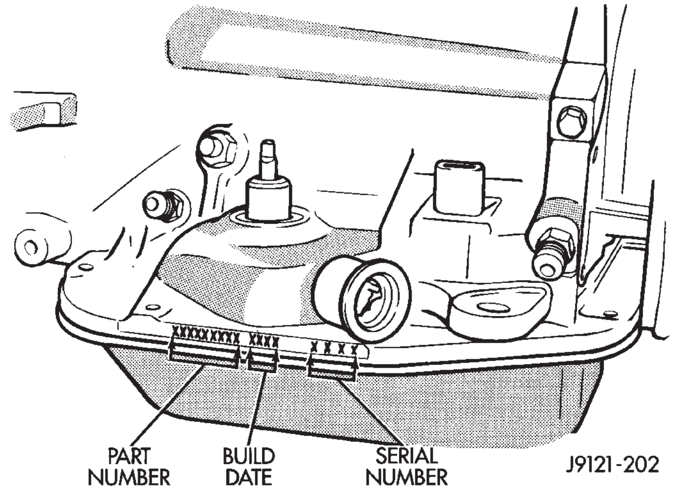

Fig. 3 Transmission Identification Code Location—46RH

The solenoid is energized upon receiving a signal. This causes the check ball to close the vent port. Closing the vent port allows line pressure from the 2-3 shift valve to act directly upon the 3-4 upshift valve.

Line pressure acting on the 3-4 shift valve overcomes valve spring tension moving the valve to the upshift position. This action exposes the feed passages to the 3-4 timing valve, 3-4 shuttle valve, 3-4 accumulator and ultimately to the overdrive piston.

Line pressure through the timing and shuttle valves move the overdrive piston into simultaneous contact with the overdrive clutch and the direct clutch sliding hub.

The overdrive clutch is engaged and the direct clutch is disengaged simultaneously to complete the 3-4 upshift. The boost valve provides increased fluid apply pressure to the overdrive clutch during the 3-4 upshift and during fourth gear operation.

The overdrive piston engages the overdrive clutch by pressing directly against the clutch pressure plate. The overdrive clutch also disengages the direct clutch during 3-4 upshifts. As fluid pressure extends the overdrive piston, the piston contacts the direct clutch hub pressing it rearward. This action compresses the direct clutch spring relieving spring load on the clutch pack. The clutch is disengaged once spring load is relieved.

The 3-4 accumulator cushions overdrive clutch engagement to smooth the transition into fourth gear. The accumulator is charged at the same time as apply pressure acts against the overdrive piston.

Closed throttle 3-4 upshifts occur at approximately 25-28 mph regardless of axle ratio. Closed throttle 4-3 downshifts occur at approximately 25 mph, regardless of axle ratio.

A 3-4 upshift will not occur if throttle opening is greater than approximately 70 percent.

Converter clutch engagement in overdrive fourth gear is controlled by sensor inputs to the powertrain control module. In third gear above 25 mph, sensor inputs to the control module that determine clutch engagement and shift timing are:
- coolant temperature (verifies temperature minimum of 60° F)
- engine speed
- vehicle speed
- throttle position
- manifold vacuum (to MAP sensor)

Gearshift Mechanism

The gear shift mechanism provides six shift positions which are:
- park (P)
- reverse (R)
- neutral (N)
- drive (D)
- manual second (2)
- manual low (1)

Manual low (1) position provides first gear only. Overrun braking is also provided in this range. Manual second (2) range provides first and second gear only.

Drive range provides first, second third and overdrive fourth gear ranges. The shift into overdrive fourth gear range occurs only after the transmission has completed the shift into D third gear range. No further movement of the shift mechansism is required to complete the 3-4 shift.

The fourth gear upshift occurs automatically when the overdrive control switch is in the ON position. Shift timing is determined by sensor inputs to the powertrain control module.

Overdrive Control Switch

The overdrive control switch is located in the instrument panel. In the On position, automatic shifts into fourth gear overdrive will occur. In the Off position, the switch overrides the powertrain control module preventing a shift to overdrive fourth gear range.

The switch has an indicator light that illuminates when overdrive is turned off. The switch also resets when the ignition key is turned to the OFF position so that the automatic overdrive feature is restored.

The use of fault codes is employed to help diagnose the electronic components that operate the overdrive unit and torque converter clutch.

TRANSMISSION HYDRAULIC CONTROLS

The 46RH hydraulic control system provides fully automatic operation. The system performs five basic functions which are: pressure supply, pressure regulation, flow control, clutch/band application, and lubrication.

PRESSURE REGULATION

The pressure regulator valve maintains line pressure. The amount of pressure developed is controlled by throttle pressure which is dependent on the degree of throttle opening. The regulator valve is located in the valve body.

The throttle valve determines line pressure and shift speed. Governor pressure increases in proportion to vehicle speed. The throttle valve controls upshift and downshift speeds by regulating pressure according to throttle position.

Shift Valve Flow Control

The manual valve is operated by the gearshift linkage and provides the operating range selected by the driver.

The 1-2 shift valve provides 1-2 or 2-1 shifts and the 2-3 shift valve provides 2-3 or 3-2 shifts.

The kickdown valve provides forced 3-2 or 3-1 downshifts depending on vehicle speed. Downshifts occur when the throttle is opened beyond downshift detent position. Detent is reached just before wide open throttle position.

The 2-3 valve throttle pressure plug provides 3-2 downshifts at varying throttle openings depending on vehicle speed.

The 1-2 shift control valve transmits 1-2 shift pressure to the accumulator piston. This controls kickdown band capacity on 1-2 upshifts and 3-2 downshifts.

The 3-4 shift valve, shuttle valve, timing valve and accumulator are only actuated when the overdrive solenoid is energized.

The solenoid contains a check ball that controls a vent port to the 3-4 valve. The check ball either diverts line pressure away from or directly to, the 3-4 shift valve. Energizing the solenoid causes the check ball to close the vent port allowing line pressure to act upon the 3-4 upshift valve.

The 46RH valve body is equipped with a limit valve. The valve determines maximum speed at which a 3-2 part throttle kickdown can be made.

The 2-3 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.

The 3-4 shuttle valve uses a combination of throttle and governor pressure to control the rate of overdrive piston apply and release. This is done to maintain shift quality at varying throttle openings.

The 3-4 timing valve is moved by line pressure coming through the 3-4 shift valve. The timing valve holds the 2-3 shift valve in an upshift position. The purpose is to prevent the 2-3 valve from up or downshifting before the 3-4 valve.

The 3-4 accumulator is mounted on the overdrive housing. It performs the same function as the 2-3 accumulator. It is used to smooth engagement during the 3-4 shift.

The boost valve provides increased fluid apply pressure for converter clutch and overdrive clutch engagement. The valve is connected to the valve body upper and lower housings by a connecting tube.

Converter Clutch Control

The converter clutch valve applies the converter clutch when supplied with line pressure through the converter clutch solenoid. The solenoid is mounted on the valve body and energized by an electrical signal from the powertrain control module. Electronic control of converter clutch operation includes clutch release at closed throttle during warmup and during part throttle acceleration. The boost valve provides additional apply pressure for converter clutch application.

The switch valve directs fluid apply pressure to the converter clutch in one position and releases it in the opposite position. It also directs oil to the cooling and lube circuits. The switch valve regulates oil pressure to the torque converter by limiting maximum oil pressure to 130 psi.

Clutch/Band Application

The front/rear clutch pistons and servo pistons are actuated by line pressure. When fluid pressure is released, the clutch pistons are released by spring pressure.

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 all throttle openings.

The overdrive direct clutch is applied by spring pressure. The direct clutch is applied in all ranges except fourth gear.

The overdrive clutch is applied in fourth gear only. The clutch is applied by the overdrive piston which is actuated by line pressure through the 3-4 shift valve.

46RH TRANSMISSION DIAGNOSIS

INDEX

GENERAL INFORMATION

Begin diagnosis by checking the easily accessible items such as fluid level, fluid condition and throttle cable/shift linkage adjustments. 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:

(1) Preliminary diagnosis
(2) Fluid Level and condition
(3) Leak tests (if fluid level is low)
(4) Linkage Adjustment
(5) Overdrive control switch test
(6) Road test
(7) Stall test
(8) Hydraulic pressure test
(9) Air pressure tests
(10) 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 and gearshift linkage if complaint was based on delayed, erratic, or harsh shifts.
(3) Road test and note how transmission upshifts, downshifts and engages.
(4) Perform stall test if complaint is based on sluggish acceleration or if abnormal throttle opening is needed to maintain normal speeds with a properly tuned engine.
(5) Perform hydraulic pressure test if shift problems were noted during road test.
(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.

CHECKING FLUID LEVEL AND CONDITION

(1) Place vehicle on level surface. This is important for an accurate reading.
(2) Do not check level until fluid is at normal hot operating temperature of approximately 180°F. This is necessary to avoid false readings which could produce under or over fill condition.
(3) Start and run engine at curb idle speed and apply parking brakes.
(4) Shift transmission through all gear ranges and back to Neutral.
(5) Clean top of filler tube and dipstick to keep dirt out of tube.
(6) Remove dipstick and check fluid level as follows:
(a) Dipstick has three fluid level indicating marks which are a MIN dot mark, an OK mark and a MAX fill arrow mark:
(b) Correct level is to Full, or MAX arrow mark on dipstick. This is correct maximum hot fluid level. Acceptable level is between OK mark and max arrow mark on dipstick.
(c) If level is at, or below MIN level dot on dipstick, add only enough fluid to restore correct level.

Mopar ATF Plus, type 7176 is the preferred fluid. Mopar Dexron II can be used if ATF Plus is not readily available.

CAUTION: Do not overfill the transmission. Overfilling may cause leakage out the pump vent which can be mistaken for a pump seal leak. In addition, overfilling will also cause fluid aeration and foaming as the excess fluid is picked up and churned by the gear train. This will reduce the life of the fluid significantly.

(7) Check fluid condition. Fluid should be dark to light red in color and free of particles and sludge.

(a) If fluid is discolored or smells burned but transmission operation was OK, flush cooler and lines and change fluid and filter. Then road test again to confirm proper operation.

(b) If fluid is black, dark brown, turned to sludge, contains extensive amount of metal or friction material particles, transmission will probably need overhaul (especially if shift problems were evident during road test).

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, aerating the fluid and 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.

OVERDRIVE ELECTRICAL CONTROLS

The electrical controls governing the shift into fourth gear consist of the control switch on the instrument panel and the overdrive solenoid on the valve body. The control switch is in circuit with the solenoid and must be in the On position to energize the solenoid. The transmission must also have reached third gear range before the shift to fourth gear will occur.

The control switch, valve body solenoid, case connectors and related wiring can all be tested with a 12 volt test lamp or a volt/ohmmeter. Check continuity of each component when diagnosis indicates this is necessary.

Switch and solenoid continuity should be checked whenever the transmission fails to shift into fourth gear range.

TRANSMISSION THROTTLE CABLE AND SHIFT LINKAGE

Transmission throttle cable adjustment is important to proper operation. This adjustment positions the valve body throttle valve which controls shift speed, quality and part throttle downshift sensitivity.

If cable setting is too short, early shifts and slippage between shifts may occur. If the setting is too long, shifts may be delayed and part throttle downshifts may be very sensitive. Refer to the In-Vehicle Service section for adjustment procedure.

Shift linkage adjustment is important because it positions the valve body manual valve. Incorrect adjustment will cause creeping in Neutral, premature clutch wear, delayed engagement in any gear, or a no-start in Park or Neutral position.

Proper operation of the park/neutral position switch will provide a quick check of linkage adjustment. Refer to the In-Vehicle Service section for linkage adjustment procedure.

ROAD TESTING

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 shift variations and engine flare, which indicates slippage. Note if shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Slippage indicated by engine flare, usually means clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul 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. 1) provides a basis for analyzing road test results.

ANALYZING THE ROAD TEST

Refer to the Clutch and Band Application chart (Fig. 1) and note which elements are in use in the various gear ranges.

Note that the rear clutch is applied in all forward ranges (D, 2, 1). The transmission overrunning clutch is applied in first gear (D, 2 and 1 ranges) only. The rear band is applied in 1 and R range only.

Note that the overdrive clutch is applied only in fourth gear and the overdrive direct clutch and overrunning clutch are applied in all ranges except fourth gear.

For example: If slippage occurs in first gear in D and 2 range but not in 1 range, the transmission overrunning clutch is faulty. Similarly, if slippage occurs in any two forward gears, the rear clutch is slipping.

SHIFT LEVER POSITION	TRANSMISSION CLUTCHES AND BANDS					OVERDRIVE CLUTCHES		
	FRONT CLUTCH	FRONT BAND	REAR CLUTCH	REAR BAND	OVERRUN. CLUTCH	OVERDRIVE CLUTCH	DIRECT CLUTCH	OVERRUN. CLUTCH
Reverse	X			X			X	
Drive Range								
First			X		X		X	X
Second		X	X				X	X
Third	X		X				X	X
Fourth	X		X			X		
2-Range: (Manual Second):								
Second		X	X				X	X
First			X		X		X	X
1-Range (Manual Low):								
First			X	X	X		X	X

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Fig. 1 Clutch And Band Application Chart

Applying the same method of analysis, note that the front and rear clutches are applied simultaneously only in D range third and fourth gear. If the transmission slips in third gear, either the front clutch or the rear clutch is slipping.

If the transmission slips in fourth gear but not in third gear, the overdrive clutch is slipping. By selecting another gear which does not use these clutches, the slipping unit can be determined. For example, if the transmission also slips in Reverse, the front clutch is slipping. If the transmission does not slip in Reverse, the rear clutch is slipping.

If slippage occurs during the 3-4 shift or only in fourth gear, the overdrive clutch is slipping. Similarly, if the direct clutch were to fail, the transmission would lose both reverse gear and overrun braking in 2 position (manual second gear). If the transmission slips in any other two forward gears, the transmission rear clutch is probably slipping.

If the transmission will not shift to fourth gear, the control switch, overdrive solenoid or related wiring may also be the problem cause.

This process of elimination can be used to identify a slipping unit and check operation. Proper use of the Clutch and Band Application Chart is the key.

Although road test analysis will help determine the slipping unit, the actual cause of a malfunction usually cannot be determined until hydraulic and air pressure tests are performed. Practically any condition can be caused by leaking hydraulic circuits or sticking valves.

Unless a malfunction is obvious, such as no drive in D range first gear, do not disassemble the transmission. Perform the hydraulic and air pressure tests to help pinpoint the problem cause.

HYDRAULIC PRESSURE TEST

Hydraulic test pressures range from a low of one psi (6.895 kPa) governor pressure, to 300 psi (2068 kPa) at the rear servo pressure port in reverse. Use 100 psi Gauge C-3292 to check pressure at the accumulator, front servo and governor. Use 300 psi Gauge C-3293 to check pressure at the rear servo.

PRESSURE TEST PORT LOCATIONS

There are pressure test ports at the accumulator, front servo, and rear servo. Governor and overdrive clutch pressure test ports are located at the left and right rear sides of the case (Fig. 6).

Line pressure is checked at the accumulator port on the right side of the case. The front servo pressure port is at the right side of the case just behind the filler tube opening.

The rear servo and governor pressure ports are at the right rear of the transmission case. The overdrive clutch pressure port is at the left rear of the case (Fig. 2).

An accurate tachometer and two test gauges are required for the pressure test. Test Gauge C-3292 has a 100 psi range and is used at the accumulator, governor, front servo, and overdrive pressure ports. Test Gauge C-3293 has a 300 psi range and is used at the rear servo port where pressures range from 250 to 290 psi. In cases where two test gauges are required, the 300 psi gauge can be used at any of the other test ports.

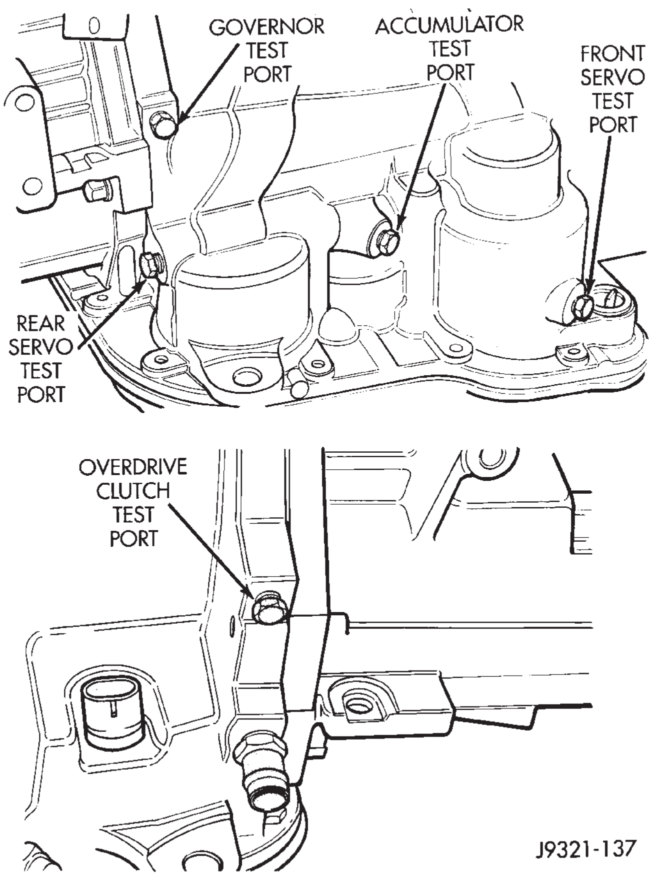

Fig. 2 Pressure Test Port Locations—46RH

HYDRAULIC 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 servo circuit. Test Gauges C-3292 and C-3293 are required for this test. Gauge C-3292 has a 100 psi range. Gauge C-3293 has a 300 psi range.

(1) Connect 100 psi Gauge C-3292 to accumulator port.

(2) Connect 300 psi Gauge C-3293 to rear servo port (Fig. 2).

(3) Disconnect throttle and gearshift rods from manual and throttle levers.

(4) Start and run engine at 1000 rpm.

(5) Move shift lever (on manual lever shaft) all the way forward into 1 range.

(6) Move transmission throttle lever from full forward to full rearward position and note pressures on both gauges.

(7) Line pressure at accumulator port should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (621-662 kPa) as lever is moved rearward.

(8) Rear servo pressure should be same as line pressure within 3 psi (20.68 kPa).

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 accumulator pressure port (Fig. 2).

(2) Start and run engine at 1000 rpm.

(3) Move shift lever (on valve body) 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 (621-662 kPa) as lever is moved rearward.

Test Three—Transmission In D Range

This test checks pressure regulation and condition of the clutch circuits. Use both pressure Test Gauges C-3292 and C-3293 for this test.

(1) Connect test gauges to accumulator and front servo ports (Fig. 2). Use either test gauge at the two ports.

(2) Start and run engine at 1600 rpm for this test.

(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 Test Gauge C-3293 for this test.

(1) Connect 300 psi gauge to rear servo port (Fig. 2).

(2) Start and run engine at 1600 rpm for test.

(3) Move valve body selector lever four detents rearward from the full forward position. This is Reverse range.

(4) Move throttle lever all way forward then all 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 downshift.

(1) Connect 100 psi Test Gauge C-3292 to governor pressure port (Fig. 2).

(2) Move shift lever to D range.

(3) Start and run engine at curb idle speed and note pressure. At idle and with vehicle 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. Or approximately 1 psi for every 1 mph.

(5) Pressure rise should be smooth and drop back to 0 to 1-1/2 psi when wheels stop rotating.

(6) Compare results of pressure tests with analysis chart (Fig. 3).

Test Six—Transmission In Overdrive Fourth Gear

This test checks line pressure at the overdrive clutch in fourth gear range. Use 300 psi Test Gauge C-3292 for this test.

(1) Raise vehicle and connect test gauge to overdrive clutch pressure port (Fig. 2).

(2) Lower vehicle to enough to allow entry into drivers seat. Leave vehicle wheels approximately one foot off shop floor.

(3) Secure test gauge where it can be viewed from drivers seat.

(4) Verify that overdrive control switch is in ON position.

(5) Start engine and shift into D range.

(6) Increase engine rpm gradually until 3-4 shift occurs and note gauge pressure.

(7) Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-827 kPa (90-120 psi) at 1/2 to 3/4 throttle.

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 DIRECTLY IN LINE WITH THE VEHICLE FRONT OR REAR DURING A STALL TEST. ALWAYS BLOCK THE WHEELS AND APPLY THE SERVICE AND PARKING BRAKES DURING THE TEST.

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 Low in D Fourth Gear Range	Overdrive clutch piston seal, or check ball problem
Pressure OK in 1, 2 but low in D3 and R	Leakage in front clutch area (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 low in 2	Leakage in servo; broken servo ring or cracked servo piston
Pressure low in all positions	Clogged filter, stuck regulator valve, worn or faulty pump, plugged fluid cooler
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. 3 Pressure Test Analysis Chart

STALL TEST PROCEDURE

(1) Connect tachometer to engine. Position tachometer so it can be viewed from driver seat.

(2) Check transmission fluid level. Add fluid if necessary.

(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. Operate engine for 20 seconds. Stop engine, shift transmission into Park and release brakes.

(9) Stall speeds should be in 1800-2100 rpm range.

STALL TEST ANALYSIS

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 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 TESTING TRANSMISSION CLUTCH AND BAND OPERATION

Air pressure testing can be used to check transmission front/rear 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 4.

FRONT CLUTCH AIR TEST

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.

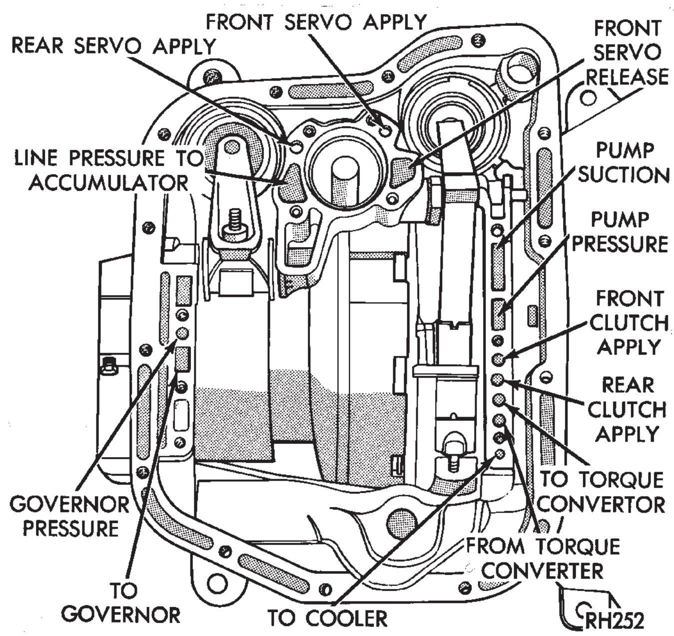

Fig. 4 Air Pressure Test Passages

REAR CLUTCH AIR TEST

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage (Fig. 4). Piston movement can be felt and a soft thud heard as the clutch applies.

FRONT SERVO AIR TEST

Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring tension should release the servo when air pressure is removed.

REAR SERVO AIR TEST

Apply air pressure to the rear servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring tension should release the servo when air pressure is removed.

CONVERTER HOUSING FLUID LEAK DIAGNOSIS

When diagnosing converter housing fluid leaks, two items must be established before repair. 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. They may only be the result of residual fluid in the converter housing, or excess fluid spilled during factory fill or refill after repair.

Converter housing leaks have several potential sources. Through careful observation, a leak source can be identified before removing the transmission for repair.

Pump seal leaks tend to move along the drive hub and onto the rear of the converter. Pump O-ring or pump body leaks follow the same path as a seal leak (Fig. 5).

Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 5).

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.

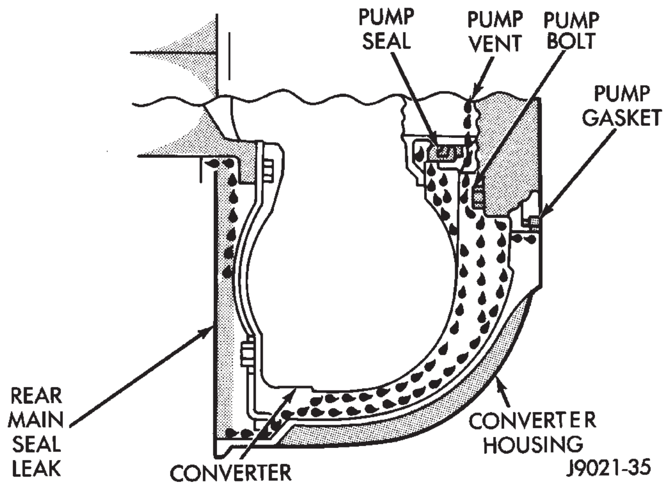

Fig. 5 Converter Housing Leak Paths

LEAK DIAGNOSIS PROCEDURE

(1) Raise rear of vehicle and allow accumulated fluid to drain out of converter housing.

(2) Check and adjust transmission fluid level.

(3) Raise vehicle. Remove converter housing dust cover and wipe as much fluid as possible from converter housing.

(4) Fabricate test probe (Fig. 6). Attach probe to converter housing with a dust shield bolt.

(5) Have a helper run engine at 2500 rpm (with transmission in Neutral) for two minutes; then stop engine.

(6) Inspect test probe and converter housing. If a leak is evident, note color of fluid. Transmission fluid is red. Engine oil ranges in color from brown to green, or to black when oil is dirty.

(7) If probe upper surface is, the converter and seal are not at fault. A path of fluid across probe upper surface indicates a converter or seal leak. Fluid leaking **under** the probe is coming from pump housing area (Fig. 7).

(8) Fluid leaking under the probe could be from: pump seal and/or bushing, pump vent, kickdown lever shaft access plug, pump bolts, or porous spots in pump body or transmission case (Fig. 7).

(9) If porous spots in the transmission case or pump body are the suspected leak source, pressurize transmission as described in Leak Testing With Air Pressure.

TORQUE CONVERTER LEAK POINTS

Possible sources of converter leaks are: (a) leaks at the weld joint around the outside diameter weld and

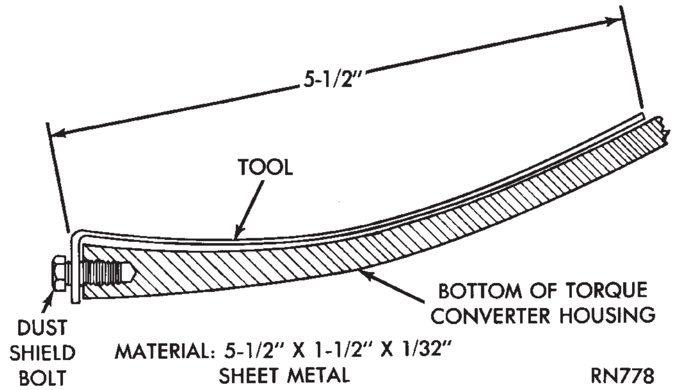

Fig. 6 Leak Test Probe

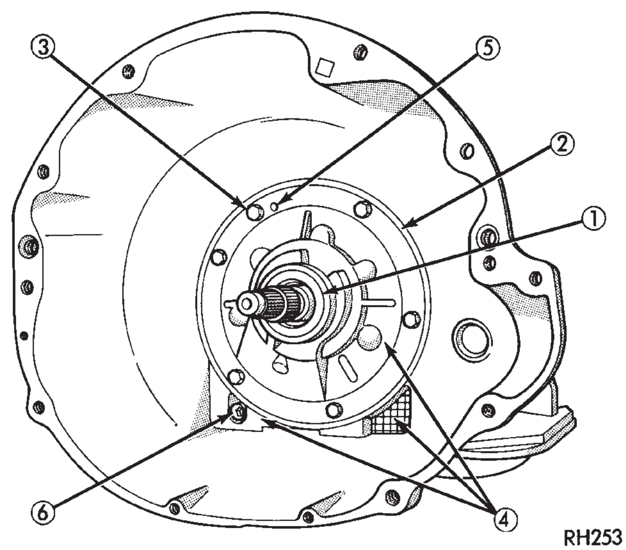

Fig. 7 Pump Area Inspection Points

(b) leaks at the converter hub weld (Fig. 8).

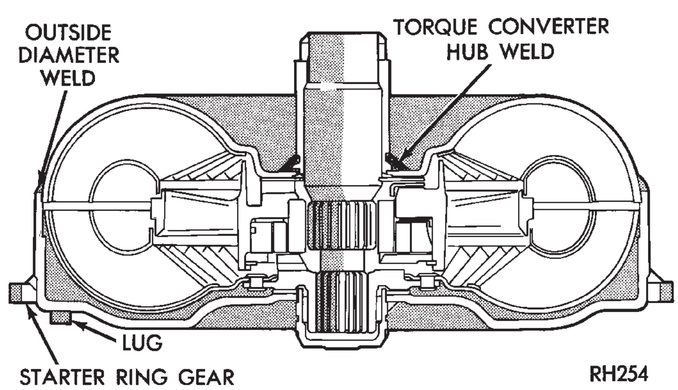

Fig. 8 Converter Potential Leak Points

LEAK TESTING WITH AIR PRESSURE

This test involves closing off all openings and pressurizing the transmission to 8 psi with Air Pump 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 3.17 mm (1/8 in.) thick disc (Fig. 9). A retaining strap is needed to secure the seal cup for testing. The strap can be made from 31.75 mm (1-1/4 in.) wide stock (Fig. 10). The strap attaching hole positions are approximate only. Measure hole position on the converter housing before drilling.

The pump vent tool is made from 6.35 mm (1/4 in.) rod and 4.76 mm (3/16 in.) plate (Fig. 11).

The fabricated tools can all be made from mild steel or aluminum stock.

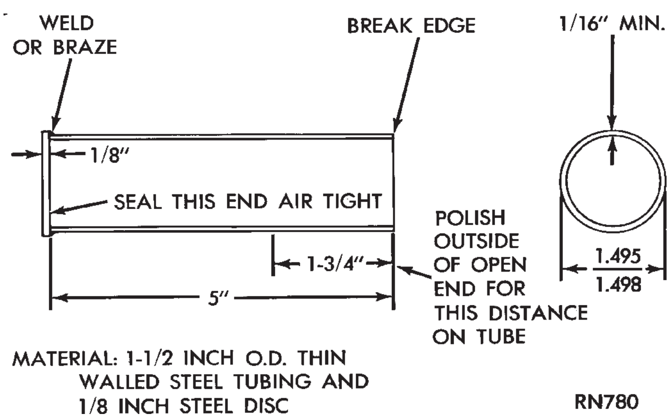

Fig. 9 Converter Hub Seal Cup

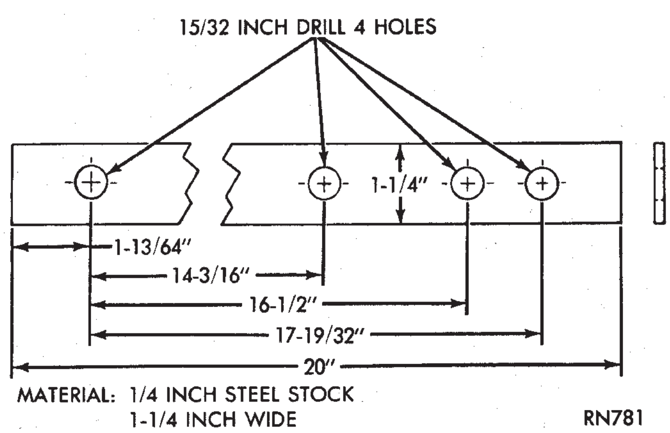

Fig. 10 Seal Cup Retaining Strap

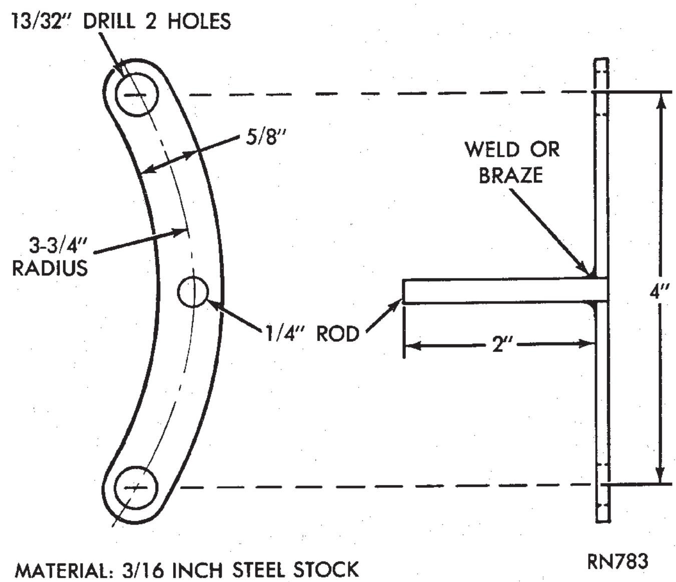

Fig. 11 Pump Vent Plug

AIR PRESSURE LEAK TEST PROCEDURE

(1) Install vent plug, converter hub seal cup and cup retaining strap (Fig. 12).

CAUTION: Be sure the surfaces of the hub seal cup are smooth and free of nicks, scratches, or burrs. Surface irregularities on the cup will damage the pump seal if not removed. Sand and/polish the cup with 400 grit sandpaper or crocus cloth to smooth the surface if necessary.

(2) Close off remaining transmission openings with rubber plugs, or stoppers or similar devices. **Do not close off rear cooler line fitting. Hand operated air pump will be attached to this fitting.**

(3) Attach Air Pump 7700 to rear cooler line fitting. Connect a length of copper tube to fitting. Then attach pump hose to tube with hose clamp (Fig. 13).

(4) Apply a 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 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.

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove converter.

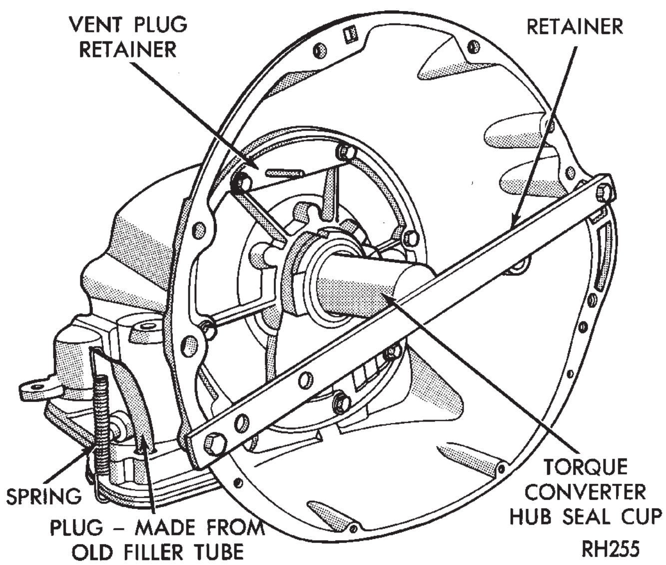

Fig. 12 Vent Plug And Hub Seal Cup Installation

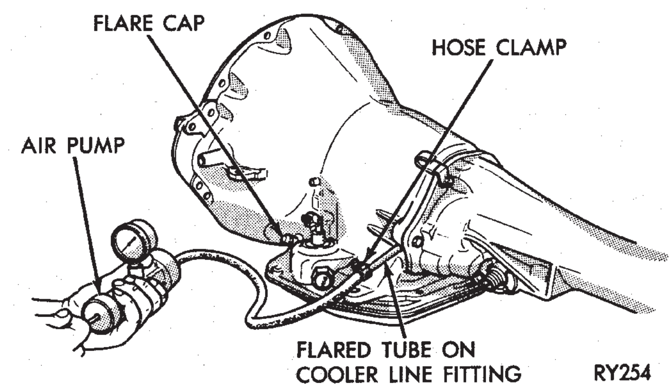

Fig. 13 Pressurizing Transmission

(2) Tighten front band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out when oil pump is removed.

(3) Remove oil pump and remove pump seal. Inspect pump housing drainback and vent holes for obstructions. Clear holes with solvent and wire.

(4) Inspect pump bushing and converter hub. If bushing is scored, replace it. If converter hub is scored, either polish it with crocus cloth or replace converter 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 access plug three 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 and converter housing dust shield.

(10) Lower vehicle.

DIAGNOSIS CHARTS

The diagnosis charts provide additional reference when diagnosing a transmission fault. The charts provide general information on a variety of transmission, overdrive unit and torque converter clutch fault conditions.

The hydraulic flow charts outline fluid flow and hydraulic circuitry. Circuit operation is provided for neutral, third, fourth and reverse gear ranges. Normal working pressures are also supplied for each of the gear ranges.

TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
HARSH ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Engine idle speed too high	1. Check/adjust idle speed
	2. Driver ''riding'' accelerator pedal during shift	2. Advise owner/operator
	3. Throttle cable or linkage misadjusted	3. Adjust cable or linkage; setting is either too long or too short
	4. Band adjustment needed	4. Adjust front/rear bands
	5. Loose mounting bolts	5. Check engine, transmission, propeller shaft, crossmember, and axle bolt torque; tighten loose bolts and replace missing bolts
	6 Worn or damaged U-joints	6. Remove propeller shaft and replace U-joints
	7. Loose axle pinion nut	7. Replace nut and check pinion threads before installing new nut; replace pinion gear if threads are damaged
	8. Hydraulic pressure is incorrect	8. Check pressures; remove, overhaul, or adjust valve body as needed; repair oil pump if necessary
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	9. Accumulator piston spring, or seal worn or damaged	9. Remove valve body and replace piston, seal, or spring as needed
	10. Faulty converter clutch (if equipped)	10. Replace converter and flush cooler and lines before installing new converter
	11. Clutch, band, or planetary component is damaged	11. Remove, disassemble, and repair transmission as necessary
DELAYED ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Engine idle speed too low	1. Adjust idle speed
	2. Low fluid level	2. Correct level and check for leaks
	3. Gearshift linkage out of adjustment	3. Adjust cable or linkage and repair linkage if worn or damaged
	4. Rear band out of adjustment	4. Adjust band
	5. Valve body filter plugged	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. Oil pump gears worn or damaged or pump body or seal is damaged, allowing pump to take in air, causing fluid aeration	6. Remove transmission and replace oil pump
	7. Reaction shaft seal rings worn or broken	7. Remove transmission, remove oil pump, and replace seal rings
	8. Governor valve stuck or valve shaft is loose or damaged	8. Remove and inspect governor components; replace worn or damaged parts
	9. Low hydraulic pressure	9. Perform pressure test, remove transmission, and repair as needed
	10. Clutch, band, or servo damage	10. Remove and disassemble transmission and repair as necessary

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TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
SHIFTS DELAYED OR ERRATIC (SHIFTS ALSO HARSH AT TIMES)	1. Low fluid level	1. Correct fluid level and check for leaks
	2. Throttle linkage out of adjustment	2. Adjust linkage as described in service section
	3. Throttle linkage is binding	3. Disassemble, clean, and adjust linkage; replace linkage grommets if removed or if worn or cracked
	4. Gearshift linkage out of adjustment	4. Adjust linkage as described in service section
	5. Fluid filter partially clogged	5. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary
	6. Air in fluid due to overfill condition or air leakage into pump suction passages	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. Clutch or servo problem	7. Remove valve body and air test clutch, band and servo operation; disassemble and repair transmission as needed
	8. Front band out of adjustment (may cause harsh 1-2 shift)	8. Adjust band
NO REVERSE (D RANGES OK)	1. Gearshift linkage is either out of adjustment or damaged	1. Repair or replace linkage parts as needed
	2. Rear band is out of adjustment	2. Adjust band
	3. Valve body malfunction (stuck/damaged manual valve, regulator valve, or check ball)	3. Remove and service valve body; replace valve body if any valves or valve bores are worn or damaged
	4. Rear servo or front clutch malfunction	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

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

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

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

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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

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

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

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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 break-down, 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

OVERDRIVE DIAGNOSIS

Condition	Possible Cause	Correction
NO 3-4 UPSHIFT	1. Fourth gear overdrive switch (on dash) in OFF position	1. Turn control switch to ON position
	2. Overdrive circuit fuse blown	2. Replace fuse; determine why fuse failed and repair as necessary (i.e., shorts, grounds in circuit)
	3. Fourth gear overdrive switch shorted, open, wires loose	3. Replace switch if shorted or open and repair loose or damaged wires
	4. Overdrive solenoid or circuit wire loose, shorted, open	4. Check wires/connections with 12V test lamp and voltmeter; repair damaged or loose wires/connections as necessary
	5. Solenoid feed orifice in valve body is blocked	5. Remove, disassemble, clean valve body thoroughly
	6. Fourth gear overdrive solenoid failure	6. Verify solenoid failure with test lamp and replace solenoid
	7. Sensor failure (vehicle speed sensor or coolant sensor)	7. Test both sensors with test lamp or volt/ohmmeter and replace faulty sensor
	8. Park/neutral switch open or shorted or switch wire to powertrain control module is damaged (loss of park/neutral input)	8. Test switch as described in service section and replace if necessary
	9. Powertrain control module faulty	9. Check with DRB II scan tool and replace if necessary
	10. T.P.S. fault	10. Adjust or replace T.P.S.
	11. Transmission fluid temperature sensor fault (if equipped)	11. Replace sensor
	12. Overdrive piston seal failure	12. Replace both seals
	13. Wrong overdrive piston spacer	13. Remove unit, check end play, and install correct spacer
	14. Low hydraulic pressure	14. Pressure test transmission to determine cause
	15. Set-reset module faulty	15. Replace module (if equipped)
SLIPS IN OVERDRIVE FOURTH GEAR	1. Low fluid level	1. Add fluid and check for leaks
	2. Overdrive piston or seal malfunction	2. Remove overdrive unit; replace piston seals if worn; replace piston if damaged, if piston retainer is damaged, it will be necessary to remove and disassemble the transmission
	3. Overdrive clutch pack worn	3. Remove overdrive unit and rebuild clutch pack
	4. 3-4 shift valve, timing valve, or accumulator malfunction	4. Remove and overhaul valve body. Replace accumulator seals. Make sure all valves operate freely in bores, and do not bind or stick. Make sure valve body screws are correctly tightened and separator plates are properly positioned
	5. Overdrive piston retainer bleed orifice blown out	5. Disassemble transmission, remove retainer, and replace orifice
	6. Overdrive unit thrust bearing failure	6. Disassemble overdrive unit and replace thrust bearing (No. 1 thrust bearing is between overdrive piston and clutch hub; No. 2 thrust bearing is between the planetary gear and the direct clutch spring plate; No. 3 thrust bearing is between overrunning clutch hub and output shaft)

J9321-252

OVERDRIVE DIAGNOSIS

Condition	Possible Cause	Correction
DELAYED 3-4 UPSHIFT (SLOW TO ENGAGE)	1. Low fluid level 2. Overdrive solenoid or wiring is faulty 3. Overdrive piston spacer too thin 4. Overdrive clutch pack worn 5. T.P.S. faulty 6. Overdrive clutch bleed orifice plugged	1. Add fluid and check for leaks 2. Test solenoid and check wiring for loose/corroded connections, or shorts/ground; replace solenoid if faulty and repiar wiring if necessary 3. Remove unit; measure end play and select proper spacer 4. Remove unit and rebuild clutch pack 5. Replace T.P.S. 6. Disassemble transmission and replace orifice
3-4 UPSHIFT OCCURS BEFORE COMPLETION OF 2-3 UPSHIFT	1. Overdrive solenoid connector or wiring problem 2. Overdrive solenoid malfunction 3. Coolant temperature or T.P.S. malfunction 4. Valve body malfunction 5. Powertrain control module malfunction	1. Test connector and wiring for loose connections, shorts, or ground, and repair as needed 2. Replace solenoid 3. Test each sensor for continuity, short, ground, and replace as necessary 4. Remove, disassemble, clean, and inspect valve body components; make sure all valves and plugs slide freely in bores; polish valves with crocus cloth if needed 5. Test with DRB II scan tool and replace controller if faulty

J9321-253

OVERDRIVE DIAGNOSIS

Condition	Possible Cause	Correction
NO 4-3 DOWNSHIFT	1. Circuit wiring and/or connectors shorted	1. Test wiring and connectors, with test lamp and volt/ohmmeter; repair wiring as necessary; replace connectors and/or harnesses as required
	2. Converter clutch solenoid not venting	2. Remove valve body and replace solenoid if seized or shorted
	3. Overdrive solenoid not venting	3. Remove valve body and replace solenoid if seized or shorted
	4. 3-4 shift, shuttle, timing valve, or accumulator malfunction	4. Remove valve body; remove and disassemble lower housing and 3-4 accumulator housing; replace seals and clean valves as necessary; be sure all valves slide freely in bores
	5. Powertrain control module malfunction	5. Check operation with DRB II scan tool; replace controller only if faulty
	6. T.P.S. malfunction	6. Replace T.P.S.
	7. Sensor or sensor wiring problem	7. Check coolant and transmission temperature sensors, speed sensor, and overdrive control switch
NO 4-3 DOWNSHIFT WHEN CONTROL SWITCH IS TURNED OFF	1. Control switch open-shorted	1. Test and replace switch if faulty
	2. Overdrive solenoid wiring or connectors faulty	2. Check solenoid wiring and connections for shorts/grounds; repair as necessary
	3. Overdrive or converter clutch solenoid not venting	3. Test solenoids and replace if seized or shorted
	4. Powertrain control module malfunction	4. Test with DRB II scan tool; replace module if faulty

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OVERDRIVE DIAGNOSIS

Condition	Possible Cause	Correction
HARSH 1-2, 2-3, OR 3-2 SHIFTS (A500)	1. Lockup solenoid failure	1. Remove valve body and replace solenoid
TORQUE CONVERTER LOCKS UP IN SECOND AND/OR THIRD GEAR (A500)	1. Lockup solenoid, relay, or wiring problem	1. Test solenoid, relay, and wiring for continuity, shorts, or grounds; replace solenoid and relay if faulty; repair wiring and connectors as necessary
NOISY OPERATION IN FOURTH GEAR ONLY	1. Overdrive clutch discs, plates, or snap rings damaged 2. Overdrive piston or planetary thrust bearing brinnelled, installed wrong, or damaged 3. Output shaft bearings brinnelled, scored, damaged 4. Planetary gears worn, chipped, damaged 5. Overdrive unit overrunning clutch rollers rough, scored, or output bushings are worn	1. Remove unit and rebuild clutch pack 2. Remove and disassemble unit; replace either thrust bearing if damaged 3. Remove and disassemble unit; replace either bearing if damaged 4. Remove and overhaul overdrive unit 5. Remove and overhaul overdrive unit

J9121-455

OVERDRIVE DIAGNOSIS

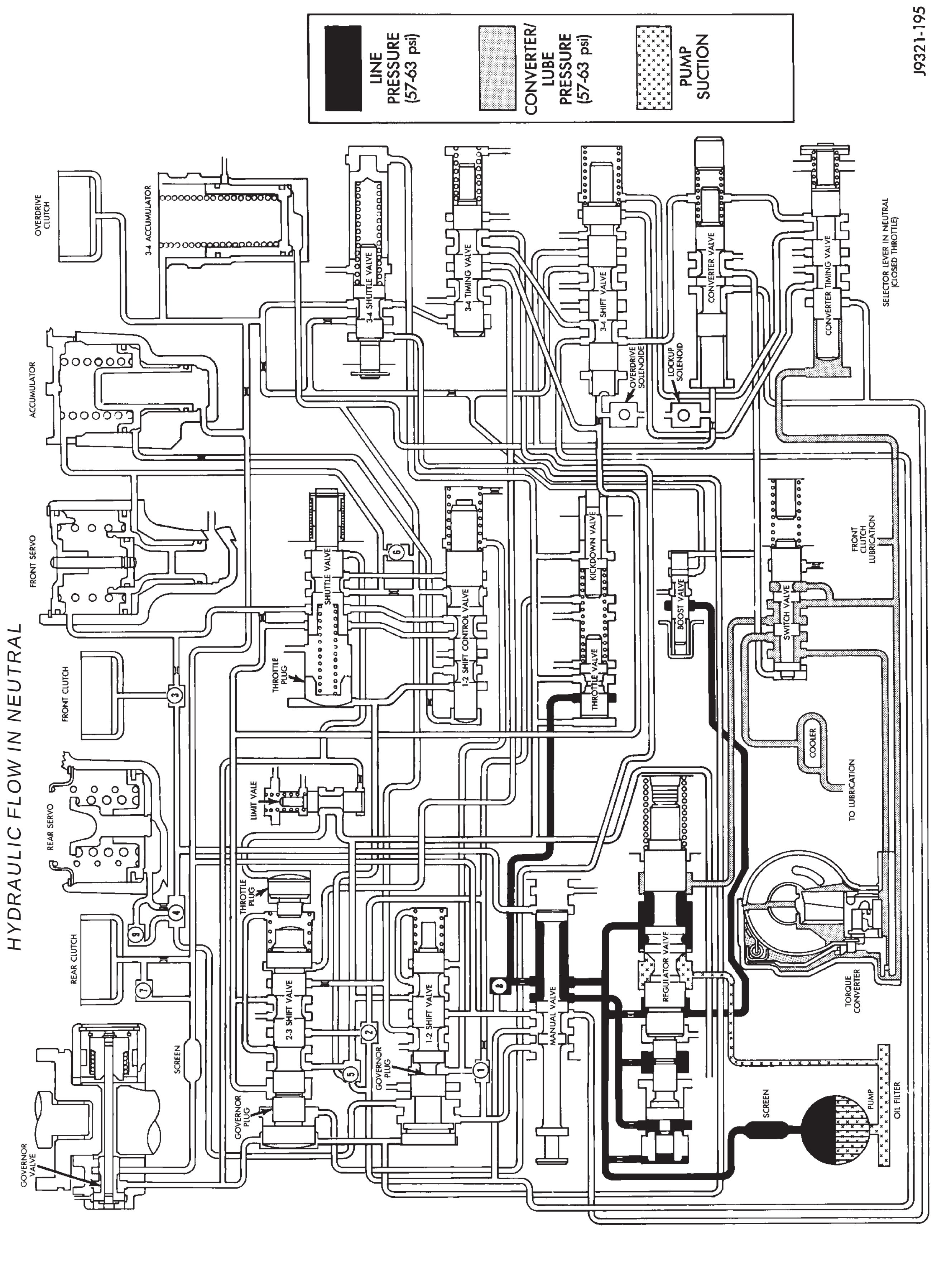
Condition	Possible Cause	Correction
NO REVERSE (OR SLIPS IN REVERSE)	1. Direct clutch spring collapsed or broken 2. Direct clutch pack worn 3. Rear band out of adjustment 4. Front clutch malfunction 5. Overdrive thrust bearing failure	1. Remove and disassemble unit; check clutch pack and replace spring 2. Disassemble unit and rebuild clutch pack 3. Adjust band 4. Air pressure test clutch operation; remove and rebuild if necessary 5. Disassemble geartrain and replace bearings
NO 1-2 OR 2-3 UPSHIFT (HAS LOW AND REVERSE ONLY)	1. Governor component loose, worn, or damaged	1. Remove and disassemble unit; replace worn or damaged governor components as needed

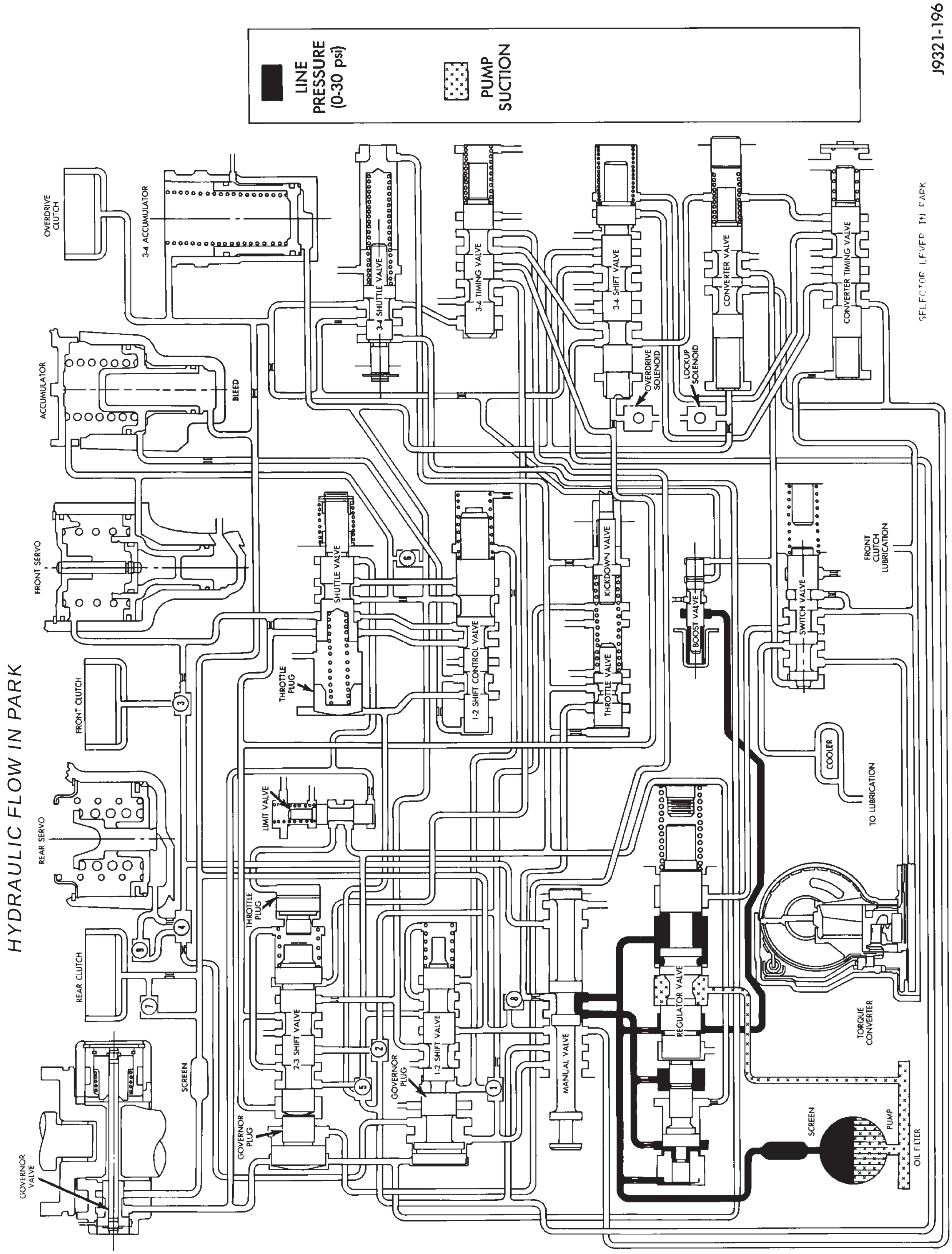
J9121-456

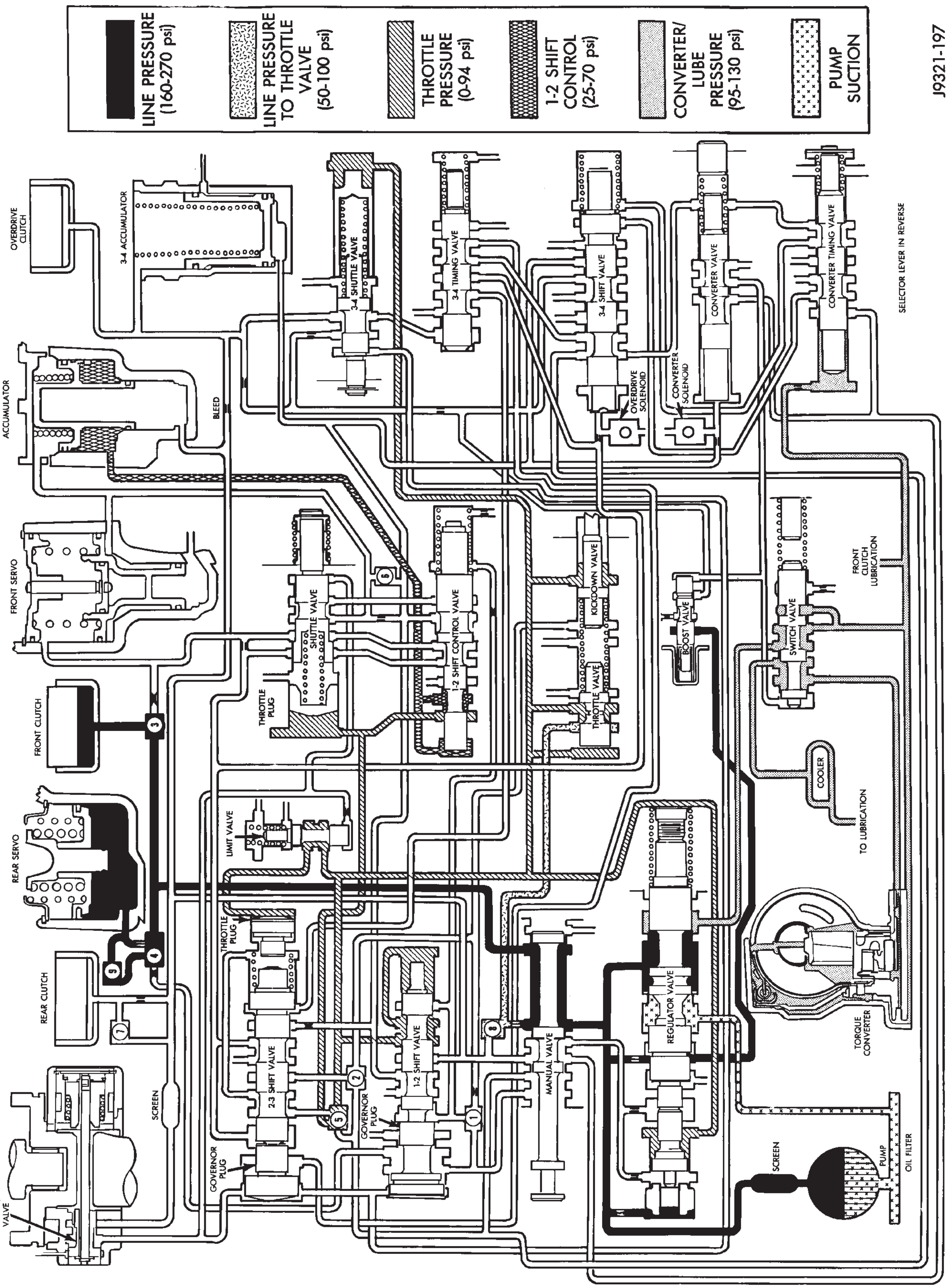
TORQUE CONVERTER CLUTCH DIAGNOSIS

POSSIBLE CAUSE / CONDITION	CONVERTER CLUTCH WILL NOT ENGAGE	CLUTCH WILL NOT DISENGAGE	STAYS ENGAGED AT TOO LOW A SPEED IN 4th GEAR	LOCKS UP OR DRAGS IN LOW OR SECOND	STALLS OR IS SLUGGISH IN REVERSE	CHATTER DURING CLUTCH ENGAGEMENT–(COLD)	VIBRATION OR SHUDDER DURING CLUTCH ENGAGEMENT	VIBRATION AFTER CLUTCH ENGAGEMENT	VIBRATION WHEN "REVVED" IN NEUTRAL	OVERHEATING: OIL COMING OUT OF FILL TUBE OR PUMP SEAL	SHUDDER AFTER CLUTCH ENGAGEMENT
FAULTY OIL PUMP	X			X	X		X				X
STICKING GOVERNOR VALVE	X	X	X								
PLUGGED COOLER, LINES OR FITTINGS					X					X	X
VALVE BODY MALFUNCTION	X	X	X	X	X		X				X
STUCK SWITCH VALVE	X	X	X	X	X					X	
STUCK CONVERTER CLUTCH VALVE	X	X	X								
STUCK CONVERTER CLUTCH SOLENOID	X		X								
SOLENOID WIRING DISCONNECTED	X										
FAILED CONVERTER CLUTCH SOLENOID	X										
FAILED CONVERTER CLUTCH RELAY	X		X								
FAULTY TORQUE CONVERTER:	X					X	X	X			X
OUT OF BALANCE									X		
FAILED CONVERTER CLUTCH	X					X					X
LEAKING TURBINE HUB SEAL	X					X					
ALIGN EXHAUST SYSTEM								X			X
TUNE ENGINE							X	X			X
FAULTY INPUT SHAFT OR SEAL RING	X				X						
THROTTLE CABLE MISADJUSTED								X			X

J9321-206

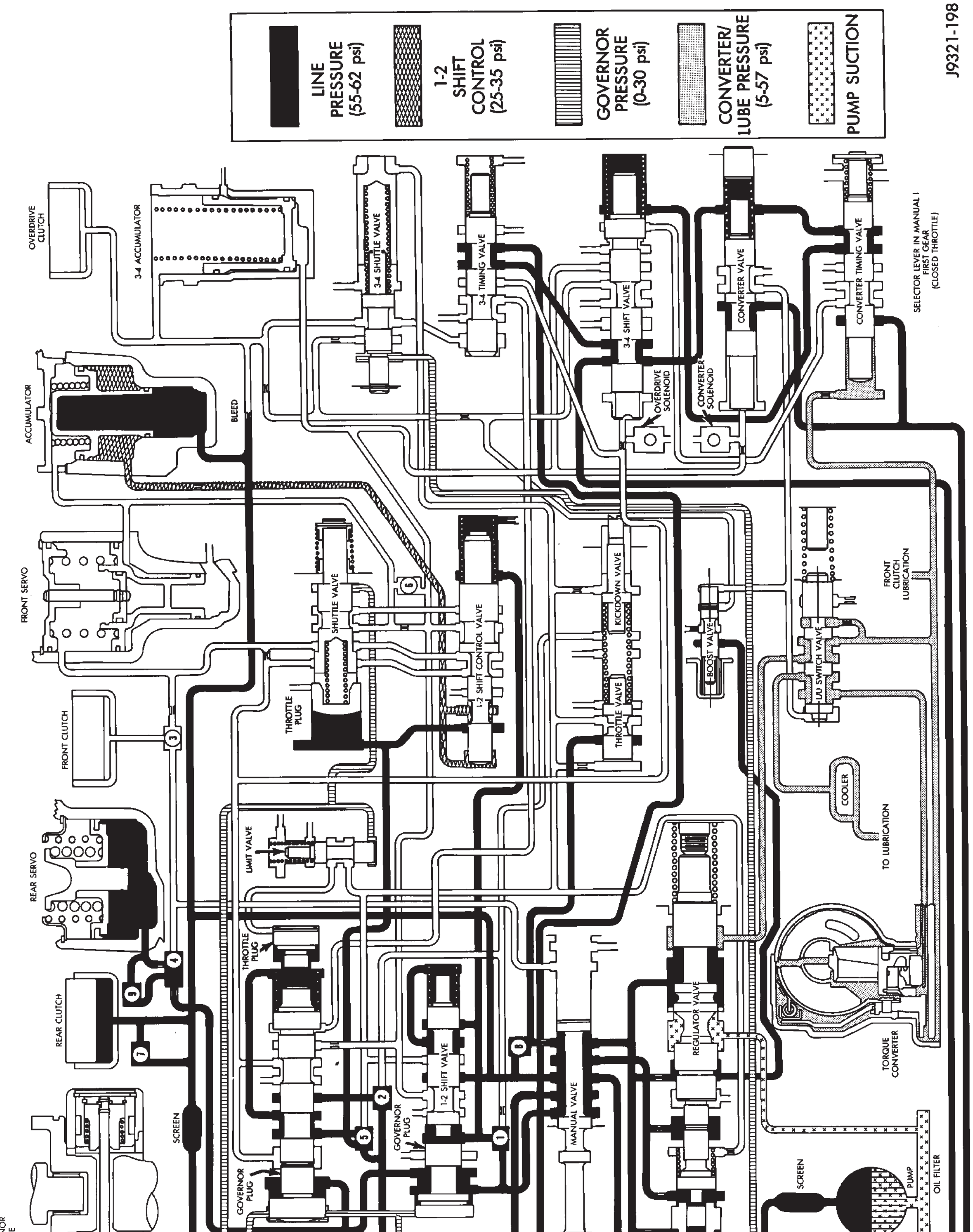

HYDRAULIC FLOW IN NEUTRAL
LINE PRESSURE (57-63 psi)
CONVERTER/ LUBE PRESSURE (57-63 psi)
PUMP SUCTION
J9321-195
OVERDRIVE CLUTCH
3-4 ACCUMULATOR
ACCUMULATOR
FRONT SERVO
FRONT CLUTCH
REAR SERVO
REAR CLUTCH
GOVERNOR VALVE
SCREEN
3-4 SHUTTLE VALVE
3-4 TIMING VALVE
3-4 SHIFT VALVE
OVERDRIVE SOLENOID
LOCKUP SOLENOID
CONVERTER VALVE
CONVERTER TIMING VALVE
SELECTOR LEVER IN NEUTRAL (CLOSED THROTTLE)
SHUTTLE VALVE
THROTTLE PLUG
1-2 SHIFT CONTROL VALVE
KICKDOWN VALVE
THROTTLE VALVE
BOOST VALVE
SWITCH VALVE
FRONT CLUTCH LUBRICATION
COOLER
TO LUBRICATION
LIMIT VALE
THROTTLE PLUG
2-3 SHIFT VALVE
GOVERNOR PLUG
1-2 SHIFT VALVE
GOVERNOR PLUG
MANUAL VALVE
REGULATOR VALVE
TORQUE CONVERTER
SCREEN
PUMP
OIL FILTER


HYDRAULIC FLOW IN PARK
LINE PRESSURE (0-30 psi)
PUMP SUCTION
J9321-196
OVERDRIVE CLUTCH
3-4 ACCUMULATOR
3-4 SHUTTLE VALVE
3-4 TIMING VALVE
3-4 SHIFT VALVE
CONVERTER VALVE
CONVERTER TIMING VALVE
OVERDRIVE SOLENOID
LOCKUP SOLENOID
ACCUMULATOR
BLEED
FRONT SERVO
SHUTTLE VALVE
THROTTLE PLUG
1-2 SHIFT CONTROL VALVE
KICKDOWN VALVE
THROTTLE VALVE
BOOST VALVE
SWITCH VALVE
FRONT CLUTCH LUBRICATION
FRONT CLUTCH
REAR SERVO
LIMIT VALVE
COOLER
TO LUBRICATION
REAR CLUTCH
THROTTLE PLUG
2-3 SHIFT VALVE
1-2 SHIFT VALVE
MANUAL VALVE
REGULATOR VALVE
TORQUE CONVERTER
SCREEN
GOVERNOR PLUG
GOVERNOR PLUG
GOVERNOR VALVE
SCREEN
PUMP
OIL FILTER
SELECTOR LEVER IN PARK

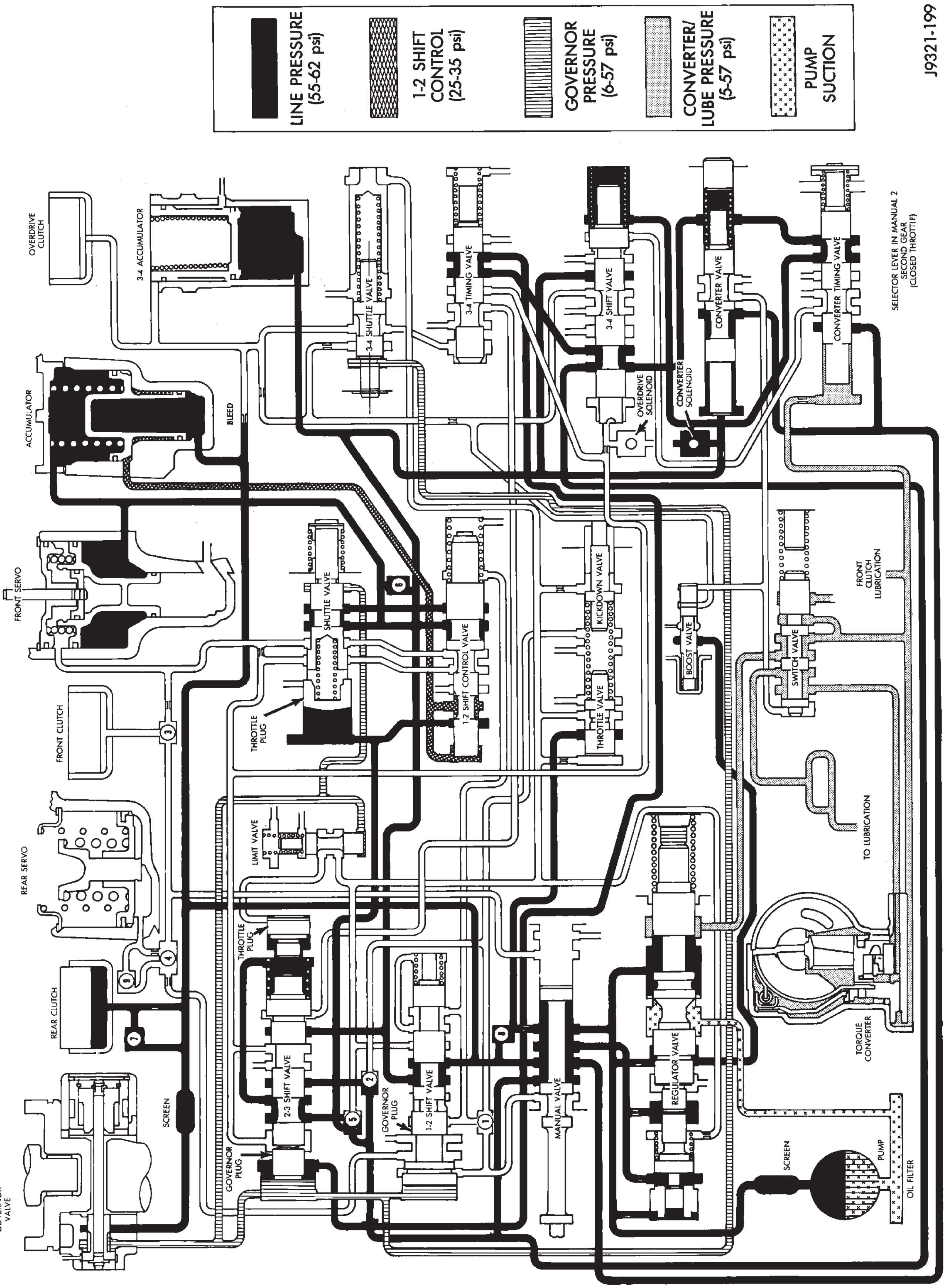


HYDRAULIC FLOW IN REVERSE

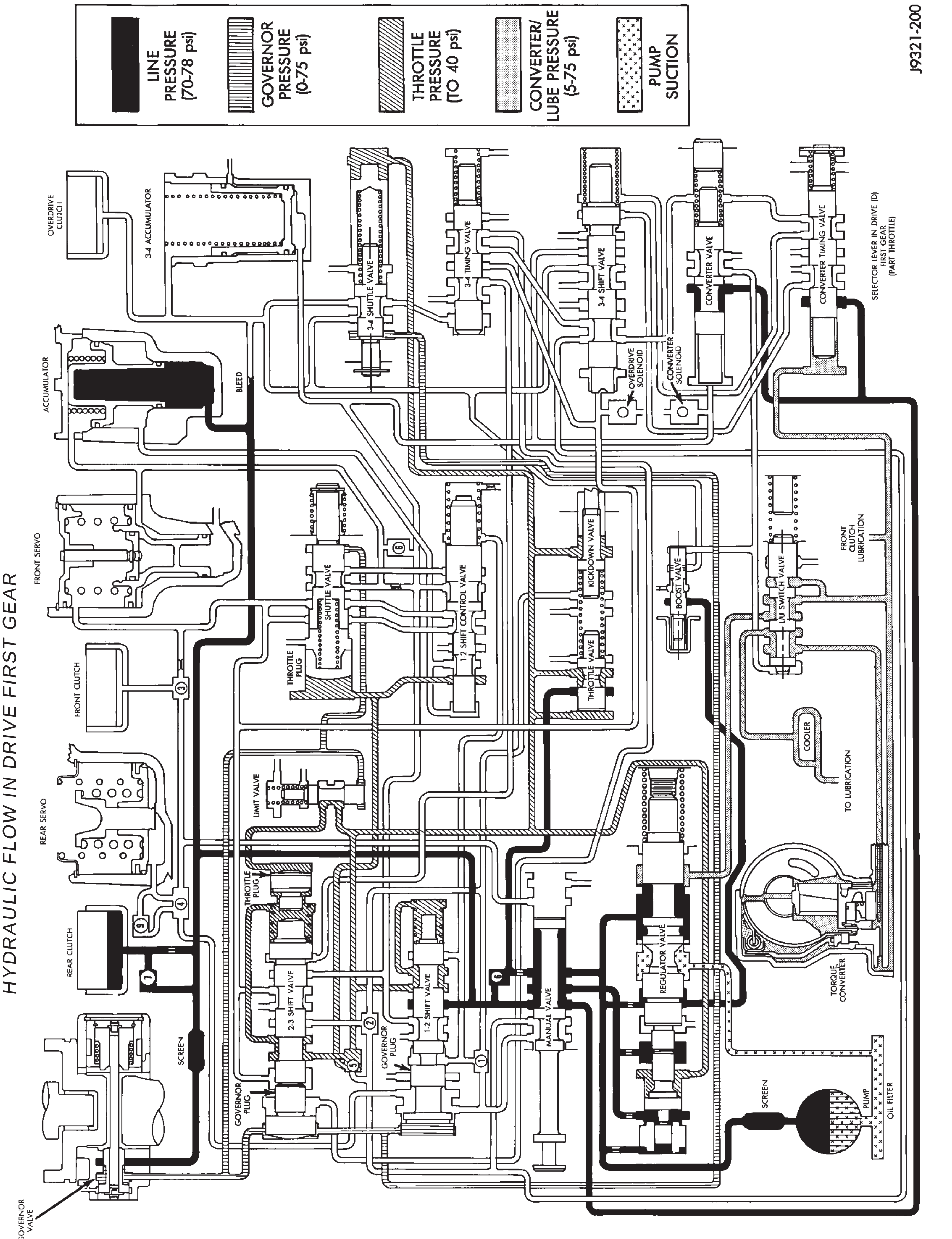
HYDRAULIC FLOW IN MANUAL LOW (1)

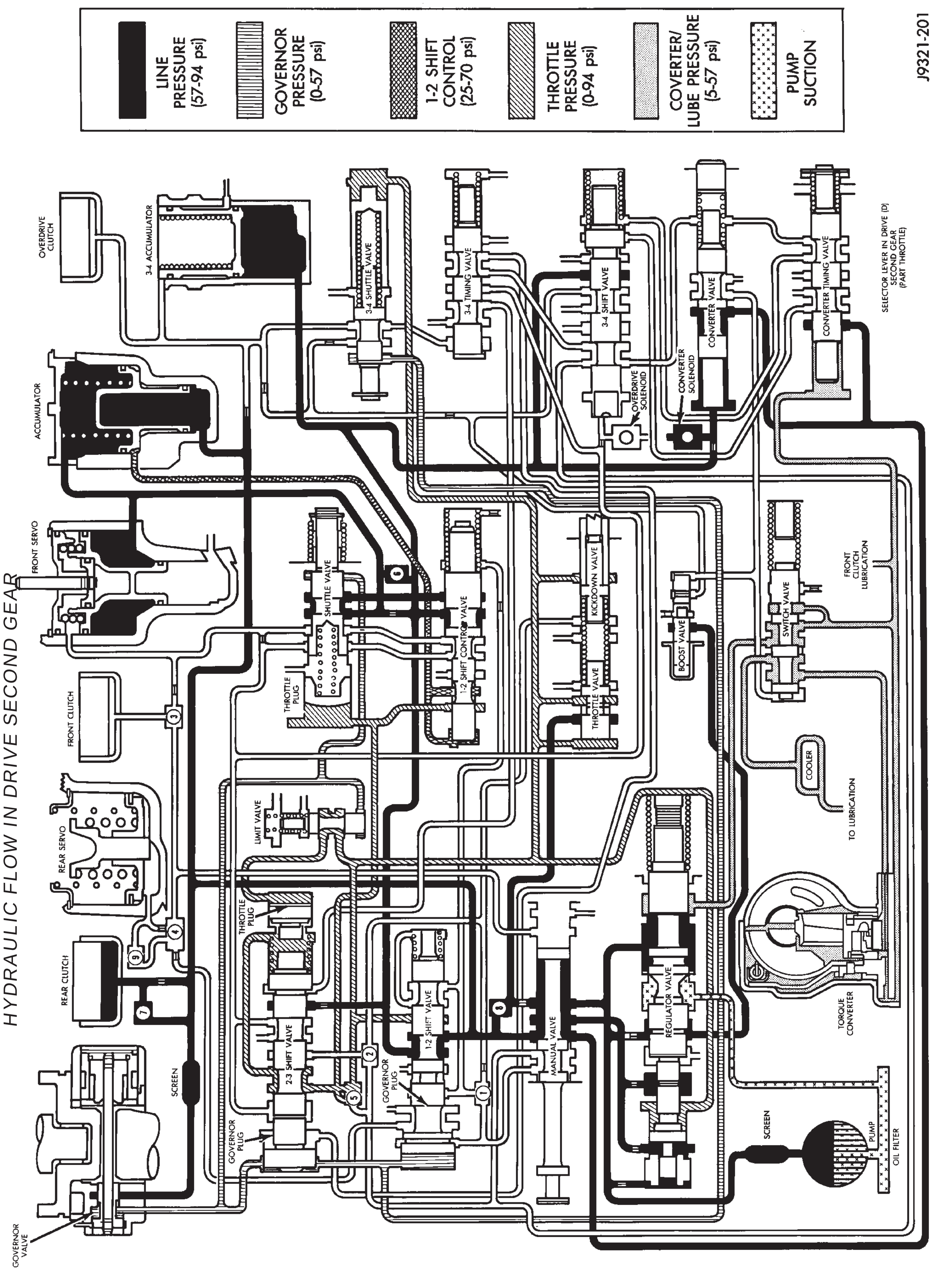


HYDRAULIC FLOW IN MANUAL SECOND (2)

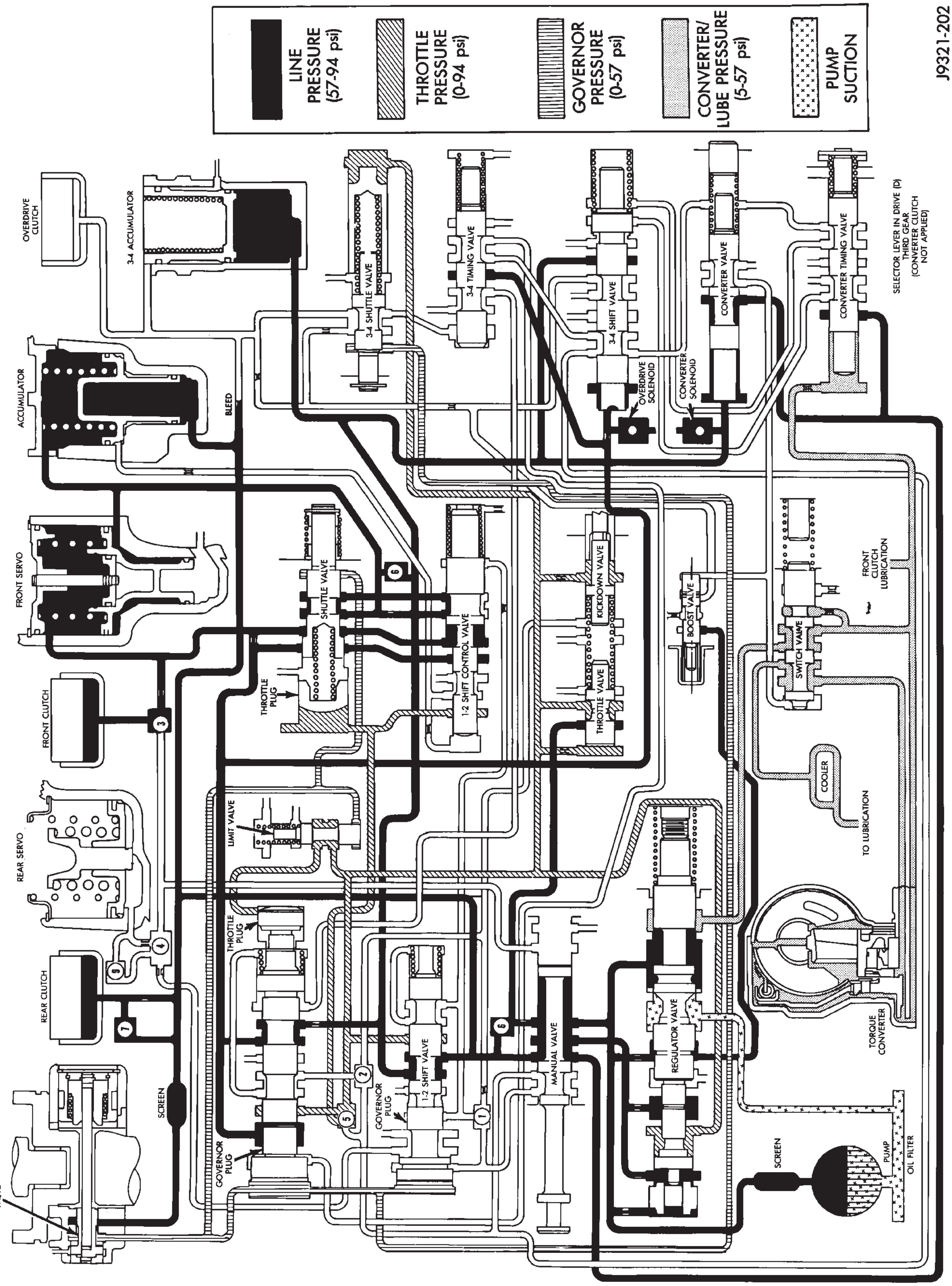


HYDRAULIC FLOW IN DRIVE FIRST GEAR



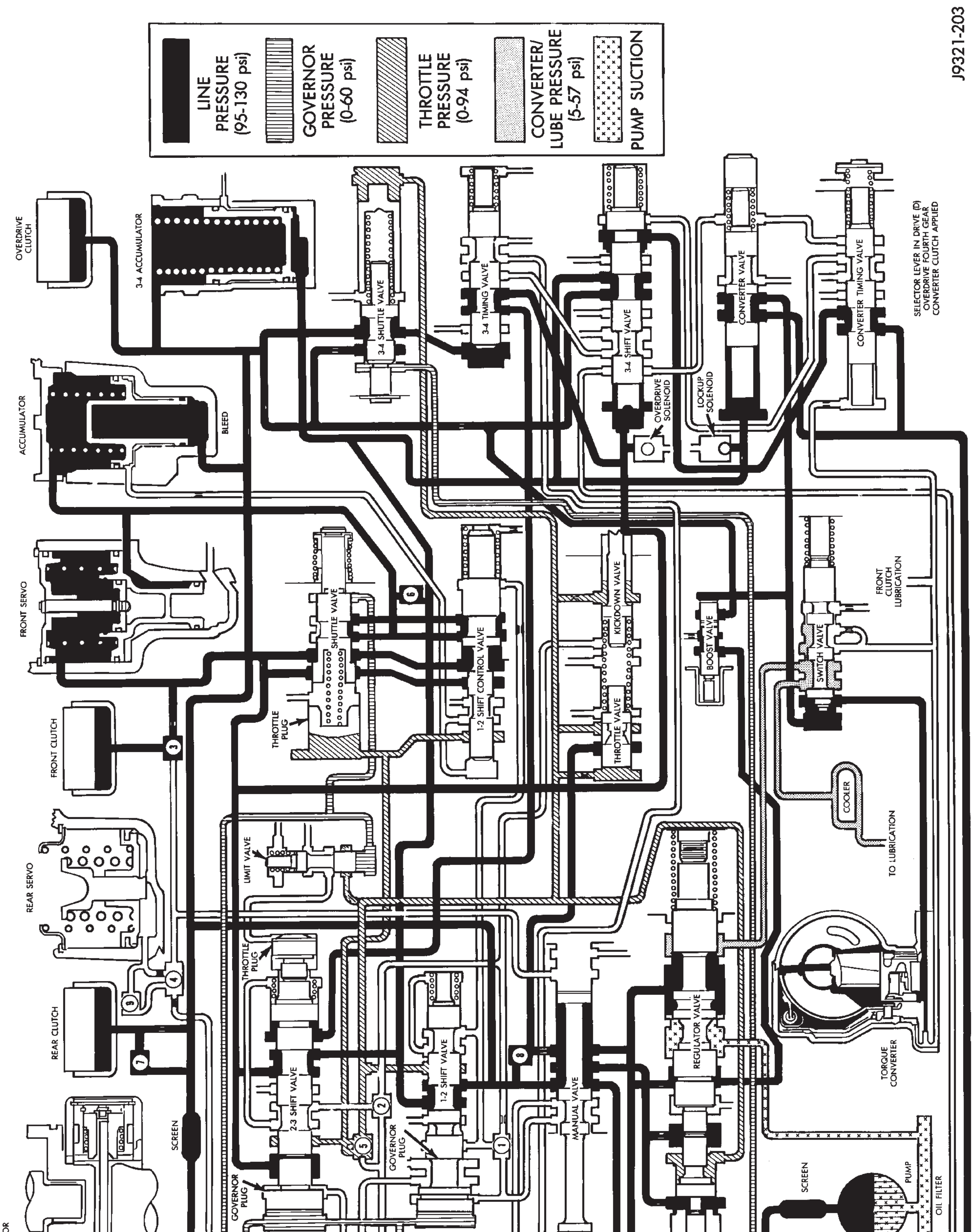


HYDRAULIC FLOW IN DRIVE SECOND GEAR



HYDRAULIC FLOW IN DRIVE THIRD GEAR

HYDRAULIC FLOW IN DRIVE FOURTH GEAR (OVERDRIVE)



IN-VEHICLE SERVICE—46RH

INDEX

GOVERNOR AND PARK LOCK SERVICE

The governor and park lock components are located within the overdrive unit and cannot be serviced in the vehicle. The overdrive unit must be removed and disassembled for access to the governor and park lock components.

Refer to the sections dealing with transmission/overdrive removal, installation and overhaul sections for overdrive unit repair procedures.

OIL PUMP SEAL

The transmission and torque converter must be removed for access to the oil pump seal. Oil pump seal replacement procedures are described in the Transmission Removal/Installation section.

RECOMMENDED FLUID

Recommended fluid for the 46RH is Mopar ATF Plus, type 7176. Mopar Dexron II fluid can be used for topping off the transmission fluid level during normal maintenance checks. This fluid can also be used for refill after overhaul if ATF Plus is not readily available.

TRANSMISSION FLUID LEVEL CHECK

Transmission fluid level should be checked a minimum of four times per year under normal operation. If the vehicle is used for trailer towing or similar heavy load hauling, check fluid level **and condition** at least once a week.

Fluid level is checked with the engine running at curb idle speed, the transmission in Neutral and the transmission fluid at normal operating temperature (hot).

The 46RH transmission dipstick is on the driver side of the engine compartment at the rear of the engine. The dipstick handle has the universal symbol for a gear imprinted on it for identification.

FLUID LEVEL CHECK PROCEDURE

(1) Transmission fluid must be at normal operating temperature for accurate fluid level check. Drive vehicle if necessary to bring fluid temperature up to normal hot operating temperature of 82°C (180°F).

(2) Position vehicle on level surface. This is extremely important for accurate fluid level check.

(3) Start and run engine at curb idle speed.

(4) Apply parking brakes.

(5) Shift transmission momentarily into all gear ranges. Then shift transmission back to **Neutral.**

(6) Clean top of filler tube and dipstick to keep dirt from entering tube.

(7) Remove dipstick and check fluid level as follows:

(a) Dipstick has three fluid level indicating marks which are a MIN dot mark, an OK mark and a MAX fill arrow mark:

(b) Correct level is to MAX arrow nark on dipstick. This is correct maximum hot fluid level. Acceptable level is between OK mark and max arrow mark on dipstick.

(c) If level is at, or below MIN level dot on dipstick, add only enough fluid to restore correct level. Mopar ATF Plus, type 7176 is the preferred fluid. Mopar Dexron II can be used if ATF Plus is not readily available.

CAUTION: Do not overfill the transmission. Overfilling will cause leakage out the pump vent which can be mistaken for a pump seal leak. Overfilling will also cause fluid aeration and foaming as the excess fluid is picked up and churned by the gear train. This will reduce fluid life significantly.

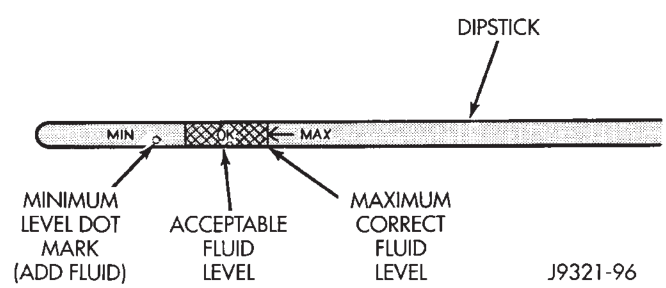


Fig. 1 Fluid Level Marks On Dipstick

FLUID AND FILTER CHANGE

NORMAL CHANGE INTERVAL

The fluid and filter should be changed (and the bands adjusted) at recommended maintenance intervals, or whenever the transmission has been disassembled for any reason.

Refer to the Driveline section in Group O, Lubrication and Maintenance for recommended change intervals. Refer to the fluid/filter replacement and band adjustment procedures in this section.

SEVERE USAGE CHANGE INTERVAL

Under severe usage, the fluid and filter should be changed and the bands adjusted at 12,000 mile (19 000 Km) intervals.

Severe usage is defined as:

(a) More than half of vehicle operation occurs in heavy city traffic during hot weather (above 90° F).

(b) Vehicle is used for taxi, police, limousine, or similar commercial operation.

(c) Vehicle is used for trailer towing or heavy load hauling.

When the factory fluid is drained, refill the transmission with Mopar ATF Plus, type 7176 fluid. Mopar Dexron II can be used when ATF Plus is not readily available.

FLUID/FILTER REPLACEMENT PROCEDURE

(1) Raise vehicle.

(2) Remove oil pan and drain fluid.

(3) Clean oil pan and pan magnet. Then clean remaining gasket material from gasket surface of transmission case.

(4) Remove fluid filter screws and remove filter.

(5) Position new filter on valve body and install filter screws. Tighten screws to 4 N•m (35 in. lbs.) torque.

(6) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 150 in. lbs. (17 N•m) torque.

(7) Lower vehicle and refill transmission with Mopar ATF Plus, type 7176 fluid.

GEARSHIFT LINKAGE ADJUSTMENT

Check linkage adjustment by starting the engine in Park and Neutral. Adjustment is OK if the engine starts only in these positions. Adjustment is incorrect if the engine starts in one but not both positions. If the engine starts in any position other than Park or Neutral, or if the engine will not start at all, the park/neutral position switch may be faulty.

GEARSHIFT LINKAGE ADJUSTMENT

Do not attempt linkage adjustment if any components are worn or damaged. If either linkage rod must be disconnected, the plastic grommet

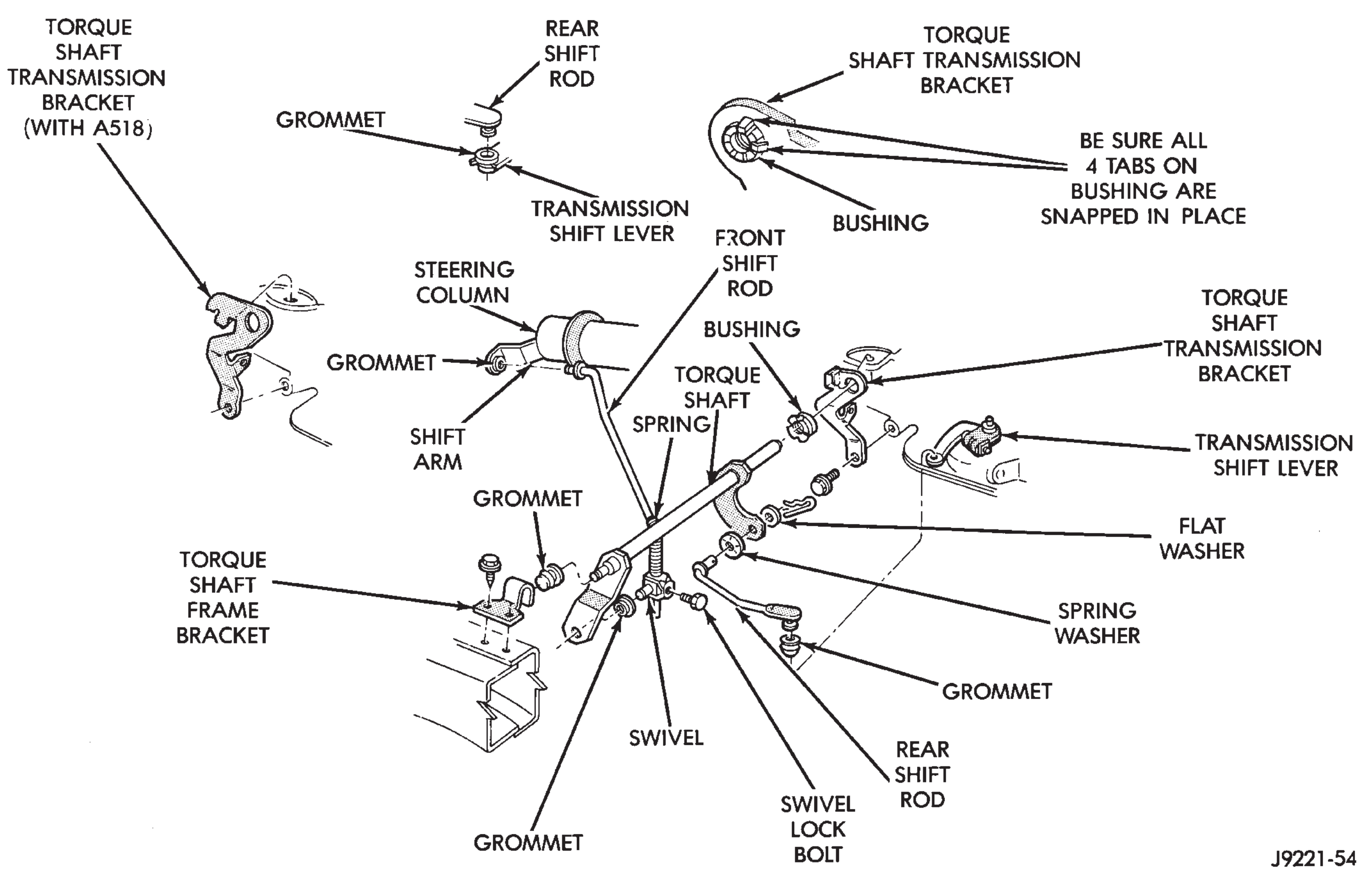


Fig. 2 Column Gearshift Linkage

securing the rod in the lever must be replaced. Disconnect the rod with a pry tool. Pry only where the grommet and rod attach and not on the rod itself. Then cut away the old grommet. Use pliers to snap the new grommet into the lever and to snap the rod into the grommet.

(1) Shift transmission into Park.

(2) Raise vehicle.

(3) Check condition of shift rods, control lever, bushings, washers and torque shaft (Fig. 2). Tighten, repair, or replace worn or damaged parts.

(4) Loosen lock bolt in rear shift rod adjusting swivel (Fig. 2).

(5) Slide adjusting swivel off torque shaft arm. Be sure swivel turns freely on rear shift rod.

(6) Verify that valve body manual lever is in Park detent. Move transmission shift lever fully rearward to check.

(7) Adjust swivel position on rear shift rod to obtain free pin fit in torque shaft lever (Fig. 2). Then tighten swivel lock bolt to 90 in. lbs. (10 N●m) torque.

(8) Check 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 park/neutral position switch is faulty.**

TRANSMISSION THROTTLE CABLE ADJUSTMENT

(1) Turn ignition key to OFF position.

(2) Remove air cleaner.

(3) Position 2.8 - 3.0 mm (0.110 - 0.120 in.) thick spacer between idle stop and throttle lever on throttle body. Use appropriate thickness of feeler gauges or shim stock as spacer (Figs. 3 and 4).

(4) Press cable lock button to release cable (Fig. 3).

(5) Pull cable conduit toward rear of vehicle until wiper is completely retracted into end of conduit fitting (Fig. 3). Then release cable lock button.

(6) Raise vehicle for access to transmission throttle valve lever (Fig. 5).

(7) Rotate throttle valve lever toward front of vehicle until ratcheting sound (from cable) stops.

CAUTION: Do not rotate the throttle valve lever beyond the idle stop. The lever, valve and manual lever shaft will be damaged if rotated too far.

(8) Remove feeler gauges or shim and check cable adjustment. Throttle valve lever should begin to move at same time lever on MPI throttle body moves off idle position.

(9) Lower vehicle.

(10) Install air cleaner.

FRONT BAND ADJUSTMENT

The front band adjusting screw is located on the driver side of the transmission case above the manual valve and throttle valve levers.

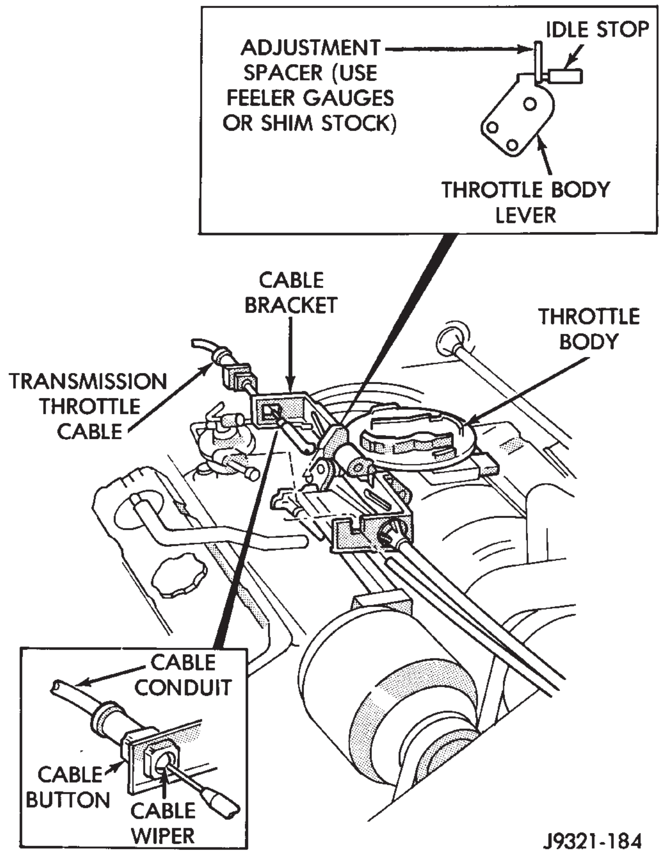


Fig. 3 Throttle Cable Attachment At Engine

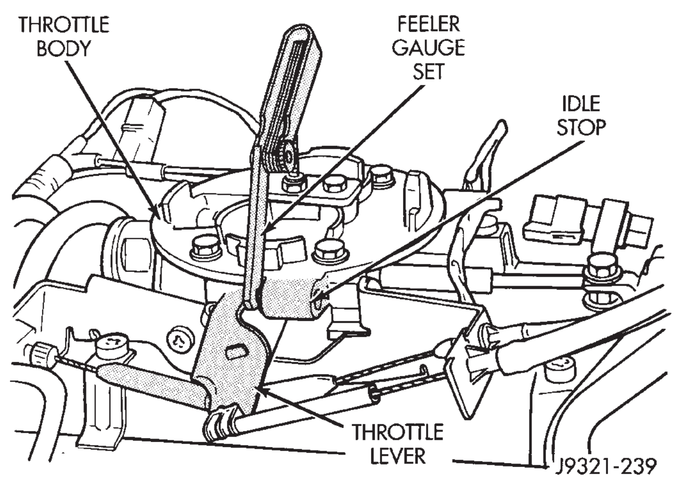


Fig. 4 Positioning Spacer Between Throttle Stop And Lever

ADJUSTMENT PROCEDURE

(1) Raise vehicle.

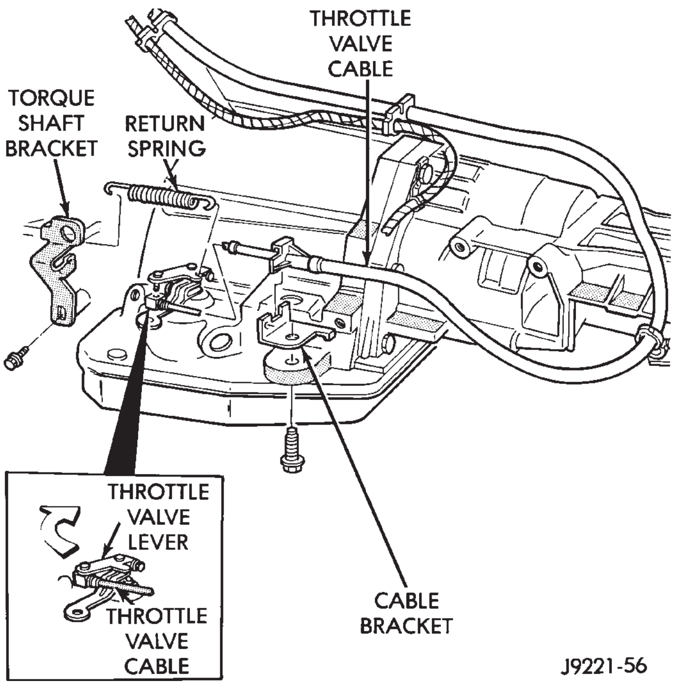


Fig. 5 Throttle Cable Attachment At Transmission

(2) Loosen band adjusting screw locknut. Then back locknut off 4-5 turns. Be sure adjusting screw turns freely in case. Lubricate screw threads if necessary.

(3) Tighten band adjusting screw to 8 N●m (72 in. lbs.) torque with inch pound Torque Wrench C-3380-A, a 3-in. extension and 5/16 socket (Fig. 6).

CAUTION: If Adapter C-3705 is needed to reach the adjusting screw (Fig. 7), tighten the screw to only 5 N●m (47-50 in. lbs.) torque.

(4) Back off band adjusting screw 2-1/2 turns.

(5) Hold adjuster screw in position and tighten locknut to 41 N●m (30 ft. lbs.) torque.

(6) Lower vehicle.

REAR BAND ADJUSTMENT

The transmission oil pan must be removed for access to the rear band adjusting screw.

(1) Raise vehicle.

(2) Remove transmission oil pan and drain fluid.

(3) Loosen band adjusting screw locknut 5-6 turns. Be sure adjusting screw turns freely in lever. Lubricate screw threads if necessary.

(4) Tighten adjusting screw to 8 N●m (72 in. lbs.) torque (Fig. 8). Use inch-pound Torque Wrench C-3380-A for adjustment.

(5) Back off band adjusting screw 2 turns.

(6) Hold adjusting screw in place and tighten locknut to 34 N●m (25 ft. lbs.) torque.

(7) Clean oil pan, pan magnet and gasket surface of case. Also inspect and replace fluid filter if necessary.

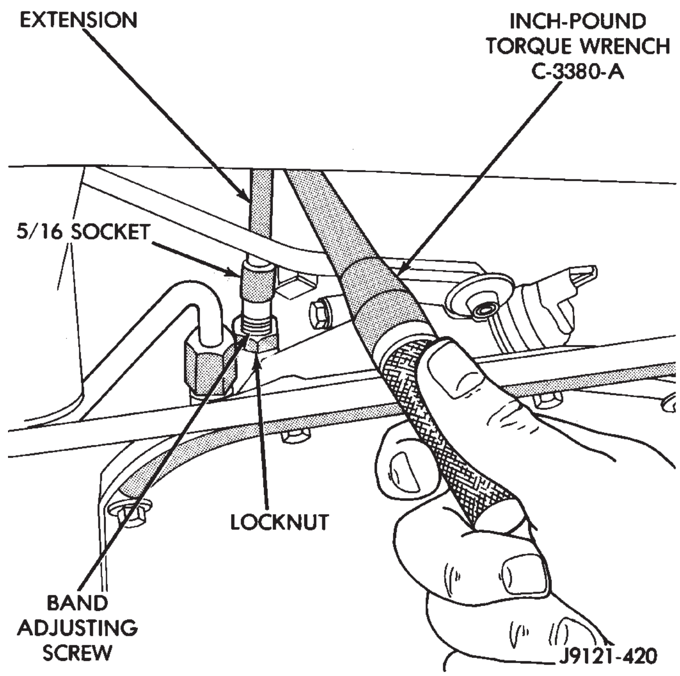


Fig. 6 Front Band Adjustment

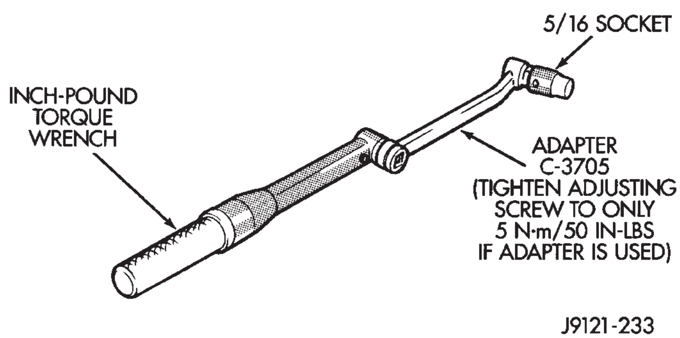


Fig. 7 Using Band Adjustment Adapter Tool C-3705

(8) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 17 N●m (150 in. lbs.) torque.

(9) Lower vehicle and refill transmission with recommended fluid.

SPEEDOMETER SERVICE

Rear axle gear ratio and tire size determine pinion gear requirements. If the gear must be replaced, refer to the parts catalogue information for the correct gear.

ADAPTER AND PINION REMOVAL/INSTALLATION

(1) Raise vehicle.

(2) Disconnect vehicle speed sensor wires and disconnect speedometer cable, if equipped.

(3) Remove vehicle speed sensor from speedometer adapter (Fig. 9).

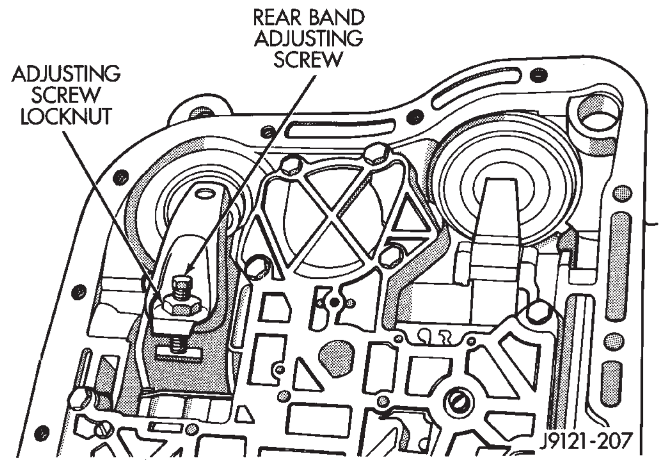


Fig. 8 Rear Band Adjustment Screw Location

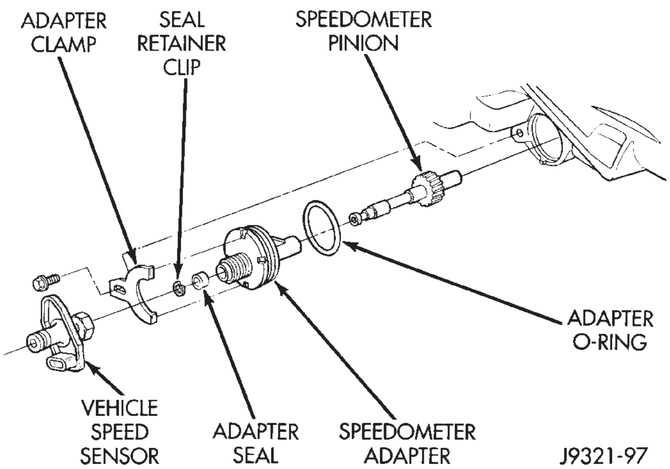


Fig. 9 Speedometer Components

(4) Check speed sensor mounting area in adapter. If transmission fluid is found in this area, adapter oil seal is leaking and will have to be replaced.

(5) Remove bolt and retainer securing pinion gear and adapter in overdrive housing.

(6) Carefully work adapter and gear out of housing.

(7) Replace adapter O-ring if cut, or worn.

(8) Replace adapter oil seal if necessary. Remove old seal and start new one in adapter by hand. Then press seal into adapter with Installer Tool C-4004 until tool bottoms (Fig. 10).

CAUTION: Before installing the pinion and adapter assembly make sure adapter flange and its mating area on extension housing are perfectly clean. Dirt or sand will cause misalignment resulting in speedometer pinion gear damage.

(9) Thoroughly clean adapter flange and adapter mounting surface in the extension housing. These surfaces must be clean for proper adapter alignment and speedometer operation.

(10) Lubricate adapter oil seal and O-ring with transmission fluid.

(11) Count number of teeth on pinion gear before installing pinion in adapter.

(12) Note range index numbers on adapter face (Fig. 11). These numbers correspond to number of teeth on pinion.

(13) Install speedometer adapter in housing.

(14) Rotate adapter until required range numbers are at 6 o-clock position (Fig. 11). Be sure range numbers correspond to number of teeth on driven gear.

(15) Lightly push or tap adapter into housing until seated.

(16) Install adapter retainer. Tighten retainer bolt to 11 N●m (100 in. lbs.) torque.

(17) Install vehicle speed sensor. Tighten sensor coupling nut to 17 N●m (150 in. lbs.) torque and install sensor wires.

(18) Connect speedometer cable to speed sensor if equipped.

(19) Lower vehicle and top off transmission fluid level.

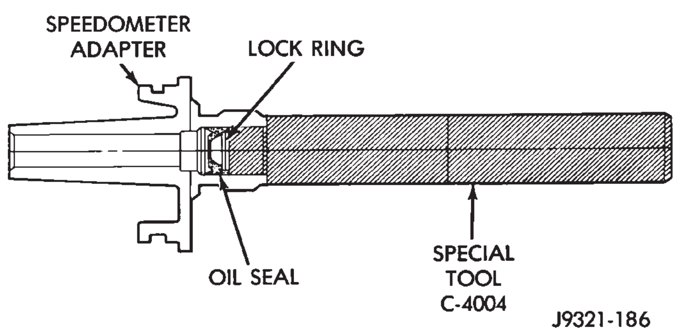


Fig. 10 Replacing Speedometer Adapter Oil Seal

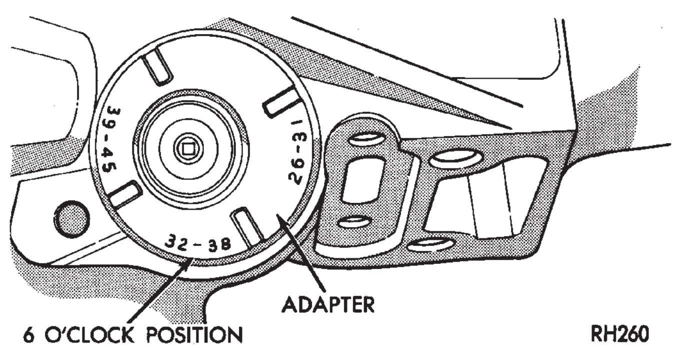


Fig. 11 Indexing Speedometer Adapter

PARK/NEUTRAL POSITION SWITCH

The center terminal of the switch is the starter circuit terminal. It provides the ground for the starter solenoid circuit through the selector lever in Park and Neutral positions only. The outer terminals on the switch are for the backup lamp circuit.

SWITCH TEST

(1) Verify that gearshift linkage is correctly adjusted before testing. Switch will not operate properly if linkage adjustment is incorrect.

(2) To test switch, remove wiring connector. Then test continuity between center terminal and transmission case. Continuity should exist only when transmission is in Park or Neutral.

(3) Shift transmission into reverse and test continuity at switch outer terminals.

(a) Continuity should exist only when transmission is in Reverse.

(b) Continuity should not exist between outer terminals and case.

PARK/NEUTRAL POSITION SWITCH REPLACEMENT

(1) Raise vehicle and position drain pan under switch.

(2) Disconnect switch wires and remove switch from case.

(3) Move shift lever to Park and Neutral positions. Verify that switch operating lever fingers are centered in switch opening in case (Fig. 12).

(4) Install new seal on switch and install switch in case. Tighten switch to 34 N●m (25 ft. lbs.) torque.

(5) Connect switch wires, lower vehicle and top off transmission fluid level.

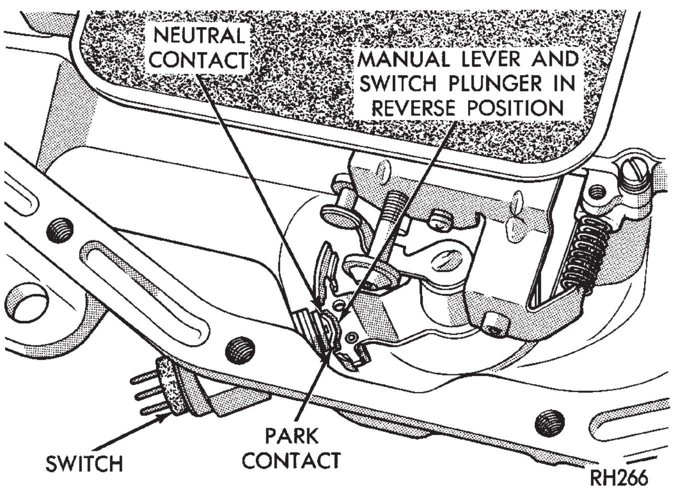


Fig. 12 Park/Neutral Position Switch Contacts

VALVE BODY SERVICE

GENERAL SERVICE INFORMATION

The valve body can be removed for service without having to remove the entire transmission assembly.

The valve body can be disassembled for cleaning and inspection of the individual components. Refer to the procedures in the Transmission Unit Subassembly Overhaul section.

The only replaceable valve body components are:

- manual lever
- manual lever washer, seal, E-clip and shaft seal
- manual lever detent ball
- throttle lever
- fluid filter
- solenoid assembly
- switch valve and spring
- pressure adjusting screw bracket

The remaining valve body components are serviced only as part of a complete valve body assembly.

VALVE BODY REMOVAL

(1) Shift transmission into Neutral.

(2) Raise vehicle.

(3) Remove gearshift and throttle levers from shaft of valve body manual lever.

(4) Disconnect and remove neutral switch.

(5) Disconnect valve body overdrive and converter clutch solenoid wires at case connector (Fig. 13).

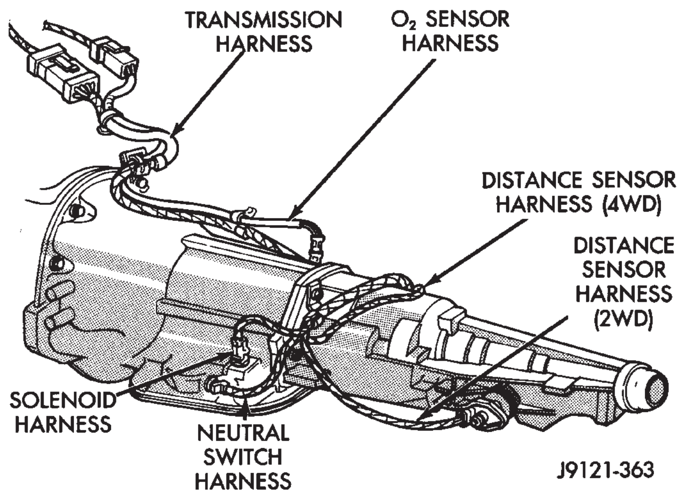


Fig. 13 Transmission Wire Harness Identification

(6) Position drain pan under transmission oil pan.

(7) Remove transmission oil pan and gasket.

(8) Remove fluid filter from valve body.

(9) Push valve body solenoid wire connector out of case.

(10) Remove valve body attaching bolts.

(11) Lower valve body slightly and remove accumulator piston and accumulator inner and outer springs.

(12) Push manual lever shaft and solenoid case connector out of transmission case. Lower valve body, rotate it away from case, pull park rod out of sprag and remove valve body (Fig. 14).

VALVE BODY INSTALLATION

(1) Verify that park/neutral position switch has NOT been installed in case. Valve body cannot be installed if switch is in place.

(2) Check condition of seals on valve body solenoid case connector (Fig. 14). Replace seals if cut or worn.

(3) Check condition of manual lever shaft seal (in case). Remove seal if lip is cut, or worn. However do not install new seal at this time.

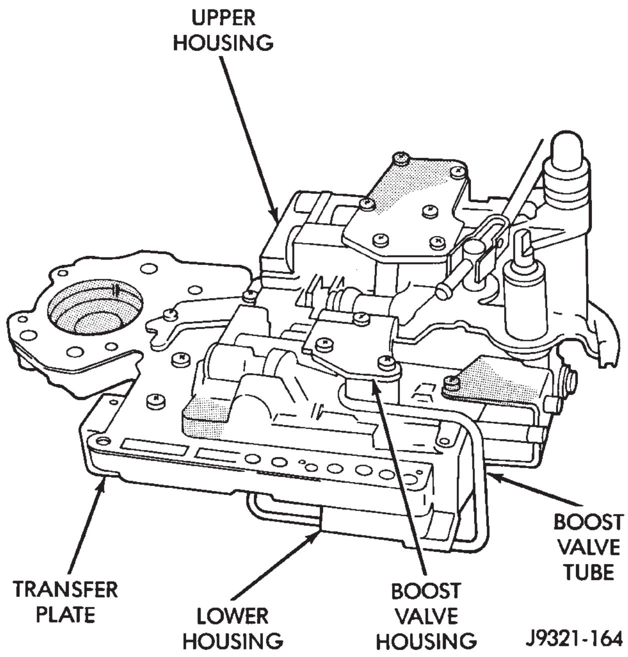


Fig. 14 Valve Body-46RH

(4) Check condition of seals on accumulator piston (Fig. 15). Install new piston seals if necessary.

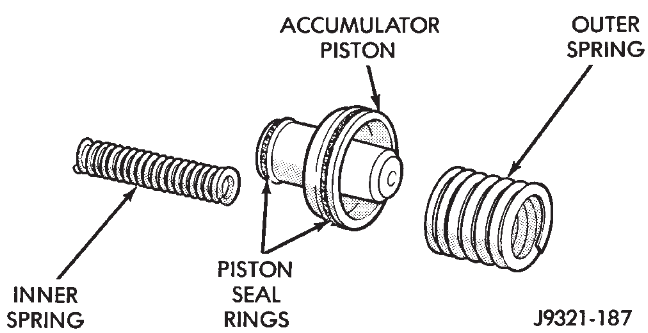


Fig. 15 Accumulator Piston And Springs

(5) Install accumulator inner spring and accumulator piston. A small amount of petroleum jelly can be used to hold piston in bore.

(6) Place valve body manual lever in low (1 position) so ball on park lock rod can be installed in sprag.

(7) Lubricate shaft of manual lever with petroleum jelly. This will ease inserting shaft through seal (in case).

(8) Lubricate seal rings on solenoid case connector with petroleum jelly.

(9) Position accumulator piston outer spring on valve body.

(10) Raise valve body and work end of park lock rod into and through sprag. Use screwdriver to align sprag if necessary.

(11) Align accumulator springs, manual lever shaft and solenoid case connector. Then seat valve body on case and install one or two bolts to hold valve body in place.

(12) Tighten valve body bolts alternately and evenly to 11 N●m (100 in. lbs.) torque.

(13) Install new fluid filter on valve body. Tighten filter screws to 4 N●m (35 in. lbs.) torque.

(14) Install new manual lever shaft seal in case if necessary. Use 15/16 deep well socket to seat seal (Fig. 16).

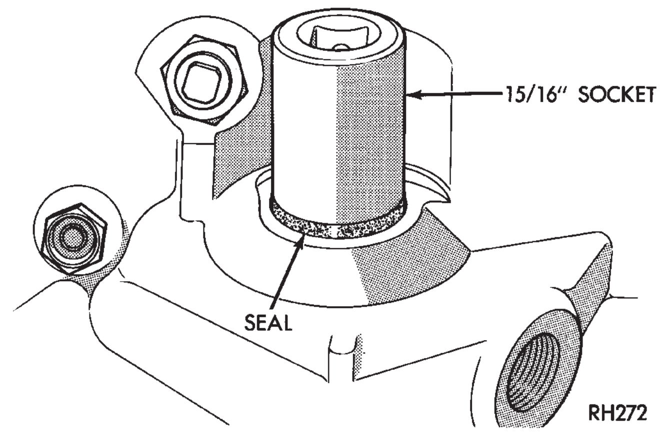


Fig. 16 Installing Manual Lever Shaft Seal

(15) Install and connect park/neutral position switch in case.

(16) Install throttle and gearshift levers on valve body manual lever shaft.

(17) Check and adjust front and rear bands if necessary.

(18) Connect valve body overdrive and converter clutch solenoid wires to case connector.

(19) Install oil pan and new gasket. Tighten pan bolts to 17 N●m (13 ft. lbs.) torque.

(20) Lower vehicle and fill transmission with Mopar ATF Plus, type 7176 fluid.

(21) Check and adjust gearshift and throttle linkage if necessary.

SERVICING COOLER LINE QUICK DISCONNECT FITTINGS

The transmission cooler lines are attached to the transmission and radiator main cooler with quick disconnect fittings (Fig. 17).

The transmission fitting consists of a fitting body, a plastic insert and a wire retainer clip (Fig. 18).

The fitting in the cooler line hose is swedged into the hose. Only the insert and retainer clip are serviceable on this fitting.

A flange on the cooler line serves as the sealing mechanism. The wire retainer clip holds the cooler line in the fitting. The clip fits behind the cooler line flange to hold the line in place. The plastic insert is not a seating or sealing device. The insert is used to indicate when the cooler line is properly seated in the fitting.

The transmission fitting, wire retainer clip and plastic insert are serviceable individually, or as an assembly.

The fittings in the cooler line hoses are serviced as part of the cooler line. Only the retaining clip and insert are serviceable.

The retainer clip is not a reusable part and must be replaced every time the cooler lines are disconnected. In addition, the plastic insert should be replaced if cut, torn, or damaged in any way. A damaged insert could prevent the cooler line from seating properly.

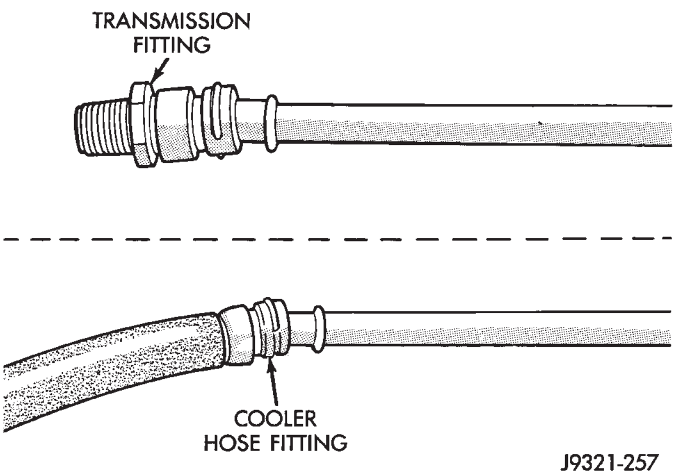


Fig. 17 Quick Disconnect Fittings

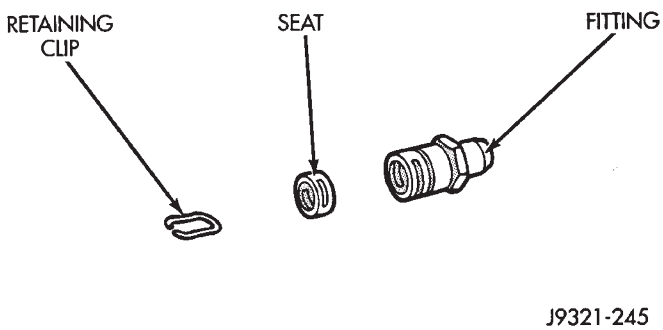


Fig. 18 Quick Disconnect Fitting Components (Transmission Fitting Shown)

PROCEDURE FOR DISCONNECTING COOLER LINES

(1) If cooler lines are to be disconnected at main cooler (in radiator), remove splash shield under radiator for access to fittings.

(2) Pry wire retainer clips off quick disconnect fittings with small screwdriver (Fig. 19). **Discard clips as they are NOT reusable parts.**

(3) Pull cooler line out of fitting.

(4) Remove and retain plastic insert from each fitting.

Quick Disconnect Fitting Inspection

Inspect condition of each plastic insert. Replace any insert that is cut, torn, or damaged in any way.

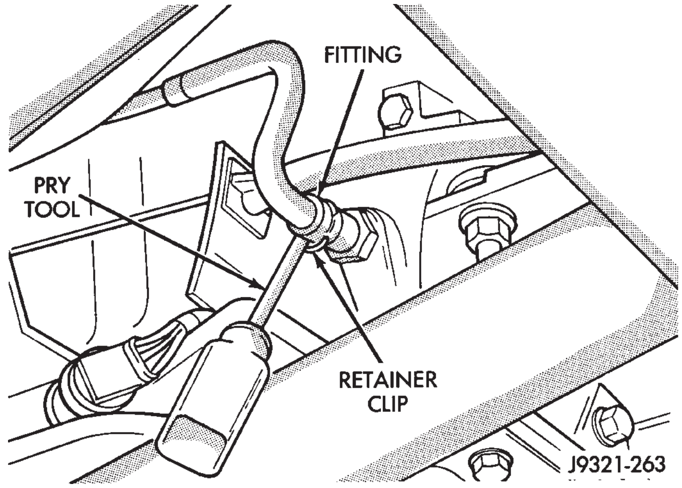


Fig. 19 Removing Retainer Clips From Quick Disconnect Fittings

Replace the transmission fitting as an assembly if the fitting body is damaged. Replace the cooler line as an assembly, if the fitting swedged into the cooler line hose, is damaged.

Quick Disconnect Fitting Replacement

The transmission fittings can be disconnected and removed as necessary. Use Loctite 242 on the replacement fitting threads before installation.

The fittings in the cooler line hoses are serviced only as part of the cooler line and hose assembly.

PROCEDURE FOR RECONNECTING COOLER LINES

(1) Wipe off fittings with lint free cloth or shop towels.

(2) Install inserts in fittings. Use new inserts if originals were damaged an any way, or if doubt exists about insert condition.

(3) Install replacement retainer clips on fittings as follows:

(a) Start retainer clip in slot on one side of fitting (Fig. 20).

(b) Swing retainer clip across and over fitting. Then carefully seat clip in slot on opposite side of fitting (Fig. 21).

(4) Wipe end of each cooler line clean with lint free cloth, or shop towel.

(5) Start cooler line into fitting. Then push cooler line inward until wire retainer clip snaps into place behind flange on cooler line.

(6) **Note position of plastic insert. When cooler line is fully seated, insert will no longer extend beyond end of fitting.**

(7) Verify that both sides of wire retainer clip are seated **behind** flange on cooler line (Fig. 22).

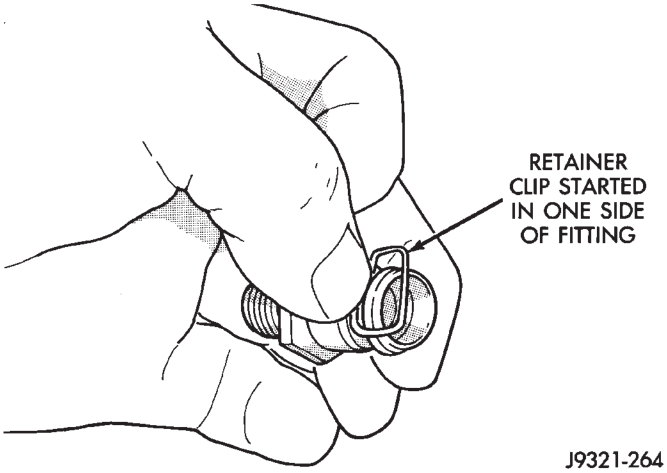


Fig. 20 Starting New Retainer Clip On Quick Disconnect Fitting

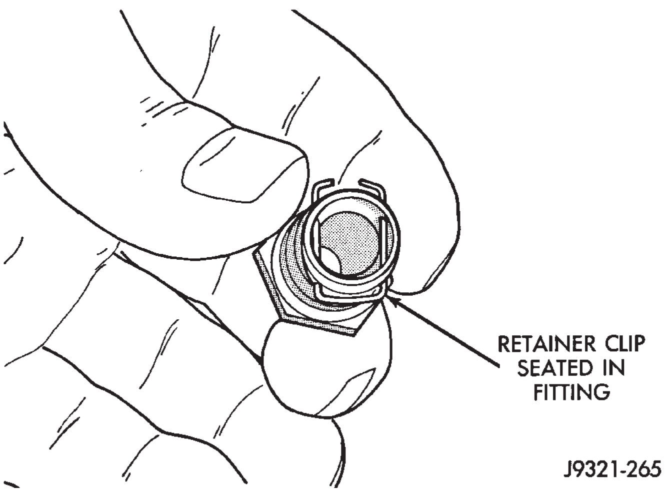


Fig. 21 Seating New Retainer Clip In Quick Disconnect Fitting

CAUTION: The retainer clips secure the cooler lines in the quick disconnect fittings. If the clips become deformed, or distorted, normal fluid pressure could unseat the cooler lines resulting in fluid loss and transmission damage. Be very sure the clips are in good condition and firmly seated behind the cooler line flanges (Fig. 22).

(8) Reinstall splash shield under radiator, if removed.

TRANSMISSION COOLER TESTING AND FLUSHING

If a transmission malfunction contaminates the fluid, the cooler and lines must be reverse flushed thoroughly. Flushing will prevent sludge and particles from flowing back into the transmission after repair. **The flushing procedure applies to standard and auxiliary coolers alike.**

Pressure equipment is preferred for reverse flushing. However, reverse flushing can be performed with hand operated equipment as follows.

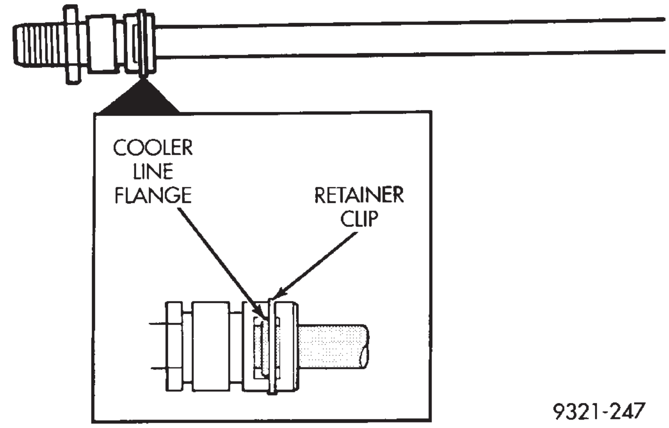


Fig. 22 Verifying Installation Of Cooler Lines In Quick Disconnect Fittings

COOLER REVERSE FLUSHING PROCEDURE

(1) Identify and disconnect cooler pressure and return lines at transmission. Rear line is return line from cooler. Front line is pressure line to cooler (Fig. 23).

(2) Position drain pan under cooler pressure line to catch 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 return line. Then force mineral spirits into line and through cooler.

(4) Continue reverse flushing until fluid exiting cooler pressure line is clear and free from debris. **Replace cooler if fluid cannot be pumped through it.**

(5) Clear flushing materials from cooler and lines with short pulses of compressed air. Insert air gun nozzle into cooler return line and continue short air pulses until all fluid is cleared from cooler and lines.

(6) Pump one quart of fresh automatic transmission fluid through cooler and lines before reconnecting lines.

TESTING COOLER FLUID FLOW

Cooler flow is tested by measuring the amount of fluid pumped through the cooler in a specified time by the transmission oil pump.

(1) Disconnect cooler return (rear) line at transmission and place it in one quart test container.

(2) Add extra quart of fluid to transmission.

(3) Use stopwatch to check test time.

(4) Shift into Neutral.

(5) Start and run engine at curb idle speed and note cooler flow. Approximately 1 quart (0.9 liter) of fluid should flow into test container in 20 seconds.

(6) If fluid flow is intermittent, or flows less than one quart in 20 seconds, or fails to allow flow at all, cooler is plugged and should be replaced.

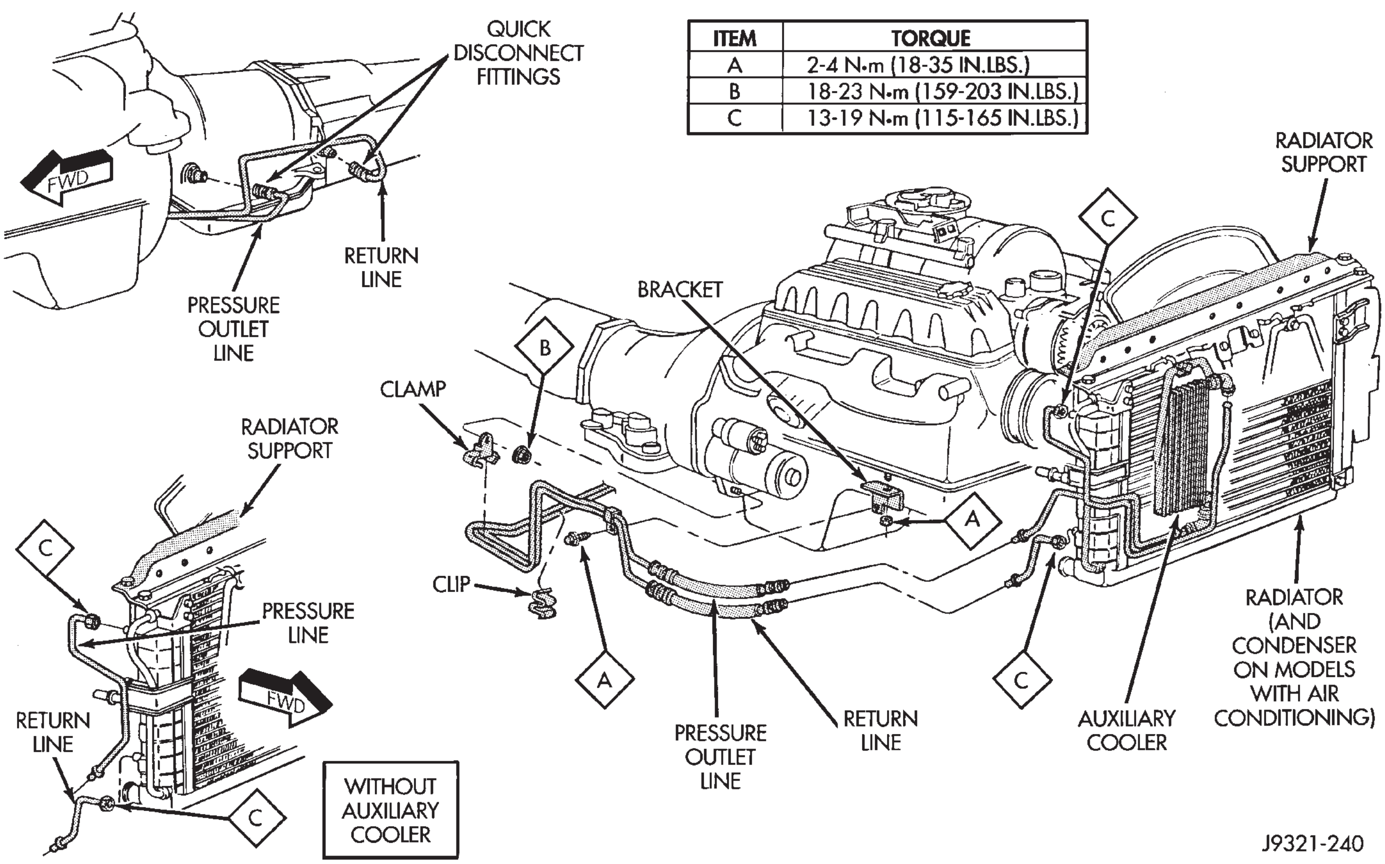


Fig. 23 Transmission Cooler Line Routing And Identification

MAIN COOLER REPLACEMENT

The main transmission 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.

AUXILIARY COOLER REPLACEMENT

(1) Remove grille and air conditioning condenser if equipped.

(2) Remove screws and U-nuts securing cooler to radiator and support (Fig. 23).

(3) Tag cooler hoses for installation reference (Fig. 23).

(4) Position drain pan under cooler hoses.

(5) Loosen cooler connecting hose clamps and disconnect hoses.

(6) Remove auxiliary cooler.

(7) Connect cooler hoses.

(8) Position cooler on radiator and install cooler attaching U-nuts and screws.

(9) Tighten cooler hose clamps securely.

(10) Install grille and air conditioning condenser.

(11) Check and adjust transmission fluid level.

(12) If air conditioning condenser lines were disconnected during service, evacuate and recharge system.

ALUMINUM THREAD REPAIR

Damaged or worn threads in the aluminum transmission case and in the valve body can be repaired with Heli-Coil or similar quality thread inserts. Essentially, repair consists of drilling out the worn or damaged threads, tapping the hole with a special tap and installing the thread insert into the tapped hole. This procedure returns the hole threads to original size. Heli-Coil, or equivalent, tools and inserts are readily available from most automotive parts suppliers. Stainless steel inserts are recommended.

46RH TRANSMISSION/OVERDRIVE REMOVAL AND INSTALLATION

INDEX

GENERAL INFORMATION

The overdrive unit can be removed for service without having to remove the entire transmission assembly. However if the transmission, torque converter, converter driveplate, or oil pump requires service, the complete transmission assembly must be removed for access to these components.

If only the overdrive unit must be removed, refer to the Overdrive Unit Removal/Installation procedures. If the complete transmission assembly must be removed, refer to the Transmission Removal/Installation procedures.

TRANSMISSION AND CONVERTER REMOVAL

(1) Raise vehicle on hoist.

(2) If transmission will be disassembled after removal, remove transmission oil pan, drain fluid and reinstall oil pan.

(3) Remove skid plate, if equipped.

(4) Mark front and rear propeller shafts and U-joints for alignment reference (Fig. 1).

(5) Disconnect and remove both propeller shafts.

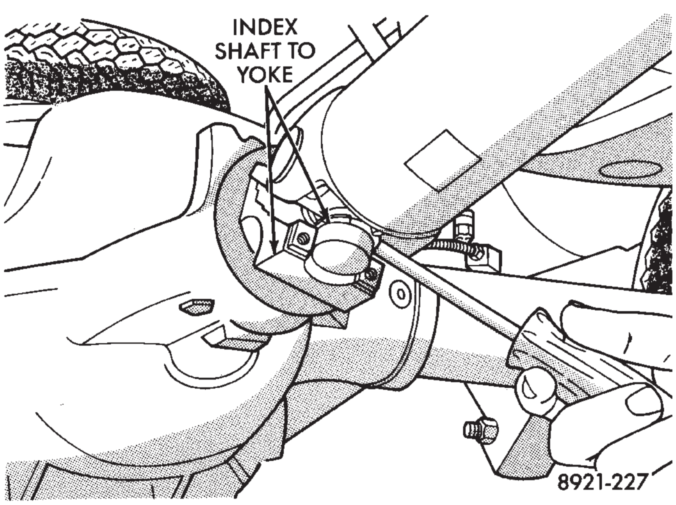


Fig. 1 Marking Propeller Shaft And Yoke For Alignment Reference

(6) Disconnect vehicle speed sensor wires.

(7) Disconnect vacuum vent hose at transfer case.

(8) Disconnect transfer case shift linkage at range lever. Then remove linkage bracket bolts and remove linkage and bracket from transfer case. Move linkage aside for clearance.

(9) Remove nuts attaching transfer case to overdrive unit gear case.

(10) Remove transfer case. Support transfer case with transmission jack. Secure transfer case to jack with safety chains. Then move transfer case rearward and off transmission.

(11) Remove transfer case from transmission jack and place transfer case on bench.

(12) Support transmission with transmission jack.

(13) Remove nuts and bolts attaching transmission mount to crossmember.

(14) Remove bolts and nuts attaching crossmember to frame rails.

(15) Rotate crossmember diagonally to clear frame rails and remove crossmember.

(16) Disconnect exhaust pipes at manifold and at converter and/or muffler connections as needed. Then remove Y-pipe from vehicle and move remaining pipes aside for working clearance.

(17) Disconnect and remove crankshaft position sensor. Retain sensor attaching bolts.

CAUTION: The crankshaft position sensor can be damaged if the transmission is removed (or installed) with the sensor still bolted to the engine block. To avoid damage, remove the sensor before removing the transmission.

(18) Disconnect transmission shift linkage at shift lever on transmission.

(19) Remove transmission shift linkage torque shaft assembly from retainers on transmission and frame rail. Move linkage aside for working clearance.

(20) Remove brackets that attach transmission to engine block, if equipped.

(21) Remove dust shield cover from front side of transmission converter housing.

(22) Remove starter motor bolts. Pull starter rearward until clear of housing and position it out of way on nearby component. Starter does not have to be removed from vehicle nor does cable have to be disconnected.

(23) Remove bolts attaching torque converter to drive plate.

(24) Disconnect cooler lines at transmission quick disconnect fittings as follows:

(a) Remove retainer clips securing cooler lines in transmission fittings. Use small flat blade screwdriver to remove clips (Fig. 2). **Discard retainer clips. They are NOT reusable.**

(b) Grasp cooler line and pull it straight out of quick disconnect fitting.

(c) Remove plastic insert from each quick disconnect fitting. Retain inserts as they are reusable if in good condition.

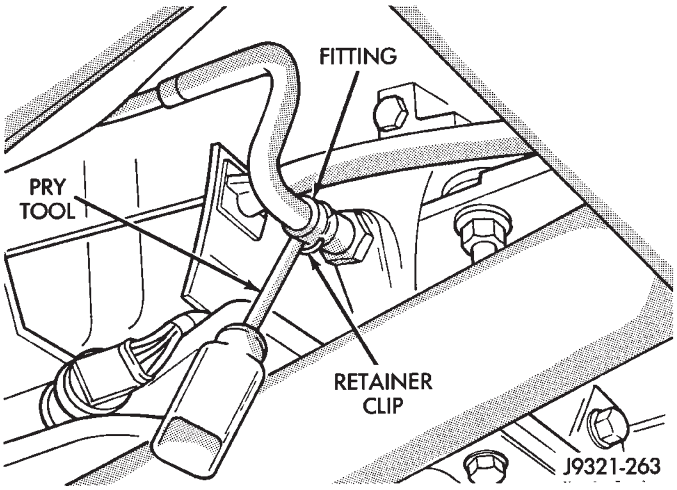


Fig. 2 Disconnecting Transmission Cooler Lines

(25) Disconnect solenoid and park/neutral position switch wires at transmission.

(26) Remove transmission fill tube and dipstick.

(27) Lower transmission for access to converter housing upper bolts.

(28) Remove bolts attaching transmission converter housing to engine. Note that some bolts may be accessible only from front (engine) side of housing.

(29) Move transmission rearward until clear of engine block dowels. On some models, part of hem flange joining vehicle cab and dash panel may interfere with transmission removal. Peen this part of flange over with a mallet if necessary.

(30) Secure torque converter in housing with small C-clamp.

(31) Lower transmission and remove it from under vehicle.

(32) Remove C-clamp and remove converter from transmission. Place converter on workbench for inspection or reassembly. Cover converter hub with clean, lint free cloth.

(33) Oil pump, converter and driveplate can now be serviced if necessary. Refer to information in this section.

OIL PUMP SEAL REPLACEMENT

The pump oil seal can be replaced without removing the pump and reaction shaft support assembly from the transmission case.

Seal Removal

Remove the seal with Special Tool C-3861 (Fig. 3). To use the remover 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.

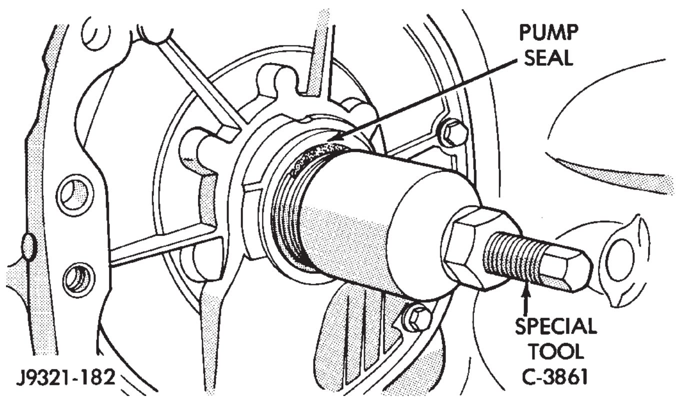


Fig. 3 Oil Pump Seal Removal—46RH

Seal Installation

Use Installer Tool C-3860-A (Fig. 4). To use the tool, place the seal in the pump opening with the seal lip facing inward. Then tap the seal into place with the installer tool. Tool Handle C-4171 may be used with the installer tool if desired.

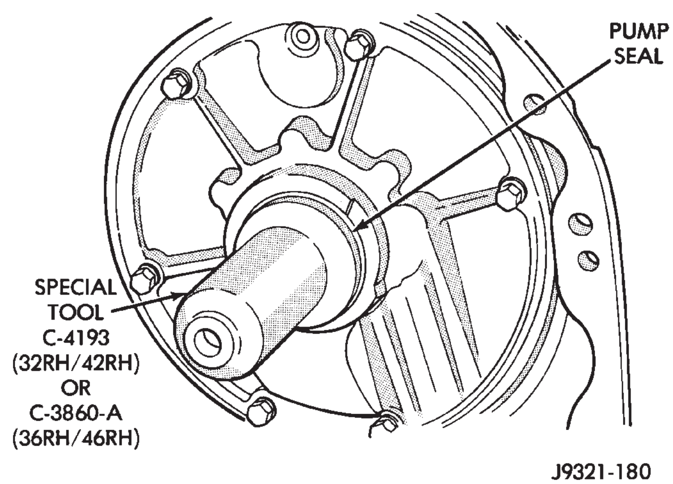


Fig. 4 Oil Pump Seal Installation—46RH

TORQUE CONVERTER AND DRIVE PLATE SERVICE

After the transmission has been removed, the drive plate and torque converter can be replaced or removed for service access.

The torque converter is not a serviceable part. If the converter is contaminated by a transmission malfunction, 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.**

Inspect the driveplate. Replace the driveplate if the hub is cracked, or the plate is bent or damaged in any way. Use new bolts to secure the driveplate to the crankshaft and use Mopar Lock N' Seal, or Loctite 242 on the bolt threads before installation.

TRANSMISSION AND CONVERTER INSTALLATION

CAUTION: The transmission cooler and lines must be flushed if repair was to correct a problem that generated sludge, metal particles, or clutch friction material. The torque converter should also be replaced when contaminated by a malfunction. The transmission, fluid and converter will all be contaminated again if residue/debris is not flushed from the cooler and lines beforehand.

(1) Mount transmission on jack. Secure transmission to jack with safety chains.

(2) Check torque converter hub for sharp edges burrs, scratches, or nicks. Polish hub with crocus cloth or 400 grit paper if necessary. Hub must be smooth to avoid damaging pump seal.

(3) Lubricate converter pilot hub, drive hub and pump seal lip with Mopar ATF Plus or Dexron II transmission fluid.

(4) Align and install converter in oil pump. Verify that converter is fully seated. Use straight edge and steel ruler to check seating (Fig. 5). Surface of converter lugs should be 12.7 mm (1/2 in.) to rear of straight edge when converter is fully seated.

(5) Temporarily secure converter with C-clamp attached to housing or with metal strap attached across converter housing.

(6) Check condition of converter driveplate. Replace driveplate if cracked, distorted or damaged.

(7) Verify that transmission dowel pins are seated in engine block and protrude far enough to held transmission in alignment.

(8) Move transmission under vehicle and position it at rear of engine. Remove C-clamp or strap used to secure converter in housing.

(9) Align transmission with engine dowels and align converter with driveplate. Offset holes in driveplate are next to 1/8 inch hole in inner circle of plate (Fig. 6).

(10) Move transmission forward until seated on engine block dowels. Then install one or two transmission attaching bolts to hold transmission in place (Fig. 7).

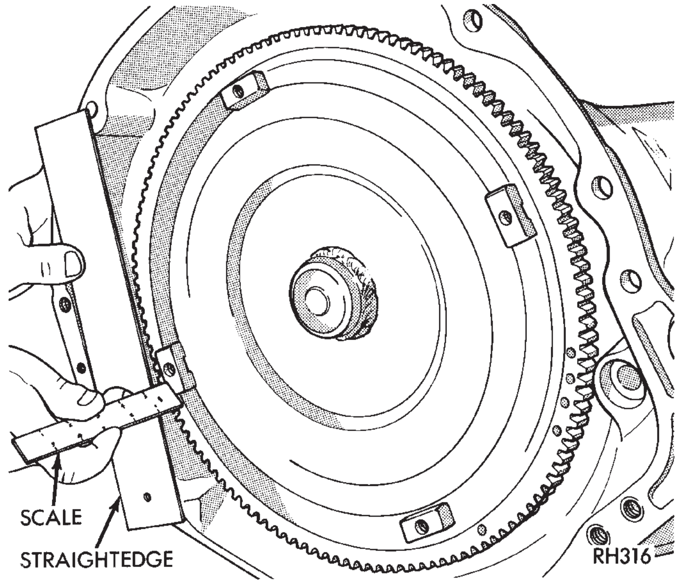


Fig. 5 Checking Torque Converter Seating

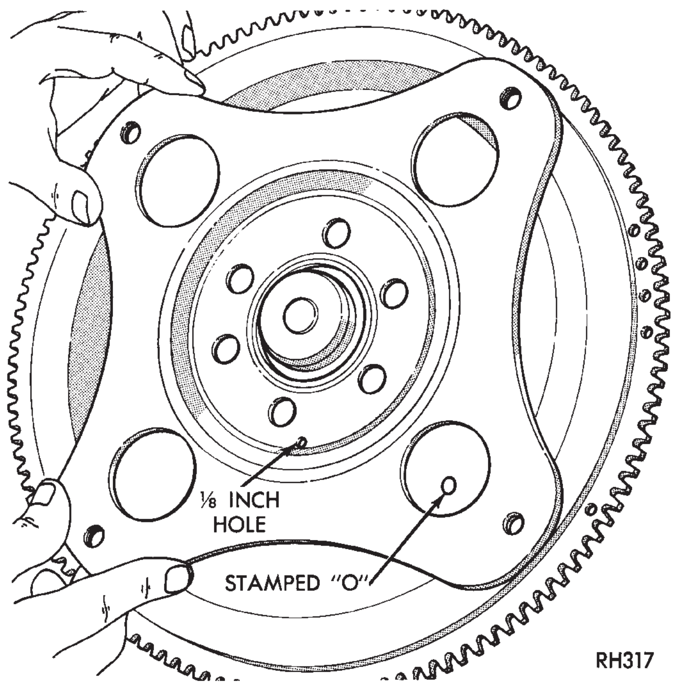


Fig. 6 Torque Converter And Driveplate Markings

CAUTION: It is essential that correct length bolts be used to attach the converter to the driveplate. Bolts that are too long will damage the modulated clutch surfaces in the converter. If new bolts are required, use the bolts specified in this procedure and in the parts catalogue only.

(11) Verify converter bolt length. Bolt measurement is from bottom (underside) of bolt head to end of bolt threads.

- On 9.5 in., 3-lug converter, bolts should be 11.7 mm (0.46 in.) long.

ITEM	TORQUE
A	3-6 N•m (30-50 IN.LBS.)
B	27-54 N•m (20-40 FT.LBS.)
C	47-88 N•m (35-65 FT.LBS.)
D	9-14 N•m (80-120 IN.LBS.)

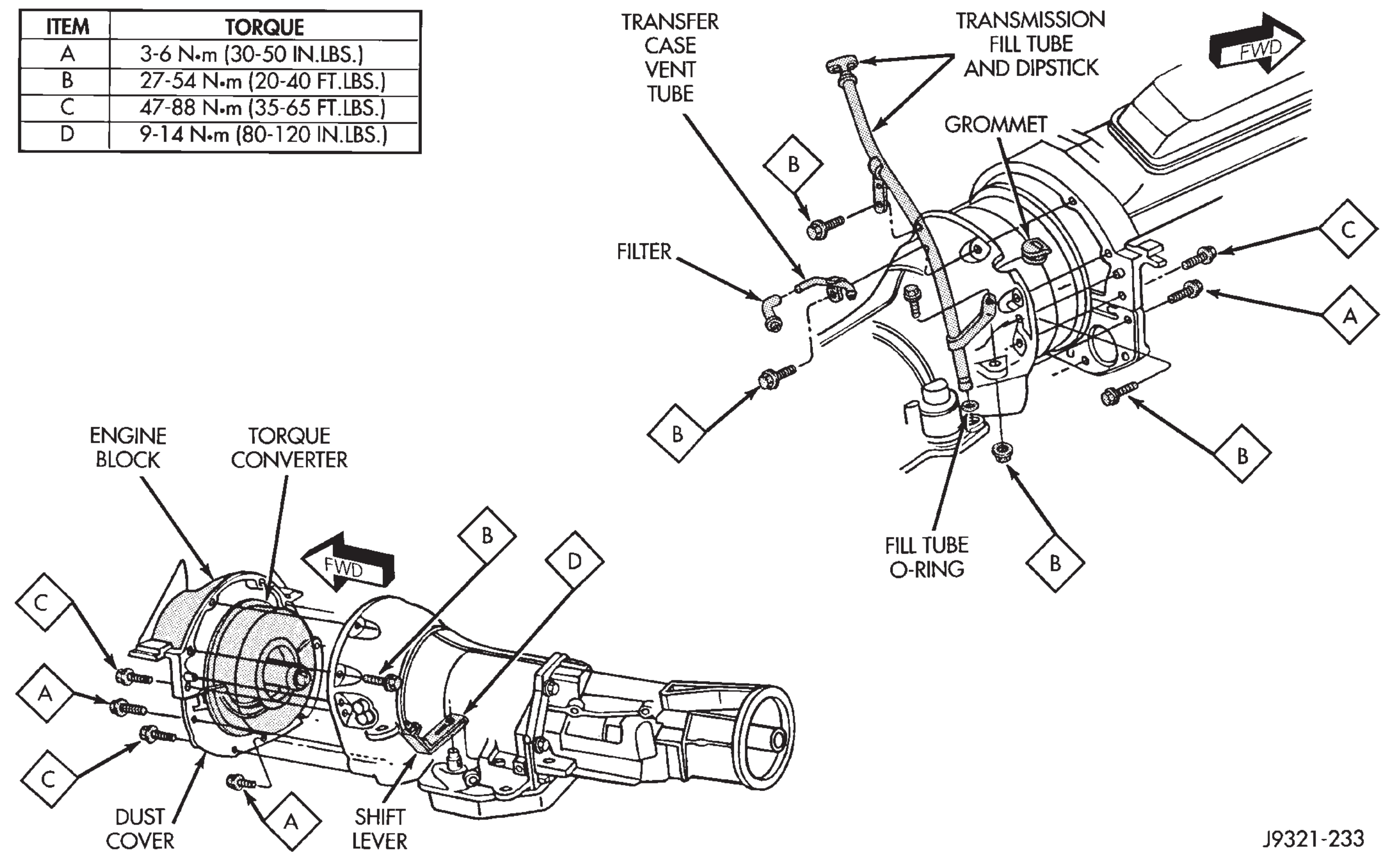


Fig. 7 Transmission And Fill Tube Mounting

• On 9.5 in., 4-lug converter, bolts should be 13.2 mm (0.52 in.) long.

• On 10.0 in., 4-lug converter, bolts should be 13.2 mm (0.52 in.) long.

• On 10.75 in., 4-lug converter, bolts should be 11.2 mm (0.44 in.) long.

(12) Install torque converter bolts. Tighten bolts as follows:

• On models with 9.5 in., 3-lug converter, tighten bolts to 54 N●m (40 ft. lbs.).

• On models with 9.5 in., 4-lug converter, tighten bolts to 74 N●m (55 ft. lbs.).

• On models with 10.0 in., 4-lug converter, tighten bolts to 74 N●m (55 ft. lbs.).

• On models with 10.75 in., 4-lug converter, tighten bolts to 31 N●m (270 in. lbs.).

(13) Install and tighten remaining transmission attaching bolts (Fig. 6).

(14) Install dust cover on transmission converter housing. Two small vise grip pliers van be used to hold and align cover during installation.

(15) Install starter motor.

(16) Install strut brackets that secure transmission to engine block and front axle.

(17) Install and connect crankshaft position sensor. Be sure sensor grommet is securely in place.

(18) Install transmission fill tube. Install new O-ring seal on tube before installation (Fig. 7).

(19) position wire harnesses in clips on transmission and transfer case.

(20) Connect exhaust Y-pipe to engine exhaust manifolds.

(21) Install shift linkage torque bracket.

(22) Connect shift linkage to transmission.

(23) Connect solenoid and park/neutral position switch wires.

(24) Install crossmember on frame rails. Place crossmember at 45° angle to rails. Insert crossmember between rails and rotate crossmember into place.

(25) Install bolts/nuts attaching transmission to rear mount (Fig. 8).

(26) Install bolts/nuts attaching crossmember to frame rails.

(27) Remove transmission jack.

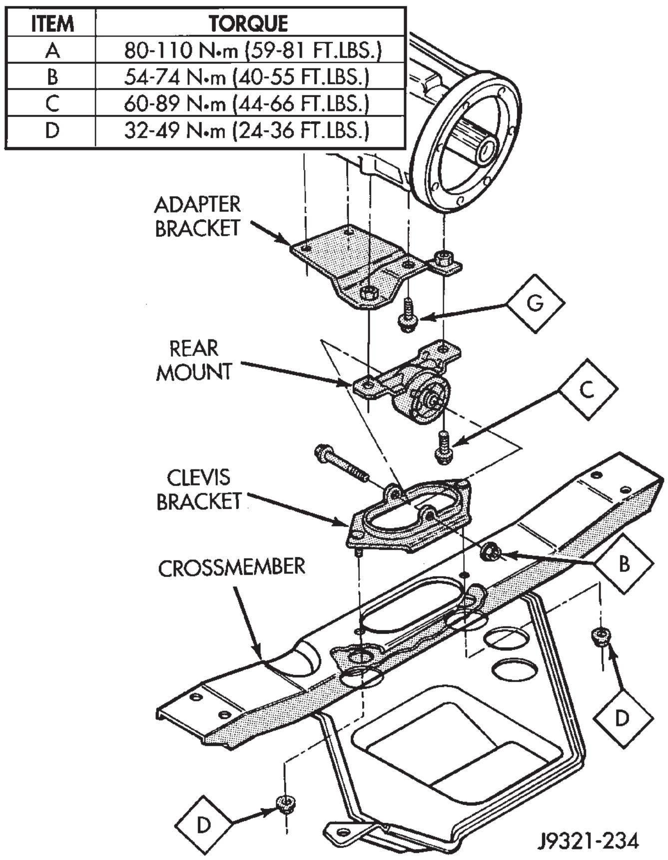
(28) Install transfer case (Fig. 9). Align and position transfer case with transmission jack or with aid of helper. Tilt case upward and work into position on transmission mounting studs.

(29) Install and tighten transfer case attaching nuts to 47 N●m (35 ft. lbs.) torque.

(30) Install damper on transfer case rear retainer if removed. Tighten damper nuts to 54 N●m (40 ft. lbs.) torque.

(31) Install and connect transfer case shift linkage.

(32) Connect transmission cooler lines to quick disconnect fittings as follows:



ITEM	TORQUE
A	80-110 N•m (59-81 FT.LBS.)
B	54-74 N•m (40-55 FT.LBS.)
C	60-89 N•m (44-66 FT.LBS.)
D	32-49 N•m (24-36 FT.LBS.)

Fig. 8 Transmission Rear Mount Components

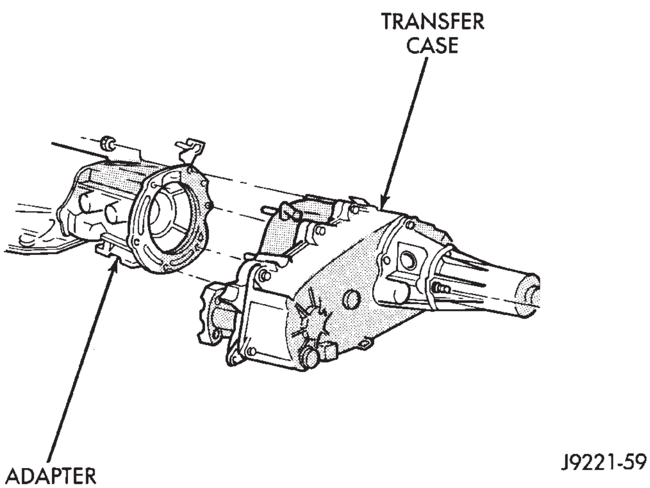


Fig. 9 Transfer Case Mounting

(a) Wipe end of each cooler line clean with lint free cloth, or shop towel.

(b) Install plastic inserts in fittings. **Replace inserts if cut, or torn. Do not reuse them if damaged. A damaged insert will prevent cooler line from seating properly.**

(c) Install NEW retainer clip on each quick disconnect fitting. First, start clip in slot at one side of fitting (Fig. 10). Then swing clip over fitting and carefully seat it in slot at opposite side of fitting (Fig. 11).

(d) Start cooler line into fitting. Then push cooler line inward until wire retainer clip snaps into place behind flange on cooler line.

(e) Verify that both sides of wire retainer clip are seated **behind** flange on cooler line (Fig. 12).

CAUTION: Be sure the cooler lines are fully seated in the fittings. Also be sure the wire retainer clips are properly seated behind each cooler line flange. Fluid pressure will force the cooler line out of the fitting if the retainer clips are improperly seated.

(33) Connect speed sensor wires. If vehicle is also equipped with speedometer cable, connect cable to sensor.

(34) Align and install remaining exhaust components. Tighten all clamp and bracket bolts and nuts securely. Be sure exhaust components are clear of all chassis and driveline components.

(35) Align and install front and rear propeller shafts. Tighten U-joint clamp bolts to 19 N●m (170 in. lbs.) torque.

(36) Verify that all linkage components, hoses and electrical wires have been connected.

(37) Check transfer case fluid level. Add Mopar ATF Plus, or Dexron II fluid if necessary. Correct level is to edge of fill plug hole. Be sure transfer case is level before checking or adding fluid.

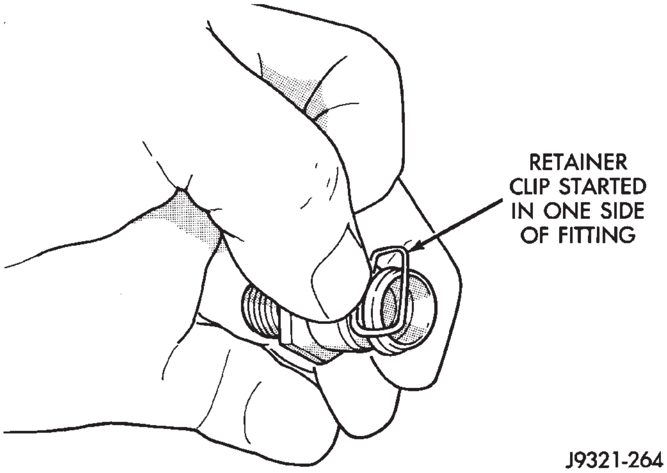


Fig. 10 Starting New Retainer Clip On Quick Disconnect Fitting

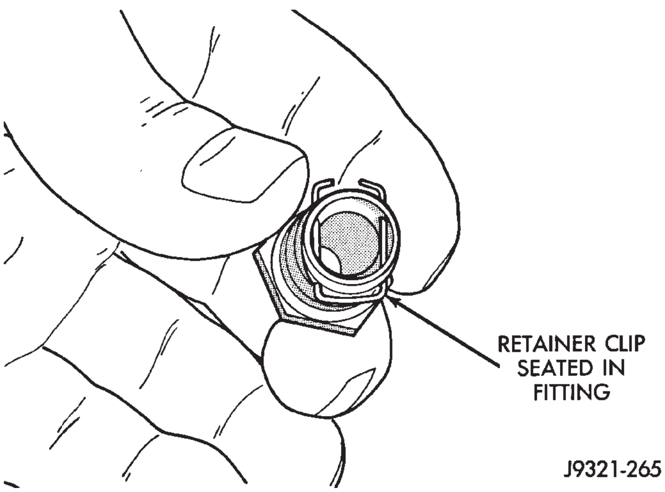


Fig. 11 Seating New Retainer Clip In Quick Disconnect Fitting

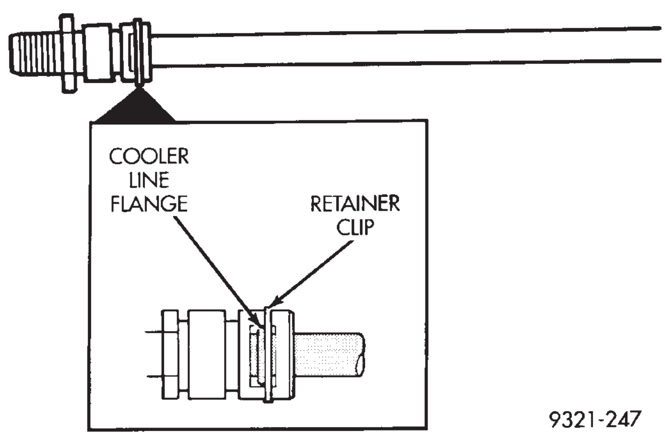


Fig. 12 Verifying Installation Of Cooler Lines In Quick Disconnect Fittings

(38) Install transfer case skid plate, if equipped.

(39) Lower vehicle.

(40) Refill transmission with Mopar ATF Plus, type 7176 fluid. Mopar Dexron II can be used if ATF Plus is not readily available.

(41) Check and adjust engine oil level as necessary.

(42) Check and adjust transmission and transfer case shift linkage if necessary.

(43) Check and adjust transmission throttle cable if necessary.

OVERDRIVE UNIT REMOVAL

(1) Disconnect battery negative cable.

(2) Raise vehicle on hoist.

(3) Remove transfer case skid plate, if equipped.

(4) Mark front and rear propeller shafts and U-joints for alignment reference (Fig. 10).

(5) Disconnect and remove both propeller shafts.

(6) Disconnect vehicle speed sensor wires.

(7) Disconnect vacuum switch hoses at transfer case, if equipped.

(8) Disconnect transfer case shift linkage at transfer case range lever. Then remove linkage bracket bolts and remove linkage and bracket from transfer case. Move linkage aside for clearance.

(9) Remove nuts attaching transfer case to overdrive unit.

(10) Remove transfer case. Support transfer case with transmission jack (secure transfer case to jack with safety chains). Then move transfer case rearward and off overdrive case.

(11) Remove transfer case from jack and position it on bench.

(12) Support transmission with adjustable jack stand. Position wood block between jack and transmission case.

(13) Remove nuts and bolts attaching transmission mount to center crossmember.

(14) Remove nuts and bolts attaching crossmember to frame rails.

(15) Rotate crossmember diagonally to clear frame rails and remove crossmember.

(16) Support overdrive unit with transmission jack.

(17) Remove bolts attaching overdrive unit to transmission (Fig. 13).

CAUTION: The overdrive unit must be fully supported during removal. This is necessary to prevent damaging the intermediate shaft. Do not allow the shaft to support the entire weight of the overdrive unit.

(18) Carefully slide overdrive unit off intermediate shaft. Do not tilt overdrive unit during removal. Keep it as level as possible.

(a) If overdrive unit does not require service, **immediately insert Alignment Tool 6227-2 in splines of planetary gear and overrunning**

clutch (Fig. 14). If misalignment occurs, overdrive unit will have to be disassembled in order to realign splines.

(b) If overdrive unit requires service, refer to Overdrive Unit Overhaul procedures.

(19) Remove and retain bearing and select fit spacer. These parts may remain on overdrive piston, rear of transmission case, sliding hub, or intermediate shaft during removal.

(20) Place several clean shop towels on a bench. Then position unit on towels to absorb spilled fluid.

(21) Position overdrive unit over drain pan and tilt unit to drain residual fluid from case. Examine fluid for clutch material or metal fragments. If fluid contains these items, overhaul will be necessary.

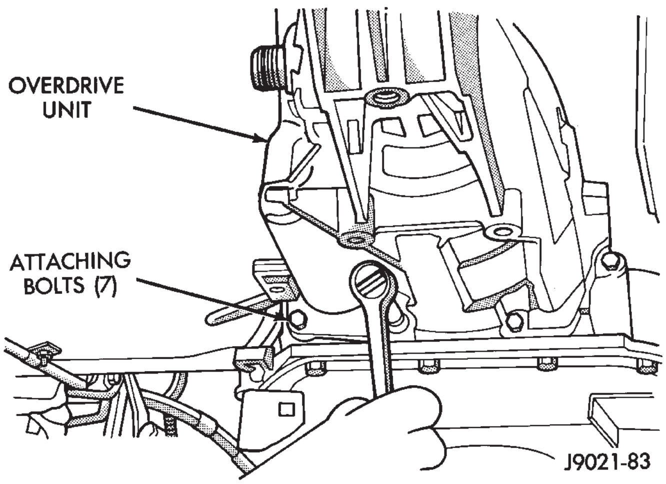


Fig. 13 Removing/Installing Overdrive Unit Attaching Bolts

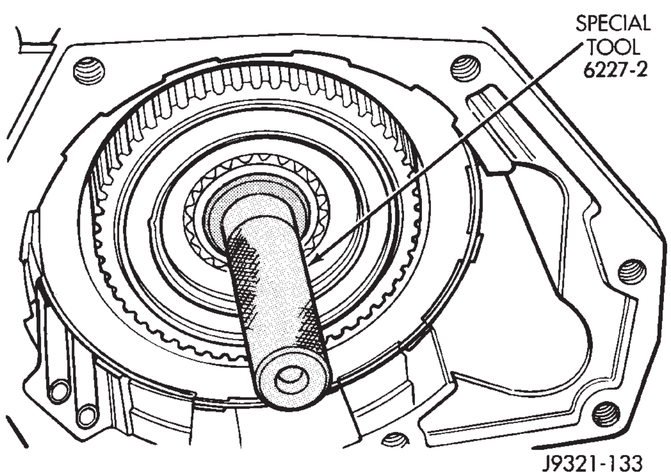


Fig. 14 Overdrive Spline Alignment Tool Installation

OVERDRIVE UNIT INSTALLATION

(1) Be sure Alignment Tool 6227-2 is still fully seated in splines of overdrive planetary gear and overrunning clutch. If misalignment occurs, overdrive will have to be disassembled in order to realign splines.

(2) If original case gasket is in good condition, proceed to step (6). If overdrive piston retainer was not removed during service and original case gasket is not reusable, prepare new gasket as described in steps (3) through (5).

(3) Cut out old case gasket around piston retainer with razor knife.

(4) Use old gasket as template and trim new gasket to fit (Fig. 15).

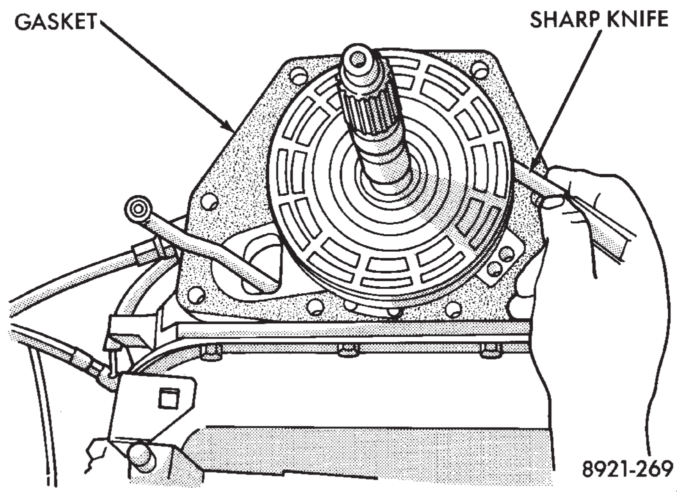


Fig. 15 Trimming Replacement Overdrive Case Gasket

(5) Position new gasket over piston retainer and on transmission case. Use petroleum jelly to hold gasket in place if necessary. **Do not use any type of sealer to secure gasket. Use petroleum jelly only.**

(6) Install selective spacer on intermediate shaft, if removed. Spacer goes in groove just rearward of shaft rear splines (Fig. 16).

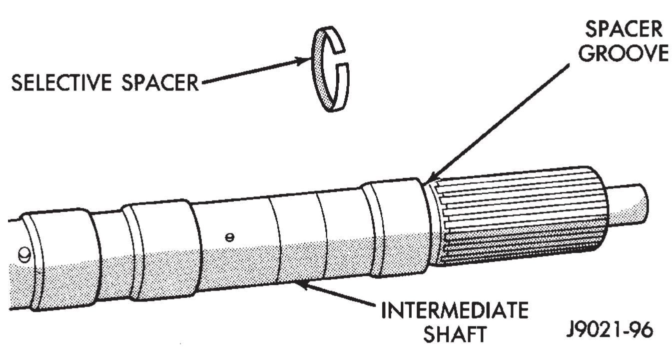


Fig. 16 Intermediate Shaft Selective Spacer Location

(7) Install overdrive piston in retainer, if removed. Lubricate piston seals with Ru-Glyde, Door-Eze or petroleum jelly to ease installation. Be sure piston locating lugs are aligned in piston retainer.

(8) Install thrust bearing in overdrive clutch hub. Use liberal quantity of petroleum jelly to hold bearing in position.

CAUTION: Be sure the shoulder on the inside diameter of the bearing is facing forward.

(9) Install thrust plate in overdrive piston hub (Fig. 17). Use liberal amount of petroleum jelly to hold thrust plate in position.

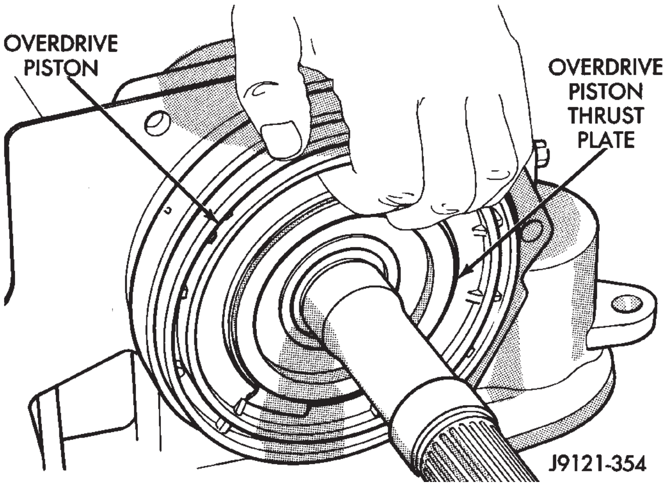


Fig. 17 Installing Overdrive Piston Thrust Plate

(10) Verify that splines in overdrive planetary gear and overrunning clutch hub are aligned with Tool 6227-2 (Fig. 13). **Overdrive unit cannot be fully installed if splines have rotated out of alignment. If misaligned has occurred, overdrive will have to be disassembled in order to realign splines.**

(11) Install overdrive unit as follows:

(a) Raise overdrive unit and carefully slide it straight onto intermediate shaft. **Avoid tilting overdrive unit during installation as planetary gear and overrunning clutch splines could rotate out of alignment. If misalignment occurs, overdrive will have to be disassembled in order to realign splines.**

(b) Align and insert park rod into park pawl reaction plug.

(c) Align governor tubes in boss on overdrive piston retainer.

(d) Work overdrive unit forward on intermediate shaft until seated against transmission case. If unit will not seat fully, turn output shaft slightly with socket to align intermediate shaft and overdrive splines.

(12) Apply Mopar Lock N' Seal or Loctite 242 to threads of overdrive attaching bolts.

(13) Install and tighten overdrive unit attaching bolts to 34 N●m (25 ft. lbs.).

(14) Install transfer case. Tighten attaching nuts to 41 N●m (30 ft. lbs.) torque.

(15) Connect transmission and transfer case shift linkage.

(16) Install crossmember and rear mount.

(17) Connect all necessary electrical wires.

(18) Align and connect propeller shafts. Tighten U-joint clamp bolts to 19 N●m (170 in. lbs.) torque.

(19) Check and adjust fluid level in transfer case. Use Mopar ATF Plus, or Dexron II to top off fluid level if necessary.

(20) Install skid plate, if equipped.

(21) Check and adjust transmission and transfer case shift linkage if necessary.

(22) Lower vehicle.

(23) Check and adjust transmission fluid level. Use Mopar ATF Plus, type 7176 fluid. Mopar Dexron II can be used if ATF Plus is not readily available.

TRANSMISSION OVERHAUL—46RH

INDEX

TRANSMISSION DISASSEMBLY

(1) Remove torque converter, if not previously removed.

(2) Clean transmission exterior with steam gun or solvent. Wear safety goggles while cleaning transmission.

(3) Remove shift and throttle levers from shaft of valve body manual lever.

(4) Remove bolts attaching overdrive unit to transmission case (Fig. 1).

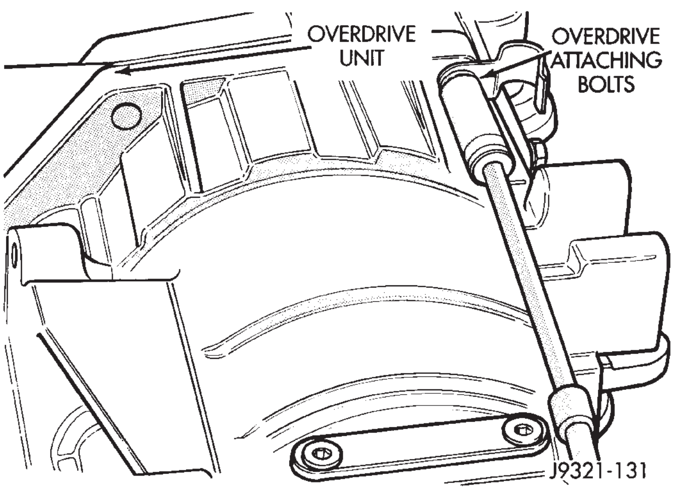


Fig. 1 Removing Overdrive Unit Attaching Bolts

(5) Loosen overdrive unit. Use pry tool to start overdrive unit off intermediate shaft and transmission case. Position pry tool between flange on overdrive case and transmission rear servo boss (Fig. 2).

(6) Work overdrive unit rearward and off transmission intermediate shaft (Fig. 3).

(a) If overdrive unit does not require service, insert Alignment Tool 6227-2 in overdrive unit overrunning clutch and planetary gear to maintain spline alignment (Fig. 4). **If clutch and gear splines rotate out of alignment, overdrive unit will have to be disassembled in order to realign splines.**

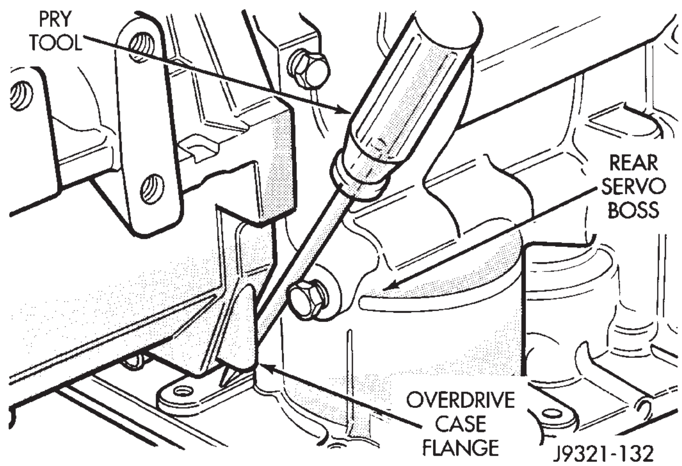


Fig. 2 Loosening Overdrive Unit From Transmission

(b) If overdrive unit does requires service, refer to Overdrive unit Overhaul section.

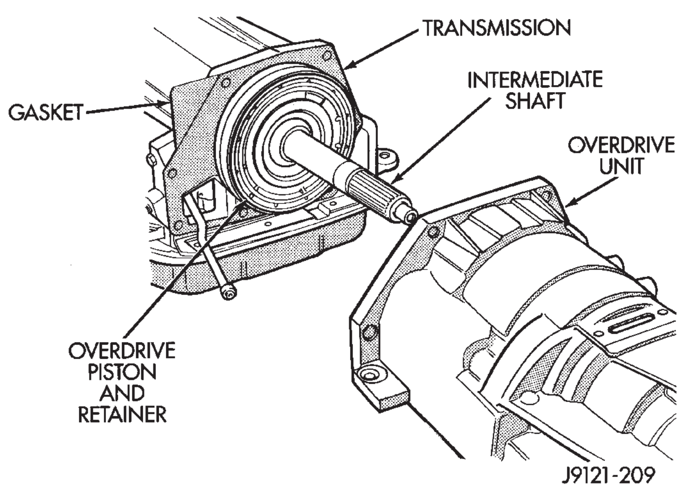


Fig. 3 Removing Overdrive Unit From Transmission—46RH

(7) Remove thrust plate from overdrive piston (Fig. 5).

(8) Remove overdrive piston from retainer (Fig. 6).

(9) Remove overdrive piston thrust bearing (Fig. 7).

(10) Mount transmission unit on Repair Stand C-3750-B, or support transmission with wood blocks.

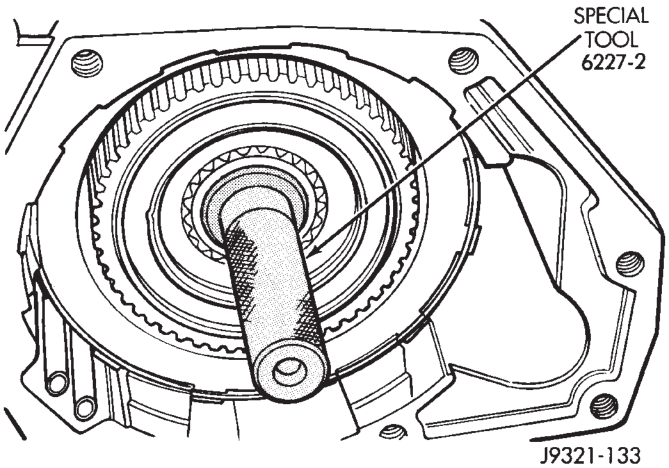


Fig. 4 Overdrive Spline Alignment Tool Installation

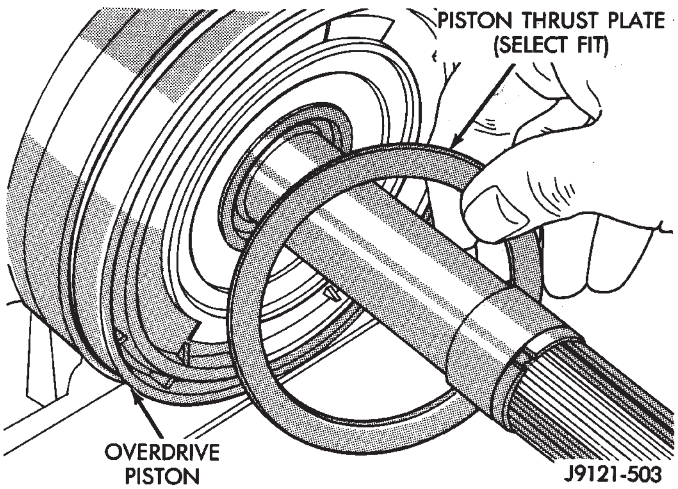


Fig. 5 Removing Overdrive Piston Thrust Plate—46RH

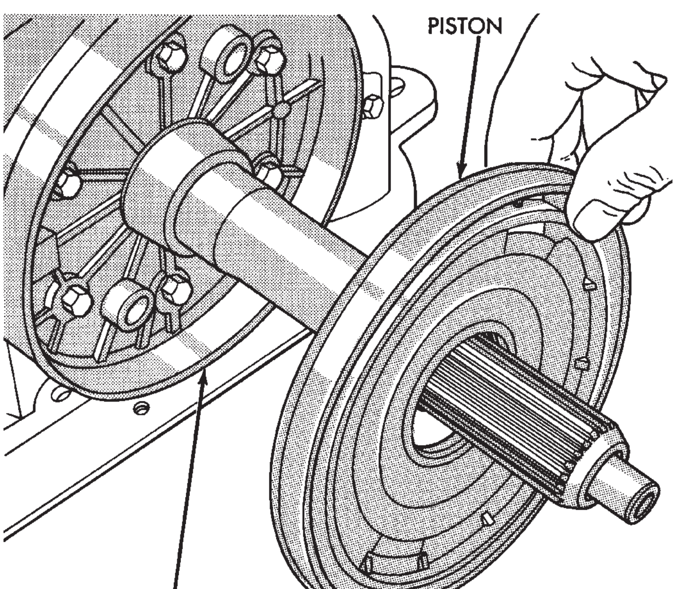


Fig. 6 Removing Overdrive Piston—46RH

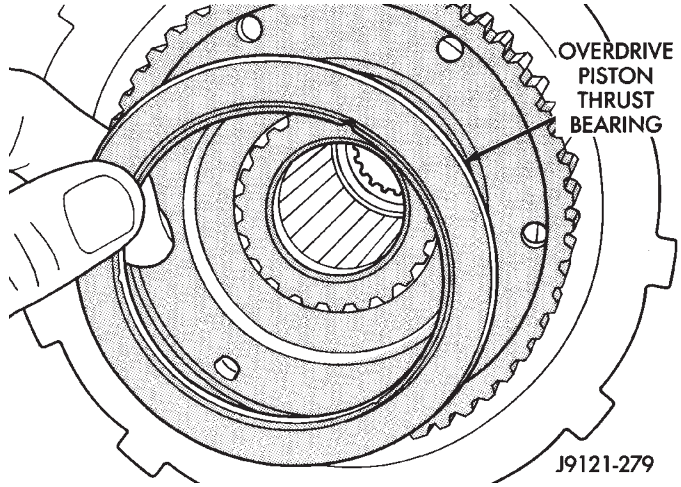


Fig. 7 Removing/Installing Overdrive Piston Thrust Bearing

(11) Remove pump oil seal with Special Tool C-3861 (Fig. 8). Be sure to tighten tool threads completely into seal before using puller bolt to withdraw seal.

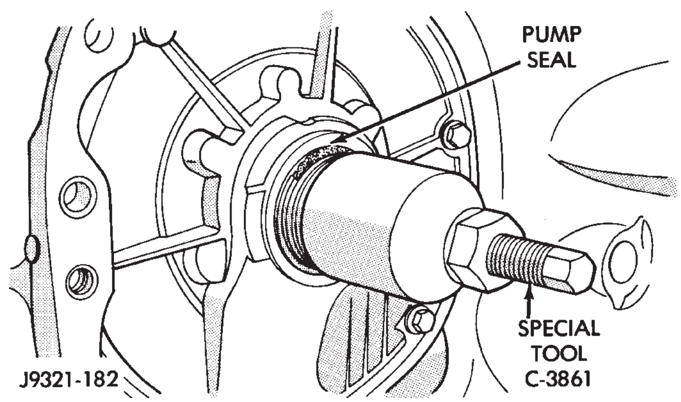


Fig. 8 Removing Pump Oil Seal—46RH

(12) Remove oil pan bolts and remove pan (Fig. 9) and gasket (Fig. 10). Oil pan magnet can be removed or left in pan as needed (Fig. 11). Exercise care when removing pan to avoid distorting or bending pan flange.

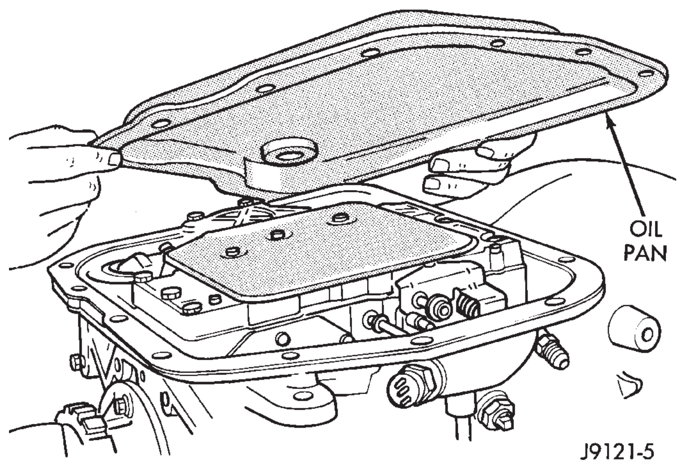


Fig. 9 Removing/Installing Oil Pan—46RH

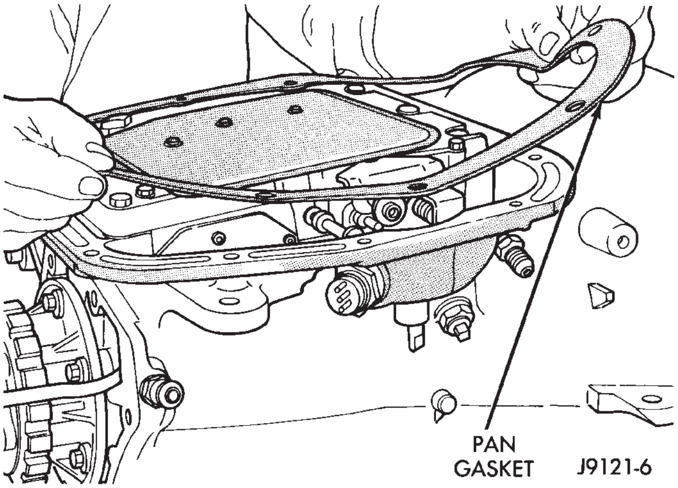


Fig. 10 Removing/Installing Pan Gasket—46RH

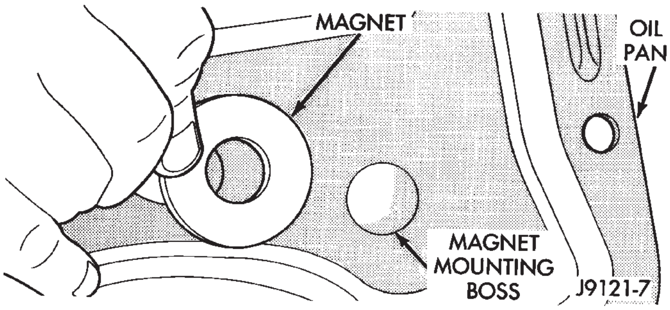


Fig. 11 Oil Pan Magnet Location—46RH

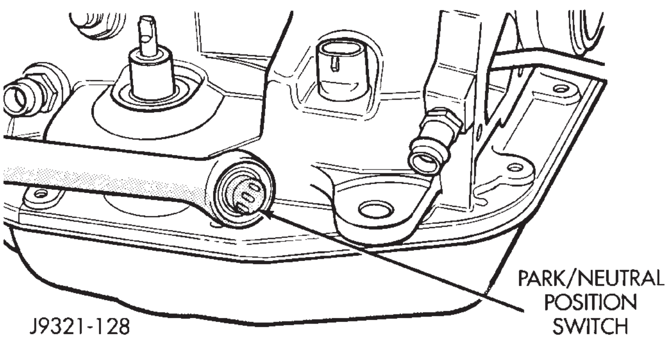


Fig. 12 Park/Neutral Position Switch Removal/Installation

(13) Remove park/neutral position switch (Fig. 12). If switch gasket is in good condition, retain gasket and keep it with switch.

(14) Remove fluid filter attaching screws and remove filter (Fig. 13). Keep filter screws separate. They are longer than valve body screws.

(15) Remove hex head valve body attaching bolts (Fig. 14). A total of 10 hex head bolts are used to secure valve body to case.

(16) Lift valve body upward. Push solenoid connector and manual lever shaft out of case. Then raise valve body, guide park rod out of case and remove valve body (Fig. 15). **Do not use boost valve tube to lift valve body.** Set valve body aside for disassembly, cleaning and inspection.

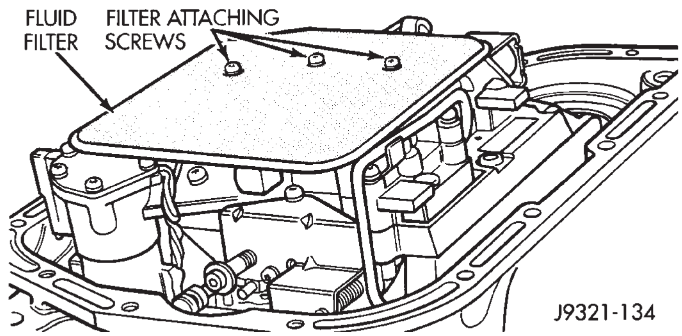


Fig. 13 Fluid Filter Removal/Installation—46RH

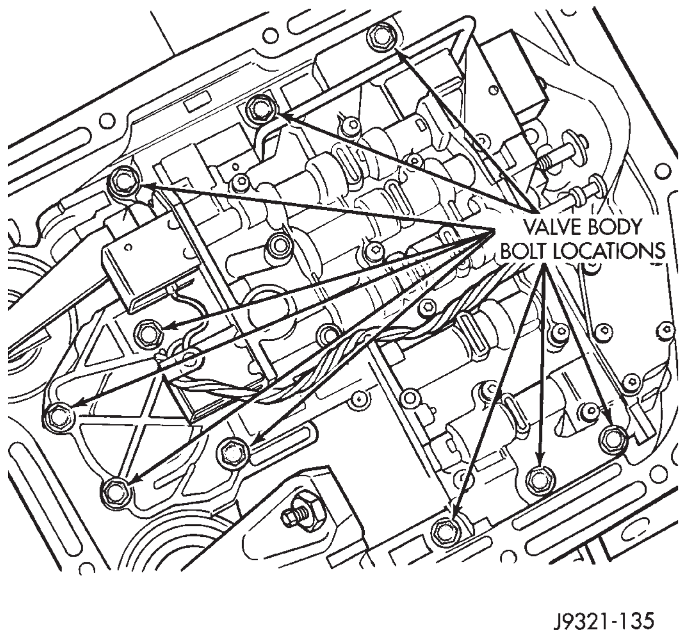


Fig. 14 Valve Body Bolt Locations—46RH

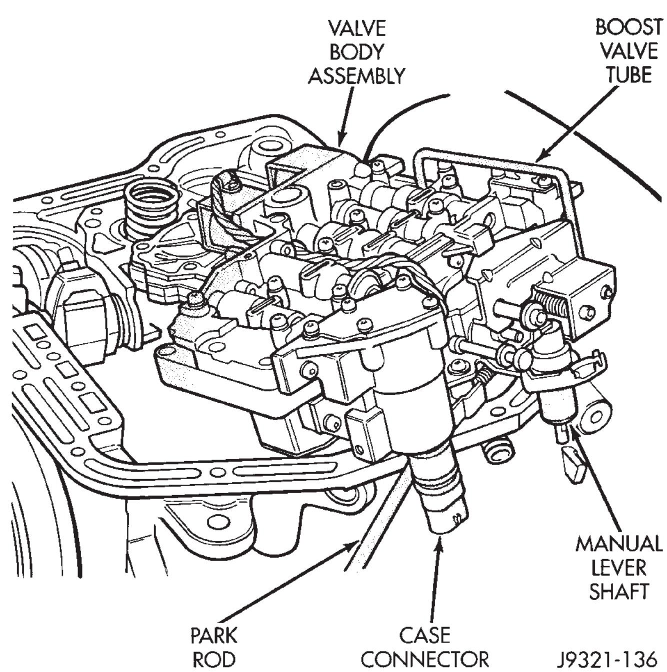


Fig. 15 Valve Body Removal—46RH

(17) Remove accumulator outer spring, piston and inner spring (Fig. 16). Note position of piston and springs for assembly reference. Remove and discard piston seals if worn or cut.

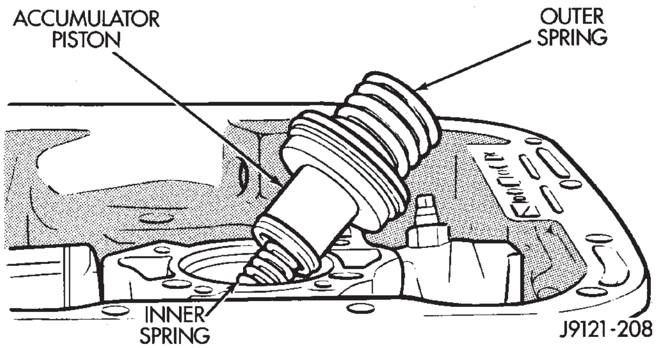


Fig. 16 Accumulator Component Removal—46RH

(18) Remove front band lever pin access plug (Fig. 17). Use square end of 1/4 in. drive extension to remove plug as shown.

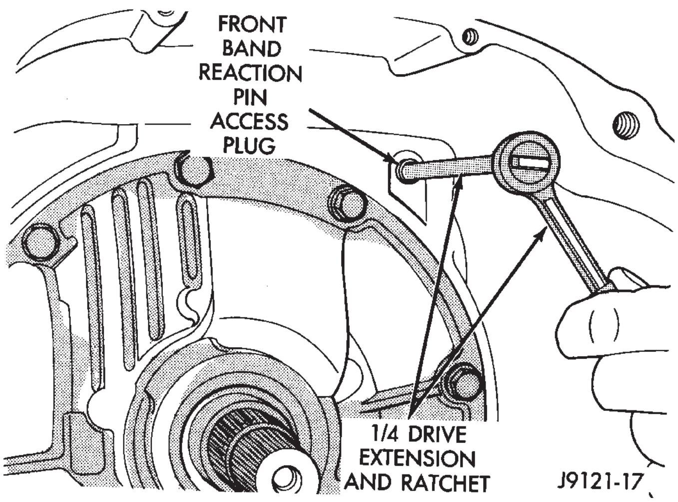


Fig. 17 Removing/Installing Front Band Lever Pin Access Plug—46RH

(19) Remove oil pump and reaction shaft support assembly as follows:

(a) Tighten front band adjusting screw until band is tight around front clutch retainer (Fig. 18). This will prevent retainer from coming out with pump and possibly damaging clutch or pump components.

(b) Remove oil pump bolts.

(c) Thread Slide Hammer Tools C-3752 into threaded holes in flange of oil pump housing (Fig. 19).

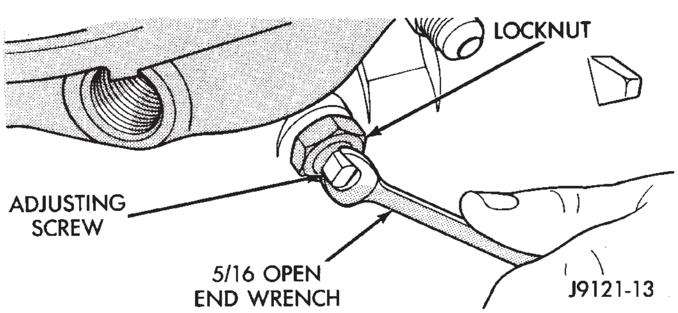


Fig. 18 Tightening Front Band To Hold Front Clutch In Place—46RH

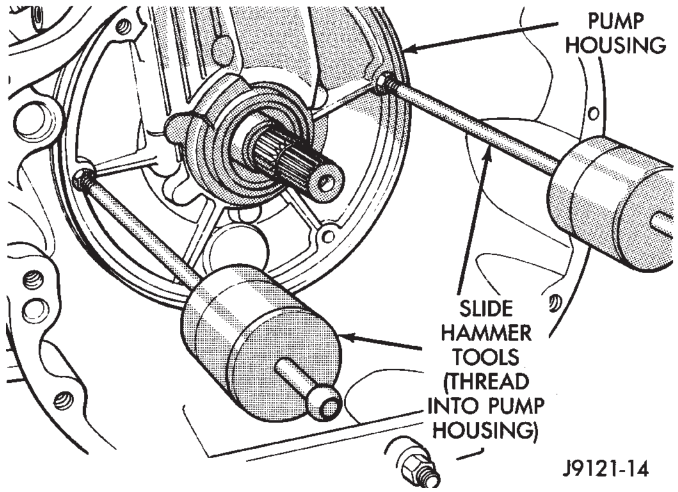


Fig. 19 Installing Oil Pump Remover Tools—46RH

(d) Remove oil pump and reaction shaft support by bumping slide hammers outward alternately to pull pump from case (Fig. 20).

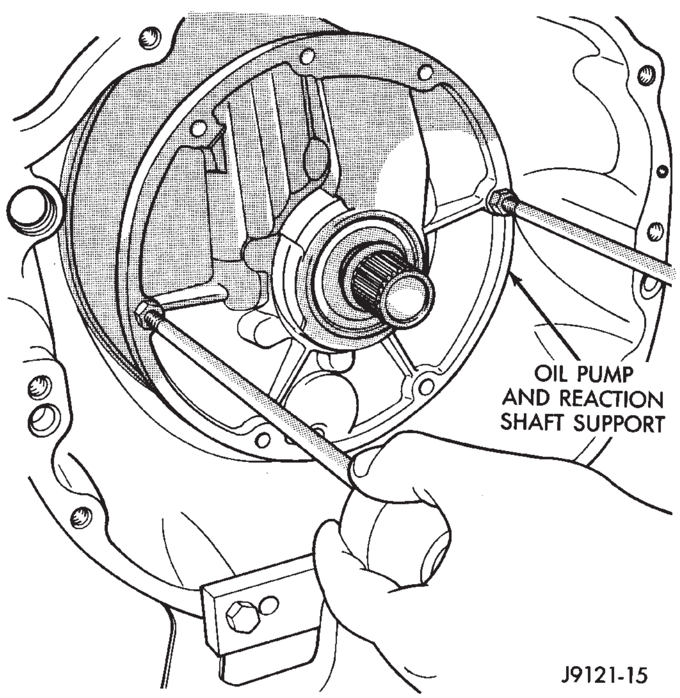


Fig. 20 Oil Pump Removal—46RH

(20) Remove oil pump gasket (Fig. 21). Note gasket position in case for assembly reference.

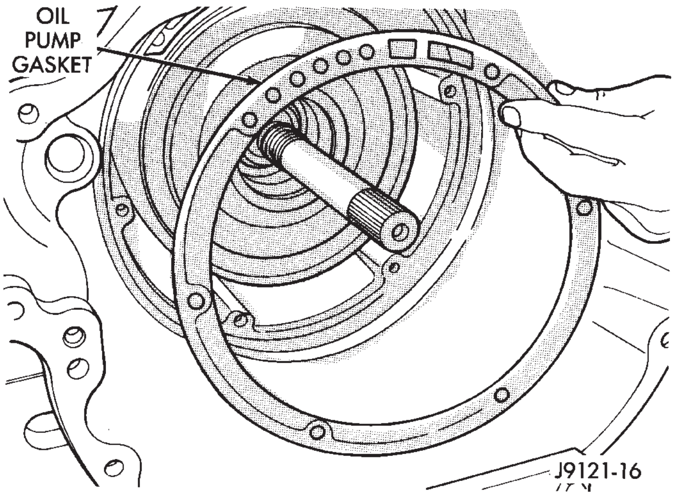


Fig. 21 Removing Oil Pump Gasket—46RH

(21) Loosen front band adjusting screw until band is completely loose.

(22) Remove front band strut and anchor (Fig. 22).

(23) Squeeze front band together slightly and slide band over front clutch retainer and out of case (Fig. 23).

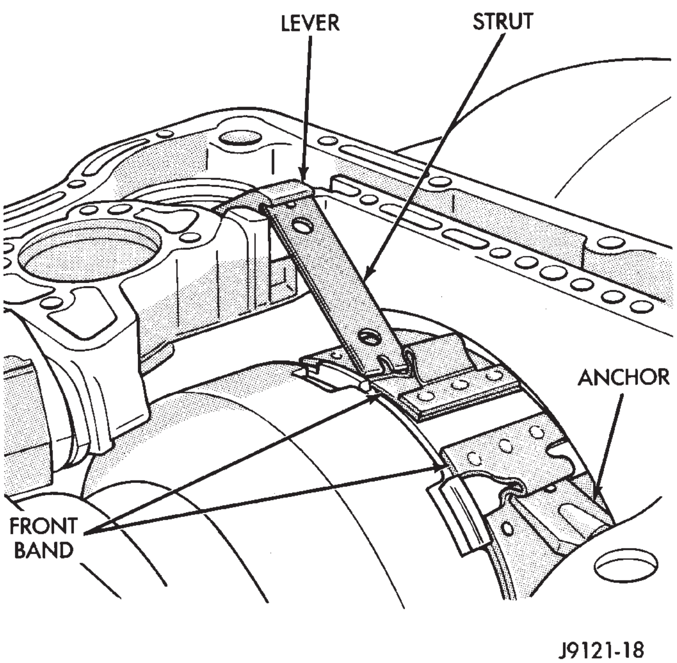


Fig. 22 Front Band Linkage—46RH

(24) Remove front and rear clutch assemblies as a unit (Fig. 24). Set assemblies aside for disassembly and inspection after removal.

(25) Remove front band reaction pin and lever. Start pin through lever and out of case bore with drift or punch. Then use pencil magnet to withdraw pin completely (Fig. 25).

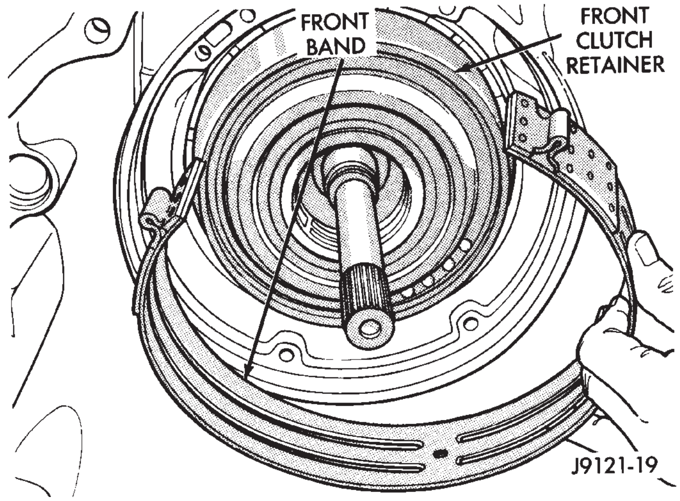


Fig. 23 Front Band Removal—46RH

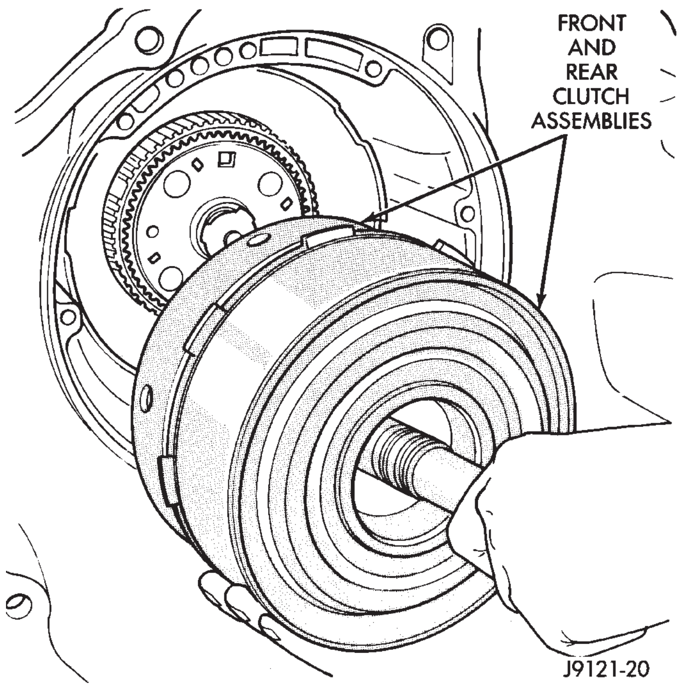


Fig. 24 Removing/Installing Front And Rear Clutch Assemblies—46RH

(26) Remove intermediate shaft thrust washer. Triangular shaped washer will either be on shaft pilot hub or in rear clutch retainer (Fig. 26).

(27) Remove thrust plate from intermediate shaft hub (Fig. 27).

(28) Remove intermediate shaft-planetary geartrain assembly (Fig. 28). Set assembly aside for disassembly and inspection later in procedure.

(29) Loosen rear band adjusting screw 3-4 turns.

(30) Remove snap ring that retains low-reverse drum on overdrive piston retainer hub (Fig. 29).

(31) Slide low-reverse drum off piston retainer hub and out of rear band (Fig. 30).

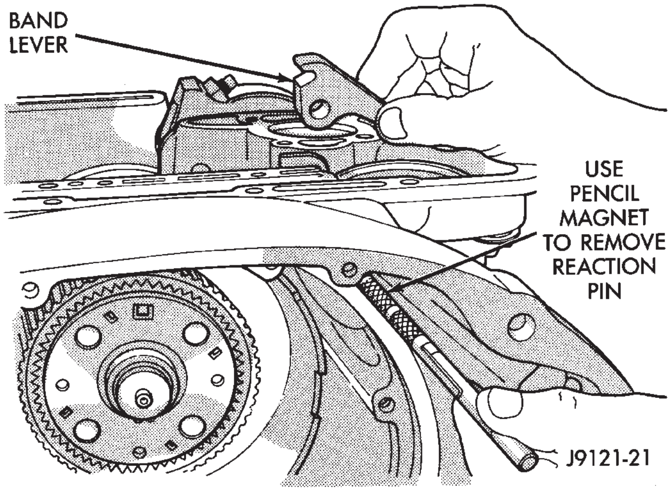


Fig. 25 Removing Front Band Lever And Pin—46RH

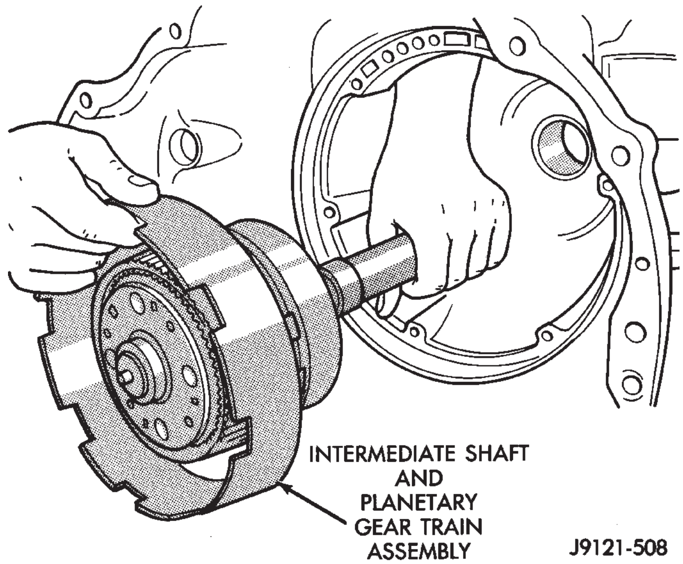


Fig. 28 Removing Intermediate Shaft And Planetary Geartrain Assembly—46RH

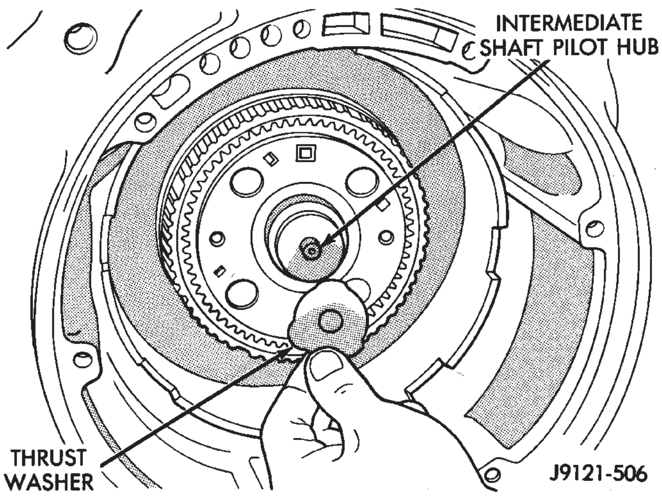


Fig. 26 Removing Intermediate Shaft Thrust Washer—46RH

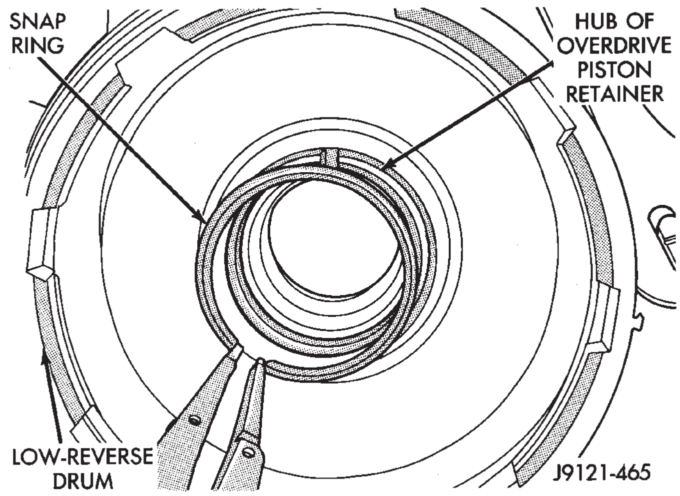


Fig. 29 Removing/Installing Low-Reverse Drum Snap Ring—46RH

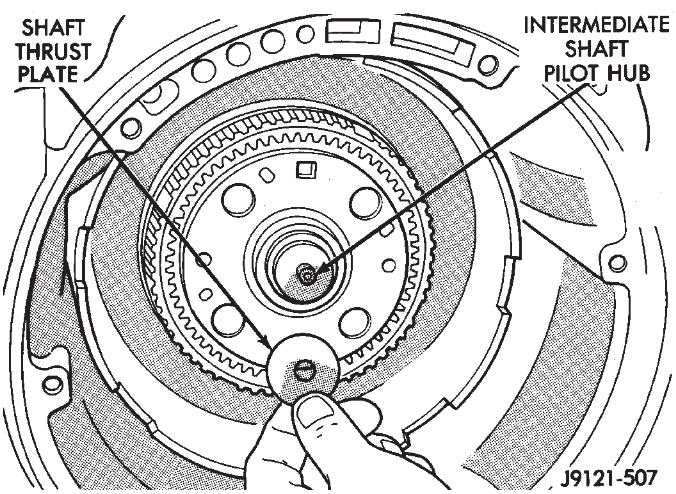


Fig. 27 Removing Intermediate Shaft Thrust Plate—46RH

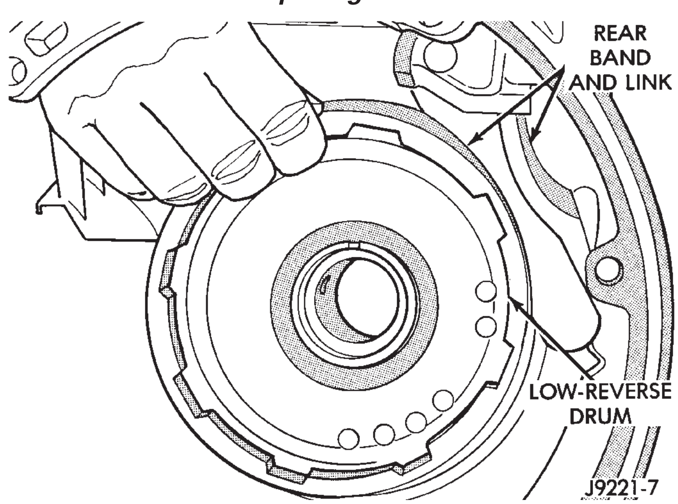


Fig. 30 Removing/Installing Low-Reverse Drum—46RH

(32) Note that overrunning clutch race will remain on splines of low-reverse drum after removal (Fig. 31). **The race is a permanent press fit on the hub splines. Do not attempt to remove the race.**

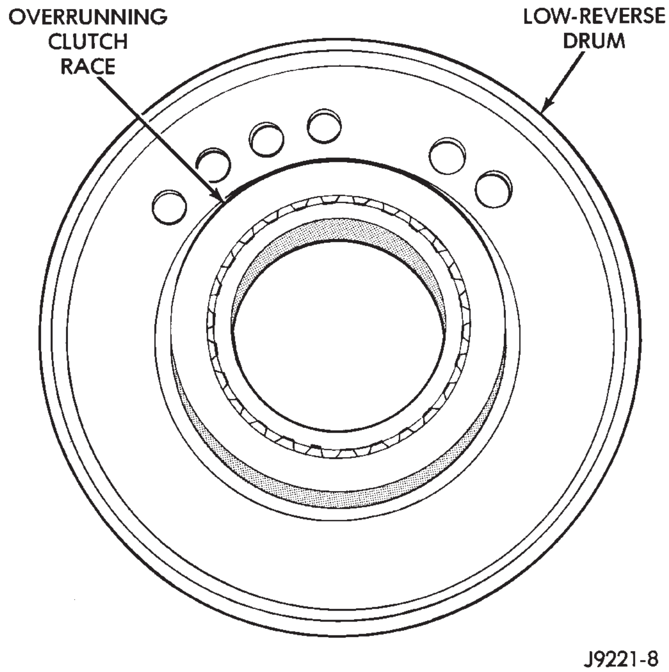


Fig. 31 Overrunning Clutch Race Position—46RH

(33) Remove overrunning clutch assembly (Fig. 32). Assembly can be removed without displacing rollers and springs if care is exercised. Note position of rollers and springs for assembly reference.

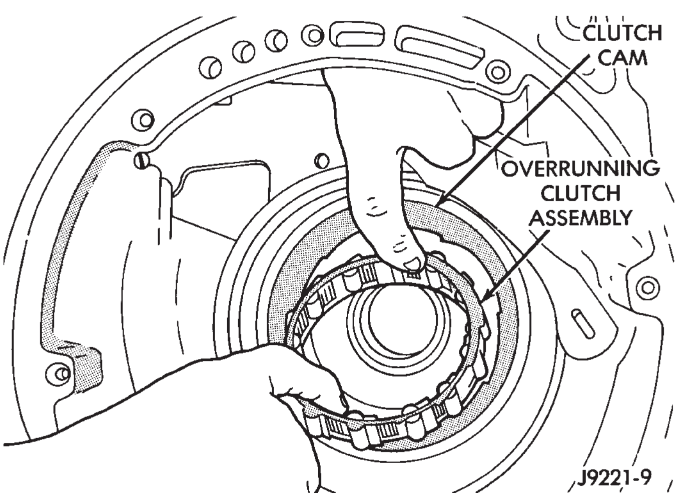


Fig. 32 Removing/Installing Overrunning Clutch—46RH

(34) Remove rear band adjusting lever, reaction lever and reaction pin (Fig. 33).

(35) Remove strut from rear band. Keep strut with levers and pin for cleaning, inspection and assembly reference.

(36) Remove rear band and link (Fig. 34).

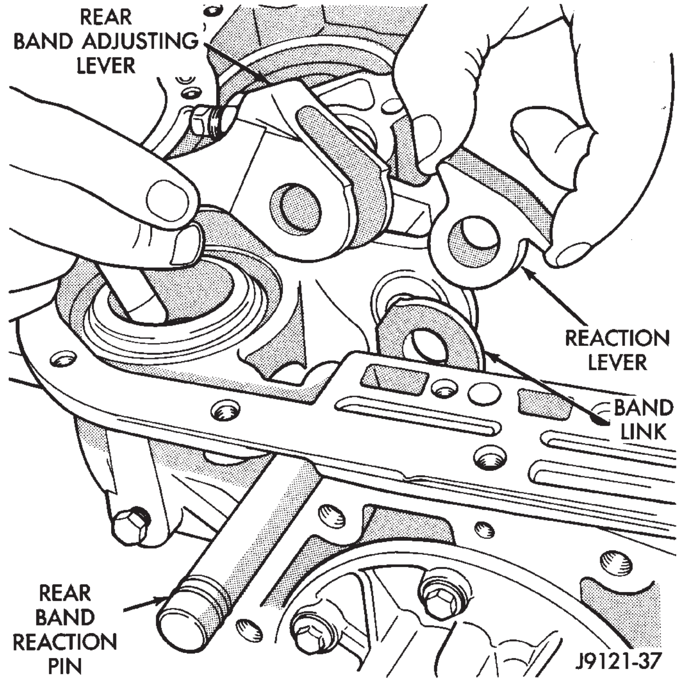


Fig. 33 Removing Rear Band Levers And Reaction Pin—46RH

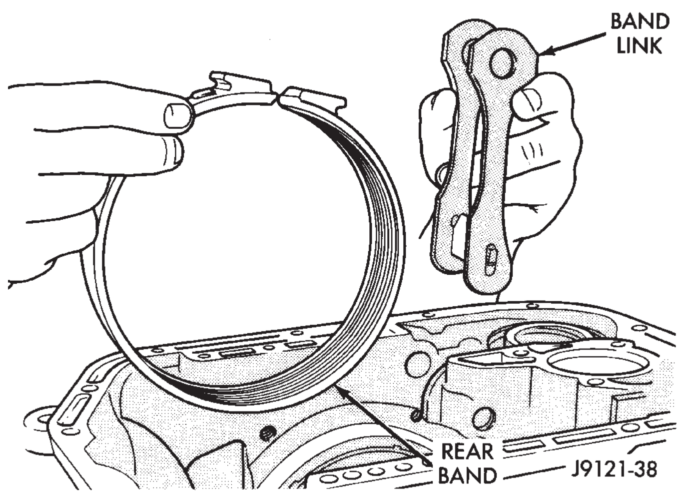


Fig. 34 Removing Rear Band And Link—46RH

(37) Compress front servo rod guide with C-clamp and Tool C-4470, or Valve Spring Compressor C-3422-B (Fig. 35). Compress guide only enough to permit snap ring removal (about 1/8 in.).

(38) Remove servo piston snap ring (Fig. 35). Unseat one end of ring. Then carefully work removal tool around back of ring until free of ring groove. **Exercise caution when removing snap ring. Servo bore can be scratched or nicked if care is not exercised.**

(39) Remove tools and remove servo piston and spring.

(40) Compress rear servo piston with C-clamp and Tool C-4470, or Valve Spring Compressor C-3422-B

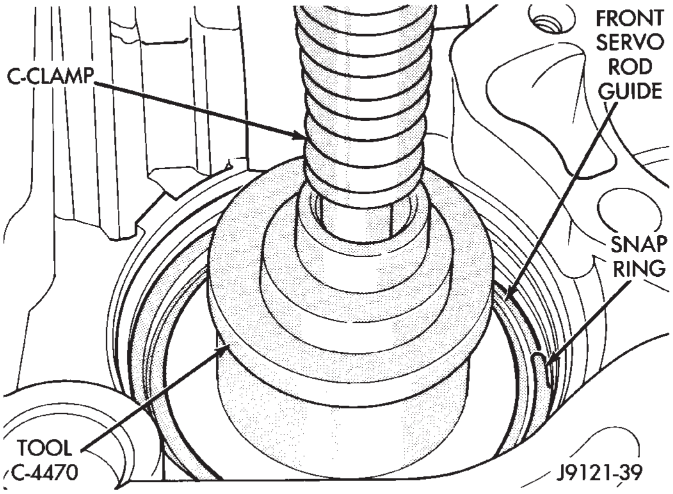


Fig. 35 Removing Front Servo Retaining Snap Ring—46RH

(Fig. 36). Compress servo spring retainer only enough to permit snap ring removal.

(41) Remove servo piston snap ring (Fig. 36). Start one end of ring out of bore. Then carefully work removal tool around back of snap ring until free of ring groove. **Exercise caution when removing snap ring. Servo bore can be scratched or nicked if care is not exercised.**

(42) Remove tools and remove rear servo retainer, spring and piston assembly.

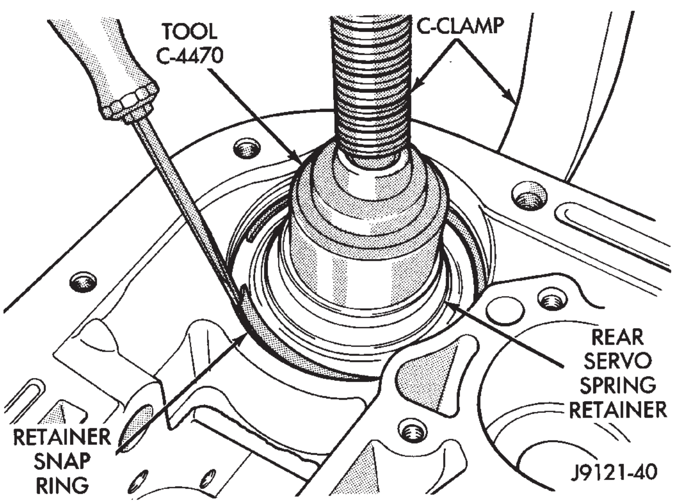


Fig. 36 Removing Rear Servo Retaining Snap Ring—46RH

(43) Remove overdrive piston retainer bolts and remove retainer from case (Fig. 37).

(44) Remove gasket from rear of case after removing piston retainer.

OVERHAUL SERVICE INFORMATION

Inspect all the transmission bushings during overhaul. Bushing condition is important as worn, scored bushings contribute to low pressures, clutch slip and

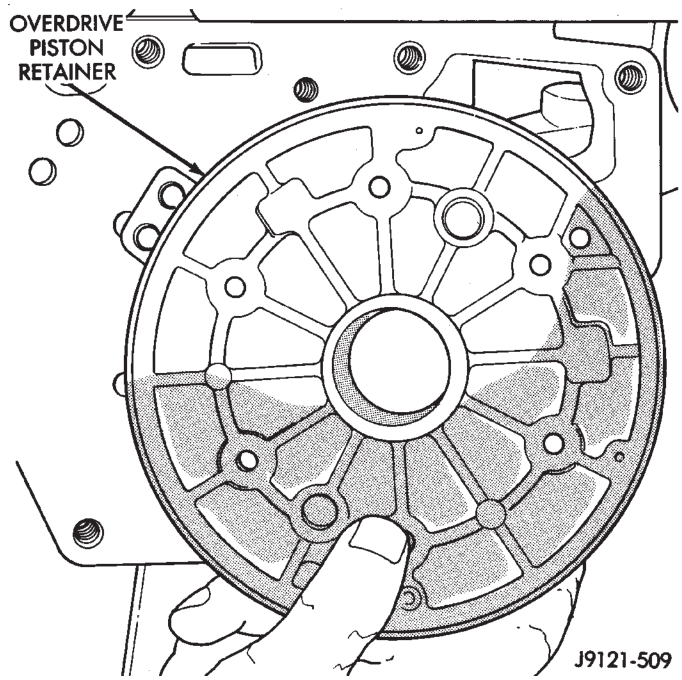


Fig. 37 Removing Overdrive Piston Retainer—46RH

accelerated wear of other components. However, do not replace bushings as a matter of course. Replace bushings only when worn, scored, or if doubt exists about bushing condition.

Use recommended tools to replace bushings. The tools are sized and designed to remove, install and seat bushings correctly. The bushing replacement tools are included in Bushing Tool Set C-3887-B.

Pre-sized service bushings are available for replacement purposes. Only the sun gear bushings are not serviced. Low cost of the sun gear assembly makes it easier to simply replace the gear and bushings as an assembly.

Heli-Coil inserts 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, providing it is used carefully. When used on valves, use extreme care to avoid rounding off sharp edges. Sharp edges are vital as they prevent foreign matter from getting between the valve and valve bore.

Do not reuse oil seals, gaskets, seal rings, or O-rings during overhaul. Replace these parts as a matter of course. Also do not reuse snap rings or E-clips that are bent or distorted. Replace these parts as well.

Lubricate transmission parts with Mopar ATF Plus, Type 7176 transmission fluid during assembly. Use Ru-Glyde, petroleum jelly, or Door Eze to prelubricate seals, O-rings, and thrust washers. Petroleum jelly can also be used to hold parts in place during reassembly.

TRANSMISSION CASE CLEANING AND INSPECTION

Clean the case in a solvent tank. Flush the case bores and fluid passages thoroughly with solvent. Dry the case and all fluid passages with compressed air. Be sure all solvent is removed from the case and that all fluid passages are clear.

Do not use shop towels or rags to dry the case (or any other transmission component) unless they are made from lint-free materials. Lint will stick to component surfaces and circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

Inspect the case for cracks, porous spots, worn servo bores, or damaged threads. Damaged threads can be repaired with Helicoil thread inserts. However, the case will have to be replaced if it exhibits damage or wear.

Lubricate the front band adjusting screw and locknut with petroleum jelly and thread it part way into the case. Be sure the screw turns freely and does not bind. Install the locknut on the screw after checking screw thread operation.

Check condition of the quick disconnect cooler line fittings in the transmission case. Replace the fitting as an assembly if the fitting body is damaged. Replace the plastic inserts if damaged, or distorted. **Do not reuse the wire retainer clips. Install new clips if the originals are removed for any reason.**

If the quick disconnect fittings are removed from the case, apply Mopar Lock N' Seal, or Loctite 242 to the fitting threads before installation. Recommended set-to tightening torque for the fittings is 27 N●m (20 ft. lbs.).

OVERDRIVE PISTON AND RETAINER SERVICE

Remove and discard the piston seals.

Clean the piston and retainer in parts cleaning solvent. Do not use any type of caustic materials for cleaning. Such materials may etch the surfaces causing damage.

Inspect the piston and retainer carefully. Replace either part if cracked, porous or damaged in any way. Check condition of the locating lugs on the piston. Be sure the lugs are in good condition and are not worn, chipped or broken.

Inspect the check ball in the piston (Fig. 38). Be sure the ball is secure and is not partially dislodged, or loose. Replace the piston if doubt exists about piston or check ball condition.

Check the governor feed tube boss in the retainer. Be sure the boss is in good condition and is not damaged in any way.

OVERRUNNING CLUTCH OVERHAUL

Inspect condition of the clutch cam, cage-type retainer, rollers, springs and clutch race.

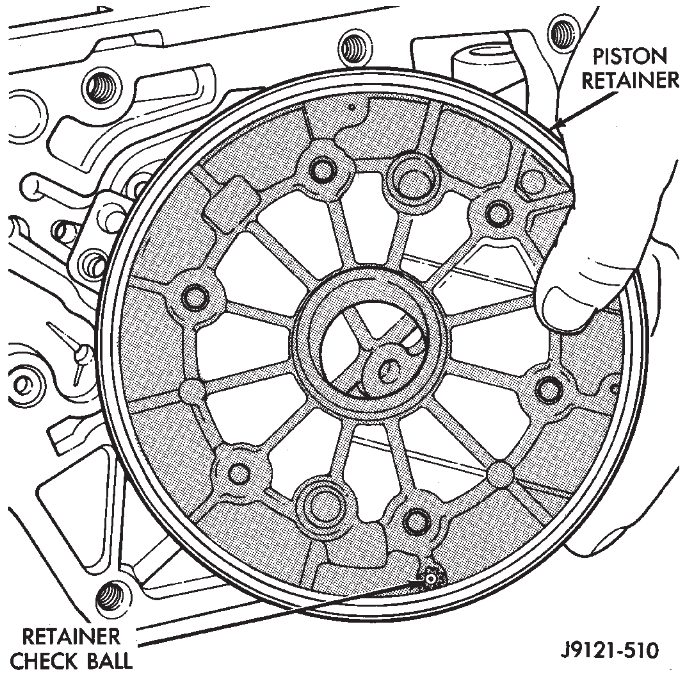


Fig. 38 Overdrive Piston—46RH

Replace the clutch cam if worn or damaged. Also check fit of the cam in the transmission case. If the cam is loose, the case may be worn, or cracked.

The clutch race is permanently pressed onto the low-reverse drum hub. If either the drum or race are worn or damaged, replace the drum and race as an assembly. Check fit of the race on the low-reverse drum hub splines. Replace the drum and race as an assembly if the race is loose on the hub splines.

Examine the overrunning clutch assembly carefully. Replace assembly if the rollers, springs, or cage-type retainer are worn, or damaged.

If the clutch cam requires replacement, install a new cam as described in the following procedure.

OVERRUNNING CLUTCH CAM REPLACEMENT

(1) Remove clutch cam setscrew (Fig. 39).

(2) Tap old cam and spring retainer out of case with pin punch. Insert punch through bolt holes at rear of case (Fig. 40). Alternate position of punch to avoid cocking cam during removal.

(3) Clean clutch cam bore and case. Be sure to remove all chips/shavings generated during cam removal.

(4) Install rear support in case. Align support with reference marks made at disassembly.

(5) Align and start new clutch cam and spring retainer in case. Be sure serrations on cam and in case are aligned (Fig. 41). Then tap cam into case just enough to hold it in place.

(6) **Verify that cam is correctly positioned before proceeding any further. Narrow ends of cam ramps should be to left when cam is viewed from front end of case** (Fig. 41).

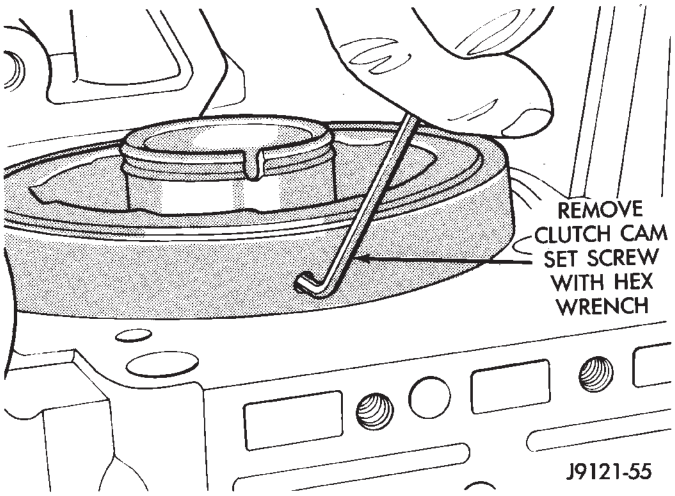


Fig. 39 Removing/Installing Clutch Cam Setscrew—46RH

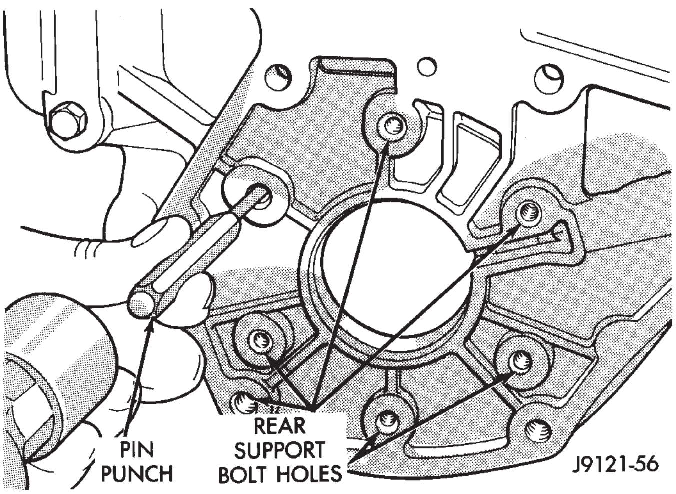


Fig. 40 Removing Overrunning Clutch Cam—46RH

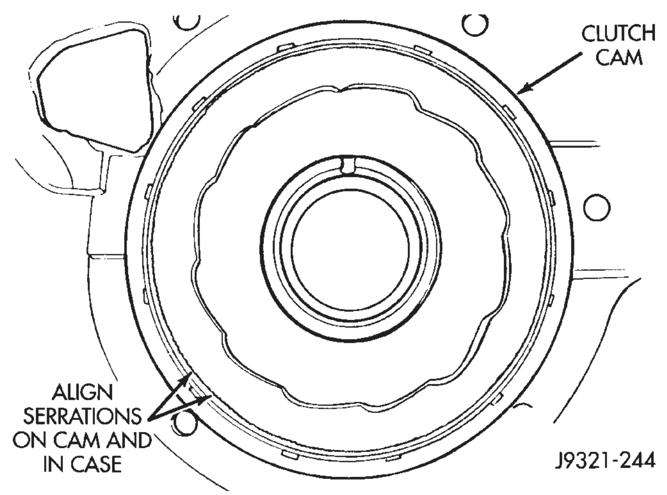


Fig. 41 Positioning Replacement Clutch Cam And Spring Retainer—46RH

(7) Insert Adapter Tool SP-5124 into piston retainer (Fig. 42).

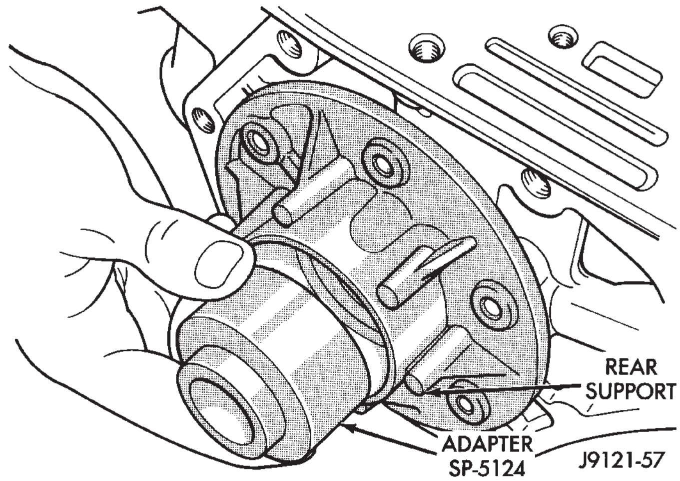


Fig. 42 Positioning Adapter Tool In Rear Support Or Overdrive Piston Retainer—46RH

(8) Assemble Puller Bolt SP-3701 and Press Plate SP-3583-A (Fig. 43).

(9) Install assembled puller plate and bolt (Fig. 44). Insert bolt through cam, case and adapter tool. Be sure plate is seated squarely on cam.

(10) Hold puller plate and bolt in place and install puller nut SP 3701 on puller bolt (Fig. 45).

(11) Tighten puller nut to draw clutch cam into case (Fig. 45). **Be sure cam is drawn into case evenly and does not become cocked.**

(12) Install clutch cam setscrew (Fig. 39).

(13) Remove clutch cam installer tools and piston retainer.

(14) **Stake case in 12 places around clutch cam to help secure cam in case. Use blunt punch or chisel to stake case.**

(15) Clean case and cam thoroughly. Be sure any chips/shavings generated during cam installation are removed from case.

INSTALLING OVERRUNNING CLUTCH ASSEMBLY

(1) Lubricate overdrive piston retainer hub, clutch race, clutch cam, and overrunning clutch rollers with transmission fluid.

(2) If any overrunning clutch rollers or springs came out of retainer, reinstall them as follows: Install and seat spring in retainer first. Then insert roller between spring and retainer stop as shown (Fig. 46). Verify that each roller and spring are fully seated before proceeding.

(3) Install and seat clutch assembly in cam (Fig. 47). **The retainer is a one-way fit in the cam. The flanged side of the retainer should be facing out-**

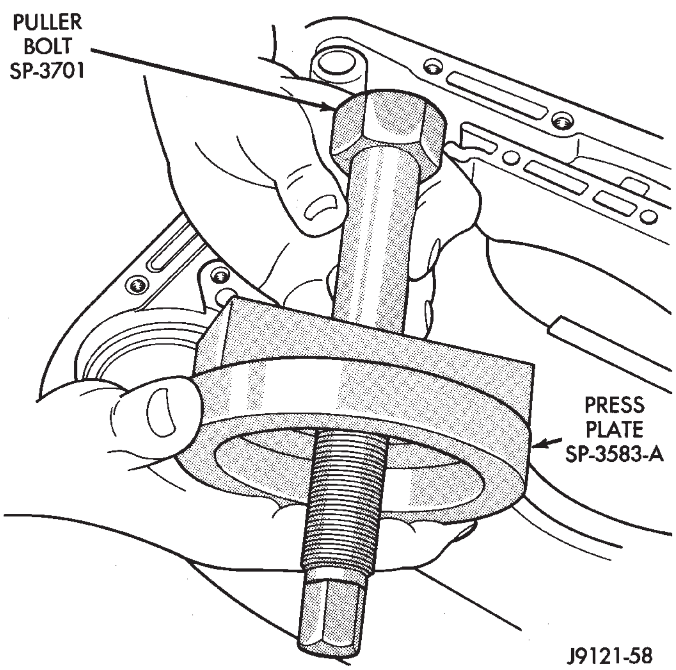


Fig. 43 Assembling Clutch Cam Puller Bolt And Press Plate

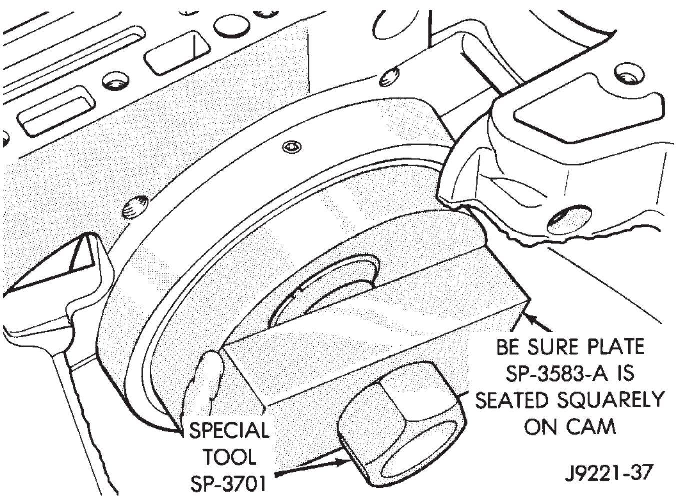


Fig. 44 Positioning Puller Plate On Clutch Cam

ward. The retainer and rollers will slip easily into the cam when properly positioned.

(4) Install low-reverse drum. Tilt drum slightly and carefully engage clutch race (on drum hub) in overrunning clutch rollers. Raise drum to level position. Then rotate the drum in clockwise direction until fully seated.

(5) Check overrunning clutch operation. Low-reverse drum should rotate freely in clockwise direction and lock in counterclockwise direction.

(6) Align and reinstall overdrive piston retainer. Tighten retainer bolts to 11 N•m (95 in. lbs.) torque.

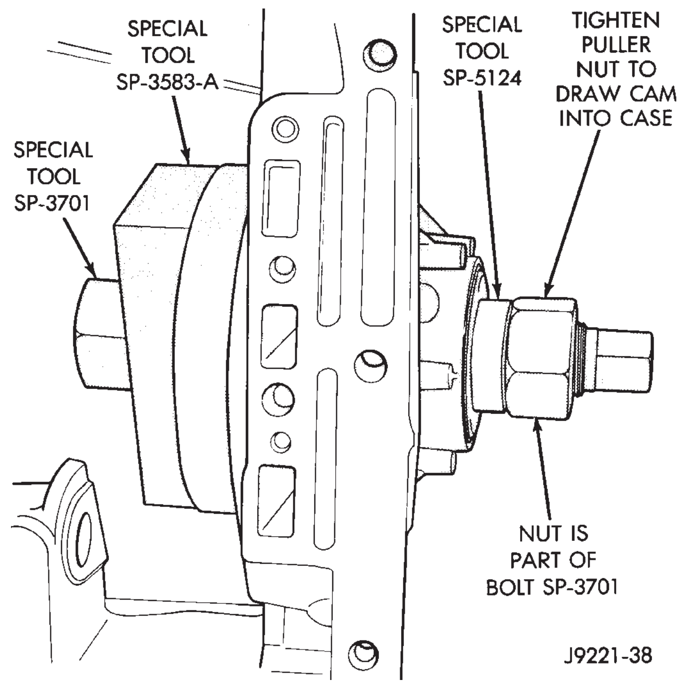


Fig. 45 Installing Overrunning Clutch Cam—46RH

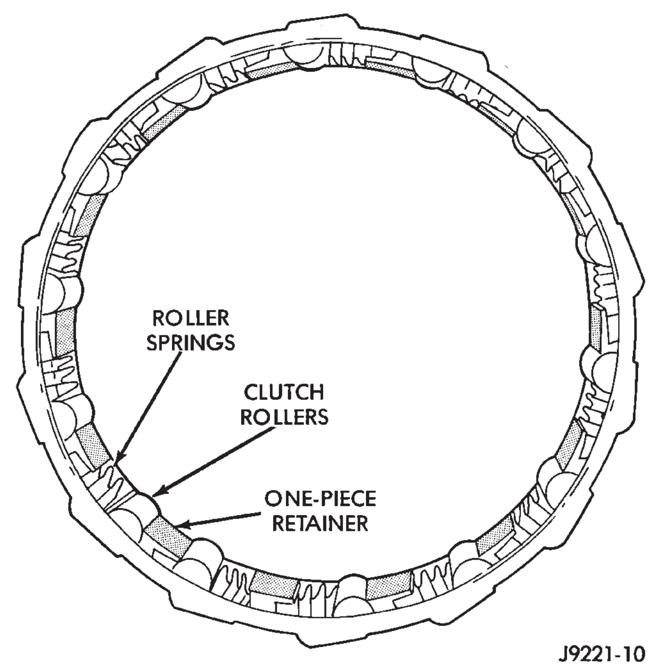


Fig. 46 Clutch Roller, Spring And Retainer Assembly—46RH

ACCUMULATOR OVERHAUL

Inspect the accumulator piston and seal rings (Fig. 48). Replace the seal rings if worn or cut. Replace the piston if chipped or cracked.

Check condition of the accumulator inner and outer springs (Fig. 48). Replace the springs if the coils are cracked, distorted or collapsed.

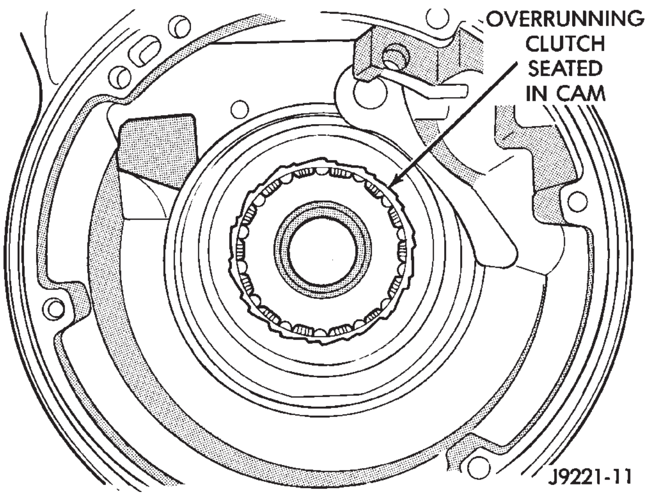


Fig. 47 Overrunning Clutch Seated In Cam

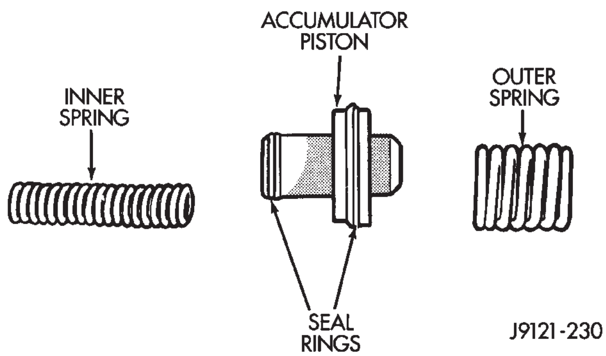


Fig. 48 Accumulator Components—46RH

FRONT SERVO AND BAND OVERHAUL

Clean the servo piston components with solvent and dry them with compressed air. Wipe the band clean with lint free shop towels.

Replace the front band if distorted, lining is burned, flaking off, or worn to the point where the grooves in the lining material are no longer visible.

Inspect the servo components. Replace the springs if collapsed, distorted or broken. Replace the guide, rod and piston if cracked, bent, or worn. Discard the servo snap ring if distorted or warped.

Check the servo piston bore for wear. If the bore is severely scored, or damaged, it will be necessary to replace the case.

Replace any servo component if in doubt about its condition. Do not reuse suspect parts.

FRONT SERVO PISTON OVERHAUL (FIG. 49)

(1) Remove seal ring from rod guide.

(2) Remove small snap ring from servo piston rod. Then remove piston rod, spring and washer from piston.

(3) Remove and discard servo component O-ring and seal rings.

(4) Lubricate new O-ring and seal rings with petroleum jelly and install them on piston, guide and rod.

(5) Install rod in piston. Install spring and washer on rod. Compress spring and install snap ring.

(6) Set servo components aside for installation during transmission reassembly.

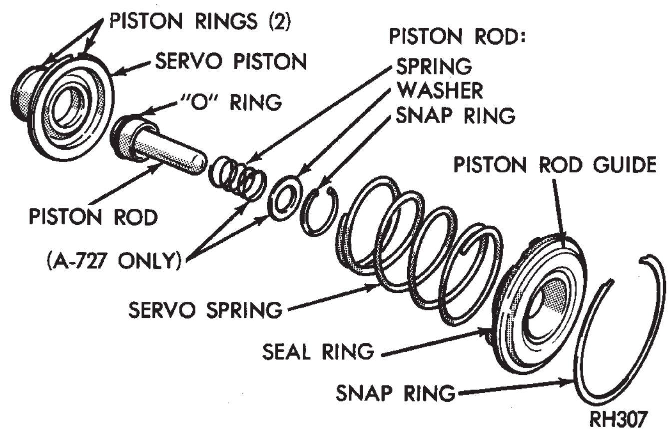


Fig. 49 Front Servo Components—46RH

REAR SERVO AND BAND OVERHAUL

Clean the servo components with solvent and dry them with compressed air. Inspect the servo components. Replace the spring if collapsed, distorted or broken. Replace the plug and piston if cracked, bent, or worn. Discard the servo snap ring if distorted or warped.

Check rear band condition. Replace the band if distorted, the lining is burned or flaking off, or the lining is worn (grooves no longer visible at any point on the lining material). If doubt exists about the condition of any servo component, replace it. Do not reuse suspect parts.

REAR SERVO PISTON OVERHAUL (FIG. 50)

(1) Remove small snap ring and remove plug and spring from servo piston.

(2) Remove and discard servo piston seal ring.

(3) Lubricate piston and guide seals with petroleum jelly. Lubricate other servo parts with Mopar ATF Plus transmission fluid.

(4) Install new seal ring on servo piston.

(5) Assemble piston, plug, spring and snap ring.

(6) Lubricate piston seal lip with petroleum jelly.

(7) Set servo components aside for assembly installation.

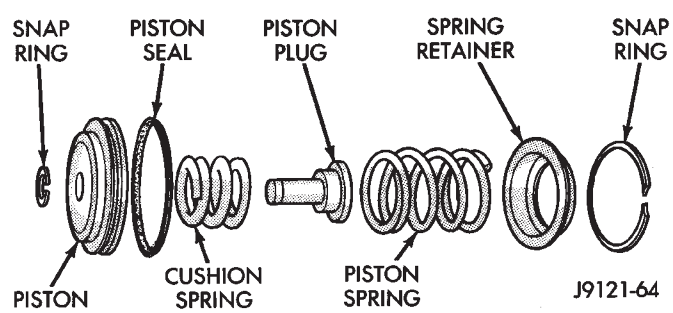


Fig. 50 Rear Servo Components—46RH

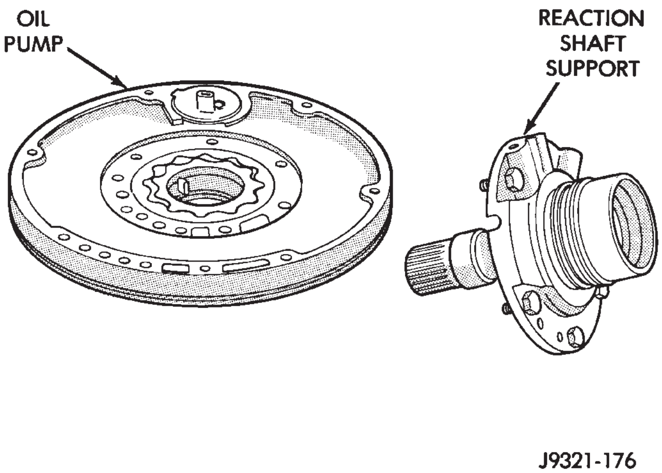


Fig. 51 Reaction Shaft Support Removal—46RH

OIL PUMP AND REACTION SHAFT SUPPORT OVERHAUL

PUMP AND SUPPORT DISASSEMBLY

(1) Mark position of support in oil pump body for assembly alignment reference. Use scriber or paint to make alignment marks.

(2) Place pump body on two wood blocks.

(3) Remove reaction shaft support bolts and separate support from pump body (Fig. 51).

(4) Remove pump inner and outer gears (Fig. 52).

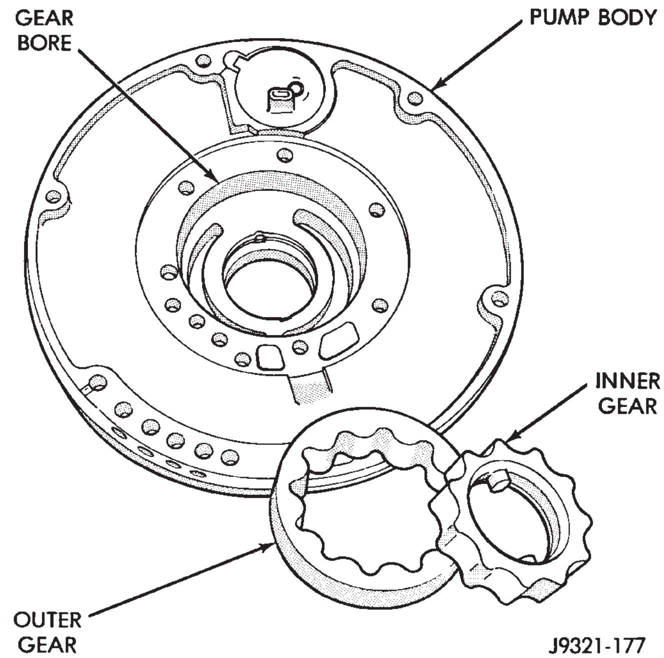


Fig. 52 Pump Gear Removal—46RH

(5) Remove O-ring seal from pump body (Fig. 53). Discard seal after removal.

(6) Remove oil pump seal with Remover Tool C-3981. Discard seal after removal.

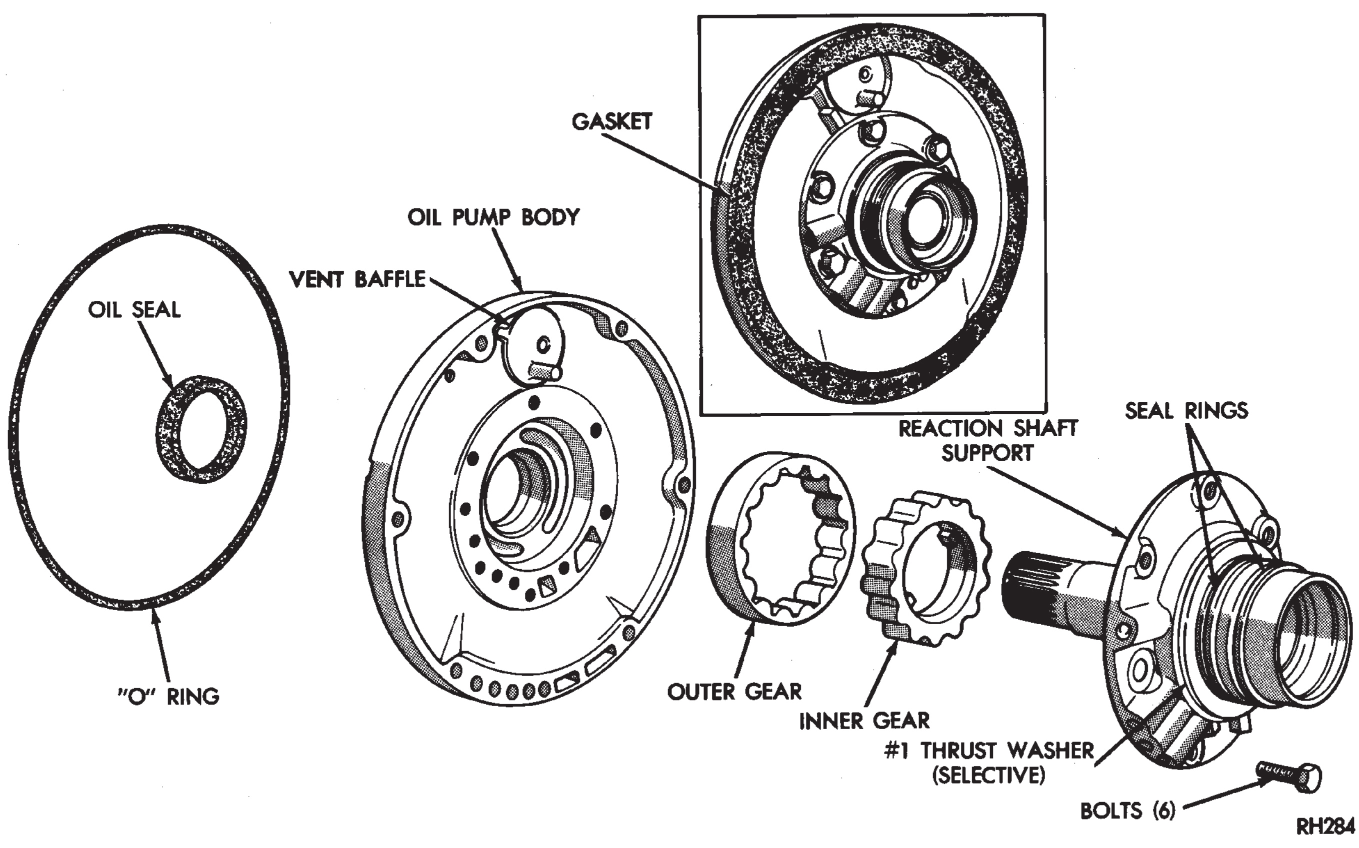


Fig. 53 Oil Pump And Reaction Shaft Components—46RH

INSPECTING PUMP AND SUPPORT

Clean pump and support components with solvent and dry them with compressed air.

Check condition of the seal rings and thrust washer on the reaction shaft support. The seal rings do not need to be replaced unless cracked, severely worn, or no longer hooked together.

Inspect the pump and support components. Replace the pump or support if the seal ring grooves or machined surfaces are worn, scored, pitted, or damaged. Replace the pump gears if pitted, worn chipped, or damaged.

Check the pump vent (Fig. 54). The vent must be secure. Replace the pump body if the vent is cracked, broken, or loose.

Inspect the pump bushing (Fig. 54). Then check the reaction shaft support bushing. Replace either bushing only if heavily worn, scored or damaged. It is not necessary to replace the bushings unless they are actually damaged.

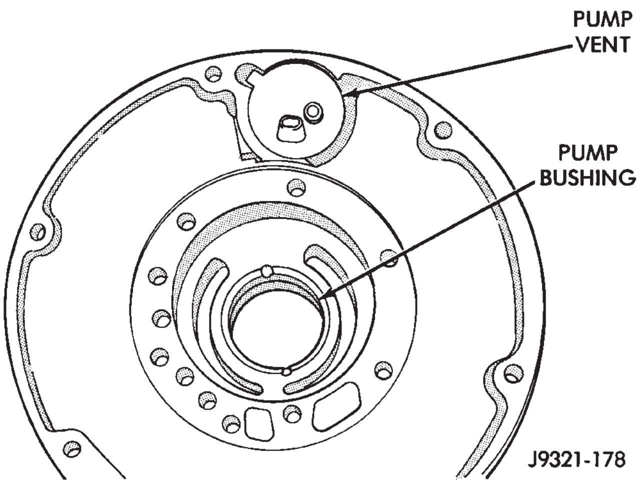


Fig. 54 Pump Vent And Bushing Location

Install the gears in the pump body and measure end clearance with a feeler gauge and straightedge (Fig. 55). Clearance should be 0.89 to 1.90 mm (0.0035 to 0.0075 in.).

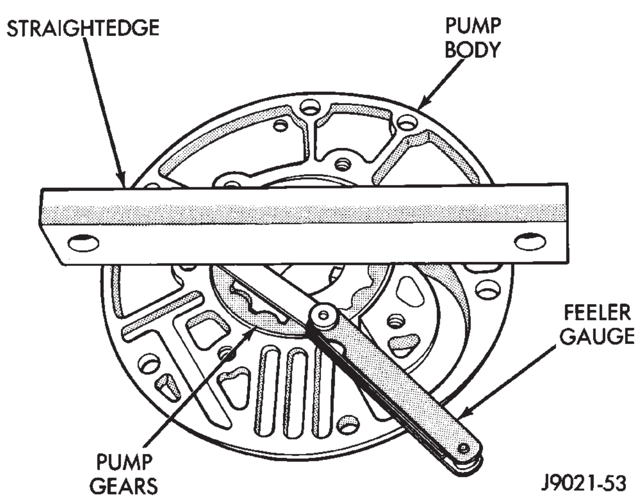


Fig. 55 Checking Pump Gear End Clearance

Measure side clearances with feeler gauge (Fig. 56). Clearance between gear teeth and between outer gear and pump body should be 0.89 to 1.90 mm (0.0035 to 0.0075 in.).

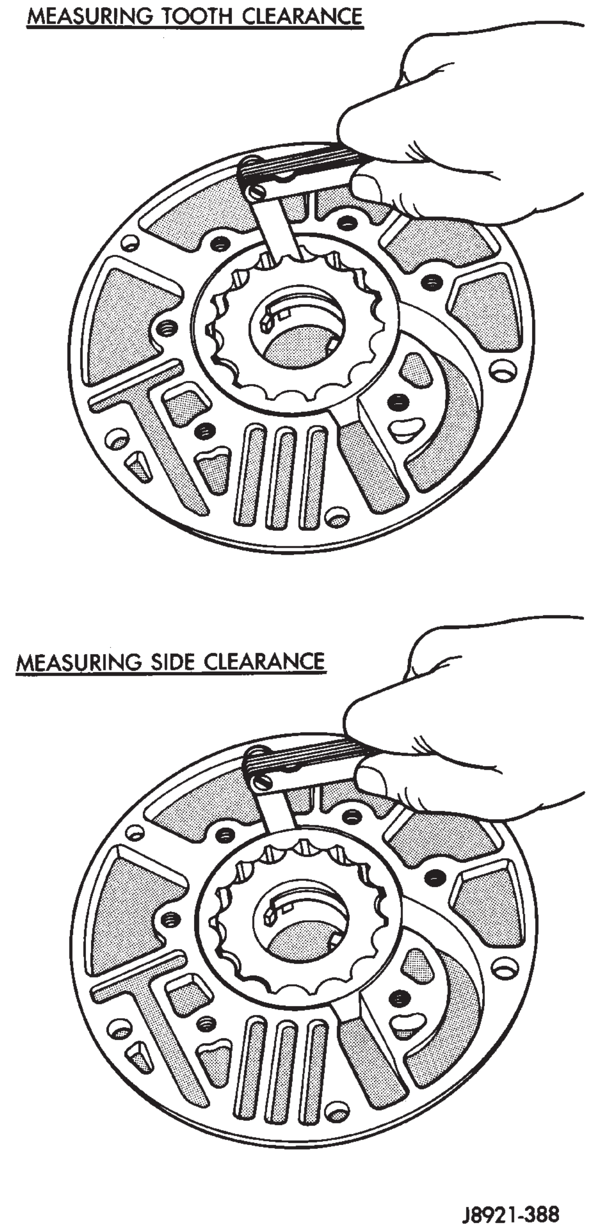


Fig. 56 Checking Pump Gear Side Clearances

OIL PUMP BUSHING REPLACEMENT (FIG. 57)

(1) Position pump housing on clean, smooth surface with gear cavity facing down.

(2) Remove bushing with Tool Handle C-4171 and Bushing Remover SP-3550.

(3) Assemble Tool Handle C-4171 and Bushing Installer SP-5118.

(4) Place bushing on installer tool and start bushing into shaft.

(5) Tap bushing into place until Installer Tool SP-5118 bottoms in pump cavity. Keep tool and bushing

square with bore. Do not allow bushing to become cocked during installation.

(6) Stake pump bushing in two places with blunt punch. Remove burrs from stake points with knife blade (Fig. 58).

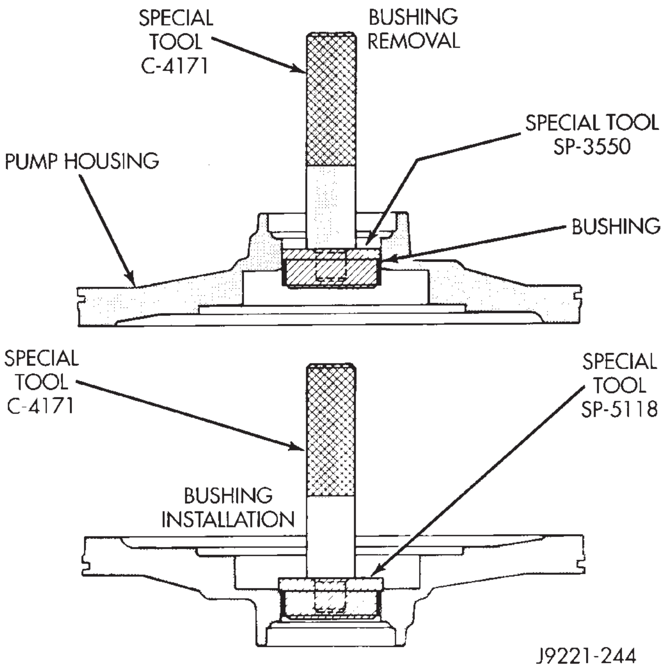


Fig. 57 Replacing Oil Pump Bushing

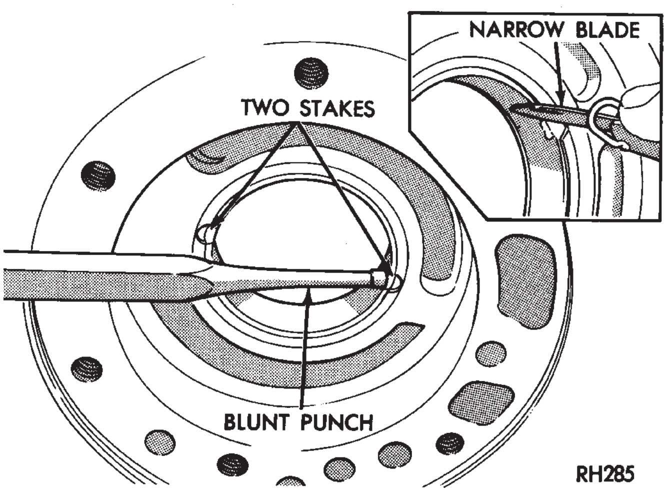


Fig. 58 Staking-Deburring Oil Pump Bushing

REPLACING REACTION SHAFT SUPPORT BUSHING (FIG. 59)

(1) Assemble Cup Tool SP-3633, Nut SP-1191 and Bushing Remover SP-5301.

(2) Hold cup tool firmly against reaction shaft. Thread remover tool into bushing as far as possible by hand.

(3) Using wrench, thread remover tool an additional 3-4 turns into bushing to firmly engage tool.

(4) Tighten tool hex nut against cup tool to pull bushing from shaft. Clean all chips from shaft and support after bushing removal.

(5) Place reaction shaft support upright on a clean, smooth surface.

(6) Assemble Bushing Installer Tools C-4171 and SP-5302. Then slide new bushing onto installer tool.

(7) Start bushing in shaft. Tap bushing into shaft until installer tool bottoms against support flange.

(8) Clean reaction shaft support thoroughly after bushing replacement (to remove any chips).

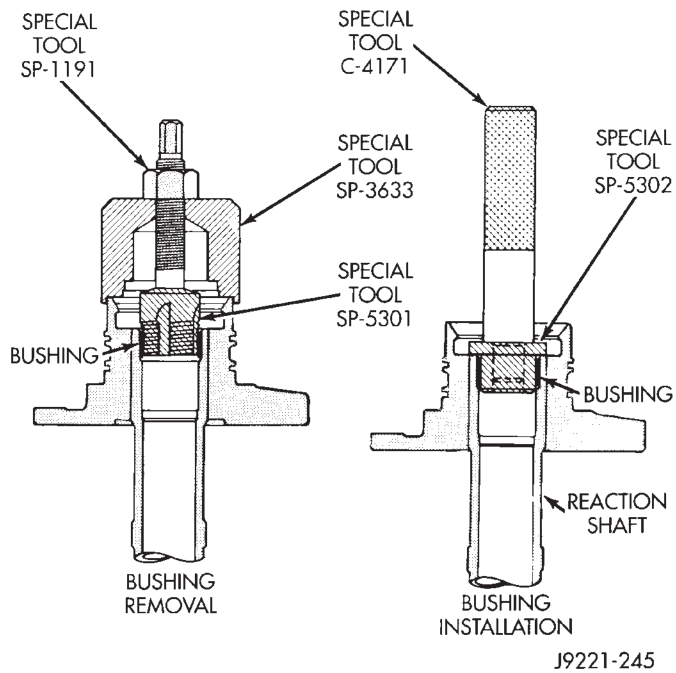


Fig. 59 Reaction Shaft Bushing Replacement—46RH

ASSEMBLING OIL PUMP AND REACTION SHAFT SUPPORT

(1) Lubricate pump gears with transmission fluid and install them in pump body.

(2) Install thrust washer on reaction shaft support hub. Lubricate washer with petroleum jelly or transmission fluid before installation.

(3) If reaction shaft seal rings are being replaced, install new seal rings on support hub. Lubricate seal rings with transmission fluid or petroleum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

CAUTION: The reaction shaft support seal rings will break if overspread, or twisted. If new rings are being installed, spread them only enough for installation. Also be very sure the ring ends are securely hooked together after installation. Otherwise, the rings will either prevent pump installation, or break during installation.

(4) Align and install reaction shaft support on pump body.

(5) Install bolts attaching reaction shaft support to pump. Tighten bolts to 20 N●m (175 in. lbs.) torque.

(6) Install new pump seal with Seal Installer C-3860-A (Fig. 60). Use hammer or mallet to tap seal into place.

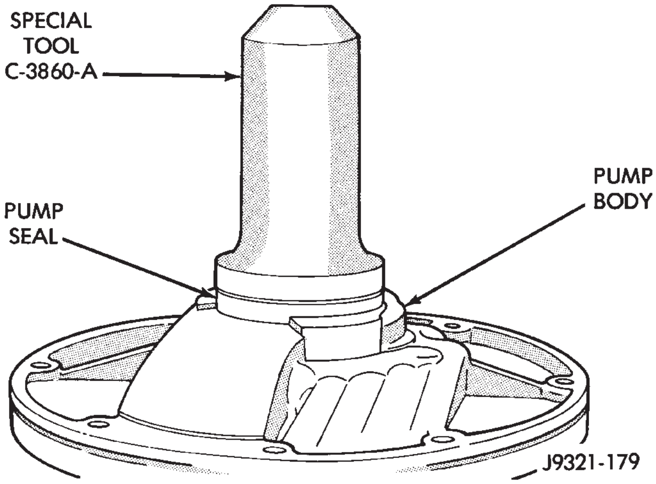


Fig. 60 Oil Pump Seal Installation—46RH

(7) Install new O-ring on pump body. Lubricate oil seal and O-ring with petroleum jelly.

(8) Set pump assembly aside for installation during transmission assembly.

FRONT CLUTCH OVERHAUL

FRONT CLUTCH DISASSEMBLY

(1) Remove waved snap ring and remove reaction plate, clutch plates and clutch discs (Fig. 61). **Note number of plates and discs in clutch pack for assembly reference. Some models have 3 discs, while others may have 4 discs.**

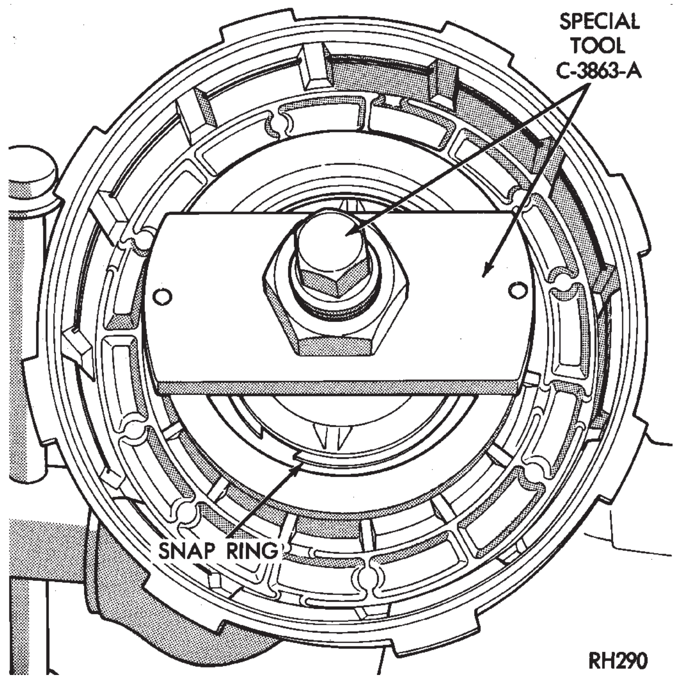


Fig. 62 Removing Front Clutch Spring Retainer Snap Ring

(2) Compress clutch piston retainer and piston springs with Compressor Tool C-3863-A (Fig. 62).

(3) Remove retainer snap ring and remove compressor tool.

(4) Remove clutch piston springs. **Note number and position of piston springs for assembly reference.**

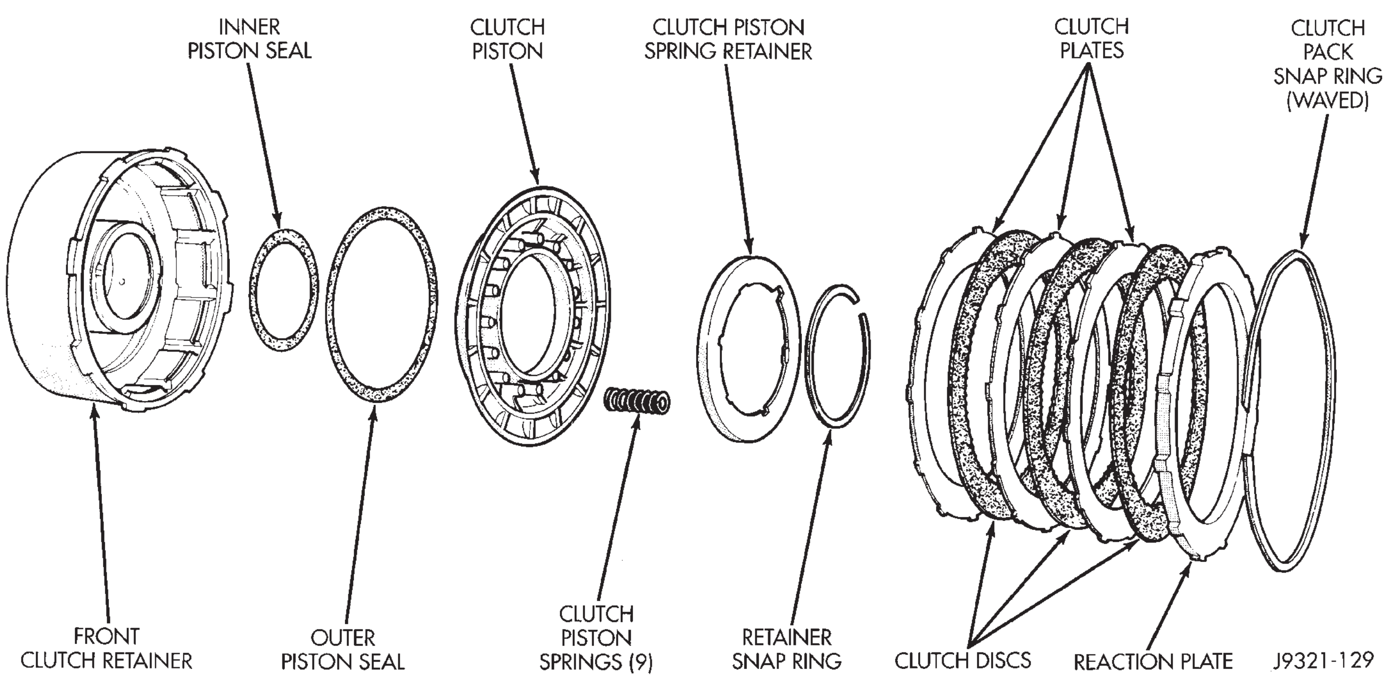


Fig. 61 46RH Front Clutch Components (3-Disc Clutch Shown)

(5) Remove clutch piston from retainer with a twisting motion.

(6) Remove and discard clutch piston inner and outer seals.

FRONT CLUTCH INSPECTION

Clean and inspect the front clutch components. Replace the clutch discs if warped, worn, scored, burned or charred, the lugs are damaged, or if the facing is flaking off. Replace the steel plates and reaction plate if heavily scored, warped, or broken. Be sure the driving lugs on the discs and plate are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston springs and spring retainer if either are distorted, warped or broken.

Check the lug grooves in the clutch piston retainer. The steel plates should slide freely in the slots. Replace the piston retainer if the grooves are worn or damaged. Also check action of the check ball in the piston retainer. The ball must move freely and not stick.

Replace the retainer bushing if worn, scored, or there is any doubt about bushing condition.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

Check the clutch piston check ball. The ball should be securely in place. Replace the piston if the ball is missing, or seized.

FRONT CLUTCH RETAINER BUSHING REPLACEMENT (FIG. 63)

(1) Assemble Tool Handle C-4171 and Bushing Remover SP-3629.

(2) Insert remover tool in bushing and drive bushing straight out of clutch retainer.

(3) Mount Bushing Installer SP-5511 on tool handle.

(4) Slide new bushing onto installer tool and start bushing into retainer.

(5) Tap new bushing into place until installer tool bottoms against clutch retainer.

(6) Remove installer tools and clean retainer thoroughly.

ASSEMBLING FRONT CLUTCH

(1) Soak clutch discs in transmission fluid. Lubricate remaining clutch components with transmission fluid. Retainer bushing can be lubricated with petroleum jelly if desired.

(2) Install new inner and outer seals on clutch piston. Be sure seal lips face interior of retainer.

(3) Lubricate new inner and outer piston seals with Ru-Glyde, or Door Eze.

(4) Install clutch piston in retainer. Use twisting motion to seat piston in retainer. **Do not force piston straight in. This could fold seals over causing leakage and clutch slip.**

(5) Install and position clutch piston springs as shown in Figure 64.

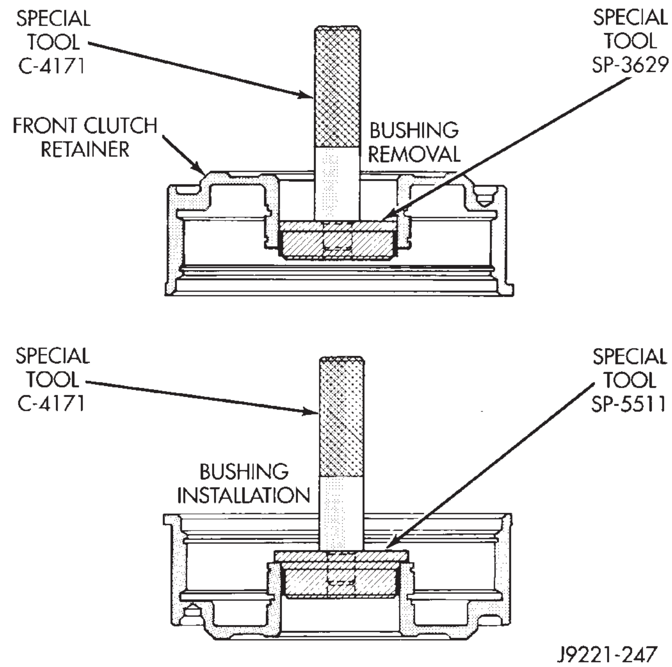


Fig. 63 Front Clutch Retainer Bushing Replacement—46RH

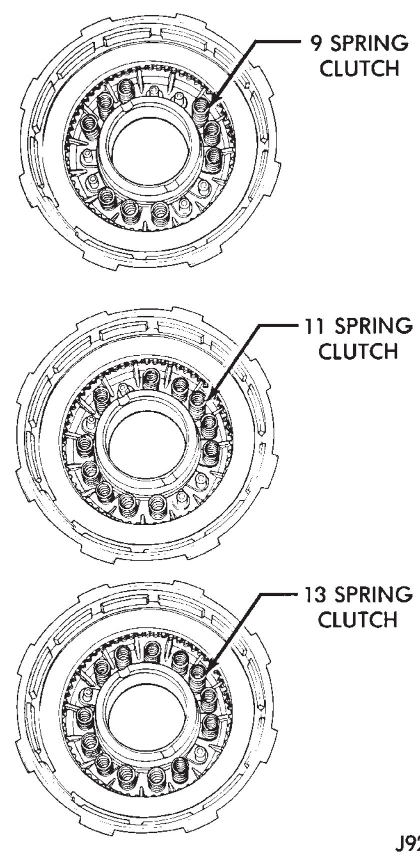


Fig. 64 Front Clutch Spring Location

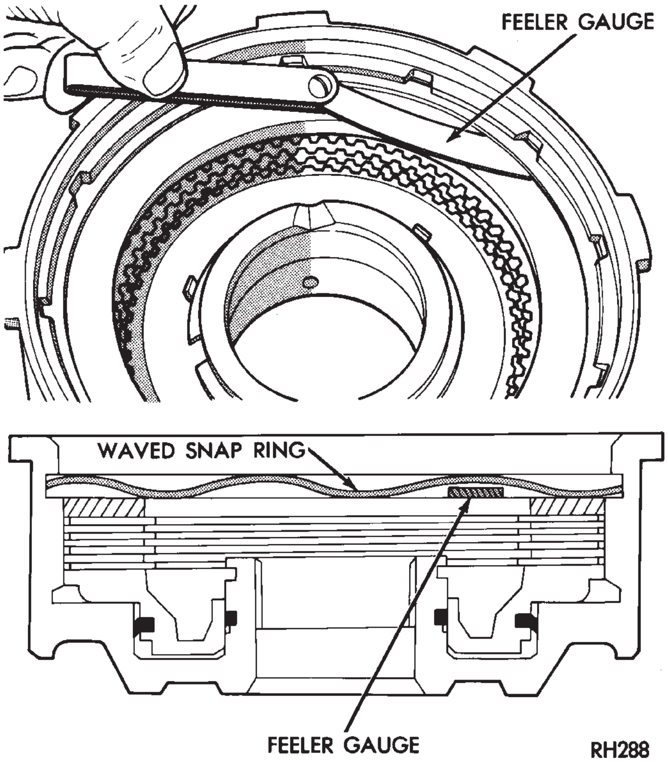


Fig. 65 Measuring Front Clutch Pack Clearance

(6) Install spring retainer on top of piston springs.

(7) Compress spring retainer and piston springs with Compressor Tool C-3863-A.

(8) Install spring retainer snap ring and remove compressor tool.

(9) Install clutch plates and discs. Install steel plate followed by clutch disc until all plates and discs are installed. **Install same number of discs and plates as removed during disassembly. Some models require 3 plates and discs. Others require 4 plates and discs.**

(10) Install reaction plate and waved snap ring.

(11) Check clutch pack clearance with feeler gauge as follows (Fig. 65):

• On 3 disc clutch, clearance between waved spring and pressure plate should 1.78 - 3.28 mm (0.070 - 0.129 in.).

• On 4 disc clutch, clearance between waved spring and pressure plate should be 2.08 to 3.83 mm (0.082 to 0.151 in.).

• **If clearance is incorrect, clutch plates, clutch discs, snap ring and pressure plate will have to be changed. Clutch pack waved snap ring is not select fit.**

REAR CLUTCH OVERHAUL

REAR CLUTCH DISASSEMBLY (FIG. 66)

(1) Remove clutch pack select fit snap ring.

(2) Remove reaction plate and remove clutch plates and discs.

(3) Remove pressure plate, wave spring, spacer ring and piston spring from clutch retainer.

(4) Remove clutch piston from piston retainer with a twisting motion.

(5) Remove input shaft thrust washer, if washer remained in piston retainer hub during removal.

(6) Remove seals from clutch piston. Discard seals after removal.

REAR CLUTCH INSPECTION

Clean the clutch components with solvent and dry them with compressed air.

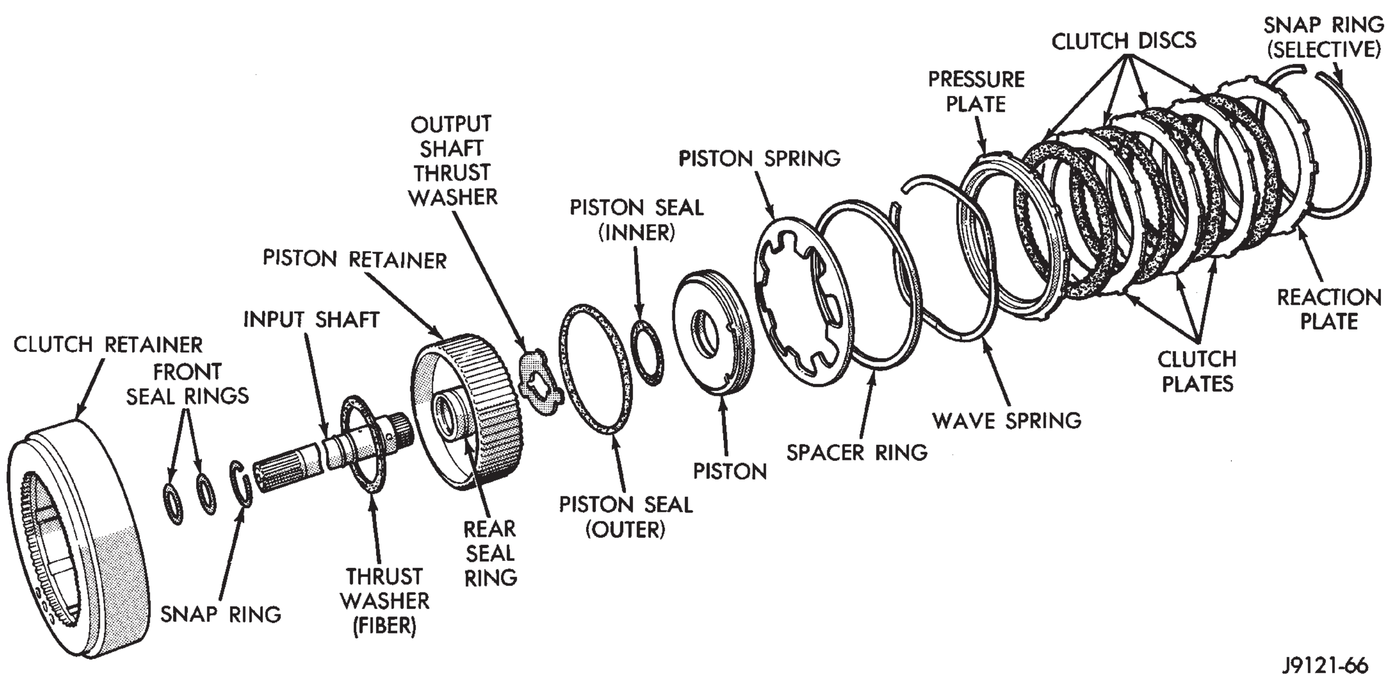


Fig. 66 Rear Clutch Components—46RH

Check condition of the input shaft seal rings. It is not necessary to remove or replace rings unless they are broken, cracked, or no longer securely hooked together.

Inspect the input shaft splines and machined surfaces. Very minor nicks or scratches can be smoothed off with crocus cloth. replace the shaft if the splines are damaged, or any of the machined surfaces are severely scored.

Replace the clutch discs if warped, worn, scored, burned/charred, the lugs are damaged, or if the facing is flaking off.

Replace the steel plates and the pressure plate if heavily scored, warped, or broken. Be sure the driving lugs on the discs and plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston spring and wave spring if either part is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The steel plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged. Also check action of the retainer check ball. The ball must move freely and not stick.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously damaged.

Check thrust washer condition. Washer thickness should be 1.55 to 1.60 mm (0.061 to 0.063 in.). Replace the washer if worn or damaged.

Check condition of the two seal rings on the input shaft and the single seal ring on the piston retainer hub. Replace the seal rings only if severely worn, cracked, or if they can no longer be hooked together.

INPUT SHAFT REPLACEMENT

If the input shaft must be replaced, first remove the retaining ring that secures the shaft in the piston retainer hub. Then press the old shaft out of the retainer with a shop press.

Lubricate the splines of the new shaft with petroleum jelly or transmission fluid. Then align the shaft in the piston retainer and carefully press it into place. Do not allow the shaft to become cocked during installation. The retainer can be cracked if misalignment occurs.

Install the shaft retaining ring after pressing the shaft into place. Be sure the ring is fully seated before proceeding with clutch assembly.

REAR CLUTCH ASSEMBLY

(1) Soak clutch discs in transmission fluid. Lubricate remaining clutch components with transmission fluid. Clutch retainer bushing can be lubricated with petroleum jelly if desired.

(2) Install new seals on clutch piston. Lubricate piston seals with Ru-Glyde or petroleum jelly to ease installation. Be sure seal lips face input shaft.

(3) Install clutch piston in piston retainer. Use twisting motion to seat piston in retainer. **Do not push piston straight in. This could distort seals causing leakage and clutch slip.**

(4) Assemble piston retainer and clutch retainer.

(5) Support clutch retainer with wood blocks, or insert input shaft through predrilled, appropriate diameter hole in workbench. Clutch pack components are easier to install if both retainers are properly supported.

(6) Install piston spring in clutch retainer. Concave side of spring faces upward and away from clutch piston. Convex side faces downward toward piston.

(7) Install spacer ring on top of piston spring.

(8) Install wave spring on top of spacer ring. Then seat wave spring in retainer groove. **If wave spring will not seat properly, spacer ring has probably shifted over and into wave spring groove in retainer. Use small screwdriver to realign spacer ring if necessary.**

(9) Install inner pressure plate in clutch retainer.

(10) Install first clutch disc followed by steel plate until all discs and plates are installed.

(11) Install reaction plate on top of last clutch disc.

(12) Install selective snap ring to secure clutch pack in retainer.

(13) Install new seal rings on input shaft if necessary (Fig. 67). Be very sure ring ends are all securely hooked together before proceeding.

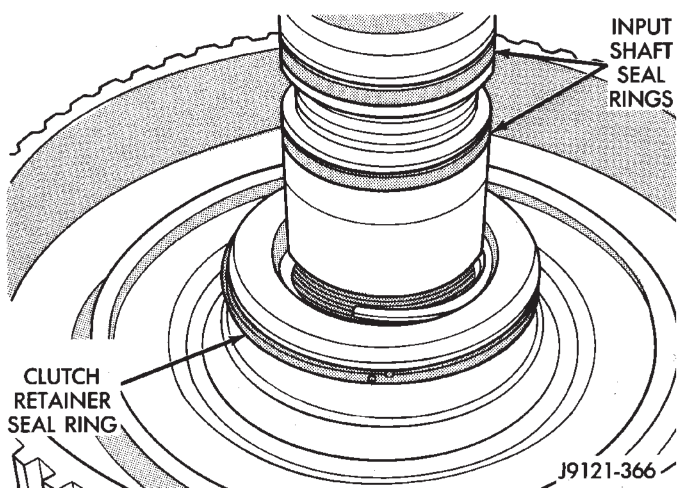


Fig. 67 Input Shaft Seal Ring Locations

(14) Check clutch pack clearance with feeler gauge (Fig. 68). Clearance should be 0.63 to 1.14 mm (0.025 to 0.045 in.).

(15) If clutch pack clearance is incorrect, clutch pack snap ring, reaction plate, or clutch pack may have to be replaced.

(16) Install thrust washer on piston retainer hub

(Fig. 66). Use petroleum jelly to hold thrust washer in place.

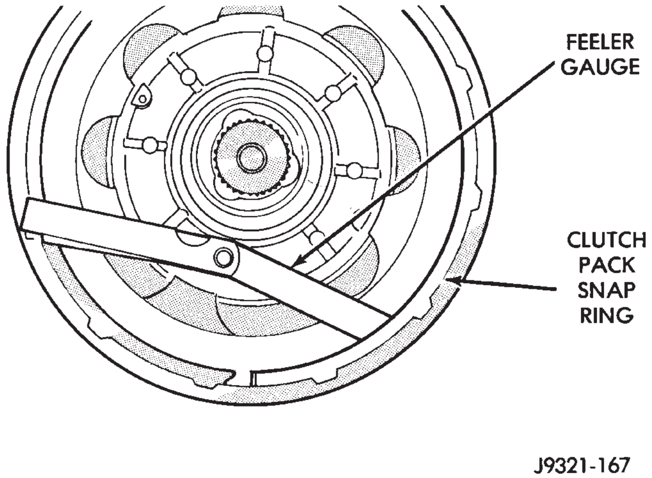


Fig. 68 Measuring Rear Clutch Pack Clearance

PLANETARY GEARTRAIN OVERHAUL

PLANETARY GEARTRAIN DISASSEMBLY

(1) Remove planetary snap ring from intermediate shaft (Fig. 69). Retain snap ring if in good condition. It is reusable.

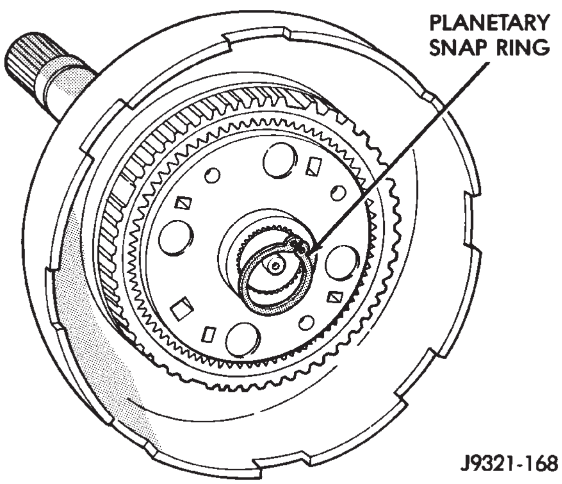


Fig. 69 Removing Planetary Snap Ring—46RH

(2) Remove front planetary gear and front annulus gear as assembly (Fig. 70).

(3) Remove front planetary gear and thrust washer from front annulus gear (Fig. 71). Note thrust washer position for assembly reference.

(4) Remove tabbed thrust washer from driving shell (Fig. 72). Note washer position for assembly reference.

(5) Remove sun gear and driving shell as assembly (Fig. 73).

(6) Remove tabbed thrust washer from rear planetary gear (Fig. 74). Note washer position on gear for assembly reference.

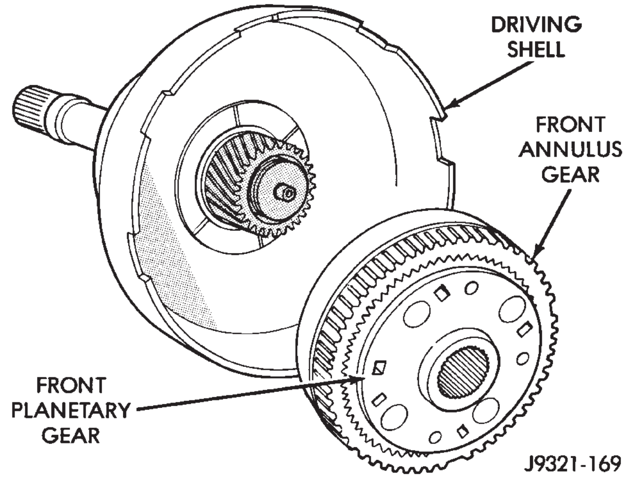


Fig. 70 Removing Front Planetary And Annulus Gears—46RH

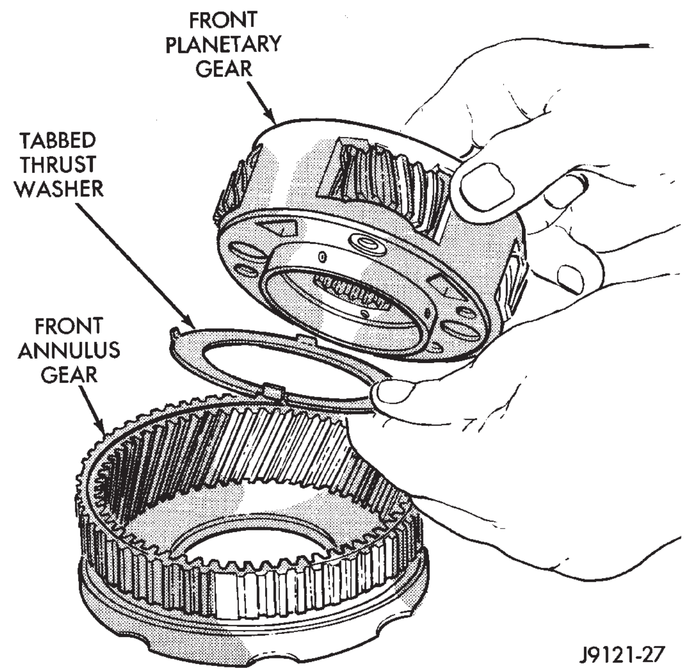


Fig. 71 Disassembling Front Planetary And Annulus Gears—46RH

(7) Remove rear planetary gear and rear annulus gear from intermediate shaft (Fig. 75).

(8) Remove thrust plate from rear annulus gear (Fig. 76).

Intermediate Shaft And Geartrain Inspection

Clean the intermediate shaft and planetary components (Fig. 77) in parts cleaning solvent and dry them with compressed air.

Inspect the planetary gear sets and annulus gears. The pinion gears, pinion shafts, pinion washers and shaft retaining pins are all serviceable and can be replaced if worn or damaged. However, if a pinion carrier is damaged, the entire planetary gear set must be replaced as an assembly.

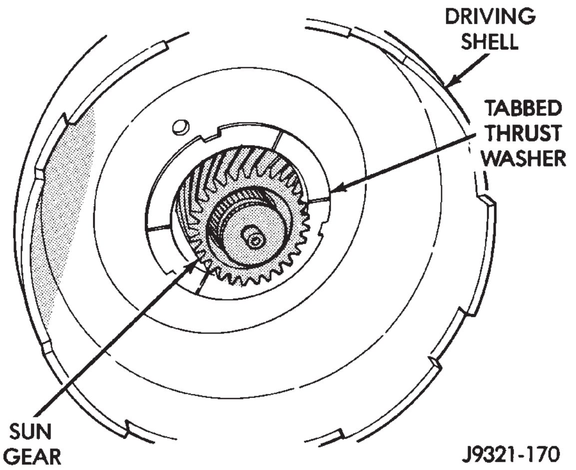


Fig. 72 Driving Shell Thrust Washer Removal—46RH

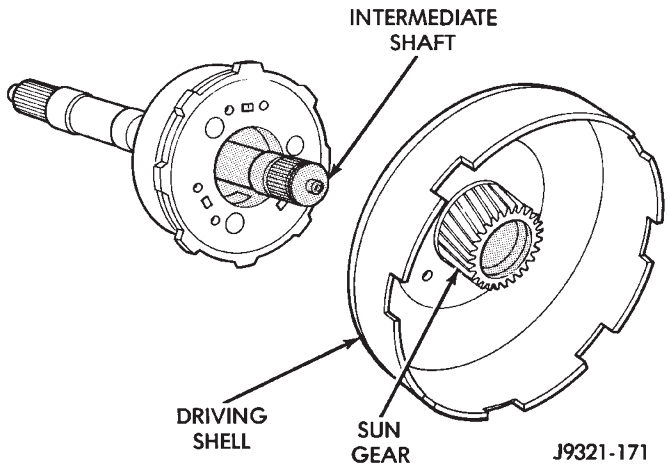


Fig. 73 Sun Gear And Driving Shell Assembly Removal—46RH

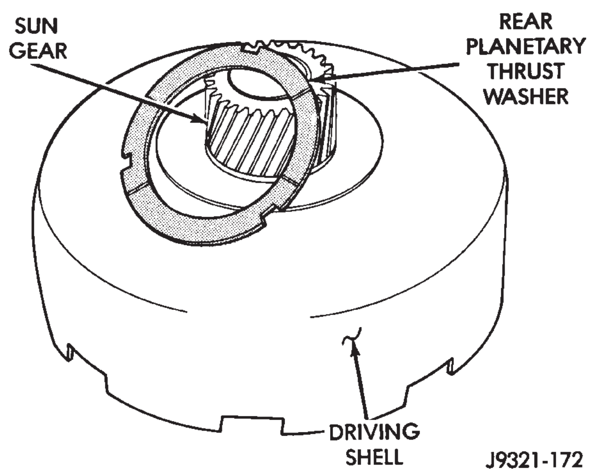


Fig. 74 Rear Planetary Thrust Washer Removal—46RH

Replace the annulus gears if the teeth are chipped, broken, or worn, or the gear is cracked. Replace the planetary thrust plates and the tabbed thrust washers if cracked, scored or worn.

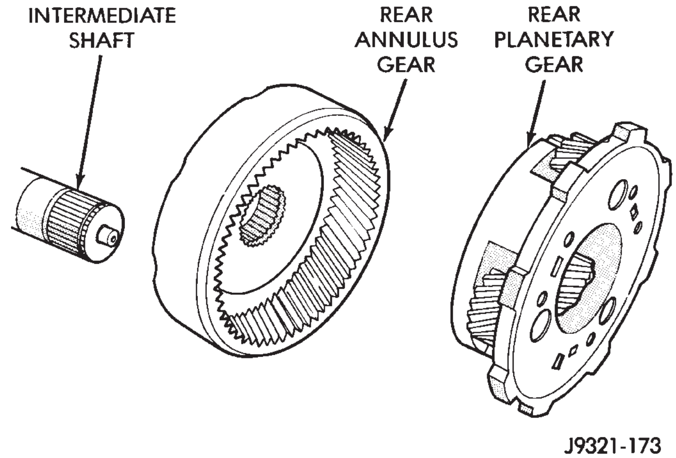


Fig. 75 Rear Planetary And Annulus Gear Removal—46RH

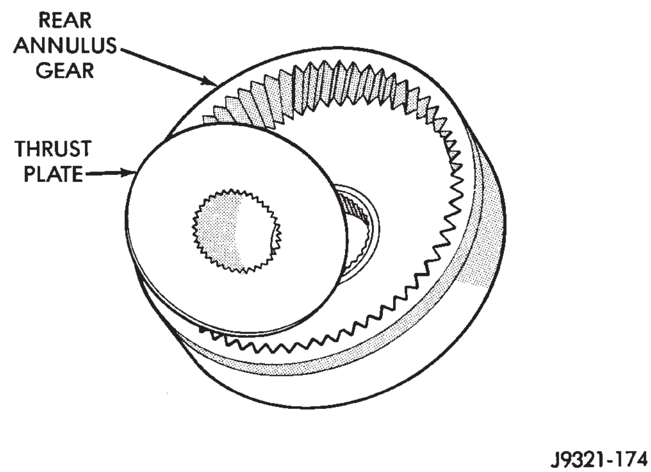


Fig. 76 Rear Annulus Thrust Plate Removal—46RH

Inspect the machined surfaces of the intermediate shaft. Be sure the oil passages are open and clear. Replace the shaft if scored, pitted, or damaged.

Inspect the sun gear and driving shell (Fig. 77). If either component is worn or damaged, remove the sun gear rear retaining ring and separate the sun gear and thrust plate from the driving shell. Then replace the necessary component.

Replace the sun gear as an assembly if the gear teeth are chipped or worn. Also replace the gear as an assembly if the bushings are scored or worn. The sun gear bushings are not serviceable. Replace the thrust plate if worn, or severely scored. Replace the driving shell if distorted, cracked, or damaged in any way.

PLANETARY GEARTRAIN ASSEMBLY AND ADJUSTMENT

(1) Lubricate sun gear and planetary gears with transmission fluid during assembly. Use petroleum jelly to lubricate output shaft bushing surfaces, thrust washers and thrust plates.

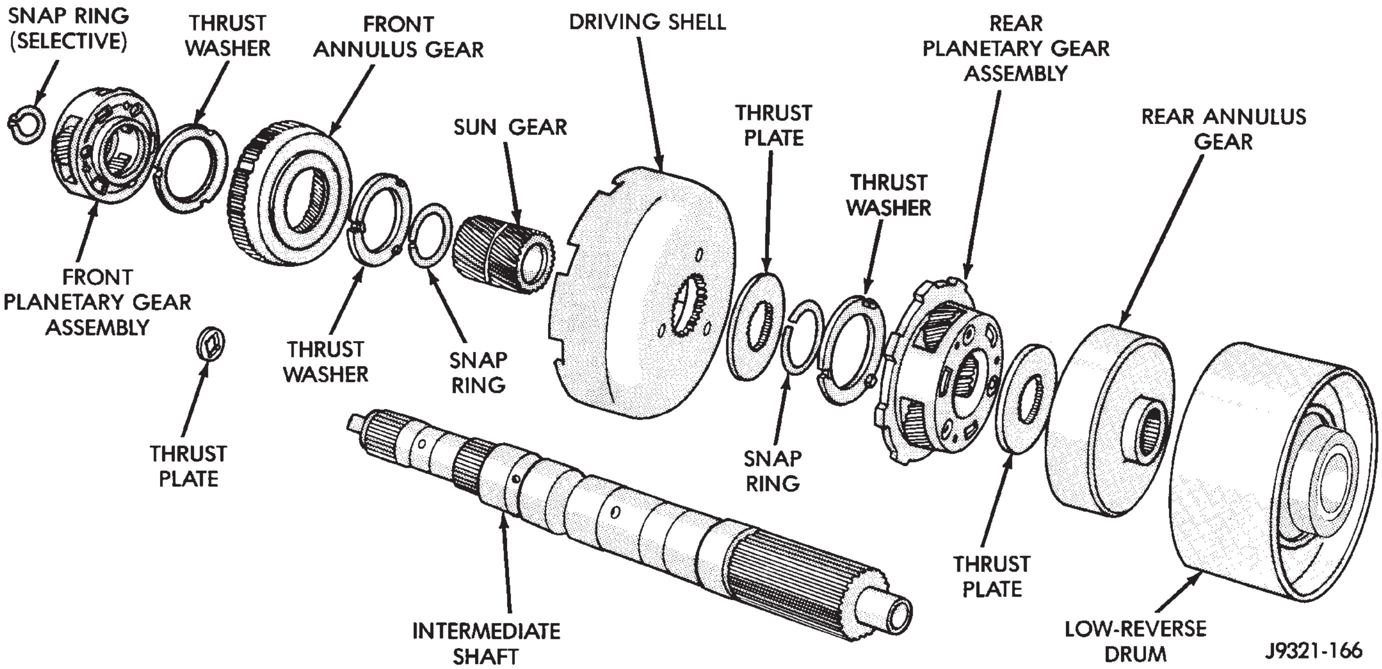


Fig. 77 Planetary Geartrain Components—46RH

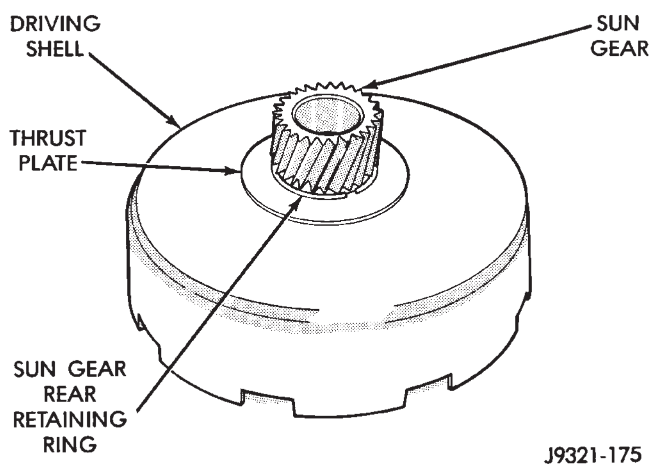


Fig. 78 Sun Gear Installation—46RH

(2) Install front snap ring on sun gear and install gear in driving shell. Then install thrust plate over sun gear and against rear side of driving shell (Fig. 78). Install rear snap ring to secure sun gear and thrust plate in driving shell.

(3) Install rear annulus gear on intermediate shaft (Fig. 79).

(4) Install thrust plate in annulus gear (Fig. 80). Be sure plate is seated on shaft splines and against gear.

(5) Install rear planetary gear in rear annulus gear (Fig. 81). Be sure planetary carrier is seated against annulus gear.

(6) Install tabbed thrust washer on front face of rear planetary gear (Fig. 82). Seat washer tabs in matching slots in face of gear carrier. Use extra petroleum jelly to hold washer in place if desired.

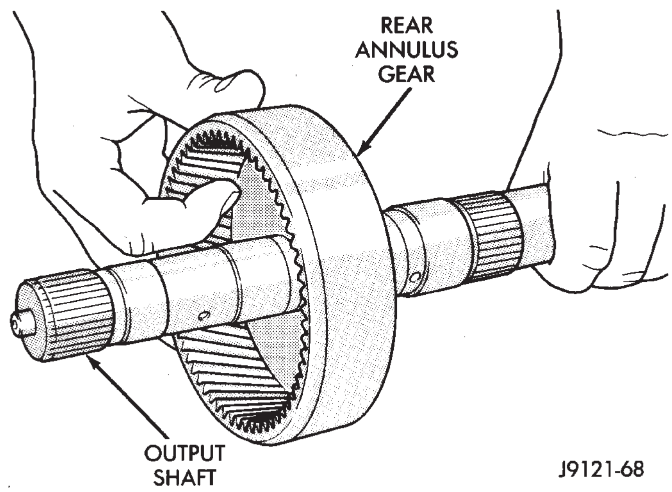


Fig. 79 Installing Rear Annulus Gear On Intermediate Shaft—46RH

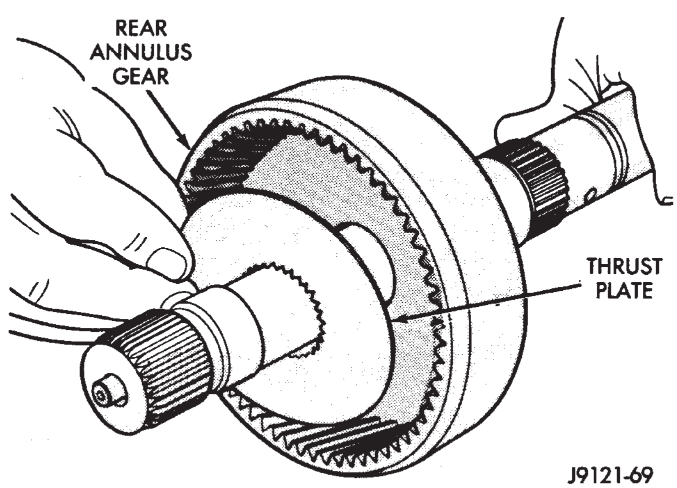


Fig. 80 Installing Rear Annulus Thrust Plate—46RH

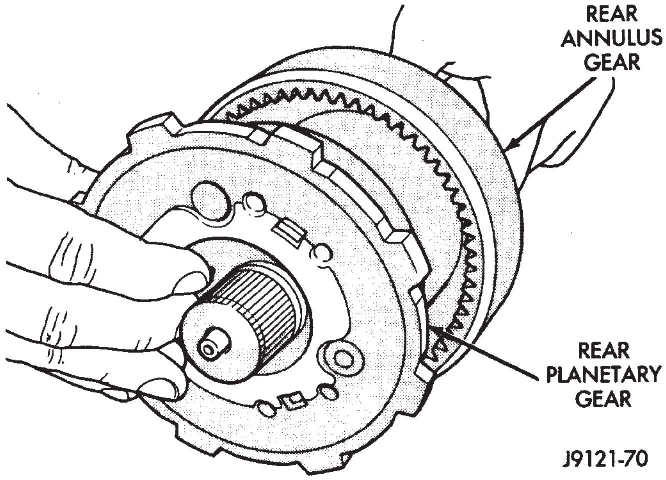


Fig. 81 Installing Rear Planetary Gear—46RH

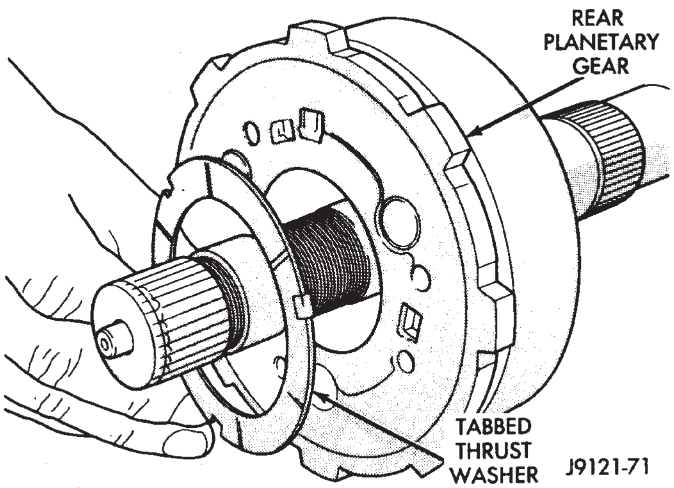


Fig. 82 Installing Rear Planetary Thrust Washer—46RH

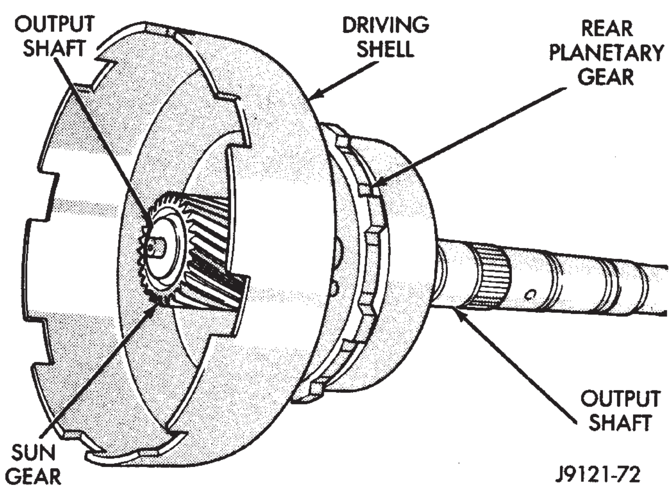


Fig. 83 Installing Sun Gear And Driving Shell—46RH

(7) Lubricate sun gear bushings with petroleum jelly or transmission fluid.

(8) Install sun gear and driving shell on output shaft (Fig. 83). Seat shell against rear planetary gear. Verify that thrust washer on planetary gear was not displaced during installation.

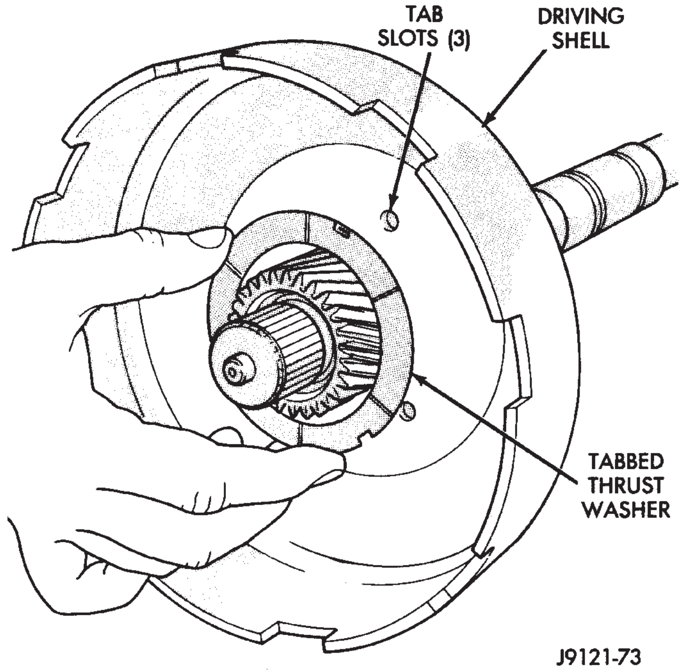


Fig. 84 Installing Driving Shell Thrust Washer—46RH

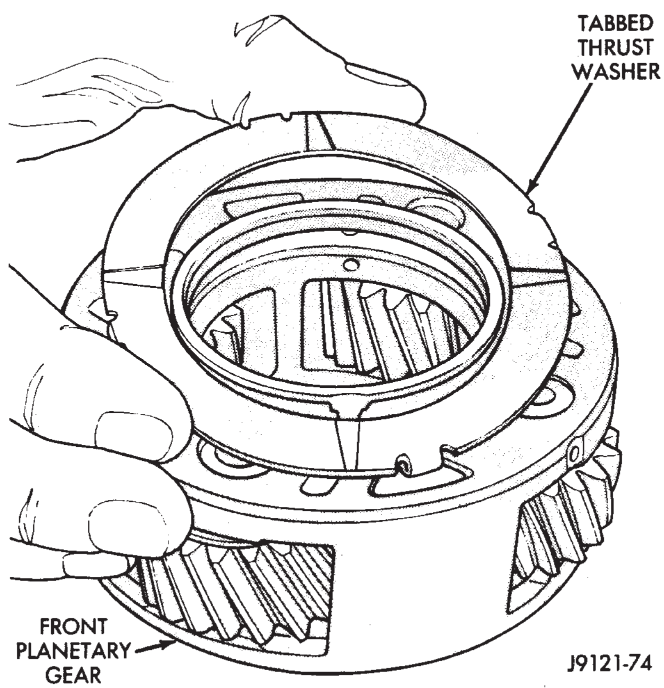


Fig. 85 Installing Thrust Washer On Front Planetary Gear—46RH

(9) Install tabbed thrust washer in driving shell (Fig. 84). be sure washer tabs are seated in tab slots of driving shell. Use extra petroleum jelly to hold washer in place if desired.

(10) Install tabbed thrust washer on front planetary gear (Fig. 85). Seat washer tabs in matching slots in face of gear carrier. Use extra petroleum jelly to hold washer in place if desired.

(11) Install front annulus gear over and onto front planetary gear (Fig. 86). Be sure gears are fully meshed and seated.

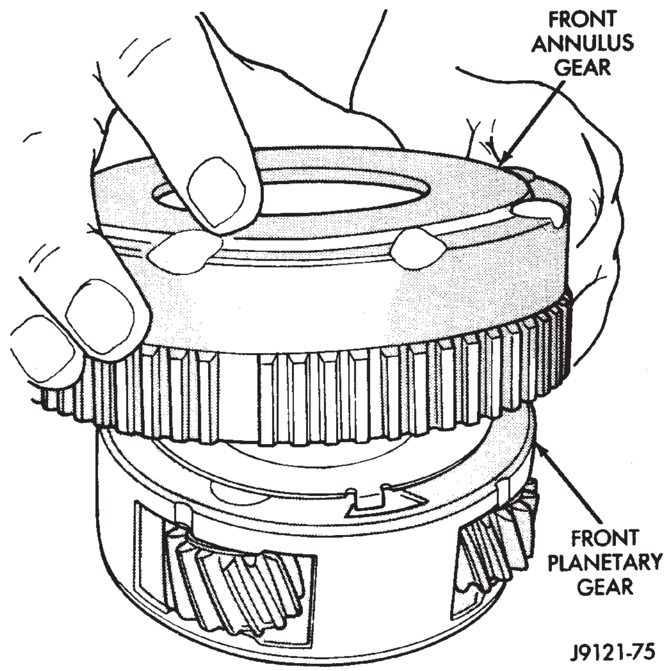


Fig. 86 Assembling Front Planetary And Annulus Gears—46RH

(12) Install front planetary and annulus gear assembly (Fig. 87). Hold gears together and slide them onto shaft. Be sure planetary pinions are seated on sun gear and that planetary carrier is seated on output shaft.

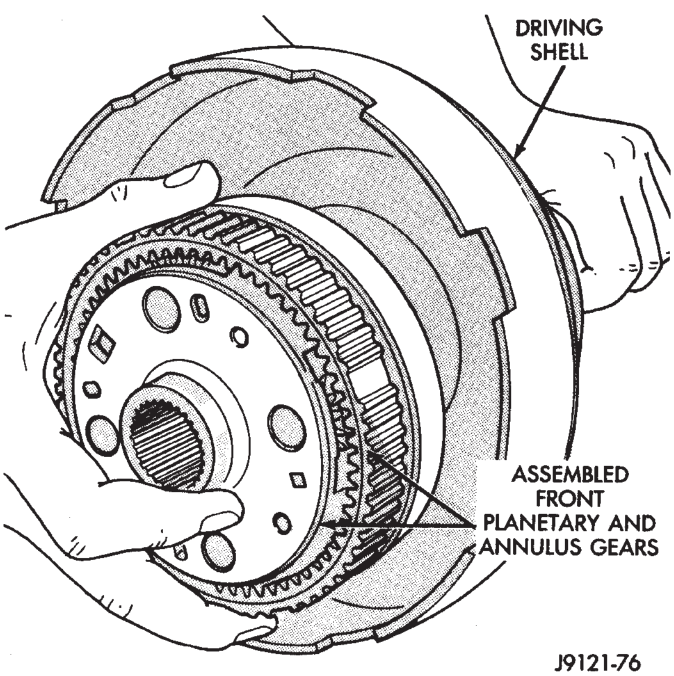


Fig. 87 Installing Front Planetary And Annulus Gear Assembly—46RH

(13) Place geartrain in upright position. Rotate gears to be sure all components are seated and properly assembled. Snap ring groove at forward end of output shaft will be completely exposed when components are assembled correctly.

(14) Install planetary snap ring in groove at end of output shaft (Fig. 88).

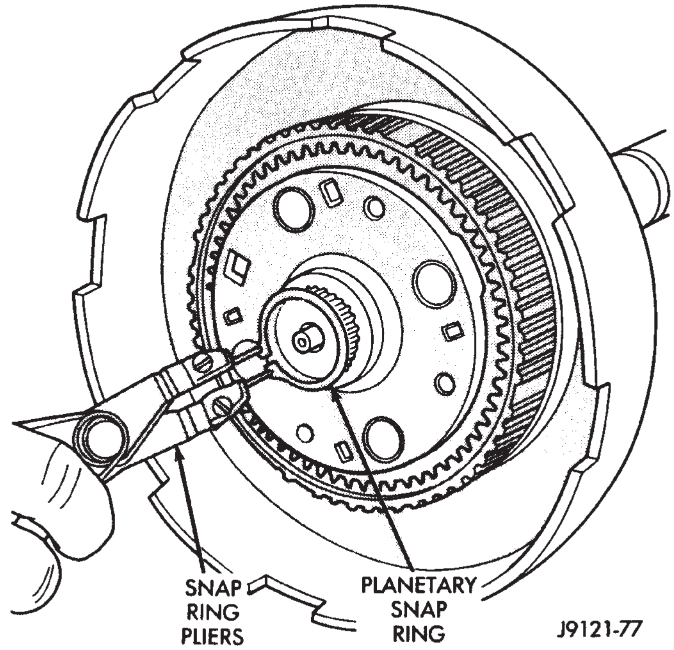


Fig. 88 Installing Planetary Snap Ring—46RH

(15) Turn planetary geartrain over. Position wood block under front end of output shaft and support geartrain on shaft. Be sure all geartrain parts have moved forward against planetary snap ring. This is important for accurate end play check.

(16) Check planetary geartrain end play with feeler gauge (Fig. 89). Insert gauge between rear annulus gear and shoulder on output shaft as shown. End play should be 0.15 to 1.22 mm (0.006 to 0.048 in.).

(17) If end play is incorrect, install thinner/thicker planetary snap ring as needed.

VALVE BODY SERVICE AND ADJUSTMENT

VALVE BODY MAIN COMPONENT DISASSEMBLY

CAUTION: Do not clamp any valve body component in a vise. This practice can damage the component resulting in unsatisfactory operation after assembly and installation. Remove valves, plugs and springs with a pencil magnet. Do not use pliers to remove any of the valves, plugs or springs and do not force any of the components out or into place. The valves and valve body housings will be damaged if force is used. Tag or mark the valve body springs for reference as they are removed. Do not allow them to become intermixed.

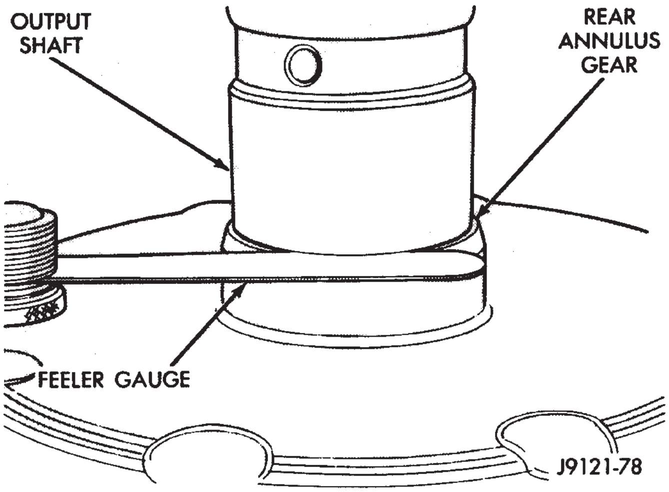


Fig. 89 Checking Planetary Geartrain End Play

(1) Remove boost valve cover (Fig. 90).

(2) Remove boost valve retainer, valve spring and boost valve (Fig. 91).

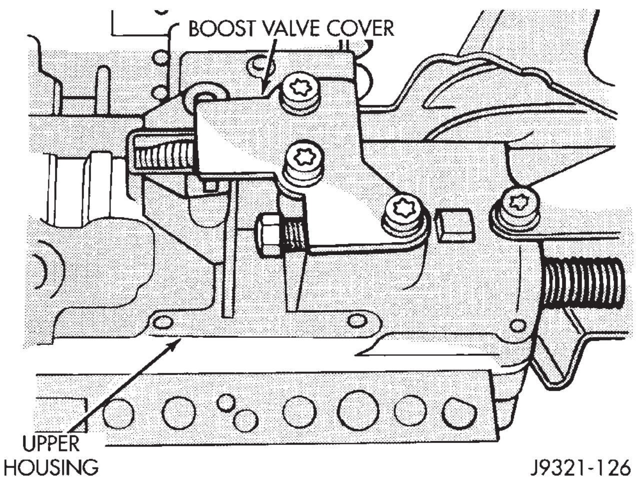


Fig. 90 Boost Valve Cover Location—46RH

(3) Secure detent ball and spring with Retainer Tool 6583 (Fig. 92).

(4) Remove E-clip that secures throttle lever in manual lever (Fig. 93).

(5) Lift and rotate manual lever far enough to clear detent housing.

(6) Remove retaining tool and remove detent ball and spring (Fig. 94).

(7) Remove washer at top of manual lever shaft. Then lift manual lever and park rod assembly upward and out of valve body (Fig. 95).

(8) Remove throttle lever from valve body housing (Fig. 96).

(9) Remove park rod E-clip and separate rod from manual lever (Fig. 97).

(10) Remove screws attaching pressure adjusting screw bracket to valve body and transfer plate. Hold bracket firmly against spring tension while removing last screw.

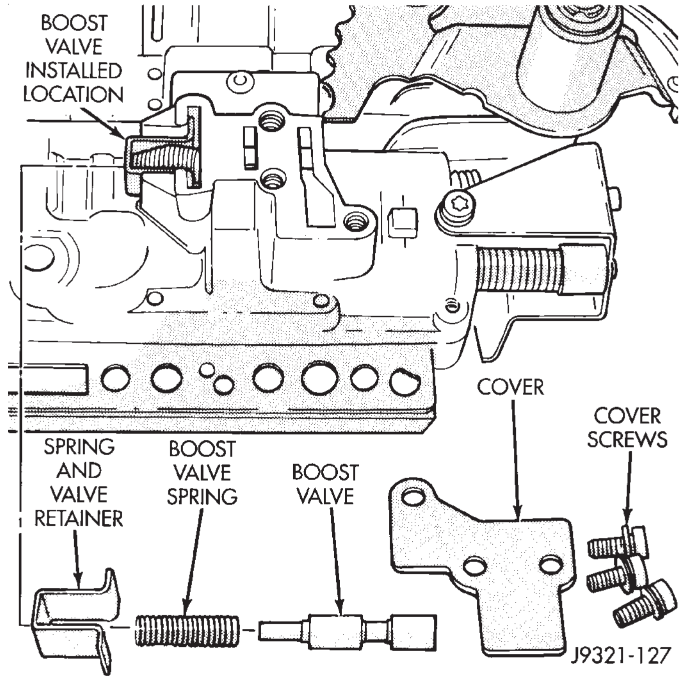


Fig. 91 Boost Valve Components—46RH

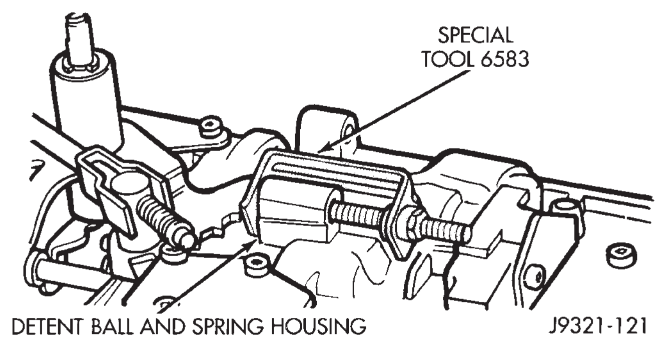


Fig. 92 Securing Detent Ball And Spring

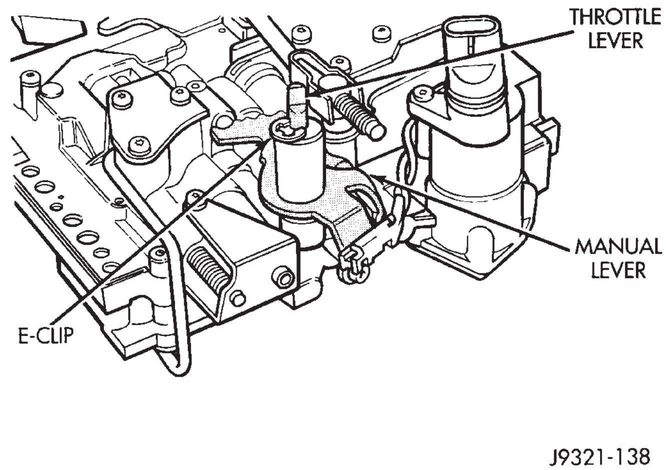


Fig. 93 Removing Throttle Lever E-Clip—46RH

(11) Remove adjusting screw bracket, line pressure adjusting screw, pressure regulator spring and switch valve spring (Fig. 98). **Do not remove throttle**

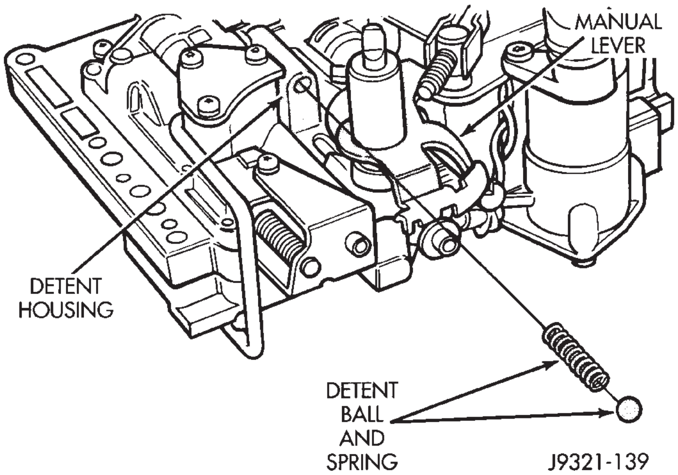


Fig. 94 Detent Ball And Spring Removal

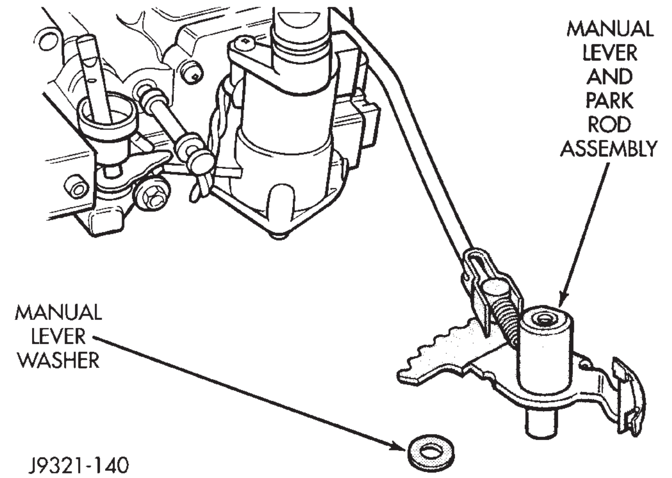


Fig. 95 Manual Lever Removal—46RH

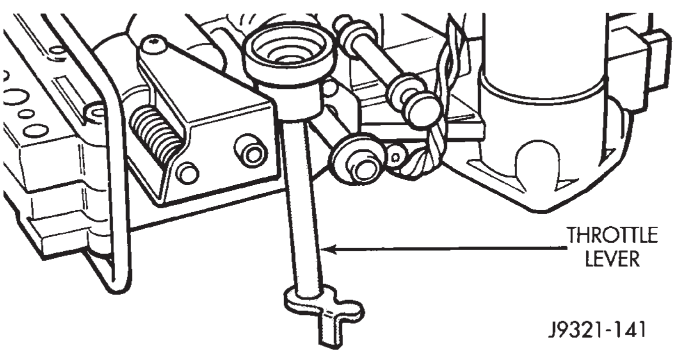


Fig. 96 Throttle Lever Removal—46RH

pressure adjusting screw from bracket and do not disturb adjusting screw settings during removal.

(12) Remove solenoid connector from 3-4 accumulator housing (Fig. 99). **Note that connector is attached to housing with shoulder-type screw. Keep this screw with accumulator housing to avoid losing it.**

(13) Note routing of solenoid wires for assembly reference (Fig. 100).

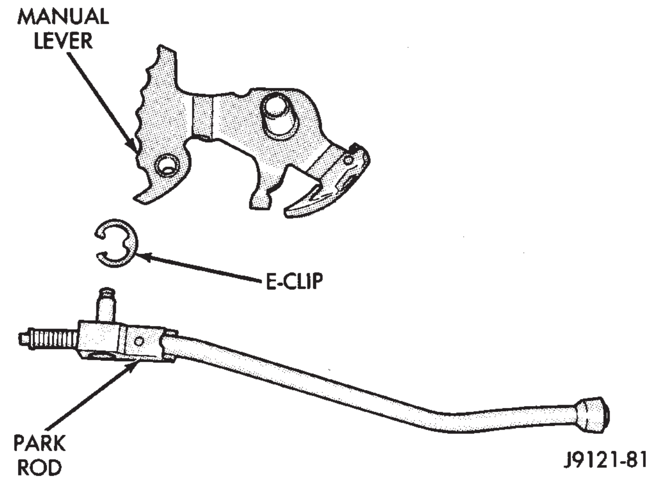


Fig. 97 Park Rod Removal—46RH

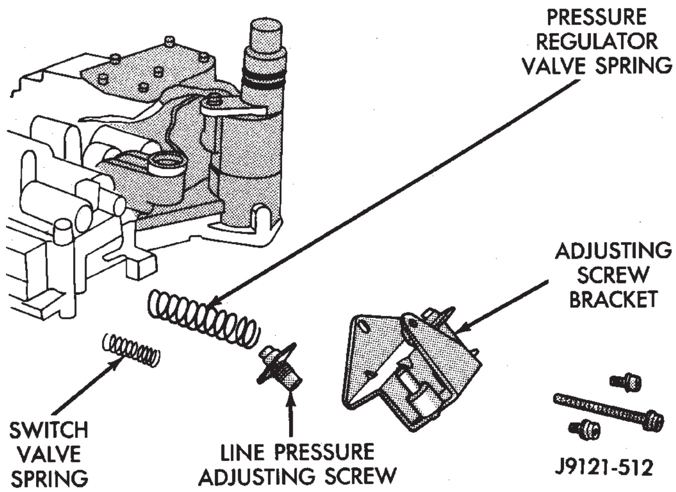


Fig. 98 Adjusting Screw Bracket And Spring Removal—46RH

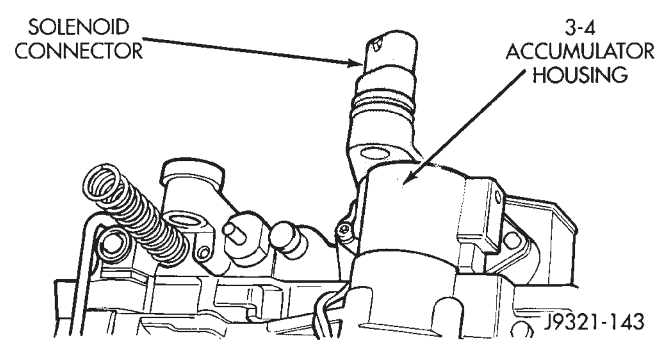


Fig. 99 Solenoid Connector Position—46RH

(14) Remove screws attaching solenoid assembly to valve body lower housing and remove solenoid and connector assembly (Fig. 101).

(15) Remove 3-4 accumulator housing attaching screws and remove housing from valve body (Fig. 102).

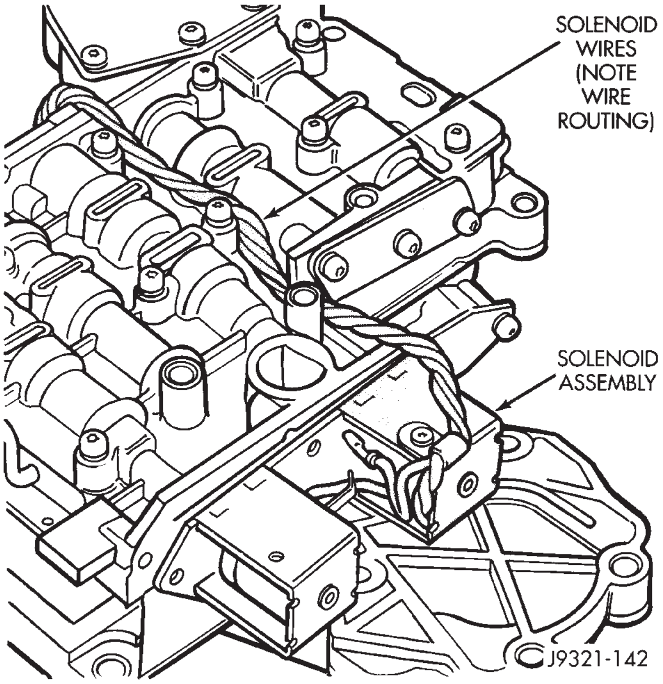


Fig. 100 Solenoid Wire Routing—46RH

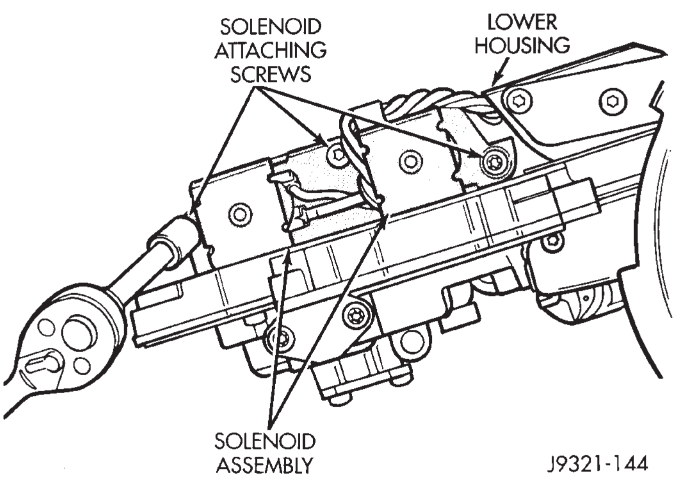


Fig. 101 Solenoid Assembly Removal—46RH

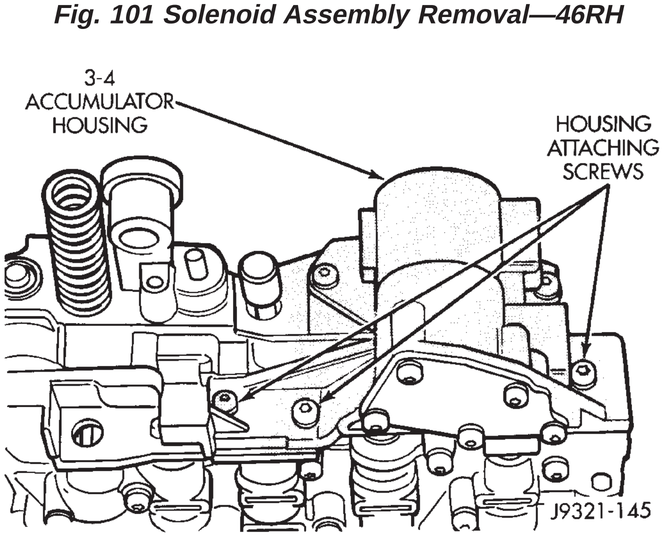


Fig. 102 Removing 3-4 Accumulator Housing

(16) Remove following parts from valve body lower housing: 3-4 shift valve and spring; pressure regulator valve spring; clutch valve; clutch valve spring; and clutch valve plug (Fig. 103).

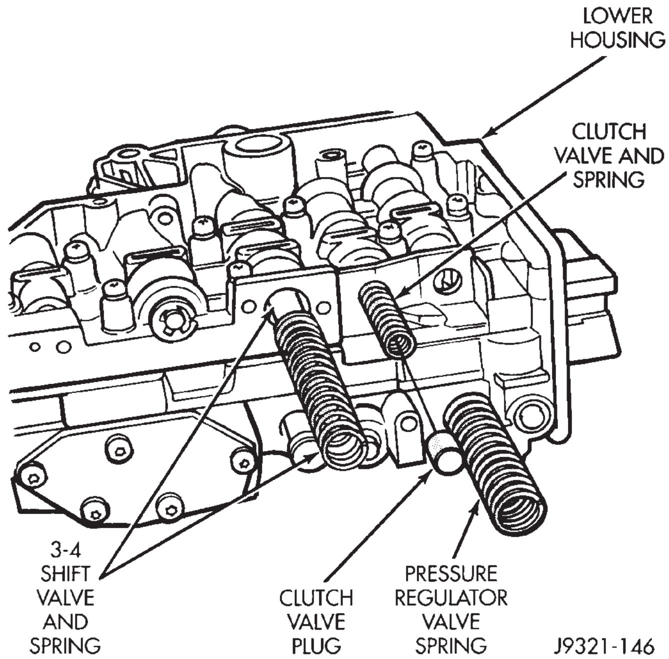


Fig. 103 Clutch Valve And 3-4 Shift Valve Locations—46RH

(17) Remove boost valve connecting tube (Fig. 104). Disengage tube from upper housing port first. Then rock opposite end of tube back and forth to work it out of lower housing.

CAUTION: Do not use tools to loosen or pry the connecting tube out of the valve body housings. Loosen and remove the tube by hand only.

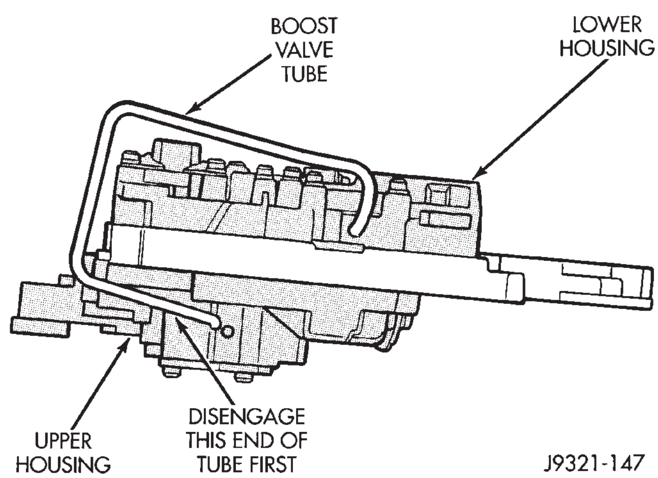


Fig. 104 Boost Valve Tube Removal—46RH

(18) Turn valve body over so valve lower housing is facing upward (Fig. 105). In this position, check

balls in upper housing will remain in place and not fall out when lower housing and transfer plate are removed.

(19) Remove screws attaching valve body lower housing to upper housing and transfer plate (Fig. 105). **Note position of boost valve tube brace for assembly reference.**

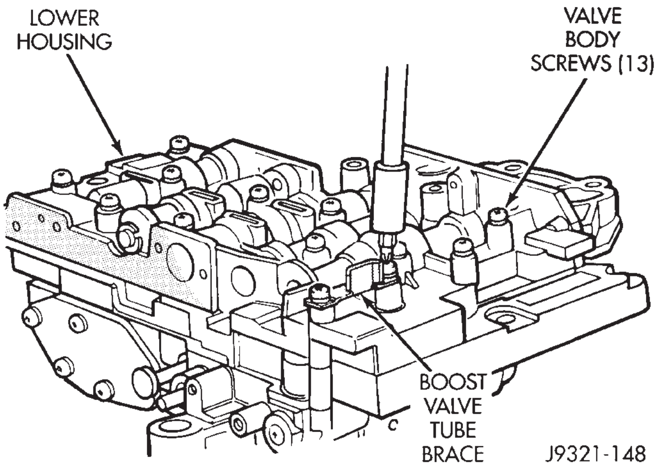


Fig. 105 Valve Body Screw And Tube Brace Location—46RH

(20) Remove lower housing and overdrive separator plate from transfer plate (Fig. 106).

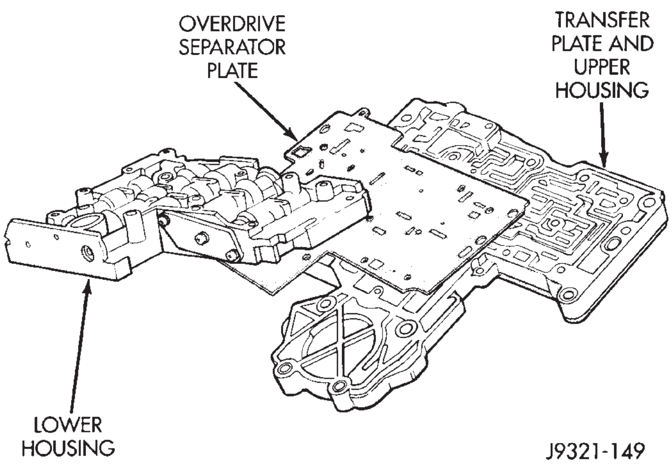


Fig. 106 Lower Housing Removal—46RH

(21) Remove transfer plate from upper housing (Fig. 107).

(22) Turn transfer plate over so upper housing separator plate is facing upward (Fig. 108).

(23) Remove brace plate from lower housing separator plate and transfer plate (Fig. 108).

(24) Remove upper housing separator plate from transfer plate (Fig. 109). Note position of filter in separator plate for assembly reference.

(25) Remove rear clutch check ball from transfer plate. **Note check ball location for assembly reference before removing it (Fig. 110).**

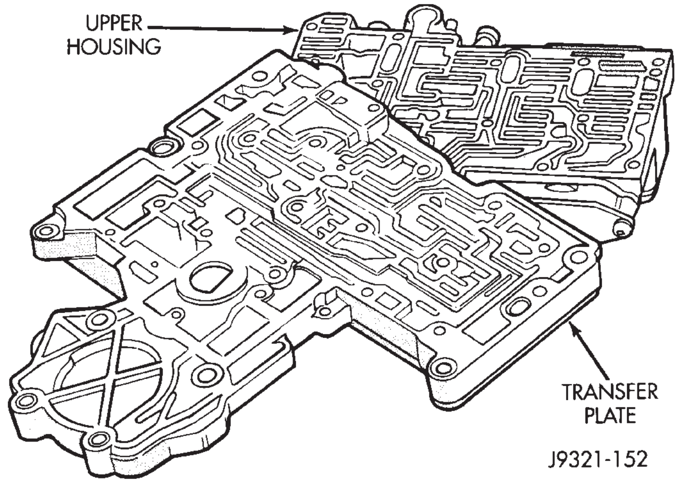


Fig. 107 Removing Transfer Plate From Upper Housing—46RH

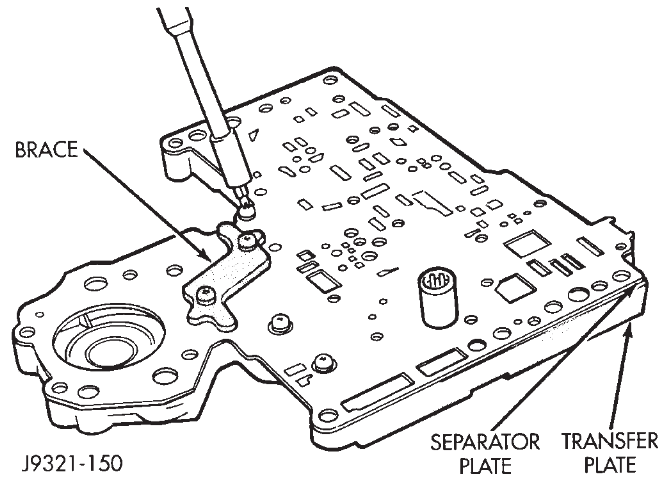


Fig. 108 Brace Plate Removal—46RH

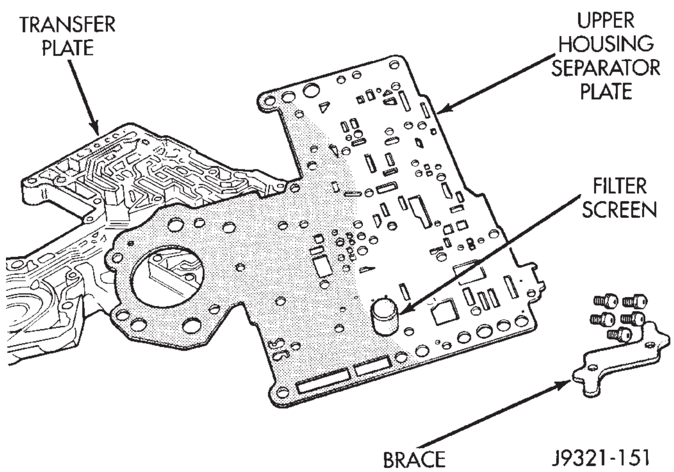


Fig. 109 Upper Housing Separator Plate Removal—RH

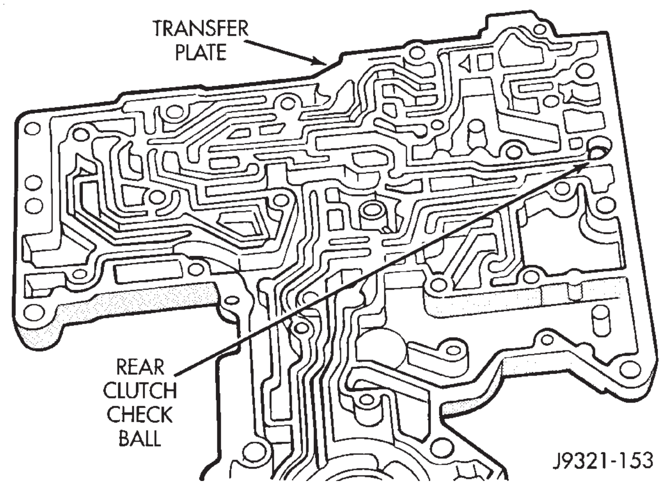


Fig. 110 Rear Clutch Check Ball Location—46RH

VALVE BODY UPPER HOUSING DISASSEMBLY

(1) Note location of check balls in valve body upper housing (Fig. 111). Then remove one large and six smaller diameter check balls with magnet (total of 7 check balls are used).

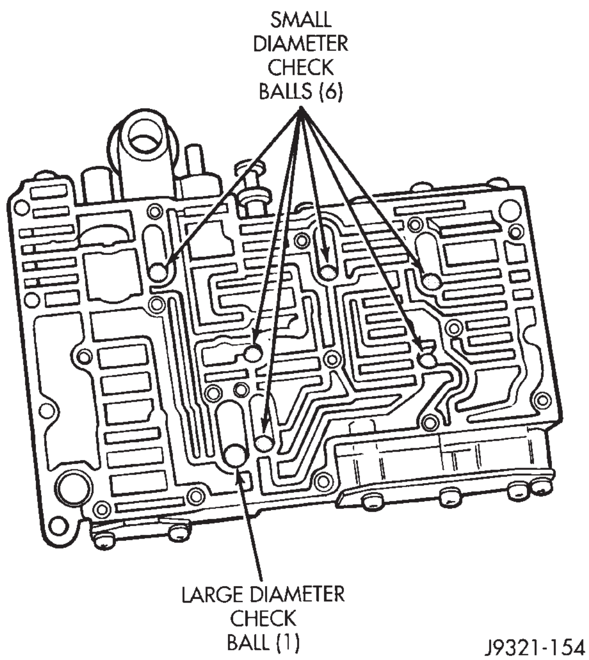


Fig. 111 Valve Body Check Ball Locations—46RH

(2) Remove E-clip that secure shuttle valve secondary spring on valve stem (Fig. 112).

(3) Remove governor plug and shuttle valve covers (Fig. 113).

(4) Remove throttle plug, primary spring, shuttle valve, secondary spring, and spring guides (Fig. 113).

(5) Remove boost valve retainer, spring and valve if not previously removed.

(6) Turn upper housing over and remove switch valve, regulator valve and spring, and manual valve (Fig. 114).

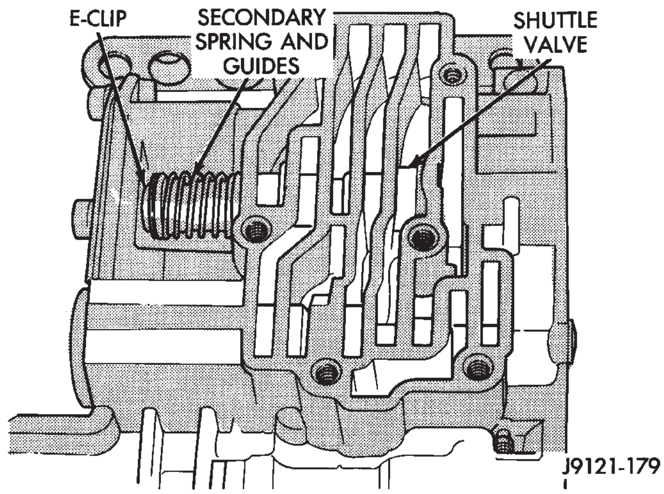


Fig. 112 Shuttle Valve E-Clip And Secondary Spring Location

(7) Remove kickdown detent, kickdown valve, and throttle valve and spring (Fig. 114).

(8) Remove throttle plug and 1-2 and 2-3 governor plugs (Fig. 114). Also remove shuttle valve primary spring if not removed in prior step.

(9) Turn upper housing around and remove limit valve and shift valve covers (Fig. 115).

(10) Remove limit valve housing. Then remove retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing (Fig. 115).

(11) Remove 1-2 shift control valve and spring (Fig. 115).

(12) Remove 1-2 shift valve and spring (Fig. 115).

(13) Remove 2-3 shift valve and spring from valve body (Fig. 115).

(14) Remove pressure plug cover (Fig. 115).

(15) Remove line pressure plug, sleeve, throttle pressure plug and spring (Fig. 115).

VALVE BODY LOWER HOUSING DISASSEMBLY (FIG. 116)

(1) Remove timing valve cover.

(2) Remove 3-4 timing valve and spring.

(3) Remove 3-4 shuttle valve E-clip and remove shuttle valve spring and plug.

(4) Remove 3-4 shift valve and spring.

(5) Remove converter clutch valve, spring and plug.

(6) Remove converter clutch timing valve, retainer and valve spring.

3-4 ACCUMULATOR HOUSING DISASSEMBLY (FIG. 117)

(1) Remove end plate from housing.

(2) Remove piston spring.

(3) Remove piston. Remove and discard piston seals.

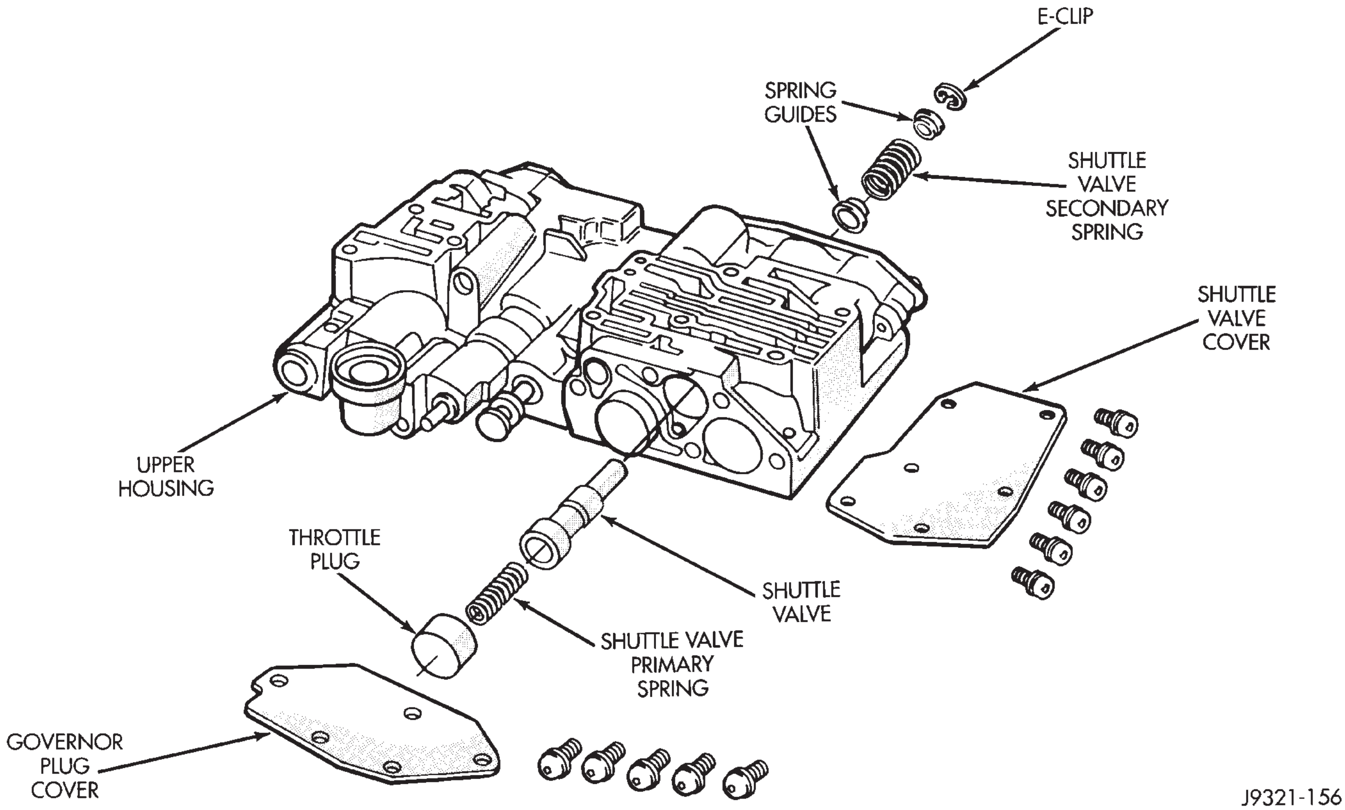


Fig. 113 Shuttle And Boost Valve Components—46RH

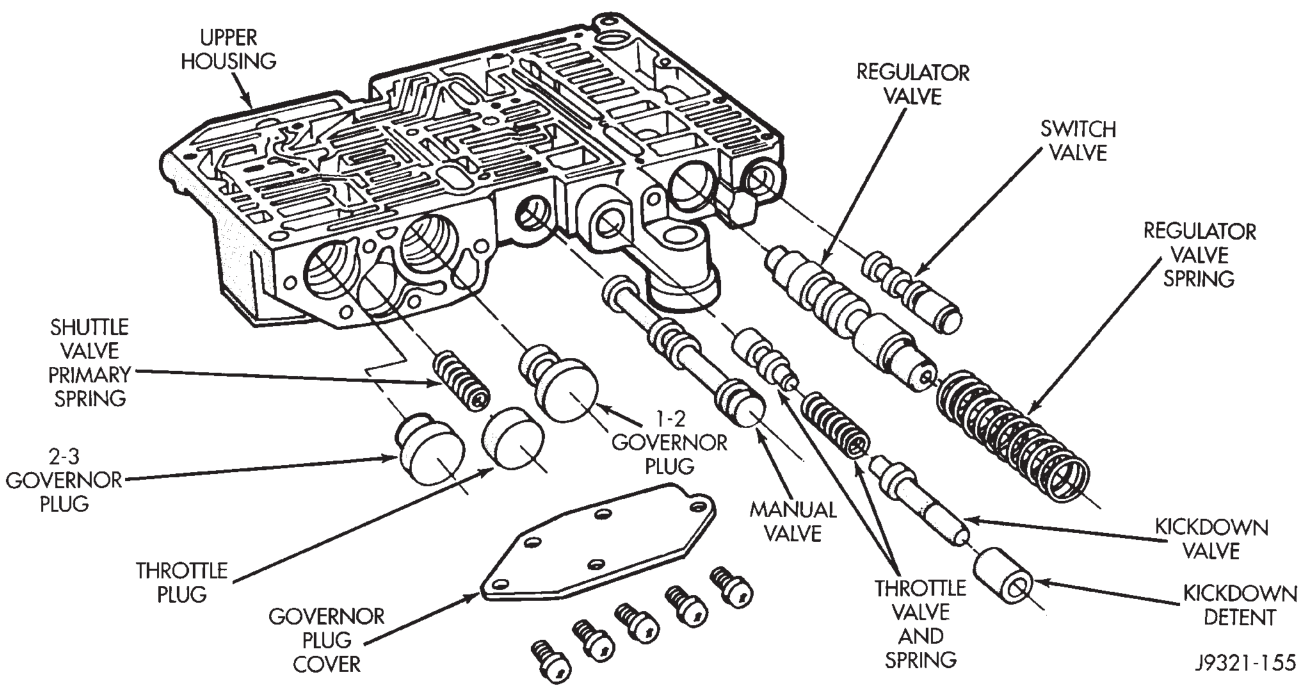


Fig. 114 Control Valve Locations—46RH Upper Housing

VALVE BODY CLEANING AND INSPECTION

The only serviceable valve body components are:

- solenoid and connector assembly
- solenoid gasket
- park rod and E-clip
- switch valve and spring
- pressure adjusting screw bracket
- throttle valve lever manual lever

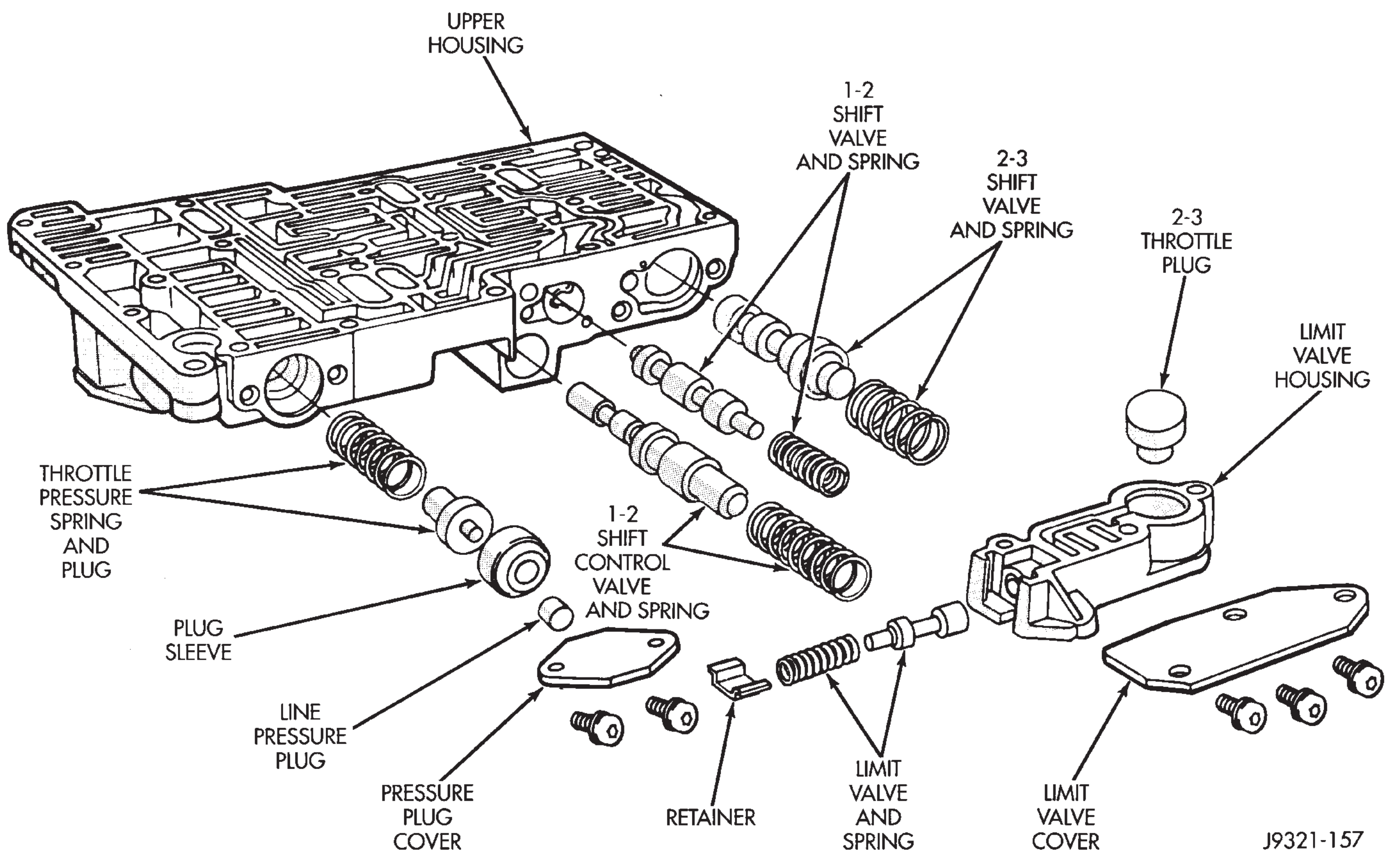


Fig. 115 Shift Valves And Pressure Plugs—46RH Upper Housing

- manual shaft seal, washer, and E-clip
- fluid filter
- detent ball and spring

The remaining valve body components are serviced only as part of a complete valve body assembly.

Clean the valve body components with a standard 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 dry or wipe off valve body components. Lint from these materials will stick 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 a sheet of crocus cloth. Position the crocus cloth on a surface plate, sheet of plate glass or equally flat surface. If distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CAUTION: Many of the valves and plugs, such as the throttle valve, shuttle valve plug, 1-2 shift valve and 1-2 governor plug, are made of coated aluminum (Fig. 118). Aluminum components are 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. This practice could 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. Minor surface scratches on steel valves or plugs can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.** Maintaining sharpness of these edges is vitally important. The edges prevent foreign matter from lodging between the valves and plugs and the bore.

Inspect all the valve and plug bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or

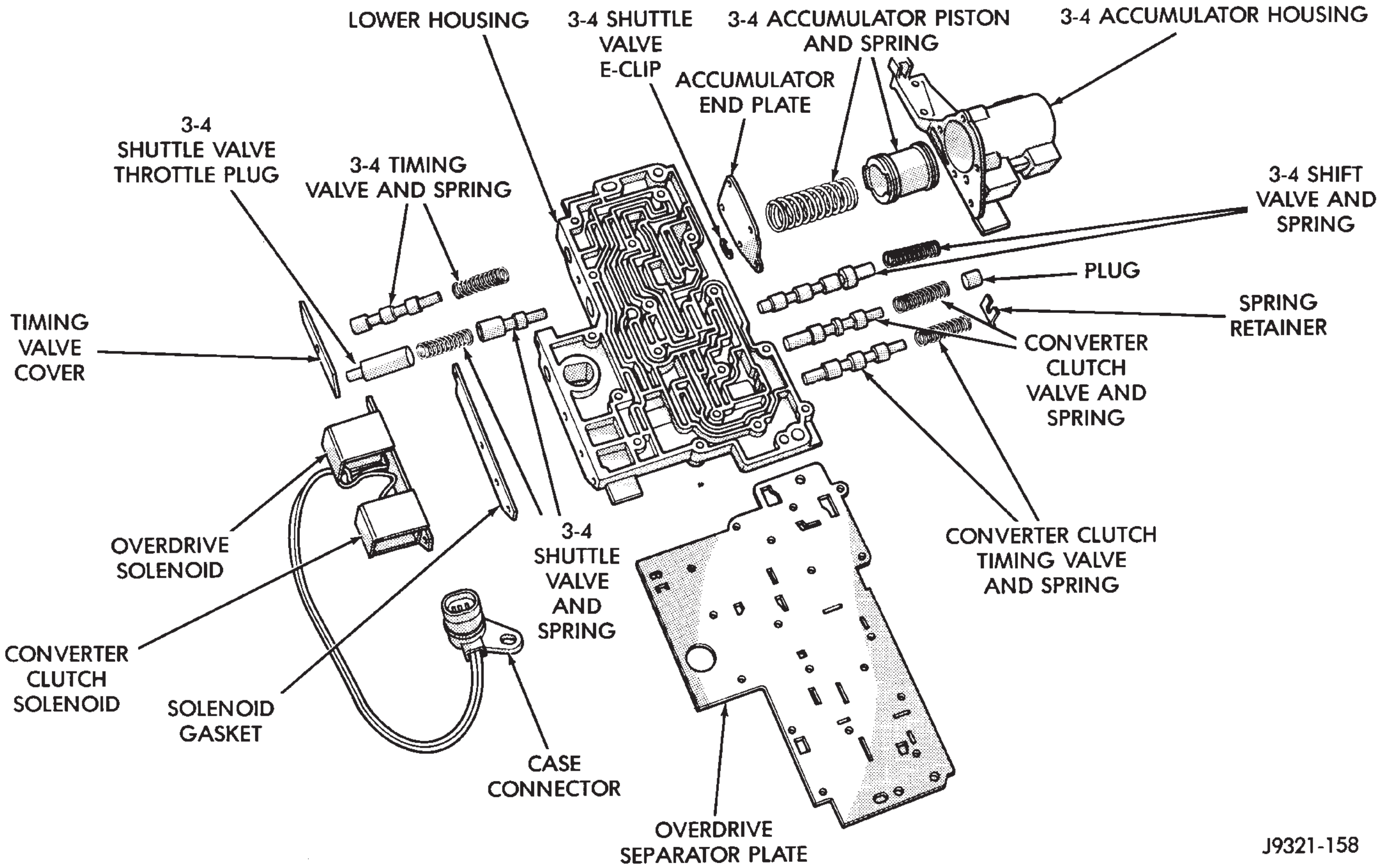


Fig. 116 Shift Valves And Springs—46RH Lower Housing

scored. Inspect all of the valve body springs. The springs must be free of distortion, warpage or broken coils.

Check the two separator plates for distortion or damage of any kind. Inspect the upper housing, lower housing, 3-4 accumulator housing, and transfer plate carefully. Be sure all fluid passages are clean and clear. Check condition of the upper housing and transfer plate check balls as well. The check balls and ball seats must not be worn or damaged.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores.

Valve body bores do not change dimensionally with use. If the valve body functioned correctly when new, it will continue to operate properly after cleaning and inspection. It should not be necessary to replace a valve body assembly unless it is damaged in handling.

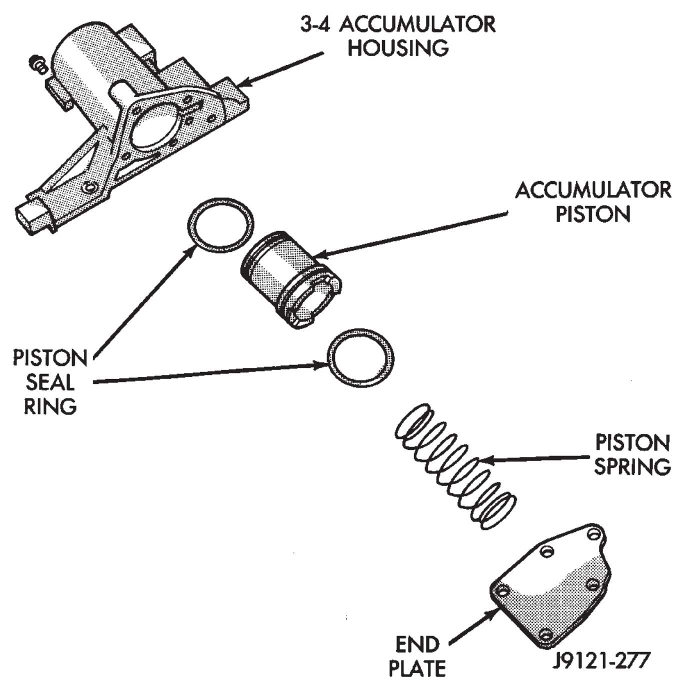


Fig. 117 3-4 Accumulator Housing Components—46RH

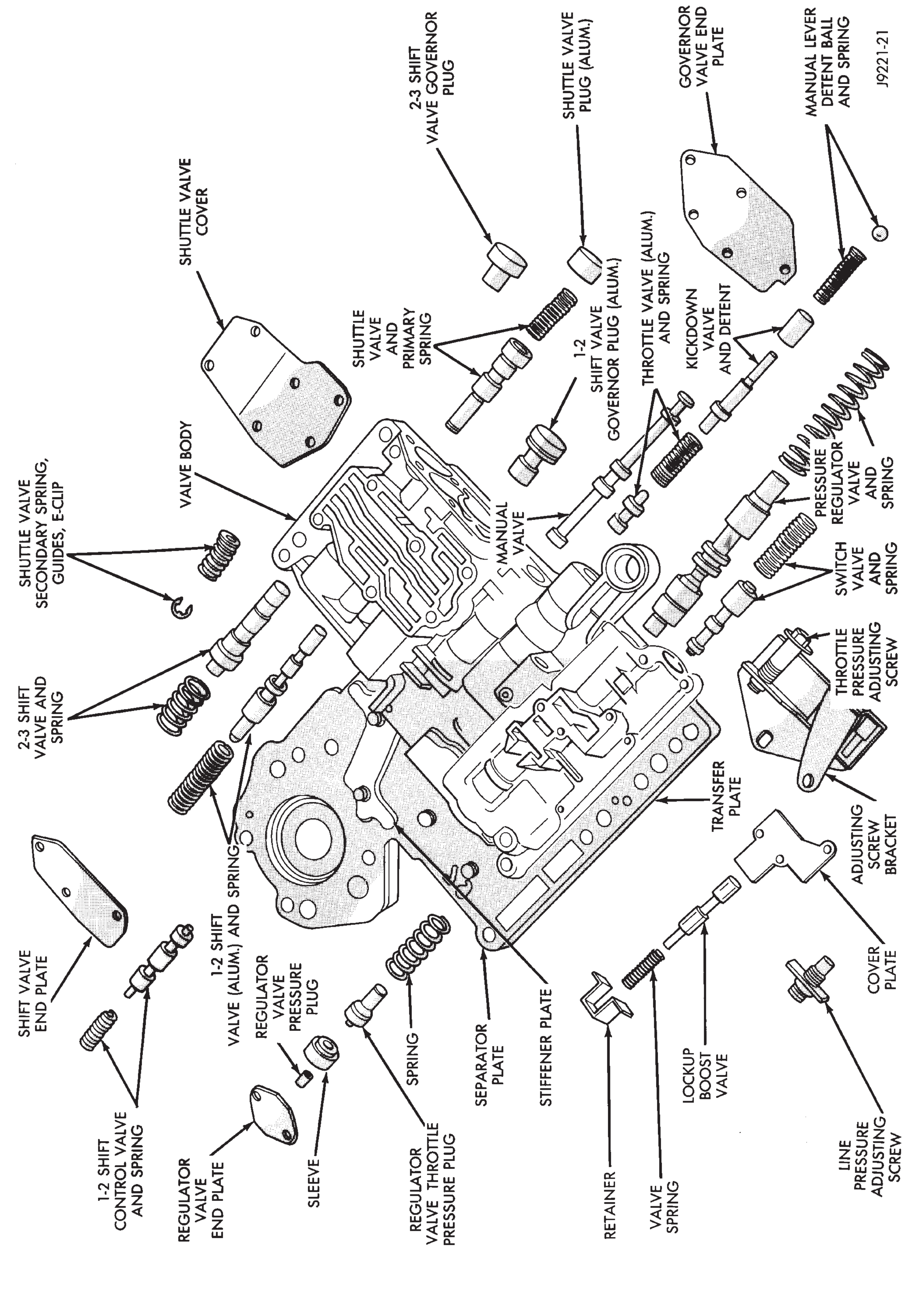


Fig. 118 Upper Housing Components—46RH Valve Body (Alum. Indicates Aluminum Part)

VALVE BODY REASSEMBLY

CAUTION: Do not force valves or plugs into place during reassembly. If the valve body bores, valves and plugs are free of distortion or burrs, the valve body components should all slide into place easily. In addition, do not overtighten the transfer plate and valve body screws during reassembly. Overtightening can distort the housings resulting in valve sticking, cross leakage and unsatisfactory operation. Tighten valve body screws to recommended torque only.

Lower Housing Assembly (Fig. 116)

(1) Lubricate valves, springs, and the housing valve and plug bores with Mopar ATF Plus, or Dexron II® transmission fluid.

(2) Install 3-4 timing valve spring and valve in lower housing.

(3) Install 3-4 shuttle valve in lower housing. Press valve inward and install E-clip on end of valve to secure it in housing.

(4) Install 3-4 shuttle valve spring and throttle plug in housing.

(5) Install timing valve end plate. Tighten end plate screws to 4 N●m (35 in. lbs.) torque.

(6) Install 3-4 shift valve and spring.

(7) Install converter clutch valve, spring and plug.

(8) Install converter clutch timing valve and spring.

3-4 Accumulator Assembly (Fig. 117)

(1) Lubricate accumulator piston, seals and housing piston bore with ATF Plus, or Dexron II®.

(2) Install new seal rings on accumulator piston.

(3) Install piston and spring in housing.

(4) Install end plate on housing.

Transfer Plate Assembly

(1) Install rear clutch check ball in transfer plate (Fig. 110).

(2) Install filter screen in upper housing separator plate (Fig. 109).

(3) Align and position upper housing separator plate on transfer plate (Fig. 109).

(4) Install brace plate (Fig. 108). Tighten brace attaching screws to 4 N●m (35 in. lbs.) torque.

(5) Install remaining separator plate attaching screws. Tighten screws to 4 N●m (35 in. lbs.) torque.

Assembling Upper And Lower Housings

(1) Position upper housing so internal passages and check ball seats are facing upward. Then install check balls in housing (Fig. 111). Seven check balls are used. The single large check ball is approximately 8.7 mm (11/32 in.) diameter. The remaining 6 check balls are approximately 6.3 mm (1/4 in.) in diameter.

(2) Position transfer plate assembly on upper housing (Fig. 119).

(3) Position lower housing separator plate on transfer plate (Fig. 119).

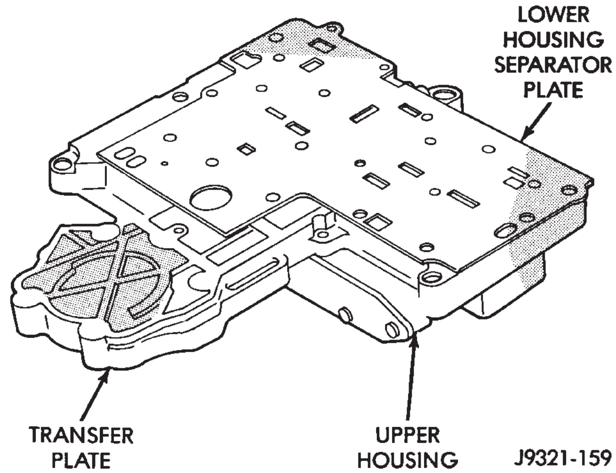


Fig. 119 Lower Housing Separator Plate Installation—46RH

(4) Install lower housing on assembled transfer plate and upper housing (Fig. 120).

(5) Install and start valve body screws by hand. Then tighten screws evenly to 4 N●m (35 in. lbs.) torque. Start at center and work out to sides when tightening screws.

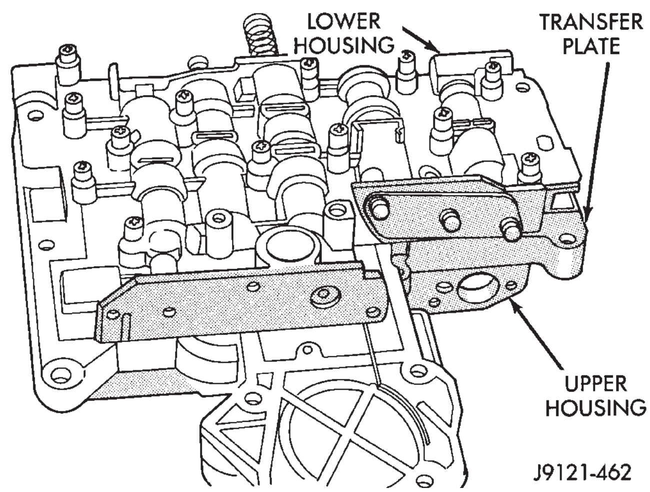


Fig. 120 Assembling Valve Body Upper And Lower Housings—46RH

Upper Housing Valve And Plug Installation (Figs. 114, 115, 118)

(1) Lubricate valves, plugs, springs with Mopar ATF Plus transmission fluid.

(2) Assemble regulator valve line pressure plug, sleeve, throttle plug and spring. Insert assembly in

upper housing and install cover plate. Tighten cover plate screws to 4 N•m (35 in. lbs.) torque.

(3) Install 1-2 and 2-3 shift valves and springs.

(4) Install 1-2 shift control valve and spring.

(5) Install shift valve cover plate.

(6) Install shuttle valve as follows:

(a) Insert plastic guides in shuttle valve secondary spring and install spring on end of valve.

(b) Hold shuttle valve in place.

(c) Compress secondary spring and install E-clip in groove at end of shuttle valve.

(d) Verify that spring and E-clip are properly seated before proceeding.

(7) Install shuttle valve cover plate. Tighten cover plate screws to 4 N•m (35 in. lbs.) torque.

(8) Install 1-2 and 2-3 valve governor plugs in valve body.

(9) Install shuttle valve primary spring and throttle plug.

(10) Align and install governor plug cover. Tighten cover screws to 4 N•m (35 in. lbs.) torque.

(11) Install manual valve.

(12) Install throttle valve and spring.

(13) Install kickdown valve and detent.

(14) Install regulator valve.

(15) Install switch valve.

Boost Valve Tube Installation

(1) Position valve body assembly so lower housing is facing upward (Fig. 121).

(2) Lubricate tube ends and housing ports with transmission fluid or petroleum jelly.

(3) Position tube behind tube brace (Fig. 121).

(4) Start tube in lower housing port first. Then swing tube downward and work opposite end of tube into upper housing port (Fig. 121).

(5) Seat each end of tube in housings.

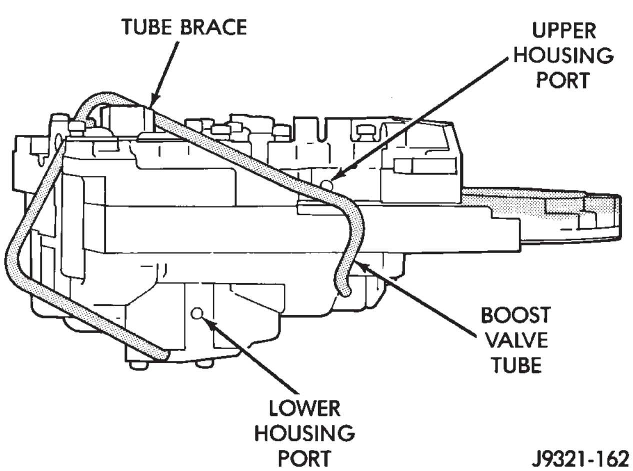


Fig. 121 Boost Valve Tube Installation—46RH

3-4 Accumulator Installation

(1) Position converter clutch valve and 3-4 shift valve springs in housing (Fig. 122).

(2) Loosely attach accumulator housing with right-side screw (Fig. 122). Install only one screw at this time as accumulator must be free to pivot upward for ease of installation.

(3) Position plug on end of converter clutch valve spring. Then compress and hold springs and plug in place with fingers of one hand.

(4) Swing accumulator housing upward over valve springs and plug.

(5) Hold accumulator housing firmly in place and install remaining two attaching screws. Be sure springs and clutch valve plug are properly seated (Fig. 123).

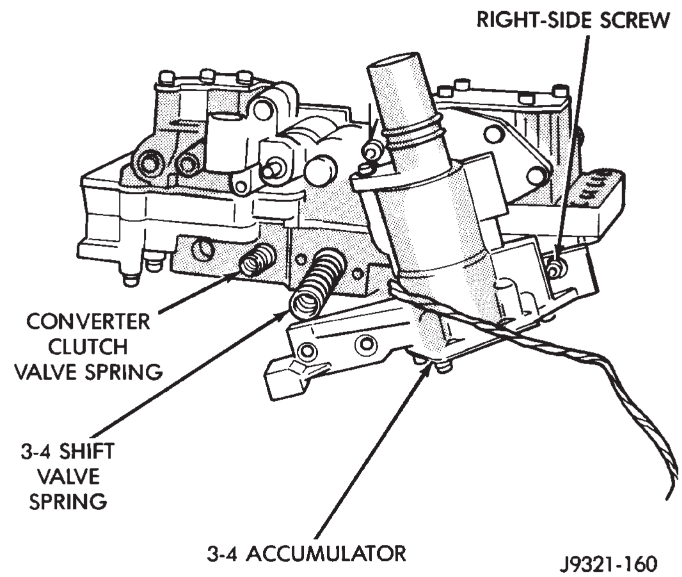


Fig. 122 Installing Converter Clutch And 3-4 Shift Valve Springs—46RH

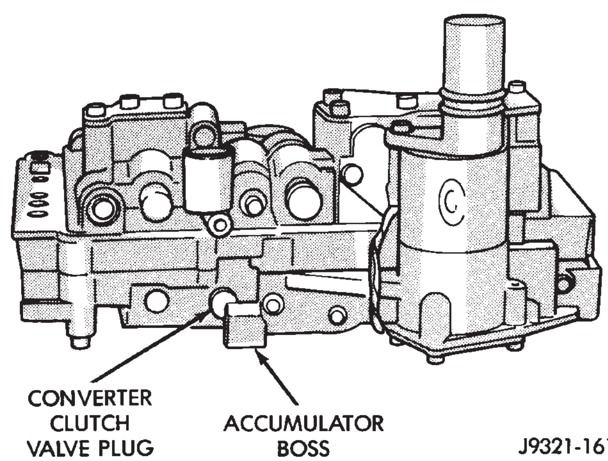


Fig. 123 Seating 3-4 Accumulator On Lower Housing—46RH

(6) Attach solenoid case connector to 3-4 accumulator with shoulder-type screw. Connector has small locating tang that fits in dimple at top of accumulator housing (Fig. 124). Seat tang in dimple before tightening connector screw.

(7) Install solenoid assembly and gasket. Tighten solenoid attaching screws to 8 N●m (72 in. lbs.) torque.

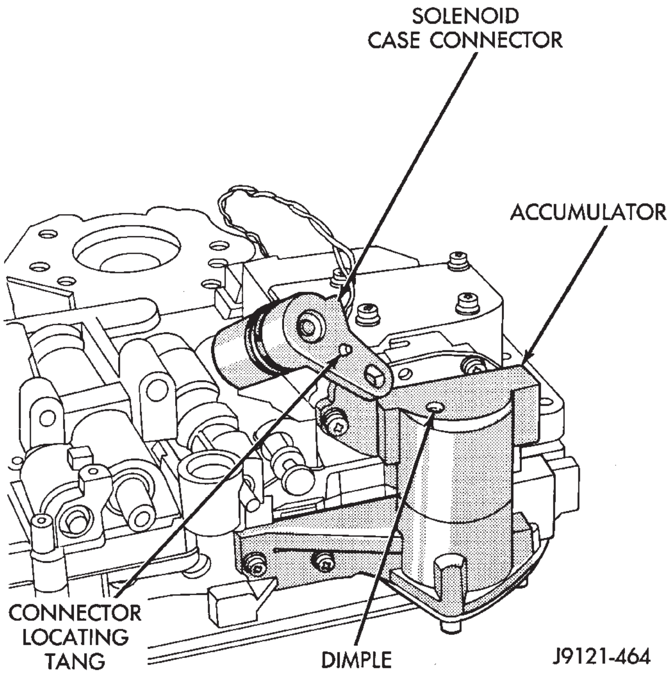


Fig. 124 Solenoid Connector Installation—46RH

(8) Verify that solenoid wires are properly routed (Fig. 125). **Solenoid wires must be clear of rear band lever, manual lever and park rod.**

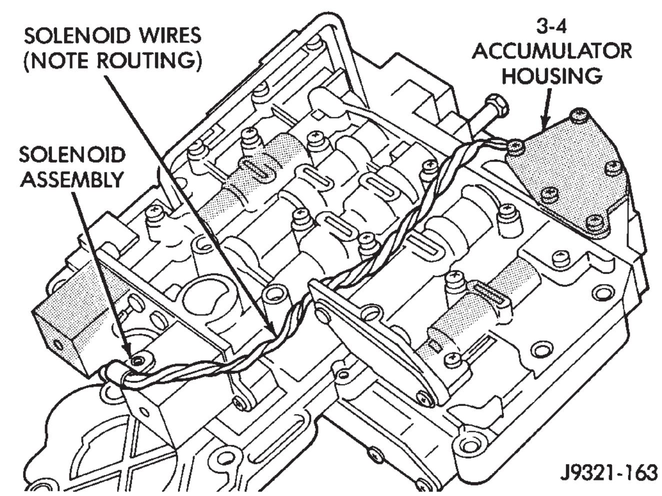


Fig. 125 Solenoid Wire Routing—46RH

Valve Body Final Assembly And Adjustment

(1) Insert manual lever detent spring in upper housing.

(2) Position line pressure adjusting screw in adjusting screw bracket.

(3) Install spring on end of line pressure regulator valve.

(4) Install switch valve spring on tang at end of adjusting screw bracket.

(5) 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.

(6) Install throttle lever in upper housing. Then install manual lever over throttle lever and start manual lever into housing.

(7) Position detent ball on end of spring. Then hold detent ball and spring in detent housing with Retainer Tool 6583 (Fig. 92).

(8) Align manual lever with detent ball and manual valve. Hold throttle lever upward. Then press down on manual lever until fully seated. Remove detent ball retainer tool after lever is seated.

(9) Then Install manual lever seal, washer and E-clip.

(10) Lubricate solenoid case connector O-rings and shaft of manual lever with light coat of petroleum jelly.

(11) Verify that throttle lever is aligned with end of kickdown valve stem and that manual lever arm is engaged in manual valve (Fig. 126).

(12) Install boost valve, valve spring, retainer and cover plate. Tighten cover plate screws to 4 N●m (35 in. lbs.) torque.

(13) Obtain new fluid filter for valve body but do not install filter at this time.

(14) If line pressure and/or throttle pressure adjustment screw settings were not disturbed, continue with overhaul or reassembly. However, if adjustment screw settings **were** moved or changed, readjust as described in Valve Body Control Pressure Adjustment procedure.

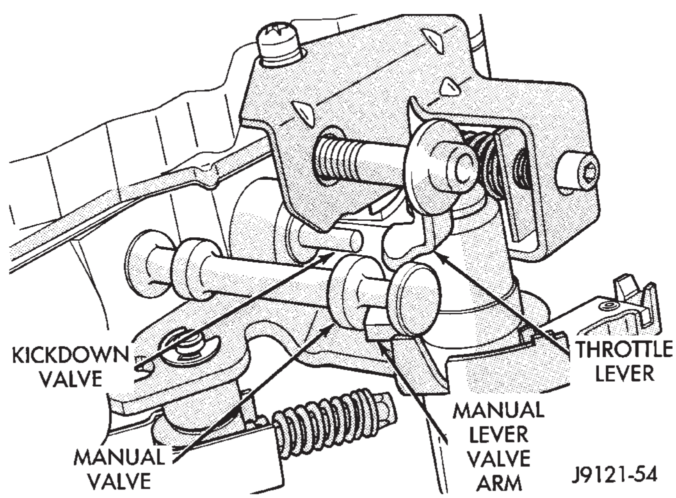


Fig. 126 Manual And Throttle Lever Alignment

VALVE BODY CONTROL PRESSURE ADJUSTMENTS

There are two control pressure adjustments on the valve body which are, line pressure and throttle pressure.

Line and throttle pressures are interdependent because each affects shift quality and timing. As a result, both adjustments must be performed properly and in the correct sequence. Adjust line pressure first and throttle pressure last.

Line Pressure Adjustment

Measure distance from the valve body to the inner edge of the adjusting screw with an accurate steel scale (Fig. 127).

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. Manufacturing tolerances may make it necessary to vary from this dimension to obtain desired pressure.

One complete turn of the adjusting screw changes line pressure approximately 1-2/3 psi (9 kPa).

Turning the adjusting screw counterclockwise increases pressure while turning the screw clockwise decreases pressure.

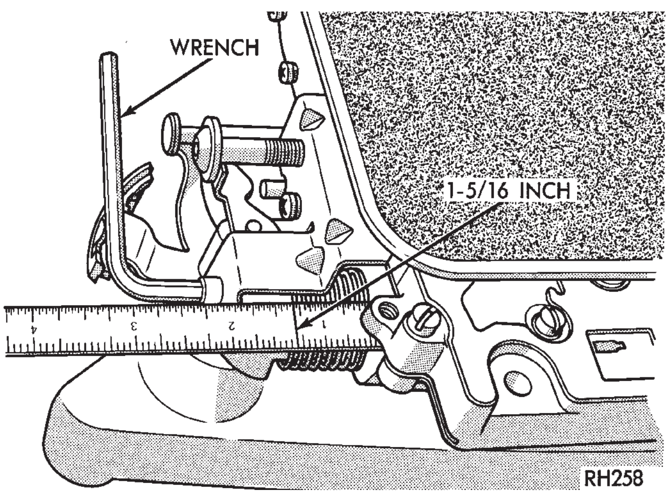


Fig. 127 Line Pressure Adjustment

Throttle Pressure Adjustment

Insert Gauge Tool C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 128).

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.

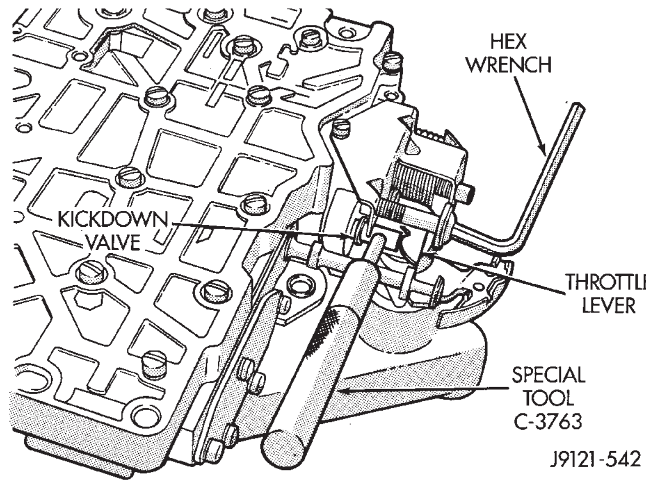


Fig. 128 Throttle Pressure Adjustment

TRANSMISSION ASSEMBLY

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 reassembly operations are equally clean.

Shop towels used for wiping off tools and your hands must be made from **lint free** materials. Lint will stick to transmission parts and could interfere with valve operation or even restrict fluid passages.

Lubricate transmission clutch and gear components with Mopar ATF Plus or Dexron II™ during reassembly. Soak clutch discs in transmission fluid before installation.

Use Ru-Glyde, Door-Eze, or petroleum jelly 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 part. These types of lubricants can eventually block or restrict fluid passages and valve operation. Use petroleum jelly only.

Do not force parts into place. The transmission components and sub-assemblies are easily installed by hand when properly aligned. If a part seems difficult to install, it is either misaligned or incorrectly assembled. Verify that thrust washers, thrust plates and seal rings are correctly positioned. These parts will prevent proper assembly is mispositioned (or "left out" by accident).

The planetary geartrain, front/rear clutch assemblies and oil pump are all much easier to install when the transmission case is upright or as close to this position as possible. Either tilt the case upward with wood blocks, or cut a hole in the bench large enough for the output shaft and rear support. Then lower the shaft and support into the hole and support the rear of the case directly on the bench.

TRANSMISSION ASSEMBLY PROCEDURE

(1) Lubricate rear servo piston seal with petroleum jelly, or Door Eze. Lubricate servo bore in case with transmission fluid.

(2) Install rear servo piston in case. Position piston at slight angle to bore and insert piston with twisting motion (Fig. 129).

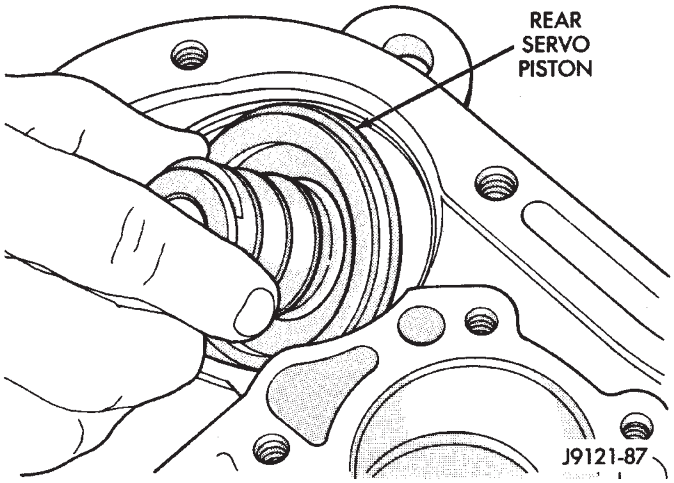


Fig. 129 Installing Rear Servo Piston—46RH

(3) Install rear servo spring and retainer in case bore (Fig. 130). Be sure spring is seated on piston.

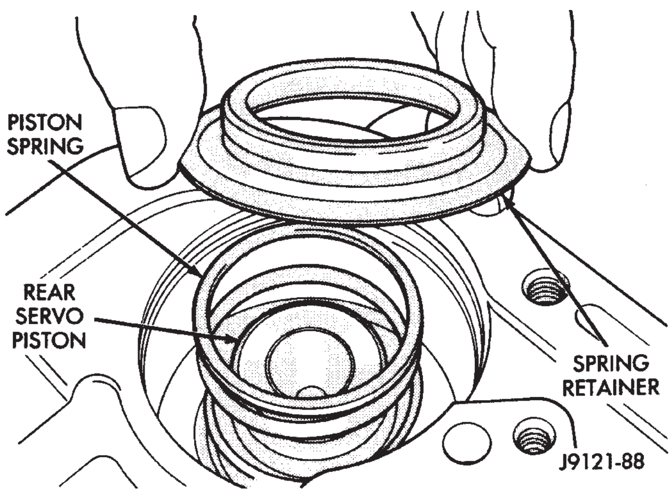


Fig. 130 Installing Rear Servo Piston Spring And Retainer—46RH

(4) Compress rear servo piston with C-clamp or Valve Spring Compressor C-3422-B and install servo piston snap ring (Fig. 131).

(5) Install new gasket at rear of transmission case. Use petroleum jelly to hold gasket in place. **Be sure to align governor feed holes in gasket with feed passages in case (Fig. 132). Install gasket before**

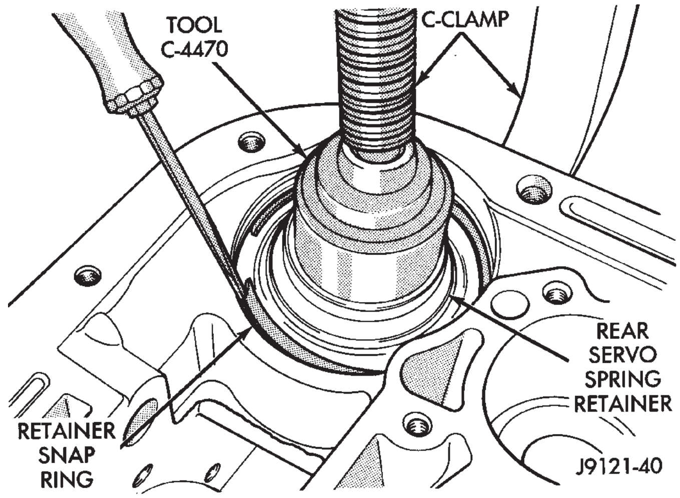


Fig. 131 Installing Rear Servo Snap Ring—46RH

overdrive piston retainer. Center hole in gasket is smaller than retainer and cannot be installed over retainer.

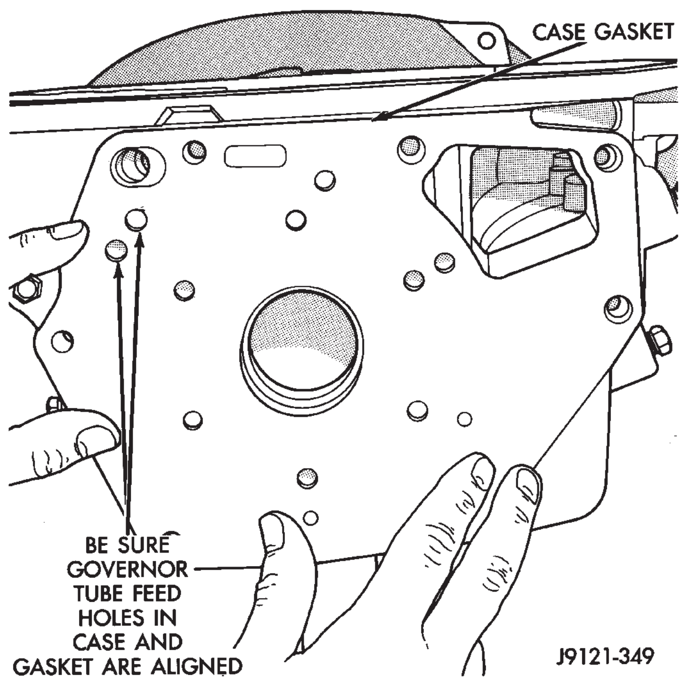


Fig. 132 Installing Case Gasket—46RH

(6) Install overdrive piston retainer. Be sure governor tube bores in retainer are aligned with governor feed passages in gasket and case (Fig. 133). Install and tighten retainer bolts to 17 N●m (13 ft. lbs.) torque.

(7) Install overrunning clutch components if not yet installed. Refer to Overrunning Clutch Overhaul in this section if necessary.

(8) Position rear band and link in case (Fig. 134). **Be sure notched side of link faces away from band.**

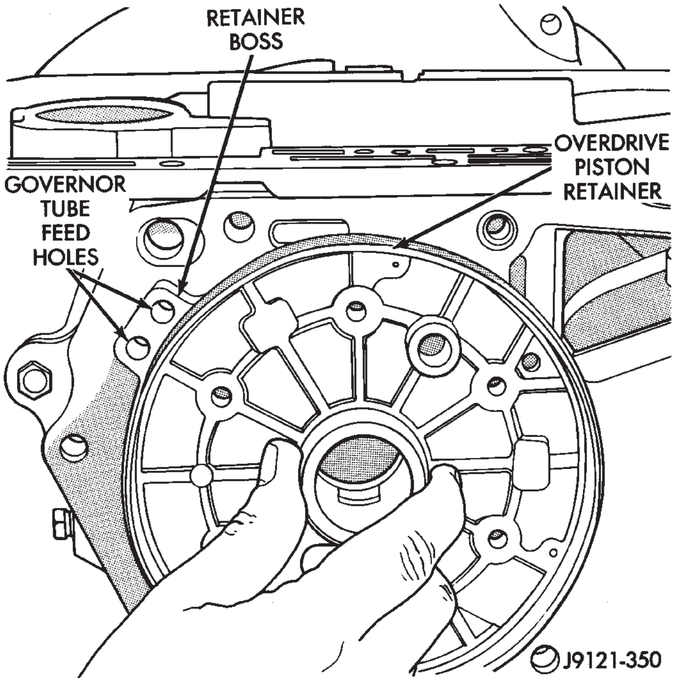


Fig. 133 Installing Overdrive Piston Retainer—46RH

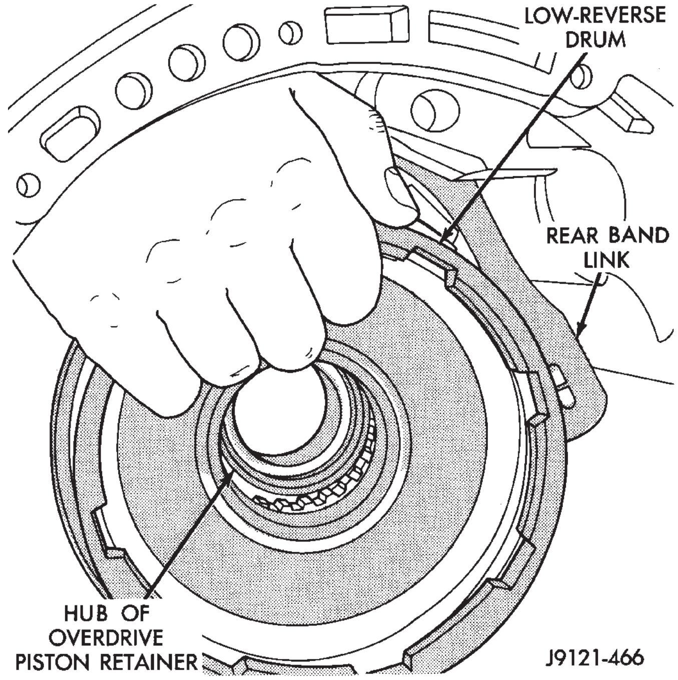


Fig. 135 Installing Low-Reverse Drum—46RH

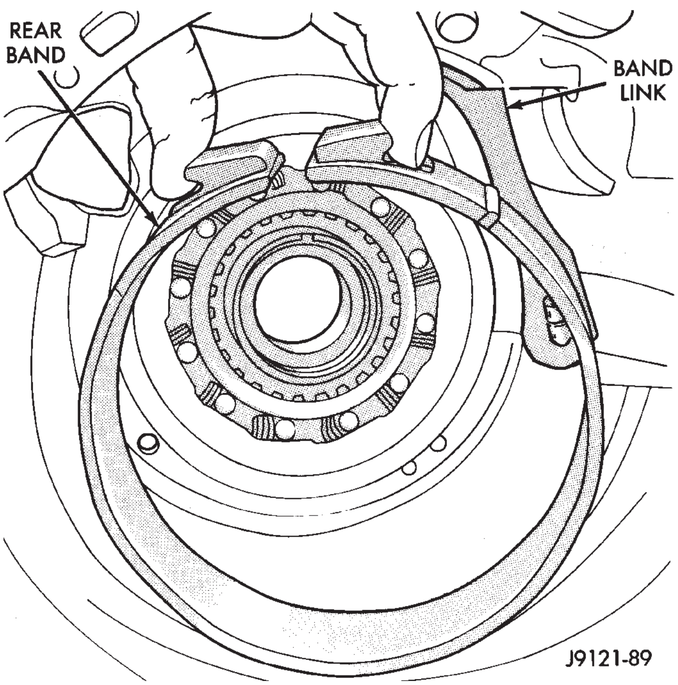


Fig. 134 Installing Rear Band And Link—46RH

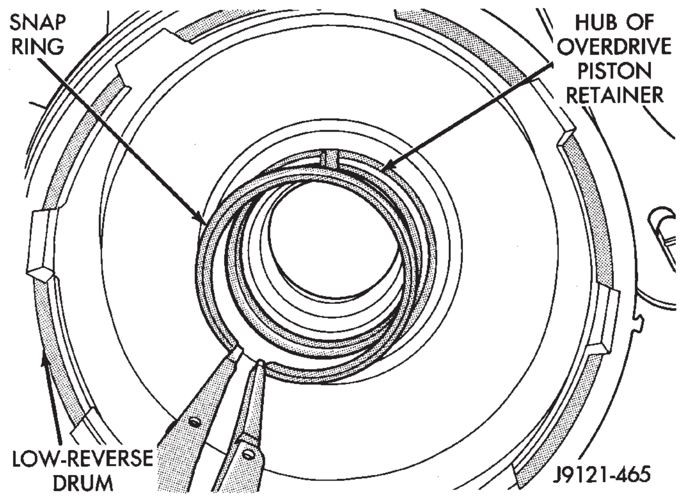


Fig. 136 Installing Low-Reverse Drum Snap Ring—46RH

(9) Install low-reverse drum (Fig. 135). Slide drum through rear band, onto rear support hub and into engagement with overrunning clutch race.

(10) Install snap ring that secures low-reverse drum to rear support hub (Fig. 136).

(11) Insert band reaction pin part way case and band link (Fig. 137).

(12) Install rear band adjusting lever, strut and reaction lever (Fig. 138). Be sure levers and strut are aligned and engaged before seating band reaction pin in case.

(13) Lubricate front servo piston components and servo bore in case with transmission fluid.

(14) Install front servo piston in bore. Carefully work small, suitable tool around piston ring to press it back into groove and ease installation (Fig. 139). Rotate piston into bore at same time. Rock piston slightly to ease piston ring past snap ring groove and into bore.

(15) Bottom front servo piston in bore and install servo spring.

(16) Install front servo piston rod guide as follows:

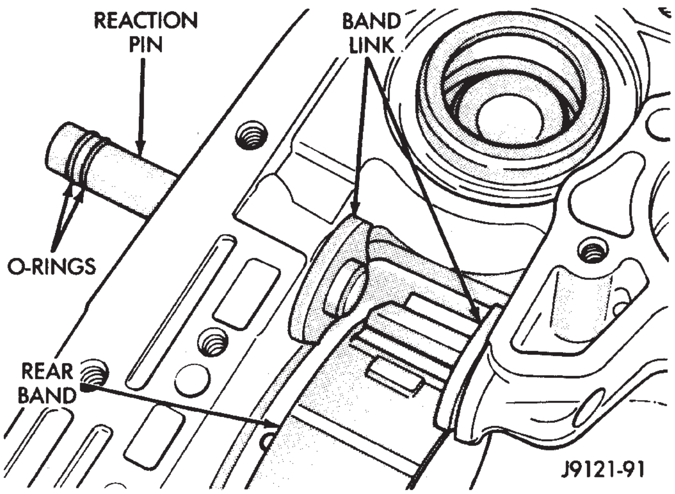


Fig. 137 Installing Rear Band Reaction Pin—46RH

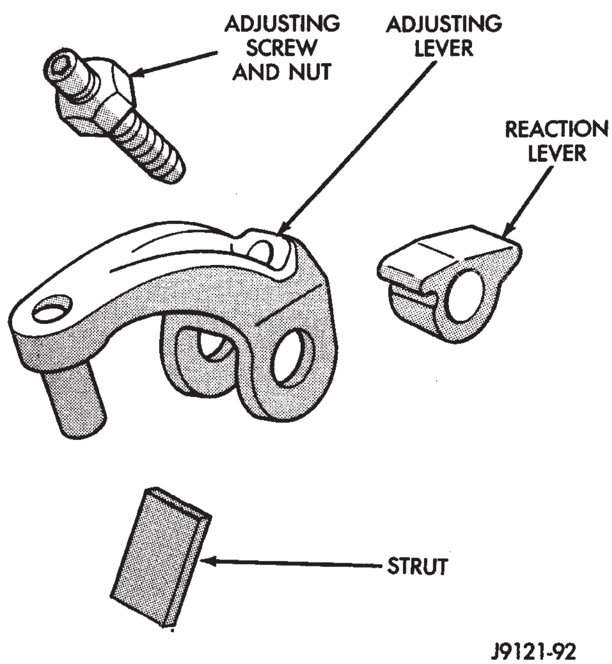


Fig. 138 Rear Band Levers And Strut—46RH

(a) Place Tool SP-5560 (or similar size tool) on guide and position C-clamp on tool and case (Fig. 140).

(b) Slowly compress rod guide while simultaneously easing seal ring into bore with suitable tool.

(17) Install rod guide snap ring (Fig. 140).

(18) Position front band lever in case and over servo rod guide. Then install front band lever pin in case and slide it through lever.

(19) Coat threads of front band lever pin access plug with sealer and install it in case. Tighten plug to 17 N•m (13 ft. lbs.) torque.

(20) Install assembled output shaft and planetary gear components (Fig. 141). **Support shaft carefully during installation. Do not allow shaft bearing/bushing surfaces to become nicked or scratched.**

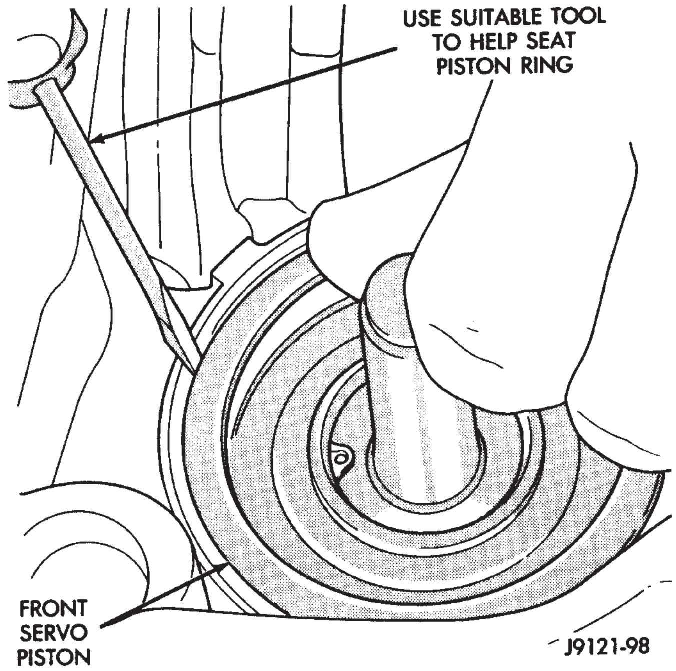


Fig. 139 Installing Front Servo Piston—46RH

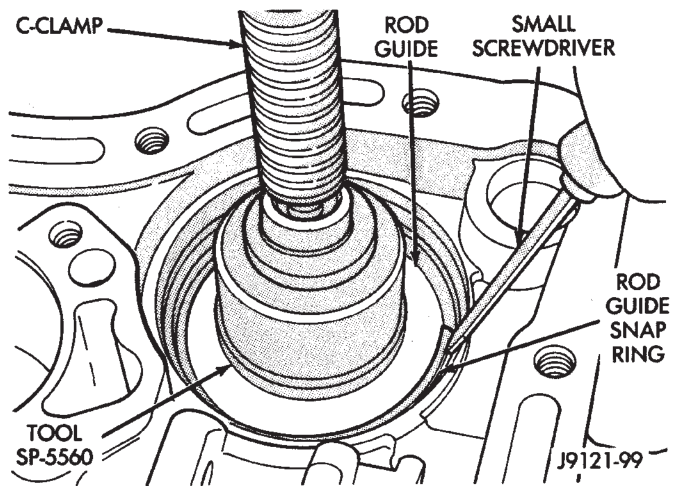


Fig. 140 Installing Front Servo Rod Guide And Snap Ring—46RH

(21) Lubricate intermediate shaft thrust plate with petroleum jelly and install plate on shaft pilot hub (Fig. 142).

(22) Check input shaft front seal rings, fiber thrust washer and rear seal ring (Fig. 143). Be ends of rear seal ring are hooked together and diagonal cut ends of front seal rings are firmly seated against each other as shown. Lubricate seal rings with petroleum jelly after checking them.

(23) Assemble front and rear clutches (Fig. 144). Align lugs on front clutch discs. Mount front clutch

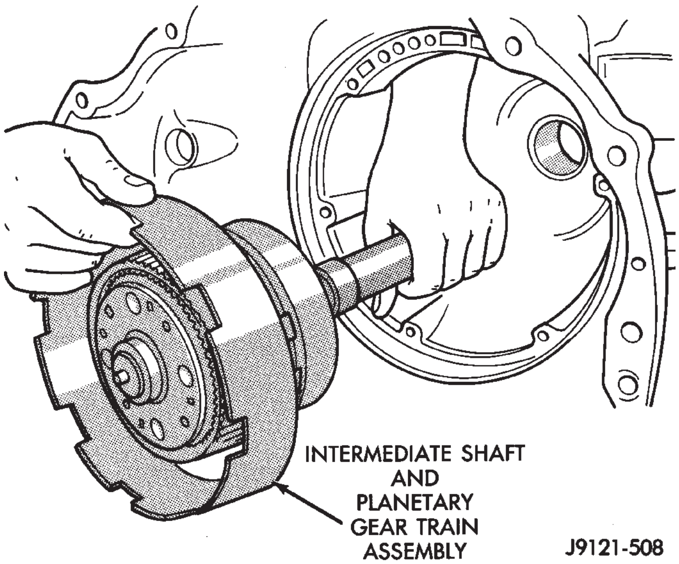


Fig. 141 Installing Intermediate Shaft And Planetary Geartrain—46RH

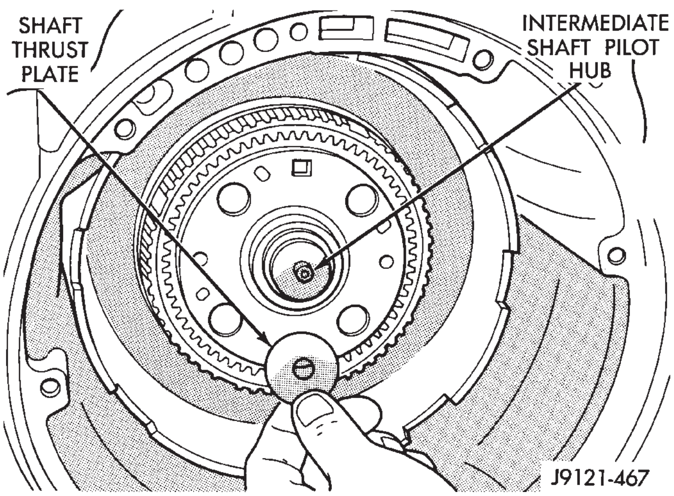


Fig. 142 Installing Intermediate Shaft Thrust Plate—46RH

on rear clutch. Turn front clutch retainer back and forth until front clutch discs are fully seated on rear clutch splined hub.

(24) Install intermediate shaft thrust washer in hub of rear clutch retainer (Fig. 145). Use petroleum jelly to hold washer in place. Position washer so grooves are facing outward. **Washer only fits one way in clutch retainer hub.**

(25) Place transmission case in upright position, or place blocks under front end of transmission repair stand to tilt case rearward. This makes it easier to install front/rear clutch assembly.

(26) Align discs in rear clutch. Then install and engage assembly in front planetary and driving shell (Fig. 146). Turn clutch retainers back and forth until both clutches are seated.

(27) Slide front band over front clutch retainer and install front band strut and anchor (Fig. 147).

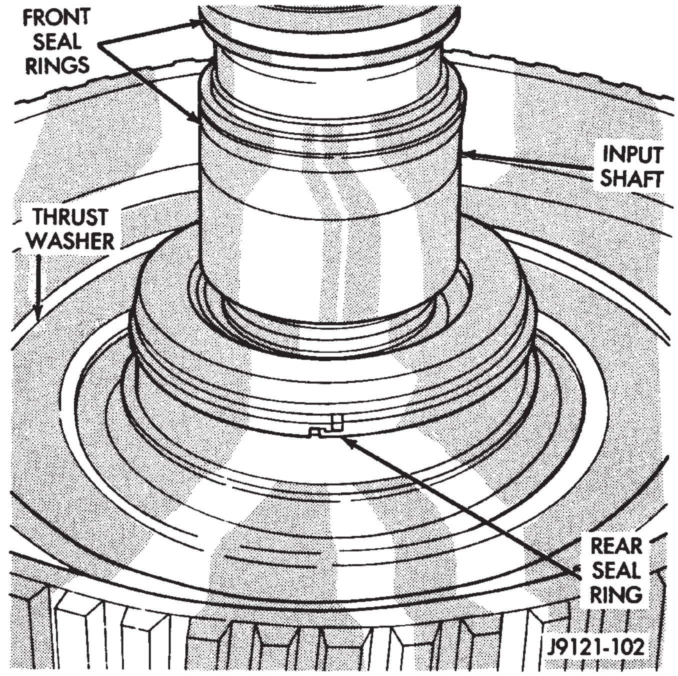


Fig. 143 Input Shaft Seal Ring And Thrust Washer Installation—46RH

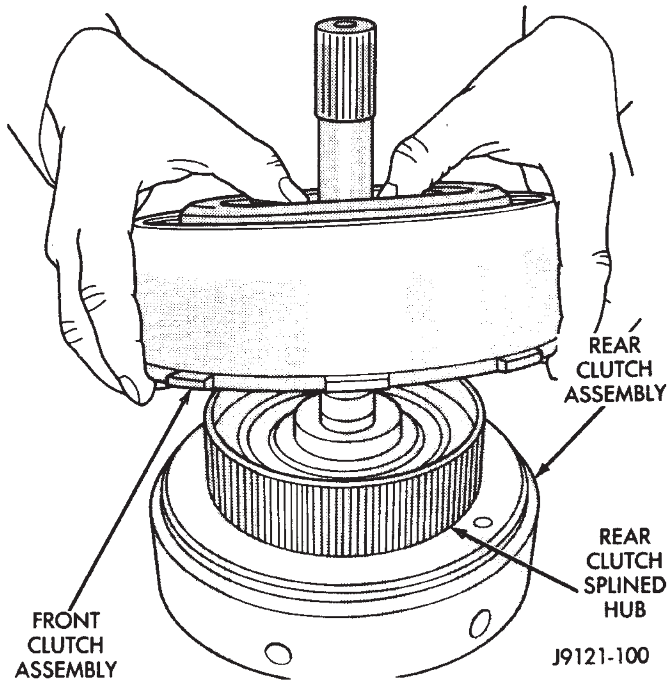


Fig. 144 Assembling Front And Rear Clutches—46RH

(28) Tighten front band adjusting screw until band is tight on clutch retainer. Verify that front/rear clutch assembly is still properly seated **before** tightening band.

(29) Install oil pump Pilot Studs C-3288-B in case (Fig. 148).

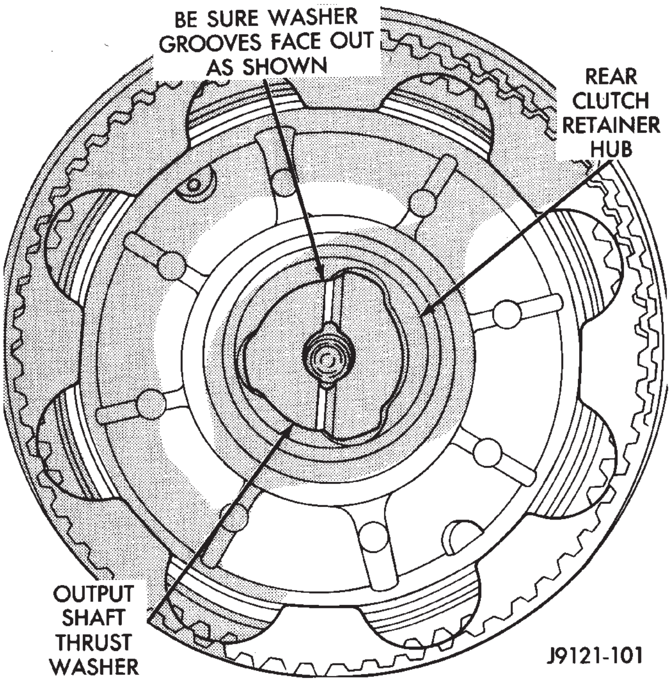


Fig. 145 Installing Intermediate Shaft Thrust Washer—46RH

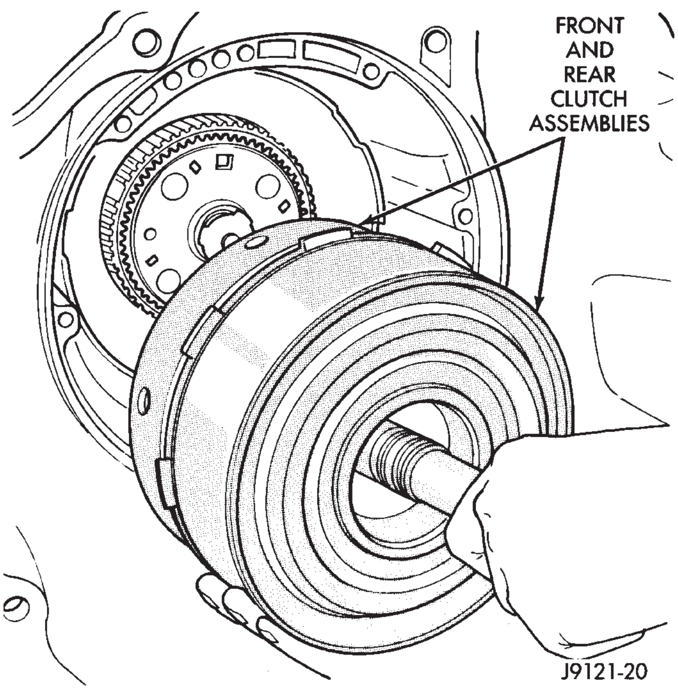


Fig. 146 Installing Front/Rear Clutch Assemblies—46RH

(30) Install new oil pump gasket on pilot studs and seat it in case. Be sure gasket is properly aligned with fluid passages in case (Fig. 148).

(31) Check seal rings on reaction shaft support. Be sure rings are hooked together correctly. Also be sure fiber thrust washer is in position (Fig. 149). Use petroleum jelly to hold washer in place if necessary.

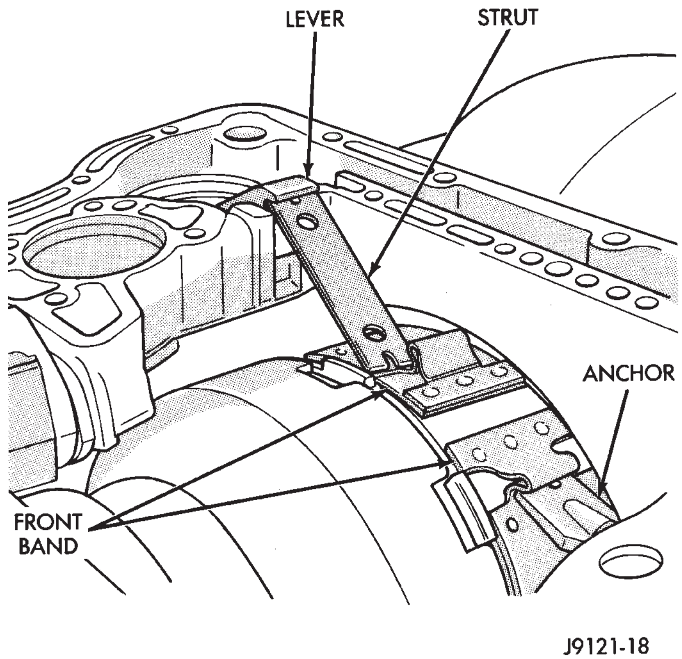


Fig. 147 Front Band And Linkage Installation—46RH

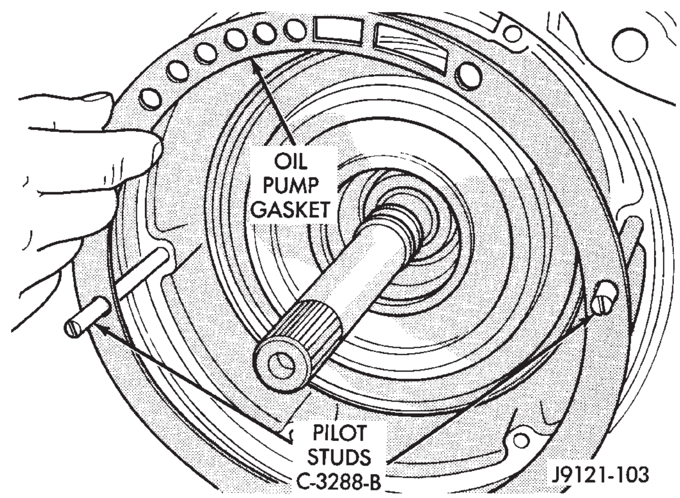


Fig. 148 Installing Oil Pump Gasket And Pilot Studs—46RH

(32) Lubricate oil pump seals with petroleum jelly or transmission fluid.

(33) Mount oil pump on pilot studs and slide pump into case opening (Fig. 150). **Work pump into case by hand. Do not use a mallet or similar tools to seat pump.**

(34) Remove pilot studs and install oil pump bolts. Tighten pump bolts alternately and evenly to fully seat pump in case. Then final-tighten pump bolts to 20 N●m (15 ft. lbs.) torque.

(35) Verify correct assembly. Rotate input and output shafts and check for bind. If bind exists, components are either misassembled, or not seated. Disassemble and correct as necessary before proceeding.

(36) Check input shaft end play as follows:

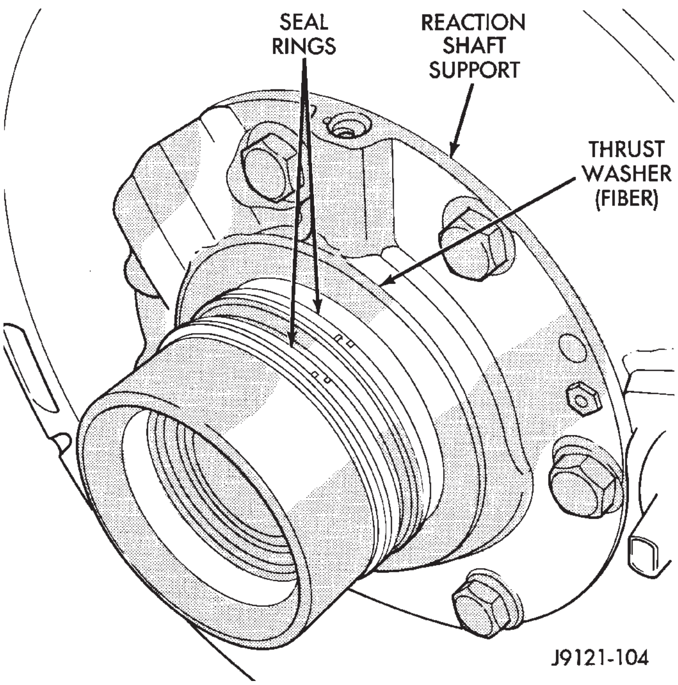


Fig. 149 Reaction Shaft Seal Ring And Thrust Washer Installation—46RH

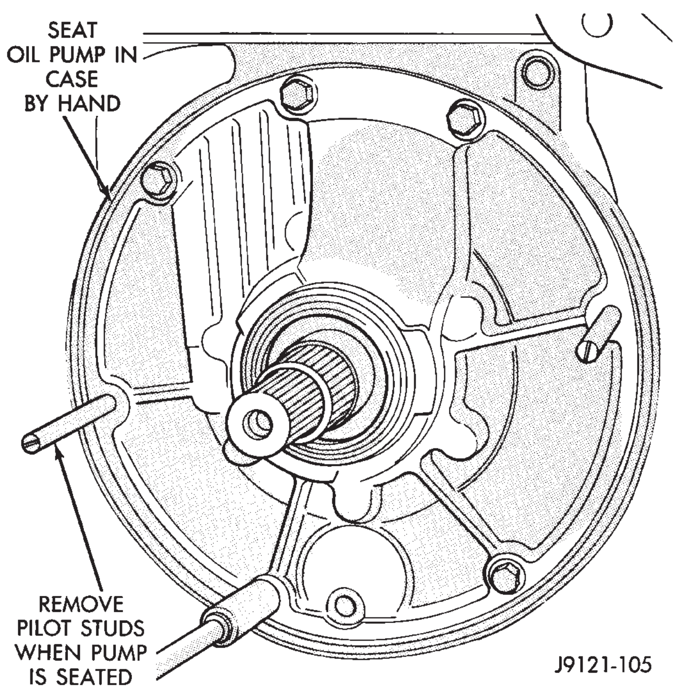


Fig. 150 Oil Pump Installation—46RH

(a) Attach dial indicator to converter housing (Fig. 151). Position indicator plunger against input shaft and zero indicator.

(b) Move input shaft in and out and record reading.

(c) End play should be 0.86 - 2.13 mm (0.034 - 0.084 in.).

(d) If end play is incorrect, change output shaft thrust washer, thrust plate, or front clutch thrust washer.

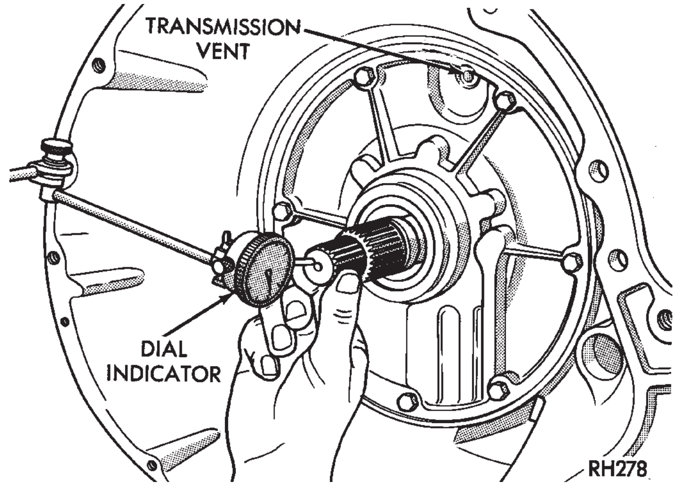


Fig. 151 Checking Input Shaft End Play

(37) Install new seals on overdrive piston. Then lubricate seals with transmission fluid, Ru-Glyde, Door-Eze or petroleum jelly.

(38) Install overdrive piston in retainer. **Align locating lugs on piston in locating bores in retainer** (Fig. 152). Use thin plastic strip or feeler gauge to help guide piston outer seal into retainer.

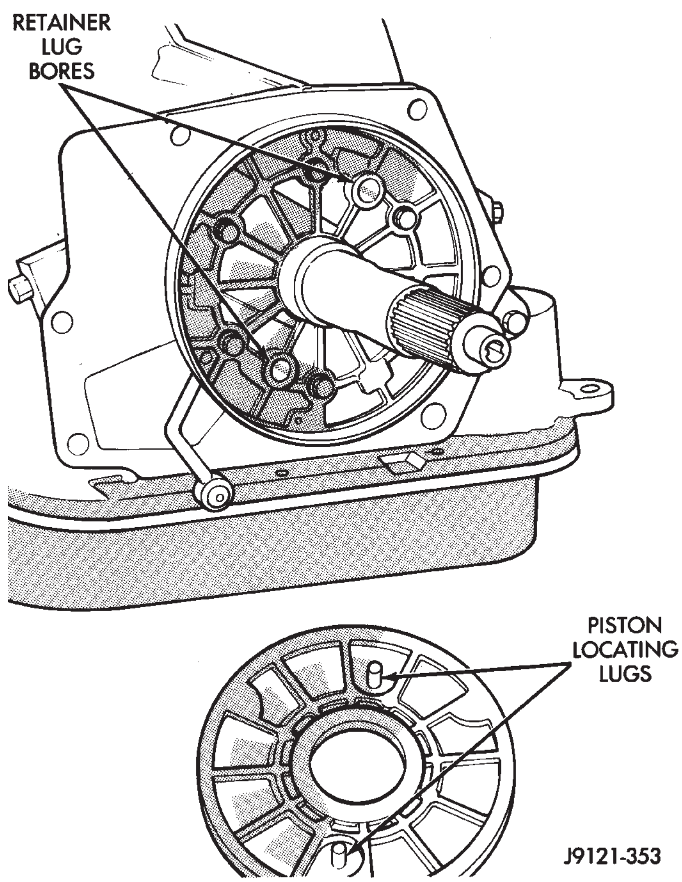


Fig. 152 Overdrive Piston Alignment

(39) Install spacer on intermediate shaft, if not previously installed.

(40) Install overdrive piston thrust plate (Fig. 153). Use liberal quantity of petroleum jelly to hold thrust plate in position on piston.

(41) Install overdrive piston thrust bearing in direct clutch hub (Fig. 154). Use liberal quantity of petroleum jelly to hold thrust bearing in place. **Note that one side of bearing has dark coated surface. This surface faces overdrive piston. Also be sure raised shoulder on inside diameter of bearing faces forward as well.**

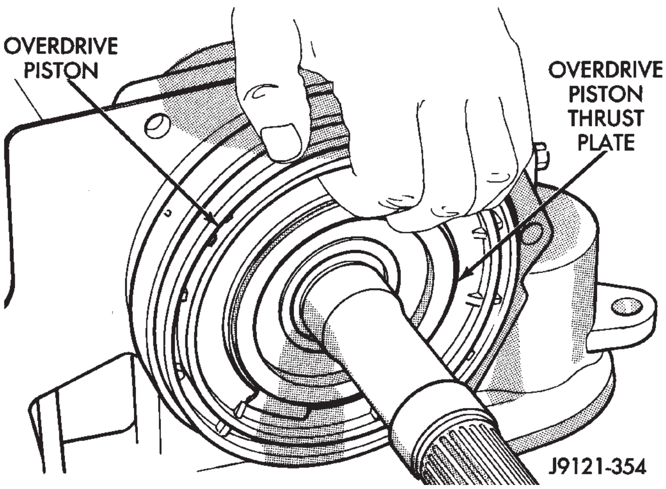


Fig. 153 Installing Overdrive Piston Thrust Plate

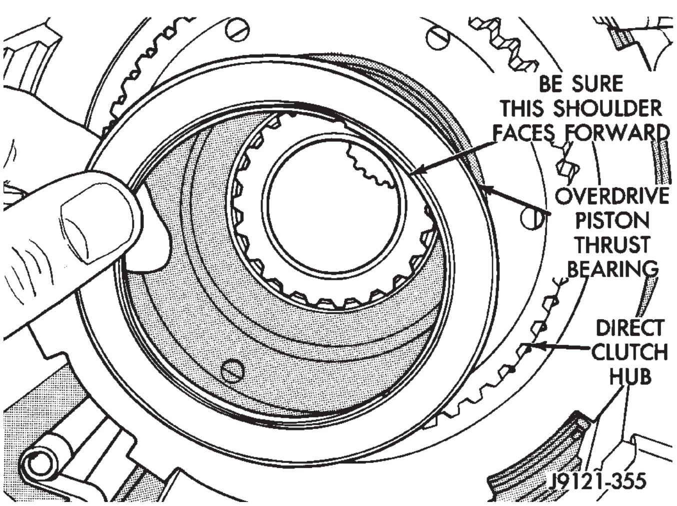


Fig. 154 Installing Overdrive Piston Thrust Bearing

(42) Apply small amount of petroleum jelly to pilot hub of intermediate shaft.

(43) Verify alignment of splines in overdrive unit planetary gear and overrunning clutch. Be sure Alignment Tool 6227-2 is fully seated (Fig. 155). **If planetary gear and overrunning clutch splines become misaligned, overdrive unit cannot be fully installed on intermediate shaft. Overdrive unit will have to be disassembled in order to realign splines.**

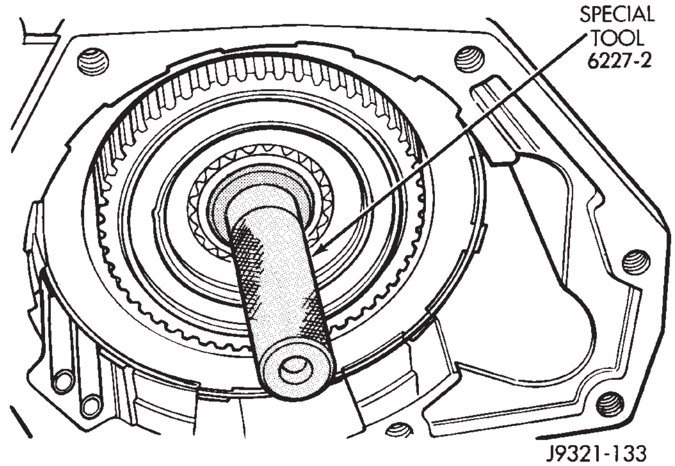


Fig. 155 Checking Alignment Of Overdrive Planetary Gear And Overrunning Clutch Splines—46RH

(44) Carefully withdraw alignment tool from overdrive unit.

(45) Lubricate intermediate shaft splines and bushing surfaces with transmission fluid or petroleum jelly.

(46) Install overdrive unit. Be sure governor tubes are aligned with feed holes in piston retainer boss. Intermediate shaft is snug fit in overdrive planetary gear and overrunning clutch. If overdrive unit will not seat fully, rotate overdrive output shaft slightly to align splines and try again.

(47) Apply 1-2 drops of Mopar thread adhesive (or Loctite 242) to overdrive unit attaching bolts. Then install and tighten bolts to 34 N• (25 ft. lbs.) torque.

(48) Install accumulator inner spring, piston and outer spring (Fig. 156).

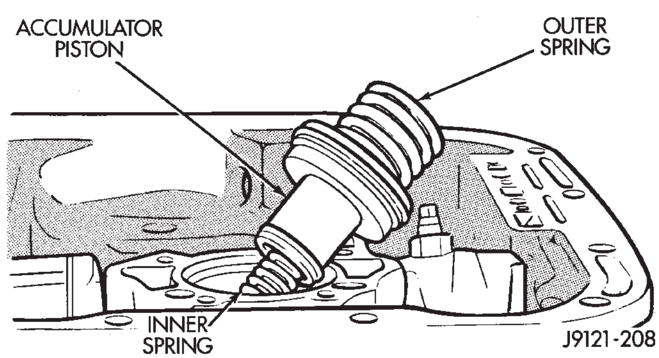


Fig. 156 Installing Accumulator Piston And Springs

(49) Verify that park/neutral position switch has **not** been installed in case. Valve body can not be installed if switch is in position.

(50) Install valve body as follows:

(a) Start park rod into park pawl. If rod will not slide past park pawl, pawl is engaged in park gear. Rotate overdrive output shaft with socket to free pawl and allow rod to engage.

(b) Align and seat valve body on case. Be sure manual lever shaft and overdrive connector are fully seated in case.

(c) Install and start all valve body attaching bolts by hand. Then tighten bolts evenly, in a diagonal pattern to 12 N●m (105 in. lbs.) torque. **Do not overtighten valve body bolts. This could result in distortion and cross leakage after installation.**.

(51) Install new filter on valve body. Tighten filter screws to 4 N●m (35 in. lbs.).

(52) Install seal on park/neutral position switch (Fig. 157). Then install and tighten switch to 34 N●m (25 ft. lbs.).

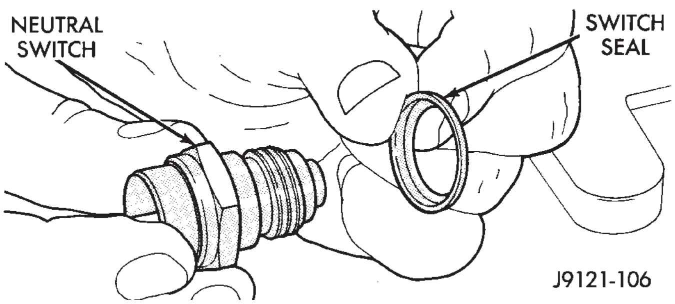


Fig. 157 Park/Neutral Position Switch Seal Position

(53) Adjust front and rear bands as follows:

(a) Loosen locknut on each band adjusting screw 4-5 turns.

(b) Tighten both adjusting screws to 8 N●m (72 in. lbs.).

(c) Back off front band adjusting screw 2-1/2 turns.

(d) Back off rear band adjusting screw 2 turns.

(e) Hold each adjusting screw in position and tighten locknuts to 34 N●m (25 ft. lbs.) torque.

(54) Install magnet in oil pan. Magnet goes on small protrusion at corner of pan.

(55) Position new oil pan gasket on case and install oil pan. Tighten pan bolts to 17 N●m (13 ft. lbs.).

(56) Install new valve body manual shaft seal in case (Fig. 158). Lubricate seal lip and manual shaft with petroleum jelly. Start seal over shaft and into case. Seat seal with 15/16 inch, deep well socket.

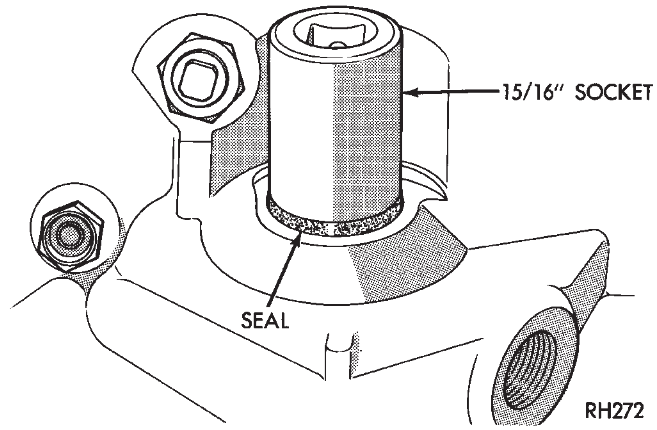


Fig. 158 Installing Manual Lever Shaft Seal

(57) Install throttle valve and shift selector levers on valve body manual lever shaft.

(58) Cap or cover transmission openings (cooler line fittings, filler tube bore, etc.) to prevent dirt entry.

(59) Install torque converter. Use C-clamp or metal strap to hold converter in place for installation.

(60) Mount transmission on jack for installation in vehicle.

(61) Apply dielectric grease to terminal pins of solenoid case connector and neutral switch.

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.

OVERDRIVE UNIT OVERHAUL—46RH

INDEX

OVERDRIVE UNIT DISASSEMBLY

(1) Remove overdrive piston thrust plate (Fig. 1). Retain thrust plate. It is a select fit part and may possibly be reused.

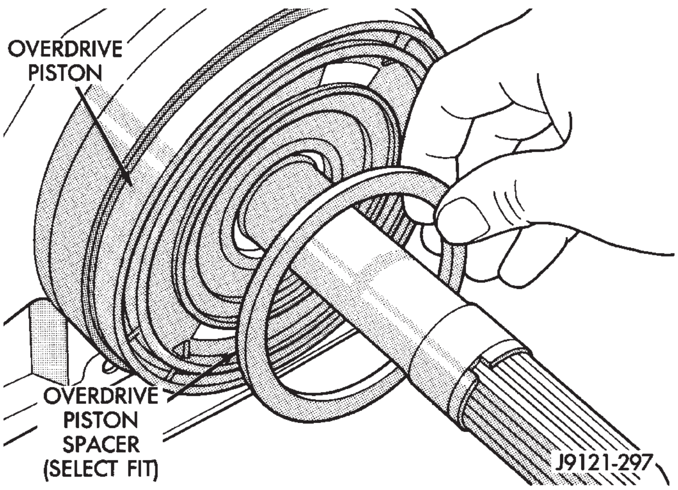


Fig. 1 Overdrive Piston Thrust Plate Removal/Installation

(2) Remove intermediate shaft spacer (Fig. 2). Retain spacer. It is a select fit part and may possibly be reused.

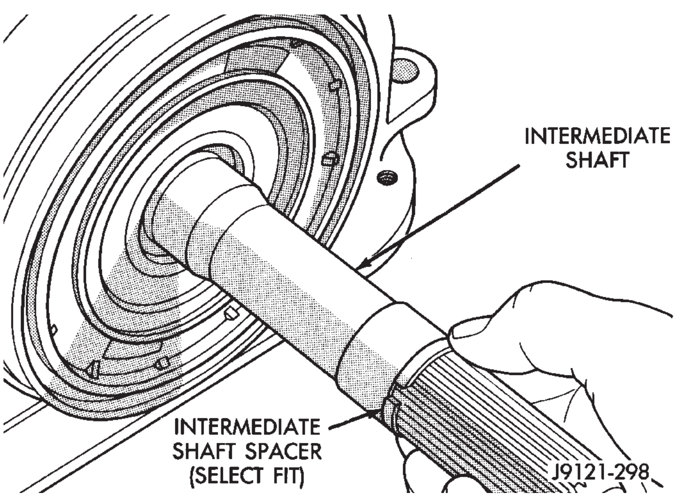


Fig. 2 Intermediate Shaft Spacer Location

(3) Remove overdrive piston from retainer (Fig. 3).

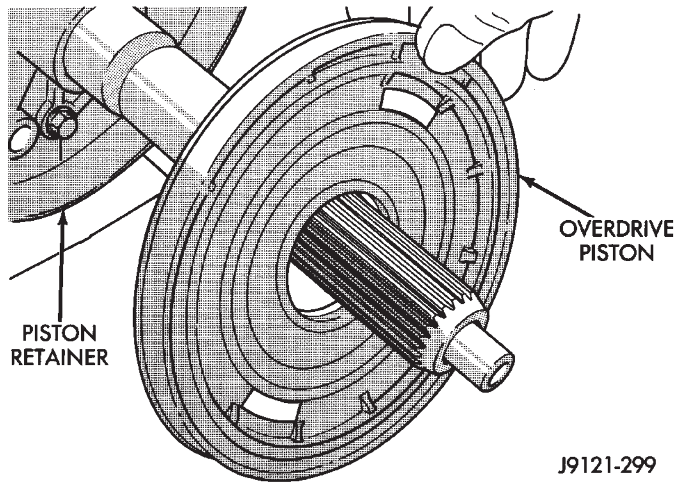


Fig. 3 Removing Overdrive Piston

(4) Remove overdrive piston thrust bearing from direct clutch hub (Fig. 4).

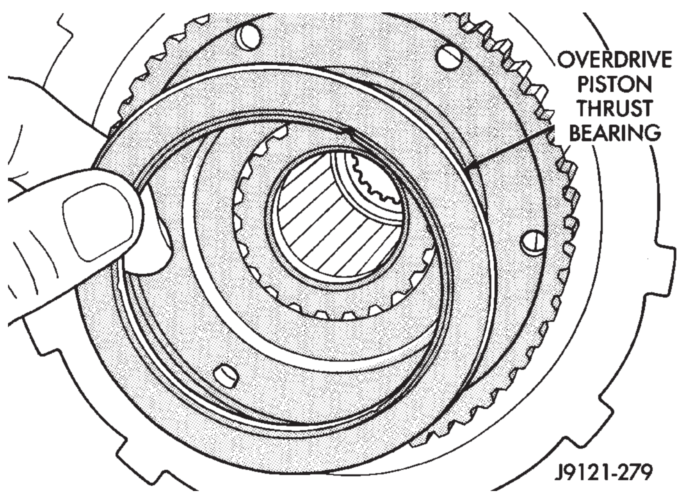


Fig. 4 Removing Overdrive Piston Thrust Bearing

(5) Remove overdrive clutch pack retaining ring (Fig. 5).

(6) Remove overdrive clutch pack (Fig. 6). Note that thickest plate is positioned at rear of clutch pack.

(7) Remove overdrive clutch wave spring (Fig. 7).

(8) Remove overdrive clutch reaction snap ring (Fig. 8). Note that snap ring is located in same groove as wave spring.

(9) Remove access cover and gasket from case (Fig. 9). Cover provides access to output shaft front bearing locating ring.

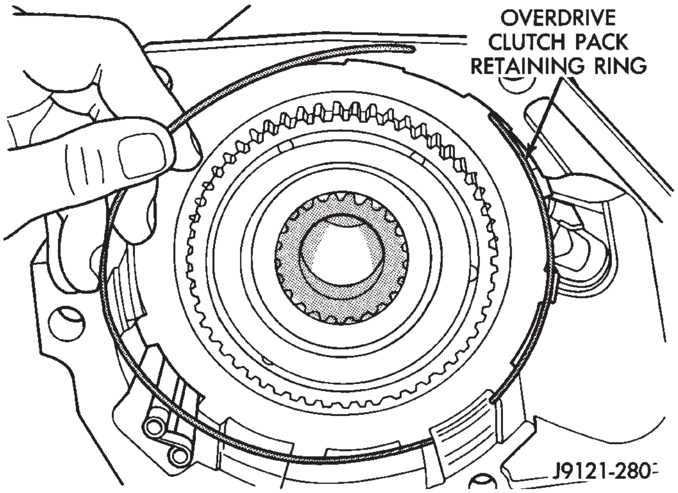


Fig. 5 Removing/Installing Overdrive Clutch Pack Retaining Ring

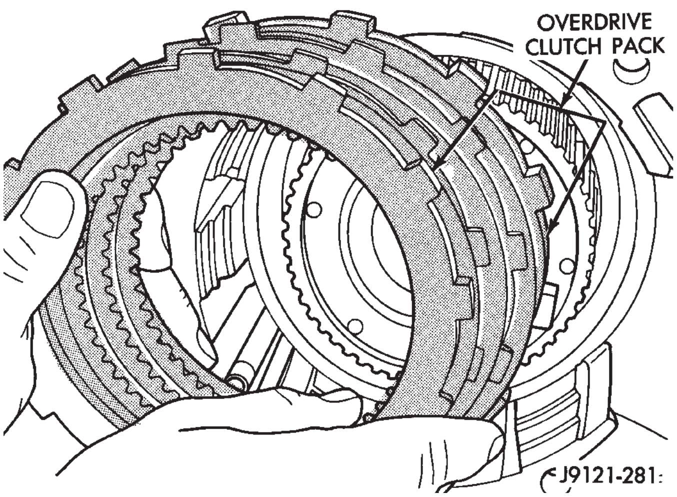


Fig. 6 Overdrive Clutch Pack Removal

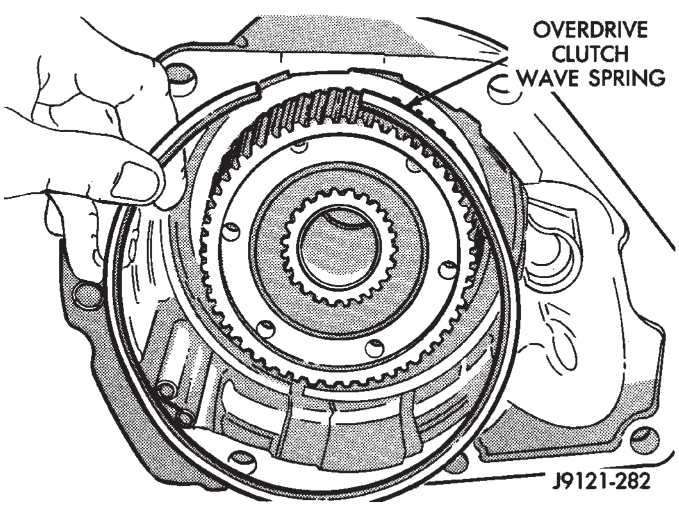


Fig. 7 Removing/Installing Overdrive Clutch Wave Spring

(10) Expand output shaft bearing snap ring with snap ring pliers and push output shaft forward to release shaft front bearing from locating ring (Fig. 10).

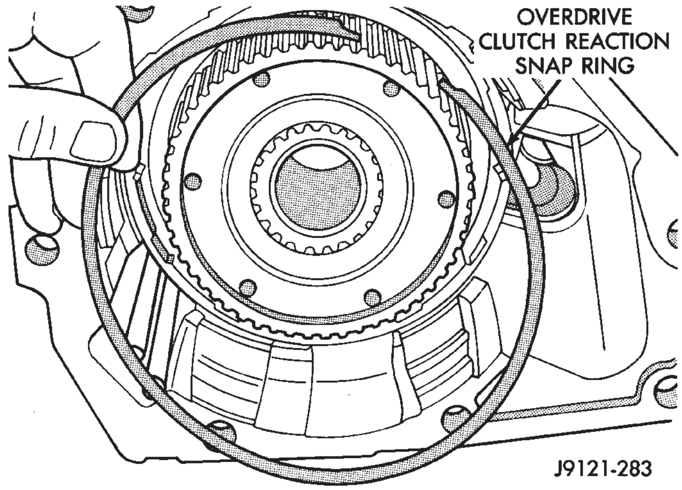


Fig. 8 Removing Overdrive Clutch Reaction Snap Ring

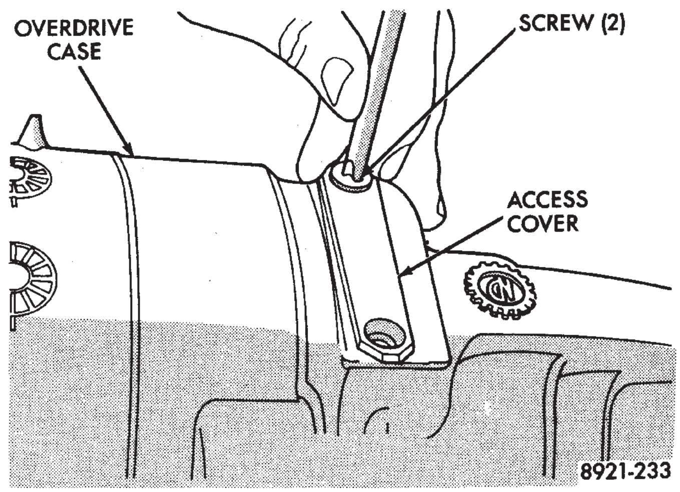


Fig. 9 Removing/Installing Locating Ring Access Cover

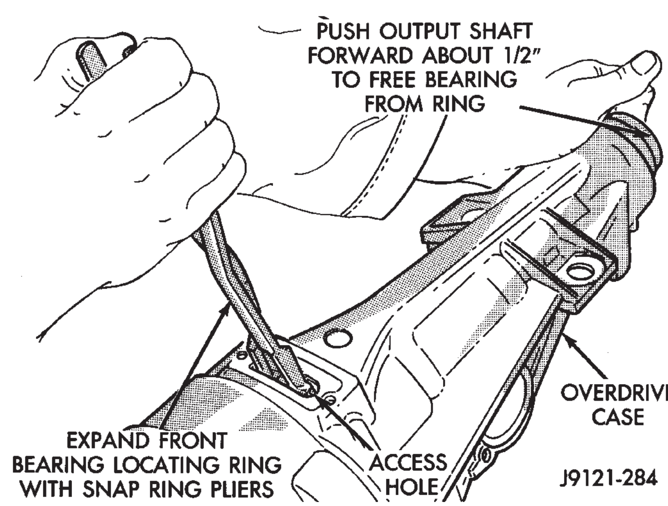


Fig. 10 Releasing Shaft Front Bearing From Locating Ring

(11) Remove geartrain assembly from housing (Fig. 11). Set geartrain aside.

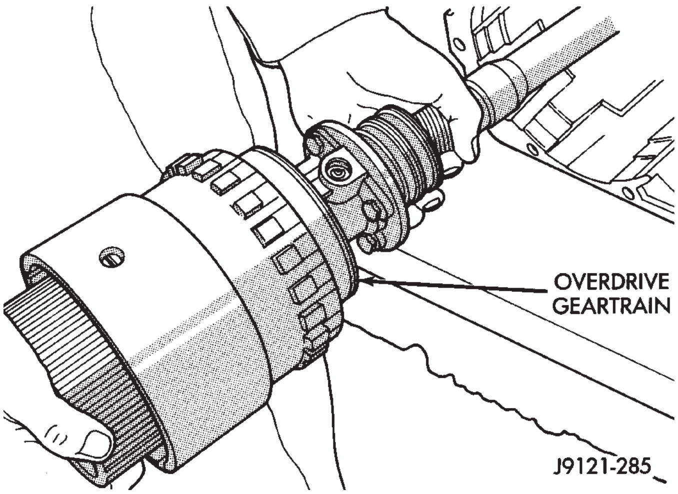


Fig. 11 Removing Overdrive Geartrain

(12) Remove output shaft front bearing locating ring and governor support snap ring (Fig. 12).

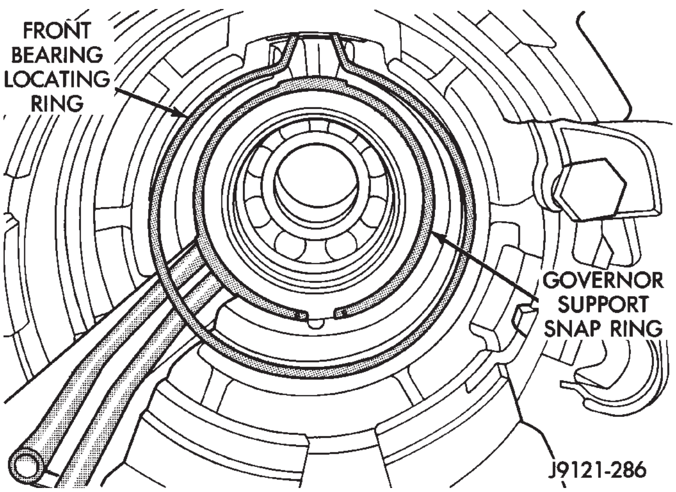


Fig. 12 Front Bearing Locating Ring And Governor Support Snap Ring Location

(13) Remove governor support and tube assembly from case (Fig. 13).

(14) Remove park pawl retaining bolt and reaction plug snap ring (Fig. 14). Compress snap ring only enough to remove it. Snap ring can be distorted if overcompressed.

(15) Remove park pawl shaft, park pawl, pawl spring and reaction plug (Fig. 14).

(16) Remove output shaft rear bearing snap ring (Fig. 15). Remove snap ring with long jaw internal type snap ring pliers. Or, rotate snap ring until one end is adjacent to notch in case. Then unseat ring with long flat blade screwdriver.

(17) Remove rear bearing by tapping overdrive case on wood block to dislodge bearing.

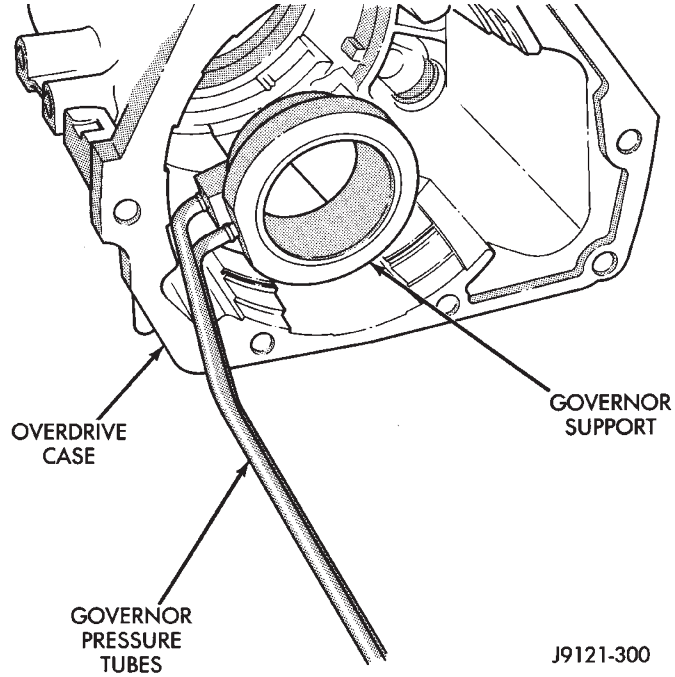


Fig. 13 Removing Governor Support And Tube Assembly

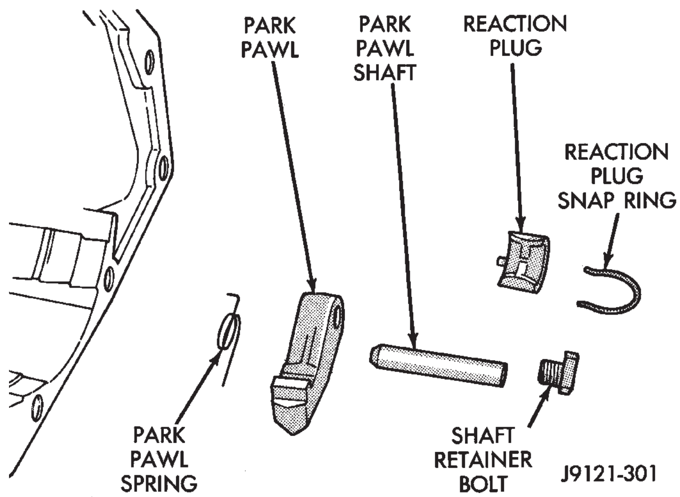


Fig. 14 Park Lock Component Removal

OVERDRIVE GEARTRAIN DISASSEMBLY

(1) Remove E-clip from one end of governor valve shaft and remove shaft and valve (Fig. 16).

(2) Remove governor snap ring (fig. 17).

(3) Remove governor body and drive as assembly (Fig. 18).

(4) Remove governor drive key (Fig. 19).

(5) Remove output shaft front bearing snap ring (Fig. 20).

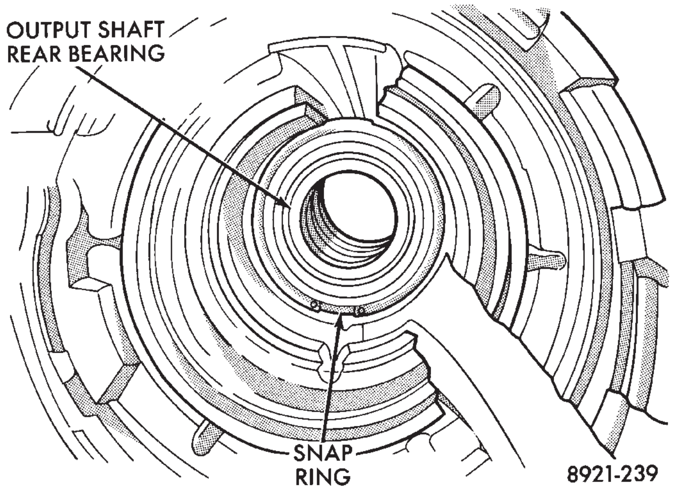


Fig. 15 Output Shaft Rear Bearing And Snap Ring Location

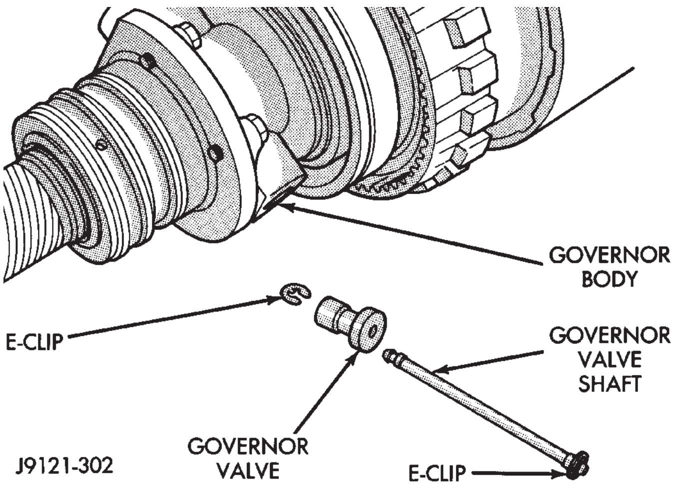


Fig. 16 Governor Valve And Shaft Removal/Installation

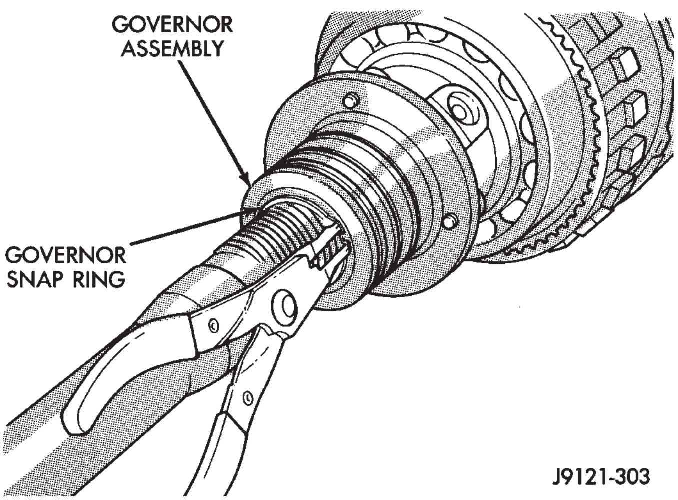


Fig. 17 Removing/Installing Governor Snap Ring

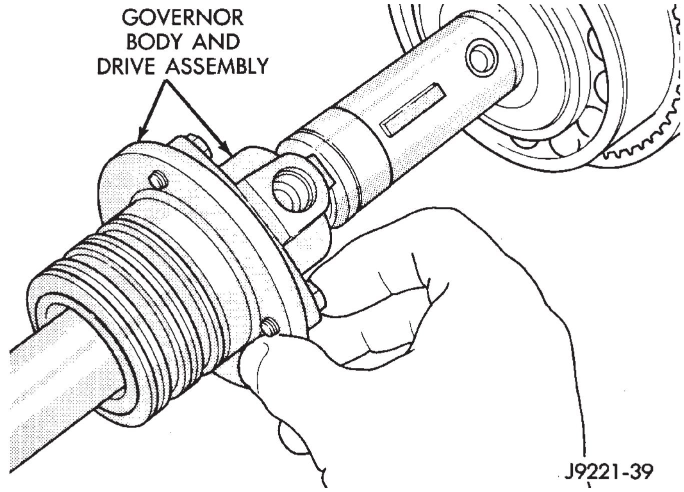


Fig. 18 Removing/Installing Governor Body And Drive Assembly

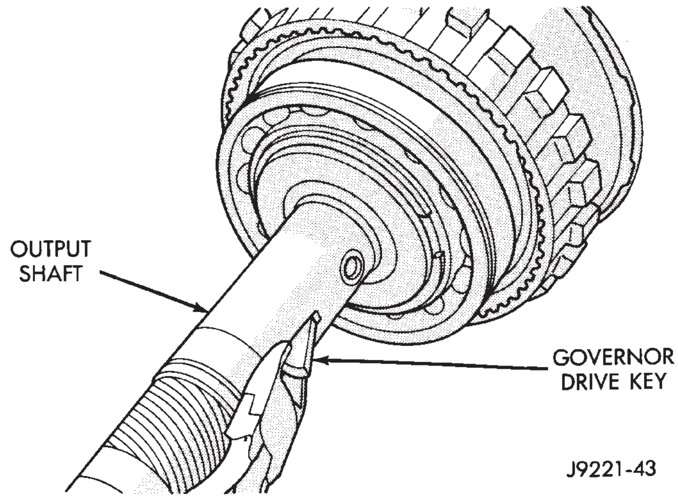


Fig. 19 Removing Governor Drive Key

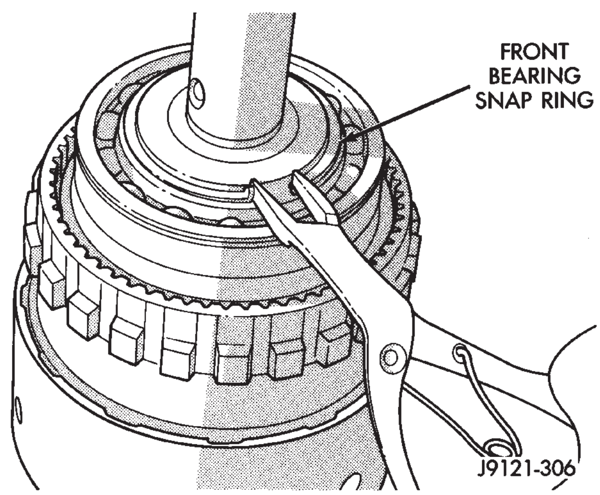


Fig. 20 Removing/Installing Front Bearing Snap Ring

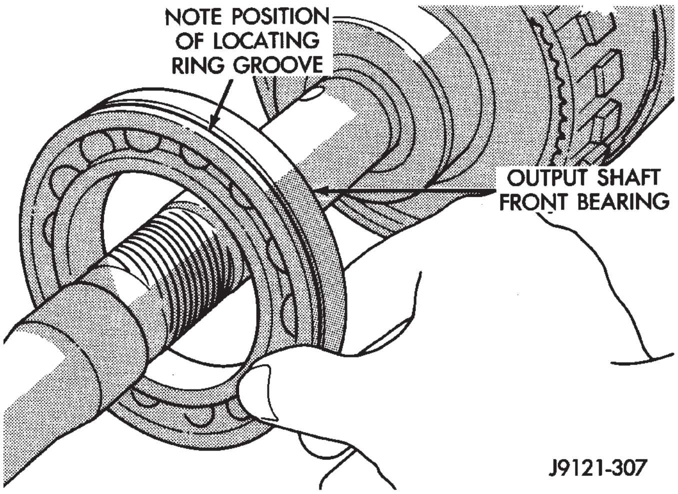


Fig. 21 Removing/Installing Output Shaft Front Bearing

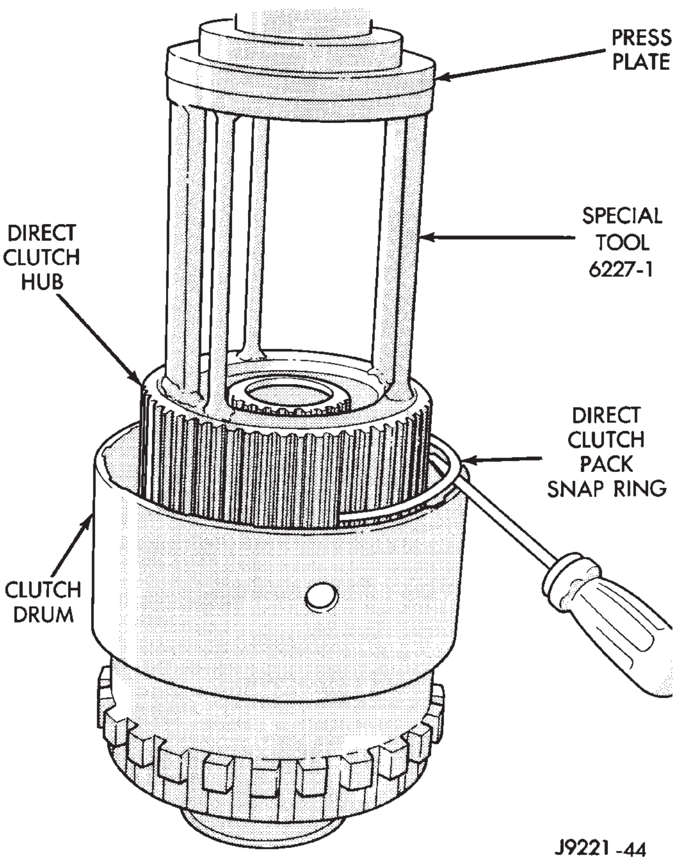


Fig. 22 Removing Direct Clutch Pack Snap Ring

(6) Remove front bearing from output shaft (Fig. 21).

WARNING: THE NEXT STEP IN GEARTRAIN DISASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 800 POUNDS. USE SPRING COMPRESSOR TOOL 6227-1 AND A HYDRAULIC SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 5-6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(7) Mount geartrain in shop press

(8) Position Compressor Tool 6227-1 on clutch hub (Fig. 22). Support output shaft flange with steel press plates as shown and center assembly under press ram.

(9) Use Bushing Tool MB990891 (or similar size tool) at top of Tool 6227-1 to help distribute load and provide needed extra press length.

(10) Apply press pressure slowly. Compress hub and spring far enough to expose clutch hub retaining ring and relieve spring pressure on clutch pack snap ring (Fig. 22).

(11) Remove direct clutch pack snap ring first (Fig. 22).

(12) Remove direct clutch hub retaining ring (Fig. 23).

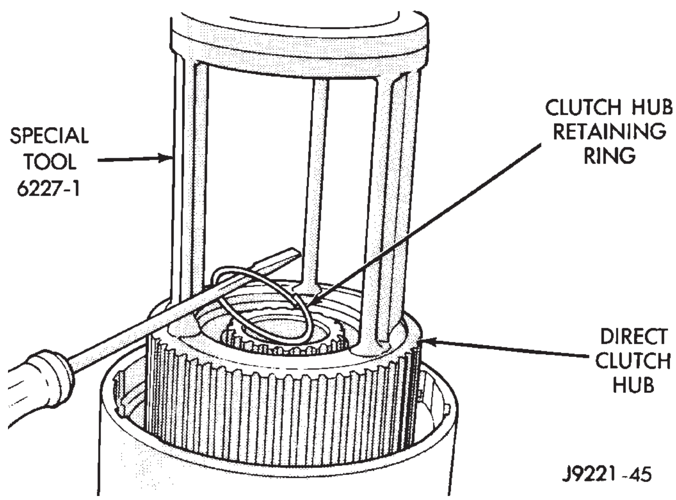


Fig. 23 Removing Direct Clutch Hub Retaining Ring

(13) Release press load on clutch spring **slowly and completely.** Remove press tools and geartrain.

(14) Remove direct clutch pack from hub (Fig. 24).

(15) Remove direct clutch hub and spring (Fig. 25).

(16) Remove sun gear and spring plate, planetary thrust bearing and planetary gear (Fig. 26).

(17) Remove overrunning clutch assembly with expanding type snap ring pliers (Fig. 27). Insert pliers into clutch hub. Expand pliers to grip hub splines and remove clutch with counterclockwise, twisting motion.

(18) Remove thrust bearing from overrunning clutch hub (Fig. 28).

(19) Remove overrunning clutch from hub (Fig. 28).

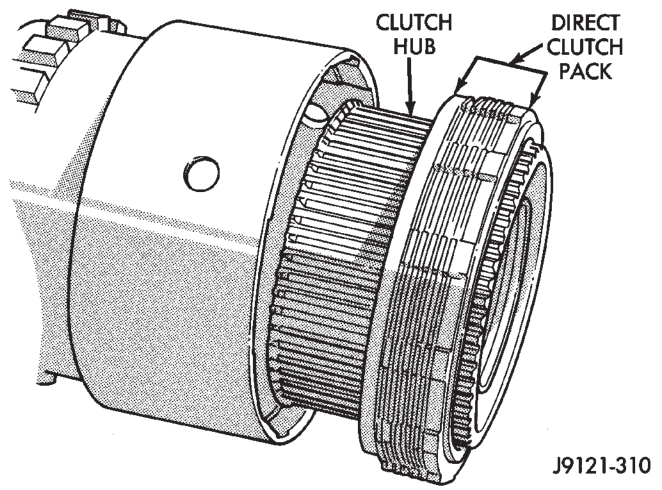


Fig. 24 Direct Clutch Pack Removal

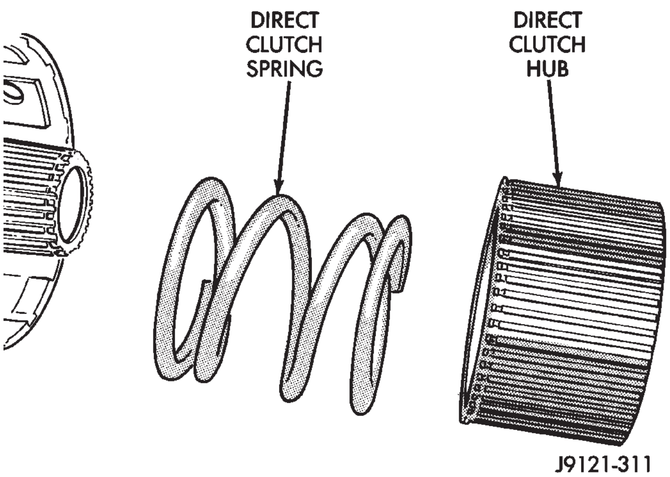


Fig. 25 Direct Clutch Hub And Spring Removal

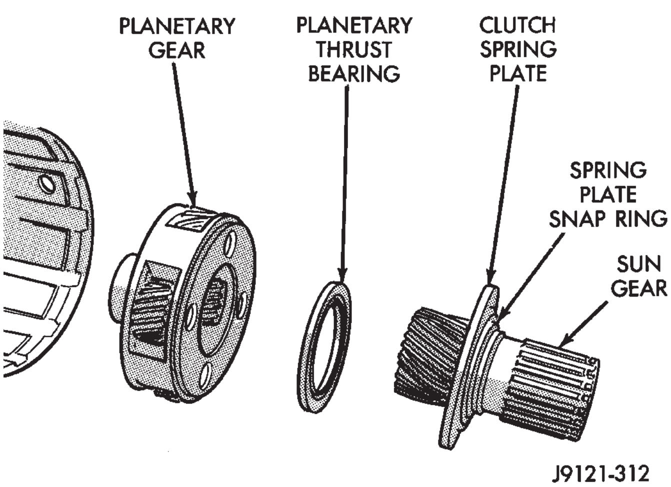


Fig. 26 Removing Sun Gear/Thrust Bearing/Planetary Gear

(20) Mark position of annulus gear and direct clutch drum for assembly alignment reference (Fig. 29). Use small center punch or scriber to make alignment marks.

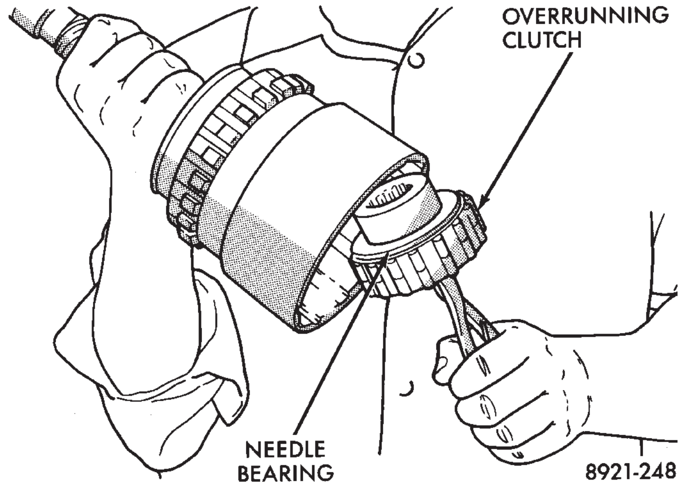


Fig. 27 Removing Overrunning Clutch Assembly

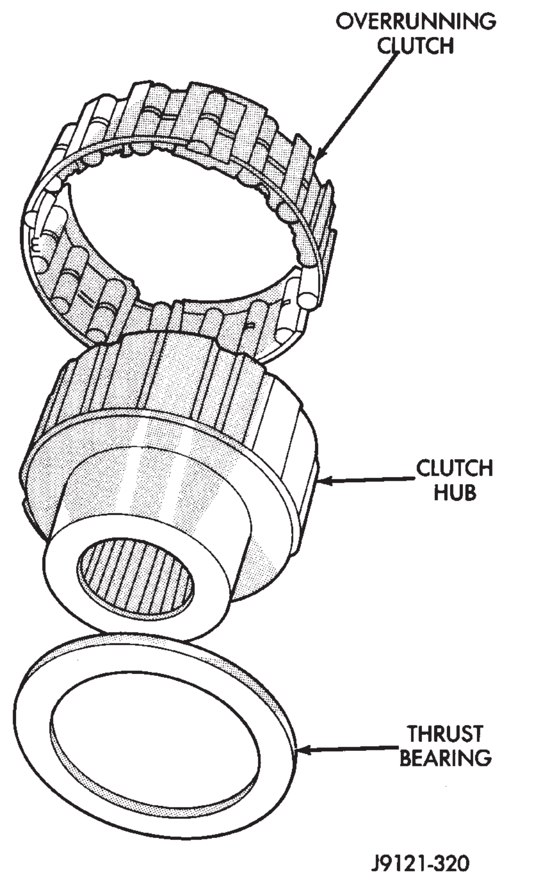


Fig. 28 Overrunning Clutch Components

(21) Remove direct clutch drum rear retaining ring (Fig. 30).

(22) Remove direct clutch drum outer retaining ring (Fig. 31).

(23) Mark annulus gear and output shaft for assembly alignment reference (Fig. 32).

(24) Remove annulus gear from output shaft (Fig. 33). Use rawhide or plastic mallet to tap gear off shaft.

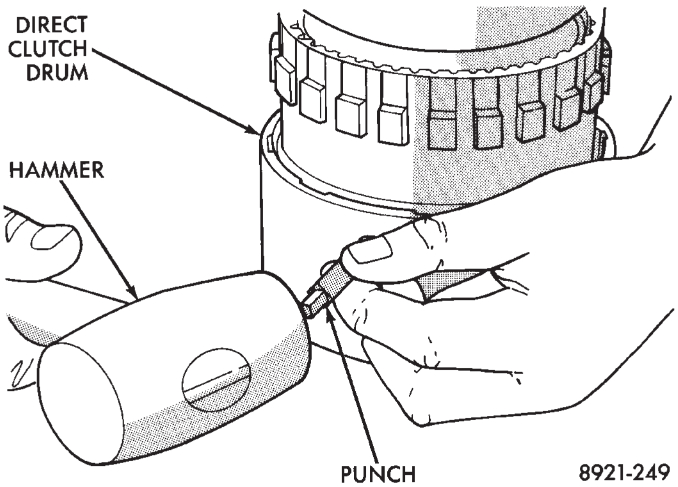


Fig. 29 Marking Direct Clutch Drum And Annulus Gear For Assembly Alignment

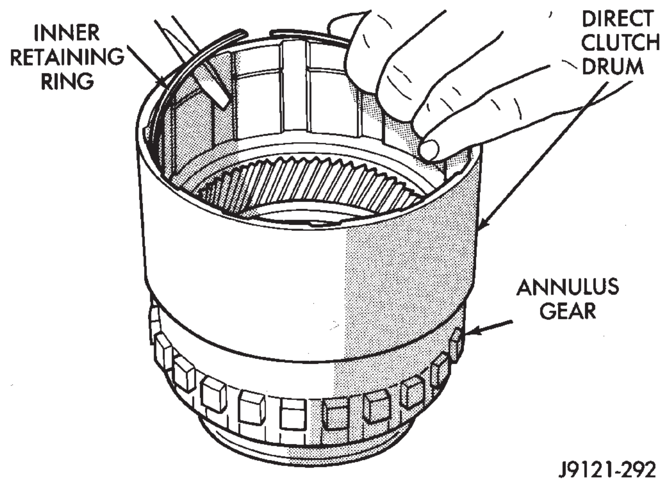


Fig. 30 Removing Clutch Drum Inner Retaining Ring

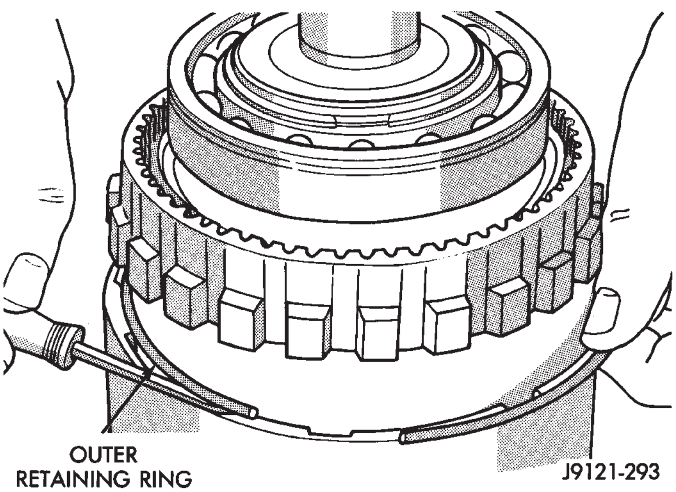


Fig. 31 Removing Clutch Drum Outer Retaining Ring

(25) Remove output shaft front bearing if not previously removed.

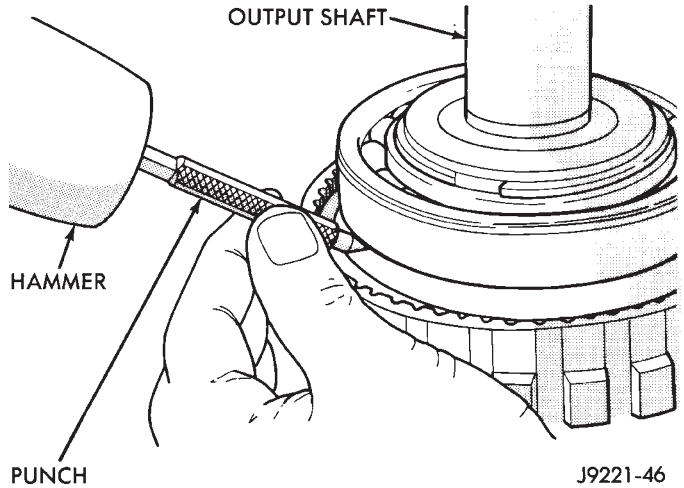


Fig. 32 Marking Annulus Gear And Output Shaft For Assembly Alignment

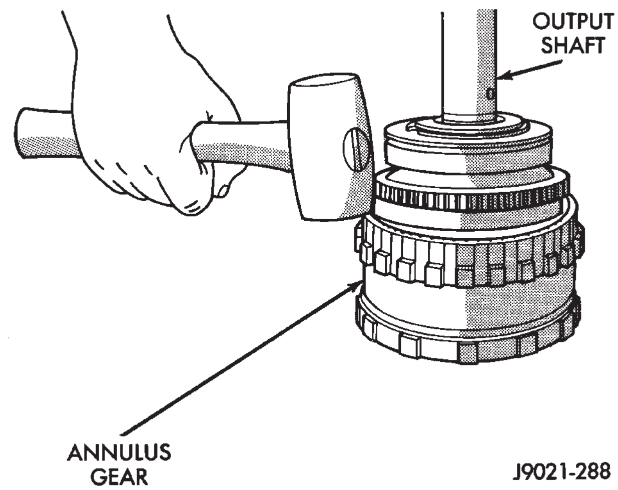


Fig. 33 Removing Annulus Gear

OVERDRIVE COMPONENT CLEANING AND INSPECTION

Clean the geartrain (Fig. 34) and case components (Fig. 35) with solvent. Dry all parts except the bearings with compressed air. Allow bearings to air dry.

Do not use shop towels for wiping parts dry unless the towels are made from a lint-free material. A sufficient quantity of lint (from shop towels, cloths, rags, etc.) could plug the transmission filter and fluid passages.

Discard the old case gasket and seals. Do not attempt to salvage these parts. They are not reusable. Replace any of the overdrive unit snap rings if distorted or damaged.

Minor nicks or scratches on components can be smoothed with crocus cloth. However, do not attempt to reduce severe scoring on any components with abrasive materials. Replace severely scored components; do not try to salvage them.

Check condition of the park lock components and the overdrive case (Fig. 36).

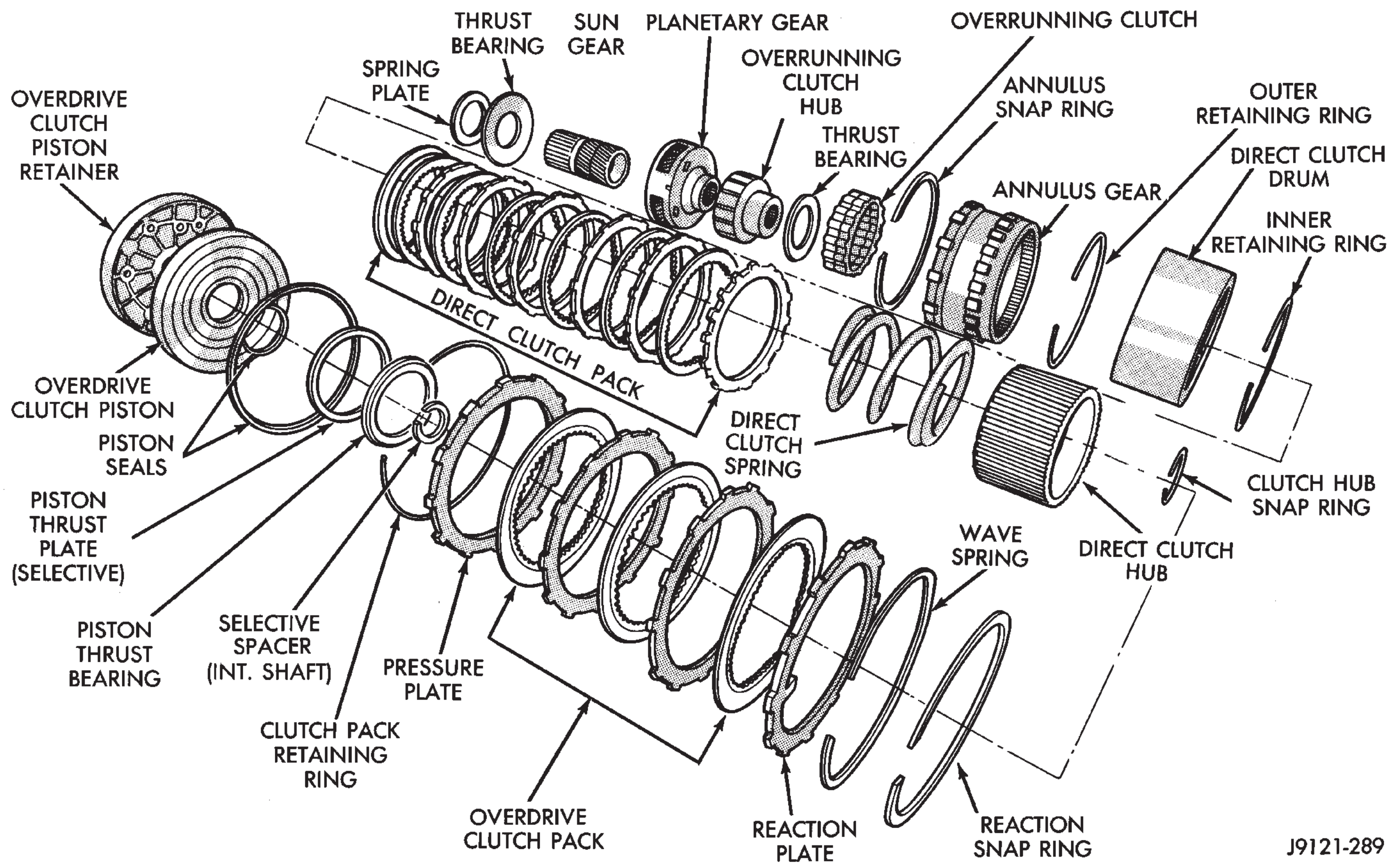


Fig. 34 Overdrive Geartrain Components

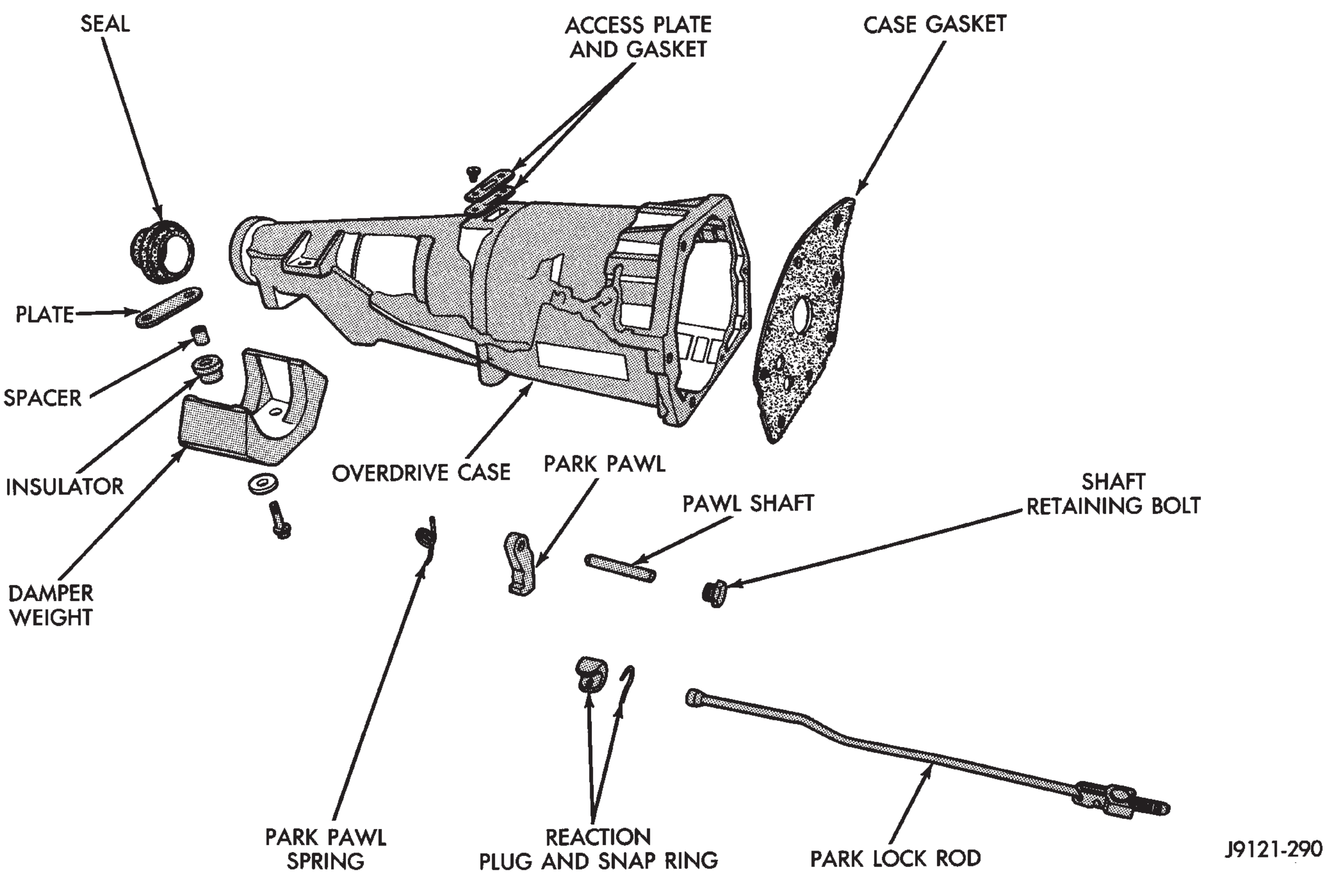


Fig. 35 Overdrive Case And Park Lock Components

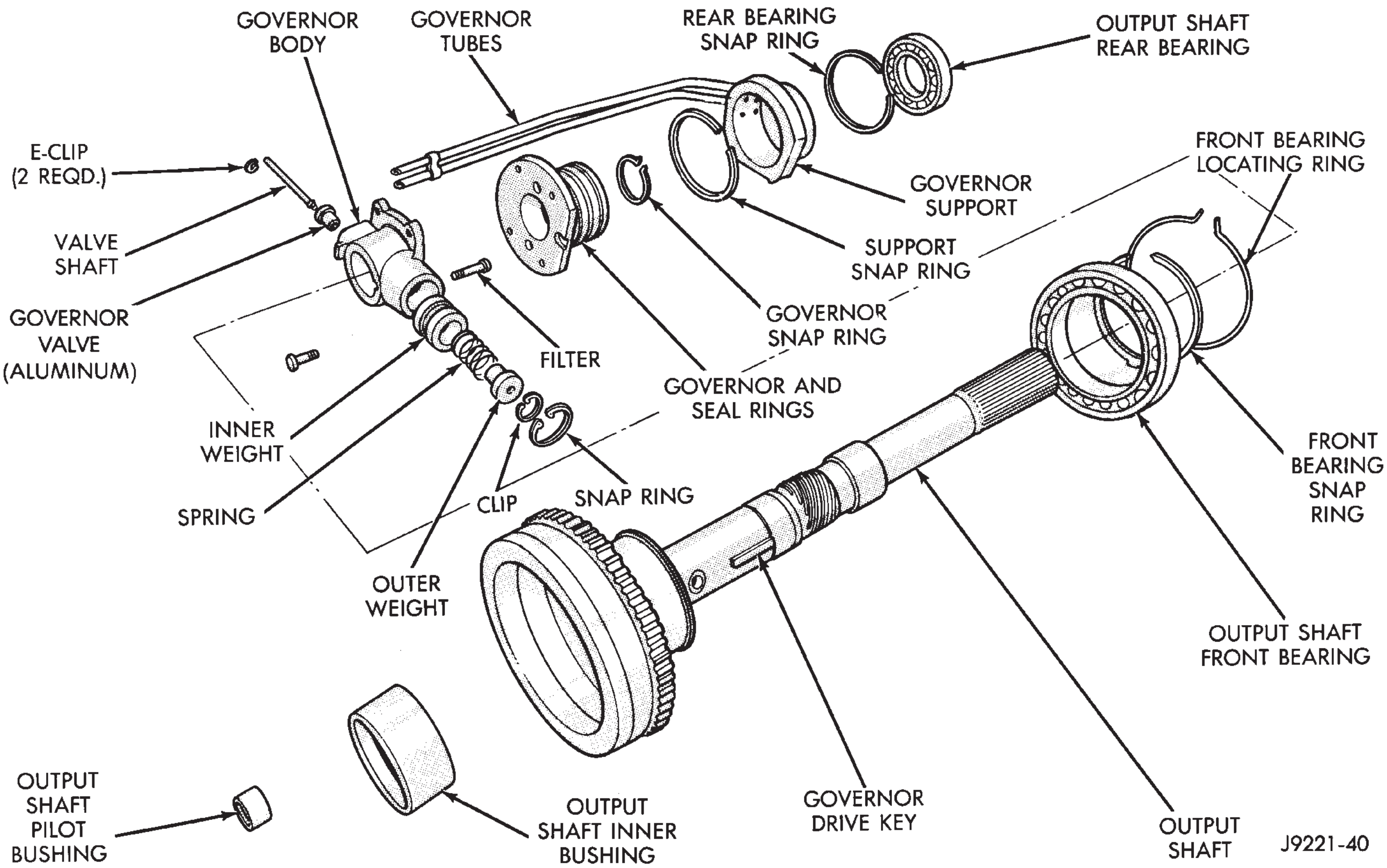


Fig. 36 Output Shaft And Governor Components

Replace the case if cracked, scored, or damaged. Replace the park lock pawl, plug, or spring if worn or damaged. Be sure the bullet at the end of the park lock rod is in good condition. Replace the rod if the bullet is worn or the rod itself is bent or distorted. Do not attempt to straighten the rod.

Check the bushings in the overdrive case. Replace the bushings if severely scored or worn. Also replace the case seal if loose, distorted, or damaged.

Examine the overdrive and direct clutch discs and plates (Fig. 34). Replace the discs if the facing is worn, severely scored, or burned and flaking off. Replace the clutch plates if worn, heavily scored, or cracked. Check the lugs on the clutch plates for wear. The plates should slide freely in the drum. Replace the plates or drum if binding occurs.

Check condition of the annulus gear, direct clutch hub, clutch drum and clutch spring (Fig. 34). Replace the gear, hub and drum if worn or damaged. Replace the spring if collapsed, distorted, or cracked.

Be sure the splines and lugs on the gear, drum and hub are in good condition. The clutch plates and discs should slide freely in these components.

Inspect the thrust bearings and spring plate (Fig. 34). Replace the plate if worn or scored. Replace the bearings if rough, noisy, brinneled, or worn.

Inspect the planetary gear assembly and the sun gear and bushings (Fig. 34). If either the sun gear or the bushings are damaged, replace the gear and bushings as an assembly. The gear and bushings are not serviced separately.

The planetary carrier and pinions must be in good condition. Also be sure the pinion pins are secure and in good condition. Replace the carrier if worn or damaged.

Inspect the overrunning clutch and race. The race surface should be smooth and free of scores. Replace the overrunning clutch assembly or the race if either assembly is worn or damaged in any way.

Inspect the output shaft and governor components (Fig. 36). Replace the shaft pilot bushing and inner bushing if damaged. Replace either shaft bearing if rough or noisy. Replace the bearing snap rings if distorted or cracked.

Check the machined surfaces on the output shaft. These surfaces should clean and smooth. Very minor nicks or scratches can be smoothed with crocus cloth. Replace the shaft if worn, scored or damaged in any way.

Check condition of the governor components. Replace the governor drive seal rings if damaged. Be sure the drive ring grooves are in good condition. Check operation of the governor valve, weights and shaft. The valves and weights should slide freely in the governor body (Fig. 36).

There are two governor component changes in 1992/93 overdrive units that affect service. The first involves the governor valve which is now made of aluminum. The second involves the output shaft which has a spotface for governor valve end clearance. The new aluminum valve is not interchangeable. It must only be used with an output shaft that has the spotface for valve end clearance.

Inspect the governor support and the two oil pressure tubes (Fig. 36). **The tubes are an integral part of the support. Do not attempt to remove them.**

The oil tubes must not be pinched, kinked, collapsed, or distorted. Blow them out with compressed air to be sure they are clear. The tubes are designed to be a slip fit in the piston retainer boss. Do not modify the tube ends in an effort to make them fit tighter.

Replace the governor support and the oil tubes as an assembly if either component is damaged.

Check condition of the governor valve and weight snap rings. Replace any snap ring that appears bent or distorted. Replace any snap ring if its condition is doubtful.

Inspect the output shaft bushings (Fig. 37). The small bushing is the intermediate shaft pilot bushing. The large bushing is the overrunning clutch hub bushing. Replace either bushing if scored, pitted, cracked, or worn.

The bushings can be removed with "blind hole puller tools" such as Snap-On set CG40CB for small bushings and set CG46 for large bushings. New bushings can be installed with tools from an all purpose installer kit such as the Snap-On A257 bushing driver set.

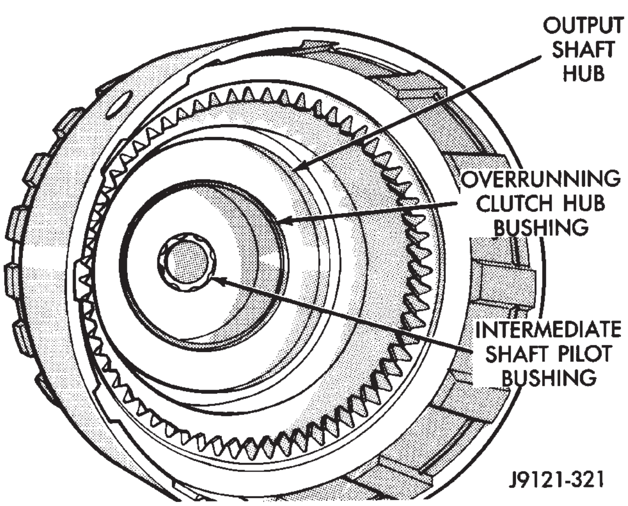


Fig. 37 Output Shaft Bushing Location

OVERDRIVE GEARTRAIN ASSEMBLY

(1) Lubricate geartrain components with Mopar ATF Plus or Dexron II™ transmission fluid.

(2) Soak direct and overdrive clutch discs in transmission fluid before installation.

(3) Install new pilot bushing and clutch hub bushing in output shaft if necessary (Fig. 37). Lubricate new (or old) bushings with petroleum jelly.

(4) Install front bearing and bearing snap ring on output shaft (Fig. 38)

(5) Align and install annulus gear on output shaft (Fig. 38).

(6) Install annulus snap ring (Fig. 38).

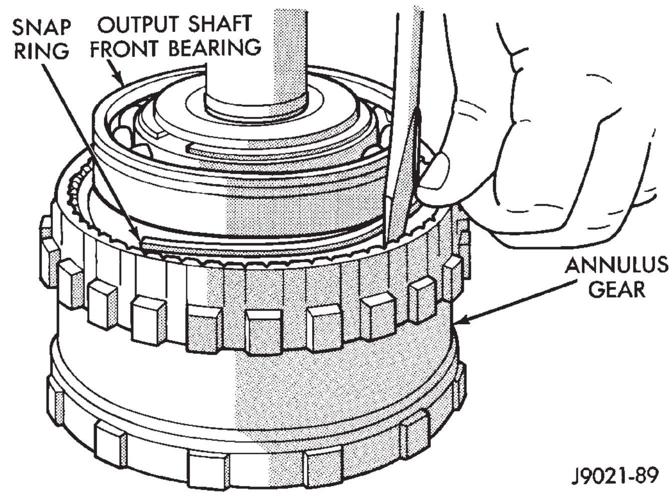


Fig. 38 Installing Annulus Gear And Snap Ring

(7) Align and install clutch drum on annulus gear (Fig. 39). Be sure drum is engaged in annulus gear lugs.

(8) Install clutch drum outer retaining ring (Fig. 31).

(9) Slide clutch drum forward and install inner retaining ring (Fig. 39).

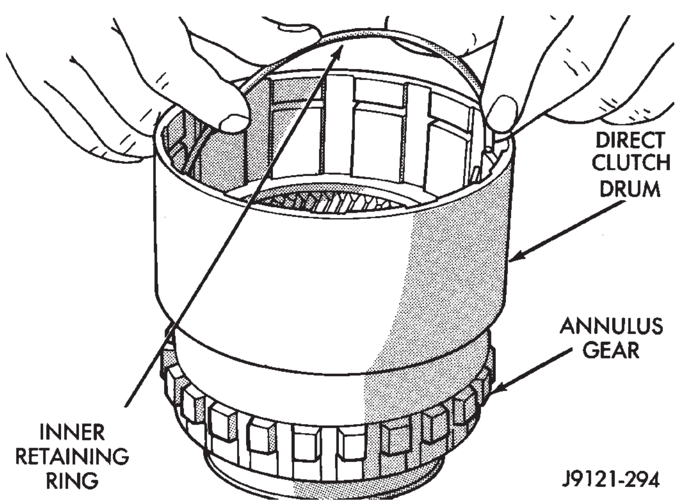


Fig. 39 Installing Clutch Drum Inner Retaining Ring

(10) Install overrunning clutch on hub (Fig. 40). **Note that clutch only fits one way. Shoulder on clutch should seat in small recess at edge of hub.**

(11) Install thrust bearing on overrunning clutch hub (Fig. 41). Use generous amount of petroleum jelly to hold bearing in place for installation. **Bearing fits one way only. Be sure bearing is seated squarely against hub. Reinstall bearing if it does not seat squarely.**

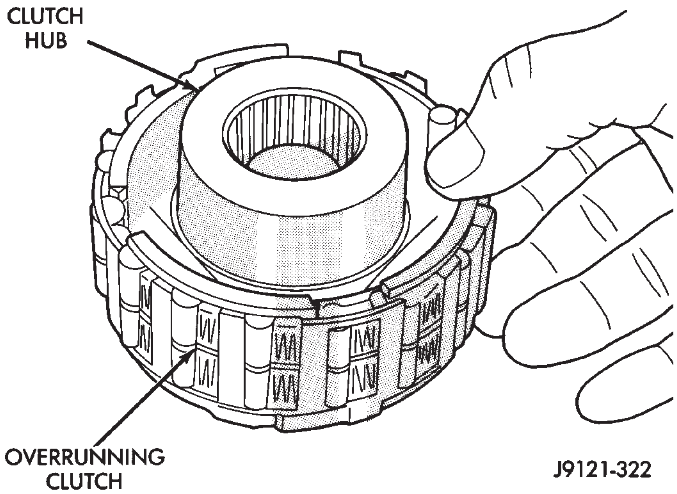


Fig. 40 Assembling Overrunning Clutch And Hub

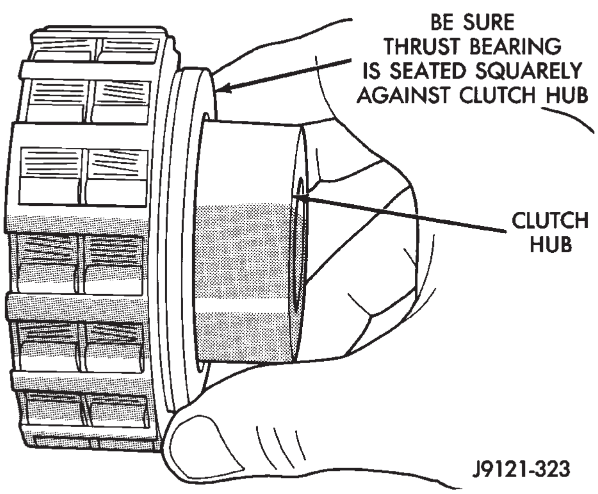


Fig. 41 Installing Overrunning Clutch Thrust Bearing

(12) Install overrunning clutch (Fig. 42). Insert snap ring pliers in hub splines. Expand pliers to grip hub. Then install assembly with counterclockwise, twisting motion.

(13) Install planetary gear in annulus gear (Fig. 43). **Be sure planetary pinions are fully seated in annulus gear before proceeding.**

(14) Install direct clutch spring plate on sun gear. Shoulder side of plate should face outward and toward front. Then secure plate to sun gear with snap ring (Fig. 44).

(15) Coat planetary thrust bearing and bearing contact surface of spring plate with generous amount of petroleum jelly. This will help hold bearing in place during installation.

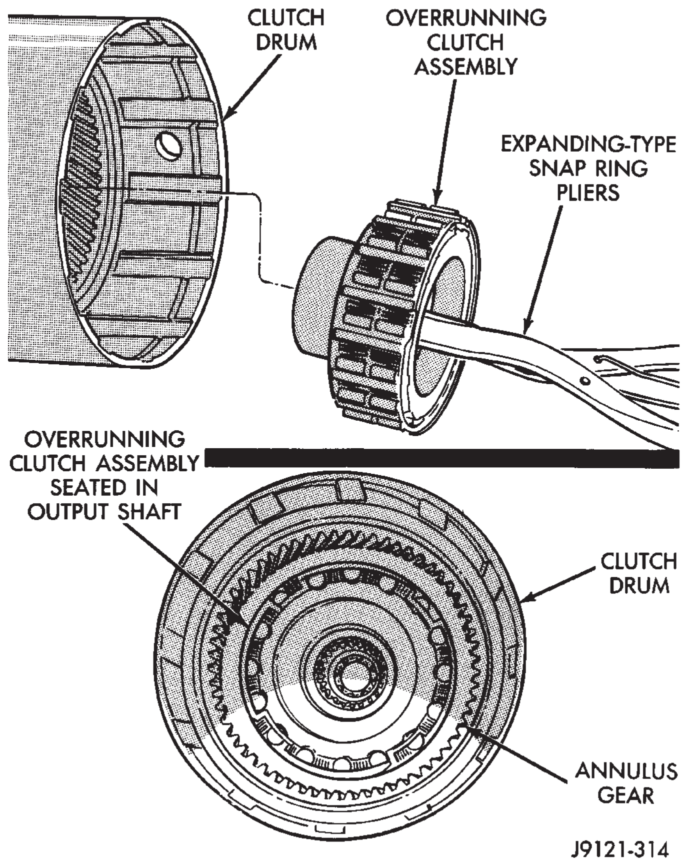


Fig. 42 Installing Overrunning Clutch

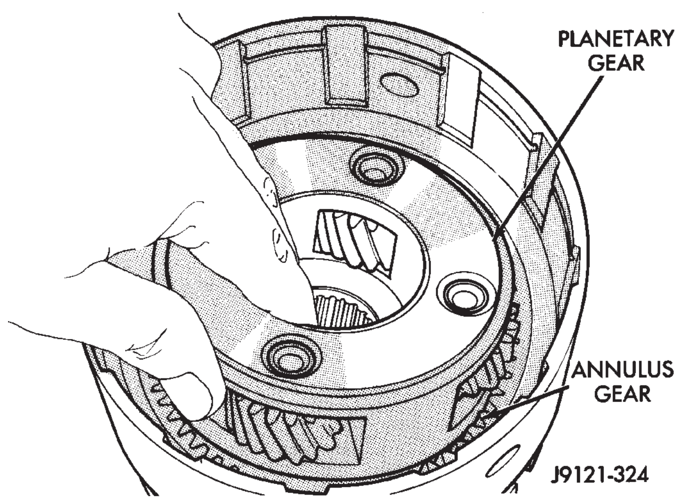


Fig. 43 Installing Planetary Gear

(16) Install planetary thrust bearing on sun gear (Fig. 45). Slide bearing onto gear and seat it against spring plate as shown. **Bearing fits one way only. If it does not seat squarely against spring plate, remove and reposition bearing.**

(17) Install assembled sun gear, spring plate and thrust bearing (Fig. 46). Be sure sun gear and thrust bearing are fully seated before proceeding.

(18) Align splines in hubs of planetary gear and overrunning clutch with Alignment tool 6227-2 (Fig.

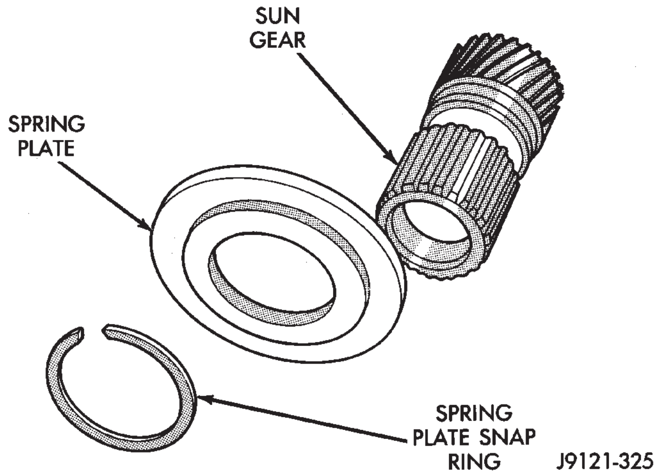


Fig. 44 Sun Gear And Spring Plate Assembly

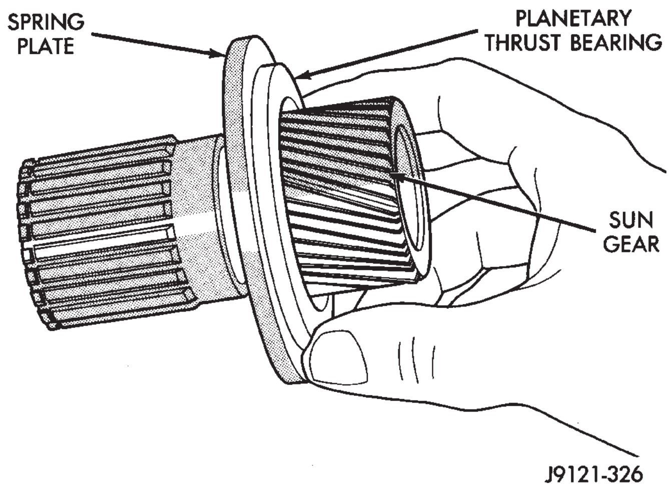


Fig. 45 Installing Planetary Thrust Bearing

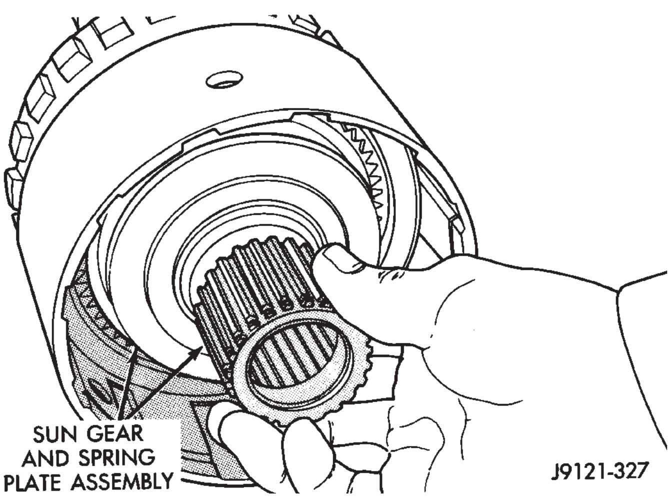


Fig. 46 Sun Gear Installation

47). Insert tool through sun gear and into splines of both hubs. Be sure alignment tool is fully seated before proceeding.

(19) Install direct clutch spring. Be sure spring is properly seated on spring plate (Fig. 47).

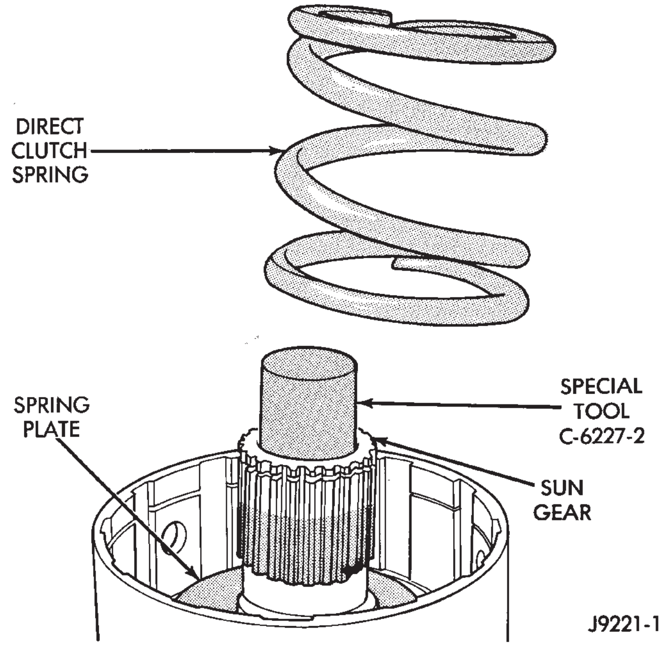


Fig. 47 Installing Direct Clutch Spring

(20) Assemble direct clutch pack for installation on hub (Fig. 48).

(21) Install direct clutch reaction plate on clutch hub. **Note that one side of reaction plate is counterbored. Be sure this side faces rearward. Splines at rear of hub are raised slightly. Counterbore in plate fits over raised splines. Plate should be flush with this end of hub (Fig. 49).**

(22) Install remainder of direct clutch components as follows:

(a) Install first clutch disc on reaction plate followed by a steel plate.

(b) Install remaining discs and plates alternately until required number of discs and plates are installed.

(c) Check direct clutch pack. 8 discs and 7 steel plates are required (Fig. 48).

(d) Last clutch pack item installed is clutch pressure plate. Be sure plate is installed with shoulder side of plate facing upward (Fig. 50).

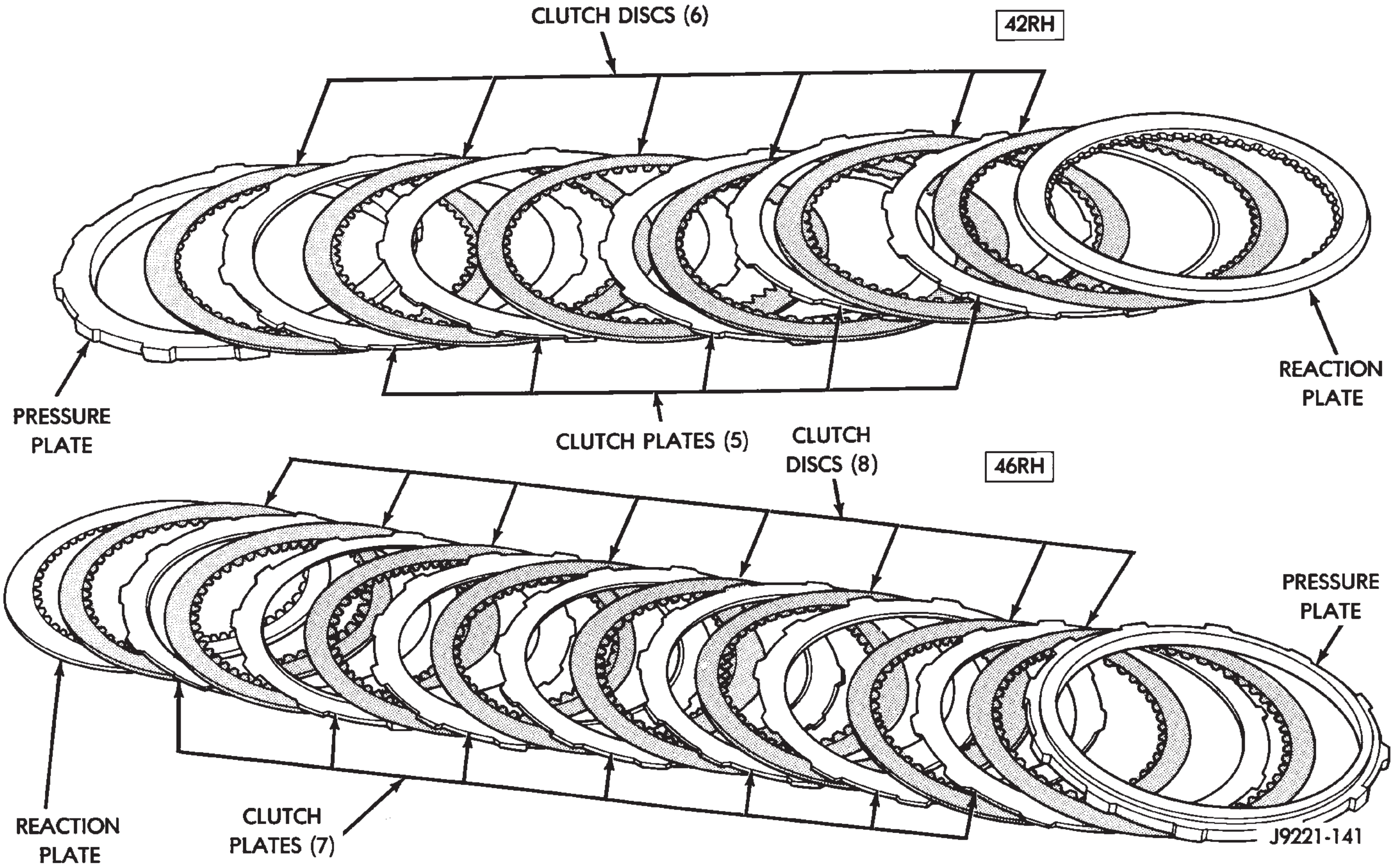


Fig. 48 Direct Clutch Pack Components

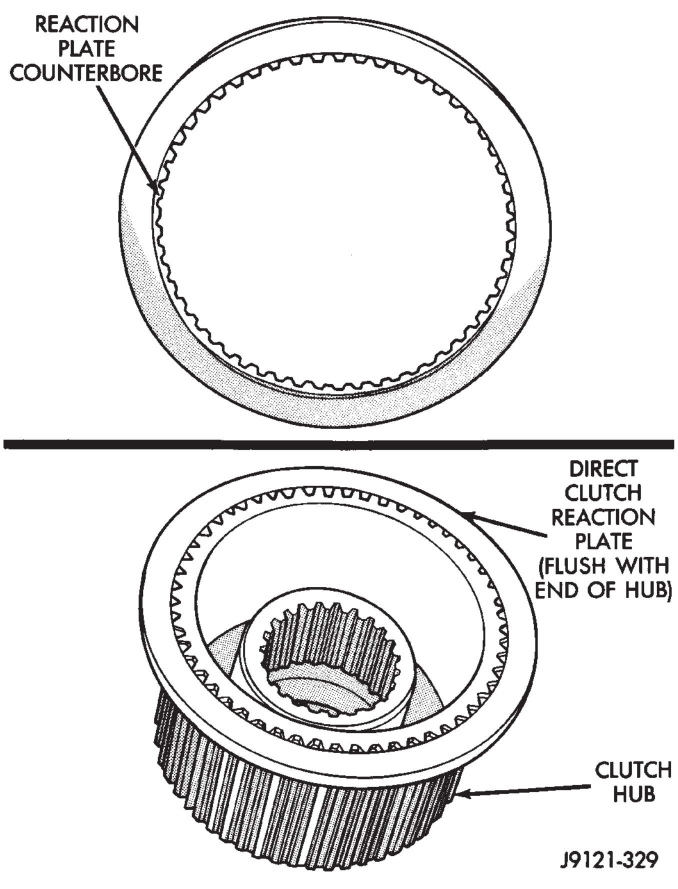


Fig. 49 Correct Position Of Direct Clutch Reaction Plate

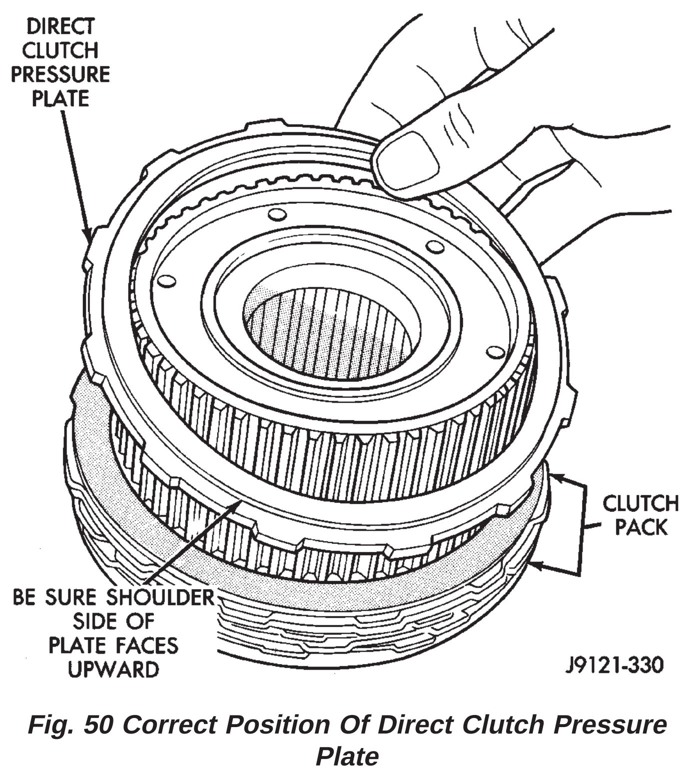


Fig. 50 Correct Position Of Direct Clutch Pressure Plate

(23) Install clutch hub and clutch pack on direct clutch spring (Fig. 51).

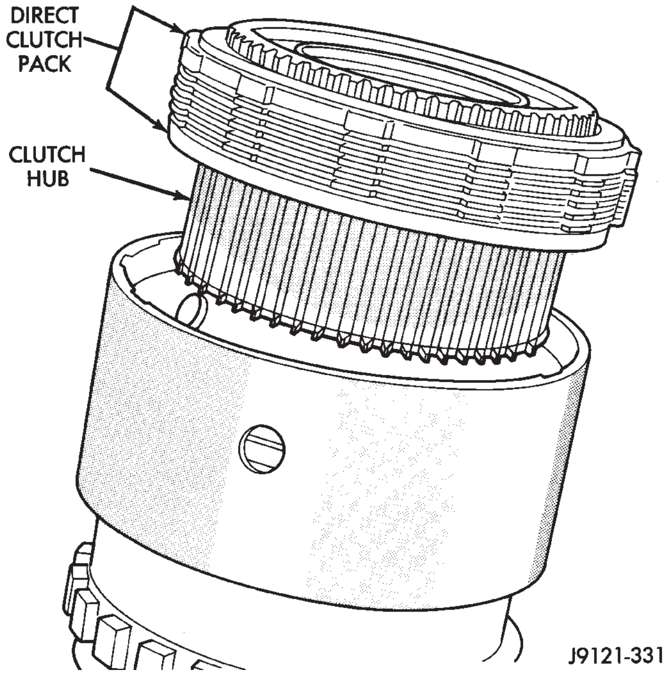


Fig. 51 Installing Assembled Direct Clutch Pack And Hub

(24) Mount geartrain assembly in shop press (Fig. 52).

WARNING: THE NEXT STEP IN GEARTRAIN ASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH HUB AND SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE SPRING COMPRESSOR TOOL C-6227-1 AND A HYDRAULIC-TYPE SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 5-6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(25) Position Compressor Tool 6227-2 on clutch hub (Fig. 52).

(26) Position Tool MB990891 or similar size tool on top of compressor tool (Fig. 52). Similar size tool should have minimum outside diameter of 3-1/2 inch, minimum wall thickness of 1/4 inch and be approximately 4 inches long.

(27) Slide direct clutch pack upwards on hub (Fig. 52). Slide pack upward and set it partially on edge of hub and compressor tool as shown in Figure 52.

(28) Slowly compress clutch hub and spring (Fig. 53). Compress spring and hub only enough to expose ring grooves for clutch pack snap ring and clutch hub retaining ring.

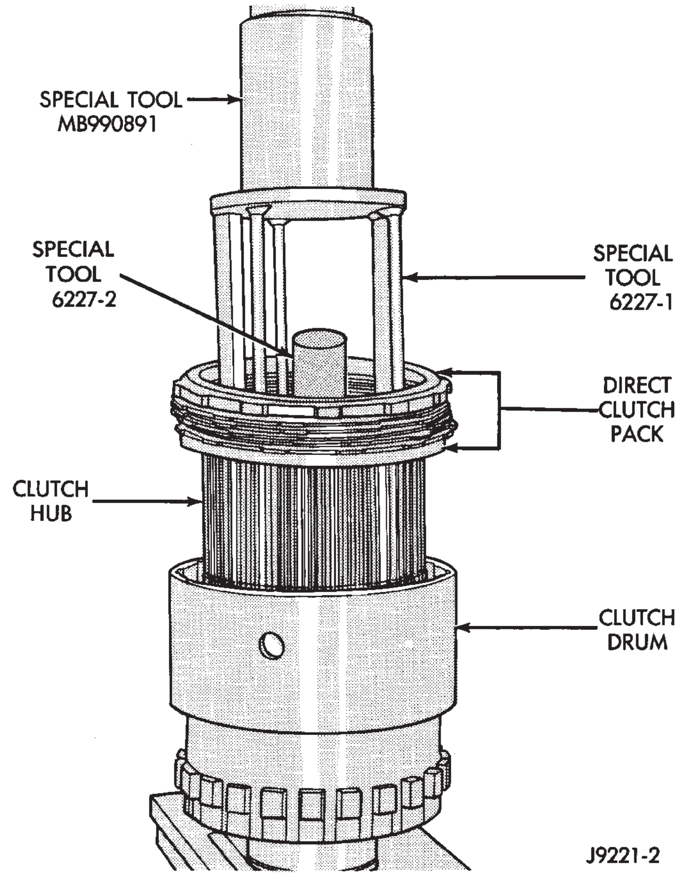


Fig. 52 Mounting Geartrain Assembly In Shop Press

(29) Realign clutch pack on hub and seat clutch discs and plates in clutch drum (Fig. 53).

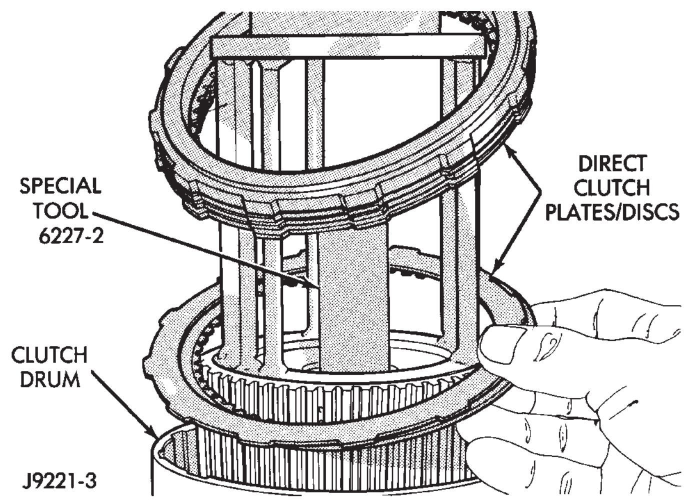


Fig. 53 Seating Clutch Pack In Drum

(30) Install direct clutch pack snap ring (Fig. 54). **Be very sure snap ring is fully seated in clutch drum ring groove.**

(31) Install clutch hub retaining ring (Fig. 55). **Be very sure retaining ring is fully seated in sun gear ring groove.**

(32) Slowly release press ram, remove compressor tools and remove geartrain assembly.

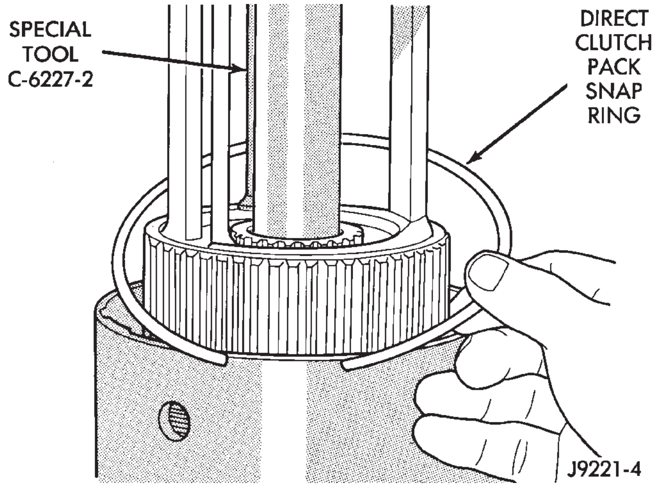


Fig. 54 Installing Direct Clutch Pack Snap Ring

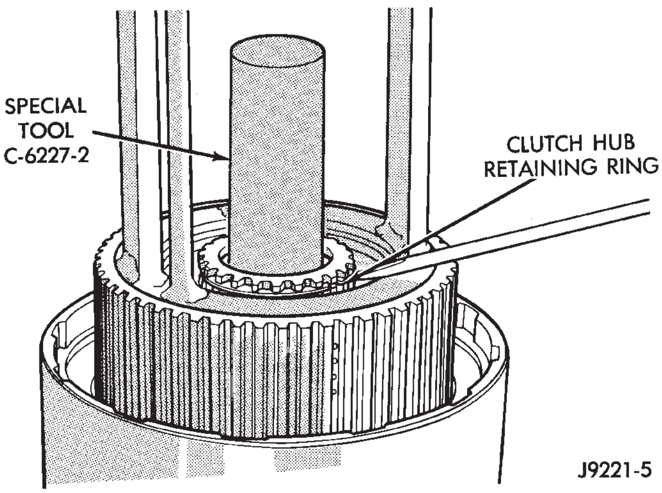


Fig. 55 Installing Clutch Hub Retaining Ring

OVERDRIVE UNIT ASSEMBLY AND ADJUSTMENT

(1) Install front bearing and snap ring on output shaft (Fig. 56). **Be sure locating ring groove in bearing is toward rear of shaft.**

(2) Install governor drive key in output shaft (Fig. 56).

(3) Install new seal rings on governor drive. Be sure ring ends are securely interlocked before proceeding (Fig. 57).

(4) Assemble governor drive and body. Be sure filter is properly seated and positioned in governor body before tightening attaching bolts.

(5) Assemble governor inner and outer weights and spring. Then install weight assembly in governor body (Fig. 58). Be sure all retaining snap rings are securely seated.

(6) Install governor assembly on output shaft (Fig. 59). Be sure drive key is fully engaged drive slot and is not displaced during installation.

(7) Align shaft holes in governor body and output shaft and install governor valve and shaft (Fig. 16).

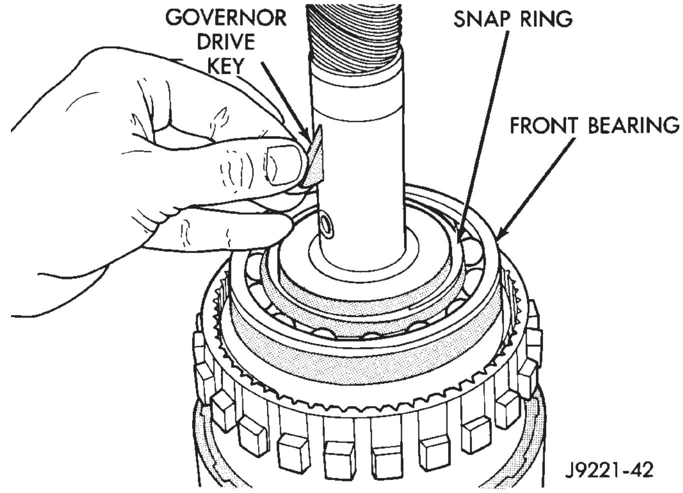


Fig. 56 Front Bearing And Drive Key Installation

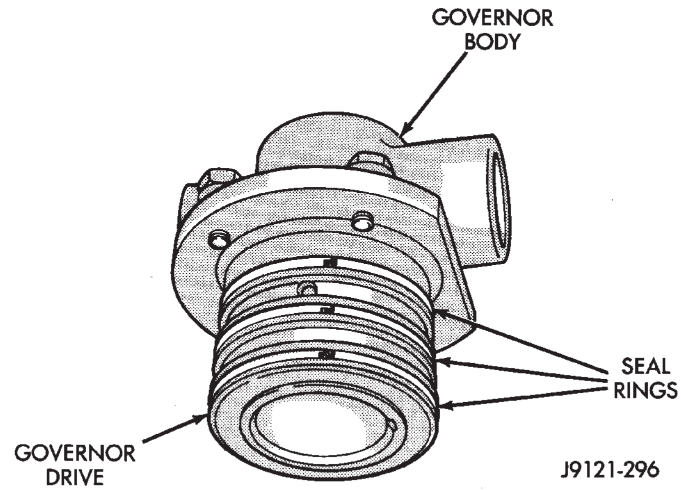


Fig. 57 Governor Drive Seal Rings

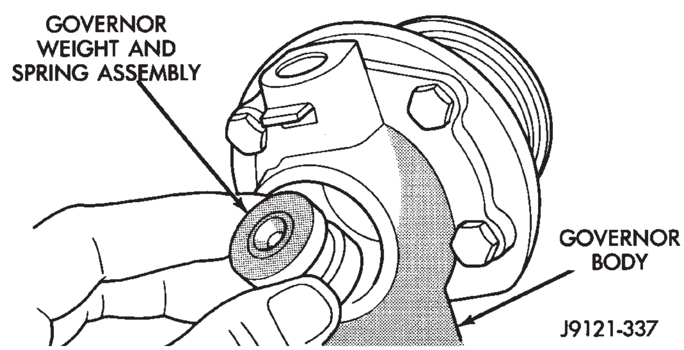


Fig. 58 Installing Governor Weight Assembly

Be very sure that E-clip retainer at each end of governor valve shaft is securely engaged.

(8) Install governor snap ring (Fig. 17).

(9) Install output shaft rear bearing in case and install bearing snap ring. Be sure snap ring is fully seated.

(10) Position park pawl and spring in case and install park pawl shaft (Fig. 14). Verify that spring end is hooked to pawl and straight end of spring

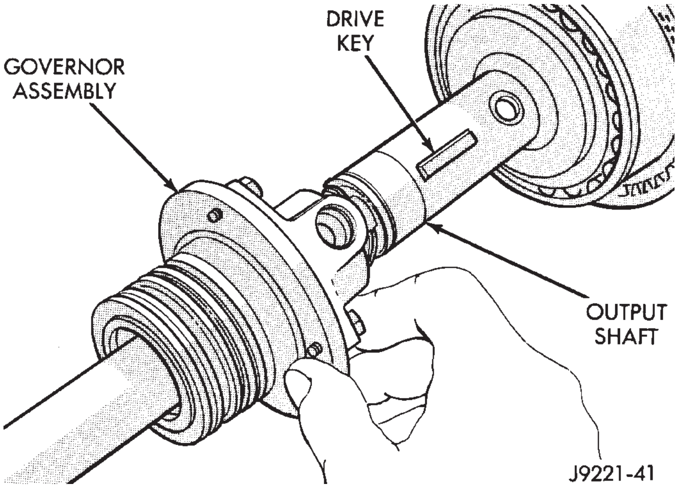


Fig. 59 Installing Governor Assembly

(11) Install pawl shaft retaining bolt. Tighten bolt to 27 N●m (20 ft. lbs.) torque.

(12) Install park lock reaction plug. **Note that plug has locating pin at rear (Fig. 60). Be sure pin is seated in hole in case before installing snap ring.**

(13) Install reaction plug snap ring (Fig. 61). **Compress snap ring only enough for installation; do not distort it.**

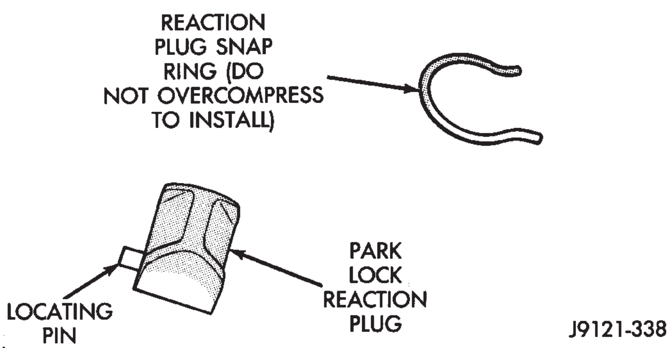


Fig. 60 Reaction Plug Locating Pin And Snap Ring

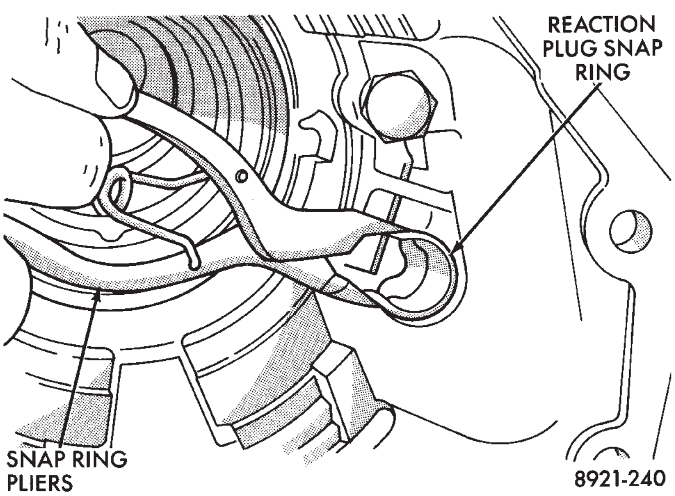


Fig. 61 Reaction Plug And Snap Ring Installation

(14) Install alignment clip on governor tubes (Fig. 62). Slide clip up against shoulder on each tube.

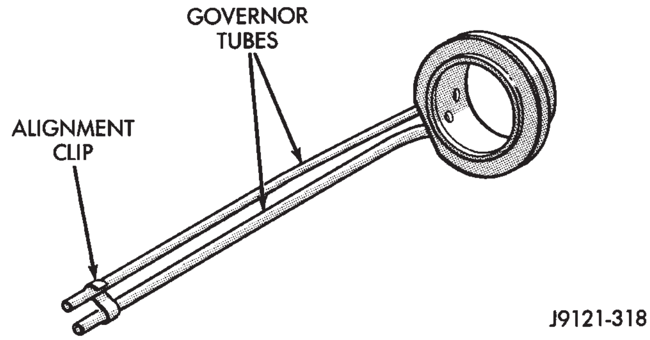


Fig. 62 Positioning Governor Tube Alignment Clip

(15) Install governor support and pressure tubes in case (Fig. 63).

(16) Install governor support snap ring (Fig. 64).

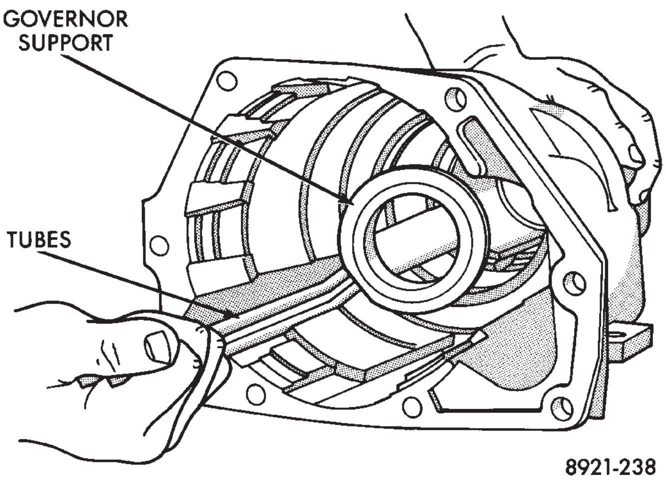


Fig. 63 Installing Governor Support And Pressure Tubes

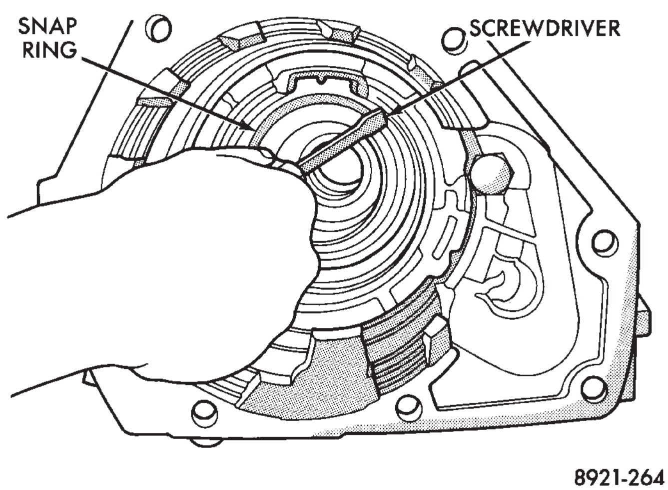


Fig. 64 Installing Governor Support Snap Ring

(17) Install output shaft front bearing locating ring in case (Fig. 65).

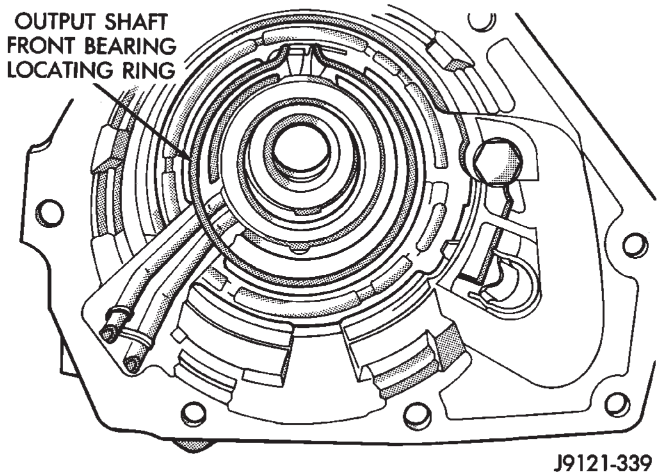


Fig. 65 Front Bearing Locating Ring Installation

(18) Support geartrain on Tool 6227-1 (Fig. 66). Be sure tool is securely seated in clutch hub.

(19) Install overdrive unit case over geartrain (Fig. 66).

(20) Expand front bearing locating ring with snap ring pliers. Then slide case downward until locating ring locks in bearing groove and release snap ring.

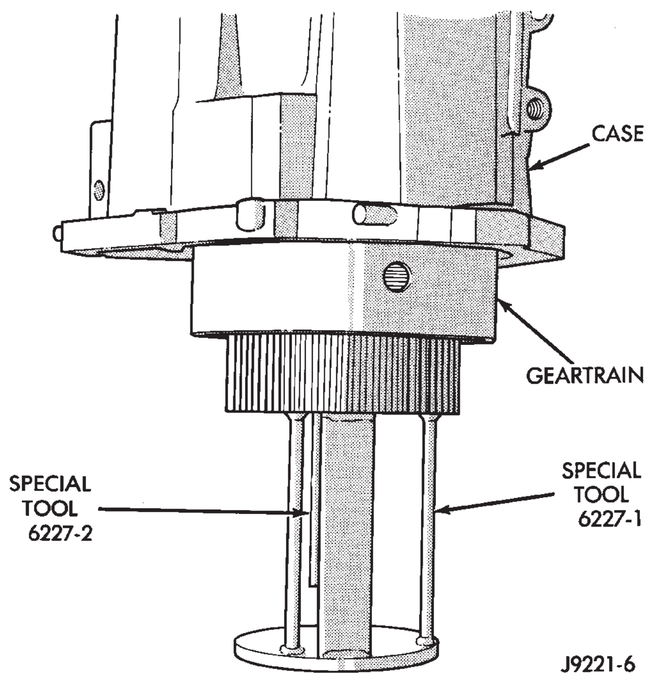


Fig. 66 Installing Overdrive Case On Geartrain

(21) Install locating ring access plate and gasket in overdrive unit case (Fig. 9).

(22) Install overdrive clutch components as follows:

(a) Install reaction ring first. Reaction ring is flat with notched ends (Fig. 67).

(b) Install wave spring on top of reaction ring. **Reaction ring and wave ring both fit in same ring groove.** Use screwdriver to seat each ring securely in groove.

(c) Install reaction plate (Fig. 68).

(d) Install first clutch disc followed by first clutch plate.

(e) Install remaining clutch discs and plates in same order.

(f) Verify clutch pack. 4 clutch discs, 3 steel plates, 1 reaction plate and 1 pressure plate are required.

(g) Install clutch pack pressure plate (Fig. 68).

(h) Install clutch pack wire-type retaining ring (Fig. 67).

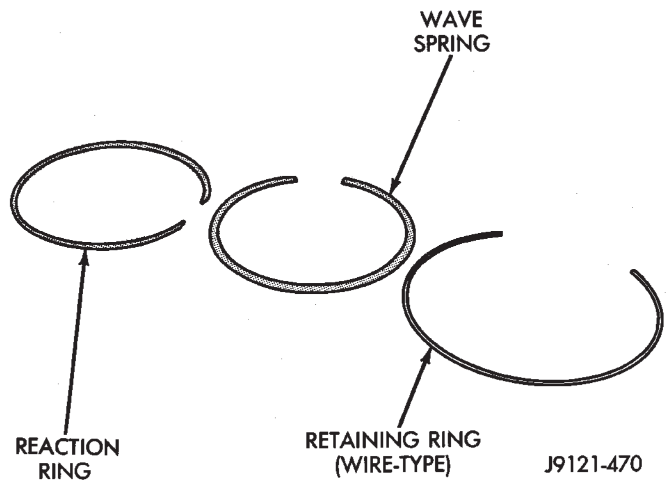


Fig. 67 Overdrive Clutch Ring Identification

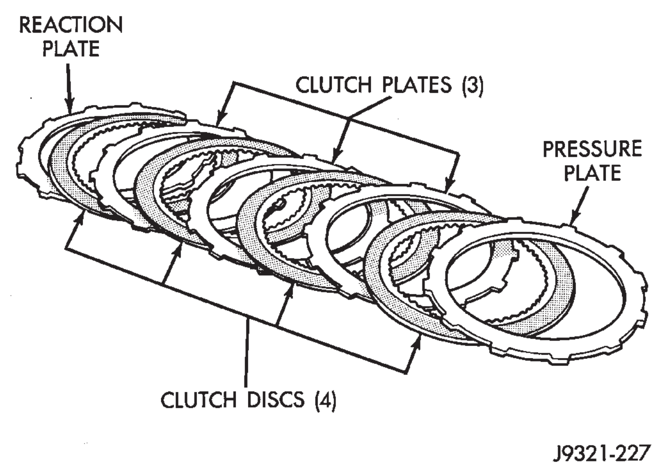


Fig. 68 Overdrive Clutch Pack Components

(23) Place overdrive unit in vertical position and mount unit in vise or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub.

(24) Determine correct thickness **intermediate shaft spacer** as follows:

(a) Insert Special Tool 6312 through sun gear, planetary gear and into pilot bushing in output shaft. Be sure tool bottoms against planetary shoulder.

(b) Position Gauge Tool 6311 across face of overdrive case (Fig. 69). Then position Dial Caliper C-4962 over gauge tool.

(c) Extend sliding scale of dial caliper downward through gauge tool slot until scale contacts end of Gauge Alignment Tool 6312. Lock scale in place. Remove dial caliper tool and note distance measured (Fig. 69).

(d) Select proper thickness end play spacer from spacer chart based on distance measured (Fig. 70).

(e) Remove Gauge Alignment Tool 6312.

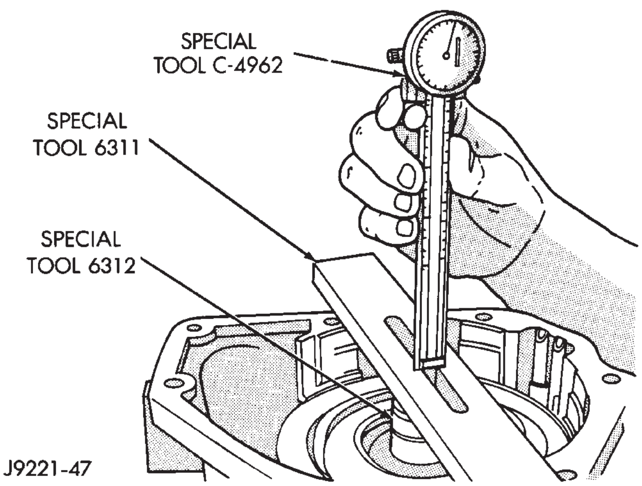


Fig. 69 Shaft End Play Measurement

End Play Measurement (Inches)	Spacer Thickness (Inches)
.7336 - .7505	.158 - .159
.7506 - .7675	.175 - .176
.7676 - .7855	.193 - .194
.7856 - .8011	.211 - .212

J9121-341

Fig. 70 Intermediate Shaft End Play Spacer Selection

(25) Determine correct thickness **overdrive piston thrust plate** as follows:

(a) Position Gauge Tool 6311 across face of overdrive case. Then position Dial Caliper C-4962 over gauge tool (Fig. 71).

(b) Measure distance to clutch hub thrust bearing seat at four points 90° apart. Then average measurements by adding them and dividing by 4.

(c) Select and install required thrust plate from information in thrust plate chart (Fig. 72).

(26) Leave Alignment Tool 6227-2 in place. Tool will keep planetary and clutch hub splines in alignment until overdrive unit is ready for installation on transmission.

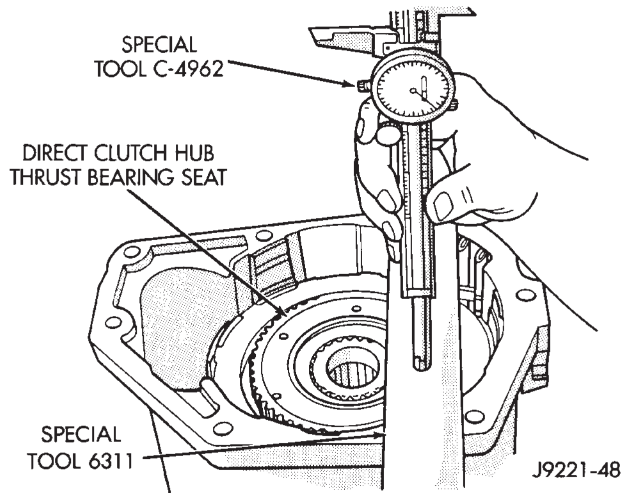


Fig. 71 Overdrive Piston Thrust Plate Measurement

End Play Measurement (Inches)	Spacer Thickness (Inches)
1.7500 - 1.7649	.108 - .110
1.7650 - 1.7799	.123 - .125
1.7800 - 1.7949	.138 - .140
1.7950 - 1.8099	.153 - .155
1.8100 - 1.8249	.168 - .170
1.8250 - 1.8399	.183 - .185
1.8400 - 1.8549	.198 - .200
1.8550 - 1.8699	.213 - .215
1.8700 - 1.8849	.228 - .230
1.8850 - 1.8999	.243 - .245

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Fig. 72 Overdrive Piston Thrust Plate Selection

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.

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.

OPERATING RANGES

NP231 operating ranges are: 2-wheel drive high; 4-wheel drive high and 4-wheel drive low (Fig. 2).

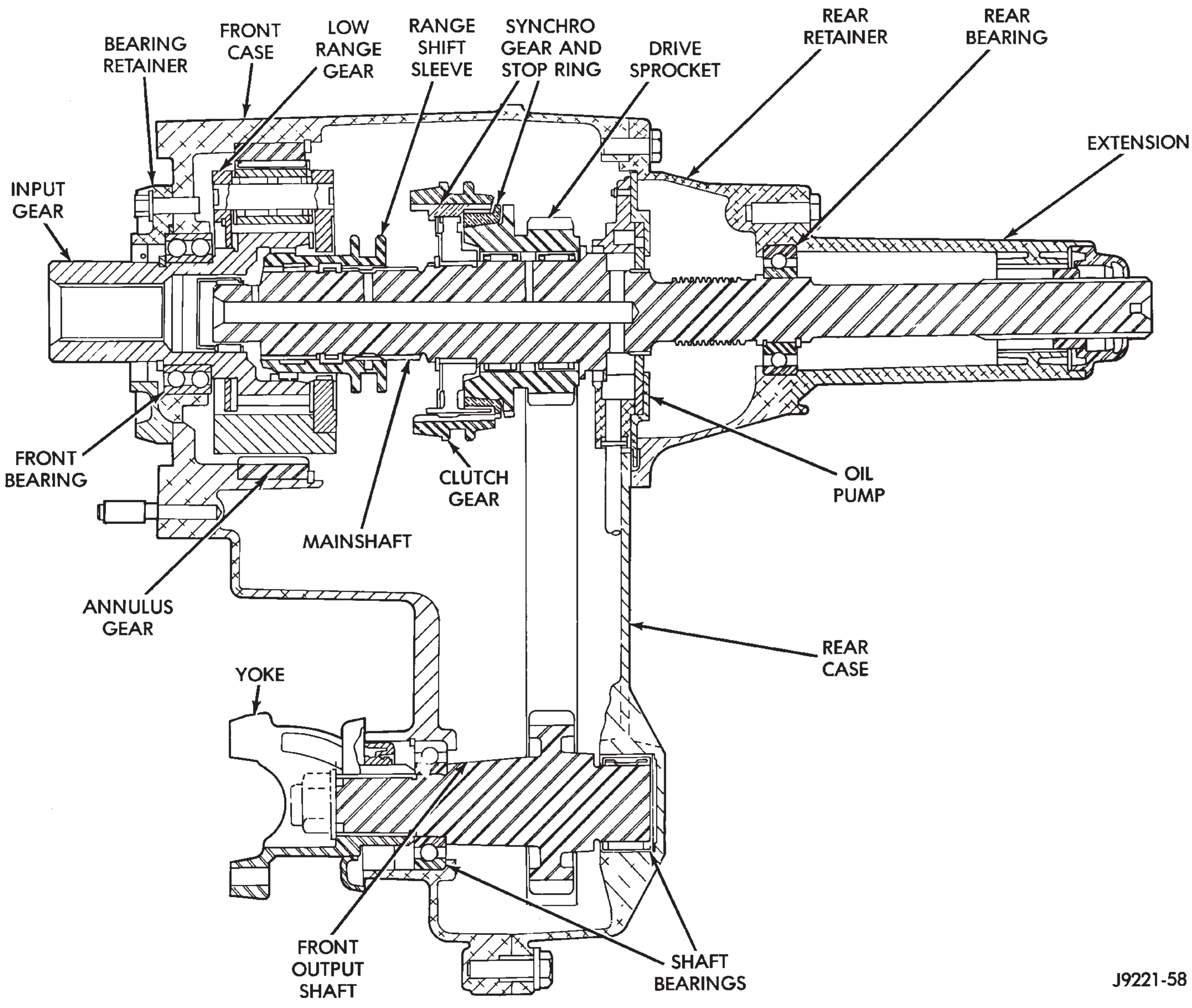

Fig. 1 NP231 Transfer Case

The NP231 is a part-time transfer case. The 4-wheel drive ranges are undifferentiated and should only be used on unpaved or 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.

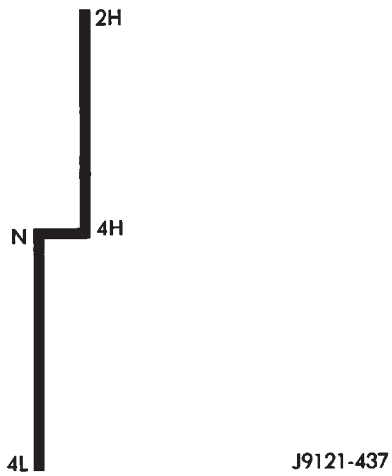

Fig. 2 NP231 Shift Pattern

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 12-10-91 would represent December 10, 1991.

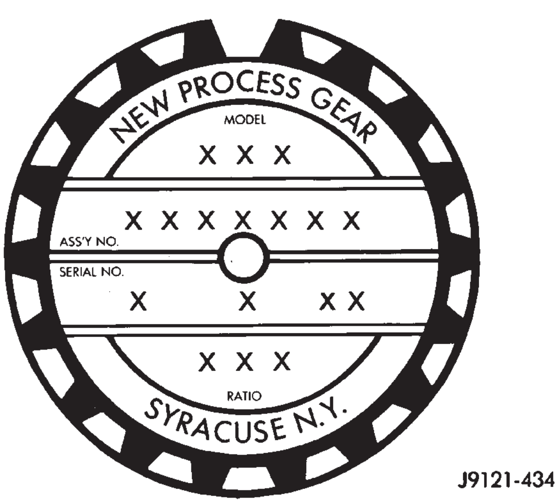

Fig. 3 Transfer Case Identification Tag

TRANSFER CASE LUBRICANT

Recommended Lubricant And Capacity

Use Mopar ATF Plus, type 7176, or Dexron II automatic transmission fluid in the NP231 transfer case. Approximate refill capacity is 1.54 liters (1.6 qts.).

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.

SHIFT LINKAGE ADJUSTMENT

(1) Shift transfer case into Neutral position.

(2) Raise vehicle on hoist.

(3) Loosen lock bolt in selector rod trunnion (Figs. 4 and 5).

(4) Verify that transfer case shift lever (Figs. 4 and 5) is in neutral position.

(5) Move trunnion on selector rod forward, or rearward as necessary. Then tighten trunnion lock bolt to 8-14 N●m (72-120 in. lbs.) torque.

(6) Lower vehicle and check transfer case shifting.

(7) Verify that transfer case is fully engaged in 2H, 4H and 4L positions. Readjust linkage if necessary.

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 speed sensor and remove speedometer adapter and sensor if necessary.

(9) Disconnect transfer case shift lever from shift lever rod.

(10) Disconnect vent hose and electrical connectors.

(11) Support transfer case with transmission jack.

(12) Remove bolts 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 (Fig. 6).

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. (2) If vehicle was operated for extended period in 4H mode on dry paved surface, driveline torque load may cause difficulty. (3) Transfer case external shift linkage binding. (4) Insufficient or incorrect lubricant. (5) Internal components binding, worn or damaged.	(1) Stop vehicle and shift into desired range. Or reduce speed to 3-4 km/h (2-3 mph) before attempting to shift. (2) Stop vehicle, shift transmission to Neutral, shift transfer case to 2H mode and operate vehicle in 2H on dry paved surfaces. (3) Lubricate, repair or replace linkage bushings or tighten loose components as necessary. (4) Drain and refill to edge of fill hole with DEXRON II® or MOPAR-MERCON® Automatic Transmission Fluid. (5) Disassemble unit and replace worn or damaged components as necessary.
TRANSFER CASE NOISY IN ALL DRIVE MODES	(1) Insufficient or incorrect lubricant.	(1) Drain and refill to edge of fill hole with DEXRON II® or MOPAR-MERCON® Automatic Transmission Fluid. Check for leaks and repair if necessary. **Note: If unit is still noisy after drain and refill, disassembly and inspection may be required to locate source of noise.**
NOISY IN – OR JUMPS OUT OF – FOUR WHEEL DRIVE LOW RANGE	(1) Transfer case not completely engaged in 4L position. (2) Shift linkage out of adjustment. (3) Shift linkage loose or binding. (4) Range fork damaged, inserts worn, or fork is binding on shift rail. (5) Low range gear worn or damaged.	(1) Stop vehicle, shift transfer case to Neutral, then shift back into 4L position. (2) Adjust linkage. (3) Tighten, lubricate or repair linkage as necessary. (4) Disassemble unit and repair as necessary. (5) Disassemble and repair as necessary.
LUBRICANT LEAKING FROM OUTPUT SHAFT SEALS OR FROM VENT	(1) Transfer case overfilled. (2) Vent closed or restricted. (3) Output shaft seals damaged or installed incorrectly.	(1) Drain to correct level. (2) Clear or replace vent if necessary. (3) Replace seals. Be sure seal lip faces interior of case when installed. Also be sure yoke seal surfaces are not scored or nicked. Remove scores and nicks with fine sandpaper or replace yoke(s) if necessary.
ABNORMAL TIRE WEAR	(1) Extended operation on dry hard surface (paved) roads in 4H range.	(1) Operate in 2H on hard surface (paved) roads.

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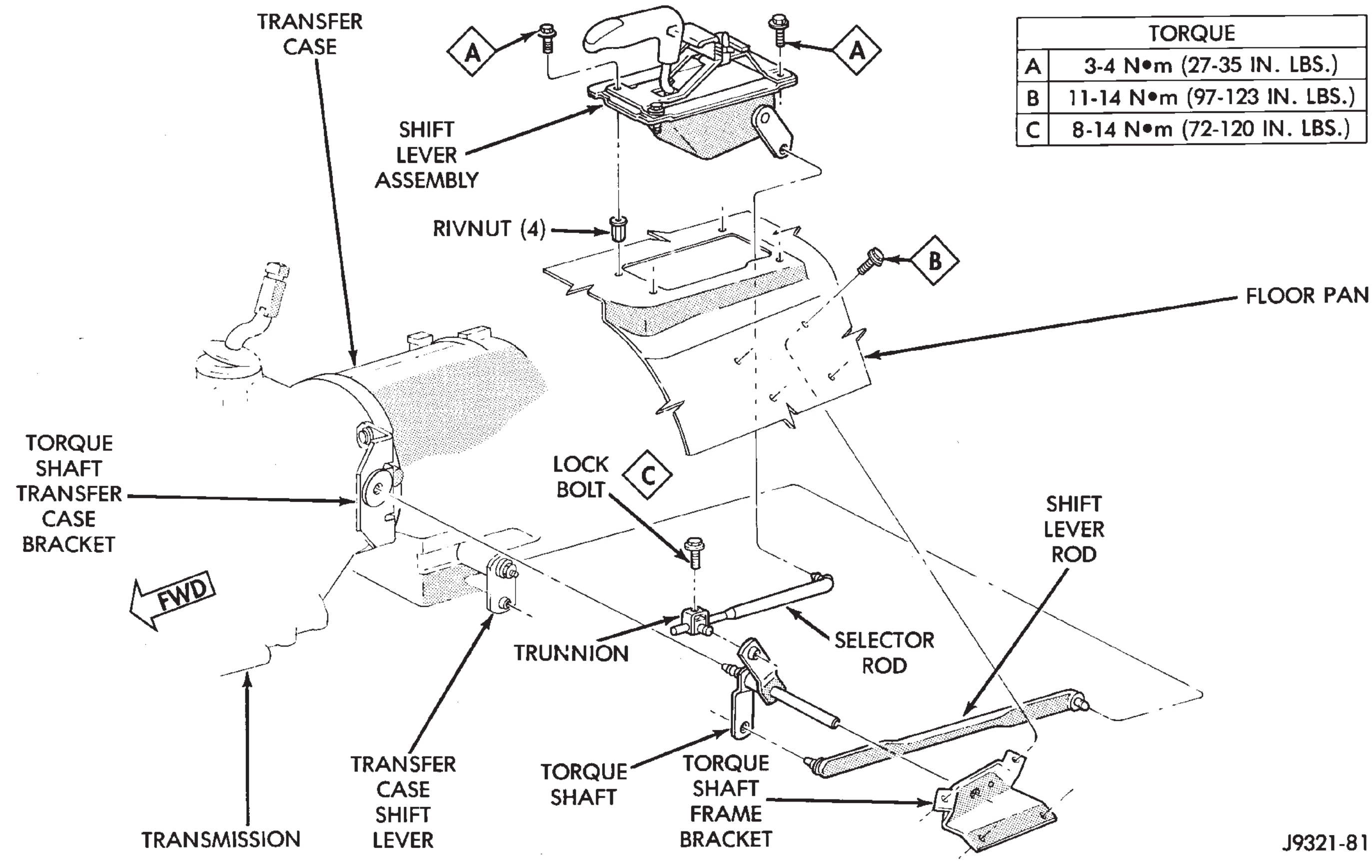


Fig. 4 Transfer Case Shift Linkage (Manual Transmission)

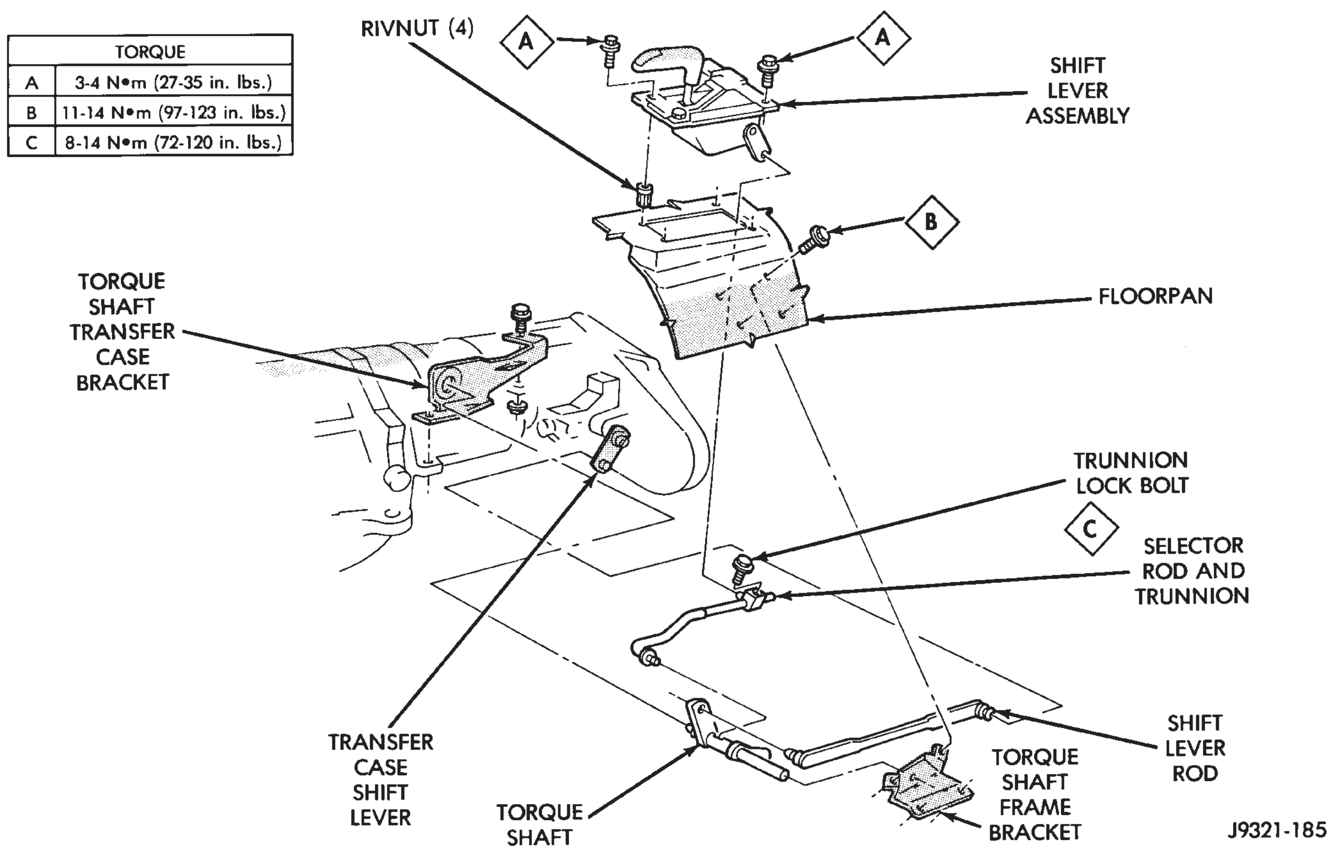


Fig. 5 Transfer Case Shift Linkage (Automatic Transmission)

(4) Install and tighten transfer case attaching nuts to 35 N●m (26 ft. lbs.) torque (Fig. 6).

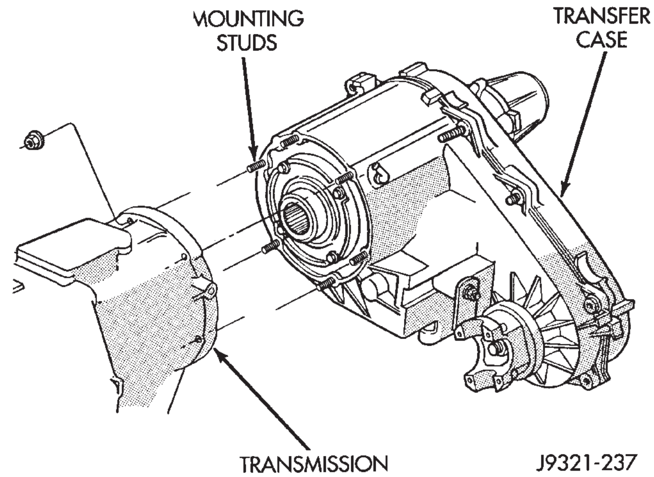


Fig. 6 Transfer Case Attachment

(5) Install speedometer adapter if removed during service (Fig. 7). Then index adapter and install speed sensor in adapter. Refer to In-Vehicle Service section.

(6) Connect electrical wires to speed sensor.

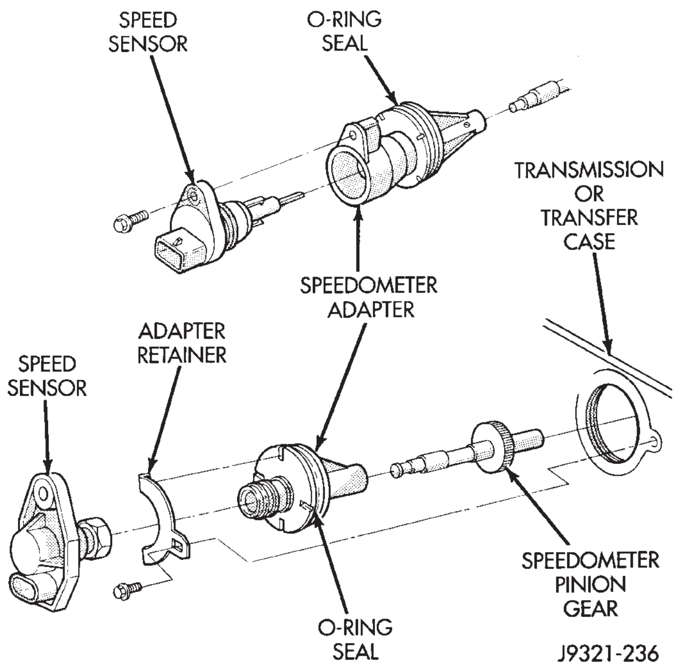


Fig. 7 Speedometer Components

(7) Connect vent hose to transfer case vent (Fig. 8).

(8) Align and connect propeller shafts. Tighten shaft attaching bolts to 19 N●m (170 in. lbs.) torque.

(9) Fill transfer case with Mopar Dexron II automatic transmission fluid.

(10) Install rear crossmember if removed. Tighten crossmember bolts to 41 N●m (30 ft. lbs.) torque.

(11) Remove transmission jack and transmission support stand.

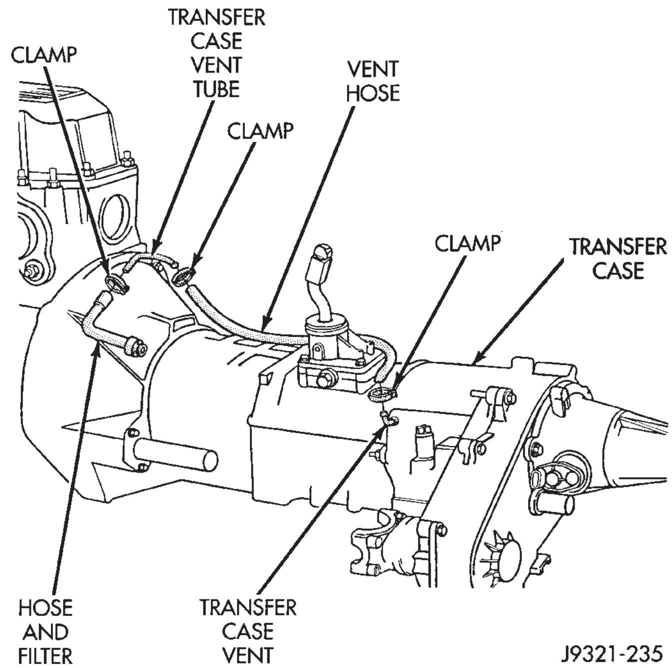


Fig. 8 Transfer Case Vent Hose Routing

(12) Connect transfer case shift lever to shift lever rod.

(13) Check and adjust transfer case shift linkage if necessary.

(14) 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.

(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.

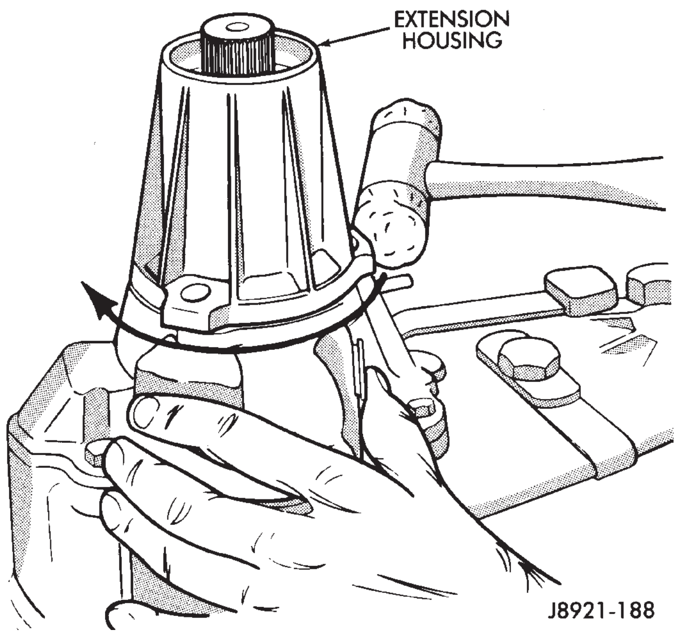


Fig. 1 Extension Housing Removal

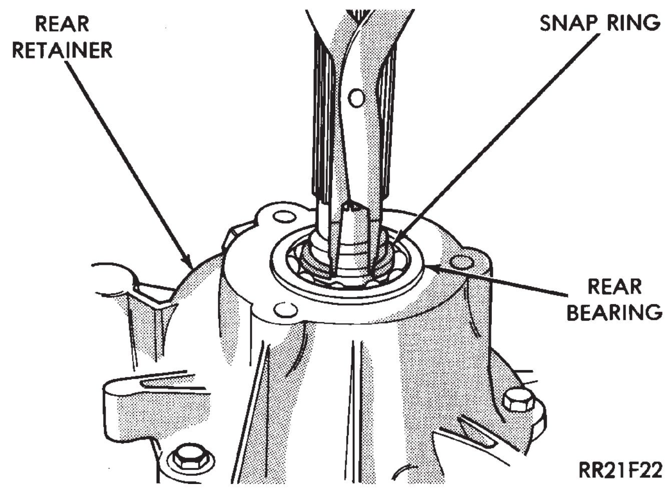


Fig. 2 Rear Bearing Snap Ring Removal

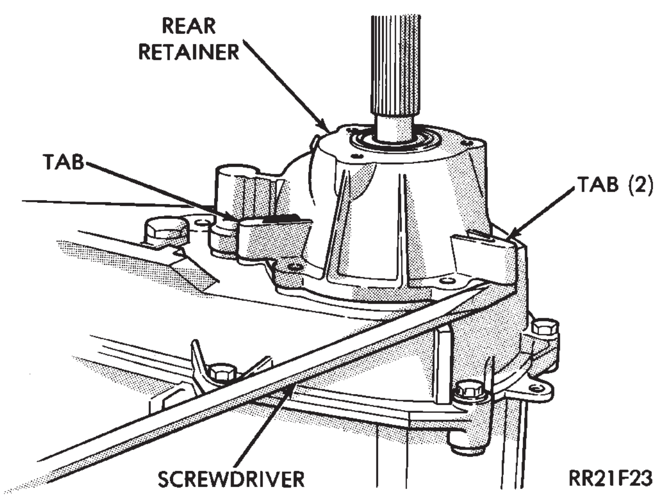


Fig. 3 Rear Retainer Removal

CAUTION: Do not pry against the sealing surfaces of the retainer or rear case. The surfaces could be damaged.

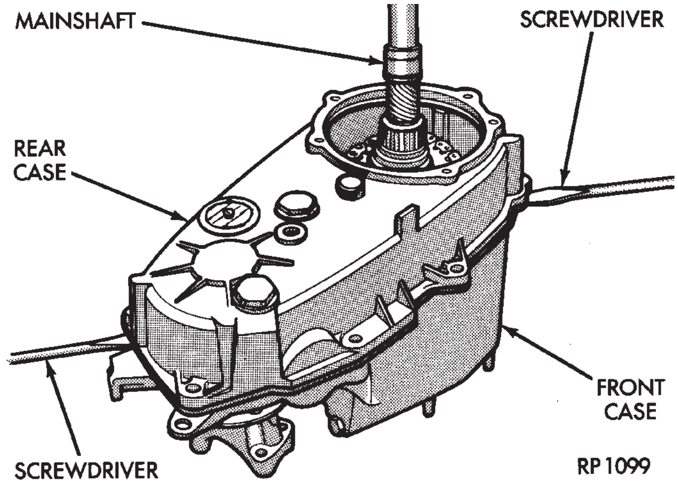


Fig. 4 Loosening Rear Case

(9) Remove bolts attaching rear case to front case. Retain bolts and washers.

(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.

(11) Remove oil pump and rear case as an assembly (Fig. 5).

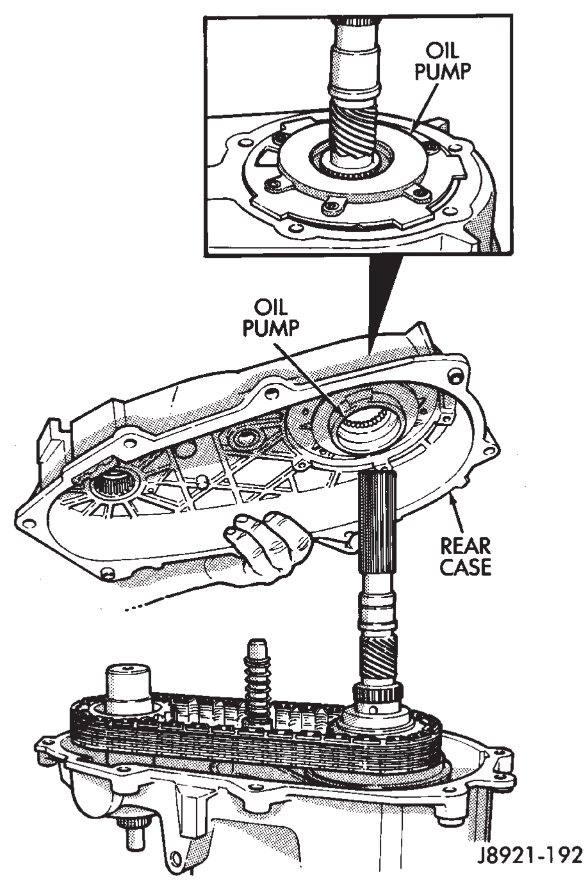


Fig. 5 Rear Case And Oil Pump Removal

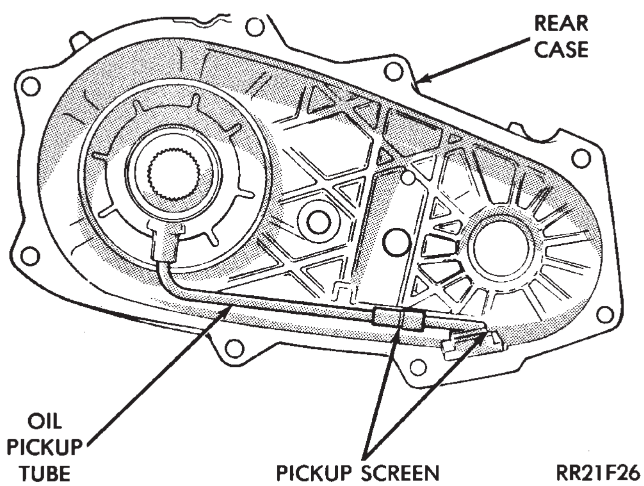


Fig. 6 Removing Oil Screen And Pickup Tube 16

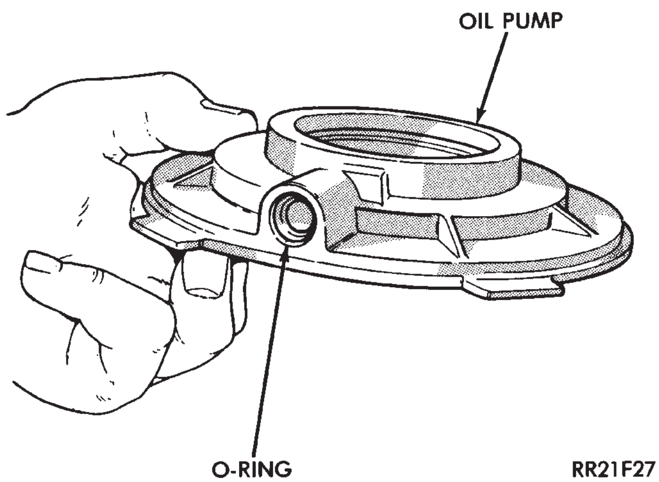


Fig. 7 Pickup Tube O-Ring Location

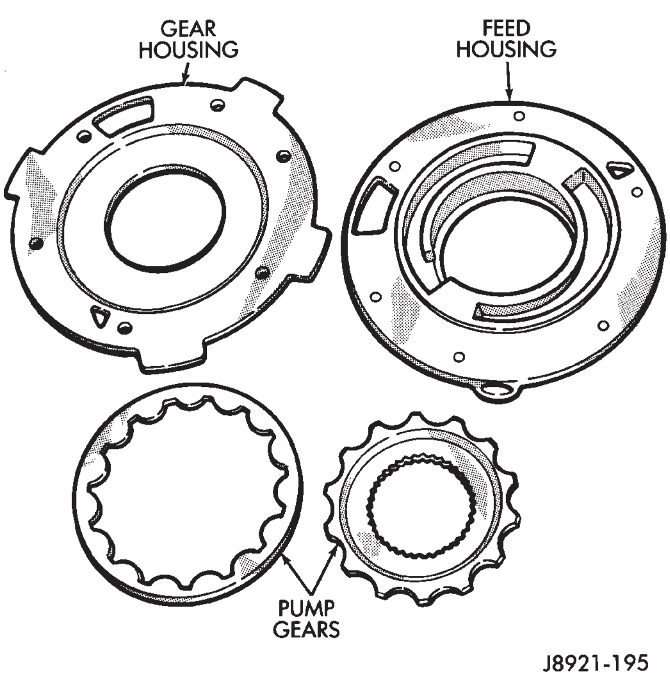


Fig. 8 Oil Pump Components

(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).

(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.**

(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).

(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).

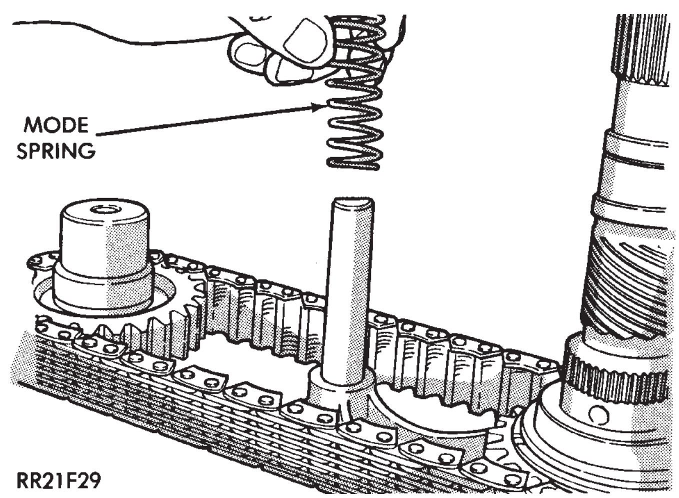


Fig. 9 Mode Spring Removal

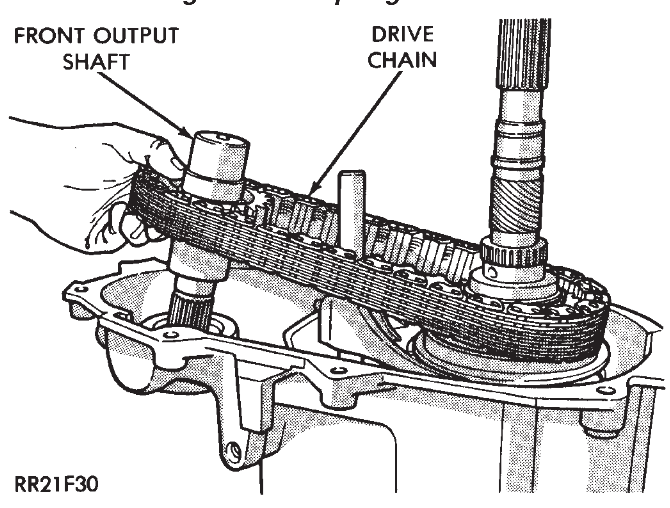


Fig. 10 Front Output Shaft And Drive Chain Removal

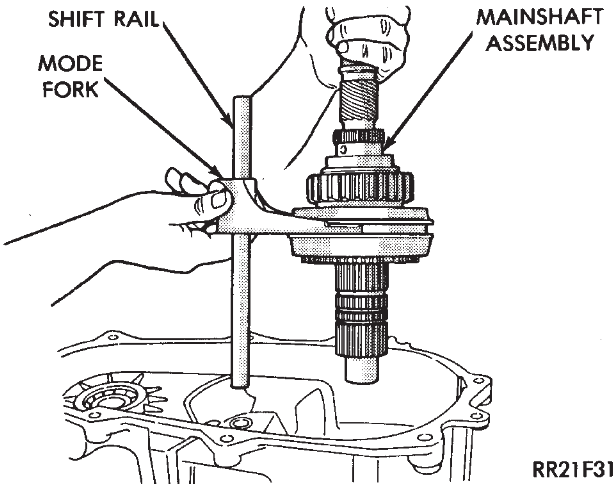


Fig. 11 Removing Mainshaft, Mode Fork And Shift Rail

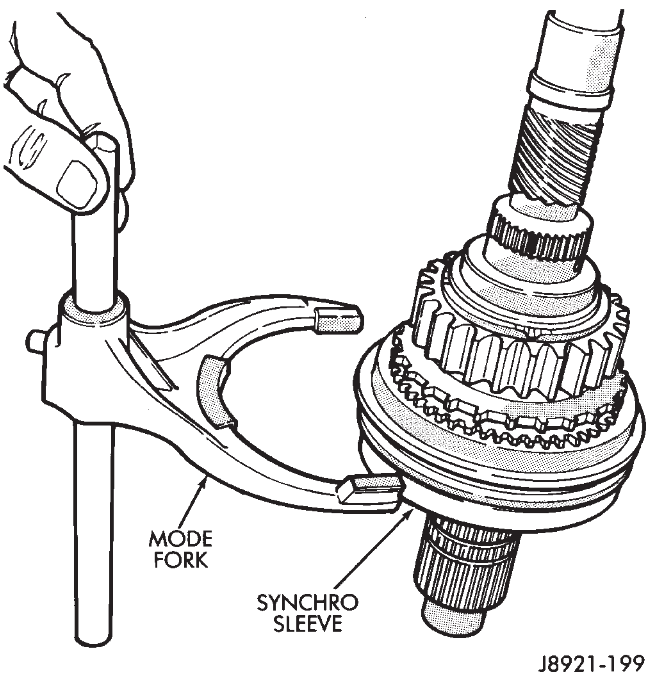


Fig. 12 Removing Mode Fork From Sleeve

(22) Remove mainshaft, mode fork and shift rail as assembly (Fig. 11).

(23) Remove mode fork and shift rail from synchro sleeve (Fig. 12).

(24) Remove synchro hub snap ring (Fig. 13).

(25) Remove synchro sleeve, hub and struts (Fig. 14).

(26) Remove synchro hub and stop ring (Fig. 15).

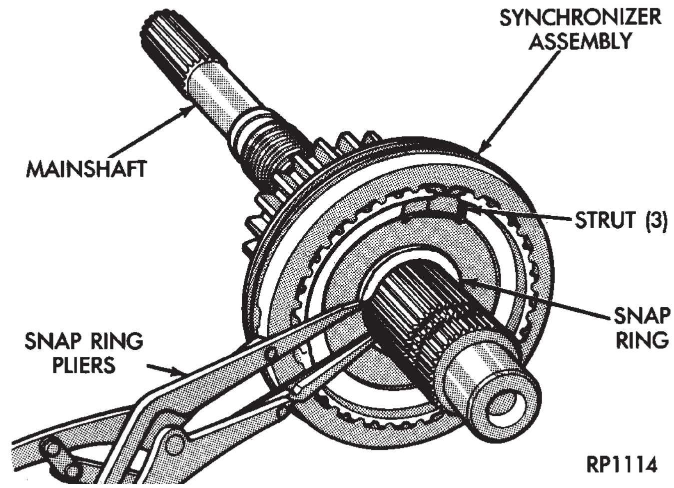


Fig. 13 Synchro Hub Snap Ring Removal/Installation

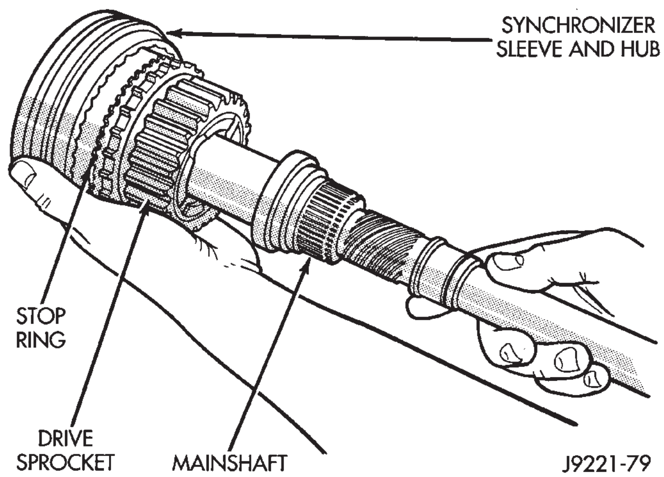


Fig. 14 Removing Synchro Sleeve, Hub And Struts

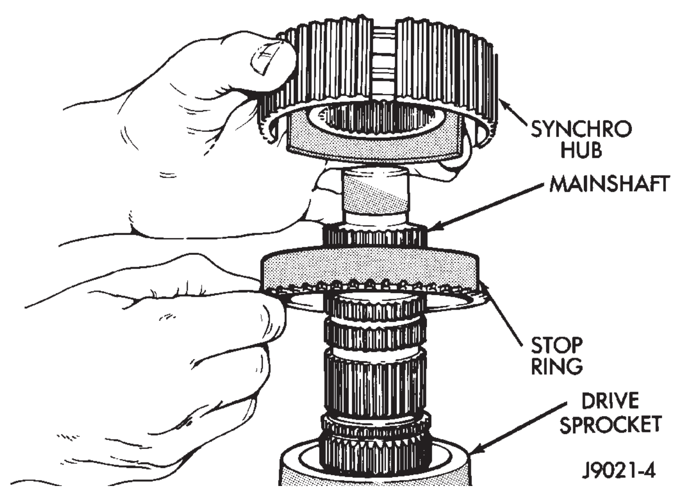


Fig. 15 Removing Synchro Hub And Stop Ring

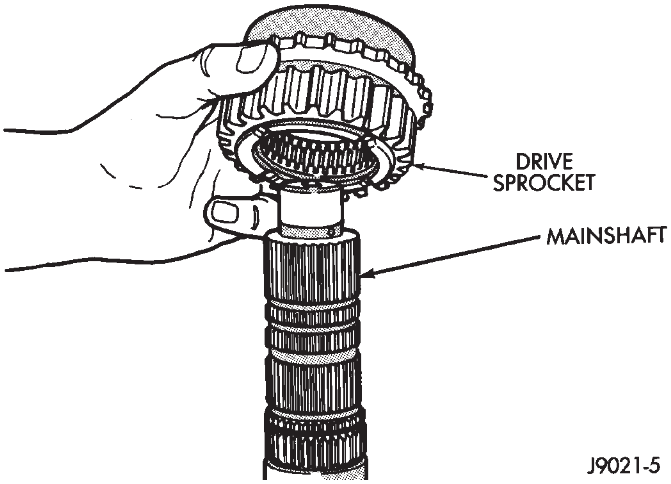


Fig. 16 Drive Sprocket Removal/Installation

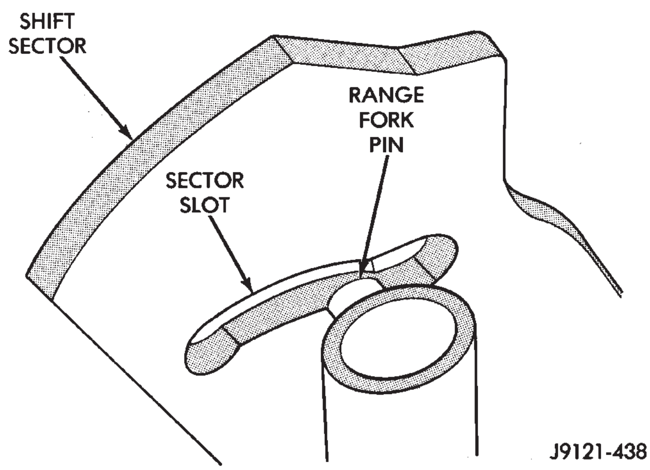


Fig. 17 Disengaging Range Fork

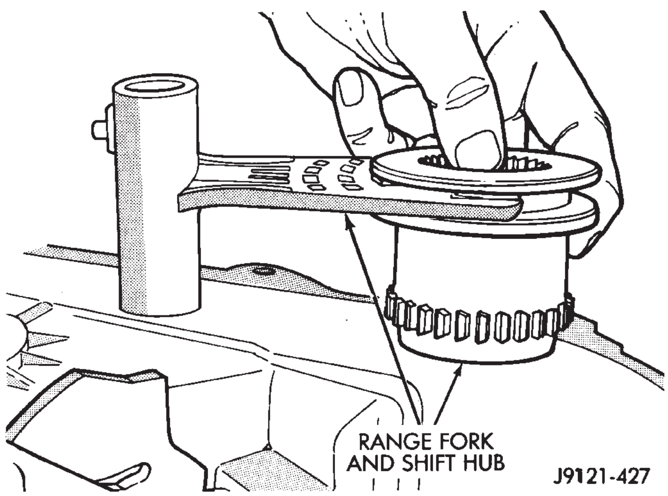


Fig. 18 Range Fork And Hub Removal/Installation

(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).

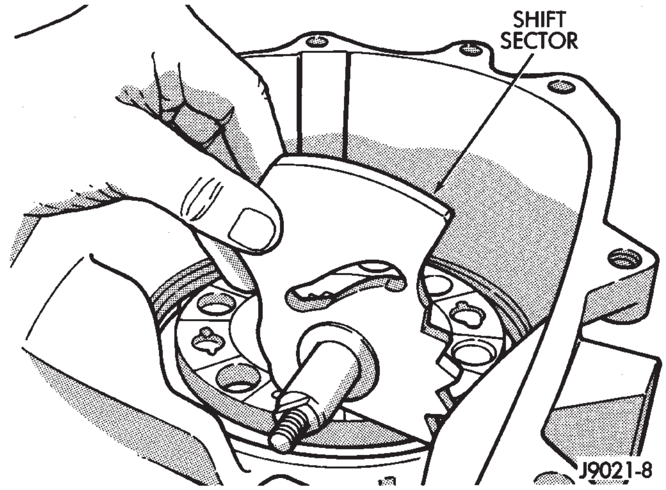


Fig. 19 Shift Sector Removal/Installation

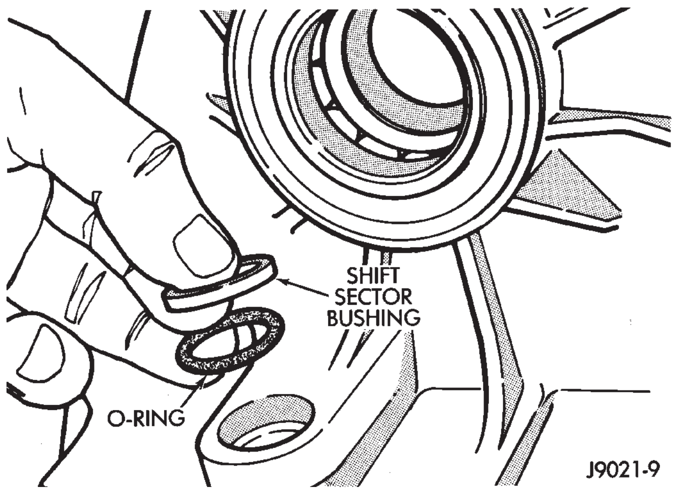


Fig. 20 Removing/Installing Sector Shaft Bushing And O-Ring

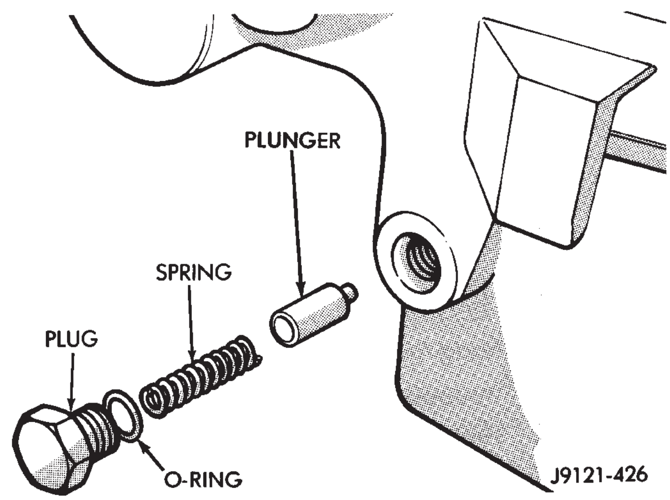


Fig. 21 Detent Component Removal

(32) Remove sector shaft bushing and O-ring (Fig. 20).

(33) Remove shift detent plunger, spring and plug (Fig. 21). Remove O-ring from plug after removal.

(34) Turn front case over and remove front bearing retainer bolts (Fig. 22).

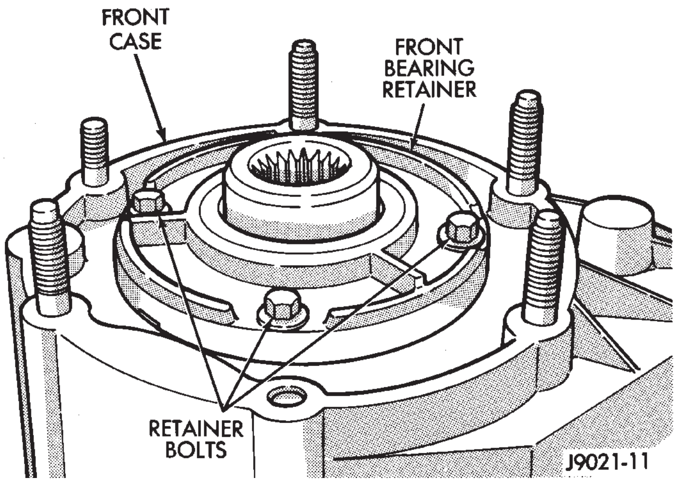


Fig. 22 Front Bearing Retainer Bolt Locations

(35) Remove front bearing retainer. Position screwdrivers in retainer slots and lift upward to loosen and remove retainer (Fig. 23).

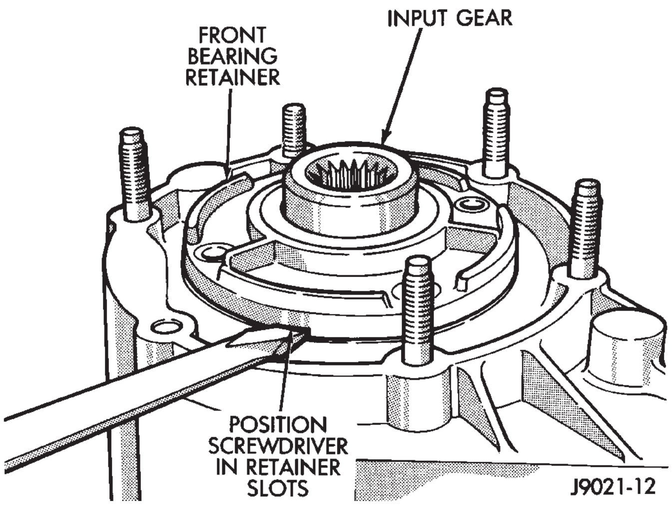


Fig. 23 Removing Front Bearing Retainer

(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.

(42) Remove the speedometer driven gear, seals and adapter.

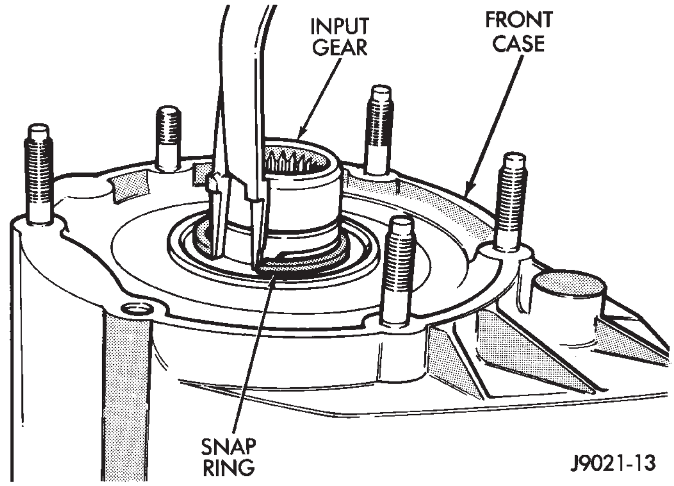


Fig. 24 Removing Input Gear Snap Ring

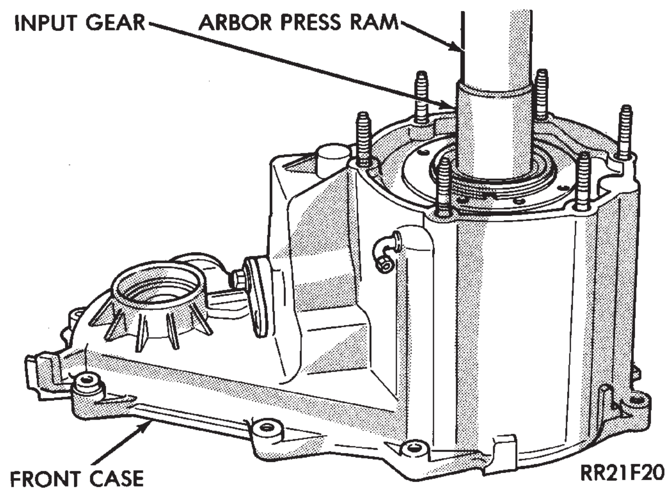


Fig. 25 Removing Input And Low Range Gear Assembly

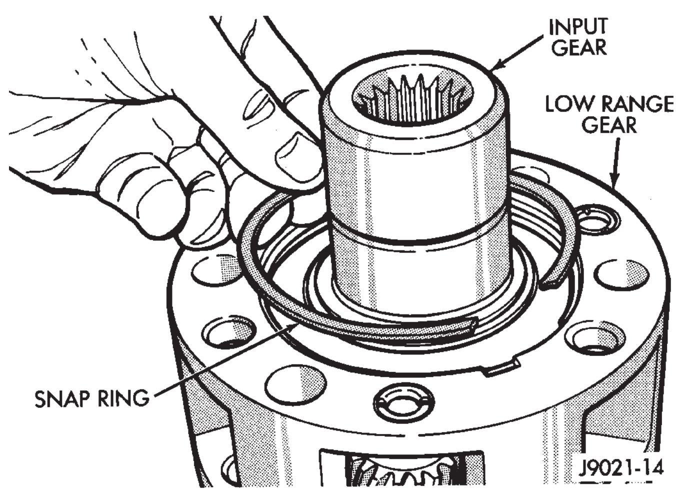


Fig. 26 Removing Low Range Gear Snap Ring

TRANSFER CASE CLEANING AND INSPECTION

Clean the transfer case components thoroughly with solvent. Remove all traces of sealer from the case and retainer seal surfaces.

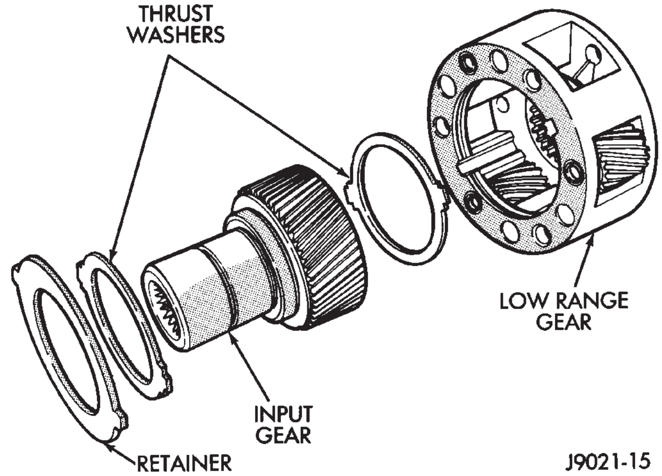


Fig. 27 Input And Low Range Gear Components

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.**

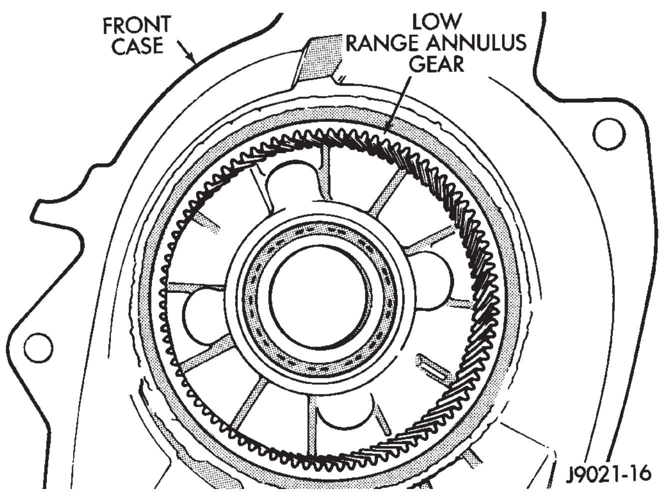


Fig. 28 Inspect Low Range Annulus Gear

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).

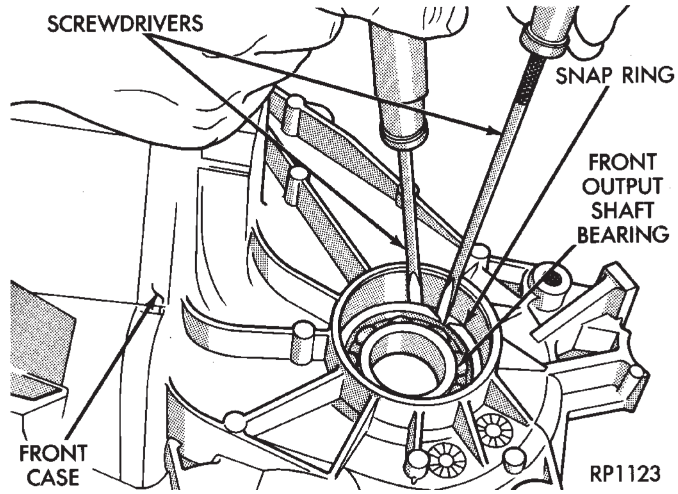


Fig. 29 Removing/Installing Front Output Shaft Bearing Snap Ring

(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 a new snap ring (Fig. 29).

(6) Install new front output shaft seal in front case.

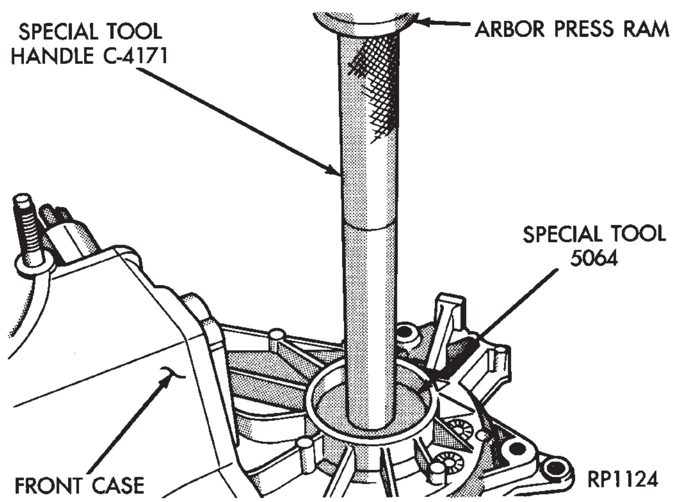


Fig. 30 Installing Output Shaft Front Bearing

(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.

(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).

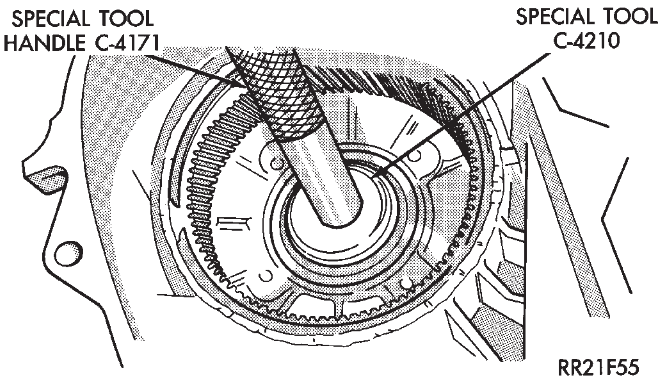


Fig. 31 Removing Input Gear Bearing

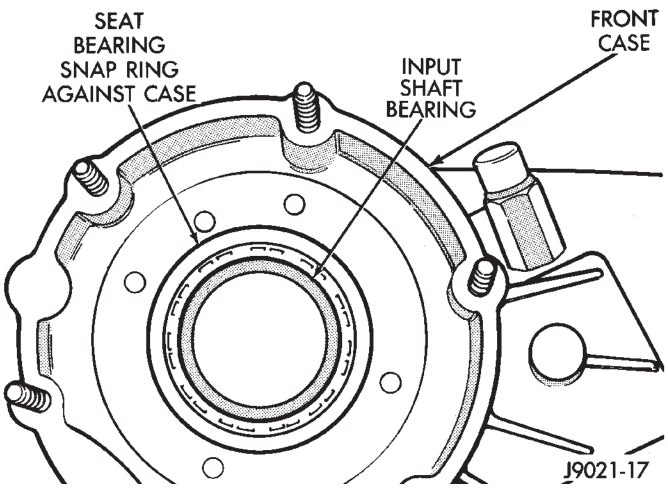


Fig. 32 Input Gear Bearing Installation

(10) Remove mainshaft pilot bearing from input gear with Tool MD-998346 and two suitable size open end wrenches (Fig. 33).

(11) Install new pilot bearing in input gear with shop press, Tool Handle C-4171 and Installer 5065 (Fig. 34).

(12) Assemble low range gear, input gear thrust washers, input gear and input gear retainer (Fig. 35).

(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).

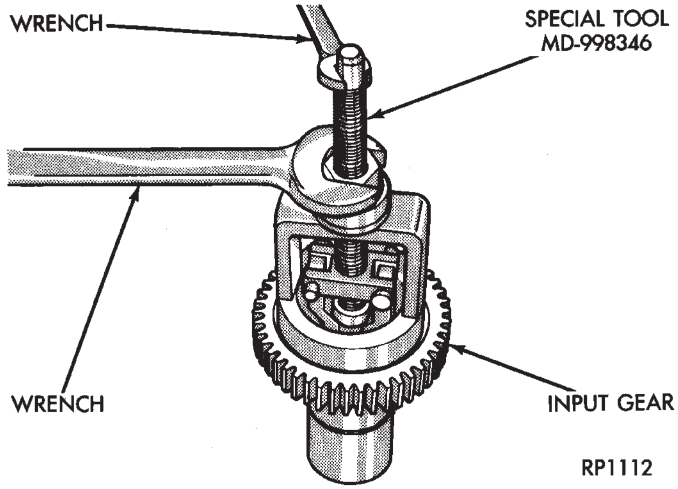


Fig. 33 Removing Mainshaft Pilot Bearing From Input Gear

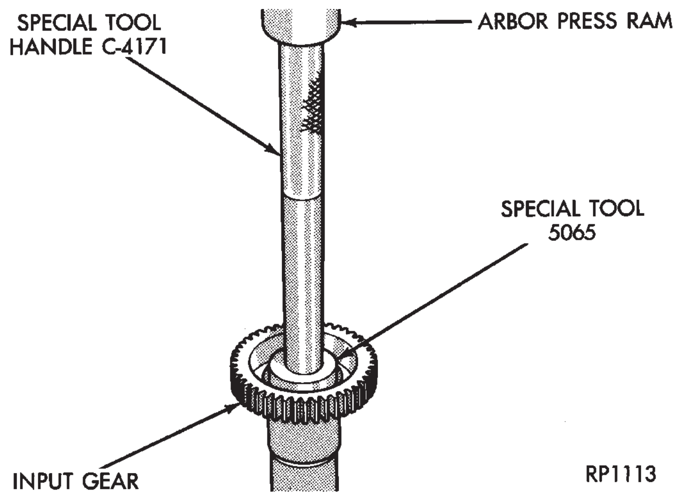


Fig. 34 Installing Mainshaft Pilot Bearing In Input Gear

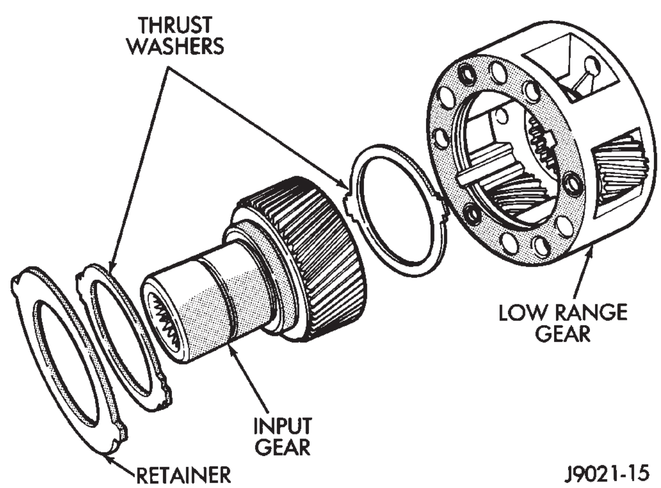


Fig. 35 Input And Low Range Gear Assembly

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. 36). Also, do not press against the end surfaces of the low range gear. The gear case and thrust washers could be damaged.

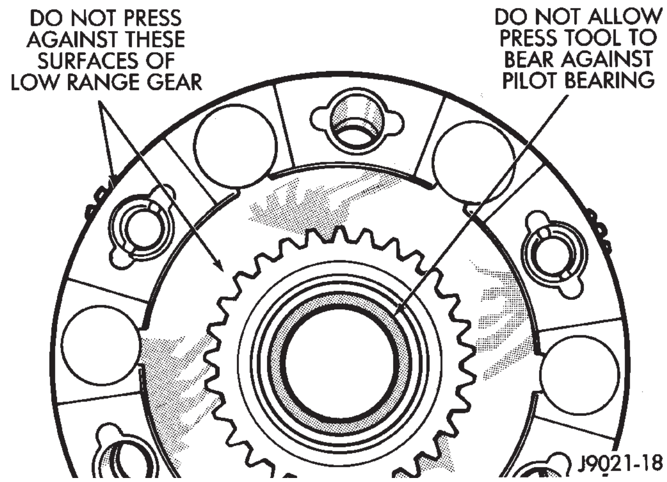


Fig. 36 Input And Low Range Gear Installation

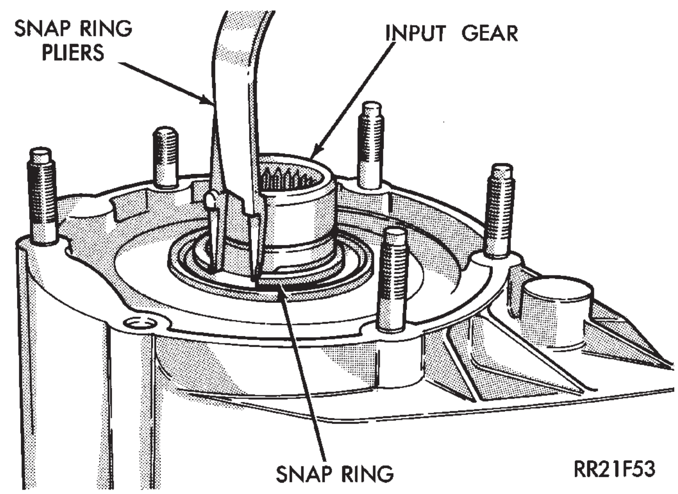


Fig. 37 Installing Input Gear Snap Ring

(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 silicone sealer 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).

(22) Install shift sector in the case (Fig. 40).

(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.

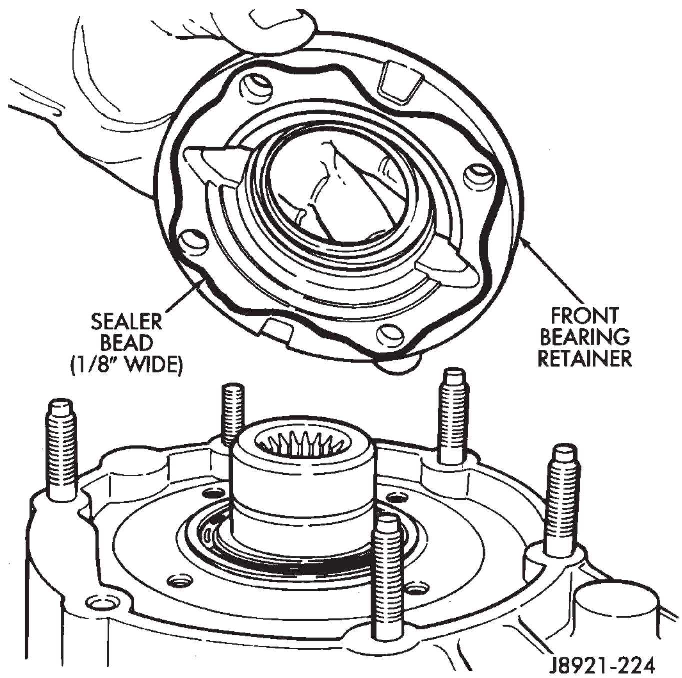


Fig. 38 Applying Sealer To Front Bearing Retainer

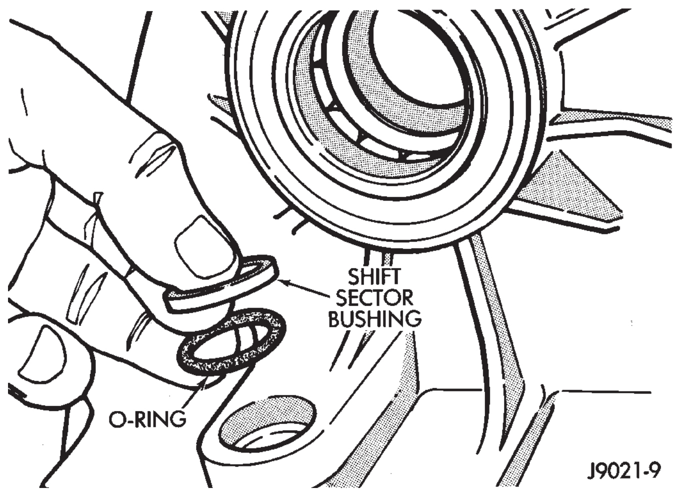


Fig. 39 Installing Sector O-Ring And Bushing

(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.

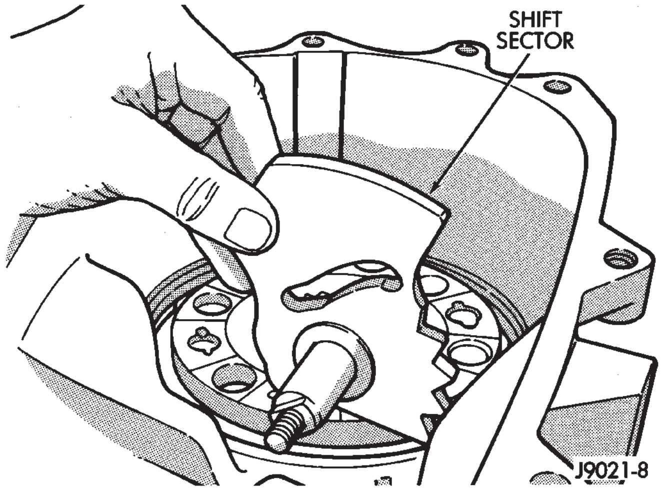


Fig. 40 Installing Shift Sector

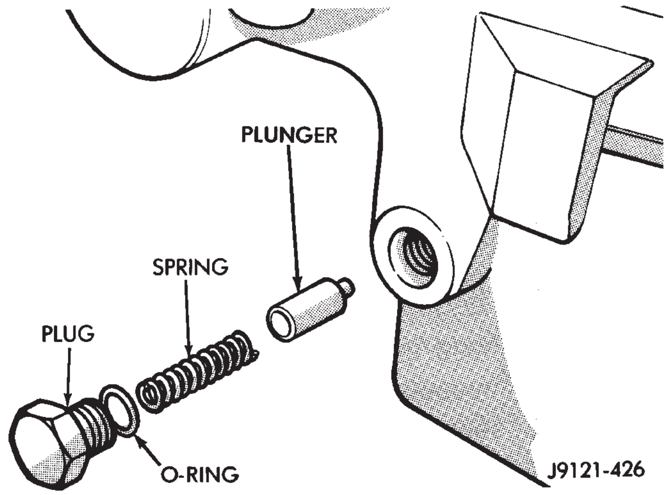


Fig. 41 Installing Detent Plunger-Spring-Plug

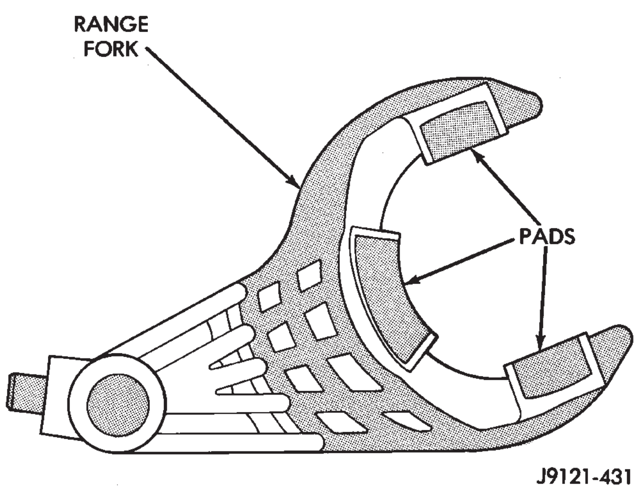


Fig. 42 Range Fork Pads

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.

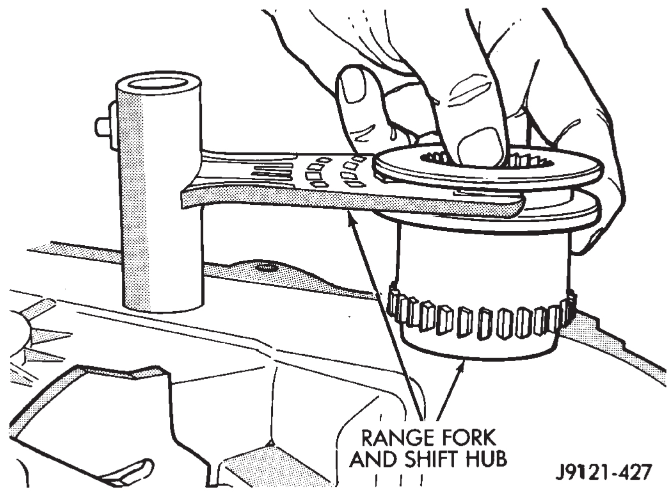


Fig. 43 Assembling Range Fork And Shift Hub

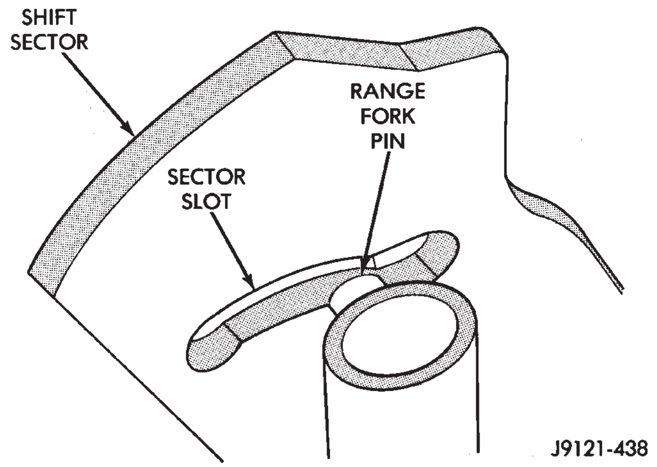


Fig. 44 Seating Range Fork In Sector

(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 it is 4.6 mm (3/16 in.) below edge of bore as shown in Figure 46.

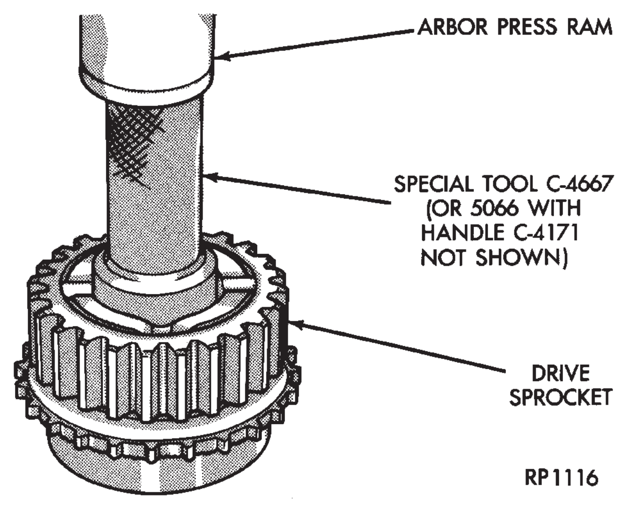


Fig. 45 Removing Drive Sprocket Bearings

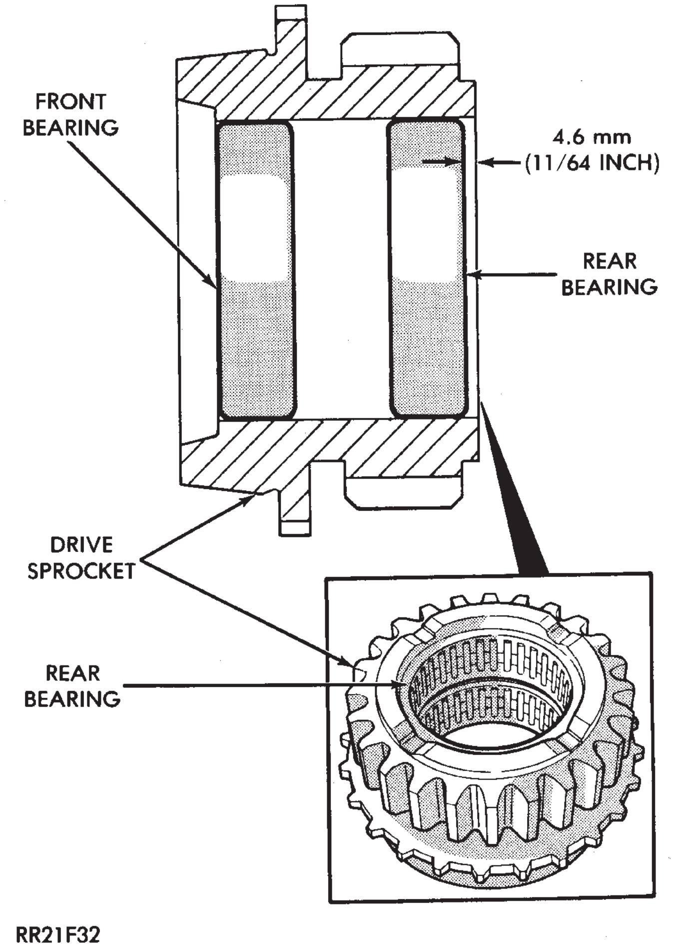


Fig. 46 Correct Position Of Bearings In Sprocket

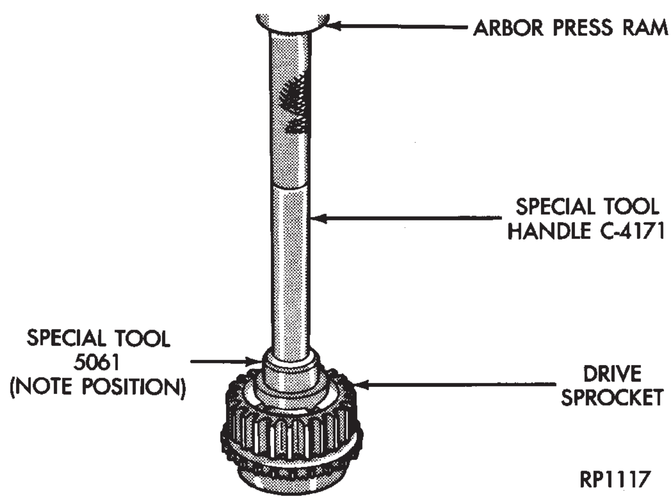


Fig. 47 Installing Drive Sprocket Front Bearing

(29) Install spring and three struts in synchro hub (Fig. 49).

(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.**

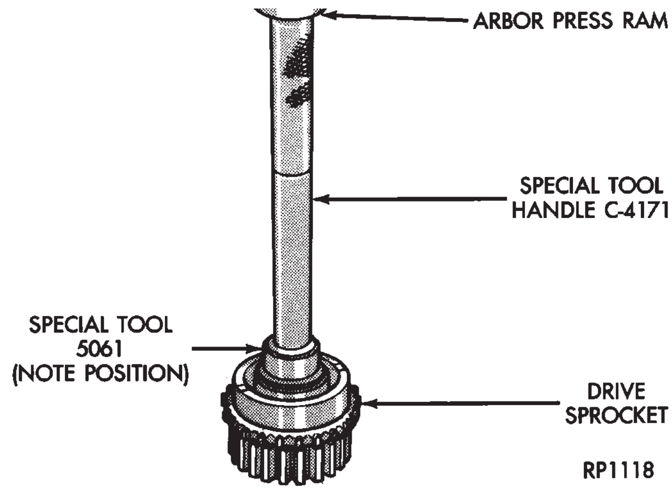


Fig. 48 Installing Drive Sprocket Rear Bearing

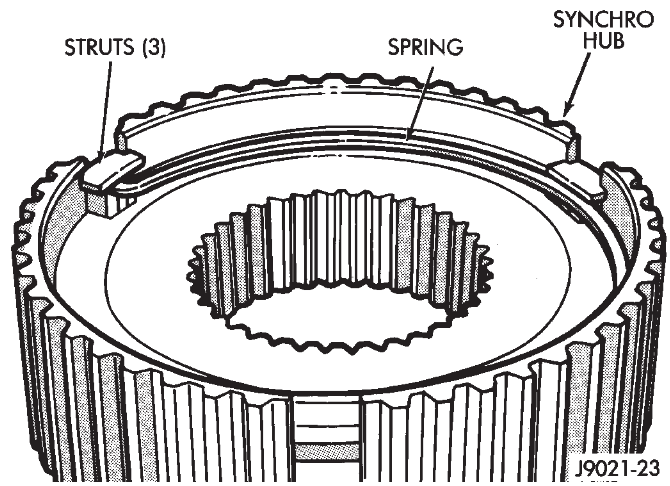


Fig. 49 Installing Synchro Hub Spring And Struts

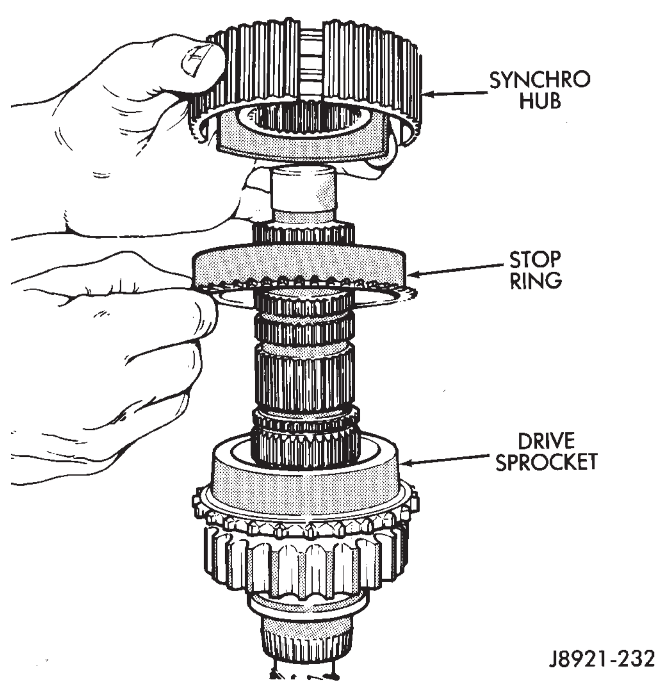


Fig. 50 Drive Sprocket, Stop Ring And Synchro Hub Installation

(32) Install new synchro hub snap ring (Fig. 51).

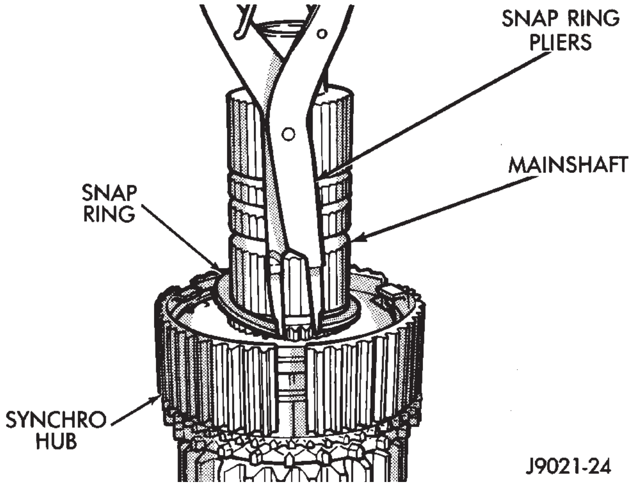


Fig. 51 Installing Synchro Hub Snap Ring

(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.

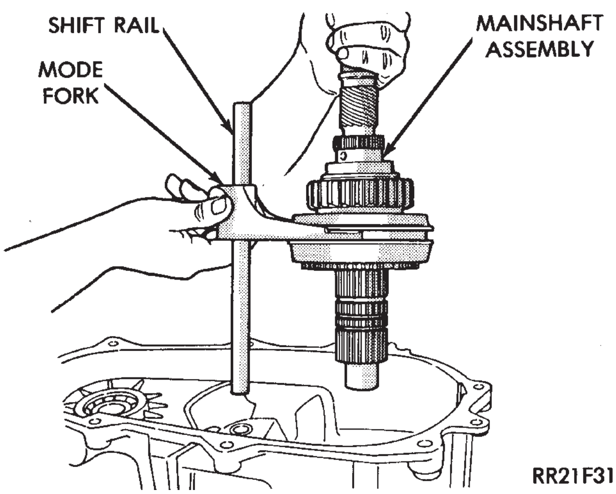


Fig. 52 Installing Mainshaft And Mode Fork Assembly

(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:

(a) Remove bearing from rear case with Bearing Remover MD-998346 and two suitable size wrenches (Fig. 55).

(b) Seat new bearing in rear case with Tool Handle C-4171 and Bearing Installer 5063 (Fig. 56).

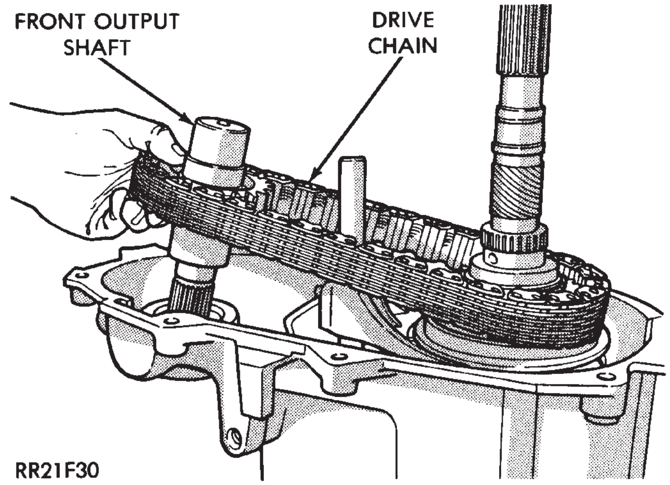


Fig. 53 Drive Chain And Front Output Shaft Installation

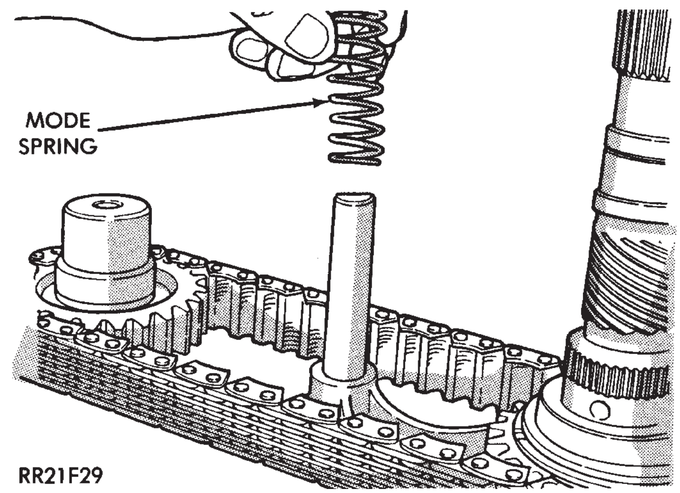


Fig. 54 Installing Mode Spring

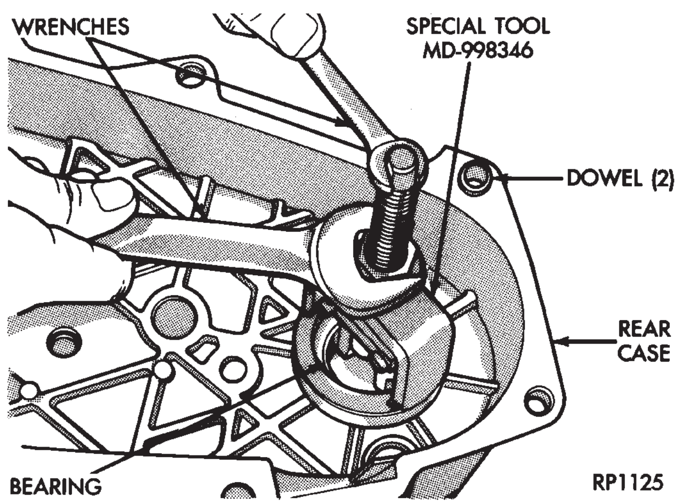


Fig. 55 Removing Front Output Shaft Rear Bearing

(40) Install new seal in oil pump feed housing (Fig. 57).

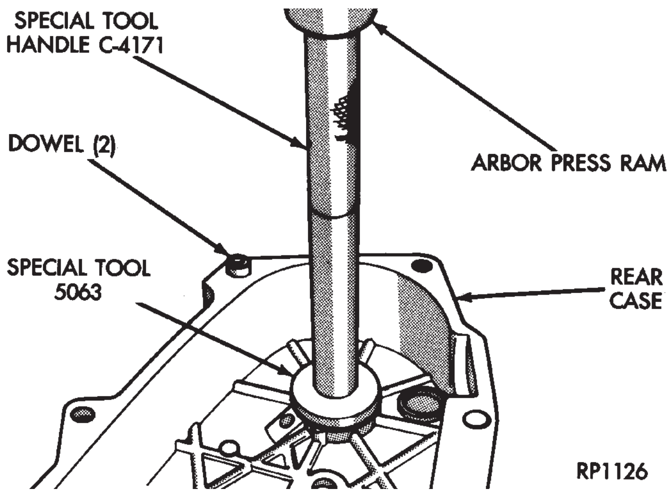


Fig. 56 Installing Front Output Shaft Rear Bearing

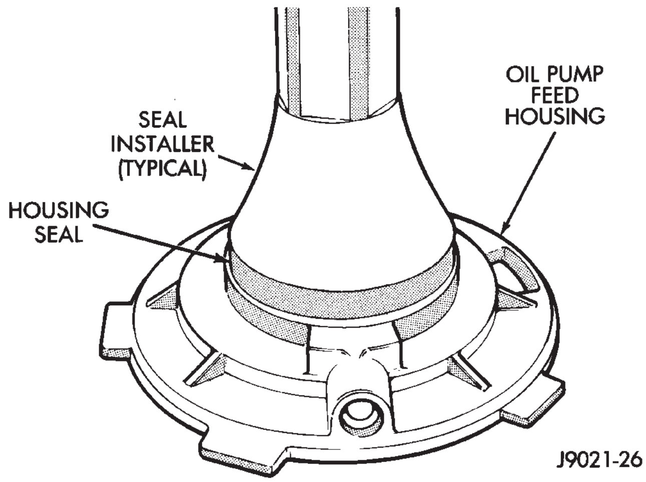


Fig. 57 Installing Oil Pump Feed Housing Seal

(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.

(43) Install new pickup tube O-ring in oil pump (Fig. 59).

(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).

(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.

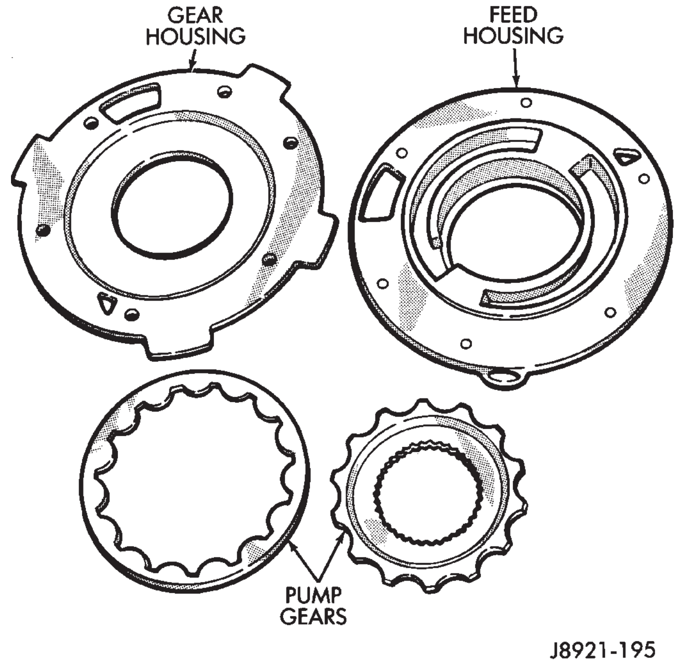


Fig. 58 Oil Pump Components

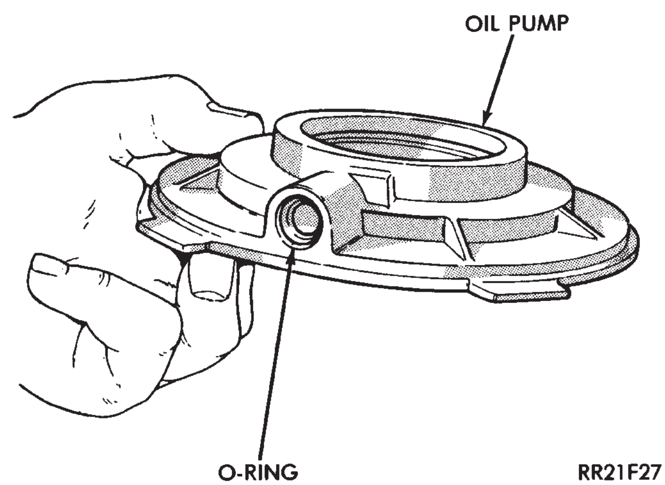


Fig. 59 Pickup Tube O-Ring Installation

(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.

(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.

(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.

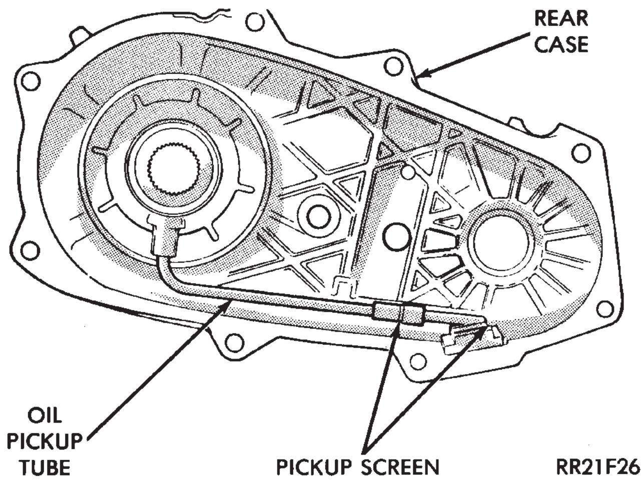


Fig. 60 Pickup Tube, Oil Screen And Pump Installation

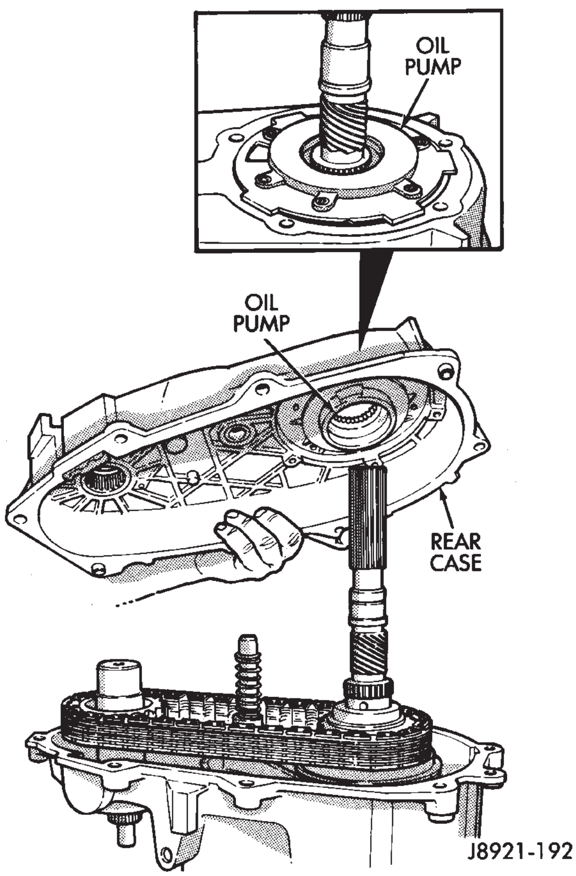


Fig. 61 Installing Rear Case On Front Case

(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.

(54) Remove extension housing seal if not removed previously.

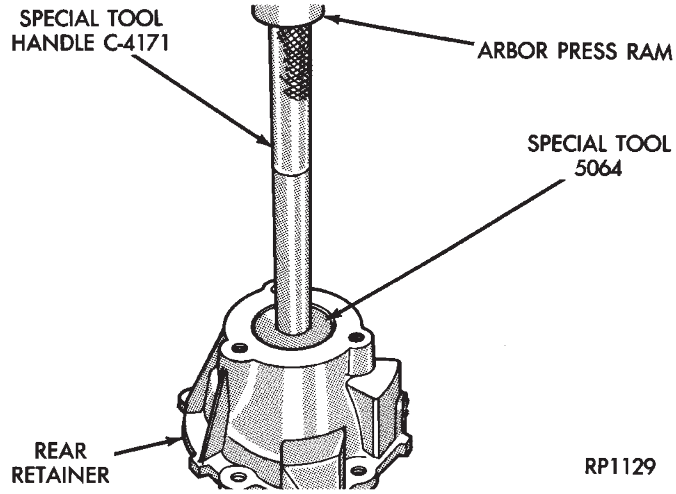


Fig. 62 Installing Mainshaft Rear Bearing In Rear Retainer

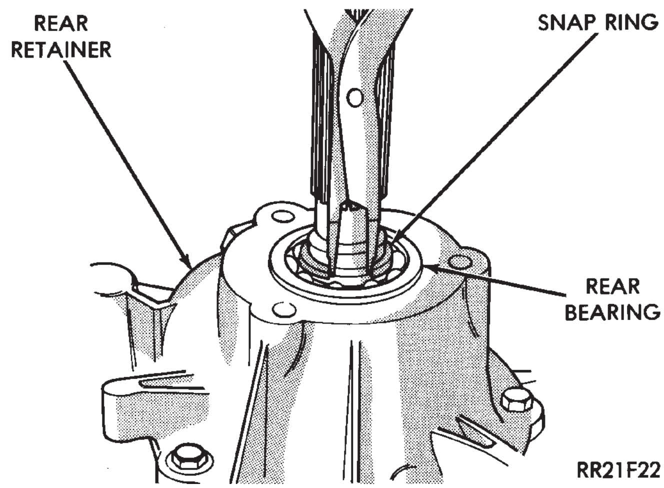


Fig. 63 Installing Rear Bearing Snap Ring

(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).

(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.

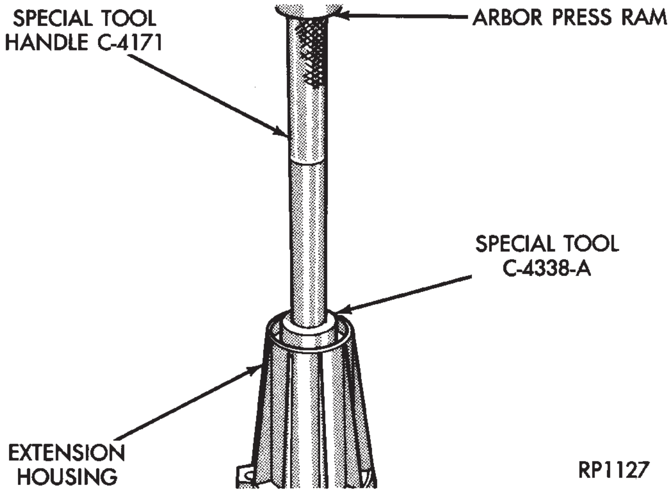


Fig. 64 Removing Extension Housing Bushing

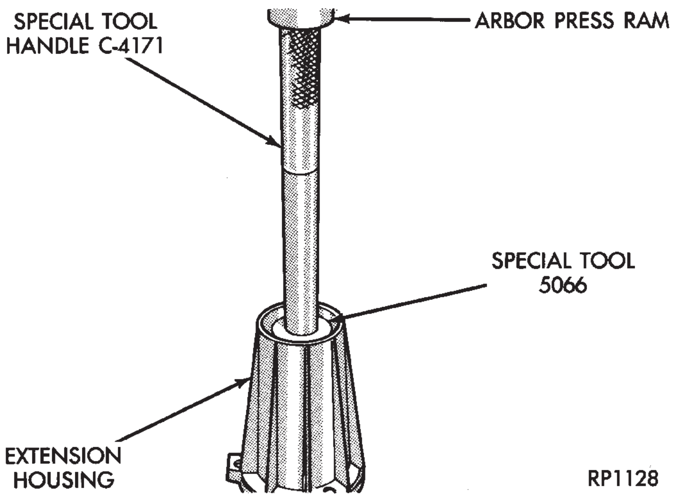


Fig. 65 Installing Extension Housing Bushing

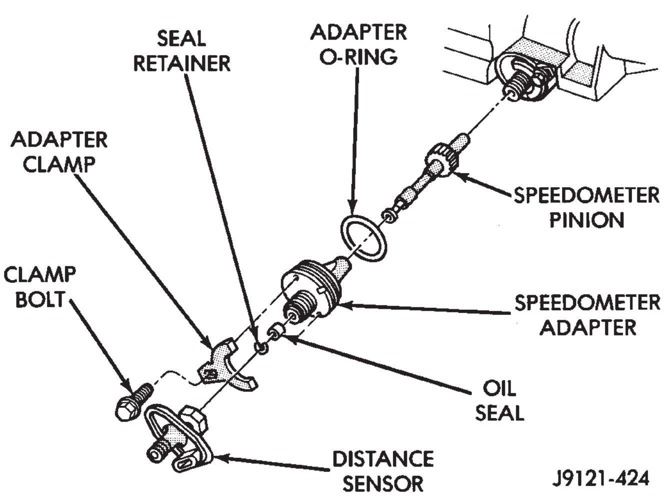
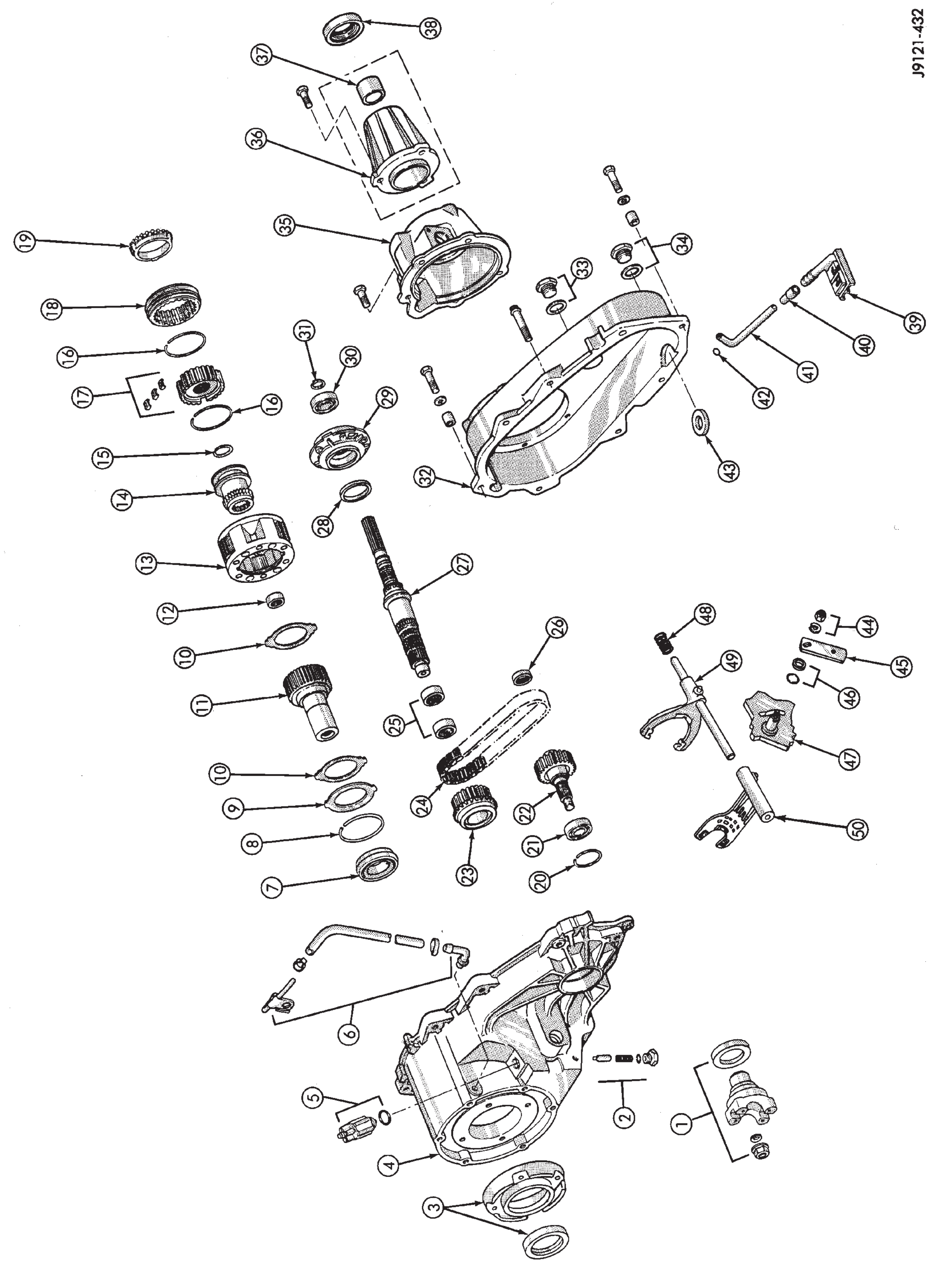


Fig. 66 Speedometer Components

(64) Install speedometer gear and adapter (Fig. 66).

(65) Fill transfer case with Mopar ATF Plus, or Dexron II transmission fluid after installation.

(66) Install and tighten fill plug to 41 N●m (35 ft. lbs.) torque.



NP231 TRANSFER CASE

LEGEND FOR NP231 TRANSFER CASE

1. Front Yoke, Nut, Seal Washer, and Oil Seal
2. Shift Detent Plug, Spring and Pin
3. Front Retainer and Seal
4. Front Case
5. Vacuum Switch and Seal
6. Vent Assembly
7. Input Gear Bearing and Snap Ring
8. Low Range Gear Snap Ring
9. Input Gear Retainer
10. Low Range Gear Thrust Washers
11. Input Gear
12. Input Gear Pilot Bearing
13. Low Range Gear
14. Range Fork Shift Hub
15. Synchro Hub Snap Ring*
16. Synchro Hub Springs*
17. Synchro Hub and Struts*
18. Synchro Sleeve*
19. Stop Ring*
20. Snap Ring
21. Output Shaft Front Bearing
22. Front Output Shaft
23. Drive Sprocket
24. Drive Chain
25. Drive Sprocket Bearings
26. Output Shaft Rear Bearing
27. Mainshaft
28. Oil Seal
29. Oil Pump Assembly
30. Mainshaft Rear Bearing
31. Snap Ring
32. Rear Case
33. Fill Plug and Gasket
34. Drain Plug and Gasket
35. Rear Retainer
36. Extension Housing
37. Bushing
38. Oil Seal
39. Oil Pickup Screen
40. Tube Connector
41. Oil Pickup Tube
42. Pickup Tube O-Ring
43. Magnet
44. Range Lever Nut and Washer
45. Range Lever
46. Sector O-Ring and Seal
47. Sector
48. Mode Spring
49. Mode Fork
50. Range Fork

*Synchro equipped models only.

J9221-76

NP242 TRANSFER CASE

INDEX

GENERAL INFORMATION

The NP242 is a full and part time transfer case with four operating ranges (Fig. 1). The NP242 provides both 2-wheel drive and full time 4-wheel drive operation.

The differential has a locking mechanism for undifferentiated 4-wheel drive in high and low ranges. A low range gear reduction system provides increased low speed torque capability.

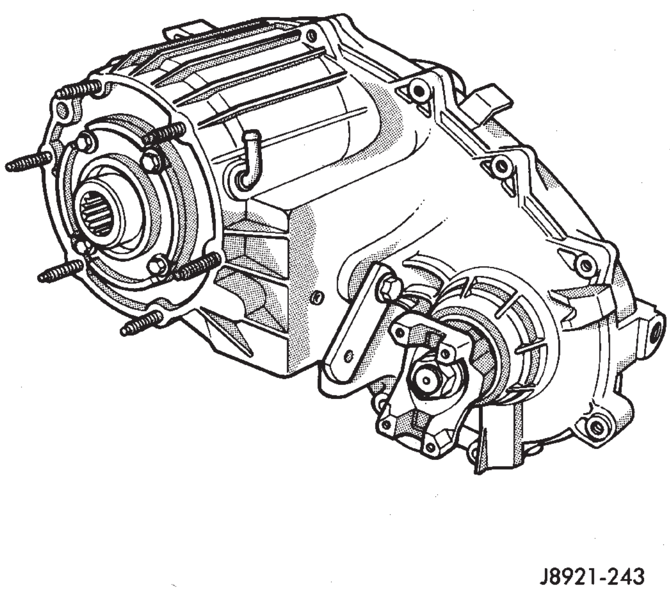


Fig. 1 NP242 Transfer Case

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 full time 4-wheel drive range is fully differentiated and can be used at any time.

The part time 4-wheel drive high 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.

Two-wheel drive and full time 4-wheel drive ranges are for normal operation. The part time, 4-wheel drive high and low ranges are for off road operation, 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).

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.

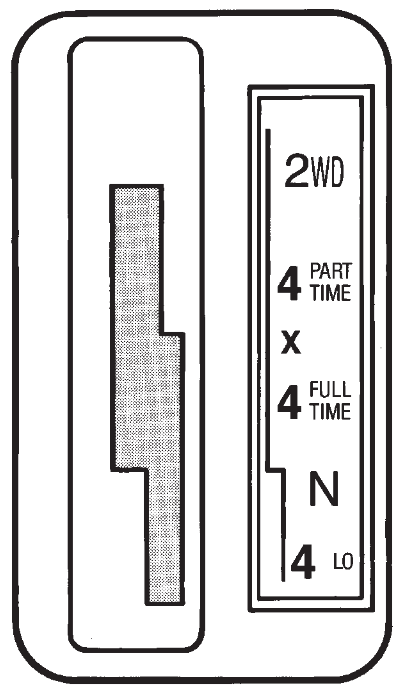


Fig. 2 NP242 Shift Pattern

The transfer case serial number also represents the date of build. For example, a serial number of 12-5-92 would represent December 5, 1992.

TRANSFER CASE LUBRICANT

Mopar ATF Plus, Type 7176, or Dexron II automatic transmission fluid can be used in the NP242 transfer case.

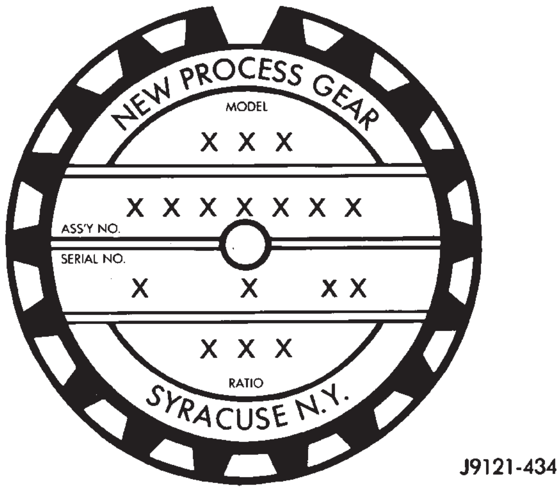


Fig. 3 Transfer Case I.D. Tag

Lubricant capacity of the Model 242 transfer case is 1.4 liters (1.45 qts.).

TRANSFER CASE FILL LEVEL

Correct fill level for the NP242 transfer case is to the bottom edge of the fill plug hole.

SHIFT LINKAGE ADJUSTMENT

(1) Move transfer case shift lever into Neutral position.

(2) Raise vehicle on hoist that will allow all four wheels to rotate freely.

(3) Loosen trunnion lock bolt (Figs. 4 and 5). Loosen bolt enough so selector rod slides freely in trunnion.

(4) Verify that shift lever on transfer case is in centered in Neutral position.

(5) Tighten trunnion lock bolt to 8-14 N●m (72-120 in. lbs.) torque.

(6) Lower vehicle enough for entry into driver's seat but keep all wheels off shop floor.

(7) Verify correct linkage adjustment. Start engine, shift transmission into gear and shift transfer case into all ranges. Be sure transfer case is fully engaged in high and low range. Readjust linkage if necessary.

(8) Shut engine off and lower vehicle completely.

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 speed sensor and remove speedometer adapter and sensor if necessary.

(9) Disconnect transfer case shift lever from shift lever rod.

(10) Disconnect vent hose and electrical connectors.

(11) Support transfer case with transmission jack.

(12) Remove bolts 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 (Fig. 6).

(4) Install and tighten transfer case attaching nuts to 35 N●m (26 ft. lbs.) torque (Fig. 6).

(5) Install speedometer adapter if removed during service (Fig. 7). Then index adapter and install speed sensor in adapter. Refer to In-Vehicle Service section.

(6) Connect electrical wires to speed sensor.

(7) Connect vent hose to transfer case vent (Fig. 8).

(8) Align and connect propeller shafts. Tighten shaft attaching bolts to 19 N●m (170 in. lbs.) torque.

(9) Fill transfer case with Mopar ATF Plus, or Dexron II automatic transmission fluid.

(10) Install rear crossmember if removed. Tighten crossmember bolts to 41 N●m (30 ft. lbs.) torque.

(11) Remove transmission jack and transmission support stand.

(12) Connect transfer case shift lever to shift lever rod.

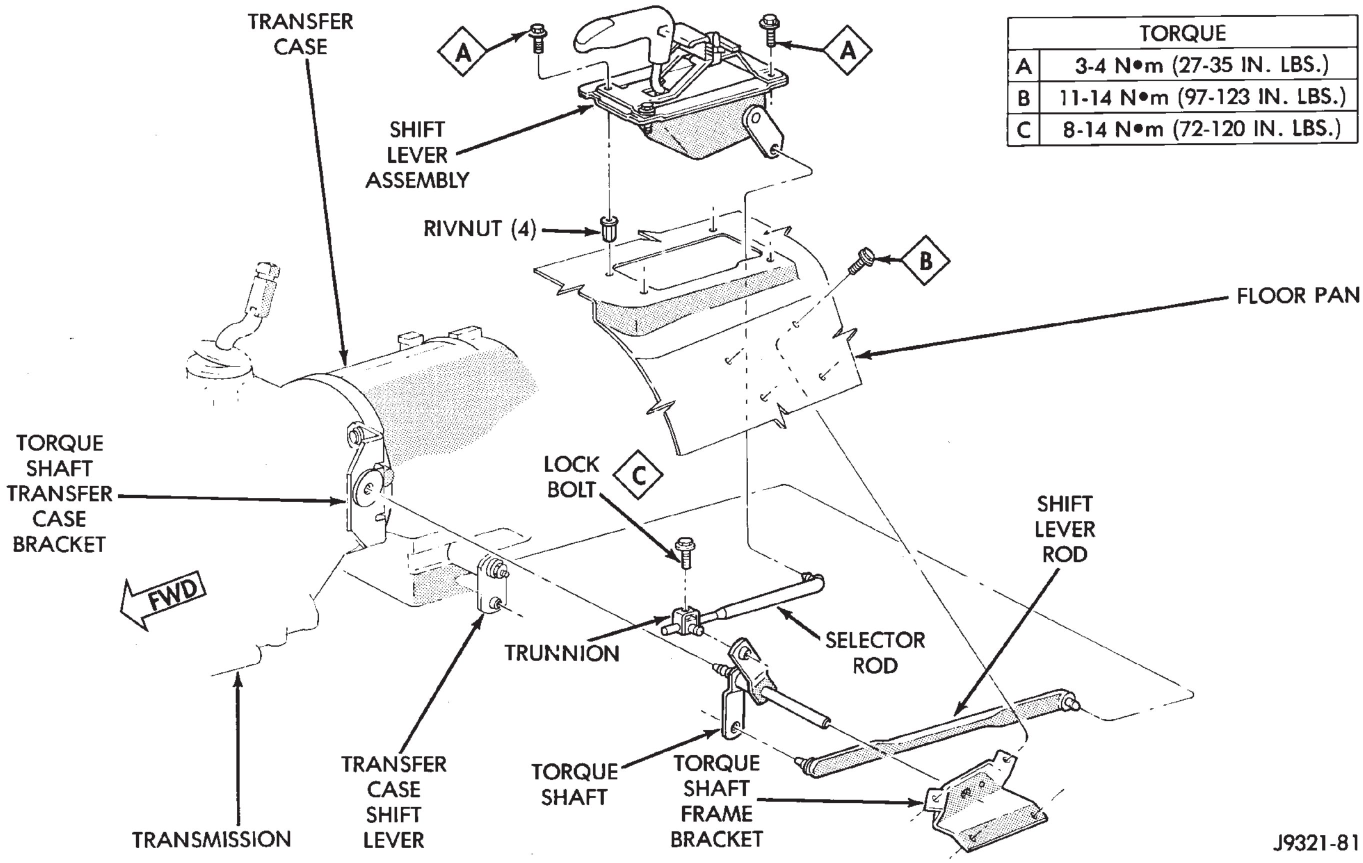
(13) Check and adjust transfer case shift linkage if necessary.

(14) Lower vehicle.

NP242 SERVICE DIAGNOSIS

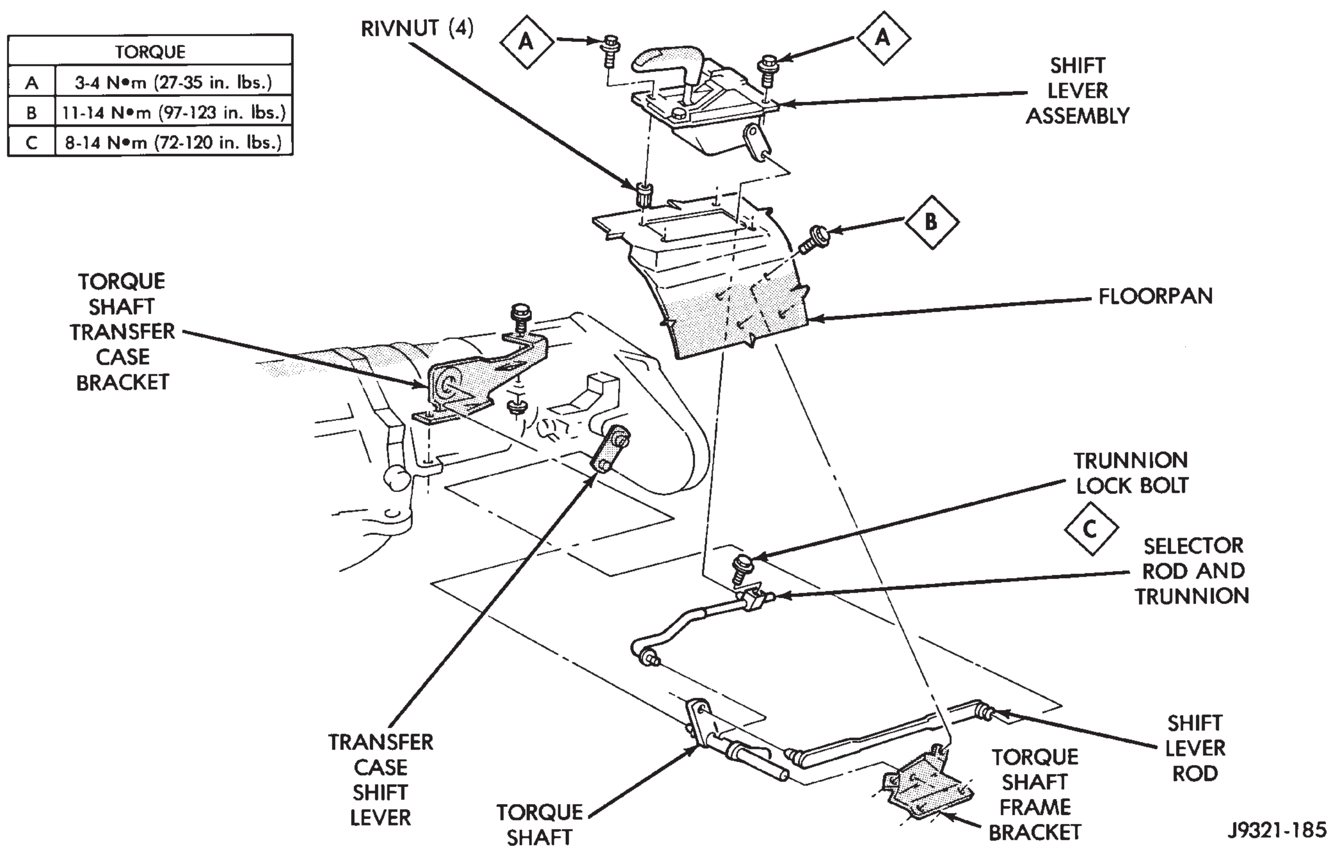
Condition	Possible Cause	Correction
TRANSFER CASE DIFFICULT TO SHIFT OR WILL NOT SHIFT INTO DESIRED RANGE	(1) Transfer case external shift linkage binding. (2) Insufficient or incorrect lubricant. (3) Internal components binding, worn or damaged.	(1) Lubricate, repair or replace linkage, or tighten loose components as necessary. (2) Drain and refill to edge of fill hole with DEXRON II® or MOPAR-MERCON® Automatic Transmission Fluid. (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. (2) Vent closed or restricted. (3) Output shaft seals damaged or installed incorrectly.	(1) Drain to correct level. (2) Clear or replace vent if necessary. (3) Replace seals. Be sure seal lip faces interior of case when installed. Also be sure yoke seal surfaces are not scored or nicked. Remove scores and nicks with fine sandpaper or replace yoke(s) if necessary.
TRANSFER CASE WILL NOT SHIFT THROUGH 4 X 4 PART-TIME RANGE (Light Remains On).	(1) Incomplete shift due to drivetrain torque load. (2) Incorrect tire pressure(s). (3) Excessive tire wear. (4) Excessive vehicle loading.	(1) Driver must momentarily release the accelerator pedal to complete the shift. (2) Inflate all tires equally to correct pressure. (3) Switch tires — Install the two tires with the most wear (one on the front axle and one on the rear axle). (4) Check vehicle loading — **Do not exceed the vehicle's GVW.**

J9121-435



TORQUE	
A	3-4 N•m (27-35 IN. LBS.)
B	11-14 N•m (97-123 IN. LBS.)
C	8-14 N•m (72-120 IN. LBS.)

Fig. 4 Transfer Case Shift Linkage (Manual Transmission)



TORQUE	
A	3-4 N•m (27-35 in. lbs.)
B	11-14 N•m (97-123 in. lbs.)
C	8-14 N•m (72-120 in. lbs.)

Fig. 5 Transfer Case Shift Linkage (Automatic Transmission)

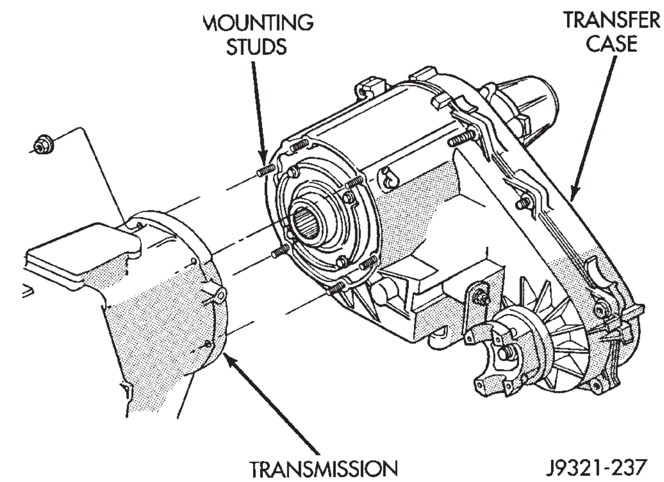


Fig. 6 Transfer Case Attachment

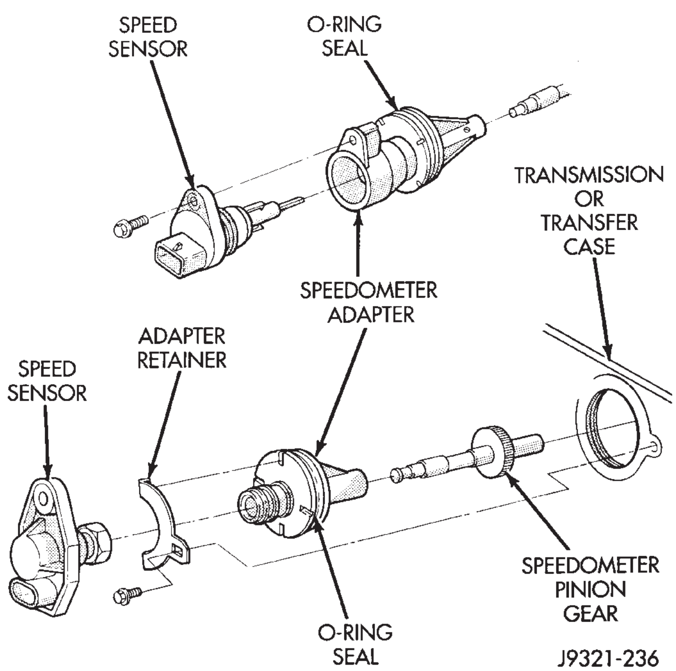


Fig. 7 Speedometer Components

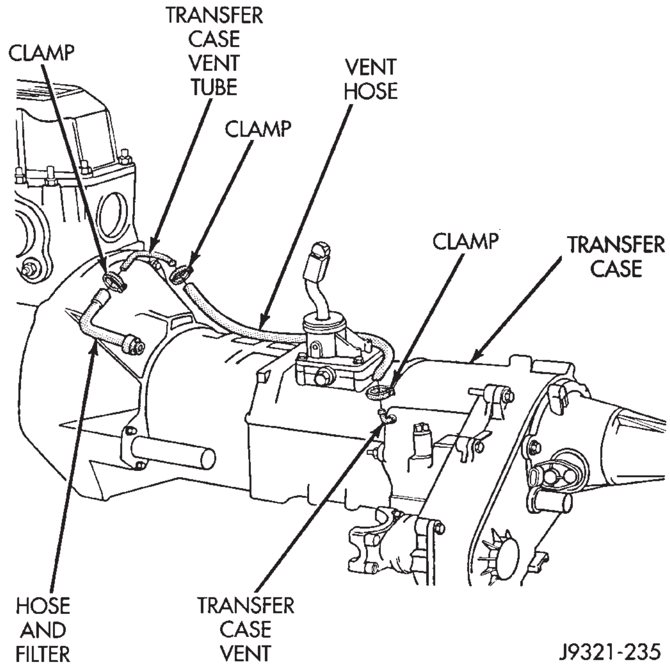


Fig. 8 Transfer Case Vent Hose Routing

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. 1).

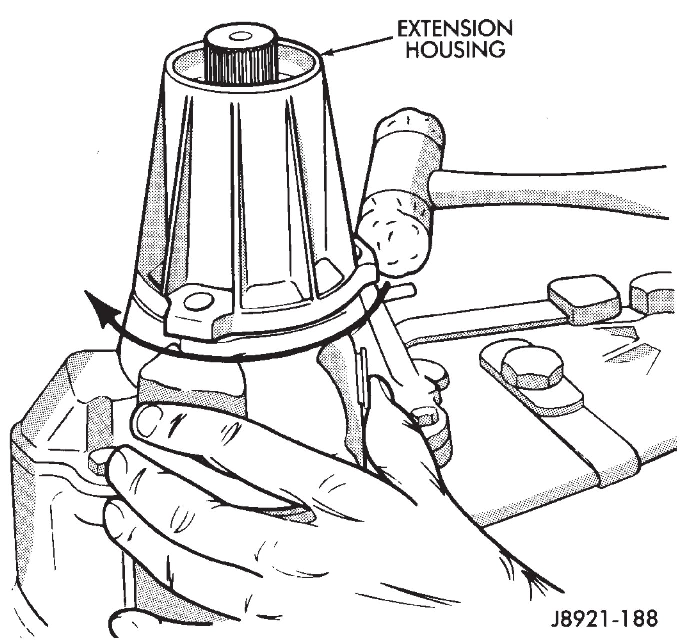


Fig. 1 Extension Housing Removal

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.

(6) Remove rear bearing snap ring from mainshaft (Fig. 2). Discard snap ring.

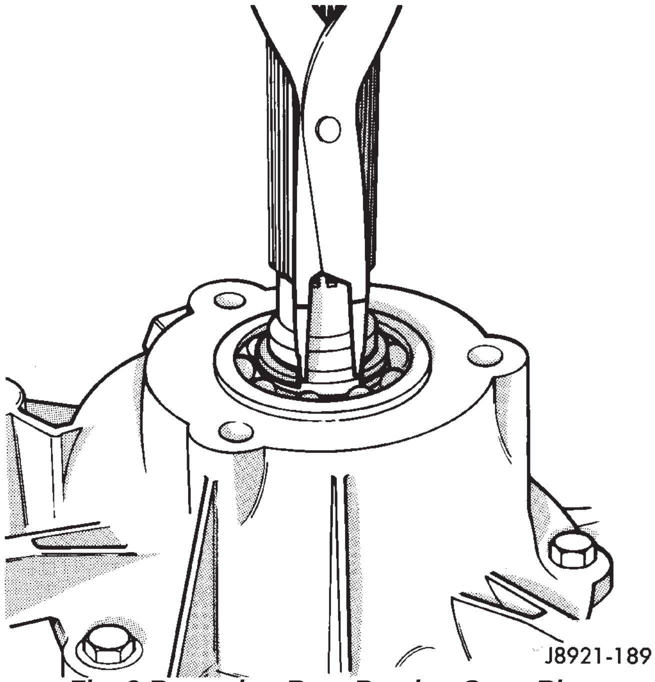


Fig. 2 Removing Rear Bearing Snap Ring

(7) Remove rear retainer attaching bolts.

(8) Loosen rear retainer (Fig. 3). Position long screwdriver under each tab at ends of retainer housing and pry retainer upward.

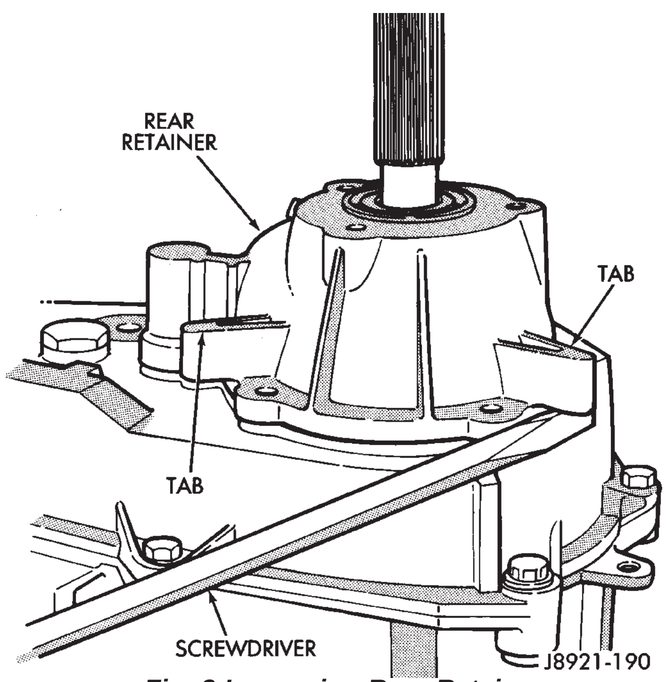


Fig. 3 Loosening Rear Retainer

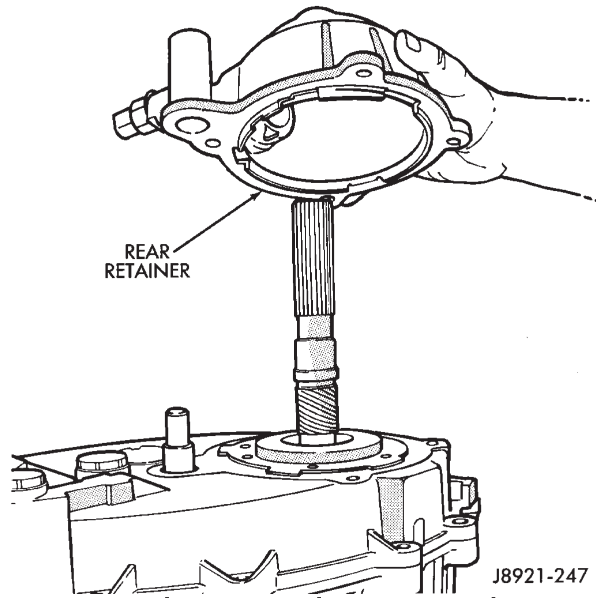


Fig. 4 Removing Rear Retainer

CAUTION: Do not pry against the sealing surfaces of the retainer or rear case. The surfaces could be damaged.

(9) Lift rear retainer up and off case and mainshaft (Fig. 4).

(10) Remove bolts attaching rear case to front case. Retain bolts and the washers.

(11) Loosen rear case with two screwdrivers (Fig. 5). 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.

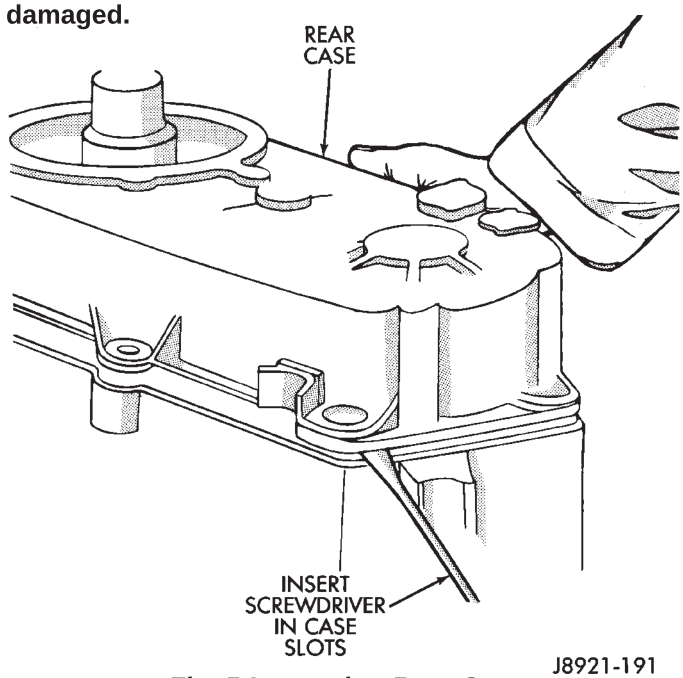


Fig. 5 Loosening Rear Case

(12) Remove rear case and oil pump as assembly (Fig. 6).

(13) Slide oil screen (Fig. 7) out of case pocket.

(14) Remove oil pump, pickup tube and oil screen from rear case (Fig. 8).

(15) Remove pickup tube and screen from pump.

(16) Remove pickup tube O-ring from oil pump (Fig. 9).

(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.**

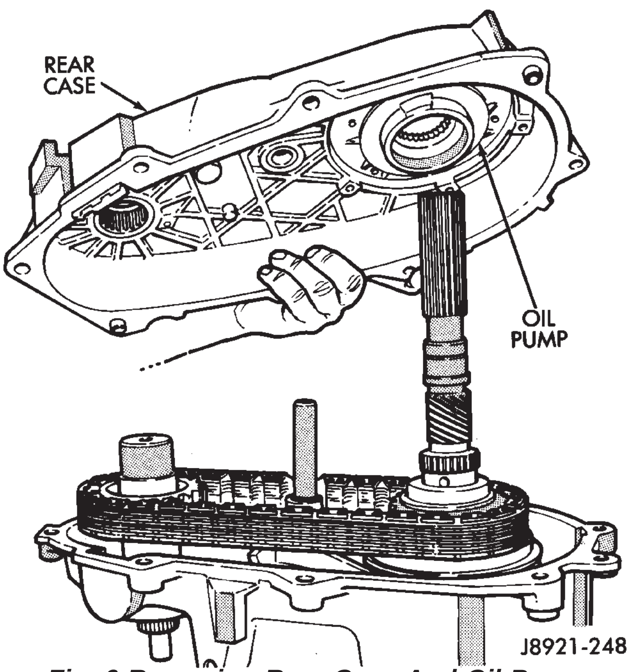


Fig. 6 Removing Rear Case And Oil Pump

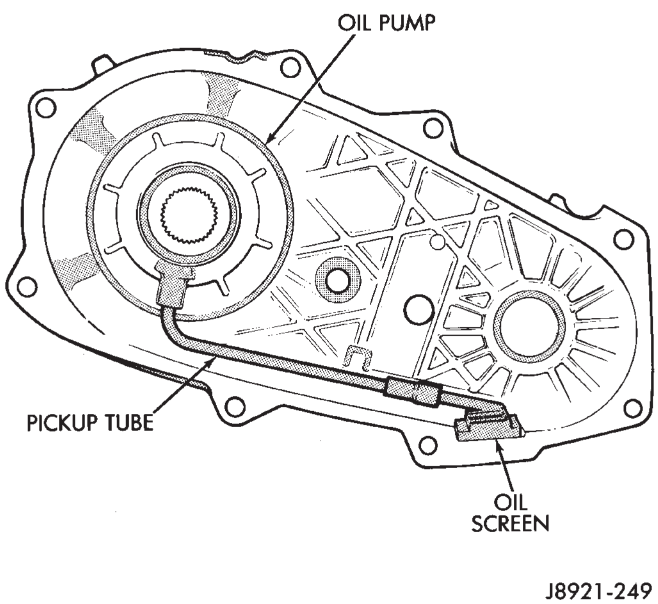


Fig. 7 Unseating Oil Screen

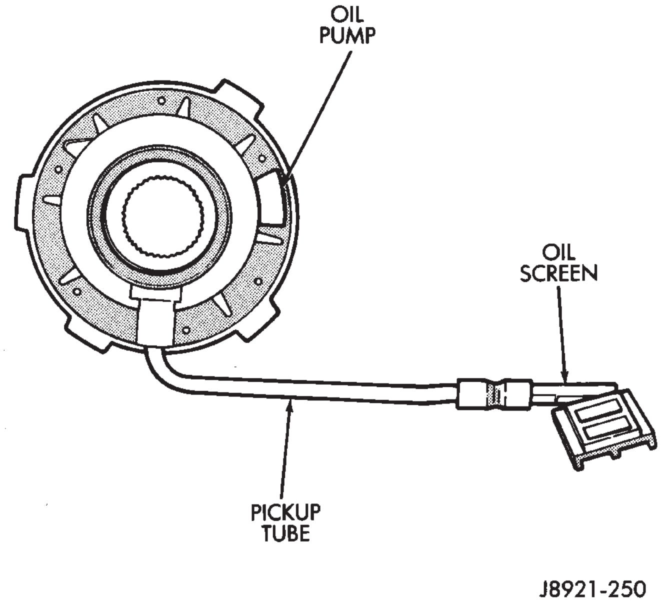


Fig. 8 Removing Oil Pump, Pickup Tube And Screen

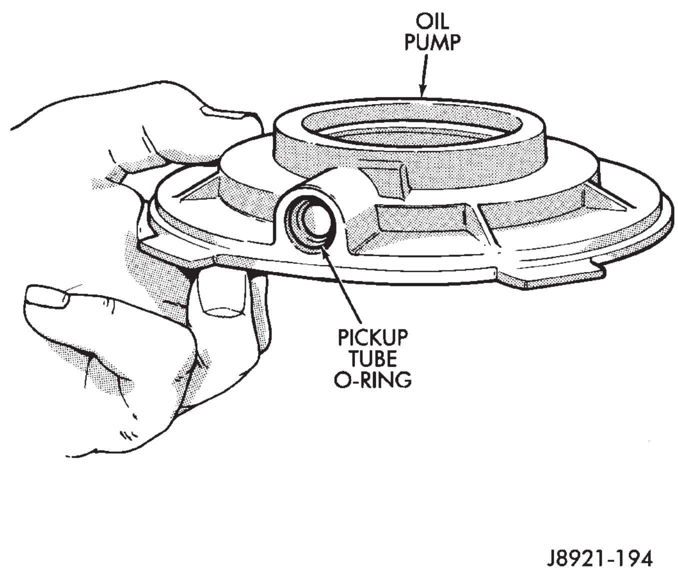


Fig. 9 Removing/Installing Pickup Tube O-Ring

(19) If oil pump will be disassembled for inspection, mark position of oil pump housings for reference (Fig. 10). Remove screws that attach two halves of the pump. Remove feed housing from gear housing. Then mark position of pump gears and remove them from housing (Fig. 10).

(20) Remove magnet from front case.

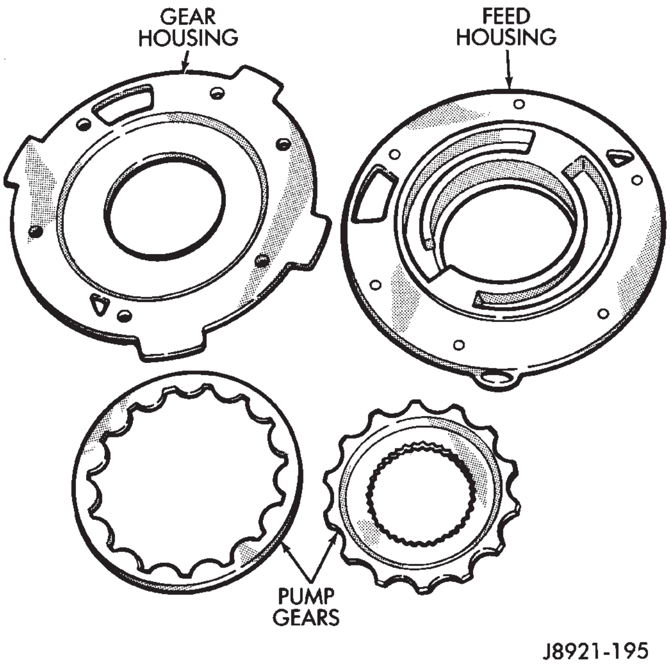


Fig. 10 Oil Pump Components

(21) Remove drive sprocket snap ring (Fig. 11).

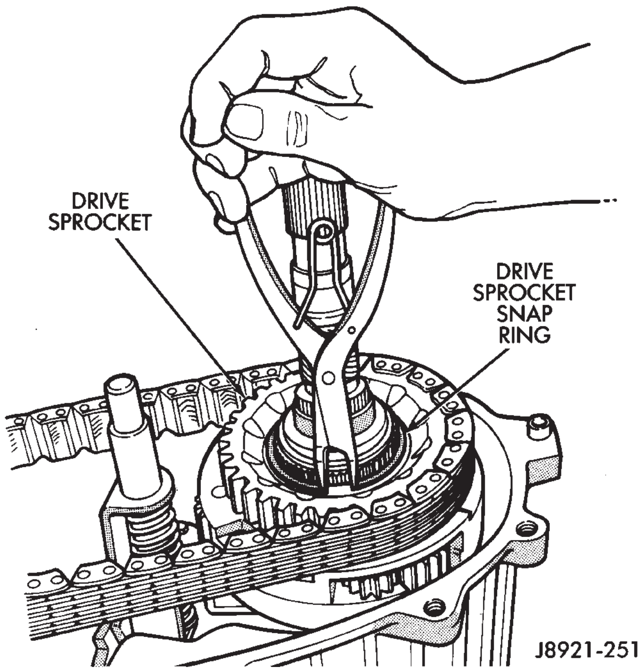


Fig. 11 Removing Drive Sprocket Snap Ring

(22) Remove drive sprocket and chain (Fig. 12).
(23) Remove front output shaft (Fig. 13).
(24) Remove transfer case shift lever nut and lever.
(25) Remove shift detent plug, spring and pin (Fig. 14)

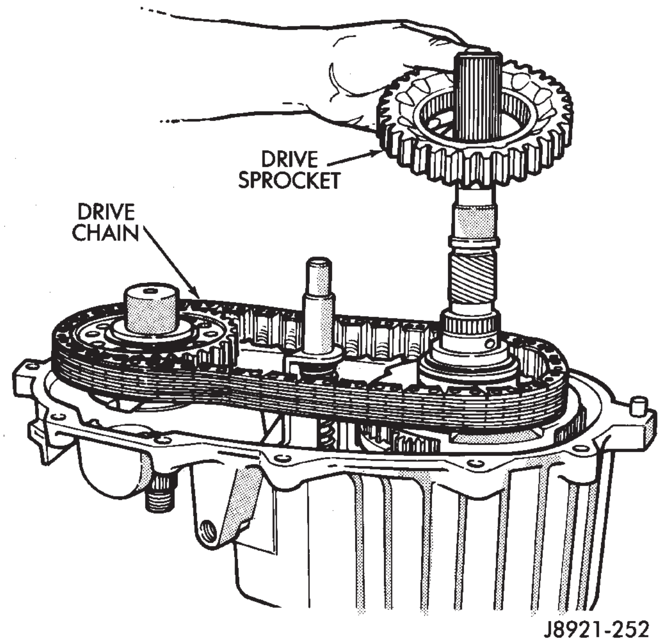


Fig. 12 Removing Drive Sprocket And Chain

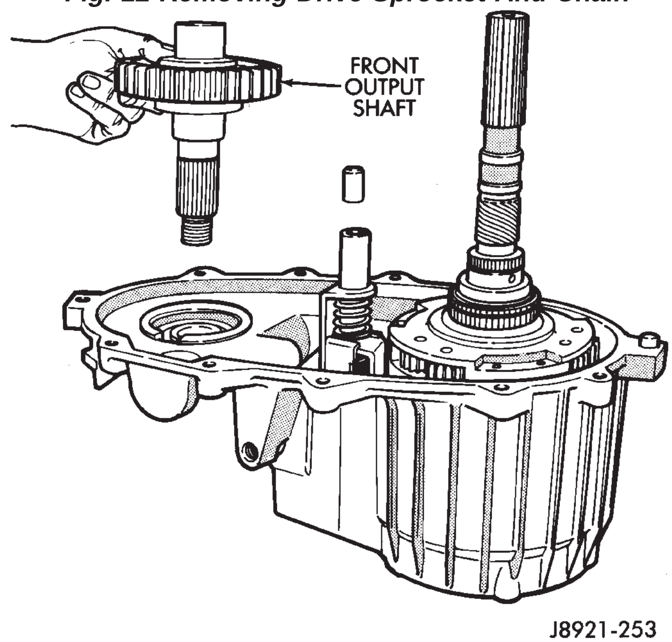


Fig. 13 Removing Front Output Shaft

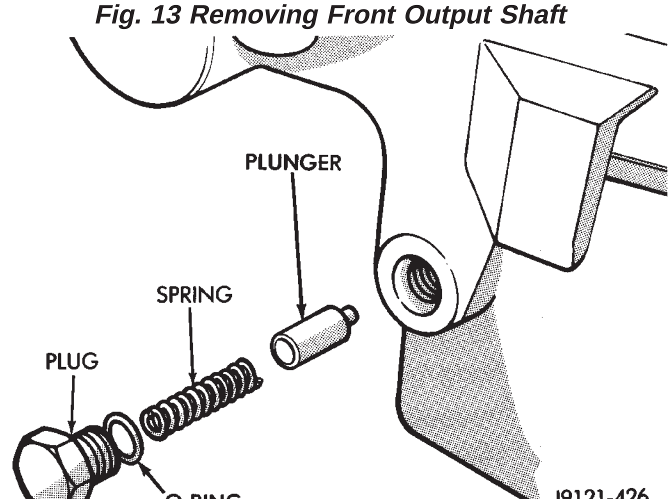


Fig. 14 Removing Detent Components

(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. 15).

(27) Remove range fork lockpin with size #1 easy-out. Grip easy-out tool with locking pliers and remove pin with counterclockwise, twist and pull motion (Fig. 15).

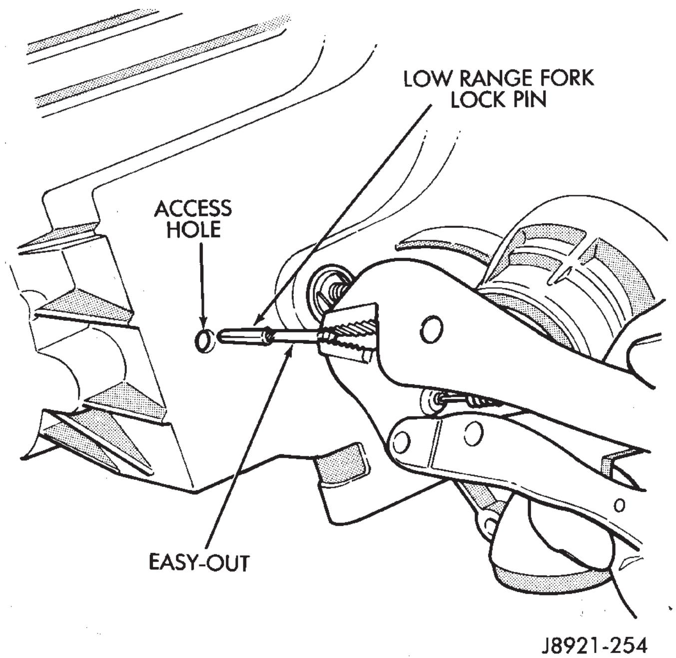


Fig. 15 Removing Low Range Fork Lockpin

(28) Remove shift rail by pulling it straight up and out of fork (Fig. 16).

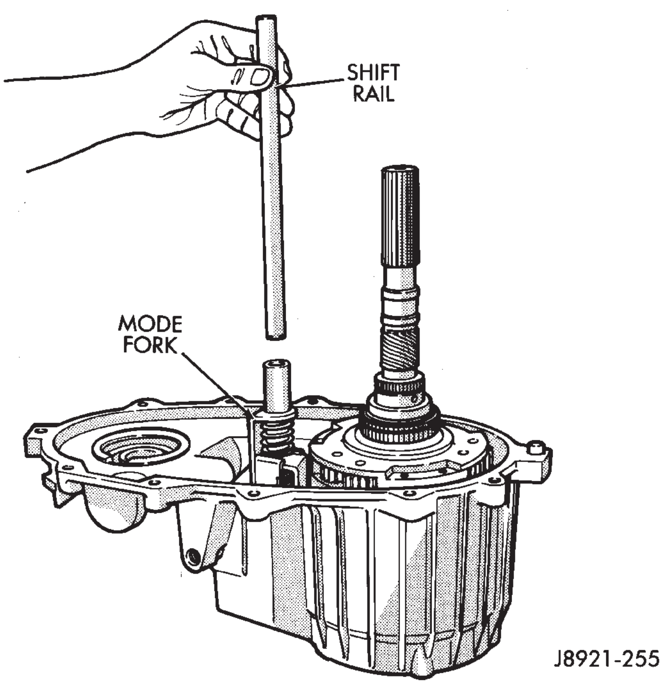


Fig. 16 Removing Shift Rail

(29) Remove mode fork and mainshaft as assembly (Fig. 17).

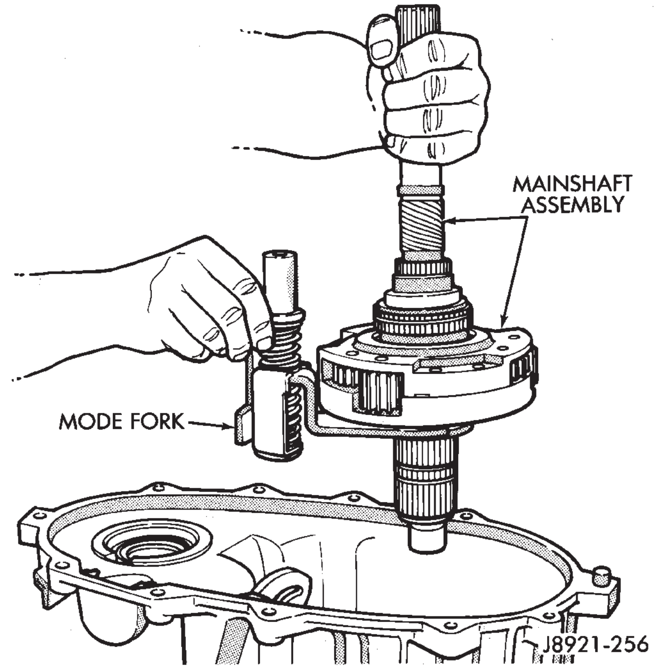


Fig. 17 Removing Mode Fork And Mainshaft

(30) Remove mode shift sleeve and mode fork assembly from mainshaft (Fig. 18). Note position of mode sleeve in fork and remove sleeve.

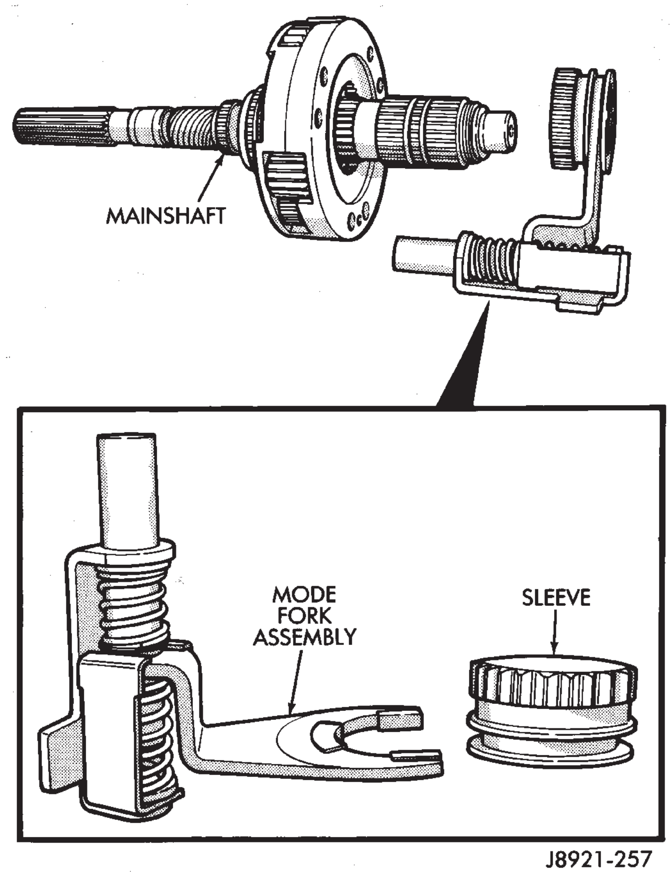


Fig. 18 Removing Mode Fork And Sleeve

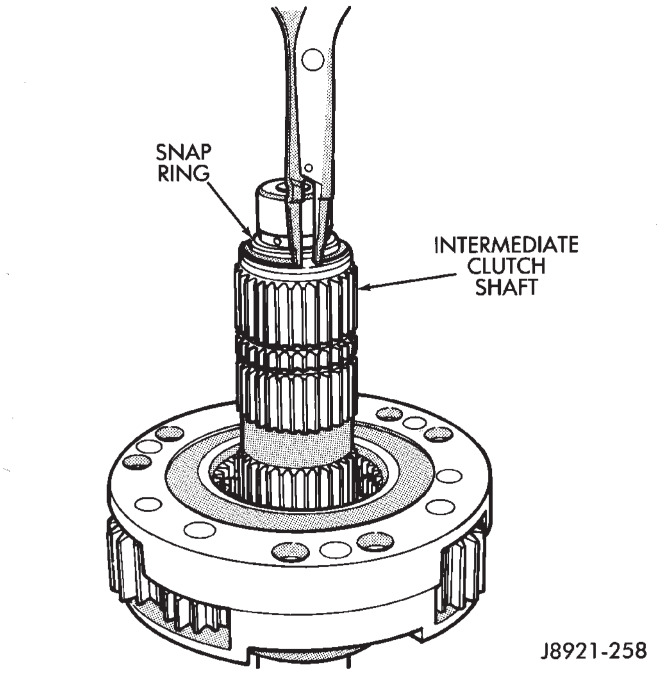


Fig. 19 Removing Intermediate Clutch Shaft Snap Ring

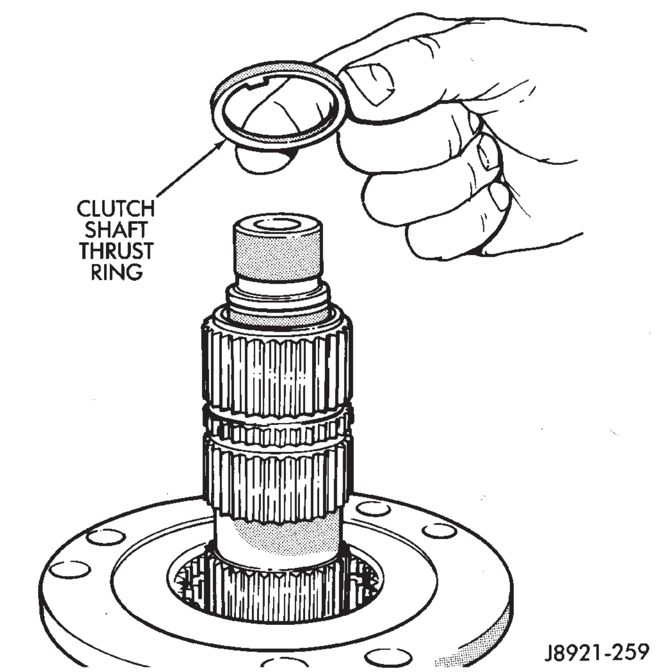


Fig. 20 Removing Clutch Shaft Thrust Ring

(31) Remove intermediate clutch shaft snap ring (Fig. 19).

(32) Remove clutch shaft thrust ring (Fig. 20).

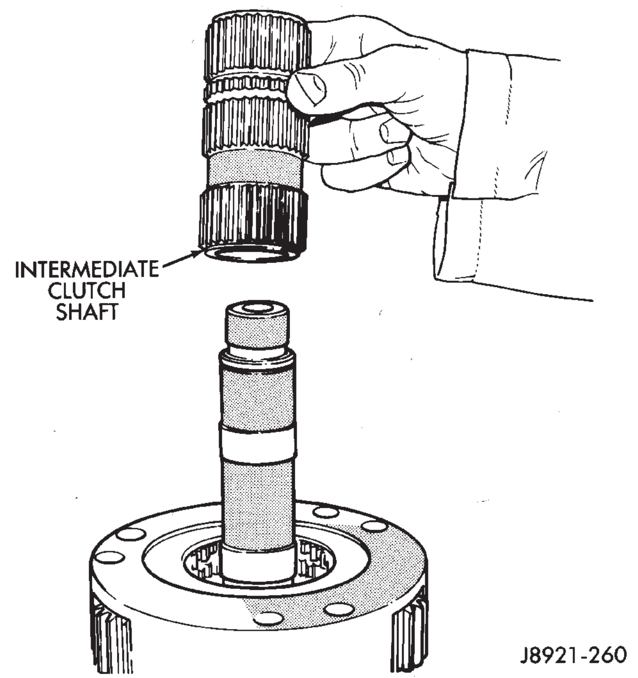


Fig. 21 Removing Intermediate Clutch Shaft

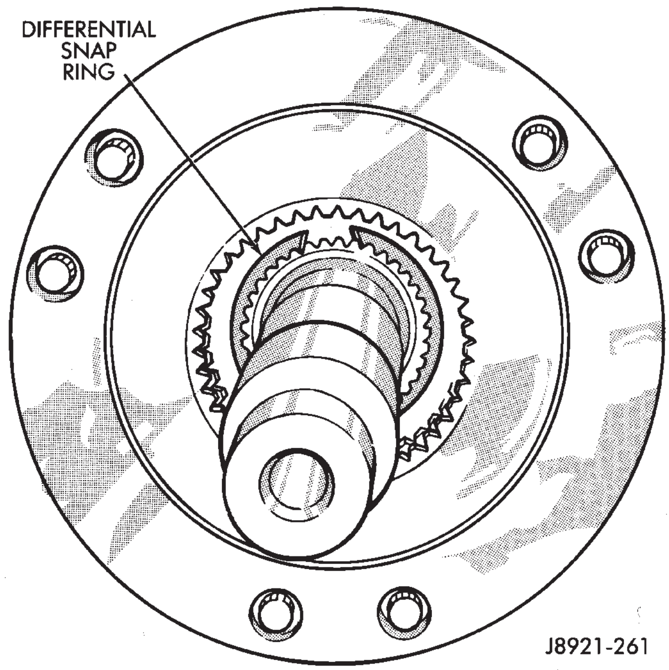


Fig. 22 Removing Differential Snap Ring

(33) Remove intermediate clutch shaft (Fig. 21).

(34) Remove differential snap ring (Fig. 22).

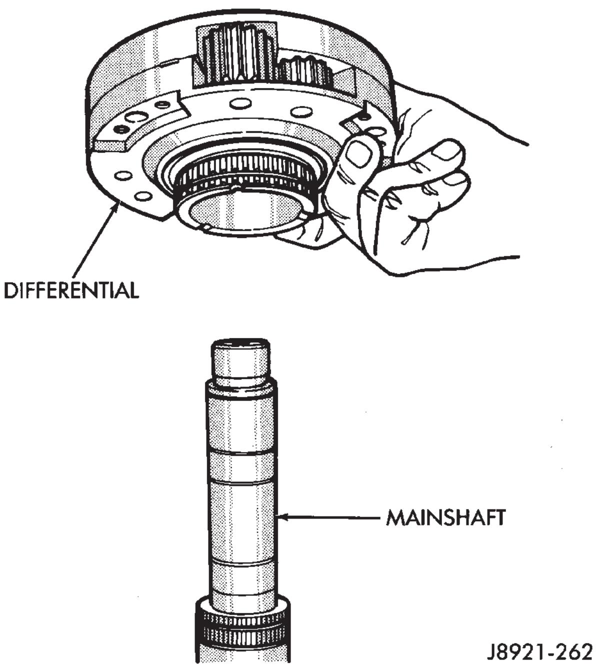


Fig. 23 Differential Removal

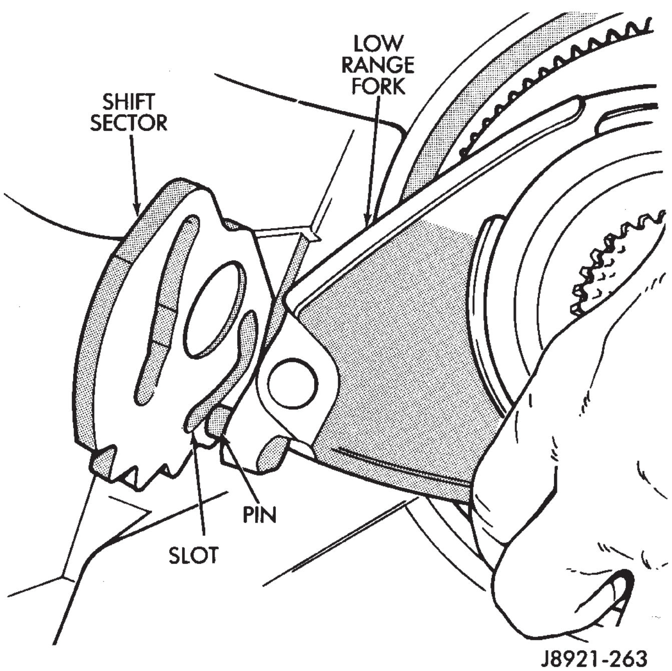


Fig. 24 Disengage Low Range Fork

(35) Remove differential (Fig. 23).

(36) Remove differential needle bearings and both needle bearing thrust washers from mainshaft.

(37) Slide low range fork pin out of shift sector slot (Fig. 24)

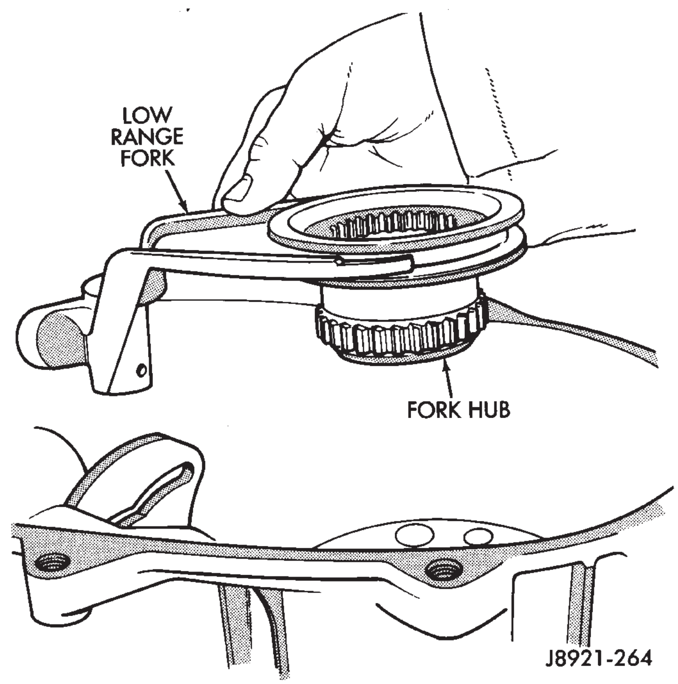


Fig. 25 Removing Low Range Fork And Hub

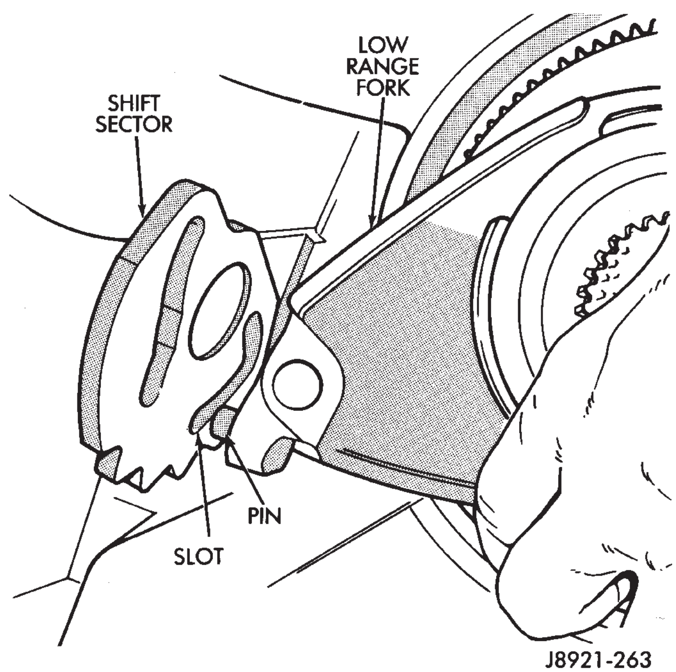


Fig. 26 Shift Sector Position

(38) Remove low range fork and hub (Fig. 25).

(39) Remove the shift sector (Fig. 26).

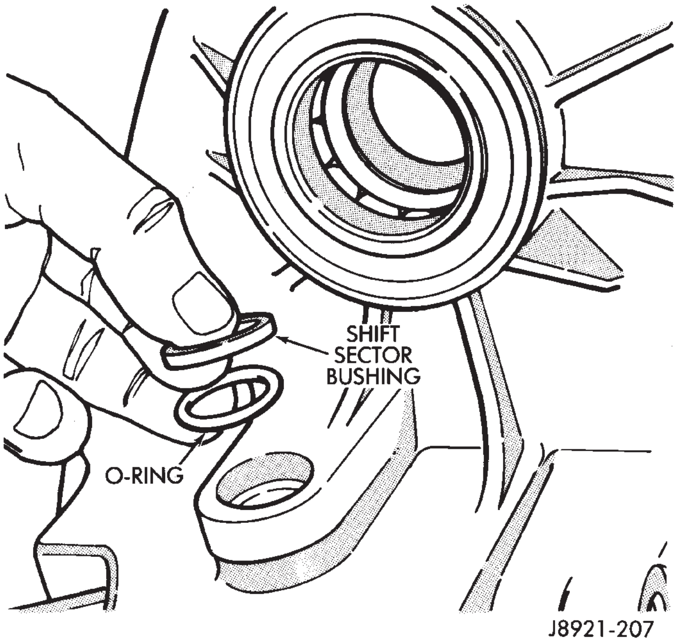


Fig. 27 Removing Sector Bushing And O-Ring

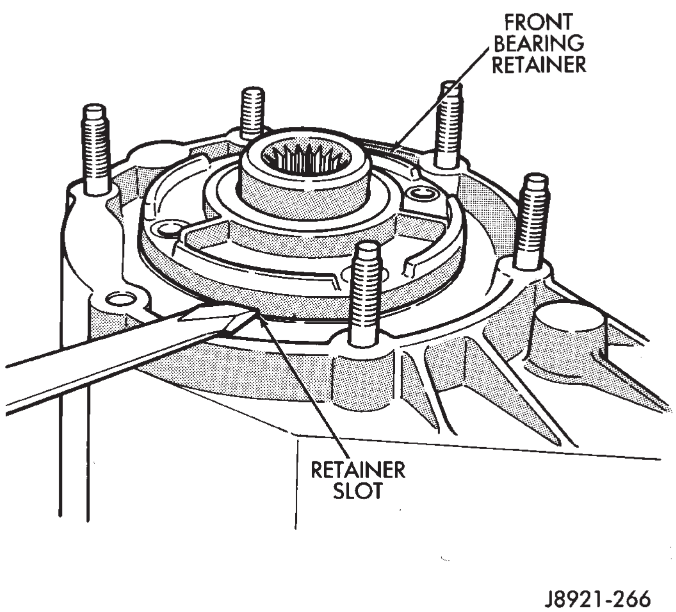


Fig. 28 Removing Front Bearing Retainer

(40) Remove shift sector bushing and O-ring (Fig. 27).

(41) Remove front bearing retainer bolts.

(42) Remove front bearing retainer. Carefully pry retainer loose with screwdriver (Fig. 28). Position screwdriver in slots cast into retainer.

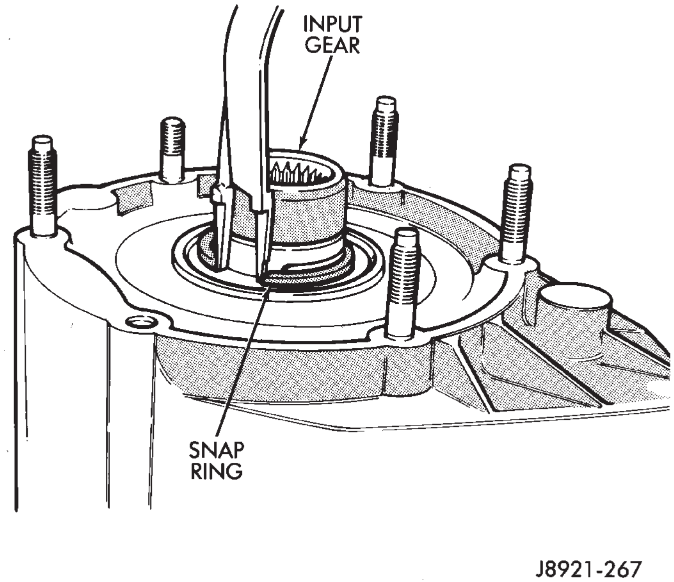


Fig. 29 Removing Input Gear Snap Ring

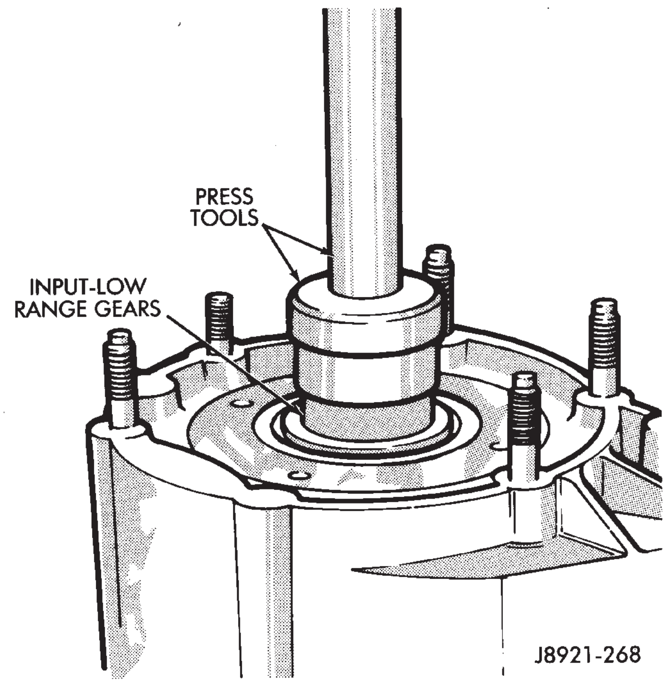


Fig. 30 Removing Input And Low Range Gears

(43) Remove input gear snap ring (Fig. 29).

(44) Press input and low range gears out of input gear bearing and case (Fig. 30). Use suitable size driver tool to press gears out of bearing and case.

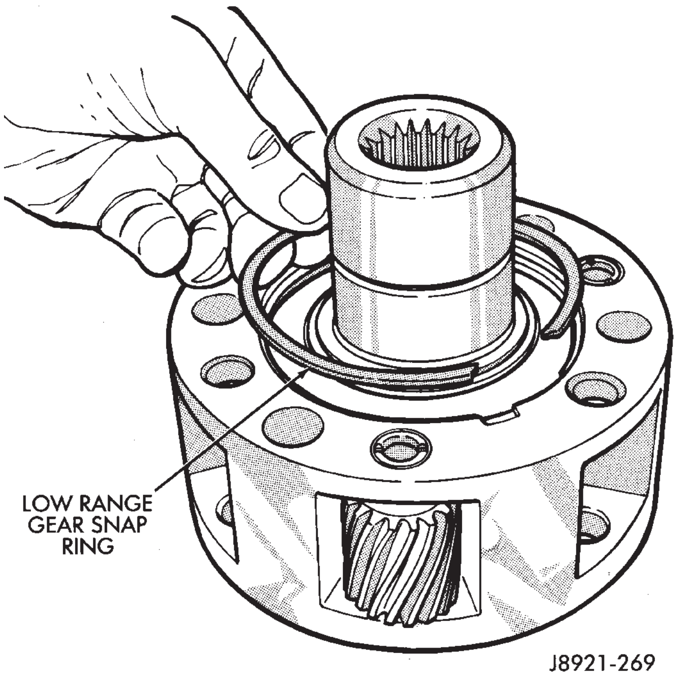


Fig. 31 Removing/Installing Low Range Gear Snap Ring

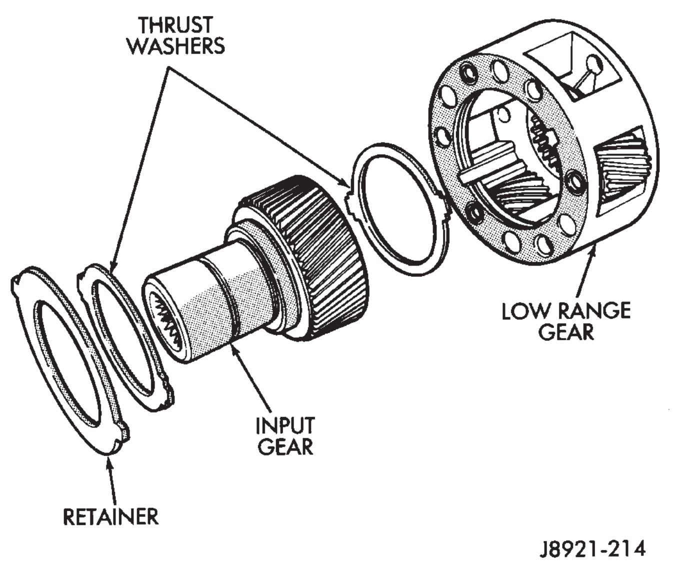


Fig. 32 Low Range Gear Disassembly

(45) Remove low range gear snap ring (Fig. 31).

(46) Remove input gear retainer, thrust washers and input gear from low range gear (Fig. 32).

(47) Inspect low range annulus gear (Fig. 33). **The gear is not a serviceable component. If damaged, replace gear and front case as an assembly.**

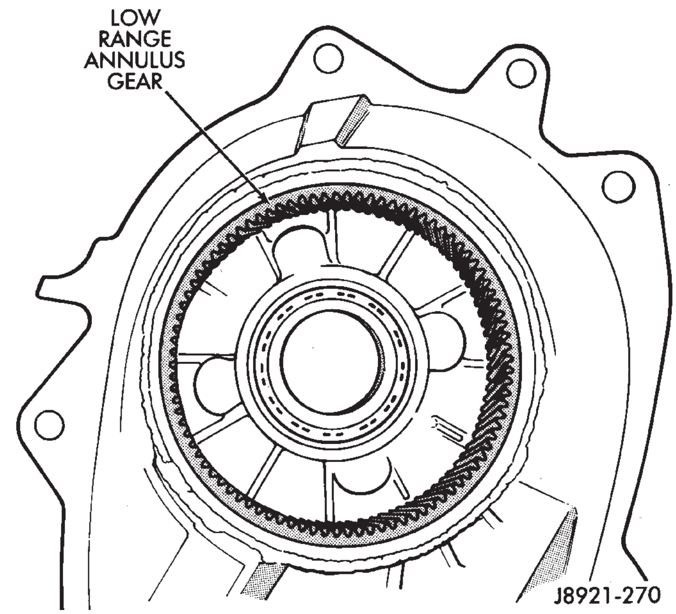


Fig. 33 Inspecting Low Range Annulus Gear

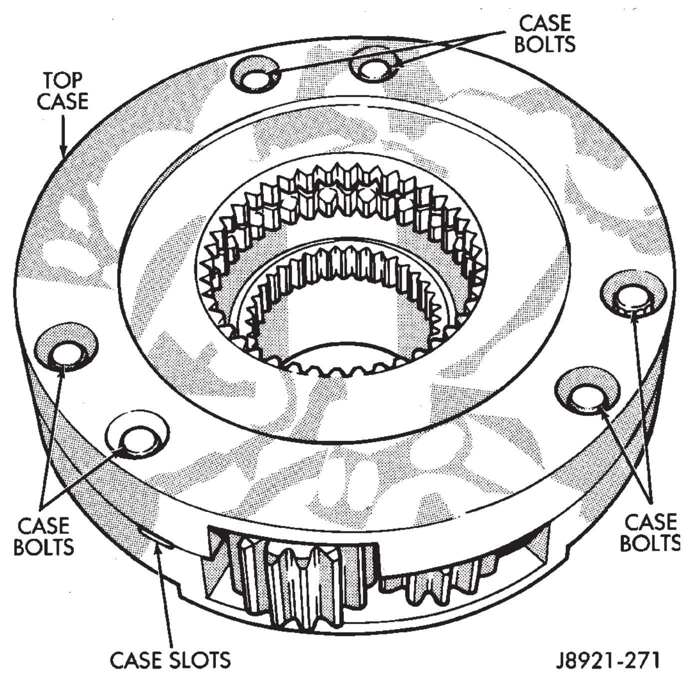


Fig. 34 Separating Differential Case Halves

(48) Remove 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. 34).

(51) Remove thrust washers and planet gears from case pins (Fig. 35).

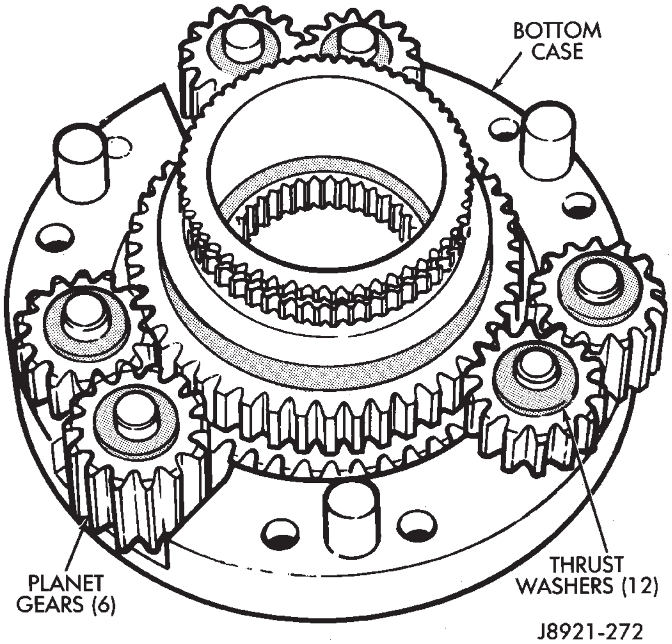


Fig. 35 Removing Planet Gears And Thrust Washers

(52) Remove mainshaft and sprocket gears from bottom case (Fig. 36). Note gear position for reference before separating them.

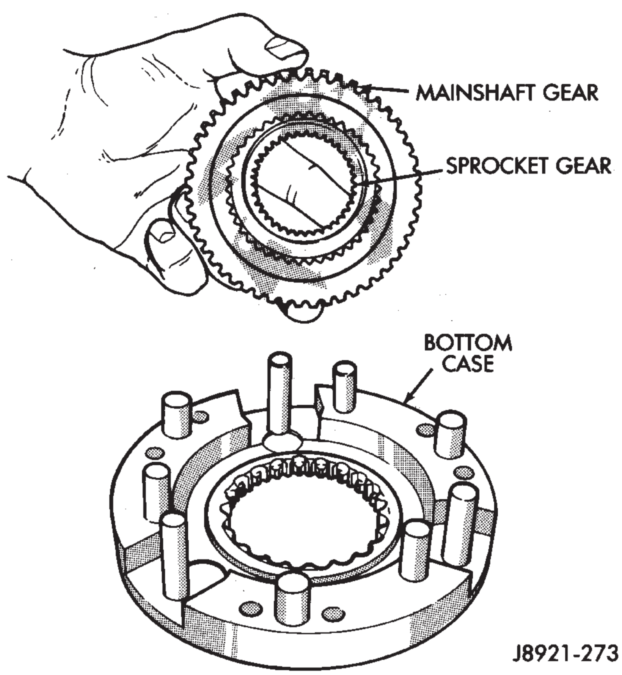


Fig. 36 Removing Mainshaft And Sprocket Gears

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 front output shaft, front bearing snap ring (Fig. 37).

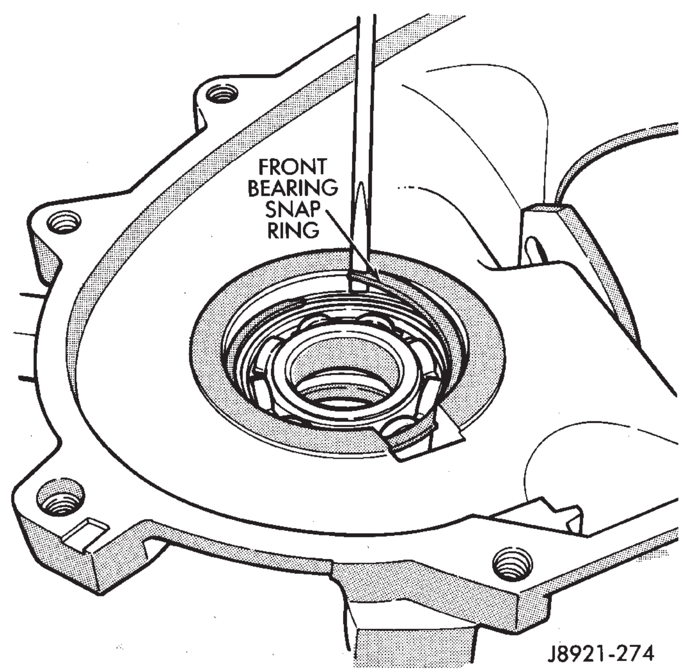


Fig. 37 Removing/Installing Front Output Shaft Front Bearing Snap Ring

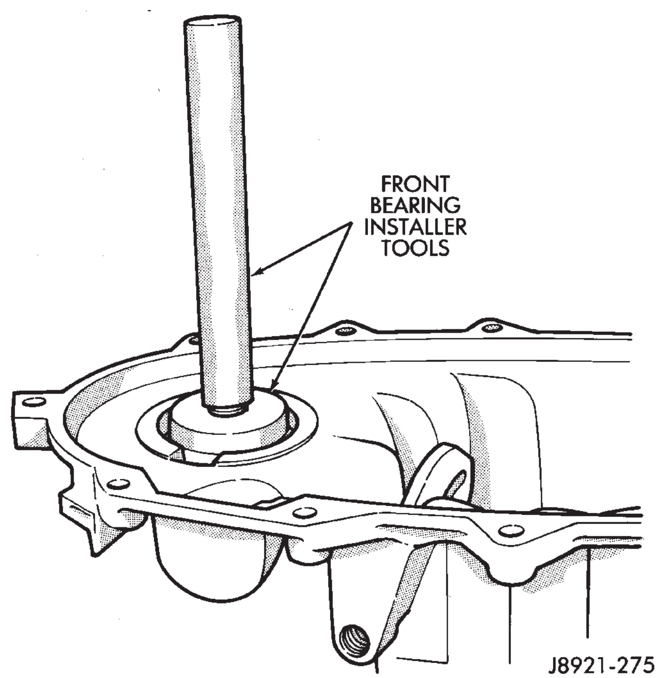


Fig. 38 Replacing Output Shaft Front Bearing

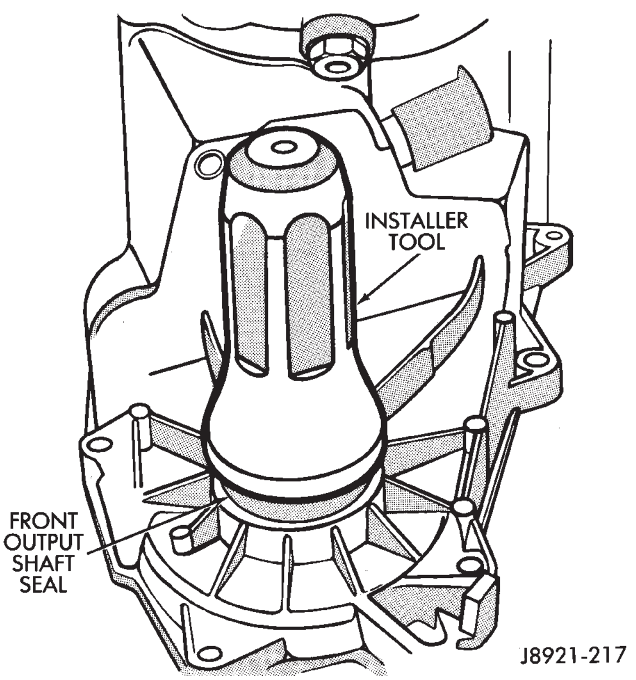


Fig. 39 Installing Front Output Shaft Seal

(3) Remove old bearing and install new bearing with driver handle and installer tool (Fig. 38).

(4) Install front bearing snap ring (Fig. 37).

(5) Install new front output shaft oil seal (Fig. 39). Use suitable size installer tool to replace seal.

(6) Press input gear bearing out of front case with Special Tools C-4210, C-4171 and shop press (Fig. 40).

(7) Install snap ring on new input gear bearing.

(8) Install new input gear bearing with shop press and wood block. Install bearing far enough to seat snap ring against case (Fig. 41).

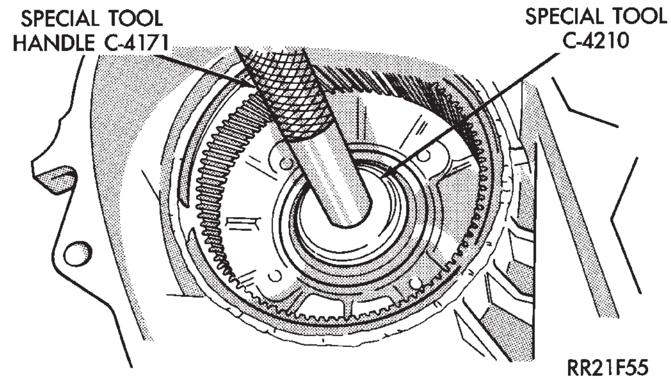


Fig. 40 Removing Input Gear Bearing

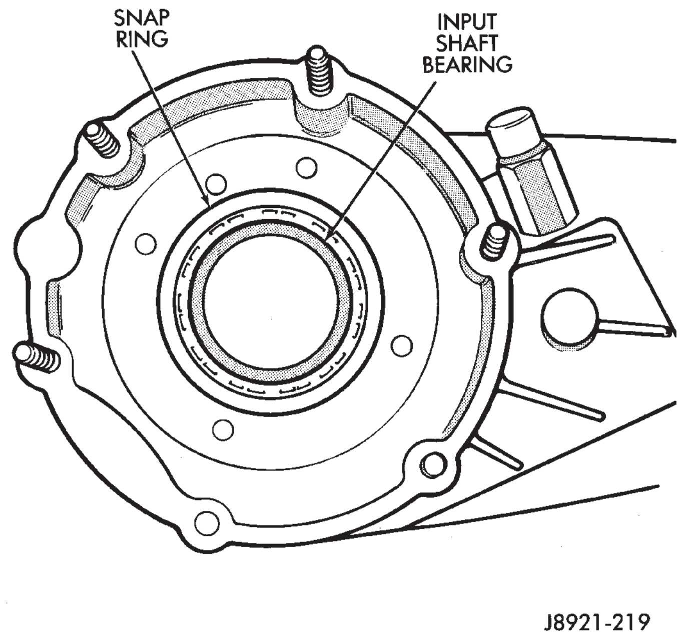


Fig. 41 Seating Input Gear Bearing

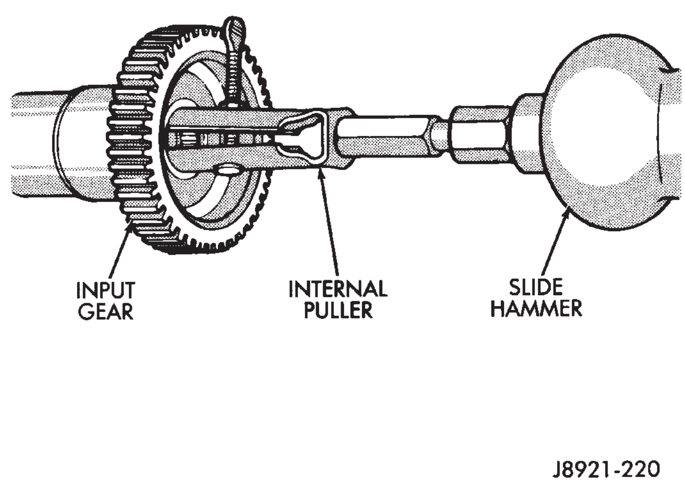


Fig. 42 Removing Input Gear Pilot Bearing

(9) Remove mainshaft pilot bearing from input gear with slide hammer and suitable size internal puller (Fig. 42).

(10) Install new pilot bearing with suitable size installer tool (Fig. 43).

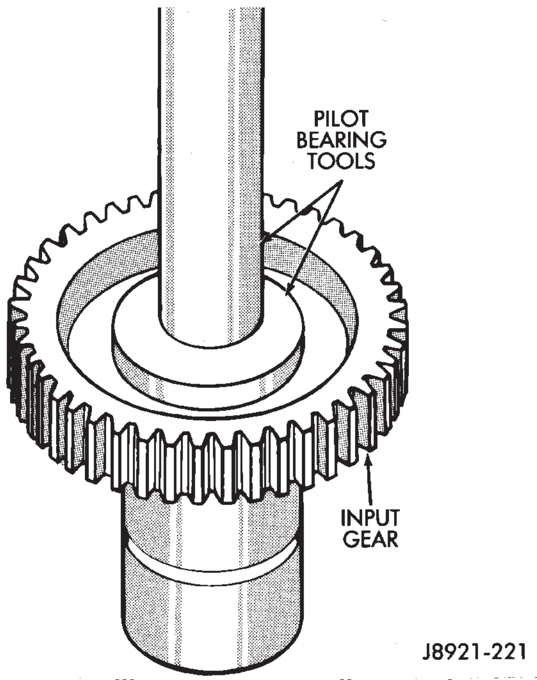


Fig. 43 Installing Input Gear Pilot Bearing

(11) Assemble low range gear, input gear thrust washers, input gear and input gear retainer (Fig. 44).

(12) Install low range gear snap ring (Fig. 45).

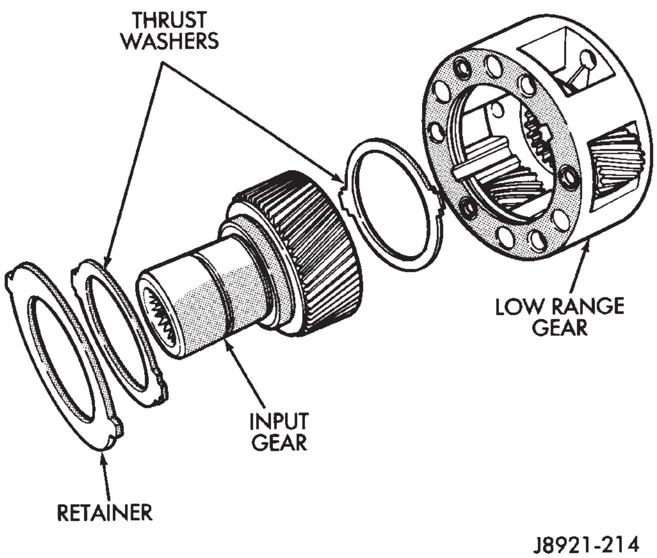


Fig. 44 Low Range And Input Gear Assembly

(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.

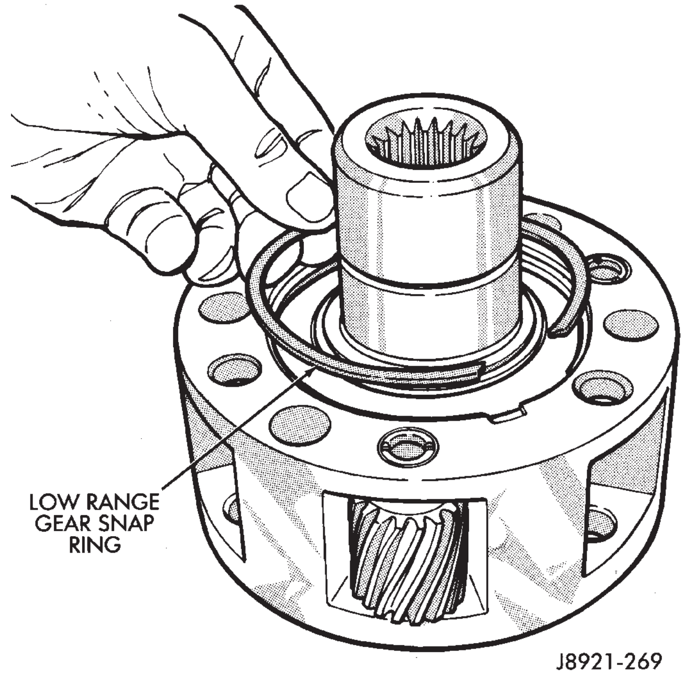


Fig. 45 Installing Low Range Gear Snap Ring

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. 46). Also, do not press against the end surfaces of the low range gear. The gear case and thrust washers could be damaged.

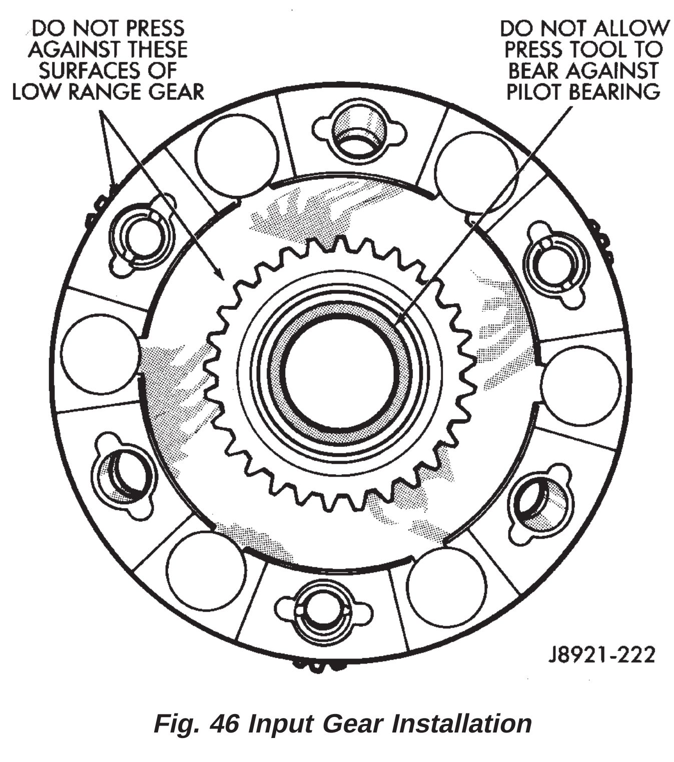


Fig. 46 Input Gear Installation

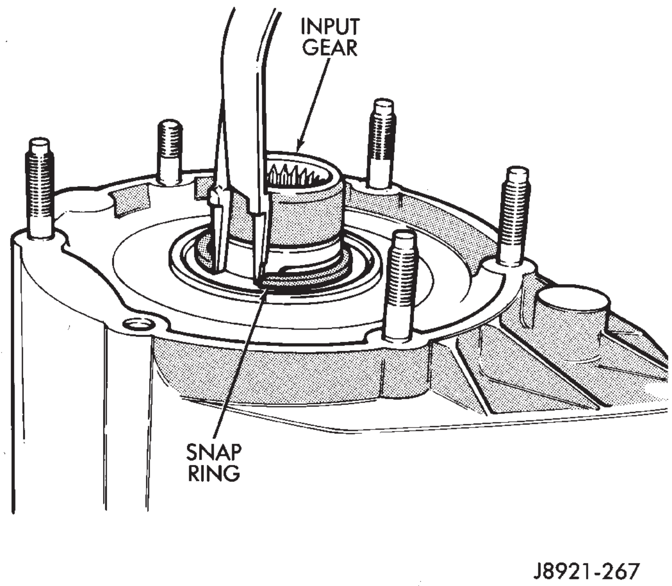


Fig. 47 Installing Input Gear Snap Ring

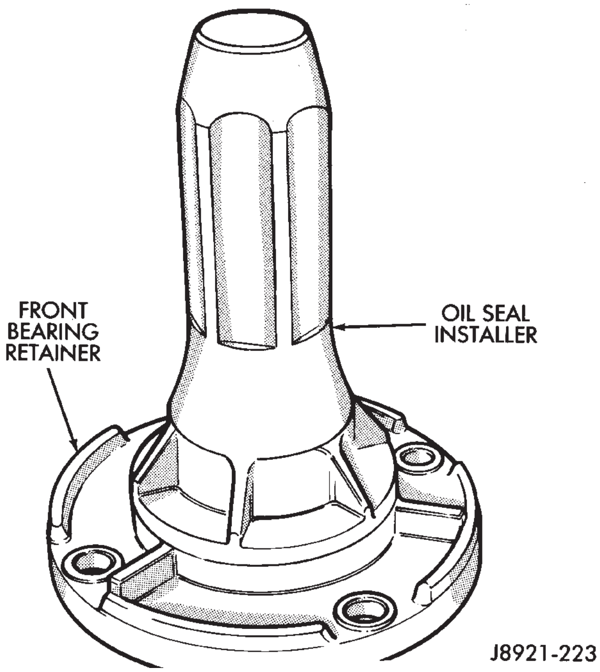


Fig. 48 Install Front Bearing Retainer Seal

(16) Install new input gear snap ring (Fig. 47).

(17) Install new seal in front bearing retainer (Fig. 48).

(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 front bearing retainer (Fig. 49). Tighten the retainer bolts to 16 ft. lbs. (21 N•m) torque.

(20) Install new sector shaft O-ring and bushing (Fig. 50).

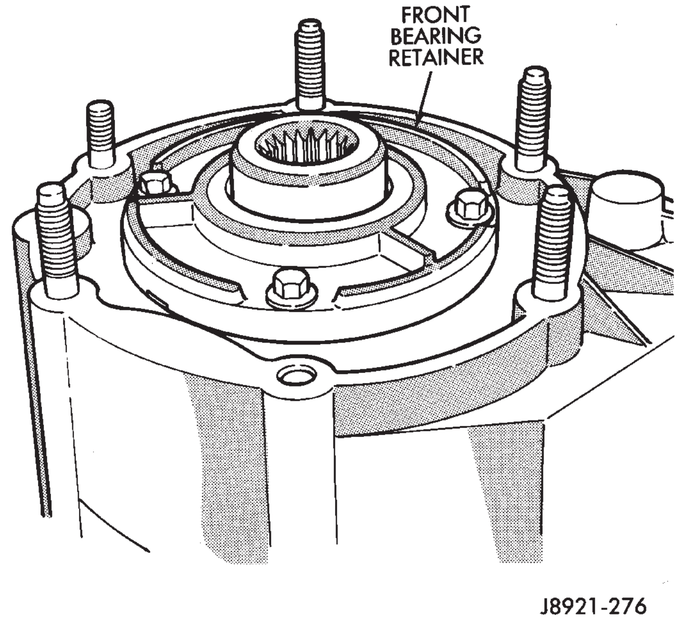


Fig. 49 Installing Front Bearing Retainer

(21) Install shift sector in case.

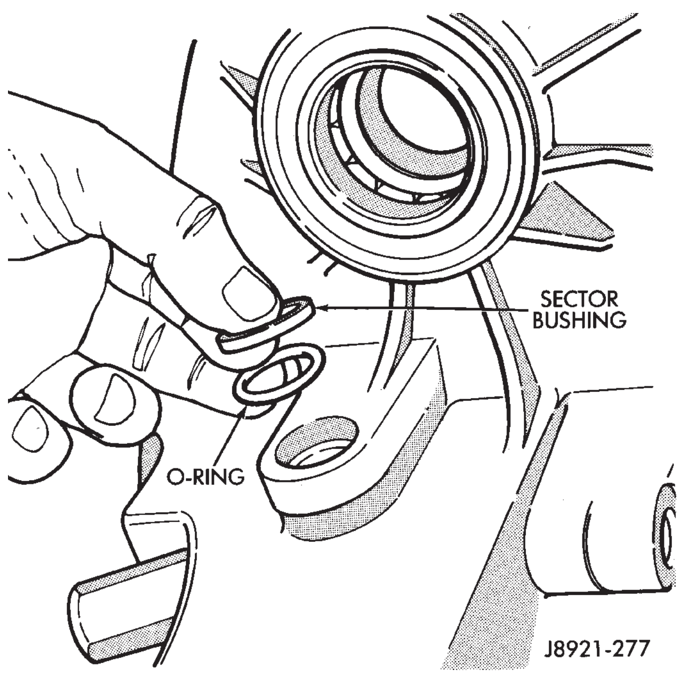


Fig. 50 Installing Sector O-Ring And Bushing

(22) Install new pads in low range fork (Fig. 51).
(23) Assemble low range fork and hub (Fig. 51).

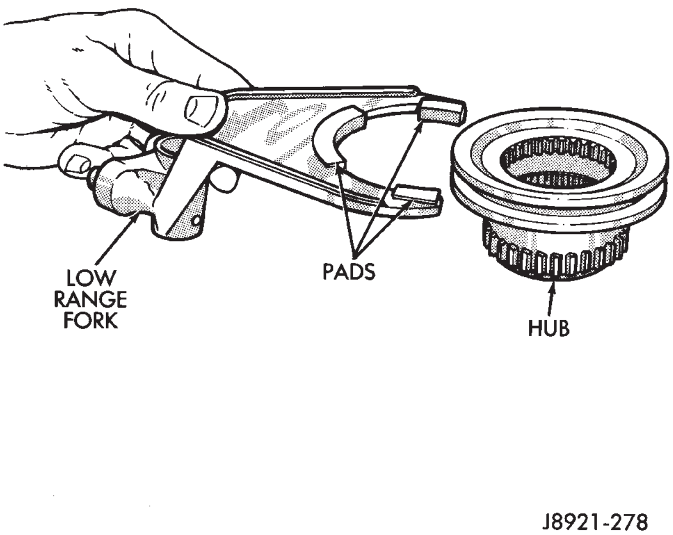


Fig. 51 Assembling Low Range Fork And Hub

(24) Position low range fork and hub in case. Be sure low range fork pin is engaged in shift sector slot (Fig. 52).

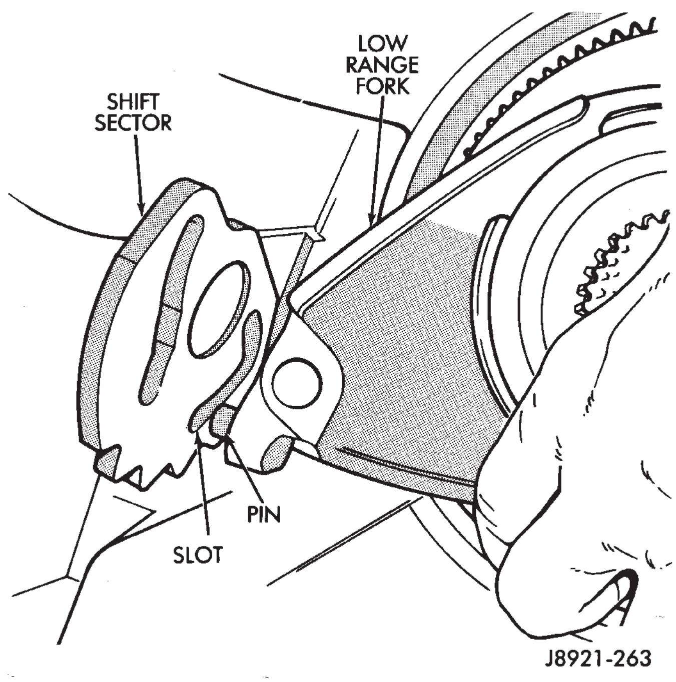


Fig. 52 Positioning Low Range Fork

(25) Lubricate differential components with automatic transmission fluid.

(26) Install sprocket gear in differential bottom case (Fig. 53).

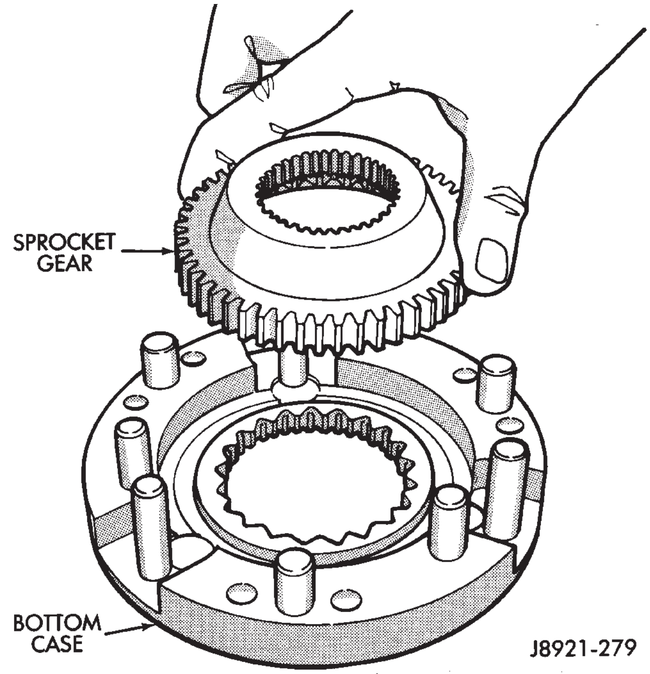


Fig. 53 Installing Differential Sprocket Gear

(27) Install differential planet gears and new thrust washers (Fig. 54). **Be sure thrust washers are installed at top and bottom of each planet gear.**
(28) Install differential mainshaft gear (Fig. 54).

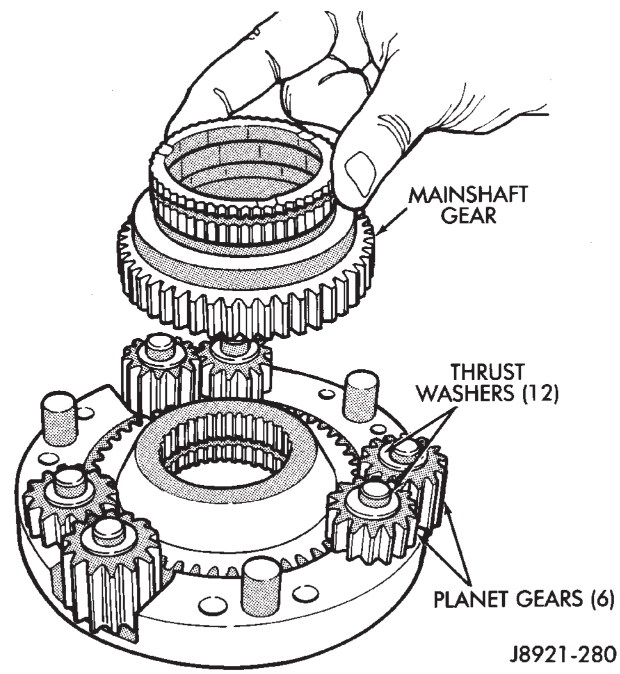


Fig. 54 Installing Mainshaft And Planet Gears

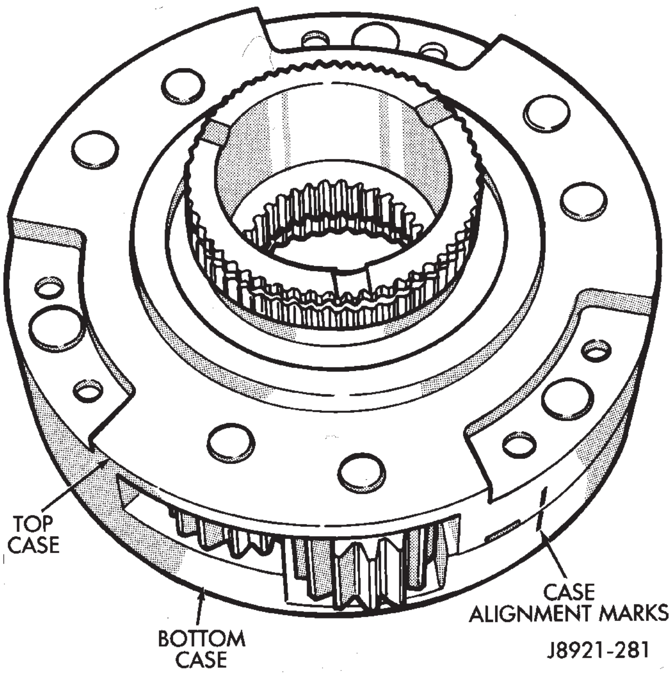


Fig. 55 Differential Case Assembly

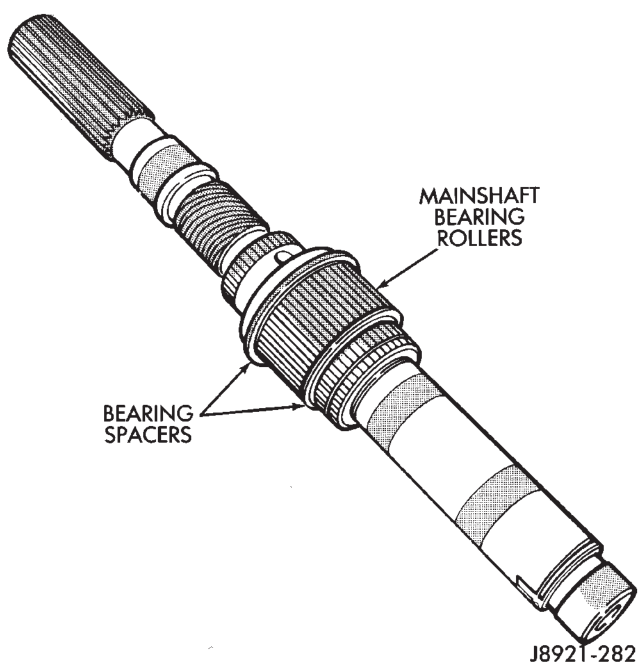


Fig. 56 Installing Mainshaft Bearing Rollers and Spacers

(29) Align and position differential top case on bottom case (Fig. 55). Align using scribe marks made at disassembly.

(30) Install and tighten differential case bolts.

(31) Install first mainshaft bearing spacer on mainshaft (Fig. 56).

(32) Install bearing rollers on mainshaft (Fig. 56). **Coat bearing rollers with generous quantity of petroleum jelly to hold them in place.**

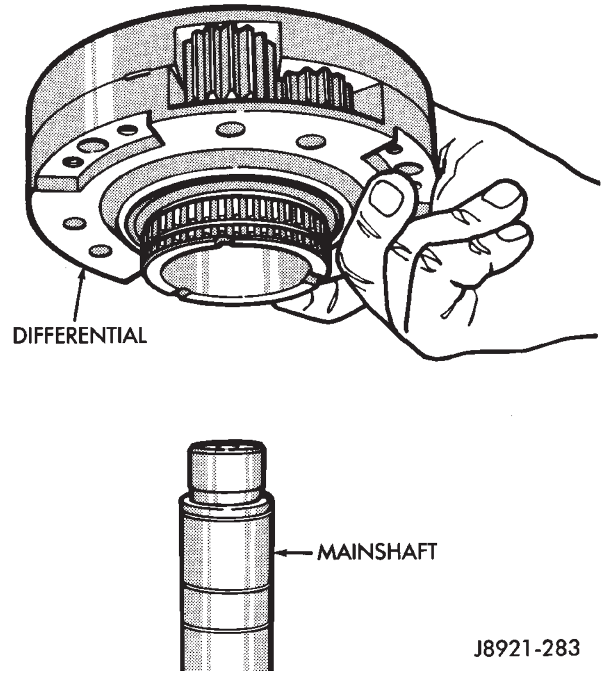


Fig. 57 Differential Installation

(33) Install remaining bearing spacer on mainshaft (Fig. 56). Do not displace any bearings while installing spacer.

(34) Install differential (Fig. 57). **Do not displace mainshaft bearings when installing differential.**

(35) Install the differential snap ring (Fig. 58).

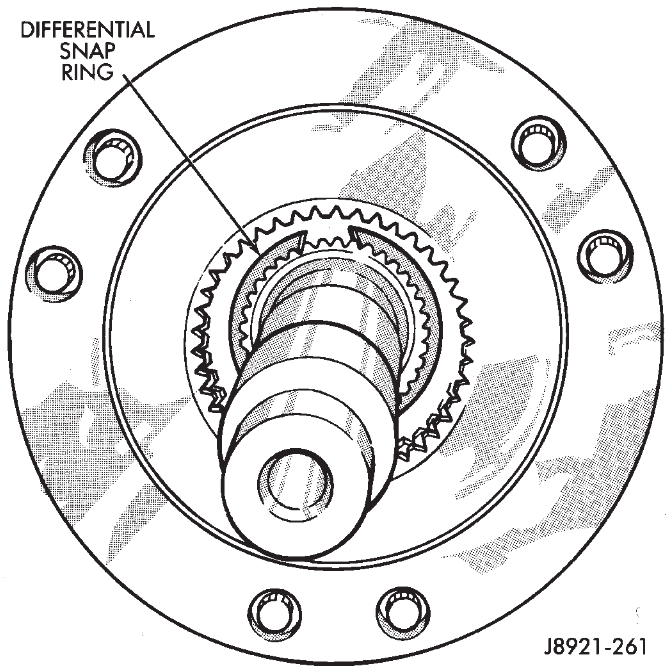


Fig. 58 Installing Differential Snap Ring

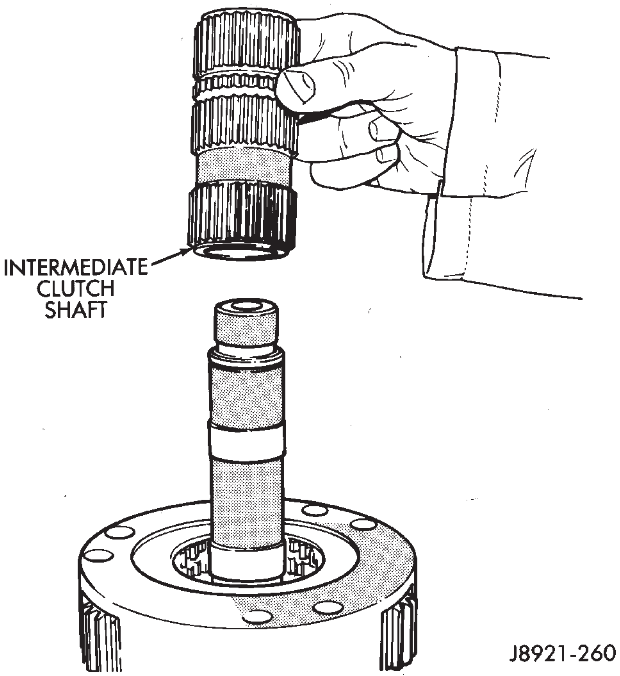


Fig. 59 Installing Intermediate Clutch Shaft

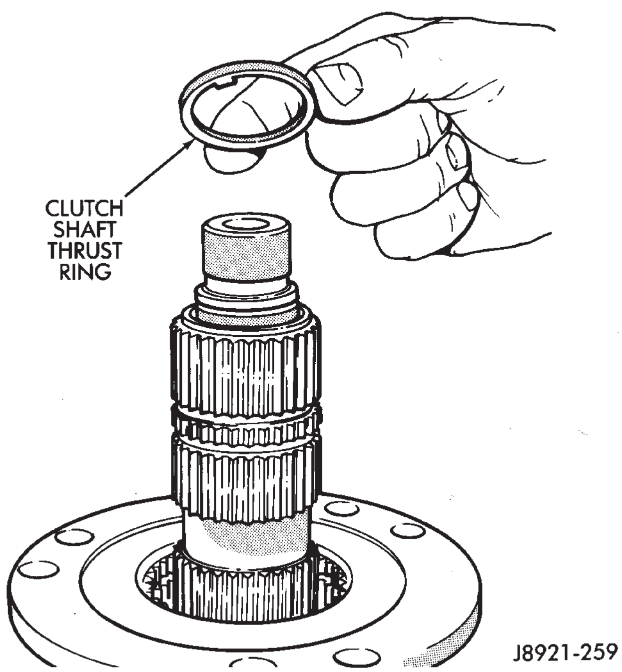


Fig. 60 Installing Clutch Shaft Thrust Washer

(36) Install the intermediate clutch shaft (Fig. 59).
(37) Install clutch shaft thrust washer (Fig. 60).

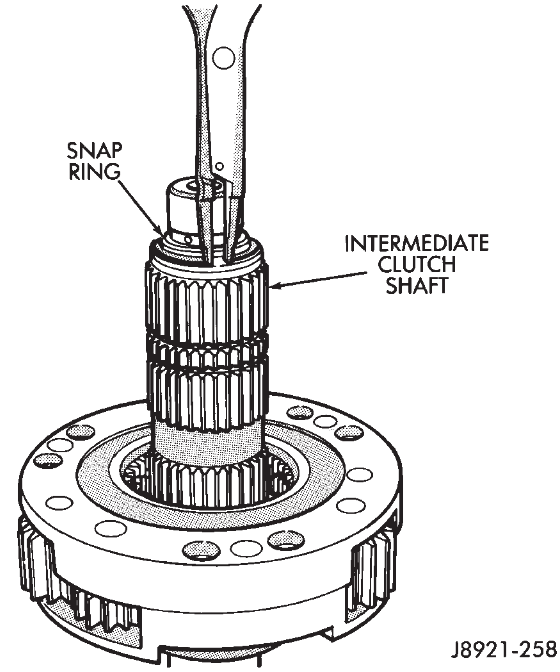


Fig. 61 Installing Clutch Shaft Snap Ring

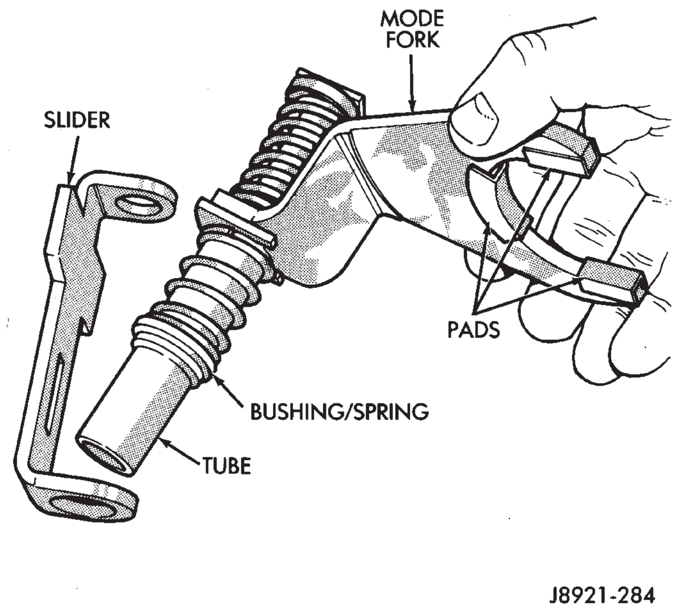


Fig. 62 Mode Fork Components

(38) Install clutch shaft snap ring (Fig. 61).
(39) Inspect mode fork assembly (Fig. 62). Replace pads and bushing if necessary. Replace fork tube if bushings inside tube are worn or damaged. Also check springs and slider bracket (Fig. 62). Replace worn, damaged components.

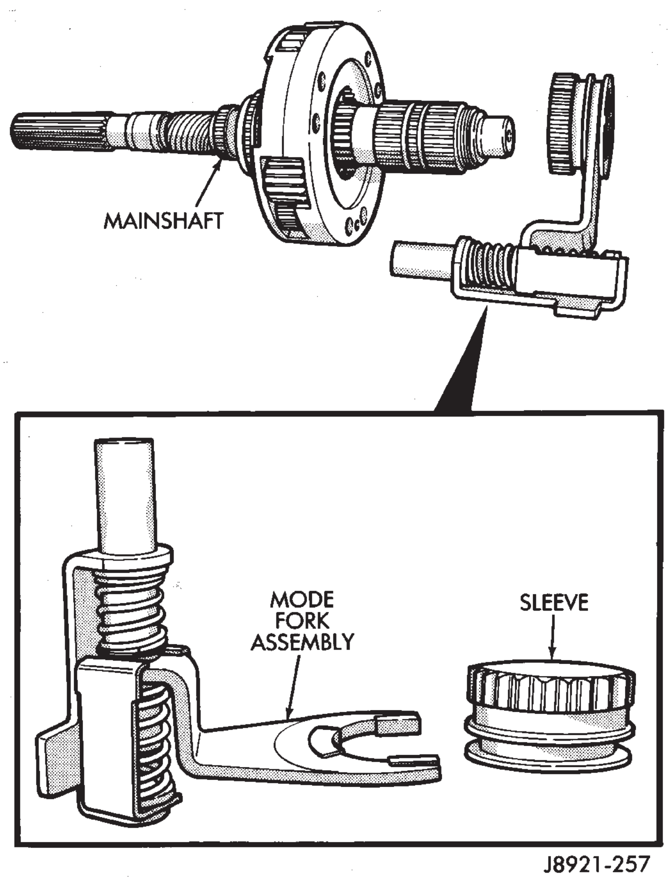


Fig. 63 Installing Mode Fork And Sleeve

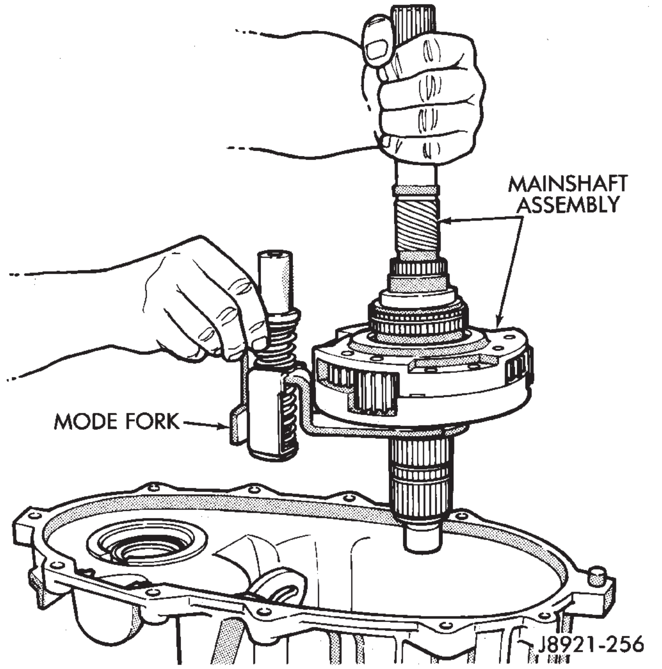


Fig. 64 Installing Mainshaft And Mode Fork

(40) Install mode sleeve in mode fork (Fig. 63). Then install assembled sleeve and fork on mainshaft. Be sure mode sleeve splines are engaged in differential splines.

(41) Install mode fork and mainshaft assembly in case (Fig. 64). Rotate mainshaft slightly to engage shaft with low range gears.

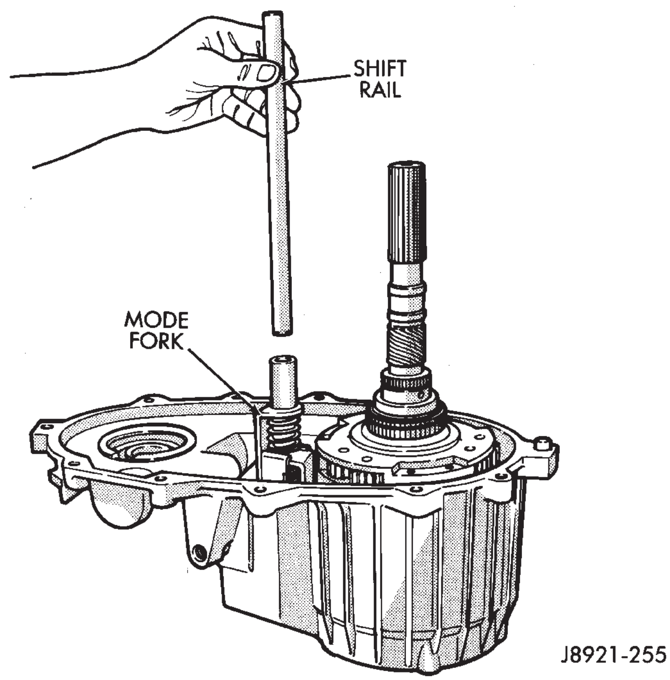


Fig. 65 Installing Shift Rail

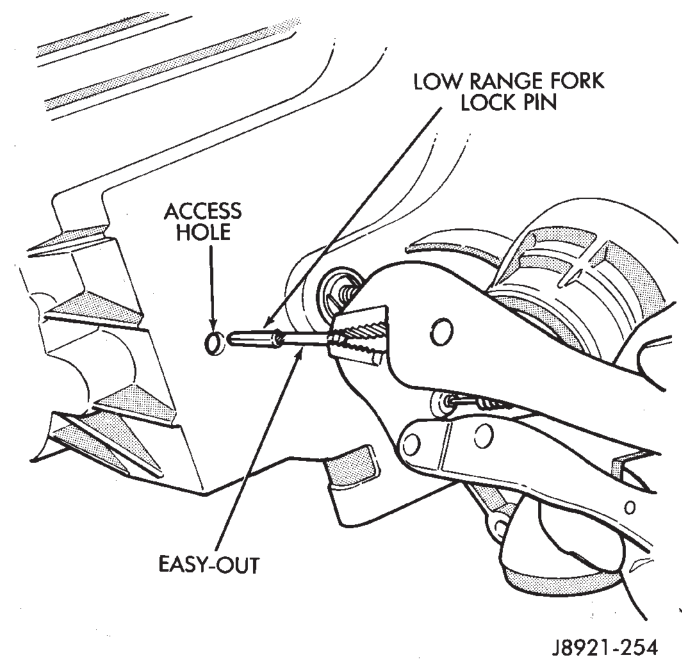


Fig. 66 Installing Low Range Fork Lockpin

(42) Rotate mode fork pin into shift sector slot.

(43) Install shift rail (Fig. 65). **Be sure rail is seated in both shift forks.**

(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. 66). **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. 66). Then remove easy-out and seat pin with pin punch.

(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. 67).

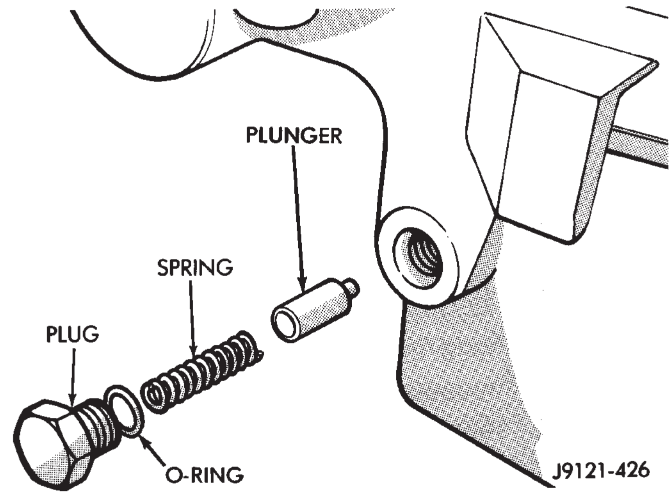


Fig. 67 Installing Detent Pin, Spring And Plug

(50) Install front output shaft (Fig. 68).

(51) Install drive chain (Fig. 68). Engage chain with front output shaft sprocket teeth.

(52) Install drive sprocket (Fig. 68).

(53) Engage drive sprocket teeth with chain. Then engage sprocket splines with mainshaft splines.

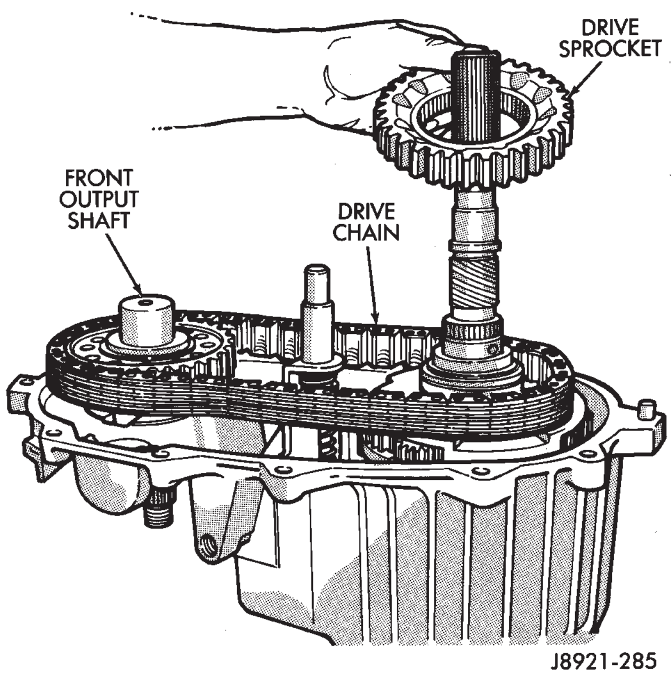


Fig. 68 Installing Drive Chain And Sprocket

(54) Install drive sprocket snap ring (Fig. 69).

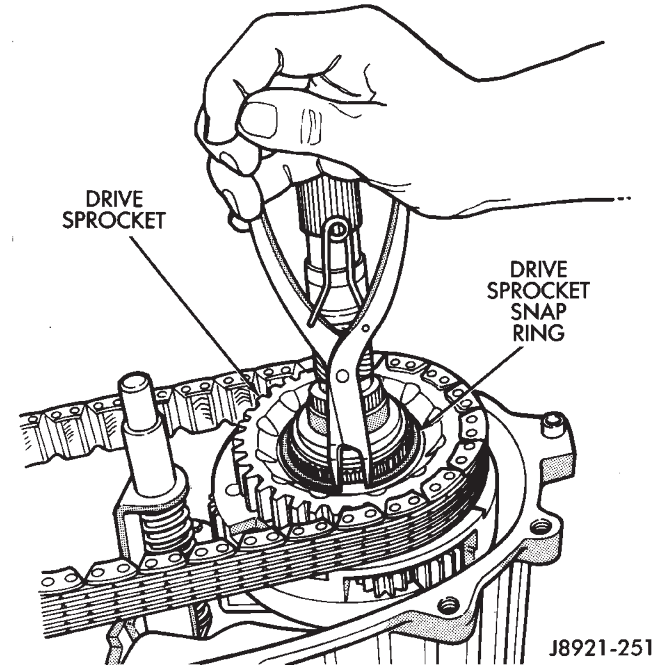


Fig. 69 Installing Drive Sprocket Snap Ring

(55) Replace front output shaft rear bearing. Remove bearing with internal puller and slide hammer (Fig. 70). Install new bearing with bearing driver tools (Fig. 70). Lubricate bearing after installation.

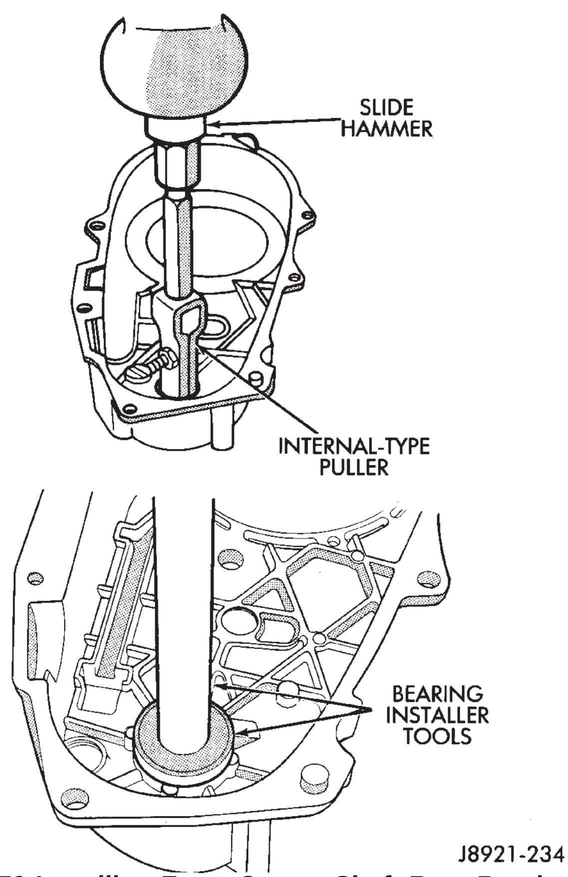


Fig. 70 Installing Front Output Shaft Rear Bearing

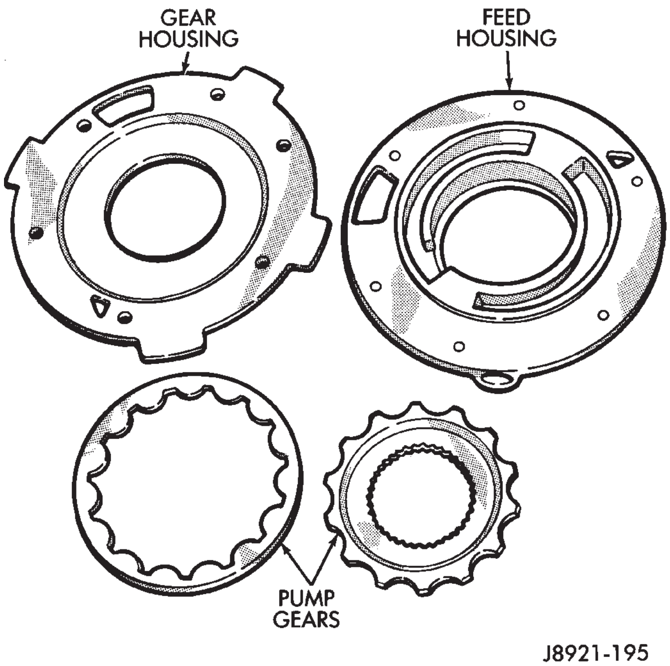


Fig. 71 Oil Pump Assembly

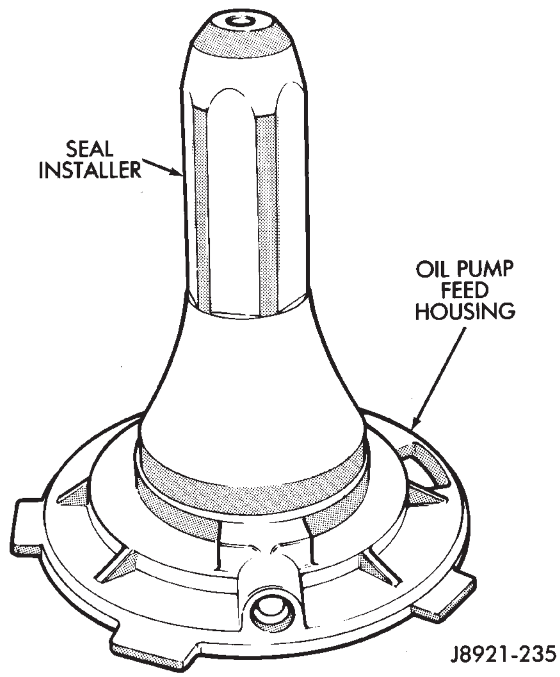


Fig. 72 Installing Oil Pump seal

(56) Assemble oil pump (Fig. 71). Replace any pump components that are worn or damaged.

(57) Install new seal in oil pump feed housing (Fig. 72).

(58) Install new pickup tube O-ring in oil pump (Fig. 73).

(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. 74). Be sure screen is seated in case slot as shown.

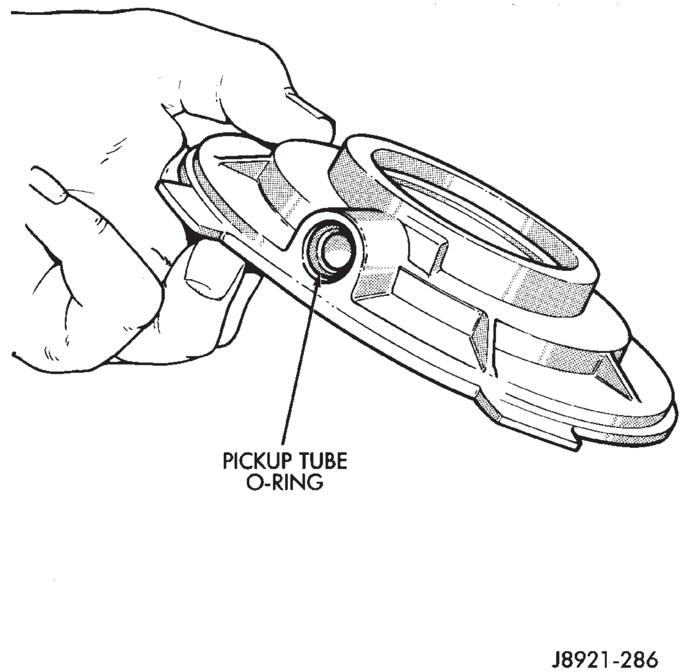


Fig. 73 Installing Pickup Tube O-Ring

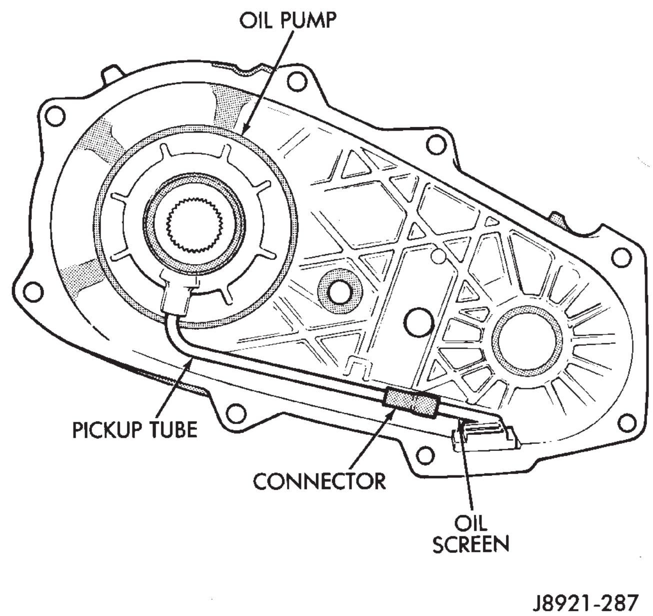


Fig. 74 Installing Oil Screen And Pickup Tube

(60) Install magnet in front case pocket (Fig. 75).

(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.**

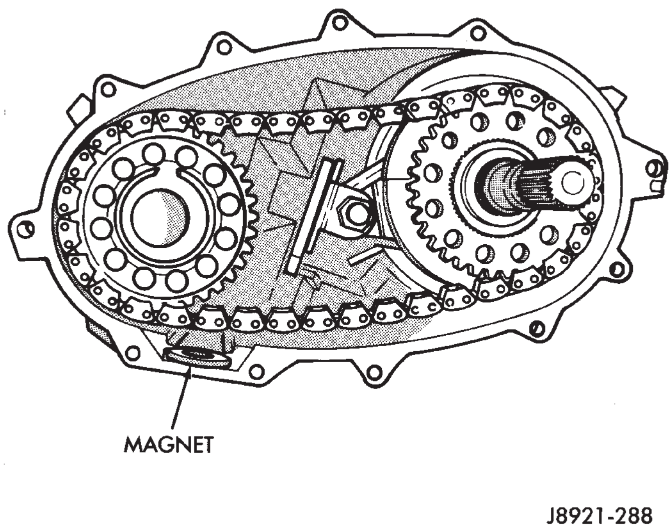


Fig. 75 Installing Case Magnet

(64) Tap rear retainer bearing out of retainer with hammer and brass drift.

(65) Install new bearing in rear retainer with driver tools (Fig. 76).

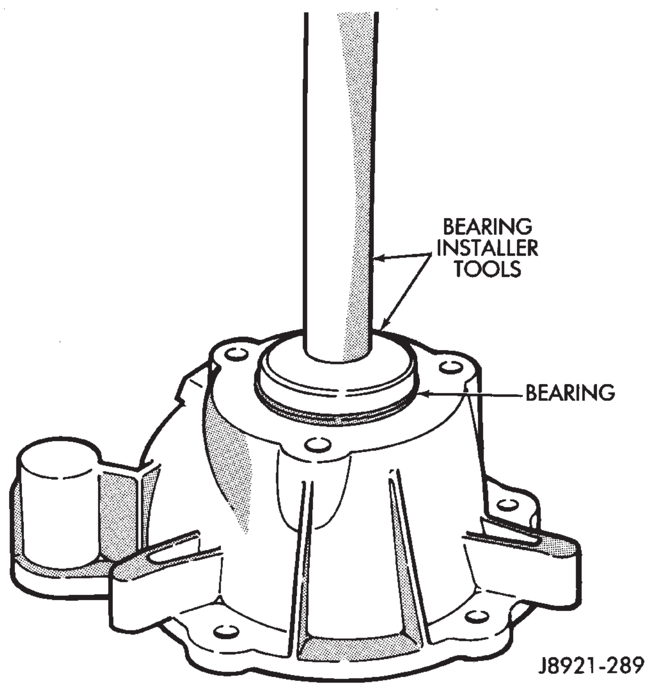


Fig. 76 Installing Rear Bearing In Retainer

(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.

(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. 77). Lift mainshaft slightly to seat the snap ring if necessary.

(69) Remove extension housing seal if not removed previously.

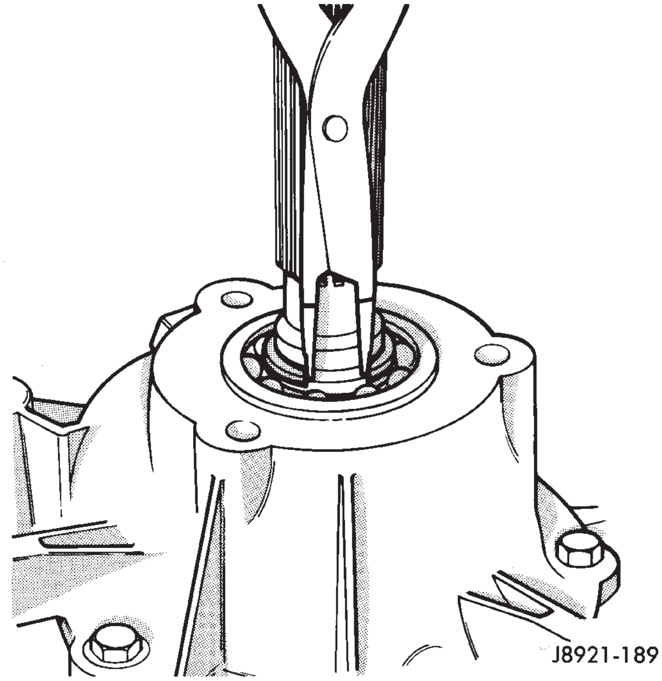


Fig. 77 Installing Rear Bearing Snap Ring

(70) Replace extension housing bushing with driver tools (Fig. 78).

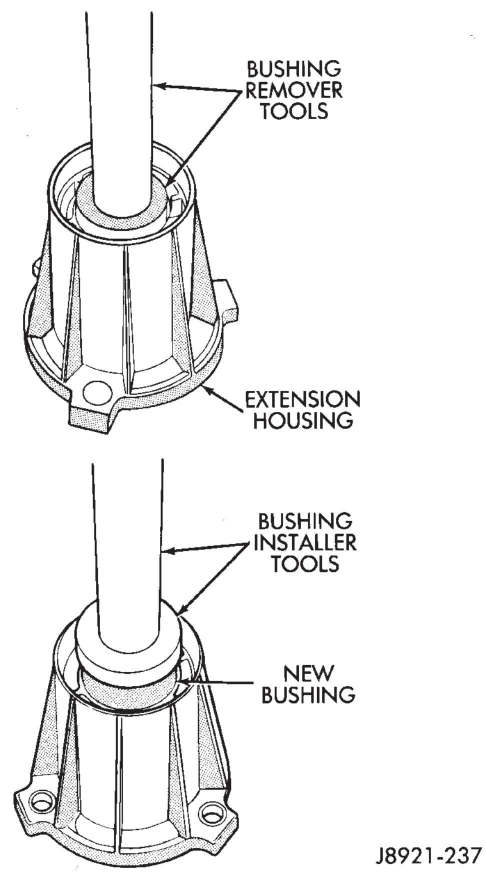


Fig. 78 Replacing Extension Housing Bushing

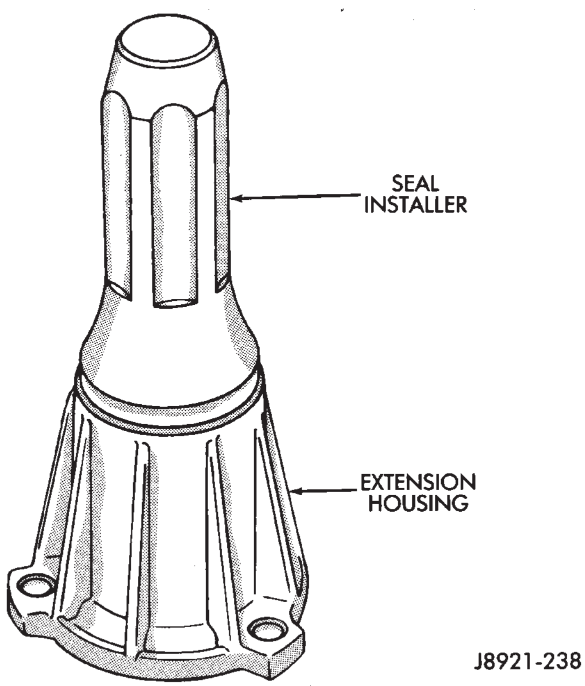


Fig. 79 Replacing Extension Housing Seal

(71) Install new extension housing oil seal (Fig. 79).

(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 indicator switch and install switch in case. Tighten switch to 27 N●m (20 ft. lbs.) torque.

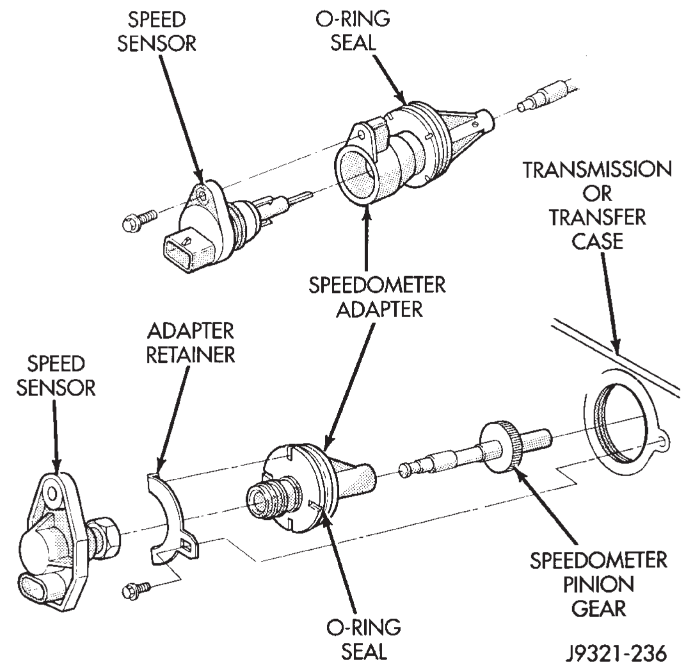


Fig. 80 Speedometer Components

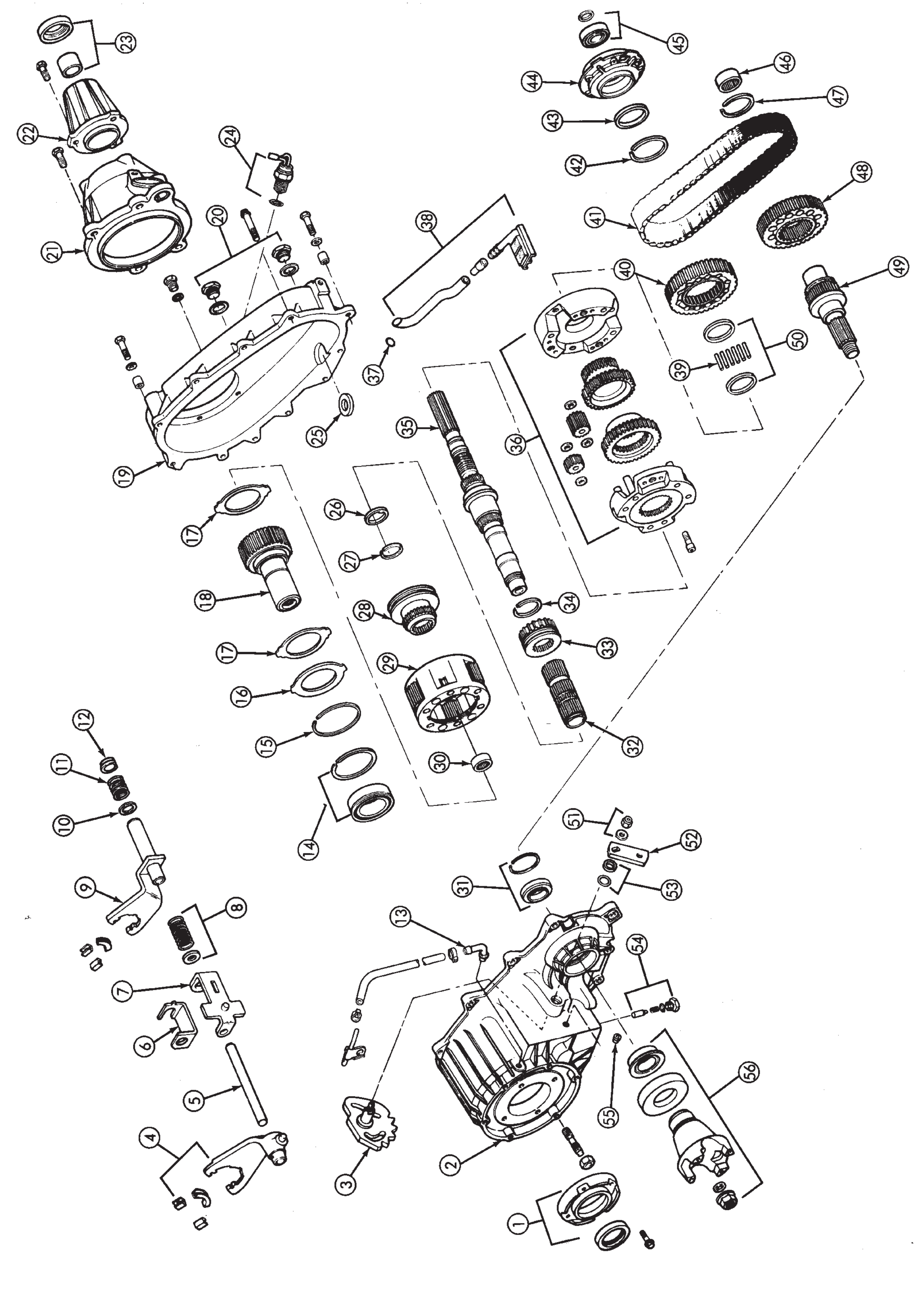
(76) Install speedometer components (Fig. 80).

(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.



NP242 TRANSFER CASE

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

NP249 TRANSFER CASE

INDEX

GENERAL INFORMATION

The NP249 is an all the time, transfer case with two operating ranges and a neutral position (Fig. 1). Operating ranges are 4-high and 4-low. The 4-low range is used for extra pulling power in off road situations.

Engine torque is distributed to the front and rear axles through a differential and viscous coupling in the transfer case. The NP249 is also equipped with a low range gear reduction system for increased low speed and off road torque capability.

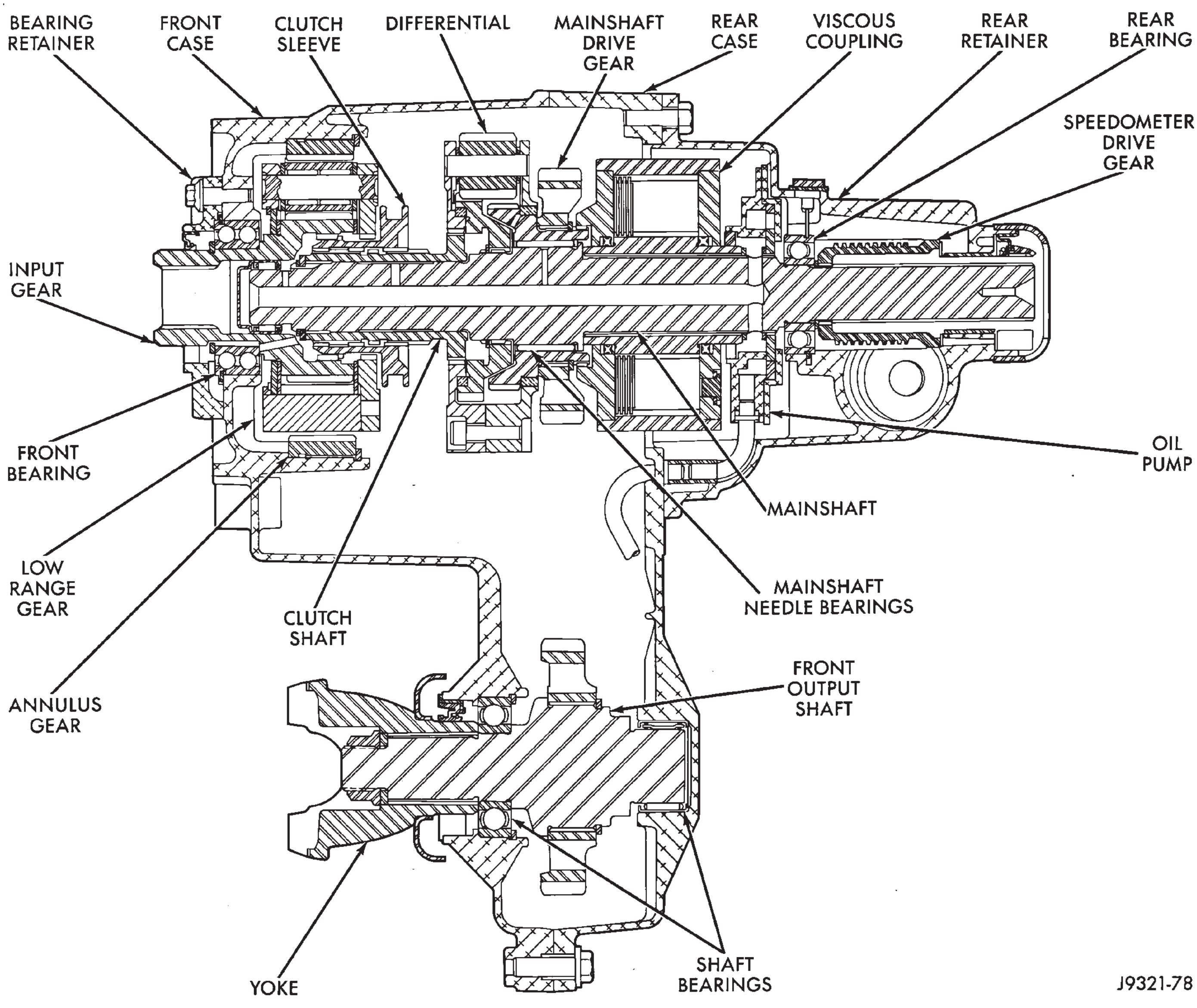


Fig. 1 NP249 Transfer Case

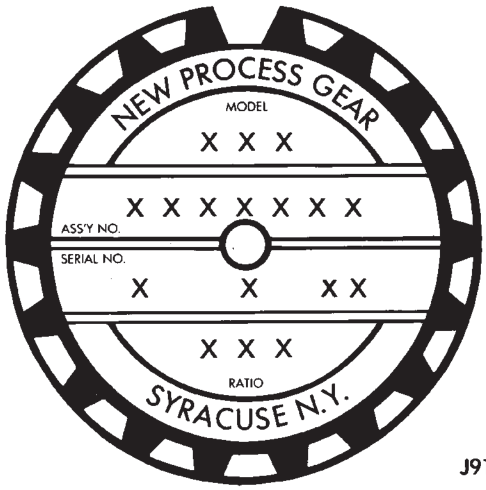


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Fig. 2 Transfer Case I.D. Tag

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.

TRANSFER CASE IDENTIFICATION

A circular I.D. tag is attached to the rear case of each NP249 transfer case (Fig. 2). 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.

RECOMMENDED LUBRICANT

Mopar Dexron II®, or ATF Plus, type 7176 automatic transmission fluid are the recommended lubricants for the NP249 transfer case.

Fluid refill capacity is approximately 1.18 liters (2.50 pints). Correct fill level is to the bottom edge of the fill plug hole.

SHIFT LINKAGE ADJUSTMENT

(1) Shift transfer case into Neutral position.

(2) Raise vehicle on hoist that will allow all four wheels to rotate freely.

(3) Loosen trunnion lock bolt (Figs. 3 and 4). Loosen bolt enough so selector rod slides freely in trunnion.

(4) Verify that shift lever on transfer case is in centered in Neutral position.

(5) Tighten trunnion lock bolt to 11-20 N•m (96-180 in. lbs.) torque.

(6) Lower vehicle enough for entry into driver's seat but keep all wheels off shop floor.

NP249 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 MOPAR DEXRON II® or ATF Plus, Type 7176 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 MOPAR DEXRON II® or ATF Plus, Type 7176 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.

J9221-50

TORQUE	
A	3-4 N•m (27-35 in. lbs.)
B	11-14 N•m (97-123 in. lbs.)
C	8-14 N•m (72-120 in. lbs.)

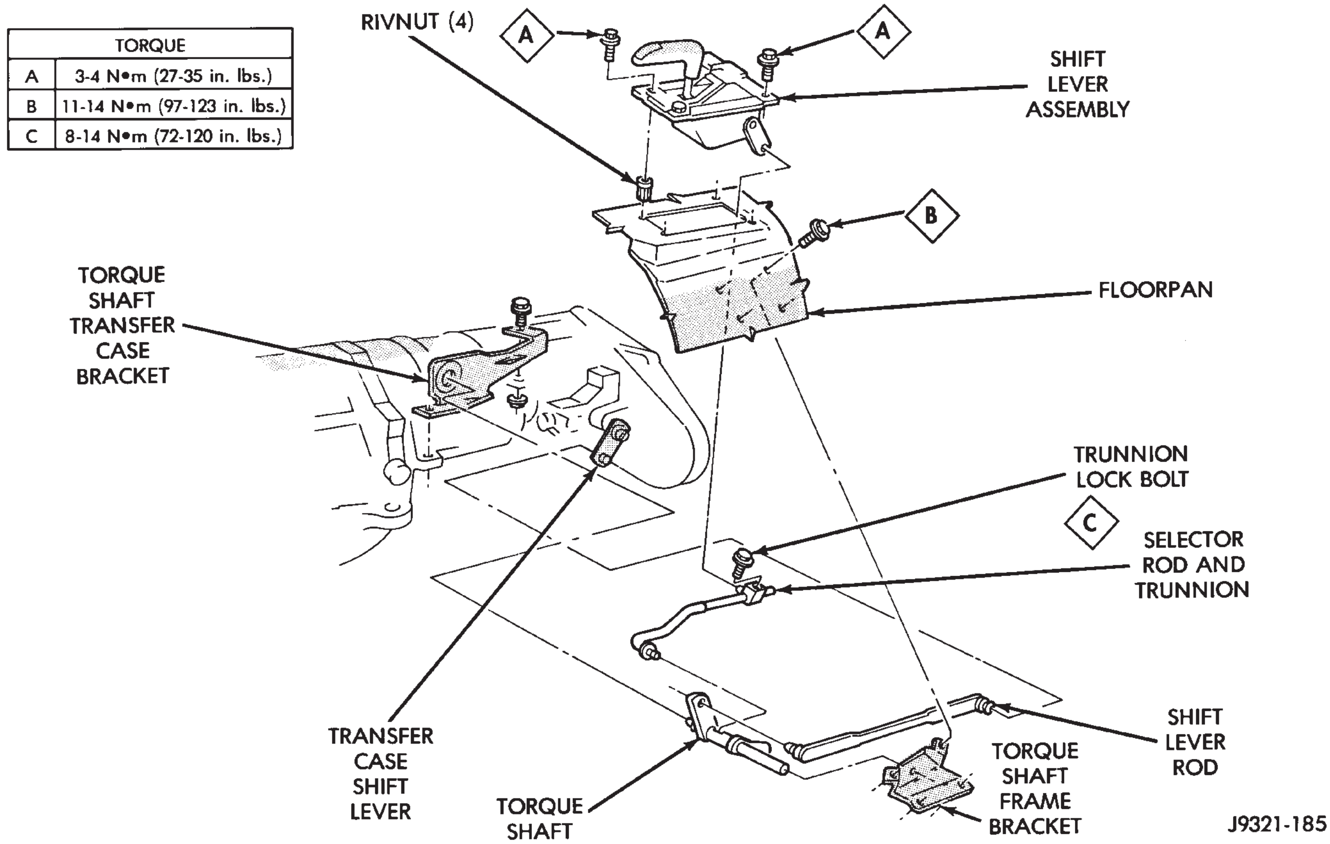


Fig. 3 Transfer Case Shift Linkage (Automatic Transmission)

TORQUE	
A	3-4 N•m (27-35 IN. LBS.)
B	11-14 N•m (97-123 IN. LBS.)
C	8-14 N•m (72-120 IN. LBS.)

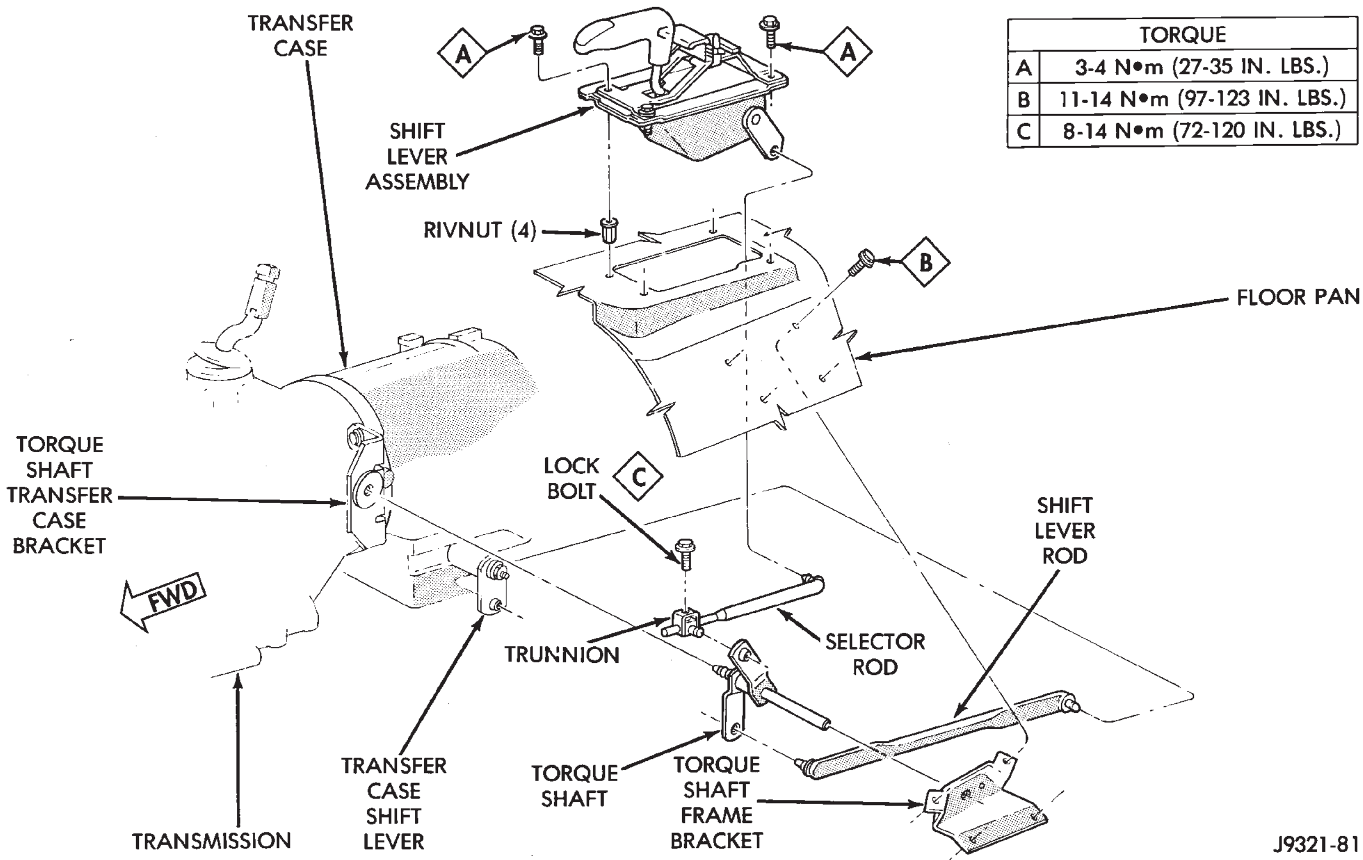


Fig. 4 Transfer Case Shift Linkage (Manual Transmission)

(7) Verify correct linkage adjustment. Start engine, shift transmission into gear and shift transfer case into all ranges. Be sure transfer case is fully engaged in high and low range. Readjust linkage if necessary.

(8) Shut engine off and lower vehicle completely.

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 speed sensor and remove speedometer adapter and sensor if necessary.

(9) Disconnect transfer case shift lever from shift lever rod.

(10) Disconnect vent hose and electrical connectors.

(11) Support transfer case with transmission jack.

(12) Remove bolts 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 (Fig. 5).

(4) Install and tighten transfer case attaching nuts to 35 N●m (26 ft. lbs.) torque (Fig. 5).

(5) Install speedometer adapter if removed during

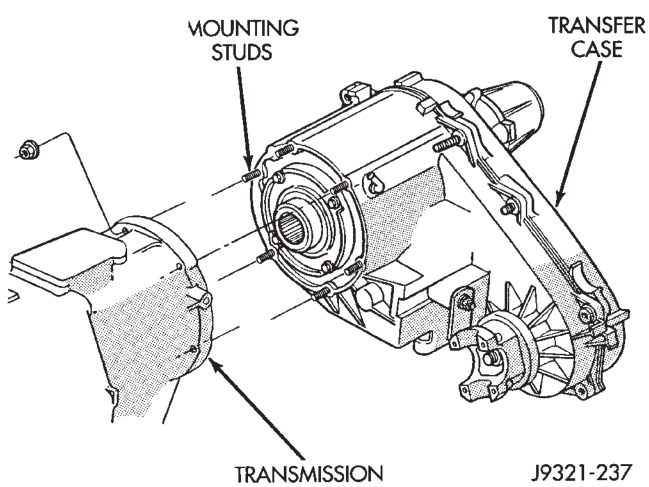


Fig. 5 Transfer Case Attachment

service (Fig. 6). Then index adapter and install speed sensor in adapter. Refer to adapter indexing procedure in In-Vehicle Service section.

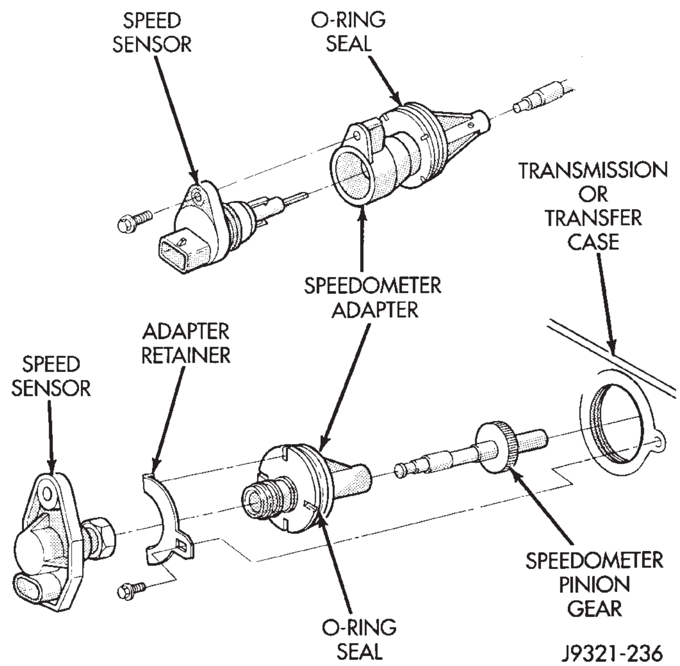


Fig. 6 Speedometer Components

(6) Connect electrical wires to speed sensor.

(7) Connect vent hose to transfer case vent (Fig. 7).

(8) Align and connect propeller shafts. Tighten

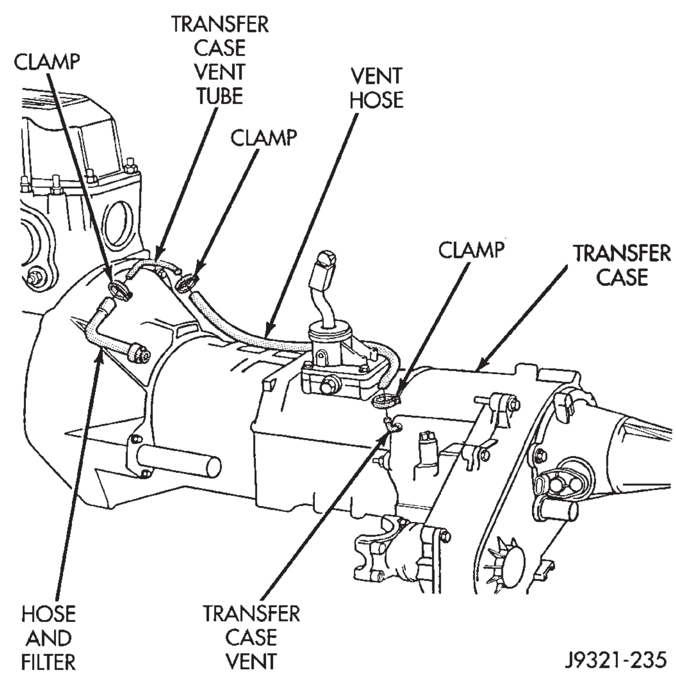


Fig. 7 Transfer Case Vent Hose Routing

shaft attaching bolts to 19 N●m (170 in. lbs.) torque.

(9) Fill transfer case with Mopar Dexron II, or ATF Plus automatic transmission fluid.

(10) Install rear crossmember if removed. Tighten crossmember bolts to 41 N●m (30 ft. lbs.) torque.

(11) Remove transmission jack and transmission support stand.

(12) Connect transfer case shift lever to shift lever rod.

(13) Check and adjust transfer case shift linkage if necessary.

(14) Lower vehicle.

TRANSFER CASE DISASSEMBLY AND OVERHAUL

TRANSFER CASE DISASSEMBLY

(1) Position transfer case on shallow drain pan. Remove drain plug and drain lubricant.

(2) Remove front yoke nut and remove yoke (Fig. 1).

(3) Remove yoke seal washer from front output shaft (Fig. 2).

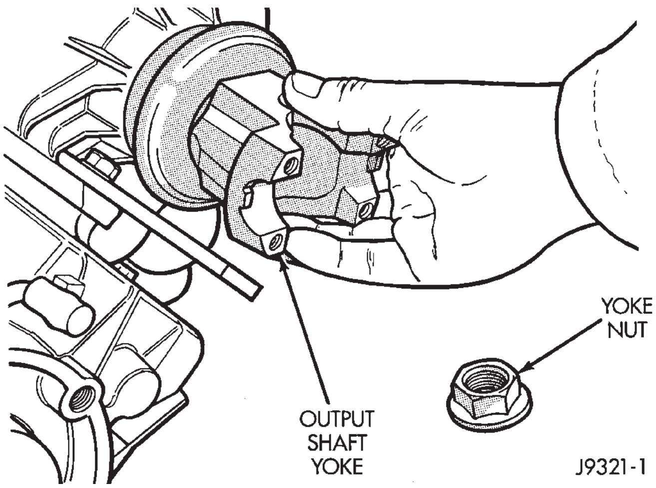


Fig. 1 Removing Front Output Shaft Yoke

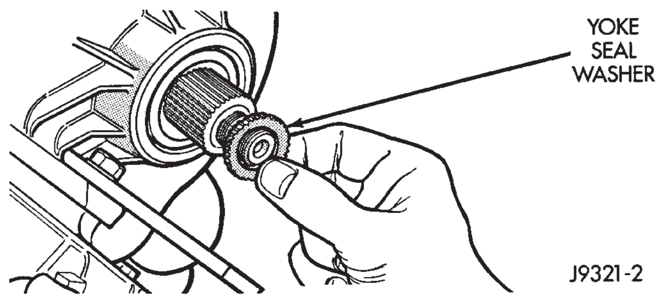


Fig. 2 Removing Yoke Seal Washer

(4) Remove rear retainer bolts (Fig. 3).

(5) Remove rear bearing locating ring access cover screws, cover and gasket (Fig. 4).

(6) Loosen rear retainer with pry tool to break sealer bead. Pry only against retainer boss as shown (Fig. 5).

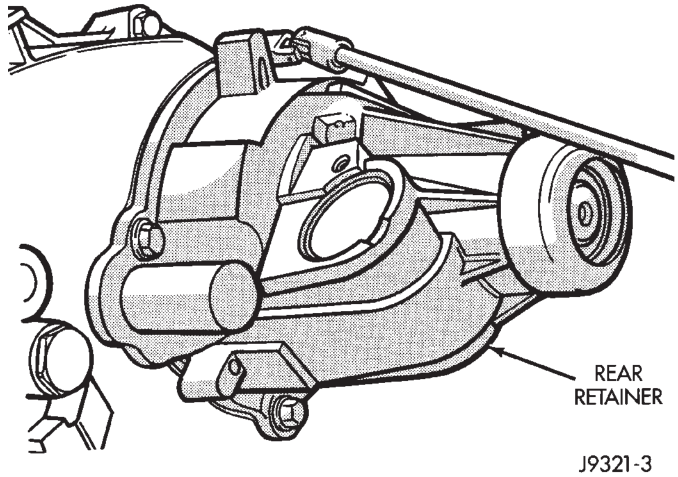


Fig. 3 Removing Rear Retainer Bolts

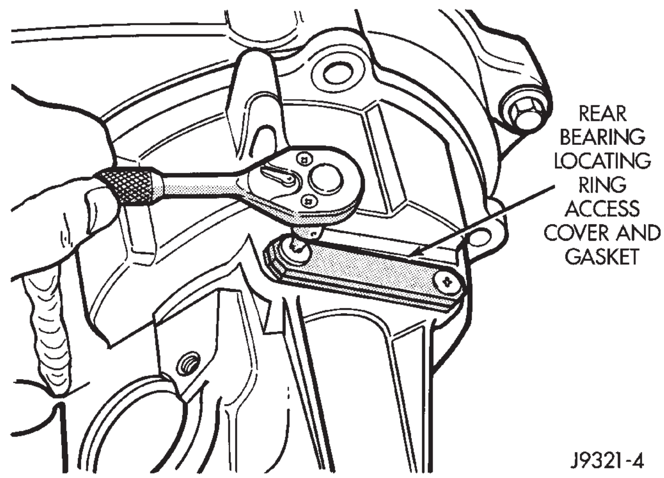


Fig. 4 Removing Locating Ring Access Cover And Gasket

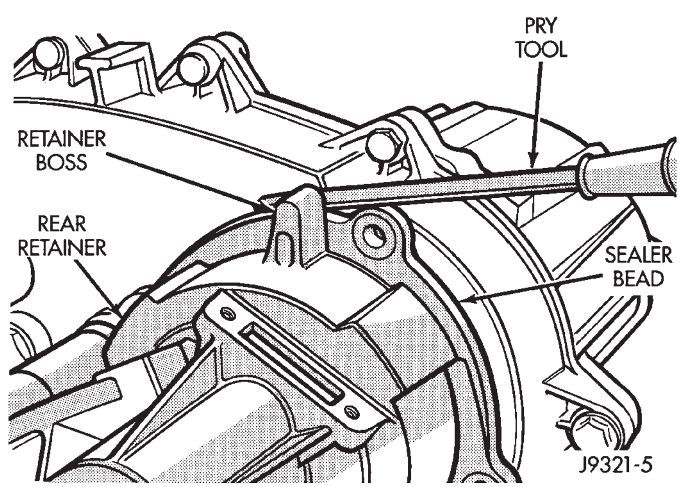


Fig. 5 Loosening Rear Retainer

(7) Remove rear retainer as follows: Spread rear bearing locating ring with snap ring pliers (Fig. 6). Then slide retainer off mainshaft and rear bearing (Fig. 7).

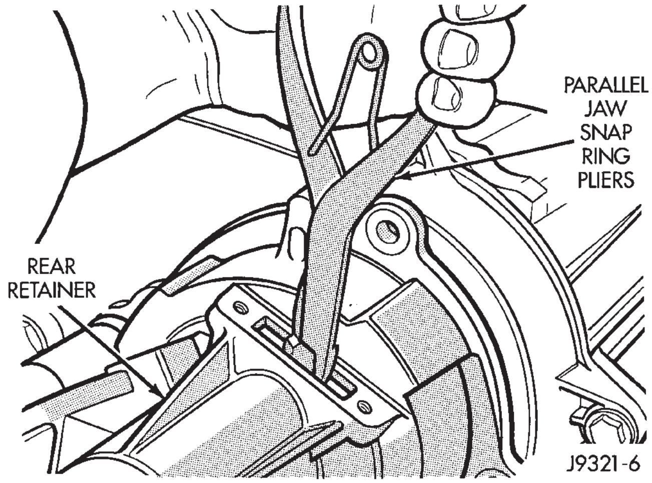


Fig. 6 Disengaging Rear Bearing Locating Ring

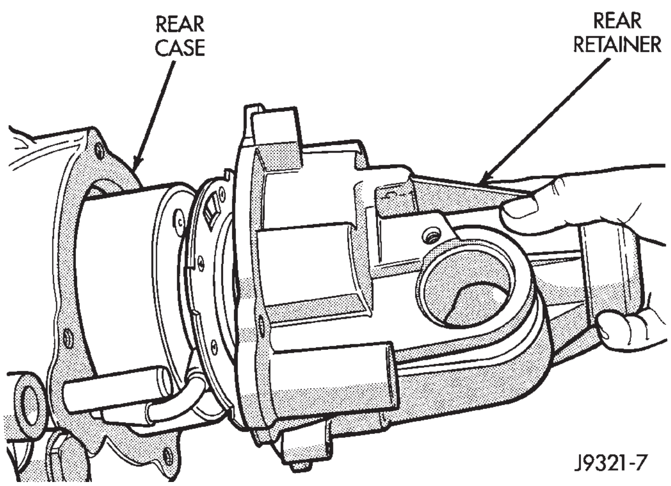


Fig. 7 Removing Rear Retainer

(8) Remove speedometer drive gear (Fig. 8).

(9) Remove rear bearing snap ring (Fig. 9).

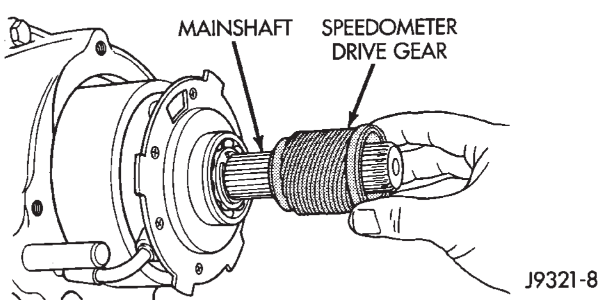


Fig. 8 Removing Speedometer Drive Gear

(10) Remove rear bearing (Fig. 10). Note position of bearing locating ring groove for assembly reference.

(11) Disengage oil pickup tube from oil pump and remove pump assembly (Fig. 11).

(12) Mount transfer case on wood blocks so rear case is facing upward (Fig. 12).

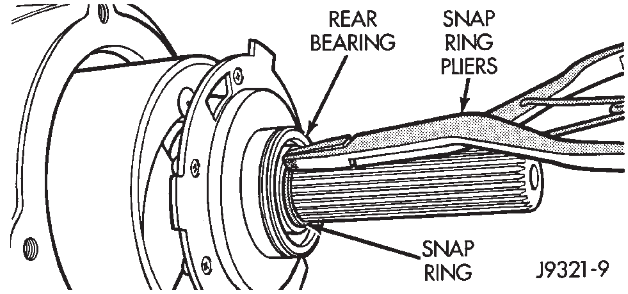


Fig. 9 Removing Rear Bearing Snap Ring

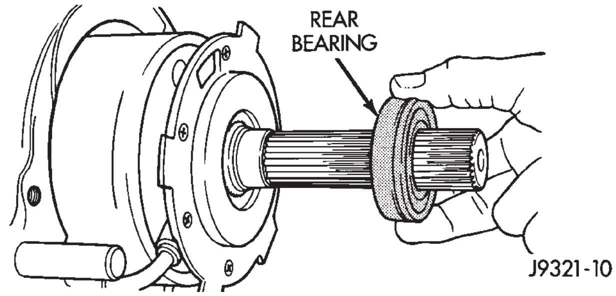


Fig. 10 Removing Rear Bearing

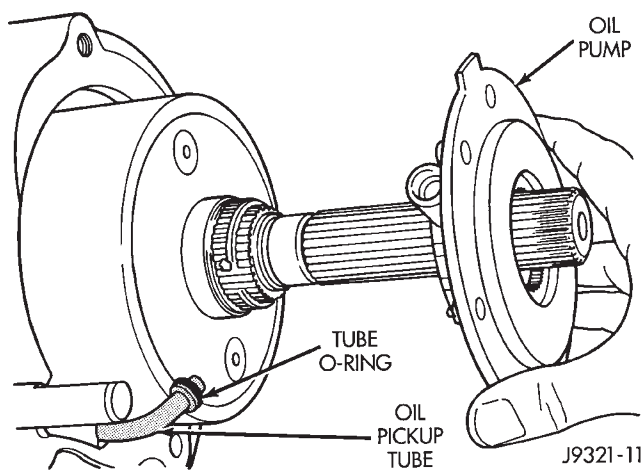


Fig. 11 Removing Oil Pump

(13) Remove bolts attaching rear case to front case. Note that two end bolts are only ones that require washers (Fig. 13). These bolts serve as case-to-case alignment bolts.

(14) Loosen rear case with flat blade screwdriver to break sealer bead. Insert screwdriver blade only into notches provided at each end of case (Fig. 14).

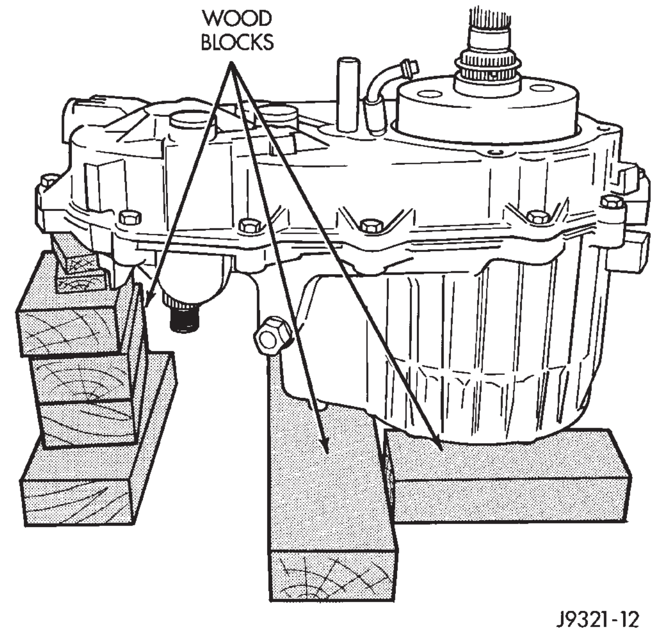


Fig. 12 Supporting Transfer Case On Wood Blocks

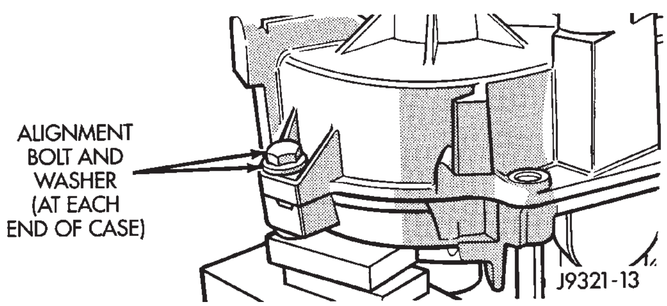


Fig. 13 Rear Case Alignment Bolt Locations

(15) Remove rear case (Fig. 15).

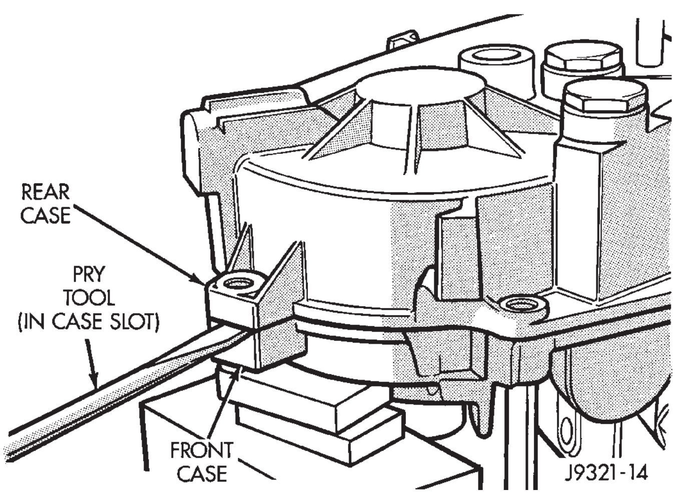


Fig. 14 Loosening Rear Case

(16) Remove oil pickup tube from rear case (Fig. 16).

(17) Remove oil pump locating snap ring and viscous coupling snap ring from mainshaft (Fig. 17).

(18) Remove viscous coupling from mainshaft (Fig. 18).

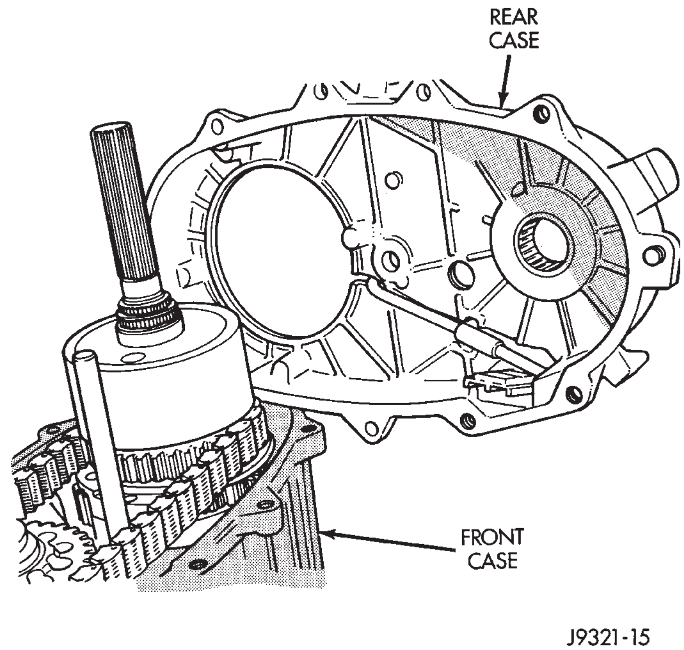


Fig. 15 Rear Case Removal

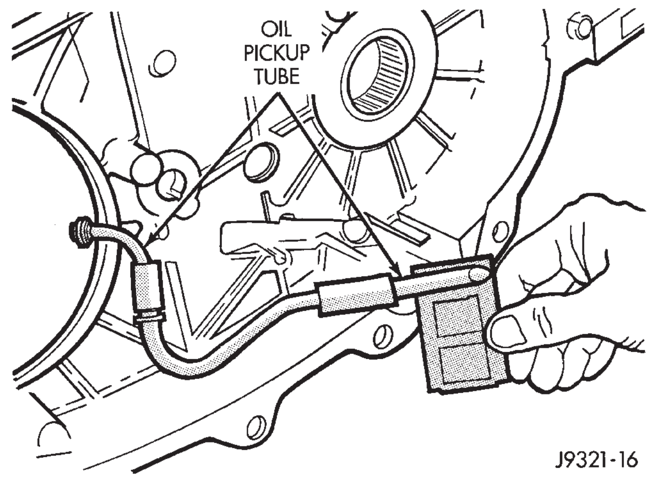


Fig. 16 Removing Oil Pickup Tube

(19) Remove drive gear snap ring (Fig. 19).

(20) Disengage drive gear (Fig. 20). Pry gear upward and off mainshaft as shown.

(21) Remove front output shaft, drive chain and drive gear as assembly (Fig. 21).

(22) Remove detent plug, plug O-ring, detent spring and detent plunger (Fig. 22).

(23) Remove mainshaft and differential assembly (Fig. 23).

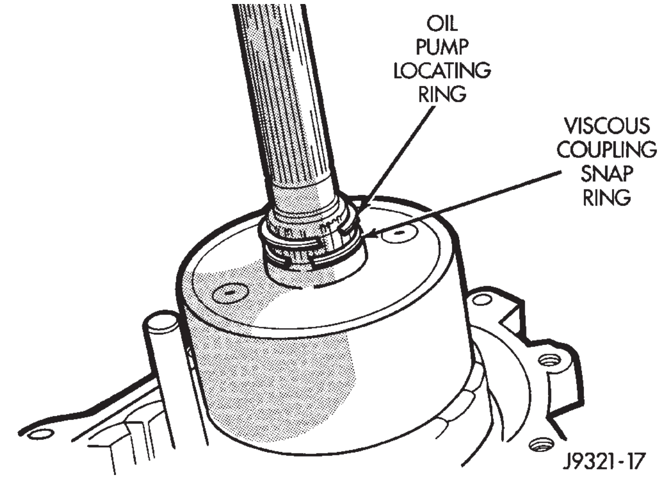


Fig. 17 Oil Pump And Viscous Coupling Snap Ring Locations

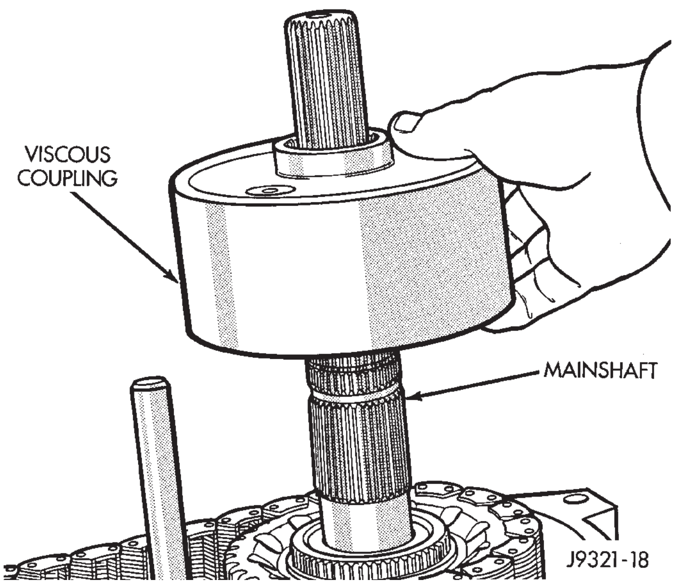


Fig. 18 Viscous Coupling Removal

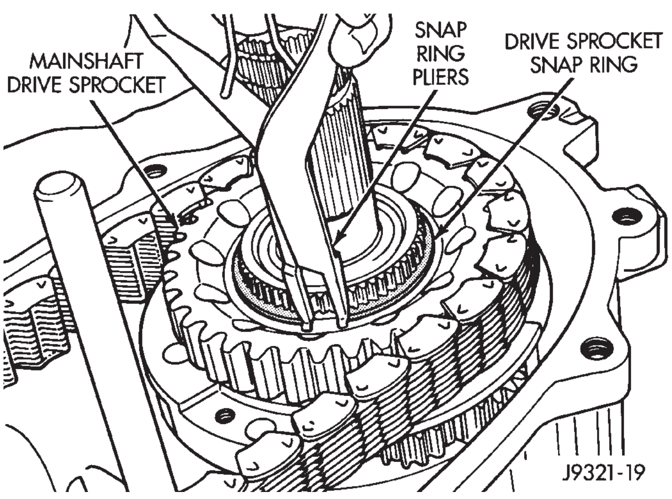


Fig. 19 Removing Drive Gear Snap Ring

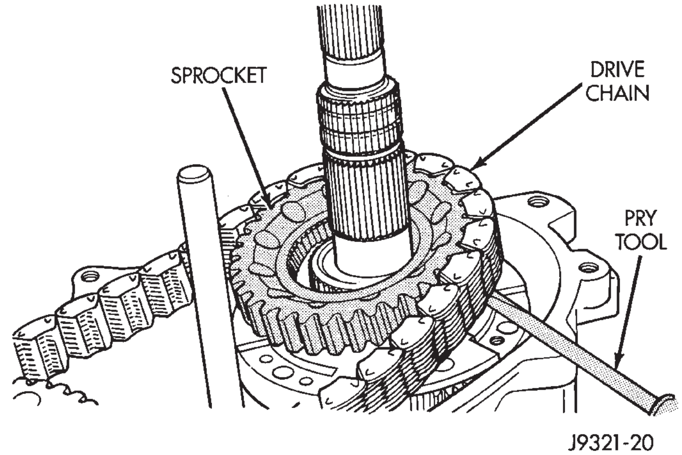


Fig. 20 Disengaging Mainshaft Drive Gear

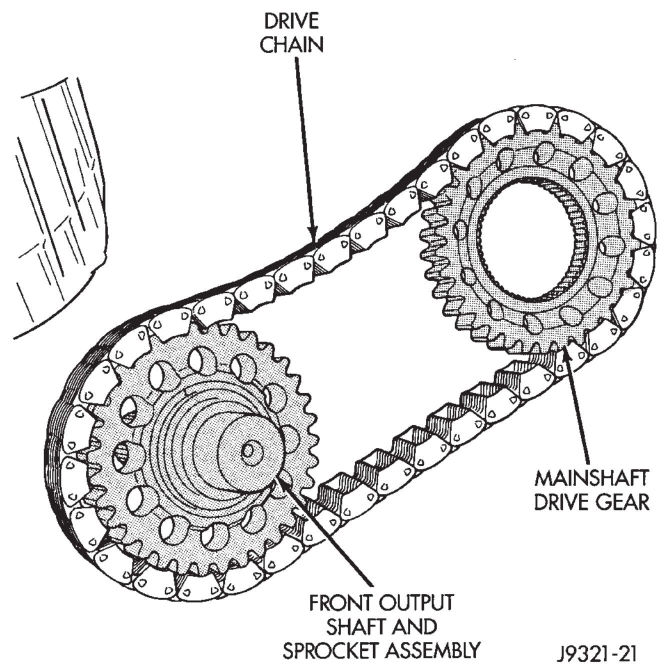


Fig. 21 Front Output Shaft, Drive Gear And Chain Removal

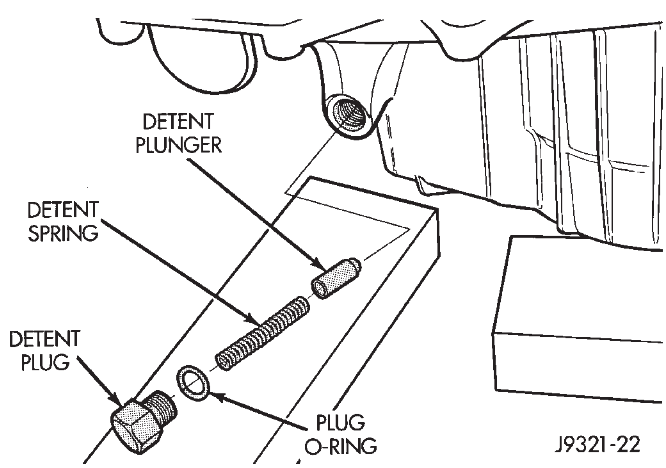


Fig. 22 Detent Plug, Spring And Plunger Removal

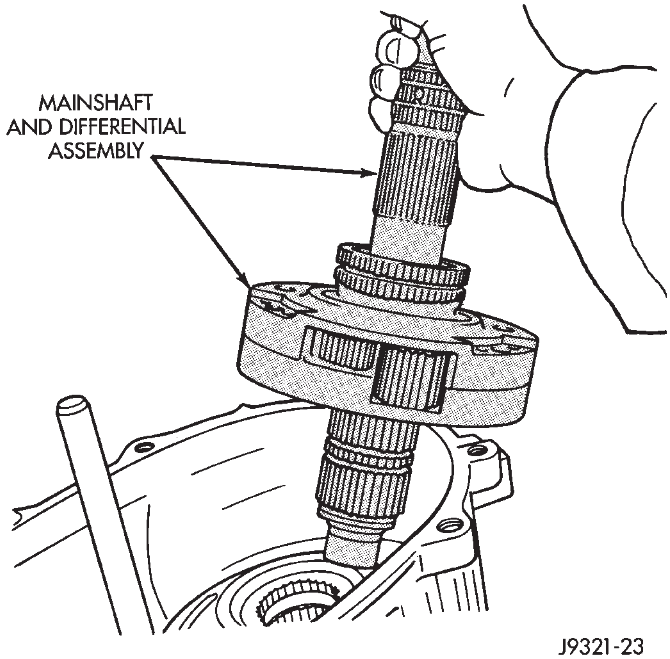


Fig. 23 Removing Mainshaft And Differential Assembly

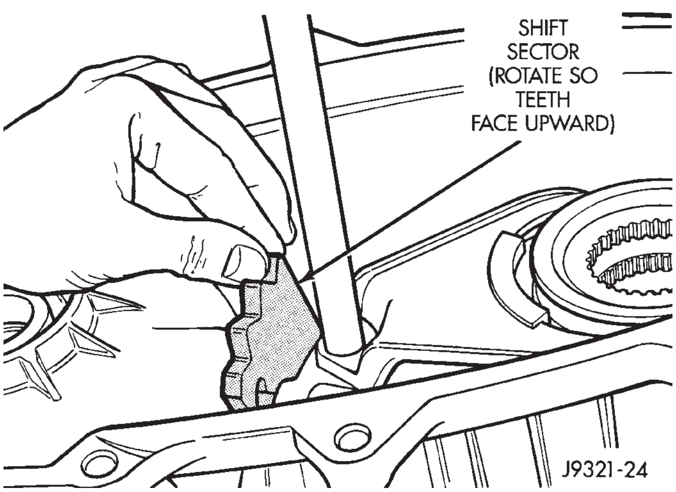


Fig. 24 Rotating Shift Sector

(24) Rotate shift sector so sector teeth face upward (Fig. 24).

(25) Remove range fork, rail and clutch sleeve as assembly (Fig. 25). Lift shift rail upward, rotate fork out of shift sector and remove assembly.

(26) Turn front case on side so front bearing retainer is accessible.

(27) Remove front bearing retainer bolts (Fig. 26).

(28) Remove front bearing retainer as follows: Loosen retainer with flat blade screwdriver to break sealer bead. Then remove retainer from case and gear. **To avoid damaging case and retainer, position screwdriver blade only in slots provided in retainer (Fig. 27).**

(29) Remove snap ring that retains input gear shaft in front bearing (Fig. 28).

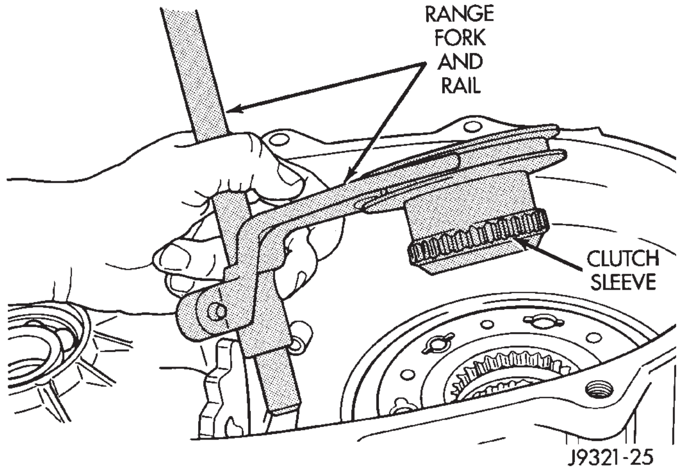


Fig. 25 Removing Range Fork And Clutch Sleeve

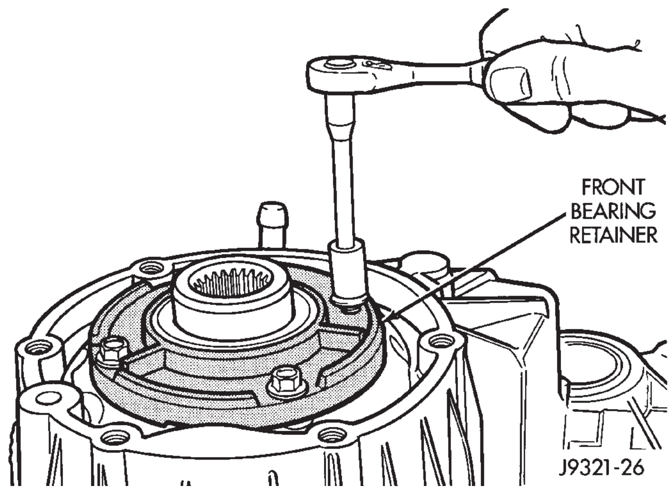


Fig. 26 Removing Front Bearing Retainer Bolts

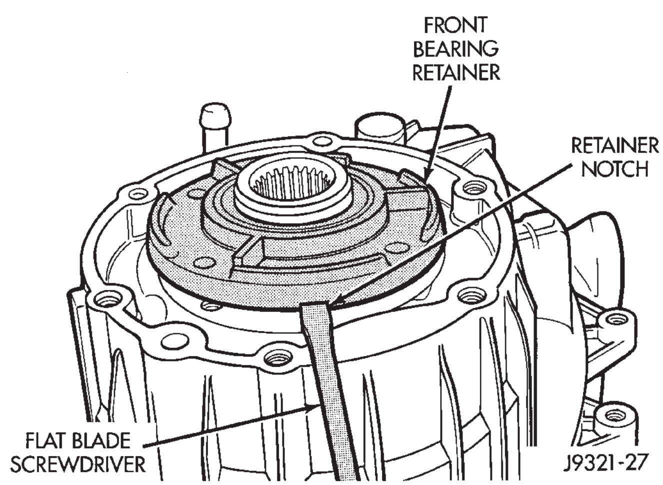


Fig. 27 Removing Front Bearing Retainer

(30) Remove input and low range gear assembly (Fig. 29).

(31) Remove range lever locknut and remove lever and washer from shift sector shaft (Fig. 30).

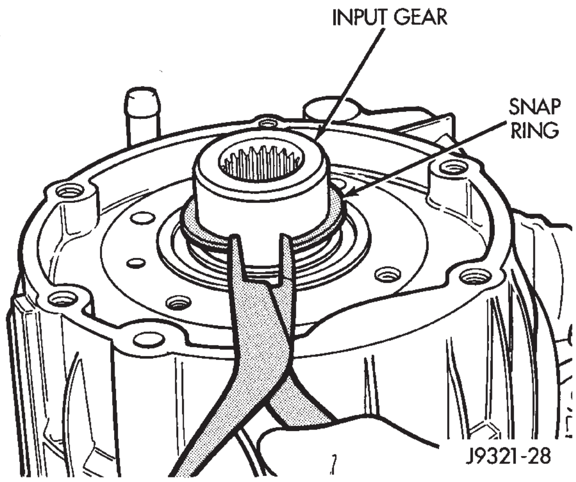


Fig. 28 Removing Input Gear Snap Ring

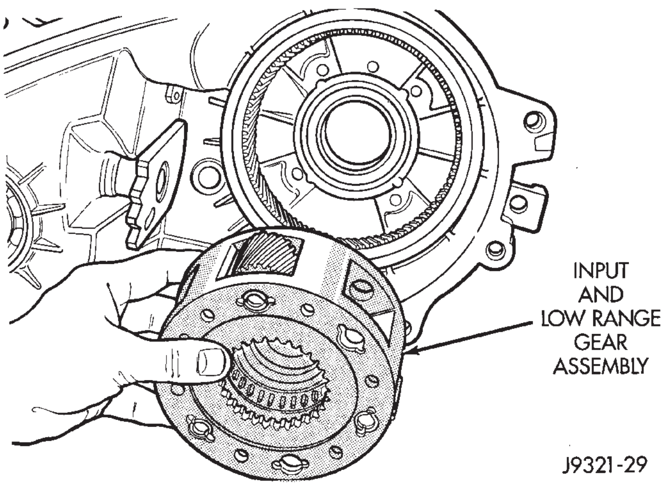


Fig. 29 Removing Input And Low Range Gear Assembly

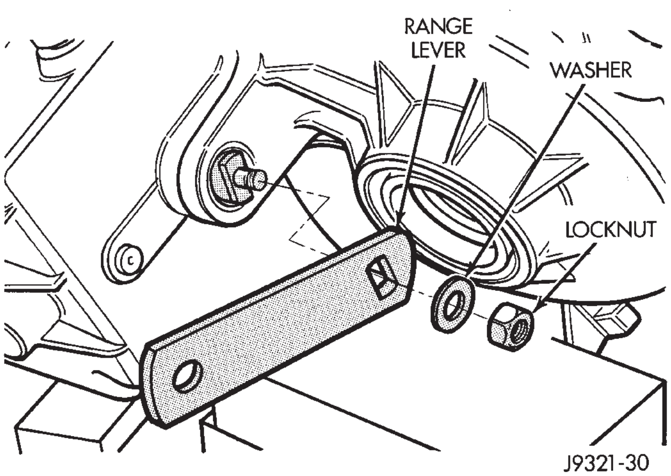


Fig. 30 Range Lever Removal

(32) Remove shift sector. Rotate and tilt sector as needed to remove it (Fig. 31).

(33) Remove magnet from case.

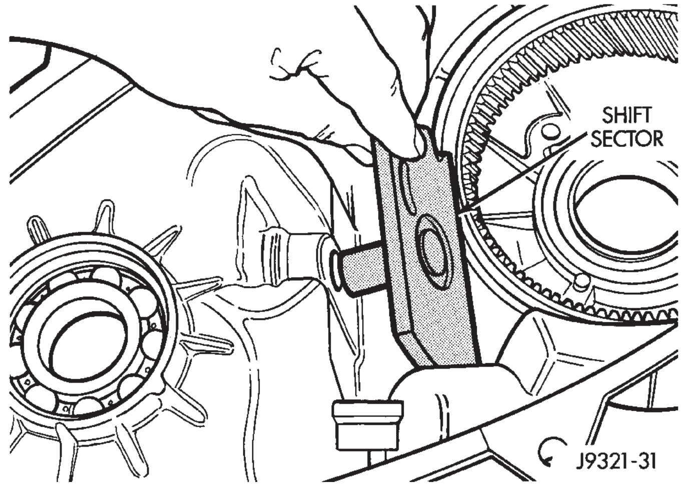


Fig. 31 Removing Shift Sector

INPUT AND LOW RANGE GEAR DISASSEMBLY

(1) Remove snap ring that retains input gear in low range gear (Fig. 32).

(2) Remove retainer (Fig. 33).

(3) Remove front tabbed thrust washer (Fig. 34).

(3) Remove input gear (Fig. 35).

(4) Remove rear tabbed thrust washer from low range gear (Fig. 36).

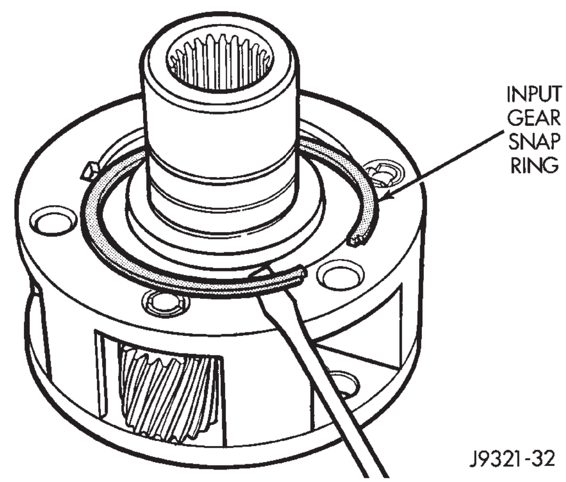


Fig. 32 Removing Input Gear Snap Ring

MAINSHAFT AND DIFFERENTIAL DISASSEMBLY

(1) Remove clutch shaft snap ring (Fig. 37).

(2) Remove thrust ring (Fig. 38).

(3) Slide clutch shaft off mainshaft (Fig. 39).

(4) Disengage snap ring that retains differential on mainshaft (Fig. 40). Work snap ring upward until clear of gear teeth and ring groove.

(5) Retrieve snap ring from shaft and interior of differential with pencil magnet (Fig. 41).

(6) Position drain pan or shop towels under differential and mainshaft. Pan or towels will help catch and retain mainshaft needle bearings when differential is removed from shaft.

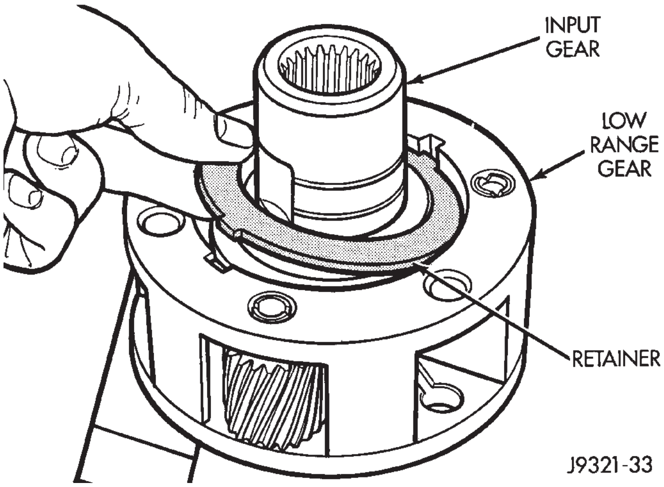


Fig. 33 Removing Input Gear Retainer

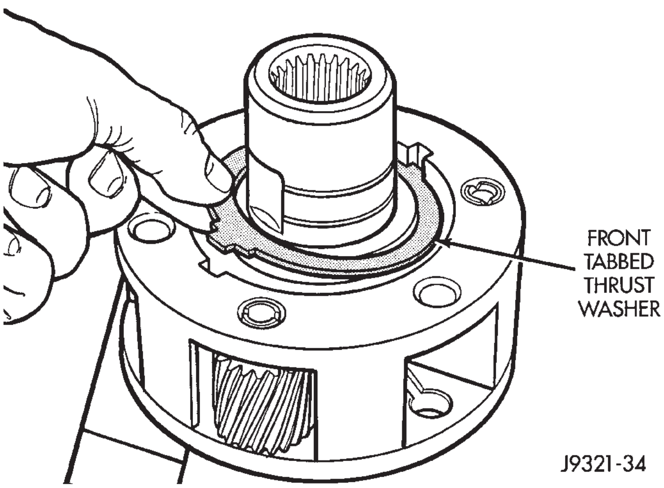


Fig. 34 Removing Front Tabbed Thrust Washer

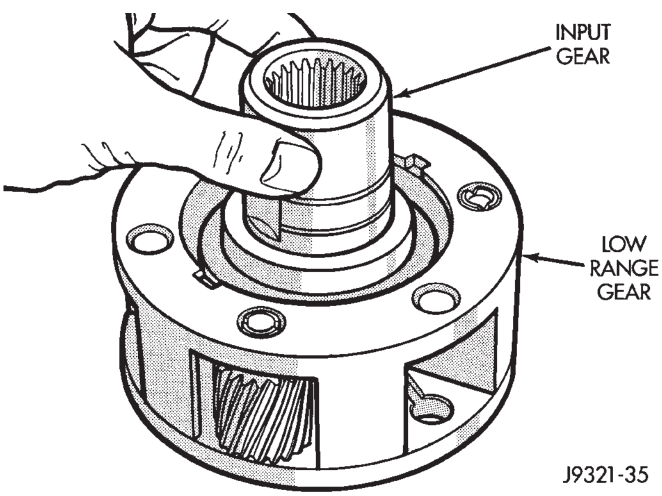


Fig. 35 Removing Input Gear

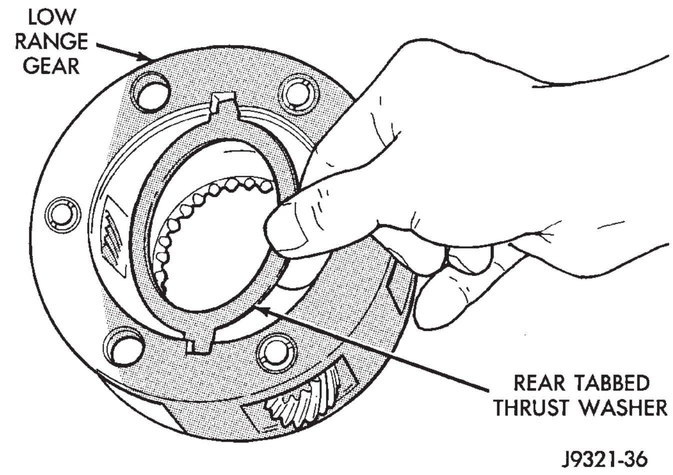


Fig. 36 Removing rear Tabbed Thrust Washer

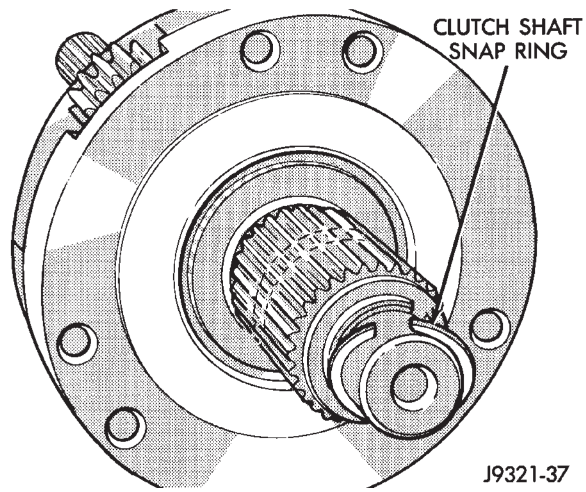


Fig. 37 Removing Clutch Shaft Snap Ring

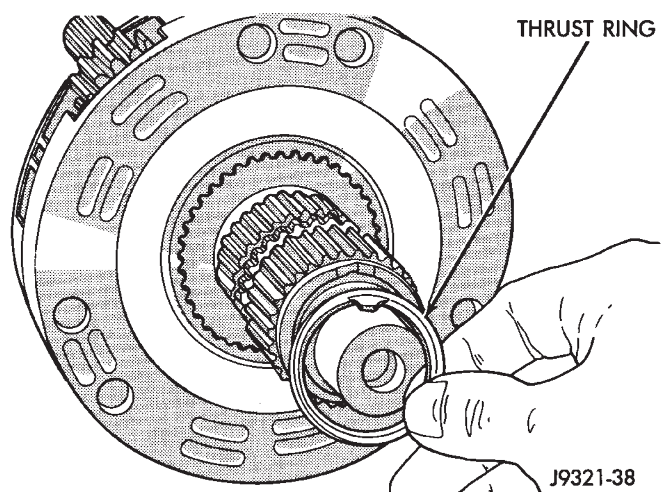


Fig. 38 Removing Thrust Ring

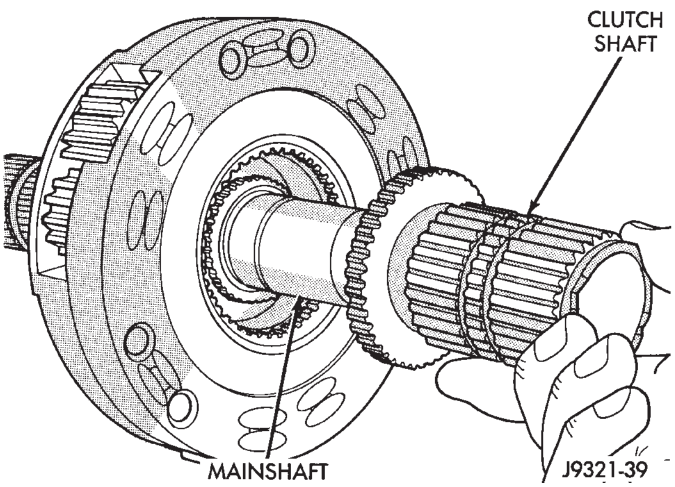


Fig. 39 Removing Clutch Shaft

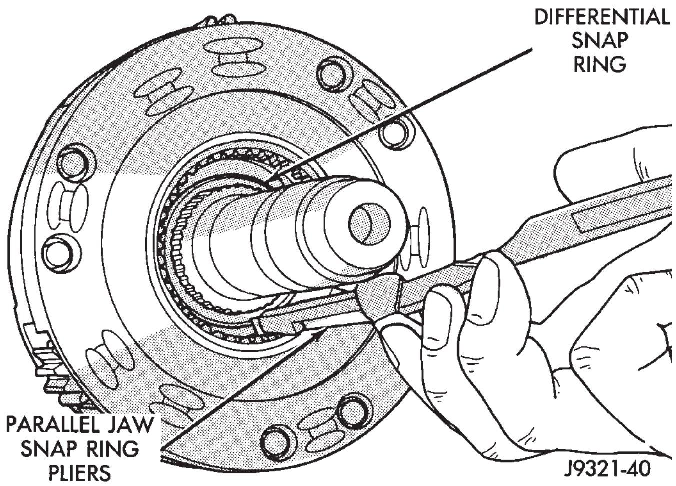


Fig. 40 Disengaging Differential Snap Ring

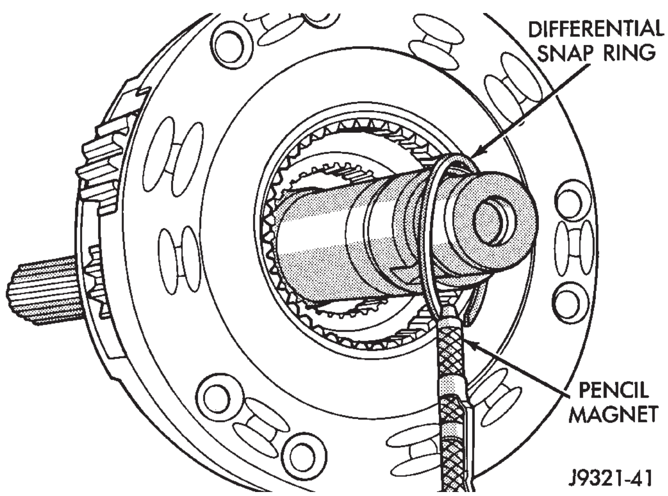


Fig. 41 Removing Differential Snap Ring

(7) Slide differential off mainshaft (Fig. 42).

(8) Remove needle bearings and spacers from mainshaft (Fig. 43), or from interior of mainshaft gear. There should be 53 bearings and two spacers. Store bearings and spacers in clean cup or jar to avoid losing them.

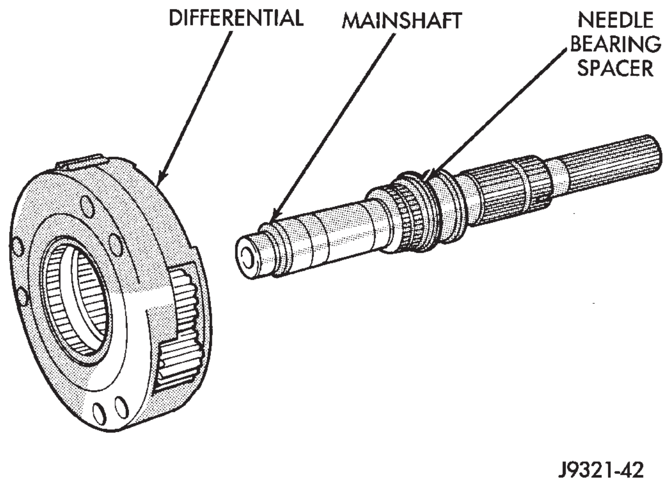


Fig. 42 Removing Differential From Mainshaft

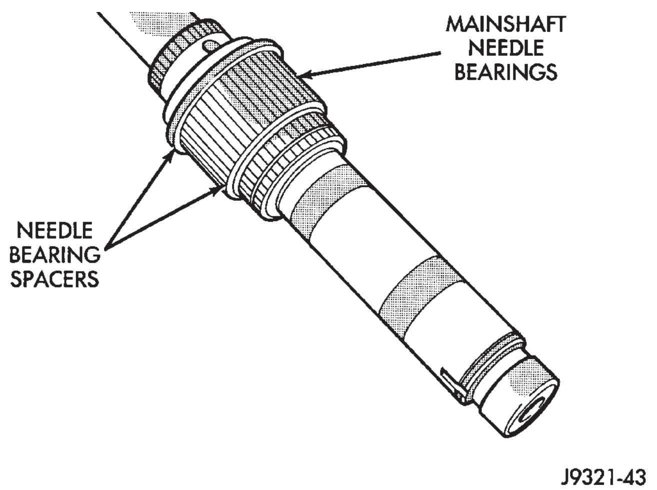


Fig. 43 Mainshaft Needle Bearing And Spacer Position

DIFFERENTIAL DISASSEMBLY

(1) Mark differential carriers with center punch or paint mark for assembly reference (Fig. 44).

(2) Remove differential bolts (Fig. 45). Use thin wall, 12 point socket to remove bolts.

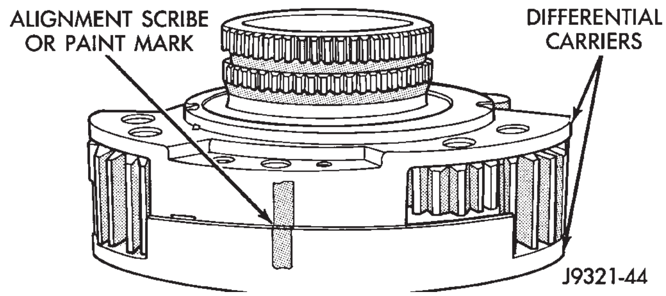


Fig. 44 Marking Differential Carriers

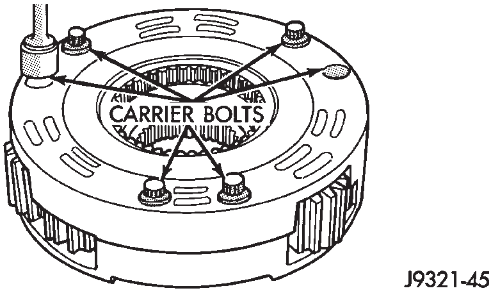


Fig. 45 Removing Differential Bolts

(3) Separate differential carriers (Fig. 46). Use two flat blade screwdrivers inserted in carrier slots to separate.

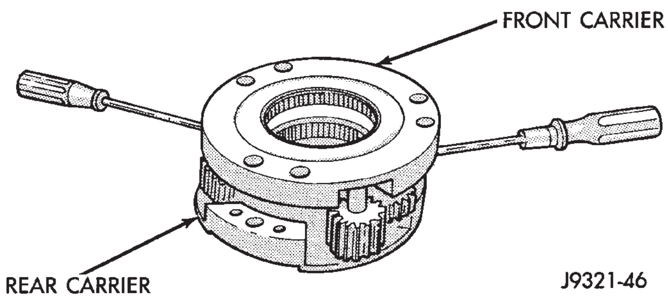


Fig. 46 Separating Differential Carriers

(4) Remove pinion gears and thrust washers (Fig. 47). Three short and three long gears are used. Also note that a thrust washer is used at each end of every pinion gear.

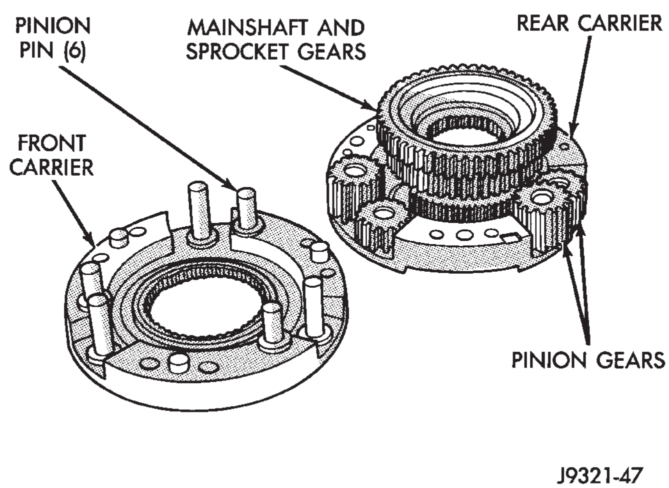


Fig. 47 Pinion Gear Positions

(5) Remove sprocket gear (Fig. 48).
(6) Remove mainshaft gear (Fig. 49).

COMPONENT CLEANING AND INSPECTION

Clean the transfer case components with parts cleaning solvent. Flush the oil passages in the cases and drivetrain components with solvent. This will help remove dirt and particles from these passages.

Dry the transfer case components with compressed air or allow them to air dry on clean shop towels.

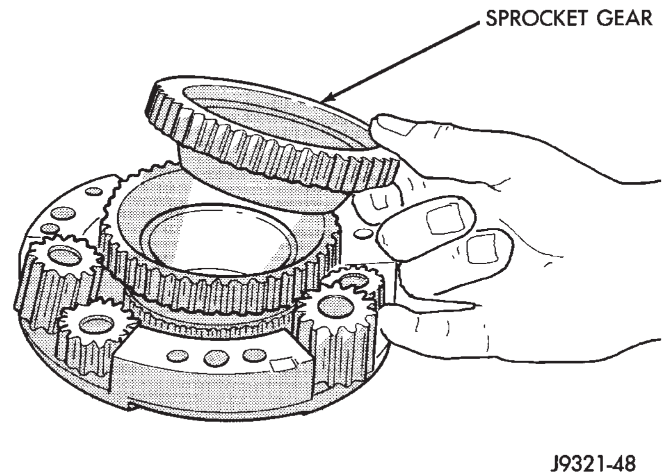


Fig. 48 Removing Sprocket Gear

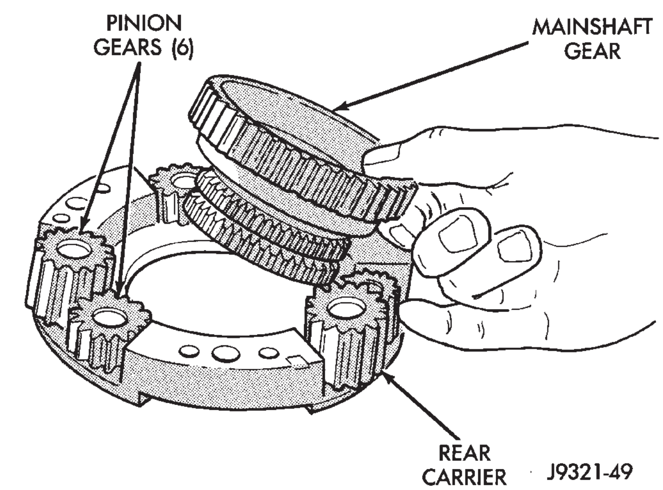


Fig. 49 Removing Mainshaft Gear

Apply compressed air through all oil passages in the cases and gear components to clear them of any residue.

Mainshaft And Differential

Examine the mainshaft and differential components carefully for evidence of wear or damage.

Replace the thrust washers and pinion gears if worn or damaged.

Replace the differential case halves as an assembly if either case is worn or damaged, or if the gear teeth in the rear half are damaged.

Replace the mainshaft and sprocket gears if the teeth or gear bores are worn or damaged.

Replace the mainshaft bearings if worn, flat spotted, brinnelled, or damaged in any way.

Replace the mainshaft if it exhibits wear or damage to the bearing surfaces, splines or gear teeth.

Input And Low Range Gears

Inspect the low range gear pinions and pinion pins. Replace the low range gear if any of the pins or pinions are worn or damaged.

Inspect the thrust washers, retainer and snap ring. Replace the snap ring if bent, or distorted. Replace the thrust washers and retainer if worn, cracked or damaged in any way.

Examine the input gear carefully. Be sure the gear teeth and bearing surfaces are in good condition. Replace the gear if wear or damage is evident.

Check the input gear pilot bearing. Rotate the bearing and check for roughness or noise. Also check bearing position in the bore. The bearing should be recessed approximately 2.5 mm (0.100 in.) below the top edge of the bore. The bearing should not be seated at the bottom of the bore. Replace the bearing if worn, or roughness is evident. Replace both the gear and bearing if the bearing is a loose fit in the bore.

Gear Cases And Extension

Examine both case halves and the extension carefully. Replace the extension or either case half if wear, cracks, or other damage is evident.

Check condition of the low range annulus gear and the shift rail bushing in the front case (Fig. 50). The low range annulus gear is not a serviceable part. Replace the gear and case as an assembly if the gear is loose, worn, or damaged. The shift rail bushing is a serviceable part and can be replaced if necessary.

Check the bushing in the rear extension. Replace the bushing if worn or scored. A shop press and

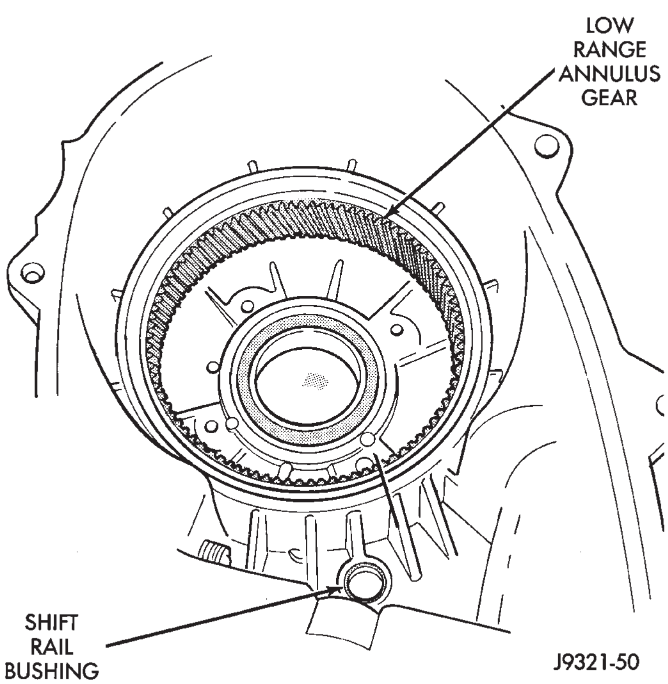


Fig. 50 Low Range Annulus Gear Location

universal type bushing driver set can be used for replacement purposes.

Examine the sealing surfaces of both case halves and the extension. Small burrs, or scratches on these surfaces can be reduced with crocus cloth or a fine tooth file.

Examine condition of the shift rail bushing in the front case. If the bushing is worn or damaged, it can be removed with a blind hole type puller. A replacement bushing can be installed with a suitable size driver. Recess the bushing slightly below the edge of the bore but do not seat it all the into the case.

Geartrain

The differential pinion gears and thrust washers are serviceable components and can be replaced if worn or damaged. The differential cases are also serviceable but must be replaced as a set if either case is damaged.

Inspect the mainshaft splines, gear teeth and bearing surfaces carefully for evidence of wear, or damage. Replace the shaft if necessary. do not attempt to salvage it if damaged.

The shift rail and range fork are an assembly. Replace both parts if either is damaged. However, the nylon pads in the fork can be replaced if worn, or cracked.

Inspect the transfer case snap rings closely. Do not attempt to salvage a distorted snap ring by straightening or reshaping it. Replace any snap ring that is distorted, or worn.

Inspect the low range gear, input gear and the gear thrust washers retainer, and snap ring. The low range gear is serviced as an assembly only. Replace the gear if the case or pinions are damaged.

During inspection, also make sure the seal surface of the input gear is in good condition. Minor nicks on this surface can be reduced with crocus cloth. However, replace the gear if the seal surface is severely scored or worn.

The speedometer gear should be replaced if worn, cracked, or if the small spline teeth are worn.

Oil Pump And Viscous Coupling

The oil pump and viscous coupling are not serviceable components. Replace the coupling as an assembly if it is leaking or damaged. Replace the oil pump as an assembly if the gear teeth are worn, or if the pump has become damaged.

Bearings And Seals

The transfer case seals should be replaced during overhaul. Use new seals in the input gear bearing retainer, front case and rear extension. Also replace the yoke seal washer and the detent plug O-ring.

Check condition of each transfer case bearing. Replace any bearing exhibiting signs of roughness, wear, or damage.

Bearing and seal replacement is described in the Transfer Case Bearing And Seal Replacement procedures.

TRANSFER CASE BEARING AND SEAL REPLACEMENT

Replacing Output Shaft Front Bearing And Seal

Remove the seal from the front case with a pry tool (Fig. 51). Then remove the snap ring that retains the front bearing in the front case (Fig. 52).

Use a rawhide mallet or drift to remove the old bearing and install the new. Then reinstall the bearing snap ring.

The new seal can be installed with any suitable size seal installer, or carefully tapped into place with a mallet.

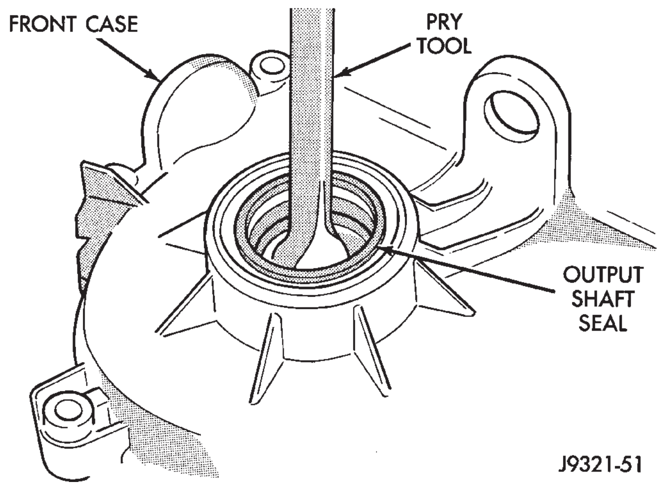


Fig. 51 Removing Output Shaft Seal

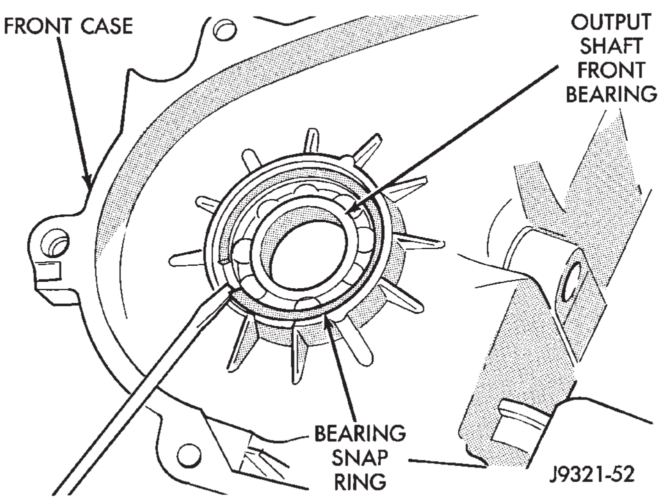


Fig. 52 Removing Output Shaft Front Bearing Snap Ring

Replacing Front Output Shaft Rear Bearing

Remove the shaft rear bearing from the rear case with Puller 7794A and Slide Hammer 7420 with Adapter 7420-8 (Fig. 53).

Install the new bearing with Tool Handle C-4171 and Bearing Installer 7823 (Fig. 54). **The bearing bore is chamfered at the top. Install the bearing so it is flush with the lower edge of this chamfer (Fig. 55).**

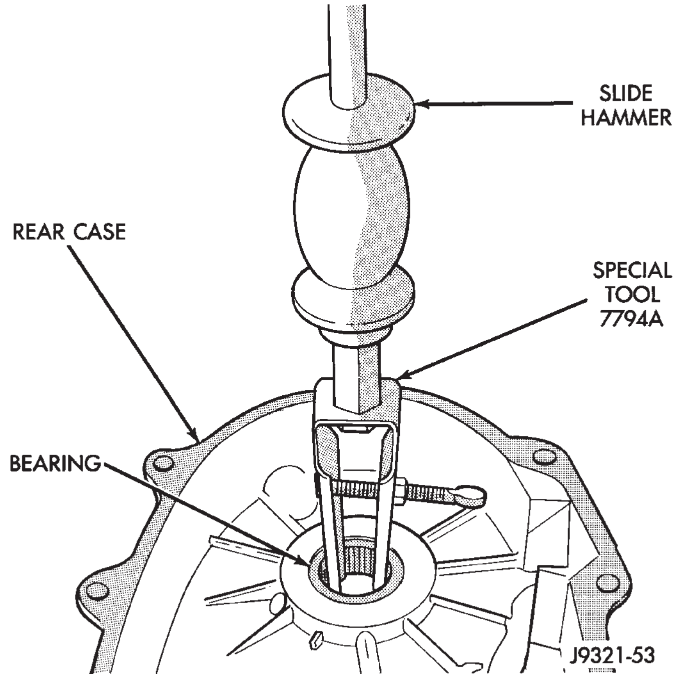


Fig. 53 Removing Front Output Shaft Rear Bearing

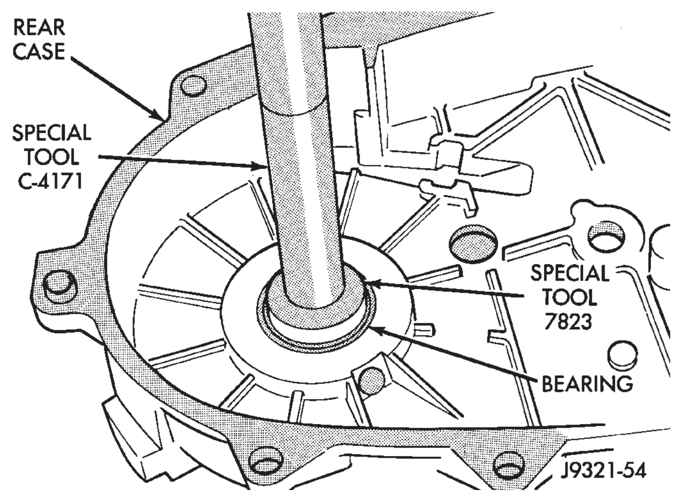


Fig. 54 Installing Front Output Shaft Rear Bearing

Replacing Front Bearing

Although the same tools are used to remove and install the bearing, the bearing is removed from different directions. Replace the bearing only as described to avoid damaging the front case.

(1) Remove old bearing with Tool Handle C-4171 and Bearing Driver 7823 (Fig. 56). Drive bearing out from case interior as shown.

(2) Install locating ring on new bearing, if necessary (Fig. 57).

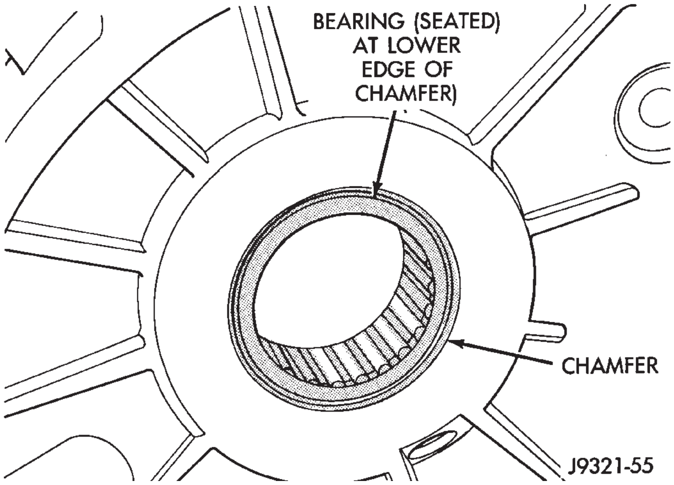


Fig. 55 Rear Bearing Installation Depth

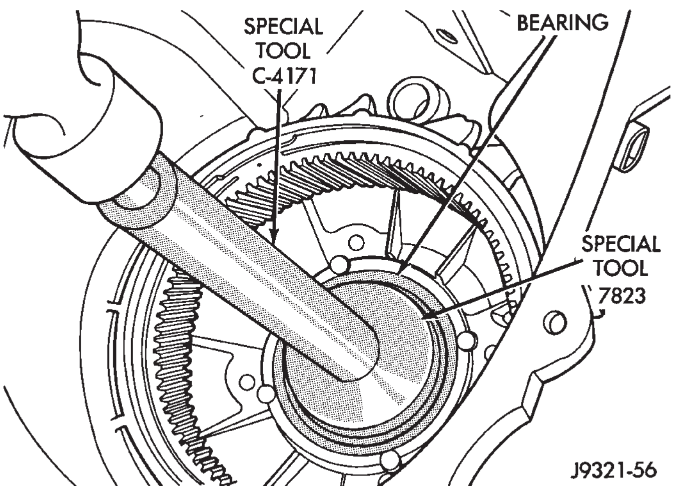


Fig. 56 Removing Front Bearing

(3) Position case so forward end is facing upward (Fig. 57).

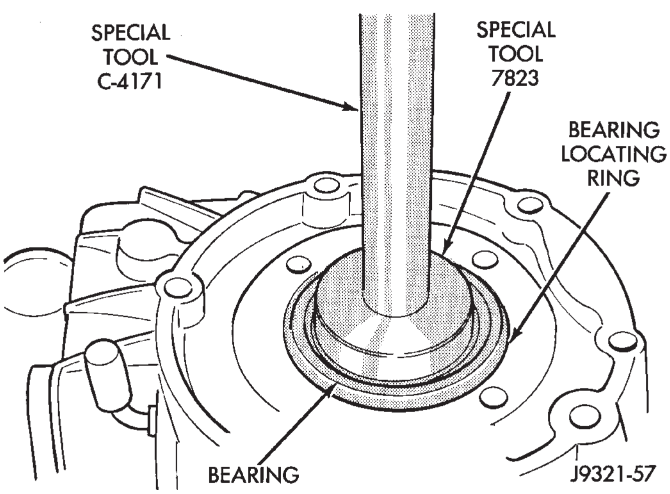


Fig. 57 Installing Front Bearing

(4) Install bearing with Tools C-4171 and 7823 (Fig. 59). Bearing locating ring should be fully seated against case surface.

Replacing Front Bearing Retainer Seal

Remove the old seal with a drift or pry bar. Then install the new seal with Tool 7884 (Fig. 58).

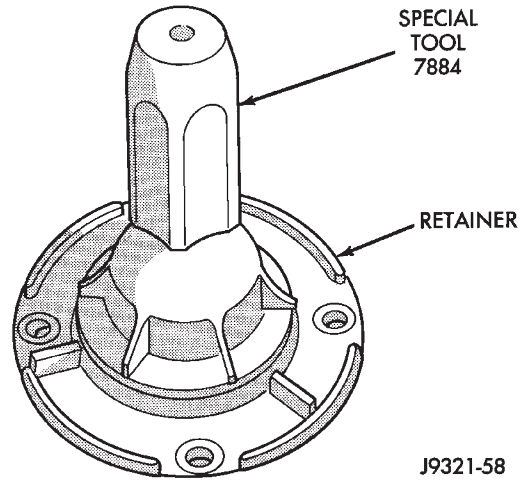


Fig. 58 Installing Seal In Front Bearing Retainer

Replacing Input Gear Pilot Bearing

The old bearing can be removed with an internal-type puller and slide hammer as shown (Fig. 59). Or, the bearing can be removed with a two-jaw blind hole puller similar to the type used to remove a clutch pilot bushing.

The new bearing can be installed with tools similar to Driver Handle 8015 and Installer 7886 (Fig. 60).

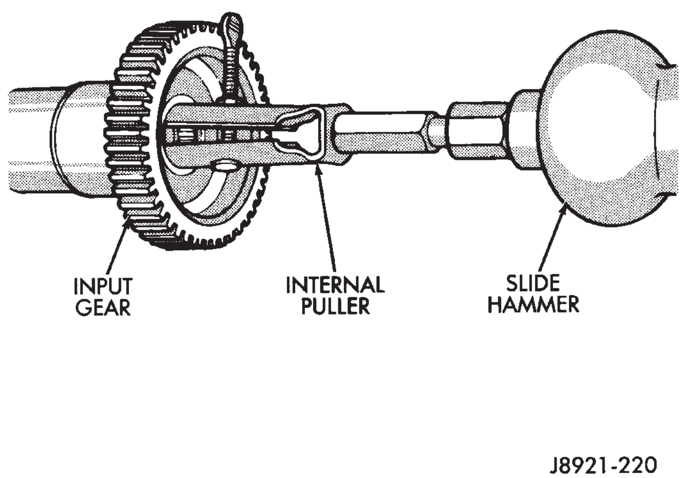


Fig. 59 Removing Input Gear Pilot Bearing

Replacing Rear Retainer Seal And Bushing

The rear retainer seal and bushing are serviceable parts. Both components are accessible once the retainer dust cap has been removed (Fig. 61).

Use a large pair of channel-lock pliers, or blunt punch to remove the dust cap. If a punch is used, work around the entire cap edge to remove it evenly from the retainer.

Remove the seal with a pry bar, drift, or punch. Then use a suitable size installer tool to position the seal in the retainer. The bushing can be replaced

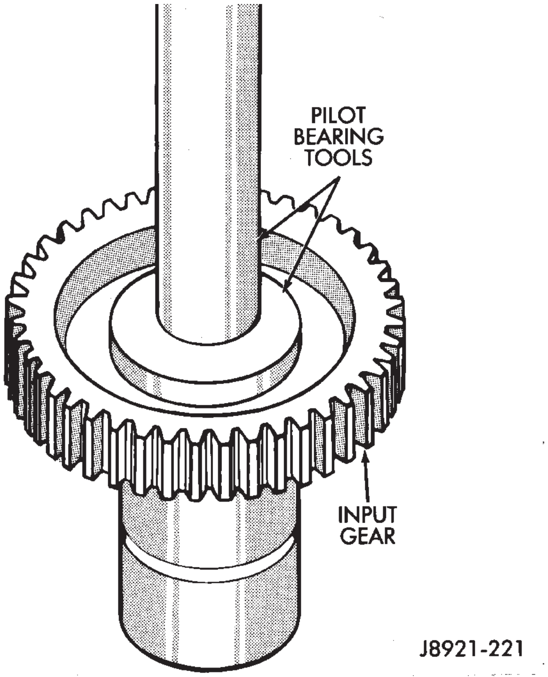


Fig. 60 Installing Input Gear Pilot Bearing

with a universal type bushing driver set once the seal has been removed from the retainer.

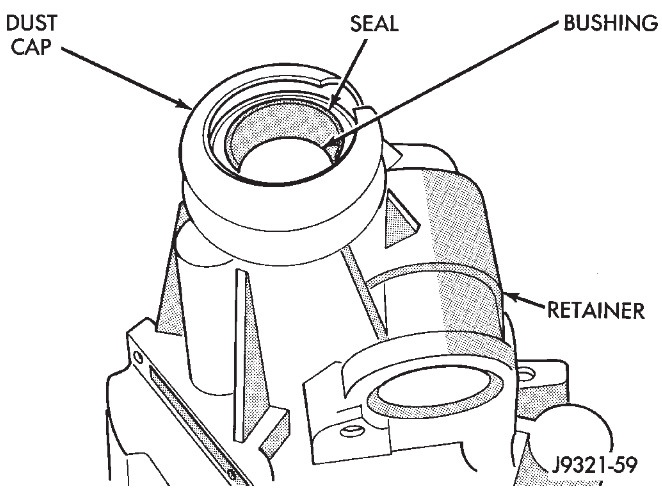


Fig. 61 Rear Retainer Cap, Bushing And Seal Position

TRANSFER CASE ASSEMBLY AND ADJUSTMENT

Lubricate the transfer case components with the Mopar ATF Plus, Type 7176, Dexron II fluid during assembly operations.

Use petroleum jelly to prelubricate and hold mainshaft needle roller bearings and spacers in place. Petroleum jelly can also be used to lubricate seals, bushings and bearings during assembly.

Gaskets are **not** used in the NP249 transfer case. Instead, the mating surfaces of the case halves, retainer and extension are sealed with Mopar Gasket Maker, silicone adhesive/sealer, or Loctite 518.

PREPARING FRONT CASE FOR ASSEMBLY

(1) Support front case on wood blocks. Position case so sector shaft bore and input gear bearing are accessible.

(2) Lubricate sector shaft, shaft O-ring and shaft bore (in case) with petroleum jelly.

(3) Install sector in case (Fig. 62).

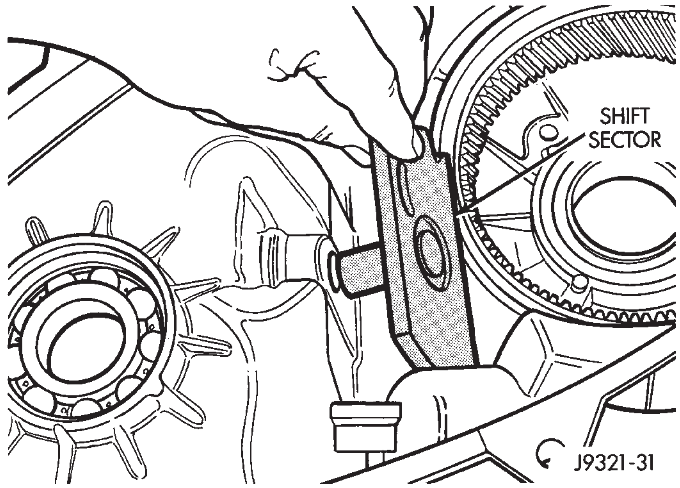


Fig. 62 Installing Shift Sector

(4) Lubricate shift rail bushing with light coat of petroleum jelly, or transmission fluid. **Do not overlubricate bushing. Excess lubricant will flow into bottom of bushing bore and prevent shift rail from fully seating; this can also make it difficult to seat rear case on front case.**

(5) Lubricate bearings and seals in front case with recommended lubricant.

(6) Install magnet in case.

INPUT—LOW RANGE GEAR ASSEMBLY AND INSTALLATION

(1) Lubricate gears and thrust washers (Fig. 63) with recommended transmission fluid.

(2) Install first thrust washer in low range gear (Figs. 36 and 63). Be sure washer tabs are properly aligned in gear notches.

(3) Install input gear in low range gear (Fig. 35). Be sure input gear is fully seated.

(4) Install remaining thrust washer in low range gear and on top of input gear (Fig. 34). Be sure washer tabs are properly aligned in gear notches.

(5) Install retainer on input gear and install snap ring.

(6) Align and install low range-input gear assembly in front case (Fig. 64). Be sure low range gear pinions are engaged in annulus gear and that input gear shaft is fully seated in front bearing.

(7) Install snap ring on input gear shaft to secure gear in bearing and case (Fig. 65).

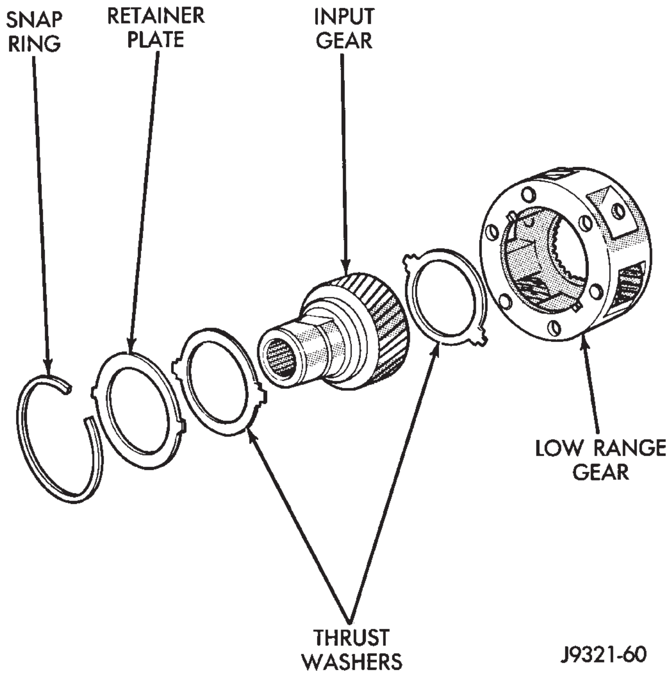


Fig. 63 Input/Low Range Gear Components

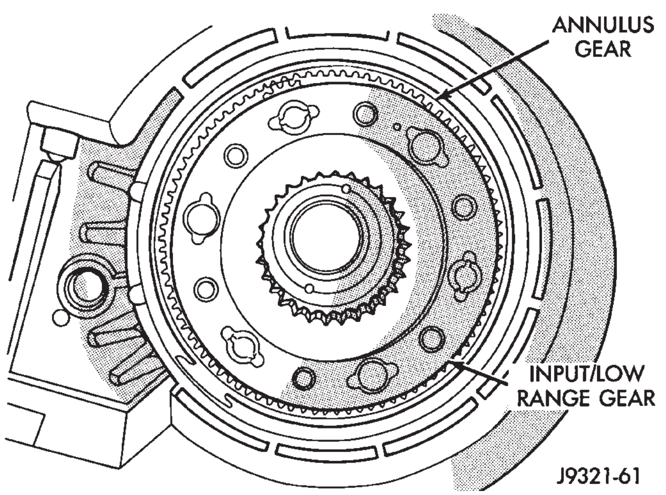


Fig. 64 Input/Low Range Gear Installation

RANGE FORK/CLUTCH SLEEVE ASSEMBLY AND INSTALLATION

(1) Install new pads on range fork (Fig. 66).

(2) Lubricate range fork pads with light coat of petroleum jelly.

(3) Install clutch sleeve in range fork (Fig. 66).

(4) Install assembled range fork and clutch sleeve (Fig. 67). Insert range fork pin in sector. Then rotate sector and seat clutch gear in low range gear.

(5) Verify that range fork rail is seated in case bushing and that clutch sleeve is properly engaged in low range gear.

DETENT INSTALLATION

(1) Rotate sector to Neutral position.

(2) Install new O-ring on detent plug (Fig. 68).

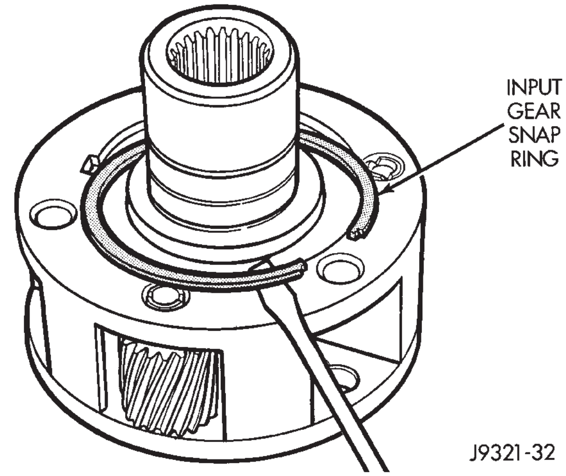


Fig. 65 Input Gear Snap Ring Installation

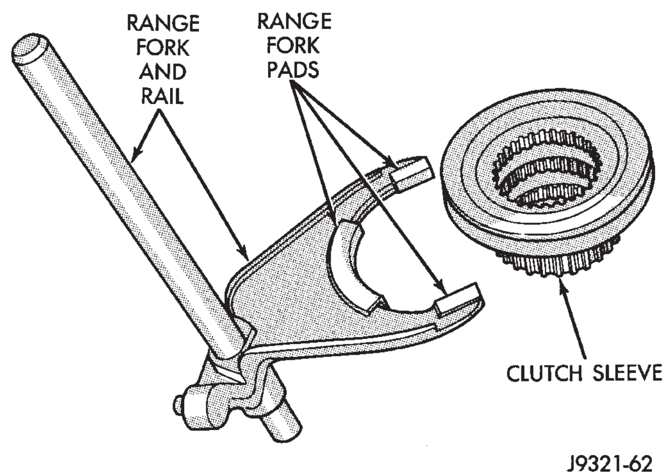


Fig. 66 Assembling Range Fork And Clutch Sleeve

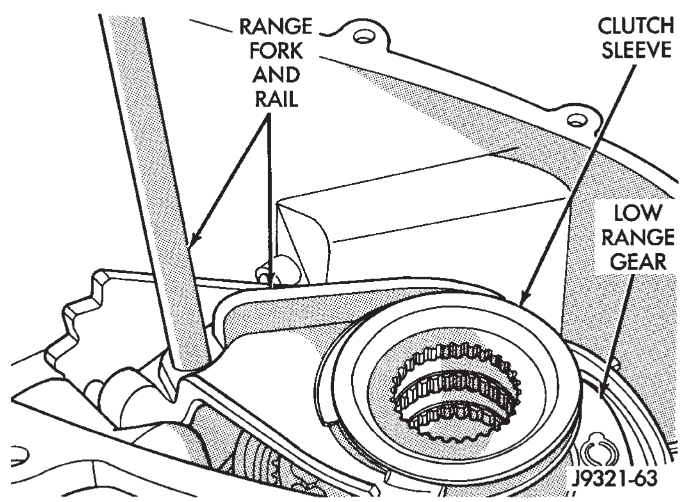


Fig. 67 Range Fork And Clutch Sleeve Installation

(3) Lubricate detent plunger with transmission fluid or light coat of petroleum jelly.

(4) Install detent plunger, spring and plug (Fig. 68).

(5) Verify that plunger is properly engaged in sector.

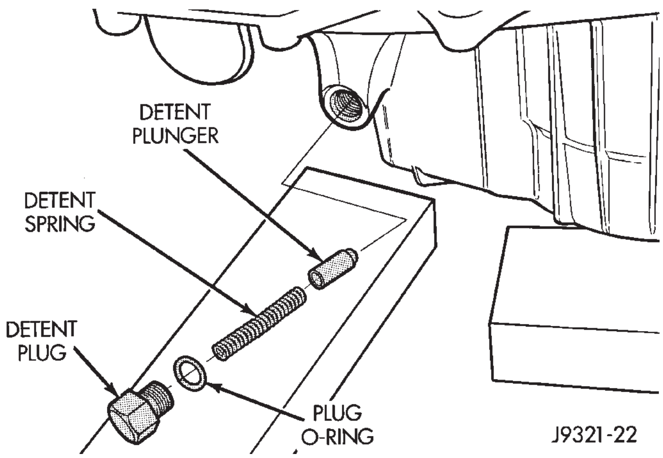


Fig. 68 Shift Detent Components

MAINSHAFT—DIFFERENTIAL ASSEMBLY AND INSTALLATION

(1) Lubricate pins on front carrier (Fig. 69) with transmission fluid or petroleum jelly.

(2) Install first set of thrust washers on front carrier pins (Fig. 69).

(3) Install sprocket gear in front carrier (Fig. 69).

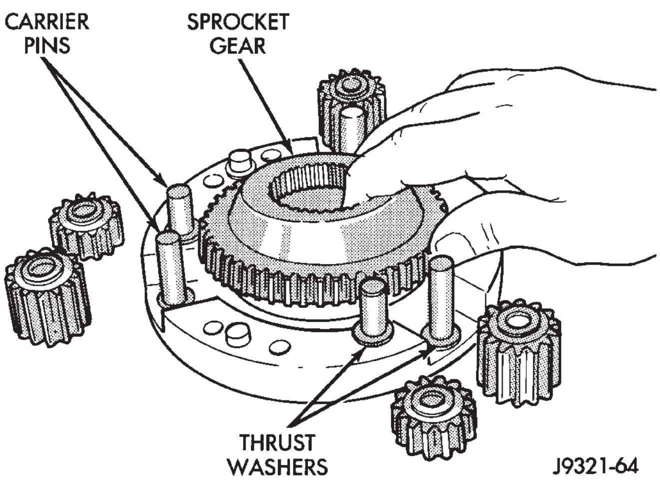


Fig. 69 Sprocket Gear And Thrust Washer Installation

(4) Install mainshaft gear in sprocket gear (Fig. 70).

(5) Install pinion gears on carrier pins (Fig. 71). Be sure short and long gears are installed on correct pins.

(6) Install remaining set of thrust washers on carrier pins and on top of pinion gears (Fig. 71).

(7) Install differential front carrier on rear carrier. Align carriers with paint mark made at disassembly (Fig. 72).

(8) Install and tighten differential carrier bolts to 17-27 N●m (150-240 in. lbs.) torque.

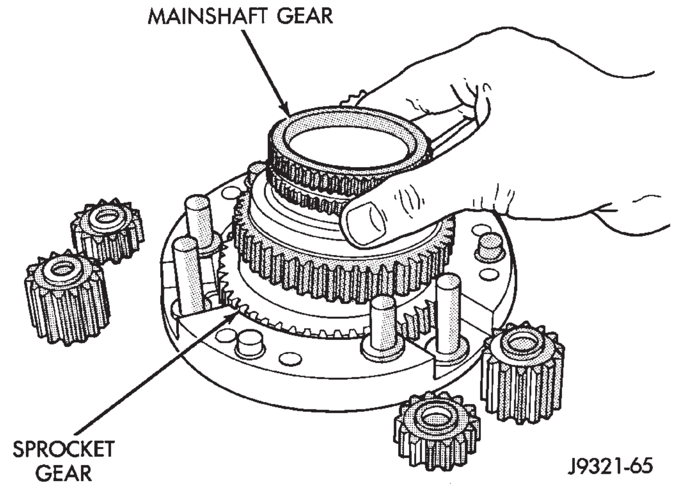


Fig. 70 Installing Mainshaft Gear

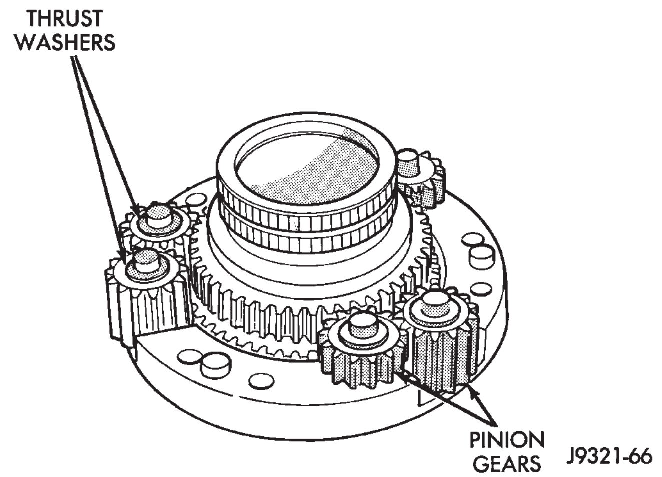


Fig. 71 Pinion Gear And Thrust Washer Installation

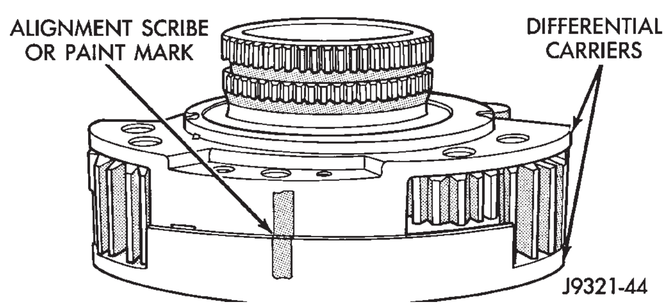


Fig. 72 Differential Carrier Alignment And Assembly

(9) Install first needle bearing spacer in bore of mainshaft gear (Fig. 73).

(10) Install remaining needle bearing spacer on mainshaft (Fig. 74). Seat spacer against shaft flange.

(11) Apply liberal quantity of petroleum jelly to needle bearings and to bore of mainshaft gear (Fig. 74). Petroleum jelly will prelubricate and hold bearings in place during assembly.

(12) Install mainshaft needle bearings in bore of mainshaft gear (Fig. 74). A total of 53 bearings are required.

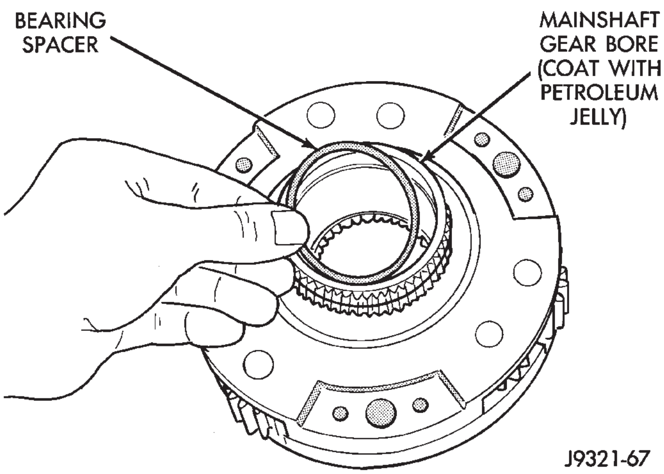


Fig. 73 Installing Bearing Spacer In Mainshaft Gear

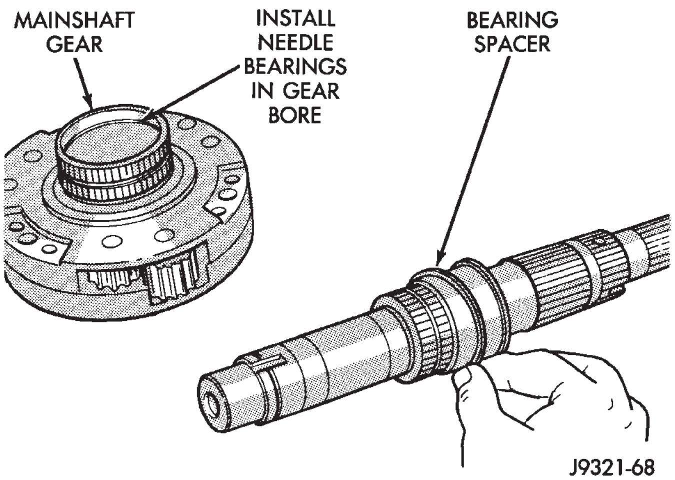


Fig. 74 Installing Bearing Spacer And Needle Bearings

(13) Install mainshaft in differential (Fig. 75). Rotate shaft to verify that bearings were not displaced during assembly. Also be sure that shaft is fully seated in differential.

(14) Install mainshaft snap ring (Fig. 76).

(15) Install clutch shaft (Fig. 77).

(16) Install thrust ring on end of mainshaft (Fig. 78). Be sure notch on ring seats in notch in shaft.

(17) Install clutch shaft snap ring (Fig. 79). Be sure snap ring is fully seated in ring groove.

(18) Install assembled mainshaft and differential in low range gear and clutch gears (Fig. 80).

DRIVE CHAIN—OUTPUT SHAFT—SPROCKET INSTALLATION

(1) Lubricate front output shaft-sprocket assembly, drive chain and drive sprocket with transmission fluid.

(2) Assemble drive chain, drive sprocket and front output shaft (Fig. 81).

(3) Start drive sprocket on mainshaft.

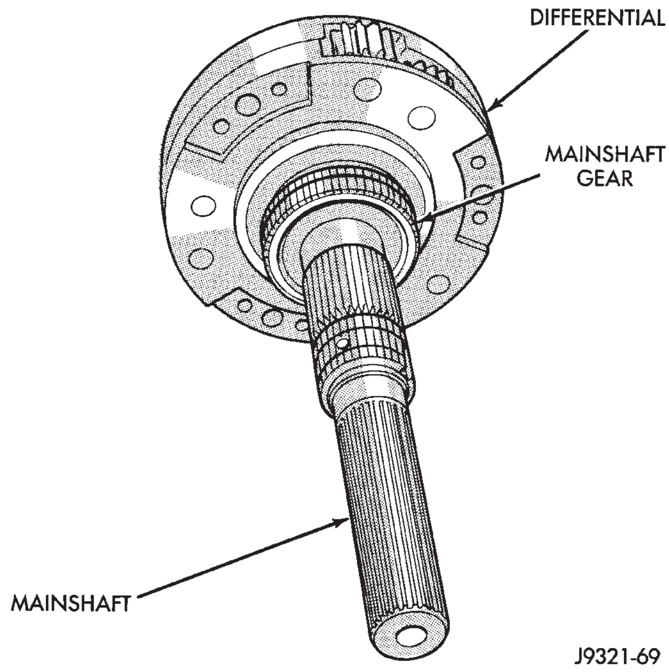


Fig. 75 Installing Mainshaft In Differential

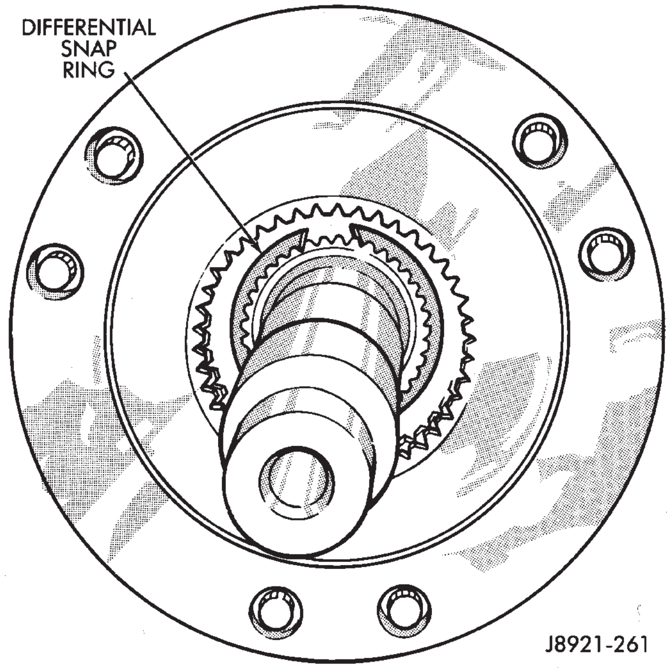


Fig. 76 Differential Snap Ring Installation

(4) Guide front shaft into bearing and drive sprocket onto mainshaft drive gear (Fig. 81).

(5) Install drive sprocket snap ring (Fig. 82).

VISCOUS COUPLING INSTALLATION

(1) Lubricate mainshaft splines with transmission fluid.

(2) Install coupling on mainshaft (Fig. 83).

(3) Install coupling retaining snap ring first (Fig. 83). Be sure snap ring is fully seated before proceeding.

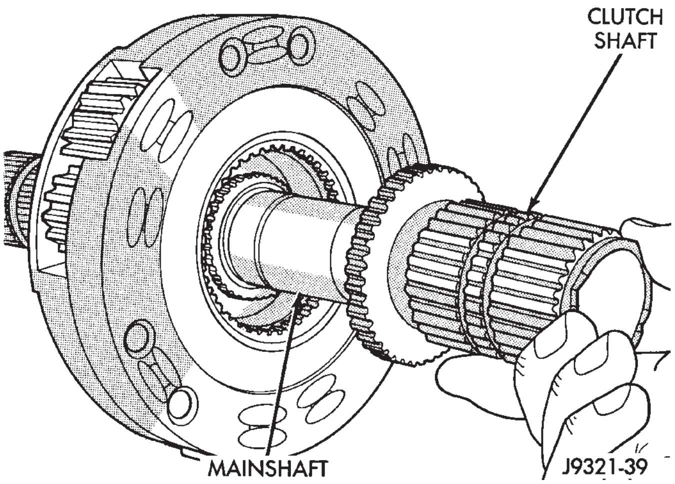


Fig. 77 Installing Clutch Shaft

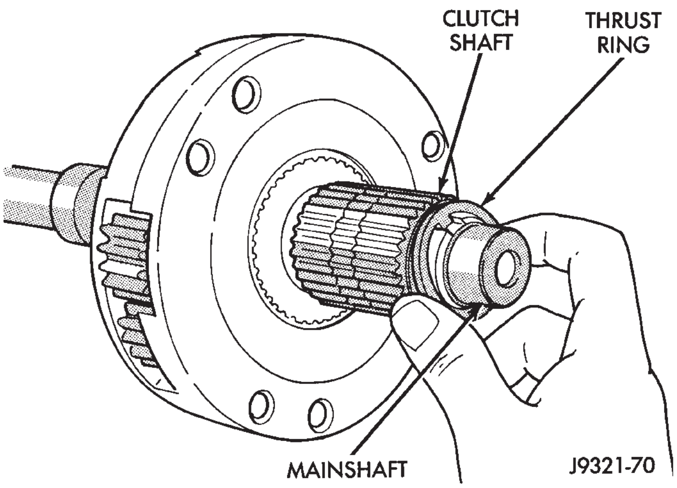


Fig. 78 Installing Clutch Shaft Thrust Ring

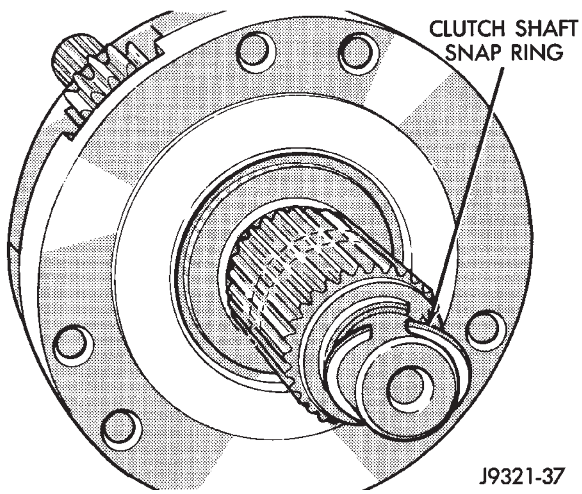


Fig. 79 Installing Clutch Shaft Snap Ring

(4) Install oil pump locating snap ring on mainshaft (Fig. 83).

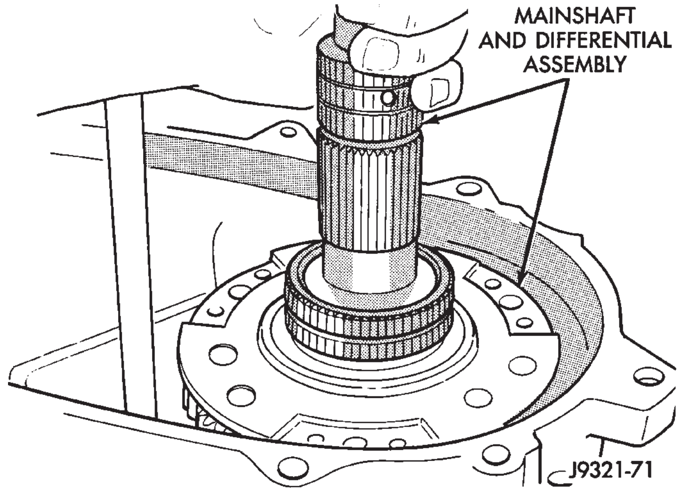


Fig. 80 Installing Mainshaft And Differential Assembly

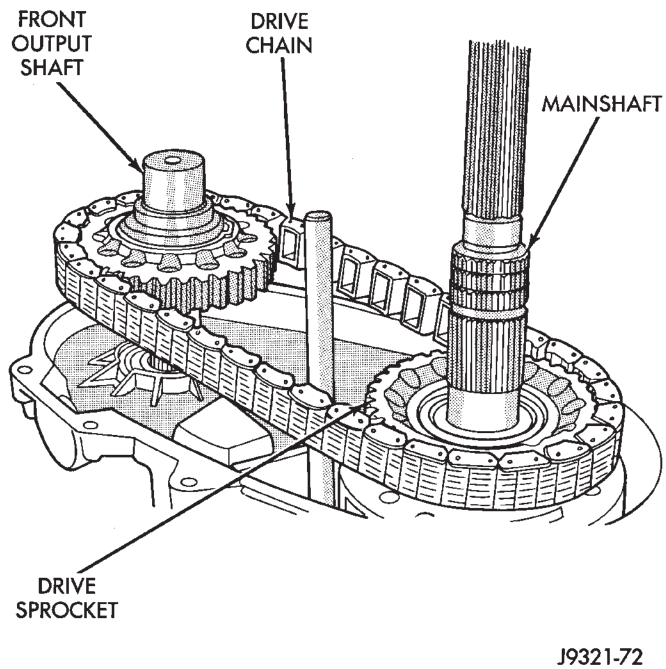


Fig. 81 Installing Drive Chain, Front Output Shaft And Drive Sprocket

REAR CASE INSTALLATION

(1) Clean sealing flanges of front case and rear case with a wax and grease remover.

(2) Install new O-ring on flanged end of oil pickup tube.

(3) Install oil pickup tube in rear case. Be sure tube is seated in case notch as shown (Fig. 84).

(4) Apply 3 mm (1/8 in.) wide bead of Mopar silicone adhesive sealer to mating flange of front case. Work sealer bead around bolt holes as shown (Fig. 85).

(5) Align and install rear case on front case (Fig. 86).

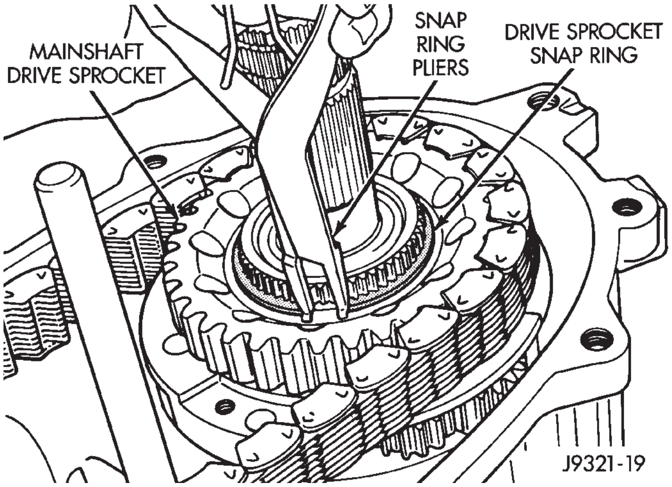


Fig. 82 Installing Drive Sprocket Snap Ring

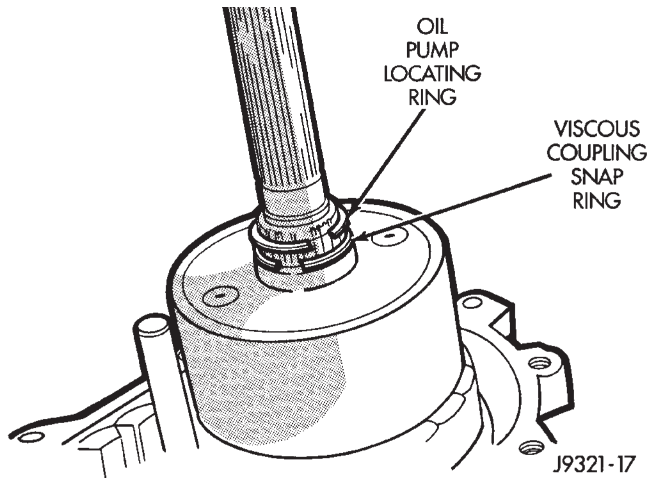


Fig. 83 Viscous Coupling And Oil Pump Ring Installation

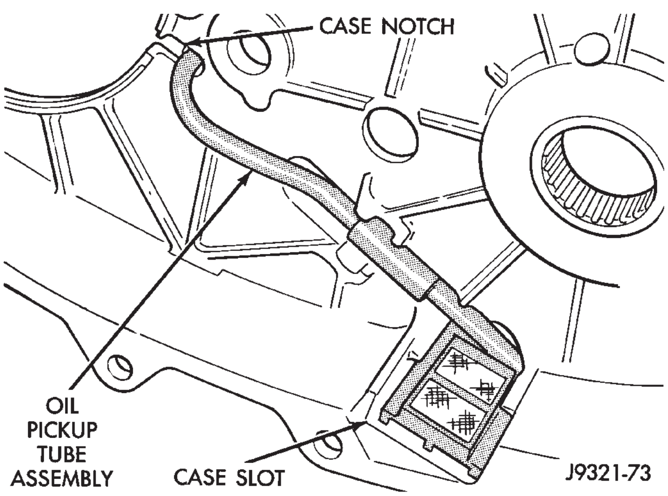


Fig. 84 Oil Pickup Tube Installation

(6) Verify that oil pickup tube is still seated in case notch and tube end is pointed toward mainshaft (Fig. 87).

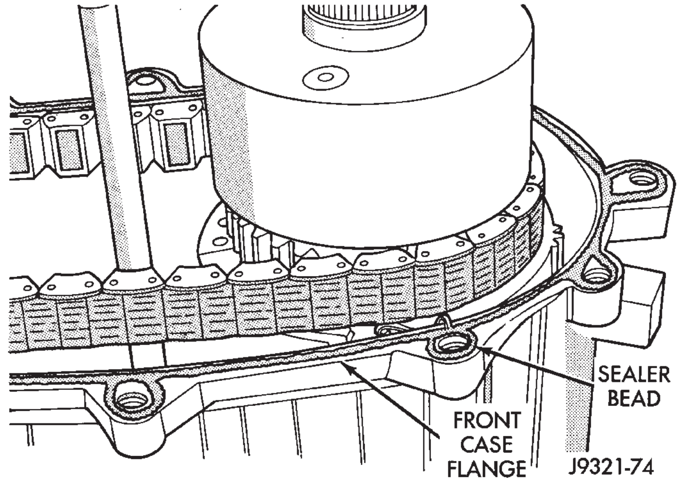


Fig. 85 Applying Sealer To Front Case Flange

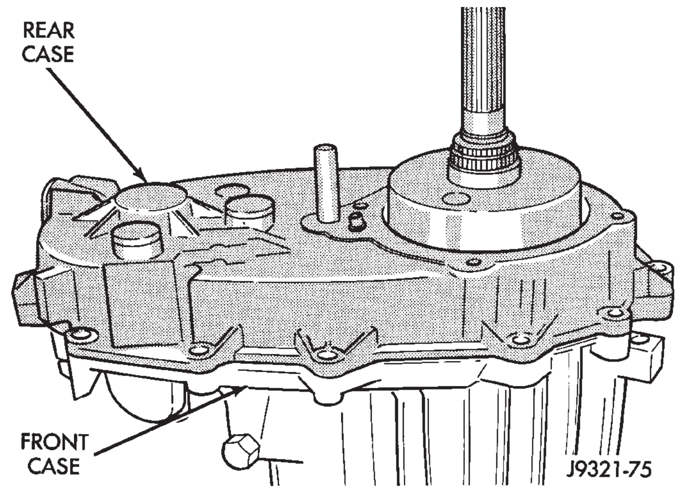


Fig. 86 Rear Case Installation

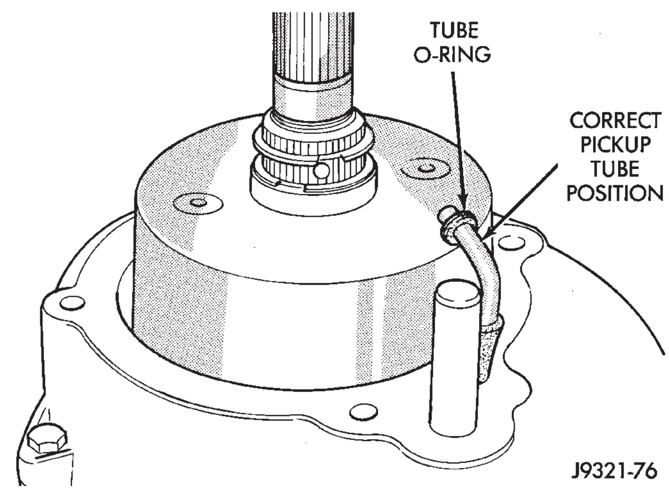


Fig. 87 Checking Position Of Oil Pickup Tube

(7) Install case attaching bolts. Alignment bolts at each end of case are only ones requiring washers (Fig. 88).

(8) Tighten case bolts to 27-34 N●m (20-25 ft. lbs.) torque.

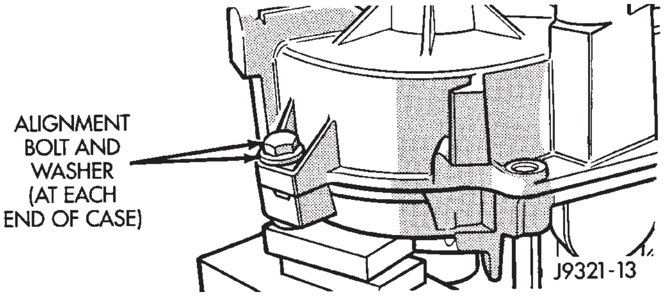


Fig. 88 Alignment Bolt Location

OIL PUMP—REAR BEARING—REAR RETAINER INSTALLATION

(1) Install oil pump (Fig. 89).

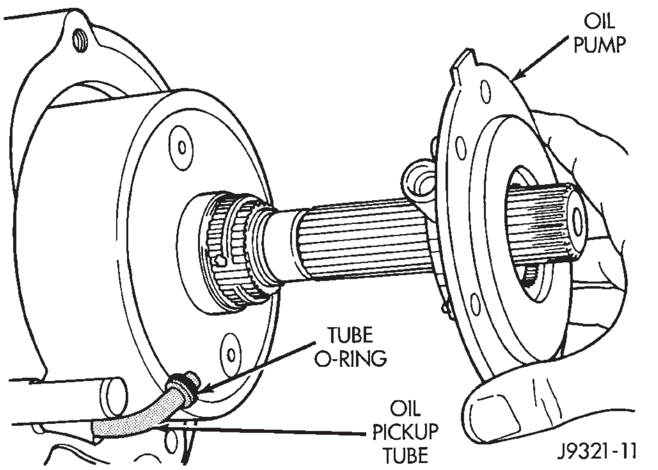


Fig. 89 Installing Oil Pump

(2) Insert oil pickup tube in pump (Fig. 90).

(3) Install rear bearing on mainshaft (Fig. 90). Locating ring groove in bearing goes toward end of mainshaft.

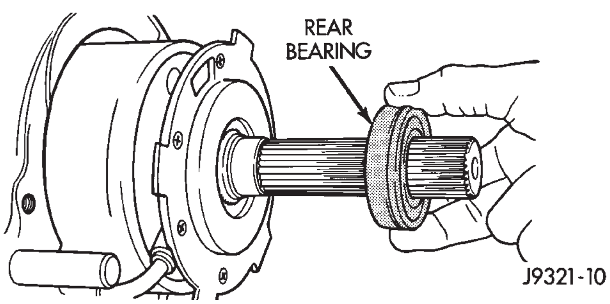


Fig. 90 Rear Bearing Installation

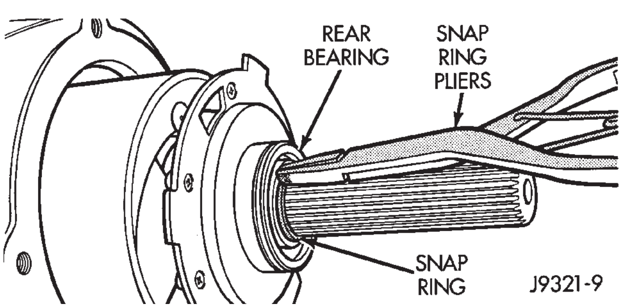


Fig. 91 Rear Bearing Snap Ring Installation

(4) Install rear bearing retaining snap ring (Fig. 91).

(5) Install speedometer drive gear (Fig. 92).

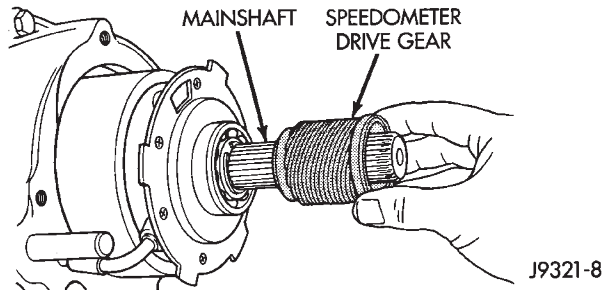


Fig. 92 Installing Speedometer Drive Gear

(6) Install rear bearing locating ring in rear retainer, if ring was removed during overhaul.

(7) Apply 3 mm (1/8 in.) wide bead of Mopar silicone adhesive sealer to mating surface of rear retainer. Allow sealer

to set-up slightly before proceeding.

(8) Slide rear retainer onto mainshaft (Fig. 93).

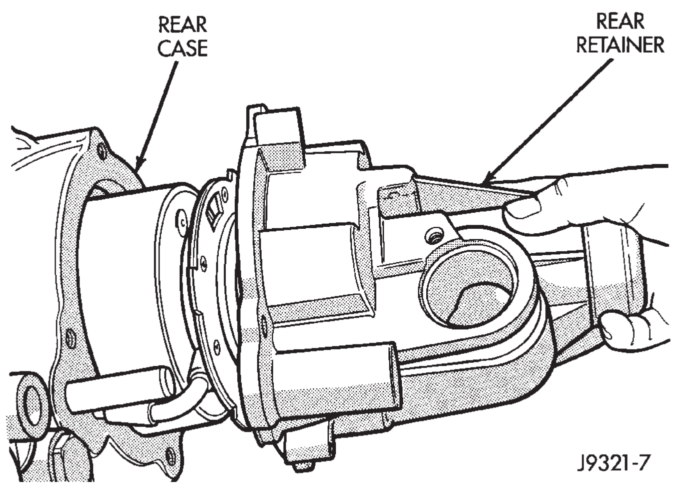


Fig. 93 Rear Retainer Installation

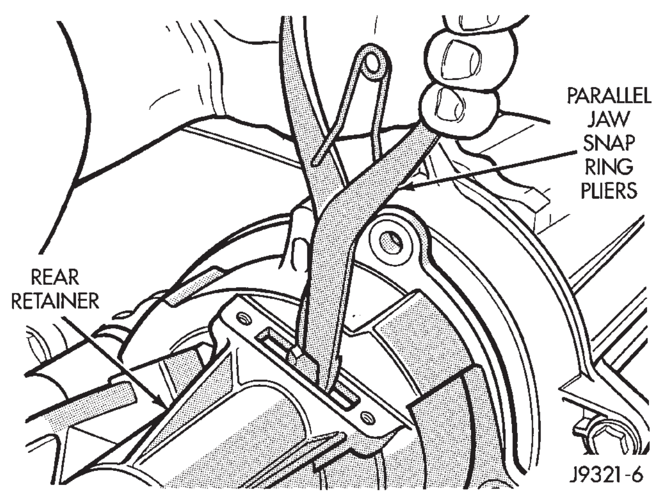


Fig. 94 Engaging Rear Bearing Locating Ring

(9) Spread rear bearing locating ring and slide rear retainer into place on rear case (Fig. 94).

(10) Install and tighten rear retainer bolts to 27-34 N●m (20-25 ft. lbs.).

(11) Install locating ring access cover and gasket (Fig. 95). Tighten plate attaching screws to 10 N●m (85 in. lbs.) torque.

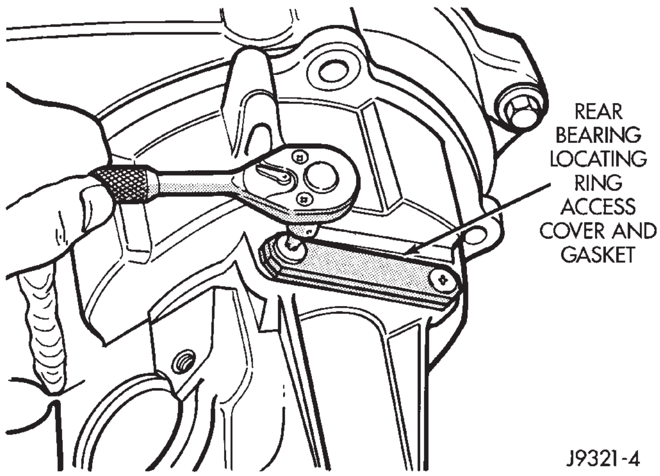


Fig. 95 Installing Locating Ring Access Cover And Gasket

FRONT BEARING RETAINER, YOKE AND RANGE LEVER INSTALLATION

(1) Apply 3 mm (1/8 in.) wide bead of Mopar silicone adhesive sealer to mating surface of front bearing retainer. Allow sealer to set-up slightly before installing retainer.

(2) Install front bearing retainer (Fig. 96). Tighten retainer bolts to 16-24 N●m (12-18 ft. lbs.) torque.

(3) Install new seal washer on front output shaft (Fig. 97).

(4) Install yoke and new yoke nut on front output shaft (Fig. 98).

(5) Tighten yoke nut to 122-176 N●m (90-130 ft. lbs.) torque. Use Tool C-3281, or similar tool to hold yoke while tightening yoke nut.

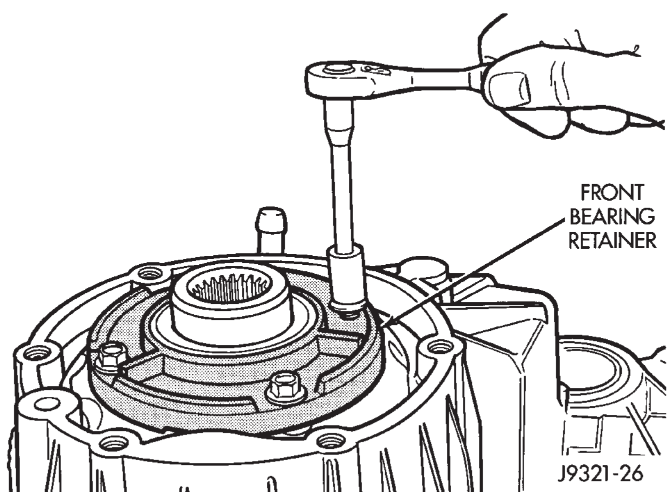


Fig. 96 Installing Front Bearing Retainer

(6) Install range lever, washer and locknut on sector shaft (Fig. 99). Tighten locknut to 27-34 N●m (20-25 ft. lbs.) torque.

(7) Install drain plug. Tighten plug and switch to 41-54 N●m (30-40 ft. lbs.) torque.

(8) Install and tighten indicator switch to 20-34 N●m (15-25 ft. lbs.) torque.

(9) Level transfer case and fill it with Mopar ATF Plus, Type 7176, or Dexron II transmission fluid. Correct fill level is to bottom edge of fill plug hole.

(10) Install and tighten fill plug to 41-54 N●m (30-40 ft. lbs.) torque.

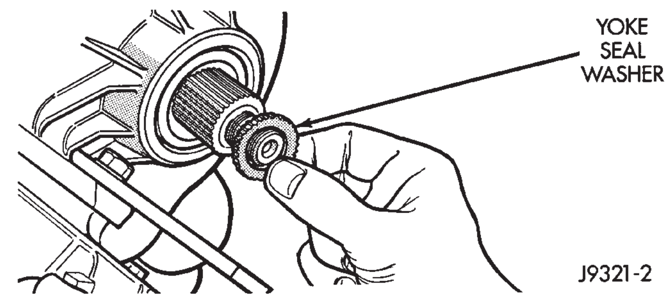


Fig. 97 Installing Yoke Seal Washer

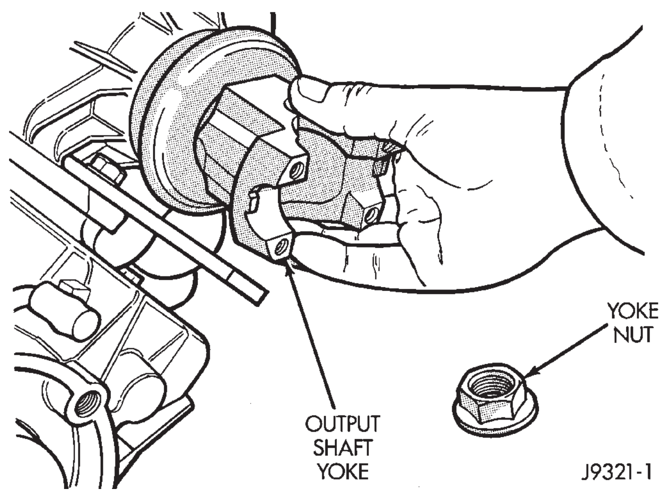


Fig. 98 Installing Output Shaft Yoke

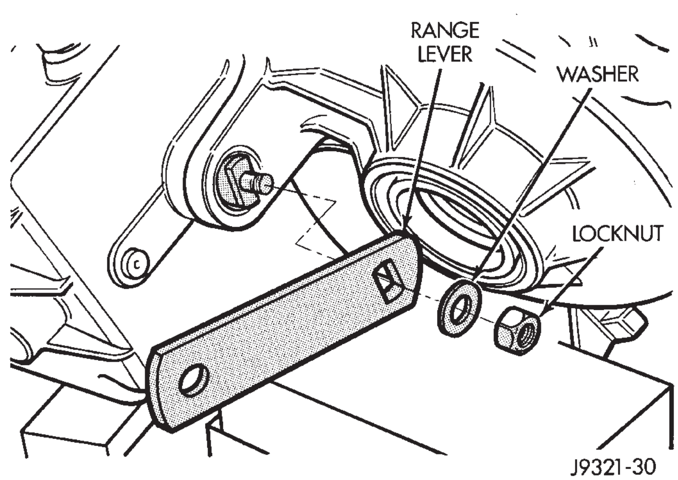
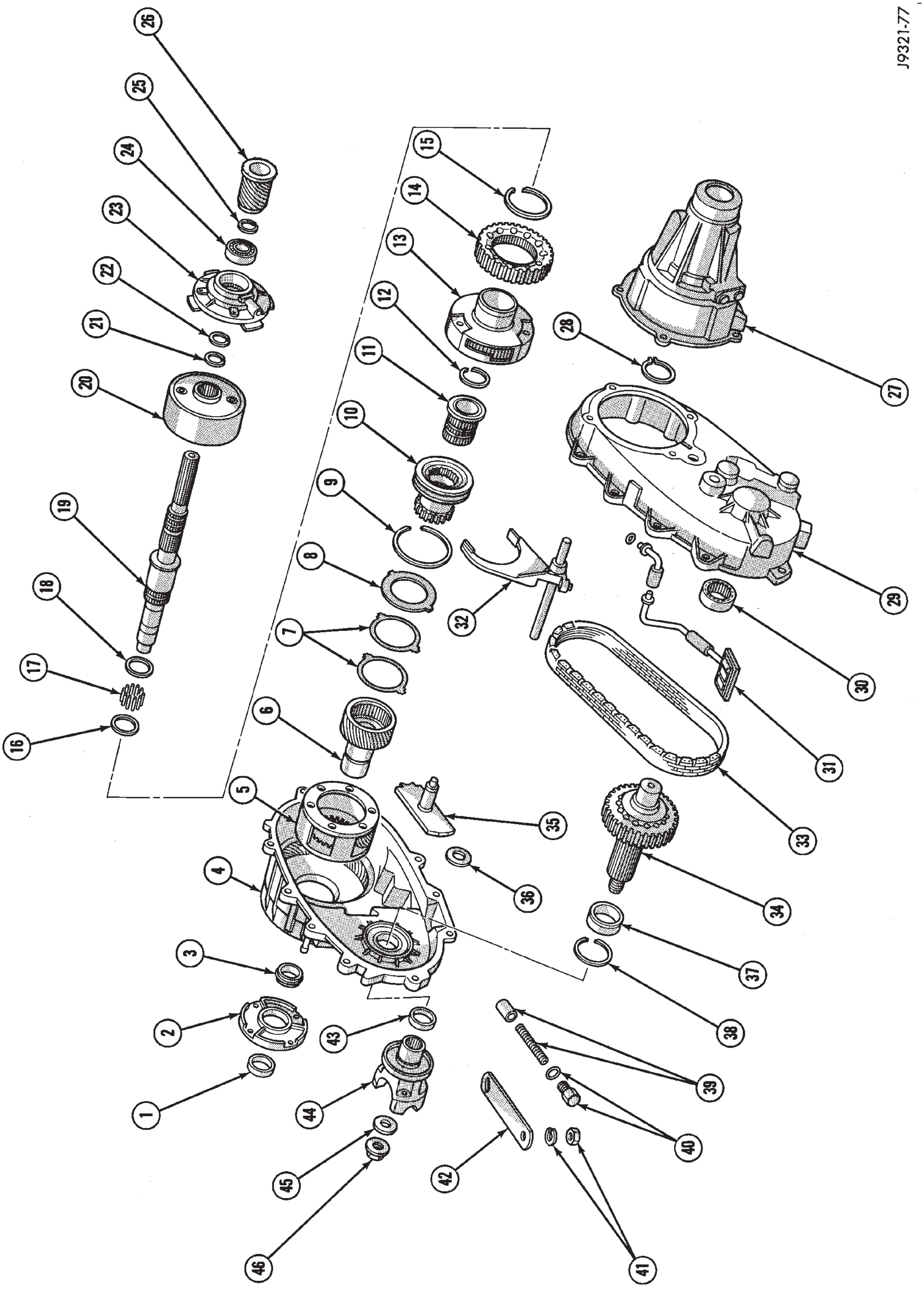


Fig. 99 Range Lever Installation



NP249 TRANSFER CASE

LEGEND FOR NP249 TRANSFER CASE

1. Oil Seal
2. Front Bearing Retainer
3. Mainshaft Front Bearing and Locating Ring
4. Front Case (includes low range annulus gear and shift rail bushing)
5. Low Range Gear
6. Input Gear
7. Tabbed Thrust Washer (2)
8. Retainer Plate
9. Input Gear Snap Ring
10. Clutch Sleeve
11. Clutch Shaft
12. Differential Snap Ring
13. Differential Assembly
14. Mainshaft Drive Gear
15. Drive Gear Snap Ring
16. Mainshaft Bearing Spacer
17. Mainshaft Needle Bearings (53)
18. Mainshaft Bearing Spacer
19. Mainshaft
20. Viscous Coupling
21. Viscous Coupling Snap Ring
22. Oil Pump Locating Snap Ring
23. Oil Pump
24. Mainshaft Rear Bearing
25. Rear Bearing Snap Ring
26. Speedometer Drive Gear
27. Rear Retainer Assembly (includes retainer cap, oil seal, bushing, access cover and gasket)
28. Rear Bearing Locating Ring
29. Front Case
30. Front Output Shaft Rear Bearing
31. Oil Pickup Tube Assembly (includes connecting hoses, pickup screen, tubes and O-ring)
32. Range Fork and Shift Rail Assembly (includes range fork pads)
33. Drive Chain
34. Front Output Shaft
35. Shift Sector
36. Case Magnet
37. Front Output Shaft Front Bearing
38. Bearing Snap Ring
39. Detent Plunger and Spring
40. Detent Plug and O-Ring
41. Range Lever Locknut and Washer
42. Range Lever
43. Oil Seal (Front Output Shaft Front Bearing)
44. Output Shaft Yoke
45. Yoke Seal Washer
46. Yoke Nut

J9321-80

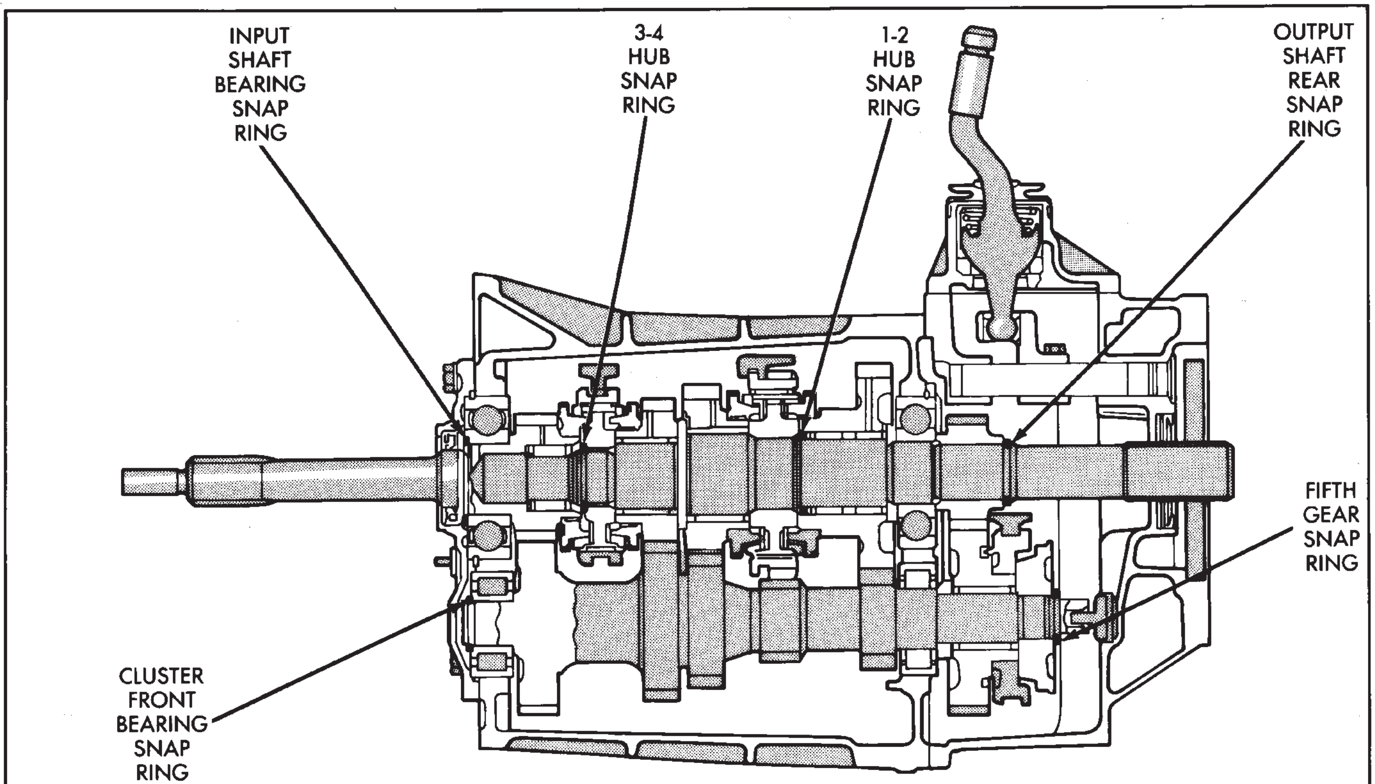
SPECIFICATIONS

TORQUE SPECIFICATIONS—AX-15

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



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

GENERAL SPECIFICATIONS—AW-4

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	Jeep automatic transmission fluid or DEXRON® II
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.)

J9121-401

OIL PUMP WEAR LIMITS—AW-4

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

CLUTCH DISC AND PLATE THICKNESS—AW-4

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

BUSHING AND PISTON CLEARANCE—AW-4

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

RETAINER AND PISTON SPECIFICATIONS—AW-4

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.)

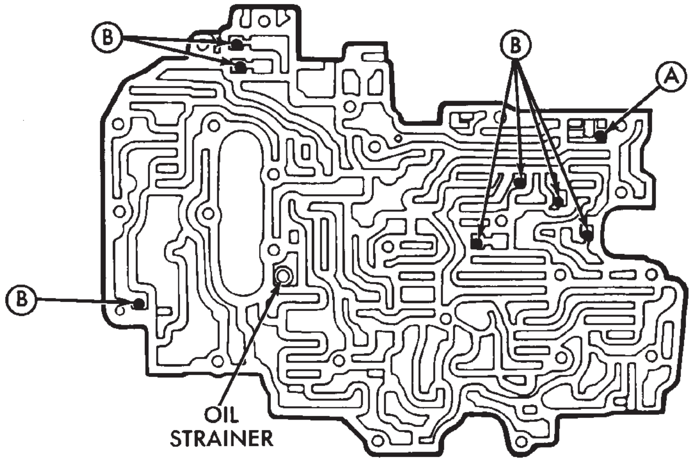
FIRST-REVERSE BRAKE CLEARANCE SELECTION

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

VALVE BODY CHECK BALL DIMENSIONS—AW-4

Check Ball	Diameter
(A) Rubber Ball	6.35 mm (0.250 in.)
(B) Rubber Ball	5.535 mm (.218 in.)



J9121-405

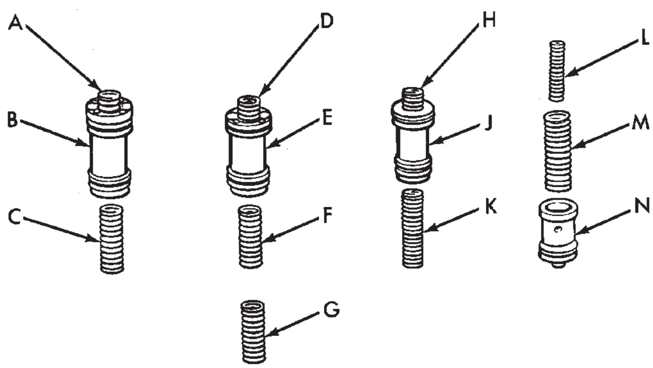
CLUTCH/BRAKE PACK REQUIREMENTS—AW-4

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

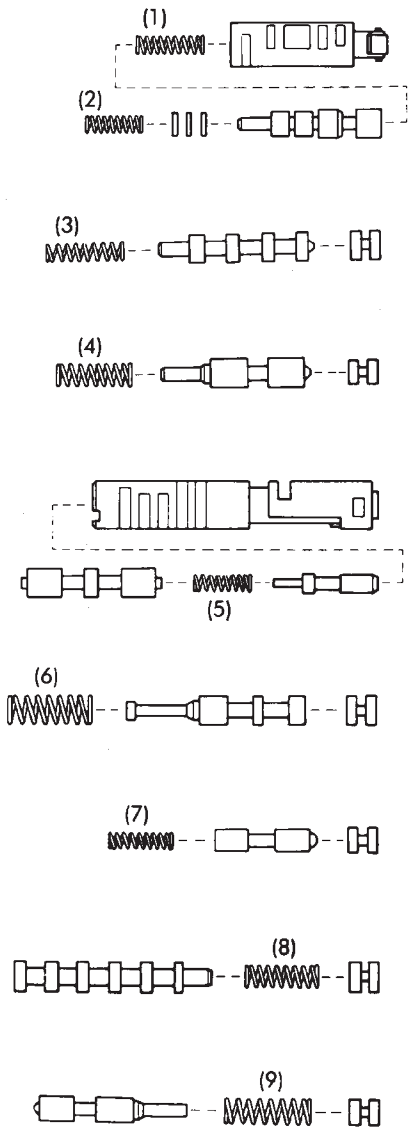
ACCUMULATOR COMPONENT IDENTIFICATION—AW-4

	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.)

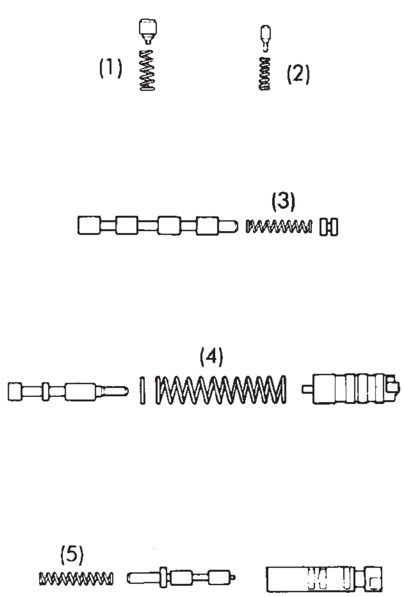


J9121-407

VALVE AND SPRING IDENTIFICATION—AW-4



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

TORQUE SPECIFICATIONS—AW-4

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

GENERAL SPECIFICATIONS—46RH

TRANSMISSION MODEL	46RH
Oil Pump Clearances (all)	0.089-0.190 mm (0.0035-0.0075 in)
Planetary End Play	0.15-1.22 mm (0.006-0.048 in)
Input Shaft End Play	0.86-2.13 mm (0.034-0.084 in)
Clutch Pack Clearance:	
Front Clutch – 3 Disc	1.78-3.28 mm (0.070-0.129 in)
Front Clutch – 4 Disc	2.08-3.83 mm (0.082-0.151 in)
Rear Clutch – 4 Disc	0.64-1.14 mm (0.025-0.045 in)
Clutch Disc Usage:	
Front Clutch	3/4
Rear Clutch	4
Overdrive Clutch	4
Direct Clutch	8
Front Clutch Spring Usage	9
Band Adjustments: (backed off from 72 in. lbs.)	
Front Band	2½ Turns
Rear Band	2 Turns
Recommended Fluid (all)	MOPAR ATF Plus, Type 7176

J9321-229

PRESSURE TEST SPECIFICATIONS—46RH

Overdrive Clutch	Fourth Gear Only	Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-896 kPa (90-130 psi) at 1/2 to 3/4 throttle.
Line Pressure (at accumulator)	Closed Throttle 1000 rpm and above	372-414 kPa (54-60 psi) 648 kPa (94 psi)
Front Servo	Third Gear Only	No more than 21 kPa (3 psi) lower than line pressure.
Rear Servo	1 Range R Range	No more then 21 kPa (3 psi) lower than line pressure. 1103 kPa (160 psi) at idle, builds to 1862 kPa (270 psi) at 1600 rpm.
Governor	D Range Closed Throttle	Pressure should respond smoothly to changes in mph and return to 0-7 kPa (0-1½ psi) when stopped with transmission in D, 1, 2. **Pressure above 7 kPa (1½ psi) at standstill will prevent transmission from downshifting.**

J9321-192

SPACER/THRUST PLATE/SNAP RING SPECIFICATIONS—46RH

	46RH
Front Clutch Thrust Washer (on reaction shaft support hub)	0.061 in. 0.084 in. 0.102 in.
Rear Clutch Thrust Washer (on clutch retainer)	0.061 in.
Intermediate Shaft Thrust Plate (on shaft pilot hub)	0.060-.063 in.
Output Shaft Thrust Washer (in rear clutch hub)	0.052-.054 in. 0.068-.070 in. 0.083-.085 in.
Rear Clutch Pack Snap Ring	0.060 in. 0.074 in.
Planetary Geartrain Snap Ring (at front end of intermediate shaft)	0.055-.059 in. 0.062-.066 in.
Overdrive Piston Thrust Plate Intermediate Shaft Spacer	Thrust plate and spacer are select fit components. Refer to "Overdrive Unit Assembly and Adjustment."

J9321-230

TORQUE SPECIFICATIONS—46RH

DESCRIPTION	TORQUE
Converter Bolts:	
10.0 in., 4-lug converter	74 N·m (55 ft. lbs.)
10.75 in., 4-lug converter	31 N·m (270 in. lbs.)
Crossmember Bolts/Nuts	68 N·m (50 ft. lbs.)
Driveplate Bolts	75 N·m (55 ft. lbs.)
Front Band Reaction Pin Access Plug	17 N·m (13 ft. lbs.)
Front Band Adjusting Screw Locknut	34 N·m (25 ft. lbs.)
Park/Neutral Position Switch	34 N·m (25 ft. lbs.)
Oil Pan Bolt	17 N·m (13 ft. lbs.)
Oil Pump Bolt	20 N·m (15 ft. lbs.)
Overrunning Clutch Cam Bolts	17 N·m (150 in. lbs.)
Overdrive-to-Transmission Case Bolts	34 N·m (25 ft. lbs.)
Overdrive Piston Retainer 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	20 N·m (15 ft. lbs.)
Rear Band Adjusting Screw Locknut	41 N·m (30 ft. lbs.)
Solenoid Wiring Connector Screw	17 N·m (13 ft. lbs.)
Solenoid-to-Transfer Plate Screw	4 N·m (35 in. lbs.)
Speedometer Adapter Bolt	11 N·m (8 ft. lbs.)
Valve Body and Oil Filter Screws	4 N·m (35 in. lbs.)
Valve Body-to-Case Bolts	12 N·m (100 in. lbs.)

J9321-231

TORQUE SPECIFICATIONS—NP231/NP242

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.)

J9321-95

TORQUE SPECIFICATIONS—NP249

DESCRIPTION	TORQUE
Crossmember Bolts	41-47 N•m (30-35 ft. lbs.)
Detent Plug	16-24 N•m (12-18 ft. lbs.)
Differential Carrier Bolts	17-27 N•m (150-240 in. lbs.)
Drain and Fill Plugs	41-54 N•m (30-40 ft. lbs.)
Electrical Switch	20-34 N•m (15-25 ft. lbs.)
Front Bearing Retainer Bolts	16-24 N•m (12-18 ft. lbs.)
Front Case-to-Rear Case Bolts	27-34 N•m (20-25 ft. lbs.)
Output Shaft Yoke Nut	122-176 N•m (90-130 ft. lbs.)
Rear Retainer Bolts	27-34 N•m (20-25 ft. lbs.)
Shift Lever Locknut	27-34 N•m (20-25 ft. lbs.)
Shift Rod Trunnion Bolt	11-20 N•m (96-180 in. lbs.)
Transfer Case Mounting Stud Nuts	33-41 N•m (24-30 ft. lbs.)
U-Joint Clamp Bolts	16-22 N•m (12-16 ft. lbs.)

J9321-79

AUTOMATIC TRANSMISSION—42RE

CONTENTS

GENERAL INFORMATION

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TRANSMISSION DESCRIPTION

The Chrysler 42RE is a 4-speed automatic transmission. Mechanical and hydraulic components in the 42RE are similar to those in Chrysler 42RH transmissions. The major difference between them involves the method of producing governor pressure for shift speed control. The 42RE uses electronic components to develop governor pressure. A mechanical governor is used to generate governor pressure in the 42RH.

First through third gear ranges in the 42RE are provided by the clutches, bands, overrunning clutch and planetary gear sets in the transmission unit. Fourth gear range is provided by the overdrive unit which contains an overdrive clutch, direct clutch, planetary gear set and overrunning clutch.

The overdrive clutch is applied in fourth gear only. The direct clutch is applied in all ranges except fourth gear.

The 42RE valve body transfer plate is completely new. It is redesigned to accept a new governor body and different hydraulic circuitry. The governor pressure solenoid valve and sensor are mounted in this body. The new transfer plate channels line pressure to the solenoid valve through the governor body. It also channels governor pressure from the solenoid valve to the governor circuit. It is the solenoid valve that develops necessary governor pressure.

The 42RE overdrive unit is quite different from previous overdrive units. It is shorter in length as a result of eliminating the mechanical governor mechanism, governor tubes and governor support.

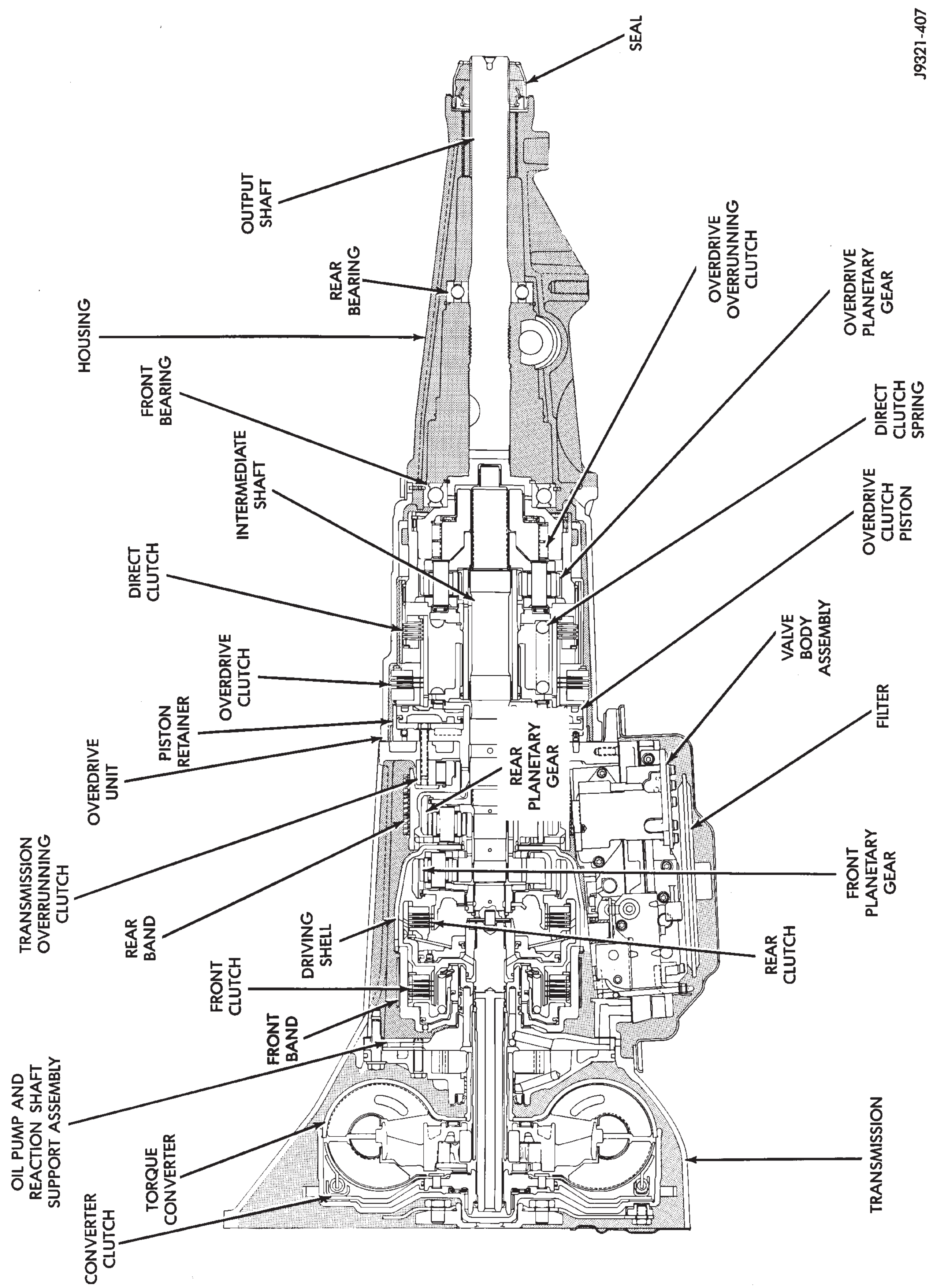

Fig. 1 42RE Automatic Transmission (4 x 2 Model)

TORQUE CONVERTER

A three element torque converter is used for all applications (Fig. 1). Converter elements consist of the turbine, stator and impeller. The converter also contains an overrunning clutch and a converter clutch mechanism.

The converter clutch is an electronically controlled mechanism. The clutch provides reduced engine speed and greater fuel economy when engaged. Clutch engagement also provides reduced transmission fluid temperatures.

The converter clutch is engaged in fourth gear and in third gear when the overdrive control switch is in the OFF position.

The overrunning clutch is mounted in the stator hub. This one-way clutch prevents the stator from rotating in a direction opposite to engine rotation. This retains the torque multiplication feature of the converter.

The torque converter is not a serviceable component. It should be replaced as an assembly when: diagnosis indicates a malfunction has occurred, or when a major malfunction allows debris to enter the converter.

GEAR RATIOS

Forward Gear ratios for the 42RE transmission are:

- First gear = 2.74:1
- Second gear = 1.54:1
- Third gear = 1.00:1
- Fourth gear = 0.69:1.

RECOMMENDED FLUID

The only fluid recommended for the 42RE transmission is Mopar ATF Plus, type 7176. Do not use Dexron II except in an emergency or if ATF Plus is not available.

TRANSMISSION IDENTIFICATION

The transmission part/identification numbers and codes are stamped on the left side of the case just above the oil pan gasket surface (Fig. 2).

The first letter/number group is the assembly part number. The next number group the transmission build date. The last number group is the transmission serial number. Refer to this information when ordering replacement parts.

FRONT BAND ADJUSTMENT

The front band adjustment for 42RE transmissions is considerably different from prior 4-speed models.

On 42RE transmissions, the front band is **backed off 3-5/8 turns** after tightening the adjusting screw to specified torque.

Refer to the front band adjustment procedure in the In-vehicle Service section when band adjustment is necessary.

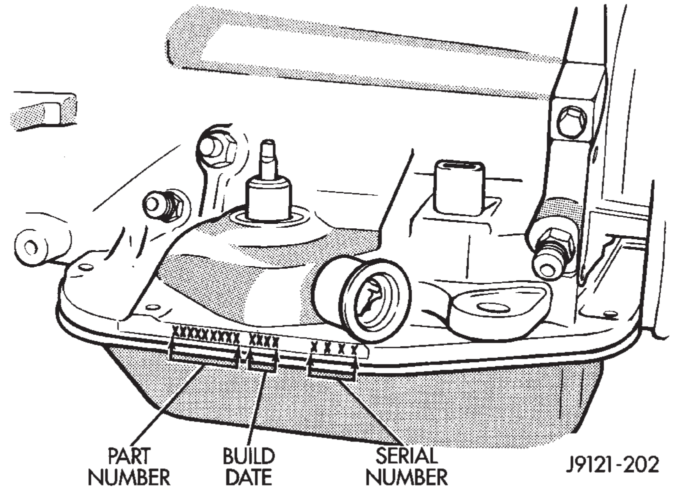

Fig. 2 Transmission Identification Number And Code Location

ELECTRONIC GOVERNOR COMPONENTS

Governor pressure is developed and controlled electronically in the 42RE transmission. Components used for development and control of governor pressure include:

- governor body
- new design valve body transfer plate
- governor pressure solenoid valve
- governor pressure sensor
- fluid temperature thermister
- transmission speed sensor
- throttle position sensor
- transmission control module (TCM)

Governor Pressure Solenoid Valve

The solenoid valve generates the governor pressure needed for upshifts and downshifts. It is an electrohydraulic device and is located in the governor body on the valve body transfer plate (Fig. 3).

The inlet side of the solenoid valve is exposed to normal transmission line pressure. The outlet side of the valve leads to the valve body governor circuit.

The solenoid valve regulates line pressure to produce governor pressure. The average current supplied to the solenoid controls governor pressure. One amp current produces zero kPa/psi governor pressure. Zero amps sets the maximum governor pressure.

The transmission control module (TCM) supplies electrical power to the solenoid valve. Operating voltage is 12 volts (DC) and is provided through the battery terminal on the module.

The solenoid is polarity sensitive. The TCM energizes the solenoid by grounding it through the power ground terminal on the transmission control module.

Governor Pressure Sensor

The governor pressure sensor measures output pressure of the governor pressure solenoid valve (Fig. 4).

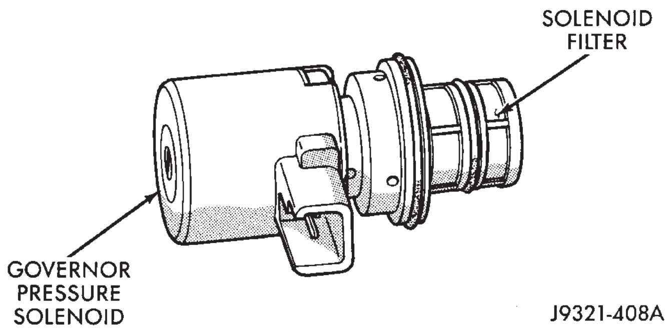

Fig. 3 Governor Pressure Solenoid Valve

The sensor output signal provides the necessary feedback to the transmission control module. This feedback is needed to adequately control governor pressure.

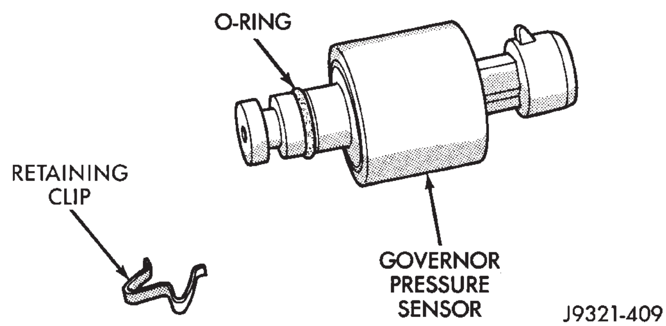

Fig. 4 Governor Pressure Sensor

Governor Body And Transfer Plate

A new transfer plate is used with the 42RE valve body. The transfer plate is designed to: (a) supply transmission line pressure to the governor pressure solenoid valve and (b) to return governor pressure.

The governor pressure solenoid valve is mounted in the governor body. The body is bolted to the lower side of the transfer plate (Fig. 5).

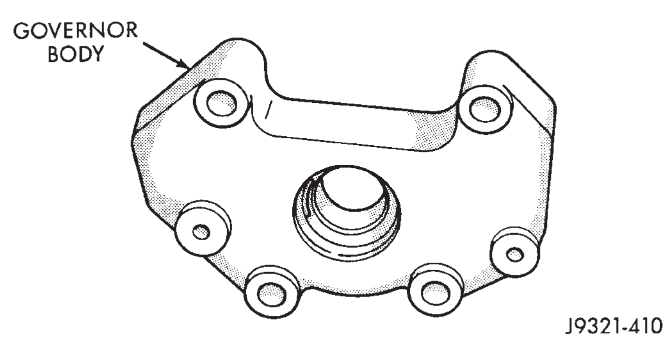

Fig. 5 Governor Body

Transmission Fluid Temperature Thermister

Transmission fluid temperature readings are supplied to the transmission control module by the thermister (Fig. 6). The temperature readings are used to control engagement of the fourth gear overdrive clutch, the converter clutch, and governor pressure. Normal resistance value for the thermister at room temperature is approximately 1000 ohms.

The transmission control module (TCM) prevents engagement of the converter clutch and overdrive clutch, when fluid temperature is below approximately 1°C (30°F).

If fluid temperature exceeds 126°C (260°F), the transmission control module will cause a 4-3 downshift and engage the converter clutch. Engagement is according to the third gear converter clutch engagement schedule.

The overdrive OFF lamp in the instrument panel, also illuminates when the shift back to third occurs. The transmission will not allow fourth gear operation until fluid temperature decreases to approximately 110°C (230°F).

The thermistor is mounted on the underside of the converter clutch solenoid (Fig. 6). It is immersed in transmission fluid at all times.

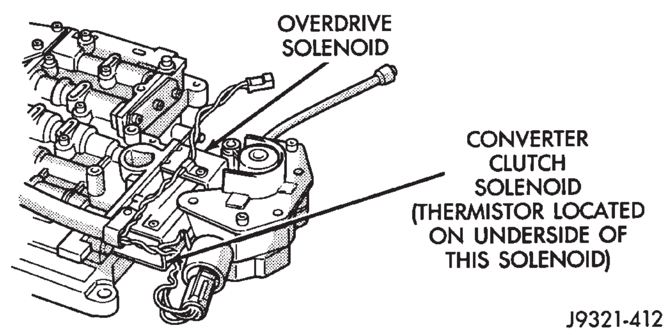

Fig. 6 Converter Clutch Solenoid And Thermistor Location

Transmission Speed Sensor

The speed sensor (Fig. 7), is located in the overdrive gear case. The sensor is positioned over the park gear and monitors transmission output shaft rotating speed. The sensor used with the 42RE transmission is the same as is used in Chrysler 41TE and 42LE

front drive automatic transmissions.

Speed sensor signals are triggered by the park gear lugs as they rotate past the sensor pickup face. Input signals from the sensor are sent to the transmission control module for processing.

The vehicle speed sensor also serves as backup to the transmission speed sensor. Signals from this sensor are shared with the powertrain control module.

Throttle Position Sensor (TPS)

The TPS provides throttle position input signals to both the transmission control module and powertrain controller. This input signal is used to determine overdrive and converter clutch shift schedule and to select the proper governor curve.

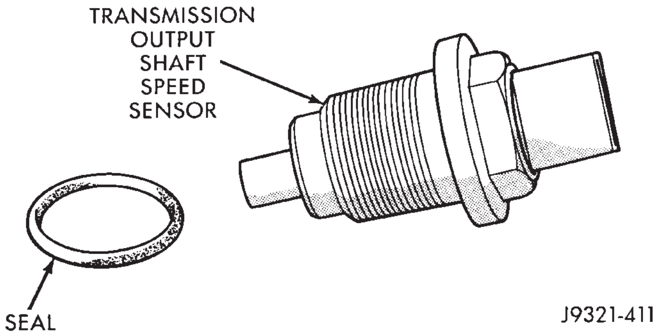

Fig. 7 Transmission Speed Sensor

Transmission Control Module (TCM)

The TCM controls operation of the converter clutch, overdrive clutch, and governor pressure solenoid.

The control module determines transmission shift points based on input signals from the transmission thermistor, transmission output shaft speed sensor, crankshaft position sensor, vehicle speed sensor and throttle position sensor.

Operating voltage is supplied through the battery terminal on the control module. The ignition voltage signal is supplied through a terminal on the ABS control module.

The DRB II scan tool can be used to check operation of the control module and transmission electrical components. The diagnostic connector (for the scan tool) is located under the driver side of the instrument panel. The connector has a 6-way terminal and is blue in color.

GOVERNOR PRESSURE CURVES

There are four governor pressure curves programmed into the transmission control module. The different curves allow the control module to adjust governor pressure for varying conditions.

One curve is used for operation when fluid temperature is at, or below 1°C (30°F).

A second curve is used when fluid temperature is at, or above -0.5°C (31°F) during normal city, or highway driving.

A third curve is used during wide open throttle operation. The fourth curve is used when driving with the transfer case in low range.

TRANSMISSION SHIFTING

Shift valve operation in 42RE transmissions with the electronic governor mechanism is basically unchanged. The 1-2 and 2-3 upshift sequence occurs exactly the same as in non-electronic governor transmission.

The valve body shift valves are still moved by a combination of throttle and governor pressure. The only real difference is that governor pressure is generated by electrical components instead of a mechanical valve and weight assembly.

The conditions under which a shift to fourth will not occur, also remain the same. These being:
- shift to third not yet completed
- overdrive switch is in OFF position
- throttle is at 3/4 to wide open position
- vehicle speed too low for 3-4 shift to occur
- transmission fluid temperature is below 1°C (30°F) or above 121°C (250°F).

CONVERTER CLUTCH ENGAGEMENT

The torque converter clutch is engaged by the clutch solenoid on the valve body. The clutch can be engaged in third and fourth gear ranges depending on overdrive control switch position.

If the overdrive control switch is in the normal ON position, the clutch will engage after the shift to fourth gear, and above approximately 72 km/h (45 mph).

If the control switch is in the OFF position, the clutch will engage after the shift to third gear, at approximately 56 km/h (35 mph) at light throttle.

OVERDRIVE OFF SWITCH

The overdrive Off switch is located in the instrument panel. The switch is a momentary contact device that signals the TCM to toggle current status of the overdrive function. At key-on, overdrive operation is allowed.

Pressing the switch once causes the overdrive Off mode to be entered and the overdrive Off switch lamp to be illuminated. Pressing the switch a second time causes normal overdrive operation to be restored and the overdrive lamp to be turned off.

The normal position for the control switch is the ON position. The switch must be in this position to energize the solenoid and allow a fourth gear upshift.

The control switch has an indicator light. The light illuminates when the overdrive switch is turned to the OFF position, or when illuminated by the transmission control module.

The control switch indicator light is also used to signal fault flash codes for diagnostic purposes.

QUICK FILL VALVE

The 3-4 shuttle valve is replaced by a 3-4 quick fill valve in the 42RE valve body. The valve maintains a prefill pressure of approximately 5 psi in the overdrive clutch. Prefill pressure is maintained in all drive (D) ranges. The purpose of the valve is faster engagement of the overdrive clutch during 3-4 upshifts.

In operation, the valve temporarily bypasses the clutch piston feed orifice at the start of a 3-4 upshift. This exposes a larger passage into the piston retainer resulting in a much faster clutch fill and apply sequence.

The valve does not bypass the regular clutch feed orifice throughout the 3-4 upshift. Instead, once a predetermined pressure develops within the clutch, the valve closes the bypass. Clutch fill is then completed through the regular feed orifice.

SERVICE MANUAL UPDATES

NEW THROTTLE VALVE CABLE

A different throttle valve cable is used on ZJ models with the 42RE transmission and 4.0L engine. The cable is similar to the one used on V8 models with the 46RH transmission.

NEW THROTTLE VALVE CABLE ADJUSTMENT PROCEDURE

A new throttle valve cable adjustment procedure has been developed for the 42RE and 46RH throttle valve cable.

The adjustment procedure is new for the 1993 model year and applies to 42RE and 46RH transmissions equally. Make a note on page 21-92, Group 21, of your 1993 Grand Cherokee Service Manual and refer to the procedure in this manual when adjustment is necessary.

The new adjustment procedure is described in the In-Vehicle Service section.

TRANSMISSION SHIFT MECHANISM

A floor shift linkage mechanism is used on all ZJ models with the 42RE and 46RH automatic transmission. A column type gearshift linkage was **not** released. Make a note of this information on page 21-191 of your 1993 Grand Cherokee/Grand Wagoneer service manual. The correct floorshift cable mechanism and adjustment procedures are provided in the transmission In-Vehicle Service section.

42RE TRANSMISSION DIAGNOSIS

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DIAGNOSIS PROCEDURES

Begin diagnosis by checking the easily accessible items such as fluid level, fluid condition and throttle cable/shift linkage adjustments. 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:

(1) Preliminary diagnosis
(2) Fluid Level and condition
(3) Leak tests (if fluid level is low)
(4) Linkage Adjustment
(5) Overdrive control switch test
(6) Road test
(7) Stall test
(8) Hydraulic pressure test
(9) Air pressure tests
(10) 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 for TCM fault codes with DRB II scan tool, or with fault flash codes at lamp in overdrive Off switch.

(2) Check fluid level and condition.

(3) Adjust throttle and gearshift linkage if complaint was based on delayed, erratic, or harsh shifts.

(4) Road test and note how transmission upshifts, downshifts and engages.

(5) Perform stall test if complaint is based on sluggish acceleration or if abnormal throttle opening is needed to maintain normal speeds with a properly tuned engine.

(6) Perform hydraulic pressure test if shift problems were noted during road test.

(7) Perform air pressure test to check clutch-band operation.

VEHICLE IS DISABLED

(1) Check fluid level and condition.

(2) Check for broken, disconnected throttle valve cable or lever.

(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.

CHECKING FLUID LEVEL AND CONDITION

(1) Place vehicle on level surface. This is important for an accurate reading.

(2) Do not check level until fluid is at normal hot operating temperature of approximately 180°F. This is necessary to avoid false readings which could produce under or over fill condition.

(3) Start and run engine at curb idle speed and apply parking brakes.

(4) Shift transmission through all gear ranges and back to Neutral.

(5) Clean top of filler tube and dipstick to keep dirt out of tube.

(6) Remove dipstick and check fluid level as follows:

(a) Dipstick has three fluid level indicating marks which are a MIN dot mark, an OK mark and a MAX fill arrow mark:

(b) Correct level is to Full, or MAX arrow mark on dipstick. This is correct maximum hot fluid level. Acceptable level is between OK mark and max arrow mark on dipstick.

(c) If level is at, or below MIN level dot on dipstick, add only enough fluid to restore correct level. Mopar ATF Plus, type 7176 is the preferred fluid. Mopar Dexron II can be used if ATF Plus is not readily available.

CAUTION: Do not overfill the transmission. Overfilling may cause leakage out the pump vent which can be mistaken for a pump seal leak. In addition, overfilling will also cause fluid aeration and foaming as the excess fluid is picked up and churned by the gear train. This will reduce the life of the fluid significantly.

(7) Check fluid condition. Fluid should be dark to light red in color and free of particles and sludge.

(a) If fluid is discolored or smells burned but transmission operation was OK, flush cooler and lines and change fluid and filter. Then road test again to confirm proper operation.

(b) If fluid is black, dark brown, turned to sludge, contains extensive amount of metal or friction material particles, transmission will probably need overhaul (especially if shift problems were evident during road test).

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, aerating the fluid and 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.

OVERDRIVE ELECTRICAL CONTROLS

The electrical controls governing the shift into fourth gear consist of the overdrive off switch in the instrument panel and the overdrive solenoid on the valve body.

The overdrive off switch, valve body solenoid, case connectors and related wiring can all be tested with a 12 volt test lamp or a volt/ohmmeter. Check continuity of each component when diagnosis indicates this is necessary.

Switch and solenoid continuity should be checked whenever the transmission fails to shift into fourth gear range.

DIAGNOSTIC TROUBLE FLASH CODES

Diagnostic trouble flash codes are provided for diagnosis purposes. The lamp in the overdrive off switch is used to signal the various flash codes.

The flash codes and type of fault indicated are outlined in the Flash Code Chart (Fig. 1).

To view flash codes, proceed as follows:

(a) Turn ignition key on and off three times. Then leave overdrive off switch in normal overdrive (on) position.

(b) Immediately begin counting number of flashes displayed by overdrive off switch indicator lamp.

(c) Flash codes will correspond to powertrain control module in duration and spacing.

(d) A code 55 identifies end of flash code transmission

FAULT CODE	FAULT DESCRIPTION
11	Engine RPM input
12	Output shaft sensor input
13	Vehicle speed input
14	Governor pressure sensor input
15	Throttle position sensor input
16	Transmission fluid temperature input
17	Overdrive override (control) switch input
18	System voltage
19	Internal fault in module
21	Governor pressure solenoid output
22	Overdrive solenoid output
23	Converter clutch solenoid output
24	Overdrive override (control switch) lamp output
25	Internal fault in module
26	Governor pressure sensor offset drift
55	End of code transmission

J9321-347

Fig. 1 DIAGNOSTIC TROUBLE FLASH CODE CHART—42RE

TRANSMISSION THROTTLE VALVE CABLE AND SHIFT CABLE ADJUSTMENT

Transmission throttle cable adjustment is important to proper operation. This adjustment positions the valve body throttle valve which controls shift speed, quality and part throttle downshift sensitivity.

If cable setting is too short, early shifts and slippage between shifts may occur. If the setting is too long, shifts may be delayed and part throttle downshifts may be very sensitive. Refer to the In-Vehicle Service section for adjustment procedure.

Shift cable adjustment is important because it positions the valve body manual valve. Incorrect adjustment will cause creep in Neutral, premature clutch wear, delayed engagement in all gear ranges, or a no-start in Park or Neutral.

Proper operation of the park/neutral position switch will provide a quick check of linkage adjustment. Refer to the In-Vehicle Service section for linkage adjustment procedure.

ROAD TESTING

Before road testing, be sure the fluid level and all cable 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 shift variations and engine flare, which indicates slippage. Note if shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Slippage indicated by engine flare, usually means clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul 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. 2) provides a basis for analyzing road test results.

ANALYZING THE ROAD TEST

Refer to the Clutch and Band Application chart (Fig. 2) and note which elements are in use in the various gear ranges.

Note that the rear clutch is applied in all forward ranges (D, 2, 1). The transmission overrunning clutch is applied in first gear (D, 2 and 1 ranges) only. The rear band is applied in 1 and R range only.

Note that the overdrive clutch is applied only in fourth gear and the overdrive direct clutch and overrunning clutch are applied in all ranges except fourth gear.

For example: If slippage occurs in first gear in D and 2 range but not in 1 range, the transmission overrunning clutch is faulty. Similarly, if slippage occurs in any two forward gears, the rear clutch is slipping.

Applying the same method of analysis, note that the front and rear clutches are applied simultaneously only in D range third and fourth gear. If the transmission slips in third gear, either the front clutch or the rear clutch is slipping.

If the transmission slips in fourth gear but not in third gear, the overdrive clutch is slipping. By selecting another gear which does not use these clutches, the slipping unit can be determined. For example, if the transmission also slips in Reverse, the front clutch is slipping. If the transmission does not slip in Reverse, the rear clutch is slipping.

If slippage occurs during the 3-4 shift or only in fourth gear, the overdrive clutch is slipping. Similarly, if the direct clutch were to fail, the transmission would lose both reverse gear and overrun

SHIFT LEVER POSITION	TRANSMISSION CLUTCHES AND BANDS					OVERDRIVE CLUTCHES		
	FRONT CLUTCH	FRONT BAND	REAR CLUTCH	REAR BAND	OVERRUN. CLUTCH	OVERDRIVE CLUTCH	DIRECT CLUTCH	OVERRUN. CLUTCH
Reverse	X			X			X	
Drive Range								
First			X		X		X	X
Second		X	X				X	X
Third	X		X				X	X
Fourth	X		X			X		
2-Range: (Manual Second):								
Second		X	X				X	X
First			X		X		X	X
1-Range (Manual Low):								
First			X	X	X		X	X

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Fig. 2 Clutch And Band Application Chart braking in 2 position (manual second gear). If the transmission slips in any other two forward gears, the transmission rear clutch is probably slipping.

If the transmission will not shift to fourth gear, the control switch, overdrive solenoid or related wiring may also be the problem cause.

This process of elimination can be used to identify a slipping unit and check operation. Proper use of the Clutch and Band Application Chart is the key.

Although road test analysis will help determine the slipping unit, the actual cause of a malfunction usually cannot be determined until hydraulic and air pressure tests are performed. Practically any condition can be caused by leaking hydraulic circuits or sticking valves.

Unless a malfunction is obvious, such as no drive in D range first gear, do not disassemble the transmission. Perform the hydraulic and air pressure tests to help pinpoint the problem cause.

HYDRAULIC PRESSURE TEST

Hydraulic test pressures range from a low of one psi (6.895 kPa) governor pressure, to 300 psi (2068 kPa) at the rear servo pressure port in reverse. Use 100 psi Gauge C-3292 to check pressure at the accumulator, front servo and governor. Use 300 psi Gauge C-3293 to check pressure at the rear servo.

PRESSURE TEST PORT LOCATIONS

There are pressure test ports at the accumulator, front servo, and rear servo. Governor and overdrive clutch pressure test ports are located at the left and right rear sides of the case (Fig. 3).

Line pressure is checked at the accumulator port on the right side of the case. The front servo pressure port is at the right side of the case just behind the filler tube opening.

The rear servo and governor pressure ports are at the right rear of the transmission case. The overdrive clutch pressure port is at the left rear of the case (Fig. 3).

An accurate tachometer and two test gauges are required for the pressure test. Test Gauge C-3292 has a 100 psi range and is used at the accumulator, governor, front servo, and overdrive pressure ports. Test Gauge C-3293 has a 300 psi range and is used at the rear servo port where pressures range from 250 to 290 psi. In cases where two test gauges are required, the 300 psi gauge can be used at any of the other test ports.

HYDRAULIC 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.

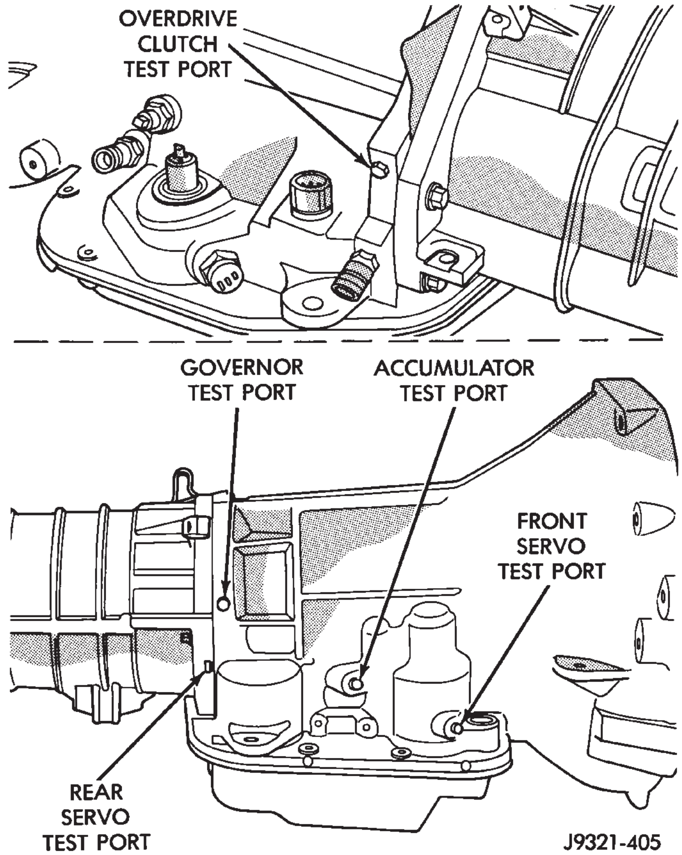

Fig. 3 Pressure Test Port Locations

Test One—Transmission In 1 Range

This test checks pump output, pressure regulation, and condition of the rear clutch and servo circuit. Test Gauges C-3292 and C-3293 are required for this test. Gauge C-3292 has a 100 psi range. Gauge C-3293 has a 300 psi range.

(1) Connect 100 psi Gauge C-3292 to accumulator port.

(2) Connect 300 psi Gauge C-3293 to rear servo port (Fig. 3).

(3) Disconnect throttle and gearshift cables from transmission levers.

(4) Start and run engine at 1000 rpm.

(5) Move shift lever (on manual lever shaft) all the way forward into 1 range.

(6) Move transmission throttle lever from full forward to full rearward position and note pressures on both gauges.

(7) Line pressure at accumulator port should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (621-662 kPa) as lever is moved rearward.

(8) Rear servo pressure should be same as line pressure within 3 psi (20.68 kPa).

Test Two—Transmission In 2 Range

This test checks pump output, line pressure and pressure regulation. Use 100 psi Test Gauge C-3292 for this test.

(1) Connect test gauge to accumulator pressure port (Fig. 3).

(2) Start and run engine at 1000 rpm.

(3) Move transmission shift lever one detent rearward from full forward position. This is 2 range.

(4) Move transmission throttle lever from full forward to full rearward position and read pressure 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 (621-662 kPa) as lever is moved rearward.

Test Three—Transmission In D Range

This test checks pressure regulation and condition of the clutch circuits. Use both pressure Test Gauges C-3292 and C-3293 for this test.

(1) Connect test gauges to accumulator and front servo ports (Fig. 3). Use either test gauge at the two ports.

(2) Start and run engine at 1600 rpm for this test.

(3) Move shift 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 Test Gauge C-3293 for this test.

(1) Connect 300 psi gauge to rear servo port (Fig. 3).

(2) Start and run engine at 1600 rpm for test.

(3) Move transmission shift lever four detents rearward from the full forward position. This is Reverse range.

(4) Move throttle lever all way forward then all 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 vehicle speed. It is usually not necessary to check governor operation unless shift speeds are incorrect or if the transmission will not downshift. The test should be performed on a hoist that will allow the rear wheels to rotate freely.

(1) Connect 100 psi Test Gauge C-3292 to governor pressure port (Fig. 3).

(2) Move transmission shift lever to D range.

(3) Start and run engine at curb idle speed and note pressure. At idle and with vehicle stopped, pressure should be zero to 1-1/2 psi maximum. If pressure exceeds this figure, a fault exists in the governor pressure control system.

(4) Slowly increase engine speed and observe speedometer and pressure test gauge. Governor pressure should increase in proportion to vehicle speed. Or approximately 1 psi for every 1 mph.

(5) Pressure rise should be smooth and drop back to 0 to 1-1/2 psi when wheels stop rotating.

(6) Compare results of pressure tests with analysis chart (Fig. 4).

Test Six—Transmission In Overdrive Fourth Gear

This test checks line pressure at the overdrive clutch in fourth gear range. Use 300 psi Test Gauge C-3292 for this test.

(1) Raise vehicle and connect test gauge to overdrive clutch pressure port (Fig. 4).

(2) Lower vehicle to enough to allow entry into drivers seat. Leave vehicle wheels approximately one foot off shop floor.

(3) Secure test gauge where it can be viewed from drivers seat.

(4) Verify that overdrive control switch is in ON position.

(5) Start engine and shift into D range.

(6) Increase engine rpm gradually until 3-4 shift occurs and note gauge pressure.

(7) Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-827 kPa (90-120 psi) at 1/2 to 3/4 throttle.

(5.0H x 3.5W) Fig. 4 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.

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 Low in D Fourth Gear Range	Overdrive clutch piston seal, or check ball problem
Pressure OK in 1, 2 but low in D3 and R	Leakage in front clutch area (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 low in 2	Leakage in servo; broken servo ring or cracked servo piston
Pressure low in all positions	Clogged filter, stuck regulator valve, worn or faulty pump, plugged fluid cooler
Governor pressure too high at idle speed	Governor pressure solenoid valve faulty
Governor pressure low at all mph figures	Faulty governor pressure solenoid, transmission control module, or governor pressure sensor
Lubrication/line pressure low at all throttle positions	Clogged fluid cooler or lines, seal rings leaking, output shaft plugged with debris, worn bushings in pump or clutch retainer

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WARNING: NEVER ALLOW ANYONE TO STAND DIRECTLY IN LINE WITH THE VEHICLE FRONT OR REAR DURING A STALL TEST. ALWAYS BLOCK THE WHEELS AND APPLY THE SERVICE AND PARKING BRAKES DURING THE TEST.

STALL TEST PROCEDURE

(1) Connect tachometer to engine. Position tachometer so it can be viewed from driver seat.

(2) Check transmission fluid level. Add fluid if necessary.

(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. Operate engine for 20 seconds. Stop engine, shift transmission into Park and release brakes.

(9) Stall speeds should be in 1800-2100 rpm range.

STALL TEST ANALYSIS

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 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 TESTING TRANSMISSION CLUTCH AND BAND OPERATION

Air pressure testing can be used to check transmission front/rear 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 5.

FRONT CLUTCH AIR TEST

Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage (Fig. 5). Piston movement can be felt and a soft thud heard as the clutch applies.

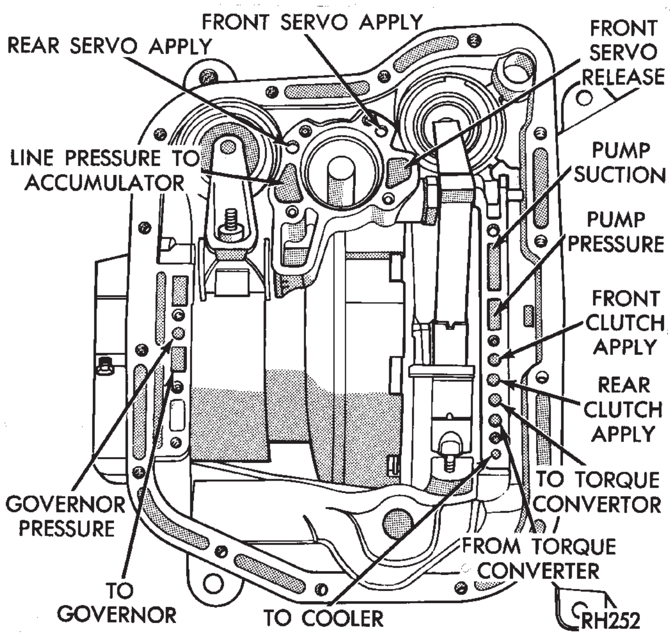

Fig. 5 Air Pressure Test Passages

REAR CLUTCH AIR TEST

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage. Piston movement can be felt and a soft thud heard as the clutch applies.

FRONT SERVO AIR TEST

Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring tension should release the servo when air pressure is removed.

REAR SERVO AIR TEST

Apply air pressure to the rear servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring tension should release the servo when air pressure is removed.

CONVERTER HOUSING FLUID LEAK DIAGNOSIS

When diagnosing converter housing fluid leaks, two items must be established before repair. 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. They may only be the result of residual fluid in the converter housing, or excess fluid spilled during factory fill or refill after repair.

Converter housing leaks have several potential sources. Through careful observation, a leak source can be identified before removing the transmission for repair.

Pump seal leaks tend to move along the drive hub and onto the rear of the converter. Pump O-ring or pump body leaks follow the same path as a seal leak (Fig. 6).

Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 6).

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.

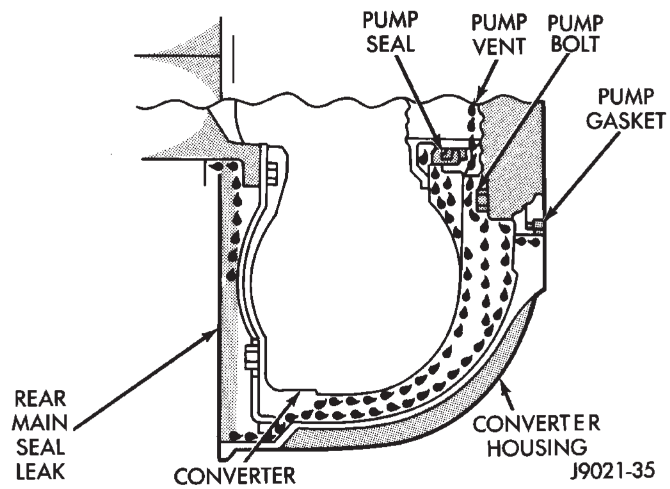

Fig. 6 Converter Housing Leak Paths

LEAK DIAGNOSIS PROCEDURE

(1) Raise rear of vehicle and allow accumulated fluid to drain out of converter housing.

(2) Check and adjust transmission fluid level.

(3) Raise vehicle. Remove converter housing dust cover and wipe as much fluid as possible from converter housing.

(4) Fabricate test probe (Fig. 7). Attach probe to converter housing with a dust shield bolt.

(5) Have a helper run engine at 2500 rpm (with transmission in Neutral) for two minutes; then stop engine.

(6) Inspect test probe and converter housing. If a leak is evident, note color of fluid. Transmission fluid is red. Engine oil ranges in color from brown to green, or to black when oil is dirty.

(7) If probe upper surface is wet with fluid, converter and seal are not at fault. A path of fluid across probe upper surface indicates a converter or seal leak. Fluid leaking **under** the probe is coming from pump housing area (Fig. 8).

(8) Fluid leaking under the probe could be from: pump seal and/or bushing, pump vent, kickdown lever shaft access plug, pump bolts, or porous spots in pump body or transmission case (Fig. 8).

(9) If porous spots in the transmission case or pump body are the suspected leak source, pressurize transmission as described in Leak Testing With Air Pressure.

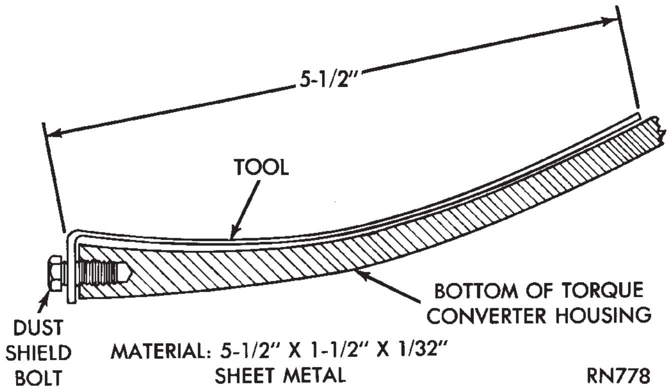

Fig. 7 Converter Housing Leak Test Probe

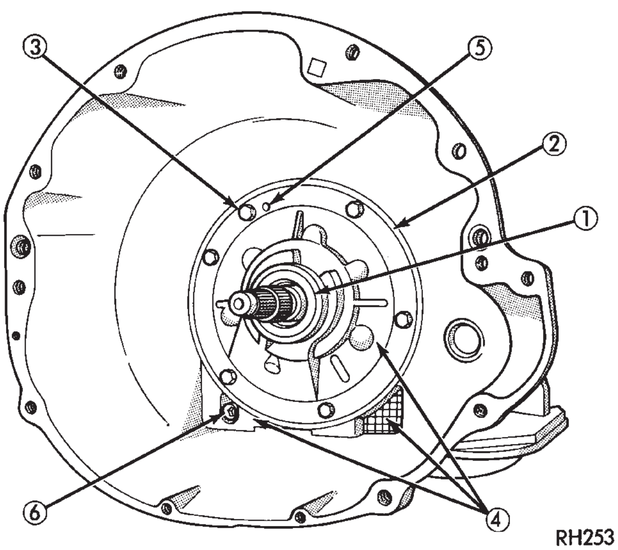

Fig. 8 Pump Area Inspection Points

TORQUE CONVERTER LEAK POINTS

Possible sources of converter leaks are: (a) leaks at the weld joint around the outside diameter weld and (b) leaks at the converter hub weld (Fig. 9).

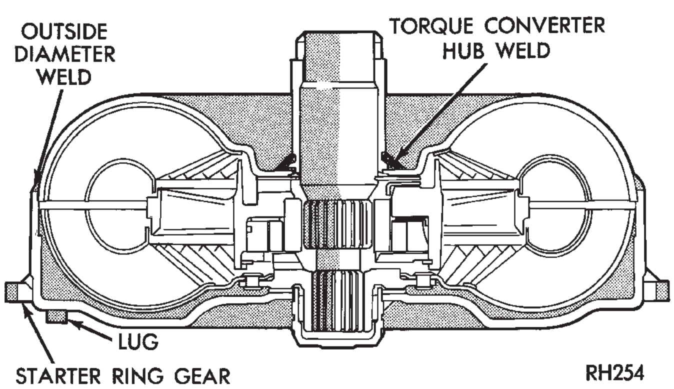

Fig. 9 Converter Potential Leak Points

LEAK TESTING WITH AIR PRESSURE

This test involves closing off all openings and pressurizing the transmission to 8 psi with Air Pump 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 3.17 mm (1/8 in.) thick disc (Fig. 10). A retaining strap is needed to secure the seal cup for testing. The strap can be made from 31.75 mm (1-1/4 in.) wide stock (Fig. 11). The strap attaching hole positions are approximate only. Measure hole position on the converter housing before drilling.

The pump vent tool is made from 6.35 mm (1/4 in.) rod and 4.76 mm (3/16 in.) plate (Fig. 12).

The fabricated tools can all be made from mild steel or aluminum stock.

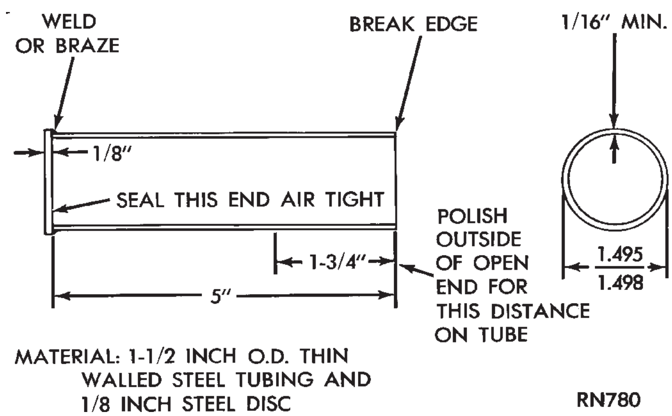

Fig. 10 Converter Hub Seal Cup

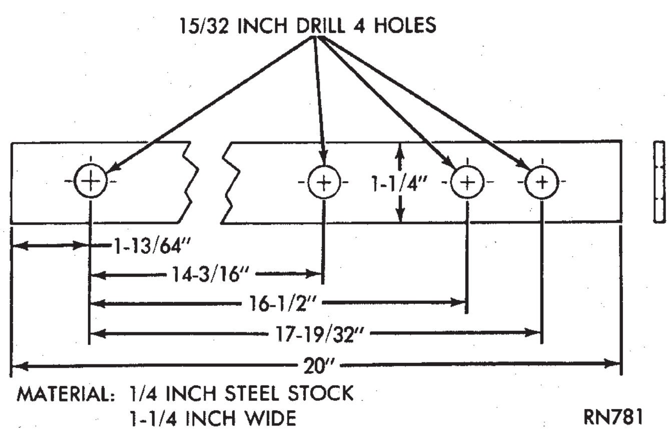

Fig. 11 Seal Cup Retaining Strap

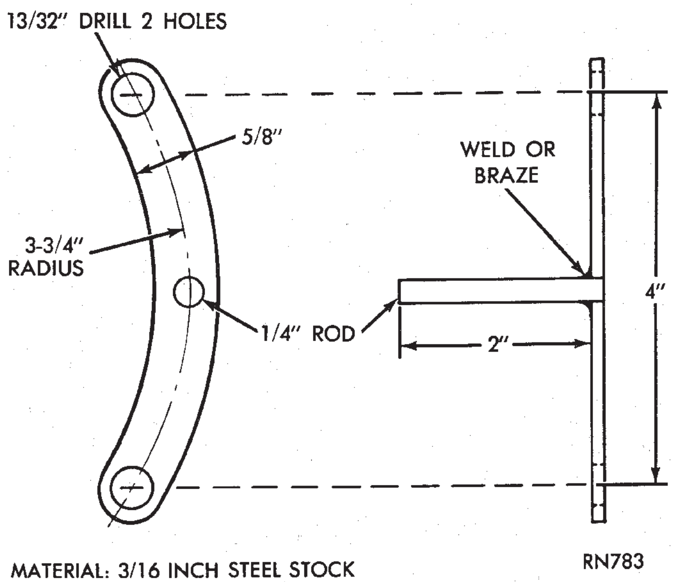

Fig. 12 Pump Vent Plug

AIR PRESSURE LEAK TEST PROCEDURE

(1) Install vent plug, converter hub seal cup and cup retaining strap (Fig. 13).

CAUTION: Be sure the surfaces of the hub seal cup are smooth and free of nicks, scratches, or burrs. Surface irregularities on the cup will damage the pump seal if not removed. Sand and/polish the cup with 400 grit sandpaper or crocus cloth to smooth the surface if necessary.

(2) Close off remaining transmission openings with rubber plugs, or stoppers or similar devices. **Do not close off rear cooler line fitting. Hand operated air pump will be attached to this fitting.**

(3) Attach Air Pump 7700 to rear cooler line fitting. Connect a length of copper tube to fitting. Then attach pump hose to tube with hose clamp (Fig. 14).

(4) Apply a 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 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.

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove converter.

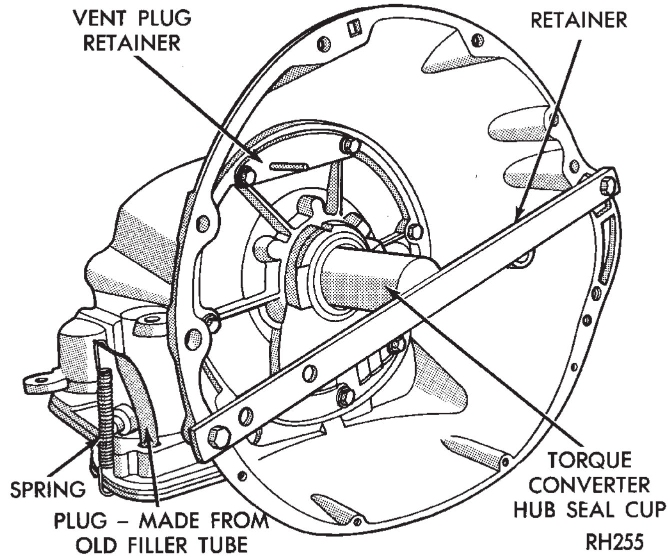

Fig. 13 Vent Plug And Hub Seal Cup Installation

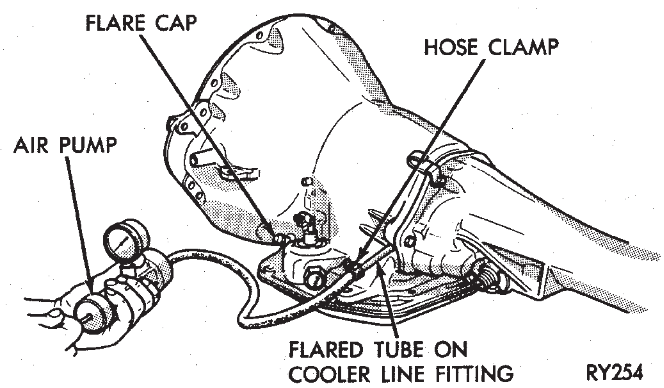

Fig. 14 Typical Method Of Pressurizing Transmission

(2) Tighten front band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out when oil pump is removed.

(3) Remove oil pump and remove pump seal. Inspect pump housing drainback and vent holes for obstructions. Clear holes with solvent and wire.

(4) Inspect pump bushing and converter hub. If bushing is scored, replace it. If converter hub is scored, either polish it with crocus cloth or replace converter 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 access plug three 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.

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(9) Install transmission and converter housing dust shield.

(10) Lower vehicle.

DIAGNOSIS AND HYDRAULIC FLOW CHARTS

The diagnosis charts provide additional reference when diagnosing a transmission fault. The charts provide general information on a variety of transmission, overdrive unit and torque converter clutch fault conditions.

The hydraulic flow charts outline fluid flow and hydraulic circuitry. Circuit flow is outlined for all gear ranges including park and neutral. Circuit flow for converter clutch application in fourth gear is also provided.

TRANSMISSION CONTROL MODULE (TCM) SERVICE

TCM Diagnosis

Use the DRB II scan tool to diagnose TCM function whenever a fault is suspected. Replace the module only when scan tool diagnosis indicates a fault has actually occurred.

TCM Location

The TCM is located on the driver side of the dash adjacent to the steering column. The module and harness connector are accessible from under the instrument panel (Fig. 15).

TCM Mounting

The module has integral mounting studs for attachment to the dash panel. A retaining plate and two locknuts secure the module to the dash (Fig. 15). Although the module is inside the vehicle, the retaining plate and locknuts are on the engine compartment side of the dash panel.

TCM Removal

(1) In engine compartment, remove module locknuts and remove module retaining plate. **Locknuts and retaining plate are on driver side of engine compartment near brake booster.**

(2) In vehicle interior, reach up under instrument panel and slide module out of dash.

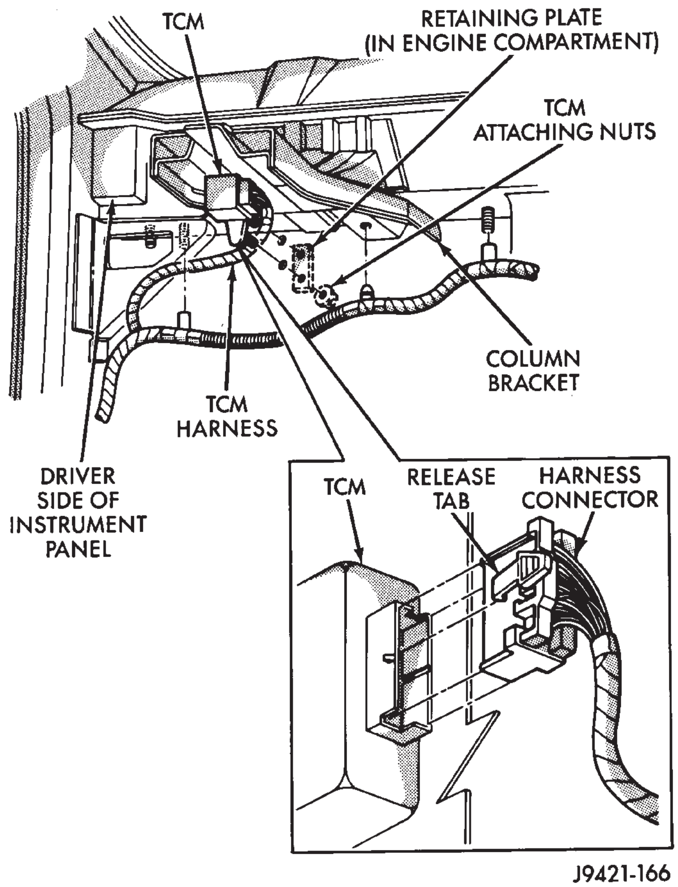

Fig. 15 TCM Location And Mounting (42RE)

(3) Work module downward until module harness connector is accessible.

(4) Lift release tab on harness connector (Fig. 15). Pull connector out of module and remove module from vehicle.

TCM Installation

(1) Carefully align and plug harness connector into module. Verify that connector is fully seated before proceeding.

(2) Work module upward into position on dash. Then slide module studs into mounting holes in dash.

(3) In engine compartment, install retaining plate on module studs. Then install and tighten locknuts to 14-16 N·m (129-144 in. lbs.) torque.

TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
HARSH ENGAGEMENT (FROM NEUTRAL TO DRIVE OR NEUTRAL TO REVERSE)	1. Engine idle speed too high	1. Check/adjust idle speed
	2. Driver "riding" accelerator pedal during shift	2. Advise owner/operator
	3. Throttle cable misadjusted or binding (reverse only)	3. Adjust cable setting
	4. Band adjustment needed	4. Adjust rear band
	5. Loose mounting bolts	5. Check engine, transmission, propeller shaft, crossmember, and axle bolt torque; tighten loose bolts and replace missing bolts
	6. Worn or damaged U-joints	6. Remove propeller shaft and replace U-joints
	7. Loose axle pinion nut	7. Replace nut and check pinion threads before installing new nut; replace pinion gear if threads are damaged
	8. Hydraulic pressure is incorrect	8. Check pressures; remove, overhaul, or adjust valve body as needed; repair oil pump if necessary
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	9. Engine/transmission mounts worn or damaged	9. Replace as necessary
	10. Faulty converter lockup clutch (if equipped)	10. Replace converter and flush cooler and lines before installing new converter
	11. Clutch, band, or planetary component is damaged	11. Remove, disassemble, and repair transmission as necessary
DELAYED ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Engine idle speed too low	1. Adjust idle speed
	2. Low fluid level	2. Correct level and check for leaks
	3. Gearshift linkage out of adjustment	3. Adjust linkage and repair linkage if worn or damaged
	4. Rear band out of adjustment	4. Adjust band
	5. Valve body filter plugged	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. Oil pump gears worn or damaged or pump body or seal is damaged, allowing pump to take in air, causing fluid aeration	6. Remove transmission and replace oil pump
	7. Reaction shaft seal rings worn or broken	7. Remove transmission, remove oil pump, and replace seal rings
	8. Governor pressure solenoid valve or electrical circuit fault	8. Check electrical functions with DRB scan tool or flash codes and repair as necessary
	9. Low hydraulic pressure	9. Perform pressure test, remove transmission, and repair as needed
	10. Clutch, band, or servo damaged	10. Remove and disassemble transmission and repair as necessary
	11. Torque converter drain down after several days out of service	11. No repair required

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TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
SHIFTS DELAYED OR ERRATIC (SHIFTS ALSO HARSH AT TIMES)	1. Low fluid level 2. Throttle cable out of adjustment 3. Throttle cable 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) 9. Accumulator springs/seals worn or damaged 10. Governor pressure control system fault	1. Correct fluid level and check for leaks 2. Adjust cable as described in service section 3. Adjust cable, replace if worn. or damaged 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 9. Inspect/replace as required 10. Check with DRB II scan tool or flash codes and repair as necessary
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 5. Overdrive unit direct 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 worm or damaged 4. Remove and disassemble transmission; replace worn, damaged servo and clutch parts as necessary 5. Remove and disassemble overdrive unit. Repair direct clutch as needed
HAS FIRST-REVERSE ONLY (NO 1-2 OR 2-3 UPSHIFT)	1. Governor component fault 2. Front servo problem	1. Test electrical components with DRB II scan tool or flash codes and repair as needed 2. Pressure check and repair as needed

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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

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TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
MOVES IN 2ND OR 3RD GEAR, ABRUPTLY DOWNSHIFTS TO LOW	1. Governor circuit fault 2. Valve body malfunction	1. Test governor components with DRB II scan tool 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. Transmission overrunning clutch faulty, not holding	1. Replace overrunning clutch
SLIPS 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 linkage or throttle cable out of adjustment 4. Low hydraulic pressure due to worn pump, incorrect control pressure adjustment, 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 as needed 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 8. Overdrive unit direct clutch slipping	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 8. Remove and disassemble overdrive unit. Repair clutch as needed

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TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
NO KICKDOWN OR NORMAL DOWNSHIFT	1. Incorrect throttle cable adjustment 2. Incorrect gear shift linkage adjustment 3. Front band out of adjustment 4. Hydraulic pressure too high or too low due to valve body malfunction, or incorrect hydraulic control pressure adjustment 5. Front servo, band, or linkage malfunction 6. Clutch or servo malfunction 7. Governor fault 8. TPS fault	1. Adjust cable 2. Adjust linkage 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 7. Check with DRB II scan tool or flash codes and repair as needed 8. Check for TPS fault at transmission control module with DRB II scan tool or flash codes
STUCK IN LOW GEAR (WILL NOT UPSHIFT)	1. Gearshift linkage or throttle cable out of adjustment. 2. Front band out of adjustment 3. Governor component fault, loose output shaft support, 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 and repair linkage or cable if worn or damaged 2. Adjust band 3. Check operating pressures, and test governor component with DRB II scan tool or flash codes. Repair as needed 4. Air pressure check operation of clutches and bands; repair faulty component
NO LOW GEAR (MOVES IN 2ND OR 3RD GEAR ONLY)	1. Governor circuit fault 2. Valve body malfunction 3. Front servo piston cocked in bore 4. Front band linkage malfunction 5. Incorrect throttle or gearshift linkage adjustment	1. Test governor components with DRB II scan tool 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

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TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
CREEPS IN NEUTRAL	1. Gearshift linkage out of adjustment 2. Valve body malfunction (warped body, cross leakage, loose screws) 3. 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
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. 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. 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

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TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
OIL COMES OUT FILLER TUBE	1. Transmission overfilled	1. Drive 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 of servo in reverse (will register low or fluctuate rapidly). Repair/replace servo piston and seal. Replace case if servo bore is damaged
	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-rign 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

J9321-339

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

TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
NO START IN PARK OR NEUTRAL	1. Gearshift linkage out of adjustment 2. Park/neutral position switch wire broken or open 3. Faulty park/neutral position 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 linkage or throttle cable out of adjustment 3. Transmission clutches slipping 4. Overrunning clutch in converter stator not holding 5. Converter stator overrunning clutch seized	1. Check engine and repair as required 2. Adjust as needed 3. Perform stall test and repair as required 4. Perform stall test and replace converter if clutch has failed 5. Replace converter as assembly
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 clutch	1. If contamination is severe, cooler flushing, converter replacement, and another overhaul may be necessary; particularly if shift problems were also present.
	2. Incorrect fluid used in transmission	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. Main cooler in radiator is cracked, allowing engine coolant to enter transmission	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. 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)	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 two vehicle, the only option is for the owner to move up to properly-equipped and load-rated tow vehicle

J9321-340

OVERDRIVE DIAGNOSIS

Condition	Possible Cause	Correction
NO 3-4 UPSHIFT	1. Fourth gear overdrive switch (in dash) in OFF position	1. Turn control switch to ON position
	3. Fourth gear overdrive switch shorted, open, wires loose	3. Replace switch if shorted or open and repair loose or damaged wires
	4. Overdrive solenoid or circuit wire loose, shorted, open	4. Check wires/connections with 12V test lamp and voltmeter; repair damaged or loose wires/connections as necessary
	5. Solenoid feed orifice in valve body is blocked or blown out	5. Remove, disassemble, clean valve body thoroughly
	6. Fourth gear overdrive solenoid failure	6. Verify solenoid failure with test lamp and replace solenoid
	7. Sensor or fluid temperature thermister fault	7. Test with DRB II scan tool or ohmmeter. Replace sensor or thermister as needed
	8. Overdrive piston seal failure	8. Replace both seals
	9. Wrong overdrive piston spacer	9. Remove unit, check end play, and install correct spacer
	10. Low hydraulic pressure	10. Pressure test transmission to determine cause
	11. Transmission fluid overheat (over 260 °F)	11. See overheat information in transmission diagnosis charts
SLIPS IN OVERDRIVE FOURTH GEAR	1. Low fluid level	1. Add fluid and check for leaks
	2. Overdrive piston or seal malfunction	2. Remove overdrive unit; replace piston seals if worn; replace piston if damaged; if piston retainer is damaged, it will be necessary to remove and disassemble the transmission
	3. Overdrive clutch pack worn	3. Remove overdrive unit and rebuild clutch pack
	4. 3-4 shift valve, timing valve, or accumulator malfunction	4. Remove and overhaul valve body. Replace accumulator seals. Make sure all valves operate freely in bores and do not bind or stick. Make sure valve body screws are correctly tightened and separator plates are properly positioned.
	5. Overdrive piston retainer bleed orifice blown out	5. Disassemble transmission, remove retainer, and replace orifice
	6. Overdrive unit thrust bearing failure	6. Disassemble overdrive unit and replace thrust bearing (No. 1 thrust bearing is between overdrive piston and clutch hub; No. 2 thrust bearing is between the planetary gear and the direct clutch spring plate; No. 3 thrust bearing is between overrunning clutch hub and output shaft)

J9321-341

OVERDRIVE DIAGNOSIS

Condition	Possible Cause	Correction
DELAYED 3-4 UPSHIFT (SLOW TO ENGAGE)	1. Low fluid level 2. Overdrive solenoid or wiring is faulty 3. Overdrive piston spacer too thin 4. Overdrive clutch pack worn 5. T.P.S. faulty 6. Overdrive clutch bleed orifice in retainer plugged or blown out	1. Add fluid and check for leaks 2. Test solenoid and check wiring for loose/corroded connections, or shorts/ground; replace solenoid if faulty and repair wiring if necessary 3. Remove unit; measure end play and select proper spacer 4. Remove unit and rebuild clutch pack 5. Replace T.P.S. 6. Disassemble transmission and replace orifice
3-4 UPSHIFT OCCURS BEFORE COMPLETION OF 2-3 UPSHIFT	1. Overdrive solenoid connector or wiring problem 2. Overdrive solenoid malfunction 3. Coolant temperature or T.P.S. malfunction 4. Valve body malfunction 5. Transmission control module malfunction	1. Test connector and wiring for loose connections, shorts, or ground, and repair as needed 2. Replace solenoid 3. Test sensor at TCM with DRB II scan tool and replace as necessary 4. Remove, disassemble, clean, and inspect valve body components; make sure all valves and plugs slide freely in bores; polish valves with crocus cloth if needed 5. Test module with DRB II scan tool and replace if faulty

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OVERDRIVE DIAGNOSIS

Condition	Possible Cause	Correction
NO 4-3 DOWNSHIFT	1. Circuit wiring and/or connectors shorted 2. Converter clutch solenoid not venting 3. Overdrive solenoid not venting 4. 3-4 shift or accumulator malfunction 5. Transmission control module malfunction 6. T.P.S. malfunction	1. Test wiring and connectors with test lamp and volt/ohmmeter; repair wiring as necessary; replace connectors and/or harness as required 2. Remove valve body and replace solenoid if seized or shorted 3. Remove valve body and replace solenoid if seized or shorted 4. Remove valve body; remove and disassemble lower housing and 3-4 accumulator housing; replace seals and clean valves as necessary; be sure all valves slide freely in bores 5. Check operation with DRB II scan tool, replace module only if faulty 6. Check operation with DRB II scan tool. Replace TPS only if faulty
NO 4-3 DOWNSHIFT WHEN CONTROL SWITCH IS TURNED OFF (OVERDRIVE OFF AND LAMP IS ILLUMINATED)	1. Overdrive solenoid wiring or connectors faulty 2. Overdrive or lockup solenoid not venting 3. Transmission control module	1. Check solenoid wiring and connections for shorts/grounds; repair as necessary 2. Test solenoids and replace if seized or shorted 3. Test with DRB II scan tool, replace controller if faulty
NO 4-3 DOWNSHIFT WHEN OVERDRIVE OFF SWITCH IS TURNED OFF (OVERDRIVE OFF AND LAMP NOT ILLUMINATED)	1. Overdrive off switch (in dash) open, shorted, or wiring is open, or shorted	1. Test switch function with DRB II scan tool connected to TCM. Replace switch or repair wiring as necessary

J9321-343

OVERDRIVE DIAGNOSIS

Condition	Possible Cause	Correction
HARSH 1-2, 2-3, OR 3-2 SHIFTS. MAY STALL WHEN GEAR SHIFT LEVER IS PLACED IN D POSITION ONLY	1. Converter clutch solenoid failure	1. Remove valve body and replace solenoid
TORQUE CONVERTER CLUTCH ENGAGES IN SECOND AND/OR THIRD GEAR	1. Converter clutch solenoid or wiring problem	1. Test solenoid and wiring for continuity, shorts, or grounds; replace solenoid and relay if faulty; repair wiring and connectors as necessary
NOISY OPERATION IN FOURTH GEAR ONLY	1. Overdrive clutch discs, plates, or snap rings damaged 2. Overdrive piston or planetary thrust bearing brinnelled, installed wrong, or damaged 3. Output shaft bearings brinnelled, scored, damaged 4. Planetary gears worn, chipped, damaged 5. Overdrive unit overrunning clutch rollers rough, scored, or output bushings are worn	1. Remove unit and rebuild clutch pack 2. Remove and disassemble unit; replace either thrust bearing if damaged 3. Remove and disassemble unit; replace either bearing if damaged 4. Remove and overhaul overdrive unit 5. Remove and overhaul overdrive unit

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OVERDRIVE DIAGNOSIS

Condition	Possible Cause	Correction
NO REVERSE (OR SLIPS IN REVERSE)	1. Direct clutch spring collapsed or broken 2. Direct clutch pack worn 3. Rear band out of adjustment 4. Front clutch malfunction 5. Overdrive thrust bearing failure	1. Remove and disassemble unit; check clutch pack and replace spring 2. Disassemble unit and rebuild clutch pack 3. Adjust band 4. Air pressure test clutch operation; remove and rebuild if necessary 5. Disassemble geartrain and replace bearings
NO 1-2 OR 2-3 UPSHIFT (HAS LOW AND REVERSE ONLY)	1. Governor fault	1. Test governor components with DRB II scan tool and repair as needed

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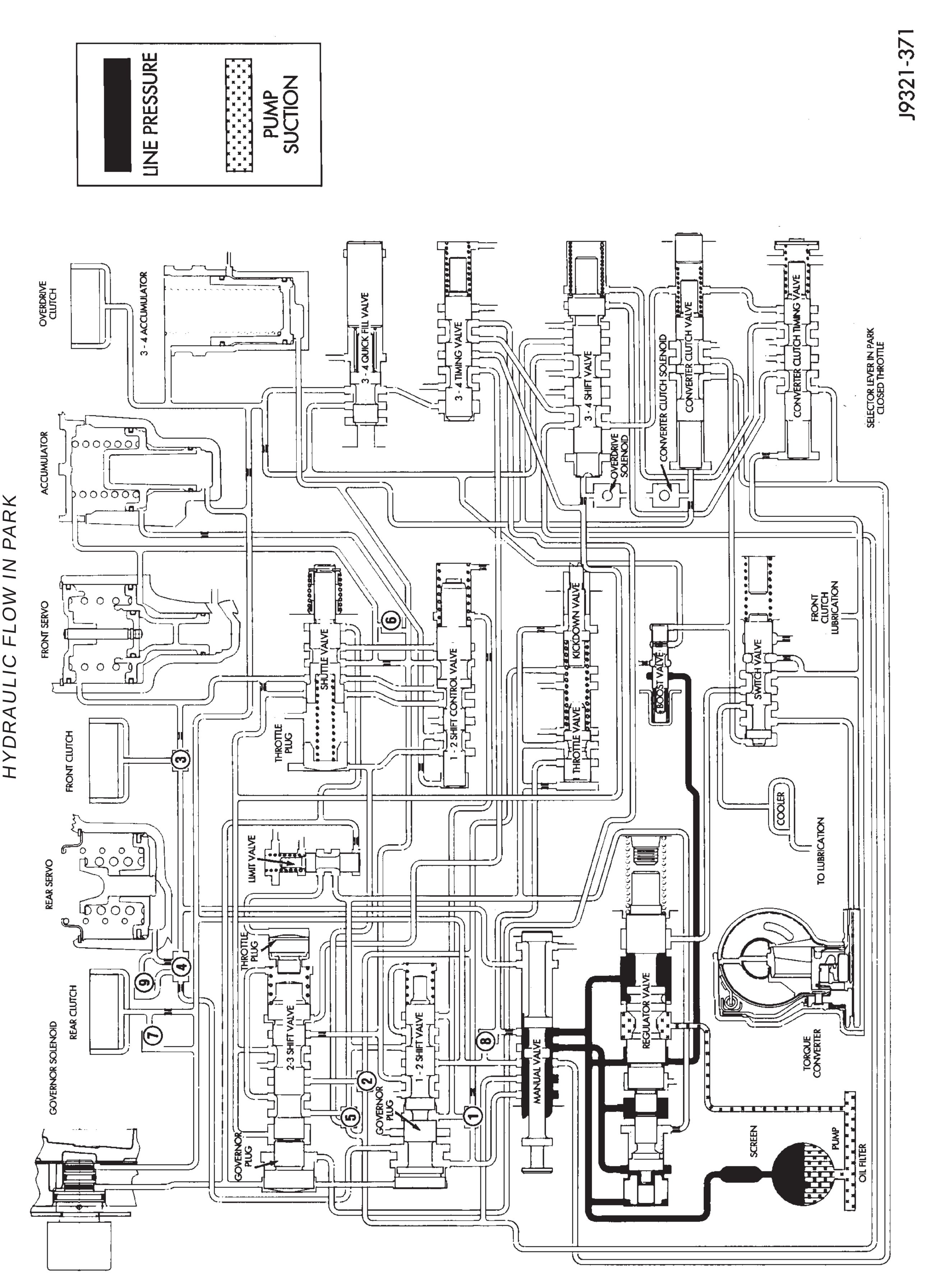
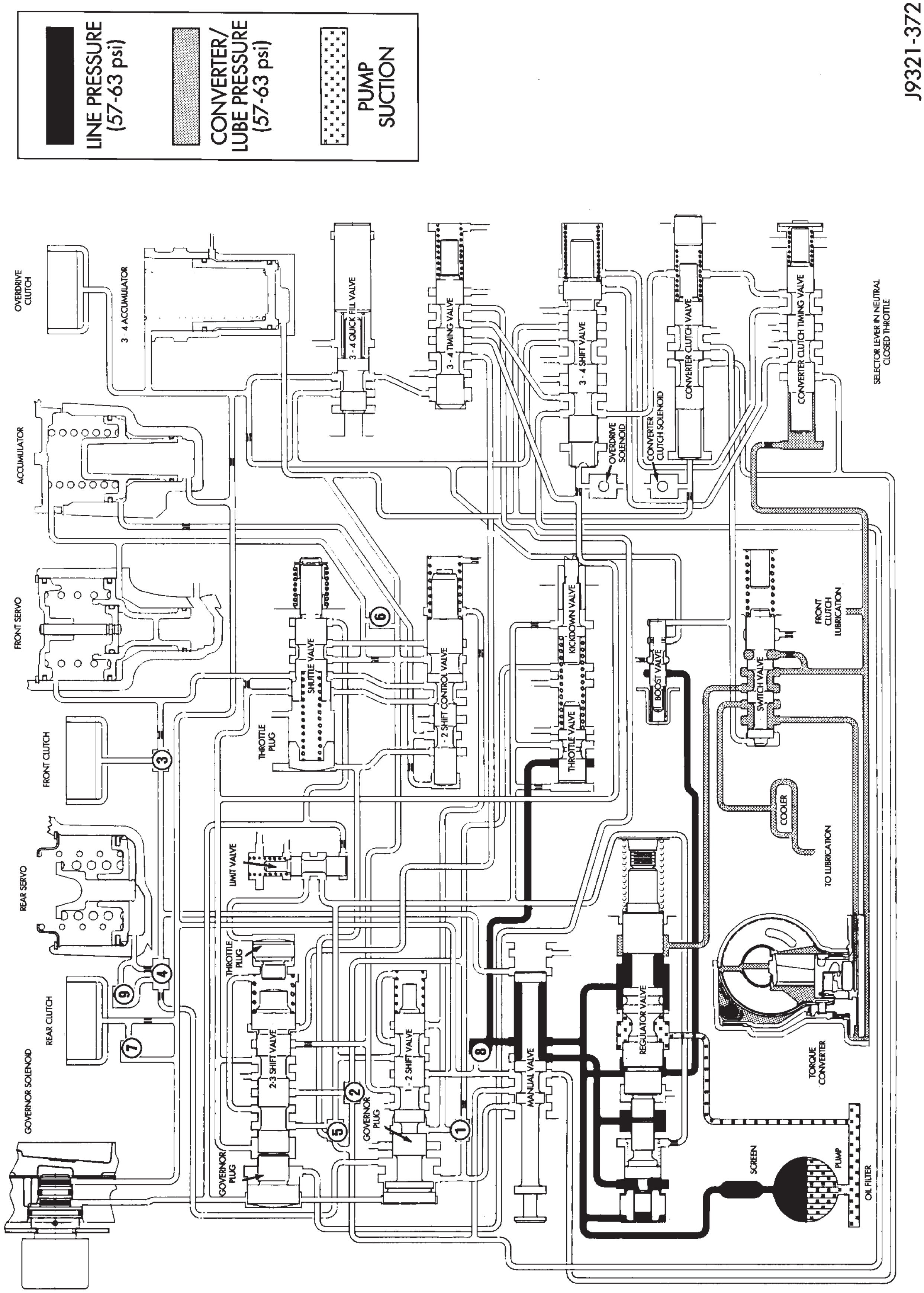
TORQUE CONVERTER CLUTCH DIAGNOSIS

POSSIBLE CAUSE / CONDITION	CONVERTER CLUTCH WILL NOT ENGAGE	CLUTCH WILL NOT DISENGAGE	STAYS ENGAGED AT TOO LOW A SPEED IN 4th GEAR	LOCKS UP OR DRAGS IN LOW OR SECOND	STALLS OR IS SLUGGISH IN REVERSE	CHATTER DURING CLUTCH ENGAGEMENT–(COLD)	VIBRATION OR SHUDDER DURING CLUTCH ENGAGEMENT	VIBRATION AFTER CLUTCH ENGAGEMENT	VIBRATION WHEN "REVVED" IN NEUTRAL	OVERHEATING: OIL COMING OUT OF FILL TUBE OR PUMP SEAL	SHUDDER AFTER CLUTCH ENGAGEMENT
FAULTY OIL PUMP	X			X	X		X				X
STICKING GOVERNOR VALVE	X	X	X								
PLUGGED COOLER, LINES OR FITTINGS					X					X	X
VALVE BODY MALFUNCTION	X	X	X	X	X		X				X
STUCK SWITCH VALVE	X	X	X	X	X					X	
STUCK CONVERTER CLUTCH VALVE	X	X	X								
STUCK CONVERTER CLUTCH SOLENOID	X		X								
SOLENOID WIRING DISCONNECTED	X										
FAILED CONVERTER CLUTCH SOLENOID	X										
FAILED CONVERTER CLUTCH RELAY	X		X								
FAULTY TORQUE CONVERTER:	X					X	X	X			X
OUT OF BALANCE									X		
FAILED CONVERTER CLUTCH	X					X					X
LEAKING TURBINE HUB SEAL	X					X					
ALIGN EXHAUST SYSTEM								X			X
TUNE ENGINE							X	X			X
FAULTY INPUT SHAFT OR SEAL RING	X				X						
THROTTLE CABLE MISADJUSTED								X			X

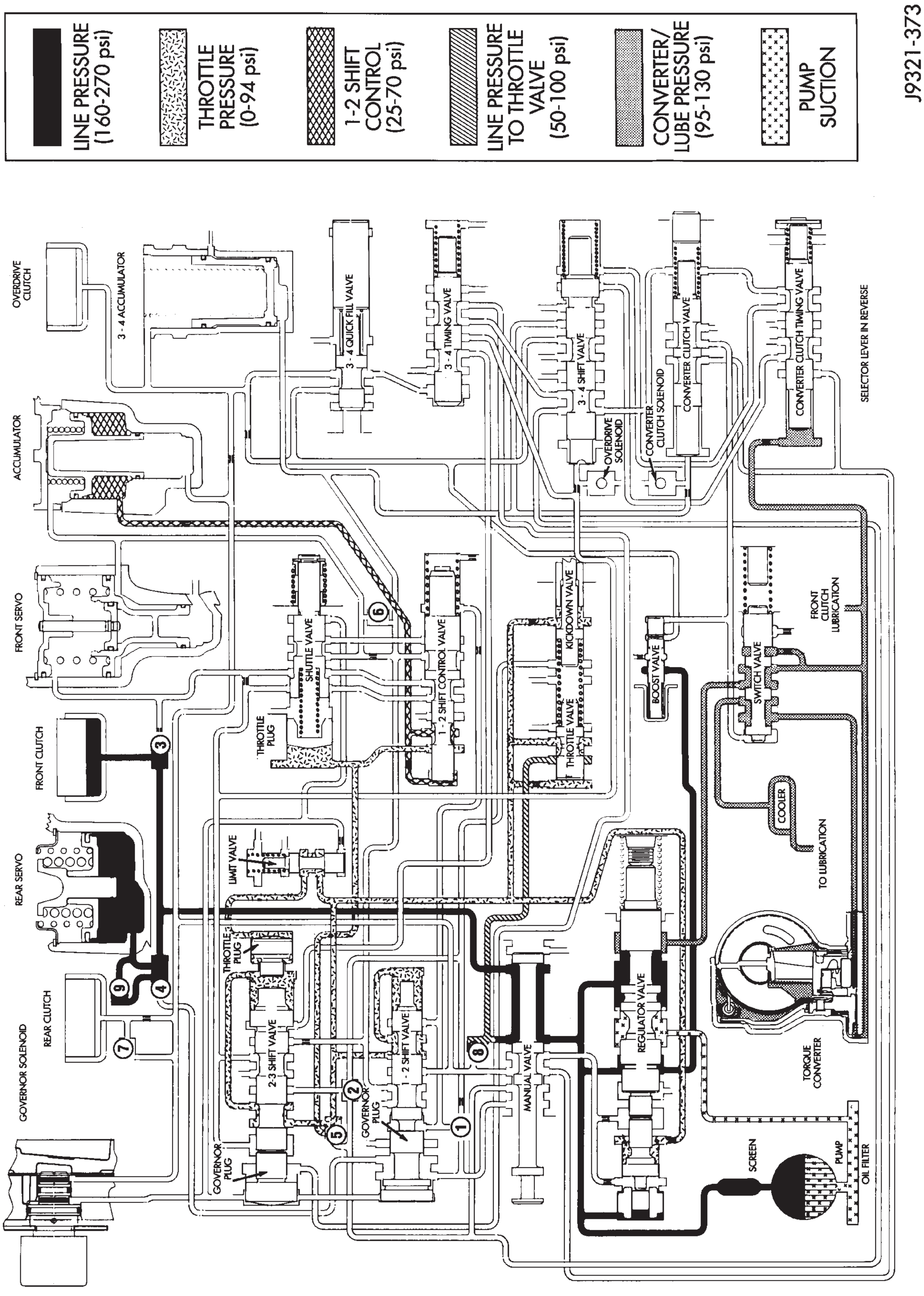
J9321-206


HYDRAULIC FLOW IN PARK
LINE PRESSURE
PUMP SUCTION
J9321-371
OVERDRIVE CLUTCH
3 - 4 ACCUMULATOR
ACCUMULATOR
FRONT SERVO
FRONT CLUTCH
REAR SERVO
REAR CLUTCH
GOVERNOR SOLENOID
3 - 4 QUICK FILL VALVE
3 - 4 TIMING VALVE
3 - 4 SHIFT VALVE
OVERDRIVE SOLENOID
CONVERTER CLUTCH SOLENOID
CONVERTER CLUTCH VALVE
CONVERTER CLUTCH TIMING VALVE
SELECTOR LEVER IN PARK CLOSED THROTTLE
SHUTTLE VALVE
THROTTLE PLUG
1 - 2 SHIFT CONTROL VALVE
KICKDOWN VALVE
THROTTLE VALVE
BOOST VALVE
SWITCH VALVE
FRONT CLUTCH LUBRICATION
COOLER
TO LUBRICATION
LIMIT VALVE
THROTTLE PLUG
2-3 SHIFT VALVE
1 - 2 SHIFT VALVE
GOVERNOR PLUG
GOVERNOR PLUG
MANUAL VALVE
REGULATOR VALVE
TORQUE CONVERTER
SCREEN
PUMP
OIL FILTER
1
2
3
4
5
6
7
8
9

HYDRAULIC FLOW IN NEUTRAL



HYDRAULIC FLOW IN REVERSE



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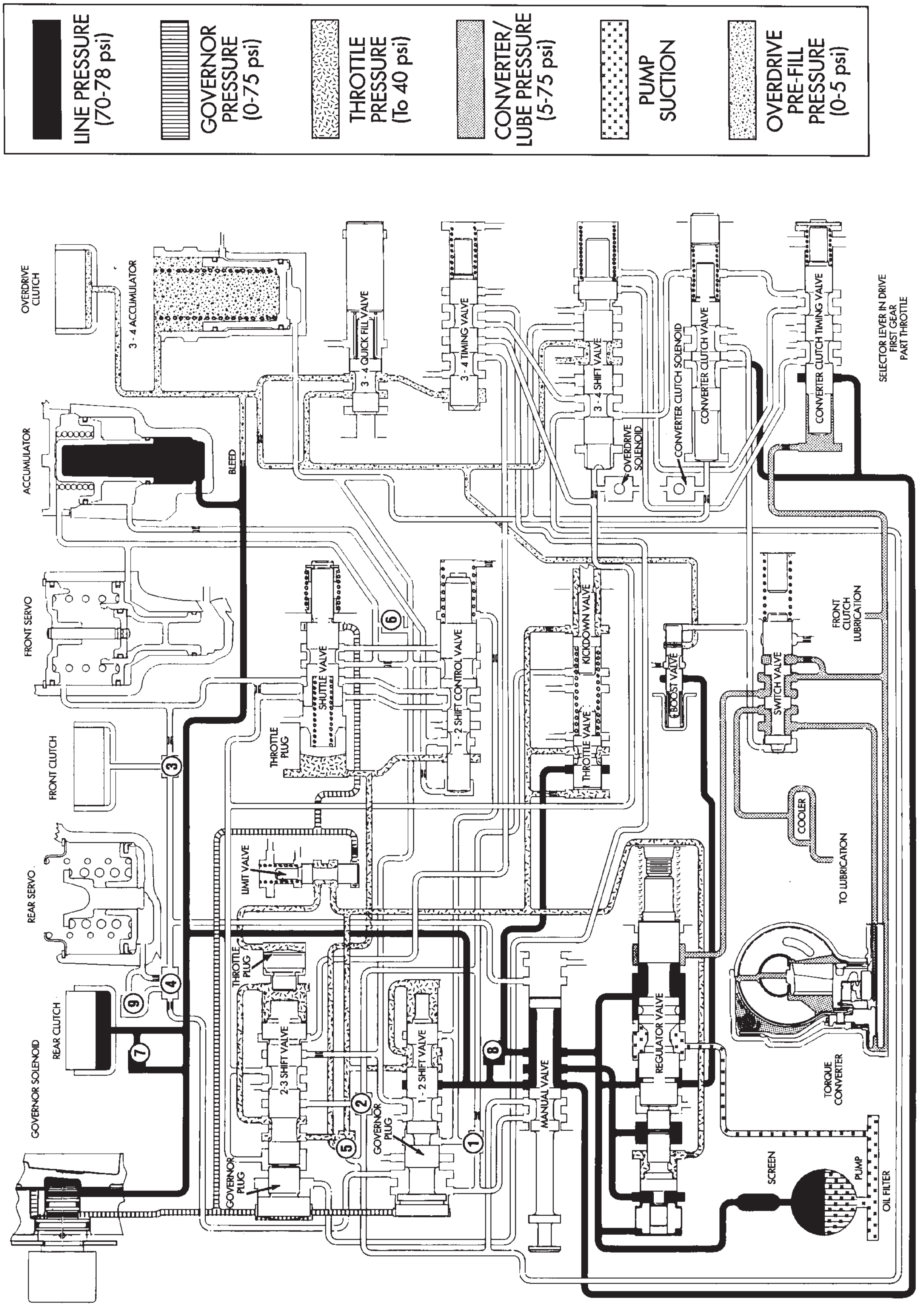
HYDRAULIC FLOW IN DRIVE FIRST GEAR



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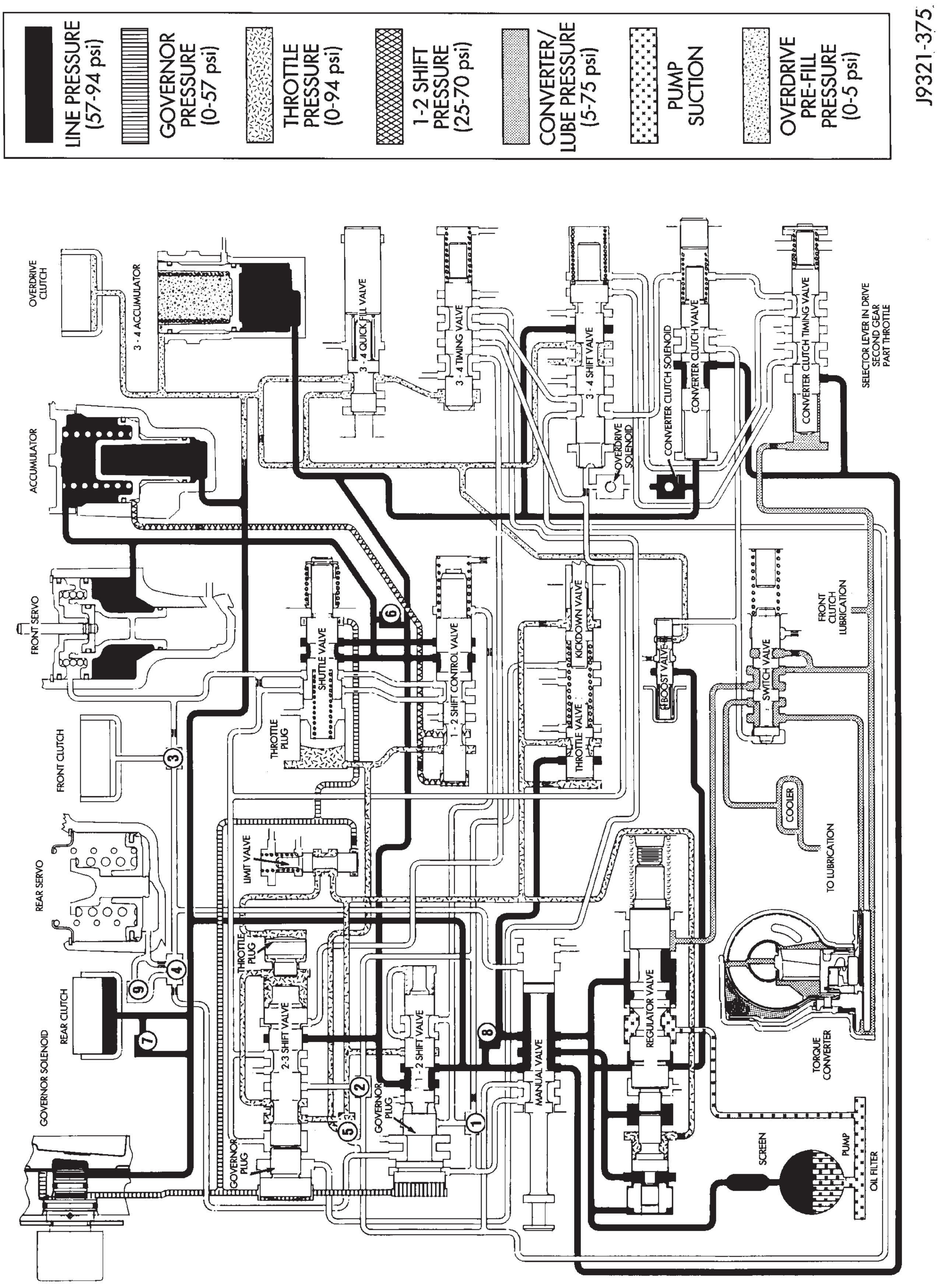
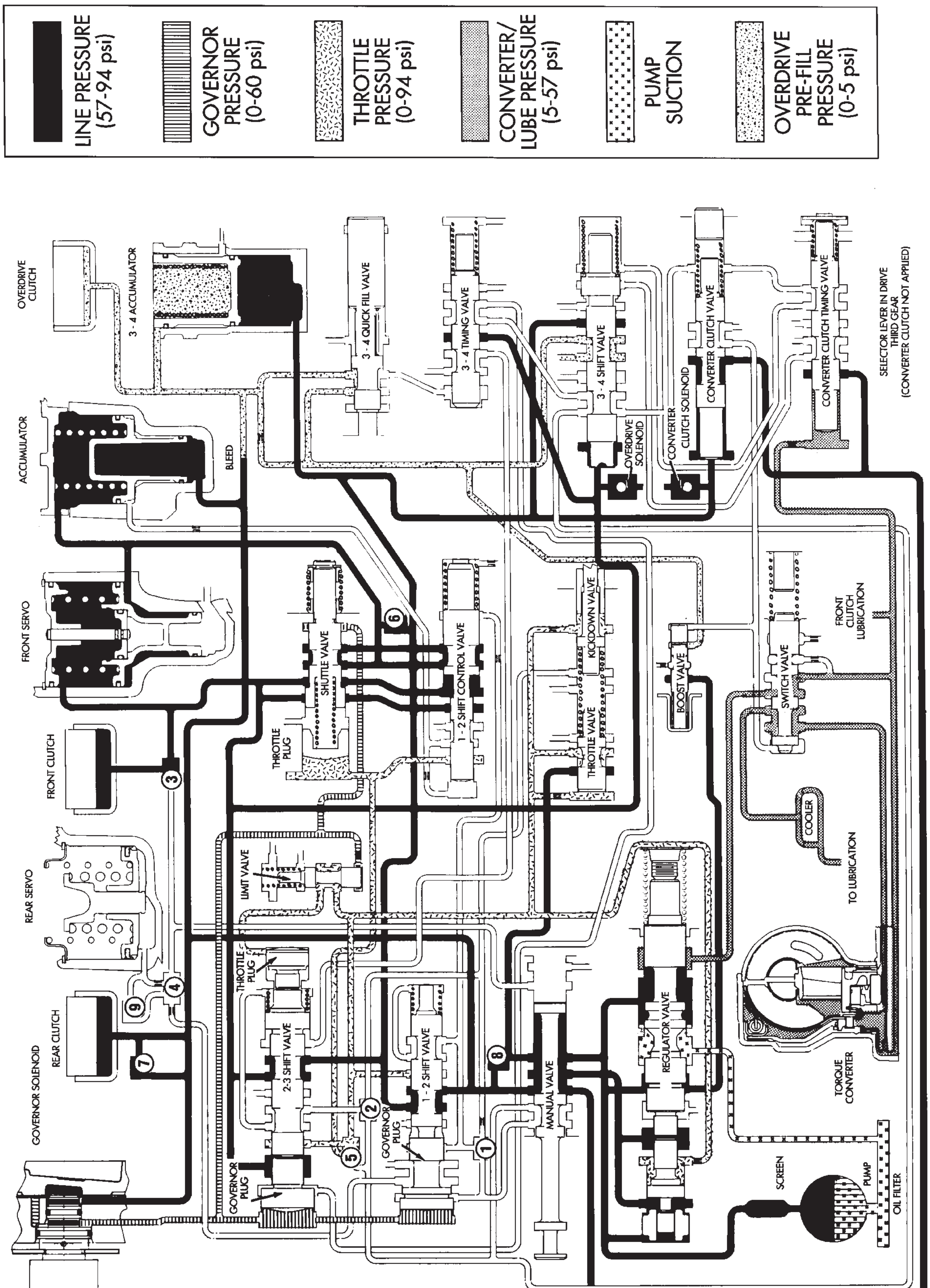
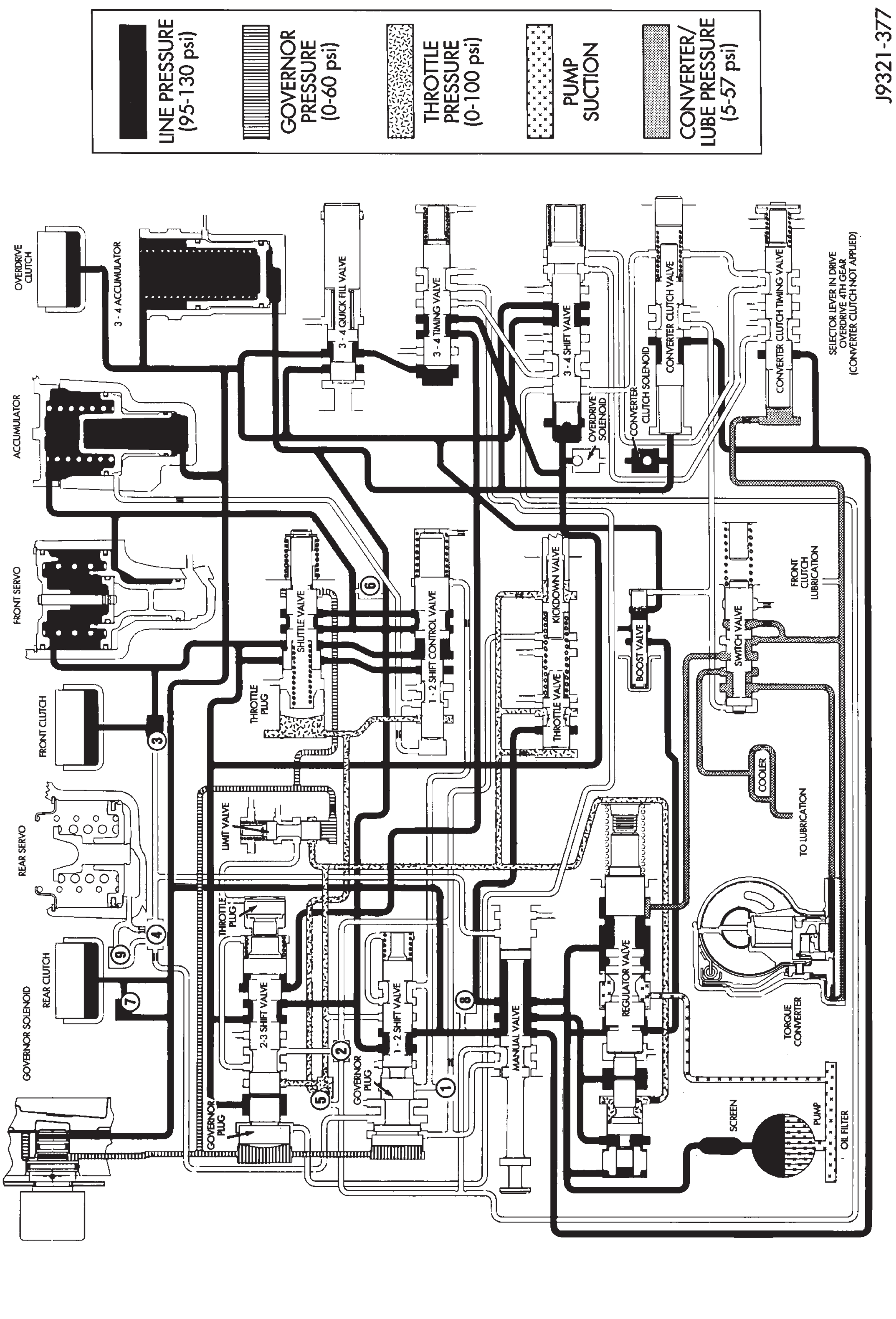
HYDRAULIC FLOW IN DRIVE SECOND GEAR



HYDRAULIC FLOW IN DRIVE THIRD GEAR

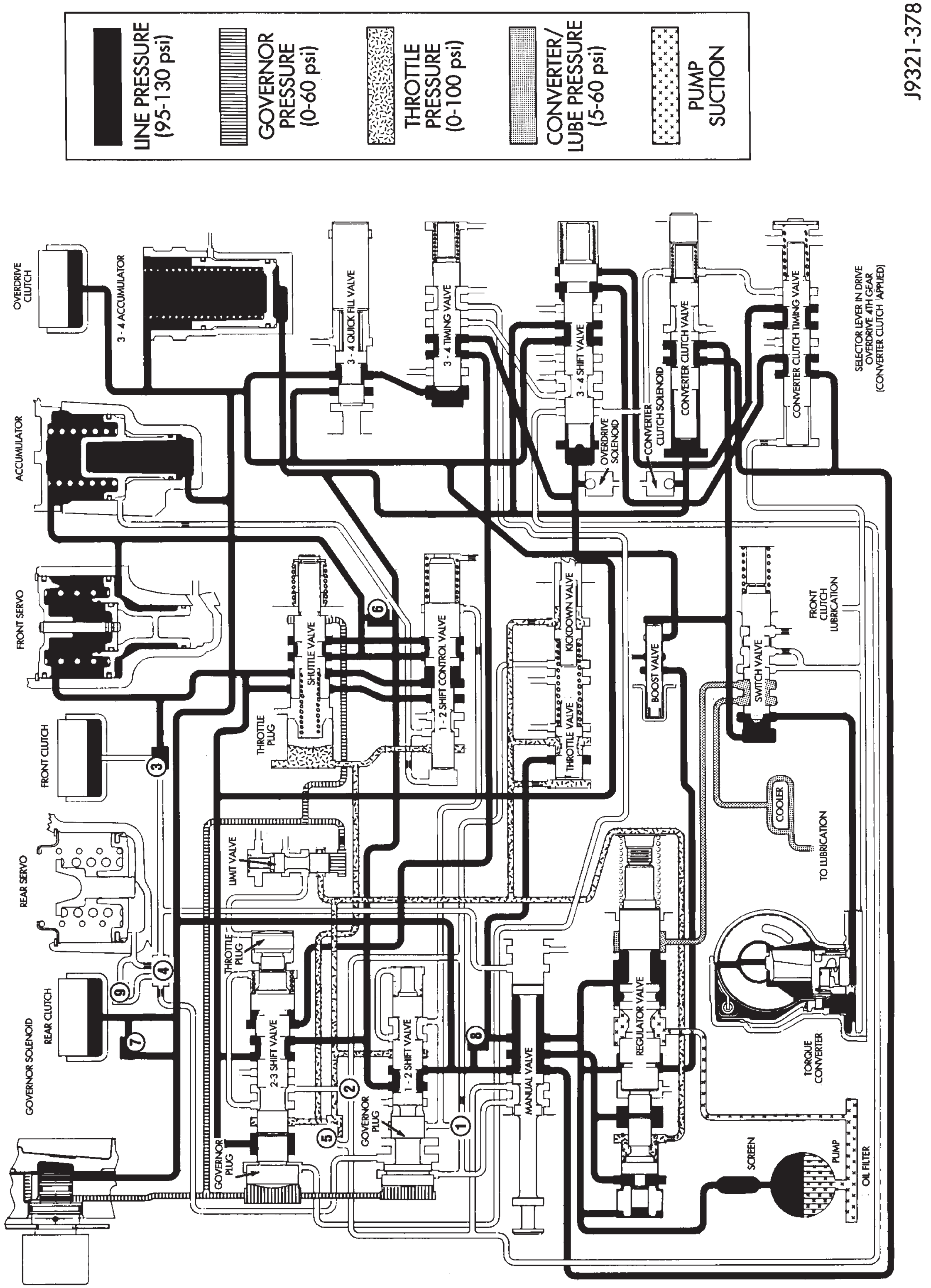


J9321-376

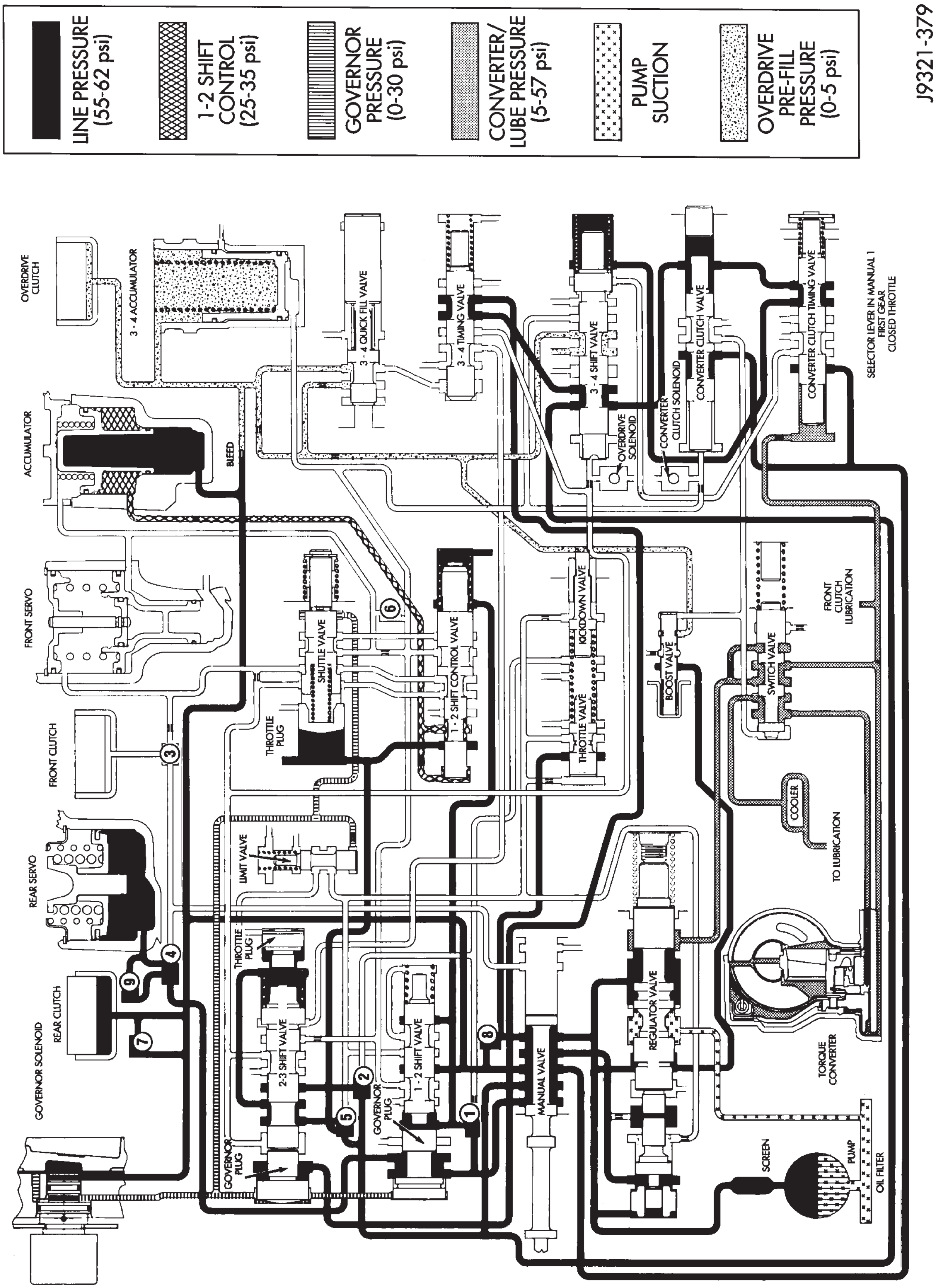


HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH NOT APPLIED)

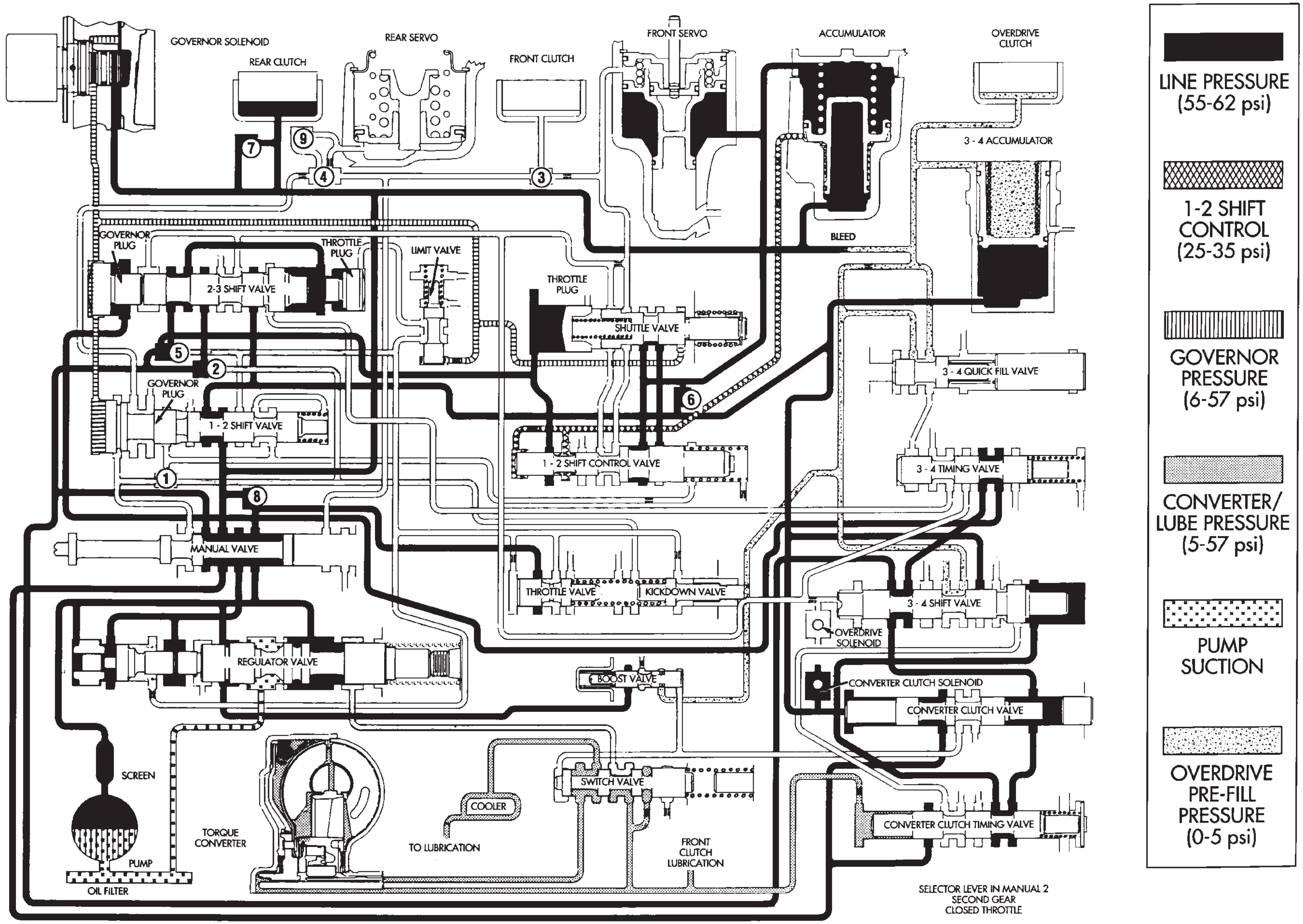
HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH APPLIED)



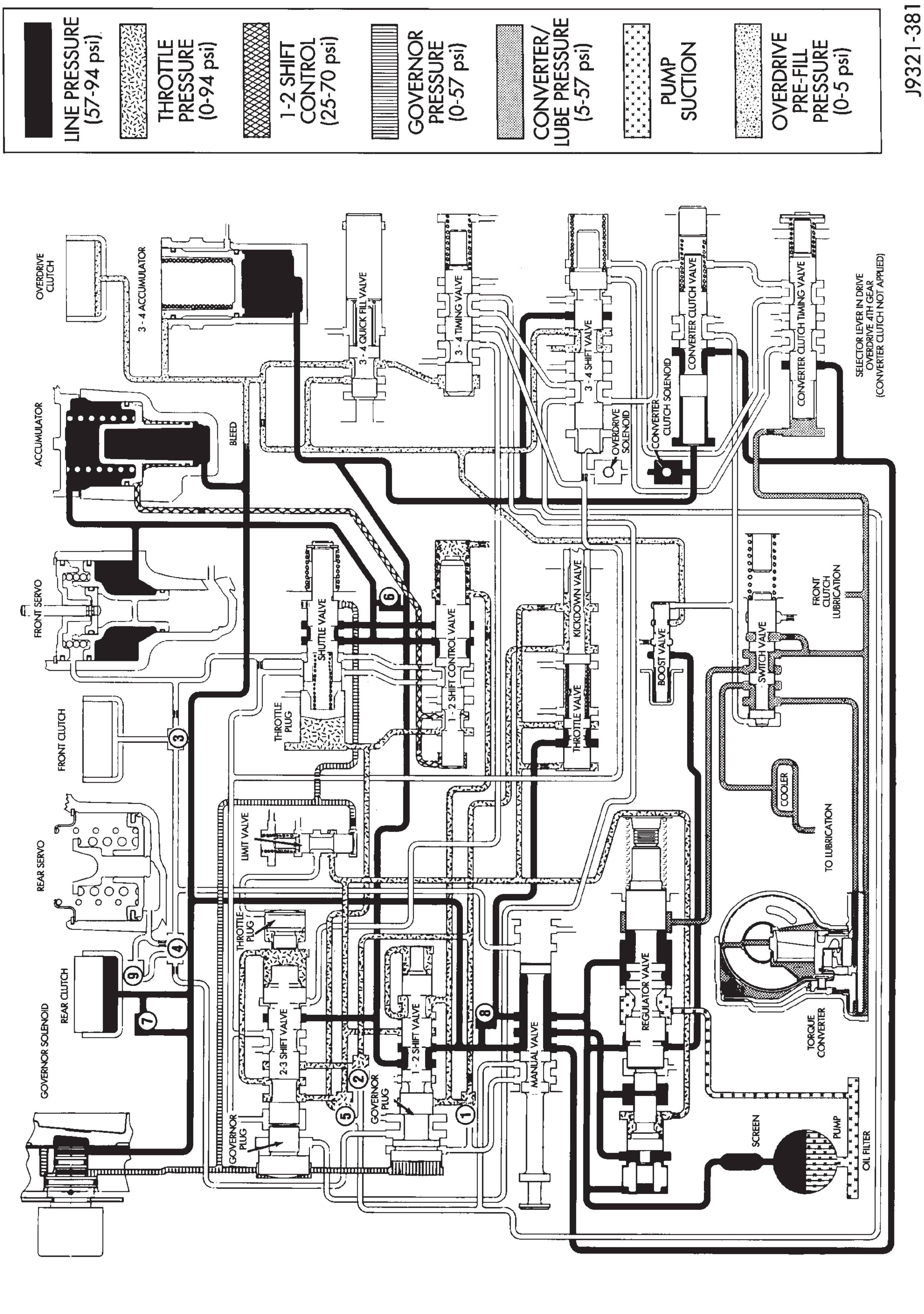
HYDRAULIC FLOW IN MANUAL LOW (1)



HYDRAULIC FLOW IN MANUAL SECOND (2)



J9321-380



HYDRAULIC FLOW DURING FULL THROTTLE 3-2 DOWNSHIFT

J9321-381

IN-VEHICLE SERVICE—42RE

INDEX

PARK LOCK SERVICE

The park lock components are located within the overdrive unit and cannot be serviced in the vehicle. The overdrive unit must be removed and disassembled for access to the park lock components.

Refer to the sections dealing with transmission/overdrive removal, installation and overhaul sections for overdrive unit repair procedures.

OIL PUMP SEAL

The transmission and torque converter must be removed for access to the oil pump seal. Oil pump seal replacement procedures are described in the Transmission Removal/Installation section.

RECOMMENDED FLUID

Recommended fluid for the 42RE is Mopar ATF Plus, type 7176. Mopar Dexron II fluid should only be used when AFT plus is not available.

TRANSMISSION FLUID LEVEL CHECK

Transmission fluid level should be checked a minimum of four times per year under normal operation. If the vehicle is used for trailer towing or similar heavy load hauling, check fluid level **and condition** at least once a week.

Fluid level is checked with the engine running at curb idle speed, the transmission in Neutral and the transmission fluid at normal operating temperature (hot).

The 42RE transmission dipstick is on the driver side of the engine compartment at the rear of the engine. The dipstick handle has the universal symbol for a gear imprinted on it for identification.

FLUID LEVEL CHECK PROCEDURE

(1) Transmission fluid must be at normal operating temperature for accurate fluid level check. Drive vehicle if necessary to bring fluid temperature up to normal hot operating temperature of 82°C (180°F).

(2) Position vehicle on level surface. This is extremely important for accurate fluid level check.

(3) Start and run engine at curb idle speed.

(4) Apply parking brakes.

(5) Shift transmission momentarily into all gear ranges. Then shift transmission back to **Neutral.**

(6) Clean top of filler tube and dipstick to keep dirt from entering tube.

(7) Remove dipstick and check fluid level as follows:

(a) Dipstick has three fluid level indicating marks which are a MIN dot mark, an OK mark and a MAX fill arrow mark:

(b) Correct level is to MAX arrow nark on dipstick. This is correct maximum hot fluid level. Acceptable level is between OK mark and max arrow mark on dipstick.

(c) If level is at, or below MIN level dot on dipstick, add only enough fluid to restore correct level. Mopar ATF Plus, type 7176 is the preferred fluid. Mopar Dexron II should only be used when ATF Plus is not available.

CAUTION: Do not overfill the transmission. Overfilling may cause leakage out the pump vent which can be mistaken for a pump seal leak. Overfilling will also cause fluid aeration and foaming as the excess fluid is picked up and churned by the gear train. This will significantly reduce fluid life.

(8) If transmission is overfilled, fluid can be removed with 1/8 to 3/16 in. diameter tubing and suction gun. Tubing will have to be adapted to nozzle of gun and be long enough to extend down fill tube and into transmission oil pan.

FLUID AND FILTER CHANGE

NORMAL CHANGE INTERVAL

The fluid and filter should be changed (and the bands adjusted) at recommended maintenance intervals, or whenever the transmission has been disassembled for any reason.

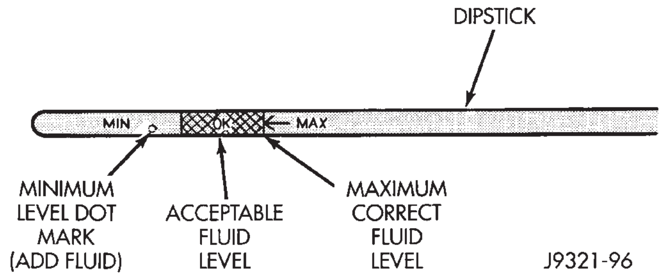


Fig. 1 Typical Dipstick Fluid Level Marks

Refer to the Driveline section in Group O, Lubrication and Maintenance for recommended change intervals. Refer to the fluid/filter replacement and band adjustment procedures in this section.

SEVERE USAGE CHANGE INTERVAL

Under severe usage, the fluid and filter should be changed and the bands adjusted at 12,000 mile (19 000 Km) intervals.

Severe usage is defined as:

(a) More than half of vehicle operation occurs in heavy city traffic during hot weather (above 90° F).

(b) Vehicle is used for taxi, police, limousine, or similar commercial operation.

(c) Vehicle is used for trailer towing or heavy load hauling.

When the factory fluid is drained, refill the transmission with Mopar ATF Plus, type 7176 fluid. Mopar Dexron II should only be used when ATF Plus is not available.

FLUID/FILTER REPLACEMENT PROCEDURE

(1) Raise vehicle.

(2) Remove oil pan and drain fluid.

(3) Clean oil pan and pan magnet. Then clean remaining gasket material from gasket surface of transmission case.

(4) Remove fluid filter screws and remove filter.

(5) Position new filter on valve body and install filter screws. Tighten screws to 4 N●m (35 in. lbs.) torque.

(6) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 150 in. lbs. (17 N●m) torque.

(7) Lower vehicle and refill transmission with Mopar ATF Plus, type 7176 fluid.

TRANSMISSION THROTTLE VALVE CABLE ADJUSTMENT

The transmission throttle valve is operated by a cam on the throttle lever. The throttle lever is operated by an adjustable cable (Fig. 2). The cable is attached to an arm mounted on the throttle lever shaft. A lock button at the engine-end of the cable is provided for cable adjustment.

A correctly adjusted throttle valve cable will cause the throttle lever on the transmission to move simultaneously with the throttle body lever from the idle position. Proper adjustment will allow simultaneous movement without causing the transmission throttle lever to either move ahead of, or lag behind the lever on the throttle body.

CHECKING THROTTLE VALVE CABLE ADJUSTMENT

(1) Turn ignition key to OFF position.

(2) Remove air cleaner.

(3) Verify that lever on throttle body is at curb idle position. Then verify that transmission throttle lever (Fig. 3) is also at idle (fully forward) position.

(4) Slide cable off attachment stud on throttle body lever (Fig. 4).

(5) Compare position of cable end to attachment stud on throttle body lever (Fig. 4):

(a) Cable end and attachment stud should be aligned (or centered on one another) to within 1 mm (0.039 in.) in either direction.

(b) If cable end and attachment stud are misaligned (off center), cable will have to be adjusted as described in Throttle Valve Cable Adjustment procedure.

(6) Reconnect cable end to attachment stud. Then with aid of a helper, observe movement of transmission throttle lever and lever on throttle body.

(a) If both levers move simultaneously from idle to half-throttle and back to idle position, adjustment is correct.

(b) If transmission throttle lever moves ahead of, or lags behind throttle body lever, cable adjustment will be necessary. Or, if throttle body lever prevents transmission lever from returning to closed position, cable adjustment will be necessary.

THROTTLE VALVE CABLE ADJUSTMENT PROCEDURE

(1) Turn ignition switch to OFF position.

(2) Remove air cleaner if necessary.

(3) Disconnect cable end from attachment stud. **Carefully slide cable off stud. Do not pry or pull cable off.**

(4) Verify that transmission throttle lever is in fully closed position. Then be sure lever on throttle body is at curb idle position.

(5) Press cable lock button inward to release cable (Fig. 4). Lock button only has to move about 2 mm (0.070 in.) to release cable in adjuster head.

(6) Center cable end on attachment stud to within 1 mm (0.039 in.) and release lock button.

(7) Check cable adjustment. Be sure transmission throttle lever and lever on throttle body move simultaneously as described in cable adjustment checking procedure.

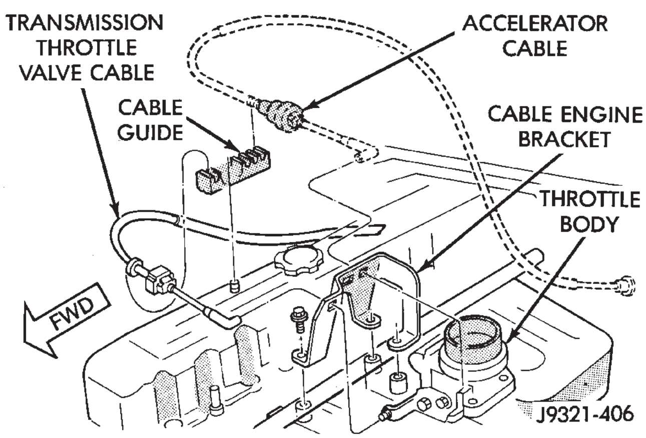


Fig. 2 Throttle Cable Attachment At Engine

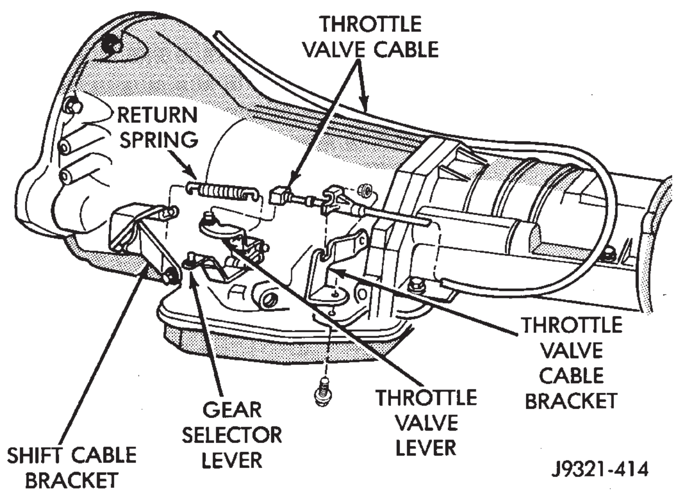


Fig. 3 Throttle Cable Attachment At Transmission

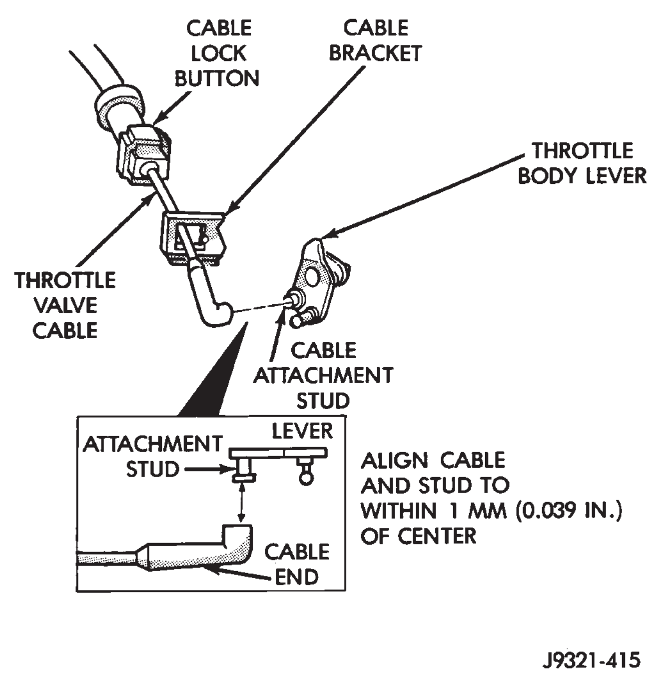


Fig. 4 Throttle Cable Adjustment Components

GEARSHIFT CABLE ADJUSTMENT

Check adjustment by starting the engine in Park and Neutral. Adjustment is OK if the engine starts only in these positions. Adjustment is incorrect if the engine starts in one but not both positions. If the engine starts in any position other than Park or Neutral, or if the engine will not start at all, the park/neutral position switch may be faulty.

Gearshift Adjustment Procedure

(1) Shift transmission into Park.

(2) Raise vehicle.

(3) Release cable adjuster clamp (at transmission end of cable) to unlock cable (Fig. 5).

(4) Unsnap cable from cable bracket (Fig. 5).

(5) Check transmission shift lever position by moving it all the way rearward into Park detent.

(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 on transmission.

(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.

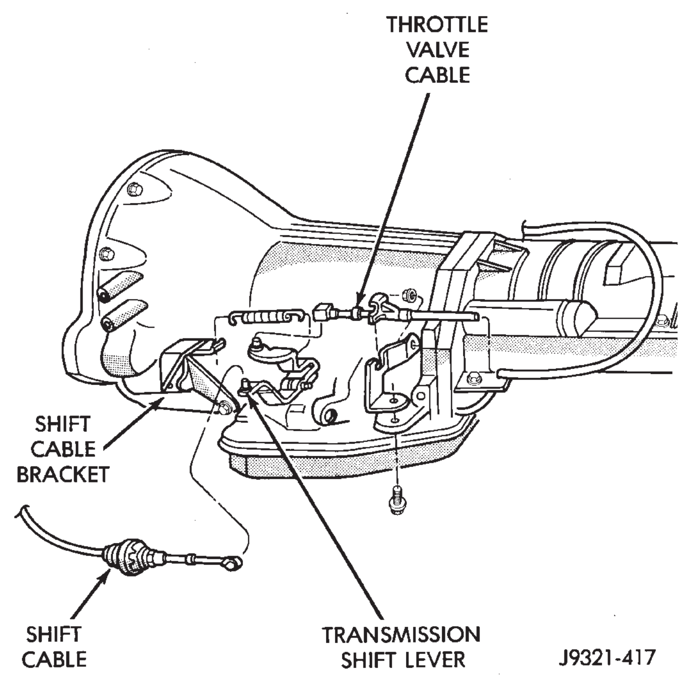


Fig. 5 Shift Cable Attachment At Transmission

PARK INTERLOCK CABLE ADJUSTMENT

(1) Shift transmission into Park.

(2) Turn ignition switch to Accessory position.

CAUTION: Be sure the ignition switch is in the Accessory position for cable adjustment. The cable and lever mechanism will not adjust correctly if the switch lock cylinder is in Park 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. 6).

(5) Pull cable forward. Then release cable and press cable lock button down until it snaps in place.

(6) Check cable adjustment as follows:

(a) Place shift lever in Park.

(b) Check shift handle release button and ignition lock cylinder operation. Release button should be in released (out) position and lock cylinder should rotate freely from Off to Lock.

(c) Next, place shift lever in D or R position and check lock cylinder operation again. Cylinder should not rotate from Off to Lock position.

(d) Check shift lever operation. Shifting out of Park position should only be possible when ignition lock cylinder is in Off, Run, or Start positions. Shift lever should be locked in when lock cylinder is in Accessory and Lock positions.

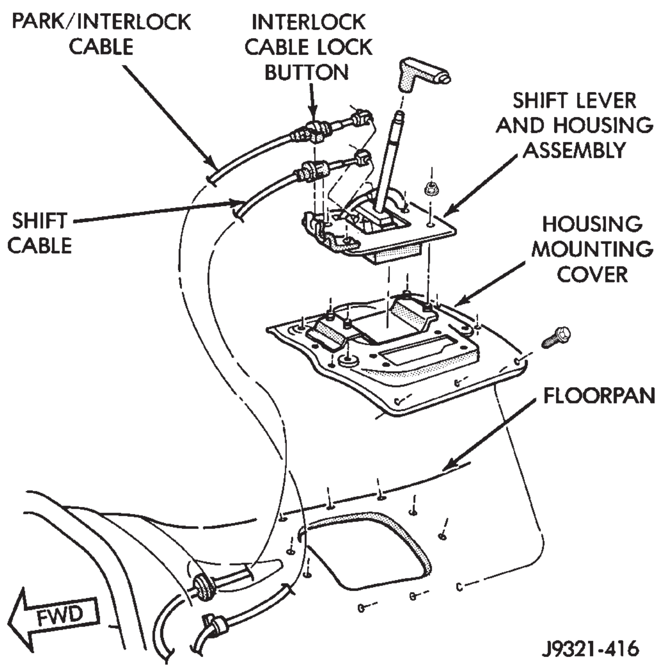


Fig. 6 Shift And Park Interlock Cables

FRONT BAND ADJUSTMENT

The front band adjusting screw is located on the driver side of the transmission case above the manual valve and throttle valve levers.

ADJUSTMENT PROCEDURE

(1) Raise vehicle.

(2) Loosen band adjusting screw locknut. Then back locknut off 4-5 turns. Be sure adjusting screw turns freely in case. Lubricate screw threads if necessary.

(3) Tighten band adjusting screw to 8 N●m (72 in. lbs.) torque with inch pound Torque Wrench C-3380-A, a 3-in. extension and 5/16 socket (Fig. 7).

CAUTION: If Adapter C-3705 is needed to reach the adjusting screw (Fig. 8), tighten the screw to only 5 N●m (47-50 in. lbs.) torque.

(4) **Back off band adjusting screw 3-5/8 turns**.

(5) Hold adjuster screw in position and tighten locknut to 41 N●m (30 ft. lbs.) torque.

(6) Lower vehicle.

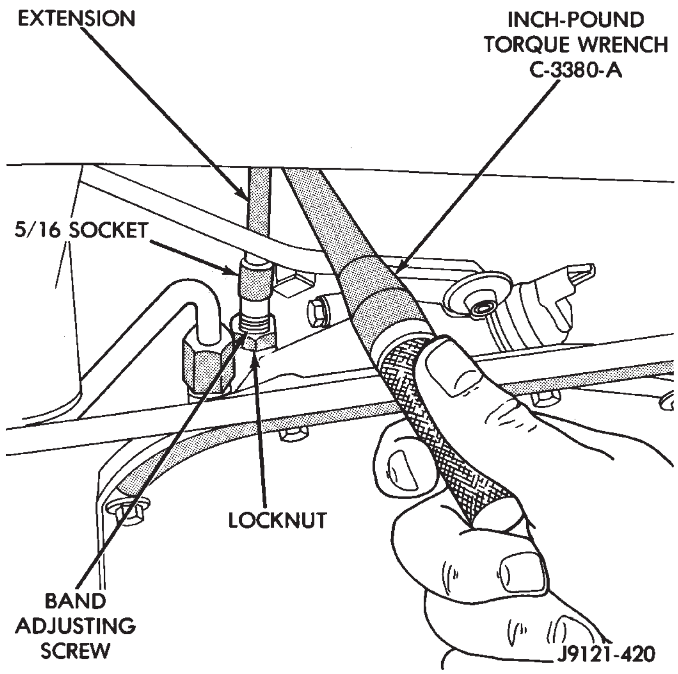


Fig. 7 Front Band Adjustment

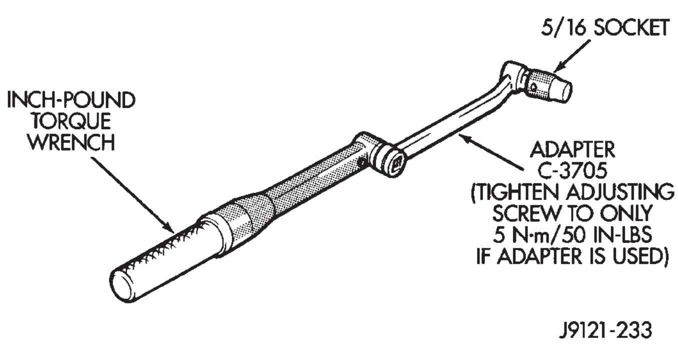


Fig. 8 Using Band Adjustment Adapter Tool C-3705

REAR BAND ADJUSTMENT

The transmission oil pan must be removed for access to the rear band adjusting screw.

(1) Raise vehicle.

(2) Remove transmission oil pan and drain fluid.

(3) Loosen band adjusting screw locknut 5-6 turns. Be sure adjusting screw turns freely in lever. Lubricate screw threads if necessary.

(4) Tighten adjusting screw to 8 N•m (72 in. lbs.) torque (Fig. 9). Use inch-pound Torque Wrench C-3380-A for adjustment.

(5) Back off band adjusting screw 4 turns.

(6) Hold adjusting screw in place and tighten locknut to 34 N•m (25 ft. lbs.) torque.

(7) Clean oil pan, pan magnet and gasket surface of case. Also inspect and replace fluid filter if necessary.

(8) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 17 N•m (150 in. lbs.) torque.

(9) Lower vehicle and refill transmission with recommended fluid.

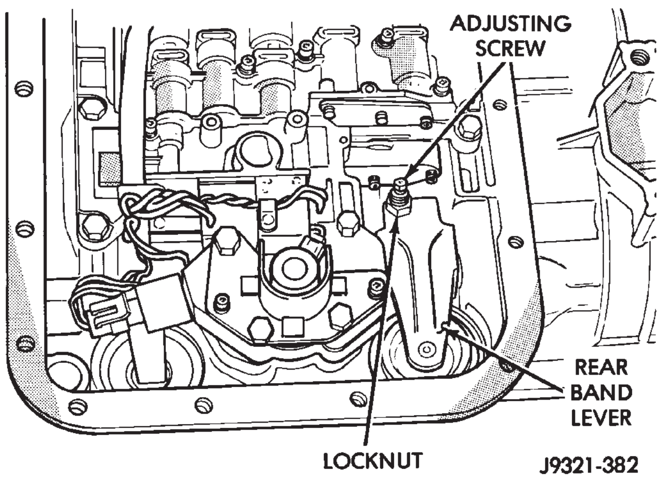


Fig. 9 Rear Band Adjusting Screw Location

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.

SPEEDOMETER ASSEMBLY REMOVAL

(1) Raise vehicle.

(2) Disconnect wires from vehicle speed sensor.

(3) Remove adapter clamp and screw (Fig. 10).

(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. 9). Remove and discard O-rings if worn or damaged.

(8) Inspect terminal pins in speed sensor. Clean pins with Mopar electrical spray cleaner if dirty or oxidized. Replace sensor if faulty, or pins are loose, severely corroded, or damaged.

SPEEDOMETER INSTALLATION AND INDEXING

(1) Thoroughly clean adapter flange and adapter mounting surface in housing. Surfaces must be clean for proper adapter alignment and speedometer operation.

(2) Install new O-rings on speed sensor and speedometer adapter if necessary (Fig. 10).

(3) Lubricate sensor and adapter O-rings with transmission fluid.

ITEM	TORQUE
A	2-3 N•m (15-27 in. lbs.)
B	10-12 N•m (90-110 in. lbs.)

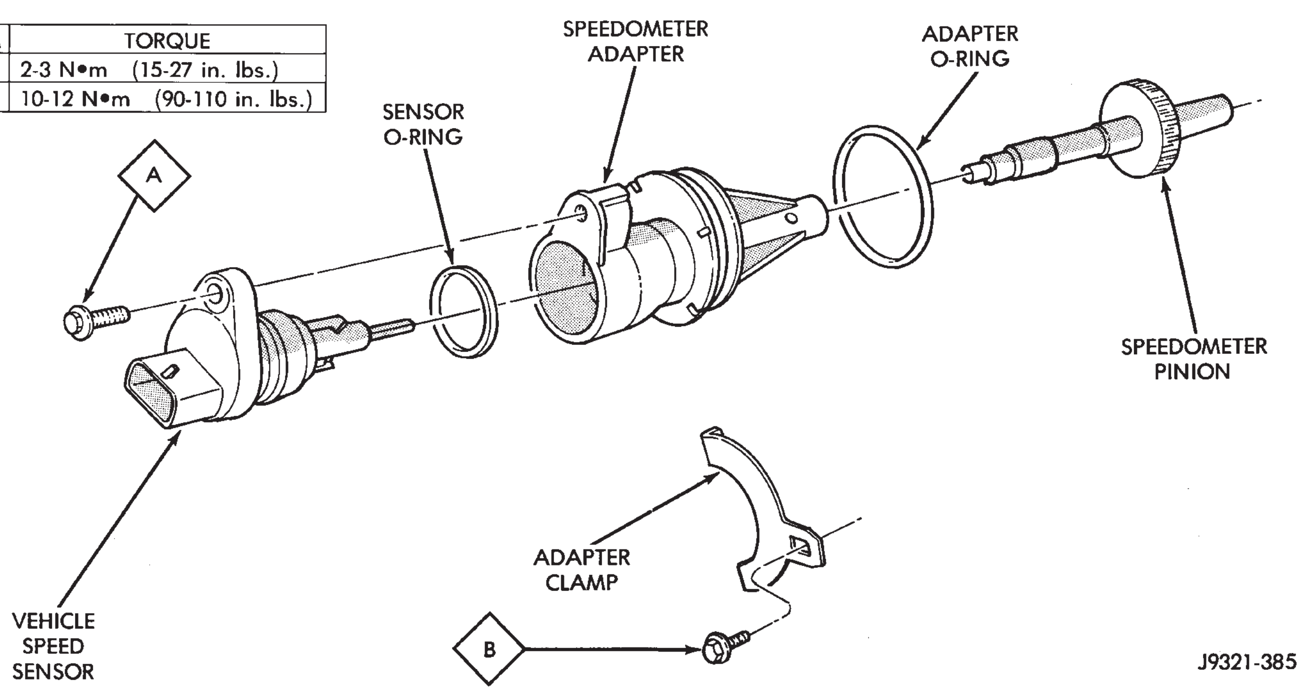


Fig. 10 Speedometer Components

(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. 11). These numbers will correspond to number of teeth on pinion.

(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.

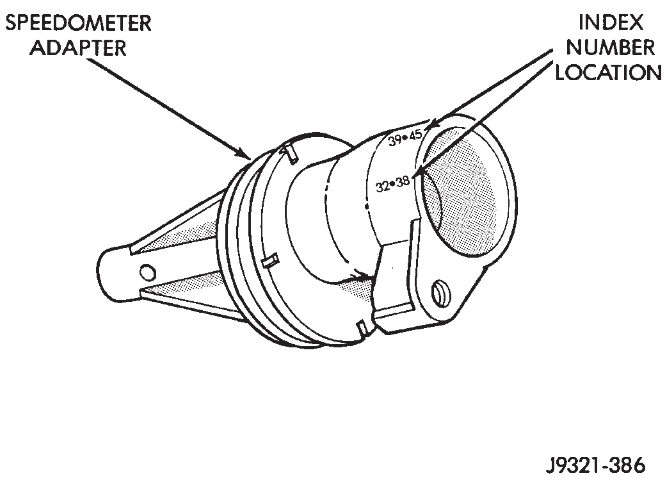


Fig. 11 Location Of Index Numbers On Speedometer Adapter

PARK/NEUTRAL POSITION SWITCH

The center terminal of the switch is the starter circuit terminal. It provides the ground for the starter solenoid circuit through the selector lever in Park and Neutral positions only. The outer terminals on the switch are for the backup lamp circuit.

SWITCH TEST

(1) Verify that gearshift linkage is correctly adjusted before testing. Switch will not operate properly if linkage adjustment is incorrect.

(2) To test switch, remove wiring connector. Then test continuity between center terminal and transmission case. Continuity should exist only when transmission is in Park or Neutral.

(3) Shift transmission into reverse and test continuity at switch outer terminals.

(a) Continuity should exist only when transmission is in Reverse.

(b) Continuity should not exist between outer terminals and case.

PARK/NEUTRAL POSITION SWITCH REPLACEMENT

(1) Raise vehicle and position drain pan under switch.

(2) Disconnect switch wires and remove switch from case.

(3) Move shift lever to Park and Neutral positions. Verify that switch operating lever fingers are centered in switch opening in case (Fig. 12).

(4) Install new seal on switch and install switch in case. Tighten switch to 34 N●m (25 ft. lbs.) torque.

(5) Connect switch wires, lower vehicle and top off transmission fluid level.

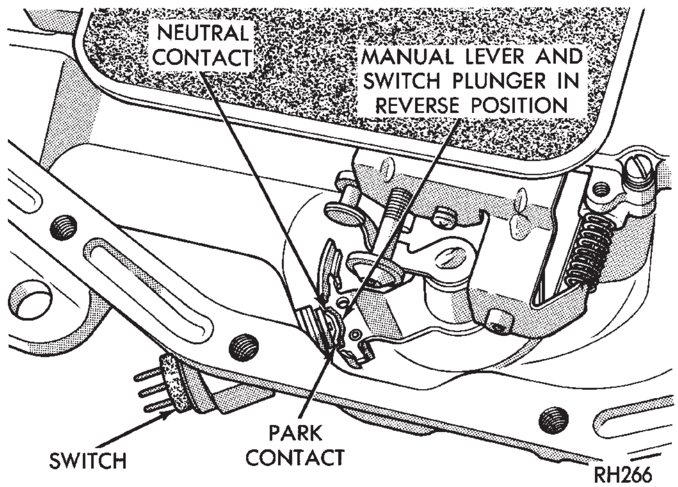


Fig. 12 Park/Neutral Position Switch Contacts

VALVE BODY SERVICE

GENERAL SERVICE INFORMATION

The valve body can be removed for service without having to remove the entire transmission assembly.

The valve body can be disassembled for cleaning and inspection of the individual components. Refer to the procedures in the Transmission Unit Subassembly Overhaul section.

The only replaceable valve body components are:

- manual lever
- manual lever washer, seal, E-clip and shaft seal
- manual lever detent ball
- throttle lever
- fluid filter
- switch valve and spring
- pressure adjusting screw bracket
- governor pressure solenoid
- governor pressure sensor
- converter clutch/overdrive solenoid assembly and harness
- governor housing gasket
- solenoid case connector O-rings

The remaining valve body components are serviced only as part of a complete valve body assembly.

VALVE BODY REMOVAL

(1) Shift transmission into Neutral.

(2) Raise vehicle.

(3) Remove gearshift and throttle levers from shaft of valve body manual lever.

(4) Disconnect wires at park/neutral position switch.

(5) Disconnect wires at park/neutral position switch and solenoid case connector (Fig. 13).

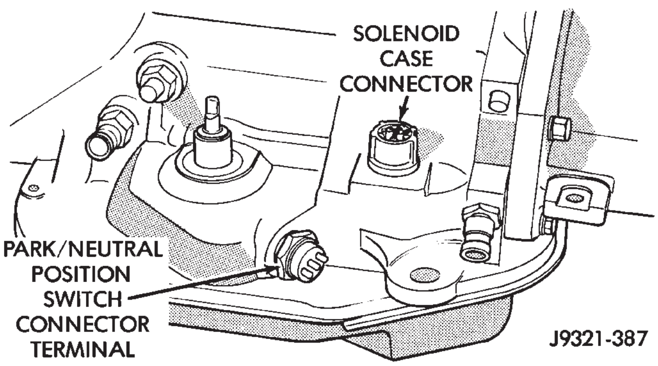


Fig. 13 Transmission Case Electrical Connector Locations

(6) Position drain pan under transmission oil pan.

(7) Remove transmission oil pan and gasket.

(8) Remove fluid filter from valve body.

(9) Remove bolts attaching valve body to transmission case.

(10) Lower valve body enough to remove accumulator piston and springs.

(11) Work manual lever shaft and electrical connector out of transmission case. Then lower valve body, rotate it away from case, pull park rod out of sprag and remove valve body (Fig. 14).

VALVE BODY INSTALLATION

(1) Verify that park/neutral position switch has NOT been installed in case. Valve body cannot be installed if switch is in place.

(2) Check condition of O-ring seals on valve body harness connector (Fig. 15). Replace seals on connector body if cut or worn.

(3) Check condition of manual lever shaft seal in transmission case. Replace seal if lip is cut, or worn. Install new seal with 15/16 deep well socket (Fig. 16).

(4) Check condition of seals on accumulator piston (Fig. 17). Install new piston seals if necessary.

(5) Place valve body manual lever in low (1 position) so ball on park lock rod will be easier to install in sprag.

(6) Lubricate shaft of manual lever with petroleum jelly. This will ease inserting shaft through seal in case.

(7) Lubricate seal rings on valve body harness connector with Ru-Glyde, or petroleum jelly.

(8) Position valve body on case and work end of park lock rod into and through pawl sprag. Turn propeller shaft to align sprag and park lock teeth if necessary. Rod will make click noise as it enters pawl. Move rod to check engagement.

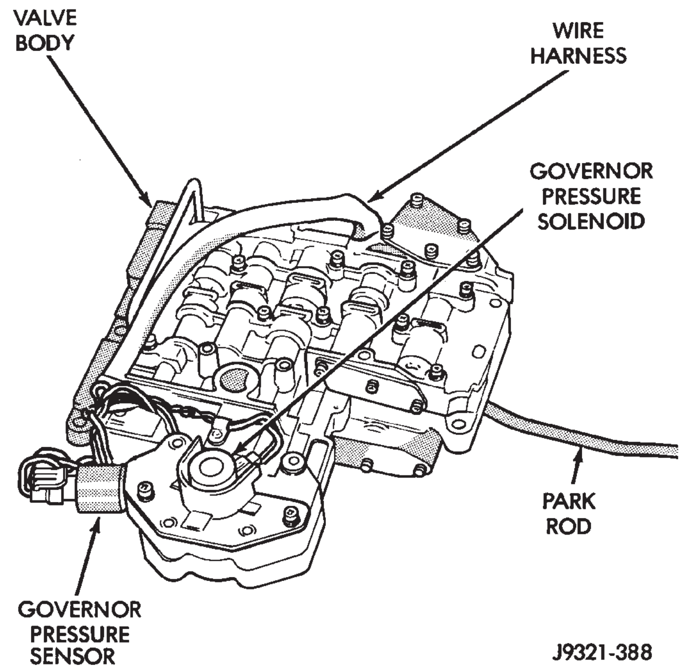


Fig. 14 42RE Valve Body

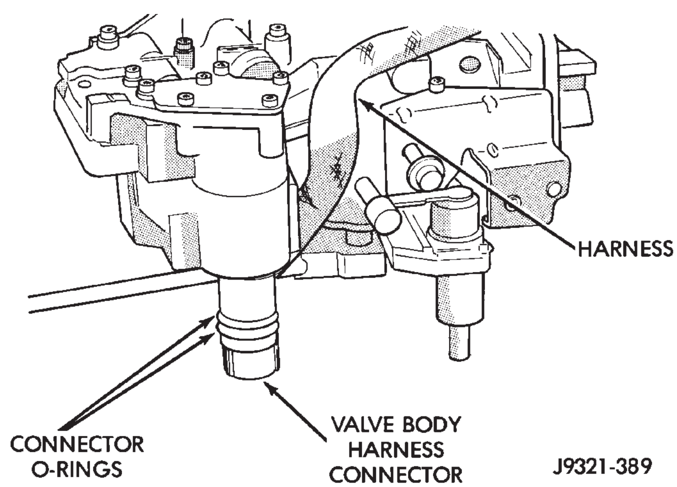


Fig. 15 Valve Body Harness Connector O-Ring Seal Locations

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into this cavity. If the rod enters the cavity during installation, it will become bent when the overdrive bolts are tightened. The rod will then have to be replaced because it is not repairable.

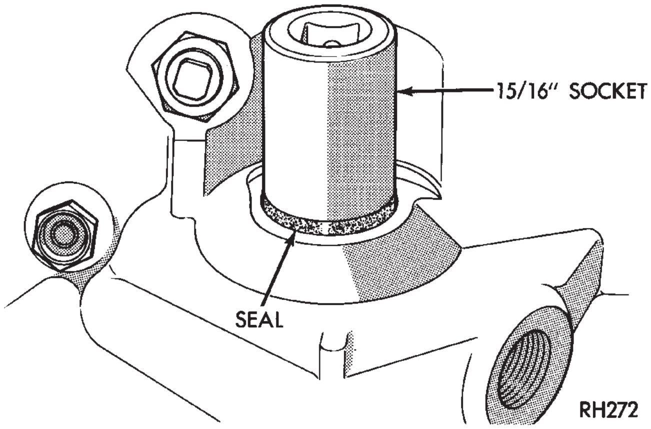


Fig. 16 Manual Lever Shaft Seal Installation

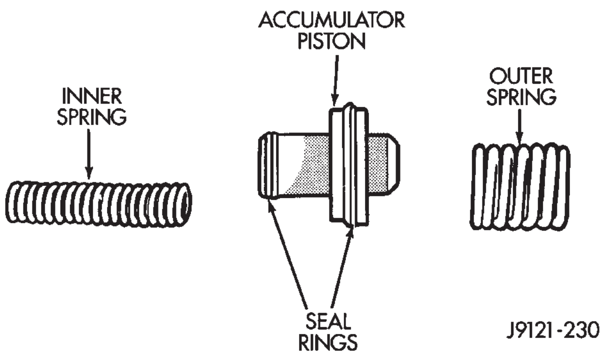


Fig. 17 Accumulator Piston Components

(9) Install accumulator springs and piston in case. Then swing valve body over piston and outer spring to hold it in place.

(10) Align accumulator piston and outer spring, manual lever shaft and electrical connector in case. Then seat valve body on case and install one or two bolts to hold valve body in place.

(11) Tighten valve body bolts alternately and evenly to 11 N●m (100 in. lbs.) torque.

(12) Install new fluid filter on valve body. Tighten filter screws to 4 N●m (35 in. lbs.) torque.

(13) Install and connect park/neutral position switch in case.

(14) Install throttle and gearshift levers on valve body manual lever shaft.

(15) Check and adjust front and rear bands if necessary.

(16) Connect valve body overdrive and converter clutch solenoid wires to case connector.

(17) Install oil pan and new gasket. Tighten pan bolts to 17 N●m (13 ft. lbs.) torque.

(18) Lower vehicle and fill transmission with Mopar ATF Plus, type 7176 fluid.

(19) Check and adjust gearshift and throttle linkage if necessary.

SERVICING TRANSMISSION COOLER LINE FITTINGS

The transmission cooler lines are attached to the transmission and radiator main cooler with quick disconnect fittings (Fig. 18).

The transmission case fitting consists of a fitting body, a plastic insert and a wire retainer clip (Fig. 19).

There are two fitting styles that will be used. Current production (type I), fittings have the retainer clip exposed as shown in Figures 18 and 19. Future production (type II), fittings will have the fitting body and wire retainer clip covered by a shrink wrap material (Fig. 20). A tool is needed with the type II fittings to spread the retainer clip for cooler line removal. A small plastic removal tool will be attached to each type II fitting for this purpose. Special service tools are not required.

The fitting in some cooler line hoses is swedged into the hose. Only the insert and retainer clip are serviceable on this fitting.

A flange on the cooler line serves as the sealing mechanism. The wire retainer clip holds the cooler line in the fitting. The clip fits behind the cooler line flange to hold the line in place. The plastic insert is not a seating or sealing device. The insert is used to indicate when the cooler line is properly seated in the fitting.

QUICK DISCONNECT FITTING SERVICE

The type I transmission fitting, wire retainer clip and plastic insert are serviceable individually, or as an assembly. The fittings in the cooler line hoses are serviced only as part of the cooler line. Only the retaining clip and insert are serviceable.

On type I fittings, the wire retainer clip is not a reusable part. It must be replaced if removed from the fitting for any reason. In addition, the plastic insert should be replaced if cut, torn, or damaged in any way. A damaged insert could prevent the cooler line from seating properly.

Type II fittings are not serviceable. The fitting or cooler line must be replaced as an assembly when necessary.

DISCONNECTING COOLER LINE (TYPE I FITTING)

(1) If cooler lines will disconnected at main cooler in radiator, remove splash shield under radiator for access to fittings.

(2) Pry wire retainer clips off fittings with small screwdriver (Fig. 21). **Discard clips as they are NOT reusable after being removed.**

(3) Pull cooler line out of fitting.

(4) Remove and retain plastic insert from each fitting.

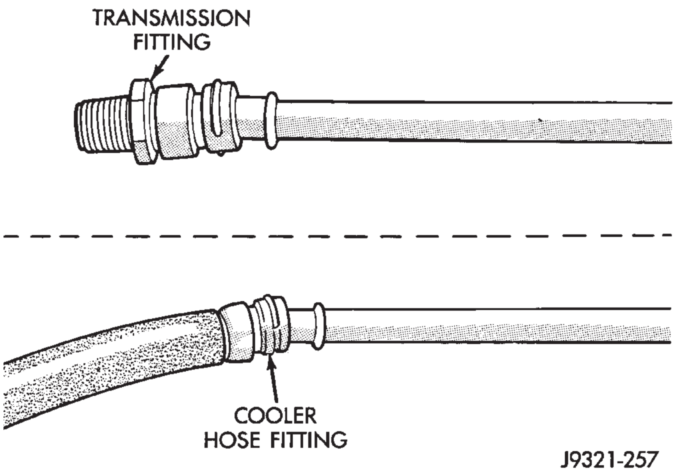


Fig. 18 Type I Quick Disconnect Fitting

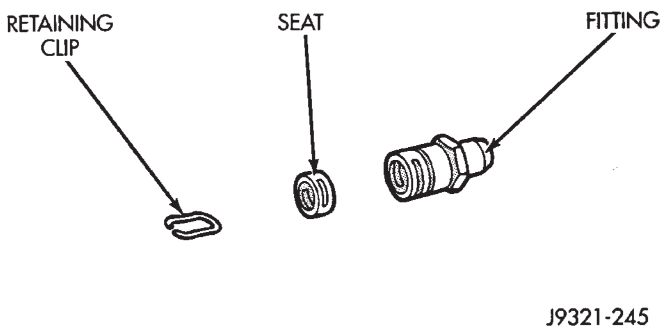


Fig. 19 Type I Quick Disconnect Fitting Components

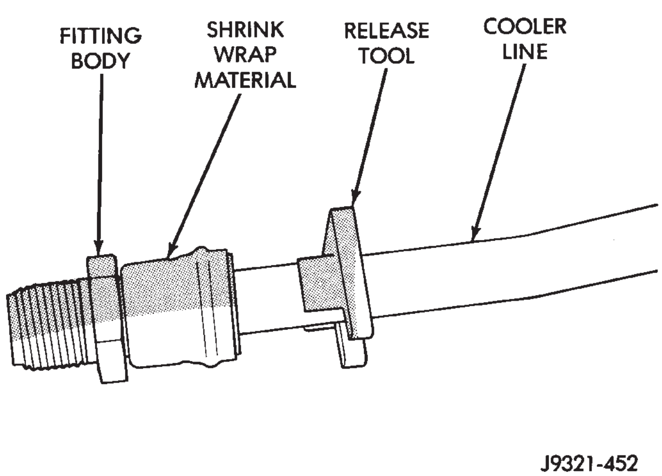


Fig. 20 Type II Quick Disconnect Fitting And Release Tool

(5) Cover open ends of line and fitting to prevent dirt entry.

(6) Inspect condition of each plastic insert. Replace any insert that is cut, torn, or damaged in any way. Replace the transmission fitting as an assembly if the fitting body is damaged. Replace the cooler line as an assembly, if the fitting swedged into the cooler line hose, is damaged.

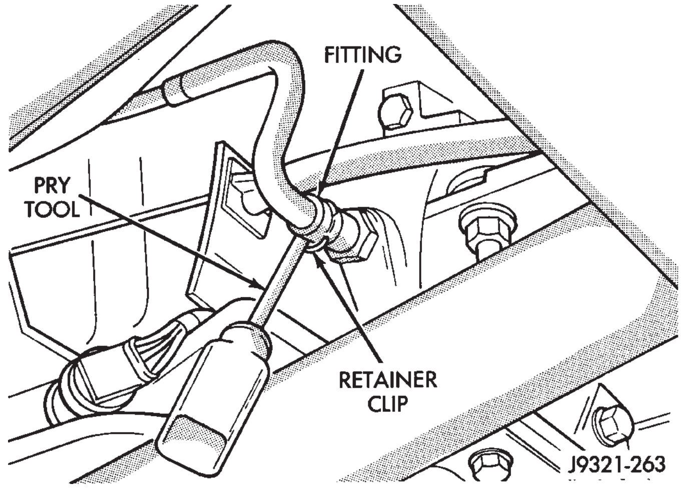


Fig. 21 Removing Retainer Clip To Release Cooler Line

RECONNECTING COOLER LINES (TYPE I FITTING)

(1) If transmission or radiator fittings will be replaced, apply Mopar Lock N' Seal, or Loctite 242 to fitting threads before installation.

(2) Wipe off fittings and cooler lines with lint free cloth or shop towels.

(2) Install plastic inserts in fittings. Use new inserts if originals were damaged an any way, or if doubt exists about insert condition.

(3) Install new clips on fittings as follows:

(a) Start retainer clip in slot on one side of fitting (Fig. 22).

(b) Swing retainer clip across and over fitting. Then carefully seat clip in slot on opposite side of fitting (Fig. 23). **It is not necessary to overspread a new clip in order to install it. Clip will easily slip into opposite fitting slot if care is exercised.**

CAUTION: Do not attempt to salvage a retainer clip if it becomes, bent, or distorted. A salvaged clip will not properly secure the cooler line in the fitting.

(4) Wipe end of each cooler line clean with lint free cloth, or shop towel.

(5) Start cooler line into fitting. Then push cooler line inward until wire retainer clip snaps into place behind cooler line flange.

(6) **Note position of plastic insert. When cooler line is fully seated, insert will no longer extend beyond end of fitting.**

(7) Verify that both sides of wire retainer clip are seated **behind** flange on cooler line (Fig. 24).

(8) Pull outward on cooler lines to verify that they are properly secured.

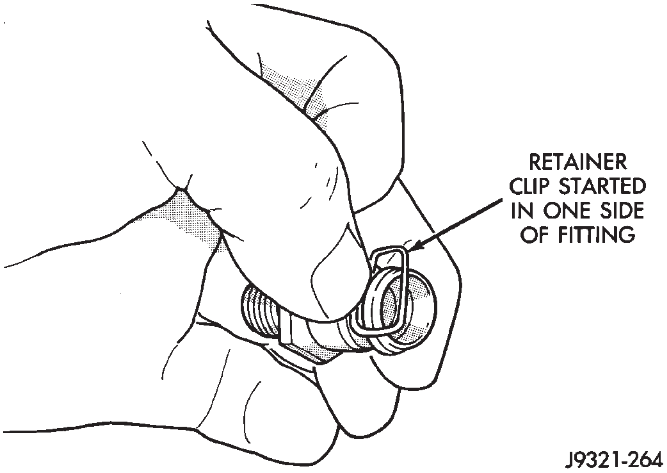


Fig. 22 Starting New Retainer Clip On Type I Fitting

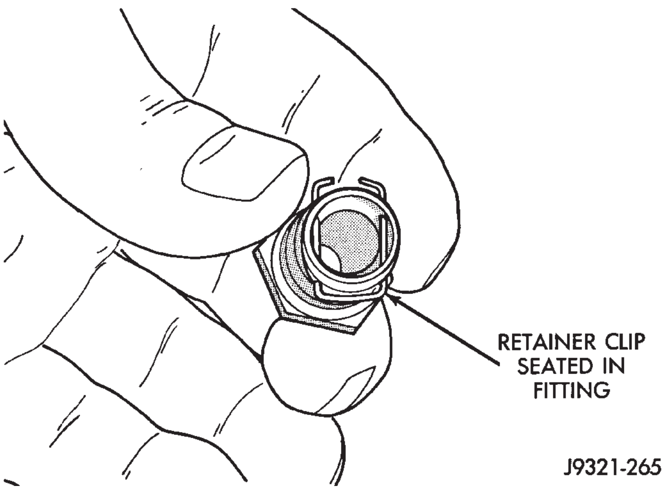


Fig. 23 Seating New Retainer Clip In Type I Fitting

CAUTION: The 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 clips are in good condition and firmly seated behind the cooler line flanges (Fig. 24).

(9) Reinstall splash shield under radiator, if removed.

DISCONNECTING COOLER LINES (TYPE II FITTING)

(1) Remove splash shield for access if cooler lines will be disconnected at radiator cooler.

(2) If fitting and cooler line are encrusted with dirt, mud, or grease, clean out fitting and line with Mopar spray type brake cleaner. Plastic release tool will not fit into retainer clip if fitting is full of foreign material.

(3) Slide small plastic release tool into fitting.

(4) Push and turn tool to spread retainer clip and disconnect cooler line and/or fitting (Fig. 25).

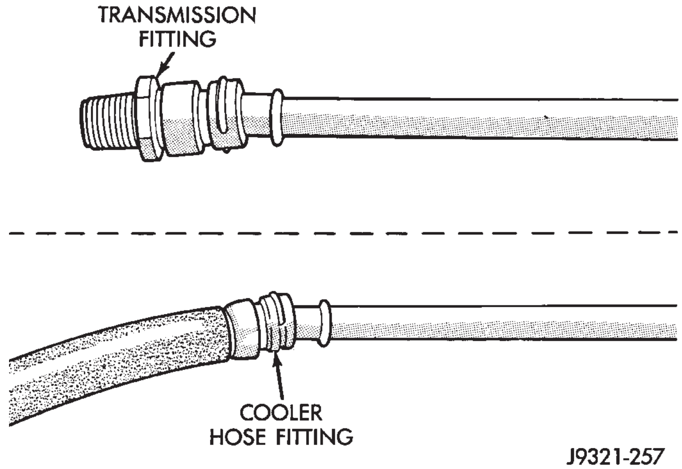


Fig. 24 Correct Seating Of Cooler Lines In Type I Fitting

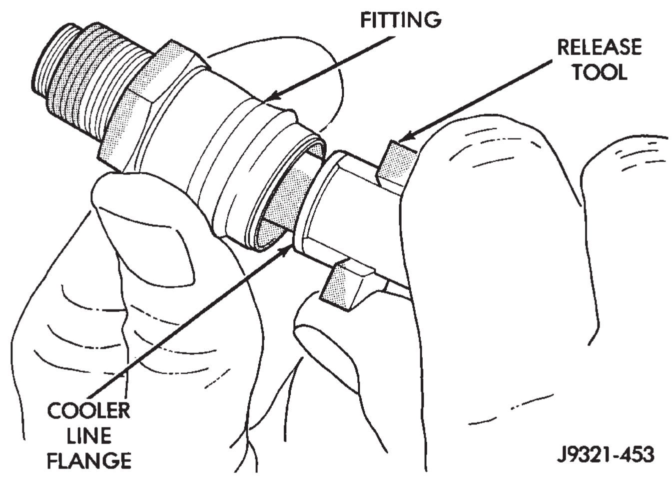


Fig. 25 Disconnecting Type II Fitting

(5) Cover open ends of cooler lines and fittings to prevent dirt entry.

(6) 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.

RECONNECTING COOLER LINES (TYPE II FITTING)

(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 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 as described in step (4) above.

(5) Install splash shield, if removed.

TRANSMISSION COOLER TESTING AND FLUSHING

If a transmission malfunction contaminates the fluid, the cooler and lines must be reverse flushed thoroughly. Flushing will prevent sludge and particles from flowing back into the transmission after repair. **The flushing procedure applies to standard and auxiliary coolers alike.**

Pressure equipment is preferred for reverse flushing. However, reverse flushing can be performed with hand operated equipment as follows.

COOLER REVERSE FLUSHING PROCEDURE

(1) Identify and disconnect cooler pressure and return lines at transmission. Rear line is return line from cooler. Front line is pressure line to cooler (Fig. 26).

(2) Position drain pan under cooler pressure line to catch 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 return line. Then force mineral spirits into line and through cooler.

(4) Continue reverse flushing until fluid exiting cooler pressure line is clear and free from debris. **Replace cooler if fluid cannot be pumped through it.**

(5) Clear flushing materials from cooler and lines with short pulses of compressed air. Insert air gun nozzle into cooler return line and continue short air pulses until all fluid is cleared from cooler and lines.

(6) Pump one quart of fresh automatic transmission fluid through cooler and lines before reconnecting lines.

TESTING COOLER FLUID FLOW

Cooler flow is tested by measuring the amount of fluid pumped through the cooler in a specified time by the transmission oil pump.

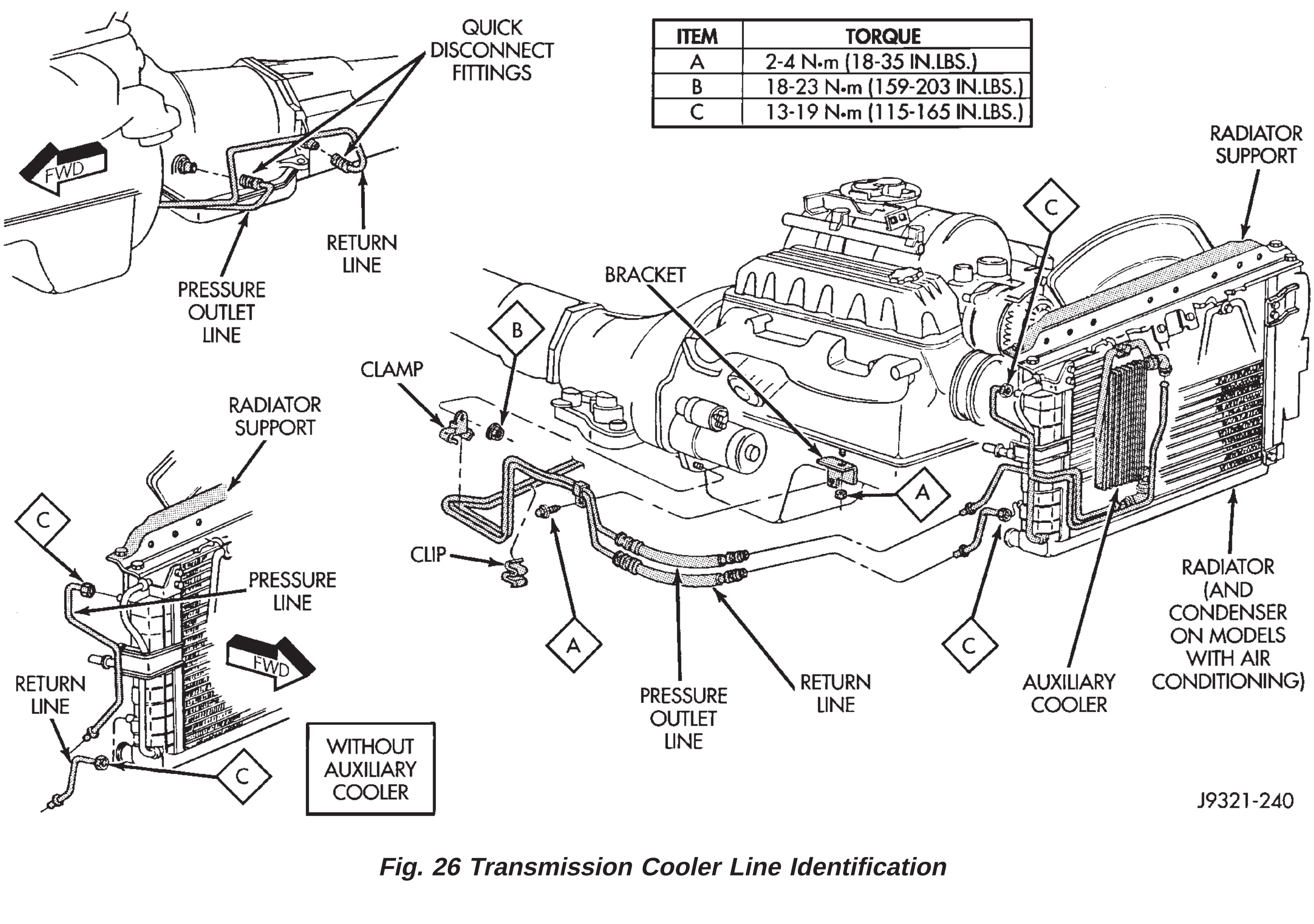
(1) Disconnect cooler return (rear) line at transmission and place it in one quart test container.

(2) Add extra quart of fluid to transmission.

(3) Use stopwatch to check test time.

(4) Shift into Neutral.

(5) Start and run engine at curb idle speed and note cooler flow. Approximately 1 quart (0.9 liter) of fluid should flow into test container in 20 seconds.



ITEM	TORQUE
A	2-4 N•m (18-35 IN.LBS.)
B	18-23 N•m (159-203 IN.LBS.)
C	13-19 N•m (115-165 IN.LBS.)

Fig. 26 Transmission Cooler Line Identification

(6) If fluid flow is intermittent, or flows less than one quart in 20 seconds, or fails to allow flow at all, cooler is plugged and should be replaced.

MAIN COOLER REPLACEMENT

The main transmission 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.

AUXILIARY COOLER REPLACEMENT

(1) Remove grille and air conditioning condenser if equipped.

(2) Remove screws and U-nuts securing cooler to radiator and support.

(3) Tag cooler hoses for installation reference.

(4) Position drain pan under cooler hoses.

(5) Loosen cooler connecting hose clamps and disconnect hoses.

(6) Remove auxiliary cooler.

(7) Connect cooler hoses.

(8) Position cooler on radiator and install cooler attaching U-nuts and screws.

(9) Tighten cooler hose clamps securely.

(10) Install grille and air conditioning condenser.

(11) Check and adjust transmission fluid level.

(12) If air conditioning condenser lines were disconnected during service, evacuate and recharge system.

ALUMINUM THREAD REPAIR

Damaged or worn threads in the aluminum transmission case and in the valve body can be repaired with Heli-Coil or similar quality thread inserts. Essentially, repair consists of drilling out the worn or damaged threads, tapping the hole with a special tap and installing the thread insert into the tapped hole. This procedure returns the hole threads to original size. Heli-Coil, or equivalent, tools and inserts are readily available from most automotive parts suppliers. Stainless steel inserts are recommended.

TRANSMISSION/OVERDRIVE REMOVAL AND INSTALLATION—42RE

INDEX

GENERAL INFORMATION

The overdrive unit can be removed for service without having to remove the entire transmission assembly. However if the transmission, torque converter, converter driveplate, or oil pump requires service, the complete transmission assembly must be removed for access to these components.

If only the overdrive unit must be removed, refer to the Overdrive Unit Removal/Installation procedures. If the complete transmission assembly must be removed, refer to the Transmission Removal/Installation procedures.

TRANSMISSION REMOVAL (2-WHEEL DRIVE)

(1) Disconnect battery negative cable.

(2) Raise vehicle on hoist.

(3) Remove skid plate if equipped.

(4) If transmission is being removed for repair, remove oil pan, drain fluid and reinstall pan on case.

(5) Mark propeller shaft for installation reference. Then disconnect and remove propeller shaft.

(6) Disconnect vehicle speed sensor wires, transmission solenoid wires and park/neutral position switch wires.

(7) Disconnect wires from transmission speed sensor at rear of overdrive unit.

(8) Remove exhaust system Y-pipe for working clearance.

(9) Unclip wire harnesses from transmission clips.

(10) Disconnect throttle valve and gearshift cables from levers on valve body manual shaft. Move cables aside and secure them to underbody.

(11) Remove dust cover from transmission converter housing.

(12) Disconnect and remove starter motor.

(13) Remove bolts attaching converter to driveplate.

(14) Disconnect cooler lines at transmission fittings. Refer to In-Vehicle Service section for procedures.

(15) Support transmission with transmission jack.

(16) Remove bolts/nuts attaching rear insulator to rear crossmember. Then remove rear crossmember.

(17) Lower transmission for access to converter housing upper bolts and crankshaft position sensor.

(18) Remove crankshaft position sensor. Retain sensor attaching screws.

CAUTION: The crankshaft position sensor can be damaged if the transmission is removed (or installed) with the sensor still bolted to the engine block. To avoid damage, remove the sensor before removing the transmission.

(19) Remove transmission fill tube and tube O-ring seal.

(20) Remove bolts attaching transmission to engine block.

(21) Slide transmission away from engine and install C-clamp on converter housing to hold converter in place.

(22) Lower transmission and move from under vehicle.

(23) If transmission is to be serviced, remove it from jack and position it on bench.

TRANSMISSION REMOVAL (4-WHEEL DRIVE)

(1) Raise vehicle on hoist.

(2) Remove skid plate, if equipped.

(3) Mark front and rear propeller shafts and U-joints for alignment reference (Fig. 1).

(4) Disconnect and remove both propeller shafts.

(5) Disconnect vehicle speed sensor and transmission output shaft speed sensor wires.

(6) Disconnect electrical wires from clips on transmission and transfer case.

(7) Disconnect transfer case shift linkage at transfer case range lever. Then remove linkage bracket bolts and remove linkage and bracket from transfer case. Move linkage aside for clearance.

(8) Remove nuts attaching transfer case to overdrive unit gear case.

(9) Remove transfer case. Support transfer case with transmission jack. Secure transfer case to jack with safety chains. Then move transfer case rearward and off transmission.

(10) Remove transfer case from transmission jack and place transfer case on bench.

(11) Support transmission with transmission jack.

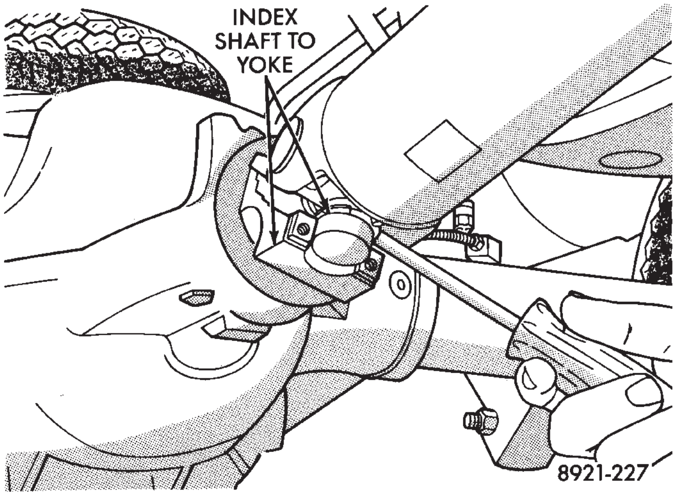


Fig. 1 Marking Propeller Shaft And Yoke For Alignment Reference

(12) Remove nuts and bolts attaching transmission mount to crossmember.

(13) Remove bolts and nuts attaching crossmember to frame rails.

(14) Rotate crossmember diagonally to clear frame rails and remove crossmember.

(15) Disconnect exhaust pipes at manifold and at converter and/or muffler connections as needed. Then remove Y-pipe from vehicle and move remaining pipes aside for working clearance.

(16) Disconnect and remove crankshaft position sensor. Retain sensor attaching bolts.

CAUTION: The crankshaft position sensor can be damaged if the transmission is removed (or installed) with the sensor still bolted to the engine block. To avoid damage, remove the sensor before removing the transmission.

(17) Disconnect transmission shift linkage at shift lever on transmission.

(18) Remove transmission shift linkage torque shaft assembly from retainers on transmission and frame rail. Move linkage aside for working clearance.

(19) Remove brackets that attach transmission to engine block, if equipped.

(20) Remove dust shield cover from front side of transmission converter housing.

(21) Remove starter motor bolts. Pull starter rearward until clear of housing and position it out of way on nearby component. Starter does not have to be removed from vehicle nor does cable have to be disconnected.

(22) Remove bolts attaching torque converter to drive plate.

(23) Disconnect cooler lines at quick disconnect fittings in transmission. Refer to In-Vehicle Service section for procedures.

(24) Disconnect solenoid and park/neutral position switch wires at transmission.

(25) Remove transmission fill tube and dipstick.

(26) Lower transmission for access to converter housing upper bolts.

(27) Remove bolts attaching transmission converter housing to engine. Note that some bolts may be accessible only from front (engine) side of housing.

(28) Move transmission rearward until clear of engine block dowels. On some models, part of hem flange joining vehicle cab and dash panel may interfere with transmission removal. Peen this part of flange over with a mallet if necessary.

(29) Secure torque converter in housing with small C-clamp.

(30) Lower transmission and remove it from under vehicle.

(31) Remove C-clamp and remove converter from transmission. Place converter on workbench for inspection or reassembly. Cover converter hub with clean, lint free cloth.

(32) Oil pump, converter and driveplate can now be serviced if necessary. Refer to information in this section.

OIL PUMP SEAL REPLACEMENT

The pump oil seal can be replaced without removing the pump and reaction shaft support assembly from the transmission case.

Seal Removal

Remove the seal with Special Tool C-3861 (Fig. 2). To use the remover 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.

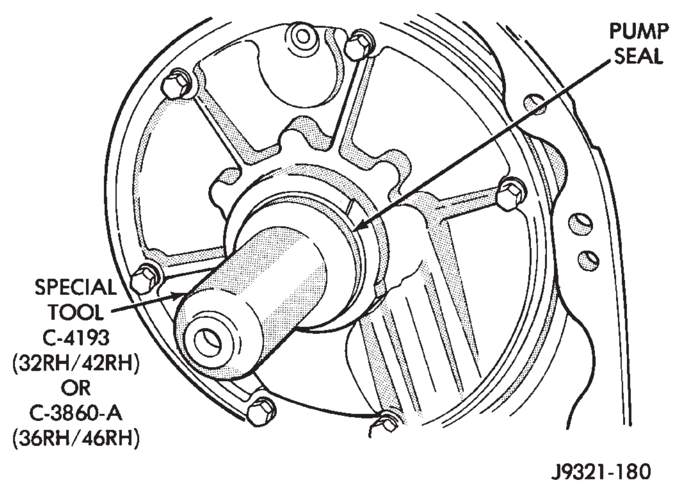


Fig. 2 Oil Pump Seal Removal

Seal Installation

Use Installer Tool C-3860-A (Fig. 3). To use the tool, place the seal in the pump opening with the seal lip facing inward. Then tap the seal into place with the installer tool. Tool Handle C-4171 may be used with the installer tool if desired.

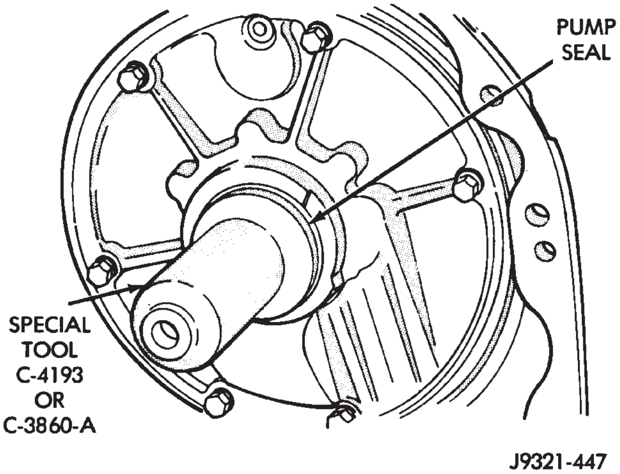


Fig. 3 Oil Pump Seal Installation

TORQUE CONVERTER AND DRIVE PLATE SERVICE

After the transmission has been removed, the drive plate and torque converter can replaced or removed for service access.

The torque converter is not a serviceable part. If the converter is contaminated by a transmission malfunction, 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.**

TRANSMISSION INSTALLATION (2-WHEEL DRIVE)

CAUTION: The transmission cooler and lines must be flushed if repair was to correct a problem that generated sludge, metal particles, or clutch friction material. The torque converter should also be replaced when contaminated by a malfunction. The transmission, fluid and converter will be contaminated again if residue/debris is not flushed from the cooler and lines beforehand.

(1) Mount transmission on jack. Secure transmission to jack with safety chains.

(2) Check torque converter hub and hub drive notches for sharp edges burrs, scratches, or nicks. Polish hub and notches with crocus cloth or 400 grit paper if necessary. Hub must be smooth to avoid damaging pump seal.

(3) Lubricate converter hub and pump seal lip with Mopar high temperature wheel bearing grease.

(4) Verify that converter is fully seated. Use straight edge and steel ruler to check seating (Fig. 4). Surface of converter lugs should be 12.7 mm (1/2 in.) to rear of straight edge when converter is fully seated.

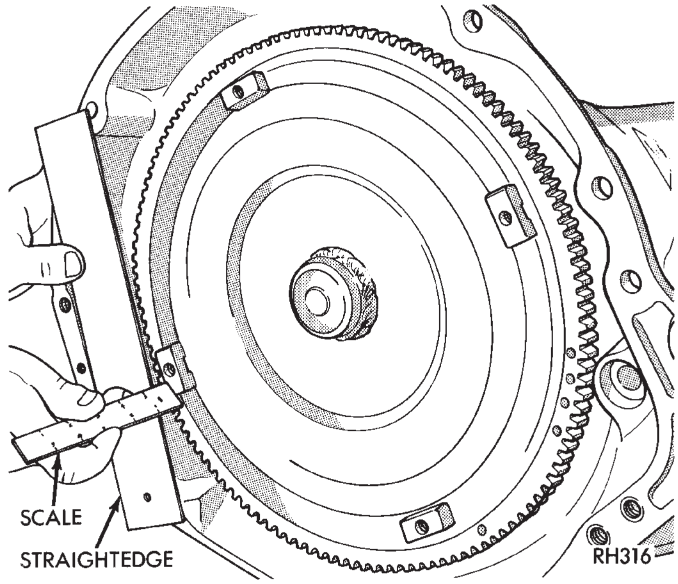


Fig. 4 Checking Torque Converter Seating

(5) Temporarily secure converter with C-clamp attached to housing or with metal strap attached across converter housing.

(6) Check condition of converter driveplate. Replace driveplate if cracked, distorted or damaged.

(7) Verify that transmission dowel pins are seated in engine block and protrude far enough to held transmission in alignment.

(8) Coat torque converter pilot hub of crankshaft with light coat of Mopar high temperature wheel bearing grease.

(9) Move transmission under vehicle and position it at rear of engine. Remove C-clamp or strap used to secure converter in housing.

(10) Align transmission with engine dowels and align converter with driveplate. Offset holes in driveplate are next to 1/8 inch hole in inner circle of plate (Fig. 5).

(11) Move transmission forward until seated on engine block dowels. Then install one or two transmission attaching bolts to hold transmission in place (Fig. 6).

CAUTION: It is essential that correct length bolts be used to attach the converter to the driveplate. Bolts that are too long will damage the modulated clutch surfaces in the converter. If new bolts are required, use the bolts specified in the parts catalogue only.

(12) Verify converter bolt length. Bolt measurement is from bottom (underside) of bolt head to end of bolt threads.

- On 9.5 in., 3-lug converter, bolts should be 11.7 mm (0.46 in.) long.

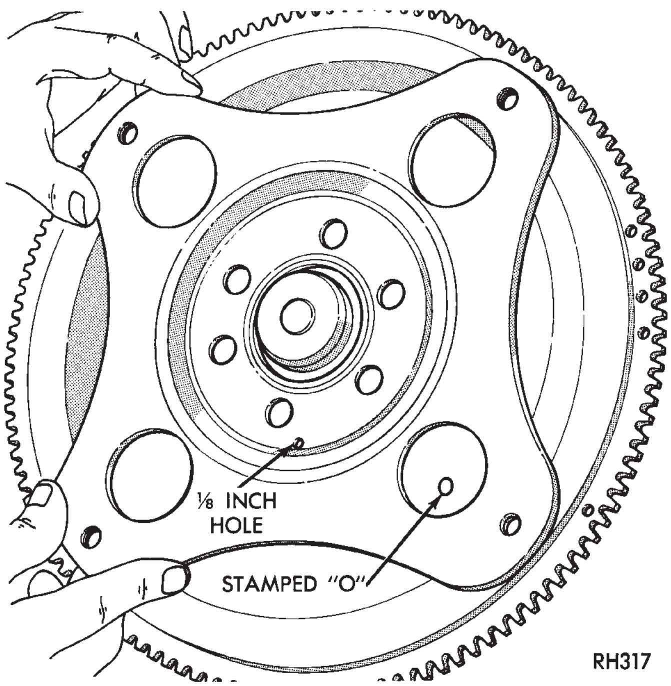


Fig. 5 Torque Converter And Driveplate Markings

• On 10.75 in., 4-lug converter, bolts should be 11.2 mm (0.44 in.) long.

(13) Install torque converter bolts. Tighten bolts as follows:

• On models with 9.5 in., 3-lug converter, tighten bolts to 54 N•m (40 ft. lbs.).

• On models with 10.75 in., 4-lug converter, tighten bolts to 31 N•m (270 in. lbs.).

(14) Install and tighten remaining transmission attaching bolts (Fig. 6).

(15) Install and connect crankshaft position sensor.

(16) Install dust cover on transmission converter housing. Two small vise grip pliers van be used to hold and align cover during installation.

(17) Install and connect starter motor.

(18) Connect transmission shift and throttle valve cables to valve body manual shaft and transmission brackets.

(19) Fasten wire harnesses in clips on transmission case.

(20) Connect wires to solenoids, park/neutral position switch, transmission speed sensor and vehicle speed sensor.

(21) Install transmission fill tube and O-ring.

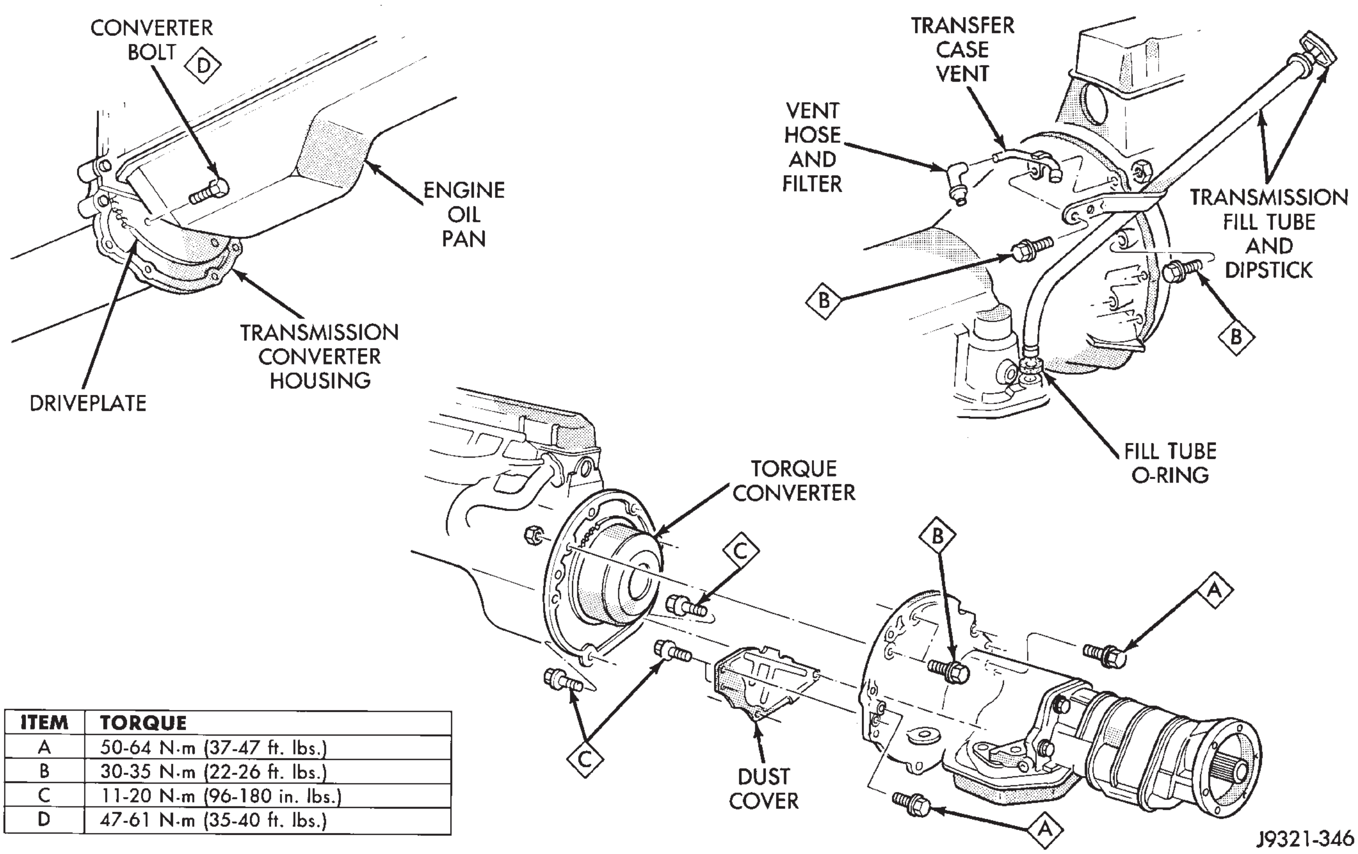
(22) Install rear crossmember and attach rear insulator to transmission and crossmember.

(23) Connect cooler lines to transmission case fittings. Pull lines outward to verify that they are securely seated and retained by wire retainer clips.

(24) Align and install propeller shaft. **Clean and lubricate slip yoke before installation.**

(25) Install exhaust system components.

(26) Lower vehicle.



ITEM	TORQUE
A	50-64 N·m (37-47 ft. lbs.)
B	30-35 N·m (22-26 ft. lbs.)
C	11-20 N·m (96-180 in. lbs.)
D	47-61 N·m (35-40 ft. lbs.)

Fig. 6 Transmission And Fill Tube Mounting

(27) Connect battery negative cable.

(28) Fill or top off transmission fluid level with Mopar ATF Plus, type 7176.

(29) Check transmission control cable adjustments. Readjust cables if necessary.

TRANSMISSION INSTALLATION—4-WHEEL DRIVE

CAUTION: The transmission cooler and lines must be flushed if repair was to correct a problem that generated sludge, metal particles, or clutch friction material. The torque converter should also be replaced when contaminated by a malfunction. The transmission, fluid and converter will be contaminated again if residue/debris is not flushed from the cooler and lines beforehand.

(1) Mount transmission on jack. Secure transmission to jack with safety chains.

(2) Check torque converter hub and hub drive notches for sharp edges burrs, scratches, or nicks. Polish hub and notches with crocus cloth or 400 grit paper if necessary. Hub must be smooth to avoid damaging pump seal.

(3) Lubricate converter hub and pump seal lip with Mopar high temperature wheel bearing grease.

(4) Verify that converter is fully seated. Use straight edge and steel ruler to check seating (Fig. 4). Surface of converter lugs should be 12.7 mm (1/2 in.) to rear of straight edge when converter is fully seated.

(5) Temporarily secure converter with C-clamp attached to housing or with metal strap attached across converter housing.

(6) Check condition of converter driveplate. Replace driveplate if cracked, distorted or damaged.

(7) Verify that transmission dowel pins are seated in engine block and protrude far enough to held transmission in alignment.

(8) Coat torque converter pilot hub of crankshaft with light coat of Mopar high temperature wheel bearing grease.

(9) Move transmission under vehicle and position it at rear of engine. Remove C-clamp or strap used to secure converter in housing.

(10) Align transmission with engine dowels and align converter with driveplate. Offset holes in driveplate are next to 1/8 inch hole in inner circle of plate (Fig. 4).

(11) Move transmission forward until seated on engine block dowels. Then install one or two transmission attaching bolts to hold transmission in place (Fig. 6).

CAUTION: It is essential that correct length bolts be used to attach the converter to the driveplate. Bolts that are too long will damage the modulated clutch surfaces in the converter. If new bolts are required, use the bolts specified in the parts catalogue only.

(12) Verify converter bolt length. Bolt measurement is from bottom (underside) of bolt head to end of bolt threads.

- On 9.5 in., 3-lug converter, bolts should be 11.7 mm (0.46 in.) long.
- On 10.75 in., 4-lug converter, bolts should be 11.2 mm (0.44 in.) long.

(13) Install torque converter bolts. Tighten bolts as follows:

- On models with 9.5 in., 3-lug converter, tighten bolts to 54 N●m (40 ft. lbs.).
- On models with 10.75 in., 4-lug converter, tighten bolts to 31 N●m (270 in. lbs.).

(14) Install and tighten remaining transmission attaching bolts (Fig. 6).

(15) Install dust cover on transmission converter housing. Two small vise grip pliers van be used to hold and align cover during installation.

(16) Install starter motor.

(17) Install strut brackets that secure transmission to engine block and front axle.

(18) Install and connect crankshaft position sensor. Be sure sensor grommet is securely in place.

(19) Install transmission fill tube. Install new O-ring seal on tube before installation (Fig. 6).

(20) Connect exhaust Y-pipe to engine exhaust manifolds.

(21) Install shift linkage torque bracket.

(22) Connect shift linkage to transmission.

(23) Connect solenoid and park/neutral position switch wires.

(24) Connect wires to transmission speed sensor and vehicle speed sensor.

(25) Install crossmember on frame rails. Place crossmember at 45° angle to rails. Insert crossmember between rails and rotate crossmember into place.

(26) Install bolts/nuts attaching transmission to rear mount.

(27) Install bolts/nuts attaching crossmember to frame rails.

(28) Remove transmission jack.

(29) Install transfer case (Fig. 7). Align and position transfer case with transmission jack or with aid of helper. Tilt case upward and work into position on transmission mounting studs.

(30) Install and tighten transfer case attaching nuts to 47 N●m (35 ft. lbs.) torque.

(31) Install damper on transfer case rear retainer if removed. Tighten damper nuts to 54 N●m (40 ft. lbs.) torque.

(32) Install and connect transfer case shift linkage.

(33) Connect transmission cooler lines to quick disconnect fittings on transmission case. Refer to In-Vehicle service section for procedures.

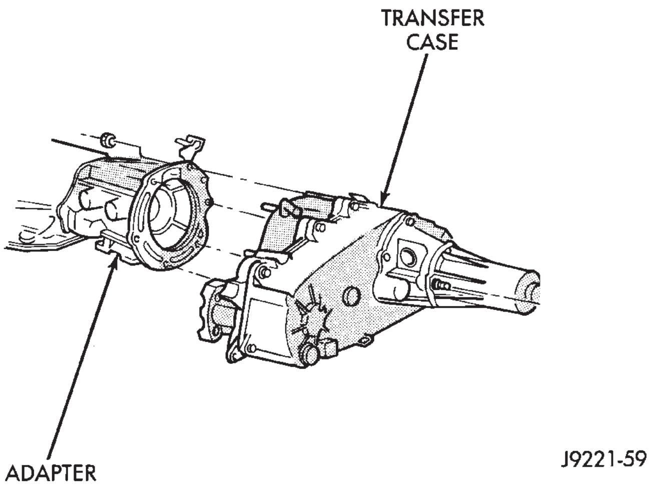


Fig. 7 Transfer Case Attachment

(34) Align and install remaining exhaust components. Tighten all clamp and bracket bolts and nuts securely. Be sure exhaust components are clear of all chassis and driveline components.

(35) Align and install front and rear propeller shafts. Tighten U-joint clamp bolts to 19 N•m (170 in. lbs.) torque.

(36) Verify that all linkage components, hoses and electrical wires have been connected.

(37) Check transfer case fluid level. Add Mopar ATF Plus, or Dexron II fluid if necessary. Correct level is to edge of fill plug hole. Be sure transfer case is level before checking or adding fluid.

(38) Install transfer case skid plate, if equipped.

(39) Lower vehicle.

(40) Connect battery negative cable.

(41) Refill transmission with Mopar ATF Plus, type 7176 fluid.

(42) Check and adjust engine oil level as necessary.

(43) Check and adjust transmission and transfer case shift linkage if necessary.

(44) Check and adjust transmission shift and throttle valve cables if necessary.

OVERDRIVE UNIT REMOVAL (4-WHEEL DRIVE)

(1) Disconnect battery negative cable.

(2) Raise vehicle on hoist.

(3) Remove transfer case skid plate, if equipped.

(4) Mark front and rear propeller shafts and U-joints for alignment reference (Fig. 1).

(5) Disconnect and remove both propeller shafts.

(6) Disconnect vehicle speed sensor and transmission speed sensor wires.

(7) Disconnect vacuum switch hoses at transfer case, if equipped.

(8) Disconnect transfer case shift linkage at transfer case range lever. Then remove linkage bracket bolts and remove linkage and bracket from transfer case. Move linkage aside for clearance.

(9) Remove nuts attaching transfer case to overdrive unit.

(10) Remove transfer case. Support transfer case with transmission jack (secure transfer case to jack with safety chains). Then move transfer case rearward and off overdrive case.

(11) Remove transfer case from jack and position it on bench.

(12) Support transmission with adjustable jack stand. Position wood block between jack and transmission case.

(13) Remove nuts and bolts attaching transmission mount to center crossmember.

(14) Remove nuts and bolts attaching crossmember to frame rails.

(15) Rotate crossmember diagonally to clear frame rails and remove crossmember.

(16) Support overdrive unit with transmission jack.

(17) Remove bolts attaching overdrive unit to transmission (Fig. 8).

CAUTION: The overdrive unit must be fully supported during removal. This is necessary to prevent damaging the intermediate shaft. Do not allow the shaft to support the entire weight of the overdrive unit.

(18) Carefully slide overdrive unit off intermediate shaft. Do not tilt overdrive unit during removal. Keep it as level as possible.

(a) If overdrive unit does not require service, **immediately insert Alignment Tool 6227-2 in splines of planetary gear and overrunning clutch (Fig. 9). If misalignment occurs, overdrive unit may have to be disassembled in order to realign splines.**

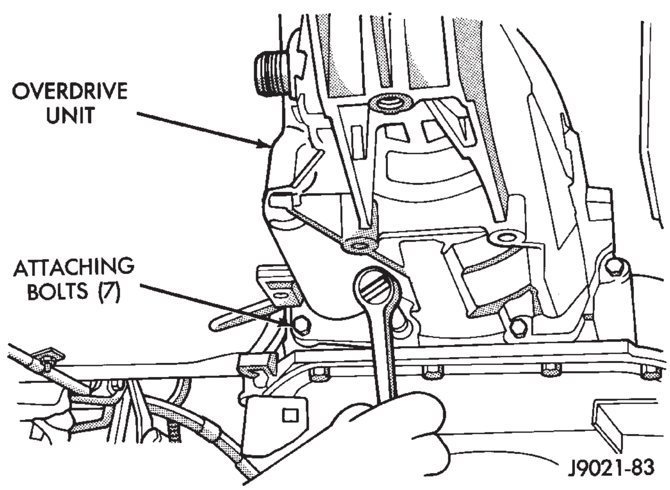


Fig. 8 Removing/Installing Overdrive Unit Attaching Bolts

(b) If overdrive unit requires service, refer to Overdrive Unit Overhaul procedures.

(19) Remove and retain bearing and select fit spacer. These parts may remain on overdrive piston, rear of transmission case, sliding hub, or intermediate shaft during removal.

(20) Place several clean shop towels on a bench. Then position unit on towels to absorb spilled fluid.

(21) Position overdrive unit over drain pan and tilt unit to drain residual fluid from case. Examine fluid for clutch material or metal fragments. If fluid contains these items, overhaul will be necessary.

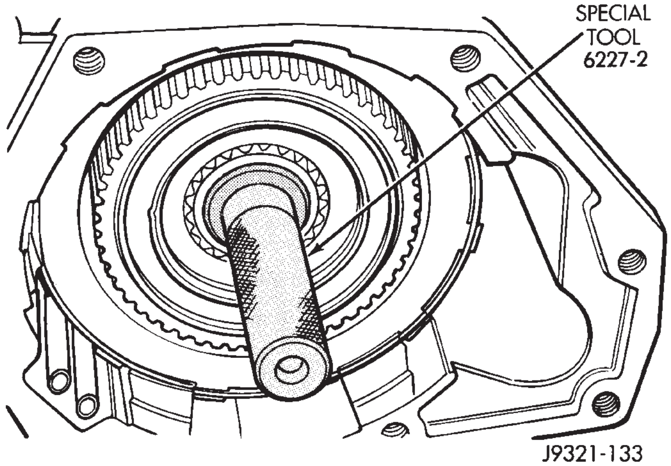


Fig. 9 Overdrive Spline Alignment Tool Installation

OVERDRIVE UNIT INSTALLATION (4-WHEEL DRIVE)

(1) Be sure Alignment Tool 6227-2 is still fully seated in splines of overdrive planetary gear and overrunning clutch. If misalignment occurs, overdrive will have to be disassembled in order to realign splines.

(2) If original case gasket is in good condition, proceed to step (6). If overdrive piston retainer was not removed during service and original case gasket is not reusable, prepare new gasket as described in steps (3) through (5).

(3) Cut out old case gasket around piston retainer with razor knife.

(4) Use old gasket as template and trim new gasket to fit (Fig. 10).

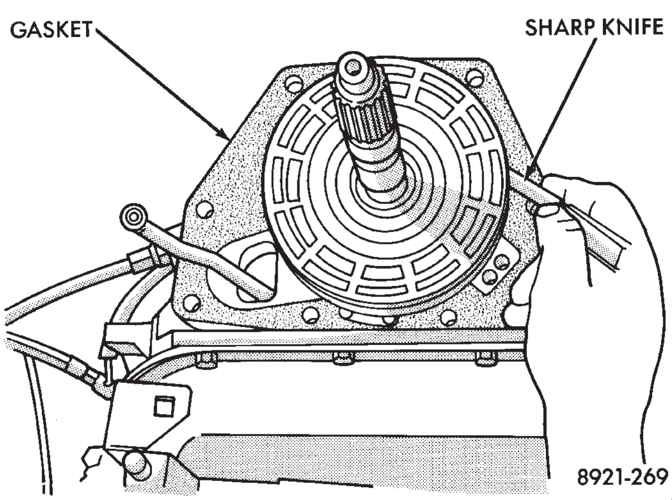


Fig. 10 Trimming Replacement Overdrive Case Gasket

(5) Position new gasket over piston retainer and on transmission case. Use petroleum jelly to hold gasket in place if necessary. **Do not use any type of sealer to secure gasket. Use petroleum jelly only.**

(6) Install selective spacer on intermediate shaft, if removed. Spacer goes in groove just rearward of shaft rear splines (Fig. 11).

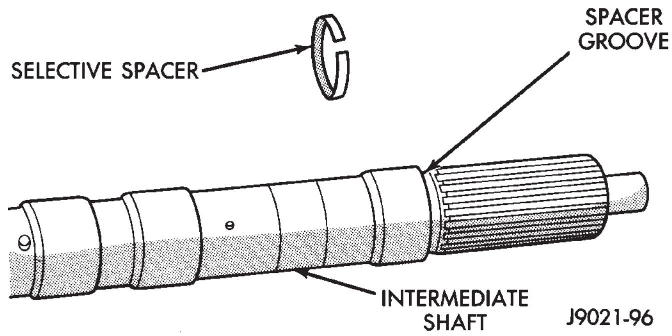


Fig. 11 Intermediate Shaft Selective Spacer Location

(7) Install overdrive piston in retainer, if removed. Lubricate piston seals with Ru-Glyde, Door-Eze or petroleum jelly to ease installation. Be sure piston locating lugs are aligned in piston retainer.

(8) Install thrust bearing in overdrive clutch hub. Use liberal quantity of petroleum jelly to hold bearing in position.

CAUTION: Be sure the shoulder on the inside diameter of the bearing is facing forward.

(9) Install thrust plate in overdrive piston hub (Fig. 12). Use liberal amount of petroleum jelly to hold thrust plate in position.

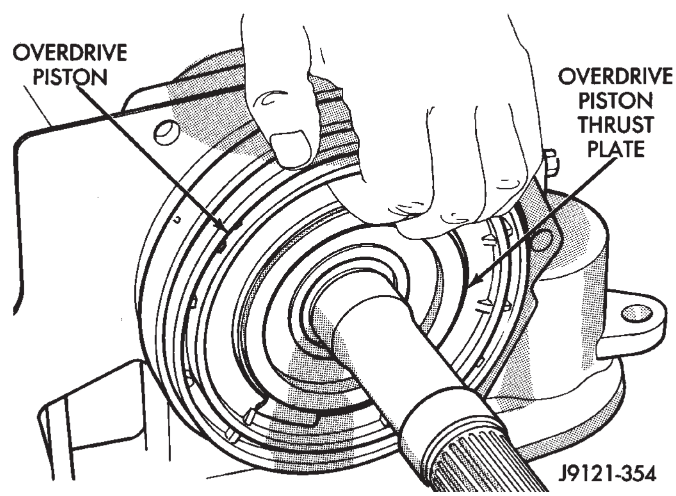


Fig. 12 Installing Overdrive Piston Thrust Plate

(10) Verify that splines in overdrive planetary gear and overrunning clutch hub are aligned with Tool 6227-2 (Fig. 8). **Overdrive unit cannot be fully installed if splines have rotated out of alignment. If misaligned has occurred, overdrive will have to be disassembled in order to realign splines.**

(11) Install overdrive unit as follows:

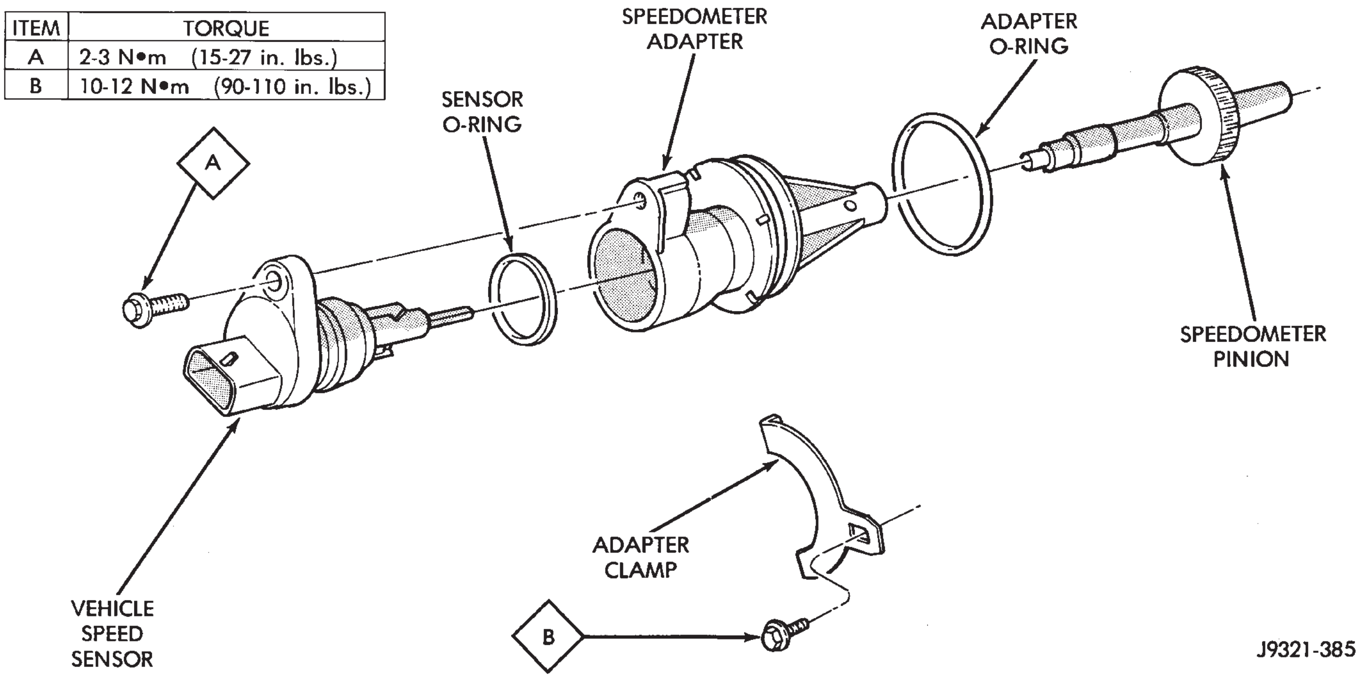


Fig. 13 Speedometer Components

(a) Raise overdrive unit and carefully slide it straight onto intermediate shaft. **Avoid tilting overdrive unit during installation as planetary gear and overrunning clutch splines could rotate out of alignment. If misalignment occurs, overdrive will have to be disassembled in order to realign splines.**

(b) Align and carefully insert park rod into park pawl. Rod will make click noise as it enters pawl. Move rod rearward slightly

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into this cavity. If the rod enters the cavity during installation, it will become bent when the overdrive bolts are tightened. The rod will then have to be replaced because it is not repairable.

(c) Work overdrive unit forward on intermediate shaft until seated against transmission case. If unit is not fully seated, tighten overdrive bolts to draw unit against transmission case.

(12) Apply Mopar Lock N' Seal or Loctite 242 to threads of overdrive attaching bolts.

(13) Install and tighten overdrive unit attaching bolts to 34 N●m (25 ft. lbs.).

(14) Install transfer case. Tighten attaching nuts to 41 N●m (30 ft. lbs.) torque.

(15) Connect transmission throttle valve and gear shift cables and connect transfer case shift linkage.

(16) Install crossmember and rear mount.

(17) Connect all necessary electrical wires.

(18) Install and index speedometer adapter and pinion if removed. Refer to In-Vehicle Service section for indexing procedure.

(19) Align and connect propeller shafts. Tighten U-joint clamp bolts to 19 N●m (170 in. lbs.) torque.

(20) Check and adjust fluid level in transfer case. Use Mopar ATF Plus, type 7176. Mopar Dexron II can be used if ATF Plus is not readily available.

(21) Install skid plate, if equipped.

(22) Check and adjust transmission and transfer case shift linkage if necessary.

(23) Lower vehicle.

(24) Check and adjust transmission fluid level. Use Mopar ATF Plus, type 7176 fluid. Do not use Mopar Dexron II unless ATF Plus is not available.

OVERDRIVE UNIT REMOVAL (2-WHEEL DRIVE)

(1) Disconnect battery negative cable.

(2) Raise vehicle on hoist.

(3) Remove exhaust Y-pipe, catalytic converter and tailpipe.

(4) Mark propeller shaft and U-joint for alignment reference (Fig. 1).

(5) Disconnect and remove propeller shaft.

(6) Disconnect vehicle speed sensor and transmission speed sensor wires.

(7) Support transmission with adjustable jack stand and wood block.

(8) Remove nuts and bolts attaching transmission mount to center crossmember.

(9) Remove nuts and bolts attaching crossmember to frame rails.

(10) Rotate crossmember diagonally to clear frame rails and remove crossmember.

(11) Support overdrive unit with transmission jack.

(12) Remove bolts attaching overdrive unit to transmission (Fig. 8).

CAUTION: The overdrive unit must be fully supported during removal. This is necessary to prevent damaging the intermediate shaft. Do not allow the shaft to support the entire weight of the overdrive unit.

(13) Carefully slide overdrive unit off intermediate shaft. Do not tilt overdrive unit during removal. Keep it as level as possible.

(a) If overdrive unit does not require service, **immediately insert Alignment Tool 6227-2 in splines of planetary gear and overrunning clutch (Fig. 9). If misalignment occurs, overdrive unit may have to be disassembled in order to realign splines.**

(b) If overdrive unit requires service, refer to Overdrive Unit Overhaul procedures.

(14) Remove and retain bearing and select fit spacer. These parts may remain on overdrive piston, rear of transmission case, sliding hub, or intermediate shaft during removal.

(15) Place several clean shop towels on a bench. Then position unit on towels to absorb spilled fluid.

(16) Position overdrive unit over drain pan and tilt unit to drain residual fluid from case. Examine fluid for clutch material or metal fragments. If fluid contains these items, overhaul will be necessary.

OVERDRIVE UNIT INSTALLATION (2-WHEEL DRIVE)

(1) Be sure Alignment Tool 6227-2 is still fully seated in splines of overdrive planetary gear and overrunning clutch. If misalignment occurs, overdrive will have to be disassembled in order to realign splines.

(2) If original case gasket is in good condition, proceed to step (6). If overdrive piston retainer was not removed during service and original case gasket is not reusable, prepare new gasket as described in steps (3) through (5).

(3) Cut out old case gasket around piston retainer with razor knife.

(4) Use old gasket as template and trim new gasket to fit (Fig. 10).

(5) Position new gasket over piston retainer and on transmission case. Use petroleum jelly to hold gasket in place if necessary. **Do not use any type of sealer to secure gasket. Use petroleum jelly only.**

(6) Install selective spacer on intermediate shaft, if removed. Spacer goes in groove just rearward of shaft rear splines (Fig. 11).

(7) Install overdrive piston in retainer, if removed. Lubricate piston seals with Ru-Glyde, Door-Eze or petroleum jelly to ease installation. Be sure piston locating lugs are aligned in piston retainer.

(8) Install thrust bearing in overdrive clutch hub. Use liberal quantity of petroleum jelly to hold bearing in position.

CAUTION: Be sure the shoulder on the inside diameter of the bearing is facing forward.

(9) Install thrust plate in overdrive piston hub (Fig. 12). Use liberal amount of petroleum jelly to hold thrust plate in position.

(10) Verify that splines in overdrive planetary gear and overrunning clutch hub are aligned with Tool 6227-2 (Fig. 8). **Overdrive unit cannot be fully installed if splines have rotated out of alignment. If misaligned has occurred, overdrive will have to be disassembled in order to realign splines.**

(11) Install overdrive unit as follows:

(a) Raise overdrive unit and carefully slide it straight onto intermediate shaft. **Avoid tilting overdrive unit during installation as planetary gear and overrunning clutch splines could rotate out of alignment. If misalignment occurs, overdrive will have to be disassembled in order to realign splines.**

(b) Align and carefully insert park rod into park pawl. Rod will make click noise as it enters pawl. Move rod slightly to check engagement.

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and ha not displaced into this case cavity. If the rod enters the cavity during installation, it will become bent when the overdrive bolts are tightened. If this occurs, the rod will have to be replaced because it is not repairable.

(c) Work overdrive unit forward on intermediate shaft until seated against transmission case. If unit is not fully seated, tighten overdrive bolts to draw it up against transmission case.

(12) Apply Mopar Lock N' Seal or Loctite 242 to threads of overdrive attaching bolts.

(13) Install and tighten overdrive unit attaching bolts to 34 N●m (25 ft. lbs.).

(14) Install transfer case. Tighten attaching nuts to 41 N●m (30 ft. lbs.) torque.

(15) Connect transmission throttle valve and gear shift cables.

(16) Install crossmember and rear mount.

(17) Connect all necessary electrical wires.

(18) Install and index speedometer adapter and pinion (Fig. 13). Refer to In-Vehicle Service section for indexing procedure.

(19) Align and connect propeller shaft. Tighten U-joint clamp bolts to 19 N●m (170 in. lbs.) torque.

(20) Install exhaust system components.

(21) Lower vehicle.

(22) Connect battery negative cable.

(23) Check and adjust transmission shift and throttle valve cables if necessary.

(24) Check and adjust transmission fluid level. Use Mopar ATF Plus, type 7176 fluid.

TRANSMISSION OVERHAUL—42RE

INDEX

TRANSMISSION DISASSEMBLY

(1) Remove torque converter if not previously removed.

(2) Clean transmission exterior with steam gun or with solvent. Wear eye protection during cleaning operations.

(3) Remove shift and throttle levers from valve body manual lever shaft.

(4) Remove transmission speed sensor and O-ring seal from overdrive unit (Fig. 1).

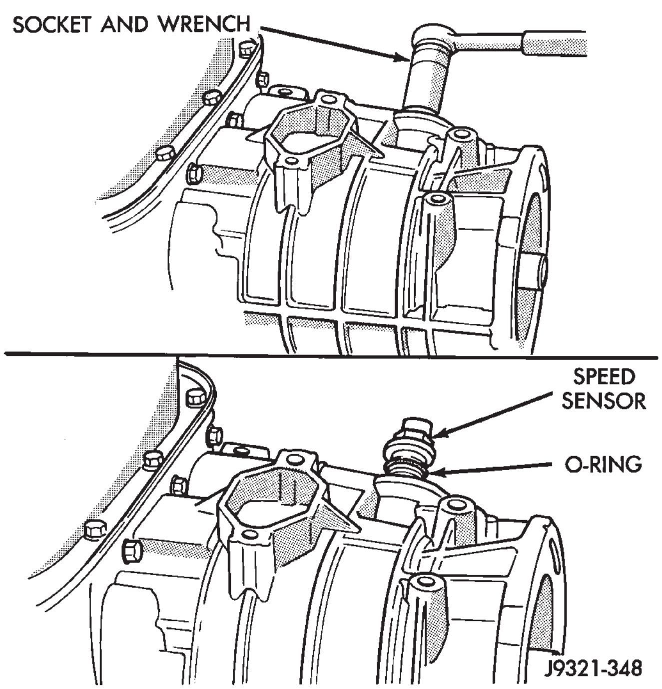


Fig. 1 Transmission Speed Sensor Removal/Installation

(5) Place transmission in upright position (Fig. 2).

(6) Remove bolts attaching overdrive unit to transmission case (Fig. 2). An 11 mm socket is required. Note position of all wiring clips for installation reference.

(7) Lift overdrive unit up and off transmission intermediate shaft (Fig. 3).

(a) If overdrive unit does not require service, insert Alignment Tool 6227-2 in overrunning clutch

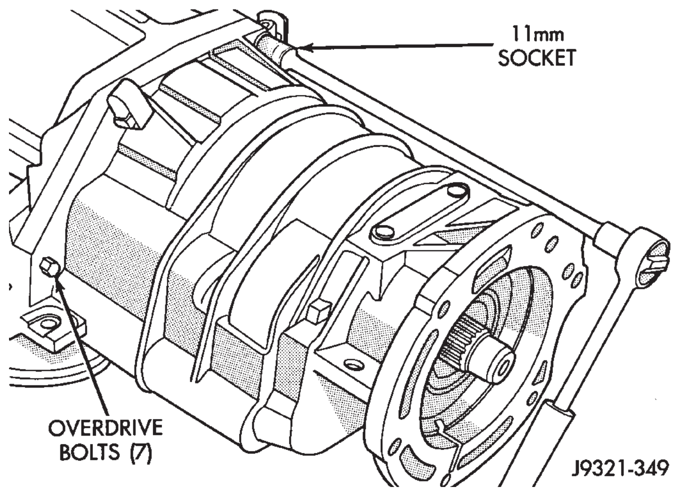


Fig. 2 Removing/Installing Overdrive Unit Attaching Bolts

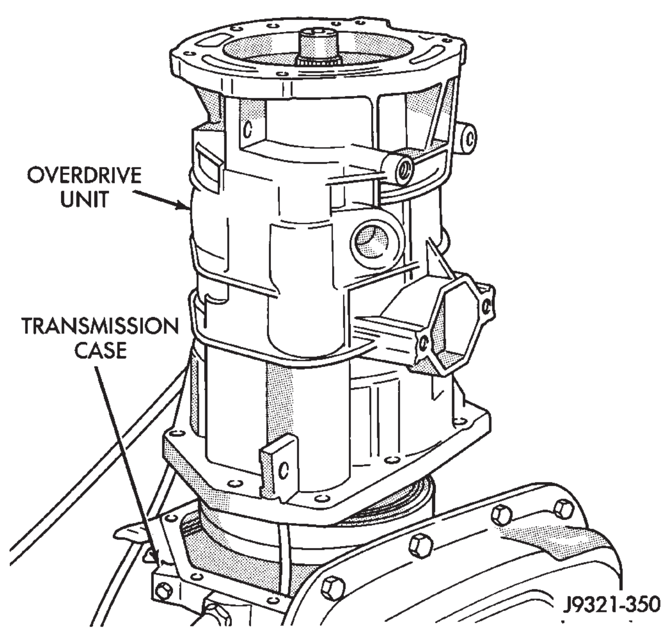


Fig. 3 Overdrive Unit Removal

and planetary gear splines to maintain alignment (Fig. 4). **If clutch and gear splines rotate out of**

alignment, overdrive unit may have to be disassembled in order to realign splines.

(b) If overdrive unit **does** requires service, refer to Overdrive Unit Overhaul section.

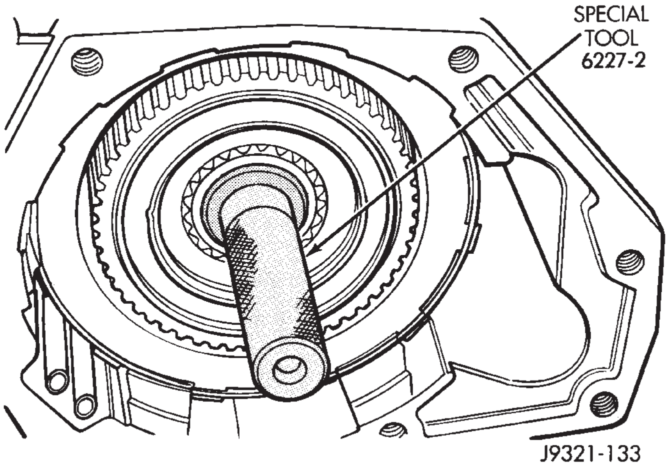


Fig. 4 Overdrive Spline Alignment Tool Installation

(8) Remove thrust bearing and thrust plate from overdrive piston (Fig. 5).

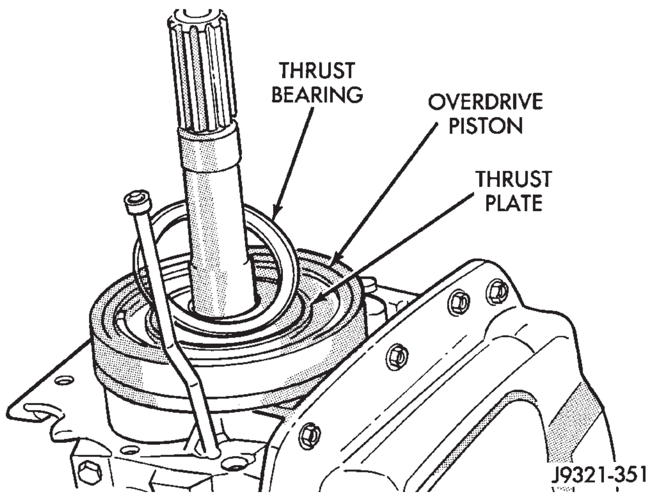


Fig. 5 Thrust Bearing And Plate Removal

(9) Place transmission in horizontal position.

(10) Remove transmission oil pan and gasket.

(11) Remove oil filter from valve body (Fig. 6). Keep filter screws separate from other valve body screws. Filter screws are longer and should be kept with filter.

(12) Remove overdrive piston from retainer (Fig. 7).

(13) Remove pump oil seal with Special Tool C-3981 (Fig. 8). Be sure to tighten tool threads completely into seal before using puller bolt to withdraw seal.

(14) Remove park/neutral position switch (Fig. 9).

(15) Remove hex head bolts attaching valve body to transmission case (Fig. 10). A total of 10 bolts are used. Note different bolt lengths for assembly reference.

(16) Remove valve body assembly. Push valve body harness connector out of case. Then work park rod and valve body out of case (Fig. 11). **Exercise care**

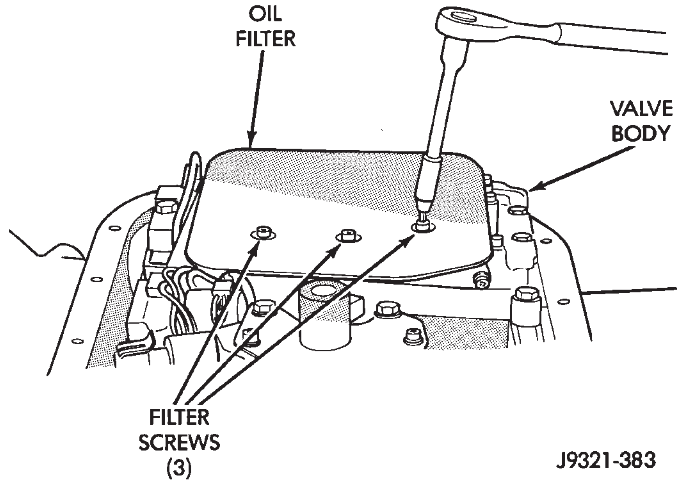


Fig. 6 Oil Filter Removal/Installation

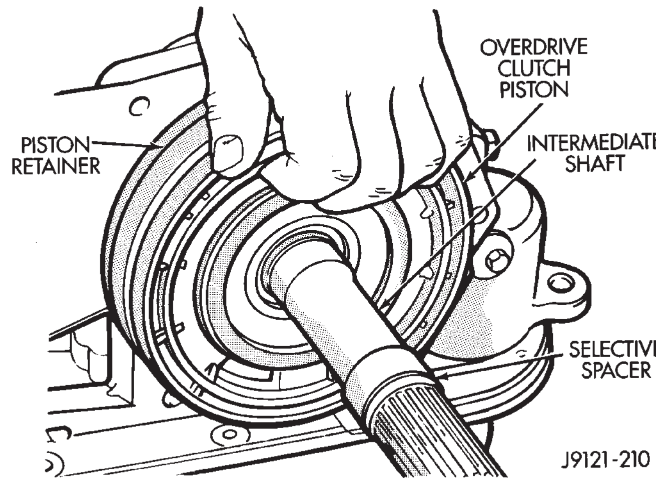


Fig. 7 Overdrive Piston Removal

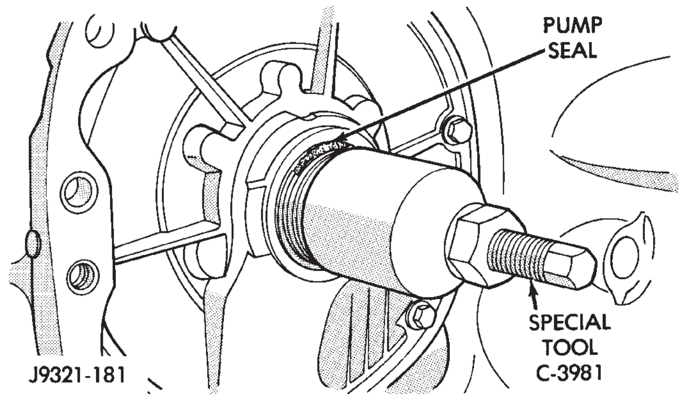


Fig. 8 Oil Pump Seal Removal

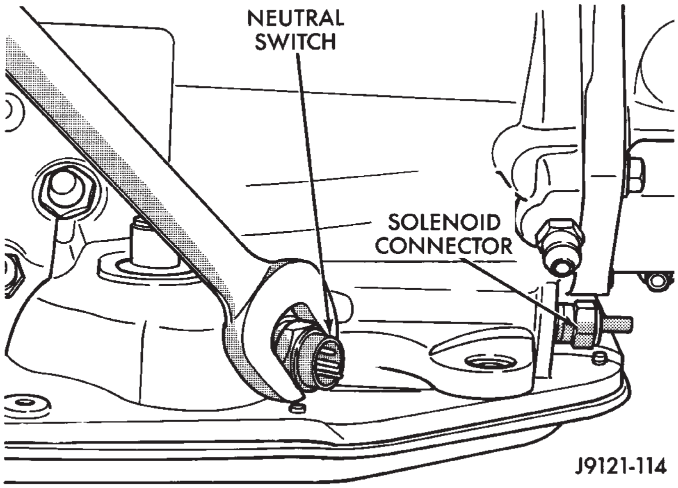


Fig. 9 Park/Neutral Position Switch Removal/Installation

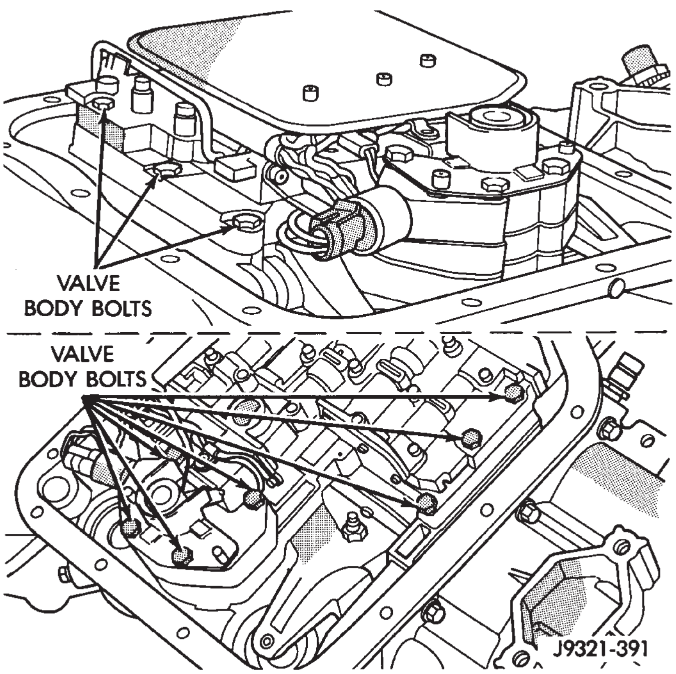


Fig. 10 Valve Body Bolt Locations

during removal as governor pressure solenoid and transducer can both be damaged by rough handling.

(17) Remove accumulator piston and inner and outer springs (Fig. 11).

(18) Remove front band lever shaft access plug (Fig. 13). Plug is accessible through converter housing. Use 1/4 inch drive extension to remove plug as shown.

(19) 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.

(20) Remove oil pump bolts.

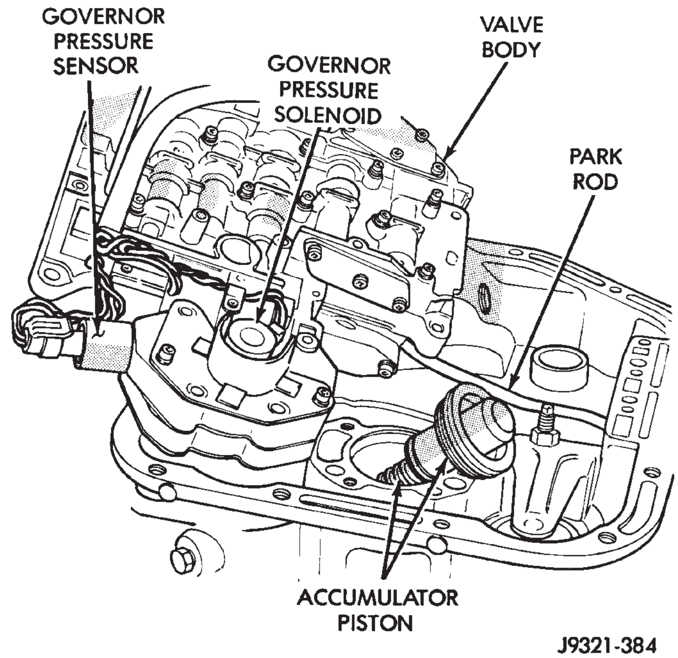


Fig. 11 Valve Body Removal

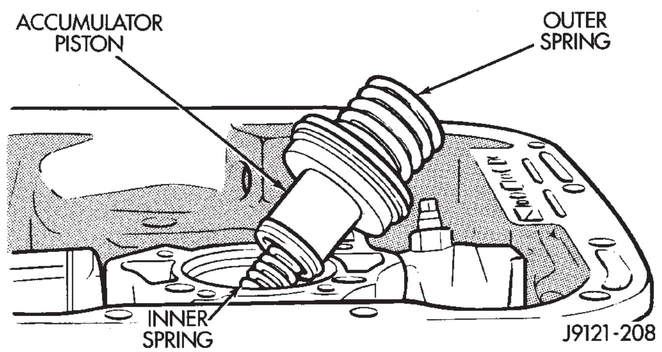


Fig. 12 Accumulator Piston And Springs

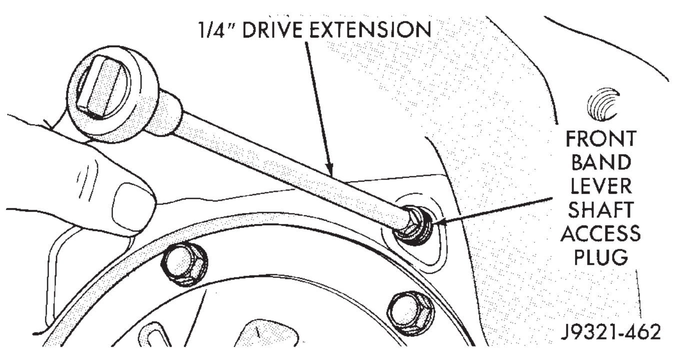


Fig. 13 Removing/Installing Front Band Lever Shaft Access Plug

(21) Thread bolts of Slide Hammer Tools C-3752 into threaded holes in pump body flange (Fig. 14).

(22) Bump slide hammer weights outward to remove pump and reaction shaft support assembly from case (Fig. 14).

(23) Loosen front band adjusting screw until band is completely loose.

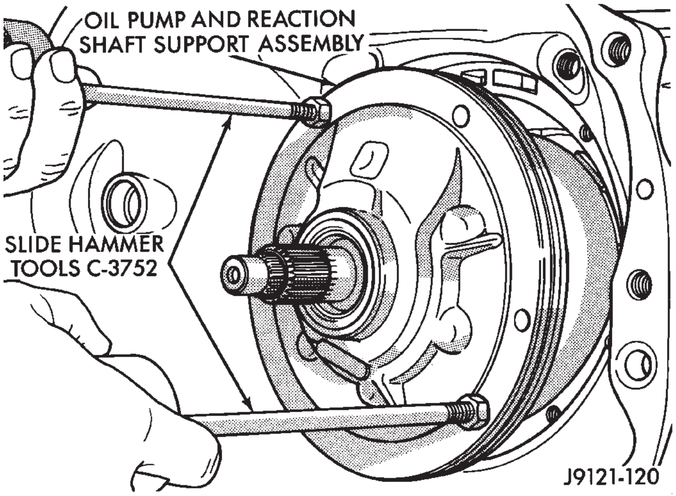


Fig. 14 Removing Oil Pump And Reaction Shaft Support Assembly

(24) Squeeze front band together and remove band strut (Fig. 15).

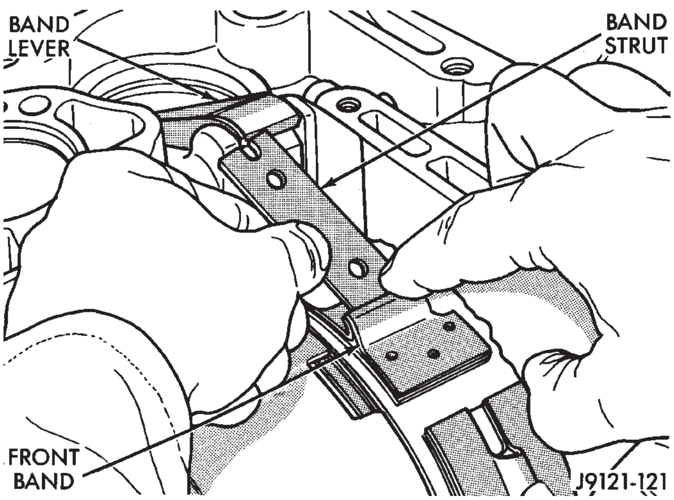


Fig. 15 Removing/Installing Front Band Strut

(25) Remove front band lever shaft with pencil magnet. Pin is accessible from converter housing side of case (Fig. 16).

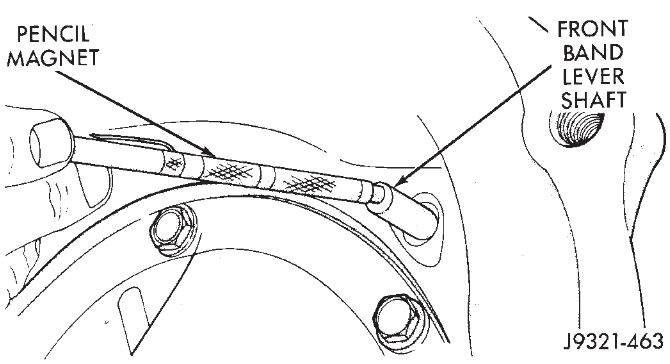


Fig. 16 Removing Front Band Lever Shaft

(26) Remove front band lever (Fig. 17)

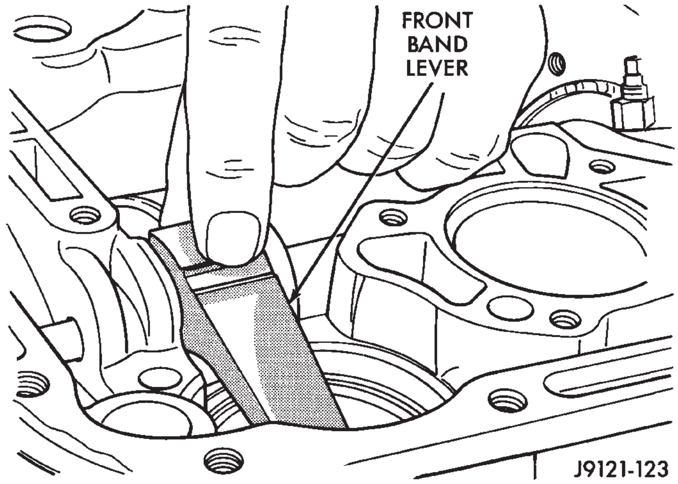


Fig. 17 Removing/Installing Front Band Lever

(27) Slide front band rearward and onto driving shell. Band will not be removed until after front/rear clutch removal.

(28) Remove front and rear clutch units as assembly. Grasp input shaft, hold clutch units together and remove them from case (Fig. 18).

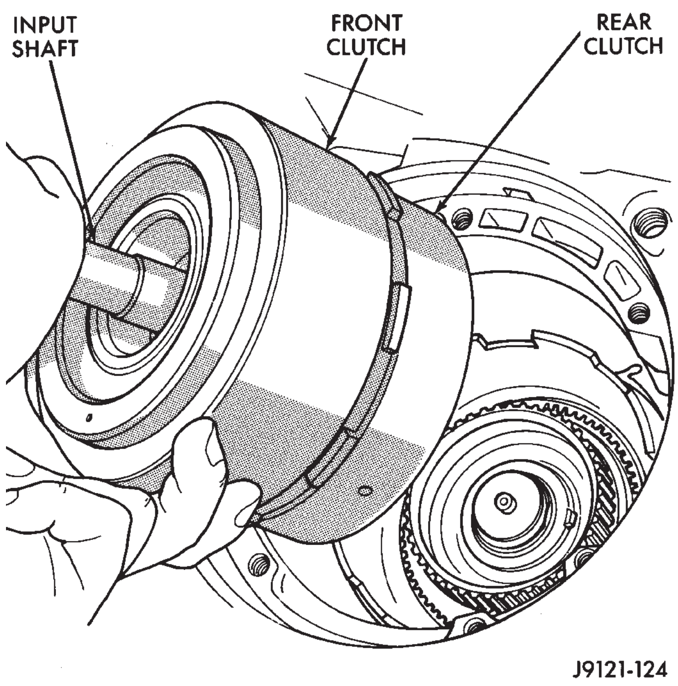


Fig. 18 Removing Front/Rear Clutch Assemblies

(29) Lift front clutch off rear clutch (Fig. 19). Set clutch units aside for overhaul.

(30) Remove intermediate shaft thrust washer from front end of shaft or from rear clutch hub (Fig. 20).

(31) Remove output shaft thrust plate from intermediate shaft hub (Fig. 21).

(32) Slide front band off driving shell (Fig. 22) and remove band from case.

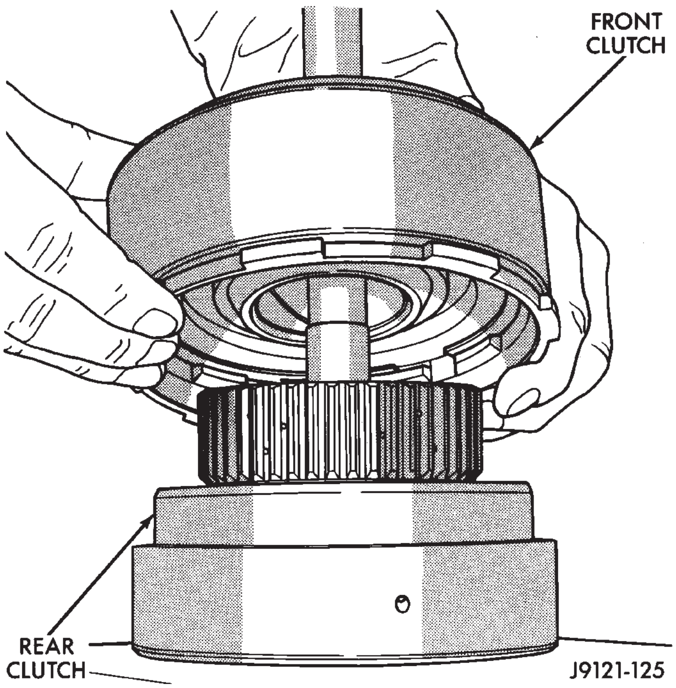


Fig. 19 Separating Front/Rear Clutch Assemblies

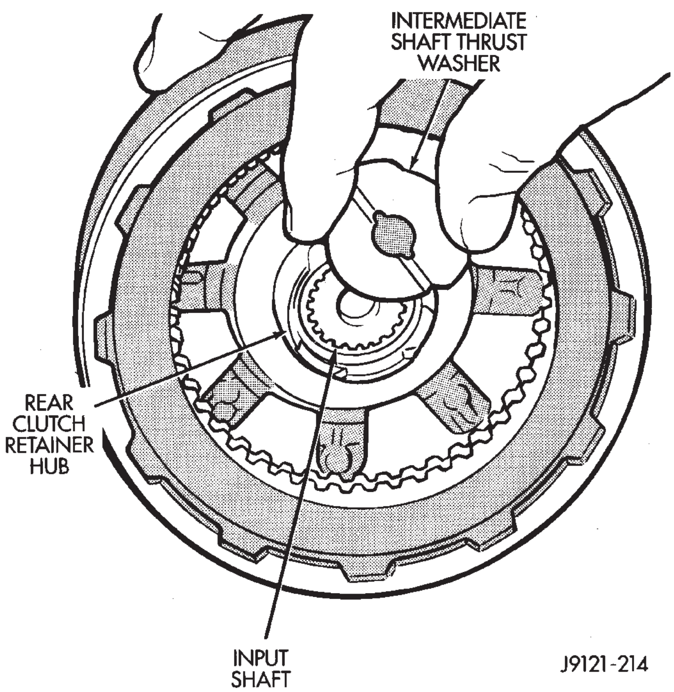


Fig. 20 Removing Intermediate Shaft Thrust Washer

(33) Remove planetary geartrain as assembly (Fig. 23). Support geartrain with both hands during removal. Do not allow machined surfaces on intermediate shaft or overdrive piston retainer to become nicked or scratched.

(34) Loosen rear band adjusting screw 4-5 turns.

(35) Remove low-reverse drum snap ring (Fig. 24).

(36) Remove bolts attaching overdrive piston retainer to rear of case (Fig. 25). Then remove piston retainer and gasket.

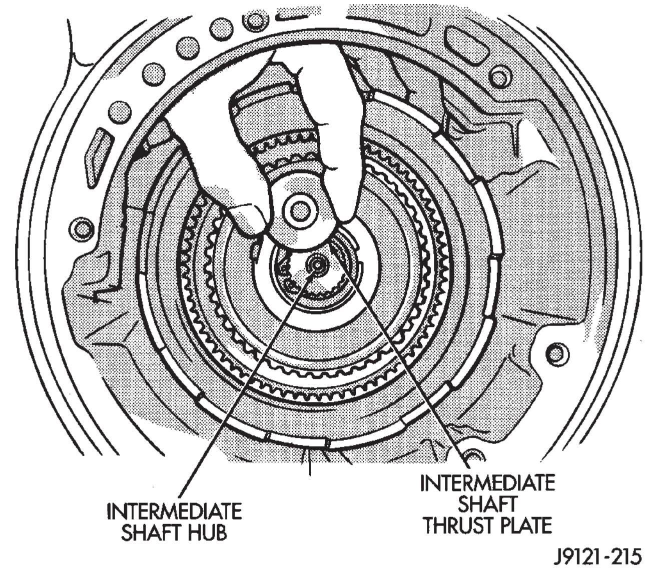


Fig. 21 Removing Intermediate Shaft Thrust Plate

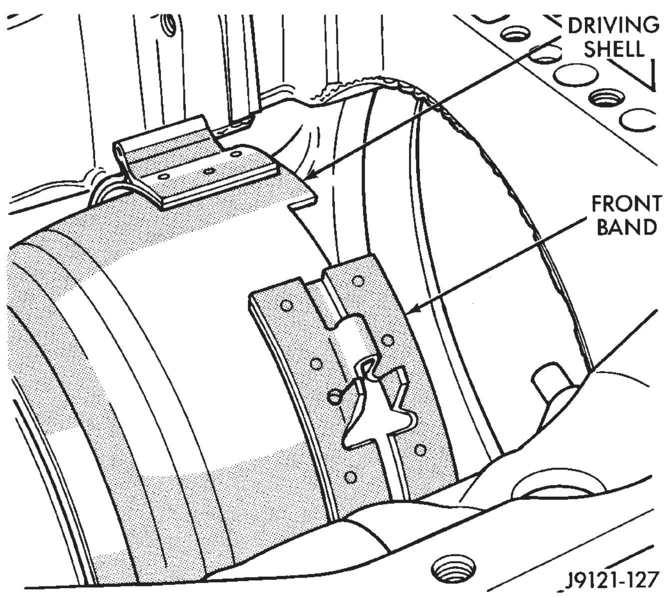


Fig. 22 Front Band Removal/Installation

(37) Remove rear band pivot and reaction pins (Fig. 26). Use parallel jaw snap ring pliers to remove pins. Insert and spread plier jaws in pin bore to grip pin. Then twist and pull pins to remove them.

(38) Remove rear band lever.

(39) Remove low-reverse drum and rear band as assembly. Turn drum clockwise and pull outward to remove it from overrunning clutch (Fig. 27).

(40) Remove bolts attaching overrunning clutch cam to case (Fig. 28).

(41) Remove overrunning clutch cam and roller clutch assembly as a unit (Fig. 29). Turn cam back and forth and tilt it inward to remove it from case.

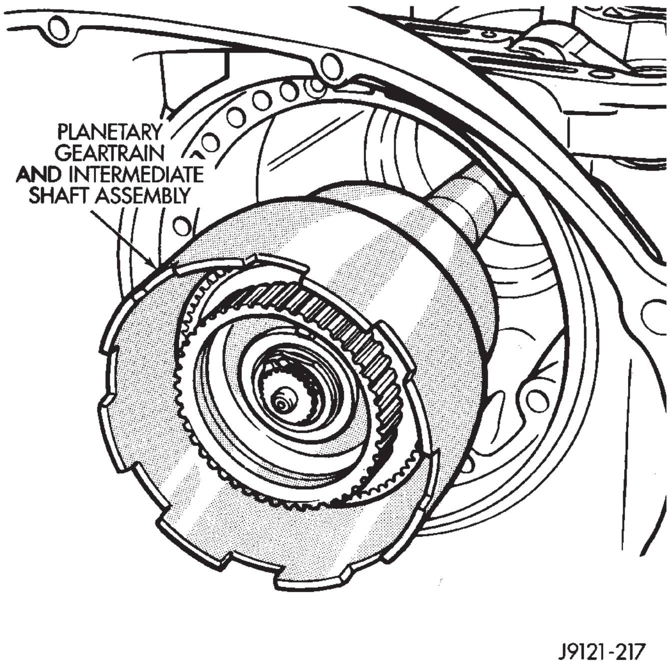


Fig. 23 Removing Planetary Geartrain And Intermediate Shaft Assembly

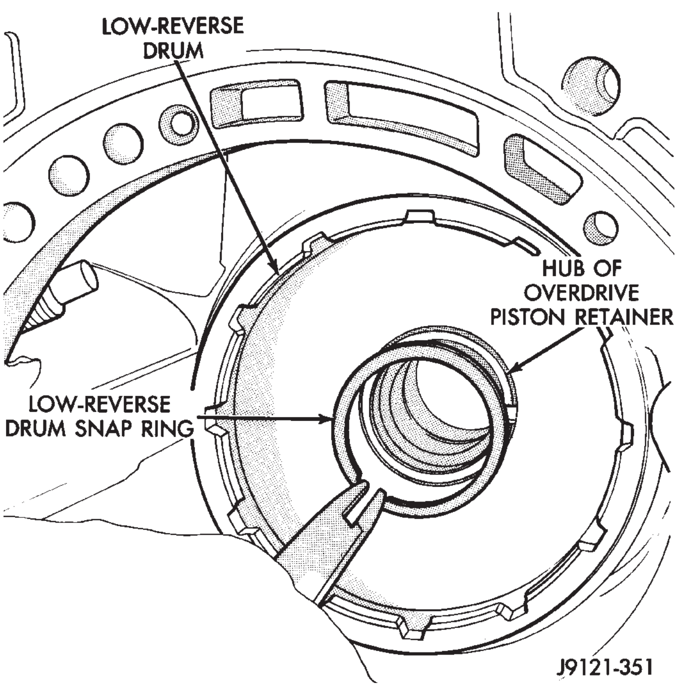


Fig. 24 Removing Low-Reverse Drum Snap Ring

(42) Compress front servo rod guide about 1/8 inch with Valve Spring Compressor C-3422-B (Fig. 30). A C-clamp and Special Tool C-4470 can also be used to compress rod guide.

(43) Remove front servo rod guide snap ring. **Exercise caution when removing snap ring. Servo bore can be scratched or nicked if care is not exercised.**

(44) Remove compressor tools and remove front servo rod guide, spring and servo piston.

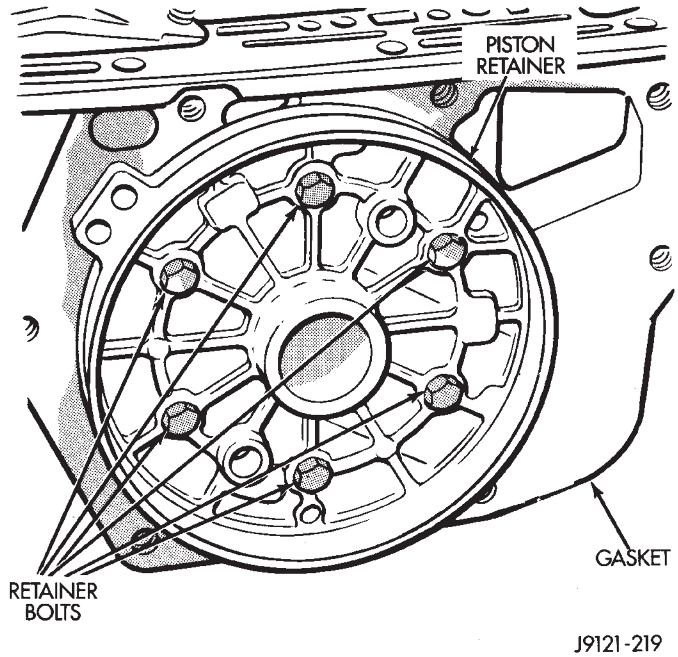


Fig. 25 Overdrive Piston Retainer Bolt Location

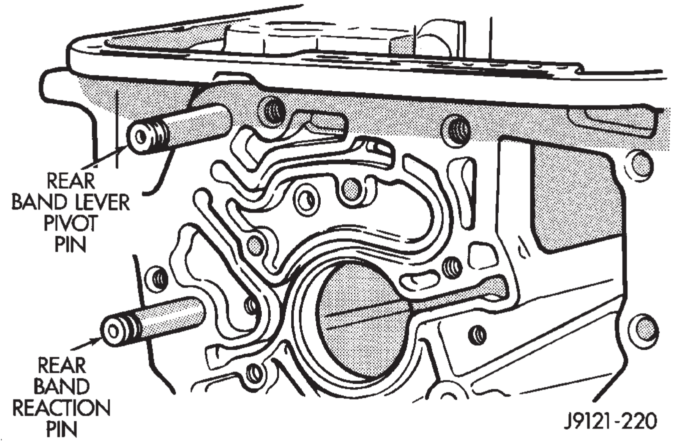


Fig. 26 Rear Band And Lever Pin Location

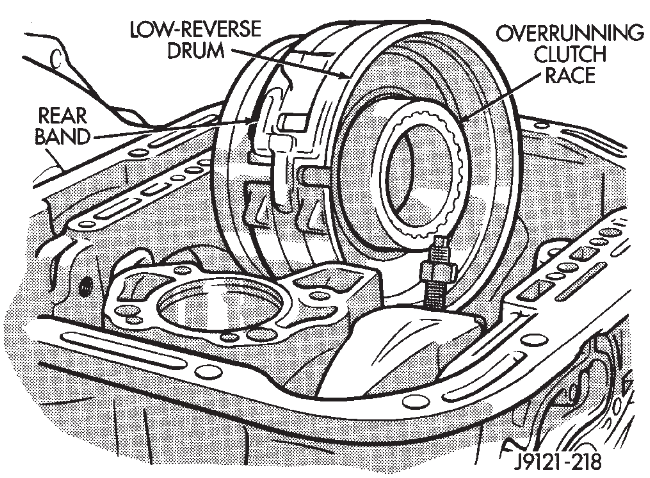


Fig. 27 Low-Reverse Drum And Rear Band Removal

(45) Compress rear servo spring retainer about 1/16 inch with Valve Spring Compressor C-3422-B

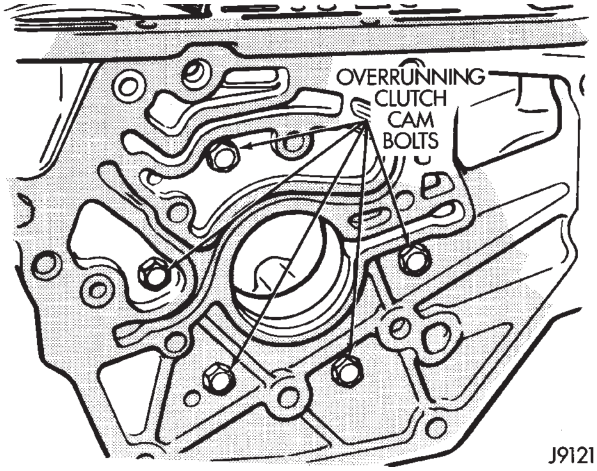


Fig. 28 Overrunning Clutch Cam Bolt Locations

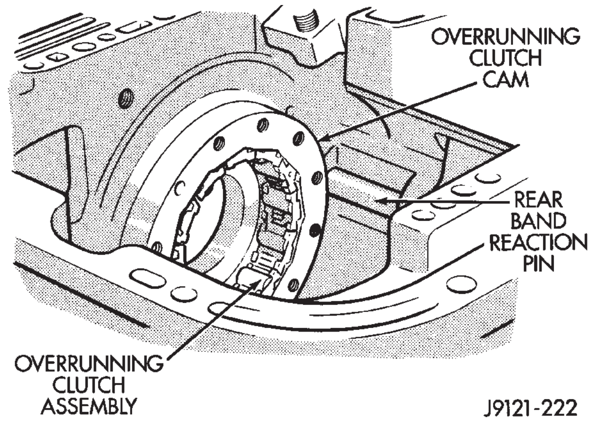


Fig. 29 Overrunning Clutch Assembly Removal

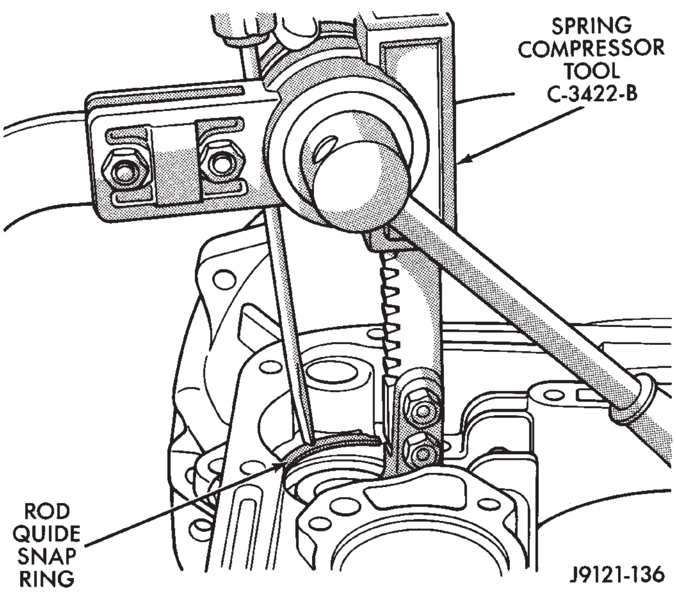


Fig. 30 Compressing Front Servo Rod Guide

(Fig. 31). A C-clamp and Tool C-4470 or SP-5560 can also be used to compress spring retainer.

(46) Remove rear servo spring retainer snap ring. Then remove compressor tools and remove rear servo spring and piston.

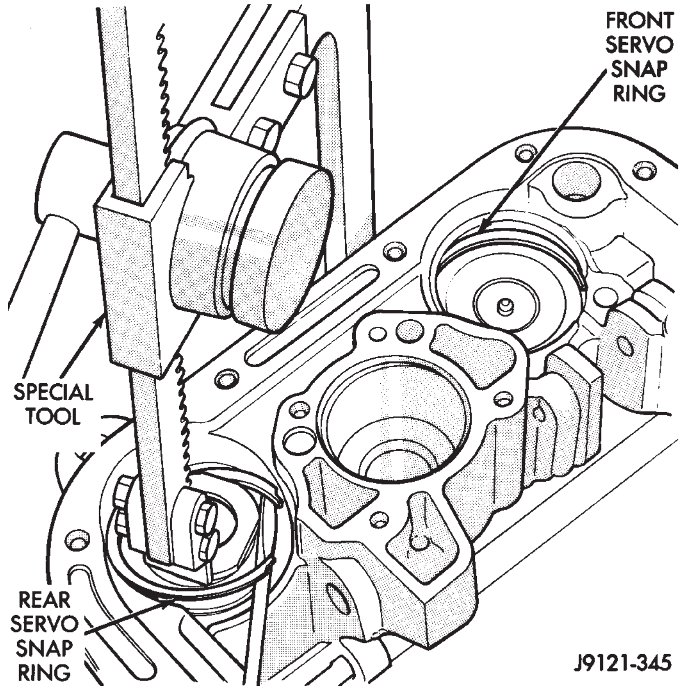


Fig. 31 Compressing Rear Servo Spring

(47) Inspect transmission and overdrive components. **If major components such as the overdrive unit, front clutch, or oil pump require service, refer to appropriate overhaul procedure.**

OVERHAUL SERVICE INFORMATION

Inspect the transmission bushings during overhaul. Bushing condition is important as worn, scored bushings contribute to low pressures, clutch slip and accelerated wear of other components. However, do not replace bushings as a matter of course. Replace bushings only when they are actually worn, or scored.

Use recommended tools to replace bushings. The tools are sized and designed to remove, install, and seat bushings correctly. The bushing replacement tools are included in Bushing Tool Set C-3887-B.

Pre-sized service bushings are available for replacement purposes. Only the sun gear bushings are not serviced. The sun gear is replaced as an assembly if the bushings are damaged.

Heli-Coil inserts can be used to repair damaged, stripped or worn threads in aluminum parts. These inserts are available from most automotive jobbers. Stainless steel inserts are recommended.

The use of crocus cloth is permissible where necessary, providing it is used carefully. When used on shafts, or valves, use extreme care to avoid rounding off sharp edges. Sharp edges are vital as they prevent foreign matter from getting between the valve and valve bore.

Do not reuse oil seals, gaskets, seal rings, or O-rings during overhaul. Replace these parts as a matter of course. Also do not reuse snap rings or E-clips that are bent or distorted. Replace these parts as well.

Lubricate transmission parts with Mopar ATF Plus, Type 7176, or Dexron II™ transmission fluid during overhaul and assembly. Use Ru-Glyde, Door-Eze or similar products to prelubricate seals, O-rings, and thrust washers. Petroleum jelly can also be used to lubricate and hold parts in place during reassembly.

TRANSMISSION CASE CLEANING AND INSPECTION

Clean the case in a solvent tank. Flush the case bores and fluid passages thoroughly with solvent. Dry the case and all fluid passages with compressed air. Be sure all solvent is removed from the case and that all fluid passages are clear.

Do not use shop towels or rags to dry the case (or any other transmission component) unless they are made from lint-free materials. Lint will stick to case surfaces and transmission components and circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

Inspect the case for cracks, porous spots, worn bores, or damaged threads. Damaged threads can be repaired with Helicoil thread inserts. However, the case will have to be replaced if it exhibits any type of damage or wear.

Lubricate the front band adjusting screw threads with petroleum jelly and thread the screw part-way into the case. Be sure the screw turns freely.

OVERRUNNING CLUTCH, LOW-REVERSE DRUM AND OVERDRIVE PISTON RETAINER INSPECTION AND OVERHAUL

If the overrunning clutch and cam came out with the low-reverse drum, remove the cam and clutch from the drum as follows: Thread two clutch cam bolts into the cam. Then lift the clutch and cam out of the drum with the bolts (Fig. 32). Rotate the cam back and forth to ease removal if necessary.

CLEANING AND INSPECTION

Clean the clutch rollers, springs and retainer, clutch cam, low-reverse drum and overdrive piston retainer in solvent. Air dry the rollers after cleaning.

Inspect condition of each clutch part after cleaning. Replace the rollers and the retainer and spring assembly if the rollers, springs or spring retainer are worn or damaged. Replace the clutch cam if worn, cracked or damaged.

Inspect the overrunning clutch race and low-reverse drum. Replace the drum and race as an assembly if either part is worn, scored or damaged.

Examine the overdrive piston retainer carefully for wear, cracks, scoring or other damage. Be sure the retainer hub is a snug fit in the case and low-reverse drum. Replace the retainer if worn or damaged.

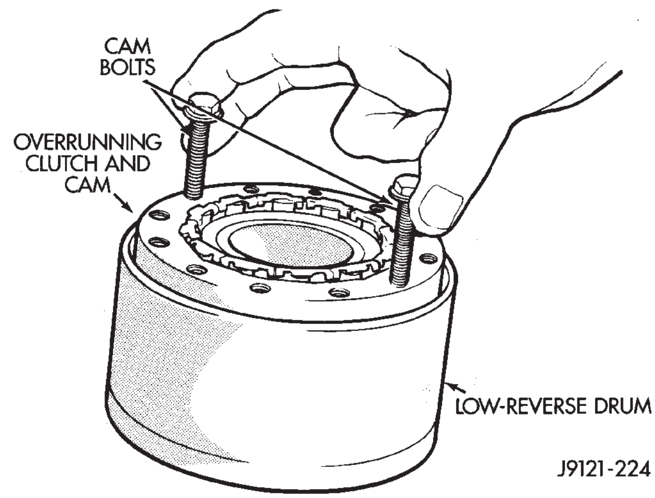


Fig. 32 Removing Overrunning Clutch From Low-Reverse Drum

OVERRUNNING CLUTCH ASSEMBLY

(1) Install clutch rollers in spring retainer (Fig. 33). Be sure springs are seated squarely against rollers.

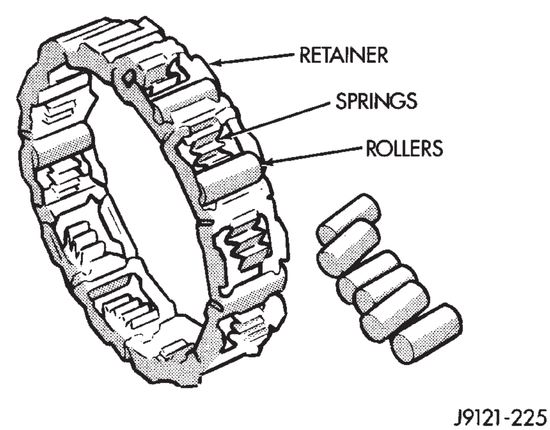


Fig. 33 Installing Overrunning Clutch Rollers In Retainer

(2) Install roller and spring assembly in clutch cam (Fig. 34).

(3) Lubricate overrunning clutch rollers, springs cam and race with transmission fluid. Verify component installation before proceeding. Bolt holes in clutch cam are countersunk on one side. Be sure this side of cam will face rearward as shown (Fig. 34).

(4) Inspect bolt holes in overrunning clutch cam. Note that one hole is **not** threaded. Identify location of non threaded hole with paint mark for assembly reference (Fig. 35).

(5) Set assembly aside for final installation after overhaul is complete.

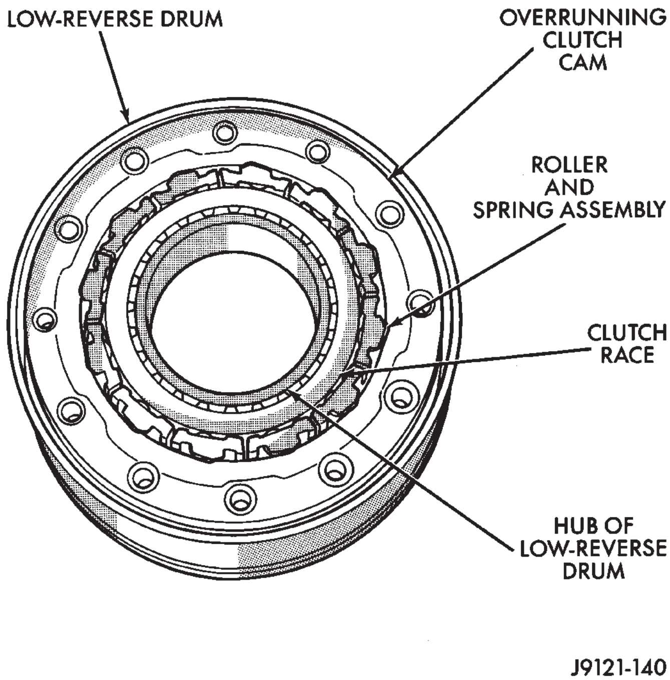


Fig. 34 Checking Overrunning Clutch Installation

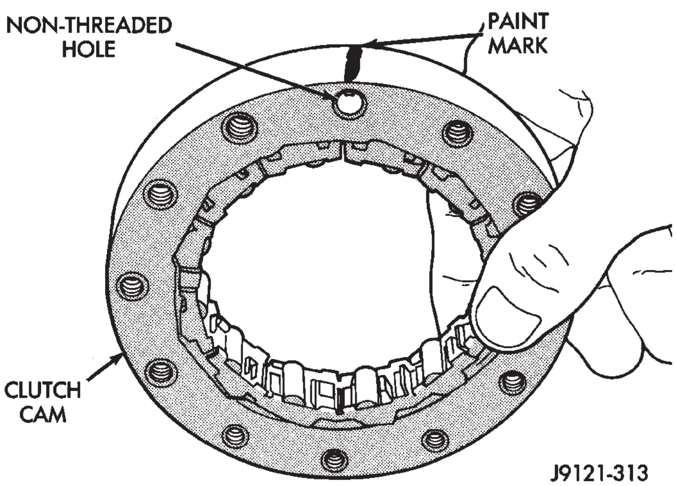


Fig. 35 Marking Location Of Non-Threaded Hole In Clutch Cam

OIL PUMP AND REACTION SHAFT SUPPORT OVERHAUL

PUMP AND SUPPORT DISASSEMBLY

(1) Remove seal from around pump housing (Fig. 36).

(2) Loosen bolts that attach pump body to support (Fig. 37).

(3) Remove pump-to-support bolts and separate support from pump housing (Fig. 38).

(4) Remove inner and outer gears from reaction shaft support (Fig. 39).

(5) If pump seal was not removed during transmission disassembly, remove seal with punch and hammer.

(6) Remove front clutch thrust washer from support hub (Fig. 40). Note position of chamfer on washer inside diameter for installation reference. Chamfer side faces pump.

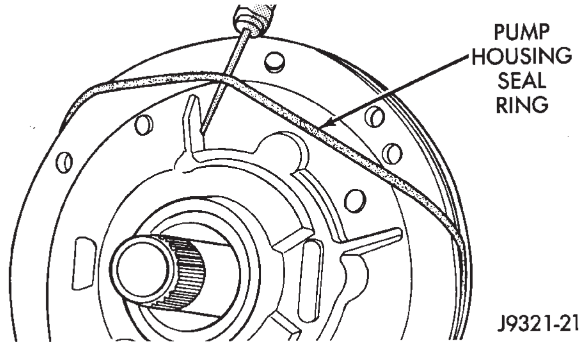


Fig. 36 Removing Pump Housing Seal

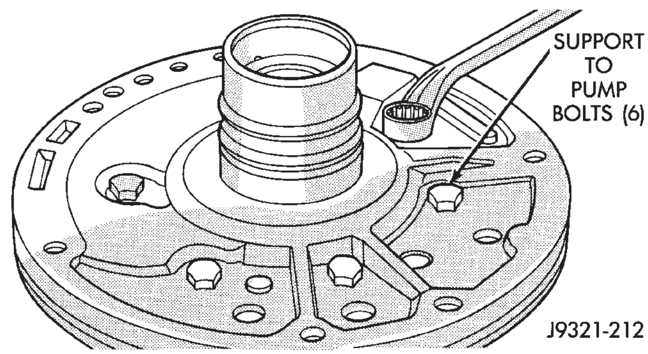


Fig. 37 Loosening Pump Support Bolts

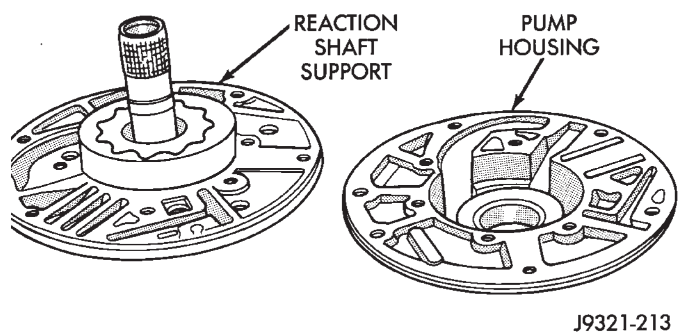


Fig. 38 Separating Pump Housing From Reaction Shaft Support

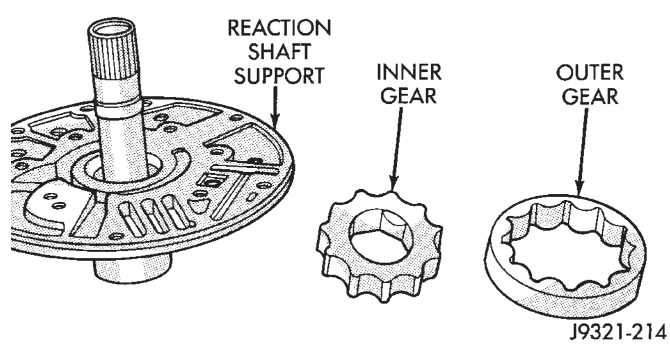


Fig. 39 Pump Gear Removal

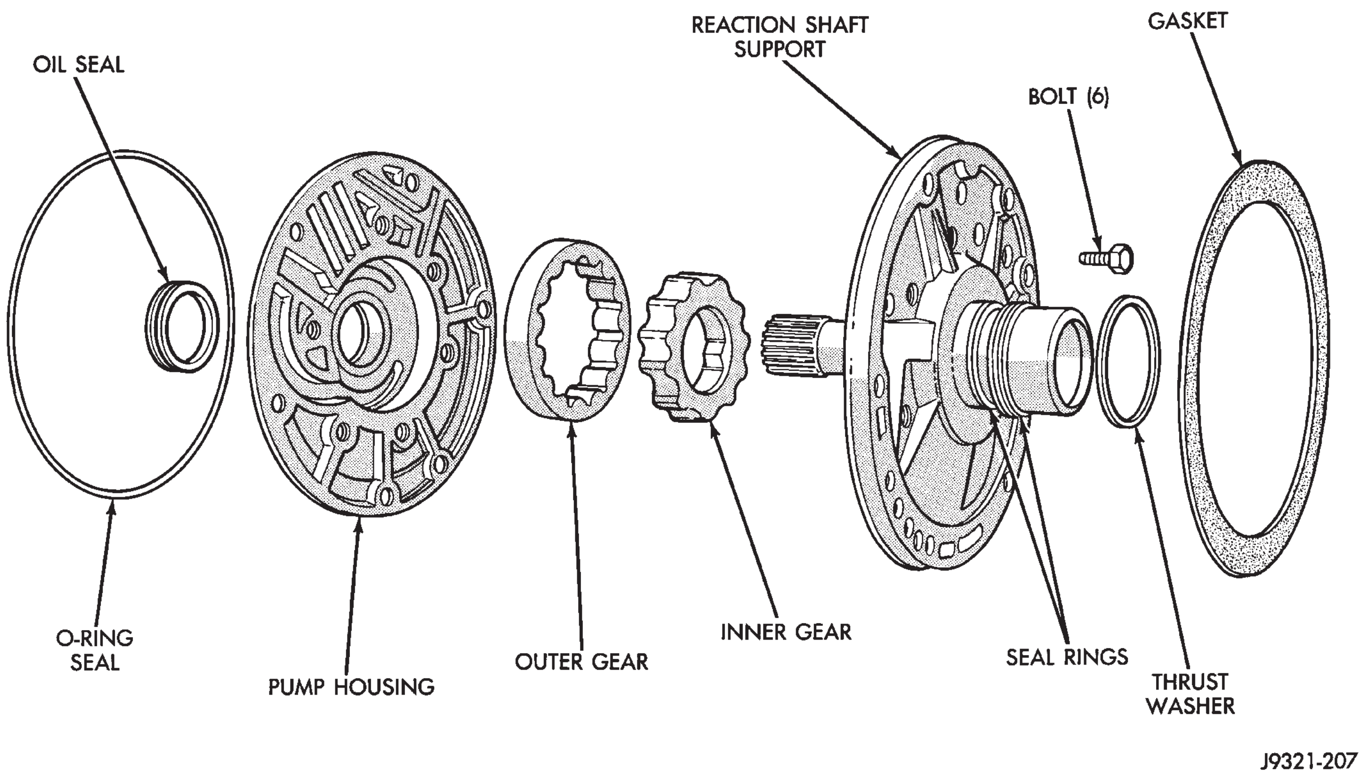


Fig. 40 Oil Pump And Reaction Shaft Support Components

OIL PUMP AND REACTION SHAFT SUPPORT CLEANING AND INSPECTION

Clean pump and reaction shaft support components with solvent and dry them with compressed air.

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 42RE oil pumps has a new design drive lug. The new design incorporates drive flats instead of the square lug used previously. The 1993 torque converter hub has also been redesigned to accept the new drive. If pump gear replacement is necessary, be very sure to order and install the new 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. 41). Clearance should be 0.010 - 0.06 mm (0.0004 - 0.0025 in.).

Measure clearance between the outer gear and the pump body (Fig. 42). Clearance should be 0.08 - 0.19 mm (0.0035 - 0.0075 in.).

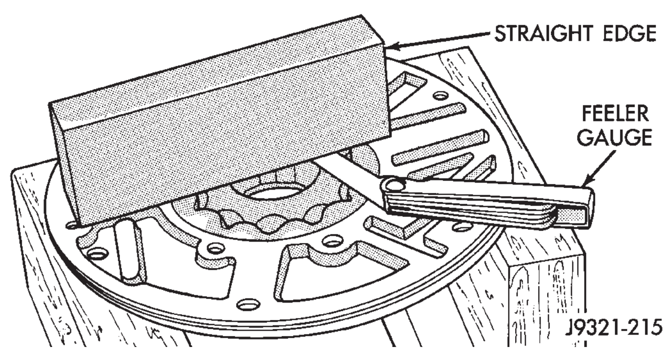


Fig. 41 Measuring Pump Gear End Clearance

Measure gear tooth clearance with a feeler gauge. Align one tooth of the outer gear in inner gear and measure clearance (Fig. 43). Clearance should be 0.08 - 0.19 mm (0.0035 - 0.0075 in.).

REPLACING OIL PUMP BUSHING

(1) Remove pump bushing with Tool Handle C-4171 and Bushing Remover SP-3551 (Fig. 44).

(2) Install new pump bushing with Tool Handle C-4171 and Bushing Installer SP-5117 (Fig. 44). Bushing should be flush with pump housing bore.

(3) Stake new pump bushing in two places with blunt punch (Fig. 45). Remove burrs from stake points with knife blade afterward.

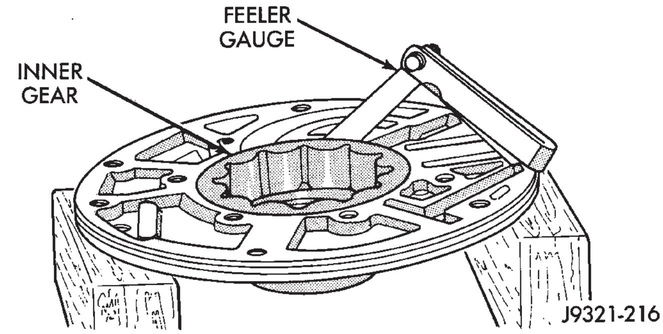


Fig. 42 Measuring Pump Housing-To-Inner Gear Clearances

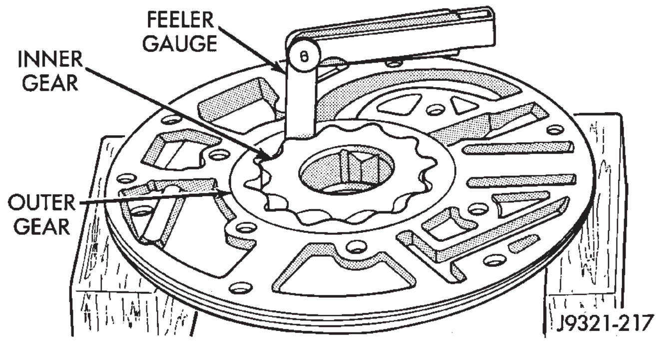


Fig. 43 Measuring Pump Gear Tooth Clearance

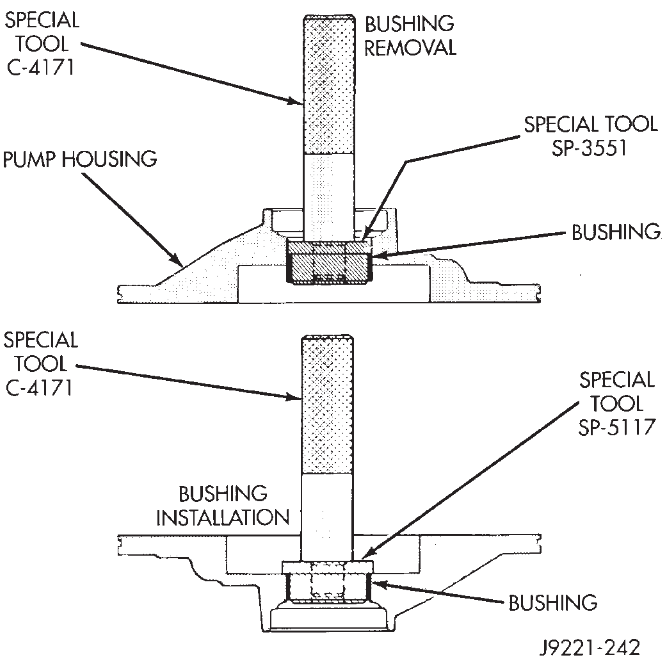


Fig. 44 Removing Oil Pump Bushing

REPLACING REACTION SHAFT SUPPORT BUSHING

(1) Assemble Bushing Remover Tools SP-1191, 3633 and 5324 (Fig. 46). **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

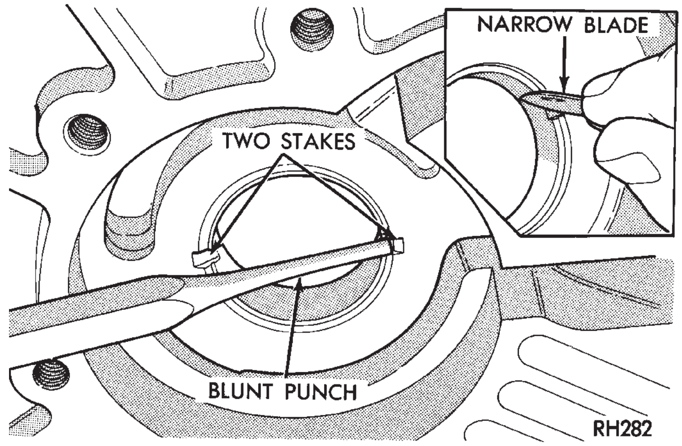


Fig. 45 Staking Oil Pump Bushing

as possible by hand. Then thread remover tool 3-4 additional turns into bushing with a wrench.

(3) Turn remover tool hex nut down against remover cup to pull bushing from shaft. Clean all chips from shaft after bushing removal.

(4) Lightly grip old bushing in vise or with pliers and back remover tool out of bushing.

(5) Assemble Bushing Installer Tools C-4171 and SP-5325 (Fig. 46).

(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.

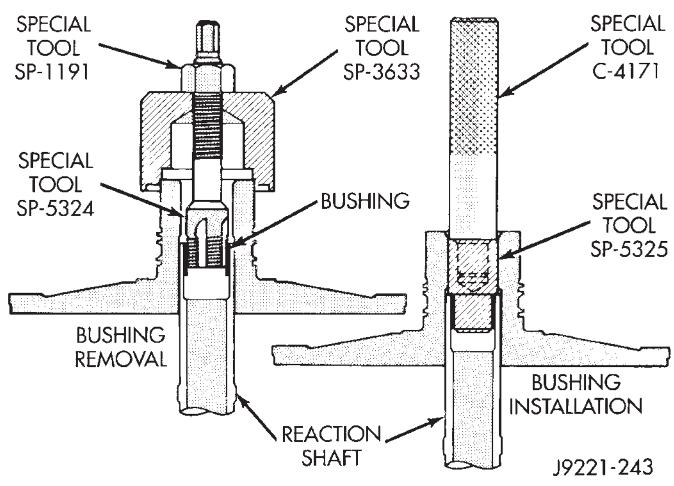


Fig. 46 Replacing Reaction Shaft Support Bushing

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. 47).

(4) Install outer gear in pump housing (Fig. 47). Gear can be installed either way (it is not a one-way fit).

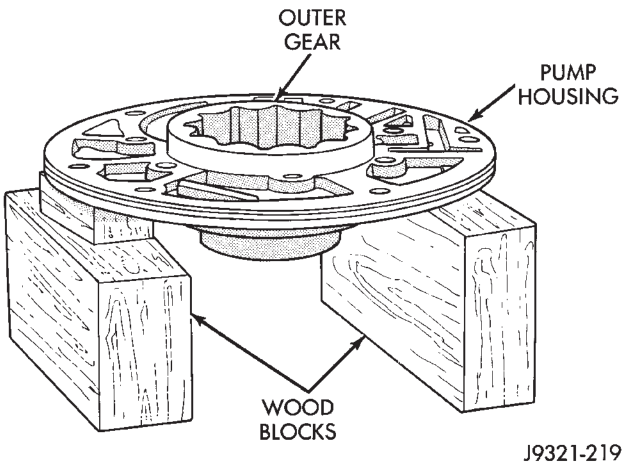


Fig. 47 Supporting Pump And Installing Outer Gear

(5) Install pump inner gear (Fig. 48).

CAUTION: The pump inner gear is a one-way fit. The bore on one side of the gear inside diameter is chamfered. Be sure the chamfered side faces forward (to front of pump).

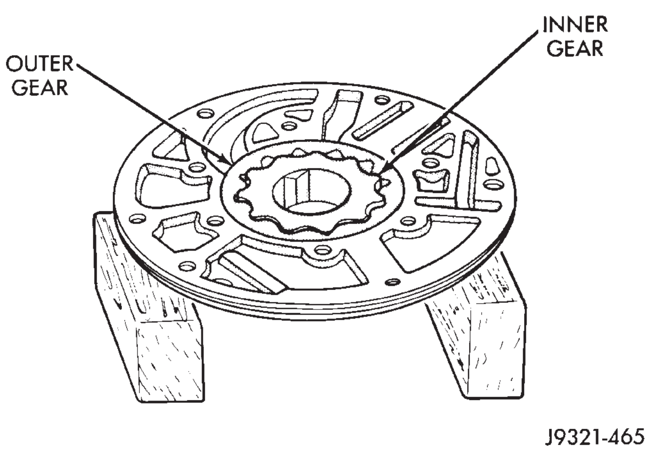


Fig. 48 Pump Inner Gear Installation

(6) Install new thrust washer on hub of reaction shaft support. Lubricate washer with transmission fluid or petroleum jelly.

CAUTION: The thrust washer is a one-way fit. The washer inside diameter is chamfered on one side. Be sure the washer is installed with the chamfered side facing forward.

(7) If reaction shaft seal rings are being replaced, install new seal rings on support hub (Fig. 49). 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.

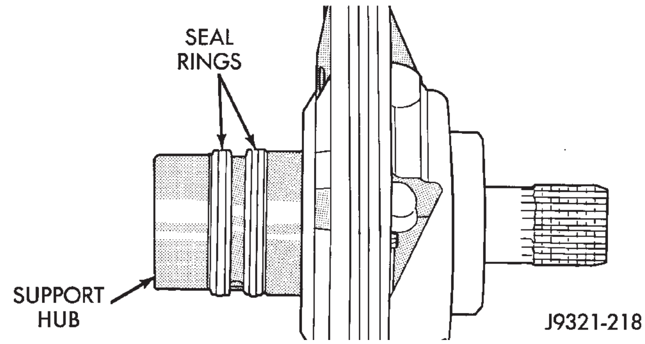


Fig. 49 Hub Seal Ring Position

(8) Install reaction shaft support on pump housing (Fig. 50).

(9) Align reaction support on pump housing. Use alignment marks made at disassembly. Or, rotate support until bolt holes in support and pump housing are all aligned (holes are offset for one-way fit).

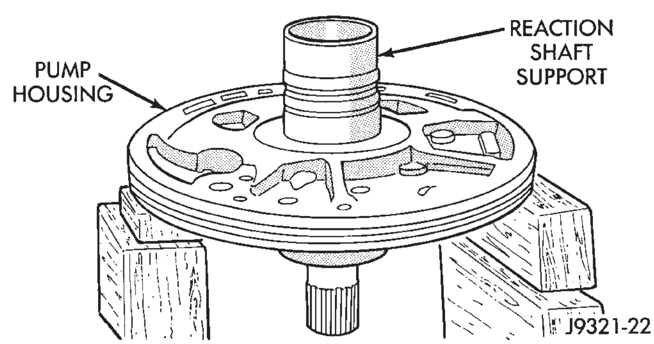


Fig. 50 Assembling Reaction Shaft Support And Pump Housing

(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. 51). 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 with petroleum jelly. Lubricate pump seal with Ru-Glyde or petroleum jelly.

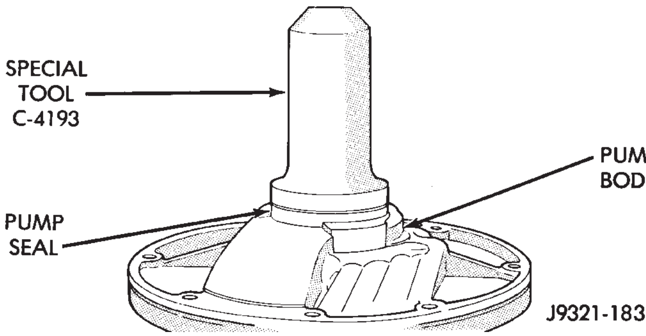


Fig. 51 Pump Oil Seal Installation

FRONT CLUTCH OVERHAUL

FRONT CLUTCH DISASSEMBLY

(1) Remove waved snap ring and remove pressure plate, clutch plates and clutch discs (Fig. 52).

(2) Compress clutch piston spring with Compressor Tool C-3575-A (Fig. 53). Be sure legs of tool are seated squarely on spring retainer before compressing spring.

(3) Remove retainer snap ring and remove compressor tool.

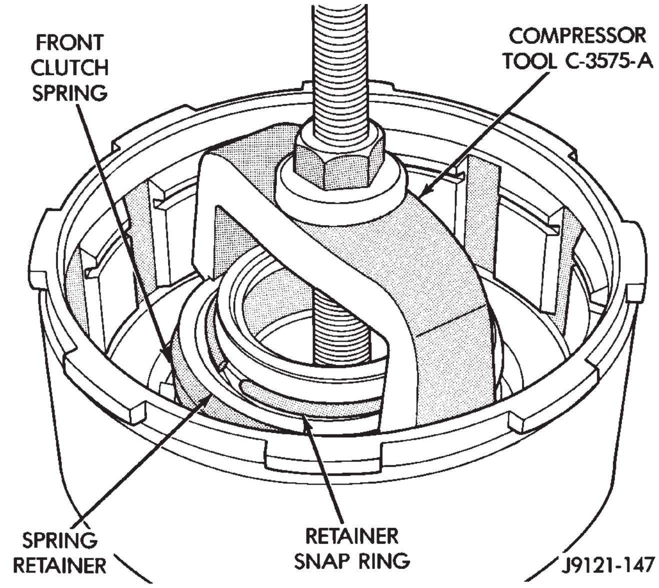


Fig. 53 Compressing Front Clutch Piston Spring

(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

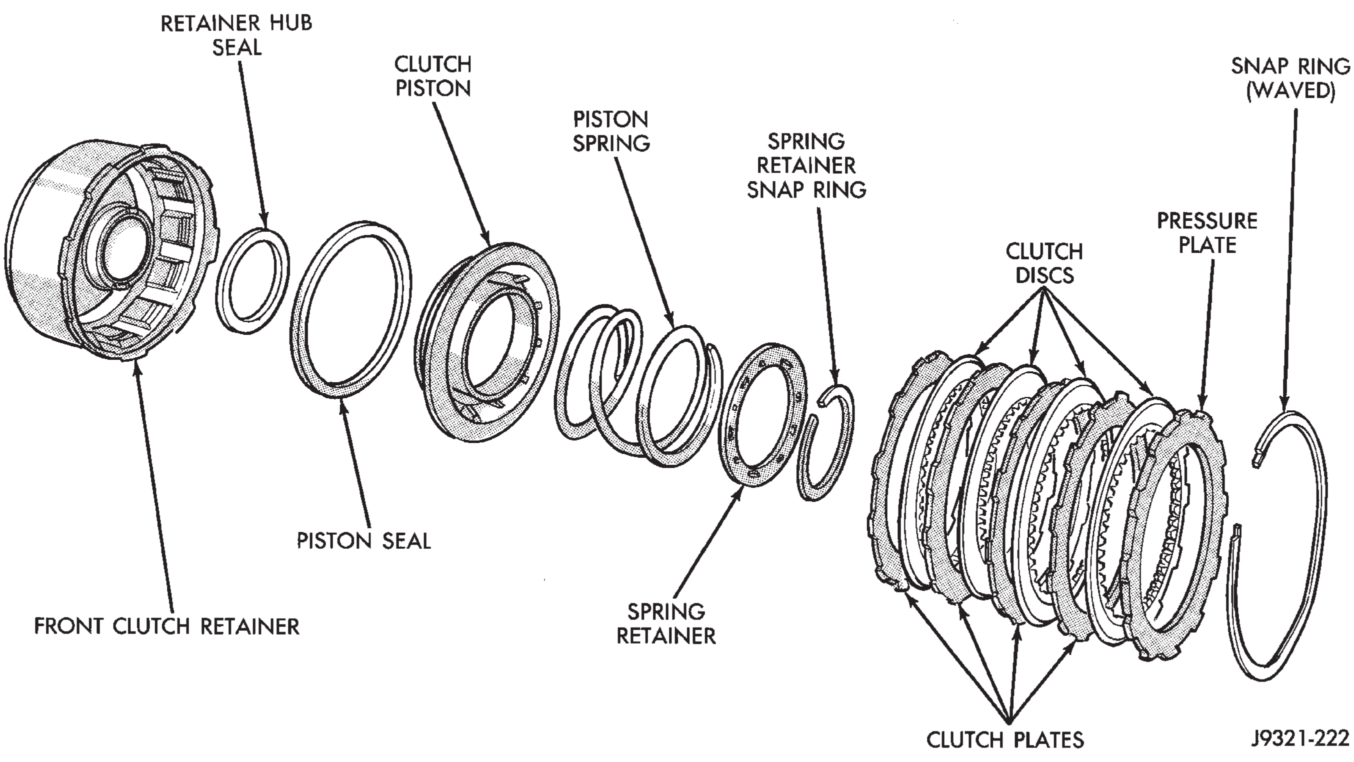


Fig. 52 Front Clutch Components

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.

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. 54). The ball must move freely and not stick.

Inspect the clutch retainer bushings carefully (Fig. 55). The retainer bushings are not serviceable. It will be necessary to replace the retainer if either bushing is scored, or worn.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

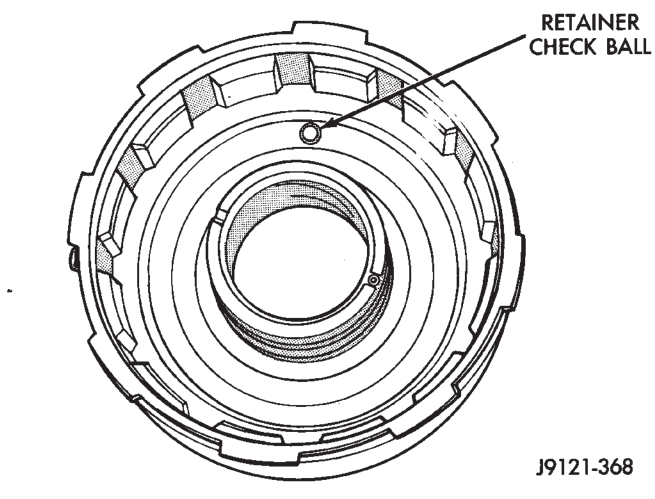


Fig. 54 Front Clutch Piston Retainer Check Ball Location

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. 56). 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.**

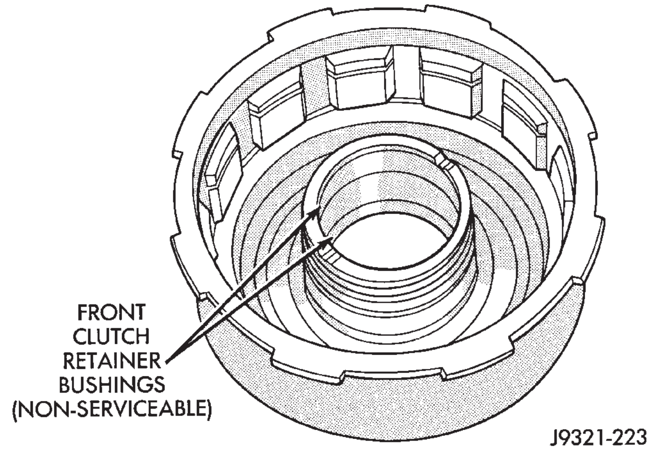


Fig. 55 Retainer Bushing Locations

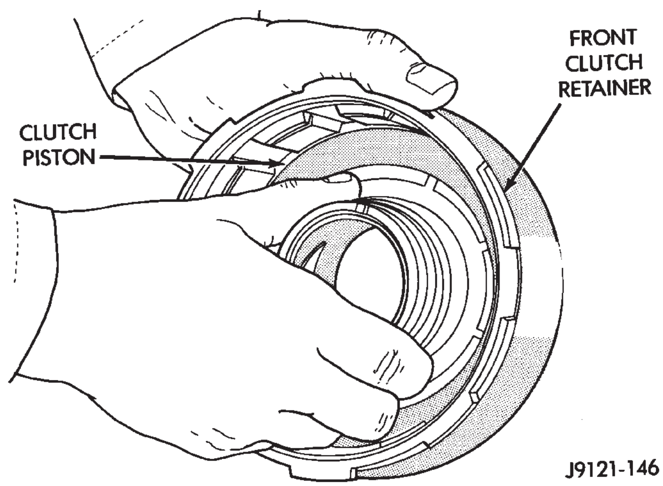


Fig. 56 Front Clutch Piston Installation

(5) Position spring in clutch piston (Fig. 57).

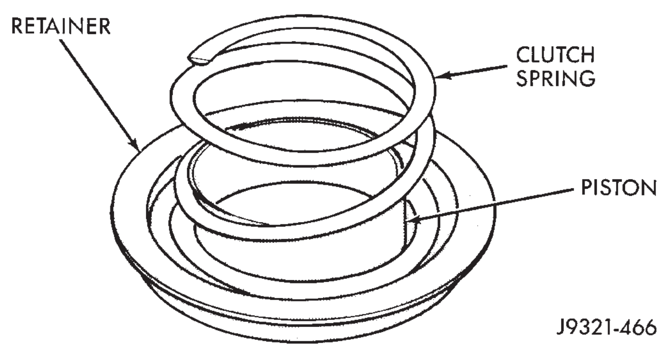


Fig. 57 Clutch Spring Installation

(6) Position spring retainer on top of piston spring (Fig. 58). **Make sure retainer is properly installed. Small raised tabs should be facing upward. Semi-circular lugs on underside of retainer are for positioning retainer in spring.**

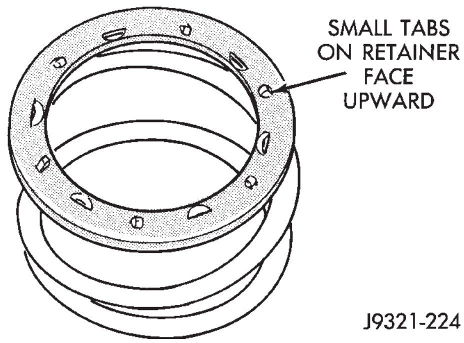


Fig. 58 Correct Spring Retainer Installed Position

(7) Compress piston spring and retainer with Compressor Tool C-3575-A (Fig. 53). Then install new snap ring to secure spring retainer and spring.

(8) Install clutch plates and discs (Fig. 52). Install steel plate then disc until all plates and discs are installed.

(9) Install pressure plate and waved snap ring (Fig. 52).

(10) Check clutch plate clearance (Fig. 59). Clearance should be 1.70 to 3.40 mm (0.067 to 0.134 in.). If clearance is incorrect, clutch discs, plates pressure plates and snap ring may have to be changed.

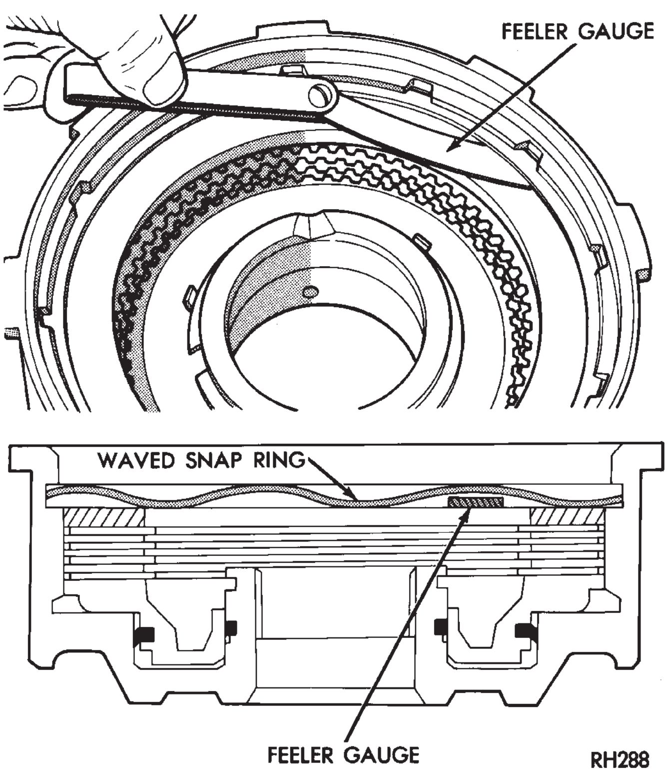


Fig. 59 Measuring Front Clutch Pack Clearance

REAR CLUTCH OVERHAUL

REAR CLUTCH DISASSEMBLY

(1) Remove plastic thrust washer from forward side of clutch retainer.

(2) Remove selective clutch pack snap ring (Fig. 60).

(3) Remove top pressure plate, clutch discs, steel plates, bottom pressure plate and wave spring (Fig. 60).

(4) Remove clutch piston. Grasp piston and rotate piston up and out of retainer.

(5) Remove and discard piston seals.

(6) Remove input shaft snap ring (Fig. 61).

(7) Press input shaft out of retainer with shop press and suitable size press tool (Fig. 62).

(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.

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 ball in the piston. The check ball must move freely and not stick.

Replace the retainer bushing if worn, scored, or doubt exists about bushing condition.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

Check condition of the fiber thrust washer and metal output shaft thrust washer. Replace either washer if worn or damaged.

Check condition of the seal rings on the input shaft and clutch retainer hub. Replace the seal rings only if obviously 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.

REAR CLUTCH ASSEMBLY

(1) Soak clutch discs in transmission fluid.

(2) Install new seal rings on clutch retainer hub and input shaft (Figs. 63 and 64).

(a) Be sure clutch hub retainer seal ring is fully seated in groove (Fig. 63). Ring must not be twisted, or distorted.

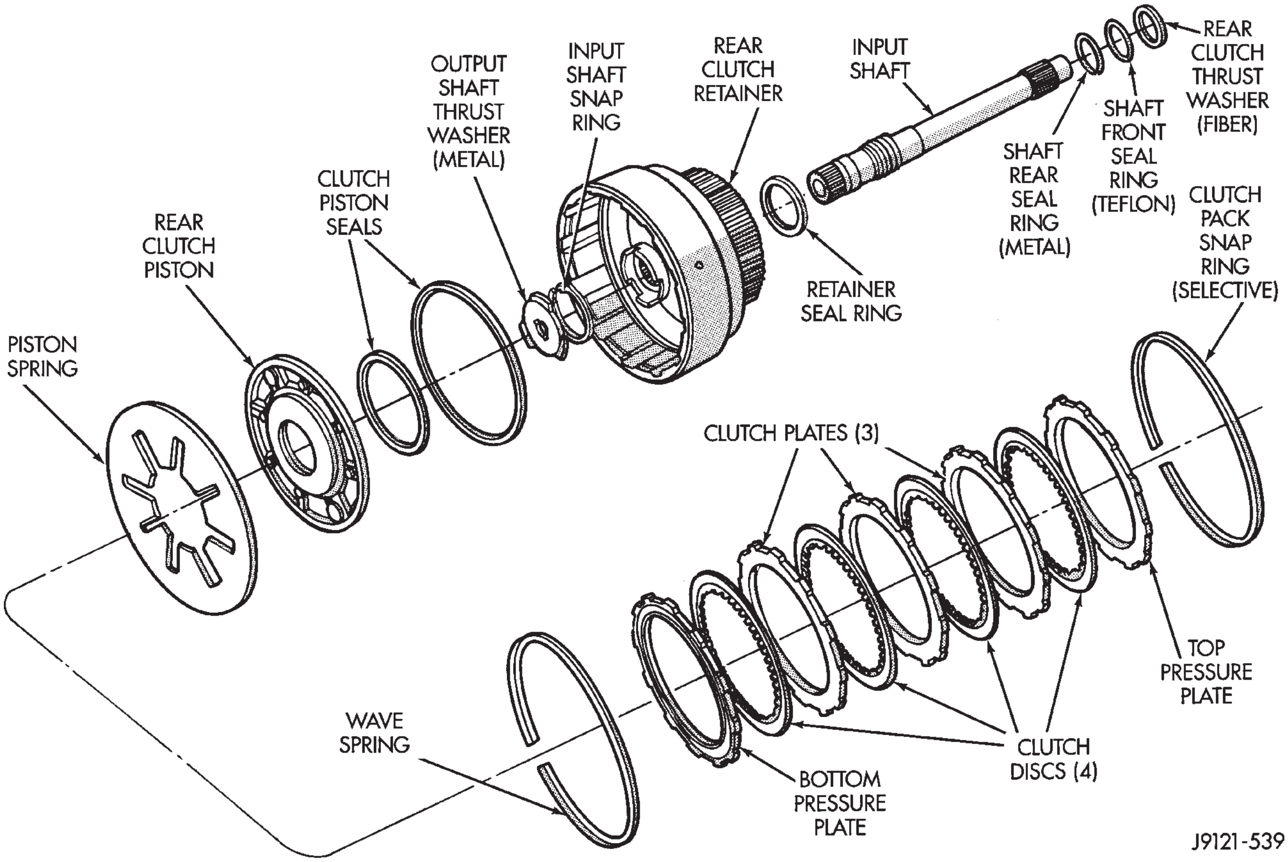


Fig. 60 Rear Clutch Components

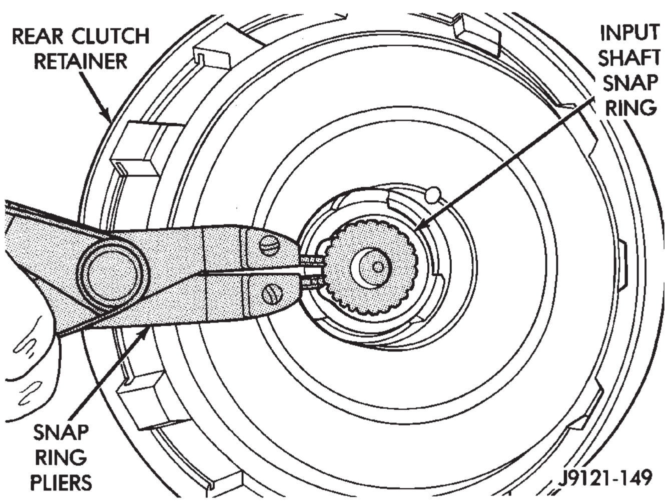


Fig. 61 Removing/Installing Input Shaft Snap Ring

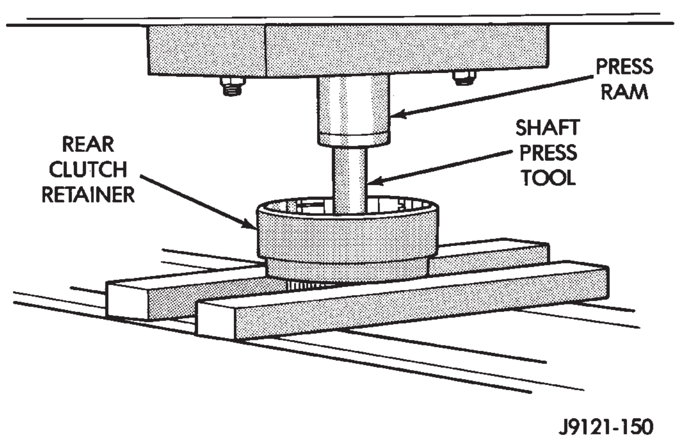


Fig. 62 Removing Input Shaft From Rear Clutch Retainer

(b) Note that input shaft front seal ring is teflon and rear seal ring is metal (Fig. 64). Be sure chamfered ends of teflon ring are properly joined and that ends of rear ring are securely hooked together.

(c) Lubricate retainer and shaft seal rings with light coat of petroleum jelly after installation.

(3) Lubricate splined end of input shaft and clutch retainer with transmission fluid. Then press input shaft into retainer (Fig. 65).

(4) Install input shaft retaining ring (Fig. 61).

(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 liberal quantity of 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.**

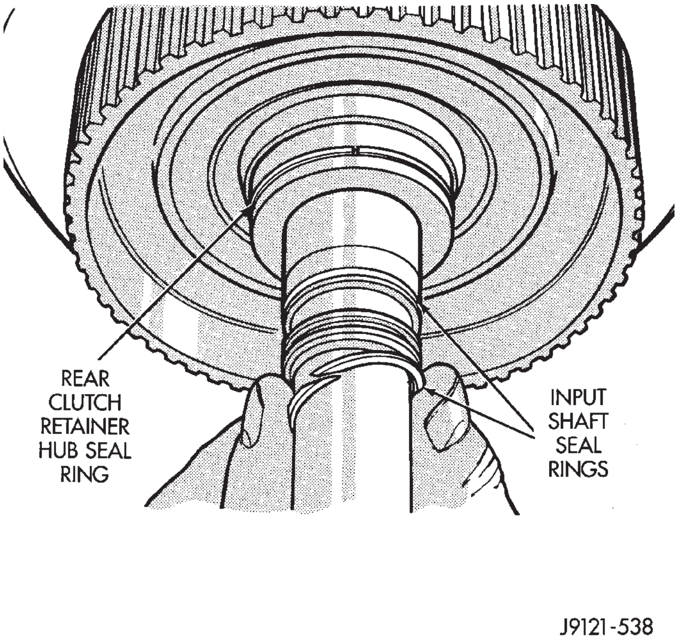


Fig. 63 Installing Rear Clutch Retainer And Input Shaft Seal Rings

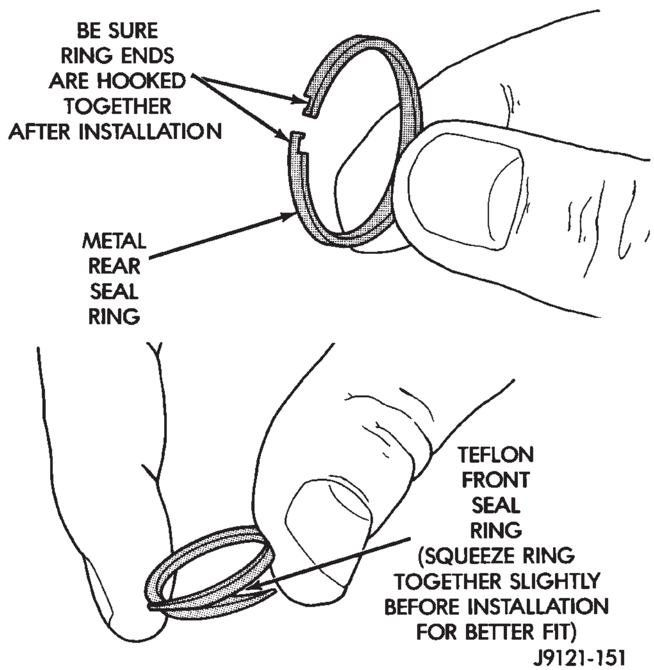


Fig. 64 Input Shaft Seal Ring Identification

(8) Install piston spring in retainer and on top of piston (Fig. 56). Concave side of spring faces up as shown.

(9) Install wave spring in retainer (Fig. 66). Be sure spring is completely seated in retainer groove.

(10) Install bottom pressure plate (Fig. 60). Ridged side of plate faces downward (toward piston) and flat side toward clutch pack.

(11) Install first clutch disc in retainer on top of bottom pressure plate. Then install a clutch plate

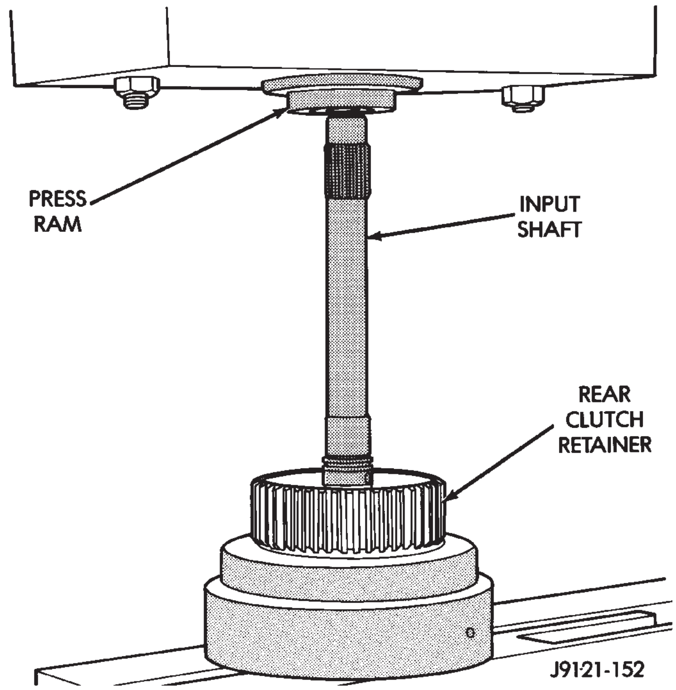


Fig. 65 Pressing Input Shaft Into Rear Clutch Retainer

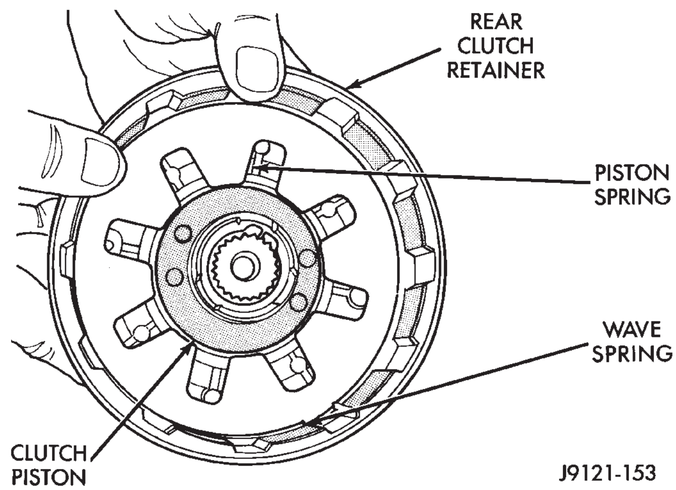


Fig. 66 Piston And Wave Spring Position

followed by a clutch disc until entire clutch pack is installed. 4 clutch discs and 3 metal plates are required.

(12) Install top pressure plate (Fig. 60).

(13) Install selective snap ring (Fig. 60). Be sure snap ring is fully seated in retainer groove.

(14) Measure clutch pack clearance (Fig. 67). Clearance should be 0.64 to 1.14 mm (0.025 to 0.045 in.). If clearance is incorrect, adjust clearance with select fit snap ring.

(15) Coat rear clutch thrust washer with petroleum jelly and install washer over input shaft and into clutch retainer (Fig. 68). Use enough petroleum jelly to hold washer in place.

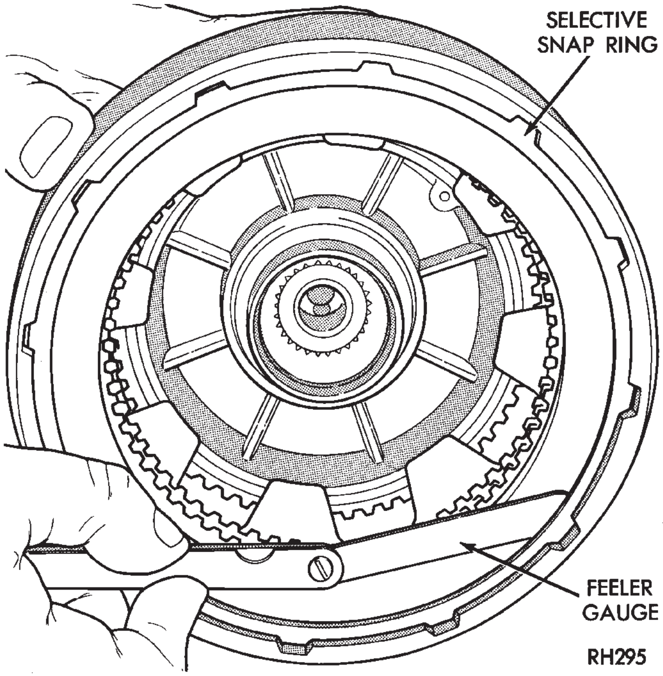


Fig. 67 Checking Rear Clutch Pack Clearance

(16) Set rear clutch aside for installation during final assembly.

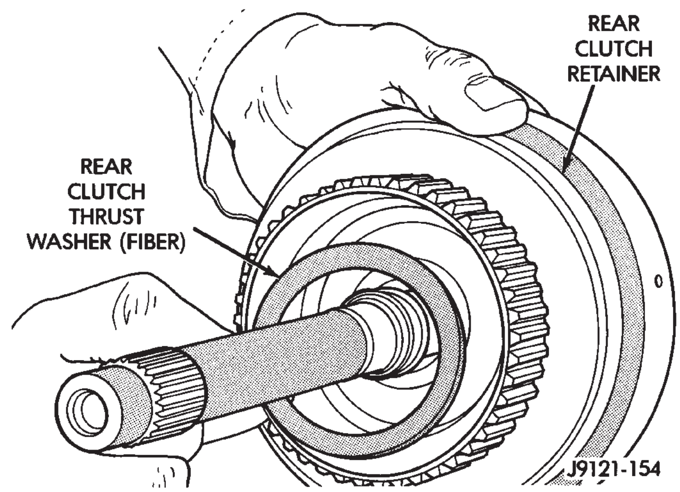


Fig. 68 Installing Rear Clutch Thrust Washer

PLANETARY GEAR TRAIN AND INTERMEDIATE SHAFT OVERHAUL

GEARTRAIN DISASSEMBLY (FIG. 69)

(1) Remove snap ring, tabbed thrust washer and thrust plate from front of output shaft.

(2) Remove front annulus gear and support assembly.

(3) Remove front planetary front thrust washer.

(4) Remove front planetary gear.

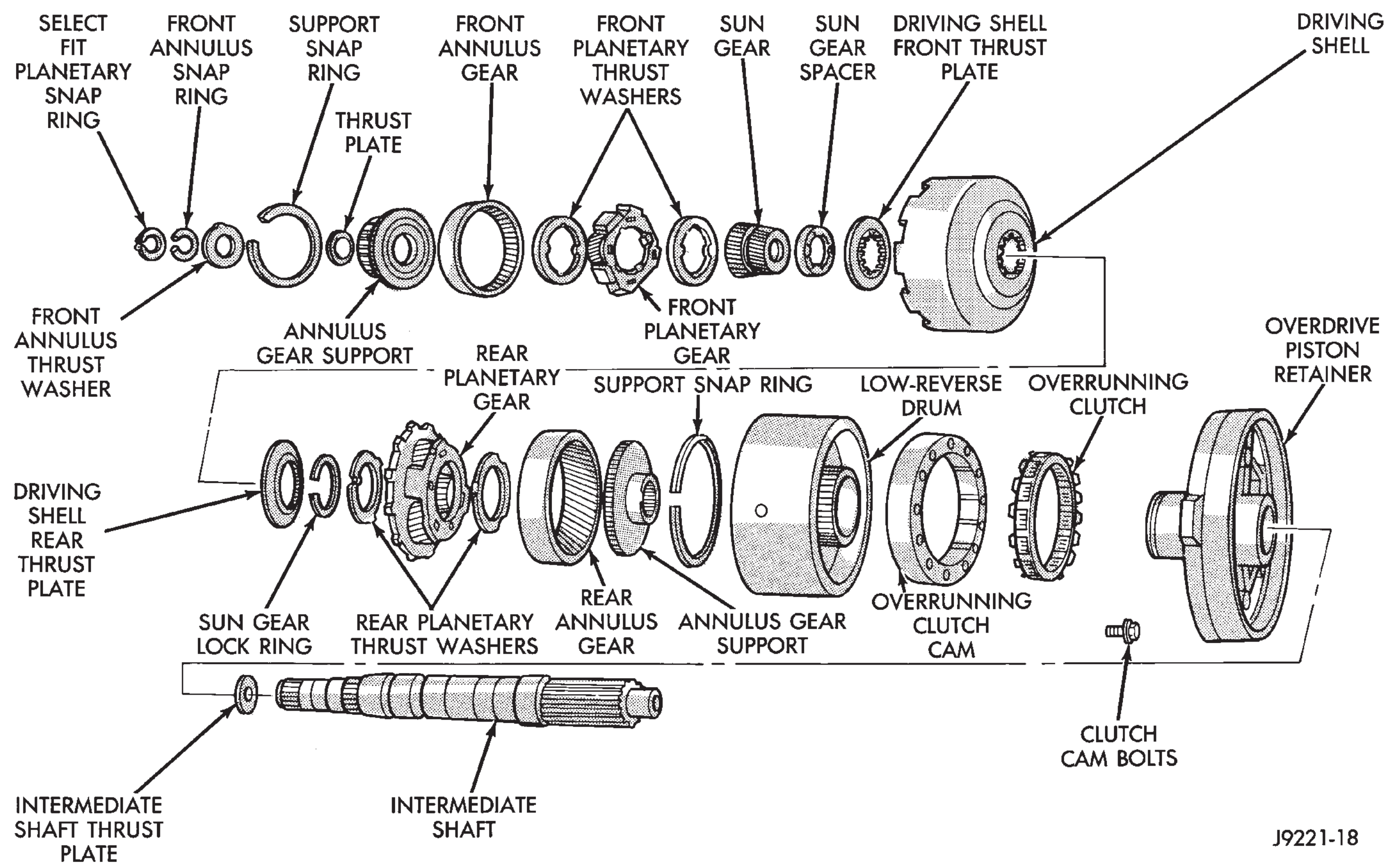


Fig. 69 Transmission Planetary Gear Train

(5) Remove front planetary rear thrust washer.

(6) Remove sun gear and driving shell.

(7) Remove snap ring that retains sun gear in driving shell and remove sun gear and thrust plates. Note thrust plate position for assembly reference.

(8) Remove tabbed thrust washer from rear planetary gear.

(9) Remove rear planetary gear from rear annulus gear and remove annulus gear from intermediate shaft.

(10) Remove snap rings securing annulus gears to supports. Then separate each gear from support.

PLANETARY GEARTRAIN INSPECTION

Clean the planetary components in solvent and dry them with compressed air.

Check sun gear and driving shell condition. Replace the gear if damaged or if the bushings are scored or worn. The bushings are not serviceable. Replace the driving shell if worn, cracked or damaged.

Replace planetary gear sets if gears, pinion pins, or carrier are damaged in any way. Replace the annulus gears and supports if either component is worn or damaged.

Inspect the geartrain spacers, thrust plates, snap rings, and thrust washers. Replace any part that is worn or damaged. Do not attempt to reuse these parts.

Inspect the intermediate shaft carefully. Pay particular attention to the machined bushing/bearing surfaces on the shaft.

Replace the intermediate shaft if any 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. Be sure the select spacer groove on the shaft is in good condition. Trial fit the spacer if necessary.

PLANETARY GEARTRAIN ASSEMBLY

(1) Lubricate intermediate 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.

(3) Install rear thrust washer on rear planetary gear (Fig. 70). Use enough petroleum jelly to hold washer in place. Also be sure washer tabs are properly engaged in gear slots.

(4) Install rear annulus over and onto rear planetary gear (Fig. 70).

(5) Install assembled rear planetary and annulus gear on intermediate shaft (Fig. 71). Verify that assembly is fully seated on shaft.

(6) Install front thrust washer on rear planetary gear (Fig. 72). Use enough petroleum jelly to hold washer on gear.

(7) Install spacer on sun gear (Fig. 73).

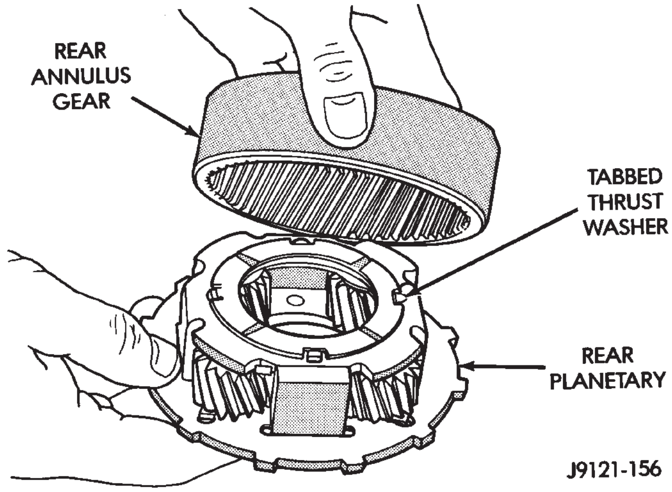


Fig. 70 Assembling Rear Annulus And Planetary Gear

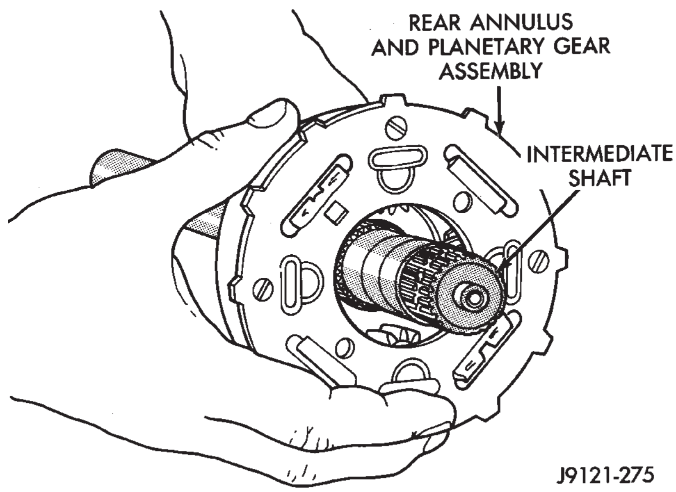


Fig. 71 Installing Assembled Rear Annulus And Planetary Gear On Intermediate Shaft

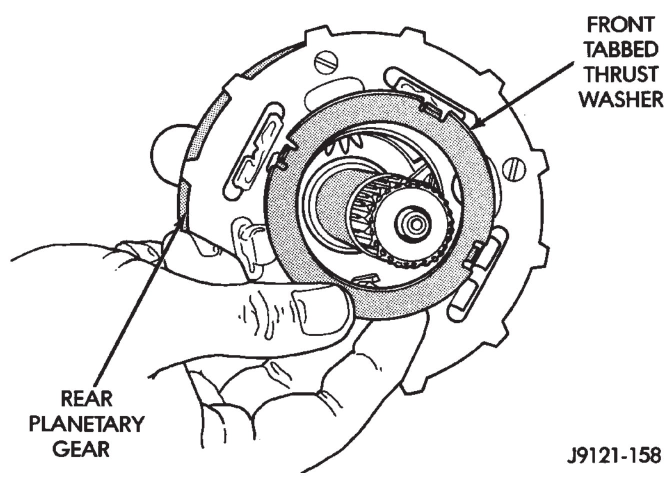


Fig. 72 Installing Rear Planetary Front Thrust Washer

(8) Install thrust plate over sun gear and on top of spacer (Fig. 74). Note that thrust plates are interchangeable. Use either plate on sun gear and rear of driving shell.

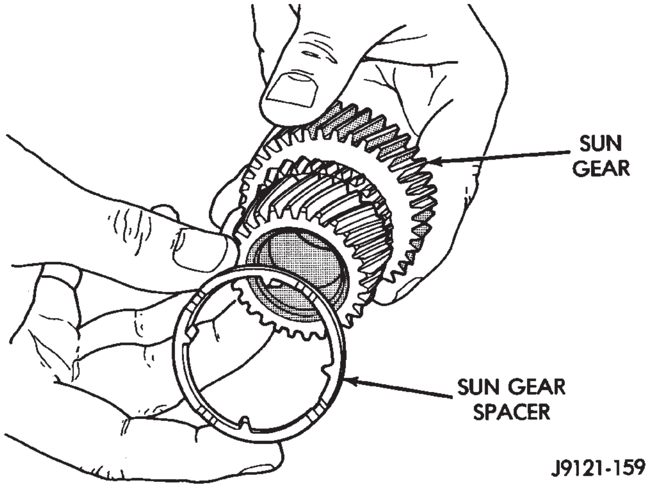


Fig. 73 Installing Sun Gear Spacer

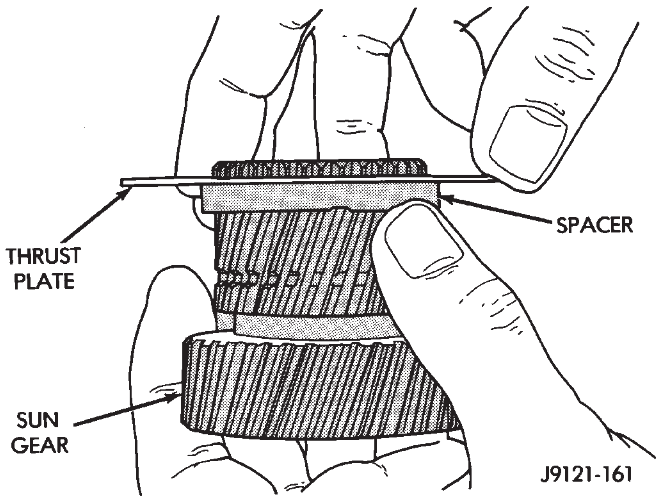


Fig. 74 Installing Spacer And Thrust Plate On Sun Gear

(9) Insert sun gear into driving shell (Fig. 75).

(10) Hold sun gear in position and install rear thrust plate. Plate goes over sun gear at rear of driving shell (Fig. 75).

(11) Position wood block on bench and support sun gear on block (Fig. 76). This makes it easier to align and install sun gear lock ring. Keep wood block handy as it will also be used for geartrain end play check.

(12) 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. 77).

(13) Install assembled driving shell and sun gear on intermediate shaft (Fig. 78).

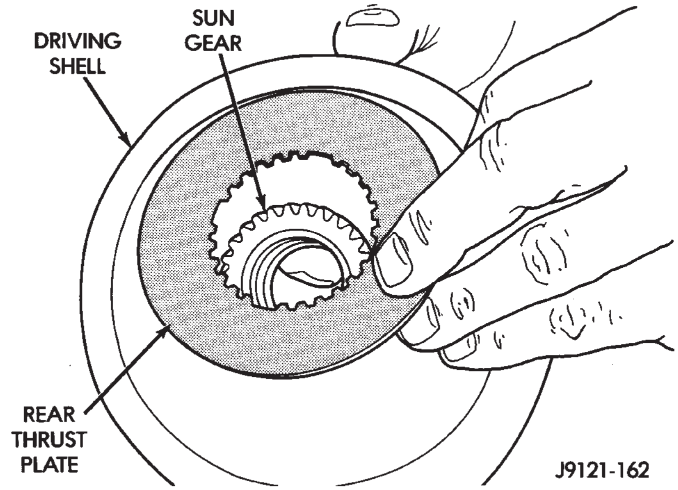


Fig. 75 Installing Sun Gear And Rear Thrust Plate In Driving Shell

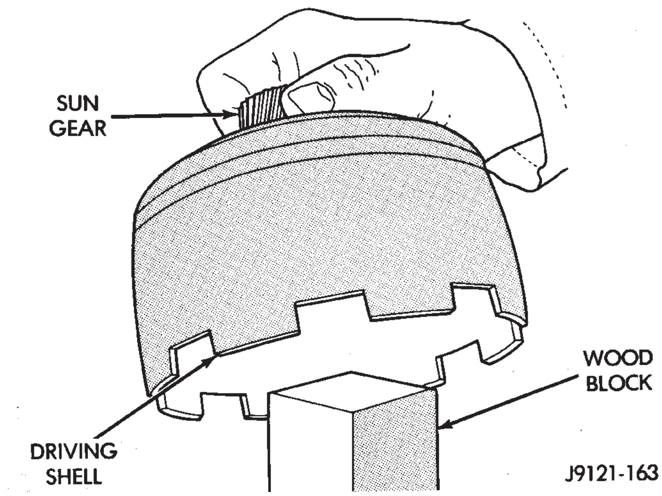


Fig. 76 Supporting Sun Gear On Wood Block

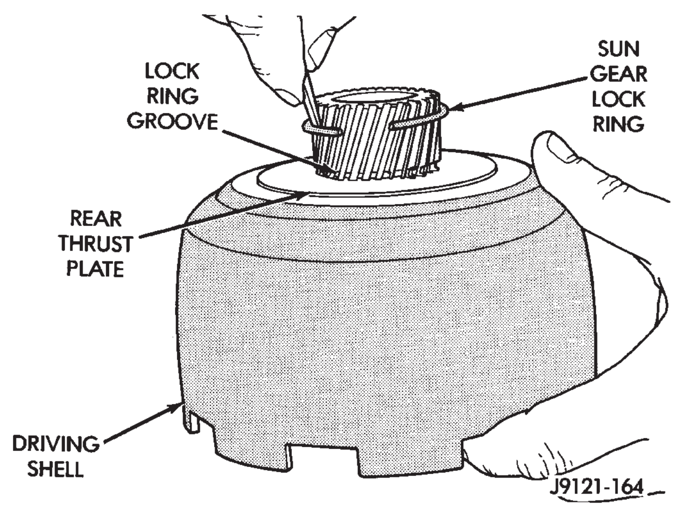


Fig. 77 Installing Sun Gear Lock Ring

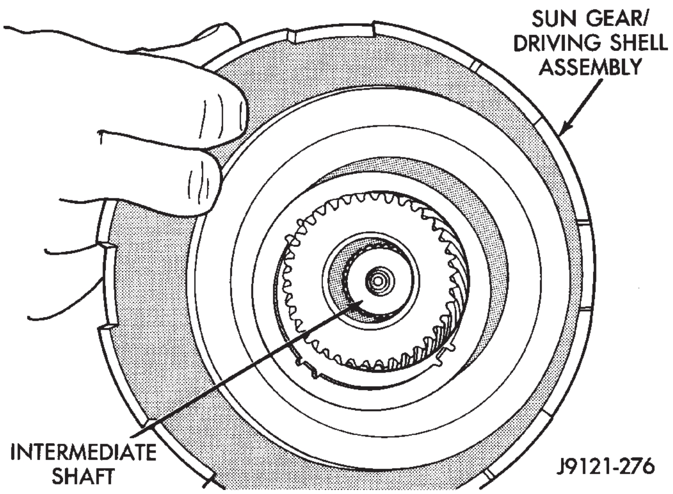


Fig. 78 Installing Assembled Sun Gear And Driving Shell On Intermediate Shaft

(14) Install rear thrust washer on front planetary gear (Fig. 79). Use enough petroleum jelly to hold washer on gear and be sure washer tabs are all properly seated.

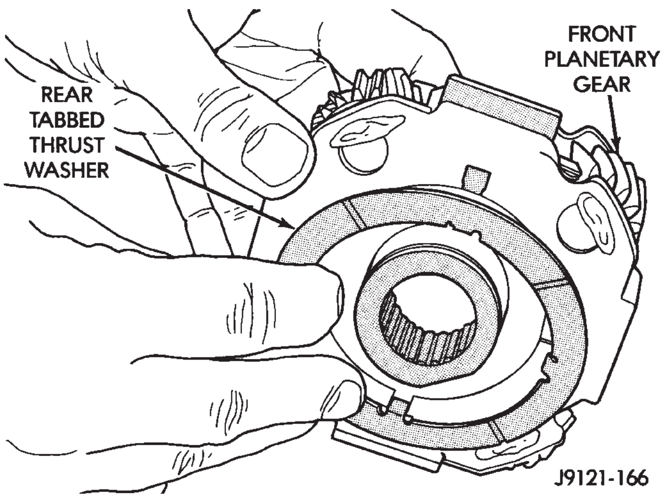


Fig. 79 Installing Rear Thrust Washer On Front Planetary Gear

(15) Assemble front annulus gear and support if necessary.

(16) Position thrust plate on front annulus gear support (Fig. 80). Use liberal quantity of petroleum jelly to hold plate in place.

(17) Install front planetary gear on intermediate shaft and in driving shell (Fig. 81).

(18) Install front thrust washer on front planetary gear (Fig. 81). Use enough petroleum jelly to hold washer in place on gear and be sure washer tabs are seated.

(19) Assemble front annulus gear and support. Be sure support snap ring is seated.

(20) Install front annulus thrust washer (Fig. 82). Align flat on washer with flat on planetary hub. Also be sure washer tab is facing forward.

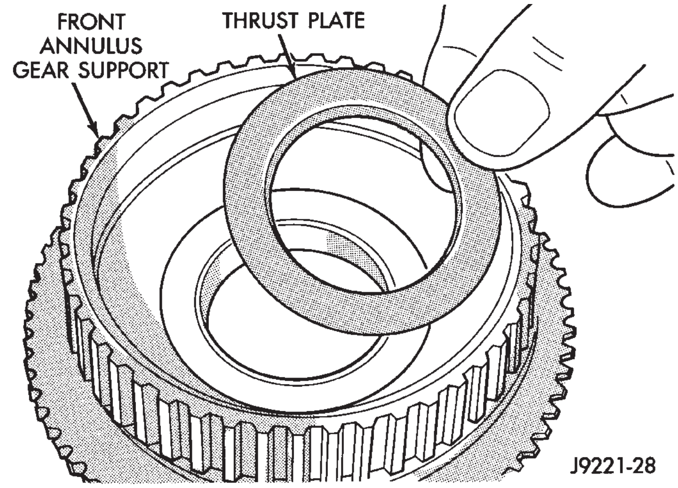


Fig. 80 Installing Thrust Plate On Front Annulus Support

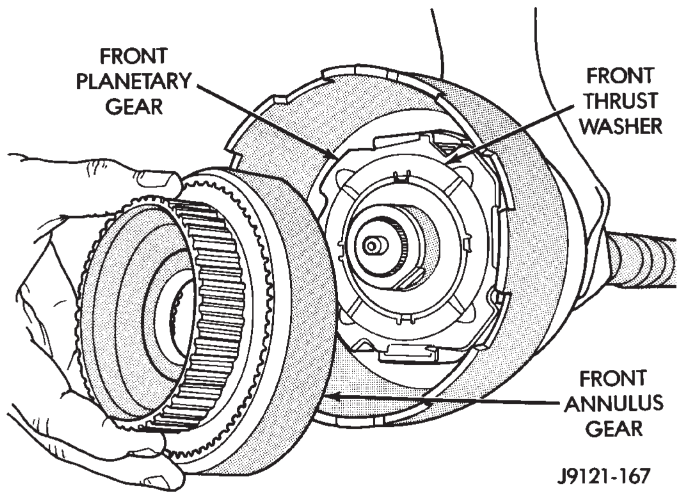


Fig. 81 Installing Front Planetary And Annulus Gears

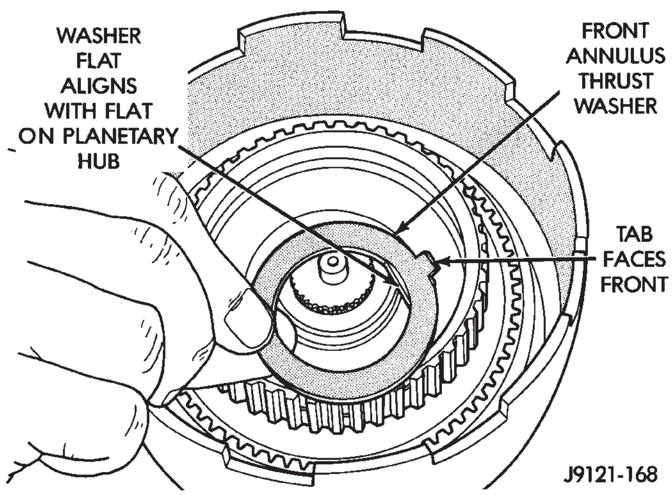


Fig. 82 Installing Front Annulus Thrust Washer

(21) Install front annulus snap ring (Fig. 83). Use snap ring pliers to avoid distorting ring during installation. Also be sure ring is fully seated.

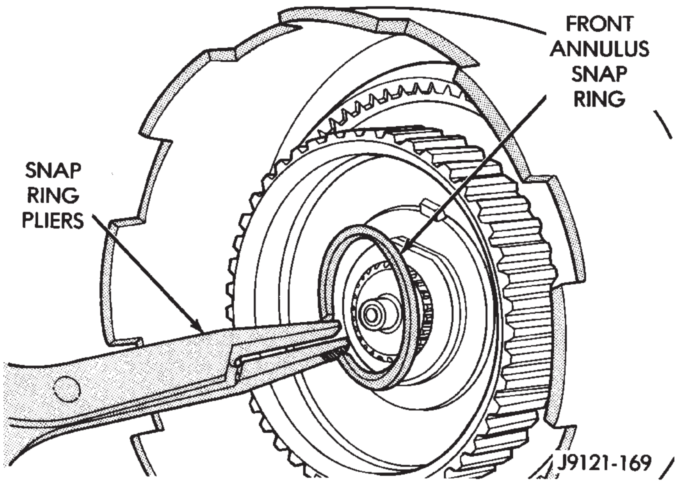


Fig. 83 Installing Front Annulus Snap Ring

(22) Install planetary selective snap ring with snap ring pliers (Fig. 84). Be sure ring is fully seated.

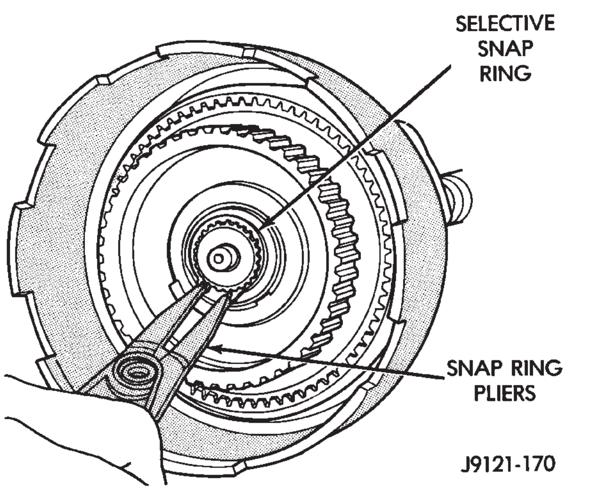


Fig. 84 Installing Planetary Selective Snap Ring

(23) 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 is necessary so geartrain components will move forward for accurate end play check.

(24) Check planetary geartrain end play with feeler gauge (Fig. 85). Gauge goes between shoulder on intermediate shaft and end of rear annulus support.

(25) Geartrain end play should be 0.12 to 1.22 mm (0.005 to 0.048 in.). If end play is incorrect, snap ring (or thrust washers) may have to be replaced. Snap ring is available in three different thicknesses for adjustment purposes.

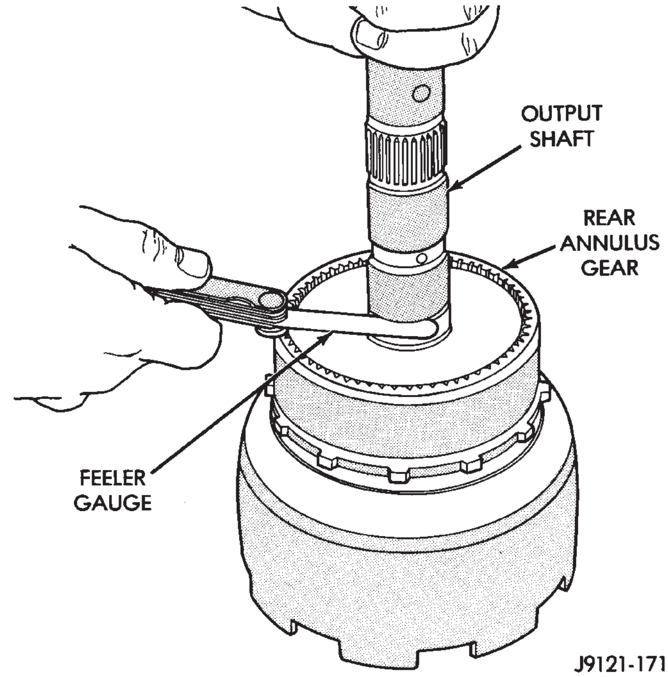


Fig. 85 Checking Planetary Geartrain End Play

FRONT SERVO AND BAND OVERHAUL

FRONT SERVO DISASSEMBLY (FIG. 86)

(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.

FRONT BAND AND SERVO 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 seal rings and O-rings with petroleum jelly. Lubricate other 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. 86).

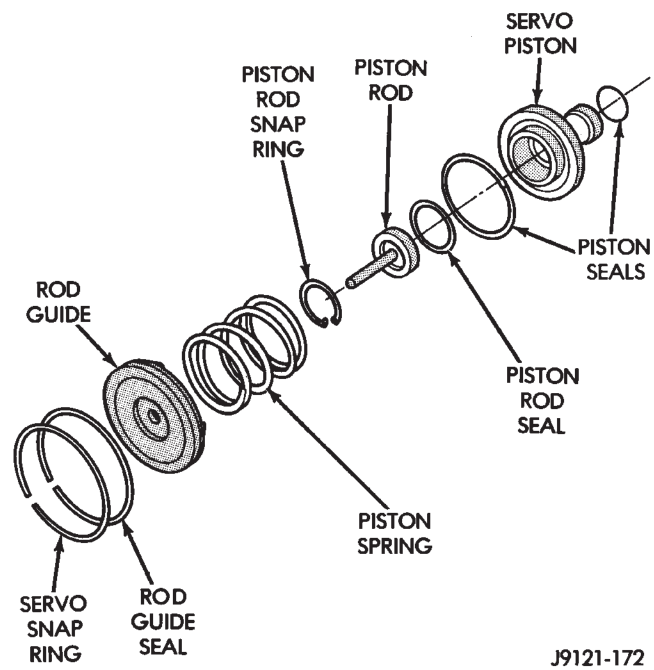


Fig. 86 Front Servo Components

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. 87). 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. 87).

(4) Open vise and remove wood block, piston plug, cushion spring and servo piston.

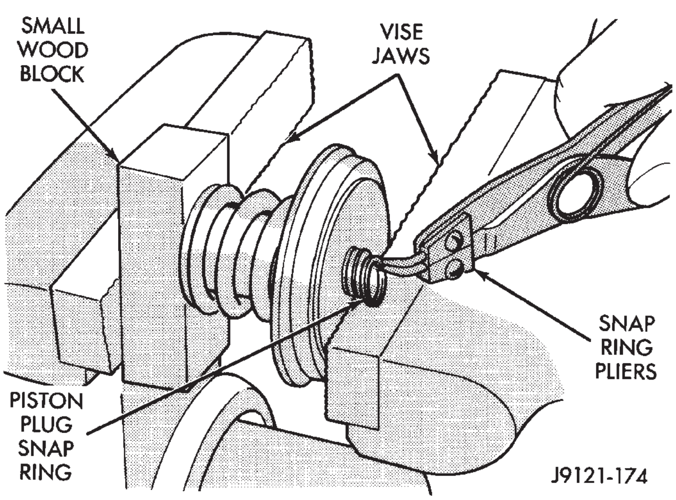


Fig. 87 Removing/Installing Servo Piston Plug Snap Ring

REAR SERVO INSPECTION

Clean the servo components (Fig. 88) 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. Check the band pivot and reaction pins. Minor pin scoring can be cleaned up with crocus cloth. However, replace the pins if worn, severely scored, or cracked. Replace the pin O-rings.

Inspect the servo components. 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.

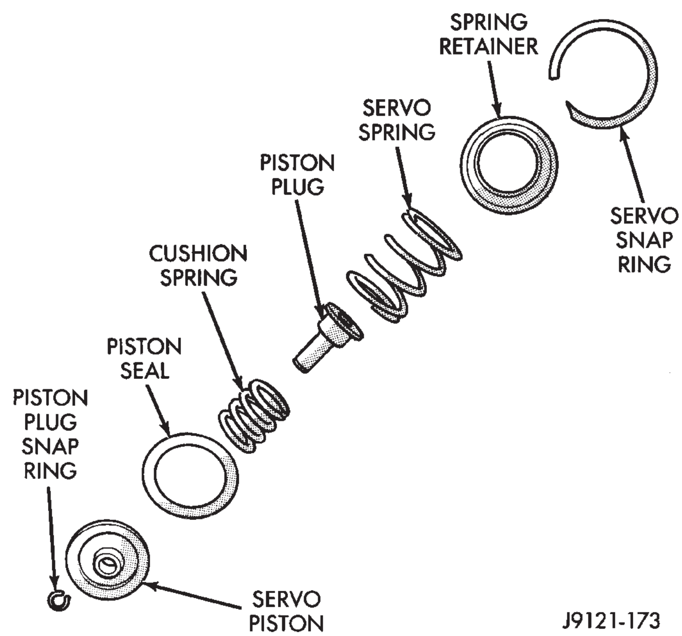


Fig. 88 Rear Servo Components

ASSEMBLING REAR SERVO PISTON

(1) Assemble piston plug, cushion spring and piston (Fig. 88).

(2) Compress cushion spring in vise and install piston plug snap ring (Fig. 87).

(3) Install new seal on piston. Be sure seal lip is toward servo bore (Fig. 89).

(4) Lubricate piston seal with petroleum jelly. Lubricate other servo parts with transmission fluid.

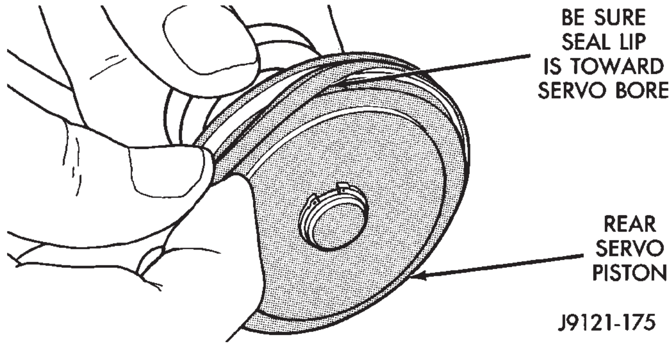


Fig. 89 Installing Rear Servo Piston Seal

VALVE BODY SERVICE AND ADJUSTMENT

VALVE BODY MAIN COMPONENT DISASSEMBLY

CAUTION: Do not clamp any valve body component in a vise. This practice can damage the component resulting in unsatisfactory operation after assembly and installation. Do not use pliers to remove any of the valves, plugs or springs and do not force any of the components out or into place. The valves and valve body housings will be damaged if force is used. Tag or mark the valve body springs for reference as they are removed. Do not allow them to become intermixed.

(1) Disconnect wires from governor pressure sensor and solenoid (Fig. 90).

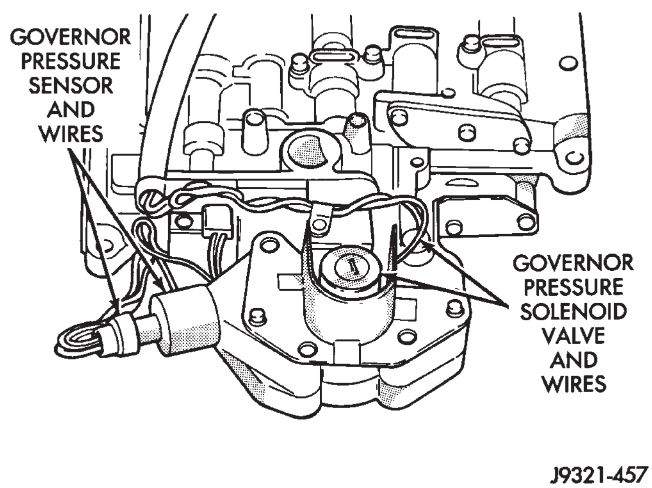


Fig. 90 Governor Pressure Solenoid And Sensor Wire Locations

(2) Remove screws attaching governor body and retainer plate to transfer plate (Fig. 91).

(3) Remove retainer plate, governor body and gasket from transfer plate (Fig. 92).

(4) Disconnect wires from governor pressure sensor, if not done previously (Fig. 93).

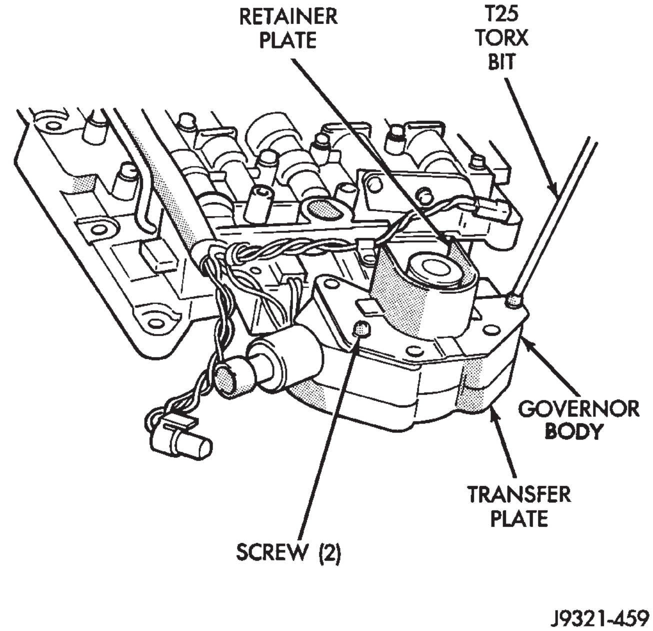


Fig. 91 Governor Body And Retainer Plate Attaching Screw Removal/Installation

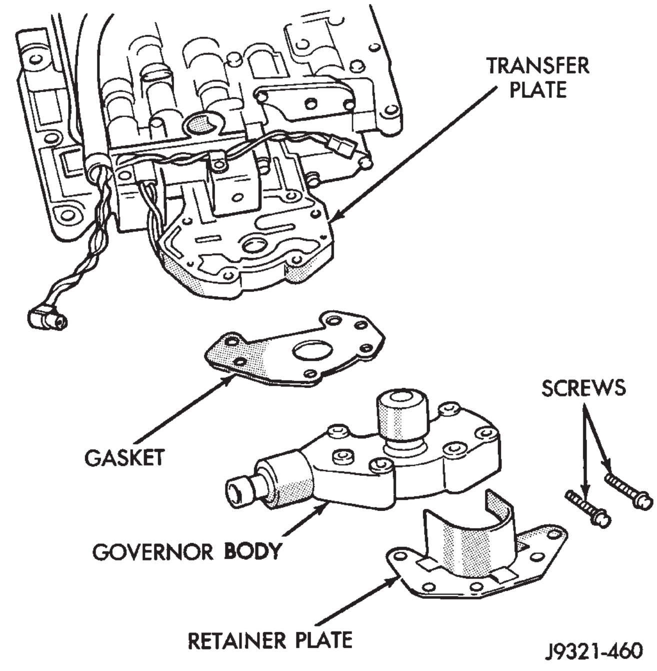


Fig. 92 Governor Body, Retainer Plate And Gasket Removal

(5) Remove governor pressure sensor from governor body. Sensor is retained in body with M-shaped spring clip (Fig. 93). Remove clip with small pointed tool and slide sensor out of body.

(6) Remove governor pressure solenoid by pulling it straight out of bore in governor body (Fig. 94). Remove and discard solenoid O-rings if worn, cut, or torn.

(7) Remove small shoulder bolt that secures solenoid harness case connector to 3-4 accumulator housing (Fig. 95). **Retain shoulder bolt. Either tape it**

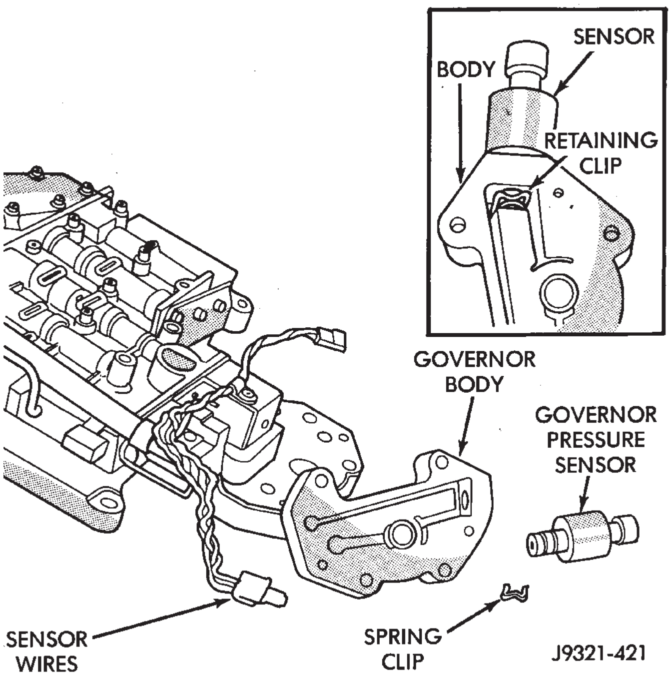


Fig. 93 Governor Pressure Sensor Removal

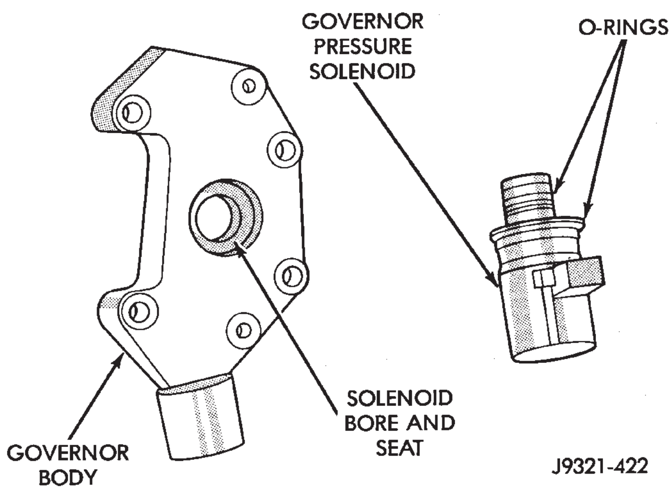


Fig. 94 Governor Pressure Solenoid Removal

to harness or thread it back into accumulator housing after connector removal.

(8) Unhook overdrive/converter solenoid harness from 3-4 accumulator cover plate (Fig. 96).

(9) Turn valve body over and remove screws that attach overdrive/converter solenoid assembly to valve body (Fig. 97).

(10) Remove solenoid and harness assembly from valve body (Fig. 98).

(11) Remove boost valve cover (Fig. 99).

(12) Remove boost valve retainer, valve spring and boost valve (Fig. 100).

(13) Secure detent ball and spring with Retainer Tool 6583 (Fig. 101).

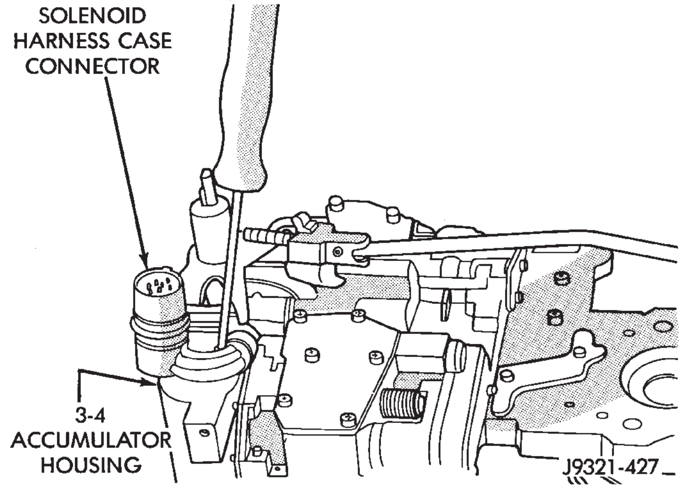


Fig. 95 Removing/Installing Solenoid Harness Case Connector Shoulder Bolt

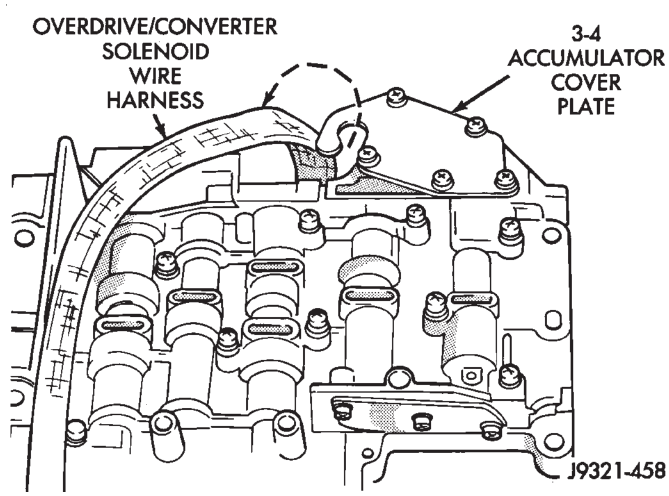


Fig. 96 Unhooking Solenoid Harness From Accumulator Cover Plate

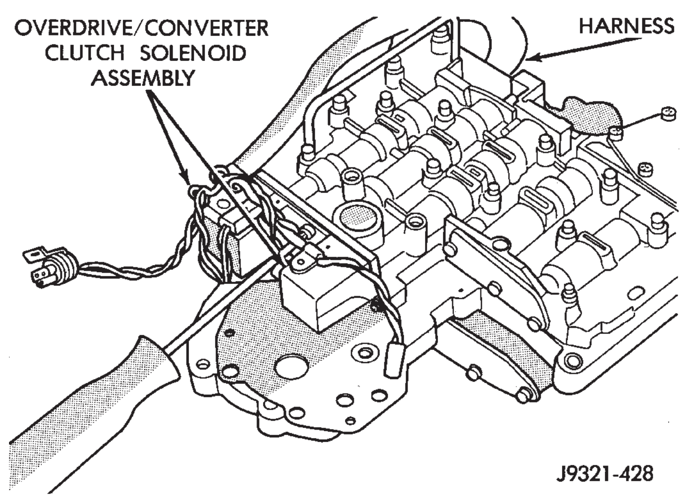


Fig. 97 Removing Overdrive/Converter Solenoid Assembly Screws

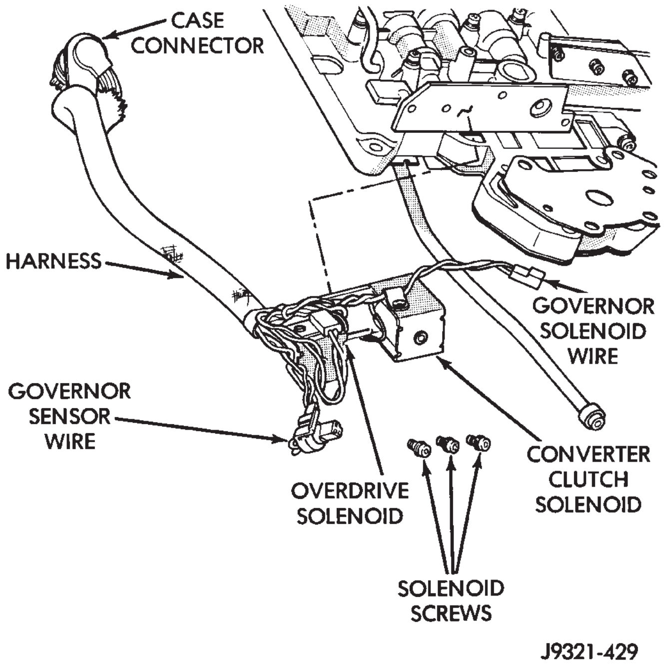


Fig. 98 Overdrive/Converter Clutch Solenoid Assembly Removal

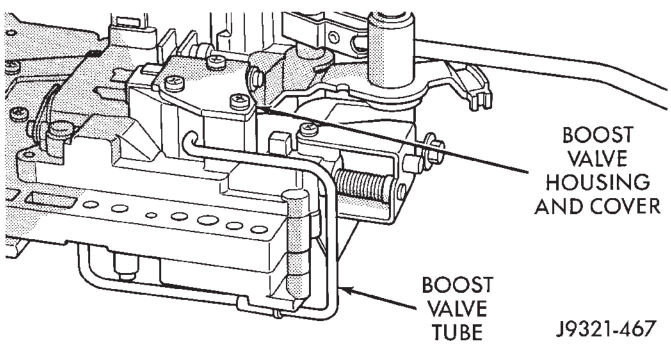


Fig. 99 Boost Valve Cover Location

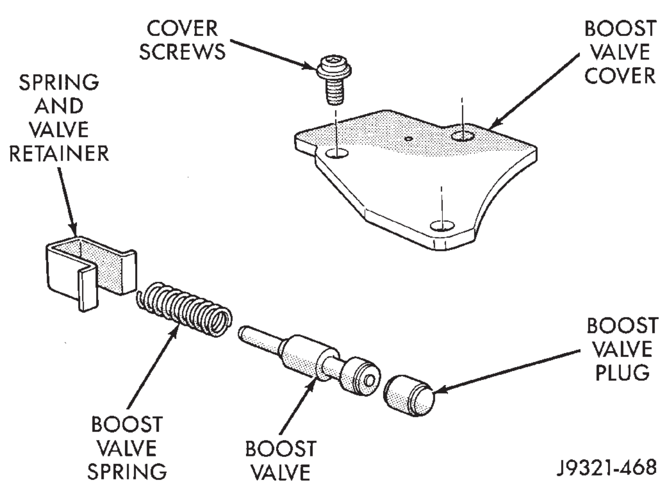


Fig. 100 Boost Valve Components

(14) Remove E-clip and washer that retains throttle lever shaft in manual lever (Fig. 102).

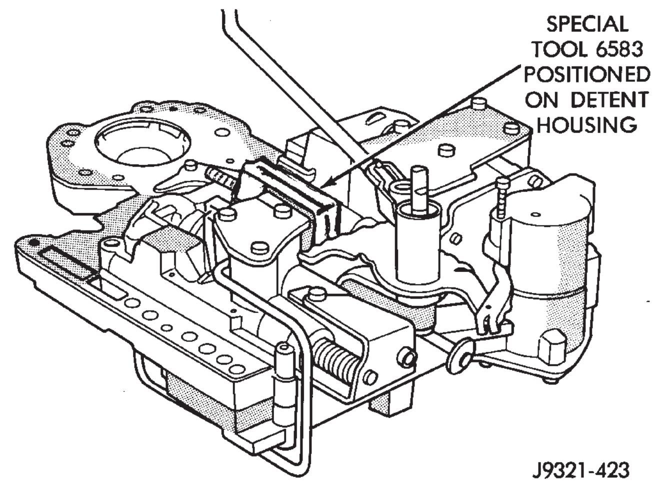


Fig. 101 Securing Detent Ball And Spring

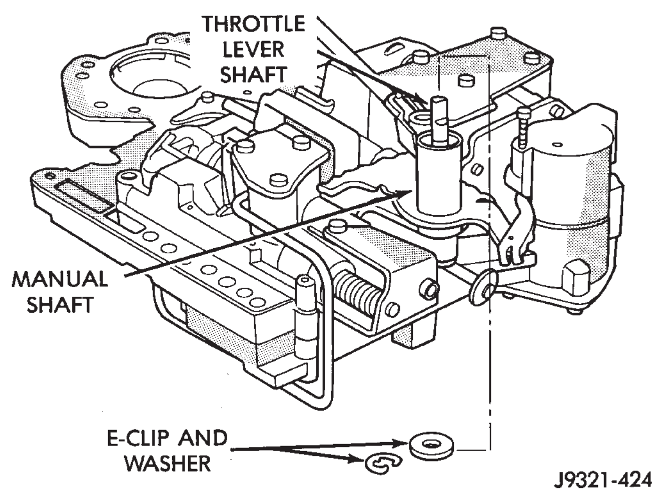


Fig. 102 Throttle Lever E-Clip And Washer Removal

(15) Remove manual lever and throttle lever (Fig. 103). Rotate and lift manual lever off valve body and throttle lever shaft. Then slide throttle lever out of valve body.

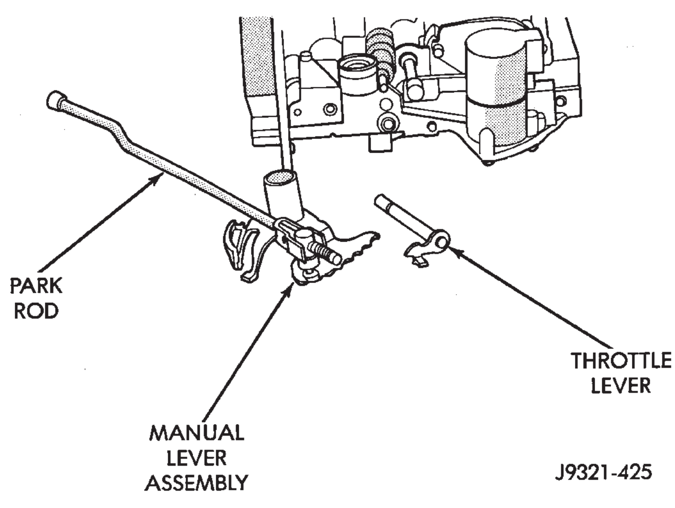


Fig. 103 Manual And Throttle Lever Removal

(16) Position pencil magnet next to detent housing to catch detent ball and spring. Then carefully remove Retainer Tool 6583 and remove detent ball and spring (Fig. 104).

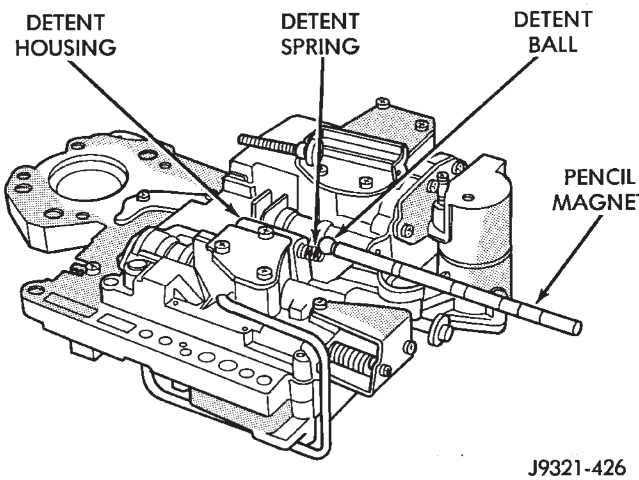


Fig. 104 Detent Ball And Spring Removal

(17) Remove park rod E-clip and separate rod from manual lever (Fig. 105).

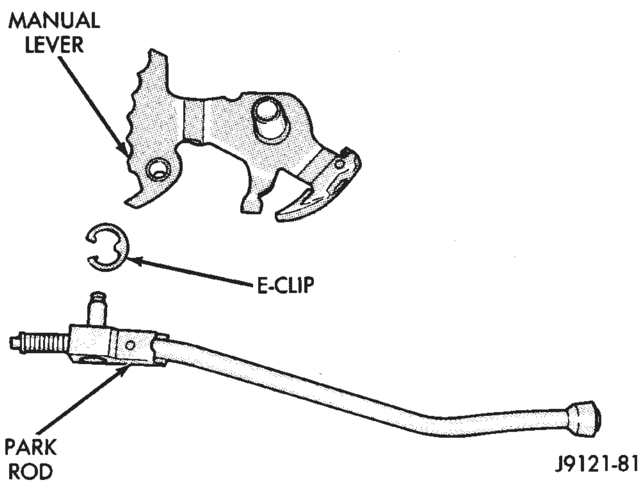


Fig. 105 Park Rod Removal

(18) Remove screws attaching pressure adjusting screw bracket to valve body and transfer plate (Fig. 106). Hold bracket firmly against spring tension while removing last screw.

(19) Remove adjusting screw bracket, line pressure adjusting screw, pressure regulator valve spring and switch valve spring (Fig. 107). **Do not remove throttle pressure adjusting screw from bracket and do not disturb setting of either adjusting screw during removal.**

(20) Loosen left-side 3-4 accumulator housing attaching screw about 2-3 threads. Then remove center and right-side housing attaching screws (Fig. 108).

(21) Carefully rotate 3-4 accumulator housing upward and remove 3-4 shift valve spring and converter clutch valve plug and spring (Fig. 109).

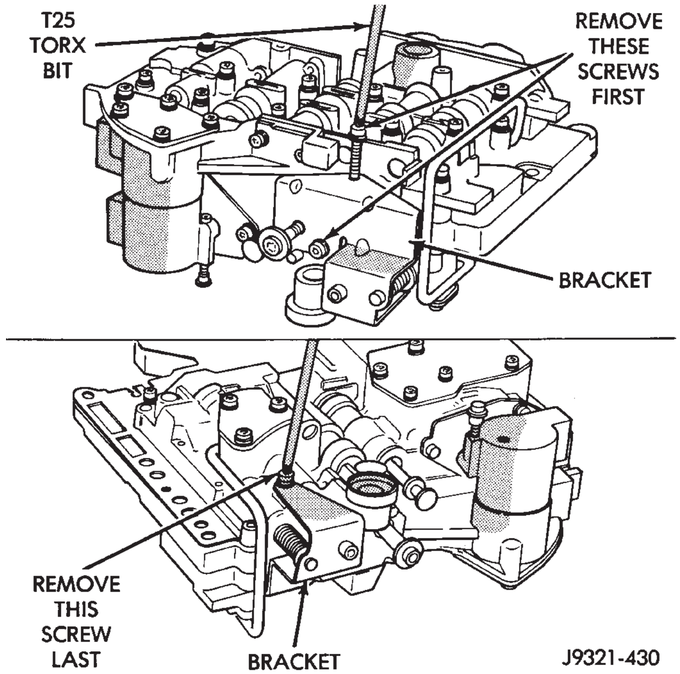


Fig. 106 Removing/Installing Adjusting Screw Bracket Fasteners

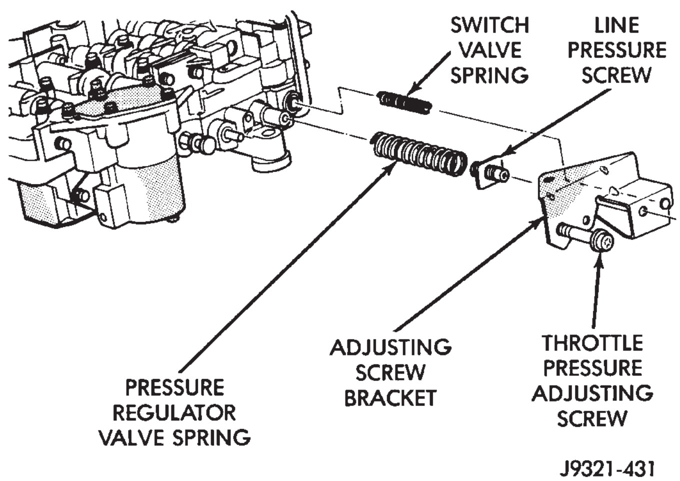


Fig. 107 Adjusting Screw Bracket And Spring Removal

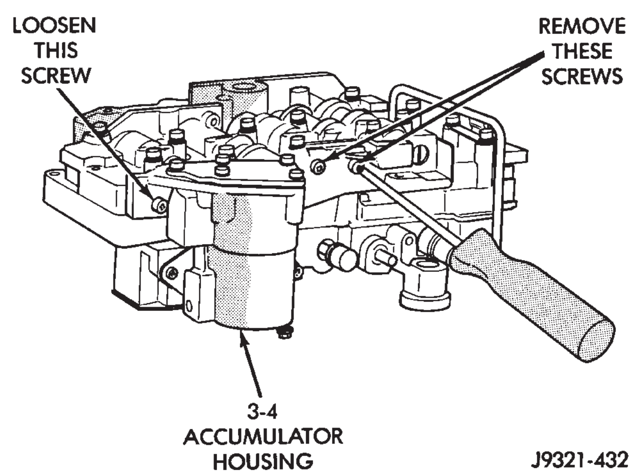


Fig. 108 Accumulator Housing Screw Locations

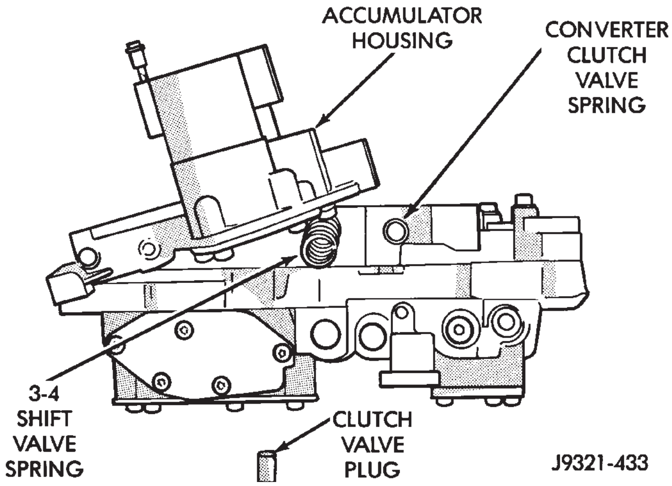


Fig. 109 Removing 3-4 Shift And Converter Clutch Valve Springs And Plug

(22) Remove left-side screw and remove 3-4 accumulator housing from valve body (Fig. 110).

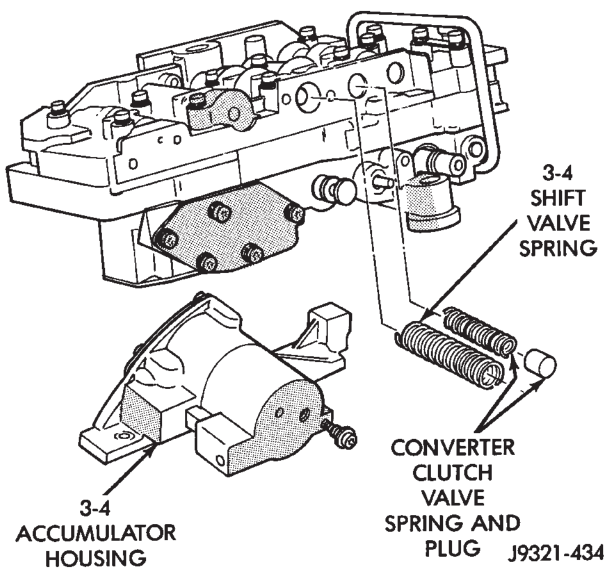


Fig. 110 3-4 Accumulator Housing, Valve Springs And Plug Removal

(23) Remove pressure regulator valve spring from lower housing (Fig. 111).

(24) Remove boost valve connecting tube (Fig. 112). Disengage tube from upper housing port first. Then rock opposite end of tube back and forth to work it out of lower housing.

CAUTION: Do not use pry tools to loosen or remove connecting tube. Loosen and remove the tube by hand only.

(25) Turn valve body over so lower housing is facing upward (Fig. 113). In this position, the two check balls in upper housing will remain in place and not fall out when lower housing and separator plate are removed.

(26) Remove screws attaching valve body lower housing to upper housing and transfer plate (Fig. 113). **Note position of boost valve tube brace for assembly reference.**

(27) Remove lower housing and overdrive separator plate from transfer plate (Fig. 114).

(28) Remove transfer plate from upper housing (Fig. 115).

(29) Turn transfer plate over so upper housing separator plate is facing upward (Fig. 116).

(30) Remove brace plate from lower housing separator plate and transfer plate (Fig. 116).

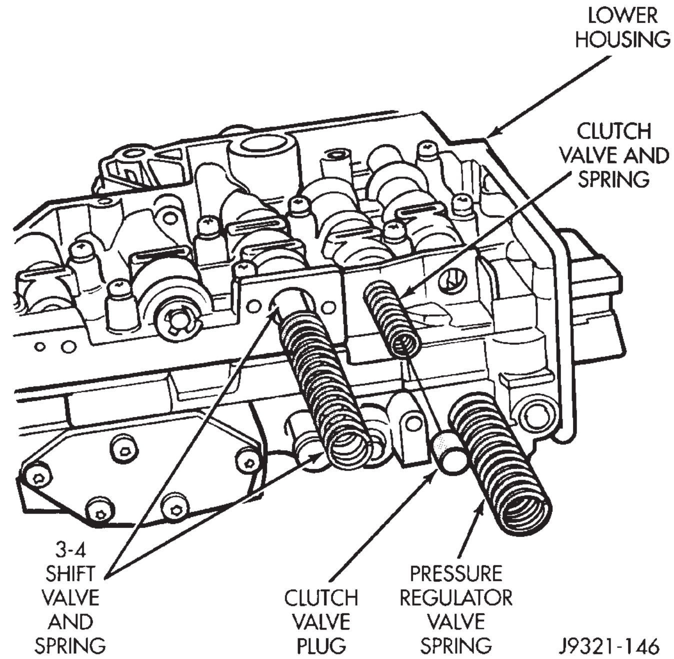


Fig. 111 Lower Housing Valve Spring Locations

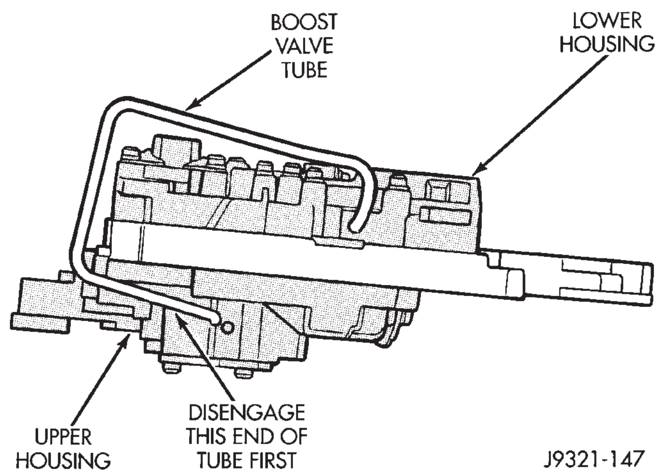


Fig. 112 Boost Valve Tube Removal

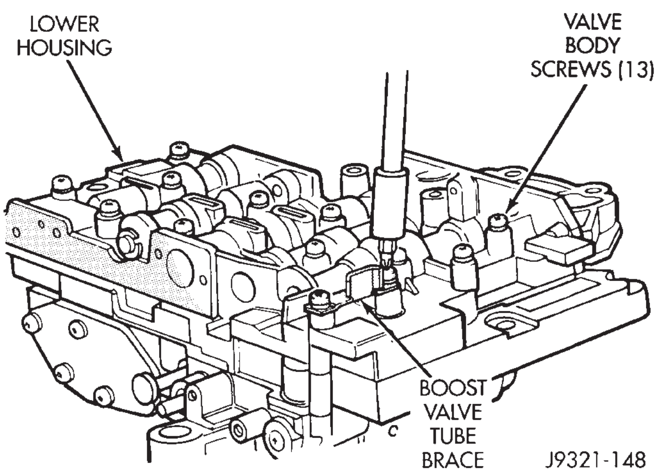


Fig. 113 Valve Body Screw And Tube Brace Location

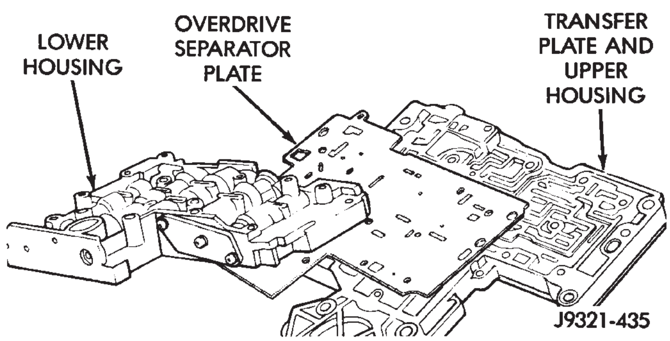


Fig. 114 Lower Housing Removal

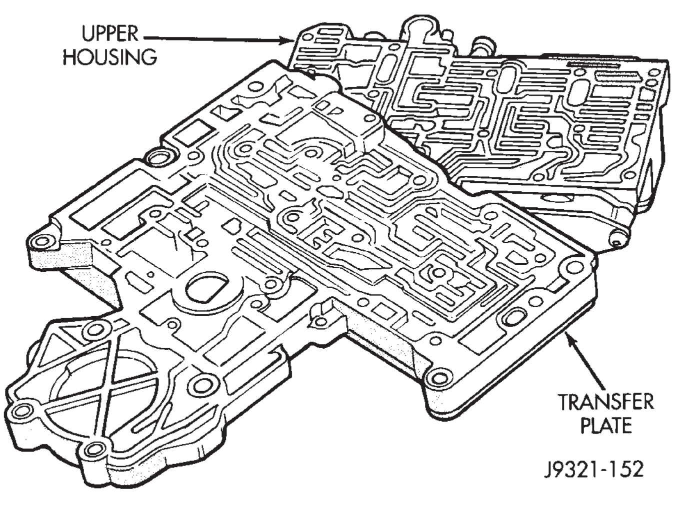


Fig. 115 Removing Transfer Plate From Upper Housing

(31) Remove upper housing separator plate from transfer plate (Fig. 117). Note position of filter in separator plate for assembly reference.

(32) Remove rear clutch and rear servo check balls from transfer plate. **Note check ball location for assembly reference before removing it (Fig. 118).**

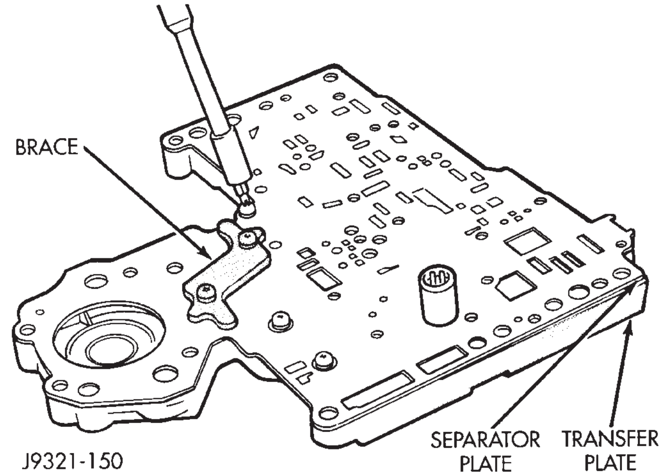


Fig. 116 Brace Plate Removal

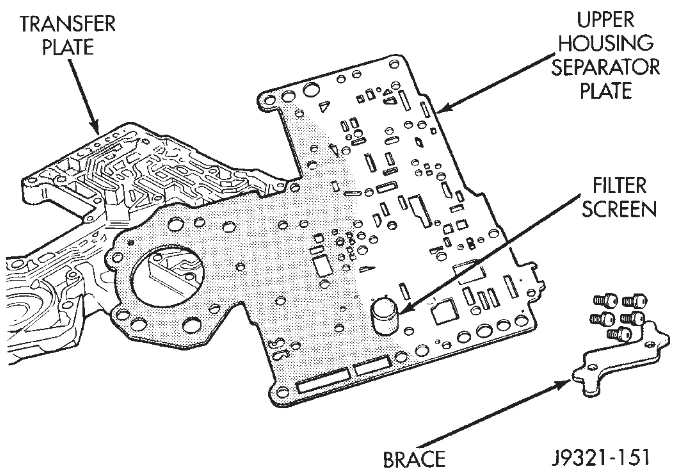


Fig. 117 Upper Housing Separator Plate Removal

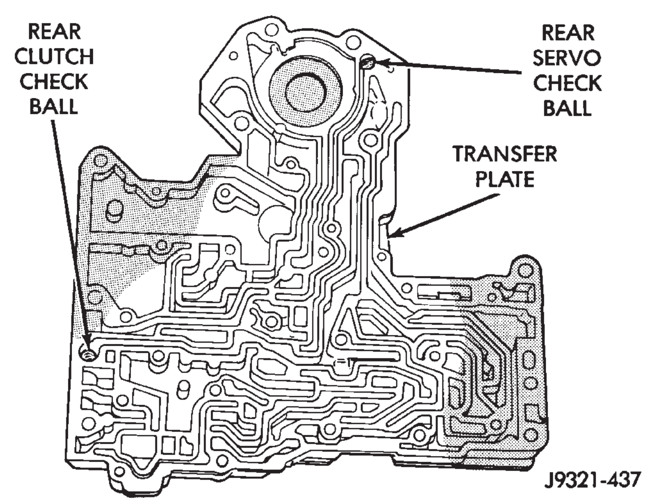


Fig. 118 Rear Clutch And Rear Servo Check Ball Locations

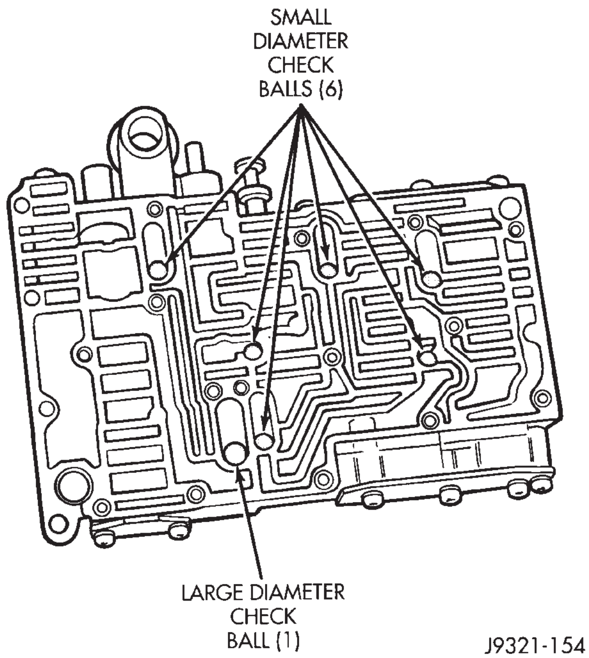


Fig. 119 Check Ball Locations In Upper Housing

VALVE BODY UPPER HOUSING DISASSEMBLY

(1) Note location of check balls in valve body upper housing (Fig. 119). Then remove the one large diameter and the six smaller diameter check balls with pencil magnet.

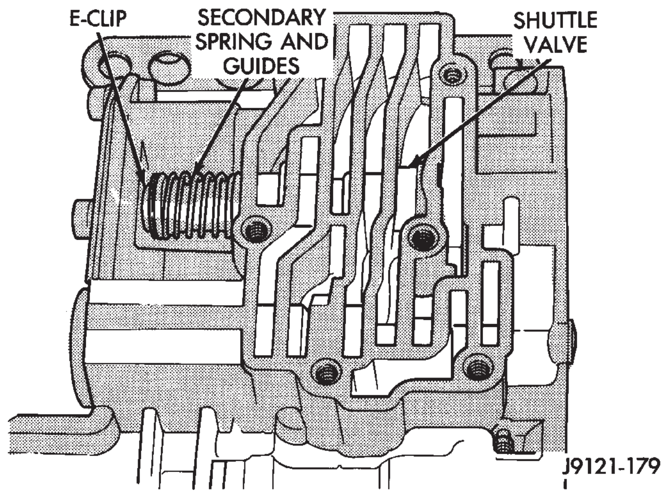


Fig. 120 Shuttle Valve E-Clip And Secondary Spring Location

(2) Remove E-clip that secure shuttle valve secondary spring on valve stem (Fig. 120).

(3) Remove governor plug and shuttle valve covers (Fig. 121).

(4) Remove throttle plug, primary spring, shuttle valve, secondary spring, and spring guides (Fig. 121).

(5) Remove boost valve retainer, spring and valve if not previously removed.

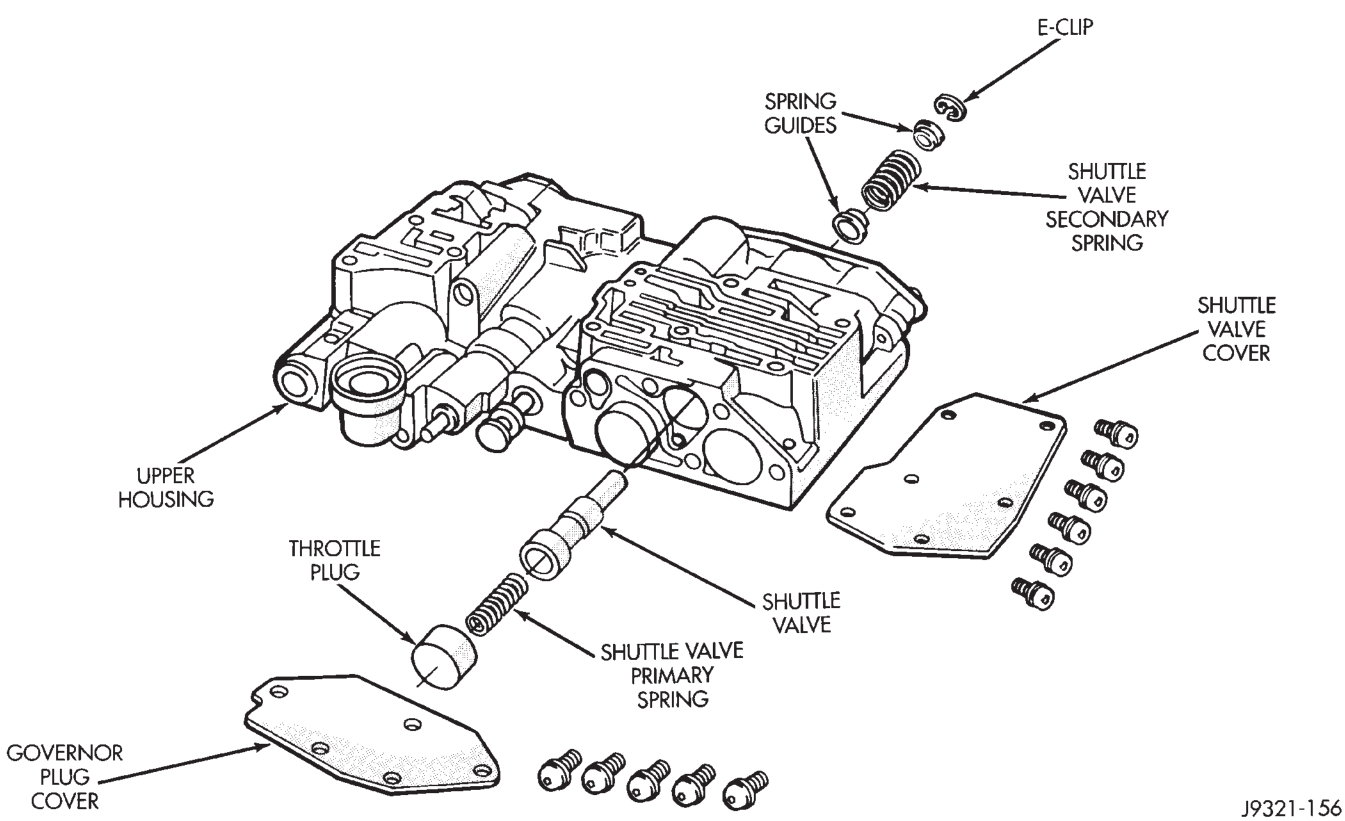


Fig. 121 Shuttle And Boost Valve Components

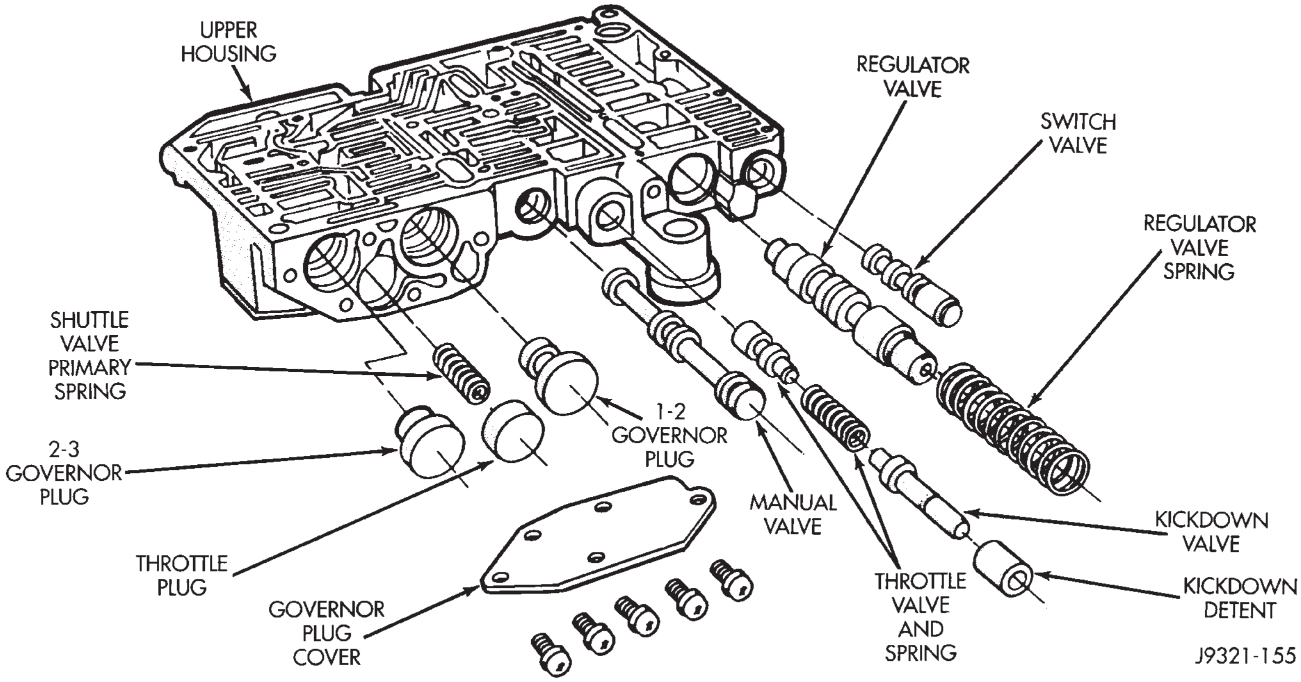


Fig. 122 Control Valve Locations In Upper Housing

(6) Turn upper housing over and remove switch valve, regulator valve and spring, and manual valve (Fig. 122).

(7) Remove kickdown detent, kickdown valve, and throttle valve and spring (Fig. 122).

(8) Remove throttle plug and 1-2 and 2-3 governor plugs (Fig. 122). Also remove shuttle valve primary spring if not removed in prior step.

(9) Turn upper housing around and remove limit valve and shift valve covers (Fig. 123).

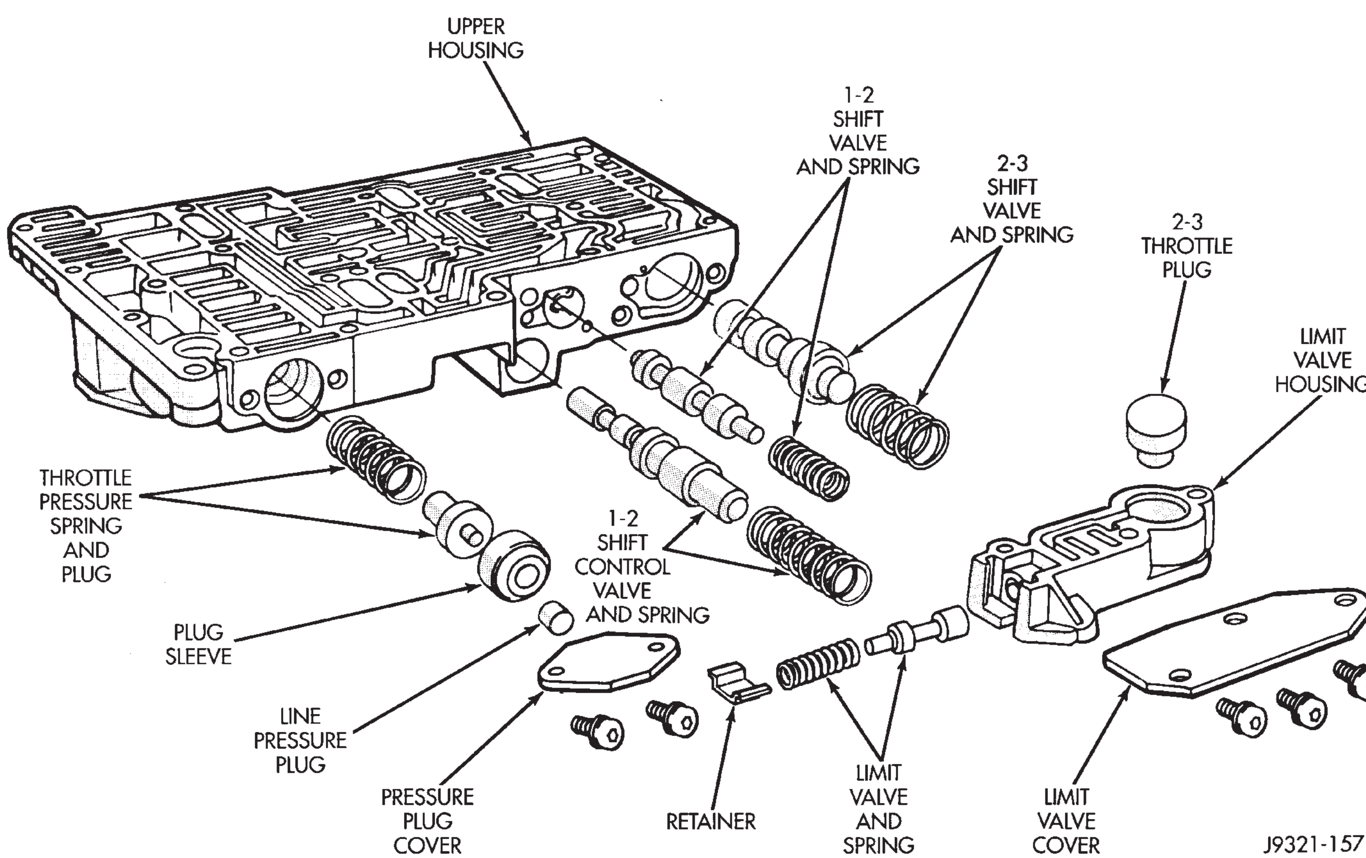


Fig. 123 Shift Valve And Pressure Plug Locations In Upper Housing

(10) Remove limit valve housing. Then remove retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing (Fig. 123).

(11) Remove 1-2 shift control valve and spring (Fig. 123).

(12) Remove 1-2 shift valve and spring (Fig. 123).

(13) Remove 2-3 shift valve and spring from valve body (Fig. 123).

(14) Remove pressure plug cover (Fig. 123).

(15) Remove line pressure plug, sleeve, throttle pressure plug and spring (Fig. 123).

VALVE BODY LOWER HOUSING DISASSEMBLY (FIG. 124)

(1) Remove timing valve cover.

(2) Remove 3-4 timing valve and spring.

(3) Remove 3-4 quick fill valve, spring and plug.

(4) Remove 3-4 shift valve and spring.

(5) Remove converter clutch valve, spring and plug.

(6) Remove converter clutch timing valve, retainer and valve spring.

3-4 ACCUMULATOR HOUSING DISASSEMBLY (FIG. 125)

(1) Remove end plate from housing.

(2) Remove piston spring.

(3) Remove piston. Remove and discard piston seals.

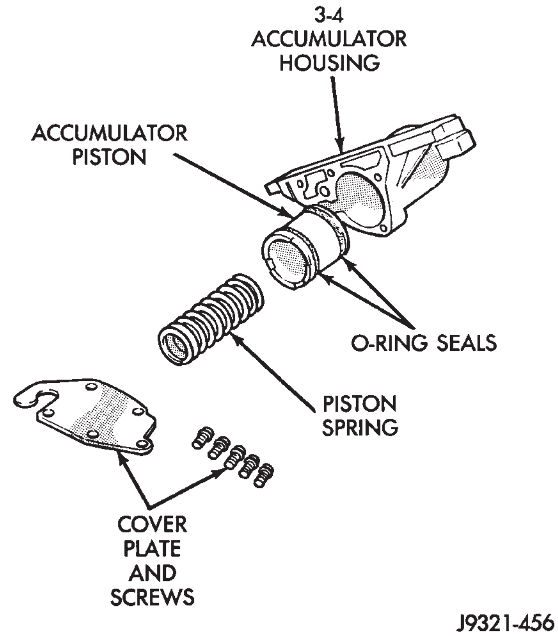


Fig. 125 3-4 Accumulator Housing Components

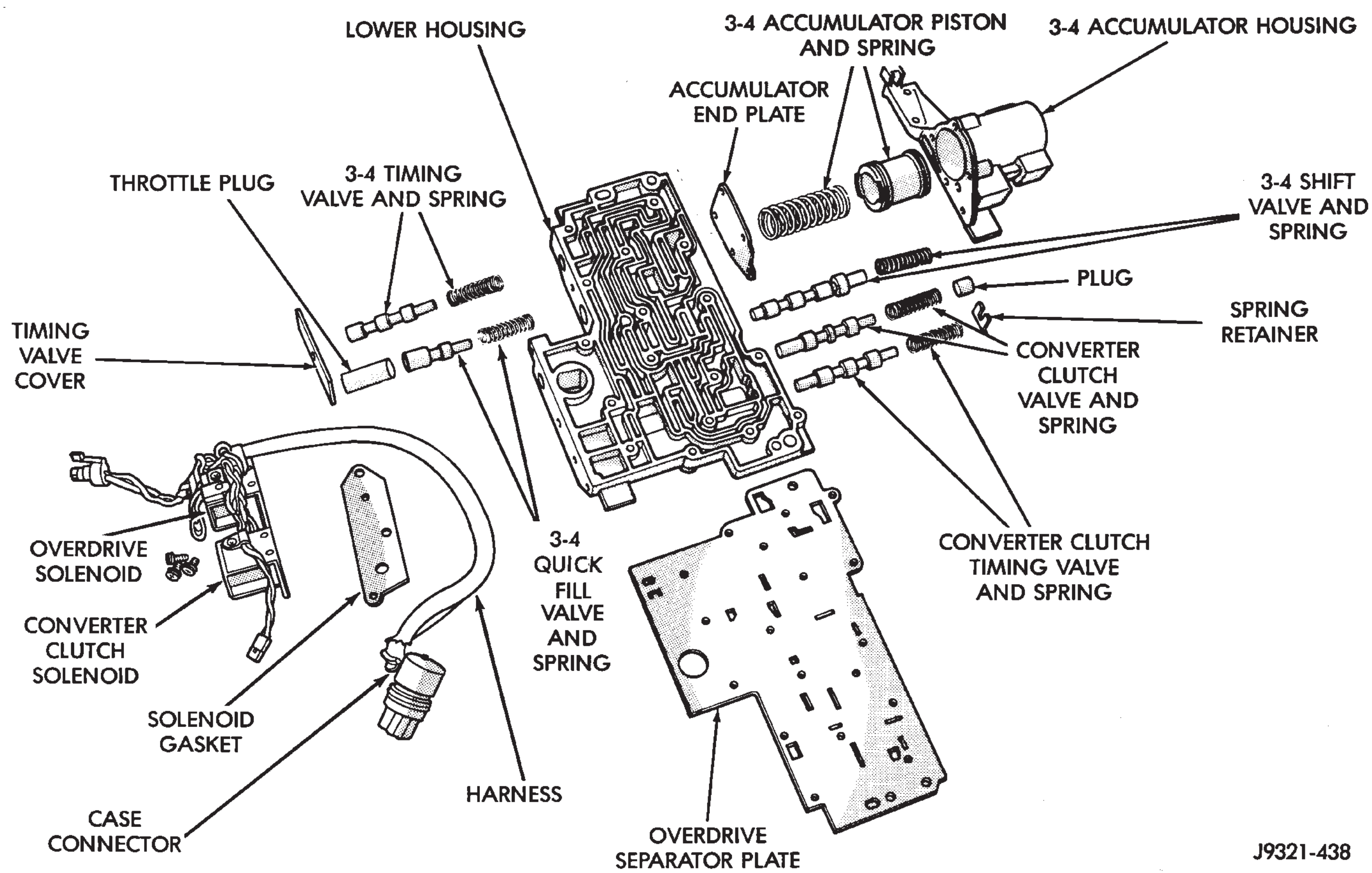


Fig. 124 Location Of 3-4 Shift Valves And Springs In Lower Housing

VALVE BODY CLEANING AND INSPECTION

Clean the valve housings, valves, plugs, springs, and separator plates with a standard parts cleaning solution only. Do not use gasoline, kerosene, or any type of caustic solution.

Do not immerse any of the electrical components in cleaning solution. Clean the governor solenoid and sensor and the dual solenoid and harness assembly by wiping them off with dry shop towels only.

Dry the parts with compressed air. Make sure all passages are clean and free from obstructions. **Do not use rags or shop towels to dry or wipe off valve body components. Lint from these materials will adhere to the valve body components. Lint will interfere with valve operation and may clog filters and fluid passages.**

Wipe the governor pressure sensor and solenoid valve with dry, lint free shop towels only. The O-rings on the sensor and solenoid valve are the only serviceable components (Figs. 126 and 127). Be sure the vent ports in the solenoid valve are open and not blocked by dirt or debris. Replace the valve and/or sensor only when DRB II scan tool diagnosis indicates this is necessary. Or, if either part has sustained physical damage (dented, deformed, broken, etc.).

CAUTION: Do not turn the small screw at the end of the solenoid valve for any reason. Turning the screw in either direction will ruin solenoid calibration and result in solenoid failure. In addition, the filter on the solenoid valve is NOT serviceable. Do not try to remove the filter as this will damage the valve housing.

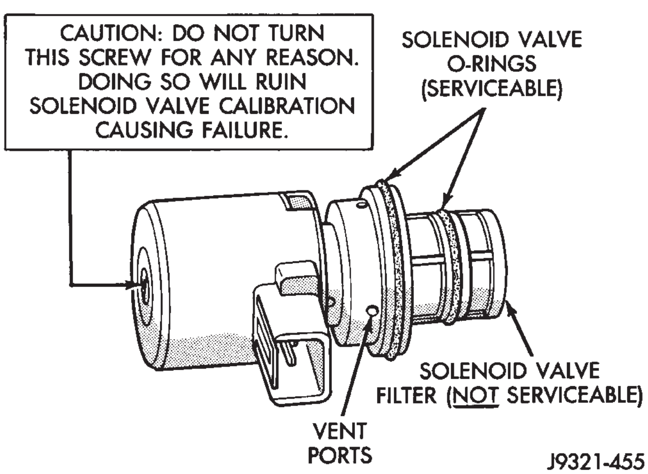


Fig. 126 Governor Pressure Solenoid Valve O-Ring And Vent Location

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 straight-

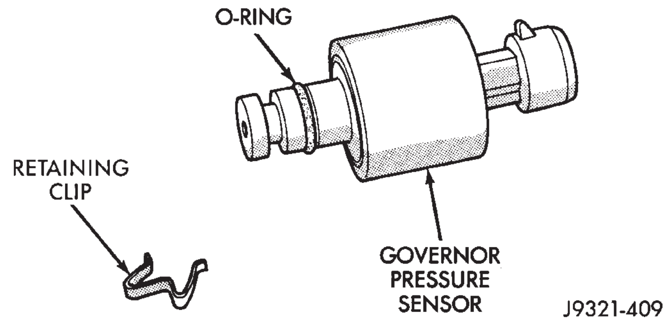


Fig. 127 Governor Pressure Sensor O-Ring Location

edge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with a sheet of crocus cloth. Position the crocus cloth on a surface plate, sheet of plate glass or equally flat surface. If distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CAUTION: Many of the valves and plugs, such as the throttle valve, shuttle valve plug, 1-2 shift valve and 1-2 governor plug, are made of coated aluminum (Fig. 128). Aluminum components are 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 under any circumstances. This practice could damage the special coating.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Minor surface scratches can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.** Maintaining sharpness of these edges is vitally important. The edges prevent foreign matter from lodging between the valves and plugs and the bore.

Inspect all the valve and plug bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or scored. Inspect all of the valve body springs. The springs must be free of distortion, warpage or broken coils.

Check the two separator plates for distortion or damage of any kind. Inspect the upper housing, lower housing, 3-4 accumulator housing, and transfer plate carefully. Be sure all fluid passages are clean and clear. Check condition of the upper housing and transfer plate check balls as well. The check balls and ball seats must not be worn or damaged.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores.

Valve body bores do not change dimensionally with use. If the valve body functioned correctly when new, it will continue to operate properly after cleaning and inspection. It should not be necessary to replace a valve body assembly unless it is damaged in handling.

The only serviceable valve body components are listed below. The remaining valve body components are serviced only as part of a complete valve body assembly. Serviceable parts are:

- dual solenoid and harness assembly
- solenoid gasket
- solenoid case connector O-rings and shoulder bolt
- switch valve and spring
- pressure adjusting screw and bracket assembly
- throttle lever
- manual lever and shaft seal
- throttle lever shaft seal, washer, and E-clip
- fluid filter and screws
- detent ball and spring
- valve body screws
- governor pressure solenoid
- governor pressure sensor and retaining clip
- park lock rod and E-clip

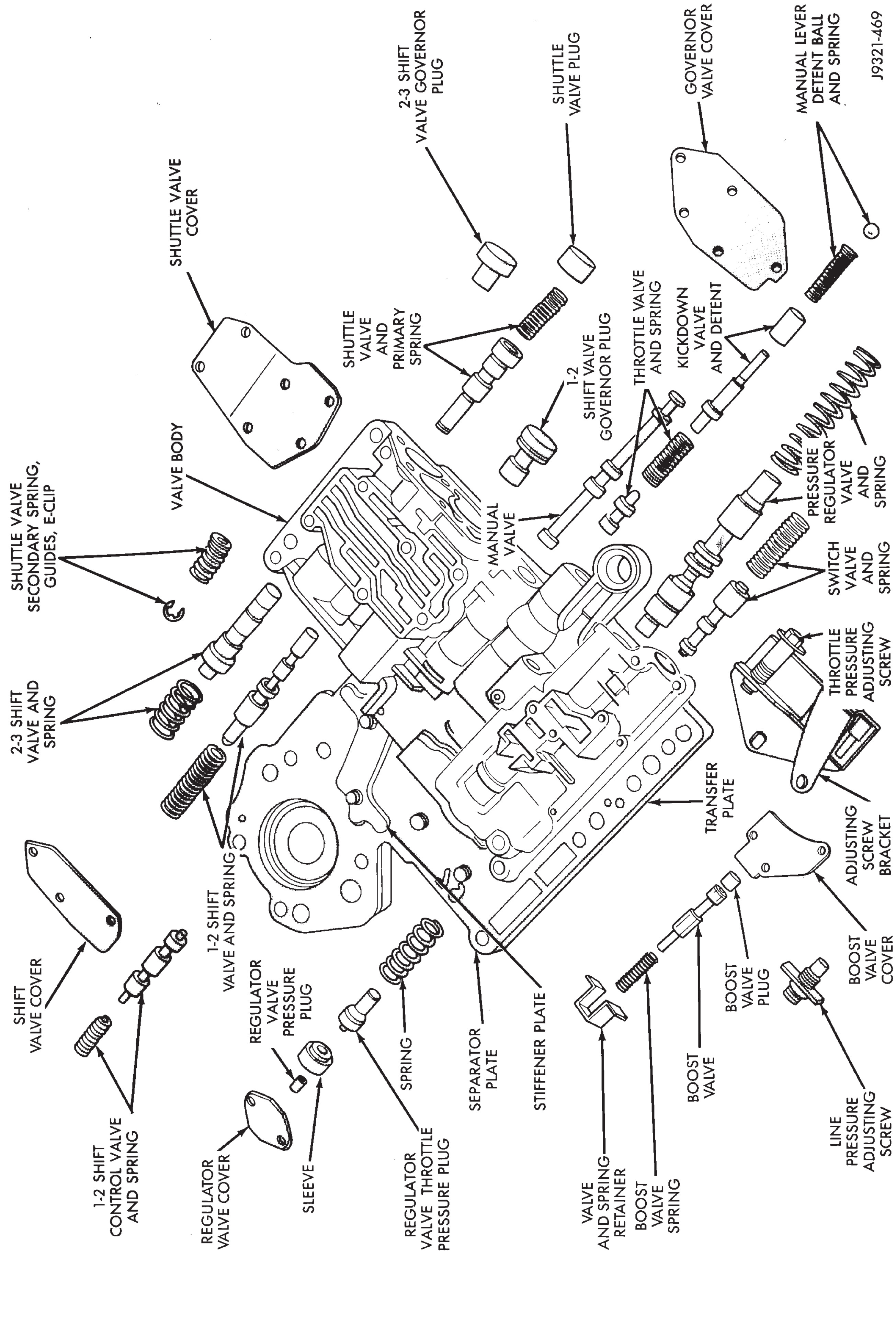


Fig. 128 Upper Housing Valves, Plug, Springs And Brackets

VALVE BODY REASSEMBLY

CAUTION: Do not force valves or plugs into place during reassembly. If the valve body bores, valves and plugs are free of distortion or burrs, the valve body components should all slide into place easily. In addition, do not overtighten the transfer plate and valve body screws during reassembly. Overtightening can distort the housings resulting in valve sticking, cross leakage and unsatisfactory operation. Tighten valve body screws to recommended torque only.

Lower Housing Assembly (Fig. 124)

(1) Lubricate valves, springs, and the housing valve and plug bores with clean transmission fluid.
(2) Install 3-4 timing valve spring and valve in lower housing.
(3) Install 3-4 quick fill valve in lower housing.
(4) Install 3-4 quick fill valve spring and plug in housing.
(5) Install timing valve end plate. Tighten end plate screws to 4 N●m (35 in. lbs.) torque.
(6) Install 3-4 shift valve and spring.
(7) Install converter clutch valve, spring and plug.
(8) Install converter clutch timing valve and spring.

3-4 Accumulator Assembly (Fig. 125)

(1) Lubricate accumulator piston, seals and housing piston bore with clean transmission fluid.
(2) Install new seal rings on accumulator piston.
(3) Install piston and spring in housing.
(4) Install end plate on housing.

Transfer Plate Assembly

(1) Install rear clutch and rear servo check balls in transfer plate (Fig. 118).
(2) Install filter screen in upper housing separator plate (Fig. 129).

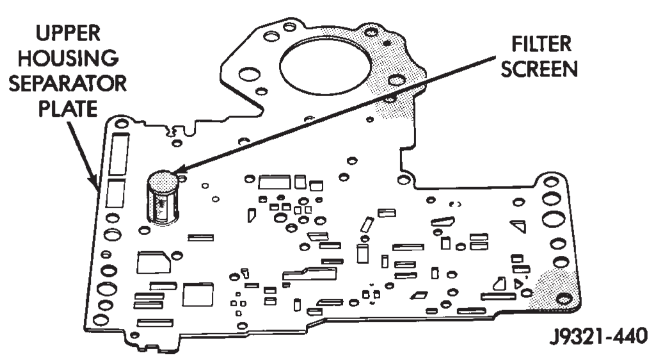


Fig. 129 Separator Plate Filter Screen Installation

(3) Align and position upper housing separator plate on transfer plate (Fig. 116).
(4) Install brace plate (Fig. 116). Tighten brace attaching screws to 4 N●m (35 in. lbs.) torque.
(5) Install remaining separator plate attaching screws. Tighten screws to 4 N●m (35 in. lbs.) torque.

Assembling Upper And Lower Housings

(1) Position upper housing so internal passages and check ball seats are facing upward. Then install check balls in housing (Fig. 119). Seven check balls are used. The single large check ball is approximately 8.7 mm (11/32 in.) diameter. The remaining 6 check balls are approximately 6.3 mm (1/4 in.) in diameter.
(2) Position assembled transfer plate and upper housing separator plate on upper housing (Fig. 130). Be sure filter screen is seated in proper housing recess.

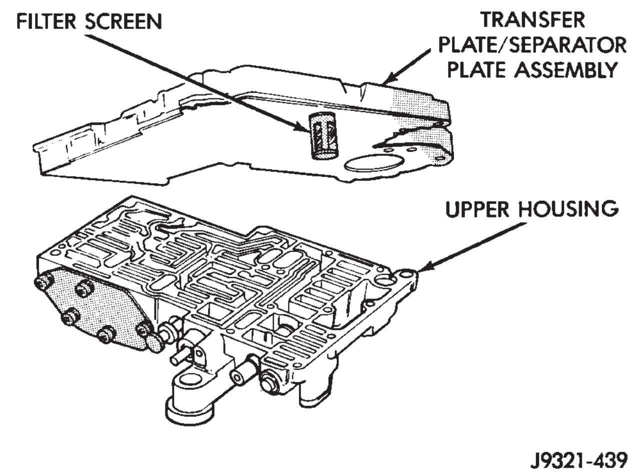


Fig. 130 Installing Transfer Plate On Upper Housing

(3) Position lower housing separator plate on transfer plate (Fig. 131).

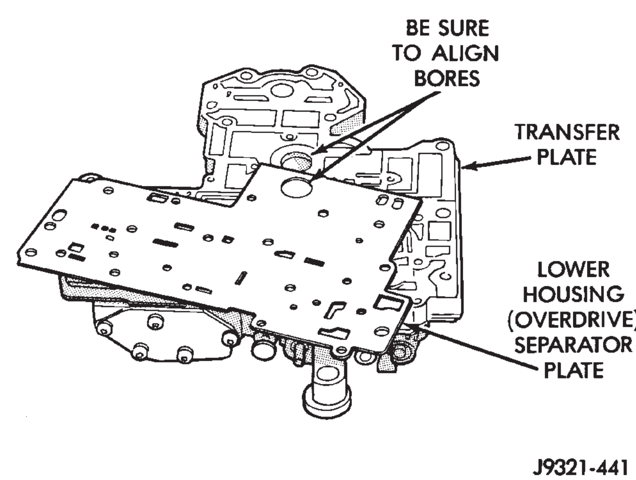


Fig. 131 Lower Housing Separator Plate Installation

(4) Install lower housing on assembled transfer plate and upper housing (Fig. 132).
(5) Install and start valve body screws by hand.

Then tighten screws evenly to 4 N●m (35 in. lbs.) torque. Start at center and work out to sides when tightening screws (Fig. 132).

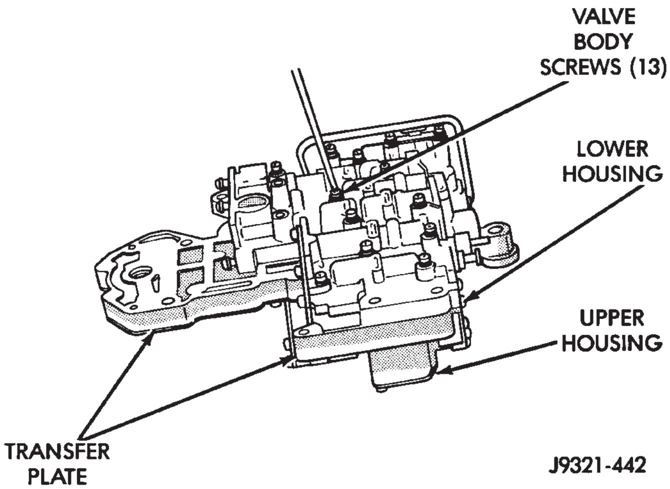


Fig. 132 Installing Lower Housing On Transfer Plate And Upper Housing

Upper Housing Valve And Plug Installation (Figs. 122, 123, 124)

(1) Lubricate valves, plugs, springs with clean transmission fluid.

(2) Assemble regulator valve line pressure plug, sleeve, throttle plug and spring. Insert assembly in upper housing and install cover plate. Tighten cover plate screws to 4 N●m (35 in. lbs.) torque.

(3) Install 1-2 and 2-3 shift valves and springs.

(4) Install 1-2 shift control valve and spring.

(5) Install shift valve cover plate.

(6) Install shuttle valve as follows:

(a) Insert plastic guides in shuttle valve secondary spring and install spring on end of valve.

(b) Hold shuttle valve in place.

(c) Compress secondary spring and install E-clip in groove at end of shuttle valve.

(d) Verify that spring and E-clip are properly seated before proceeding.

(7) Install shuttle valve cover plate. Tighten cover plate screws to 4 N●m (35 in. lbs.) torque.

(8) Install 1-2 and 2-3 valve governor plugs in valve body.

(9) Install shuttle valve primary spring and throttle plug.

(10) Align and install governor plug cover. Tighten cover screws to 4 N●m (35 in. lbs.) torque.

(11) Install manual valve.

(12) Install throttle valve and spring.

(13) Install kickdown valve and detent.

(14) Install pressure regulator valve.

(15) Install switch valve.

Boost Valve Tube Installation (Fig. 133)

(1) Position valve body assembly so lower housing is facing upward.

(2) Lubricate tube ends and housing ports with transmission fluid or petroleum jelly.

(3) Position tube behind tube brace.

(4) Start tube in lower housing port first. Then swing tube downward and work opposite end of tube into upper housing port.

(5) Seat both ends of tube once they are in position. Note that tube brace may be bent slightly to ease installation and secure tube lower connection.

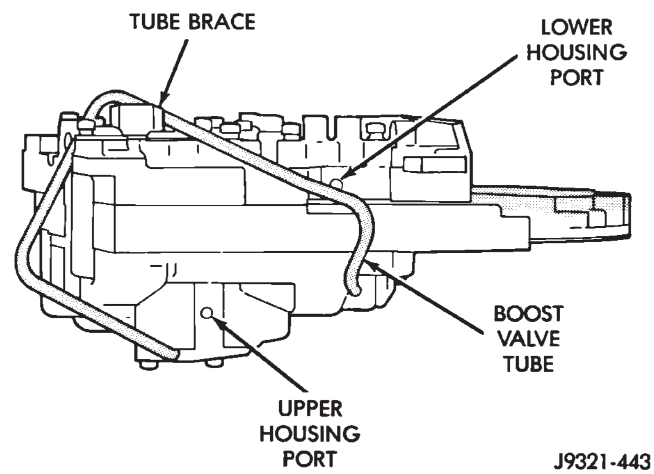


Fig. 133 Boost Valve Tube Installation

3-4 Accumulator Installation

(1) Position converter clutch valve and 3-4 shift valve springs in housing (Fig. 134).

(2) Loosely attach accumulator housing with right-side screw (Fig. 134). Install only one screw at this time as accumulator must be free to pivot upward for ease of installation.

(3) Position plug on end of converter clutch valve spring. Then compress and hold springs and plug in place with fingers of one hand.

(4) Swing accumulator housing upward over valve springs and plug.

(5) Hold accumulator housing firmly in place and install remaining two attaching screws. Be sure springs and clutch valve plug are properly seated (Fig. 135).

(6) Attach solenoid case connector to 3-4 accumulator with shoulder-type screw. Connector has small locating tang that fits in dimple at top of accumulator housing (Fig. 95). Seat tang in dimple before tightening connector screw.

(7) Install solenoid assembly and gasket. Tighten solenoid attaching screws to 8 N●m (72 in. lbs.) torque.

(8) Verify that solenoid wires are properly routed (Figs. 95 and 96). **Solenoid wires must be clear of manual lever and park rod.**

Valve Body Final Assembly And Adjustment

(1) Insert manual lever detent spring in upper housing.

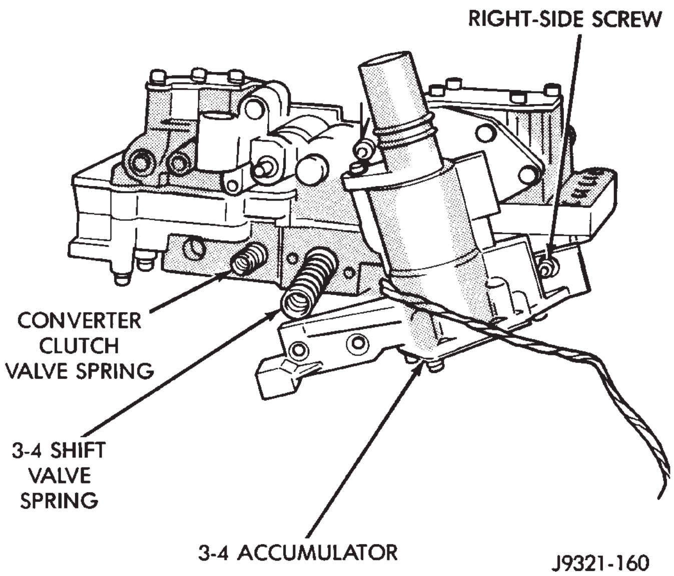


Fig. 134 Installing Converter Clutch And 3-4 Shift Valve Springs

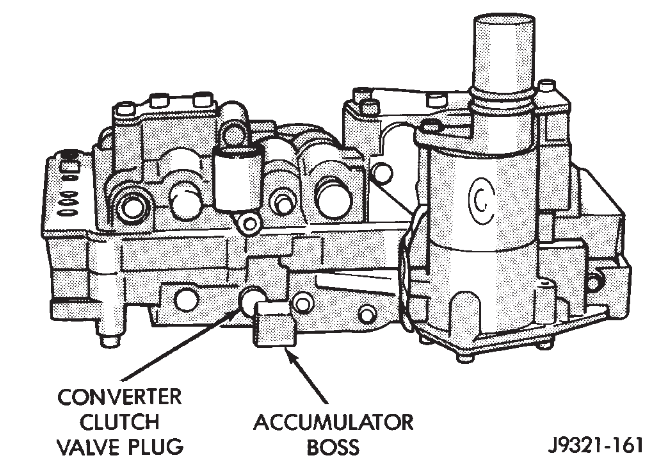


Fig. 135 Seating 3-4 Accumulator On Lower Housing

(2) Position line pressure adjusting screw in adjusting screw bracket.

(3) Install spring on end of line pressure regulator valve.

(4) Install switch valve spring on tang at end of adjusting screw bracket.

(5) 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.

(6) Install throttle lever in upper housing. Then install manual lever over throttle lever and start manual lever into housing.

(7) Position detent ball on end of spring. Then hold detent ball and spring in detent housing with Retainer Tool 6583 (Fig. 101).

(8) Align manual lever with detent ball and manual valve. Hold throttle lever upward. Then press down on manual lever until fully seated. Remove detent ball retainer tool after lever is seated.

(9) Then Install manual lever seal, washer and E-clip.

(10) Lubricate solenoid case connector O-rings and shaft of manual lever with light coat of petroleum jelly.

(11) Verify that throttle lever is aligned with end of kickdown valve stem and that manual lever arm is engaged in manual valve (Fig. 136).

(12) Install boost valve, valve spring, retainer and cover plate. Tighten cover plate screws to 4 N●m (35 in. lbs.) torque.

(13) Obtain new fluid filter for valve body but do not install filter at this time.

(14) If line pressure and/or throttle pressure adjustment screw settings were not disturbed, continue with overhaul or reassembly. However, if adjustment screw settings **were** moved or changed, readjust as described in Valve Body Control Pressure Adjustment procedure.

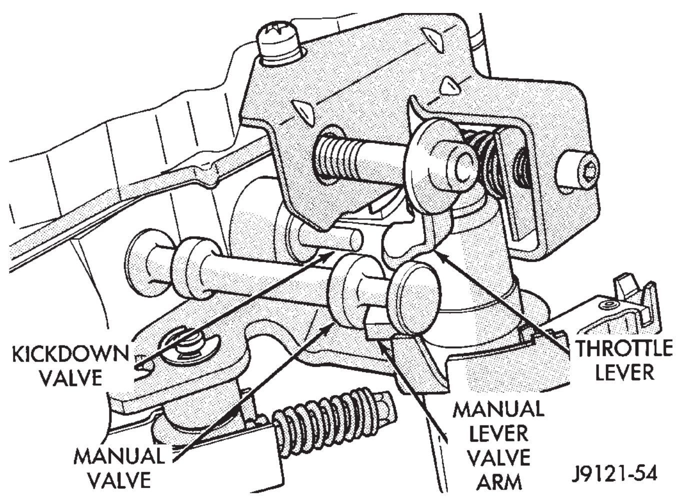


Fig. 136 Manual And Throttle Lever Alignment

GOVERNOR BODY, SENSOR AND SOLENOID INSTALLATION

CAUTION: Do not turn the small screw at the end of the governor pressure solenoid valve for any reason (Fig. 126). Turning the screw in either direction will ruin solenoid calibration and result in solenoid failure. In addition, the filter on the solenoid valve is NOT serviceable. Do not try to remove the filter as this will damage the solenoid valve housing.

(1) Turn valve body assembly over so accumulator side of transfer plate is facing down.

(2) Install new O-rings on governor pressure solenoid and sensor (Figs. 126 and 127).

(3) Lubricate solenoid and sensor O-rings with clean transmission fluid.

(4) Install governor pressure sensor in governor body. Then secure sensor with M-shaped retaining clip (Fig. 93).

(5) Install governor pressure solenoid in governor body (Fig. 94). Push solenoid in until it snaps into place in body.

(6) Position governor body gasket on transfer plate (Fig. 92).

(7) Install retainer plate on governor body and around solenoid (Fig. 90). Be sure solenoid connector is positioned in retainer cutout.

(8) Align screw holes in governor body and transfer plate. Then install and tighten governor body screws to 4 N●m (35 in. lbs.) torque.

(9) Connect harness wires to governor pressure solenoid and governor pressure sensor (Fig. 90).

VALVE BODY CONTROL PRESSURE ADJUSTMENTS

There are two control pressure adjustments on the valve body which are, line pressure and throttle pressure.

Line and throttle pressure work together as each affects shift quality and timing. Both adjustments must be performed properly and in the correct sequence. Line pressure is adjusted first and throttle pressure is adjusted last.

Line Pressure Adjustment

Measure distance from the valve body to the inner edge of the adjusting screw with an accurate steel scale (Fig. 137).

Distance should be 33.4 mm (1-5/16 inch).

If adjustment is required, turn the adjusting screw in, or out, to obtain required distance setting.

The 33.4 mm (1-5/16 inch) 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.

Throttle Pressure Adjustment

Insert Gauge C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 138).

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.

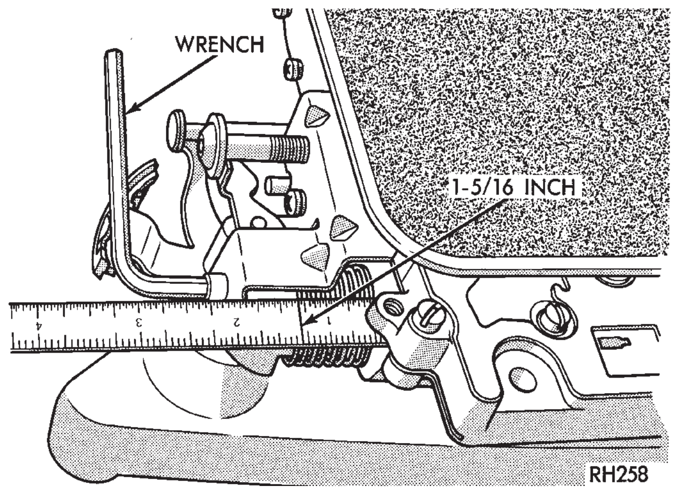


Fig. 137 Line Pressure Adjustment

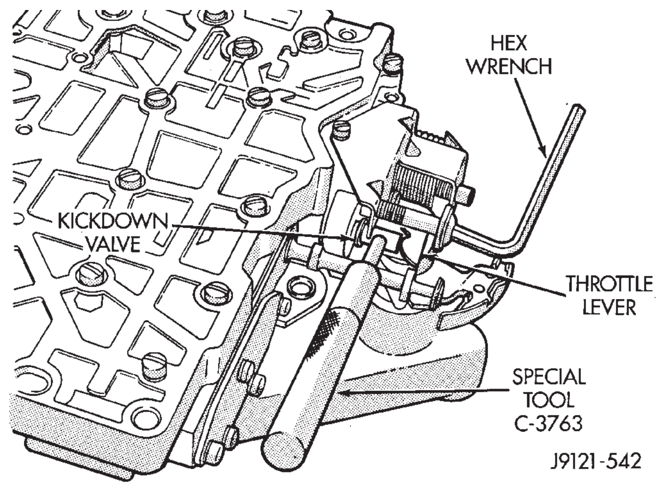


Fig. 138 Throttle Pressure Adjustment

TRANSMISSION ASSEMBLY AND ADJUSTMENT

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 operations are equally clean.

Shop towels used for wiping off tools and hands must be made from **lint free** material. Lint will stick to transmission parts and could interfere with valve operation, or even restrict fluid passages.

Lubricate the transmission components with Mopar transmission fluid during reassembly. Use 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, thrust plates and gaskets in position during assembly. However, **do not** use chassis grease, bearing grease, white grease, or similar lubricants on any transmission part. These types of lubricants can eventually block or restrict fluid passages and interfere with valve operation. Use petroleum jelly only.

Do not force parts into place. The transmission components and sub-assemblies 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).

The planetary geartrain, front/rear clutch assemblies and oil pump are all much easier to install when the transmission case is upright or as close to this position as possible. Either tilt the case upward with wood blocks, or cut a hole in the bench large enough for the output shaft. Then lower the shaft through the hole and support the transmission case directly on the bench.

TRANSMISSION ASSEMBLY PROCEDURE

(1) Install rear servo piston, spring and retainer (Fig. 139). Install spring on top of servo piston and install retainer on top of spring.

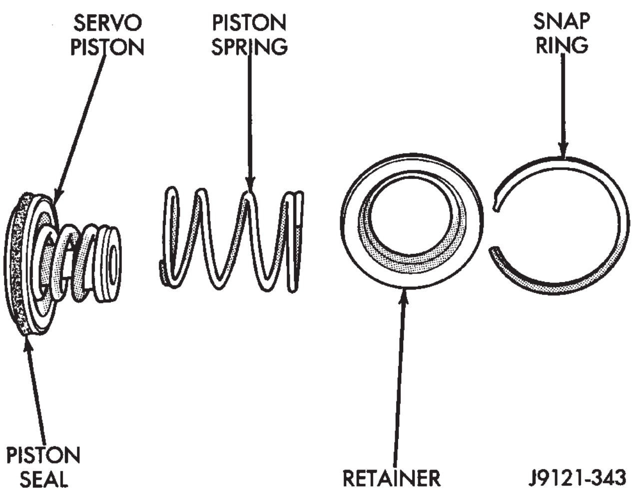


Fig. 139 Rear Servo Components

(2) Install front servo piston assembly, servo spring and rod guide (Fig. 140).

(3) Compress front/rear servo springs with Valve Spring Compressor C-3422-B and install each servo snap ring (Fig. 141).

(4) Examine bolt holes in overrunning clutch cam. Note that one hole is **not threaded** (Fig. 142). This hole must align with blank area in clutch cam bolt circle (Fig. 143). Mark hole location on clutch cam and blank area in case with grease pencil, paint stripe, or scribe mark for assembly reference.

(5) Mark location of non-threaded hole in clutch cam and blank area in bolt circle with grease pencil.

(6) Align and install overrunning clutch and cam in case (Fig. 144). **Be sure cam is correctly installed. Bolt holes in cam are slightly countersunk on one side. Be sure this side of cam faces rearward (toward piston retainer).**

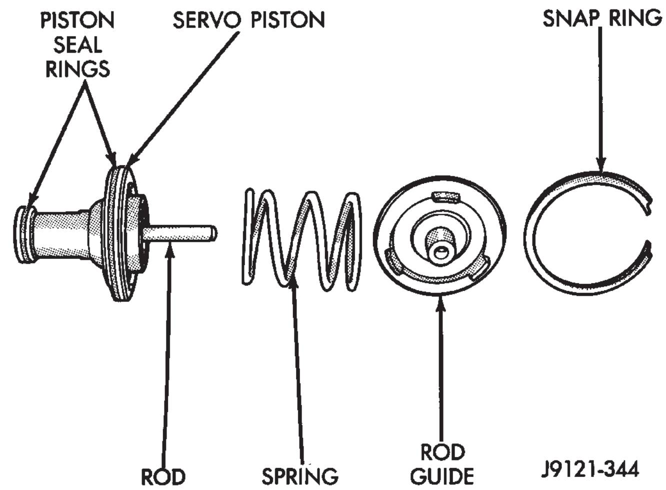


Fig. 140 Front Servo Components

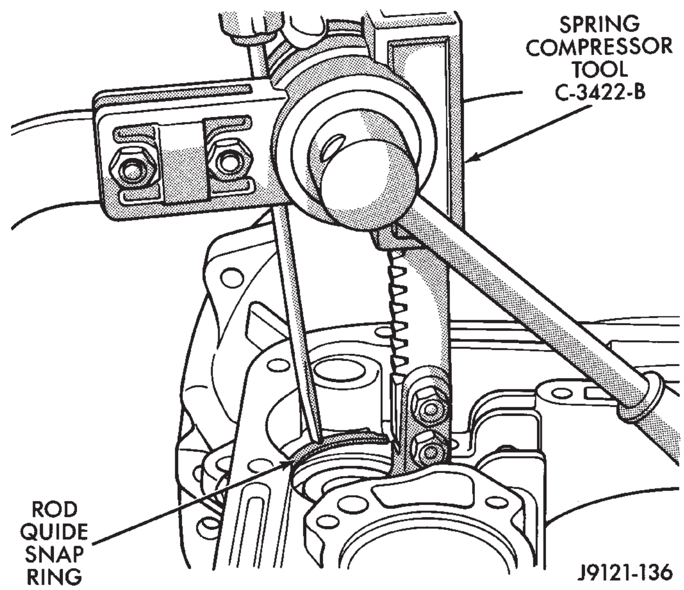


Fig. 141 Compressing Front/Rear Servo Springs

(7) Verify that non-threaded hole in clutch cam is properly aligned. Check alignment by threading a bolt into each bolt hole. Adjust clutch cam position if necessary.

(8) Install and tighten overrunning clutch cam bolts to 17 N●m (13 ft. lbs.) torque. Note that clutch cam bolts are shorter than piston retainer bolts.

(9) Lubricate clutch cam rollers with transmission fluid.

(10) Install rear band reaction pin (Fig. 145). Be sure pin is fully seated in case.

(11) Install rear band in case (Fig. 146). Be sure twin lugs on band are seated against reaction pin.

(12) Install low-reverse drum and check overrunning clutch operation as follows:

(a) Lubricate overrunning clutch race (on drum hub) with transmission fluid.

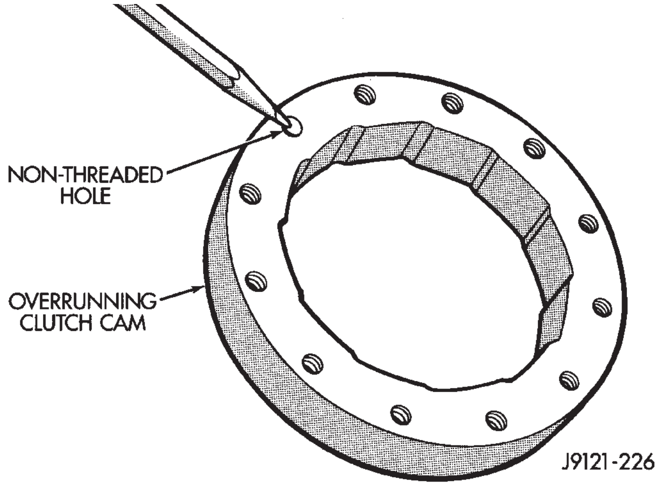


Fig. 142 Location Of Non-Threaded Hole In Clutch Cam

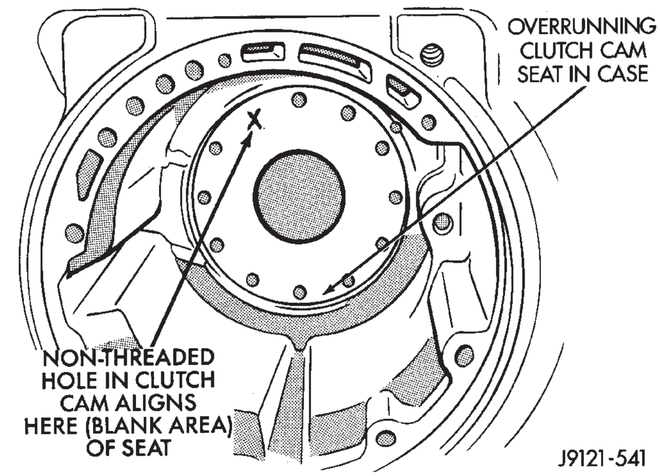


Fig. 143 Location Of Blank Area In Clutch Cam Bolt Circle

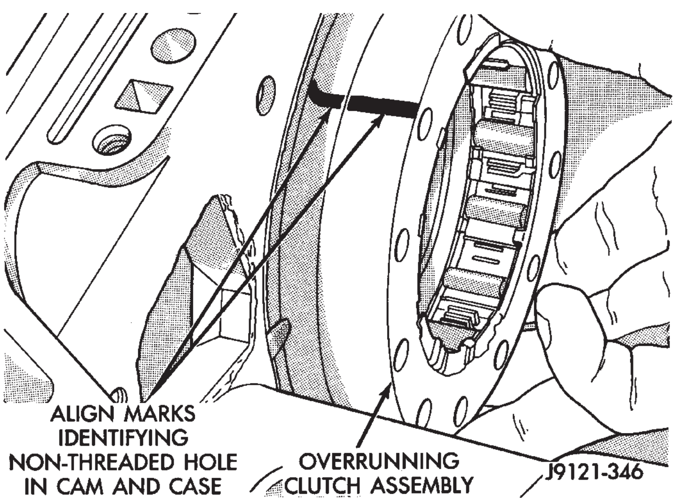


Fig. 144 Overrunning Clutch Installation

(b) Guide drum through rear band.

(c) Tilt drum slightly and start race (on drum hub) into overrunning clutch rollers.

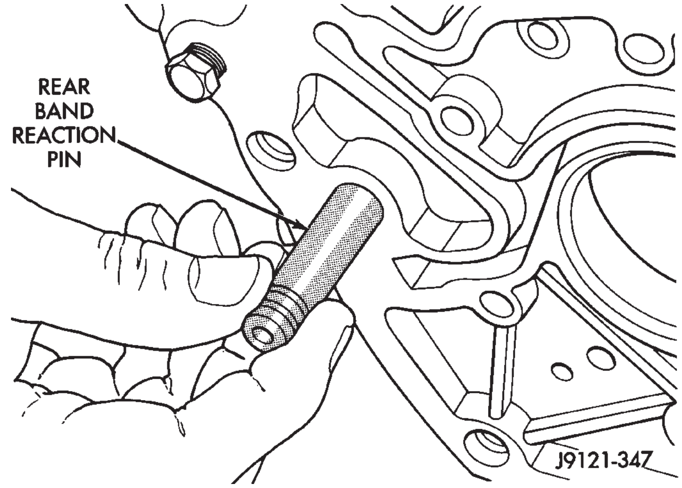


Fig. 145 Installing Rear Band Reaction Pin

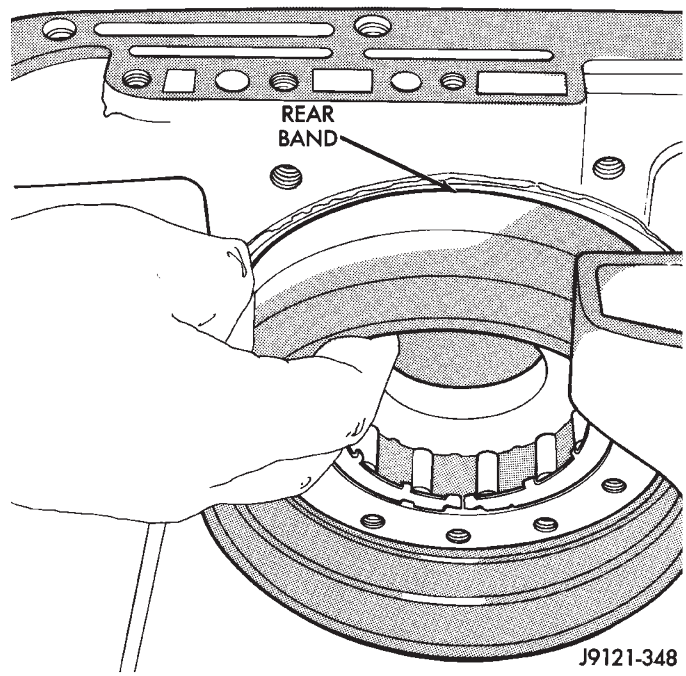


Fig. 146 Rear Band Installation

(d) Press drum rearward and turn it in clockwise direction until drum seats in overrunning clutch (Fig. 147).

(e) Turn drum back and forth. **Drum should rotate freely in clockwise direction and lock in counterclockwise direction (as viewed from front of case).**

(13) Install new gasket at rear of transmission case. Use petroleum jelly to hold gasket in place. Be sure to align governor feed holes in gasket with feed passages in case (Fig. 148). Also install gasket before overdrive piston retainer. Center hole in gasket is smaller than retainer and cannot be installed over retainer.

(14) Position overdrive piston retainer on transmission case and align bolt holes in retainer, gasket

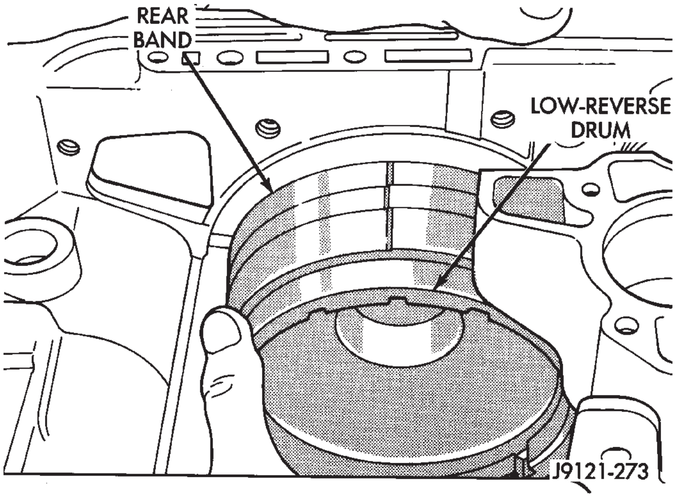


Fig. 147 Installing Low-Reverse Drum

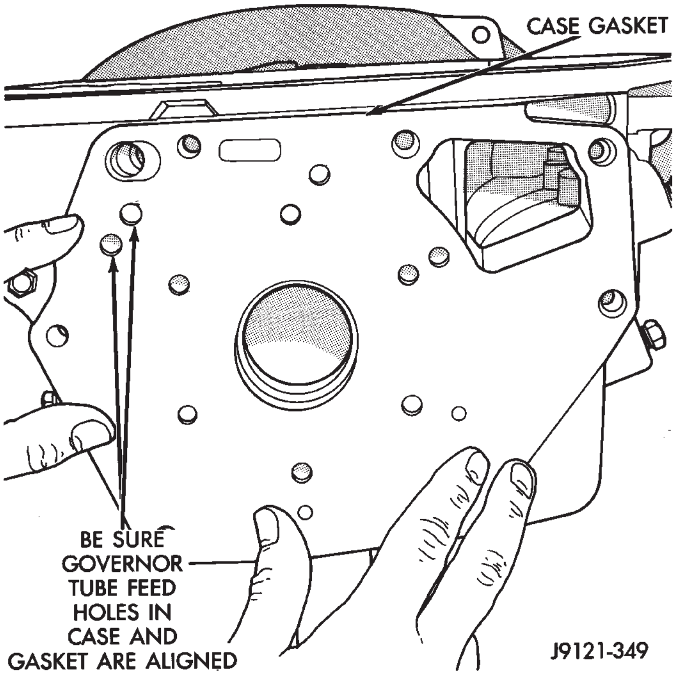


Fig. 148 Installing/Aligning Case Gasket

and case (Fig. 149). Then install and tighten retainer bolts to 17 N●m (13 ft. lbs.) torque.

(15) Install snap ring that secures low-reverse drum to hub of piston retainer (Fig. 150).

(16) Install rear band lever and pivot pin (Fig. 151). Align lever with pin bores in case and push pivot pin into place.

(17) Install planetary geartrain assembly (Fig. 152)

(18) Install thrust plate on intermediate shaft hub (Fig. 153). Use petroleum jelly to hold thrust plate in place.

(19) Check seal ring on rear clutch retainer hub (Fig. 49) and seal rings on input shaft (Fig. 154). Verify that diagonal-cut ends of teflon seal rings are properly

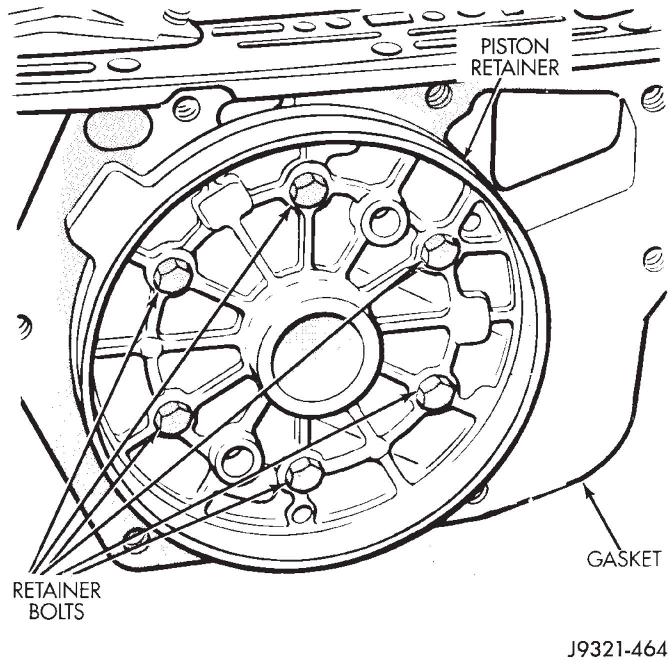


Fig. 149 Aligning Overdrive Piston Retainer

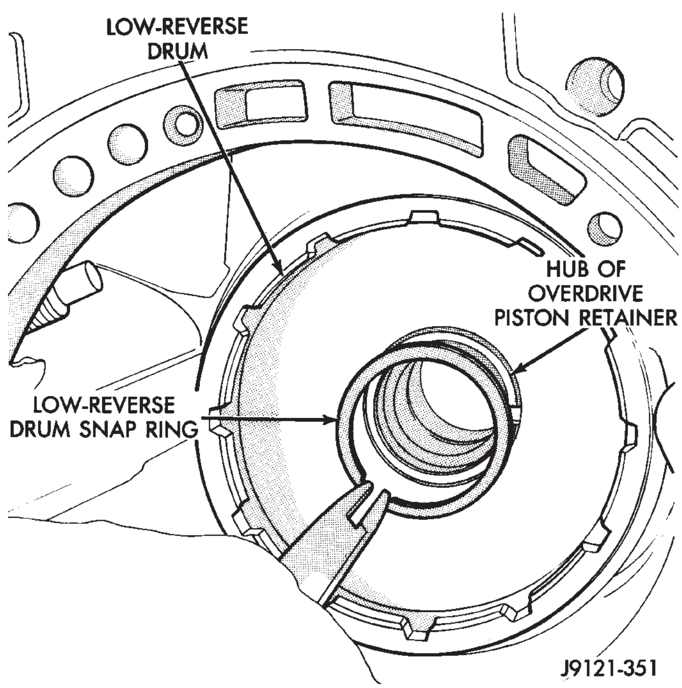


Fig. 150 Installing Low-Reverse Drum Retaining Snap Ring

joined and ends of metal ring are correctly hooked together. Also verify that shaft seal rings are installed in sequence shown.

(20) Check rear clutch thrust washer (Fig. 155). Use additional petroleum jelly to hold washer in place if necessary.

(21) Align clutch discs in front clutch and install front clutch on rear clutch (Fig. 156). Rotate front clutch retainer back and forth until completely seated on rear clutch.

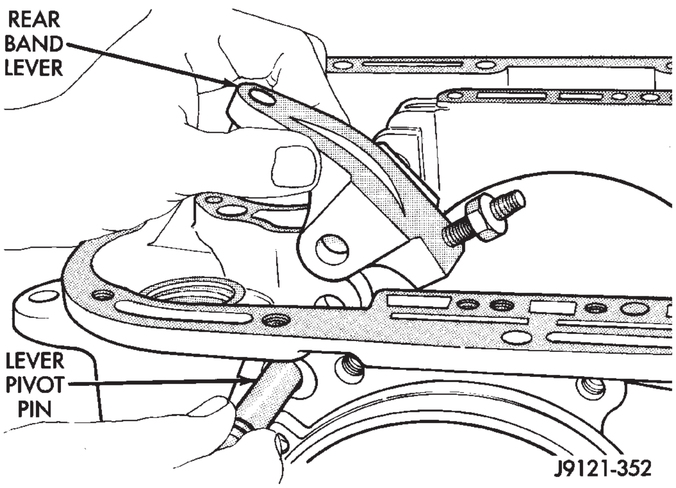


Fig. 151 Rear Band Lever And Pivot Pin Installation

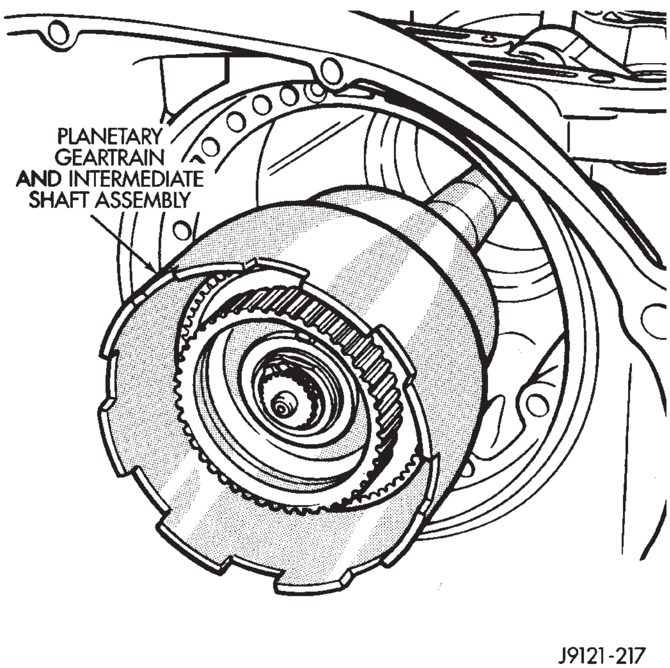


Fig. 152 Installing Planetary Geartrain

(22) Coat intermediate shaft thrust washer with petroleum jelly. Then install washer in rear clutch hub (Fig. 157). Use enough petroleum jelly to hold washer in place. **Be sure grooved side of washer faces rearward (toward output shaft) as shown. Also note that washer only fits one way in clutch hub.** Note thickness of this washer. It is a select fit part and is used to control transmission end play.

(23) Align drive teeth on rear clutch discs with small screwdriver (Fig. 158). This makes installation on front planetary easier.

(24) 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.

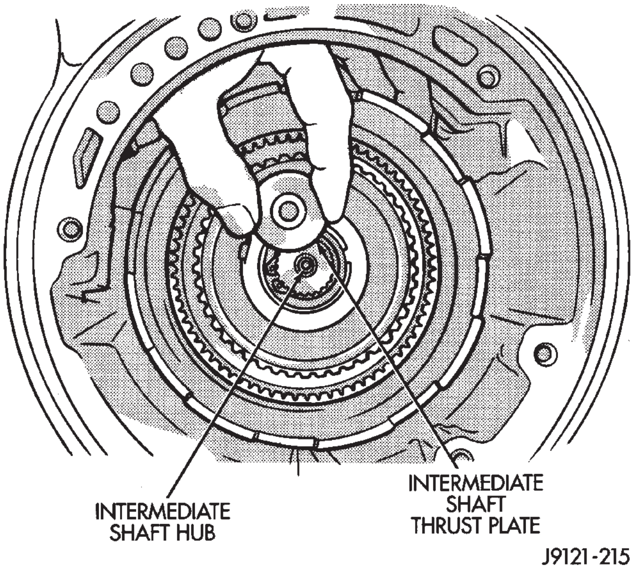


Fig. 153 Installing Intermediate Shaft Thrust Plate

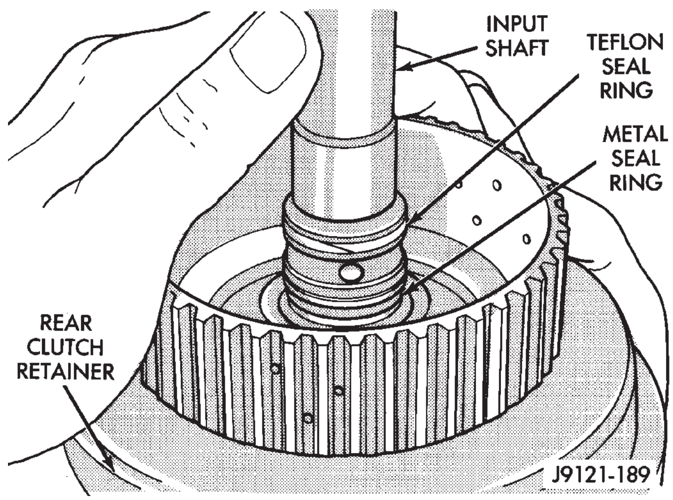


Fig. 154 Input Shaft Seal Ring Location

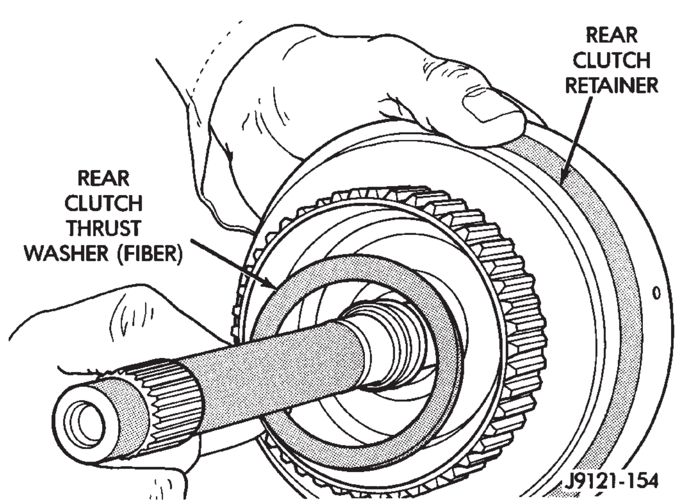


Fig. 155 Installing Rear Clutch Thrust Washer

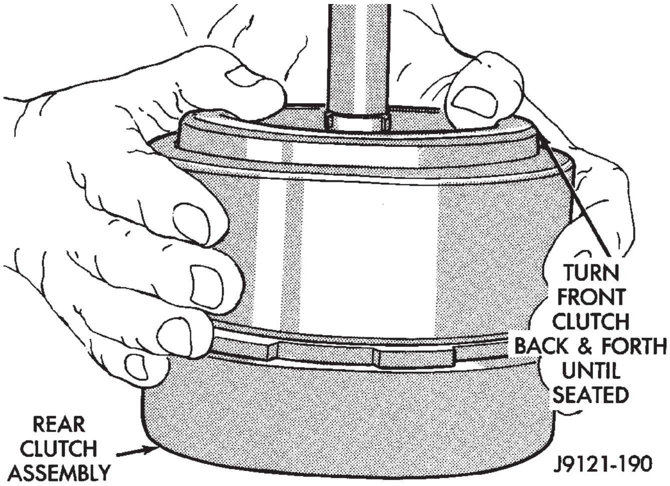


Fig. 156 Assembling Front And Rear Clutch Units

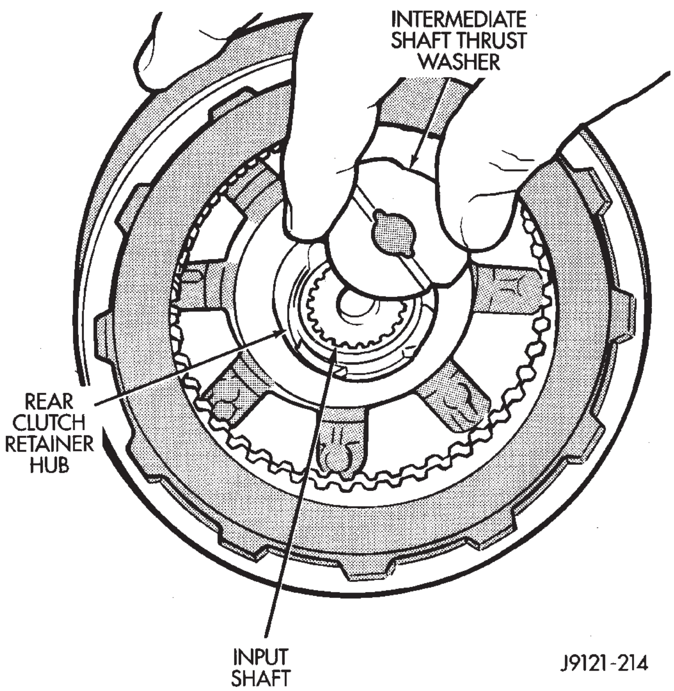


Fig. 157 Installing Intermediate Shaft Thrust Washer

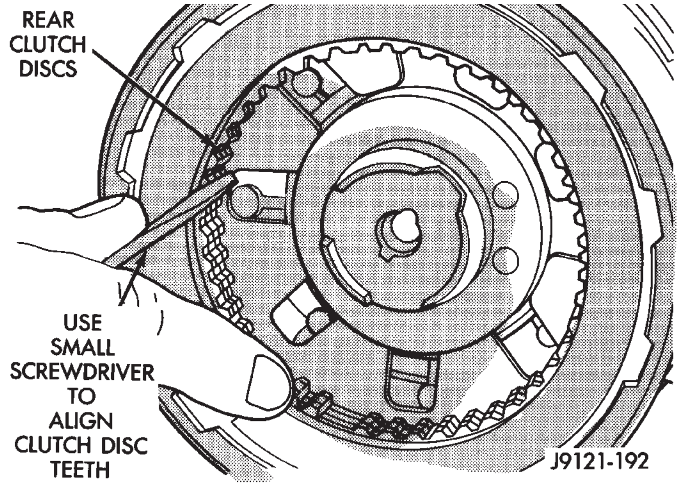


Fig. 158 Aligning Rear Clutch Disc Lugs

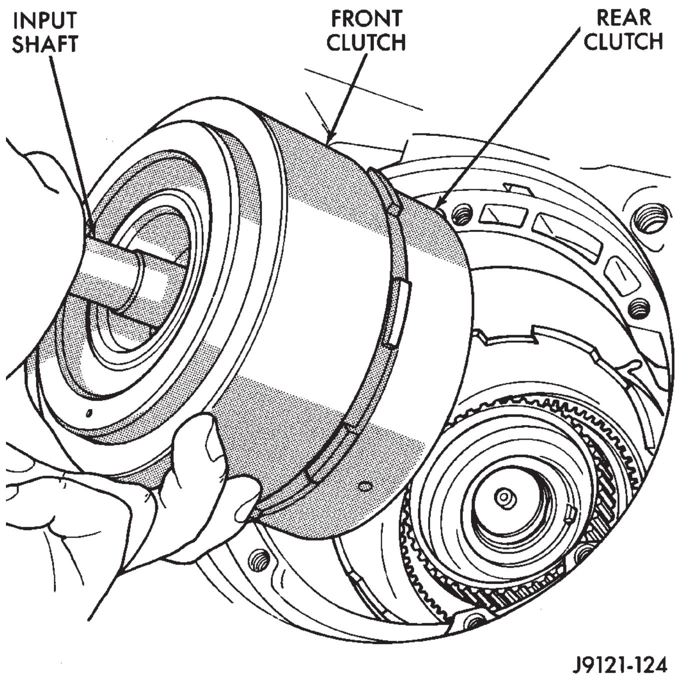


Fig. 159 Installing Front/Rear Clutch Assemblies

(25) Install front and rear clutch units as assembly (Fig. 159). 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.**

(26) Carefully work assembled clutches back and forth to engage and seat rear clutch discs on front annulus gear. Also be sure front clutch drive lugs are fully engaged in slots of driving shell after installation.

(27) Slide front band over front clutch retainer (Fig. 160).

(28) Insert front band lever pivot shaft part way into case (Fig. 160).

(29) Install front band lever, strut and adjusting screw (Fig. 161).

(30) Push front band lever shaft completely into place. Then tighten band adjusting screw until band just grips clutch retainer. Verify that front/rear clutches are still seated before continuing.

(31) Coat band reaction pin access plug with sealer and install plug in converter housing.

(32) Check seal rings on reaction shaft support hub. Verify that seal rings are hooked together and that front clutch thrust washer is properly positioned (Fig. 162). Use extra petroleum jelly to hold thrust washer in place if necessary.

CAUTION: The thrust washer bore ID is chamfered on one side. Make sure this side of the washer is facing toward the front of the transmission.

(33) Thread two Pilot Stud Tools C-3288-B into

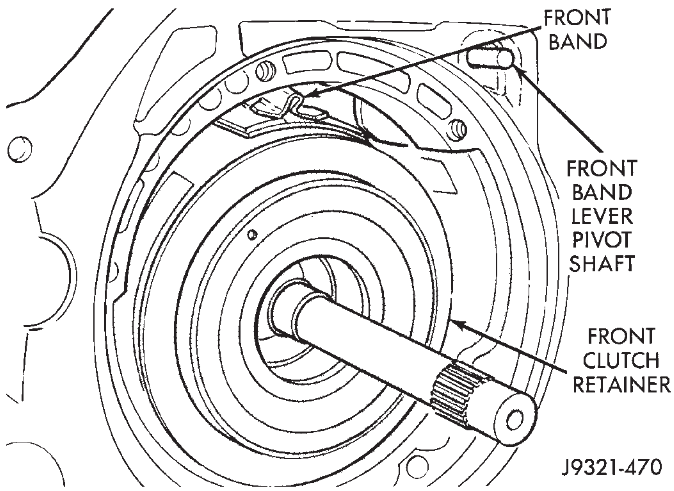


Fig. 160 Installing Front Band And Reaction Pin

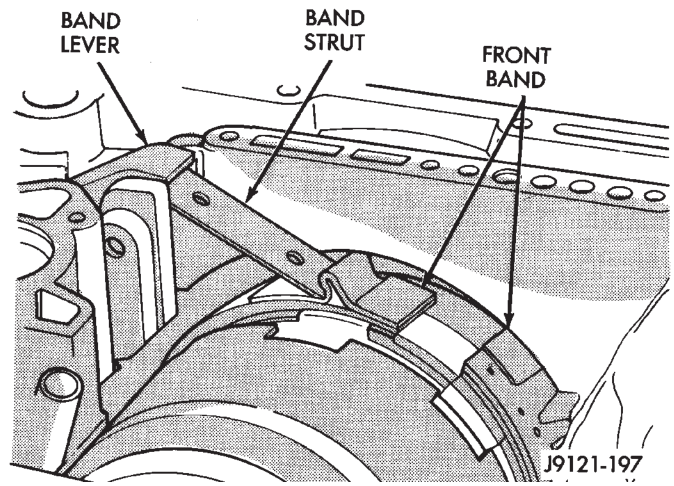


Fig. 161 Front Band Linkage Installation

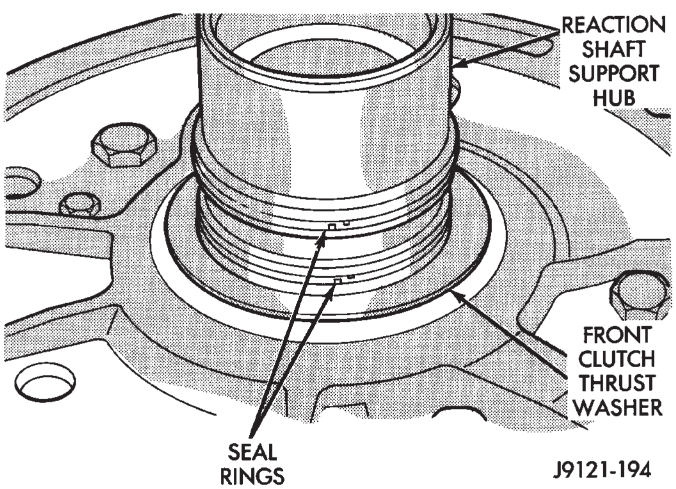


Fig. 162 Reaction Shaft Support Seal Rings And Front Clutch Thrust Washer Position

bolt holes in oil pump flange (Fig. 163).

(34) Align and install oil pump gasket (Fig. 163).

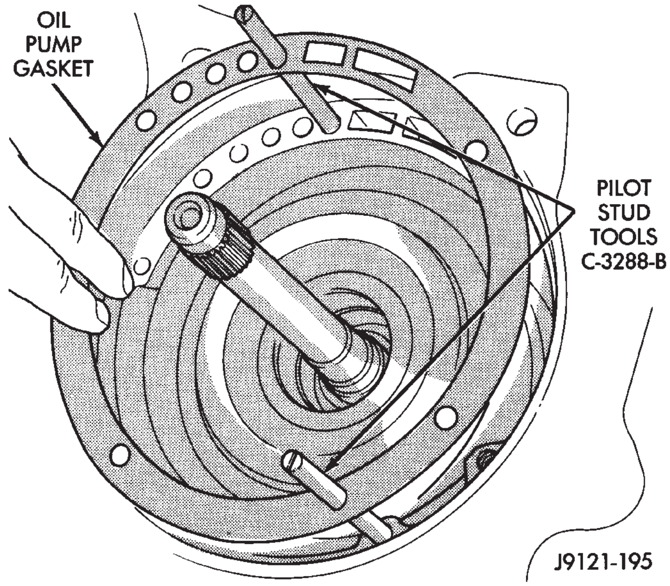


Fig. 163 Installing Pilot Studs And Oil Pump Gasket

(35) Lubricate oil pump body seal with Ru-Glyde, or petroleum jelly. Lubricate pump shaft seal lip with petroleum jelly.

(36) Install oil pump (Fig. 164). Align and position pump on pilot studs. Slide pump down studs and work it into front clutch hub and case by hand. Then install 2 or 3 pump bolts to hold pump in place.

(37) Remove pilot stud tools and install remaining oil pump bolts. Tighten bolts alternately in diagonal pattern to 20 N●m (15 ft. lbs.).

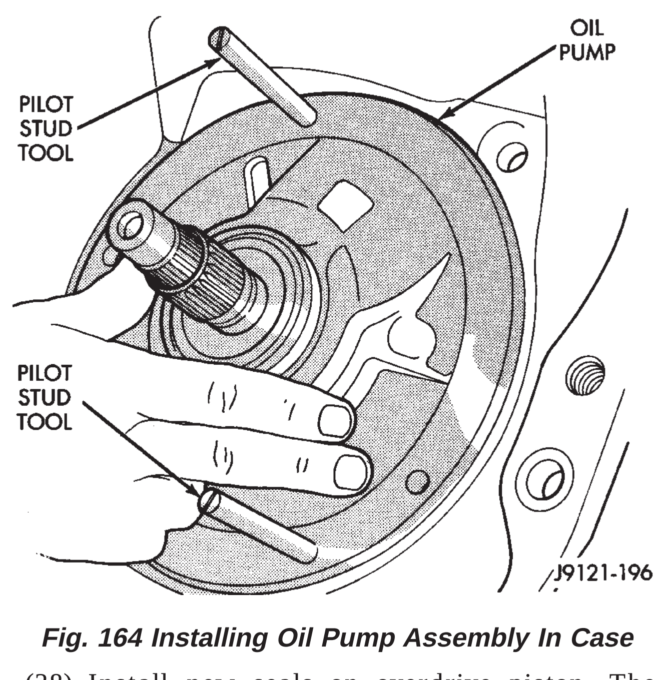


Fig. 164 Installing Oil Pump Assembly In Case

(38) Install new seals on overdrive piston. Then lubricate seals with Ru-Glyde, Door-Eze or petroleum jelly.

(39) Install overdrive piston in retainer. **Align locating lugs on piston in locating bores in re-**

tainer (Fig. 165). Use thin plastic strip or feeler gauge to help guide piston outer seal into retainer.

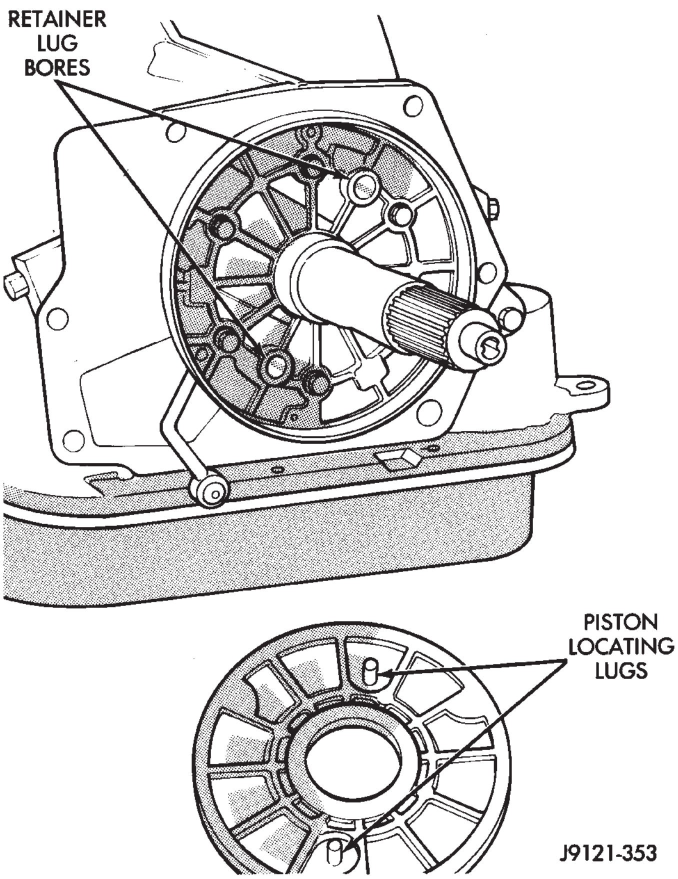


Fig. 165 Overdrive Piston Alignment

(40) Install spacer on intermediate shaft, if not previously installed.

(41) Install overdrive piston thrust plate (Fig. 166). Use liberal quantity of petroleum jelly to hold thrust plate in position on piston.

(42) Install overdrive piston thrust bearing in direct clutch hub (Fig. 167). Use liberal quantity of petroleum jelly to hold thrust bearing in place. **Note that one side of bearing has dark coated surface. This surface faces overdrive piston. Also be sure raised shoulder on inside diameter of bearing faces forward as well.**

(43) Apply small amount of petroleum jelly to pilot hub of intermediate shaft.

(44) Verify alignment of splines in overdrive unit planetary gear and overrunning clutch. Be sure Alignment Tool 6227-2 is still fully seated (Fig. 168). **If planetary gear and overrunning clutch splines become misaligned, overdrive unit cannot be fully installed on intermediate shaft. Overdrive unit may have to be disassembled in order to realign splines.**

(45) Carefully withdraw alignment tool from overdrive unit.

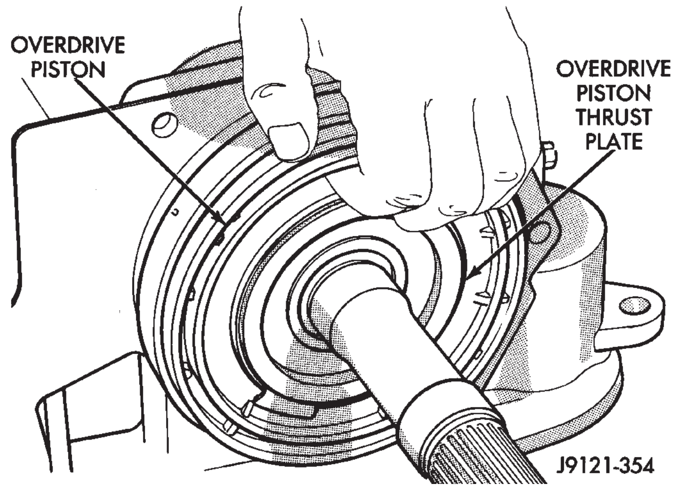


Fig. 166 Installing Overdrive Piston Thrust Plate

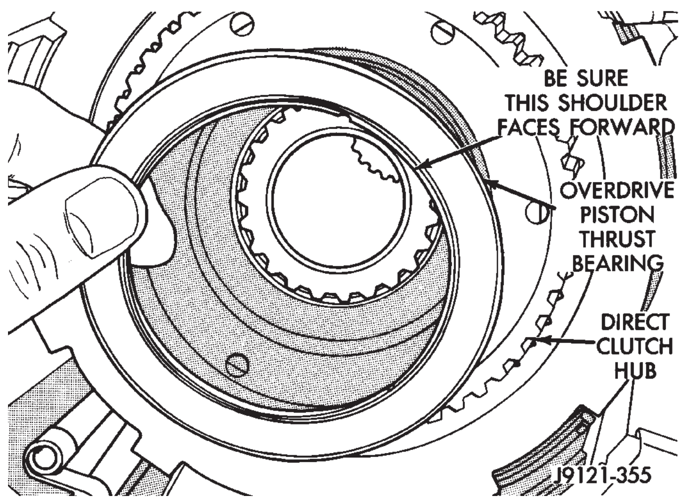


Fig. 167 Installing Overdrive Piston Thrust Bearing

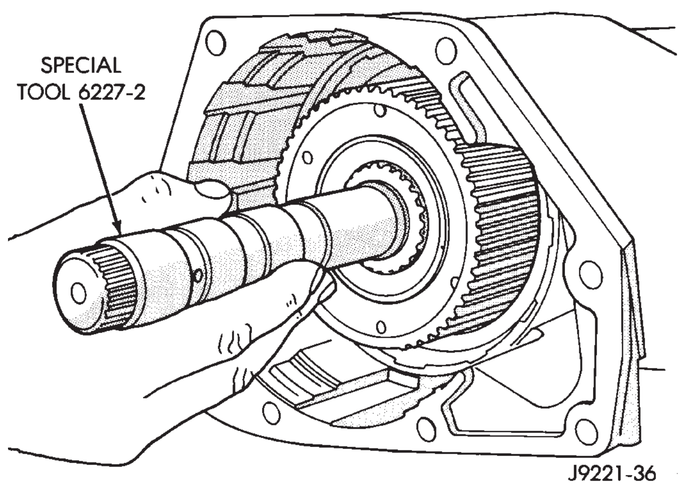


Fig. 168 Checking Alignment Of Overdrive Planetary Gear And Overrunning Clutch Splines

(46) Lubricate intermediate shaft splines and bushing surfaces with transmission fluid or petroleum jelly.

(47) Install overdrive unit. Note that intermediate shaft is snug fit in overdrive planetary gear and overrunning clutch. If overdrive unit will not seat fully, use overdrive attaching bolts to draw gear case down and seat it against transmission.

(48) Apply 1-2 drops of Mopar thread adhesive (or Loctite 242) to overdrive unit attaching bolts. Then install and tighten bolts to 34 N● (25 ft. lbs.) torque. **Be sure wire harness clips are placed on appropriate overdrive bolts beforehand.**

(49) Measure and if necessary, correct input shaft end play as follows (Fig. 169):

(a) Be sure overdrive unit is installed on transmission. **End play cannot be properly checked with overdrive unit off transmission.**

(b) Attach dial indicator to converter housing.

(c) Position indicator plunger against input shaft and zero indicator.

(d) Move input shaft in and out and record reading. End play should be 0.56 - 2.31 mm (0.022 - 0.091 in.). Proceed to step (e) if end play is not within specified limits.

(e) Intermediate shaft thrust washer (in hub of rear clutch retainer) controls end play. Washer is a select fit part and can be changed to adjust end play. If end play turns out to be incorrect, remove oil pump, and clutches. Then install thinner/thicker thrust washer as necessary.

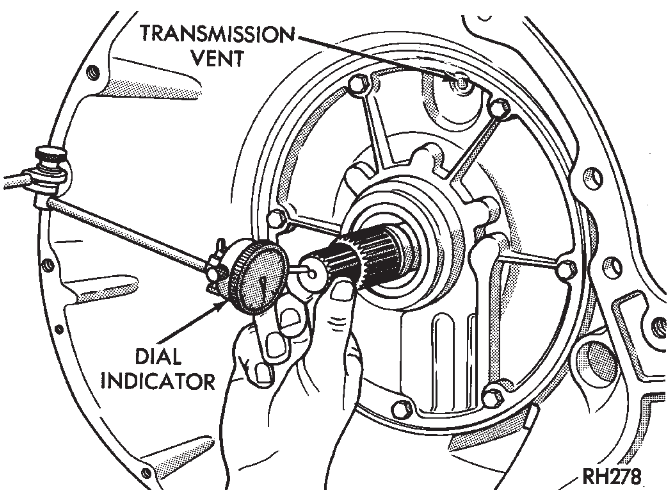


Fig. 169 Measuring Input Shaft End Play

(50) Install accumulator piston and inner and outer springs (Fig. 11).

(51) Verify that park/neutral position switch has **not** been installed in case. Valve body can not be installed if switch is in position.

(52) Verify that valve body solenoid harness is secured in 3-4 accumulator housing cover plate.

(53) Install valve body as follows:

(a) Align and carefully insert park rod into pawl. Rod will make click noise as it enters pawl. Move rod slightly to check engagement.

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into the cavity. If the rod enters the cavity during installation, it will become bent when the overdrive bolts are tightened. If this occurs, the rod will have to be removed and replaced.

(b) Align and seat valve body on case. Be sure manual lever shaft and overdrive connector are fully seated in case. Also be sure valve body wiring is not pinched or kinked.

(c) Install and start all valve body attaching bolts by hand. Then tighten bolts evenly, in a diagonal pattern to 12 N●m (105 in. lbs.) torque. **Do not overtighten valve body bolts. This could result in distortion and cross leakage after installation.**.

(54) Install new filter on valve body. Tighten filter screws to 4 N●m (35 in. lbs.).

(55) Adjust front and rear bands as follows:

(a) Loosen band adjusting screw locknuts.

(b) Tighten each band adjusting screw to 5 N●m (72 in. lbs.) with torque wrench.

(c) **Back off front band adjusting screw 3-5/8 turns.**

(d) Back off rear band screw 4 turns.

(e) Tighten each adjusting screw locknut. Hold adjusting screws with wrench to prevent turning when tightening locknut.

(56) Install seal on park/neutral position switch (Fig. 170). Then install and tighten switch to 34 N●m (25 ft. lbs.).

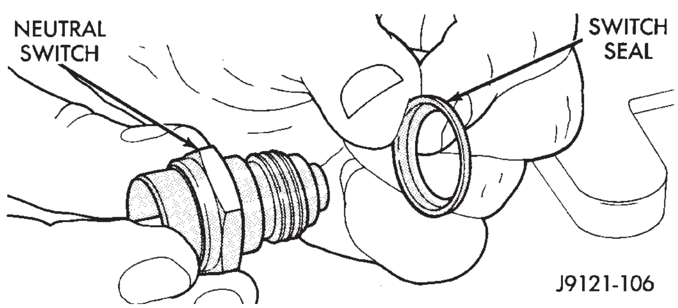


Fig. 170 Park/Neutral Position Switch Seal Position

(57) Install magnet in oil pan. Magnet goes on small protrusion at corner of pan.

(58) Position new oil pan gasket on case and install oil pan. Tighten pan bolts to 17 N●m (13 ft. lbs.).

(59) Install new valve body manual shaft seal in case (Fig. 171). Lubricate seal lip and manual shaft with petroleum jelly. Start seal over shaft and into case. Seat seal with 15/16 inch, deep well socket.

(60) Install throttle valve and shift selector levers on valve body manual lever shaft.

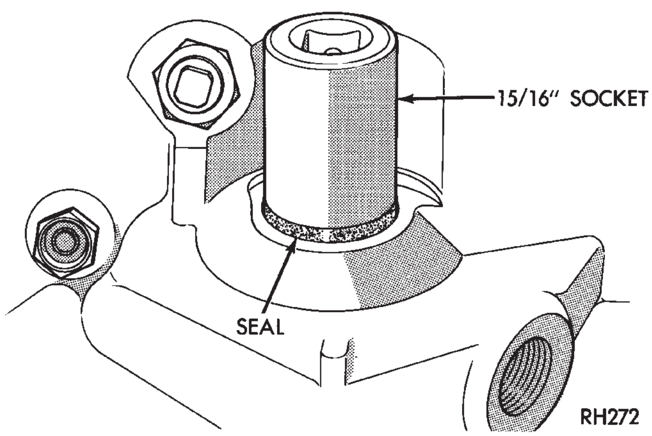


Fig. 171 Installing Manual Lever Shaft Seal

(61) Cap or cover transmission openings (cooler line fittings, filler tube bore, etc.) to prevent dirt entry.

(62) Install torque converter. Use C-clamp or metal strap to hold converter in place for installation.

(63) Install transmission speed sensor in overdrive case (Fig. 1).

(64) Mount transmission on jack for installation in vehicle.

(65) Apply dielectric grease to terminal pins of solenoid case connector and neutral switch.

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.

OVERDRIVE UNIT OVERHAUL-42RE

INDEX

OVERDRIVE UNIT DISASSEMBLY

OVERDRIVE REMOVAL

(1) Remove transmission speed sensor and O-ring seal from overdrive case (Fig. 1).

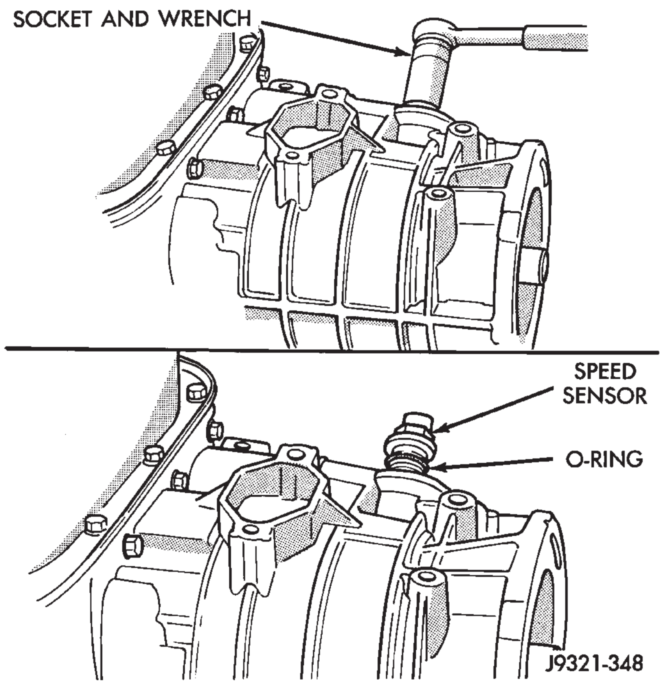


Fig. 1 Transmission Speed Sensor Removal/Installation

(2) Place transmission in upright position (Fig. 2).

(3) Remove bolts attaching overdrive unit to transmission case (Fig. 2). An 11 mm socket is required. Note position of wire harness clips for installation reference.

(4) Lift overdrive unit up and off transmission case and intermediate shaft (Fig. 3).

(5) Remove overdrive piston thrust bearing (Fig. 4).

OVERDRIVE PISTON REMOVAL

(1) Remove overdrive piston thrust plate (Fig. 5). Retain thrust plate. It is a select fit part and may possibly be reused.

(2) Remove intermediate shaft spacer (Fig. 6). Retain spacer. It is a select fit part and may possibly be reused.

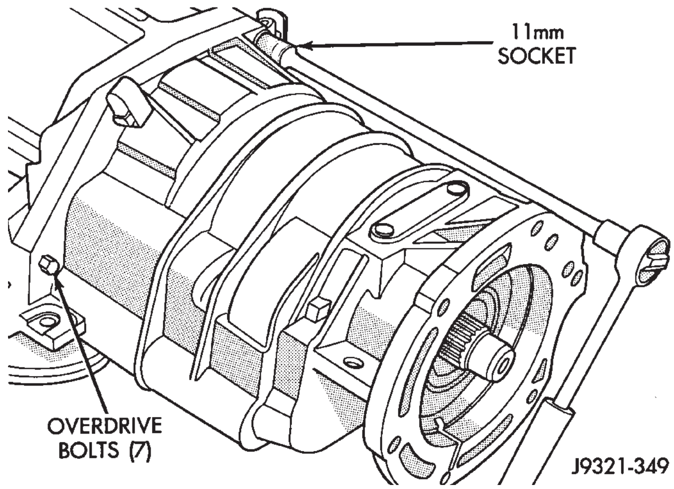


Fig. 2 Removing/Installing Overdrive Unit Attaching Bolts

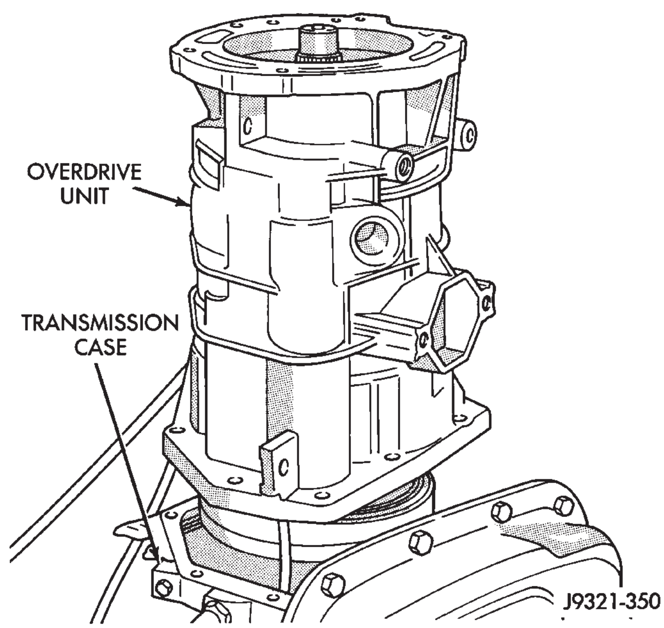


Fig. 3 Overdrive Unit Removal/Installation

(3) Remove overdrive piston from retainer (Fig. 7).

OVERDRIVE CLUTCH PACK REMOVAL

(1) Remove overdrive clutch pack wire retaining ring (Fig. 8).

(2) Remove overdrive clutch pack (Fig. 9).

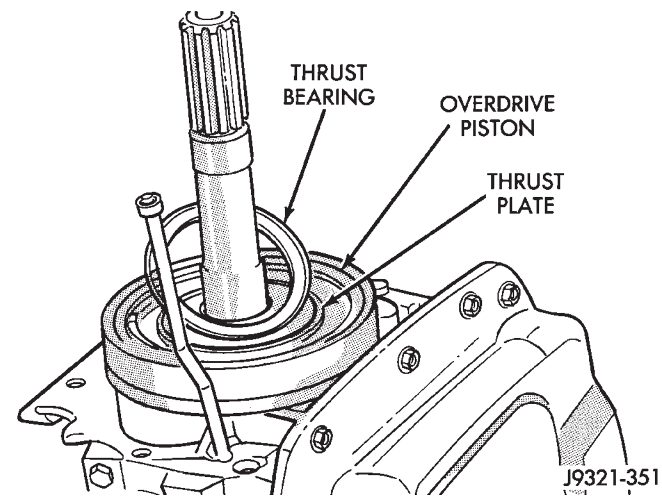


Fig. 4 Overdrive Piston Thrust Bearing Removal/ Installation

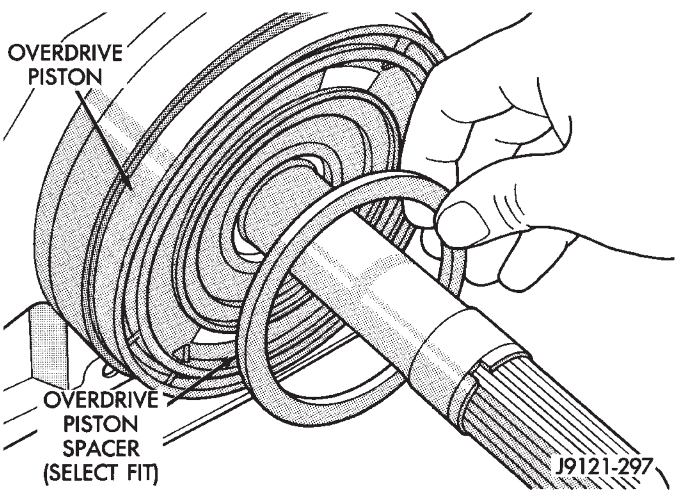


Fig. 5 Overdrive Piston Thrust Plate Removal/ Installation

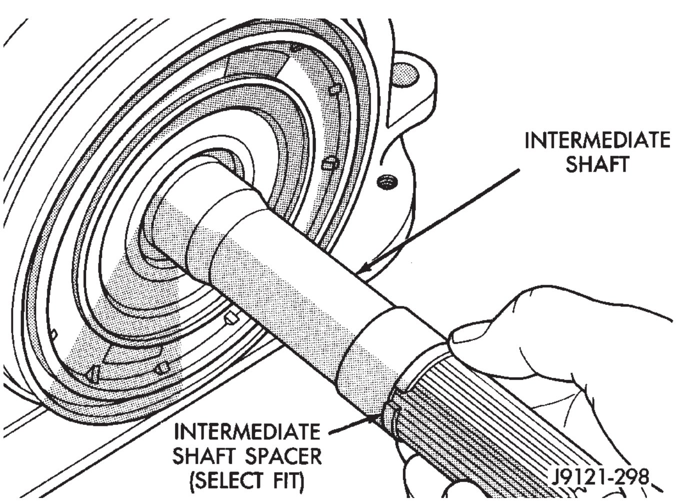


Fig. 6 Intermediate Shaft Spacer Location

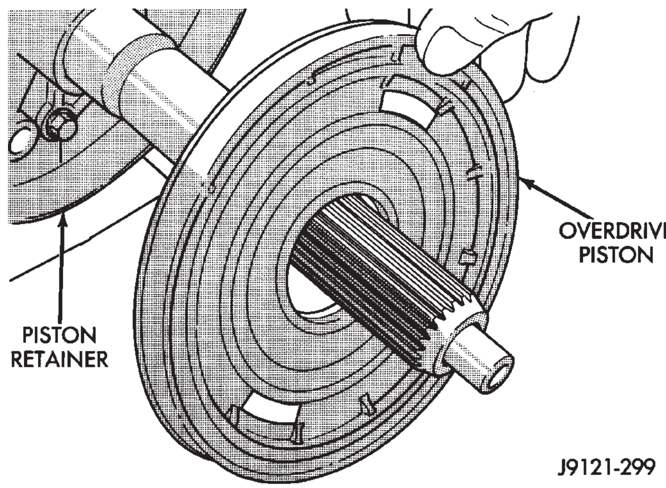


Fig. 7 Overdrive Piston Removal

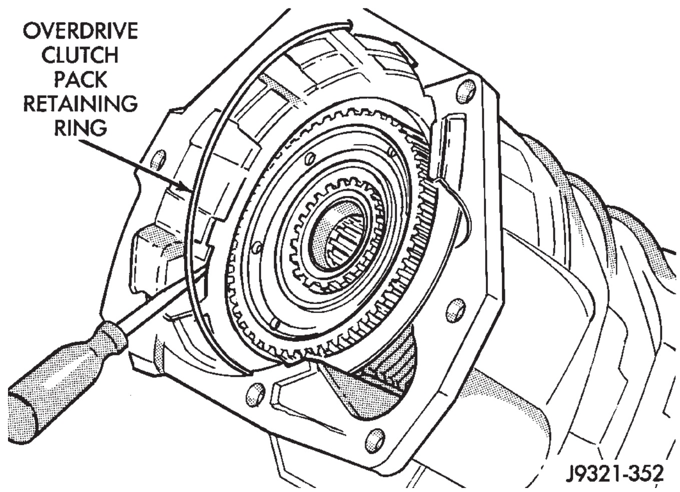


Fig. 8 Removing Overdrive Clutch Pack Retaining Ring

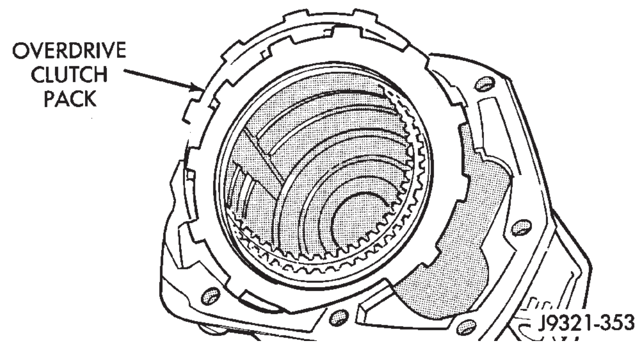


Fig. 9 Overdrive Clutch Pack Removal

(3) Note position of clutch pack components for assembly reference (Fig. 10). Thick reaction plate goes to front as shown.

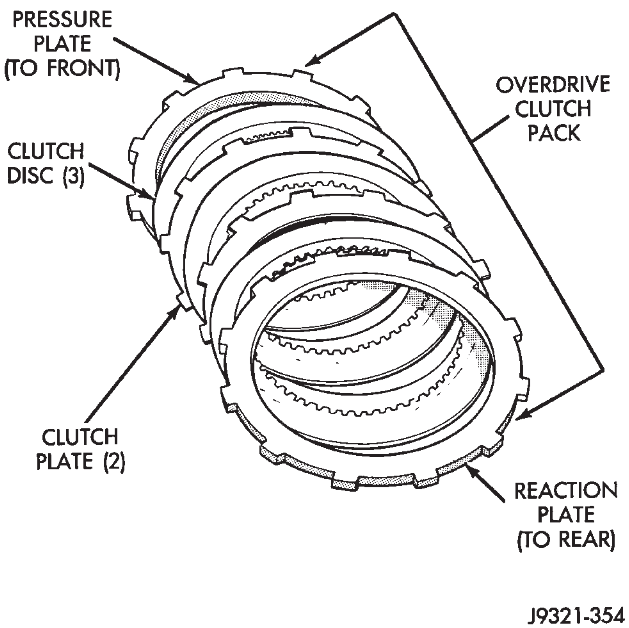


Fig. 10 Overdrive Clutch Component Position

OVERDRIVE GEARTRAIN REMOVAL

(1) Remove overdrive clutch wave spring (Fig. 11).

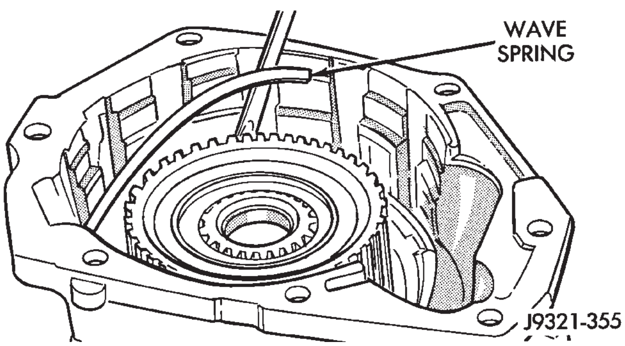


Fig. 11 Overdrive Clutch Wave Spring Removal/Installation

(2) Remove overdrive clutch reaction snap ring (Fig. 12). Note that snap ring is located in same groove as wave spring.

(3) Remove Torx head screws that attach access cover and gasket to overdrive case (Fig. 13). A T25 size Torx head bit is required.

(4) Remove access cover and gasket (Fig. 14).

(5) Expand output shaft bearing snap ring with expanding-type snap ring pliers. Then push output shaft forward to release shaft bearing from locating ring (Fig. 15).

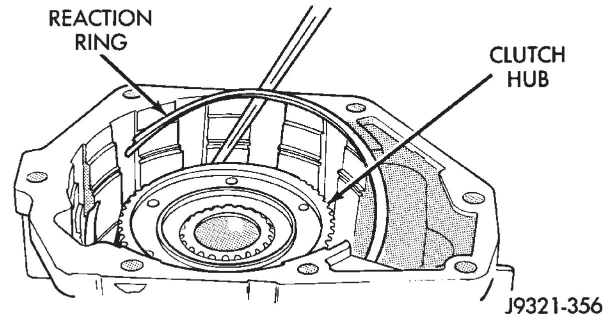


Fig. 12 Removing/Installing Overdrive Clutch Reaction Snap Ring

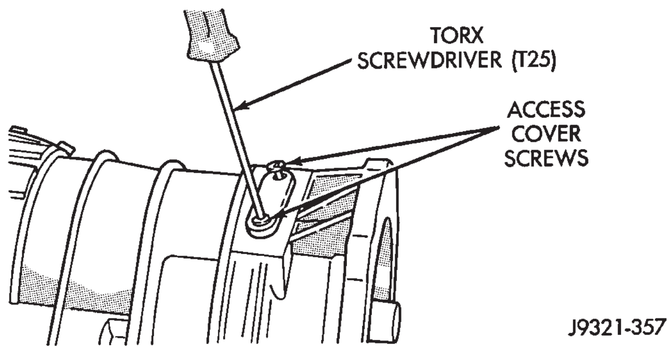


Fig. 13 Removing/Installing Access Cover Screws

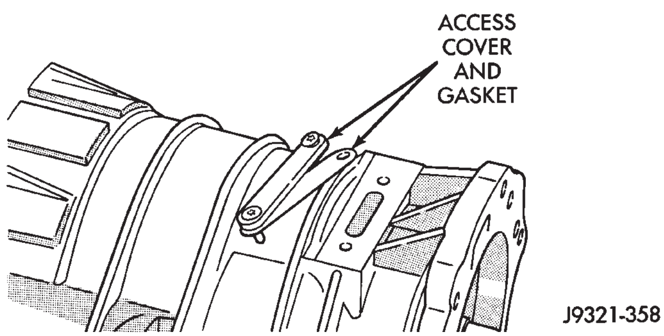


Fig. 14 Removing/Installing Access Cover And Gasket

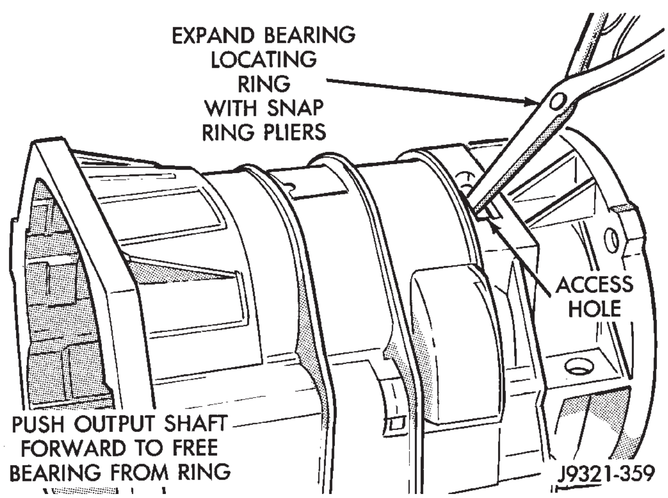


Fig. 15 Releasing Bearing From Locating Ring

(6) Lift gear case up and off geartrain assembly (Fig. 16).

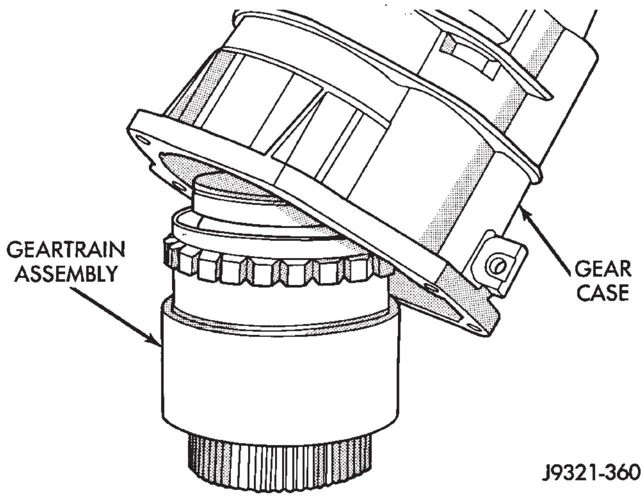


Fig. 16 Removing Gear Case From Geartrain Assembly

(7) Remove snap ring that retains rear bearing on output shaft (Fig. 17).

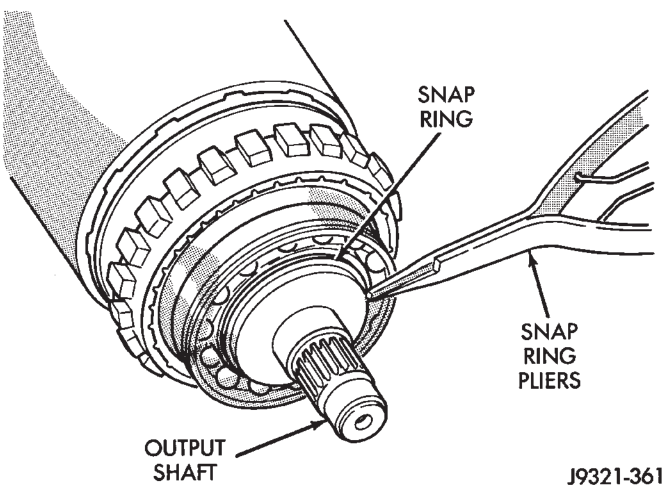


Fig. 17 Rear Bearing Snap Ring Removal/Installation

(8) Remove rear bearing from output shaft (Fig. 18).

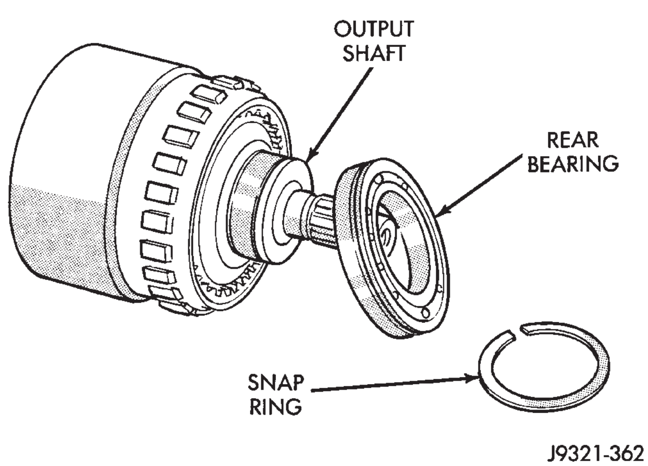


Fig. 18 Rear Bearing Removal

DIRECT CLUTCH, HUB AND SPRING REMOVAL

WARNING: THE NEXT STEP IN DISASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE SPRING COMPRESSOR TOOL 6227-1 AND A HYDRAULIC SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 5-6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(1) Mount geartrain assembly in shop press (Fig. 19).

(2) Position Compressor Tool 6227-1 on clutch hub (Fig. 19). Support output shaft flange with steel press plates as shown and center assembly under press ram.

(3) Use Special Tool C-3995-A (or similar size tool) at top of Tool 6227-1 to help distribute load and provide needed extra press length (Fig. 19).

(4) Apply press pressure slowly. Compress hub and spring far enough to expose clutch hub retaining ring and relieve spring pressure on clutch pack snap ring (Fig. 19).

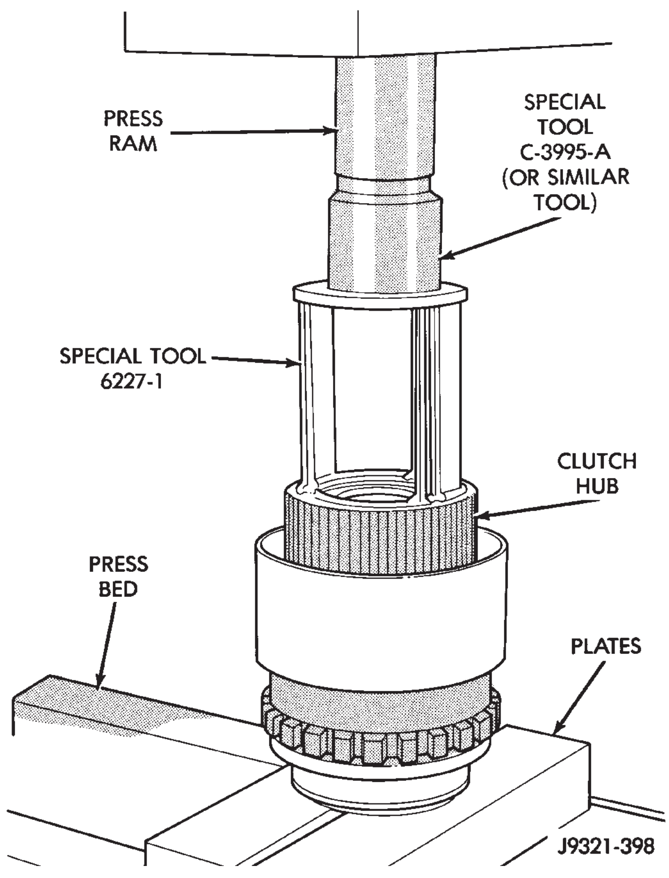


Fig. 19 Geartrain Mounted In Shop Press

(5) Remove direct clutch pack snap ring (Fig. 20).

(6) Remove direct clutch hub retaining ring (Fig. 21).

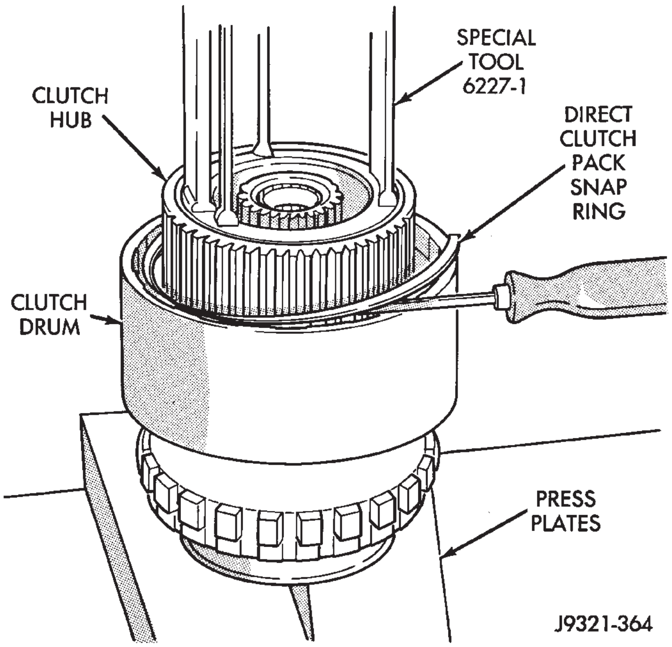


Fig. 20 Direct Clutch Pack Snap Ring Removal

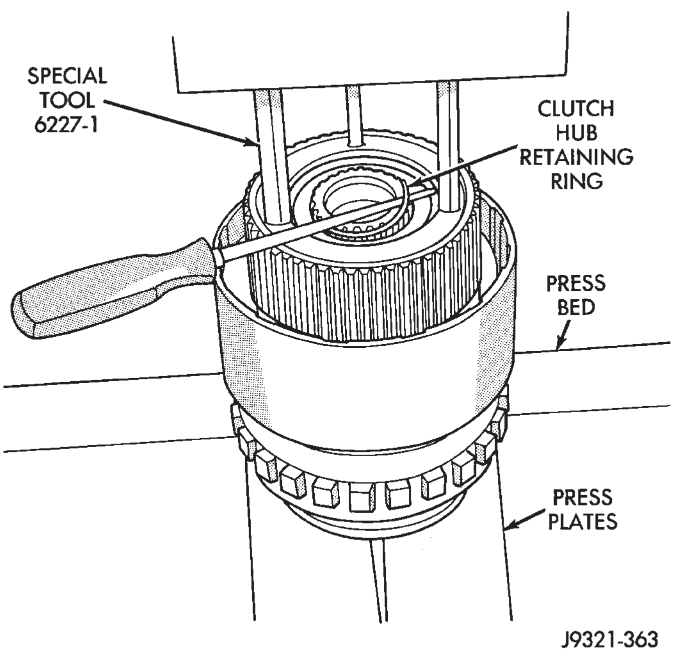


Fig. 21 Direct Clutch Hub Retaining Ring Removal

(7) Release press load **slowly and completely (Fig. 22).**

(8) Remove Special Tool 6227-1. Then remove clutch pack from hub (Fig. 22).

GEARTRAIN DISASSEMBLY

(1) Remove direct clutch hub and spring (Fig. 23).

(2) Remove sun gear and spring plate. Then remove planetary thrust bearing and planetary gear (Fig. 24).

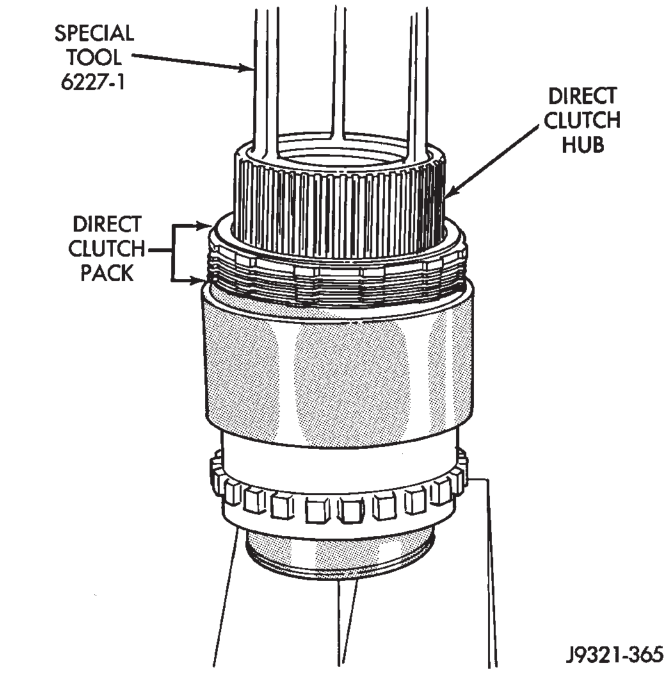


Fig. 22 Direct Clutch Pack Removal

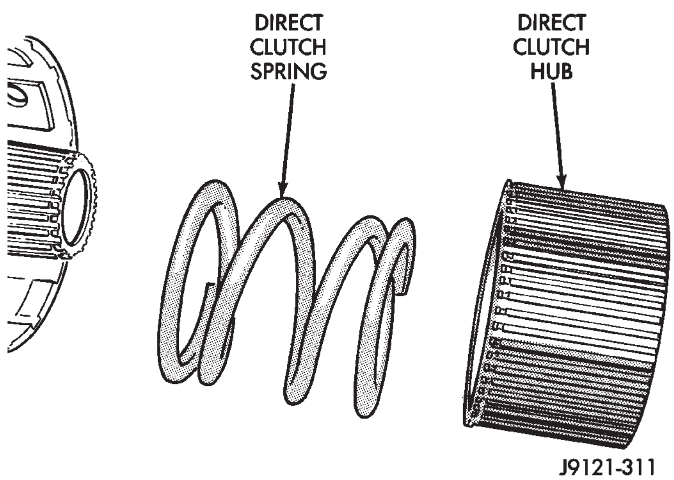


Fig. 23 Direct Clutch Hub And Spring Removal

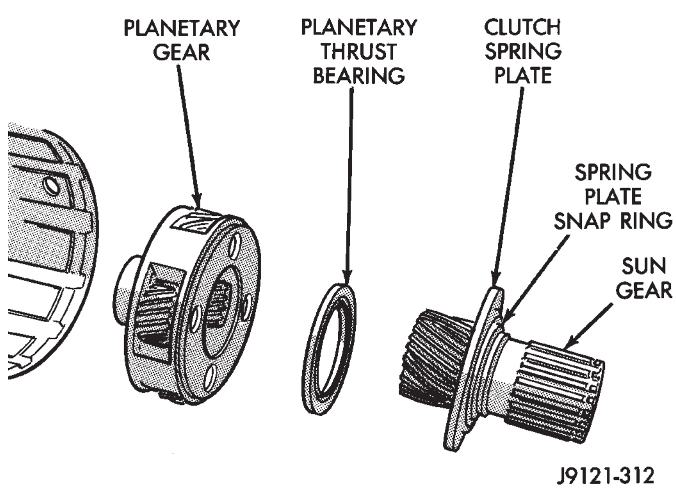


Fig. 24 Removing Sun Gear, Thrust Bearing And Planetary Gear

(3) Remove overrunning clutch assembly with expanding type snap ring pliers (Fig. 25). Insert pliers into clutch hub. Expand pliers to grip hub splines and remove clutch with counterclockwise, twisting motion.

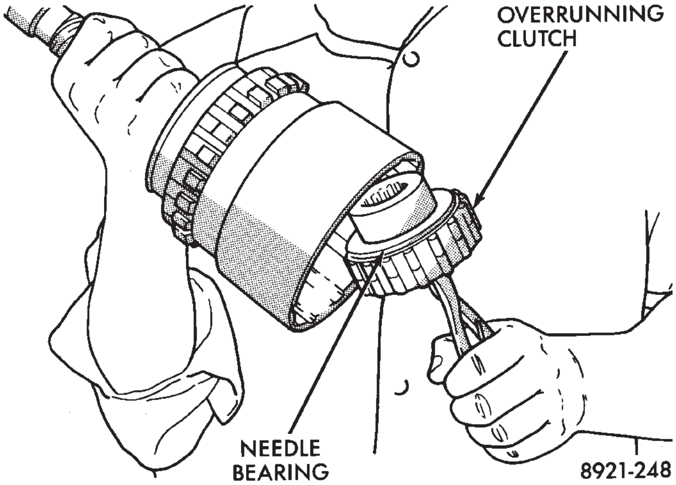


Fig. 25 Overrunning Clutch Assembly Removal/Installation

(4) Remove thrust bearing from overrunning clutch hub (Fig. 26).

(5) Remove overrunning clutch from hub (Fig. 26).

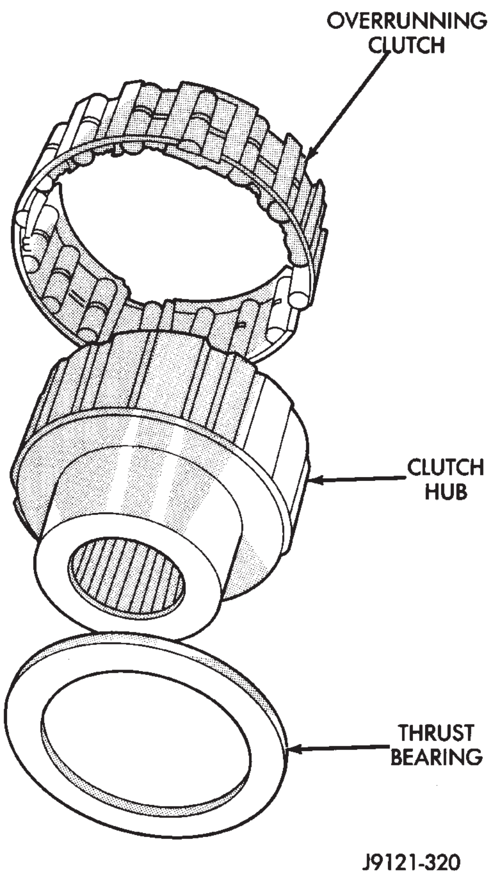


Fig. 26 Overrunning Clutch Components

(6) Mark position of annulus gear and direct clutch drum for assembly alignment reference (Fig. 27). Use small center punch or scriber to make alignment marks.

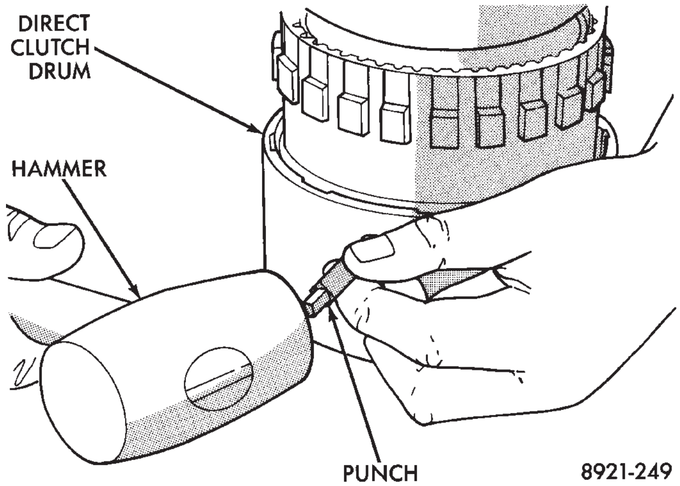


Fig. 27 Marking Direct Clutch Drum And Annulus Gear For Assembly Alignment

(7) Remove direct clutch drum rear retaining ring (Fig. 28).

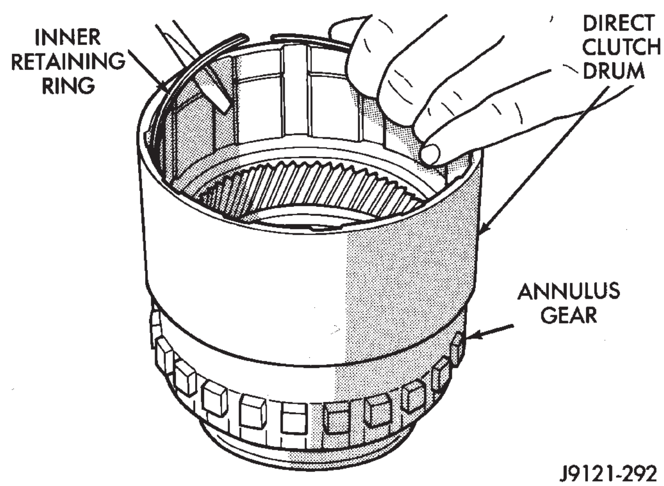


Fig. 28 Clutch Drum Inner Retaining Ring Removal

(8) Remove direct clutch drum outer retaining ring (Fig. 29).

(9) Mark annulus gear and output shaft for assembly alignment reference (Fig. 30). Use punch or scriber to mark gear and shaft.

(10) Remove snap ring that secures annulus gear on output shaft (Fig. 31). Use two screwdrivers to unseat and work snap ring out of groove as shown.

(11) Remove annulus gear from output shaft (Fig. 32). Use rawhide or plastic mallet to tap gear off shaft.

GEAR CASE AND PARK LOCK DISASSEMBLY

(1) Remove locating ring from gear case.

(2) Remove park pawl shaft retaining bolt and remove shaft, pawl and spring.

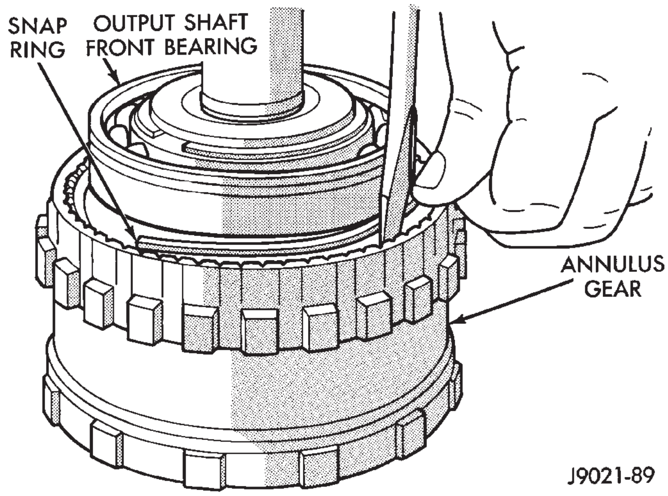


Fig. 29 Clutch Drum Outer Retaining Ring Removal

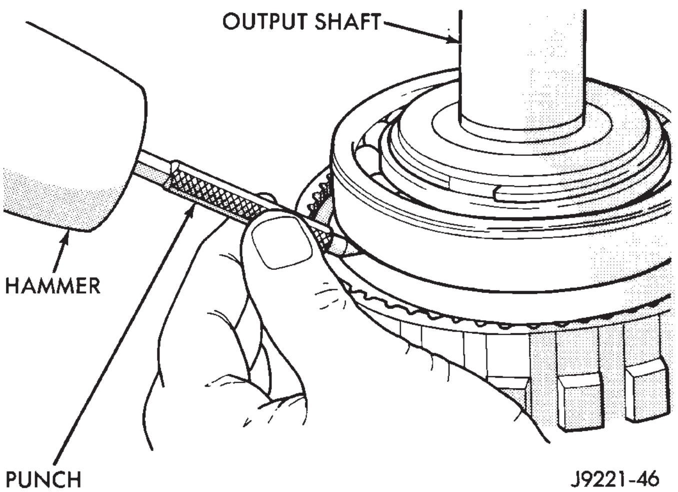


Fig. 30 Marking Annulus Gear And Output Shaft For Assembly Alignment

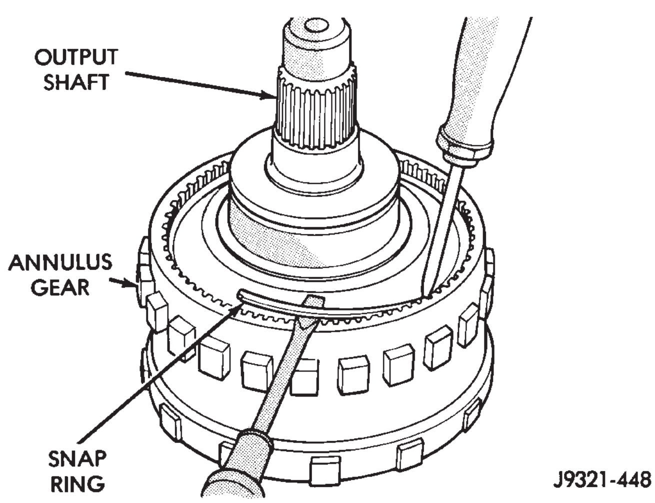


Fig. 31 Removing Annulus Gear Snap Ring

(3) Remove reaction plug snap ring and remove reaction plug.

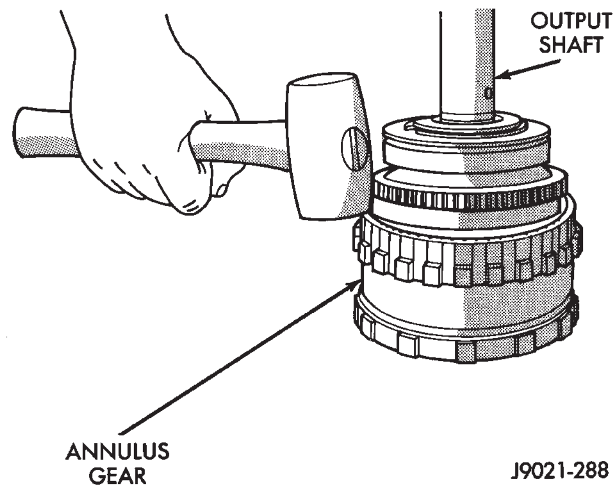


Fig. 32 Annulus Gear Removal

(4) Remove output shaft seal. Use punch or tool similar to Seal Remover C-3981.

OVERDRIVE COMPONENT CLEANING AND INSPECTION

Clean the geartrain (Fig. 33) and case components (Fig. 34) with solvent. Dry all parts except the bearings with compressed air. Allow bearings to air dry.

Do not use shop towels for wiping parts dry unless the towels are made from a lint-free material. A sufficient quantity of lint (from shop towels, cloths, rags, etc.) could plug the transmission filter and fluid passages.

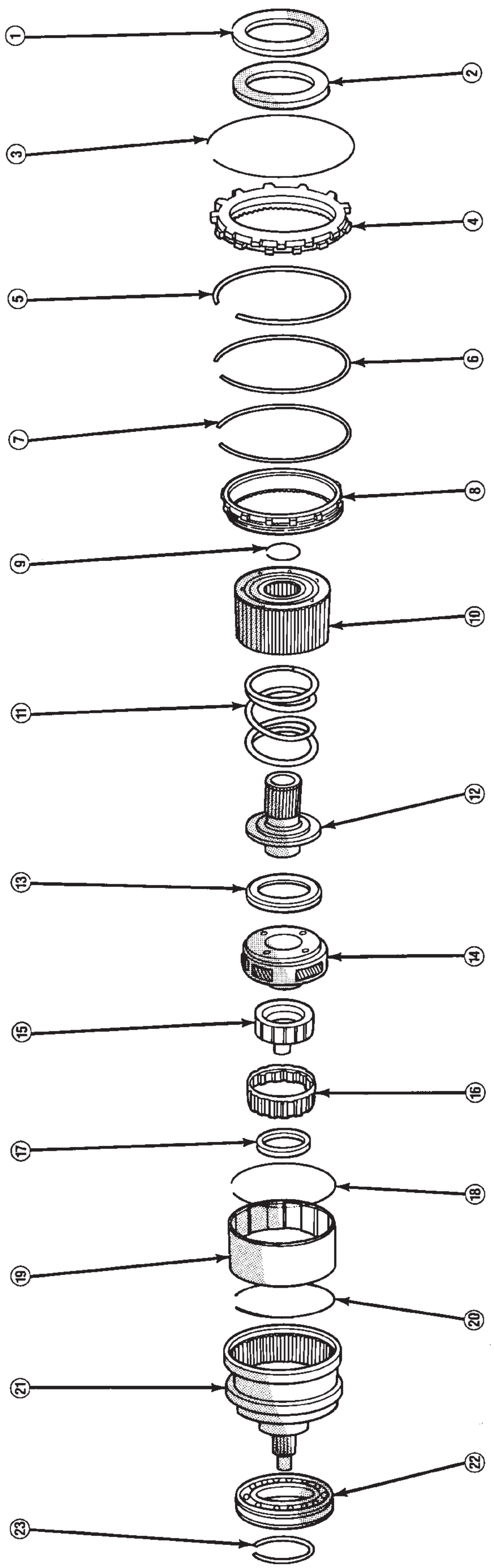
Discard the old case gasket and seals. Do not attempt to salvage these parts. They are not reusable. Replace any of the overdrive unit snap rings if distorted or damaged.

Minor nicks or scratches on components can be smoothed with crocus cloth. However, do not attempt to reduce severe scoring on any components with abrasive materials. Replace severely scored components; do not try to salvage them.

Check condition of the park lock components and the overdrive gear case (Fig. 34).

Replace the case if cracked, scored, or damaged. Replace the park lock pawl, plug, or spring if worn or damaged. Be sure the bullet at the end of the park lock rod is in good condition. Replace the rod if the bullet is worn or the rod itself is bent or distorted. Do not attempt to straighten the rod.

Check the bushings in the overdrive case. Replace the bushings if severely scored or worn. Also replace the case seal if loose, distorted, or damaged.



1. OVERDRIVE PISTON THRUST PLATE
2. OVERDRIVE PISTON THRUST BEARING
3. OVERDRIVE CLUTCH PACK RETAINING RING
4. OVERDRIVE CLUTCH PACK
5. OVERDRIVE CLUTCH REACTION RING
6. OVERDRIVE CLUTCH SNAP RING
7. DIRECT CLUTCH PACK SNAP RING
8. DIRECT CLUTCH PACK
9. CLUTCH HUB RETAINING RING
10. DIRECT CLUTCH HUB
11. DIRECT CLUTCH SPRING
12. SUN GEAR AND SPRING PLATE ASSEMBLY
13. PLANETARY THRUST BEARING
14. PLANETARY GEAR
15. OVERRUNNING CLUTCH HUB
16. OVERRUNNING CLUTCH
17. OVERRUNNING CLUTCH THRUST BEARING
18. RETAINING RING (CLUTCH DRUM INNER)
19. DIRECT CLUTCH DRUM
20. RETAINING RING (CLUTCH DRUM OUTER)
21. ANNULUS GEAR, OUTPUT SHAFT, AND SNAP RING ASSEMBLY
22. REAR BEARING
23. REAR BEARING SNAP RING

Fig. 33 Overdrive Geartrain Components

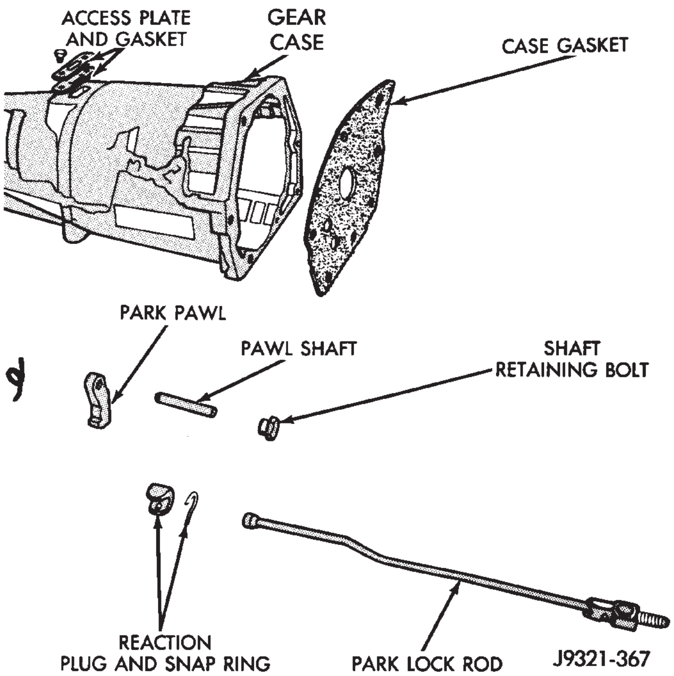


Fig. 34 Overdrive Gear Case And Park Lock Components

Examine the overdrive and direct clutch discs and plates (Fig. 32). Replace the discs if the facing is worn, severely scored, or burned and flaking off. Replace the clutch plates if worn, heavily scored, or cracked. Check the lugs on the clutch plates for wear. The plates should slide freely in the drum. Replace the plates or drum if binding occurs.

Check condition of the annulus gear, direct clutch hub, clutch drum and clutch spring (Fig. 32). Replace the gear, hub and drum if worn or damaged. Replace the spring if collapsed, distorted, or cracked. Be sure the splines and lugs on the gear, drum and hub are in good condition. The clutch plates and discs should slide freely in these components.

Inspect the thrust bearings and spring plate (Fig. 33). Replace the plate if worn or scored. Replace the bearings if rough, noisy, brinnelled, or worn.

Inspect the planetary gear assembly and the sun gear and bushings (Fig. 34). If either the sun gear or the bushings are damaged, replace the gear and bushings as an assembly. The gear and bushings are not serviced separately.

The planetary carrier and pinions must be in good condition. Also be sure the pinion pins are secure and in good condition. Replace the carrier if worn or damaged.

Inspect the overrunning clutch and race. The race surface should be smooth and free of scores. Replace the overrunning clutch assembly or the race if either assembly is worn or damaged in any way.

Check the machined surfaces on the output shaft. These surfaces should be clean and smooth. Very minor nicks or scratches can be polished down with crocus cloth. Replace the shaft if worn, severely scored, or damaged in any way.

Inspect the output shaft bushings (Fig. 35). The small bushing is the intermediate shaft pilot bushing. The large bushing is the overrunning clutch hub bushing. Replace either bushing if scored, pitted, cracked, or worn. Remove the annulus gear from the output shaft if bushing replacement is required. This will provide more working room and make bushing replacement easier.

The bushings can be removed with “blind hole puller tools” such as Snap-On set CG40CB for small bushings and set CG46 for large bushings. New bushings can be installed with tools from an all purpose installer kit such as the Snap-On A257 bushing driver set.

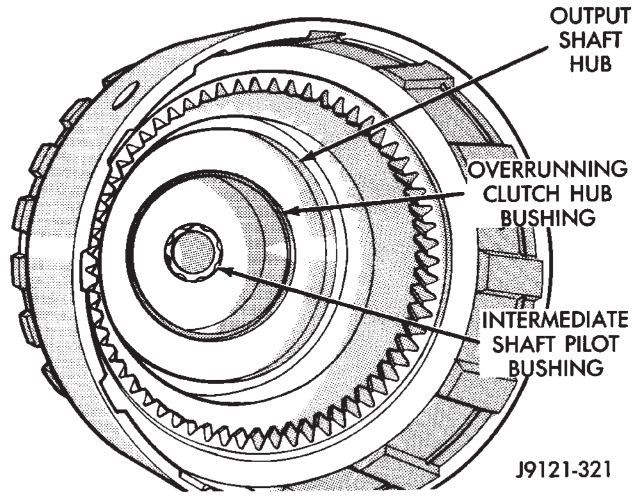


Fig. 35 Output Shaft Bushing Location

OVERDRIVE UNIT ASSEMBLY AND ADJUSTMENT

GEARTRAIN AND DIRECT CLUTCH ASSEMBLY

(1) Soak direct clutch and overdrive clutch discs in Mopar ATF Plus transmission fluid. Allow discs to soak for 10-20 minutes.

(2) Install new pilot bushing and clutch hub bushing in output shaft if necessary (Fig. 34). Lubricate new (or old) bushings with petroleum jelly, or transmission fluid.

(3) Install annulus gear on output shaft, if removed. Then install annulus gear retaining snap ring (Fig. 36).

(4) Align and install clutch drum on annulus gear (Fig. 37). Be sure drum is engaged in annulus gear lugs.

(5) Install clutch drum outer retaining ring (Fig. 37).

(6) Slide clutch drum forward and install inner retaining ring (Fig. 38).

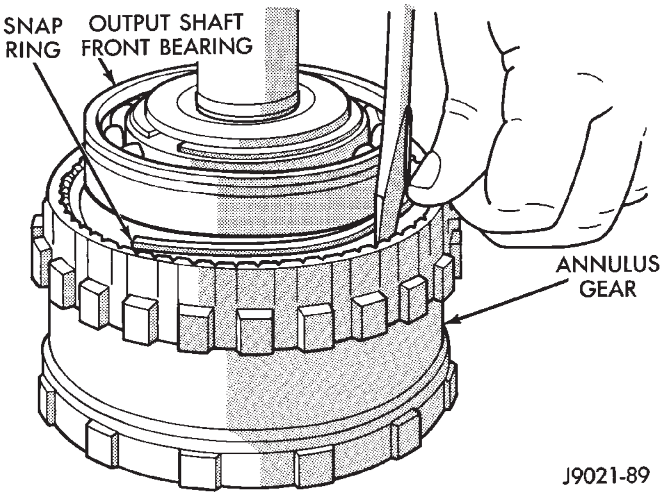


Fig. 36 Annulus Gear Installation

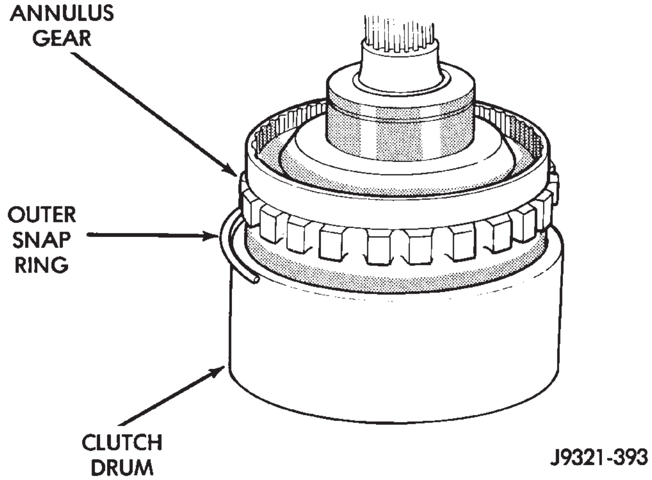


Fig. 37 Installing Clutch Drum And Outer Retaining Ring

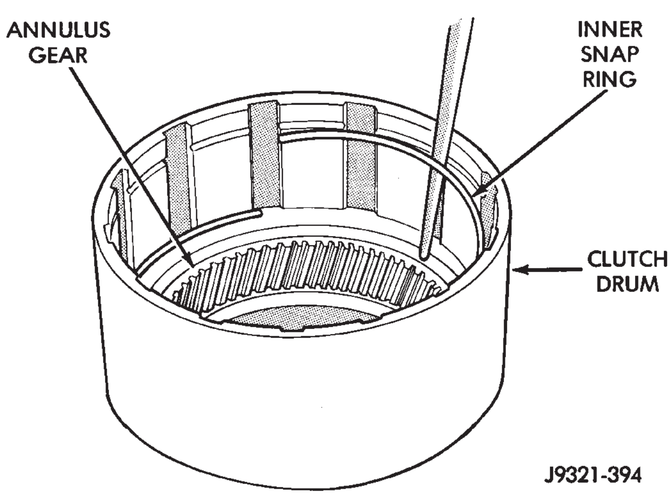


Fig. 38 Installing Clutch Drum Inner Retaining Ring

(7) Install rear bearing and snap ring on output shaft (Fig. 39). Be sure locating ring groove in bearing is toward rear.

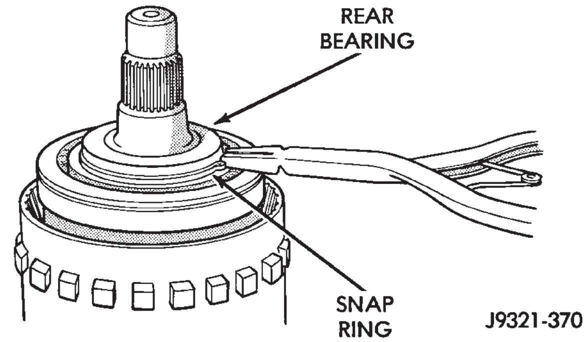


Fig. 39 Rear Bearing And Snap Ring Installation

(8) Install overrunning clutch on hub (Fig. 40). **Note that clutch only fits one way. Shoulder on clutch should seat in small recess at edge of hub.**

(9) Install thrust bearing on overrunning clutch hub (Fig. 41). Use generous amount of petroleum jelly to hold bearing in place for installation. **Bearing fits one way only. Be sure bearing is seated squarely against hub. Reinstall bearing if it does not seat squarely.**

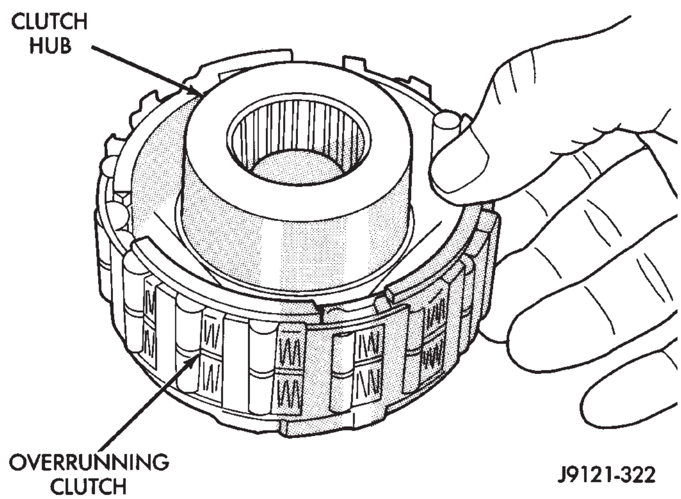


Fig. 40 Assembling Overrunning Clutch And Hub

(10) Install overrunning clutch in output shaft (Fig. 42). Insert snap ring pliers in hub splines. Expand pliers to grip hub. Then install assembly with counter-clockwise, twisting motion.

(11) Install planetary gear in annulus gear (Fig. 43). **Be sure planetary pinions are fully seated in annulus gear before proceeding.**

(12) Install direct clutch spring plate on sun gear. Shoulder side of plate should face outward and toward front. Then secure plate to sun gear with snap ring (Fig. 44).

(13) Coat planetary thrust bearing and bearing contact surface of spring plate with generous amount of petroleum jelly. This will help hold bearing in place during installation.

(14) Install planetary thrust bearing on sun gear

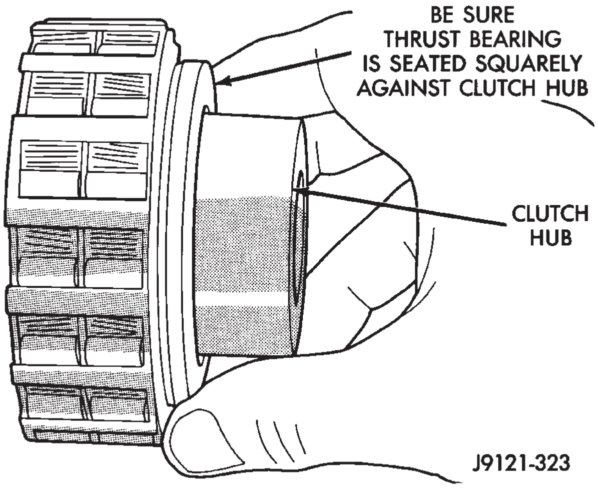


Fig. 41 Installing Overrunning Clutch Thrust Bearing

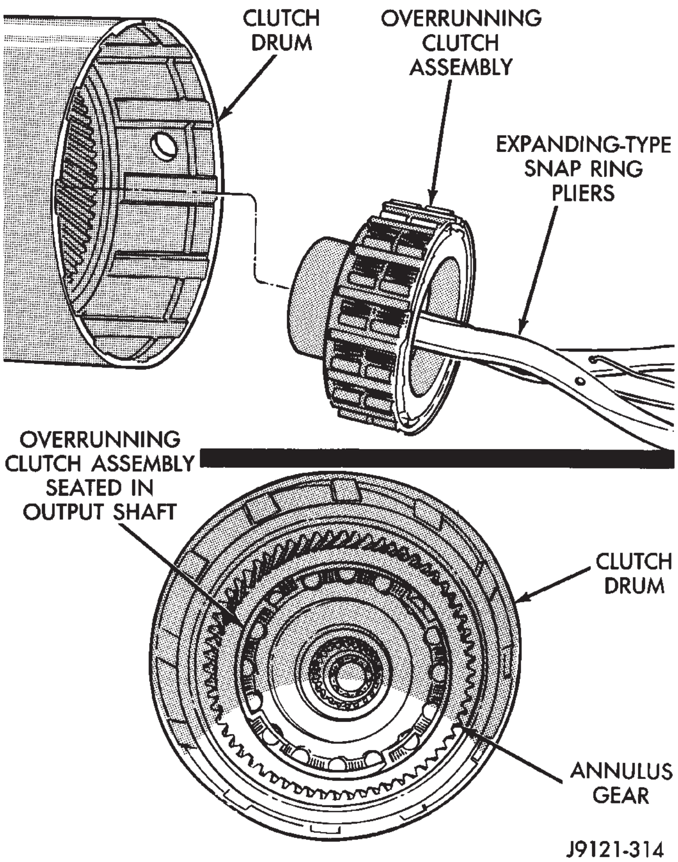


Fig. 42 Installing Overrunning Clutch

(Fig. 45). Slide bearing onto gear and seat it against spring plate as shown. **Bearing fits one way only. If it does not seat squarely against spring plate, remove and reposition bearing.**

(15) Install assembled sun gear, spring plate and thrust bearing (Fig. 46). Be sure sun gear and thrust bearing are fully seated before proceeding.

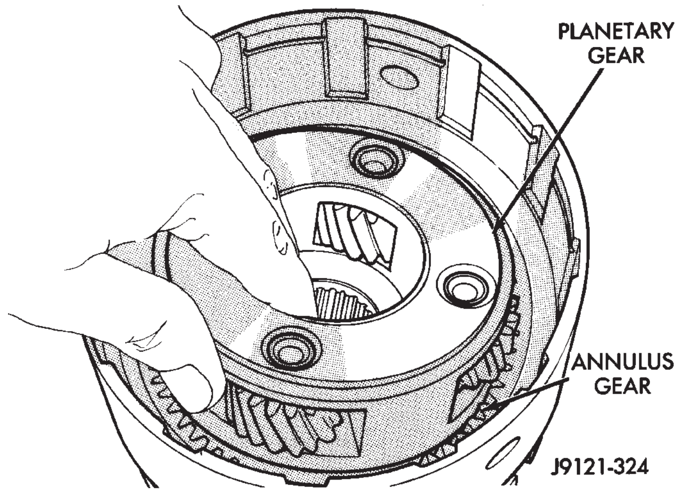


Fig. 43 Installing Planetary Gear

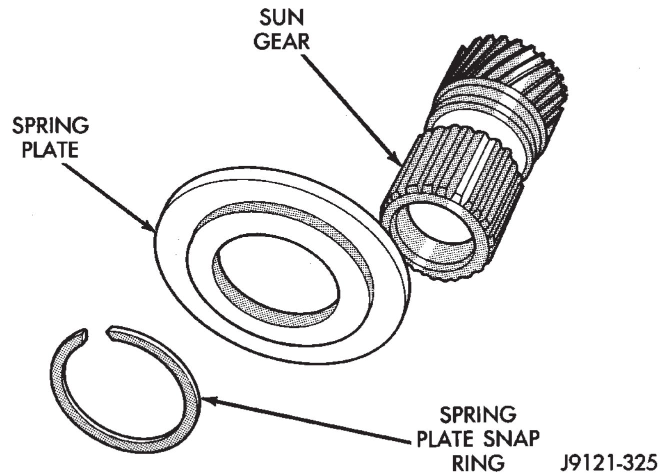


Fig. 44 Sun Gear And Spring Plate Assembly

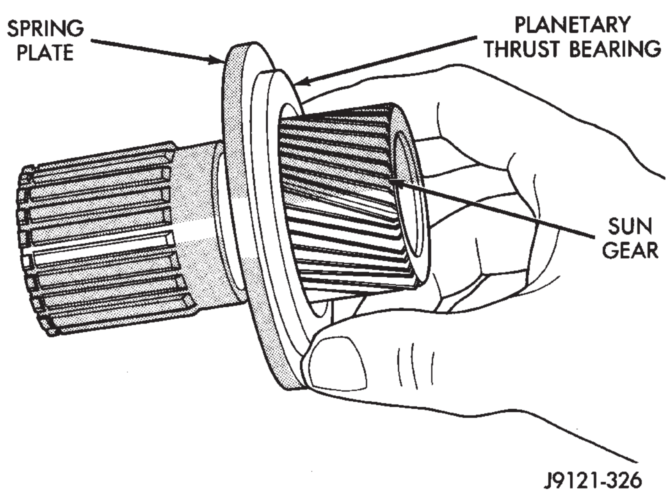


Fig. 45 Installing Planetary Thrust Bearing

(16) Mount assembled output shaft, annulus gear, and clutch drum in shop press. Direct clutch spring, hub and clutch pack are easier to install with assembly mounted in press.

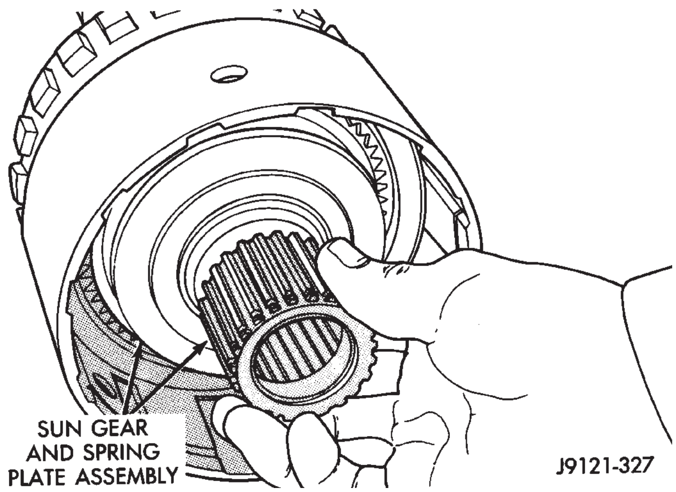


Fig. 46 Sun Gear Installation

(17) Align splines in hubs of planetary gear and overrunning clutch with Alignment tool 6227-2 (Fig. 47). Insert tool through sun gear and into splines of both hubs. Be sure alignment tool is fully seated before proceeding.

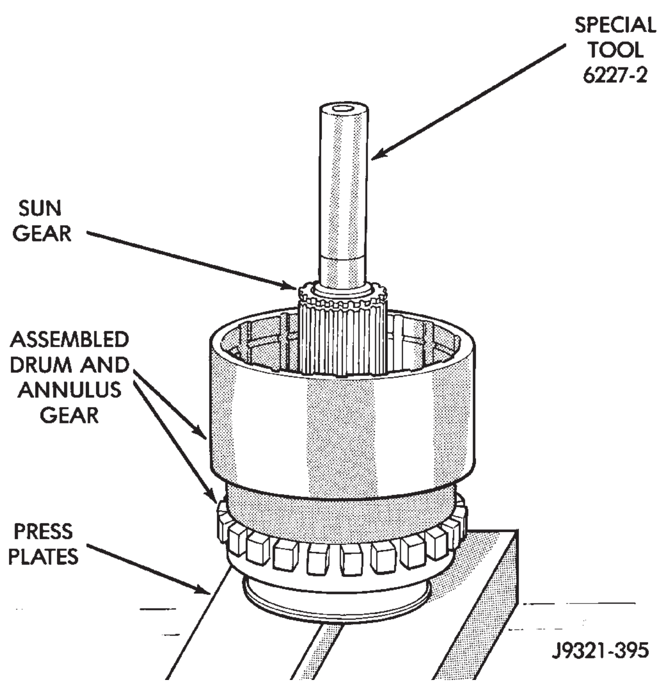


Fig. 47 Alignment Tool Installation

(18) Install direct clutch spring (Fig. 48). Be sure spring is properly seated on spring plate.

(19) Assemble and install direct clutch pack on hub as follows:

(a) Assemble clutch pack components (Fig. 49).

(b) Install direct clutch reaction plate on clutch hub first. **Note that one side of reaction plate is counterbored. Be sure this side faces rearward. Splines at rear of hub are raised slightly. Counterbore in plate fits over raised splines. Plate should be flush with this end of hub (Fig. 50).**

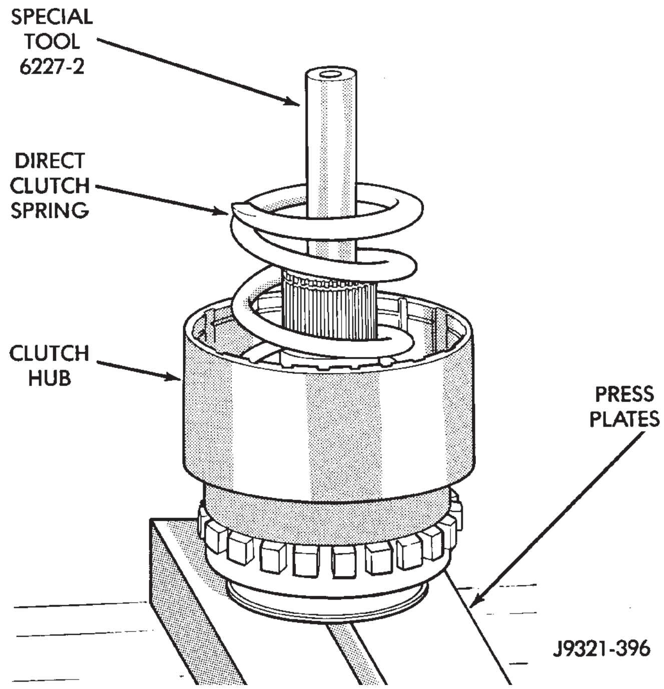


Fig. 48 Direct Clutch Spring Installation

(c) Install first clutch disc followed by a steel plate until 6 discs and 5 plates have been installed.

(d) Install pressure plate. This is last clutch pack item to be installed. **Be sure plate is installed with shoulder side facing upward (Fig. 51).**

(20) Install clutch hub and clutch pack on direct clutch spring (Fig. 52). **Be sure hub is started on sun gear splines before proceeding.**

WARNING: THE NEXT STEP IN GEARTRAIN ASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH HUB AND SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE COMPRESSOR TOOL C-6227-1 AND A HYDRAULIC-TYPE SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(21) Carefully **remove** Alignment Tool 6227-2 from clutch and hub splines. Withdraw tool slowly to avoid spline misalignment. Tool must be removed at this point to provide room for compressor tool movement.

(22) Position Compressor Tool 6227-1 on clutch hub (Fig. 53).

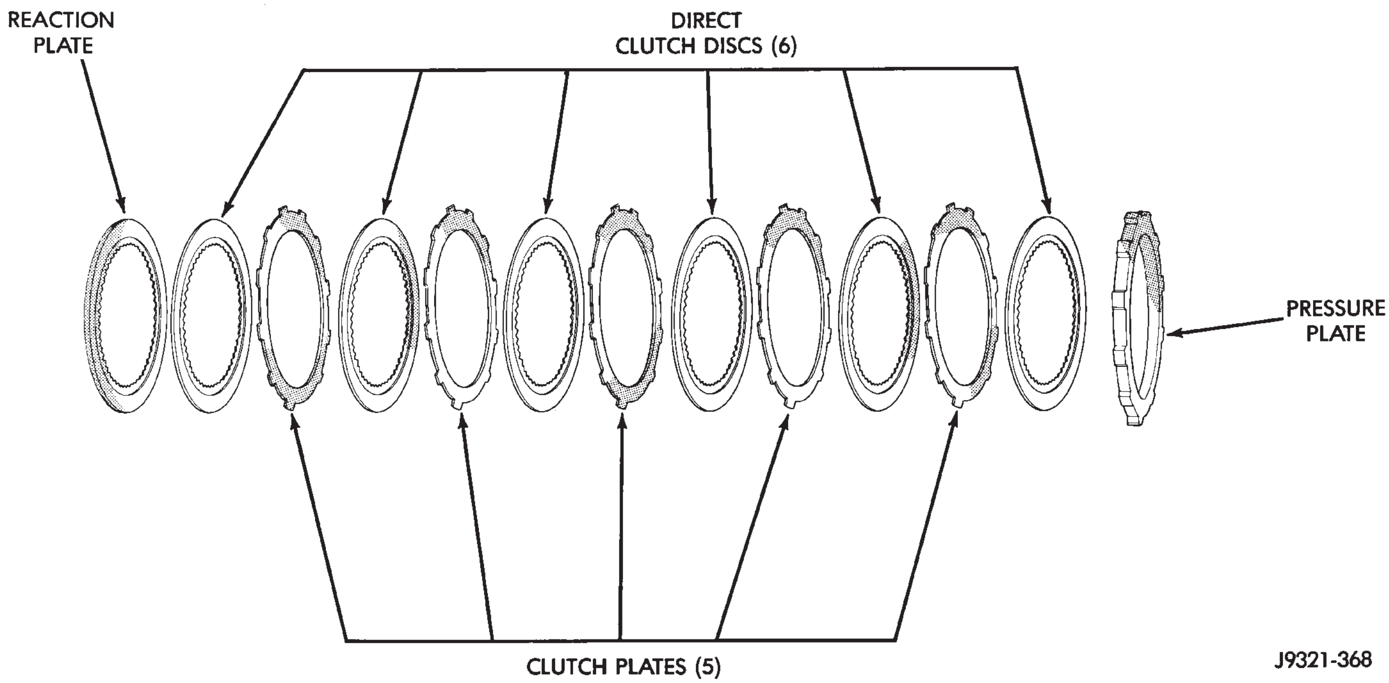


Fig. 49 Direct Clutch Pack Components

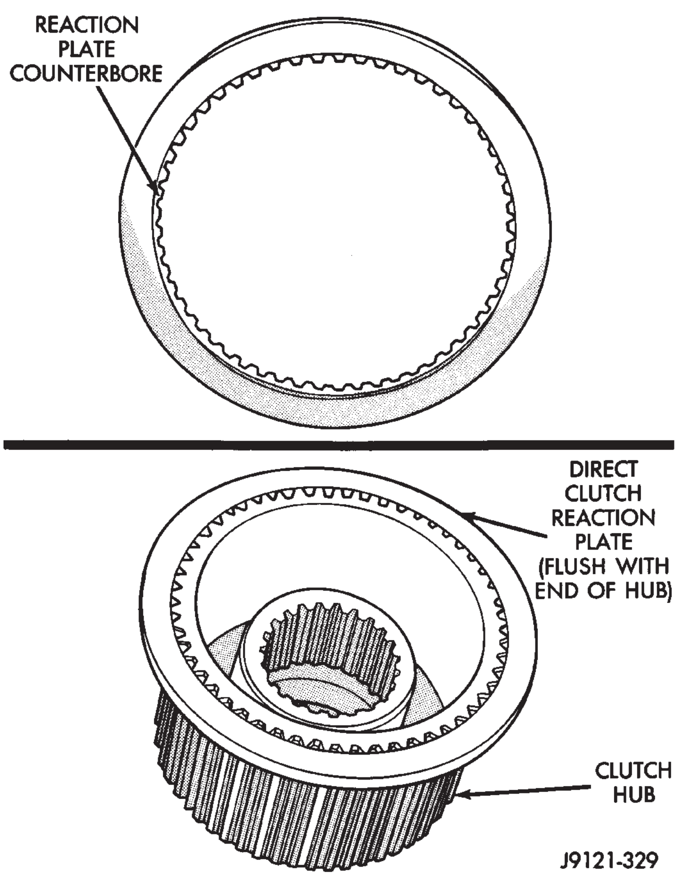


Fig. 50 Correct Position Of Direct Clutch Reaction Plate

(23) Position Special Tool C-3995-A or similar type tool on top of Tool 6227-1 (Fig. 19).

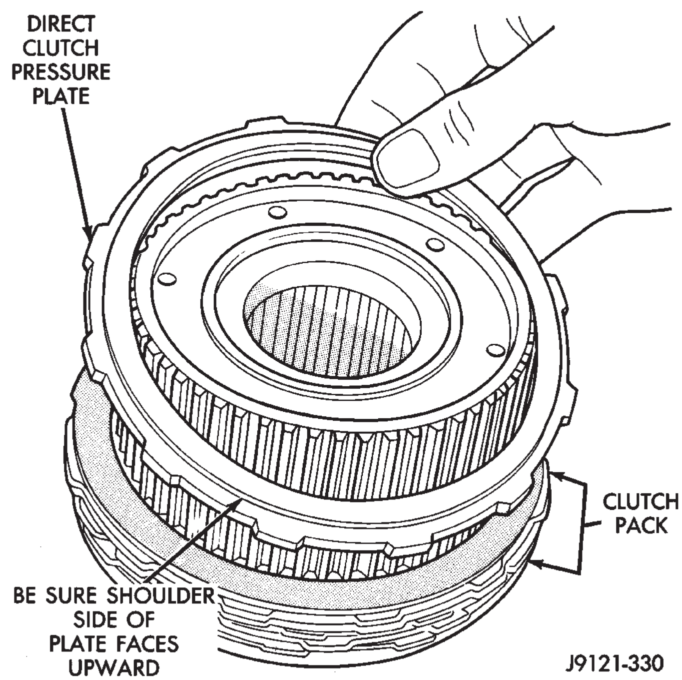


Fig. 51 Correct Position Of Direct Clutch Pressure Plate

(24) Compress clutch hub and spring just enough to place tension on hub and hold it in place.

(25) Slide direct clutch pack upwards on hub (Fig. 53). Then set clutch pack on edge of clutch hub and compressor tool as shown.

(26) Slowly compress clutch hub and spring (Fig. 53). Compress spring and hub only enough to expose ring grooves for clutch pack snap ring and clutch hub retaining ring.

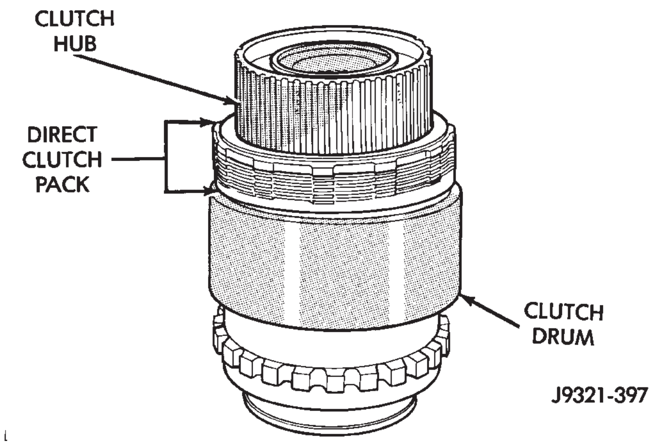


Fig. 52 Installing Direct Clutch Pack And Clutch Hub

(27) Realign clutch pack on hub and seat clutch discs and plates in clutch drum (Fig. 53).

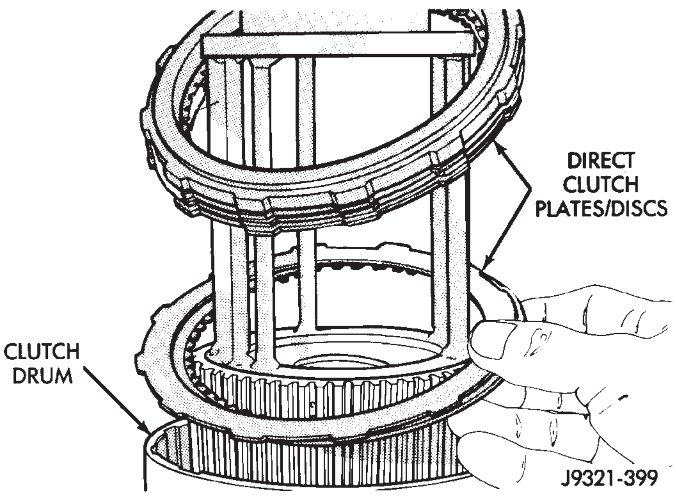


Fig. 53 Seating Clutch Pack In Drum

(28) Install direct clutch pack snap ring (Fig. 54). **Be very sure snap ring is fully seated in clutch drum ring groove.**

(29) Install clutch hub retaining ring (Fig. 55). **Be very sure retaining ring is fully seated in sun gear ring groove.**

(30) Slowly release press ram, remove compressor tools and remove geartrain assembly.

GEAR CASE ASSEMBLY AND INSTALLATION

(1) Position park pawl and spring in case and install park pawl shaft (Fig. 34). Verify that end of spring with 90° bend is hooked to pawl and straight end of spring is seated against case.

(2) Install pawl shaft retaining bolt. Tighten bolt to 27 N●m (20 ft. lbs.) torque.

(3) Install park lock reaction plug. **Note that plug has locating pin at rear (Fig. 56). Be sure pin is seated in hole in case before installing snap ring.**

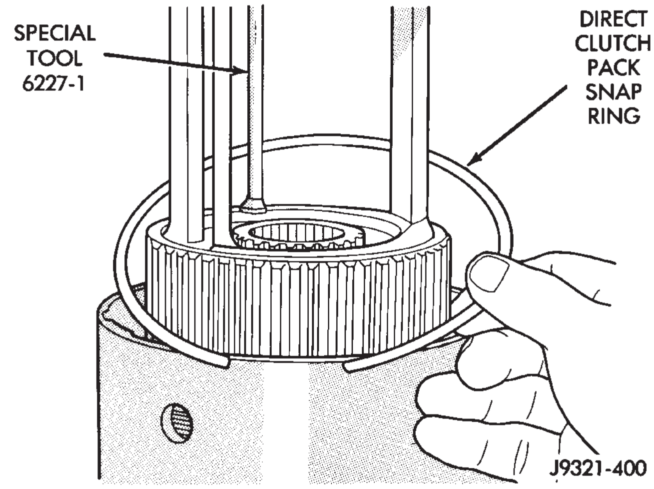


Fig. 54 Installing Direct Clutch Pack Snap Ring

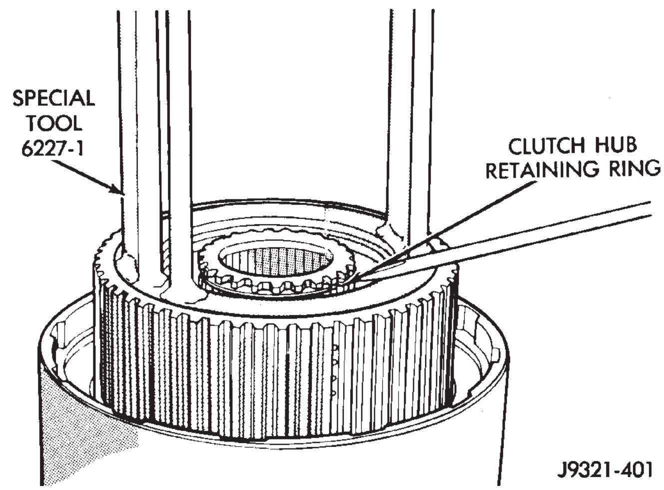


Fig. 55 Installing Clutch Hub Retaining Ring

(4) Install reaction plug snap ring (Fig. 57). **Compress snap ring only enough for installation; do not distort it.**

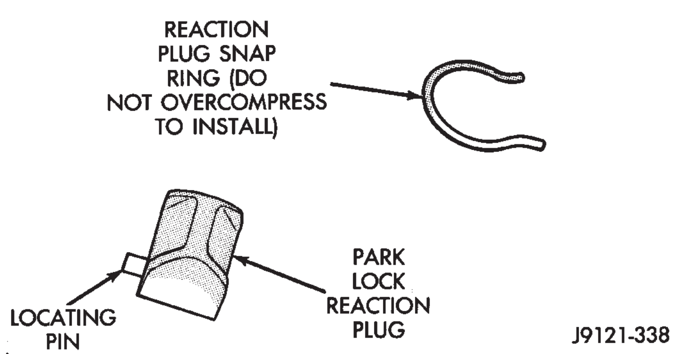


Fig. 56 Reaction Plug Locating Pin And Snap Ring

(5) Install new seal in gear case (Fig. 58). On 4 x 4 gear case, use Tool Handle C-4171 and Installer 5062

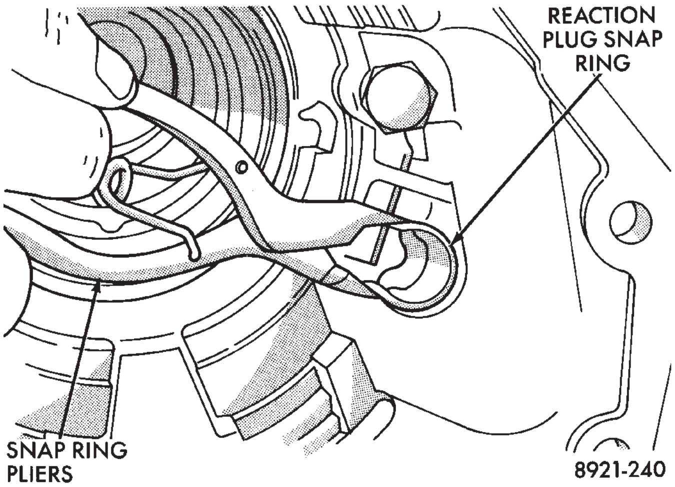


Fig. 57 Reaction Plug And Snap Ring Installation

(or similar size tool) to seat seal in case. On 4 x 2 gear case, use same tool handle and suitable size installer to seat seal in case.

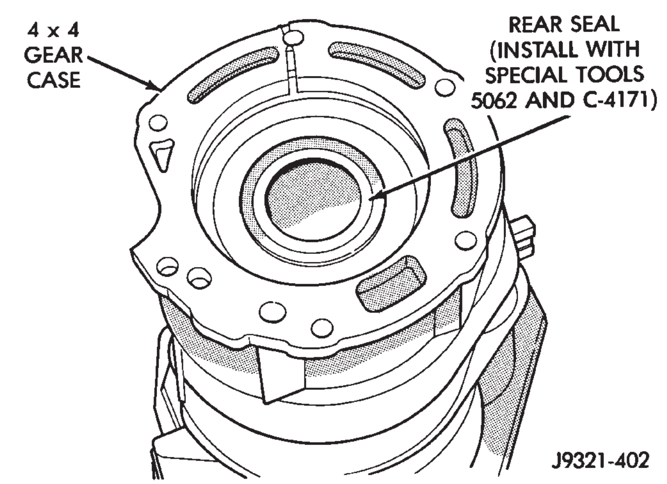


Fig. 58 Rear Seal Installation (In 4 x 4 Gear Case)

(6) Verify that tab ends of rear bearing locating ring extend into access hole in gear case (Fig. 59).

(7) Support geartrain on Tool 6227-1 (Fig. 60). Be sure tool is securely seated in clutch hub.

(8) Install overdrive gear case on geartrain (Fig. 60).

(9) Expand front bearing locating ring with snap ring pliers (Fig. 61). Then slide case downward until locating ring locks in bearing groove and release snap ring.

(10) Install locating ring access cover and gasket in overdrive unit case (Fig. 62).

OVERDRIVE CLUTCH INSTALLATION

(1) Install overdrive clutch reaction ring first. Reaction ring is flat with notched ends (Fig. 63).

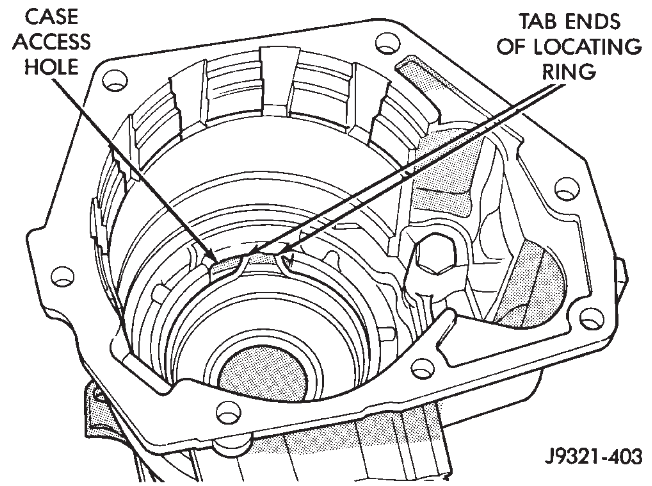


Fig. 59 Correct Rear Bearing Locating Ring Position

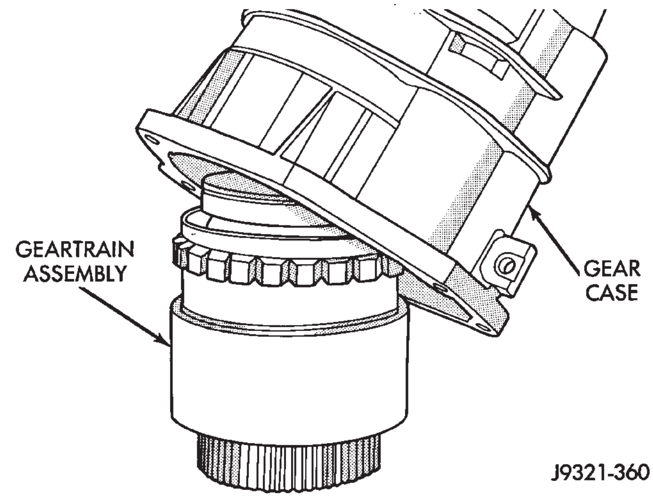


Fig. 60 Overdrive Gear Case Installation

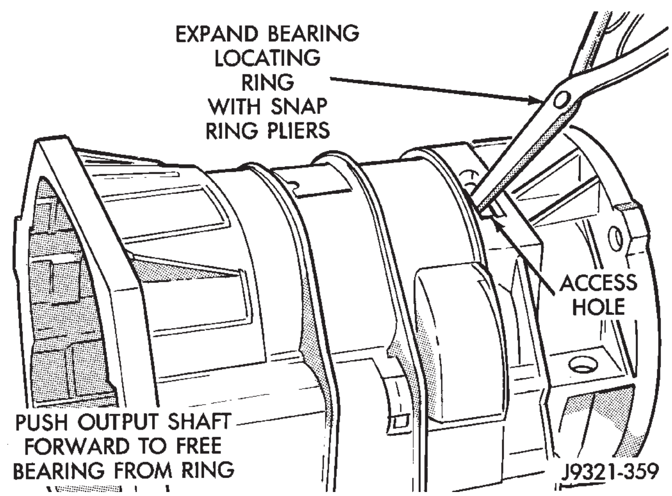


Fig. 61 Seating Locating Ring In Rear Bearing

(2) Install wave spring on top of reaction ring (Fig. 64). **Reaction ring and wave ring both fit in same ring groove.** Use screwdriver to seat each ring securely in groove.

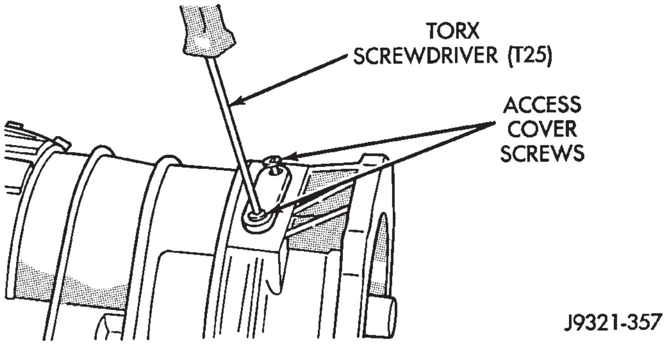


Fig. 62 Installing Locating Ring Access Cover And Gasket

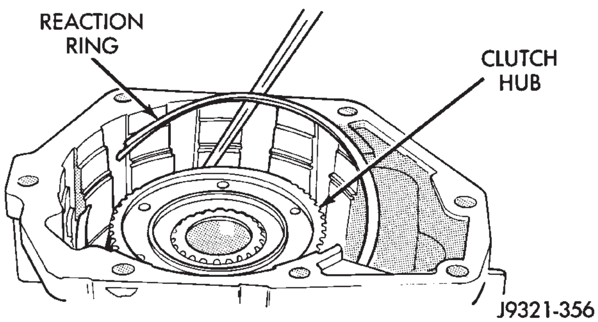


Fig. 63 Overdrive Clutch Reaction Ring Installation

(3) Assemble overdrive clutch pack (Fig. 65).

(4) Install overdrive clutch reaction plate first. **Note that reaction plate is thinner than pressure plate.**

(5) Install first clutch disc followed by first clutch plate. Then install remaining clutch discs and plates in same order.

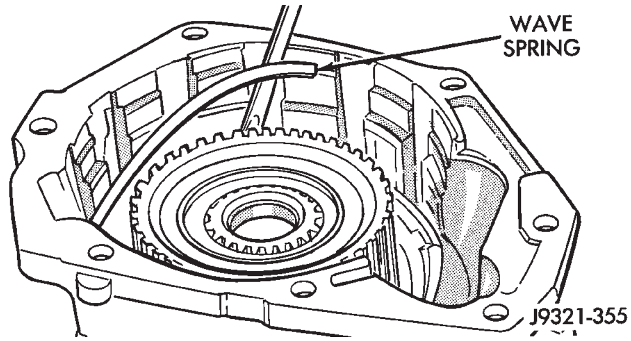


Fig. 64 Overdrive Clutch Wave Spring Installation

(6) Verify clutch pack. 4 clutch discs, 3 steel plates, 1 reaction plate and 1 pressure plate are required.

(7) Install clutch pack pressure plate. Note that pressure plate is thickest plate in clutch pack.

(8) Install clutch pack wire-type retaining ring (Fig. 66).

SHAFT END PLAY ADJUSTMENT

(1) Place overdrive unit in vertical position and mount unit in vise or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub.

(2) Determine correct thickness **intermediate shaft spacer** as follows:

(a) Insert Special Tool 6312 through sun gear, planetary gear and into pilot bushing in output shaft. Be sure tool bottoms against planetary shoulder.

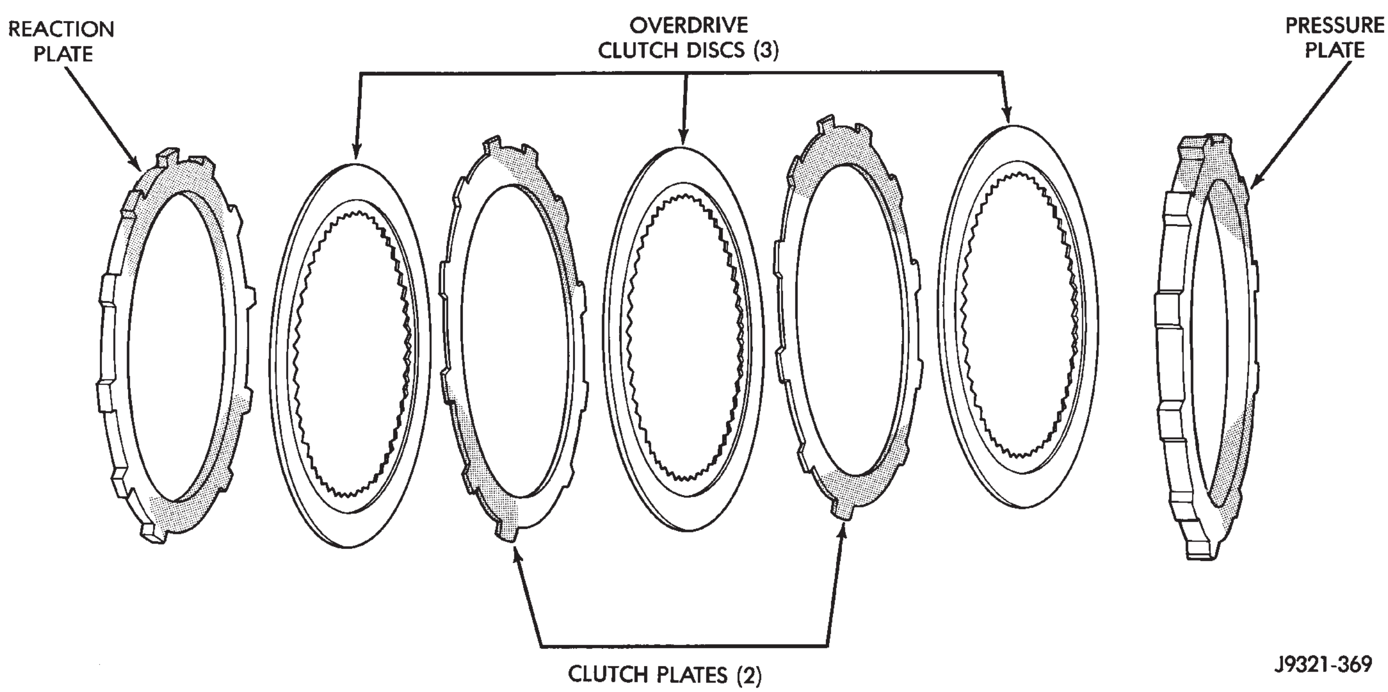


Fig. 65 Overdrive Clutch Components

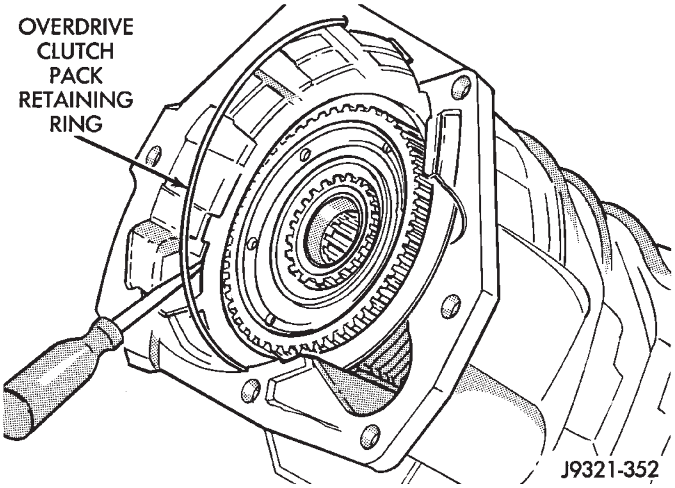


Fig. 66 Installing Overdrive Clutch Pack Retaining Ring

(b) Position Gauge Tool 6311 across face of overdrive case (Fig. 67). Then position Dial Caliper C-4962 over gauge tool.

(c) Extend sliding scale of dial caliper downward through gauge tool slot until scale contacts end of Gauge Alignment Tool 6312. Lock scale in place. Remove dial caliper tool and note distance measured (Fig. 67).

(d) Select proper thickness end play spacer from spacer chart based on distance measured (Fig. 68).

(e) Remove Gauge Alignment Tool 6312.

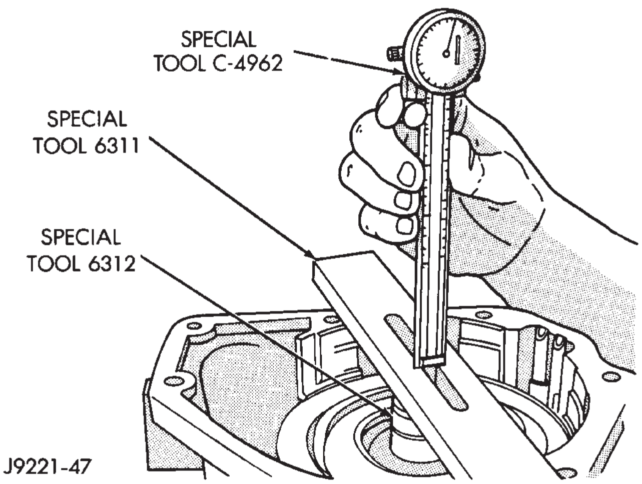


Fig. 67 Shaft End Play Measurement

(3) Determine correct thickness **overdrive piston thrust plate** as follows:

(a) Position Gauge Tool 6311 across face of overdrive case. Then position Dial Caliper C-4962 over gauge tool (Fig. 69).

(b) Measure distance to clutch hub thrust bearing seat at four points 90° apart. Then average measurements by adding them and dividing by 4.

(c) Select and install required thrust plate from information in thrust plate chart (Fig. 70).

End Play Measurement (Inches)	Spacer Thickness (Inches)
.7336 - .7505	.158 - .159
.7506 - .7675	.175 - .176
.7676 - .7855	.193 - .194
.7856 - .8011	.211 - .212

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Fig. 68 Intermediate Shaft End Play Spacer Selection

(4) Leave Alignment Tool 6227-2 in place. Tool will keep planetary and clutch hub splines in alignment until overdrive unit is ready for installation on transmission.

(5) Transmission speed sensor can be installed at this time if desired. However, it is recommended that sensor not be installed until after overdrive unit is secured to transmission.

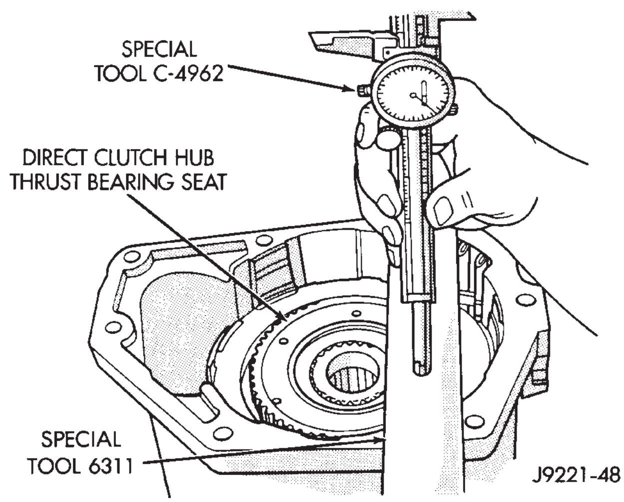

Fig. 69 Overdrive Piston Thrust Plate Measurement

End Play Measurement (Inches)	Spacer Thickness (Inches)
1.7500 - 1.7649	.108 - .110
1.7650 - 1.7799	.123 - .125
1.7800 - 1.7949	.138 - .140
1.7950 - 1.8099	.153 - .155
1.8100 - 1.8249	.168 - .170
1.8250 - 1.8399	.183 - .185
1.8400 - 1.8549	.198 - .200
1.8550 - 1.8699	.213 - .215
1.8700 - 1.8849	.228 - .230
1.8850 - 1.8999	.243 - .245

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Fig. 70 Overdrive Piston Thrust Plate Selection

SPECIFICATIONS

42RE GENERAL SPECIFICATIONS

TRANSMISSION MODEL	42 RE
Oil Pump Clearances (all)	0.089-0.190 mm (0.0035-0.0075 in)
Planetary End Play	0.127-1.22 mm (0.005-0.048 in)
Input Shaft End Play	0.56-2.31 mm (0.022-0.091 in)
Clutch Pack Clearance: Front Clutch (4 Disc) Rear Clutch (4 Disc)	 1.70-3.40 mm (0.067-0.134 in) 0.81-1.40 mm (0.032-0.055 in)
Clutch Disc Usage: Front Clutch Rear Clutch Overdrive Clutch Direct Clutch	 4 4 3 6
Band Adjustments: (backed off form 72 in. lbs.) Front Band Rear Band	 3-5/8 Turns 4 Turns
Recommended (and preferred) Fluid	MOPAR ATF Plus, Type 7176 Automatic Transmission Fluid

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42RE THRUST WASHER/SPACER/SNAP RING DIMENSIONS

TRANSMISSION MODEL	42 RE
Front Clutch Thrust Washer (on reaction shaft support hub)	0.061 in.
Rear Clutch Thrust Washer (on clutch retainer)	0.061 in.
Intermediate Shaft Thrust Plate (on shaft pilot hub)	0.060-0.063 in.
Intermediate Shaft Thrust Washer (in rear clutch hub)	Select fit to set overall end play
Rear Clutch Pack Snap Ring	0.060 in. 0.076 in. 0.098 in.
Planetary Geartrain Snap Ring (at front end of intermediate shaft)	Select fit (3 thicknesses available)
Overdrive Piston Thrust Plate	Thrust plate and spacer are select fit components. Refer to size charts and selection procedures in "Overdrive Unit Assembly and Adjustment."
Intermediate Shaft Spacer	

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42RE PRESSURE SPECIFICATIONS

Overdrive Clutch	Fourth Gear Only	Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-896 kPa (90-130 psi) at 1/2 to 3/4 throttle.
Line Pressure (at accumulator)	Closed Throttle	372-414 kPa (54-60 psi)
Front Servo	Third Gear Only	No more than 21 kPa (3 psi) lower than line pressure.
Rear Servo	1 Range R Range	No more then 21 kPa (3 psi) lower than line pressure. 1103 kPa (160 psi) at idle, builds to 1862 kPa (270 psi) at 1600 rpm.
Governor	D Range Closed Throttle	Pressure should respond smoothly to changes in mph and return to 0-7 kPa (0-1½ psi) when stopped with transmission in D, 1, 2. **Pressure above 7 kPa (1½ psi) at standstill will prevent transmission from downshifting.**

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42RE TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Cooler Line Fittings (at transmission)	18 N•m (13 ft. lbs.)
Converter Bolts:	
10.75 in., 4-lug converter	31 N•m (270 in. lbs.)
Crossmember Bolts/Nuts	68 N•m (50 ft. lbs.)
Driveplate Bolts	75 N•m (55 ft. lbs.)
Front Band Lever Pivot Shaft Access Plug	17 N•m (13 ft. lbs.)
Front Band Adjusting Screw Locknut	34 N•m (25 ft. lbs.)
Park/Neutral Position Switch	34 N•m (25 ft. lbs.)
Oil Filter Screws	4 N•m (35 in. lbs.)
Oil Pan Bolt	17 N•m (13 ft. lbs.)
Oil Pump Bolt	20 N•m (15 ft. lbs.)
Overrunning Clutch Cam Bolts	17 N•m (150 in. lbs.)

DESCRIPTION	TORQUE
Overdrive-to-Transmission Case Bolts	34 N•m (25 ft. lbs.)
Overdrive Piston Retainer 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	20 N•m (15 ft. lbs.)
Rear Band Adjusting Screw Locknut	41 N•m (30 ft. lbs.)
Solenoid Wiring Connector Screw	4 N•m (35 in. lbs.)
Solenoid-to-Transfer Plate Screw	4 N•m (35 in. lbs.)
Speedometer Adapter Bolt	11 N•m (8 ft. lbs.)
Valve Body/Governor Body Screws	4 N•m (35 in. lbs.)
Valve Body-to-Case Bolts	12 N•m (100 in. lbs.)
Transmission speed sensor	27 N•m (20 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.

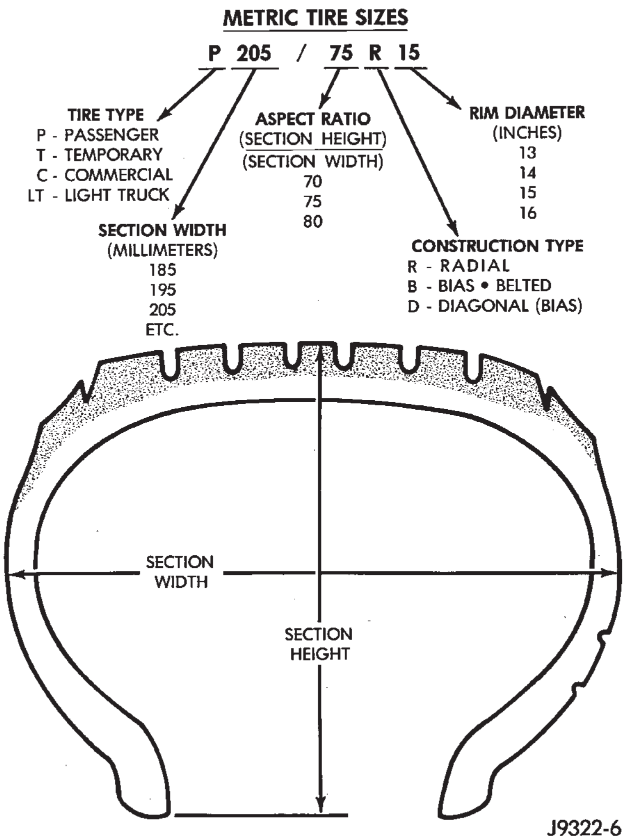


Fig. 1 Tire Size Identification

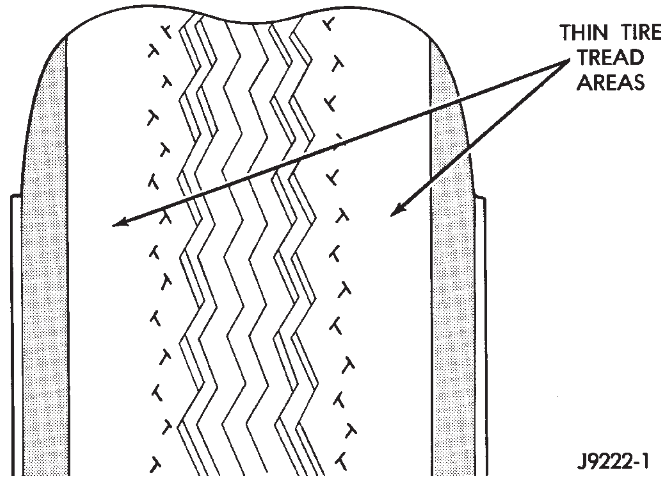


Fig. 2 Under Inflation Wear

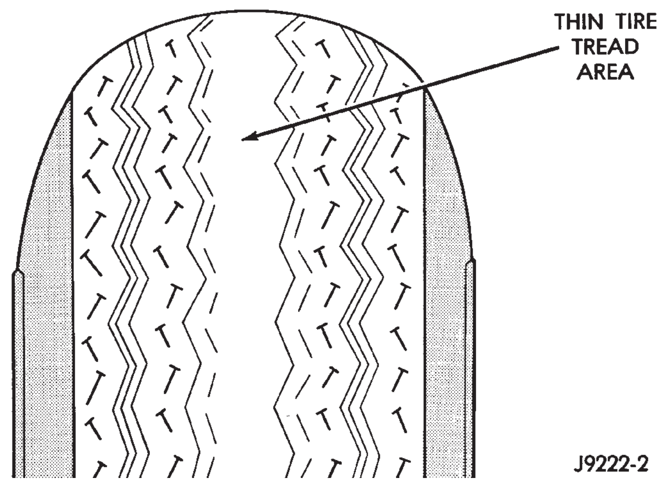


Fig. 3 Over Inflation Wear

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 caps and tighten 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.

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

We recommend that tires equivalent to the original equipment tires 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 equipment 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;

- They wear at unequal rates
- Tend to develop irregular wear patterns

These effects can be reduced by timely rotation of tires. The benefits of rotation are especially worthwhile. Rotation will:

- Increase tread life
- Help to maintain mud, snow, and wet traction levels
- Contribute to 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 they will not provide all the tire longevity benefits.

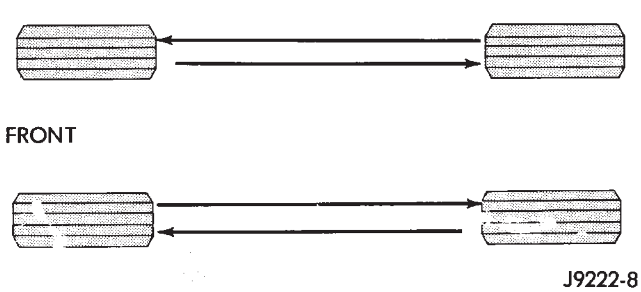


Fig. 4 Tire Rotation Pattern

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.

Tire replacement is necessary when indicators appear in two or more grooves, or if localized balding occurs (Fig. 5).

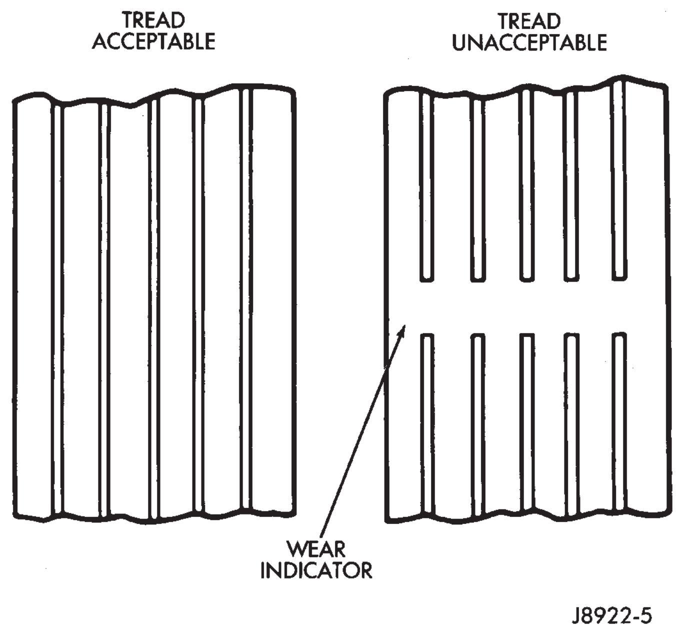


Fig. 5 Tread Wear Indicators

REPAIRING LEAKS

For proper repairing, a radial tire 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.

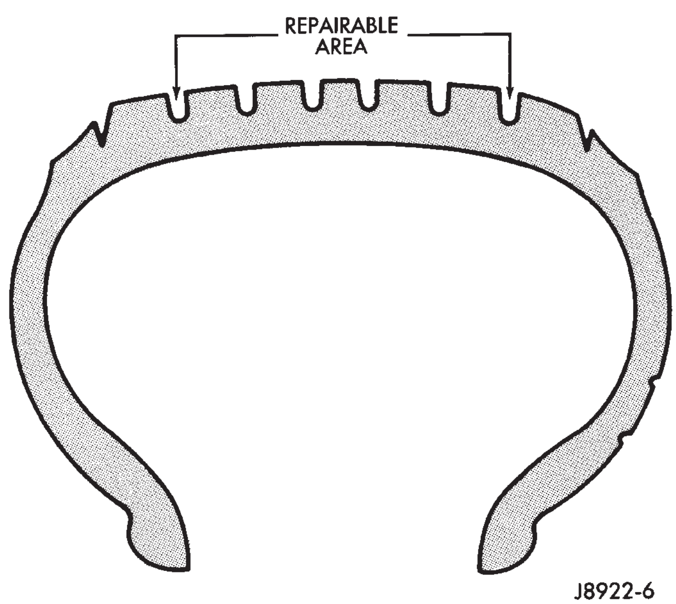


Fig. 6 Tire Repair Area

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 results in faster wear on shoulders of tire. Over inflation causes faster wear at center of 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 of the tire, from dragging of tire. There is a feathered effect across the tread (Fig. 7).

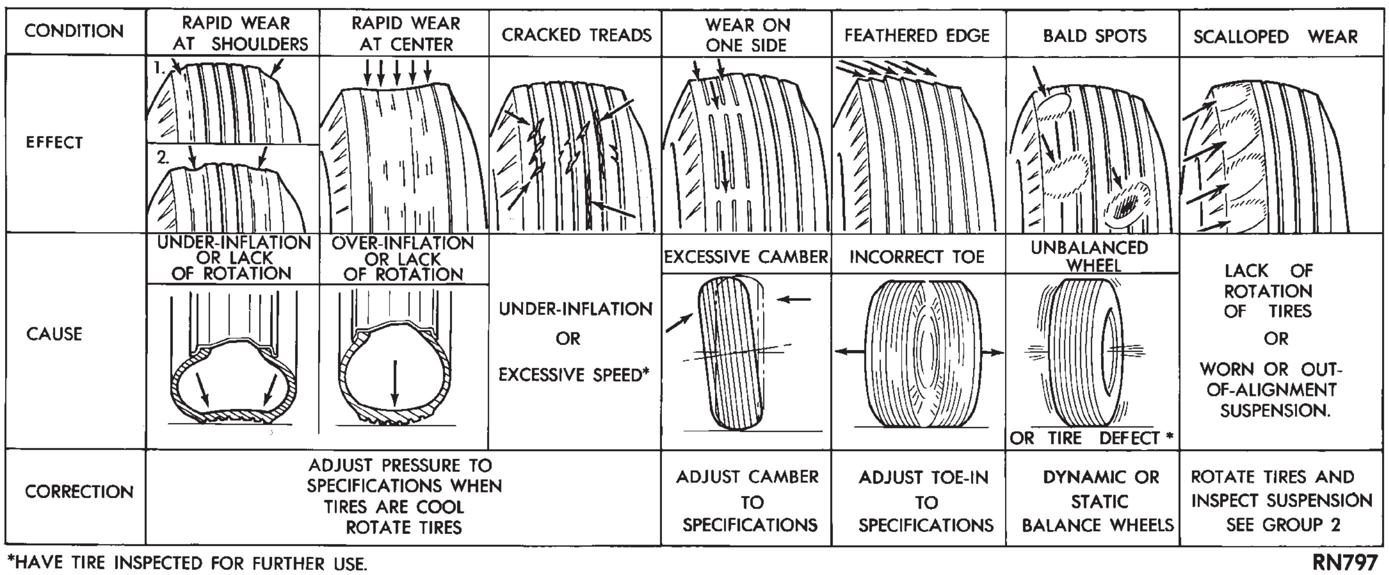
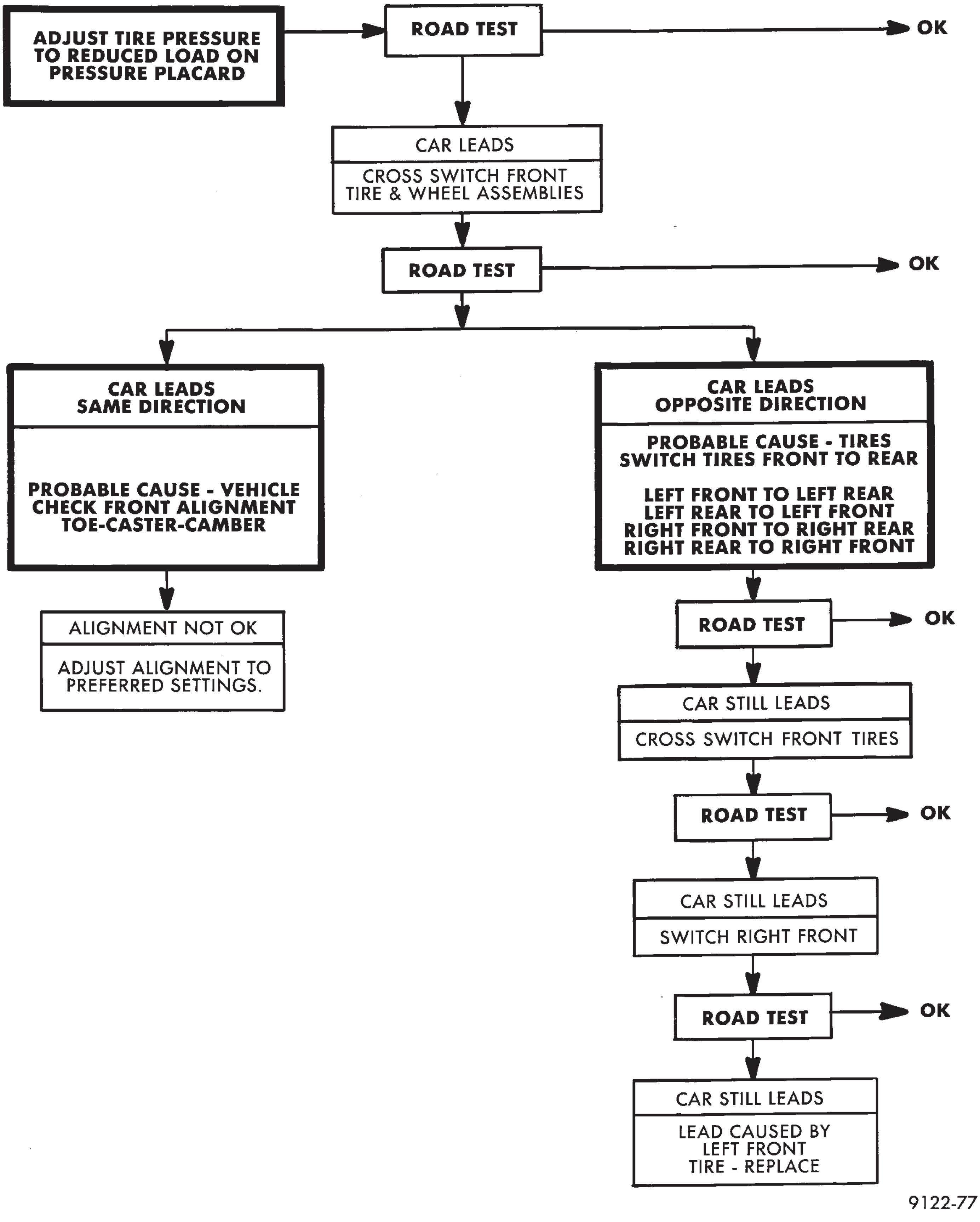


Fig. 7 Abnormal Tire Tread Wear Patterns

LEAD CORRECTION CHART



WHEELS

GENERAL INFORMATION

Original equipment wheels are designed for all loads up to 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.

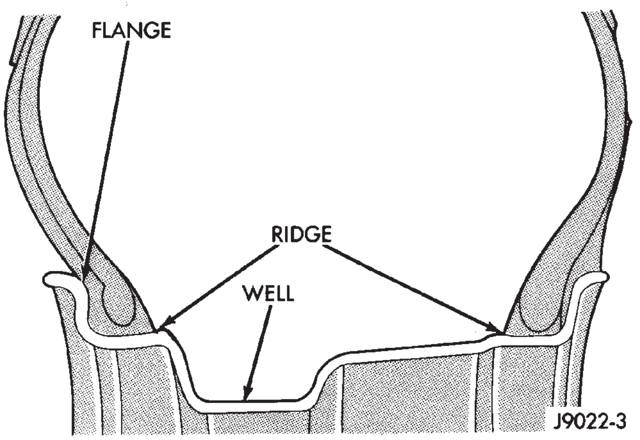


Fig. 1 Wheel Safety Rim

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

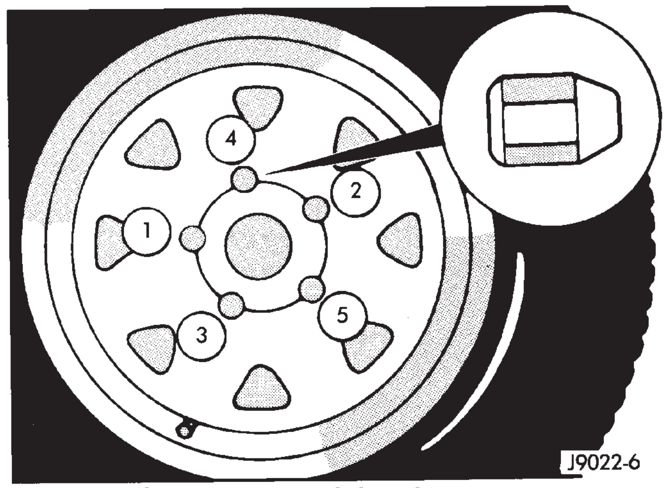


Fig. 2 Lug Nut Tightening Pattern

- 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

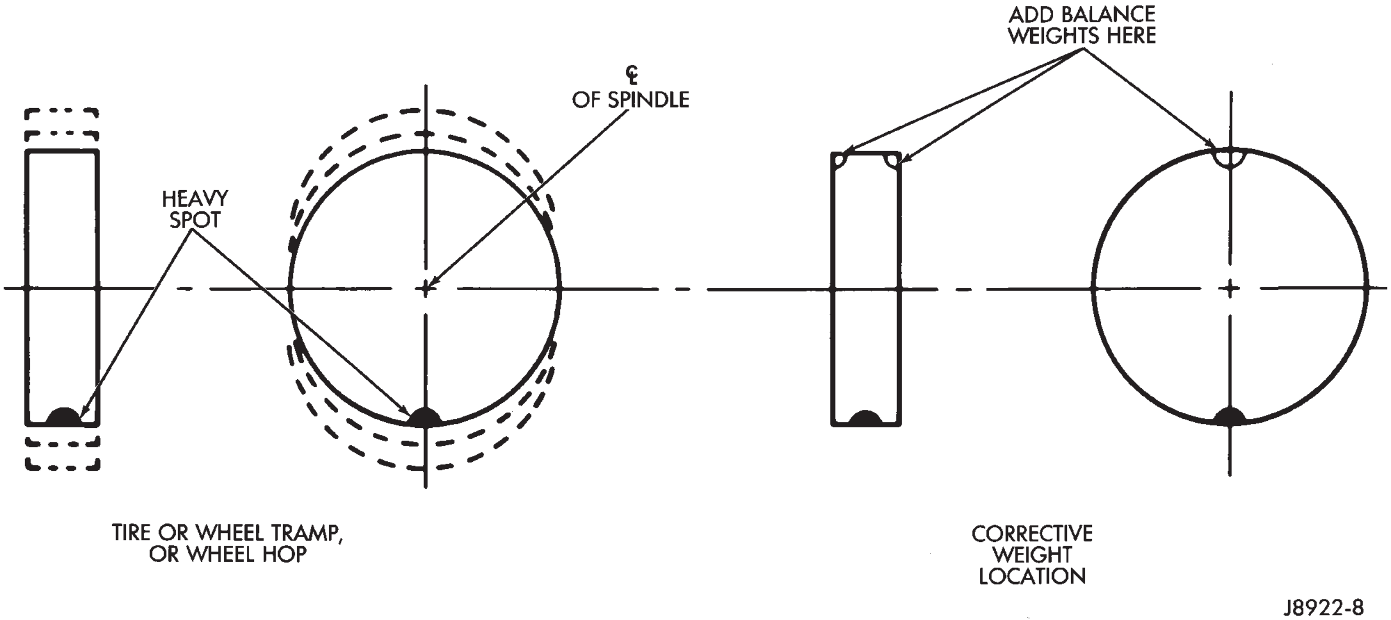


Fig. 3 Static Unbalance & Balance

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 assure 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.

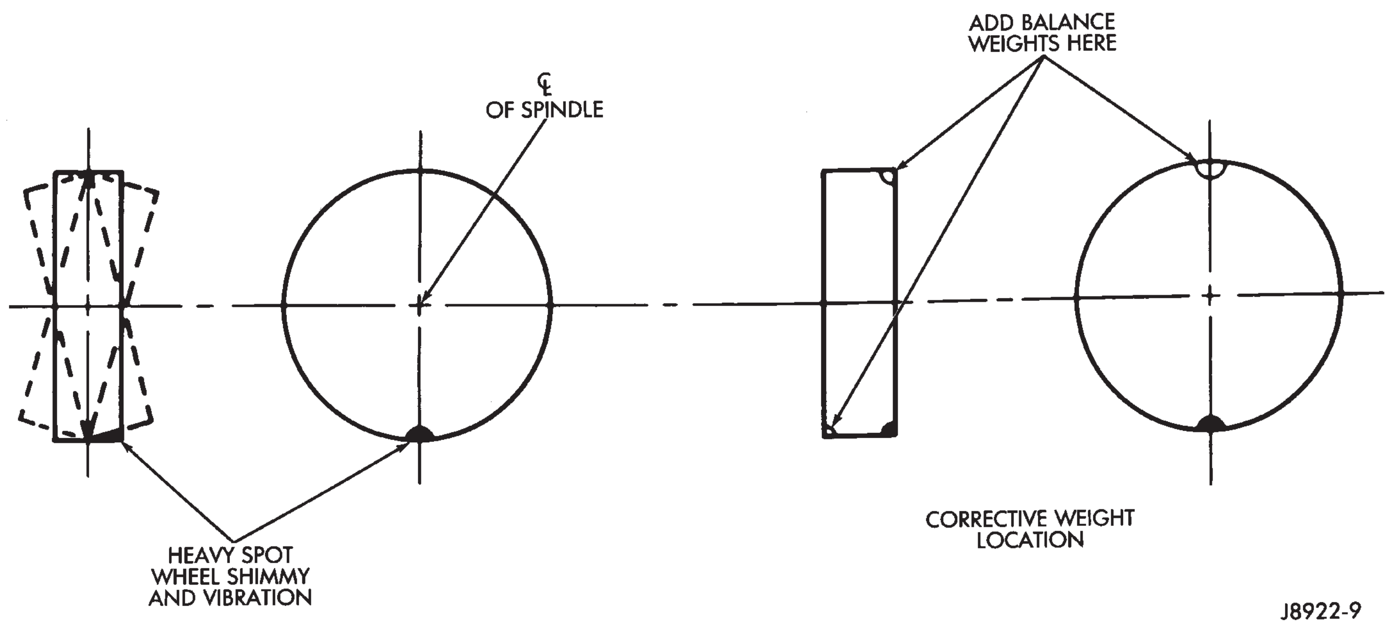


Fig. 4 Dynamic Unbalance & Balance

Mark the tire to indicate the high spot. Place a mark on the tire at the valve stem location (Fig. 5).

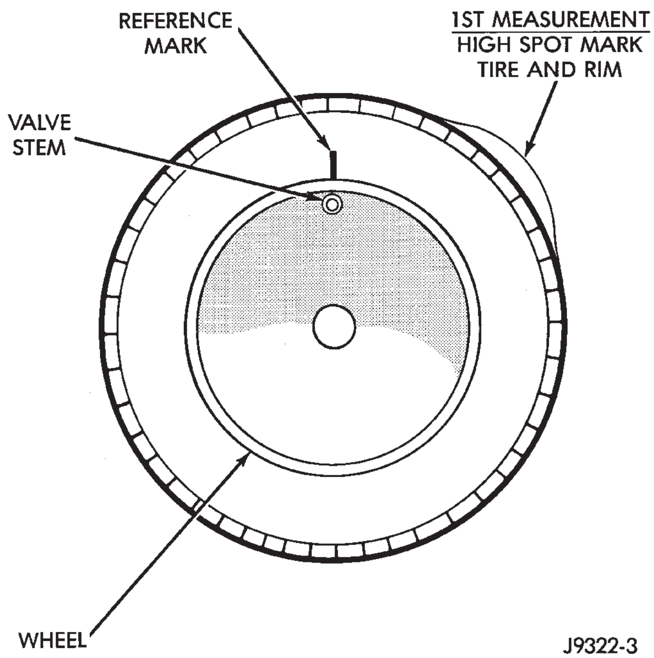


Fig. 5 First Measurement On Tire

(2) Break down the tire and remount it 180 degrees on the rim (Fig. 6).

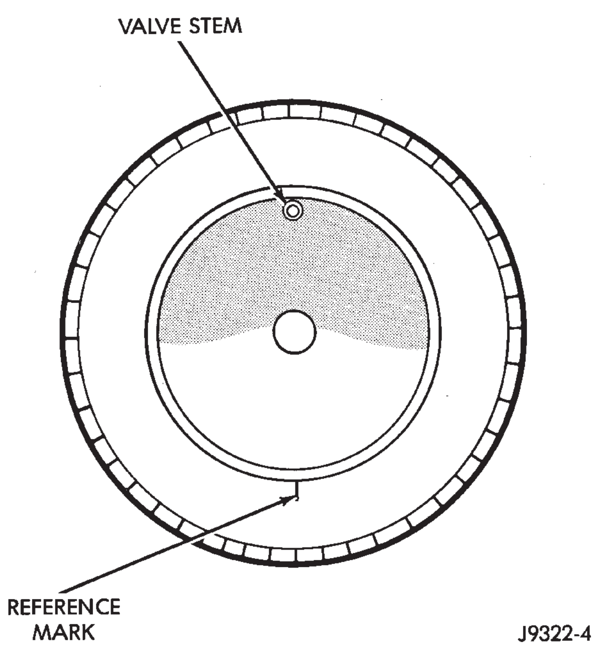


Fig. 6 Remount Tire 180 Degrees

(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.

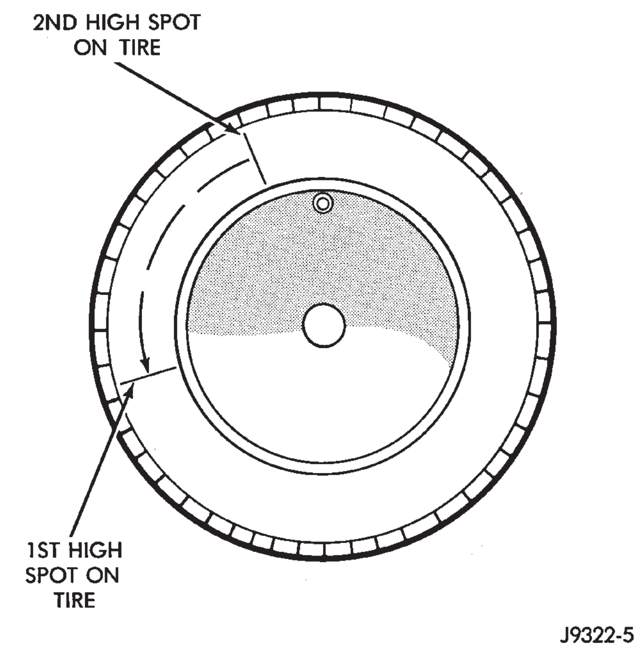


Fig. 7 Remount Tire 90 Degrees In Direction of Arrow

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.

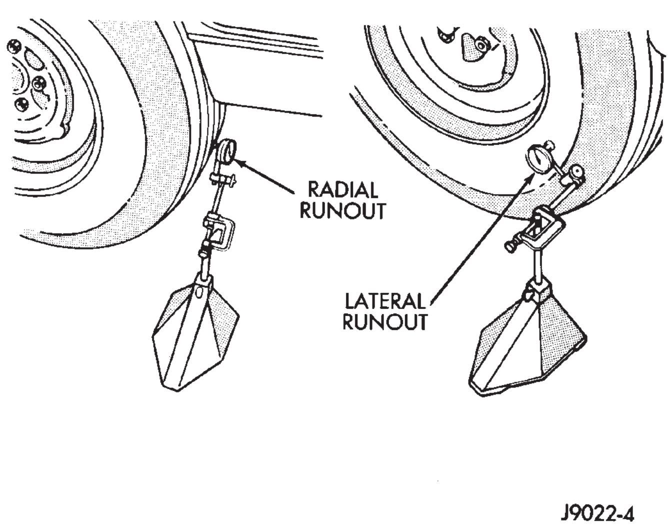


Fig. 8 Checking Tire Runout

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.

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.

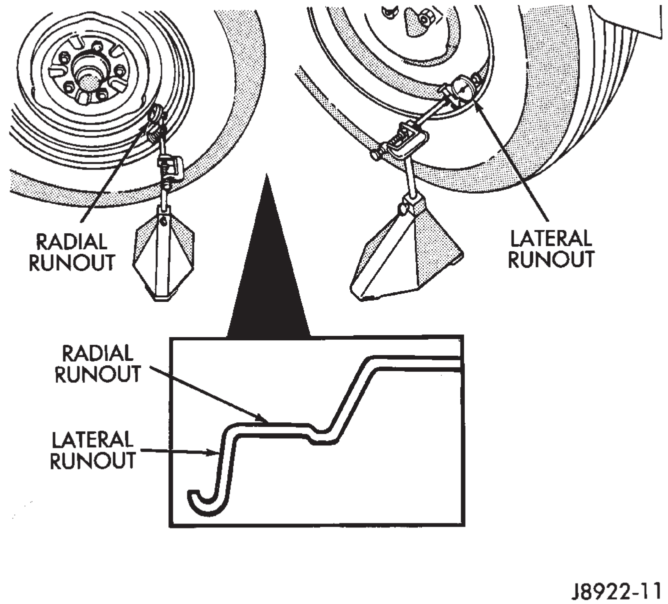


Fig. 9 Checking Wheel Runout

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 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.

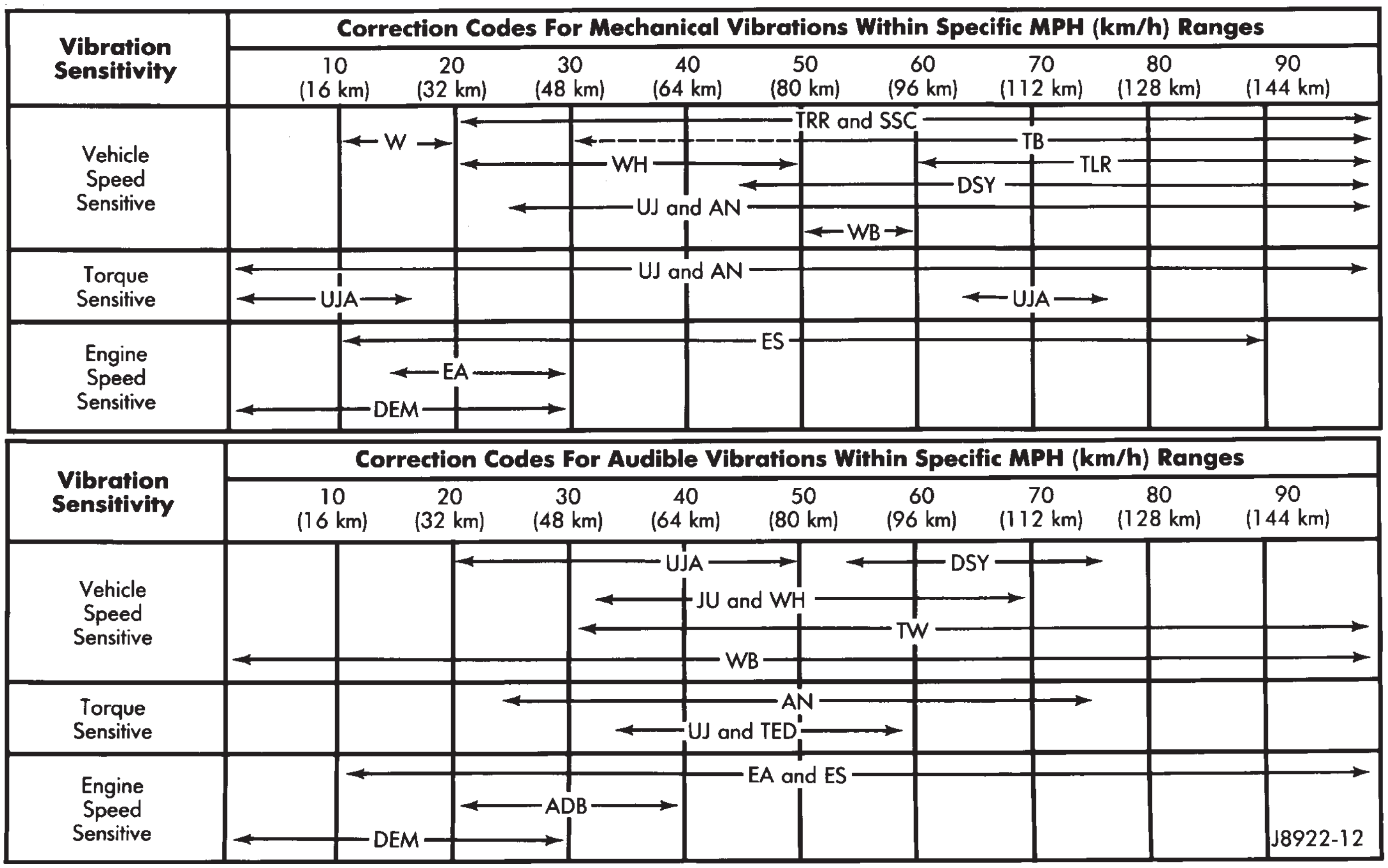
TW—Tire Wear: Vehicle speed sensitive, audible vibration. Abnormal tire wear causes small vibration in the 30 - 55 mph (88 km/h) range. This will produce a whine noise at high speed. The whine will change to a growl noise when the speed is reduced.

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

VIBRATION DIAGNOSIS



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.)

J9322-7

WHEEL DESCRIPTION

Description	Bolt Pattern	Offset	Load Rating
15 X 7 Spoke Argent	5 X 4.5"	1.25"	1700 lbs.
16 X 4 Mini Spare	5 X 4.5"	1.75"	1500 lbs.
15 X 7 Full Face Triangle Hole	5 X 4.5"	1.00"	1500 lbs.
15 X 7 Directional Sport Aluminum	5 X 4.5"	1.00"	1500 lbs.
15 X 7 Luxury Alum. Painted Pocket	5 X 4.5"	1.25"	1500 lbs.

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BODY COMPONENTS

CONTENTS

EXTERIOR COMPONENTS

INDEX

GRILLE AND GRILLE OPENING REINFORCEMENT (GOR)

REMOVAL

(1) Remove 3 screws and grille (Fig. 1) from grille opening reinforcement (GOR).

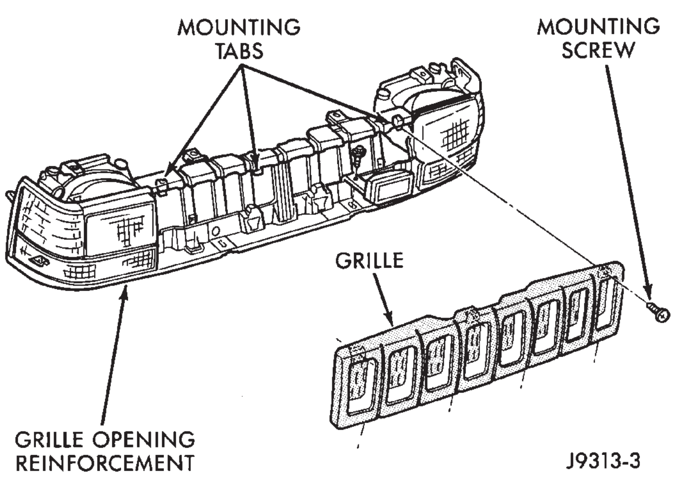


Fig. 1 Grille Removal

(2) Grasp lower edge of headlamp lens. Pull straight back (away) from grille opening reinforcement (GOR). Disengage lower adjuster pivots from lens assembly (Fig. 2).

(3) Grasp upper edge of headlamp lens. Pull straight back (away) from grille opening reinforcement (GOR). Disengage upper adjuster pivot from lens assembly.

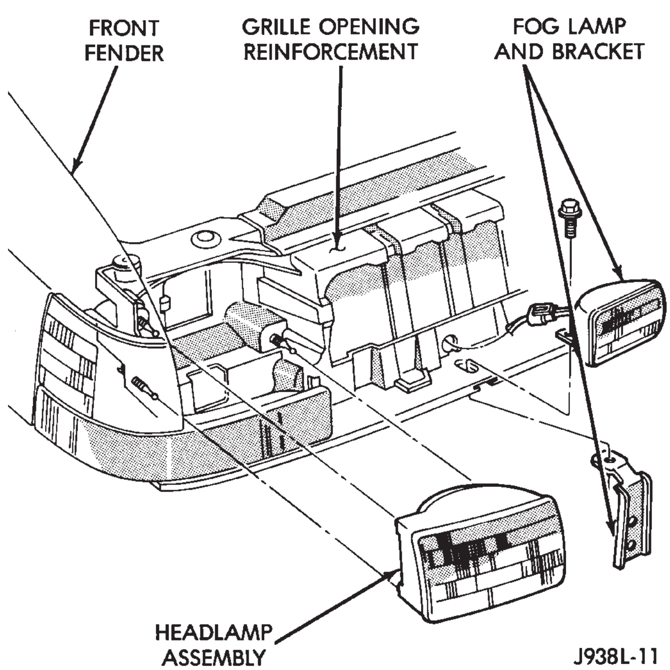


Fig. 2 Headlamp Removal

(4) Locate and disconnect the 3 wire connector behind headlamp.

(5) Rotate bulb ring counterclockwise. Remove ring and bulb from lens (Fig. 3).

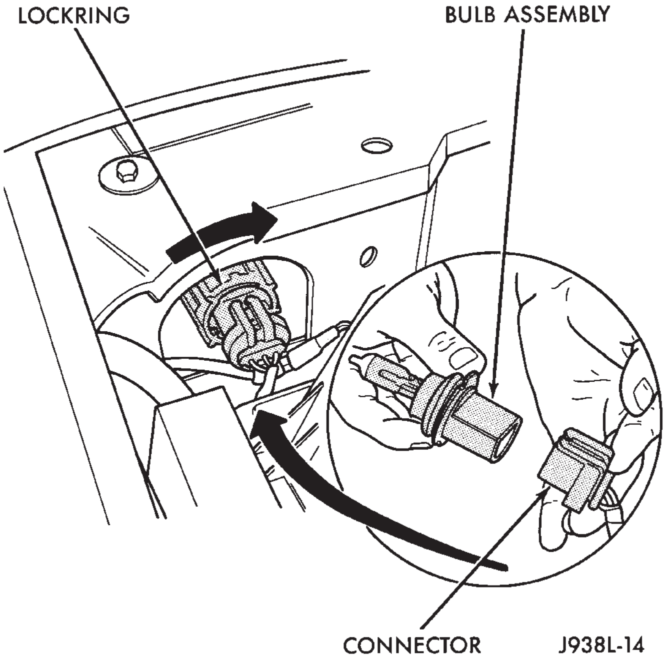


Fig. 3 Headlamp Bulb Removal

(6) Open hood.

(7) Remove side marker lamp upper screw located below radiator side closure panel (Fig. 4).

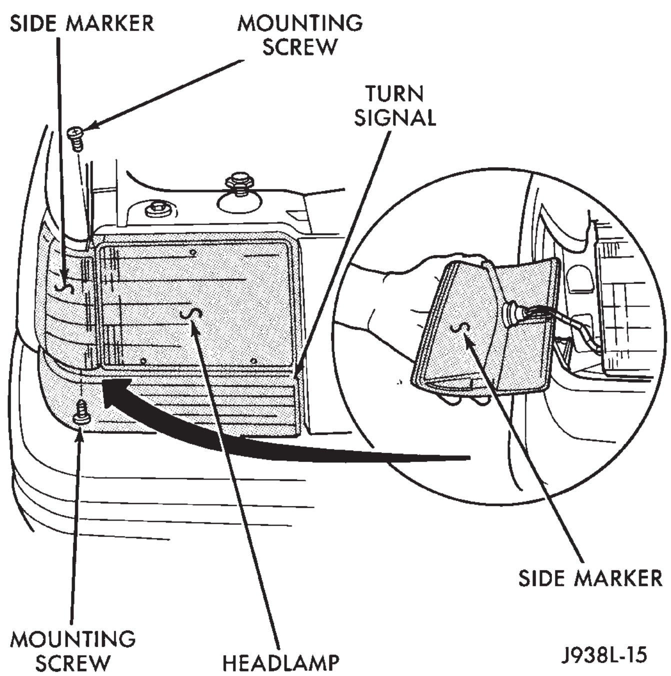


Fig. 4 Side Marker Lamp Removal

(8) Remove lower screw located above park/turn signal lamp.

(9) Pull out lamp.

(10) Twist lamp socket clockwise. Disconnect lamp socket from lamp.

(11) Remove upper screws at turn signal lens. Pull lens out to access lamp sockets (Fig. 5).

(12) Remove turn signal and side marker lamp sockets by twisting sockets clockwise.

(13) Remove lens.

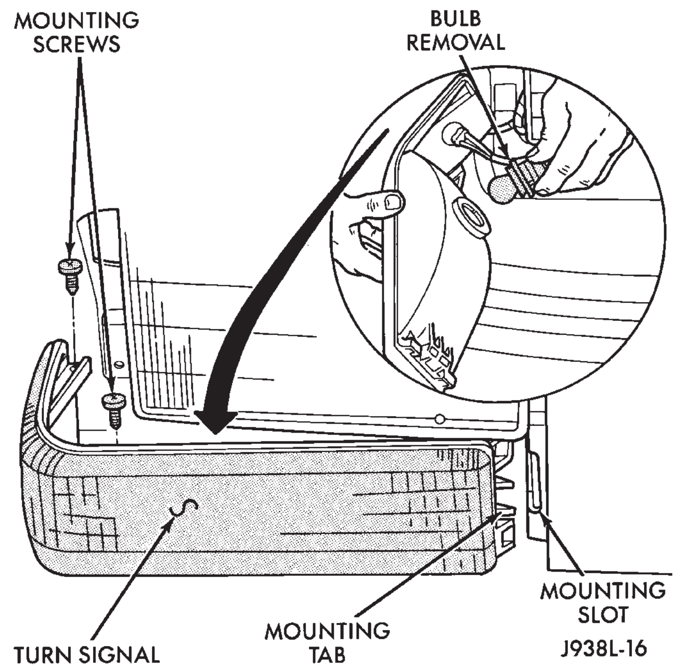


Fig. 5 Turn Signal Lens

(14) Repeat procedure for other side of front end.

(15) Remove license plate bracket if equipped, from bumper fascia/crossmember.

(16) Remove 6 retainers at front fascia (Fig. 6).

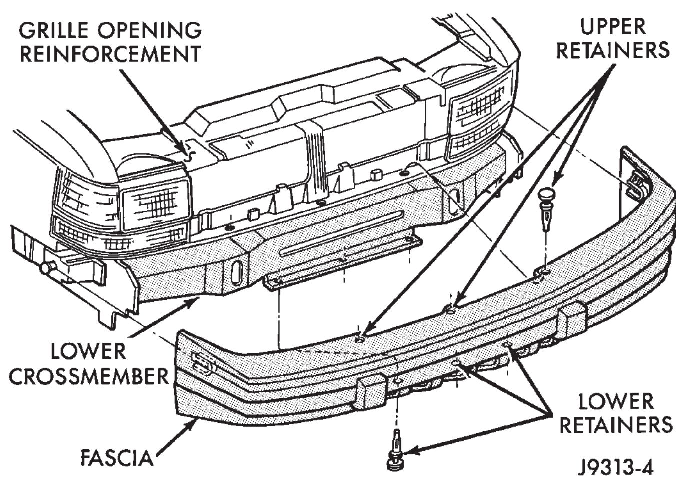


Fig. 6 Lower Fascia Removal

(17) Remove 3 plastic rivets at each front wheel well (Fig. 7).

(18) Slide fascia off retainer pegs at side of lower crossmember.

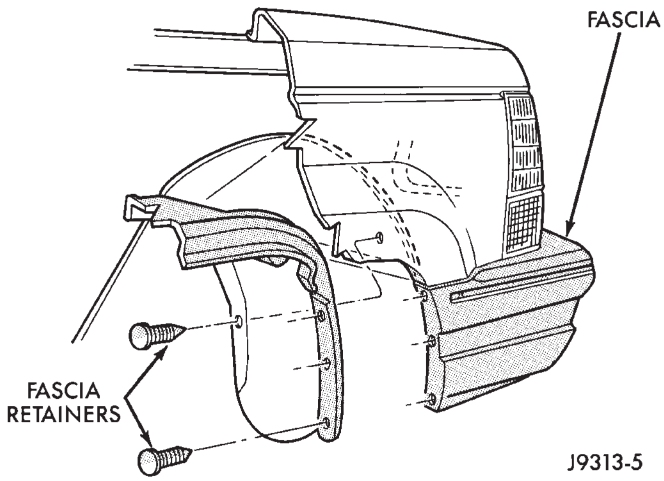


Fig. 7 Wheel Well Retainers

(19) Remove fascia from lower crossmember (Fig. 6).

(20) Remove 8 bolts that attach grille opening reinforcement (GOR) to the upper and lower crossmember (Fig. 8).

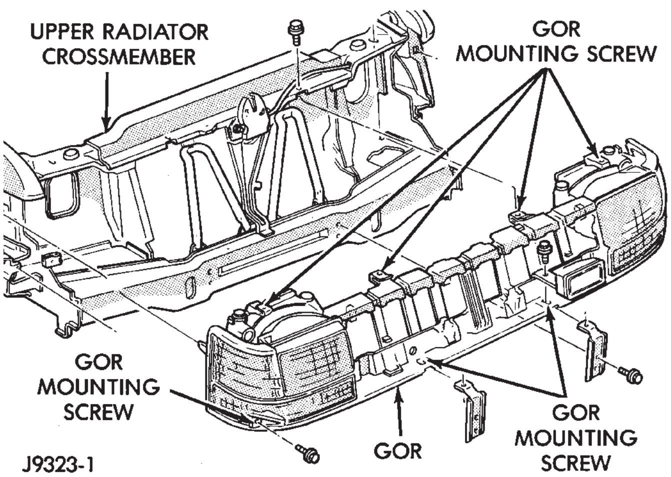


Fig. 8 Grille Opening Reinforcement

(21) Remove grille opening reinforcement.

(22) If necessary, remove air seals located at headlamp wiring inlets (Fig. 9).

INSTALLATION

For installation, reverse removal procedure.

RADIATOR SUPPORT CROSSMEMBER

Refer to Group 7, Cooling Systems for service information.

HOOD

REMOVAL

(1) Raise hood.

(2) Disconnect underhood lamp wire harness connector (Fig. 10), if equipped.

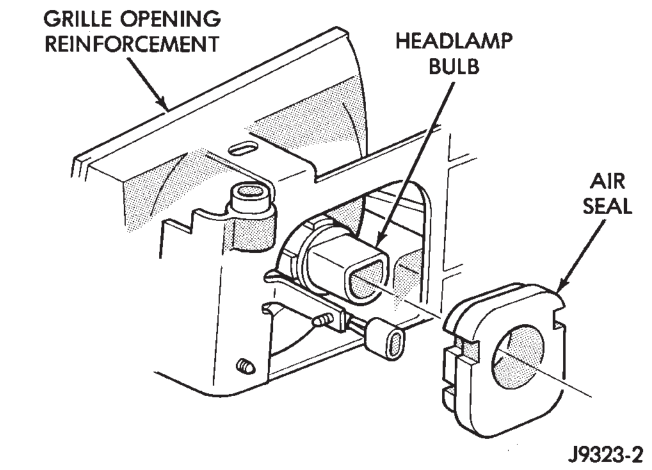


Fig. 9 GOR Air Seals

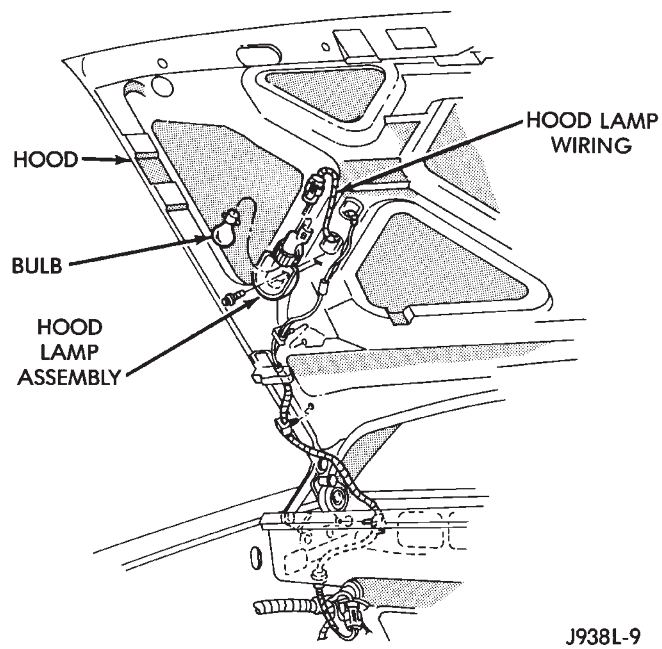


Fig. 10 Underhood Lamp

(3) Mark location of the hood hinges and hinge shims (Fig. 11) for installation alignment.

(4) Remove nuts that attach hinges to hood. Remove hood from vehicle with aid of a helper.

INSTALLATION

(1) Position hood on shims and hinges. Finger-tighten hinge nuts (Fig. 12).

(2) Align hinges and shims (Fig. 11) with installation reference marks. Tighten hinge nuts to 23 N●m (17 ft-lbs) torque.

(3) Test latch release cable and latches for proper operation.

(4) Connect underhood lamp wire harness connector (Fig. 10).

(5) Inspect hood for proper alignment and adjust as necessary.

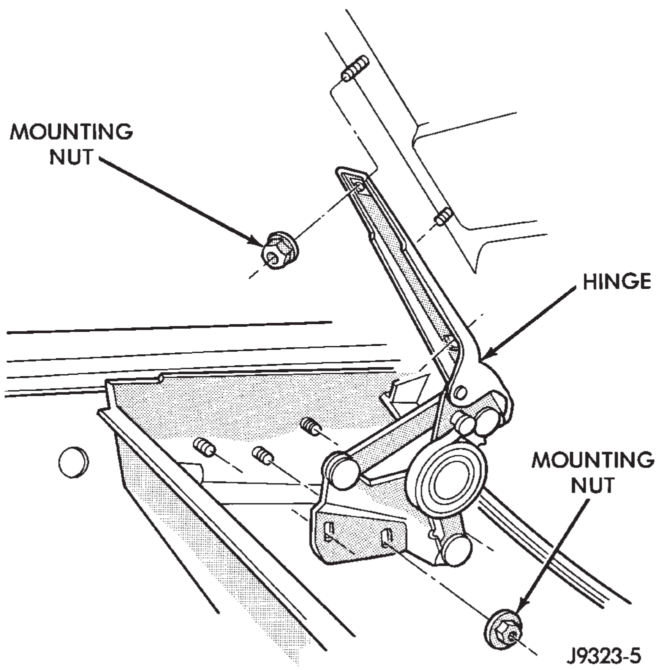


Fig. 11 Hood Hinge

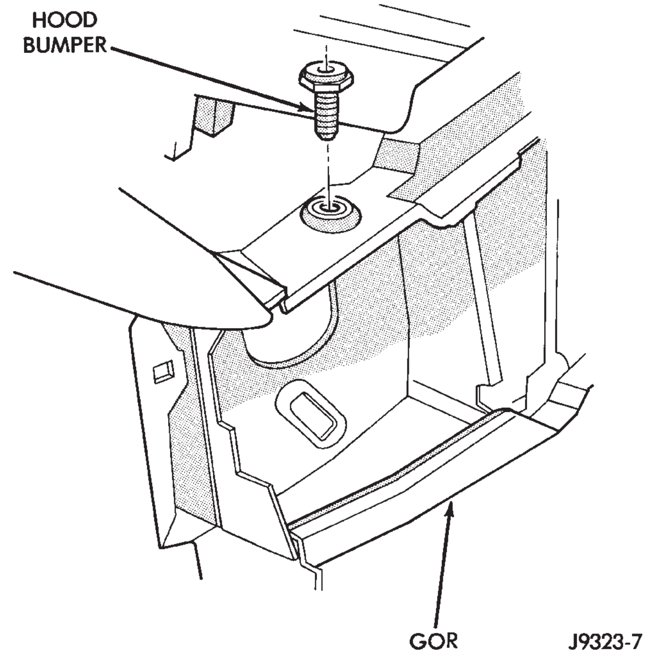


Fig. 13 Hood Bumper

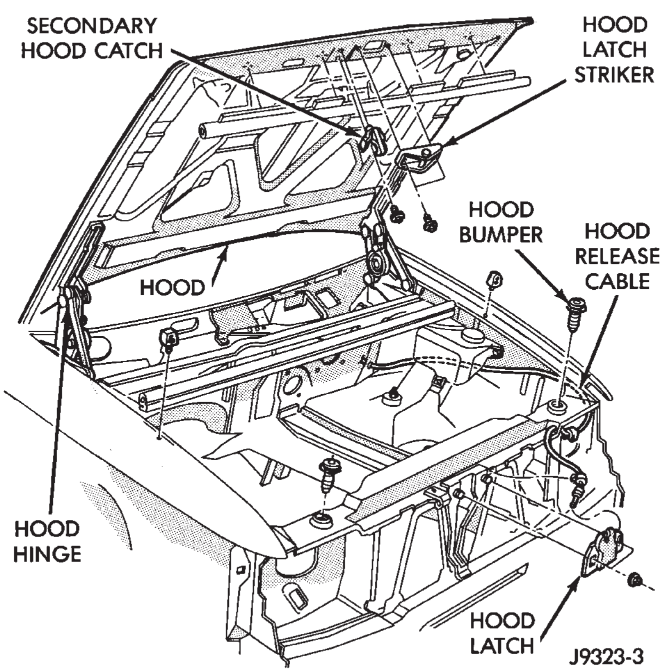


Fig. 12 Hood Hinges and Release Cable

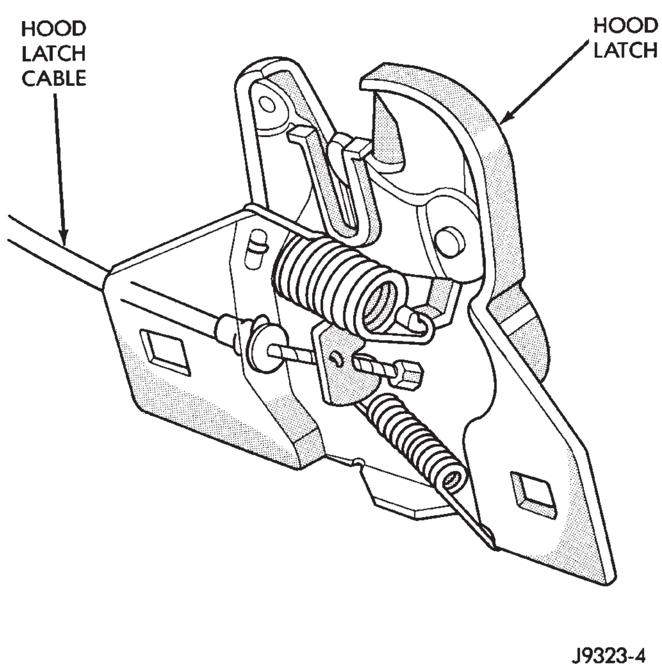


Fig. 14 Hood Latch

HOOD ADJUSTMENT

The hood attaching holes are enlarged to aid front, back and side-to-side adjustment.

(1) If hood is low in relation to cowl panel, insert shims between hinge and hood.

(2) Adjust hood bumper (Fig. 13) in or out to adjust hood-to-fender height alignment.

(3) Adjust the hood latch (Fig. 14) as necessary. Tighten the nuts to 11 N•m (8 ft-lbs) torque after adjustment.

(4) Align latch striker (Fig. 12) so that striker enters the latch squarely and without binding.

HOOD HINGES

REMOVAL

(1) Remove hood from vehicle.

(2) Remove hinge retaining nuts from studs (Fig. 11).

(3) Remove hinge from inner cowl side panel.

INSTALLATION

(1) Position hinge over studs (Fig. 11).

(2) Install hinge retaining nuts on studs. Tighten retaining nuts to 23 N●m (17 ft-lbs) torque.

(3) Install hood.

(4) Adjust hood as necessary. If necessary, refer to adjustment procedure.

HOOD LATCH

REMOVAL

(1) Remove nuts that attach latch to radiator crossmember support (Fig. 12).

(2) Disconnect latch from the hood release cable. Remove latch.

INSTALLATION

(1) Connect latch to latch release cable. Position it on radiator crossmember support (Fig. 12).

(2) Install nuts.

(3) Tighten nuts to 11 N●m (8 ft-lbs) torque.

(4) Test operation of latch release cable and latch.

HOOD LATCH STRIKER

REMOVAL

(1) Remove 2 striker retaining bolts.

(2) Remove striker from hood (Fig. 12).

INSTALLATION

(1) Position striker on hood. Install bolts (Fig. 12).

(2) Tighten bolts to 11 N●m (8 ft-lbs) torque.

(3) Test striker/hood alignment by opening and closing hood several times. Adjust striker, if necessary.

LATCH RELEASE CABLE

REMOVAL

(1) Disconnect cable from hood latch (Fig. 14).

(2) Disconnect cable from retaining clips (Fig. 12).

(3) Remove left cowl side (kick) trim panel.

(4) Remove cable bracket attaching screws from cowl side panel (Fig. 15).

(5) Pull cable through dash panel and remove it from under instrument panel.

INSTALLATION

(1) Insert replacement cable end through hole in dash panel (Fig. 15) into engine compartment.

(2) Pull cable forward and seat grommet in dash panel (Fig. 15).

(3) Position cable bracket on cowl side panel and install screws (Fig. 15). Tighten screws to 11 N●m (8 ft-lbs) torque.

(4) Install left cowl side trim panel.

(5) Route cable into retaining clips.

(6) Attach cable to hood latch (Fig. 12).

(7) Test release cable for proper operation.

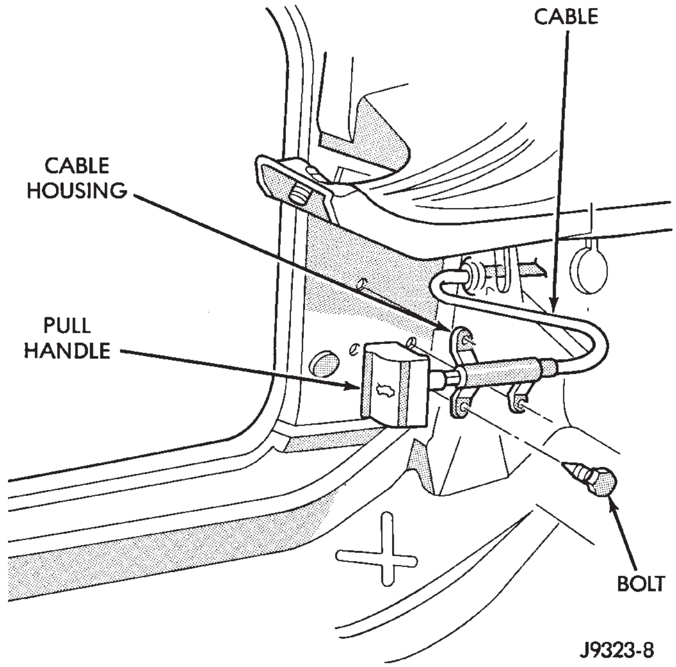


Fig. 15 Hood Release Cable

SAFETY LATCH STRIKER

REMOVAL

(1) Remove latch striker screw from hood (Fig. 12).

(2) Remove striker from hood (Fig. 12).

INSTALLATION

(1) Position striker on hood. Install screw (Fig. 12).

(2) Test safety latch operation.

COWL GRILLE AND SCREEN

REMOVAL

(1) Use a wax pencil to mark position of wiper arms (Fig. 16).

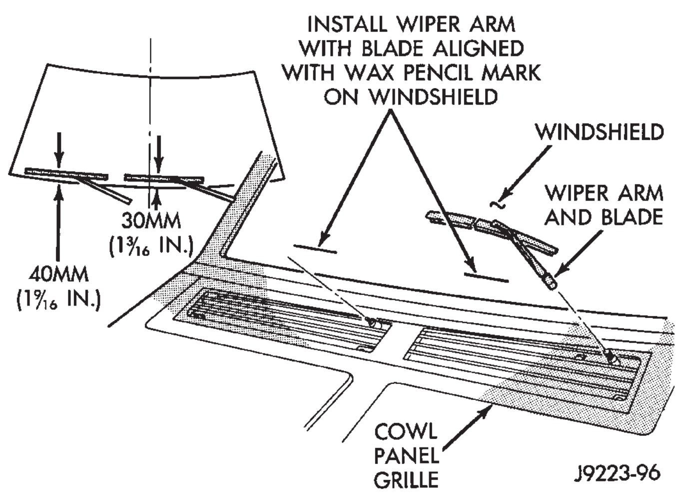


Fig. 16 Wiper Locations On Windshield

(2) Remove windshield wiper arms from pivots (Fig. 16).

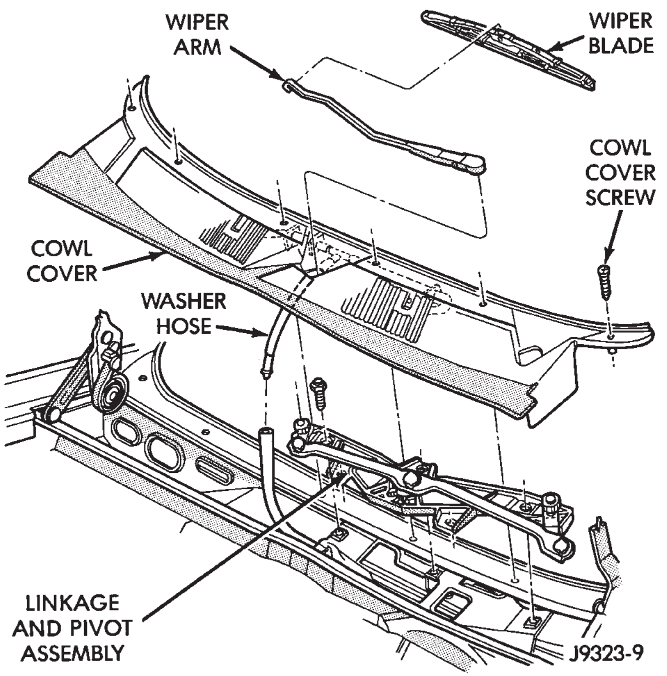


Fig. 17 Cowl Grille Components

(3) Remove 6 screws that attach grille to cowl (Fig. 17).

(4) Remove windshield washer tubes from nozzles (Fig. 18).

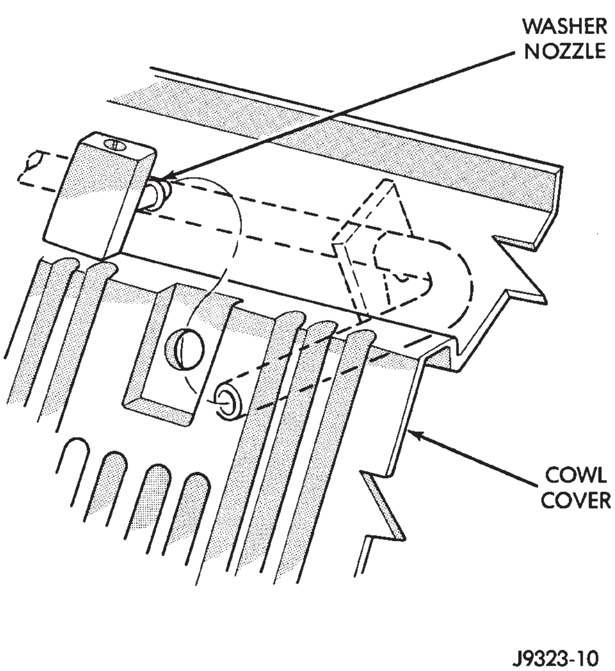


Fig. 18 Washer Fluid Tubes

(5) Remove cowl grille and screen from cowl (Fig. 17).

INSTALLATION

(1) Position cowl grille on cowl. Install windshield washer tubes on nozzles (Fig. 18).

(2) Install cowl grille retaining screws.

(3) Install windshield wiper arms on pivots with wipers aligned with wax pencil (Fig. 16).

BATTERY TRAY

REMOVAL

(1) Remove 2 bolts and holddown bracket from battery tray (Fig. 19).

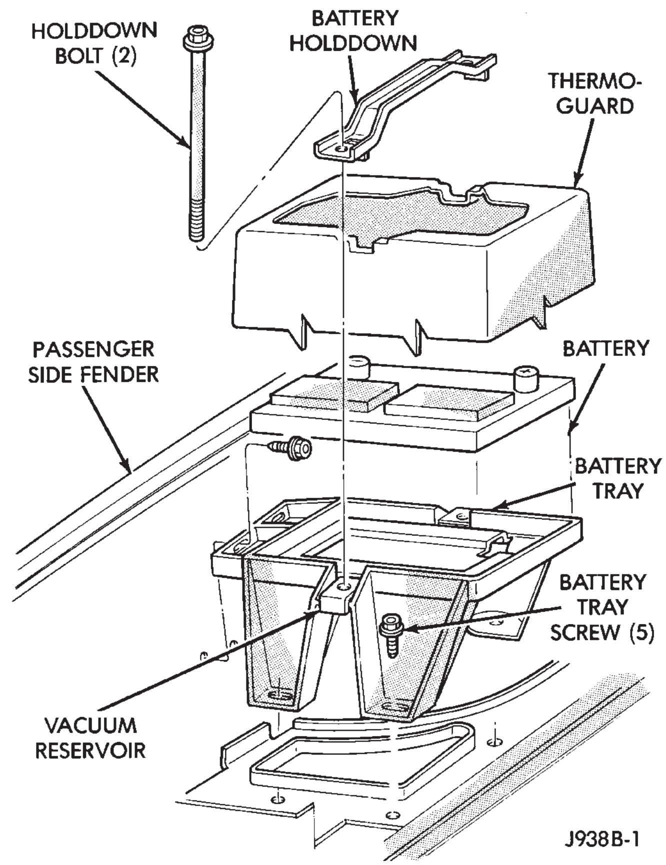


Fig. 19 Battery Tray

(2) Remove battery thermo-guard from battery.

(3) Remove battery from tray.

(4) Remove 5 screws that attach battery tray to inner fender panel.

(5) Remove battery tray. Disconnect vacuum reservoir hoses.

(6) If necessary, remove 2 screws that attach reservoir to bottom of battery tray.

INSTALLATION

(1) If removed, install vacuum reservoir and screws to bottom of tray.

(2) Position battery tray on inner fender panel. Connect vacuum lines to reservoir.

(3) Attach battery tray to inner fender panel with the 5 screws (Fig. 19). Tighten screws to 10 N•m (7 ft-lbs) torque.

(4) Install battery in tray.

(5) Position upper holddown bracket over battery.

(6) Install holddown bracket and holddown bolts. Tighten the bolts to 10 N•m (7 ft-lbs) torque.

FRONT FENDER

REMOVAL

(1) Remove headlamp, side marker and turn signal lamp. Refer to Group 8L, Lamps for service information.
(2) Remove front bumper fascia. Refer to Group 13, Frame and Bumpers for service information.
(3) Remove front wheel.
(4) Remove 12 fasteners attaching inner front fender liner to fender and inner fender (Fig. 20).
(5) Remove inner fender liner.
(6) Right fender only:
• If equipped, remove radio antenna mast, nut, pad and base from fender (Figs. 21 and 22);

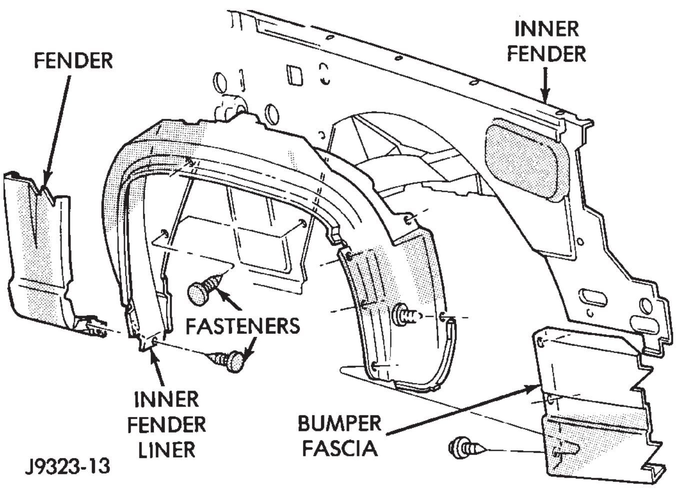


Fig. 20 Inner Fender Liner

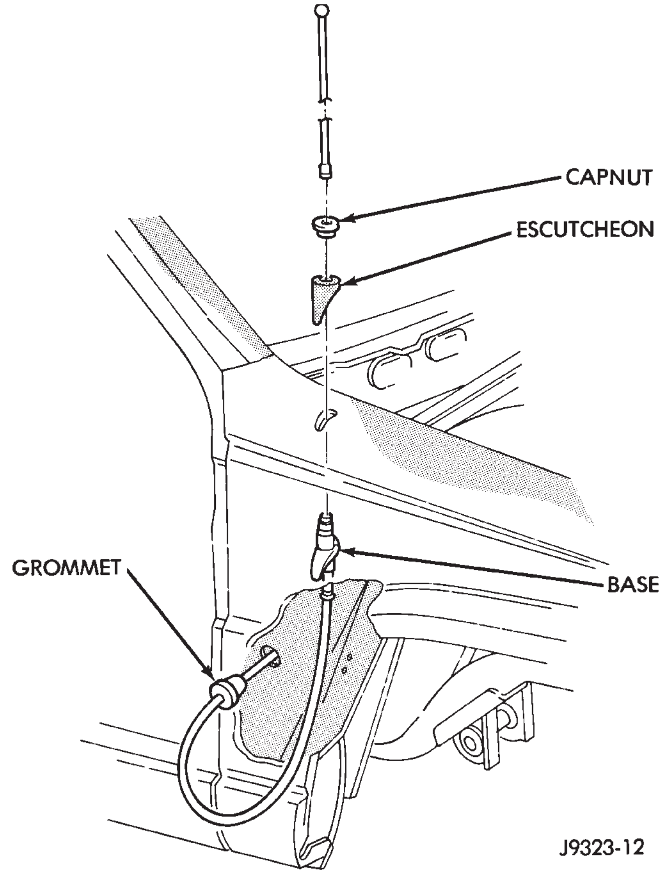


Fig. 21 Radio Antenna

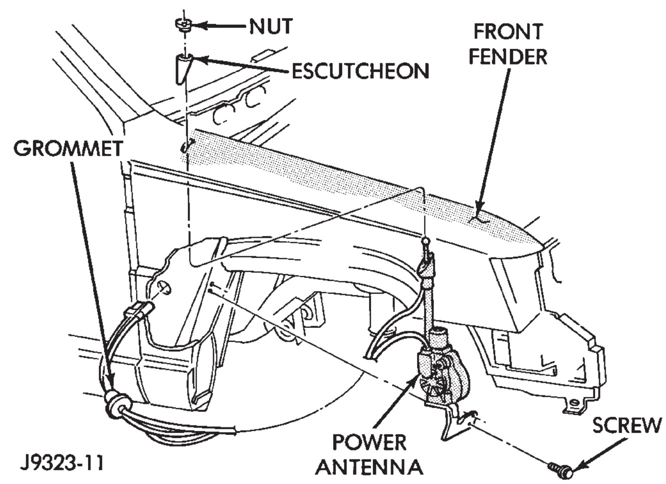


Fig. 22 Power Antenna

(7) Install front headlamp, side marker and turn signal lamp. If necessary refer to Group 8L, Lamps for service information.

(7) From inside wheel well, remove 2 bolts at rear of fender reinforcements (Fig. 23).
(8) Remove 2 bolts at front fender bracket (Fig. 24).
(9) Remove 2 bolts at lower rear of fender at A-pillar (Fig. 24).
(10) Remove 5 upper mounting bolts at top of fender (Fig. 24).
(11) Remove fender from inner fender.

INSTALLATION

(1) Position fender on inner fender panel (Fig. 24).
(2) Install all of fender attaching screws finger-tight (Figs. 20, 23 and 24).
(3) Align fender with adjacent body panels. Tighten fender bolts to 9 N•m (80 in-lbs) torque.
(4) Install inner fender liner (Fig. 20).
(5) Install front wheel.
(6) Install front bumper fascia. If necessary refer to Group 13, Frame and Bumpers for installation instructions.

BODY SIDE CLADDING

REMOVAL/FRONT DOOR

(1) Using a trim stick, gently lift up from bottom of cladding. Unsnap molding from retaining clips (Fig. 25)
(2) Lift upward and remove molding.

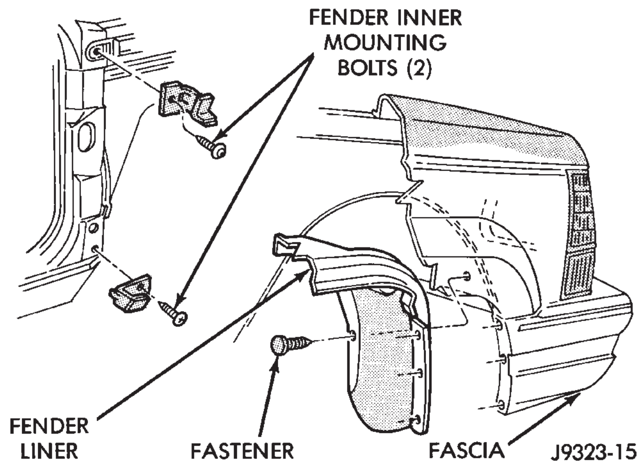


Fig. 23 Inner Fender Mounting

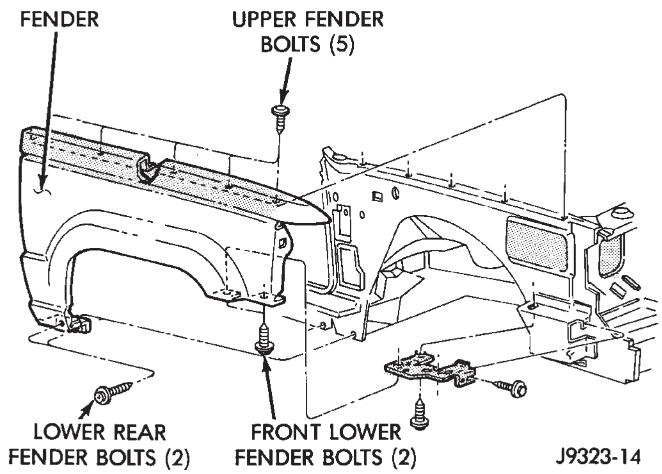


Fig. 24 Fender Mounting

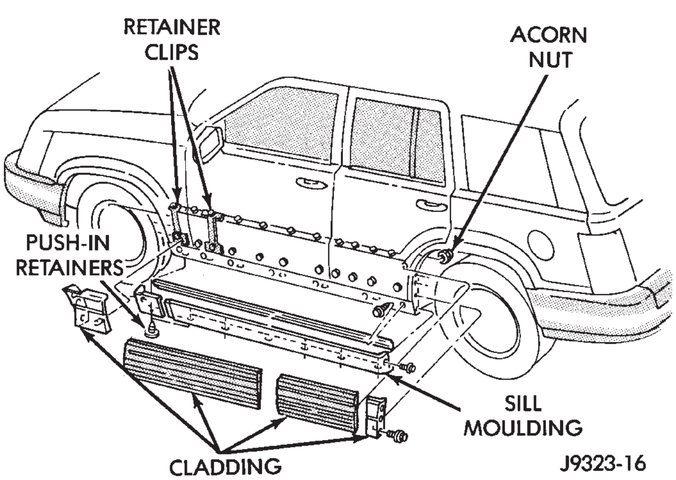


Fig. 25 Body Side Cladding

INSTALLATION/FRONT DOOR

(1) Install molding over top of retaining clips.
(2) Align molding to door edges.
(3) Snap molding down over retaining clips.

REMOVAL/REAR DOOR

(1) Open rear door.
(2) Remove acorn nut at rear dogleg (Fig. 25).
(3) Using a trim stick, gently lift up from bottom of cladding. Unsnap molding from retaining clips.

INSTALLATION/REAR DOOR

(1) Install molding retainer into hole at dogleg.
(2) Install molding over top of retaining clips.
(3) Snap molding down over top of retaining clips.
(4) Install acorn nut onto retainer.

REMOVAL/FENDER-QUARTER PANEL

(1) Remove 3 screws at wheel opening.
(2) Using a trim stick, Gently pry upward from bottom of cladding.
(3) Unsnap cladding from retainers.

INSTALLATION/FENDER-QUARTER PANEL

(1) Install molding over top of retainer clips.
(2) Snap molding down over retaining clips.
(3) Install 3 screws into wheel opening.

WOODGRAIN (VINYL CLAD METAL) MOLDING

Woodgrain body moldings are attached to outer body panels using various clips and retainers.

REMOVAL/INSTALLATION

(1) Push down on upper molding and carefully pry molding off along bottom (Fig.26 and 27).
(2) Pull up on lower molding and carefully pry along top of molding.
(3) Align molding with retainers and with clips in panel (Fig. 28). Press molding into place on panel.

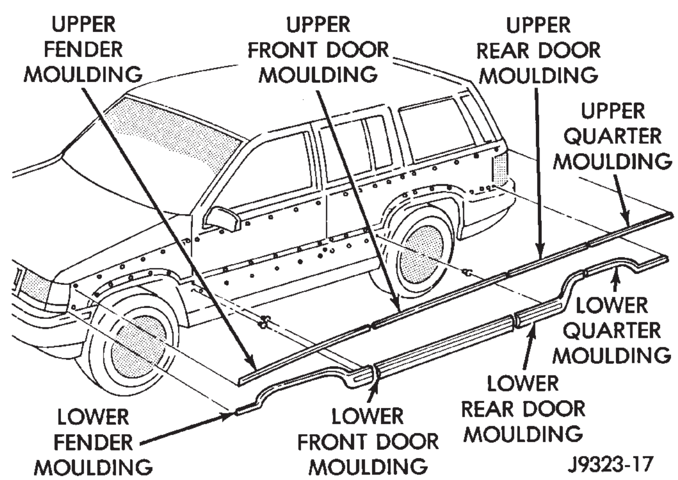


Fig. 26 Body Panel Woodgrain Moldings

WOODGRAIN OVERLAY

REMOVAL

(1) Remove exterior trim as necessary to clear captured edges of overlay being removed
(2) Remove overlay using a suitable heat gun or lamp.

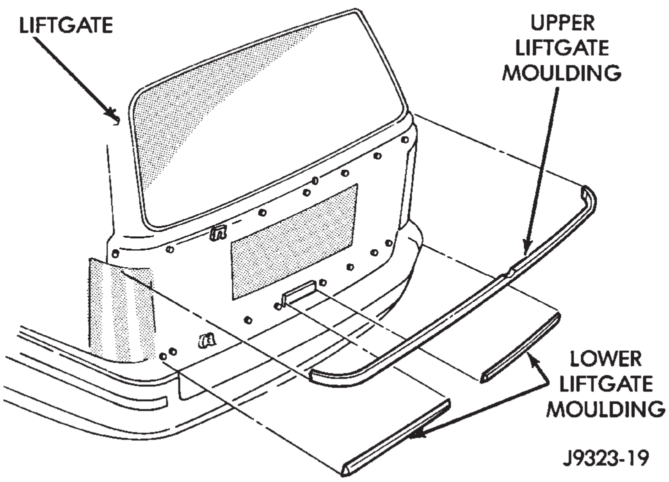


Fig. 27 Liftgate Woodgrain Moldings

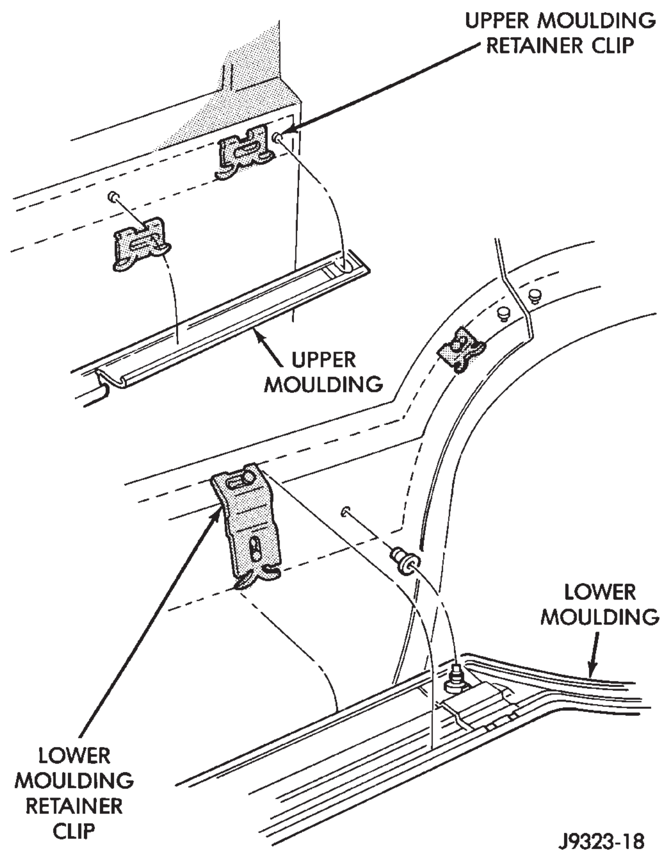


Fig. 28 Woodgrain Molding Attaching Methods

This will soften adhesive backing.

(3) Clean adhesive residue from body finish using a suitable adhesive remover.

INSTALLATION

INSTALLATION EQUIPMENT

- Bucket filled with a mild dish soap solution.
- Lint free applicator cloth or sponge.
- Body putty applicator squeegee.
- Heat gun or sun lamp.
- Razor knife.

The painted surface of body panel to be covered by an overlay must be smooth and completely cured. If painted surface is not smooth, wet sand with 600 grit wet/dry sand paper until surface is smooth.

Ripples and feather edges will read through overlay if surface is not properly prepared.

(1) With backing still in place, position overlay across panel. Apply masking at top of overlay to hold it in position.

(2) Mark outside edge of panel on overlay with grease pencil.

(3) Trim overlay to within 17 mm (0.750 in.) of outline marks.

(4) Spread overlay across a smooth flat work surface, overlay side down.

(5) Peel paper backing away from overlay exposing adhesive backing of overlay.

(6) Apply soap solution liberally to adhesive backing of overlay.

(7) Apply soap solution to body panel surface.

(8) Place overlay into position on body panel. Smooth out wrinkles by pulling lightly on edges of overlay until it lays flat on panel surface.

(9) Push air pockets from under overlay to perimeter of panel from center of overlay out.

(10) Remove air bubbles from under overlay using a body putty squeegee.

CAUTION: Do nut cut into painted surface of body when trimming overlay to size.

(11) Trim overlay to size using a razor knife. Leave at least 13 mm (0.5 in.) for edges of doors and openings.

CAUTION: Do not overheat overlay when performing step 12.

(12) Apply heat to overlay to evaporate residual moisture from edges of overlay. This will also allow overlay to be stretched into concave surfaces.

(13) Edge turn overlay around doors or fenders.

(14) Install exterior trim if necessary. Small air or water bubbles under overlay can be pierced with a pin and smoothed out.

BODY STRIPES/DECALS

GENERAL INFORMATION

Body stripes are durable, weather-resistant tape stripes with pressure-sensitive backing (Fig. 26). The tape stripe is protected by a carrier until installed on a body panel. Carrier also is an installation alignment aid.

REMOVAL

(1) Remove exterior trim as necessary to clear captured edges of tape stripe being removed

(2) Remove tape stripe using a suitable heat gun or lamp.

This will soften adhesive backing.

(3) Clean adhesive residue from body finish using a suitable adhesive remover.

INSTALLATION

INSTALLATION EQUIPMENT

- Bucket filled with a mild dish soap solution.
- Lint free applicator cloth or sponge.
- Body putty applicator squeegee.
- Heat gun or sun lamp.
- Razor knife.

The painted surface of the body panel to be covered by a tape stripe must be smooth and completely cured before stripe can be applied. If painted surface is not smooth, wet sand with 600 grit wet/dry sand paper until surface is smooth.

Ripples and feather edges will read through stripe if surface is not properly prepared.

(1) With backing still in place, position stripe across panel to receive the stripe. Apply masking at top of stripe to hold it in position.

(2) Mark outside edge of panel on stripe with grease pencil.

(3) Trim stripe to within 17 mm (0.750 in.) of outline marks.

(4) Spread stripe across a smooth flat work surface, stripe side down.

(5) Peel paper backing away from stripe exposing adhesive backing of stripe.

(6) Apply soap solution liberally to adhesive backing of stripe.

(7) Apply soap solution to body panel surface.

(8) Place stripe into position on body panel (Fig. 29). Smooth out wrinkles by pulling lightly on edges of tape stripe until it lays flat on panel surface.

(9) Push air pockets from under tape stripe to perimeter of panel from center of the tape stripe out.

(10) Remove air bubbles from under tape stripe using a body putty squeegee.

CAUTION: Do nut cut into painted surface of body when trimming tape stripe to size.

(11) Trim tape stripe to size using a razor knife. Leave at least 13 mm (0.5 in.) for edges of doors and openings.

CAUTION: Do not overheat tape stripe when performing step 12.

(12) Apply heat to tape stripe to evaporate residual moisture from edges of tape stripe. This will also allow tape stripe to be stretched into concave surfaces.

(13) Edge turn tape stripe around doors or fenders.

(14) Install exterior trim if necessary. Small air or water bubbles under tape stripe can be pierced with a pin and smoothed out.

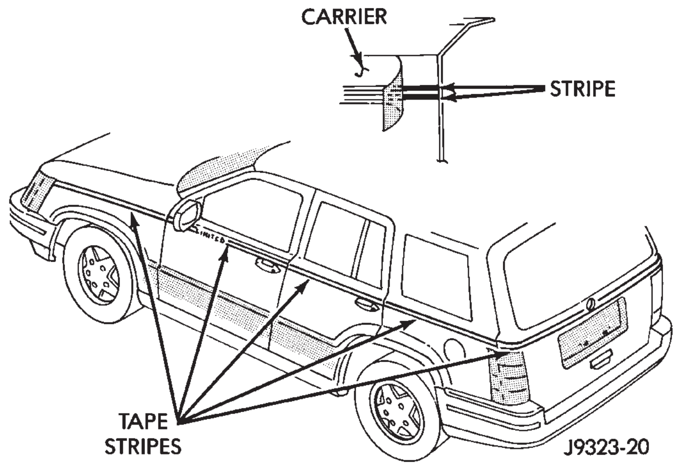


Fig. 29 Tape Stripes

QUARTER WINDOW APPLIQUE/AIR EXHAUSTER

REMOVAL

(1) Carefully pry applique from panel (Fig. 30).

(2) Carefully pry air exhauster from upper quarter panel using a flat blade screwdriver.

INSTALLATION

(1) Reseal air exhauster using foam tape.

(2) Install air exhauster on panel.

(3) Position applique on panel with retainers aligned (Fig. 30). Press applique firmly in place.

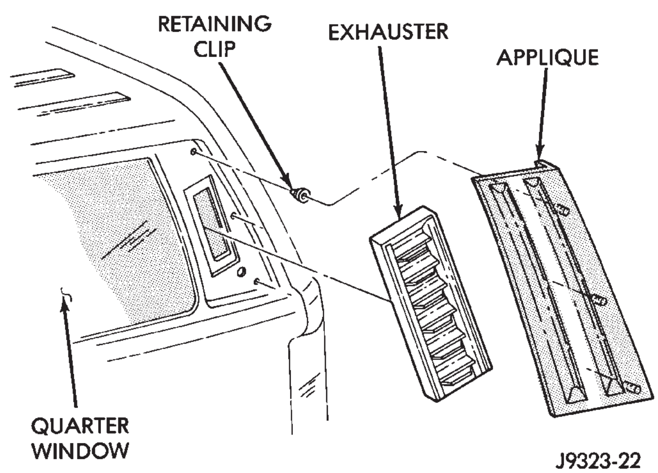


Fig. 30 Quarter Window Applique & Air Exhauster

EXTERIOR NAMEPLATES

SERVICE INFORMATION

All of the vehicle exterior nameplates (Fig. 31), are attached to the vehicle panels with adhesive.

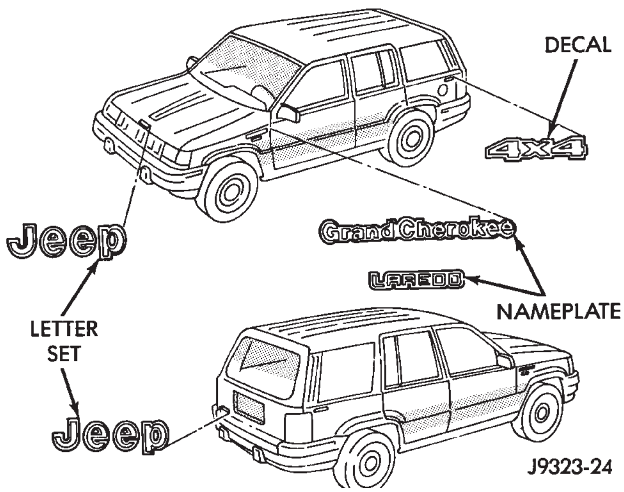


Fig. 31 Exterior Nameplates

REMOVAL/INSTALLATION

(1) Carefully pry nameplate (Fig. 31) from body panel.

(2) Clean panel surface.

(3) Position replacement nameplate on panel and push inward to seat it.

EXTERNAL MIRRORS

REMOVAL

(1) Remove door trim panel.

(2) Remove mirror inside trim cover attaching screw.

(3) For power mirrors, remove inside trim cover.

(4) For remote control mirrors, loosen toggle control setscrew.

(5) For remote control mirrors, remove inside trim cover.

(6) Remove mirror retaining nuts.

(7) Remove mirror from door. Refer to Group 8—Electrical for additional information involving power mirrors.

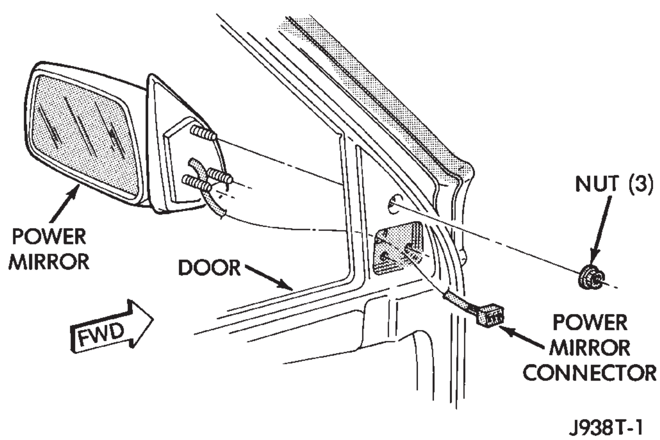


Fig. 32 Exterior Mirror

INSTALLATION

(1) Position mirror on door. Verify that the O-ring seal and gasket are properly positioned.

(2) Install mirror retaining nuts.

(3) For remote mirrors, position inside trim cover over toggle control. Tighten setscrew.

(4) Install inside trim cover.

(5) Install inside trim cover attaching screw and tighten it securely.

(6) Install door trim panel.

LUGGAGE RACK

REMOVAL

(1) Remove slide rail screws (Fig. 33).

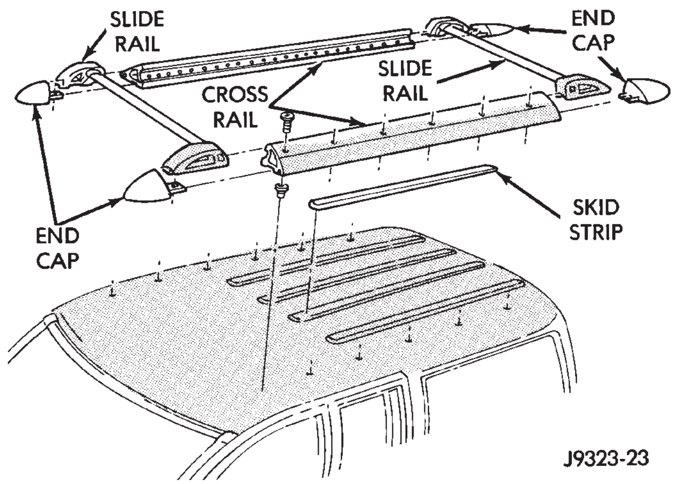


Fig. 33 Luggage Rack

(2) Remove luggage rack from vehicle roof.

The skid strips are attached to roof panel with adhesive.

(3) Loosen each skid strip (Fig. 33) with a heat gun.

(4) Lift one edge of each skid strip with a putty knife and peel it from roof panel. Apply additional heat to any location where a skid strip remains.

(5) Remove original adhesive from roof panel with an all-purpose adhesive removal solution.

INSTALLATION

(1) Install 3M 06379 double-sided tape on skid strips.

(2) Align each skid strip on roof panel.

(3) Verify that each skid strip is properly aligned.

(4) Press each skid strip onto roof panel with a roller.

Apply 3M Drip-Chek Sealant (or an equivalent product) to underside of side rail screw heads.

(5) Position luggage rack on roof (Fig. 33).

(6) Install and tighten slide rail screws to 3 N•m (28 in-lbs) torque.

POWER SUNROOF

INDEX

GENERAL INFORMATION

All sunroofs are equipped with drain tubes that are located in the A, B or D-pillars. The drain tubes must be kept open to prevent water from entering passenger compartment.

LUBRICATION

(1) Lubricate cables with Lubriplate or equivalent when cables are replaced.

(2) Periodically clean dirt from guide rail covers.

DRAIN TUBES

• Inspect drain holes, located in trough around sunroof opening to verify they are clear. Inspection should be performed once a year or when problems are suspected. If drain hose or tubes are plugged, use compressed air or blunt flexible wire to clear them. If tubes cannot be cleared, they must be repaired.

• The lower ends of rear drain tubes are located in rear quarter panel drop wells. To clear rear drain tubes, use compressed air or blunt flexible wire from lower ends of tubes.

GLASS VERTICAL HEIGHT ADJUSTMENT

GLASS VERTICAL ADJUSTMENT

(1) Open glass to vent position.

(2) Slide upper half of mechanism covers rearward until clips disengage and separate covers from vehicle (Fig. 1).

(3) Close glass panel, separately loosen adjusting bolts and individually adjust the corners of the glass.

(4) Adjust front of glass panel to 1.0 mm (0.040 in.) below top surface of roof panel.

(5) Adjust rear of glass to 1.0 mm (0.040 in.) above top surface of roof panel.

(6) Secure adjustment bolts and install cover.

WIND DEFLECTOR

REMOVAL

(1) Open sun roof glass panel.

(2) Remove screws holding wind deflector to sun roof unit side rail (Fig. 2).

(3) Separate wind deflector from vehicle.

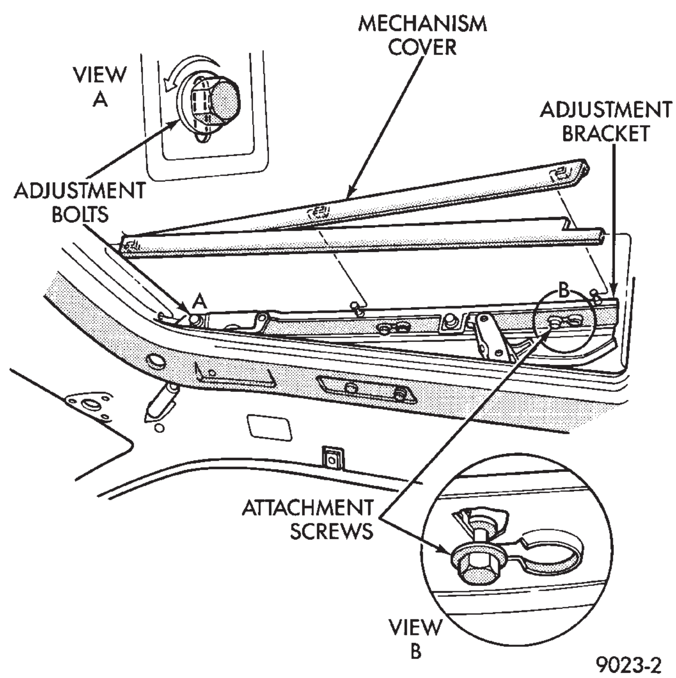


Fig. 1 Glass Adjustment

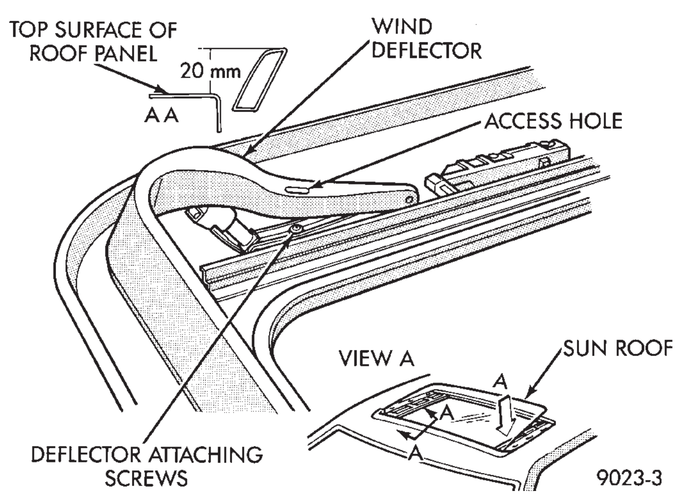


Fig. 2 Deflector Assembly

INSTALLATION

Reverse preceding operation.

WIND DEFLECTOR ADJUSTMENT

(1) Open sunroof.

(2) Position wind deflector so 19 mm (0.75in.) above top surface of roof panel and 1 mm (0.040 in.) rearward of roof panel forward edge (Fig. 2).

(3) Secure wind deflector to sunroof unit.

GLASS PANEL

REMOVAL

(1) Remove wind deflector mechanism covers (Fig. 1)

(2) Position glass to vent position.

(3) Position sunshade full rearward.

(4) Loosen nuts holding glass panel to side adjustment brackets.

(5) Slide glass panel rearward 12mm (0.5in.) and separate glass from sunroof unit.

INSTALLATION

(1) Position glass panel in opening with logo rearward and slide panel forward 12 mm (0.5in.).

(2) Verify that attaching nuts are below top surface of glass adjustment brackets.

(3) Close sunroof to center glass panel in roof opening.

(4) Tighten center screws to hold adjustment.

(5) Open glass to vent position and tighten nuts to 8 N•m (70.8 in. lbs.).

(6) Close glass and check alignment.

(7) Install mechanism covers.

(8) Adjust wind deflector, if necessary.

ADJUSTMENT BRACKET

REMOVAL AND INSTALLATION

(1) Remove wind deflector, mechanism covers and glass panel.

(2) Move glass carriage to vent position and remove rearward adjustment bolt from adjustment bracket.

(3) Lift rear of adjustment bracket to highest vertical position and disengage front of bracket from unit (Fig. 3).

(4) For installation reverse the preceding operation. Adjust glass,and wind deflector as necessary.

DRAIN CHANNEL

REMOVAL AND INSTALLATION

(1) Remove wind deflector mechanism covers and glass panel.

(2) Locate glass carriage to vent position and drain channel in full forward position.

(3) Remove screws holding drain channel to support frame.

(4) For installation reverse preceding operation.

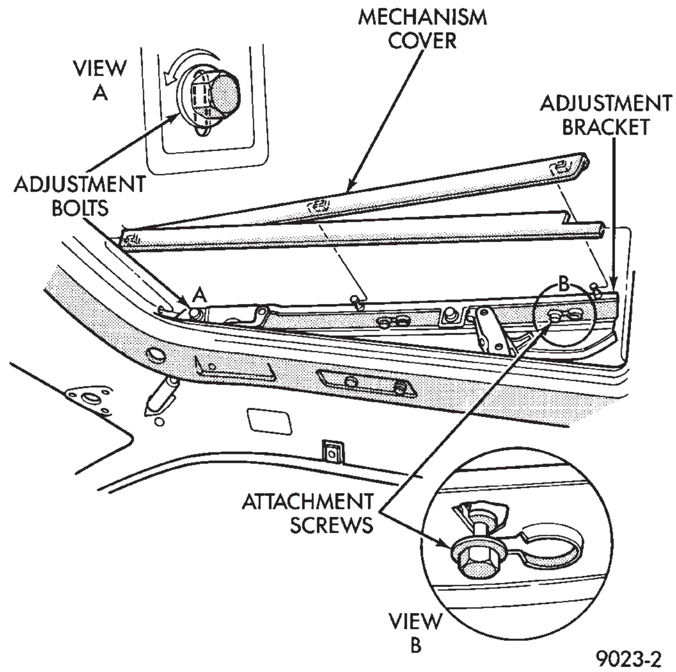


Fig. 3 Glass Height Vertical Adjustment

DRIVE CABLE LOCATORS

REMOVAL AND INSTALLATION

(1) Position glass 19 mm (0.75 in.) until rearward cable locator is visible.

(2) Remove screws holding drive cable locator to unit.

(3) Remove travel limiting micro switch grommet and disconnect wire connector.

(4) Insert a small screwdriver under rear edge of locator and pry locator from track Fig. 4.

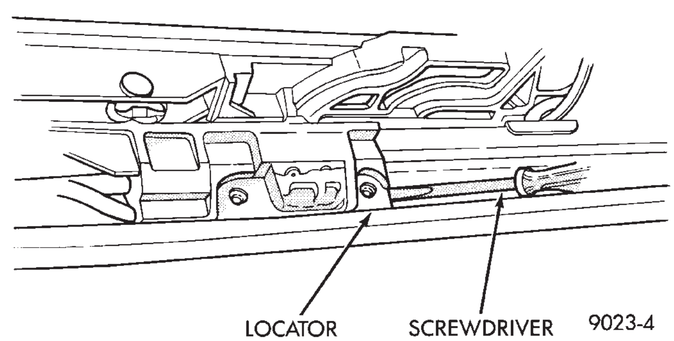


Fig. 4 Removing Cable Drive Locator

(5) For installation reverse preceding operation. The small out-board lip underneath cable locator slips under bottom slot on guide track. After locator is seated install screws.

MOTOR AND DRIVE GEARS

REMOVAL

(1) Open sunroof to vent position.

(2) Remove headlining.

(3) Remove bolts holding sunroof motor to motor bracket.
(4) Disconnect wire connector.
(5) Separate motor and drive gear from drive cables Fig. 5.

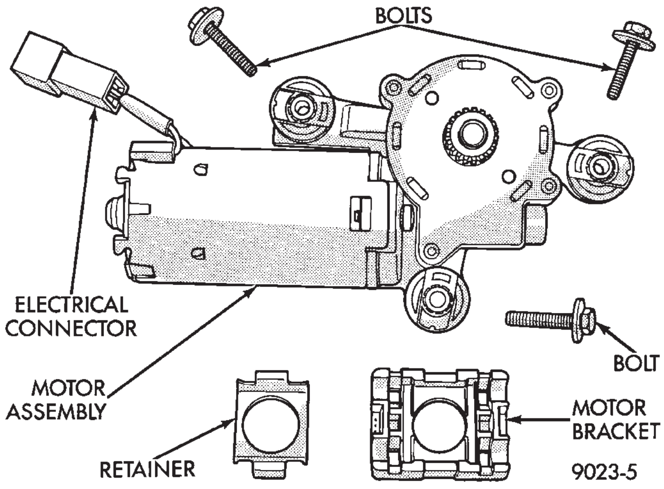


Fig. 5 Sunroof Motor And Drive Gear

INSTALLATION

(1) Verify that sunroof is in vent position. Push mechanism forward on both sides to align drive cables.
(2) Engage drive gears onto drive cables.
(3) Install motor and drive gear screws and tighten to 5 N●m (44in-lbs.).
(4) Install headlining.

DRIVE CABLES

REMOVAL

(1) Open sunroof to vent position.
(2) Remove headlining, wind deflector, mechanism covers, glass panel, side glass adjustment brackets, motor and drive cable locators.
(3) Lift cable out of cable retainer and pull forward. Separate cable from assembly Fig. 6.

INSTALLATION

Verify sunroof is in vent position. Push mechanism forward on both sides to align drive cables. Reverse the preceding operation.

SUNSHADE

REMOVAL AND INSTALLATION

(1) Remove wind deflector, mechanism covers and glass panel.
(2) Position system to full rearward position.
(3) Slide sunshade panel full forward and release the front tabs from track assembly.
(4) Pull rear retaining clip inboard and lift sunshade out Fig. 7.
(5) For installation reverse preceding operation.

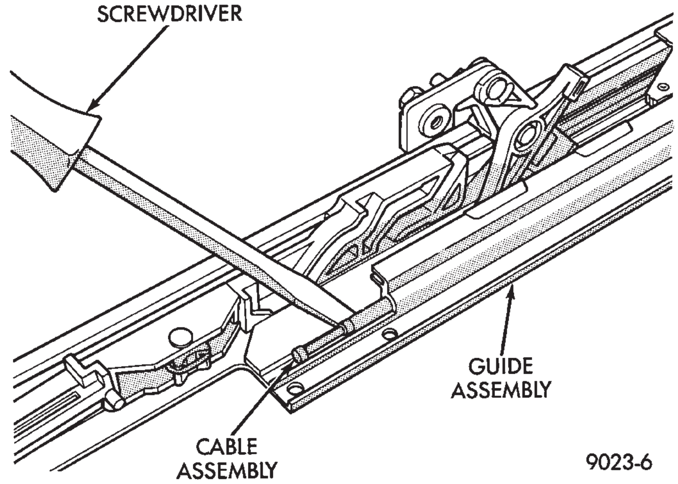


Fig. 6 Drive Cables

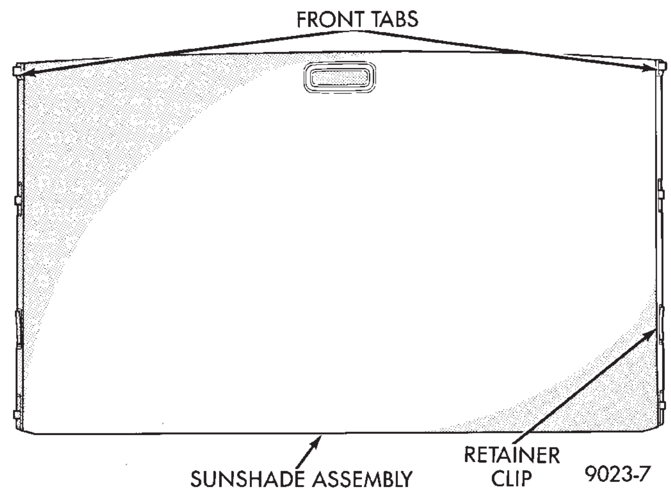


Fig. 7 Sunshade Assembly

GUIDE ASSEMBLY

REMOVAL

(1) Remove wind deflector, mechanism covers, glass panel, drain channel, sunshade and drive cable locator as necessary.
(2) Move glass carriage to vent position.
(3) Remove front slide from guide assembly.
(4) Remove screws holding front and center guide track to unit.
(5) Pull cable out of groove for cable end.
(6) Pull guide outward to release from housing. Separate rear end of guide from clips. Slide guide out of unit Fig. 8.

INSTALLATION

(1) Install guide cable into rear of guide assembly.
(2) Install guide assembly at an angle so the rear portion slips under finger clips at rear of module housing.
(3) Place cable in groove of cable holder.
(4) Install screws in track assembly.
(5) Install locators.

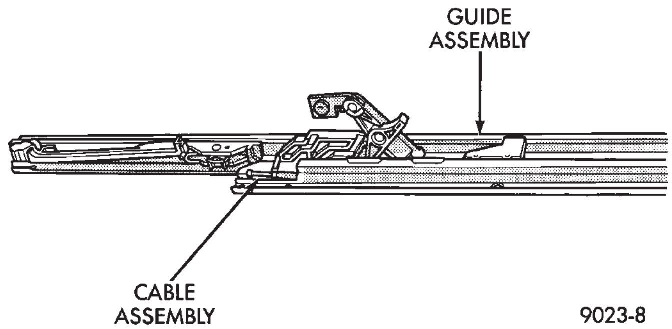


Fig. 8 Guide Assembly

(6) Reverse removal operation.

DOORS

INDEX

FRONT DOOR TRIM PANEL

REMOVAL

(1) Remove inside release handle assembly screws (Fig. 1).

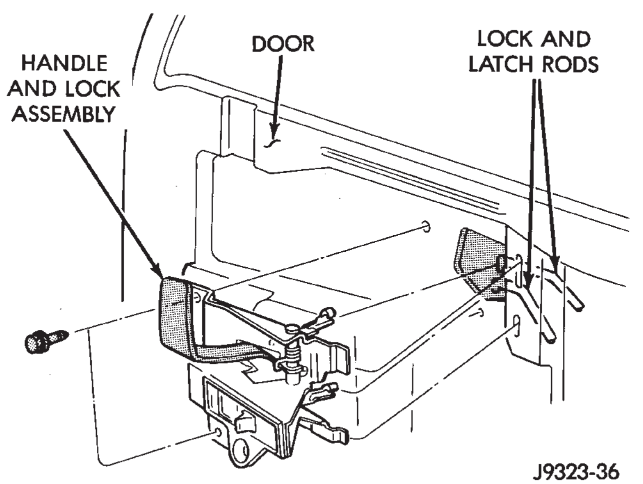


Fig. 1 Front Door Inside Latch Release Handle

(2) Disconnect handle latch and lock rods.
(3) Remove window crank handle (Fig. 2).
(4) Remove screw at armrest (Fig. 2).
(5) Remove screw at window demister slot (Fig. 2).

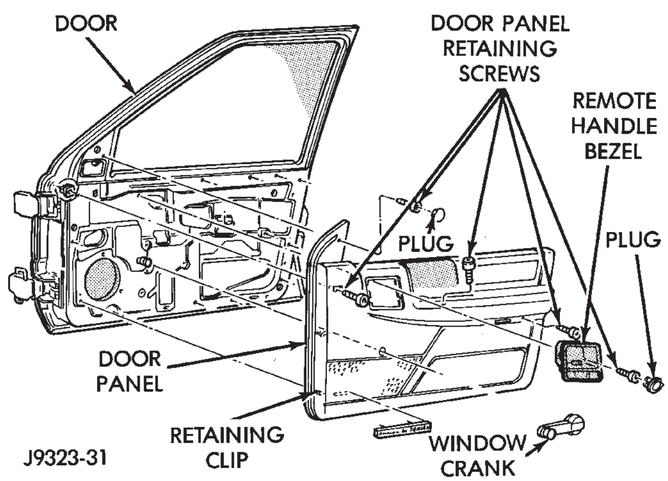


Fig. 2 Door Panel

(6) Remove screw at the upper mirror bezel (Fig. 2).
(7) Detach trim panel perimeter retainers from door inner panel with an appropriate pry tool (Fig. 2).
(8) If equipped, disconnect the wiring connectors from power switch panel.
(9) Remove trim panel from door (Fig. 2).
(10) If necessary, remove waterdams from door.
(11) If necessary, remove power switches from door panel (Figs. 3 and 4).

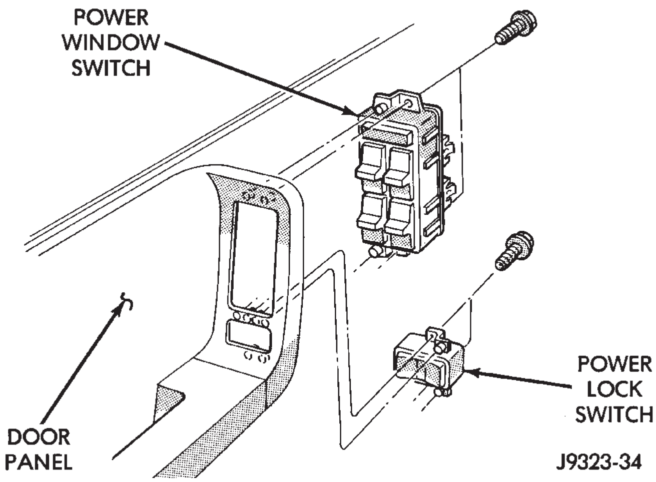


Fig. 3 Left Power Door Switches

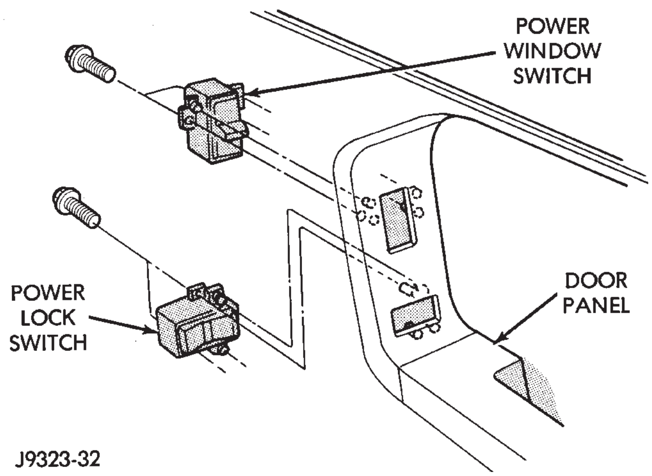


Fig. 4 Right Power Door Switches

INSTALLATION

(1) Apply adhesive/sealant to edges of door waterdam.

(2) Position waterdam on door inner panel. Press it inward to attach it to inner panel.

(3) If removed, install power door switches (Figs. 3 and 4).

(4) Position trim panel on door inner panel. For vehicles equipped with power door locks/windows, connect wire harness connectors. Press nylon retainers inward to attach it to inner panel (Fig. 2).

(5) Install armrest screw. Install demister slot screw. Install mirror bezel screw (Fig. 2). Tighten screws to 4 N●m (34 in-lbs) torque.

(6) Install window crank handle (Fig. 2).

(7) Connect rods to inside handle assembly. Install handle assembly (Fig. 2). Tighten screws to 2 N●m (16 in-lbs) torque.

DOOR REMOVAL/INSTALLATION

(1) For vehicles equipped with power windows and locks, remove door trim panel. Disconnect power window regulator, power door lock motor and all other wire harness connectors. Slide wire harness out of boot and door.

(2) Mark an outline around door hinges for installation alignment reference.

(3) Remove door hinge covers, retaining bolts, plates and shims (Fig. 5). Remove door from vehicle.

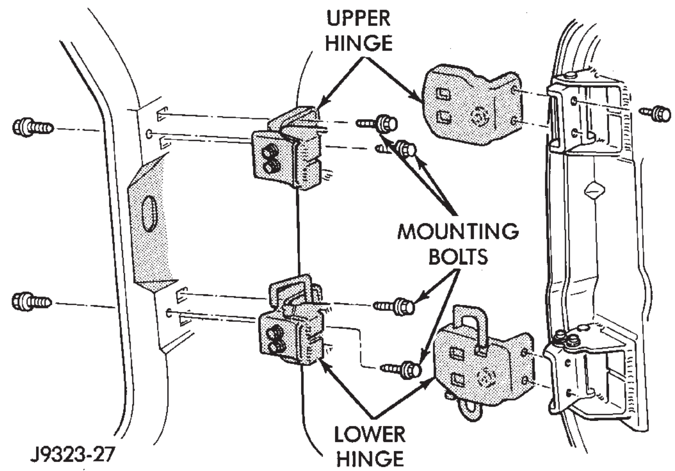


Fig. 5 Door Hinges and Bolts

(4) Identify and retain door hinge plates and shims for correct installation (Fig. 5).

(5) If a replacement front door is being installed, coat door interior with anti-corrosion wax. Also, seal door hem flange with sealant.

(6) Before installing a replacement door, transfer original hardware. If necessary, refer to applicable procedures.

(7) Position door in body opening.

(8) Align door hinges, plates and shims with bolt holes. Install (but do not tighten) hinge bolts,install hinge covers (Fig. 5).

(9) Adjust door to reference marks. If necessary, refer to adjustment procedure. Tighten hinge bolts to 35 N●m (26 ft-lbs) torque.

(10) Adjust latch striker as necessary.

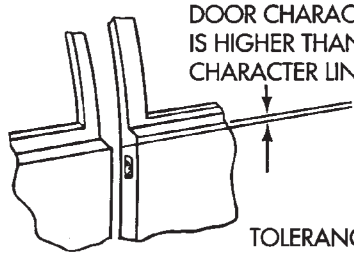
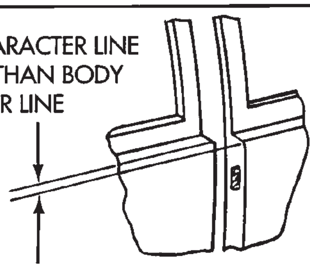
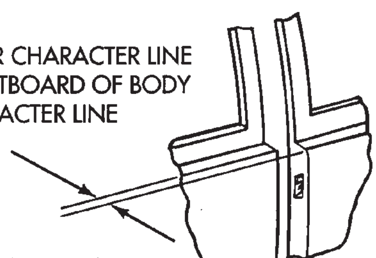
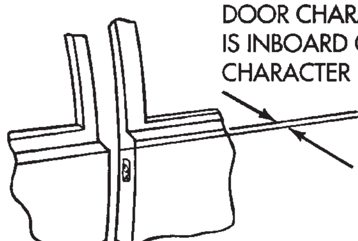
(11) If applicable, route and connect harness connectors to door and vehicle body wire harness connectors.

(12) Install door waterdam (if removed), trim panel, armrest and window glass regulator handle. If necessary, refer to trim panel installation procedure.

DOOR ALIGNMENT ADJUSTMENT—MINOR

Minor adjustment of door position within body opening is done by moving the latch striker. Refer to Door Alignment (Minor) chart.

DOOR ALIGNMENT—MINOR

DOOR/BODY ALIGNMENT CONDITION		ALIGNMENT CORRECTION
A.  DOOR CHARACTER LINE IS HIGHER THAN BODY CHARACTER LINE. 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.  DOOR CHARACTER LINE IS LOWER THAN BODY CHARACTER LINE. 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.  DOOR CHARACTER LINE IS OUTBOARD OF BODY CHARACTER LINE. 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.  DOOR CHARACTER LINE IS INBOARD OF BODY CHARACTER LINE. 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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FRONT DOOR WINDOW REGULATOR

REMOVAL

(1) Remove door trim panel and waterdam. If necessary, refer to removal procedure.

(2) Position window glass to access window track nuts (Fig. 6).

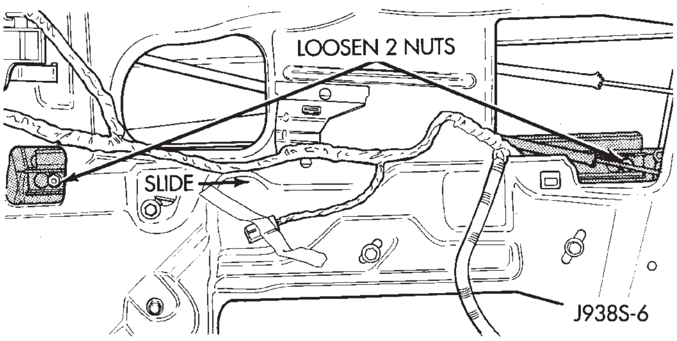

Fig. 6 Front Door Window Track

(3) Loosen 2 window track nuts and slide track off of the window (Fig. 6).

(4) Remove 4 window regulator retaining screws (Fig. 7).

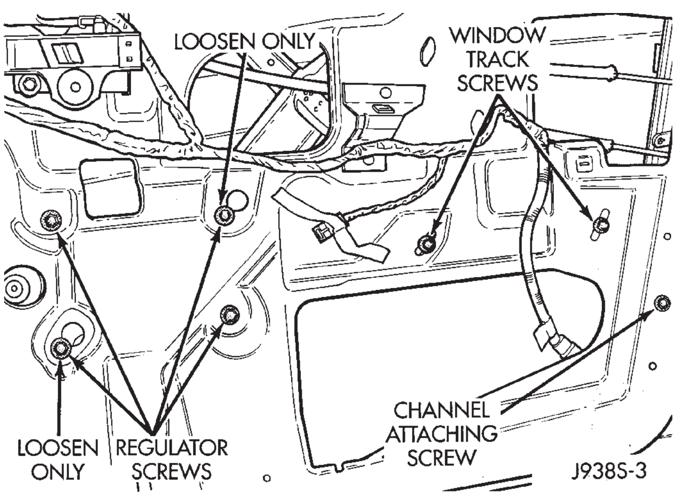

Fig. 7 Front Door Window Regulator

(5) Remove 2 door track screws (Fig. 7)

(6) Lift window upward and separate it from regulator. Support window.

(7) Remove window regulator from door.

Reverse removal procedure for installation.

FRONT DOOR WINDOW

REMOVAL

(1) Remove door trim panel and waterdam. If necessary, refer to removal procedure.

(2) Remove beltline molding and weatherstrip seals.

(3) Remove window track retaining nuts (Fig. 6). If necessary, refer to removal procedure.

(4) Lift window glass upward and out of door.

For installation, reverse removal procedure.

REAR DOOR WINDOW REGULATOR

REMOVAL

(1) Remove door trim panel and waterdam. If necessary, refer to removal procedure.

(2) Position window glass to access window track nuts (Fig. 8).

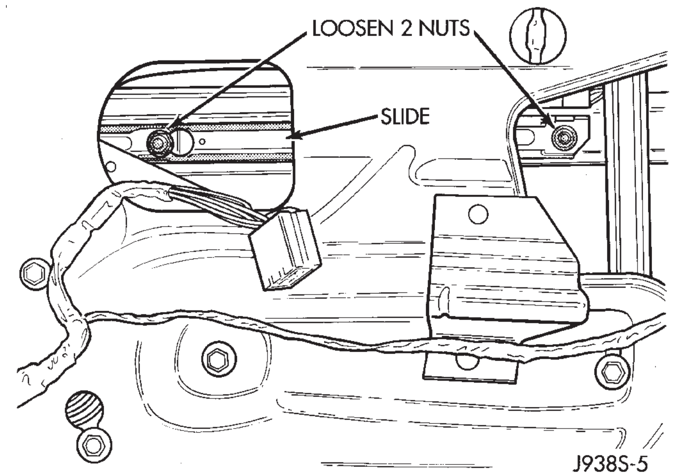

Fig. 8 Rear Door Window Track

(3) Loosen 2 window track nuts and slide track off of window (Fig. 8).

(4) Remove 4 window regulator retaining screws (Fig. 9).

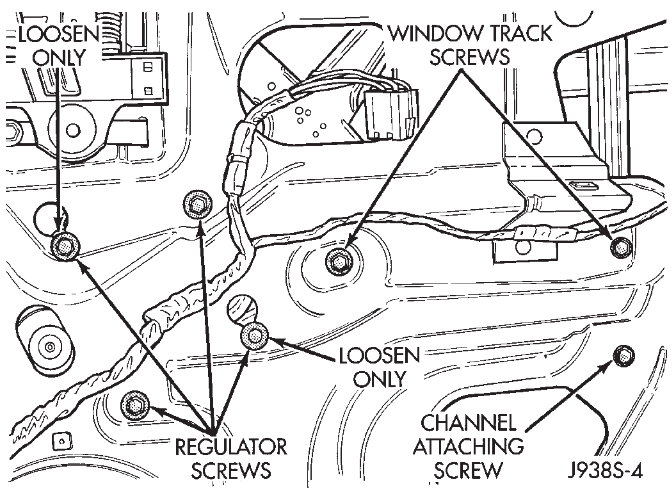

Fig. 9 Rear Door Window Regulator

(5) Remove 2 door track screws (Fig. 9)

(6) Lift window upward and separate it from regulator. Support window.

(7) Remove window regulator from door.

Reverse removal procedure for installation.

REAR DOOR WINDOW

REMOVAL

(1) Lower window glass.

(2) Pry window beltline molding from flange. Remove molding from door.

(3) Remove window weatherstrip seals from door.

(4) Remove trim panel and waterdam from door inner panel. If necessary, refer to removal procedure.

(5) Remove window track nuts and slide track off of window (Fig. 8).

(6) Remove division bar upper attaching screw and belt line screw (Fig. 10).

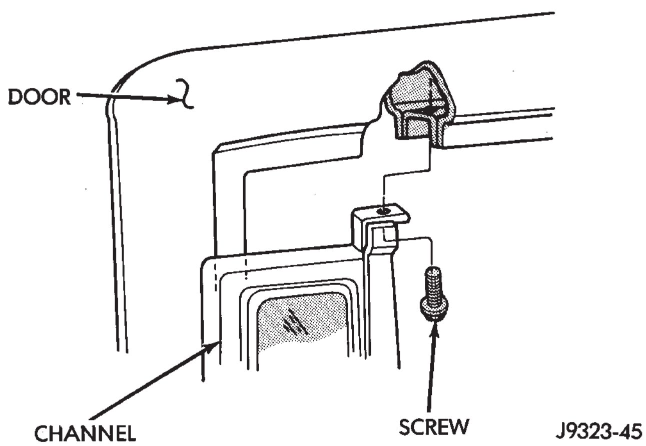

Fig. 10 Stationary Glass Channel

(7) Tilt stationary glass channel assembly forward and remove it from door.

(8) Remove window glass from door.

INSTALLATION

(1) Install window glass in door.

(2) Tighten glass track nuts to 6 N●m (53 in-lbs) torque.

(3) Install stationary glass channel in door.

(4) Install stationary glass channel screws (Fig. 10). Tighten screw to 6 N●m (5 ft-lbs) torque.

(5) Install window glass channel and belt weather-strip seals.

(6) Install window beltline molding.

(7) Install door waterdam and trim panel. If necessary, refer to installation procedure.

DOOR KEY LOCK CYLINDER

REMOVAL

(1) Remove door trim panel and waterdam. If necessary. refer to removal procedure.

(2) Disconnect door latch lock cylinder rod at door latch (Fig. 11).

(3) If equipped, disconnect security alarm switch connector from lock cylinder (Fig. 12).

(4) Remove key lock cylinder retainer clip. Remove lock cylinder, gasket and clip from door (Fig. 13).

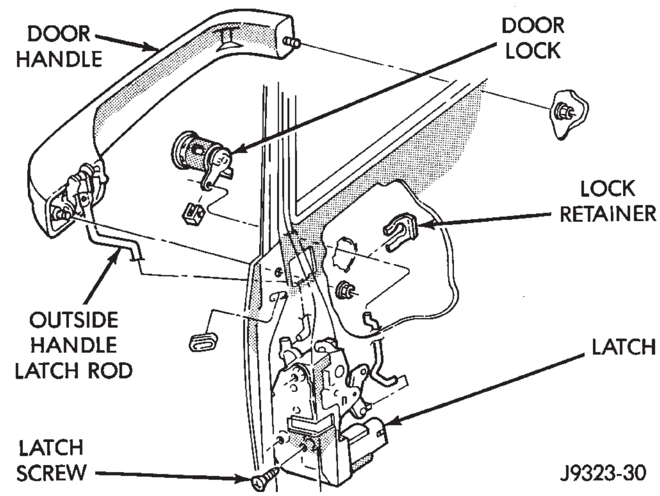

Fig. 11 Key Lock Cylinder & Door Latch

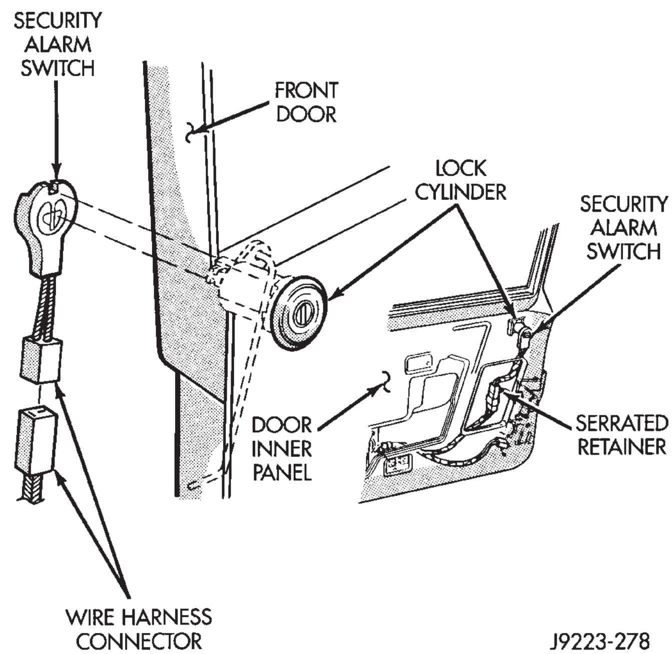

Fig. 12 Security Alarm Switch

(5) If applicable, remove door latch lock cylinder rod from original lock cylinder. Connect it to replacement lock cylinder (Fig. 13).

For installation, reverse removal procedure.

DOOR LATCH ADJUSTMENT

(1) Locate access hole (Fig. 14).

(2) Insert a 5/32-inch hex-wrench through hole and into adjustment screw (Fig. 14). Loosen screw.

(3) Operate outside handle button several times to release any restriction because of mis-alignment.

(4) Tighten adjustment screw to 3 N●m (30 in-lbs) torque.

(5) Test handle button and lock cylinder for proper operation.

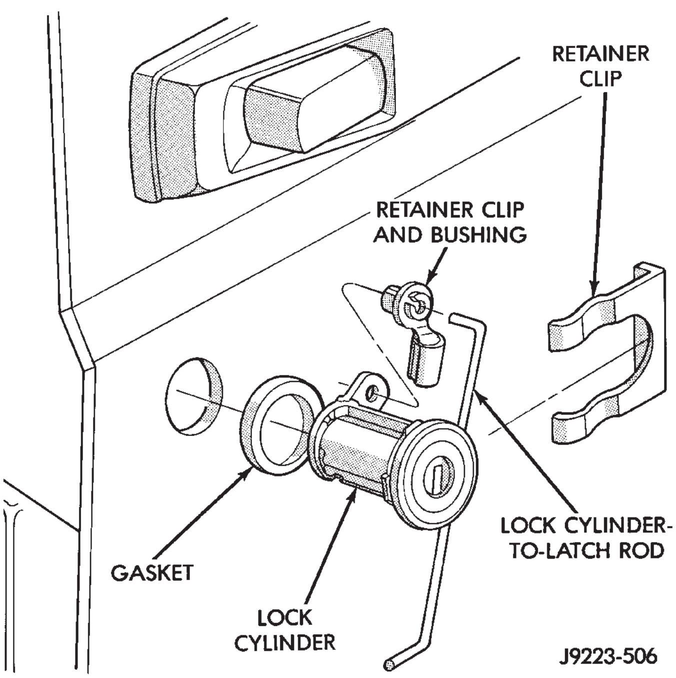

Fig. 13 Key Lock Cylinder Removal/Installation

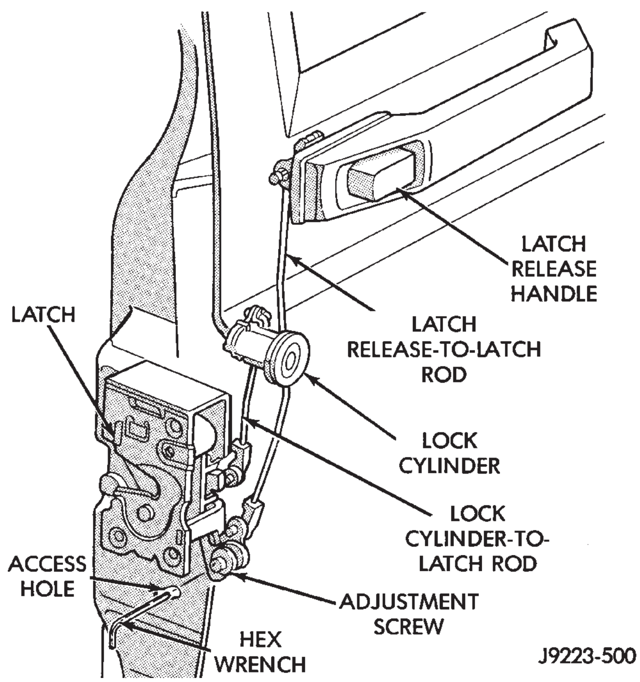

Fig. 14 Door Latch Adjustment

OUTSIDE DOOR HANDLE

REMOVAL

(1) Remove door trim panel and waterdam. If necessary, refer to installation procedure.

(2) Remove access hole cover (Fig. 15). Remove door handle retaining nuts (Fig. 16).

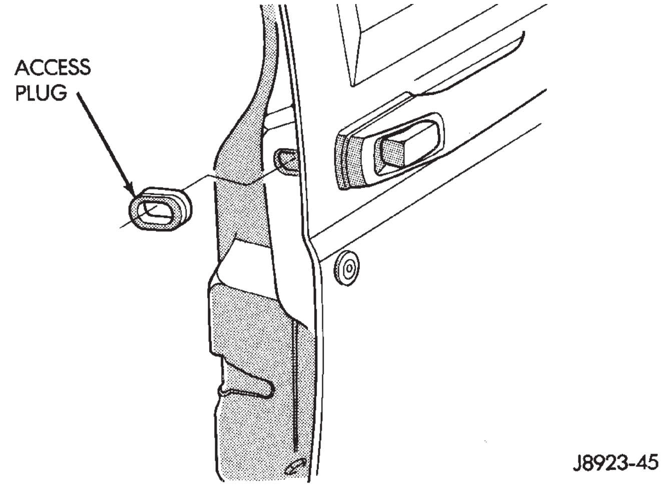

Fig. 15 Access Plug

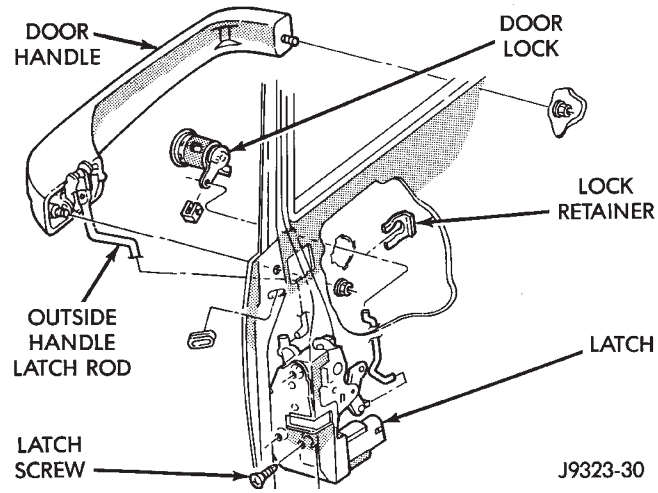

Fig. 16 Outside Door Handle

(3) Disconnect handle latch rod from latch (Fig. 16).

(4) Remove gaskets from door, if necessary.

For installation, reverse removal procedure.

DOOR LATCH

REMOVAL

(1) Remove door trim panel and waterdam. If necessary, refer to removal procedure.

(2) Remove door latch retaining screws (Fig. 17).

(3) Disconnect all rods from door latch (Fig. 18).

(4) Remove door latch from door.

For installation, reverse removal procedure.

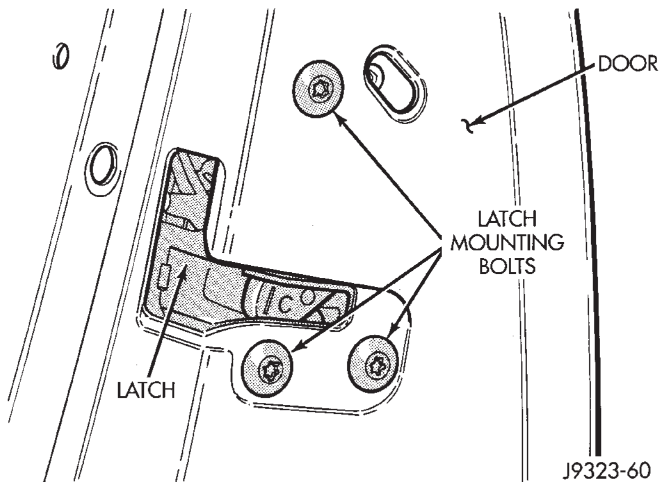

Fig. 17 Door Latch Retaining Screws

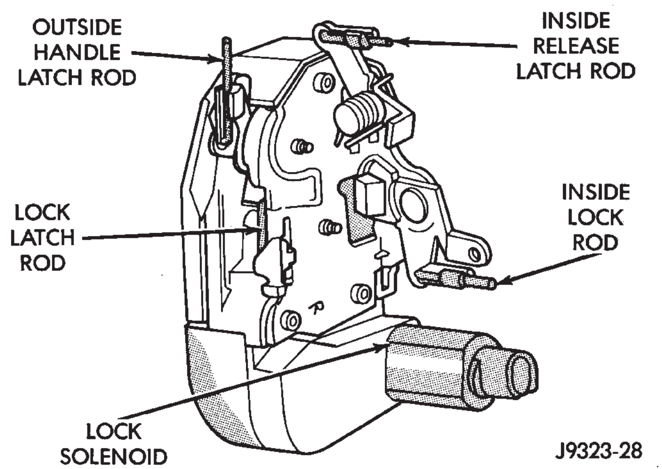

Fig. 18 Door Latch

DOOR INSIDE LATCH RELEASE AND LOCK RODS

REMOVAL

(1) Remove door trim panel and waterdam. If necessary, refer to removal procedure.

(2) Remove door inside latch release handle screws (Figs. 19 and 20).

(3) Move door release handle outward. Disconnect handle latch and lock rods.

(4) Remove door inside release handle from door.

For installation, reverse removal procedure.

DOOR WINDOW EXTERIOR MOLDINGS

REMOVAL

(1) Lower window glass completely.

(2) Carefully pull molding from door panel flange and/or retaining clips.

INSTALLATION

(1) When installing window moldings, start at forward end of molding.

(2) Force molding onto door flange. Continue rearward until it is seated on flange.

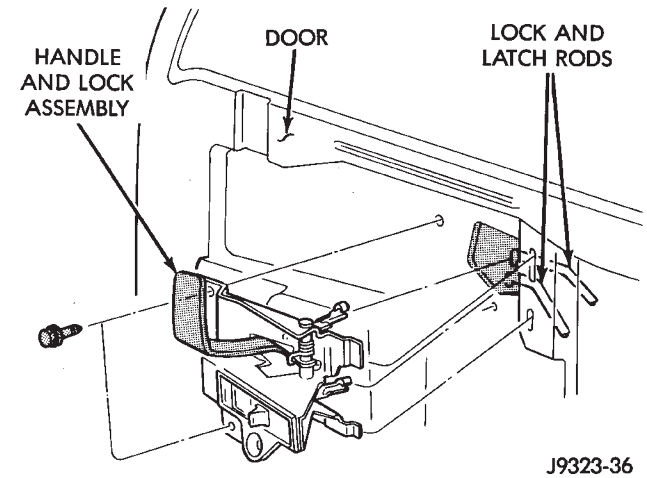

Fig. 19 Front Door Inside Latch Release Handle

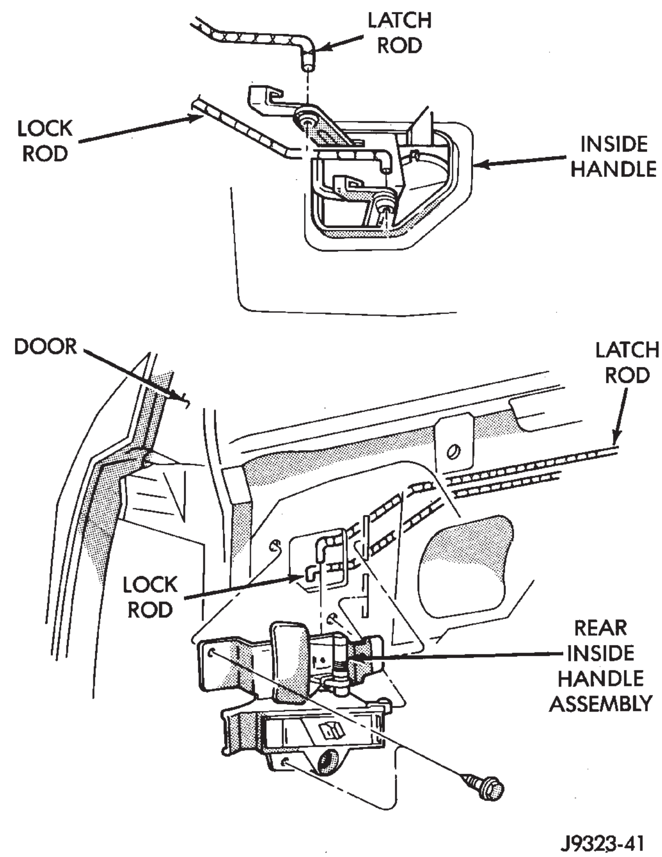

Fig. 20 Rear Door Inside Latch Release Handle

(3) Mate rear molding with upper molding. Force molding edge inward.

(4) Continue pressing downward to complete installation.

DOOR WINDOW GLASS AND DOOR OPENING SEALS

The window glass seals can be removed by hand.

The door opening seal is attached to edge of door opening in body. The front door secondary seal is attached to A-pillar.

WINDOW GLASS SEAL INSTALLATION

When installing front or rear door window glass weatherstrip seals, open window completely.

(1) To install a front door window channel weather-strip seal, start at upper, rear corner.

(2) To install a rear door window glass channel weatherstrip seal, start at upper, front corner.

(3) Install seal evenly until it is fully seated in channel.

(4) Position belt weatherstrip seals at window edge. Force them downward until seated on flange.

DOOR OPENING WEATHERSTRIP SEAL INSTALLATION

(1) When installing a door opening weatherstrip seal, start at rear of front seal and front of rear seal using paint dots as location points.

(2) Use adhesive along with push-studs to aid in retaining a weatherstrip seal.

(3) Move upward and around edge of door opening. Seat seal on flange.

LIFTGATE

TRIM PANEL

REMOVAL

(1) Remove the CHMSL access panel. Remove the 6 screws that attach liftgate panel to liftgate (Fig. 21).

(2) Use a trim panel removal tool to detach panel retainers from liftgate (Fig. 22).

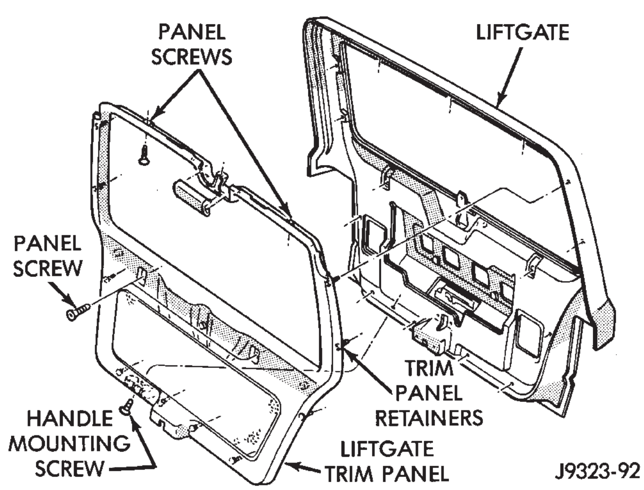

Fig. 21 Liftgate Trim Panel

(3) Remove trim panel from liftgate.

INSTALLATION

(1) Position trim panel on liftgate.

(2) Align trim panel retainers with holes in liftgate inner panel. Force trim panel inward to seat retainers in holes (Fig. 22).

(3) Install screws to attach panel to liftgate (Fig. 21). Tighten screws securely.

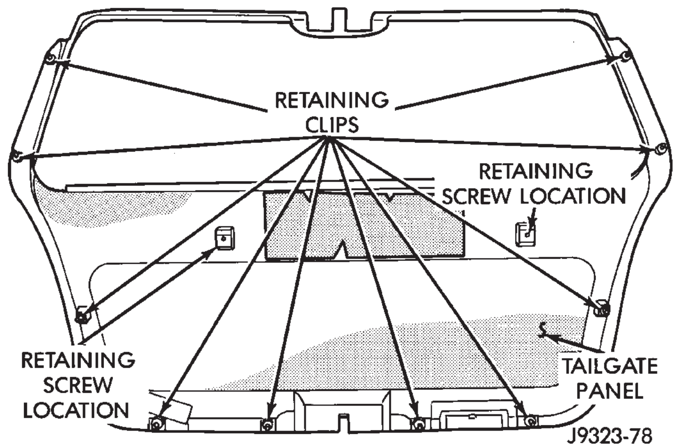

Fig. 22 Liftgate Retainer Location

LIFTGATE

REMOVAL

WARNING: DO NOT DISCONNECT THE SUPPORT ROD CYLINDERS WITH THE LIFTGATE CLOSED. THE SUPPORT ROD PISTONS ARE OPERATED BY HIGH PRESSURE GAS. THIS PRESSURE COULD CAUSE DAMAGE AND/OR PERSONAL INJURY IF THEY ARE REMOVED WHILE THE PISTONS ARE COMPRESSED.

(1) Open liftgate. Support liftgate for ease of repair.

(2) Remove liftgate trim panel (Fig. 21). If necessary, refer to removal procedure.

(3) Remove retainer clips that secure support rod cylinders to ball studs (Fig. 23).

(4) Remove support rod cylinders from ball studs (Fig. 23).

(5) Remove upper support rod retaining screws (Fig. 23). Remove support rods.

(6) Disconnect wire harnesses and washer hose from liftgate.

(7) Remove hinge screws at liftgate (Fig. 24).

(8) Remove liftgate from vehicle.

For installation, reverse removal procedure. Torque hinge screws to 9 N●m (7 ft-lbs) torque.

HINGE

REMOVAL

It is not necessary to remove liftgate to replace one or both hinges. The hinges can be replaced one at a time.

(1) Remove liftgate (headliner) upper trim molding (Fig. 25). Disconnect wiring harness to cargo lamp.

(2) Remove hinge screws at roof panel (Fig. 24).

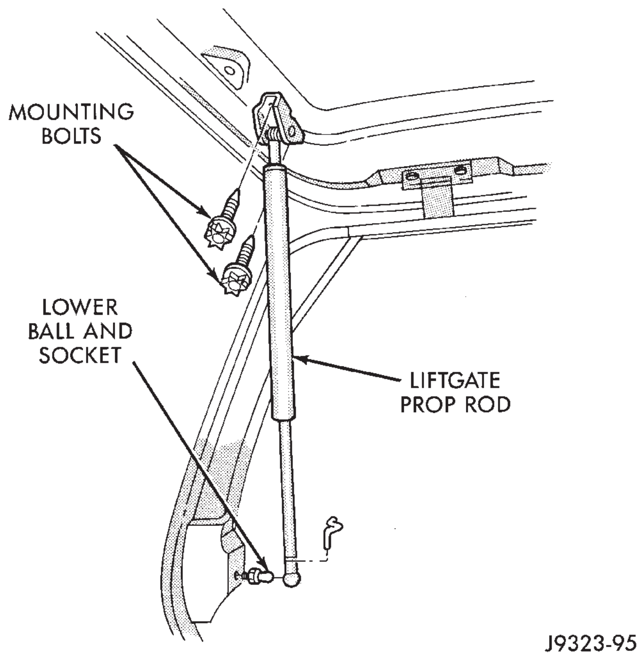

Fig. 23 Support Rod

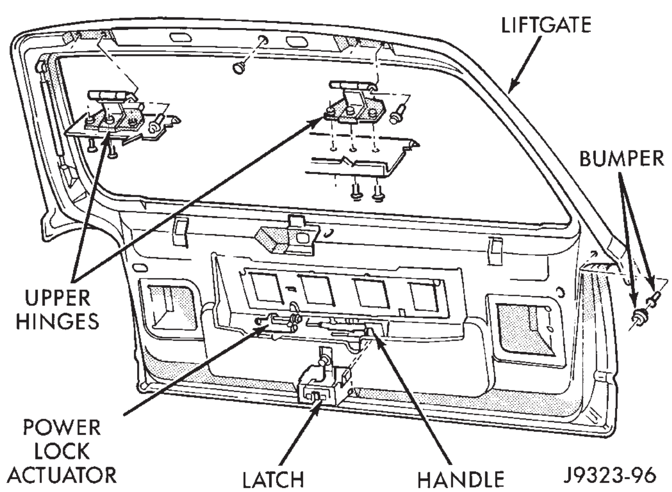

Fig. 24 Liftgate Components

(3) Remove hinge screws at liftgate (Fig. 24). Remove hinge from liftgate (Fig. 24).

INSTALLATION

(1) Position gaskets, shim and hinge on liftgate and roof panel (Fig. 24).

(2) Install and tighten hinge screws at roof panel (Fig. 24) to 9 N●m (7 ft-lbs) torque.

(3) Install hinge screws at liftgate (Fig. 24). Tighten screws to 9 N●m (7 ft-lbs) torque.

(4) Install liftgate (headliner) upper trim molding (Fig. 25).

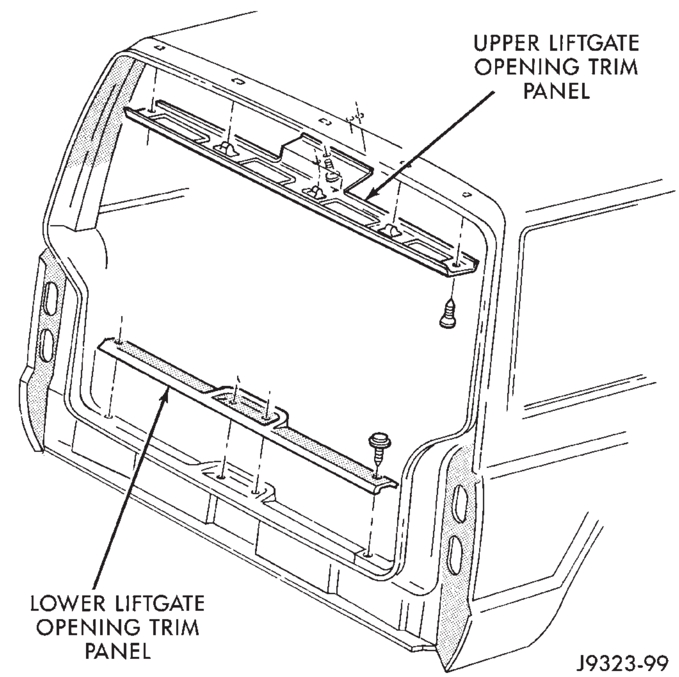

Fig. 25 Liftgate Upper Trim Molding

LIFTGATE LATCH/LOCK COMPONENTS

REMOVAL

(1) Raise liftgate. Remove liftgate trim panel. If necessary refer to service procedure.

(2) Remove latch screws (Fig. 26).

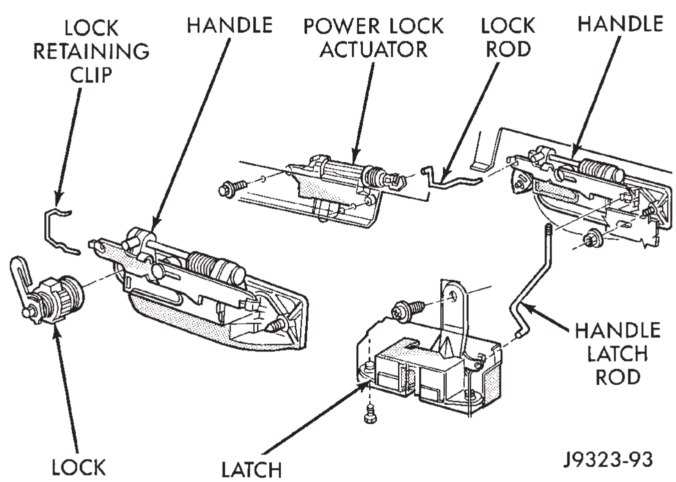

Fig. 26 Liftgate Latch/Lock Component

(3) Disconnect rod from latch (Fig. 26).

(4) Remove latch from liftgate (Fig. 26).

(5) Remove lock cylinder retainer clip (Fig. 26).

(6) Remove key lock cylinder (Fig. 26).

(7) Remove 2 nuts retaining the liftgate handle. Remove the handle (Fig. 26).

(8) Remove latch striker nuts from below scuff plate. Access nuts from under bumper fascia/beam. (Fig. 27)

(9) Remove striker and shim (Fig. 27).

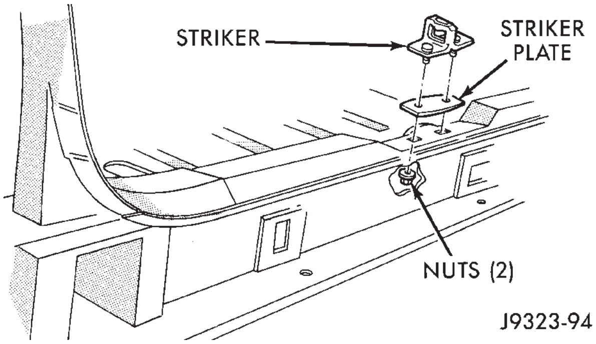

Fig. 27 Liftgate Latch Striker

For installation of components, reverse removal procedure.

LIFTGATE ADJUSTMENT

The position of liftgate can be adjusted upward or downward, and inward or outward by use of hinge shims. Liftgate stop bumpers must also be adjusted if liftgate hinges are adjusted. The inward/outward position of each stop bumper is adjusted by the of shims.

LIFTGATE OPENING WEATHERSTRIP SEAL

REMOVAL

(1) Pull seal away from flange around edge of liftgate opening. Remove it from vehicle.

(2) Clean seal flange as necessary.

INSTALLATION

(1) Position weatherstrip seal in opening with left end of seal at opening centerline. Install seal in a clockwise direction.

(2) Seat installed part of seal. Move from left bottom end of seal to top left half of the seal.

(3) Center and butt seal ends together at centerline.

LICENSE PLATE LAMP HOUSING

REMOVAL

(1) Remove lamp housing retaining screws from liftgate (Fig. 28).

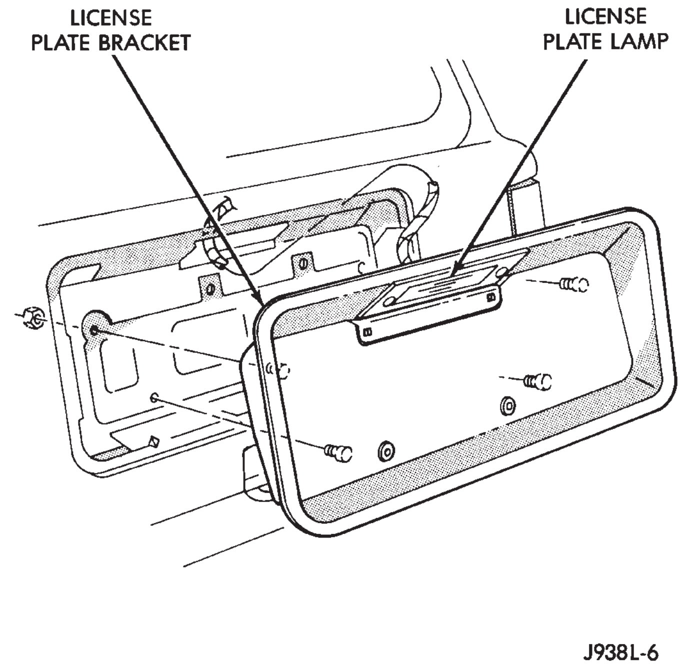

Fig. 28 License Plate Lamp Housing

(2) Disconnect bulb socket from lamp housing (Fig. 28).

(3) Remove housing from liftgate (Fig. 28).

INSTALLATION

(1) Position lamp housing at liftgate (Fig. 28).

(2) Connect bulb socket to lamp housing (Fig. 28).

(3) Install lamp housing retaining screws in liftgate (Fig. 28). Tighten screws securely.

FIXED WINDOW GLASS

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SAFETY PRECAUTIONS AND WARNINGS

WARNING: DO NOT USE URETHANE ADHESIVE OR PRIMER IN CLOSED WORK AREA, PERSONAL INJURY CAN RESULT. PROTECT SKIN FROM COMING IN CONTACT WITH URETHANE, PERSONAL INJURY CAN RESULT. WEAR EYE AND HAND PROTECTION WHEN WORKING WITH GLASS, PERSONAL INJURY CAN RESULT.

CAUTION: Protect all painted or trimmed surfaces from coming in contact with urethane or primers, damage will result. Do not damage painted surfaces when removing moldings or cutting urethane around windshield.

WARNING: DO NOT OPERATE VEHICLE FOR AT LEAST 24 HOURS AFTER WINDSHIELD INSTALLATION. WINDSHIELD MAY NOT PERFORM PROPERLY IN THE EVENT OF A COLLISION IF URETHANE ADHESIVE IS NOT SUFFICIENTLY CURED. REFER TO MANUFACTURER OF URETHANE BEING USED FOR CURING TIME SPECIFICATIONS. WHEN INSTALLING GLASS, DO NOT USE URETHANE ADHESIVE AFTER DATE ON PRODUCT HAS EXPIRED. SAFETY AND QUALITY OF REPAIR WOULD BE QUESTIONABLE.

It is difficult to salvage a windshield during the removal operation. The windshield is part of the structural support for the roof. The urethane bonding used to secure windshield to fence is difficult to cut or clean from any surface. If moldings are set in urethane, it would also be unlikely they could be salvaged. Before removing windshield, check availability of windshield and moldings from the parts supplier.

WINDSHIELD REPLACEMENT

The procedure for windshield replacement can also be used to service rear quarter glass and liftgate glass (Figs. 1 and 2).

WINDSHIELD REMOVAL

(1) Remove inside rear view mirror.
(2) Remove cowl cover.

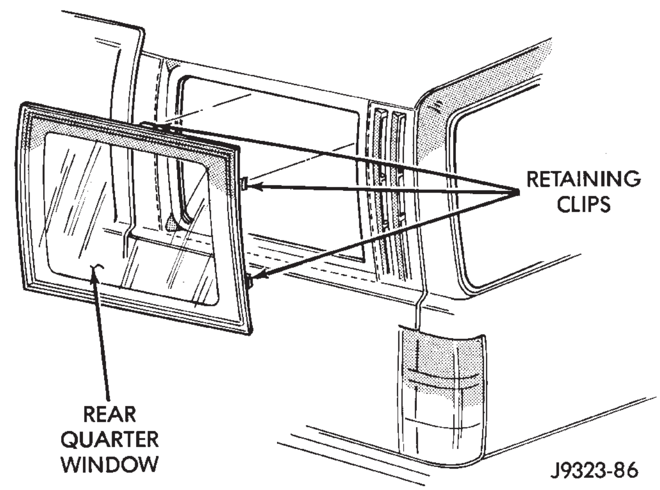

Fig. 1 Rear Quarter Glass

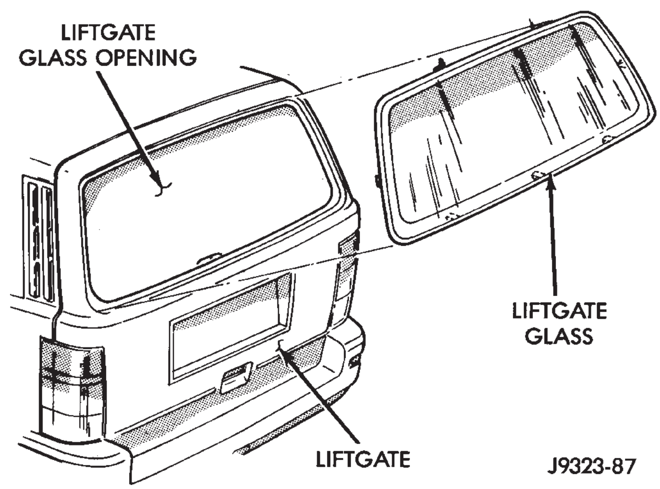

Fig. 2 Liftgate Glass

(3) Remove windshield moldings (Fig. 3). Pull outward on molding at the bottom of A-pillars using pliers.
(4) Cut urethane bonding from around windshield using a suitable sharp cold knife. A pneumatic cutting device can be used if available (Fig. 4).
(5) Separate windshield from vehicle.

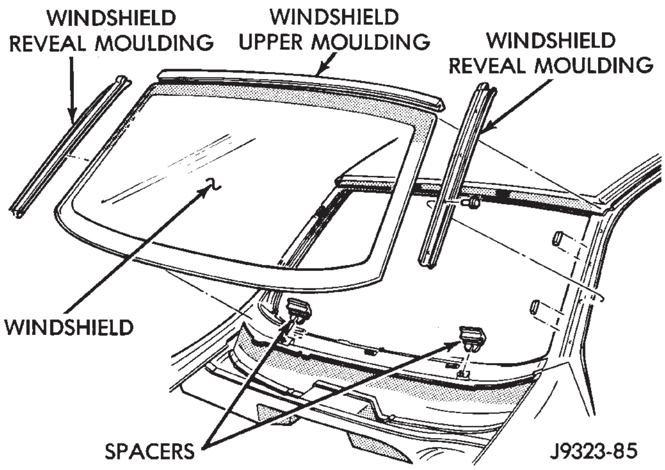

Fig. 3 Windshield Moldings

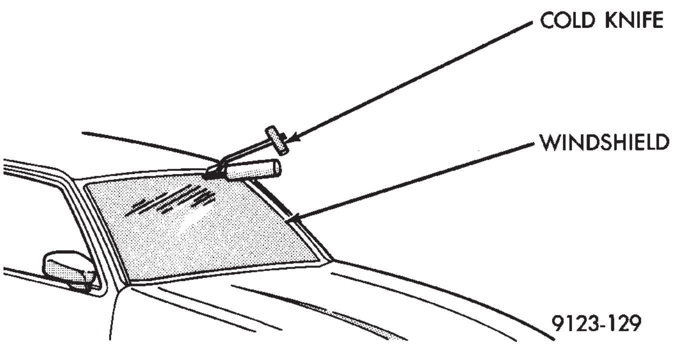

Fig. 4 Cut Urethane Around Windshield—Typical

WINDSHIELD INSTALLATION

CAUTION: Open a window before installing windshield. This will avoid pressurizing the passenger compartment. If a door or trunk lid is slammed before urethane is cured, water leaks can result.

Allow the urethane at least 4 hours to cure before returning the vehicle to use.

The windshield fence should be cleaned of old urethane bonding material. Support spacers should be cleaned and properly installed on weld studs or repair screws at bottom of windshield opening.

(1) Place replacement windshield into windshield opening. Position glass in the center of the opening against the support spacers. Mark the glass at the support spacers with a grease pencil or masking tape and ink pen to use as a reference for installation. Remove replacement windshield from windshield opening (Fig. 5).

(2) Position the windshield inside up on a suitable work surface with two padded, wood 10 cm by 10 cm by 50 cm (4 in. by 4 in. by 20 in.) blocks, placed parallel 75 cm (2.5 ft.) apart (Fig. 6).

(3) Clean inside of windshield with Mopar® Glass Cleaner and lint-free cloth.

(4) Apply clear glass primer 25 mm (1 in.) wide around edge of windshield. Wipe with clean/dry lint-free cloth.

(5) Apply black-out primer 15 mm (.75 in.) wide on top and sides of windshield and 25 mm (1 in.) on bottom of windshield. Allow at least three minutes drying time.

(6) Position windshield spacers on lower fence above support spacers at the edge of the windshield opening (Fig. 7).

(7) Apply a 10 mm (0.4 in.) bead of urethane around perimeter of windshield along the inside of the moldings.

(8) With aid of a helper, position windshield over windshield opening. Align reference marks at bottom of windshield to support spacers.

(9) Slowly lower windshield glass to windshield opening fence. Guide top molding into proper position if necessary. Push windshield inward to fence spacers at bottom and until top molding is flush to roof line (Fig. 8).

(10) Clean excess urethane from exterior with Mopar®, Super Clean or equivalent.

(11) Install windshield molding. Apply 150 mm (6 in.) lengths of 50 mm (2 in.) masking tape spaced 250 mm (10 in.) apart to hold molding in place until urethane cures.

(12) Install cowl cover and wipers.

(13) Install inside rear view mirror.

(14) After urethane has cured, remove tape strips. Water test windshield to verify repair.

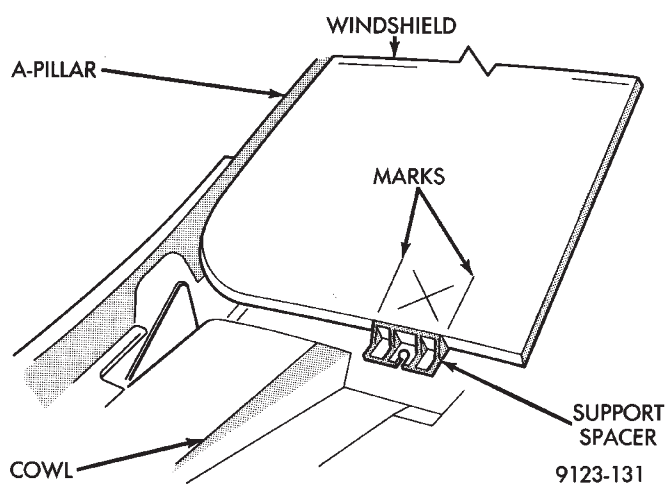

Fig. 5 Center Windshield and Mark at Support Spacers

FIXED GLASS WATER LEAK DETECTION AND REPAIR

SERVICE INFORMATION

The sources of water leaks around edge of the windshield or a fixed glass can be sealed without removing glass. If glass is firmly bonded and only has a small leak, seal the area with a liquid sealant.

LEAK TEST

Water test glass with a spray only. **Do not use hard streams of water.** Work from the bottom to the top of glass.

SEALING LEAK AREAS

(1) Thoroughly clean and remove all foreign material from leak area. Dry area with compressed air.

(2) Seal leak area with butyl sealant. Allow sealant to cure for at least 1/2 hour. Next, water test glass to ensure that leak area is sealed.

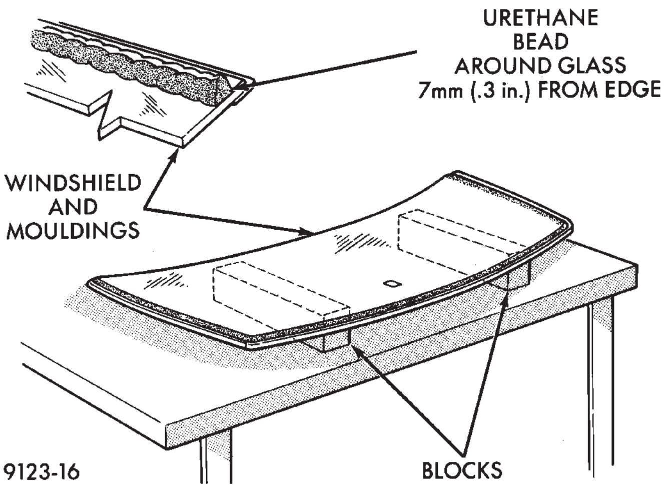

Fig. 6 Work Surface Set up and Molding Installation

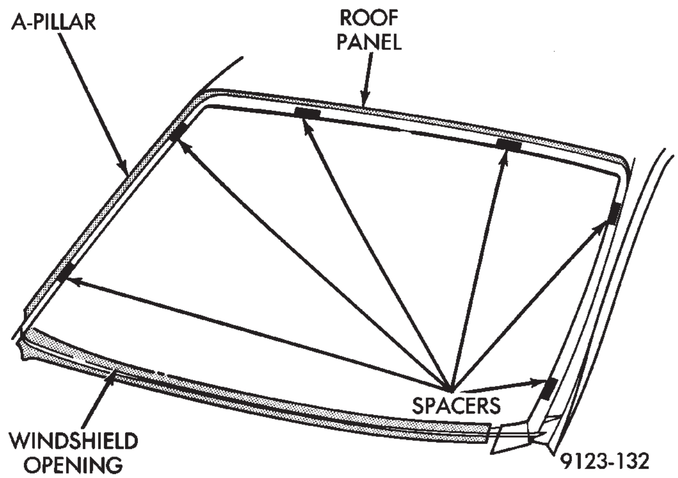

Fig. 7 Position Urethane Compression Spacers

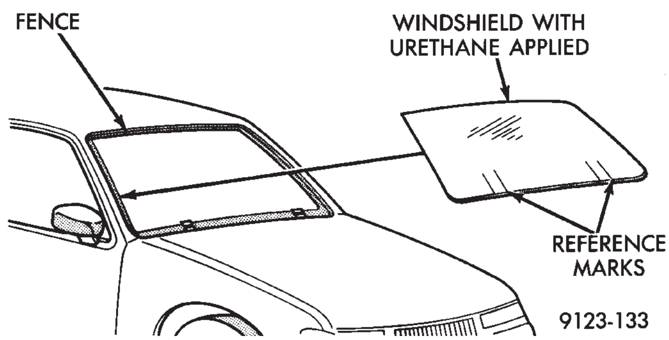

Fig. 8 Lower Windshield Into Position

UNDERBODY COMPONENTS

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SERVICE INFORMATION

In some instances, the components in the following procedures are concealed by other components. Refer to applicable component removal procedure for service access.

TRANSFER CASE SKID PLATE

REMOVAL

(1) Support skid plate.

(2) Remove bolts that attach skid plate to transmission support crossmember and frame sill (Fig. 1).

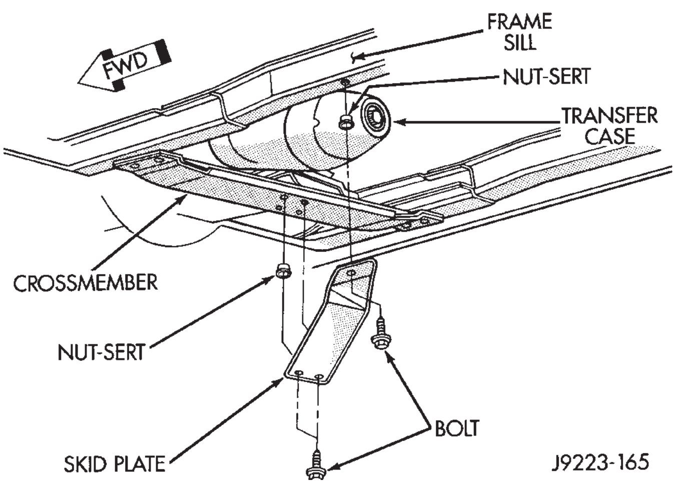

Fig. 1 Transfer Case Skid Plate

(3) Remove support and skid plate from vehicle (Fig. 1).

INSTALLATION

(1) Position and support skid plate at the frame sill and transmission support crossmember (Fig. 1).

(2) Attach skid plate to frame sill and crossmember with the bolts (Fig. 1). Tighten bolts to 22 N●m (16 ft. lbs) torque.

TRAILER HITCH

REMOVAL

(1) If necessary, remove trailer tow wire harness connector from hitch.

(2) Support hitch.

(3) Remove nuts that attach the towing tube to frame sills (Fig. 2).

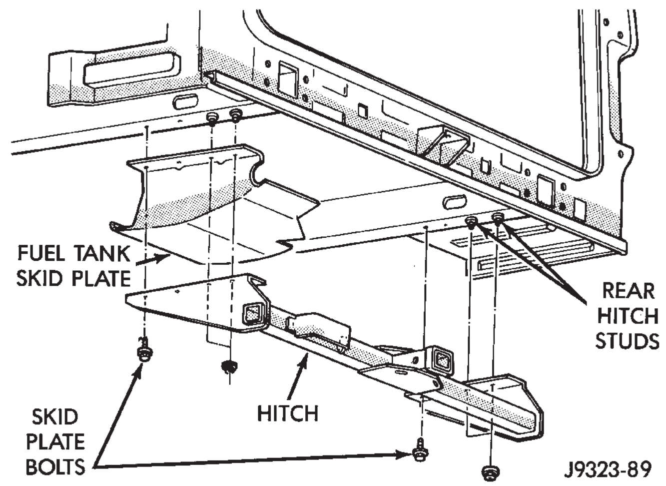

Fig. 2 Equalizer Type Hitch

Reinforcement brackets are retained on frame sills with 4 studs.

(4) Remove bolts from plate bracket and vehicle rear crossmember (Fig. 2). Lower support and hitch.

INSTALLATION

(1) Place hitch on a lifting device. Raise, position hitch at proper location (Fig. 2) and support it.

(2) Loosely install nuts that attach towing tube to vehicle frame sills (Fig. 2).

(3) Position plate bracket and install attaching bolts through vehicle rear crossmember (Fig. 2).

(4) Tighten all attaching bolts/nuts.

(5) Remove support and, if removed, attach trailer wire harness connector to hitch (Fig. 2).

INTERIOR COMPONENTS

INDEX

INSTRUMENT PANEL

REMOVAL

(1) Remove defroster duct bezel from instrument panel.

(2) Remove speaker grilles.

(3) Remove 4 upper instrument panel retaining nuts.

(4) Remove 3 screws retaining lower left side panel at instrument panel. Remove mounting bolt for instrument panel at left side cowl through access hole provided.

(5) Remove ashtray. Remove instrument panel mounting screw located behind ashtray.

(6) Remove instrument panel mounting bolt located on right side cowl.

(7) Fold down carpet at left side of the console. Remove 2 mounting screws.

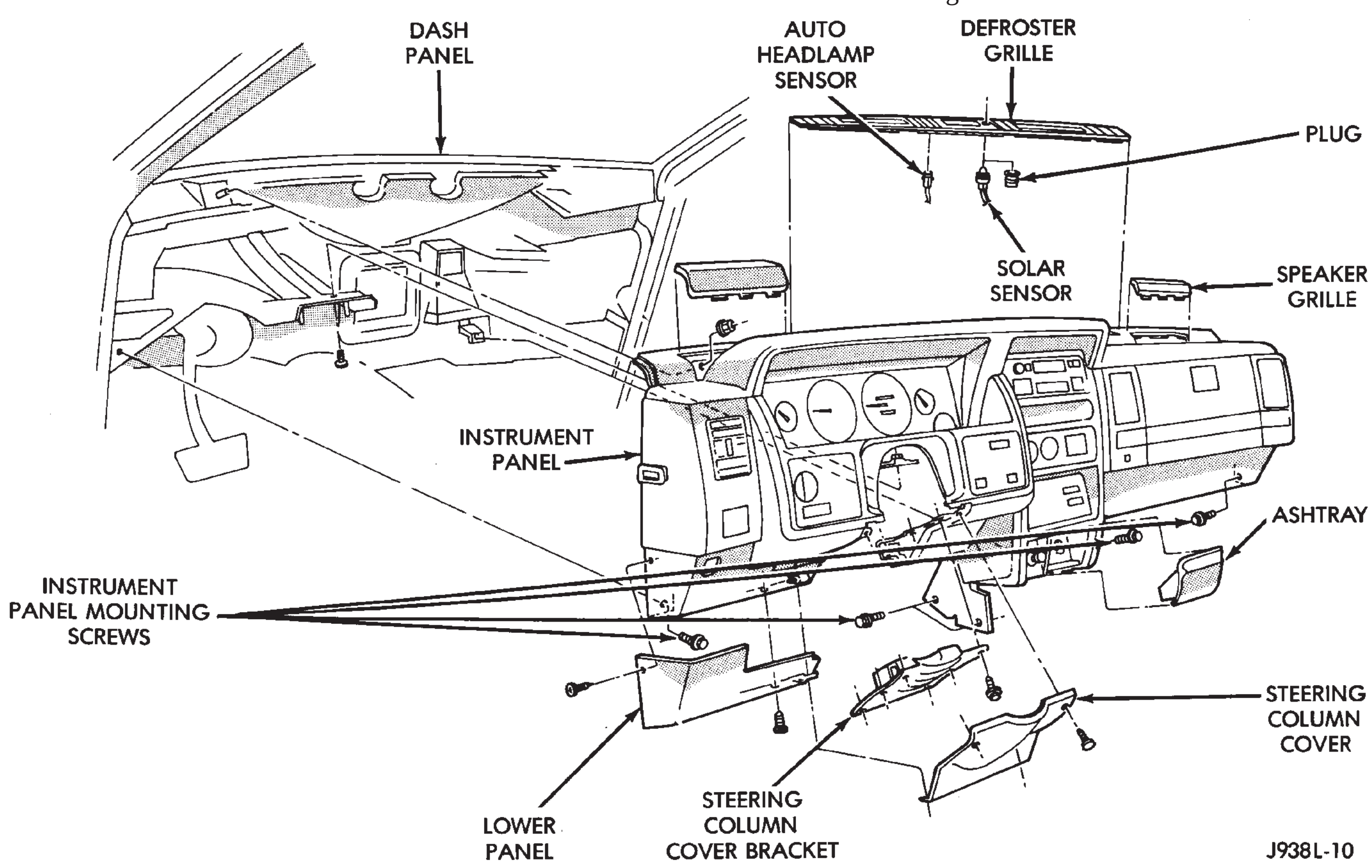

Fig. 1 Instrument Panel

(8) Remove 3 screws at lower column cover and remove cover (Fig. 2).

(9) Remove 6 screws at lower knee bolster and remove bolster (Fig. 2).

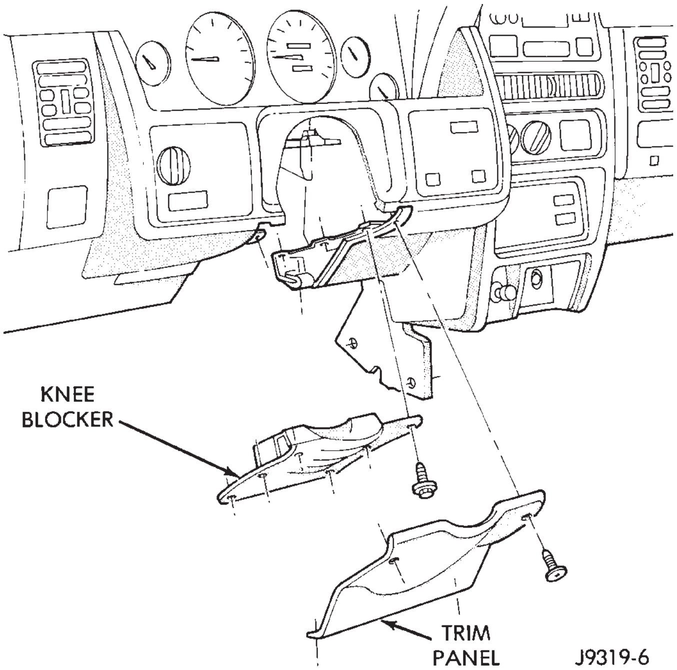

Fig. 2 Knee Bolster

(10) Remove tilt lever and both column covers. Disconnect column wiring.

(11) Remove 2 nuts at column mount. Lower steering column.

(12) Remove instrument panel mounting bolt above center of column.

(13) Disconnect bulkhead connector at left side of dash panel.

(14) Disconnect cluster wiring at lower left side of instrument panel.

(15) Remove right side kick panel access door. Disconnect wiring at kick panel.

(16) Pull back and lower instrument panel. Disconnect A/C vacuum lines and antenna.

(17) Remove Instrument Panel.

For component disassembly refer to related group.

To install reverse removal procedure.

FRONT BUCKET SEATS

REMOVAL

Bucket seat platforms are attached to floor panel with 4 bolts (Fig. 3). The trim covers are attached to platform with 3 screws.

(1) Remove 4 bolts retaining seat.

(2) For power seats, disconnect wire harness connector (Fig. 4)

(3) Remove seat from floor panel.

Fig. 3 Front Bucket Seat

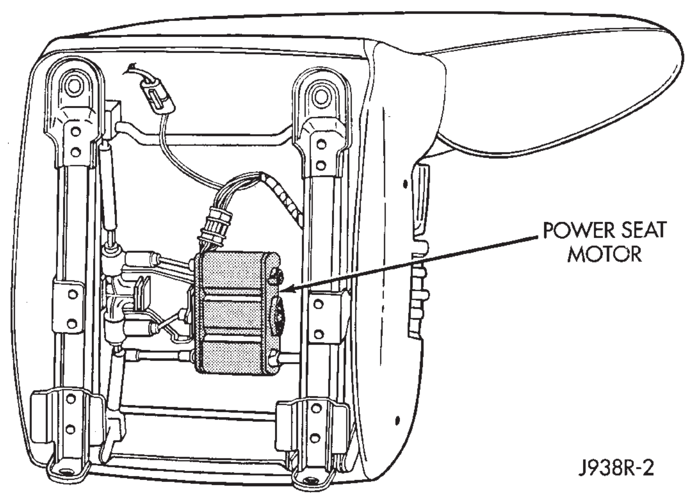

Fig. 4 Power Bucket Seat Wire Harness Connector

INSTALLATION

(1) Position seat on floor panel.

(2) Install and tighten seat retaining bolts to 25 N●m (18 ft-lbs) torque (Fig. 3).

(3) For power seats, connect wire harness connector (Fig. 4).

BUCKET SEAT CUSHION AND COVER

REMOVAL

(1) Remove the seat from vehicle (Fig. 3). If necessary, refer to removal procedure.

(2) Remove 3 screws retaining seat trim cover (Fig. 3).

(3) Remove wire support rod and rear carpet seat track cover, and flap retainer.

(4) For power seats, remove control housing from seat cushion.

(5) Remove retaining screws and seat cushion from seat frame.

(6) Remove seat cushion cover retaining screws and wire rods from cushion cover. Remove cover from cushion frame.

INSTALLATION

(1) Install seat cushion cover on cushion frame. Install wire rods and retaining screws. Tighten screws to 2 N●m (13 in-lbs) torque.

(2) Install cushion and retaining screws on seat frame.

(3) For power seats, install control housing on seat cushion. Tighten screws to 2 N●m (13 in-lbs) torque.

(4) Install rear carpet seat track cover and support rod and flap retainer.

(5) Install seat trim cover and screws onto seat platform.

(6) Install seat in vehicle (Fig. 3). If necessary, refer to removal procedure.

BUCKET SEATBACK COVER AND FRAME

REMOVAL

(1) Remove seat from vehicle. If necessary, refer to removal procedure.

(2) Remove seat cushion from frame. If necessary, refer to removal procedure.

(3) If equipped, remove headrest. Twist knob under headrest and pull up and out of cylinders in seatback.

(4) Remove headrest latch release lever bezel from seatback.

(5) Squeeze plastic retainers together. Detach lower flap from front of cover.

(6) Remove cover retainer clips and remove cover from seatback.

(7) For power seats, remove retaining screws and remove the seat control from seat track/platform.

(8) Remove retaining screws and nuts. Remove seat frame from seat track/platform.

INSTALLATION

(1) Position seat frame on seat track/platform. Install retaining screws and nuts.

(2) For power seats, position seat control on seat track/platform. Install retaining screws. Tighten screws securely.

(3) Position cover on seatback. Install cover retainer clips.

(4) Attach cover bottom elastic band or attach Velcro flap to front of cover.

(5) Install seatback insert.

(6) Install headrest latch release lever bezel.

(7) Install headrest by pushing it down into seatback cylinders.

(8) Install cushion on frame. If necessary, refer to installation procedure.

(9) Install seat in the vehicle. If necessary, refer to the installation procedure.

(10) For power seats, test seat operation.

BUCKET SEAT PLATFORM

REPLACEMENT

Bucket seat platforms are not repairable. If the seat platform is damaged, replace platform as a unit. Refer to Group 8—Electrical for additional service information.

REAR SEAT CUSHION

REMOVAL

(1) Disengage seat cushion at rear by pulling upward on release strap.

(2) Tilt seat cushion forward.

(3) Disengage lower seat cushion hinge by pulling upward and out. Remove cushion from vehicle.

INSTALLATION

(1) Position seat cushion in vehicle.

(2) Insert hinge into lower pivot.

(3) Push downward to engage hinge into pivot.

(4) Lock seat cushion down by pressing firmly on center of cushion until latch engages.

REAR SEAT CUSHION COVER

REMOVAL

(1) Remove seat cushion from vehicle. If necessary, refer to removal procedure.

(2) Using a trim tool, disengage seat cover retainers around edge of seat bottom.

(3) Remove cover side, front and rear retaining clips from wire retainers with an appropriate removal tool.

(4) Remove seat cover from cushion.

INSTALLATION

(1) Place replacement cover on cushion.

(2) Compress cover and attach retaining clips to front and rear wire retainers.

(3) Install serrated retainers at ends of cover.

(4) Install seat cushion in vehicle. If necessary, refer to installation procedure.

REAR SEATBACK

REMOVAL

(1) Remove lower seat cushion. Refer to removal procedure.

(2) Remove 2 bolts holding seatback side support (Fig. 5).

(3) Tilt seatback forward, lift it upward and detach it from center pivot.

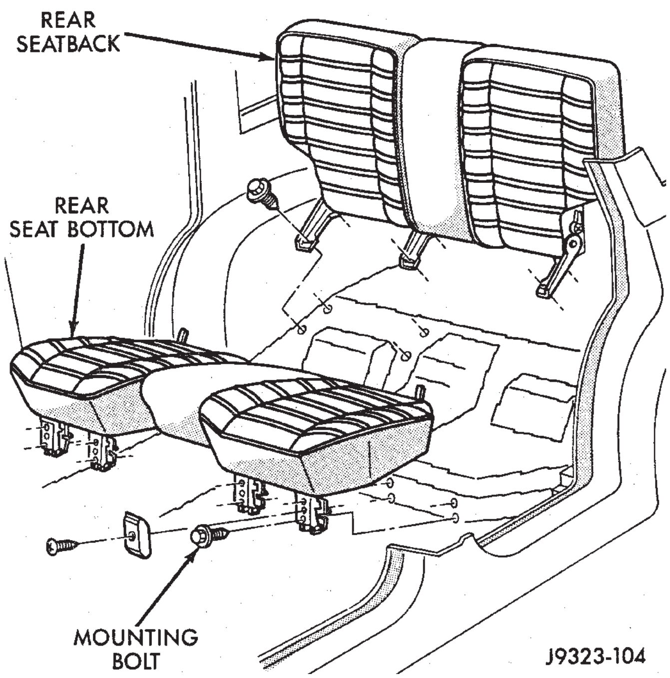

Fig. 5 Rear Seat Mounting

(4) Remove it from vehicle.

INSTALLATION

(1) Position seatback in vehicle.
(2) Install seatback onto center pivot.
(3) Position side support with bolt holes aligned. Install 2 side support bolts (Fig. 5).
(4) Install lower seat cushion. Refer to installation procedure.

REAR SEATBACK COVER

REMOVAL

(1) Remove seatback from vehicle. If necessary, refer to removal procedure.
(2) Remove seatback latch release handle and bezel from seatback.
(3) Disengage cover zipper and J-rail retainer. Remove cover from seatback pad.

INSTALLATION

(1) Install replacement cover on seatback.
(2) Attach cover J-rail retainer clip to frame/panel edge and engage cover zipper.
(3) Install seat latch release bezel and handle on cover and pad.
(4) Install seatback in the vehicle. If necessary, refer to installation procedure.

INTERIOR TRIM PANELS AND SCUFF PLATES

SERVICE INFORMATION

CAUTION: Do not attempt to remove trim panels/moldings without first removing overlapping adjacent panels.

To avoid damaging panels, verify that all screws and clips are removed before attempting to remove a trim panel/molding. Trim panels are somewhat flexible but can be damaged if handled improperly.

LOWER B-PILLAR TRIM PANEL

REMOVAL

(1) Remove retaining screws along bottom edge of trim panel (Fig. 6).

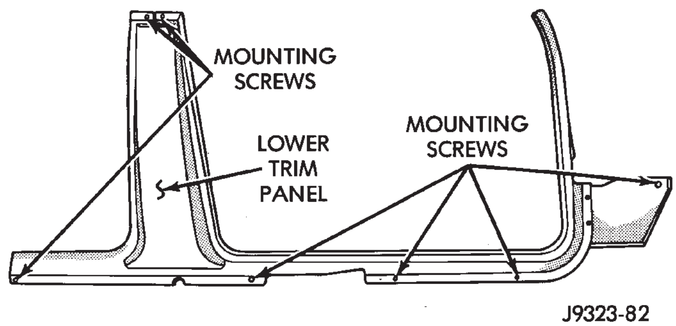

Fig. 6 B-Pillar Trim Panel

(2) Detach and remove the A-pillar upper trim panel (Fig. 7).
(3) Remove upper front seat belt mounting pivot (Fig. 8).
(4) Detach and remove upper B-pillar trim panel.
(5) Remove lower front seat belt mounting bolt (Fig. 8).
(6) Remove 2 mounting screws located behind upper B-pillar trim.
(7) Remove trim panel.
For installation, reverse removal procedure.

WINDSHIELD SIDE MOLDING

REMOVAL

(1) Unsnap clips retaining upper A-pillar trim panel.
(2) Remove trim panel (Fig. 7).
For installation, reverse removal procedure.

QUARTER TRIM PANELS

REMOVAL

(1) Pull rear seat bottom forward and fold down rear seat.
(2) Remove lower retaining screw at rear door opening (Figs. 9 and 10).
(3) Remove tonneau cover (If applicable).

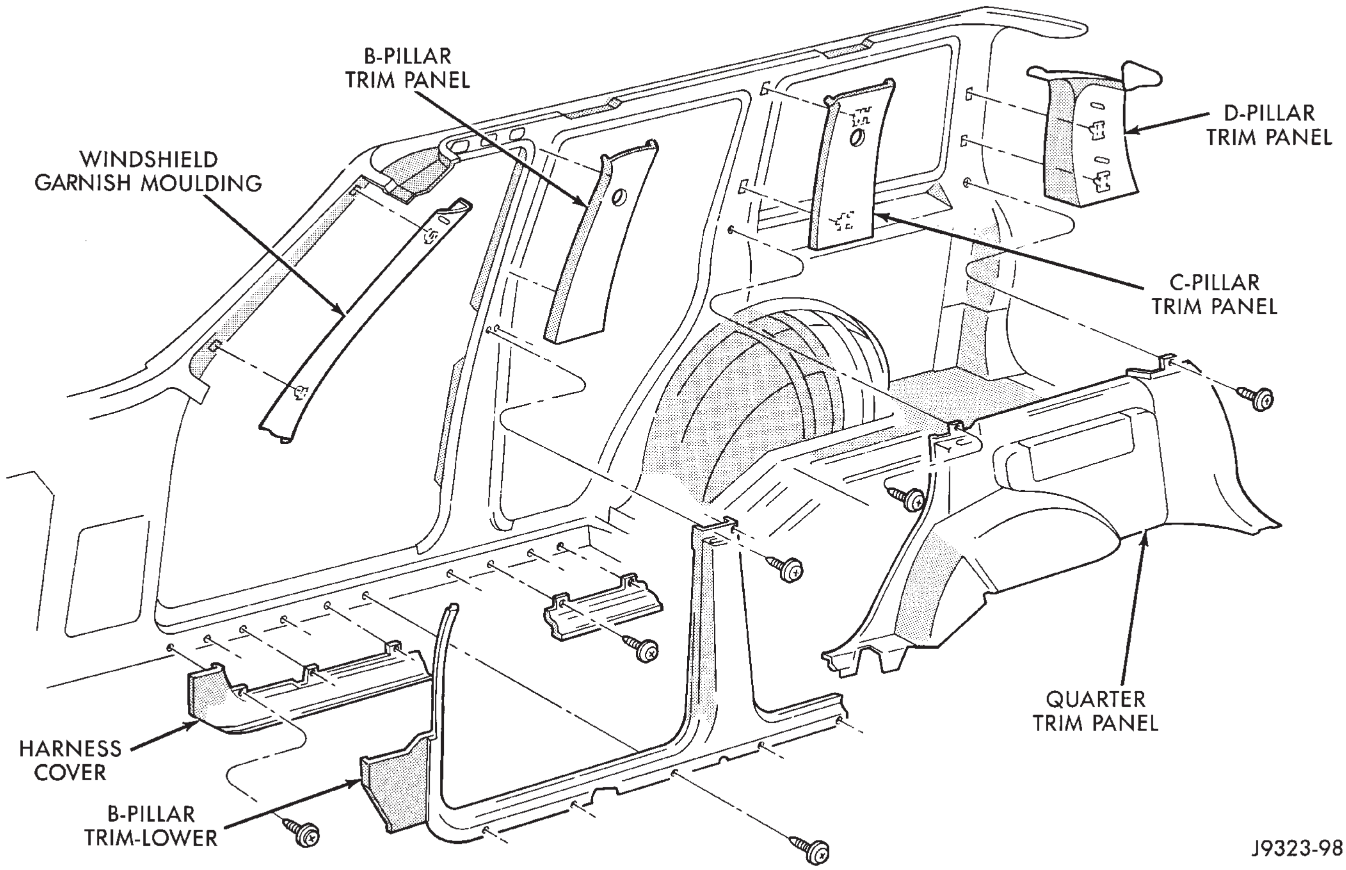

Fig. 7 Interior Trim Panels

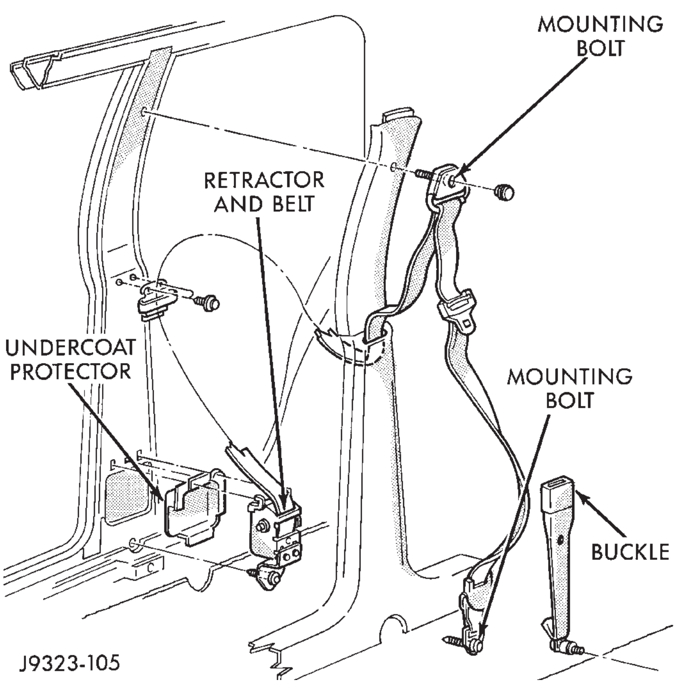

Fig. 8 Front Seat Belt

(4) Remove rear seat shoulder belt retaining bolt (Fig. 11).

(5) Detach and remove C-pillar trim panel (Fig. 7).

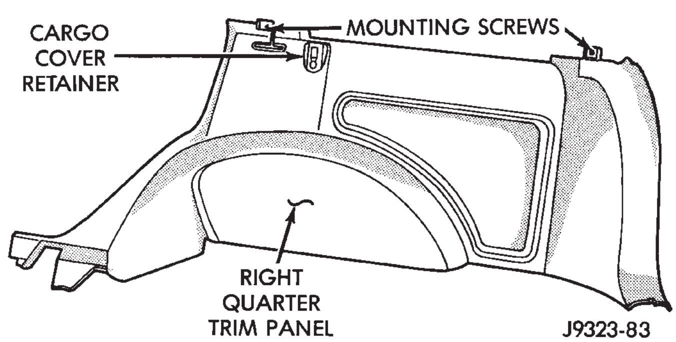

Fig. 9 Right Quarter Trim Panel

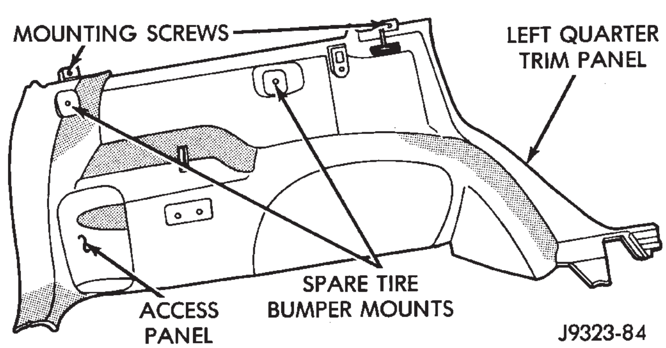

Fig. 10 Left Quarter Trim Panel

(6) Remove 5 screws retaining upper liftgate trim panel (Fig. 12).

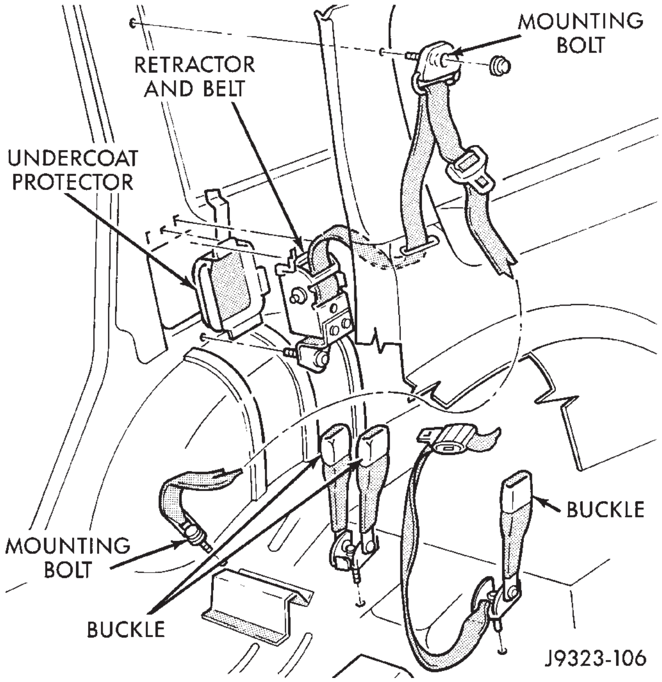

Fig. 11 Rear Seat Shoulder Belt

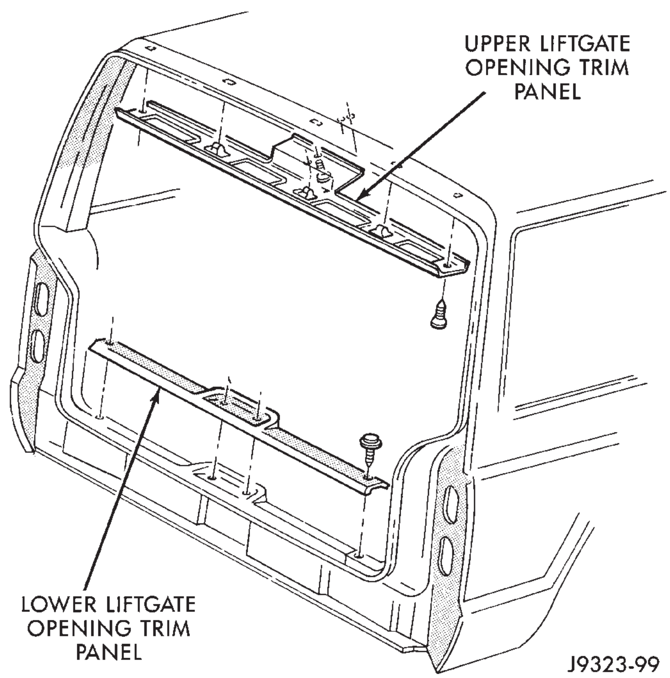

Fig. 12 Liftgate Opening Trim Panels

(7) Disconnect wiring to cargo lamp.

(8) Remove retaining clip at liftgate prop rod lower mount and detach rod (Fig. 13).

(9) Remove liftgate lower trim panel from liftgate opening (Fig. 12).

(10) Remove quarter trim panel mounting screws (Figs. 9 and 10).

(11) If necessary, remove spare tire (Fig. 14) and tire stand-offs from left quarter trim panel (Fig. 15).

(12) Remove rear quarter trim panel.

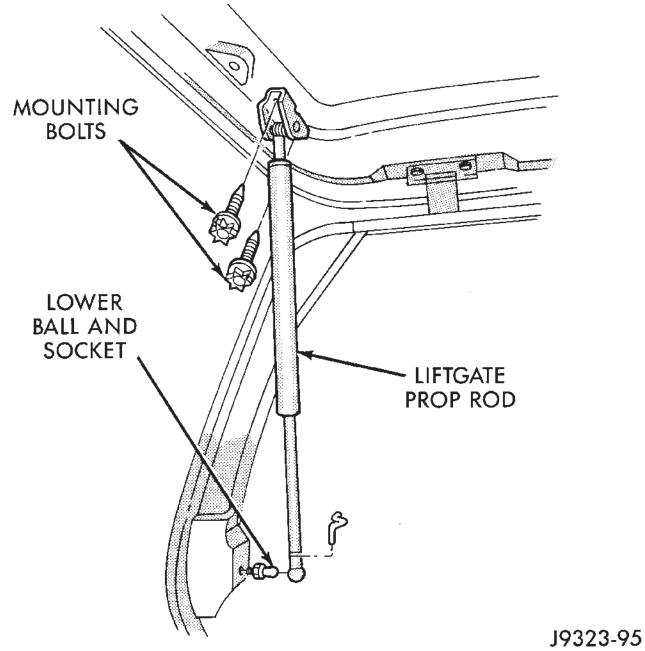

Fig. 13 Liftgate Prop Rod

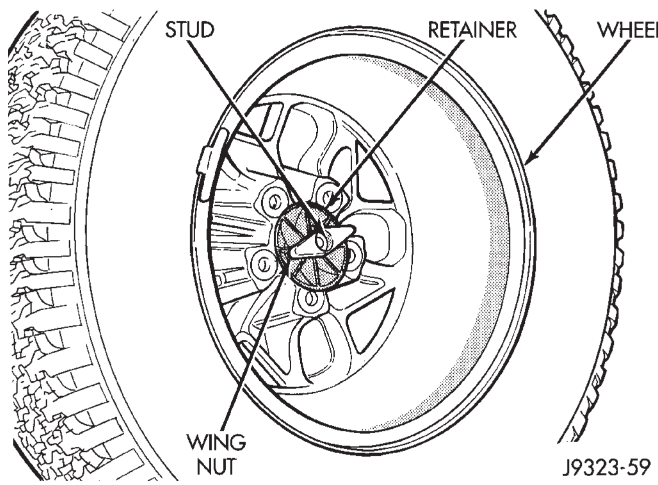

Fig. 14 Spare Tire Mounting

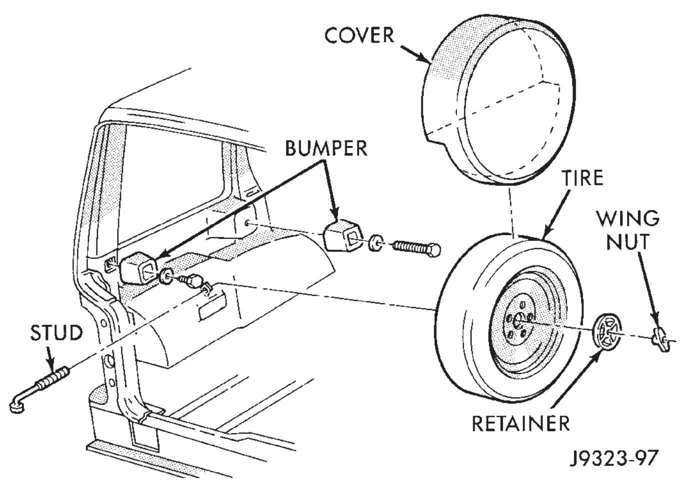

Fig. 15 Tire Stand-Offs—Left Quarter Trim Panel

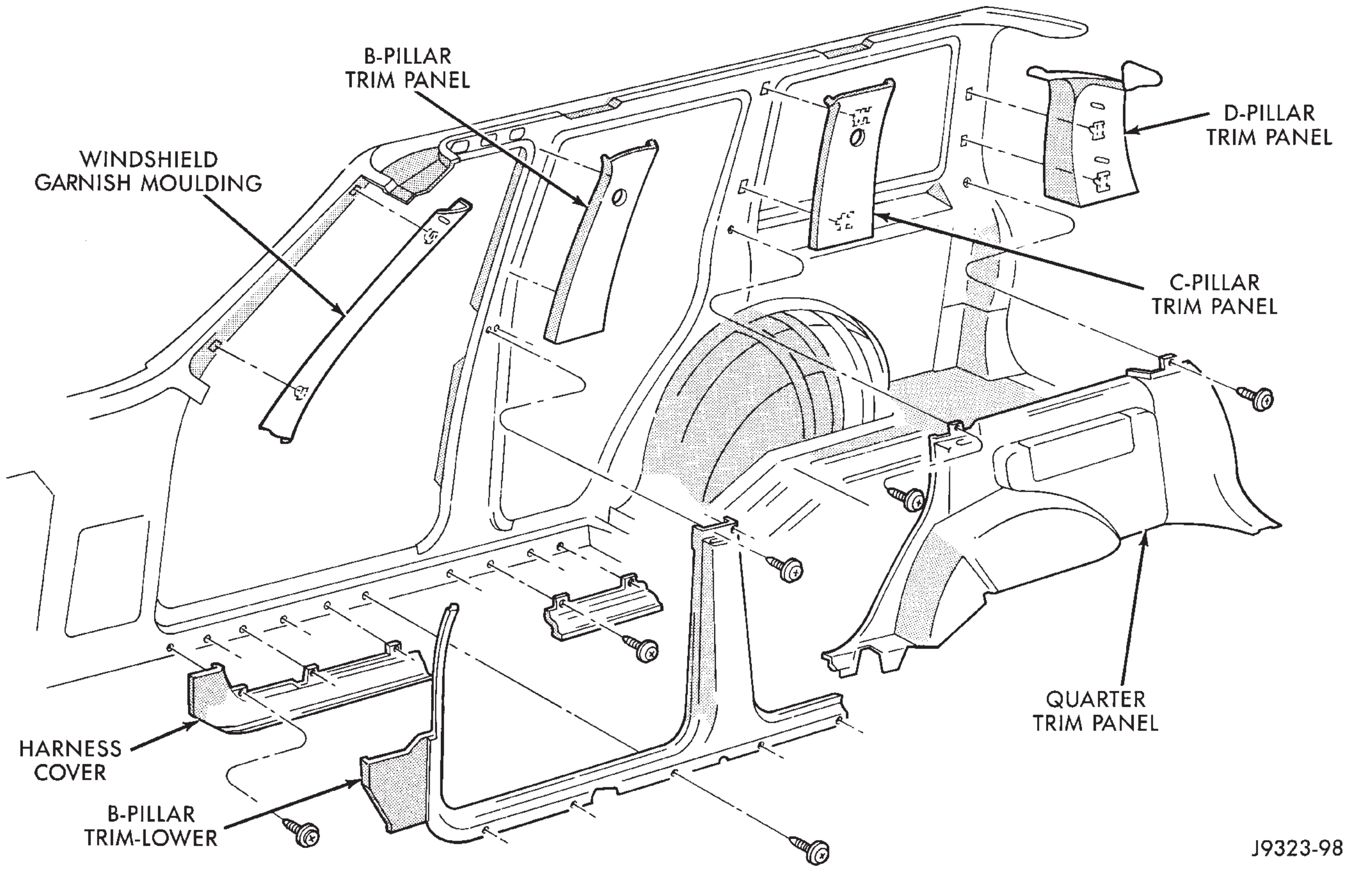

Fig. 16 Interior Trim Panels

For installation, reverse removal procedure.

B AND C-PILLAR TRIM COVERS

REMOVAL

(1) Remove shoulder belt retaining bolt (Figs. 8 and 11).

(2) Detach and remove pillar trim panel from pillar (Fig. 16).

INSTALLATION

(1) Position trim cover on pillar. Snap trim panel into place (Fig. 16).

(2) Install shoulder belt retaining bolt.

D-PILLAR TRIM COVER

REMOVAL

(1) Remove liftgate upper trim panel (Fig. 12).

(2) Remove prop rod lower retaining clip and detach prop rod from mount (Fig. 13).

(3) Detach and remove trim panel from D-pillar (Fig. 16).

INSTALLATION

(1) Position D-pillar trim panel on D-pillar and snap in place (Fig. 16).

(2) Snap prop rod onto mount and install retaining clip (Fig. 13).

(3) Install upper liftgate trim panel (Fig. 12).

OUTER SCUFF PLATES

REMOVAL

The door sill outer scuff plates are attached to the sills with molded-in snap retainers.

Using a flat blade screwdriver, detach scuff plate from sill (Fig. 17).

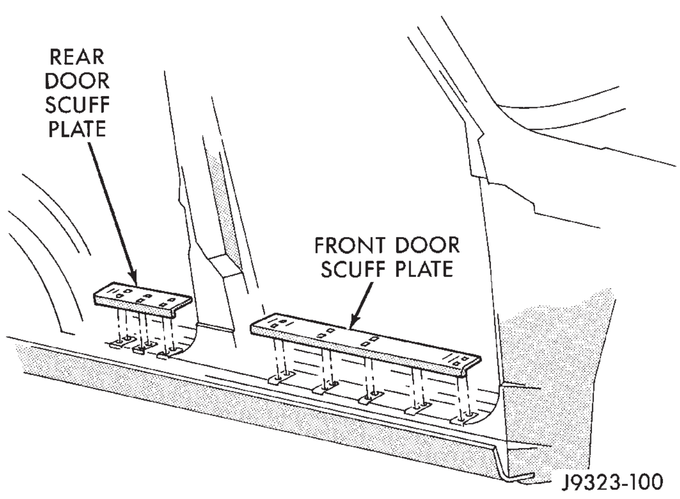

Fig. 17 Scuff Plates

For installation, reverse removal procedure.

ASSIST HANDLE

REMOVAL

(1) Remove the 2 Torx retaining screws (Fig. 18).

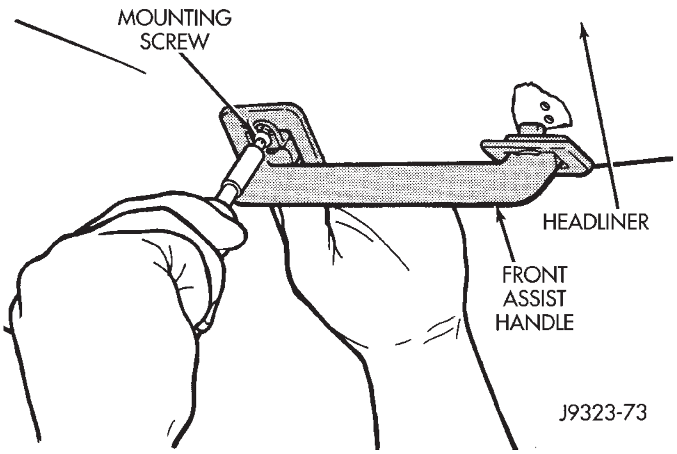

Fig. 18 Assist Handle

(2) Remove assist handle from roof panel.

INSTALLATION

(1) Position handle on the roof panel and install retaining screws (Fig. 18). Tighten retaining screws to 3 N●m (22 in-lbs) torque.

FRONT SHOULDER BELT/BUCKLE

REMOVAL

(1) Slide front seats all the way forward for access to buckle anchor bolt.

(2) Disconnect buckle wire harness connector.

(3) Remove anchor bolt cover.

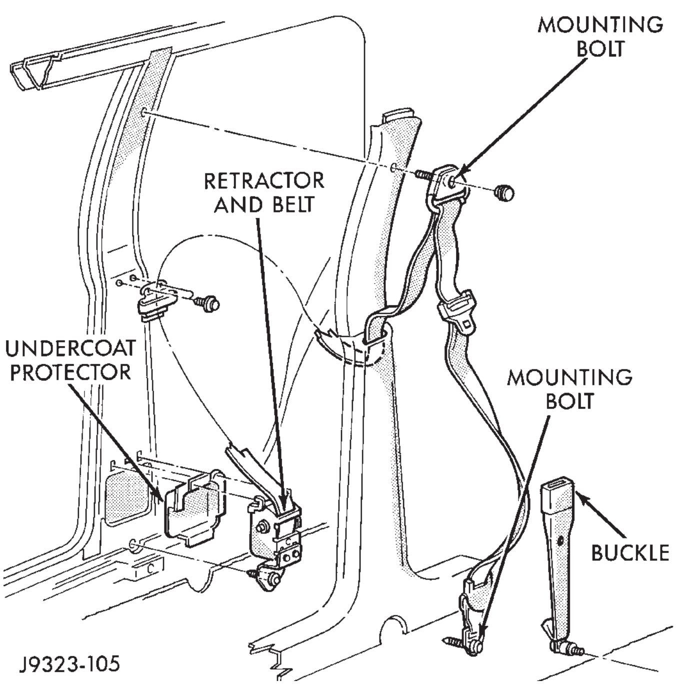

Fig. 19 Front Shoulder Belt/Buckle

(4) Remove buckle anchor bolt with a Torx bit (Fig. 19).

(5) Remove shoulder belt buckle from transmission tunnel.

(6) Remove cap concealing shoulder belt upper anchor bolt (Fig. 19).

(7) Use a Torx bit to remove upper anchor bolt (Fig. 20).

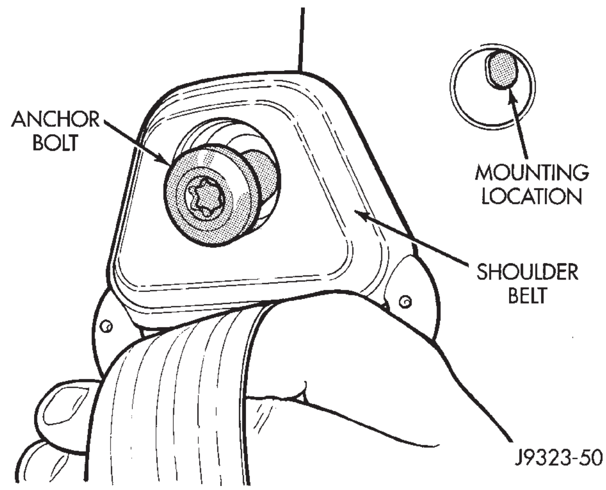

Fig. 20 Upper Seat Belt Mounting

(8) Remove lower A to B trim panel, refer to service procedure. Remove shoulder belt lower retractor anchor bolt with a Torx bit (Fig. 19).

(9) Remove shoulder belt and retractor (Fig. 19).

For installation, reverse removal procedure. Tighten anchor bolts to 37 N●m (27 ft-lbs)

REAR SHOULDER/LAP BELT/BUCKLE

REMOVAL

(1) Pull rear seat release strap and tilt seat bottom forward. Remove seat bottom from lower latch.

(2) Unlatch seat back and tilt forward.

(3) Remove shoulder belt buckle and lap belt/buckle anchor plate bolts from the floor panel (Fig. 21).

(4) Remove quarter trim panel.

(5) Remove shoulder belt upper anchor bolt (Fig. 20).

(6) Remove belt retractor anchor bolt from rear quarter rail (Fig. 21).

(7) Remove retractor and shoulder belt from panel (Fig. 21).

For installation, reverse removal procedure. Tighten anchor bolts to 37 N●m (27 ft-lbs)

HEADLINER

REMOVAL

CAUTION: The headliner is a one-piece, molded component. It has limited flexibility and must not be bent. Damage possibly will result.

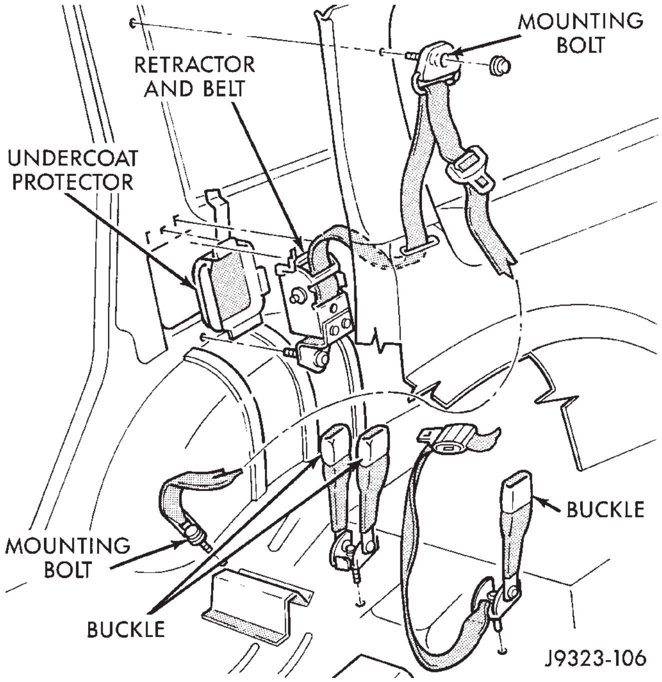

Fig. 21 Rear Seat Shoulder/Lap Belts & Buckles

(1) Remove the A,B,C and D-pillar trim moldings from perimeter of headliner (Fig. 22).

(2) Remove upper liftgate trim molding (Fig. 23).

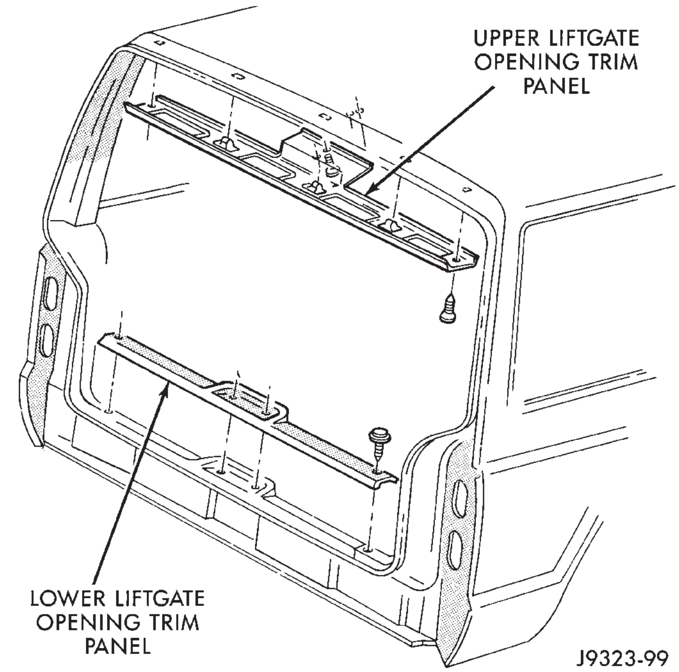

Fig. 23 Liftgate (Headliner) Trim Molding

(3) Remove sunvisors from front of roof panel (Fig. 24). Disconnect vanity lamp wiring (if applicable)

(4) Remove assist handles or plugs from side of roof rails (Fig. 25)

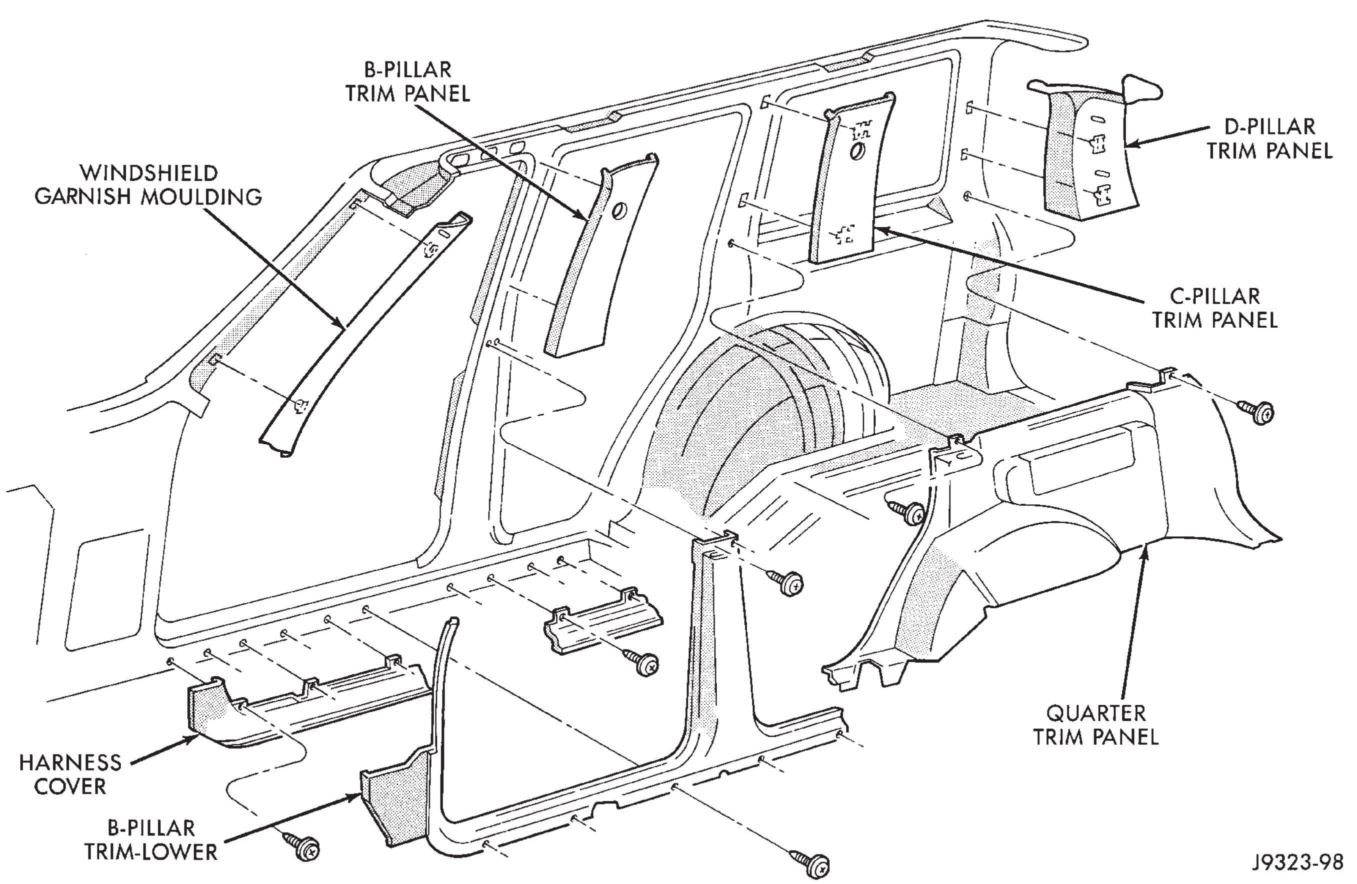

Fig. 22 Trim Moldings

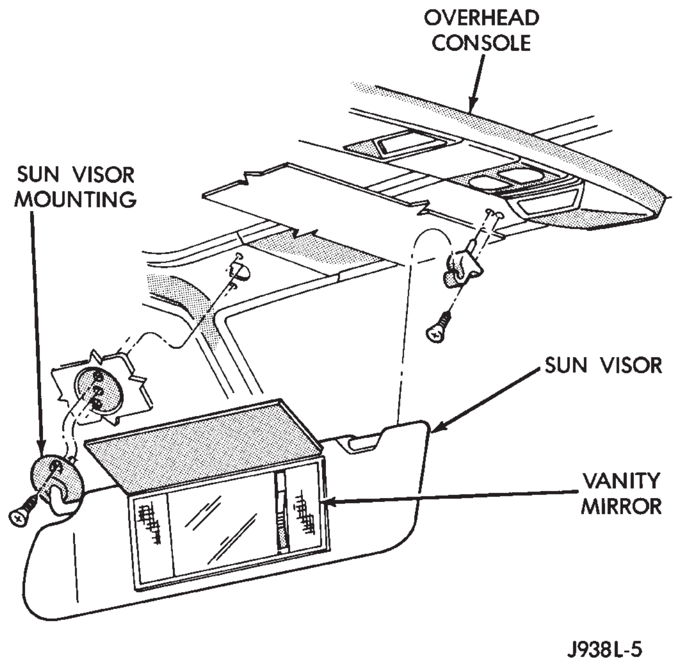

Fig. 24 Sun Visor

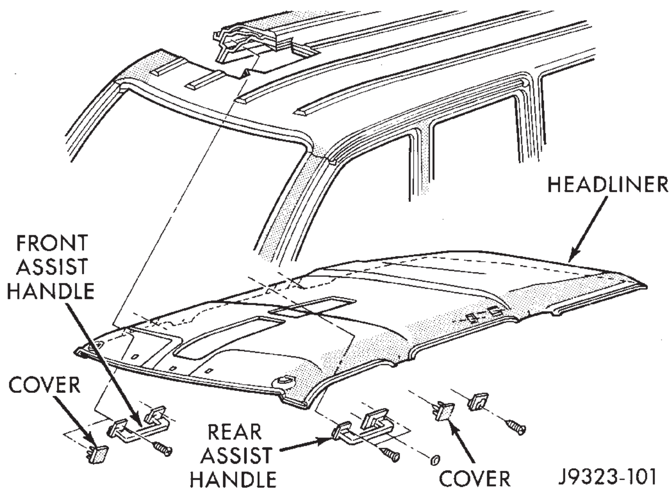

Fig. 25 Assist Handles

(5) Remove dome/reading lamp or overhead console from center of roof panel (Fig. 26).

(6) With aid of an assistant, remove headliner through liftgate opening.

INSTALLATION

(1) With the aid of an assistant, position headliner in vehicle (Figs. 27, 28, 29)

(2) Install dome/reading lamp (Fig. 26).

(3) Install sunvisors (Fig. 24).

(4) Install assist handles or plugs (Fig. 25).

(5) Install A,B,C and D-pillar trim panels (Fig. 22).

(6) Install liftgate upper trim panel (Fig. 23).

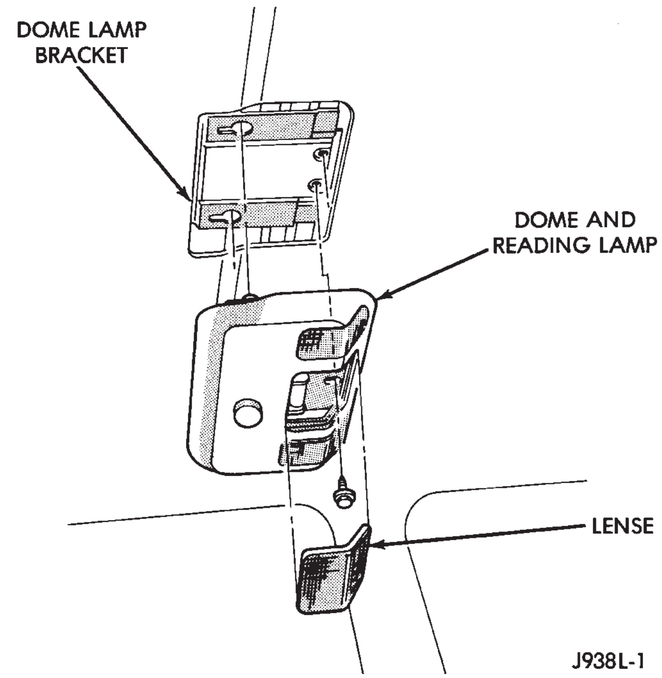

Fig. 26 Dome/Reading Lamp

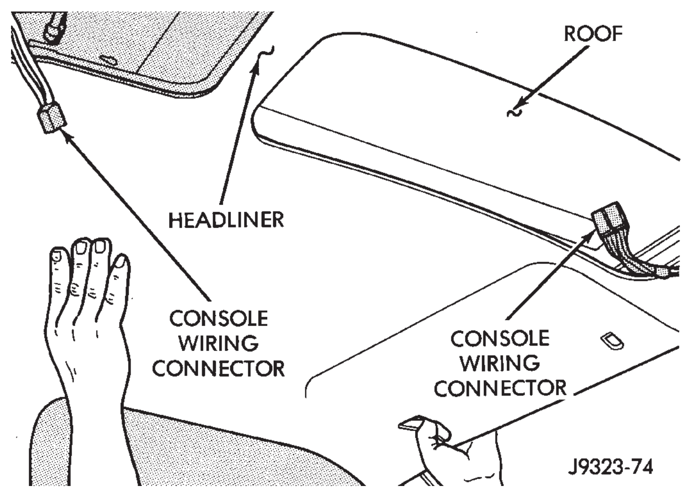

Fig. 27 Headliner Positioning/Front

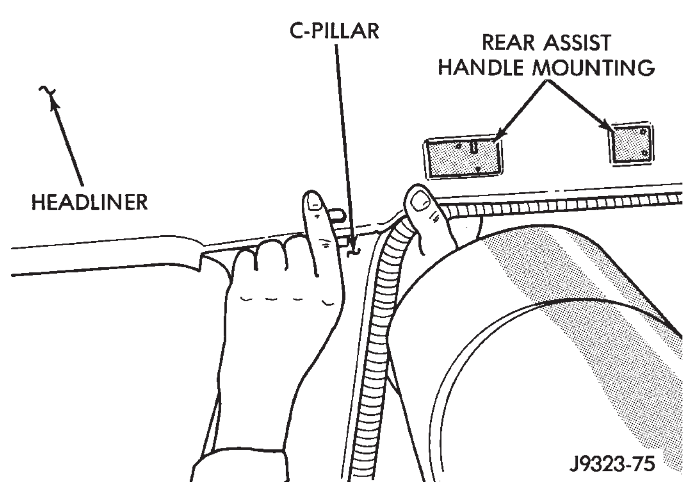

Fig. 28 Headliner Positioning/Side

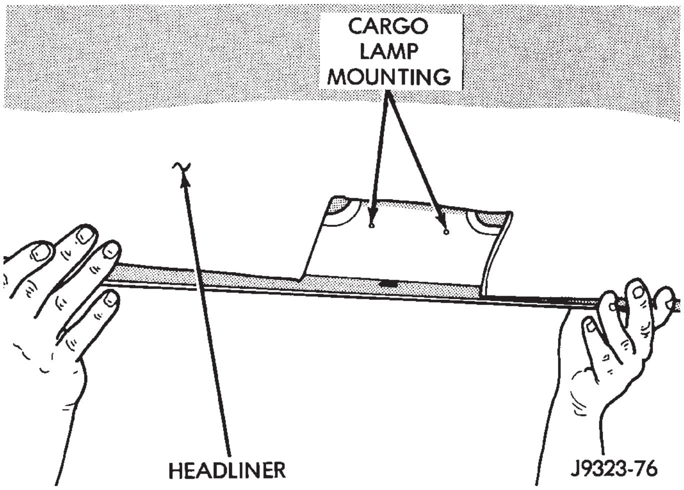

Fig. 29 Headliner Positioning/Rear

SUNVISORS

REMOVAL

(1) Remove screws that attach sunvisor arm support bracket to headliner and roof panel (Fig. 24).

(2) Detach sunvisor from support bracket (Fig. 24).

(3) Remove sunvisor from vehicle.

(4) Remove retaining screw and support bracket (Fig. 24).

For installation, reverse removal procedure.

MINI-FLOOR CONSOLE

PARKING BRAKE HANDLE COVER

REMOVAL

(1) Pull up and remove cup holder from center of parking brake cover (Fig. 30).

(2) Remove 2 screws retaining parking brake bezel (Fig. 31).

(3) Pull up on parking brake and remove parking brake cover.

For installation, reverse removal procedure.

SHIFTER COVER

REMOVAL

(1) Pull transmission shift lever handle straight up and remove handle.

(2) Remove transmission and transfer case shift indicator bezels by prying upward to release them (Fig. 31).

(3) Disconnect lamp sockets from bezels (Fig. 30).

(4) Remove console retaining screws (Fig. 32).

(5) Remove mini-console from transmission tunnel (Fig. 30).

For installation, reverse removal procedure.

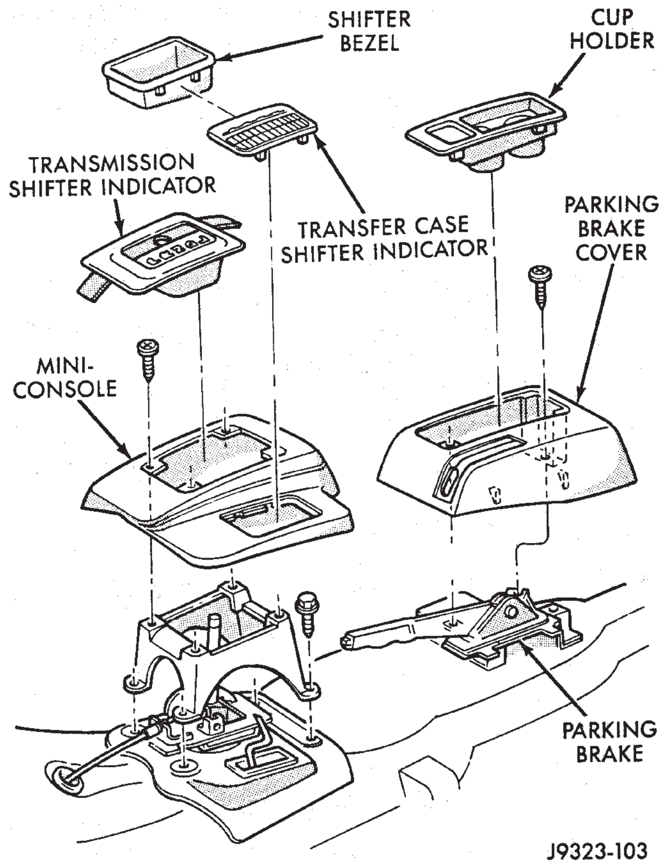

Fig. 30 Mini-Console Components

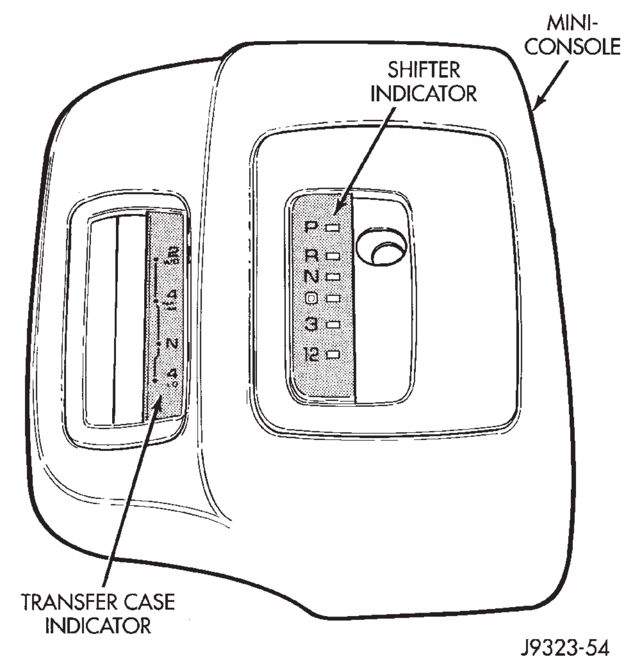

Fig. 31 Mini-Console Bezels

FULL FLOOR CONSOLE

REMOVAL

(1) Pull transmission shift lever handle straight up and remove handle.

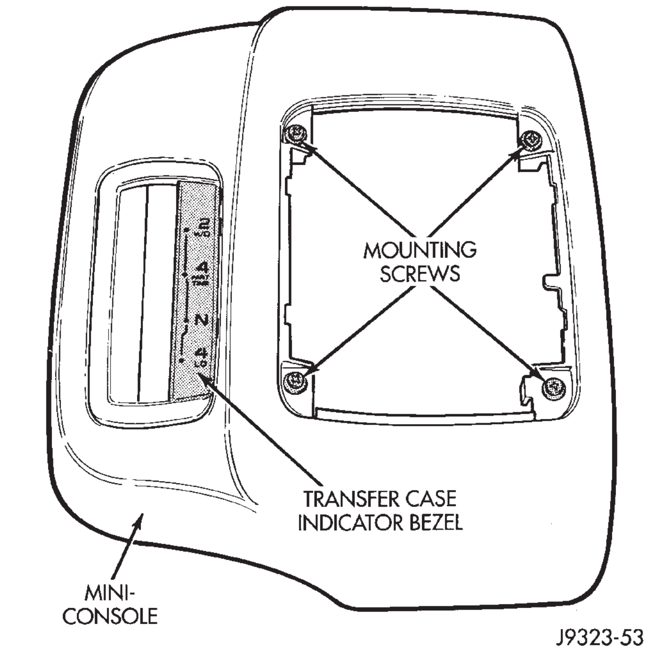

Fig. 32 Mini-Console Mounting

(2) Remove transmission and transfer case shift indicator bezels by prying upward to release them. Position flat screwdriver between bezel and console to remove indicator bezel.

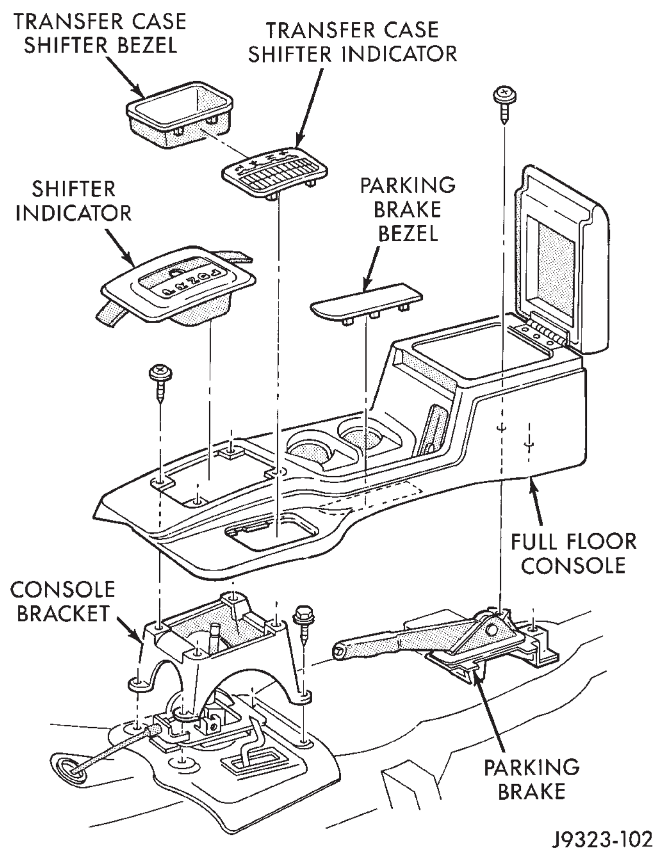

Fig. 33 Full Console Components

(3) Disconnect lamp sockets from bezels (Fig. 33).

(4) Remove console retaining screws (Figs. 34 and 35).

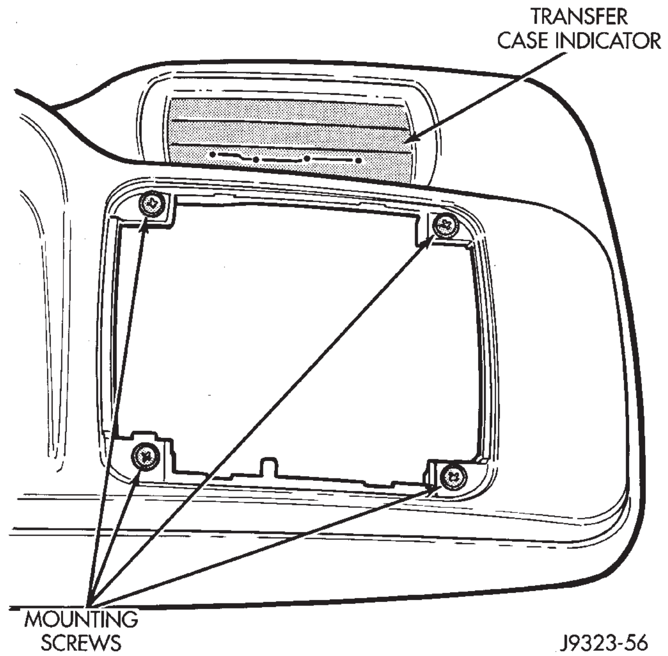

Fig. 34 Console Mounting/Front

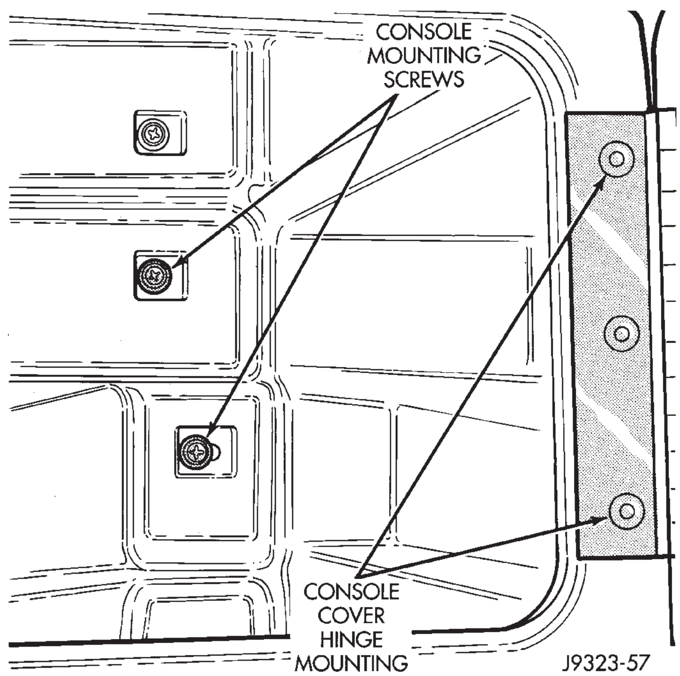

Fig. 35 Console Mounting/Rear

(5) Remove console from floor (Fig. 36).

For installation, reverse removal procedure.

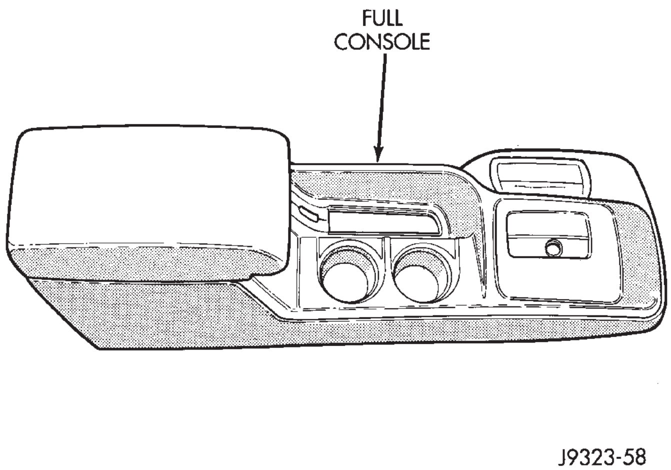

Fig. 36 Full Console

CARPETS AND FLOOR MATS

FRONT CARPET/MAT

REMOVAL

(1) Remove lower B-pillar trim panels.
(2) Remove front and rear seats (as applicable).
(3) As necessary, remove trim panels and moldings.
(4) Remove floor console.
(5) Remove all other interfering components.
(6) Remove carpet and mat from floor panel (Fig. 37).

For installation, reverse removal procedure.

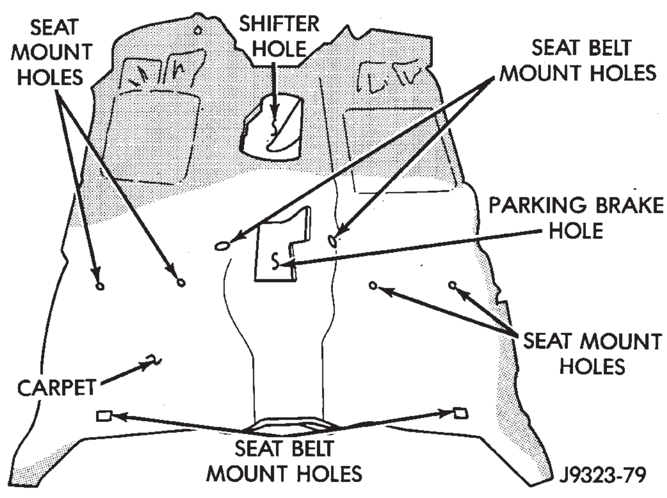

Fig. 37 Front Carpet & Mat

CARGO CARPET/MAT

REMOVAL

(1) Remove quarter trim panels.
(2) Remove retaining screws, and liftgate trim panel.
(3) Drill-out retaining rivet heads and remove cargo tie-down footman loops from carpet (Fig. 38).
(4) Remove rear seats and belts.
(5) As necessary, remove trim panels and moldings.

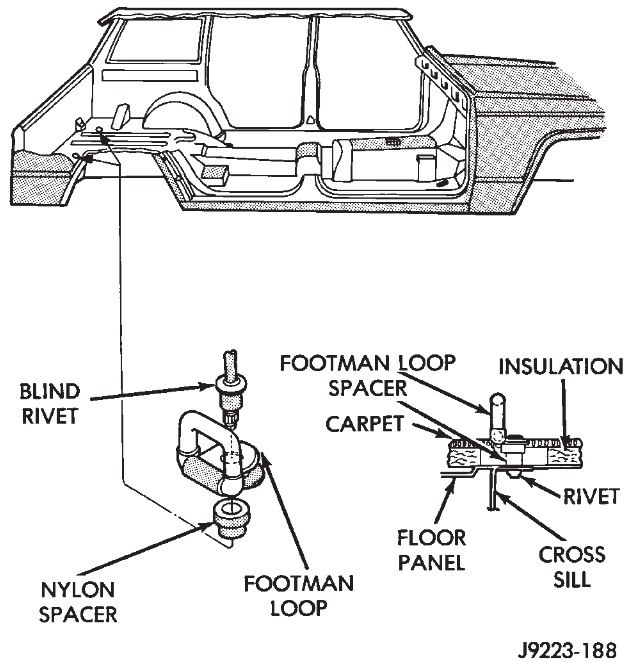

Fig. 38 Cargo Tie-Down Footman Loop

(6) Remove all other interfering components.
(7) Remove carpet and mat from floor panel (Fig. 39).

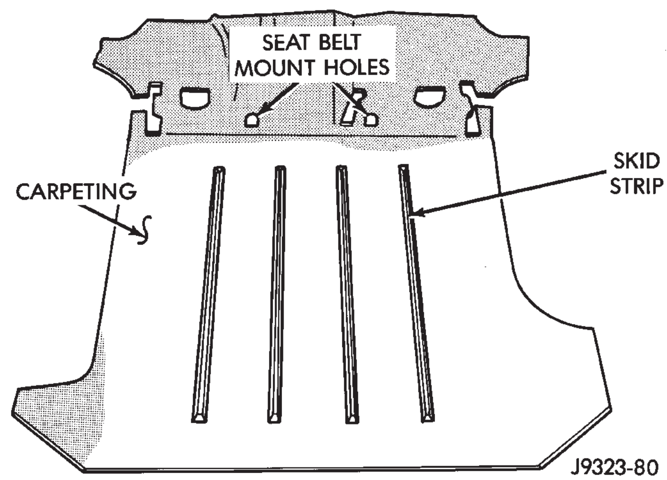

Fig. 39 Rear Carpet & Mat

(8) If necessary, remove skid strips from carpet.

For installation, reverse removal procedure.

FUEL DOOR CABLE

REMOVAL

(1) Remove left lower B-pillar trim panel.
(2) Remove rear seats.
(3) Remove left rear quarter trim panel.
(4) Pull up on side of carpeting along rear door sill.
(5) Disconnect and remove fuel door cable at fuel door lever (Fig. 40).

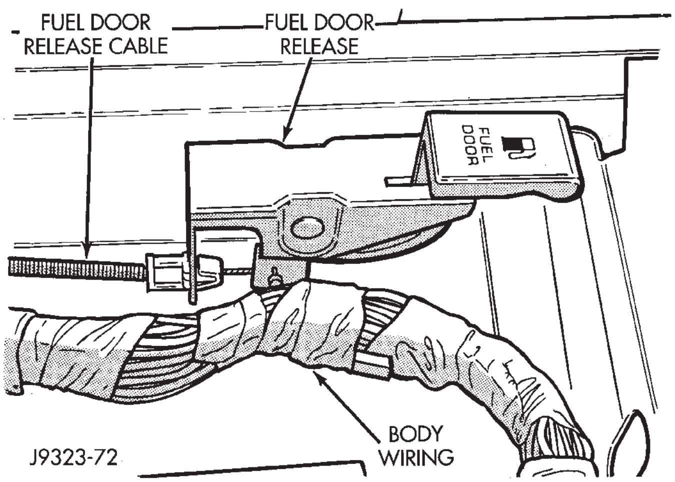

Fig. 40 Fuel Door Lever

(6) Remove cable from routing clips along floor (Fig. 41).

(7) Remove cable from fuel door latch and grommet (Fig. 42).

(8) Remove cable from vehicle.

For installation, reverse removal procedure.

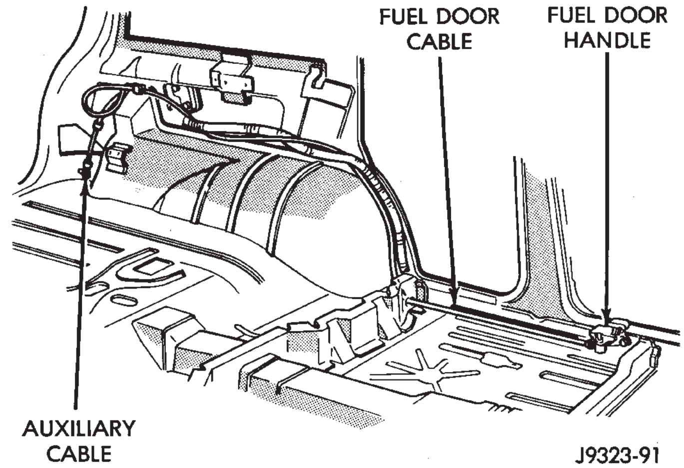

Fig. 41 Fuel Door Cable Routing

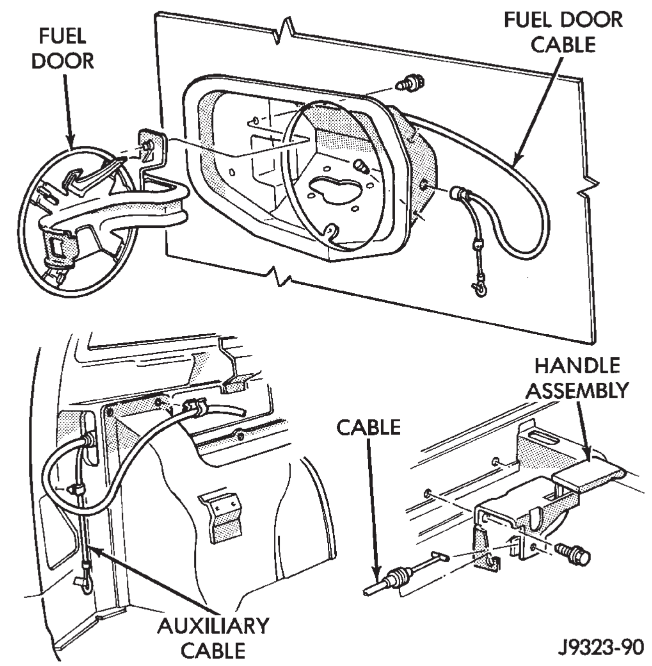

Fig. 42 Fuel Door Components

REFINISHING PROCEDURES

SERVICE INFORMATION

Exterior vehicle body colors are identified on the Body Code plate. The plate is attached to the top, right side of the cowl below the cowl grille. The color code location is described in the manual introduction.

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 colors and corresponding Grand Cherokee paint codes are listed in the following chart.

BASE COAT/CLEAR COAT FINISH

On most vehicles a two part paint application (base coat/clear coat) is used. Color paint that is applied to primer is called base coat. The clear coat protects base coat from ultraviolet light. It also provides a durable high gloss finish.

WET SANDING, BUFFING AND POLISHING

Minor acid etching, orange peel or smudging in clear coat can be reduced with light wet sanding, hand buffing and polishing. If the finish has been wet sanded in the past, it cannot be repeated. Wet sanding operation should be performed by a trained automotive painter.

CAUTION: Do not remove clear coat finish, if equipped. Base coat paint must retain clear coat to shine.

PAINTED SURFACE TOUCH-UP

When a painted metal surface has been scratched or chipped, it should be touched-up as soon as possible. For best results, use Mopar®Scratch Filler/Primer, Touch-up Paints and Clear Top Coat. Refer to Introduction group of this manual for Body Code Plate information.

TOUCH-UP PROCEDURE

(1) Scrape loose paint and corrosion from inside scratch or chip.

(2) Clean affected area with Mopar®Tar/Road Oil Remover and allow to dry.

(3) Fill the inside of the scratch or chip with a coat of filler/primer. Do not overlap primer onto good surface finish. The applicator should be wet enough to puddle/fill the defect without running. Do not stroke brush applicator on body surface. Allow the filler/primer to dry hard.

(4) Cover the filler/primer with color touch-up paint. Do not overlap color touch-up onto the original color coat. Butt the new color to the original color if possible. Do not stroke applicator brush on body surface. Allow touch-up paint to dry hard.

(5) On vehicles without clear coat, the touch-up color can be lightly (600 grit) wet sanded and polished with rubbing compound.

(6) On vehicles with clear coat, apply clear top coat to touch-up paint with the same technique as described in step 4. Allow clear top coat to dry hard. If desired, step 5 can be performed on clear top coat.

PAINT CODE CHART

GENERAL INFORMATION

The following paint code chart lists the paint color name on the left side and the paint code on the right side. The paint colors listed are available at your local paint supplier. Clear Coat (CC) colors are designated after the color title.

EXTERIOR COLORS

Colorado Red—CC HE4
Bk. Cherry Pearl—CC..FM9
Lt. Pearlstone Pearl—CC....................................HV1
Hunter Green (Met)—CC.....................................JG5
Jewel Blue Pearl—CC..MC9
Lt. Blue Satin Glow—CC ....KBD
Black—CC DX8
Brt. Silver Quartz Met.—CC ....LDA
Dk. Quartz Gray Met.—CC HD8
Bright White—CC...GW7

INTERIOR COLORS

Agate/Med. Quartz..AD
Crimson Red/Dk. Crimson ....MM
Lt./Med. Driftwood ....FF

HEATING AND AIR CONDITIONING

CONTENTS

GENERAL INFORMATION

INDEX

Both the heater and the heater/air conditioning systems share many of the same functioning components. This Group will deal with both systems together when component function is common and separately when they are not. The automatic temperature control (ATC) system diagnostics is dealt with separately.

For proper operation of the instrument panel controls (Fig. 1), refer to the Owner's Manual provided with the vehicle.

All vehicles are equipped with a common heater-A/C unit housing assembly (Fig. 2). On heater only systems, the evaporator coil is omitted and replaced with an air restrictor plate.

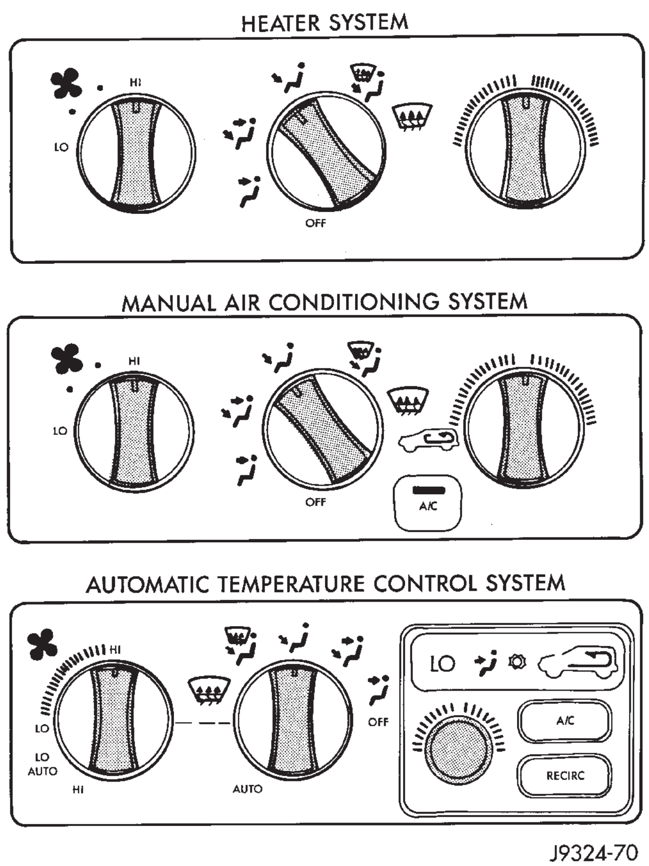

Fig. 1 Heater, Manual A/C and ATC Controls

HEATER SYSTEM

All models use a Blend-Air type heater. Outside air enters the heater through the cowl opening and passes through a plenum chamber to the heater core. Air intake openings must be kept free of snow, ice and other obstructions for the heater system to pick up a sufficient volume of outside air. A temperature control door in the heater housing directs incoming air through and/or around the heater core. The amount of blend (heated and non-heated air) is determined by the setting of the temperature knob on the instrument panel. Direction of the blended air is controlled by the mode knob on the instrument panel.

The blower switch and resistor block controls the speed of the blower motor. This in turn controls the

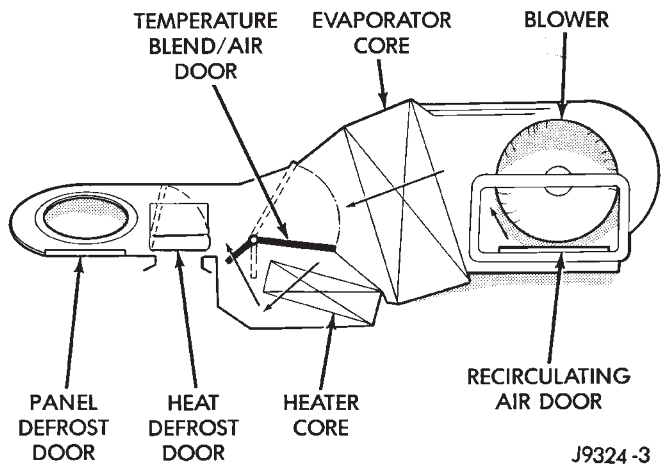

Fig. 2 Common Blend-Air Heater-A/C System

velocity of the air flow from the FLOOR (heater), DEFROST or PANEL outlets.

SIDE WINDOW DEMISTERS

The side window demisters direct air from the heater assembly. The outlets are located on the top left and right edges of the door panels. The Demisters operate when the control mode selector is on FLOOR, BI-LEVEL, FLOOR/DEFROST or DEFROST mode.

AIR CONDITIONING SYSTEM

The A/C system uses a 10PA17 fixed displacement compressor. A label identifying the use of R-134a refrigerant is located on the compressor.

CAUTION: DO NOT use an R-12 compressor on an R-134a system. The systems are not compatible.

The air conditioning system has an evaporator to cool and dehumidify the incoming outside air prior to blending with the heated air. The compressor is in operation during the FLOOR/DEFROST mode, DEFROST mode and when the A/C button is engaged. The compressor is not in operation at ambient temperatures below approximately -1°C (30°F). To maintain minimum evaporator temperature, a fixed pressure setting switch cycles the compressor clutch. The blower is operating in the heater or air conditioning systems, except in the OFF mode. In the OFF mode the blower and the outside air are shut off.

The Automatic Temperature Control (ATC) system lets the operator change the passenger compartment comfort conditions. A computer, built into the control panel, regulates the desired temperature, air flow direction and blower speed. The operator may also select an AUTO mode feature in which the computer would select the blower speed and air flow direction. Refer to the Owner's Manual for proper operation.

SYSTEM AIRFLOW

Refer to Fig. 3 for the system airflow. The system pulls outside (ambient) air through the cowl opening at the base of the windshield. Then it goes into the plenum chamber above the heater-A/C unit housing. On air conditioned vehicles, the air passes through the evaporator. Air flow can be directed either through or around the heater core. This is done by adjusting the blend-air door with the TEMP control on the instrument panel. The air flow can then be directed from the PANEL, BI-LEVEL (panel and floor), FLOOR, FLOOR/DEFROST or DEFROST outlets. Air flow velocity can be adjusted with the blower speed selector switch on the instrument panel.

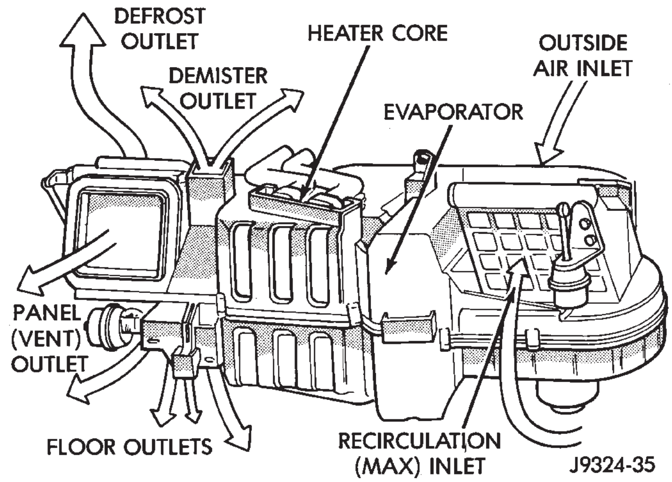

Fig. 3 Heater-A/C System Airflow (Front View)

On air conditioned vehicles, outside air can be shut off by opening the recirculating air door. This will recirculate the air that is already inside the vehicle. This is done by rotating the TEMP control knob into the RECIRC position.

REFRIGERANT

This vehicle uses 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. Even a small amount of R-12 in a R-134a system will cause compressor failure, refrigerant oil sludge or poor air conditioning system performance.

CAUTION: Never add R-12 to a system designed to use R-134a. Damage to the system will result.

The service port to charge the air conditioning system is located on the condenser to evaporator tube near the cowl panel. New service port couplers have been used to ensure that the system is not accidentally filled with the wrong refrigerant (R-12).

R-134a refrigerant requires a special type of compressor oil (ND8 PAG). When adding oil, make sure that it is designed to be used in a R-134a system.

CAUTION: R-12 compressor oil can not be mixed with the R-134a compressor oil. They ARE NOT compatible.

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 an (R-134a) refrigerant recycling device that meets SAE standard J2210 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.

REFRIGERANT SAFETY PRECAUTIONS AND WARNINGS FOR R134a

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 TYPE 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.

CAUTION: Liquid refrigerant is corrosive to metal surfaces. Follow the operating instructions supplied with equipment being used.

CAUTION: DO NOT use R-12 equipment or parts on the R-134a system. Damage to the system will result.

COOLING SYSTEM

REQUIREMENTS

To maintain the performance level of the heating/air conditioning system, the engine cooling system must be properly maintained.

The use of a bug screen is not recommended. Any obstructions in front of the radiator or condenser can reduce the performance of the A/C and/or the engine cooling system.

PRECAUTIONS

WARNING: ANTIFREEZE IS AN ETHYLENE GLYCOL BASE COOLANT AND IS HARMFUL IF SWALLOWED OR INHALED. IF SWALLOWED, DRINK TWO GLASSES OF WATER AND INDUCE VOMITING. IF INHALED, MOVE TO FRESH AIR AREA. SEEK MEDICAL ATTENTION IMMEDIATELY.

WARNING: WASH SKIN AND CLOTHING THOROUGHLY AFTER COMING IN CONTACT WITH ETHYLENE GLYCOL.

WARNING: KEEP OUT OF REACH OF CHILDREN AND PETS.

WARNING: DO NOT OPEN A COOLING SYSTEM WHEN THE ENGINE IS AT RUNNING TEMPERATURE. PERSONAL INJURY CAN RESULT.

WARNING: DO NOT STORE IN OPEN OR UNMARKED CONTAINERS.

The engine cooling system is designed to develop internal pressure of 97 to 124 kPa (14 to 18 psi). Allow the vehicle 15 minutes to cool down (or until a safe temperature and pressure are attained) before opening the cooling system. Refer to Group 7, Cooling System.

HANDLING TUBING AND FITTINGS

The air conditioning hoses used on this vehicle are made from reinforced rubber with a nylon liner on the inner walls. The ends of the A/C hoses are made from light-weight aluminum and use new braze-less fittings.

The A/C hoses use special connectors called QUICK CONNECTS. Never attempt to disconnect a quick connect without discharging the air conditioning system. All quick connects use two O-rings to seal the connection. The O-rings are made from a special type of rubber that is not affected by R-134a refrigerant. If O-ring replacement is required be sure to use the correct type of O-ring. Failure to use the correct type of O-ring will cause the connection to leak within a short period of time.

Kinks in the refrigerant tubing or sharp bends in the refrigerant hose lines will greatly reduce the capacity of the entire system. High pressures are produced in the system when it is operating. Extreme care must be exercised to make sure that all connections are pressure tight. Dirt and moisture can enter the system when it is opened for repair or replacement of lines or components. The refrigerant oil will absorb moisture readily out of the air. This moisture will convert into acids within a closed system.

The following precautions must be observed:

CAUTION: DO NOT use R-12 equipment or parts on the R-134a system. Damage to the system will result.

(1) The refrigerant system must be completely discharged into a refrigerant recovery/recycling device before opening any fitting or connection. Open fittings with caution even after the system has been discharged. If any pressure is noticed as a fitting is loosened, allow trapped pressure to bleed off very slowly into an approved recycling device.

(2) DO NOT discharge refrigerant into the atmosphere. Use an R-134a refrigerant recycling device that meets SAE Standard J2210.

(3) A good rule for the flexible hose lines is to keep the radius of all bends at least 10 times the diameter of the hose. Sharper bends will reduce the flow of refrigerant. The flexible hose lines should be routed so they are at least 80 mm (3 in) from the engine exhaust manifold. Inspect all flexible hose lines to make sure they are in good condition and properly routed.

(4) The use of correct tools when making connections is very important. Improper tools or improper use of tools can damage the fittings.

(5) The A/C system will remain chemical stable as long as pure-moisture-free R-134a refrigerant oil is used. Abnormal amounts of dirt, moisture or air can upset the chemical stability. This condition could cause operational troubles or even serious damage if present in more than very small quantities.

(6) When it is necessary to open the refrigeration system, have everything needed to service the system ready. The system should not be left open any longer than necessary. Cap or plug all lines and fittings as soon as they are opened to prevent the entrance of dirt and moisture. All lines and components in parts stock should be capped or sealed until they are ready to be used.

(7) All tools, including the refrigerant recycling equipment, the manifold gauge set and test hoses should be kept clean and dry. All tools and equipment must be designed for the R-134a refrigerant.

COMPONENT DESCRIPTION

COMPRESSOR

The A/C system uses a Model 10PA17 fixed displacement compressor (Fig. 4 or 5). This compressor is a 10 piston double acting type. The compressor is mounted on the front right side of the 4.0L engine and on the front left side of the 5.2L engine. The compressor is driven by a serpentine drive belt. The system is lubricated with polyalkylene glycol synthetic wax-free refrigerant oil (ND8 PAG).

The clutch used on the compressor consists of three 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 attached to the compressor shaft and is retained with a compressor shaft bolt. Special service tools are required to remove and install the clutch plate on the compressor shaft.

EVAPORATOR CORE

The evaporator core is located in the heater-A/C unit (Fig. 4 or 5). It is the plate fin type with a multi-pass refrigerant flow path. A mixture of refrigerant and oil enters the bottom of the core. It then flows through the evaporator inlet tube and is routed so that it flows in a W pattern through the evaporator and out the outlet tube.

CONDENSER

The air conditioning condenser is an aluminum heat exchanger located in front of the radiator (Fig. 4 or 5). It cools compressed refrigerant gas. This is done by allowing air to pass over fins and tubes to extract heat and condense gas to liquid refrigerant as it is cooled.

The condenser inlet and outlet connections require a special service tool to disconnect the refrigerant lines from the condenser. To disconnect and reconnect the spring lock coupling, refer to SPRING LOCK COUPLING in this section.

SPRING LOCK COUPLING

The spring lock coupling (Fig. 4 or 5) is a refrigerant line coupling held together by a garter spring inside a circular cage. When the coupling is connected together, the flared end of the female fitting slips be-

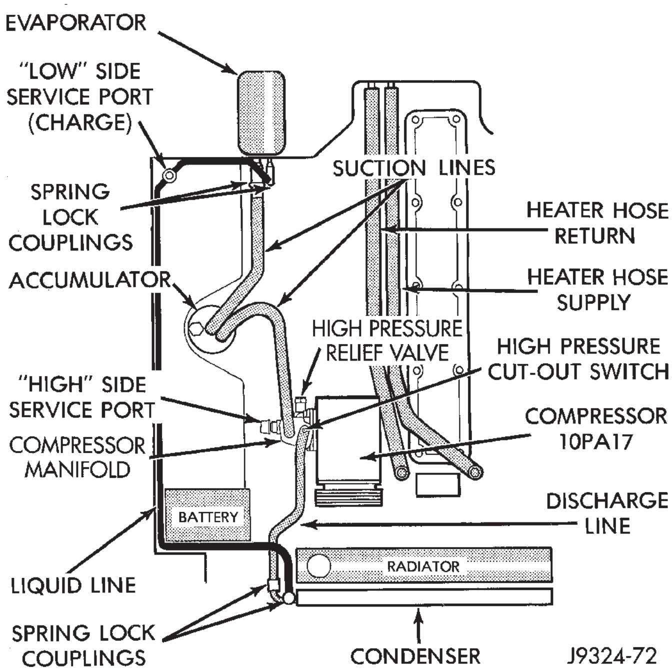

Fig. 4 Heater-A/C Components (4.0L Engine)

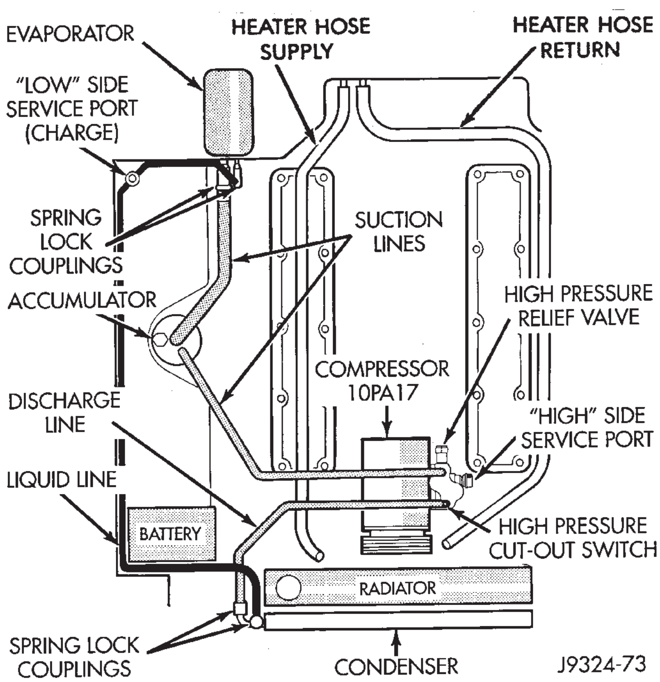

Fig. 5 Heater-A/C Components (5.2L Engine)

hind the garter spring inside the cage of the male fitting. The garter spring and cage prevent the flared end of the female fitting from pulling out of the cage.

Two O-rings are used to seal between the two halves of the coupling. These O-rings are made of special material that are compatible with R-134a refrigerant and must be replaced with an O-ring made of the same material. The O-rings normally used in refrigerant system connections are not the same material and should not be used with the spring lock coupling. Use only the O-rings listed in the parts book for the spring lock coupling.

A plastic indicator ring is used on spring lock couplings to indicate, during vehicle assembly, that the coupling is connected. Once the coupling is connected, the indicator ring is no longer necessary but will remain captive by the coupling near the cage opening.

The indicator ring may also be used during service operations to indicate connection of the coupling. After the coupling has been cleaned, new O-rings installed and lubricated with clean refrigerant oil, insert the tabs of the indicator ring into the cage opening. Connect the coupling together by pushing with a slight twisting motion. When the coupling is connected, the indicator ring will snap out of the cage opening. It will also remain captured on the coupling by the refrigerant line.

COUPLING DISCONNECT

(1) Discharge the refrigerant from the system using a recovery/recycling device.

(2) Fit the appropriate Spring Lock Coupling Tool from A/C Tool Kit 6125 (Fig. 6).

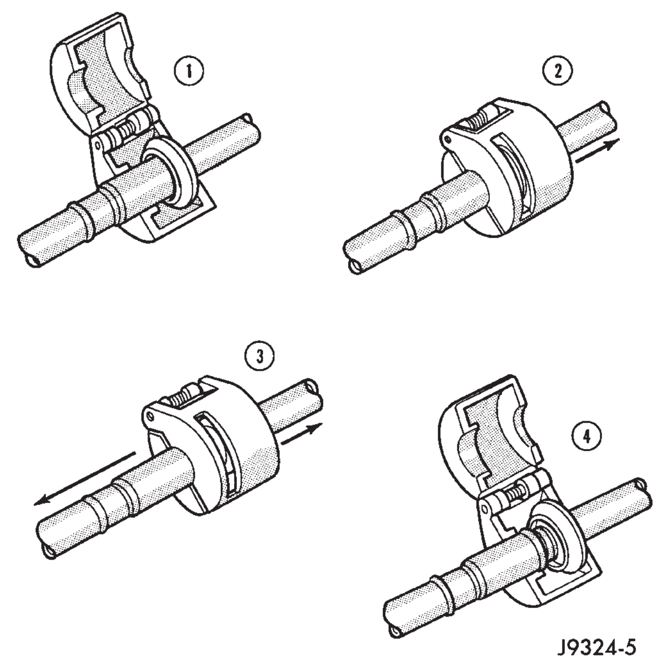

Fig. 6 Spring Lock Coupling Disconnect

(3) Close the tool and push into the open side of the cage to expand garter spring and release female fitting.

The garter spring may not release if the tool is cocked while pushing it into the cage opening.

(4) After garter spring is expanded, pull fittings apart within the tool.

(5) Remove the tool from the disconnected coupling.

(6) Separate the two ends of the coupling.

COUPLING CONNECT

(1) Check to ensure that the garter spring is in the cage of the male fitting. If the garter spring is missing, install a new spring by pushing it into the cage opening. If the garter spring is damaged, remove it from the cage with a small wire hook (do not use a screwdriver) and install a new spring.

(2) Clean all dirt or foreign material from both pieces of the coupling.

(3) Install new O-rings on the male fitting.

CAUTION: Use only the specified O-rings as they are made of a special material for the R-134a system. The use of any O-ring other than the specified O-ring may allow the connection to leak intermittently during vehicle operation.

(4) Lubricate the male fitting and O-rings and the inside of the female fitting with clean R-134a (ND8 PAG) refrigerant oil.

(5) Install the plastic indicator ring into the cage opening if indicator ring is to be used.

(6) Fit female fitting to male fitting and push until garter spring snaps over flared end of female fitting. If plastic indicator ring is used, it will snap out of the cage opening when the coupling is connected to indicate engagement.

(7) If indicator ring is not used, ensure coupling engagement. This is done by visually checking to be sure garter spring is over the flared end of female fitting.

ACCUMULATOR

The accumulator is mounted in the engine compartment on the right side of the vehicle (Fig. 4 or 5). The inlet tube of the accumulator attaches directly to the evaporator core outlet tube. Refrigerant enters the accumulator canister through the inlet tube. The liquid oil-laden refrigerant falls to the bottom of the canister which acts as a separator allowing refrigerant to enter the compressor suction line (Fig. 7).

A desiccant bag is mounted inside the suction accumulator canister to absorb any moisture which may be in the refrigerant system.

A fitting located on top of the canister is used to attach the clutch cycling pressure switch. A long travel Schrader-Type valve stem core is installed in the fitting opening. This is done to prevent refrigerant loss when the clutch cycling pressure switch is removed.

CAUTION: DO NOT use this fitting to charge the system or to check suction pressure.

To check the accumulator for excessive refrigerant oil, the oil must be poured from the accumulator and the hoses (refer to Accumulator Removal/Installation). This is done through the pressure switch fitting when the Schrader-Type valve stem is removed.

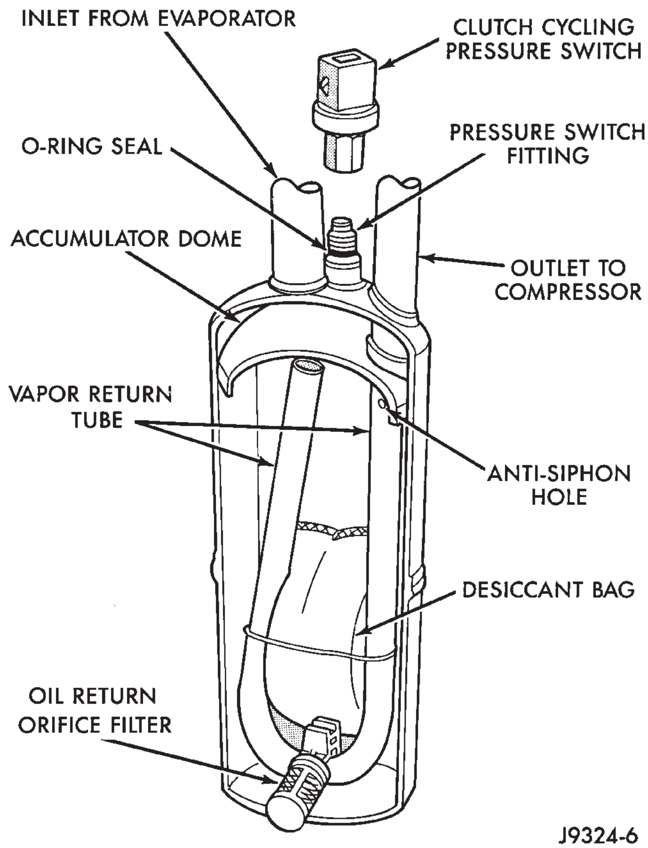

Fig. 7 Accumulator and Clutch Cycling Pressure Switch

REPLACE ACCUMULATOR WHEN:

- The accumulator is restricted, plugged or perforated.
- If there is evidence of moisture in the system (internal corrosion of metal lines or dark-thick refrigerant oil).
- The system is contaminated (such as if the compressor has seized).

DO NOT REPLACE ACCUMULATOR EVERY TIME IF:

- There is a loss of refrigerant charge.
- A component such as a condenser, evaporator or compressor (except as previously described) is changed.
- A dent is found in the outer shell of the accumulator.

CLUTCH CYCLING PRESSURE SWITCH

The clutch cycling pressure switch is mounted on a Schrader-Type valve fitting on the top of accumulator (Fig. 7). A valve depressor, is located inside the threaded end of the pressure switch. It presses in on the Schrader-Type valve stem as the switch is mounted and allows the suction evaporator outlet pressure inside the accumulator canister to control switch operation. The electrical switch contacts are normally open when the suction evaporator outlet pressure is approximately 172 kPa (25 psi) or lower. They will close when the suction evaporator outlet pressure rises to approximately 296 kPa (43 psi) or above. Lower ambient temperatures, below approximately -1°C (30°F) during cold weather will also open the clutch cycling pressure switch contacts. This is due to the pressure/temperature relationship of the refrigerant in the system. The electrical switch contacts control the electrical circuit to the compressor magnetic clutch coil. When the switch contacts are closed, the clutch coil is energized and the A/C clutch is engaged to drive the compressor.

WHEN THE SWITCH CONTACTS ARE OPEN:

- The compressor magnetic clutch coil is de-energized.
- The A/C clutch is disengaged.
- The compressor does not operate.

The clutch cycling pressure switch, when functioning properly, will control the evaporator core refrigerant flow. This is at a point where the plate/fin surface temperature will be maintained slightly above freezing. This also prevents evaporator icing and the blockage of airflow.

FIXED ORIFICE TUBE

The fixed orifice tube is located in the liquid line near the condenser (Fig. 4 or 5). It has filter screens on the inlet and outlet ends of the tube body. The filter screens act as a strainer for the liquid refrigerant flowing through the fixed orifice opening. O-rings, on the tube body, prevent the high pressure liquid refrigerant from bypassing the orifice. Adjustments cannot be made to the fixed orifice tube. If it becomes clogged or damaged, replace the condenser to evaporator tube.

The fixed orifice tube assembly is the restriction between the high and low pressure liquid refrigerant. It meters the flow of liquid refrigerant into the evaporator core. Minimum evaporator temperature is controlled by sensing the pressure within the evaporator with a pressure-operated electric switch. The pressure switch controls compressor operation as necessary to prevent evaporator freeze-up.

The condenser to evaporator tube should be replaced whenever a compressor is replaced for lack of performance (internal damage).

HIGH PRESSURE RELIEF VALVE

A pressure relief valve is used to prevent excessive high pressure build up of 3445 to 4135 kPa (500 to 600 psi) and above. This will prevent damage to the compressor and other system components. The pressure relief valve is located on the rear end of the compressor manifold.

HIGH PRESSURE CUT-OUT SWITCH

The high pressure cut-out switch is located at the plumbing connection on the compressor manifold. When the discharge pressure reaches 3100 to 3375 kPa (450 to 490 psi), the switch interrupts the electrical power to the compressor clutch. This will prevent compressor operation when compressor discharge pressure approaches high levels.

SERVICE GAUGE PORT VALVES

Two Schrader-Type gauge ports are used with the refrigerant system. The high pressure service gauge port is located on the compressor manifold. The low pressure service gauge port is located on the condenser-to-evaporator refrigerant line near the back of the engine compartment.

After servicing the refrigerant system, install cap on service gauge port.

SYSTEM DIAGNOSTICS

INDEX

A/C PERFORMANCE TEST

The air conditioning system is designed to provide the passenger compartment with low temperature and low humidity air. The evaporator, located in the heater-A/C unit behind the instrument panel, is cooled to temperatures near the freezing point. As warm damp air passes over the fins in the evaporator, the air is cooled and moisture is removed to condense on the fins. During periods of high heat and humidity an A/C system will be more effective in the RECIRC mode. With the control set to RECIRC, only air from the passenger compartment passes through the evaporator. As the passenger compartment air dehumidifies, A/C performance levels improve.

Review Safety Precautions and Warnings before proceeding with this procedure. Air temperature in test room and in the vehicle must be 21°C (70°F) minimum for this test.

(1) Connect an engine tachometer and manifold gauge set.

(2) Set control to A/C, PANEL, RECIRC (temperature knob on full cool) and blower on HIGH.

(3) Start engine and hold at 1,000 RPM with A/C clutch engaged.

(4) Engine should be warmed up with windows and/or doors opened.

(5) Insert a thermometer in the left center A/C outlet and operate the engine for 5 minutes.

(6) The A/C clutch may cycle depending on ambient conditions. If clutch cycles, remove the clutch cycling pressure switch connector from the switch located on the accumulator (Fig. 1). Place a jumper wire across the terminals of the clutch cycling pressure switch connector.

(7) With the A/C clutch engaged, record the discharge air temperature and the compressor discharge pressure.

(8) Compare the discharge air temperature to the A/C Performance (Temperature and Pressure) chart. If the discharge air temperature is high, refer to the Refrigerant Service Procedures (Refrigerant Leak Testing and Refrigerant Charge Check).

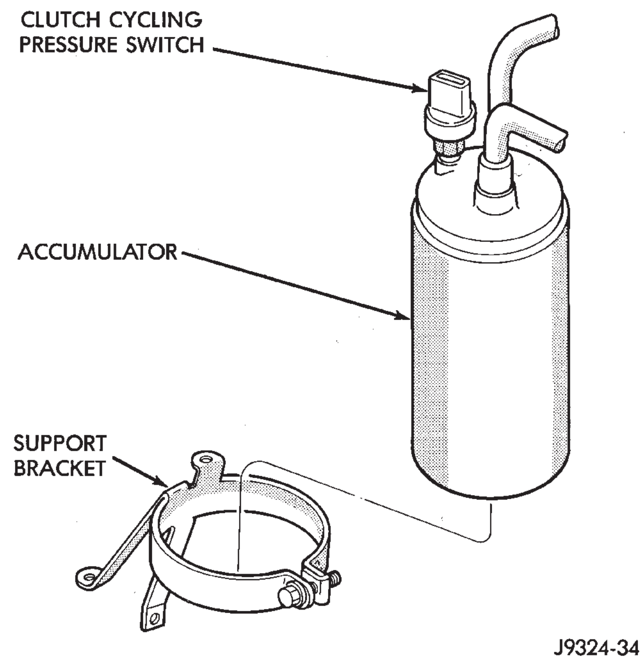

Fig. 1 Clutch Cycling Pressure Switch

(9) Compare the compressor discharge pressure to the A/C Performance (Temperature and Pressure) chart. If the compressor discharge pressure is high, refer to the Refrigerant Service Procedures (High Compressor Discharge Pressure).

REFRIGERANT SYSTEM

To check the operation of the refrigerant system, refer to Refrigerant System Diagnosis Chart.

VACUUM CONTROL

This control is used with the heater and A/C (manual) systems.

Use an adjustable Vacuum Test Gauge (C-3707) and a suitable vacuum pump to test heater-A/C control vacuum. With a finger placed over the end of test hose (Fig. 2), calibrate vacuum control valve on the test gauge to obtain -27 kPa (8 in. Hg.). Release and block the end of the test hose several times to verify vacuum setting.

A/C PERFORMANCE (TEMPERATURE AND PRESSURE)

Ambient Temperature	21°C (70°F)	27°C (80°F)	32°C (90°F)	38°C (100°F)	43°C (110°F)
Air Temperature at Center Panel Outlet	-3 to 3°C (27-38°F)	1 to 7°C (33-44°F)	3 to 9°C (37-48°F)	6 to 13°C (43-55°F)	10 to 18°C (50-64°F)
Evaporator Inlet Pressure at Charge Port	179-241 kPa (26-35 psi)	221-283 kPa (32-41 psi)	262-324 kPa (38-47 psi)	303-365 kPa (44-53 psi)	345-414 kPa (50-60 psi)
Compressor Discharge Pressure	1240-1655 kPa (180-240 psi)	1380-1790 kPa (200-260 psi)	1720-2070 kPa (250-300 psi)	1860-2345 kPa (270-340 psi)	2070-2690 kPa (300-390 psi)

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VACUUM TESTING THE ONE-WAY CHECK VALVE

(1) In the engine compartment, disconnect the Heater-A/C vacuum supply (black) hose. This hose passes through an opening in the dash panel.

(2) Remove the vacuum check valve. This valve is located on the (black) vacuum supply hose at the intake manifold.

(3) Connect test vacuum supply hose to the HEATER SIDE of the valve. In this direction the gauge should return to calibrated setting. If valve leaks vacuum in this direction, valve replacement is necessary.

(4) Connect test vacuum supply hose to the ENGINE VACUUM SIDE of the valve. Vacuum should flow through valve.

VACUUM TESTING THE HEATER-A/C CONTROLS

(1) Connect the test vacuum probe to the vehicles (black) vacuum supply hose. Position vacuum test gauge so it can be viewed from the passenger compartment.

(2) Position the heater-A/C control mode selector to DEFROST, FLOOR, BI-LEVEL, PANEL or RECIRC (with A/C). Pause after each selection. The test gauge should return to the calibrated setting of -27 kPa (8 in. Hg.) after each selection is made. If the gauge cannot achieve the calibrated setting, a vacuum circuit or component has a leak.

LOCATING VACUUM LEAKS

To locate a vacuum leak, disconnect 7-way vacuum connector behind the heater-A/C control panel (refer to Heater-A/C Control Panel Removal/Installation). Connect the calibrated vacuum hose probe to each port in the vacuum harness connector (Fig. 3). After each connection is made, the test gauge should return to calibrated setting. If all circuits function properly, replace heater-A/C control. If not, determine the color of the vacuum circuit that is leaking. To determine vacuum line colors, refer to the Vacuum Circuits chart for the heater and manual A/C units. Disconnect the vacuum actuator at the other end of the circuit. Instrument panel removal may be necessary to gain access to some components. Block the end of the disconnected vacuum line. The test gauge should return to calibrated setting. If not, that circuit has a leak and must be repaired or replaced. If test gauge returns to calibrated setting, the vacuum actuator must be replaced.

CONDENSATE WATER DRAINAGE

Condensate that accumulates in the bottom of the evaporator housing is drained from a drain hole in the heater-A/C unit. When the heater-A/C unit is installed in the vehicle, be sure that the drain hole is located properly in the dash panel. If the drain hole is out of position, water will drain into the passenger compartment. It is normal to see condensate drainage below the vehicle.

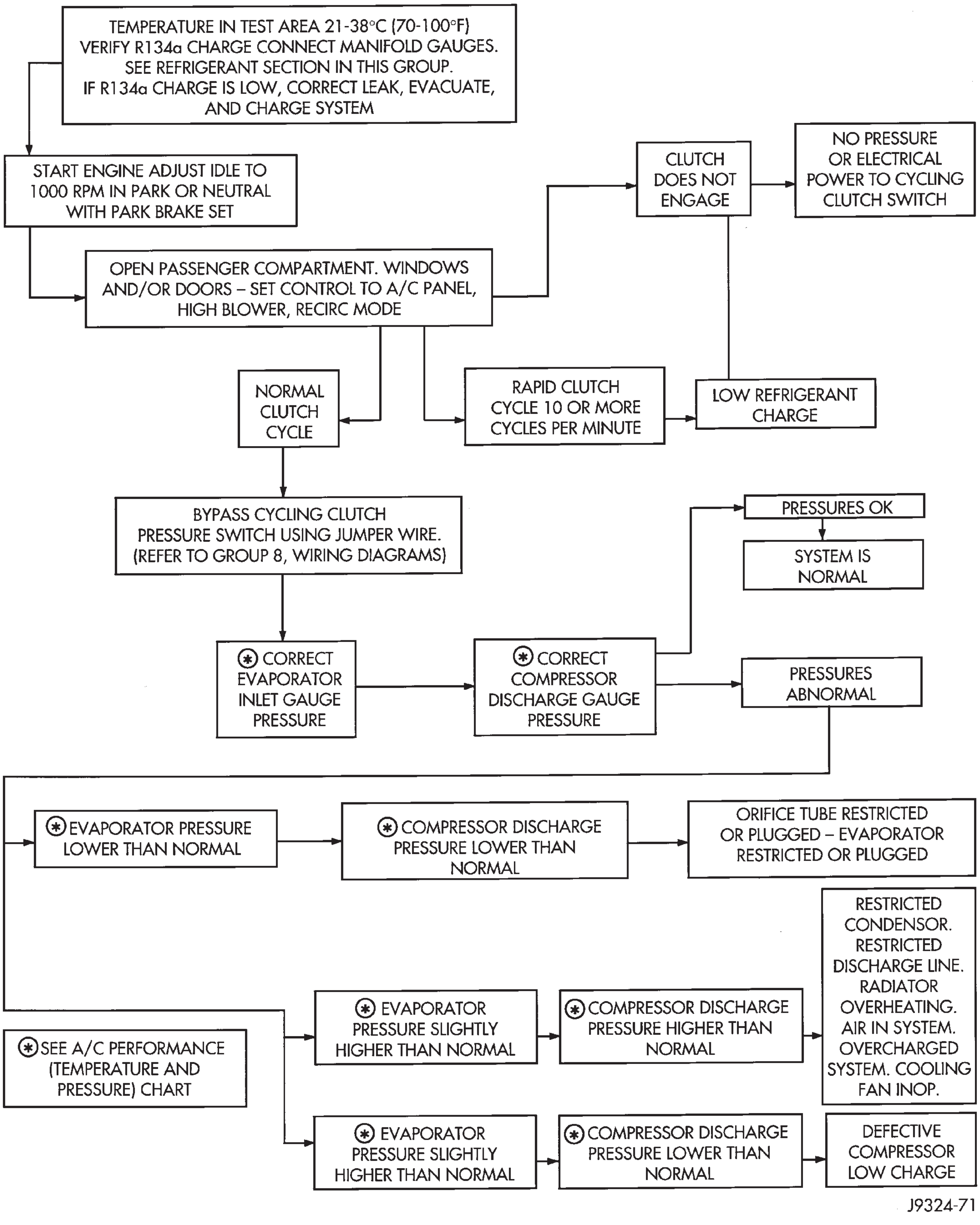
BLOWER MOTOR VIBRATION AND/OR NOISE DIAGNOSIS

The blower resistor supplies the blower motor with varied voltage (low and middle speeds) or battery voltage (high speed).

CAUTION: Stay clear of the blower motor and resistor (Hot). Do not operate the blower motor with the resistor block removed from the heater-A/C unit.

Refer to the Blower Motor Vibration/Noise chart in this section for diagnosis.

REFRIGERANT SYSTEM DIAGNOSIS



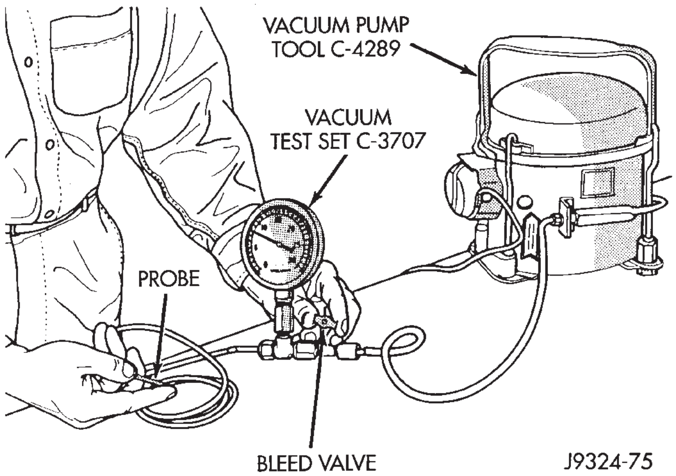


Fig. 2 Adjust Vacuum Test Bleed Valve

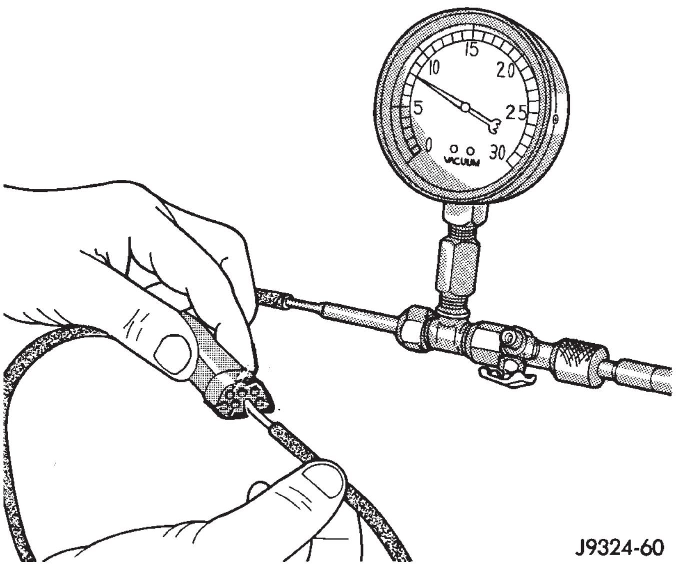


Fig. 3 Vacuum Circuit Test

BLOWER MOTOR ELECTRICAL DIAGNOSIS

Refer to the Blower Motor Electrical System Diagnosis chart in this section. Also refer to Group 8W, Wiring Diagrams for more information.

COMPRESSOR NOISE

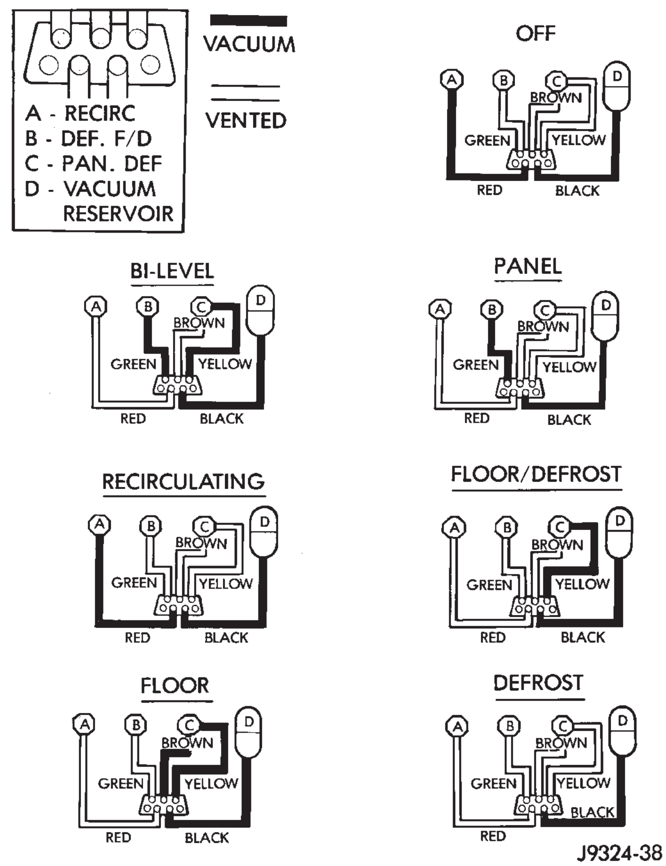
Excessive noise that occurs when the air conditioning is being used, can be caused by:

- Loose bolts
- Mounting brackets
- Loose clutch
- Excessive high refrigerant system operating pressure

Verify compressor drive belt condition, proper refrigerant charge and head pressure before compressor repair is performed.

For noise diagnostic procedures, refer to the Compressor Noise and Compressor Clutch Diagnosis chart in this section.

VACUUM CIRCUITS



COMPRESSOR CLUTCH INOPERATIVE

The air conditioning compressor clutch electrical circuit is controlled by the powertrain control module (Fig. 4).

If the compressor clutch does not engage, verify refrigerant charge.

If the compressor clutch still does not engage, check for battery voltage at the low pressure switch located on the accumulator. If voltage is not detected, refer to:

- Group 8W, Wiring Diagrams.
- The appropriate Powertrain Diagnostic Procedures Manual for diagnostic information.

If voltage is detected at the cut-off switch, reconnect switch. Then check for battery voltage between the compressor clutch connector terminals.

If voltage is detected, perform A/C Clutch Coil Tests.

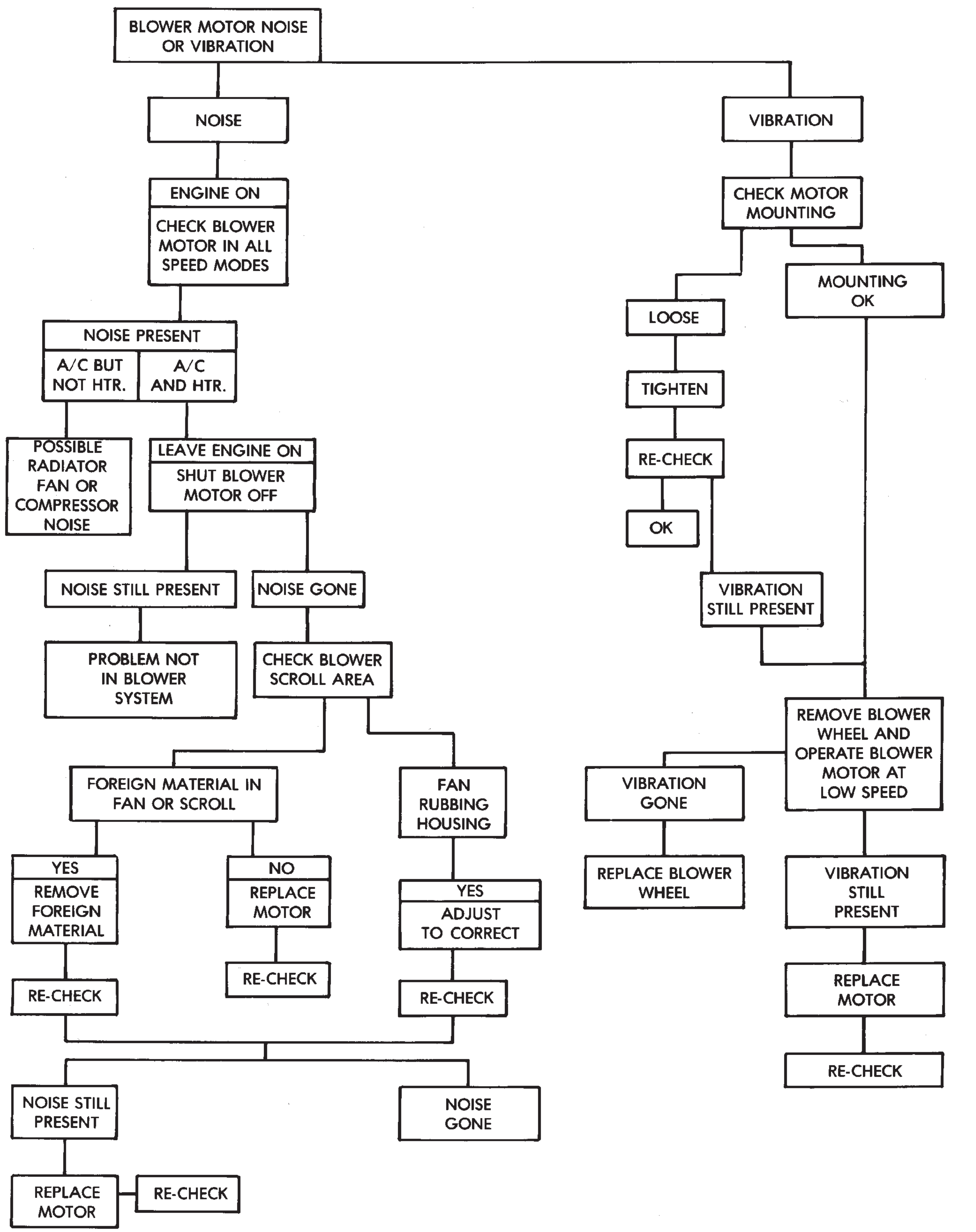
CLUTCH COIL TESTS

(1) Verify battery state of charge. Test indicator in battery should be green.

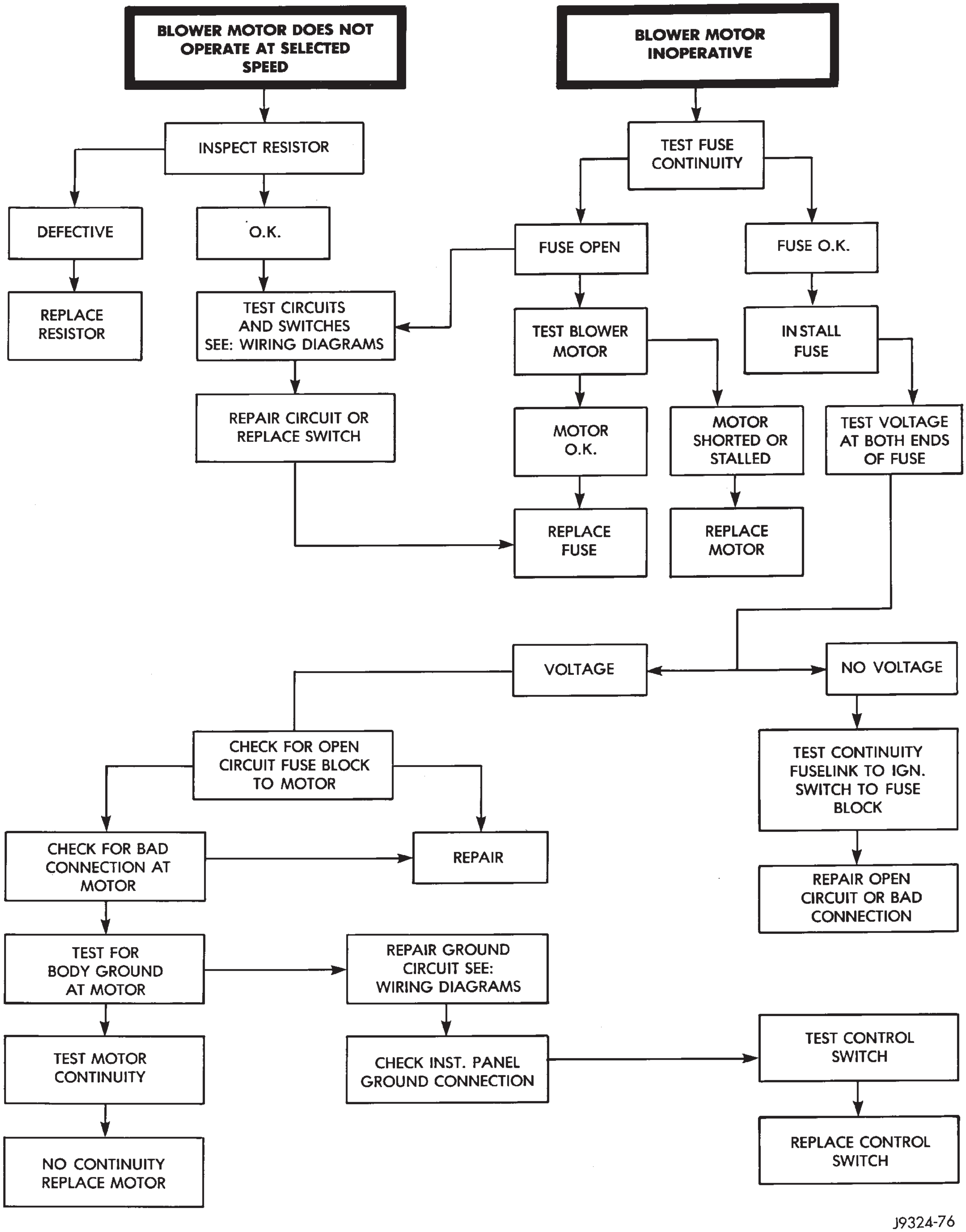
(2) Connect an ammeter (0-10 ampere scale) in series with the clutch coil terminal. Use a volt meter (0-20 volt scale) with clip leads measuring voltage across the battery and A/C clutch.

(3) With A/C control in A/C mode and blower at low speed, start the engine and run at normal idle.

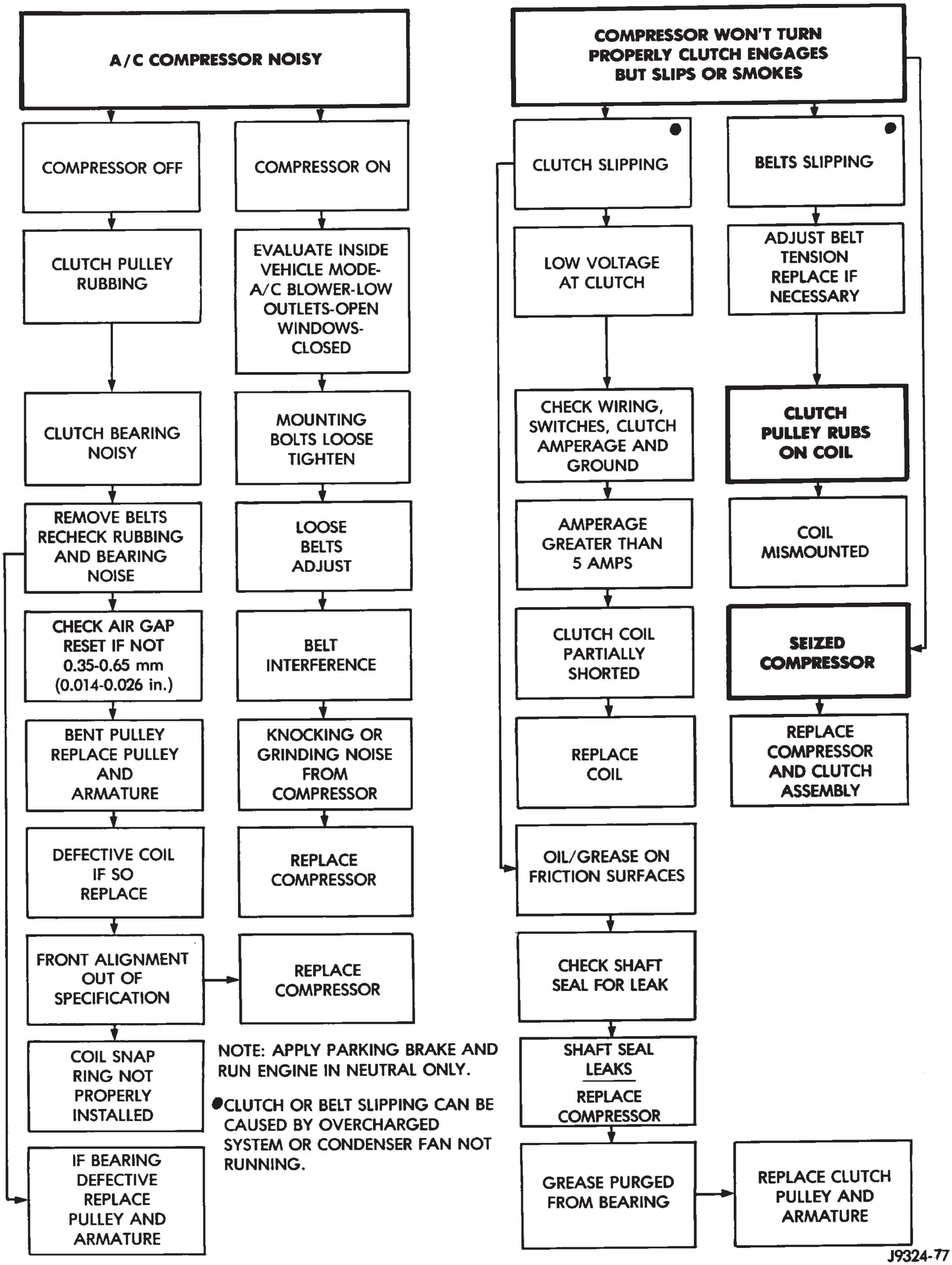
BLOWER MOTOR NOISE/VIBRATION DIAGNOSIS



BLOWER MOTOR ELECTRICAL SYSTEM DIAGNOSIS



COMPRESSOR NOISE AND COMPRESSOR CLUTCH DIAGNOSIS



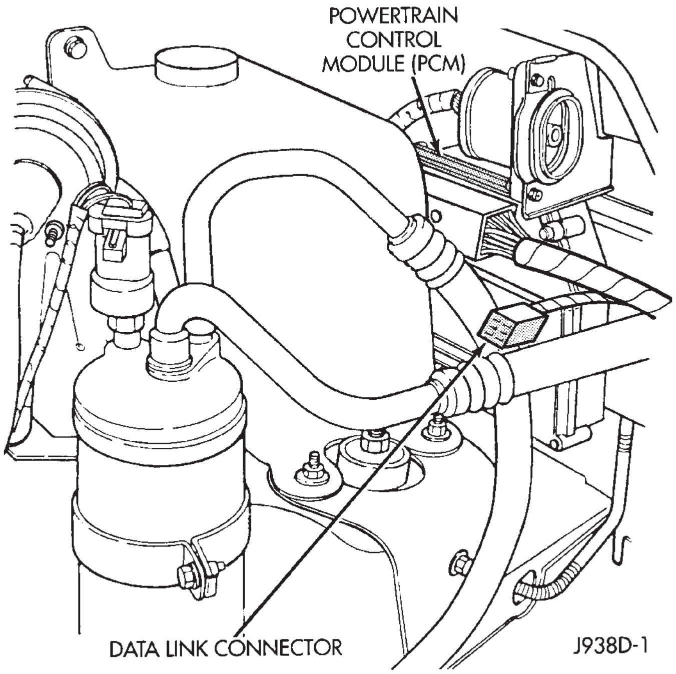


Fig. 4 Power Control Module Location

(4) The A/C clutch should engage immediately and the clutch voltage should be within 2 volts of the battery voltage. If the A/C clutch does not engage, test the fusible link.

(5) The A/C clutch coil is acceptable if the current draw is 2.0 to 3.7 amperes at 11.5 to 12.5 volts at clutch coil. This is with the work area temperature at 21°C (70°F). If voltage is more than 12.5 volts, add electrical loads by turning on electrical accessories until voltage reads below 12.5 volts.

If coil current reads zero, the coil is open and should be replaced. If the ammeter reading is 4 amperes or more, the coil is shorted and should be replaced. If the coil voltage is not within two volts of the battery voltage, test clutch coil feed circuit for excessive voltage drop.

HIGH PRESSURE RELIEF VALVE

The high pressure relief valve is located on the compressor manifold (Fig. 5).

The high pressure relief valve vents only a small amount of refrigerant necessary to reduce system pressure and then reseats itself. This prevents damage to the air conditioning system if excessive pressure develops. Excessive pressure may be caused by condenser air flow blockage, refrigerant overcharge, or air and moisture in the system. The majority of the refrigerant is conserved in the system. The valve is calibrated to vent at a pressure of 3445 to 4135 kPa (500 to 600 psi). If a valve has vented a small amount of refrigerant, it does not necessarily mean the valve is defective.

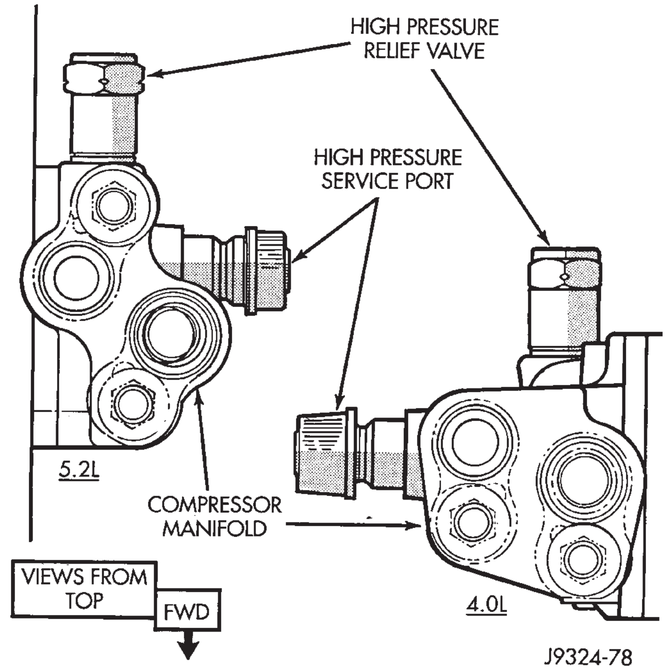


Fig. 5 High Pressure Relief Valve

HEATER OUTPUT TEST

PRE-DIAGNOSTIC PREPARATIONS

Review Safety Precautions and Warnings before performing the following procedures.

Check the radiator coolant level, drive belt tension and engine vacuum line connections. Also check radiator air flow and radiator fan operation. Start engine and allow to warm up to normal operating temperature.

WARNING: DO NOT REMOVE RADIATOR CAP WHEN ENGINE IS HOT, PERSONAL INJURY CAN RESULT.

If vehicle has been run recently, wait 15 minutes before removing cap. Place a rag over the cap and turn it to the first safety stop. Allow pressure to escape through the overflow tube. When the system stabilizes, remove the cap completely.

MAXIMUM HEATER OUTPUT

Engine coolant is provided to the heater system by 2 heater hoses. With engine idling at normal running temperature, set the control to maximum heat, floor and high blower setting. Using a test thermometer, check the air temperature coming from the floor outlets, refer to Temperature Reference chart.

If the floor outlet air temperature is low, refer to Group 7, Cooling System for coolant temperature specifications. Both heater hoses should be HOT to the touch. The coolant return hose should be slightly cooler than the supply hose. If coolant return hose is much cooler than the supply hose, locate and repair engine coolant flow obstruction in heater system.

TEMPERATURE REFERENCE CHART

Ambient Temperature		Minimum Heater System Floor Outlet Temperature	
Celsius	Fahrenheit	Celsius	Fahrenheit
15.5°	60°	62.2°	144°
21.1°	70°	63.8°	147°
26.6°	80°	65.5°	150°
32.2°	90°	67.2°	153°

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Possible locations or cause of obstructed coolant flow:
- Pinched or kinked heater hoses.
- Improper heater hose routing.
- Plugged heater hoses or supply and return ports at cooling system connections (refer to Group 7, Cooling System).
- Plugged heater core.

If proper coolant flow through heater system is verified and outlet air temperature is still low, a mechanical problem may exist.

Possible location or cause of insufficient heat:
- Obstructed cowl air intake.
- Obstructed heater system outlets.
- Blend-air door not functioning properly.

TEMPERATURE CONTROL

If temperature cannot be adjusted with the TEMP knob on the control panel, the following could require service:
- Blend-air door circuit.
- Improper engine coolant temperature.

AUTOMATIC TEMPERATURE CONTROL DIAGNOSTICS

The ATC controller is designed with on-board diagnostics which is capable of troubleshooting each input and output circuit of the controller. When a fault is detected and in memory, an "Er" is momentarily displayed, but only once during an ignition cycle. There are three different groups of testing features that this system is capable of:

(1) Fault Codes
(2) Input Circuit Testing
(3) Output Circuit Testing/Actuator Tests

DIAGNOSTICS TEST SELECTOR

The test selector is located in the same location as the temperature control point. The test selector is used to display fault codes, identify the test selection mode and is used to show the value of each circuit being tested.

(1) If the floor (bottom) arrow is showing, the test selector value will be a range of numbers below 0 (Fig. 6).

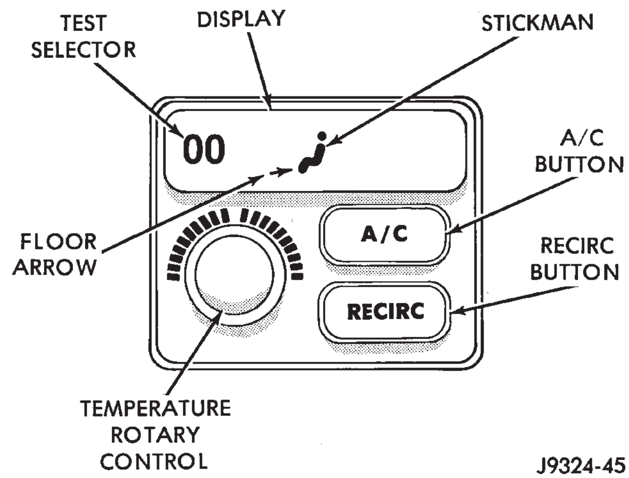

Fig. 6 Test Selector Values Below 0

(2) If the stickman shows no arrows, the test selector value will be a range of numbers between 0 and 99 (Fig. 7).

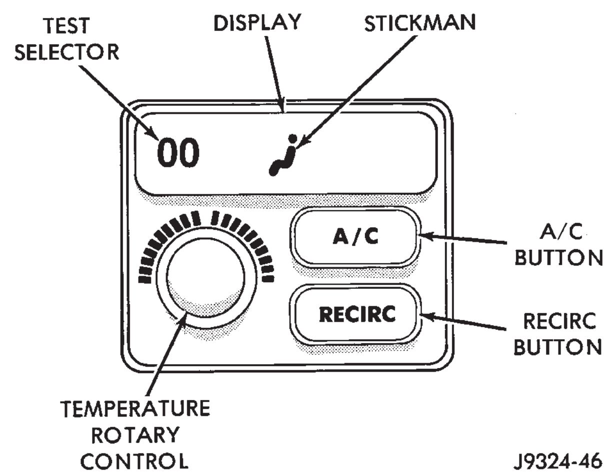

Fig. 7 Test Selector Values Between 0 and 99

(3) If the panel (middle) arrow is showing, the test selector value will be a range of numbers between 100 and 199 (Fig. 8).

(4) If the panel (middle) and defrost (top) arrows are showing, the test selector value will be a range of numbers between 200 and 255 (Fig. 9).

During diagnostics you may return to the test selector mode by simply turning the temperature (rotary) control one CLICK in either direction. Again the stickman and arrows are not shown in test selector mode. Also, you have the option of monitoring or testing another circuit (Fig. 10).

ENTER DIAGNOSTICS

To enter the diagnostics, perform the following:

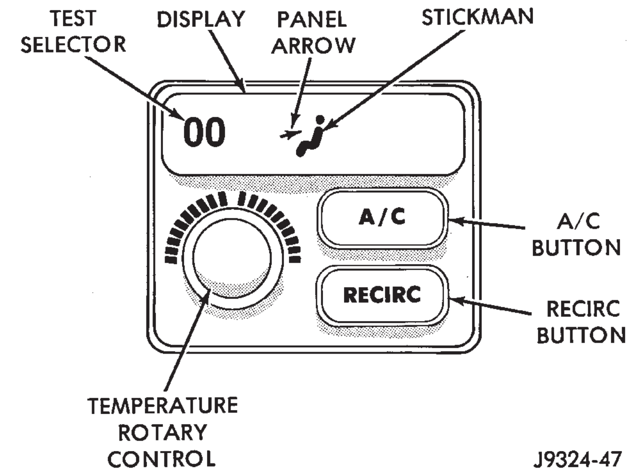

Fig. 8 Test Selector Values Between 100 and 199

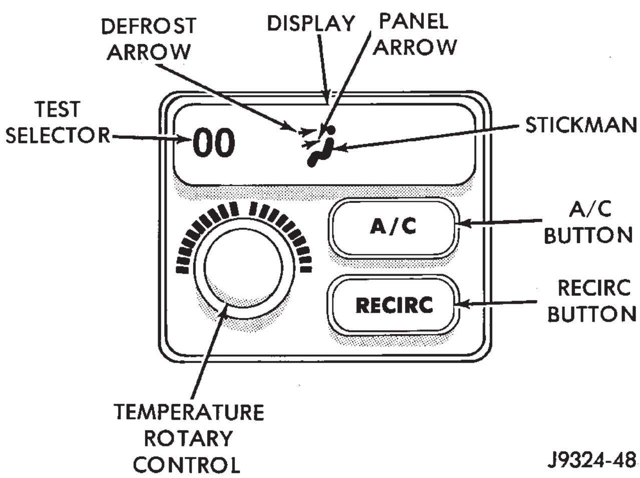

Fig. 9 Test Selector Values Between 200 and 255

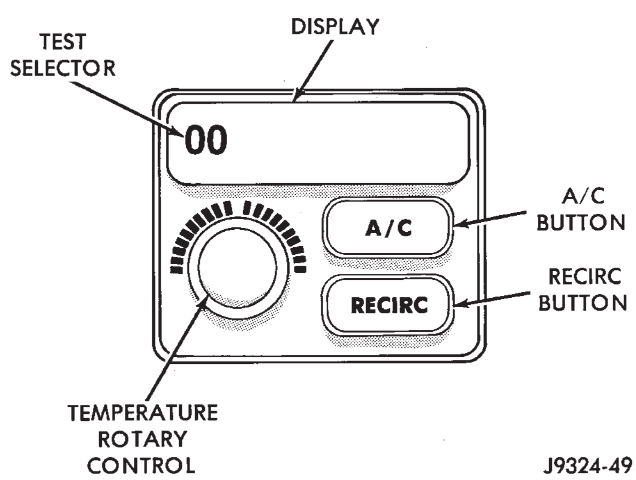

Fig. 10 Return to Test Selector Mode

(1) Depress the A/C and RECIRC buttons simultaneously and hold. Rotate the control knob clockwise one CLICK.

(2) If you continue to hold the A/C and RECIRC buttons you will see the display completely light up. This is the Segment Test.

(3) After viewing the Segment Test, release the A/C and RECIRC buttons. This will put the test selector at 00, the Select Test level.

At this point a number of tests can be performed. However, the Fault Code Diagnostics should be preformed now.

FAULT CODE DIAGNOSTICS

The codes are two digit numbers that identify which circuit is malfunctioning. There are two different kinds of fault codes.

(1) Current Fault Codes are divided into two categories; input faults and system faults. Current faults means they are present right now.

(2) Historical Fault Codes are referred to as historical faults or faults that are stored in memory. Historical faults are an indication that a circuit failed previously, but is OK right now. A majority of historical fault codes are caused by wiring or connector problems.

CAUTION: A battery disconnect will erase all faults stored in Read Available Memory (RAM). It is recommended that all faults be recorded before they are erased.

While 00 is displayed, push either A/C or RECIRC button. The stickman will appear indicating you have entered the fault section. The numbers displayed will range from 00 to 64.

Fault codes will appear and repeat if there are more than one. Record the fault codes and refer to the Current and Historical Fault Code Charts. If there are no fault codes, the display remains at 00.

If Fault Code 25 or 29 is displayed, the ATC Control Module must be replaced before any further testing is performed.

For more detailed information about a fault code, refer to the Input Circuit Testing or Output Circuit Testing/Actuator Tests.

CLEARING FAULT CODES

Current faults are cleared whenever the problem goes away. To clear the historical faults, press and hold either A/C or RECIRC for 3 seconds. The faults have cleared when 2 horizontal bars appear in the display screen.

CURRENT FAULTS

Fail Code/Description	Circuit Description
00 = No Faults	
01 = Circuit open	Ambient Temperature Sensor
02 = Circuit open	In-Vehicle Temperature Sensor
03 = Circuit open	Solar Sensor Input Circuit
04 = Circuit open	Front Panel Blower/Fan Control Input
05 = Circuit open	Front Panel Mode Control Input
06 = Circuit open	Blend Air Door Feedback Circuit
07 = Circuit open	Mode Door Feedback Circuit
08 = Feedback too high	Blower/Fan Feedback Circuit
09 = Circuit shorted	Ambient Temperature Sensor
10 = Circuit shorted	In-Vehicle Temperature Sensor
11 = Circuit shorted	Solar Sensor Input Circuit
12 = Circuit shorted	Front Panel Blower/Fan Control Input
13 = Circuit shorted	Front Panel Mode Control Input
14 = Circuit shorted	Blend Air Door Feedback Circuit
15 = Circuit shorted	Mode Door Feedback Circuit
16 = Feedback too low	Blower/Fan Feedback Circuit
17 = Dimming input error	Pulse Width Dimming PWD Input
19 = Door not responding	Mode Door Feedback Circuit
20 = Door not responding	Blend Air Door Actuator Drive Circuit
21 = Door travel range too small	Mode Door Feedback Circuit
22 = Door travel range too large	Mode Door Feedback Circuit
23 = Door travel range too small	Blend Air Door Actuator Drive Circuit
24 = Door travel range too large	Blend Air Door Actuator Drive Circuit
25 = Calibration data error	Calibration and CPU Data
26 = Coolant temp message missing	Collision Detection C2D BUS Inputs
27 = Vehicle speed message missing	Collision Detection C2D BUS Inputs
28 = Engine RPM message missing	Collision Detection C2D BUS Inputs
29 = CPU error	Calibration and CPU Data
30 = Reserved	
31 = Reserved	
32 = Reserved	

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HISTORICAL FAULTS

Fail Code/Description	Circuit Description
33 = Circuit was open	Ambient Temperature Sensor
34 = Circuit was open	In-Vehicle Temperature Sensor
35 = Circuit was open	Solar Sensor Input Circuit
36 = Circuit was open	Front Panel Blower/Fan Control Input
37 = Circuit was open	Front Panel Mode Control Input
38 = Circuit was open	Blend Air Door Feedback Circuit
39 = Circuit was open	Mode Door Feedback Circuit
40 = Feedback was too high	Blower/Fan Feedback Circuit
41 = Circuit was shorted	Ambient Temperature Sensor
42 = Circuit was shorted	In-Vehicle Temperature Sensor
43 = Circuit was shorted	Solar Sensor Input Circuit
44 = Circuit was shorted	Front Panel Blower/Fan Control Input
45 = Circuit was shorted	Front Panel Mode Control Input
46 = Circuit was shorted	Blend Air Door Feedback Circuit
47 = Circuit was shorted	Mode Door Feedback Circuit
48 = Feedback was too low	Blower/Fan Feedback Circuit
49 = Dimming input was in error	Pulse Width Dimming PWD Input
51 = Door was not responding	Mode Door Feedback Circuit
52 = Door was not responding	Blend Air Door Actuator Drive Circuit
53 = Door travel range was too small	Mode Door Feedback Circuit
54 = Door travel range was too large	Mode Door Feedback Circuit
55 = Door travel range was too small	Blend Air Door Actuator Drive Circuit
56 = Door travel range was too large	Blend Air Door Actuator Drive Circuit
57 = Calibration data was in error	Calibration and CPU Data
58 = Coolant temp message was missing	Collision Detection C2D BUS Inputs
59 = Vehicle speed message was missing	Collision Detection C2D BUS Inputs
60 = Engine RPM message was missing	Collision Detection C2D BUS Inputs
61 = CPU was in error	Calibration and CPU Data
62 = Reserved	
63 = Reserved	
64 = Reserved	

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INPUT CIRCUIT TESTING

After diagnostics is entered, the status of input circuits can be viewed or monitored. If a failure occurs within an input circuit the controller will display a "?" for unknown values, a "OC" for an open circuit and a "SC" for a shorted circuit.

Use the following steps to view the inputs into the controller:

(1) Enter the diagnostics mode.

(2) Turn the knob until the test you are looking for appears (refer to Circuit Testing chart).

(3) To see the input, press the A/C or RECIRC button. The digits displayed will represent the input seen by the controller.

OUTPUT CIRCUIT TESTING / ACTUATOR TESTS

After diagnostics is entered, you have the ability to view or monitor, override and test the output circuits. If a failure occurs within an output circuit it can be tested by overriding the system and testing it through its full range of operation. When the override control has been activated, the display will be flashing. The control will display feedback information about the circuit being tested.

Use the following steps to view the output commands from the controller:

(1) Enter the diagnostics mode.

(2) Turn the knob until the test you are looking for appears (refer to Circuit Testing chart).

(3) To see the output, press the A/C or RECIRC button. The digits displayed will represent the output from the controller.

(4) To enter the actuator test, press the A/C or RECIRC button. The display will blink, indicating you are in an actuator testing mode. Manual tests are those in which you will have to continuously press the A/C or RECIRC button to control the output. Press the A/C or RECIRC button once to run the automatic tests.

CIRCUIT TESTING

Test No.	Test Item	Test Type	System Tested	Displayed Values
01	Blower Control Switch (A/D)	I	Blower System	"?" "OC" "SC" 00-255
02	Blower Feedback	I	Blower System	"?" 00-255
03	Blower Speed	O/A	Blower System	00-255
04	Hi Blower Relay	O/A	Blower System	00 = OFF 01 = ON
05	Mode Control A/D	I	Mode Door System	"OC" "SC" 00-255
06	Mode Door Feedback	I	Mode Door System	"OC" "SC" 00-255
07	Panel Stop	I	Mode Door System	"?" 00-255 If "?" is displayed, activate Mode 11 to find panel stop position.
08	Defrost Stop	I	Mode Door System	"?" 00-255 If "?" is displayed, activate Mode 11 to find defrost stop position.
09	A/C Request	O/A	A/C System	00 = OFF 01 = ON
10	Mode Door Position	O/A	Mode Door System	00-255 It is possible to command the door position beyond the stops. The motor will try to move there.
11	Mode Motor	O/A	Mode Door System	Pressing A/C or RECIRC button for 3 sec. begins reinitialization. 00 = searching for panel stop 01 = searching for defrost stop 02 = moving toward panel 03 = moving toward defrost 04 = in position 05 = stalled moving toward panel 06 = stalled moving toward defrost 07 = feedback error
12	Mode Motor Drive Lines	O	Mode Door System	00 = stopped (lines low) 01 = toward defrost 02 = toward panel 03 = stopped (lines high)
13	Recirc Door	O/A	Recirc Door System	00 = continuous operation (lines grounded) 01 = fresh 02 = recirc. 03 = stopped (lines open)
14	In-Vehicle Temp. A/D	I	Temperature Inputs	"OC" "SC" 00-255
15	Ambient Sensor A/D	I	Temperature Inputs	"OC" "SC" 00-255
16	Blend Door Feedback	I	Blend Door System	"OC" "SC" 00-255
17	Blend Door Cold Stop	I	Blend Door System	"?" 00-255
18	Blend Door Hot Stop	I	Blend Door System	"?" 00-255

TEST TYPE: I = Input O = Output O/A = Output/Actuator

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CIRCUIT TESTING (CONT.)

Test No.	Test Item	Test Type	System Tested	Displayed Values
19	In-Vehicle Temperature	I	Temperature Inputs	"OC" "SC" -40 to +60 C (-40 to +140 F)
20	Ambient Sensor	I	Temperature Inputs	"OC" "SC" -40 to +60 C (-40 to +140 F)
21	Solar Sensor A/D	I	Sun Intensity Input	"OC" "SC" 00-255
22	Engine Coolant	I	CCD	"?" -40 to +185 C (-40 to +260 F)
23	Vehicle Speed (MPH/KPM)	I	CCD	"?" 00-255
24	Engine RPM (x100)	I	CCD	00-82
25	Blend Door Motor	O/A	Blend Door System	Pressing A/C or RECIRC button for 3 sec. begins reinitialization. 00 = searching for hot stop 01 = searching for cold stop 02 = moving to warmer 03 = moving to cooler 04 = in position 05 = stalled moving to warmer 06 = stalled moving to cooler 07 = feedback error
26	Blend Door Motor	O/A	Blend Door System	00-255 It is possible to command the door position beyond the stops. The motor will try to move there.
27	Blend Door Motor Lines	O/A	Blend Door System	00 = stopped (lines low) 01 = toward cold 02 = toward hot 03 = stopped (lines high)
28	Lights On	I	Headlight Switch	00 = OFF 01 = ON
29	Dimming	I	PWD System	"?" 00-255
30	Dimming Level	O/A	Dimming System	"?" 00-255
31	ROM & EEPROM			00-FF
32	ROM & EEPROM			00-FF
33	ROM & EEPROM			00-FF
34	ROM & EEPROM			00-FF
35	ROM & EEPROM			00-FF
36	ROM & EEPROM			00-FF
37	ROM & EEPROM			00-FF
38	ROM & EEPROM			00-FF

TEST TYPE: I = Input O = Output O/A = Output/Actuator

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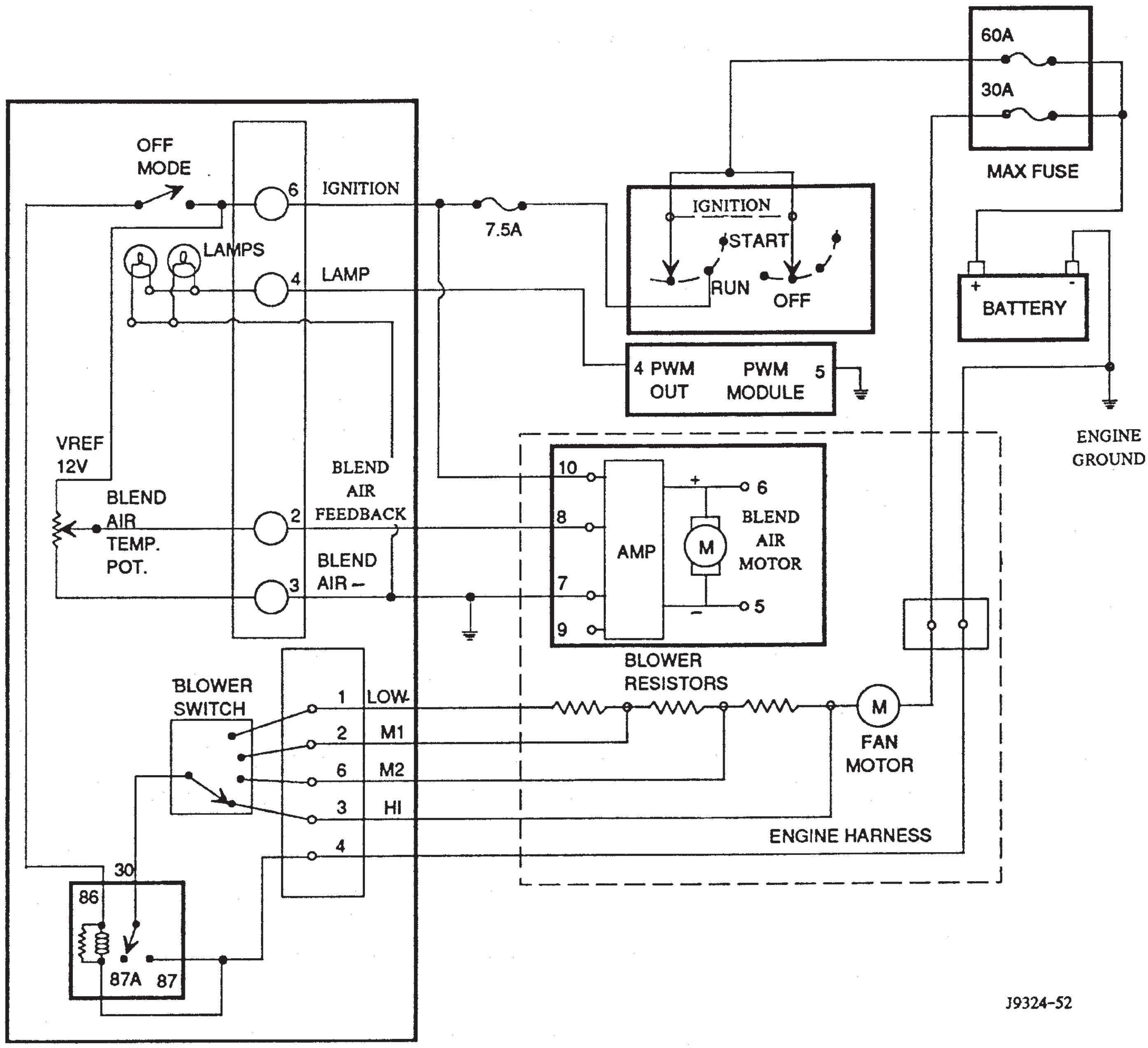
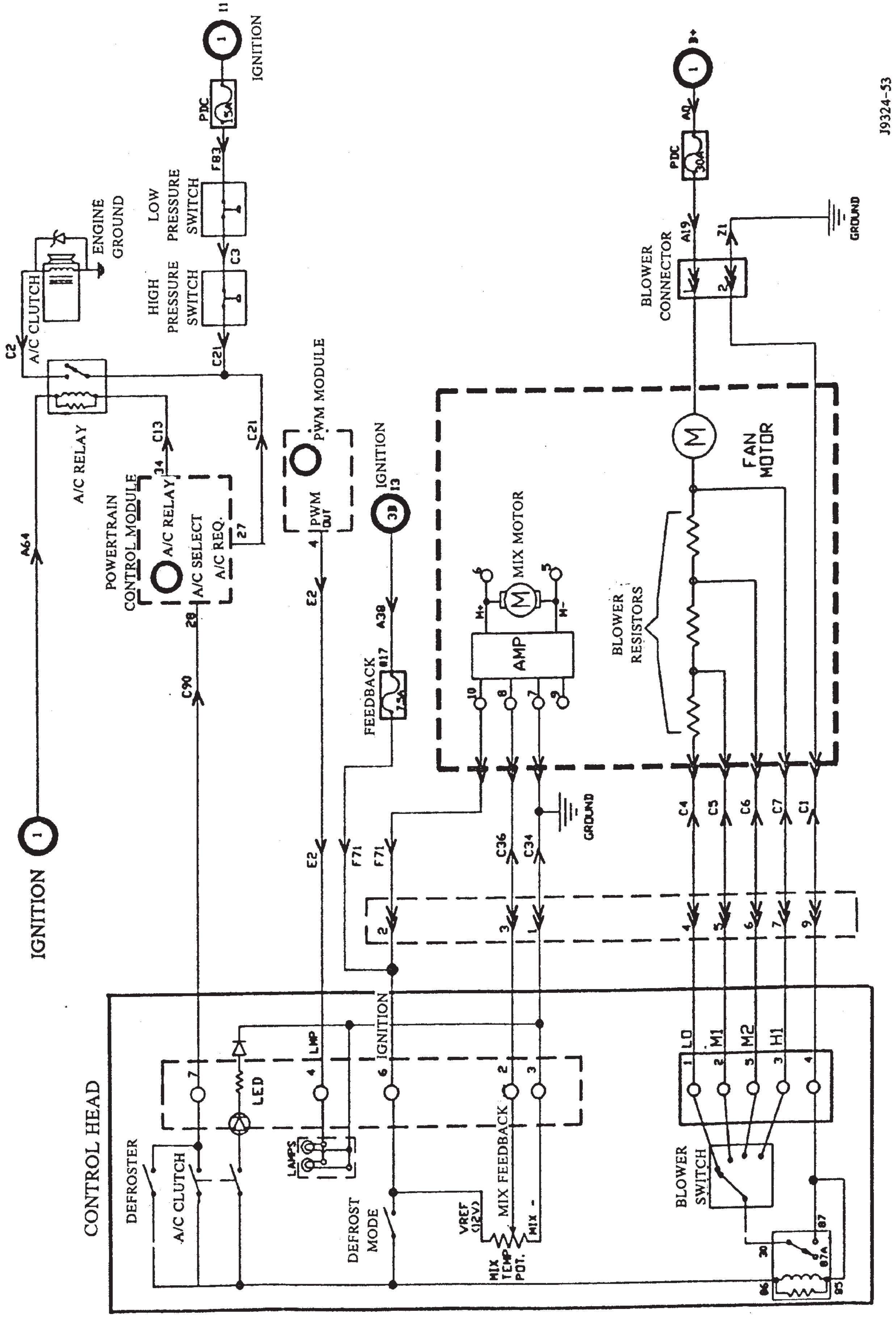
ELECTRICAL CIRCUITS

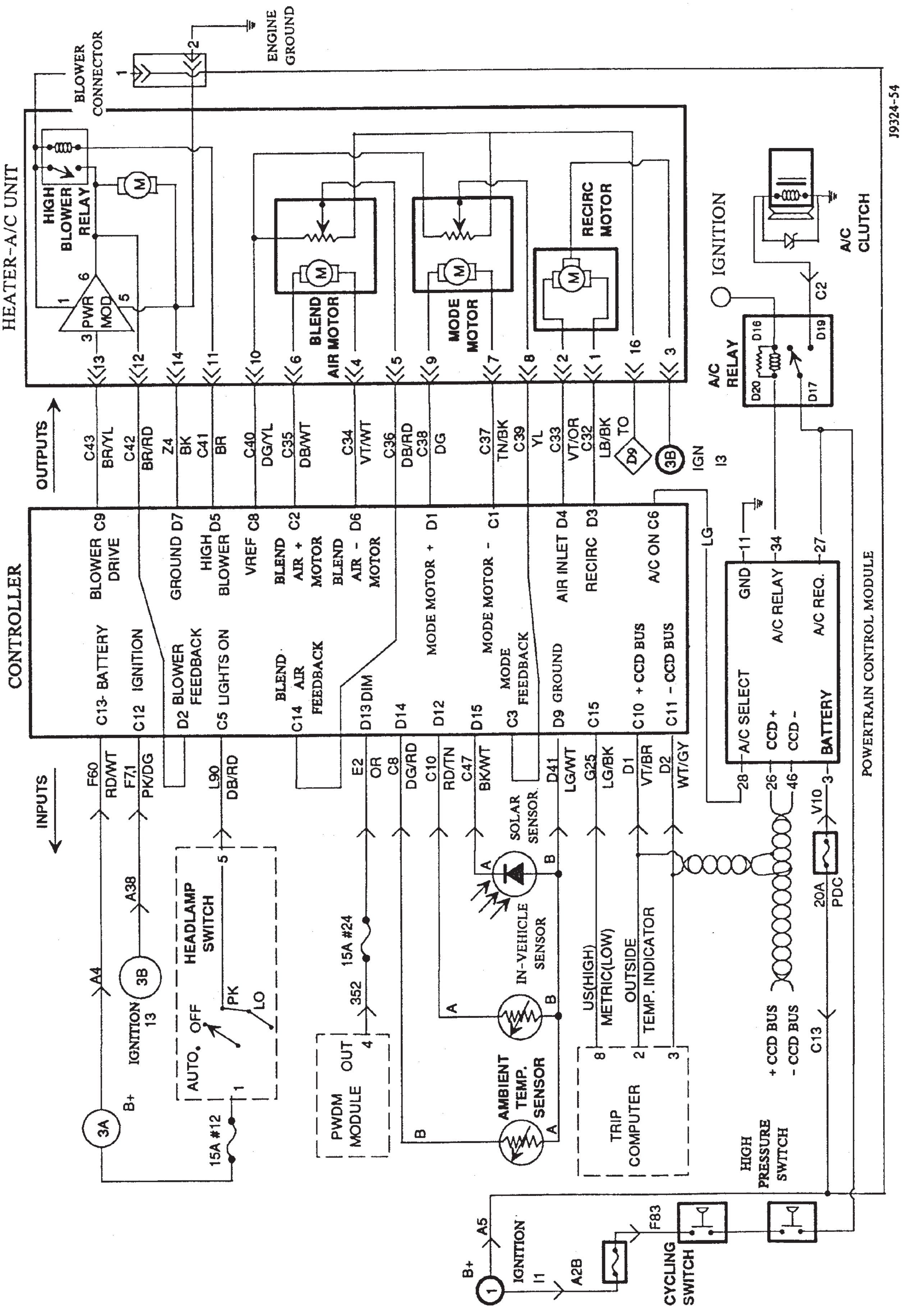
HEATER SYSTEM



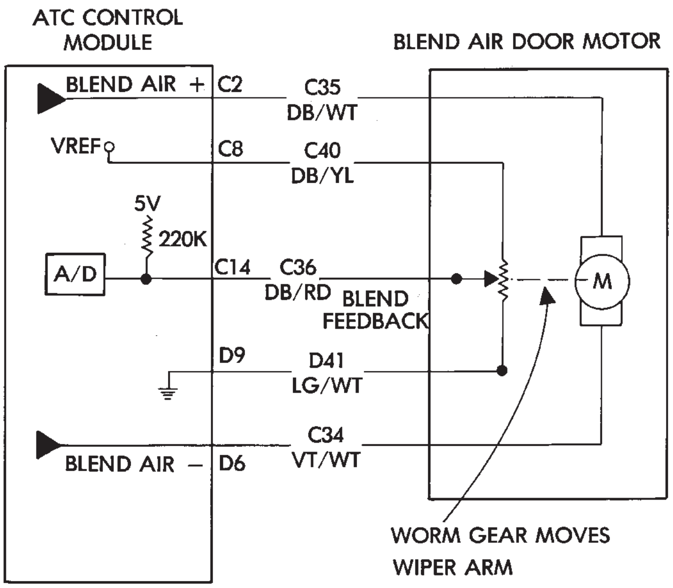
MANUAL AIR CONDITIONING SYSTEM



AUTOMATIC TEMPERATURE CONTROL SYSTEM



BLEND AIR DOOR ACTUATOR DRIVE CIRCUIT



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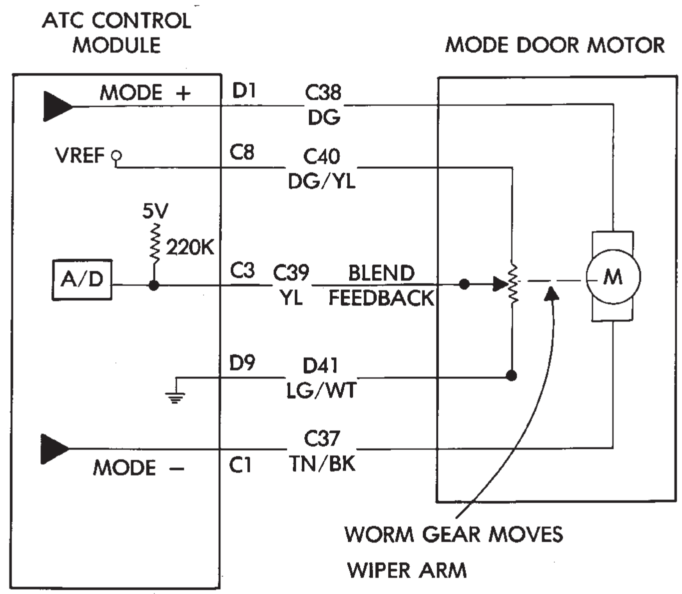
MODE DOOR ACTUATOR DRIVE CIRCUIT



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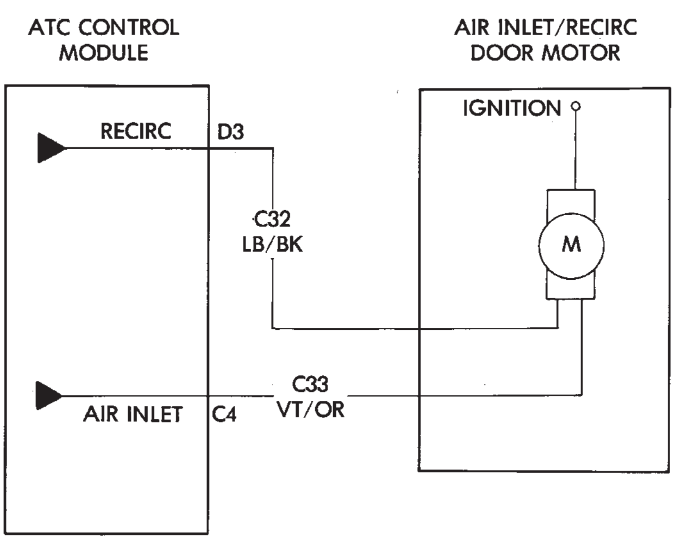
AIR INLET/RECIRC DOOR ACTUATOR DRIVE CIRCUIT



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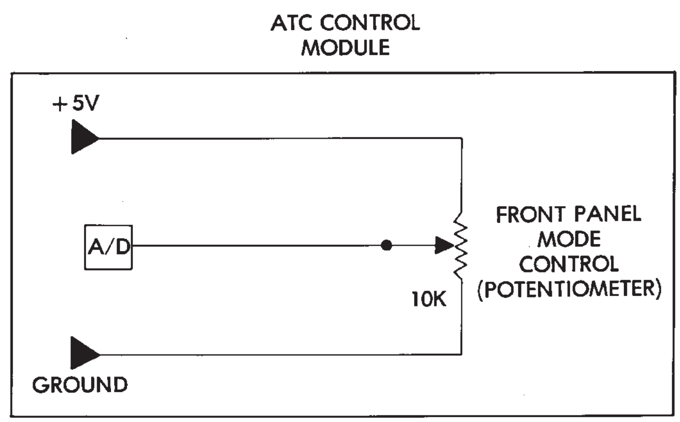
FRONT PANEL MODE CONTROL



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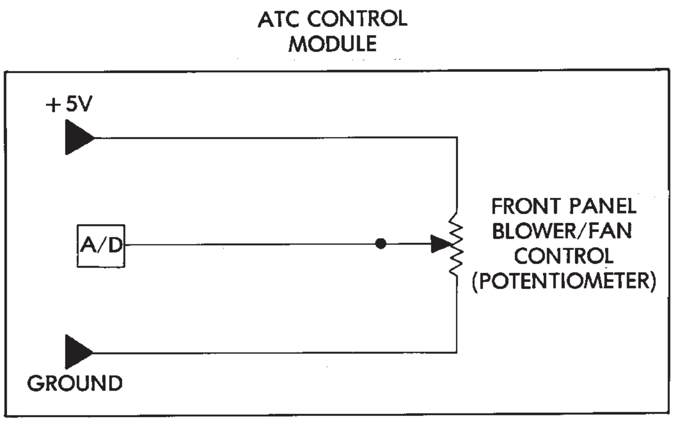
FRONT PANEL BLOWER/FAN CONTROL



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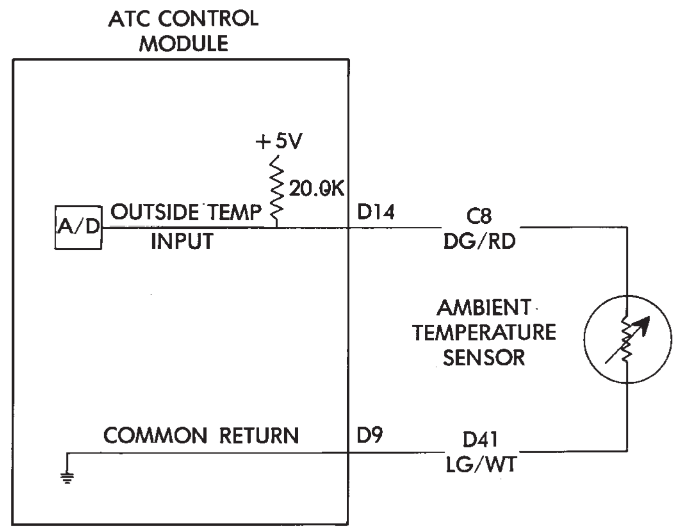
AMBIENT TEMPERATURE SENSOR



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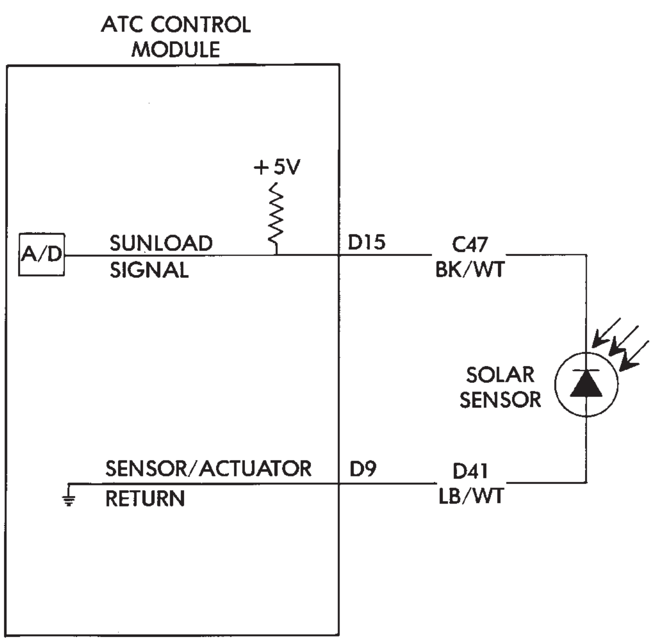
SOLAR SENSOR



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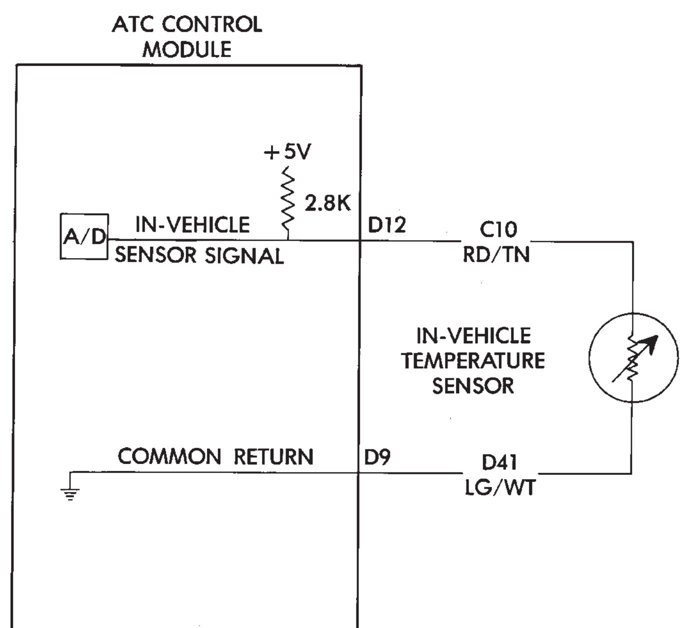
IN-VEHICLE TEMPERATURE SENSOR



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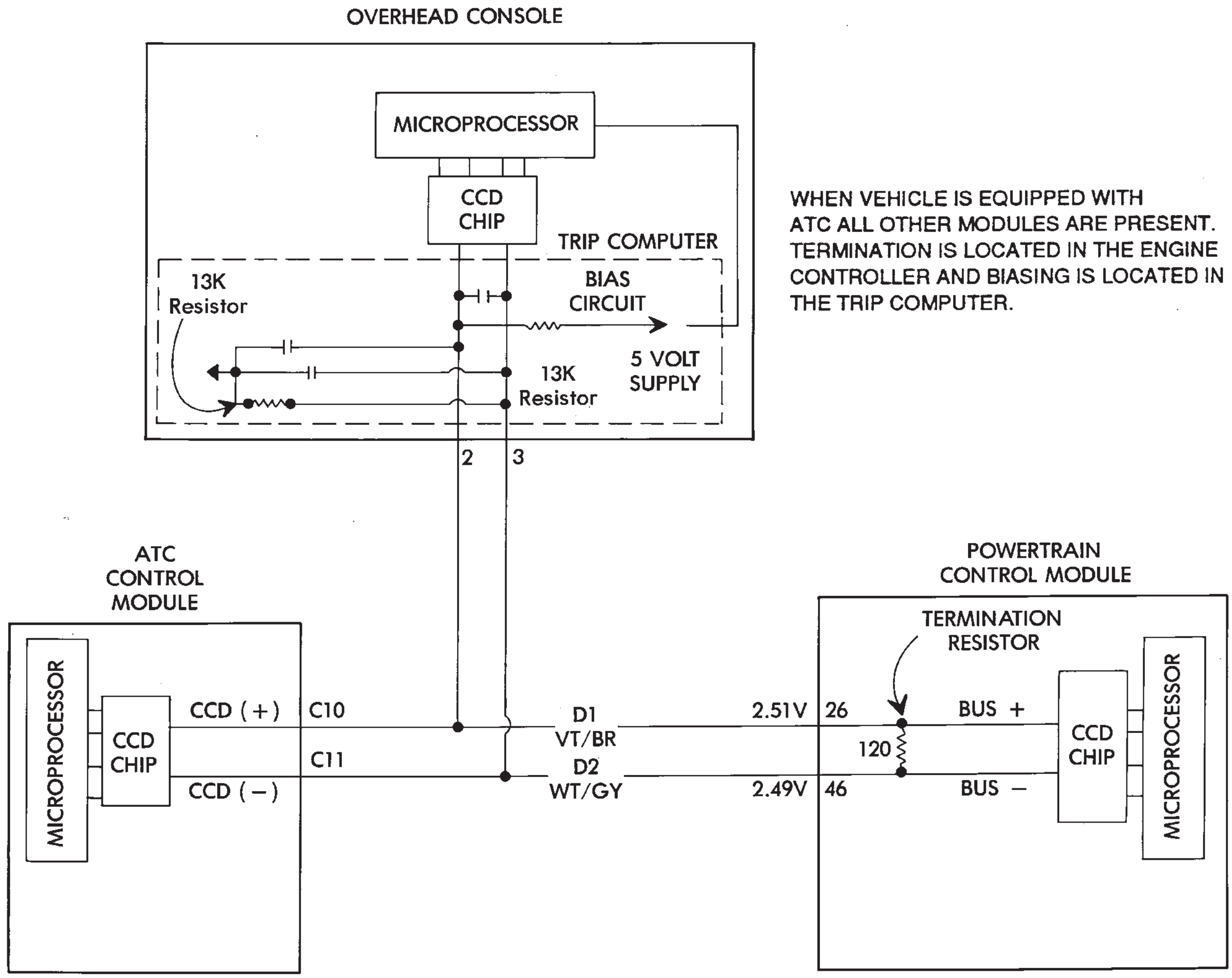
CHRYSLER COLLISION DETECTION BUS



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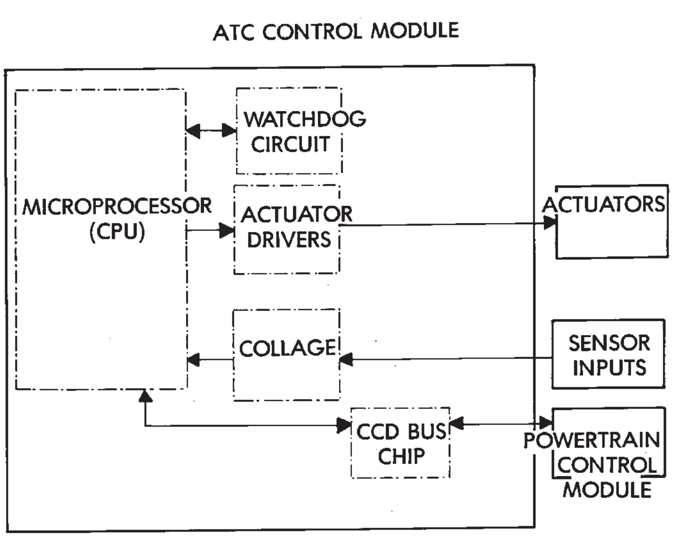
CALIBRATION AND CPU DATA



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REFRIGERANT SERVICE PROCEDURES

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REFRIGERANT 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, an A/C charging station and a refrigerant recovery/recycling device for R-134a should be used. This device must meet SAE standard J2210. Contact an automotive service equipment supplier for charging and refrigerant recycling/recovering equipment. Refer to the operating instructions provided with the equipment for proper operation.

A manifold gauge set (Fig. 1) must also be used in conjunction with the charging and/or recovery/recycling device. The service hoses on the gauge set being used should have manual (turn wheel) or automatic back flow valves at the service port connector ends. This will prevent refrigerant from being release into the atmosphere.

MANIFOLD GAUGE SET CONNECTIONS

CAUTION: DO NOT use an R-12 manifold gauge set on an R-134a system. The refrigerants are not compatible and system damage will result.

LOW PRESSURE GAUGE HOSE

The low pressure hose (BLUE with BLACK STRIP) should be attached to the charging/service port. This port is located at the right rear of the engine compartment in the condenser-to-evaporator line.

CAUTION: NEVER try to attach the low pressure hose to the clutch cycling pressure switch port located on the accumulator.

CONNECTION

(1) Remove the service port cap from the charging/service port.

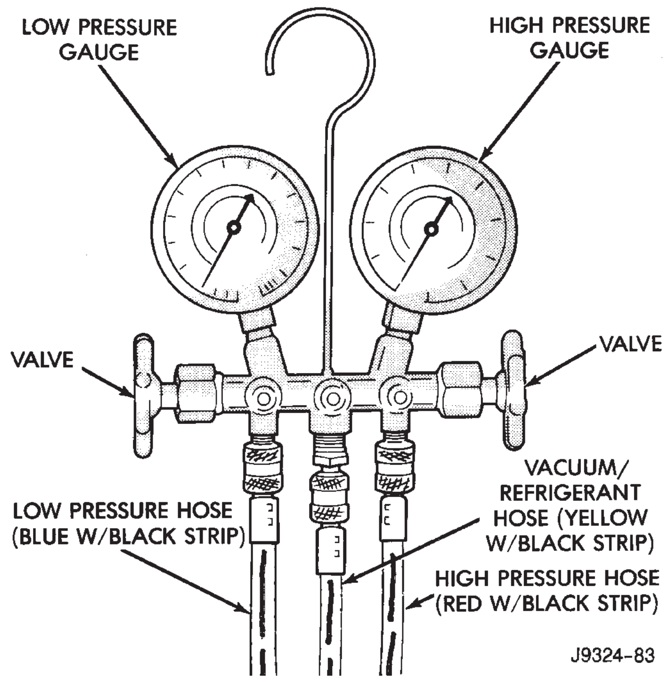

Fig. 1 Manifold Gauge Set

(2) Check all valves on the equipment being used to verify they are CLOSED.

(3) Inspect the hose gasket in the service port connector at the end of the hose (BLUE with BLACK STRIP). If the gasket is flawed, replace it.

(4) Attach the connector to the charging/service port.

DISCONNECT

(1) Close the connector knob.

(2) Remove the connector by releasing the quick connect fitting.

(3) Install the service port caps.

HIGH PRESSURE GAUGE HOSE

The high pressure hose (RED with BLACK STRIP) should be attached to the discharge/service port. This port is located on the underside of the compressor manifold.

CONNECTION

(1) Remove the service port cap from the discharge/service port.

(2) Check all valves on the equipment being used to verify they are closed.

(3) Inspect the hose gasket in the service port connector at the end of the hose (RED with BLACK STRIP). If the gasket is flawed, replace it.

(4) Attach the connector to the discharge/service port.

DISCONNECT

(1) Close the connector knob.

(2) Remove the connector by releasing the quick connect fitting.

(3) Install the service port.

EVACUATION / RECOVERY / RECYCLING / CHARGING LINE CONNECTION

The center manifold hose (YELLOW or WHITE with BLACK STRIP) is used to discharge, recycle, recover, evacuate and charge the refrigerant system. When the low or high pressure valves on the manifold gauge set are opened, the refrigerant in the system will escape through this hose.

This hose should be attached to an R-134a Recovery/Recycling device. Refer to the Recovery/Recycling devices operators manual for proper procedures.

REFRIGERANT LEAK TESTING

If the A/C system is not cooling properly, determine if the refrigerant system is fully charged with R-134a (refer to Refrigerant Charge Check). If the refrigerant system is empty or low in refrigerant charge, a leak at any line fitting or component seal is likely. To detect a leak in the refrigerant system, perform one of the following procedures:

CAUTION: Review Safety Precautions and Warnings in General Information section of this Group.

SYSTEM EMPTY

(1) Evacuate the A/C system.

(2) Prepare a 0.6 lbs. (10 oz.) R-134a refrigerant charge to be injected into the system. Refer to Charging Refrigerant System for instructions.

(3) Connect and dispense 0.6 lbs. (10 oz.) of refrigerant into the evacuated refrigerant system.

(4) Position the vehicle in a wind free work area. This will aid in detecting small leaks.

(5) With the engine not running, use an Electronic Leak Detector (R-134a refrigerant) and search for leaks (Fig. 2 or 3). Fittings, lines, or components that appear to be oily usually will indicate a refrigerant leak. To inspect the evaporator core for leaks, it is possible to insert the leak detector probe into the recirculating air door opening. With the blower at low speed and the selector in FLOOR and RECIRC mode check for leaks at left and right heater outlets.

LOW LEVEL

(1) Position the vehicle in a wind free work area. This will aid in detecting small leaks.

(2) Bring the refrigerant system up to operating temperature and pressure. This is done by allowing the engine to run with the A/C on for 5 minutes.

(3) With the engine not running, use an Electronic Leak Detector (R-134a refrigerant) and search for leaks (Fig. 2 or 3). Fittings, lines, or components that appear to be oily usually will indicate a refrigerant leak. To inspect the evaporator core for leaks, it is possible to insert the leak detector probe into the recirculating air door opening. With the blower at low speed and the selector in FLOOR and RECIRC mode check for leaks at left and right heater outlets.

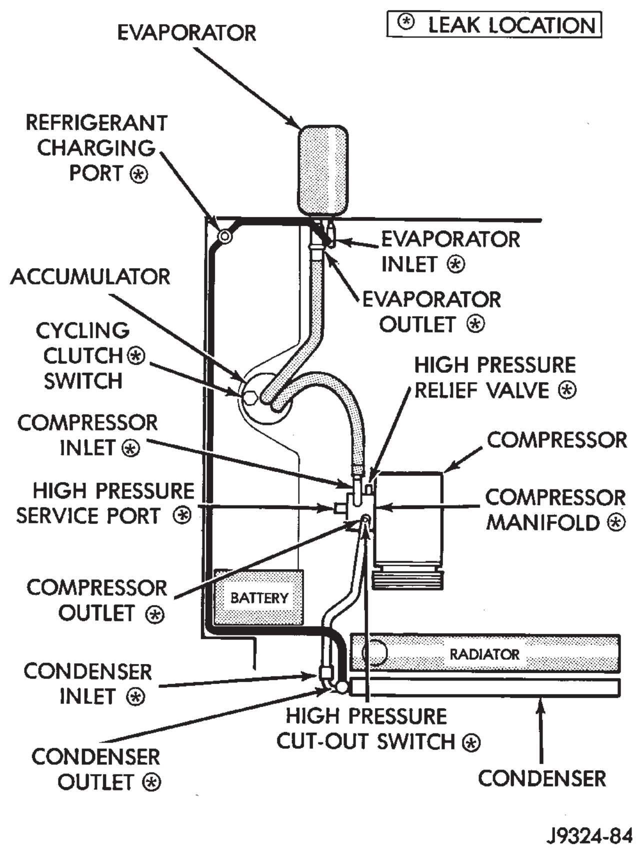

Fig. 2 Testing for A/C Leaks (4.0L Engine)

REFRIGERANT CHARGE CHECK

PREFERRED METHOD:

The most accurate method of charging the system is to discharge, evacuate and charge the system using a recovery/recycling device approved for R-134a refrigerant.

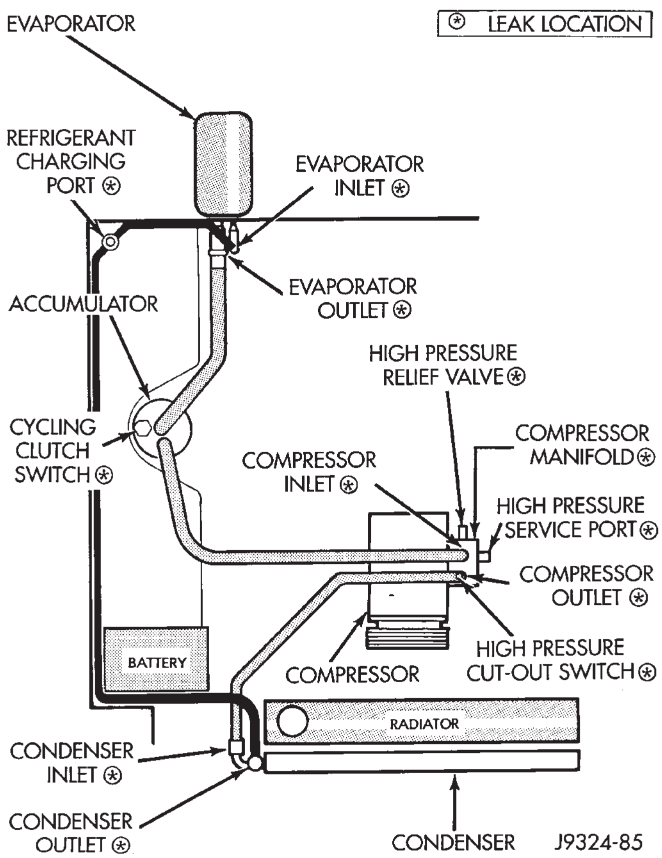

Fig. 3 Testing for A/C Leaks (5.2L Engine)

CAUTION: Review all Safety Precautions and Warnings before attempting to add refrigerant to the system. Do not add refrigerant to a system that is known to have a leak.

(1) Check for leaks (refer to Refrigerant Leak Testing). If found correct the leaks.

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.

(2) Attach manifold gauge set.

(3) Discharge the A/C system into a recovery/recycle device (refer to Discharging Refrigerant System).

(4) Evacuate the A/C system (refer to Evacuating Refrigerant System).

CAUTION: Never add R-12 to a system designed to use R-134a. Damage to the system will result.

(5) Charge the A/C system with 1.75 lbs. (28 oz.) of R-134a refrigerant (refer to Charging Refrigerant System - System Empty).

ALTERNATIVE METHOD:

This method of adding partial charge requires the measuring of the temperature difference between the evaporator inlet and outlet tubes. If it was not necessary to discharge the refrigerant system, a partial refrigerant charge can be added.

CAUTION: Review all Safety Precautions and Warnings before attempting to add refrigerant to the system. Do not add refrigerant to a system that is known to have a leak.

(1) Check for leaks (refer to Refrigerant Leak Testing). If found correct the leaks.

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.

(2) Attach manifold gauge set.

(3) Attach the probes to the inlet and outlet tubes of the evaporator.

(a) If a single temperature probe device is used, attach the probe to the evaporator inlet tube just before the collar of the quick-connect fitting. Be sure the end of the probe makes contact with the bottom surface of the tube.

(b) If dual temperature probes are used, connect probe (1) to the evaporator inlet tube and probe (2) to the evaporator outlet tube. Be sure to connect the probe just before the collar of the quick-connect fittings. Be sure the end of the probes make contact with the bottom surface of the tubes. This tool will measure the temperature difference between the inlet tube and outlet tube.

(4) Open the windows and/or doors of the passenger compartment. Set the air conditioning controls to A/C, PANEL, RECIRC (temperature knob on full cool) and blower speed on HIGH.

(5) Start the engine and hold at 1,000 RPM. Allow the engine to warm up to normal operating temperature.

(6) The A/C clutch may cycle depending on ambient conditions. If clutch cycles, remove the clutch cycling pressure switch connector from the switch located on the accumulator (Fig. 4). Place a jumper wire across the terminals of the clutch cycling pressure switch connector.

(7) Hold the engine speed at 1,000 RPM.

(8) Allow 3 to 5 minutes for the A/C system to stabilize. Record the temperature difference between the evaporator inlet and outlet tubes. Allow the equipment to stabilize.

(a) If a single temperature probe device is used, record the temperature of the inlet tube. Remove the probe from the inlet tube and attach the probe to the outlet tube just before the quick-connect fitting. Be sure the end of the probe makes contact with the tube. Allow the equipment to stabilize. Record the temperature of the outlet line. Subtract the evaporator inlet temperature from the outlet temperature.

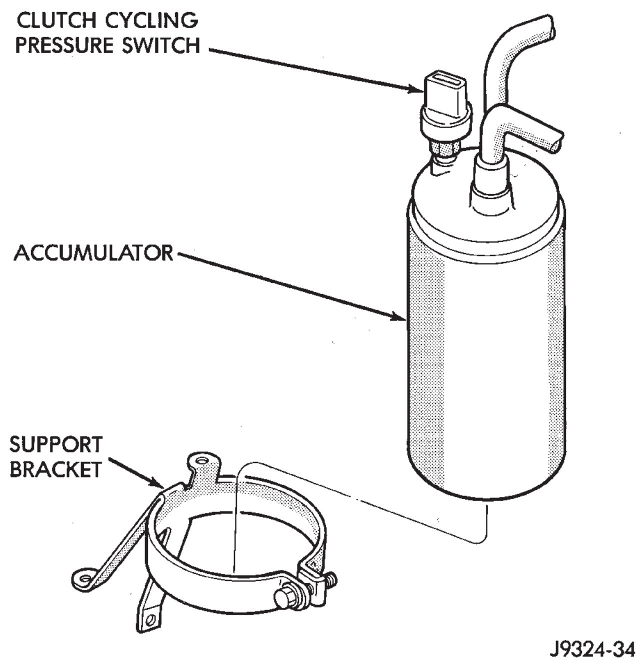

Fig. 4 Clutch Cycling Pressure Switch

(b) If dual temperature probes are used, record the temperature difference (probe 2 minus probe 1).

(9) Refer to the Low Charge Determination chart. Depending on the ambient temperature and the recorded differential temperature, you can determine the additional charge required. If the measured temperature differential (refer to Low Charge Determination chart) is higher than 22°C to 26°C (40°F to 47°F), add 0.90 lbs. (14 oz.). Allow 3 to 5 minutes for the system to stabilize. Record the lowest temperature difference between the evaporator inlet and outlet tubes and again refer to the Low Charge Determination chart to determine if additional charge is required.

(10) Record the compressor discharge pressure. If higher than the pressure in the Compressor Discharge Pressure chart, the system could be overcharged (refer to High Compressor Discharge Pressure). If the pressure is equal to or lower than the chart pressure, continue on with this procedure.

FOR EXAMPLE: The ambient temperature is 21°C (70°F). The evaporator INLET temperature is 12°C (54°F) and the evaporator OUTLET temperature is 10°C (50°F). The difference is OUTLET - INLET = -2°C (-4°F). With a -2°C (-4°F) temperature differential at 21°C (70°F) ambient temperature, the system is fully charged.

(11) Following the instructions provided with the charging equipment, charge through the service ports. Add enough refrigerant to bring the A/C system up to 1.75 lbs. (28 oz.).

(12) Remove the jumper wire from the clutch cycling pressure switch connector. Connect the clutch cycling pressure switch connector to the switch.

(13) Close all valves on the charging equipment and disconnect the hoses from the service ports. Install the service port caps.

HIGH COMPRESSOR DISCHARGE PRESSURE

Refer to the Compressor Discharge Pressure Diagnosis chart to determine the problem.

REPLACE VISCOUS FAN DRIVE

Refer to Group 7, Cooling System for the proper procedures.

SYSTEM OVERCHARGED

(1) Discharge the A/C system into a recovery/recycle device.

(2) Evacuate the A/C system.

CAUTION: Never add R-12 to a system designed to use R-134a. Damage to the system will result.

(3) Charge the A/C system with 1.75 lbs. (28 oz.) of R-134a refrigerant.

RESTRICTION IN SYSTEM

(1) Discharge the A/C system into a recovery/recycle device.

(2) Replace the condenser-to-evaporator line (liquid line).

(3) Evacuate the A/C system.

CAUTION: Never add R-12 to a system designed to use R-134a. Damage to the system will result.

(4) Charge the A/C system with 1.75 lbs. (28 oz.) of R-134a refrigerant.

REPLACE COMPRESSOR

(1) Discharge the A/C system into a recovery/recycle device.

(2) Remove the compressor (refer to Refrigerant Oil Level, Oil Level Check).

(3) Install a new 10PA17 (R-134a refrigerant) compressor.

(4) Replace the condenser-to-evaporator line (liquid line).

(5) Evacuate the A/C system.

CAUTION: Never add R-12 to a system designed to use R-134a. Damage to the system will result.

(6) Charge the A/C system with 1.75 lbs. (28 oz.) of R-134a refrigerant.

DISCHARGING REFRIGERANT SYSTEM

R-134a refrigerant is a hydrofluorocarbon (HFC) that does not contain chlorine. R-134a refrigerant recycling device that meets SAE standard J2210 must be used to discharge the refrigerant system. Contact an automotive service equipment supplier for refrig-

LOW CHARGE DETERMINATION

Open the windows and/or doors of the passenger compartment. Set the air conditioning controls to A/C, PANEL, RECIRC (temperature knob on full cool) and blower speed on HIGH. Set the engine speed at 1,000 RPM.

Evaporator Outlet and Inlet Temperature Differential

- If Outlet is WARMER than Inlet, temperature differential is plus (+).
- If Outlet is COLDER than Inlet, temperature differential is minus (-).

See the example in the Refrigerant Charge Check (Alternative Method).

Added Amount of R134a to Properly Charge A/C System	Ambient Temperature				
	21°C (70°F)	27°C (80°F)	32°C (90°F)	38°C (100°F)	43°C (110°F)
	Differential Temperature				
0.90 lbs. (14 oz.)	+22°C (+40°F)	+23°C (+42°F)	+24°C (+43°F)	+25°C (+45°F)	+26°C (+47°F)
0.75 lbs. (12 oz.)	+12°C (+22°F)	+12°C (+23°F)	+13°C (+24°F)	+15°C (+26°F)	+16°C (+28°F)
0.60 lbs. (10 oz.)	+4°C (+8°F)	+5°C (+9°F)	+6°C (+10°F)	+7°C (+12°F)	+8°C (+13°F)
0.50 lbs. (8 oz.)	0°C (0°F)	+0°C (+1°F)	+1°C (+2°F)	+2°C (+3°F)	+3°C (+4°F)
0.40 lbs. (6 oz.)	-1°C (-2°F)	-1°C (-1°F)	+0°C (-0°F)	0°C (0°F)	0°C (0°F)
Recommended Charge	-2 to -6°C (-3 to -10°F)				

Note: A temperature differential of -2°C to -6°C (-3°F to -10°F) indicates an acceptable charge.

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COMPRESSOR DISCHARGE PRESSURE

Ambient Temperature	16°C (60°F)	21°C (70°F)	27°C (80°F)	32°C (90°F)	38°C (100°F)	43°C (110°F)
Compressor Discharge Pressure	1515 kPa (220 psi)	1655 kPa (240 psi)	1790 kPa (260 psi)	2070 kPa (300 psi)	2345 kPa (340 psi)	2690 kPa (390 psi)

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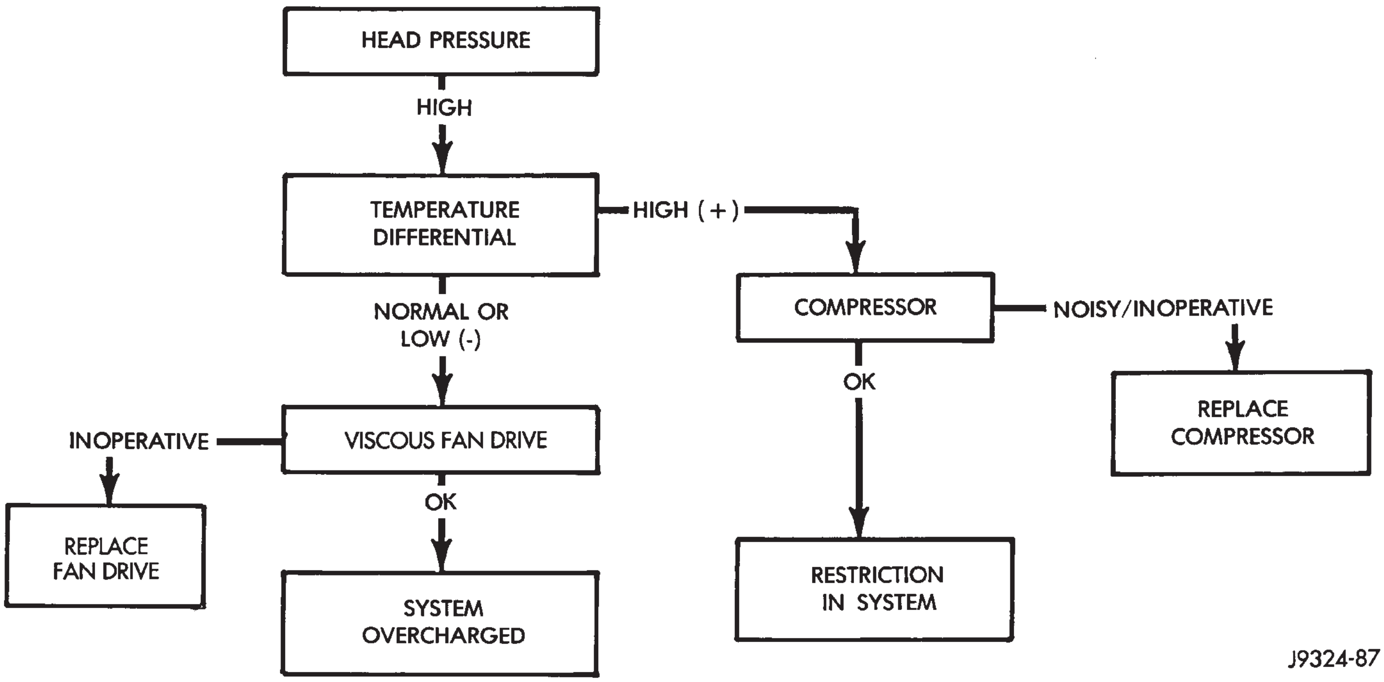
erant recycling equipment. Refer to the operating instructions provided with the recycling equipment for proper operation.

EVACUATING REFRIGERANT 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 the 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:

COMPRESSOR DISCHARGE PRESSURE DIAGNOSIS



(1) Connect a suitable charging station, refrigerant recovery machine and a manifold gauge set with vacuum pump.

(2) Open the low and high side valves and start the vacuum pump. When the suction gauge reads 88 kPa (26 in. Hg) vacuum or greater, close all valves and turn off vacuum pump. If the system fails to reach specified vacuum, the refrigerant system likely has a leak that must be corrected. If the refrigerant system maintains specified vacuum for at least 30 minutes, start the vacuum pump. Then open the suction and discharge valves and allow the system to evacuate an additional 10 minutes.

(3) Close all valves. Turn off and disconnect the vacuum pump.

The refrigerant system is prepared to be charged with refrigerant.

CHARGING REFRIGERANT SYSTEM—SYSTEM EMPTY

Review safety precautions and warnings before charging the refrigerant system.

CAUTION: Do not over charge refrigerant system, as excessive compressor head pressure can cause noise and system failure.

After the system has been tested for leaks and evacuated, a refrigerant charge can be injected into the system.

(1) Connect manifold gauge set.

(2) Measure refrigerant (refer to capacities) and heat to 52°C (125°F) with the charging station. Refer to the instructions provided with the equipment being used. The proper charge is 1.75 lbs. (28 oz.).

(3) Open the low and high side valves. Open the charge valve to allow the heated refrigerant to flow into the system. When the transfer of refrigerant has stopped, close the suction and discharge valve.

(4) If all of the refrigerant charge did not transfer from the dispensing device, start engine and hold at idle (1,500 RPM). Set the A/C control to A/C, low blower speed and open windows. If the A/C compressor does not engage, test the compressor clutch control circuit and correct any failure. Refer to Group 8W, Wiring Diagrams.

(5) Open the low side valve to allow the remaining refrigerant to transfer to the system.

WARNING: TAKE CARE NOT TO OPEN THE DISCHARGE (HIGH-PRESSURE) VALVE AT THIS TIME.

(6) Close all valves and test the A/C system performance. Refer to Heater and A/C Performance Tests in this Group.

(7) Disconnect the charging station or manifold gauge set. Install the service port caps.

REFRIGERANT OIL LEVEL

It is important to have the correct amount of oil in the A/C system to 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 10PA17 compressor is a polyalkylene glycol synthetic oil (ND8 PAG), 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 tightly capped after use to prevent contamination from dirt and moisture. 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 ruptured line, shaft seal leakage, leakage from the evaporator, condenser leak, accumulator leakage or loss of refrigerant due to a collision. Oil loss at a leak point will be evident by the presence of a wet, shiny surface around the leak.

OIL LEVEL CHECK

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 with R-134a and operated, the oil in the compressor is dispersed through the lines and components. The evaporator, condenser and accumulator 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.

A/C REFRIGERANT OIL CAPACITIES

Component	ml	oz
A/C System	230	7.75
Accumulator	120	4
Condenser	30	1
Evaporator Care	60	2
Compressor	(see Oil Level Check)	

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When a refrigerant line or component has ruptured and it has released an unknown amount of oil. The A/C compressor should be removed and drained through the discharge and suction ports.

VERIFY REFRIGERANT OIL LEVEL

(1) Slowly discharge refrigerant system into a recovery/recycle device.

(2) Remove refrigerant lines from A/C compressor.

(3) Remove compressor from vehicle.

(4) From suction port on top of compressor, drain refrigerant oil from compressor.

(5) Add system oil capacity minus the capacity of components that have not been replaced. Refer to the Refrigerant Oil Capacity chart. Add oil through suction port on compressor.

(6) Install compressor, connect refrigerant lines, evacuate and charge refrigerant system.

COMPRESSOR SERVICE PROCEDURES

INDEX

COMPRESSOR

REMOVAL

The A/C compressor may be removed and repositioned without discharging the refrigerant system. Discharging is not necessary if removing the A/C compressor clutch/coil assembly, engine, cylinder head or generator.

WARNING: REFRIGERANT PRESSURES REMAIN HIGH EVEN THOUGH THE ENGINE MAY BE TURNED OFF. BEFORE REMOVING A FULLY CHARGED COMPRESSOR, REVIEW THE SAFETY PRECAUTIONS AND WARNINGS SECTION IN THIS GROUP. DO NOT TWIST OR KINK THE REFRIGERANT LINES WHEN REMOVING A FULLY CHARGED COMPRESSOR. SAFETY GLASSES MUST BE WORN.

(1) Disconnect the negative cable from the battery.

(2) Loosen and remove the serpentine belt (refer to Group 7, Cooling System).

(3) Disconnect compressor clutch wire lead.

(4) If the compressor must be removed from the vehicle, discharge the A/C system into a recovery/recycle device (refer to Refrigerant Service Procedures). Remove refrigerant lines from compressor.

(5) Remove compressor attaching bolts.

(6) Remove compressor. If refrigerant lines were not removed, lift compressor/clutch assembly and tie it to a suitable component.

INSTALLATION

(1) Position compressor on mount.

(2) Install and tighten the bolts to 27 N●m (20 ft. lbs.) torque.

(3) If refrigerant lines were removed, install the lines to the manifold. Use new O-rings.

(4) Evacuate the A/C system (refer to Refrigerant Service Procedures).

(5) If the compressor was removed from the vehicle:

(a) Charge the A/C system (refer to Refrigerant Service Procedures).

(b) Connect the compressor clutch wire lead.

(6) Install and tighten the serpentine belt (refer to Group 7, Cooling System).

(7) Connect the negative cable to the battery.

COMPRESSOR MANIFOLD

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Discharge the A/C system into a recovery/recycle device (refer to Refrigerant Service Procedures).

(3) Remove the A/C lines from the manifold.

(4) Remove the compressor manifold bolts.

(5) Remove the manifold.

INSPECTION

Check the manifold seal for damage. Replace seal if damaged.

INSTALLATION

(1) With the seal in place, position the manifold onto the compressor.

(2) Install and tighten the compressor manifold bolts to 25 N●m (19 ft. lbs.) torque.

(3) Using new O-rings, install the A/C lines to the manifold.

(4) Evacuate the A/C system (refer to Refrigerant Service Procedures).

(5) Charge the A/C system (refer to Refrigerant Service Procedures).

(6) Connect the negative cable to the battery.

COMPRESSOR CLUTCH / COIL ASSEMBLY

REMOVAL

Compressor assembly must be removed from mounting. Refrigerant discharge is not necessary.

(1) Disconnect the negative cable from the battery.

(2) Remove the compressor shaft bolt (Fig. 1). A band type oil filter removal tool can be placed around the clutch plate to aid in bolt removal.

(3) Tap the clutch plate with a plastic hammer and remove clutch plate and shim (Fig. 2).

CAUTION: Do not use screwdrivers between the clutch plate assembly and pulley to remove front plate. This may damage the front plate assembly.

(4) Remove pulley retaining snap ring with Snap Ring Pliers (C-4574) and slide pulley assembly off of compressor (Fig. 3).

(5) Remove coil wire clip screw and wire harness.

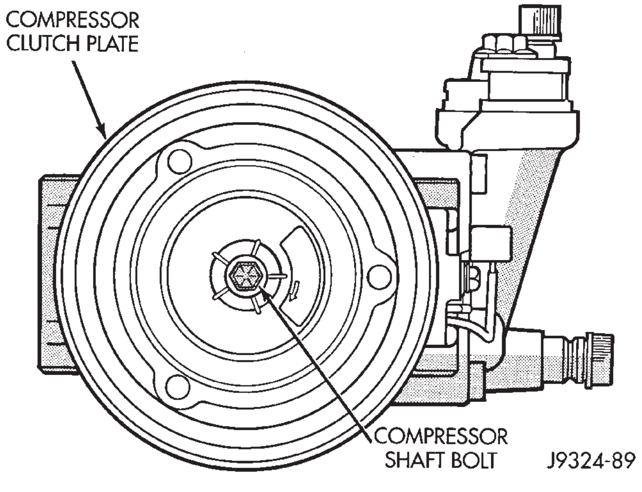

Fig. 1 Compressor Shaft Bolt and Clutch Plate

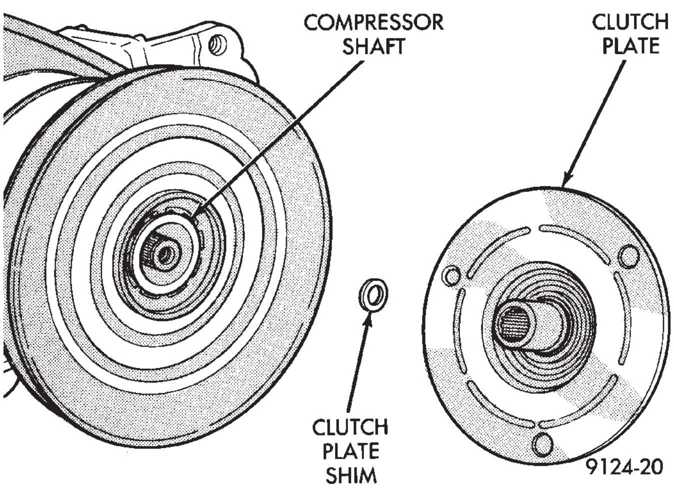

Fig. 2 Clutch Plate and Shim(s)

(6) Remove snap ring retaining field coil onto compressor housing (Fig. 4). Slide field coil off of compressor housing.

INSPECTION

Examine frictional faces of the clutch pulley and front plate for wear. The pulley and front plate should be replaced if there is excessive wear or scoring.

The friction surfaces are oily, inspect the shaft nose area of the compressor for oil and remove the felt from the front cover. If the compressor felt is saturated with oil, the shaft seal is leaking and will have to be replaced.

Check bearing for roughness or excessive leakage of grease. Replace bearing as required.

INSTALLATION

(1) Align pin in back of field coil with hole in compressor end housing and position field coil into place. Make sure that lead wires are properly routed and fasten with the wire clip retaining screw.

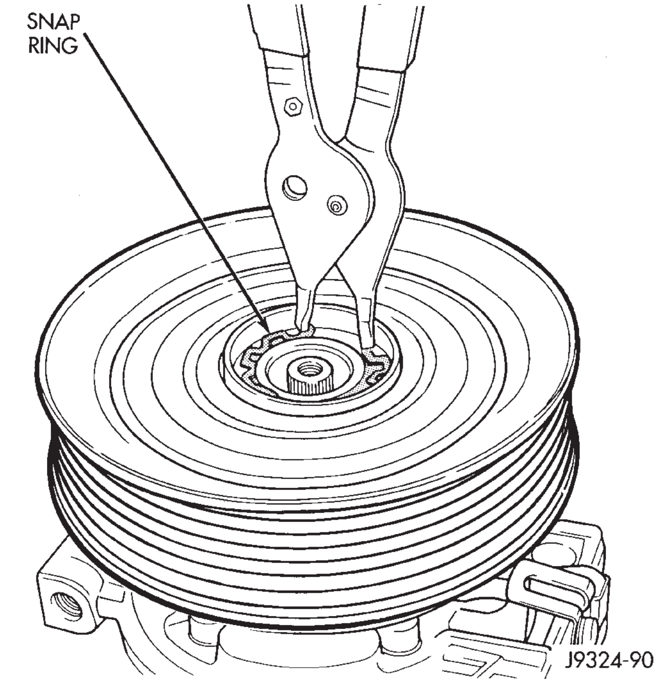

Fig. 3 Removing Pulley Snap Ring

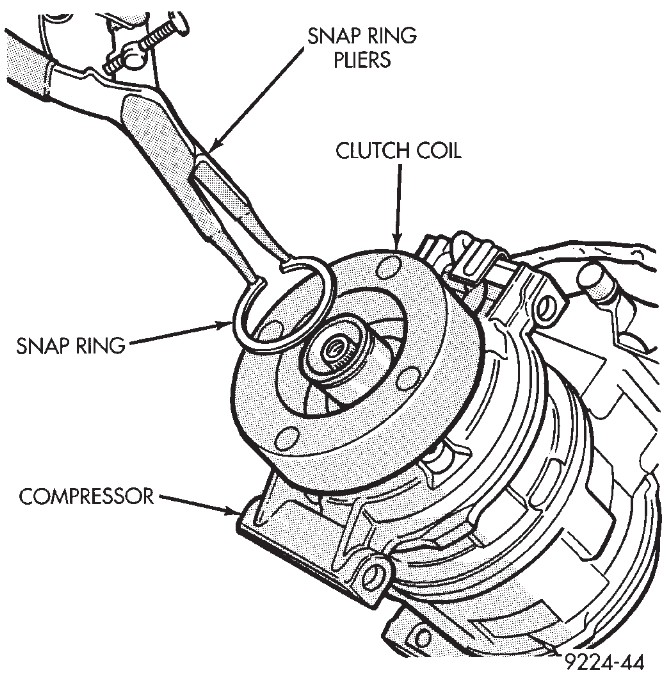

Fig. 4 Clutch Coil Snap Ring

(2) Install field coil retaining snap ring with Snap Ring Pliers (C-4574). The bevel side of the snap ring must be outward. Also both eyelets must be to the right or left of the pin on the compressor. Press snap ring to make sure it is properly seated in the groove.

CAUTION: If snap ring is not fully seated it will vibrate out, resulting in a clutch failure and severe damage to the front face of the compressor.

(3) Install pulley assembly to compressor. If necessary, tap gently with a block of wood on the friction surface (Fig. 5).

CAUTION: Do not mar the pulley frictional surface.

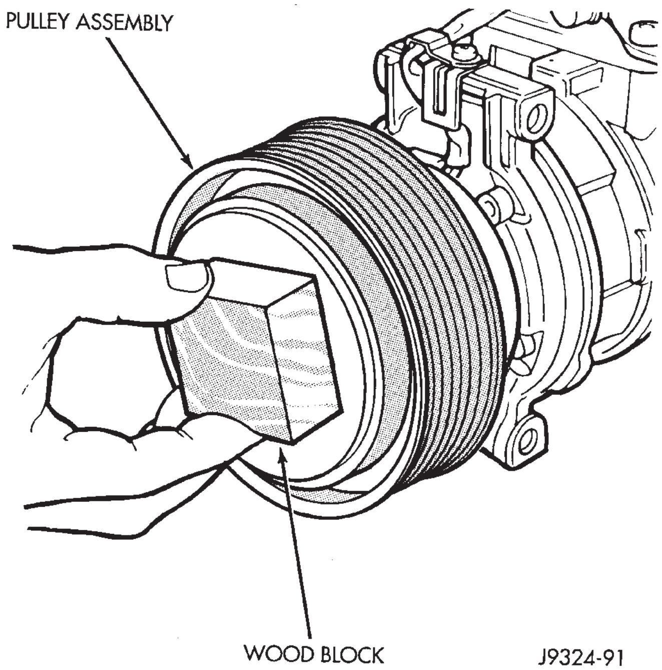

Fig. 5 Installing Pulley Assembly

(4) Install pulley assembly retaining snap ring (bevel side outward) with Snap Ring Pliers (C-4574). Press the snap ring to make sure it is properly seated in the groove.

(5) If the original front plate assembly and pulley assembly are to be reused, the old shim(s) can be used. If not, place a stack of shim(s) equal to the old shim(s) on the shaft against the shoulder.

(6) Install front plate assembly onto shaft.

(7) With the front plate assembly tight against the shim(s), measure the air gap between front plate and pulley face with feeler gauges. The air gap should be between 0.35 and 0.65 mm (.014 and .026 in.) If proper air gap is not obtained, add or subtract shims until desired air gap is obtained.

(8) Install compressor shaft bolt. Tighten bolt to 13 N●m (115 in. lbs.) torque.

Shims may compress after tightening shaft nut. Check air gap in four or more places to verify if air gap is still correct. Spin pulley for final check.

(9) Connect the negative cable to the battery.

CLUTCH BREAK-IN

After a new clutch has been installed cycle the A/C clutch 20 times (5 sec. on and 5 sec. off). During this procedure, set the system to the A/C mode, engine RPM at 1500 - 2000 and high blower speed. This procedure (burnishing) will seat the opposing friction surfaces and provide a higher clutch torque capability.

COMPRESSOR HIGH-PRESSURE RELIEF VALVE

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Discharge the A/C refrigerant system into a recovery/recycle device (refer to Refrigerant Service Procedures).

(3) Rotate the high pressure relief valve counterclockwise and separate relief valve from the vehicle (Fig. 6).

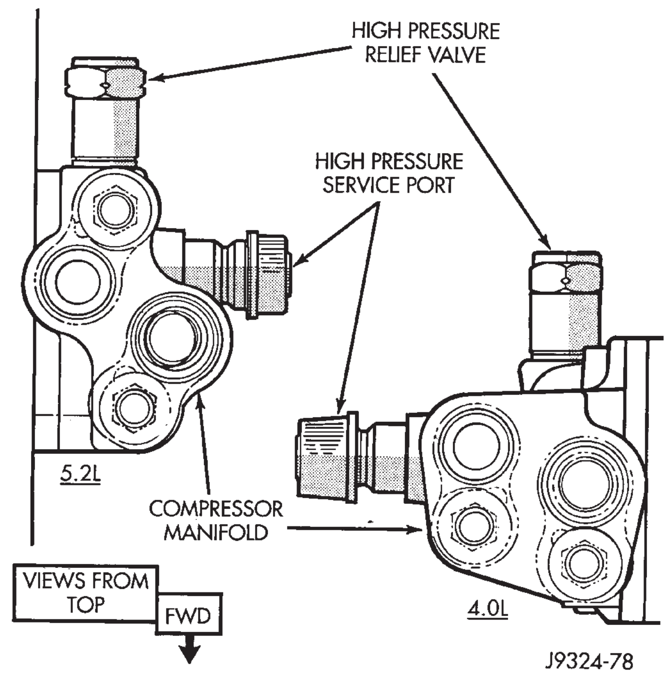

Fig. 6 High Pressure Relief Valve

INSTALLATION

(1) Install the high pressure relief valve.

(2) Evacuate the A/C system (refer to Refrigerant Service Procedures).

(3) Charge the A/C system (refer to Refrigerant Service Procedures).

(4) Connect the negative cable to the battery.

CLIMATE CONTROL SYSTEM

INDEX

CONTROL PANEL

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove ash tray.

(3) Remove screws holding center cluster bezel (Fig. 1).

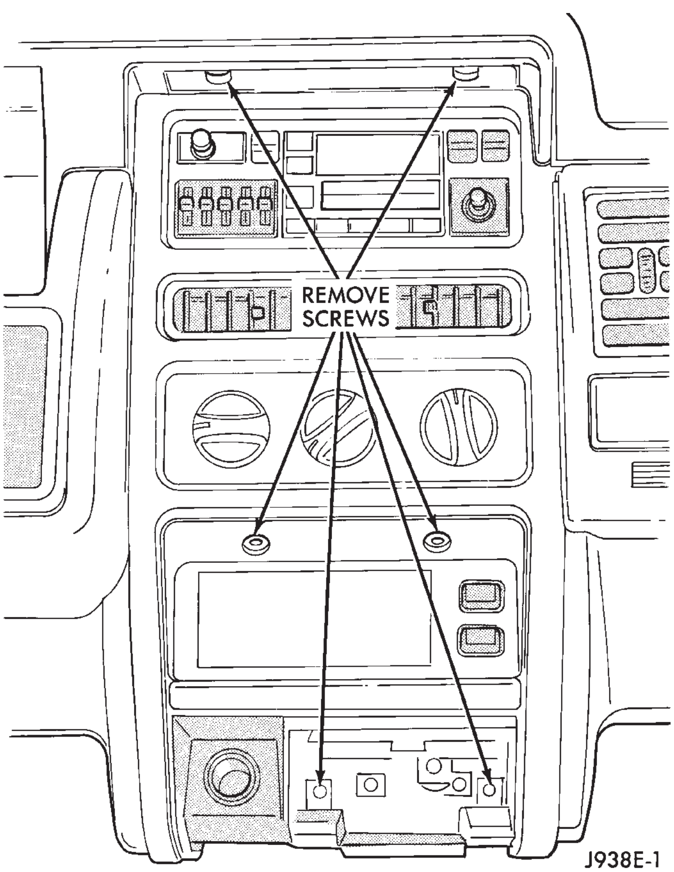

Fig. 1 Remove Center Bezel Retaining Screws

(4) Remove center bezel.

(5) Remove the control panel screws (Fig. 2).

(6) Remove the control panel.

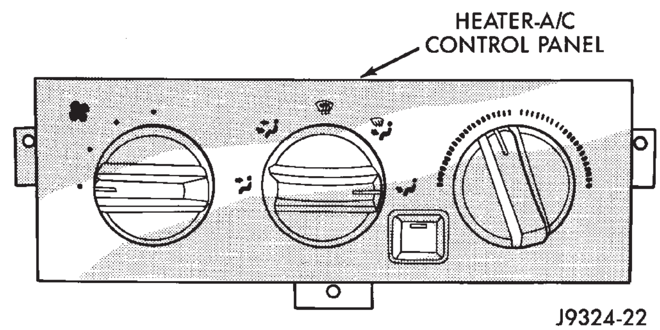

Fig. 2 Heater-A/C Control Panel

(7) Disconnect the electrical connector(s).

(8) Disconnect the vacuum connector on heater and manual A/C vehicles (Fig. 3).

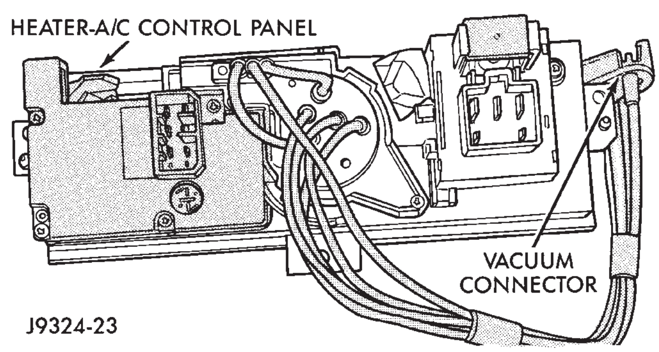

Fig. 3 Vacuum Connector

INSTALLATION

(1) If the vehicle is equipped with heater and manual A/C, connect the vacuum connector.

(2) Connect electrical connectors.

(3) Install control panel and tighten screws.

(4) Install center bezel.

(5) Install and tighten the center bezel screws.

(6) Install ash tray.

(7) Connect the negative cable to the battery.

BLOWER MOTOR AND WHEEL

The blower motor and wheel are located under the glove box and can be removed from the passenger compartment.

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Disconnect the blower motor cooling tube (Fig. 4).
(3) Remove the blower motor electrical connector from the retainer. Disconnect the electrical connector (Fig. 4).
(4) Remove the blower motor and wheel assembly mounting screws (Fig. 4).
(5) Remove the blower motor and wheel assembly.

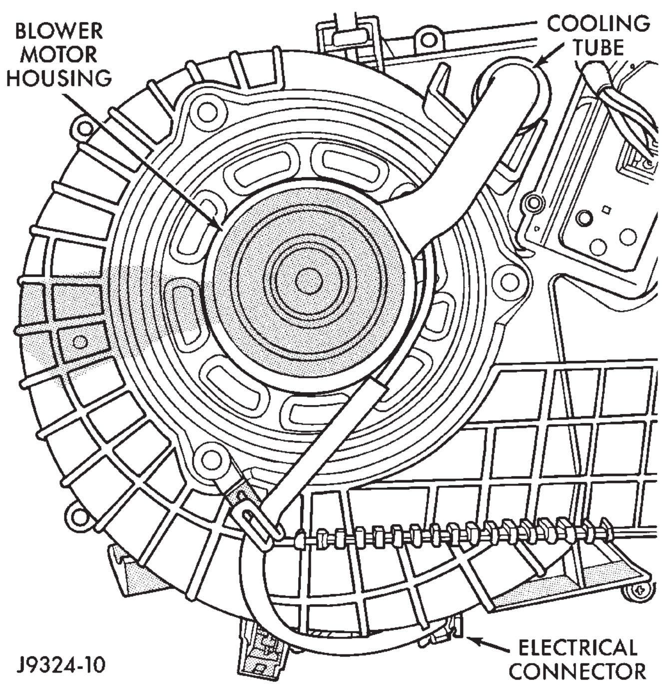

Fig. 4 Blower Motor

(6) Remove the blower motor wheel retainer clip (Fig. 5).
(7) Pull the blower motor wheel off of the blower motor shaft.

INSPECTION

Inspect the blower motor seal for damage.

INSTALLATION

(1) Press the blower motor wheel onto the blower motor shaft. Be sure the flat on the blower motor shaft lines up with the flat inside the wheel.
(2) Install the retainer clip. The ears of the retainer clip must be over the flat surface on the motor shaft.
(3) Be sure the seal is installed on the blower motor housing (Fig. 6).

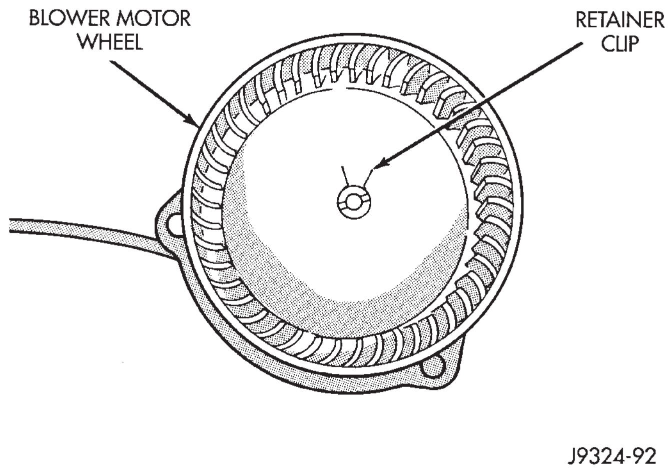

Fig. 5 Blower Motor Wheel

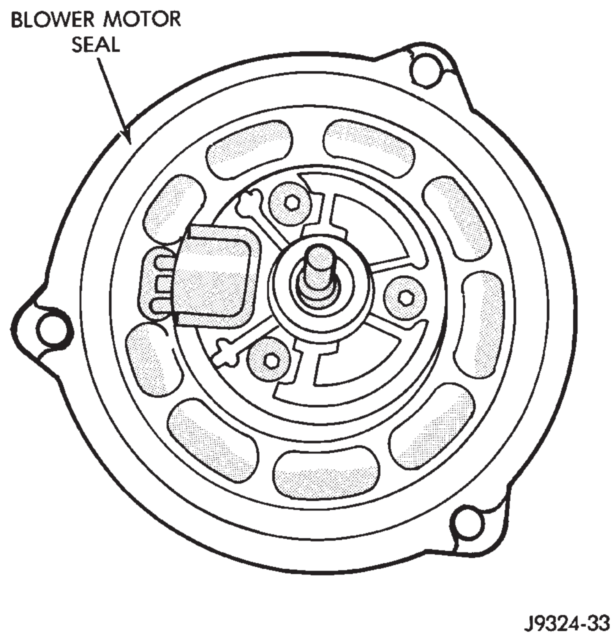

Fig. 6 Blower Motor Seal

(4) Install the blower motor and wheel assembly.
(5) Install and tighten blower motor and wheel assembly screws.
(6) Connect the electrical connector and install into the retainer.
(7) Connect the blower motor cooling tube.
(8) Connect the negative cable to the battery.

BLOWER MOTOR RESISTOR

The blower motor resistor is located under the glove box and can be removed from the passenger compartment.

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Remove the blower motor resistor connector(s).
(3) Remove the resistor retaining screws.
(4) Remove the blower motor resistor (Fig. 7).

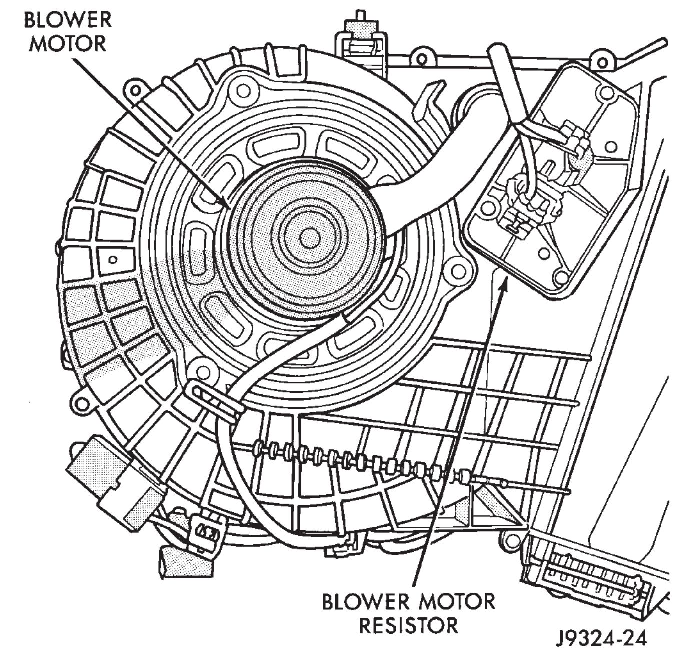

Fig. 7 Blower Motor Resistor (ATC Shown)

INSTALLATION

(1) Install the blower motor resistor. Install and tighten the screws.

(2) Connect the resistor connectors.

(3) Connect the negative cable to the battery.

HEATER—A/C UNIT

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Discharge the A/C system into a recovery/recycle device (refer to Refrigerant Service Procedures).

(3) Disconnect the A/C hoses from the evaporator lines (Fig. 8).

(4) Drain the cooling system (refer to Group 7, Cooling System).

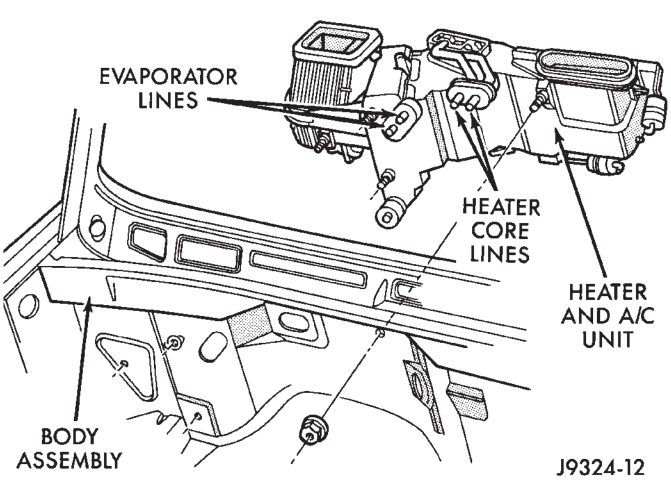

Fig. 8 Heater-A/C Unit (Shown from Engine Compartment)

(5) Disconnect the heater hoses from the heater core lines (Fig. 8).

(6) Remove the coolant reserve/overflow bottle (Fig. 9).

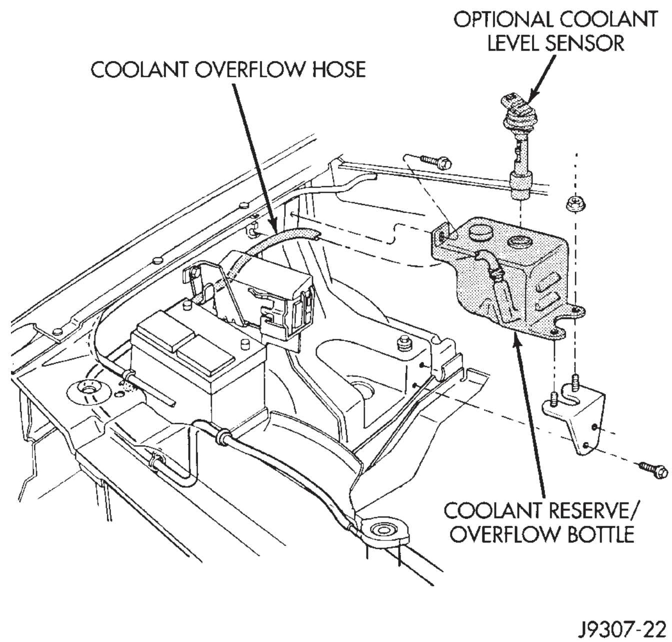

Fig. 9 Coolant Reserve/Overflow Bottle—Typical

(7) DO NOT disconnect the 60-way connector from the powertrain control module (PCM) - (Fig. 10). Remove the PCM and set aside.

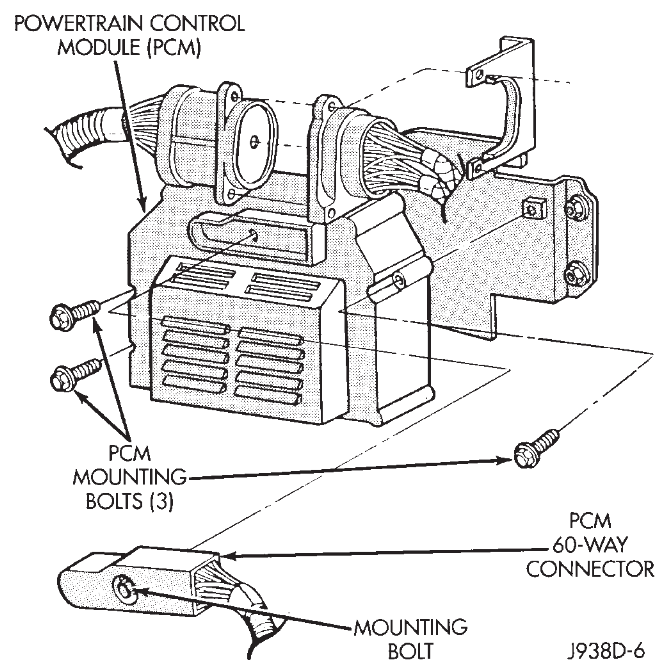

Fig. 10 Powertrain Control Module (PCM)

(8) Remove the attaching nuts from the studs on the engine compartment side of the dash panel (Fig. 8).

(9) Remove the instrument panel (refer to Group 23, Body).

(10) Remove the defrost duct (Fig. 11).

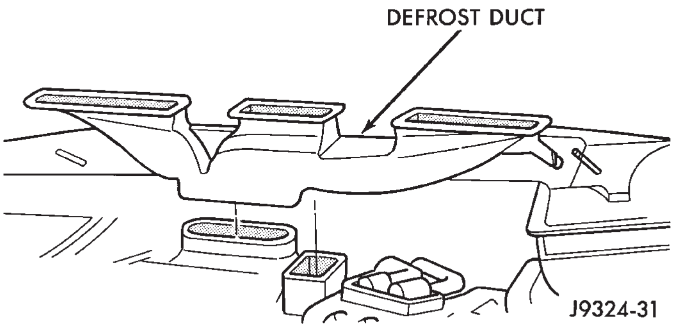

Fig. 11 Defrost Duct

(11) Disconnect the rear floor heat duct from the center adaptor heat duct (Fig. 12).

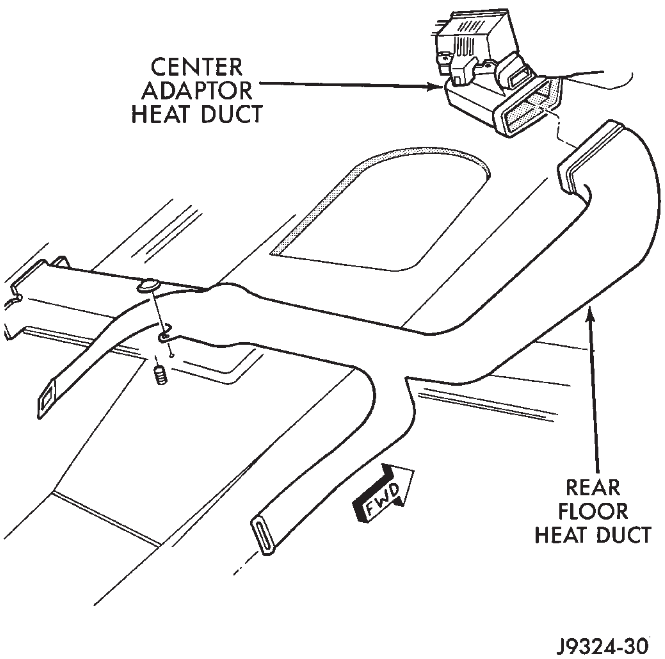

Fig. 12 Rear Floor Heat Duct

(12) Disconnect the electrical connections.

(13) Remove the attaching nuts from the studs in the passenger compartment side of the dash panel (Fig. 13).

(14) Remove the heater-A/C unit from the vehicle.

INSTALLATION

(1) Position the heater-A/C unit into the dash panel. Be sure the drain tube is positioned in the dash panel drain hole.

(2) Install the passenger compartment attaching nuts (Fig. 13). Tighten the nuts to 4.5 N●m (40 in. lbs.) torque.

(3) Install the attaching nuts on the engine compartment side of the dash panel (Fig. 8). Tighten the nuts to 7 N●m (60 in. lbs.) torque.

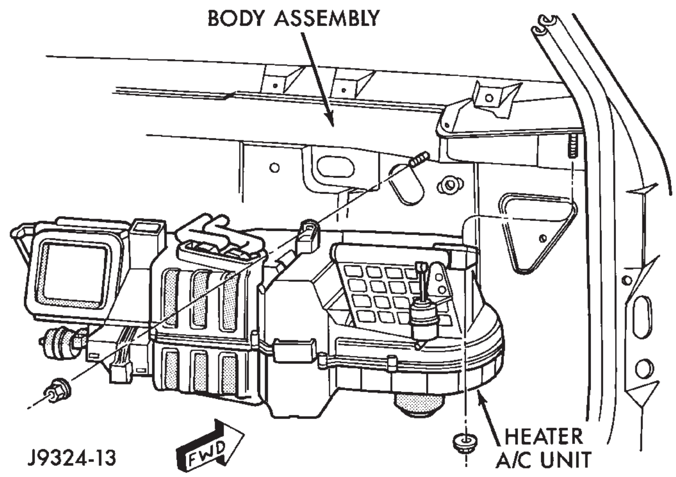

Fig. 13 Heater-A/C Unit (Shown from Passenger Compartment)

(4) Connect the heater hoses to the heater core lines.

(5) Connect the A/C hoses to the evaporator lines.

(6) Install the coolant reserve/overflow bottle.

(7) Install the powertrain control module (PCM).

(8) Install the defrost duct.

(9) Connect the rear floor heat duct to the center adaptor heat duct.

(10) Connect the electrical connectors.

(11) Install the instrument panel (refer to Group 23, Body).

(12) Fill the cooling system (refer to Group 7, Cooling System).

(13) Evacuate the A/C system (refer to Refrigerant Service Procedures).

(14) Charge the A/C system (refer to Refrigerant Service Procedures).

(15) Connect the negative cable to the battery.

(16) Start the vehicle and check for proper operation of the heater and A/C system.

HEATER CORE

REMOVAL

(1) Remove the heater-A/C unit from the vehicle (refer to Heater-A/C Unit Removal).

(2) Remove the heater core retaining screws.

(3) Pull the heater core straight out of the housing (Fig. 14).

INSTALLATION

(1) Install the heater core into the housing.

(2) Position the clips over the heater core tubes. Install and tighten the screws.

(3) Install the heater-A/C unit into the vehicle (refer to Heater-A/C Unit Installation).

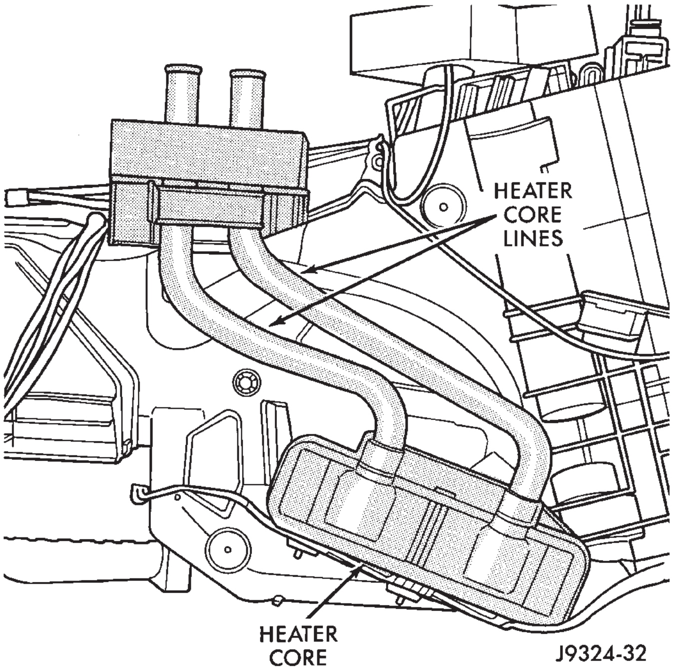

Fig. 14 Heater Core

EVAPORATOR CORE

REMOVAL

(1) Remove the heater-A/C unit from the vehicle (refer to Heater-A/C Unit Removal).

(2) Turn the heater-A/C unit upside down.

(3) Remove the retaining screws holding the two halves together. Remove the center adaptor heat duct (Fig. 15) and remove the screw.

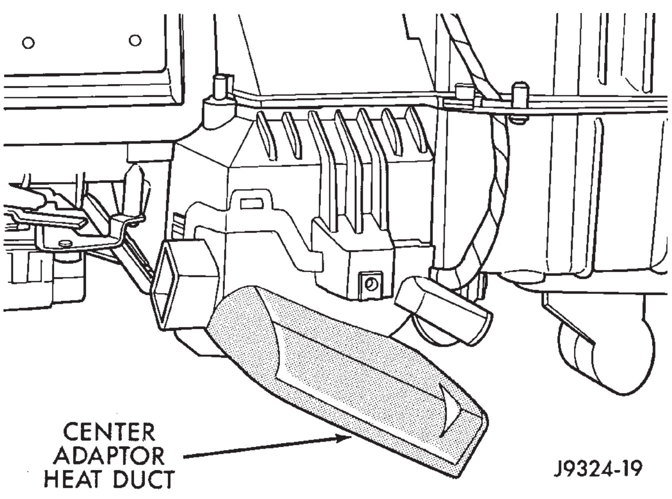

Fig. 15 Center Adaptor Heat Duct

(4) Carefully turn the heater-A/C unit over. Remove the top half of the unit (Fig. 16).

(5) Remove the evaporator out of the unit.

INSTALLATION

(1) Position the evaporator in the bottom half of the heater-A/C unit.

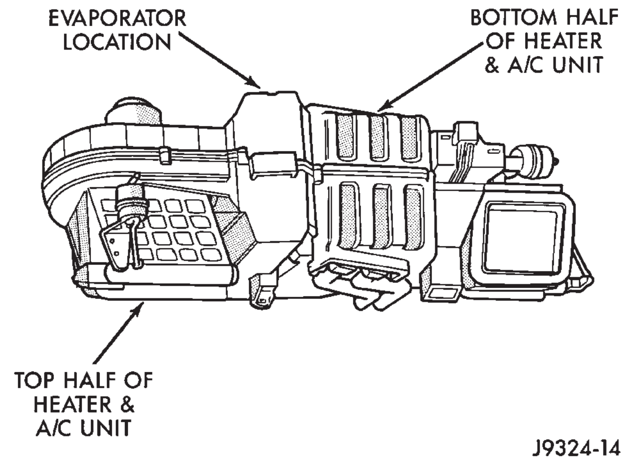

Fig. 16 Evaporator Location in Heater-A/C Unit (Upside Down)

(2) Position the top half of the heater-A/C unit in place. Carefully turn the unit over. Install and tighten the retaining screws.

(3) Snap on the center adaptor heat duct.

(4) Install the heater-A/C unit into the vehicle (refer to Heater-A/C Unit Installation).

(5) If the evaporator was replaced, add 2 ounces of ND8 PAG refrigerant oil to the air conditioning system.

RECIRCULATING AIR DOOR ACTUATOR

REMOVAL

(1) Remove the instrument panel (refer to Group 23, Body).

(2) Disconnect the vacuum line (Fig. 17) or electrical connector (Fig. 18).

(3) Disconnect the actuating rod clip (Figs. 17 and 18).

(4) Remove the actuator retaining screws.

(5) Remove the actuator (Fig. 17 or 18).

INSTALLATION

(1) Position the actuator on the heater-A/C unit. Install and tighten the screws.

(2) Connect the rod and rod clip to the door lever.

(3) Connect the vacuum line (heater and manual A/C) or the electrical connector (ATC).

(4) Install the instrument panel (refer to Group 23, Body).

RECIRCULATING AIR DOOR

REMOVAL

(1) Remove the heater-A/C unit from the vehicle (refer to Heater-A/C Unit Removal).

(2) Disconnect the actuating rod clip (Fig. 17 or 18).

(3) Pry the recirculating door shaft retainer from the shaft (Fig. 17 or 18).

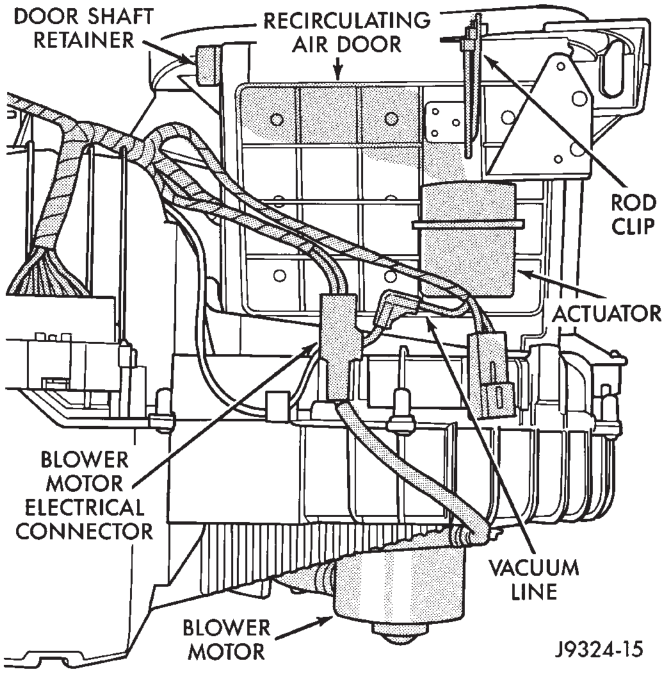

Fig. 17 Recirculating Air Door Actuator (Heater and Manual A/C)

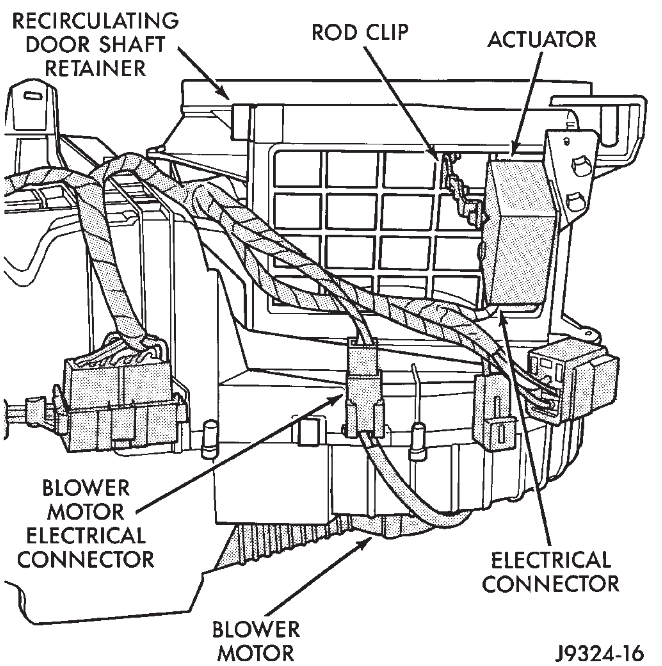

Fig. 18 Recirculating Air Door Actuator (ATC)

(4) Remove the recirculating door through the top opening.

INSTALLATION

(1) Install the recirculating door through the top opening and position in place.

(2) Press the recirculating door shaft retainer onto the shaft.

(3) Connect the rod and rod clip to the door lever.

(4) Install the heater-A/C unit into the vehicle (refer to Heater-A/C Unit Installation).

TEMPERATURE / BLEND AIR DOOR MOTOR

The temperature/blend air door motor is located under the instrument panel and can be removed from the passenger compartment.

REMOVAL

(1) Disconnect the electrical connector (Fig. 19).

(2) Remove the retaining screws.

(3) Remove the temperature/blend air door motor (Fig. 19).

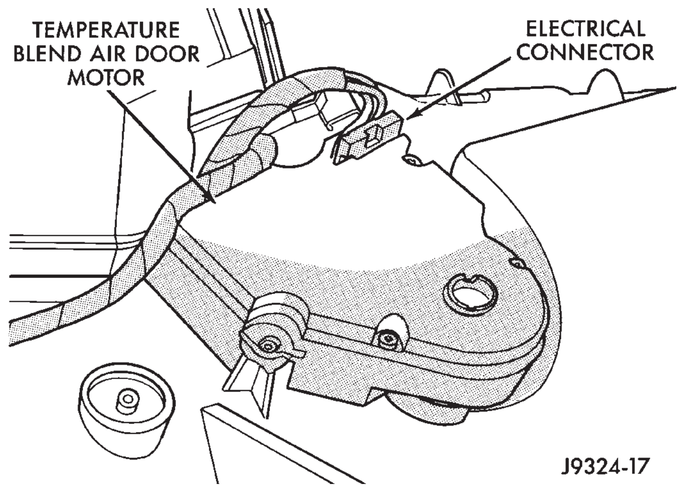

Fig. 19 Temperature/Blend Air Door Motor

INSTALLATION

(1) Position the motor over the door connection.

(2) Install and tighten the retaining screws.

(3) Connect the electrical connector.

TEMPERATURE / BLEND AIR DOOR

REMOVAL

(1) Remove the heater-A/C unit from the vehicle (refer to Heater-A/C Unit Removal).

(2) Turn the heater-A/C unit upside down.

(3) Remove the retaining screws holding the two halves together. Remove the center adaptor heat duct (Fig. 20) and remove the screw.

(4) Disconnect the electrical connectors.

(5) Remove the bottom half of the heater-A/C unit (Fig. 21).

(6) Remove the door (Fig. 21).

(7) To replace the door-to-motor pivot connection, the motor must be removed.

INSTALLATION

(1) If removed, install the door-to-motor pivot connection. Position the motor and tighten the screws.

(2) Install the door.

(3) Position the top half of the heater-A/C unit onto the bottom. Be sure the door pivot pins align with the pivot holes.

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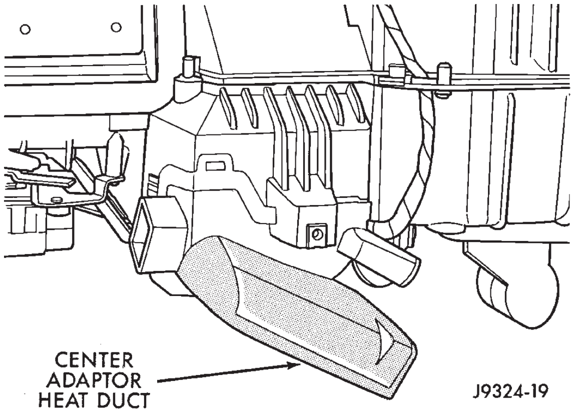

Fig. 20 Center Adaptor Heat Duct

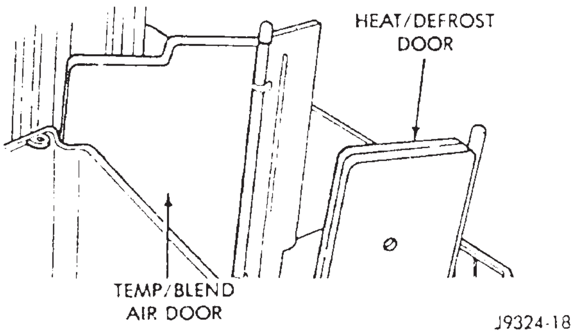

Fig. 21 Temperature/Blend Air Door

(4) Carefully turn the heater-A/C unit over. Install and tighten the screws.
(5) Snap on the lower center air duct.
(6) Connect the electrical connectors.
(7) Install the heater-A/C unit into the vehicle (refer to Heater-A/C Unit Installation).

HEAT / DEFROST DOOR ACTUATOR

This actuator is used only on the heater and manual A/C units.

REMOVAL

(1) Remove the heater-A/C unit from the vehicle (refer to Heater-A/C Unit Removal).
(2) Turn the heater-A/C unit upside down.
(3) Disconnect the vacuum line (Fig. 22).
(4) Separate the door pivot connection from the door pivot pin (Fig. 22).
(5) Remove the retaining screws.
(6) Remove the heat/defrost door actuator (Fig. 22).

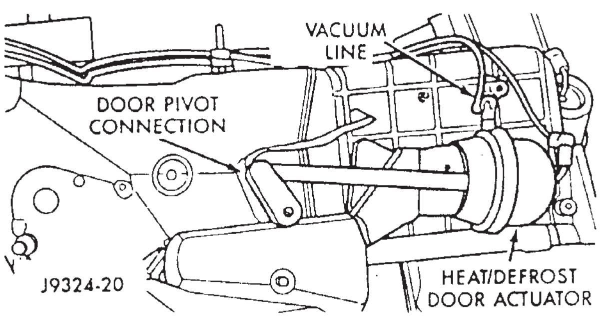

Fig. 22 Heat/Defrost Door Actuator

INSTALLATION

(1) Install the heat/defrost door actuator.
(2) Install and tighten the retaining screws.
(3) Press the door pivot connection onto the door pivot pin.
(4) Connect the vacuum line.
(5) Install the heater-A/C unit into the vehicle (refer to Heater-A/C Unit Installation).

HEAT / DEFROST - PANEL / DEFROST DOOR MOTOR

This motor is used only on models equipped with the optional Automatic Temperature Control (ATC) system.

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Remove the three screws that secure the upper and lower steering column shrouds to the steering column and remove the shrouds.
(3) Remove the cluster bezel, instrument panel center bezel, instrument panel top cover, steering column opening cover, knee blocker, left instrument panel end cap and left lower instrument panel trim from the instrument panel. Refer to Group 8E - Instrument Panel and Gauges for the procedures.
(4) Remove the two bolts that secure the center instrument panel support bracket to the left side of the floor pan transmission tunnel.
(5) Remove the two bolts that secure the center instrument panel support bracket to the instrument panel.
(6) Remove the center instrument panel support bracket from the vehicle.
(7) Unplug the wire harness connector from the motor (Fig. 23).
(8) Remove the three screws that secure the motor to the bottom of the heater-A/C housing.
(9) Remove the motor from the housing.

INSTALLATION

(1) Position the heat/defrost - panel/defrost door motor to the bottom of the heater-A/C housing.
(2) Install and tighten the three screws that secure the motor to the housing.
(3) Plug in the wire harness connector to the motor.
(4) Position the center instrument panel support bracket to the instrument panel.
(5) Install and tighten the two bolts that secure the center instrument panel support bracket to the instrument panel.
(6) Install and tighten the two bolts that secure the center instrument panel support bracket to the left side of the floor pan transmission tunnel.
(7) Install the cluster bezel, instrument panel center bezel, instrument panel top cover, steering column opening cover, knee blocker, left instrument panel end cap and left lower instrument panel trim from the instrument panel. Refer to Group 8E - Instrument Panel and Gauges for the procedures.
(8) Install the upper and lower steering column shrouds onto the steering column.
(9) Connect the battery negative cable.

HEAT / DEFROST DOOR

REMOVAL

(1) Remove the heater-A/C unit from the vehicle (refer to Heater-A/C Unit Removal).
(2) Turn the heater-A/C unit upside down.
(3) Separate the door pivot connection from the door pivot pin.

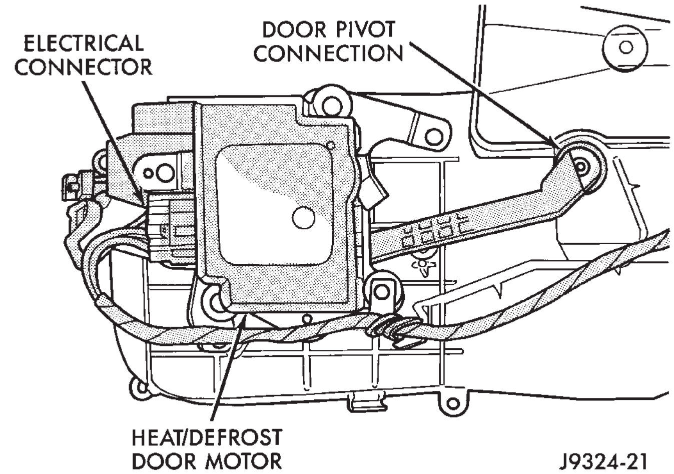

Fig. 23 Heat/Defrost Door Motor

(4) Disconnect the electrical connector or the vacuum line.

(5) Remove the retaining screws holding the two halves together. Remove the center adaptor heat duct (Fig. 24) and remove the screw.

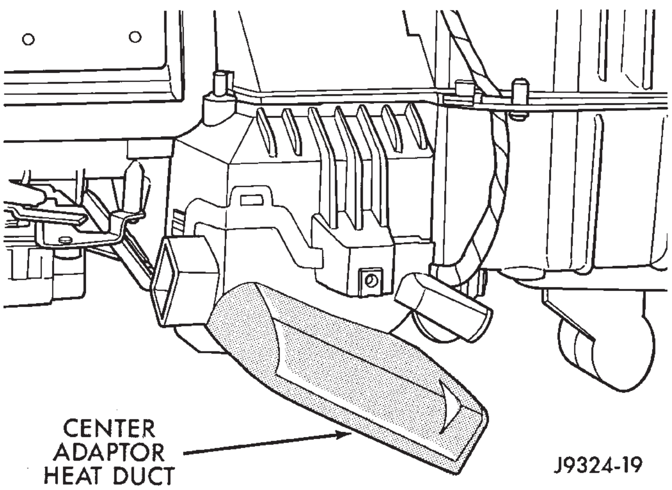

Fig. 24 Center Adaptor Heat Duct

(6) Remove the bottom half of the heater-A/C unit.

(7) Remove the door (Fig. 25).

INSTALLATION

(1) Position the door in the hole.

(2) Press the door pivot connection onto the door pivot pin.

(3) Position the top half of the heater-A/C unit onto the bottom. Be sure the door pivot pins align with the pivot holes.

(4) Carefully turn the heater-A/C unit over. Install and tighten the screws.

(5) Snap on the lower center air duct.

(6) Connect the electrical connectors.

(7) Install the heater-A/C unit into the vehicle (refer to Heater-A/C Unit Installation).

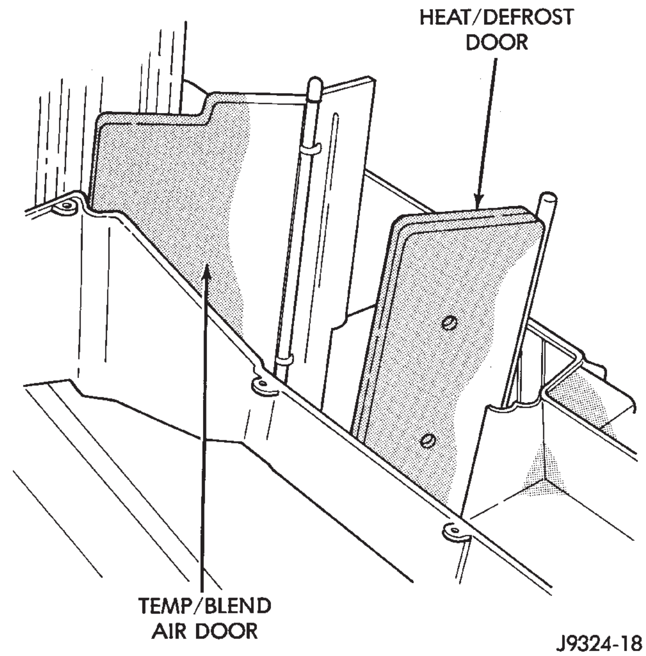

Fig. 25 Heat/Defrost Door

PANEL / DEFROST DOOR ACTUATOR

This actuator is used only on the heater and manual A/C units.

REMOVAL

(1) Remove the heater-A/C unit from the vehicle (refer to Heater-A/C Unit Removal).

(2) Disconnect the vacuum line (Fig. 26).

(3) Separate the door pivot connection from the door pivot pin (Fig. 26).

(4) Remove the retaining screws.

(5) Remove the panel/defrost door actuator (Fig. 26).

INSTALLATION

(1) Install the panel/defrost door actuator.

(2) Install and tighten the retaining screws.

(3) Press the door pivot connection onto the door pivot pin.

(4) Connect the vacuum line.

(5) Install the heater-A/C unit into the vehicle (refer to Heater-A/C Unit Installation).

PANEL / DEFROST DOOR

REMOVAL

(1) Remove the instrument panel (refer to Group 23, Body).

(2) Remove the defrost duct (Fig. 27).

(3) Disconnect the actuating rod (Fig. 26 or 28).

(4) Pry the panel/defrost door shaft retainer from the shaft (Fig. 26 or 28).

(5) Remove the door through the top opening.

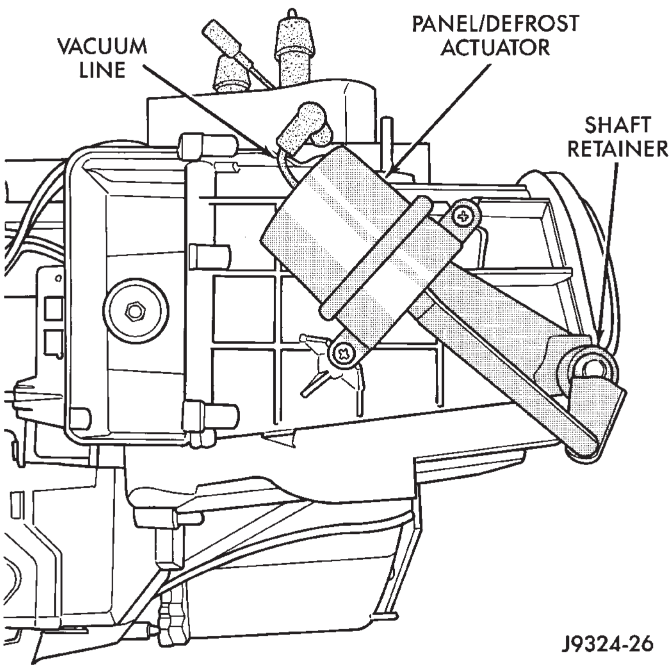

Fig. 26 Panel/Defrost Door Actuator (Heater and Manual A/C)

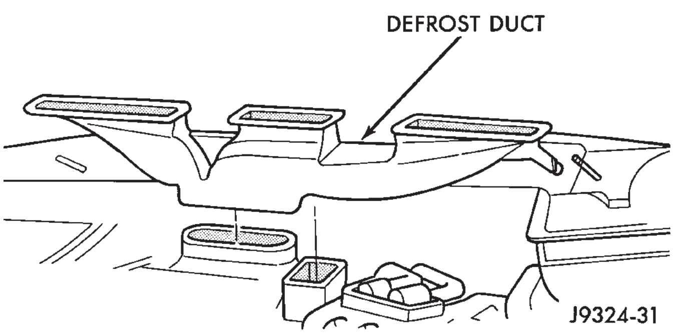

Fig. 27 Defrost Duct

INSTALLATION

(1) Install the panel/defrost door through the top opening and position in place.
(2) Press the door shaft retainer onto the shaft.
(3) Connect the rod and rod clip to the door lever.
(4) Install the defrost duct.
(5) Install the instrument panel (refer to Group 23, Body).

SOLAR SENSOR

This sensor is used only on the ATC units. It is amber in color and located right of center in the defrost grille.

REMOVAL

(1) Pop out the defrost grille (Fig. 29).
(2) Remove the solar sensor from the defrost grille (Fig. 29).
(3) Disconnect the solar sensor connector (Fig. 29).

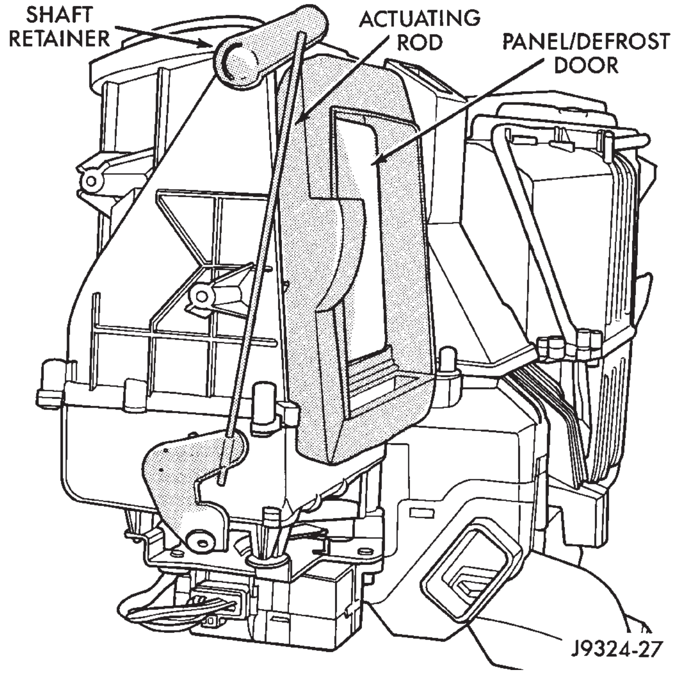

Fig. 28 Panel/Defrost Door (ATC)

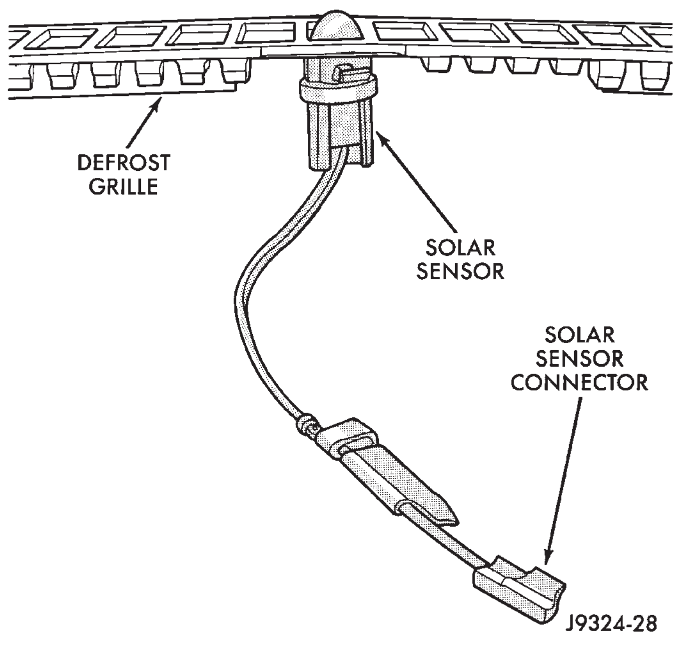

Fig. 29 Solar Sensor

INSTALLATION

(1) Connect the solar sensor connector.
(2) Install the solar sensor into the defrost grille.
(3) Press the defrost grille into the instrument panel.

IN-VEHICLE TEMPERATURE SENSOR

This sensor is used only on the ATC units.

REMOVAL

(1) Remove the instrument panel (refer to Group 23, Body).

(2) Disconnect the sensor tube from the sensor assembly and the heater-A/C unit (Fig. 30).

(3) Remove the sensor assembly screws from the instrument panel bracket. Remove the sensor assembly.

(4) Disconnect the in-vehicle temperature sensor from the sensor assembly (Fig. 30).

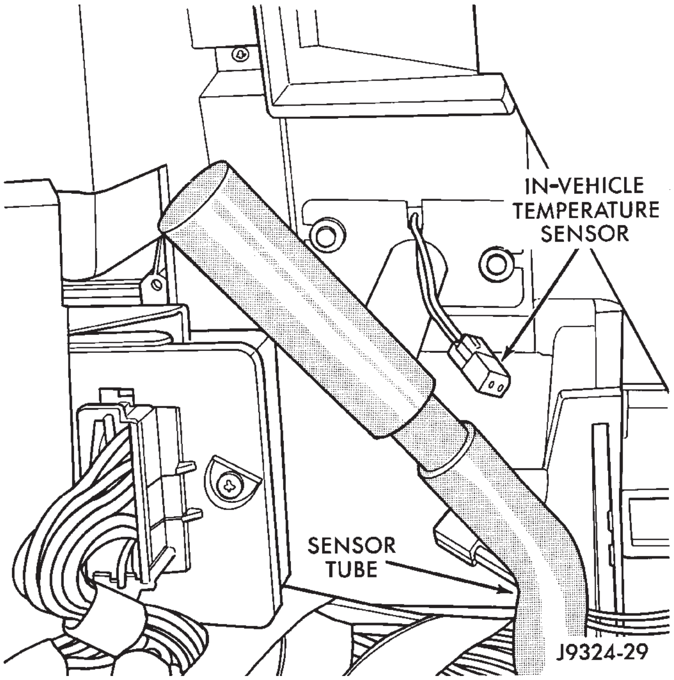

Fig. 30 In-Vehicle Temperature Sensor

INSTALLATION

(1) Connect the in-vehicle temperature sensor to the sensor assembly.

(2) Install the sensor assembly to the instrument panel bracket. Tighten the screws.

(3) Connect the sensor tube to the sensor assembly and the heater-A/C unit.

(4) Install the instrument panel (refer to Group 23, Body).

AMBIENT AIR TEMPERATURE SENSOR

This sensor is used only on the ATC units.

REMOVAL

(1) Remove the grille.

(2) Disconnect the ambient air temperature sensor connector (Fig. 31).

(3) Remove the sensor (Fig. 31).

INSTALLATION

(1) Install the ambient air temperature sensor.

(2) Connect the sensor.

(3) Install the grille.

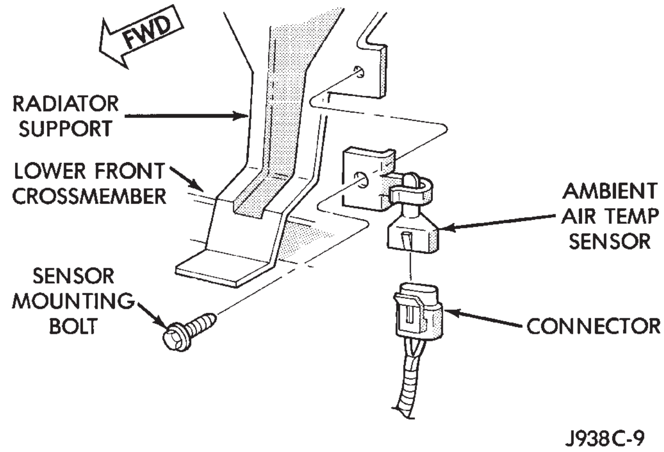

Fig. 31 Ambient Air Temperature Sensor

DEFROSTER DUCT

REMOVAL

(1) Remove the instrument panel (refer to Group 23, Body).

(2) Remove the defroster duct retaining screws.

(3) Remove the defroster duct (Fig. 32).

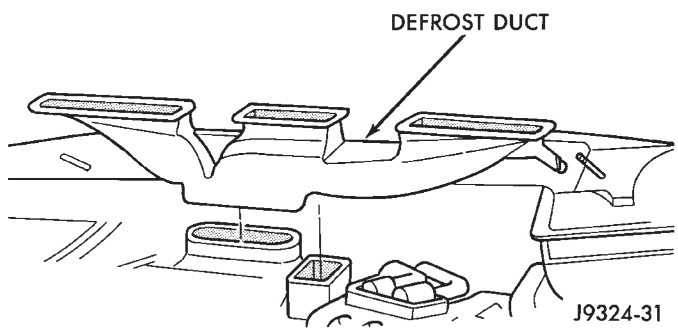

Fig. 32 Defrost Duct

INSTALLATION

(1) Install the defroster duct.

(2) Install and tighten the defroster duct retaining screws.

(3) Install the instrument panel (refer to Group 23, Body).

REAR FLOOR HEAT DUCT

REMOVAL

(1) Remove the center console (refer to Group 23, Body).

(2) Remove the passenger seat (refer to Group 23, Body).

(3) Remove the passenger side door trim (refer to Group 23, Body).

(4) Roll carpet back.

(5) Remove the stud nut (Fig. 33).

(6) Disconnect the rear floor heat duct from the center adaptor heat duct (Fig. 33).

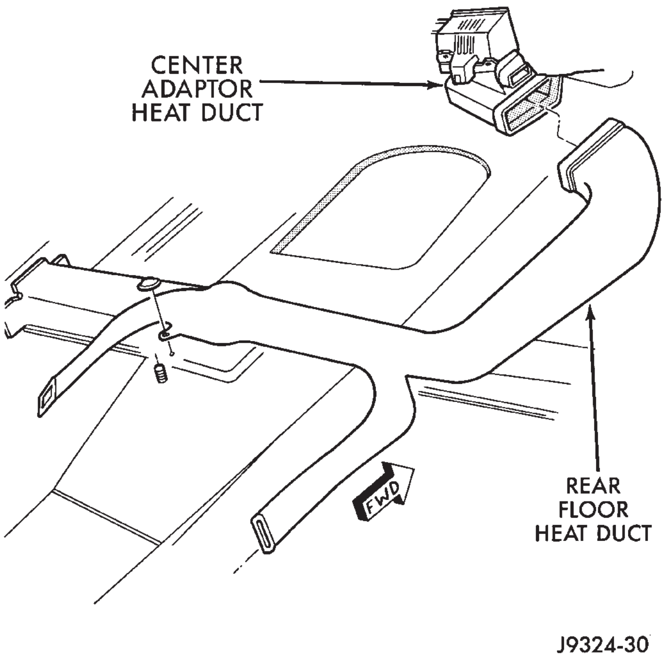

Fig. 33 Rear Floor Heat Duct

INSTALLATION

(1) Connect the rear floor heat duct to the center adaptor heat duct.

(2) Install and tighten the stud nut.

(3) Position carpet over duct and onto the floor.

(4) Install the passenger side door trim (refer to Group 23, Body).

(5) Install the passenger seat (refer to Group 23, Body).

(6) Install the center console (refer to Group 23, Body).

CONDENSER

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Discharge the A/C system into a recovery/recycle device (refer to Refrigerant Service Procedures).

(3) Disconnect the A/C hoses from the condenser. Plug the openings.

(4) Remove the grille.

(5) Remove the upper brace bolts from the two radiator braces (Fig. 34).

(6) Remove the two crossmember-to-radiator mounting nuts (Fig. 35).

(7) Working through grille opening, remove the bolt securing lower part of hood latch support brace to lower frame crossmember (Fig. 34).

(8) The radiator upper crossmember (Fig. 35) can be adjusted left or right through the use of slotted holes. Before removal, mark the original position of the crossmember.

(9) Remove the remaining bolts securing the radiator upper crossmember to the body. Do not remove the hood latch or hood latch cable from the crossmember. Lift the crossmember straight up and lay to the side (Fig. 35).

(10) Remove the four lower condenser attaching bolts.

(11) Remove the two upper condenser attaching bolts (Fig. 35).

(12) Carefully remove the condenser from the vehicle.

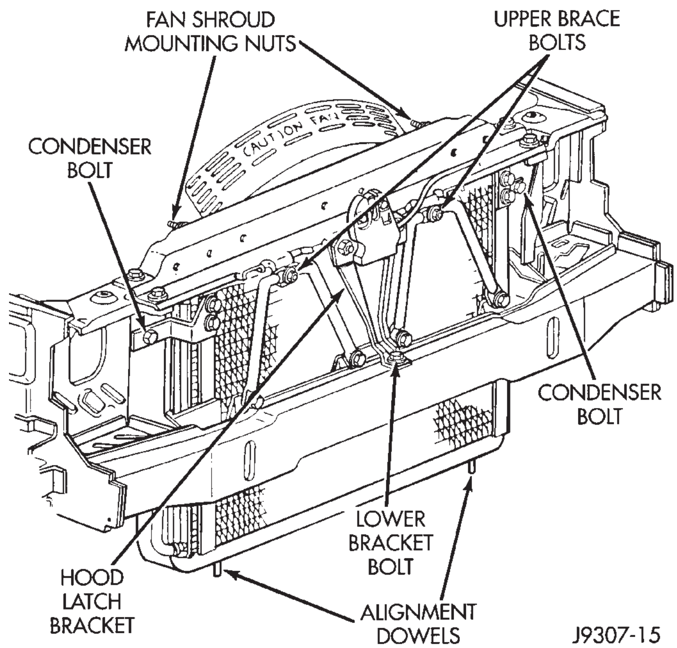

Fig. 34 Radiator—A/C Condenser Mounting—Typical

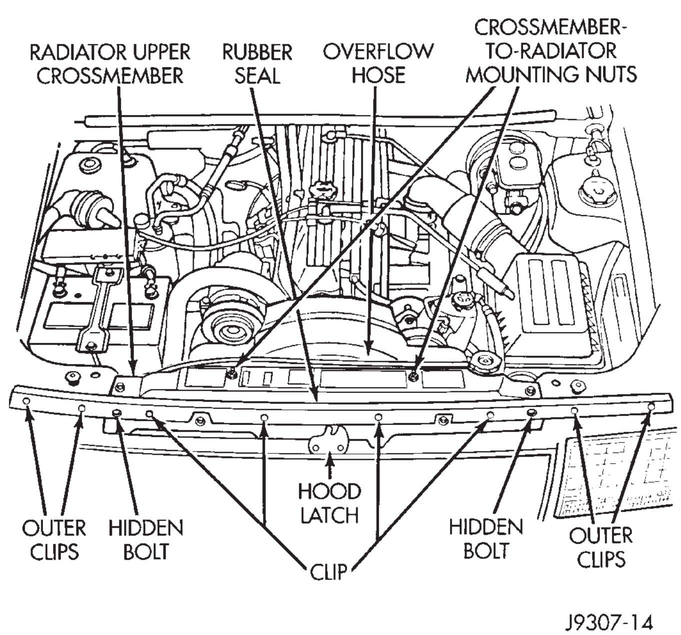

Fig. 35 Radiator Upper Crossmember—Typical

INSTALLATION

(1) Carefully position the condenser into the vehicle.

(2) Install and tighten the two upper condenser attaching bolts.

(3) Install and tighten the four lower condenser attaching bolts.

(4) Align the radiator upper crossmember with the scribe marks. Install and tighten the radiator upper crossmember bolts to the body.

(5) Install and tighten the radiator upper crossmember mounting nuts.

(6) Working through grille opening, install and tighten the bolt securing lower part of hood latch support brace to lower frame crossmember.

(7) Install and tighten the two upper bolts holding the radiator brace to the upper radiator crossmember.

(8) Install the grille.

(9) Remove the plugs from the openings. Connect the A/C hoses to the condenser.

(10) Evacuate the A/C system (refer to Refrigerant Service Procedures).

(11) Add 1 ounce of refrigerant oil to the A/C system if the condenser was replaced.

(12) Charge the A/C system (refer to Refrigerant Service Procedures).

(13) Connect the negative cable to the battery.

ACCUMULATOR

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Discharge the A/C system into a recovery/recycle device (refer to Refrigerant Service Procedures).

(3) Disconnect the A/C hoses from the compressor and the evaporator. Plug the openings.

(4) Unplug the harness from the low pressure switch (Fig. 36).

(5) Loosen the support bracket screw (Fig. 36).

(6) Remove the accumulator (Fig. 36).

INSTALLATION

(1) Install the accumulator in the support bracket.

(2) Tighten the support bracket screw.

(3) Plug the harness into the low pressure switch.

(4) Remove the plugs from the A/C hoses. Connect the A/C hoses to the compressor and the evaporator.

(5) Evacuate the A/C system (refer to Refrigerant Service Procedures).

(6) Charge the A/C system (refer to Refrigerant Service Procedures).

(7) Connect the negative cable to the battery.

LIQUID LINE

The fixed orifice tube is located in the liquid line near the condenser. It has filter screens on the inlet and outlet ends of the tube body. If the fixed orifice tube is plugged, the liquid line must be replaced.

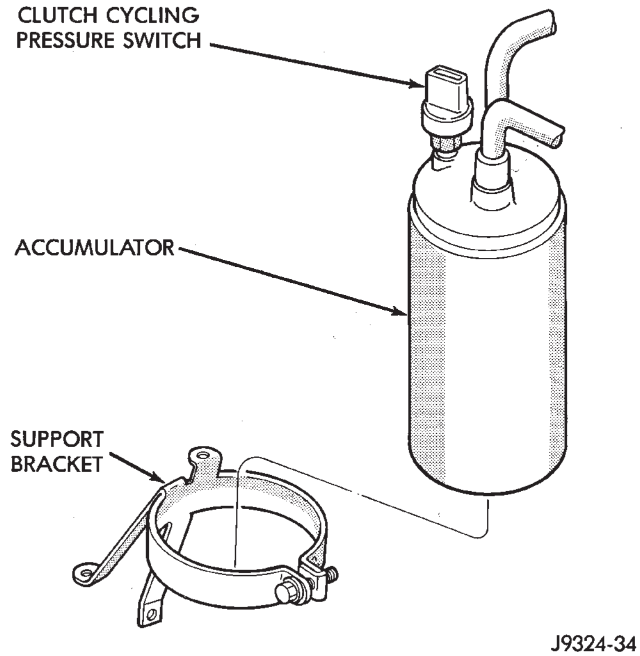

Fig. 36 Accumulator and Bracket

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Discharge the A/C system into a recovery/recycle device (refer to Refrigerant Service Procedures).

(3) Disconnect the quick-connect fittings at the evaporator and the condenser.

(4) Remove the liquid line.

INSTALLATION

(1) Install the liquid line.

(2) Connect the quick-connect fittings at the evaporator and the condenser.

(3) Evacuate the A/C system (refer to Refrigerant Service Procedures).

(4) Charge the A/C system (refer to Refrigerant Service Procedures).

(5) Connect the negative cable to the battery.

DISCHARGE LINE

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Discharge the A/C system into a recovery/recycle device (refer to Refrigerant Service Procedures).

(3) Disconnect the quick-connect fitting at the condenser.

(4) Remove the discharge line-to-compressor manifold bolt. Discard the O-ring.

INSTALLATION

(1) Using a new O-ring, install the discharge line-to-compressor manifold bolt.

(2) Connect the quick-connect fitting at the condenser.

(3) Evacuate the A/C system (refer to Refrigerant Service Procedures).

(4) Charge the A/C system (refer to Refrigerant Service Procedures).

(5) Connect the negative cable to the battery.

HIGH PRESSURE CUT-OUT SWITCH

The high pressure cut-out switch is located on the discharge line connection at the compressor manifold.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove the connector from the switch.

(3) Unscrew the switch.

INSTALLATION

(1) Install and tighten the switch.

(2) Install the connector onto the switch.

(3) Connect the negative cable to the battery.

VACUUM RESERVOIR

The vacuum reservoir is located under the battery tray.

REMOVAL

(1) Remove the battery (refer to Group 8B, Battery/Starter/Generator Service).

(2) Disconnect the vacuum hose (Fig. 37).

(3) Remove the battery tray and vacuum reservoir assembly (refer to Group 8B, Battery/Starter/Generator Service).

(4) Remove the reservoir attaching screws (Fig. 37). Remove the vacuum reservoir from the battery tray.

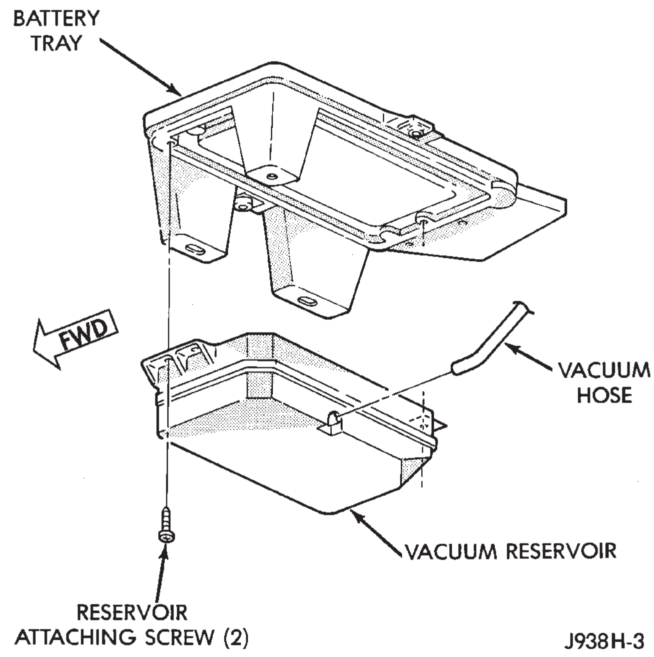

Fig. 37 Vacuum Reservoir

INSTALLATION

(1) Position the vacuum reservoir to the battery tray. Install and tighten the vacuum reservoir screws.

(2) Install the battery tray and vacuum reservoir assembly (refer to Group 8B, Battery/Starter/Generator Service).

(3) Connect the vacuum hose.

(4) Install the battery (refer to Group 8B, Battery/Starter/Generator Service).

TORQUE SPECIFICATIONS

Description	Torque
Compressor Manifold Bolts	25 N•m (19 ft. lbs.)
Compressor Mounting Bolts	27 N•m (20 ft. lbs.)
Compressor Shaft Bolt	13 N•m (115 in. lbs.)

Description	Torque
Heater-A/C Unit Attaching Nuts	
Passenger Compartment Side	5 N•m (40 in. lbs.)
Engine Compartment Side	7 N•m (60 in. lbs.)

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EMISSION CONTROL SYSTEMS

CONTENTS

GENERAL INFORMATION

VEHICLE EMISSION CONTROL INFORMATION (VECI) LABEL

All vehicles are equipped with a combined VECI label. The label is located in the engine compartment (Fig. 1). 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 following label illustrations are used as examples only. If there are any differences between these illustrations and the VECI label, those shown on the VECI label should be used.

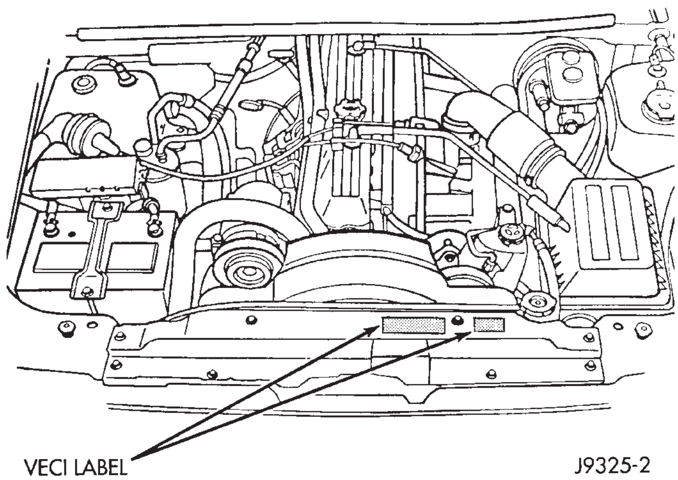
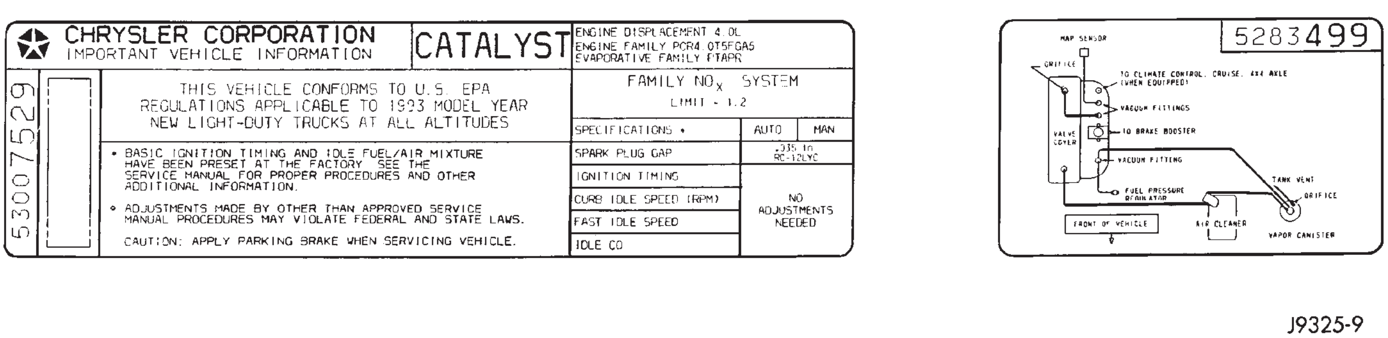
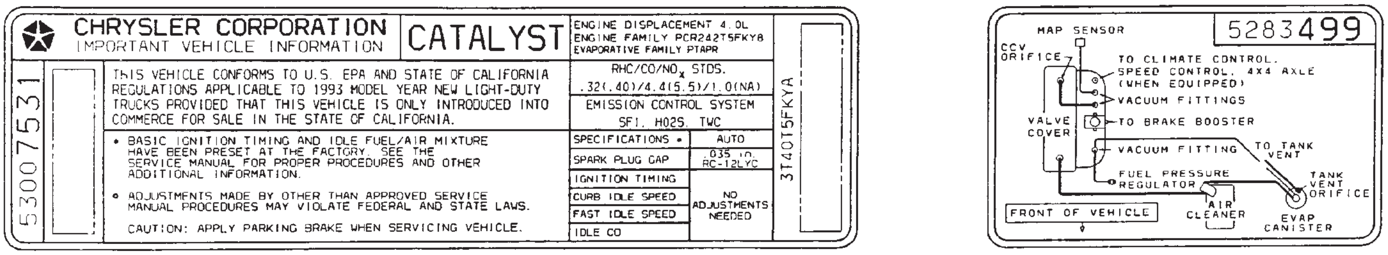


Fig. 1 VECI Label Location

FEDERAL VECI LABEL—TYPICAL



CALIFORNIA VECI LABEL—TYPICAL



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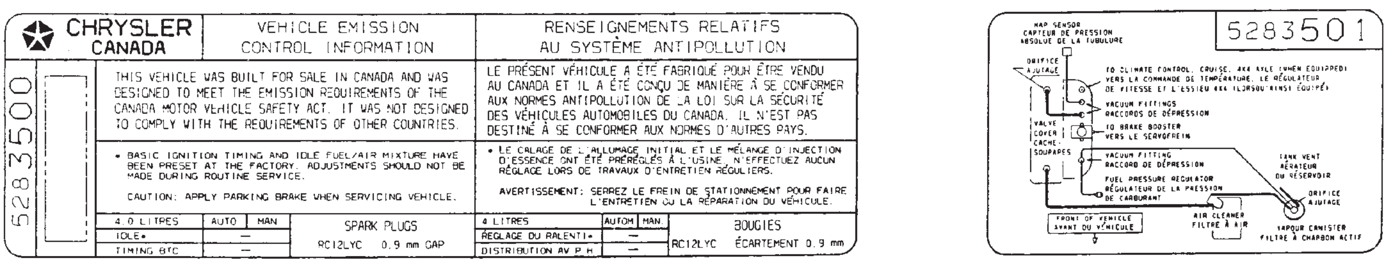
CANADIAN VECI LABEL—TYPICAL



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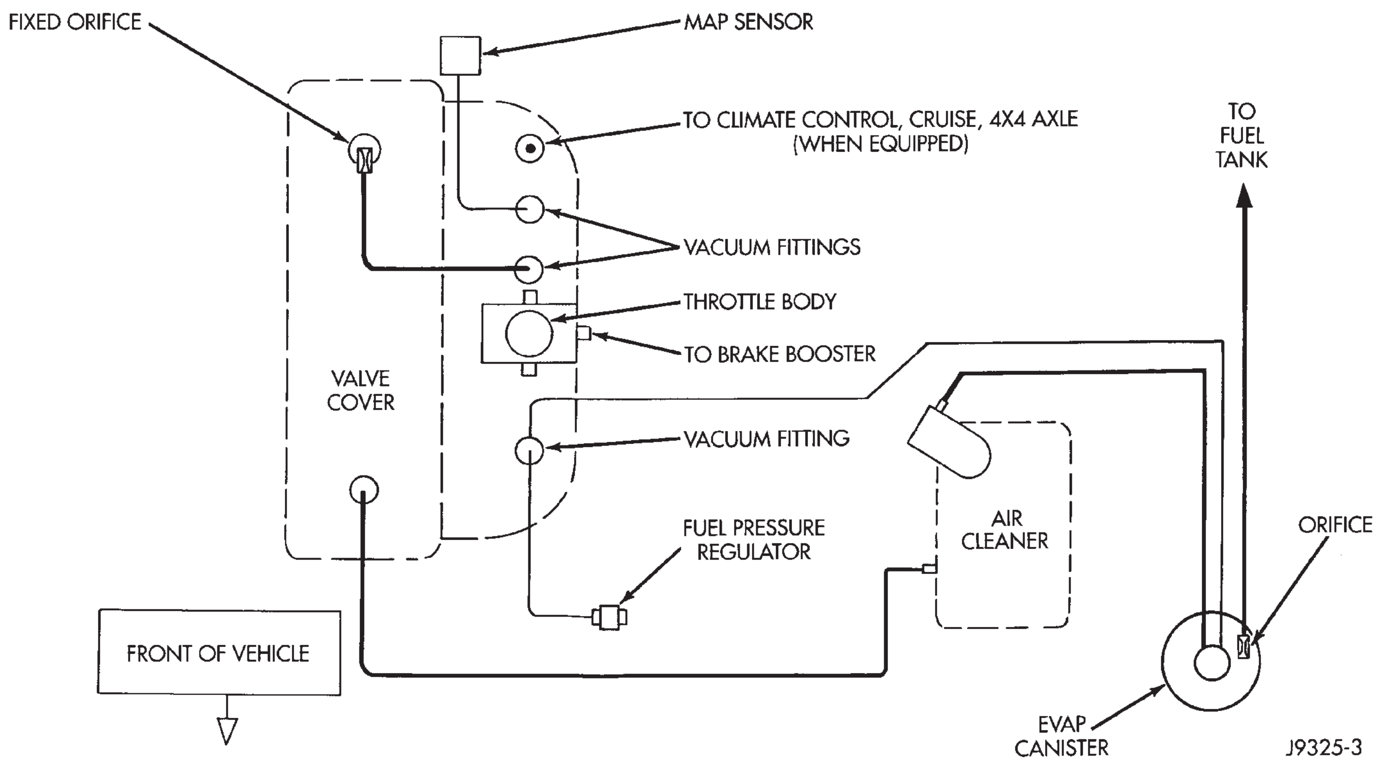
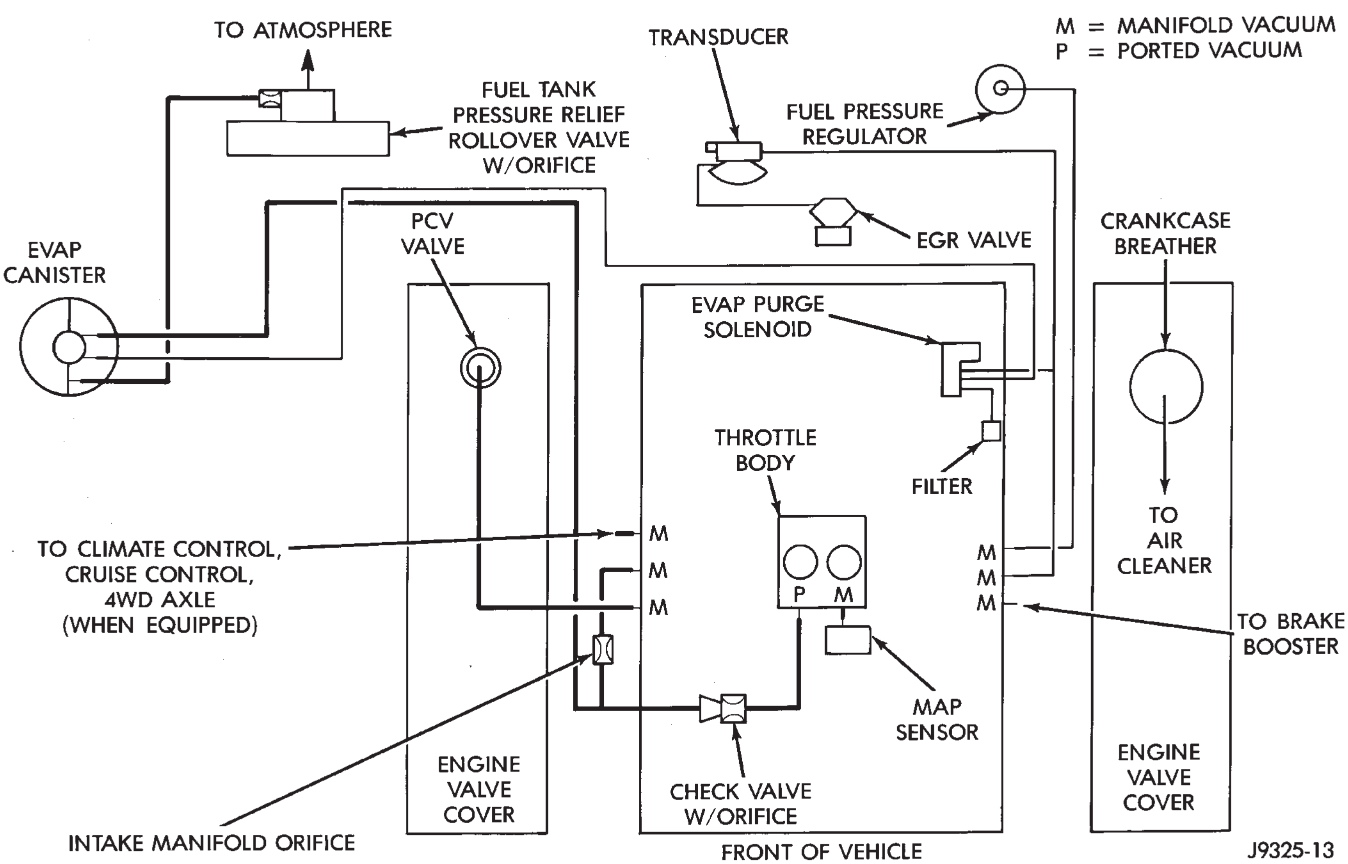
VACUUM HOSE ROUTING SCHEMATICS

The following vacuum hose routing schematics are used as examples only. If there are any differences between these schematics and the Vehicle Emission Control Information (VECI) label schematics, those shown on the VECI label should be used.

VACUUM ROUTING SCHEMATIC—4.0L ENGINE



VACUUM ROUTING SCHEMATIC—5.2L ENGINE—TYPICAL



EVAPORATIVE EMISSION CONTROLS

INDEX

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. The EVAP canister is located in the left front corner of vehicle below the left front headlamp (Fig. 1). The EVAP canister is filled with granules of an activated carbon mixture. Fuel vapors entering the EVAP canister are absorbed by the charcoal granules.

Operation of the EVAP canister is different between the 4.0L six-cylinder engine and the 5.2L V-8 engine. Refer to the following Canister Operation.

CANISTER OPERATION—4.0L ENGINE

The EVAP canister is equipped with a vacuum controlled purge shutoff switch (orifice) (Fig. 2) 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. 2).

The air cleaner contains a venturi in the air cleaner cover used as a purge line vacuum source (Fig. 3). 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. 3). The vapors pass through the intake manifold into the engine combustion chambers where they are consumed during engine combustion.

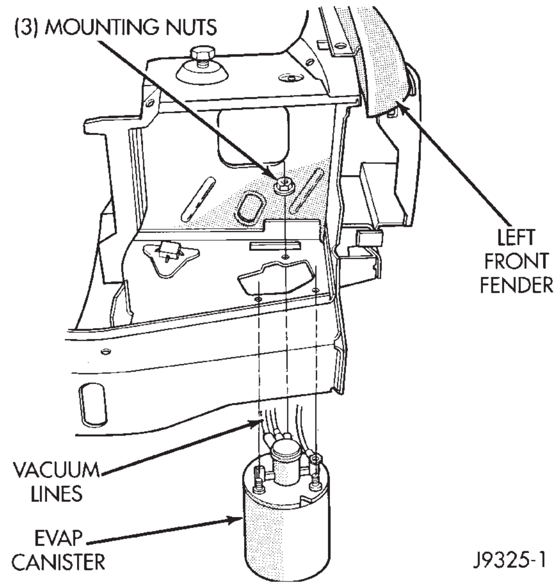


Fig. 1 EVAP Canister Location

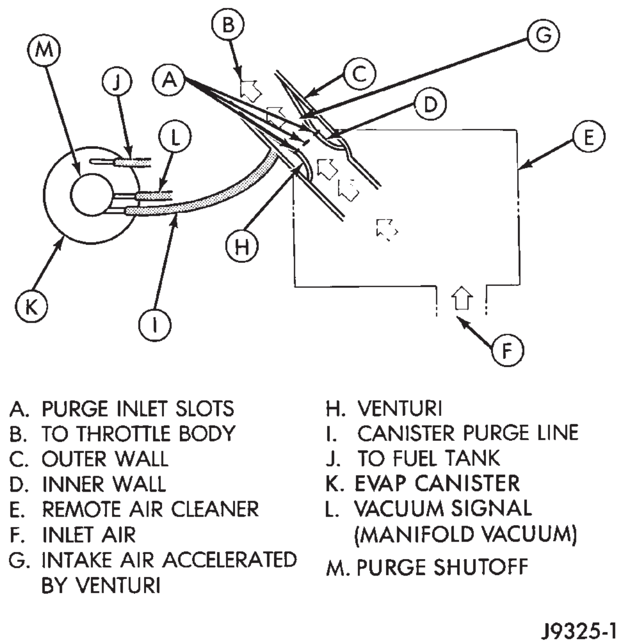


Fig. 2 EVAP System—4.0L Engine—Typical

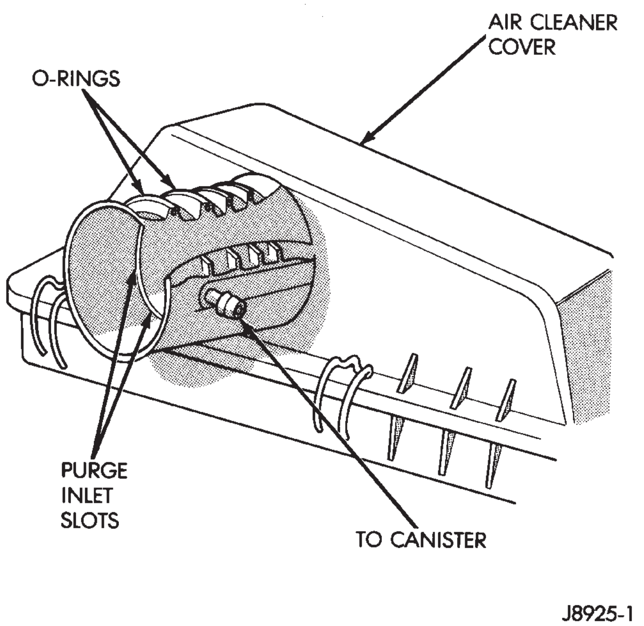


Fig. 3 Air Cleaner Venturi—4.0L Engine—Typical

CANISTER OPERATION—5.2L ENGINE

Fuel tank pressure vents into the EVAP canister. Fuel vapors are temporarily held in the canister until they can be drawn into the intake manifold. The EVAP canister purge solenoid allows the EVAP canister to be purged at predetermined times and at certain engine operating conditions. For more information, refer to the following EVAP Canister Purge Solenoid—5.2L Engine.

EVAP CANISTER PURGE SOLENOID—5.2L ENGINE

The EVAP canister purge solenoid is used with the 5.2L (V-8) engine only.

Vacuum for the EVAP canister is controlled by the EVAP Canister Purge Solenoid (Fig. 4). The solenoid is operated by the powertrain control module (PCM). The PCM regulates the solenoid by switching the ground circuit on and off based on engine operating conditions. When energized, the solenoid prevents vacuum from reaching the EVAP canister. When not energized, the solenoid allows vacuum to flow through to the EVAP canister.

During warm-up and for a specified time period after hot starts, the PCM grounds the EVAP canister purge solenoid causing it to energize. This will prevent vacuum from reaching the EVAP canister valve. When the engine reaches an operating temperature of approximately 27°C (80°F) and a time delay interval of about 100 seconds has occurred, the PCM removes the ground to solenoid. The de-energized solenoid allows vacuum to flow to the EVAP canister and purge fuel vapors through the intake manifold.

The EVAP canister purge solenoid will also be energized during certain idle conditions in order to update the fuel delivery calibration.

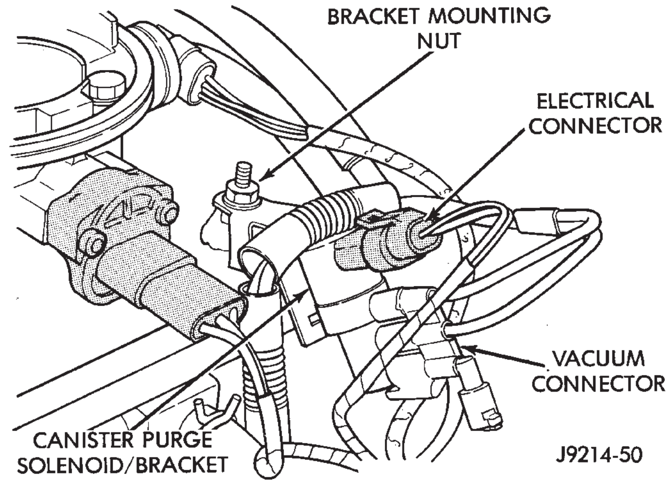


Fig. 4 Purge Solenoid—5.2L Engine—Typical

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.

CAUTION: The fuel filler cap must be removed prior to disconnecting any fuel system component.

CRANKCASE VENTILATION SYSTEM—4.0L ENGINE

The 4.0L engine is equipped with a Crankcase Ventilation (CCV) system (Fig. 5). The CCV system performs the same function as a conventional PCV system, but does not use a vacuum controlled valve.

A molded vacuum tube connects manifold vacuum to top of cylinder head cover at dash panel end. The vacuum tube contains a fixed orifice (Fig. 5) of a calibrated size. It meters the amount of crankcase vapors drawn out of the engine.

A fresh air supply hose from the air cleaner (Fig. 5) is connected to front of cylinder head (valve) cover. When the engine is operating, fresh air enters the engine and mixes with crankcase vapors. Manifold vacuum draws the vapor/air mixture through the fixed orifice and into the intake manifold. The vapors are then consumed during engine combustion.

POSITIVE CRANKCASE VENTILATION SYSTEM

DESCRIPTION/OPERATION

The 5.2L V-8 engine is equipped with a closed positive crankcase ventilation (PCV) system (Fig. 6).

This system consists of a crankcase PCV valve mounted on the cylinder head cover with a hose extending from the valve to the intake manifold.

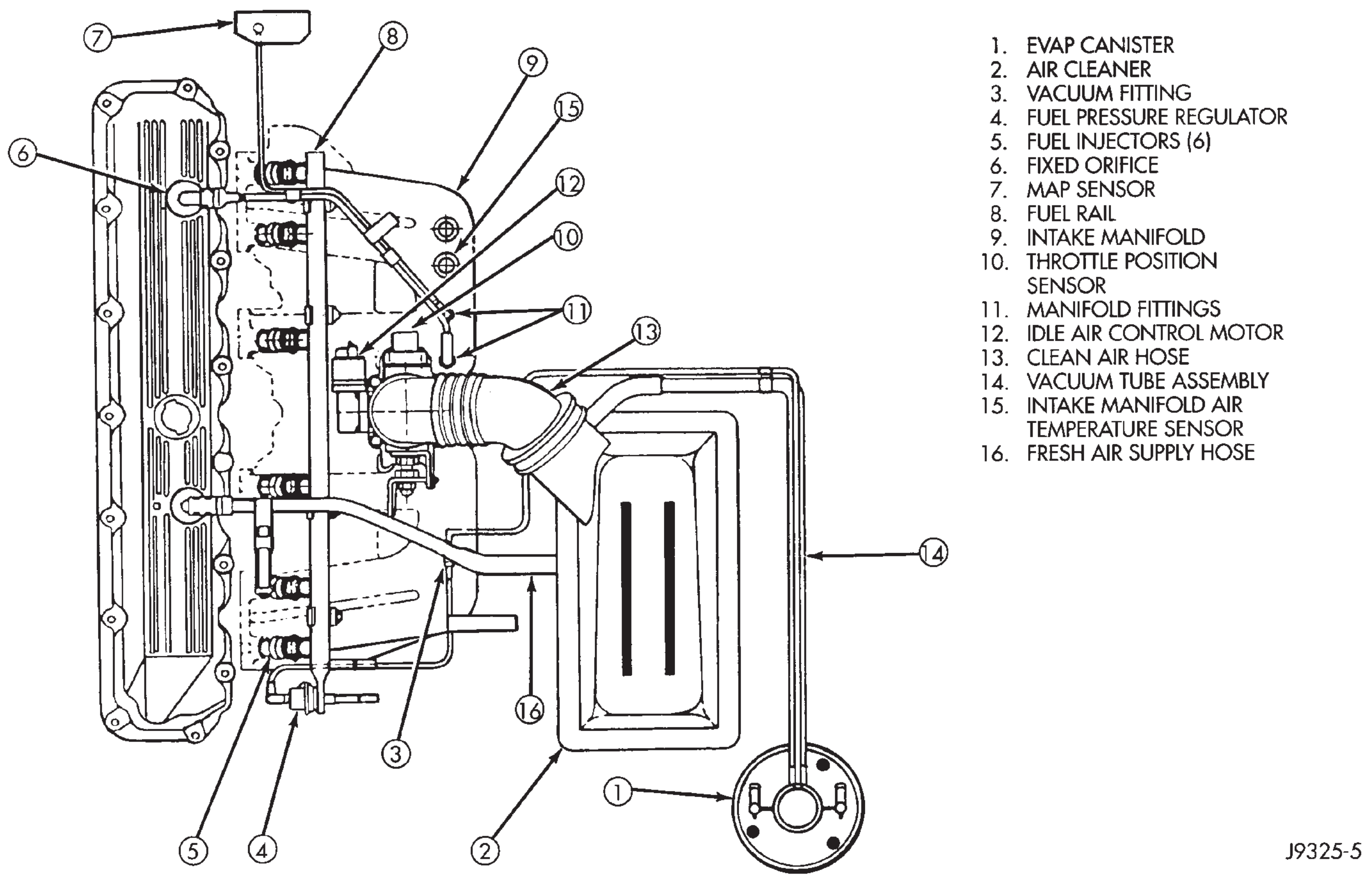


Fig. 5 CCV System—4.0L Engine—Typical

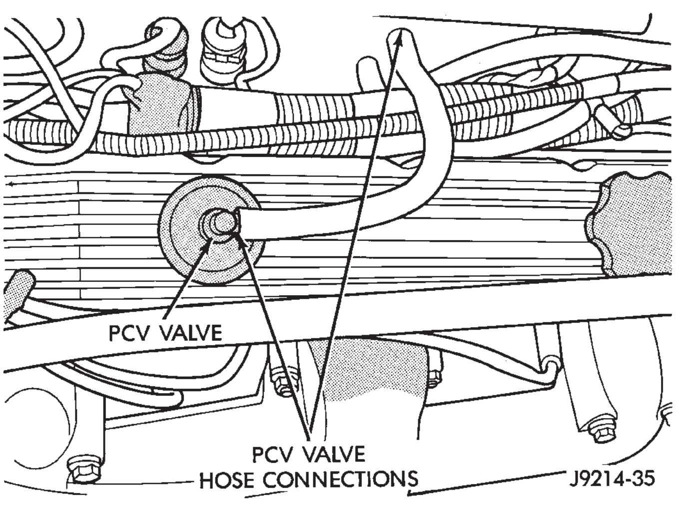


Fig. 6 PCV Valve/Hose—5.2L Engines

A closed engine crankcase breather/filter, with a hose connecting it to the air cleaner housing, provides the source of air for system.

The positive crankcase ventilation (PCV) system operates by engine intake manifold vacuum (Fig. 7). Filtered air is routed into the crankcase through the air cleaner hose and crankcase breather/filter. This forces crankcase vapors through the PCV valve. It is then drawn into the intake manifold. Here it becomes part of the calibrated air/fuel mixture to be consumed in the combustion chamber. The PCV system constantly ventilates the crankcase to help prevent sludge formation and vapors from entering the atmosphere.

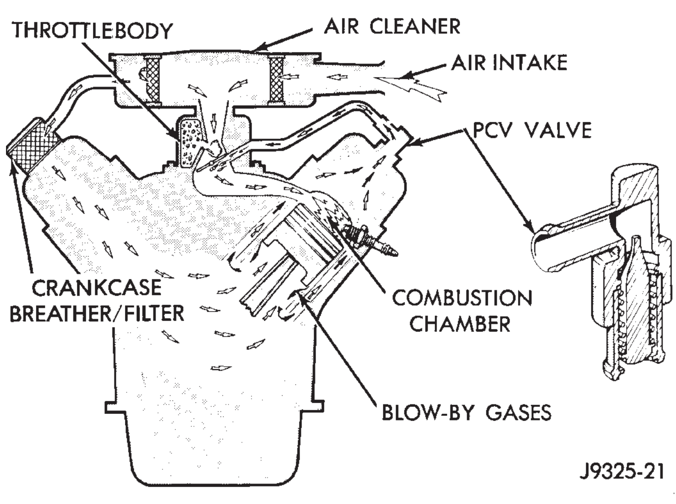


Fig. 7 Typical Closed Crankcase Ventilation System

POSITIVE CRANKCASE VENTILATION (PCV) VALVE

The PCV valve contains a spring loaded plunger. This plunger meters the amount of crankcase vapors routed into the combustion chamber based on intake manifold vacuum.

When the engine is not operating, or during an engine popback, the spring forces the plunger back against the seat. This will prevent vapors from flowing through the valve (Fig. 8).

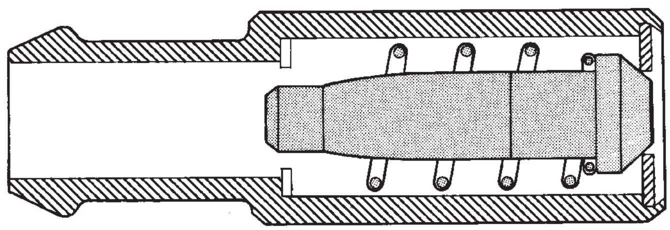


Fig. 8 Engine Off or Engine PopBack—No Vapor Flow

During periods of high manifold vacuum, such as idle or cruising speeds, vacuum is sufficient to completely compress spring. It will then pull the plunger to the top of the valve (Fig. 9). In this position there is minimal vapor flow through the valve.

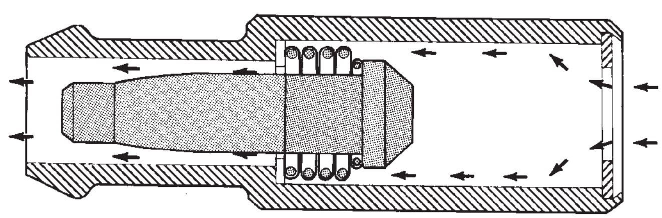


Fig. 9 High Intake Manifold Vacuum—Minimal Vapor Flow

During periods of moderate manifold vacuum, the plunger is only pulled part way back from inlet. This results in maximum vapor flow through the valve (Fig. 10).

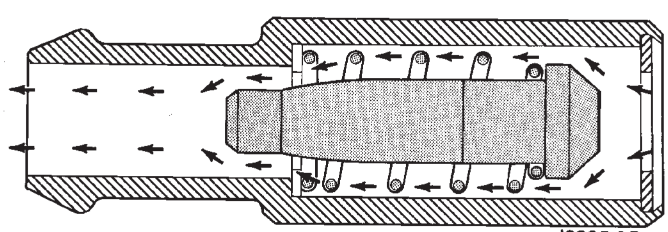


Fig. 10 Moderate Intake Manifold Vacuum—Maximum Vapor Flow

INSPECTION AND SERVICE PROCEDURE

(1) With engine idling, remove the PCV valve from cylinder head cover. If the valve is not plugged, a hissing noise will be heard as air passes through the valve. Also, a strong vacuum should be felt at the valve inlet (Fig. 11).

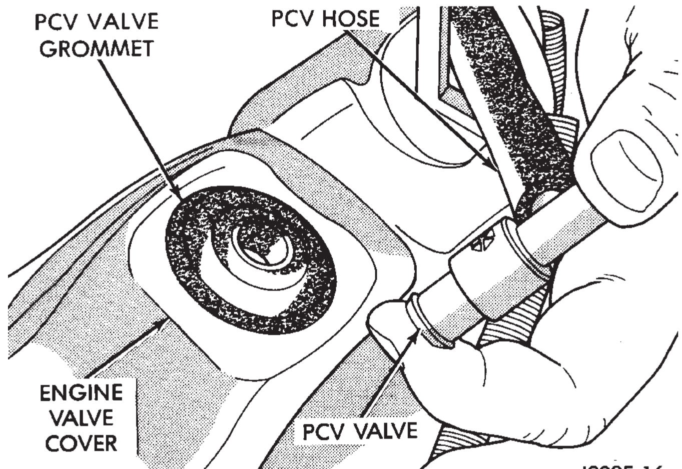


Fig. 11 Check Vacuum at PCV Valve—Typical

(2) Install the PCV valve. Remove the crankcase breather/filter. Hold a piece of stiff paper, such as a parts tag, loosely over the opening of crankcase breather/filter at the cylinder head (valve) cover (Fig. 12).

(3) The paper should be drawn against the opening in the cylinder head (valve) cover with noticeable force. This will be after allowing approximately one minute for crankcase pressure to reduce.

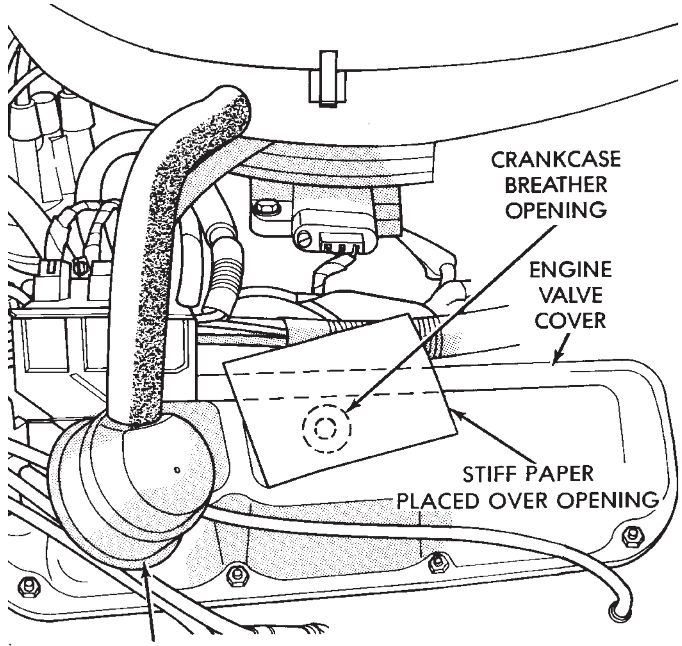


Fig. 12 Check Vacuum at Crankcase Breather Opening—Typical

cylinder head (valve) cover. The valve should rattle when shaken (Fig. 13).

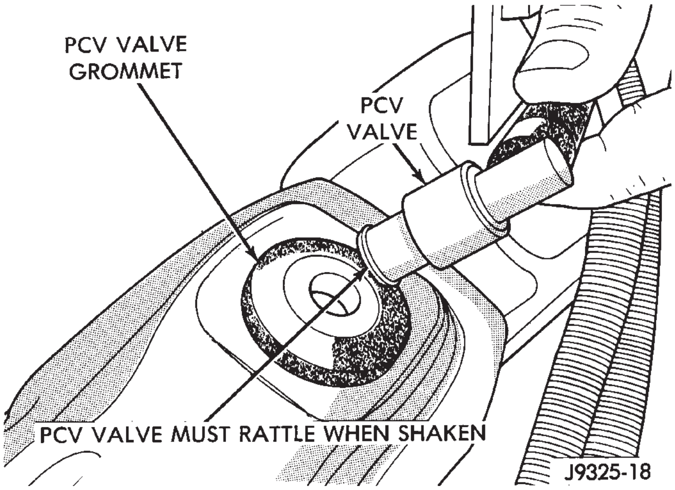


Fig. 13 Shake PCV Valve—Typical

Replace the PCV valve and retest the system if it does not operate as described in the preceding tests. **Do not attempt to clean the old PCV valve.**

(5) If the paper is not held against the opening in cylinder head (valve) cover after new valve is installed, the PCV valve hose may be restricted and must be replaced. The passage in the intake manifold must also be checked and cleaned.

(6) To clean the intake manifold fitting, turn a 1/4 inch drill (by hand) through the fitting to dislodge any solid particles. Blow out the fitting with shop air. If necessary, use a smaller drill to avoid removing any metal from the fitting.

CRANKCASE BREATHER/FILTER—5.2L ENGINES

The crankcase breather/filter is used with the 5.2L V-8 engine only.

The crankcase breather/filter (Fig. 14) is located on the engine valve cover. It must be kept clean and lubricated. At the recommended interval, remove the filter and wash it thoroughly in kerosene, or similar solvent. Lubricate or wet the filter by inverting it and filling with SAE 30 engine oil. Filter must then be thoroughly drained. More frequent service may be necessary for vehicles operated extensively on short run, stop and go, or extended engine idle service.

The filter must be replaced at correct intervals. Refer to Lubrication and Maintenance, Group 0.

PRESSURE RELIEF/ROLLOVER VALVE

These vehicles are equipped with a combination fuel tank pressure relief and rollover valve (Fig. 15). 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.

The valve incorporates a pressure relief mechanism (Fig. 16) 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.

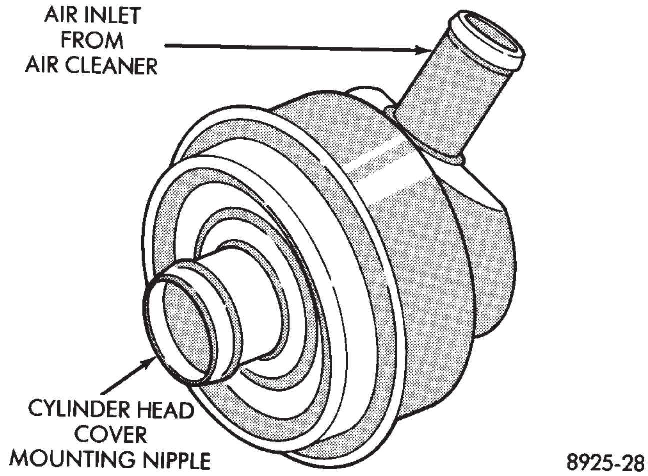


Fig. 14 Crankcase Breather/Filter—5.2L Engine

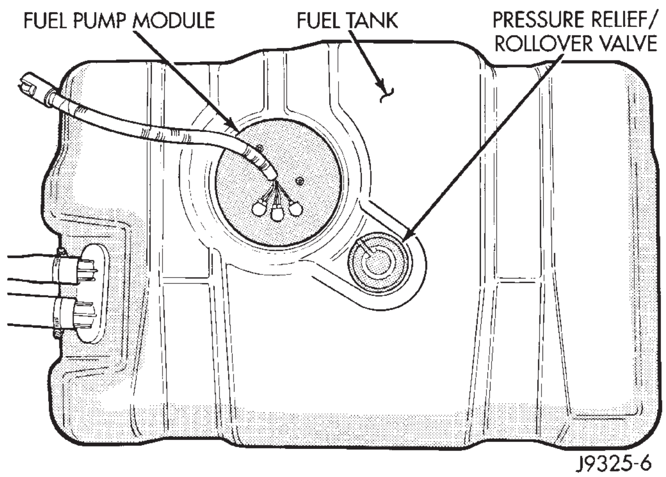


Fig. 15 Pressure Relief/Rollover Valve Location

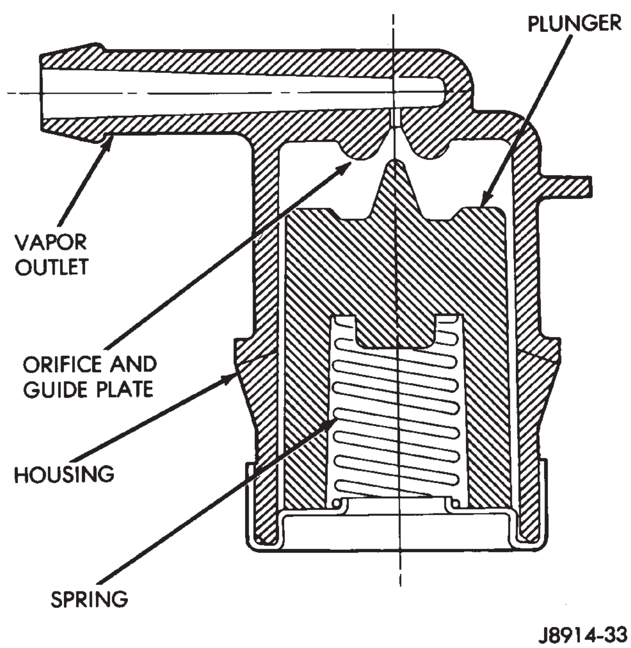


Fig. 16 Pressure Relief/Rollover Valve Operation

EXHAUST EMISSION CONTROLS

INDEX

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 4.0L 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.

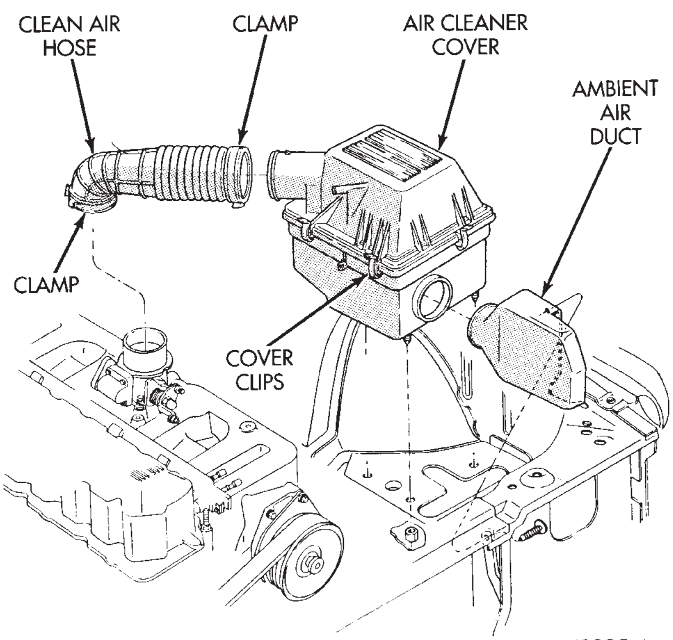


Fig. 1 Air Cleaner—4.0L Engine

EXHAUST GAS RECIRCULATION SYSTEM—5.2L ENGINE

GENERAL INFORMATION

The Exhaust Gas Recirculation (EGR) System is used with the 5.2L engine only.

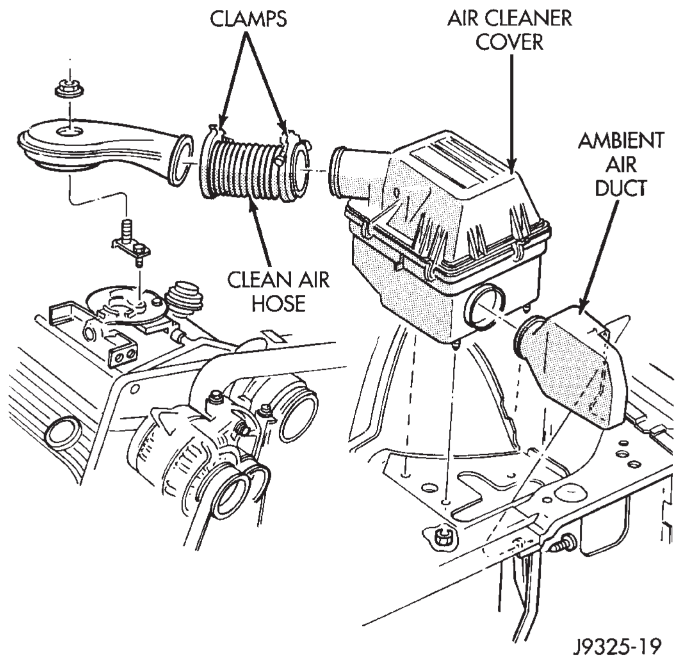


Fig. 2 Air Cleaner—5.2L Engine

The EGR system reduces oxides of nitrogen (NOx) in the engine exhaust and helps prevent spark knock. This is accomplished by allowing a predetermined amount of hot exhaust gas to recirculate and dilute the incoming fuel/air mixture. This dilution reduces peak flame temperature during combustion.

The system consists of an intake manifold mounted EGR valve (Fig. 3) and connecting hoses. The vacuum to the EGR is controlled by the Electric EGR Transducer (EET) (Figs. 3 and 4). The EET is a dual electric/vacuum function switch. It is controlled by the powertrain control module (PCM).

EGR OPERATION—5.2L ENGINE

The Electric Exhaust Gas Recirculation Transducer (EET) is a back pressure transducer and an electric vacuum solenoid combined into a single unit (Figs. 3 and 4). The vacuum solenoid portion of the EET receives its electrical signal from the powertrain control module (PCM). Using this signal, the solenoid regulates the vacuum flowing through to the transducer portion of the EET. The back pressure transducer measures the amount of exhaust gas back pressure on the exhaust side of the EGR valve. It then varies the strength of the vacuum signal ap-

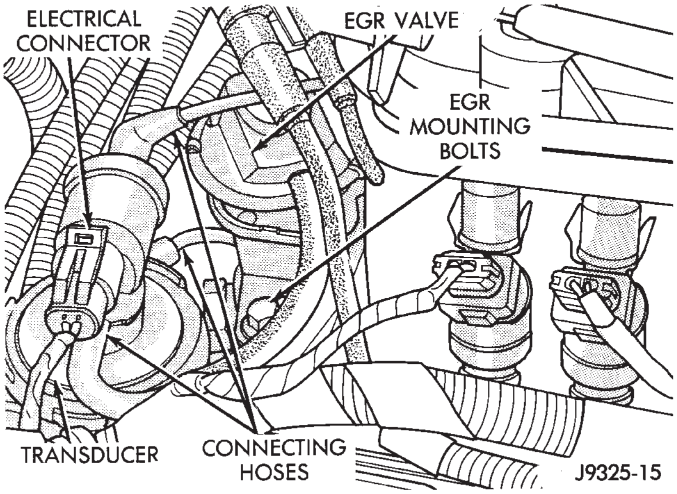


Fig. 3 EGR System—5.2L Engine

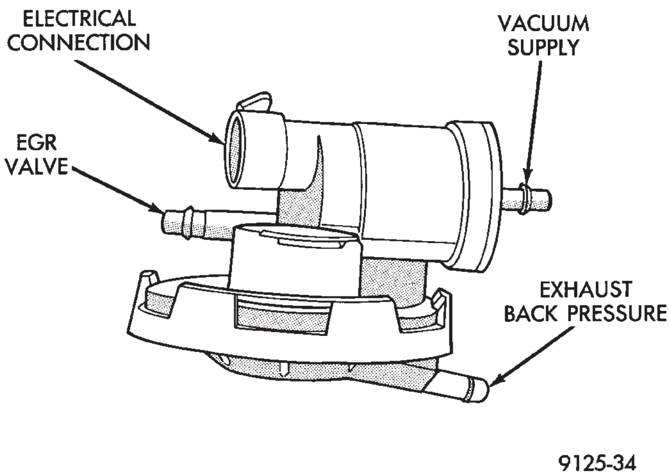


Fig. 4 Electric EGR Transducer (EET)—5.2L Engine

plied to the EGR valve. The transducer uses this back pressure signal to provide the correct amount of exhaust gas recirculation under all conditions.

The vacuum supply for the EGR valve is controlled by the EET. The electrical solenoid portion of the EET is controlled by the powertrain control module (PCM). The PCM monitors engine coolant temperature and other operating conditions to determine when EGR operation is desired. Refer to Open Loop/Closed Loop Modes of Operation in Group 14, Fuel Systems for a description of EGR solenoid operation based on engine operating conditions.

If the electrical connector to the EET is disconnected, or the electrical signal is lost, the EGR valve will operate at all times. This results in poor engine performance and reduced driveability during certain operating conditions.

Vacuum flows between the solenoid portion of the EET and the transducer portion of the EET. This happens only when the solenoid is not electrically energized. The transducer is connected to the EGR valve by a vacuum hose and a back pressure hose. The transducer is controlled by exhaust back pressure and is ported to the exhaust manifold through a hose connecting it to the bottom of the EGR valve.

Vacuum will be supplied to the EGR valve and EGR operation will begin when:

• The electrical solenoid portion of the EET is not energized.
• The engine back pressure entering the EGR valve inlet is strong enough to close the transducer bleed valve.

If back pressure is not strong enough to close the transducer bleed valve, the transducer will bleed off the vacuum preventing EGR operation.

When the electrical solenoid portion of the EET is de-energized by the powertrain control module (PCM), vacuum flows to the transducer. The transducer is connected to the engine exhaust system by a small hose that connects to the base of the EGR valve.

The vacuum section of the transducer is controlled by exhaust system back pressure. When back pressure is high enough it will close a bleed valve in the transducer allowing vacuum to actuate the EGR valve. If back pressure does not close the bleed valve, vacuum will be bled off.

For more information, refer to the Multi-Port Fuel Injection section of Group 14, Fuel Systems for 5.2L engines.

EGR SYSTEM ON-BOARD DIAGNOSTICS (CALIFORNIA VEHICLES ONLY)

The powertrain control module (PCM) performs an On-Board Diagnostic (OBD) check of the EGR system on all California vehicles. The diagnostic system uses the Electric EGR Transducer (EET) for the system tests.

The OBD check activates only during selected engine/driving conditions. When the conditions are met, the PCM energizes the EET solenoid to disable the EGR. The PCM checks for a change in the oxygen sensor signal. If the air-fuel mixture goes lean, the PCM will attempt to enrichen the mixture. The PCM registers a Diagnostic Trouble Code (DTC) if the EGR system has failed or degraded. After registering a DTC, the PCM turns the **Malfunction Indicator Lamp (MIL)** on. (The Malfunction Indicator Lamp was formerly referred to as the Check Engine Lamp). The Malfunction Indicator Lamp indicates the need for immediate service.

If a malfunction is indicated by the Malfunction Indicator Lamp and a DTC for the EGR system was set, check for proper operation of EGR system. Use the following: System Test, EGR Gas Flow Test and EGR Diagnosis Chart.

If the EGR system tests properly, check the system using the DRB II scan tool. For use of the DRB II, refer to the appropriate Powertrain Diagnostics Procedure service manual.

EGR SYSTEM SERVICE—5.2L ENGINE

A malfunctioning EGR system can cause engine spark knock, sags or hesitation, rough idle, engine stalling and poor driveability. To be sure of proper operation of the EGR system, inspect all passages for blockage. Check moving parts for binding. Inspect the complete system for leaks. Replace system components or hoses that are leaking.

Inspect all hose connections between throttle body, intake manifold, EGR valve and EGR purge solenoid. Replace any vacuum harness components that are leaking or damaged.

Refer to EGR Control System Test and EGR Gas Flow Test to check EGR System operation.

EGR GAS FLOW TEST—5.2L ENGINE

(1) Disconnect hose from EGR valve and connect a hand vacuum pump to EGR valve nipple. Apply a minimum of 12 inches vacuum the valve.

(2) The engine should now idle roughly or stall. If this occurs, the valve is performing correctly. Proceed to Electric EGR Transducer Test.

(3) If the engine idle speed did not change, remove the EGR valve and inspect the valve and the exhaust passage in the manifold for blockage. Repair as necessary. If blockage is not present, replace the EGR valve.

ELECTRIC EGR TRANSDUCER (EET)—5.2L ENGINE

TESTING ELECTRIC SOLENOID PORTION OF TRANSDUCER

(1) Bring the engine to normal operating temperature. Operate at idle speed. Test the EET as follows:

(2) Check vacuum at EET vacuum source. Disconnect the hose and attach a vacuum gauge to it.

(3) Vacuum should be a minimum of 15 inches:

- If vacuum is low, check the line for kinks, twists, or a loose connection at vacuum connector or intake manifold.
- If vacuum is correct, remove gauge. Connect the vacuum line and proceed to next step.

(4) Check EET operation using the appropriate Powertrain Diagnostic Procedures service manual. Refer to this manual for use of the DRB II scan tool and repair EET as necessary.

TESTING VACUUM PORTION OF TRANSDUCER

(1) Disconnect the EET vacuum lines, back pressure line and electrical connector. Remove transducer.

(2) Plug the EET EGR valve port.

(3) Apply 1-2 pounds air pressure to exhaust back pressure port. Air pressure can be supplied with a hand operated air pump or compressed air (regulated to correct psi).

(4) Apply a minimum of 12 inches of vacuum to vacuum supply port.

Replace the EET if it will not hold vacuum.

For electrical tests of the EET and its circuitry, refer to the appropriate Powertrain Diagnostic Procedures service manual and use the DRB II scan tool.

OXYGEN (O_2) SENSOR

For description, operation, diagnosis and removal/installation procedures of the O_2 sensor, refer to Group 14, Fuel Systems.

EGR DIAGNOSIS CHART—5.2L ENGINE

NOTE: ALL TESTS MUST BE MADE WITH FULLY WARM ENGINE RUNNING CONTINUOUSLY FOR AT LEAST TWO MINUTES

WARNING: BE SURE TO APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING IDLE CHECK OR ADJUSTMENT, OR ANY ENGINE RUNNING TESTS OR ADJUSTMENTS.

Condition	Possible Cause	Correction
EGR VALVE STEM DOES NOT MOVE ON SYSTEM TEST.	(a) Cracked, leaking, disconnected or plugged hoses.	(a) Verify correct hose connections and leak check and confirm that all hoses are open. If defective hoses are found, replace hose harness. (b) Disconnect hose harness from EGR vacuum transducer and connect auxiliary vacuum supply. Raise engine rpm to 2000 rpm and hold. Apply 10" Hg vacuum while checking valve movement. If no valve movement occurs, replace valve/transducer assy. If valve opens (approx. 3mm or 1/8" travel), hold supply vacuum to check for diaphragm leakage. Valve should remain open 30 seconds or longer. If leakage occurs, replace valve/transducer assy. If valve is satisfactory, check control system.
EGR VALVE STEM DOES NOT MOVE ON SYSTEM TEST. OPERATES NORMALLY ON EXTERNAL VACUUM SOURCE.	(a) Defective control system—Plugged passages.	(a) Remove throttle body and inspect port (slot type) in throttle bore and associated passage in throttle body. Use suitable solvent to remove deposits and check for flow with light air pressure. Normal operation should be restored to EGR system.
	(b) Defective control system—solenoid or solenoid control circuit.	(b) Refer to Group 14. General Diagnosis "On Board Diagnostics" to check solenoid.
ENGINE WILL NOT IDLE. DIES OUT ON RETURN TO IDLE OR IDLE IS VERY ROUGH OR SLOW.	(a) High EGR valve leakage in closed position.	(a) If removal of vacuum hose from EGR valve does not correct rough idle, (a1) Turn engine off. Remove the air cleaner exposing the inlet to the throttle body. (a2) Disconnect the backpressure hose from the EGR valve. (a3) Using a nozzle with a rubber grommet connection, direct compressed air (50 to 60 psi) down through the steel backpressure tube on the EGR valve while opening and closing the throttle blade. (a4) If the sound from the compressed air changes distinctly in step a3, the poppet is leaking and air is entering the intake manifold. Replace the EGR valve.
	(b) EGR tube to intake manifold leak.	(b) Remove tube and visually inspect tube seal on gasket. Tube end should be uniformally indented on gasket with no signs of leak. If signs of exhaust gas leakage are present, replace gaskets and tighten flange nuts to 23 N·m (200 in. lbs.). If an intake plenum leak persists, replace EGR tube and gaskets, following installation instructions.
	(c) Solenoid or control signal to solenoid failure.	(c) Verify correct hose connections and leak check and confirm that all hoses are open. If defective hoses are found, replace hose harness. (c1) Refer to Group 14, General Diagnosis "On Board Diagnostics" to check solenoid.

NOTE: DO NOT ATTEMPT TO CLEAN BACK-PRESSURE EGR VALVE, REPLACE ENTIRE VALVE/TRANSDUCER ASSEMBLY IF NECESSARY.

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COMPONENT REMOVAL/INSTALLATION

INDEX

AIR CLEANER HOUSING

REMOVAL

(1) Unlock clean air hose clamp (Figs. 1 or 2) at air cleaner cover. To unlock the clamp, attach adjustable pliers to clamp and rotate pliers as shown in figure 3.

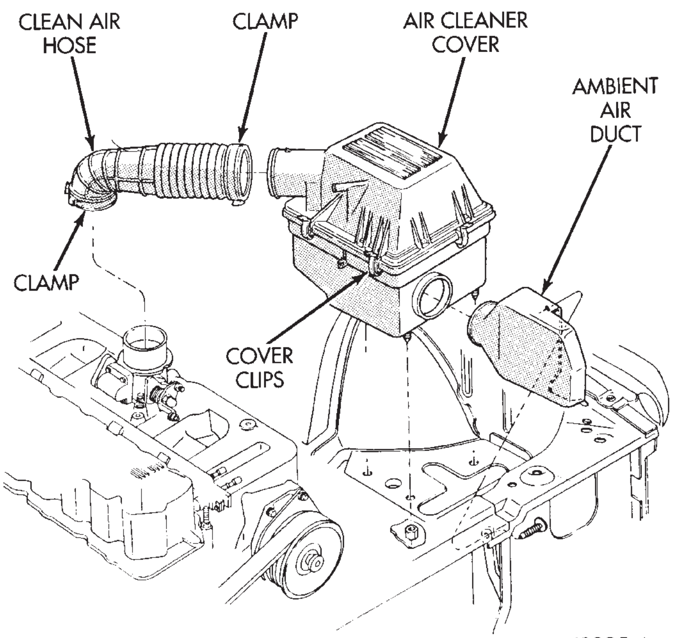

Fig. 1 Air Cleaner—4.0L Engine

Remove clean air hose at cover.

(2) Remove crankcase breather/filter hose at air cleaner cover.

(3) From under vehicle, remove three housing nuts (Figs. 1 or 2).

(4) Release the air cleaner housing from the ambient air duct and remove housing from vehicle.

INSTALLATION

(1) Position air cleaner housing to body and ambient air duct (Figs. 1 or 2).

(2) Install three nuts and tighten to 10 N●m (93 in. lbs.) torque.

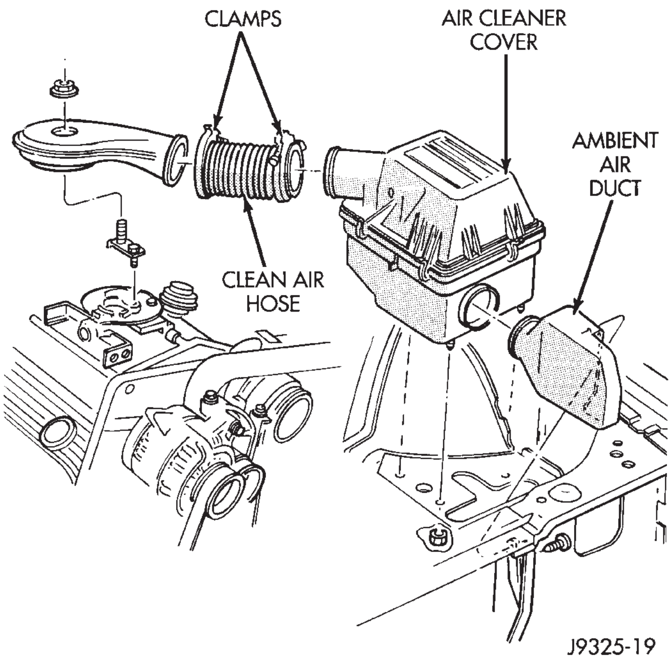

Fig. 2 Air Cleaner—5.2L Engine

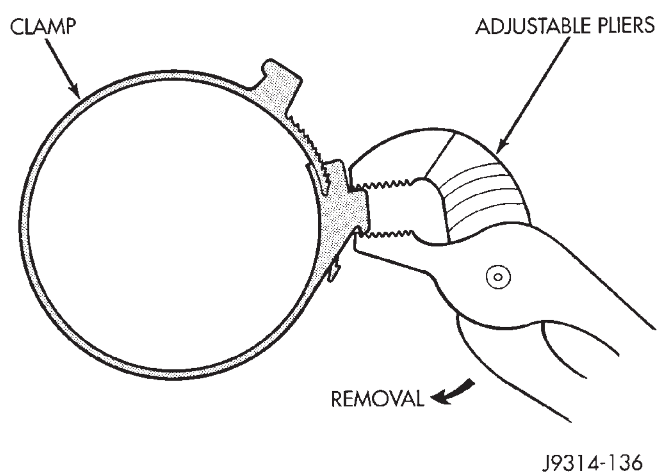

Fig. 3 Clamp Removal

(3) Install crankcase breather/filter hose to cover.

(4) Install clamp to cover. Compress the clamp snugly with adjustable pliers as shown in figure 4.

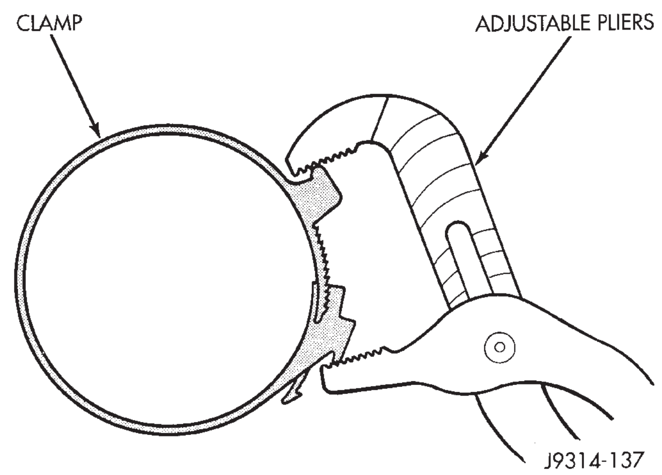

Fig. 4 Clamp Installation

AIR FILTER

REMOVAL/INSTALLATION

(1) Pry back the six clips retaining the air cleaner cover to the air cleaner housing (Fig. 5).

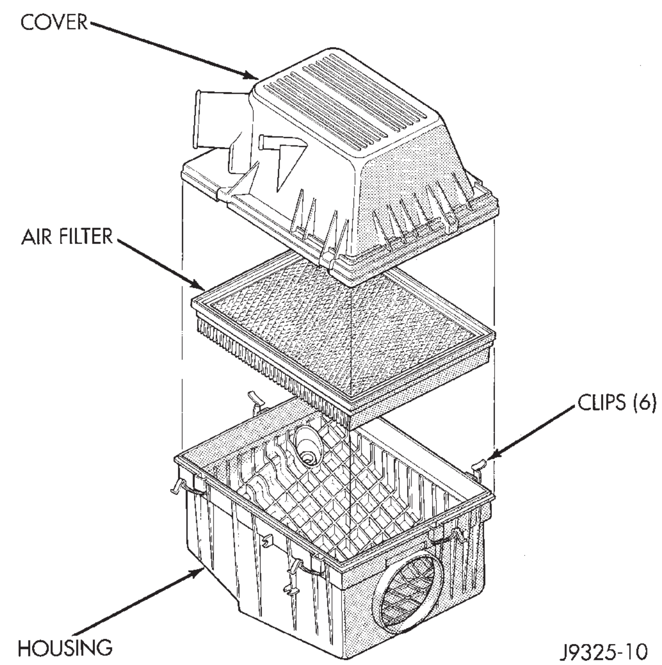

Fig. 5 Air Filter Removal/Installation

(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.

EGR VALVE—5.2L ENGINE

REMOVAL

The EGR valve and the Electric EGR Transducer (EET) are serviced as one unit on the 5.2L engine.

(1) Disconnect vacuum hose to EGR valve/transducer assembly. Note position of hoses (Fig. 6) on the EGR valve and transducer for easier installation.

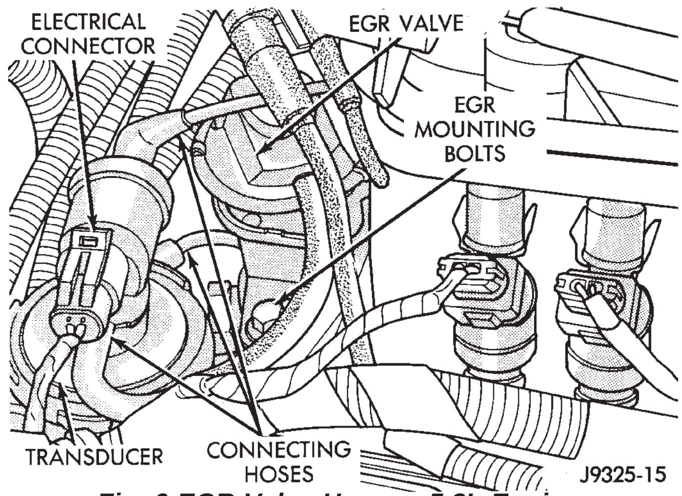

Fig. 6 EGR Valve Hoses—5.2L Engines

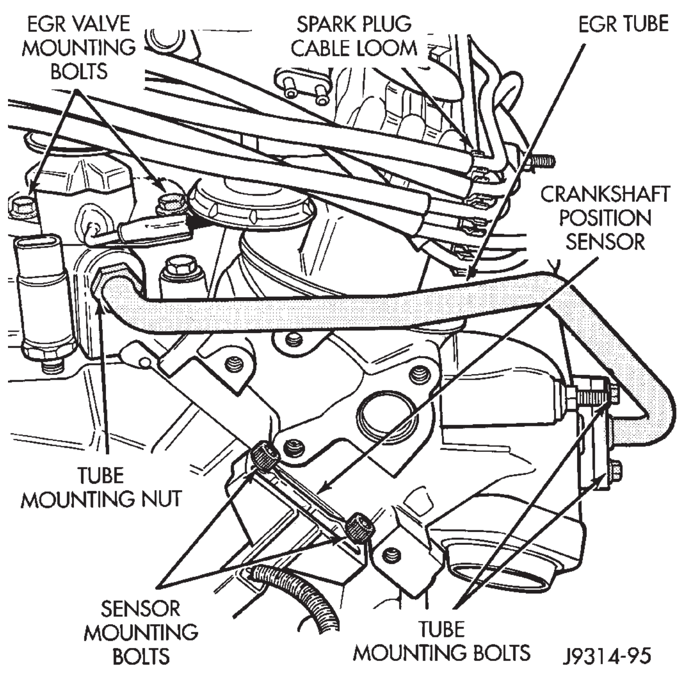

Fig. 7 EGR Valve Mounting Bolts—5.2L Engines

(2) Remove EGR mounting bolts (Figs. 6 or 7).
(3) Remove EGR valve and gasket. Discard old gasket. Clean intake manifold mating surface and check for cracks.

INSTALLATION

(1) Place new EGR gasket on intake manifold.
(2) Install EGR valve. Tighten mounting bolts to 23 N●m (200 in. lbs.) torque.

(3) Connect vacuum hose to valve/transducer assembly.

EGR TUBE—5.2L ENGINE

REMOVAL

(1) Remove the spark plug cable loom and spark plug cables from valve cover mounting stud at rear of right valve cover (Fig. 8). Position spark plug cables to top of valve cover.

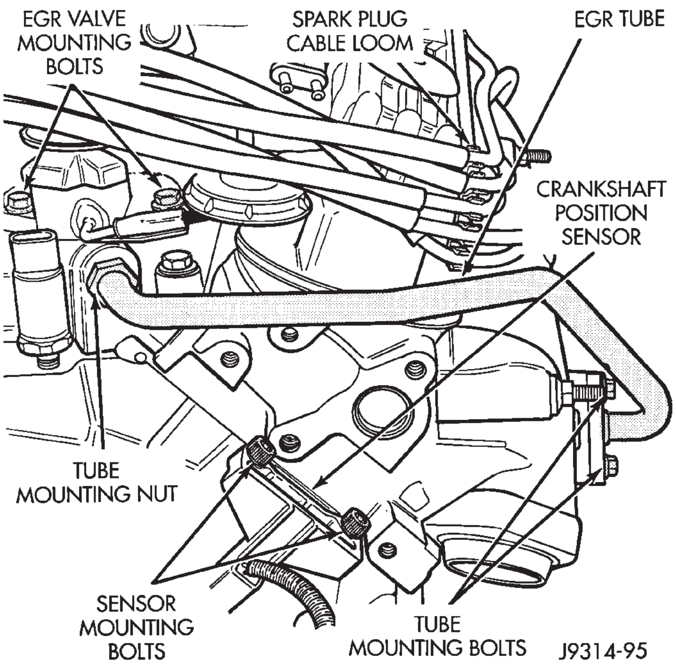

Fig. 8 EGR Tube—5.2L Engine

(2) Remove the right exhaust manifold heat shield nuts/bolts and remove heat shield (Fig. 9).

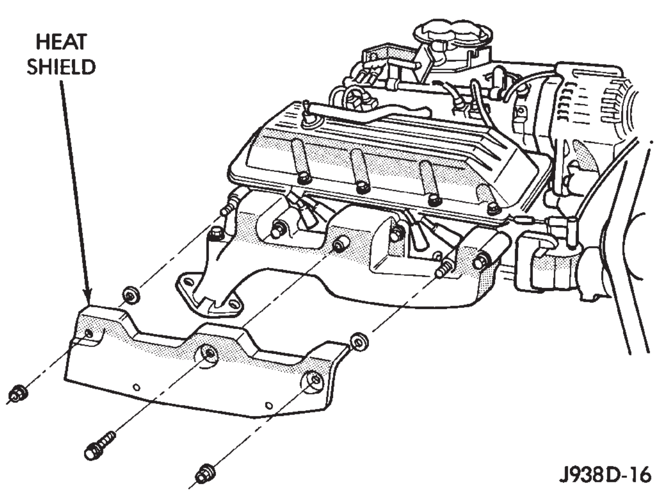

Fig. 9 Exhaust Manifold Heat Shield—5.2L Engine

(3) Disconnect 2 hoses at Exhaust Gas Recirculation (EGR) valve. Note position of hoses at EGR valve before removal.

(4) Disconnect electrical connector and hoses at electric EGR transducer (EET). Note position of hoses at EET before removal.

(5) Remove 2 EGR valve mounting bolts (Fig. 8) and remove EGR valve. Discard old EGR gasket.

(6) Disconnect electrical connector at engine oil pressure sending unit.

(7) To prevent damage to oil pressure sending unit, a special tool, such as number C-4597 must be used (Fig. 10). Remove sending unit from engine.

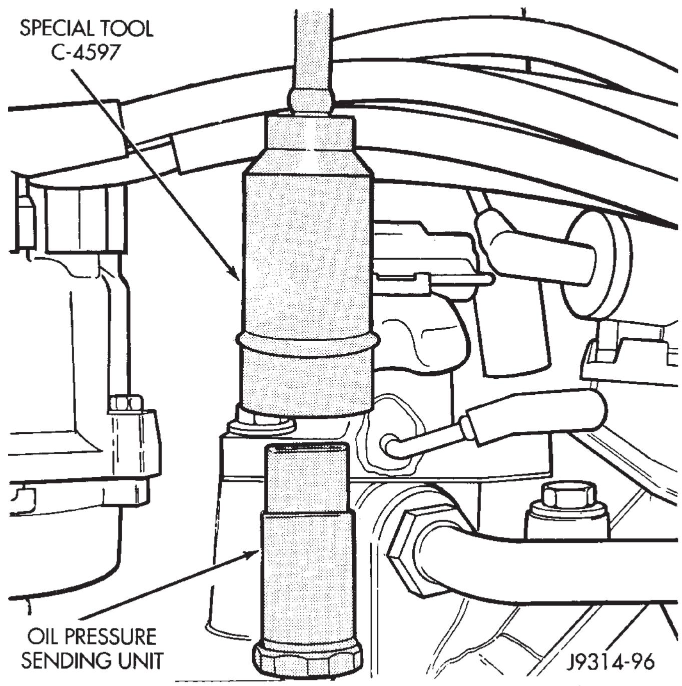

Fig. 10 Oil Pressure Sending Unit—Removal/ Installation

(8) Loosen EGR tube mounting nut at intake manifold (Fig. 8).

(9) Remove 2 EGR tube mounting bolts at exhaust manifold (Fig. 8) and remove EGR tube. Discard old gasket at exhaust manifold.

(10) Remove EGR tube from vehicle.

INSTALLATION

(1) Clean the EGR tube and exhaust manifold (at EGR tube mounting point) of any old gasket material.

(2) Install a new gasket to exhaust manifold end of EGR tube and install EGR tube to both manifolds. Tighten tube mounting nut at intake manifold. Tighten 2 mounting bolts at exhaust manifold to 23 N•m (204 in. lbs.) torque.

(3) Coat the threads of the oil pressure sending unit with thread sealant. Do not allow any of the thread sealant to get into the sending unit opening, or the opening at the engine. Install sending unit to engine and tighten to 14 N•m (130 in. lbs.) torque. Install electrical connector to sending unit.

(4) Clean the intake manifold and EGR valve of any old gasket material.
(5) Install a new EGR valve gasket at intake manifold.
(6) Install EGR valve to intake manifold. Tighten 2 EGR bolts to 23 N●m (200 in. lbs.) torque.
(7) Position EET and install its electrical connector. Connect hoses between EGR valve and EET. Connect hose between main vacuum harness and EET.
(8) Install spark plug cable loom and spark plug cables to valve cover mounting stud.
(9) Install heat shield at right exhaust manifold.

ELECTRIC EGR TRANSDUCER (EET)—5.2L ENGINE

The EGR valve and the EET are serviced as one unit on the 5.2L engine. Also refer to EGR valve removal/installation.

REMOVAL

(1) Disconnect wiring connector at EET (Fig. 11).
(2) Disconnect hoses at EET. Note position of hoses for easier installation.
(3) Remove EET from engine.

INSTALLATION

(1) Position EET to engine and connect hoses.
(2) Connect wiring connector.

EVAP CANISTER

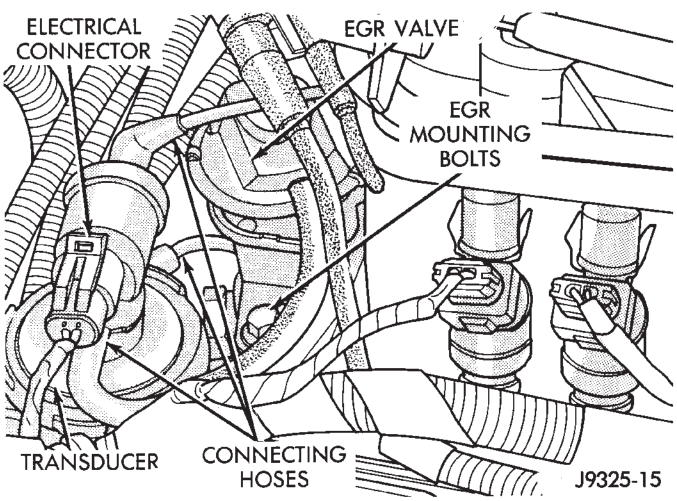

Fig. 11 Electric EGR Transducer—5.2L Engine

REMOVAL

(1) Remove the grill. Refer to group 23, Body.
(2) Remove the front bumper/fascia assembly. Refer to group 23, Body.
(3) Disconnect vacuum lines at canister.
(4) Remove the three canister mounting nuts (Fig. 12).
(5) Lower the canister through bottom of vehicle.

INSTALLATION

(1) Position canister to body.

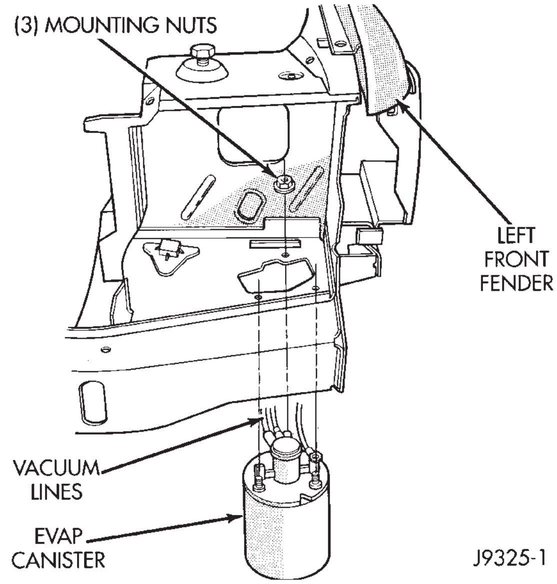

Fig. 12 EVAP Canister Location

(2) Install canister mounting nuts. Tighten nuts to 6 N●m (55 in. lbs.) torque.
(3) Connect vacuum lines.
(4) Install the front bumper/fascia assembly and grill. Refer to Group 23, Body.

EVAP CANISTER PURGE SOLENOID

REMOVAL—5.2L ENGINE

(1) Remove air duct at throttle body.
(2) Disconnect wiring connector at solenoid (Fig. 13).
(3) Disconnect vacuum harness at solenoid (Fig. 13).

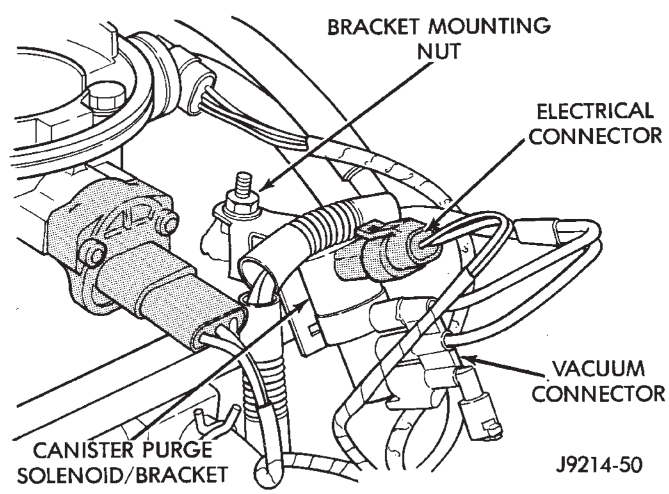

Fig. 13 EVAP Canister Purge Solenoid—5.2L Engine

(4) Remove solenoid and its support bracket from intake manifold.

(5) Remove EVAP canister purge solenoid from engine.

INSTALLATION

(1) Install EVAP canister purge solenoid and its mounting bracket to intake manifold.
(2) Connect vacuum harness and wiring connector.
(3) Install air duct to throttle body.

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 (O_2) SENSOR

For description, operation, diagnosis and removal/installation procedures of the O_2 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.

COMPONENT AND SYSTEM INDEX

COMPONENT AND SYSTEM INDEX