GROUP TAB LOCATOR

INTRODUCTION

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GENERAL INFORMATION

VEHICLE IDENTIFICATION NUMBER

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

The Vehicle Identification Number is also imprinted on the:

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

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

VEHICLE IDENTIFICATION NUMBER DECODING CHART

POSITION	INTERPRETATION	CODE = DESCRIPTION
1	Country of Origin	1 = United States
2	Make	J = Jeep
3	Vehicle Type	4 = MPV
4	Gross Vehicle Weight Rating	E = 3001-4000 lbs. F = 4001-5000 lbs.
5	Vehicle Line	Y = Wrangler 4X4
6	Series	1 = Sport 2 = SE 4 = Sahara
7	Body Style	9 = Open Body
8	Engine	H = 2.5L Leaded-Gasoline P = 2.5L Unleaded-Gasoline S = 4.0L Unleaded-Gasoline V = 4.0L Leaded-Gasoline
9	Check Digit	
10	Model Year	V = 1997
11	Assembly Plant	P = Toledo #2
12 thru 17	Vehicle Build Sequence	

GENERAL INFORMATION (Continued)

VEHICLE SAFETY CERTIFICATION LABEL

A vehicle safety certification label (Fig. 1) is attached to every Chrysler Corporation vehicle. The label certifies that the vehicle conforms to all applicable Federal Motor Vehicle Safety Standards. The label also lists:

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

The label is located on the driver-side door shutface.

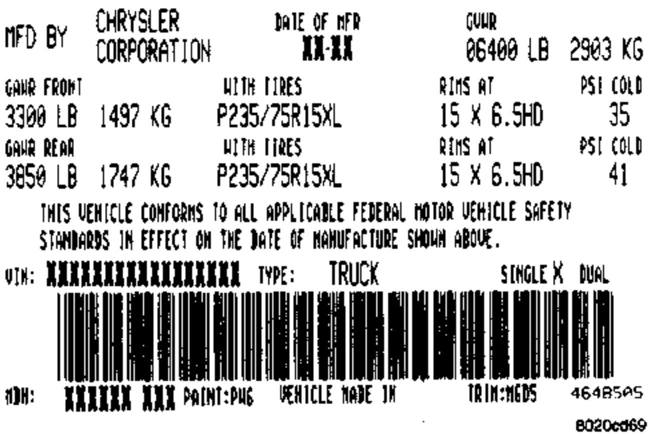


Fig. 1 Vehicle Safety Certification Label—Typical

BODY CODE PLATE

LOCATION AND DECODING

A metal body code plate is attached to the floor pan under the drivers seat (Fig. 2). Disengage the snaps attaching the carpet to the floor pan to read the information. There are seven lines of information on the body code plate. Lines 4, 5, 6, and 7 are not used to define service information. Information reads from left to right, starting with line 3 in the center of the plate to line 1 at the bottom of the plate (Fig. 3).

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

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

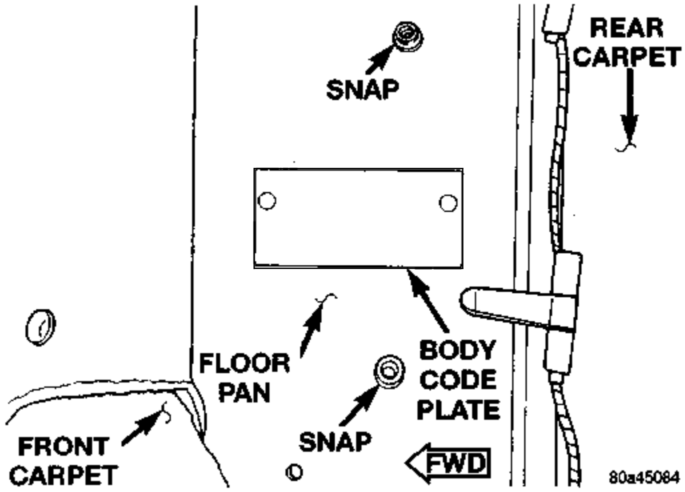


Fig. 2 Body Code Plate Location

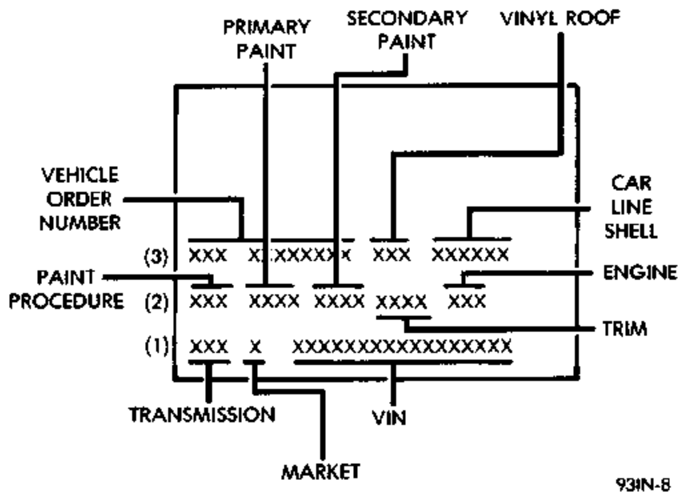


Fig. 3 Body Code Plate Decoding

BODY CODE PLATE—LINE 3

DIGITS 1 THROUGH 12

Vehicle Order Number

DIGITS 13, 14, AND 15

Open Space

DIGITS 16, 17, AND 18

Car Line Shell

- TJJ = Wrangler (LHD)
- TJU = Wrangler (RHD)

DIGIT 19

Price Class

- L = Wrangler (All)

DIGITS 20 AND 21

Body Type

- 77 = Wheel Base (93.4 in.)

GENERAL INFORMATION (Continued)

BODY CODE PLATE—LINE 2

DIGITS 1,2, AND 3
Paint Procedure

DIGIT 4
Open Space

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

DIGIT 9
Open Space

DIGITS 10 THROUGH 13
Secondary Paint

DIGIT 14
Open Space

DIGITS 15 THROUGH 18
Interior Trim Code

DIGIT 19
Open Space

DIGITS 20, 21, AND 22
Engine Code
- EPE = 2.5 L 4 cyl. MPI Gasoline
- ERH = 4.0L 6 cyl. MPI Gasoline

BODY CODE PLATE LINE 1

DIGITS 1, 2, AND 3
Transmission Codes
- DDQ = AX5 5–speed Manual
- DDO = AX15 5–speed Manual
- DGD = 30RH 3–speed Automatic
- DGG = 32RH 3–speed Automatic

DIGIT 4
Open Space

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

DIGIT 6
Open Space

DIGITS 7 THROUGH 23
Vehicle Identification Number (VIN)

Refer to Vehicle Identification Number (VIN) paragraph for proper breakdown of VIN code.

VEHICLE DIMENSIONS

The vehicle dimension data charts list the exterior and interior dimensions. All dimensions are listed in inches and centimeters.

VEHICLE EXTERIOR DIMENSIONS

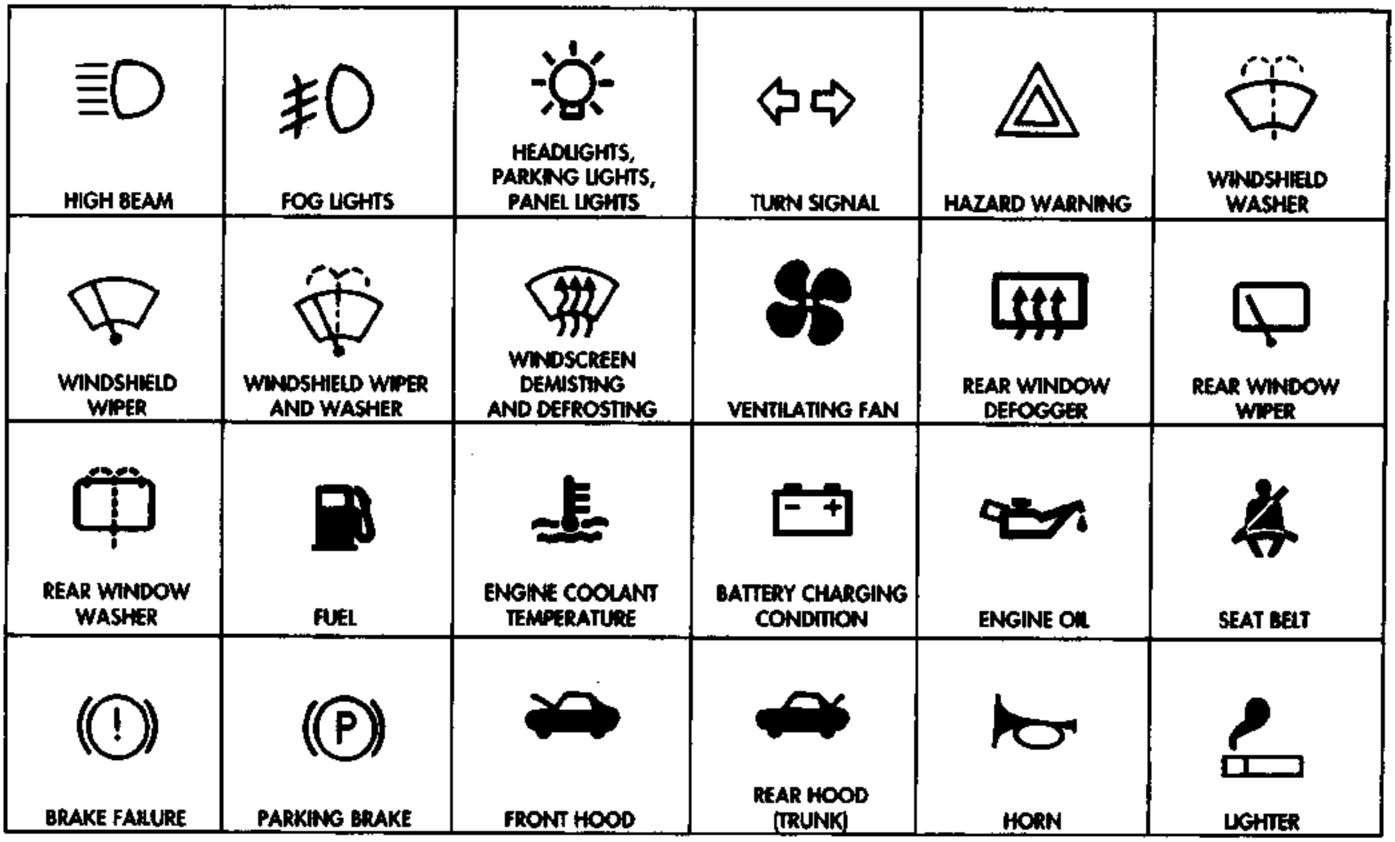
MODEL NAME	WHEEL BASE	TRACK FRONT	TRACK REAR	LENGTH	OVERALL WIDTH	HEIGHT
TJ-Wrangler	93.4 237.3	58.0 147.3	58.0 147.3	147.7 375.1	66.7 169.3	70.6 179.4

VEHICLE INTERIOR DIMENSIONS

HEAD FRONT/ REAR SOFT TOP	HEAD FRONT/ REAR HARD TOP	LEG FRONT / REAR	SHOULDER FRONT / REAR	HIP FRONT / REAR
42.3 / 40.2 107.5 / 102.2	40.9 / 39.1 103.8 / 99.4	41.0 / 36.4 104.1 / 92.4	51.9 / 57.3 131.9 / 145.5	51.1 / 43.5 129.7 / 110.5

GENERAL INFORMATION (Continued)

INTERNATIONAL CONTROL AND DISPLAY SYMBOLS



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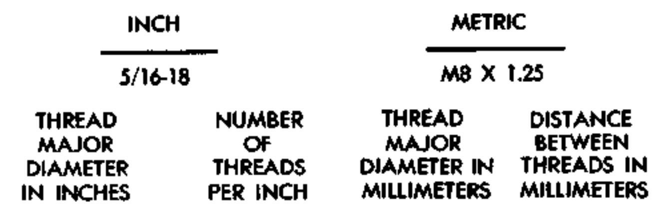
INTERNATIONAL VEHICLE CONTROL AND DISPLAY SYMBOLS

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.

FASTENER IDENTIFICATION

THREAD IDENTIFICATION

SAE and metric bolt/nut threads are not the same. The difference is described in the Thread Notation chart (Fig. 4).



PR606B

Fig. 4 Thread Notation—SAE and Metric

GRADE/CLASS IDENTIFICATION

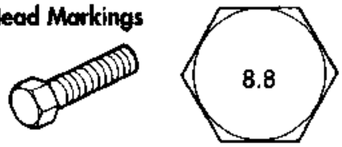
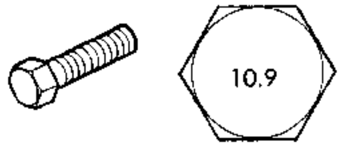
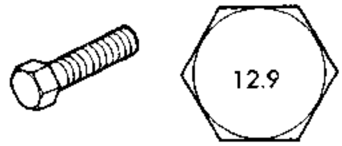
The SAE bolt strength grades range from grade 2 to grade 8. The higher the grade number, the greater the bolt strength. Identification is determined by the line marks on the top of each bolt head. The actual bolt strength grade corresponds to the number of line marks plus 2. The most commonly used metric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

GENERAL INFORMATION (Continued)

FASTENER IDENTIFICATION

Bolt Markings and Torque - Metric

Commercial Steel Class

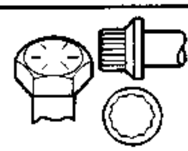
	8.8	10.9	12.9
Bolt Head Markings			

Body Size	Torque 8.8				Torque 10.9				Torque 12.9			
Diam.	Cast Iron		Aluminum		Cast Iron		Aluminum		Cast Iron		Aluminum	
mm	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
6	9	5	7	4	14	9	11	7	14	9	11	7
7	14	9	11	7	18	14	14	11	23	18	18	14
8	25	18	18	14	32	23	25	18	36	27	28	21
10	40	30	30	25	60	45	45	35	70	50	55	40
12	70	55	55	40	105	75	80	60	125	95	100	75
14	115	85	90	65	160	120	125	95	195	145	150	110
16	180	130	140	100	240	175	190	135	290	210	220	165
18	230	170	180	135	320	240	250	185	400	290	310	230

Bolt Markings and Torque Values - U.S. Customary

SAE Grade Number 5 8

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



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

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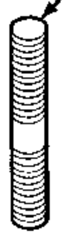
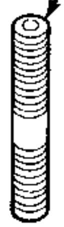
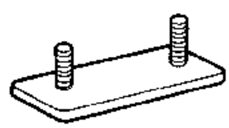
GENERAL INFORMATION (Continued)

FASTENER STRENGTH

HOW TO DETERMINE BOLT STRENGTH

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

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

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GENERAL INFORMATION (Continued)

FASTENER USAGE

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

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

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

METRIC SYSTEM

The metric system is based on quantities of one, ten, one hundred, one thousand and one million (Fig. 5).

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

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

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Fig. 5 Metric Prefixes

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

TORQUE REFERENCES

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

CONVERSION FORMULAS AND EQUIVALENT VALUES

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

COMMON METRIC EQUIVALENTS

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

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GENERAL INFORMATION (Continued)

METRIC CONVERSION

in-lbs to N•m

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

N•m to in-lbs

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

ft-lbs to N•m

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

N•m to ft-lbs

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

in. to mm

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

mm to in.

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

J901N-10

GENERAL INFORMATION (Continued)

TORQUE SPECIFICATIONS

SPECIFIED TORQUE FOR STANDARD BOLTS

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

LUBRICATION AND MAINTENANCE

CONTENTS

GENERAL INFORMATION

INDEX

GENERAL INFORMATION

INTRODUCTION

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

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

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

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

Use the schedule that best describes your driving conditions.

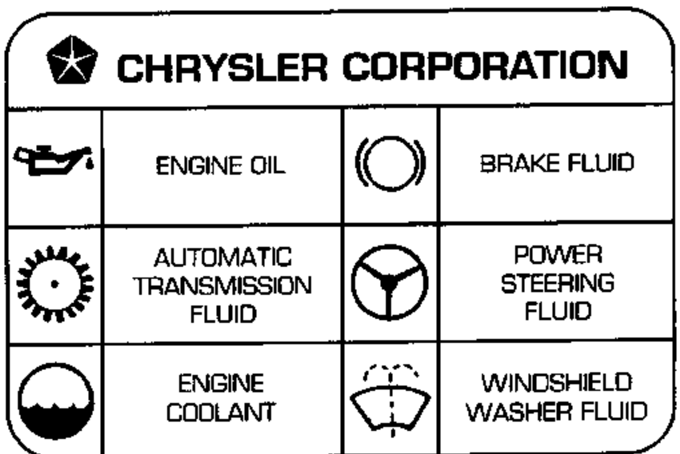
Where time and mileage are listed, follow the interval that occurs first.

PARTS AND LUBRICANT RECOMMENDATIONS

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

INTERNATIONAL SYMBOLS

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



9500-1

Fig. 1 International Symbols

GENERAL INFORMATION (Continued)

CLASSIFICATION OF LUBRICANTS

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

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

9400-9

Fig. 2 API Symbol

ENGINE OIL

SAE GRADE RATING INDICATES ENGINE OIL VISCOSITY

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

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

API QUALITY CLASSIFICATION

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

Use engine oil that is API Service Grade Certified or an oil that conforms to the API Service Grade SH or SH/CD. MOPAR engine oils conform to all of these service grades.

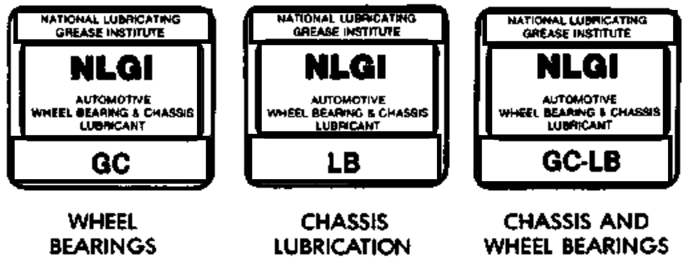
Refer to Group 9, Engine for engine oil specification.

GEAR LUBRICANTS

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

LUBRICANTS AND GREASES

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



9200-7

Fig. 3 NLGI Symbol

FLUID CAPACITIES

FUEL TANK

Standard . . . . .56.8 L (15 gal.)
Optional . . . . .71.9 L (19.0 gal.)

ENGINE OIL

2.5L . . . . .3.8 L (4.0 qts.)
4.0L . . . . .5.7 L (6.0 qts.)

COOLING SYSTEM

2.5L . . . . .8.5 L (9.0 qts.)
4.0L . . . . .9.9 L (10.5 qts.)

AUTOMATIC TRANSMISSION

Dry fill capacity*

32RH . . . . .8.1 L (17.1pts.)
30RH . . . . .6.6 L (14.0 pts.)

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

MANUAL TRANSMISSION

AX5 . . . . .3.2 L (3.3 qts.)
AX15 . . . . .3.15 L (3.32 qts.)

TRANSFER CASE

COMMAND-TRAC 231 (Auto Trans). .1.0 L (2.2 pts.)
COMMAND-TRAC 231 (Man Trans) .1.5 L (3.25 pts.)

FRONT AXLE

MODEL 181. . . . . .1.65 L (3.76 pts.)

REAR AXLE

MODEL 216. . . . . .1.77 L (3.75 pts.)
MODEL 194. . . . . .1.6 L (3.5 pts.*)

* When equipped with TRAC-LOK, include 2 ounces of Friction Modifier Additive.

MAINTENANCE SCHEDULES

INDEX

GENERAL INFORMATION

INTRODUCTION

There are two maintenance schedules that show proper service intervals for TJ vehicles. Use the schedule that best describes the conditions the vehicle is operated under. When mileage and time is listed, follow the interval that occurs first.

Schedule-A lists all the scheduled maintenance to be performed under normal operating conditions.

Schedule-B is a schedule for vehicles that are usually operated under one or more of the following conditions:

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

EMISSION CONTROL SYSTEM MAINTENANCE

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

UNSCHEDULED INSPECTION

At Each Stop For Fuel

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

Once A Month

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

At Each Oil Change

- Inspect exhaust system.
- Inspect brake hoses.
- Rotate the tires at each oil change interval shown on Schedule—A (7,500 miles) or every other interval shown on Schedule—B (6,000 miles).
- Check coolant level, hoses, and clamps.
- Lubricate propeller shaft universal joints and slip splines (if equipped).
- Lubricate suspension ball joints.
- After completion of off-road (4WD) operation, the underside of the vehicle should be thoroughly inspected. Examine threaded fasteners for looseness.

SCHEDULE—A

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Inspect brake linings.

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

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**

GENERAL INFORMATION (Continued)

- **Replace spark plugs.**
- Inspect drive belts. Adjust as needed.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill transfer case fluid.

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill manual transmission fluid.

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Inspect brake linings.
- Flush and replace engine coolant at 36 months, regardless of mileage.

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Flush and replace engine coolant if not done at 36 months.

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

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Replace spark plugs.**
- Inspect drive belts. Adjust as needed.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill transfer case fluid.

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Inspect brake linings.

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill manual transmission fluid.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.

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

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

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

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- Inspect drive belts. Adjust as needed.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill transfer case fluid.
- Inspect brake linings.

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.

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

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

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill manual transmission fluid.
- Inspect brake linings.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.

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

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Replace spark plugs.**
- Inspect drive belts. Adjust as needed.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill transfer case fluid.

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

SCHEDULE—B

3,000 Miles (4 800 km)

- Change engine oil.
- Replace engine oil filter.

GENERAL INFORMATION (Continued)

6,000 Miles (9 600 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.

9,000 Miles (14 400 km)
- Change engine oil.
- Replace engine oil filter.

12,000 Miles (19 200 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill front and rear axles.*
- Inspect brake linings.

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

18,000 miles (29 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill manual transmission fluid.

21,000 Miles (34 000 km)
- Change engine oil.
- Replace engine oil filter.

24,000 Miles (38 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill front and rear axles.*
- Inspect brake linings.

27,000 Miles (43 000 km)
- Change engine oil.
- Replace engine oil filter.

30,000 Miles 48 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- Inspect drive belts. Adjust as needed.
- Lubricate steering linkage.
- Drain and refill transfer case fluid.

33,000 Miles (53 000 km)
- Change engine oil.
- Replace engine oil filter.

36,000 Miles (58 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill manual transmission fluid.
- Drain and refill automatic transmission fluid.
- Drain and refill front and rear axles.*
- Inspect brake linings.

39,000 Miles (62 000 km)
- Change engine oil.
- Replace engine oil filter.

42,000 Miles (67 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.

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

48,000 Miles (77 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill front and rear axles.*
- Inspect brake linings.

51,000 Miles (82 000 km)
- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant.

54,000 miles (86 400 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill manual transmission fluid.

57,000 Miles (91 000 km)
- Change engine oil.
- Replace engine oil filter.

60,000 Miles (96 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Replace spark plugs.**
- Inspect drive belts. Adjust as needed.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill transfer case fluid.

GENERAL INFORMATION (Continued)

- Drain and refill front and rear axles.*
- Inspect brake linings.

63,000 Miles (102 000 km)
- Change engine oil.
- Replace engine oil filter.

66,000 miles (105 600 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.

69,000 Miles (110 000 km)
- Change engine oil.
- Replace engine oil filter.

72,000 Miles (115 200 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill manual transmission fluid.
- Drain and refill automatic transmission fluid.
- Drain and refill front and rear axles.*
- Inspect brake linings.

75,000 Miles (120 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Inspect engine air filter, replace as necessary.**

78,000 Miles (125 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.

81,000 Miles (130 000 km)
- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant.

84,000 Miles (134 400 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill front and rear axles.*
- Inspect brake linings.

87,000 Miles (140 000 km)
- Change engine oil.
- Replace engine oil filter.

90,000 Miles (144 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- Inspect drive belts. Adjust as needed.
- Lubricate steering linkage.
- Drain and refill manual transmission fluid.
- Drain and refill transfer case fluid.

93,000 Miles (149 000 km)
- Change engine oil.
- Replace engine oil filter.

96,000 Miles (154 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill front and rear axles.*
- Inspect brake linings.

99,000 Miles (158 000 km)
- Change engine oil.
- Replace engine oil filter.

102,000 Miles (163 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.

105,000 Miles (168 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Inspect engine air cleaner element, replace as necessary.**

108,000 Miles (172 800 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill manual transmission fluid.
- Drain and refill automatic transmission fluid.
- Drain and refill front and rear axles.*
- Inspect brake linings.

111,000 Miles (177 600 km)
- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant.

114,000 Miles (182 400 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.

117,000 Miles (187 200 km)
- Change engine oil.
- Replace engine oil filter.

GENERAL INFORMATION (Continued)

120,000 Miles (192 000 km)

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Replace spark plugs.**
- Inspect drive belts. Adjust as needed.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill transfer case fluid.
- Drain and refill front and rear axles.*
- Inspect brake linings.

*Off-highway operation, trailer towing, taxi, limousine, bus, snow plowing, or other types of commercial service or prolonged operation with heavy loading, especially in hot weather, require front and rear axle service indicated with a * in Schedule—B. Perform these services if the vehicle is operated under these conditions.

JUMP STARTING, HOISTING AND TOWING

INDEX

SERVICE PROCEDURES

JUMP STARTING PROCEDURE

WARNING: REVIEW ALL SAFETY PRECAUTIONS AND WARNINGS IN GROUP 8A, BATTERY/STARTING/CHARGING SYSTEMS DIAGNOSTICS.

DO NOT JUMP START A FROZEN BATTERY, PERSONAL INJURY CAN RESULT.

DO NOT JUMP START WHEN BATTERY INDICATOR DOT IS YELLOW OR BRIGHT COLOR. BATTERY CAN EXPLODE.

DO NOT ALLOW JUMPER CABLE CLAMPS TO TOUCH EACH OTHER WHEN CONNECTED TO A BOOSTER SOURCE.

DO NOT USE OPEN FLAME NEAR BATTERY.

REMOVE METALLIC JEWELRY WORN ON HANDS OR WRISTS TO AVOID INJURY BY ACCIDENTAL ARCHING OF BATTERY CURRENT.

WHEN USING A HIGH OUTPUT BOOSTING DEVICE, DO NOT ALLOW DISABLED VEHICLE'S BATTERY TO EXCEED 16 VOLTS. PERSONAL INJURY OR DAMAGE TO ELECTRICAL SYSTEM CAN RESULT.

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

TO JUMP START A DISABLED VEHICLE:

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

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

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

(2) When using another vehicle as a booster source, turn off all accessories, place gear selector in park or neutral, set park brake or equivalent and operate engine at 1200 rpm.

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

(4) Connect jumper cables to booster battery. RED clamp to positive terminal (+). BLACK clamp to negative terminal (-). DO NOT allow clamps at opposite end of cables to touch, electrical arc will result (Fig. 1). Review all warnings in this procedure.

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

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

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

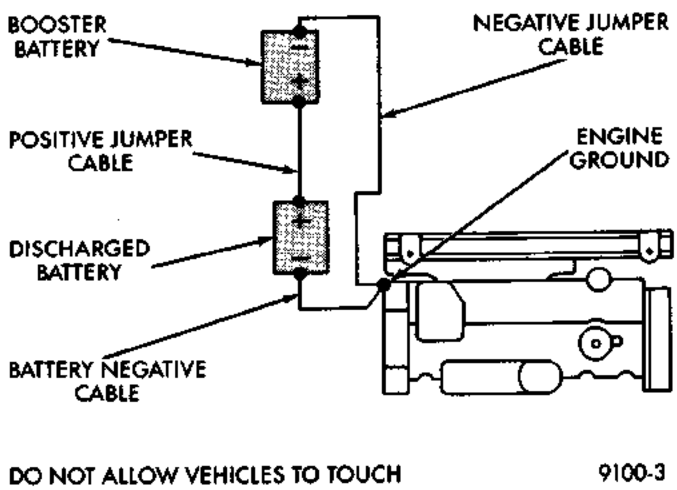


Fig. 1 Jumper Cable Clamp Connections

SERVICE PROCEDURES (Continued)

DISCONNECT CABLE CLAMPS AS FOLLOWS:

• Disconnect BLACK cable clamp from engine ground on disabled vehicle.

• When using a Booster vehicle, disconnect BLACK cable clamp from battery negative terminal. Disconnect RED cable clamp from battery positive terminal.

• Disconnect RED cable clamp from battery positive terminal on disabled vehicle.

TOWING RECOMMENDATIONS

WARNING: DO NOT ATTACH SLING-TYPE TOWING EQUIPMENT TO THE REAR OF A TJ.

When towing a TJ using a wheel-lift, or when sling-type towing equipment is attached to the front end, place tow dollies under the opposite end of the vehicle. Tow vehicles equipped with a flat-bed can also be used to transport a disabled vehicle (Fig. 2).

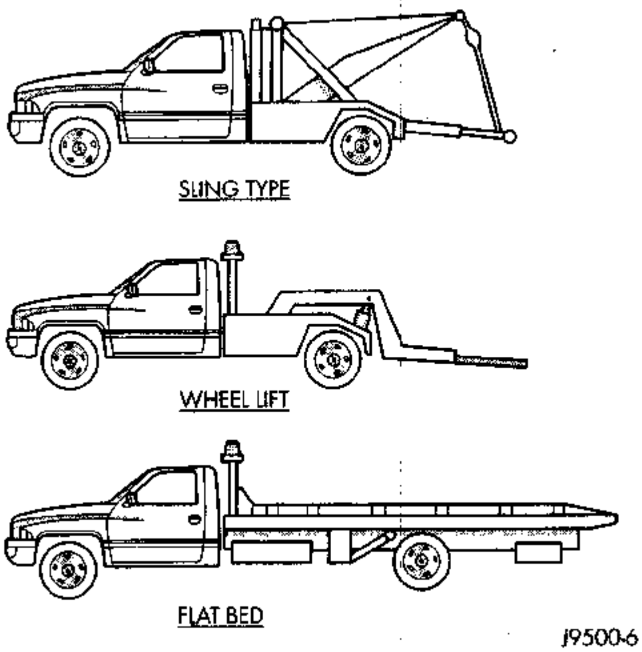


Fig. 2 Tow Vehicles With Approved Equipment

SAFETY PRECAUTIONS

• Secure loose and protruding parts.

• Always use a safety chain system that is independent of the lifting and towing equipment.

• Do not allow towing equipment to contact the disabled vehicle's fuel tank.

• Do not allow anyone under the disabled vehicle while it is lifted by the towing device.

• Do not allow passengers to ride in a vehicle being towed.

• Always observe state and local laws regarding towing regulations.

• Do not tow a vehicle in a manner that could jeopardize the safety of the operator, pedestrians or other motorists.

• Do not attach tow chains, T-hooks, J-hooks, or a tow sling to a bumper, steering linkage, drive shafts or a non-reinforced frame hole.

GROUND CLEARANCE

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

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

FLAT-BED TOWING RAMP ANGLE

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

VEHICLE TOWING

Chrysler Corporation recommends that a 4WD vehicle be transported on a flat-bed device. A Wheel-lift or front end attached Sling-type device can be used provided all the wheels are lifted off the ground using tow dollies.

TOWING-FRONT END LIFTED (WHEEL LIFT)

(1) Raise the rear of the vehicle off the ground and install tow dollies under rear wheels.

(2) Attach the wheel lift to the front wheels.

TOWING-REAR END LIFTED (WHEEL LIFT ONLY)

(1) Raise the front of the vehicle off the ground and install tow dollies under front wheels.

(2) Attach the wheel lift to the rear wheels.

SERVICE PROCEDURES (Continued)

TOWING-FRONT END LIFTED (SLING-TYPE)

(1) Raise the rear of the vehicle off the ground and install tow dollies under rear wheels.

(2) Attach T-hooks to the access holes on the outboard side of the frame rails (Fig. 3).

(3) Before tightening the chain, position a protective pad between the chain and the bumper.

(4) Attach the safety chains to the vehicle (Fig. 4).

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

(6) Shift transfer case to NEUTRAL.

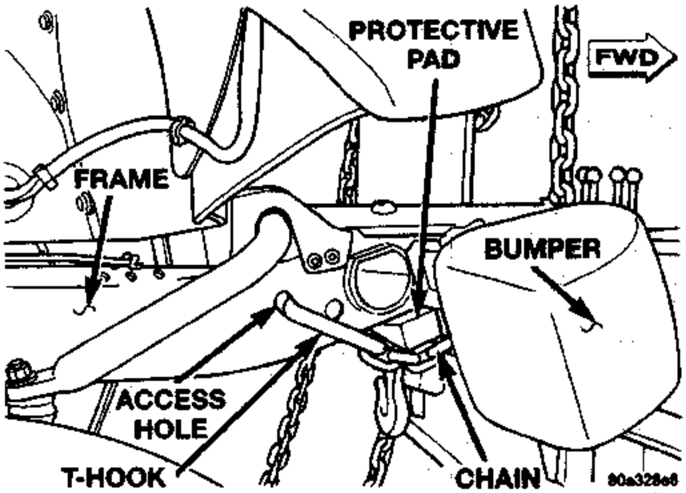


Fig. 3 T-Hook Attachment

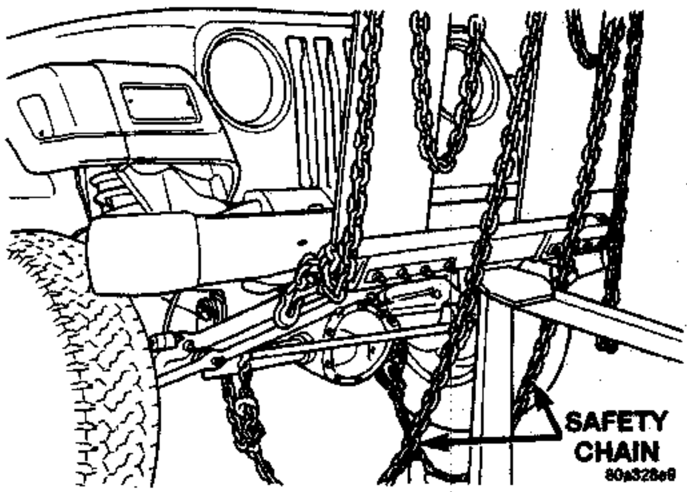


Fig. 4 Safety Chain Attachment

RECREATIONAL TOWING

Refer to the Owners Manual for towing procedures.

EMERGENCY TOW HOOKS

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

Some Jeep vehicles are equipped with front emergency tow hooks. The tow hooks should be used for **EMERGENCY** purposes only.

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

HOISTING RECOMMENDATIONS

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

FLOOR JACK

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

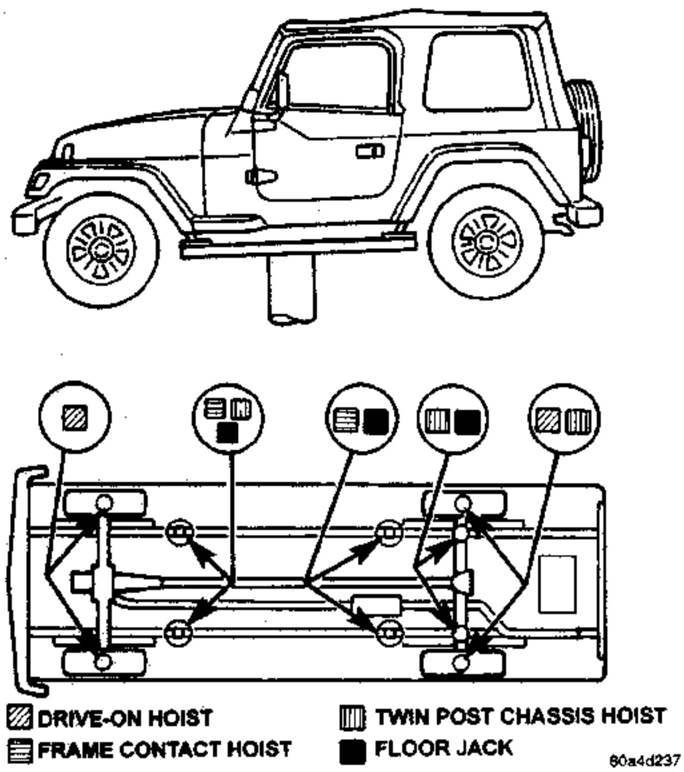


Fig. 5 Vehicle Lifting Locations

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

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

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

SERVICE PROCEDURES (Continued)

HOIST

A vehicle can be lifted with:

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

NOTE: When a frame-contact type hoist is used, verify that the lifting pads are positioned properly.

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

SUSPENSION

CONTENTS

ALIGNMENT

INDEX

GENERAL INFORMATION

WHEEL ALIGNMENT

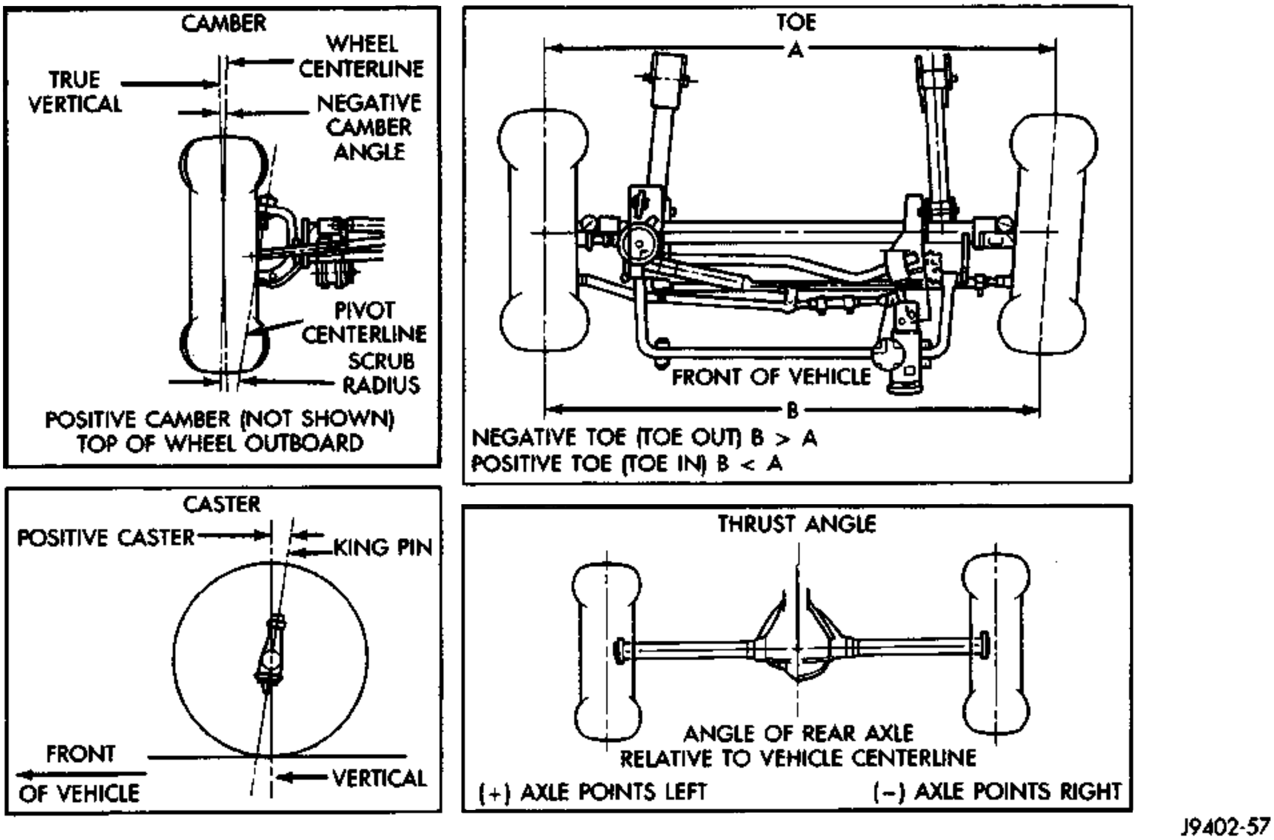
Wheel alignment involves the correct positioning of the wheels in relation to the vehicle. The positioning is accomplished through suspension and steering linkage adjustments. An alignment is considered essential for efficient steering, good directional stability and to maximize tire wear. The most important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

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

- **CASTER** is the forward or rearward tilt of the steering knuckle from vertical. Tilting the top of the knuckle rearward provides positive caster. Tilting the top of the knuckle forward provides negative caster. Caster is a directional stability angle. This angle enables the front wheels to return to a straight ahead position after turns.
- **CAMBER** is the inward or outward tilt of the wheel relative to the center of the vehicle. Tilting the top of the wheel inward provides negative camber. Tilting the top of the wheel outward provides positive camber. Incorrect camber will cause wear on the inside or outside edge of the tire. The angle is not adjustable, the damaged component(s) must be replaced to correct mis-alignment.
- **WHEEL TOE POSITION** is the difference between the leading inside edges and trailing inside edges of the front tires. Incorrect wheel toe position is the most common cause of unstable steering and uneven tire wear. The wheel toe position is the **final** front wheel alignment adjustment.
- **STEERING AXIS INCLINATION ANGLE** is measured in degrees and is the angle that the steering knuckles are tilted. The inclination angle has a fixed relationship with the camber angle. It will not change except when a spindle or ball stud is damaged or bent. The angle is not adjustable, the damaged component(s) must be replaced to correct misalignment.

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

SERVICE PROCEDURES (Continued)



Wheel Alignment Measurements

Suspension And Steering System Diagnosis

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

SERVICE PROCEDURES

PRE-ALIGNMENT INSPECTION

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

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

(2) Inspect front wheel bearings for wear or adjustment.

(3) Inspect front wheels for excessive radial, lateral runout and unbalance. Refer to Group 22, Wheels and Tires for diagnosis information.

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

(5) Inspect suspension components for wear and noise. Refer to Suspension And Steering System Diagnosis for additional information. Check components for correct torque.

SERVICE PROCEDURES (Continued)

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 three times. Always release the bumper in the down position.

CAMBER

The wheel camber angle is preset. This angle is not adjustable and cannot be altered.

CASTER

Check the caster of the front axle for correct angle. Be sure the axle is not bent or twisted. Road test the vehicle and 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, a low caster angle is probable.

Caster can be adjusted by loosening and rotating the cams on the lower suspension arm (Fig. 1). **Changing caster angle will also change the front propeller shaft angle. The propeller shaft angle has priority over caster. Refer to Group 3, Differential and Driveline for additional information.**

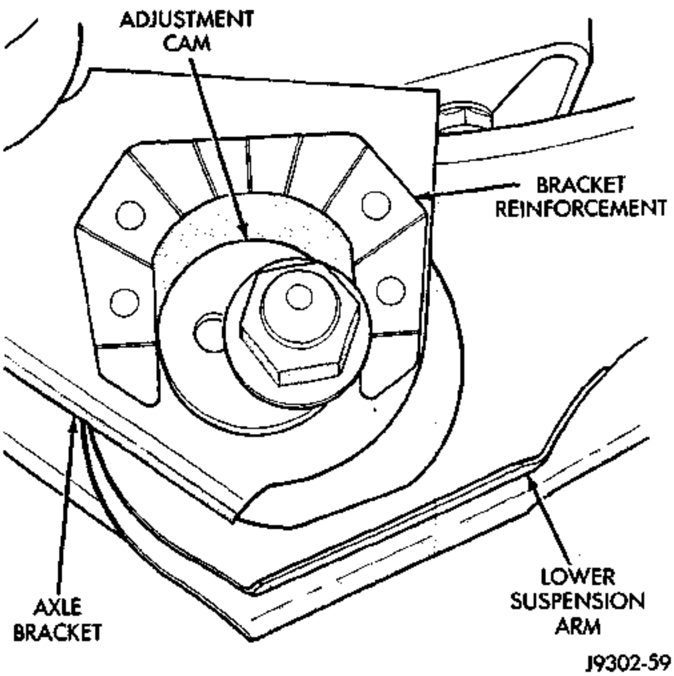


Fig. 1 Cam Adjuster

TOE POSITION

NOTE: The wheel toe position adjustment should be the final adjustment.

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

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

(3) Adjust the right wheel toe position with the drag link (Fig. 3). Turn the sleeve until the right wheel is at the correct positive TOE-IN position. Position the clamp bolts as shown (Fig. 2) and tighten to 49 N·m (36 ft. lbs.). **Make sure the toe setting does not change during clamp tightening.**

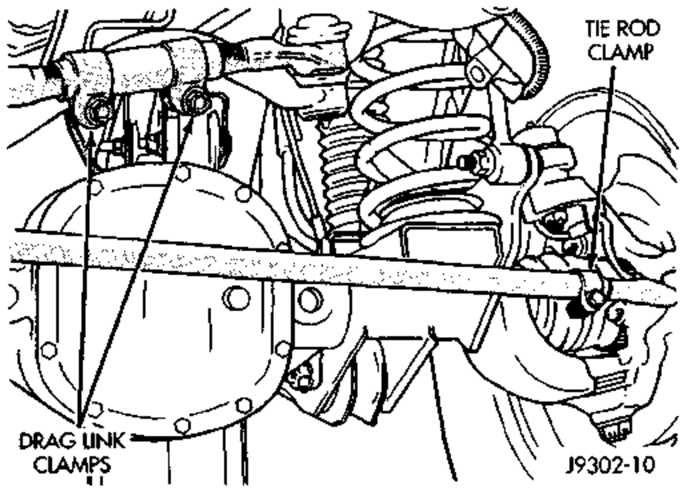


Fig. 2 Drag Link and Tie Rod Clamp

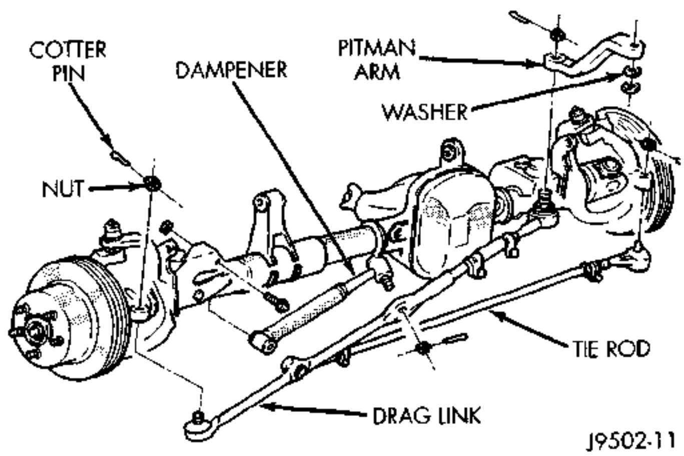


Fig. 3 Steering Linkage

(4) Adjust the left wheel toe position with the tie rod. Turn the sleeve until the left wheel is at the same TOE-IN position as the right wheel. Position the clamp bolts as shown (Fig. 2) and tighten to 27

SERVICE PROCEDURES (Continued)

N·m (20 ft. lbs.). **Make sure the toe setting does not change during clamp tightening.**

(5) Verify the right toe setting.

SPECIFICATIONS

ALIGNMENT SPECIFICATIONS

ADJUSTMENT	PREFERRED	RANGE
CASTER	7°	± 1.0°
CAMBER (fixed angle)	– 0.25°	± 0.63°
WHEEL TOE-IN (each wheel)	0.15°	± 0.15°
THRUST ANGLE	0	± 0.15°

FRONT SUSPENSION

INDEX

DESCRIPTION AND OPERATION

FRONT SUSPENSION

The front suspension is a link/coil design comprised of:

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

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

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

Coil Springs: The coil springs control ride quality and maintain proper ride height. The coil springs mount up in the wheelhouse. A rubber doughnut isolator is located between the top of the spring and the frame. The bottom of the spring seats on a axle pad and is retained with a clip.

Upper And Lower Suspension: The suspension arms use bushings to isolate road noise. The suspension arms are bolted to the frame and axle through the rubber bushings. The lower suspension arm uses cam bolts at the axle to allow for caster and pinion angle adjustment. The suspension arm travel is limited through the use of jounce bumpers in compression and shocks absorbers in rebound.

Stabilizer Bar: The stabilizer bar is used to control vehicle body roll during turns. The spring steel bar helps to control the vehicle body in relationship to the suspension. The bar extends across the top of the chassis frame rails. Stabilizer bar mounts are isolated by rubber bushings. Links are connected from the bar to the axle brackets.

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

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

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

DIAGNOSIS AND TESTING

SHOCK DIAGNOSIS

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

The shock absorbers are not refillable or adjustable. If a malfunction occurs, the shock absorber

DIAGNOSIS AND TESTING (Continued)

must be replaced. To test a shock absorber, hold it in an upright position and force the piston in and out of the cylinder four or five times. The action throughout each stroke should be smooth and even.

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

REMOVAL AND INSTALLATION

SHOCK ABSORBER

REMOVAL

(1) Remove the nut, retainer and grommet from the upper stud through engine compartment access hole (Fig. 1).

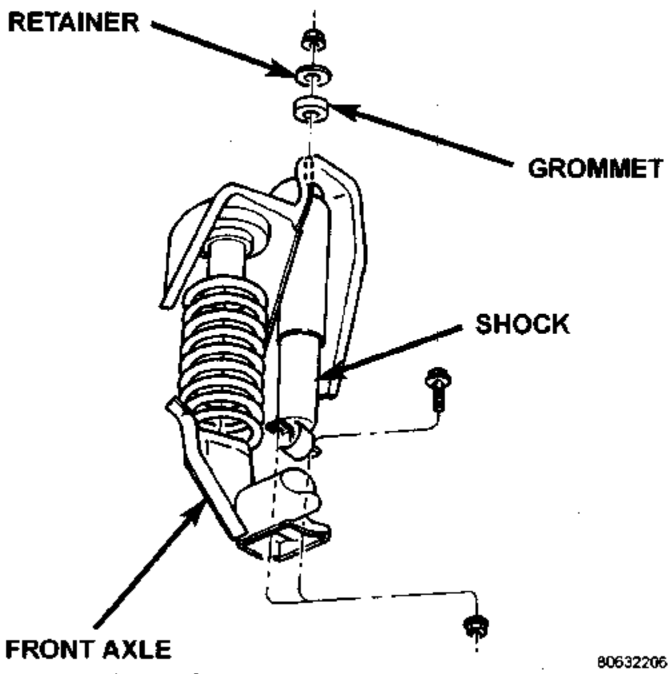


Fig. 1 Coil Spring & Shock Absorber

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

INSTALLATION

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

(2) Install the lower bolts and nuts. Tighten nuts to 28 N·m (250 in. lbs.).

(3) Install the upper grommet and retainer on the stud and install the nut and tighten to 23 N·m (17 ft. lbs.).

COIL SPRING

REMOVAL

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

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

(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.

(5) Disconnect the stabilizer bar links and shock absorbers 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 retainer bolt and remove the spring.

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

INSTALLATION

(1) Position the coil spring on the axle pad. Install the spring retainer and bolt and tighten to 22 N·m (16 ft. lbs.).

(2) Install the jounce bumper.

(3) Raise the axle into position until the spring seats in the upper mount, then raise another 51 mm (2 in.).

(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) Install drag link to pit man arm.

(8) Remove the supports and lower the vehicle.

(9) Tighten all suspension components to proper torque.

STEERING KNUCKLE

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

LOWER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.

(2) If equipped with ABS brakes remove sensor wire from the inboard side of the arm.

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

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

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

INSTALLATION

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

REMOVAL AND INSTALLATION (Continued)

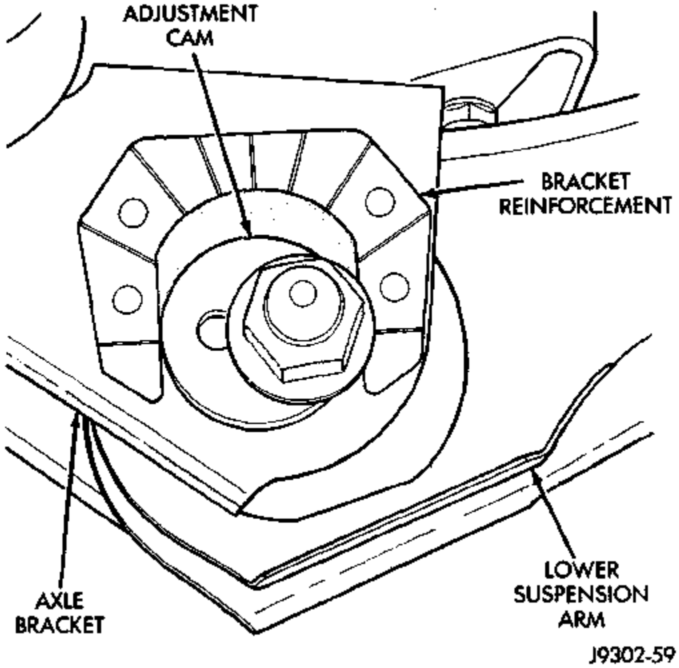


Fig. 2 Cam Adjuster

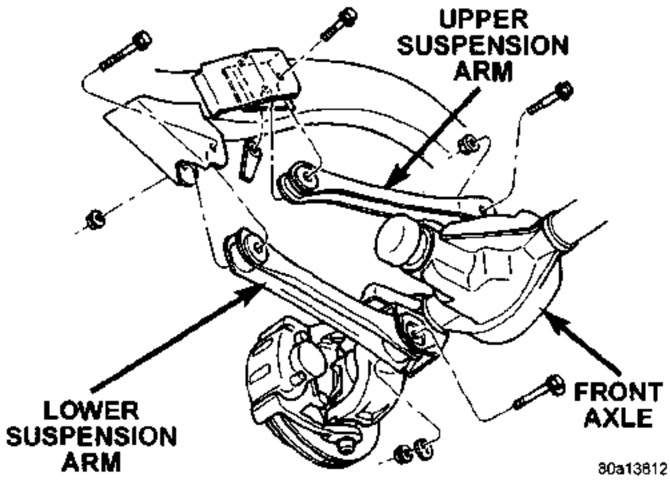


Fig. 3 Upper & Lower Suspension Arms

NOTE: Small holes in the side of the arm face inboard.

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

(3) Install new cam bolt and new nut finger tighten in the axle and align the reference marks.

(4) If equipped with ABS brakes install sensor wire to the inboard side of the arm with new clips.

(5) Lower the vehicle.

(6) Tighten axle bracket nut to 115 N·m (85 ft. lbs.).

(7) Tighten frame bracket nut to 176 N·m (130 ft. lbs.).

(8) Align 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 at the frame rail and remove the upper suspension arm.

INSTALLATION

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

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

(3) Remove the supports and lower the vehicle.

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

AXLE BUSHING

REMOVAL

(1) Remove the upper suspension arm from axle

(2) Position Receiver 7932-1 (J-35581-1) over the bushing in the axle and install Bushing Removal/Installer (Fig. 4).

(3) Remove the bushing by tightening the Long Nut.

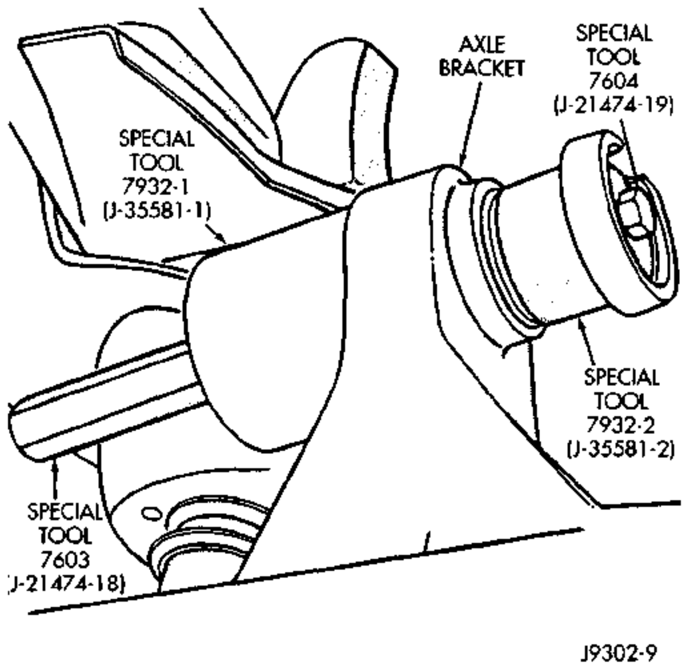


Fig. 4 Bushing Removal

NOTE: For two-wheel drive axles and right side on Model 30 axle, do not remove Receiver 7932-1 (J-35581-1) at this time.

INSTALLATION

(1) Position new bushing, Receiver and Installer on axle (Fig. 5).

REMOVAL AND INSTALLATION (Continued)

(2) Install the bushing by tightening the Long Nut.

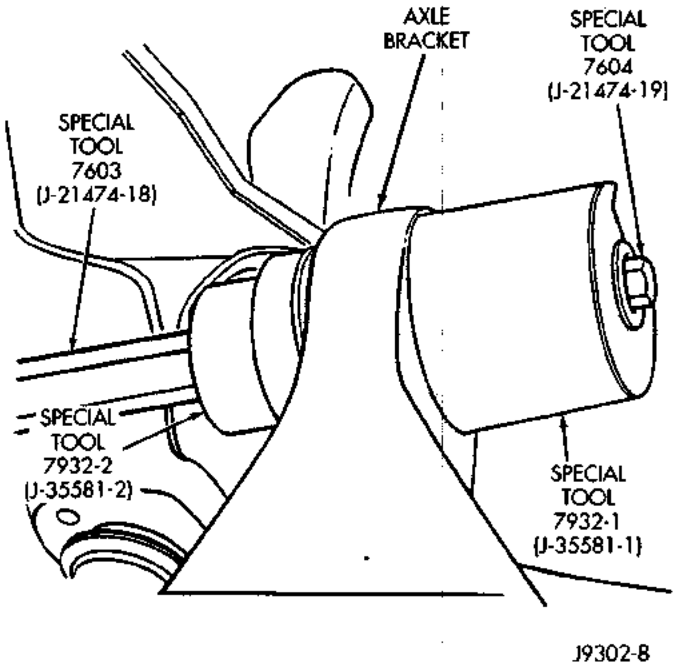


Fig. 5 Bushing Installation

(3) Remove tools and install the upper suspension arm.

STABILIZER BAR

REMOVAL

(1) Remove upper link nuts (Fig. 6) and separate the links from the stabilizer bar with Remove MB-990635.

(2) Remove front bumper valence, refer to Group 23 Body for procedure.

(3) Remove stabilizer retainer bolts (Fig. 6) and remove retainers.

(4) Remove stabilizer bar.

(5) Remove lower link nuts and bolts and remove links (Fig. 6).

INSTALLATION

(1) Center stabilizer bar on top of the frame rails and install retainers and bolts. Tighten bolts to 54 N·m (40 ft. lbs.).

(2) Position links on axle brackets and into the stabilizer bar. Install lower link bolts and nuts and tighten to 95 N·m (70 ft. lbs.).

(3) Install upper link nuts and tighten to 61 N·m (45 ft. lbs.).

(4) Install bumper valence.

TRACK BAR

CAUTION: Use a universal puller tool to separate the track bar ball stud from the frame rail bracket. This will prevent damage to the ball stud seal.

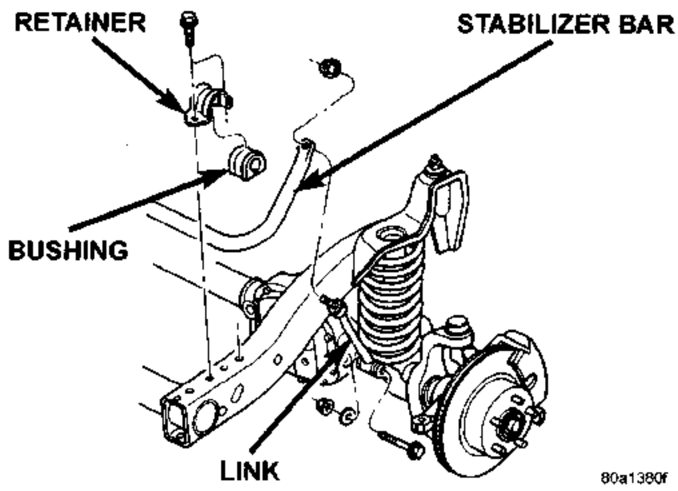


Fig. 6 Stabilizer Bar

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. 7).

(3) Use a universal puller tool to separate the track bar ball stud from the frame rail bracket.

(4) Remove the bolt and flag nut from the axle bracket (Fig. 7). Remove the track bar.

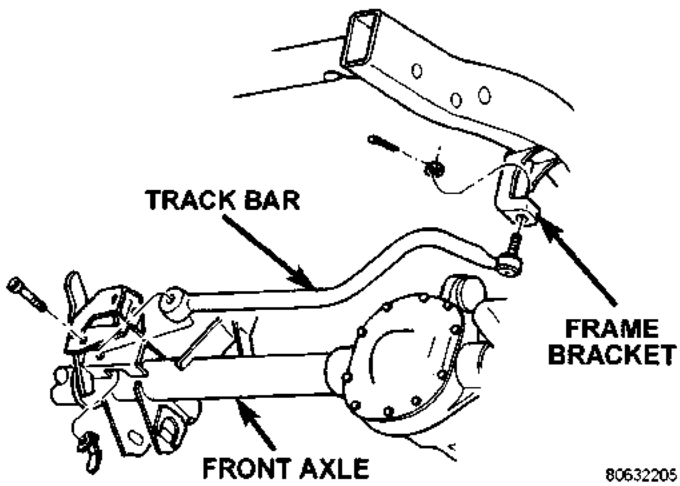


Fig. 7 Track Bar

INSTALLATION

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

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

(3) Tighten the ball stud nut to 88 N·m (65 ft. lbs.) and install a new cotter pin.

(4) Remove the supports and lower the vehicle.

(5) Tighten the bolt at the axle bracket to 75 N·m (55 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

(6) Check alignment if a new track bar was installed.

HUB BEARING

The Hub Bearing is serviced as an assembly.

REMOVAL

(1) Raise and support the vehicle.
(2) Remove the wheel and tire assembly.
(3) Remove the brake components from the axle, refer to Group 5 Brakes.
(4) Remove the cotter pin, nut retainer and axle hub nut (Fig. 8).
(5) Remove the hub mounting bolts and remove hub bearing from the steering knuckle and axle shaft.

INSTALLATION

(1) Install the hub bearing and brake dust shield to the knuckle.
(2) Install the hub to knuckle bolts and tighten to 102 N·m (75 ft. lbs.).
(3) Install the hub washer and nut. Tighten the hub nut to 237 N·m (175 ft. lbs.). Install the nut retainer and a new cotter pin.
(4) Install the brake components, refer to Group 5 Brakes.
(5) Install the wheel and tire assembly.
(6) Remove support and lower the vehicle.

WHEEL MOUNTING STUDS

REMOVAL

(1) Raise and support vehicle.
(2) Remove wheel and tire assembly.
(3) Remove brake caliper and rotor, refer to Group 5 Brakes for procedure.
(4) Remove stud from hub with Remover C-4150A (Fig. 9).

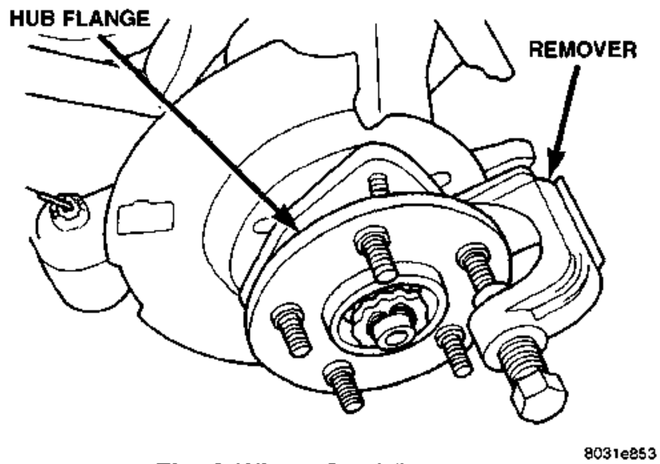


Fig. 9 Wheel Stud Removal

INSTALLATION

(1) Install new stud into hub flange.
(2) Install three washer onto stud, then install lug nut with the flat side of the nut against the washers.
(3) Tighten lug nut until the stud is pulled into the hub flange. Verify that the stud is properly seated into the flange.

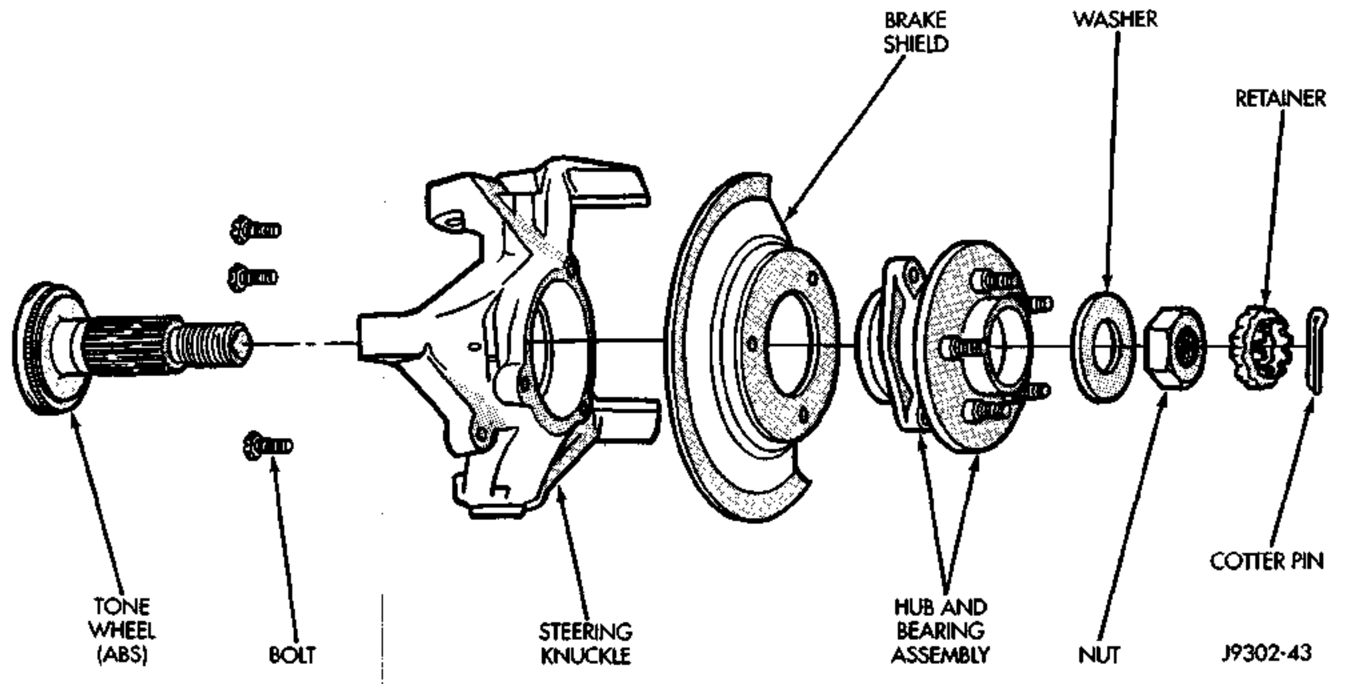


Fig. 8 Hub Bearing & Knuckle

REMOVAL AND INSTALLATION (Continued)

(4) Remove lug nut and washers.

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

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

(7) Remove support and lower vehicle.

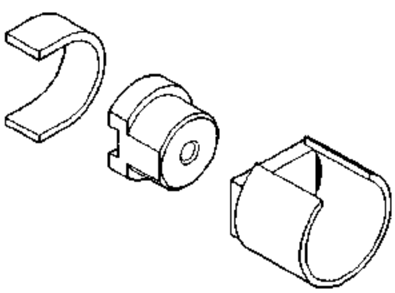
SPECIFICATIONS

TORQUE CHART

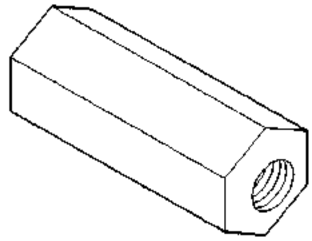
DESCRIPTION	TORQUE
Shock Absorber	
Upper Nut	23 N·m (17 ft. lbs.)
Lower Nut	28 N·m (250 in. lbs.)
Suspension Arm Lower	
Axle Bracket Nut	115 N·m (85 ft. lbs.)
Frame Bracket Nut	176 N·m (130 ft. lbs.)
Suspension Arm Upper	
Axle Bracket Nut	75 N·m (55 ft. lbs.)
Frame Bracket Bolt	75 N·m (55 ft. lbs.)
Stabilizer Bar	
Retainer Bolts	54 N·m (40 ft. lbs.)
Link Upper Nut	61 N·m (45 ft. lbs.)
Link Lower Bolt	95 N·m (70 ft. lbs.)
Track Bar	
Ball Stud Nut	88 N·m (65 ft. lbs.)
Axle Bracket Bolt	75 N·m (55 ft. lbs.)

SPECIAL TOOLS

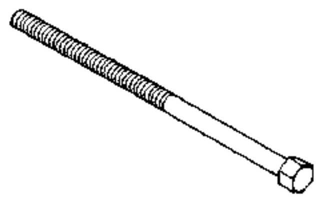
FRONT SUSPENSION



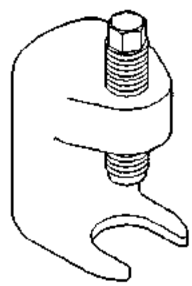
Remover/Installer Suspension Bushing 7932 (J-35581)



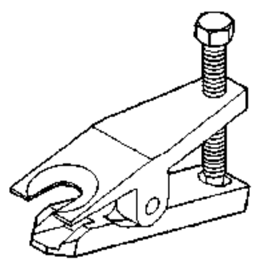
Nut, Long 7603 (J-21474–18)



Bolt, Special 7604 (J-21474–19)



Remover C-4150A



Remover Tie Rod End MB-990635

REAR SUSPENSION

INDEX

DESCRIPTION AND OPERATION

REAR SUSPENSION

The rear suspension is link/coil design comprised of:

- Dual-action shock absorbers
- Coil springs
- Upper and lower suspension arms
- Stabilizer bar
- Track bar

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

Coil Springs: The coil springs control ride quality and maintain proper ride height. The springs mount between the bottom of the frame rail and the rear axle.

Upper And Lower Suspension: The 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 has provision for the use of cam bolts at the axle to allow for pinion angle or thrust angle adjustment. The cams are available as a service kit and are not installed at the factory. The suspension arm travel is limited through the of use jounce bumpers in compression and shock absorbers in rebound.

Stabilizer Bar: The stabilizer bar is used to control vehicle body roll 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 mounts to the rear axle. Links are connected from the bar to frame brackets. The bar is isolated by rubber bushings.

Track Bar: The track bar is used to control rear axle lateral movement. The track bar is attached to a frame rail bracket and an axle bracket. It is isolated with bushings at both ends.

CAUTION: Suspension components that use rubber bushings should be tightened with the vehicle at normal ride height. This will prevent premature failure of the bushing and maintain ride comfort. Rubber bushings must never be lubricated.

DIAGNOSIS AND TESTING

SHOCK DIAGNOSIS

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

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

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

REMOVAL AND INSTALLATION

SHOCK ABSORBER

REMOVAL

(1) Raise and support the vehicle and the axle.

(2) Remove the upper mounting bolts (Fig. 1).

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

REMOVAL AND INSTALLATION (Continued)

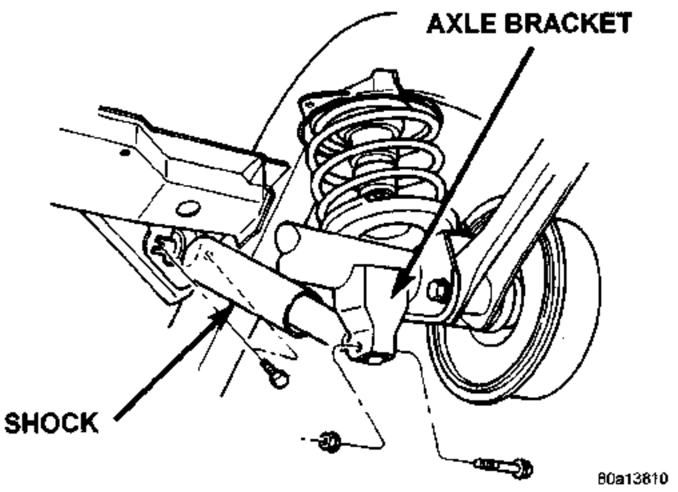


Fig. 1 Shock Absorber

INSTALLATION

(1) Install the shock absorber on the upper frame rail and install mounting bolts.
(2) Tighten the upper bolts to 31 N·m (23 ft. lbs.).
(3) Install lower bolt and nut finger tight.
(4) Remove the supports and lower the vehicle.
(5) Tighten the lower nut to 100 N·m (74 ft. lbs.).

COIL SPRING

REMOVAL

(1) Raise and support the vehicle. Position a hydraulic jack under the axle to support it.
(2) Disconnect the stabilizer bar links and shock absorbers from the axle brackets.
(3) Disconnect the track bar from the frame rail bracket.
(4) Lower the axle until the spring is free from the upper mount seat and remove the spring.

INSTALLATION

(1) Position the coil spring on the axle pad.
(2) Raise the axle into position until the spring seats in the upper mount.
(3) Connect the stabilizer bar links and shock absorbers to the axle bracket. Connect the track bar to the frame rail bracket.
(4) Remove the supports and lower the vehicle.
(5) Tighten the stabilizer bar links, shock absorbers and track bar to specified 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. 2).
(3) Remove the nut and bolt at the frame rail mount (Fig. 3) and remove the lower suspension arm.

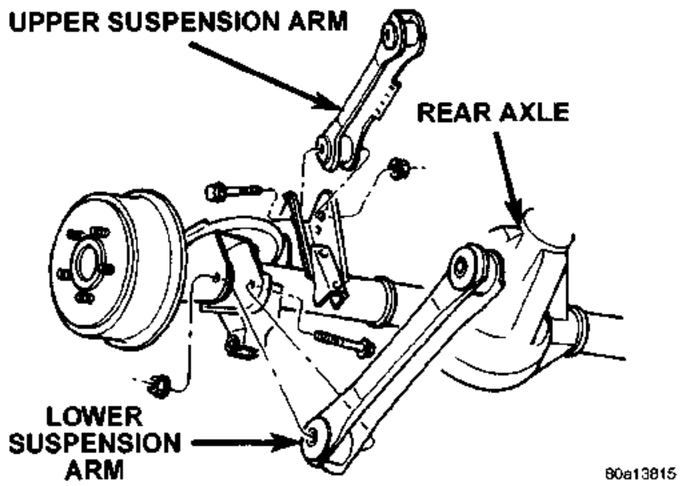


Fig. 2 Upper & Lower Suspension Arms

INSTALLATION

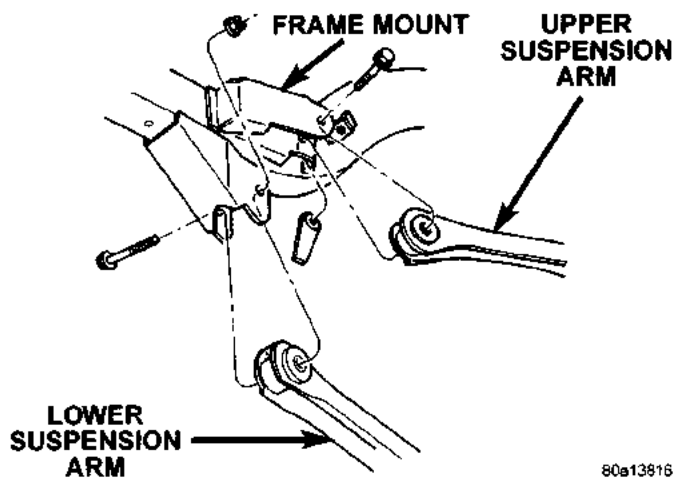


Fig. 3 Upper & Lower Suspension Arms

(1) Position the lower suspension arm in the axle bracket and frame rail mount.
(2) Install the mounting bolts and finger tighten the nuts.
(3) Remove the supports and lower the vehicle.
(4) Tighten the lower suspension arm nuts to 177 N·m (130 ft. lbs.).

UPPER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.
(2) Remove the parking brake cable/bracket and ABS wiring bracket from the arm if equipped (Fig. 4).
(3) Remove the upper suspension arm nut and bolt from the axle bracket (Fig. 2).
(4) Remove the nut and bolt from the frame rail bracket (Fig. 3) and remove the upper suspension arm.

REMOVAL AND INSTALLATION (Continued)

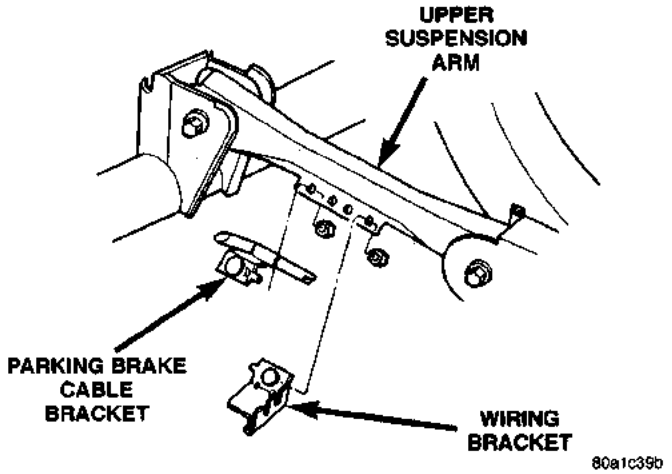


Fig. 4 Parking Brake Cable/Bracket And Wiring Bracket

INSTALLATION

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

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

(3) Install the parking brake cable/bracket and ABS wiring bracket on the arm if equipped.

(4) Remove the supports and lower the vehicle.

(5) Tighten the upper suspension arm frame rail bracket bolt to 75 N·m (55 ft. lbs.).

(6) Tighten the upper suspension arm axle bracket nut to 75 N·m (55 ft. lbs.).

STABILIZER BAR

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the stabilizer bar link bolts from the frame mounts (Fig. 5).

(3) Remove the link bolts from the stabilizer bar.

(4) Remove the stabilizer bar retainer bolts and retainers from the axle mounts (Fig. 6) and remove the bar.

INSTALLATION

(1) Install the stabilizer bar on the axle mounts and install the retainers and bolts.

NOTE: Ensure the bar is centered with equal spacing on both sides and is positioned above the differential housing (Fig. 6).

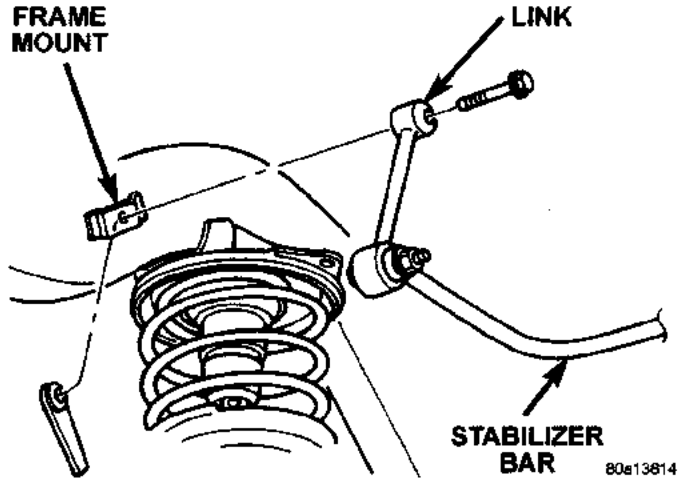


Fig. 5 Stabilizer Bar Link

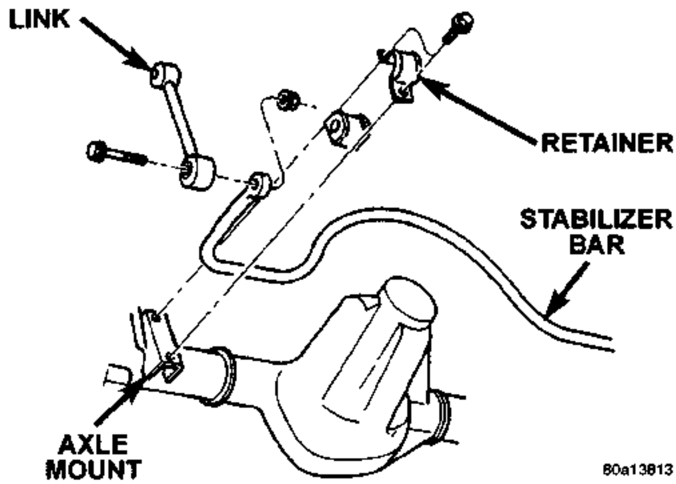


Fig. 6 Stabilizer Bar

(2) Tighten the retainer bolts to 54 N·m (40 ft. lbs.).

(3) Install the links onto the stabilizer bar and frame mounts. Install the bolts and nuts finger tight.

(4) Remove support and lower vehicle.

(5) Tighten the link nuts/bolts to 54 N·m (40 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

TRACK BAR

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the bolt and nut from the frame rail bracket (Fig. 7).

(3) Remove the bolt from the axle bracket (Fig. 7) and remove the track bar.

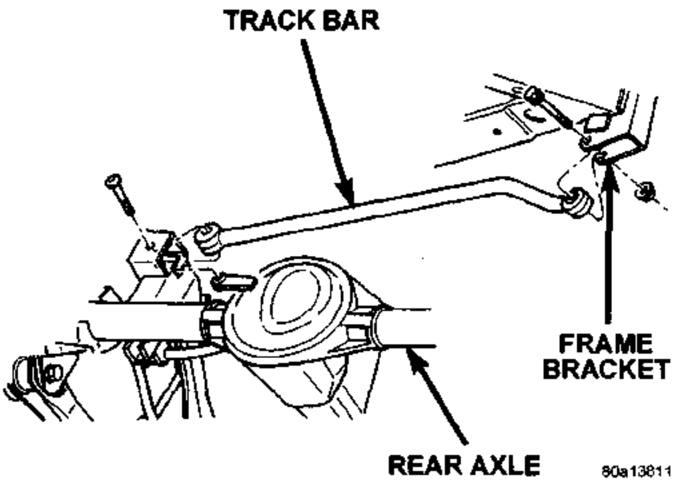


Fig. 7 Rear Track Bar

INSTALLATION

(1) Install the track bar in the axle bracket and install the bolt loosely.

(2) Install the track bar in the frame rail bracket and loosely install the bolt and nut.

NOTE: It may be necessary to pry the axle assembly over to install the track bar.

(3) Remove supports and lower the vehicle.

(4) Tighten the track bar nut/bolt at both ends to 100 N·m (74 ft. lbs.).

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Shock Absorber	
Upper Bolts	31 N·m (23 ft. lbs.)
Lower Nut	100 N·m (74 ft. lbs.)
Suspension Arm Lower	
Axle Bracket Nut	177 N·m (130 ft. lbs.)
Frame Bracket Nut	177 N·m (130 ft. lbs.)
Suspension Arm Upper	
Axle Bracket Nut	75 N·m (55 ft. lbs.)
Frame Bracket Bolt	75 N·m (55 ft. lbs.)
Stabilizer Bar	
Retainer Bolts	54 N·m (40 ft. lbs.)
Link Nut/Bolt	54 N·m (40 ft. lbs.)
Track Bar	
Frame Bracket Nut	100 N·m (74 ft. lbs.)
Axle Bracket Bolt	100 N·m (74 ft. lbs.)

BRAKES

CONTENTS

BASE BRAKE SYSTEM

INDEX

GENERAL INFORMATION

BRAKE SYSTEM

Power assist front disc and rear drum brakes are standard equipment. Disc brake components consist of single piston calipers and ventilated rotors. Rear drum brakes are dual shoe units with cast brake drums.

The parking brake mechanism is lever and cable operated. The cables are attached to levers on the rear drum brake secondary shoes. The parking brakes are operated hand lever.

A dual diaphragm vacuum power brake booster is used for all applications. All models have a two-piece master cylinder with plastic reservoir.

All models are equipped with a combination valve. The valve contains a pressure differential valve and switch and a fixed rate rear proportioning valve.

Factory brake lining on all models consists of an organic base material combined with metallic particles. The lining does not contain asbestos.

SERVICE WARNINGS & CAUTIONS

WARNING: FACTORY INSTALLED BRAKE LININGS DO NOT CONTAIN ASBESTOS FIBERS. DUST AND DIRT ACCUMULATING ON BRAKE PARTS DURING NORMAL USE MAY CONTAIN ASBESTOS FIBERS FROM AFTER MARKET BRAKE LININGS. BREATHING EXCESSIVE CONCENTRATIONS OF ASBESTOS FIBERS CAN CAUSE SERIOUS BODILY HARM. EXERCISE CARE WHEN SERVICING BRAKE PARTS. DO NOT CLEAN BRAKE PARTS WITH COMPRESSED AIR OR BY DRY BRUSHING. USE A VACUUM CLEANER SPECIFICALLY DESIGNED FOR THE REMOVAL OF ASBESTOS FIBERS FROM BRAKE COMPONENTS. IF A SUITABLE VACUUM CLEANER IS NOT AVAILABLE, CLEANING SHOULD BE DONE WITH A WATER DAMPENED CLOTH. DO NOT SAND, OR GRIND BRAKE LINING UNLESS EQUIPMENT USED IS DESIGNED TO CONTAIN THE DUST RESIDUE. DISPOSE OF ALL RESIDUE CONTAINING ASBESTOS FIBERS IN SEALED BAGS OR CONTAINERS TO MINIMIZE EXPOSURE TO YOURSELF AND OTHERS. FOLLOW PRACTICES PRESCRIBED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION AND THE ENVIRONMENTAL PROTECTION AGENCY FOR THE HANDLING, PROCESSING, AND DISPOSITION OF DUST OR DEBRIS THAT MAY CONTAIN ASBESTOS FIBERS.

CAUTION: Never use gasoline, kerosene, alcohol, motor oil, transmission fluid, or any fluid containing mineral oil to clean the system components. These fluids damage rubber cups and seals. Use only fresh brake fluid or Mopar brake cleaner to clean or flush brake system components. These are the only cleaning materials recommended. If system contamination is suspected, check the fluid for dirt, discoloration, or separation into distinct layers. Drain and flush the system with new brake fluid if contamination is suspected.

CAUTION: Use Mopar brake fluid, or an equivalent quality fluid meeting SAE/DOT standards J1703 and DOT 3. Brake fluid must be clean and free of contaminants. Use fresh fluid from sealed containers only to ensure proper antilock component operation.

CAUTION: Use Mopar multi-mileage or high temperature grease to lubricate caliper slide surfaces, drum brake pivot pins, and shoe contact points on the backing plates. Use multi-mileage grease or GE 661 or Dow 111 silicone grease on caliper bushings and slide pins to ensure proper operation.

DESCRIPTION AND OPERATION

BRAKE PEDAL

A suspended-type brake pedal is used, the pedal pivots on a shaft mounted in the pedal support bracket. The bracket is attached to the dash panel.

The brake pedal is a serviceable component. The pedal, pedal bushings and shaft are all replaceable parts. The pedal bracket can also be replaced when necessary.

STOP LAMP SWITCH

The plunger type stop lamp switch is mounted on a bracket attached to the brake pedal support. The switch can be adjusted when necessary.

RED BRAKE WARNING LAMP

A red warning lamp is used for the service brake portion of the hydraulic system. The lamp is located in the instrument cluster.

The red warning light alerts the driver if a pressure differential exists between the front and rear hydraulic systems. The light also alerts the driver when the parking brakes are applied.

POWER BRAKE BOOSTER

The booster assembly consists of a housing divided into separate chambers by two internal diaphragms. The outer edge of each diaphragm is attached to the booster housing. The diaphragms are connected to the booster primary push rod.

Two push rods are used in the booster. The primary push rod connects the booster to the brake

DESCRIPTION AND OPERATION (Continued)

pedal. The secondary push rod connects the booster to the master cylinder to stroke the cylinder pistons.

The atmospheric inlet valve is opened and closed by the primary push rod. Booster vacuum supply is through a hose attached to an intake manifold fitting at one end and to the booster check valve at the other. The vacuum check valve in the booster housing is a one-way device that prevents vacuum leak back.

Power assist is generated by utilizing the pressure differential between normal atmospheric pressure and a vacuum. The vacuum needed for booster operation is taken directly from the engine intake manifold. The entry point for atmospheric pressure is through a filter and inlet valve at the rear of the housing (Fig. 1).

The chamber areas forward of the booster diaphragms are exposed to vacuum from the intake manifold. The chamber areas to the rear of the diaphragms, are exposed to normal atmospheric pressure of 101.3 kilopascals (14.7 pounds/square in.).

Brake pedal application causes the primary push rod to open the atmospheric inlet valve. This exposes the area behind the diaphragms to atmospheric pressure. The resulting pressure differential provides the extra apply pressure for power assist.

MASTER CYLINDER

The master cylinder has a removable nylon reservoir (Fig. 2). The cylinder body is made of aluminum and contains a primary and secondary piston assembly. The cylinder body including the piston assemblies are not serviceable. If diagnosis indicates an internal problem with the cylinder body, it must be replaced as an assembly. The reservoir and grommets are the only replaceable parts on the master cylinder.

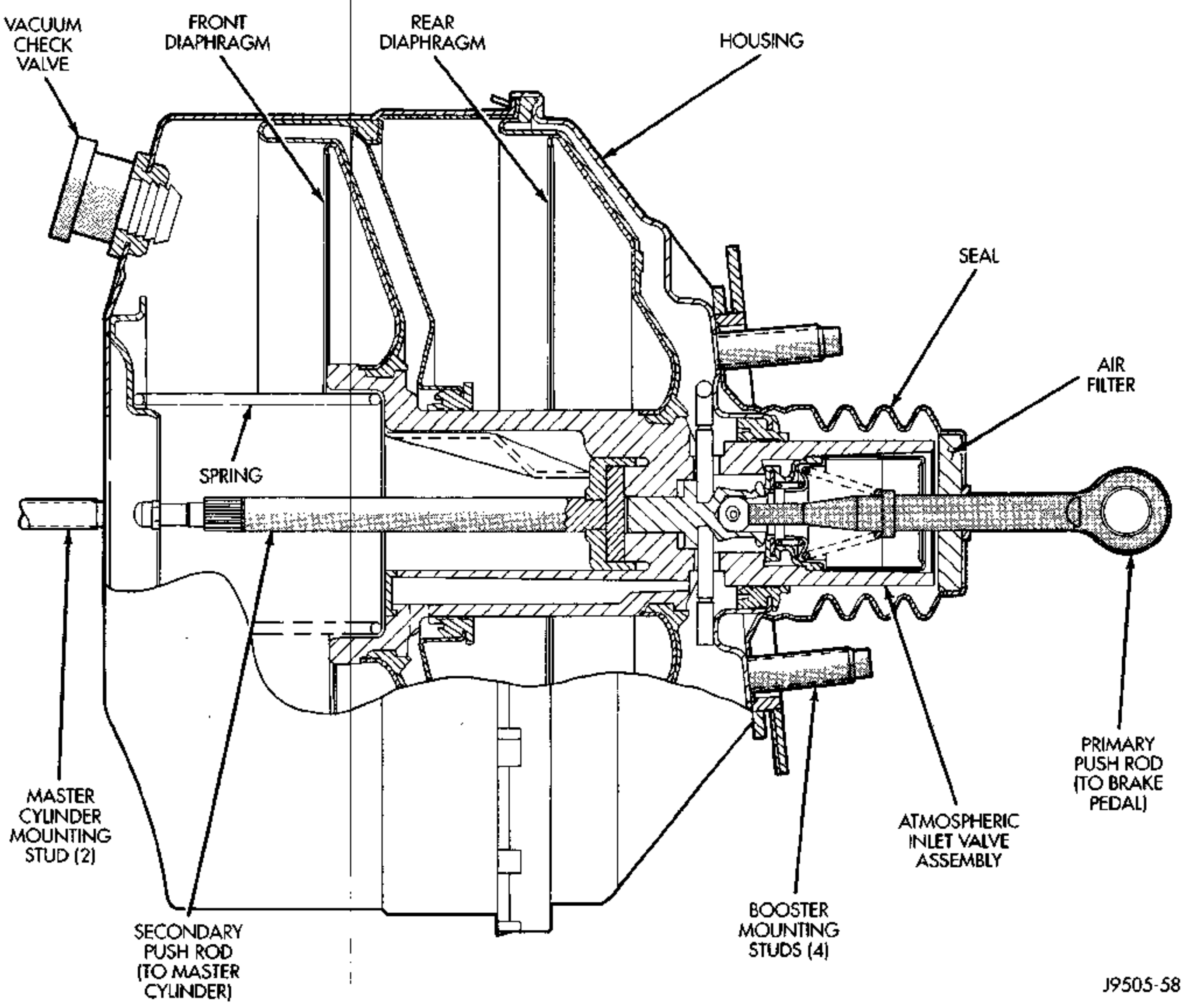


Fig. 1 Power Brake Booster–Typical

DESCRIPTION AND OPERATION (Continued)

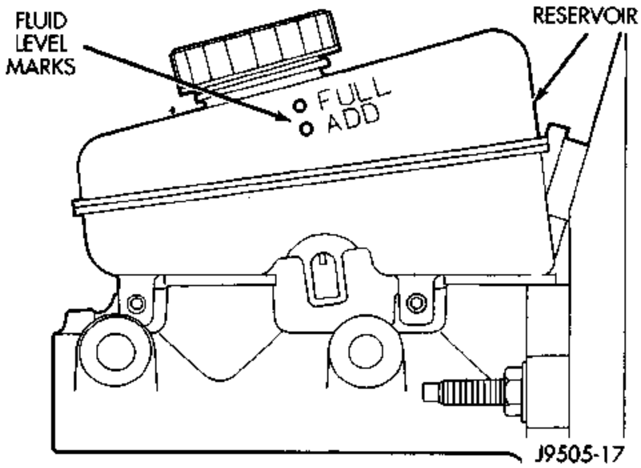


Fig. 2 Master Cylinder–Typical

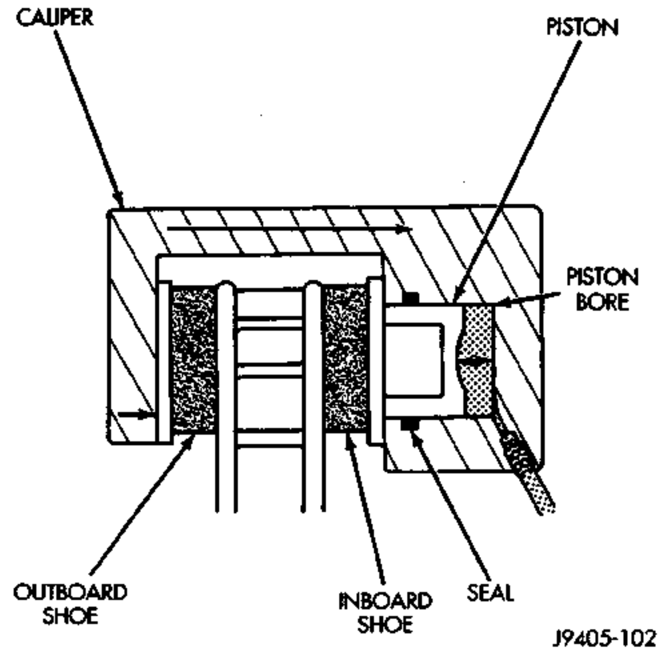


Fig. 3 Brake Caliper Operation

COMBINATION VALVE

The combination valve contains a pressure differential valve and switch and a rear brake proportioning valve. The valve is not repairable. It must be replaced if diagnosis indicates this is necessary.

The pressure differential switch is connected to the brake warning light. The switch is actuated by movement of the switch valve. The switch monitors fluid pressure in the separate front/rear brake hydraulic circuits.

A decrease or loss of fluid pressure in either hydraulic circuit will cause the switch valve to shuttle to the low pressure side. Movement of the valve pushes the switch plunger upward. This action closes the switch internal contacts completing the electrical circuit to the red warning light. The switch valve will remain in an actuated position until repairs are made.

The rear proportioning valve is used to balance front-rear brake action. The valve allows normal fluid flow during moderate effort brake stops. The valve only controls (meters) fluid flow during high effort brake stops.

FRONT DISC BRAKES

The calipers are a single piston type. The calipers are free to slide laterally, this allows continuous compensation for lining wear.

When the brakes are applied fluid pressure is exerted against the caliper piston. The fluid pressure is exerted equally and in all directions. This means pressure exerted against the caliper piston and within the caliper bore will be equal (Fig. 3).

Fluid pressure applied to the piston is transmitted directly to the inboard brake shoe. This forces the shoe lining against the inner surface of the disc brake rotor. At the same time, fluid pressure within the piston bore forces the caliper to slide inward on the mounting bolts. This action brings the outboard brake shoe lining into contact with the outer surface of the disc brake rotor.

In summary, fluid pressure acting simultaneously on both piston and caliper, produces a strong clamping action. When sufficient force is applied, friction will stop the rotors from turning and bring the vehicle to a stop.

Application and release of the brake pedal generates only a very slight movement of the caliper and piston. Upon release of the pedal, the caliper and piston return to a rest position. The brake shoes do not retract an appreciable distance from the rotor. In fact, clearance is usually at, or close to zero. The reasons for this are to keep road debris from getting between the rotor and lining and in wiping the rotor surface clear each revolution.

The caliper piston seal controls the amount of piston extension needed to compensate for normal lining wear.

During brake application, the seal is deflected outward by fluid pressure and piston movement (Fig. 4). When the brakes (and fluid pressure) are released, the seal relaxes and retracts the piston.

The amount of piston retraction is determined by brake lining wear. Generally the amount is just enough to maintain contact between the piston and inboard brake shoe.

REAR DRUM BRAKE

The brake systems use a leading shoe (primary) and trailing shoe (secondary). The mounting hardware is similar but not interchangeable (Fig. 5).

DESCRIPTION AND OPERATION (Continued)

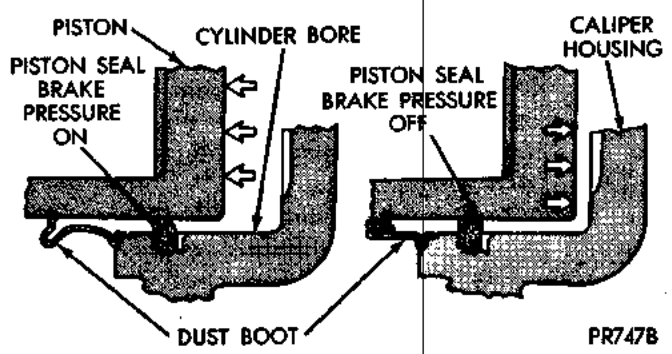


Fig. 4 Lining Wear Compensation By Piston Seal

When the brake pedal is depressed hydraulic pressure pushes the rear brake wheel cylinder pistons outward. The wheel cylinder push rods then push the brake shoes outward against the brake drum. When the brake pedal is released return springs attached to the brake shoes pull the shoes back to there original position.

PARKING BRAKE

Parking brake adjustment is controlled by a cable tensioner mechanism. The cable tensioner, once adjusted at the factory, should not need further adjustment under normal circumstances. Adjustment may be required if a new tensioner, or cables are installed, or disconnected.

PARKING BRAKE OPERATION

A hand operated lever in the passenger compartment is the main application device. The front cable is connected between the hand lever and the tensioner. The tensioner rod is attached to the equalizer which is the connecting point for the rear cables (Fig. 6).

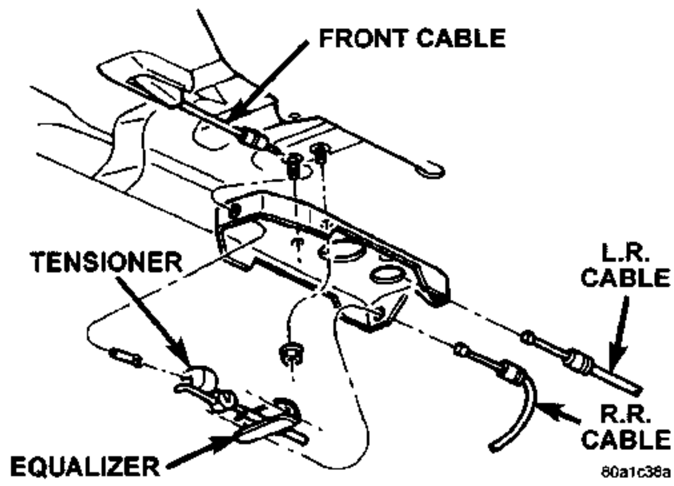


Fig. 6 Parking Brake Components

The rear cables are connected to the actuating lever on each secondary brake shoe. The levers are attached to the brake shoes by a pin either pressed into, or welded to the lever. A clip is used to secure the pin in the brake shoe. The pin allows each lever to pivot independently of the brake shoe.

To apply the parking brakes, the hand lever is pulled upward. This pulls the rear brake shoe actuating levers forward, by means tensioner and cables. As the actuating lever is pulled forward, the parking brake strut (which is connected to both shoes), exerts a linear force against the primary brake shoe. This action presses the primary shoe into contact with the

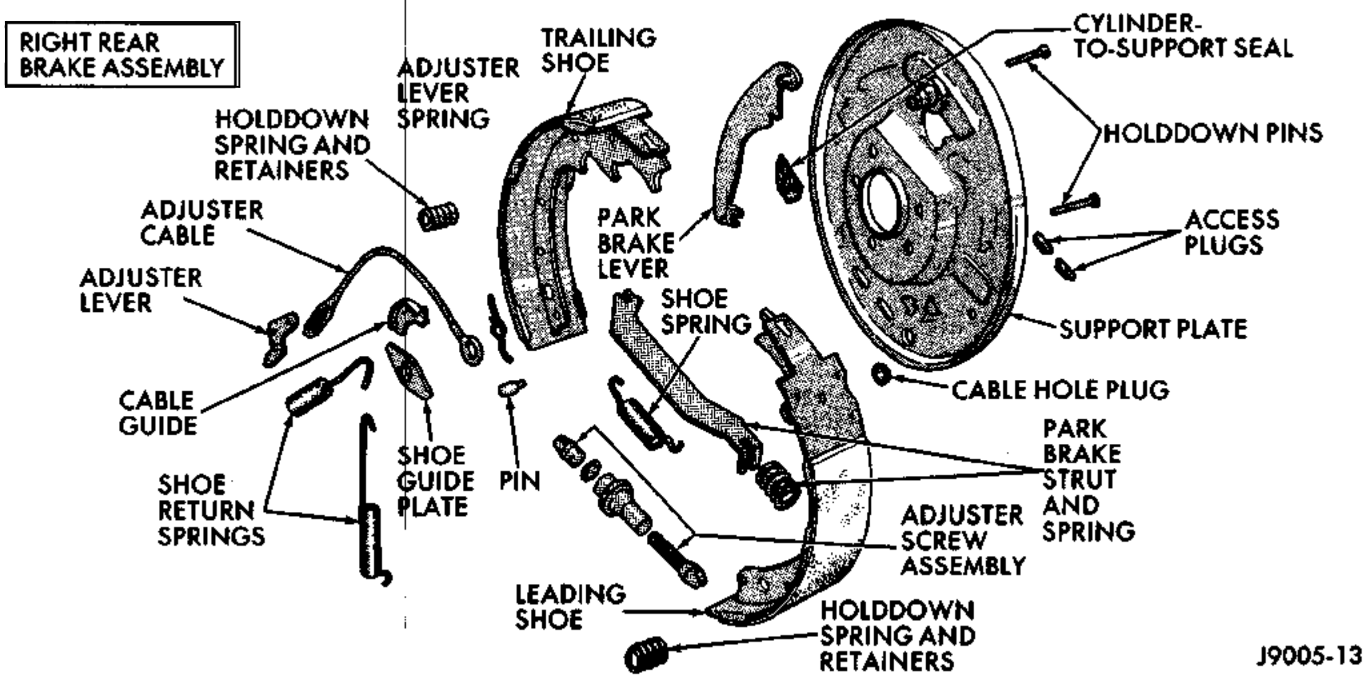


Fig. 5 Brake Components

DESCRIPTION AND OPERATION (Continued)

drum. Once the primary shoe contacts the drum, force is exerted through the strut. This force is transferred through the strut to the secondary brake shoe causing it to pivot into the drum as well.

A gear type ratcheting mechanism is used to hold the lever in an applied position. Parking brake release is accomplished by the hand lever release button.

A parking brake switch is mounted on the parking brake lever and is actuated by movement of the lever. The switch, which is in circuit with the red warning light in the dash, will illuminate the warning light whenever the parking brakes are applied.

BRAKE HOSES AND LINES

Flexible rubber hose is used at both front brakes and at the rear axle junction block. Double walled steel tubing is used to connect the master cylinder to the major hydraulic braking components and then to the flexible rubber hoses.

DIAGNOSIS AND TESTING

BASE BRAKE SYSTEM

Base brake components consist of the brake shoes, calipers, wheel cylinders, brake drums, rotors, brake lines, master cylinder, booster, and parking brake components.

Brake diagnosis involves determining if the problem is related to a mechanical, hydraulic, or vacuum operated component.

The first diagnosis step is the preliminary check.

PRELIMINARY BRAKE CHECK

(1) Check condition of tires and wheels. Damaged wheels and worn, damaged, or underinflated tires can cause pull, shudder, vibration, and a condition similar to grab.

(2) If complaint was based on noise when braking, check suspension components. Jounce front and rear of vehicle and listen for noise that might be caused by loose, worn or damaged suspension or steering components.

(3) Inspect brake fluid level and condition. Note that the front disc brake reservoir fluid level will decrease in proportion to normal lining wear. **Also note that brake fluid tends to darken over time. This is normal and should not be mistaken for contamination.**

(a) If fluid level is abnormally low, look for evidence of leaks at calipers, wheel cylinders, brake lines, and master cylinder.

(b) If fluid appears contaminated, drain out a sample. System will have to be flushed if fluid is separated into layers, or contains a substance other than brake fluid. The system seals and cups will also have to be replaced after flushing. Use clean brake fluid to flush the system.

(4) Check parking brake operation. Verify free movement and full release of cables and pedal. Also note if vehicle was being operated with parking brake partially applied.

(5) Check brake pedal operation. Verify that pedal does not bind and has adequate free play. If pedal lacks free play, check pedal and power booster for being loose or for bind condition. Do not road test until condition is corrected.

(6) If components checked appear OK, road test the vehicle.

ROAD TESTING

(1) If complaint involved low brake pedal, pump pedal and note if it comes back up to normal height.

(2) Check brake pedal response with transmission in Neutral and engine running. Pedal should remain firm under constant foot pressure.

(3) During road test, make normal and firm brake stops in 25-40 mph range. Note faulty brake operation such as low pedal, hard pedal, fade, pedal pulsation, pull, grab, drag, noise, etc.

PEDAL FALLS AWAY

A brake pedal that falls away under steady foot pressure is generally the result of a system leak. The leak point could be at a brake line, fitting, hose, or caliper/wheel cylinder. 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 may not be physically evident.

LOW PEDAL

If a low pedal is experienced, pump the pedal several times. If the pedal comes back up, worn lining, rotors, or drums are the most likely causes.

SPONGY PEDAL

A spongy pedal is most often caused by air in the system. However, thin brake drums or substandard brake lines and hoses can also cause a spongy pedal. The proper course of action is to bleed the system, 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.

DIAGNOSIS AND TESTING (Continued)

PEDAL PULSATION

Pedal pulsation is caused by components that are loose, or beyond tolerance limits.

The primary cause of pulsation are disc brake rotors with excessive lateral runout or thickness variation, or out of round brake drums. Other causes are loose wheel bearings or calipers and worn, damaged tires.

NOTE: Some pedal pulsation may be felt during ABS activation.

BRAKE DRAG

Brake drag occurs when the lining is in constant contact with the rotor or drum. Drag can occur at one wheel, all wheels, fronts only, or rears only.

Drag is a product of incomplete brake shoe release. Drag can be minor or severe enough to overheat the linings, rotors and drums.

Minor drag will usually cause slight surface charring of the lining. It can also generate hard spots in rotors and drums from the overheat-cool down process. In most cases, the rotors, drums, wheels and tires are quite warm to the touch after the vehicle is stopped.

Severe drag can char the brake lining all the way through. It can also distort and score rotors and drums to the point of replacement. The wheels, tires and brake components will be extremely hot. In severe cases, the lining may generate smoke as it chars from overheating.

Possible causes for brake drag condition are:

- Seized or improperly adjusted parking brake cables.
- Loose/worn wheel bearing.
- Seized caliper or wheel cylinder piston.
- Caliper binding on corroded bushings or rusted slide surfaces.
- Loose caliper mounting bracket.
- Drum brake shoes binding on worn/damaged support plates.
- Misassembled components.

If brake drag occurs at all wheels, the problem may be related to a blocked master cylinder return port, or faulty power booster (binds-does not release).

BRAKE FADE

Brake fade is usually a product of overheating caused by brake drag. However, brake overheating and resulting fade can also be caused by riding the brake pedal, making repeated high deceleration stops in a short time span, or constant braking on steep mountain roads. Refer to the Brake Drag information in this section for causes.

BRAKE PULL

Possible causes for front brake pull condition are:

- Contaminated lining in one caliper.
- Seized caliper piston.
- Binding caliper.
- Loose caliper.
- Rusty adapter/caliper slide surfaces.
- Improper brake shoes.
- Damaged rotor.

A worn, damaged wheel bearing or suspension component are further causes of pull. A damaged front tire (bruised, ply separation) can also cause pull.

A common and frequently misdiagnosed pull condition is where direction of pull changes after a few stops. The cause is a combination of brake drag followed by fade at one of the brake units.

As the dragging brake overheats, efficiency is so reduced that fade occurs. Since the opposite brake unit is still functioning normally, its braking effect is magnified. This causes pull to switch direction in favor of the normally functioning brake unit.

An additional point when diagnosing a change in pull condition concerns brake cool down. Remember that pull will return to the original direction, if the dragging brake unit is allowed to cool down (and is not seriously damaged).

REAR BRAKE GRAB OR PULL

Rear grab or pull is usually caused by improperly adjusted or seized parking brake cables, contaminated lining, bent or binding shoes and support plates, or improperly assembled components. This is particularly true when only one rear wheel is involved. However, when both rear wheels are affected, the master cylinder, proportioning valve, or RWAL valve could be at fault.

BRAKES DO NOT HOLD AFTER DRIVING THROUGH DEEP WATER PUDDLES

This condition is generally caused by water soaked lining. If the lining is only wet, it can be dried by driving with the brakes very lightly applied for a mile or two. However, if the lining is both soaked and dirt contaminated, cleaning and/or replacement will be necessary.

BRAKE SQUEAK/SQUEAL

Brake squeak or squeal may be due to linings that are wet or contaminated with brake fluid, grease, or oil. Glazed linings and rotors with hard spots can also contribute to squeak. Dirt and foreign material embedded in the brake lining will also cause squeak/squeal.

A very loud squeak or squeal is frequently a sign of severely worn brake lining. If the lining has worn through to the brake shoes in spots, metal-to-metal

DIAGNOSIS AND TESTING (Continued)

contact occurs. If the condition is allowed to continue, rotors and drums can become so scored that replacement is necessary.

BRAKE CHATTER

Brake chatter is usually caused by loose or worn components, or glazed/burnt lining. Rotors with hard spots can also contribute to chatter. Additional causes of chatter are out-of-tolerance rotors, brake lining not securely attached to the shoes, loose wheel bearings and contaminated brake lining.

THUMP/CLUNK NOISE

Thumping or clunk noises during braking are frequently **not** caused by brake components. In many cases, such noises are caused by loose or damaged steering, suspension, or engine components. However, calipers that bind on the slide surfaces can generate a thump or clunk noise. In addition, worn out, improperly adjusted, or improperly assembled rear brake shoes can also produce a thump noise.

BRAKE LINING CONTAMINATION

Brake lining contamination is mostly a product of leaking calipers or wheel cylinders, worn seals, driving through deep water puddles, or lining that has become covered with grease and grit during repair. Contaminated lining should be replaced to avoid further brake problems.

WHEEL AND TIRE PROBLEMS

Some conditions attributed to brake components may actually be caused by a wheel or tire problem.

A damaged wheel can cause shudder, vibration and pull. A worn or damaged tire can also cause pull.

Severely worn tires with very little tread left can produce a grab-like condition as the tire loses and recovers traction. Flat-spotted tires can cause vibration and generate shudder during brake operation. A tire with internal damage such as a severe bruise, cut, or ply separation can cause pull and vibration.

STOP LAMP SWITCH

Stop lamp switch operation can be tested with an ohmmeter. The ohmmeter is used to check continuity between the pin terminals at different plunger positions (Fig. 7).

NOTE: The switch wire harness must be disconnected before testing switch continuity.

SWITCH CIRCUIT IDENTIFICATION

- Terminals 1 and 2 are for brake sensor circuit.
- Terminals 5 and 6 are for the stop lamp circuit.
- Terminals 3 and 4 are not used.

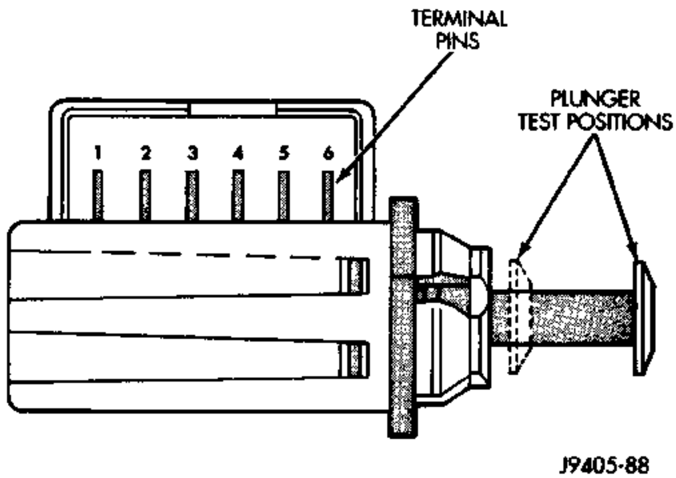


Fig. 7 Stop Lamp Switch Terminal Identification

SWITCH CONTINUITY TEST

(1) Check continuity between terminal pins 5 and 6 as follows:

(a) Pull plunger all the way out to fully extended position.

(b) Attach test leads to pins 5 and 6 and note ohmmeter reading.

(c) If continuity exists, proceed to next test. Replace switch if meter indicates lack of continuity (shorted or open).

(2) Check continuity between terminal pins 1 and 2 as follows:

(a) Push switch plunger inward to fully retracted position.

(b) Attach test leads to pins 1 and 2 and note ohmmeter reading.

(c) If continuity exists, switch is OK. Replace switch if meter indicates lack of continuity (switch is open).

RED BRAKE WARNING LAMP

The red brake warning light will illuminate under the following conditions:

- 2-3 seconds at start-up as part of normal bulb check.
- When parking brakes are applied.
- Low brake pedal caused by leak in front/rear brake hydraulic circuit.

If the red light remains on after start-up, first verify that the parking brakes are fully released. Then check pedal action and fluid level. A red light plus low pedal indicates the pressure differential switch and valve have been actuated due to a system leak.

On models with ABS brakes, the amber warning light only illuminates when an ABS malfunction has occurred. The ABS light operates independently of the red warning light.

For addition information refer to Group 8W.

DIAGNOSIS AND TESTING (Continued)

MASTER CYLINDER/POWER BOOSTER

(1) Start engine and check booster vacuum hose connections. A hissing noise indicates vacuum leak. Correct any vacuum leak before proceeding.

(2) Stop engine and shift transmission into Neutral.

(3) Pump brake pedal until all vacuum reserve in booster is depleted.

(4) Press and hold brake pedal under light foot pressure. The pedal should hold firm, if the pedal falls away master cylinder is faulty (internal leakage).

(5) Start engine and note pedal action it should falls away slightly under light foot pressure then holds firm. If no pedal action is discernible, power booster, vacuum supply, or vacuum check valve is faulty. Proceed to the POWER BOOSTER VACUUM TEST.

(6) If the POWER BOOSTER VACUUM TEST passes, rebuild booster vacuum reserve as follows: Release brake pedal. Increase engine speed to 1500 rpm, close the throttle and immediately stop turn off ignition to stop engine.

(7) Wait a minimum of 90 seconds and try brake action again. Booster should provide two or more vacuum assisted pedal applications. If vacuum assist is not provided, booster is faulty.

POWER BOOSTER VACUUM TEST

(1) Connect vacuum gauge to booster check valve with short length of hose and T-fitting (Fig. 8).

(2) Start and run engine at curb idle speed for one minute.

(3) Observe the vacuum supply. If vacuum supply is not adequate, repair vacuum supply.

(4) Clamp hose shut between vacuum source and check valve.

(5) Stop engine and observe vacuum gauge.

(6) If vacuum drops more than one inch HG (33 millibars) within 15 seconds, booster diaphragm or check valve is faulty.

POWER BOOSTER CHECK VALVE TEST

(1) Disconnect vacuum hose from check valve.

(2) Remove check valve and valve seal from booster.

(3) Use a hand operated vacuum pump for test.

(4) Apply 15-20 inches vacuum at large end of check valve (Fig. 9).

(5) Vacuum should hold steady. If gauge on pump indicates vacuum loss, check valve is faulty and should be replaced.

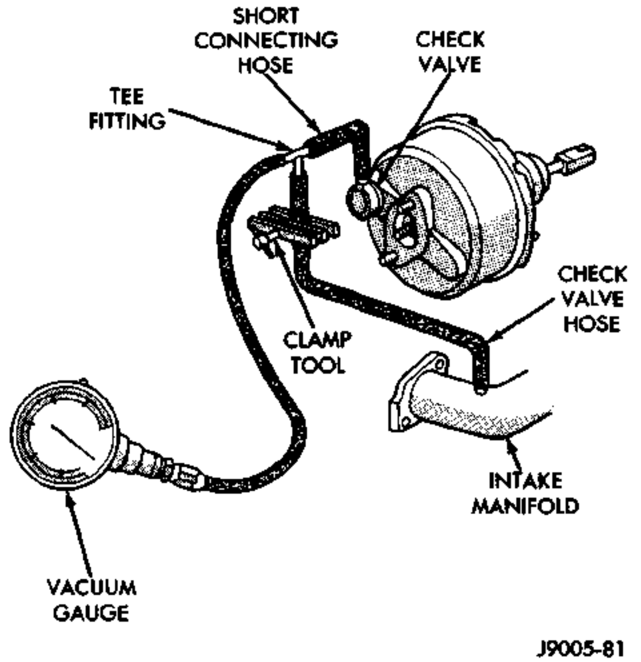


Fig. 8 Typical Booster Vacuum Test Connections

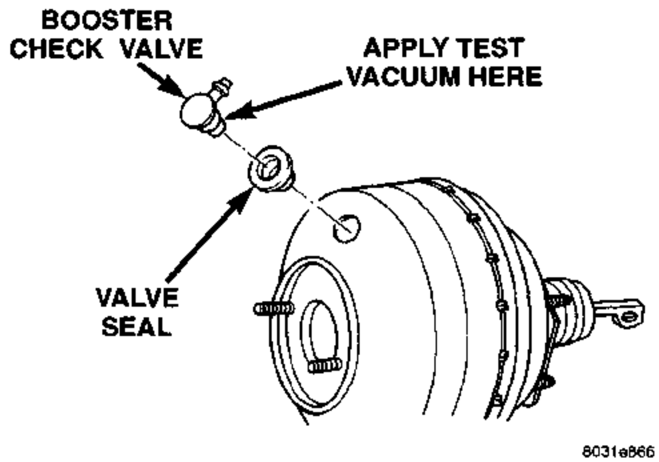


Fig. 9 Vacuum Check Valve And Seal

COMBINATION VALVE

Metering Valve

Metering valve operation can be checked visually and with the aid of a helper. Observe the metering valve stem while a helper applies and releases the brakes. If the valve is operating correctly, the stem will extend slightly when the brakes are applied and retract when the brakes are released. If the valve is faulty, replace the entire combination valve as an assembly.

Pressure Differential Switch

(1) Have helper sit in drivers seat to apply brake pedal and observe red brake warning light.

(2) Raise vehicle on hoist.

DIAGNOSIS AND TESTING (Continued)

(3) Connect bleed hose to a rear wheel cylinder and immerse hose end in container partially filled with brake fluid.

(4) Have helper press and hold brake pedal to floor and observe warning light.

(a) If warning light illuminates, switch is operating correctly.

(b) If light fails to illuminate, check circuit fuse, bulb, and wiring. The parking brake switch can be used to aid in identifying whether or not the brake light bulb and fuse is functional. Repair or replace parts as necessary and test differential pressure switch operation again.

(5) If warning light still does not illuminate, switch is faulty. Replace combination valve assembly, bleed brake system and verify proper switch and valve operation.

DISC BRAKE ROTOR

The rotor braking surfaces should not be refinished unless necessary.

Light surface rust and scale can be removed with a lathe equipped with dual sanding discs. The rotor surfaces can be restored by machining in a disc brake lathe if surface scoring and wear are light.

Replace the rotor under the following conditions:

- Severely Scored
- Tapered
- Hard Spots
- Cracked
- Below Minimum Thickness

ROTOR MINIMUM THICKNESS

Measure rotor thickness at the center of the brake shoe contact surface. Replace the rotor if worn below minimum thickness, or if machining would reduce thickness below the allowable minimum.

Rotor minimum thickness is usually specified on the rotor hub. The specification is either stamped or cast into the hub surface.

ROTOR RUNOUT

Check rotor lateral runout with dial indicator C-3339 (Fig. 10). Excessive lateral runout will cause brake pedal pulsation and rapid, uneven wear of the brake shoes. Position the dial indicator plunger approximately 25.4 mm (1 in.) inward from the rotor edge.

NOTE: Be sure wheel bearing has zero end play before checking rotor runout.

Maximum allowable rotor runout is 0.102 mm (0.004 in.).

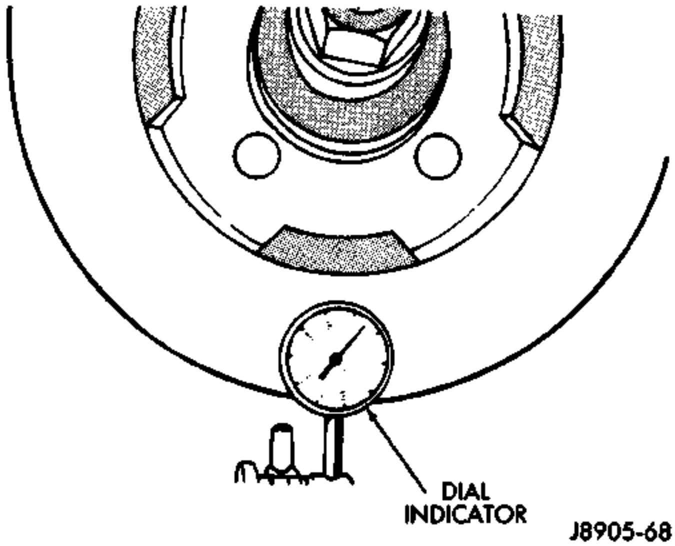


Fig. 10 Checking Rotor Runout And Thickness Variation

ROTOR THICKNESS VARIATION

Variations in rotor thickness will cause pedal pulsation, noise and shudder.

Measure rotor thickness at 6-to-12 points around the rotor face (Fig. 11).

Position the micrometer approximately 25.4 mm (1 in.) from the rotor outer circumference for each measurement.

Thickness should not **vary** by more than 0.013 mm (0.0005 in.) from point-to-point on the rotor. Machine or replace the rotor if necessary.

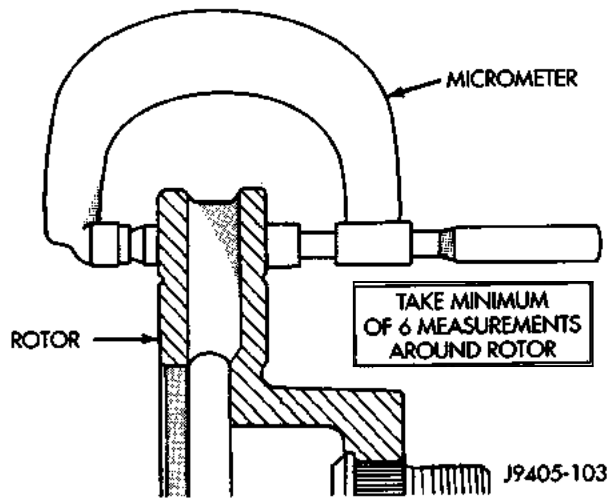


Fig. 11 Measuring Rotor Thickness

BRAKE DRUM

The maximum allowable diameter of the drum braking surface is stamped or cast into the drum outer edge. Generally, a drum can be machined to a maximum of 1.52 mm (0.060 in.) oversize. Always

DIAGNOSIS AND TESTING (Continued)

replace the drum if machining would cause drum diameter to exceed the size limit indicated on the drum.

BRAKE DRUM RUNOUT

Measure drum diameter and runout with an accurate gauge. The most accurate method of measurement involves mounting the drum in a brake lathe and checking variation and runout with a dial indicator.

Variations in drum diameter should not exceed 0.076 mm (0.003 in.). Drum runout should not exceed 0.20 mm (0.008 in.) out of round. Machine the drum if runout or variation exceed these values. Replace the drum if machining causes the drum to exceed the maximum allowable diameter.

PARKING BRAKE

NOTE: Parking brake adjustment is controlled by a cable tensioner. Once the tensioner is adjusted at the factory, it should not require further attention. However, there are two instances when adjustment will be required. The first is when a new tensioner, or cables have been installed. And the second, is when the tensioner and cables are disconnected for access to other brake components.

The parking brake switch is in circuit with the red warning lamp in the dash. The switch will cause the lamp to illuminate only when the parking brakes are applied. If the lamp remains on after parking brake release, the switch or wires are faulty, or cable tensioner adjustment is incorrect.

In most cases, the actual cause of an improperly functioning parking brake (too loose/too tight/won't hold), can be traced to a parking brake component.

The leading cause of improper parking brake operation, is excessive clearance between the parking brake shoes and the shoe braking surface. Excessive clearance is a result of lining and/or drum wear, drum surface machined oversize, or inoperative adjuster components.

Excessive parking brake lever travel (sometimes described as a loose lever or too loose condition), is the result of worn brake shoes, improper brake shoe adjustment, or improperly assembled brake parts.

A condition where the parking brakes do not hold, will most probably be due to a wheel brake component.

Items to look for when diagnosing a parking brake problem, are:

- Rear brake shoe wear.
- Drum surface machined oversize.
- Front cable not secured to lever.
- Rear cable not attached to lever.
- Rear cable seized.
- Brake shoes reversed.
- Parking brake strut not seated in shoes.
- Parking brake lever not seated.
- Parking brake lever bind.
- Adjuster screws seized.
- Adjuster screws reversed.

Parking brake adjustment and parts replacement procedures are described in the Parking Brake section.

BRAKE LINE AND HOSES

Flexible rubber hose is used at both front brakes and at the rear axle junction block. Inspect the hoses whenever the brake system is serviced, at every engine oil change, or whenever the vehicle is in for service.

Inspect the hoses for surface cracking, scuffing, or worn spots. Replace any brake hose immediately if the fabric casing of the hose is exposed due to cracks or abrasions.

Also check brake hose installation. Faulty installation can result in kinked, twisted hoses, or contact with the wheels and tires or other chassis components. All of these condition can lead to scuffing, cracking and eventual failure.

The steel brake lines should be inspected periodically for evidence of corrosion, twists, kinks, leaks, or other damage. Heavily corroded lines will eventually rust through causing leaks. In any case, corroded or damaged brake lines should be replaced.

Factory replacement brake lines and hoses are recommended to ensure quality, correct length and superior fatigue life. Care should be taken to make sure that brake line and hose mating surfaces are clean and free from nicks and burrs. Also remember that right and left brake hoses are not interchangeable.

Use new copper seal washers at all caliper connections. Be sure brake line connections are properly made (not cross threaded) and tightened to recommended torque.

BRAKE FLUID CONTAMINATION

Indications of fluid contamination are swollen or deteriorated rubber parts.

Swollen rubber parts indicate the presence of petroleum in the brake fluid.

To test for contamination, put a small amount of drained brake fluid in clear glass jar. If fluid separates into layers, there is mineral oil or other fluid contamination of the brake fluid.

If brake fluid is contaminated, drain and thoroughly flush system. Replace master cylinder, proportioning valve, caliper seals, wheel cylinder seals, Antilock Brakes hydraulic unit and all hydraulic fluid hoses.

SERVICE PROCEDURES

BRAKE FLUID LEVEL

Always clean the master cylinder reservoir and cap before adding fluid. This will prevent dirt from falling in the reservoir and contaminating the brake fluid.

The reservoir has a ADD and a FULL mark on the side (Fig. 12) fill to the FULL mark.

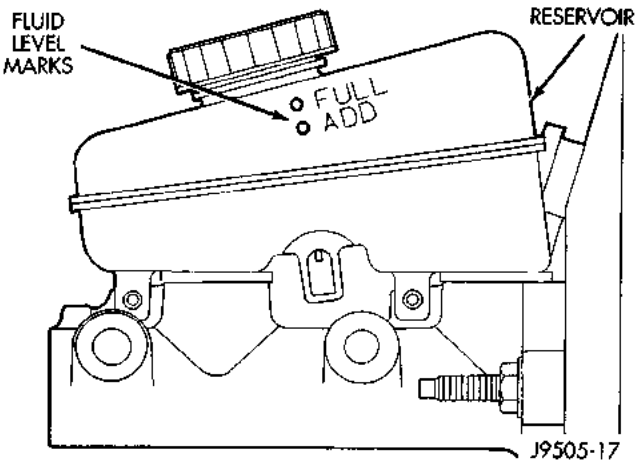


Fig. 12 Master Cylinder Fluid Level

MASTER CYLINDER

A new master cylinder should be bled before installation on the vehicle. Required bleeding tools include bleed tubes and a wood dowel to stroke the pistons. Bleed tubes can be fabricated from brake line.

BLEEDING PROCEDURE

(1) Mount master cylinder in vise.

(2) Attach bleed tubes to cylinder outlet ports. Then position each tube end in matching reservoir fluid compartment (Fig. 13).

NOTE: If master cylinders has one reservoir opening, position both outlet bleed tubes into the single reservoir opening.

(3) Fill reservoir with fresh brake fluid.

(4) Press cylinder pistons inward with wood dowel. Then release pistons and allow them to return under spring pressure. Continue bleeding operations until air bubbles are no longer visible in fluid.

BRAKE BLEEDING

Use Mopar brake fluid, or an equivalent quality fluid meeting SAE J1703-F and DOT 3 standards only. Use fresh, clean fluid from a sealed container at all times.

Do not pump the brake pedal at any time while bleeding. Air in the system will be compressed into small bubbles that are distributed throughout the hydraulic system. This will make additional bleeding operations necessary.

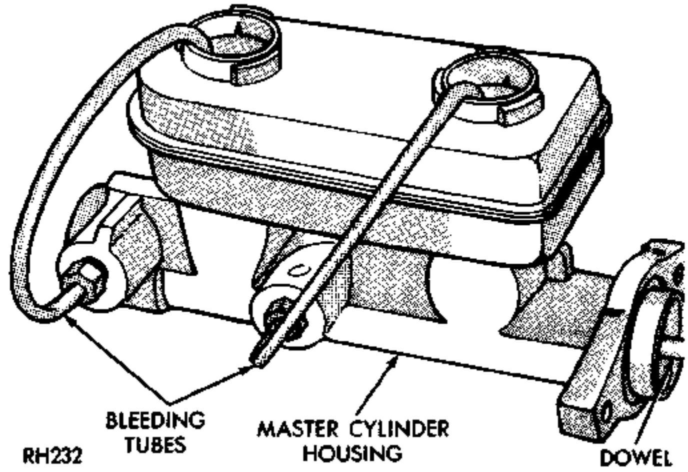


Fig. 13 Master Cylinder Bleeding

Do not allow the master cylinder to run out of fluid during bleed operations. An empty cylinder will allow additional air to be drawn into the system. Check the cylinder fluid level frequently and add fluid as needed.

The Brakes should be bled in sequence. First the right rear wheel then the left rear wheel. Then move to the front brakes and bleed the right front wheel then the left front wheel.

MANUAL BLEEDING

(1) Remove reservoir filler caps and fill reservoir with Mopar, or equivalent quality DOT 3 brake fluid.

(2) If calipers, or wheel cylinders were overhauled, open all caliper and wheel cylinder bleed screws. Then close each bleed screw as fluid starts to drip from it. Top off master cylinder reservoir once more before proceeding.

(3) Attach one end of bleed hose to bleed screw and insert opposite end in glass container partially filled with brake fluid (Fig. 14). Be sure end of bleed hose is immersed in fluid.

(4) Open up bleeder, then have a helper press down the brake pedal. Once the pedal is down close the bleeder. Repeat bleeding until fluid stream is clear and free of bubbles. Then move to the next wheel.

DISC ROTOR MACHINING

Rotor braking surfaces can be sanded or machining in a disc brake lathe.

The lathe must machine both sides of the rotor simultaneously with dual (two) cutter heads (Fig. 15). Equipment capable of machining only one side at a time will produce a tapered rotor.

SERVICE PROCEDURES (Continued)

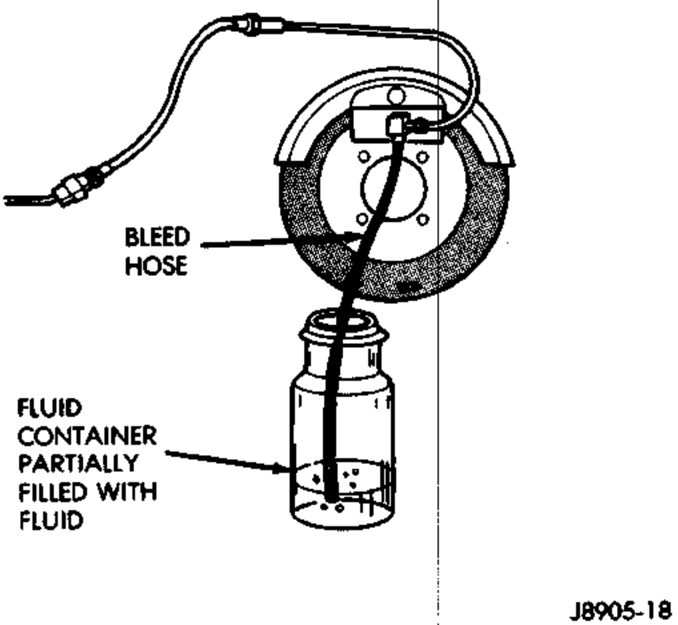


Fig. 14 Typical Fluid Container And Bleed Hose Setup

The lathe should also be equipped with a grinder attachment or dual sanding discs for final cleanup or light refinishing (Fig. 15).

If the rotor surfaces only need minor cleanup of rust, scale, or minor scoring, use abrasive discs to clean up the rotor surfaces. However, when a rotor is scored or worn, machining with cutting tools will be required.

CAUTION: Do not machine the rotor if it will cause the rotor to fall below minimum allowable thickness.

BRAKE DRUM MACHINING

The brake drums can be machined on a drum lathe when necessary. Initial machining cuts should be limited to 0.12 - 0.20 mm (0.005 - 0.008 in.) at a time as heavier feed rates can produce taper and surface variation. Final finish cuts of 0.025 to 0.038 mm (0.001 to 0.0015 in.) are recommended and will generally provide the best surface finish.

Be sure the drum is securely mounted in the lathe before machining operations. A damper strap should always be used around the drum to reduce vibration and avoid chatter marks.

The maximum allowable diameter of the drum braking surface is stamped or cast into the drum outer edge. Always replace the drum if machining would cause drum diameter to exceed the size limit indicated on the drum.

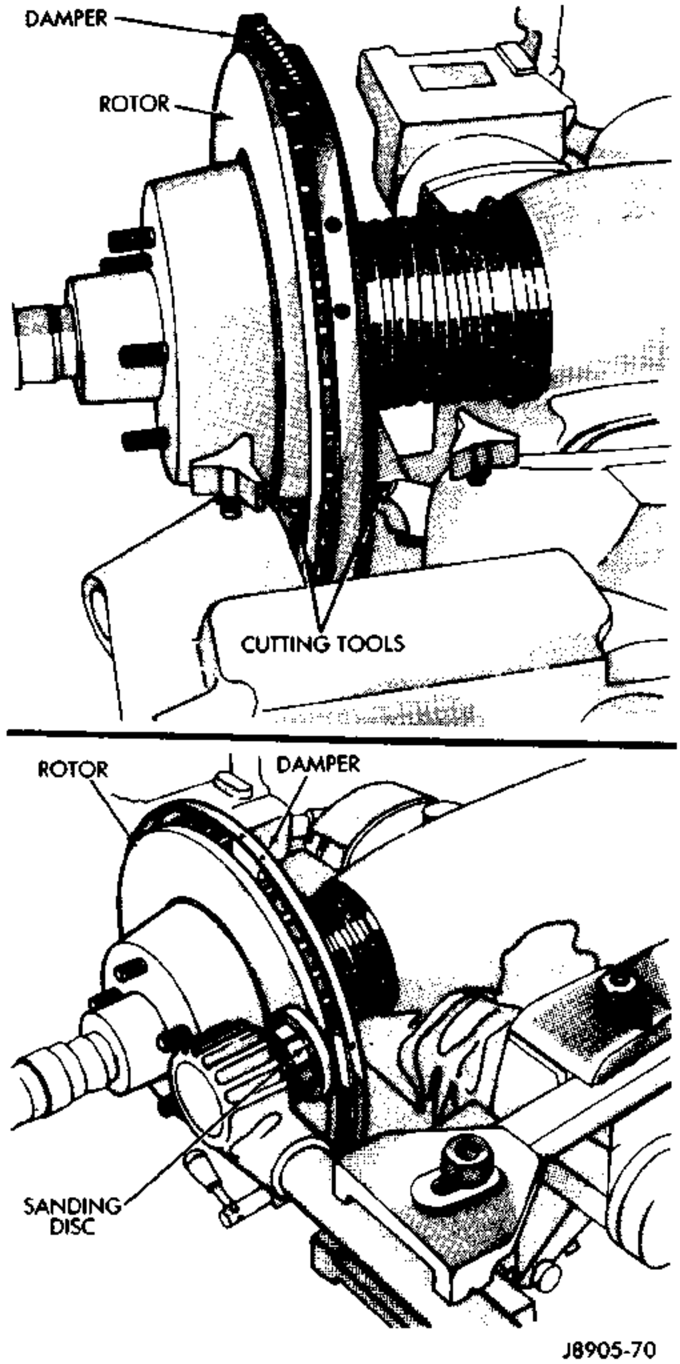


Fig. 15 Rotor Refinishing

BRAKE LINE

Mopar preformed metal brake line is recommended and preferred for all repairs. However, double-wall steel line can be used for emergency repair when factory replacement parts are not readily available.

Special, heavy duty tube bending and flaring equipment is required to prepare double wall brake line. Special bending tools are needed to avoid kinking or twisting metal brake line. In addition, special

SERVICE PROCEDURES (Continued)

flaring tools are needed to provide the inverted-type, double flare required on metal brake lines.

FLARING PROCEDURE

(1) Cut off damaged tube with Tubing Cutter.
(2) Ream cut edges of tubing to ensure proper flare.
(3) Install replacement tube nut on section of tube to be repaired.
(4) Insert tube in flaring tool. Center tube in area between vertical posts.
(5) Place gauge form over the end of the tube.
(6) Push tubing through flaring tool jaws until tube contacts recessed notch in gauge that matches tube diameter.
(7) Squeeze flaring tool jaws to lock tubing in place.
(8) Insert plug on gauge in the tube. Then swing compression disc over gauge and center tapered flaring screw in recess of compression disc (Fig. 16).
(9) Tighten tool handle until plug gauge is seated on jaws of flaring tool. This will start the inverted flare.
(10) Remove the plug gauge and complete the inverted flare.
(11) Remove the flaring tools and verify that the inverted flare is correct.

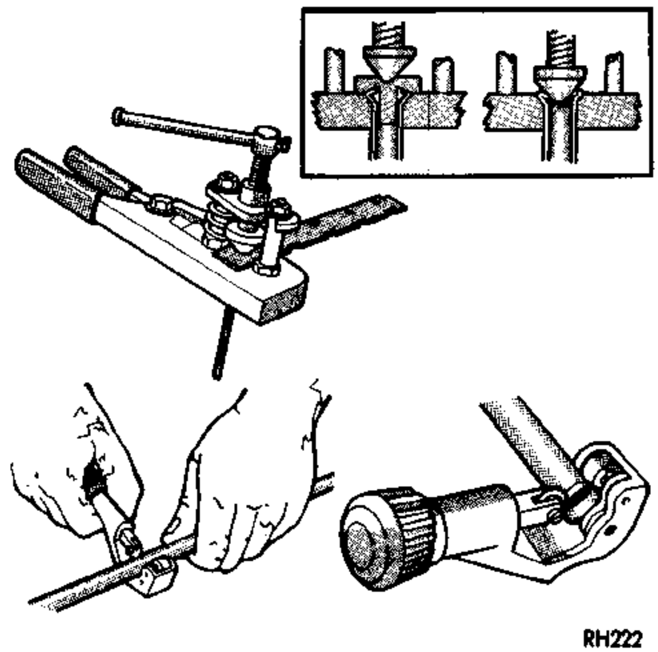


Fig. 16 Inverted Flare Tools

REMOVAL AND INSTALLATION

STOP LAMP SWITCH

REMOVAL

(1) Remove steering column cover and lower trim panel for switch access (if necessary).
(2) Press brake pedal downward to fully applied position.
(3) Rotate switch approximately 30° in counterclockwise direction to unlock switch retainer. Then pull switch rearward and out of bracket.
(4) Disconnect switch wire harness and remove switch from vehicle (Fig. 17).

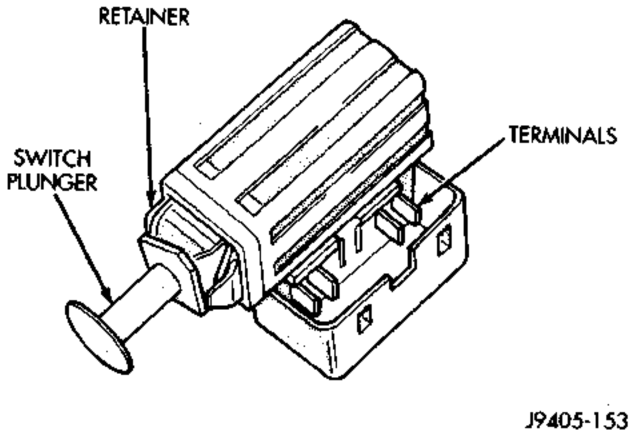


Fig. 17 Stop Lamp Switch

INSTALLATION

(1) Pull switch plunger all the way out to fully extended position.
(2) Connect harness wires to switch.
(3) Press and hold brake pedal in applied position.
(4) Install switch as follows: Align tab on switch with notch in switch bracket. Then insert switch in bracket and turn it clockwise about 30° to lock it in place.
(5) Release brake pedal, then pull pedal fully rearward. Pedal will set plunger to correct position as pedal pushes plunger into switch body. Switch will make racheting sound as it self adjusts.

BRAKE PEDAL

REMOVAL

(1) Remove negative battery cable.
(2) Remove brake lamp switch.
(3) Remove ABS controller if equipped.
(4) Remove retainer clip securing booster push rod to pedal (Fig. 18) and clutch rod retainer clip if equipped.

REMOVAL AND INSTALLATION (Continued)

(5) Remove bolts from brake pedal support and booster mounting nuts. Remove mounting stud plate nuts or clutch cylinder mounting nuts if equipped.

(6) Slid brake booster/master cylinder assembly forward.

(7) Remove mounting stud plate or slid clutch cylinder forward if equipped.

(8) Tilt the pedal support down to gain shaft clearance.

(9) Remove pedal shaft C–clip from passenger side of the shaft.

(10) Slide the pedal shaft toward the drivers side and remove the remaining C-clip.

(11) Slid the shaft out of the pedal bracket and remove the pedal.

(12) Remove pedal bushings if they are to be replaced.

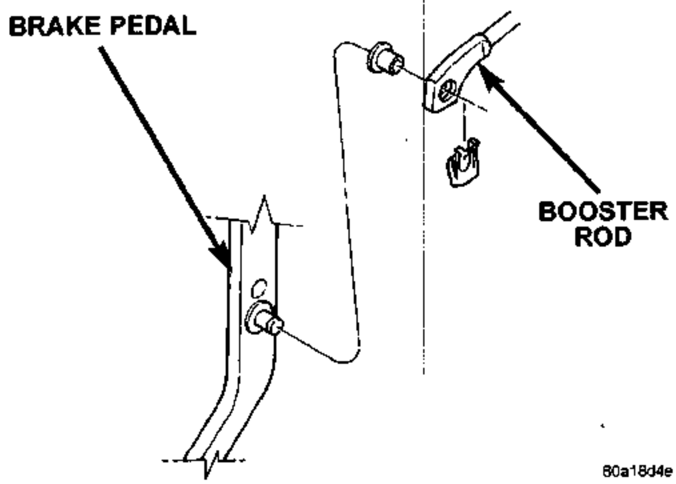


Fig. 18 Push Rod Attachment

INSTALLATION

(1) Install new bushings in pedal. Lubricate bushings and shaft with multi-purpose grease.

(2) Position pedal in bracket and install shaft.

(3) Install new pivot pin C-clip.

(4) Position pedal support and install support bolts and tighten to 28 N·m (21 ft. lbs.).

(5) Slid the booster/master cylinder assembly into place, install mounting nuts and tighten to 37 N·m (27 ft. lbs.).

(6) Install stud plate or clutch cylinder if equipped and tighten mounting nut to 28 N·m (21 ft. lbs.).

Install retainer clip securing booster push rod to pedal (Fig. 18) and clutch rod retainer clip if equipped.

(7) Install ABS controller if equipped.

(8) Install and connect stop lamp switch.

(9) Install negative battery cable.

COMBINATION VALVE

REMOVAL

(1) Remove brake lines that connect master cylinder to combination valve (Fig. 19).

(2) Disconnect brake lines that connect combination valve to front and rear brakes.

(3) Disconnect wire from combination valve switch terminal. Be careful when separating wire connector as lock tabs are easily damaged if not fully disengaged.

(4) Remove nuts attaching combination valve bracket to booster studs and remove valve bracket off booster studs (Fig. 20).

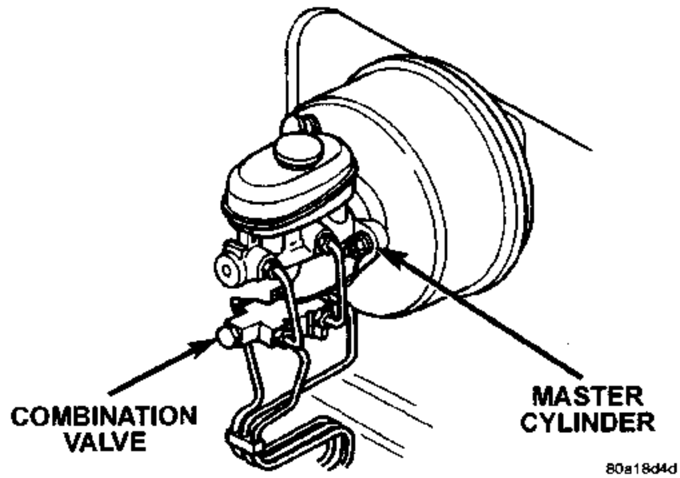


Fig. 19 Combination Valve/Master Cylinder

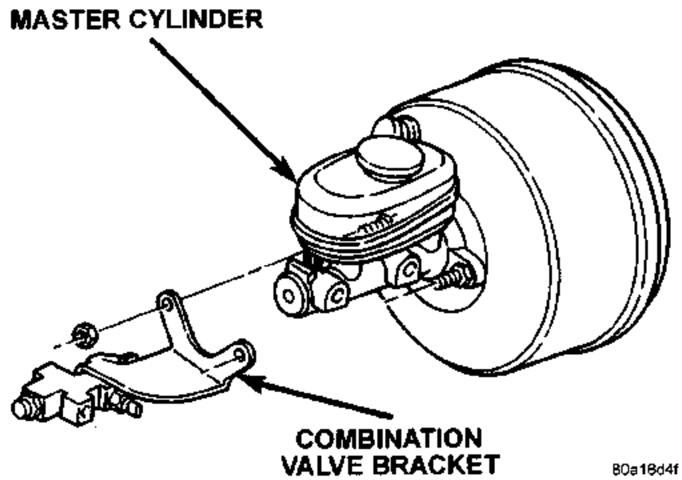


Fig. 20 Combination Valve Bracket

INSTALLATION

(1) Position valve bracket on booster studs and tighten bracket attaching nuts to 24 N·m (18 ft. lbs.).

(2) Align and start brake line fittings in combination valve and master cylinder by hand to avoid cross threading.

REMOVAL AND INSTALLATION (Continued)

(3) Tighten brake line fittings at combination valve to 21 N·m (15 ft. lbs.).

(4) Tighten brake line fittings at master cylinder to 15 N·m (11 ft. lbs.).

(5) Connect wire to differential pressure switch in combination valve.

(6) Bleed base brake system.

MASTER CYLINDER

REMOVAL

(1) Remove evaporative canister, refer to Group 25 Emissions for service procedure.

(2) Disconnect brake lines to master cylinder and combination valve.

(3) Remove combination valve mounting nuts and remove valve.

(4) Remove master cylinder mounting nuts and remove master cylinder.

(5) Remove cylinder cover and drain fluid.

(6) If master cylinder reservoir requires service, refer to Reservoir Replacement Procedure.

INSTALLATION

NOTE: Bleed new master cylinder on bench before installation, refer to Service Procedures.

(1) Remove protective sleeve from primary piston shank on new master cylinder.

(2) Check condition of seal at rear of cylinder body. Reposition seal if dislodged. Replace seal if cut, or torn.

(3) Install master cylinder onto brake booster studs and tighten mounting nuts to 24 N·m (18 ft. lbs.).

(4) Install combination valve onto brake booster studs and tighten mounting nuts to 24 N·m (18 ft. lbs.).

(5) Install brake lines to master cylinder and combination valve by hand to avoid cross threading.

(6) Tighten master cylinder brake lines to 15 N·m (11 ft. lbs.).

(7) Tighten combination valve brake lines to 21 N·m (15 ft. lbs.).

(8) Install evaporative canister, refer to Group 25 Emissions for service procedure.

(9) Bleed base brake system.

POWER BRAKE BOOSTER

REMOVAL

(1) Remove combination valve and master cylinder.

(2) Disconnect vacuum hose from booster check valve.

(3) Remove retaining clip that secures booster push rod to brake pedal (Fig. 21).

(4) Remove nuts attaching booster to cowl panel (Fig. 22).

(5) In engine compartment, slide booster studs out of cowl panel, and remove booster from engine compartment.

(6) Remove dash seal from booster.

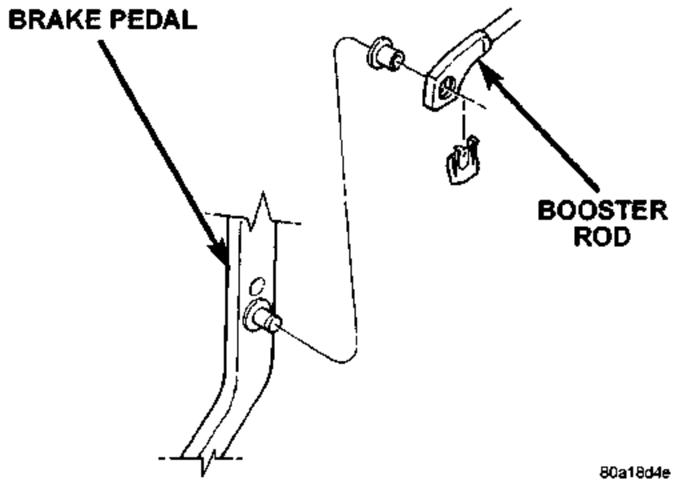


Fig. 21 Push Rod & Clip

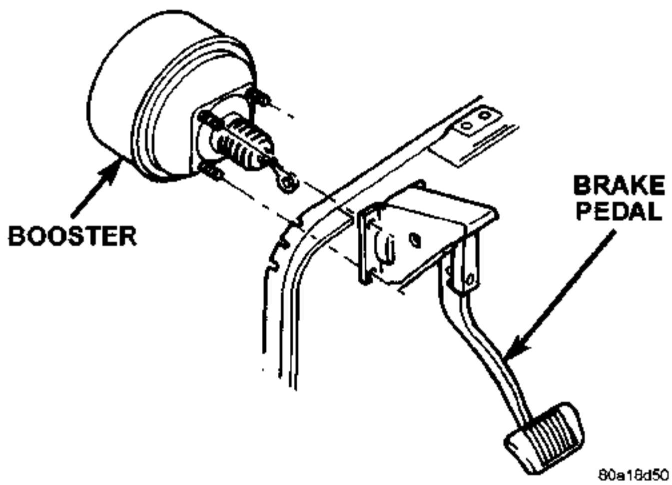


Fig. 22 Booster Mounting Nuts

INSTALLATION

(1) Install dash seal on booster.

(2) Align and position booster on dash panel.

(3) In passenger compartment, install nuts that attach booster to dash panel. Tighten nuts just enough to hold booster in place.

(4) Slide booster push rod onto brake pedal. Then secure push rod to pedal pin with retaining clip.

(5) Tighten booster mounting nuts to 37 N·m (27 ft. lbs.).

(6) Connect vacuum hose to booster check valve.

(7) Install master cylinder and combination valve.

(8) Top off master cylinder fluid level and bleed base brakes.

REMOVAL AND INSTALLATION (Continued)

DISC BRAKE CALIPER

REMOVAL

(1) Raise vehicle and remove front wheel and tire assemblies.

(2) Remove and discard brake hose mounting bolt (Fig. 23).

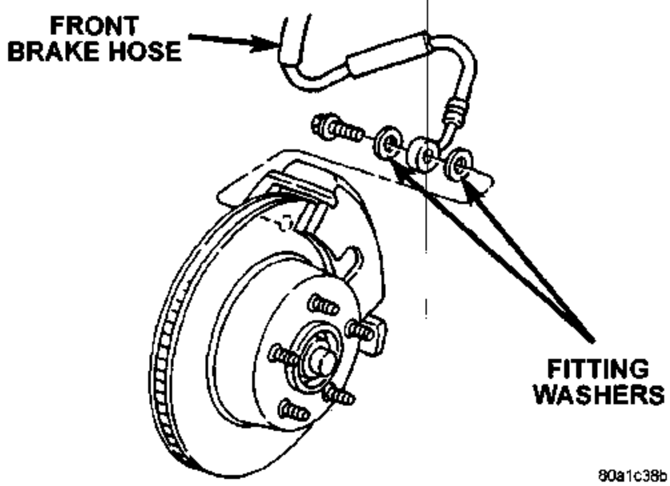


Fig. 23 Brake Hose And Bolt

(3) Remove caliper mounting bolts.

(4) Rotate caliper rearward with pry tool if necessary. Then rotate caliper and brake shoes off mounting ledges.

(5) Remove caliper from vehicle.

INSTALLATION

(1) Install brake shoes in caliper.

(2) Connect brake hose to caliper but do not tighten fitting bolt completely at this time. **Be sure to use new gaskets on bolt to avoid leaks**

(3) Install caliper. Position mounting notches at lower end of brake shoes on bottom mounting ledge. Then rotate caliper over rotor and seat notches at upper end of shoes on mounting ledge.

(4) Coat caliper mounting bolts with GE 661 or Dow 111 silicone grease. Then install and tighten bolts to 15 N·m (11 ft. lbs.).

CAUTION: If new caliper bolts are being installed, or if the original reason for repair was a drag/pull condition, check caliper bolt length before proceeding. If the bolts have a shank length greater than 67.6 mm (2.66 in.), they may contact the inboard brake shoe causing a partial apply condition. Refer to Figure 14 for the required caliper bolt length.

(5) Position front brake hose clear of all chassis components and tighten caliper fitting bolt to 31 N·m (23 ft. lbs.).

CAUTION: Be sure the brake hose is not twisted or kinked at any point. Also be sure the hose is clear of all steering and suspension components. Loosen and reposition the hose if necessary.

(6) Install wheel and tire assembly.

(7) Fill master cylinder and bleed base brake system.

DISC BRAKE SHOES

REMOVAL

(1) Raise vehicle and remove front wheel and tire assemblies.

(2) Drain small amount of fluid from master cylinder front brake reservoir with suction gun.

(3) Bottom caliper piston in bore with C-clamp. Position clamp screw on outboard brake shoe and clamp frame on rear of caliper. Typical C-clamp attachment is shown in (Fig. 24). **Do not allow clamp screw to bear directly on outboard shoe retainer spring. Use wood or metal spacer between shoe and clamp screw if necessary.**

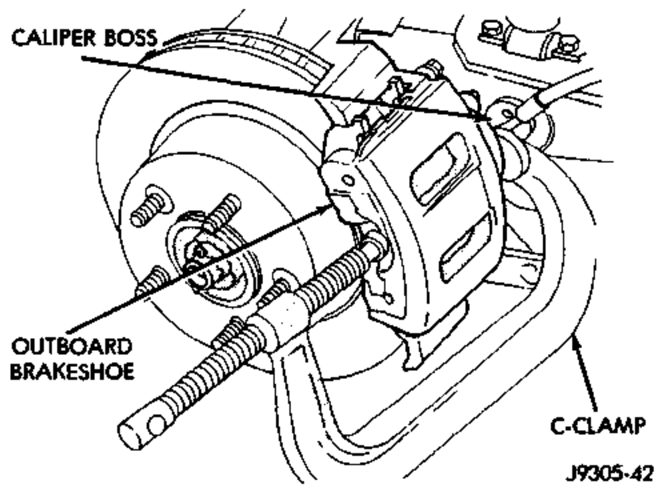


Fig. 24 Bottoming Caliper Piston With C-Clamp

(4) Remove caliper mounting bolts (Fig. 25).

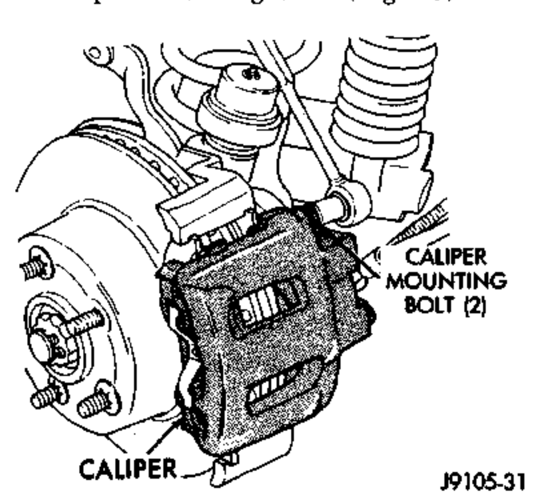


Fig. 25 Caliper Mounting Bolts

REMOVAL AND INSTALLATION (Continued)

(5) Tilt top of caliper outward with pry tool if necessary (Fig. 26) and remove caliper.

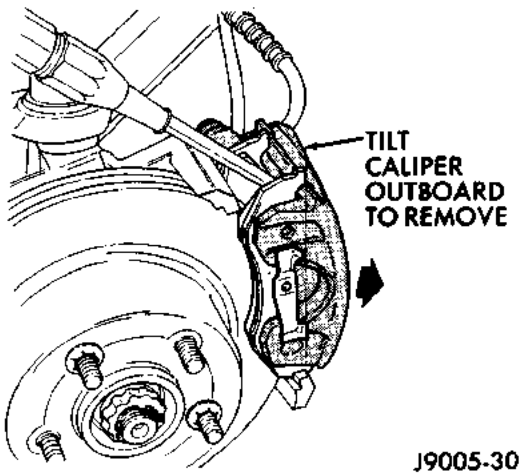


Fig. 26 Caliper Removal

(6) Remove outboard shoe by pressing one end of shoe inward to disengage shoe lug. Then rotate shoe upward until retainer spring clears caliper. Press opposite end of shoe inward to disengage shoe lug and rotate shoe up and out of caliper (Fig. 27).

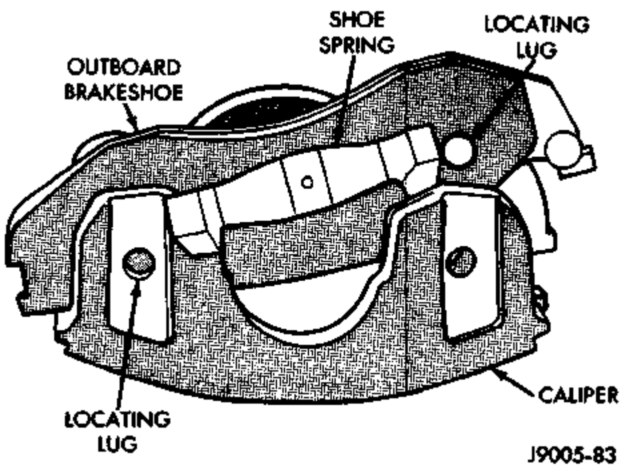


Fig. 27 Outboard Brake Shoe Removal

(7) Remove inboard shoe. Grasp ends of shoe and tilt shoe outward to release springs from caliper piston (Fig. 28). Then remove shoe from caliper.

NOTE: If original brake shoes will be used, keep them in sets (left and right).

(8) Secure caliper to nearby suspension part with wire. **Do not allow brake hose to support caliper weight.**

(9) Wipe caliper off with shop rags or towels. **Do not use compressed air.**

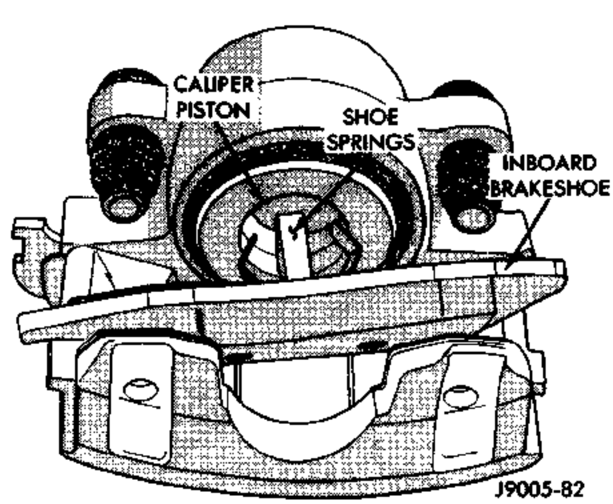


Fig. 28 Inboard Brake Shoe Removal

INSTALLATION

(1) Clean brake shoe mounting ledge slide surfaces of steering knuckle with wire brush. Then apply light coat of high temperature multi-purpose grease to slide surfaces. Lubricate mounting bolts and bushings silicone grease (Fig. 29).

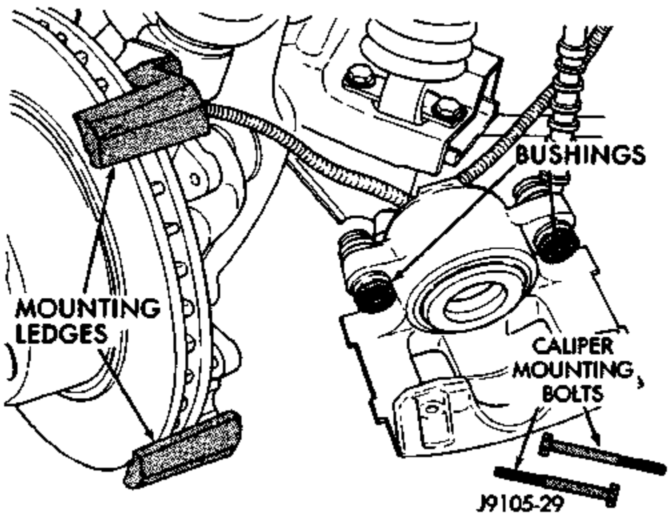


Fig. 29 Caliper Lubrication Points

(2) Install inboard shoe in caliper and verify shoe retaining springs are fully seated into the piston.

(3) Install outboard shoe in caliper by starting one end of shoe in caliper and rotating shoe downward into place. Verify shoe locating lugs and shoe spring are seated.

(4) Install caliper by position notches at lower end of brake shoes on bottom mounting ledge. Then install caliper over rotor and seat upper ends of brake shoes on top mounting ledge (Fig. 30).

NOTE: Before securing the caliper, be sure the caliper brake hose is not twisted, kinked or touching any chassis components.

REMOVAL AND INSTALLATION (Continued)

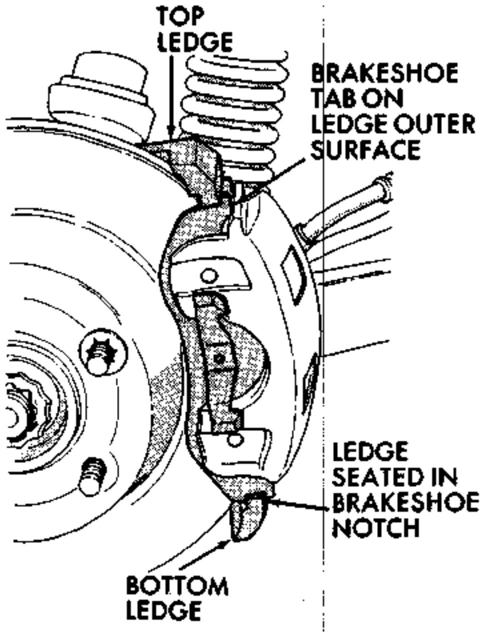


Fig. 30 Caliper Installation

(5) Install and tighten caliper mounting bolts to 15 N·m (11 ft. lbs.).

CAUTION: If new caliper bolts are being installed, or if reason for repair was a drag/pull condition, check caliper bolt length. If the bolts have a shank length greater than 67.6 mm (2.66 in.), they will contact the inboard brake shoe causing a partial apply condition. Refer to (Fig. 31) for correct caliper bolt length.

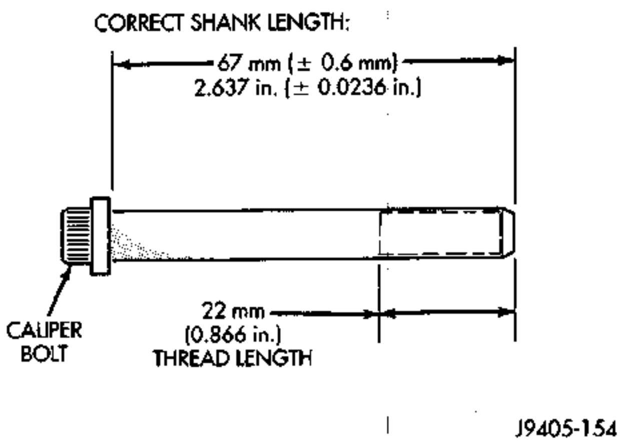


Fig. 31 Mounting Bolt Dimensions

(6) Install wheel and tire assemblies.
(7) Pump brake pedal until caliper pistons and brake shoes are seated.
(8) Top off brake fluid level if necessary.

DISC BRAKE ROTOR

REMOVAL

(1) Remove wheel and tire assemble.
(2) Remove caliper.
(3) Remove retainers securing rotor to hub studs (Fig. 32).
(4) Remove rotor from hub.
(5) If rotor shield requires service, remove front hub and bearing assembly.

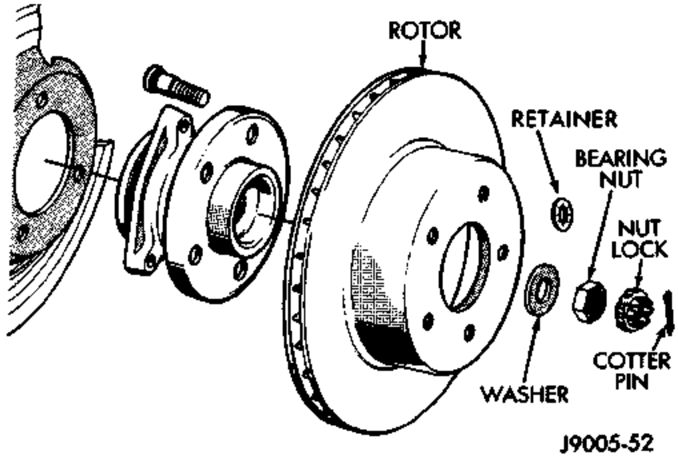


Fig. 32 Rotor & Hub

INSTALLATION

(1) If new rotor is being installed, remove protective coating from rotor surfaces with carburetor cleaner.
(2) Install rotor on hub.
(3) Install caliper.
(4) Install new spring nuts on wheel studs.
(5) Install wheel and tire assembly.

DRUM BRAKE SHOES

REMOVAL

(1) Raise vehicle and remove rear wheels.
(2) Remove and discard spring nuts securing drums to wheel studs.
(3) Remove brake drums.

NOTE: If drums are difficult to remove, back off adjuster through support plate access hole with brake tool and screwdriver.

(4) Remove U-clip and washer securing adjuster cable to parking brake lever (Fig. 33).
(5) Remove primary and secondary return springs from anchor pin with brake spring pliers.
(6) Remove hold-down springs, retainers and pins with standard retaining spring tool.
(7) Install spring clamps on wheel cylinders to hold pistons in place.

REMOVAL AND INSTALLATION (Continued)

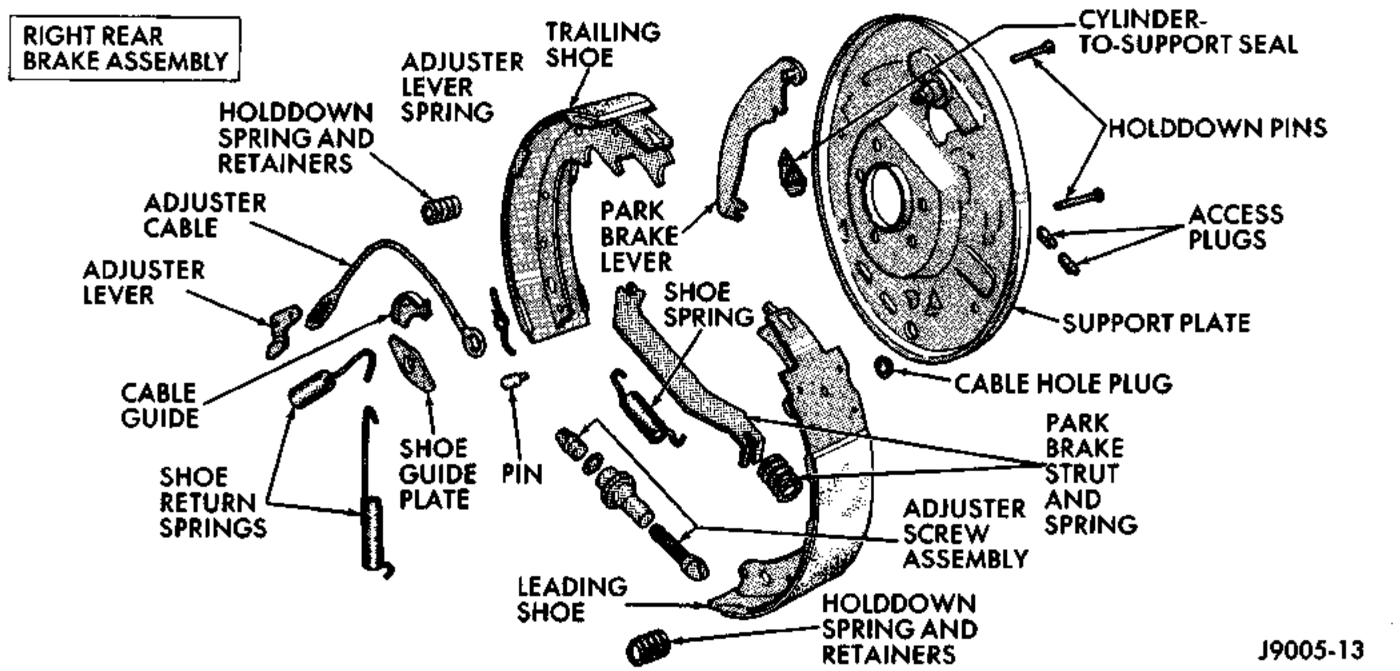


Fig. 33 Drum Brake Components—Typical

(8) Remove adjuster lever, adjuster screw and spring.

(9) Remove adjuster cable and cable guide.

(10) Remove brake shoes and parking brake strut.

(11) Disconnect cable from parking brake lever and remove lever.

INSTALLATION

(1) Clean support plate with brake cleaner.

(2) If new drums are being installed, remove protective coating with carburetor cleaner or brake cleaner.

(3) Apply multi-purpose grease to brake shoe contact surfaces of support plate (Fig. 34).

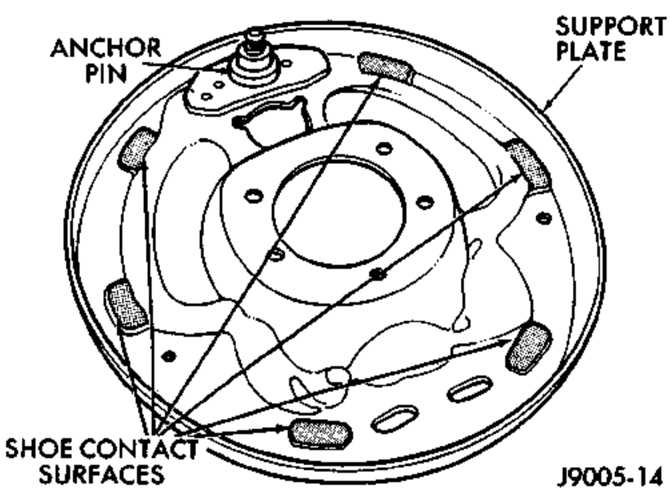


Fig. 34 Shoe Contact Surfaces

(4) Lubricate adjuster screw threads and pivot with spray lube.

(5) Attach parking brake lever to secondary brake shoe. Use new washer and U-clip to secure lever.

(6) Remove wheel cylinder clamps.

(7) Attach parking brake cable to lever.

(8) Install brake shoes on support plate. Secure shoes with new hold-down springs, pins and retainers.

(9) Install parking brake strut and spring.

(10) Install guide plate and adjuster cable on anchor pin.

(11) Install primary and secondary return springs.

(12) Install adjuster cable guide on secondary shoe.

(13) Lubricate and assemble adjuster screw.

(14) Install adjuster screw, spring and lever and connect to adjuster cable.

(15) Adjust shoes to drum.

(16) Install wheel/tire assemblies and lower vehicle.

(17) Verify firm brake pedal before moving vehicle.

WHEEL CYLINDER

REMOVAL

(1) Remove wheel and tire assembly.

(2) Remove brake drum.

(3) Remove wheel cylinder brake line.

(4) Remove brake shoe return springs and move shoes out of engagement with cylinder push rods.

(5) Remove cylinder attaching bolts and remove cylinder from support plate.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Apply bead of silicone sealer around cylinder mounting surface of support plate.

(2) Install cylinder mounting bolts and tighten to 10 N·m (7 ft. lbs.).

(3) Install brake line to cylinder and tighten to 16 N·m (12 ft. lbs.)..

(4) Install brake shoe return spring.

(5) Install brake drum.

(6) Install wheel and tire assembly.

(7) Bleed base brake system.

PARKING BRAKE HAND LEVER

REMOVAL

(1) Release parking brakes.

(2) Raise vehicle on hoist.

(3) Remove front cable adjusting nut and disengage cable tensioner from equalizer. Then remove front cable from tensioner (Fig. 35).

(4) Lower vehicle.

(5) Remove lever cover or center console if equipped. Refer to Group 23 Body for procedures.

(6) Disconnect parking brake switch wiring connectors (Fig. 36).

(7) Remove screws attaching parking brake lever to mount (Fig. 37).

(8) Disengage front cable from parking brake lever and remove lever assembly from vehicle.

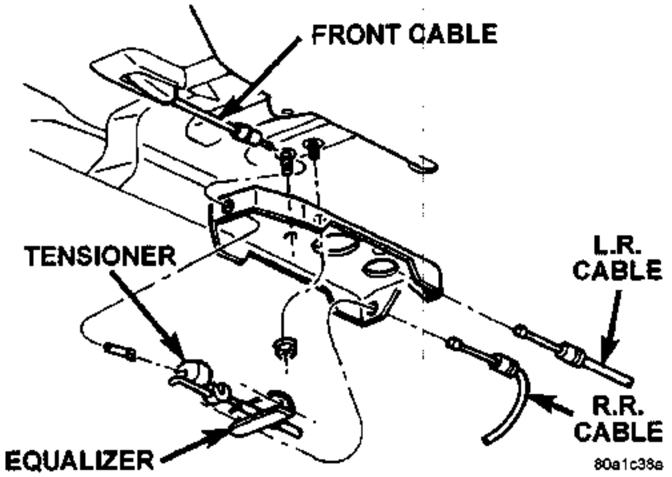


Fig. 35 Parking Brake Cable Attachment

INSTALLATION

(1) Install front cable on lever assembly.

(2) Install lever assembly on mounting bracket and tighten mounting bolts to 12 N·m (9 ft. lbs.).

(3) Connect parking brake switch wire.

(4) Install parking lever cover.

(5) Raise vehicle.

(6) Assemble front cable, cable tensioner and cable bracket.

(7) Adjust parking brake front cable.

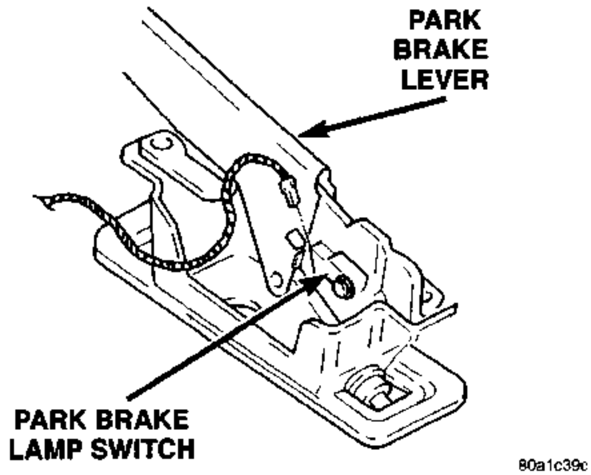


Fig. 36 Parking Brake Lamp Switch

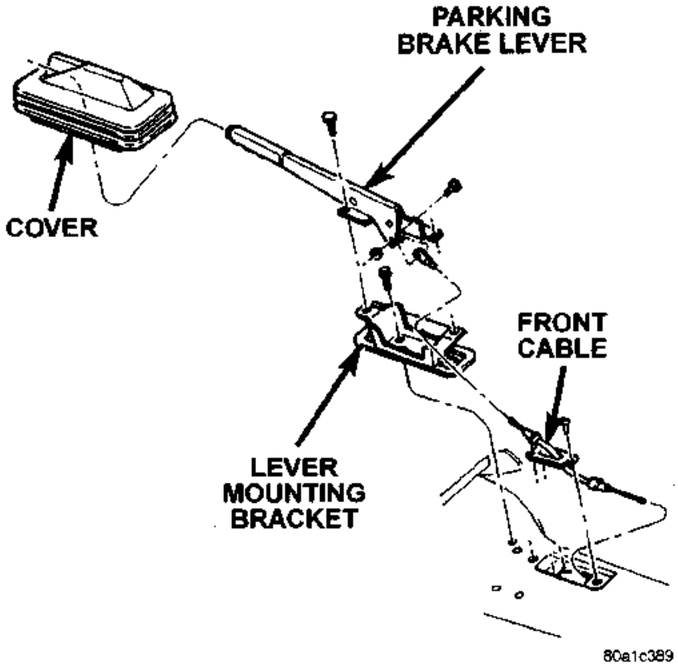


Fig. 37 Parking Brake Lever

(8) Lower vehicle.

REAR PARKING BRAKE CABLE

REMOVAL

(1) Raise vehicle and loosen equalizer nuts until rear cables are slack.

(2) Disengage cable from equalizer and remove cable (Fig. 35).

(3) Remove cable bracket from upper suspension arm (Fig. 38).

(4) Remove rear wheel and brake drum.

(5) Remove secondary brake shoe and disconnect cable from lever on brake shoe.

(6) Compress cable retainer with worm drive hose clamp (Fig. 39) and remove cable from backing plate.

REMOVAL AND INSTALLATION (Continued)

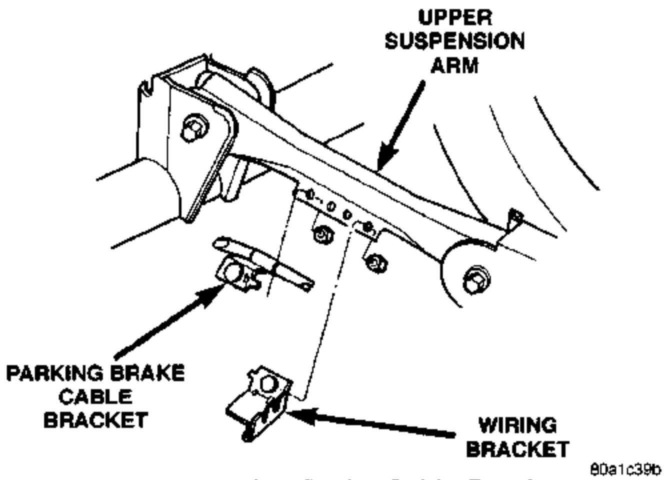


Fig. 38 Parking Brake Cable Bracket

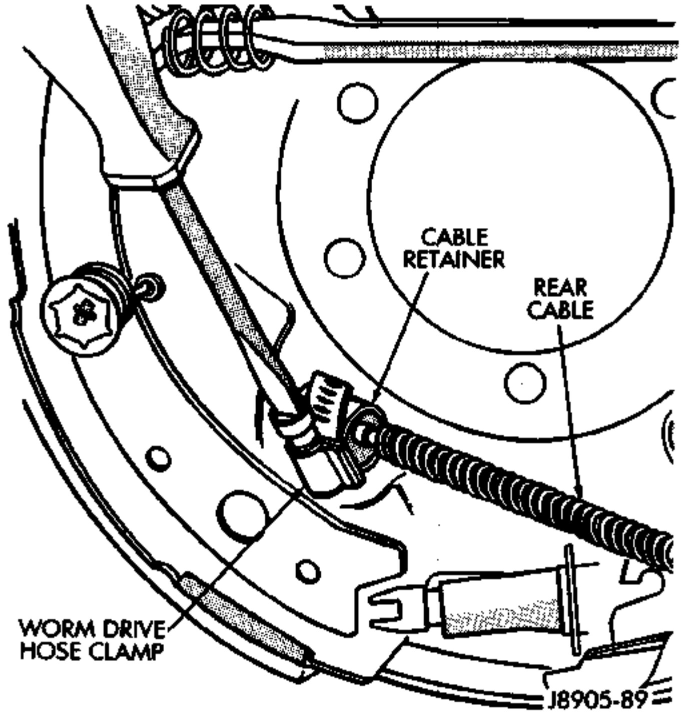


Fig. 39 Cable Retainer

INSTALLATION

(1) Install new cable in backing plate. Be sure cable retainer is seated.

(2) Attach cable to lever on brake shoe and install brake shoe on backing plate.

(3) Adjust brake shoes to drum with brake gauge.

(4) Install brake drum and wheel.

(5) Install cable/bracket on upper suspension arm.

(6) Engage cable in equalizer and install equalizer nuts.

(7) Adjust parking brakes.

DISASSEMBLY AND ASSEMBLY

MASTER CYLINDER RESERVOIR

REMOVAL

(1) Remove reservoir cap and empty fluid into drain container.

(2) Remove pins that retain reservoir to master cylinder. Use hammer and pin punch to remove pins (Fig. 40).

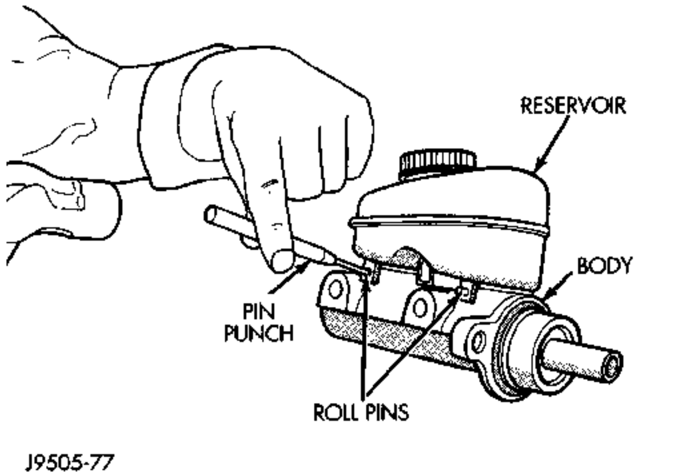


Fig. 40 Reservoir Retaining Pins

(3) Clamp cylinder body in vise with brass protective jaws.

(4) Loosen reservoir from grommets with pry tool (Fig. 41).

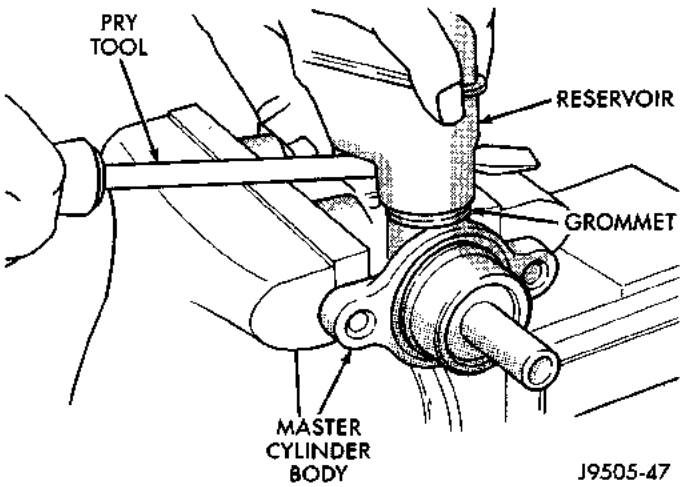


Fig. 41 Loosening Reservoir

(5) Remove reservoir by rocking it to one side and pulling free of grommets (Fig. 42).

(6) Remove old grommets from cylinder body (Fig. 43).

INSTALLATION

CAUTION: Do not use any type of tool to install the grommets. Tools may cut, or tear the grommets creating a leak problem after installation. Install the grommets using finger pressure only.

DISASSEMBLY AND ASSEMBLY (Continued)

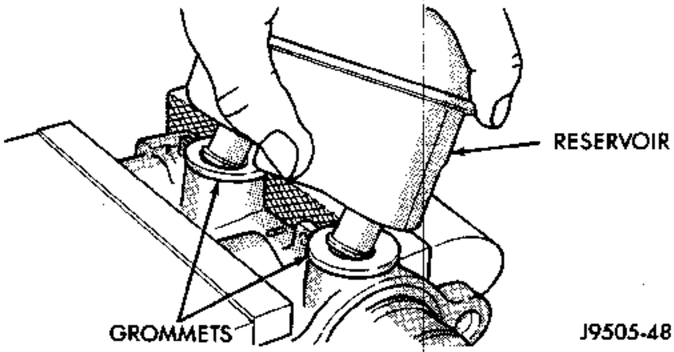


Fig. 42 Reservoir Removal

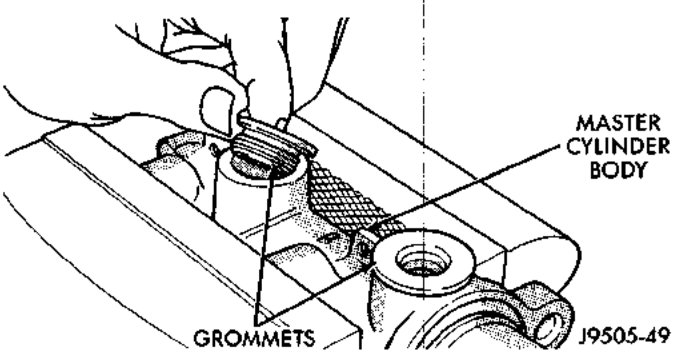


Fig. 43 Grommet Removal

(1) Lubricate new grommets with clean brake fluid and Install new grommets in cylinder body (Fig. 44). Use finger pressure to install and seat grommets.

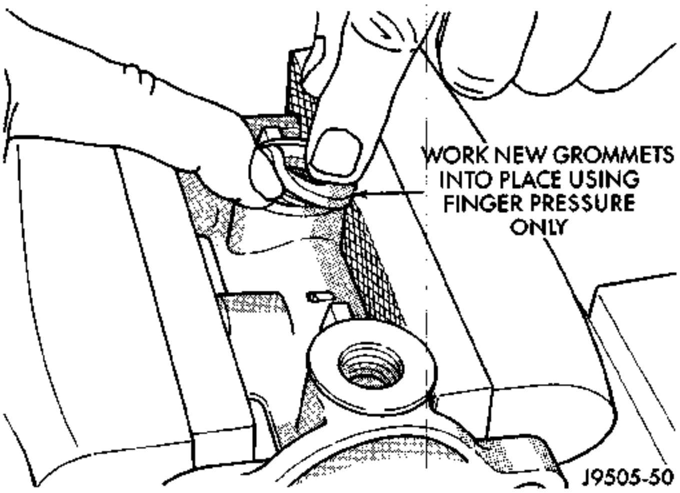


Fig. 44 Grommet Installation

(2) Start reservoir in grommets. Then rock reservoir back and forth while pressing downward to seat it in grommets.

(3) Install pins that retain reservoir to cylinder body.

(4) Fill and bleed master cylinder on bench before installation in vehicle.

DISC BRAKE CALIPER

DISASSEMBLY

(1) Remove brake shoes from caliper.

(2) Drain brake fluid out of caliper.

(3) Pad interior of caliper with minimum, 2.54 cm (1 in.) thickness of shop towels or rags (Fig. 45). Towels are needed to protect caliper piston during removal.

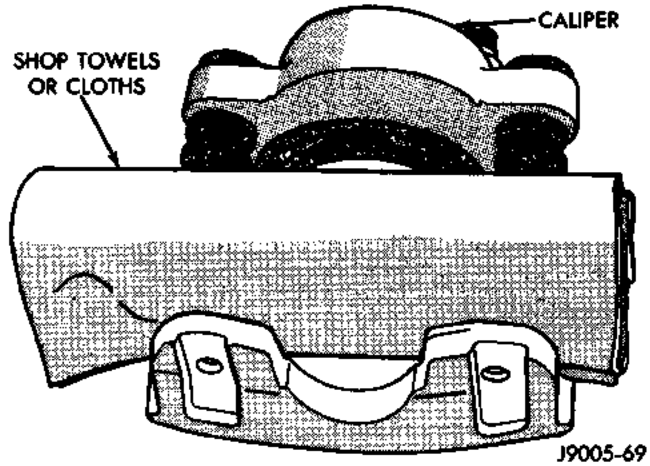


Fig. 45 Padding Caliper Interior

(4) Remove caliper piston with **short bursts** of low pressure compressed air. Direct air through fluid inlet port and ease piston out of bore (Fig. 46).

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. NEVER attempt to catch the piston as it leaves the bore. This will result in personal injury.

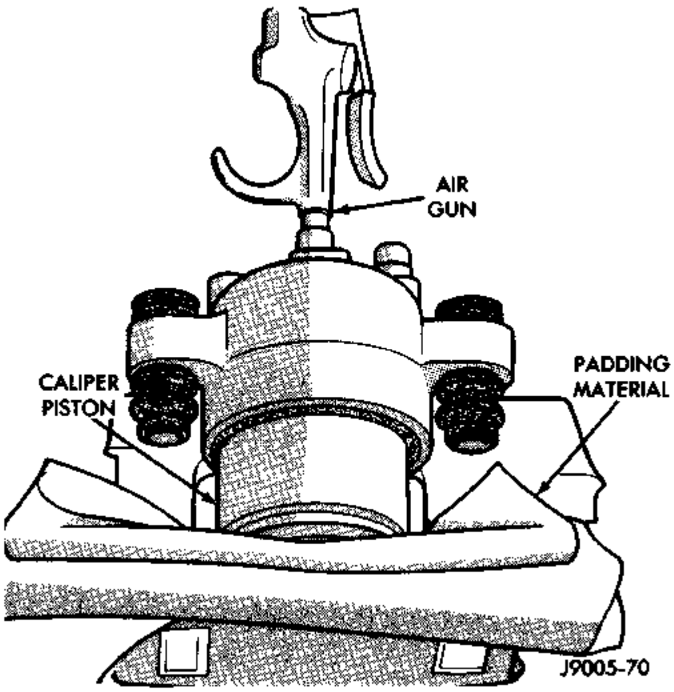


Fig. 46 Caliper Piston Removal

(5) Remove caliper piston dust boot with suitable tool (Fig. 47) and discard boot.

(6) Remove caliper piston seal with wood or plastic tool (Fig. 48) and discard seal. Do not use metal tools as they will scratch piston bore.

DISASSEMBLY AND ASSEMBLY (Continued)

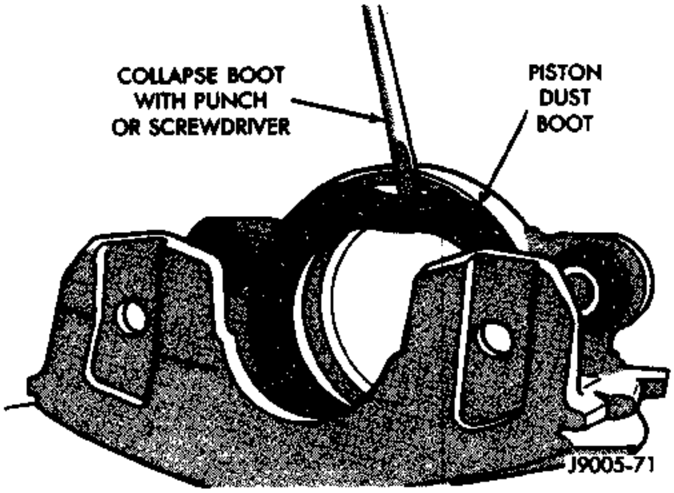


Fig. 47 Caliper Piston Dust Boot Removal

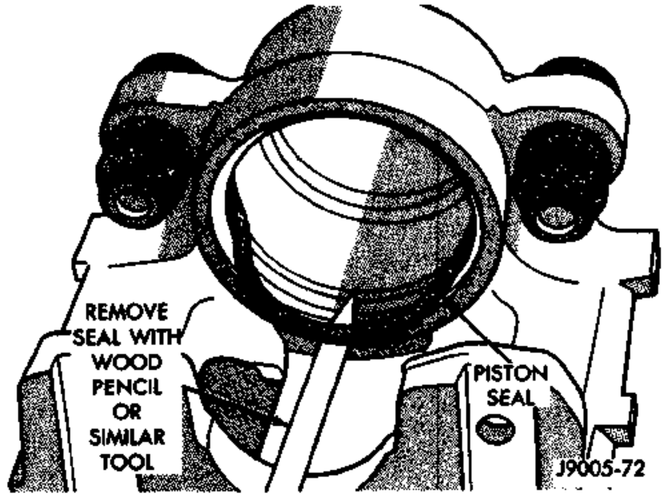


Fig. 48 Piston Seal Removal

(7) Remove caliper mounting bolt bushings and boots (Fig. 49).

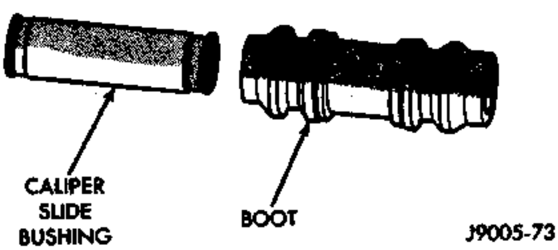


Fig. 49 Mounting Bolt Bushing And Boot

ASSEMBLY

(1) Coat caliper piston bore, new piston seal and piston with clean brake fluid.

(2) Lubricate caliper bushings and interior of bushing boots with Dielectric silicone grease.

(3) Install bushing boots in caliper, then insert bushing into boot and push bushing into place (Fig. 50).

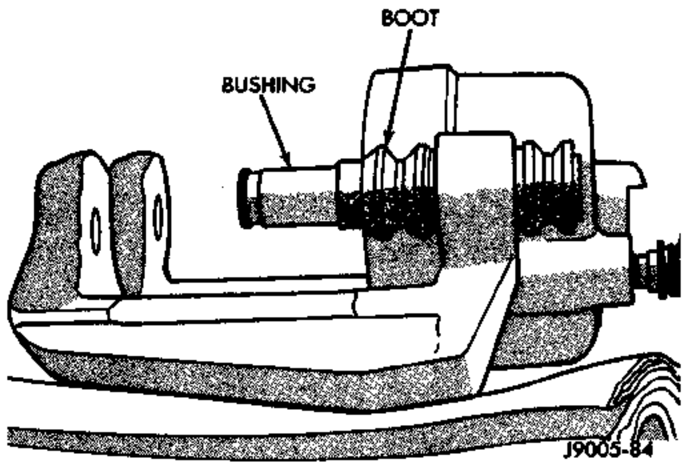


Fig. 50 Bushings And Boots Installation

(4) Install new piston seal into seal groove with finger (Fig. 51).

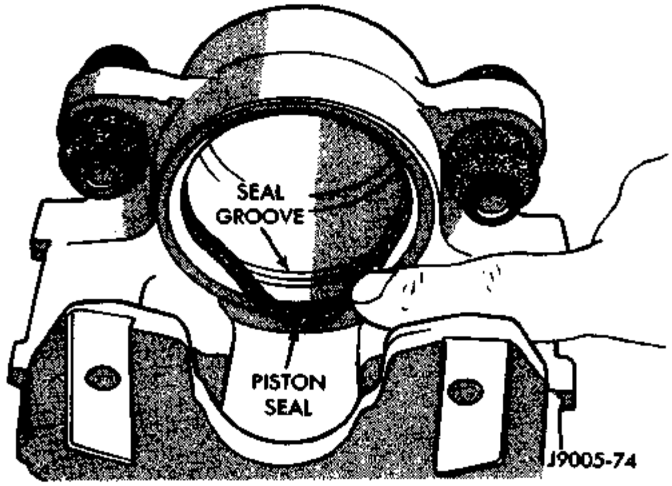


Fig. 51 Piston Seal Installation

(5) Install dust boot on caliper piston and seat boot in piston groove (Fig. 52).

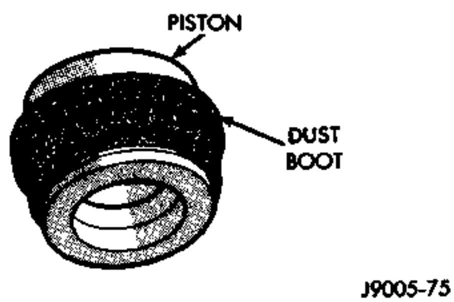


Fig. 52 Dust Boot On Piston

DISASSEMBLY AND ASSEMBLY (Continued)

(6) Press piston into caliper bore by hand, use a turn and push motion to work piston into seal (Fig. 53).

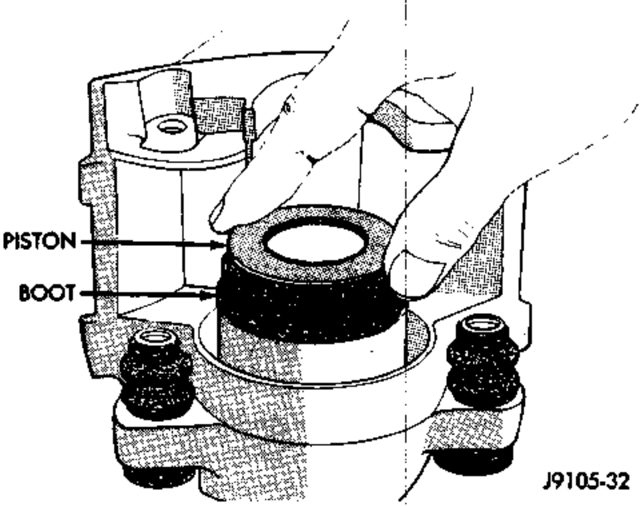


Fig. 53 Caliper Piston Installation

(7) Press caliper piston to bottom of bore.
(8) Seat dust boot in caliper with Installer Tool C-4842 and Tool Handle C-4171 (Fig. 54).

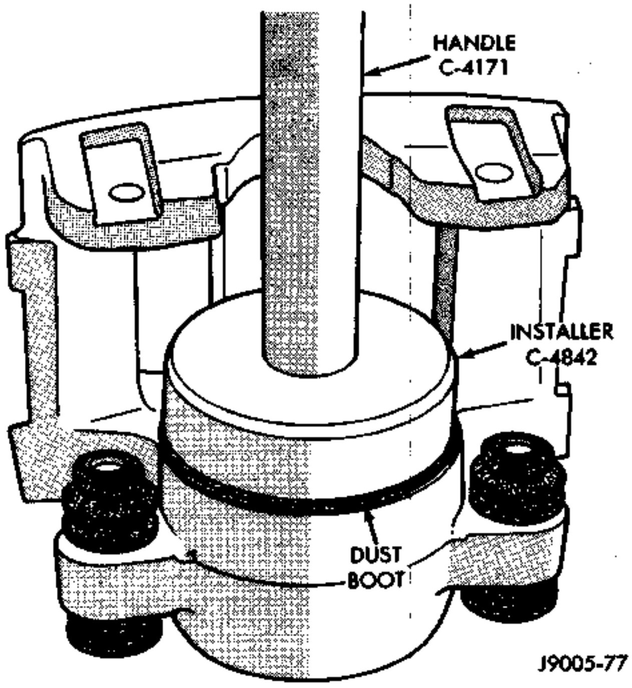


Fig. 54 Piston Dust Boot Installation

(9) Replace caliper bleed screw if removed.

WHEEL CYLINDER

DISASSEMBLY

(1) Remove push rods and boots (Fig. 55).
(2) Press pistons, cups and spring and expander out of cylinder bore.
(3) Remove bleed screw.

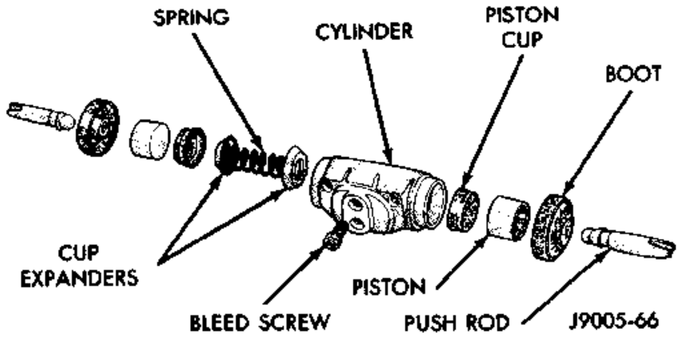


Fig. 55 Wheel Cylinder Components

ASSEMBLY

(1) Lubricate wheel cylinder bore, pistons, piston cups and spring and expander with clean brake fluid.
(2) Install first piston in cylinder bore. Then install first cup in bore and against piston. **Be sure lip of piston cup is facing inward (toward spring and expander) and flat side is against piston.**
(3) Install spring and expander followed by remaining piston cup and piston.
(4) Install boots on each end of cylinder and insert push rods in boots.
(5) Install cylinder bleed screw.

CLEANING AND INSPECTION

CALIPER

CLEANING

Clean the caliper components with clean brake fluid or brake clean only. Do not use gasoline, kerosene, thinner, or similar solvents. 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.

INSPECTION

The piston is made from a phenolic resin (plastic material) and should be smooth and clean.

Replace the piston if cracked or scored. Do not attempt to restore a scored piston surface by sanding or polishing. The piston must be replaced if damaged.

NOTE: If the caliper piston must be replaced, install the same type of piston in the caliper. Never interchange phenolic resin and steel caliper pistons. The pistons, seals, seal grooves, caliper bore and piston tolerances are different for resin and steel pistons. Do not intermix these components at any time.

CLEANING AND INSPECTION (Continued)

The bore can be lightly polished with a brake hone to remove very minor surface imperfections (Fig. 56). The caliper should be replaced if the bore is severely corroded, rusted, scored, or if polishing would increase bore diameter more than 0.025 mm (0.001 inch).

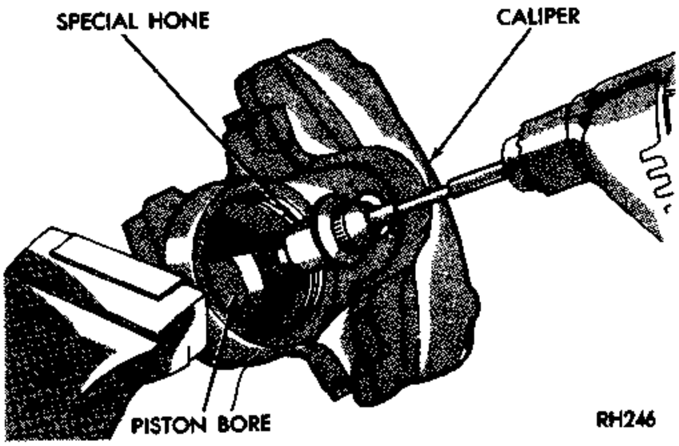


Fig. 56 Lightly Polishing Piston Bore With Tool

REAR DRUM BRAKE

CLEANING

Clean the individual brake components, including the support plate and wheel cylinder exterior, with a water dampened cloth or with brake cleaner. Do not use any other cleaning agents. Remove light rust and scale from the brake shoe contact pads on the support plate with fine sandpaper.

INSPECTION

As a general rule, riveted brake shoes should be replaced when worn to within 0.78 mm (1/32 in.) of the rivet heads. Bonded lining should be replaced when worn to a thickness of 1.6 mm (1/16 in.).

Examine the lining contact pattern to determine if the shoes are bent or the drum is tapered. The lining should exhibit contact across its entire width. Shoes exhibiting contact only on one side should be replaced and the drum checked for runout or taper.

Inspect the adjuster screw assembly. Replace the assembly if the star wheel threads are damaged, or the components are severely rusted or corroded.

Discard the brake springs and retainer components if worn distorted, or collapsed. Also replace the springs if a brake drag condition had occurred. Overheating will distort and weaken the springs.

Inspect the brake shoe contact pads on the support plate, replace the support plate if any of the pads are worn or rusted through. Also replace the plate if it is bent or distorted (Fig. 57).

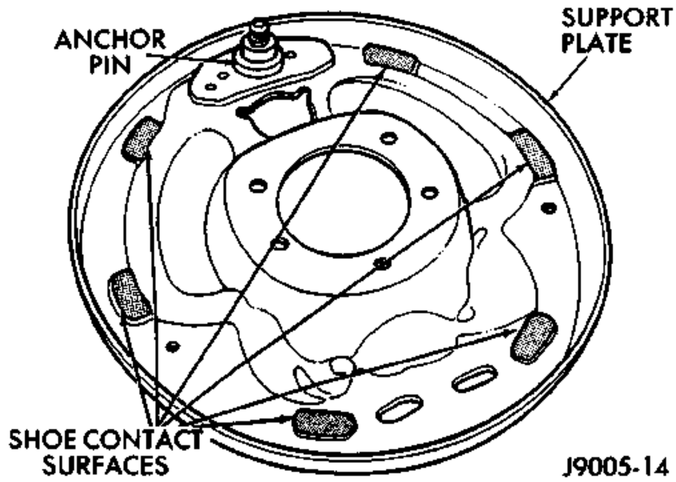


Fig. 57 Shoe Contact Surfaces

WHEEL CYLINDER

CLEANING

Clean the cylinder and pistons with clean brake fluid or brake cleaner only. Do not use any other cleaning agents.

Dry the cylinder and pistons with compressed air. Do not use rags or shop towels to dry the cylinder components. Lint from cloth material will adhere to the cylinder bores and pistons.

INSPECTION

Inspect the cylinder bore. Light discoloration and dark stains in the bore are normal and will not impair cylinder operation.

The cylinder bore can be lightly polished but only with crocus cloth. Replace the cylinder if the bore is scored, pitted or heavily corroded. Honing the bore to restore the surface is not recommended.

Inspect the cylinder pistons. The piston surfaces should be smooth and free of scratches, scoring and corrosion. Replace the pistons if worn, scored, or corroded. Do attempt to restore the surface by sanding or polishing.

Discard the old piston cups and the spring and expander. These parts are not reusable. The original dust boots may be reused but only if they are in good condition.

ADJUSTMENTS

STOP LAMP SWITCH

(1) Press and hold brake pedal in applied position.

(2) Pull switch plunger all the way out to fully extended position.

(3) Release brake pedal. Then pull pedal fully rearward. Pedal will set plunger to correct position as pedal pushes plunger into switch body. Switch will make racheting sound as it self adjusts.

ADJUSTMENTS (Continued)

PARKING BRAKE CABLE TENSIONER

NOTE: Parking brake adjustment is only necessary when the tensioner, or a cable has been replaced or disconnected for service. When adjustment is necessary, perform the following procedure for proper parking brake operation.

ADJUSTMENT

(1) Raise vehicle.

(2) Back off tensioner adjusting nut to create slack in cables.

(3) Remove rear wheel/tire assemblies and remove brake drums.

(4) Check rear brake shoe adjustment with standard brake gauge. **Excessive shoe-to-drum clearance, or worn brake components will result in faulty parking brake adjustment and operation.**

(5) Verify that parking brake cables operate freely and are not binding, or seized. Replace faulty cables, before proceeding.

(6) Reinstall brake drums and wheel/tire assemblies after brake shoe adjustment is complete.

(7) Lower vehicle enough for access to parking brake lever. Then **fully** apply parking brakes. Leave brakes applied until adjustment is complete.

(8) Raise vehicle and mark tensioner rod 6.5 mm (1/4 in.) from tensioner bracket (Fig. 58).

(9) Tighten adjusting nut at equalizer until mark on tensioner rod moves into alignment with tensioner bracket.

(10) Lower vehicle until rear wheels are 15-20 cm (6-8 in.) off shop floor.

(11) Release parking brake lever and verify that rear wheels rotate freely without drag.

(12) Lower vehicle.

NOTE: Do not loosen/tighten equalizer adjusting nut for any reason after completing adjustment.

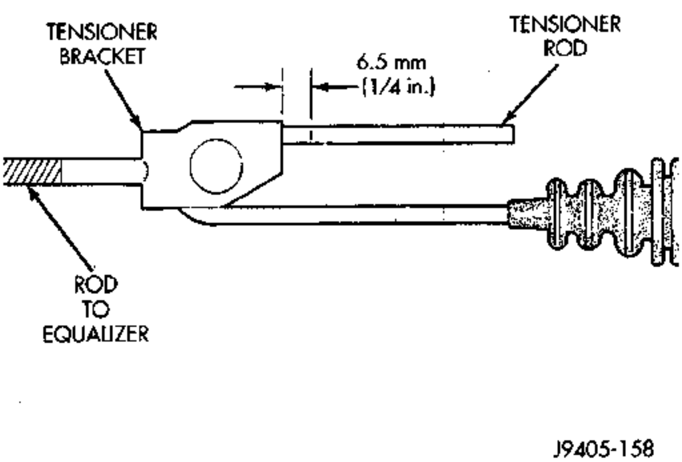


Fig. 58 Tensioner Rod Measurement

REAR DRUM BRAKE

The rear drum brakes are equipped with a self-adjusting mechanism. Under normal circumstances, the only time adjustment is required is when the shoes are replaced, removed for access to other parts, or when one or both drums are replaced.

Adjustment can be made with a standard brake gauge or with adjusting tool. Adjustment is performed with the complete brake assembly installed on the backing plate.

ADJUSTMENT WITH BRAKE GAUGE

(1) Be sure parking brakes are fully released.

(2) Raise rear of vehicle and remove wheels and brake drums.

(3) Verify that left and right automatic adjuster levers and cables are properly connected.

(4) Insert brake gauge in drum. Expand gauge until gauge inner legs contact drum braking surface. Then lock gauge in position (Fig. 59).

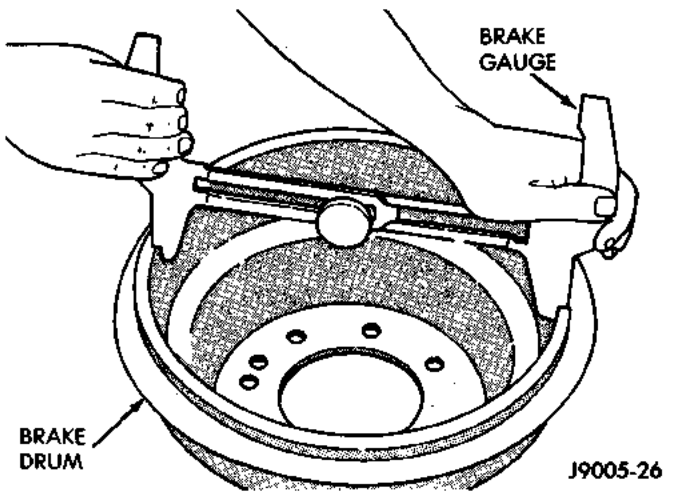


Fig. 59 Adjusting Gauge On Drum

(5) Reverse gauge and install it on brake shoes. Position gauge legs at shoe centers as shown (Fig. 60). If gauge does not fit (too loose/too tight), adjust shoes.

(6) Pull shoe adjuster screw star wheel away from adjuster lever.

(7) Turn adjuster screw star wheel (by hand) to expand or retract brake shoes. Continue adjustment until gauge outside legs are light drag-fit on shoes.

(8) Install brake drums and wheels and lower vehicle.

(9) Drive vehicle and make one forward stop followed by one reverse stop. Repeat procedure 8-10 times to operate automatic adjusters and equalize adjustment.

ADJUSTMENTS (Continued)

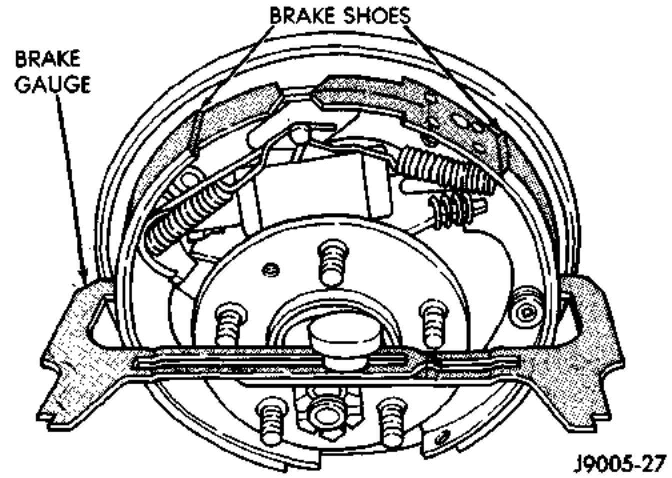


Fig. 60 Adjusting Gauge On Brake Shoes

NOTE: Bring vehicle to complete standstill at each stop. Incomplete, rolling stops will not activate automatic adjusters.

ADJUSTMENT WITH ADJUSTING TOOL

(1) Be sure parking brake lever is fully released.

(2) Raise vehicle so rear wheels can be rotated freely.

(3) Remove plug from each access hole in brake support plates.

(4) Loosen parking brake cable adjustment nut until there is slack in front cable.

(5) Insert adjusting tool through support plate access hole and engage tool in teeth of adjusting screw star wheel (Fig. 61).

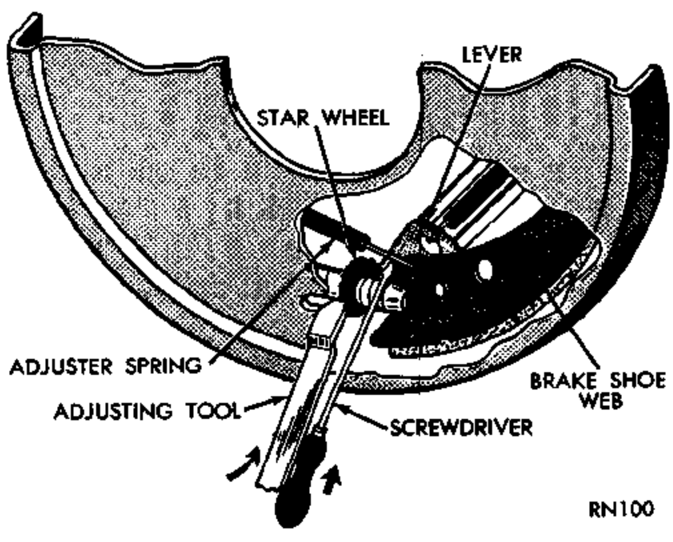


Fig. 61 Brake Adjustment

(6) Rotate adjuster screw star wheel (move tool handle upward) until slight drag can be felt when wheel is rotated.

(7) Push and hold adjuster lever away from star wheel with thin screwdriver.

(8) Back off adjuster screw star wheel until brake drag is eliminated.

(9) Repeat adjustment at opposite wheel. Be sure adjustment is equal at both wheels.

(10) Install support plate access hole plugs.

(11) Adjust parking brake cable and lower vehicle.

(12) Install brake drums and wheels and lower vehicle.

(13) Drive vehicle and make one forward stop followed by one reverse stop. Repeat procedure 8-10 times to operate automatic adjusters and equalize adjustment.

NOTE: Bring vehicle to complete standstill at each stop. Incomplete, rolling stops will not activate automatic adjusters.

SPECIFICATIONS

BRAKE FLUID

The brake fluid used in this vehicle must conform to DOT 3 specifications and SAE J1703 standards. No other type of brake fluid is recommended or approved for usage in the vehicle brake system. Use only Mopar brake fluid or an equivalent from a tightly sealed container.

CAUTION: Never use reclaimed brake fluid or fluid from an container which has been left open. An open container will absorb moisture from the air and contaminate the fluid.

CAUTION: Never use any type of a petroleum-based fluid in the brake hydraulic system. Use of such type fluids will result in seal damage of the vehicle brake hydraulic system causing a failure of the vehicle brake system.

BRAKE COMPONENTS

Disc Brake Caliper
Type . . . . Sliding

Disc Brake Rotor
Type . . . . Ventilated
Max. Runout. . . . . 0.12 mm (0.005 in.)
Max. Thickness Variation . . . 0.013mm (0.0005 in.)

Brake Drum
Size . . . . 9 x 2.5 in.

Brake Booster
Type. . . . . Tandem Diaphragm

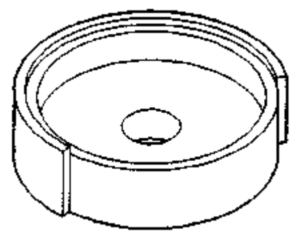
SPECIFICATIONS (Continued)

TORQUE CHART

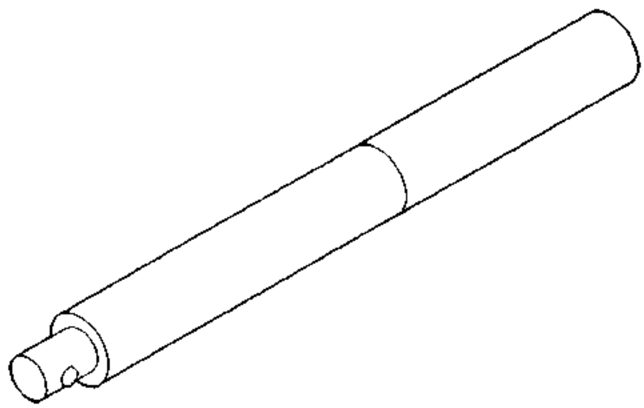
DESCRIPTION	TORQUE
Brake Pedal	
Support Bolt	28 N·m (21 ft. lbs.)
Brake Booster	
Mounting Nuts	37 N·m (27 ft. lbs.)
Master Cylinder	
Mounting Nuts	24 N·m (18 ft. lbs.)
Brake Lines	15 N·m (11 ft. lbs.)
Combination Valve	
Mounting Nuts	24 N·m (18 ft. lbs.)
Brake Lines	21 N·m (15 ft. lbs.)
Caliper	
Mounting Bolts	15 N·m (11 ft. lbs.)
Brake Hose Bolt	31 N·m (23 ft. lbs.)
Wheel Cylinder	
Mounting Bolts	10 N·m (7 ft. lbs.)
Brake Line	16 N·m (12 ft. lbs.)
Parking Brake	
Lever Bolts	12 N·m (9 ft. lbs.)
Lever Bracket Bolts	12 N·m (9 ft. lbs.)
Cable Retainer Nut	1.5 N·m (14 in. lbs.)

SPECIAL TOOLS

BASE BRAKES



Installer Caliper Dust Boot C-4842



Handle C-4171

ANTILOCK BRAKES

INDEX

GENERAL INFORMATION

ANTILOCK BRAKE SYSTEM

The antilock brake system (ABS) is an electronically operated, all wheel brake control system.

The system is designed to prevent wheel lockup and maintain steering control during periods of high wheel slip when braking. Preventing lockup is accomplished by modulating fluid pressure to the wheel brake units.

The hydraulic system is a three channel design. The front wheel brakes are controlled individually and the rear wheel brakes in tandem (Fig. 1). The ABS electrical system is separate from other electrical circuits in the vehicle. A specially programmed controller antilock brake unit operates the system components.

ABS system major components include:

- Controller Antilock Brakes (CAB)
- Hydraulic Control Unit (HCU)
- Wheel Speed Sensors (WSS)
- Acceleration Switch
- Main Relay And Pump Motor Relay
- ABS Warning Light
- Pump Motor Sensor

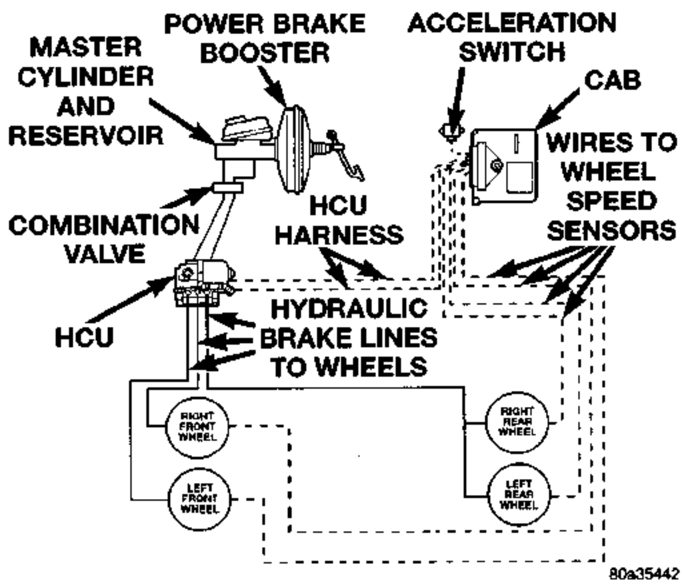


Fig. 1 Antilock Brake System

DESCRIPTION AND OPERATION

ANTILOCK BRAKE SYSTEM

Battery voltage is supplied to the CAB ignition terminal when the ignition switch is turned to Run position. The CAB performs a system initialization procedure at this point. Initialization consists of a static and dynamic self check of system electrical components.

The static check occurs after the ignition switch is turned to Run position. The dynamic check occurs when vehicle road speed reaches approximately 10 kph (6 mph). During the dynamic check, the CAB briefly cycles the pump and solenoids to verify operation.

If an ABS component exhibits a fault during initialization, the CAB illuminates the amber warning light and registers a fault code in the microprocessor memory.

DESCRIPTION AND OPERATION (Continued)

NORMAL BRAKING

The CAB monitors wheel speed sensor inputs continuously while the vehicle is in motion. However, the CAB will not activate any ABS components as long as sensor inputs 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.

ANTILOCK BRAKING

The purpose of the antilock system is to prevent wheel lockup during periods of high wheel slip. Preventing lockup helps maintain vehicle braking action and steering control.

The antilock CAB activates the system whenever sensor signals indicate periods of high wheel slip. High wheel slip can be described as the point where wheel rotation begins approaching 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 prevents lockup during high slip conditions by modulating fluid apply pressure to the wheel brake units.

Brake fluid apply pressure is modulated according to wheel speed, degree of slip and rate of deceleration. A sensor at each wheel converts wheel speed into electrical signals. These signals are transmitted to the CAB for processing and determination of wheel slip and deceleration rate.

The ABS system has three fluid pressure control channels. The front brakes are controlled separately and the rear brakes in tandem. A speed sensor input signal indicating a high slip condition activates the CAB antilock program.

Two solenoid valves are used in each antilock control channel. The valves are all located within the HCU valve body and work in pairs to either increase, hold, or decrease apply pressure as needed in the individual control channels.

The solenoid valves are not static during antilock braking. They are cycled continuously to modulate pressure. Solenoid cycle time in antilock mode can be measured in milliseconds.

CONTROLLER ANTILOCK BRAKES

The CAB is located under the instrument panel to the right side of the steering column. It is mounted to bracket with one bolt. The bracket is mounted to the front upper cowl panel.

The CAB operates the ABS system (Fig. 2) and is separate from other vehicle electrical circuits. CAB voltage source is through the ignition switch in the RUN position.

The CAB contains dual microprocessors. A logic block in each microprocessor receives identical sensor signals. These signals are processed and compared simultaneously.

The CAB contains a self check program that illuminates the ABS warning light when a system fault is detected. Faults are stored in a diagnostic program memory and are accessible with the DRB scan tool.

ABS faults remain in memory until cleared, or until after the vehicle is started approximately 50 times. Stored faults are **not** erased if the battery is disconnected.

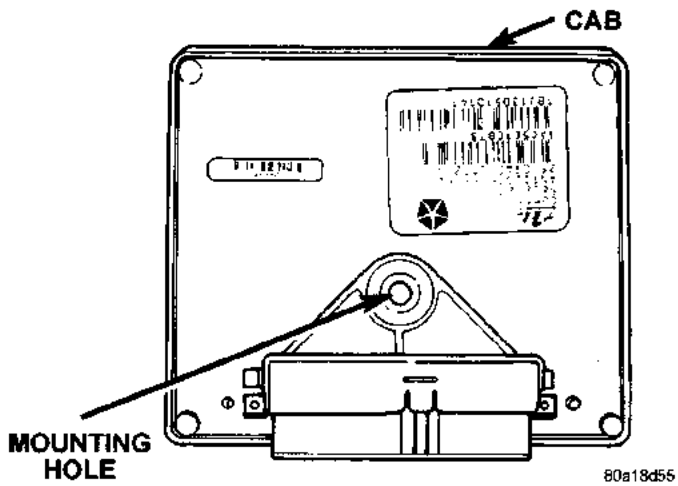


Fig. 2 Controller Antilock Brakes

HYDRAULIC CONTROL UNIT

The hydraulic control unit (HCU) consists of a valve body, pump body, accumulators, pump motor, and wire harnesses (Fig. 3).

The pump, motor, and accumulators are combined into an assembly attached to the valve body. The accumulators store the extra fluid released to the system for ABS mode operation. The pump provides the fluid volume needed and is operated by a DC type motor. The motor is controlled by the CAB.

The valve body contains the solenoid valves. The valves modulate brake pressure during antilock braking and are controlled by the CAB.

The HCU provides three channel pressure control to the front and rear brakes. One channel controls the rear wheel brakes in tandem. The two remaining channels control the front wheel brakes individually.

During antilock braking, the solenoid valves are opened and closed as needed. The valves are not static. They are cycled rapidly and continuously to modulate pressure and control wheel slip and deceleration.

During normal braking, the HCU solenoid valves and pump are not activated. The master cylinder and power booster operate the same as a vehicle without an ABS brake system.

DESCRIPTION AND OPERATION (Continued)

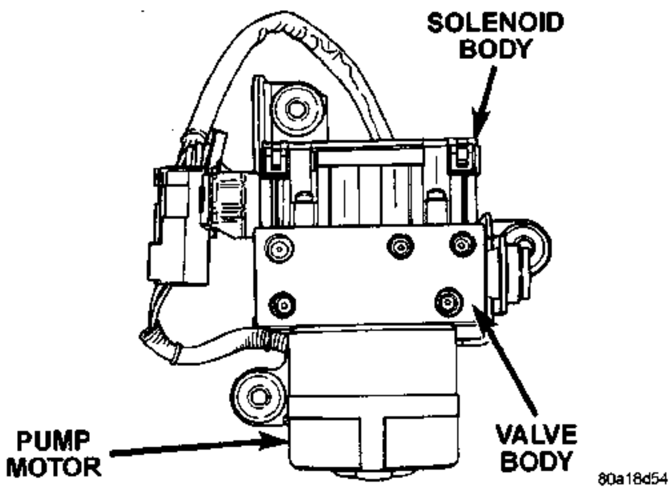


Fig. 3 Hydraulic Controller Unit

During antilock braking, solenoid valve pressure modulation occurs in three stages, pressure increase, pressure hold, and pressure decrease. The valves are all contained in the valve body portion of the HCU.

Pressure Decrease

The outlet valve is opened and the inlet valve is closed during the pressure decrease cycle.

A pressure decrease cycle is initiated when speed sensor signals indicate high wheel slip at one or more wheels. At this point, the CAB opens the outlet valve, which also opens the return circuit to the accumulators. Fluid pressure is allowed to bleed off (decrease) as needed to prevent wheel lock.

Once the period of high wheel slip has ended, the CAB closes the outlet valve and begins a pressure increase or hold cycle as needed.

Pressure Hold

Both solenoid valves are closed in the pressure hold cycle. Fluid apply pressure in the control channel is maintained at a constant rate. The CAB maintains the hold cycle until sensor inputs indicate a pressure change is necessary.

Pressure Increase

The inlet valve is open and the outlet valve is closed during the pressure increase cycle. The pressure increase cycle is used to counteract unequal wheel speeds. This cycle controls re-application of fluid apply pressure due to changing road surfaces or wheel speed.

WHEEL SPEED SENSORS AND TONE WHEEL

A speed sensor is used at each wheel. The front sensors are mounted to the steering knuckles. The rear sensors are mounted to the rear brake backing plate.

The sensors convert wheel speed into a small AC electrical signal. This signal is transmitted to the CAB. The CAB convert the AC signal into a digital signal for each wheel. This voltage is generated by magnetic induction when a tone wheel passes by the stationary magnetic of the wheel speed sensor.

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. 4). The front/rear sensors have the same electrical values but are not interchangeable. The sensors have a resistance between 900 and 1300 ohms.

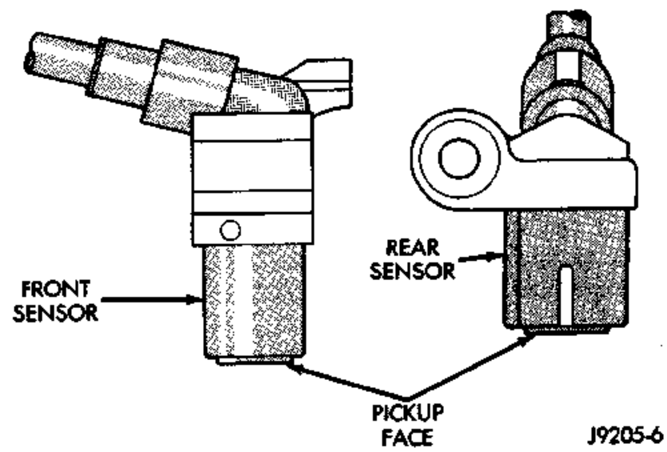


Fig. 4 Typical Wheel Speed Sensors

SPEED SENSOR AIR GAP

Front Sensor

Front sensor air gap is fixed and not adjustable. Only rear sensor air gap is adjustable.

Although front air gap is not adjustable, it can be checked if diagnosis indicates this is necessary. Front air gap should be 0.40 to 1.3 mm (0.0157 to 0.051 in.). If gap is incorrect, the sensor is either loose, or damaged.

Rear Sensor

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. Rear sensor air gap is 0.28-1.5 mm (0.011-0.059 in.).

Sensor air gap measurement, or adjustment procedures are provided in this section. Refer to the front, or rear sensor removal and installation procedures as required.

DESCRIPTION AND OPERATION (Continued)

COMBINATION VALVE

The combination valve contains a pressure differential valve and switch and a rear brake proportioning valve. The valve is not repairable. It must be replaced if diagnosis indicates this is necessary.

The pressure differential switch is connected to the brake warning light. The switch is actuated by movement of the switch valve. The switch monitors fluid pressure in the separate front/rear brake hydraulic circuits.

A decrease or loss of fluid pressure in either hydraulic circuit will cause the switch valve to shuttle to the low pressure side. Movement of the valve pushes the switch plunger upward. This action closes the switch internal contacts completing the electrical circuit to the red warning light. The switch valve will remain in an actuated position until repairs are made.

The rear proportioning valve is used to balance front-rear brake action. The valve allows normal fluid flow during moderate effort brake stops. The valve only controls (meters) fluid flow during high effort brake stops.

ACCELERATION SWITCH

The acceleration switch is located in front of the console/shifter mounted to a bracket on the floor pan.

The switch (Fig. 5), provides an additional vehicle deceleration reference during 4-wheel drive operation. The switch is monitored by the CAB at all times. The switch reference signal is utilized by the CAB when all wheels are decelerating at the same speed.

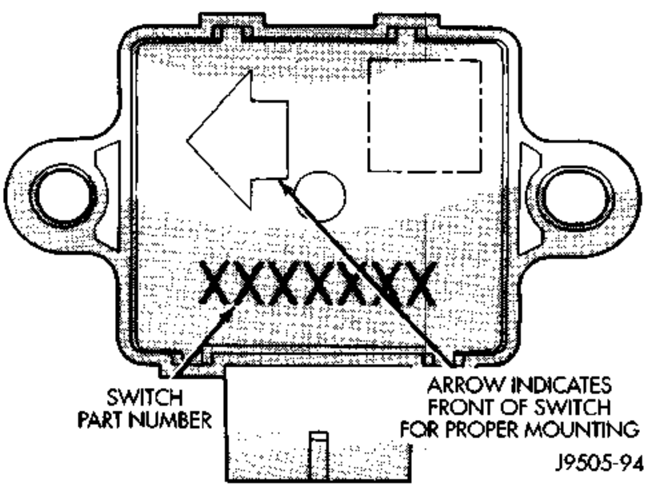


Fig. 5 Acceleration Switch

ABS SYSTEM RELAYS

The ABS brakes has two relays, which are the system and pump motor relays. The ABS system relay is used for the solenoid valves and CAB. The system relay is connected to the CAB at the power control relay terminal. The pump motor relay is used for the pump motor only. The pump motor relay starts/stops the pump motor when signaled by the CAB.

The relays are located in the power distribution box in the engine compartment.

ABS WARNING LAMP

The amber ABS warning lamp is located in the instrument cluster. The lamp illuminates at start-up to perform a self check. The lamp goes out when the self check program determines the system is operating normal. If an ABS component exhibits a fault the CAB will illuminate the lamp and register a trouble code in the microprocessor. The lamp is controlled by the CAB and or the main relay through an in-harness diode. The CAB controls the lamp by directly grounding the circuit. The main relay grounds the lamp circuit when it is de-energized.

DIAGNOSIS AND TESTING

ANTILOCK BRAKES

The ABS brake system performs several self-tests every time the ignition switch is turned on and the vehicle is driven. The CAB monitors the systems input and output circuits to verify the system is operating correctly. If the on board diagnostic system senses that a circuit is malfunctioning the system will set a trouble code in its memory.

NOTE: The MDS or DRB III scan tool is used to diagnose the ABS system. For additional information refer to the Antilock Brake section in Group 8W. For test procedures refer to the Chassis Diagnostic Manual.

SERVICE PROCEDURES

BLEEDING ABS BRAKE SYSTEM

ABS system bleeding requires conventional bleeding methods plus use of the DRB scan tool. The procedure involves performing a base brake bleeding, followed by use of the scan tool to cycle and bleed the HCU pump and solenoids. A second base brake bleeding procedure is then required to remove any air remaining in the system.

(1) Perform base brake bleeding. Refer to base brake section for procedure.

(2) Connect scan tool to ABS diagnostic connector under carpet at front of console, just under instrument panel center bezel.

(3) Select CHASSIS SYSTEM, followed by TEVES ABS BRAKES, then BLEED BRAKES. When scan

SERVICE PROCEDURES (Continued)

tool displays TEST COMPLETE, disconnect scan tool and proceed.

(4) Perform base brake bleeding a second time. Refer to base brake section for procedure.

(5) Top off master cylinder fluid level and verify proper brake operation before moving vehicle.

REMOVAL AND INSTALLATION

CONTROLLER ANTILOCK BRAKES

REMOVAL

(1) Remove negative battery terminal.

(2) Remove the harness connector from the CAB located underneath the instrument panel (Fig. 6).

(3) Remove mounting bolt and remove the CAB.

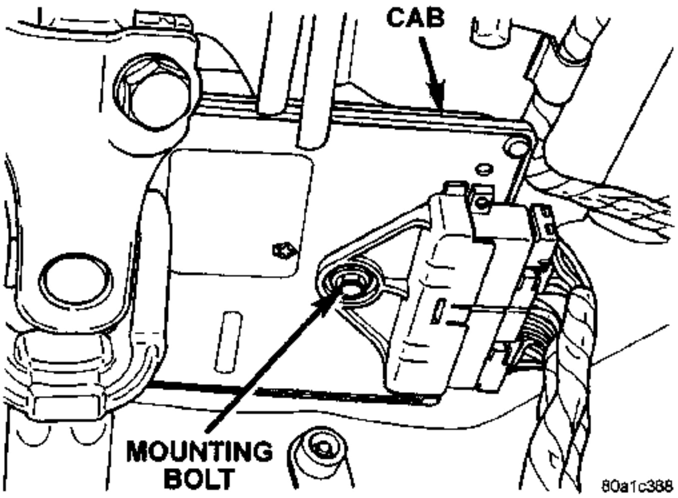


Fig. 6 Controller Antilock Brakes

INSTALLATION

(1) Install the controller and install the mounting bolt.

(2) Tighten the mounting bolt to 8 N·m (70 in. lbs.).

(3) Plug in the harness connector into the controller.

(4) Install negative battery cable.

HYDRAULIC CONTROLLER UNIT

REMOVAL

(1) Disconnect and isolate the negative battery terminal.

(2) Disconnect the HCU harness connectors.

(3) Remove all the brake lines from the HCU (Fig. 7).

(4) Remove HCU mounting bolts and remove HCU (Fig. 8).

(5) Remove bolts from mount and remove mount from HCU.

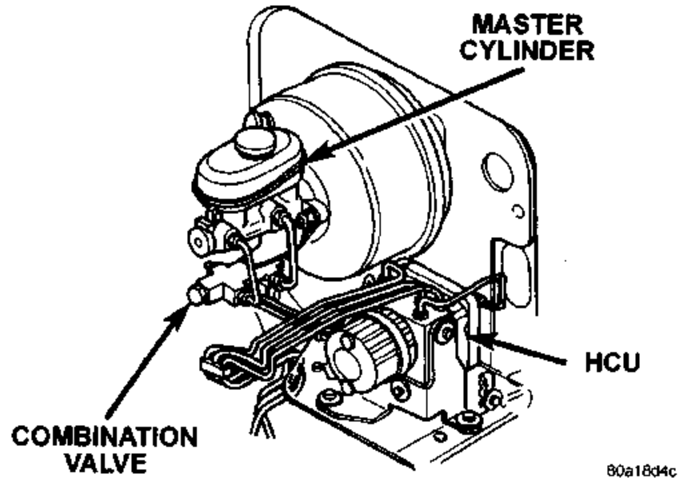


Fig. 7 HCU Brake Lines

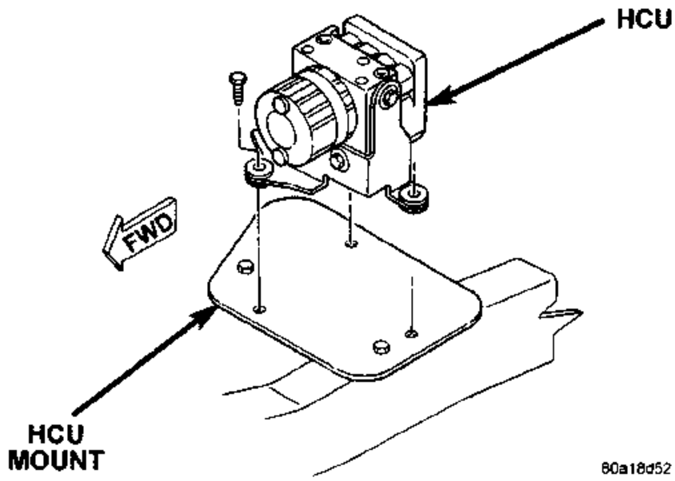


Fig. 8 HCU Mount

INSTALLATION

(1) Install mount on HCU and tighten to 6.5 N·m (57 in. lbs.).

(2) Install HCU and tighten mounting bolts to 20 N·m (177 in. lbs.).

(3) Align and start brake line fittings by hand to avoid cross threading.

(4) Tighten brake lines to 16 N·m (144 in. lbs.).

(5) Connect HCU harness.

(6) Connect negative battery terminal.

(7) Bleed complete brake system.

FRONT WHEEL SENSOR

REMOVAL

(1) Raise vehicle and turn wheel outward to access the sensor.

(2) Disconnect sensor wire connector at harness plug.

(3) Remove sensor wire from mounting retainers.

(4) Clean sensor and surrounding area with shop towel before removal.

REMOVAL AND INSTALLATION (Continued)

(5) Remove bolt attaching sensor to steering knuckle and remove sensor (Fig. 9).

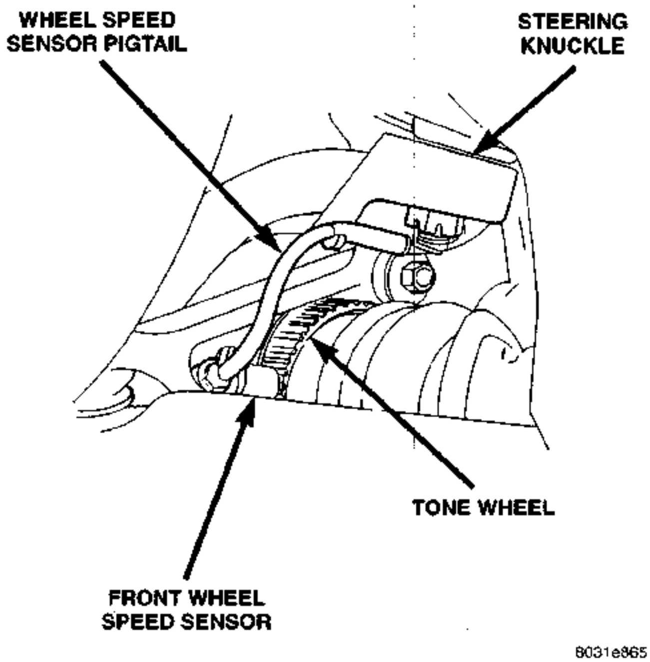


Fig. 9 Front Wheel Speed Sensor

INSTALLATION

(1) If **original** sensor will be installed, wipe all traces of old spacer material off sensor pickup face. Use a dry shop towel for this purpose.

(2) Apply Mopar Lock N' Seal or Loctite 242 to bolt that secures sensor in steering knuckle. Use new sensor bolt if original bolt is worn or damaged.

(3) Position sensor on steering knuckle. Seat sensor locating tab in hole in knuckle and install sensor attaching bolt finger tight.

(4) Tighten sensor attaching bolt to 14 N·m (11 ft. lbs.).

(5) If original sensor has been installed, check sensor air gap. Air gap should be 0.40 to 1.3 mm (0.0157 to 0.051 in.). If gap is incorrect, sensor is either loose, or damaged.

(6) Route sensor wire and install into mounting retainers.

(7) Connect sensor wire to harness.

REAR WHEEL SPEED SENSOR

REMOVAL

(1) Disconnect sensors at rear harness connectors.

(2) Remove wheel and tire assembly.

(3) Remove brake drum.

(4) Remove clips securing sensor wires to brake lines, rear axle and, brake hose.

(5) Unseat sensor wire support plate grommet.

(6) Remove bolt attaching sensor to bracket and remove sensor.

INSTALLATION

(1) If **original sensor** is being installed, remove any remaining pieces of cardboard spacer from sensor pickup face. Use dry shop towel only to remove old spacer material.

(2) Insert sensor wire through support plate hole. Then seat sensor grommet in support plate.

(3) Apply Mopar Lock N' Seal or Loctite 242 to original sensor bolt. Use new bolt if original is worn or damaged.

(4) Install sensor bolt finger tight only at this time.

(5) If **original** rear sensor was installed, adjust sensor air gap to 0.28-1.5 mm (0.011-0.059 in.). Use feeler gauge to measure air gap (Fig. 10). Tighten sensor bolt to 11 N·m (11 ft. lbs.).

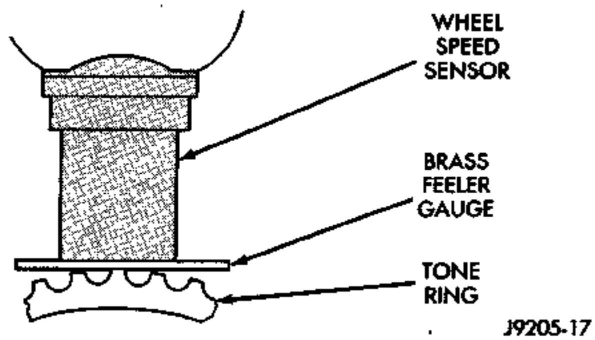


Fig. 10 Setting Air Gap On Original Rear Sensor

(6) If **new** sensor was installed, push cardboard spacer on sensor face against tone ring (Fig. 11). Then tighten sensor bolt to 8 N·m (6 ft. lbs.). Correct air gap will be established as tone ring rotates and peels spacer off sensor face.

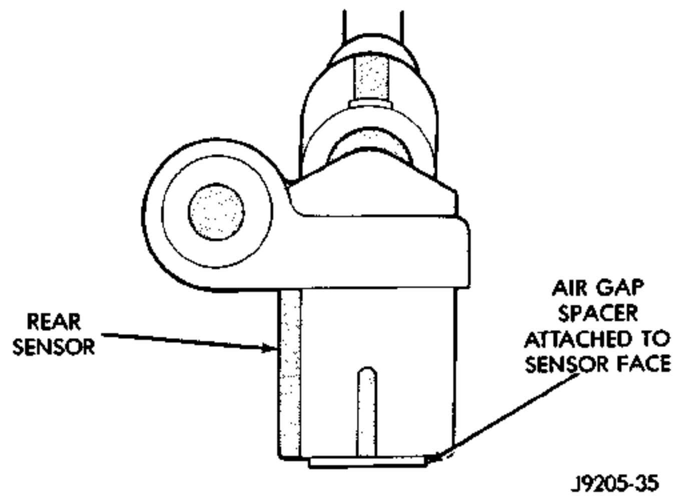


Fig. 11 New Rear Sensor

(7) Secure the rear sensor wires to the retainer clips. Verify that wire is clear of rotating components.

(8) Connect sensor wire to harness connector.

REMOVAL AND INSTALLATION (Continued)

(9) Install brake drum and wheel and tire assembly.

(10) Lower vehicle.

(11) Connect sensor wire to harness connector.

COMBINATION VALVE

REMOVAL

(1) Remove brake lines that connect master cylinder to combination valve (Fig. 12).

(2) Disconnect brake lines that connect combination valve to HCU.

(3) Disconnect wire from combination valve switch terminal. Be careful when separating wire connector as lock tabs are easily damaged if not fully disengaged.

(4) Remove nuts attaching combination valve bracket to booster studs and valve bracket off booster studs (Fig. 13).

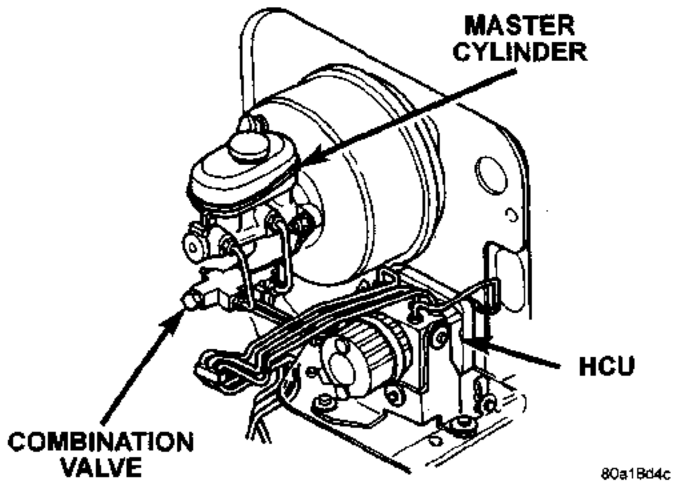


Fig. 12 Combination Valve Brake Lines

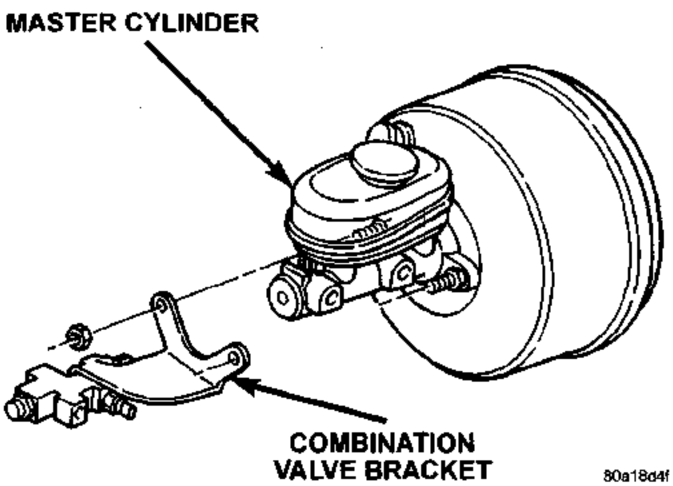


Fig. 13 Combination Valve Bracket

INSTALLATION

(1) Position valve bracket on booster studs and tighten bracket attaching nuts to 17 N·m (13 ft. lbs.).

(2) Align and start brake line fittings in combination valve, master cylinder and HCU by hand to avoid cross threading.

(3) Tighten brake line fittings at combination valve to 21 N·m (15 ft. lbs.).

(4) Tighten brake line fittings at master cylinder to 15 N·m (11 ft. lbs.).

(5) Tighten brake line fittings at HCU to 16 N·m (12 ft. lbs.).

(6) Connect wire to differential pressure switch in combination valve.

(7) Bleed base brake system.

ACCELERATION SWITCH

REMOVAL

(1) From the drivers side lift carpet back in front of the console/shifter.

(2) Disconnect harness for switch.

(3) Remove mounting bolts and remove switch (Fig. 14).

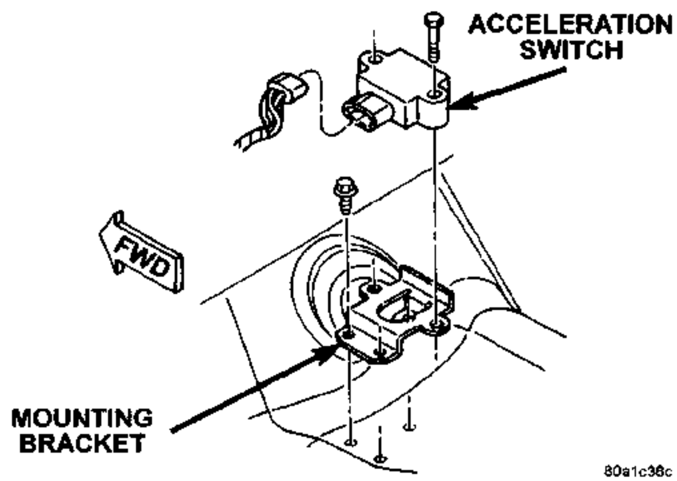


Fig. 14 Acceleration Switch

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

CAUTION: The acceleration switch must be installed with the arrow pointing toward the front of the vehicle (Fig. 15). The switch will not operate properly in any other position.

(1) Position switch on mounting bracket.
(2) Install mounting bolts and tighten to 4.5 N·m (40 in. lbs.)
(3) Connect harness to switch.
(4) Place carpet back into position.

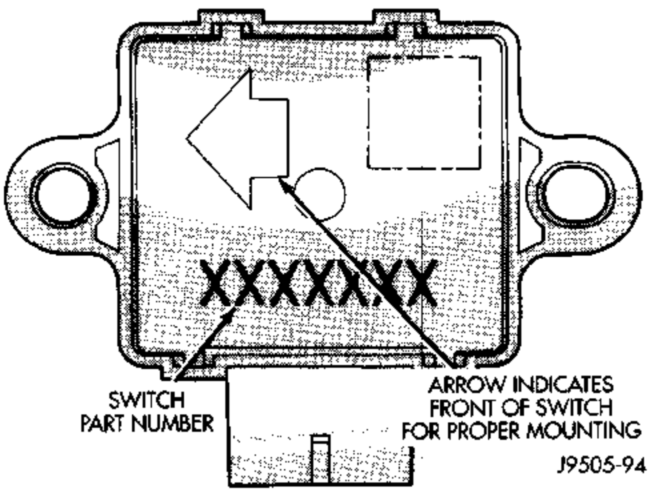


Fig. 15 Acceleration Switch Position Indicator

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Acceleration Sensor	
Sensor Bolt	8-9 N·m (71-83 in. lbs.)
Bracket Bolt	1-2 N·m (13-18 in. lbs.)
Hydraulic Control Unit	
Mounting bolts	20 N·m (177 in. lbs.)
Bracket Mounting bolts	4-9 N·m (35-76 in. lbs.)
Brake Lines	16 N·m (144 in. lbs.)
Controller Anitlock Brakes	
Mounting Bolts	8-13 N·m (75-115 in. lbs.)
Wheel Speed Sensors	
Front Mounting Bolt	4-6 (34-50 in. lbs.)
Rear Mounting Bolt	12-14 N·m (106-124 in. lbs.)

CLUTCH

CONTENTS

GENERAL INFORMATION

CLUTCH COMPONENTS

The clutch mechanism in TJ models consists of a single, dry-type disc and a diaphragm style clutch cover. A hydraulic linkage is used to operate the clutch release bearing and fork.

A needle-type pilot bearing supports the transmission input shaft in the crankshaft. A conventional 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 in the housing. The release fork is actuated by a hydraulic slave cylinder mounted on the housing. The slave cylinder is operated by a clutch master cylinder mounted on the dash panel. The cylinder push rod is connected to the clutch pedal.

The clutch disc has cushion springs in the disc hub. The clutch disc facing is riveted to the hub. The facing is made from a non-asbestos material. The clutch cover pressure plate is a diaphragm type with a one-piece spring and multiple release fingers. The pressure plate release fingers are preset during manufacture and are not adjustable.

HYDRAULIC LINKAGE COMPONENTS

The hydraulic linkage consists of a clutch master cylinder with integral reservoir, a clutch slave cylinder and an interconnecting fluid line.

The clutch master cylinder push rod is connected to the clutch pedal. The slave cylinder push rod is connected to the clutch release fork. The master cylinder is mounted on the driver side of the dash panel adjacent to the brake master cylinder and booster assembly. This positioning is similar for both left and right hand drive models.

INSTALLATION METHODS AND PARTS USAGE

Distortion of clutch components during installation and the use of non-standard components are common 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 Removal and Installation section.

An improperly seated flywheel and/or clutch housing are additional causes of clutch failure. Improper seating will produce misalignment and additional clutch problems.

The use of non-standard or low quality parts will also lead to problems and wear. Use recommended factory quality parts to avoid comebacks.

A cocked pilot bearing is another cause of clutch noise, drag, hard shifting, and rapid bearing wear. Always use an alignment tool to install a new bearing. This practice helps avoid cocking the bearing during installation.

CLUTCH INTERLOCK SAFETY SWITCH BY-PASS

WARNING: This procedure is intended for use only off-road. When the vehicle is returned to road use, properly connect the clutch interlock safety switch. Dangerous conditions may result.

The Clutch Interlock Safety Switch will inhibit the starter cranking circuit until the clutch pedal is

GENERAL INFORMATION (Continued)

depressed. In some off-road situations this safety feature is not desirable.

BY-PASS PROCEDURE

(1) Disengage wire connector from clutch interlock safety switch, located under the instrument panel next to the 100–way connector (Fig. 1).

(2) Locate open by-pass connector, located next to the 100–way connector.

(3) Engage clutch interlock switch harness connector into by-pass connector (Fig. 1).

Reverse the preceding procedure to activate the Clutch Interlock Safety Switch.

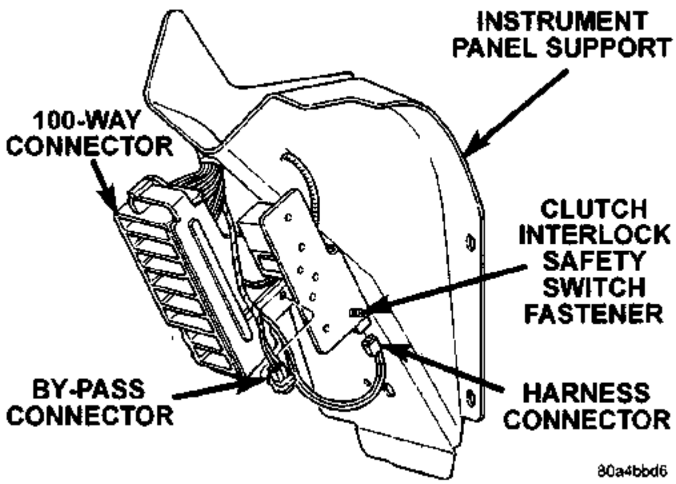


Fig. 1 Clutch Interlock Safety Switch By-Pass

DESCRIPTION AND OPERATION

CLUTCH OPERATION

Leverage, clamping force, and friction are what make the clutch work. The disc serves as the friction element and a diaphragm spring and pressure plate provide the clamping force. The clutch pedal, hydraulic linkage, release lever and bearing provide the leverage.

The clutch cover assembly clamps the disc against the flywheel. The assembly consists of the cover, diaphragm spring, pressure plate, and fulcrum components. The pressure plate clamps the clutch disc against the flywheel and the spring provides the clamping force.

The clutch disc friction material is riveted to the disc hub. The hub bore is splined for installation on the transmission input shaft. The hub splines connect the disc to the transmission.

The clutch linkage uses hydraulic pressure to operate the clutch. The clutch master cylinder push rod is connected to the clutch pedal and the slave cylinder push rod is connected to the release lever in the clutch housing.

Depressing the clutch pedal develops fluid pressure in the clutch master cylinder. This pressure is transmitted to the slave cylinder through a connecting line. In turn, the slave cylinder operates the clutch release lever.

The clutch release bearing is mounted on the transmission front bearing retainer. The bearing is attached to the release lever, which moves the bearing into contact with the clutch cover diaphragm spring.

Slave cylinder force causes the release lever to move the release bearing into contact with the diaphragm spring. As additional force is applied, the bearing presses the diaphragm spring fingers inward on the fulcrums. This action moves the pressure plate rearward relieving clamp force on the disc. The clutch disc is disengaged and freewheeling at this point.

The process of clutch re-engagement is simply the reverse of what occurs during disengagement. Releasing pedal pressure removes clutch linkage pressure. The release bearing moves away from the diaphragm spring which allows the pressure plate to exert clamping force on the clutch disc.

DIAGNOSIS AND TESTING

DIAGNOSTIC INFORMATION

Unless the cause of a clutch problem is obvious, accurate problem diagnosis will usually require a road test to confirm a problem. Component inspection (Fig. 2) will then be required to determine the actual problem cause.

During a road test, drive the vehicle at normal speeds. Shift the transmission through all gear ranges and observe clutch action. If chatter, grab, slip, or improper release is experienced, remove and inspect the clutch components. However, if the problem is noise or hard shifting, further diagnosis may be needed as the transmission or another driveline component may be at fault. Careful observation during the test will help narrow the problem area.

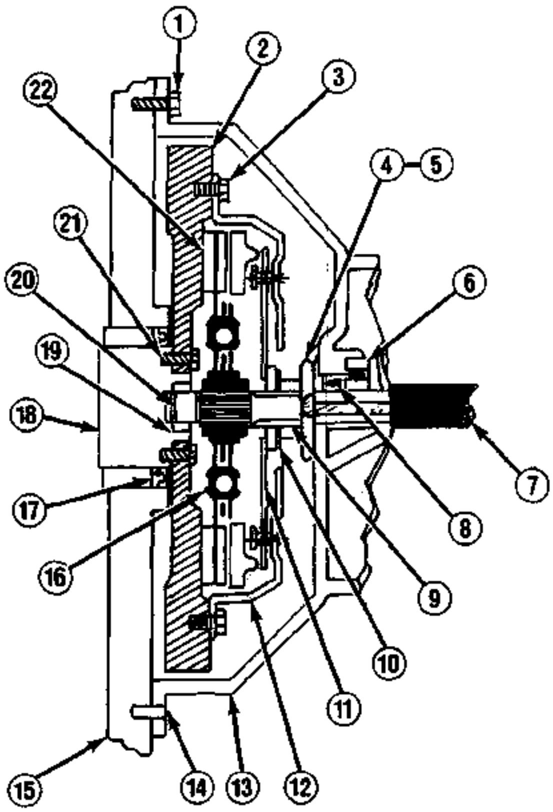
CLUTCH CONTAMINATION

Fluid contamination is a frequent cause of clutch malfunctions. Oil, water, or clutch fluid on the clutch disc and pressure plate surfaces will cause chatter, slip and grab.

During inspection, note if any components are contaminated with oil, hydraulic fluid, or water/road splash.

Oil contamination indicates a leak at either the rear main seal or transmission input shaft. Oil leakage produces a residue of oil on the housing interior and on the clutch cover and flywheel. Heat buildup caused by slippage between the cover, disc and flywheel, can sometimes bake the oil residue onto the

DIAGNOSIS AND TESTING (Continued)



1 Check clutch housing bolts. Tighten if loose. Be sure housing is fully seated on engine block.

2 Check flywheel. Scuff sand face to remove glaze. Clean surface with wax and grease remover. Replace flywheel if severely scored, worn or cracked. Secure flywheel with new bolts (if removed). Do not reuse old bolts. Use Mopar Lock N'Seal on bolts.

3 Tighten clutch cover bolts 2-3 threads at a time, alternately and evenly (in a star pattern) to specified torque. Failure to do so could warp the cover.

4 Check release fork. Replace fork if bent or worn. Make sure pivot and bearing contact surfaces are lubricated.

5 Check release fork pivot (in housing). Be sure pivot is secure and ball end is lubricated.

6 Transmission input shaft bearing will cause noise, chatter, or improper release if damaged. Check condition before installing transmission.

7 Check slave cylinder. Replace it if leaking. Be sure cylinder is properly secured in housing and cylinder piston is seated in release fork.

8 Check input shaft seal if clutch cover and disc were oil covered. Replace seal if worn, or cut.

9 Inspect release bearing slide surface of trans. front bearing retainer. Surface should be smooth, free of nicks, scores. Replace retainer if necessary. Lubricate slide surface before installing release bearing.

10 Do not replace release bearing unless actually faulty. Replace bearing only if seized, noisy, or damaged.

11 Check clutch cover diaphragm spring and release fingers. Replace cover if spring or fingers are bent, warped, broken, cracked. Do not tamper with factory spring setting as clutch problems will result.

12 Check condition of clutch cover. Replace clutch cover if plate surface is deeply scored, warped, worn, or cracked. Be sure cover is correct size and properly aligned on disc and flywheel.

13 Inspect clutch housing. Be sure bolts are tight. Replace housing if damaged.

14 Verify that housing alignment dowels are in position before installing housing.

15 Clean engine block surface before installing clutch housing. Dirt, grime can produce misalignment.

16 Make sure side of clutch disc marked "flywheel side" is toward flywheel.

17 Check rear main seal if clutch disc and cover were oil covered. Replace seal if necessary.

18 Check crankshaft flange (if flywheel is removed). Be sure flange is clean and flywheel bolt threads are in good condition.

19 Check pilot bearing. Replace bearing if damaged. Lube with Mopar high temp. bearing grease before installation.

20 Check transmission input shaft. Disc must slide freely on shaft splines. Lightly grease splines before installation. Replace shaft if splines or pilot bearing hub are damaged.

21 Check flywheel bolt torque. If bolts are loose, replace them. Use Mopar Lock N'Seal to secure new bolts.

22 Check clutch disc facing. Replace disc if facing is charred, scored, flaking off, or worn. Also check runout of new disc. Runout should not exceed 0.5 mm (0.02 in.).

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Fig. 2 Clutch Components And Inspection

DIAGNOSIS AND TESTING (Continued)

components. The glaze-like residue ranges in color from amber to black.

Road splash contamination means dirt/water is entering the clutch housing due to loose bolts, housing cracks, or through hydraulic line openings. Driving through deep water puddles can force water/road splash into the housing through such openings.

Clutch fluid leaks are usually from damaged slave cylinder push rod seals. This type of leak can only be confirmed by visual inspection.

CLUTCH MISALIGNMENT

Clutch components must be in proper alignment with the crankshaft and transmission input shaft. Misalignment caused by excessive runout or warpage of any clutch component will cause grab, chatter and improper clutch release.

FLYWHEEL RUNOUT

Check flywheel runout whenever misalignment is suspected. Flywheel runout should not exceed 0.08 mm (0.003 in.). Measure runout at the outer edge of the flywheel face with a dial indicator. Mount the indicator on a stud installed in place of one of the flywheel bolts.

Common causes of runout are:
- heat warpage
- improper machining
- incorrect bolt tightening
- improper seating on crankshaft flange shoulder
- foreign material on crankshaft flange

Flywheel machining is not recommended. The flywheel clutch surface is machined to a unique contour and machining will negate this feature. However, minor flywheel scoring can be cleaned up by hand with 180 grit emery, or with surface grinding equipment. Remove only enough material to reduce scoring (approximately 0.001 - 0.003 in.). Heavy stock removal is **not recommended.** Replace the flywheel if scoring is severe and deeper than 0.076 mm (0.003 in.). Excessive stock removal can result in flywheel cracking or warpage after installation; it can also weaken the flywheel and interfere with proper clutch release.

Clean the crankshaft flange before mounting the flywheel. Dirt and grease on the flange surface may cock the flywheel causing excessive runout. Use new bolts when remounting a flywheel and secure the bolts with Mopar Lock And Seal. Tighten flywheel bolts to specified torque only. Overtightening can distort the flywheel hub causing runout.

CLUTCH COVER AND DISC RUNOUT

Check the clutch disc before installation. Axial (face) runout of a **new** disc should not exceed 0.50 mm (0.020 in.). Measure runout about 6 mm (1/4 in.) from the outer edge of the disc facing. Obtain another disc if runout is excessive.

Check condition of the clutch before installation. A warped cover or diaphragm spring will cause grab and incomplete release or engagement. Be careful when handling the cover and disc. Impact can distort the cover, diaphragm spring, release fingers and the hub of the clutch disc.

Use an alignment tool when positioning the disc on the flywheel. The tool prevents accidental misalignment which could result in cover distortion and disc damage.

A frequent cause of clutch cover distortion (and consequent misalignment) is improper bolt tightening.

CLUTCH HOUSING MISALIGNMENT

Clutch housing alignment is important to proper clutch operation. The housing maintains alignment between the crankshaft and transmission input shaft. Misalignment can cause clutch noise, hard shifting, incomplete release and chatter. It can also result in premature wear of the pilot bearing, cover release fingers and clutch disc. In severe cases, misalignment can also cause premature wear of the transmission input shaft and front bearing.

Housing misalignment is generally caused by incorrect seating on the engine or transmission, loose housing bolts, missing alignment dowels, or housing damage. Infrequently, misalignment may also be caused by housing mounting surfaces that are not completely parallel. Misalignment can be corrected with shims.

INSPECTION AND DIAGNOSIS CHARTS

The clutch inspection chart (Fig. 2) outlines items to be checked before and during clutch installation. Use the chart as a check list to help avoid overlooking potential problem sources during service operations.

The diagnosis charts describe common clutch problems, causes and correction. Fault conditions are listed at the top of each chart. Conditions, causes and corrective action are outlined in the indicated columns.

The charts are provided as a convenient reference when diagnosing faulty clutch operation.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
DISC FACING WORN OUT	1. Normal wear. Driver frequently rides (slips) clutch. Results in rapid wear overheating. Insufficient clutch cover diaphragm spring tension.	1. Replace clutch disc. Also replace cover if spring is weak or pressure plate surface is damaged.
CLUTCH DISC FACING CONTAMINATED WITH OIL, GREASE, OR CLUTCH FLUID	1. Leak at rear main seal or at transmission input shaft seal. Excessive amount of grease applied to input shaft splines. Road splash, water entering housing. Slave cylinder leaking.	1. 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.
CLUTCH IS RUNNING PARTIALLY DISENGAGED	1. Release bearing sticking-binding. Does not return to normal running position.	1. Verify that bearing is actually binding, then replace bearing and transmission front bearing retainer if sleeve surface is damaged.
FLYWHEEL HEIGHT INCORRECT	1. Flywheel surface improperly machined. Too much stock removed or surface is tapered.	1. Replace flywheel.
WRONG DISC OR PRES-SURE PLATE INSTALLED	1. Incorrect parts order or model number.	1. Replace with correct parts. Compare old and new parts before installation.
CLUTCH DISC, COVER AND/OR DIAPHRAGM SPRING, WARPED, DISTORTED	1. Rough handling (impact) bent cover, spring, or disc. Incorrect bolt tightening sequence and method caused warped cover.	1. Install new disc or cover as needed. Follow installation/tightening instructions.
FACING ON FLYWHEEL SIDE OF DISC TORN, GOUGED, WORN	1. Flywheel surface scored and nicked.	1. Reduce scores and nicks by sanding or surface grinding. Replace flywheel if scores-nicks are deeper than .002-.004 inch.
CLUTCH DISC FACING BURNT (CHARRED). FLY-WHEEL AND COVER PRESSURE PLATE SURFACES HEAVILY GLAZED	1. Frequent operation under high loads or hard acceleration conditions. Driver frequently rides (slips) clutch. Results in rapid wear and overheating of disc and cover.	1. Scuff sand flywheel. Replace clutch cover and disc. Alert driver to problem cause.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
CLUTCH DISC WARPED	1. New disc not checked for axial runout before installation.	1. Replace disc. Be sure runout of new disc is less than .5 mm (.020 in.).
CLUTCH DISC BINDS ON INPUT SHAFT SPLINES	1. Clutch disc hub splines damaged during installation. Input shaft splines rough, damaged. Corrosion, rust formations on splines of disc and input shaft.	1. Clean, smooth and lubricate disc and shaft splines. Replace disc and/or input shaft if splines are severely damaged.
CLUTCH DISC RUSTED TO FLYWHEEL AND/OR PRESSURE PLATE	1. 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.	1. Remove clutch cover and disc. Sand rusted surfaces clean with 180 grit paper. Replace disc cover, and flywheel if corrosion is severe.
CLUTCH DISC FACING STICKS TO FLYWHEEL	1. Vacuum may form in pockets over rivet heads in clutch disc. Occurs as clutch cools down after use.	1. Drill 1/16 inch diameter hole through rivets and scuff sand disc facing with 180 grit paper.
CLUTCH DISC TOO THICK	1. Wrong disc installed.	1. Replace disc.
PILOT BEARING SEIZED, LOOSE, OR ROLLERS ARE WORN	1. Bearing cocked during installation. Bearing defective. Bearing not lubricated. Clutch misalignment.	1. Lubricate and install new bearing. Check and correct any misalignment.
CLUTCH WILL NOT DISENGAGE PROPERLY	1. Low clutch fluid level.	1. Top off reservoir and check for leaks.
	2. Clutch cover loose.	2. Tighten bolts.
	3. Wrong clutch disc.	3. Install correct disc.
	4. Disc bent, distorted during installation.	4. Replace disc.
	5. Clutch cover diaphragm spring bent or warped during transmission installation.	5. Replace cover.
	6. Clutch disc installed backwards.	6. Remove and reinstall disc correctly. Be sure disc side marked "to flywheel" is actually toward flywheel.
	7. Release fork bent or fork pivot is loose or damaged.	7. Replace fork and pivot if worn or damaged.
	8. Clutch master or slave cylinder fault.	8. Replace master and slave cylinder as assembly.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
CLUTCH DISC FACING COVERED WITH OIL, GREASE, OR CLUTCH FLUID	1. Oil leak at rear main or input shaft seal. 2. Too much grease applied to splines or disc and input shaft.	1. Correct leak and replace disc (do not clean and reuse the disc). 2. Apply lighter grease coating to splines and replace disc (do not clean and reuse the disc).
CLUTCH DISC AND/OR COVER WARPED, OR DISC FACINGS EXHIBIT UNUSUAL WRONG TYPE	1. Incorrect or substandard parts.	1. Replace disc and/or cover with correct parts.
CLUTCH MASTER OR SLAVE CYLINDER PLUNGER DRAGGING-BINDING	1. Master or slave cylinder components worn or corroded.	1. Replace both cylinders as assembly (and reservoir).
NO FAULT FOUND WITH CLUTCH COMPONENTS	1. Problem actually related to suspension or driveline component. 2. Engine related problem.	1. Further diagnosis required. Check engine/transmission mounts, propeller shafts and U-joints, tires, suspension attaching parts and other driveline components as needed. 2. Check EFI and ignition systems.
PARTIAL ENGAGEMENT OF CLUTCH DISC (ONE SIDE WORN-OPPOSITE SIDE GLAZED AND LIGHTLY WORN)	1. Clutch pressure plate position setting incorrect or modified. 2. Clutch cover, spring, or release fingers bent, distorted (rough handling, improper assembly). 3. Clutch disc damaged or distorted. 4. Clutch misalignment.	1. Replace clutch cover and disc. 2. Replace clutch cover and disc. 3. Replace disc. 4. Check alignment and runout of flywheel, disc, or cover and/or clutch housing. Correct as necessary.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
Clutch components damaged or worn out prematurely.	1. Incorrect or sub-standard clutch parts.	1. Replace with parts of correct type and quality.
Pilot bearing damaged.	1. Bearing cocked during installation. Bearing not lubricated prior to installation. Bearing defect. 2. Clutch misalignment.	1. Replace bearing. Be sure it is properly seated and lubricated before installing clutch. 2. Check and correct misalignment caused by excessive runout of flywheel, disc, cover or clutch housing. Replace input shaft if bearing hub is damaged.
Loose components.	1. Attaching bolts loose at flywheel, cover, or clutch housing.	1. Tighten bolts to specified torque. Replace any clutch bolts that are damaged.
Components appear overheated. Hub of disc cracked or torsion damper springs are distorted or broken.	1. Frequent high load, full throttle operation.	1. Replace parts as needed. Alert driver to condition causes.
Contact surface of release bearing damaged.	1. Clutch cover incorrect, or release fingers are bent or distorted causing damage. 2. Release bearing defect. 3. Release bearing misaligned.	1. Replace clutch cover and bearing. 2. Replace bearing. 3. Check and correct runout of clutch components. Check front bearing retainer sleeve surface. Replace if damaged.
Release bearing is noisy.	1. Release bearing defect.	1. Replace bearing.
Clutch pedal squeak.	1. Pivot pin loose. Pedal bushings worn out or cracked.	1. Tighten pivot pin. Replace bushings if worn or damaged. Lubricate pin and bushings with silicone base lubricator chassis grease.

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SERVICE PROCEDURES

CLUTCH COMPONENT LUBRICATION

Proper clutch component lubrication is important to satisfactory operation. Using the correct lubricant and not over lubricating 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

NOTE: 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 over lubricate.

CLUTCH LINKAGE FLUID

The integral clutch master cylinder reservoir, slave cylinder and fluid lines are pre-filled with fluid prior to assembly operations.

The hydraulic system should not require additional fluid under normal circumstances. In fact, **the reservoir fluid level will actually increase as normal clutch wear occurs. For this reason, it is important to avoid overfilling, or removing fluid from the reservoir. This will cause clutch release problems.**

If inspection or diagnosis indicates additional fluid may be needed, use Mopar brake fluid, or an equivalent meeting standards SAE J1703 and DOT 3. Do not use any other type of fluid.

CLUTCH FLUID LEVEL

The clutch fluid reservoir, master cylinder, slave cylinder and fluid lines are pre-filled with fluid at the factory during assembly operations.

The hydraulic system should not require additional fluid under normal circumstances. **The reservoir fluid level will actually increase as normal clutch wear occurs. Avoid overfilling, or removing fluid from the reservoir.**

If inspection or diagnosis indicates fluid level is low, add Mopar brake fluid, or an equivalent meeting standards SAE J1703 and DOT 3. Do not use any other type of fluid.

Clutch fluid level is checked at the master cylinder reservoir (Fig. 3). An indicator ring is provided on the outside of the reservoir. With the cap and diaphragm removed, fluid level should not be above indicator ring.

To avoid contaminating the hydraulic fluid during inspection, wipe reservoir and cover clean before removing the cap.

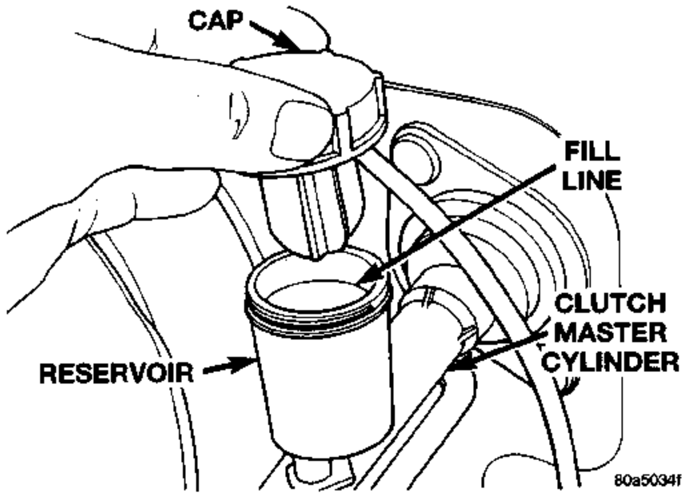

Fig. 3 Clutch Master Cylinder Reservoir And Cap

FLYWHEEL

Inspect the flywheel whenever the clutch disc, cover and housing are removed for service. Check condition of the flywheel face, hub, ring gear teeth, and flywheel bolts.

Minor scratches, burrs, or glazing on the flywheel face can be reduced with 180 grit emery cloth. However, the flywheel should be replaced if the disc contact surface is severely scored, heat checked, cracked, or obviously worn.

Flywheel machining is not recommended. The flywheel surface is manufactured with a unique contour that would be negated by machining. However, cleanup of minor flywheel scoring can be performed by hand with 180 grit emery, or with surface grinding equipment. Replace the flywheel if scoring is deeper than 0.0762 mm (0.003 in.).

Heavy stock removal by grinding is **not recommended.** Excessive stock removal can result in flywheel cracking or warpage after installation. It can also weaken the flywheel and interfere with proper clutch release.

Check flywheel runout if misalignment is suspected. Runout should not exceed 0.08 mm (0.003 in.). Measure runout at the outer edge of the flywheel face with a dial indicator. Mount the dial indi-

SERVICE PROCEDURES (Continued)

cator on a stud installed in place of one of the flywheel attaching bolts.

Clean the crankshaft flange before mounting the flywheel. Dirt and grease on the flange surface may cock the flywheel causing excessive runout.

Check condition of the flywheel hub and attaching bolts. Replace the flywheel if the hub exhibits cracks in the area of the attaching bolt holes.

Install new attaching bolts whenever the flywheel is replaced and use Mopar Lock N' Seal, or Loctite 242 on the replacement bolt threads.

Recommended flywheel bolt torques are:

- 142 N·m (105 ft. lbs.) for 6-cylinder flywheels
- 68 N·m (50 ft. lbs.) plus an additional turn of 60° for 4-cylinder flywheels

Inspect the teeth on the starter ring gear. **If the teeth are worn or damaged, the flywheel should be replaced as an assembly. This is the recommended and preferred method of repair.**

In cases where a new flywheel is not readily available, a replacement ring gear can be installed. However, the following precautions must be observed to avoid damaging the flywheel and replacement gear.

(1) Mark position of the old gear for alignment reference on the flywheel. Use a scriber for this purpose.

(2) Wear protective goggles or approved safety glasses. Also wear heat resistant gloves when handling a heated ring gear.

(3) 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.

(4) The ring gear is a shrink fit on the flywheel. This means the gear must be expanded by heating in order to install it. **The method of heating and expanding the gear is extremely important.** Every surface of the gear must be heated at the same time to produce uniform expansion. An oven or similar enclosed heating device must be used. Temperature required for uniform expansion is approximately 375° F.

CAUTION: Do not use an oxy/acetylene torch to remove the old gear, or to heat and expand a new gear. The high temperature of the torch flame can cause localized heating that will damage the flywheel. In addition, using the torch to heat a replacement gear will cause uneven heating and expansion. The torch flame can also anneal the gear teeth resulting in rapid wear and damage after installation.

(5) 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.

(6) Be sure to wear eye and hand protection. Heat resistant 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.

(7) 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.

REMOVAL AND INSTALLATION

CLUTCH COVER AND DISC

REMOVAL

(1) Remove transmission. Refer to procedures in Group 21.

(2) If original clutch cover will be reinstalled, mark position of cover on flywheel for assembly reference. Use paint or a scriber for this purpose.

(3) If clutch cover is to be replaced, cover bolts can be removed in any sequence. However, if original cover will be reinstalled, loosen cover bolts evenly and in rotation to relieve spring tension equally. This is necessary to avoid warping cover.

(4) Remove cover bolts and remove cover and disc (Fig. 4).

INSTALLATION

(1) Lightly scuff sand flywheel face with 180 grit emery cloth. Then clean surface with a wax and grease remover.

(2) Lubricate pilot bearing with Mopar high temperature bearing grease.

(3) Check runout and free operation of new clutch disc as follows:

(a) Slide disc onto transmission input shaft splines. Disc should slide freely on splines.

(b) Leave disc on shaft and check face runout with dial indicator. Check runout at disc hub and about 6 mm (1/4 in.) from outer edge of facing.

(c) Face runout should not exceed 0.5 mm (0.020 in.). Obtain another clutch disc if runout exceeds this limit.

(4) Position clutch disc on flywheel. Be sure side of disc marked flywheel side is positioned against flywheel (Fig. 4). If disc is not marked, be sure flat side of disc hub is toward flywheel.

(5) Inspect condition of pressure plate surface of clutch cover (Fig. 4). Replace cover if this surface is worn, heat checked, cracked, or scored.

REMOVAL AND INSTALLATION (Continued)

(6) Insert clutch alignment tool in clutch disc (Fig. 5).

(7) Insert alignment tool in pilot bearing and position disc on flywheel. Be sure disc hub is positioned correctly. Side of hub marked Flywheel Side should face flywheel (Fig. 4). If disc is not marked, place flat side of disc against flywheel.

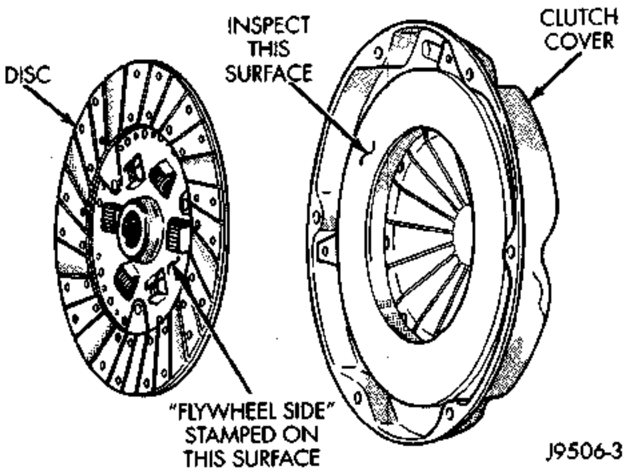

Fig. 4 Clutch Disc And Pressure Plate Inspection

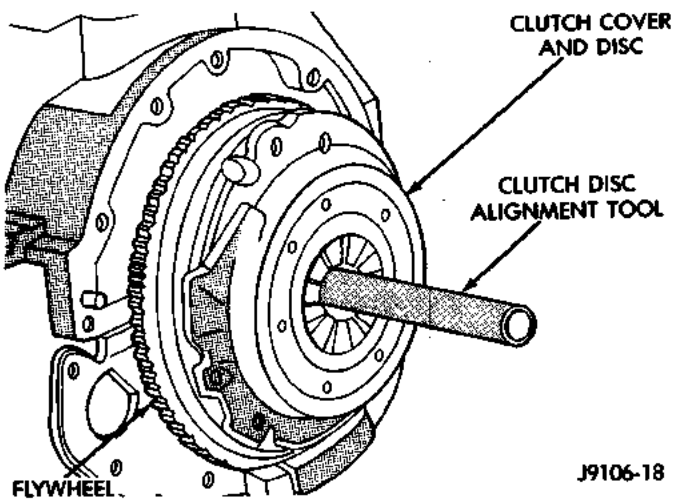

Fig. 5 Typical Method Of Aligning Clutch Disc

(8) Position clutch cover over disc and on flywheel (Fig. 5).

(9) Install clutch cover bolts finger tight.

(10) Tighten cover bolts evenly and in rotation a few threads at a time. **Cover bolts must be tightened evenly and to specified torque to avoid distorting cover. Tightening torques are 31 N·m (23 ft. lbs.) on 2.5L engines and 52 N·m (40 ft. lbs.) on 4.0L engines.**

(a) Start all 6 bolts by hand.

(b) Tighten 3 pilot hole bolts 3/4s of the way (any sequence).

(c) Starting 180 degrees from the last pilot bolt, tighten 3 large hole bolts 3/4s of the way (any sequence).

(d) Tighten 3 pilot hole bolts all the way (any sequence).

(e) Starting 180 degrees from last pilot bolt, tighten 3 large bolts all the way (any sequence).

(11) Apply light coat of Mopar high temperature bearing grease to pilot bearing hub and splines of transmission input shaft. **Do not over-lubricate shaft splines. This will result in grease contamination of disc.**

(12) Install Transmission.

RELEASE BEARING

REMOVAL

(1) Remove transmission.

(2) Disconnect release bearing from release lever and remove bearing (Fig. 6).

(3) Inspect bearing slide surface of transmission front bearing retainer. Replace retainer if slide surface is scored, worn, or cracked.

(4) Inspect release fork and fork pivot. Be sure pivot is secure and in good condition. Be sure fork is not distorted or worn. Replace release fork retainer spring if bent or damaged.

INSTALLATION

(1) Lubricate crankshaft pilot bearing with Mopar high temperature bearing grease. Apply grease to end of long shank, small diameter flat blade screwdriver. Then insert tool through clutch disc hub to reach bearing.

(2) Lubricate input shaft splines, bearing retainer slide surface, fork pivot and release fork pivot surface with Mopar high temperature grease.

(3) Install new release bearing. Be sure bearing is properly secured to release fork.

(4) Install transmission as described in Group 21.

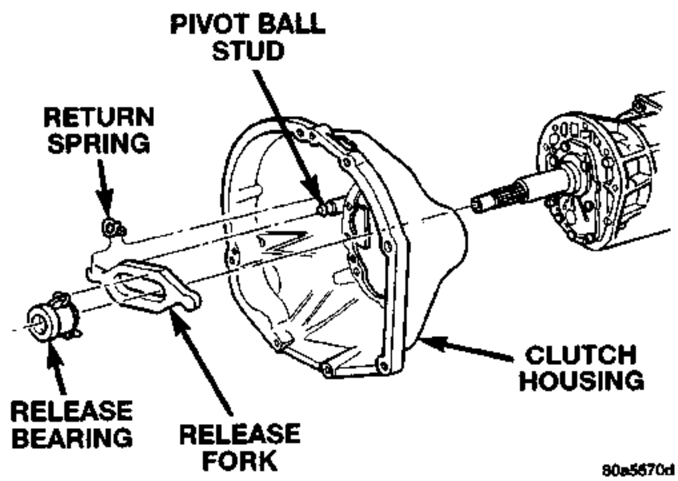

Fig. 6 Release Bearing Attachment

REMOVAL AND INSTALLATION (Continued)

PILOT BEARING

REMOVAL

(1) Remove transmission. Refer to Group 21 for procedure.

(2) Remove clutch cover and disc.

(3) Remove pilot bearing. Use internal (blind hole) puller such those as supplied in Snap On Tool Set CG40CB to remove bearing.

INSTALLATION

(1) Lubricate new bearing with Mopar high temperature bearing grease.

(2) Start new bearing into crankshaft by hand. Then seat bearing with clutch alignment tool (Fig. 7).

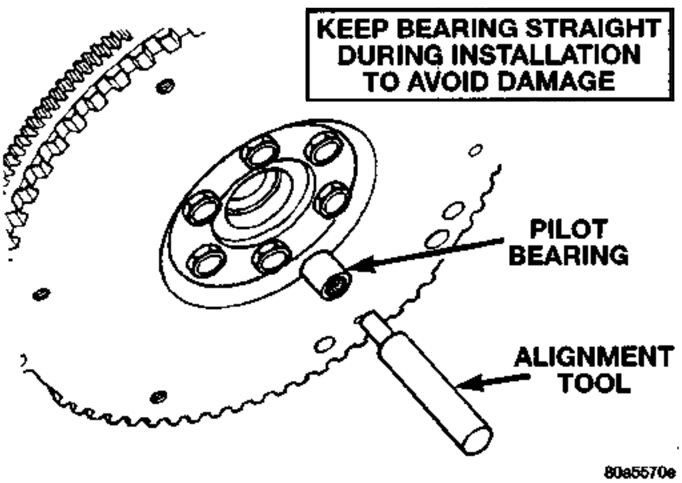

Fig. 7 Pilot Bearing Installation

(3) Lightly scuff sand flywheel surface with 180 grit emery cloth. Then clean surface with wax and grease remover.

(4) Install clutch disc and cover as described in this section.

(5) Install transmission. Refer to Group 21 for procedure.

CLUTCH HOUSING

The clutch housing is removable and can be replaced when the transmission is out of the vehicle.

The bolts attaching the housing to the transmission case are located inside the housing (Fig. 8). Recommended tightening torque for the clutch housing-to-transmission bolts is 38 N·m (28 ft. lbs.).

NOTE: Be sure the transmission and housing mating surfaces are clean before installing an original, or replacement clutch housing. Dirt/foreign material trapped between the housing and transmission will cause misalignment. If misalignment is severe enough, the result will be clutch drag, incomplete release and hard shifting.

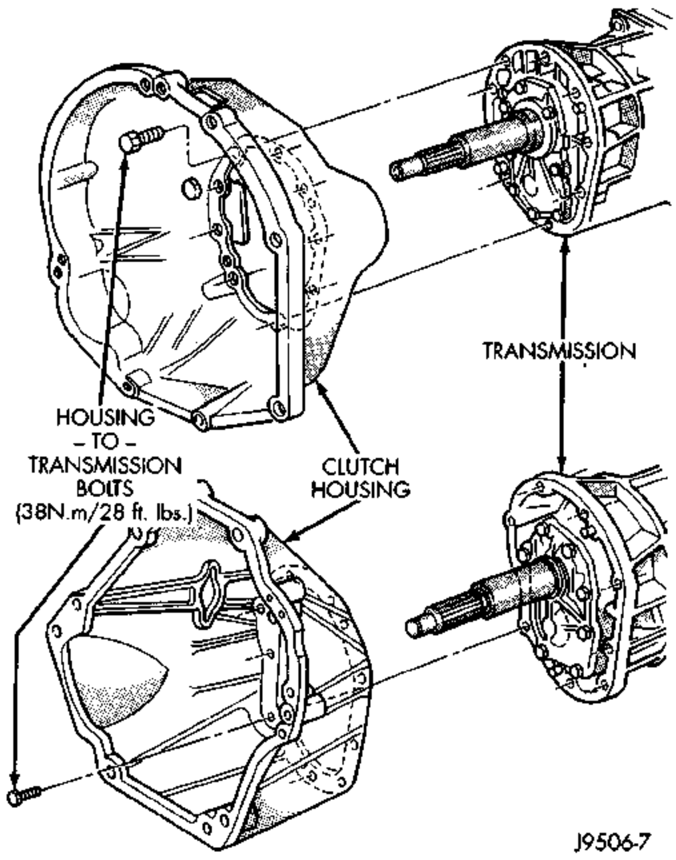

Fig. 8 Clutch Housing Attachment

CLUTCH HYDRAULIC LINKAGE

The clutch master cylinder, slave cylinder and connecting line are serviced as an assembly only. The linkage components cannot be overhauled or serviced separately. The cylinders and connecting line are sealed units. Also note that removal/installation procedures for right and left hand drive models are basically the same. Only master cylinder location is different.

REMOVAL

(1) Raise vehicle.

(2) Remove fasteners attaching slave cylinder to clutch housing.

(3) Remove slave cylinder from clutch housing (Fig. 9).

(4) Disengage clutch fluid line from body clips.

(5) Lower vehicle.

(6) Verify that cap on clutch master cylinder reservoir is tight. This is necessary to avoid spilling fluid during removal.

(7) Remove clutch master cylinder attaching nuts (Fig. 9) or (Fig. 10).

REMOVAL AND INSTALLATION (Continued)

(8) disengage tabs securing captured washer in clutch master cylinder actuator to pivot pin on pedal arm.

(9) Slide actuator off pivot pin.

(10) Disconnect clutch pedal position switch wires.

(11) Remove clutch hydraulic linkage through engine compartment.

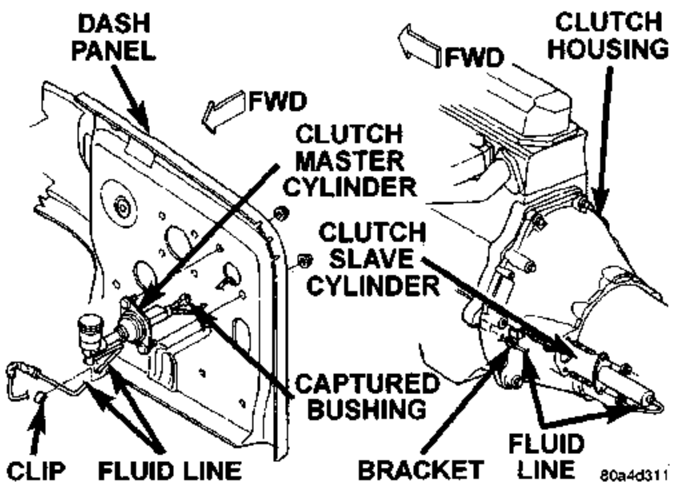

Fig. 9 Slave Cylinder and Left Hand Drive Clutch Master Cylinder

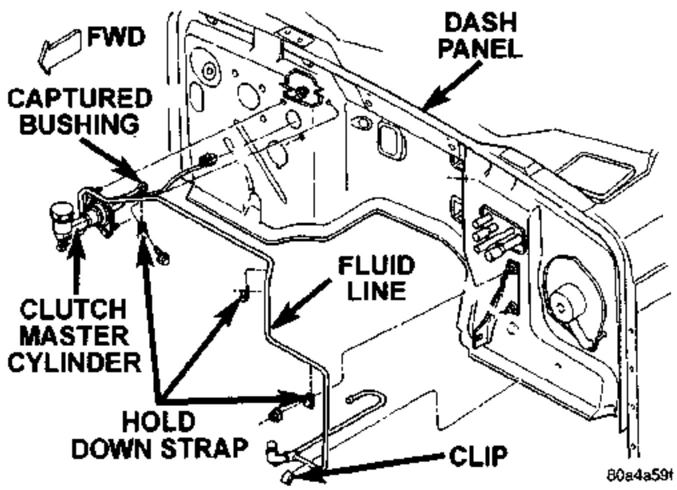

Fig. 10 Right Hand Drive Clutch Master Cylinder

INSTALLATION

(1) Be sure reservoir cover on clutch master cylinder is tight to avoid spills.

(2) Position clutch linkage components in vehicle. Work connecting line and slave cylinder downward past engine and adjacent to clutch housing (Fig. 9) or (Fig. 10).

(3) Position clutch master cylinder on dash panel (Fig. 9) or (Fig. 10).

(4) Attach clutch master cylinder actuator to pivot pin on clutch pedal.

(5) Install and tighten clutch master cylinder attaching nuts to 38 N·m (28 ft. lbs.) torque.

(6) Raise vehicle.

(7) Insert slave cylinder push rod through clutch housing opening and into release lever. Be sure cap on end of rod is securely engaged in lever. Check this before installing cylinder attaching nuts.

(8) Install and tighten slave cylinder attaching nuts to 23 N·m (17 ft. lbs.) torque.

(9) Secure clutch fluid line in body clips.

(10) Lower vehicle.

(11) Connect clutch pedal position switch wires.

CLUTCH PEDAL

REMOVAL

(1) Remove steering column lower cover and knee blocker for access. Refer to Group 8E, Instrument Panel for procedure.

(2) Disconnect clutch pedal position switch wires.

(3) Disengage captured bushing lock tabs attaching clutch master cylinder actuator to pedal pivot (Fig. 11) or (Fig. 12).

(4) Remove nuts attaching pedal and bracket to dash panel and upper cowl support (Fig. 11) or (Fig. 12).

(5) Separate pedal assemble from vehicle.

INSTALLATION

(1) Place clutch pedal and bracket over studs on dash panel and cowl support (Fig. 11) or (Fig. 12).

(2) Install nuts to attach pedal and bracket to dash panel and upper cowl support (Fig. 11) or (Fig. 12). Tighten nuts to 39 N·m (29 ft. lbs.) torque

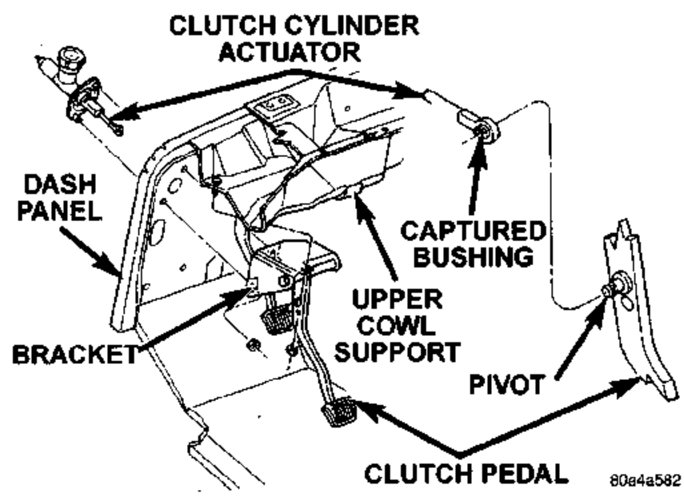

Fig. 11 Clutch Pedal Mounting

REMOVAL AND INSTALLATION (Continued)

(3) Engage captured bushing and actuator on brake pedal pivot (Fig. 11) or (Fig. 12).

(4) Connect clutch pedal position switch wires.

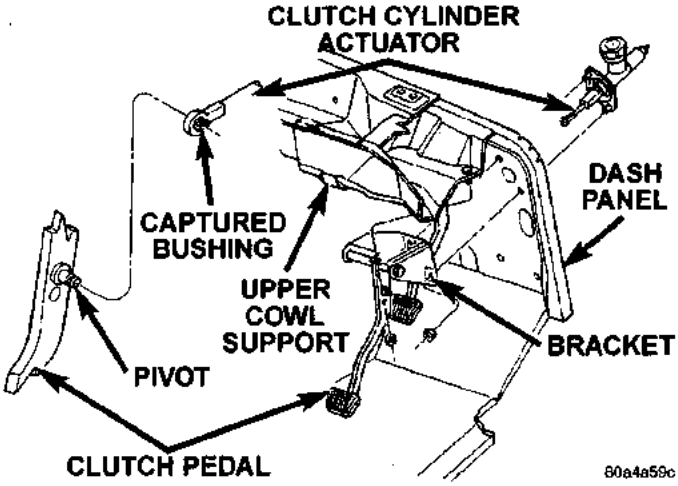

Fig. 12 Clutch Pedal Mounting—Right Hand Drive

SPECIFICATIONS

TORQUE

DESCRIPTION	TORQUE
Bolts, clutch cover 2.5 L	31 N·m (23 ft. lbs)
Bolts, clutch cover 4.0 L	52 N·m (38 ft. lbs)
Nut, clutch master cyl.	38 N·m (28 ft. lbs)
Nut, clutch slave cyl.	23 N·m (17 ft. lbs)
Bolt, clutch housing M12	75 N·m (55 ft. lbs)
Bolt, clutch housing 3/8	37 N·m (27 ft. lbs)
Bolt, clutch housing 7/16	58 N·m (43 ft. lbs)
Bolt, clutch housing/trans.	38 N·m (28 ft. lbs)
Bolt, dust shield M8	8 N·m (72 in. lbs)
Bolt, dust shield lower	50 N·m (37 ft. lbs)
Bolt, X-member/frame	41 N·m (30 ft. lbs)
Bolt, X-member/rear support	45 N·m (33 ft. lbs.)
Bolts, flywheel 4.0 L	142 N·m (105 ft. lbs)
Bolts, flywheel 2.5 L	68 N·m (50 ft. lbs) +1/4 turn
Bolts, U-joints	19 N·m (170 in. lbs.)

COOLING SYSTEM

CONTENTS

GENERAL INFORMATION

COOLING SYSTEM

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible, maintains normal operating temperature and prevents overheating.

The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid (if equipped). The cooling system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system.

An optional factory installed heavy duty cooling package is available on most models. The package consists of a radiator that has an increased number of cooling fins.

GENERAL INFORMATION (Continued)

COOLING SYSTEM COMPONENTS

The cooling system consists of:

- A radiator
- Cooling fan (mechanical)
- Thermal viscous fan drive
- Fan shroud
- Radiator pressure cap
- Thermostat
- Coolant reserve/overflow system
- Transmission oil cooler (if equipped with an automatic transmission)
- Coolant
- Water pump
- Hoses and hose clamps

SYSTEM COOLANT ROUTING

For cooling system flow routings, refer to (Fig. 1) or (Fig. 2).

WATER PUMP

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core. The pump is driven from the engine crankshaft by a drive belt on all engines.

COOLANT

The cooling system is designed around the coolant. Coolant flows through the engine water jackets absorbing heat produced during engine operation. The coolant carries heat to the radiator and heater core. Here it is transferred to the ambient air passing through the radiator and heater core fins. The coolant also removes heat from the automatic transmission fluid in vehicles equipped with an automatic transmission.

RADIATOR

All radiators are down flow types with plastic tanks.

CAUTION: Plastic tanks, while stronger than brass, are subject to damage by impact, such as wrenches.

If the plastic tank has been damaged, the plastic tank and/or O-rings are available for service repair. Tank replacement should be done by qualified personal with proper equipment.

ENGINE ACCESSORY DRIVE BELTS

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.

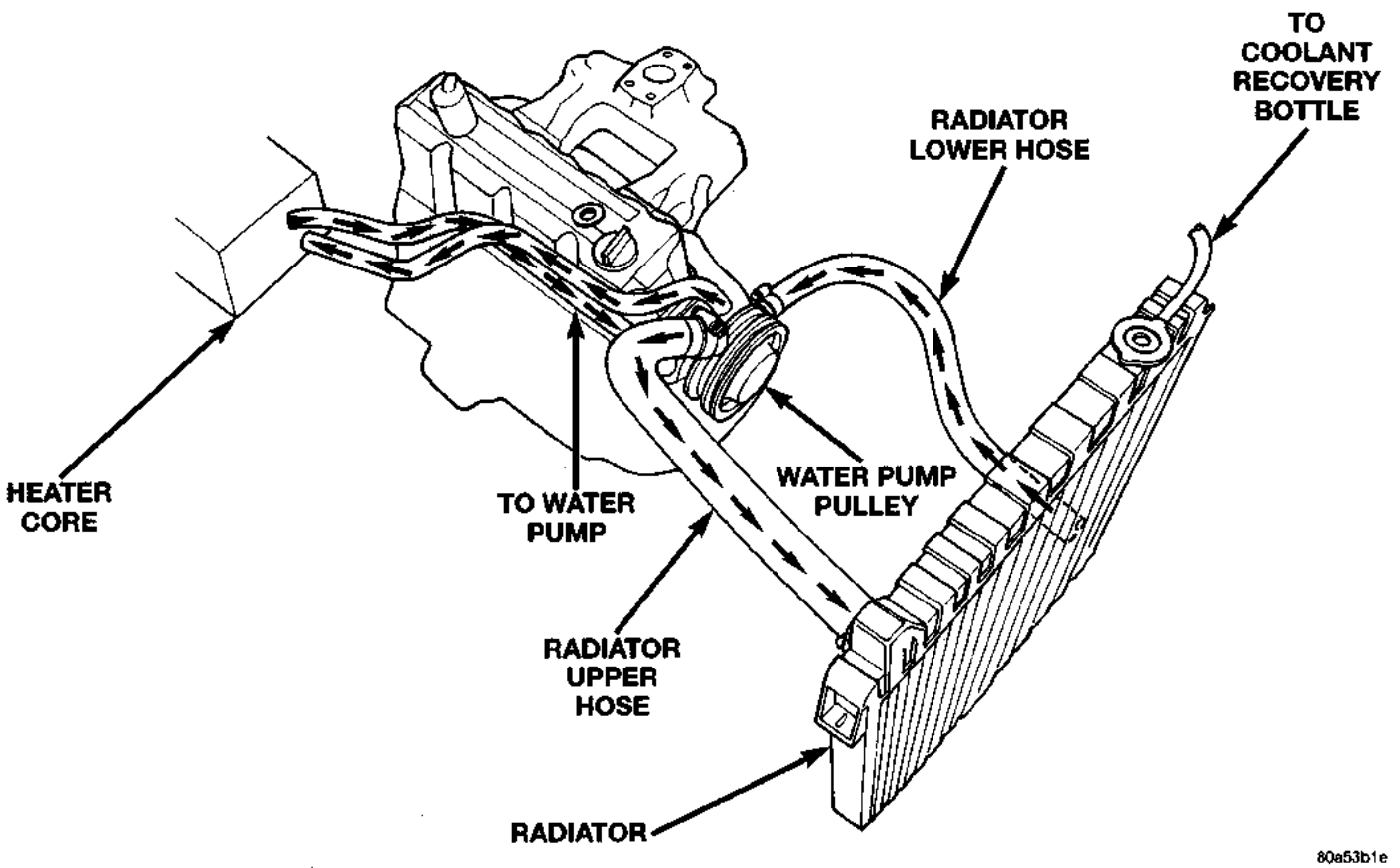

Fig. 1 Coolant Flow—2.5L Engine

GENERAL INFORMATION (Continued)

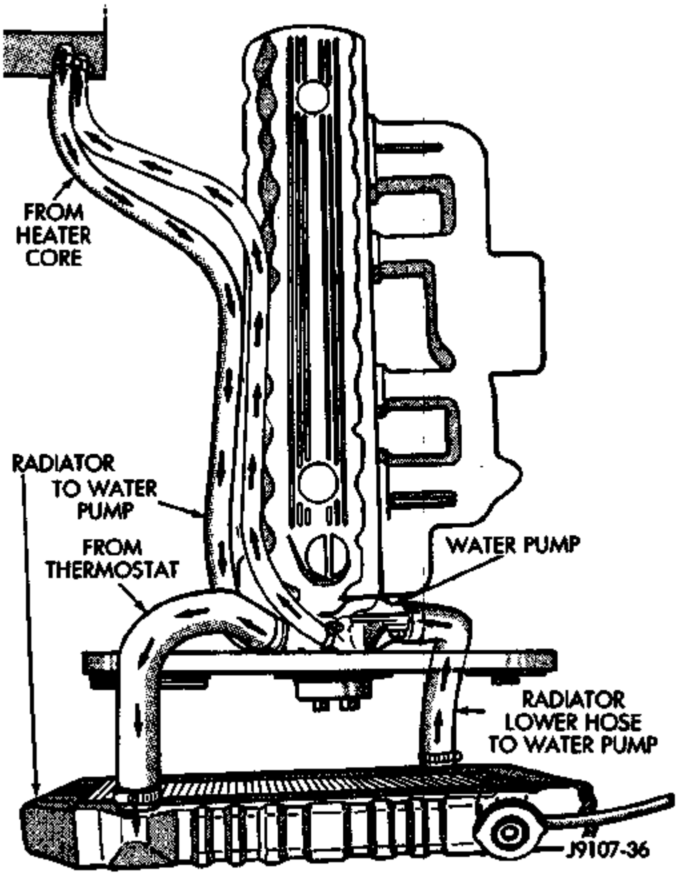

Fig. 2 Coolant Flow—4.0L Engine

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.

ENGINE BLOCK HEATER

An optional engine block heater is available for all models. The heater is equipped with a power cord. The cord is attached to an engine compartment component with tie-straps. The heater warms the engine providing easier engine starting and faster warm-up in low temperatures. The heater is mounted in a core hole of the engine cylinder block (in place of a freeze plug) with the heating element immersed in engine coolant. Connect the power cord to a grounded 110-120 volt AC electrical outlet with a grounded, three-wire extension cord.

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE.

DESCRIPTION AND OPERATION

TRANSMISSION OIL COOLER

WATER-TO-OIL COOLER

All models equipped with an automatic transmission are equipped with a transmission oil cooler mounted internally within the radiator tank. This internal cooler is supplied as standard equipment on all models equipped with an automatic transmission.

Transmission oil is cooled when it passes through this separate cooler. In case of a leak in the internal radiator mounted transmission oil cooler, engine coolant may become mixed with transmission fluid or transmission fluid may enter engine cooling system. Both cooling system and transmission should be drained and inspected if the internal radiator mounted transmission cooler is leaking.

Also refer to the section on Transmission Air-to-Oil Coolers. This auxiliary air-to-oil cooler is an option on most engine packages.

AIR-TO-OIL COOLER

An auxiliary air-to-oil transmission oil cooler is available with most engine packages.

The cooler is located in front of the radiator (Fig. 3) or A/C condenser (if equipped) and behind the grill. It is mounted to the front frame crossmember.

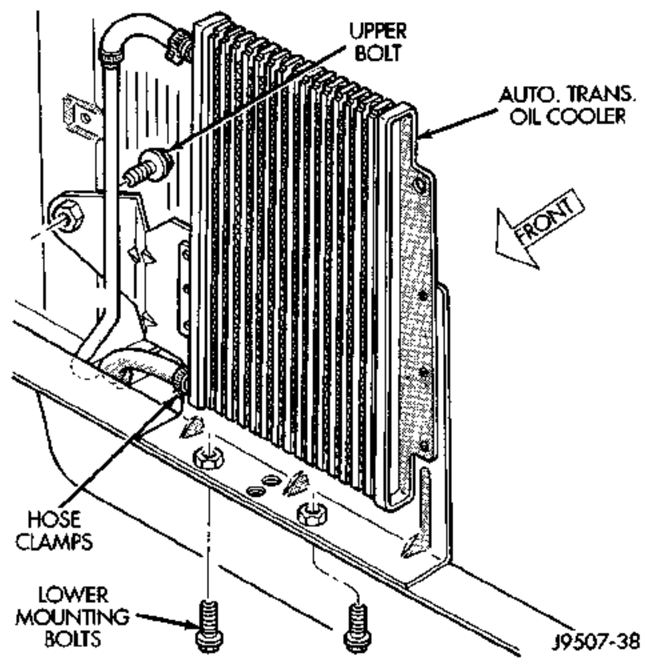

Fig. 3 Auxiliary Air-To-Oil Cooler

DESCRIPTION AND OPERATION (Continued)

COOLANT RESERVE/OVERFLOW SYSTEM

The system works along with the radiator pressure cap. This is done by using thermal expansion and contraction of the coolant to keep the coolant free of trapped air. It provides:

- A volume for coolant expansion and contraction.
- A convenient and safe method for checking/adjusting coolant level at atmospheric pressure. This is done without removing the radiator pressure cap.
- Some reserve coolant to the radiator to cover minor leaks and evaporation or boiling losses.

As the engine cools, a vacuum is formed in the cooling system of both the radiator and engine. Coolant will then be drawn from the coolant tank and returned to a proper level in the radiator.

The coolant reserve/overflow system consists of a radiator mounted pressurized cap, a plastic coolant recovery bottle (Fig. 4), a tube (hose) connecting the radiator and recovery bottle, and an overflow tube on the side of the bottle.

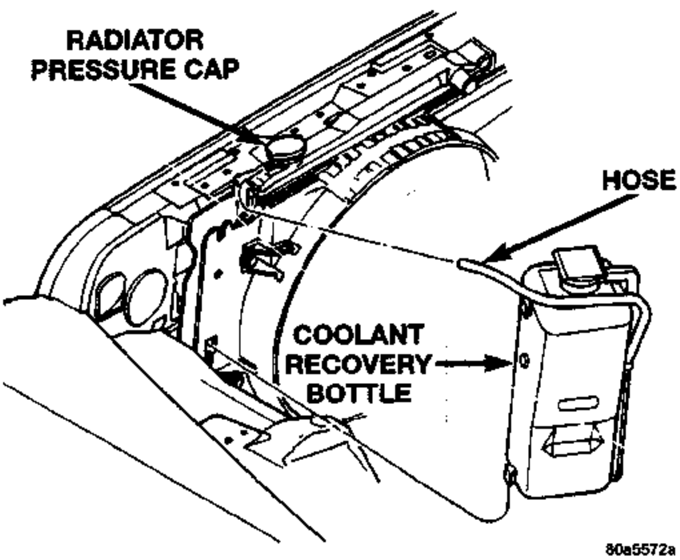

Fig. 4 Coolant Recovery Bottle

BLOCK HEATER

The heater unit is mounted in a block core hole and is immersed in coolant. The heater uses ordinary house current (110 Volt A.C.) and should **never** be pluged in unless it is immersed in coolant.

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE.

BLOCK HEATER SPECIFICATIONS

- 2.5L 4-Cylinder Engine: 115 Volts 400 Watts
- 4.0L 6-Cylinder Engine: 120 Volts 600 Watts

THERMOSTAT

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 warm-up time, unreliable warm-up 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.

COOLANT PERFORMANCE

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

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

100 percent Ethylene-Glycol-The corrosion inhibiting additives in ethylene-glycol need the presence of water to dissolve. Without water, additives form deposits in system. These act as insulation causing temperature to rise to as high as 149°C (300°F). This temperature is hot enough to melt plastic and soften solder. The increased temperature can result in engine detonation. In addition, 100 percent ethylene-glycol freezes at -22°C (-8°F).

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

DESCRIPTION AND OPERATION (Continued)

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

COOLANT SELECTION AND ADDITIVES

Coolant should be maintained at the specified level with a mixture of ethylene glycol-based antifreeze and low mineral content water.

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

RADIATOR PRESSURE CAP

All radiators are equipped with a pressure cap. This cap releases pressure at some point within a range of 83-124 kPa (12-18 psi). The pressure relief point (in pounds) is engraved on top of the cap (Fig. 5).

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 contains a spring-loaded pressure relief valve. This valve opens when system pressure reaches the release range of 83-124 kPa (12-18 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 coolant cools, it contracts and creates a vacuum in the cooling system. This causes the vacuum valve to open and coolant in reserve/overflow tank to be drawn through connecting hose into radiator. If the vacuum valve is stuck shut, radiator hoses will collapse on cool-down.

A rubber gasket seals the radiator filler neck. This is done to maintain vacuum during coolant cool-down and to prevent leakage when system is under pressure.

WATER PUMP

The water pump impeller is pressed onto the rear of a shaft that rotates in bearings pressed into the housing. The housing has a small hole to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant mixture. No additional lubrication is necessary.

CAUTION: All engines are equipped with a reverse (counter-clockwise) rotating water pump and viscous fan drive assembly. REVERSE is stamped or imprinted on the cover of the viscous fan drive and inner side of the fan. The letter R is stamped into the back of the water pump impeller (Fig. 6).

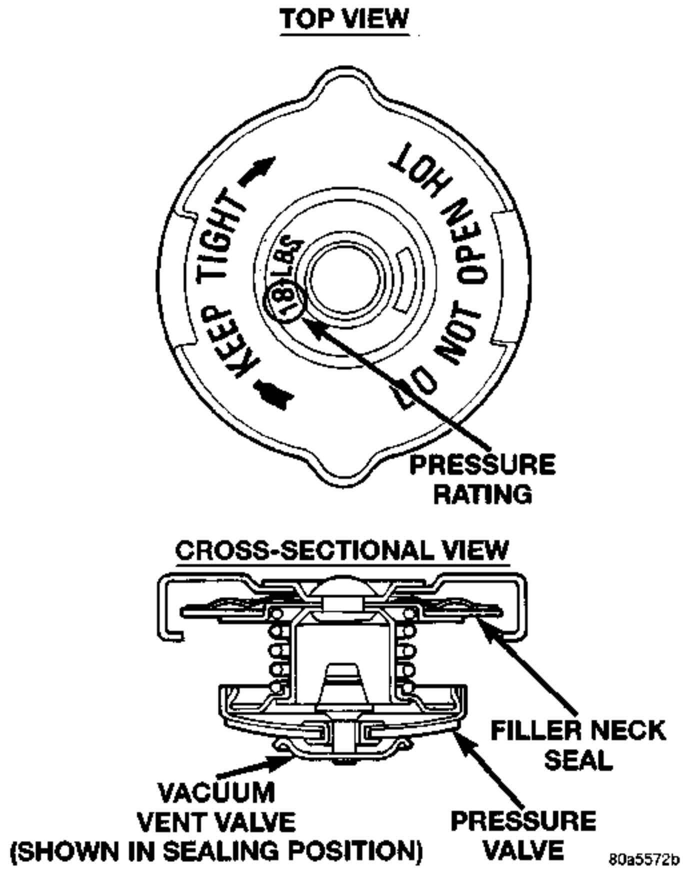

Fig. 5 Radiator Pressure Cap

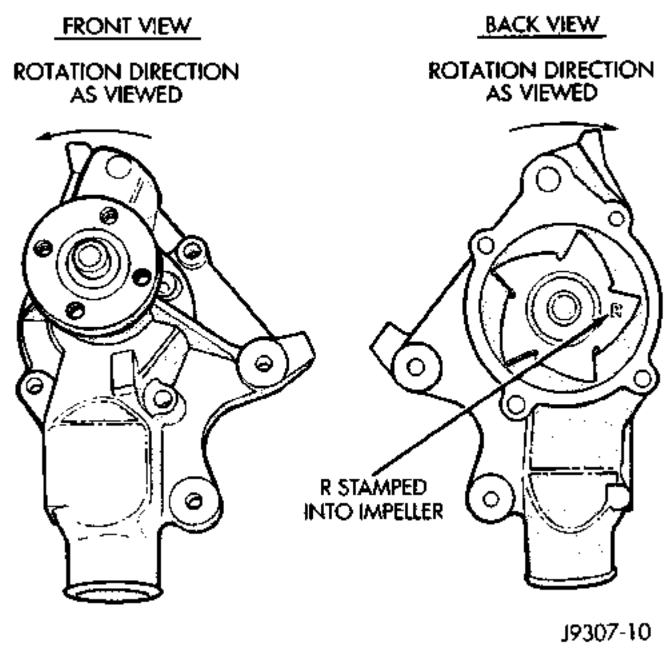

Fig. 6 Reverse Rotating Water Pump—Typical

Engines from previous model years, depending upon application, may have been equipped with a forward (clockwise) rotating water pump. Installation of the wrong water pump will cause engine overheating.

DESCRIPTION AND OPERATION (Continued)

COOLING SYSTEM HOSES

Rubber hoses route coolant to and from the radiator, intake manifold and heater core.

Radiator lower hoses are spring-reinforced to prevent collapse from water pump suction at moderate and high engine speeds.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (Fig. 7). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 8). If replacement is necessary, use only an original equipment clamp with matching number or letter.

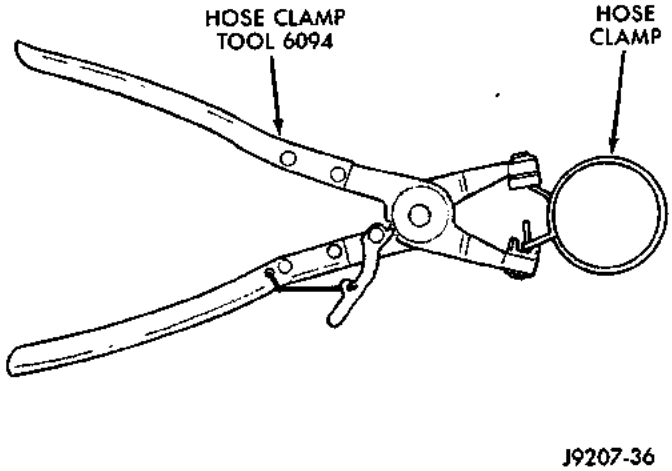

Fig. 7 Hose Clamp Tool—Typical

Inspect the hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed, or swell excessively when the system is pressurized.

For all vehicles: In areas where specific routing clamps are not provided, be sure that hoses are positioned with sufficient clearance. Check clearance from exhaust manifolds and pipe, fan blades, drive belts and sway bars. Improperly positioned hoses can be damaged, resulting in coolant loss and engine overheating.

Ordinary worm gear type hose clamps (when equipped) can be removed with a straight screwdriver or a hex socket. **To prevent damage to hoses or clamps, the hose clamps should be tightened to 4 N·m (34 in. lbs.) torque. Do not over tighten hose clamps.**

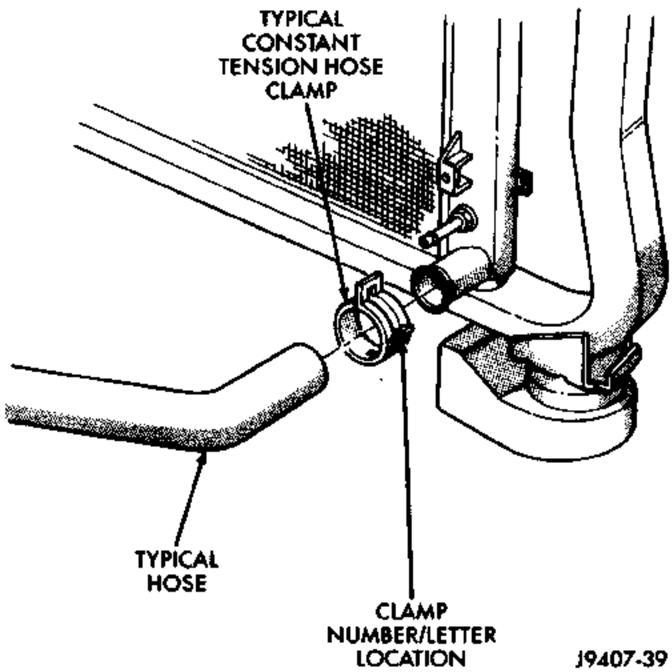

Fig. 8 Clamp Number/Letter Location

When performing a hose inspection, inspect the radiator lower hose for proper position and condition of the internal spring.

VISCOUS FAN DRIVE

The thermal viscous fan drive (Fig. 9) is a silicone-fluid-filled coupling used to connect the fan blades to either the engine or the water pump shaft. The coupling allows the fan to be driven in a normal manner. This is done at low engine speeds while limiting the top speed of the fan to a predetermined maximum level at higher engine speeds.

A thermostatic bimetallic spring coil is located on the front face of the viscous fan drive unit (a typical viscous unit is shown in (Fig. 10). This spring coil reacts to the temperature of the radiator discharge air. It engages the viscous fan drive for higher fan speed if the air temperature from the radiator rises above a certain point. Until additional engine cooling is necessary, the fan will remain at a reduced rpm regardless of engine speed.

Only when sufficient heat is present, will the viscous fan drive engage. This is when the air flowing through the radiator core causes a reaction to the bimetallic coil. It then increases fan speed to provide the necessary additional engine cooling.

Once the engine has cooled, the radiator discharge temperature will drop. The bimetallic coil again reacts and the fan speed is reduced to the previous disengaged speed.

DESCRIPTION AND OPERATION (Continued)

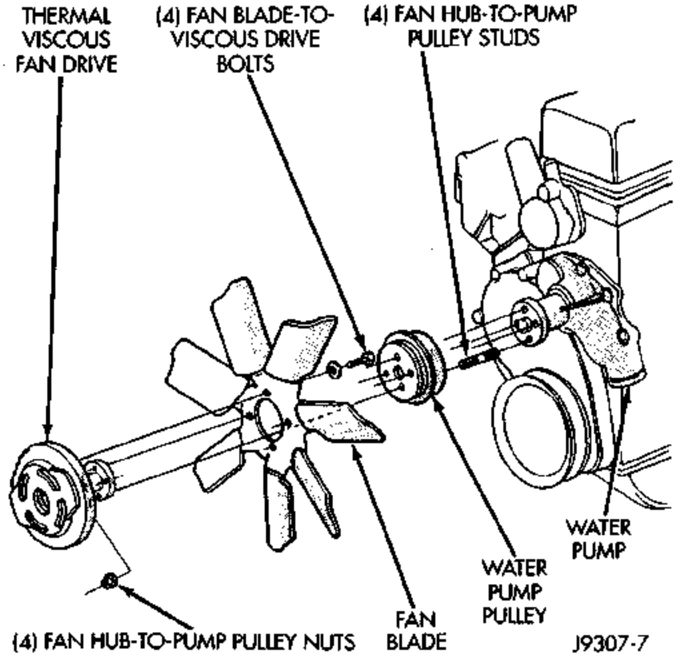

Fig. 9 Water Pump Mounted Fan Drive

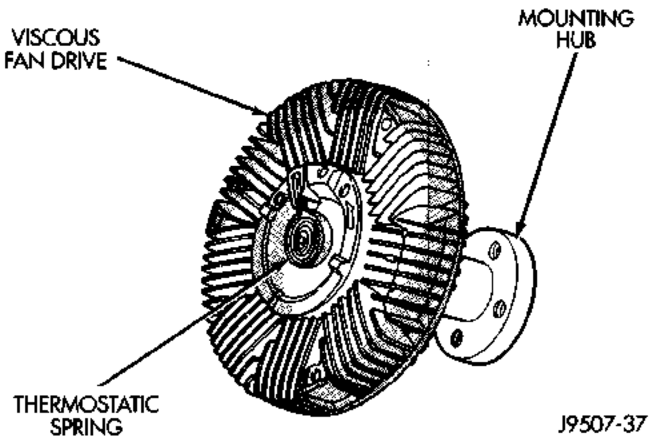

Fig. 10 Viscous Fan Drive—Typical

CAUTION: Engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

DIAGNOSIS AND TESTING

ON-BOARD DIAGNOSTICS (OBD)

FOR CERTAIN COOLING SYSTEM COMPONENTS

The powertrain control module (PCM) has been programmed to monitor the certain following cooling system components:

• If the engine has remained cool for too long a period, such as with a stuck open thermostat, a Diagnostic Trouble Code (DTC) number 17 can be observed at the malfunction indicator lamp. This lamp is displayed on the instrument panel as the CHECK ENGINE lamp.

If the problem is sensed in a monitored circuit often enough to indicate an actual problem, a DTC is stored. The DTC will be stored in the PCM memory for eventual display to the service technician (Fig. 11). If the problem is repaired or ceases to exist, the PCM cancels the DTC after 51 engine starts.

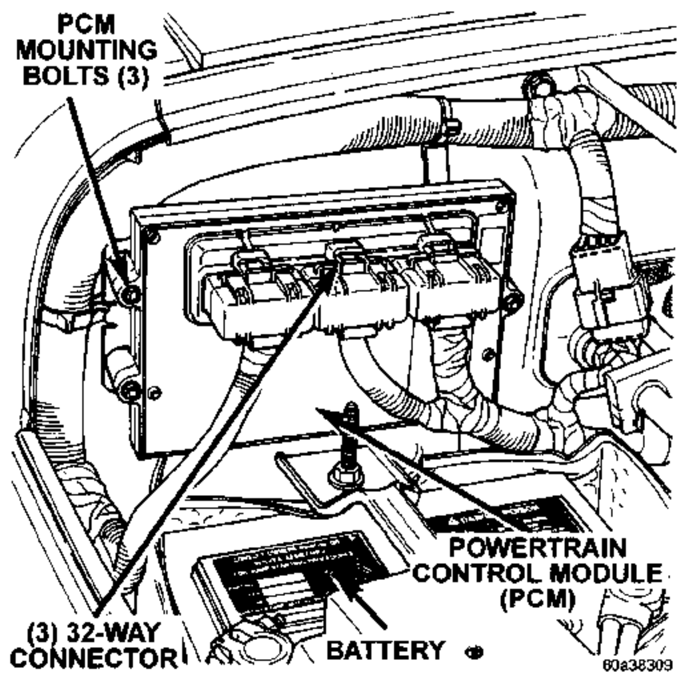

Fig. 11 Powertrain Control Module (PCM)

Certain criteria must be met for a DTC to be entered into PCM memory. The criteria may be a specific range of engine rpm, engine temperature and/or input voltage to the PCM.

A DTC indicates that the PCM has recognized an abnormal signal in a circuit or the system. A DTC

DIAGNOSIS AND TESTING (Continued)

may indicate the result of a failure, but never identify the failed component directly.

It is possible that a DTC for a monitored circuit may not be entered into memory even though a malfunction has occurred. Refer to On-Board Diagnostics (OBD) in Group 14, Fuel Systems for additional DTC information.

ACCESSING DIAGNOSTIC TROUBLE CODES

A stored Diagnostic Trouble Code (DTC) can be displayed by cycling the ignition key On-Off-On-Off-On within three seconds and observing the malfunction indicator lamp. This lamp is displayed on the instrument panel as the CHECK ENGINE lamp.

They can also be displayed through the use of the Diagnostic Readout Box (DRB) scan tool. The DRB connects to the data link connector located under the instrument panel left of the steering column (Fig. 12). For operation of the DRB, refer to the appropriate Powertrain Diagnostic Procedures service manual.

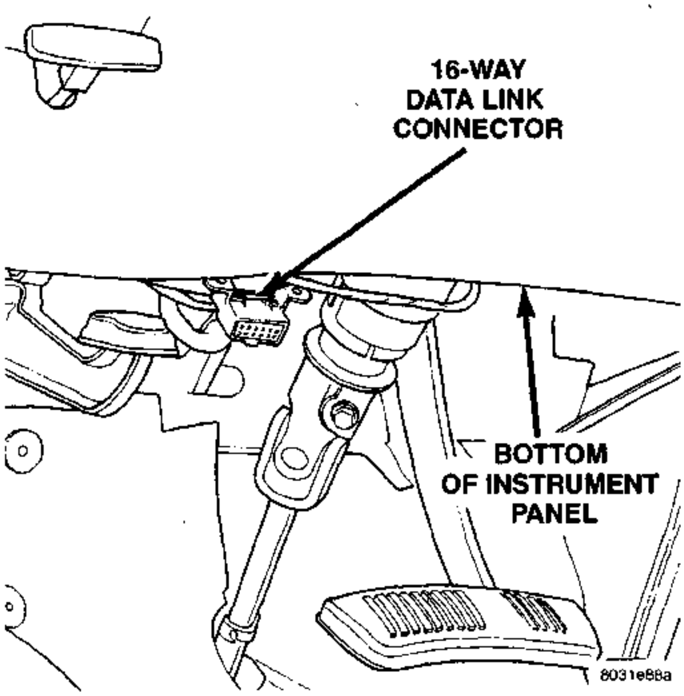

Fig. 12 16–Way Data Link Connector—Typical

EXAMPLES:

• If the lamp flashes 1 time, pauses and flashes 2 more times, a flashing Diagnostic Trouble Code (DTC) number 12 is indicated. If this code is observed, it is indicating that the battery has been disconnected within the last 50 key-on cycles. It could also indicate that battery voltage has been disconnected to the PCM. In either case, other DTC's may have been erased.

• If the lamp flashes 1 time, pauses and flashes 7 more times, a flashing Diagnostic Trouble Code (DTC) number 17 is indicated.

• If the lamp flashes 3 times, pauses and flashes 5 more times, a flashing Diagnostic Trouble Code (DTC) number 35 is indicated.

After any stored DTC information has been observed, the display will end with a flashing DTC number 55. This will indicate the end of all stored information.

ERASING TROUBLE CODES

After the problem has been repaired, the DRB scan tool must be used to erase a DTC. Refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB scan tool.

DRB SCAN TOOL

For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

WATER PUMP

LOOSE IMPELLER

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

(1) Drain the cooling system.

(2) Loosen the fan belt.

(3) Disconnect the lower radiator hose from the water pump.

(4) Bend a stiff clothes hanger or welding rod as shown in (Fig. 13).

(5) Position the rod in the water pump inlet and attempt to hold the impeller while turning the fan blades. If equipped with a viscous fan drive, turn the water pump shaft with a breaker bar and socket attached to a mounting flange nut. If the impeller is loose and can be held with the rod while the fan blades are turning, the pump is defective. If the impeller turns, the pump is OK.

(6) Connect the hose and install the coolant, or proceed with repairs.

WATER PUMP TEST

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.

ACCESSORY DRIVE BELT

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the

DIAGNOSIS AND TESTING (Continued)

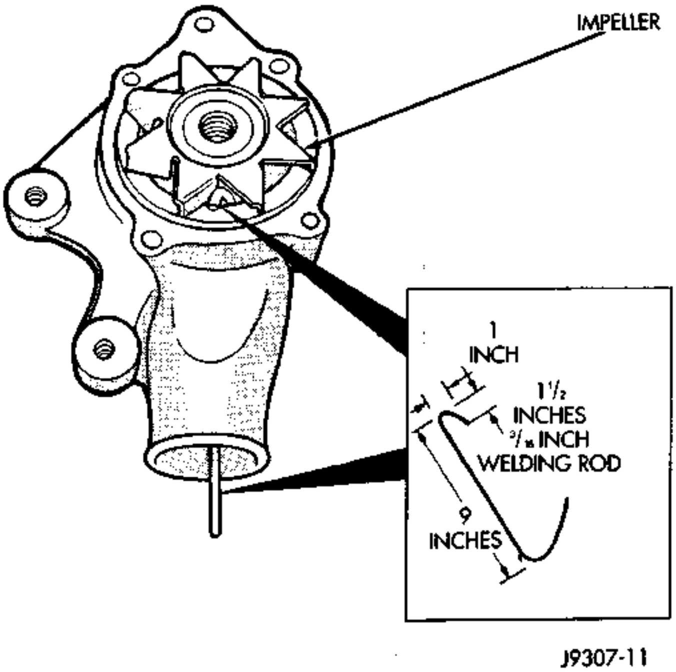

Fig. 13 Impeller Test—Typical

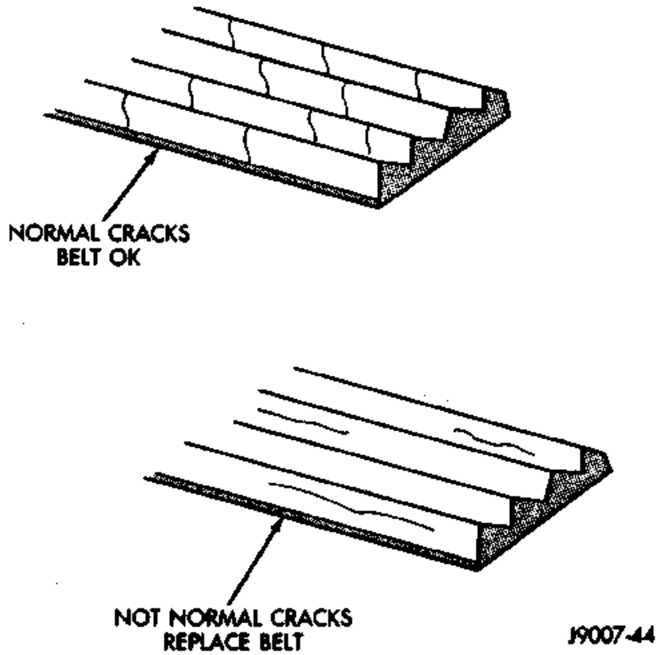

Fig. 14 Serpentine Belt Wear Patterns

belt from rib to rib (Fig. 14), 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. 14). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to the Serpentine Drive Belt Diagnosis charts for further belt diagnosis.

DIAGNOSIS AND TESTING (Continued)

SERPENTINE DRIVE BELT DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (ONE OR MORE RIBS HAS SEPARATED FROM BELT BODY	1. Foreign objects imbedded in pulley grooves. 2. Installation damage.	1. Remove foreign objects from pulley grooves. Replace belt. 2. Replace belt.
RIB OR BELT WEAR	1. Pulley(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. 2. Replace belt and clean pulleys. 3. Replace faulty component bearing. 5. 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. 2. Replace pulley(s). 3. Remove foreign objects from grooves. 4. Align component. 5. Replace belt.
BELT BROKEN (NOTE: IDENTIFY AND CORRECT PROBLEM BEFORE NEW BELT IS INSTALLED)	1. Excessive tension. 2. Tensile member damaged during belt installation. 3. Severe misalignment. 4. Bracket, pulley, or bearing failure.	1. Replace belt and adjust tension to specification. 2. Replace belt. 3. Align pulley(s). 4. Replace defective component and belt.
NOISE (OBJECTIONAL SQUEAL, SQUEAK, OR RUMBLE IS HEARD OR FELT WHILE DRIVE BELT IS IN OPERATION)	1. Belt slippage. 2. Bearing noise. 3. Belt misalignment. 4. Belt-to-pulley mismatch.	1. Adjust belt. 2. Locate and repair. 3. Align belt/pulley(s). 4. Install correct belt.

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DIAGNOSIS AND TESTING (Continued)

SERPENTINE DRIVE BELT DIAGNOSIS (CONT.)

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISE (OBJECTIONAL SQUEAL, SQUEAK, OR RUMBLE IS HEARD OR FELT WHILE DRIVE BELT IS IN OPERATION (Continued)	5. Driven component induced vibration. 6. System resonant frequency induced vibration.	5. Locate defective driven component and repair. 6. Vary belt tension within specifications. Replace belt.
TENSION SHEETING FABRIC FAILURE (WOVEN FABRIC ON OUTSIDE, CIRCUMFERENCE OF BELT HAS CRACKED OR SEPARATED FROM BODY OF BELT)	1. Tension sheeting contacting stationary object. 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. 2. Correct as necessary. 3. Replace pulley. 4. Replace belt and adjust tension to specifications.

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DIAGNOSIS AND TESTING (Continued)

PRELIMINARY CHECKS

ENGINE COOLING SYSTEM OVERHEATING

Establish what driving conditions caused the complaint. Abnormal loads on the cooling system such as the following may be the cause.

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.

TRAILER TOWING

Consult Trailer Towing section of owners manual. Do not exceed limits.

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.

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).

NOTE: If investigation reveals none of the previous items as a cause for an engine overheating complaint, refer to following Cooling System Diagnosis charts.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOW	1. Has a Diagnostic Trouble Code (DTC) number 17 been set indicating a stuck open engine thermostat?	1. Refer to On-Board Diagnostics in the service manual text. Replace thermostat if necessary. If a Diagnostic Trouble Code (DTC) number 17 has not been set, the problem may be with the temperature gauge.
	2. Is the temperature gauge (if equipped) connected to the temperature gauge coolant sensor on the engine?	2. Check the engine temperature sensor connector in the engine compartment. Refer to Group 8E. Repair as necessary.
	3. Is the temperature gauge (if equipped) operating OK?	3. Check gauge operation. Refer to Group 8E. Repair as necessary.
	4. Coolant level low in cold ambient temperatures accompanied with poor heater performance.	4. Check coolant level in the coolant reserve/overflow tank and the radiator. Inspect system for leaks. Repair leaks as necessary. Refer to the Coolant section of the manual text for Warnings and precautions before removing the radiator cap.
	5. Improper operation of internal heater doors of heater controls.	5. Inspect heater and repair as necessary. Refer to Group 24, Heating and Air Conditioning for procedures.
TEMPERATURE GAUGE READS HIGH OR ENGINE COOLANT WARNING LAMP ILLUMINATES. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM COOLING SYSTEM	1. Trailer is being towed, a steep hill is being climbed, vehicle is operated in slow moving traffic, or engine is being idled with very high ambient (outside) temoeratures and the air conditioning is on. Higher altitudes could aggravate these conditions.	1. This may be a temporary condition and repair is not necessary. Turn off the air conditioning and attempt to drive the vehicle without any of the previous conditions. Observe the temperature gauge. The gauge should return to the normal range. If the gauge does not return to normal range, determine the cause for overheating and repair. Refer to POSSIBLE CAUSES (numbers 2 through 18).
	2. Is temperature gauge (if equipped) reading correctly?	2. Check gauge. Refer to Group 8E. Repair as necessary.
	3. Is temperature warning lamp (if equipped) illuminating unnecessarily?	3. Check warning lamp operation. Refer to Group 8E. Repair as necessary.
	4. Coolant low in coolant reserve/overflow tank and radiator?	4. Check for coolant leaks and repair as necessary. Refer to Testing Cooling System for Leaks in this group.
	5. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following step 6.	5. Tighten cap.
	6. Poor seals at radiator cap.	6. (a) Check condition of cap and cap seals. Refer to Radiator Cap. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS CONT.

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH OR ENGINE COOLANT WARNING LAMP ILLUMINATES. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM COOLING SYSTEM - CONT.	7. Coolant level low in radiator but not in coolant reserve/overflow tank. This means the radiator is not drawing coolant from the coolant reserve/overflow tank as the engine cools. As the engine cools, a vacuum is formed in the cooling system of the engine and radiator. If radiator cap seals are defective, or cooling system has leaks, a vacuum can not be formed.	7. (a) Check condition of radiator cap and cap seals. Refer to Radiator Cap in this group. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator. (c) lCheck the condition of the hose from the radiator to the coolant tank. It should fit tight at both ends without any kinks or tears. Replace hose if necessary. (d) Check coolant reserve/overflow tank and tank hoses for blockage. Repair as necessary
	8. Freeze point of antifreeze not correct. Mixture may be too rich.	8. Check antifreeze. Refer to Coolant section of this group. Adjust antifreeze-to-water ratio as required.
	9. Coolant not flowing through system.	9. Check for coolant flow at radiator filler neck with some coolant removed, engine warm and thermostat open. Coolant should be observed flowing through radiator. If flow is not observed, determine reason for lack of flow and repair as necessary.
	10. Radiator or A/C condenser fins are dirty or clogged.	10. Clean insects or debris. Refer to Radiator Cleaning in this group.
	11. Radiator core is corroded or plugged.	11. Have radiator re-cored or replaced.
	12. Fuel or ignition system problems.	Refer to Fuel and Ignition System groups for diagnosis. Also refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB scan tool.
	13. Dragging brakes.	13. Check and correct as necessary. Refer to Group 5, Brakes in the manual text.
	14. Bug screen is being used reducing airflow.	14. Remove bug screen.
	15. Thermostat partially or completely shut. This is more prevalent of high mileage vehicles.	15. Check thermostat operation and replace as necessary. Refer to Thermostats in this group.
	16. Thermal viscous fan drive not operating properly.	16. Check fan drive operation and replace if necessary. Refer to Viscous Fan Drive in this group.
	17. Cylinder head gasket leaking.	17. Check for cylinder head gasket leaks. Refer to Testing Cooling System for Leaks in this group. For repair, refer to Group 9, Engines.
	18. Heater core leaking.	18. Check heater core for leaks. Refer to Group 24, Heating and Air Conditioning. Repair as necessary.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS CONT.

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READING IS INCONSISTENT (FLUCTUATES, CYCLES OR IS ERRATIC)	1. During cold weather operation, with the heater blower in the high position, the gauge reading may drop slightly.	1. A normal condition. No correction is necessary.
	2. Temperature gauge or engine mounted gauge sensor defective or shorted. Also, corroded or loose wiring in the circuit.	2. Check operation of gauge and repair if necessary. Refer to Group 8E, Instrument Panel and Gauges.
	3. Gauge reading rises when vehicle is brought to a stop after heavy use (engine still running).	3. A normal condition. No correction is necessary. Gauge reading should return to normal range after vehicle is driven.
	4. Gauge reading high after restarting a warmed-up (hot) engine.	4. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation.
	5. Coolant level low in radiator (air will build up in the cooling system causing the thermostat to open late).	5. Check and correct coolant leaks. Refer to Testing Cooling System for Leaks in this group.
	6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing thermostat to open late.	6. (a) Check for cylinder head gasket leaks with a commercially available Block Leak Tester. Repair as necessary. (b) Check for coolant in the engine oil. Inspect for white steam emitting from exhaust system. Repair as necessary.
	7. Water pump impeller loose on shaft.	7. Check water pump and replace as necessary. Refer to Water Pumps in this group.
	8. Loose accessory drive belt (water pump slipping).	Refer to Engine Accessory Drive Belts in this group. Check and correct as necessary.
	9. Air leak on the suction side of water pump allows air to build up in cooling system causing thermostat to open late.	9. Locate leak and repair as necessary.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS CONT.

CONDITION	POSSIBLE CAUSES	CORRECTION
PRESSURE CAP IS BLOWING OFF STEAM AND/OR COOLANT TO COOLANT TANK. TEMPERATURE GAUGE READING MAY BE ABOVE NORMAL BUT NOT HIGH. COOLANT LEVEL MAY BE HIGH IN COOLANT RESERVE/ OVERFLOW TANK	1. Pressure relief valve in radiator cap is defective.	1. Check condition of radiator cap and cap seals. Refer to Radiator Caps in this group. Replace cap as necessary.
COOLANT LOSS TO THE GROUND WITHOUT PRESSURE CAP BLOWOFF. GAUGE IS READING HIGH OR HOT	1. Coolant leaks in radiator, cooling system hoses, water pump or engine.	1. Pressure test and repair as necessary. Refer to Testing Cooling System for Leaks in this group.
DETONATION OR PRE-IGNITION (NOT CAUSED BY IGNITION SYSTEM). GAUGE MAY OR MAY NOT BE READING HIGH	1. Engine overheating.	1. Check reason for overheating and repair as necessary.
	2. Freeze point of antifreeze not correct. Mixture is too rich or too lean.	2. Check antifreeze. Refer to the Coolant section of this group. Adjust antifreeze-to-water ratio as required.
HOSE OR HOSES COLLAPSED WHEN ENGINE IS COOLING	1. Vacuum created in cooling system on engine cool-down is not being relieved through coolant reserve/overflow system.	1. (a) Radiator cap relief valve stuck. Refer to Radiator Cap in this group. Replace if necessary. (b) Hose between coolant reserve (c) Vent at coolant reserve/overflow tank is plugged. Clean vent and repair as necessary. (d) Reserve/overflow tank is interally blocked or plugged. Check for blockage and repair as necessary.
NOISY FAN	1. Fan blades loose.	1. Replace fan blade assembly. Refer to Cooling System Fans in this group.
	2. Fan blades striking a surrounding object.	2. Locate point of fan blade contact and repair as necessary.
	3. Air obstructions at radiator or air conditioning condenser.	Remove obstructions and/or clean debris or insects from radiator or A/C condenser.
	4. Thermal viscous fan drive has defective bearing.	Replace fan drive. Bearing is not serviceable. Refer to Viscous Fan Drive in this group.
	5. A certain amount of fan noise (roaring) may be evident on models equipped with a thermal viscous fan drive. Some of this noise is normal.	5. Refer to Viscous Fan Drive in this group for an explanation of normal fan noise.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS CONT.

CONDITION	POSSIBLE CAUSES	CORRECTION
INADEQUATE AIR CONDITIONER PERFORMANCE (COOLING SYSTEM SUSPECTED)	1. Radiator and/or A/C condenser is restricted, obstructed or dirty (insects, leaves etc.) 2. Thermal viscous fan drive is free-wheeling. 3. Engine is overheating (heat may be transferred from radiator to A/C condenser. High underhood temperatures due to engine overheating may also transfer heat to A/C components). 4. Some models with certain engines are equipped with air seals at the radiator and/or A/C condenser. If these seals are missing or damaged, not enough air flow will be pulled through the radiator and A/C condenser.	1. Remove restriction and/or clean as necessary. Refer to Radiator Cleaning in this group. 2. Refer to Viscous Fan Drive for diagnosis. Repair as necessary. 3. Correct overheating condition. Refer to text in Group 7, Cooling. 4. Check for missing or damaged air seals and repair as necessary.
INADEQUATE HEATER PERFORMANCE. THERMOSTAT FAILED IN OPEN POSITION	1. Has a diagnostic trouble code (DTC) number 17 been set? 2. Coolant level low. 3. Obstructions in heater hose fittings at engine. 4. Heater hose kinked. 5. Some models with certain engines are equipped with a water control valve located on one of the heater hoses. This valve maybe defective. 6. Water pump is not pumping water to heater core. When the engine is fully warmed up, both heater hoses should be hot to the touch. If only one of the hoses is hot, the water pump may not be operating correctly. The accessory drive belt may also be slipping causing poor water pump operation.	1. Refer to On-Board Diagnostics in the manual text and replace thermostat if necessary. 2. Refer to Testing Cooling System for Leaks in the manual text. Repair as necessary. 3. Remove heater hoses at both ends and check for obstructions. Repair as necessary. 4. Locate kinked area and repair as necessary. 5. Refer to Group 24, Heating and Air Conditioning for diagnosis. Repair as necessary. 6. Refer to Water Pumps in this group. Repair as necessary. If a slipping belt is detected, refer to Engine Accessory Drive Belts in this group. Repair as necessary.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS CONT.

CONDITION	POSSIBLE CAUSES	CORRECTION
HEAT ODOR	1. Various heat shields are used at certain drive line components. One or more of these shields may be missing.	1. Locate missing shields and replace or repair as necessary.
	2. Is temperature gauge reading above the normal range?	2. Refer to the previous Temperature Gauge Reads High in these Diagnosis Charts. Repair as necessary.
	3. Is cooling fan operating correctly.	3. Refer to Cooling System Fan in this group for diagnosis. Repair as necessary
	4. Has undercoating been applied to any unnecessary component.	4. Clean undercoating as necessary.
	5. Engine may be running rich causing the catalytic converter to overheat.	5. Refer to the DRB scan tool and the appropriate Powertrain Diagnostic Procedures service manual. Repair as necessary.
POOR DRIVEABILITY (THERMOSTAT POSSIBLY STUCK OPEN). GAUGE MAY BE READING LOW	1. For proper driveability, good vehicle emissions and for preventing build-up of engine oil sludge, the thermostat must be operating properly. Has a diagnostic trouble code (DTC) number 17 been set?	1. Refer to On-Board Diagnostics in this group. DTC's may also be checked using the DRB scan tool. Refer to the proper Powertrain Diagnostics Procedures service manual for checking the thermostat using the DRB scan tool. Replace thermostat if necessary.
STEAM IS COMING FROM FRONT OF VEHICLE NEAR GRILL AREA WHEN WEATHER IS WET, ENGINE IS WARMED UP AND RUNNING, AND VEHICLE IS STATIONARY. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. During wet weather, moisture (snow, ice or rain condensation) on the radiator will evaporate when the thermostat opens. This opening allows heated water into the radiator. When the moisture contacts the hot radiator, steam may be emitted. This usually occurs in cold weather with no fan or airflow to blow it away.	1. Occasional steam emitting from this area is normal. No repair is necessary.
COOLANT COLOR	1. Coolant color is not necessarily an indication of adequate corrosion or temperature protection. Do not rely on coolant color for determining condition of coolant.	1. Refer to Coolant in this group for antifreeze tests. Adjust antifreeze-to-water ratio as necessary.
COOLANT LEVEL CHANGES IN COOLANT RESERVE/ OVERFLOW TANK. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. Level changes are to be expected as coolant volume fluctuates with engine temperature. If the level in the tank was between the FULL and ADD marks at normal engine operating temperature, the level should return to within that range after operation at elevated temperatures.	1. A normal condition. No repair is necessary.

DIAGNOSIS AND TESTING (Continued)

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.

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 commercially available black light tool 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. 15).

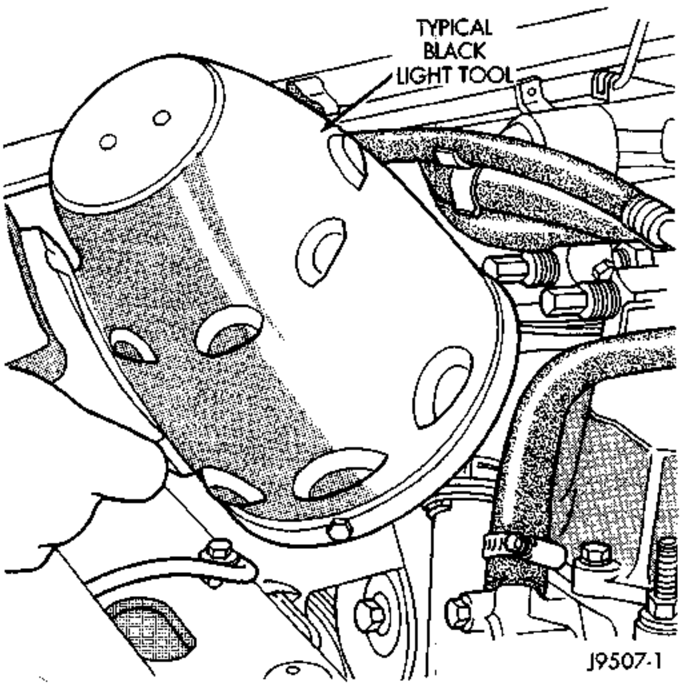


Fig. 15 Leak Detection Using Black Light—Typical

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. Replace cap if cams are bent.

Attach pressure tester 7700 (or an equivalent) to the radiator filler neck (Fig. 16).

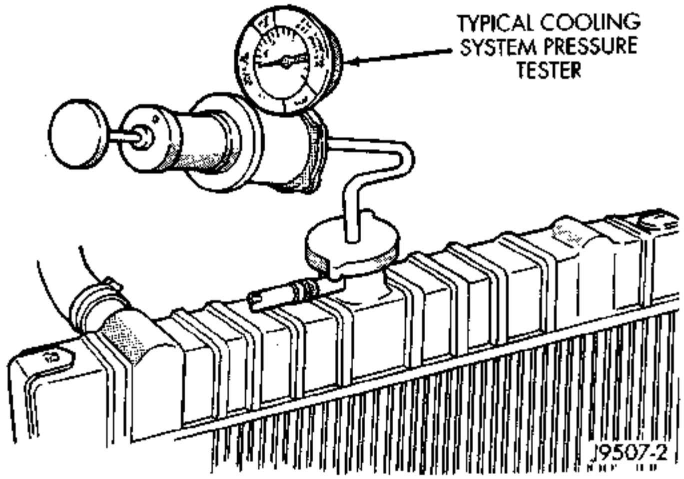


Fig. 16 Pressurizing System—Typical

Operate the tester pump to apply 124 kPa (18 psi) pressure to the system. If the hoses enlarge excessively or bulge while testing, replace as necessary. Observe the gauge pointer and determine the condition of the cooling system according to the following criteria:

- Holds Steady: If the pointer remains steady for two minutes, there are no serious coolant leaks in the system. However, there could be an internal leak that does not appear with normal system test pressure. Inspect for interior leakage or do the Internal 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

DIAGNOSIS AND TESTING (Continued)

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 engine oil pan drain plug and drain a small amount of engine oil. Coolant, being heavier than engine oil, will drain first. Another way of testing is to operate the engine and check for water globules on the engine oil dipstick. Also inspect the automatic transmission oil dipstick for water globules. Inspect the automatic 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 a 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.

VISCOUS FAN DRIVE

NOISE

NOTE: It is normal for fan noise to be louder (roaring) when:

- The underhood temperature is above the engagement point for the viscous drive coupling. This may occur when ambient (outside air temperature) is very high.
- Engine loads and temperatures are high such as when towing a trailer.
- Cool silicone fluid within the fan drive unit is being redistributed back to its normal disengaged (warm) position. This can occur during the first 15 seconds to one minute after engine start-up on a cold engine.

LEAKS

Viscous fan drive operation is not affected by small oil stains near the drive bearing. If leakage appears excessive, replace the fan drive unit.

TESTING

If the fan assembly free-wheels without drag (the fan blades will revolve more than five turns when spun by hand), replace the fan drive. This spin test must be performed when the engine is cool.

For the following test, the cooling system must be in good condition. It also will ensure against excessively high coolant temperature.

WARNING: BE SURE THAT THERE IS ADEQUATE FAN BLADE CLEARANCE BEFORE DRILLING.

DIAGNOSIS AND TESTING (Continued)

(1) Drill a 3.18-mm (1/8-in) diameter hole in the top center of the fan shroud.

(2) Obtain a dial thermometer with an 8 inch stem (or equivalent). It should have a range of -18°-to-105°C (0°-to-220° F). Insert thermometer through the hole in the shroud. Be sure that there is adequate clearance from the fan blades.

(3) Connect a tachometer and an engine ignition timing light (timing light is to be used as a strobe light).

(4) Block the air flow through the radiator. Secure a sheet of plastic in front of the radiator (or air conditioner condenser). Use tape at the top to secure the plastic and be sure that the air flow is blocked.

(5) Be sure that the air conditioner (if equipped) is turned off.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(6) Start the engine and operate at 2400 rpm. Within ten minutes the air temperature (indicated on the dial thermometer) should be up to 88° C (190° F). Fan drive **engagement** should have started to occur at between 74° to 85° C (165° to 185° F). Engagement is distinguishable by a definite **increase** in fan flow noise (roaring). The timing light also will indicate an increase in the speed of the fan.

(7) When the air temperature reaches 88° C (190° F), remove the plastic sheet. Fan drive **disengagement** should have started to occur at between 57° to 82° C (135° to 180° F). A definite **decrease** of fan flow noise (roaring) should be noticed. If not, replace the defective viscous fan drive unit.

CAUTION: Engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

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. 17) 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:

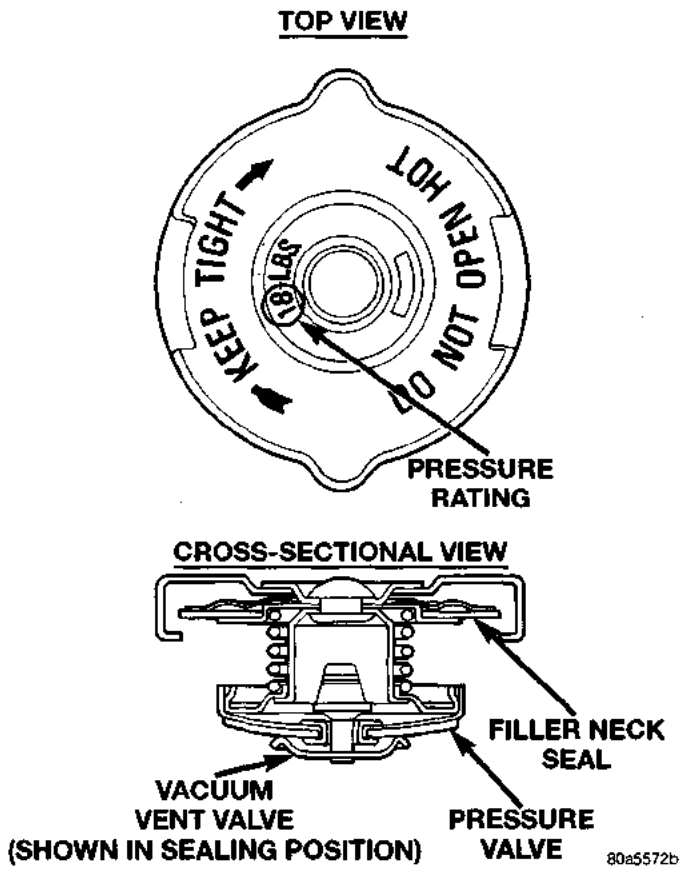


Fig. 17 Radiator Pressure Cap

(1) To check and adjust antifreeze freeze point.
(2) To refill system with new antifreeze.
(3) For conducting service procedures.
(4) When checking for vacuum leaks.

DIAGNOSIS AND TESTING (Continued)

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. 18).

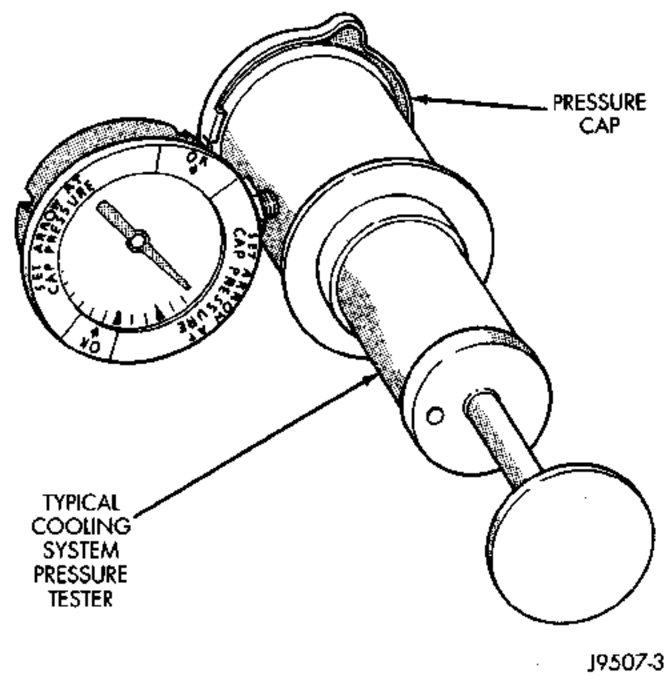


Fig. 18 Pressure Testing Radiator Pressure Cap—Typical

Operate the tester pump and observe the gauge pointer at its highest point. The cap release pressure should be 83 to 110 kPa (12 to 16 psi). The cap is satisfactory when the pressure holds steady. It is also good if it holds pressure within the 83 to 110 kPa (12 to 16 psi) range for 30 seconds or more. If the pointer drops quickly, replace the cap.

CAUTION: Radiator pressure testing tools are very sensitive to small air leaks, which will not cause cooling system problems. A pressure cap that does not have a history of coolant loss should not be replaced just because it leaks slowly when tested with this tool. Add water to tool. Turn tool upside down and recheck pressure cap to confirm that cap needs replacement.

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.

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.

SERVICE PROCEDURES

ROUTINE COOLANT LEVEL CHECK

NOTE: 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.

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.

SERVICE PROCEDURES (Continued)

ADDING ADDITIONAL COOLANT

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 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.

SERVICE COOLANT LEVEL

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

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.

DO NOT remove the radiator cap when draining the coolant from the reserve/overflow tank. Open the radiator draincock and when the tank is empty, remove the radiator cap. The coolant does not have to be removed from the tank unless the system is being refilled with a fresh mixture.

(1) Drain the coolant from the radiator by loosening the draincock.

(2) Drain coolant from engine as follows:

On 2.5L 4-cylinder engine by removing drain plug at left rear side of block.

On 4.0L 6-cylinder engine by removing the drain plug or coolant temperature sensor on the left side of the block (Fig. 19).

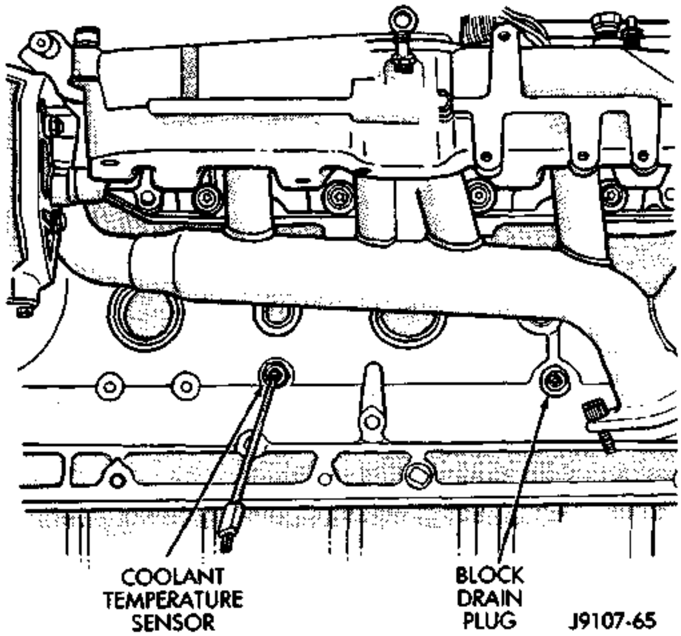


Fig. 19 Draining Coolant—4.0L 6-Cylinder Engine

REFILLING COOLING SYSTEM

(1) Tighten the radiator draincock and the cylinder block drain plug(s).

(2) Fill system using a 50/50 mixture of water and antifreeze. This is described in the Coolant section of this group. Fill the radiator to the top and install the radiator cap. Add sufficient coolant to the reserve/overflow tank to raise the level to the FULL mark.

(3) Operate the engine with both the radiator cap and reserve/overflow tank cap in place. After the engine has reached the normal operating temperature, shut the engine off and allow it to cool.

(4) Add coolant to the reserve/overflow tank as necessary. **Only add coolant when the engine is cold. Coolant level in a warm engine will be higher due to thermal expansion.**

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.

SERVICE PROCEDURES (Continued)

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.

REMOVAL AND INSTALLATION

AUTOMATIC TRANSMISSION OIL COOLER

The internal transmission oil cooler located within the radiator is not serviceable. If it requires service, the radiator must be replaced.

Once the repaired or replacement radiator has been installed, fill the cooling system and inspect for leaks. Refer to the Filling Cooling System and Testing Cooling System For Leaks sections in this group. If the transmission operates properly after repairing the leak, drain the transmission and remove the transmission oil pan. Inspect for sludge. Inspect for a dirty or plugged inlet filter. If none of these conditions are found, the transmission and torque convertor may not require reconditioning. Refer to Group 21 for automatic transmission servicing.

AUXILIARY TRANSMISSION OIL COOLER

REMOVAL/INSTALLATION

(1) Remove fan shroud and radiator. Refer to the Radiators section for procedures.

(2) Remove the air conditioning filter/drier mounting bolts.

WARNING: BEFORE PROCEEDING WITH THE NEXT STEP, BE SURE TO WEAR SAFETY GLASSES. THE A/C SYSTEM IS UNDER PRESSURE EVEN WITH THE ENGINE OFF.

(3) Remove the A/C condenser mounting bolts.

(4) Carefully tilt the A/C condenser rearward for access to the auxiliary transmission oil cooler.

(5) Place a drain pan below the oil cooler.

(6) Remove the two hose clamps at oil cooler inlet and outlet tubes (Fig. 20).

(7) Remove the three oil cooler mounting bolts (Fig. 20).

(8) Remove the oil cooler from vehicle.

(9) Reverse the preceding operation for installation. Tighten the two clamps 2 N·m (15 in. lbs.) torque. Tighten mounting bolts to 8 N·m (72 in. lbs.) torque.

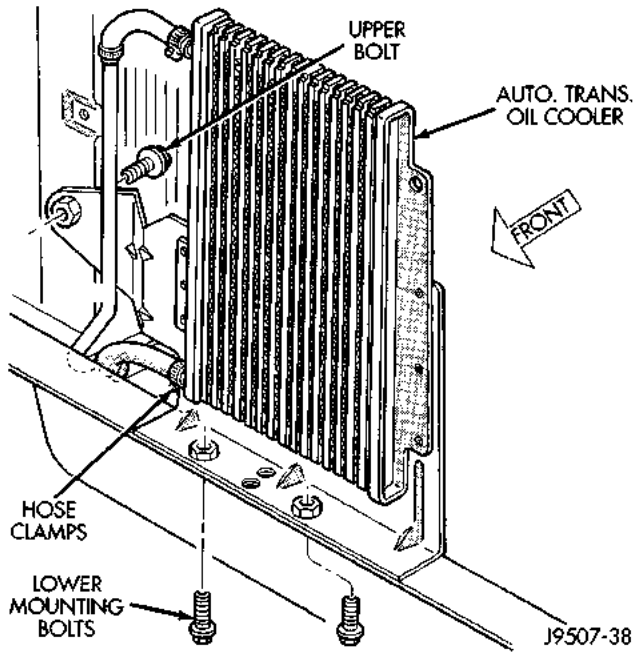


Fig. 20 Auxiliary Air-To-Oil Cooler

COOLANT RESERVE/OVERFLOW BOTTLE

REMOVAL/INSTALLATION

(1) Remove the tube from radiator filler neck.

(2) Remove coolant recovery bottle (Fig. 21).

(3) Reverse the preceding steps for installation.

REMOVAL AND INSTALLATION (Continued)

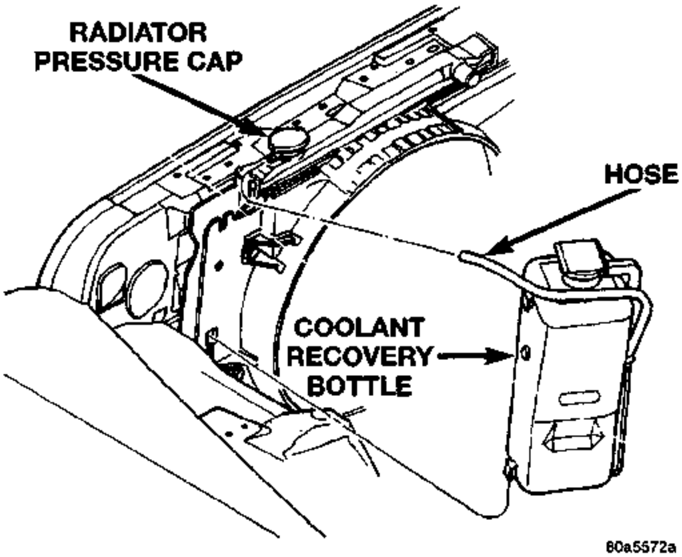


Fig. 21 Coolant Reserve/Overflow Bottle

WATER PUMP

CAUTION: If the water pump is replaced because of mechanical damage, the fan blades and viscous fan drive should also be inspected. These components could have been damaged due to excessive vibration.

REMOVAL

The water pump can be removed without discharging the air conditioning system (if equipped).

CAUTION: All engines have a reverse (counterclockwise) rotating water pump. The letter R is stamped into the back of the water pump impeller (Fig. 22) 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.

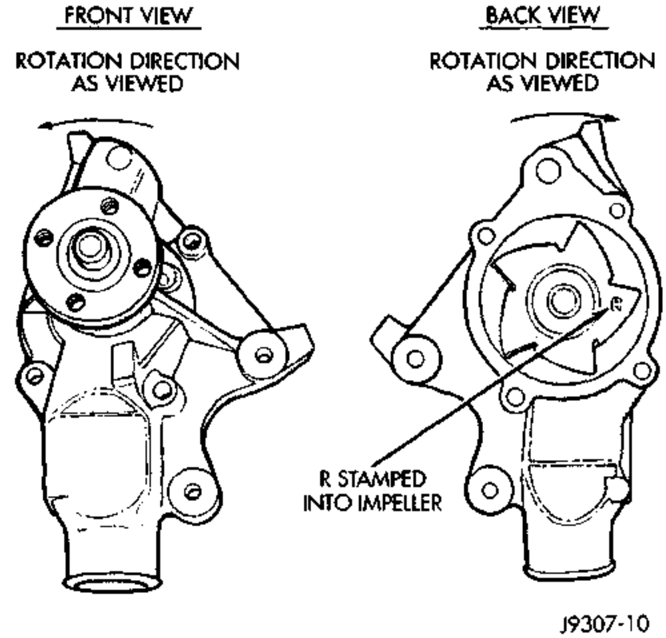


Fig. 22 Reverse Rotating Water Pump—Typical

(3) Loosen (but do not remove at this time) the four fan hub-to-water pump pulley mounting nuts (Fig. 23).

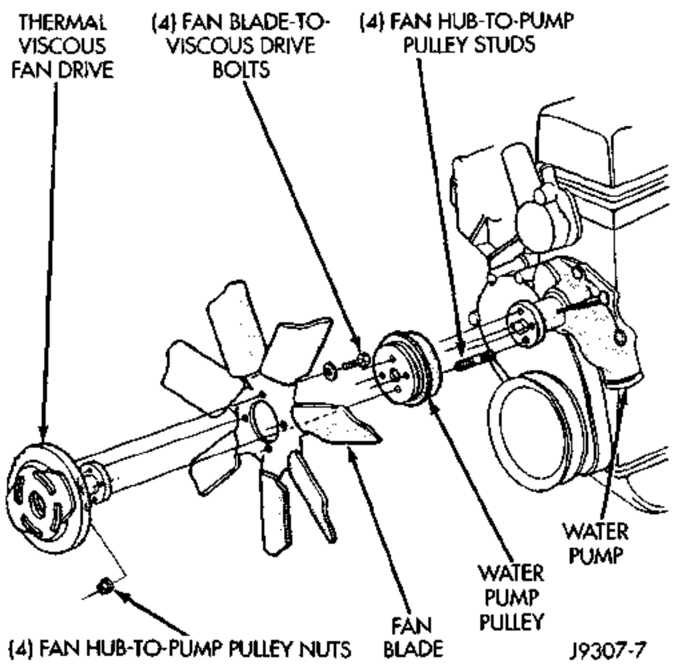


Fig. 23 Fan Mounting Nuts

NOTE: The engine accessory drive belt must be removed prior to removing the fan.

(4) Remove engine drive belt.

(5) Remove power steering pump (Fig. 24), refer to Group 19 Steering.

REMOVAL AND INSTALLATION (Continued)

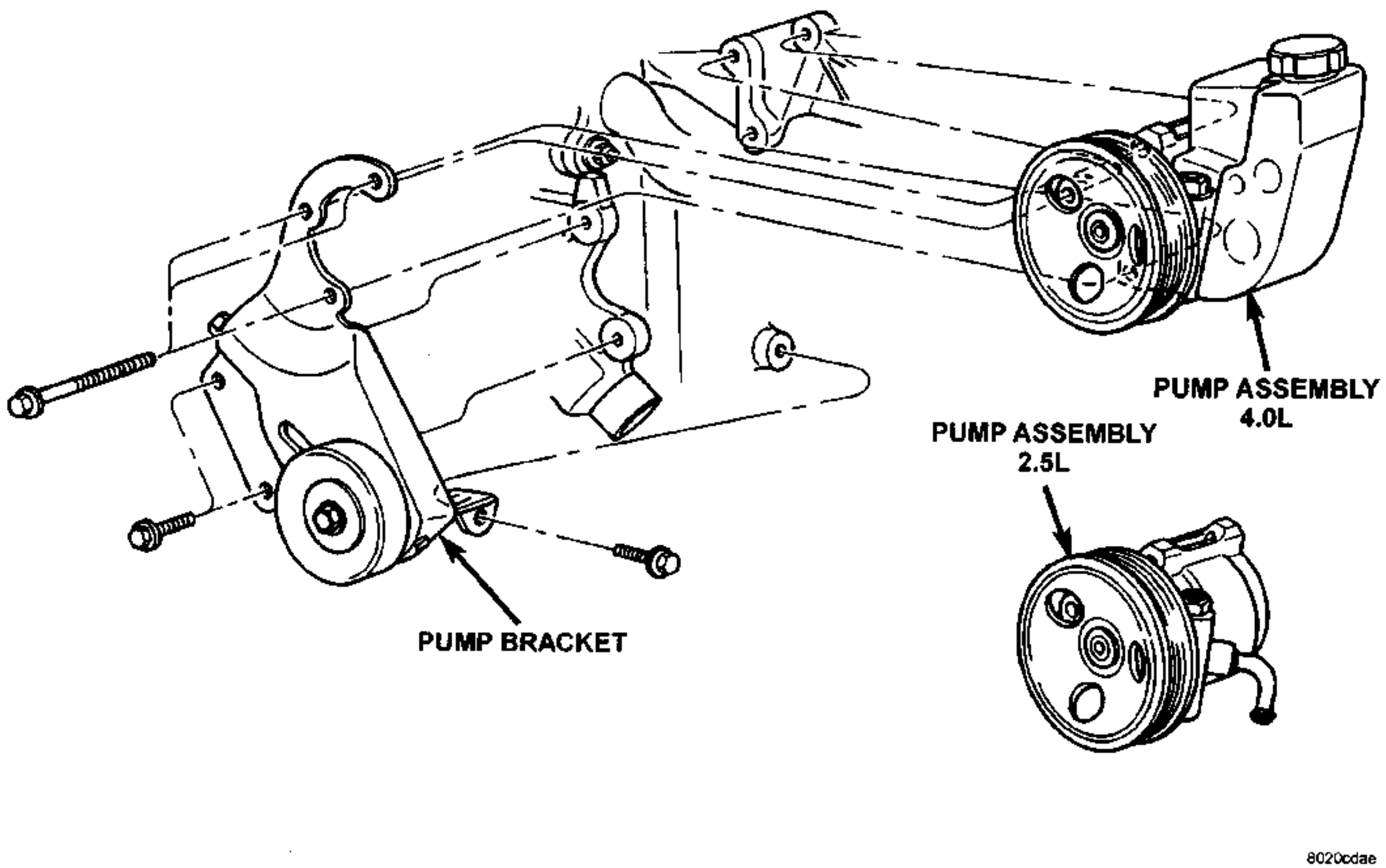


Fig. 24 Power Steering Pump Attachment

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (Fig. 25) SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

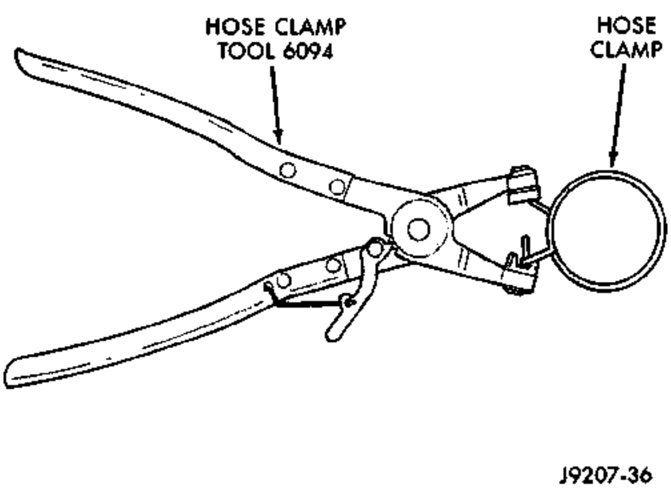


Fig. 25 Hose Clamp Tool–Typical

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 26). If replacement is necessary, use only an original equipment clamp with matching number or letter.

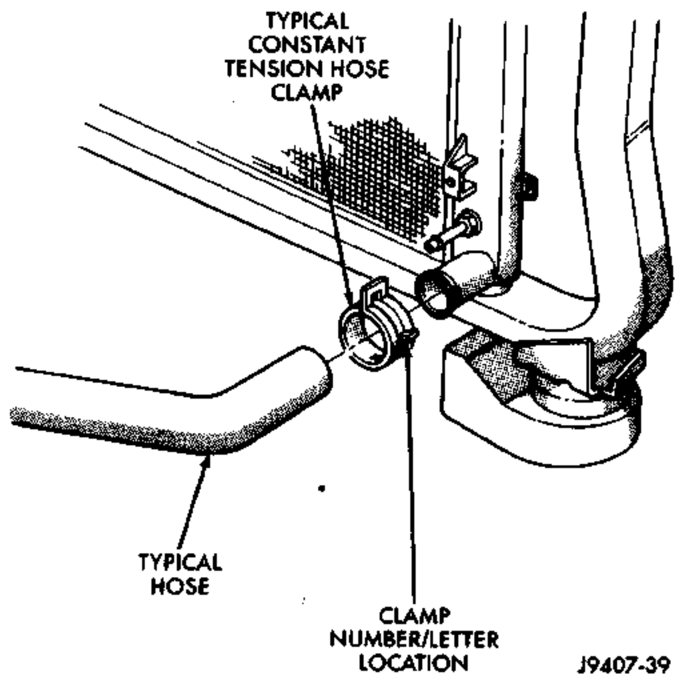


Fig. 26 Clamp Number/Letter Location

REMOVAL AND INSTALLATION (Continued)

(6) Remove lower radiator hose from water pump. Remove heater hose from water pump fitting.

(7) Remove four nuts previously loosened and remove the fan blade assembly and pulley.

(8) 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.

(9) Remove the four pump mounting bolts (Fig. 27) and remove pump from vehicle. Discard old gasket. Note that one of the four bolts is longer than the other bolts.

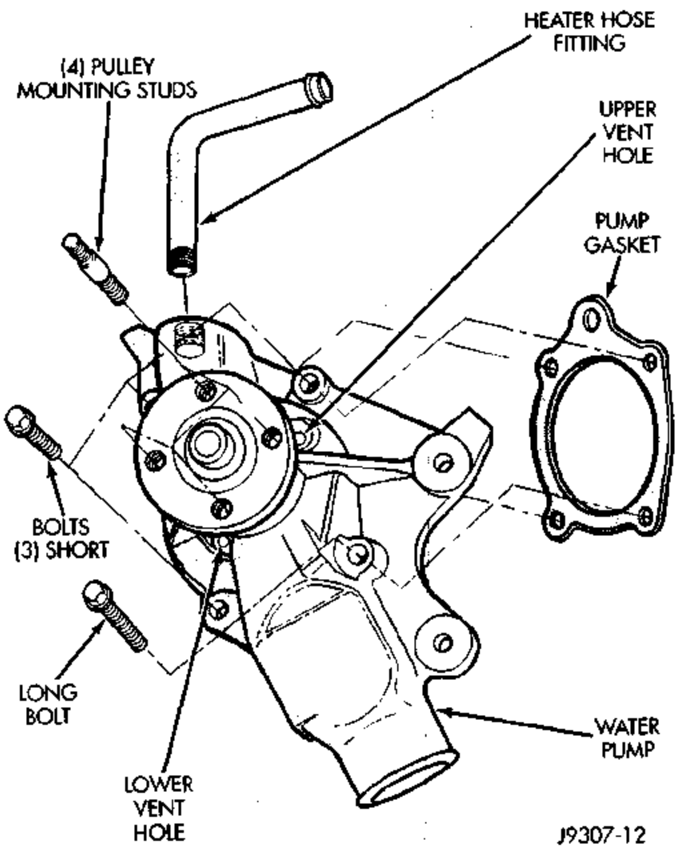


Fig. 27 Water Pump Remove/Install—Typical

(10) If pump is to be replaced, the heater hose fitting must be removed. Note position of fitting before removal.

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 silicone bead on the gasket should be facing the water pump. Also, the gasket is installed dry. Tighten mounting bolts to 30 N·m (22 ft. lbs.) torque. Rotate the shaft by hand to be sure it turns freely.

(4) Connect the radiator and heater hoses to the water pump.

(5) Position water pump pulley to water pump hub.

(6) Install fan and four nuts to water pump hub. Tighten or nuts to 27 N·m (20 ft. lbs.) torque.

(7) Install power steering pump.

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 the Belt Removal and Installation in this group for appropriate belt routing. You may also refer to the Belt Routing Label in the vehicle engine compartment.

(8) Adjust accessory drive belt, refer to Accessory Drive Belt removal and installation in this group.

(9) Fill cooling system with coolant and check for leaks. Refer to Refilling Cooling System in this group.

(10) Connect battery cable to battery.

(11) Start and warm the engine. Check for leaks.

THERMOSTAT

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Drain the coolant from the radiator until the level is below the thermostat housing.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (Fig. 25). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

REMOVAL AND INSTALLATION (Continued)

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 26). If replacement is necessary, use only an original equipment clamp with matching number or letter.

(2) Remove radiator upper hose and heater hose at thermostat housing.

(3) Disconnect wiring connector at engine coolant temperature sensor.

(4) Remove thermostat housing mounting bolts, thermostat housing, gasket and thermostat (Fig. 28). Discard old gasket.

(5) Clean the gasket mating surfaces.

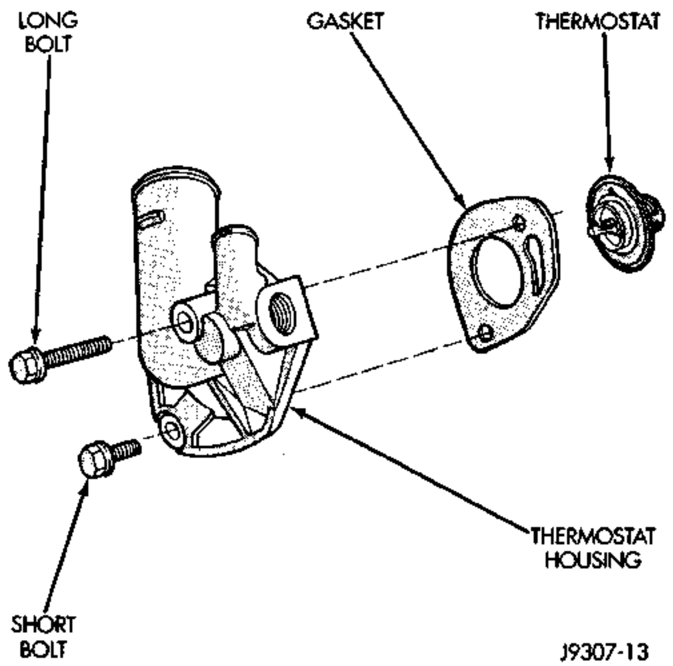


Fig. 28 Thermostat Removal/Installation

(6) Clean the gasket mating surfaces.

INSTALLATION

(1) Install the replacement thermostat so that the pellet, which is encircled by a coil spring, faces the engine. All thermostats are marked on the outer flange to indicate the proper installed position.

(2) Observe the recess groove in the engine cylinder head (Fig. 29).

(3) Position thermostat into this groove with arrow and air bleed hole on outer flange pointing up.

(4) 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.

(5) Tighten the housing bolts to 20 N·m (15 ft. lbs.) torque.

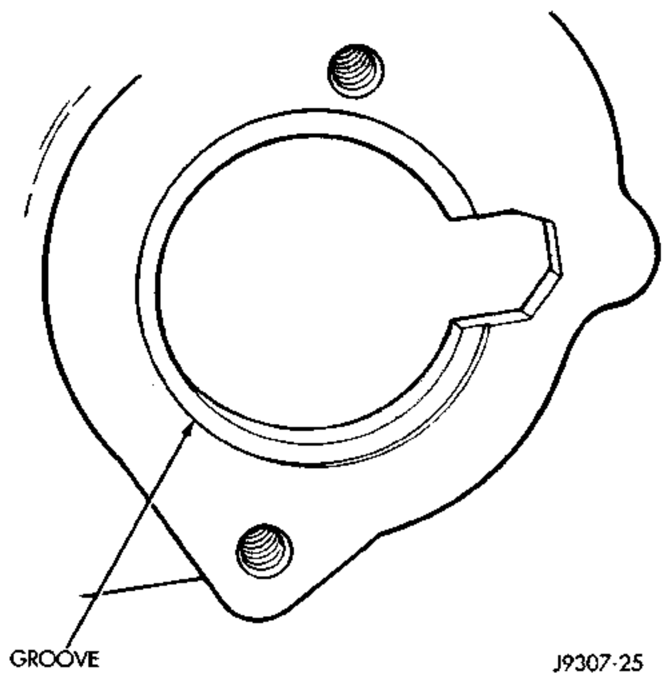


Fig. 29 Thermostat Recess

(6) Install hoses to thermostat housing.

(7) Install electrical connector to coolant temperature sensor.

(8) 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.

(9) Start and warm the engine. Check for leaks.

RADIATOR

REMOVAL

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

(1) Disconnect negative battery cable at battery.

(2) Observe the previous **WARNINGS.** Remove the radiator cap.

(3) Position drain pan under draincock. Open radiator draincock and drain radiator.DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse. DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(4) Remove radiator upper and lower hose clamps. Remove radiator hoses.

(5) Disconnect coolant reserve/overflow tank hose from radiator.

(6) Remove the four fan shroud mounting bolts (Fig. 30). On some models the power steering fluid

REMOVAL AND INSTALLATION (Continued)

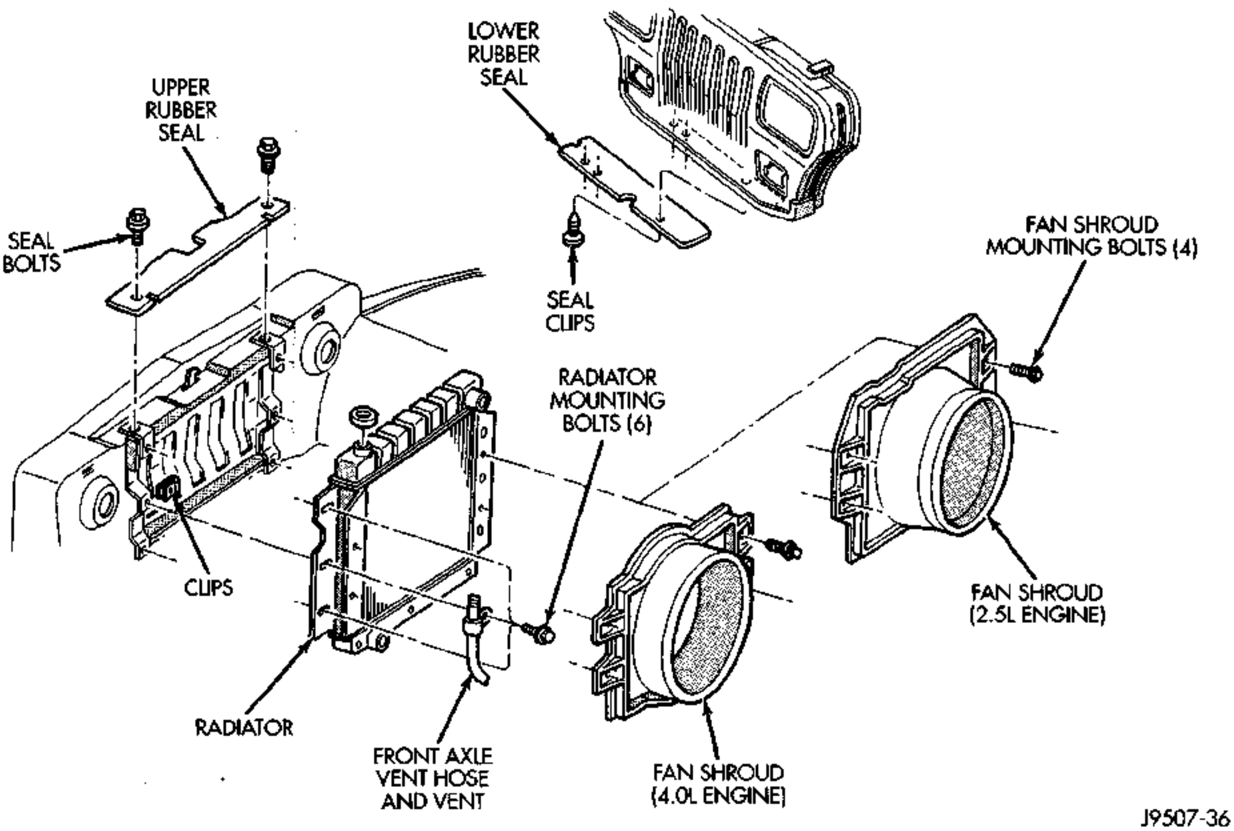


Fig. 30 Radiator—Remove/Install

reservoir tank is attached to the side of the fan shroud. Tie the reservoir back to prevent spillage. Position the fan shroud back over the fan blades.

(7) If equipped, disconnect and plug automatic transmission fluid cooler lines.

(8) Remove six radiator mounting bolts. Position the front axle vent hose (Fig. 30) to the side.

(9) Lift radiator straight up and out of vehicle taking care not to damage radiator fins.

(10) When removing radiator, note position of the rubber seals located on the top and bottom of radiator (on certain models only) (Fig. 30). To prevent possible overheating, these seals must be installed to their original positions.

INSTALLATION

(1) Position the radiator. Install and tighten the six mounting bolts (Fig. 30) to 8 N·m (72 in. lbs.) torque.

(2) Close radiator draincock.

(3) Position fan shroud and power steering reservoir tank (if equipped). Install and tighten four mounting bolts to 8 N·m (72 in. lbs.) torque.

(4) If equipped, remove plugs and connect automatic transmission fluid cooler lines.

(5) Connect radiator hoses and install hose clamps.

(6) Connect negative battery cable.

(7) Fill cooling system with correct coolant. Refer to the Coolant section of this group.

(8) Connect reserve/overflow tank hose.

(9) Install radiator cap.

(10) Check and adjust automatic transmission fluid level (if equipped).

ENGINE BLOCK HEATER

REMOVAL

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(1) Drain coolant from radiator and engine cylinder block.

(2) Unplug power cord from block heater.

(3) Loosen screw in center of block heater (Fig. 31) or (Fig. 32).

(4) Remove block heater from cylinder block.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Thoroughly clean the engine core hole and the block heater seat.

(2) Insert block heater assembly into core hole with element loop pointing **Up.**

(3) Seat block heater flush against block face. Tighten mounting screw to 3.6 N·m (32 in. lbs.) torque.

(4) Fill cooling system with coolant. Pressurize system and inspect for leaks.

(5) Plug power cord into block heater. Route cord away from moving parts, linkages and exhaust system components. Secure cord in place with tie-straps.

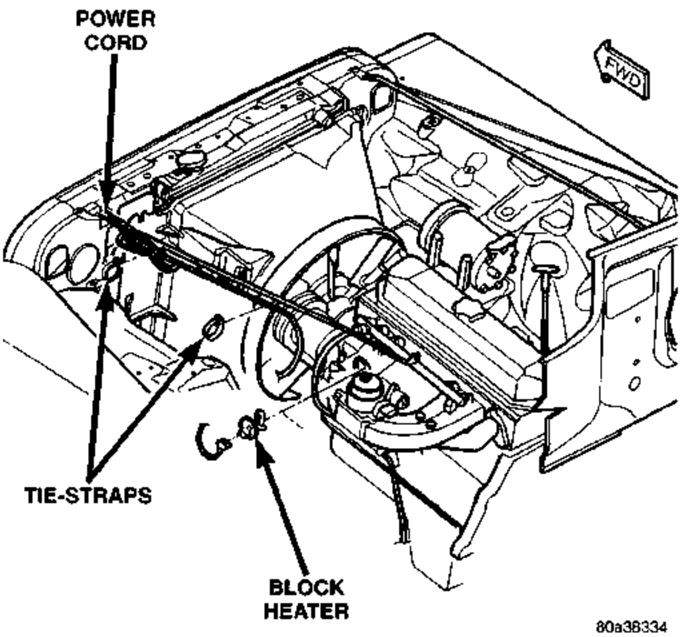


Fig. 31 Block Heater and Cord—2.5L Engine

FAN

REMOVAL

(1) Loosen but do not remove at this time, the four fan hub mounting nuts (Fig. 33).

(2) Remove accessory serpentine drive belt. Refer to Belt Service in the Engine Accessory Drive Belt section of this group.

(3) Some models with certain engines may require the removal of the fan shroud to remove the viscous fan drive. The fan shroud and fan blade/viscous fan drive should be removed from the vehicle as one assembly.

(4) Remove four fan hub mounting nuts (Fig. 33) and remove fan/viscous fan drive assembly from vehicle.

(5) After removing fan blade/viscous fan drive assembly, **do not** place thermal viscous fan drive in horizontal position. If stored horizontally, silicone

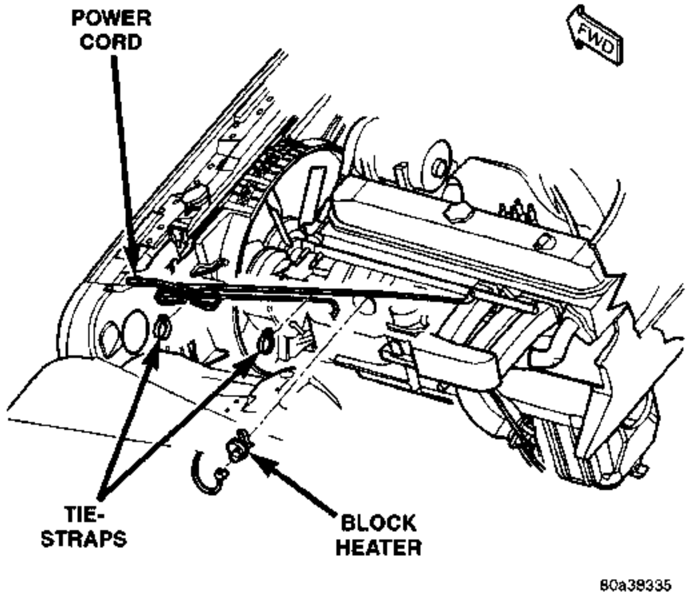


Fig. 32 Block Heater and Cord—4.0L Engine

fluid in viscous fan drive could drain into its bearing assembly and contaminate lubricant.

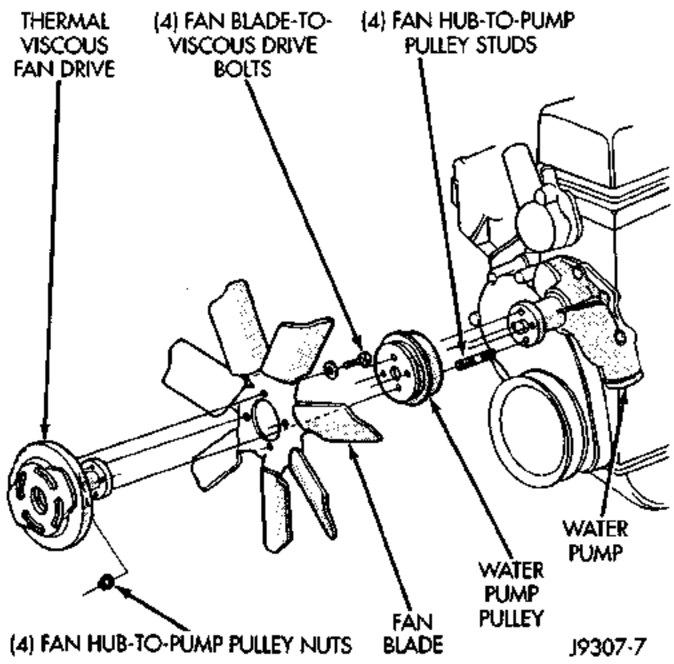


Fig. 33 Fan Mount

INSTALLATION

(1) Assemble fan blade to viscous fan drive. Tighten mounting bolts to 27 N·m (20 ft. lbs.) torque.

(2) Position mounting flange of fan blade/viscous fan drive assembly onto hub. Install four nuts and tighten to 24 N·m (18 ft. lbs.) torque. Tighten the

REMOVAL AND INSTALLATION (Continued)

first two nuts 180 degrees apart. Then tighten last two nuts.

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to Serpentine Drive Belt Removal and Installation in this group for correct belt routing.

VISCOUS FAN DRIVE

Refer to Cooling System Fan for removal and installation procedures of the viscous drive unit.

Viscous Fan Drive Fluid Pump Out Requirement: After installing a **new** viscous fan drive, bring the engine speed up to approximately 2000 rpm and hold for approximately two minutes. This will ensure proper fluid distribution within the drive.

SERPENTINE DRIVE BELT

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. Do not allow the gauge (or gauge adapter) to contact anything but the belt.

BELT SCHEMATICS

The belt routing schematics are published from the latest information available at the time of publication. Vehicles not equipped with Power Steering have an idler pulley in place of the power steering pump pulley.**If anything differs between these schematics and the Belt Routing Label, use the schematics on Belt Routing Label.** This label is located in the engine compartment.

Refer to (Fig. 34) (Fig. 35)for proper belt routing. Or, refer to Belt Routing Label located in the vehicle engine compartment.

REPLACEMENT OR ADJUSTMENT

REMOVAL

Belt tension is adjusted at the power steering pump bracket and idler pulley assembly.

(1) Disconnect negative battery cable from battery.

(2) Loosen belt tension at power steering pump bracket and idler pulley (Fig. 36).

(3) Remove belt.

INSTALLATION

(1) Check condition of all pulleys.

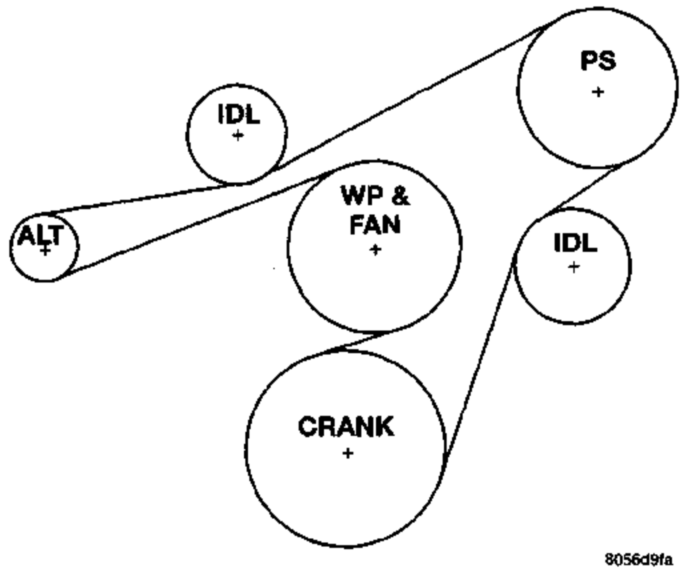


Fig. 34 Vehicles with 2.5L or 4.0L Engine–Without A/C

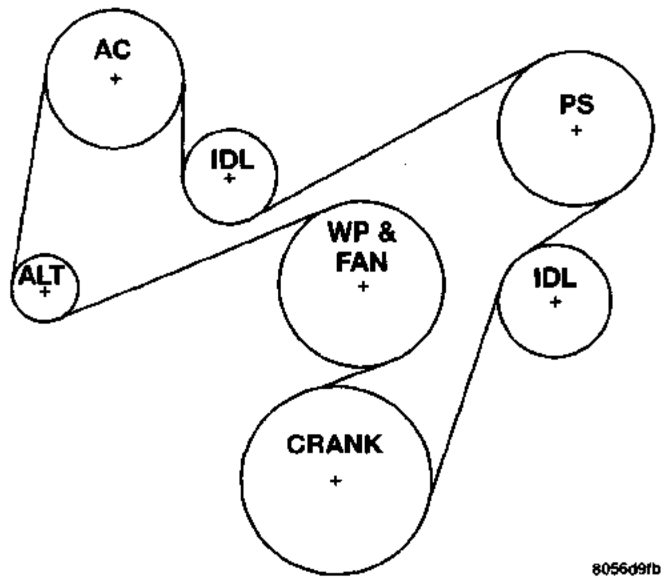


Fig. 35 Vehicles with 2.5L or 4.0L Engine–With A/C

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. 34) (Fig. 35)for correct belt routing.

(2) Install new belt. Refer to the end of this group for Drive Belt Tension specifications.

(3) After power steering pump bracket and idler pulley has been tightened into position, recheck belt tension. Adjust if necessary.

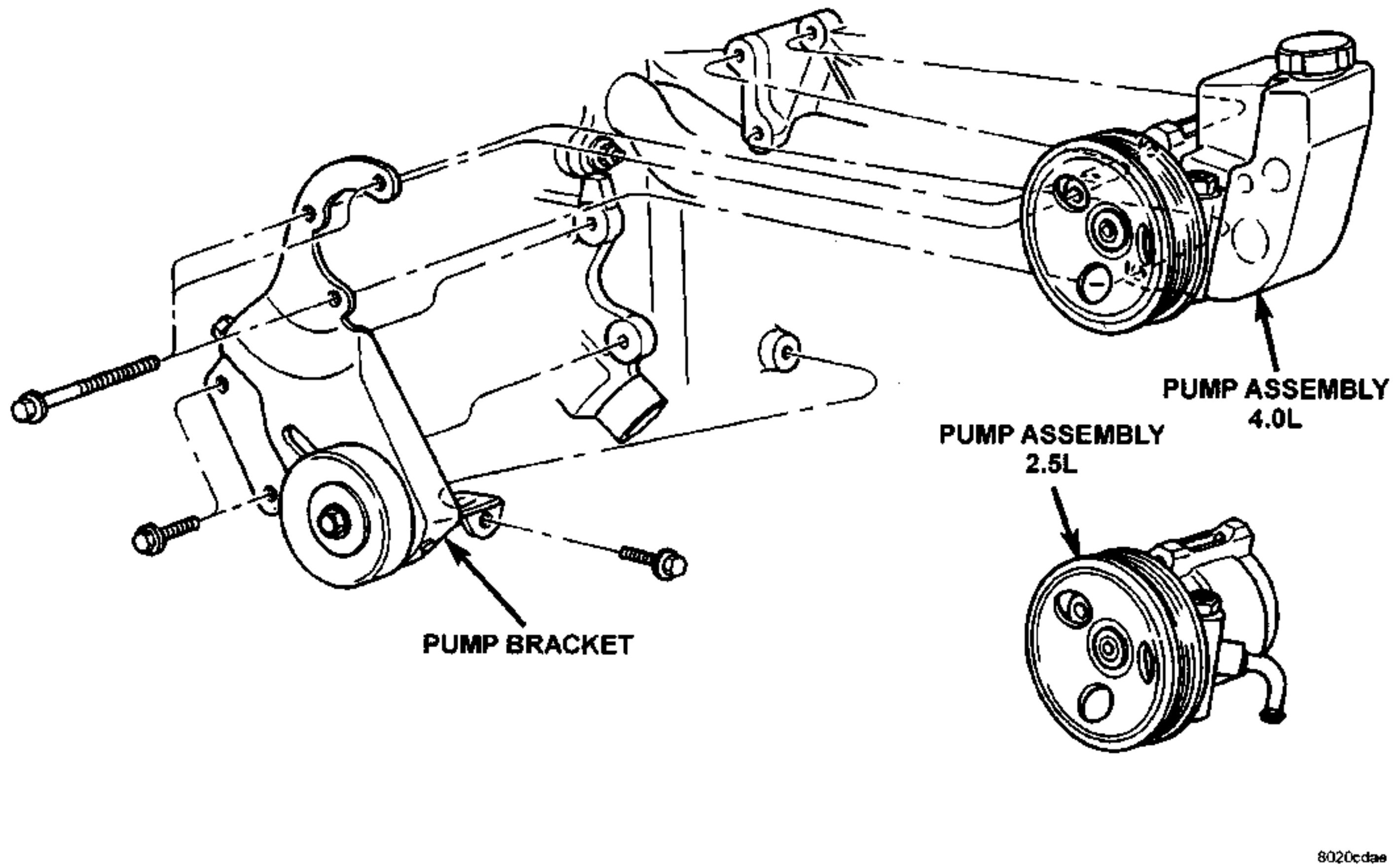


Fig. 36 Power Steering Pump Bracket and Idler Pulley

CLEANING AND INSPECTION

RADIATOR PRESSURE CAP

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

The radiator and air conditioning fins should be cleaned when an accumulation of bugs, leaves etc. has occurred. Clean radiator fins are necessary for good heat transfer. With the engine cold, apply cold water and compressed air to the back (engine side) of the radiator to flush the radiator and/or A/C condenser of debris.

COOLING SYSTEM

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.

FAN BLADE

The fan blades cannot be repaired. If fan is damaged, it must be replaced. Inspect fan as follows:

(1) Remove fan blade and viscous fan drive as an assembly from the engine. Refer to Removal procedure.

(2) Remove fan blade assembly from viscous fan drive unit (four bolts).

(3) Lay fan on a flat surface with leading edge facing down. With tip of blade touching flat surface, replace fan if clearance between opposite blade and surface is greater than 2.0 mm (.090 inch). Rocking motion of opposite blades should not exceed 2.0 mm (.090 inch). Test all blades in this manner.

WARNING: DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN BLADES IF NOT WITHIN SPECIFICATIONS.

(4) Inspect fan assembly for cracks, bends, loose rivets or broken welds. Replace fan if any damage is found.

CLEANING AND INSPECTION (Continued)

CAUTION: If fan blade assembly is replaced because of mechanical damage, water pump and viscous fan drive should also be inspected. These components could have been damaged due to excessive vibration.

COOLING SYSTEM HOSES

Inspect the hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed, or swell excessively when the system is pressurized.

For all vehicles: In areas where specific routing clamps are not provided, be sure that hoses are positioned with sufficient clearance. Check clearance from exhaust manifolds and pipe, fan blades, drive belts and sway bars. Improperly positioned hoses can be damaged, resulting in coolant loss and engine overheating.

Ordinary worm gear type hose clamps (when equipped) can be removed with a straight screwdriver or a hex socket. **To prevent damage to hoses or clamps, the hose clamps should be tightened to 4 N·m (34 in. lbs.) torque. Do not over tighten hose clamps.**

When performing a hose inspection, inspect the radiator lower hose for proper position and condition of the internal spring.

SPECIFICATIONS

COOLING SYSTEM CAPACITIES

ENGINE	COOLING CAPACITY	RADIATOR		A/C	MECHANICAL FAN (VISCOUS DRIVE)		
		ROWS OF TUBES	FINS PER INCH		DIA. (INCH)	NO. OF BLADES	BLADE PITCH (INCH)
2.5L	8.5L (9.0 Qts.)	1	17	WITH OR WITHOUT	15.0	5	2.5
4.0L	9.9L (10.5 Qts.)	2	15	WITH OR WITHOUT	18.0	5	3.0

SPECIFICATIONS (Continued)

BELT TENSION

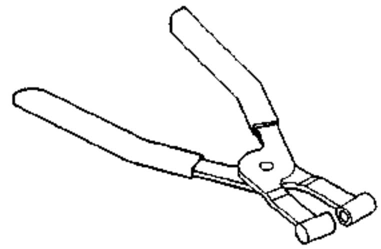
BELT	SPECIFICATION
**NEW SERPENTINE BELT	800-900 N (180-200 lbs. force)
USED SERPENTINE BELT	623-712 N (140-160 lbs. force)
**Belt is considered new if it has been used 15 minutes or less.	
Specifications for use with a belt tension gauge. Refer to operating instructions supplied with gauge.	

TORQUE

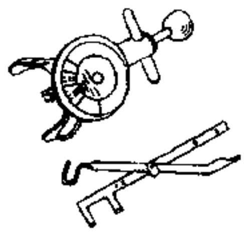
DESCRIPTION . . . .**TORQUE**
Generator Pivot
Bolt. . . . . .38 N·m (28 ft. lbs.)
Generator Rear Adjusting
Bolt . . . . .27 N·m (20 ft. lbs.)
Auto. Trans. Auxiliary Oil Cooler
Mounting Bolts. . . . . .2 N·m (18 in. lbs.)
Fan Blade-to-Viscous Fan Drive
Bolts . . . . .24 N·m (18 ft. lbs.)
Viscous Fan Drive-to-Water Pump
Nuts . . . . .27 N·m (20 ft. lbs.)
Fan Shroud—2.5L
Screws. . . . . .16 N·m (12 ft. lbs.)
Fan Shroud—4.0L
Screws .4 N·m (31 in. lbs.)
Engine Block Heater
Fastener. . . . . .4 N·m (31 in. lbs.)
Thermostat Housing
Bolts . . . . .20 N·m (15 ft. lbs.)
Water Pump—2.5L or 4.0L
Bolts . . . . .30 N·m (22 ft. lbs.)

SPECIAL TOOLS

COOLING



Pliers Hose Clamp 6094



Gauge Belt Tension C-4162

DIFFERENTIAL AND DRIVELINE

CONTENTS

PROPELLER SHAFTS

INDEX

GENERAL INFORMATION

PROPELLER SHAFTS

The function of a propeller shaft is to transmit power from one point to another. The shaft is designed to send torque from the transmission and transfer case to the drive axles (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. The propeller shaft must be able to change operating angles when going over various road surfaces. This is done through universal joints, which permit the propeller shaft to operate at different angles. The slip joints (or yokes) permit contraction or expansion (Fig. 1).

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 ot prevent an out-of-balance condition and driveline vibration.

CAUTION: Use original equipment replacement parts for attaching the propeller shafts. The specified torque must always be applied when tightening the fasteners.

GENERAL INFORMATION (Continued)

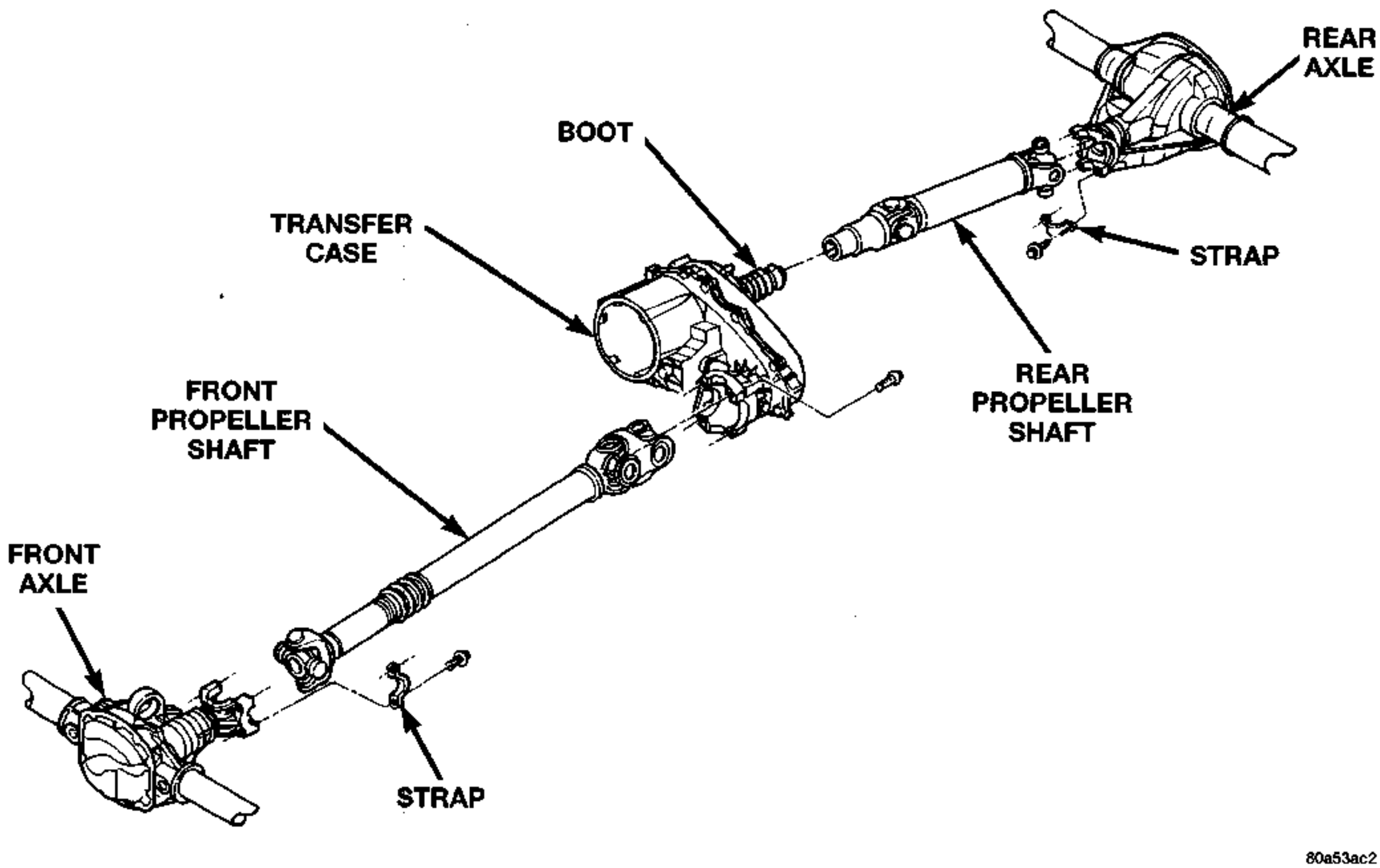


Fig. 1 Propeller Shafts

UNIVERSAL JOINTS

Two different types of U–joints are used with the propeller shafts:

- Single cardan U–joint (Fig. 2)
- Double cardan (CV) U–joint (Fig. 3)

LUBRICATION

The factory installed U–joints are lubricated for the 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.

PRECAUTIONS

Use exact replacement hardware for attaching the propeller shafts. Exact replacement will ensure safe operation. The specified torque must always be applied when tightening the fasteners.

Put reference marks on the propshaft yoke and axle or transmission yoke before service (Fig. 4). This will assure correct phasing and eliminate possible vibration.

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.

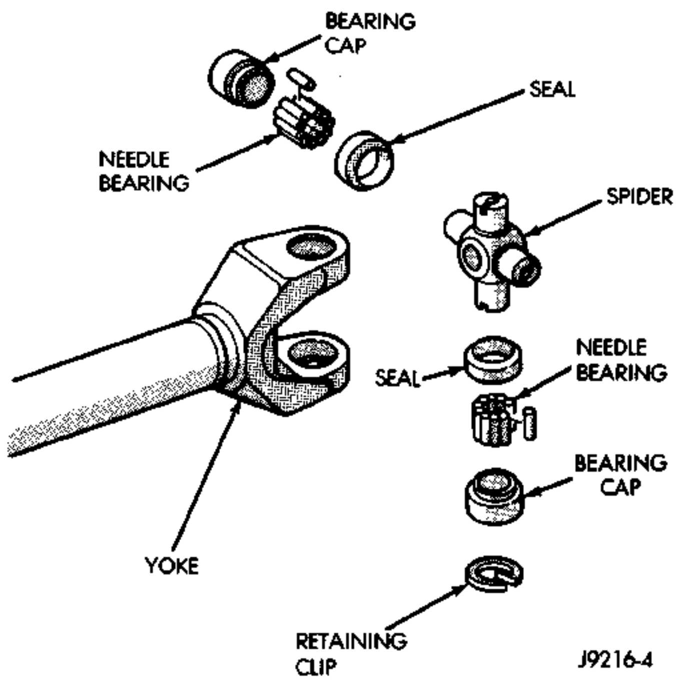


Fig. 2 Single Cardan Universal Joint

GENERAL INFORMATION (Continued)

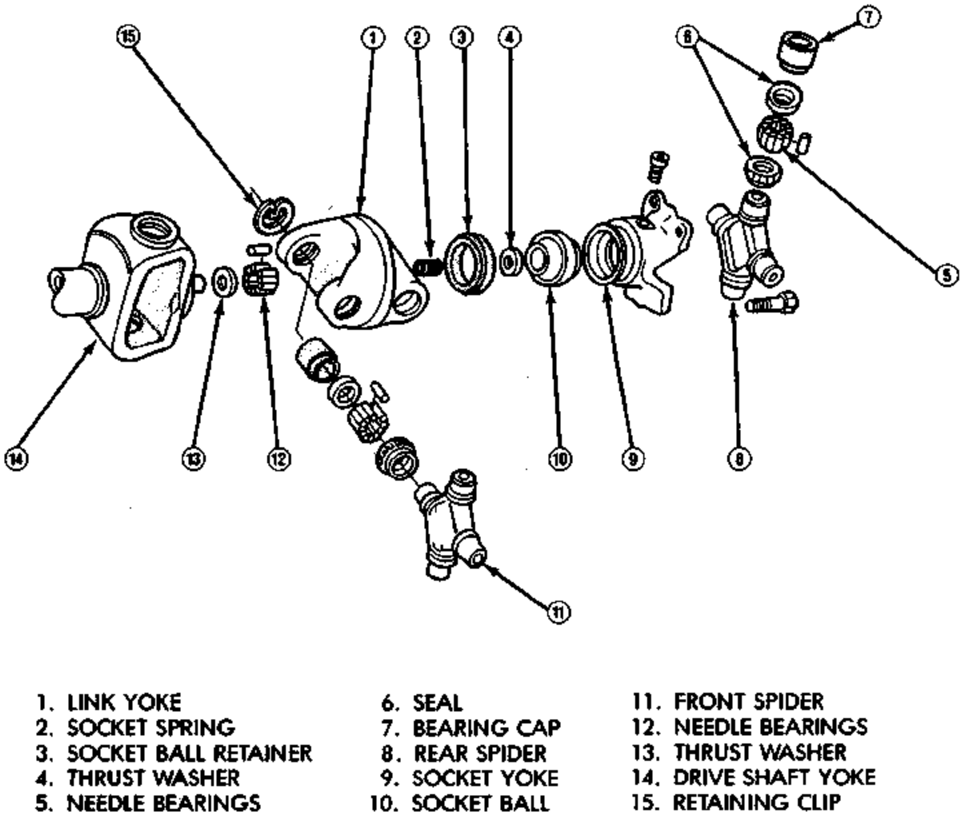


Fig. 3 Double Cardan (CV) Universal Joint

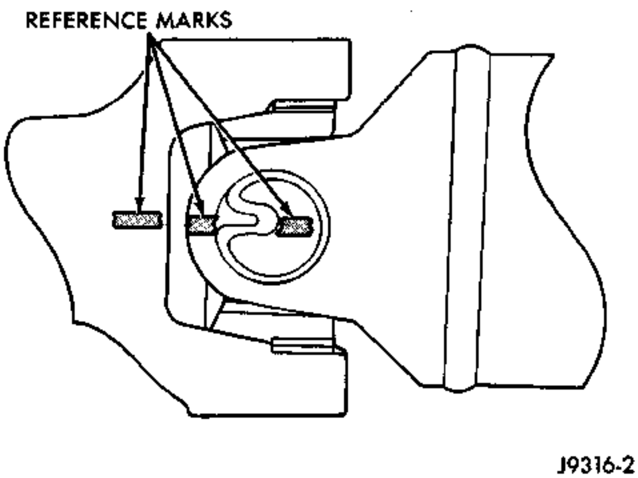


Fig. 4 Reference Marks on Yokes

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.

DIAGNOSIS AND TESTING

VIBRATION

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

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

Driveline vibration can also result from loose or damaged engine mounts. Refer to Group 21, Transmissions for additional information.

Propeller shaft vibration will increase as the vehicle speed is increased. A vibration that occurs within a specific speed range is not caused by propeller shaft unbalance. Defective universal joints or an incorrect propeller shaft angle are usually the cause.

UNBALANCE

If propeller shaft unbalance is suspected, it can be verified with the following procedure:

Removing and re–indexing the propeller shaft 180° may eliminate some vibrations.

- Clean all the foreign material from the propeller shaft and the universal joints.

DIAGNOSIS AND TESTING (Continued)

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

• Ensure the universal joints are not worn, are properly installed, and are correctly aligned with the shaft.

• Check the universal joint clamp screws torque

(1) Raise the vehicle.

(2) Remove the wheel and tires assembly. Install the wheel lug nuts to retain the brake drums.

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

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

(5) Install a screw clamp at position 1 (Fig. 5).

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

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

(8) If the vibration decreased, install a second clamp (Fig. 6) and repeat the test.

(9) If the clamps cause an additional unbalance, separate the clamps (1/4 inch above and below the mark). Repeat the vibration test (Fig. 7).

(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.

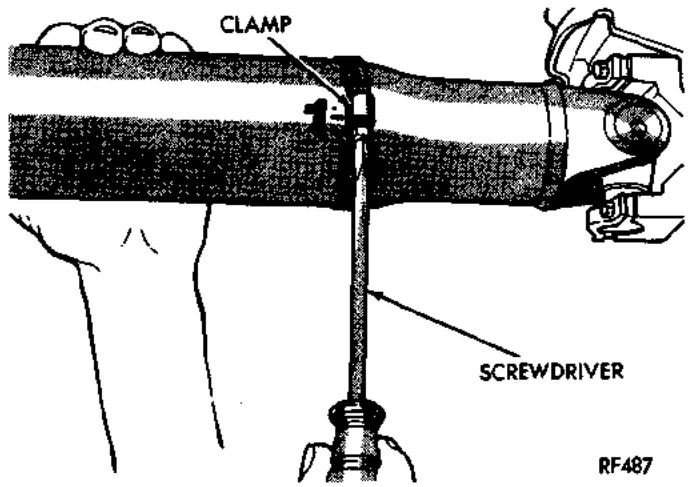

Fig. 5 Clamp Screw At Position 1

(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.

DIAGNOSIS AND TESTING (Continued)

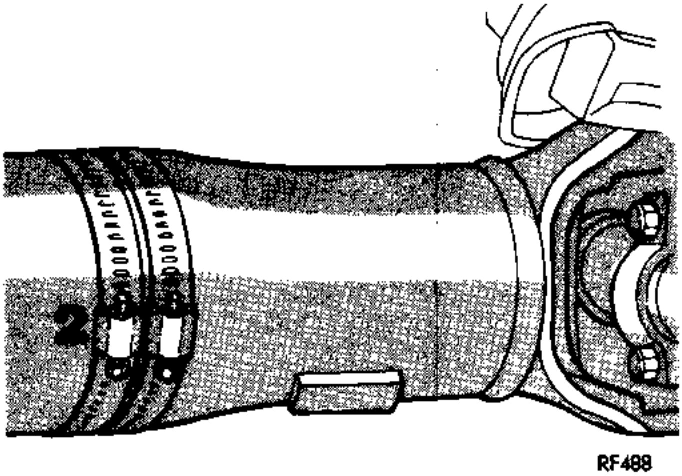

Fig. 6 Two Clamp Screws At The Same Position

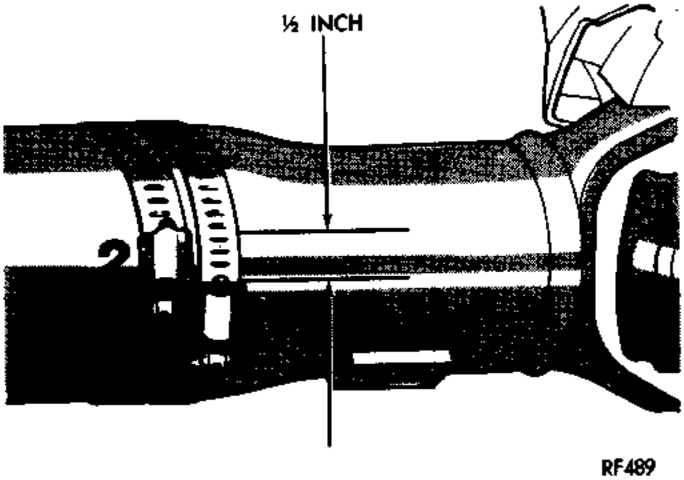

Fig. 7 Clamp Screws Separated

RUNOUT SPECIFICATIONS

Front of shaft	0.010 in. (0.25 mm)
Center of shaft	0.015 in. (0.38 mm)
Rear of shaft	0.010 in. (0.25 mm)

NOTE: Measure front/rear runout approximately 3 inches (76 mm) from the weld seam at each end of the shaft tube for tube lengths over 30 inches. Under 30 inches the max. runout is 0.20 inch for full length of the tube.

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SERVICE PROCEDURES

UNIVERSAL JOINT ANGLE

INFORMATION

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

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

When taking universal joint angle measurements or checking phasing with two piece shafts, consider each shaft separately. On 4WD vehicles, the front shaft input (pinion shaft) angle has priority over the caster angle.

Ideally the driveline system should have;

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

Engine speed (rpm) is the main factor though in determining maximum allowable operating angles. As a guide to maximum normal operating angles refer to the chart listed (Fig. 8).

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. 8 Maximum Angles And Engine Speed

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. Propeller 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 components and verify all fasteners are torqued to specifications.
- Check the condition of the engine and transmission mounts and verify all fasteners are torqued to specifications.

PROPELLER SHAFT ANGLE MEASUREMENT

To accurately check driveline alignment, raise and support the vehicle at the axles as level as possible.

SERVICE PROCEDURES (Continued)

Allow the wheels and propeller shaft to turn. Remove any external bearing snap rings (if equipped) from universal joint so protractor base sits flat.

(1) Rotate the shaft until transmission/transfer case output yoke bearing is facing downward.

Always make measurements from front to rear.

(2) Place Inclinometer on yoke bearing (A) parallel to the shaft (Fig. 9). Center bubble in sight glass and record measurement.

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

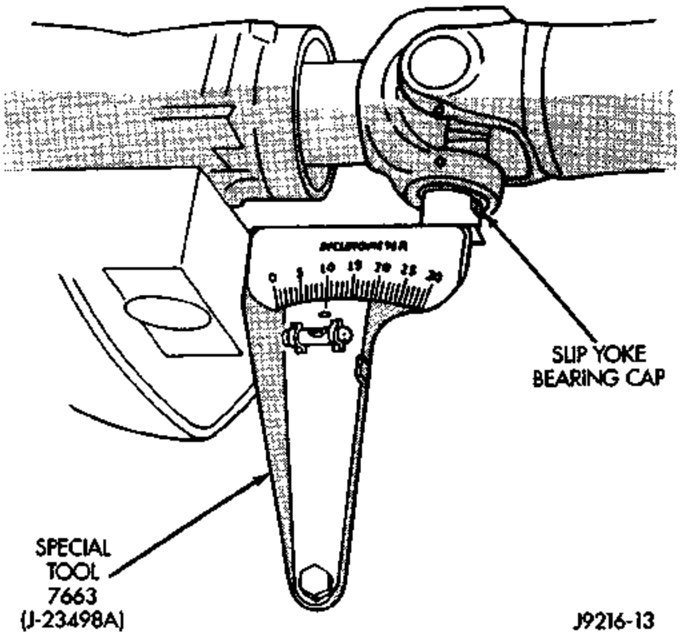

Fig. 9 Front (Output) Angle Measurement (A)—Typical

(3) Rotate propeller shaft 90 degrees and place Inclinometer on yoke bearing parallel to the shaft (Fig. 10). Center bubble in sight glass and record measurement. This measurement can also be taken at the rear end of the shaft.

This measurement will give you the Propeller Shaft Angle (C).

(4) Subtract smaller figure from larger (C minus A) to obtain Transmission Output Operating Angle.

(5) Rotate propeller shaft 90 degrees and place Inclinometer on pinion yoke bearing parallel to the shaft (Fig. 11). 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. 12) for additional information.

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

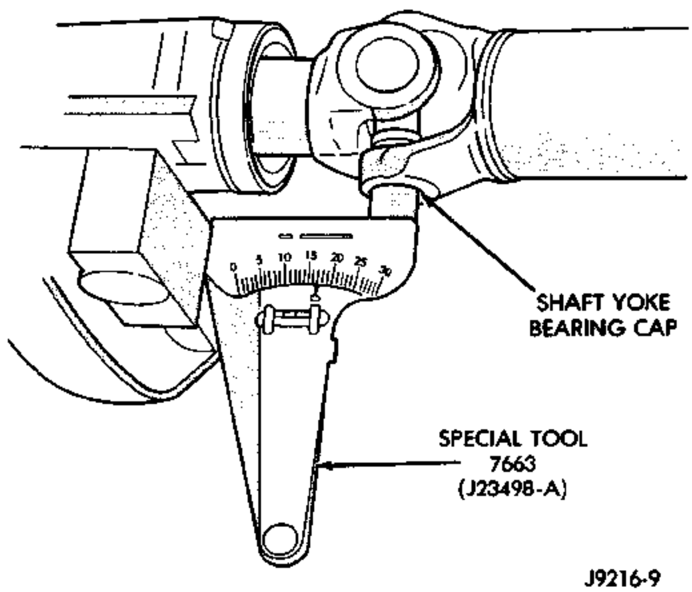

Fig. 10 Propeller Shaft Angle Measurement (C)—Typical

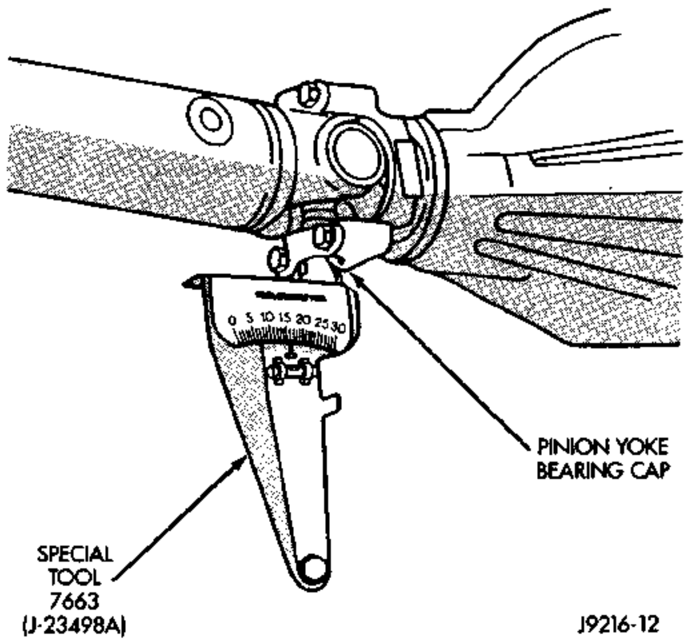

Fig. 11 Rear (Input) Angle Measurement (B)—Typical

- Operating angles less than 3°
- At least 1/2 of one degree continuous operating (propeller shaft) angle

REMOVAL AND INSTALLATION

FRONT PROPELLER SHAFT

REMOVAL

(1) Hoist and support vehicle on safety stands.

REMOVAL AND INSTALLATION (Continued)

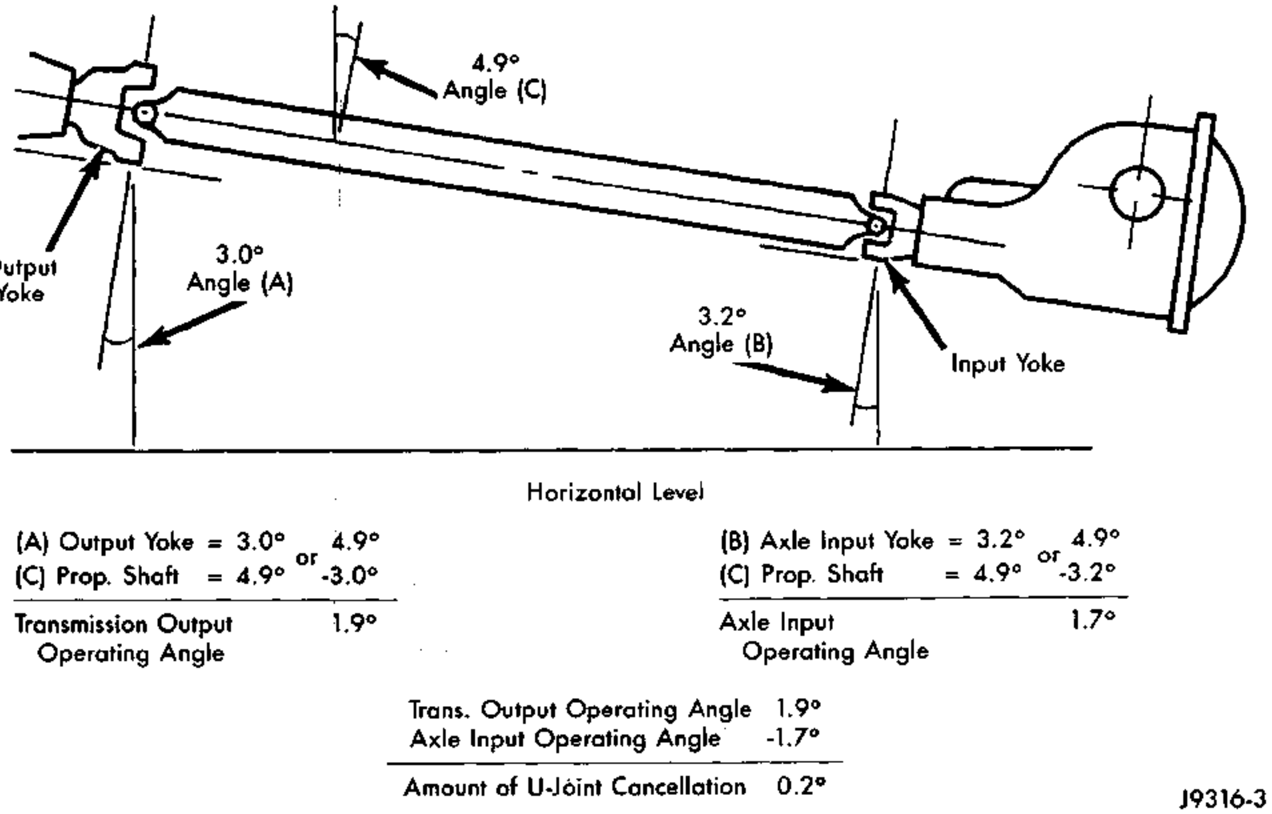

Fig. 12 Universal Joint Angle Example—Typical

(2) Scribe alignment marks on the yokes at the transfer case. Place marks at the pinion shaft and at each end of the propeller shaft. These marks will be used for installation reference (Fig. 13).

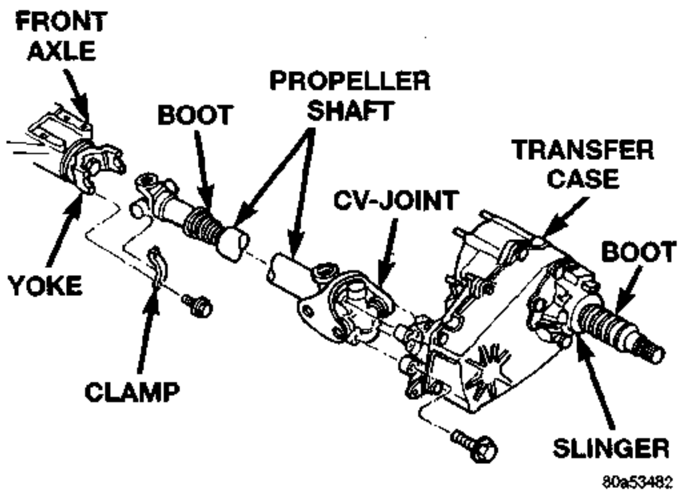

Fig. 13 Front Propeller Shaft

(3) Remove the U-joint strap bolts at the pinion shaft yoke.

(4) Disconnect the propeller shaft at the transfer case and remove the propeller shaft.

INSTALLATION

(1) Position the propeller shaft with the yoke reference marks aligned (Fig. 14). Install the propeller shaft.

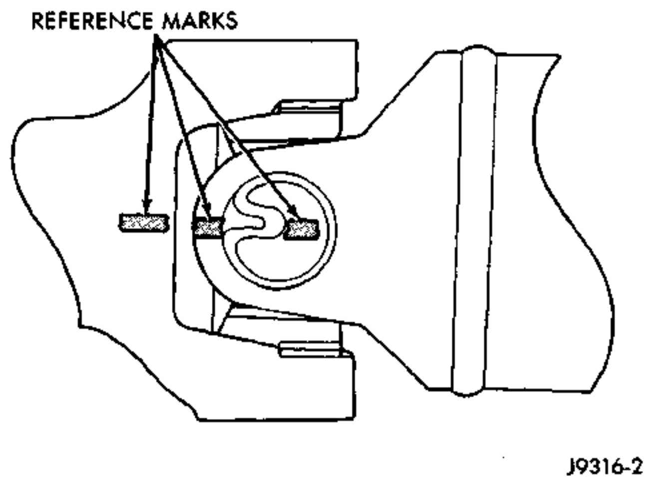

Fig. 14 Reference Marks on Yokes

Replacement U-joint straps and bolts must be installed.

(2) Tighten the U-joint strap/clamp bolts at the axle yoke to 19 N·m (14 ft. lbs.) torque.

(3) Tighten the flange to transfer case bolts to 27 N·m (20 ft. lbs.) torque.

(4) Lower the vehicle.

REMOVAL AND INSTALLATION (Continued)

REAR PROPELLER SHAFT

REMOVAL

(1) Shift the transmission and transfer case into Neutral.

(2) Hoist and support vehicle on safety stands.

(3) Scribe alignment marks at the pinion shaft and at each end of the propeller shaft. These marks will be used for installation reference.

(4) Remove the U-joint strap bolts at the pinion shaft yoke.

(5) Pry open clamp holding the dust boot to propeller shaft yoke (Fig. 15).

(6) Slide the slip yoke off of the transmission/transfer case output shaft and remove the propeller shaft (Fig. 16).

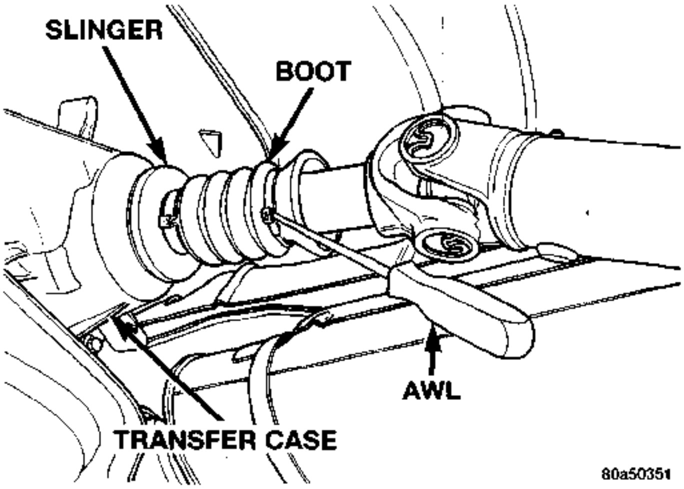

Fig. 15 Dust Boot Clamp

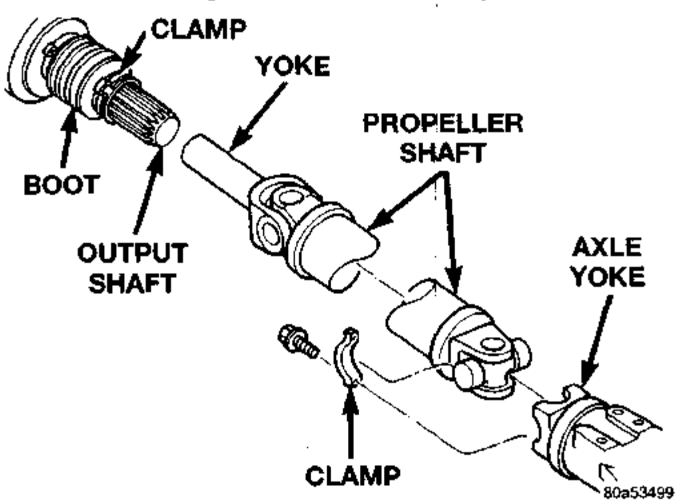

Fig. 16 Rear Propeller Shaft

INSTALLATION

(1) Slide the slip yoke on the transmission/transfer case output shaft. Align the installation reference marks at the axle yoke and install the propeller shaft (Fig. 16).

Replacement U-joint straps and bolts must be installed.

(2) Tighten the U-joint strap/clamp bolts at the axle yoke to 19 N·m (14 ft. lbs.) torque.

(3) Crimp clamp to hold dust boot to propeller shaft yoke (Fig. 17).

(4) Lower the vehicle.

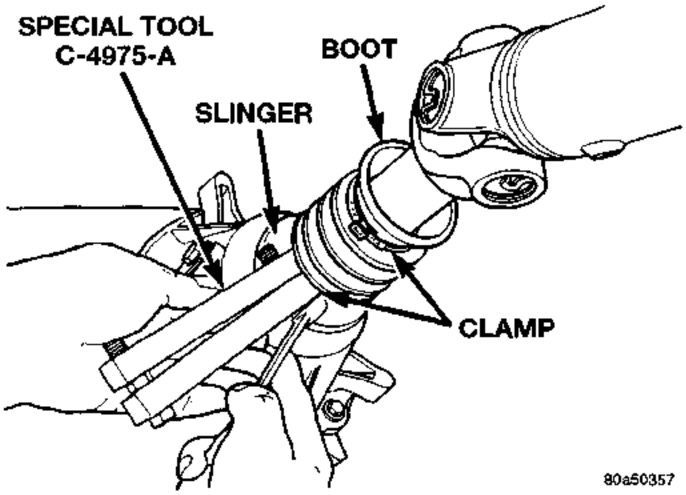

Fig. 17 Crimping Dust Boot Clamp—Typical

DISASSEMBLY AND ASSEMBLY

SINGLE CARDAN

REMOVAL

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. 18).

(5) Set the yoke in an arbor press or vise with a large socket beneath it. Position the yoke with the grease 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. 19).

(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. 20).

DISASSEMBLY AND ASSEMBLY (Continued)

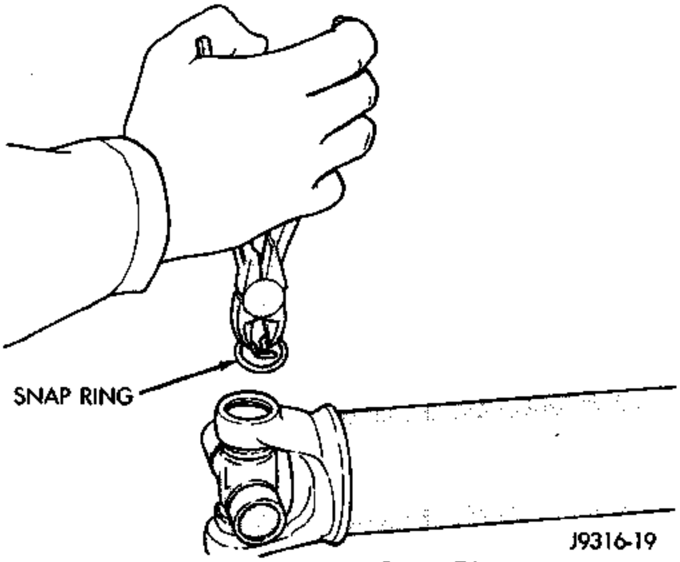

Fig. 18 Remove Snap Ring

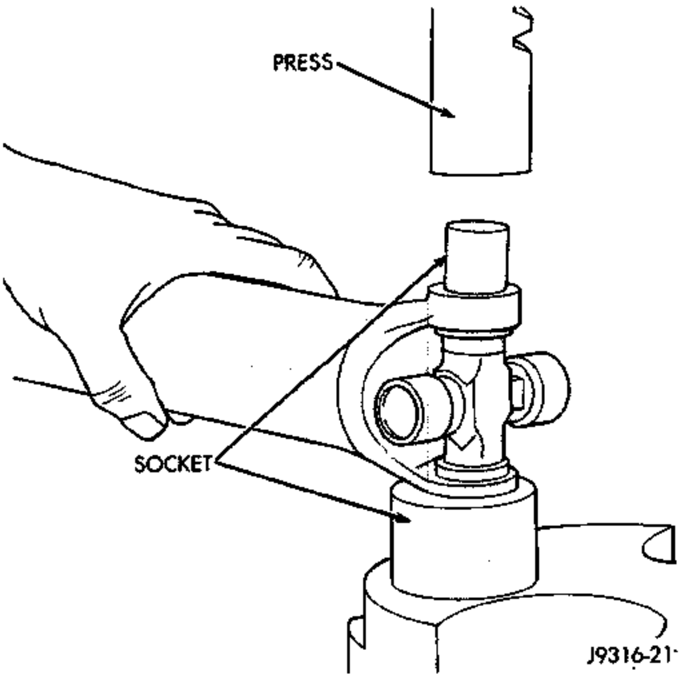

Fig. 19 Press Out Bearing

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.

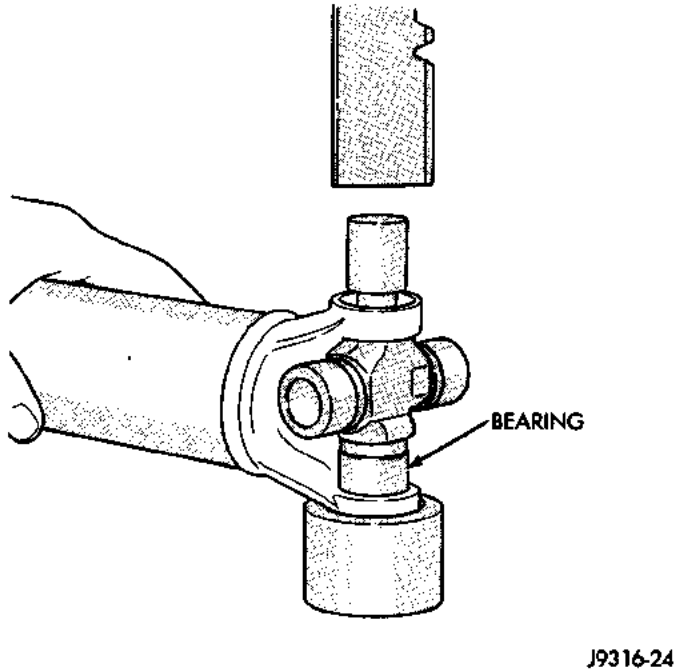

Fig. 20 Press Out Remaining Bearing

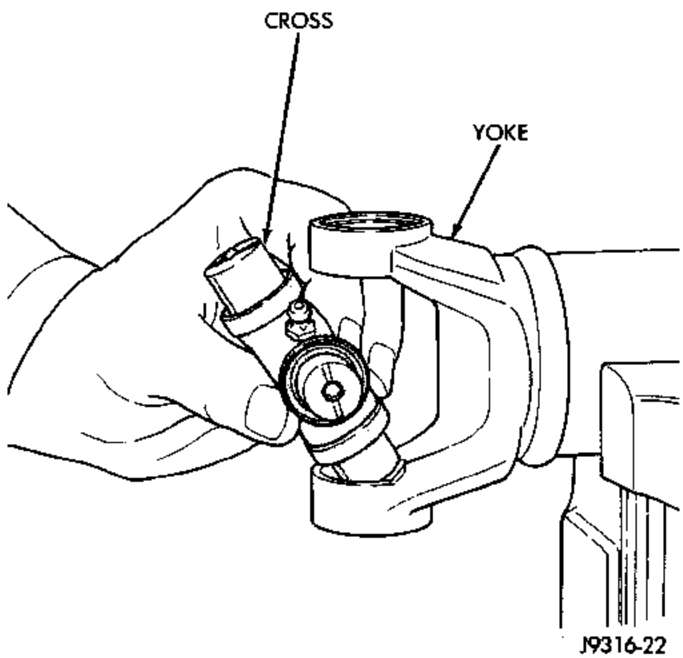

Fig. 21 Install Cross In Yoke

ASSEMBLY

(1) Apply extreme pressure (EP) N.L.G.I. Grade 1 or 2 grease to aid in installation.

(2) Position the cross in the yoke with its lube fitting (if equipped) pointing up (Fig. 21).

(3) Place a bearing assembly over the trunnion and align it with the cross hole (Fig. 22). 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.

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

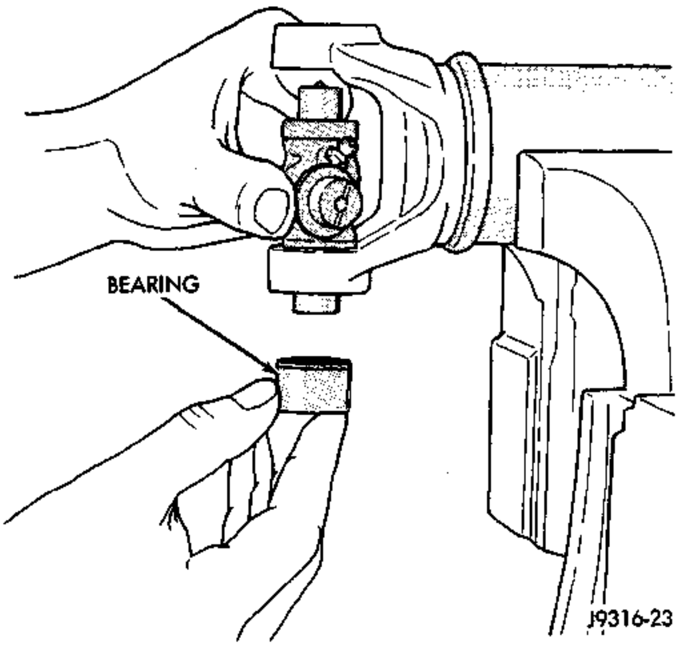

Fig. 22 Install Bearing On Trunnion

DOUBLE CARDAN (CV)

REMOVAL

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. 23).

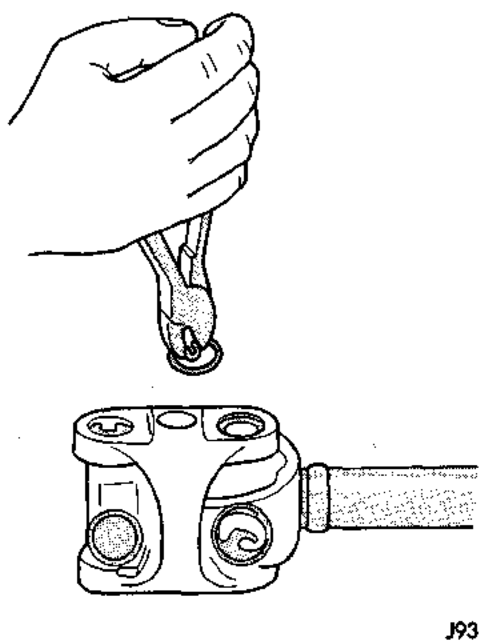

Fig. 23 Remove Snap Rings

(4) Press the bearing assembly partially from the outboard side of the center yoke, enough to grasp by vise jaws (Fig. 24). Be sure to remove grease fittings that interfere with removal.

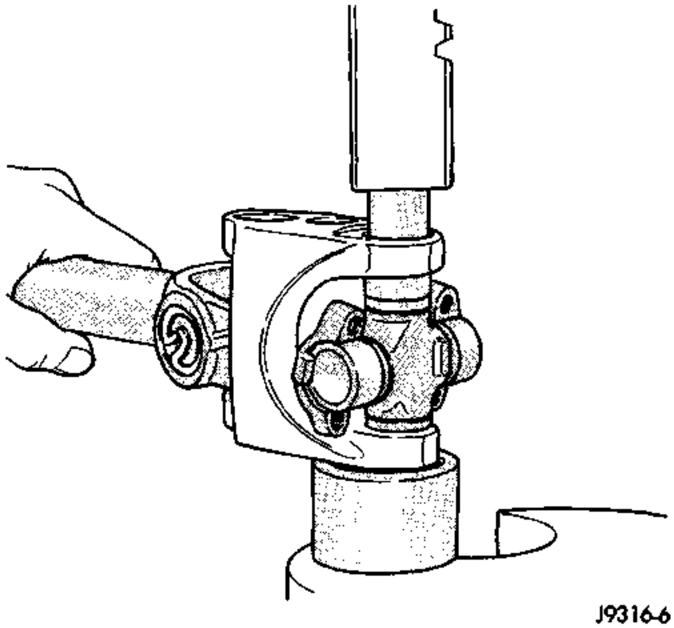

Fig. 24 Press Out Bearing

(5) Grasp the protruding bearing by vise jaws. Tap the tube yoke with a mallet and drift to dislodge from the yoke (Fig. 25).

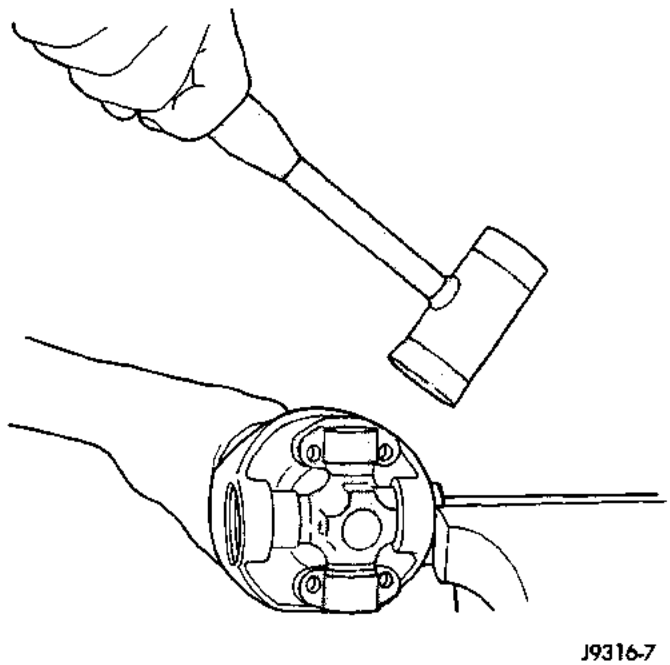

Fig. 25 Remove Bearing From Yoke

DISASSEMBLY AND ASSEMBLY (Continued)

(6) Flip assembly and repeat steps 4 and 5 for removing the opposite side bearing. This will then allow removal of the cross centering kit assembly and spring (Fig. 26).

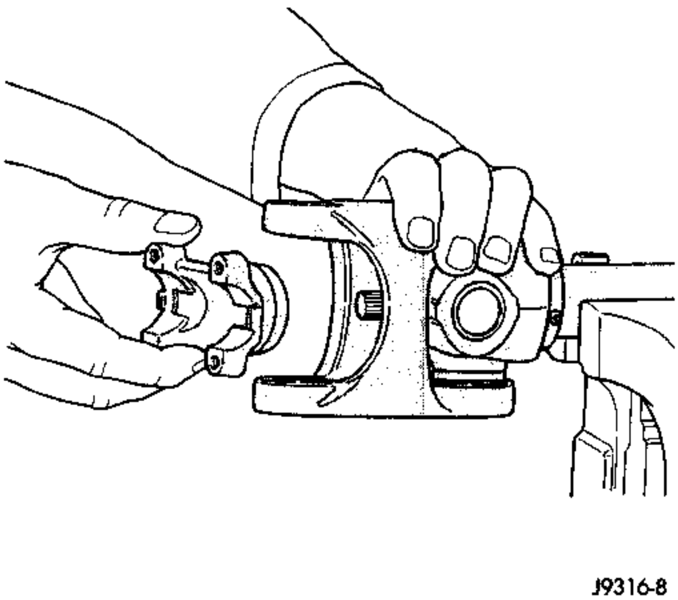

Fig. 26 Remove Centering Kit

(7) Press the remaining bearing assemblies out the other cross as described above to complete the disassembly.

INSTALLATION

During installation, ensure that the spiders and yokes are aligned to the reference marks.

(1) Fit a cross into the tube yoke (Fig. 27).

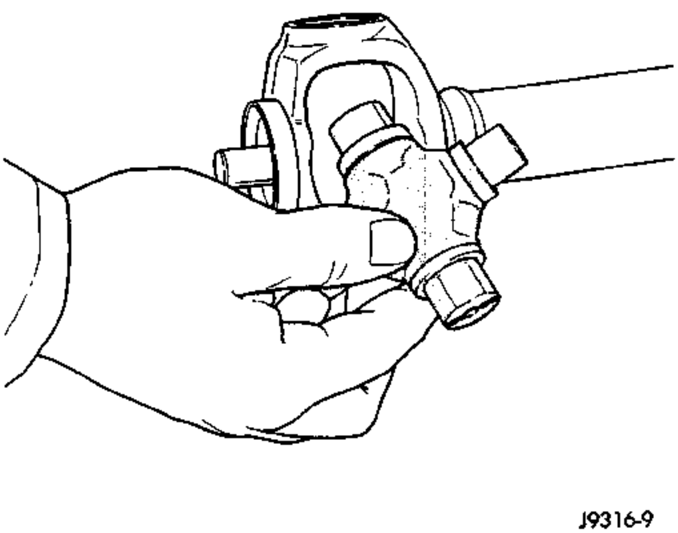

Fig. 27 Install Cross In Yoke

(2) Place a bearing assembly in a tube yoke hole and over a trunnion. Keep the needle bearings upright in the bearing assembly (Fig. 28). A needle roller lying at the bottom will prevent proper assembly. Be sure to remove any lube fittings that may interfere with removal.

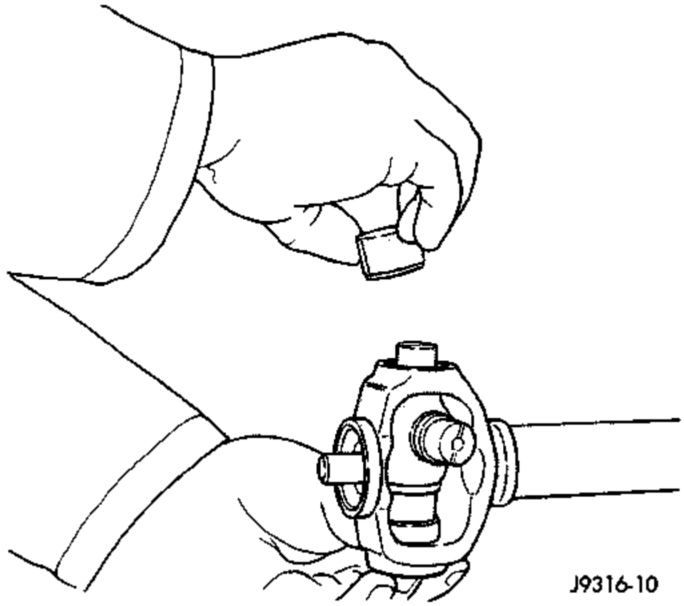

Fig. 28 Install Bearing Assembly

(3) Press the bearing assembly in place and install a snap ring (Fig. 29).

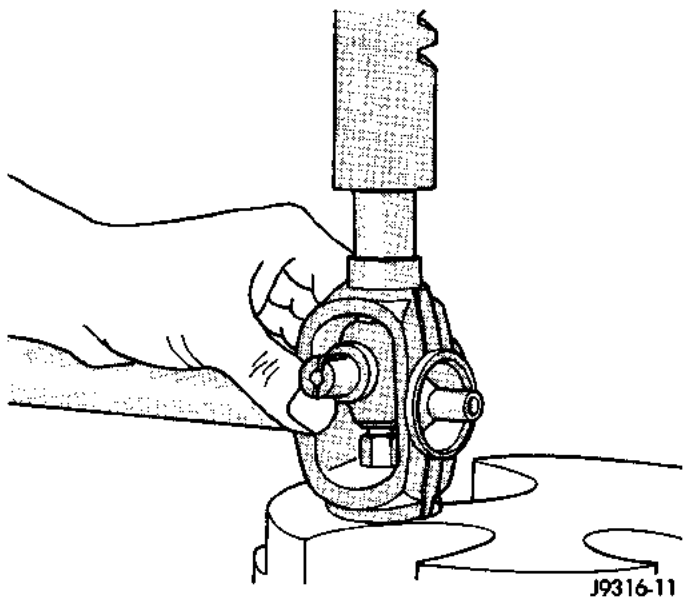

Fig. 29 Press In Bearing Assembly

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Flip the tube yoke and bearing assembly installation on the opposite trunnion. Install a snap ring (Fig. 30).

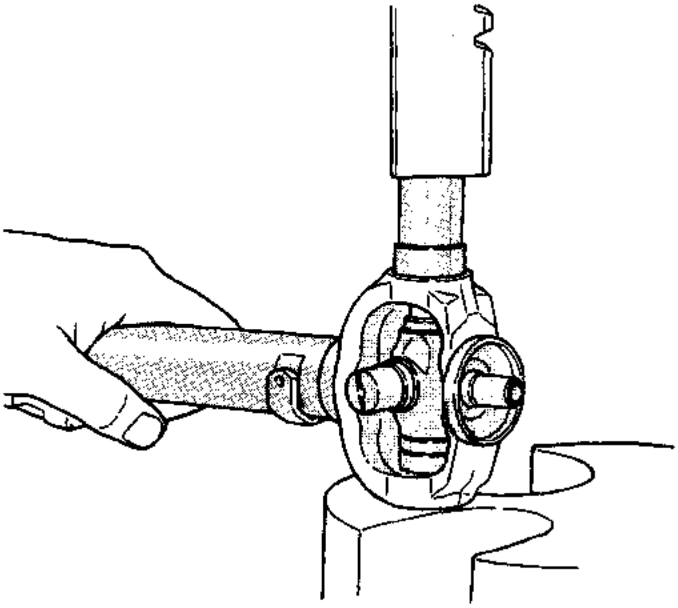

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Fig. 30 Press In Bearing Assembly

(5) Fit the center yoke on the remaining two trunnions and press bearing assemblies in place, both sides (Fig. 31). Install a snap ring.

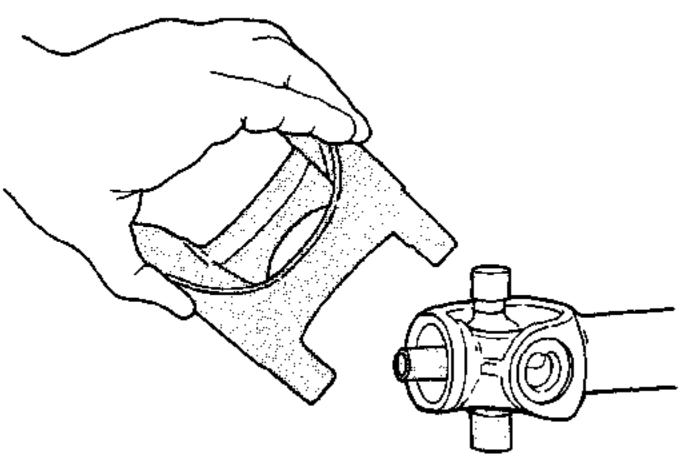

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Fig. 31 Install Center Yoke

(6) Install the centering kit assembly inside the center yoke making sure the spring is in place (Fig. 32).

(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. 33).

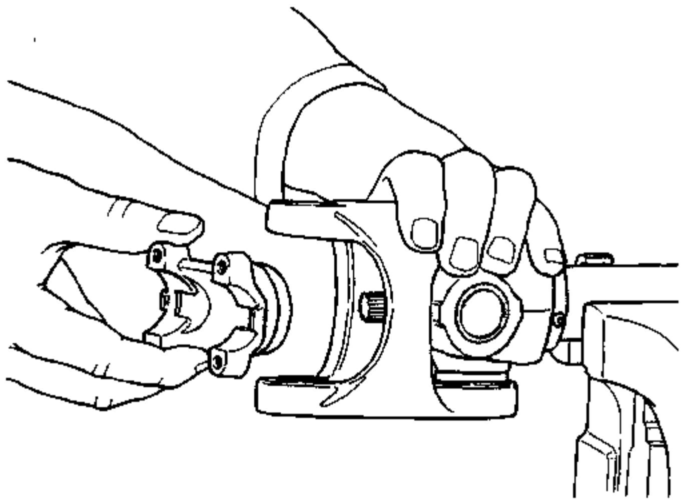

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Fig. 32 Install Centering Kit

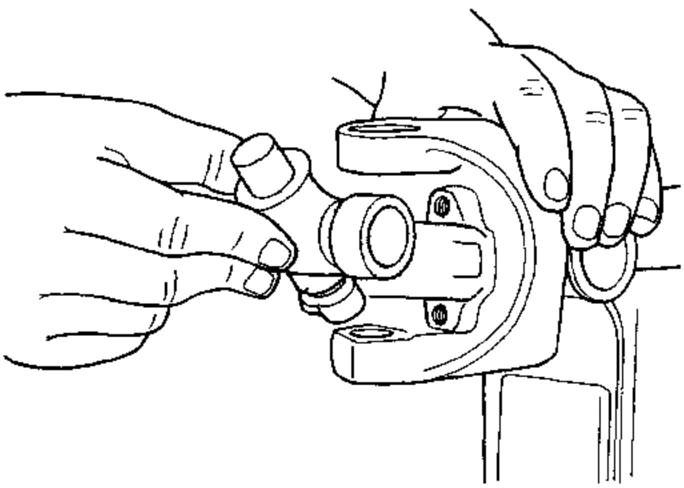

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Fig. 33 Install Remaining Cross

(8) Press the remaining two bearing assemblies into place and install snap rings (Fig. 34).

(9) Tap the snap rings to allow them to seat into the grooves (Fig. 35).

(10) Check for proper assembly. Flex the CV joint beyond center, it should snap over–center in both directions when correctly assembled (Fig. 36).

(11) Install the propeller shaft.

CLEANING AND INSPECTION

SINGLE AND DOUBLE CARDAN JOINT

(1) Clean all the universal joint yoke bores with cleaning solvent and a wire brush.

CLEANING AND INSPECTION (Continued)

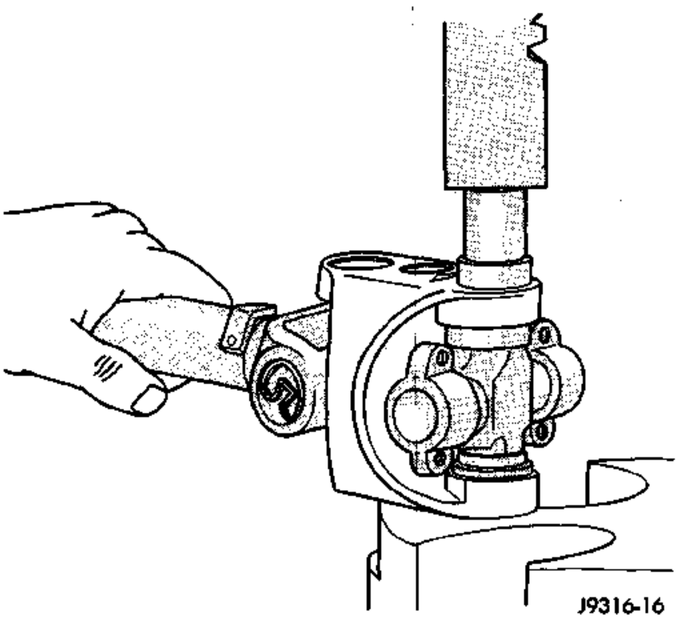


Fig. 34 Press In Bearing Assembly

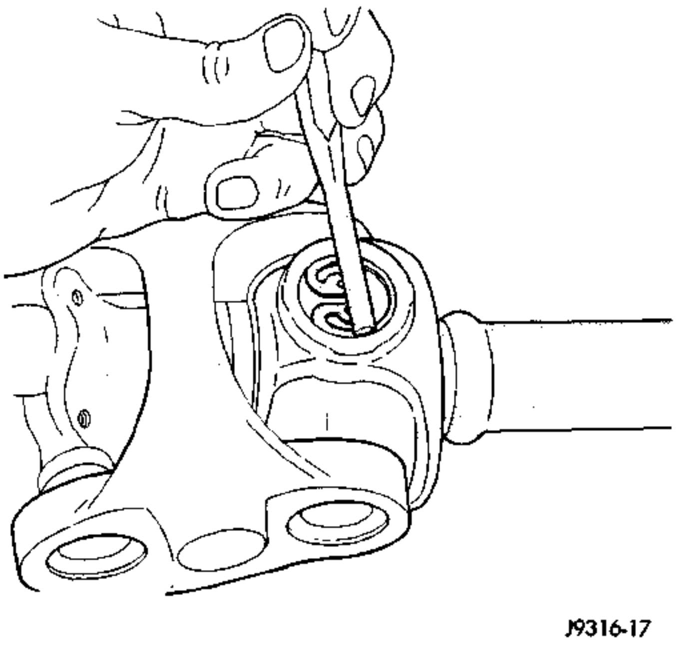


Fig. 35 Seat Snap Rings In Groove

(2) Inspect the yokes for distortion, cracks and worn bearing assembly bores.

ADJUSTMENTS

ADJUSTMENT WITH CAMS

Adjust the angle by rotating cams on the upper suspension arms (Fig. 37). The front shaft input (pinion shaft) angle has priority over the caster angle.

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. Pry out the slugs

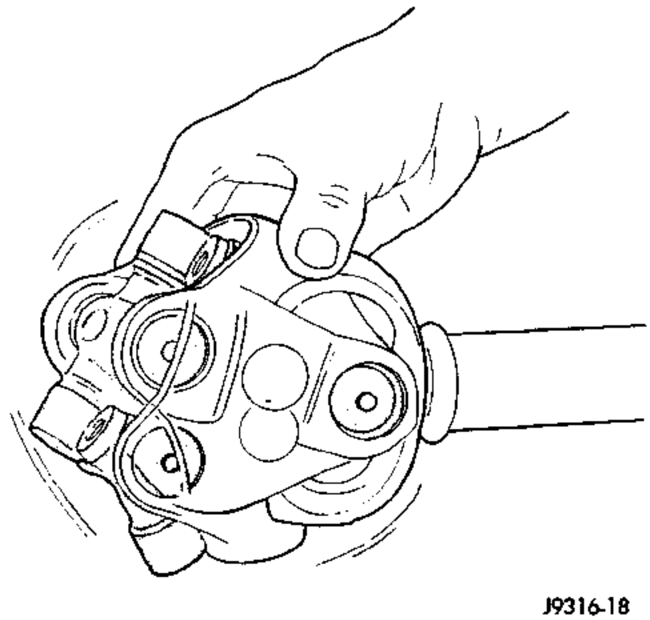


Fig. 36 Check Assembly

at the front and rear edges of the upper arm mounting holes on the axle brackets to convert round holes to elongated.

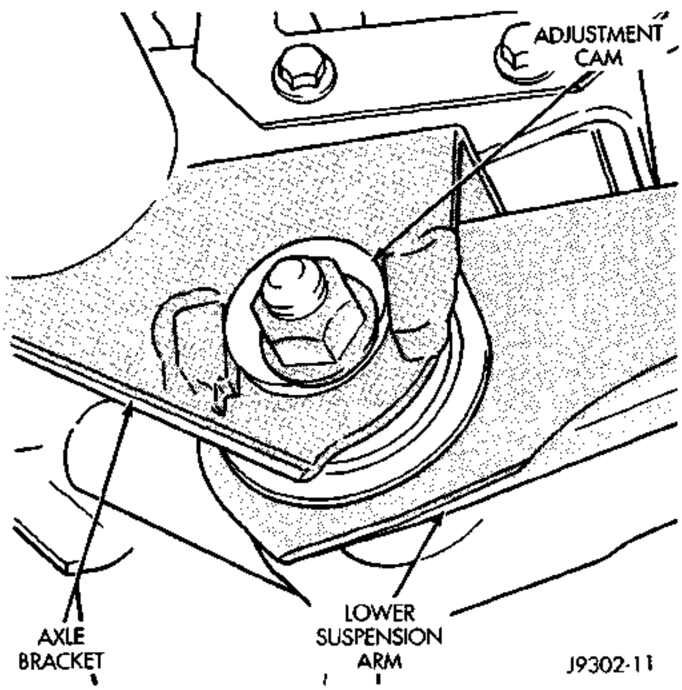


Fig. 37 Angle Adjustment With Cams—Typical

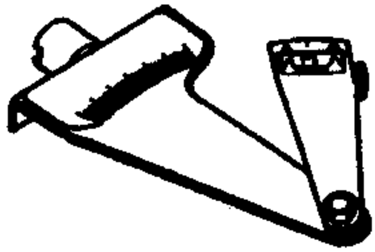
SPECIFICATIONS

PROPELLER SHAFTS AND U-JOINTS

DESCRIPTION	TORQUE
Front Shaft	
Transfer Case Yoke Bolts	27 N·m (20 ft. lbs.)
Axle Yoke Bolts	19 N·m (14 ft. lbs.)
Rear Shaft	
Axle Yoke Bolts	19 N·m (14 ft. lbs.)

SPECIAL TOOLS

PROPELLER SHAFT



Inclinometer—7663

181 FBI FRONT AXLE

INDEX

GENERAL INFORMATION

181 FBI FRONT AXLE

The 181 Front/Beam-design/Iron (FBI) front axle consists of a cast iron differential housing with axle shaft tubes extending from either side. The tubes are pressed into the differential housing and welded.

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

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

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

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

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

The 181 FBI axle has the assembly part number and gear ratio listed on a tag. The tag is attached to the housing cover. Build date identification codes are stamped on the axle shaft tube cover side.

The differential case is a one-piece design. The differential pinion mate shaft is retained with a roll pin. Differential bearing preload and ring gear backlash is adjusted by the use of shims (select thickness). The shims are located between the differential bearing cones and case. Pinion bearing preload is set and maintained by the use of collapsible spacer.

LUBRICATION SPECIFICATIONS

Multi–purpose, hypoid gear lubricant should be used for 181 FBI 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 181 FBI axle is SAE Thermally Stable 80W–90 gear lubricant.
- The factory installed lubricant quantity for the non–disconnect type axle is 1.65 L (3.76 pts.).

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

DESCRIPTION AND OPERATION

AXLES

TJ vehicles are equipped with a 181 FBI front axle. The 181 FBI axle housing has a cast iron center section. Two steel axle shaft tubes are pressed and welded into the center section.

It is not necessary to remove the axle from the vehicle for service. A removable differential cover is provided for routine vehicle service. If the differential housing is damaged, the complete axle assembly can be removed.

IDENTIFICATION

181 FBI axle has the assembly part number and gear ratio listed on a tag. The tag is attached to the left side of the housing cover. Build date identification codes on axles are stamped on the axle shaft tube cover side. The 181 FBI axle has a flat housing cover gasket flange at the outer edge.

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:

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

During straight ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 1).

When turning corners, the outside wheel must travel a greater distance than the inside wheel in order to complete a turn. The difference must be compensated for, to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 2). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

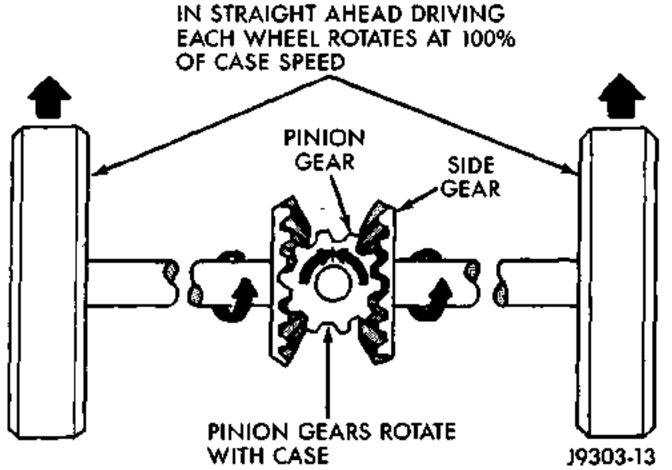


Fig. 1 Differential Operation—Straight Ahead Driving

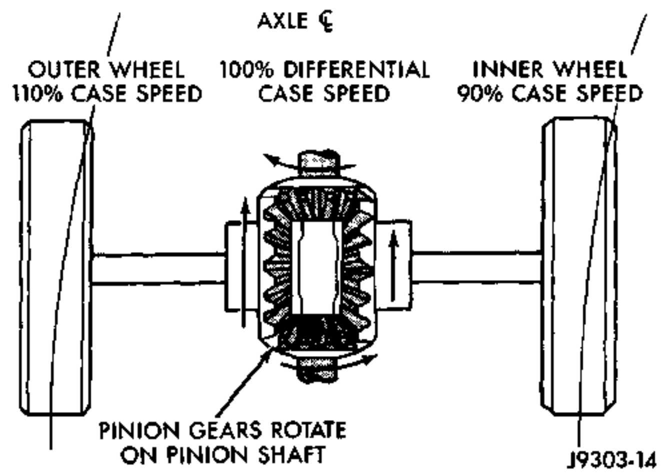


Fig. 2 Differential Operation—On Turns

DIAGNOSIS AND TESTING

DIAGNOSTIC INFORMATION

Axle bearing problem conditions are usually caused by:

- Insufficient or incorrect lubricant
- Foreign matter/water contamination
- Incorrect bearing preload torque adjustment

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 or over filling will cause overheating and gear failure. Gear tooth cracking and bearing spalling are indicators of this.

DIAGNOSIS AND TESTING (Continued)

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 wil 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. The side 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 side gear/case clearance

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

DIAGNOSIS AND TESTING (Continued)

FRONT DRIVE AXLE

DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
WHEEL NOISE	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	1. Misaligned axle shaft tube. 2. Bent or sprung axle shaft. 3. End play in drive pinion bearings. 4. Excessive gear backlash between ring gear and pinion gear. 5. Improper adjustment of drive pinion gear shaft bearings. 6. Loose drive pinion gearshaft yoke nut. 7. Improper wheel bearing adjustment. 8. Scuffed gear tooth contact surfaces.	1. Inspect axle shaft tube alignment. Correct as necessary. 2. Replace bent or sprung axle shaft. 3. Refer to Drive Pinion Bearing Pre-Load Adjustment. 4. Check adjustment of ring gear backlash and pinion gear. Correct as necessary. 5. Adjust drive pinion shaft bearings. 6. Tighten drive pinion gearshaft yoke nut with specified torque. 7. Readjust as necessary. 8. If necessary, replace scuffed gears.
AXLE SHAFT BROKE	1. Misaligned axle shaft tube. 2. Vehicle overloaded. 3. Erratic clutch operation. 4. Grabbing clutch.	1. Replace broken axle shaft after correcting axle shaft tube alignment. 2. Replace broken axle shaft. Avoid excessive weight on vehicle. 3. Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch. 4. Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	1. Improper adjustment of differential bearings. 2. Excessive ring gear backlash. 3. Vehicle overloaded. 4. Erratic clutch operation.	1. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly. 2. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly. 3. Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle. 4. Replace cracked case. After inspecting for other possible causes, examine gears and bearings for possible damage. Avoid erratic use of clutch.
DIFFERENTIAL GEARS SCORED	1. Insufficient lubrication. 2. Improper grade of lubricant. 3. Excessive spinning of one wheel/tire.	1. Replace scored gears. Scoring marks on the drive face of gear teeth or in the bore are caused by instantaneous fusing of the mating surfaces. Scored gears should be replaced. Fill rear differential housing to required capacity with proper lubricant. Refer to Specifications. 2. Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant. 3. Replace scored gears. Inspect all gears, pinion bores and shaft for damage. Service as necessary.
LOSS OF LUBRICANT	1. Lubricant level too high.	1. Drain excess lubricant by removing fill plug and allow lubricant to level at lower edge of fill plug hole.

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DIAGNOSIS AND TESTING (Continued)

CONTINUED

CONDITION	POSSIBLE CAUSES	CORRECTION
LOSS OF LUBRICANT	2. Worn axle shaft seals. 3. Cracked differential housing. 4. Worn drive pinion gear shaft seal. 5. Scored and worn yoke. 6. Axle cover not properly sealed.	2. Replace worn seals. 3. Repair or replace housing as necessary. 4. Replace worn drive pinion gear shaft seal. 5. Replace worn or scored yoke and seal. 6. Remove cover and clean flange and reseal.
AXLE OVERHEATING	1. Lubricant level too low. 2. Incorrect grade of lubricant. 3. Bearings adjusted too tight. 4. Excessive gear wear. 5. Insufficient ring gear backlash.	1. Refill differential housing. 2. Drain, flush and refill with correct amount of the correct lubricant. 3. Readjust bearings. 4. Inspect gears for excessive wear or scoring. Replace as necessary. 5. Readjust ring gear backlash and inspect gears for possible scoring.
GEAR TEETH BROKE (RING GEAR AND PINION)	1. Overloading. 2. Erratic clutch operation. 3. Ice-spotted pavements. 4. Improper adjustments.	1. Replace gears. Examine other gears and bearings for possible damage. 2. Replace gears and examine the remaining parts for possible damage. Avoid erratic clutch operation. 3. Replace gears. Examine the remaining parts for possible damage. Replace parts as required. 4. Replace gears. Examine other parts for possible damage. Ensure ring gear backlash is correct.
AXLE NOISE	1. Insufficient lubricant. 2. Improper ring gear and drive pinion gear adjustment. 3. Unmatched ring gear and drive pinion gear. 4. Worn teeth on ring gear or drive pinion gear. 5. Loose drive pinion gear shaft bearings. 6. Loose differential bearings. 7. Misaligned or sprung ring gear. 8. Loose differential bearing cap bolts	1. Refill axle with correct amount of the proper lubricant. Also inspect for leaks and correct as necessary. 2. Check ring gear and pinion gear teeth contact pattern. 3. Remove unmatched ring gear and drive pinion gear. Replace with matched gear and drive pinion gear set. 4. Check teeth on ring gear and drive pinion gear for correct contact. If necessary, replace with new matched set. 5. Adjust drive pinion gearshaft bearing preload torque. 6. Adjust differential bearing preload torque. 7. Measure ring gear runout. 8. Tighten with specified torque

J9503-4

SERVICE PROCEDURES

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. 3). **Allow the sealant to cure for a few minutes.**

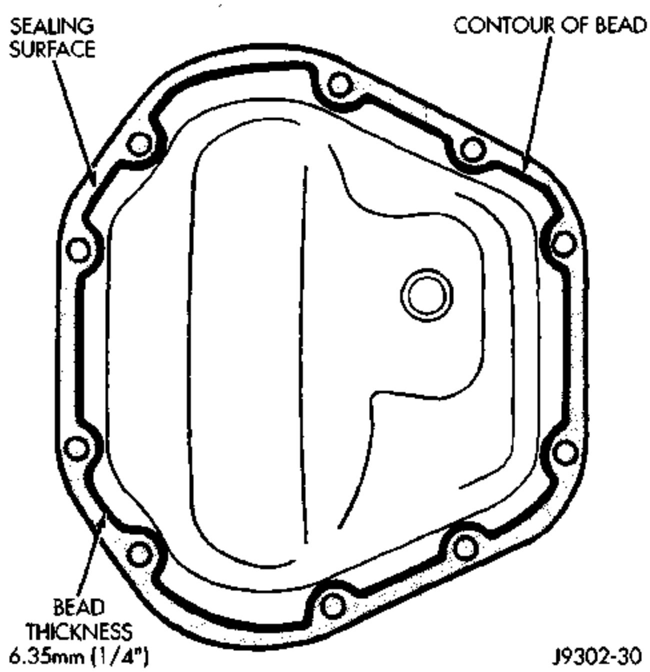

Fig. 3 Typical Housing Cover With Sealant

Install the housing cover within 5 minutes after applying the sealant. If not installed the sealant must be removed and another bead applied.

(7) Install the cover and any identification tag. Tighten the cover bolts in a criss–cross pattern to 41 N·m (30 ft. lbs.) torque.

(8) Refill the differential with Mopar Hypoid Gear Lubricant to bottom of the fill plug hole.

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

REMOVAL AND INSTALLATION

DRIVE AXLE ASSEMBLY REPLACEMENT

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove front wheels.

(3) Remove brake components and ABS brake sensor (if equipped).

(4) Disconnect the axle vent hose.

(5) Remove propeller shaft.

(6) Disconnect the stabilizer bar link at the axle bracket.

(7) Disconnect the shock absorbers from axle bracket.

(8) Disconnect the track bar from the axle bracket.

(9) Disconnect the tie rod and drag link from the steering knuckle. Disconnect the steering damper from the axle bracket.

(10) Support axle with suitable lifting device.

(11) Disconnect the upper and lower suspension arms from the axle bracket.

(12) Lower axle from vehicle. The coil springs will drop with the axle.

INSTALLATION

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

(1) Install the springs and retainer clip. Tighten the bolts to 21 N·m (16 ft. lbs.) torque.

(2) Position on lifting device axle under vehicle.

(3) Raise the axle and align it with the spring pads.

(4) Position the upper and lower suspension arm at the axle bracket. Install bolts and nuts finger tighten.

(5) Connect the track bar to the axle bracket and install the bolt. **Do not tighten at this time.**

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

(6) Install the shock absorber and tighten the bolt to 23 N·m (17 ft. lbs.) torque.

(7) Install the stabilizer bar link to the axle bracket. Tighten the nut to 95 N·m (70 ft. lbs.) torque.

(8) Install the drag link and tie rod to the steering knuckles and tighten the nuts to 47 N·m (35 ft. lbs.)

REMOVAL AND INSTALLATION (Continued)

torque. Install the steering damper to the axle bracket and tighten the nut to 75 N·m (55 ft. lbs.) torque.

(9) Install the brake components and ABS brake sensor (if equipped).

(10) Connect the vent hose to the tube fitting.

(11) Install propeller shaft.

(12) Check differential lubricant and add if necessary.

(13) Install wheels.

(14) Lower the vehicle.

(15) Tighten the upper suspension arm nuts to 75 N·m (55 ft. lbs.) torque. Tighten the lower suspension arm nuts to 115 N·m (85 ft. lbs.) torque.

(16) Tighten the track bar bolt at the axle bracket to 100 N·m (74 ft. lbs.) torque.

(17) Check the front wheel alignment and propeller shaft angle.

HUB BEARING AND AXLE SHAFT

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

(3) Remove the brake components from the axle, refer to Group 5, Brakes.

(4) Remove the cotter pin, nut retainer and axle hub nut (Fig. 4).

(5) Remove the hub to knuckle bolts (Fig. 4). Remove the hub from the steering knuckle and axle shaft.

(6) Remove the disc brake rotor shield from the bearing carrier (Fig. 4).

(7) On disconnect axles, remove vacuum shift motor housing. Refer to Vacuum Disconnect Axle in this section.

(8) Remove the axle shaft from the housing. **Avoid damaging the axle shaft oil seals in the differential.**

INSTALLATION

(1) Thoroughly clean the axle shaft (Fig. 4) and apply a thin film of Mopar Wheel Bearing Grease to the shaft splines, seal contact surface, hub bore.

(2) Install the axle shaft into the housing and differential side gears. Avoid damaging the axle shaft oil seals in the differential.

(3) Install the hub bearing and brake dust shield to the knuckle.

(4) Install the hub to knuckle bolts and tighten to 102 N·m (75 ft. lbs.) torque.

(5) Install the hub washer and nut. Tighten the hub nut to 237 N·m (175 ft. lbs.) torque. Install the nut retainer and a new cotter pin (Fig. 4).

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

(7) Install the wheel and tire assembly.

(8) Remove support and lower the vehicle.

STEERING KNUCKLE AND BALL STUDS

Ball Stud service procedures below require removal of the hub bearing and axle shaft. Removal and installation of upper and lower ball stud requires use of Tool Kit 6289 (J34503–A).

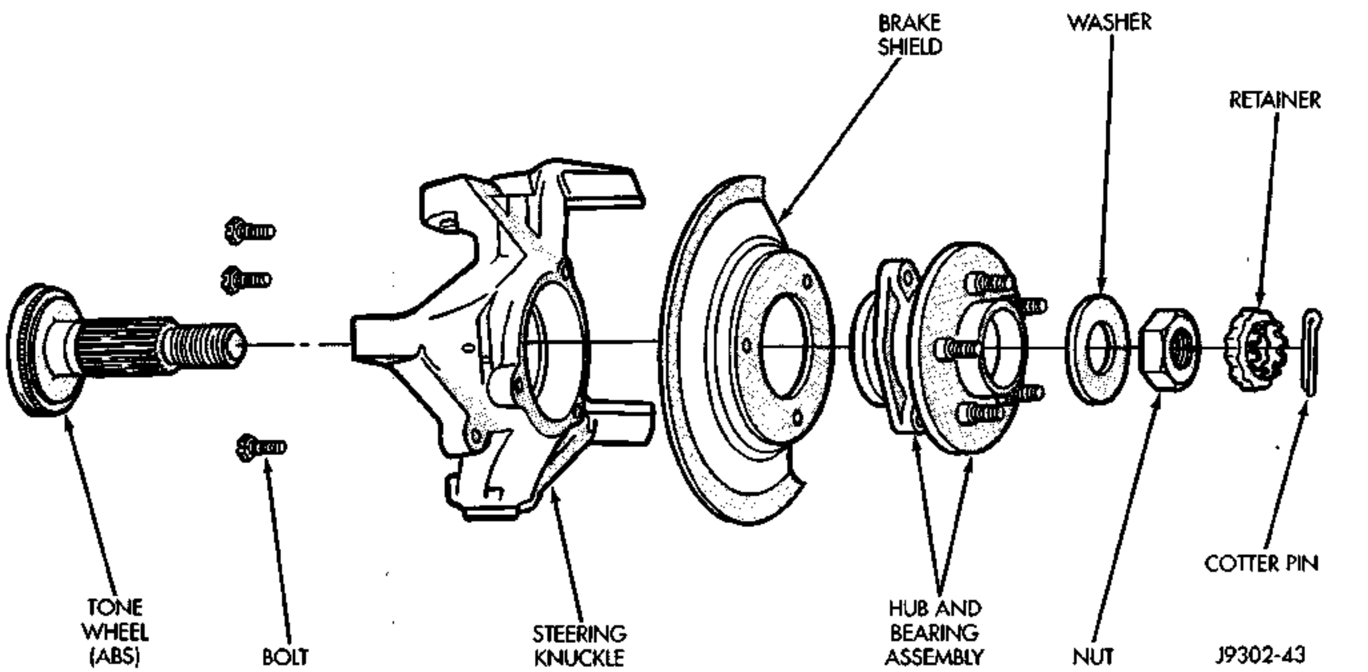

Fig. 4 Hub, Knuckle and Axle Shaft

REMOVAL AND INSTALLATION (Continued)

The lower ball stud has two different designs. For this reason Installer 6752 will also be needed. Check installers for proper fit.

KNUCKLE REMOVAL

(1) Remove hub bearing and axle shaft refer to the Removal procedure.

(2) Disconnect the tie–rod or drag link end from the steering knuckle arm. Remove the ABS sensor wire and bracket from knuckle.

(3) Remove the cotter pins from the upper and lower ball studs. Remove the upper and lower ball stud nuts.

(4) Strike the steering knuckle with a brass hammer to loosen. Remove knuckle from axle tube yokes (Fig. 5).

UPPER BALL STUD REPLACEMENT

(1) Position tools as shown to remove and install ball stud (Fig. 6).

LOWER BALL STUD REPLACEMENT

(1) Position tools as shown to remove and install ball stud (Fig. 7). Because there are two different designs for the lower ball studs try both installers for proper fit.

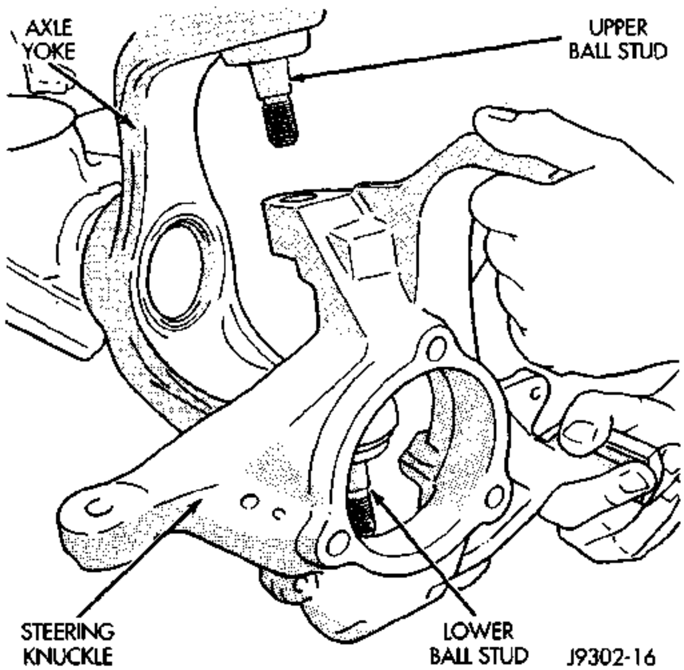

Fig. 5 Steering Knuckle Removal/Installation

KNUCKLE INSTALLATION

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

(2) Install and tighten the bottom retaining nut to 109 N·m (80 ft. lbs.) torque. Install new cotter pin.

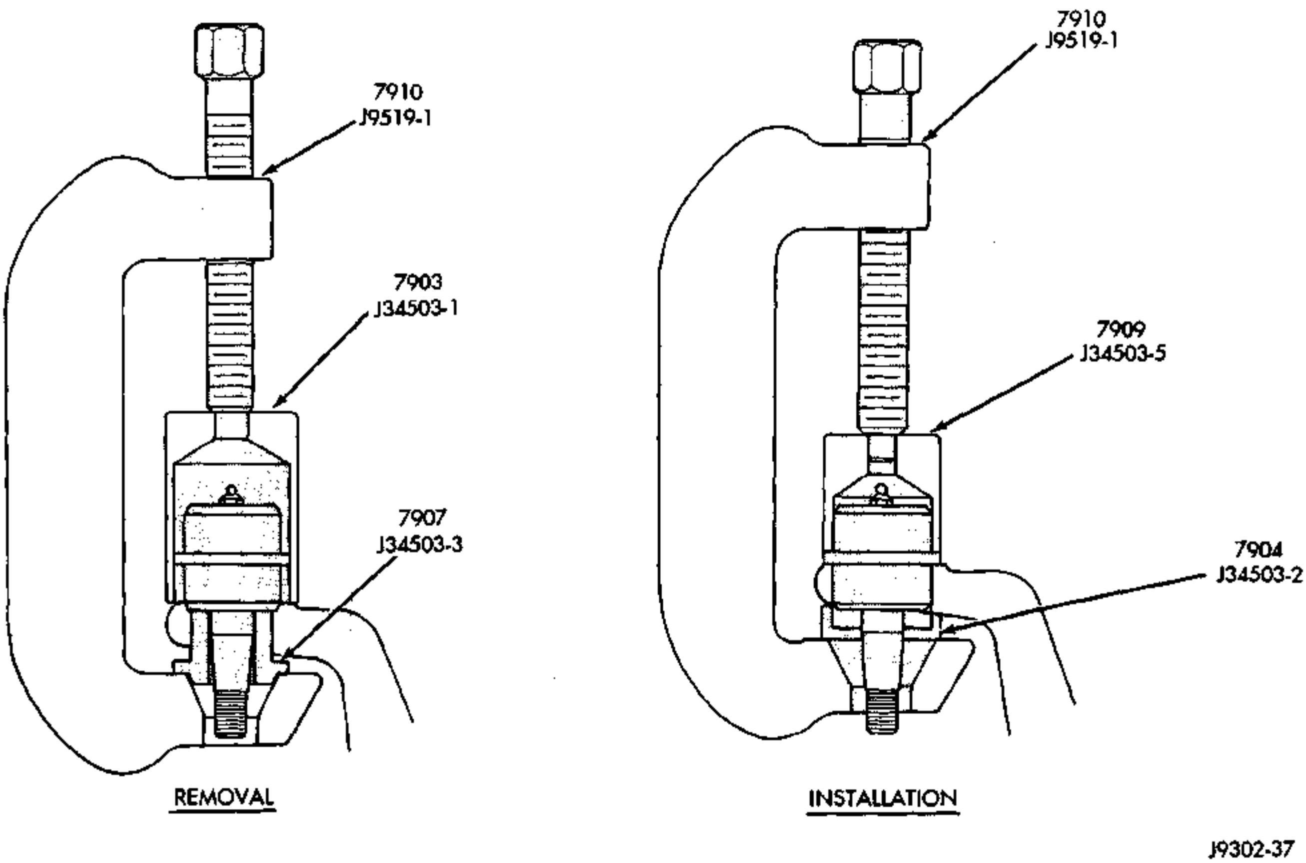

Fig. 6 Upper Ball Stud Remove/Install

REMOVAL AND INSTALLATION (Continued)

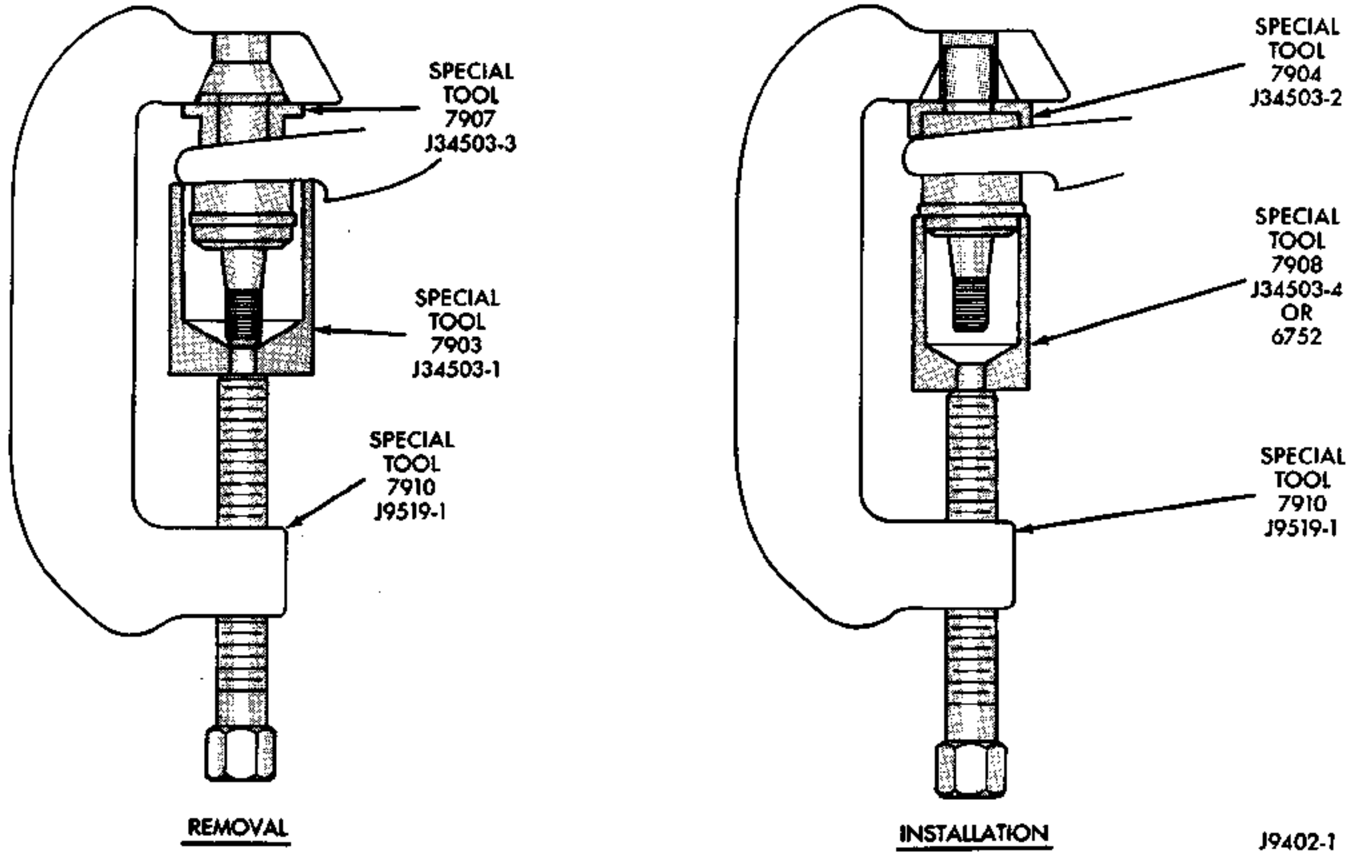

Fig. 7 Lower Ball Stud Remove/Install

(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 according to the installation procedure.

(5) Reconnect the tie–rod or drag link end onto the steering knuckle arm. Install the ABS sensor wire and bracket to the knuckle, refer to Group 5 Brakes.

AXLE BUSHING REPLACEMENT

Refer to Axle Bushing Replacement in the Front Suspension section.

PINION SEAL

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheels.

(3) Remove brake calipers.

(4) Mark propeller shaft and pinion yoke for installation reference.

(5) Remove propeller shaft from the yoke.

(6) Rotate the pinion gear by hand several times to verify bearing smoothness.

(7) Measure amount of torque necessary to rotate pinion gear with an (in. lbs.) dial-type torque wrench. Record the torque reading for installation reference (Fig. 13).

(8) Hold pinion yoke with Holder 6958 and remove pinion yoke nut and washer (Fig. 8).

(9) Use Remover C-452 and Holder 6958 to remove the pinion yoke (Fig. 9).

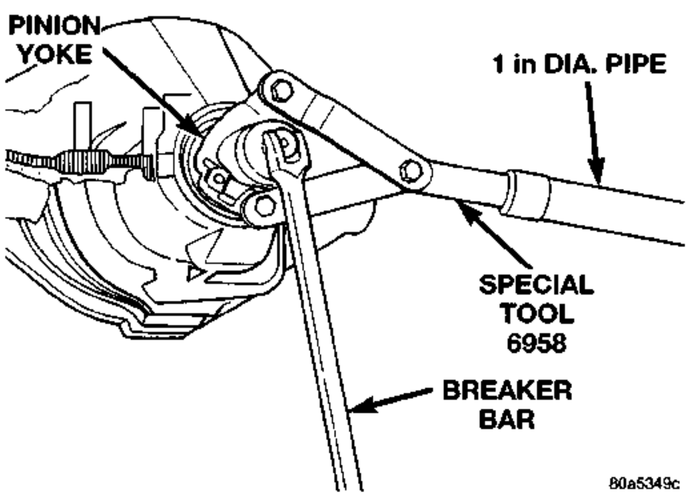

Fig. 8 Pinion Nut

REMOVAL AND INSTALLATION (Continued)

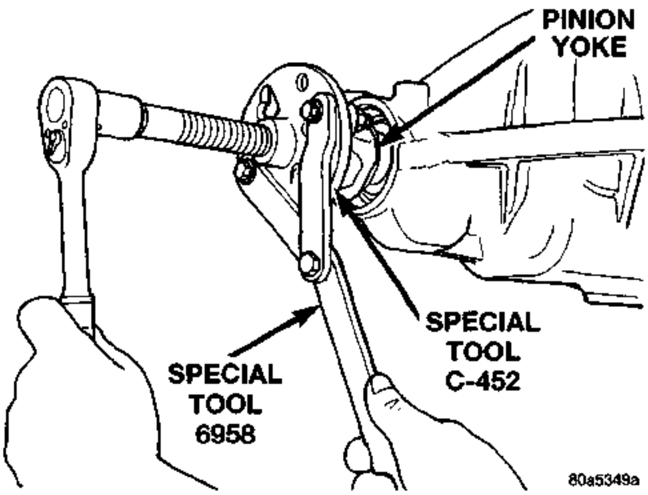

Fig. 9 Pinion Yoke, Remove

(10) Use Remover 7794A and Slide Hammer 7420 to remove pinion seal (Fig. 10).

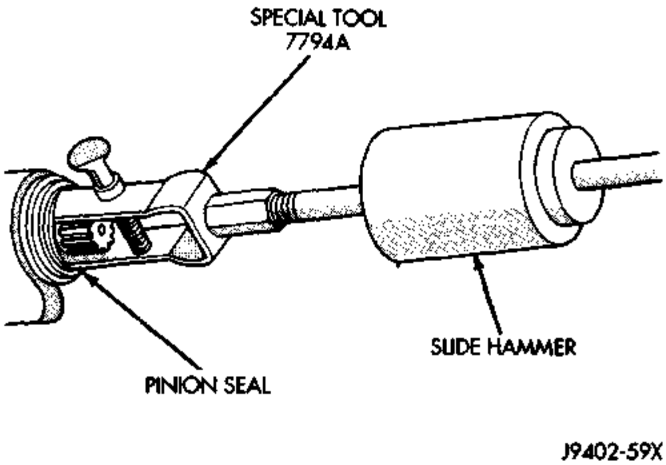

Fig. 10 Seal Removal

INSTALLATION

(1) Apply a light coating of gear lubricant on lip of pinion seal. Install seal with Installer D-163 and Handle C-4171 (Fig. 11).

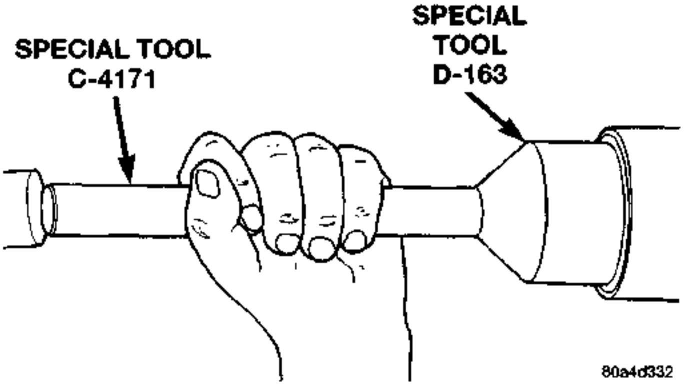

Fig. 11 Pinion Seal Installation

Install yoke on pinion gear with Installer W-162-D and Holder 6958 (Fig. 12).

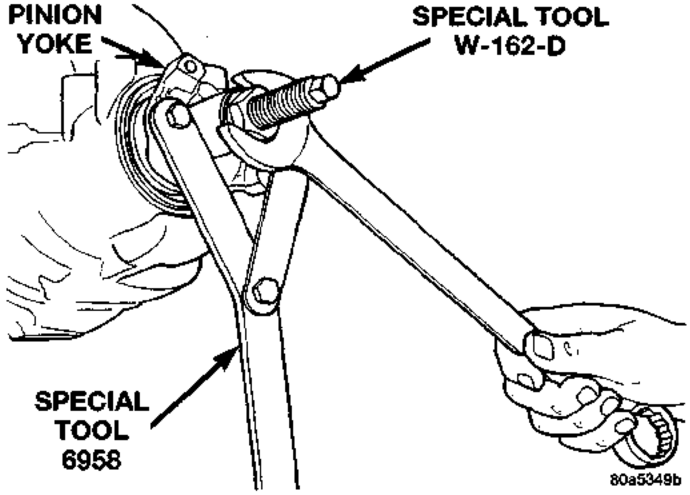

Fig. 12 Pinion Yoke, Install

CAUTION: Do not exceed the minimum tightening torque when installing the pinion yoke retaining nut. Damage to collapsible spacer or bearings may result.

(2) Remove yoke installing tool.

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

(4) Rotate the pinion shaft using an (in. lbs.) torque wrench. Rotating resistance torque should be equal to the reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.). (Fig. 13).

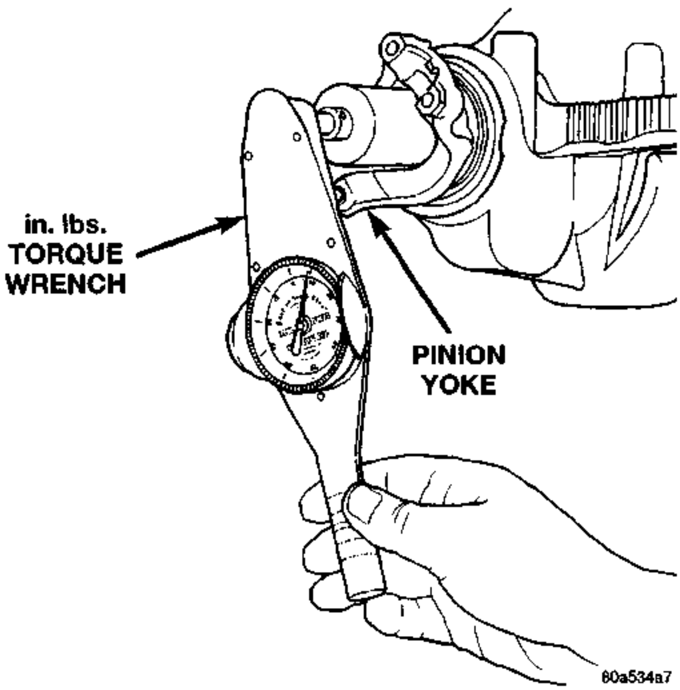

Fig. 13 Check Pinion Rotation Torque

REMOVAL AND INSTALLATION (Continued)

(5) If the rotating torque is too low, use Holder 6758 and a lenght of 1 in. dia. pipe to hold the pinion yoke (Fig. 14), and tighten the pinion shaft nut in small increments until proper rotating torque is achieved.

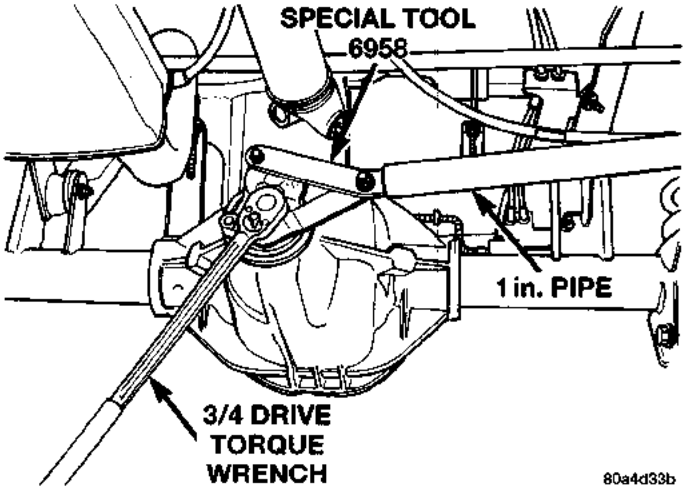

Fig. 14 Tightening Pinion Shaft Nut

(6) Align the installation reference marks and attach the propeller shaft to the yoke.
(7) Add gear lubricant, if necessary.
(8) Install brake calipers.
(9) Install wheels.
(10) Lower vehicle.

DIFFERENTIAL

REMOVAL

(1) Hoist and support vehicle on safety stands.
(2) Remove axle shafts, refer Axle Removal and Installation paragraph.
(3) Place a suitable drain pan under center of axle housing.
(4) Remove axle housing cover.

NOTE: The differential side bearing retaining caps are reference marked for installation by the manufacturer (Fig. 15).

(5) Position Spreader W-129-B with dowel pins inserted into access holes in axle housing. (Fig. 16). Install safety hold down clamps and tighten the tool turnbuckle hand tight .
(6) Install a Pilot Stud C-3288-B at the left side of the differential housing. Attach Dial Indicator C-3339 to housing pilot stud. Load the indicator lever against the opposite side of the housing (Fig. 17) and zero the indicator face to the pointer.

CAUTION: Do not spread axle housing over 0.51 mm (0.020 in), axle housing can become distorted or damaged.

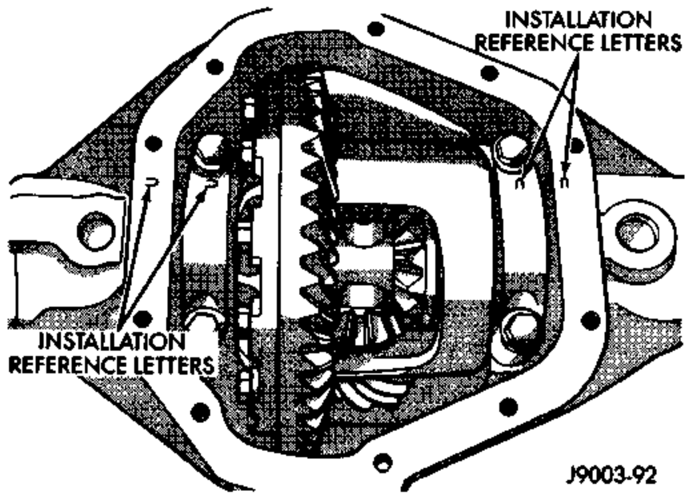

Fig. 15 Bearing Cap Identification

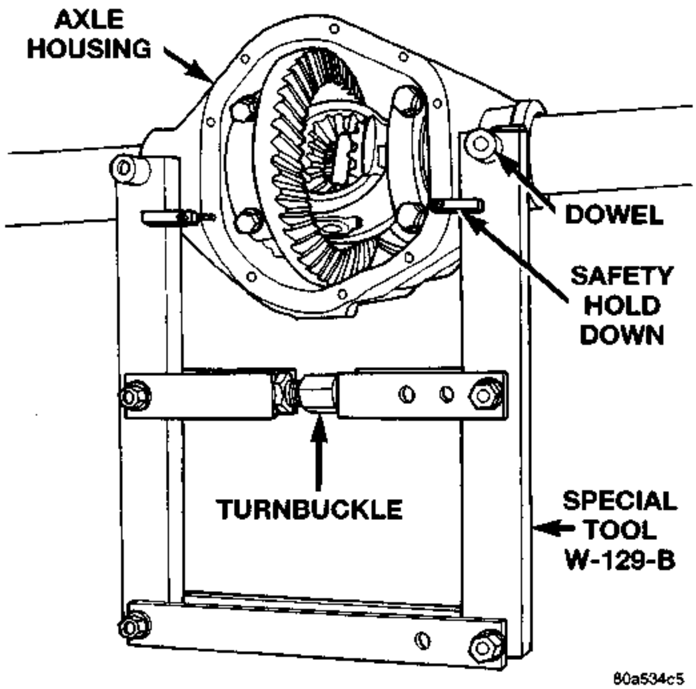

Fig. 16 Install Axle Housing Spreader

(7) Spread axle housing apart enough to remove differential case. Measure amount of spread being applied with the dial indicator, do not exceed 0.51 mm (0.020 in.) (Fig. 18).
(8) Remove dial indicator.
(9) While holding differential case in position, remove bolts holding differential bearing caps to axle housing.
(10) Separate bearing caps from axle housing.
(11) While holding differential bearing cups, pull differential case from axle housing. It may be necessary to pry differential case from axle housing (Fig. 19).
(12) Mark the differential bearing cups indicating the side they were removed from.

REMOVAL AND INSTALLATION (Continued)

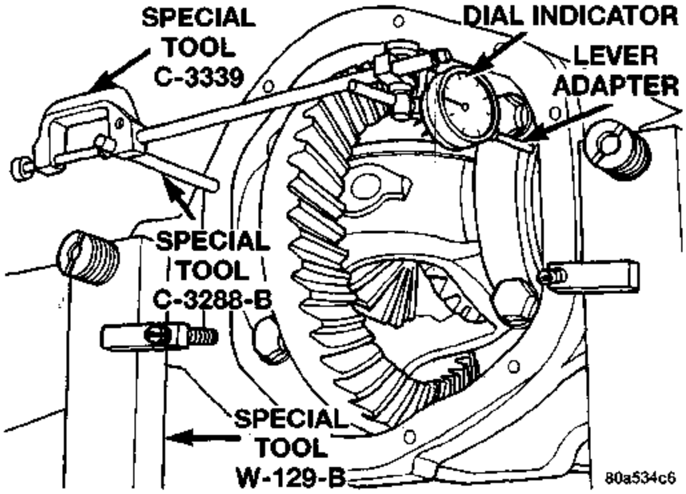

Fig. 17 Install Dial Indicator

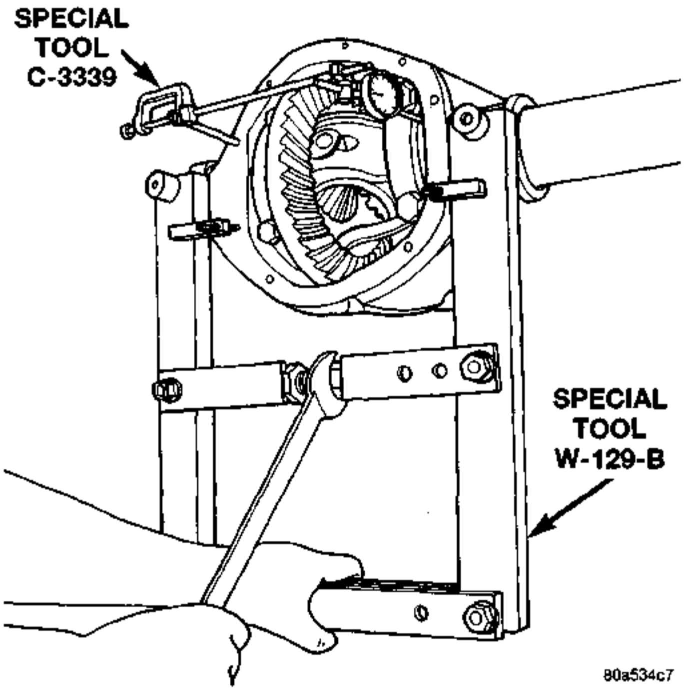

Fig. 18 Spread Axle Housing

CAUTION: Do not allow spreader to apply outward pressure on axle housing for an extended period, damage to axle housing can result.

(13) If differential case is not installed within 15 minutes, remove axle housing spreader.

DIFFERENTIAL INSTALLATION

If replacement differential side bearings or differential case are being installed, differential side bearing shim requirements could change. Refer to Differential Bearing Preload and Gear Backlash paragraph in the Adjustments section to determine proper shim selection.

(1) Position Spreader W-129-B with dowel pins inserted into access holes in axle housing (Fig. 20).

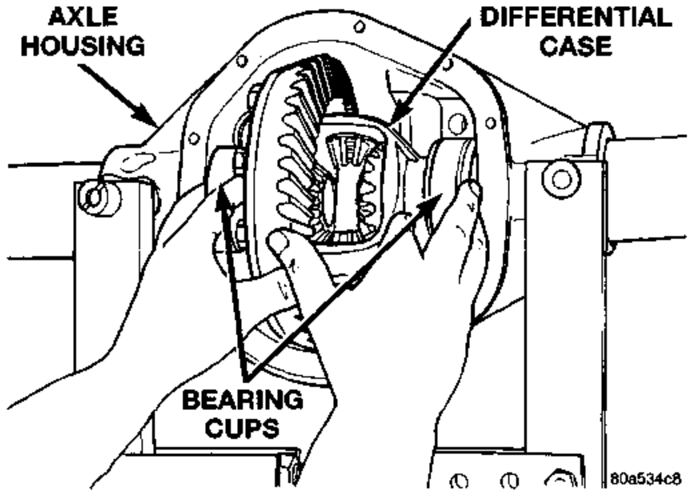

Fig. 19 Differential Case and Side Bearings

Install safety hold down clamps and tighten the tool turnbuckle hand tight.

(2) Install Dial Indicator C-3339. Load the indicator lever against the opposite side of the housing (Fig. 20) and zero indicator face to pointer.

CAUTION: Do not spread axle housing over 0.51 mm (0.020 in), axle housing can become distorted or damaged.

(3) Spread axle housing apart enough to install differential case. Measure amount of spread being applied with the dial indicator, do not exceed 0.51 mm (0.020 in.) (Fig. 20).

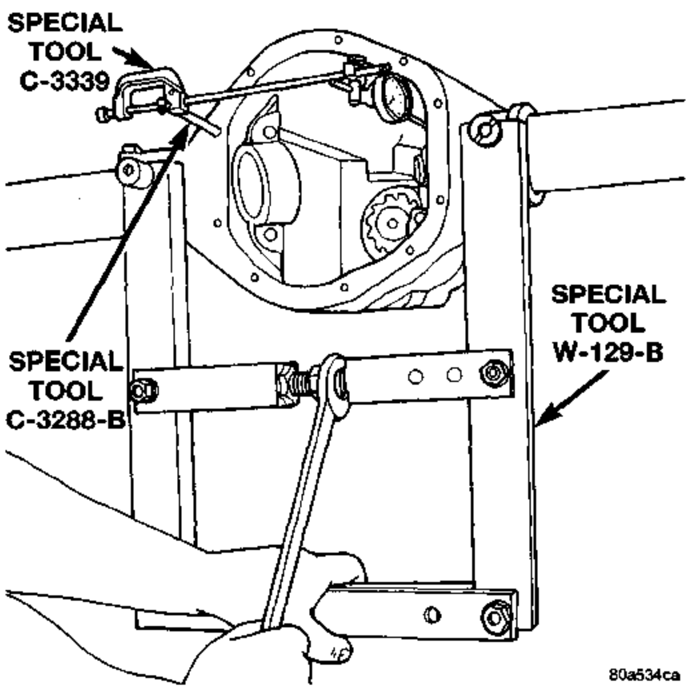

Fig. 20 Spread Axle Housing

(4) Remove dial indicator.

REMOVAL AND INSTALLATION (Continued)

(5) Install differential case and bearing cups into housing. If necessary, tap the differential case side bearing cups inward to assure they are seated (Fig. 19).

(6) Install differential side bearing caps in position with corresponding letters aligned (Fig. 21).

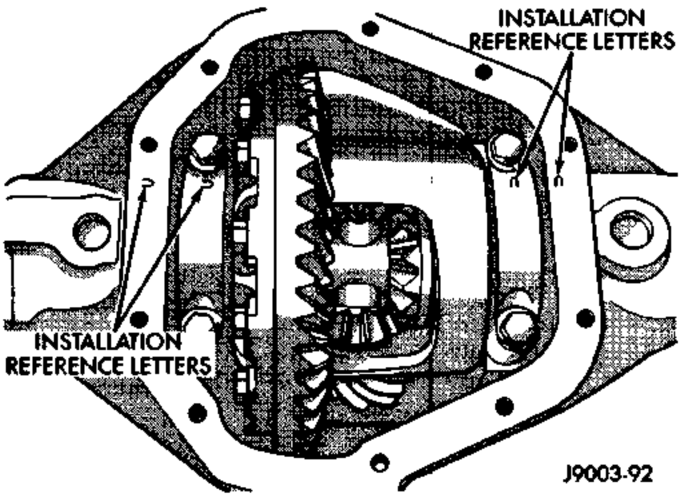

Fig. 21 Differential Bearing Cap Reference Letters

(7) Install bolts (hand tight) to hold bearing caps to axle housing.

(8) Remove axle housing spreader.

(9) Tighten the bearing cap bolts to 110 N·m (80 ft. lbs.) torque (Fig. 22).

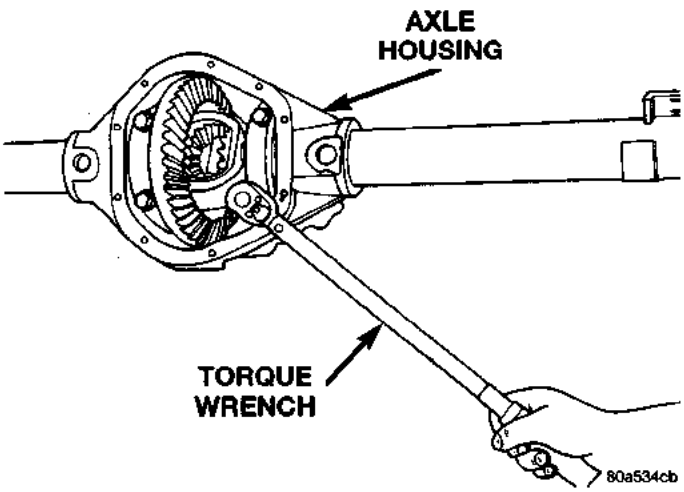

Fig. 22 Tighten Differential Bearing Cap Bolts

DIFFERENTIAL SIDE BEARINGS

REMOVAL

(1) Remove Differential case from axle housing.

(2) Remove the bearings from the differential case with Puller/Press C-293-PA, C-293-39 Blocks (3) from Puller/Press Set C-293–M, and Adapter C-293-3 (Fig. 23).

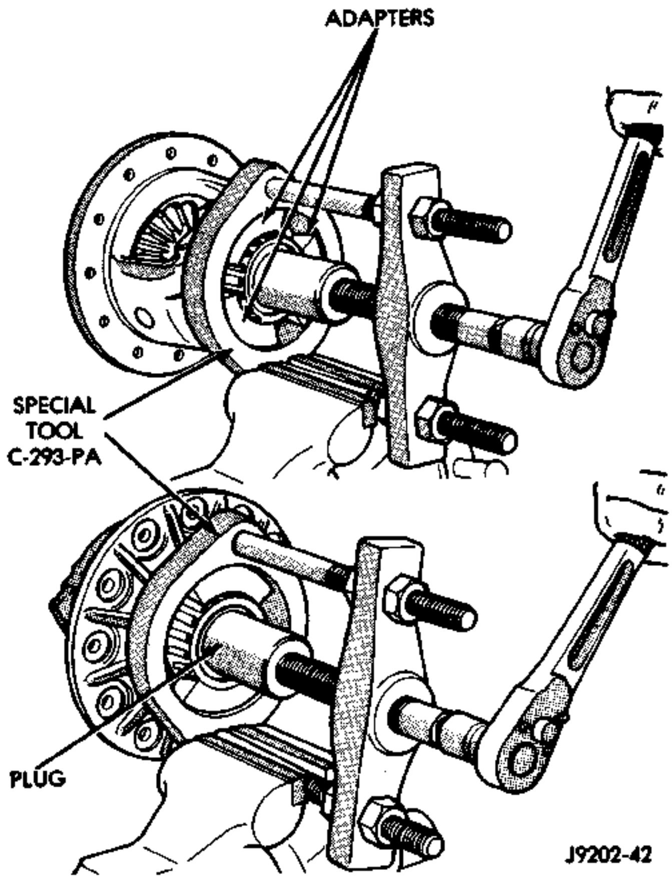

Fig. 23 Differential Bearing Removal

DIFFERENTIAL SIDE BEARING INSTALLATION

If ring and pinion gears have been replaced, verify differential side bearing preload and gear mesh backlash.

(1) Using tool C-3716 with handle C-4171, install differential side bearings (Fig. 24).

(2) Install differential in axle housing.

INNER AXLE SHAFT OIL SEAL REPLACEMENT

SELECT–TRAC

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

(2) Install oil seals with Discs 6764 and Turnbuckle D–112A (Fig. 25). Tighten tool until disc bottoms in housing.

PINION GEAR

REMOVAL

(1) Remove differential case from axle housing.

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

(3) Disconnect propeller shaft from pinion yoke. Using suitable wire, tie propeller shaft to underbody.

REMOVAL AND INSTALLATION (Continued)

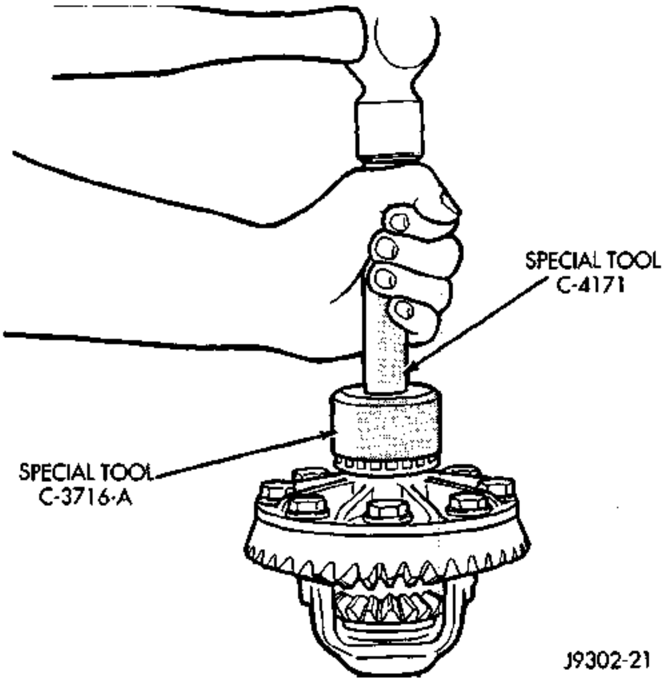

Fig. 24 Install Differential Side Bearings

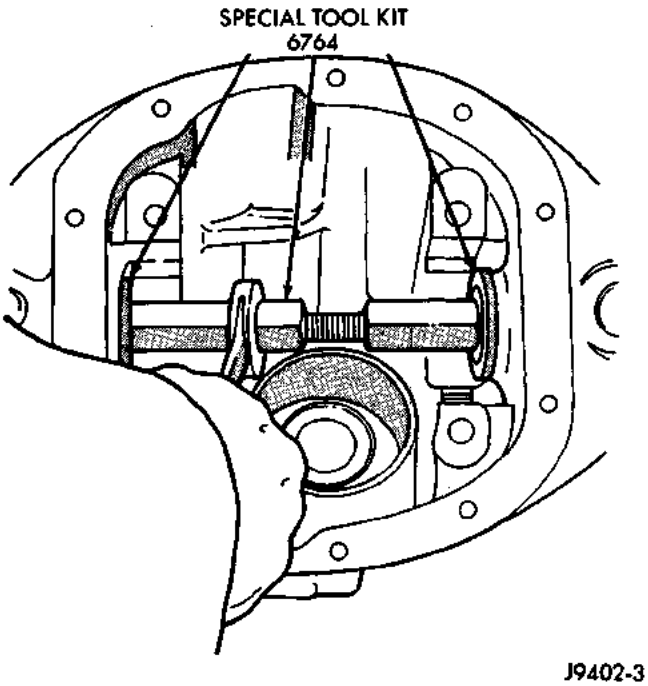

Fig. 25 Axle Seal Installation

(4) Using Holder 6958 to hold yoke and a short length of 1 in. pipe, remove the pinion yoke nut and washer (Fig. 26).

(5) Using Remover C–452 and Holder 6958, remove the pinion yoke from pinion shaft (Fig. 27).

(6) Remove the pinion gear and collapsible spacer from housing (Fig. 28). Catch the pinion with your hand to prevent it from falling and being damaged.

(7) Remove the pinion gear seal.

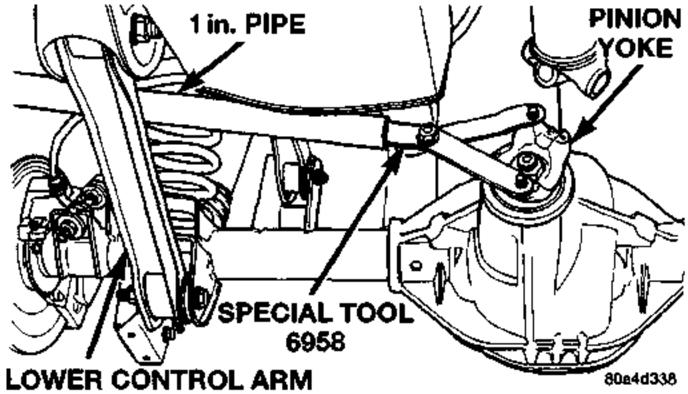

Fig. 26 Pinion Yoke Holder

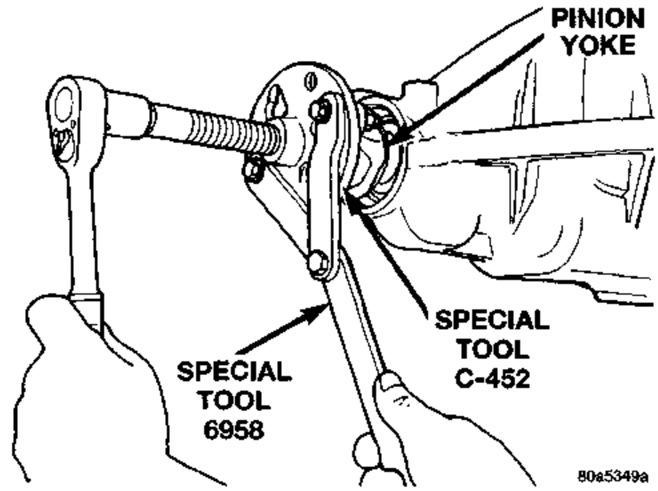

Fig. 27 Pinion Yoke Removal

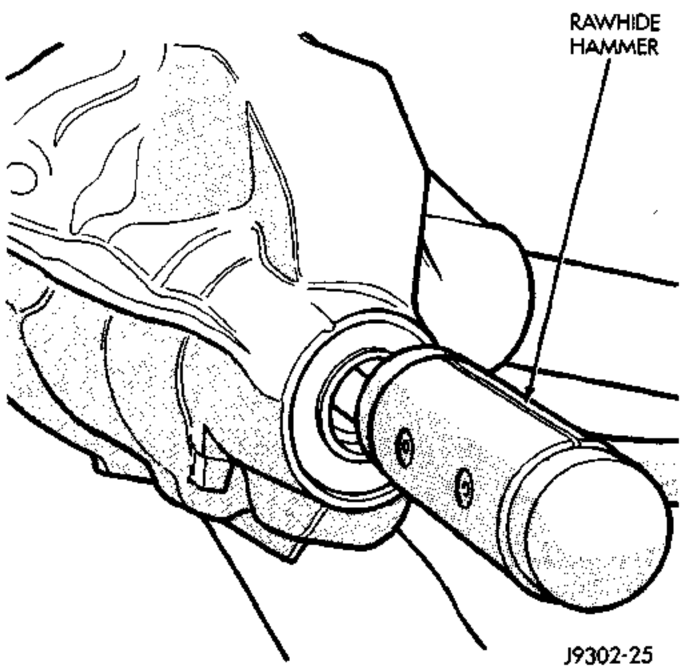

Fig. 28 Remove Pinion Gear

REMOVAL AND INSTALLATION (Continued)

(8) Remove oil slinger and front bearing from axle housing.

(9) Remove the outer pinion bearing cup and seal with Remover D-147 and Handle C–4171 (Fig. 29).

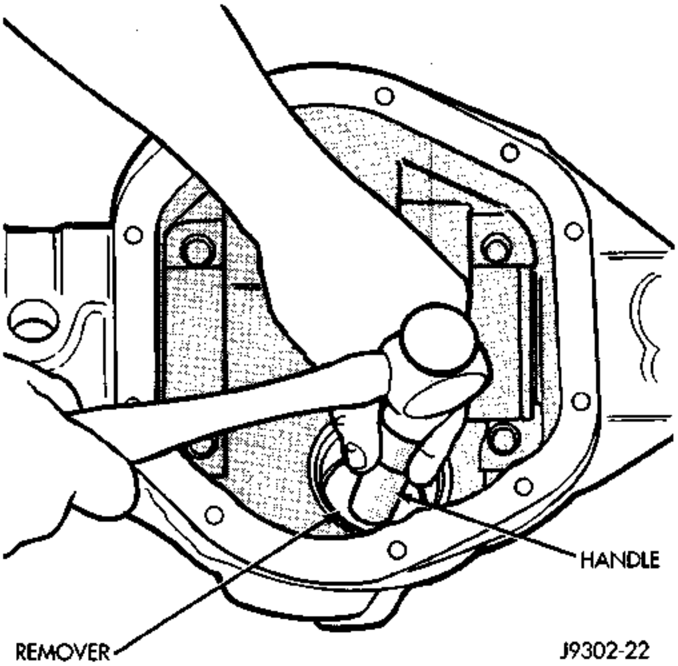

Fig. 29 Front Bearing Cup Removal

(10) Remove the inner bearing cup from axle housing (Fig. 30). Use Remover D-149 and Handle C–4171.

(11) Remove the depth shims and oil baffle from inner pinion bearing cup bore in axle housing. Record the thickness of the depth shims and baffel.

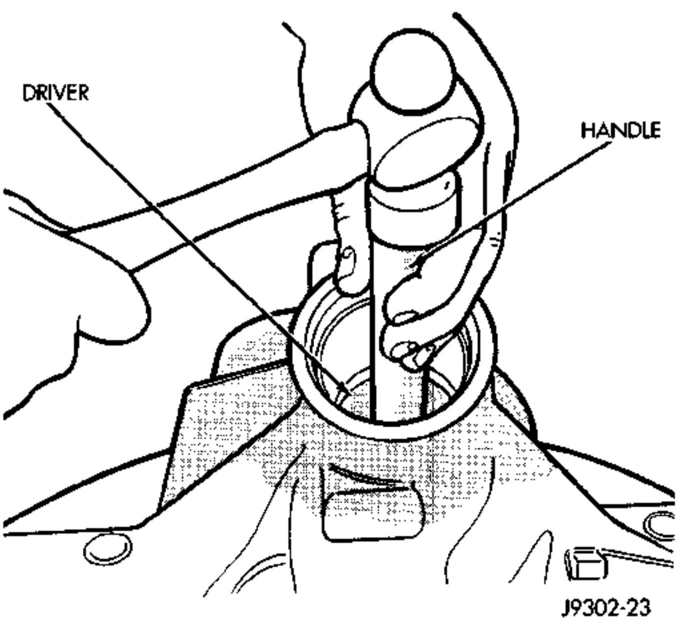

Fig. 30 Rear Bearing Cup Removal

(12) Remove the collapsible preload spacer from pinion gear (Fig. 31).

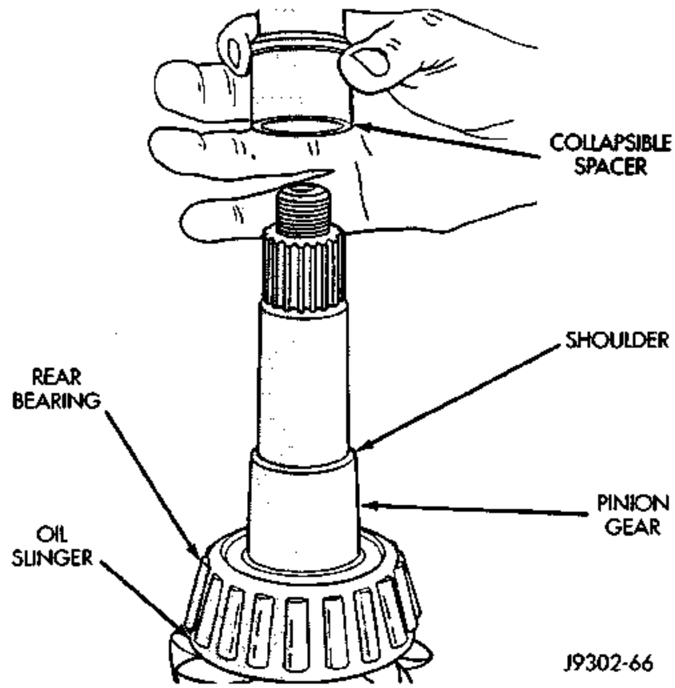

Fig. 31 Collapsible Spacer

(13) Remove the inner bearing from the pinion with Puller/Press C–293PA and Adapter C–293–39 from Puller/Press set C–293–M. (Fig. 32).

Place 3 adapter blocks so they do not damage the bearing cage.

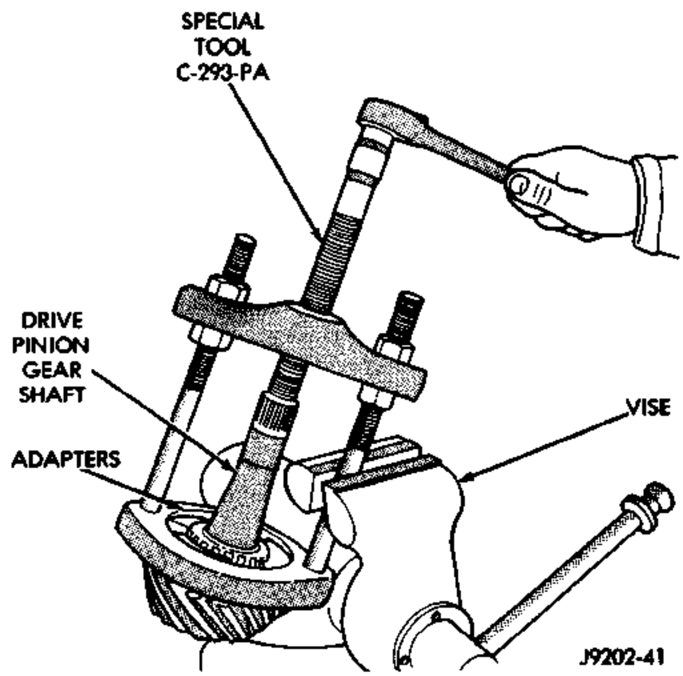

Fig. 32 Inner Bearing Removal

REMOVAL AND INSTALLATION (Continued)

PINION GEAR INSTALLATION

NOTE: Pinion depth shims and baffle are placed between the inner pinion bearing cup and axle housing to achieve proper ring and pinion gear mesh. If the factory installed ring and pinion gears are reused, the pinion depth shim should not require replacement. Refer to Pinion Gear Depth to select the proper thickness shim and baffle before installing pinion gear.

(1) Place proper thickness depth shim and baffle in inner pinion bearing axle housing bore.

(2) Apply Mopar, Door Ease stick lubricant to outside surface of inner pinion bearing cup. Install the bearing cup with Installer D-146 and Driver Handle C–4171 (Fig. 33). Verify cup is correctly seated.

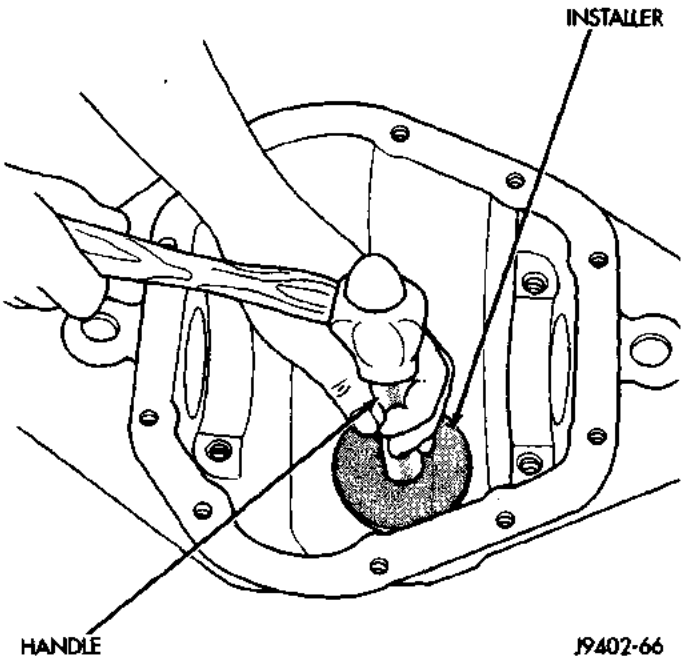

Fig. 33 Pinion Inner Bearing Cup Installation

(3) Apply Mopar, Door Ease stick lubricant to outside surface of bearing cup. Install the pinion outer bearing cup with Installer D-144 and Handle C–4171 (Fig. 34).

(4) Install pinion front bearing, and oil slinger. Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer D–163 and Handle C–4171 (Fig. 35).

(5) Install the inner bearing (and slinger if used) on the pinion gear with Installer W-262 (Fig. 36).

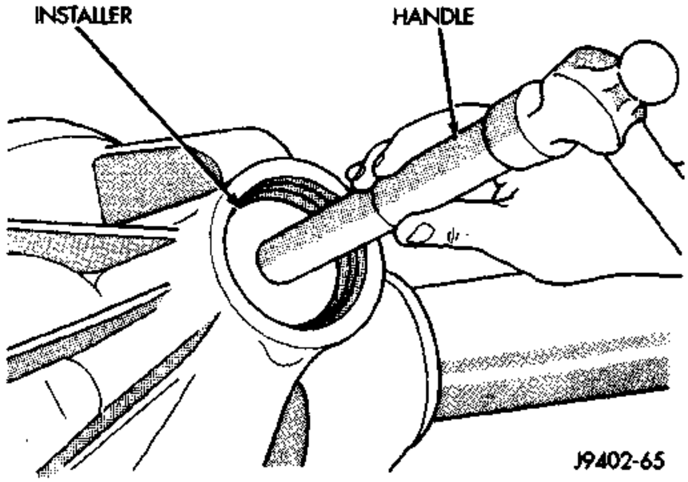

Fig. 34 Pinion Outer Bearing Cup Installation

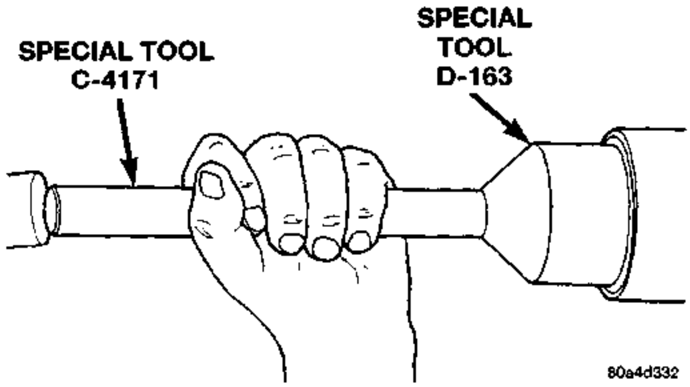

Fig. 35 Pinion Seal Installation

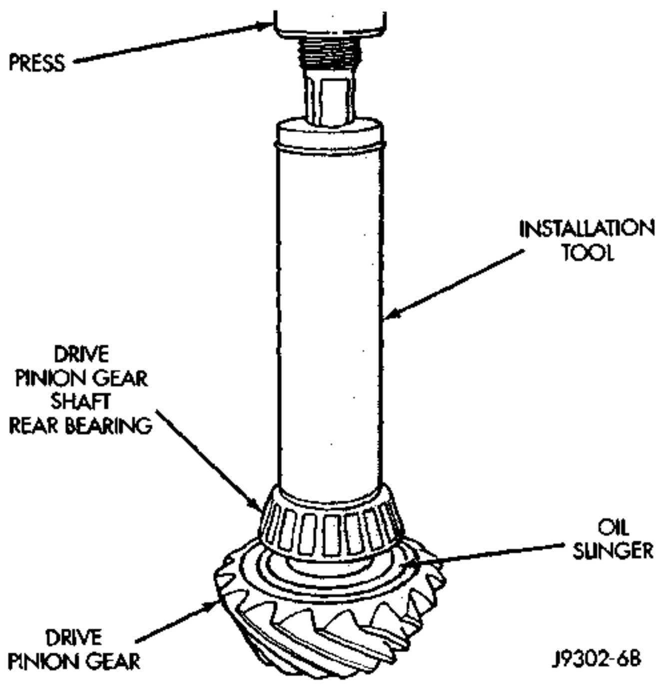

Fig. 36 Shaft Inner Bearing Installation

REMOVAL AND INSTALLATION (Continued)

(6) Install a new collapsible preload spacer on pinion shaft and install pinion gear in housing (Fig. 37).

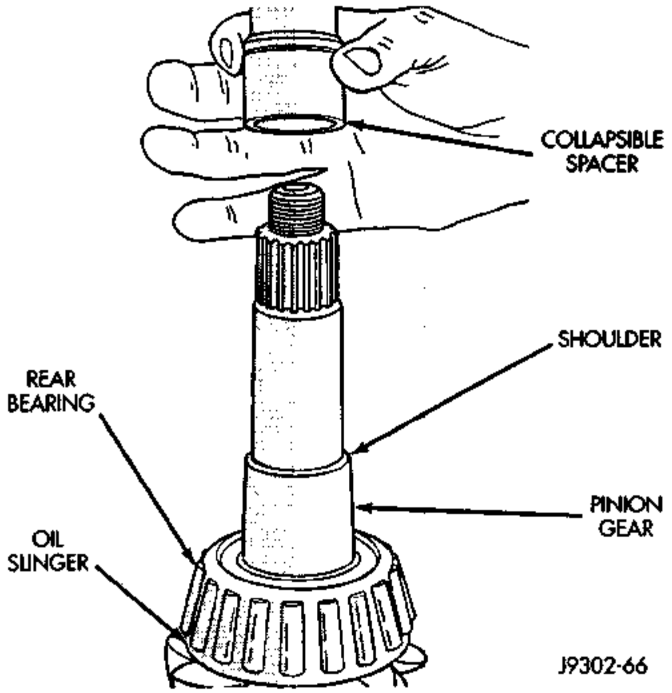

Fig. 37 Collapsible Preload Spacer

(7) Install yoke with Installer W-162-B and Holder 6958 (Fig. 38).

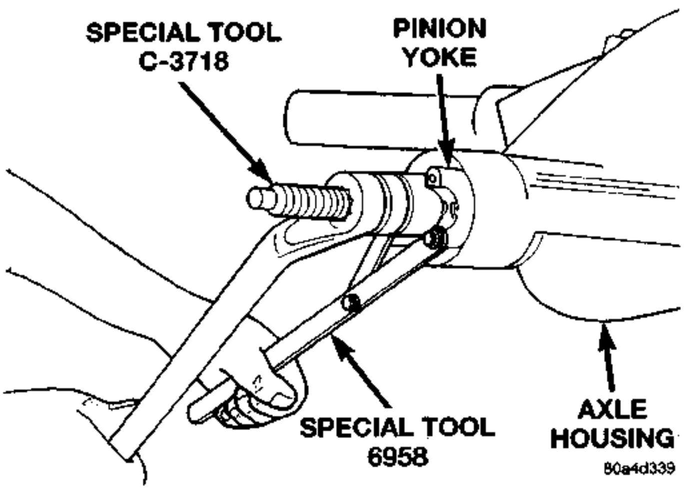

Fig. 38 Pinion Yoke Installation

(8) Install the yoke, washer and a new nut on the pinion gear. Tighten the nut to 298 N·m (220 ft. lbs.) minimum. **Do not over-tighten.** Maximum torque is 352 N·m (260 ft. lbs.).

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing preload torque and never exceed specified preload torque. If preload torque is exceeded a new collapsible spacer must be installed. The torque sequence will have to be repeated.

NOTE: A new collapsible spacer will start to crush at around 245 ft. lbs. torque. If the spacer requires more than 260 ft. lbs. torque to crush, the collapsible spacer is defective.

(9) Using yoke holder 6958, a short length of 1 in. pipe, and a 3/4 in. drive torque wrench (set at 280 ft. lbs.), crush collapsible spacer until bearing end play is taken up (Fig. 39).

(10) Slowly tighten the nut in small increments until the rotating torque is achieved. Measure the preload torque frequently to avoid over crushing the collapsible spacer (Fig. 40).

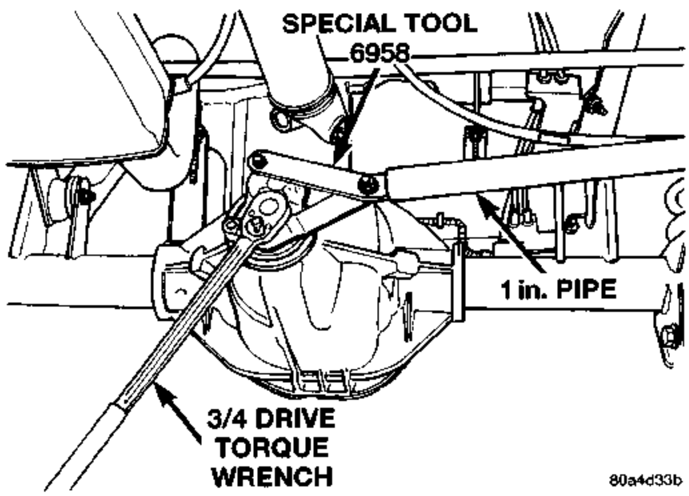

Fig. 39 Tightening Pinion Nut

(11) Check bearing preload torque with an inch pound torque wrench (Fig. 40). The torque necessary to rotate the pinion gear with New Bearings should be 2 to 5 N·m (15 to 35 in. lbs.).

(12) Install differential case.

FINAL ASSEMBLY

After pinion gear depth, differential bearing preload, and gear lash has been determined, install the pinion gear and differential assembly and proceed with this procedure.

(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. 41). Allow the sealant to cure for a few minutes.

Install the housing cover within 5 minutes after applying the sealant.

(3) Install the cover on the differential with the attaching bolts. Install the identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

REMOVAL AND INSTALLATION (Continued)

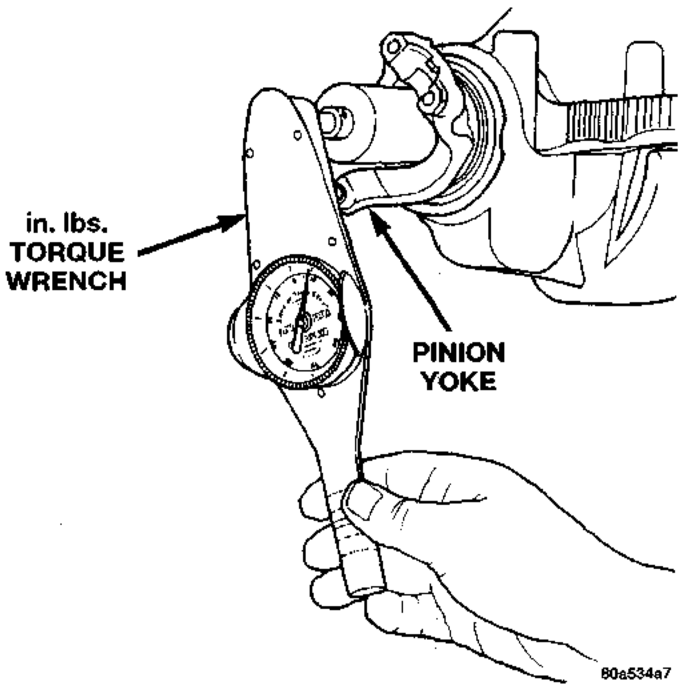

Fig. 40 Check Pinion Gear Rotation Torque

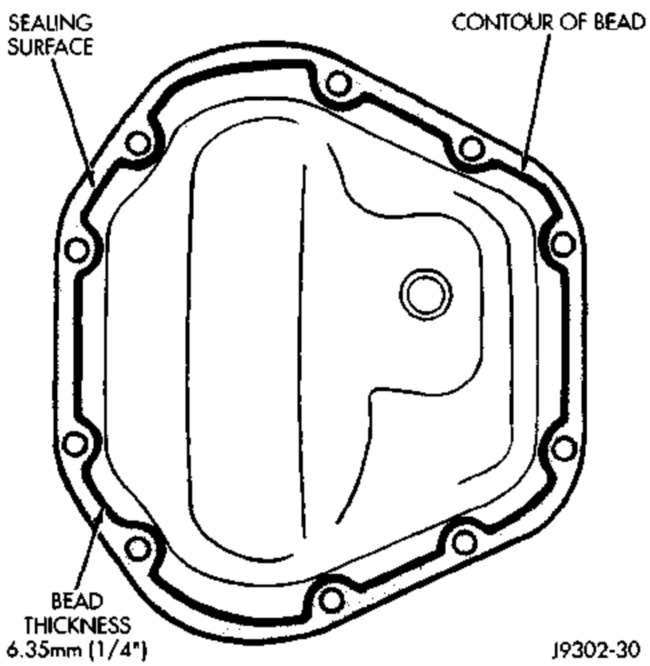

Fig. 41 Typical Housing Cover With Sealant

(4) Refill the differential housing with the specified quantity of Mopar Hypoid Gear Lubricant.

(5) Install the fill hole plug and tighten to 34 N·m (25 ft. lbs.) torque.

DISASSEMBLY AND ASSEMBLY

AXLE SHAFT—CARDAN U-JOINT

DISASSEMBLY

Single cardan U–joints are not serviceable. If defective, they must be replaced as a unit. If the bearings, seals, spider or bearing caps are damaged or worn, replace the complete U–joint.

CAUTION: Clamp only the forged portion of the yoke in the vise. Also, to avoid distorting the yoke, do not over tighten the vise jaws.

(1) Remove the bearing cap retaining snap rings (Fig. 42).

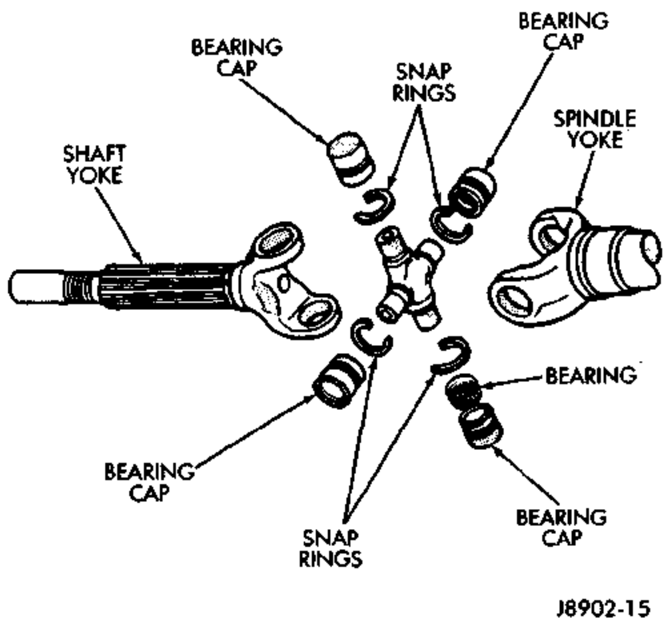

Fig. 42 Axle Shaft Outer U–Joint

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. 43).

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

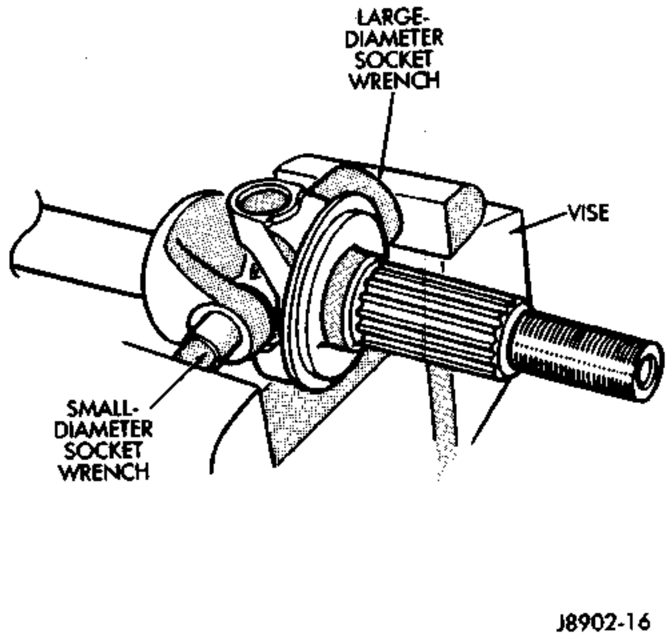

Fig. 43 Yoke Bearing Cap Removal

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.

STANDARD DIFFERENTIAL

DISASSEMBLE

(1) Using a suitable roll pin punch, drive roll pin holding pinion gear mate shaft in differential case (Fig. 44).

(2) Remove pinion gear mate shaft.

(3) Rotate differential side gears and remove the pinion mate gears and thrust washers (Fig. 45).

(4) Remove differential side gears and thrust washers.

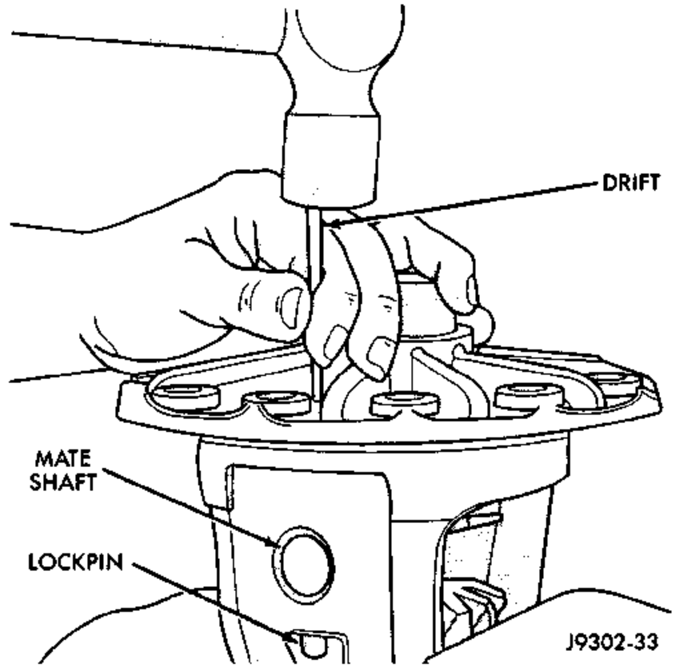

Fig. 44 Mate Shaft Roll Pin Removal

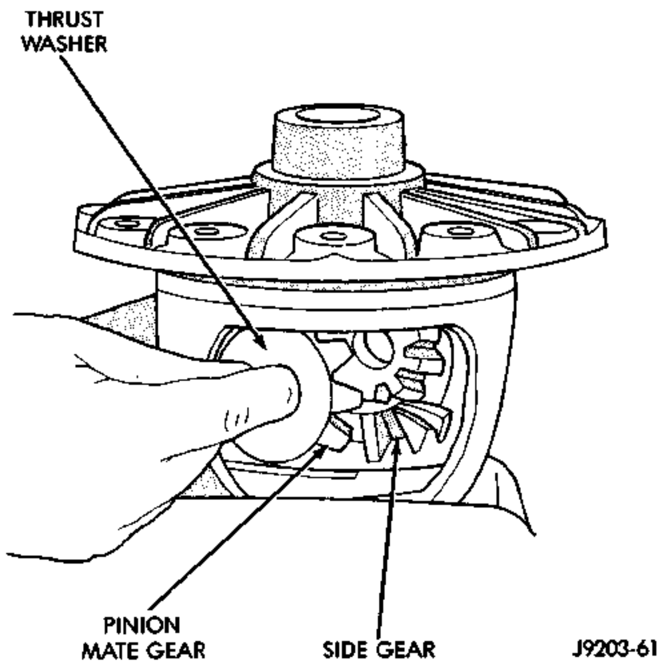

Fig. 45 Pinion Mate Gear Removal

DISASSEMBLY AND ASSEMBLY (Continued)

DIFFERENTIAL ASSEMBLE

(1) Differential side gears and thrust washers

(2) Pinion gears and thrust washers

(3) Pinion gear mate shaft (align holes in shaft and case)

(4) Install roll pin to hold mate shaft in differential case (Fig. 46).

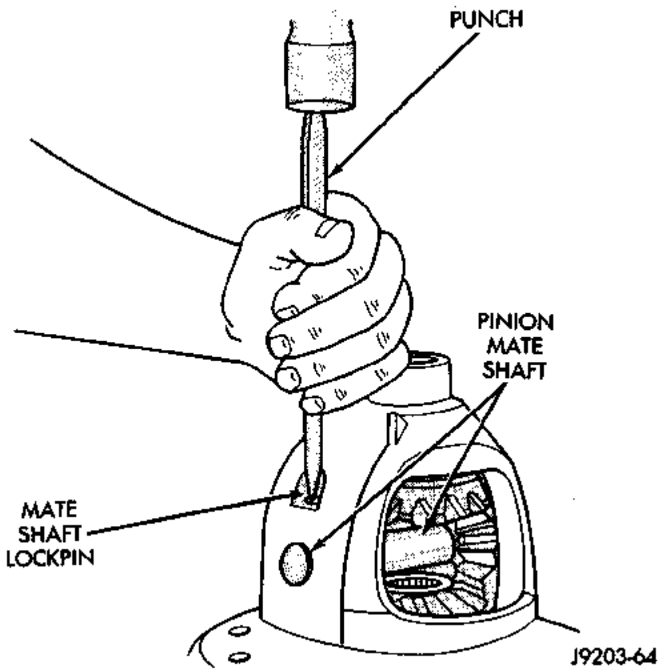

Fig. 46 Mate Shaft Roll Pin Installation

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

(6) Install differential case in axle housing. Refer to Differential removal and installation procedure.

CLEANING AND INSPECTION

CARDAN U-JOINT

(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.

DIFFERENTIAL

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

Wash bearings with solvent and towel dry, or dry with compressed air. DO NOT spin bearings with compressed air. **Cup and bearing must be replaced as a matched sets only.**

Clean axle shaft tubes and oil channels with 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 or damage to pinion gear mate shaft, pinion gears, side gears and thrust washers. Replace as a matched set only.
- Worn or chipped teeth to ring and pinion gears.
- Damaged bolt threads to ring gear. Replaced as a matched set only.
- Pinion yoke for cracks, worn splines, pitted areas, and a rough/corroded seal contact surface. Repair or replace the as necessary.

ADJUSTMENTS

PINION GEAR DEPTH

GENERAL INFORMATION

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and pinion gear are etched into the face of each gear (Fig. 47). A plus (+) number, minus (–) number or zero (0) is etched into the face of the pinion gear. This number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion etched with a (0). The standard setting from the center line of the ring gear to the back face of the pinion is 92.08 mm (3.625 in.). The standard depth provides the best gear tooth contact pattern. Refer to Backlash and Contact Pattern Analysis paragraph in this section for additional information.

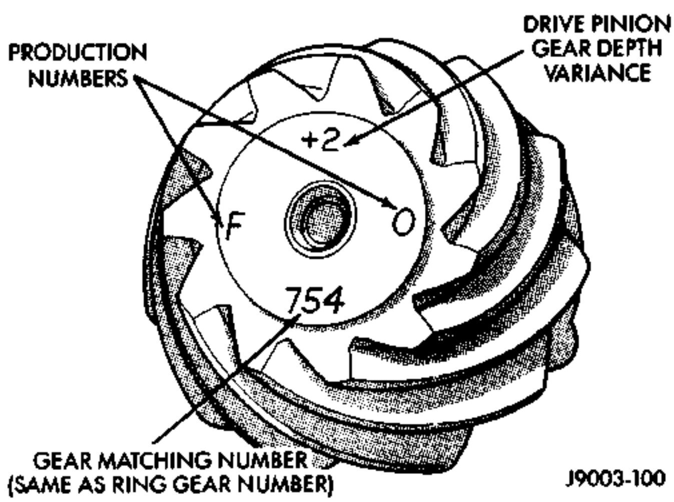

Fig. 47 Pinion Gear ID Numbers

ADJUSTMENTS (Continued)

Compensation for pinion depth variance is achieved with select shims and/or baffle. The shims/baffle are placed behind the inner pinion bearing cup (Fig. 48).

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

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

Note the etched number on the face of the drive pinion gear (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shims/baffle. If the number is positive, subtract that value from the thickness of the depth shim/baffle. If the number is 0 no change is necessary.

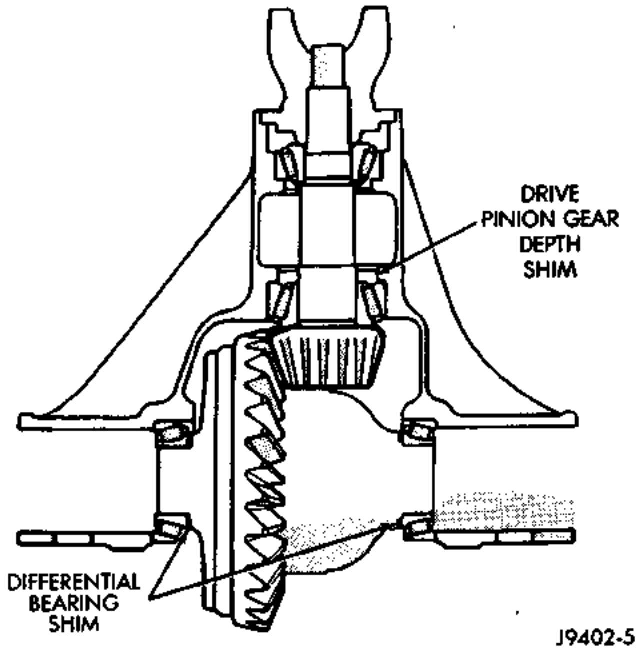

Fig. 48 Shim Locations

PINION GEAR DEPTH VARIANCE

Original Pinion Gear Depth Variance	Replacement Pinion Gear Depth Variance								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

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ADJUSTMENTS (Continued)

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Pinion gear depth measurement is necessary when:

- Axle housing or differential case is replaced
- Pinion select shim pack is unknown
- Ring and pinion gears are replaced

Measurements are taken with pinion cups and pinion bearings installed in axle housing without shims or baffle placed behind the inner pinion bearing cup. Take measurements with Pinion Gauge Set 6774 and Dial Indicator C-3339 (Fig. 49).

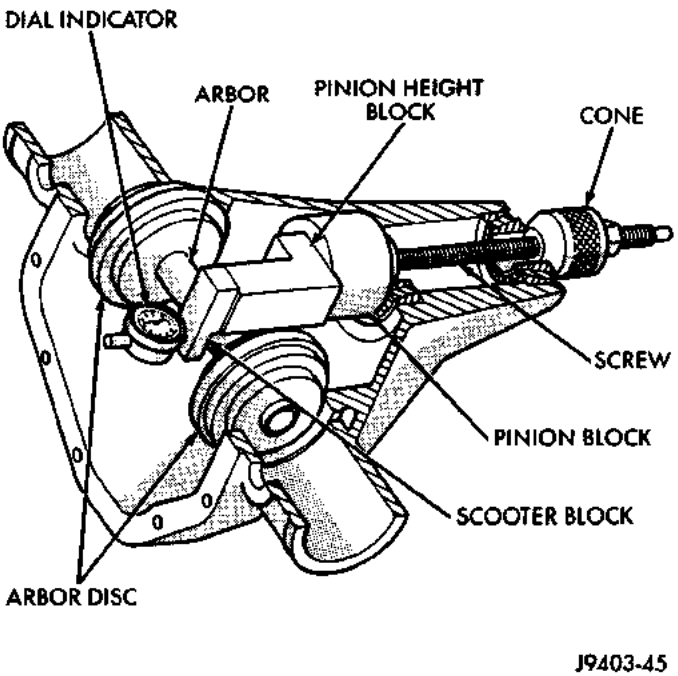


Fig. 49 Pinion Gear Depth Gauge Tools—Typical

(1) Assemble Pinion Height Block 6739, Pinion Block 6733, and inner pinion bearing cone onto Screw 6741 (Fig. 49).

(2) Insert assembled height gauge components, rear bearing and screw into axle housing through pinion bearing cups (Fig. 50).

(3) Install outer pinion bearing cone and Cone-nut 6740 hand tight (Fig. 49).

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in axle housing side bearing cradles (Fig. 51). Install differential bearing caps on Arbor Discs and tighten cap bolts to 41 N·m (30 ft. lbs.).

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

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

(6) Place Scooter Block/Dial Indicator in position in axle housing so dial probe and scooter block are

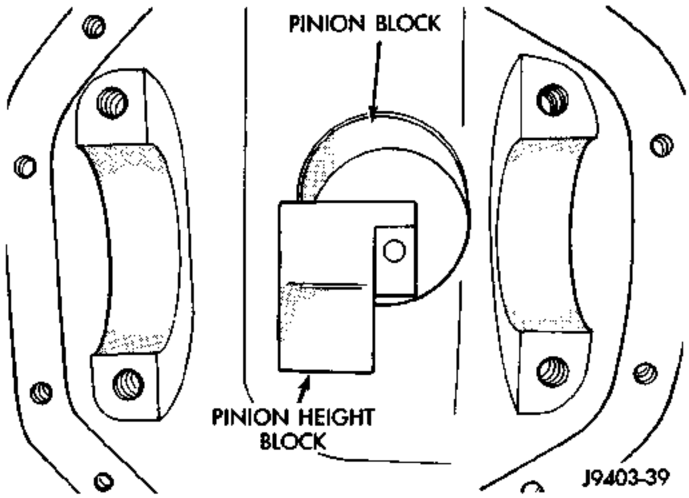


Fig. 50 Pinion Height Block—Typical

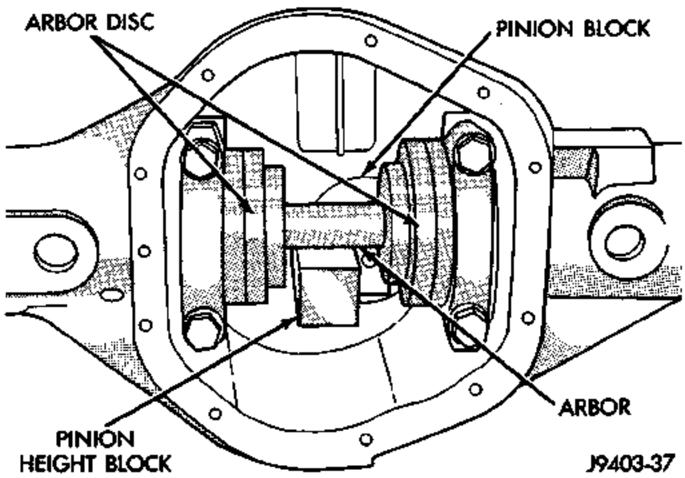


Fig. 51 Gauge Tools In Housing—Typical

flush against the rearward surface of the pinion height block (Fig. 49). Hold scooter block in place and zero the dial indicator face to the pointer. Tighten dial indicator face lock screw.

(7) With scooter block still in position against the pinion height block, slowly slide the dial indicator probe over the edge of the pinion height block. Observe how many revolutions counterclockwise the dial pointer travels (approximately 0.125 in.) to the out-stop of the dial indicator.

(8) Slide the dial indicator probe across the gap between the pinion height block and the arbor bar with the scooter block against the pinion height block (Fig. 52). When the dial probe contacts the arbor bar, the dial pointer will turn clockwise. Bring dial pointer back to zero against the arbor bar, do not turn dial face. Continue moving the dial probe to the crest of the arbor bar and record the highest reading. If the dial indicator can not achieve the zero reading, the rear bearing cup or the pinion depth gauge set is not installed correctly.

ADJUSTMENTS (Continued)

(9) Select a shim/baffle equal to the thickest dial indicator reading ± the drive pinion gear depth variance number etched in the face of the pinion gear (Fig. 47).

NOTE: If an oil slinger is used behind the inner pinion bearing cone, deduct the thickness of the slinger from the dial indicator reading and use that total for shim/baffle selection.

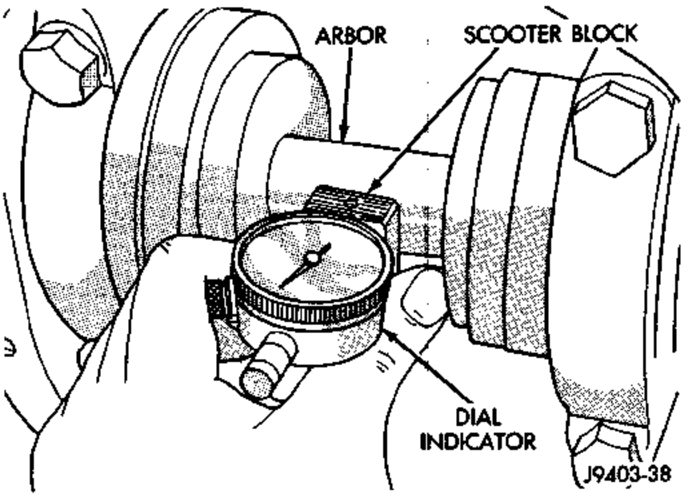


Fig. 52 Pinion Gear Depth Measurement—Typical

(10) Remove the pinion depth gauge components from the axle housing

NOTE: If the ring and pinion gear, differential case, or axle housing has been replaced, proceed to Differential Bearing Preload and Gear Lash

(11) Install the pinion gear in the axle housing.

(12) Install differential with ring gear mounted and with dummy bearings D-348 in place in axle housing.

(13) Determine the proper shim thickness to achieve specified gear lash. Refer to Differential Bearing Preload and Gear Lash paragraph in this group for proper procedure.

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

Differential side bearing preload and gear backlash is achieved by selective shims positioned behind the differential side bearing cones. The proper shim thickness can be determined using slip-fit dummy bearings D-348 in place of the differential side bearings and a dial indicator C-3339. Before proceeding with the differential bearing preload and gear backlash measurements, measure the pinion gear depth and prepare the pinion gear for installation. Establishing proper pinion gear depth is essential to establishing gear backlash and tooth contact patterns. After the overall shim thickness to take up differential side play is measured, the pinion gear is installed, and the gear backlash shim thickness is measured. The overall shim thickness is the total of the dial indicator reading and the preload specification added together. The gear backlash measurement determines the thickness of the shim used on the ring gear side of the differential case. Subtract the gear backlash shim thickness from the total overall shim thickness and select that amount for the pinion gear side of the differential (Fig. 53). Differential shim measurements are performed with axle spreader W-129-B removed.

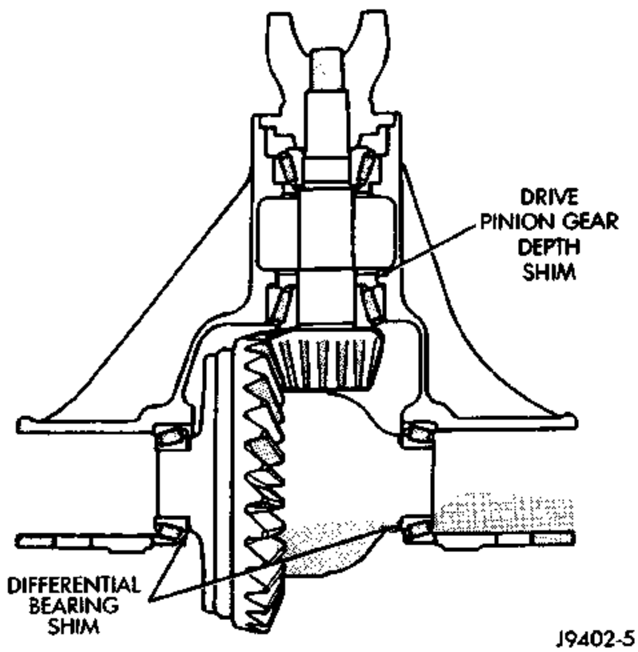


Fig. 53 Axle Adjustment Shim Locations

DIFFERENTIAL PRELOAD AND GEAR BACHLASH SHIM SELECTION

NOTE: It is difficult to salvage the differential side bearings during the removal procedure. Install replacement bearings whenever removal is required.

(1) Remove differential side bearings from differential case.

(2) Remove factory installed shims from differential case.

(3) Install ring gear on differential case and tighten bolts to specification.

(4) Install dummy side bearings D-348 on differential case.

(5) Install differential case in axle housing.

(6) Install the marked bearing caps in their correct positions. Install and snug the bolts (Fig. 54).

ADJUSTMENTS (Continued)

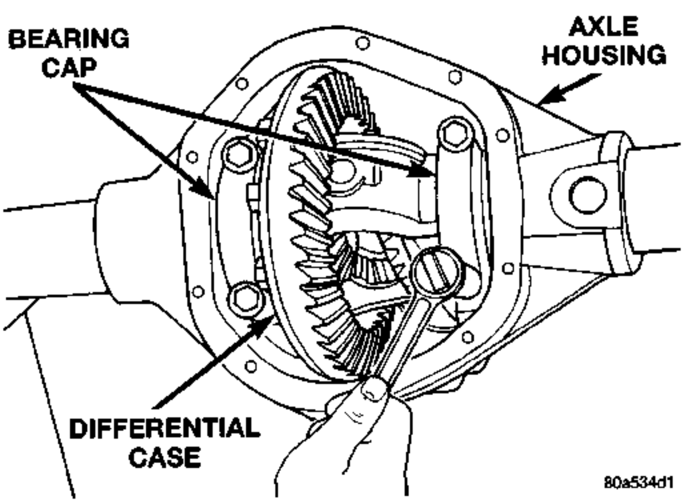


Fig. 54 Tighten Bolts Holding Bearing Caps

(7) Using a dead-blow type mallet, seat the differential dummy bearings to each side of the axle housing (Fig. 55) and (Fig. 56).

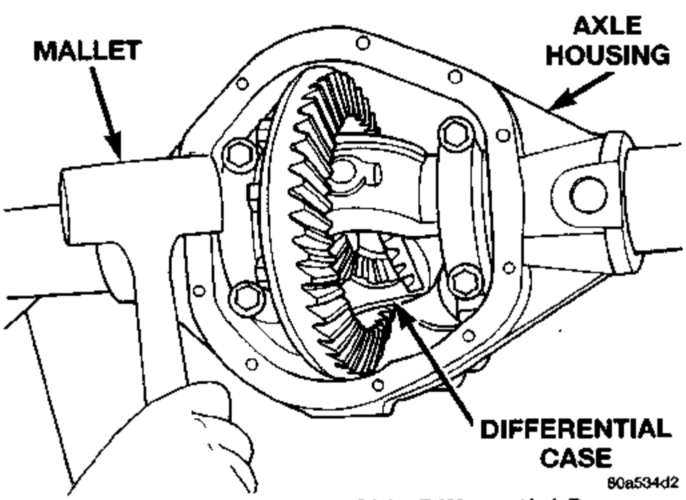


Fig. 55 Seat Pinion Gear Side Differential Dummy Side Bearing

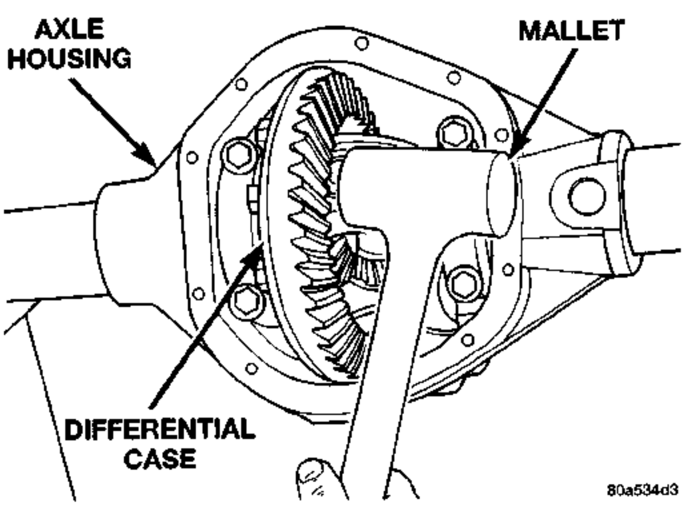


Fig. 56 Seat Ring Gear Side Differential Dummy Side Bearing

(8) Thread guide stud C-3288 into rear cover bolt hole below ring gear (Fig. 57).

(9) Attach a dial indicator C-3339 to guide stud. Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 57).

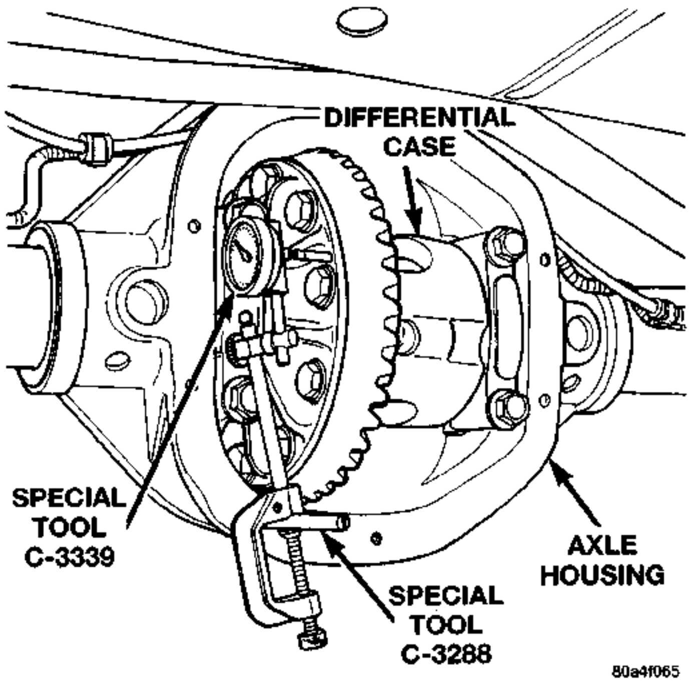


Fig. 57 Differential Side play Measurement

(10) Push and hold differential case to pinion gear side of axle housing (Fig. 58).

(11) Zero dial indicator face to pointer (Fig. 58).

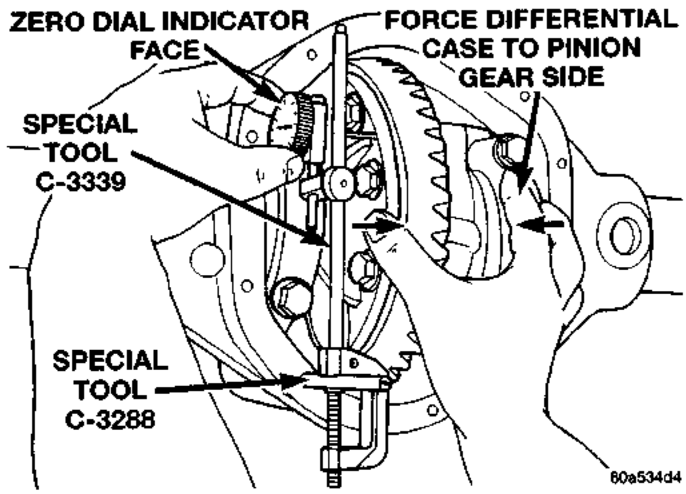


Fig. 58 Hold Differential Case and Zero Dial Indicator

ADJUSTMENTS (Continued)

(12) Push and hold differential case to ring gear side of the axle housing (Fig. 59).

(13) Record dial indicator reading (Fig. 59).

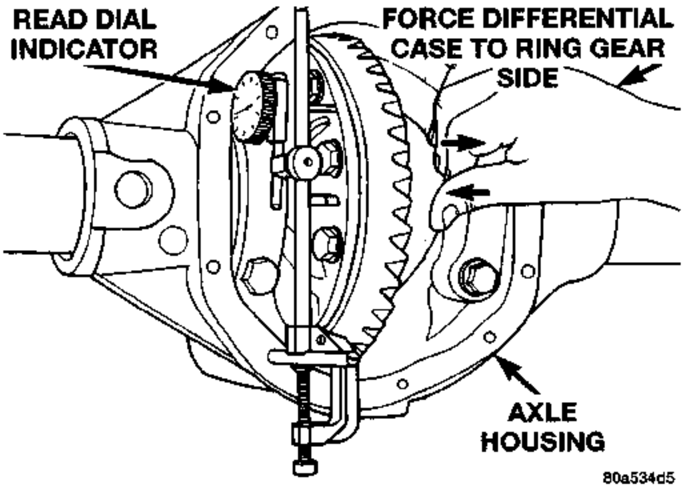


Fig. 59 Hold Differential Case and Read Dial Indicator

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

(15) Add 0.008 in. (0.2 mm) to the zero end play total. This new total represents the thickness of shims to compress, or preload the new bearings when the differential is installed.

(16) Rotate dial indicator out of the way on guide stud.

(17) Remove differential case and dummy bearings from axle housing.

(18) Install Pinion Gear in axle housing.

(19) Install differential case and dummy bearings D-348 in axle housing (without shims), install bearing caps and tighten bolts snug.

(20) Seat ring gear side dummy bearing (Fig. 56).

(21) Position the dial indicator plunger on a flat surface between the ring gear bolt heads. (Fig. 57).

(22) Push and hold differential case toward pinion gear (Fig. 60).

(23) Zero dial indicator face to pointer (Fig. 60).

(24) Push and hold differential case to ring gear side of the axle housing (Fig. 61).

(25) Record dial indicator reading (Fig. 61).

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

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

(28) Rotate dial indicator out of the way on guide stud.

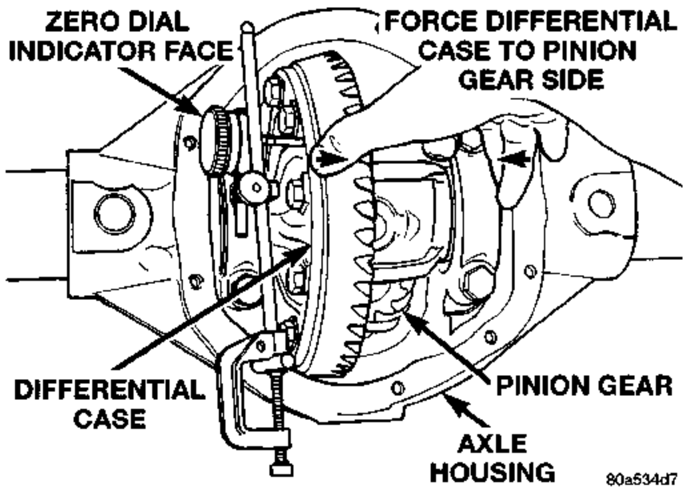


Fig. 60 Hold Differential Case and Zero Dial Indicator

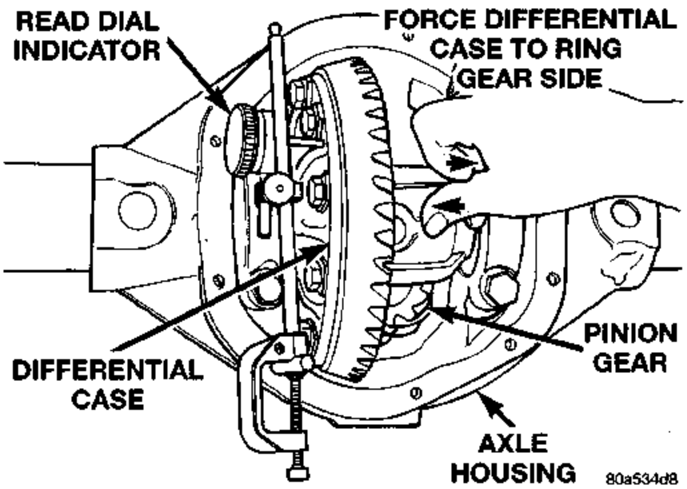


Fig. 61 Hold Differential Case and Read Dial Indicator

(29) Remove differential case and dummy bearings from axle housing.

(30) Install side bearing shims on differential case hubs.

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

(32) Install spreader W-129-B on axle housing and spread axle opening enough to receive differential case.

(33) Install differential case in axle housing. Refer to Differential Removal and Installation paragraph.

(34) Remove spreader from axle housing.

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

(36) Position the indicator plunger against a ring gear tooth (Fig. 62).

(37) Push and hold ring gear upward (do not rotate differential).

(38) Zero dial indicator face to pointer.

ADJUSTMENTS (Continued)

(39) Push and hold ring gear downward (do not rotate differential). Dial indicator reading should be between 0.12 mm (0.005 in.) and 0.20 mm (0.008 in.). If backlash is not within specifications transfer the necessary amount of shim thickness from one side of the axle housing to the other (Fig. 63).

(40) Verify differential case and ring gear runout by measuring ring to pinion gear backlash at several locations around the ring gear. Readings should not vary more than 0.05 mm (0.002 in.). If readings vary more than specified, the ring gear or the differential case is defective.

After the proper backlash is achieved, perform Gear Contact Pattern Analysis procedure.

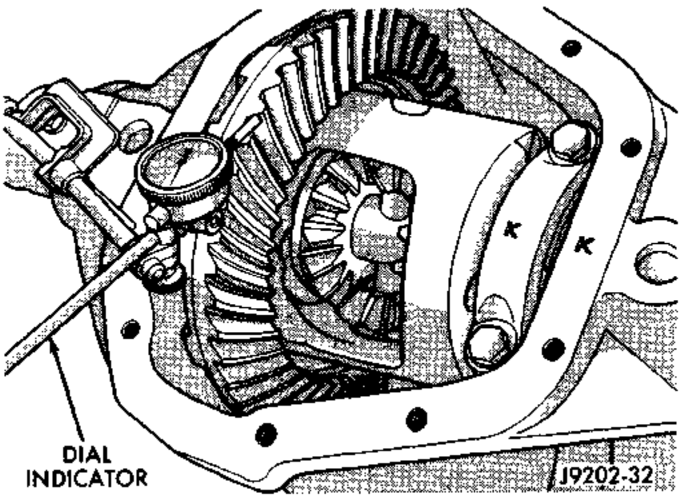


Fig. 62 Ring Gear Backlash Measurement

GEAR CONTACT PATTERN ANALYSIS

The ring and pinion gear teeth contact patterns will show if the pinion gear depth is correct in the axle housing. It will also show if the ring gear backlash has been adjusted correctly. The backlash can be adjusted within specifications to achieve desired tooth contact patterns.

(1) Apply a thin coat of hydrated ferric oxide, or equivalent, to the drive and coast side of the ring gear teeth.

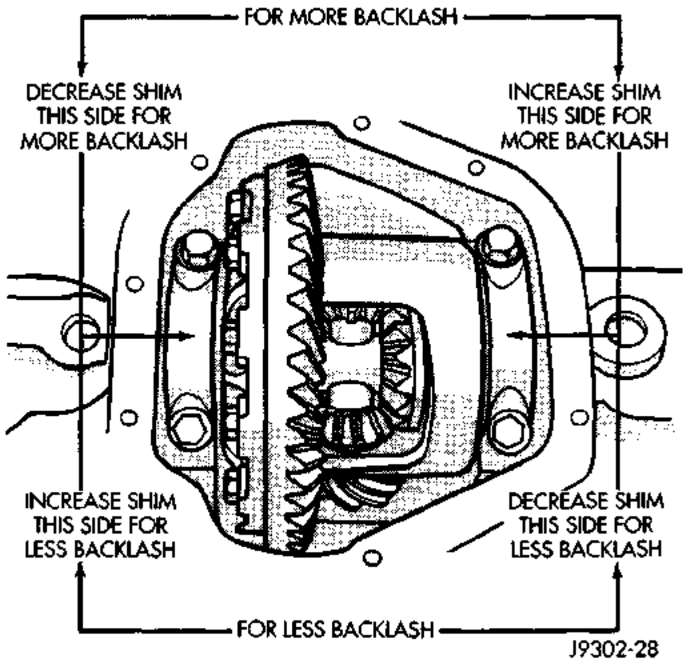


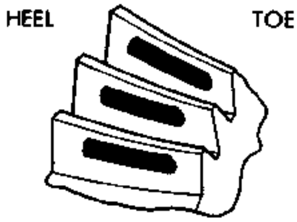
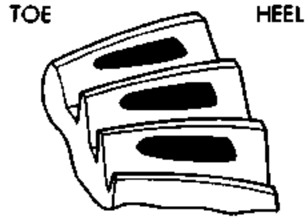
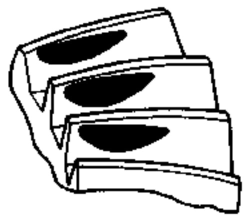
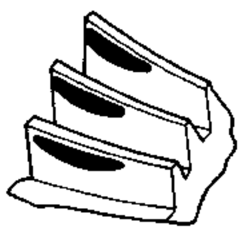
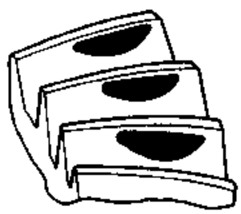
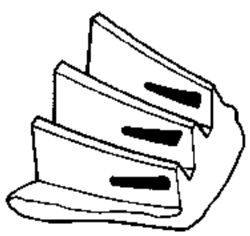
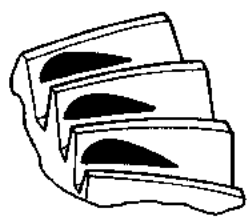
Fig. 63 Backlash Shim Adjustment

(2) Wrap, twist, and hold a shop towel around the pinion yoke to increase the turning resistance of the pinion gear. This will provide a more distinct contact pattern.

(3) Using a boxed end wrench on a ring gear bolt, Rotate the differential case one complete revolution in both directions while a load is being applied from shop towel.

The areas on the ring gear teeth with the greatest degree of contact against the pinion gear teeth will squeegee the compound to the areas with the least amount of contact. Note and compare patterns on the ring gear teeth to Gear Tooth Contact Patterns chart and adjust pinion depth and gear backlash as necessary.

ADJUSTMENTS (Continued)

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

J9003-24

Gear Tooth Contact Patterns

SPECIFICATIONS

181 FBI AXLE

Axle Type . . . . .Hypoid
Lubricant. . . . . .80W-90 Gear Lubericant
Lube Capacity. . . . . .1.65 L (3.76 pts.)
Axle Ratio 3.07/3.55/3.73/4.10
Diff. S/Gear Clrnc. . .0.12-0.20 mm (0.005-0.008 in.)
Ring Gear Dia.. . . . . .180.9 mm (7.125 in.)
Gear Backlash . . . .13-.20 mm (0.005-0.008 in.)
Pinion Std. Depth. . . . . .92.1 mm (3.625 in.)
Pinion Preload-Original. . .1-2 N·m (10-20 in. lbs.)
Pinion Preload-New. . . . . . .1.5-4 N·m (15-35 in. lbs.)

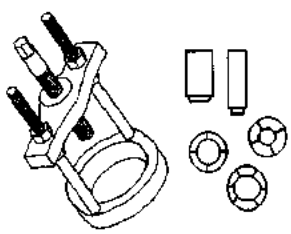
TORQUE

DESCRIPTION	TORQUE
Fill Hole Plug	34 N·m (25 ft. lbs.)
Diff. Cover Bolt	41 N·m (30 ft. lbs.)
Bearing Cap Bolt	61 N·m (45 ft. lbs.)
Ring Gear Bolt	95–122 N·m (70–90 ft. lbs.)
Axle Nut	237 N·m (175 ft. lbs.)
Wheel Brg. Bolt	102 N·m (75 ft. lbs.)
Lower Ball Stud	108 N·m (80 ft. lbs.)
Upper Ball Stud	101 N·m (75 ft. lbs.)
ABS Sensor Bolt	11 N·m (96 in. lbs.)
Nut, Pinion-Minimum*	217 N·m (160 in. lbs.)

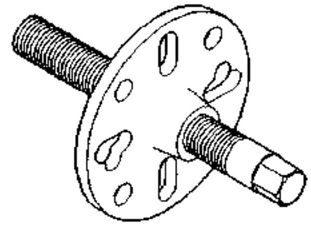
NOTE: *—Refer to Pinion Gear Removal and Installation procedures for proper pinion nut tightening instructions. Do not exceed 352 N·m (260 ft. lbs.) during collapsible spacer crushing procedure.

SPECIAL TOOLS

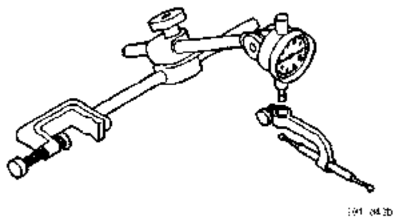
181 FBI AXLE



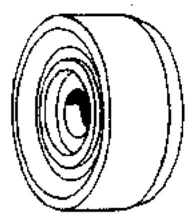
Puller—C-293-M



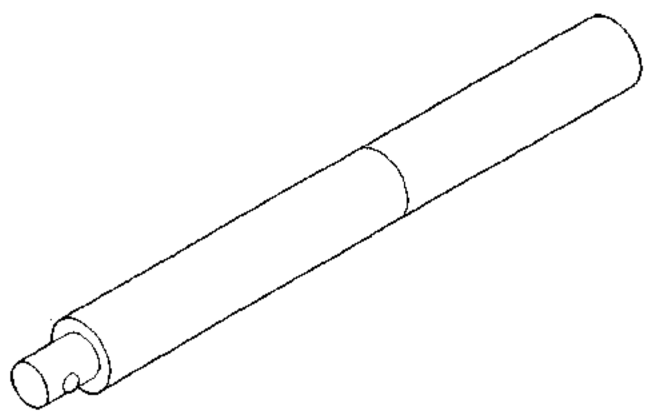
Puller—C-452



Dial Indicator—C-3339

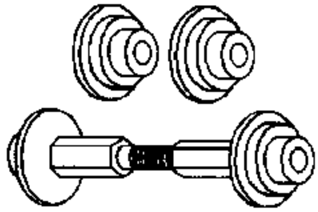


Driver—C-3716-A



Handle—C-4171

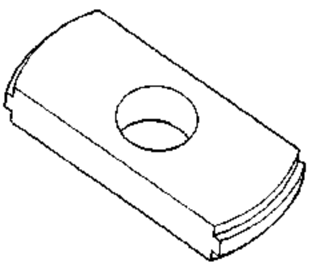
SPECIAL TOOLS (Continued)



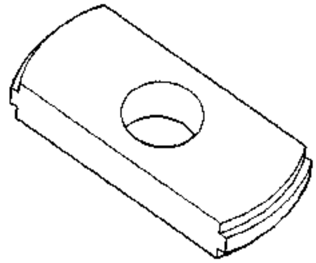
Installer—D-112

Installer—D-144

Installer—D-146



Remover—D-147



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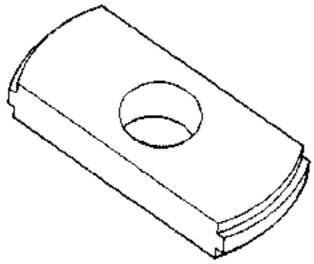

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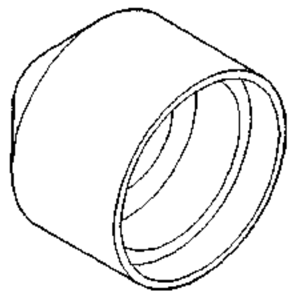
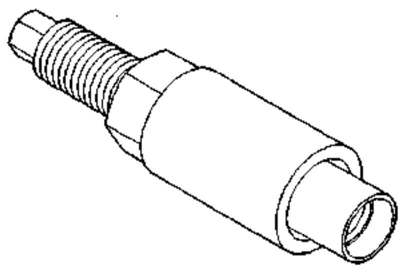
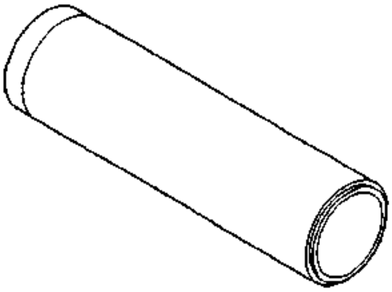


Installer—D163

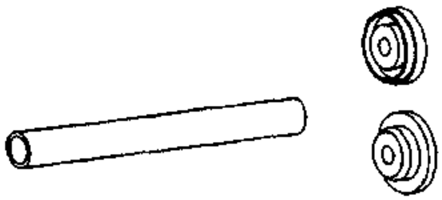


Installer—W-162-D

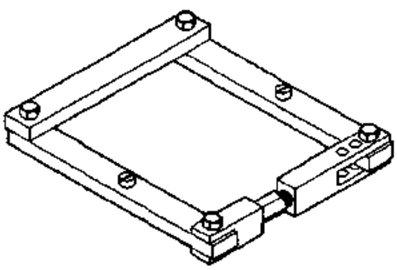
SPECIAL TOOLS (Continued)



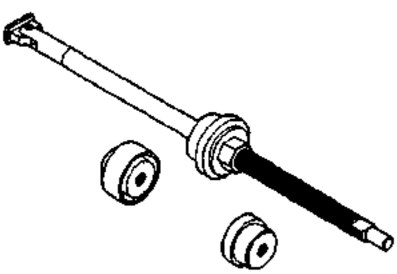
Installer—W-262



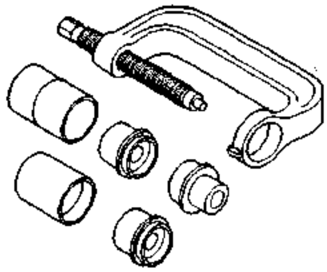
Installer—6228



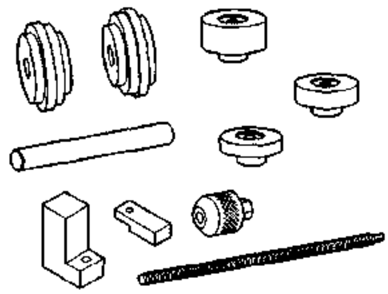
Spreader—W-129-B



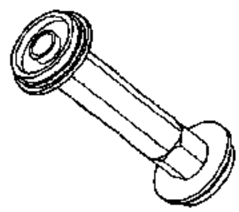
Remover/Installer—6288



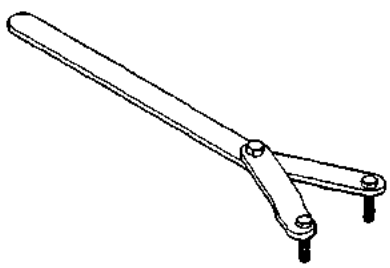
Remover/Installer—6289



Tool Set, Pinion Depth—6774

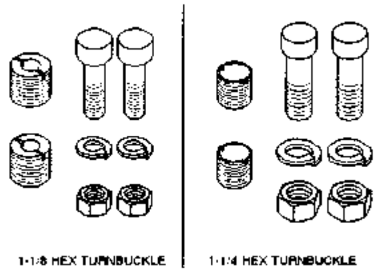


Installer—6764

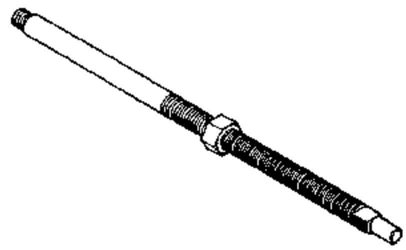


Holder—6958

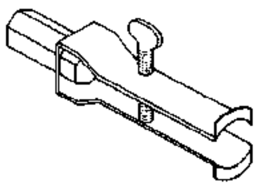
SPECIAL TOOLS (Continued)



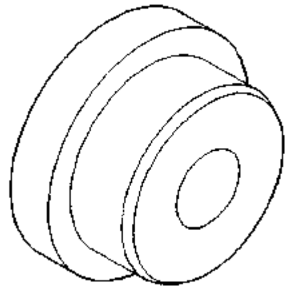
Adapter Set—6987



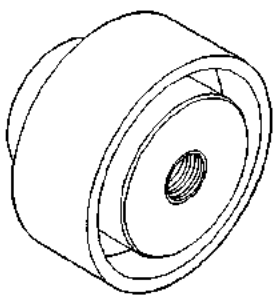
Screw, Forcing—7918



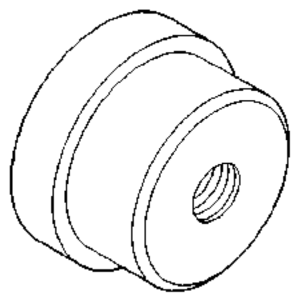
Puller—7794-A



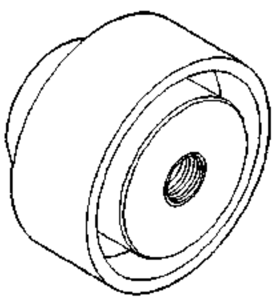
Support—7919



Remover—7916



Remover—7920



Installer—7917

194 RBI REAR AXLE

INDEX

GENERAL INFORMATION

194 RBI AXLE

The 194 Rear Beam-design Iron (RBI) axle housing has an iron center casting with axle shaft tubes extending from either side. The tubes are pressed and welded into the center section to form an integral axle houssing.

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

The 194 RBI is equipped with semi-floating axle shafts. Vehicle loads are supported by the axle shaft and bearings. The axle shafts are retained by C-clips in the differential side gears.

The differential case is a one-piece design. The differential pinion mate shaft is retained with a threaded pin. Differential bearing preload and ring gear backlash is adjusted by shims positioned between the side bearing cone and the differential case. Pinion gear depth is adjusted by shims positioned between the inner pinion bearing cup and the axle housing. Pinion gear bearing preload is set and maintained by the use of a collapsible spacer (Fig. 1).

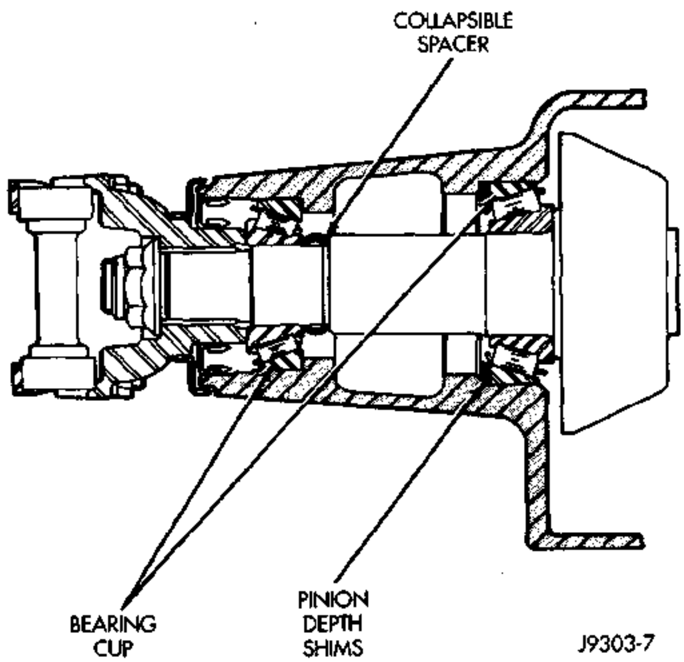


Fig. 1 Axle Adjustment Shims and Spacer

GENERAL INFORMATION (Continued)

LUBRICANT SPECIFICATIONS

Multi–purpose, hypoid gear lubricant should be used. The lubricant should have MIL–L–2105C and API GL 5 quality specifications. Mopar Hypoid Gear Lubricant conforms to both of these specifications.

- Lubricant is a thermally stable SAE 80W–90 gear lubricant.
- Lubricant for axle with Trailer Tow is SAE 75W–140 SYNTHETIC gear lubricant.
- Trac–Lok differentials add 4 oz. of friction modifier.
- Lubricant capacity is 1.66 L (3.50 pts.).

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

DESCRIPTION AND OPERATION

AXLES

TJ vehicles are equipped with a 194 FBI rear axle. The 194 FBI axle housing has a cast iron center section. Two steel axle shaft tubes are pressed and welded into the center section.

It is not necessary to remove the axle from the vehicle for service. A removable differential cover is provided for routine vehicle service. If the differential housing is damaged, the complete axle assembly can be removed.

IDENTIFICATION

194 FBI axle has the assembly part number and gear ratio listed on a tag. The tag is attached to the left side of the housing cover. Build date identification codes on axles are stamped on the axle shaft tube cover side. The 194 FBI axle has a flat housing cover gasket flange at the outer edge.

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:

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

During straight ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 2).

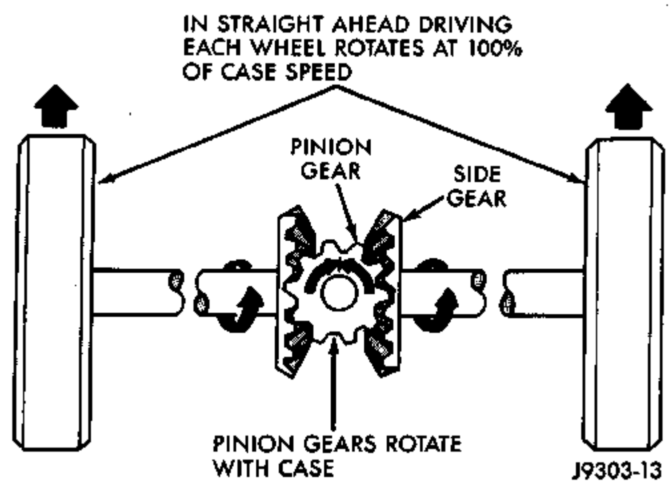


Fig. 2 Differential Operation—Straight Ahead Driving

When turning corners, the outside wheel must travel a greater distance than the inside wheel in order to complete a turn. The difference must be compensated for, to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 3). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

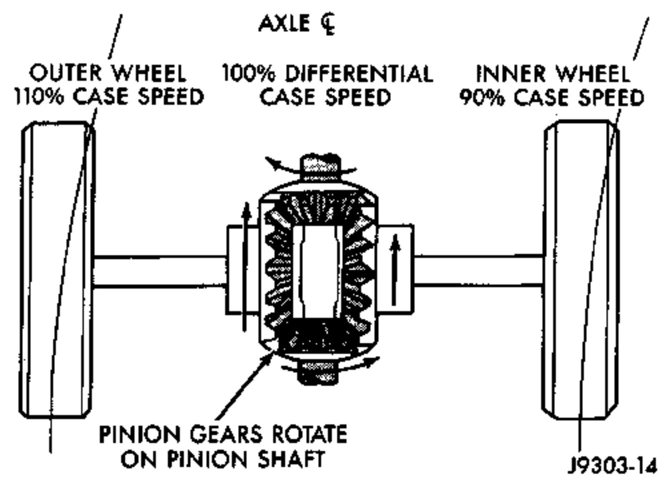


Fig. 3 Differential Operation—On Turns

TRAC-LOK OPERATION

In a conventional differential, the torque applied to the ring gear is transmitted to the axle shafts

DESCRIPTION AND OPERATION (Continued)

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. The clutch will have radial grooves on the plates, and concentric grooves on the discs or bonded fiber material that is smooth appearance.

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 from separating forces generated by the side gears as torque is applied through the ring gear (Fig. 4).

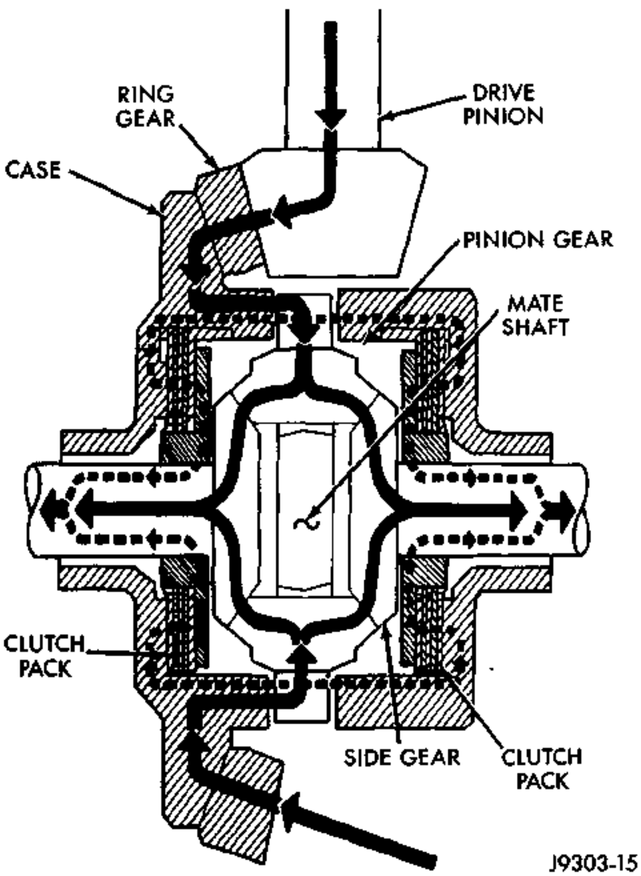


Fig. 4 Trac-lok Limited Slip Differential Operation

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.

DIAGNOSIS AND TESTING

DIAGNOSTIC INFORMATION

Axle bearing problem conditions are usually caused by:

- Insufficient or incorrect lubricant
- Foreign matter/water contamination
- Incorrect bearing preload torque adjustment

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 or over filling 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 wil 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

DIAGNOSIS AND TESTING (Continued)

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. The side 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 side gear/case clearance

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

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 in. (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.

DIAGNOSIS AND TESTING (Continued)

(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 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.

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.

DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS

SERVICE DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
WHEEL NOISE	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	1. Misaligned axle shaft tube. 2. Bent or sprung axle shaft. 3. End play in drive pinion bearings. 4. Excessive gear backlash between ring gear and pinion gear. 5. Improper adjustment of drive pinion gear shaft bearings. 6. Loose drive pinion gearshaft yoke nut. 7. Improper wheel bearing adjustment. 8. Scuffed gear tooth contact surfaces.	1. Inspect axle shaft tube alignment. Correct as necessary. 2. Replace bent or sprung axle shaft. 3. Refer to Drive Pinion Bearing Pre-Load Adjustment. 4. Check adjustment of ring gear backlash and pinion gear. Correct as necessary. 5. Adjust drive pinion shaft bearings. 6. Tighten drive pinion gearshaft yoke nut with specified torque. 7. Readjust as necessary. 8. If necessary, replace scuffed gears.
AXLE SHAFT BROKE	1. Misaligned axle shaft tube. 2. Vehicle overloaded. 3. Erratic clutch operation. 4. Grabbing clutch.	1. Replace broken axle shaft after correcting axle shaft tube alignment. 2. Replace broken axle shaft. Avoid excessive weight on vehicle. 3. Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch. 4. Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	1. Improper adjustment of differential bearings. 2. Excessive ring gear backlash. 3. Vehicle overloaded. 4. Erratic clutch operation.	1. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly. 2. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly. 3. Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle. 4. Replace cracked case. After inspecting for other possible causes, examine gears and bearings for possible damage. Avoid erratic use of clutch.
DIFFERENTIAL GEARS SCORED	1. Insufficient lubrication. 2. Improper grade of lubricant. 3. Excessive spinning of one wheel/tire.	1. Replace scored gears. Scoring marks on the drive face of gear teeth or in the bore are caused by instantaneous fusing of the mating surfaces. Scored gears should be replaced. Fill rear differential housing to required capacity with proper lubricant. Refer to Specifications. 2. Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant. 3. Replace scored gears. Inspect all gears, pinion bores and shaft for damage. Service as necessary.
LOSS OF LUBRICANT	1. Lubricant level too high.	1. Drain excess lubricant by removing fill plug and allow lubricant to level at lower edge of fill plug hole.

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DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS (CONT'D)

CONDITION	POSSIBLE CAUSES	CORRECTION
LOSS OF LUBRICANT	2. Worn axle shaft seals. 3. Cracked differential housing. 4. Worn drive pinion gear shaft seal. 5. Scored and worn yoke. 6. Axle cover not properly sealed.	2. Replace worn seals. 3. Repair or replace housing as necessary. 4. Replace worn drive pinion gear shaft seal. 5. Replace worn or scored yoke and seal. 6. Remove cover and clean flange and reseal.
AXLE OVERHEATING	1. Lubricant level too low. 2. Incorrect grade of lubricant. 3. Bearings adjusted too tight. 4. Excessive gear wear. 5. Insufficient ring gear backlash.	1. Refill differential housing. 2. Drain, flush and refill with correct amount of the correct lubricant. 3. Readjust bearings. 4. Inspect gears for excessive wear or scoring. Replace as necessary. 5. Readjust ring gear backlash and inspect gears for possible scoring.
GEAR TEETH BROKE (RING GEAR AND PINION)	1. Overloading. 2. Erratic clutch operation. 3. Ice-spotted pavements. 4. Improper adjustments.	1. Replace gears. Examine other gears and bearings for possible damage. 2. Replace gears and examine the remaining parts for possible damage. Avoid erratic clutch operation. 3. Replace gears. Examine the remaining parts for possible damage. Replace parts as required. 4. Replace gears. Examine other parts for possible damage. Ensure ring gear backlash is correct.
AXLE NOISE	1. Insufficient lubricant. 2. Improper ring gear and drive pinion gear adjustment. 3. Unmatched ring gear and drive pinion gear. 4. Worn teeth on ring gear or drive pinion gear. 5. Loose drive pinion gear shaft bearings. 6. Loose differential bearings. 7. Misaligned or sprung ring gear. 8. Loose differential bearing cap bolts	1. Refill axle with correct amount of the proper lubricant. Also inspect for leaks and correct as necessary. 2. Check ring gear and pinion gear teeth contact pattern. 3. Remove unmatched ring gear and drive pinion gear. Replace with matched gear and drive pinion gear set. 4. Check teeth on ring gear and drive pinion gear for correct contact. If necessary, replace with new matched set. 5. Adjust drive pinion gearshaft bearing preload torque. 6. Adjust differential bearing preload torque. 7. Measure ring gear runout. 8. Tighten with specified torque

J9503-4

DIAGNOSIS AND TESTING (Continued)

TRAC-LOK 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.

The differential can be tested without removing the differential case by measuring rotating torque. Make sure brakes are not dragging during this measurement.

(1) Engine off, transmission in neutral, and parking brake off.

(2) Place blocks in front and rear of both front wheels.

(3) Raise one rear wheel until it is completely off the ground.

(4) Remove wheel and bolt Special Tool 6790 to studs.

(5) Use torque wrench on special tool to rotate wheel and read rotating torque (Fig. 5).

(6) If rotating torque is less than 22 N·m (30 ft. lbs.) or more than 271 N·m (200 ft. lbs.) on either wheel the unit should be service.

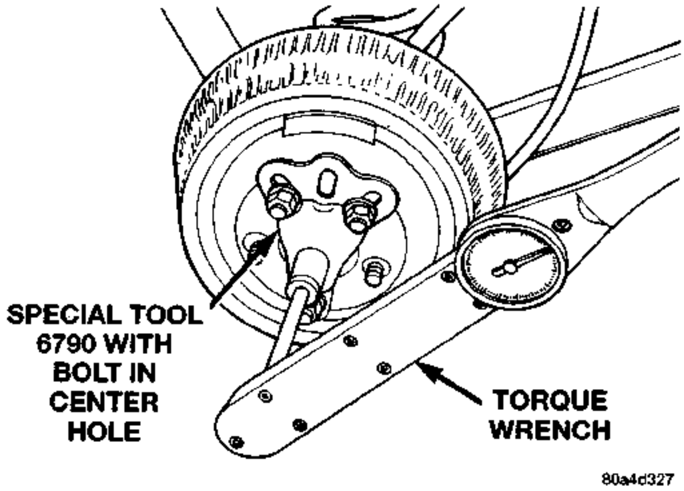


Fig. 5 Trac-lok Test

SERVICE PROCEDURES

LUBRICANT CHANGE

(1) Raise and support the vehicle.

(2) Remove the lubricant fill hole plug from the differential housing cover.

(3) Remove the differential housing cover and drain the lubricant from the housing.

(4) Clean the housing cavity with a flushing oil, light engine oil or lint free cloth. **Do not use water, steam, kerosene or gasoline for cleaning.**

(5) Remove the sealant from the housing and cover surfaces.

(6) Apply a bead of Mopar Silicone Rubber Sealant to the housing cover (Fig. 6). **Allow the sealant to cure for a few minutes.**

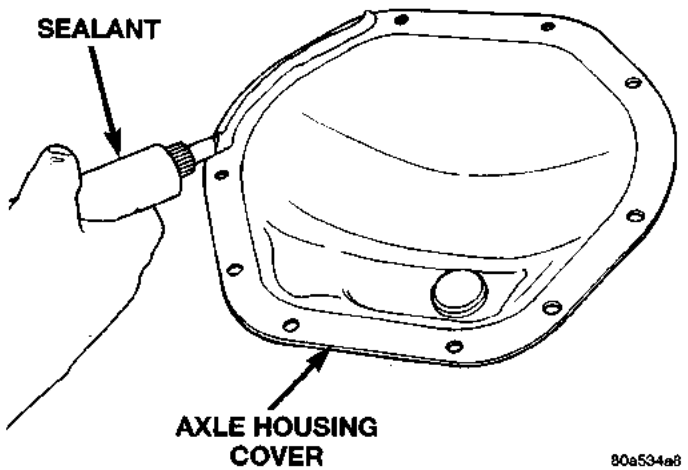


Fig. 6 Apply Sealant

Install the housing cover within 5 minutes after applying the sealant.

(7) Install the cover and any identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

(8) Fill differential with Mopar, Hypoid Gear Lubricant to bottom of the fill plug hole.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

Trac–Lok 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.

SERVICE PROCEDURES (Continued)

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.

REMOVAL AND INSTALLATION

REAR AXLE

REMOVAL

(1) Raise and support the vehicle.
(2) Position a suitable lifting device under the axle.
(3) Secure axle to device.
(4) Remove the wheels and tires.
(5) Remove the brake components from the axle, refer to Group 5, Brakes.
(6) Disconnect the vent hose from the axle shaft tube.
(7) Remove propeller shaft.
(8) Disconnect stabilizer bar links.
(9) Disconnect shock absorbers from axle.
(10) Disconnect track bar.
(11) Disconnect upper and lower suspension arms from the axle brackets.
(12) Separate the axle from the vehicle.

INSTALLATION

NOTE: The weight of the vehicle must be supported by the springs before suspension arms and track bar fasteners can be tightened. If the springs are not at their normal ride position, vehicle ride height and handling could be affected.

(1) Raise the axle with a floor jack and align coil springs.
(2) Position the upper and lower suspension arms on the axle brackets. Install nuts and bolts, do not tighten bolts at this time.
(3) Install track bar and attachment bolts, do not tighten bolts at this time.
(4) Install shock absorber and tighten nuts to 60 N·m (44 ft. lbs.) torque
(5) Install stabilizer bar link and tighten nuts to 36 N·m (27 ft. lbs.) torque
(6) Install brake components refer to Group 5 Brakes.
(7) Install axle vent hose
(8) Align propeller shaft and pinion yoke reference marks. Install U-joint straps and bolts tighten to 19 N·m (14 ft. lbs.) torque
(9) Install the wheels and tires.
(10) Check and add gear lubricant if needed.
(11) Remove support and lower the vehicle.
(12) Tighten lower suspension arms bolts to 177 N·m (130 ft. lbs.) torque.
(13) Tighten upper suspension arms bolts to 75 N·m (55 ft. lbs.) torque.
(14) Tighten track bar bolts to 100 N·m (74 ft. lbs.) torque.

PINION SEAL

REMOVAL

(1) Raise and support vehicle.
(2) Remove wheels.
(3) Remove brake drums or calipers.
(4) Mark propeller shaft and pinion yoke for installation reference.
(5) Remove propeller shaft from pinion yoke.
(6) Rotate pinion gear by hand several times to verify bearing smoothness.
(7) Measure amount of torque necessary to rotate pinion gear with an (in. lbs.) dial-type torque wrench. Record torque reading for installation reference (Fig. 12).
(8) Hold pinion yoke with Holder 6958 and remove pinion yoke nut and washer (Fig. 7).
(9) Use Remover C-452 and Holder 6958 to remove pinion yoke (Fig. 8).

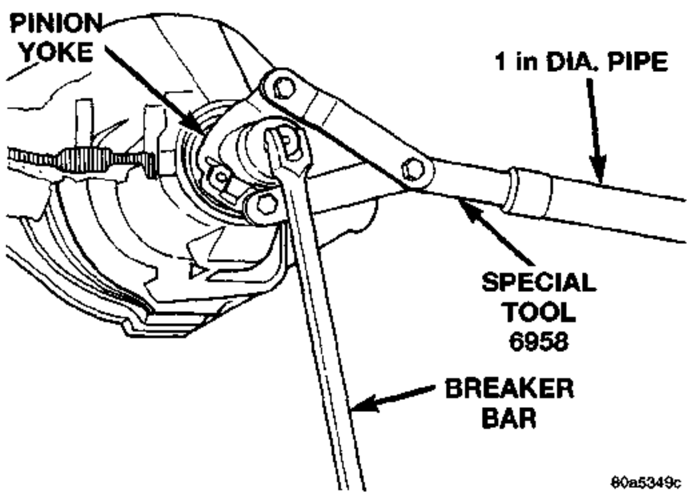


Fig. 7 Pinion Nut

(10) Use Remover 7794A and Slide Hammer 7420 to remove pinion seal (Fig. 9).

INSTALLATION

(1) Apply a light coating of gear lubricant on lip of pinion seal. Install seal with Installer D-163 and Handle C-4171 (Fig. 10).

Install yoke on pinion gear with Installer W-162-D and Holder 6958 (Fig. 11).

REMOVAL AND INSTALLATION (Continued)

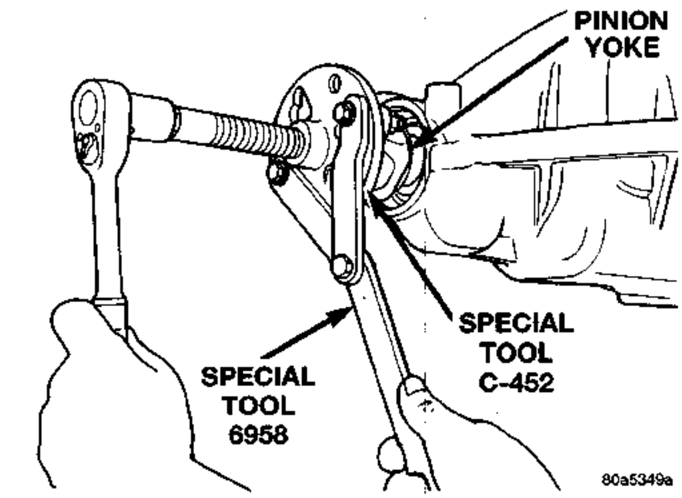


Fig. 8 Pinion Yoke, Remove

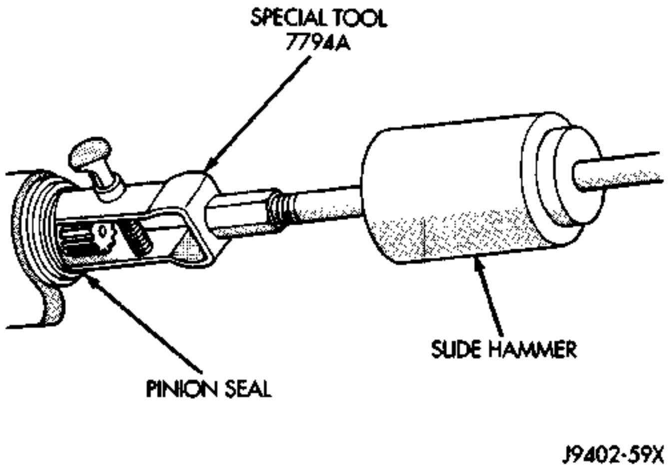


Fig. 9 Seal Removal

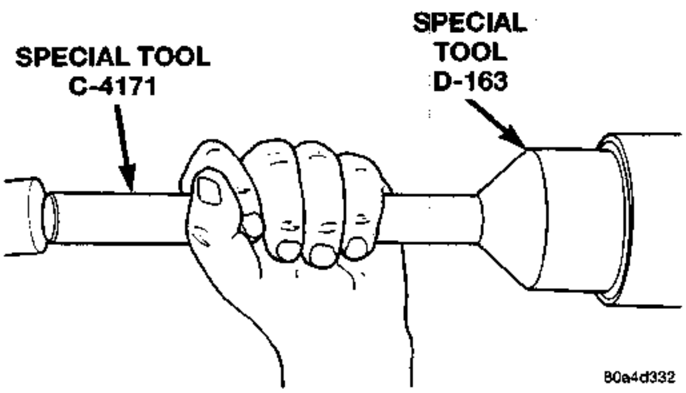


Fig. 10 Pinion Seal Installation

CAUTION: Do not exceed the minimum tightening torque when installing the pinion yoke retaining nut. Damage to collapsible spacer or bearings may result.

(2) Remove yoke installing tool.

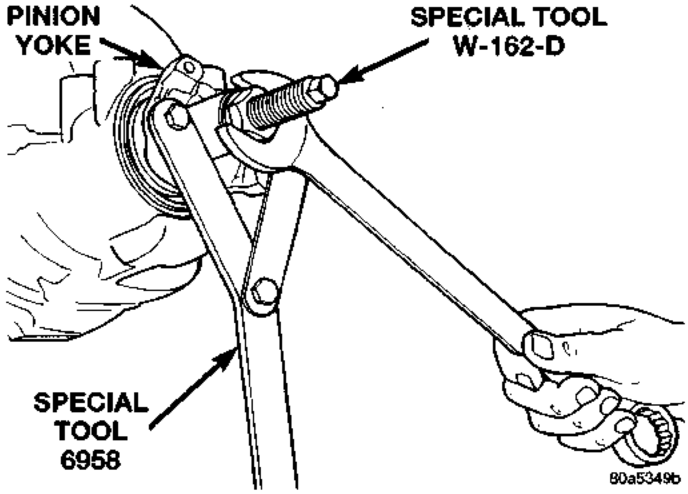


Fig. 11 Pinion Yoke, Install

(3) Install washer and new nut on pinion gear. **Tighten nut only enough to remove bearing end play.**

(4) Rotate the pinion shaft using an (in. lbs.) torque wrench. Rotating resistance torque should be equal to reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.). (Fig. 12).

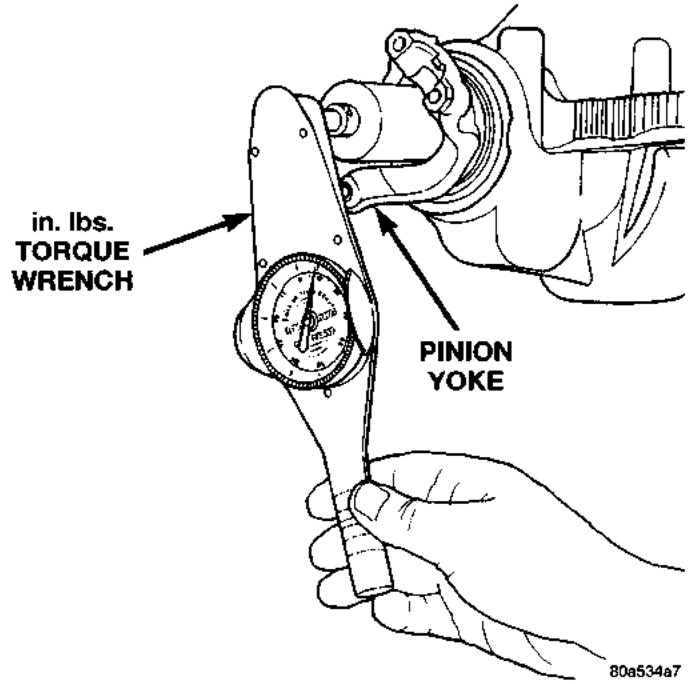


Fig. 12 Check Pinion Rotation Torque

(5) If rotating torque is to low, use Holder 6758 and a lenght of 1 in. dia. pipe to hold the pinion yoke (Fig. 13), and tighten pinion shaft nut in small increments until proper rotating torque is achieved.

(6) Align installation reference marks and attach propeller shaft to the yoke.

(7) Add gear lubricant, if necessary.

(8) Install brake drums or calipers.

REMOVAL AND INSTALLATION (Continued)

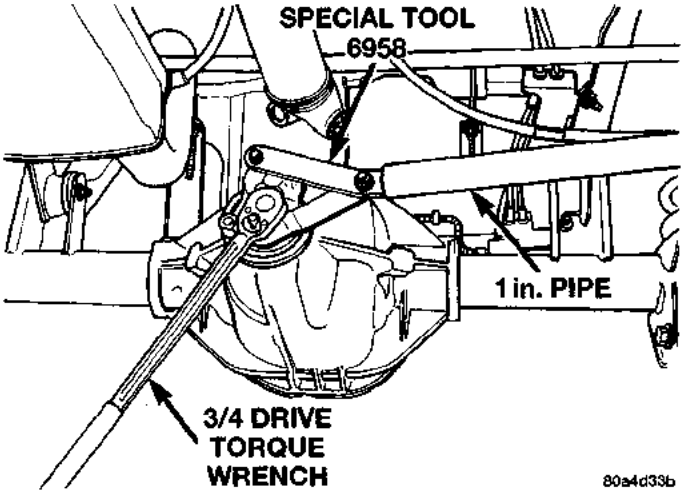


Fig. 13 Tightening Pinion Shaft Nut

(9) Install wheels.
(10) Lower vehicle.

AXLE SHAFT

REMOVAL

(1) Raise and support vehicle.
(2) Remove rear wheel and tire.
(3) Remove brake drum or rotor. Refer to Group 5, Brakes for procedure.
(4) Clean all foreign material from housing cover area.
(5) Loosen housing cover bolts. Drain lubricant from the housing and axle shaft tubes. Remove housing cover.
(6) Rotate differential case so that pinion mate gear shaft lock screw is accessible. Remove lock screw and pinion mate gear shaft from differential case (Fig. 14).

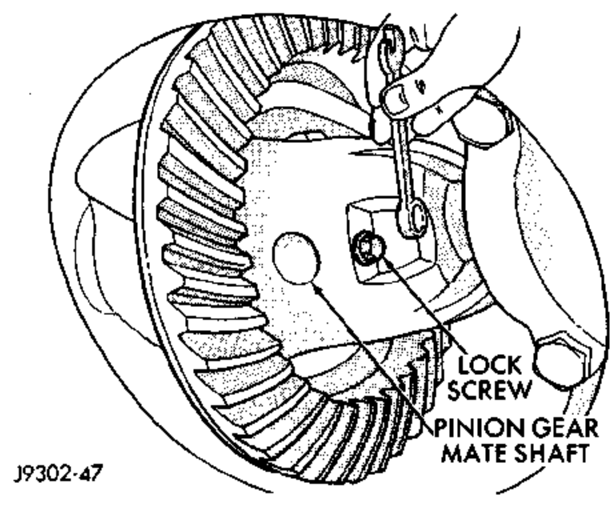


Fig. 14 Mate Shaft Lock Screw

(7) Push axle shaft inward and remove axle shaft C–clip lock from the axle shaft (Fig. 15).

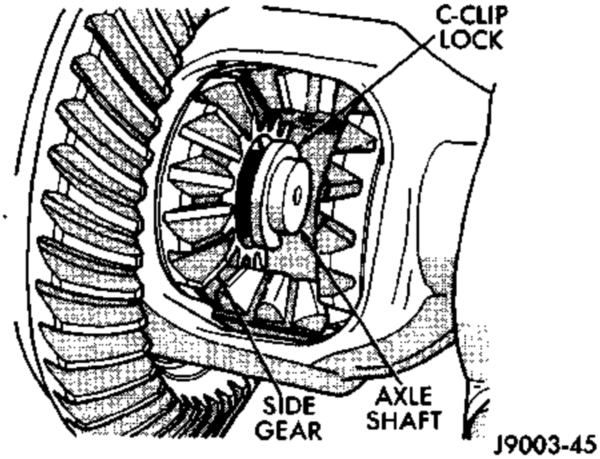


Fig. 15 Axle Shaft C–Clip Lock

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

INSTALLATION

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

REMOVAL AND INSTALLATION (Continued)

AXLE SHAFT SEAL AND BEARING

REMOVAL

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

(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. 16) with Bearing Removal Tool Set 6310.

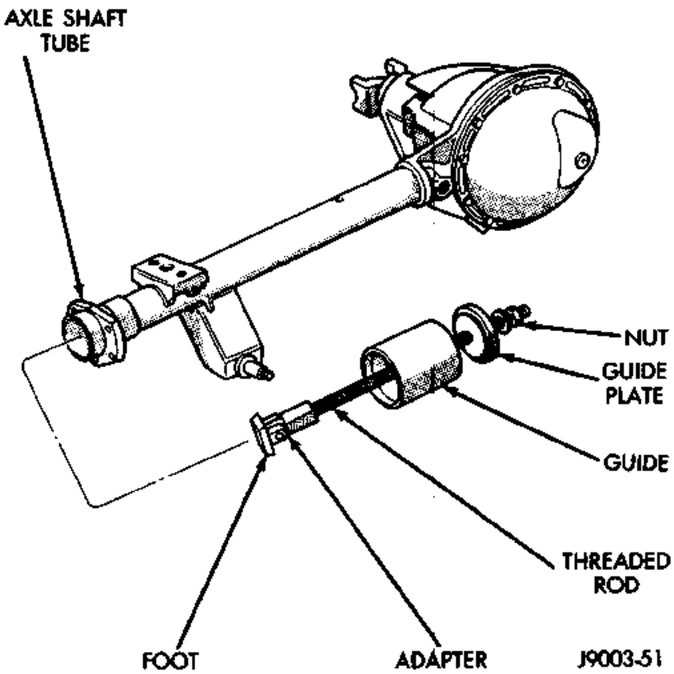


Fig. 16 Axle Shaft Bearing Removal Tool

(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. 17) with Installer 6437 and Handle C–4171.

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

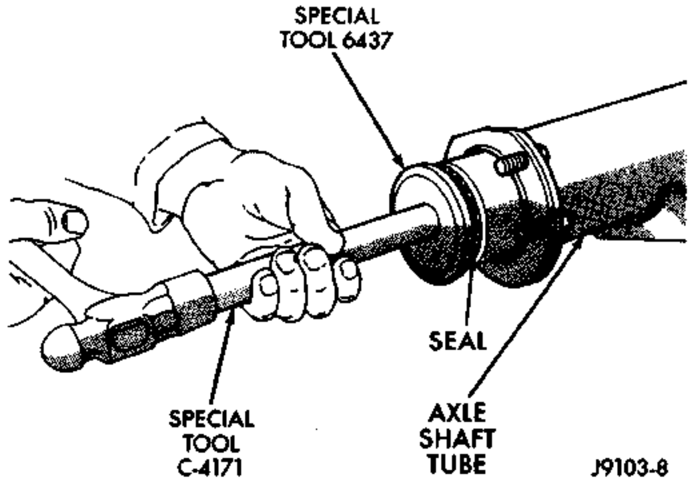


Fig. 17 Axle Shaft Seal Installation

DIFFERENTIAL

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove axle shafts, refer Axle Removal and Installation paragraph.

(3) Place a suitable drain pan under center of axle housing.

(4) Remove axle housing cover.

NOTE: The differential side bearing retaining caps are reference marked for installation by the manufacturer (Fig. 18).

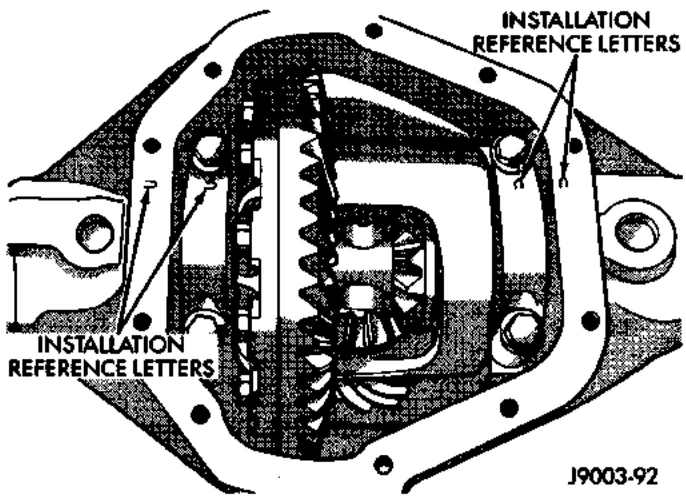


Fig. 18 Bearing Cap Identification

(5) Position Spreader W-129-B with dowel pins inserted into access holes in axle housing. (Fig. 19). Install safety hold down clamps and tighten the tool turnbuckle hand tight .

(6) Install a Pilot Stud C-3288-B at the left side of the differential housing. Attach Dial Indicator C-3339 to housing pilot stud. Load the indicator lever

REMOVAL AND INSTALLATION (Continued)

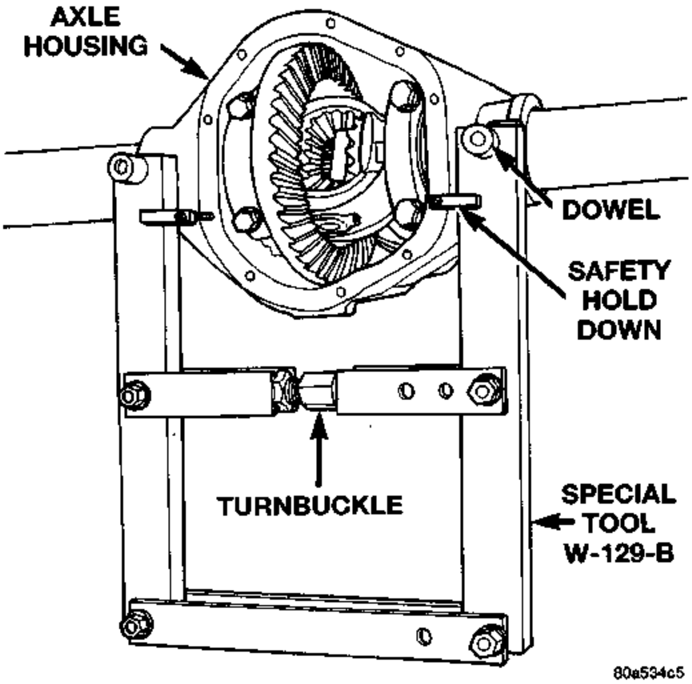


Fig. 19 Install Axle Housing Spreader

against the opposite side of the housing (Fig. 20) and zero the indicator face to the pointer.

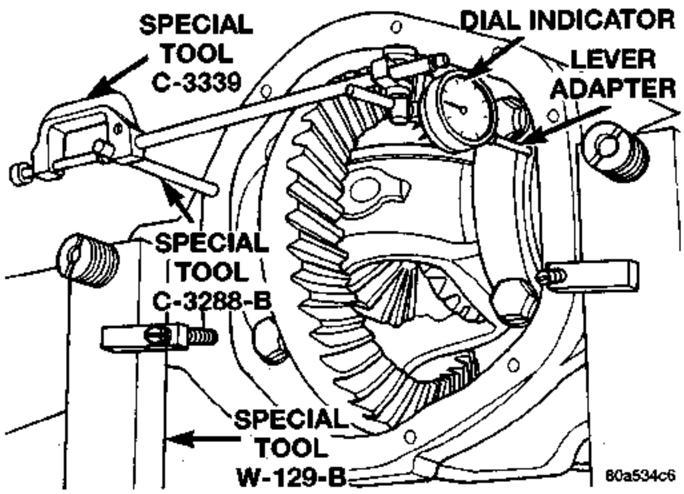


Fig. 20 Install Dial Indicator

CAUTION: Do not spread axle housing over 0.51 mm (0.020 in), axle housing can become distorted or damaged.

(7) Spread axle housing apart enough to remove differential case. Measure amount of spread being applied with the dial indicator, do not exceed 0.51 mm (0.020 in.) (Fig. 21).

(8) Remove dial indicator.

(9) While holding differential case in position, remove bolts holding differential bearing caps to axle housing.

(10) Separate bearing caps from axle housing.

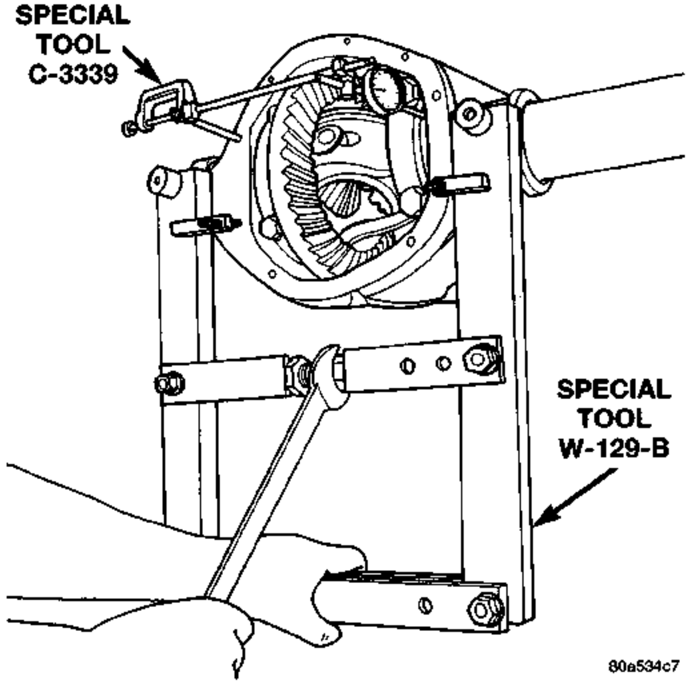


Fig. 21 Spread Axle Housing

(11) While holding differential bearing cups, pull differential case from axle housing. It may be necessary to pry differential case from axle housing (Fig. 22).

(12) Mark the differential bearing cups indicating the side they were removed from.

CAUTION: Do not allow spreader to apply outward pressure on axle housing for an extended period, damage to axle housing can result.

(13) If differential case is not installed within 15 minutes, remove axle housing spreader.

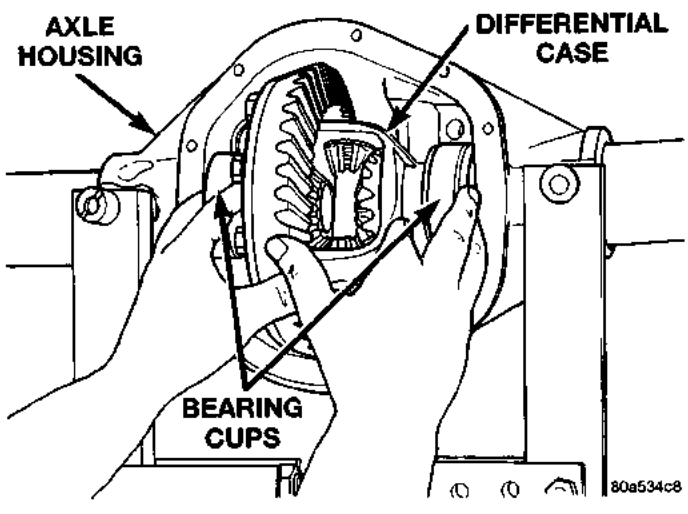


Fig. 22 Differential Case and Side Bearings

DIFFERENTIAL INSTALLATION

If replacement differential side bearings or differential case are being installed, differential side bear-

REMOVAL AND INSTALLATION (Continued)

ing shim requirements could change. Refer to Differential Bearing Preload and Gear Backlash paragraph in the Adjustments section to determine proper shim selection.

(1) Position Spreader W-129-B with dowel pins inserted into access holes in axle housing (Fig. 23). Install safety hold down clamps and tighten the tool turnbuckle hand tight.

(2) Install Dial Indicator C-3339. Load the indicator lever against the opposite side of the housing (Fig. 23) and zero indicator face to pointer.

CAUTION: Do not spread axle housing over 0.51 mm (0.020 in), axle housing can become distorted or damaged.

(3) Spread axle housing apart enough to install differential case. Measure amount of spread being applied with the dial indicator, do not exceed 0.51 mm (0.020 in.) (Fig. 23).

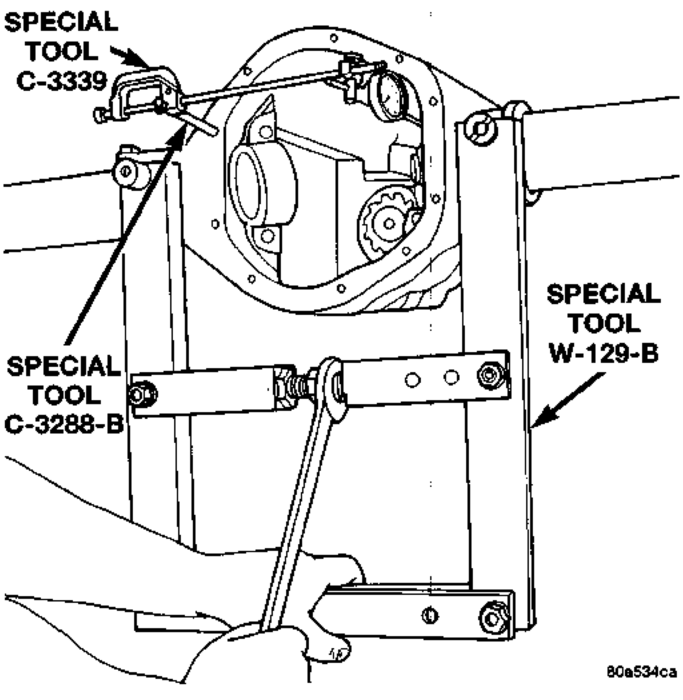


Fig. 23 Spread Axle Housing

(4) Remove dial indicator.

(5) Install differential case and bearing cups into housing. If necessary, tap the differential case side bearing cups inward to assure they are seated (Fig. 22).

(6) Install differential side bearing caps in position with corresponding letters aligned (Fig. 24).

(7) Install bolts (hand tight) to hold bearing caps to axle housing.

(8) Remove axle housing spreader.

(9) Tighten the bearing cap bolts to 110 N·m (80 ft. lbs.) torque (Fig. 25).

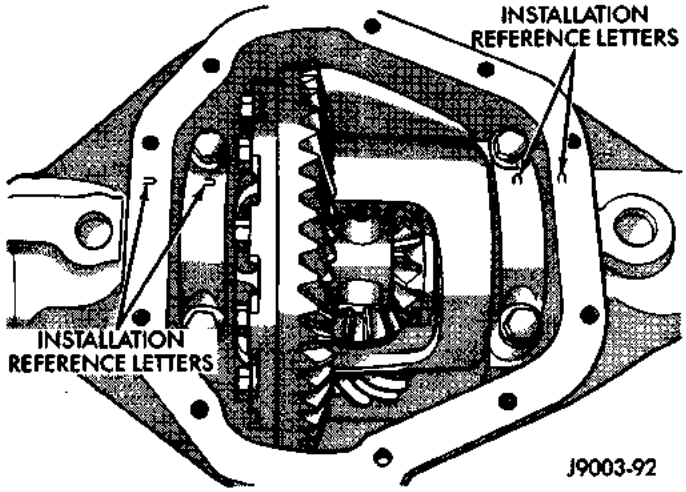


Fig. 24 Differential Bearing Cap Reference Letters

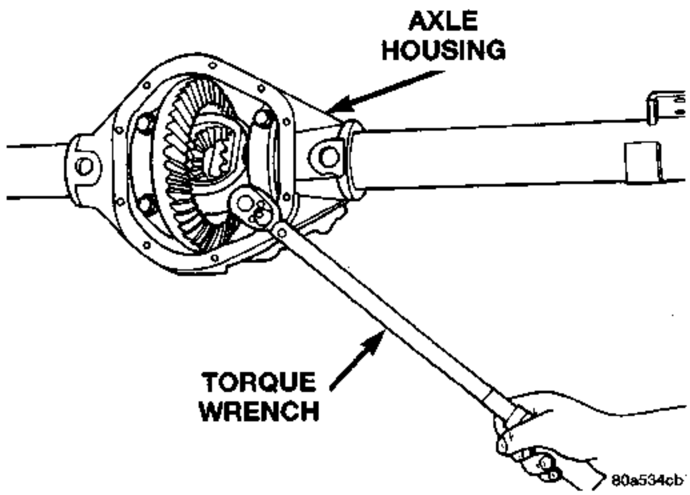


Fig. 25 Tighten Differential Bearing Cap Bolts

DIFFERENTIAL SIDE BEARINGS

REMOVAL

(1) Remove Differential case from axle housing.

(2) Remove the bearings from the differential case with Puller/Press C-293-PA, C-293-39 Blocks (3) from Puller/Press Set C-293–M, and Adapter C-293-3 (Fig. 26).

DIFFERENTIAL SIDE BEARING INSTALLATION

If ring and pinion gears have been replaced, verify differential side bearing preload and gear mesh backlash.

(1) Using tool C-3716 with handle C-4171, install differential side bearings (Fig. 27).

(2) Install differential in axle housing.

RING GEAR

The ring and pinion gears are service in a matched set. Do not replace the ring gear without replacing the pinion gear. Refer to Pinion Gear removal and

REMOVAL AND INSTALLATION (Continued)

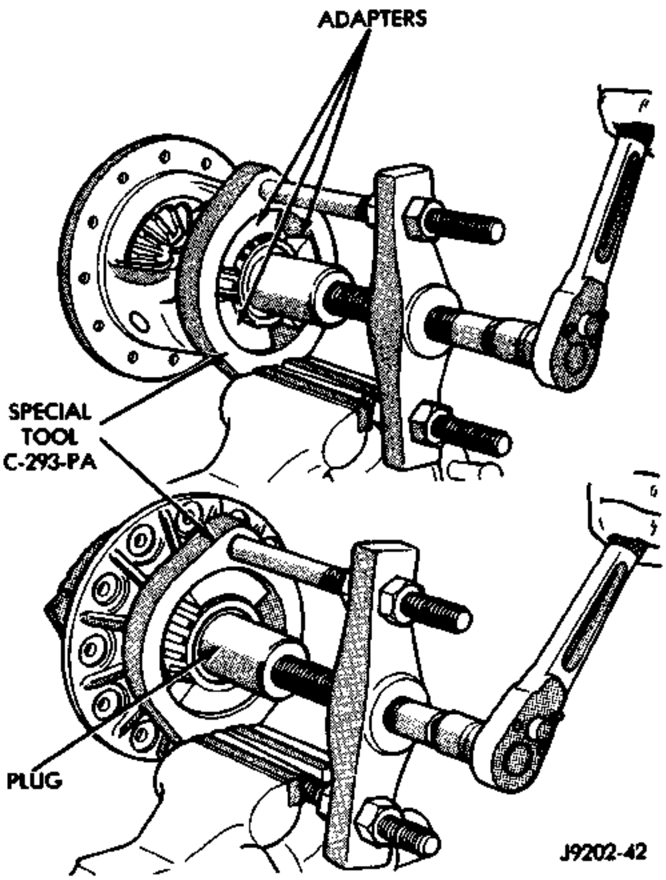


Fig. 26 Differential Bearing Removal

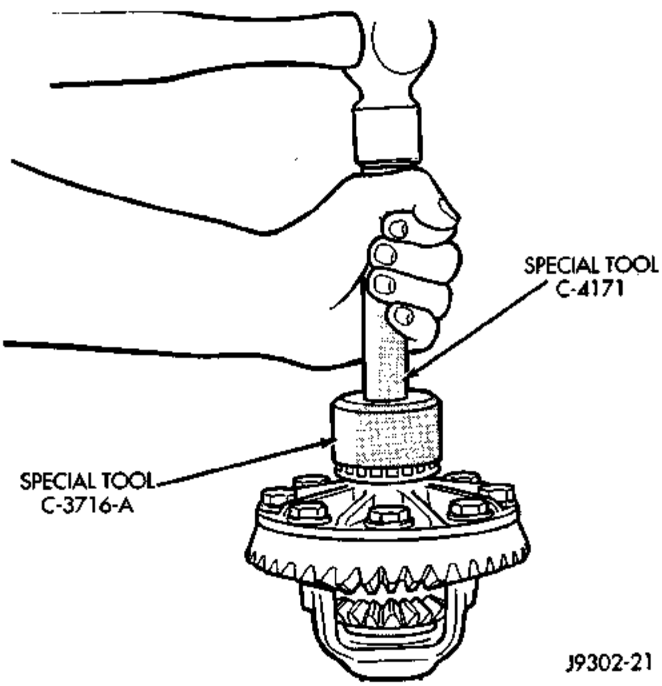


Fig. 27 Install Differential Side Bearings

installation paragraph in this section for proper procedure.

REMOVAL

(1) Remove differential from axle housing.

(2) Place differential case in a suitable vise with soft metal jaw protectors. (Fig. 28)

(3) Remove bolts holding ring gear to differential case.

(4) Using a soft hammer, drive ring gear from differential case (Fig. 28).

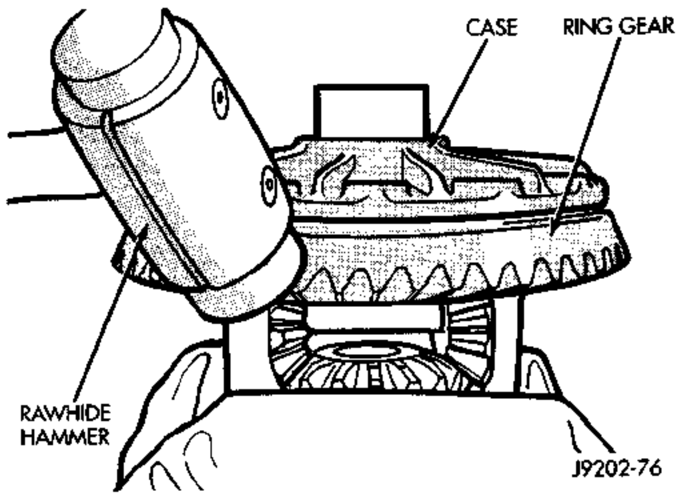


Fig. 28 Ring Gear Removal

RING GEAR INSTALLATION

CAUTION: Do not reuse the bolts that held the ring gear to the differential case. The bolts can fracture causing extensive damage.

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

(2) Install new ring gear bolts and alternately tighten to 95–122 N·m (70–90 ft. lbs.) torque (Fig. 29).

(3) Install differential in axle housing and verify gear mesh and contact pattern.

PINION GEAR

REMOVAL

(1) Remove differential assembly from axle housing.

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

(3) Disconnect propeller shaft from pinion yoke. Using suitable wire, tie propeller shaft to underbody.

(4) Using Holder 6958 to hold yoke and a short length of 1 in. pipe, remove the pinion yoke nut and washer (Fig. 30).

(5) Using Remover C–452 and Holder 6958, remove the pinion yoke from pinion shaft (Fig. 31).

REMOVAL AND INSTALLATION (Continued)

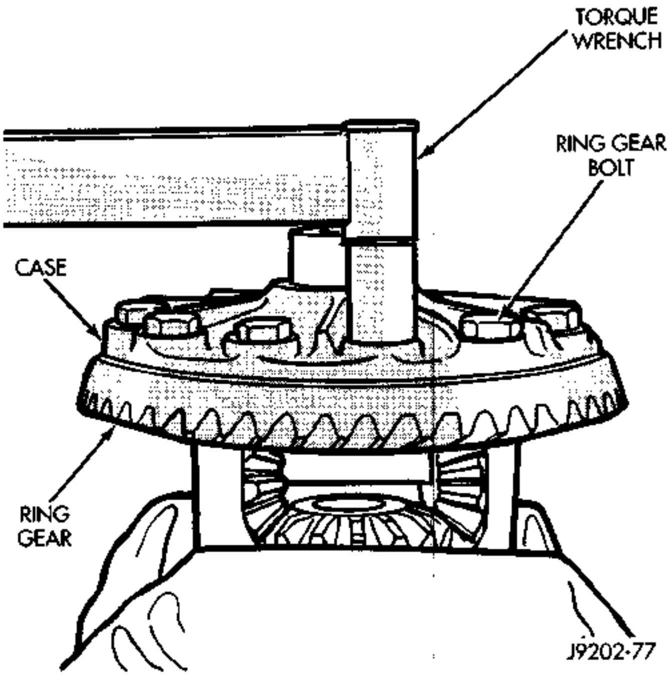


Fig. 29 Ring Gear Bolt Installation

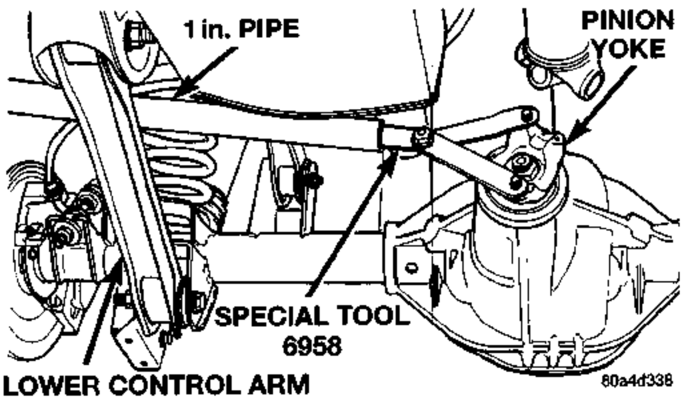


Fig. 30 Pinion Yoke Holder

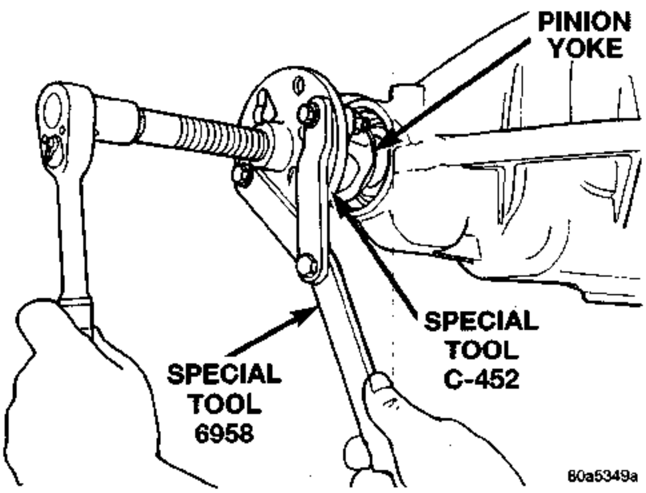


Fig. 31 Pinion Yoke Removal

(6) Remove the pinion gear from housing (Fig. 32). Hold the pinion gear inside axle housing prevent the gear from falling and being damaged.

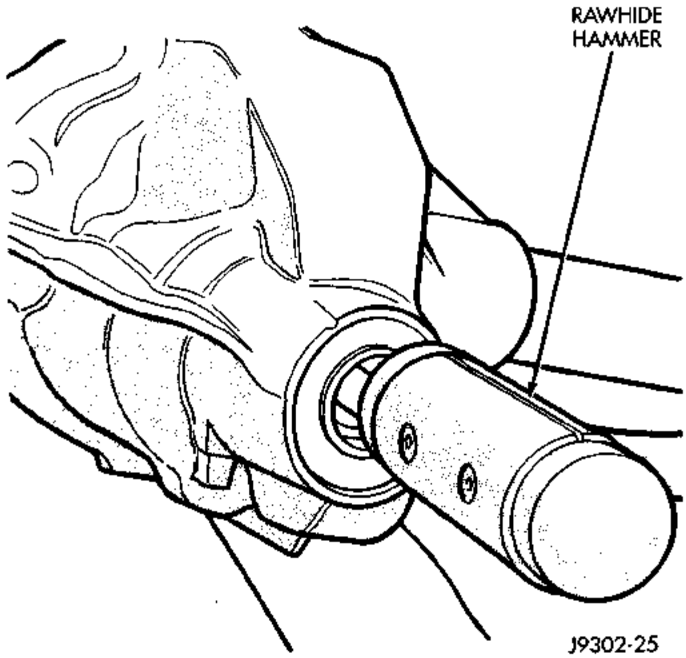


Fig. 32 Remove Pinion Gear

(7) Remove the pinion gear seal, slinger, and outer bearing with Remover 7794-A and Slide Hammer 7420 (Fig. 33).

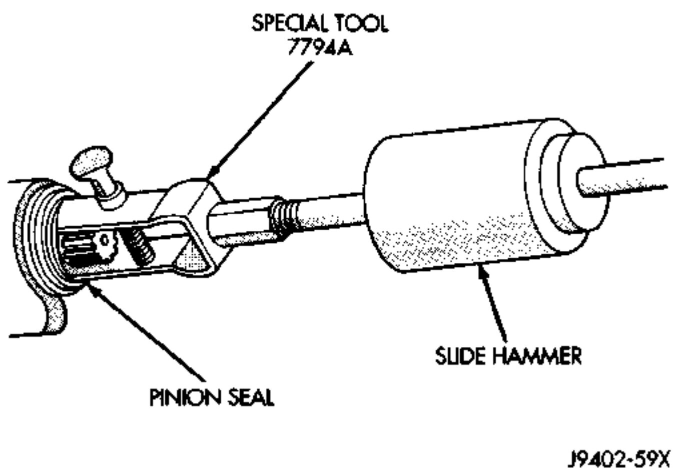


Fig. 33 Remove Pinion Seal, Slinger, and Outer Bearing

(8) Remove oil slinger, front bearing.

(9) Remove the outer pinion bearing cup and seal with Remover D-147 and Handle C–4171 (Fig. 34).

(10) Remove the inner bearing cup from housing (Fig. 35). Use Remover D-148 and Handle C–4171.

NOTE: The pinion gear depth shims are located behind the inner pinion bearing cup.

REMOVAL AND INSTALLATION (Continued)

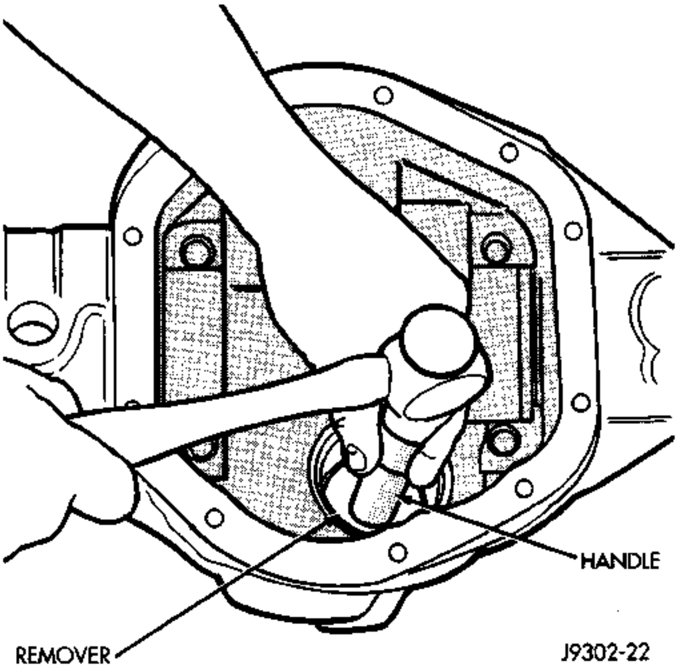


Fig. 34 Outer Bearing Cup Removal

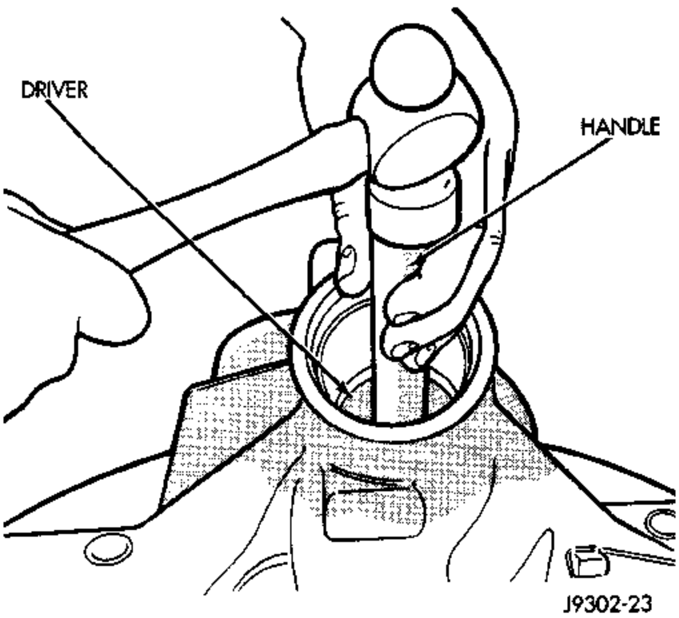


Fig. 35 Inner Bearing Cup Removal

(11) Remove and save pinion depth shims from bearing cup bore in axle housing. The factory installed shims may be reusable when the pinion gear is assembled. Using a micrometer, measure and record the thickness of the shims to use as a reference point when determining proper shim thickness for new bearings or gear set.

(12) Remove collapsible preload spacer from pinion gear shaft (Fig. 36).

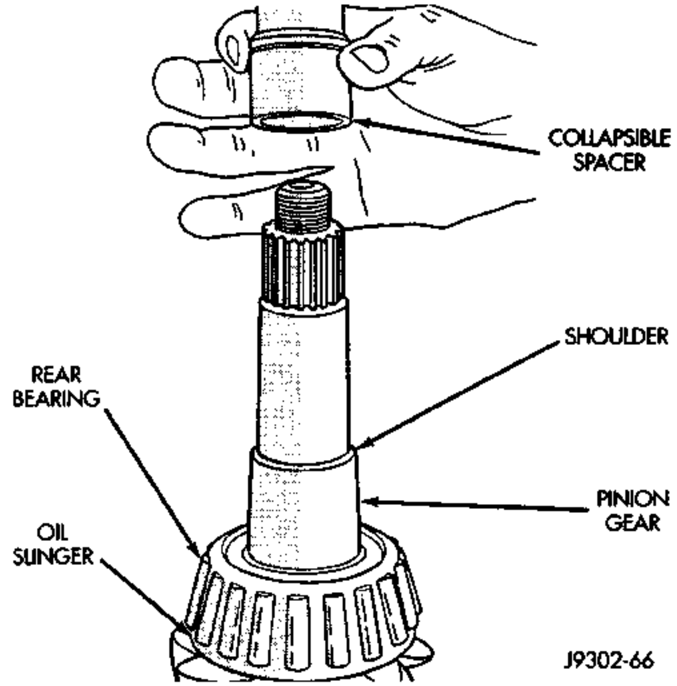


Fig. 36 Collapsible Spacer

(13) Remove the inner bearing from the pinion with Puller/Press C–293PA and Adapter C–293–39 from Puller/Press set C–293–M. (Fig. 37).

Place 3 adapter blocks so they do not damage the bearing cage.

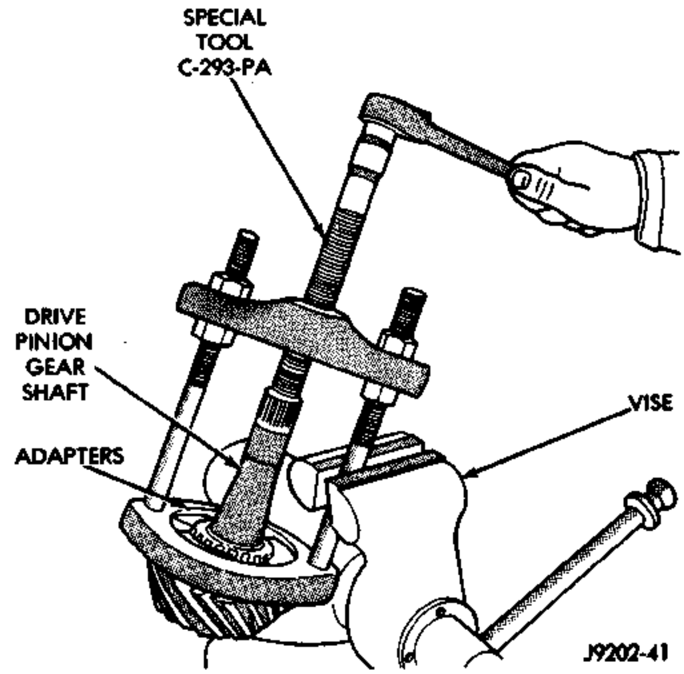


Fig. 37 Inner Bearing Removal

PINION GEAR INSTALLATION

Before installing replacement gear set and bearings, measure and select the proper pinion gear

REMOVAL AND INSTALLATION (Continued)

depth shims (Fig. 38). Refer to Pinion Gear Depth paragraph.

NOTE: If factory installed pinion gear oil slinger is used behind the inner bearing cone, deduct the thickness of the oil slinger from the pinion gear depth shims.

(1) Place proper thickness pinion gear depth shims in bore of inner pinion bearing cup in axle housing (Fig. 38).

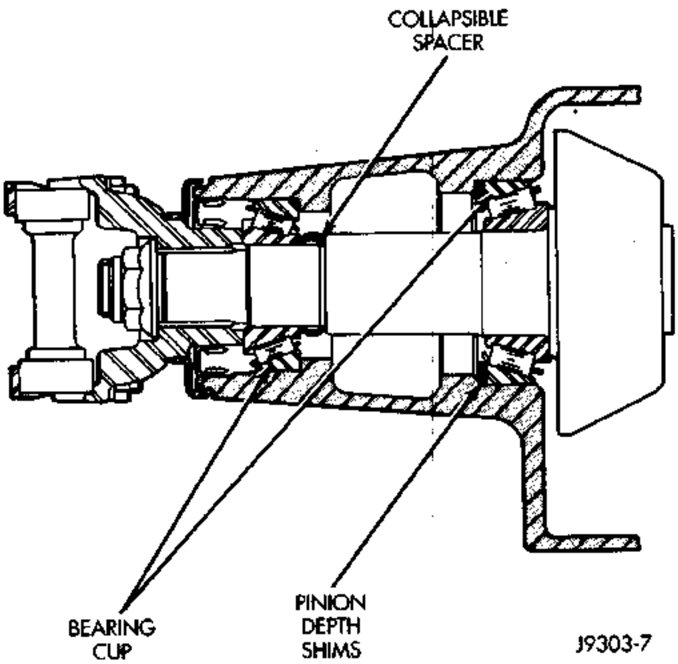


Fig. 38 Pinion Shim and Spacer Locations—typical

(2) Apply Mopar, Door Ease stick lubricant to outside surface of bearing cup. Install the pinion inner bearing cup with Installer D-146 and Driver Handle C–4171 (Fig. 39). Verify cup is properly seated.

(3) Apply Mopar, Door Ease stick lubricant to outside surface of bearing cup. Install the pinion outer bearing cup with Installer D–130 and Handle C–4171 (Fig. 40).

(4) Install pinion outer bearing cone, and oil slinger. Apply a light coating of gear lubricant on lip of pinion seal. Install seal with Installer D–163 and Handle C–4171 (Fig. 41).

NOTE: If factory installed pinion gear oil slinger is used, deduct the thickness of the slinger from the pinion gear depth shims.

(5) Install the inner bearing (and slinger if used) on the pinion gear with Installer W-262 (Fig. 42).

(6) Install a new collapsible preload spacer on pinion shaft and install pinion gear in housing (Fig. 43).

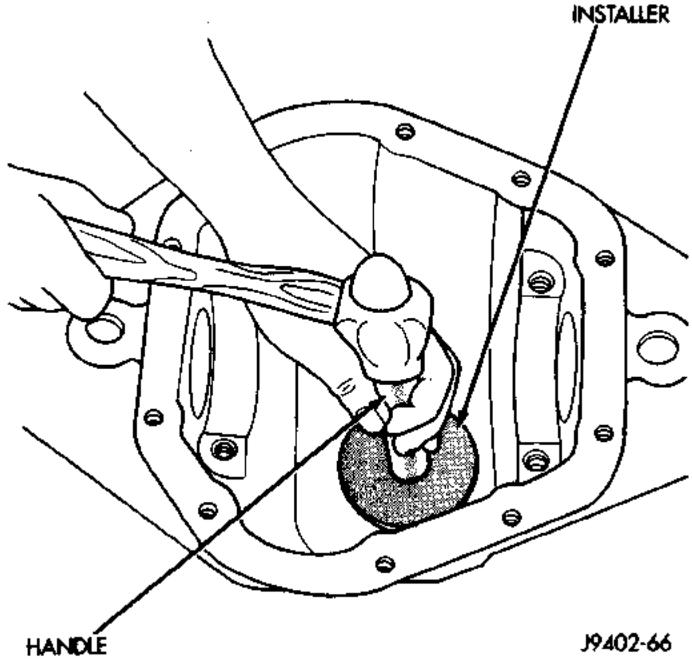


Fig. 39 Pinion Inner Bearing Cup Install

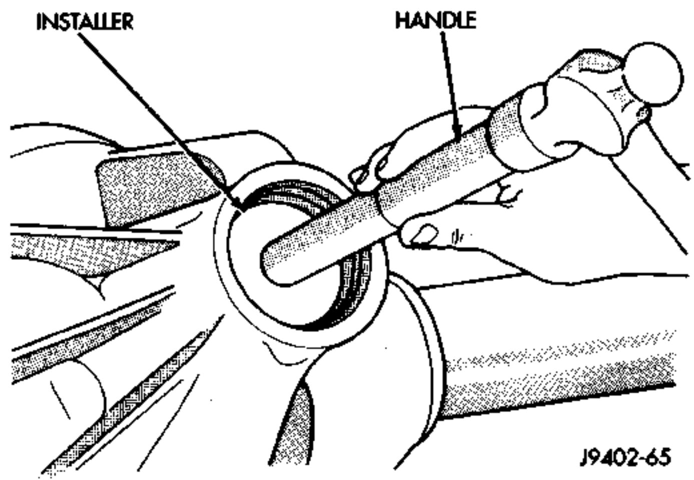


Fig. 40 Pinion Outer Bearing Cup Install

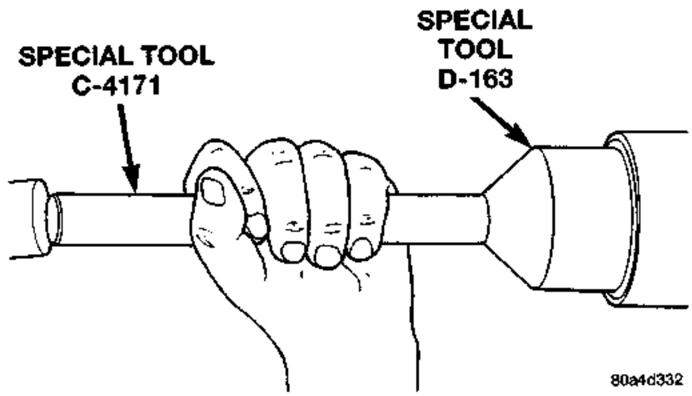


Fig. 41 Pinion Seal Installation

REMOVAL AND INSTALLATION (Continued)

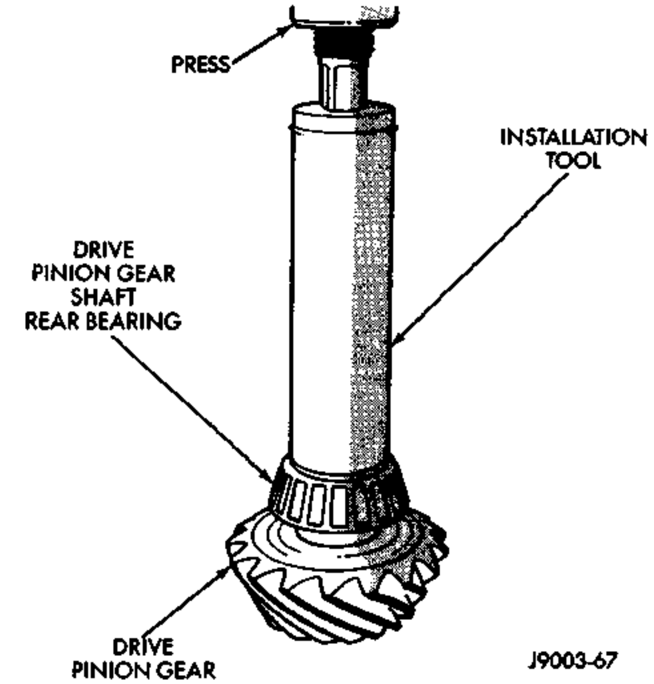


Fig. 42 Shaft Rear Bearing Installation

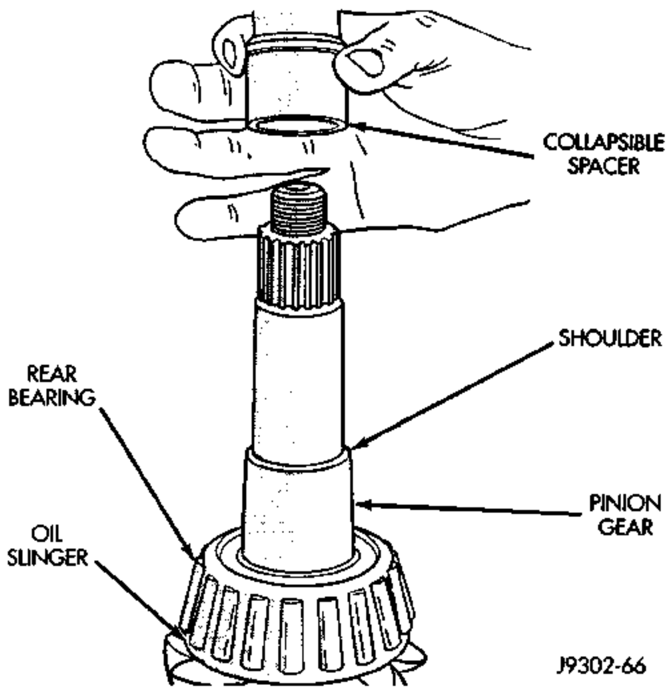


Fig. 43 Collapsible Preload Spacer

(7) Install yoke with Installer W-162-D and holder 6958 (Fig. 44).

(8) Install the yoke washer and a new nut on the pinion gear. Tighten the nut to 271 N·m (200 ft. lbs.) minimum. **Do not over-tighten.** Maximum torque is 427 N·m (315 ft. lbs.).

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing preload torque and never exceed specified preload torque. If preload

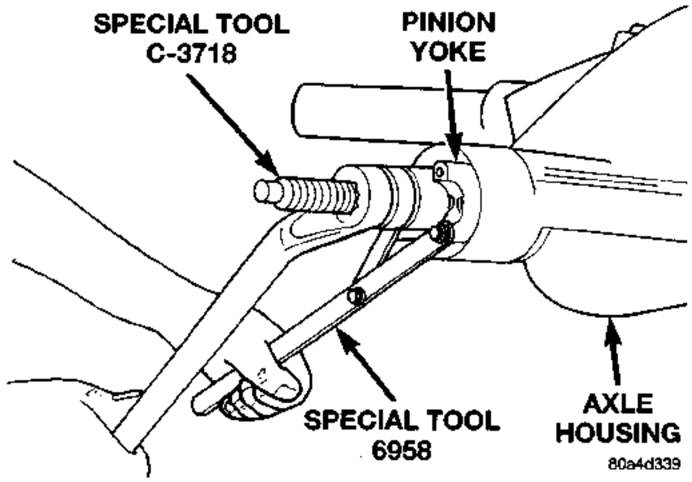


Fig. 44 Pinion Yoke Installation

torque is exceeded a new collapsible spacer must be installed. The torque sequence will have to be repeated.

NOTE: A new collapsible spacer will start to crush at around 295 ft. lbs. torque. If the spacer requires more than 315 ft. lbs. torque to crush, the collapsible spacer is defective.

(9) Using yoke holder 6958, a short length of 1 in. dia. pipe, and a 3/4 in. drive torque wrench (set at 315 ft. lbs.), crush collapsible spacer until bearing end play is taken up (Fig. 45).

(10) Slowly tighten the nut in small increments until the rotating torque is achieved. Measure the preload torque frequently to avoid over crushing the collapsible spacer (Fig. 46).

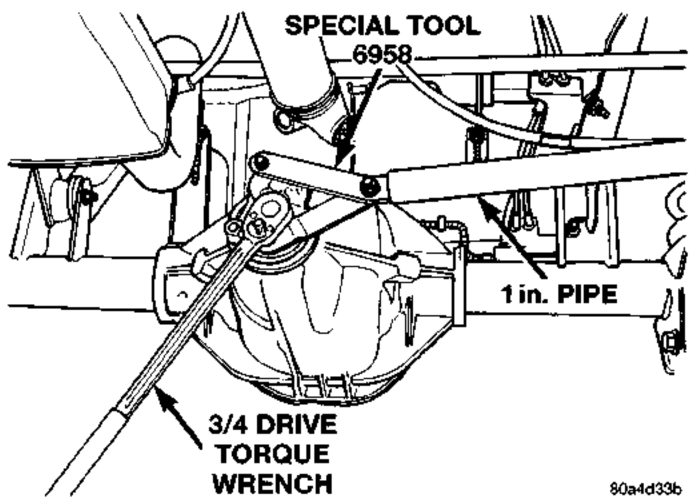


Fig. 45 Tightening Pinion Nut

(11) Check bearing preload torque with an inch pound torque wrench (Fig. 46). The torque necessary to rotate the pinion gear should be:

REMOVAL AND INSTALLATION (Continued)

• Original Bearings — 1 to 3 N·m (10 to 20 in. lbs.).
• New Bearings — 2 to 5 N·m (15 to 35 in. lbs.).

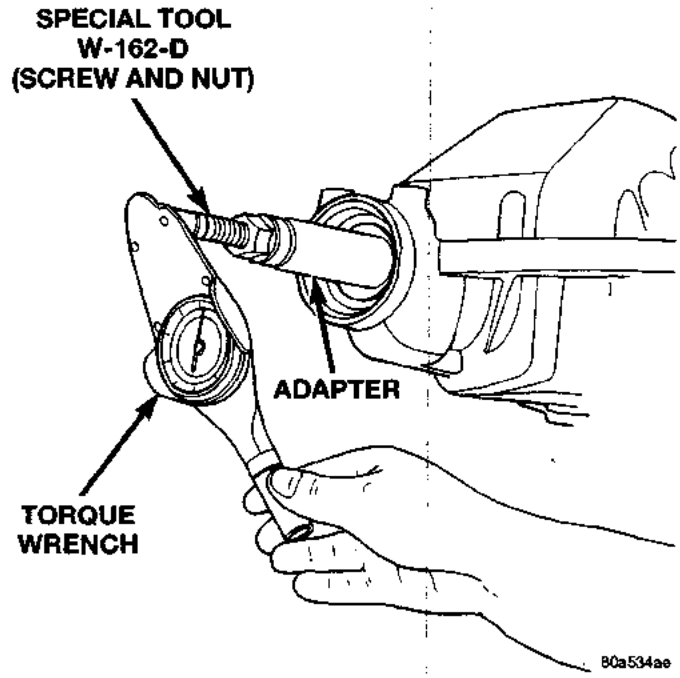


Fig. 46 Check Pinion Gear Rotation Torque

FINAL ASSEMBLY

After pinion gear depth, differential bearing preload, and gear lash has been determined, install the pinion gear and differential assembly and proceed with this procedure.

(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. 47). Allow the sealant to cure for a few minutes.

Install the housing cover within 5 minutes after applying the sealant.

(3) Install the cover on the differential with the attaching bolts. Install the identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

(4) Refill the differential housing with the specified quantity of Mopar Hypoid Gear Lubricant.

(5) Install the fill hole plug and tighten to 34 N·m (25 ft. lbs.) torque.

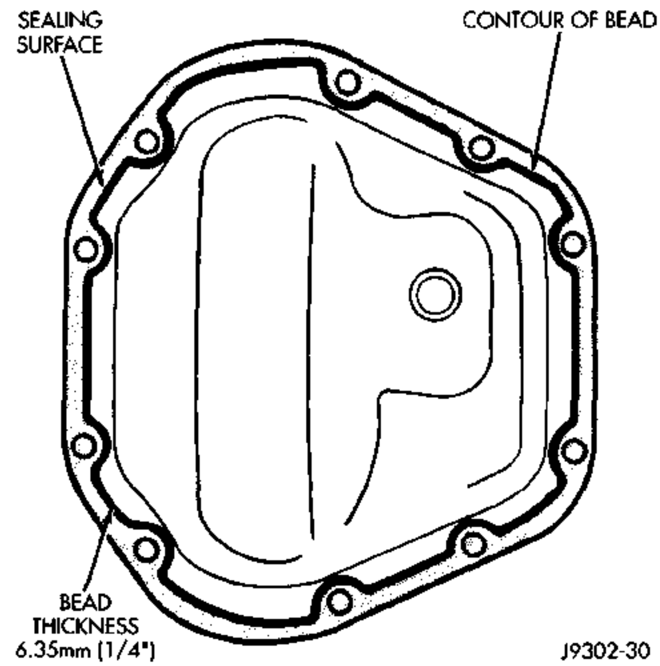


Fig. 47 Typical Housing Cover With Sealant

DISASSEMBLY AND ASSEMBLY

STANDARD DIFFERENTIAL

DISASSEMBLE

(1) Remove pinion gear mate shaft.

(2) Rotate the differential side gears and remove the pinion mate gears and thrust washers (Fig. 48).

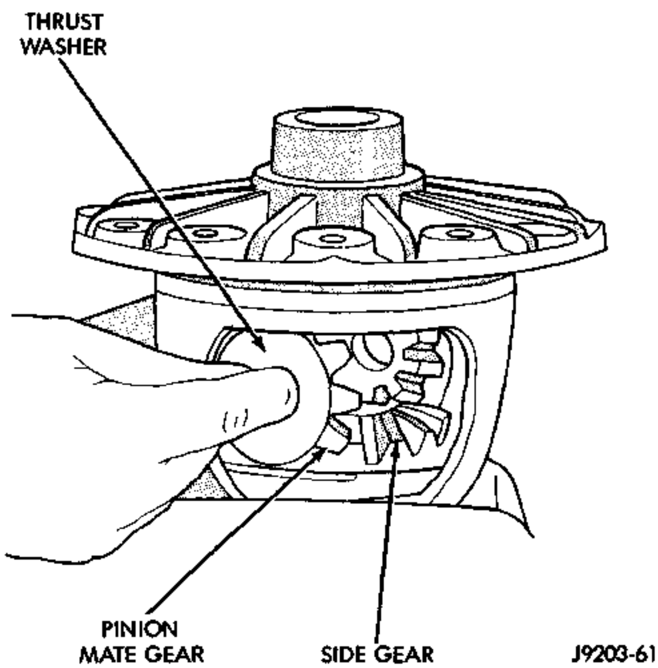


Fig. 48 Pinion Mate Gear Removal

DISASSEMBLY AND ASSEMBLY (Continued)

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

DIFFERENTIAL ASSEMBLE

(1) Differential side gears and thrust washers
(2) Pinion gears and thrust washers
(3) Pinion gear mate shaft (align holes in shaft and case)
(4) Lubricate all differential components with hypoid gear lubricant.
(5) Install differential case in axle housing. Refer to Differential removal and installation procedure.

TRAC-LOK DIFFERENTIAL

Trac-Lok differential disassemble and assembly requires Tool Set 6960 and Side Gear Holder 6965.

DISASSEMBLE

(1) Remove differential case from axle housing. Refer to Differential paragraph in the Removal and Installation section of this group.
(2) Clamp Side Gear Holding Tool 6965 in a vise.
(3) Position the differential case on the holding tool (Fig. 49).

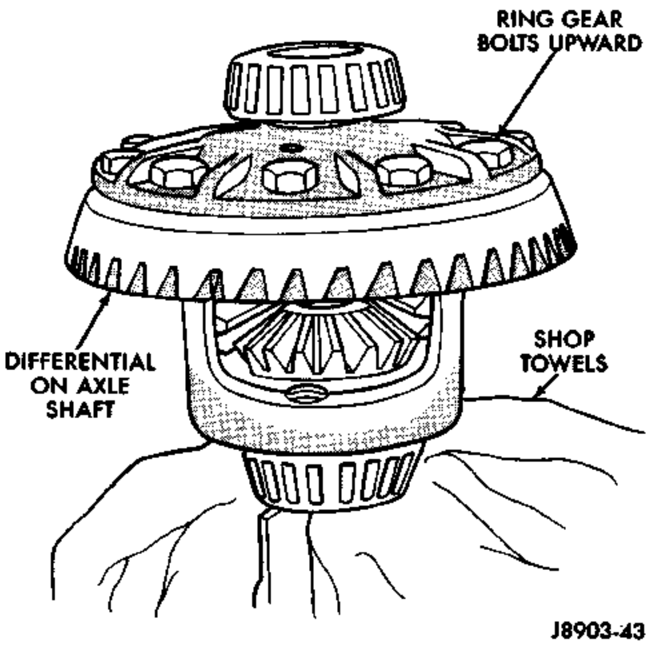


Fig. 49 Differential Case Holding Tool

(4) Bolt holding pinion gear mate shaft in differential case (Fig. 50).
(5) Remove the pinion gear mate shaft. If necessary, use a drift and hammer (Fig. 51).
(6) Lubricate centering countersink on Step Plate 6960-3 with Mopar, Door-ease stick lubricant.
(7) Place Step Plate 6960-3 in differential side gear at bottom of differential case. (Fig. 52).
(8) Place and hold threaded Step Plate 6960-1 into side gear at top of differential case.

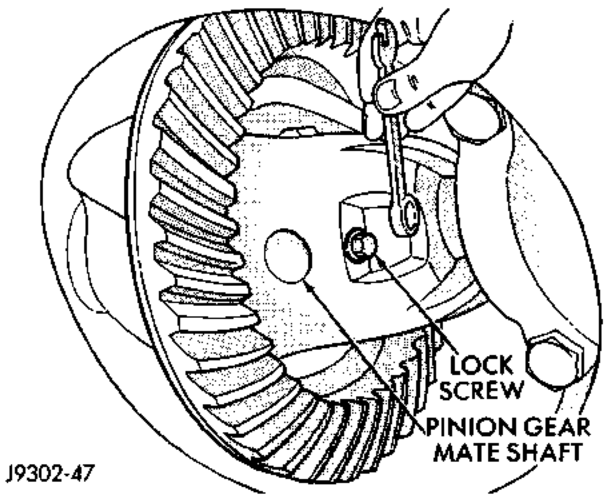


Fig. 50 Mate Shaft Roll Pin Removal

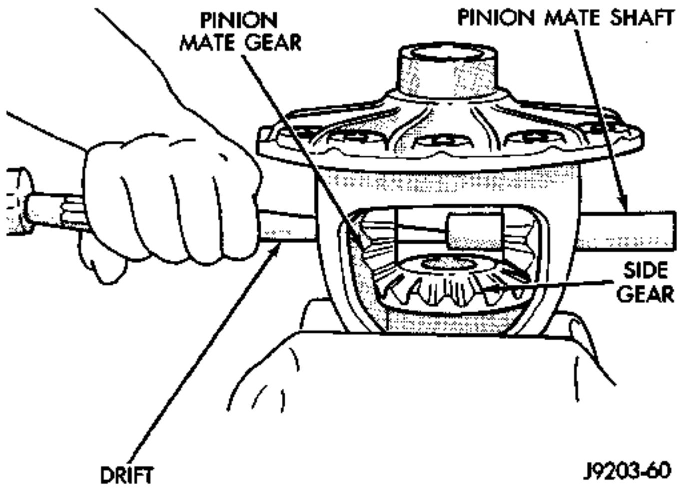


Fig. 51 Mate Shaft Removal

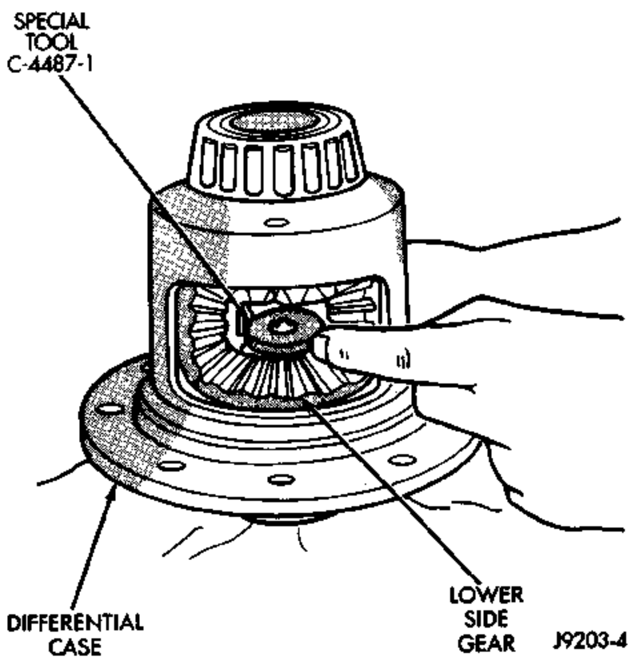


Fig. 52 Step Plate Tool Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(9) Insert Screw 6960-4 into top of differential case and thread screw into step plate until it is centered in lower step plate.

(10) If necessary, insert a small screw driver into slot in side of Step Plate 6960-1 (Fig. 53) to prevent it from turning.

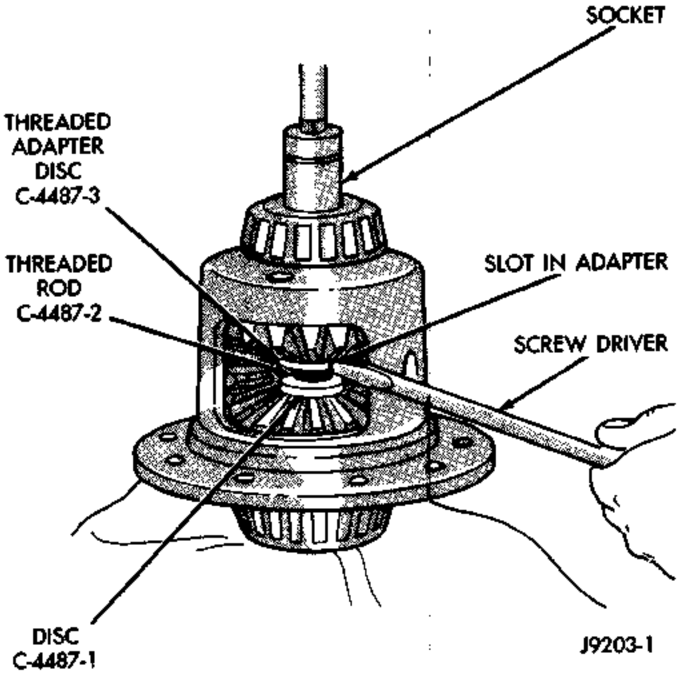


Fig. 53 Threaded Adapter Installation

(11) Tighten Screw 6960-4 to 122 N·m (90 ft. lbs.) (maximum) torque to compress Belleville springs in clutch packs (Fig. 54).

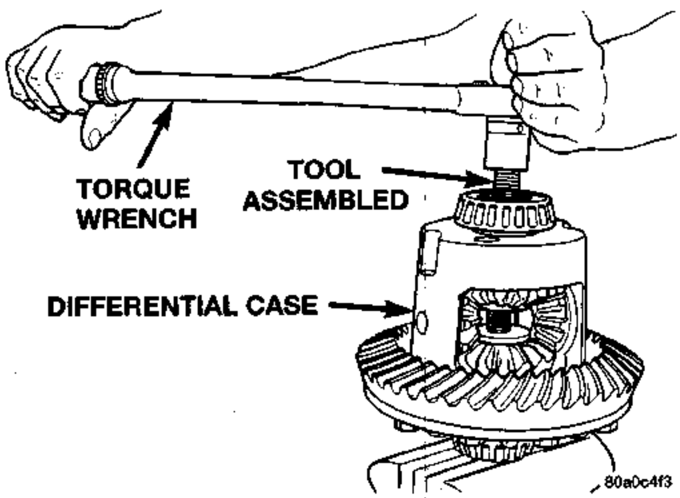


Fig. 54 Tighten Belleville Spring Compressor Tool

(12) Using a 0.020 in. feeler gauge and mallet, remove thrust washers from behind the pinion gears (Fig. 55).

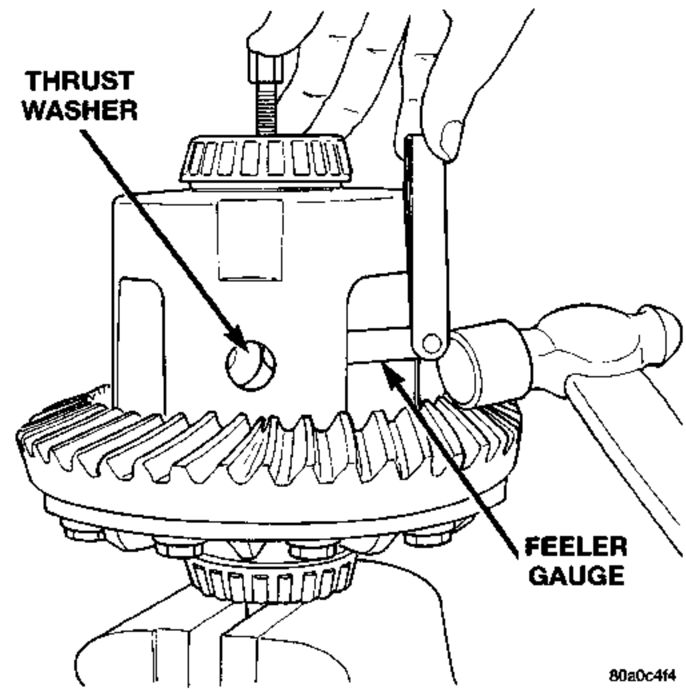


Fig. 55 Remove Pinion Thrust Washer

(13) Loosen the forcing screw until the clutch pack tension is relieved and the pinion gears can be slightly rattled between the case and side gears.

(14) Insert Handle 6960-2 in pinion mate shaft hole in side of differential case. Rotate differential case until pinion gears can be removed (Fig. 56).

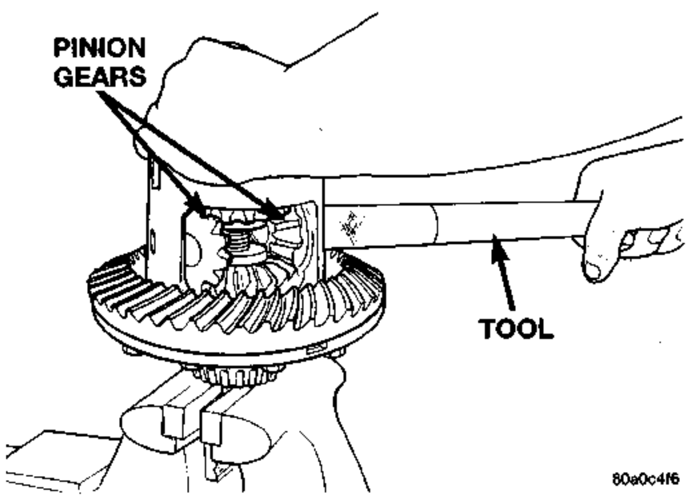


Fig. 56 Pinion Gear Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(15) Remove tool 6960 from differential case.

(16) Remove top side gear and clutch pack. Keep plates in correct order during removal (Fig. 57).

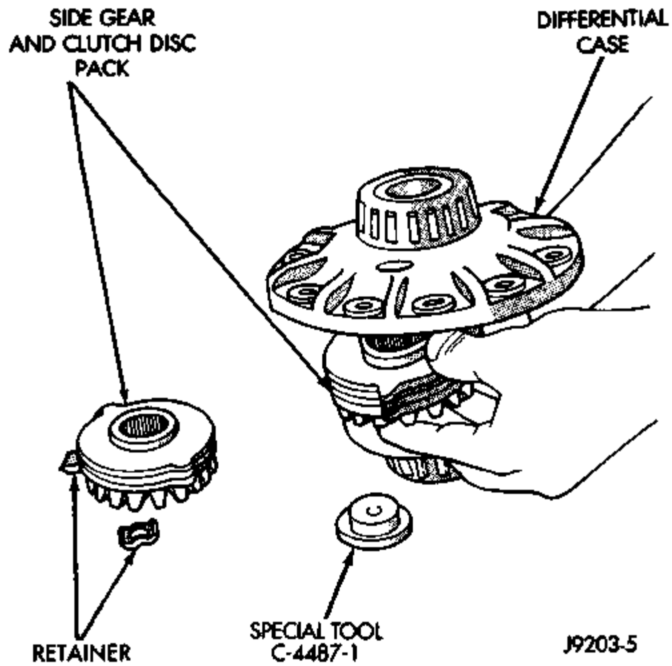


Fig. 57 Side Gear & Clutch Disc Removal

(17) Lift differential case from holding tool.

(18) Remove bottom side gear and clutch pack from differential case.

(19) Mark each clutch pack for installation reference.

ASSEMBLY

The clutch discs are replaceable as complete sets only. **If one clutch disc pack is damaged, both packs must be replaced.**

Lubricate each component with Mopar, gear lubricant before assembly.

(1) Assemble the clutch discs into packs and secure disc packs with retainers (Fig. 58).

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

(3) Insert side gear and clutch pack into ring gear side of differential case (Fig. 59). Guide clutch pack retainers into recesses in differential case.

(4) Place differential case on holder 6965.

(5) Install lubricated Step Plate 6960-3 on bottom clutch pack (Fig. 60).

(6) Insert and hold side gear and clutch pack into upper side of differential case (Fig. 60). Guide clutch pack retainers into recesses in differential case.

(7) Insert Step Plate 6960-1 into top side gear, install forcing Screw 6960-4.

(8) Tighten forcing screw tool to slightly compress Belleville washer in clutch packs.

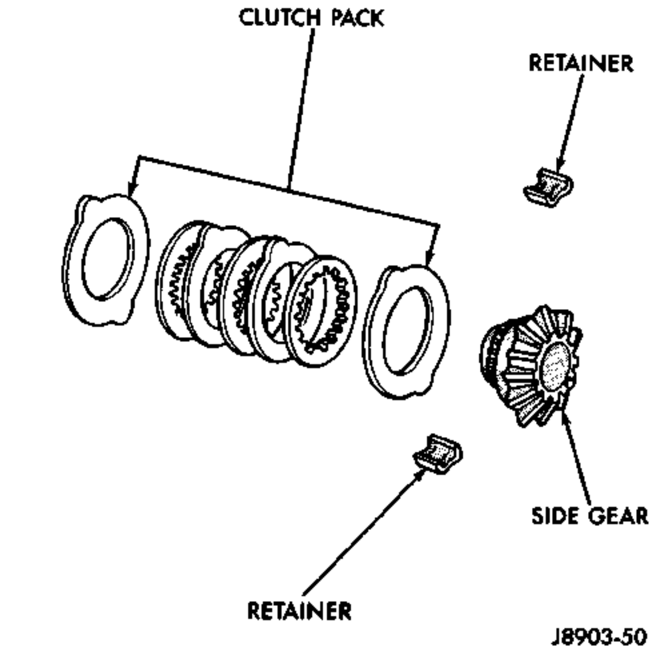


Fig. 58 Clutch Disc Pack

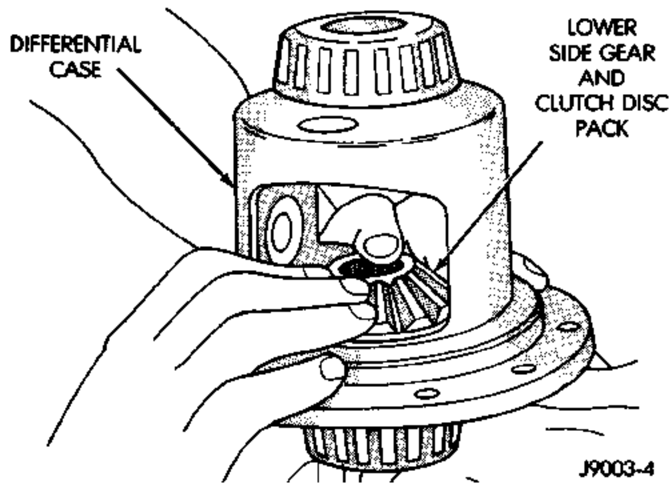


Fig. 59 Clutch Discs and Ring Gear Side Gear Installation

(9) Place pinion gears in position in side gears and verify that mate shaft hole line up.

(10) Rotate case with Handle 6960-2 until mate shaft holes in pinion gears align with holes in differential case.

(11) Tighten forcing screw to 122 N·m (90 ft. lbs.) to compress the Belleville springs.

(12) Lubricate and insert thrust washers behind pinion gears. Align washers with a small screw driver.

(13) Install pinion gear mate shaft in differential case.

(14) Install bolt to hold mate shaft in differential case (Fig. 61).

(15) Remove tool 6960 from differential case.

DISASSEMBLY AND ASSEMBLY (Continued)

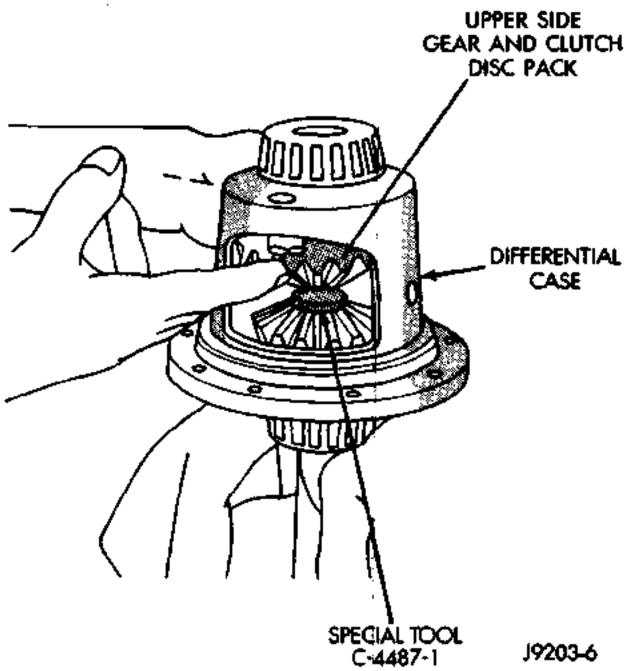


Fig. 60 Upper Side Gear & Clutch Disc Pack Installation

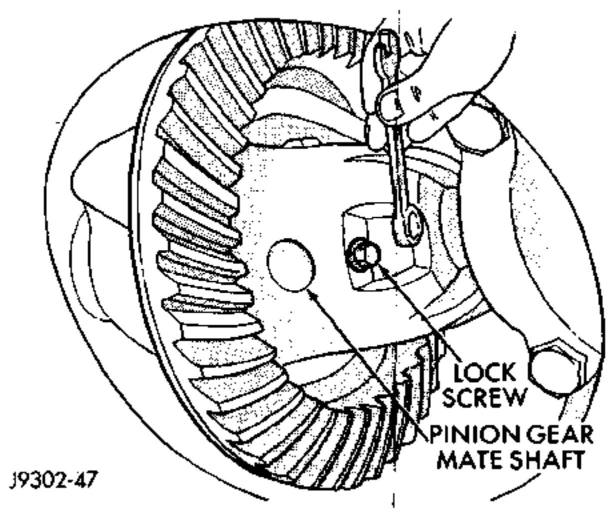


Fig. 61 Mate Shaft Roll Pin Installation

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

(17) Install differential case in axle housing.

CLEANING AND INSPECTION

AXLE COMPONENTS

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

Wash bearings with solvent and towel dry, or dry with compressed air. DO NOT spin bearings with compressed air. **Cup and bearing must be replaced as matched sets only.**

Clean axle shaft tubes and oil channels in housing. Inspect for;

- Smooth appearance with no broken/dented surfaces on the bearing rollers or the roller contact surfaces
- Bearing cups must not be distorted or cracked
- Machined surfaces should be smooth and without any raised edges
- Raised metal on shoulders of cup bores should be removed with a hand stone
- Wear and damage to pinion gear mate shaft, pinion gears, side gears and thrust washers. Replace as a matched set only.
- Ring and pinion gear for worn and chipped teeth
- Ring gear for damaged bolt threads. Replaced as a matched set only.
- Pinion yoke for cracks, worn splines, pitted areas, and a rough/corroded seal contact surface. Repair or replace as necessary.
- Preload shims for damage and distortion. Install new shims if necessary.

TRAC-LOK

(1) Clean all components 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.

PRESOAK PLATES AND DISC

Plates and discs with fiber coating (no grooves or lines) must be presoaked in Friction Modifier before assembly. Soak plates and discs for a minimum of 20 minutes. Add remaining Friction Modifier to differential after assembly.

ADJUSTMENTS

PINION GEAR DEPTH

GENERAL INFORMATION

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and pinion gear are etched into the face of each gear (Fig. 62). A plus (+) number, minus (–) number or zero (0) is etched into the face of the pinion gear. This number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion etched with a (0). The standard setting from the center line of the ring gear to the back face of the pinion is 92.08 mm (3.625 in.). The standard depth provides the best gear tooth contact pattern. Refer to

ADJUSTMENTS (Continued)

Backlash and Contact Pattern Analysis paragraph in this section for additional information.

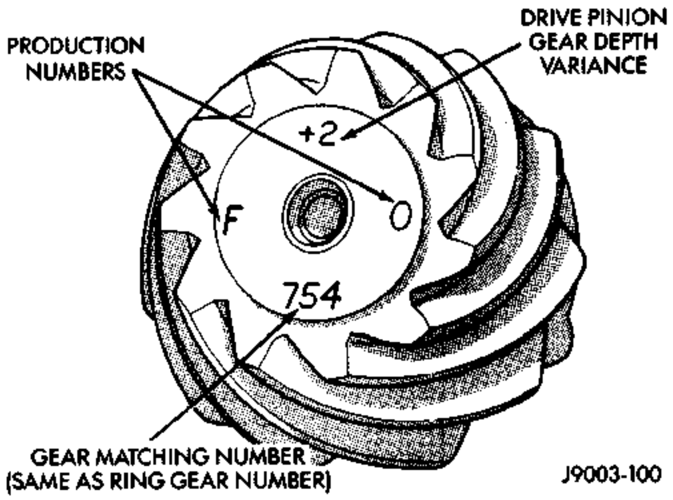


Fig. 62 Pinion Gear ID Numbers

Compensation for pinion depth variance is achieved with select shims. The shims are placed behind the inner pinion bearing cup (Fig. 63).

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

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

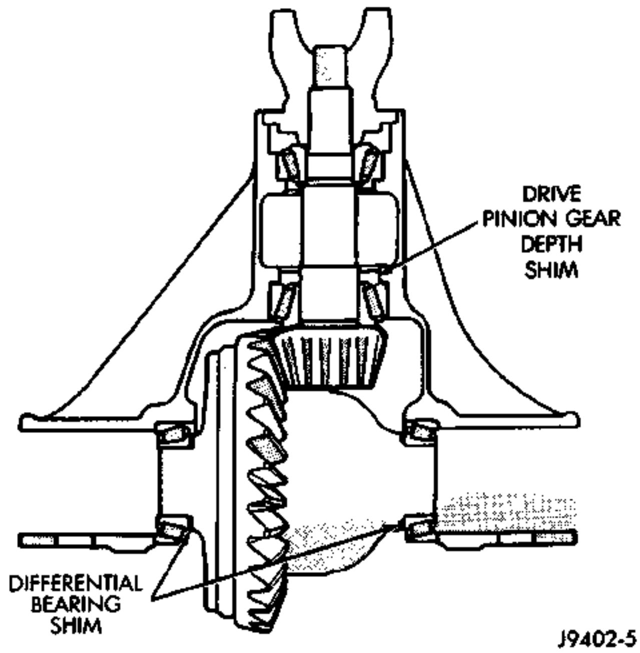


Fig. 63 Shim Locations

Note the etched number on the face of the drive pinion gear (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shims. If the number is positive, subtract that value from the thickness of the depth shim/baffle. If the number is 0 no change is necessary.

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

J8902-46

ADJUSTMENTS (Continued)

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Pinion gear depth measurement is necessary when:

- Axle housing or differential case is replaced
- Pinion select shim pack is unknown
- Ring and pinion gears are replaced

Measurements are taken with pinion cups and pinion bearings installed in axle housing without shims or baffle placed behind the inner pinion bearing cup. Take measurements with Pinion Gauge Set 6774 and Dial Indicator C-3339 (Fig. 64).

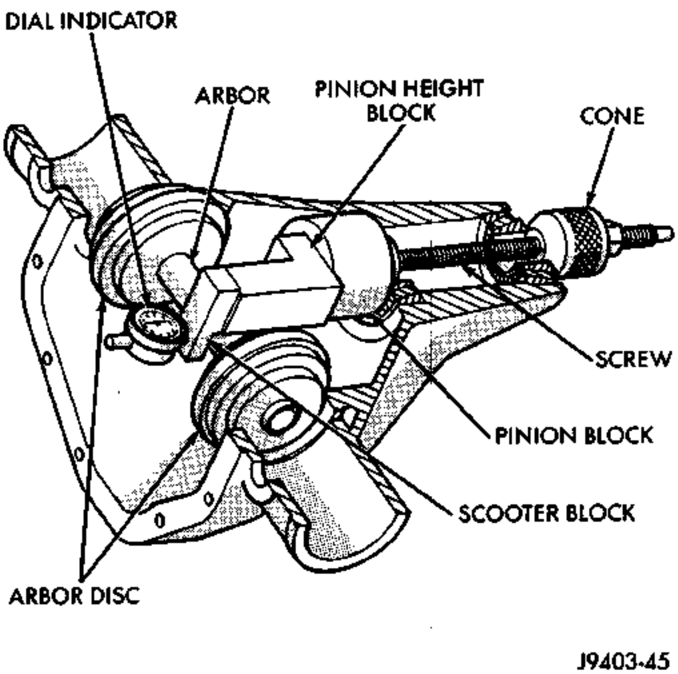


Fig. 64 Pinion Gear Depth Gauge Tools—Typical

(1) Assemble Pinion Height Block 6739, Pinion Block 6733, and inner pinion bearing cone onto Screw 6741 (Fig. 64).

(2) Insert assembled height gauge components, rear bearing and screw into axle housing through pinion bearing cups (Fig. 65).

(3) Install outer pinion bearing cone and Cone-nut 6740 hand tight (Fig. 64).

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in axle housing side bearing cradles (Fig. 66). Install differential bearing caps on Arbor Discs and tighten cap bolts to 41 N·m (30 ft. lbs.).

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

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

(6) Place Scooter Block/Dial Indicator in position in axle housing so dial probe and scooter block are

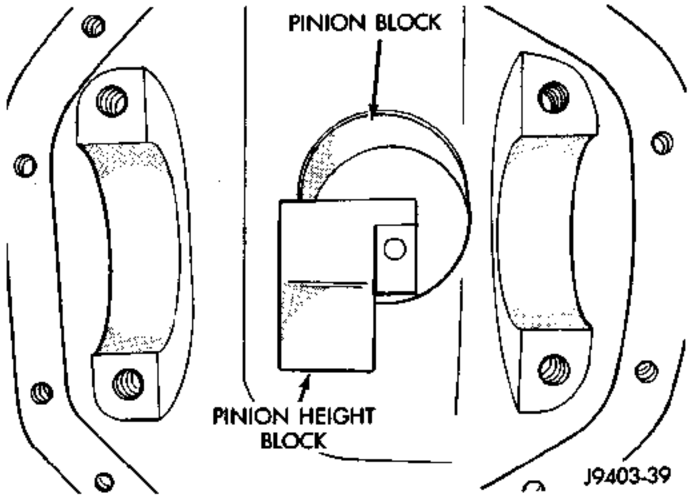


Fig. 65 Pinion Height Block—Typical

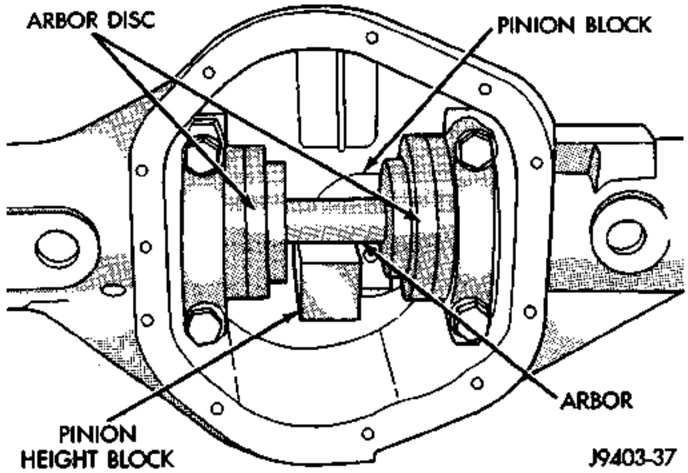


Fig. 66 Gauge Tools In Housing—Typical

flush against the rearward surface of the pinion height block (Fig. 64). Hold scooter block in place and zero the dial indicator face to the pointer. Tighten dial indicator face lock screw.

(7) With scooter block still in position against the pinion height block, slowly slide the dial indicator probe over the edge of the pinion height block. Observe how many revolutions counterclockwise the dial pointer travels (approximately 0.125 in.) to the out-stop of the dial indicator.

(8) Slide the dial indicator probe across the gap between the pinion height block and the arbor bar with the scooter block against the pinion height block (Fig. 67). When the dial probe contacts the arbor bar, the dial pointer will turn clockwise. Bring dial pointer back to zero against the arbor bar, do not turn dial face. Continue moving the dial probe to the crest of the arbor bar and record the highest reading. If the dial indicator can not achieve the zero reading, the rear bearing cup or the pinion depth gauge set is not installed correctly.

ADJUSTMENTS (Continued)

(9) Select a shim equal to the thickest dial indicator reading ± the drive pinion gear depth variance number etched in the face of the pinion gear (Fig. 62).

NOTE: If an oil slinger is used behind the inner pinion bearing cone, deduct the thickness of the slinger from the dial indicator reading and use that total for shim selection.

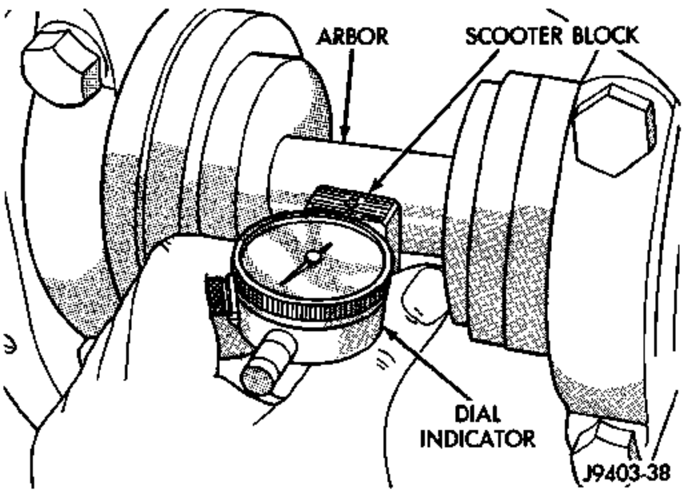


Fig. 67 Pinion Gear Depth Measurement—Typical

(10) Remove the pinion depth gauge components from the axle housing

NOTE: If the ring and pinion gear, differential case, or axle housing has been replaced, proceed to Differential Bearing Preload and Gear Lash

(11) Install the pinion gear in the axle housing.
(12) Install differential with ring gear mounted and with dummy bearings D-348 in place in axle housing.
(13) Determine the proper shim thickness to achieve specified gear lash. Refer to Differential Bearing Preload and Gear Lash paragraph in this group for proper procedure.

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

Differential side bearing preload and gear backlash is achieved by selective shims positioned behind the differential side bearing cones. The proper shim thickness can be determined using slip-fit dummy bearings D-348 in place of the differential side bearings and a dial indicator C-3339. Before proceeding with the differential bearing preload and gear backlash measurements, measure the pinion gear depth and prepare the pinion gear for installation. Establishing proper pinion gear depth is essential to establishing gear backlash and tooth contact patterns. After the overall shim thickness to take up differential side play is measured, the pinion gear is installed, and the gear backlash shim thickness is measured. The overall shim thickness is the total of the dial indicator reading and the preload specification added together. The gear backlash measurement determines the thickness of the shim used on the ring gear side of the differential case. Subtract the gear backlash shim thickness from the total overall shim thickness and select that amount for the pinion gear side of the differential (Fig. 68). Differential shim measurements are performed with axle spreader W-129-B removed.

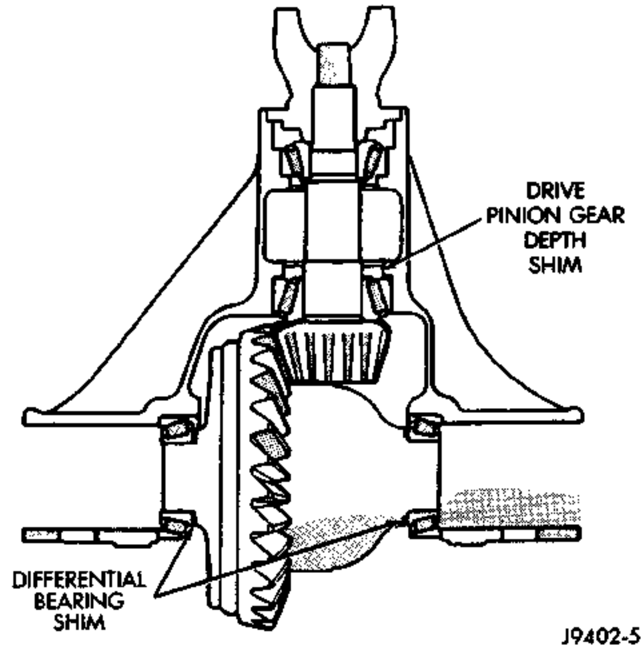


Fig. 68 Axle Adjustment Shim Locations

DIFFERENTIAL PRELOAD AND GEAR BACHLASH SHIM SELECTION

NOTE: It is difficult to salvage the differential side bearings during the removal procedure. Install replacement bearings whenever removal is required.

(1) Remove differential side bearings from differential case.
(2) Remove factory installed shims from differential case.
(3) Install ring gear on differential case and tighten bolts to specification.
(4) Install dummy side bearings D-348 on differential case.
(5) Install differential case in axle housing.
(6) Install the marked bearing caps in their correct positions. Install and snug the bolts (Fig. 69).

ADJUSTMENTS (Continued)

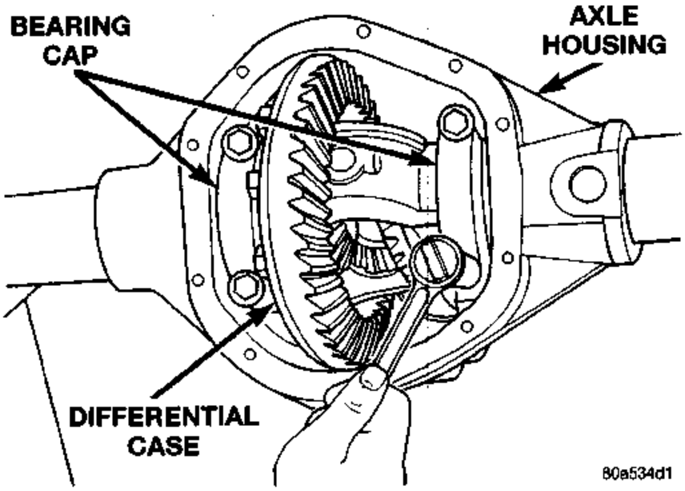


Fig. 69 Tighten Bolts Holding Bearing Caps

(7) Using a dead-blow type mallet, seat the differential dummy bearings to each side of the axle housing (Fig. 70) and (Fig. 71).

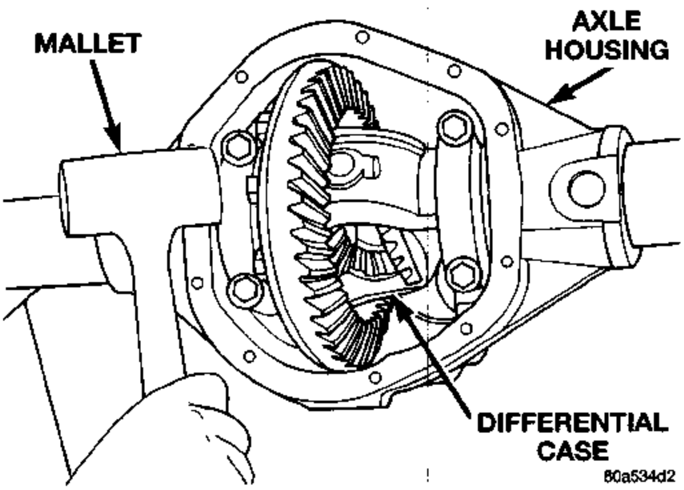


Fig. 70 Seat Pinion Gear Side Differential Dummy Side Bearing

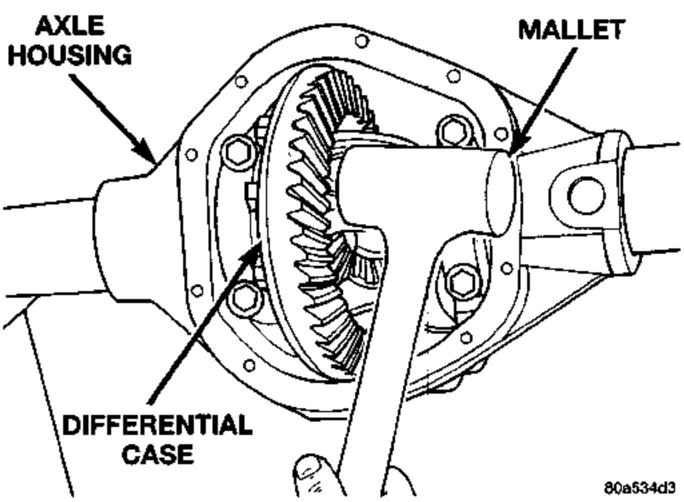


Fig. 71 Seat Ring Gear Side Differential Dummy Side Bearing

(8) Thread guide stud C-3288 into rear cover bolt hole below ring gear (Fig. 72).

(9) Attach a dial indicator C-3339 to guide stud. Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 72).

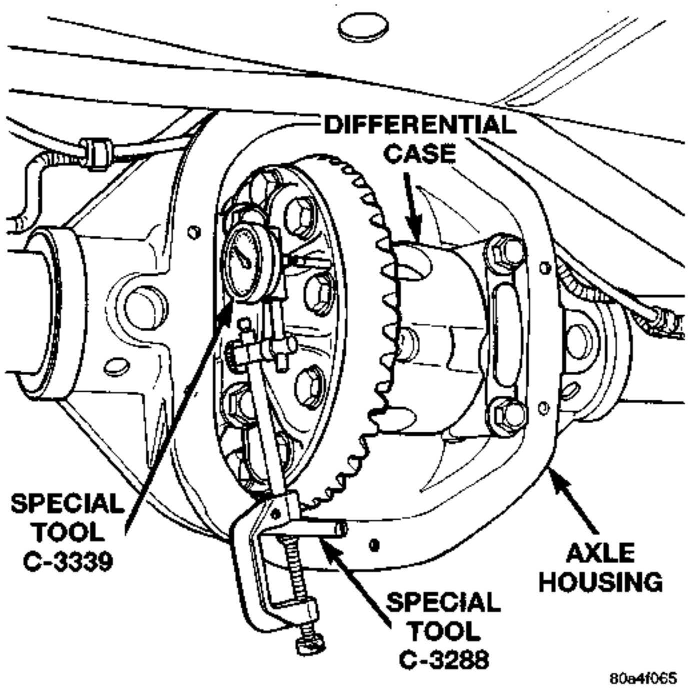


Fig. 72 Differential Side play Measurement

(10) Push and hold differential case to pinion gear side of axle housing (Fig. 73).

(11) Zero dial indicator face to pointer (Fig. 73).

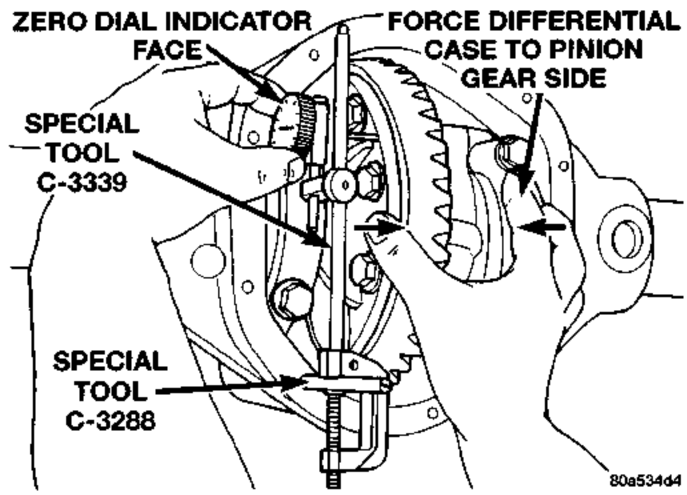


Fig. 73 Hold Differential Case and Zero Dial Indicator

ADJUSTMENTS (Continued)

(12) Push and hold differential case to ring gear side of the axle housing (Fig. 74).

(13) Record dial indicator reading (Fig. 74).

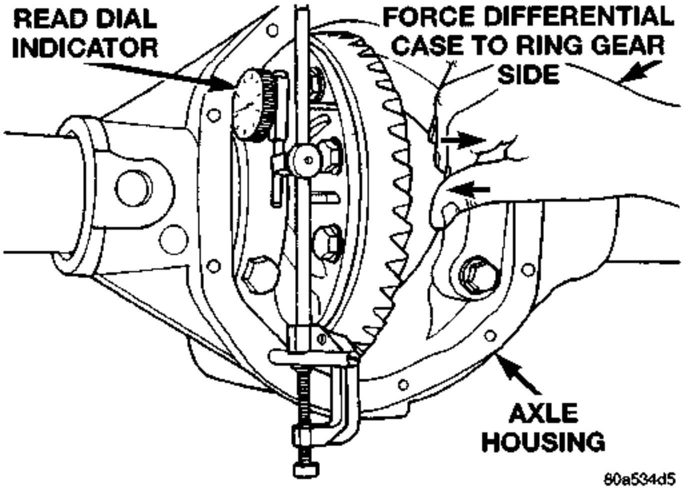


Fig. 74 Hold Differential Case and Read Dial Indicator

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

(15) Add 0.008 in. (0.2 mm) to the zero end play total. This new total represents the thickness of shims to compress, or preload the new bearings when the differential is installed.

(16) Rotate dial indicator out of the way on guide stud.

(17) Remove differential case and dummy bearings from axle housing.

(18) Install Pinion Gear in axle housing.

(19) Install differential case and dummy bearings D-348 in axle housing (without shims), install bearing caps and tighten bolts snug.

(20) Seat ring gear side dummy bearing (Fig. 71).

(21) Position the dial indicator plunger on a flat surface between the ring gear bolt heads. (Fig. 72).

(22) Push and hold differential case toward pinion gear (Fig. 75).

(23) Zero dial indicator face to pointer (Fig. 75).

(24) Push and hold differential case to ring gear side of the axle housing (Fig. 76).

(25) Record dial indicator reading (Fig. 76).

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

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

(28) Rotate dial indicator out of the way on guide stud.

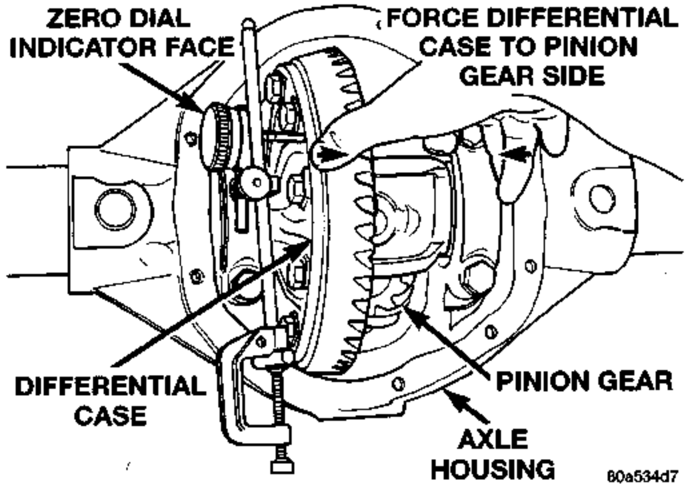


Fig. 75 Hold Differential Case and Zero Dial Indicator

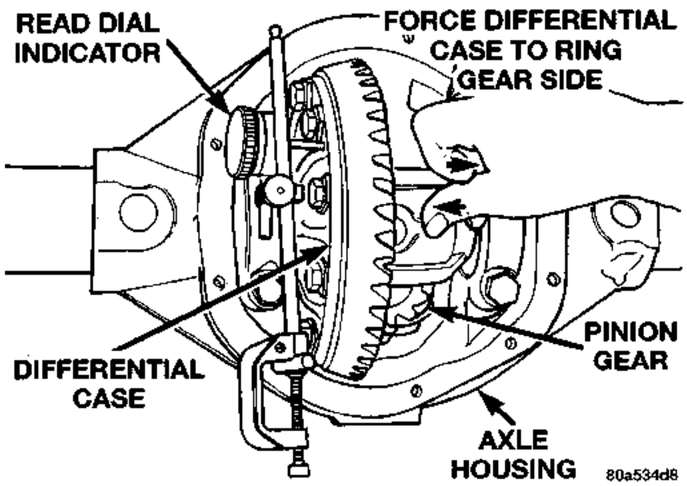


Fig. 76 Hold Differential Case and Read Dial Indicator

(29) Remove differential case and dummy bearings from axle housing.

(30) Install side bearing shims on differential case hubs.

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

(32) Install spreader W-129-B on axle housing and spread axle opening enough to receive differential case.

(33) Install differential case in axle housing. Refer to Differential Removal and Installation paragraph.

(34) Remove spreader from axle housing.

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

(36) Position the indicator plunger against a ring gear tooth (Fig. 77).

(37) Push and hold ring gear upward (do not rotate differential).

(38) Zero dial indicator face to pointer.

ADJUSTMENTS (Continued)

(39) Push and hold ring gear downward (do not rotate differential). Dial indicator reading should be between 0.12 mm (0.005 in.) and 0.20 mm (0.008 in.). If backlash is not within specifications transfer the necessary amount of shim thickness from one side of the axle housing to the other (Fig. 78).

(40) Verify differential case and ring gear runout by measuring ring to pinion gear backlash at several locations around the ring gear. Readings should not vary more than 0.05 mm (0.002 in.). If readings vary more than specified, the ring gear or the differential case is defective.

After the proper backlash is achieved, perform Gear Contact Pattern Analysis procedure.

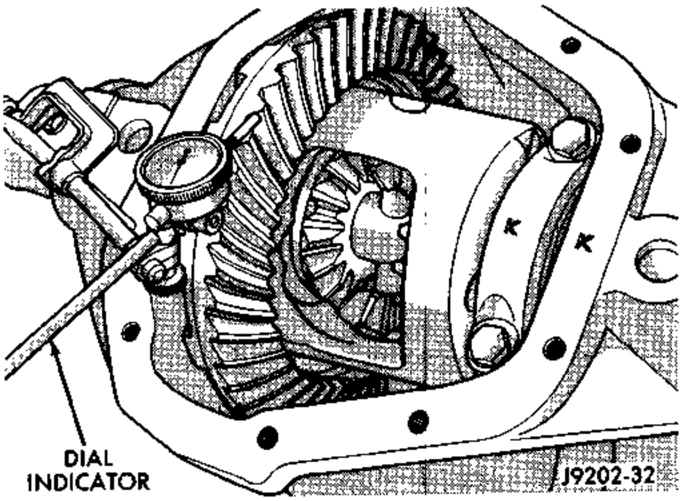


Fig. 77 Ring Gear Backlash Measurement

GEAR CONTACT PATTERN ANALYSIS

The ring and pinion gear teeth contact patterns will show if the pinion gear depth is correct in the axle housing. It will also show if the ring gear backlash has been adjusted correctly. The backlash can be adjusted within specifications to achieve desired tooth contact patterns.

(1) Apply a thin coat of hydrated ferric oxide, or equivalent, to the drive and coast side of the ring gear teeth.

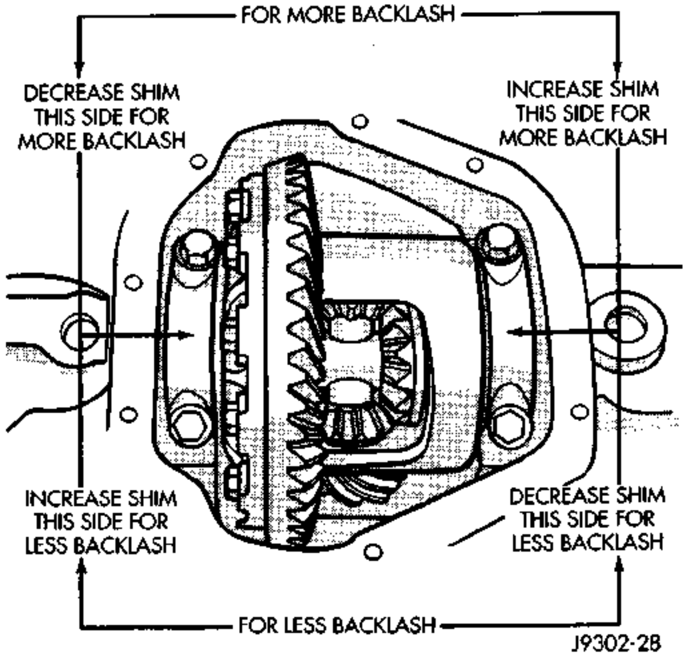


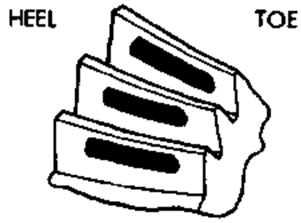
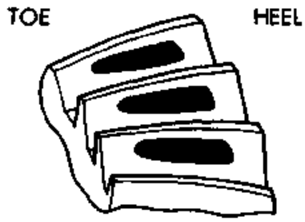
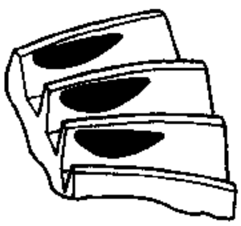
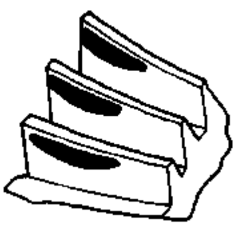
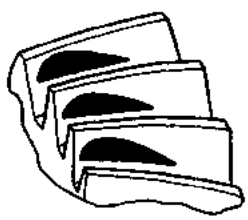
Fig. 78 Backlash Shim Adjustment

(2) Wrap, twist, and hold a shop towel around the pinion yoke to increase the turning resistance of the pinion gear. This will provide a more distinct contact pattern.

(3) Using a boxed end wrench on a ring gear bolt, Rotate the differential case one complete revolution in both directions while a load is being applied from shop towel.

The areas on the ring gear teeth with the greatest degree of contact against the pinion gear teeth will squeegee the compound to the areas with the least amount of contact. Note and compare patterns on the ring gear teeth to Gear Tooth Contact Patterns chart and adjust pinion depth and gear backlash as necessary.

ADJUSTMENTS (Continued)

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

J9003-24

Gear Tooth Contact Patterns

SPECIFICATIONS

194 RBI AXLE

DESCRIPTION	SPEC.
Type	Semi-floating Hypoid
Axle Ratios	3.07/3.55/3.73/4.11
Ring Gear Diameter	193.55 mm (7.62 in.)
Gear Backlash	0.13–0.20 mm (0.005–0.008 in.)
Pinion Depth	96.85mm (3.813 in.)
Brg. Perload, Pinion (New)	1.7-3.9 N·m (15-35 in. lbs.)
Brg. Perload, Pinion (Used)	1–3 N·m (10–20 in. lbs.)
Maximum Carrier Spread	0.51 mm (0.020 in.

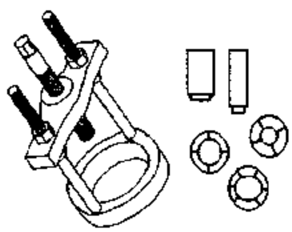
TORQUE

DESCRIPTION	TORQUE
Bolts, Diff. Cover	41 N·m (30 ft. lbs.)
Bolts, Diff. Bearing Cap	108 N·m (80 ft. lbs.)
Bolts, Ring Gear	108 N·m (80 ft. lbs.)
Nuts, Brake Backing Plate	61 N·m (45 ft. lbs.)
Nut, Pinion Gear— Minimum *	292 N·m (215 ft. lbs.)

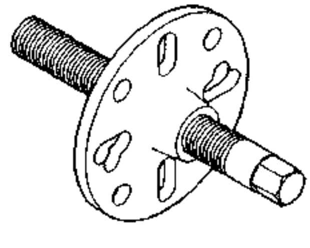
NOTE: *—Refer to Pinion Gear Removal and Installation procedures for proper pinion nut tightening instructions. Do not exceed 427 N·m (315 ft. lbs) during collapsible spacer crushing procedure.

SPECIAL TOOLS

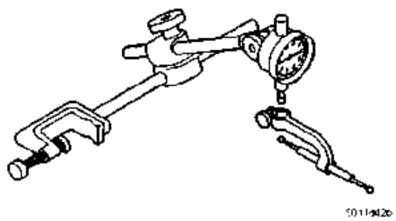
194 RBI AXLE



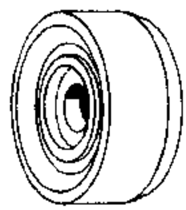
Puller—C-293-M



Puller—C-452

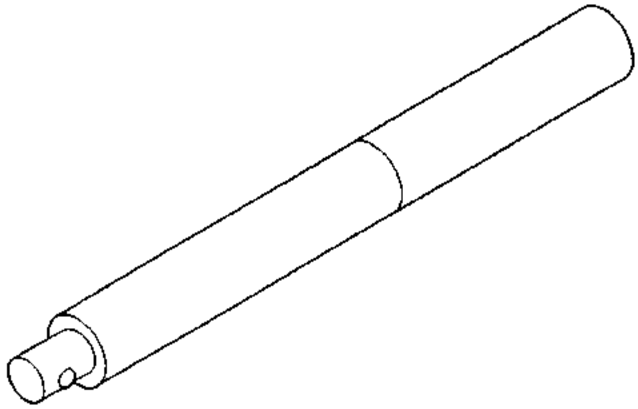


Dial Indicator—C-3339

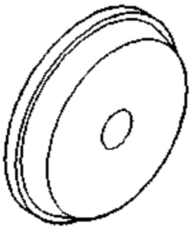


Driver—C-3716-A

SPECIAL TOOLS (Continued)

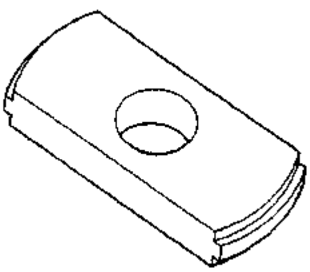


Handle—C-4171

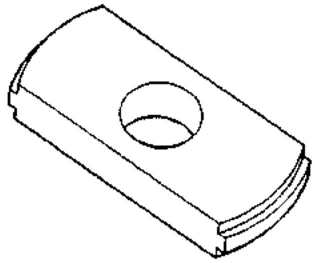


Installer—D-130

Installer—D-146



Remover—D-147



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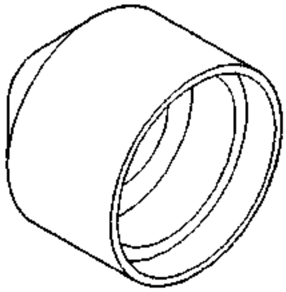
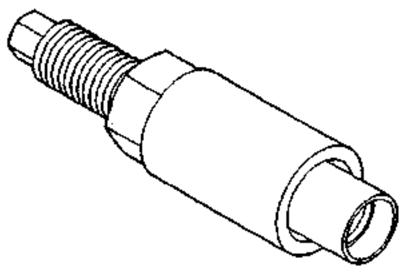
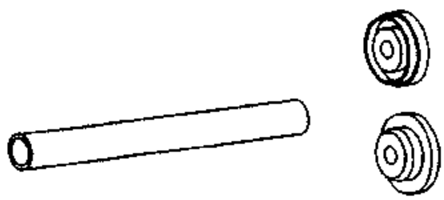


Installer—D163

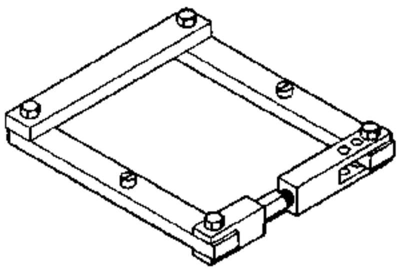


Installer—W-162-D

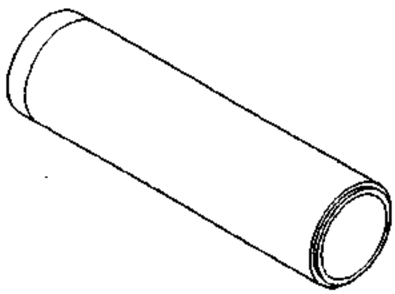


Installer—6228

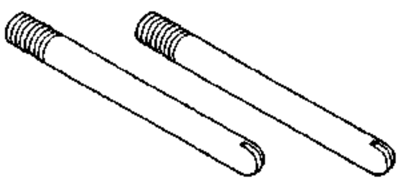
SPECIAL TOOLS (Continued)



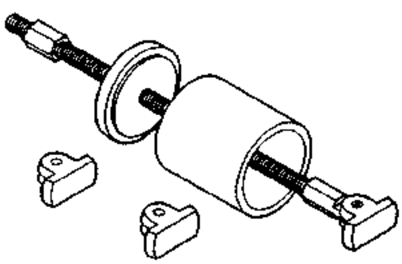
Spreader—W-129-B



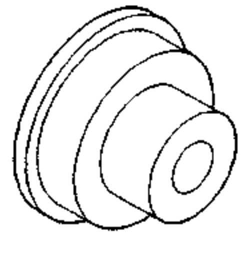
Installer—W-262



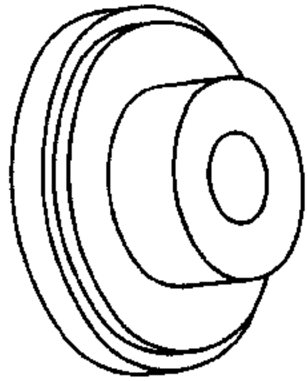
Pilot—3288



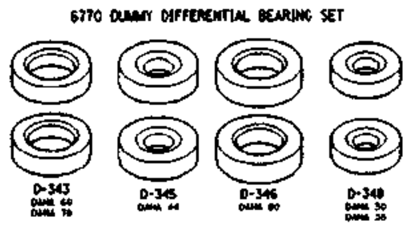
Remover Set—6310



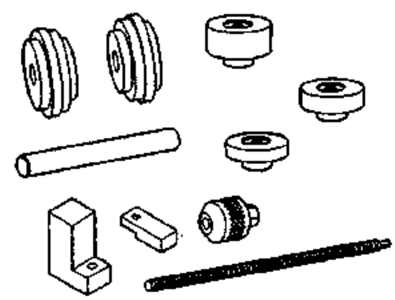
Installer—6436



Installer—6437

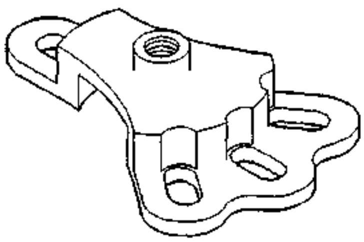


Dummy Bearing Set—6770

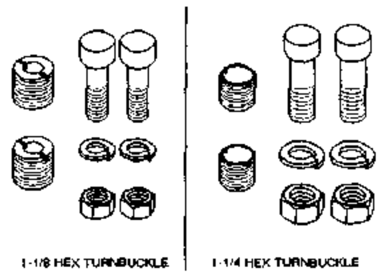


Tool Set, Pinion Depth—6774

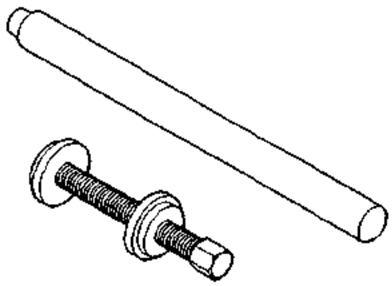
SPECIAL TOOLS (Continued)



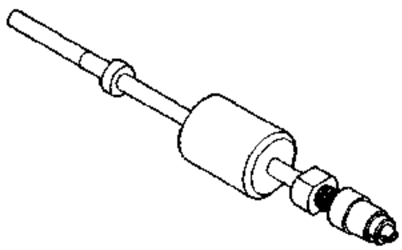
Adapter—6790



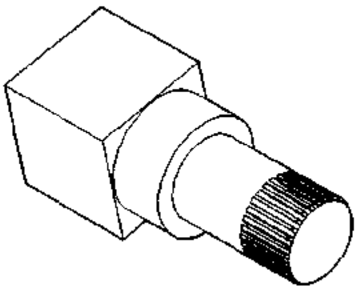
Adapter Set—6987



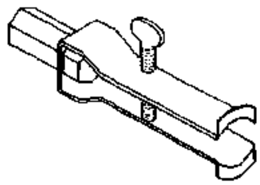
Installer—6960



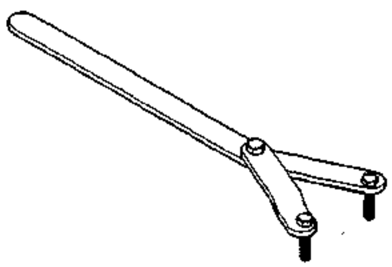
Slide Hammer—7420



Holder—6965



Puller—7794-A



Holder—6968

216 RBI REAR AXLE

INDEX

GENERAL INFORMATION

GENERAL INFORMATION

The Model 216–RBI (Rear/Beam-design/Iron) axle housing has an iron center casting (axle housing) with axle shaft tubes extending from either side. The tubes are pressed and welded into the differential housing to form a one-piece axle housing.

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

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

The axles are equipped with semi-floating axle shafts. The vehicle weight is supported by the axle shaft and bearings. The axle shafts are retained by plates bolted to the end flanges of the axle tubes.

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

The differential case is a one-piece design. The differential pinion mate shaft is retained with a roll-pin. Differential side bearing preload and ring gear backlash is adjusted by shims positioned between the side bearing cone and differential case. Pinion gear depth is adjusted by shims positioned between the axle housing and the inner pinion bearing cup. Pinion bearing preload is maintained by shims positioned between the pinion gear shaft shoulder and the outer bearing cone. (Fig. 1)

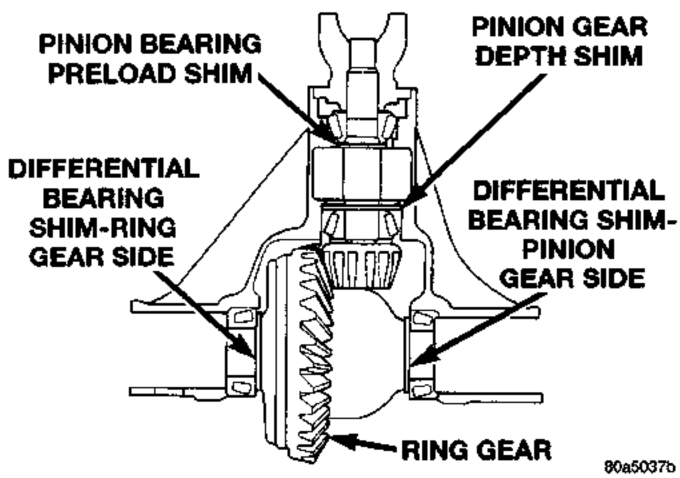


Fig. 1 Axle Adjustment Shims

LUBRICANT SPECIFICATIONS

Multi–purpose, hypoid gear lubricant should be used. The lubricant should have MIL–L–2105C and

GENERAL INFORMATION (Continued)

API GL 5 quality specifications. Mopar Hypoid Gear Lubricant conforms to both of these specifications.

- Lubricant is a thermally stable SAE 80W–90 gear lubricant.
- Lubricant for axle with Trailer Tow is SAE 75W–140 SYNTHETIC gear lubricant.
- Trac–Lok differentials add 4 oz. of friction modifier.
- Lubricant capacity is 1.66 L (3.50 pts.).

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

DESCRIPTION AND OPERATION

AXLES

TJ vehicles with 4.0 L engine is equipped with a Model 216 RBI rear axle.

The Model 216 RBI axle housing has a cast iron center section. Two steel axle shaft tubes are pressed and welded into the center section.

It is not necessary to remove the axle from the vehicle for service. A removable differential cover is provided for routine vehicle service.

IDENTIFICATION

Model 216 RBI axle has the assembly part number and gear ratio listed on a tag. The tag is attached to the left side of the housing cover. Build date identification codes on axles 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:

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

During straight- ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 2).

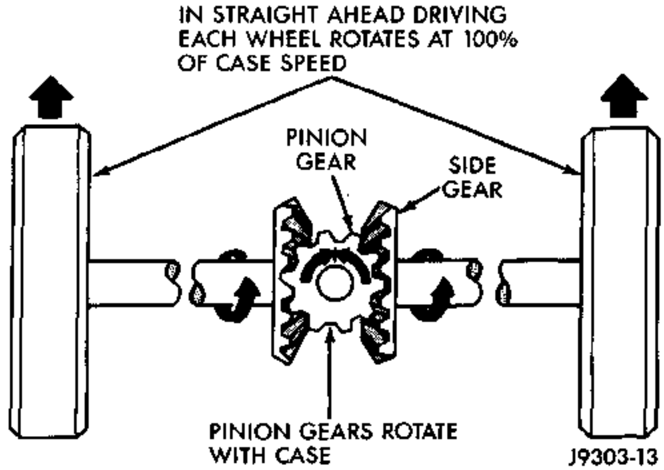


Fig. 2 Differential Operation—Straight Ahead Driving

When turning corners, the outside wheel must travel a greater distance than the inside wheel in order to complete a turn. The difference must be compensated for, to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 3). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

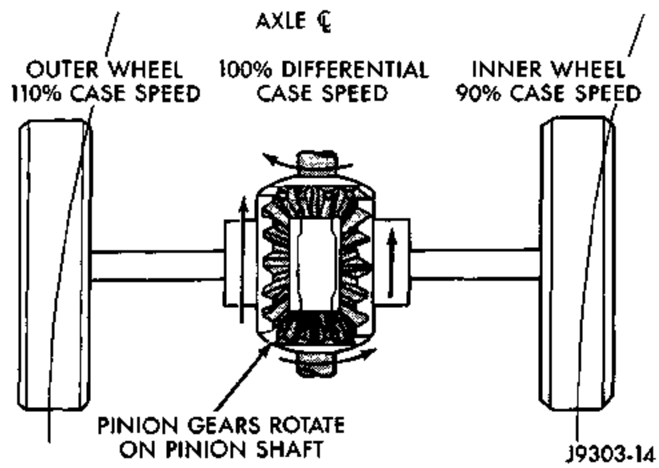


Fig. 3 Differential Operation—On Turns

TRAC-LOK 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

DESCRIPTION AND OPERATION (Continued)

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. The clutch will have radial grooves on the plates, and concentric grooves on the discs or bonded fiber material that is smooth appearance.

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 from separating forces generated by the side gears as torque is applied through the ring gear (Fig. 4).

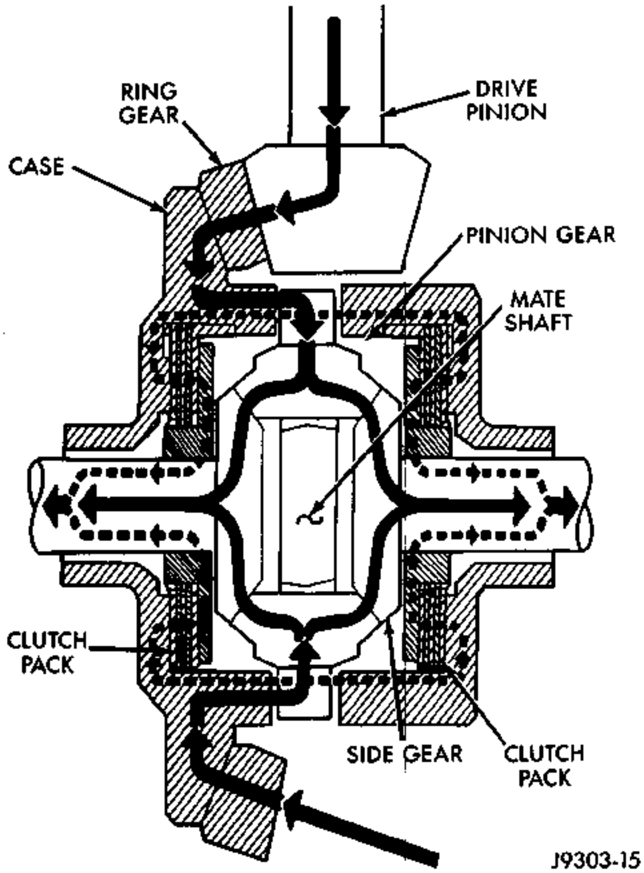


Fig. 4 Trac-lok Limited Slip Differential Operation

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.

DIAGNOSIS AND TESTING

DIAGNOSTIC INFORMATION

Axle bearing problem conditions are usually caused by:

- Insufficient or incorrect lubricant
- Foreign matter/water contamination
- Incorrect bearing preload torque adjustment

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 or over filling 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 wil 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 insuf-

DIAGNOSIS AND TESTING (Continued)

ficient 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. The side 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 side gear/case clearance

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

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 in. (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

DIAGNOSIS AND TESTING (Continued)

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 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.

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.

DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS

SERVICE DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
WHEEL NOISE	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	1. Misaligned axle shaft tube. 2. Bent or sprung axle shaft. 3. End play in drive pinion bearings. 4. Excessive gear backlash between ring gear and pinion gear. 5. Improper adjustment of drive pinion gear shaft bearings. 6. Loose drive pinion gearshaft yoke nut. 7. Improper wheel bearing adjustment. 8. Scuffed gear tooth contact surfaces.	1. Inspect axle shaft tube alignment. Correct as necessary. 2. Replace bent or sprung axle shaft. 3. Refer to Drive Pinion Bearing Pre-Load Adjustment. 4. Check adjustment of ring gear backlash and pinion gear. Correct as necessary. 5. Adjust drive pinion shaft bearings. 6. Tighten drive pinion gearshaft yoke nut with specified torque. 7. Readjust as necessary. 8. If necessary, replace scuffed gears.
AXLE SHAFT BROKE	1. Misaligned axle shaft tube. 2. Vehicle overloaded. 3. Erratic clutch operation. 4. Grabbing clutch.	1. Replace broken axle shaft after correcting axle shaft tube alignment. 2. Replace broken axle shaft. Avoid excessive weight on vehicle. 3. Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch. 4. Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	1. Improper adjustment of differential bearings. 2. Excessive ring gear backlash. 3. Vehicle overloaded. 4. Erratic clutch operation.	1. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly. 2. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly. 3. Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle. 4. Replace cracked case. After inspecting for other possible causes, examine gears and bearings for possible damage. Avoid erratic use of clutch.
DIFFERENTIAL GEARS SCORED	1. Insufficient lubrication. 2. Improper grade of lubricant. 3. Excessive spinning of one wheel/tire.	1. Replace scored gears. Scoring marks on the drive face of gear teeth or in the bore are caused by instantaneous fusing of the mating surfaces. Scored gears should be replaced. Fill rear differential housing to required capacity with proper lubricant. Refer to Specifications. 2. Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant. 3. Replace scored gears. Inspect all gears, pinion bores and shaft for damage. Service as necessary.
LOSS OF LUBRICANT	1. Lubricant level too high.	1. Drain excess lubricant by removing fill plug and allow lubricant to level at lower edge of fill plug hole.

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DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS (CONT'D)

CONDITION	POSSIBLE CAUSES	CORRECTION
LOSS OF LUBRICANT	2. Worn axle shaft seals. 3. Cracked differential housing. 4. Worn drive pinion gear shaft seal. 5. Scored and worn yoke. 6. Axle cover not properly sealed.	2. Replace worn seals. 3. Repair or replace housing as necessary. 4. Replace worn drive pinion gear shaft seal. 5. Replace worn or scored yoke and seal. 6. Remove cover and clean flange and reseal.
AXLE OVERHEATING	1. Lubricant level too low. 2. Incorrect grade of lubricant. 3. Bearings adjusted too tight. 4. Excessive gear wear. 5. Insufficient ring gear backlash.	1. Refill differential housing. 2. Drain, flush and refill with correct amount of the correct lubricant. 3. Readjust bearings. 4. Inspect gears for excessive wear or scoring. Replace as necessary. 5. Readjust ring gear backlash and inspect gears for possible scoring.
GEAR TEETH BROKE (RING GEAR AND PINION)	1. Overloading. 2. Erratic clutch operation. 3. Ice-spotted pavements. 4. Improper adjustments.	1. Replace gears. Examine other gears and bearings for possible damage. 2. Replace gears and examine the remaining parts for possible damage. Avoid erratic clutch operation. 3. Replace gears. Examine the remaining parts for possible damage. Replace parts as required. 4. Replace gears. Examine other parts for possible damage. Ensure ring gear backlash is correct.
AXLE NOISE	1. Insufficient lubricant. 2. Improper ring gear and drive pinion gear adjustment. 3. Unmatched ring gear and drive pinion gear. 4. Worn teeth on ring gear or drive pinion gear. 5. Loose drive pinion gear shaft bearings. 6. Loose differential bearings. 7. Misaligned or sprung ring gear. 8. Loose differential bearing cap bolts	1. Refill axle with correct amount of the proper lubricant. Also inspect for leaks and correct as necessary. 2. Check ring gear and pinion gear teeth contact pattern. 3. Remove unmatched ring gear and drive pinion gear. Replace with matched gear and drive pinion gear set. 4. Check teeth on ring gear and drive pinion gear for correct contact. If necessary, replace with new matched set. 5. Adjust drive pinion gearshaft bearing preload torque. 6. Adjust differential bearing preload torque. 7. Measure ring gear runout. 8. Tighten with specified torque

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DIAGNOSIS AND TESTING (Continued)

TRAC-LOK 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.

The differential can be tested without removing the differential case by measuring rotating torque. Make sure brakes are not dragging during this measurement.

(1) Engine off, transmission in neutral, and parking brake off.

(2) Place blocks in front and rear of both front wheels.

(3) Raise one rear wheel until it is completely off the ground.

(4) Remove wheel and bolt Special Tool 6790 to studs.

(5) Use torque wrench on special tool to rotate wheel and read rotating torque (Fig. 5).

(6) If rotating torque is less than 22 N·m (30 ft. lbs.) or more than 271 N·m (200 ft. lbs.) on either wheel the unit should be service.

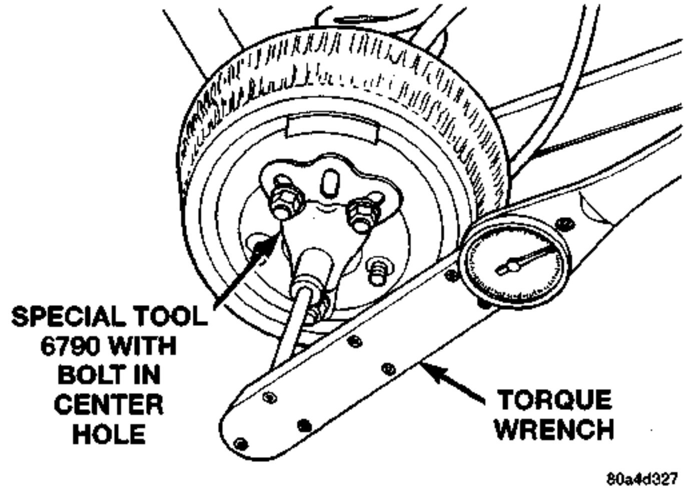

Fig. 5 Trac-lok Test

SERVICE PROCEDURES

LUBRICANT CHANGE

(1) Raise and support the vehicle.

(2) Remove the lubricant fill hole plug from the differential housing cover.

(3) Remove the differential housing cover and drain the lubricant from the housing.

(4) Clean the housing cavity with a flushing oil, light engine oil or lint free cloth. **Do not use water, steam, kerosene or gasoline for cleaning.**

(5) Remove the sealant from the housing and cover surfaces.

(6) Apply a bead of Mopar Silicone Rubber Sealant to the housing cover (Fig. 6). **Allow the sealant to cure for a few minutes.**

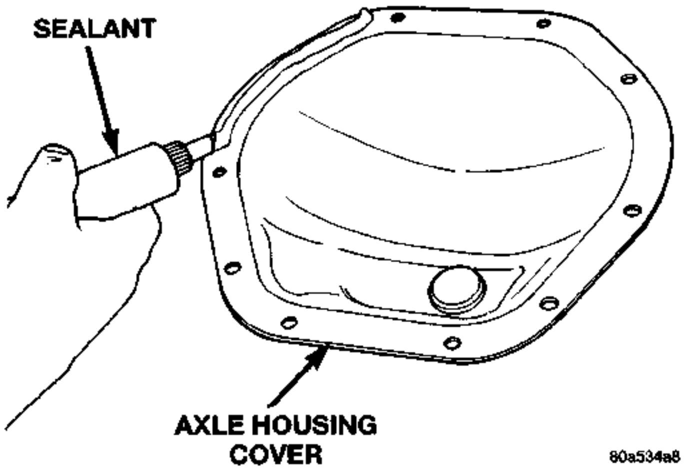

Fig. 6 Apply Sealant

Install the housing cover within 5 minutes after applying the sealant.

(7) Install the cover and any identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

(8) Fill differential with Mopar, Hypoid Gear Lubricant to bottom of the fill plug hole.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

Trac–Lok 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.

SERVICE PROCEDURES (Continued)

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.

REMOVAL AND INSTALLATION

REAR AXLE

REMOVAL

(1) Raise and support the vehicle.
(2) Position a suitable lifting device under the axle.
(3) Secure axle to device.
(4) Remove the wheels and tires.
(5) Remove the brake components from the axle, refer to Group 5, Brakes.
(6) Disconnect the vent hose from the axle shaft tube.
(7) Remove propeller shaft.
(8) Disconnect stabilizer bar links.
(9) Disconnect shock absorbers from axle.
(10) Disconnect track bar.
(11) Disconnect upper and lower suspension arms from the axle brackets.
(12) Separate the axle from the vehicle.

INSTALLATION

NOTE: The weight of the vehicle must be supported by the springs before suspension arms and track bar fasteners can be tightened. If the springs are not at their normal ride position, vehicle ride height and handling could be affected.

(1) Raise the axle with a floor jack and align coil springs.
(2) Position the upper and lower suspension arms on the axle brackets. Install nuts and bolts, do not tighten bolts at this time.
(3) Install track bar and attachment bolts, do not tighten bolts at this time.
(4) Install shock absorber and tighten nuts to 60 N·m (44 ft. lbs.) torque
(5) Install stabilizer bar link and tighten nuts to 36 N·m (27 ft. lbs.) torque
(6) Install brake components refer to Group 5 Brakes.
(7) Install axle vent hose
(8) Align propeller shaft and pinion yoke reference marks. Install U-joint straps and bolts tighten to 19 N·m (14 ft. lbs.) torque
(9) Install the wheels and tires.
(10) Check and add gear lubricant if needed.
(11) Remove support and lower the vehicle.
(12) Tighten lower suspension arms bolts to 177 N·m (130 ft. lbs.) torque.
(13) Tighten upper suspension arms bolts to 75 N·m (55 ft. lbs.) torque.
(14) Tighten track bar bolts to 100 N·m (74 ft. lbs.) torque.

PINION SEAL

REMOVAL

(1) Raise and support the vehicle.
(2) Remove wheel and tire assemblies.
(3) Remove rear brake drums or calipers.
(4) Mark the propeller shaft and pinion yoke for installation reference.
(5) Remove the propeller shaft from the yoke.
(6) Rotate the pinion gear several times to verify bearing smoothness.
(7) Measure the amount of torque necessary to rotate the pinion gear with an (in. lbs.) dial-type torque wrench. Record the torque reading for installation reference (Fig. 12).
(8) Hold pinion yoke with Holder 6958 and remove the pinion yoke nut and washer (Fig. 7).
(9) Use Remover C-452 and Holder 6958 to remove the pinion yoke (Fig. 8).

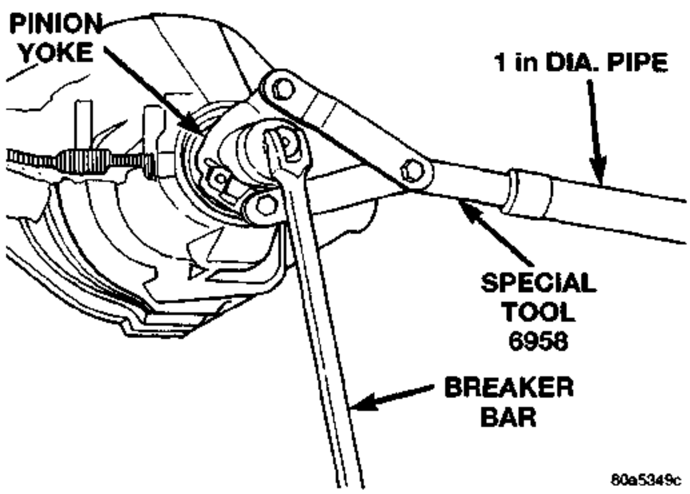

Fig. 7 Pinion Nut

(10) Use Remover 7794A and Slide Hammer 7420 to remove the pinion gear seal (Fig. 9).

INSTALLATION

(1) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer D-163 and Handle C-4171 (Fig. 10).
(2) Install yoke on the pinion gear with Installer W-162-D and Holder 6958 (Fig. 11).
(3) Rotate the pinion shaft using an (in. lbs.) torque wrench. Rotating resistance torque should be equal to the reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.). (Fig. 12).

REMOVAL AND INSTALLATION (Continued)

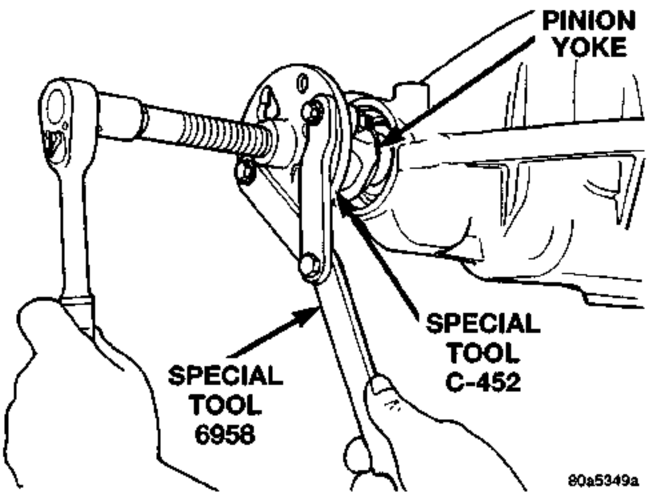

Fig. 8 Pinion Yoke, Remove

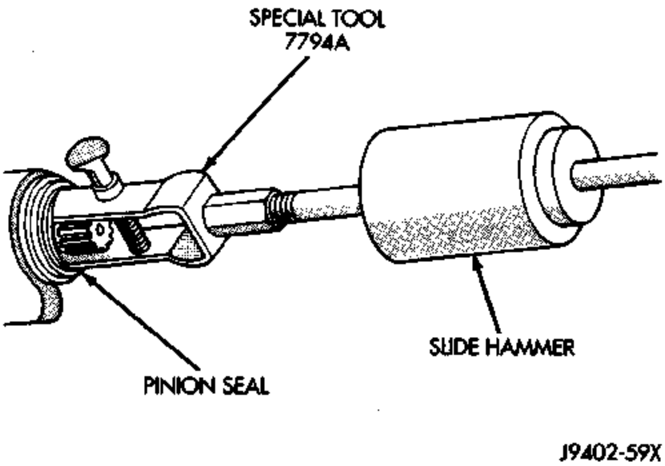

Fig. 9 Seal Removal

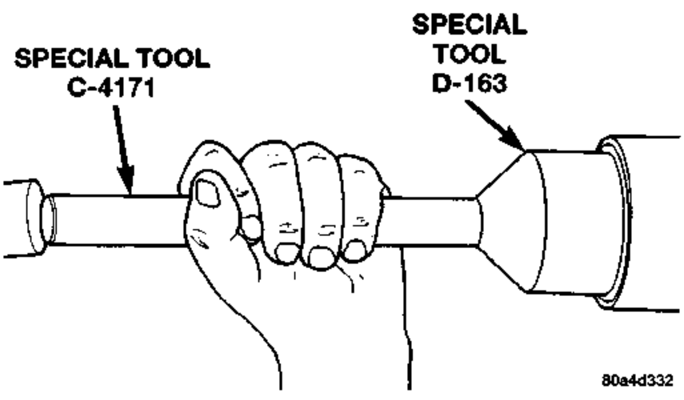

Fig. 10 Pinion Seal Installation

(4) Install washer and new nut on the pinion gear and tighten to 250 N·m (180 ft. lbs.) (Fig. 13).

(5) Align the installation reference marks and attach the propeller shaft to the yoke.

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

(7) Install brake drums or calipers.

(8) Install wheel and tire assemblies.

(9) Lower the vehicle.

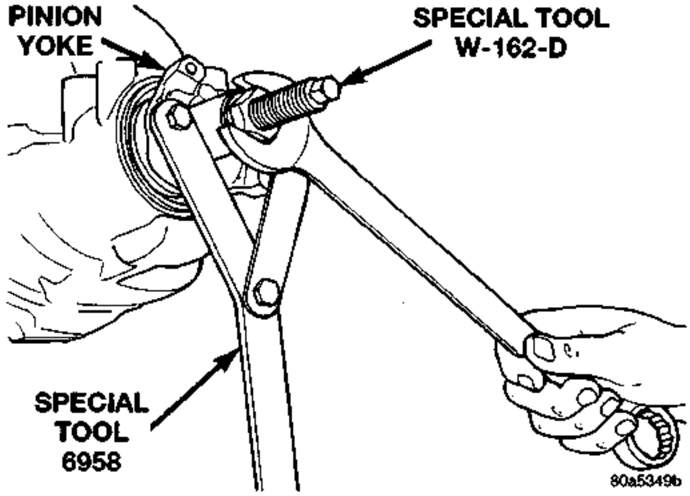

Fig. 11 Pinion Yoke, Install

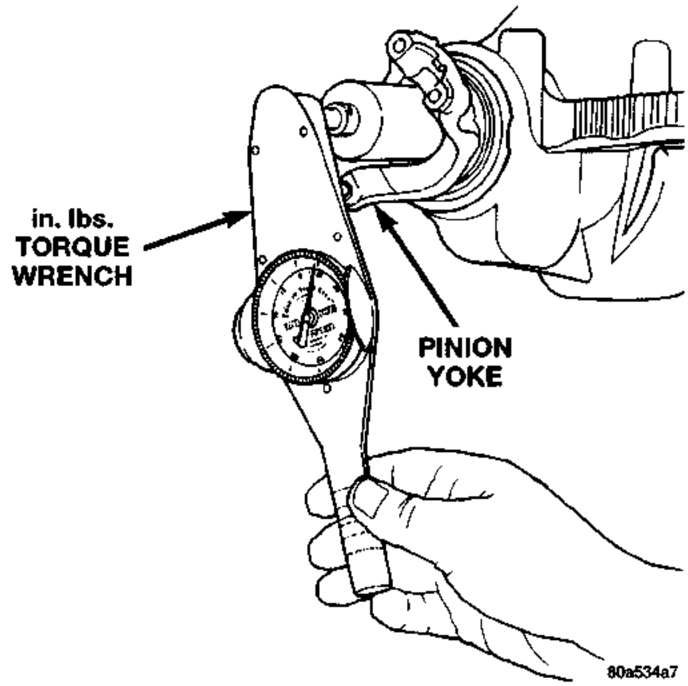

Fig. 12 Check Pinion Rotation Torque

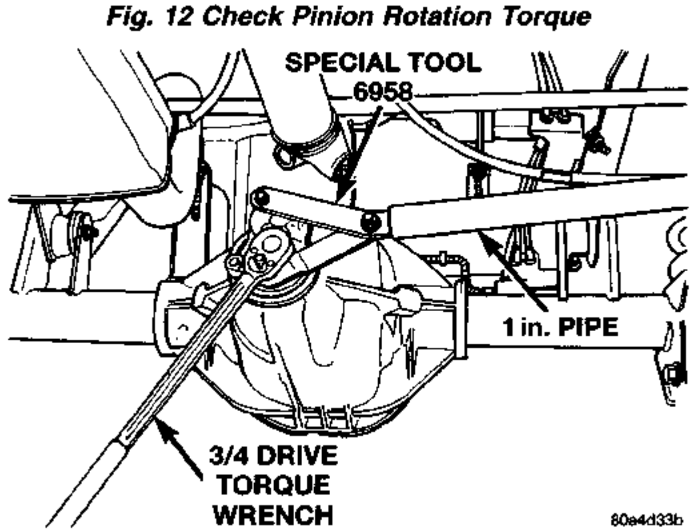

Fig. 13 Tightening Pinion Shaft Nut

REMOVAL AND INSTALLATION (Continued)

AXLE SHAFT

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove wheel lugnuts.

(3) Remove wheel from vehicle.

(4) Remove brake drum or caliper and rotor. Refer to Group 5, Brakes for procedure.

(5) Through access hole in axle flange, remove nuts holding axle retainer plate to axle tube.

(6) Using Slide Hammer 7420 and Adapter 6790 and lug nuts provided with vehicle, pull axle shaft from vehicle (Fig. 14).

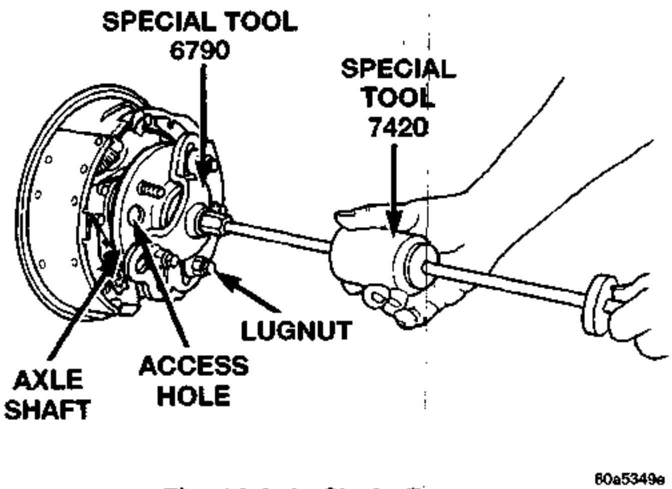

Fig. 14 Axle Shaft, Remove

INSTALLATION

WARNING: Do not reuse factory installed bolts and nuts to retain axle shaft to axle tube flange. Used prevailing torque nuts can loosen causing a dangerous condition. Personal injury may result.

(1) Replace axle shaft retaining bolts and nuts with original equipment parts.

(2) Insert axle into opening at end of axle tube.

(3) Align flat area on axle shaft retaining plate upward.

(4) Insert bolt in axle tube flange through holes in axle shaft retaining plate

(5) Install nuts to hold axle retaining plate to axle tube.

(6) Through access hole in axle flange, tighten nuts to 61 N·m (45 ft. lbs.)

(7) Install brake drum or rotor and caliper.

(8) Install wheel and lugnuts.

(9) Check lubricant level, add if necessary.

(10) Lower vehicle and road test to verify repair.

AXLE BEARING AND SEAL

CAUTION: Use safety goggles while performing the following procedure.

REMOVAL

(1) Remove axle shaft from vehicle.

(2) Wash oily residue from axle shaft.

(3) Using a 3/8 in. dia. drill bit, drill a shallow hole into soft steel axle bearing retaining ring (Fig. 15). If possible, use a drill depth stop to avoid marking axle.

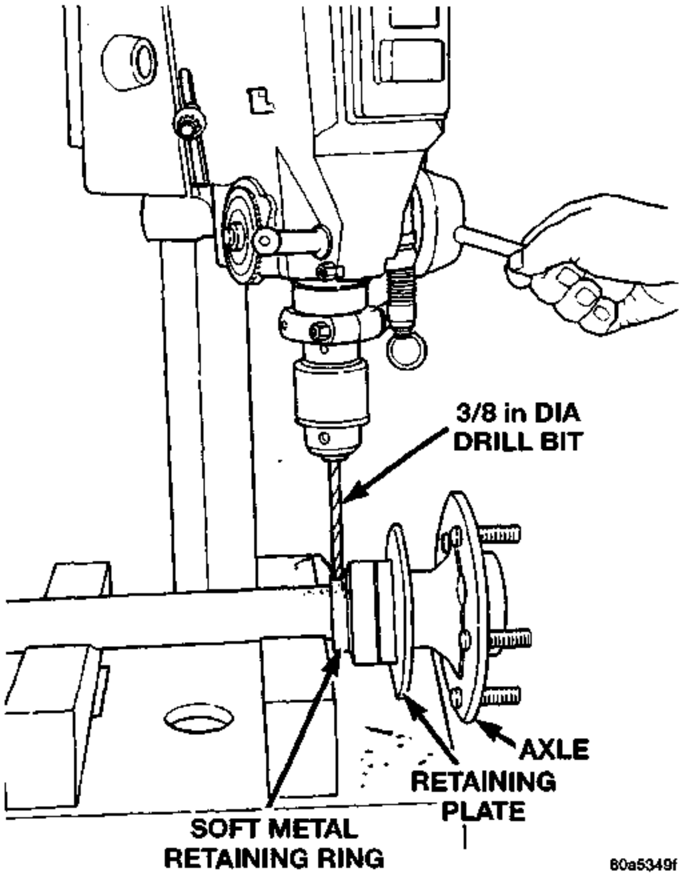

Fig. 15 Drill Retaining Ring

(4) Using a suitable cold chisel, cut retaining ring across drilled hole. (Fig. 16)

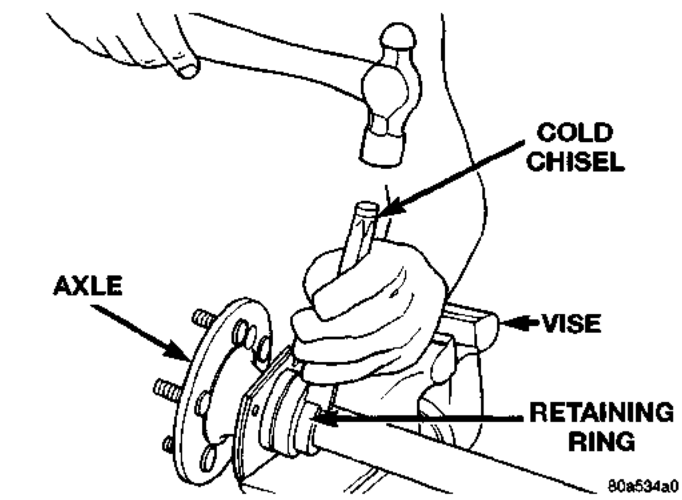

Fig. 16 Cut Retaining Ring

REMOVAL AND INSTALLATION (Continued)

(5) Slide retaining ring from axle shaft.

(6) Using Splitter 1130 placed between the seal and bearing and a suitable Arbor Press, press unit bearing from axle shaft (Fig. 17).

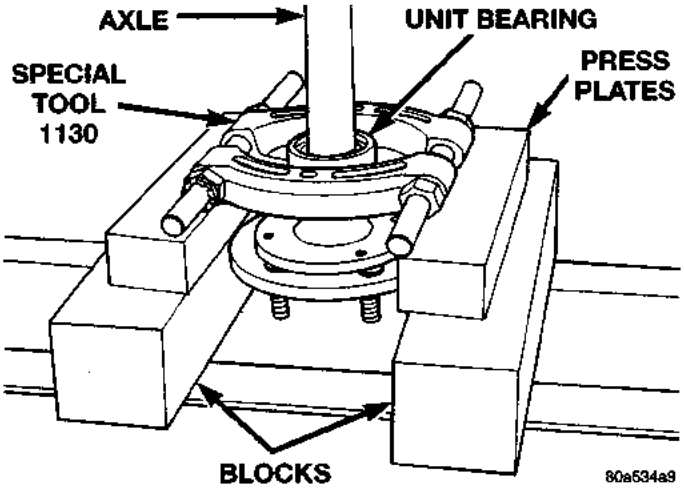

Fig. 17 Axle Bearing and Seal Remove

(7) Slide seal from axle.

(8) Slide retaining plate from axle shaft.

INSTALLATION

(1) Using a suitable straight edge, verify flatness of axle shaft retaining plate. Replace plate if warped.

(2) Install retaining plate on axle (Fig. 18).

(3) Apply a coat of multi-purpose grease on sealing surface of axle seal.

(4) Install seal on axle with cavity away from retaining plate (Fig. 18).

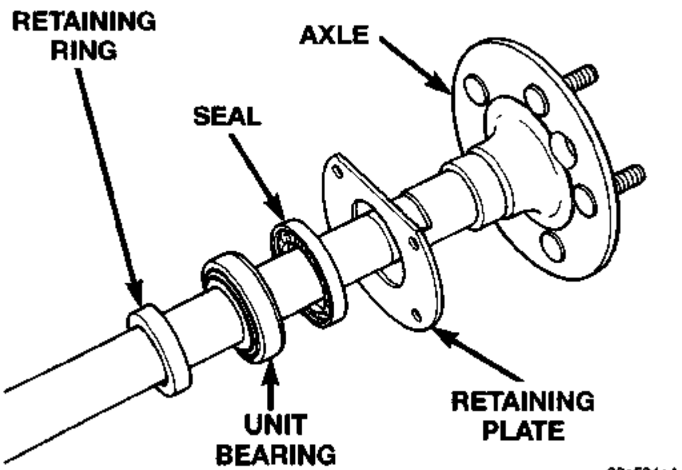

Fig. 18 Axle Bearing and Seal Components

(5) Using a suitable wheel bearing packing device, lubricate bearing with Mopar, Wheel Bearing Grease. Wipe excess grease from outside of bearing.

(6) Slide bearing onto axle shaft with groove in outer surface toward seal (Fig. 18).

(7) Using Installer 7913 and Arbor Press, press retaining plate seal and beating on axle shaft (Fig. 19).

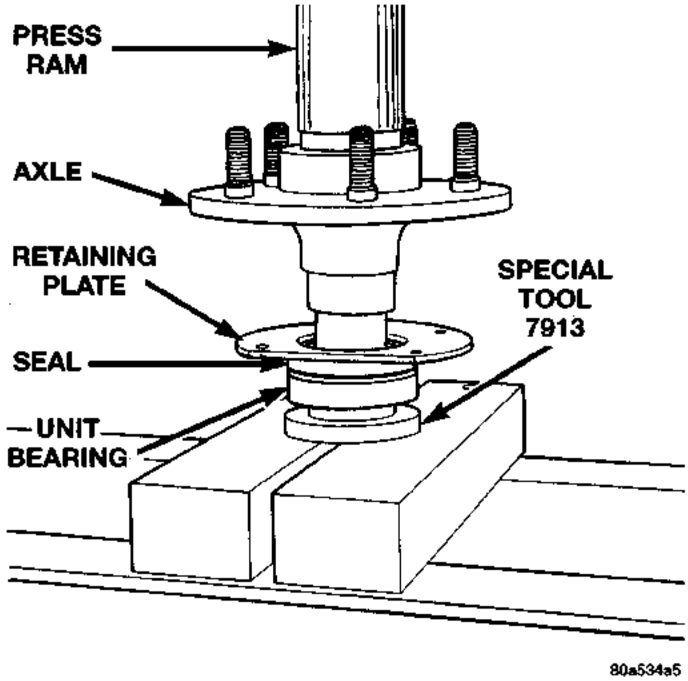

Fig. 19 Press Bearing On Axle

(8) Using Installer 7913 and Arbor Press, press soft metal retaining ring on axle shaft (Fig. 20).

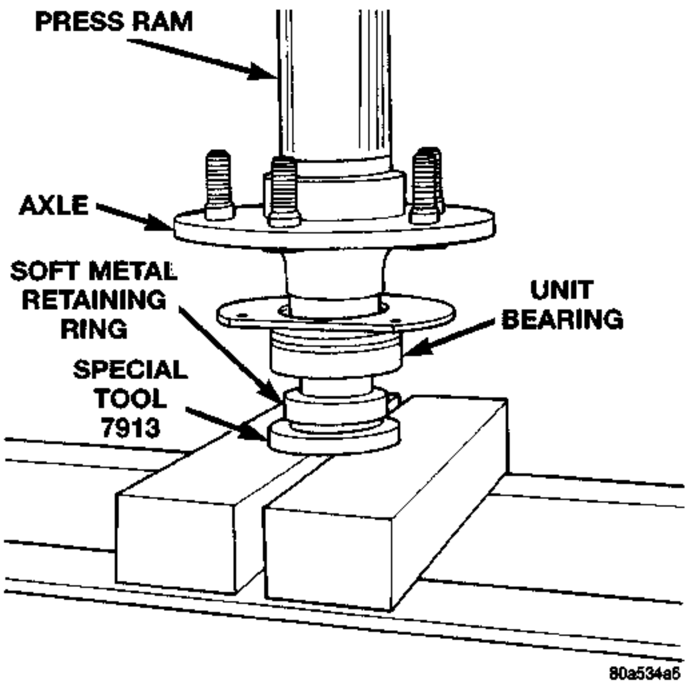

Fig. 20 Press Bearing Retaining Ring On Axle

(9) Install axle in vehicle, refer to Axle Shaft Removal and Installation paragraph in this section.

REMOVAL AND INSTALLATION (Continued)

DIFFERENTIAL

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove axle shafts, refer Axle Removal and Installation paragraph.

(3) Place a suitable drain pan under center of axle housing.

(4) Remove axle housing cover.

NOTE: The differential side bearing retaining caps are reference marked for installation by the manufacturer (Fig. 21).

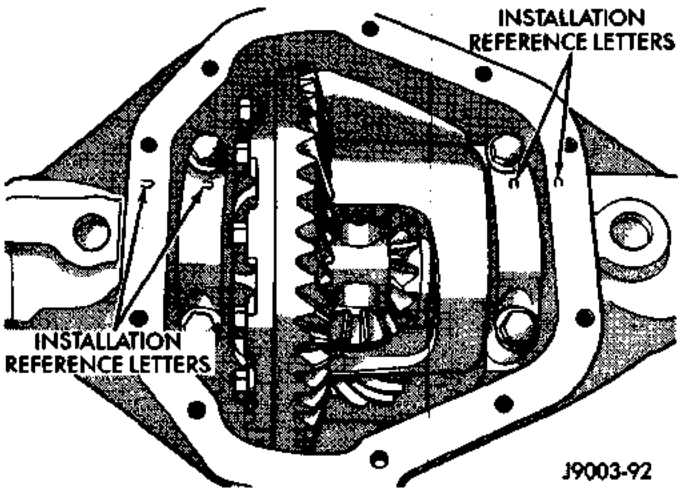

Fig. 21 Bearing Cap Identification

(5) Position Spreader W-129-B with dowel pins inserted into access holes in axle housing. (Fig. 22). Install safety hold down clamps and tighten the tool turnbuckle hand tight.

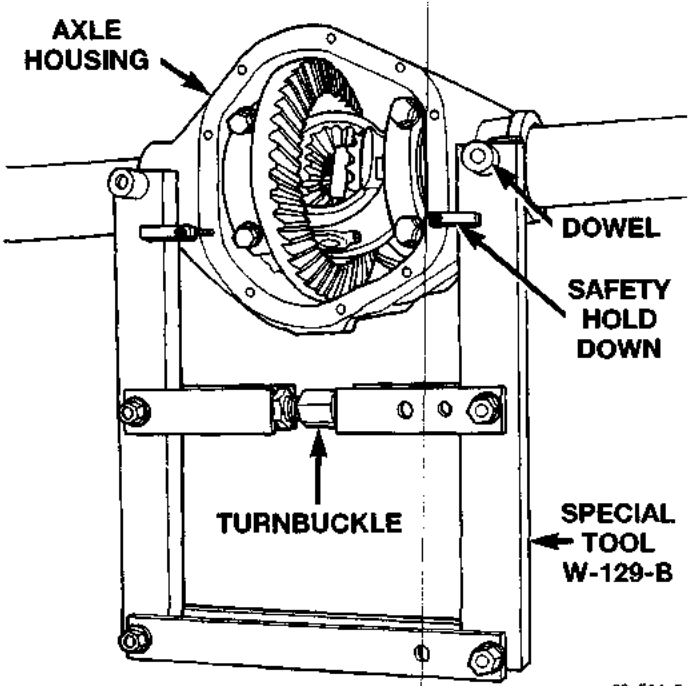

Fig. 22 Install Axle Housing Spreader

(6) Install a Pilot Stud C-3288-B at the left side of the differential housing. Attach Dial Indicator C-3339 to housing pilot stud. Load the indicator lever against the opposite side of the housing (Fig. 23) and zero the indicator face to the pointer.

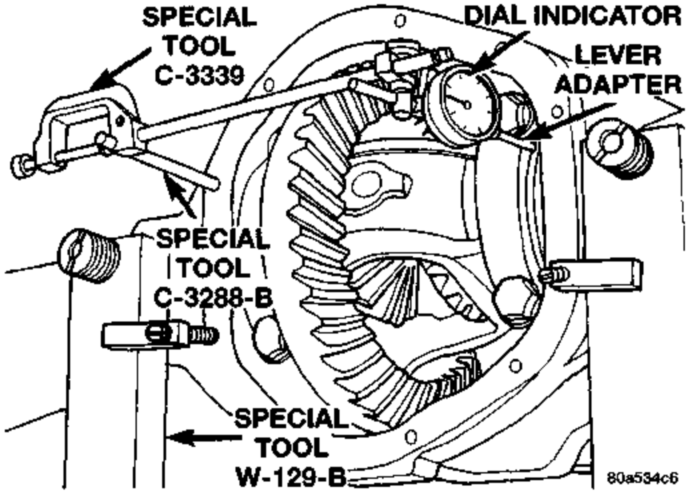

Fig. 23 Install Dial Indicator

CAUTION: Do not spread axle housing over 0.51 mm (0.020 in), axle housing can become distorted or damaged.

(7) Spread axle housing apart enough to remove differential case. Measure amount of spread being applied with the dial indicator, do not exceed 0.51 mm (0.020 in.) (Fig. 24).

(8) Remove dial indicator.

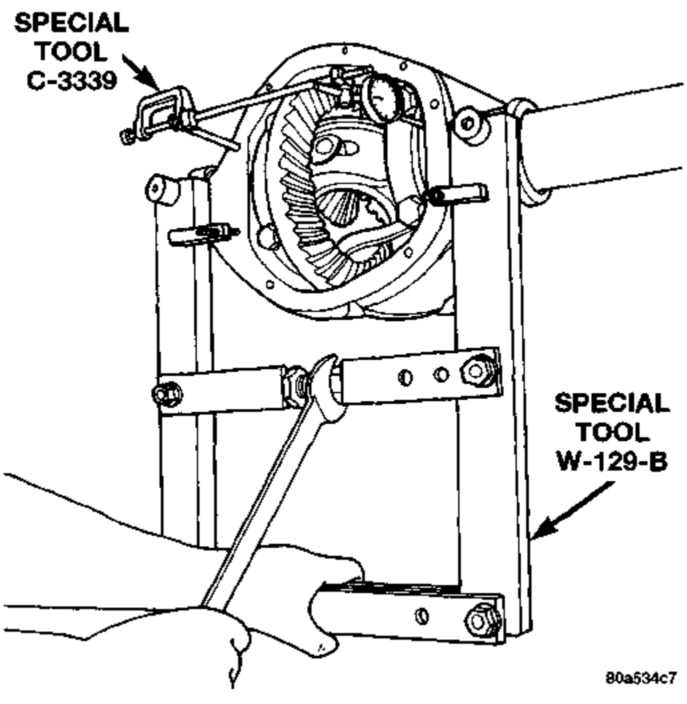

Fig. 24 Spread Axle Housing

REMOVAL AND INSTALLATION (Continued)

(9) While holding differential case in position, remove bolts holding differential bearing caps to axle housing.

(10) Separate bearing caps from axle housing.

(11) While holding differential bearing cups, pull differential case from axle housing. It may be necessary to pry differential case from axle housing (Fig. 25).

(12) Mark the differential bearing cups indicating the side they were removed from.

CAUTION: Do not allow spreader to apply outward pressure on axle housing for an extended period, damage to axle housing can result.

(13) If differential case is not installed within 15 minutes, remove axle housing spreader.

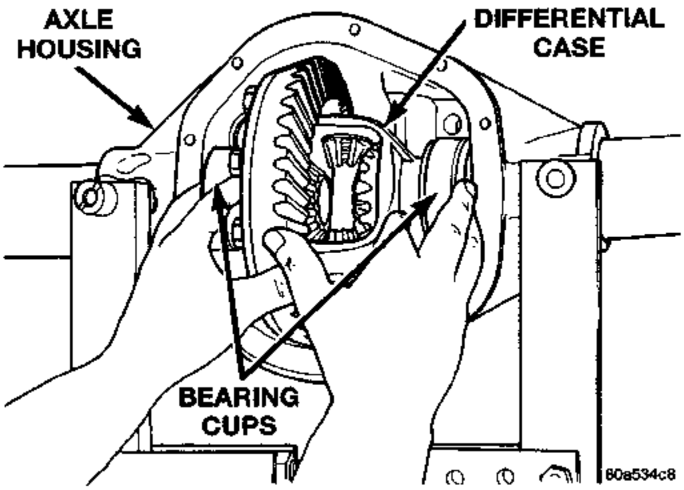

Fig. 25 Differential Case and Side Bearings

DIFFERENTIAL INSTALLATION

If replacement differential side bearings or differential case are being installed, differential side bearing shim requirements could change. Refer to Differential Bearing Preload and Gear Backlash paragraph in the Adjustments section to determine proper shim selection.

(1) Position Spreader W-129-B with dowel pins inserted into access holes in axle housing (Fig. 26). Install safety hold down clamps and tighten the tool turnbuckle hand tight.

(2) Install Dial Indicator C-3339. Load the indicator lever against the opposite side of the housing (Fig. 26) and zero indicator face to pointer.

CAUTION: Do not spread axle housing over 0.51 mm (0.020 in), axle housing can become distorted or damaged.

(3) Spread axle housing apart enough to install differential case. Measure amount of spread being applied with the dial indicator, do not exceed 0.51 mm (0.020 in.) (Fig. 26).

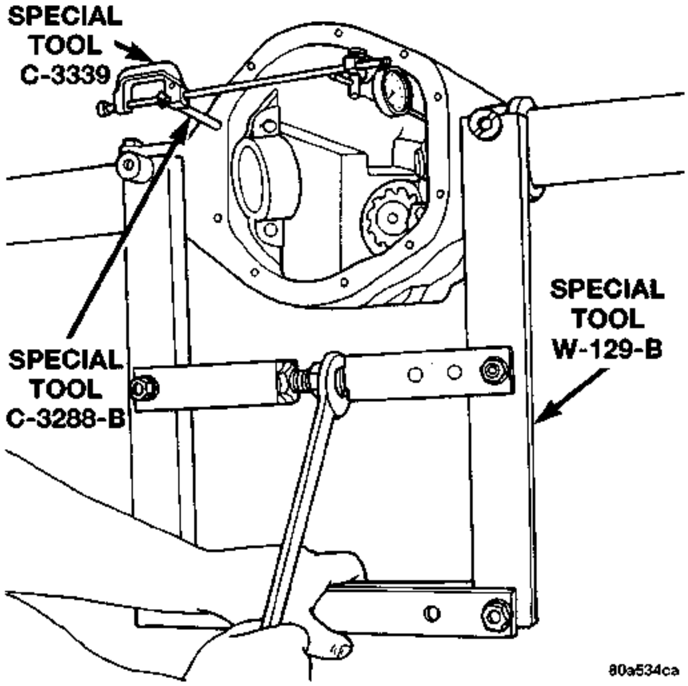

Fig. 26 Spread Axle Housing

(4) Remove dial indicator.

(5) Install differential case and bearing cups into housing. If necessary, tap the differential case side bearing cups inward to assure they are seated (Fig. 25).

(6) Install differential side bearing caps in position with corresponding letters aligned (Fig. 27).

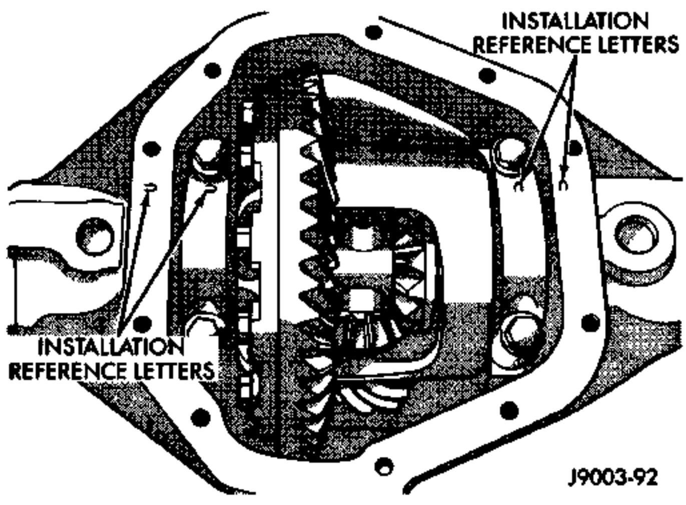

Fig. 27 Differential Bearing Cap Reference Letters

(7) Install bolts (hand tight) to hold bearing caps to axle housing.

(8) Remove axle housing spreader.

REMOVAL AND INSTALLATION (Continued)

(9) Tighten the bearing cap bolts to 110 N·m (80 ft. lbs.) torque (Fig. 28).

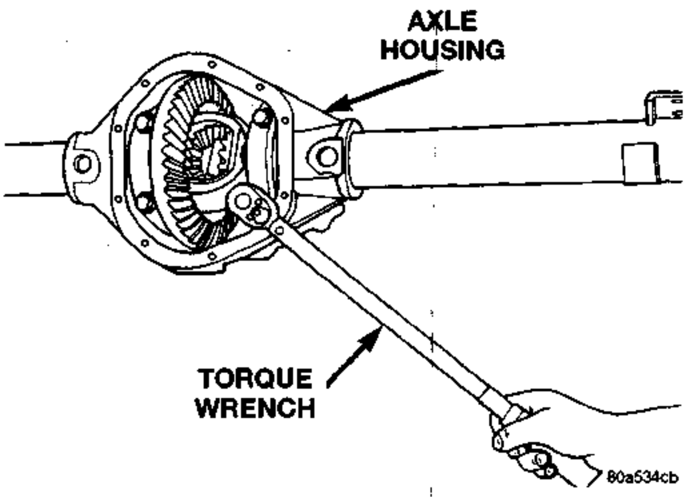

Fig. 28 Tighten Differential Bearing Cap Bolts

DIFFERENTIAL SIDE BEARINGS

REMOVAL

(1) Remove Differential case from axle housing.

(2) Remove the bearings from the differential case with Puller/Press C-293-PA, C-293-42 Blocks (3) from Puller/Press Set C-293–M, and Adapter C-293-3 (Fig. 29).

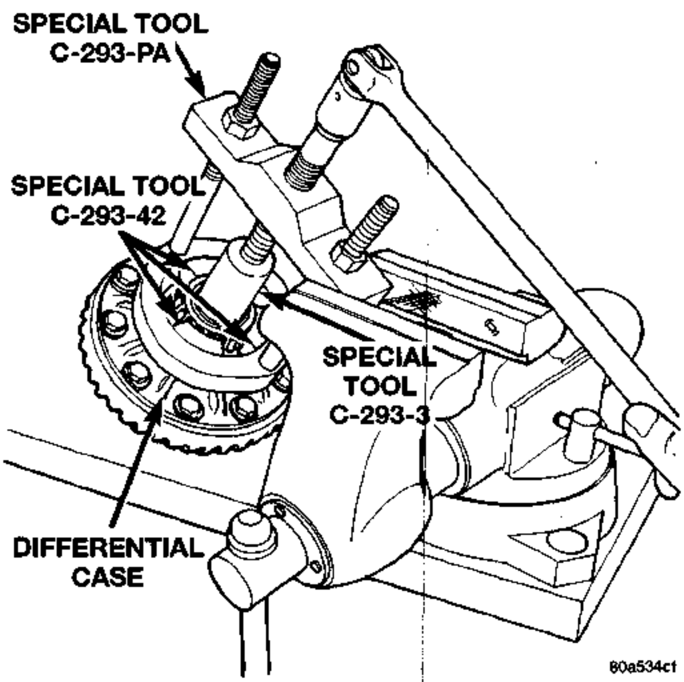

Fig. 29 Differential Bearing Removal

DIFFERENTIAL SIDE BEARING INSTALLATION

If ring and pinion gears have been replaced, verify differential side bearing preload and gear mesh backlash.

(1) Using tool C-4340 with handle C-4171, install differential side bearings (Fig. 30).

(2) Install differential in axle housing.

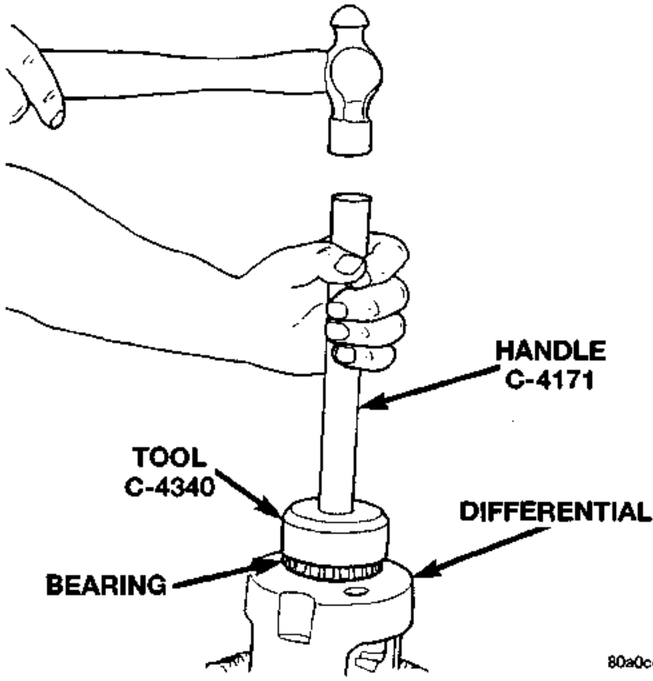

Fig. 30 Install Differential Side Bearings

RING GEAR

The ring and pinion gears are service in a matched set. Do not replace the ring gear without replacing the pinion gear. Refer to Pinion Gear removal and installation paragraph in this section for proper procedure.

REMOVAL

(1) Remove differential from axle housing.

(2) Place differential case in a suitable vise with soft metal jaw protectors. (Fig. 31)

(3) Remove bolts holding ring gear to differential case.

(4) Using a soft hammer, drive ring gear from differential case (Fig. 31).

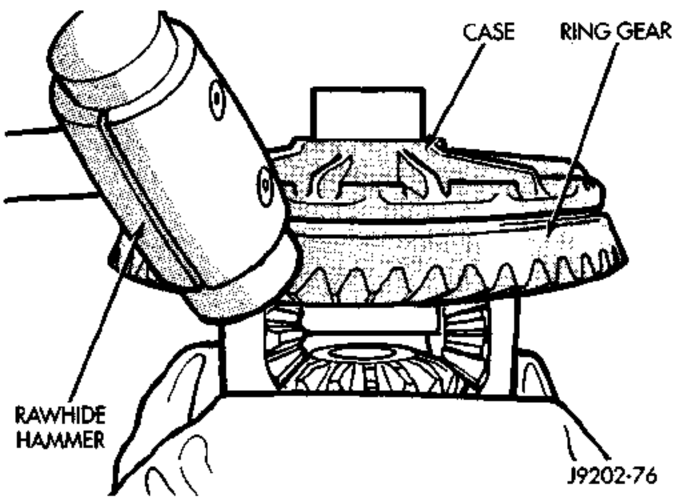

Fig. 31 Ring Gear Removal

REMOVAL AND INSTALLATION (Continued)

RING GEAR INSTALLATION

CAUTION: Do not reuse the bolts that held the ring gear to the differential case. The bolts can fracture causing extensive damage.

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

(2) Install new ring gear bolts and alternately tighten to 95–122 N·m (70–90 ft. lbs.) torque (Fig. 32).

(3) Install differential in axle housing and verify gear mesh and contact pattern.

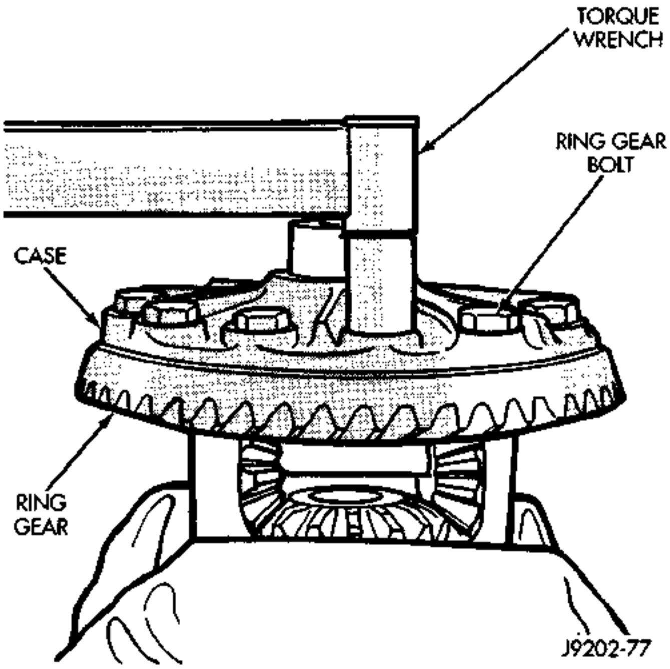

Fig. 32 Ring Gear Bolt Installation

PINION GEAR

REMOVAL

(1) Remove differential case from axle housing.

(2) Disconnect propeller shaft from pinion yoke. Using suitable wire, tie propeller shaft to underbody.

(3) Using Holder 6958 to hold yoke and a short length of 1 in. pipe, remove the pinion yoke nut and washer (Fig. 33).

(4) Using Remover C–452 and Holder 6958, remove the pinion yoke from pinion shaft (Fig. 34).

(5) Remove the pinion gear from housing (Fig. 35). Hold the pinion gear inside axle housing prevent the gear from falling and being damaged.

(6) Remove and save pinion bearing preload shims from pinion gear shaft. The factory installed shims may be reusable when the pinion gear is assembled. Using a micrometer, measure and record the thickness of the shims to use as a reference point when determining proper shim thickness for new bearings or gear set. **If the pinion depth shims require change to a different thickness, the preload shims will also require change to a different thickness .**

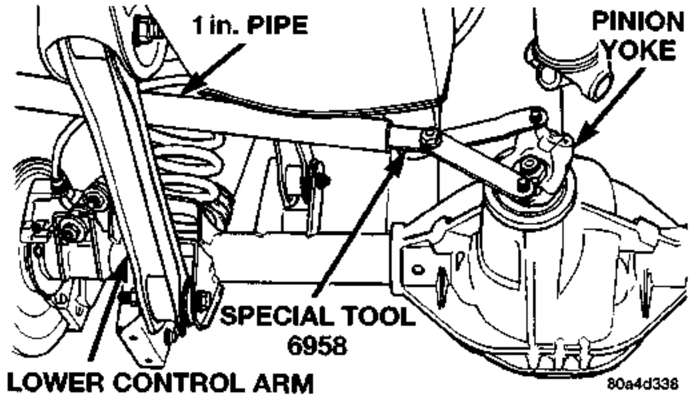

Fig. 33 Pinion Yoke Holder

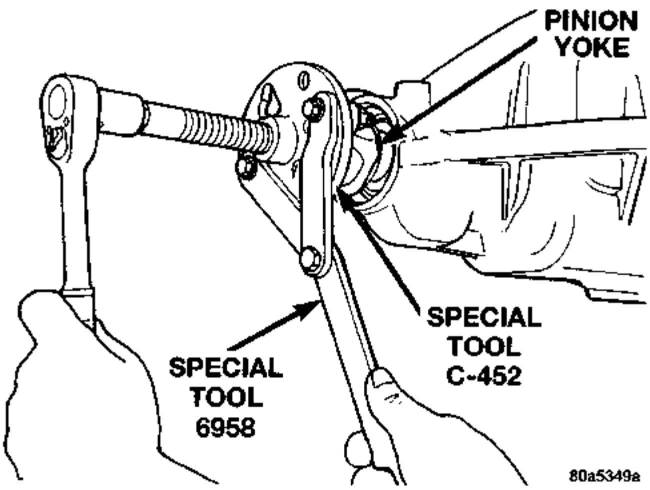

Fig. 34 Pinion Yoke Removal

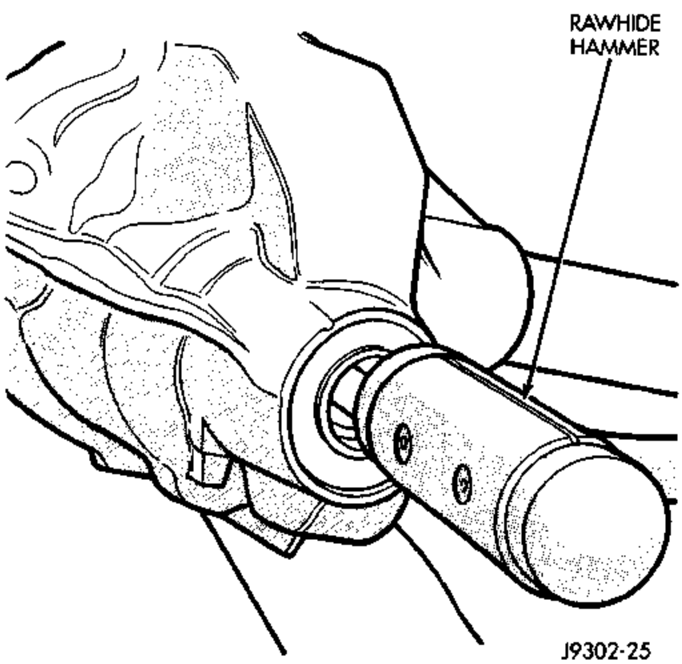

Fig. 35 Remove Pinion Gear

REMOVAL AND INSTALLATION (Continued)

(7) Remove the pinion gear seal, slinger, and outer bearing with Remover 7794-A and Slide Hammer 7420 (Fig. 36).

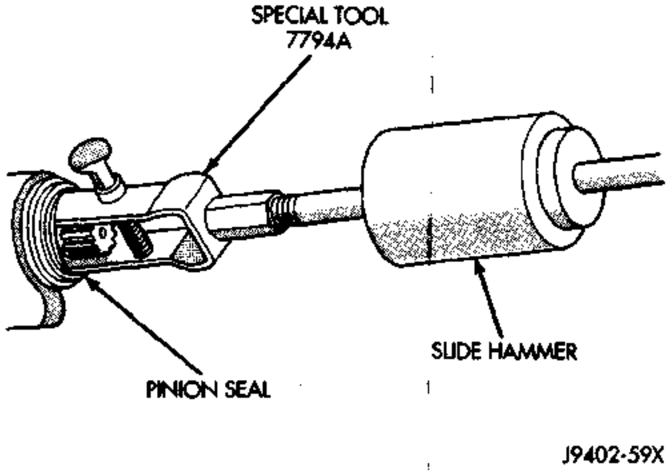

Fig. 36 Remove Pinion Seal, Slinger, and Outer Bearing

(8) Remove the front pinion bearing cup and seal with Remover D-147 and Handle C–4171 (Fig. 37).

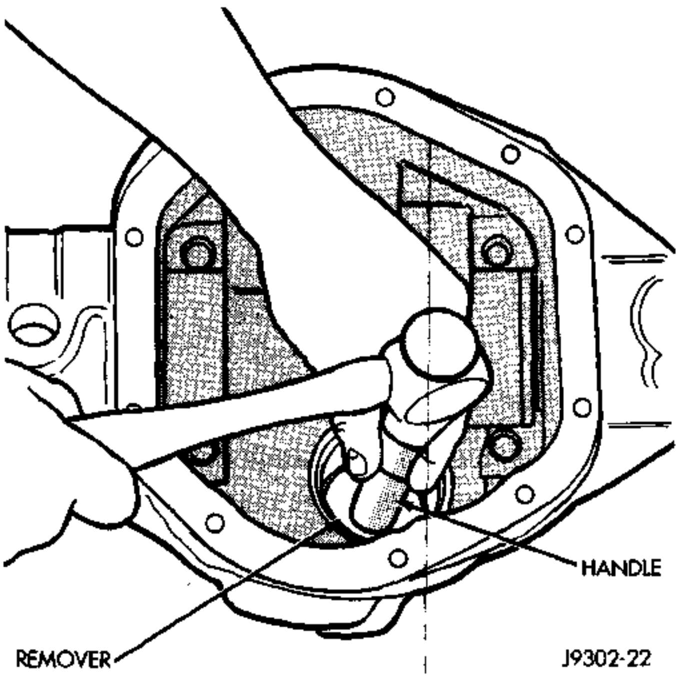

Fig. 37 Front Bearing Cup Removal

(9) Remove the rear bearing cup from housing (Fig. 38). Use Remover D-148 and Handle C-4171.

NOTE: The pinion gear depth shims are located behind the inner pinion bearing cup.

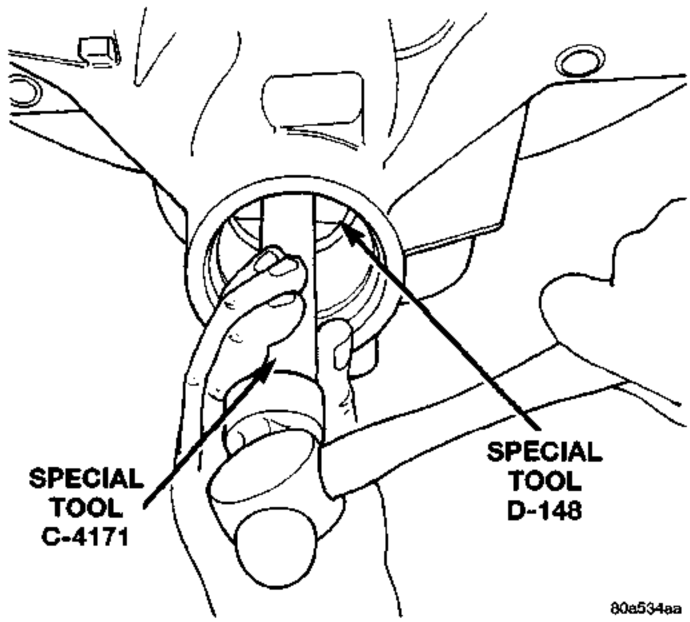

Fig. 38 Rear Bearing Cup Removal

(10) Remove and save pinion depth shims from bearing cup bore in axle housing. The factory installed shims may be reusable when the pinion gear is assembled. Using a micrometer, measure and record the thickness of the shims to use as a reference point when determining proper shim thickness for new bearings or gear set. **If the pinion depth shims require change to a different thickness, the preload shims will also require change to a different thickness.**

(11) Remove the inner bearing from the pinion with Puller/Press C-293PA and Adapter C-293-39 (3) from Puller/Press set C-293-M. (Fig. 39).

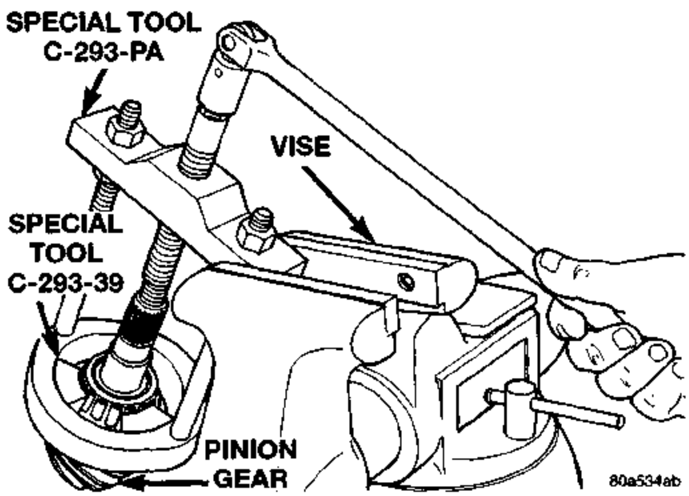

Fig. 39 Inner Bearing Cone Removal

REMOVAL AND INSTALLATION (Continued)

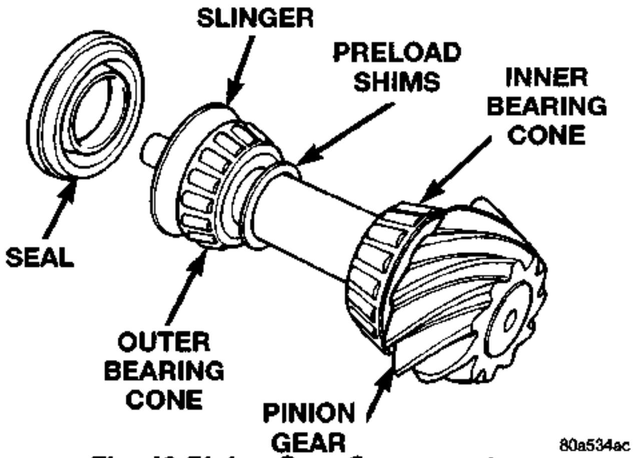

Fig. 40 Pinion Gear Components

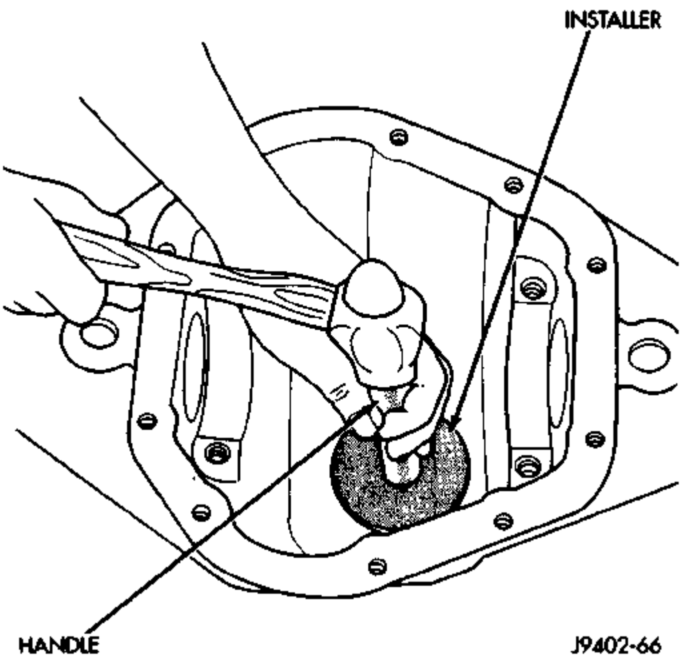

Fig. 41 Pinion Rear Bearing Cup Install

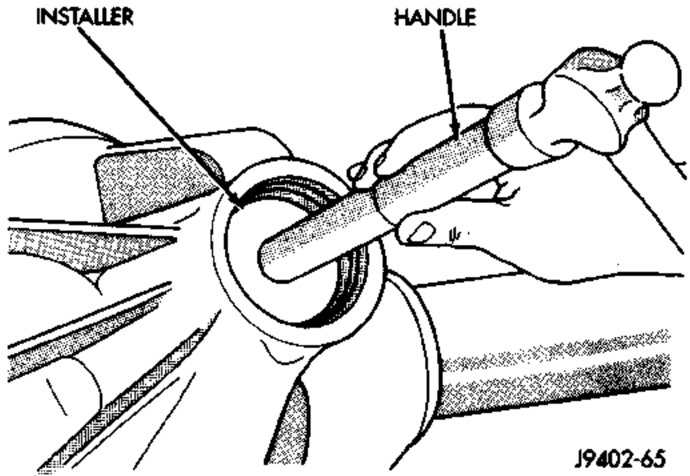

Fig. 42 Pinion Front Bearing Cup Install

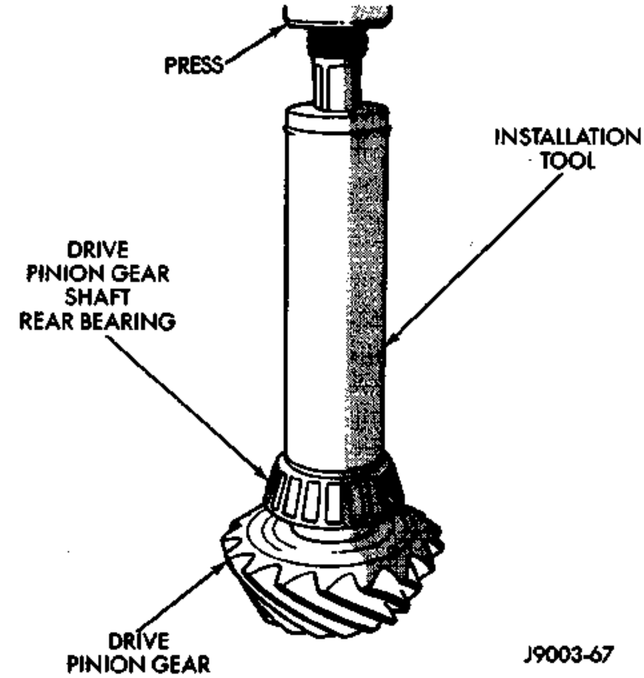

Fig. 43 Inner Pinion Bearing Cone Install

PINION GEAR INSTALLATION

Before installing replacement gear set and bearings (Fig. 40), measure and adjust the pinion gear depth shims. Refer to Pinion Gear Depth paragraph in the Adjustment section of this group.

(1) Place proper thickness pinion gear depth shims in bore of inner pinion bearing cup in axle housing.

(2) Apply Mopar, Door-ease stick lubricant to outside surface of bearing cup.

(3) Install the pinion rear bearing cup with Installer D-145 and Handle C-4171 (Fig. 41). Verify that cup is properly seated.

(4) Apply Mopar, Door-ease stick lubricant to outside surface of bearing cup.

(5) Install the outer pinion bearing cup with Installer D-144 and Handle C-4171 (Fig. 42).

(6) Install the inner bearing cone on pinion gear with Installer 6448 (Fig. 43).

NOTE: If the pinion depth shims did not require change of thickness, the factory installed pinion bearing preload shims may properly preload the new bearings. If the new pinion gear has a different ± indication on the pinion gear head than the factory installed gear, the pinion depth shims and bearing preload shims would require change of thickness. If the new pinion depth shims are thicker than the original shims, deduct the difference from the pinion bearing preload shims. If the new pinion depth shims are thinner than the original shims, add the difference to the pinion bearing preload shims. If the factory installed shim thickness is not known, temporarily install a thick enough shim(s) to create a small amount of pinion bearing end play. Measure the end play with a dial indicator. Deduct the dial indicator reading minus 0.20 mm (0.008 in.) from the temporary shim thickness. Install a shim equal to the total.

REMOVAL AND INSTALLATION (Continued)

(7) Install pinion bearing preload shim(s) on pinion gear (Fig. 40).

(8) Lightly lubricate inner and outer pinion bearing cones with axle lubricant.

NOTE: Before installing pinion gear, establish the proper differential side bearing preload shim requirement. Refer to Differential Bearing Preload and Gear backlash paragraph in the Adjustments section of this group.

(9) Insert pinion gear into axle housing through the pinion bearing cups.

(10) Install outer pinion bearing in axle housing over pinion gear shaft (Fig. 40).

(11) Using screw, nut, and washer from Installer W-162–D and a 3/4 in. drive 1-5/16 in. deep well socket as an adapter, push outer pinion bearing cone onto pinion shaft (Fig. 44). Tighten installer nut to 122 N·m (90 ft. lbs.).

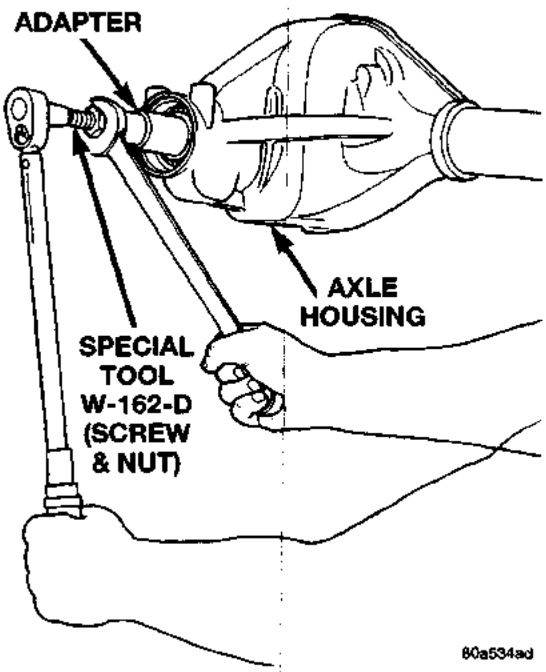

Fig. 44 Outer Pinion Bearing Install

(12) Rotate pinion gear several times to lap in bearings.

(13) Using a dial type (in. lbs.) torque wrench, measure the preload resistance of the pinion bearings (Fig. 45). Preload should not be less than 2.25 N·m (20 in. lbs.) and not exceed 4.5 N·m (40 in. lbs.). If preload is out of specification, add or subtract shims to achieve proper preload.

(14) Remove screw from Installer W-162-D and adapter. Assemble Installer W-162-D.

(15) Install pinion slinger over end of pinion shaft.

(16) Apply a light coating of multi-purpose on inner seal surface of pinion seal.

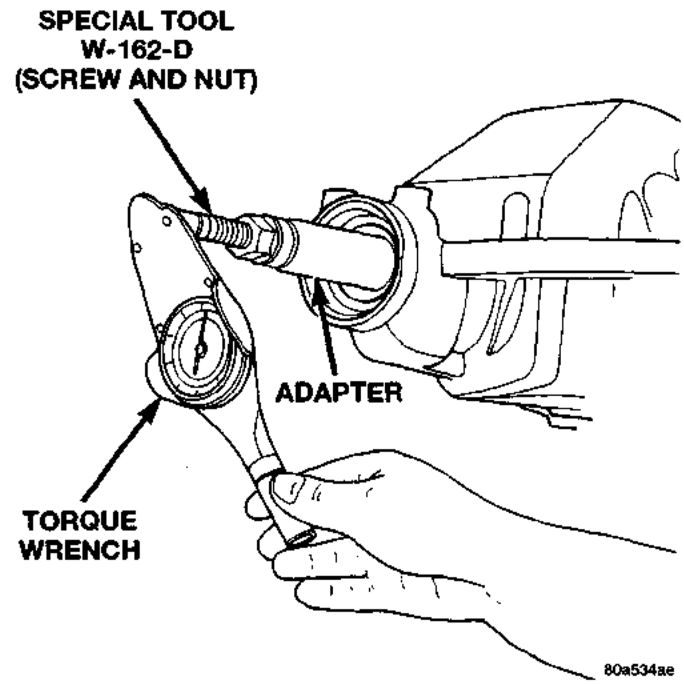

Fig. 45 Measure Pinion Bearing Preload.

(17) Install seal with Installer D-163 and Handle C-4171 (Fig. 46).

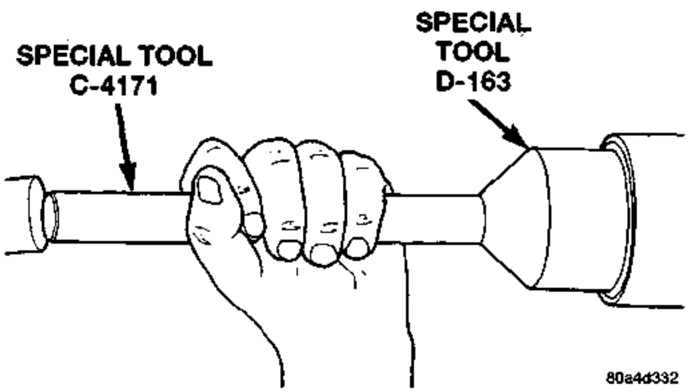

Fig. 46 Pinion Seal Installation

(18) Install yoke with Installer W-162-D and holder 6958 (Fig. 47).

(19) Install yoke washer and a new nut on the pinion gear.

(20) Using yoke holder 6958, a short length of 1 in. pipe, and a 3/4 in. drive torque wrench, Tighten nut to 234 N·m (180 ft. lbs.). (Fig. 48).

(21) Verify pinion bearing preload rotating torque (Fig. 49). If preload is within specifications, proceed with assembly of axle components. If preload is not within specifications, add or subtract shims to achieve proper preload.

- Original Bearings — 1 to 3 N·m (10 to 20 in. lbs.).
- New Bearings — 2 to 5 N·m (15 to 35 in. lbs.).

NOTE: After installing pinion gear, establish the proper differential (ring gear side) backlash shim requirement. Refer to Differential Bearing Preload and Gear Backlash paragraph in the Adjustments section of this group.

REMOVAL AND INSTALLATION (Continued)

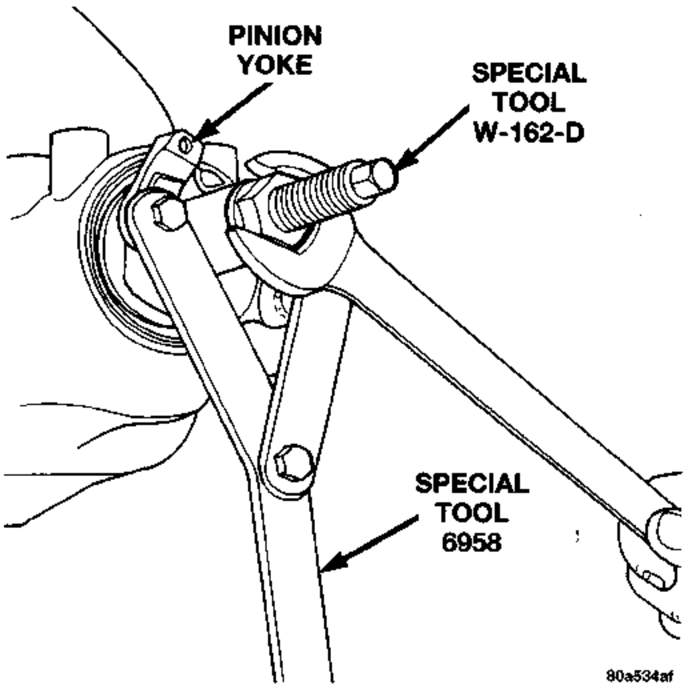

Fig. 47 Pinion Yoke Installation

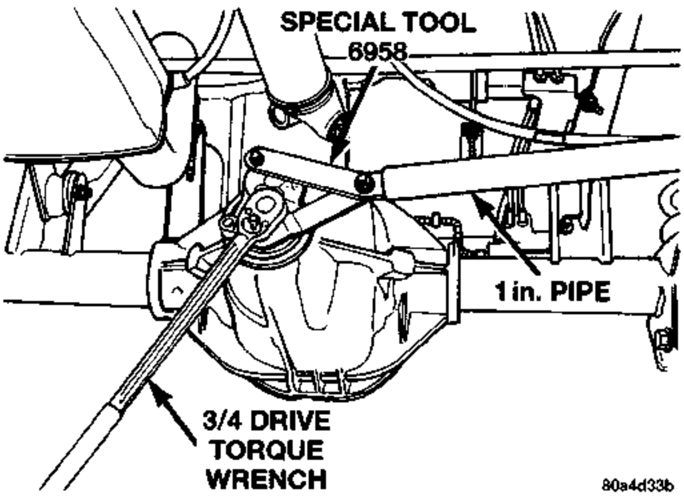

Fig. 48 Tightening Pinion Nut

(22) Install differential case and ring gear.
(23) Install axle shafts.
(24) Install axle housing cover.
(25) Install propeller shaft
(26) Fill axle to bottom of fill hole with Mopar, Gear Lubricant, refer to Lubricant Specifications paragraph in the General Information section of this group.
(27) Lower vehicle and road test to verify repair.

FINAL ASSEMBLY

After pinion gear depth, differential bearing preload, and gear lash has been determined, install the pinion gear and differential assembly and proceed with this procedure.

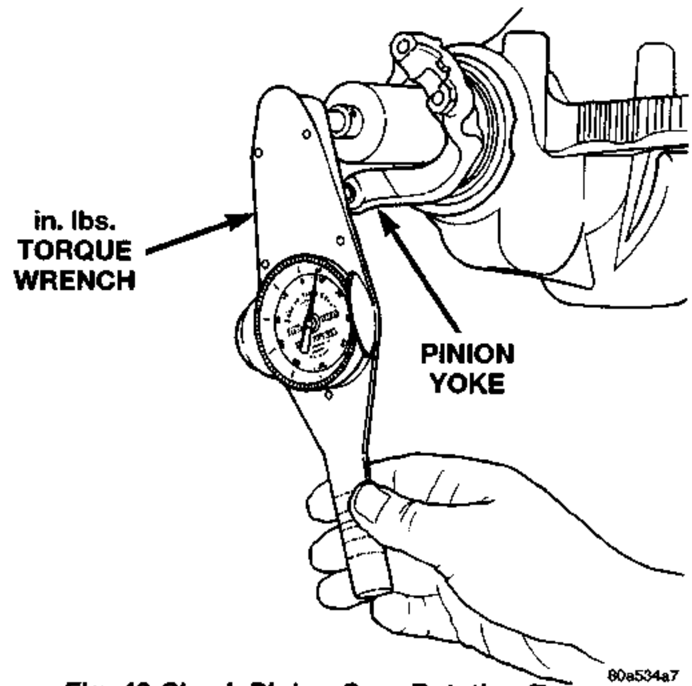

Fig. 49 Check Pinion Gear Rotation Torque

(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. 50). Allow the sealant to cure for a few minutes.

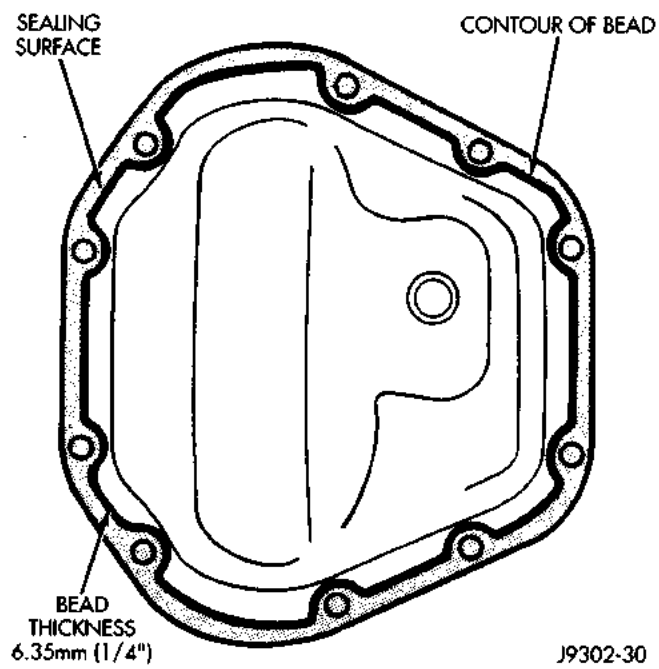

Fig. 50 Typical Housing Cover With Sealant

Install the housing cover within 5 minutes after applying the sealant.

REMOVAL AND INSTALLATION (Continued)

(3) Install the cover on the differential with the attaching bolts. Install the identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

(4) Refill the differential housing with the specified quantity of Mopar Hypoid Gear Lubricant.

(5) Install the fill hole plug and tighten to 34 N·m (25 ft. lbs.) torque.

DISASSEMBLY AND ASSEMBLY

STANDARD DIFFERENTIAL

DISASSEMBLE

(1) Using a suitable roll pin punch, drive roll pin holding pinion gear mate shaft in differential case (Fig. 51).

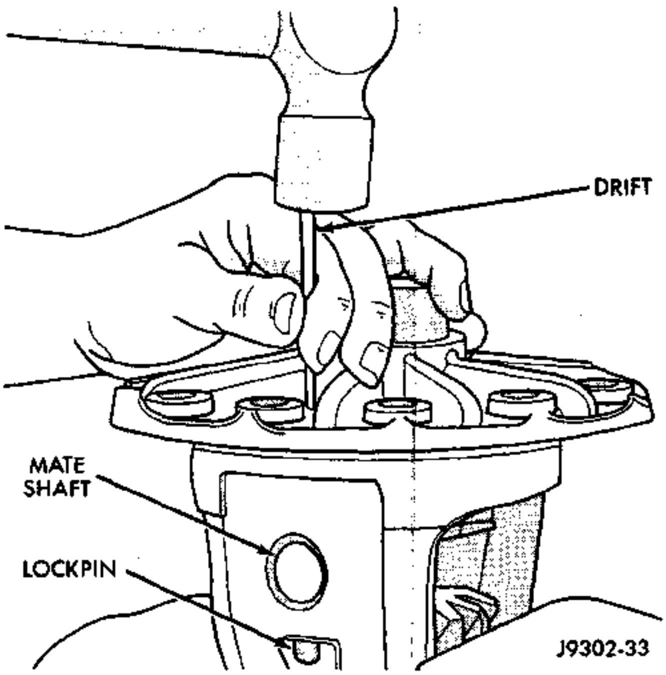

Fig. 51 Mate Shaft Roll Pin Removal

(2) Remove pinion gear mate shaft.

(3) Rotate differential side gears and remove the pinion mate gears and thrust washers (Fig. 52).

(4) Remove differential side gears and thrust washers.

DIFFERENTIAL ASSEMBLE

(1) Differential side gears and thrust washers

(2) Pinion gears and thrust washers

(3) Pinion gear mate shaft (align holes in shaft and case)

(4) Install roll pin to hold mate shaft in differential case (Fig. 53).

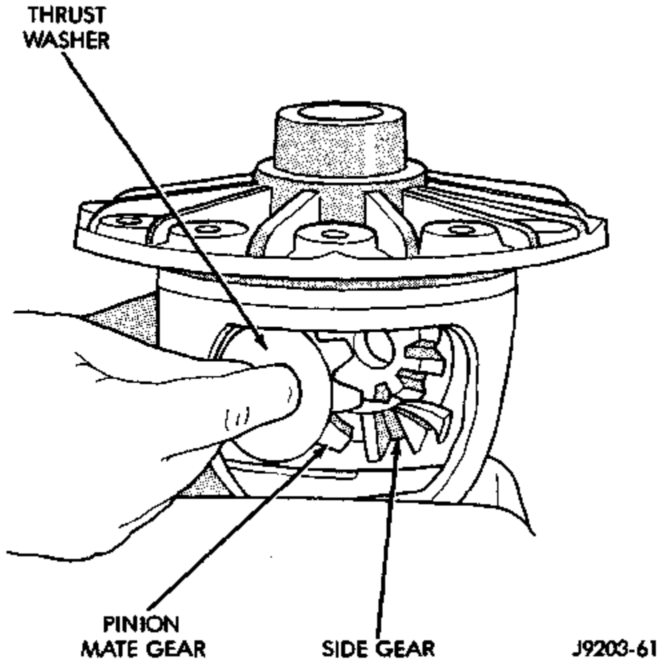

Fig. 52 Pinion Mate Gear Removal

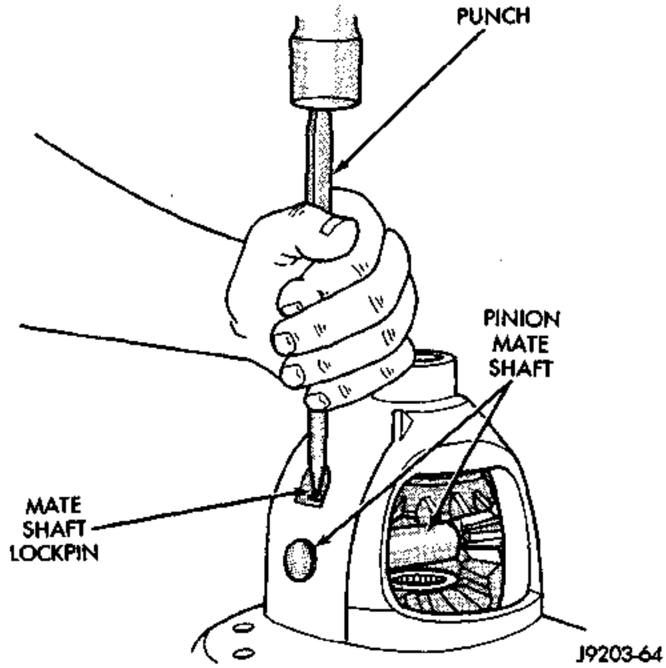

Fig. 53 Mate Shaft Roll Pin Installation

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

(6) Install differential case in axle housing. Refer to Differential removal and installation procedure.

TRAC-LOK DIFFERENTIAL

DISASSEMBLE

Trac-Lok differential disassemble and assembly requires Tool Set C-4487.

DISASSEMBLY AND ASSEMBLY (Continued)

(1) Remove differential case from axle housing. Refer to Differential paragraph in the Removal and Installation section of this group.

(2) Clamp Side Gear Holding Tool 6963-A in a vise.

(3) Position the differential case on the holding tool (Fig. 54).

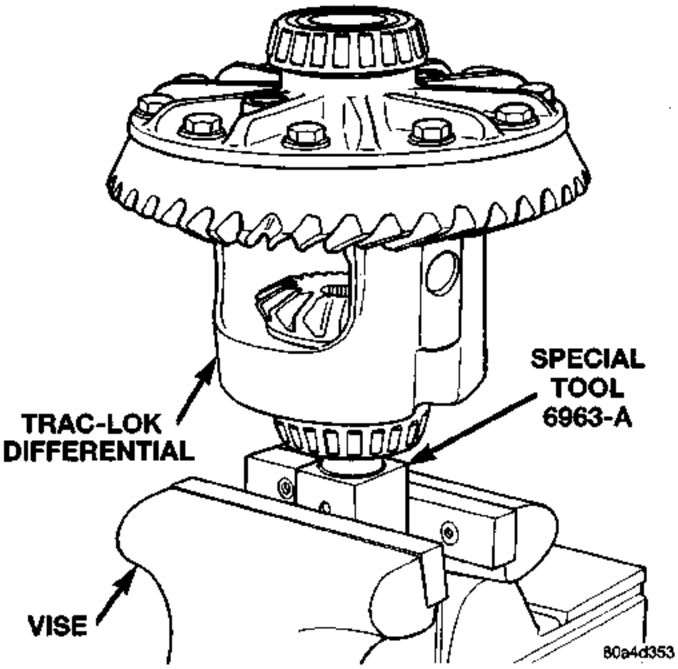

Fig. 54 Differential Case Holding Tool

(4) Using a suitable roll pin punch, drive roll pin holding pinion gear mate shaft in differential case (Fig. 55).

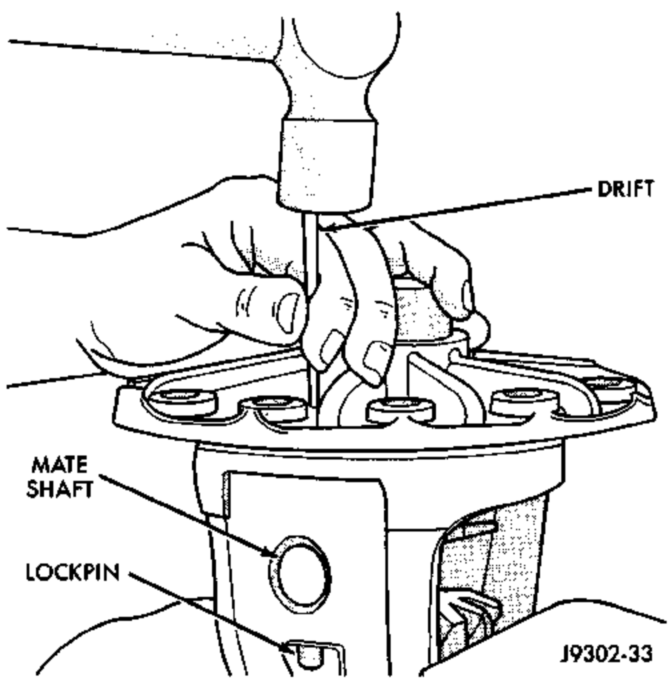

Fig. 55 Mate Shaft Roll Pin Removal

(5) Remove the pinion gear mate shaft. If necessary, use a drift and hammer (Fig. 56).

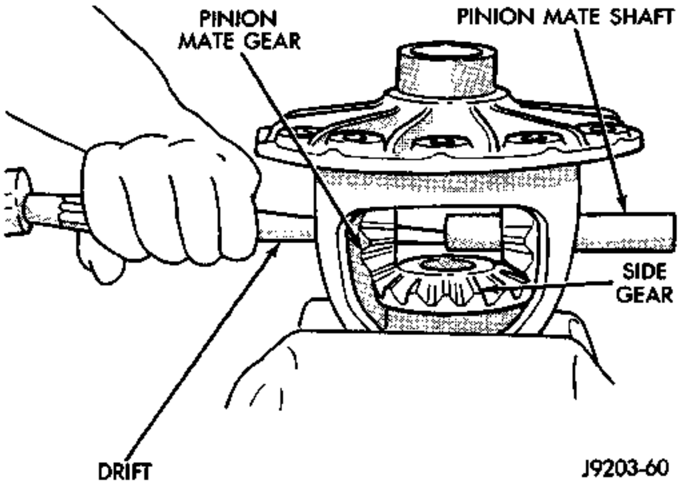

Fig. 56 Mate Shaft Removal

(6) Lubricate centering countersink on Step Plate C-4487-1 with Mopar, Door-ease stick lubricant.

(7) Place Step Plate C–4487–1 in differential side gear at bottom of differential case. (Fig. 57).

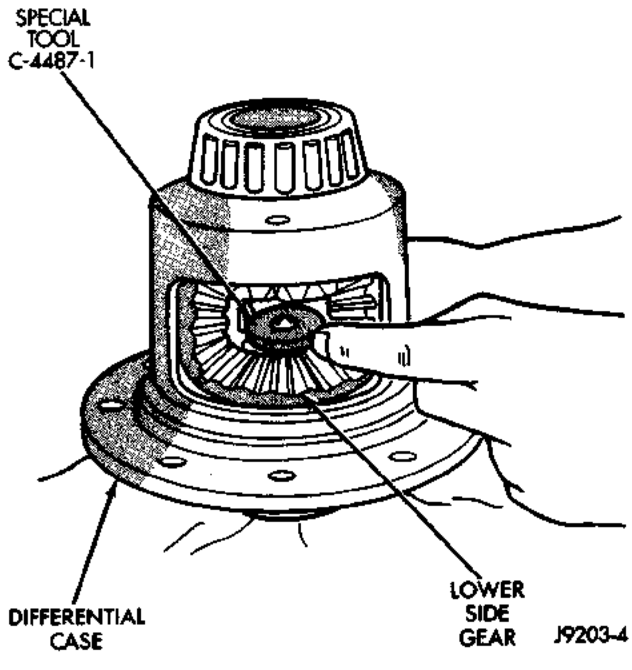

Fig. 57 Step Plate Tool Installation—Shown With 6963-A Holder

DISASSEMBLY AND ASSEMBLY (Continued)

(8) Place and hold threaded Step Plate C–4487–3 into side gear at top of differential case.

(9) Insert Screw C–4487–2 into top of differential case and thread screw into step plate until it is centered in lower step plate.

(10) If necessary, insert a small screw driver into slot in side of Step Plate C–4487–3 (Fig. 58) to prevent it from turning.

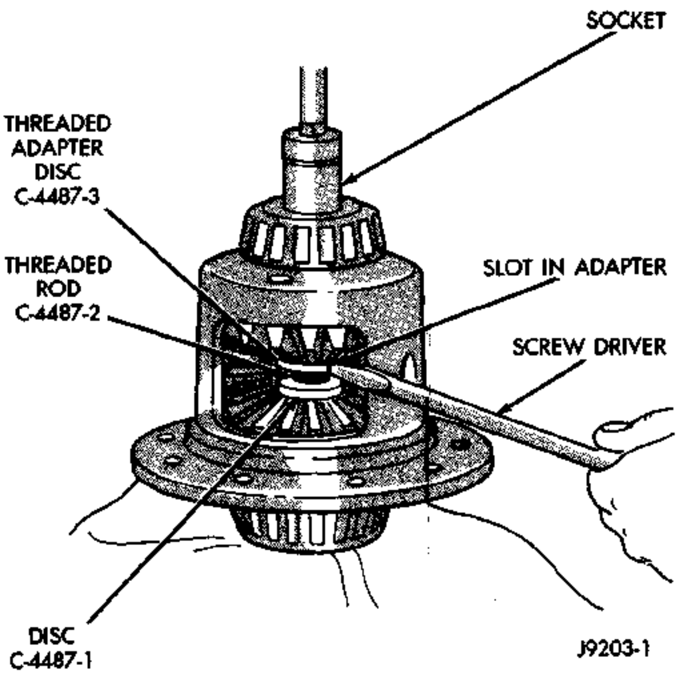

Fig. 58 Threaded Adapter Installation—Shown With 6963-A Holder

(11) Tighten Screw C-4487-2 to 122 N·m (90 ft. lbs.) (maximum) torque to compress Belleville springs in clutch packs (Fig. 59).

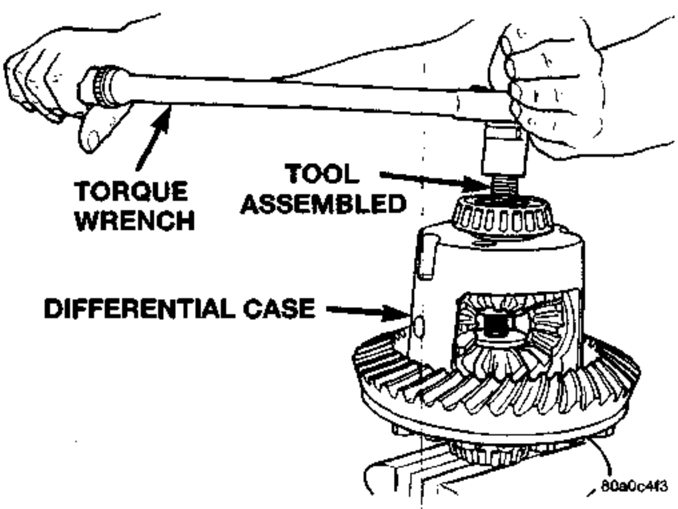

Fig. 59 Tighten Belleville Spring Compressor Tool—Shown With 6963-A Holder

(12) Using a 0.020 in. feeler gauge and mallet, remove thrust washers from behind the pinion gears (Fig. 60).

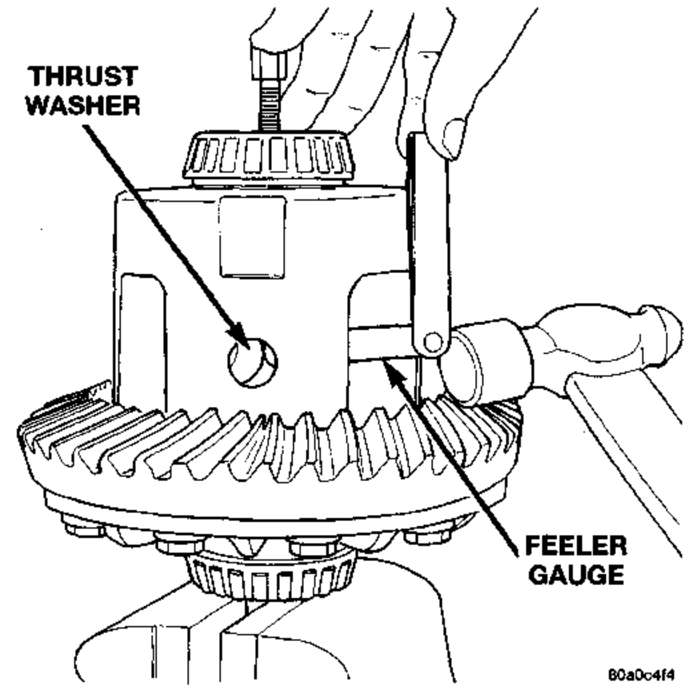

Fig. 60 Remove Pinion Thrust Washer—Shown With 6963-A Holder

(13) Loosen the forcing screw until the clutch pack tension is relieved and the pinion gears can be slightly rattled between the case and side gears.

(14) Insert Handle C-4487-4 in pinion mate shaft hole in side of differential case. Rotate differential case until pinion gears can be removed (Fig. 61).

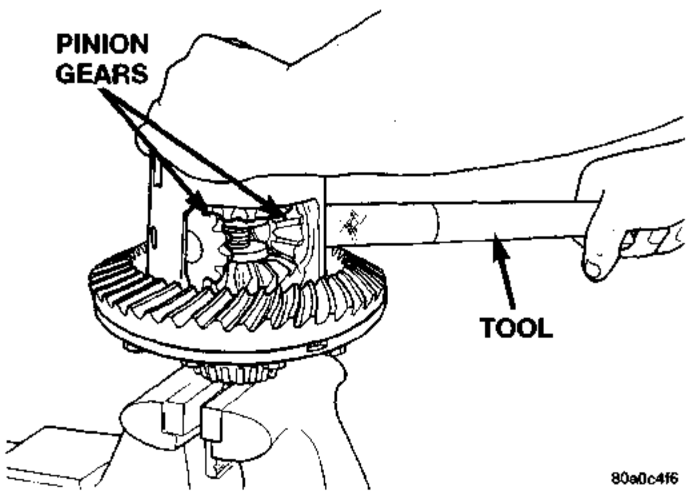

Fig. 61 Pinion Gear Removal—Shown With 6963-A Holder

DISASSEMBLY AND ASSEMBLY (Continued)

(15) Remove tool C-4487 from differential case.

(16) Remove top side gear and clutch pack. Keep plates in correct order during removal (Fig. 62).

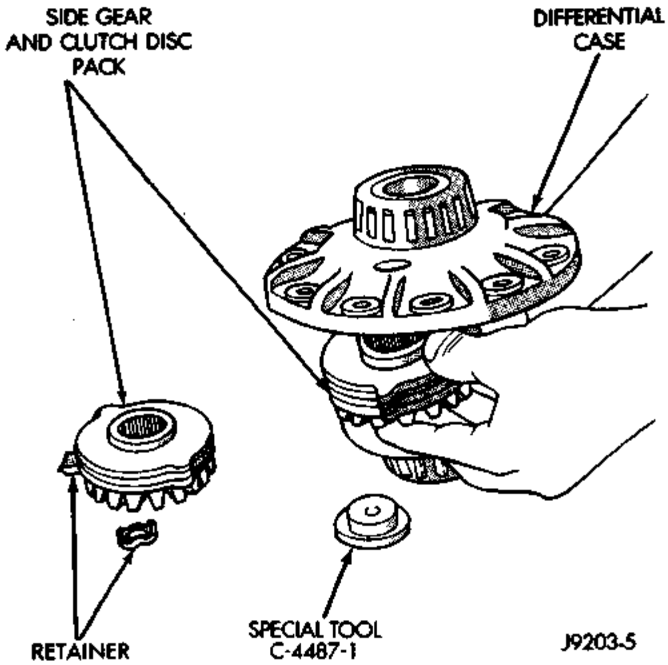

Fig. 62 Side Gear & Clutch Disc Removal

(17) Lift differential case from holding tool.

(18) Remove bottom side gear and clutch pack from differential case.

(19) Mark each clutch pack for installation reference.

ASSEMBLY

The clutch discs are replaceable as complete sets only. **If one clutch disc pack is damaged, both packs must be replaced.**

Lubricate each component with Mopar, gear lubricant before assembly.

(1) Assemble the clutch discs into packs and secure disc packs with retainers (Fig. 63).

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

(3) Insert side gear and clutch pack into ring gear side of differential case (Fig. 64). Guide clutch pack retainers into recesses in differential case.

(4) Place differential case on holder 6963-A.

(5) Install lubricated Step Plate C-4487-1 on bottom clutch pack (Fig. 65).

(6) Insert and hold side gear and clutch pack into upper side of differential case (Fig. 65). Guide clutch pack retainers into recesses in differential case.

(7) Insert Step Plate C-4487-3 into top side gear, install forcing Screw C-4487-2.

(8) Tighten forcing screw tool to slightly compress Belleville washer in clutch packs.

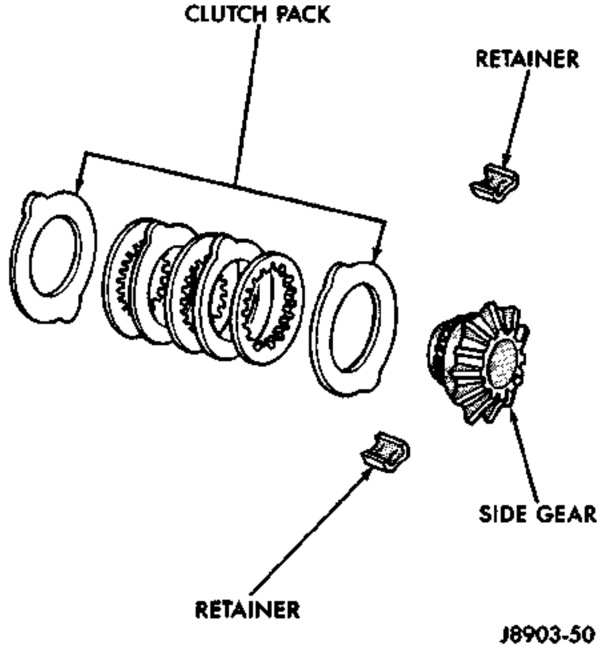

Fig. 63 Clutch Disc Pack

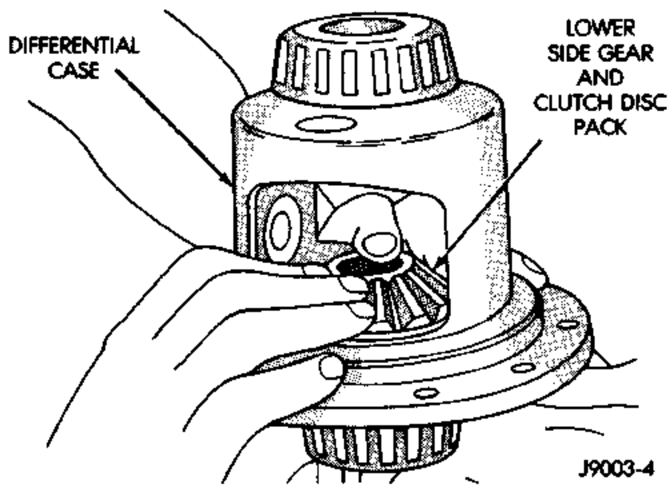

Fig. 64 Clutch Discs and Ring Gear Side Gear Installation

(9) Place pinion gears in position in side gears and verify that mate shaft hole line up.

(10) Rotate case with Handle C-4487-4 until mate shaft holes in pinion gears align with holes in differential case.

(11) Tighten forcing screw to 122 N·m (90 ft. lbs.) to compress the Belleville springs.

(12) Lubricate and insert thrust washers behind pinion gears. Align washers with a small screw driver.

(13) Install pinion gear mate shaft in differential case.

(14) Install roll pin to hold mate shaft in differential case (Fig. 66).

(15) Remove tool C-4487 from differential case.

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

DISASSEMBLY AND ASSEMBLY (Continued)

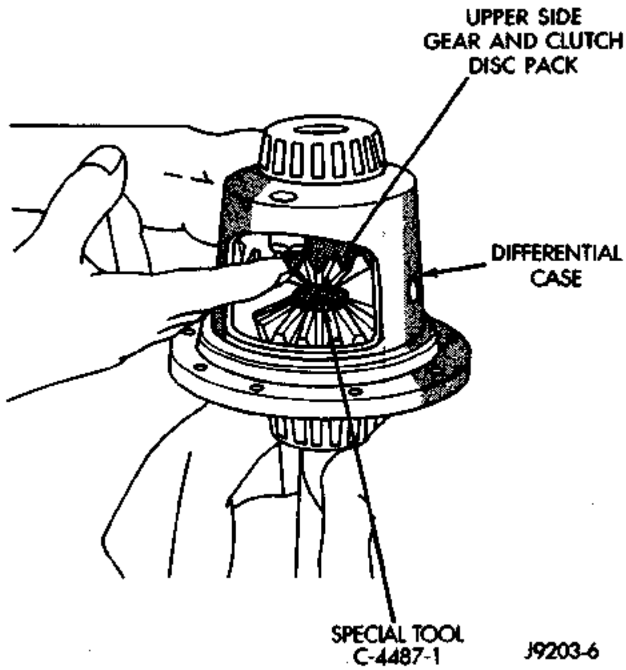

Fig. 65 Upper Side Gear & Clutch Disc Pack Installation—Shown With 6963-A Holder

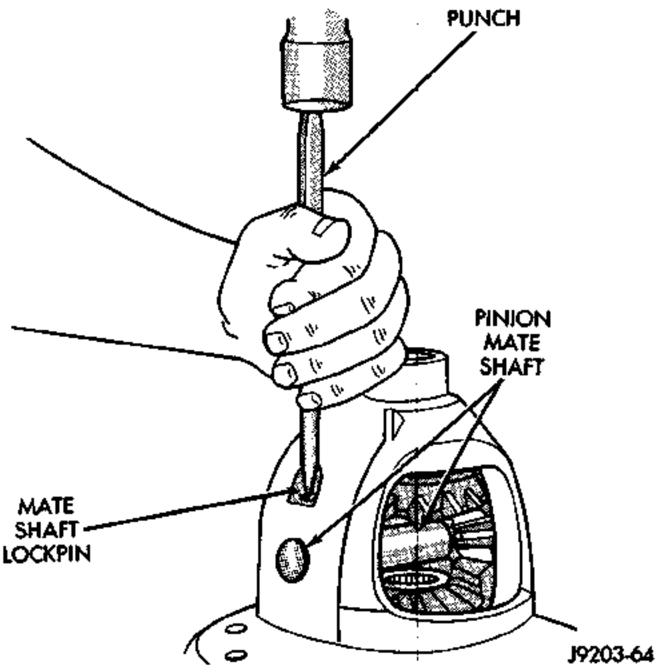

Fig. 66 Mate Shaft Roll Pin Installation

(17) Install differential case in axle housing.

CLEANING AND INSPECTION

AXLE COMPONENTS

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

Wash bearings with solvent and towel dry, or dry with compressed air. DO NOT spin bearings with compressed air. **Cup and bearing must be replaced as matched sets only.**

Clean axle shaft tubes and oil channels in housing. Inspect for;

- Smooth appearance with no broken/dented surfaces on the bearing rollers or the roller contact surfaces
- Bearing cups must not be distorted or cracked
- Machined surfaces should be smooth and without any raised edges
- Raised metal on shoulders of cup bores should be removed with a hand stone
- Wear and damage to pinion gear mate shaft, pinion gears, side gears and thrust washers. Replace as a matched set only.
- Ring and pinion gear for worn and chipped teeth
- Ring gear for damaged bolt threads. Replaced as a matched set only.
- Pinion yoke for cracks, worn splines, pitted areas, and a rough/corroded seal contact surface. Repair or replace as necessary.
- Preload shims for damage and distortion. Install new shims if necessary.

TRAC-LOK

(1) Clean all components 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.

PRESOAK PLATES AND DISC

Plates and discs with fiber coating (no grooves or lines) must be presoaked in Friction Modifier before assembly. Soak plates and discs for a minimum of 20 minutes. Add remaining Friction Modifier to differential after assembly.

ADJUSTMENTS

PINION GEAR DEPTH

GENERAL INFORMATION

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and pinion gear are etched into the face of each gear (Fig. 67). A plus (+) number, minus (–) number or zero (0) is etched into the face of the pinion gear. This number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a

ADJUSTMENTS (Continued)

pinion etched with a (0). The standard setting from the center line of the ring gear to the back face of the pinion is 109.52 mm (4.312 in.). The standard depth provides the best teeth contact pattern. Refer to Backlash and Contact Pattern Analysis Paragraph in this section for additional information.

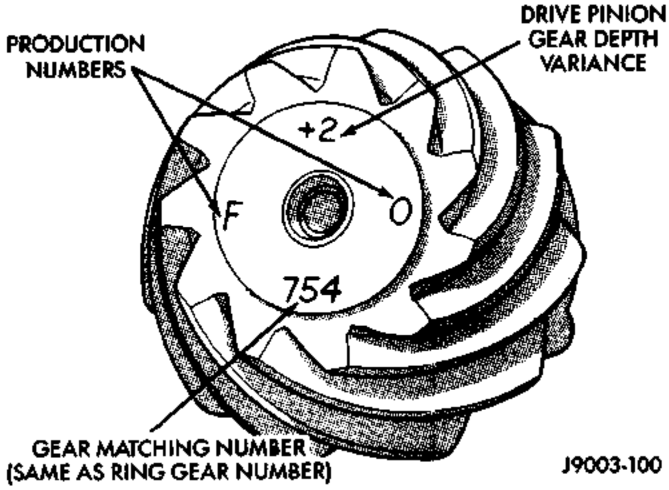

Fig. 67 Pinion Gear ID Numbers

Compensation for pinion depth variance is achieved with select shims. The shims are placed under the inner pinion bearing cup in the axle housing bore (Fig. 68).

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

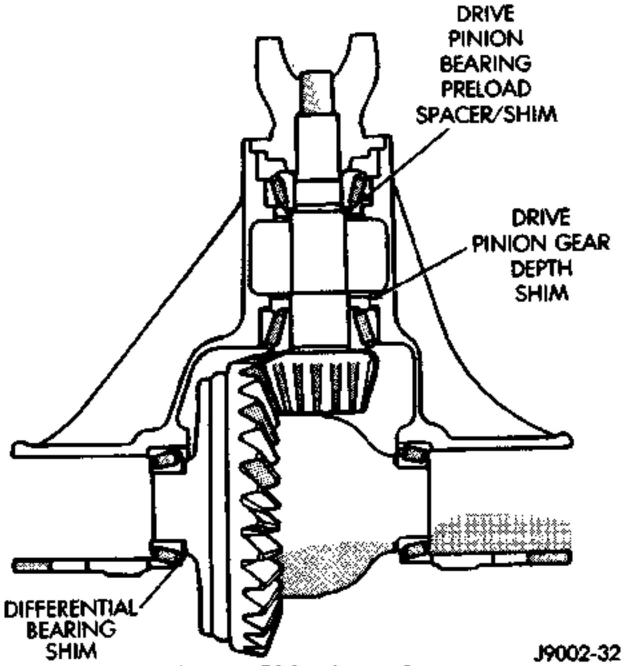

Fig. 68 Shim Locations

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

Note the etched number on the face of the drive pinion gear (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shim(s). If the number is positive, subtract that value from the thickness of the depth shim(s). If the number is 0 no change is necessary. Refer to the Pinion Gear Depth Variance Chart.

PINION GEAR DEPTH VARIANCE

Original Pinion Gear Depth Variance	Replacement Pinion Gear Depth Variance								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

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ADJUSTMENTS (Continued)

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Pinion gear depth measurement is necessary when:

- Axle housing or differential case is replaced
- Pinion select shim pack is unknown
- Ring and pinion gears are replaced

NOTE: Measurements are taken with pinion cups and pinion bearings installed in housing without shims placed behind the inner pinion bearing cup. Take measurements with Pinion Gauge Set 6730 and Dial Indicator C-3339 (Fig. 69).

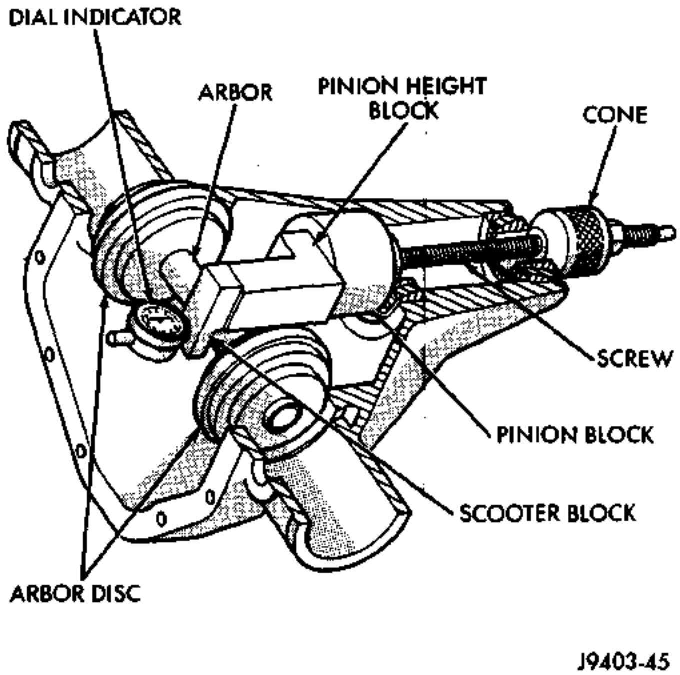


Fig. 69 Pinion Gear Depth Gauge Tools—Typical

(1) Assemble Pinion Height Block 6739, Pinion Block 6734, and rear pinion bearing onto Screw 6741 (Fig. 69).

(2) Insert assembled height gauge components, rear bearing and screw into axle housing through pinion bearing cups (Fig. 70).

(3) Install front pinion bearing and Cone 6740 hand tight (Fig. 69).

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in axle housing side bearing cradles (Fig. 71). Install differential bearing caps on Arbor Discs and tighten cap bolts to 41 N·m (30 ft. lbs.).

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

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

(6) Place Scooter Block/Dial Indicator in position in axle housing so dial probe and scooter block are flush against the rearward surface of the pinion height block (Fig. 69). Hold scooter block in place and zero the dial indicator face to the pointer. Tighten dial indicator face lock screw.

(7) With scooter block still in position against the pinion height block, slowly slide the dial indicator probe over the edge of the pinion height block. Observe how many revolutions counterclockwise the dial pointer travels (approximately 0.125 in.) to the out-stop of the dial indicator.

(8) Slide the dial indicator probe across the gap between the pinion height block and the arbor bar with the scooter block against the pinion height block (Fig. 72). When the dial probe contacts the arbor bar, the dial pointer will turn clockwise. Bring dial pointer back to zero against the arbor bar, do not turn dial face. Continue moving the dial probe to the crest of the arbor bar and record the highest reading. If the dial indicator can not achieve the zero reading, the rear bearing cup or the pinion depth gauge set is not installed correctly.

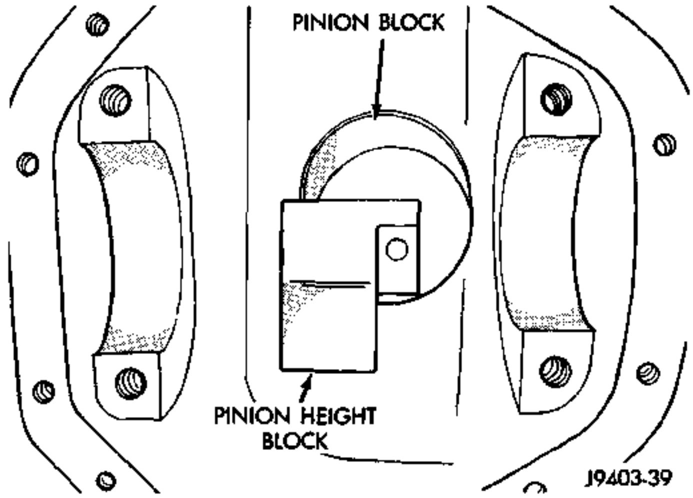


Fig. 70 Pinion Height Block—Typical

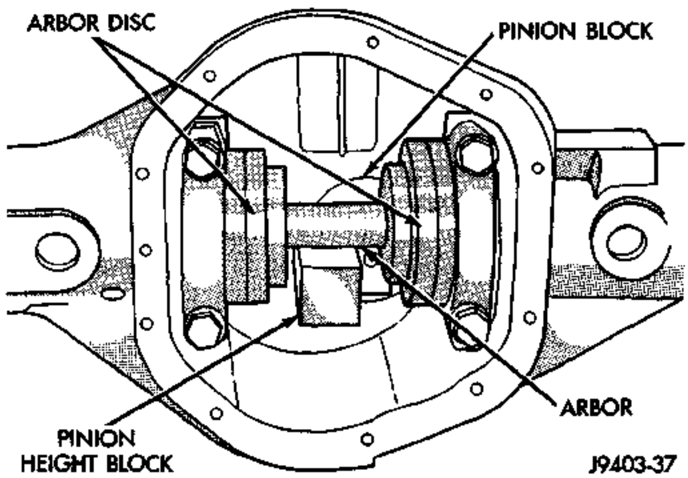


Fig. 71 Gauge Tools In Housing—Typical

ADJUSTMENTS (Continued)

(9) Select a shim equal to the thickest dial indicator reading plus or minus the drive pinion gear depth variance number etched in the face of the pinion gear (Fig. 67).

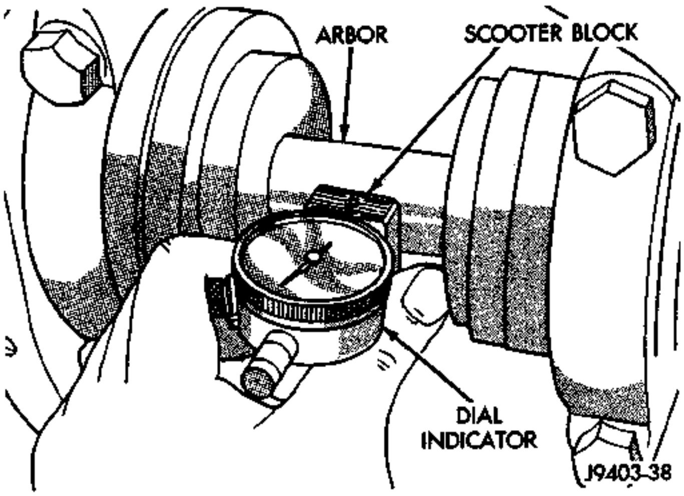


Fig. 72 Pinion Gear Depth Measurement—Typical

(10) Remove the pinion depth gauge components from the axle housing

(11) Remove inner pinion bearing cup from axle housing. Refer to Pinion Gear paragraph in the Removal and Installation section of this group.

(12) Place proper thickness pinion depth shims in axle housing bore behind inner pinion bearing cup.

(13) Install inner pinion bearing cup.

NOTE: If the ring and pinion gear, differential case, or axle housing has been replaced, proceed to Differential Bearing Preload and Gear Lash

NOTE: If pinion depth shim thickness is not the same as the factory installed pinion depth shims, the pinion bearing preload shims will require adjustment. Refer to Pinion Gear paragraph in the Removal and Installation section of this group.

(14) Install the pinion gear in the axle housing. Refer to Pinion Gear paragraph in the Removal and Installation section of this group.

(15) Install differential case with ring gear mounted and with dummy bearings D-435 in place in axle housing.

(16) Determine the proper shim thickness to achieve specified gear lash. Refer to Differential bearing Preload and Gear Lash paragraph in this section for proper procedure.

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

Differential side bearing preload and gear backlash is achieved by selective shims inserted between the bearing cup and the axle housing. The proper shim thickness can be determined using slip-fit dummy bearings D-345 in place of the differential side bearings and a dial indicator C-3339. Before proceeding with the differential bearing preload and gear backlash measurements, measure the pinion gear depth and prepare the pinion gear for installation. Establishing proper pinion gear depth is essential to establishing gear backlash and tooth contact patterns. After the overall shim thickness to take up differential side play is measured, the pinion gear is installed, and the gear backlash shim thickness is measured. The overall shim thickness is the total of the dial indicator reading and the preload specification added together. The gear backlash measurement determines the thickness of the shim used on the ring gear side of the differential case. Subtract the gear backlash shim thickness from the total overall shim thickness and select that amount for the pinion gear side of the differential (Fig. 73). Differential shim measurements are performed with axle spreader W-129-B removed.

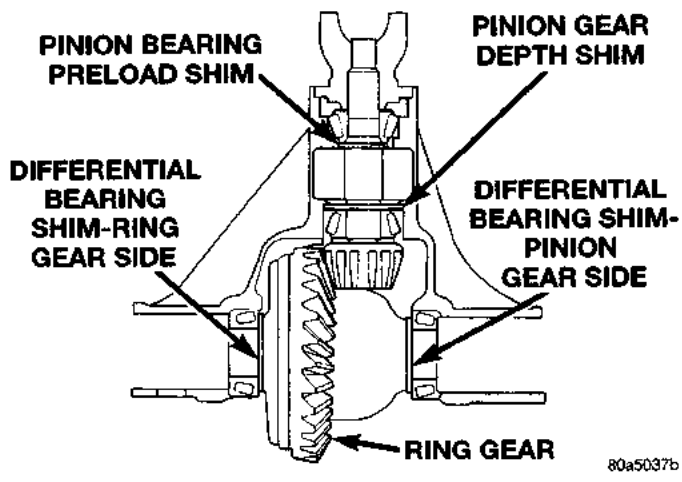


Fig. 73 Axle Adjustment Shim Locations

DIFFERENTIAL PRELOAD AND GEAR BACHLASH SHIM SELECTION

NOTE: It is difficult to salvage the differential side bearings during the removal procedure. Install replacement bearings whenever removal is required.

(1) Remove differential side bearings from differential case.

(2) Remove factory installed shims from differential case.

(3) Install ring gear on differential case and tighten bolts to specification.

(4) Install dummy side bearings D-345 on differential case (Fig. 74).

(5) Install differential case in axle housing.

(6) Install the marked bearing caps in their correct positions. Install and snug the bolts (Fig. 75).

ADJUSTMENTS (Continued)

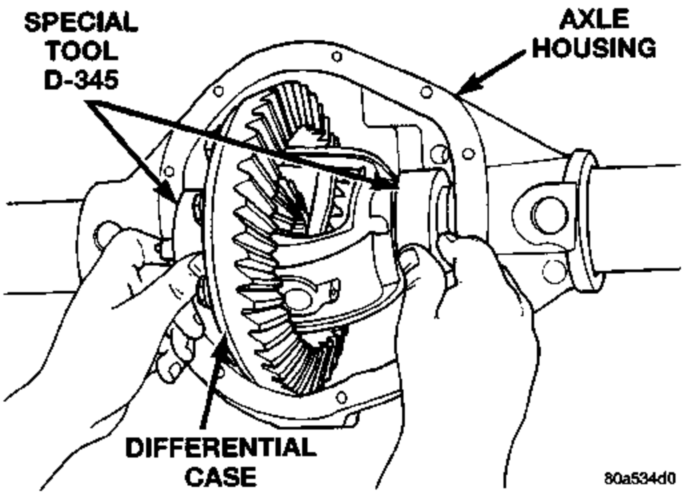


Fig. 74 Install Differential Case W/Dummy Bearings

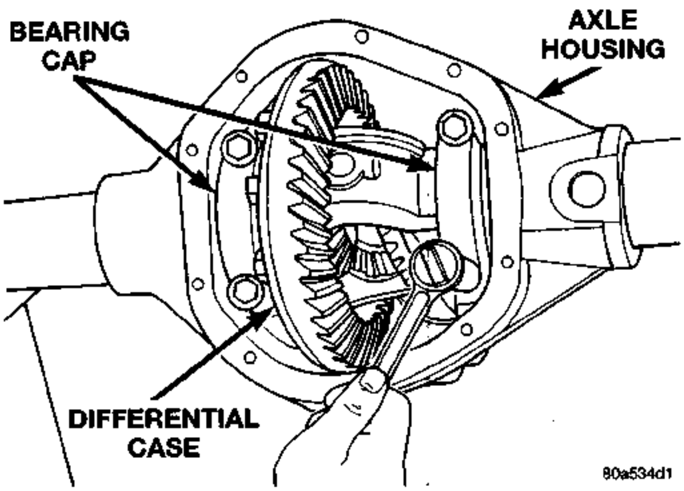


Fig. 75 Tighten Bolts Holding Bearing Caps

(7) Using a dead-blow type mallet, seat the differential dummy bearings to each side of the axle housing (Fig. 76) and (Fig. 77).

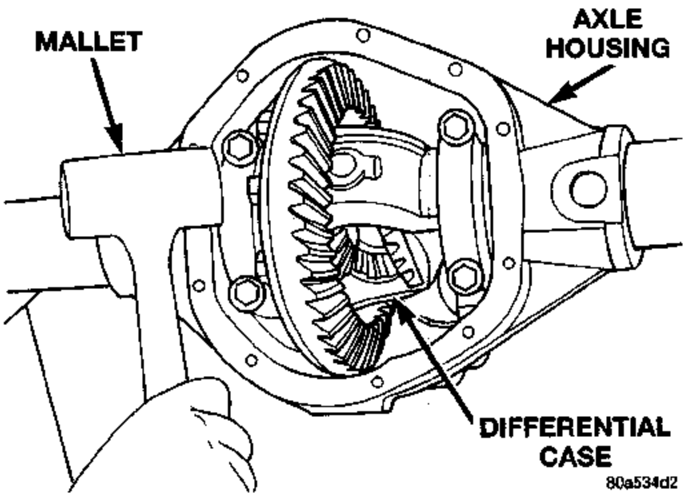


Fig. 76 Seat Pinion Gear Side Differential Dummy Side Bearing

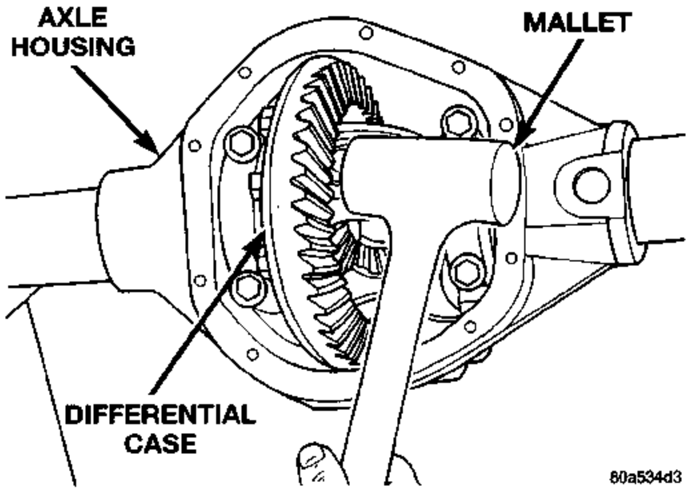


Fig. 77 Seat Ring Gear Side Differential Dummy Side Bearing

(8) Thread guide stud C-3288 into rear cover bolt hole below ring gear (Fig. 78).

(9) Attach a dial indicator C-3339 to guide stud. Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 78).

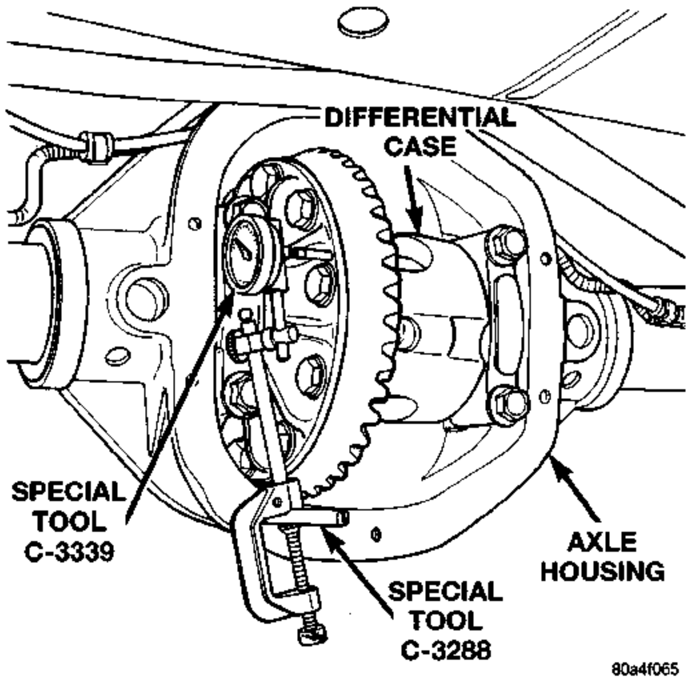


Fig. 78 Differential Side play Measurement

(10) Push and hold differential case to pinion gear side of axle housing (Fig. 79).

(11) Zero dial indicator face to pointer (Fig. 79).

(12) Push and hold differential case to ring gear side of the axle housing (Fig. 80).

(13) Record dial indicator reading (Fig. 80).

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

(15) Add 0.008 in. (0.2 mm) to the zero end play total. This new total represents the thickness of

ADJUSTMENTS (Continued)

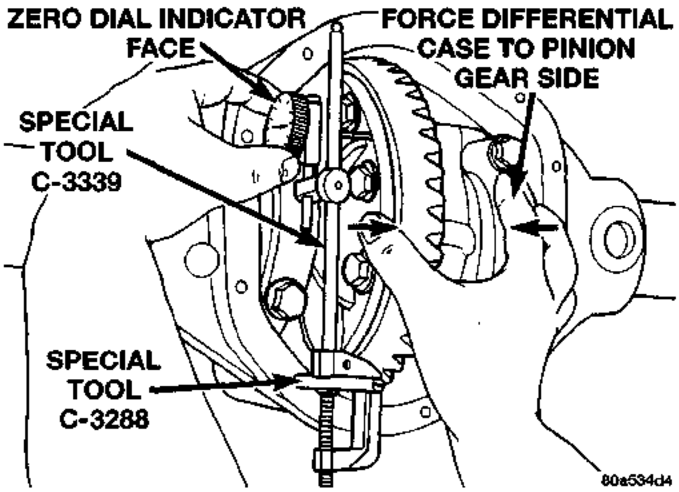


Fig. 79 Hold Differential Case and Zero Dial Indicator

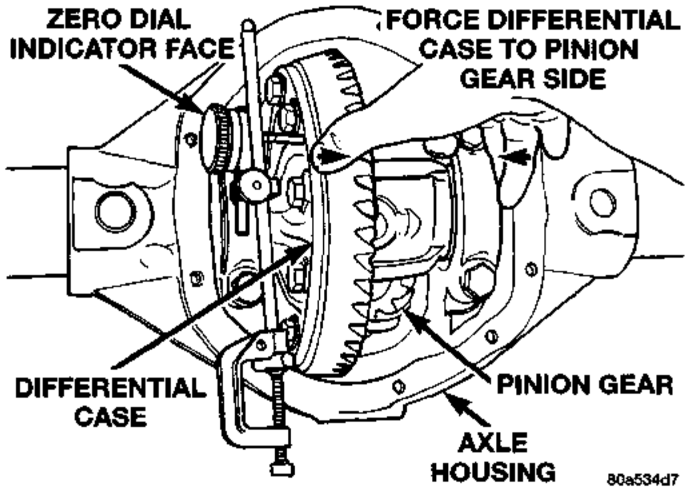


Fig. 81 Hold Differential Case and Zero Dial Indicator

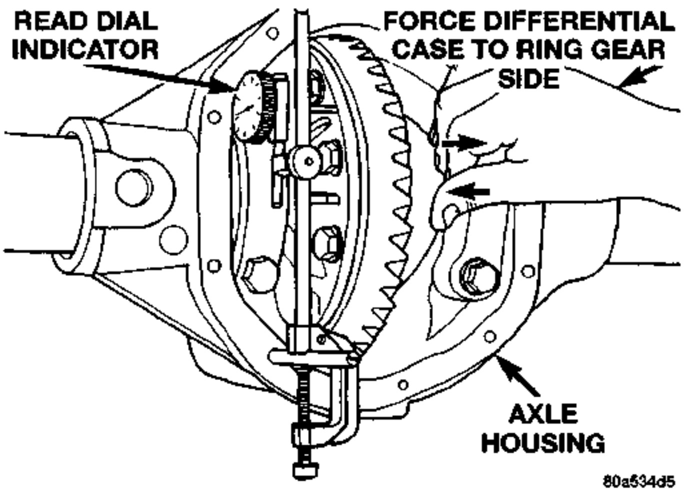


Fig. 80 Hold Differential Case and Read Dial Indicator

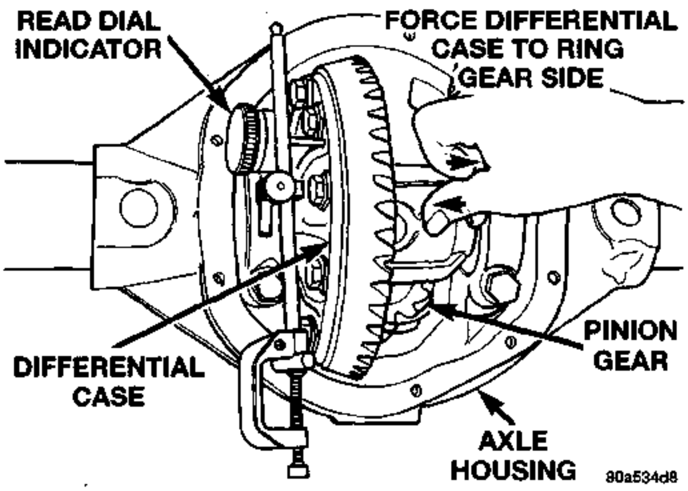


Fig. 82 Hold Differential Case and Read Dial Indicator

shims to compress, or preload the new bearings when the differential is installed.

(16) Rotate dial indicator out of the way on guide stud.

(17) Remove differential case and dummy bearings from axle housing.

(18) Install Pinion Gear in axle housing.

(19) Install differential case and dummy bearings D-345 in axle housing (without shims), install bearing caps and tighten bolts snug.

(20) Seat ring gear side dummy bearing (Fig. 77).

(21) Position the dial indicator plunger on a flat surface between the ring gear bolt heads. (Fig. 78).

(22) Push and hold differential case toward pinion gear (Fig. 81).

(23) Zero dial indicator face to pointer (Fig. 81).

(24) Push and hold differential case to ring gear side of the axle housing (Fig. 82).

(25) Record dial indicator reading (Fig. 82).

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

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

(28) Rotate dial indicator out of the way on guide stud.

(29) Remove differential case and dummy bearings from axle housing.

(30) Install side bearing shims on differential case hubs.

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

(32) Install spreader W-129-B on axle housing and spread axle opening enough to receive differential case.

ADJUSTMENTS (Continued)

(33) Install differential case in axle housing. Refer to Differential Removal and Installation paragraph.

(34) Remove spreader from axle housing.

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

(36) Position the indicator plunger against a ring gear tooth (Fig. 83).

(37) Push and hold ring gear upward (do not rotate differential).

(38) Zero dial indicator face to pointer.

(39) Push and hold ring gear downward (do not rotate differential). Dial indicator reading should be between 0.12 mm (0.005 in.) and 0.20 mm (0.008 in.). If backlash is not within specifications transfer the necessary amount of shim thickness from one side of the axle housing to the other (Fig. 84).

(40) Verify differential case and ring gear runout by measuring ring to pinion gear backlash at several locations around the ring gear. Readings should not vary more than 0.05 mm (0.002 in.). If readings vary more than specified, the ring gear or the differential case is defective.

After the proper backlash is achieved, perform Gear Contact Pattern Analysis procedure.

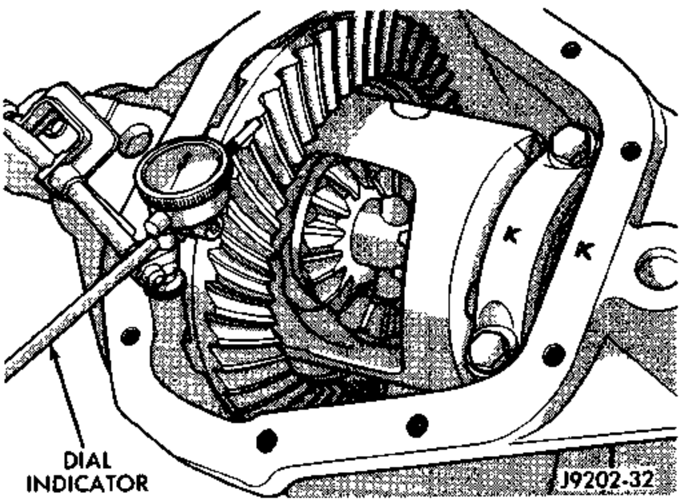


Fig. 83 Ring Gear Backlash Measurement

GEAR CONTACT PATTERN ANALYSIS

The ring and pinion gear teeth contact patterns will show if the pinion gear depth is correct in the axle housing. It will also show if the ring gear backlash has been adjusted correctly. The backlash can be adjusted within specifications to achieve desired tooth contact patterns.

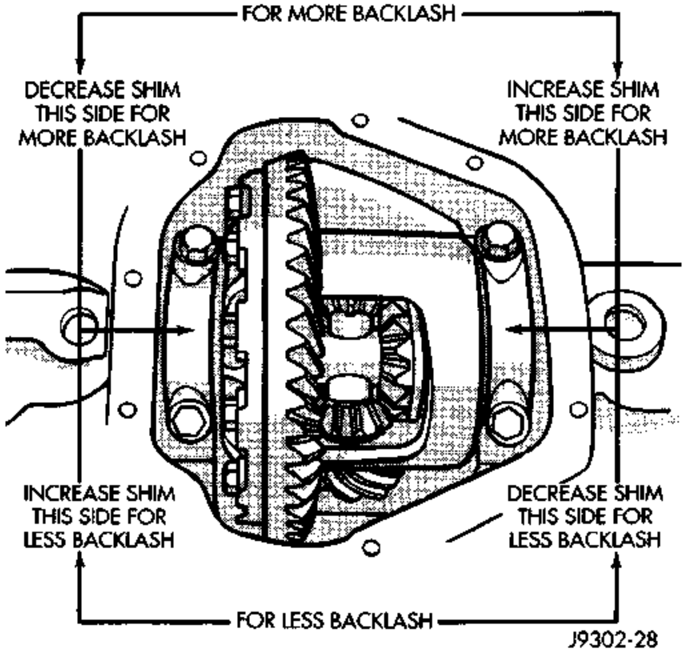


Fig. 84 Backlash Shim Adjustment

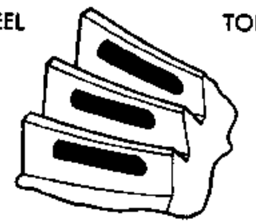
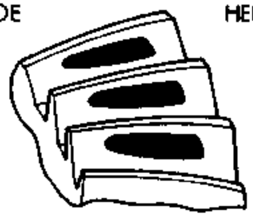
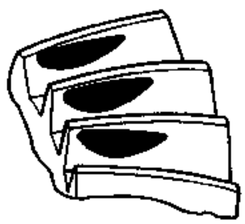
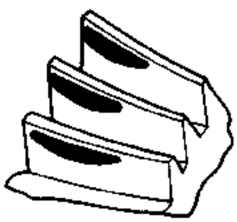
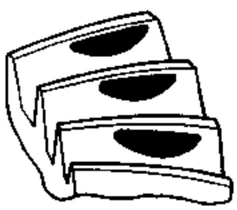
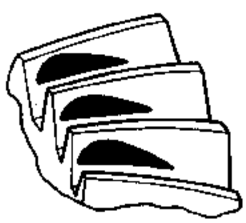
(1) Apply a thin coat of hydrated ferric oxide, or equivalent, to the drive and coast side of the ring gear teeth.

(2) Wrap, twist, and hold a shop towel around the pinion yoke to increase the turning resistance of the pinion gear. This will provide a more distinct contact pattern.

(3) Using a boxed end wrench on a ring gear bolt, Rotate the differential case one complete revolution in both directions while a load is being applied from shop towel.

The areas on the ring gear teeth with the greatest degree of contact against the pinion gear teeth will squeegee the compound to the areas with the least amount of contact. Note and compare patterns on the ring gear teeth to Gear Tooth Contact Patterns chart and adjust pinion depth and gear backlash as necessary.

ADJUSTMENTS (Continued)

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

J9003-24

Gear Tooth Contact Patterns

SPECIFICATIONS

216 RBI 44 AXLE

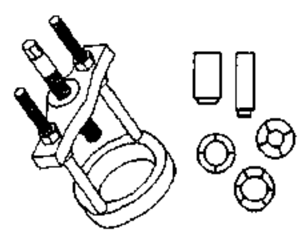
DESCRIPTION	SPEC.
Type	Semi-floating Hypoid
Axle Ratios	3.07/3.55/4.10
Ring Gear Diameter	216 mm (8.5 in.)
Gear Backlash	0.13–0.20 mm (0.005–0.008 in.)
Pinion Depth	109.52 mm (4.312 in.)
Brg. Preload, Pinion (New)	2.26–4.52 N·m (20–40 in. lbs.)
Brg. Preload, Pinion (Used)	1–3 N·m (10–20 in. lbs.)
Maximum Carrier Spread	0.51 mm (0.020 in.

TORQUE

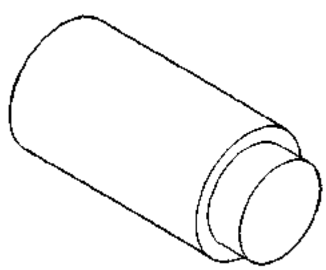
DESCRIPTION	TORQUE
Plug, Fill	34 N·m (25 ft. lbs.)
Bolts, Diff. Cover	41 N·m (30 ft. lbs.)
Bolts, Diff. Bearing Cap	108 N·m (80 ft. lbs.)
Bolts, Ring Gear	108 N·m (80 ft. lbs.)
Nuts, Brake Backing Plate	61 N·m (45 ft. lbs.)
Nut, Pinion Gear—Minimum	244 N·m (180 ft. lbs.)

SPECIAL TOOLS

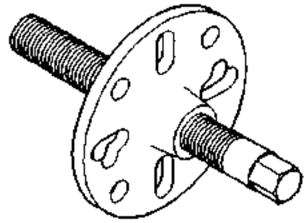
216 RBI 44 AXLE



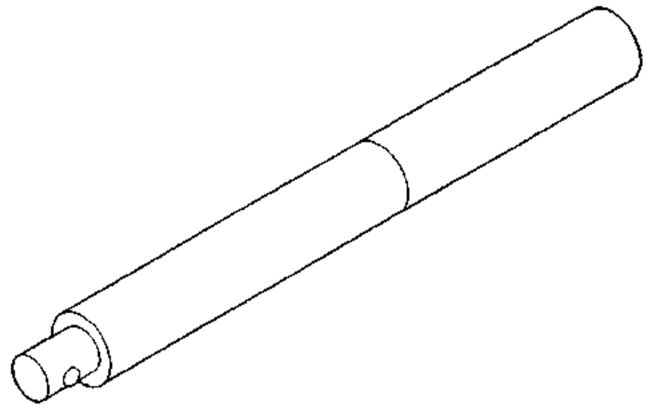
Puller Set—C-293-M



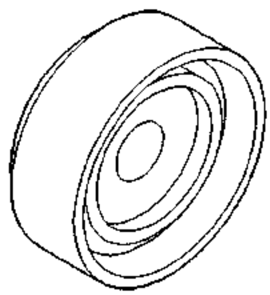
Extension—C-293-3



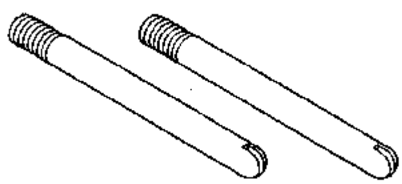
Remover—C-452



Handle—C-4171

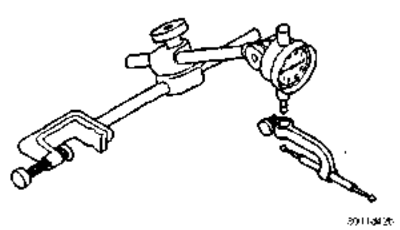


Installer—C-4340

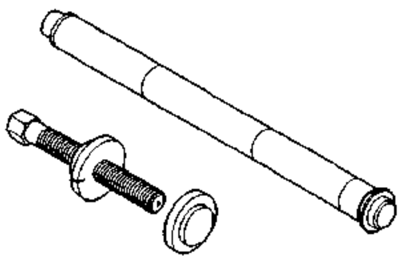


Pilot—C-3288

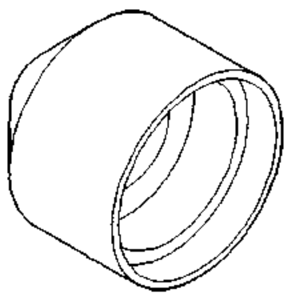
SPECIAL TOOLS (Continued)



Dial Indicator—C-3339



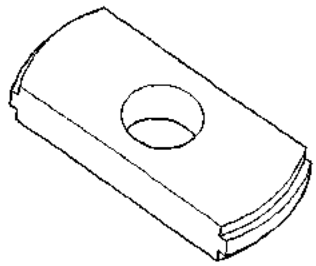
Trac-lok Tool Set—C-4487



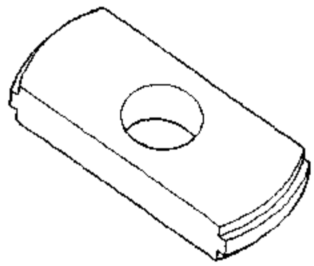
Installer—D-163

Installer—D-144

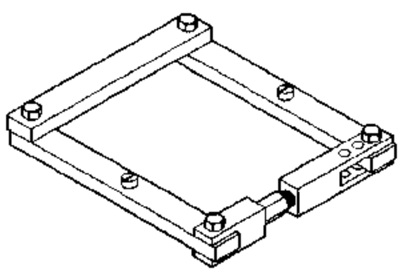
Installer—D-145



Remover—D-147

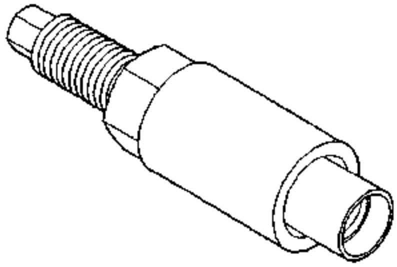


Remover—D-148

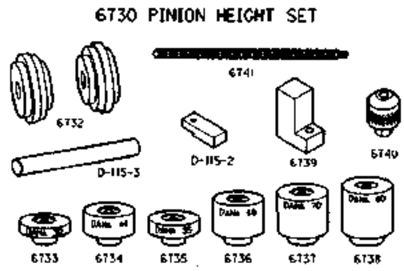


Spreader—W-129-B

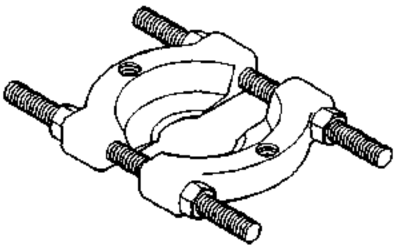
SPECIAL TOOLS (Continued)



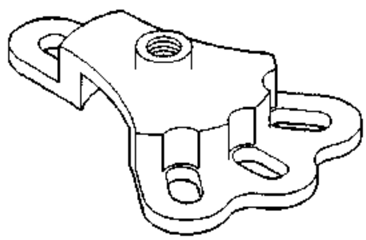
Installer—W-162-D



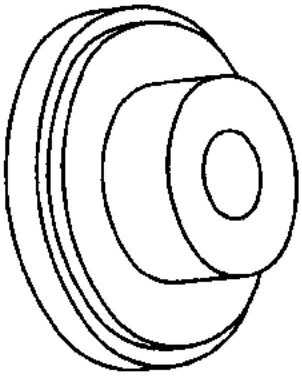
Pinion Depth Set—6730 or 6755



Splitter—1130



Adapter—6790



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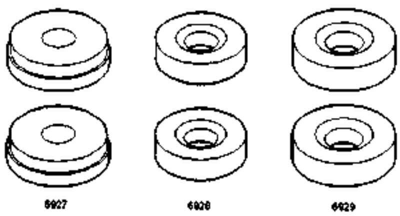
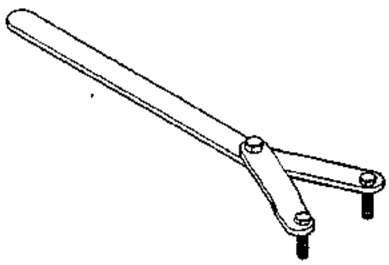
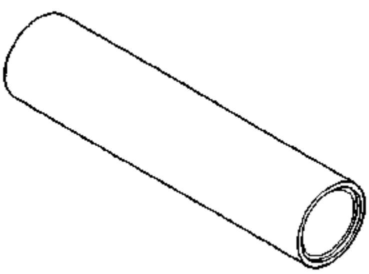


Adapter Set—6956

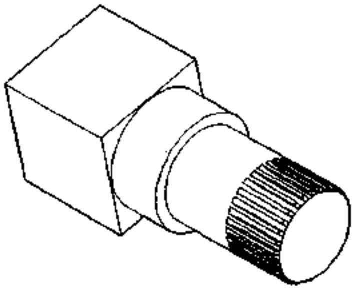


Holder—6958

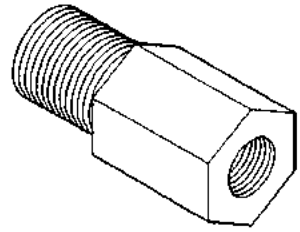


Installer—6448

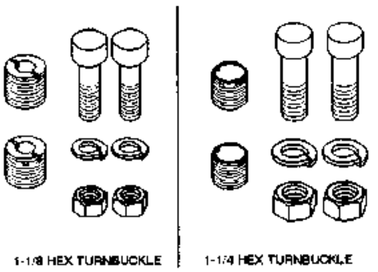
SPECIAL TOOLS (Continued)



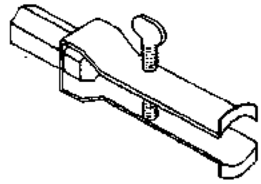
Holder—6963-A



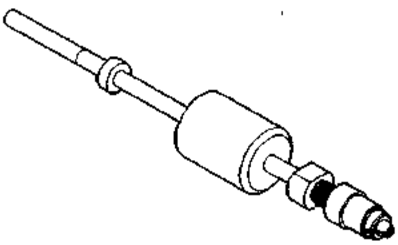
Adapter—7420-8



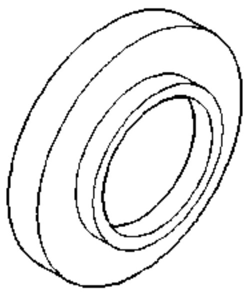
Adapter Set—6978



Remover—7794-A



Slide Hammer—7420



Installer—7913-A

BATTERY

CONTENTS

GENERAL INFORMATION

OVERVIEW

The battery, starting, and charging systems operate with one another, and must be tested as a complete system. In order for the vehicle to start and charge properly, all of the components involved in these systems must perform within specifications.

Group 8A covers the battery, Group 8B covers the starting system, and Group 8C covers the charging system. Refer to Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams. We have separated these systems to make it easier to locate the information you are seeking within this Service Manual. However, when attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used in these groups include the most basic conventional diagnostic methods to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of a induction milliampere ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. See the On-Board Diagnostics Test in Group 8C - Charging System for more information.

INTRODUCTION

This section covers battery diagnostic and service procedures only. For battery maintenance procedures, refer to Group 0 - Lubrication and Maintenance. While battery charging can be considered a maintenance procedure, battery charging information is located in this group. This was done because the battery must be fully-charged before any diagnosis can be performed.

The factory-installed low-maintenance battery has removable battery cell caps. Water can be added to this battery. The battery is not sealed and has vent holes in the cell caps (Fig. 1). The chemical composition within the low-maintenance battery reduces battery gassing and water loss at normal charge and discharge rates.

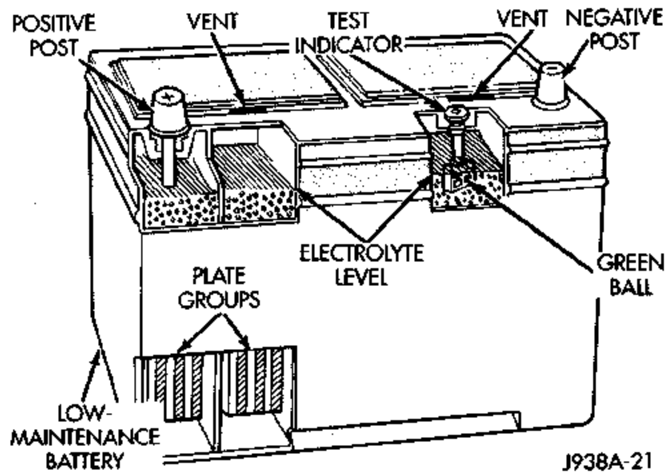


Fig. 1 Low-Maintenance Battery - Typical

Rapid loss of electrolyte can be caused by an overcharging condition. Be certain to diagnose the charging system before returning the vehicle to service. Refer to Group 8C - Charging System for more information.

The factory-installed battery also has a built-in test indicator (hydrometer). The color visible in the sight glass of the indicator will reveal the battery condition. See Built-In Test Indicator in this group for more information.

GENERAL INFORMATION (Continued)

It is important that the battery, starting, and charging systems be thoroughly tested and inspected any time a battery needs to be charged or replaced. The cause of abnormal discharge, overcharging, or early battery failure must be diagnosed and corrected before a battery is replaced or returned to service.

NOTE: This group covers both Left-Hand Drive (LHD) and Right-Hand Drive (RHD) versions of this model. Whenever required and feasible, the RHD versions of affected vehicle components have been constructed as mirror-image of the LHD versions. While most of the illustrations used in this group represent only the LHD version, the diagnostic and service procedures outlined can generally be applied to either version. Exceptions to this rule have been clearly identified as LHD or RHD, if a special illustration or procedure is required.

DESCRIPTION AND OPERATION

BATTERY

The storage battery is a device used to store electrical energy potential in a chemical form. When an electrical load is applied to the battery terminals, an electrochemical reaction occurs within the battery. This reaction causes the battery to discharge electrical current.

The battery is made up of six individual cells that are connected in series. Each cell contains positively charged plate groups made of lead oxide, and negatively charged plate groups made of sponge lead. These dissimilar metal plates are submerged in a sulfuric acid and water solution called an electrolyte.

As the battery discharges, a gradual chemical change takes place within each cell. The sulfuric acid in the electrolyte combines with the plate materials, causing both plates to slowly change to lead sulfate. At the same time, oxygen from the positive plate material combines with hydrogen from the sulfuric acid, causing the electrolyte to become mainly water.

The chemical changes within the battery are caused by the movement of excess, or free, electrons between the positive and negative plate groups. This movement of electrons produces a flow of electrical current through the load device attached to the battery terminals.

As the plate materials become more similar chemically, and the electrolyte becomes less acid, the voltage potential of each cell is reduced. However, by charging the battery with a voltage higher than that of the battery, the battery discharging process is reversed.

Charging the battery gradually changes the sulfated lead plates back into sponge lead and lead oxide, and the water back into sulfuric acid. This action restores the difference in the electron charges deposited on the plates, and the voltage potential of the battery cells.

For a battery to remain useful, it must be able to produce high-amperage current over an extended period. A battery must also be able to accept a charge, so that its voltage potential may be restored.

In addition to producing and storing electrical energy, the battery serves as a capacitor, or voltage stabilizer, for a vehicle's electrical system. It absorbs most abnormal or transient voltages caused by the switching of any of the vehicle's electrical components.

The battery is vented to release excess hydrogen gas that is created when the battery is being charged or discharged. However, even with these vents, the hydrogen gas can collect in or around the battery. If hydrogen gas is exposed to flame or sparks, it may ignite.

If the electrolyte level is low, the battery may arc internally and explode. If the battery is equipped with removable cell caps, add distilled water whenever the electrolyte level is below the top of the plates. If the battery cell caps cannot be removed, the battery must be replaced if the electrolyte level becomes low.

BATTERY SIZE AND RATINGS

The outside dimensions and terminal placement of the battery conform to standards established by the Battery Council International (BCI). Each battery is assigned a BCI Group Size number to help identify a correctly-sized replacement.

In addition, there are two commonly accepted methods for rating and comparing battery performance. These ratings are called Cold Cranking Amperage (CCA) and Reserve Capacity (RC). A third rating method used in many export markets is called Ampere-Hours (AH). Each rating is described in more detail below.

The Group Size number, CCA rating, RC rating and, where applicable, the AH rating can be found on the original equipment battery label. Be certain that a replacement battery has the correct Group Size number, as well as CCA, and RC or AH ratings that equal or exceed the original equipment specification for the vehicle being serviced. See the Battery Classifications and Ratings chart in Specifications at the back of this group for more information.

COLD CRANKING AMPERAGE

The Cold Cranking Amperage (CCA) rating specifies how much current (in amperes) the battery can deliver for 30 seconds at -18°C (0°F). Terminal voltage must not fall below 7.2 volts during or after the 30 second discharge. The CCA required is generally higher as engine displacement increases, depending also upon the starter current draw requirements.

DESCRIPTION AND OPERATION (Continued)

RESERVE CAPACITY

The Reserve Capacity (RC) rating specifies the time (in minutes) it takes for battery terminal voltage to fall below 10.2 volts, at a discharge rate of 25 amperes. RC is determined with the battery fully-charged at 26.7°C (80°F). This rating estimates how long the battery might last after a charging system failure, under minimum electrical load.

AMPERE-HOURS

The Ampere-Hours rating specifies the current (in amperes) that a battery can deliver steadily for 20 hours, with the voltage in none of the battery cells falling below 1.75 volts. This rating is also sometimes referred to as the 20-hour discharge rating.

BATTERY MOUNTING

The battery is mounted to a stamped steel tray located in the passenger side rear corner of the engine compartment. A J-bolt is inserted through holes on the front and rear edges of the tray. A hold-down strap fits across the top of the battery case and thermoguard. The J-bolts pass through the hold-down strap on each side of the battery, and a nut secures the J-bolts to the hold-down strap.

The battery tray is fastened with four screws to a support bracket mounted between the front fender inner wheelhouse and the dash panel, rearward of the passenger side front wheel.

A hole in the bottom of the battery tray is fitted with a battery temperature sensor on some models. Models without the battery temperature sensor have a plug fitted to this hole. Refer to Group 8C - Charging System for more information on the battery temperature sensor.

DIAGNOSIS AND TESTING

BATTERY

The battery must be completely charged and the top, posts, and terminal clamps should be properly cleaned before diagnostic procedures are performed. See Battery Charging in this group for more information.

WARNING:

- **IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.**
- **IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.**

The condition of a battery is determined by two criteria:

1. **State-Of-Charge** - This can be determined by viewing the built-in test indicator, by checking the specific gravity of the electrolyte (hydrometer test), or by checking the battery voltage (open-circuit voltage test).
2. **Cranking Capacity** - This can be determined by performing a battery load test, which measures the ability of the battery to supply high-amperage current.

First, determine the battery state-of-charge. This can be done in one of three ways. If the battery has a built-in test indicator, use this test to determine the state-of-charge. If the battery has no test indicator, but has removable cell caps, perform the hydrometer test to determine the state-of-charge. If the cell caps are not removable, or a hydrometer is not available, perform the open-circuit voltage test to determine the state-of-charge.

The battery must be charged before proceeding with a load test if:

- The built-in test indicator has a black or dark color visible.
- The temperature corrected specific gravity is less than 1.235.
- The open-circuit voltage is less than 12.4 volts.

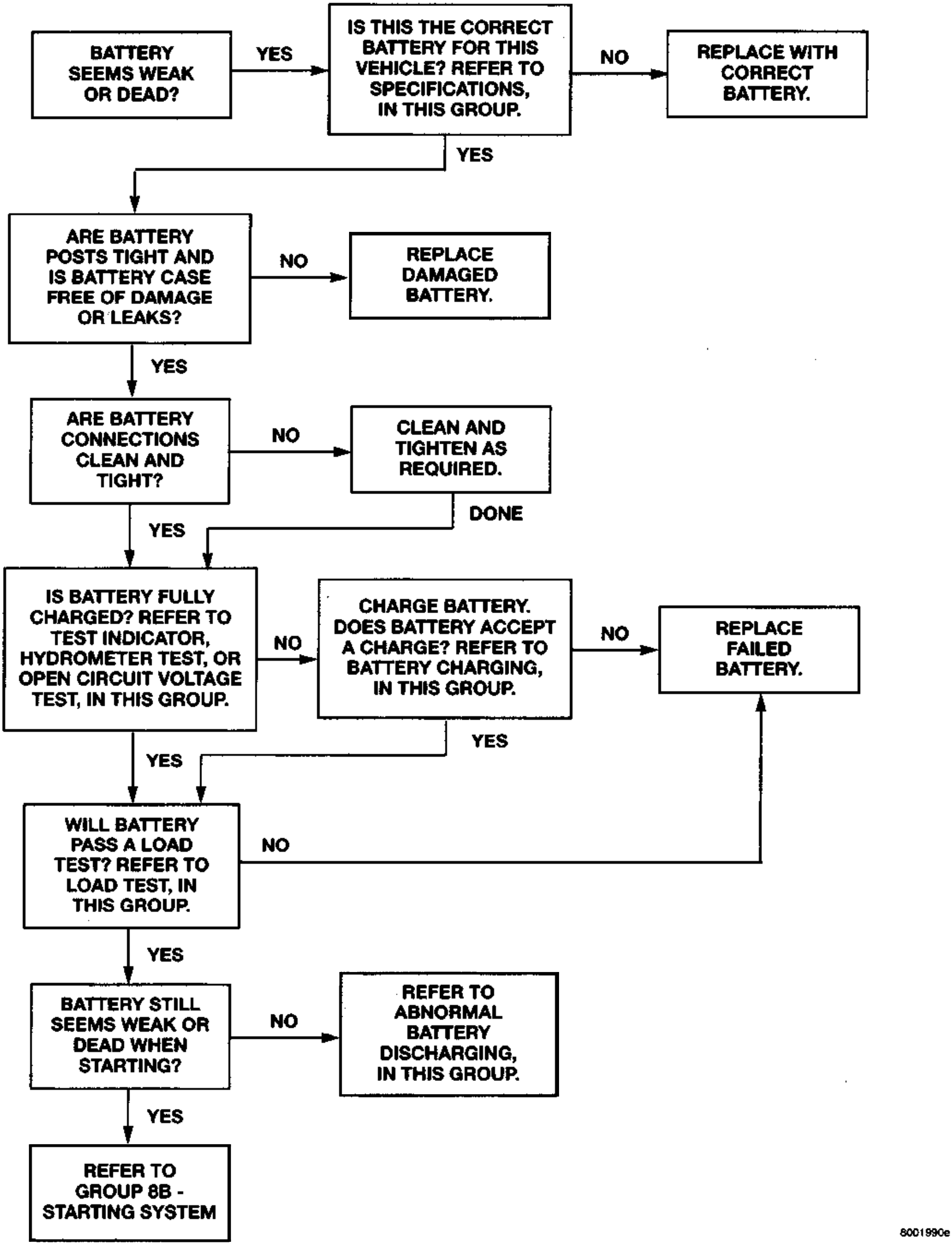
A battery that will not accept a charge is faulty, and must be replaced. Further testing is not required. A fully-charged battery must be load tested to determine its cranking capacity. A battery that is fully-charged, but does not pass the load test, is faulty and must be replaced.

NOTE: Completely discharged batteries may take several hours to accept a charge. See Charging A Completely Discharged Battery in this group for more information.

A battery is fully-charged when:

- All cells are gassing freely during charging.
- A green color is visible in the sight glass of the built-in test indicator.
- Three corrected specific gravity tests, taken at one-hour intervals, indicate no increase in the specific gravity.
- Open-circuit voltage is 12.4 volts or greater.

DIAGNOSIS AND TESTING (Continued)



Battery Diagnosis

DIAGNOSIS AND TESTING (Continued)

ABNORMAL BATTERY DISCHARGING

Any of the following conditions can result in abnormal battery discharging:

1. Corroded or loose battery posts and terminal clamps.
2. A loose or worn generator drive belt.
3. Electrical loads that exceed the output of the charging system. This can be due to equipment installed after manufacture, or repeated short trip use.
4. Slow driving speeds (heavy traffic conditions) or prolonged idling, with high-amperage draw systems in use.
5. A faulty circuit or component causing excessive ignition-off draw. See Ignition-Off Draw Test in this group for more information.
6. A faulty or incorrect charging system component.
7. A faulty or incorrect battery.

BUILT-IN TEST INDICATOR

A test indicator (hydrometer) built into the top of the battery case provides visual information for battery testing (Fig. 2). Like a hydrometer, the built-in test indicator measures the specific gravity of the electrolyte. The test indicator reveals the battery state-of-charge; however, it will not reveal the cranking capacity of the battery. A load test must be performed to determine the battery cranking capacity. See Load Test in this group for more information.

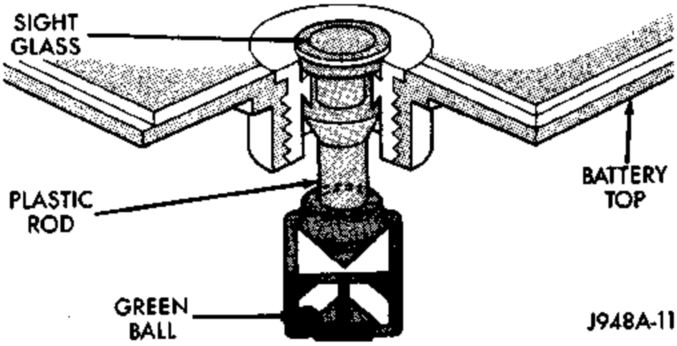


Fig. 2 Built-In Test Indicator

WARNING:

• IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

• EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

• THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.

• IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.

Before testing, visually inspect the battery for any damage (a cracked case or cover, loose posts, etc.) that would cause the battery to be faulty. In order to obtain correct indications from the built-in test indicator, it is important that the battery be level and have a clean sight glass. Additional light may be required to view the indicator. **Do not use open flame as a source of additional light.**

To read the built-in test indicator, look into the sight glass and note the color of the indicator (Fig. 3). Refer to the following description, as the color indicates:

• **Green** - indicates 75% to 100% state-of-charge. The battery is adequately charged for further testing or return to use. If the vehicle will not crank for a minimum of fifteen seconds with a fully-charged battery, perform the Load Test.

• **Black or Dark** - indicates 0% to 75% state-of-charge. The battery is inadequately charged and must be charged until a green indication is visible in the sight glass (12.4 volts or more), before the battery is tested further or returned to service. See Battery Charging in this group for more information. Also see Abnormal Battery Discharging in this group for possible causes of the discharged condition.

• **Yellow or Bright** - indicates a low electrolyte level. The electrolyte level in the battery is below the test indicator. A maintenance-free battery with non-removable cell caps must be replaced if the electrolyte level is low. Water must be added to a low-maintenance battery with removable cell caps before it is charged. See Battery Charging in this group for more information. A low electrolyte level may be caused by an overcharging condition. Refer to Group 8C - Charging System to diagnose an overcharging condition.

HYDROMETER TEST

The hydrometer test reveals the battery state-of-charge by measuring the specific gravity of the electrolyte. This test cannot be performed on maintenance-free batteries with non-removable cell caps. If the battery has non-removable cell caps, see

DIAGNOSIS AND TESTING (Continued)

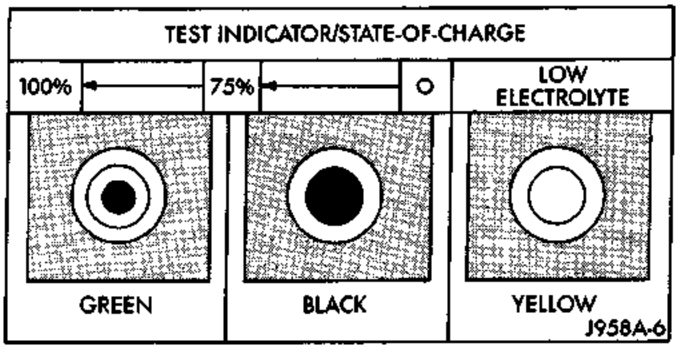


Fig. 3 Built-In Test Indicator Sight Glass

Built-In Test Indicator or Open Circuit Voltage Test in this group.

Specific gravity is a comparison of the density of the electrolyte to the density of pure water. Pure water has a specific gravity of 1.000, and sulfuric acid has a specific gravity of 1.835. Sulfuric acid makes up approximately 35% of the electrolyte by weight, or 24% by volume.

In a fully-charged battery the electrolyte will have a temperature-corrected specific gravity of 1.260 to 1.290. However, a specific gravity of 1.235 or above is satisfactory for battery load testing and/or return to service.

WARNING:

• IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

• EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

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• IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.

Before testing, visually inspect the battery for any damage (a cracked case or cover, loose posts, etc.) that would cause the battery to be faulty. Then remove the cell caps and check the electrolyte level. Add distilled water if the electrolyte level is below the top of the battery plates.

Refer to the hydrometer manufacturer's instructions for correct use of the hydrometer. Remove only enough electrolyte from the battery cell so that the float is off the bottom of the hydrometer barrel with pressure on the bulb released.

CAUTION: Exercise care when inserting the tip of the hydrometer into a cell to avoid damaging the plate separators. Damaged plate separators can cause early battery failure.

To read the hydrometer correctly, hold it with the top surface of the electrolyte at eye level. Hydrometer floats are generally calibrated to indicate the specific gravity correctly only at 26.7°C (80°F). When testing the specific gravity at any other temperature, a correction factor is required.

The correction factor is approximately a specific gravity value of 0.004, referred to as 4 points of specific gravity. For each 5.5°C above 26.7°C (10°F above 80°F), add 4 points. For each 5.5°C below 26.7°C (10°F below 80°F), 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 -12.2°C (10°F) and has a specific gravity of 1.240. Determine the actual specific gravity as follows:

(1) Determine the number of degrees above or below 26.7°C (80°F):

`26.6°C - -12.2°C = 38.8°C (80°F - 10°F = 70°F)`

(2) Divide the result from Step 1 by 5.5 (10):

`38.8°C/5.5 = 7 (70°F/10 = 7)`

(3) Multiply the result from Step 2 by the temperature correction factor (0.004):

`7 X 0.004 = 0.028`

(4) The temperature at testing was below 26.7°C (80°F); therefore, the temperature correction factor is subtracted:

`1.240 - 0.028 = 1.212`

The corrected specific gravity of the battery in this example is 1.212.

If the specific gravity of all cells is above 1.235, but the variation between cells is more than 50 points (0.050), the battery should be replaced. If the specific gravity of one or more cells is less than 1.235, charge the battery at a rate of approximately 5 amperes.

Continue charging until three 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 the cell variation is less than 50 points (0.050), the battery may be load tested to determine its cranking capacity. See Load Test in this group for more information.

DIAGNOSIS AND TESTING (Continued)

OPEN-CIRCUIT VOLTAGE TEST

A battery open-circuit voltage (no load) test will show the state-of-charge of a battery. This test can be used in place of the hydrometer test when a hydrometer is not available, or for maintenance-free batteries with non-removable cell caps.

WARNING:

• IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

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Before proceeding with this test, completely charge the battery as described in Battery Charging in this group.

(1) Before measuring the open-circuit voltage, the surface charge must be removed from the battery. Turn on the head lamps for fifteen seconds, then allow up to five minutes for the battery voltage to stabilize.

(2) Disconnect and isolate both battery cables, negative cable first.

(3) Using a voltmeter connected to the battery posts (refer to the instructions provided with the voltmeter), measure the open-circuit voltage (Fig. 4).

See the Open-Circuit Voltage chart. This voltage reading will indicate the battery state-of-charge, but will not reveal its cranking capacity. If a battery has an open-circuit voltage reading of 12.4 volts or greater, it may be load tested to reveal its cranking capacity. See Load Test in this group for more information.

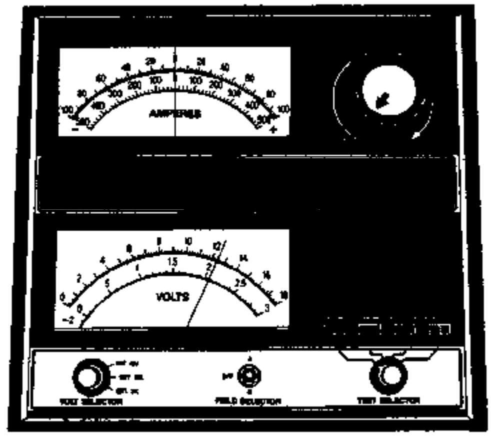

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Fig. 4 Testing Open-Circuit Voltage

Open Circuit Voltage	
Open Circuit Volts	**Charge Percentage**
11.7 volts or less	0%
12.0 volts	25%
12.2 volts	50%
12.4 volts	75%
12.6 volts or more	100%

LOAD TEST

A battery load test will verify the battery cranking capacity. The test is based on the Cold Cranking Amperage (CCA) rating of the battery. See the Battery Classifications and Ratings chart in Specifications at the back of this group.

WARNING:

• IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

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Before proceeding with this test, completely charge the battery as described in Battery Charging in this group.

(1) Disconnect and isolate both battery cables, negative cable first. The battery top and posts should be clean.

(2) Connect a suitable volt-ammeter-load tester (Fig. 5) to the battery posts (Fig. 6). Refer to the operating

DIAGNOSIS AND TESTING (Continued)

instructions provided with the tester being used. Check the open-circuit voltage (no load) of the battery. Open-circuit voltage must be 12.4 volts or greater.

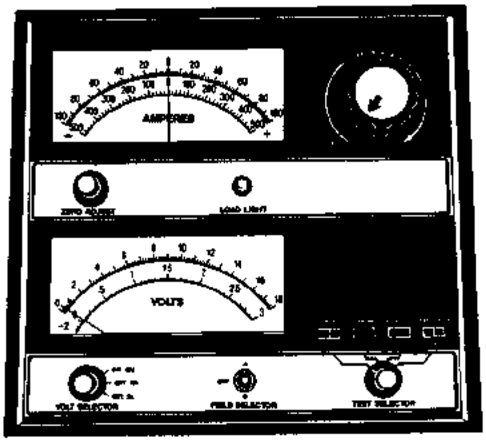

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Fig. 5 Volt-Ammeter-Load Tester - Typical

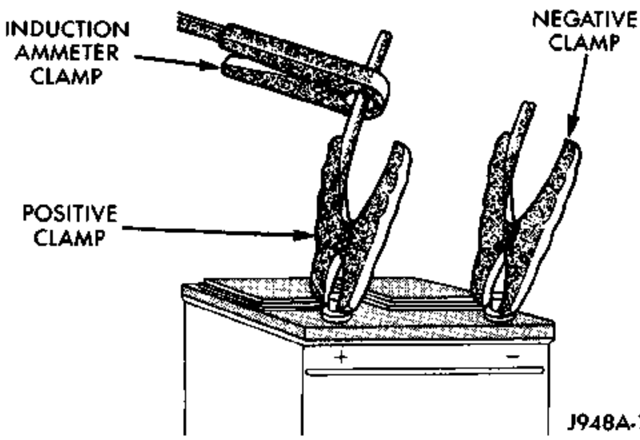

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Fig. 6 Volt-Ammeter-Load Tester Connections

(3) Rotate the load control knob (carbon pile rheostat) to apply a 300 ampere load to the battery for fifteen seconds, then return the control knob to the Off position (Fig. 7). This will remove the surface charge from the battery.

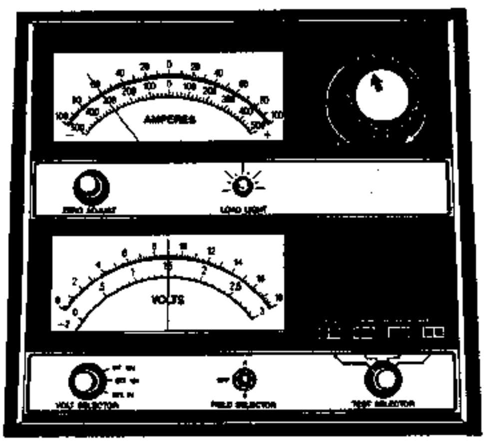

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Fig. 7 Remove Surface Charge from Battery

(4) Allow the battery to stabilize to open-circuit voltage. It may take up to five minutes for the battery voltage to stabilize.

(5) Rotate the load control knob to maintain a load equal to 50% of the battery's CCA rating (Fig. 8). After fifteen seconds, record the loaded voltage reading, then return the load control knob to the Off position.

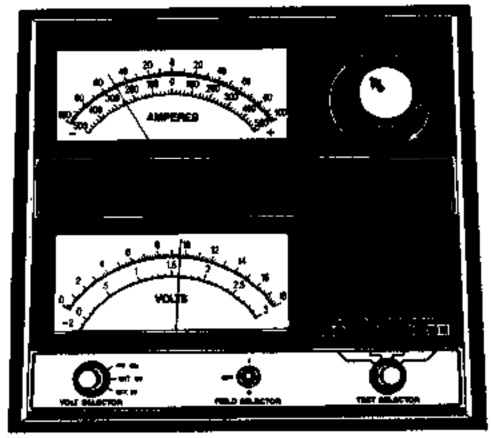

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Fig. 8 Load 50% CCA Rating - Note Voltage

(6) The voltage drop will vary with the battery temperature at the time of the load test. The battery temperature can be estimated by using the ambient temperature during the past several hours. If the battery has been charged, boosted, or loaded a few minutes prior to the test, the battery will be somewhat warmer. See the Load Test Temperature chart for the proper loaded voltage reading.

Load Test Temperature		
Minimum Voltage	Temperature	
	°F	°C
9.6 volts	70° and above	21° and above
9.5 volts	60°	16°
9.4 volts	50°	10°
9.3 volts	40°	4°
9.1 volts	30°	-1°
8.9 volts	20°	-7°
8.7 volts	10°	-12°
8.5 volts	0°	-18°

(7) If the voltmeter reading falls below 9.6 volts, at a minimum battery temperature of 21°C (70°F), the battery is faulty and must be replaced.

DIAGNOSIS AND TESTING (Continued)

IGNITION-OFF DRAW TEST

Ignition-Off Draw (IOD) refers to power being drained from the battery with the ignition switch in the Off position. A normal vehicle electrical system will draw from 5 to 25 milliamperes (0.005 - 0.025 ampere) with the ignition switch in the Off position, and all non-ignition controlled circuits in proper working order. The 25 milliamperes are needed to supply Powertrain Control Module (PCM) memory, digital clock memory, and electronically tuned radio memory.

A vehicle that has not been operated for approximately 20 days, may discharge the battery to an inadequate level. When a vehicle will not be used for 20 days or more (stored), remove the IOD fuse from the Power Distribution Center (PDC). This will reduce battery discharging.

Excessive IOD can be caused by:

- Electrical items left on
- Faulty or improperly adjusted switches
- An internally shorted generator
- Intermittent shorts in the wiring.

If the IOD is over 25 milliamperes, the problem must be found and corrected before replacing a battery. In most cases, the battery can be charged and returned to service.

DIAGNOSIS

CAUTION: Testing for high-amperage IOD must be performed first to prevent damage to most milliampere meters.

(1) Verify that all electrical accessories are off. Turn off all lamps, remove the ignition key, and close all doors. If the vehicle is equipped with a illuminated entry system or electronically tuned radio, allow the electronic timer function of these systems to automatically shut off (time out). This may take up to three minutes.

(2) Determine that the under-hood lamp is operating properly, then disconnect the lamp or remove the bulb.

(3) Disconnect the battery negative cable.

(4) Connect a typical 12-volt test lamp (low-wattage bulb) between the disconnected battery negative cable clamp and the battery negative terminal post. Make sure that the doors remain closed so that the illuminated entry system is not activated. The test lamp may light brightly for up to three minutes, or may not light at all, depending upon the vehicle's electrical equipment. The term "brightly," as used throughout the following tests, implies the brightness of the test lamp will be the same as if it were connected across the battery. The test lamp must be securely clamped to the battery negative cable clamp and the battery negative terminal post. If the continuity between the battery negative terminal post and cable clamp is lost during any part of the IOD test, the electronic timer function will be activated and all tests must be repeated.

(5) After three minutes, the test lamp should turn off or be dimly lit, depending upon the vehicle's electrical equipment. If the test lamp remains brightly lit, do not disconnect it. Remove each fuse or circuit breaker (refer to Group 8W - Wiring Diagrams for more information) until the test lamp is either off, or dimly lit. This will isolate each circuit and identify the source of the high-amperage IOD. If the test lamp is still brightly lit after disconnecting each fuse and circuit breaker, disconnect the wiring harness from the generator. If the test lamp now turns off or is dimly lit, refer to Group 8C - Charging System to diagnose the faulty charging system. Do not disconnect the test lamp. After the high-amperage IOD has been corrected, the low-amperage IOD may be checked. It is now safe to install a milliampere meter to check the low-amperage IOD.

(6) With the test lamp still connected securely, clamp a milliampere meter between the battery negative terminal post and the negative cable clamp.

CAUTION: Do not open any doors, or turn on any electrical accessories, with the test lamp disconnected or the milliampere meter may be damaged.

(7) Disconnect the test lamp. Observe the milliampere meter. The current draw should not exceed 25 milliamperes (0.025 ampere). If the draw exceeds 25 milliamperes, isolate each circuit by removing the circuit breakers and fuses. The milliampere meter reading will drop when the source of the draw is disconnected. Repair this circuit as required, whether it is a wiring short, incorrect switch adjustment or a component failure.

SERVICE PROCEDURES

BATTERY CHARGING

A battery is fully-charged when:

- All cells are gassing freely during battery charging.
- A green color is visible in the sight glass of the built-in test indicator.
- Three corrected specific gravity tests, taken at one-hour intervals, indicate no increase in the specific gravity.
- Open-circuit voltage is 12.4 volts or above.

SERVICE PROCEDURES (Continued)

WARNING:

• IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

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• IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.

CAUTION:

• Always disconnect and isolate the battery negative cable before charging a battery. Do not exceed sixteen volts while charging a battery. Damage to the vehicle electrical system components may result.

• Battery electrolyte will bubble inside the battery case during normal battery charging. Electrolyte boiling or being discharged from the battery vents indicates a battery overcharging condition. Immediately reduce the charging rate or turn off the charger to evaluate the battery condition. Damage to the battery may result from overcharging.

• The battery should not be hot to the touch. If the battery feels hot to the touch, turn off the charger and let the battery cool before continuing the charging operation. Damage to the battery may result.

Some battery chargers are equipped with polarity-sensing circuitry. This circuitry protects the charger and/or battery from being damaged if they are improperly connected. If the battery state-of-charge is too low for the polarity-sensing circuitry to detect, the charger will not operate. This makes it appear that the battery will not accept charging current. Refer to the instructions provided with the battery charger to bypass the polarity-sensing circuitry.

After the battery has been charged to 12.4 volts or greater, perform a load test to determine the battery cranking capacity. If the battery will endure a load test, return the battery to use. If the battery will not endure a load test, it is faulty and must be replaced.

Clean and inspect the battery hold-downs, tray, terminals, posts, and top before completing service. See the Battery Removal and Installation procedures in this group for more information.

CHARGING A COMPLETELY DISCHARGED BATTERY

The following procedure should be used to recharge a completely discharged battery. Unless this procedure is properly followed, a good battery may be needlessly replaced.

(1) Measure the voltage at the battery posts with a voltmeter, accurate to 1/10 (0.10) volt (Fig. 9). If the reading is below ten volts, the charge current will be low. It could take some time before the battery accepts a current greater than a few milliamperes. Such low current may not be detectable on the ammeters built into many chargers.

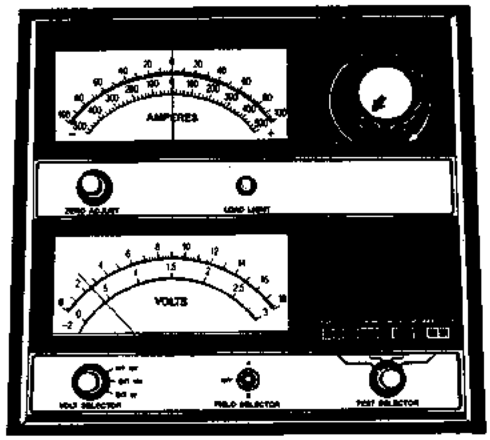

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Fig. 9 Voltmeter Accurate to 1/10 Volt Connected

(2) Disconnect and isolate the battery negative cable. Connect the battery charger leads. Some battery chargers are equipped with polarity-sensing circuitry. This circuitry protects the charger and/or battery from being damaged if they are improperly connected. If the battery state-of-charge is too low for the polarity-sensing circuitry to detect, the charger will not operate. This makes it appear that the battery will not accept charging current. Refer to the instructions provided with the battery charger to bypass the polarity-sensing circuitry.

(3) Battery chargers vary in the amount of voltage and current they provide. The amount of time required for a battery to accept measurable charger current at various voltages is shown in the Charge Rate chart. If the charge current is still not measurable at the end of the charging time, the battery is faulty and must be replaced. If the charge current is measurable during the charging time, the battery may be good and the charging should be completed in the normal manner.

SERVICE PROCEDURES (Continued)

Charge Rate	
Voltage	**Hours**
16.0 volts maximum	up to 4 hours
14.0 to 15.9 volts	up to 8 hours
13.9 volts or less	up to 16 hours

CHARGING TIME REQUIRED

The time required to charge a battery will vary, depending upon the following factors:

- **Battery Capacity** - A completely discharged heavy-duty battery requires twice the charging time of a small capacity battery.
- **Temperature** - A longer time will be needed to charge a battery at -18°C (0°F) than at 27°C (80°F). When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first. As the battery warms, it will accept a higher charging current rate (amperage).
- **Charger Capacity** - A charger that supplies only five amperes will require a longer charging time. A charger that supplies twenty amperes or more will require a shorter charging time.
- **State-Of-Charge** - A completely discharged battery requires more charging time than a partially discharged battery. Electrolyte is nearly pure water in a completely discharged battery. At first, the charging current (amperage) will be low. As the battery charges, the specific gravity of the electrolyte will gradually rise.

WARNING: NEVER EXCEED TWENTY AMPERES WHEN CHARGING A COLD (-1°C/30°F) BATTERY. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

Battery Charging Timetable			
Charging Amperage	**5 Amperes**	**10 Amperes**	**20 Amperes**
Open Circuit Voltage	**Hours Charging at 21°C (70°F)**		
12.25 to 12.39	6 hours	3 hours	1.5 hours
12.00 to 12.24	8 hours	4 hours	2 hours
11.95 to 11.99	12 hours	6 hours	3 hours
10.00 to 11.94	14 hours	7 hours	3.5 hours
less than 10.00	See Charging Completely Discharged Battery		

REMOVAL AND INSTALLATION

BATTERY

(1) Turn the ignition switch to the Off position. Make sure all electrical accessories are turned off.

(2) Loosen the cable terminal clamps and disconnect both battery cables, negative cable first. If necessary, use a puller to remove the terminal clamps from the battery posts (Fig. 10).

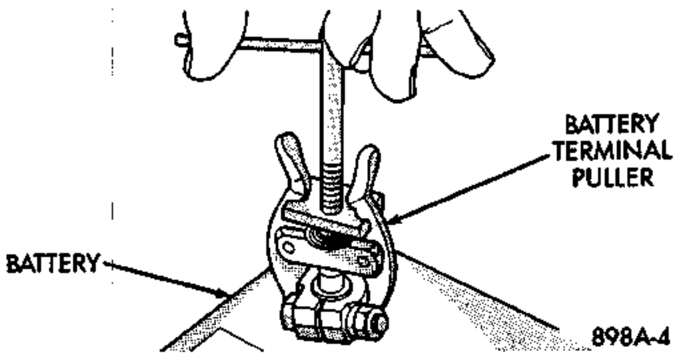


Fig. 10 Remove Battery Terminal Clamp - Typical

(3) Inspect the cable terminal clamps for corrosion and damage. Remove any corrosion using a wire brush or a post and terminal cleaning tool, and a sodium bicarbonate (baking soda) and warm water cleaning solution (Fig. 11). Replace any cable that has damaged or deformed terminal clamps.

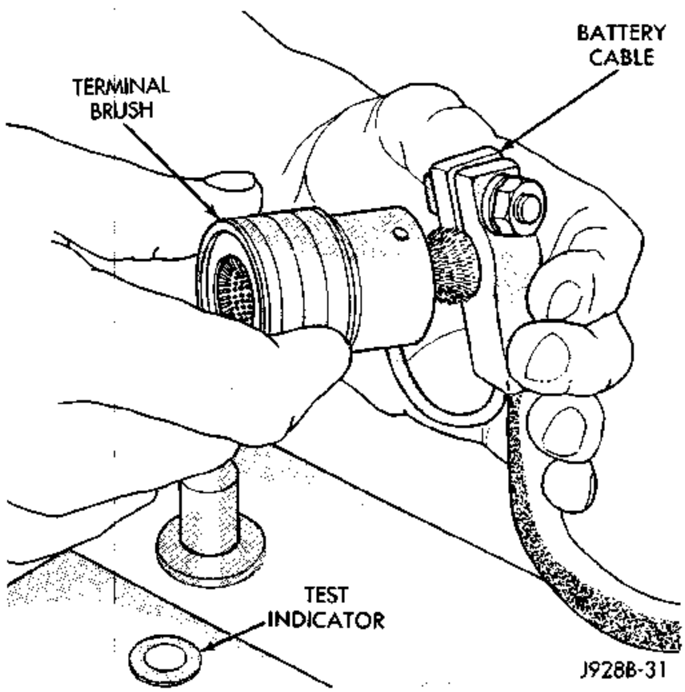


Fig. 11 Clean Battery Cable Terminal Clamp - Typical

REMOVAL AND INSTALLATION (Continued)

WARNING: WEAR A SUITABLE PAIR OF RUBBER GLOVES (NOT THE HOUSEHOLD TYPE) WHEN REMOVING A BATTERY BY HAND. SAFETY GLASSES SHOULD ALSO BE WORN. IF THE BATTERY IS CRACKED OR LEAKING, THE ELECTROLYTE CAN BURN THE SKIN AND EYES.

(4) Remove the battery hold-downs and remove the battery from the vehicle (Fig. 12).

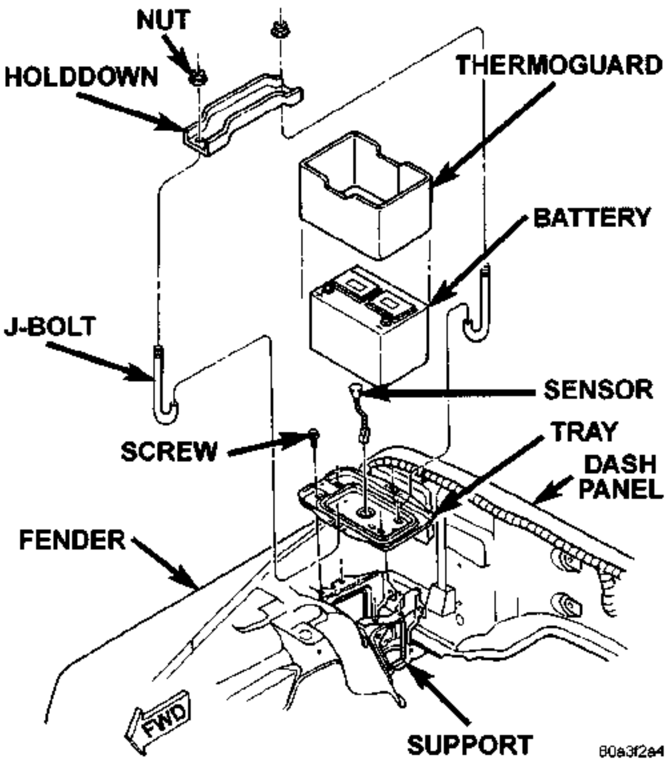


Fig. 12 Battery Hold-down

(5) Inspect the battery tray and hold-downs for corrosion or damage. Remove any corrosion using a wire brush and a sodium bicarbonate (baking soda) and warm water cleaning solution. Paint any exposed bare metal and replace any damaged parts.

(6) Inspect the battery case for cracks or other damage that could result in electrolyte leaks. Also, check the battery terminal posts for looseness. Batteries with damaged cases or loose posts must be replaced.

(7) Check the electrolyte level in the battery. Use a putty knife or another suitable wide flat-bladed tool to pry the cell caps off (Fig. 13). Do not use a screwdriver. Add distilled water to each cell until the liquid reaches the bottom of the vent well. DO NOT OVERFILL.

(8) Inspect the battery built-in test indicator sight glass for an indication of the battery condition. If the battery is discharged, charge as required. See Built-In Test Indicator and Battery Charging in this group for more information.

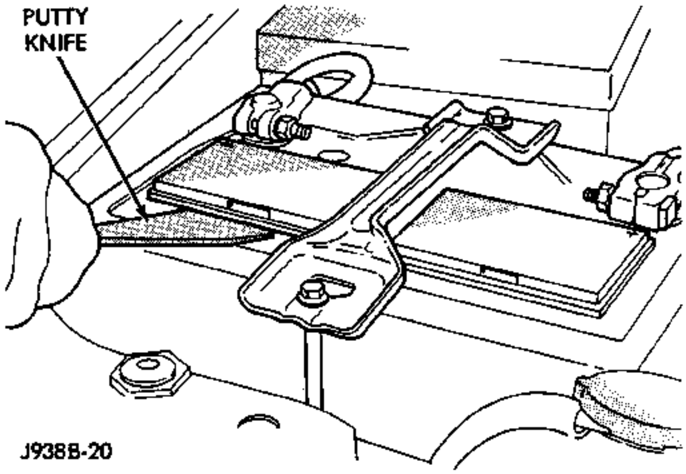


Fig. 13 Removing Cell Caps - Typical

(9) If the battery is to be reinstalled, clean the outside of the battery case and the top cover with a sodium bicarbonate (baking soda) and warm water cleaning solution to remove any acid film (Fig. 14). Rinse the battery with clean water. Ensure that the cleaning solution does not enter the battery cells through the vent holes. If the battery is being replaced, see the Battery Ratings and Classifications chart in Specifications at the back of this group. Confirm that the replacement battery is the correct size and has the correct ratings for the vehicle.

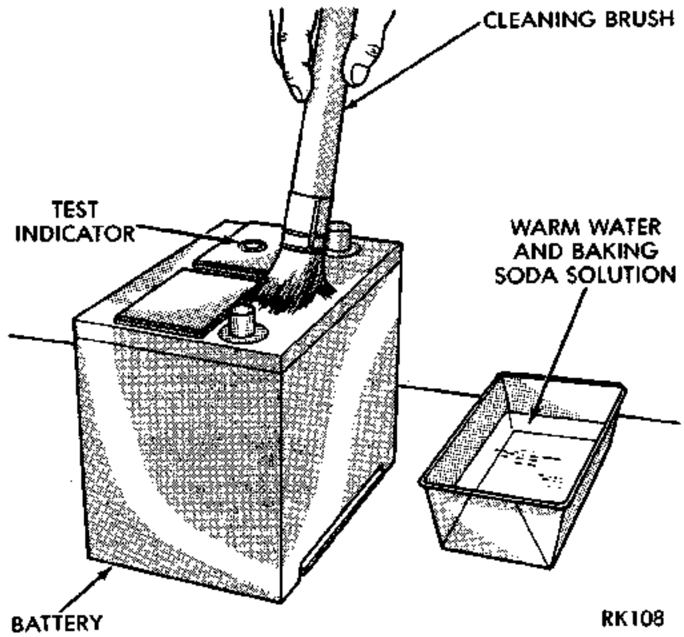


Fig. 14 Clean Battery - Typical

(10) Clean any corrosion from the battery terminal posts with a wire brush or a post and terminal cleaner, and a sodium bicarbonate (baking soda) and warm water cleaning solution (Fig. 15).

(11) Position the battery in the tray. Ensure that the positive and negative terminal posts are correctly

REMOVAL AND INSTALLATION (Continued)

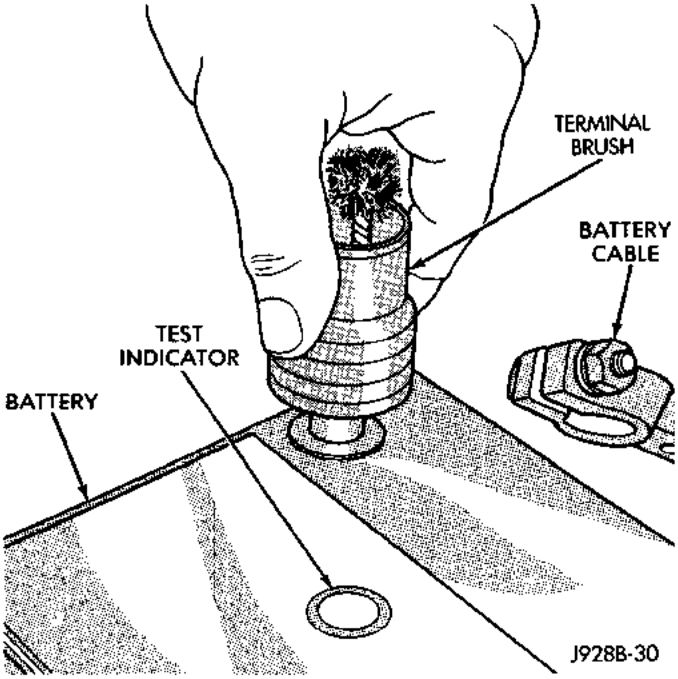


Fig. 15 Clean Battery Terminal Post - Typical

positioned. The cable terminal clamps must reach the correct battery post without stretching the cables (Fig. 16).

(12) Loosely install the battery hold-down hardware. Ensure that the battery base is correctly positioned in the tray, then tighten the hold-downs to 18 N·m (160 in. lbs.).

CAUTION: Be certain that the battery cables are connected to the correct battery terminals. Reverse polarity may damage electrical components.

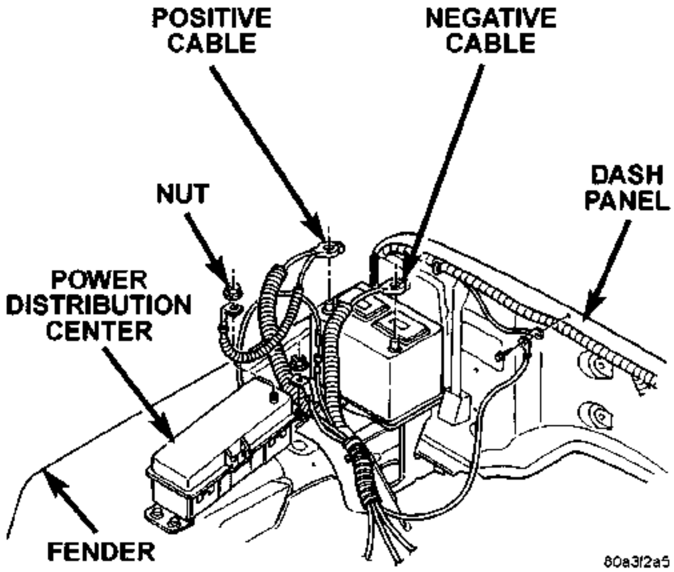


Fig. 16 Battery Cables

(13) Install and tighten the battery positive cable terminal clamp. Then install and tighten the negative cable terminal clamp. Tighten both cable terminal clamp bolts to 6.2 N·m (55 in. lbs.).

(14) Apply a thin coating of petroleum jelly or chassis grease to the exposed surfaces of the cable terminal clamps and battery terminal posts.

SPECIFICATIONS

BATTERY

Battery Classifications and Ratings			
BCI Group Size Classification	Cold Cranking Amperage	Ampere-Hours	Load Test Amperage
34	500	60	250
34	600	66	300

STARTING SYSTEMS

CONTENTS

GENERAL INFORMATION

OVERVIEW

The battery, starting, and charging systems operate with one another, and must be tested as a complete system. In order for the vehicle to start and charge properly, all of the components involved in these systems must perform within specifications.

Group 8A covers the battery, Group 8B covers the starting system, and Group 8C covers the charging system. Refer to Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams. We have separated these systems to make it easier to locate the information you are seeking within this Service Manual. However, when attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used in these groups include the most basic conventional diagnostic methods to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of a induction milliampere ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. See the On-Board Diagnostics Test in Group 8C - Charging System for more information.

INTRODUCTION

The starting system consists of:

- Battery
- Starter relay
- Starter with an integral solenoid
- Ignition switch
- Clutch pedal position switch (manual transmission)
- Park/neutral position switch (automatic transmission)
- Wiring harness and connections.

This group covers diagnosis of the complete starting system, except the battery. However, this group only covers service procedures for the starter and starter relay. Service procedures for other starting system components can be located as follows:

- Battery - refer to Group 8A - Battery for the diagnostic and service procedures
- Ignition switch - refer to Group 8D - Ignition Systems for the service procedures
- Clutch pedal position switch - refer to Group 6 - Clutch for the service procedures
- Park/neutral position switch - refer to Group 21 - Transmission for the service procedures
- Wiring harness and connections - refer to Group 8W - Wiring Diagrams for the service procedures.

NOTE: This group covers both Left-Hand Drive (LHD) and Right-Hand Drive (RHD) versions of this model. Whenever required and feasible, the RHD versions of affected vehicle components have been constructed as mirror-image of the LHD versions. While most of the illustrations used in this group represent only the LHD version, the diagnostic and service procedures outlined can generally be applied to either version. Exceptions to this rule have been clearly identified as LHD or RHD, if a special illustration or procedure is required.

DESCRIPTION AND OPERATION

STARTING SYSTEM

The starting system components form two separate circuits. A high-amperage feed circuit that feeds the starter between 150 and 350 amperes, and a low-amperage control circuit that operates on less than 20 amperes.

If the vehicle is equipped with an automatic transmission, battery voltage is supplied through the low-amperage control circuit to the coil battery terminal of the starter relay when the ignition switch is turned to the Start position. The park/neutral position switch is installed in series between the starter relay coil ground terminal and ground. This normally open switch prevents the starter relay from being energized unless the automatic transmission gear selector is in the Neutral or Park positions.

If the vehicle is equipped with a manual transmission, it has a clutch pedal position switch installed in series between the ignition switch and the coil battery terminal of the starter relay. This normally open switch prevents the starter relay from being energized unless the clutch pedal is depressed. The starter relay coil ground terminal is always grounded on vehicles with a manual transmission.

When the starter relay coil is energized, the normally open relay contacts close. The relay contacts connect the relay common feed terminal to the relay normally open terminal. The closed relay contacts energize the starter solenoid coil windings.

The energized solenoid pull-in coil pulls in the solenoid plunger. The solenoid plunger pulls the shift lever in the starter. This engages the starter overrunning clutch and pinion gear with the starter ring gear on the automatic transmission torque converter drive plate, or the manual transmission flywheel.

As the solenoid plunger reaches the end of its travel, the solenoid contact disc completes the high-amperage starter feed circuit and energizes the solenoid plunger hold-in coil. Current now flows between the solenoid battery terminal and the starter motor, energizing the starter.

Once the engine starts, the overrunning clutch protects the starter from damage by allowing the starter pinion gear to spin faster than the pinion shaft. When the driver releases the ignition switch to the On position, the starter relay coil is de-energized. This causes the relay contacts to open. When the relay contacts open, the starter solenoid plunger hold-in coil is de-energized.

When the solenoid plunger hold-in coil is de-energized, the solenoid plunger return spring returns the plunger to its relaxed position. This causes the contact disc to open the starter feed circuit, and the shift lever to disengage the overrunning clutch and pinion gear from the starter ring gear.

STARTER

The starter motor incorporates several features to create a reliable, efficient, compact and lightweight unit. A planetary gear system (intermediate transmission) is used between the electric motor and the pinion gear. This feature makes it possible to reduce the dimensions of the starter. At the same time, it allows higher armature rotational speed and delivers increased torque through the pinion gear to the starter ring gear on the automatic transmission torque converter or torque converter drive plate.

The use of a permanent magnet field also reduces the size and weight of the starter. The permanent magnet field consists of four high-strength permanent magnets. The magnets are aligned according to their polarity, and are permanently mounted in the starter field frame.

The starter motors for all engines are activated by a solenoid mounted to the overrunning clutch housing. However, the starter motor and solenoid are serviced only as a complete assembly. If either component fails, the entire assembly must be replaced.

CAUTION:

- **Permanent magnet starters are highly sensitive to hammering, shocks, and external pressure. The permanent magnets may be damaged and the starter rendered unserviceable, if subjected to any of these conditions.**
- **The starter motor must not be clamped in a vise by the starter field frame. Doing so may damage the permanent magnets. The starter should only be clamped by the mounting flange.**
- **Do not connect the starter motor incorrectly when testing. Reverse polarity may damage the permanent magnets and render the starter unserviceable.**

STARTER RELAY

The starter relay is a International Standards Organization (ISO)-type relay. The starter relay is a electro-mechanical device that switches current to the pull-in coil of the starter solenoid, when the ignition switch is turned to the Start position. See the Diagnosis and Testing section of this group for more information on the starter relay.

The starter relay is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for relay identification and location.

DIAGNOSIS AND TESTING

STARTING SYSTEM

For circuit descriptions and diagrams, refer to 8W-21 - Starting System in Group 8W - Wiring Diagrams.

INSPECTION

Before removing any unit from the starting system for repair or diagnosis, perform the following inspections:

- **Battery** - Visually inspect the battery for indications of physical damage and loose or corroded cable connections. Determine the state-of-charge and cranking capacity of the battery. Charge or replace the battery, if required. Refer to Group 8A - Battery for more information.
- **Ignition Switch** - Visually inspect the ignition switch for indications of physical damage and loose or corroded wiring connections.
- **Clutch Pedal Position Switch** - Visually inspect the clutch pedal position switch for indications of physical damage and loose or corroded wiring connections.
- **Park/Neutral Position Switch** - Visually inspect the park/neutral position switch for indications of physical damage and loose or corroded wiring connections.
- **Starter Relay** - Visually inspect the starter relay for indications of physical damage and loose or corroded wiring connections.
- **Starter** - Visually inspect the starter for indications of physical damage and loose or corroded wiring connections.
- **Starter Solenoid** - Visually inspect the starter solenoid for indications of physical damage and loose or corroded wiring connections.
- **Wiring** - Visually inspect the wiring for damage. Repair or replace the faulty wiring, as required.

DIAGNOSIS AND TESTING (Continued)

STARTING SYSTEM DIAGNOSIS

Starting System Diagnosis		
CONDITION	**POSSIBLE CAUSE**	**CORRECTION**
STARTER FAILS TO ENGAGE.	1. Battery discharged or faulty. 2. Starting circuit wiring faulty. 3. Starter relay faulty. 4. Ignition switch faulty. 5. Park/Neutral position switch (auto trans) faulty or misadjusted. 6. Clutch pedal position switch (man trans) faulty. 7. Starter solenoid faulty. 8. Starter assembly faulty.	1. Refer to Group 8A - Battery. Charge or replace battery, if required. 2. See Cold Cranking Test, in this group. Test and repair feed and/or control circuits, if required. 3. See Relay Test, in this group. Replace relay, if required. 4. See Ignition Switch Test, in this group. Replace switch, if required. 5. See Park/Neutral Position Switch Test, in this group. Replace switch, if required. 6. See Clutch Pedal Position Switch Test, in this group. Replace switch, if required. 7. See Solenoid Test, in this Group. Replace starter assembly, if required. 8. If all other starting system components and circuits check OK, replace starter assembly.
STARTER ENGAGES, FAILS TO TURN ENGINE.	1. Battery discharged or faulty. 2. Starting circuit wiring faulty. 3. Starter assembly faulty. 4. Engine seized.	1. Refer to Group 8A - Battery. Charge or replace battery, if required. 2. See Cold Cranking Test, in this group. Test and repair feed and/or control circuits, if required. 3. If all other starting system components and circuits check OK, replace starter assembly. 4. Refer to Group 9 - Engine, for diagnostic and service procedures.
STARTER ENGAGES, SPINS OUT BEFORE ENGINE STARTS.	1. Broken teeth on starter ring gear. 2. Starter assembly faulty.	1. Remove starter as described in this group. Inspect ring gear and replace, if required. 2. If all other starting system components and circuits check OK, replace starter assembly.
STARTER DOES NOT DISENGAGE.	1. Starter improperly installed. 2. Starter relay faulty. 3. Ignition switch faulty. 4. Starter assembly faulty.	1. Install starter as described in this group. Tighten starter mounting hardware to correct torque specifications. 2. See Relay Test, in this group. Replace relay, if required. 3. See Ignition Switch Test, in this group. Replace switch, if required. 4. If all other starting system components and circuits check OK, replace starter assembly.

DIAGNOSIS AND TESTING (Continued)

COLD CRANKING TEST

For circuit descriptions and diagrams, refer to 8W-21 - Starting System in Group 8W - Wiring Diagrams. The battery must be fully-charged and load-tested before proceeding. Refer to Group 8A - Battery for more information.

(1) Connect a suitable volt-ampere tester to the battery terminals (Fig. 1). Refer to the operating instructions provided with the tester being used.

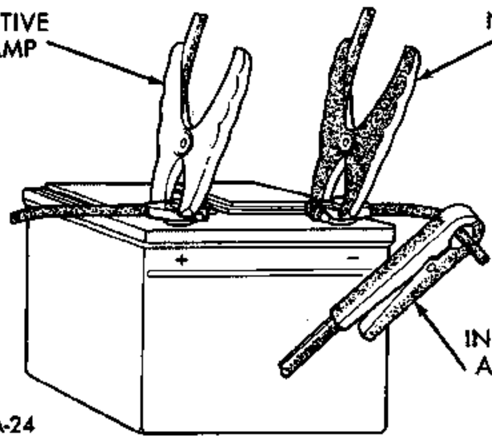


Fig. 1 Volts-Amps Tester Connections - Typical

(2) Fully engage the parking brake.

(3) If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position. If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and fully depress the clutch pedal.

(4) Verify that all lamps and accessories are turned off.

(5) To prevent the engine from starting, unplug the Automatic Shutdown (ASD) relay. The ASD relay is located in the Power Distribution Center (PDC). Refer to the PDC label for relay identification and location.

(6) Rotate and hold the ignition switch in the Start position. Note the cranking voltage and current (amperage) draw.

(a) If the voltage reads above 9.6 volts and the current (amperage) draw reads above specifications, see the Feed Circuit Tests in this group.

(b) If the voltage reads 12.5 volts or greater and the current (amperage) draw reads below specifications, see the Control Circuit Tests in this group.

NOTE: A cold engine will increase the starter current (amperage) draw reading, and reduce the battery voltage reading.

FEED CIRCUIT TESTS

The starter feed circuit tests (voltage drop method) will determine if there is excessive resistance in the high-amperage circuit. For circuit descriptions and diagrams, refer to 8W-21 - Starting System in Group 8W - Wiring Diagrams.

When performing these tests, it is important to remember that the voltage drop is giving an indication of the resistance between the two points at which the voltmeter probes are attached.

Example: When testing the resistance of the battery positive cable, touch the voltmeter leads to the battery positive cable clamp and the cable connector at the starter solenoid. If you probe the battery positive terminal post and the cable connector at the starter solenoid, you are reading the combined voltage drop in the battery positive cable clamp-to-terminal post connection and the battery positive cable.

The following operation will require a voltmeter accurate to 1/10 (0.10) volt. Before performing the tests, be certain the following procedures are accomplished:

- Battery is fully-charged. Refer to Group 8A - Battery for more information.
- Fully engage the parking brake.
- If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position. If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and fully depress the clutch pedal.
- Unplug the Automatic Shutdown (ASD) relay to prevent the engine from starting. The relay is located in the Power Distribution Center (PDC). Refer to the PDC label for relay identification and location.

(1) Connect the positive lead of the voltmeter to the battery negative terminal post. Connect the negative lead of the voltmeter to the battery negative cable clamp (Fig. 2). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor contact between the cable clamp and the terminal post.

(2) Connect the positive lead of the voltmeter to the battery positive terminal post. Connect the negative lead of the voltmeter to the battery positive cable clamp (Fig. 3). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor contact between the cable clamp and the terminal post.

(3) Connect the voltmeter to measure between the battery positive terminal post and the starter solenoid battery terminal stud (Fig. 4). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery cable connection at the solenoid.

DIAGNOSIS AND TESTING (Continued)

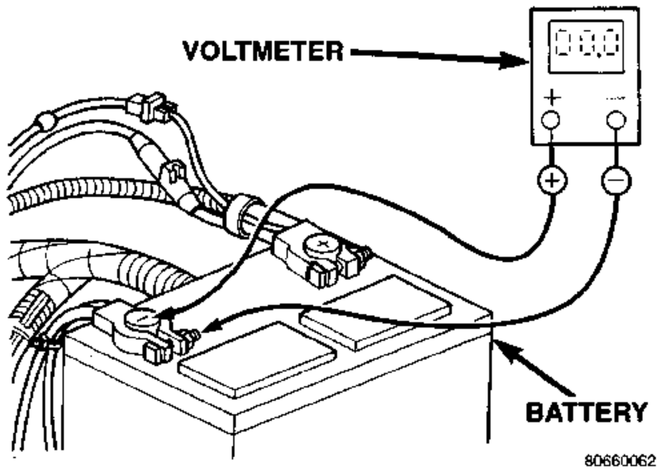


Fig. 2 Test Battery Negative Connection Resistance - Typical

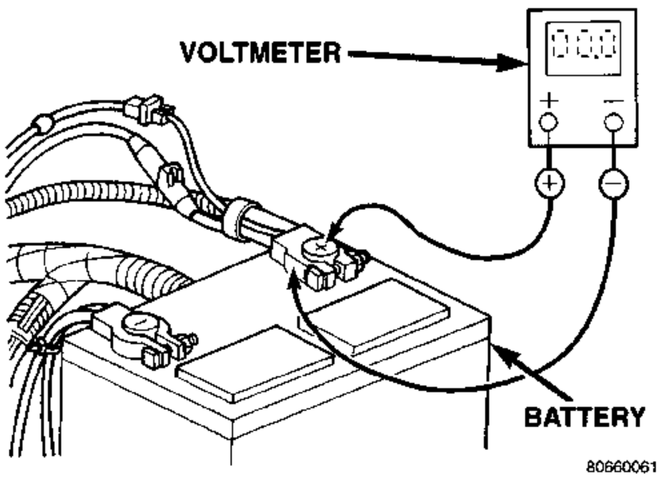


Fig. 3 Test Battery Positive Connection Resistance - Typical

Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery positive cable.

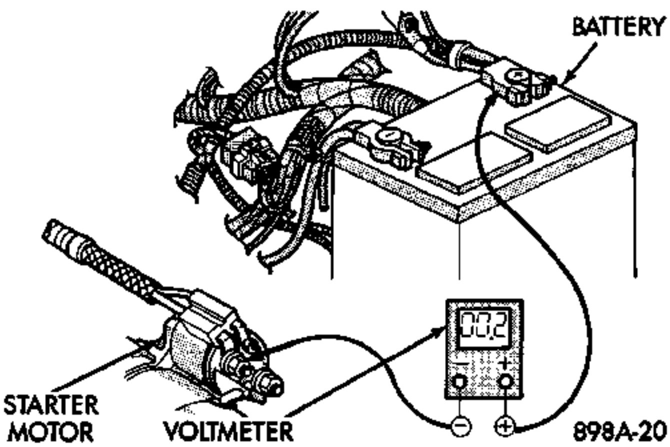


Fig. 4 Test Battery Positive Cable Resistance - Typical

(4) Connect the voltmeter to measure between the battery negative terminal post and a good clean ground on the engine block (Fig. 5). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery negative cable attachment on the engine block. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery negative cable.

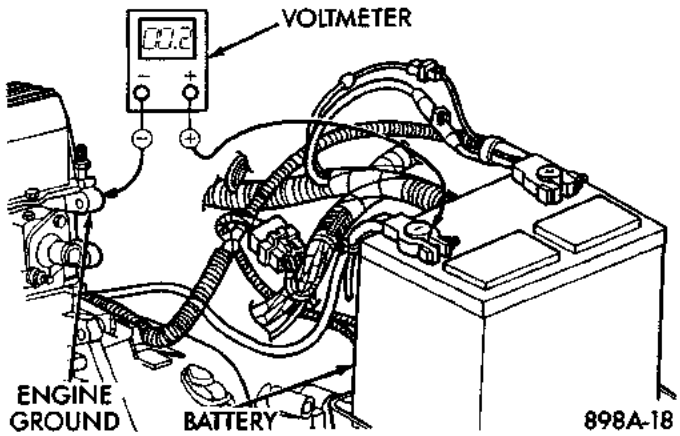


Fig. 5 Test Ground Circuit Resistance - Typical

(5) Connect the positive lead of the voltmeter to the starter housing. Connect the negative lead of the voltmeter to the battery negative terminal post (Fig. 6). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, correct the poor starter to engine block ground contact.

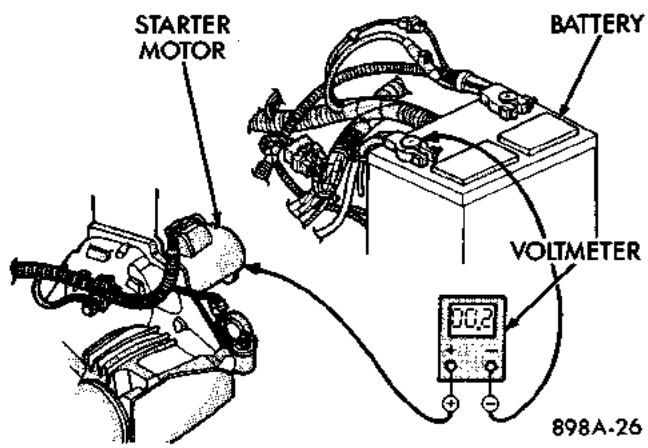


Fig. 6 Test Starter Ground - Typical

If the resistance tests detect no feed circuit problems, remove the starter and see the Solenoid Test in this group.

DIAGNOSIS AND TESTING (Continued)

CONTROL CIRCUIT TESTS

For circuit descriptions and diagrams, refer to 8W-21 - Starting System in Group 8W - Wiring Diagrams. The starter control circuit consists of:

- Battery
- Starter relay
- Starter solenoid
- Ignition switch
- Park/neutral position switch (automatic transmission)
- Clutch pedal position switch (manual transmission)
- Wiring harness and connections.

Test procedures for these components should be performed in the order in which they are listed, as follows:

SOLENOID TEST

Remove the starter as described in this group. Then proceed as follows:

(1) Disconnect the wire from the solenoid field coil terminal.

(2) Check for continuity between the solenoid terminal and field coil terminal with a continuity tester (Fig. 7). There should be continuity. If OK, go to Step 3. If not OK, replace the faulty starter assembly.

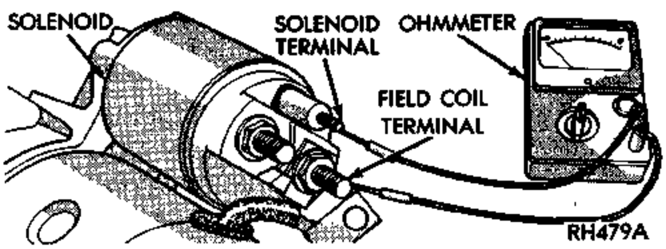


Fig. 7 Continuity Test Between Solenoid Terminal and Field Coil Terminal

(3) Check for continuity between the solenoid terminal and the solenoid case (Fig. 8). There should be continuity. If OK, go to Step 4. If not OK, replace the faulty starter assembly.

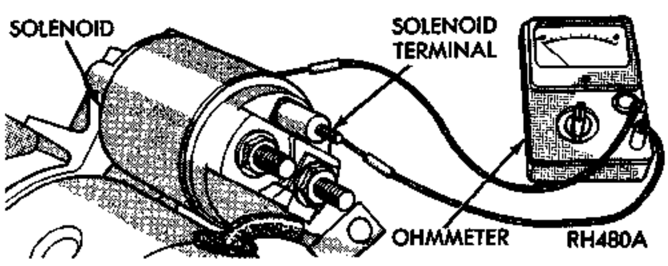


Fig. 8 Continuity Test Between Solenoid Terminal and Solenoid Case

(4) Connect the solenoid field coil wire to the field coil terminal.

(5) Install the starter as described in this group.

RELAY TEST

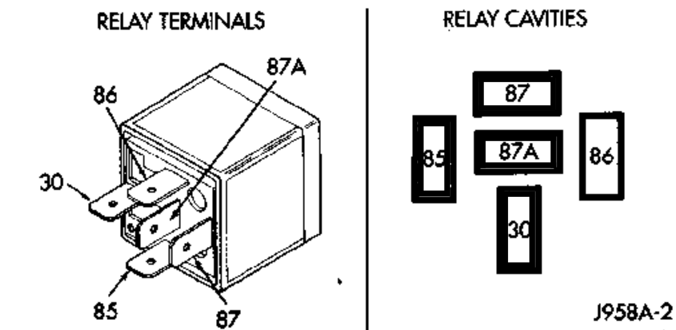
The starter relay is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for relay identification and location.

Remove the starter relay from the PDC as described in this group to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75±5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see the Relay Circuit Test in this group. If not OK, replace the faulty relay.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Starter Relay

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair the open circuit to the PDC fuse as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the starter solenoid field coils. There should be continuity between the cavity for relay terminal 87 and the starter solenoid terminal at all times. If OK, go to Step 4. If not OK, repair the open circuit to the starter solenoid as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. It is energized when the ignition switch is held in the Start position. On vehicles with a manual transmission, the clutch pedal must be fully depressed for this test. Check for

DIAGNOSIS AND TESTING (Continued)

battery voltage at the cavity for relay terminal 86 with the ignition switch in the Start position, and no voltage when the ignition switch is released to the On position. If OK, go to Step 5. If not OK with an automatic transmission, check for an open or short circuit to the ignition switch and repair, if required. If the circuit to the ignition switch is OK, see the Ignition Switch Test in this group. If not OK with a manual transmission, check the circuit between the relay and the clutch pedal position switch for an open or a short. If the circuit is OK, see the Clutch Pedal Position Switch Test in this group.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. On vehicles with an automatic transmission, it is grounded through the park/neutral position switch only when the gearshift selector lever is in the Park or Neutral positions. On vehicles with a manual transmission, it is grounded at all times. Check for continuity to ground at the cavity for relay terminal 85. If not OK with an automatic transmission, check for an open or short circuit to the park/neutral position switch and repair, if required. If the circuit is OK, see the Park/Neutral Position Switch Test in this group. If not OK with a manual transmission, repair the circuit to ground as required.

PARK/NEUTRAL POSITION SWITCH TEST

(1) Place the transmission gear selector lever in the Park position.

(2) Disconnect and isolate the battery negative cable.

(3) Raise and support the vehicle.

(4) Disconnect the park/neutral position switch harness connector.

(5) Check for continuity between the center switch terminal and a good chassis ground. There should be continuity. If OK, go to Step 6. If not OK, replace the faulty switch.

(6) Move the transmission gear selector to the Reverse position and check for continuity between the center switch terminal and a good chassis ground. There should be no continuity. If not OK, replace the faulty switch.

CLUTCH PEDAL POSITION SWITCH TEST

The clutch pedal position switch is integral to the clutch pedal pushrod. It is located near the dash panel under the instrument panel. The harness connector for the switch is wrapped with foam tape.

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the switch harness connector.

(3) Check for continuity between the two cavities in the switch-half of the harness connector with the clutch pedal released. There should be no continuity. If OK, go to Step 4. If not OK, replace the faulty switch.

(4) Check for continuity between the two cavities in the switch-half of the harness connector again with the clutch pedal depressed. There should now be continuity. If OK, see the Ignition Switch Test in this group. If not OK, replace the faulty switch.

IGNITION SWITCH TEST

WARNING: ON VEHICLES EQUIPPED WITH AN AIRBAG, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL OR STEERING COLUMN COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column shrouds and disconnect the ignition switch harness connector. Refer to Group 8D - Ignition Systems for the procedures.

(3) With the ignition switch in the On position, check for continuity between the ignition switch **fused B+** circuit terminal and the **ignition switch output (start)** circuit terminal. There should be no continuity. If OK, go to Step 4. If not OK, replace the faulty switch.

(4) With the ignition switch held in the Start position, check for continuity between the ignition switch **fused B+** circuit terminal and the **ignition switch output (start)** circuit terminal. There should now be continuity. If not OK, replace the faulty switch.

STARTER NOISE - 2.5L ENGINE

See the Starter Noise Diagnosis chart (Fig. 9). If the complaint is similar to Conditions 1 and 2 in the chart, correction can be made by shimming the starter using the following procedures:

CAUTION: Disconnect the battery negative cable to prevent the engine from starting.

(1) If the complaint is similar to Condition 1, the starter must be moved toward the starter ring gear by removing shims (Fig. 10).

NOTE: The shim thickness is 0.381 mm (0.015 in.), and the shims may be stacked if additional thickness is required.

(2) If the complaint is similar to Condition 2, the starter must be moved away from the starter ring gear. This is done by installing shim(s) across both starter mounting pads. More than one shim may be required.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
1. VERY HIGH FREQUENCY WHINE BEFORE ENGINE STARTS; ENGINE STARTS OK.	1. Excessive distance between pinion gear and flywheel/drive plate gear.	1. Move starter motor toward flywheel/drive plate by removing shim(s), if possible.
2. VERY HIGH FREQUENCY WHINE AFTER ENGINE STARTS WITH IGNITION KEY RELEASED. ENGINE STARTS OK.	2. Insufficient distance between starter motor pinion gear and flywheel/drive plate runout can cause noise to be intermittent.	2. Shim starter motor away from flywheel/drive plate. Inspect flywheel/drive plate for damage; bent, unusual wear, and excessive runout. Replace flywheel/drive plate as necessary.
3. A LOUD "WHOOP" AFTER ENGINE STARTS WHILE STARTER MOTOR IS ENGAGED.	3. Most probably cause is defective overrunning clutch.	3. Replace starter motor.
4. A "RUMBLE," "GROWL," OR "KNOCK" AS STARTER MOTOR COASTS TO STOP AFTER ENGINE STARTS.	4. Most probable cause is bent or unbalanced starter motor armature.	4. Replace starter motor.

NOTE: A high frequency whine during cranking is normal for this starter motor.

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Fig. 9 Starter Noise Diagnosis

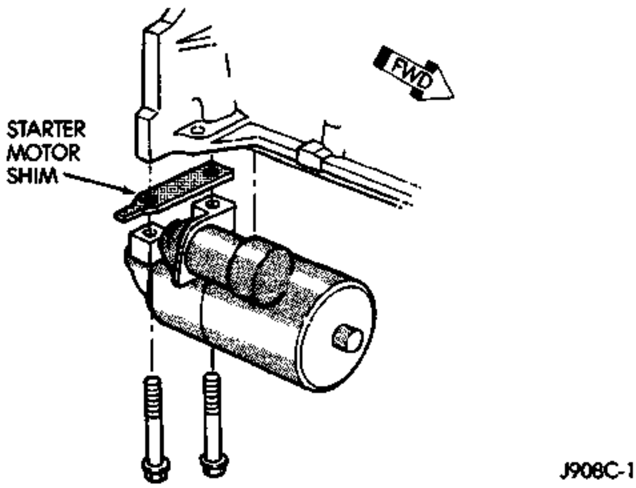

Fig. 10 Starter Shim

NOTE: This is a condition that will generally cause broken starter (flywheel/drive plate) ring gear teeth or broken starter housings.

REMOVAL AND INSTALLATION

STARTER

(1) Disconnect and isolate the battery negative cable.

(2) Raise and support the vehicle.

(3) Disconnect the battery cable and solenoid feed wire from the starter solenoid (Fig. 11) or (Fig. 12).

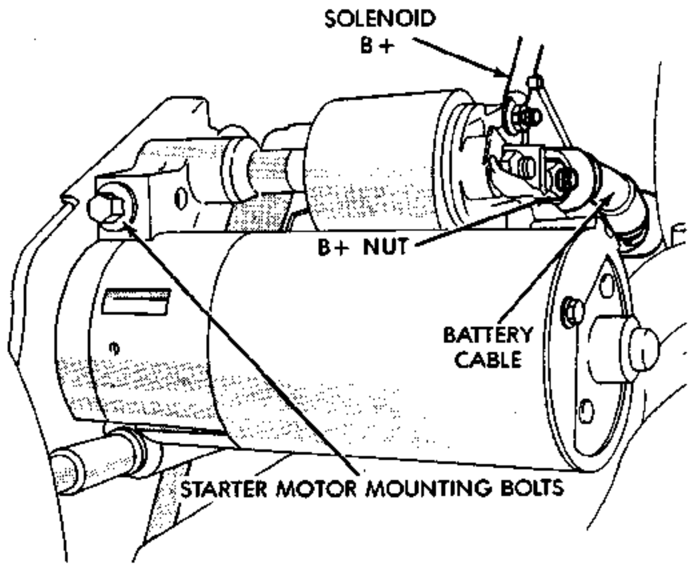

Fig. 11 Starter Remove/Install - 2.5L Engine

(4) Remove the two starter mounting bolts, the starter motor, and any starter motor shims, if equipped.

NOTE: Shim thickness available is 0.381 mm (0.015 in.). See Starter Noise - 2.5L Engine in this group for more information.

(5) Reverse the removal procedures to install. Tighten the starter hardware as follows:

- Mounting bolts
  - 2.5L engine - 45 N·m (33 ft. lbs.)

REMOVAL AND INSTALLATION (Continued)

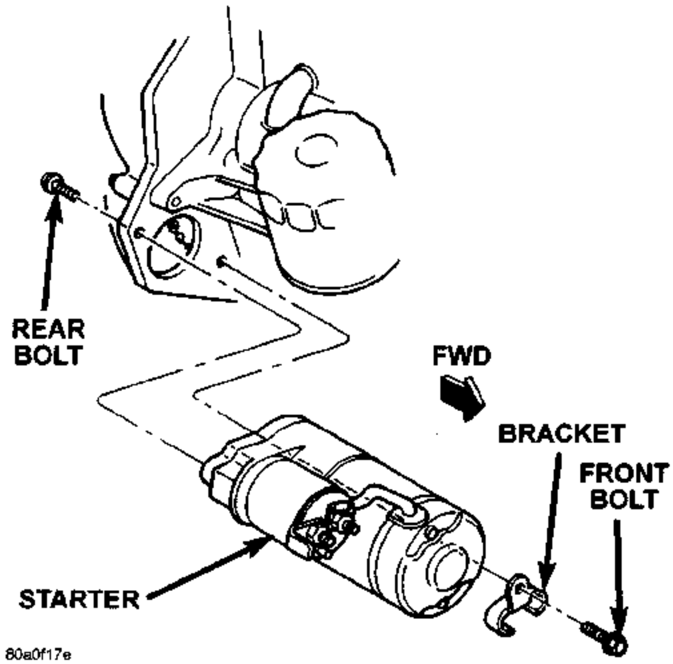

Fig. 12 Starter Remove/Install - 4.0L Engine

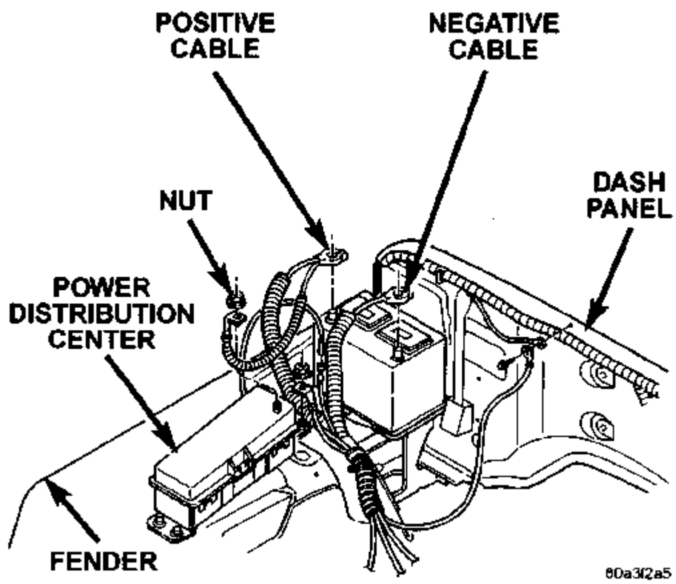

Fig. 13 Power Distribution Center

- 4.0L engine (rear bolt) - 55 N·m (40 ft. lbs.)
- 4.0L engine (front bolt) - 41 N·m (30 ft. lbs.)
- Solenoid battery cable nut - 10 N·m (90 in. lbs.)
- Solenoid terminal nut - 6 N·m (55 in. lbs.).

STARTER RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 13).

(3) Refer to the label on the PDC for starter relay identification and location.

(4) Remove the starter relay by unplugging it from the PDC.

(5) Install the starter relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

SPECIFICATIONS

STARTING SYSTEM

Starter and Solenoid	
Manufacturer	Mitsubishi
Engine Application	2.5L, 4.0L
Power Rating	1.2 Kilowatt - 2.5L 1.4 Kilowatt - 4.0L
Voltage	12 Volts
Number of Fields	4
Number of Poles	4
Number of Brushes	4
Drive Type	Planetary Gear Reduction
Free Running Test Voltage	11.2 Volts
Free Running Test Maximum Amperage Draw	90 Amperes
Free Running Test Minimum Speed	2600 rpm - 2.5L 2500 rpm - 4.0L
Solenoid Closing Maximum Voltage	7.8 Volts
*Cranking Amperage Draw Test	130 Amperes - 2.5L 160 Amperes - 4.0L
*Test at operating temperature. Cold engine, tight (new) engine, or heavy oil will increase starter amperage draw.	

CHARGING SYSTEM

CONTENTS

GENERAL INFORMATION

OVERVIEW

The battery, starting, and charging systems operate with one another, and must be tested as a complete system. In order for the vehicle to start and charge properly, all of the components involved in these systems must perform within specifications.

Group 8A covers the battery, Group 8B covers the starting system, and Group 8C covers the charging system. Refer to Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams. We have separated these systems to make it easier to locate the information you are seeking within this Service Manual. However, when attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used in these groups include the most basic conventional diagnostic methods to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of a induction milliampere ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. See the On-Board Diagnostics Test in Group 8C - Charging System for more information.

DESCRIPTION AND OPERATION

CHARGING SYSTEM OPERATION

The charging system consists of:

- Generator
- Electronic Voltage Regulator (EVR) circuitry within the Powertrain Control Module (PCM)
- Ignition switch (refer to Group 8D, Ignition System for information)
- Battery (refer to Group 8A, Battery for information)
- Battery temperature sensor
- Generator Lamp (if equipped)
- Check Gauges Lamp (if equipped)
- Voltmeter (refer to Group 8E, Instrument Panel and Gauges for information)
- Wiring harness and connections (refer to Group 8W, Wiring for information)

The charging system is turned on and off with the ignition switch. When the ignition switch is turned to the ON position, battery voltage from the powertrain control module (PCM) is supplied to the generator rotor to produce a magnetic field. This is done through one of the two field terminals at the rear of generator. **On Jeep models of previous years, battery voltage to this field terminal was supplied from the ASD relay.**

The amount of DC current produced by the generator is controlled by the EVR (field control) circuitry contained within the PCM. This circuitry is connected in series with the second rotor field terminal and ground.

A battery temperature sensor, located in the battery tray housing, is used to sense battery temperature. This temperature data, along with data from monitored line voltage, is used by the PCM to vary

DESCRIPTION AND OPERATION (Continued)

the battery charging rate. This is done by cycling the ground path to control the strength of the rotor magnetic field. The PCM then compensates and regulates generator current output accordingly.

All vehicles are equipped with On-Board Diagnostics (OBD). All OBD-sensed systems, including the EVR (field control) circuitry, are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. Refer to On-Board Diagnostic Test For Charging System in this group for more information.

The Check Gauges lamp monitors the **Voltage**, Engine Coolant and Engine Oil Pressure gauges. The lamp is located on the instrument panel. If any of the three gauges detects an extreme condition, the lamp will be illuminated. This is done as reminder to check the three gauges. The signal to activate the lamp is sent via the CCD bus circuits. Refer to Group 8E, Instrument Panel and Gauges for additional information.

GENERATOR

The generator is belt-driven by the engine using a serpentine type drive belt. It is serviced only as a complete assembly. If the generator fails for any reason, the entire assembly must be replaced.

As the energized rotor begins to rotate within the generator, the spinning magnetic field induces a current into the windings of the stator coil. Once the generator begins producing sufficient current, it also provides the current needed to energize the rotor.

The Y type stator winding connections deliver the induced AC current to 3 positive and 3 negative diodes for rectification. From the diodes, rectified DC current is delivered to the vehicle electrical system through the generator battery and ground terminals.

Although the generators appear the same externally, different generators with different output ratings are used on this vehicle. This will depend upon engine size and optional equipment. Be certain that the replacement generator has the same output rating as the original unit. See Generator Ratings in the Specifications section at the back of this group for amperage ratings.

Noise emitting from the generator may be caused by: worn, loose or defective bearings; a loose or defective drive pulley; incorrect, worn, damaged or misadjusted fan drive belt; loose mounting bolts; a misaligned drive pulley or a defective stator or diode.

BATTERY TEMPERATURE SENSOR

The battery temperature sensor is used to determine the battery temperature and control battery charging rate. This temperature data, along with data from monitored line voltage, is used by the PCM to vary the battery charging rate. System voltage will be higher at colder temperatures and is gradually reduced at warmer temperatures.

The sensor is located under the vehicle battery, and is attached to the battery tray (Fig. 1).

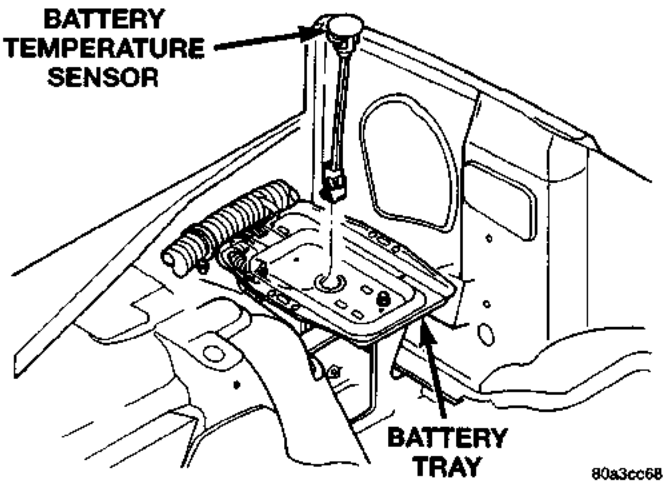

Fig. 1 Battery Temperature Sensor Location

VOLTAGE REGULATOR

The Electronic Voltage Regulator (EVR) is not a separate component. It is actually a voltage regulating circuit located within the Powertrain Control Module (PCM). The EVR is not serviced separately. If replacement is necessary, the PCM must be replaced.

Operation: The amount of DC current produced by the generator is controlled by EVR circuitry contained within the PCM. This circuitry is connected in series with the generators second rotor field terminal and its ground.

Voltage is regulated by cycling the ground path to control the strength of the rotor magnetic field. The EVR circuitry monitors system line voltage and battery temperature (refer to Battery Temperature Sensor for more information). It then compensates and regulates generator current output accordingly. Also see Charging System Operation for additional information.

DIAGNOSIS AND TESTING

CHARGING SYSTEM

When the ignition switch is turned to the ON position, battery potential will register on the voltmeter. During engine cranking a lower voltage will appear on the meter. With the engine running, a voltage reading higher than the first reading (ignition in ON) should register.

The following procedures may be used to diagnose the charging system if:

- the voltmeter does not register properly

DIAGNOSIS AND TESTING (Continued)

• an undercharged or overcharged battery condition occurs.

Remember that an undercharged battery is often caused by:

• accessories being left on with the engine not running

• a faulty or improperly adjusted switch that allows a lamp to stay on. See Ignition-Off Draw Test in Group 8A, Battery for more information.

INSPECTION

(1) Inspect condition of battery cable terminals, battery posts, connections at engine block, starter solenoid and relay. They should be clean and tight. Repair as required.

(2) Inspect all fuses in the fuseblock module and Power Distribution Center (PDC) for tightness in receptacles. They should be properly installed and tight. Repair or replace as required.

(3) Inspect the electrolyte level in the battery. Replace battery if electrolyte level is low.

(4) Inspect generator mounting bolts for tightness. Replace or tighten bolts if required. Refer to the Generator Removal/Installation section of this group for torque specifications.

(5) Inspect generator drive belt condition and tension. Tighten or replace belt as required. Refer to Belt Tension Specifications in Group 7, Cooling System.

(6) Inspect automatic belt tensioner (if equipped). Refer to Group 7, Cooling System for information.

(7) Inspect connections at generator field, battery output, and ground terminals. Also check ground connection at engine. They should all be clean and tight. Repair as required.

CHARGING SYSTEM RESISTANCE TESTS

These tests will show the amount of voltage drop across the generator output wire, from the generator output (B+) terminal to the battery positive post. They will also show the amount of voltage drop from the ground (-) terminal on the generator to the battery negative post. A typical generator wiring harness is shown in (Fig. 2). Wiring harness routing as shown in (Fig. 2) may be slightly different depending on vehicle model and/or engine. Refer to Group 8W, Wiring Diagrams for additional information.

A voltmeter with a 0–18 volt DC scale should be used for these tests. By repositioning the voltmeter test leads, the point of high resistance (voltage drop) can easily be found.

PREPARATION

(1) Before starting test, make sure battery is in good condition and is fully-charged. See Group 8A, Battery for more information.

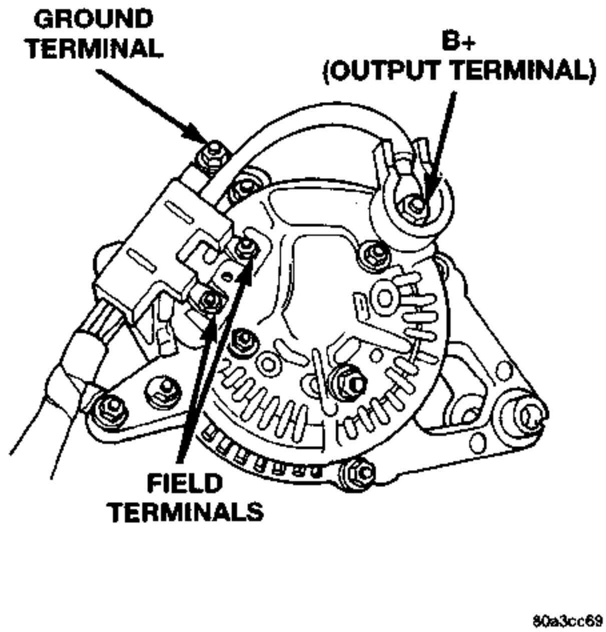

Fig. 2 Generator Terminals (Typical Wiring Harness Shown)

(2) Check condition of battery cables at battery. Clean if necessary.

(3) Start the engine and allow it to reach normal operating temperature.

(4) Shut engine off.

(5) Connect an engine tachometer.

(6) Fully engage the parking brake.

TEST

(1) Start engine.

(2) Place heater blower in high position.

(3) Turn on headlamps and place in high-beam position.

(4) Turn vehicle interior lamps on.

(5) Start engine. Bring engine speed up to 2400 rpm and hold.

(6) Testing (+) circuitry:

(a) Touch the negative lead of voltmeter directly to battery positive post.

(b) Touch the positive lead of voltmeter to the B+ output terminal stud on the generator (not the terminal mounting nut). Voltage should be no higher than 0.6 volts. If voltage is higher than 0.6 volts, touch test lead to terminal mounting stud nut and then to the wiring connector. If voltage is now below 0.6 volts, look for dirty, loose or poor connection at this point. Also check condition of the generator output wire-to-battery bullet connector. Refer to Group 8, Wiring for connector location. A voltage drop test may be performed at each (+) connection in this circuit to locate the excessive resistance.

DIAGNOSIS AND TESTING (Continued)

(7) Testing (-) circuitry:

(a) Touch the negative lead of voltmeter directly to battery negative post.

(b) Touch the positive lead of voltmeter to the ground terminal stud on the generator case (not the terminal mounting nut). Voltage should be no higher than 0.3 volts. If voltage is higher than 0.3 volts, touch test lead to terminal mounting stud nut and then to the wiring connector. If voltage is now below 0.3 volts, look for dirty, loose or poor connection at this point. A voltage drop test may be performed at each (-) connection in this circuit to locate the excessive resistance. This test can also be performed between the generator case and the engine. If test voltage is higher than 0.3 volts, check for corrosion at generator mounting points or loose generator mounting.

CURRENT OUTPUT TEST

The current output test will determine if the charging system can deliver its minimum test current (amperage) output. Refer to the Specifications section at the end of this group for minimum test current (amperage) requirements.

The first part of this test (Test 1) will determine the combined amperage output of both the generator and the Electronic Voltage Regulator (EVR) circuitry. The second part of this test (Test 2) will determine only generator amperage and **will not** include analysis of EVR circuitry. EVR circuitry is located within the Powertrain Control Module (PCM). To test voltage regulator circuitry, refer to the appropriate Powertrain Diagnostic Procedures service manual.

PREPARATION

(1) Determine if any Diagnostic Trouble Codes (DTC's) exist. To determine a DTC, refer to On-Board Diagnostics in this group. For repair, refer to the appropriate Powertrain Diagnostic Procedures manual.

(2) Before starting test, make sure battery is in good condition and is fully-charged. See Group 8A, Battery for more information.

(3) Check condition of battery cables at battery. Clean if necessary.

(4) Perform the previous Output Wire Resistance Test (voltage drop test). This will ensure clean and tight generator/battery electrical connections.

(5) Be sure the generator drive belt is properly tensioned. Refer to Group 7, Cooling System for information.

(6) A volt/amp tester equipped with both a battery load control (carbon pile rheostat) and an inductive-type pickup clamp (ammeter probe) will be used for this test. Refer to operating instructions supplied with tester. When using a tester equipped with an inductive-type clamp, removal of wiring at the generator will not be necessary.

(7) Start the engine and allow it to reach operating temperature.

(8) Shut engine off.

(9) Turn off all electrical accessories and all vehicle lighting.

(10) Connect the volt/amp tester leads to the battery. Be sure the carbon pile rheostat control is in the OPEN or OFF position before connecting leads. See Load Test in Group 8A, Battery for more information. Also refer to the operating instructions supplied with test equipment.

(11) Connect the inductive clamp (ammeter probe). Refer to the operating instructions supplied with test equipment.

(12) If volt/amp tester is not equipped with an engine tachometer, connect a separate tachometer to the engine.

TEST 1

(1) Perform the previous test Preparation.

(2) Fully engage the parking brake.

(3) Start engine.

(4) Bring engine speed to 2500 rpm.

(5) With engine speed held at 2500 rpm, slowly adjust the rheostat control (load) on the tester to obtain the highest amperage reading. Do not allow voltage to drop below 12 volts. Record the reading. **This load test must be performed within 15 seconds to prevent damage to test equipment.** On certain brands of test equipment, this load will be applied automatically. Refer to the operating manual supplied with test equipment.

(6) The ammeter reading must meet the Minimum Test Amps specifications as displayed in the Generator Ratings chart. This can be found in the Specifications section at the end of this group. A label stating a part reference number is attached to the generator case. On some engines this label may be located on the bottom of the case. Compare this reference number to the Generator Ratings chart.

(7) Rotate the load control to the OFF position.

(8) Continue holding engine speed at 2500. If EVR circuitry is OK, amperage should drop below 15–20 amps. With all electrical accessories and vehicle lighting off, this could take several minutes of engine operation. If amperage did not drop, refer to the appropriate Powertrain Diagnostic Procedures manual for testing.

(9) Remove volt/amp tester.

If minimum amperage could not be met, proceed to Test 2. This test will determine if the generator is faulty, or if EVR circuitry is defective.

DIAGNOSIS AND TESTING (Continued)

TEST 2

(1) Perform the previous test preparation.

(2) Fully engage the parking brake.

(3) Connect one end of a jumper wire to a good ground. Connect the other end of jumper wire to the generator field driver (-) terminal. The 2 field terminals (+ and -) are located on the back of the generator (Fig. 2). To locate and identify the (-) terminal and circuit, refer to Group 8W, Wiring Diagrams. Another way to identify the (-) terminal is to start the engine and measure voltage at both field terminals. The (+) terminal will show battery voltage (12.5–14.5 volts). The (-) terminal will show 3–5 volts less than battery voltage.

CAUTION: Do not connect the jumper ground wire to the generator field source (+) field terminal. Damage to electrical system components may result.

Connecting the jumper wire will remove the voltage regulator circuitry from the test. It will also generate a Diagnostic Trouble Code (DTC).

(4) Start engine. **Immediately** after starting, reduce engine speed to idle. This will prevent any electrical accessory damage from high voltage.

(5) Adjust carbon pile rheostat (load) and engine speed in slow increments until a speed of 1250 rpm, and a voltmeter reading of 15 volts is obtained. Immediately record ammeter reading. Do not apply load to system longer than 15 seconds as damage to test equipment may result.

CAUTION: When adjusting rheostat load, do not allow voltage to rise above 16 volts. Damage to the battery and electrical system components may result.

(6) The ammeter reading must meet the Minimum Test Amps specifications as displayed in the Generator Ratings chart. This can be found in the Specifications section at the end of this group. A label stating a part reference number is attached to the generator case. On some engines this label may be located on the bottom of the case. Compare this reference number to the Generator Rating chart.

(7) Remove volt/amp tester.

(8) Remove jumper wire.

(9) Use the DRB scan tool to erase the DTC. Refer to the DRB screen for procedures.

RESULTS

• If amp reading meets specifications in Test 2, generator is OK.

• If amp reading is less than specified in Test 2, and wire resistance (voltage drop) tests were OK, the generator should be replaced. Refer to Removal and Installation in this group for procedures.

• If Test 2 results were OK, but Test 1 results were not, the problem is in EVR circuitry. Refer to appropriate Powertrain Diagnostic Procedures manual for diagnosis.

BATTERY TEMPERATURE SENSOR

To perform a complete test of this sensor and its circuitry, refer to the appropriate Powertrain Diagnostic Procedures manual. To test the sensor only, refer to the following:

(1) The sensor is located under the battery and is attached to the battery tray (Fig. 1). A two-wire pigtail harness is attached directly to the sensor. The opposite end of this harness connects the sensor to the engine wiring harness.

(2) Disconnect the two-wire pigtail harness from the engine harness.

(3) Attach ohmmeter leads to the wire terminals of the pigtail harness.

(4) At room temperature of 25° C (75–80° F), an ohmmeter reading of 9,000 to 11,000 ohms should be observed.

(5) If reading is above or below the specification, replace the sensor.

(6) Refer to the Removal and Installation section for procedures.

ON-BOARD DIAGNOSTIC TEST FOR CHARGING SYSTEM

GENERAL INFORMATION

The Powertrain Control Module (PCM) monitors critical input and output circuits of the charging system, making sure they are operational. A Diagnostic Trouble Code (DTC) is assigned to each input and output circuit monitored by the On-Board Diagnostic (OBD) system. Some circuits are checked continuously and some are checked only under certain conditions.

If the OBD system senses that a monitored circuit is bad, it will put a DTC into electronic memory. The DTC will stay in electronic memory as long as the circuit continues to be bad. The PCM is programmed to clear the DTC's from memory after 40 engine warm–up cycles if the problem does not occur again. The DRB scan tool may also be used to erase a DTC.

Diagnostic trouble codes are the results of a system or circuit failure, but do not directly identify the failed component or components.

DIAGNOSTIC TROUBLE CODES

The technician can display a DTC in three different ways:

• a two-digit number flashed on the Malfunction Indicator (Check Engine) Lamp

• a two-digit number displayed on the vehicle odometer

DIAGNOSIS AND TESTING (Continued)

- a description of the DTC can be read using the DRB scan tool

Refer to the following Charging System Diagnostic Trouble Code Descriptions chart for DTC's which apply to the charging system. Refer to the Powertrain Diagnostic Procedures manual and DRB scan tool to diagnose an on-board diagnostic system trouble code.

OBTAINING DIAGNOSTIC TROUBLE CODES

USING DRB SCAN TOOL

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING ANY TEST ON AN OPERATING ENGINE.

(1) Connect the DRB scan tool to the 16–way data link (diagnostic) connector. This connector is located in the passenger compartment, below and to the left of steering column.

(2) Turn the ignition switch on, access Read Fault Screen. Record all the DTC's shown on the DRB scan tool. Observe the malfunction indicator (check engine) lamp on the instrument panel. The lamp should light for 2 seconds then go out (bulb check).

(3) To erase DTC's, use the Erase Trouble Code data screen on the DRB scan tool.

USING THE MALFUNCTION INDICATOR LAMP (MIL)

(1) Cycle the ignition key On - Off - On - Off - On within 5 seconds.

(2) Count the number of times the MIL (check engine lamp) on the instrument panel flashes on and off. The number of flashes represents the trouble code. There is a slight pause between the flashes representing the first and second digits of the code. Longer pauses separate individual two digit trouble codes.

An example of a flashed DTC is as follows:

(3) Lamp flashes 4 times, pauses, and then flashes 6 more times. This indicates a DTC code number 46.

(4) Lamp flashes 5 times, pauses, and flashes 5 more times. This indicates a DTC code number 55. A DTC 55 will always be the last code to be displayed. This indicates the end of all stored codes.

(5) To erase DTC's, use the Erase Trouble Code data screen on the DRB scan tool.

USING THE VEHICLE ODOMETER

(1) Cycle the ignition key On - Off - On - Off - On within 5 seconds.

(2) Read the actual DTC number displayed on the vehicle odometer. Each number will be displayed with a slight delay between numbers.

(3) A DTC 55 will always be the last code to be displayed. This indicates the end of all stored codes.

(4) To erase DTC's, use the Erase Trouble Code data screen on the DRB scan tool.

* Check Engine Lamp (MIL) will not illuminate during engine operation if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

CHARGING SYSTEM DIAGNOSTIC TROUBLE CODE DESCRIPTIONS

MIL Code	Generic Scan Tool Code	Hex Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
12*			Battery Disconnect	Direct battery input to PCM was disconnected within the last 50 Key-on cycles.
41***		0B	Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
44**	P1493	99	Battery Temp Sns Low	Battery temp. sensor has shorted to ground (-)
44**	P1492	9A	Battery Temp Sns High	Battery temp. sensor has shorted to (+)
46***		06	Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
47***		05	Charging System Voltage Too Low	Battery voltage sense input below target charging during engine operation. Also, no significant change detected in battery voltage during active test of generator output circuit.
55*				Completion of fault code display on Check Engine lamp.

DIAGNOSIS AND TESTING (Continued)

** Check Engine Lamp (MIL) will be illuminated during engine operation if this Diagnostic Trouble Code was recorded.

*** Check Gauge Lamp illuminated

REMOVAL AND INSTALLATION

GENERATOR

WARNING: DISCONNECT NEGATIVE CABLE FROM BATTERY BEFORE REMOVING BATTERY OUTPUT WIRE FROM GENERATOR. FAILURE TO DO SO CAN RESULT IN INJURY.

(1) Disconnect negative battery cable at battery.

(2) Remove generator drive belt. Refer to Group 7, Cooling System for procedure.

(3) Remove nuts from harness hold-down, battery terminal, ground terminal and 2 field terminals (Fig. 3). Remove wire connectors.

(4) Remove the upper and lower generator mounting bolts (Fig. 4).

(5) A spacer (Fig. 4) is pressed into the rear mounting ear of the generator. Pry or drive this spacer rearward about 1/8 inch to loosen generator from upper mounting bracket. This will allow generator to be tilted for removal.

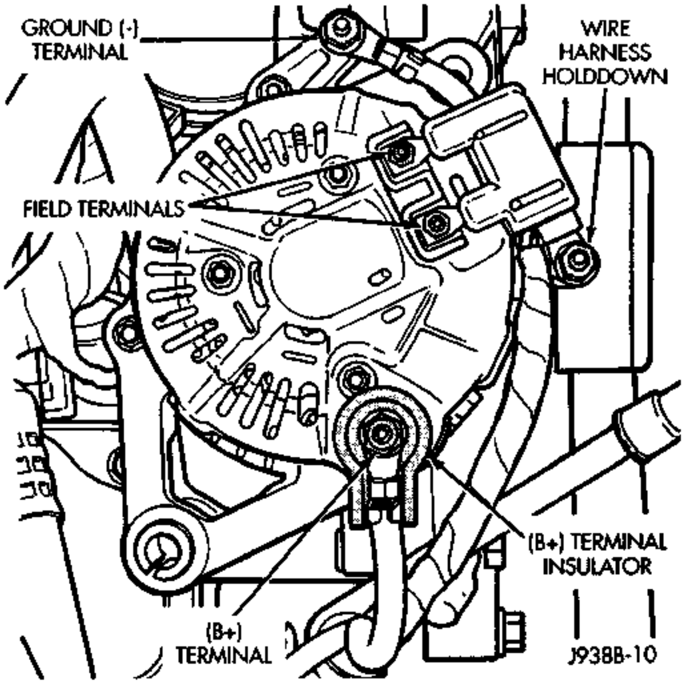

Fig. 3 Remove/Install Generator Connectors—Typical

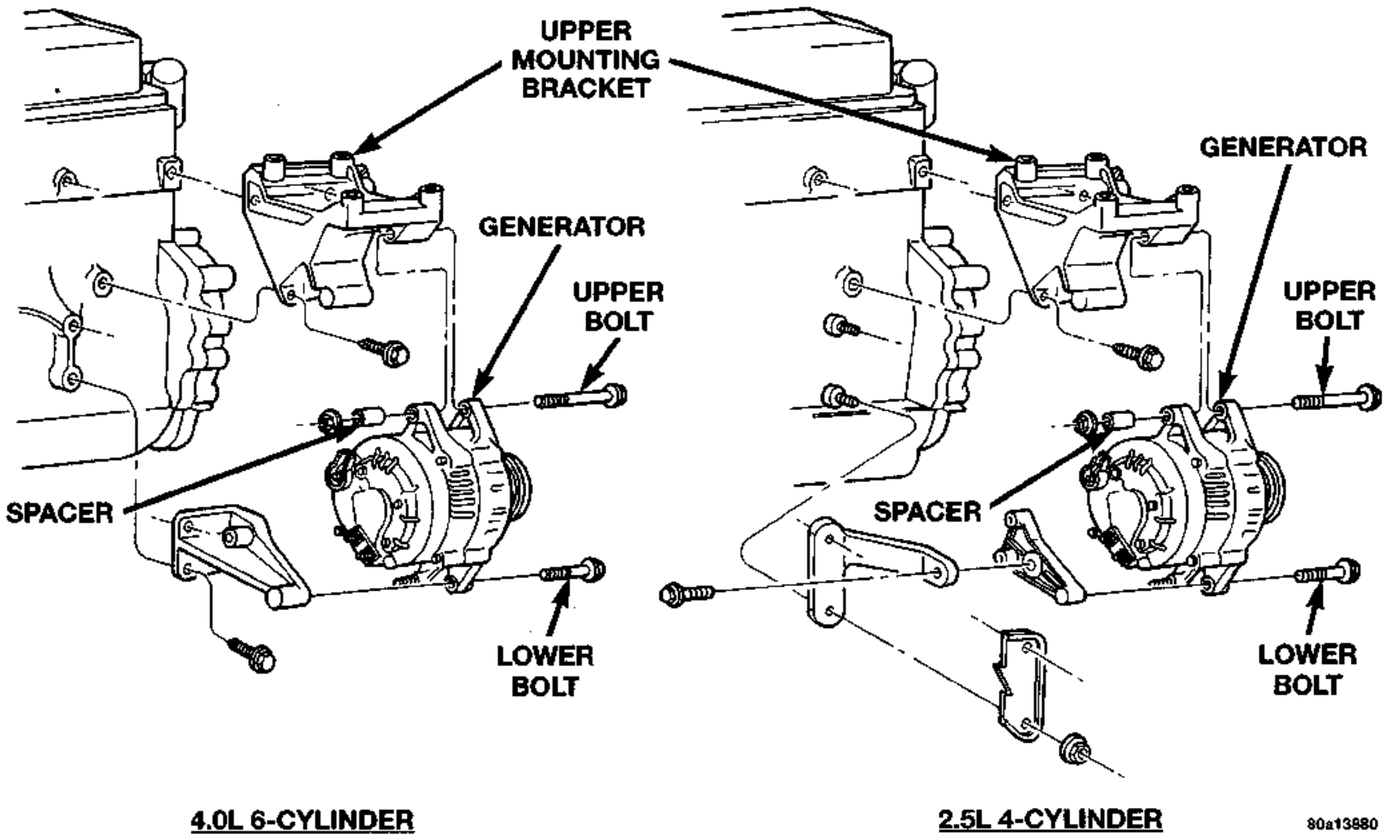

Fig. 4 Generator Remove/Install

REMOVAL AND INSTALLATION (Continued)

(6) Remove generator from vehicle.

(7) Reverse removal procedures to install. Tighten generator hardware as follows:

- Generator upper mounting bolt—All engines - 55 N·m (41 ft. lbs.)
- Generator lower mounting bolt —All engines - 55 N·m (41 ft. lbs.)
- Battery terminal nut - 8.5 N·m (75 in. lbs.)
- Ground terminal nut - 8.5 N·m (75 in. lbs.)
- Harness hold-down nut - 8.5 N·m (75 in. lbs.)
- Field terminal nuts - 2.8 N·m (25 in. lbs.)

CAUTION: Never force a belt over a pulley rim using a screwdriver. The synthetic fiber of the belt can be damaged.

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. The water pump will be rotating in the wrong direction if the belt is installed incorrectly, causing the engine to overheat. Refer to belt routing label in engine compartment, or refer to Belt Schematics in Group 7, Cooling System.

BATTERY TEMPERATURE SENSOR

The battery temperature sensor is located under the vehicle battery and is attached to a mounting hole on battery tray.

REMOVAL

(1) Remove the battery. Refer to Group 8A, Battery for procedures.

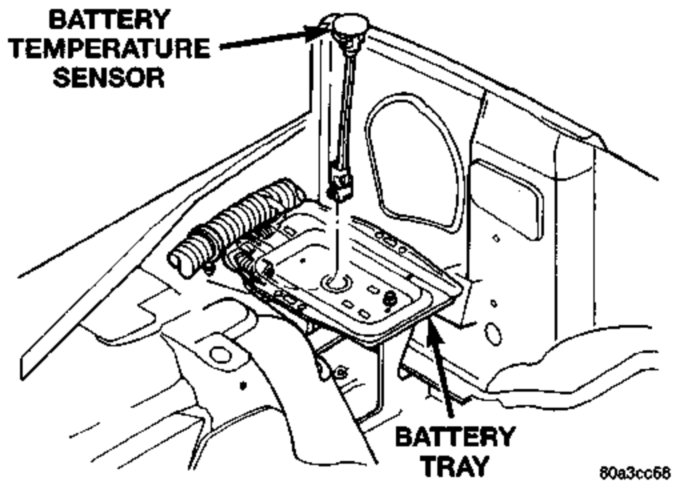

Fig. 5 Battery Temperature Sensor Remove/Install

(2) Disconnect the sensor pigtail harness from the engine wire harness.

(3) Pry the sensor straight up from the battery tray mounting hole.

INSTALLATION

(1) Feed the pigtail harness through the hole in top of battery tray and press sensor into top of battery tray.

(2) Connect the pigtail harness.

(3) Install the battery. Refer to Group 8A, Battery for procedures.

SPECIFICATIONS

GENERATOR RATINGS

TYPE	PART NUMBER	RATED SAE AMPS	ENGINES	MINIMUM TEST AMPS
DENSO	56005684	81	2.5L/4.0L	75
DENSO	56005685	117	2.5L/4.0L	90

TORQUE CHART

Description	Torque
Generator Upper Mounting Bolt—2.5L/4.0L Engine	55 N·m (41 ft. lbs.)
Generator Lower Mounting Bolt—2.5L/4.0L Engine	55 N·m (41 ft. lbs.)
Battery Terminal Nut	8.5 N·m (75 in. lbs.)
Ground Terminal Nut	8.5 N·m (75 in. lbs.)
Harness Hold-down Nut	8.5 N·m (75 in. lbs.)
Field Terminal Nuts	2.8 N·m (25 in. lbs.)

IGNITION SYSTEM

CONTENTS

GENERAL INFORMATION

INTRODUCTION

This group describes the ignition systems for both the 2.5L 4–cylinder and the 4.0L 6–cylinder engines.

On Board Diagnostics is described in Group 25, Emission Control Systems.

Group 0, Lubrication and Maintenance, contains general maintenance information (in time or mileage intervals) for ignition related items. The Owner's Manual also contains maintenance information.

DESCRIPTION AND OPERATION

IGNITION SYSTEM

The ignition systems used on the 2.5L 4–cylinder and the 4.0L 6–cylinder engine are basically identical. Similarities and differences between the systems will be discussed.

DESCRIPTION AND OPERATION (Continued)

The ignition system is controlled by the powertrain control module (PCM) on all engines.

The ignition system consists of:

- Spark Plugs
- Ignition Coil
- Secondary Ignition Cables
- Distributor (contains rotor and camshaft position sensor)
- Powertrain Control Module (PCM)
- Crankshaft Position, Camshaft Position, Throttle Position and MAP Sensors

POWERTRAIN CONTROL MODULE

The Powertrain Control Module (PCM) is located in the engine compartment (Fig. 1).

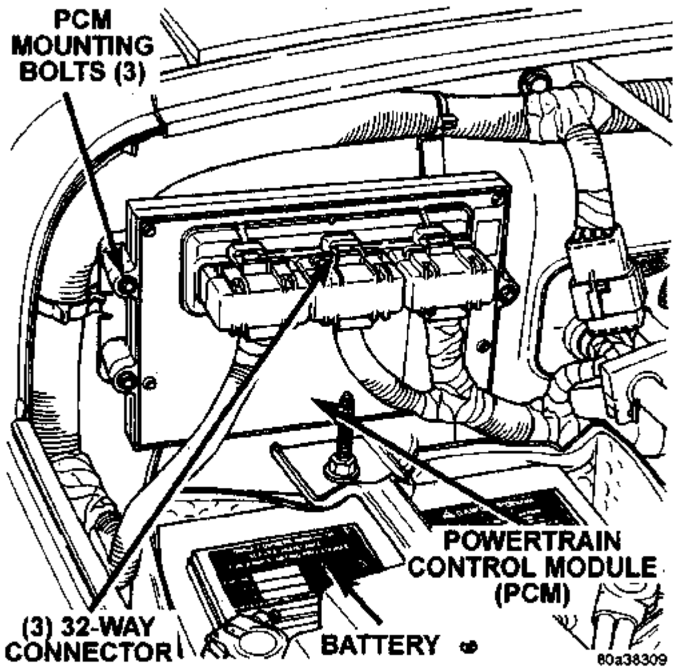

Fig. 1 Powertrain Control Module (PCM) Location

The ignition system is controlled by the PCM.

NOTE: Base ignition timing by rotation of distributor is not adjustable.

The PCM opens and closes the ignition coil ground circuit to operate the ignition coil. This is done to adjust ignition timing, both initial (base) and advance, and for changing engine operating conditions.

The amount of electronic spark advance provided by the PCM is determined by five input factors: engine coolant temperature, engine rpm, intake manifold temperature, manifold absolute pressure and throttle position.

DISTRIBUTOR

All 2.5L 4-cylinder and 4.0L 6-cylinder engines are equipped with a camshaft driven mechanical distributor containing a shaft driven distributor rotor. These distributors are equipped with an internal camshaft position (fuel sync) sensor (Fig. 2). This sensor provides fuel injection synchronization and cylinder identification.

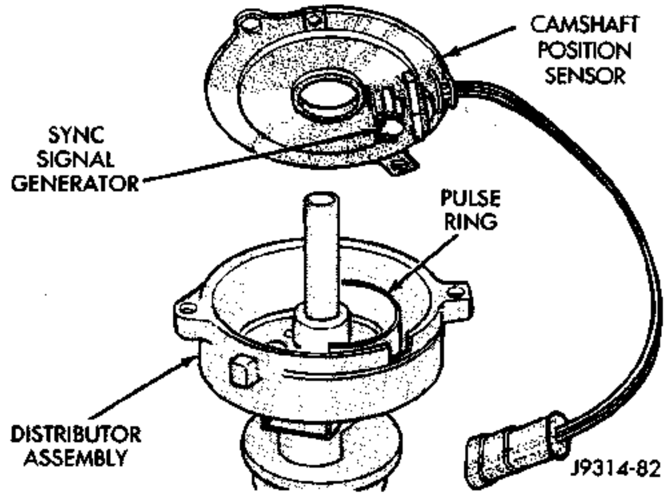

Fig. 2 Distributor and Camshaft Position Sensor (Typical Sensor Shown)

The distributors on 2.5L or 4.0L engines do not have built in centrifugal or vacuum assisted advance. Base ignition timing and all timing advance is controlled by the powertrain control module (PCM). Because ignition timing is controlled by the PCM, **base ignition timing is not adjustable on any of these engines.**

The distributor is locked in place by a fork with a slot located on the distributor housing base. The distributor hold-down clamp bolt passes through this slot 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. The position of the distributor will determine fuel synchronization only.**

All distributors contain an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

SPARK PLUGS

All engines use resistor type spark plugs. Remove the spark plugs and examine them for burned electrodes and fouled, cracked or broken porcelain insulators. Keep plugs arranged in the order in which they were removed from the engine. A single plug displaying an abnormal condition indicates that a problem exists in the corresponding cylinder. Replace

DESCRIPTION AND OPERATION (Continued)

spark plugs at the intervals recommended in Group O, Lubrication and Maintenance

Spark plugs that have low milage may be cleaned and reused if not otherwise defective, carbon or oil fouled. Refer to the Spark Plug Condition section of this group.

SPARK PLUG CABLES

Spark plug cables are sometimes referred to as secondary ignition wires. These cables transfer electrical current from the ignition coil(s) and/or distributor, to individual spark plugs at each cylinder. The resistive spark plug cables are of nonmetallic construction. The cables provide suppression of radio frequency emissions from the ignition system.

IGNITION COIL

Battery voltage is supplied to the ignition coil positive terminal from the ASD relay.

The Powertrain Control Module (PCM) opens and closes the ignition coil ground circuit for ignition coil operation.

Base ignition timing is not adjustable on any engine. By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

The ignition coil is not oil filled. The windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the ignition coil to be mounted on the engine.

AUTOMATIC SHUTDOWN (ASD) RELAY

As one of its functions, the ASD relay will supply battery voltage to the ignition coil. The ground circuit for the ASD relay is controlled by the Powertrain Control Module (PCM). The PCM regulates ASD relay operation by switching the ground circuit on-and-off.

CRANKSHAFT POSITION SENSOR

The crankshaft position sensor is mounted to the transmission bellhousing at the left/rear side of the engine block (Fig. 3), (Fig. 4), or (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.

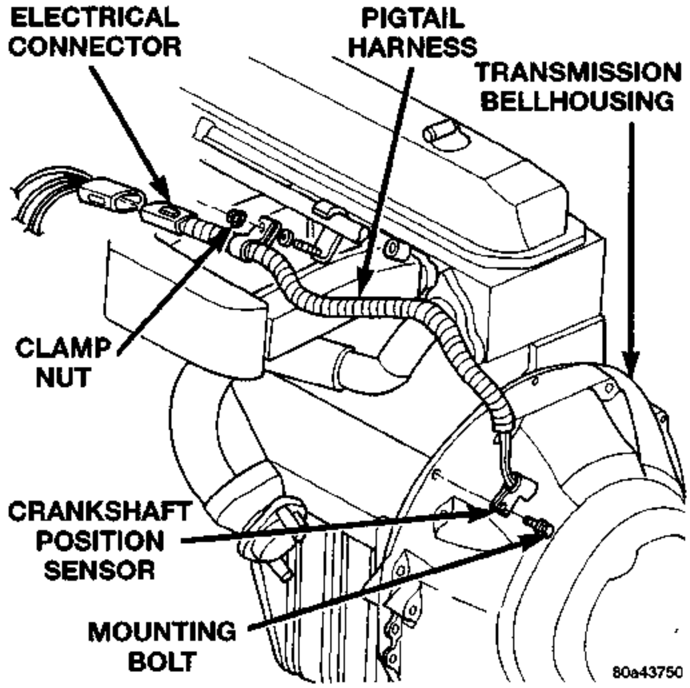

Fig. 3 Crankshaft Position Sensor—4.0L 6-Cyl. Engine—Auto. Trans.

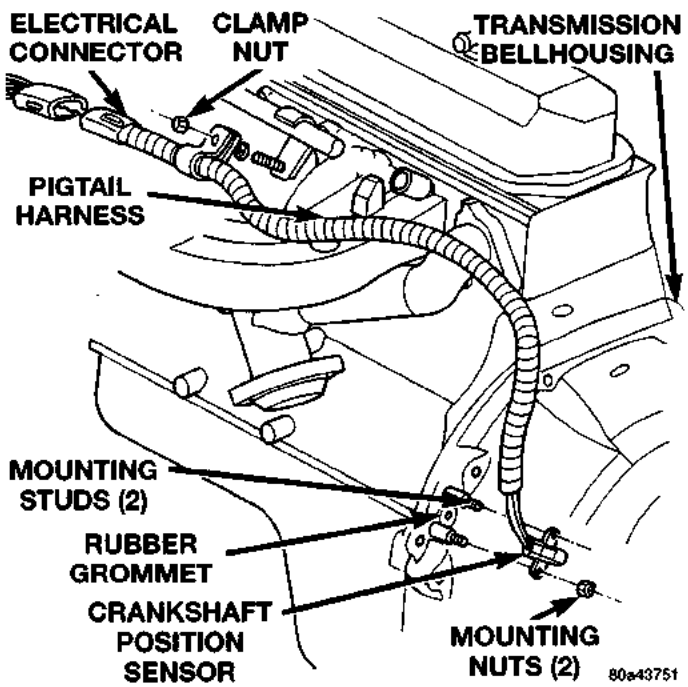

Fig. 4 Crankshaft Position Sensor—2.5L 4-Cyl. Engine—Auto. Trans.

SENSOR OPERATION

The flywheel/drive plate has groups of four notches at its outer edge. On 4.0L 6-cylinder engines there are three sets of notches (Fig. 7) or (Fig. 8). On 2.5L 4-cylinder engines there are two sets of notches (Fig. 6).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input

DESCRIPTION AND OPERATION (Continued)

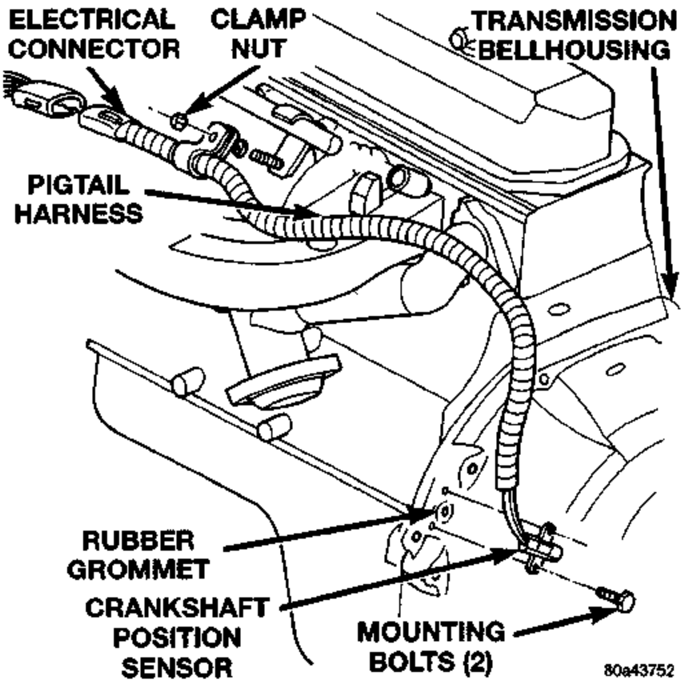

Fig. 5 Crankshaft Position Sensor—Manual Transmission (Typical)

to the PCM. For each engine revolution there are two groups of four pulses generated on 2.5L 4-cylinder engines. There are 3 groups of four pulses generated on 4.0L 6-cylinder engines.

The trailing edge of the fourth notch, which causes the pulse, is four degrees before top dead center (TDC) of the corresponding piston.

The engine will not operate if the PCM does not receive a crankshaft position sensor input.

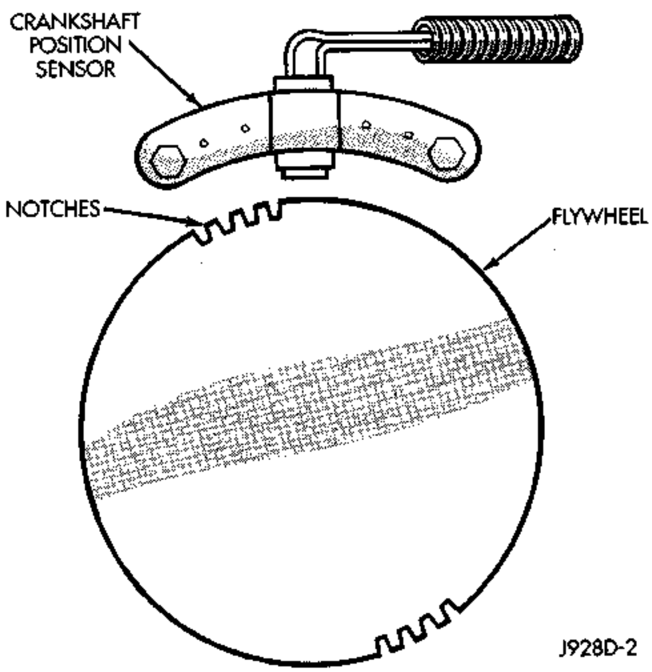

Fig. 6 Sensor Operation—2.5L 4-Cyl. Engine

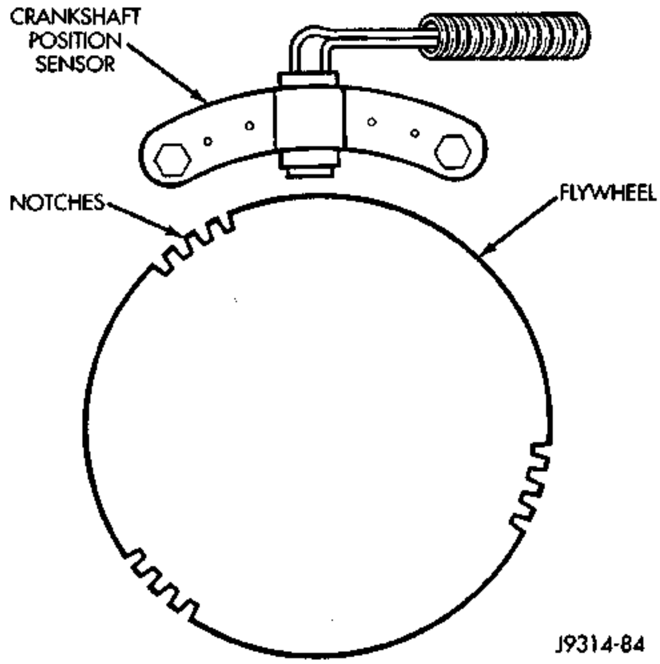

Fig. 7 Sensor Operation—4.0L 6-Cyl. Engine—Manual Transmission

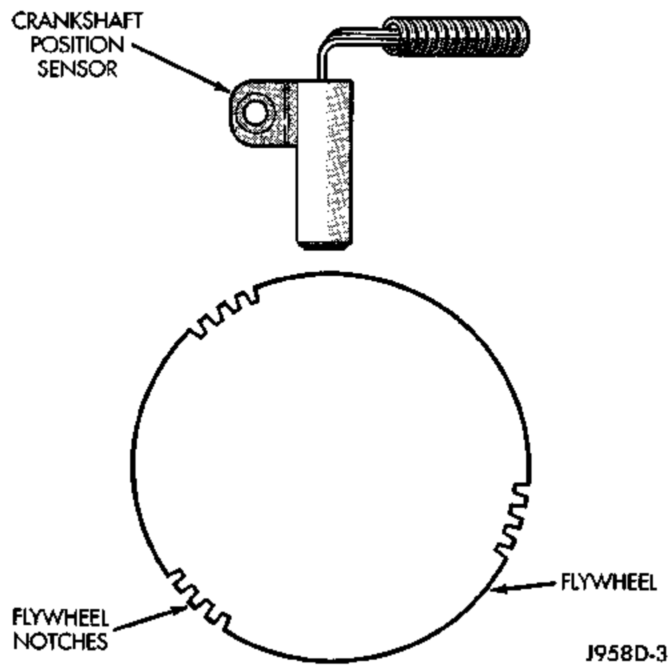

Fig. 8 Sensor Operation—4.0L 6-Cyl. Engine—Automatic Transmission

CAMSHAFT POSITION SENSOR

The camshaft position sensor is located in the distributor on all engines (Fig. 2).

The sensor contains a hall effect device called a sync signal generator to generate a fuel sync signal. This sync signal generator detects a rotating pulse ring (shutter) on the distributor shaft. The pulse ring rotates 180 degrees through the sync signal genera-

DESCRIPTION AND OPERATION (Continued)

tor. Its signal is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

When the leading edge of the pulse ring (shutter) enters the sync signal generator, the following occurs: The interruption of magnetic field causes the voltage to switch high resulting in a sync signal of approximately 5 volts.

When the trailing edge of the pulse ring (shutter) leaves the sync signal generator, the following occurs: The change of the magnetic field causes the sync signal voltage to switch low to 0 volts.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

ENGINE COOLANT TEMPERATURE SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

THROTTLE POSITION SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

IGNITION SWITCH AND KEY LOCK CYLINDER

The ignition switch is located on the steering column. The Key-In-Switch is located in the ignition switch module. For electrical diagnosis of the Key-In-Switch, refer to Group 8U, Chime/Buzzer Warning Systems. For removal/installation of either the key lock cylinder or ignition switch, refer to Ignition Switch and Key Cylinder in this group.

On vehicles equipped with an automatic transmission, a cable connects an interlock device within the steering column assembly to the transmission floor shift lever. This interlock device is used to lock the transmission shifter in the PARK position when the key is in the LOCKED or ACCESSORY position. The interlock device is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures. The shifter interlock cable can be adjusted or replaced. Refer to Group 21, Transmissions for procedures.

On vehicles equipped with a manual transmission, a lever is located on the steering column behind the ignition key lock cylinder. The lever must be operated to allow rotation of the ignition key lock cylinder. The lever mechanism is not serviced separately. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

DIAGNOSIS AND TESTING

AUTOMATIC SHUTDOWN (ASD) RELAY TEST

To perform a complete test of this relay and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the relay only, refer to Relays—Operation/Testing in the Group 14, Fuel Systems section.

TESTING FOR SPARK AT COIL

CAUTION: When disconnecting a high voltage cable from a spark plug or from the distributor cap, twist the rubber boot slightly (1/2 turn) to break it loose (Fig. 9). Grasp the boot (not the cable) and pull it off with a steady, even force.

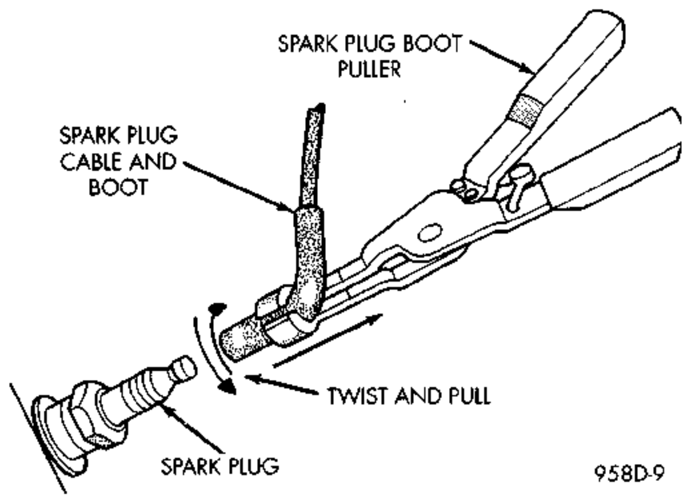

Fig. 9 Cable Removal

(1) Disconnect the ignition coil secondary cable from center tower of the distributor cap. Hold the cable terminal approximately 12 mm (1/2 in.) from a good engine ground (Fig. 10).

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

DIAGNOSIS AND TESTING (Continued)

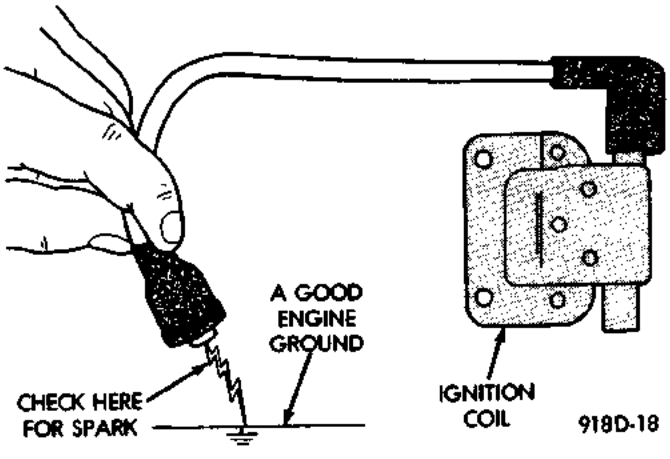

Fig. 10 Checking for Spark—Typical

arcing occurs, connect ignition coil cable to the distributor cap.

(3) Remove a cable from one spark plug.

(4) Using insulated pliers, hold the cable terminal approximately 12 mm (1/2 in.) from the engine cylinder head or block while rotating the engine with the starter motor. Observe the spark plug cable terminal for an arc. If steady arcing occurs, it can be expected that the ignition secondary system is operating correctly. **(If the ignition coil cable is removed for this test, instead of a spark plug cable, the spark intensity will be much higher).** If steady arcing occurs at the spark plug cables, but the engine will not start, connect the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual.

CHECK COIL TEST

To perform a complete test of the ignition coil and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the coil only, refer to the following:

The ignition coil (Fig. 11) or (Fig. 12) 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.

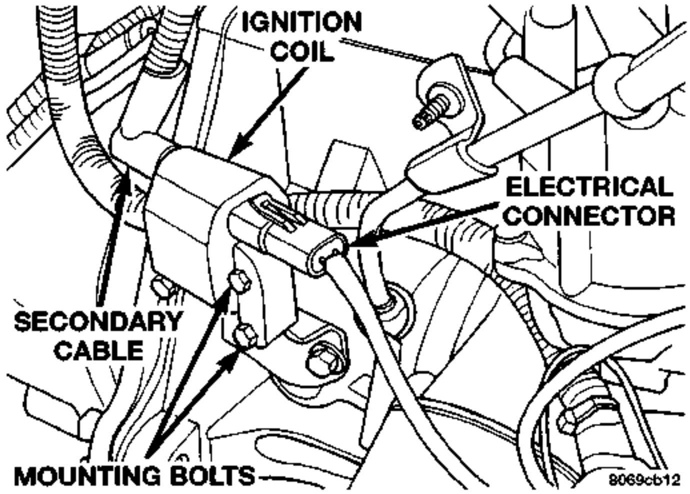

Fig. 11 Ignition Coil—2.5L Engine

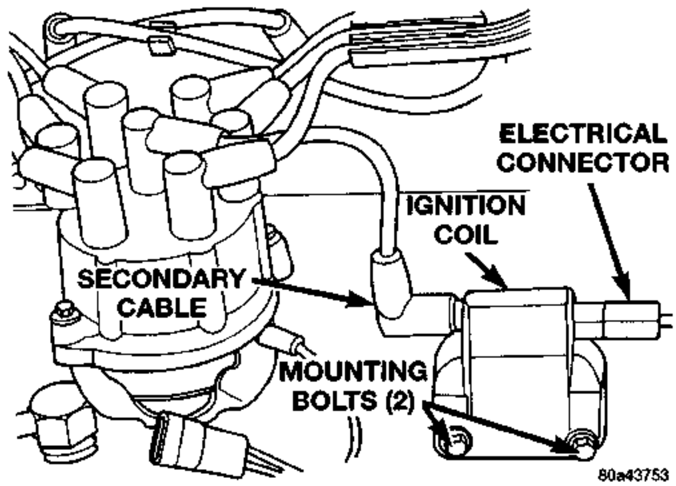

Fig. 12 Ignition Coil—4.0L Engine

Replace any coil that does not meet specifications. Refer to the Ignition Coil Resistance chart (Fig. 13).

If the ignition coil is being replaced, the secondary spark plug cable must also be checked. Replace cable if it has been burned or damaged.

Arcing at the tower will carbonize the cable boot, which if it is connected to a new ignition coil, will cause the coil to fail.

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

Fig. 13 Ignition Coil Resistance

DIAGNOSIS AND TESTING (Continued)

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.

FAILURE TO START TEST

To prevent unnecessary diagnostic time and wrong test results, the Testing For Spark At Coil test should be performed prior to this test.

WARNING: SET PARKING BRAKE OR BLOCK THE DRIVE WHEELS BEFORE PROCEEDING WITH THIS TEST.

(1) Unplug the ignition coil electrical harness connector at the coil (Fig. 11) or (Fig. 12).

(2) Connect a set of small jumper wires (18 gauge or smaller) between the disconnected harness terminals and the ignition coil terminals. To determine polarity at connector and coil, refer to Group 8W, Wiring Diagrams.

(3) Attach one lead of a voltmeter to the positive (12 volt) jumper wire. Attach the negative side of voltmeter to a good ground.

(4) Determine that sufficient battery voltage (12.4 volts) is present for the starting and ignition systems.

(5) Crank the engine for 5 seconds while monitoring the voltage at the coil positive terminal:

- If the voltage remains near zero during the entire period of cranking, refer to On-Board Diagnostics in Group 14, Fuel Systems. Check the Powertrain Control Module (PCM) and auto shutdown relay.
- If voltage is at or near battery voltage and drops to zero after 1-2 seconds of cranking, check the powertrain control module circuit. Refer to On-Board Diagnostics in Group 14, Fuel Systems.
- If voltage remains at or near battery voltage during the entire 5 seconds, turn the key off. Remove the three 32-way connectors (Fig. 14) from the PCM. Check 32-way connectors for any spread terminals or corrosion.

(6) Remove test lead from the coil positive terminal. Connect an 18 gauge jumper wire between the battery positive terminal and the coil positive terminal.

(7) Make the special jumper shown in (Fig. 15). Using the jumper, **momentarily** ground the ignition coil driver circuit at the PCM connector (cavity A-7). For cavity/terminal location of this circuit, refer to Group 8W, Wiring. A spark should be generated at the coil cable when the ground is removed.

(8) If spark is generated, replace the PCM.

(9) If spark is not seen, use the special jumper to ground the coil negative terminal directly.

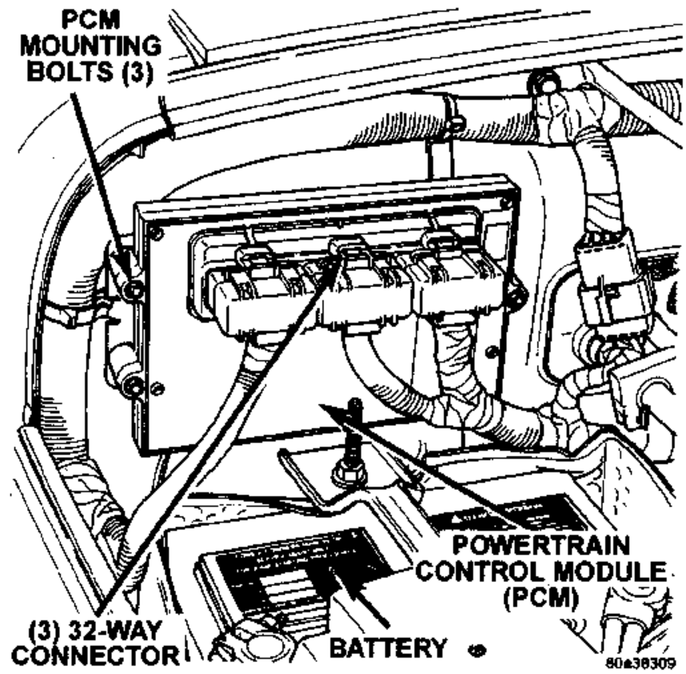

Fig. 14 PCM and Three 32–Way Connectors

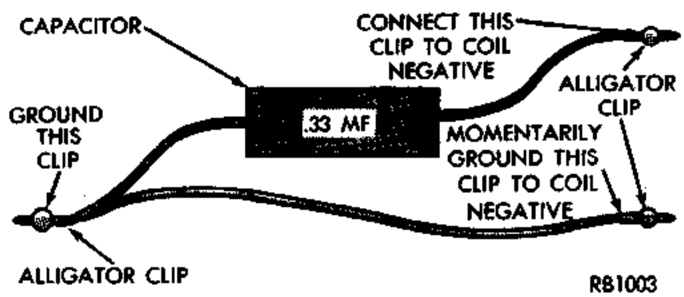

Fig. 15 Special Jumper Ground-to-Coil Negative Terminal

(10) If spark is produced, repair wiring harness for an open condition.

(11) If spark is not produced, replace the ignition coil.

DISTRIBUTOR CAP

Remove the distributor cap and wipe it clean with a dry lint free cloth. Visually inspect the cap for cracks, carbon paths, broken towers or damaged rotor button (Fig. 16) or (Fig. 17). 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.

DIAGNOSIS AND TESTING (Continued)

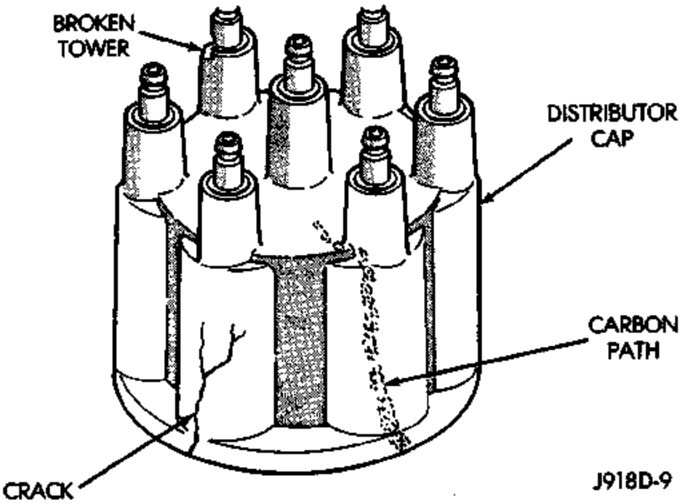

Fig. 16 Cap Inspection—External—Typical

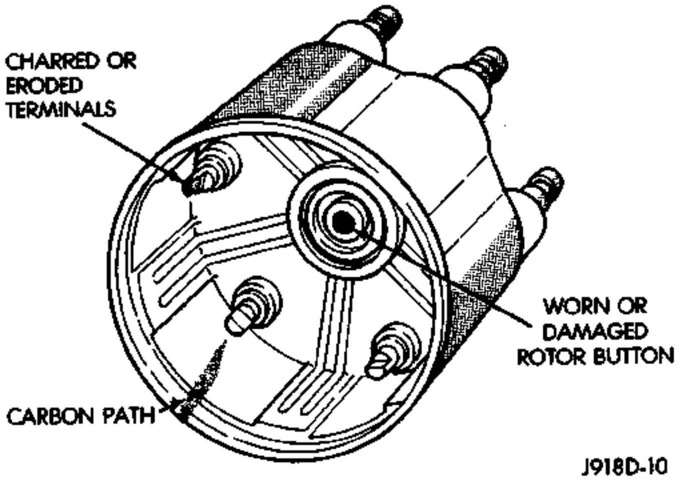

Fig. 17 Cap Inspection—Internal—Typical

DISTRIBUTOR ROTOR

Visually inspect the rotor (Fig. 18) for cracks, evidence of corrosion or the effects of arcing on the metal tip. Also check for evidence of mechanical interference with the cap. Some charring is normal on the end of the metal tip. The silicone-dielectric-varnish-compound applied to the rotor tip for radio interference noise suppression, will appear charred. This is normal. **Do not remove the charred compound.** Test the spring for insufficient tension. Replace a rotor that displays any of these adverse conditions.

IGNITION TIMING

NOTE: Base (initial) ignition timing is NOT adjustable on any 2.5L 4-cylinder or 4.0L 6-cylinder engine. Do not attempt to adjust ignition timing by rotating the distributor.

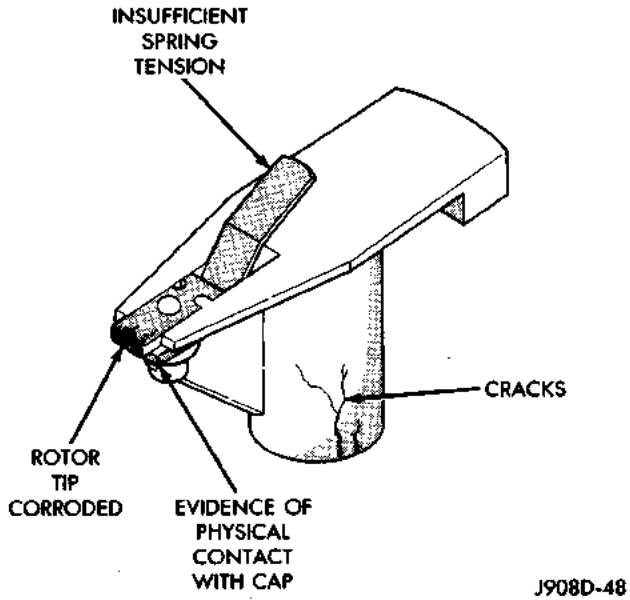

Fig. 18 Rotor Inspection—Typical

NOTE: Do not attempt to modify the distributor housing to get distributor rotation. Distributor position will have no effect on ignition timing.

All ignition timing functions are controlled by the powertrain control module (PCM). For additional information, refer to the appropriate Powertrain Diagnostics Procedures service manual for operation of the DRB Scan Tool.

MAP SENSOR

For an operational description, diagnosis or removal/ installation procedures, refer to Group 14, Fuel Systems.

CRANKSHAFT POSITION SENSOR TEST

To perform a complete test of this sensor and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

The crankshaft position sensor is mounted to the transmission bellhousing at the left/rear side of the engine block (Fig. 19), (Fig. 20), or (Fig. 21).

(1) Near the rear of the intake manifold, disconnect sensor pigtail harness connector from main wiring harness (Fig. 19), (Fig. 20), or (Fig. 21).

(2) Place an ohmmeter across terminals B and C (Fig. 22). Ohmmeter should be set to 1K-to-10K scale for this test. The meter reading should be open (high resistance). Replace sensor if a low resistance is indicated.

CAMSHAFT POSITION SENSOR

The camshaft position sensor is located in the distributor (Fig. 23) on all engines.

DIAGNOSIS AND TESTING (Continued)

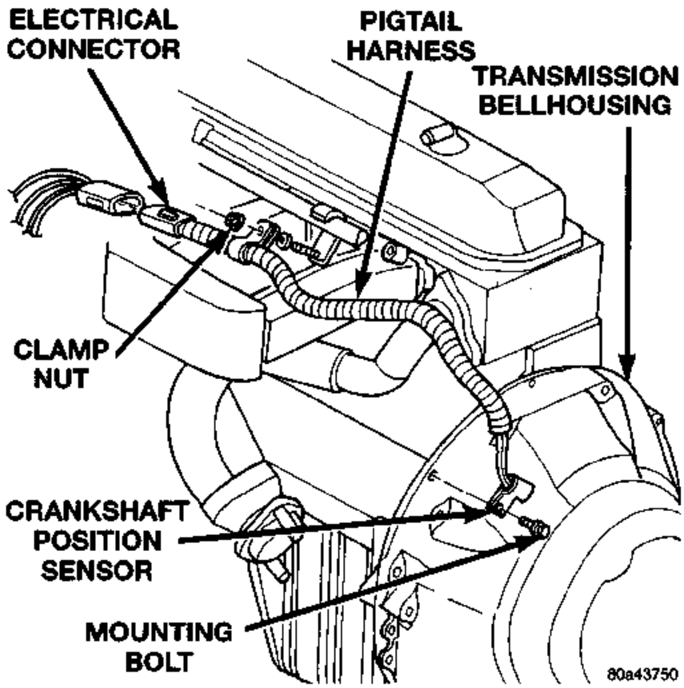

Fig. 19 Crankshaft Position Sensor—4.0L 6-Cyl. Engine—Auto. Trans.

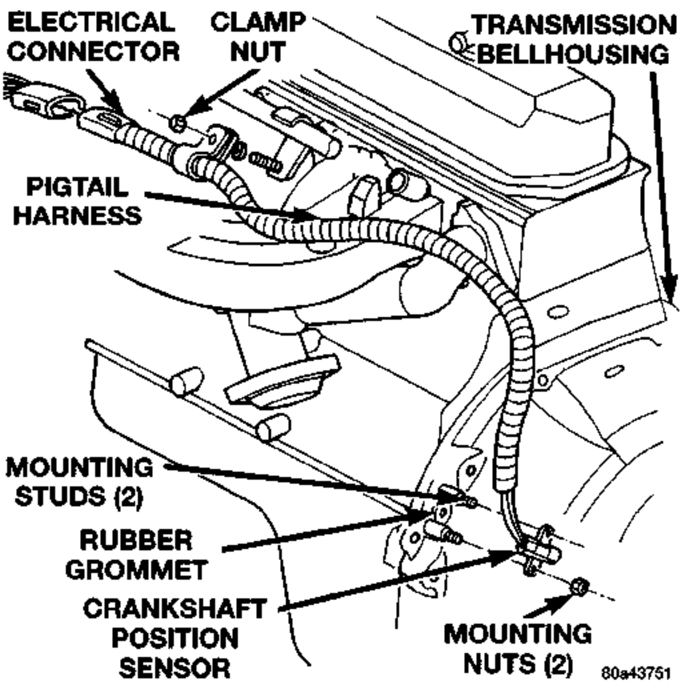

Fig. 20 Crankshaft Position Sensor—2.5L 4-Cyl. Engine—Auto. Trans.

To perform a complete test of this sensor and its circuitry, refer to the appropriate Powertrain Diagnostics Procedures service manual. To test the sensor only, refer to the following:

For this test, an analog (non-digital) voltmeter is needed. Do not remove the distributor connector from the distributor. Using small paper clips, insert them into the backside of the distributor wire

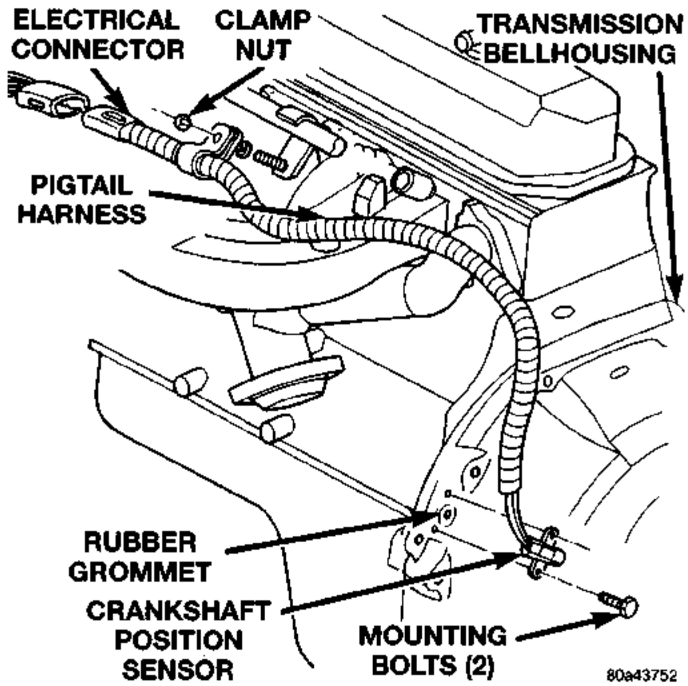

Fig. 21 Crankshaft Position Sensor—Manual Transmission (Typical)

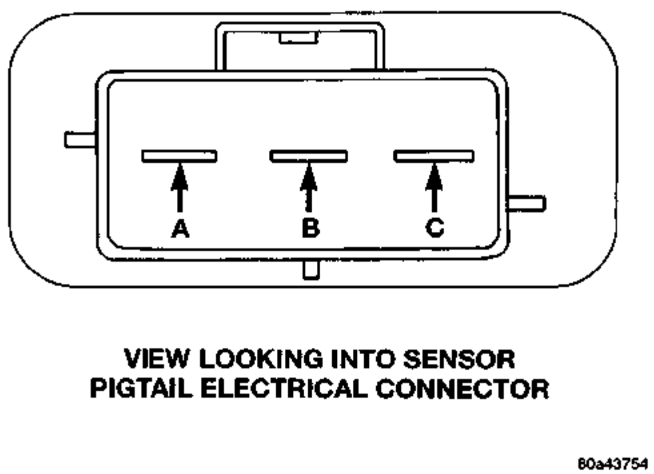

Fig. 22 Crankshaft Position Sensor Connector

harness connector to make contact with the terminals. Be sure that the connector is not damaged when inserting the paper clips. Attach voltmeter leads to these paper clips.

(1) Connect the positive (+) voltmeter lead into the sensor output wire. This is at done the distributor wire harness connector. For wire identification, refer to Group 8W, Wiring Diagrams.

(2) Connect the negative (-) voltmeter lead into the ground wire. For wire identification, refer to Group 8W, Wiring Diagrams.

(3) Set the voltmeter to the 15 Volt DC scale.

(4) Remove distributor cap from distributor (two screws). Rotate (crank) the engine until the distributor rotor is approximately in the 11 o'clock position.

DIAGNOSIS AND TESTING (Continued)

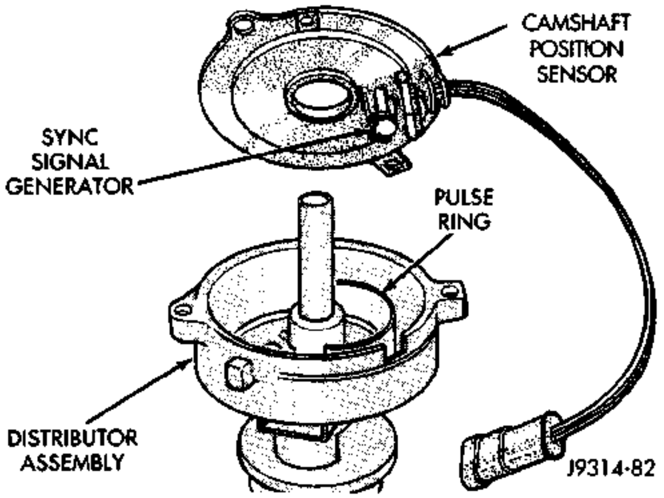

Fig. 23 Camshaft Position Sensor—Typical

The movable pulse ring should now be within the sensor pickup.

(5) Turn ignition key to ON position. Voltmeter should read approximately 5.0 volts.

(6) If voltage is not present, check the voltmeter leads for a good connection.

(7) If voltage is still not present, check for voltage at the supply wire. For wire identification, refer to Group 8W, Wiring Diagrams.

(8) If 5 volts is not present at supply wire, check for voltage at PCM 32-way connector (cavity A-17). Refer to Group 8W, Wiring for location of connector/terminal. Leave the PCM connector connected for this test.

(9) If voltage is still not present, perform vehicle test using the DRB scan tool.

(10) If voltage is present at cavity A-17, but not at the supply wire:

(a) Check continuity between the supply wire. This is checked between the distributor connector and cavity A-17 at the PCM. If continuity is not present, repair the harness as necessary.

(b) Check for continuity between the camshaft position sensor output wire and cavity A-18 at the PCM. If continuity is not present, repair the harness as necessary.

(c) Check for continuity between the ground circuit wire at the distributor connector and ground. If continuity is not present, repair the harness as necessary.

(11) While observing the voltmeter, crank the engine with ignition switch. The voltmeter needle should fluctuate between 0 and 5 volts while the engine is cranking. This verifies that the camshaft position sensor in the distributor is operating properly and a sync pulse signal is being generated.

If sync pulse signal is not present, replacement of the camshaft position sensor is necessary

ENGINE COOLANT TEMPERATURE SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

SPARK PLUG CABLES

Check the spark plug cable connections for good contact at the coil(s), distributor cap towers, and spark plugs. Terminals should be fully seated. The insulators should be in good condition and should fit tightly on the coil, distributor and spark plugs. Spark plug cables with insulators that are cracked or torn must be replaced.

Clean high voltage ignition cables with a cloth moistened with a non-flammable solvent. Wipe the cables dry. Check for brittle or cracked insulation.

TESTING

When testing secondary cables for damage with an oscilloscope, follow the instructions of the equipment manufacturer.

If an oscilloscope is not available, spark plug cables may be tested as follows:

CAUTION: Do not leave any one spark plug cable disconnected for longer than necessary during testing. This may cause possible heat damage to the catalytic converter. Total test time must not exceed ten minutes.

With the engine running, remove spark plug cable from spark plug (one at a time) and hold next to a good engine ground. If the cable and spark plug are in good condition, the engine rpm should drop and the engine will run poorly. If engine rpm does not drop, the cable and/or spark plug may not be operating properly and should be replaced. Also check engine cylinder compression.

With the engine not running, connect one end of a test probe to a good ground. Start the engine and run the other end of the test probe along the entire length of all spark plug cables. If cables are cracked or punctured, there will be a noticeable spark jump from the damaged area to the test probe. The cable running from the ignition coil to the distributor cap can be checked in the same manner. Cracked, damaged or faulty cables should be replaced with resistance type cable. This can be identified by the words ELECTRONIC SUPPRESSION printed on the cable jacket.

Use an ohmmeter to test for open circuits, excessive resistance or loose terminals. 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 corre-

DIAGNOSIS AND TESTING (Continued)

sponding 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.

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

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SPARK PLUG CABLE RESISTANCE

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 CONDITIONS

NORMAL OPERATING

The few deposits present on the spark plug will probably be light tan or slightly gray in color. This is evident with most grades of commercial gasoline (Fig. 24). There will not be evidence of electrode burning. Gap growth will not average more than approximately 0.025 mm (.001 in) per 1600 km (1000 miles) of operation. Spark plugs that have normal wear can usually be cleaned, have the electrodes filed, have the gap set and then be installed.

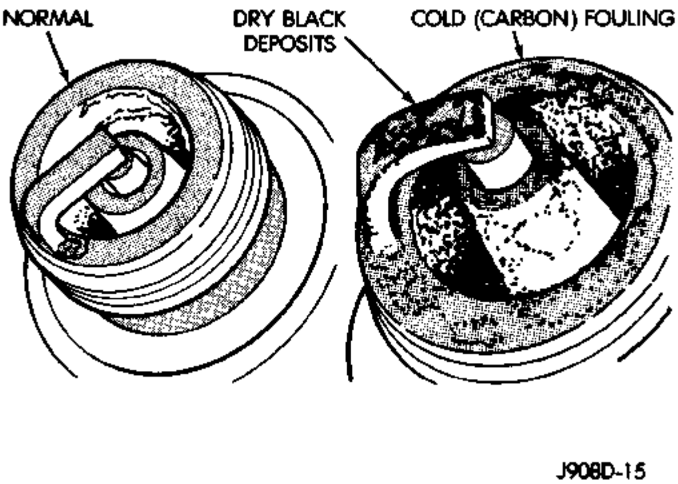


Fig. 24 Normal Operation and Cold (Carbon) Fouling

Some fuel refiners in several areas of the United States have introduced a manganese additive (MMT) for unleaded fuel. During combustion, fuel with MMT causes the entire tip of the spark plug to be coated with a rust colored deposit. This rust color can be misdiagnosed as being caused by coolant in the combustion chamber. Spark plug performance is not affected by MMT deposits.

COLD FOULING/CARBON FOULING

Cold fouling is sometimes referred to as carbon fouling. The deposits that cause cold fouling are basically carbon (Fig. 24). A dry, black deposit on one or two plugs in a set may be caused by sticking valves or defective spark plug cables. Cold (carbon) fouling of the entire set of spark plugs may be caused by a clogged air cleaner element or repeated short operating times (short trips).

WET FOULING OR GAS FOULING

A spark plug coated with excessive wet fuel or oil is wet fouled. In older engines, worn piston rings, leaking valve guide seals or excessive cylinder wear can cause wet fouling. In new or recently overhauled engines, wet fouling may occur before break-in (normal oil control) is achieved. This condition can usually be resolved by cleaning and reinstalling the fouled plugs.

OIL OR ASH ENCRUSTED

If one or more spark plugs are oil or oil ash encrusted (Fig. 25), evaluate engine condition for the cause of oil entry into that particular combustion chamber.

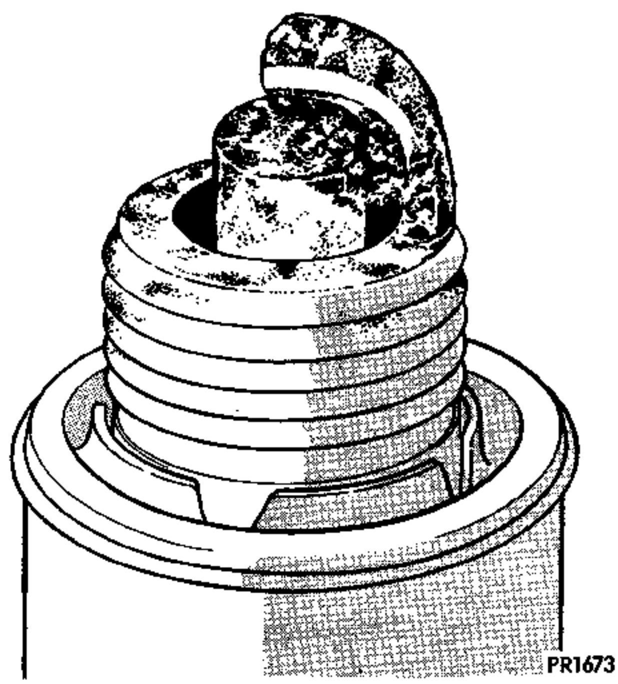


Fig. 25 Oil or Ash Encrusted

DIAGNOSIS AND TESTING (Continued)

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. 26). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

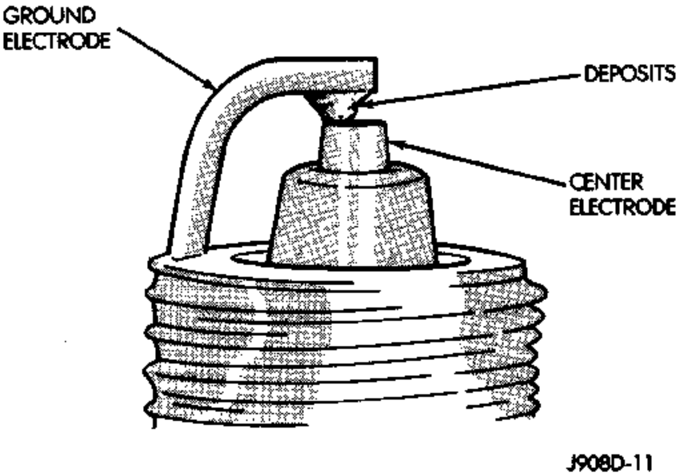


Fig. 26 Electrode Gap Bridging

SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 27). 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.

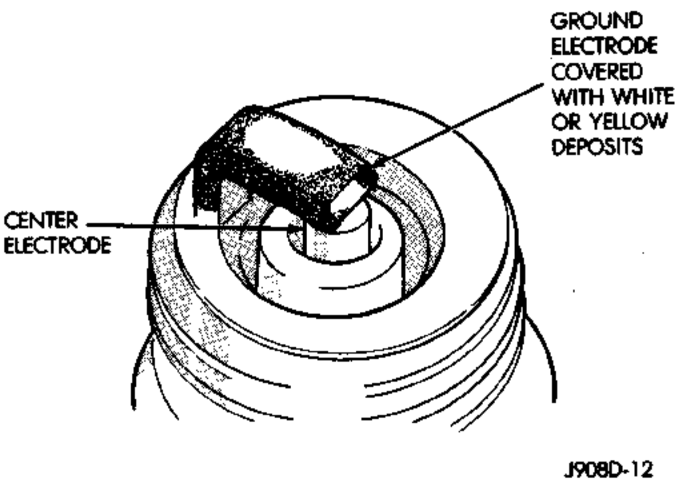


Fig. 27 Scavenger Deposits

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. 28). Spark plugs with this condition must be replaced.

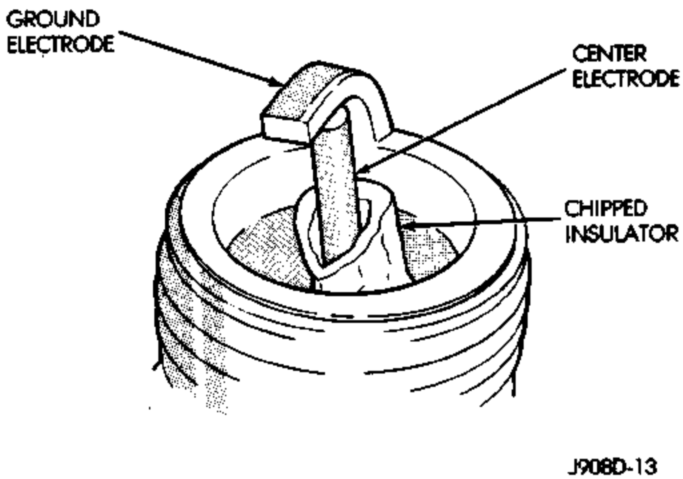


Fig. 28 Chipped Electrode Insulator

PREIGNITION DAMAGE

Preignition damage is usually caused by excessive combustion chamber temperature. The center electrode dissolves first and the ground electrode dissolves somewhat latter (Fig. 29). 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.)

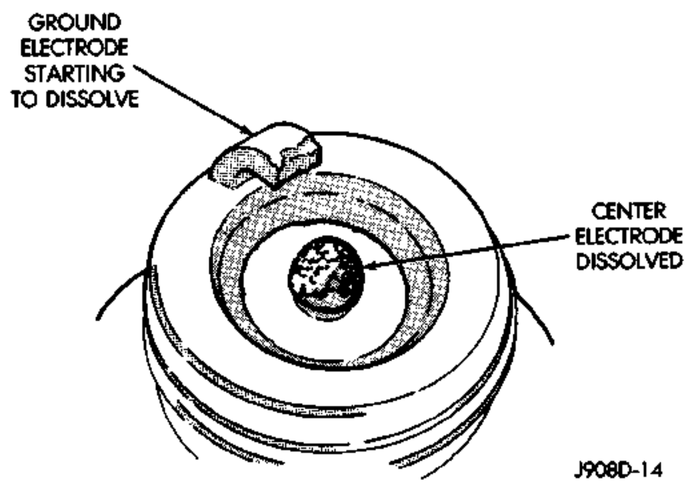


Fig. 29 Preignition Damage

DIAGNOSIS AND TESTING (Continued)

SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 30). The increase in electrode gap will be considerably in excess of 0.001 inch per 1000 miles of operation. This suggests that a plug with a cooler heat range rating should be used. Over advanced ignition timing, detonation and cooling system malfunctions can also cause spark plug overheating.

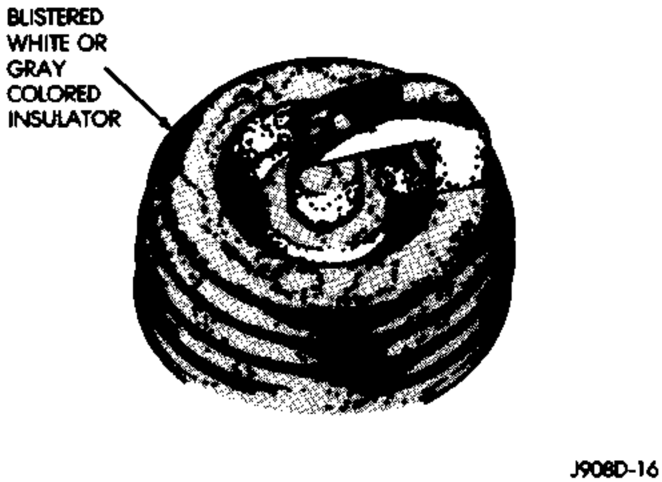


Fig. 30 Spark Plug Overheating

REMOVAL AND INSTALLATION

SPARK PLUG CABLES

CAUTION: When disconnecting a high voltage cable from a spark plug or from the distributor cap, twist the rubber boot slightly (1/2 turn) to break it loose (Fig. 31). Grasp the boot (not the cable) and pull it off with a steady, even force.

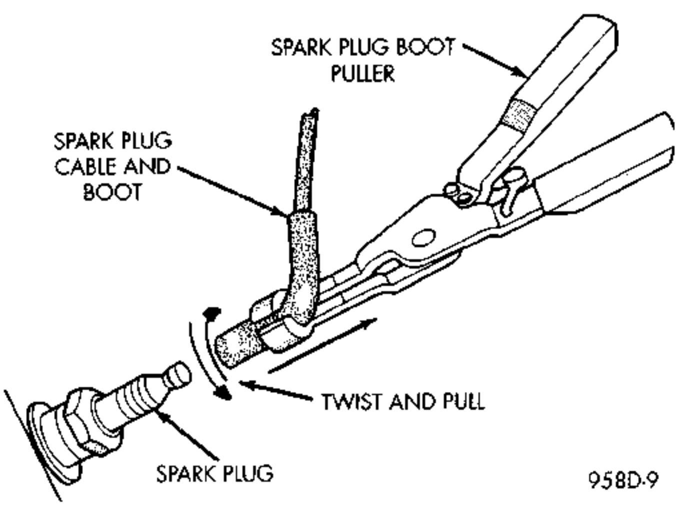


Fig. 31 Cable Removal

Install cables into the proper engine cylinder firing order (Fig. 32) or (Fig. 33).

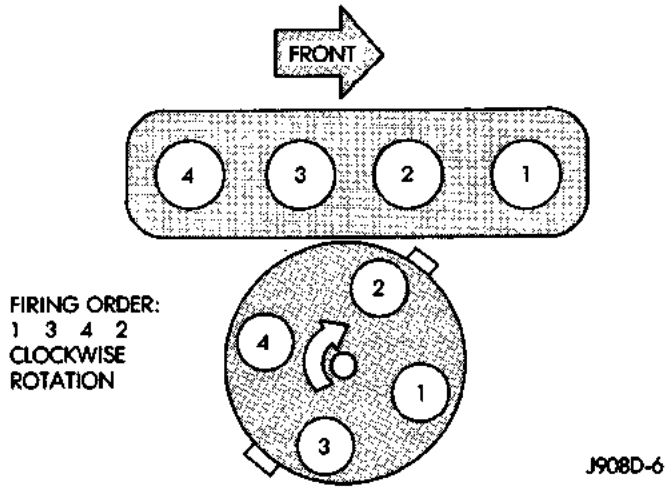


Fig. 32 Engine Firing Order—2.5L 4-Cylinder Engine

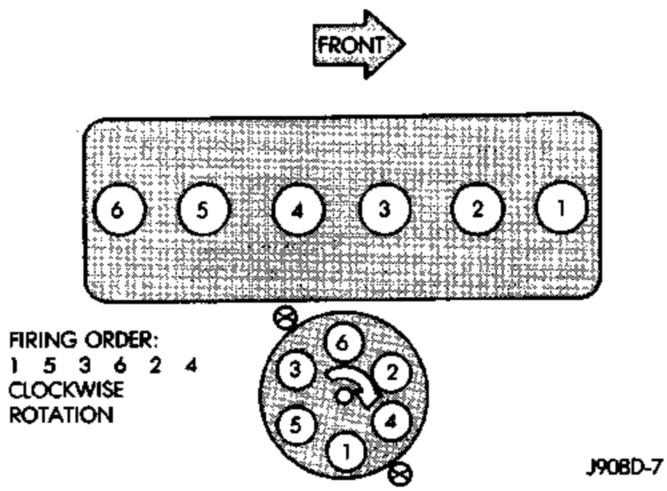


Fig. 33 Engine Firing Order—4.0L 6-Cylinder Engine

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.

SPARK PLUGS

PLUG REMOVAL

(1) Always remove spark plug or ignition coil cables by grasping at the cable boot (Fig. 31). 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.

REMOVAL AND INSTALLATION (Continued)

(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.

CAUTION: Never use a motorized wire wheel brush to clean the spark plugs. Metallic deposits will remain on the spark plug insulator and will cause plug misfire.

PLUG GAP ADJUSTMENT

Check the spark plug gap with a gap gauge tool. If the gap is not correct, adjust it by bending the ground electrode (Fig. 34). **Never attempt to adjust the gap by bending the center electrode.**

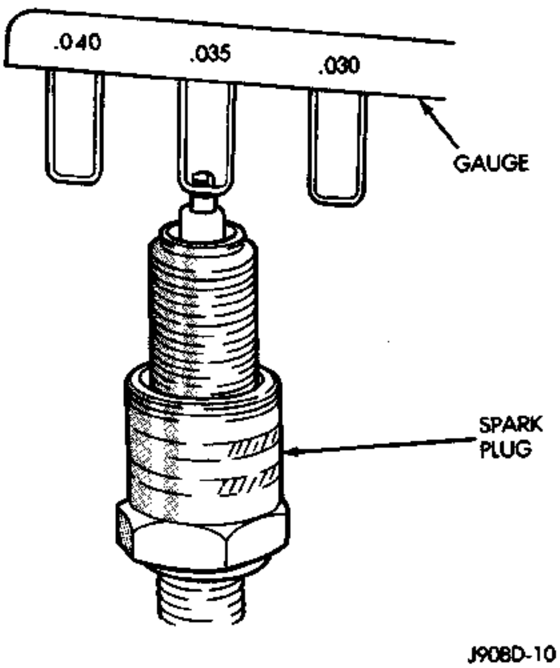


Fig. 34 Setting Spark Plug Gap—Typical

SPARK PLUG GAP

- 2.5L 4-Cylinder Engine Spark Plug Gap: .89 mm (.035 in).
- 4.0L 6-Cylinder Engine Spark Plug Gap: .89 mm (.035 in).

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, or a cracked porcelain insulator.

When replacing the spark plug and ignition coil cables, route the cables correctly and secure them in the appropriate retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise. It could cause cross ignition of the spark plugs, or short circuit the cables to ground.

(1) Start the spark plug into the cylinder head by hand to avoid cross threading.

(2) Tighten the spark plugs to 35-41 N·m (26-30 ft. lbs.) torque.

(3) Install spark plug cables over spark plugs.

IGNITION COIL

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

REMOVAL

On the 2.5L 4-cylinder engine, the ignition coil is mounted to a bracket on the side of the engine (to the rear of the distributor) (Fig. 35).

On the 4.0L 6-cylinder engine, the ignition coil is mounted to a bracket on the side of the engine (to the front of the distributor) (Fig. 36).

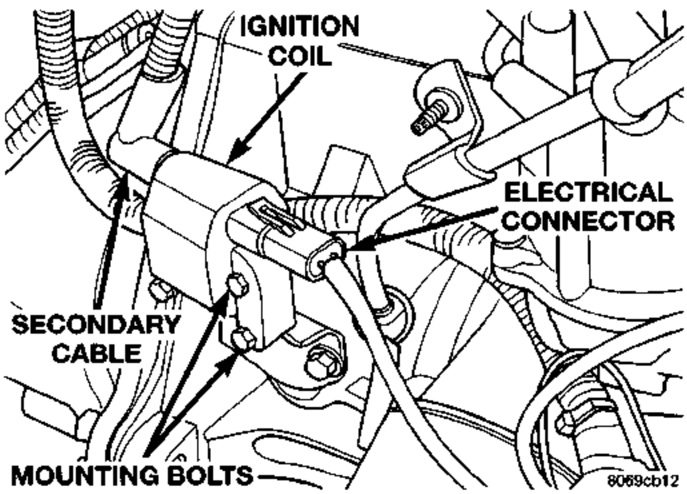


Fig. 35 Ignition Coil—2.5L Engine

(1) Disconnect the ignition coil secondary cable from ignition coil.

(2) Disconnect engine harness connector from ignition coil.

(3) Remove ignition coil mounting bolts (nuts are used on back side of bracket on some coils).

(4) Remove coil from vehicle.

INSTALLATION

(1) Install ignition coil to bracket on cylinder block with mounting bolts (and nuts if equipped). If

REMOVAL AND INSTALLATION (Continued)

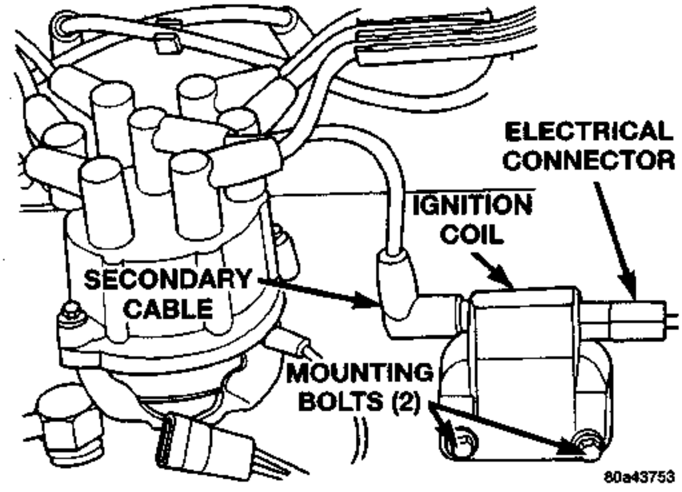


Fig. 36 Ignition Coil—4.0L Engine

equipped with nuts and bolts, tighten to 11 N·m (100 in. lbs.) torque. If equipped with bolts only, tighten to 5 N·m (50 in. lbs.) torque.

(2) Connect engine harness connector to coil.

(3) Connect ignition coil cable to ignition coil.

AUTOMATIC SHUTDOWN (ASD) RELAY

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 37). Relay location is printed on a label on PDC cover.

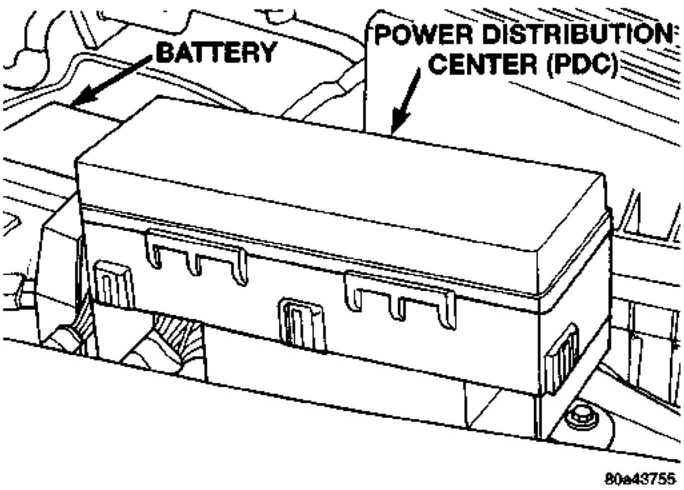


Fig. 37 PDC Location

REMOVAL

(1) Remove the PDC cover.

(2) Remove the relay by lifting straight up.

INSTALLATION

(1) Check condition of relay terminals at PDC for corrosion or damage. Also check the heights of relay terminal pins at PDC. Pin height should be same for all pins. Repair as necessary before installing relay.

(2) Push the relay into the connector.

(3) Install the relay cover.

CRANKSHAFT POSITION SENSOR

The crankshaft position sensor is mounted to the transmission bellhousing at the left/rear side of the engine block (Fig. 38), (Fig. 39), or (Fig. 40).

On 2.5L 4-cylinder and 4.0L 6-cylinder engines equipped with a manual transmission, the sensor is attached with two bolts. On 2.5L engines equipped with an automatic transmission, the sensor is attached with two nuts. On 4.0L engines equipped with an automatic transmission, the sensor is attached with one bolt.

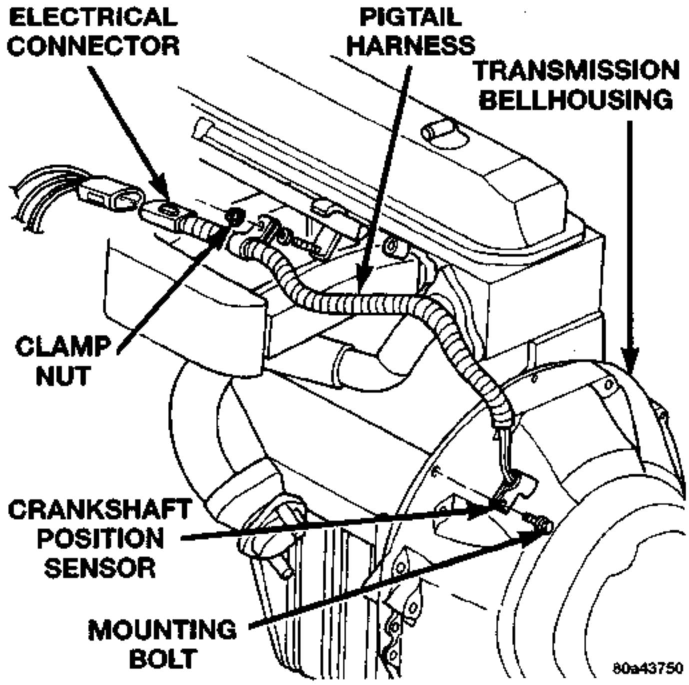


Fig. 38 Crankshaft Position Sensor—4.0L 6-Cyl. Engine—Auto. Trans.

REMOVAL

(1) Near the rear of the intake manifold, disconnect the pigtail harness (electrical connector) from the main electrical harness.

(2) Remove the nut holding sensor harness wire clip to fuel rail mounting stud.

(3) Depending upon application, remove either the sensor mounting bolt(s) or nuts.

(4) Remove the sensor.

(5) Remove clip from sensor wire harness.

INSTALLATION

(1) Install the sensor flush against the opening in the transmission housing.

(2) 2.5L and 4.0L engines equipped with a manual transmission: Install and tighten the two sensor mounting bolts to 19 N·m (14 ft. lbs.) torque. **The two sensor mounting bolts are specially machined to correctly space the unit to the flywheel. Do not attempt to install any other bolts.**

REMOVAL AND INSTALLATION (Continued)

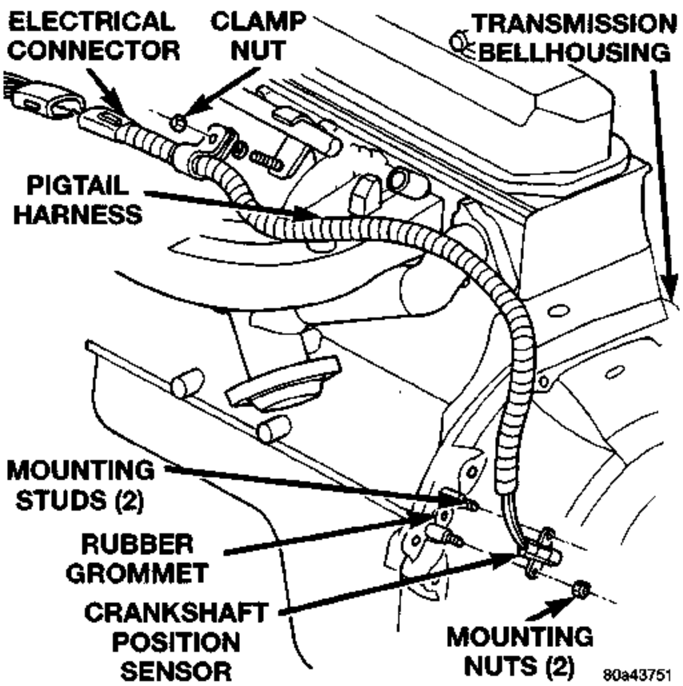


Fig. 39 Crankshaft Position Sensor—2.5L 4-Cyl. Engine—Auto. Trans.

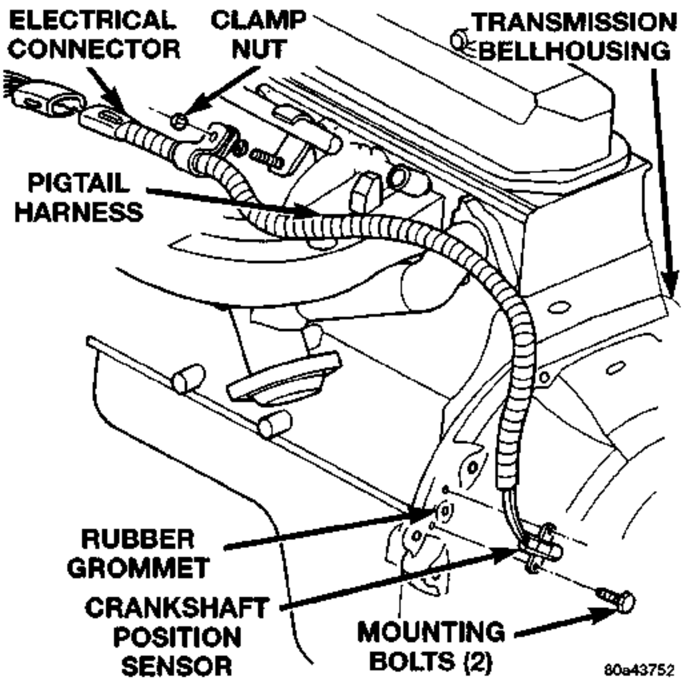


Fig. 40 Crankshaft Position Sensor—Manual Transmission (Typical)

(3) 2.5L engines equipped with an automatic transmission: Install and tighten the two sensor mounting nuts to 19 N·m (14 ft. lbs.) torque.

(4) 4.0L engines equipped with an automatic transmission: Install and tighten the sensor mounting bolt to 7 N·m (60 in. lbs.) torque.

(5) Connect the sensor pigtail harness electrical connector to main wiring harness.

(6) Install clip on sensor wire harness.

(7) Install clip over fuel rail mounting stud.

(8) Install clip mounting nut.

CAMSHAFT POSITION SENSOR

The camshaft position sensor is located in the distributor (Fig. 41).

REMOVAL

Distributor removal is not necessary to remove camshaft position sensor.

(1) Disconnect negative battery cable at battery.

(2) Remove distributor cap from distributor (two screws).

(3) Disconnect camshaft position sensor wiring harness from main engine wiring harness.

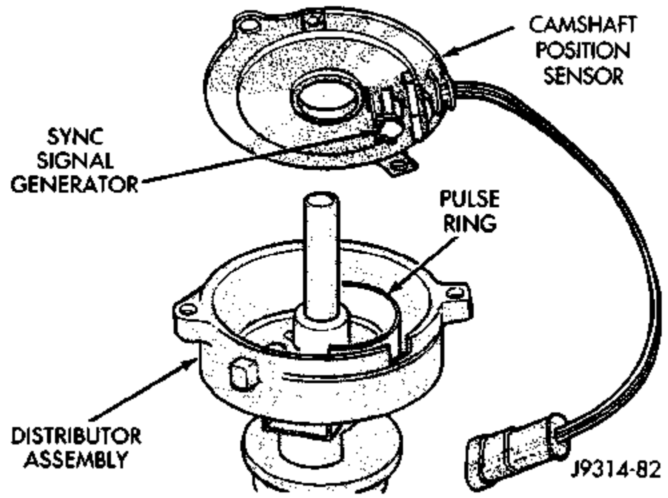


Fig. 41 Camshaft Position Sensor

(4) Remove distributor rotor from distributor shaft.

(5) Lift the camshaft position sensor assembly from the distributor housing (Fig. 41).

INSTALLATION

(1) Install camshaft position sensor to distributor. Align sensor into notch on distributor housing.

(2) Connect wiring harness.

(3) Install rotor.

(4) Install distributor cap. Tighten mounting screws.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

For removal and installation, refer to Manifold Absolute Pressure Sensor in group 14, Fuel Systems.

ENGINE COOLANT TEMPERATURE SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

REMOVAL AND INSTALLATION (Continued)

THROTTLE POSITION SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

DISTRIBUTOR

All distributors contain an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

Factory replacement distributors are equipped with a plastic alignment pin already installed. The pin is located in an access hole on the bottom of the distributor housing (Fig. 42). It is used to temporarily lock the rotor to the cylinder number 1 position during installation. The pin must be removed after installing the distributor.

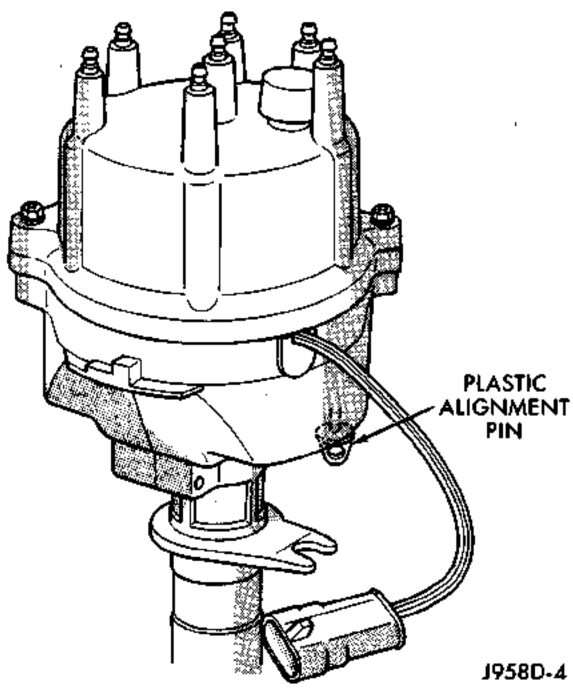


Fig. 42 Plastic Alignment Pin

The camshaft position sensor is located in the distributor on all engines (Fig. 43). For removal/installation procedures, refer to Camshaft Position Sensor. Distributor removal is not necessary for sensor removal.

Refer to (Fig. 43) for an exploded view of the distributor.

A fork with a slot is supplied on the bottom of the distributor housing where the housing base seats against the engine block (Fig. 43). The centerline of the slot aligns with the distributor hold-down bolt hole in the engine block. Because of the fork, the distributor cannot be rotated. Distributor rotation is not necessary as all ignition timing requirements are handled by the powertrain control module (PCM).

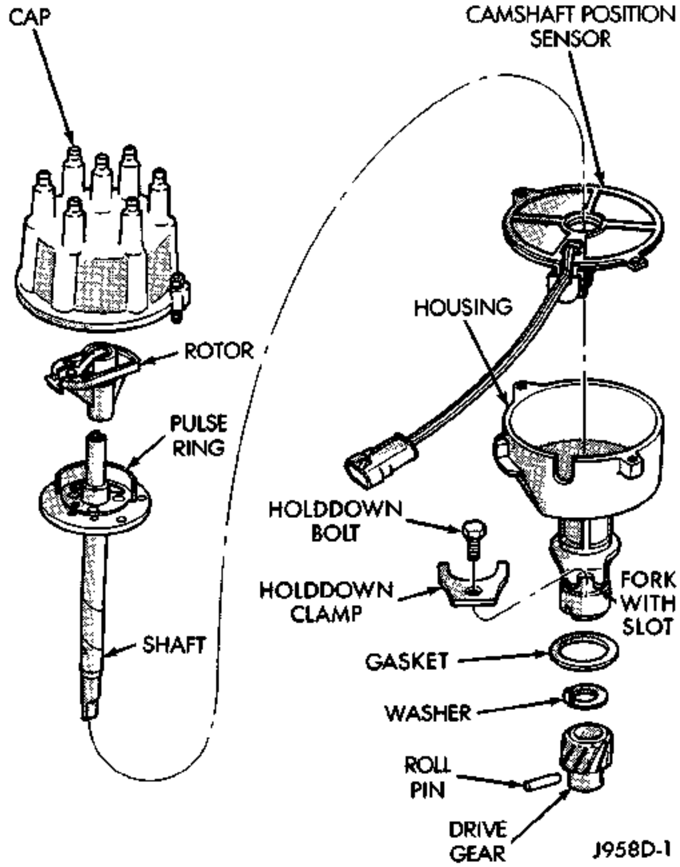


Fig. 43 Distributor—2.5L Or 4.0L Engines—Typical

The position of the distributor determines fuel synchronization only. It does not determine ignition timing.

NOTE: Do not attempt to modify this fork to attain ignition timing.

REMOVAL—2.5L OR 4.0L ENGINE

(1) Disconnect the negative battery cable at the battery.

(2) Disconnect coil secondary cable at coil.

(3) Remove distributor cap from distributor (2 screws). Do not remove cables from cap. Do not remove rotor.

(4) Disconnect the distributor wiring harness from the main engine harness.

(5) Remove the cylinder number 1 spark plug.

(6) Hold a finger over the open spark plug hole. Rotate the engine at the vibration dampener bolt until compression (pressure) is felt.

(7) Slowly continue to rotate the engine. Do this until the timing index mark on the vibration damper

REMOVAL AND INSTALLATION (Continued)

pulley aligns with the top dead center (TDC) mark (0 degree) on timing degree scale (Fig. 44). Always rotate the engine in direction of normal rotation. Do not rotate the engine backward to align the timing marks.

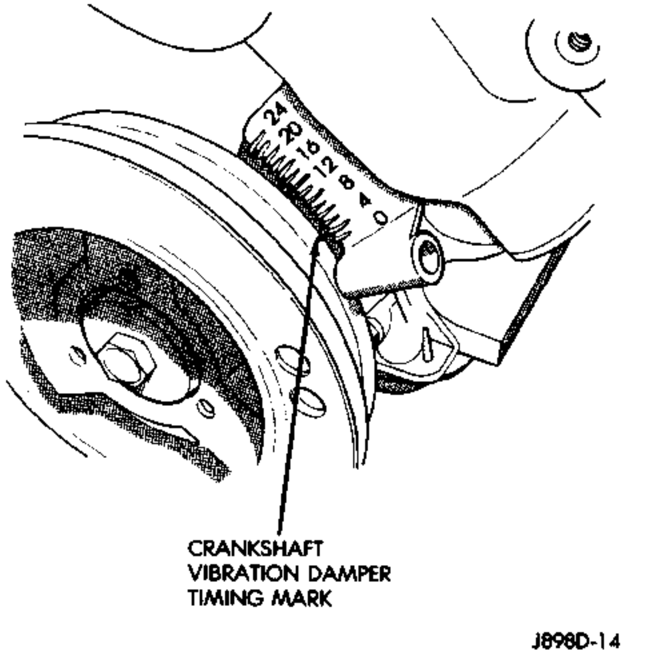


Fig. 44 Align Timing Marks

(8) Remove the distributor hold-down bolt and clamp.

(9) Remove the distributor from engine by slowly lifting straight up.

(10) Note that the rotor will rotate slightly in a counterclockwise direction while lifting up the distributor. The oil pump gear will also rotate slightly in a counterclockwise direction while lifting up the distributor. This is due to the helical cut gears on the distributor and camshaft.

(11) Note the removed position of the rotor during distributor removal. During installation, this will be referred to as the Pre-position.

(12) **2.5L 4-Cylinder Engine:** Observe the slot in the oil pump gear through the hole on the side of the engine. It should be slightly before (counterclockwise of) the 10 o'clock position (Fig. 45).

(13) **4.0L 6-Cylinder Engine:** Observe the slot in the oil pump gear through the hole on the side of the engine. It should be slightly before (counterclockwise of) the 11 o'clock position (Fig. 46).

(14) Remove and discard the old distributor-to-engine block gasket.

INSTALLATION

(1) If the engine crankshaft has been rotated after distributor removal, cylinder number 1 must be returned to its proper firing stroke. Refer to previous

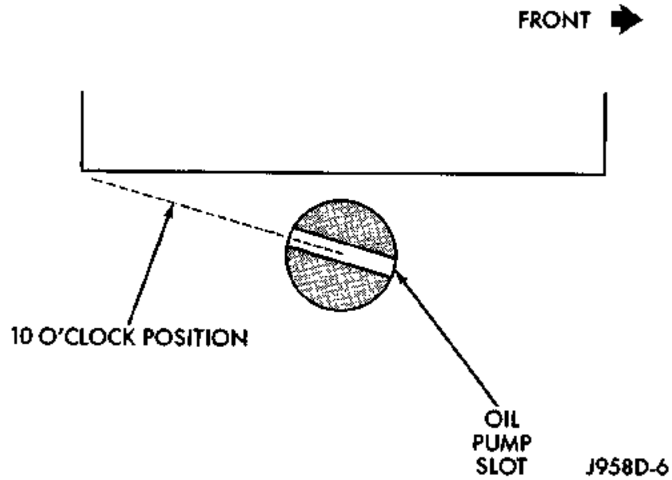


Fig. 45 Slot At 10 O'clock Position—2.5L Engine

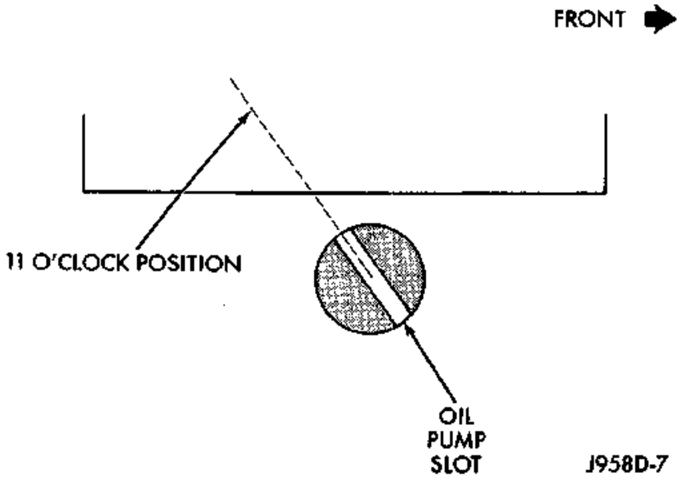


Fig. 46 Slot At 11 O'clock Position—4.0L Engine

REMOVAL Step 5 and Step 6. These steps must be done before installing distributor.

(2) Check the position of the slot on the oil pump gear. On the 2.5L engine, it should be just slightly before (counterclockwise of) the 10 o'clock position (Fig. 45). On the 4.0L engine, it should be just slightly before (counterclockwise of) the 11 o'clock position (Fig. 46). If not, place a flat blade screwdriver into the oil pump gear and rotate it into the proper position.

(3) Factory replacement distributors are equipped with a plastic alignment pin already installed (Fig. 42). This pin is used to temporarily hold the rotor to the cylinder number 1 firing position during distributor installation. If this pin is in place, proceed to Step 8. If not, proceed to next step.

(4) If the original distributor is to be reinstalled, such as during engine overhaul, the plastic pin will not be available. A 3/16 inch drift pin punch tool may be substituted for the plastic pin.

(5) Remove the camshaft position sensor from the distributor housing. Lift straight up.

REMOVAL AND INSTALLATION (Continued)

(6) Four different alignment holes are provided on the plastic ring (Fig. 47). **Note that 2.5L and 4.0L engines have different alignment holes (Fig. 47).**

(7) Rotate the distributor shaft and install the pin punch tool through the proper alignment hole in the plastic ring (Fig. 47) and into the mating access hole in the distributor housing. This will prevent the distributor shaft and rotor from rotating.

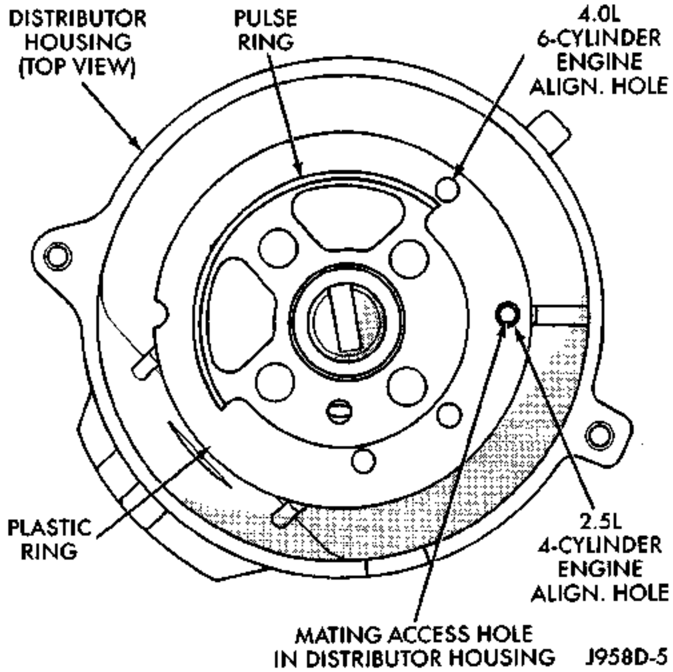


Fig. 47 Pin Alignment Holes

(8) Clean the distributor mounting hole area of the engine block.

(9) Install a new distributor-to-engine block gasket (Fig. 43).

(10) Install the rotor to the distributor shaft.

(11) **2.5L 4-Cylinder Engine:** Pre-position the distributor into the engine while holding the centerline of the base slot in the 1 o'clock position (Fig. 48). Continue to engage the distributor into the engine. The rotor and distributor will rotate clockwise during installation. This is due to the helical cut gears on the distributor and camshaft. When the distributor is fully seated to the engine block, the centerline of the base slot should be aligned to the clamp bolt mounting hole on the engine (Fig. 49). The rotor should also be pointed slightly past (clockwise of) the 3 o'clock position.

4.0L 6-Cylinder Engine: Pre-position the distributor into the engine while holding the centerline of the base slot in the 1 o'clock position (Fig. 48). Continue to engage the distributor into the engine. The rotor and distributor will rotate clockwise during installation. This is due to the helical cut gears on the distributor and camshaft. When the distributor is fully seated to the engine block, the centerline of the base slot should be aligned to the clamp bolt mounting hole on the engine (Fig. 50). The rotor should also be pointed at the 5 o'clock position.

It may be necessary to rotate the rotor and distributor shaft (very slightly) to engage the distributor shaft with the slot in the oil pump gear. The same may have to be done to engage the distributor gear with the camshaft gear.

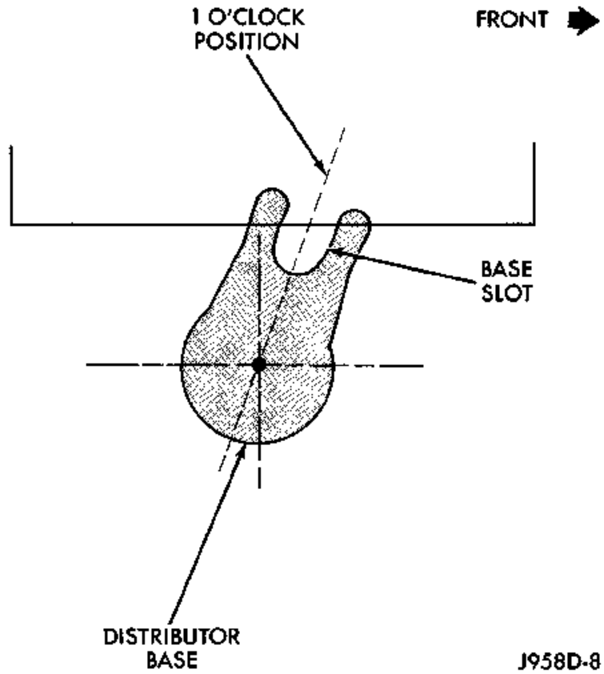


Fig. 48 Distributor Pre-position—All Engines

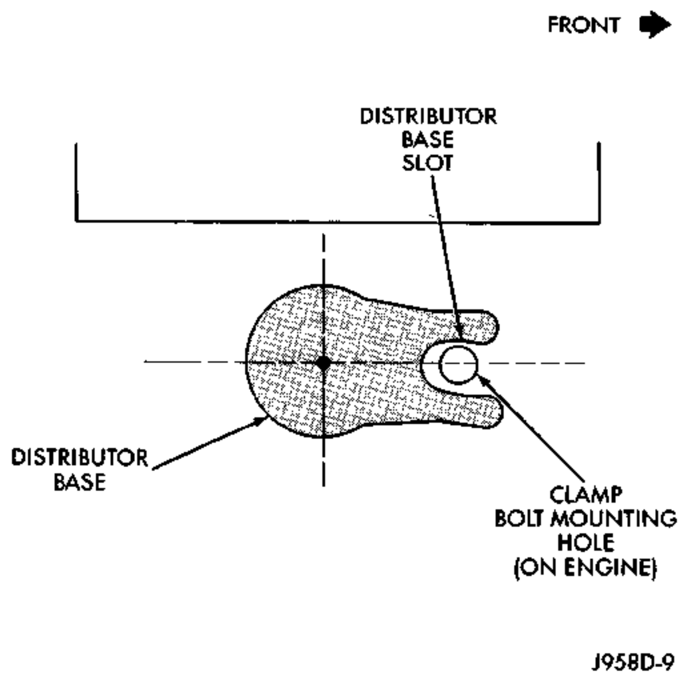


Fig. 49 Distributor Engaged Position—2.5L 4-Cylinder Engine

REMOVAL AND INSTALLATION (Continued)

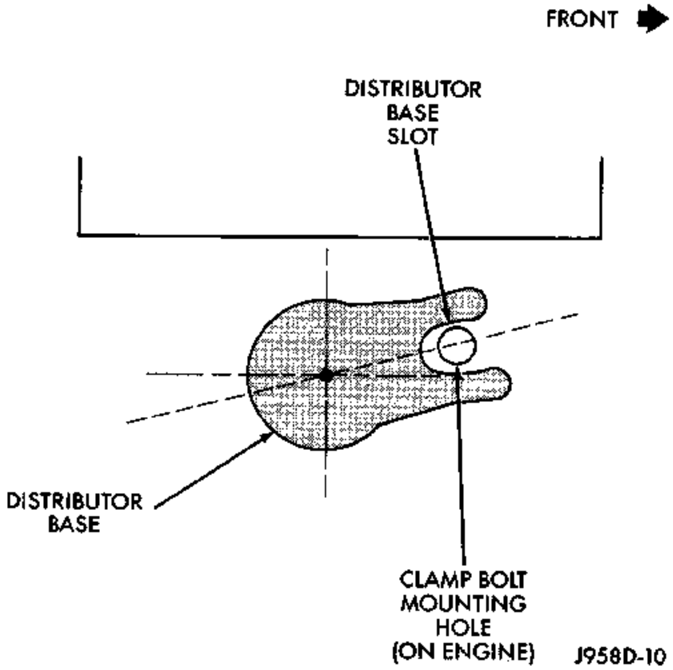


Fig. 50 Distributor Engaged Position—4.0L 6-Cylinder Engine

The distributor is correctly installed when:

- the rotor is pointed at the 3 o'clock position (2.5L engine), or at the 5 o'clock position (4.0L engine).
- the plastic alignment pin (or pin punch tool) is still installed to distributor.
- the number 1 cylinder piston is set at top dead center (TDC) (compression stroke).
- the centerline of the slot at the base of the distributor is aligned to the centerline of the distributor hold-down bolt hole on the engine. In this position, the hold-down bolt should easily pass through the slot and into the engine.

No adjustments are necessary. Proceed to next step.

(12) Install the distributor hold-down clamp and bolt. Tighten the bolt to 23 N·m (17 ft. lbs.) torque.

(13) Remove the pin punch tool from the distributor. Or, if the plastic alignment pin was used, remove it straight down from the bottom of the distributor. Discard plastic pin.

(14) If removed, install the camshaft position sensor to the distributor. Align the wiring harness grommet to the notch in the distributor housing.

(15) Install the rotor.

CAUTION: If the distributor cap is incorrectly positioned on distributor housing, the cap or rotor may be damaged when engine is started.

(16) Install the distributor cap. Tighten distributor cap hold-down screws to 3 N·m (26 in. lbs.) torque.

(17) If removed, install the spark plug cables to the distributor cap. For proper firing order, refer to the Specifications section at the end of this group. See Engine Firing Order.

(18) Connect the distributor wiring harness to the main engine harness.

(19) Connect battery cable to battery.

POWERTRAIN CONTROL MODULE (PCM)

Refer to Group 14, Fuel System for procedures.

IGNITION SWITCH AND KEY CYLINDER

The ignition key must be in the key cylinder for cylinder removal. The key cylinder must be removed first before removing ignition switch.

KEY CYLINDER REMOVAL

(1) Disconnect negative battery cable at battery.

(2) If equipped with an automatic transmission, place shifter in PARK position.

(3) Rotate key to ON position.

(4) A release tang is located on bottom of key cylinder (Fig. 51).

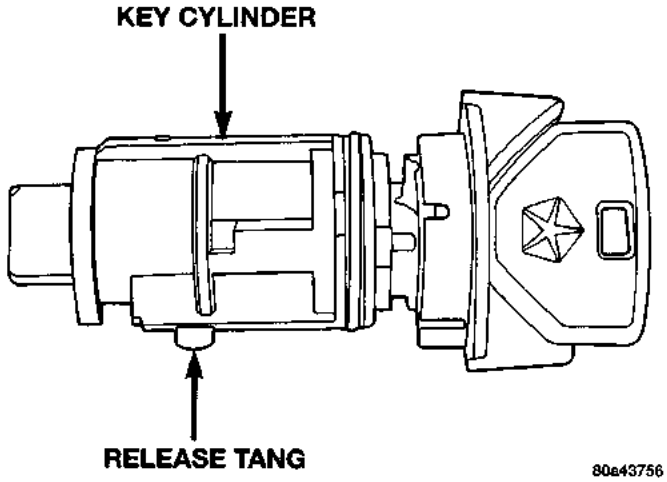


Fig. 51 Key Cylinder Release Tang

(5) Position a small screwdriver or pin punch into tang access hole on bottom of steering column lower cover (Fig. 52).

(6) Push the pin punch up while pulling key cylinder from steering column.

IGNITION SWITCH REMOVAL

(1) Remove key cylinder. Refer to previous steps.

(2) Remove lower steering column cover screws and remove cover (Fig. 52).

(3) Disconnect two electrical connectors at rear of ignition switch (Fig. 53).

(4) Remove ignition switch mounting screw (Fig. 53). Use tamper proof torx bit (Snap-On® SDMTR10 or equivalent) to remove the screw.

REMOVAL AND INSTALLATION (Continued)

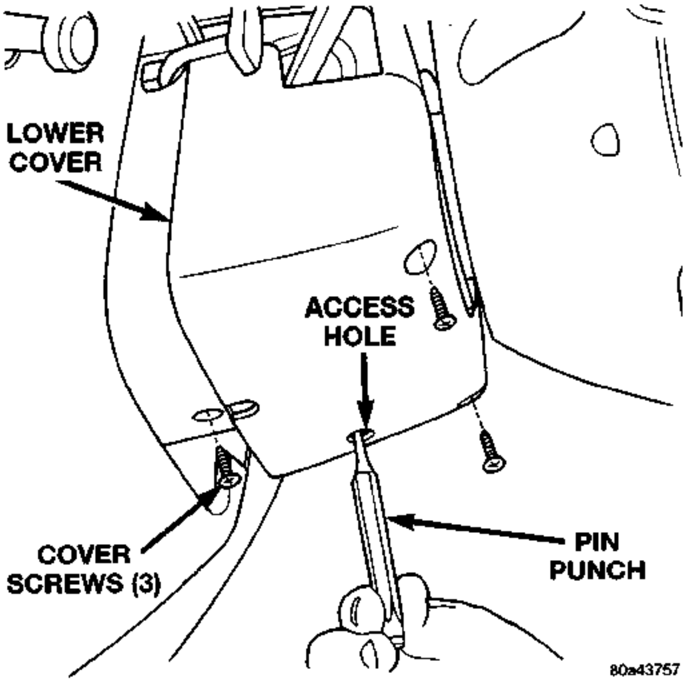


Fig. 52 Key Cylinder and Cover Removal

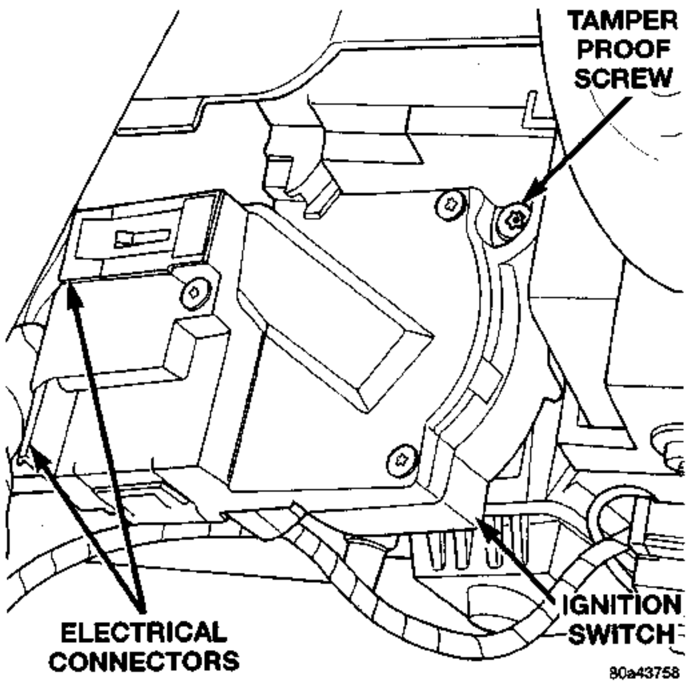


Fig. 53 Ignition Switch Removal/Installation

(5) Using a small screwdriver, push on locking tab (Fig. 54) and remove switch from steering column.

IGNITION SWITCH INSTALLATION

(1) Before installing ignition switch, rotate the slot in the switch to the ON position (Fig. 55).

(2) Position switch to column and install tamper proof screw. Tighten screw to 3 N·m (26 in. lbs.).

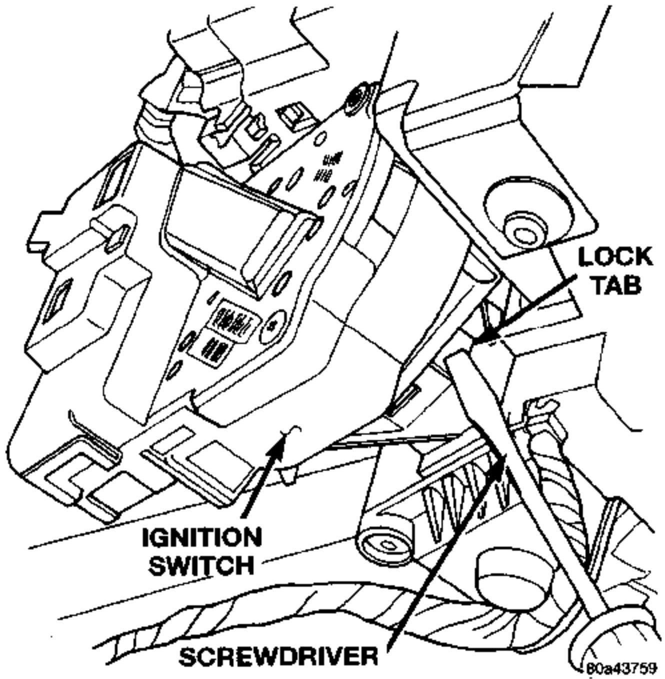


Fig. 54 Ignition Switch Lock Tab

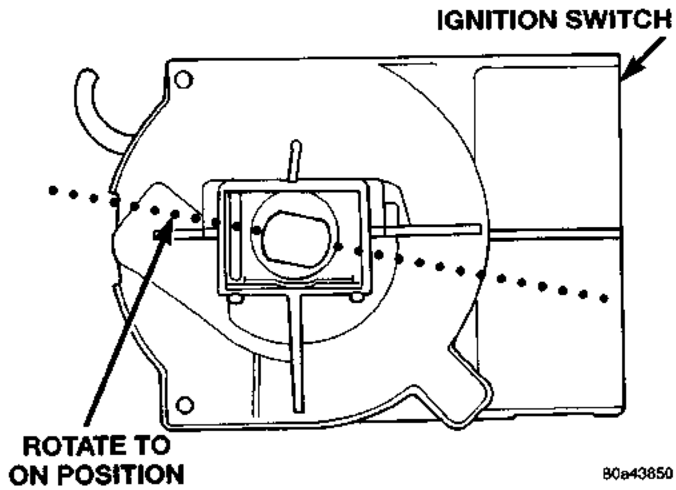


Fig. 55 Switch in ON Position

(3) Connect two electrical connectors to rear of ignition switch. Make sure that locking tabs are fully seated into wiring connectors.

(4) Install steering column lower cover.

KEY CYLINDER INSTALLATION

(1) If equipped with an automatic transmission, place shifter in PARK position.

(2) Position key cylinder into steering column as it would normally be in the ON position.

(3) Press key cylinder into column until it snaps into position.

(4) Check mechanical operation of switch. **Automatic Transmission:** Be sure transmission lever is locked in PARK position after key removal. If key is difficult to rotate or is difficult to remove, the shift

REMOVAL AND INSTALLATION (Continued)

lever-to-steering column cable may be out of adjustment or defective. Refer to Group 21, Transmission for procedures. **Manual Transmission:** Be sure key cannot be removed until release lever is operated. If key can be removed, release lever mechanism may be defective. Release lever mechanism is not serviced separately. If repair is necessary, the steering column must be replaced. Refer to Group 19, Steering for procedures.

(5) Connect negative cable to battery.

(6) Check electrical operation of switch.

SHIFTER/IGNITION INTERLOCK

On models equipped with an automatic transmission, a cable connects the ignition switch with the floor shift lever. The shifter will be locked in the PARK position when the ignition key is in the LOCK or ACCESSORY positions. The cable can be adjusted or replaced. Refer to Group 21, Transmissions for procedures. The ignition interlock device within the steering column is not serviceable. If service is necessary, the steering column must be replaced. Refer to Group 19, Steering for procedures.

SPECIFICATIONS

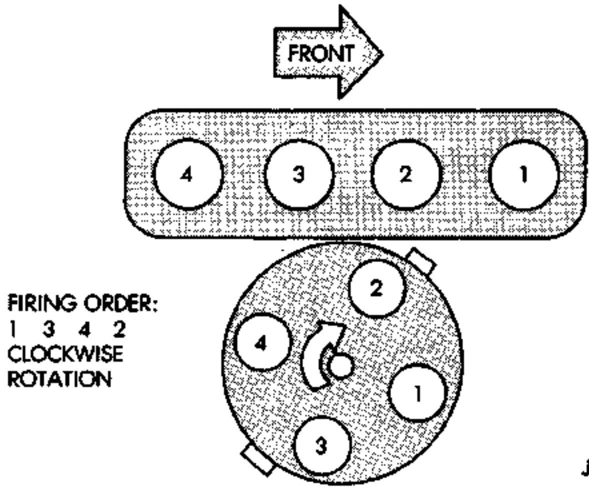
VECI LABEL SPECIFICATIONS

If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label. The VECI label is located in the engine compartment.

IGNITION TIMING

Ignition timing is not adjustable on any engine. Refer to Ignition Timing in the Diagnostics/Service Procedures section of this group for more information.

ENGINE FIRING ORDER—2.5L 4-CYLINDER ENGINE



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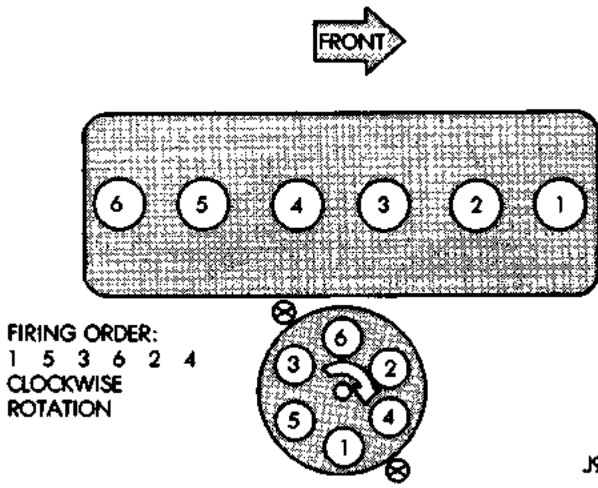
ENGINE FIRING ORDER—4.0L 6-CYLINDER ENGINE



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SPECIFICATIONS (Continued)

TORQUE CHART

DESCRIPTION	TORQUE
Crankshaft Position Sensor Bolts—With Manual Transmission	19 N·m (14 ft. lbs.)
Crankshaft Position Sensor Nuts—2.5L With Automatic Transmission	19 N·m (14 ft. lbs.)
Crankshaft Position Sensor Bolt—4.0L With Automatic Transmission	7 N·m (60 in. lbs.)
Distributor Hold Down Bolt	23 N·m (17 ft. lbs.)
Distributor Cap Screws	3 N·m (26 in. lbs.)
Ignition Coil Mounting (if tapped bolts are used)	5 N·m (50 in. lbs.)
Ignition Coil Mounting (if nuts/bolts are used)	11 N·m (100 in. lbs.)
Spark Plugs (all engines)	41 N·m (30 ft. lbs.)

SPARK PLUGS

ENGINE	PLUG TYPE	ELECTRODE GAP
2.5L/4.0L	RC12LYC	0.89 mm (0.035 in.)

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SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

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IGNITION COIL

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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INSTRUMENT PANEL SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

This group is responsible for covering the vehicle instrument panel. However, because the instrument panel serves as the vehicle's command center, it is a very complex unit. The instrument panel is designed to house the controls and monitors for standard and optional powertrains, climate control systems, audio systems, lighting systems, safety systems and many other comfort or convenience items. It is also designed so that all of the controls and monitors can

GENERAL INFORMATION (Continued)

be safely reached and/or viewed by the vehicle operator, while still allowing relative ease of access to these items for service.

Complete service information coverage for all of the systems and components housed in the instrument panel in this section of the service manual would not be practical. It would result in a great deal of duplication and make this group too large for the information to be easily accessed and used. Therefore, the information found in this group has been limited as follows:

- General Information - Covers non-electrical components and features of the instrument panel that are not related to other systems.
- Description and Operation - Covers gauges and their sending units, warning lamps and their switches, and instrument panel illumination lamps.
- Diagnosis and Testing - Covers gauges and their sending units, warning lamps and their switches, and instrument panel illumination lamps.
- Removal and Installation - Covers components installed on or in the instrument panel that require removal for diagnosis or service of instrument panel components covered in this group.

For more information on components or systems not covered above, refer to the proper group in this manual. If you are uncertain as to the proper group, refer to the Component and System Index at the back of this manual. Refer to Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

NOTE: This group covers both Left-Hand Drive (LHD) and Right-Hand Drive (RHD) versions of this model. Whenever required and feasible, the RHD versions of affected vehicle components have been constructed as mirror-image of the LHD versions. While most of the illustrations used in this group represent only the LHD version, the diagnostic and service procedures outlined can generally be applied to either version. Exceptions to this rule have been clearly identified as LHD or RHD, if a special illustration or procedure is required.

INSTRUMENT PANEL

Modular instrument panel construction allows all of the gauges and controls to be serviced from the front of the panel. In addition, most of the instrument panel electrical or heating and air conditioning components can be accessed without complete instrument panel removal. If necessary, the instrument panel can be removed from the vehicle as an assembly.

Removal of the steering column cover and knee blocker provides access to the steering column mounts, steering column wiring, the gearshift interlock mechanism, the headlamp switch, and much of the instrument panel wiring. Removal of the glove box allows access to the fuseblock module, additional instrument panel wiring, and many of the heating and air conditioning components.

Removal of the instrument cluster bezel allows access to the cluster assembly. Removal of the cluster assembly allows access to the cluster illumination and indicator lamp bulbs, and more of the instrument panel wiring.

Removal of the instrument panel center bezel allows access to the radio, climate controls, and accessory switches. The power outlet/cigar lighter is serviced only as a unit with the accessory switch bezel. A bezel on each outboard end of the lower instrument panel is removed to service the instrument panel speakers. Removal of the complete instrument panel is required for service of the passenger side airbag module and components within the heater-A/C housing.

INSTRUMENT CLUSTERS

One basic instrument cluster option is offered on this model. This cluster is an electro-mechanical unit that utilizes integrated circuitry and information carried on the Chrysler Collision Detection (CCD) data bus network for control of all gauges and many of the indicator lamps. This cluster also incorporates a vacuum fluorescent display tube for the digital odometer/trip odometer display functions. Some variations of the cluster exist due to optional equipment and regulatory requirements.

The cluster includes the following analog gauges:

- Coolant temperature gauge
- Fuel gauge
- Oil pressure gauge
- Speedometer
- Tachometer
- Voltmeter.

This cluster includes provisions for the following indicator lamps:

- Airbag indicator lamp
- Anti-lock brake system lamp
- Brake warning lamp
- Check gauges lamp
- Four-wheel drive (Part Time and/or Full Time) indicator lamps
- Headlamp high beam indicator lamp
- Low fuel warning lamp
- Malfunction indicator (Check Engine) lamp
- Master lighting indicator lamp
- Seat belt reminder lamp
- Turn signal indicator lamps
- Upshift indicator lamp (manual transmission)

The instrument cluster circuitry has a self-diagnostic actuator test capability, which will test each of the

GENERAL INFORMATION (Continued)

CCD bus message-controlled functions of the cluster by lighting the appropriate indicator lamps and positioning the gauge needles at several predetermined locations on the gauge faces in a prescribed sequence. For more information on this function, see Instrument Cluster in the Diagnosis and Testing section of this group.

The instrument cluster circuitry also integrates a chime tone generator and a timer circuit. These items replace the chime or buzzer module, and the separate timer circuit for the rear window defogger system. Refer to Group 8U - Chime/Buzzer Warning Systems or Group 8N - Electrically Heated Systems for more information on these cluster circuitry functions.

The instrument cluster for this model is serviced only as a complete unit. If a cluster gauge or the cluster circuit board are faulty, the entire cluster must be replaced. The cluster lens is available for service, and individual cluster lamp bulbs can be serviced.

GAUGES

With the ignition switch in the On or Start positions, voltage is supplied to all gauges through the instrument cluster electronic circuit board. With the ignition switch in the Off position, voltage is not supplied to the gauges. The gauges do not accurately indicate any vehicle condition unless the ignition switch is in the On or Start positions.

All gauges, except the odometer, are air core magnetic units. Two fixed electromagnetic coils are located within the gauge. These coils are wrapped at right angles to each other around a movable permanent magnet. The movable magnet is suspended within the coils on one end of a shaft. The gauge needle is attached to the other end of the shaft.

One of the coils has a fixed current flowing through it to maintain a constant magnetic field strength. Current flow through the second coil changes, which causes changes in its magnetic field strength. The current flowing through the second coil is changed by the instrument cluster electronic circuitry in response to messages received on the Chrysler Collision Detection (CCD) data bus network.

The gauge needle moves as the movable permanent magnet aligns itself to the changing magnetic fields created around it by the electromagnets. These gauges also feature a small fixed permanent magnet which will cause the gauge needles to return to zero after the ignition switch is turned to the Off position.

INDICATOR LAMPS

Indicator lamps are located in the instrument cluster and are served by the cluster circuit board and connector. Many of the indicator lamps in the instrument cluster are controlled by the instrument cluster circuitry in response to messages received over the Chrysler Collision Detection (CCD) data bus network.

The anti-lock brake system lamp, brake warning lamp, four-wheel drive indicator lamps, headlamp high beam indicator lamp, master lighting indicator lamp, and turn signal indicator lamps are hardwired. The instrument cluster circuitry uses CCD data bus messages from the Powertrain Control Module (PCM) and Airbag Control Module (ACM) to control all of the remaining indicator lamps.

FUSEBLOCK MODULE

The fuseblock module is mounted to a bracket on the dash panel, above the heater-A/C housing and behind the glove box. It has cavities for up to 20 blade-type fuses. A label on the heater-A/C housing beneath the fuseblock module identifies the cavity assignments and fuse sizes. The fuseblock module is accessed by removing the glove box.

DESCRIPTION AND OPERATION

COOLANT TEMPERATURE GAUGE

The coolant temperature gauge gives an indication of the engine coolant temperature. The instrument cluster circuitry controls the gauge pointer position. The instrument cluster circuitry calculates the proper gauge pointer position based upon an engine coolant temperature message received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the engine coolant temperature sensor and internal programming to decide what engine coolant temperature message is required. The PCM then sends the proper message to the instrument cluster on the CCD data bus.

If the PCM message indicates that coolant temperature is high, the instrument cluster circuitry moves the gauge needle into the beginning of the red zone on the gauge face, turns on the Check Gauges lamp, and generates a single chime tone. If the PCM message indicates that coolant temperature is critical, the instrument cluster circuitry moves the gauge needle to the stop at the end of the red zone on the gauge face and generates a single chime tone.

The engine coolant temperature sensor is installed in a threaded hole that penetrates a coolant passage of the engine. It is a thermistor-type sensor that changes its internal resistance with changes in engine coolant temperature. Refer to Group 14 - Fuel Systems for more information on the PCM and the coolant temperature sensor.

DESCRIPTION AND OPERATION (Continued)

FUEL GAUGE

The fuel gauge gives an indication of the level of fuel in the fuel tank. The instrument cluster circuitry controls the gauge pointer position. The instrument cluster circuitry calculates the proper gauge pointer position based upon a fuel level message received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the fuel gauge sending unit and internal programming to decide what fuel level message is required. The PCM then sends the proper message to the instrument cluster on the CCD data bus. If the PCM message indicates that the fuel level is below one-eighth of a full tank, the instrument cluster circuitry turns on the low fuel warning lamp and generates a single chime tone.

The fuel gauge sending unit is mounted to the electric fuel pump module inside the fuel tank. The sending unit has a float attached to the end of a swing-arm. The float moves up or down within the fuel tank as the fuel level changes. As the float moves, an electrical contact on the pivot end of the swing-arm wipes across a resistor coil, which changes the resistance of the sending unit. Refer to Group 14 - Fuel Systems for more information on the PCM and the fuel gauge sending unit.

ODOMETER/TRIP ODOMETER

The odometer and the trip odometer share the same vacuum fluorescent digital display tube in the instrument cluster circuit board. Each gives an indication of the distance the vehicle has travelled. However, by depressing the reset knob on the face of the instrument cluster, the display can be switched from odometer to trip odometer. Depressing the reset knob for longer than two seconds while in the trip odometer mode will reset the trip odometer to zero. The odometer and trip odometer display values are based on distance pulse messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the Vehicle Speed Sensor (VSS) and internal programming to decide what distance pulse signal is required. The PCM then sends the proper message to the instrument cluster circuitry on the CCD data bus. The instrument cluster stores both the odometer and trip odometer distance information and displays the proper value based upon ignition key-on and trip odometer reset knob inputs.

If the instrument cluster is not receiving distance information on the CCD data bus when the ignition switch is turned to the On position, the odometer display will remain blank. If the instrument cluster does not receive a distance message on the CCD data bus after the ignition switch has been turned to the On position, the instrument panel circuitry will insert the last normally displayed distance in the odometer display. If the instrument cluster is receiving CCD messages, but cannot display odometer values due to an internal error, the odometer will display dashes.

The VSS is a hall-effect sensor that is installed in the transfer case, and is driven by the output shaft through a speedometer gear. Incorrect tire size, incorrect axle ratio, a faulty or incorrect speedometer gear, or a faulty VSS can each result in inaccurate odometer readings. Refer to Group 14 - Fuel Systems for more information on the PCM and the VSS.

OIL PRESSURE GAUGE

The oil pressure gauge gives an indication of the engine oil pressure. The instrument cluster circuitry controls the gauge pointer position. The instrument cluster circuitry calculates the proper gauge pointer position based upon an engine oil pressure message received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the engine oil pressure sensor and internal programming to decide what engine oil pressure message is required. The PCM then sends the proper message to the instrument cluster on the CCD data bus. If the PCM message indicates that oil pressure is low, the instrument cluster circuitry moves the gauge needle to below the zero graduation on the gauge face, turns on the Check Gauges lamp, and generates a single chime tone.

The engine oil pressure sensor is installed in a threaded hole that penetrates an oil passage of the engine. The engine oil pressure sensor contains a flexible diaphragm and a variable resistor coil. The diaphragm moves in response to changes in the engine oil pressure. As the diaphragm moves, resistance in the resistor coil increases or decreases. Refer to Group 14 - Fuel Systems for more information on the PCM and the oil pressure sending unit.

SPEEDOMETER

The speedometer gives an indication of the current vehicle speed. The instrument cluster circuitry controls the gauge pointer position. The instrument cluster circuitry calculates the proper gauge pointer position based upon a vehicle speed message received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the Vehicle Speed Sensor (VSS) and internal programming to calculate what vehicle speed message is required. The PCM then sends the proper message to the instrument cluster on the CCD data bus.

DESCRIPTION AND OPERATION (Continued)

Vehicles sold in countries where it is required include a vehicle speed warning feature. The cluster circuitry is programmed to generate a warning of fifty chime tones-per-minute when a vehicle speed message of over 120 Km/h is received. This warning will continue until the cluster receives a vehicle speed message of 115 Km/h or lower.

The VSS is a hall-effect sensor that is installed in the transfer case, and is driven by the output shaft through a speedometer gear. Incorrect tire size, incorrect axle ratio, a faulty or incorrect speedometer gear, or a faulty VSS can each result in inaccurate speedometer readings. Refer to Group 14 - Fuel Systems for more information on the PCM and the VSS.

TACHOMETER

The tachometer gives an indication of the engine speed in revolutions-per-minute (rpm). The instrument cluster circuitry controls the gauge pointer position. The instrument cluster circuitry calculates the proper gauge pointer position based upon an engine speed message received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the crankshaft position sensor and internal programming to calculate what engine speed message is required. The PCM then sends the proper message to the instrument cluster on the CCD data bus.

The crankshaft position sensor is installed near the rear of the engine, where it is aimed at the trigger wheel attached to the rear flange of the crankshaft. Refer to Group 14 - Fuel Systems for more information on the PCM. For models with a gasoline engine, refer to Group 8D - Ignition Systems for more information on the crankshaft position sensor. For models with a diesel engine, refer to Group 14 - Fuel Systems for more information on the crankshaft position sensor.

VOLTMETER

The voltmeter gives an indication of the electrical system voltage. The instrument cluster circuitry controls the gauge pointer position. The instrument cluster circuitry calculates the proper gauge pointer position based upon a system voltage message received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the electrical system and internal programming to decide what system voltage message is required. The PCM then sends the proper message to the instrument cluster on the CCD data bus.

If the PCM message indicates that the charging system has failed, the instrument cluster circuitry moves the gauge needle to the 9 volt graduation on the gauge face, turns on the Check Gauges lamp, and generates a single chime tone. If the PCM message indicates that system voltage is high, the instrument cluster circuitry moves the gauge needle to the 19 volt graduation on the gauge face, turns on the Check Gauges lamp, and generates a single chime tone.

Refer to Group 14 - Fuel Systems for more information on the PCM. Refer to Group 8C - Charging Systems for more information on charging system components and diagnosis.

AIRBAG INDICATOR LAMP

The airbag indicator lamp gives an indication when the airbag system is faulty or inoperative. The lamp is turned on by the instrument cluster circuitry for about seven seconds when the ignition switch is turned to the On position as a bulb test. After the bulb test, the lamp is controlled by the instrument cluster circuitry based upon a message received from the Airbag Control Module (ACM) on the Chrysler Collision Detection (CCD) data bus.

The ACM continually monitors the airbag system circuits and sensors to decide whether the system is in good operating condition. The ACM then sends the proper message to the instrument cluster on the CCD data bus to turn the lamp on or off. If the ACM turns the lamp on after the bulb test, it indicates the ACM has detected a system malfunction and/or that the airbag system has become inoperative. Each time the instrument cluster circuitry receives a lamp-on message from the ACM, it will light the lamp for twelve seconds or the duration of the airbag system malfunction, whichever is longer.

The airbag indicator lamp also has a lamp backup feature. About twenty seconds after the ignition switch is turned to the On position, if the instrument cluster circuitry has detected an inoperative airbag warning lamp circuit during the bulb test sequence, it will flash the seat belt reminder lamp on and off for about twenty seconds. If the seat belt reminder lamp flashes longer than twenty seconds, or flashes at any time other than about twenty seconds after the initial ignition-on sequence, it indicates an airbag system fault has been detected and that the airbag indicator lamp is inoperative.

Refer to Group 8M - Passive Restraint Systems for more information on the airbag system.

ANTI-LOCK BRAKE SYSTEM LAMP

The Anti-Lock Brake System (ABS) lamp gives an indication when the ABS system is faulty or inoperative. The lamp is hard-wired in the instrument cluster, and is completely controlled by the Controller Anti-lock Brake (CAB). It receives battery voltage through the instrument cluster fused ignition switch

DESCRIPTION AND OPERATION (Continued)

output feed circuit, and is grounded by the CAB. The lamp is turned on by the CAB for about two seconds when the ignition switch is turned to the On position as a bulb test. After the bulb test, the CAB turns the lamp on or off based upon the results of the ABS system self-tests.

The CAB continually monitors the ABS circuits and sensors to decide whether the system is in good operating condition. If the CAB turns the lamp on after the bulb test, it indicates that the CAB has detected a system malfunction and/or that the ABS system has become inoperative. Refer to Group 5 - Brakes for more information.

BRAKE WARNING LAMP

The brake warning lamp gives an indication when the parking brake is applied, or when the pressures in the two halves of the split brake hydraulic system are unequal. The lamp is turned on when the ignition switch is in the Start position as a bulb test. After the bulb test, the lamp is controlled by hard-wired inputs from the parking brake switch and/or the brake warning switch.

The brake warning switch closes to ground when it senses unequal hydraulic pressures in the two halves of the split brake hydraulic system, possibly due to low brake fluid level or brake fluid leakage. The parking brake switch closes to ground when the parking brake is applied. Refer to Group 5 - Brakes for more information.

CHECK GAUGES LAMP

The check gauges lamp gives an indication when certain gauges reflect a condition requiring immediate attention. The lamp is turned on by the instrument cluster circuitry for about three seconds after the ignition switch is turned to the On position as a bulb test. After the bulb test, the lamp is controlled by the instrument cluster circuitry based upon gauge data messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses several inputs to decide what gauge data messages are required. The PCM then sends the proper message to the instrument cluster on the CCD data bus. When the instrument cluster circuitry receives a gauge data message that requires the check gauges lamp be turned on, it also generates a single chime tone.

The gauge data messages for which the instrument cluster is programmed to turn on the check gauges lamp are:

- Engine coolant temperature is high or critical
- Engine oil pressure is low
- Charging system failure
- System voltage is high.

CIGAR LIGHTER/POWER OUTLET

An accessory power outlet is standard equipment on this model. A cigar lighter that fits into the power outlet is a dealer-installed option. Power to the outlet is switched by an accessory relay, which is only energized when the ignition switch is in the Accessory or On positions.

The accessory relay is a International Standards Organization (ISO)-type relay. The relay is a electromechanical device that switches current to the cigar lighter/power outlet when the relay coil is provided a battery feed signal by the ignition switch. See the Diagnosis and Testing section of this group for more information on the relay's operation.

The cigar lighter/power outlet receptacle is located in, and serviced only as a part of, the accessory switch bezel unit. If the receptacle is faulty, the accessory switch bezel must be replaced. The accessory relay is located in a connector mounted to the 100-way connector bracket under the driver's side of the instrument panel, near the cowl side panel. The relay cannot be repaired and, if faulty, it must be replaced.

CLUSTER ILLUMINATION LAMPS

The cluster illumination lamps are hard-wired in the instrument cluster. When the park or head lamps are turned on, the cluster illumination lamps light. Illumination brightness is adjusted by rotating the headlamp switch knob (clockwise to dim, counterclockwise to brighten). The instrument cluster illumination lamps receive battery feed from the panel dimmer rheostat in the headlamp switch through a fuse in the fuseblock module.

Each of the five illumination lamps is located on the instrument cluster circuit board. Each lamp has a replaceable bulb and bulb holder. Refer to Group 8L - Lamps for more information.

FOUR-WHEEL DRIVE INDICATOR LAMPS

PART TIME

On vehicles with the Command-Trac Four-Wheel Drive system, the Part Time lamp lights when the transfer case is engaged in the 4H or 4L positions. On vehicles with the Selec-Trac Four-Wheel Drive system, the Part Time lamp lights when the transfer case is engaged in the 4 X 4 Part Time or 4 Lo positions. When the ignition switch is in the On position, battery voltage is supplied to one side of the indicator lamp bulb. A switch in the transfer case is hard-wired to the other side of the indicator lamp bulb. When the switch is closed, a path to ground is provided and the indicator lamp bulb lights.

DESCRIPTION AND OPERATION (Continued)

FULL TIME

The Full Time lamp is only operational on vehicles equipped with the Selec-Trac Four-Wheel Drive system. The Full Time lamp lights when the transfer case is engaged in the 4 X 4 Full Time position. When the ignition switch is in the On position, battery voltage is supplied to one side of the indicator lamp bulb. A switch in the transfer case is hard-wired to the other side of the indicator lamp bulb. When the switch is closed, a path to ground is provided and the indicator lamp bulb lights.

HEADLAMP HIGH BEAM INDICATOR LAMP

The headlamp high beam indicator lamp gives an indication when the headlamp high beams are turned on. The lamp is controlled by a hard-wired input from the headlamp dimmer (multi-function) switch. One side of the indicator bulb is grounded at all times. The other side of the bulb receives a battery feed through the contacts of the dimmer switch when the multi-function switch stalk is actuated to turn on the headlamp high beams. Refer to Group 8L - Lamps for more information.

LOW FUEL WARNING LAMP

The low fuel warning lamp gives an indication when the fuel level in the fuel tank has fallen below about one-eighth of a full tank, as registered on the fuel gauge. The instrument cluster circuitry lights the lamp for about three seconds when the ignition switch is turned to the On position as a bulb test. After the bulb test, the instrument cluster circuitry controls the lamp based upon a fuel level message received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the fuel gauge sending unit and internal programming to decide what fuel level message is required. The PCM then sends the proper message to the instrument cluster on the CCD data bus. If the PCM message indicates that the fuel level is below one-eighth of a full tank for more than ten seconds, the instrument cluster circuitry turns on the low fuel warning lamp and generates a single chime tone. Once the lamp is turned on, an increase in the fuel level message of at least one full needle width for more than twenty seconds is required before the cluster will turn the lamp off.

The fuel gauge sending unit is mounted to the electric fuel pump module inside the fuel tank. The sending unit has a float attached to the end of a swing-arm. The float moves up or down within the fuel tank as the fuel level changes. As the float moves, an electrical contact on the pivot end of the swing-arm wipes across a resistor coil, which changes the resistance of the sending unit. Refer to Group 14 - Fuel Systems for more information on the PCM and the fuel gauge sending unit.

MALFUNCTION INDICATOR LAMP

The Check Engine or Malfunction Indicator Lamp (MIL) gives an indication when the Powertrain Control Module (PCM) has recorded a Diagnostic Trouble Code (DTC) for an On-Board Diagnostics II (OBDII) emissions-related circuit or component malfunction. The lamp is controlled by the instrument cluster circuitry based upon messages received from the PCM on the Chrysler Collision Detection (CCD) data bus. The PCM sends a lamp-on message for about three seconds when the ignition switch is turned to the On position as a bulb test.

Following the bulb test, the PCM uses inputs from many emissions-related circuits and sensors, along with its internal programming, to decide whether a condition exists that requires the MIL lamp to be turned on. The PCM then sends the proper message to the instrument cluster on the CCD data bus to turn the lamp on or off.

The MIL lamp can also be used to display a stored DTC by flashing on and off. Refer to Group 14 - Fuel Systems for more information on the PCM or the PCM inputs. Refer to Group 25 - Emission Control Systems for more information on DTCs and their retrieval.

MASTER LIGHTING INDICATOR LAMP

In countries where it is required, a master lighting indicator lamp is available. The master lighting indicator lamp gives an indication when the exterior lamps are lighted. The lamp is hard-wired in the instrument cluster, and is completely controlled by the headlamp switch.

The lamp is grounded at all times and receives a battery feed from the headlamp switch when the head or park lamps are turned on. Refer to Group 8L - Lamps for more information.

SEAT BELT REMINDER LAMP

The seat belt reminder lamp gives a visual reminder to the vehicle occupants to fasten their seat belts. The lamp is turned on by the instrument cluster circuitry for about seven seconds when the ignition switch is turned to the On position. The instrument cluster also receives a hard-wired input from the driver's seat belt switch. If the driver's seat belt switch is closed (seat belt is not buckled), the instrument cluster will generate a chime warning for the duration of the seat belt reminder lamp illumination. The chime warning will stop when the driver's seat belt switch is open (seat belt is buckled).

The seat belt reminder lamp also serves as a backup for the airbag indicator lamp. About twenty

DESCRIPTION AND OPERATION (Continued)

seconds after the ignition switch is turned to the On position, if the instrument cluster circuitry has detected an inoperative airbag warning lamp circuit during the bulb test sequence, it will flash the seat belt reminder lamp on and off for about twenty seconds. If the seat belt reminder lamp flashes longer than twenty seconds, or flashes at any time other than about twenty seconds after the initial ignition-on sequence, it indicates an airbag system fault has been detected and that the airbag indicator lamp is inoperative.

Refer to Group 8U - Chime/Buzzer Warning Systems for more information on the seat belt switch. Refer to Group 8M - Passive Restraint Systems for more information on the airbag system.

TURN SIGNAL INDICATOR LAMPS

The left and right turn signal indicator lamps give an indication when the turn signal circuits are activated. The lamps are completely controlled by a hard-wired input to the instrument cluster from the turn signal and hazard warning (multi-function) switches.

The lamps are grounded at all times and receive battery feed through the contacts of the multi-function switch when the turn signal lever (multi-function switch stalk) or hazard warning button are actuated to the On position. The instrument cluster circuitry does not perform a bulb test of these lamps. Refer to Group 8J - Turn Signal and Hazard Warning Systems for more information.

UPSHIFT INDICATOR LAMP

Vehicles equipped with a manual transmission have an upshift indicator lamp. The upshift indicator lamp gives an indication when the driver should shift to the next highest gear for the best fuel economy. The lamp is turned on by the instrument cluster circuitry for about three seconds when the ignition switch is turned to the On position as a bulb test. After the bulb test, the lamp is controlled by the instrument cluster circuitry based upon a message received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses inputs from many sensors and its internal programming to decide whether the engine speed and load conditions are proper for a transmission upshift. The PCM then sends the proper message to the instrument cluster on the CCD data bus to turn the lamp on or off. The PCM will send a lamp-off message three to five seconds after a lamp-on message, if an upshift is not performed. The lamp will then remain off until the vehicle stops accelerating and is brought back into the range of lamp operation, or until the transmission is shifted into another gear. Refer to Group 14 - Fuel Systems for more information on the PCM and the PCM inputs.

DIAGNOSIS AND TESTING

INSTRUMENT CLUSTER

If all of the gauges and/or indicator lamps are inoperative, review the following Preliminary Diagnosis. If an individual gauge or CCD data bus message-controlled indicator lamp is inoperative, go directly to the Actuator Test. If an individual hard-wired indicator lamp is inoperative, go directly to the diagnosis for that lamp. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

PRELIMINARY DIAGNOSIS

(1) If the indicator lamps operate, but none of the gauges operate, go to Step 2. If all of the gauges and the data bus message-controlled indicator lamps are inoperative, go to Step 5.

(2) Check the Ignition-Off Draw (IOD) fuse in the Power Distribution Center (PDC). If OK, go to Step 3. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(3) Check for battery voltage at the IOD fuse in the PDC. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Remove the instrument cluster as described in this group. Check for battery voltage at the **fused B(+)** circuit cavity of the left (black) cluster connector. If OK, go to the Actuator Test. If not OK, repair the open circuit to the IOD fuse as required.

(5) Check the fuse in the fuseblock module. If OK, go to Step 6. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(6) Turn the ignition switch to the On position and check for battery voltage at the fuse in the fuseblock module. If OK, go to Step 7. If not OK, repair the open circuit to the ignition switch as required.

(7) With the ignition switch still in the On position, set the parking brake. The brake warning lamp should light. If OK, go to Step 8. If not OK, go to Step 9.

DIAGNOSIS AND TESTING (Continued)

(8) Turn on the park lamps and adjust the panel lamps dimmer rheostat to the full bright position. The cluster illumination lamps should light. If OK, go to the Actuator Test. If not OK, go to Step 10.

(9) Remove the instrument cluster as described in this group. Turn the ignition switch to the On position and check for battery voltage at the **fused ignition switch output (run/start)** circuit cavity of the left (black) cluster connector. If OK, go to the Actuator Test. If not OK, repair the open circuit to the fuseblock module as required.

(10) Remove the instrument cluster as described in this group. Check for continuity between the **ground** circuit cavity of the left (black) cluster connector and a good ground. There should be continuity. If OK, go to the Actuator Test. If not OK, repair the open circuit to ground as required.

ACTUATOR TEST

The instrument panel actuator test will put the cluster into its self-diagnostic mode. In this mode the cluster will position each of the gauge needles at different specified points, and turn all of the CCD data bus message-controlled lamps on and off at the specified time intervals (Fig. 1).

Successful completion of the actuator test proves that the cluster circuitry, gauges, and lamps are capable of operating as designed. However, there may still be a problem with the CCD data bus, the Powertrain Control Module (PCM), or a PCM input. Refer to the proper Powertrain Diagnostic Procedures manual for testing of these components.

If an individual gauge does not respond properly or at all during the Actuator Test, the instrument cluster should be removed. However, check the gauge mounting screws on the printed circuit for proper tightness before considering instrument cluster replacement. If the mounting screws check OK, replace the faulty cluster.

If an individual lamp does not illuminate during the Actuator Test, the instrument cluster should be removed. However, check that the lamp bulb is not faulty and that the bulb holder is properly installed on the printed circuit before considering instrument cluster replacement. If the bulb and bulb holder check OK, replace the faulty cluster.

(1) Begin the test with the ignition switch in the Off position.

(2) Depress the trip odometer reset button.

(3) While holding the trip odometer reset button depressed, turn the ignition switch to the On position, but do not start the engine.

(4) Release the trip odometer reset button.

(5) Compare the operation of the suspect gauge(s) and/or lamp(s) with the chart (Fig. 1).

(6) The cluster will exit the self-diagnostic mode at the completion of the test, or if the ignition switch is turned to the Off position.

(7) Go to Step 1 to repeat the test, if required.

COOLANT TEMPERATURE GAUGE

If the problem being diagnosed is related to gauge accuracy, be certain to confirm that the problem is with the gauge and not with cooling system performance. The actual engine coolant temperature should be checked with a test gauge or thermometer and compared to the gauge readings before you proceed with gauge diagnosis. Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Diagnosis of the coolant temperature sensor and circuit, the CCD data bus, and/or the Powertrain Control Module should be performed with the DRB scan tool as described in the proper Powertrain Diagnostic Procedures manual. For diagnosis of the coolant temperature gauge and the gauge cluster circuitry, see Instrument Cluster in this group.

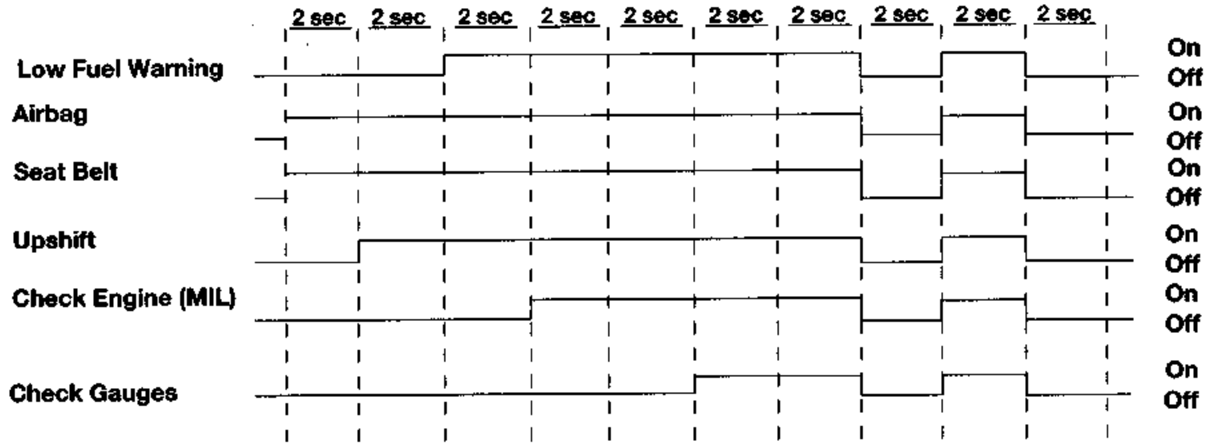
FUEL GAUGE

If the problem being diagnosed is related to gauge accuracy, be certain to confirm that the problem is with the gauge or sending unit and not with the fuel tank. Inspect the fuel tank for signs of damage or distortion that could affect the sending unit performance before you proceed with gauge diagnosis. Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Diagnosis of the fuel gauge sending unit and circuit, the CCD data bus, and/or the Powertrain Control Module should be performed with the DRB scan tool as described in the proper Powertrain Diagnostic

DIAGNOSIS AND TESTING (Continued)



	2 sec	2 sec	2 sec	2 sec	2 sec	2 sec	2 sec	2 sec	2 sec	2 sec
Speedometer (miles per hour UK only)	0 MPH	20 MPH	55 MPH	80 MPH	110 MPH	80 MPH	55 MPH	20 MPH	0 MPH	0 MPH
Speedometer (miles per hour except UK)	0 MPH	20 MPH	55 MPH	80 MPH	100 MPH	80 MPH	55 MPH	20 MPH	0 MPH	0 MPH
Speedometer (kilometer)	0 KM/H	40 KM/H	80 KM/H	120 KM/H	180 KM/H	120 KM/H	80 KM/H	40 KM/H	0 KM/H	0 KM/H
Tachometer (diesel engines)	0 RPM	2000 RPM	4000 RPM	6000 RPM	4000 RPM	2000 RPM	0 RPM	0 RPM	0 RPM	0 RPM
Tachometer (gasoline engines)	0 RPM	2000 RPM	5000 RPM	6000 RPM	5000 RPM	2000 RPM	0 RPM	0 RPM	0 RPM	0 RPM
Fuel	E	E	1/2	1/2	F	F	1/2	1/2	E	E
Temperature	40°C (100°F)	40°C (100°F)	100°C (210°F)	100°C (210°F)	Full Scale	Full Scale	100°C (210°F)	100°C (210°F)	40°C (100°F)	40°C (100°F)
Oil	0kg/cm2 (0 PSI)	0kg/cm2 (0 PSI)	4kg/cm2 (40 PSI)	4kg/cm2 (40 PSI)	8.3kg/cm2 (80 PSI)	8.3kg/cm2 (80 PSI)	4kg/cm2 (40 PSI)	4kg/cm2 (40 PSI)	0kg/cm2 (0 PSI)	0kg/cm2 (0 PSI)
Volt	9 V	9 V	14 V	14 V	19 V	19 V	14 V	14 V	9 V	9 V
Odometer	000000	111111	222222	333333	444444	555555	666666	777777	888888	999999

Start Diagnostics — Complete Diagnostics

NOTE: 1.5 Seconds after completing test, all pointers should return to pointer stop and odometer should be turned off.

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Fig. 1 Instrument Cluster Actuator Test

DIAGNOSIS AND TESTING (Continued)

Procedures manual. For diagnosis of the fuel gauge and the gauge cluster circuitry, see Instrument Cluster in this group.

ODOMETER - TRIP ODOMETER

If the problem being diagnosed is related to gauge accuracy, be certain to confirm that the problem is with the gauge and not with an incorrect speedometer pinion, axle ratio, or tire size. Refer to Group 21 - Transmission for more information. Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Diagnosis of the vehicle speed sensor and circuit, the CCD data bus, and/or the Powertrain Control Module should be performed with the DRB scan tool as described in the proper Powertrain Diagnostic Procedures manual. For diagnosis of the odometer - trip odometer and the gauge cluster circuitry, see Instrument Cluster in this group.

OIL PRESSURE GAUGE

If the problem being diagnosed is related to gauge accuracy, be certain to confirm that the problem is with the gauge and not with the engine oiling system performance. The actual engine oil pressure should be checked with a test gauge and compared to the instrument cluster gauge readings before you proceed with gauge diagnosis. Refer to Group 9 - Engines for more information. Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Diagnosis of the oil pressure sensor and circuit, the CCD data bus, and/or the Powertrain Control Module should be performed with the DRB scan tool as described in the proper Powertrain Diagnostic Procedures manual. For diagnosis of the oil pressure gauge and the gauge cluster circuitry, see Instrument Cluster in this group.

SPEEDOMETER

If the problem being diagnosed is related to gauge accuracy, be certain to confirm that the problem is with the gauge and not with an incorrect speedometer pinion, axle ratio, or tire size. Refer to Group 21 - Transmission for more information. Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Diagnosis of the vehicle speed sensor and circuit, the CCD data bus, and/or the Powertrain Control Module should be performed with the DRB scan tool as described in the proper Powertrain Diagnostic Procedures manual. For diagnosis of the speedometer and the gauge cluster circuitry, see Instrument Cluster in this group.

TACHOMETER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams. Diagnosis of the crankshaft position sensor and circuit, the CCD data bus, and/or the Powertrain Control Module should be performed with the DRB scan tool as described in the proper Powertrain Diagnostic Procedures manual. For diagnosis of the tachometer and the gauge cluster circuitry, see Instrument Cluster in this group.

VOLTMETER

If the problem being diagnosed is related to gauge accuracy, be certain to confirm proper charging system operation before considering gauge replacement. Refer to Group 8C - Charging System for more infor-

DIAGNOSIS AND TESTING (Continued)

mation. Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Diagnosis of the system voltage input circuit, the CCD data bus, and/or the Powertrain Control Module should be performed with the DRB scan tool as described in the proper Powertrain Diagnostic Procedures manual. For diagnosis of the voltmeter and the gauge cluster circuitry, see Instrument Cluster in this group.

AIRBAG INDICATOR LAMP

The diagnosis found here addresses an inoperative lamp condition. If the airbag indicator lamp stays on with the ignition switch in the On position, or comes on and stays on while driving, refer to Group 8M - Passive Restraint Systems for diagnosis. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster, and 8W-43 - Airbag System in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The airbag indicator lamp has a lamp backup feature. Twenty seconds after the ignition switch is turned to the On position, if the instrument cluster circuitry has detected an inoperative airbag warning lamp circuit it will flash the seat belt reminder lamp on and off for twenty seconds. Once the instrument cluster circuitry has detected an inoperative airbag warning lamp circuit, if a lamp-on message is received from the airbag control module on the CCD data bus, the seat belt reminder lamp will flash for twelve seconds or the duration of the airbag system malfunction, whichever is longer.

If the airbag indicator lamp fails to light when the ignition switch is turned to the On position, and the seat belt reminder lamp flashes following its normal display function (about seven seconds after the ignition switch is turned to the On position), replace the airbag indicator lamp bulb with a known good unit. If the airbag indicator lamp still fails to operate, diagnosis of the airbag system should be performed with a DRB scan tool as described in the proper Body Diagnostic Procedures manual. Diagnosis of the CCD data bus should be performed with a DRB scan tool as described in the proper Powertrain Diagnostic Procedures manual. For diagnosis of the airbag lamp and the gauge cluster circuitry, see Instrument Cluster in this group.

ANTI-LOCK BRAKE SYSTEM LAMP

The diagnosis found here addresses an inoperative Anti-lock Brake System (ABS) lamp condition. If the ABS lamp stays on with the ignition switch in the On position, or comes on and stays on while driving, refer to Group 5 - Brakes for diagnosis. If no ABS problem is found, the following procedure will help locate a short or open in the ABS lamp circuit. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster, and 8W-35 - All-Wheel Anti-Lock Brakes in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the fuseblock module. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) With the ignition switch in the On position, check for battery voltage at the fuse in the fuseblock module. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Disconnect and isolate the battery negative cable. Remove the instrument cluster bezel and the cluster assembly.

(4) Connect the battery negative cable. Check for battery voltage between the **fused ignition switch output (run/start)** circuit and the **ABS warning lamp driver** circuit cavities of the left (black) cluster connector within five seconds of turning the ignition switch to the On position. If OK, replace the faulty bulb. If not OK, go to Step 5.

(5) Disconnect and isolate the battery negative cable. Disconnect the Controller Anti-lock Brake (CAB) connector. Check for continuity between the **ABS warning lamp driver** circuit cavity of the left (black) cluster connector and a good ground. There

DIAGNOSIS AND TESTING (Continued)

should be no continuity. If OK, go to Step 6. If not OK, repair the short circuit as required.

(6) Check for continuity between the **ABS warning lamp driver** circuit cavities of the cluster connector and the CAB connector. There should be continuity. If OK, refer to Group 5 - Brakes for diagnosis of the CAB. If not OK, repair the open circuit as required.

BRAKE WARNING LAMP

The diagnosis found here addresses an inoperative brake warning lamp condition. If the brake warning lamp stays on with the ignition switch in the On position and the parking brake released, or comes on while driving, refer to Group 5 - Brakes for diagnosis. If no service brake or parking brake problem is found, the following procedure will help locate a short or open circuit, or a faulty switch. Refer to 8W-40 - Instrument Cluster, and 8W-35 - All-Wheel Anti-Lock Brakes in Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Unplug the connector at the park brake switch. With the park brake released, check for continuity between the park brake switch terminal and a good ground. There should be no continuity. If OK, go to Step 2. If not OK, adjust or replace the faulty park brake switch.

(2) Unplug the connector at the brake warning switch. Check for continuity between the two terminals of the brake warning switch. There should be continuity. If OK, go to Step 3. If not OK, replace the faulty brake warning switch.

(3) Check for continuity between each of the two brake warning switch terminals and a good ground. In each case, there should be no continuity. If OK, go to Step 4. If not OK, replace the faulty brake warning switch.

(4) With the ignition switch in the Off position and both the park brake switch and the brake warning switch connectors unplugged, check for continuity between the park brake switch connector cavity and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the short circuit as required.

(5) With the ignition switch held in the Start position and both the park brake switch and the brake warning switch connectors unplugged, check for continuity between the park brake switch connector cavity and a good ground. There should be continuity. If OK, go to Step 6. If not OK, refer to Group 8D - Ignition Systems for diagnosis of the ignition switch.

(6) Remove the instrument cluster as described in this group. With the brake warning switch connector unplugged, check for continuity between the **red brake warning lamp driver** circuit cavity of the left (black) cluster connector and a good ground. There should be no continuity. If OK, go to Step 7. If not OK, repair the short circuit as required.

(7) With the brake warning switch connector unplugged, check for continuity between the **red brake warning lamp driver (G99)** circuit cavities of the left (black) cluster connector and the brake warning switch connector. There should be continuity. If OK, replace the faulty brake warning lamp bulb. If not OK, repair the open circuit as required.

CHECK GAUGES LAMP

The diagnosis found here addresses an inoperative lamp condition. If the check gauges lamp stays on with the ignition switch in the On position, or comes on while driving with no unusual gauge readings evident, refer to the Instrument Cluster diagnosis in this group. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the check gauges lamp fails to light during the bulb test (about three seconds after the ignition switch is turned to the On position), replace the check gauges lamp bulb with a known good unit. If the check gauges lamp still fails to operate, diagnosis of the Powertrain Control Module and the CCD data bus should be performed with a DRB scan tool as described in the proper Powertrain Diagnostic Procedures manual. For diagnosis of the check gauges lamp and the gauge cluster circuitry, see Instrument Cluster in this group.

DIAGNOSIS AND TESTING (Continued)

CIGAR LIGHTER/POWER OUTLET

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

To test the cigar lighter/power outlet receptacle, first check for continuity to ground at the **ground** circuit cavity of the cigar lighter/power outlet connector. There should be continuity. If OK, check the operation of the accessory relay and relay circuits. If the accessory relay and relay circuits check OK, replace the accessory switch bezel unit, which includes the cigar lighter/power outlet receptacle.

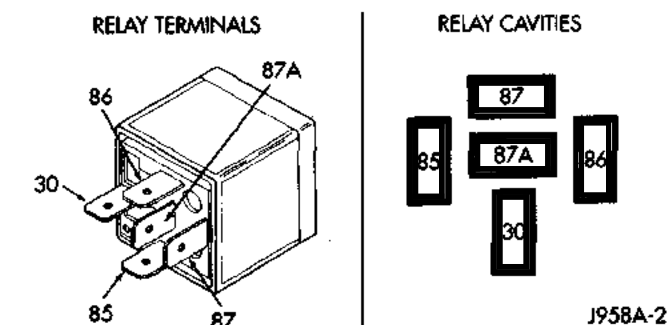
ACCESSORY RELAY TEST

The accessory relay is located in a connector mounted to the 100-way connector bracket under the driver side of the instrument panel, near the cowl side panel. Remove the relay from its connector to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75±5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see the Accessory Relay Circuit Test in this group. If not OK, replace the faulty relay.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Accessory Relay

ACCESSORY RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair the **fused B(+)** circuit to the fuse in the Power Distribution Center as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the cigar lighter/power outlet when the relay is energized by the ignition switch. There should be continuity between the cavity for relay terminal 87 and the **accessory relay output** circuit cavity of the cigar lighter/power outlet connector at all times. If OK, go to Step 4. If not OK, repair the open circuit to the cigar lighter/power outlet connector as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. The connector cavity for this terminal should have continuity to ground at all times. If OK, go to Step 5. If not OK, repair the open circuit to ground as required.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. It receives battery feed to energize the relay when the ignition switch is in the Accessory or On positions. There should be continuity between the cavity for relay terminal 85 and the **ignition switch output (acc/run)** cavity of the ignition switch connector at all times. If OK, refer to Group 8D - Ignition Systems for diagnosis of the ignition switch. If not OK, repair the open circuit as required.

CLUSTER ILLUMINATION LAMPS

For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the fuseblock module. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the park lamps on with the headlamp switch. Rotate the headlamp switch knob counterclockwise to just before the interior lamps detent. Check for battery voltage at the fuse in the fuseblock

DIAGNOSIS AND TESTING (Continued)

module. Rotate the headlamp switch knob clockwise while observing the test voltmeter. The reading should go from battery voltage to zero volts. If OK, go to Step 3. If not OK, repair the open circuit to the headlamp switch or refer to Group 8L - Lamps to diagnose the headlamp switch.

(3) Disconnect and isolate the battery negative cable. Remove the instrument cluster bezel and the cluster assembly. Turn the park lamps off. Remove the fuse from the fuseblock module. Probe the **fused panel lamp dimmer switch signal** circuit cavity of the left (black) cluster connector. Check for continuity to a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the short circuit as required.

(4) Install the fuse in the fuseblock module. Connect the battery negative cable. Turn the park lamps on with the headlamp switch. Rotate the headlamp switch knob counterclockwise to just before the interior lamps detent. Check for battery voltage at the **fused panel lamp dimmer switch signal** circuit cavity of the left (black) cluster connector. If OK, replace the faulty bulb(s). If not OK, repair the open circuit as required.

FOUR-WHEEL DRIVE INDICATOR LAMPS

The diagnosis found here addresses an inoperative four-wheel drive indicator lamp condition. If the problem being diagnosed is related to lamp accuracy, be certain to confirm that the problem is with the lamp or switch and not with a damaged or inoperative transmission or transfer case. Refer to Group 21 - Transmission for more information. If no transmission or transfer case problem is found, the following procedure will help locate a short or open in the indicator lamp circuit. For circuit diagrams and descriptions, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

PART TIME

(1) Unplug the four-wheel drive switch connector at the transfer case and check for continuity between the **ground** circuit cavity of the switch connector and a good ground. There should be continuity. If OK, go to Step 2. If not OK, repair the open circuit to ground as required.

(2) Turn the ignition switch to the On position. Install a jumper wire between the **part time four wheel drive indicator lamp driver** circuit cavity of the transfer case switch connector and a good ground. The lamp should light. If OK, replace the faulty switch. If not OK, go to Step 3.

(3) Remove the instrument cluster bezel and the instrument cluster. With the four-wheel drive switch connector still unplugged, check for continuity between the **part time four wheel drive indicator lamp driver** circuit cavity of the right (gray) cluster connector and a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the short circuit as required.

(4) Check for continuity between the **part time four wheel drive indicator lamp driver** circuit cavities of the right (gray) cluster connector and the four-wheel drive switch connector. There should be continuity. If OK, replace the faulty bulb. If not OK, repair the open circuit to the four-wheel drive switch as required.

FULL TIME

(1) Unplug the four-wheel drive switch connector at the transfer case and check for continuity between the **ground** circuit cavity of the switch connector and a good ground. There should be continuity. If OK, go to Step 2. If not OK, repair the open circuit to ground as required.

(2) Turn the ignition switch to the On position. Install a jumper wire between the **full time four wheel drive indicator lamp driver** circuit cavity of the transfer case switch connector and a good ground. The lamp should light. If OK, replace the faulty switch. If not OK, go to Step 3.

(3) Remove the instrument cluster bezel and the instrument cluster. With the four-wheel drive switch connector still unplugged, check for continuity between the **full time four wheel drive indicator lamp driver** circuit cavity of the right (gray) cluster connector and a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the short circuit as required.

(4) Check for continuity between the **full time four wheel drive indicator lamp driver** circuit cavities of the right (gray) cluster connector and the four-wheel drive switch connector. There should be continuity. If OK, replace the faulty bulb. If not OK, repair the open circuit to the four-wheel drive switch as required.

HEADLAMP HIGH BEAM INDICATOR LAMP

The diagnosis found here addresses an inoperative headlamp high beam indicator lamp condition. If the problem being diagnosed is related to inoperative headlamp high beams, refer to Group 8L - Lamps for diagnosis of the headlamp system. If no headlamp

DIAGNOSIS AND TESTING (Continued)

system problems are found, the following procedure will help locate an open in the high beam indicator lamp circuit. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster and 8W-50 - Front Lighting in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster bezel and the instrument cluster.

(2) Connect the battery negative cable. Turn the headlamps on and select the high beams with the multi-function switch stalk. Check for battery voltage at the **high beam indicator driver** circuit cavity of the left (black) cluster connector. If OK, replace the faulty bulb. If not OK, repair the open circuit to the headlamp dimmer (multi-function) switch as required.

LOW FUEL WARNING LAMP

The diagnosis found here addresses an inoperative low fuel warning lamp condition. If the problem being diagnosed is related to lamp accuracy, be certain to confirm the problem is the with the low fuel warning lamp and not with the fuel gauge circuit. See the diagnosis for the Fuel Gauge in this group. If no fuel gauge problem is found, refer to the Instrument Cluster diagnosis in this group. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the low fuel warning lamp fails to light during the bulb test (about three seconds after the ignition switch is turned to the On position), replace the low fuel warning lamp bulb with a known good unit. If the indicator lamp still fails to operate, diagnosis of the fuel gauge sending unit and circuit, the Powertrain Control Module, and the CCD data bus should be performed with a DRB scan tool as described in the proper Powertrain Diagnostic Procedures manual. For diagnosis of the low fuel warning lamp and the gauge cluster circuitry, see Instrument Cluster in this group.

MALFUNCTION INDICATOR LAMP

The diagnosis found here addresses an inoperative malfunction indicator lamp condition. If the lamp comes on and stays on with the engine running, refer to Group 14 - Fuel Systems for diagnosis. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the malfunction indicator lamp fails to light during the bulb test (about three seconds after the ignition switch is turned to the On position), replace the malfunction indicator lamp bulb with a known good unit. If the indicator lamp still fails to operate, diagnosis of the Powertrain Control Module and the CCD data bus should be performed with a DRB scan tool as described in the proper Powertrain Diagnostic Procedures manual. For diagnosis of the malfunction indicator lamp and the gauge cluster circuitry, see Instrument Cluster in this group.

MASTER LIGHTING INDICATOR LAMP

The diagnosis found here addresses an inoperative master lighting indicator lamp condition. If the problem being diagnosed is related to inoperative exterior lamps, refer to Group 8L - Lamps for diagnosis of the lighting system. If no lighting system problems are found, the following procedure will help locate an open in the master lighting indicator lamp circuit. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster and 8W-50 - Front Lighting in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

DIAGNOSIS AND TESTING (Continued)

(1) Disconnect and isolate the battery negative cable. Remove the cluster bezel and the cluster assembly as described in this group.

(2) Connect the battery negative cable and turn the park lamps on with the headlamp switch. Check for battery voltage at the **park lamp switch output** circuit cavity of the left (black) cluster connector. If OK, replace the faulty bulb. If not OK, go to Step 3.

(3) Disconnect and isolate the battery negative cable. Unplug the headlamp switch connector. Check for continuity between the **park lamp switch output** circuit cavities of the left (black) cluster connector and the headlamp switch connector. If OK, refer to Group 8L - Lamps for diagnosis of the headlamp switch. If not OK, repair the open circuit as required.

SEAT BELT REMINDER LAMP

The diagnosis found here addresses an inoperative seat belt reminder lamp condition. If the lamp comes on and flashes following its display function (for about seven seconds after the ignition switch is turned to the On position), refer to the diagnosis for the airbag indicator lamp in this group. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the seat belt reminder lamp fails to light during its display function, replace the seat belt reminder lamp bulb with a known good unit. If the reminder lamp still fails to operate, see Instrument Cluster in this group for diagnosis of the seat belt reminder lamp and gauge cluster circuitry.

TURN SIGNAL INDICATOR LAMPS

The diagnosis found here addresses an inoperative turn signal indicator lamp condition. For any other turn signal problem, refer to Group 8J - Turn Signal and Hazard Warning Systems for diagnosis. If no turn signal or hazard warning system problem is found, the following procedure will help locate a short or open in the indicator lamp circuit. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster and 8W-50 - Front Lighting in Group 8W - Wiring Diagrams.

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(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster bezel and the cluster assembly as described in this group.

(2) Connect the battery negative cable. Activate the hazard warning system by moving the hazard warning switch button to the On position. Check for battery voltage at the inoperative **(right or left) turn signal** circuit cavity of the cluster connector. There should be a switching (on and off) battery voltage signal. If OK, replace the faulty (right or left) indicator bulb. If not OK, repair the open circuit to the turn signal/hazard warning (multi-function) switch as required.

UPSHIFT INDICATOR LAMP

The diagnosis found here addresses an inoperative upshift indicator lamp condition. If lamp accuracy is suspect, diagnosis should be performed with a DRB scan tool as described in the proper Powertrain Diagnostic Procedures manual. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

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If the upshift indicator lamp fails to light during the bulb test (about three seconds after the ignition switch is turned to the On position), replace the upshift indicator lamp bulb with a known good unit. If the indicator lamp still fails to operate, diagnosis of the Powertrain Control Module and the CCD data bus should be performed with a DRB scan tool as described in the proper Powertrain Diagnostic Procedures manual. For diagnosis of the upshift indicator lamp and the gauge cluster circuitry, see Instrument Cluster in this group.

REMOVAL AND INSTALLATION

STEERING COLUMN COVER

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(1) Disconnect and isolate the battery negative cable.

(2) If the vehicle is equipped with a tilt steering column, move the column to the fully raised position.

(3) Remove the two screws securing the steering column cover to the instrument panel (Fig. 2).

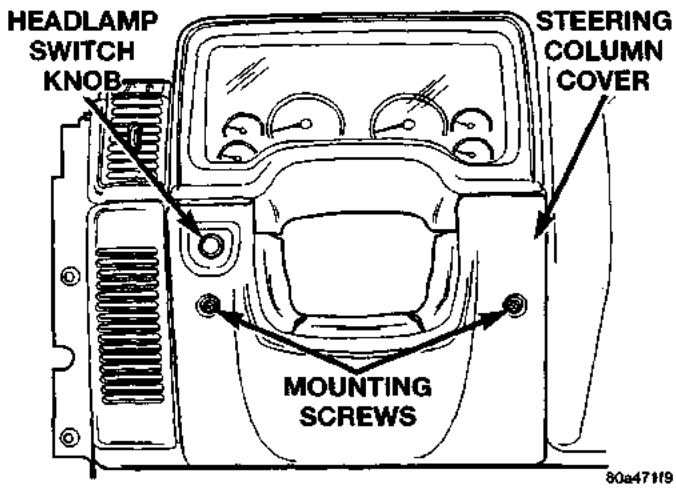

Fig. 2 Steering Column Cover Remove/Install

(4) Pull the upper edge of the steering column cover away from the instrument panel and past the headlamp switch knob and the ignition switch lock cylinder.

(5) Lower the steering column cover downwards, then lift the hook formations on the lower edge of the cover off of the pivots on the lower edge of the instrument panel.

(6) After removing the steering column cover from the instrument panel, remove the headlamp switch knob and shaft from the headlamp switch as described in this group.

NOTE: The headlamp switch knob and shaft must be removed from the headlamp switch after the steering column cover is removed, and reinstalled after the steering column cover is installed.

(7) Reverse the removal procedures to install. Be certain that the hook formations on the lower edge of the cover are fully engaged on the instrument panel pivots before rotating the top of the cover up into place.

KNEE BLOCKER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column cover as described in this group.

NOTE: The headlamp switch knob and shaft must be removed from the headlamp switch after the steering column cover is removed, and reinstalled after the steering column cover is installed.

(3) Remove the four screws securing the knee blocker to the instrument panel (Fig. 3).

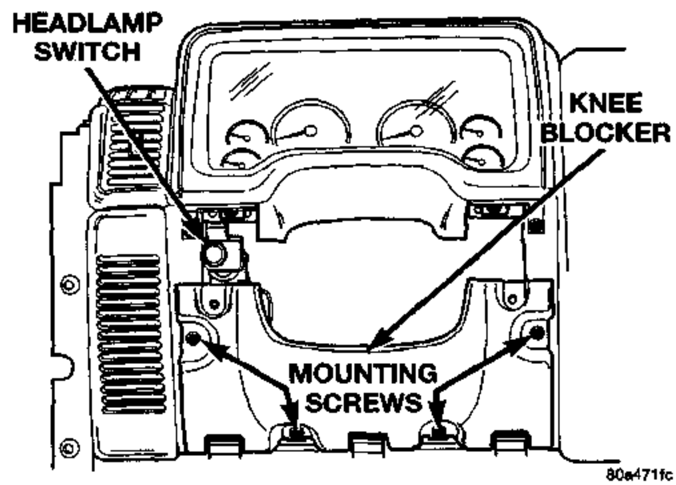

Fig. 3 Knee Blocker Remove/Install

(4) Remove the knee blocker from the instrument panel.

(5) Reverse the removal procedures to install.

REMOVAL AND INSTALLATION (Continued)

HEADLAMP SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) Remove the steering column cover and knee blocker as described in this group.

NOTE: The headlamp switch knob and shaft must be removed from the headlamp switch after the steering column cover is removed, and reinstalled after the steering column cover is installed.

(3) Place the headlamp switch control knob in the On position.
(4) Depress the headlamp switch knob and shaft release button on the top of the switch and pull the switch knob and shaft out of the switch (Fig. 4).

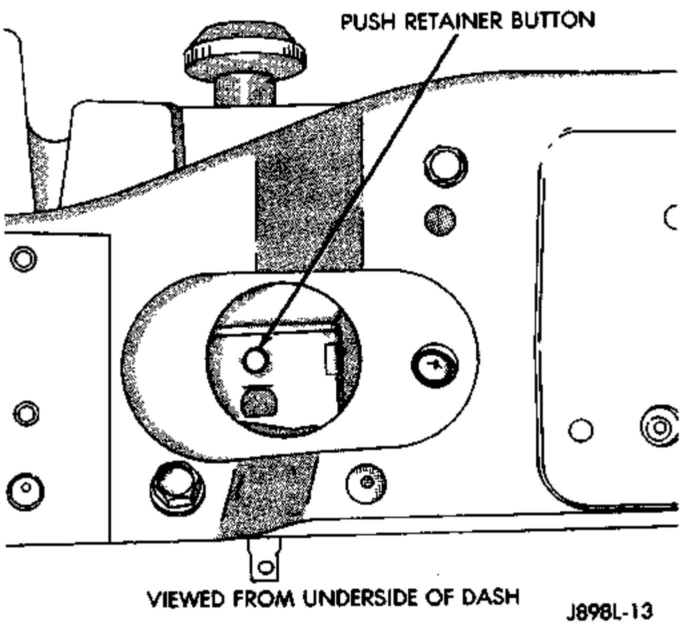

Fig. 4 Headlamp Switch Knob and Shaft Remove/ Install - Typical

(5) Remove the headlamp switch spanner nut from the front of the instrument panel switch mounting bracket.
(6) Unplug the two wire harness connectors from the headlamp switch.
(7) Remove the headlamp switch from the instrument panel.
(8) Reverse the removal procedures to install.

INSTRUMENT PANEL TOP COVER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) Using a trim stick or another suitable wide-bladed flat tool, pry the instrument panel top cover away from the instrument panel to release the five snap clip retainers.
(3) Lift the top cover off of the instrument panel and remove it from the vehicle.
(4) Reverse the removal procedures to install.

CLUSTER BEZEL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) Remove the steering column cover and instrument panel top cover as described in this group.
(3) Remove the two lower screws securing the cluster bezel to the instrument panel (Fig. 5).

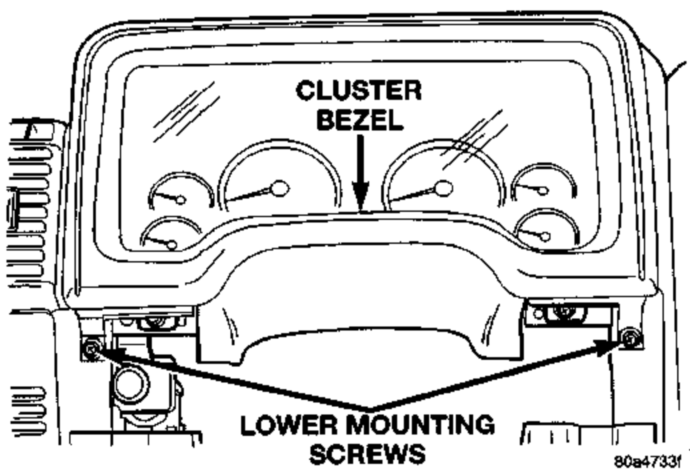

Fig. 5 Cluster Bezel Lower Screws Remove/Install

REMOVAL AND INSTALLATION (Continued)

(4) Remove the three upper screws securing the cluster bezel to the instrument panel (Fig. 6).

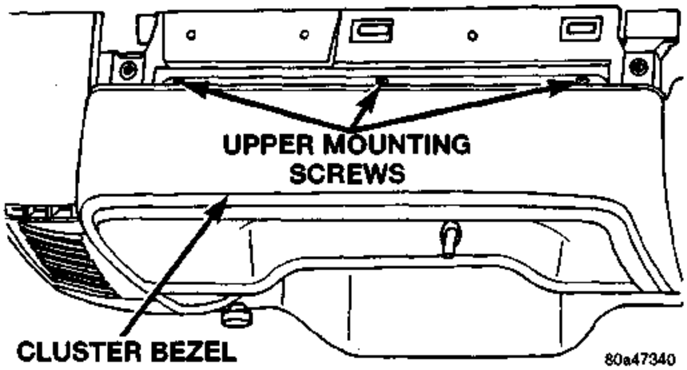

Fig. 6 Cluster Bezel Upper Screws Remove/Install

(5) Pull the cluster bezel rearward and remove it from the vehicle.
(6) Reverse the removal procedures to install.

INSTRUMENT CLUSTER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the cluster bezel as described in this group.
(2) Remove the four screws securing the cluster to the instrument panel.
(3) Pull the cluster rearward and remove it from the vehicle.

NOTE: The instrument cluster has two self-docking connectors that will be automatically aligned with and connected to the instrument panel wiring harness when the cluster is installed in the instrument panel.

(4) Reverse the removal procedures to install.

CLUSTER LENS

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the cluster bezel as described in this group.
(2) Remove the instrument cluster as described in this group.
(3) Work around the perimeter of the cluster depressing the snap clips securing the cluster lens to the cluster housing and gently pull the lens away from the cluster.
(4) Remove the trip odometer reset knob boot by pulling it out of the lens (Fig. 7).
(5) Reverse the removal procedures to install.

CLUSTER BULBS

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the instrument cluster as described in this group.
(2) Remove the bulb and bulb holder from the rear of the cluster circuit and gauge housing by turning the holder counterclockwise (Fig. 8).
(3) Unplug the bulb from the socket.
(4) Reverse the removal procedures to install.

INSTRUMENT PANEL CENTER BEZEL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) Remove the instrument panel top cover as described in this group.
(3) Remove the two screws that were hidden by the instrument panel top cover, securing the top of the instrument panel center bezel to the instrument panel.
(4) Remove the ash receiver from the ash receiver housing (Fig. 9).

REMOVAL AND INSTALLATION (Continued)

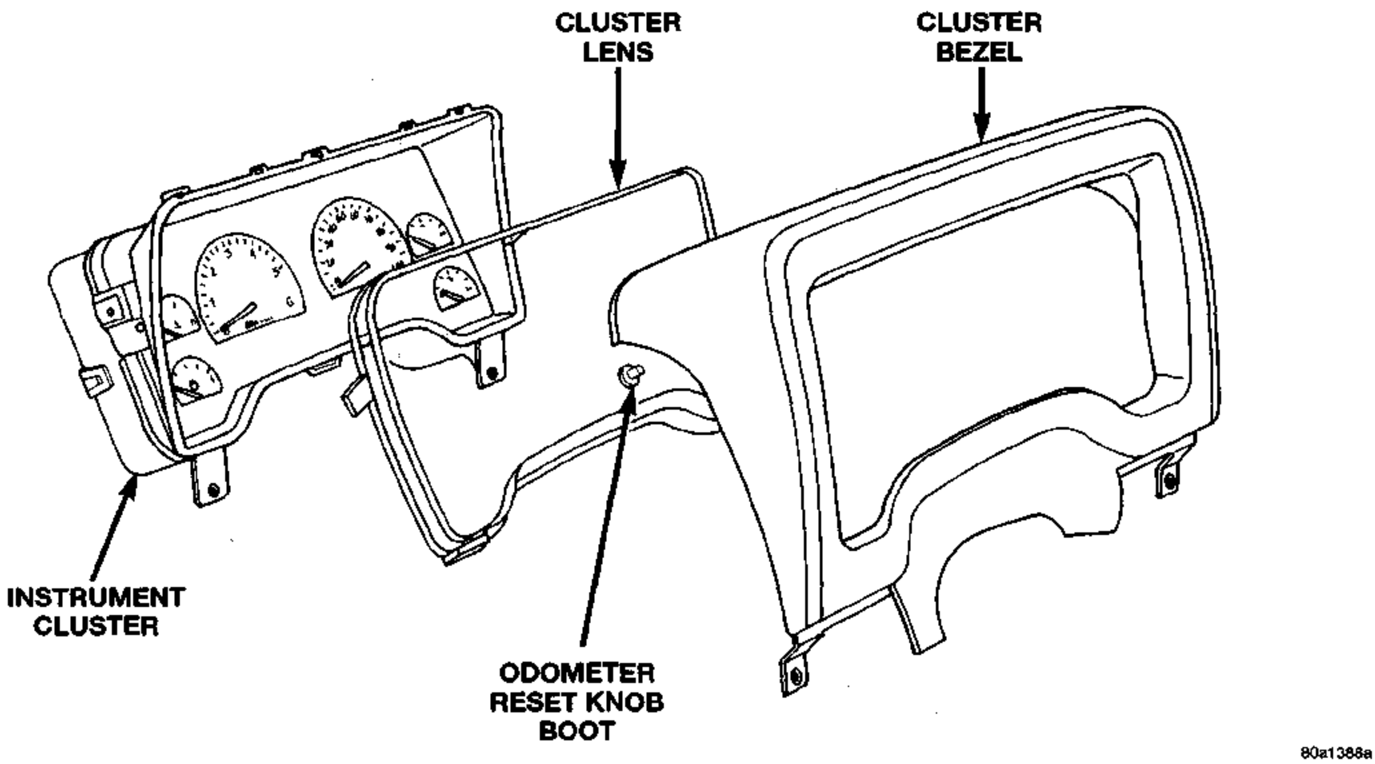

Fig. 7 Instrument Cluster Components

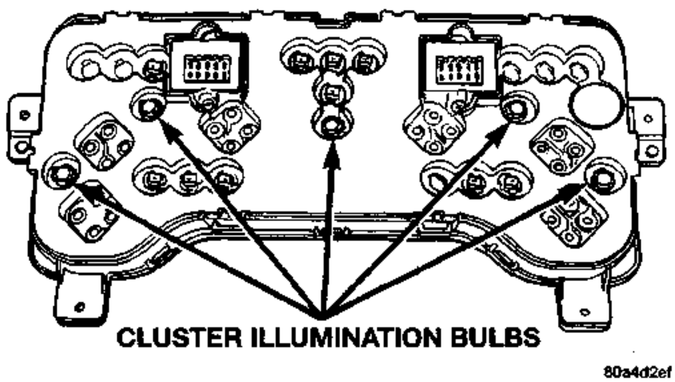

Fig. 8 Cluster Bulb Locations

(5) Remove the one screw located in the back of the ash receiver housing securing the center bezel to the instrument panel.

(6) Pry the lower edge of the center bezel off of the instrument panel using a trim stick. Then lift the lower edge upwards to release the four snap clip retainers from the instrument panel.

(7) Reverse the removal procedures to install.

ACCESSORY SWITCH BEZEL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

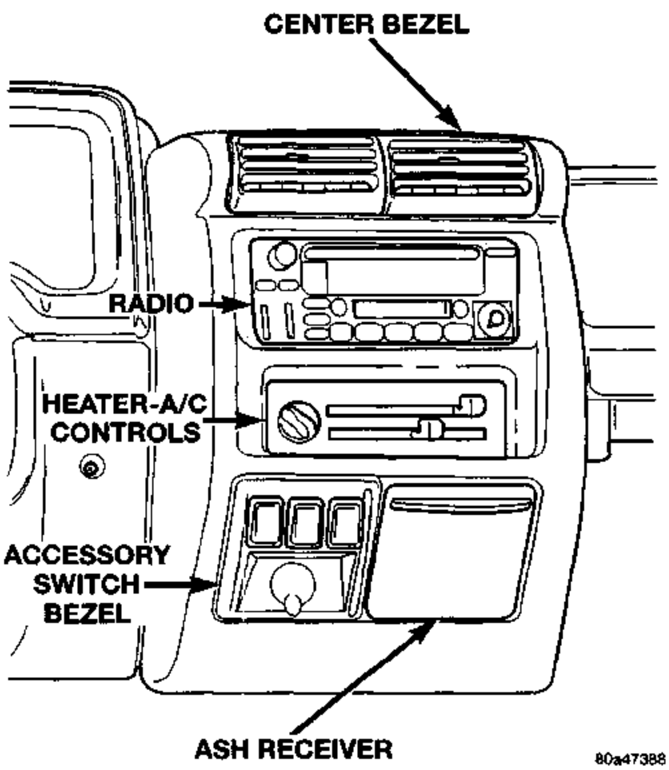

Fig. 9 Center Bezel Remove/Install

REMOVAL AND INSTALLATION (Continued)

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel center bezel as described in this group.

(3) Remove the four screws securing the accessory switch bezel to the instrument panel (Fig. 10).

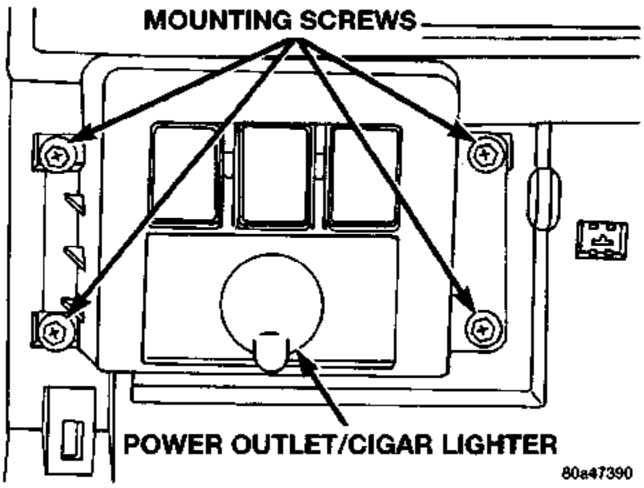

Fig. 10 Accessory Switch Bezel Remove/Install

(4) Pull the accessory switch bezel out from the instrument panel far enough to unplug the wiring connectors.

(5) Remove the accessory switch bezel from the instrument panel.

(6) Reverse the removal procedures to install.

ACCESSORY RELAY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Reach under the driver's side of the instrument panel and unplug the accessory relay from the connector, which is attached to the 100-way connector mounting bracket (Fig. 11).

(3) To install the relay, align the terminals with the cavities in the connector and push the relay firmly into place.

(4) Connect the battery negative cable.

(5) Test the accessory relay operation.

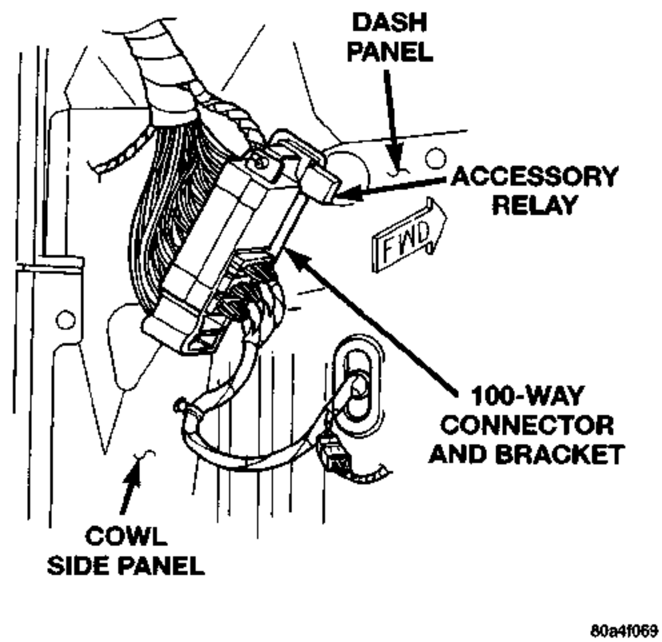

Fig. 11 Accessory Relay Remove/Install

GLOVE BOX

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Release the glove box latch and open the glove box door.

(2) While supporting the glove box door with one hand, reach inside the glove box and depress the retaining tab (Fig. 12).

(3) Open the glove box door until the retaining tab clears the glove box opening, then lift the hook formations on the lower edge of the glove box door off of the pivots on the instrument panel.

(4) Remove the glove box from the instrument panel.

(5) Reverse the removal procedures to install. Be certain that the hook formations on the lower edge of the glove box door are fully engaged on the instrument panel pivots before rotating the top of the glove box door up into place.

GLOVE BOX COMPONENTS

Service of all glove box components must be performed with the glove box removed from the instrument panel as described in this group.

REMOVAL AND INSTALLATION (Continued)

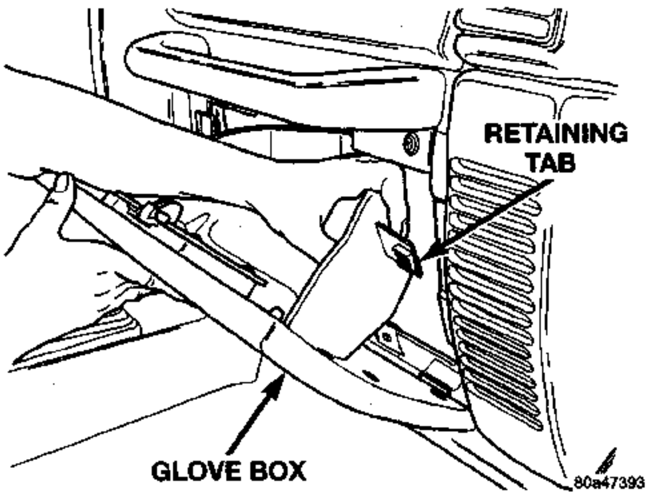

Fig. 12 Glove Box Remove/Install

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

GLOVE BOX DOOR/BIN

(1) Remove the glove box as described in this group.
(2) Remove the screws securing the glove box latch and handle to the glove box door.
(3) Remove the screws securing the inner door and bin unit to the outer glove box door panel.
(4) Separate the inner door and bin unit from the outer door.
(5) Reverse the removal procedures to install.

GLOVE BOX LATCH AND HANDLE

(1) Remove the glove box as described in this group.
(2) Remove the four screws securing the glove box latch and handle to the glove box door from the inside of the glove box door.
(3) Remove the latch and handle from the glove box door.
(4) Reverse the removal procedures to install.

GLOVE BOX LOCK CYLINDER

(1) Remove the glove box latch and handle as described in this group.
(2) Insert the key into the glove box lock cylinder.
(3) Insert a small screwdriver into the retaining tumbler release slot and depress the retaining tumbler (Fig. 13).

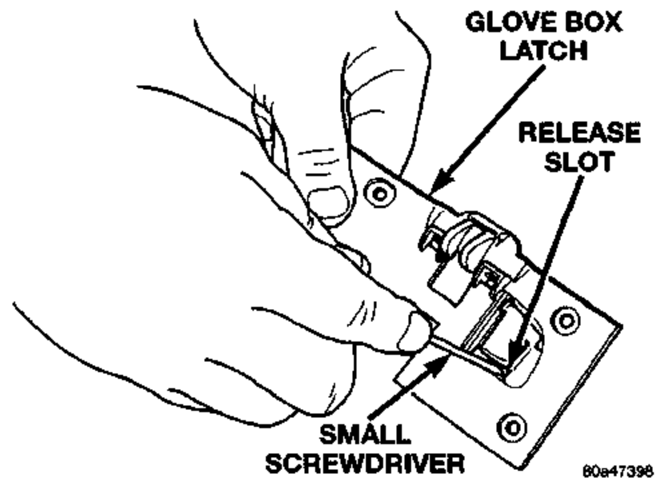

Fig. 13 Glove Box Lock Cylinder Remove/Install

(4) Pull the lock cylinder out of the latch handle by using a gentle twisting and pulling action on the key.
(5) Reverse the removal procedures to install.

GLOVE BOX LATCH STRIKER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the glove box as described in this group.
(2) Remove the two screws securing the latch striker to the grab handle bezel at the top of the glove box opening (Fig. 14).

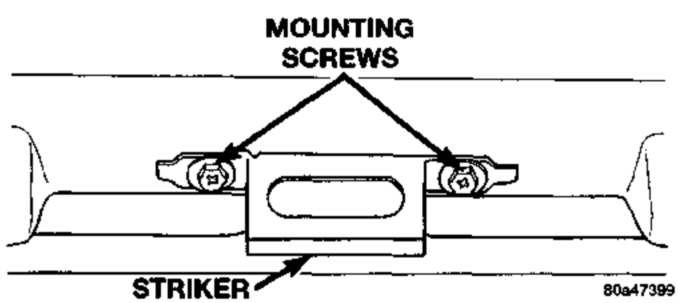

Fig. 14 Glove Box Latch Striker Remove/Install

(3) Remove the latch striker from the glove box opening.
(4) Reverse the removal procedures to install.

REMOVAL AND INSTALLATION (Continued)

FUSEBLOCK MODULE

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) Remove the glove box as described in this group.
(3) Reach through the glove box opening and remove the two screws holding the fuseblock module to the bracket on the dash panel (Fig. 15).

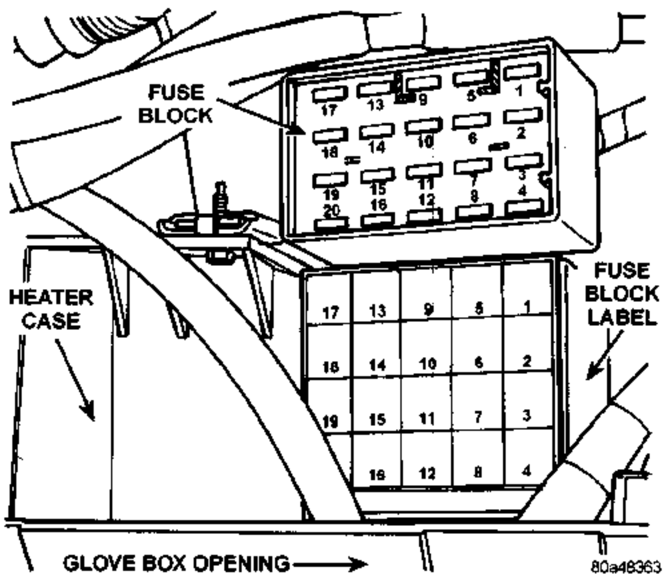

Fig. 15 Fuseblock Module Remove/Install

(4) Remove the fuseblock module from the dash panel.
(5) Reverse the removal procedures to install.

GRAB HANDLE

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the glove box as described in this group.
(2) Reach through and above the glove box opening to remove the nut securing the stud on each end of the grab handle to the instrument panel armature (Fig. 16).

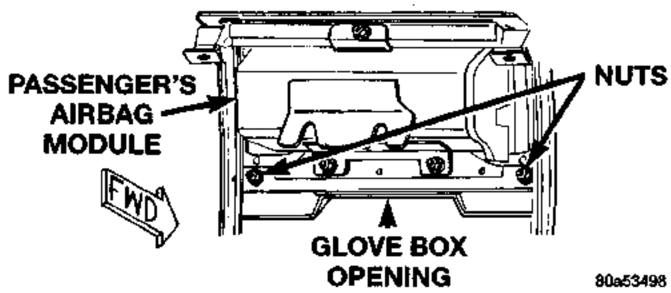

Fig. 16 Grab Handle Remove/Install

(3) Pull the grab handle from the front of the instrument panel to remove it.
(4) Reverse the removal procedures to install.

GRAB HANDLE BEZEL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the grab handle as described in this group.
(2) Remove the glove box latch striker as described in this group.
(3) Remove the two screws securing the bezel to the instrument panel armature (Fig. 17).

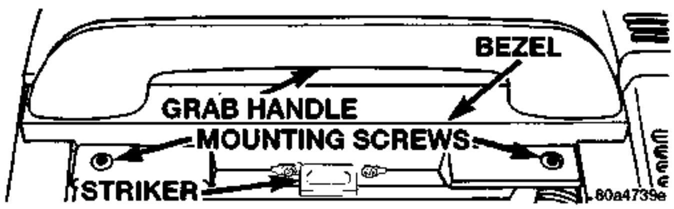

Fig. 17 Grab Handle Bezel Remove/Install

(4) Remove the bezel from the instrument panel.
(5) Reverse the removal procedures to install.

INSTRUMENT PANEL ASSEMBLY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL AND INSTALLATION (Continued)

(1) Disconnect and isolate the battery negative cable.
(2) Place the front wheels in the straight-ahead position.
(3) Remove the steering column cover and knee blocker as described in this group.
(4) Insert the key in the ignition lock cylinder and turn the ignition switch to the On position.
(5) Insert a small screwdriver or pin punch through the access hole in the lower steering column shroud and depress the ignition lock cylinder retaining tumbler (Fig. 18).

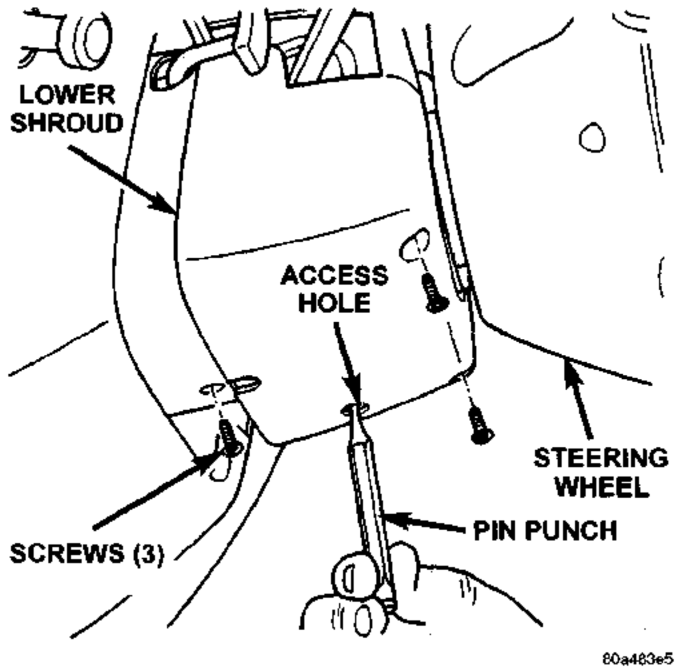

Fig. 18 Steering Column Shrouds Remove/Install

(6) While holding the retaining tumbler depressed, pull the ignition lock cylinder and key out of the ignition lock housing.
(7) Remove the three screws that secure the lower steering column shroud to the upper shroud.
(8) If the vehicle is equipped with a tilt steering column, move the column to the fully lowered position.
(9) Remove both the upper and lower shrouds from the steering column.

NOTE: If the vehicle is equipped with a tilt steering column, release the tilt mechanism control cable from the tilt lever to ease access to the steering column wiring connectors.

(10) Unplug the wiring connectors on the steering column-mounted components and switches, including:
- Two connectors on the multi-function switch
- One connector on the windshield wiper/washer switch
- Two connectors on the ignition switch
- Two connectors on the clockspring.

(11) Release the steering column wiring harness retainer from the steering column.

CAUTION: Use tie-wraps or another suitable method to keep the steering wheel indexed to the steering column. Failure to prevent steering wheel rotation can result in the loss of clockspring centering and damage to the clockspring.

(12) Remove the pinch-bolt from the upper half of the steering shaft coupler (Fig. 19).

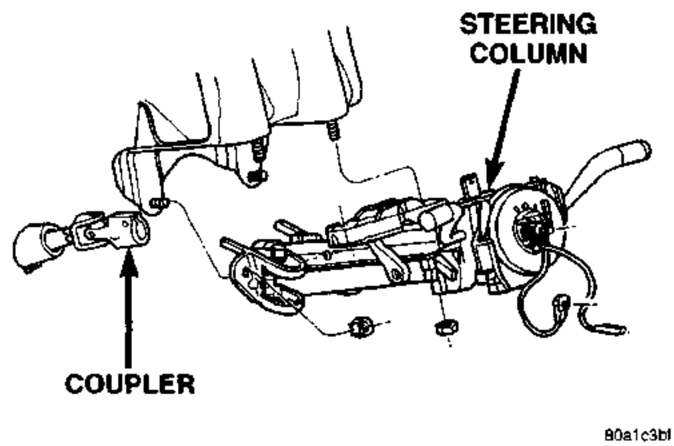

Fig. 19 Steering Column Mounting

(13) Remove the four nuts securing the steering column mounts to the steering column support bracket.

WARNING: WHEN A STEERING COLUMN HAS AN AIRBAG MODULE ATTACHED, NEVER PLACE THE COLUMN ON THE FLOOR OR ANY OTHER SURFACE WITH THE STEERING WHEEL OR AIRBAG MODULE FACE DOWN.

(14) Lower the steering column mounts off of the support bracket studs and remove the steering column from the vehicle.
(15) Reach through the steering column cover/knee blocker opening to disconnect the following:
- Instrument panel wiring harness connectors at the 100-way connector near the cowl side panel
- Side window demister hose at the heater-A/C housing demister/defroster duct (driver side)
- RHD only - radio antenna coaxial cable connector.

(16) Remove the glove box as described in this group.
(17) Reach through the glove box opening to disconnect the following:
- Heater-A/C temperature control cable (refer to Group 24 - Heating and Air Conditioning for the procedures)

REMOVAL AND INSTALLATION (Continued)

- Heater-A/C vacuum harness connector
- Heater-A/C wiring harness connector
- Passenger airbag module wiring connector
- Radio power wiring connector
- Side window demister hose at the heater-A/C housing demister/defroster duct (passenger side)
- LHD only - radio antenna coaxial cable connector.

(18) Remove the two nuts securing the lower passenger airbag module bracket to the studs on the dash panel (Fig. 20).

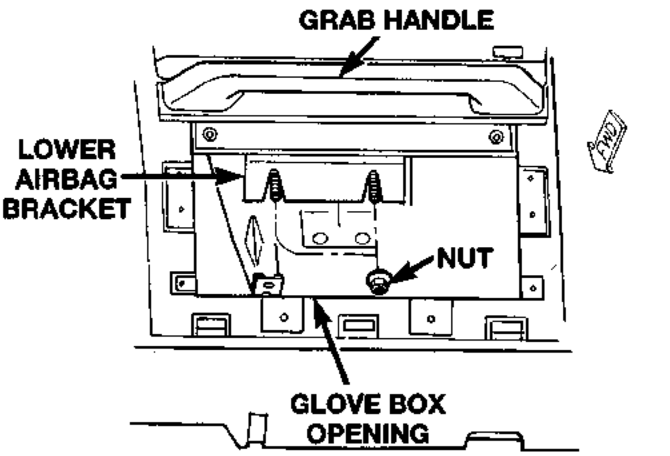

Fig. 20 Passenger Airbag Module Lower Bracket Nuts Remove/Install

(19) Remove the instrument panel top cover as described in this group.

(20) Remove the two screws securing each end of the instrument panel to the door hinge pillars (Fig. 21).

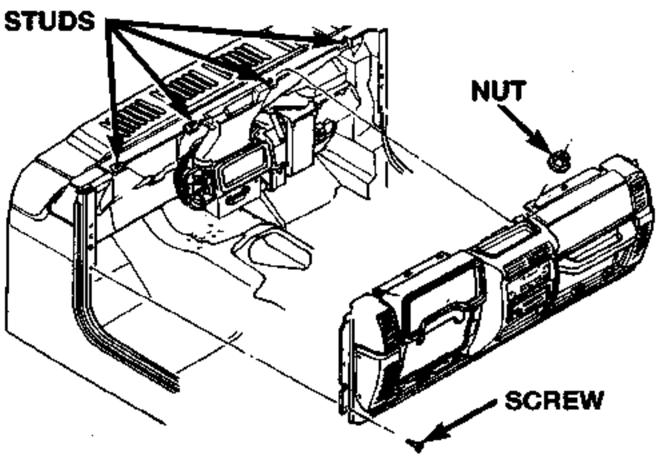

Fig. 21 Instrument Panel Assembly Remove/Install

(21) Remove the four nuts securing the top of the instrument panel to the dash panel.

(22) With the aid of an assistant, lift the instrument panel assembly off of the dash panel studs and remove it from the vehicle.

(23) Reverse the removal procedures to install. Tighten the mounting hardware as follows:

- Instrument panel to hinge pillar screws - 12 N·m (105 in. lbs.)
- Instrument panel top to dash nuts - 12 N·m (105 in. lbs.)
- Passenger airbag lower bracket to dash nuts - 28 N·m (250 in. lbs.)
- Steering column coupling pinch bolt - 49 N·m (36 ft. lbs.)
- Steering column mounting nuts - 22 N·m (200 in. lbs.).

INSTRUMENT PANEL BASE

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel assembly as described in this group.

(3) Completely de-trim the instrument panel of the following components, as described in this group:

- Instrument cluster
- Instrument panel center bezel
- Accessory switch bezel
- Glove box latch striker
- Grab handle and bezel.

(4) Remove the following components, as described in other groups:

- Speaker bezels (refer to Group 8F - Audio Systems for the procedures)
- Radio (refer to Group 8F - Audio Systems for the procedures)
- Passenger airbag module (refer to Group 8M - Restraint Systems for the procedures)
- Passenger airbag door (refer to Group 8M - Restraint Systems for the procedures)
- Heater-A/C controls (refer to Group 24 - Heating and Air Conditioning for the procedures)
- Outboard heater-A/C panel outlet barrels (refer to Group 24 - Heating and Air Conditioning for the procedures).

(5) Remove the two screws securing the 16-way data link connector to the instrument panel.

(6) Remove all of the screws securing the instrument panel base to the instrument panel armature.

(7) Remove the instrument panel base from the armature.

(8) Reverse the removal procedures to install.

AUDIO SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Following are general descriptions of the major components used in both the standard and optional factory-installed audio systems. Refer to 8W-47 Audio System in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

NOTE: This group covers both Left-Hand Drive (LHD) and Right-Hand Drive (RHD) versions of this model. Whenever required and feasible, the RHD versions of affected vehicle components have been constructed as mirror-image of the LHD versions. While most of the illustrations used in this group represent only the LHD version, the diagnostic and service procedures outlined can generally be applied to either version. Exceptions to this rule have been clearly identified as LHD or RHD, if a special illustration or procedure is required.

DESCRIPTION AND OPERATION

RADIOS

Receiver availability is affected by the country for which the vehicle is manufactured. Available radio receivers for North American vehicles include an AM/FM (RAL sales code), an AM/FM/cassette (RAS sales code), and an AM/FM/CD/cassette/3-band graphic equalizer (RAZ sales code). Available radio receivers for export vehicles include an FM/MW/LW/cassette with RDS traffic information and anti-theft features (RBL sales code), an AM/FM/cassette with CD changer control feature (RBA sales code), or an AM/FM/cassette with CD changer control feature (RBJ sales code). All receivers are stereo Electronically Tuned Radios (ETR) and include a digital clock function.

For more information on radio features, setting procedures, and control functions refer to the owner's manual in the vehicle glove box.

IGNITION-OFF DRAW FUSE

All vehicles are equipped with an Ignition-Off Draw (IOD) fuse that is removed when the vehicle is shipped from the factory. This fuse feeds various accessories that require current when the ignition switch is in the Off position, including the clock and radio station preset memory functions. The fuse is removed to prevent battery discharge during vehicle storage.

When removing or installing the IOD fuse, it is important that the ignition switch be in the Off position. Failure to place the ignition switch in the Off position can cause the radio display to become scrambled when the IOD fuse is removed and replaced. Removing and replacing the IOD fuse again, with the ignition switch in the Off position, will correct the scrambled display condition.

The IOD fuse should be checked if the radio station preset memory or clock functions are erratic or inoperative. The IOD fuse is located in the Power Distribution Center (PDC). Refer to the PDC label for IOD fuse identification and location.

SPEAKERS

The standard equipment speaker system includes two full-range speakers. Each speaker is mounted

DESCRIPTION AND OPERATION (Continued)

behind a removable bezel located on the outboard ends of the lower instrument panel.

The sound bar option adds two full-range speakers to the standard speaker system, for a total of four speakers. Each of the additional speakers is mounted behind a grille located on the outboard ends of the sound bar, which is attached from side-to-side to the sport bar above the rear seating area of the vehicle.

ANTENNA

All models use a fixed-length stainless steel rod-type antenna mast, installed on the right front cowl side panel of the vehicle. The antenna mast is connected to the center wire of the coaxial antenna cable and is not grounded to any part of the vehicle.

To eliminate static, the antenna base must have a good ground. The antenna coaxial cable shield (the outer wire mesh of the cable) is grounded to the antenna base and the radio chassis.

The antenna cable has an additional disconnect, located behind the right end of the instrument panel between the radio and the right cowl side panel. This antenna disconnect allows the instrument panel assembly to be removed and installed without removing the radio.

The factory-installed ETRs automatically compensate for radio antenna trim. Therefore, no antenna trimmer adjustment is required or possible when replacing the receiver or the antenna.

RADIO NOISE SUPPRESSION

Radio Frequency Interference (RFI) and Electro-Magnetic Interference (EMI) noise suppression is accomplished primarily through circuitry internal to the radio receivers. These internal suppression devices are only serviced as part of the radio receiver.

External suppression devices that are serviced, and should be checked in the case of RFI or EMI noise complaints, include the following:

- Radio antenna base ground
- Radio chassis ground wire, strap, or bracket
- Engine-to-body ground strap (if equipped)
- Cab-to-bed ground strap (if equipped)
- Heater core ground strap (if equipped)
- Resistor-type spark plugs
- Radio suppression-type secondary ignition wiring.

In addition, if the source of RFI or EMI noise is identified as a component on the vehicle (i.e., generator, blower motor, etc.), the ground path for that component should be checked. If excessive resistance is found in that circuit, repair that circuit as required before considering any component replacement.

If the source of the noise is identified as two-way mobile radio or telephone equipment, check the following:

- Power connections should be made directly to the battery, and fused as closely to the battery as possible.
- The antenna should be mounted on the roof or toward the rear of the vehicle. Remember that magnetic antenna mounts on the roof panel can adversely affect the operation of an overhead console compass, if the vehicle is so equipped.
- The antenna cable should be fully shielded coaxial cable, should be as short as is practical, and should be routed away from the vehicle wiring whenever possible.
- The antenna and cable must be carefully matched to ensure a low Standing Wave Ratio (SWR).

Fleet vehicles are available with an extra-cost RFI-suppressed Powertrain Control Module (PCM). This unit reduces interference generated by the PCM on some radio frequencies used in two-way radio communications. However, this unit will not resolve complaints of RFI in the commercial AM or FM radio frequency ranges.

DIAGNOSIS AND TESTING

AUDIO SYSTEM

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DIAGNOSIS AND TESTING (Continued)

Audio System Diagnosis		
CONDITION	**POSSIBLE CAUSE**	**CORRECTION**
NO AUDIO.	1. Fuse faulty. 2. Radio connector faulty. 3. Wiring faulty. 4. Ground faulty. 5. Radio faulty. 6. Speakers faulty.	1. Check radio fuses in Power Distribution Center. Replace fuses, if required. 2. Check for loose or corroded radio connector. Repair, if required. 3. Check for battery voltage at radio connector. Repair wiring, if required. 4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 5. Exchange or replace radio, if required. 6. See speaker diagnosis, in this group.
NO DISPLAY.	1. Fuse faulty. 2. Radio connector faulty. 3. Wiring faulty. 4. Ground faulty. 5. Radio faulty.	1. Check radio fuses in Power Distribution Center. Replace fuses, if required. 2. Check for loose or corroded radio connector. Repair, if required. 3. Check for battery voltage at radio connector. Repair wiring, if required. 4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 5. Exchange or replace radio, if required.
NO MEMORY.	1. Fuse faulty. 2. Radio connector faulty. 3. Wiring faulty. 4. Ground faulty. 5. Radio faulty.	1. Check ignition-off draw fuse. Replace fuse, if required. 2. Check for loose or corroded radio connector. Repair, if required. 3. Check for battery voltage at radio connector. Repair wiring, if required. 4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 5. Exchange or replace radio, if required.
POOR RADIO RECEPTION.	1. Antenna faulty. 2. Ground faulty. 3. Radio faulty.	1. See antenna diagnosis, in this group. Repair or replace antenna, if required. 2. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.. 3. Exchange or replace radio, if required.
NO/POOR TAPE OPERATION.	1. Faulty tape. 2. Foreign objects behind tape door. 3. Dirty cassette tape head. 4. Faulty tape deck.	1. Insert known good tape and test operation. 2. Remove foreign objects and test operation. 3. Clean head with Mopar Cassette Head Cleaner. 4. Exchange or replace radio, if required.
NO COMPACT DISC OPERATION	1. Faulty CD. 2. Foreign material on CD. 3. Condensation on CD or optics. 4. Faulty CD player.	1. Insert known good CD and test operation. 2. Clean CD and test operation. 3. Allow temperature of vehicle interior to stabilize and test operation. 4. Exchange or replace radio, if required.

DIAGNOSIS AND TESTING (Continued)

RADIO

For circuit descriptions and diagrams, refer to 8W-47 - Audio System in Group 8W - Wiring Diagrams.

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CAUTION: The speaker output of the radio is a "floating ground" system. Do not allow any speaker lead to short to ground, as damage to the radio may result.

(1) Check the fuse(s) in the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, replace the faulty fuse(s).

(2) Check for battery voltage at the fuse(s) in the PDC. If OK, go to Step 3. If not OK, repair the open circuit as required.

(3) Disconnect and isolate the battery negative cable. Remove the instrument cluster center bezel. Remove the radio, but do not unplug any connections. Check for continuity between the radio chassis and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the **fused ignition switch output (accessory/run)** circuit cavity of the gray radio connector. If OK, go to Step 5. If not OK, repair the open circuit to the fuseblock module as required.

(5) Turn the ignition switch to the Off position. Check for battery voltage at the **fused B(+)** circuit cavity of the gray radio connector. If OK, replace the faulty radio. If not OK, repair the open circuit as required.

SPEAKERS

For circuit descriptions and diagrams, refer to 8W-47 - Audio System in Group 8W - Wiring Diagrams.

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CAUTION: The speaker output of the radio is a "floating ground" system. Do not allow any speaker lead to short to ground, as damage to the radio may result.

(1) Turn the radio on. Adjust the balance and fader controls to check the performance of each individual speaker. Note the speaker locations that are not performing correctly. Go to Step 2.

(2) Turn the radio off. Disconnect and isolate the battery negative cable. Remove the instrument cluster center bezel and remove the radio. Unplug the wiring connectors at the radio. Check for continuity to ground at both the speaker **feed** (+) circuit and **return** (–) circuit cavities of the radio connectors for each inoperative speaker location. In each case, there should be no continuity. If OK, go to Step 4. If not OK, go to Step 3.

(3) Leave the radio wiring connectors unplugged. Unplug the wiring connector at the inoperative speaker. Check both the speaker **feed (+)** circuit and **return (–)** circuit cavities for continuity to ground. In each case, there should be no continuity. If OK, replace the shorted speaker. If not OK, repair the shorted circuit as required.

(4) Check the resistance between the speaker **feed (+)** circuit and **return (–)** circuit cavities of the radio connector for each inoperative speaker location. In each case, the meter should read between 3 and 8 ohms (speaker resistance). If OK, go to Step 5. If not OK, go to Step 6.

(5) Install a known good radio. Connect the battery negative cable. Turn on the radio and test the inoperative speaker operation. If OK, replace the faulty radio. If not OK, replace the faulty speaker.

(6) Unplug the speaker wiring connector at the speaker. Check the resistance between the speaker **feed (+)** circuit cavities of the radio connector and the speaker connector. Repeat the check between the speaker **return (-)** circuit cavities of the radio connector and the speaker connector. In each case, there should be no measurable resistance. If OK, replace the faulty speaker. If not OK, repair the circuit(s) as required.

DIAGNOSIS AND TESTING (Continued)

ANTENNA

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The following four tests are used to diagnose the antenna with an ohmmeter:

- **Test 1** - Mast to ground test
- **Test 2** - Tip-of-mast to tip-of-conductor test
- **Test 3** - Body ground to battery ground test
- **Test 4** - Body ground to coaxial shield test.

The ohmmeter test lead connections for each test are shown in Antenna Tests (Fig. 1).

NOTE: This model has a two-piece antenna cable. Tests 2 and 4 must be conducted in two steps to isolate a coaxial cable problem; from the coaxial cable connection under the right end of the instrument panel near the right cowl side panel to the antenna base, and then from the coaxial cable connection to the radio chassis connection.

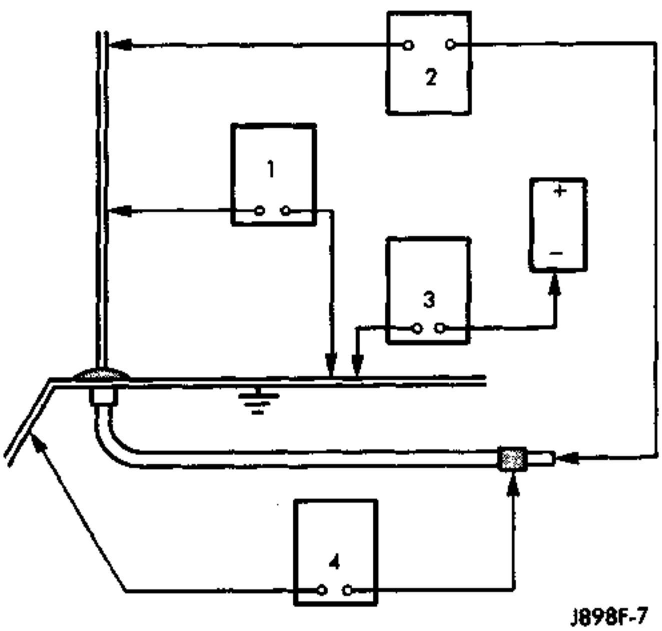


Fig. 1 Antenna Tests

TEST 1

Test 1 determines if the antenna mast is insulated from the base. Proceed as follows:

(1) Disconnect the antenna cable lead from the radio chassis and isolate.

(2) Connect one ohmmeter lead to the tip of the antenna mast and the other lead to the antenna base. Check for continuity.

(3) There should be no continuity. If continuity is found, replace the faulty or damaged antenna base and cable assembly.

TEST 2

Test 2 checks the antenna for an open circuit as follows:

(1) Disconnect the antenna cable lead from the radio chassis.

(2) Connect one ohmmeter test lead to the tip of the antenna mast. Connect the remaining lead to the tip of the antenna cable lead (the part inserted into the radio).

(3) Continuity should exist (the ohmmeter should only register a fraction of an ohm). High or infinite resistance indicates damage to the base and cable assembly. Replace the faulty base and cable, if required.

TEST 3

Test 3 checks the condition of the vehicle body ground connection. This test should be performed with the battery positive cable removed from the battery. Disconnect both battery cables, the negative cable first. Reconnect the negative cable and perform the test as follows:

(1) Connect one ohmmeter test lead to the vehicle fender and the other lead to the battery negative post.

(2) The resistance should be less than one ohm.

(3) If the resistance is more than one ohm, check the braided ground strap connected to the engine and the vehicle body for being loose, corroded, or damaged. Repair the ground strap connection, if required.

TEST 4

Test 4 checks the condition of the ground between the antenna base and the vehicle body as follows:

(1) Connect one ohmmeter test lead to the fender and the other lead to the crimp on the coaxial antenna cable shield.

(2) The resistance should be less then one ohm.

(3) If the resistance is more then one ohm, clean and/or tighten the antenna base to fender mounting hardware.

DIAGNOSIS AND TESTING (Continued)

RADIO FREQUENCY INTERFERENCE

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Inspect the ground connections at the following:
- Blower motor
- Electric fuel pump
- Generator
- Ignition module
- Wiper motor
- Antenna coaxial ground
- Radio ground
- Body-to-engine braided ground strap (if equipped).

Clean, tighten or repair the connections as required.

Also inspect the following secondary ignition system components, as described in Group 8D - Ignition Systems:
- Spark plug wire routing and condition
- Distributor cap and rotor
- Ignition coil
- Spark plugs.

Reroute the spark plug wires or replace the faulty components as required.

SERVICE PROCEDURES

ANTI-THEFT SECURITY CODE

Certain export models equipped with the RBL sales code radio have a radio anti-theft security code feature. This feature requires that a security code be entered into the radio following a battery disconnect in order for the radio to become operational. When the radio is new, a label identifying the four-digit security code is affixed to the radio faceplate. It is recommended that the vehicle owner note this security code in his vehicle owner's manual for future reference, then remove and destroy the security code label. To enter the security code in the radio, proceed as follows:

(1) Turn the ignition switch to the On position.

(2) Momentarily depress the power (PWR) button on the radio faceplate. The word "code" should appear on the radio display.

(3) Enter the four-digit radio security code by depressing the radio station preset buttons in the proper sequence.

(4) The radio is now ready for normal operation.

The security code must be reentered any time the radio or vehicle is disconnected from battery feed.

REMOVAL AND INSTALLATION

RADIO

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Using a trim stick or another suitable wide-bladed flat tool, pry the instrument panel top cover away from the instrument panel to release the five snap clip retainers.

(3) Remove the instrument panel top cover from the vehicle.

(4) Remove the two screws that were hidden by the instrument panel top cover securing the top of the instrument panel center bezel to the instrument panel.

(5) Remove the ash receiver from the ash receiver housing (Fig. 2).

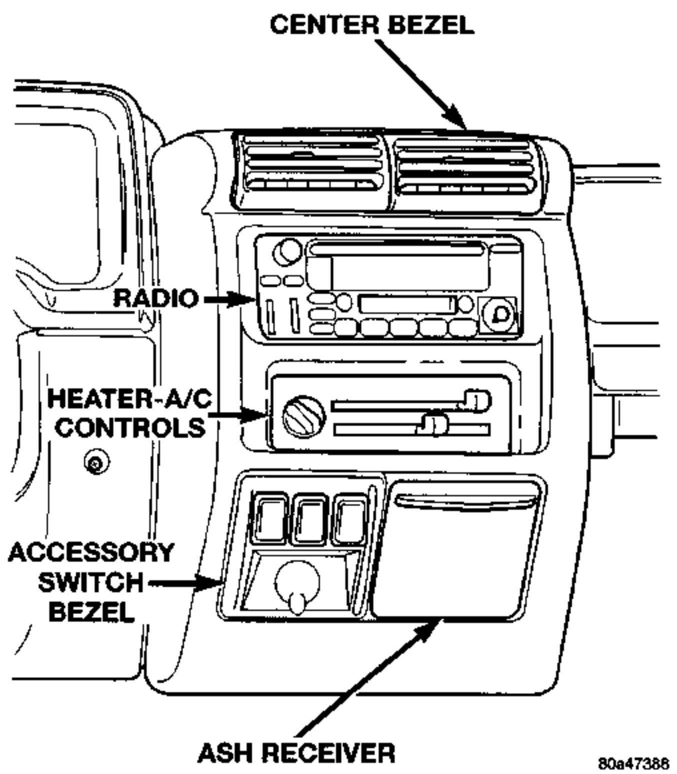


Fig. 2 Center Bezel Remove/Install

REMOVAL AND INSTALLATION (Continued)

(6) Remove the one screw located in the back of the ash receiver housing securing the center bezel to the instrument panel.

(7) Pry the lower edge of the center bezel away from the instrument panel using a trim stick. Then lift the lower edge upwards to release the four snap clip retainers from the instrument panel.

(8) Remove the two radio mounting screws from the front of the radio (Fig. 3).

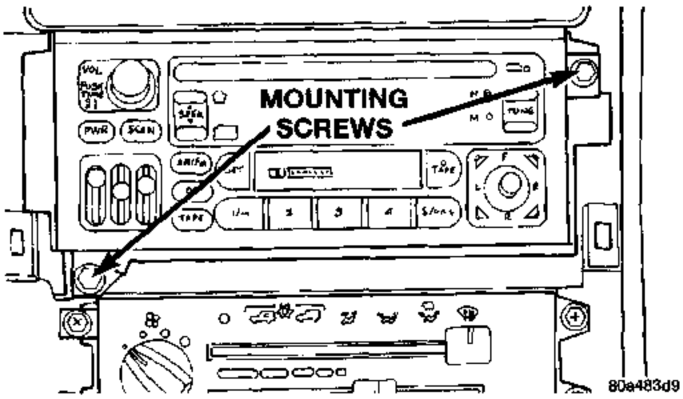


Fig. 3 Radio Remove/Install

(9) Pull the radio out from the instrument panel far enough to unplug the wiring connectors and the antenna coaxial cable (Fig. 4).

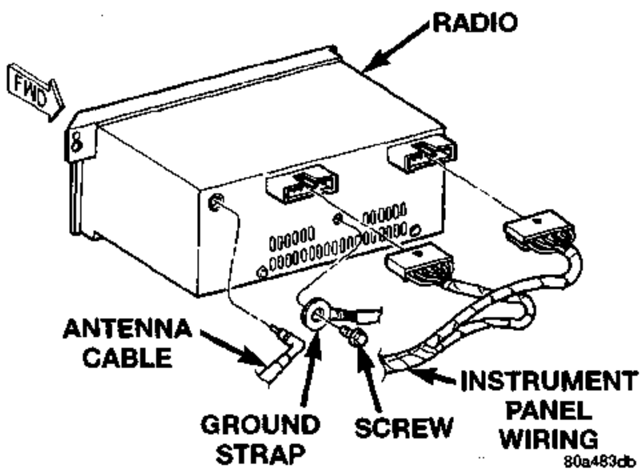


Fig. 4 Radio Connections - Typical

(10) Remove the screw securing the ground strap to the radio chassis.

(11) Remove the radio from the instrument panel.

(12) Reverse the removal procedures to install.

SPEAKERS

INSTRUMENT PANEL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the two screws from the outboard end of the instrument panel speaker bezel (Fig. 5).

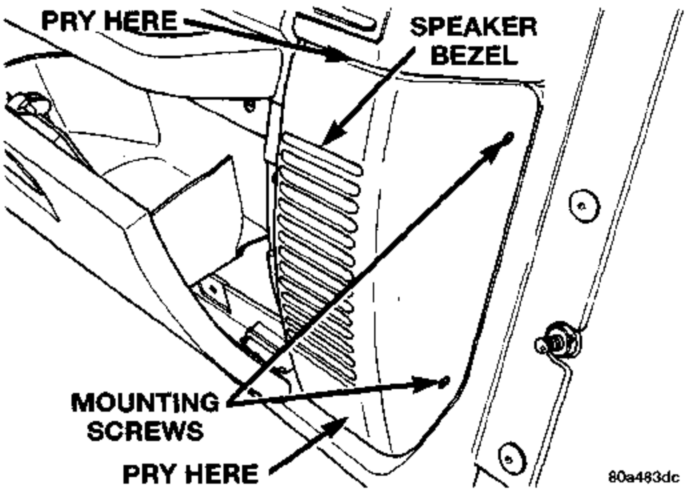


Fig. 5 Instrument Panel Speaker Bezel Remove/Install

(3) Using a wide flat-bladed tool such as a trim stick, pry at the top and bottom of the bezel to release the two snap clip retainers.

(4) Remove the speaker bezel from the instrument panel.

(5) Remove the foam rubber speaker baffle from the speaker.

(6) Remove the four screws securing the speaker to the instrument panel armature (Fig. 6).

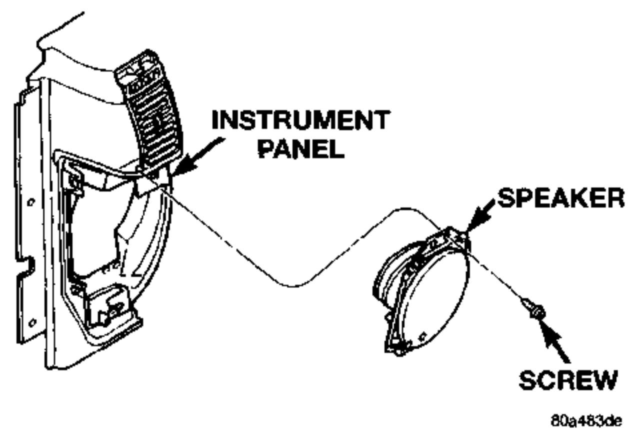


Fig. 6 Instrument Panel Speaker Remove/Install

REMOVAL AND INSTALLATION (Continued)

(7) Pull the speaker away from the instrument panel far enough to unplug the speaker wiring connector.

(8) Remove the speaker from the instrument panel.

(9) Reverse the removal procedures to install.

SOUND BAR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the four screws securing the speaker grille and speaker to the sound bar.

(3) Lower the speaker and grille from the sound bar far enough to unplug the speaker wiring connector.

(4) Remove the speaker grille from the speaker.

(5) Reverse the removal procedures to install.

SOUND BAR

(1) Disconnect and isolate the battery negative cable.

(2) If equipped with the soft top option, lower the soft top. Refer to the owner's manual for the procedures.

(3) If equipped with the hardtop option, remove the hardtop. Refer to Group 23 - Body for the procedures.

(4) Release the hook and loop closure on each outboard end flap of the sound bar cover.

(5) Lift the left outboard end flap of the sound bar cover over the sport bar and unplug the sound bar wiring connector (Fig. 7).

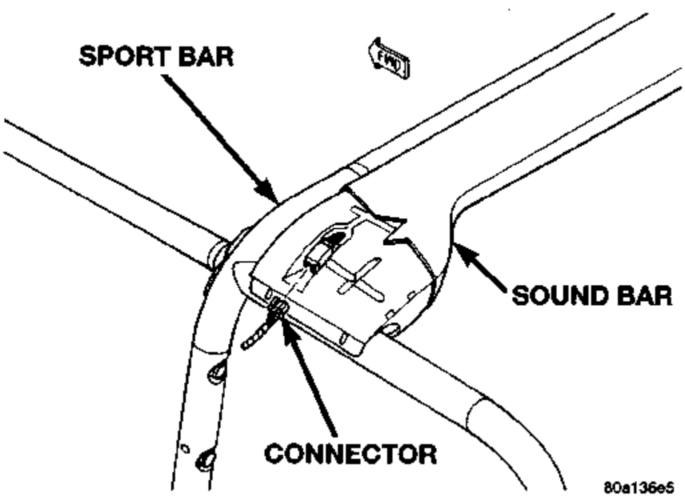


Fig. 7 Sound Bar Wiring Connector Remove/Install

(6) Lift each outboard end flap of the sound bar cover over the sport bar and remove the two screws securing each end of the sound bar to the sport bar (Fig. 8).

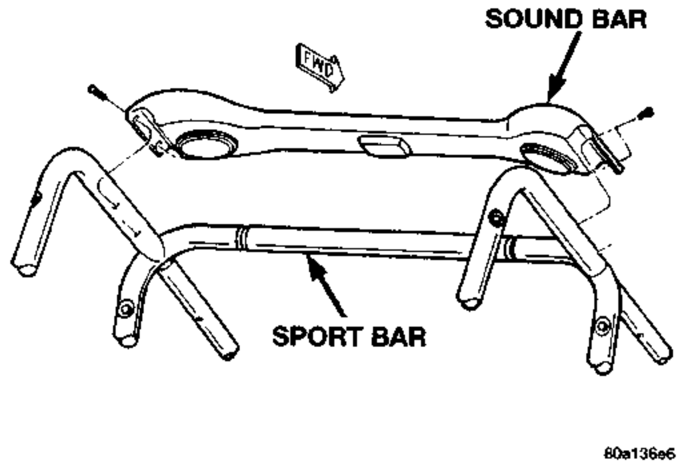


Fig. 8 Sound Bar Remove/Install

(7) Lift the sound bar off of the sport bar to remove it from the vehicle.

(8) Reverse the removal procedures to install.

ANTENNA

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) On LHD models, remove the glove box. On RHD models, remove the steering column cover and knee blocker. Refer to Group 8E - Instrument Panel Systems for both procedures.

(3) Reach through the instrument panel opening and unplug the antenna coaxial cable connector.

REMOVAL AND INSTALLATION (Continued)

(4) Push the grommet on the antenna body half of the coaxial cable out through the hole in the right inner cowl side panel (Fig. 9).

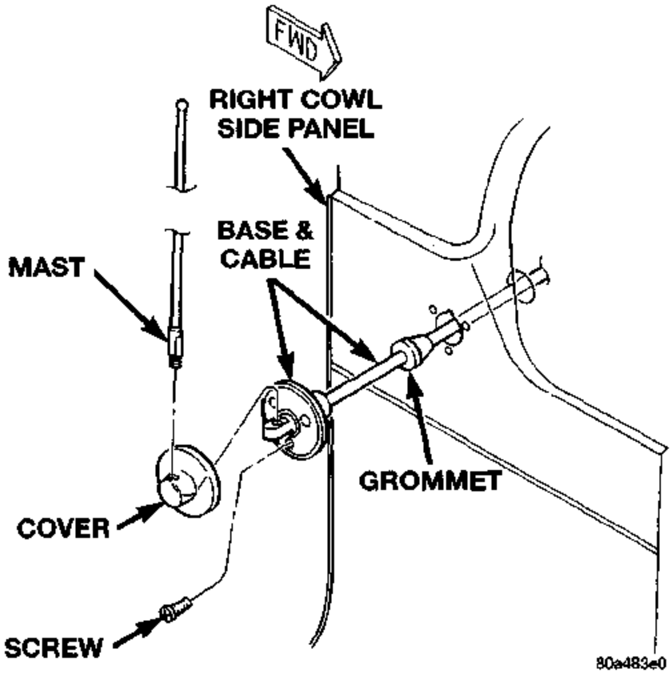


Fig. 9 Antenna Remove/Install

(5) Unscrew the antenna mast from the antenna body.

(6) Unsnap the antenna base cover from the base using a trim stick or other suitable flat wide-bladed tool.

(7) Remove the three screws securing the antenna body to the right outer cowl side panel.

(8) Pull the antenna body and cable out through the hole in the right outer cowl side panel.

(9) Reverse the removal procedures to install.

HORN SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Following are general descriptions of the major components in the factory-installed horn systems. Refer to 8W-41 - Horns/Cigar Lighter in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

NOTE: This group covers both Left-Hand Drive (LHD) and Right-Hand Drive (RHD) versions of this model. Whenever required and feasible, the RHD versions of affected vehicle components have been constructed as mirror-image of the LHD versions. While most of the illustrations used in this group represent only the LHD version, the diagnostic and service procedures outlined can generally be applied to either version. Exceptions to this rule have been clearly identified as LHD or RHD, if a special illustration or procedure is required.

DESCRIPTION AND OPERATION

HORN RELAY

The horn relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (or footprint) is different, current capacity is lower, and the relay case dimensions are smaller than on the conventional ISO relay.

The horn relay is a electro-mechanical device that switches current to the horn when the horn switch on the steering wheel is depressed. See the Diagnosis and Testing section of this group for more information on the horn relay's operation.

The horn relay is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for horn relay identification and location.

If a problem is encountered with a continuously sounding horn, it can usually be quickly resolved by removing the horn relay from the PDC until further diagnosis is completed.

HORN SWITCH

A center-blow, resistive membrane type horn switch is installed on the back side of the driver's airbag module trim cover in the center of the steering wheel. When the center area of the airbag trim cover is depressed, the horn switch completes a circuit to ground for the coil side of the horn relay. The steering wheel and steering column must be properly grounded for the horn switch to function.

The horn switch is only serviced as a part of the airbag module trim cover. If the horn switch should fail, or if the airbag is deployed, the airbag module trim cover and horn switch unit must be replaced.

HORNS

Dual-note, diaphragm-type horns are standard equipment, except on models built for sale in countries where a single, low-note, horn is required equipment. Each horn is mounted on a bracket secured to the left inner fender ahead of the left front wheelhouse in the engine compartment. Models with dual horns have the two horn brackets mounted to the same location, one on top of the other.

On models with dual horns, the horns are connected in parallel. The horn(s) are grounded through the horn wiring connector and circuit to an eyelet bolted to the engine compartment side of the grille/ headlamp mounting panel near the left headlamp,

DESCRIPTION AND OPERATION (Continued)

and receive battery feed through the closed contacts of the horn relay.

These horns cannot be repaired and, if faulty or damaged, they must be replaced.

DIAGNOSIS AND TESTING

HORN RELAY

For circuit descriptions and diagrams, refer to 8W-41 - Horns/Cigar Lighter in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

RELAY TESTS

The horn relay is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for horn relay identification and location.

Remove the horn relay from the PDC as described in this group to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75±5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

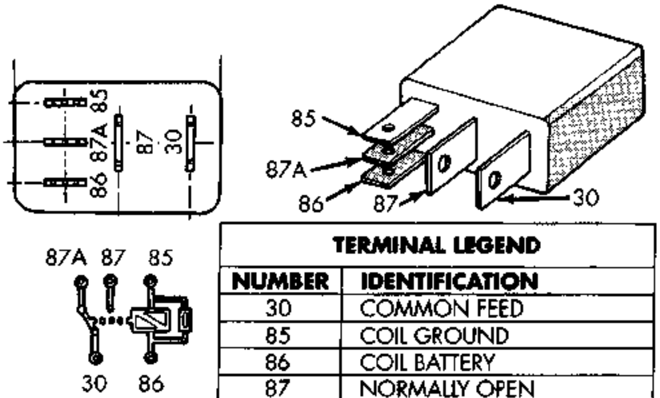
(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see the Relay Circuit Test in this group. If not OK, replace the faulty relay.

RELAY CIRCUIT TESTS

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair the open circuit to the PDC fuse as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the horn(s). There should be continuity between the cavity for relay terminal 87 and the **horn relay**



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Horn Relay

output circuit cavities of both horn connectors at all times. If OK, go to Step 4. If not OK, repair the open circuit to the horn(s) as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. It is connected to battery voltage and should be hot at all times. Check for battery voltage at the cavity for relay terminal 86. If OK, go to Step 5. If not OK, repair the open circuit to the PDC fuse as required.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. It is grounded through the horn switch when the horn switch is depressed. Check for continuity to ground at the cavity for relay terminal 85. There should be continuity with the horn switch depressed, and no continuity with the horn switch released. If not OK, see the diagnosis for the Horn Switch in this group.

HORN SWITCH

For circuit descriptions and diagrams, refer to 8W-41 - Horns/Cigar Lighter in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the lower steering column cover/knee blocker. Check for continuity between the metal steering column jacket and a good ground. There should be continuity. If OK, go to Step 2. If not OK,

DIAGNOSIS AND TESTING (Continued)

refer to Group 19 - Steering and check for proper installation of the steering column mounting nuts.

(2) Remove the driver's airbag module. Unplug the horn switch wire connector. Remove the horn relay from the Power Distribution Center (PDC). Check for continuity between the steering column half of the horn switch feed wire connector and a good ground. There should be no continuity. If OK, go to Step 3. If not OK, repair the short circuit as required.

(3) Check for continuity between the steering column half of the horn switch feed wire connector and the **horn relay control** circuit cavity for the horn relay in the PDC. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Check for continuity between the horn switch feed wire and the horn switch ground wire on the airbag module. There should be no continuity. If OK, go to Step 5. If not OK, replace the faulty horn switch.

(5) Depress the center of the airbag module cover and check for continuity between the horn switch feed wire and the horn switch ground wire on the airbag module. There should be continuity. If not OK, replace the faulty horn switch.

HORNS

For circuit descriptions and diagrams, refer to 8W-41 - Horns/Cigar Lighter in Group 8W - Wiring Diagrams.

(1) Disconnect the horn wiring connector. Measure the resistance between the **ground** circuit cavity of the horn connectors and a good ground. There should be no measurable resistance. If OK, go to Step 2. If not OK, repair the faulty horn ground circuit as required.

(2) Depress the horn switch. There should be battery voltage at the **horn relay output** circuit cavity of the horn connectors. If OK, replace the faulty horn(s). If not OK, repair the open circuit to the horn relay as required.

REMOVAL AND INSTALLATION

HORN RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 1).

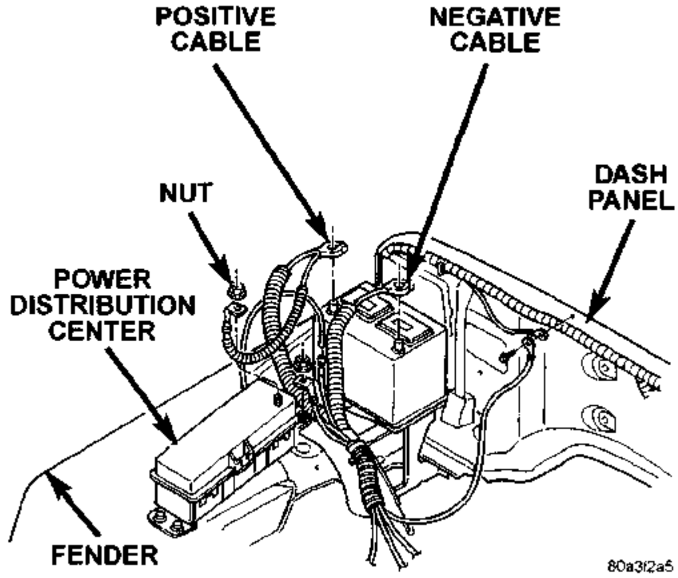


Fig. 1 Power Distribution Center

(3) Refer to the label on the PDC for horn relay identification and location.

(4) Remove the horn relay by unplugging it from the PDC.

(5) Install the horn relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

HORN SWITCH

WARNING: ON VEHICLES EQUIPPED WITH A DRIVER'S AIRBAG, THE HORN SWITCH IS INTEGRAL TO THE AIRBAG MODULE TRIM COVER. SERVICE OF THIS COMPONENT SHOULD BE PERFORMED ONLY BY CHRYSLER-TRAINED AND AUTHORIZED DEALER SERVICE TECHNICIANS. FAILURE TO TAKE THE PROPER PRECAUTIONS OR TO FOLLOW THE PROPER PROCEDURES COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY. REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS FOR THE SERVICE PROCEDURES.

REMOVAL AND INSTALLATION (Continued)

HORNS

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the horn wiring connector(s) (Fig. 2).

(3) Remove the two bolts holding the horn mounting bracket(s) to the inner fender and remove the horns.

(4) Reverse the removal procedures to install.

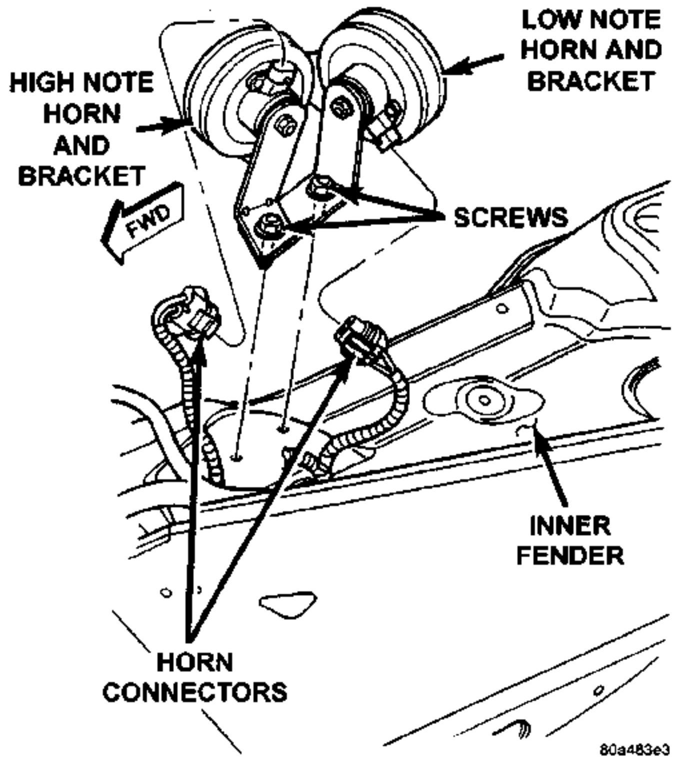


Fig. 2 Horn(s) Remove/Install - Typical

TURN SIGNAL AND HAZARD WARNING SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Following are general descriptions of the major components in the turn signal and hazard warning systems. Refer to 8W-52 - Turn Signals in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

NOTE: This group covers both Left-Hand Drive (LHD) and Right-Hand Drive (RHD) versions of this model. Whenever required and feasible, the RHD versions of affected vehicle components have been constructed as mirror-image of the LHD versions. While most of the illustrations used in this group represent only the LHD version, the diagnostic and service procedures outlined can generally be applied to either version. Exceptions to this rule have been clearly identified as LHD or RHD, if a special illustration or procedure is required.

DESCRIPTION AND OPERATION

TURN SIGNAL SYSTEM

With the ignition switch in the On or Accessory position, and the multi-function switch control lever moved up (right turn) or down (left turn), the turn signal system is activated. The switch has a detent position in each direction that provides turn signals with automatic cancellation, and an intermediate momentary position that provides turn signals only until the multi-function switch lever is released.

When the turn signal switch is in a detent position, it is turned off by one of two cancelling cam lobes molded into the hub of the clockspring mechanism. When turning the steering wheel causes one of the cam lobes to contact a cancel actuator in the multi-function switch, the turn signal switch automatically returns to the off position.

When the turn signal system is activated, the selected (right or left) turn signal indicator lamp, front park/turn signal lamp and rear tail/stop/turn signal lamp bulbs will flash. With the headlamp switch in the Off position, the front turn signal and front side marker lamps flash in unison. With the head or park lamps turned on, the front turn signal and front side marker lamps flash alternately.

HAZARD WARNING SYSTEM

The hazard warning system is activated by a switch button in the multi-function switch. The button is located on the top of the steering column between the steering wheel and the instrument panel. The hazard warning switch button is identified with a double triangle.

The hazard warning system is connected to an unswitched battery feed so that the system remains functional, regardless of the ignition switch position. Slide the switch button to the left to activate the hazard warning system, and slide the switch button to the right to turn the system off.

When the hazard warning system is activated, the right and left turn signal indicators, front park/turn signal lamps, front side marker lamps, and rear tail/stop/turn signal lamps will flash. With the headlamp switch in the Off position, the front turn signal and front side marker lamps flash in unison. With the head or park lamps turned on, the front turn signal and front side marker lamps flash alternately.

COMBINATION FLASHER

The combination flasher is a smart relay that functions as both the turn signal system and hazard

DESCRIPTION AND OPERATION (Continued)

warning system flasher. The combination flasher is designed to handle the current flow requirements of the factory installed lighting.

If supplemental lighting is added to the turn signal lamp circuits, such as when towing a trailer with lights, the combination flasher will automatically compensate. This allows the flash rate to remain the same, regardless of electrical load increases. However, if a bulb fails in the turn signal lamp circuits, the flash rate of the remaining bulbs in that circuit will increase to 120 flashes per minute, or higher.

While the combination flasher shares the terminal orientation (footprint) of a International Standards Organization (ISO)-type relay, the internal circuitry is much different. The combination flasher contains active electronic integrated circuitry elements. Do not substitute any other relay for the combination flasher.

The combination flasher cannot be repaired and, if faulty, it must be replaced. Also, because of the combination flasher's active electronic elements, it cannot be tested with conventional automotive electrical test equipment. If the flasher is believed to be faulty, test the turn signal and hazard warning system circuits as described in this group. Then, replace the combination flasher with a known good unit to confirm system operation.

MULTI-FUNCTION SWITCH

The multi-function switch assembly is mounted to the left side of the steering column (Fig. 1). This switch contains circuitry for the following functions:

- Turn signals
- Hazard warning
- Headlamp beam selection
- Headlamp optical horn.

The information contained in this group addresses only the switch functions for the turn signal and hazard warning circuits. For information relative to the other switch functions, refer to the appropriate group. However, the multi-function switch cannot be repaired. If any function of the switch is faulty, the entire switch assembly must be replaced.

TURN SIGNAL INDICATOR LAMPS

The turn signal indicator lamps are located in the instrument cluster. They flash with the exterior turn signal lamps to give the driver a visual indication that a turn signal or the hazard warning system is operating. For diagnosis and service of these lamps, refer to Group 8E - Instrument Panel Systems.

TURN SIGNAL LAMPS

The exterior lamps in the turn signal and hazard warning circuits include the front park/turn signal, the front side marker, and the rear tail/stop/turn signal. For diagnosis and service of these lamps, refer to Group 8L - Lamps.

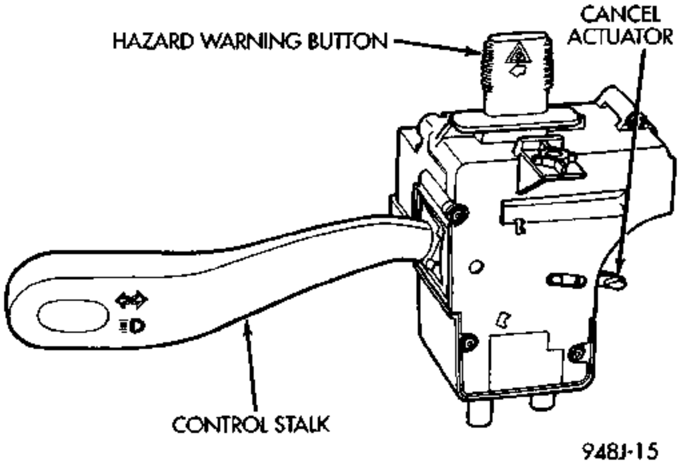


Fig. 1 Multi-Function Switch

DIAGNOSIS AND TESTING

INTRODUCTION

When diagnosing the turn signal or hazard warning circuits, remember that high generator output can burn out bulbs rapidly and repeatedly. If this is a problem on the vehicle being diagnosed, refer to Group 8C - Charging Systems for further diagnosis.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

TURN SIGNAL AND HAZARD WARNING SYSTEMS

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Turn the ignition switch to the On position. Actuate the turn signal lever or hazard warning button. Observe the turn indicator lamp(s) in the instrument cluster. If the flash rate is very high, check for

DIAGNOSIS AND TESTING (Continued)

a turn signal bulb that is not lit. Replace that bulb or repair the circuits to that lamp, as required. Test the operation of the system again. If the turn indicator(s) fail to light, go to Step 2.

(2) Remove and inspect the turn signal fuse in the fuseblock module, or the hazard warning fuse in the Power Distribution Center (PDC). Replace the faulty fuse(s), if required, and go to Step 3.

(3) Remove the combination flasher from its connector and replace it with a known good unit. Test the operation of the turn signal and hazard warning systems. If OK, discard the faulty combination flasher. If not OK, remove the test flasher and go to Step 4.

(4) With the ignition switch in the On position, check for battery voltage at the **combination flasher input** circuit cavity in the combination flasher connector. If OK, go to Step 5. If not OK, go to Step 7.

(5) With the ignition switch in the Off position and the hazard warning switch in the On position, check for battery voltage at the **combination flasher input** circuit cavity in the combination flasher connector. If OK, go to Step 6. If not OK, go to Step 7.

(6) With the ignition switch in the Off position, check for continuity between the **ground** circuit cavity of the combination flasher connector and a good ground. There should be continuity. If OK, go to Step 7. If not OK, repair the circuit to ground as required.

(7) Disconnect the multi-function switch connector as described in this group. Check for continuity between the **combination flasher input** circuit cavities of the combination flasher connector and the multi-function switch connector. There should be continuity. If OK, go to Step 8. If not OK, repair the open circuit as required.

(8) Check for continuity between the **combination flasher output** cavities of the combination flasher connector and the multi-function switch connector. There should be continuity. If OK, test the multi-function switch as described in this group. If not OK, repair the open circuit as required.

MULTI-FUNCTION SWITCH

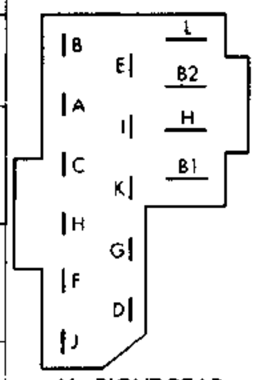
Perform the diagnosis of the hazard warning and/or turn signal systems as described in this group before testing the multi-function switch. For circuit descriptions and diagrams, see 8W-52 - Turn Signals in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect the multi-function switch connector as described in this group.

(2) Using an ohmmeter, perform the switch continuity checks at the switch terminals as shown in the Multi-Function Switch Continuity chart (Fig. 2).

SWITCH POSITION		CONTINUITY BETWEEN
TURN SIGNAL	HAZARD WARNING	
NEUTRAL	OFF	F and H F and K A and E
LEFT	OFF	F and H C and K C and I A and E
RIGHT	OFF	F and K C and H C and J A and E
NEUTRAL	ON	B and E C and H C and K C and I C and J



H - RIGHT REAR
I - LEFT FRONT
J - RIGHT FRONT
K - LEFT REAR

948J-12

Fig. 2 Multi-Function Switch Continuity

(3) If the switch fails any of the continuity checks, replace the faulty switch. If the switch is OK, repair the lighting circuits as required.

REMOVAL AND INSTALLATION

COMBINATION FLASHER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the lower steering column cover and knee blocker as described in Group 8E - Instrument Panel Systems.

REMOVAL AND INSTALLATION (Continued)

NOTE: The combination flasher and flasher mounting bracket are serviced only as a unit.

(3) Reach through the inboard side of the steering column opening and remove the screw securing the combination flasher and mounting bracket to the upper steering column mounting bracket (Fig. 3).

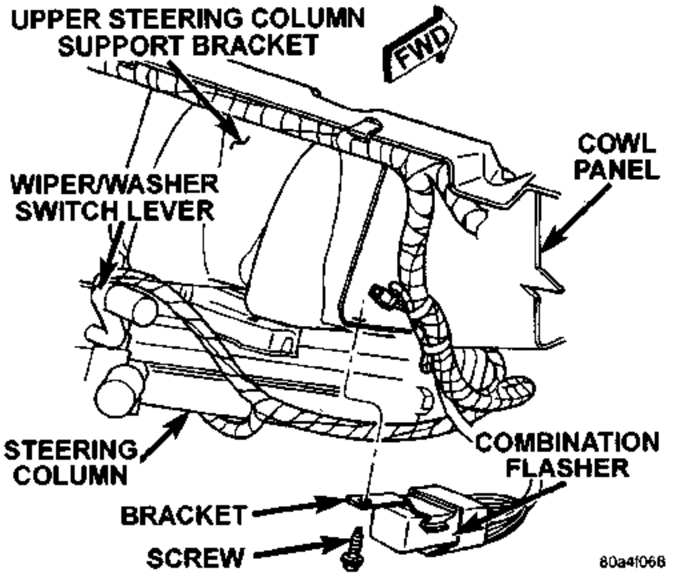


Fig. 3 Combination Flasher Remove/Install

(4) Unplug the combination flasher and bracket from the wiring connector.

(5) To install the flasher, align the terminals with the cavities in the connector and push the flasher firmly into place.

(6) Reinstall the screw securing the flasher and mounting bracket to the upper steering column mounting bracket.

(7) Reinstall the knee blocker and steering column cover as described in Group 8E - Instrument Panel Systems.

(8) Connect the battery negative cable.

(9) Test the combination flasher operation.

MULTI-FUNCTION SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column cover as described in Group 8E - Instrument Panel Systems.

(3) If the vehicle is equipped with a tilt steering column, move the column to the fully raised position.

(4) Insert the key in the ignition lock cylinder and turn the ignition switch to the On position.

(5) Insert a small screwdriver or pin punch through the access hole in the lower steering column shroud and depress the ignition lock cylinder retaining tumbler (Fig. 4).

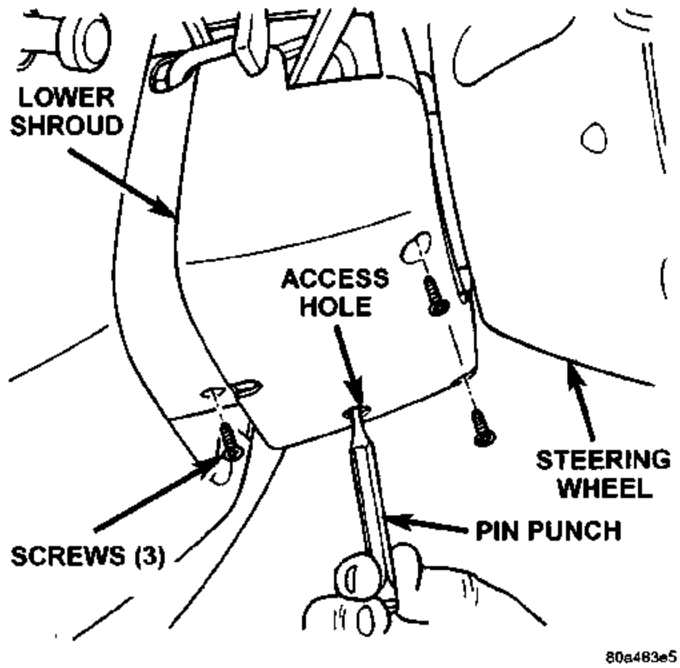


Fig. 4 Steering Column Shrouds Remove/Install

(6) While holding the retaining tumbler depressed, pull the ignition lock cylinder and key out of the ignition lock housing.

(7) Remove the three screws that secure the lower steering column shroud to the upper shroud.

(8) If the vehicle is equipped with a tilt steering column, move the column to the fully lowered position.

(9) Remove both the upper and lower shrouds from the steering column.

(10) Remove the two screws securing the switch water shield and bracket to the top of the steering column (Fig. 5).

(11) Remove the one screw located below the multi-function switch lever that secures the switch water shield and bracket to the steering column (Fig. 6).

(12) Pull the lower mounting tab of the switch water shield bracket away from the steering column far enough to clear the screw boss below the multi-function switch lever.

(13) Lift the water shield and bracket with the multi-function switch away from the steering column

REMOVAL AND INSTALLATION (Continued)

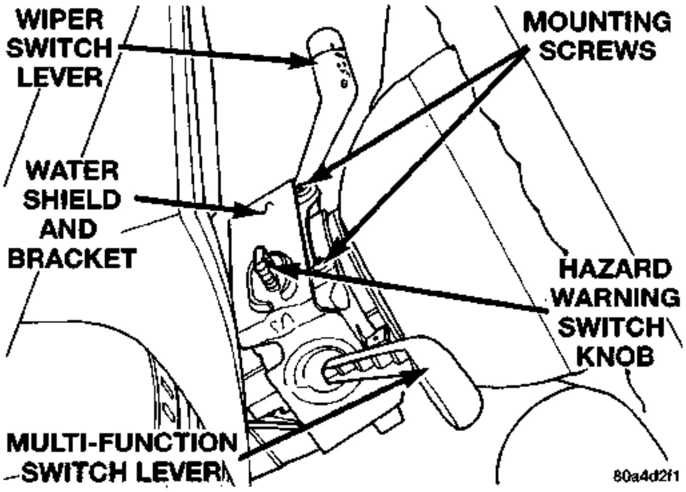


Fig. 5 Water Shield Upper Screws Remove/Install

far enough to unplug the two multi-function switch wiring connectors.

(14) Remove the multi-function switch and water shield from the steering column as a unit.

(15) Gently pull the water shield over the hazard warning switch knob and the multi-function switch lever.

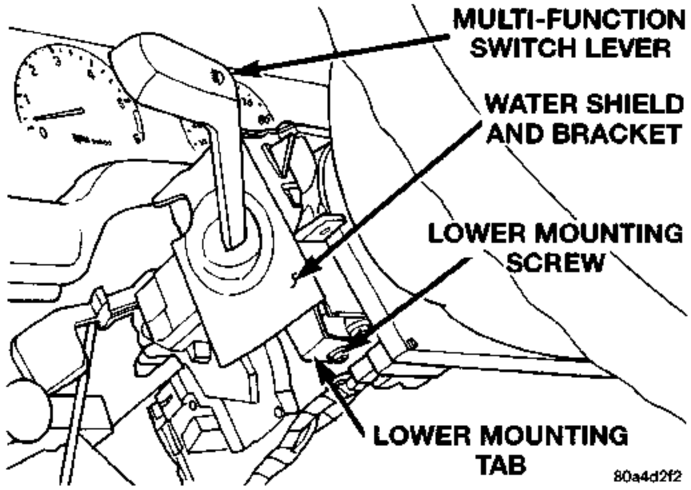


Fig. 6 Water Shield Lower Screw Remove/Install

(16) Reverse the removal procedures to install.

WIPER AND WASHER SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Following are general descriptions of the major components in the wiper and washer systems. Refer to 8W-53 - Wipers in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

NOTE: This group covers both Left-Hand Drive (LHD) and Right-Hand Drive (RHD) versions of this model. Whenever required and feasible, the RHD versions of affected vehicle components have been constructed as mirror-image of the LHD versions. While most of the illustrations used in this group represent only the LHD version, the diagnostic and service procedures outlined can generally be applied to either version. Exceptions to this rule have been clearly identified as LHD or RHD, if a special illustration or procedure is required.

DESCRIPTION AND OPERATION

WINDSHIELD WIPER SYSTEM

A two-speed windshield wiper system is standard equipment on this model. An intermittent windshield wiper system is optional. The standard system lets the driver select from two wiper speeds, low or high. The intermittent wiper system adds an intermittent wiper delay feature.

The intermittent wiper system allows the driver to select a delay between wipes of from one to fifteen seconds by adjusting the knob on the end of the intermittent wiper/washer switch stalk. The intermittent wipe delay times are controlled by delay logic and relay control circuitry contained within the intermittent wiper/washer switch. The intermittent wipe relay is also contained within the switch.

The windshield wipers will operate only when the ignition switch is in the Accessory or On positions. A fuse located in the fuseblock module protects the circuitry of either wiper system. Refer to the owner's manual for more information on the wiper system controls and operation.

WINDSHIELD WASHER SYSTEM

A electrically operated windshield washer system is standard equipment. A reservoir in the engine compartment holds the washer fluid, which is pressurized by a pump when the windshield washer switch lever is actuated. The windshield washer pump feeds the pressurized washer fluid through the washer system plumbing to the windshield washer nozzles.

If the vehicle is equipped with the two-speed wiper system and the wipers are not turned on when the washers are activated, the wiper switch will be turned on to the low speed position automatically. The wipers must be turned off manually following a washer switch activation. If the vehicle is equipped with the intermittent wiper system and the wipers are not turned on when the washers are activated, the wipers will be automatically cycled for one or two wipes, then turn off.

The washers will operate only when the ignition switch is in the Accessory or On positions. A fuse located in the fuseblock module protects the circuitry of the washer system. Refer to the owner's manual

DESCRIPTION AND OPERATION (Continued)

for more information on the windshield washer system controls and operation.

REAR WIPER AND WASHER SYSTEM

A rear wiper and washer system is standard equipment on models equipped with the optional hardtop. The rear wiper system provides the following operating modes:

- Continuous fixed-cycle wipe.
- A rear washer mode.
- A park mode that operates the wiper motor until the blade reaches its park position when the rear wiper switch is placed in the Off position.

A single switch in the instrument panel accessory switch bezel controls both the rear wiper and washer functions. The rear washer system shares the reservoir of the windshield washer system, but has its own dedicated washer pump and plumbing.

These systems will operate only when the ignition switch is in the On position. A fuse in the fuseblock module protects the circuitry of both the rear wiper and washer systems. Refer to the owner's manual for more information on the rear wiper and washer system controls and operation.

WIPER ARMS AND BLADES

All models have two 33.02-centimeter (13-inch) windshield wiper blades with replaceable rubber elements (squeegees). The rear wiper uses a single 45.72-centimeter (18-inch) wiper blade with a replaceable rubber element (squeegee).

Caution should be exercised to protect the rubber squeegees from any petroleum-based cleaners or contaminants, which will rapidly deteriorate the rubber. If the squeegees are damaged, worn, or contaminated, they must be replaced.

Wiper squeegees exposed to the elements for a long time tend to lose their wiping effectiveness. Periodic cleaning of the squeegees is suggested to remove deposits of salt and road film. The wiper blades, arms, and windshield or rear glass should be cleaned with a sponge or cloth and windshield washer solvent, a mild detergent, or a non-abrasive cleaner. If the squeegees continue to streak or smear, they should be replaced.

The blades are mounted to spring-loaded wiper arms. Spring tension of the wiper arms controls the pressure applied to the blades on the glass. The windshield wiper arms are attached by an integral latch to the two wiper pivots on the cowl grille panel at the base of the windshield. The rear wiper arm is attached by an integral latch directly to the rear wiper motor output shaft on the liftglass. The wiper arms and blades cannot be adjusted or repaired. If faulty or damaged, they must be replaced.

WIPER LINKAGE AND PIVOTS

The wiper linkage and pivot module is fastened with screws to the cowl plenum panel beneath the cowl plenum cover/grille panel. The wiper motor is fastened with screws to the center of the linkage and pivot module bracket. The wiper pivots are fastened to the ends of the module bracket.

The driver side wiper pivot crank arm and the wiper motor crank arm each have ball studs on their ends. The passenger side crank arm has two ball studs. A drive link connects from the motor crank arm ball stud to one ball stud on the passenger side pivot crank arm. A connecting link connects from the other ball stud on the passenger side pivot crank arm to the driver side pivot crank arm ball stud.

Both the drive link and the connector link has a plastic socket-type bushing on each end. The socket-type bushings each are snap-fit over their respective ball studs.

The wiper linkage, pivots, bushings, motor crank arm, and mounting bracket are only serviced as a complete unit. If any part of this assembly is faulty, the entire unit must be replaced. The wiper motor is serviced separately.

WIPER MOTORS

FRONT

The two-speed permanent magnet wiper motor has an integral transmission and park switch. The motor also contains an internal automatic resetting circuit breaker to protect the motor from overloads. The motor is mounted to the wiper linkage and pivot module bracket with three screws. The motor output shaft passes through a hole in the module bracket, where a nut secures the wiper motor crank arm to the motor output shaft.

Wiper speed is controlled by current flow to the appropriate set of brushes. The wiper motor completes its wipe cycle when the wiper/washer switch stalk is moved to the Off position, and parks the blades in the lowest portion of the wipe pattern. The wiper motor cannot be repaired. If faulty, the entire wiper motor assembly must be replaced. The linkage and pivot module is available for service.

REAR

The rear wiper motor is mounted on the inside of the liftglass with a slotted bracket that fits onto a grommet under the right liftglass hinge mounting nut. The motor output shaft passes through the liftglass where a gasket, bezel, and nut, seal and secure the unit to the outside of the liftglass. The rear wiper arm is mounted directly to the motor output shaft.

The rear wiper motor unit contains an internal park switch. The motor also contains an automatic resetting thermal switch for overload protection. The

DESCRIPTION AND OPERATION (Continued)

rear wiper motor cannot be repaired. If faulty, the entire wiper motor assembly must be replaced.

WIPER AND WASHER SWITCHES

FRONT

The windshield wiper and washer switches are mounted on the right side of the steering column (Fig. 1). A switch stalk is moved up or down to select the wiper switch mode, and pulled towards the steering wheel to activate the washer system. Models with the intermittent wiper system also have a knob on the end of the switch stalk, which is rotated to select the desired delay interval. The wiper/washer switch contains circuitry for the following functions:

- Windshield wipers
- Intermittent wiper delay relay control and logic (if equipped)
- Intermittent wipe relay (if equipped)
- Windshield washers.

The windshield wiper/washer switch cannot be repaired. If any function of the switch is faulty, the entire switch assembly must be replaced.

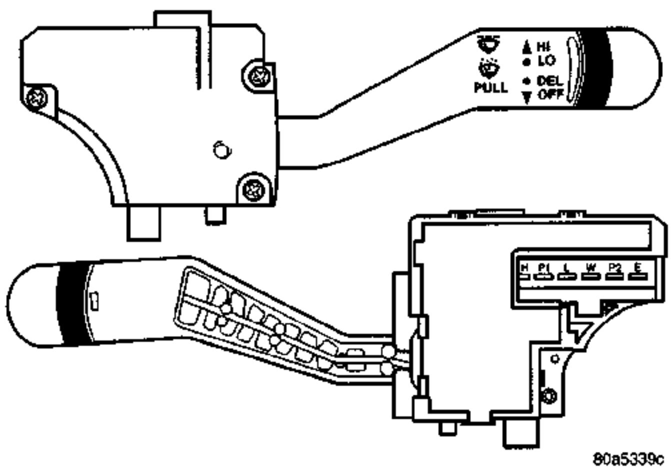


Fig. 1 Windshield Wiper/Washer Switch

REAR

The single two-function rear wiper/washer switch is installed in the instrument panel accessory switch bezel, which is located near the bottom of the instrument panel center bezel next to the ash receiver. The rear wiper switch controls the rear wiper and washer functions. The toggle-type switch features a detent in the On position, and a momentary wash position. The rear wiper/washer switch also has an integral illumination lamp with a serviceable bulb.

The switch knob is pushed down to its detent to activate the rear wiper system, and down again to the momentary position to activate the rear washer system. Both the rear wiper and rear washer motors will operate continuously for as long as the switch is held in the momentary Wash position. Lift upward on the switch knob to turn the rear wiper system off.

The rear wiper switch cannot be repaired and, if faulty, the switch unit must be replaced.

WASHER RESERVOIR

A single washer fluid reservoir is used for both the front and rear washer systems. The washer fluid reservoir is mounted to the inner fender shield, in the engine compartment.

Each washer pump and motor unit has a barbed nipple, which is installed through a rubber grommet seal inserted in a hole near the bottom of the reservoir. The washer pumps are retained by an interference fit between the barbed nipple and the grommet seal, which is a light press fit.

The reservoir and filler cap are each available for service.

WASHER PUMPS

The washer pumps and motors are mounted near the bottom of the washer reservoir. A barbed nipple on the pump housing passes through a grommet seal in the reservoir. The washer pumps are retained by an interference fit between the barbed nipple and the grommet seal, which is a light press fit.

A permanently lubricated and sealed motor is coupled to a rotor-type pump. Washer fluid is gravity-fed from the reservoir to the pump. The pump then pressurizes the fluid and forces it through the plumbing to the nozzles, when the pump motor is energized.

The washer pump and motor unit cannot be repaired. If faulty, the entire washer pump and motor unit must be replaced.

WASHER NOZZLES AND PLUMBING

FRONT

Pressurized washer fluid is fed through a single hose, attached to a nipple on the front washer pump, to a tee fitting located near the rear inner hood panel reinforcement. Hoses from the tee fitting are routed to the two nozzles, which are snapped into openings in the hood panel below the windshield.

The two washer nozzles each emit two streams of washer fluid into the wiper pattern (Fig. 2). If the aim of the washer fluid streams is unacceptable, each stream can be adjusted using a pin inserted in the nozzle orifice to rotate the nozzle ball. The nozzles cannot be repaired and, if faulty, they must be replaced.

REAR

Pressurized washer fluid is fed through a single hose, attached to a nipple on the rear washer pump, to the liftglass. The hose is routed, from the front of the vehicle to the liftglass, with the body wiring har-

DESCRIPTION AND OPERATION (Continued)

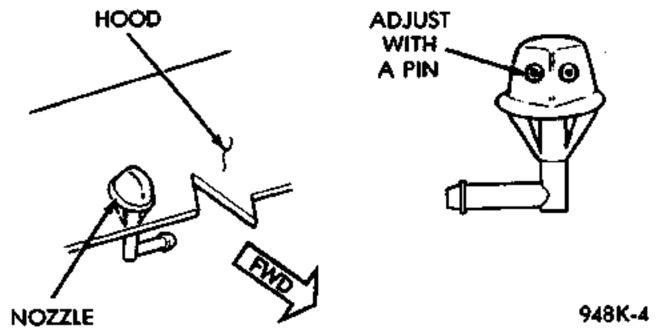


Fig. 2 Windshield Washer Nozzles

ness. At the rear corner of the body, the hose connects to a check valve, which prevents washer fluid drain-back or siphoning from occurring.

There is also a washer hose cap attached to the hose near the check valve (Fig. 3). The cap is to be used to plug the washer hose after the hose is disconnected from the check valve when the hardtop is removed.

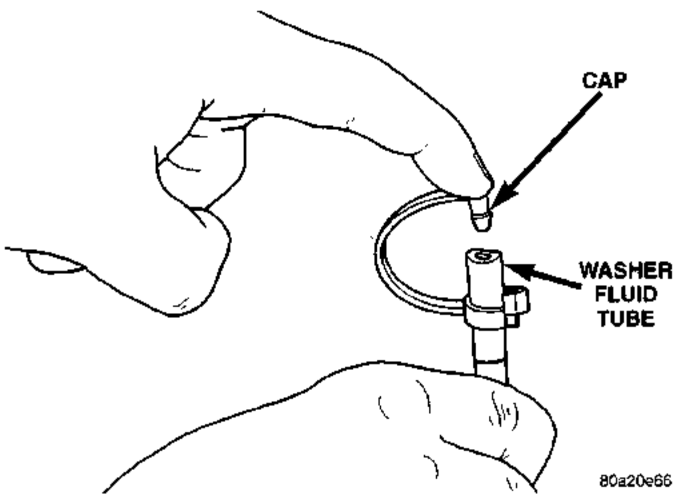


Fig. 3 Rear Washer Hose Cap

From the check valve, another single hose is routed through the rear liftglass opening reinforcements of the hardtop to the rear wiper motor cover. Behind the wiper motor cover, the hose attaches to the rear washer nozzle nipple.

The fluidic rear washer nozzle and a seal are installed through a hole in the liftglass near the wiper motor from the outside. The nozzle is secured on the inside of the glass by a plastic hex nut. The nozzle and check valve cannot be adjusted or repaired and, if faulty, they must be replaced.

DIAGNOSIS AND TESTING

WIPER SYSTEMS

FRONT

For circuit descriptions and diagrams, refer to 8W-53 - Wipers in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the fuseblock module. If OK, go to Step 2. If not OK, replace the faulty fuse.

(2) Unplug the windshield wiper/washer switch connector. Turn the ignition switch to the Accessory or On position. Check for battery voltage at the **fused ignition switch output (run/acc)** circuit cavity of the wiper/washer switch connector. If OK, go to Step 3. If not OK, repair the open circuit to the fuseblock module as required.

(3) If the vehicle is equipped with the intermittent wiper system and the problem being diagnosed involves only the pulse wipe, wipe-after-wash, or intermittent wipe modes, go to Step 4. If not, go to Step 5.

(4) Turn the ignition switch to the Off position. Check for continuity between the **ground** circuit cavity of the wiper/washer switch connector. There should be continuity. If OK, replace the faulty switch. If not OK, repair the open circuit to ground as required.

(5) Turn the ignition switch to the Off position. Check the windshield wiper/washer switch continuity as described in this group. If OK, go to Step 6. If not OK, replace the faulty switch.

(6) Unplug the windshield wiper motor connector. Check for continuity between the **ground** circuit cavity in the body half of the wiper motor connector and a good ground. There should be continuity. If OK, go to Step 7. If not OK, repair the open circuit to ground as required.

(7) Turn the ignition switch to the Accessory or On position. Check for battery voltage at the **fused ignition switch output (run/acc)** circuit cavity in the body half of the wiper motor connector. If OK, go to Step 8. If not OK, repair the open circuit to the fuseblock module as required.

(8) Turn the ignition switch to the Off position. With the windshield wiper/washer switch connector still unplugged, check the cavities for each of the fol-

DIAGNOSIS AND TESTING (Continued)

lowing circuits in the body half of the wiper motor connector for continuity to ground. In each case, there should be no continuity. If OK, go to Step 9. If not OK, repair the short circuit as required.

- **wiper park switch sense**
- **wiper switch low speed output**
- **wiper switch high speed output.**

(9) With the ignition switch still in the Off position, check for continuity between the cavities in the body half of the wiper motor connector and the cavities in the wiper/washer switch connector for each of the following circuits. In each case, there should be continuity. If OK, replace the faulty wiper motor. If not OK, repair the open circuit as required.

- **wiper park switch sense**
- **wiper switch low speed output**
- **wiper switch high speed output.**

REAR

For circuit descriptions and diagrams, refer to 8W-53 - Wipers in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the fuseblock module. If OK, go to Step 2. If not OK, replace the faulty fuse.

(2) Remove the rear wiper/washer switch and unplug the wiring connector. Turn the ignition switch to the On position. Check for battery voltage at the **rear washer switch output** circuit cavity of the rear wiper/washer switch connector. If OK, go to Step 3. If not OK, repair the open circuit to the fuseblock module as required.

(3) Turn the ignition switch to the Off position. Check for continuity between the **ground** circuit cavity of the rear wiper washer switch connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit to ground as required.

(4) Check the continuity of the rear wiper/washer switch as described in this group. If OK, go to Step 5. If not OK, replace the faulty switch.

(5) Remove the rear wiper motor cover and unplug the rear wiper motor connector. Turn the ignition switch to the On position. Check for battery voltage at the **fused ignition switch output (run)** circuit cavity of the rear wiper motor connector. If OK, go to Step 6. If not OK, repair the open circuit to the fuseblock module as required.

(6) Turn the ignition switch to the Off position. Check for continuity between the **ground** circuit cavity of the rear wiper motor connector and a good ground. There should be continuity. If OK, go to Step 7. If not OK, repair the open circuit to ground as required.

(7) With the ignition switch still in the Off position and the rear wiper/washer switch still unplugged, check for continuity between the **rear wiper motor control** circuit cavity of the rear wiper motor connector and a good ground. There should be no continuity. If OK, go to Step 8. If not OK, repair the short circuit as required.

(8) Check for continuity between the **rear wiper motor control** circuit cavities of the rear wiper motor connector and the rear wiper/washer switch connector. There should be continuity. If OK, replace the faulty rear wiper motor. If not OK, repair the open circuit as required.

WASHER SYSTEMS

FRONT

The diagnosis found here addresses an inoperative washer pump. If the washer pump operates, but no washer fluid is emitted from the washer nozzles, be certain to check the fluid level in the reservoir. Check for ice or other foreign material in the reservoir, and for pinched, disconnected, broken, or incorrectly routed washer system plumbing. For circuit descriptions and diagrams, refer to 8W-53 - Wipers in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Turn the ignition switch to the On position. Turn the wiper switch to the Low or High speed position. Check whether the wipers operate. If OK, go to Step 2. If not OK, see the Windshield Wiper System diagnosis in this group.

(2) Turn the ignition switch to the Off position. Unplug the front washer pump wiring connector. Check for continuity between the **ground** circuit cavity of the washer pump connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit to ground as required.

(3) Turn the ignition switch to the On position. Check for battery voltage at the **front washer switch output** circuit cavity of the washer pump

DIAGNOSIS AND TESTING (Continued)

connector while actuating the washer switch. If OK, replace the faulty washer pump. If not OK, go to Step 4.

(4) Turn the ignition switch to the Off position. Leave the front washer pump connector unplugged. Unplug the windshield wiper/washer switch connector. Check for continuity between the **front washer switch output** circuit cavity of the washer pump connector and a good ground. There should be no continuity. If OK, go to Step 5 If not OK, repair the short circuit as required.

(5) Check for continuity between the **front washer switch output** circuit cavities of the washer pump connector and the wiper washer switch connector. There should be continuity. If OK, replace the faulty switch. If not OK, repair the open circuit as required.

REAR

The diagnosis found here addresses an inoperative washer pump. If the washer pump operates, but no washer fluid is emitted from the washer nozzles, be certain to check the fluid level in the reservoir. Check for ice or other foreign material in the reservoir, and for pinched, disconnected, broken, or incorrectly routed washer system plumbing. For circuit descriptions and diagrams, refer to 8W-53 - Wipers in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Turn the ignition switch to the On position. Place the rear wiper/washer switch in the Wipe position. Check whether the rear wiper is operating. If OK, go to Step 2. If not OK, see the Rear Wiper System diagnosis in this group.

(2) Turn the ignition switch to the Off position and unplug the rear washer pump wiring connector. Check for continuity between the **ground** circuit cavity of the pump connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit to ground as required.

(3) Turn the ignition switch to the On position. Depress the rear washer switch. Check for battery voltage at the **rear washer motor control** circuit cavity of the rear washer pump connector. If OK, replace the faulty pump. If not OK, go to Step 4.

(4) Turn the ignition switch to the Off position. Leave the rear washer pump connector unplugged. Remove the rear wiper/washer switch and unplug the wiring connector. Check for continuity between the **rear washer motor control** circuit cavity of the rear washer pump connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the short circuit as required.

(5) Check for continuity between the **rear washer motor control** circuit cavities of the rear washer pump connector and the rear wiper/washer switch connector. There should be continuity. If OK, replace the faulty switch. If not OK, repair the open circuit as required.

WIPER AND WASHER SWITCHES

FRONT

Perform the diagnosis for the wiper and/or washer systems as described in this group before testing the wiper/washer switch. For circuit descriptions and diagrams, see 8W-53 - Wipers in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the windshield wiper/washer switch connector as described in this group.

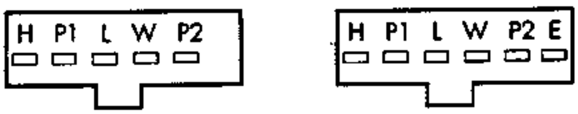
(3) Using an ohmmeter, perform the switch continuity checks at the switch terminals as shown in the chart (Fig. 4).

(4) If the switch fails any of the continuity checks, replace the faulty switch.

REAR

Perform the diagnosis for the rear wiper and/or washer systems as described in this group before testing the rear wiper/washer switch. For circuit descriptions and diagrams, see 8W-53 - Wipers in Group 8W - Wiring Diagrams.

DIAGNOSIS AND TESTING (Continued)



TWO SPEED WIPER SWITCH PINS

INTERMITTENT WIPER SWITCH PINS

SWITCH POSITION	CONTINUITY BETWEEN
OFF	PIN P2 and PIN L
LOW	PIN P1 and PIN L
HIGH	PIN P1 and PIN H
WASH	PIN P1 and PIN W
INTERMITTENT	CANNOT BE CHECKED

948K-38

Fig. 4 Windshield Wiper/Washer Switch Continuity

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the rear wiper/washer switch as described in this group.

(2) Using an ohmmeter, check the switch continuity at the switch terminals as shown in the chart (Fig. 5).

(3) If the switch fails any of the continuity checks, replace the faulty switch.

REMOVAL AND INSTALLATION

WIPER BLADES AND ELEMENTS

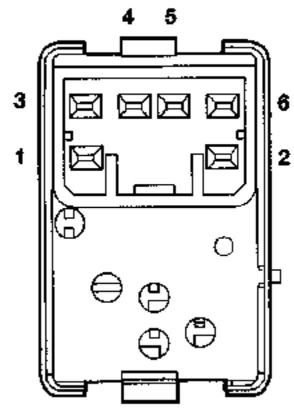
FRONT

NOTE: The notched retainer end of the wiper element should always be oriented towards the end of the wiper blade that is nearest to the wiper pivot.

To remove the wiper blade and/or element, proceed as follows:

(1) Lift the wiper arm to raise the wiper blade and element off of the windshield glass.

(2) Remove the wiper blade from the wiper arm, or the wiper element from the wiper blade as follows:



SWITCH POSITION	CONTINUITY BETWEEN
OFF	1 AND 4
WIPE	4 AND 5
WASH	2 AND 5, 4 AND 5
ILLUMINATION LAMP	1 AND 3

80a5035e

Fig. 5 Rear Wiper/Washer Switch Continuity

(a) To remove the wiper blade from the wiper arm, push the release tab under the arm tip and slide the blade away from the tip towards the pivot end of the arm (Fig. 6).

(b) To remove the wiper element from the wiper blade, pinch the notched retainer (pivot) end of the wiper element tightly between the thumb and forefinger. Then, pull the element firmly towards the wiper pivot until the notched retainer of the wiper element clears the wiper blade claw. Once the notched retainer is released from the claw, the element will slide easily out of the remaining claws.

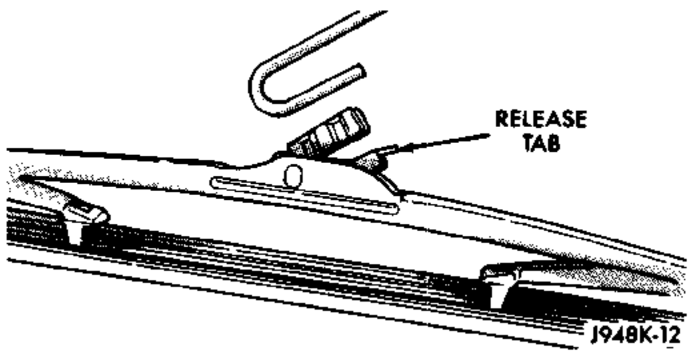


Fig. 6 Front or Rear Wiper Blade Remove/Install - Typical

(3) Install the wiper blade on the wiper arm, or the wiper element in the wiper blade as follows:

(a) To install the wiper blade on the wiper arm, slide the blade retainer into the U-shaped formation on the tip of the wiper arm until the release tab snaps into its locked position. Be certain that the notched retainer for the wiper element is ori-

REMOVAL AND INSTALLATION (Continued)

ented towards the end of the wiper blade that is nearest to the wiper pivot.

(b) To install the wiper element in the wiper blade, start at the wiper pivot end of the blade and slide the element through each pair of wiper blade claws. The element is fully installed when the notched retainer on the wiper element is engaged with the claws on the wiper pivot end of the wiper blade.

REAR

NOTE: The notched retainer end of the wiper element should always be oriented towards the end of the wiper blade that is nearest to the wiper pivot.

To remove the wiper blade and/or element, proceed as follows:

(1) Lift the wiper arm to raise the wiper blade and element off of the liftglass.

(2) Remove the wiper blade from the wiper arm, or the wiper element from the wiper blade as follows:

(a) To remove the wiper blade from the wiper arm, push the release tab under the arm tip and slide the blade away from the tip towards the pivot end of the arm (Fig. 6).

(b) To remove the wiper element from the wiper blade, pinch the notched (pivot) end release clip of the wiper element tightly between the thumb and forefinger. Then, pull the element firmly towards the wiper pivot to release the wiper element release clip from the wiper blade claw. Once the clip is released from the claw, the element will slide easily out of the remaining claws.

(3) Install the wiper blade on the wiper arm, or the wiper element in the wiper blade as follows:

(a) To install the wiper blade on the wiper arm, slide the blade retainer into the U-shaped formation on the tip of the wiper arm until the release tab snaps into its locked position. Be certain that the pinch-release clip for the wiper element is oriented towards the end of the wiper blade that is nearest to the wiper pivot.

(b) To install the wiper element in the wiper blade, start at the wiper pivot end of the blade and slide the element through each pair of wiper blade claws. The element is fully installed when the claws on the wiper pivot end of the blade are engaged in the wiper element retaining clip notches.

WIPER ARMS

CAUTION: The use of a screwdriver or other prying tool to remove a wiper arm may distort it. This distortion could allow the arm to come off of the pivot shaft, regardless of how carefully it is installed.

FRONT

(1) Lift the wiper arm to permit the latch to be pulled out to its holding position, then release the arm (Fig. 7). The arm will remain off the windshield with the latch in this position.

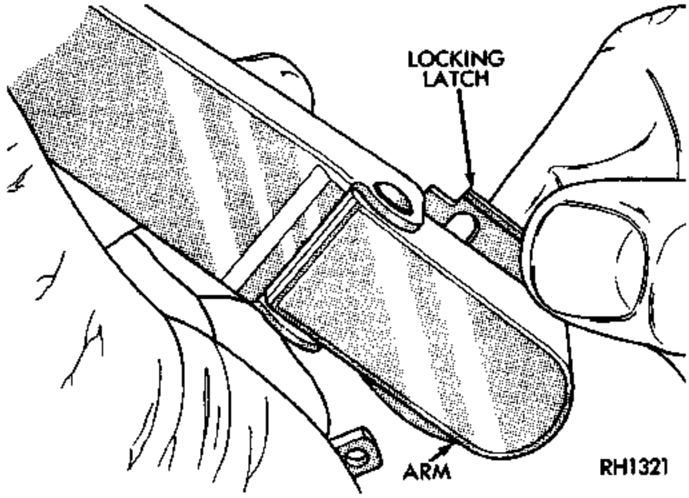


Fig. 7 Wiper Arm Remove/Install

(2) Remove the arm from the pivot using a rocking motion.

(3) Install the arm and blade with the wiper motor in the Park position. See the Wiper Arm Installation illustration (Fig. 8). Mount the arms on the pivot shafts so that the tip of the wiper blade is on the upper edge of the lower windshield blackout area, +15 mm –0 mm (+0.59 in. –0 in.).

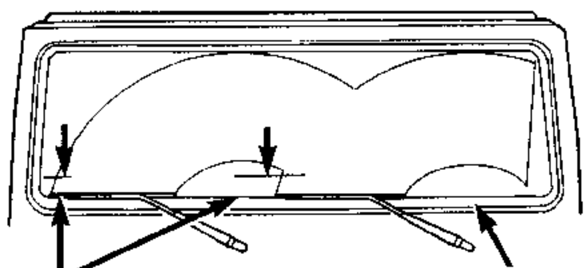


Fig. 8 Front Wiper Arm Installation

(4) Lift the wiper arm away from the windshield slightly to relieve the spring tension on the locking latch. Push the latch into the locked position and slowly release the arm until the wiper blade rests on the windshield.

(5) Operate the wipers with the windshield glass wet, then turn the wiper switch to the Off position. Check for the correct wiper arm positioning and readjust if required.

REMOVAL AND INSTALLATION (Continued)

REAR

(1) Lift the wiper arm to permit the latch to be pulled out to its holding position, then release the arm (Fig. 7). The arm will remain off the liftglass with the latch in this position.

(2) Remove the wiper arm from the motor output shaft using a rocking motion.

(3) Install the rear wiper arm with the wiper motor in the Park position. Place the rear wiper blade on the glass so that it is parallel to or tipped down from the upper edge of the glass a maximum of 80 mm (3.14 in.) (Fig. 9).

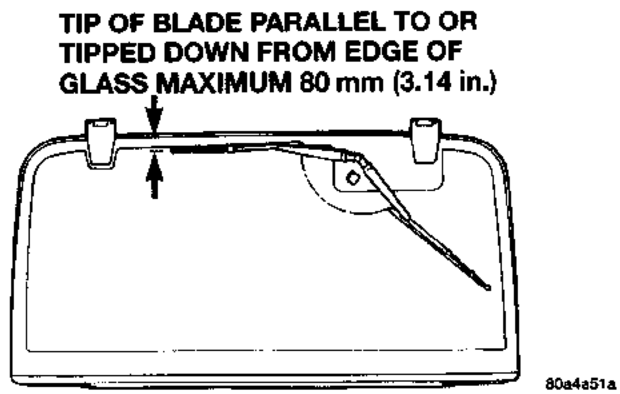


Fig. 9 Rear Wiper Arm Installation

(4) Lift the wiper arm away from the liftglass slightly to relieve the spring tension on the locking latch. Push the latch into the locked position and slowly release the arm until the wiper blade rests on the liftglass.

(5) Operate the wipers with the liftglass wet, then turn the wiper switch to the Off position. Check for the correct wiper arm positioning and readjust if required.

WIPER LINKAGE AND PIVOTS

The wiper linkage and pivots can only be removed from the vehicle as a unit with the wiper motor. See Wiper Motor in this group for the service procedures.

WIPER MOTOR

FRONT

(1) Disconnect and isolate the battery negative cable.

(2) Remove the wiper arms as described in this group.

(3) Open the hood and pull back each end of the hood seal from the dash panel to cowl plenum panel pinch weld far enough to remove one screw on each outboard end of the cowl plenum cover/grille panel (Fig. 10).

(4) Close the hood and remove the one screw in the top center of the cowl plenum cover/grille panel.

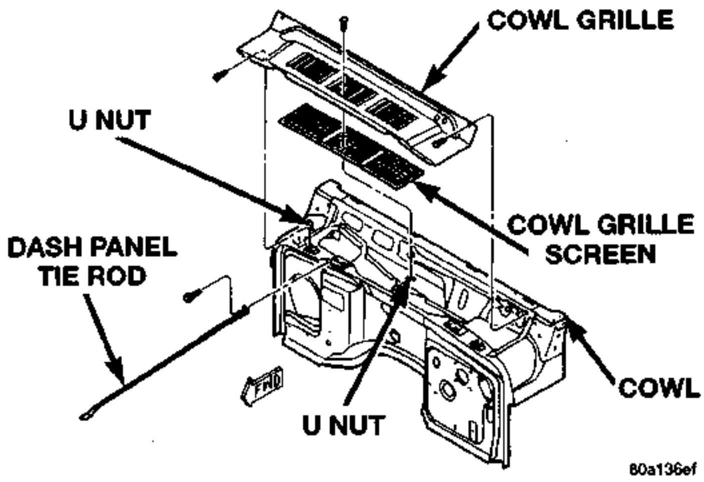


Fig. 10 Cowl Plenum Cover/Grille Panel Remove/Install

(5) Remove four screws securing the cowl plenum cover/grille panel near the base of the windshield.

(6) Carefully remove the cowl plenum cover/grille panel from the vehicle, so as not to damage the paint around the pivot openings of the panel.

(7) Reach into the cowl plenum and unplug the wiper motor wiring connector.

(8) Remove the three wiper linkage cowl mounting bracket screws (Fig. 11).

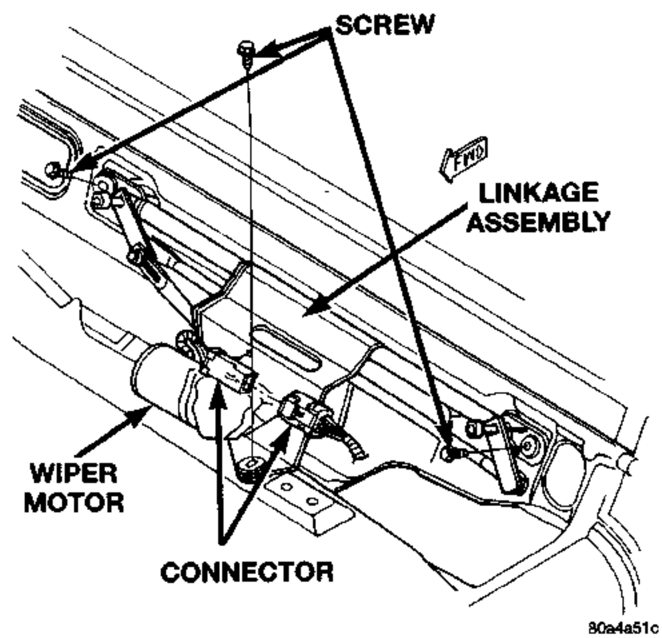


Fig. 11 Wiper Linkage Assembly Remove/Install

(9) Remove the motor and linkage assembly from the cowl plenum as a unit.

(10) Release the retainer securing the wiper motor connector to the wiper linkage assembly bracket.

REMOVAL AND INSTALLATION (Continued)

(11) Turn the linkage and motor assembly over and remove the nut holding the wiper motor crank arm to the output shaft.

(12) Remove the three screws holding the motor to the linkage assembly bracket and remove the motor.

(13) Reverse the removal procedures to install.

REAR

(1) Disconnect and isolate the battery negative cable.

(2) From the outside of the liftglass, remove the rear wiper arm as described in this group.

(3) Remove the motor output shaft nut (Fig. 12).

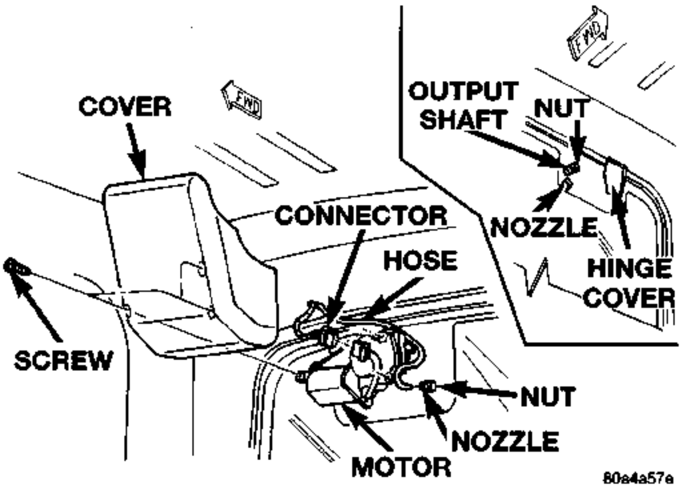


Fig. 12 Rear Wiper and Washer System

(4) Remove the external output shaft bezel and gasket.

(5) From the inside of the liftglass, remove the three screws securing the motor cover to the motor.

(6) Unplug the rear wiper motor wiring connector.

(7) Loosen, but do not remove, the right liftglass hinge nut.

(8) Pull carefully on the motor until the output shaft clears the hole in the liftglass.

(9) Move the motor towards the right side of the vehicle until the slotted hole in the motor mounting bracket clears the grommet under the right liftglass hinge nut.

(10) Remove the rear wiper motor from the vehicle.

(11) Reverse the removal procedures to install.

WIPER AND WASHER SWITCHES

FRONT

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column cover as described in Group 8E - Instrument Panel Systems.

(3) If the vehicle is equipped with a tilt steering column, move the column to the fully raised position.

(4) Insert the key in the ignition lock cylinder and turn the ignition switch to the On position.

(5) Insert a small screwdriver or pin punch through the access hole in the lower steering column shroud and depress the ignition lock cylinder retaining tumbler (Fig. 13).

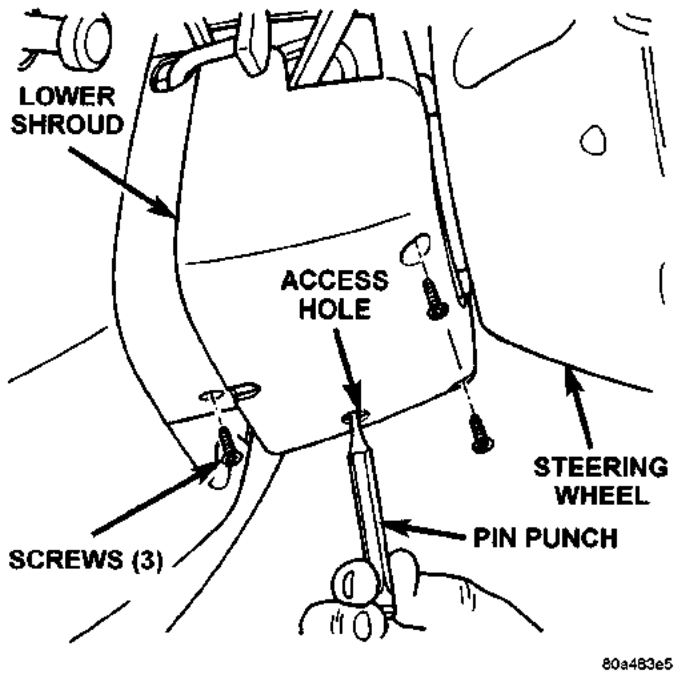


Fig. 13 Steering Column Shrouds Remove/Install

(6) While holding the retaining tumbler depressed, pull the ignition lock cylinder and key out of the ignition lock housing.

(7) Remove the three screws that secure the lower steering column shroud to the upper shroud.

(8) If the vehicle is equipped with a tilt steering column, move the column to the fully lowered position.

(9) Remove both the upper and lower shrouds from the steering column.

(10) Remove the two screws securing the switch water shield and bracket to the top of the steering column (Fig. 14).

(11) Remove the one screw located below the multi-function switch lever that secures the switch

REMOVAL AND INSTALLATION (Continued)

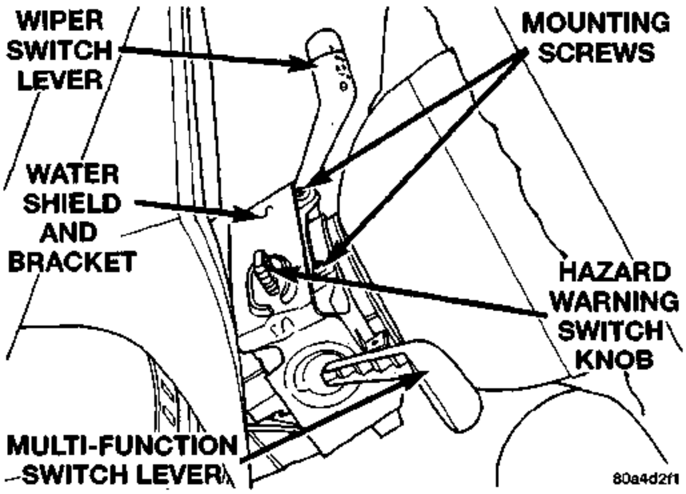


Fig. 14 Water Shield Upper Screws Remove/Install

water shield and bracket to the steering column (Fig. 15).

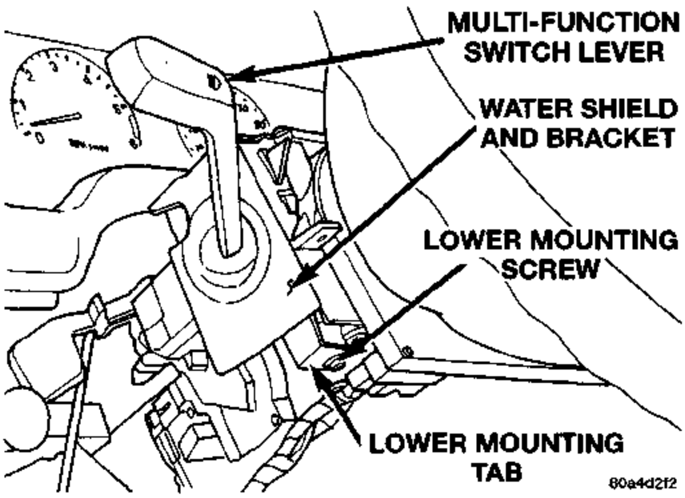


Fig. 15 Water Shield Lower Screw Remove/Install

(12) Pull the lower mounting tab of the switch water shield bracket away from the steering column far enough to clear the screw boss below the multi-function switch lever.

(13) Lift the water shield and bracket with the multi-function switch off of the left side of the steering column as a unit and move it out of the way.

(14) Gently pull the wiper/washer switch up and away from the right side of the column far enough to access the wiring connector.

(15) Unplug the wiring connector from the wiper/washer switch.

(16) Remove the wiper/washer switch from the steering column.

(17) Reverse the removal procedures to install.

REAR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Using a trim stick or another suitable wide-bladed flat tool, pry the instrument panel top cover away from the instrument panel to release the five snap clip retainers.

(3) Remove the instrument panel top cover from the vehicle.

(4) Remove the two screws that were hidden by the instrument panel top cover securing the top of the instrument panel center bezel to the instrument panel.

(5) Remove the ash receiver from the ash receiver housing (Fig. 16).

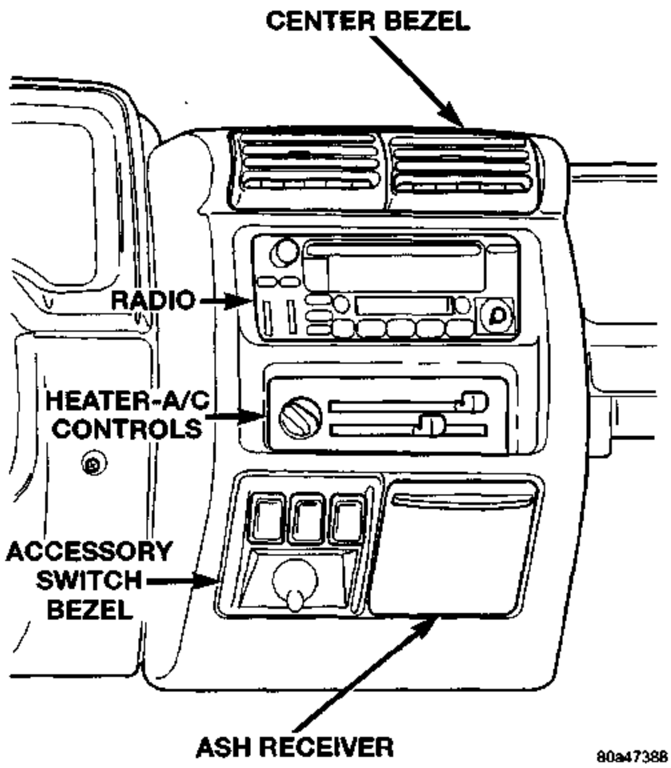


Fig. 16 Center Bezel Remove/Install

(6) Remove the one screw located in the back of the ash receiver housing securing the center bezel to the instrument panel.

(7) Pry the lower edge of the center bezel away from the instrument panel using a trim stick. Then lift the lower edge upwards to release the four snap clip retainers from the instrument panel.

REMOVAL AND INSTALLATION (Continued)

(8) Remove the four screws securing the accessory switch bezel to the instrument panel (Fig. 17).

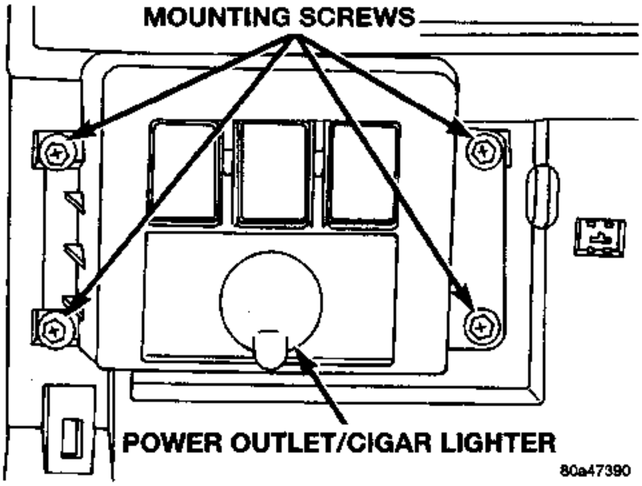


Fig. 17 Accessory Switch Bezel Remove/Install

(9) Pull the accessory switch bezel out from the instrument panel far enough to unplug the wiring connectors.

(10) Remove the accessory switch bezel from the instrument panel.

(11) Carefully pry the snap clips at the top and bottom of the rear wiper/washer switch cavity on the back of the accessory switch bezel with a small thin-bladed screwdriver and remove the switch from the bezel.

(12) Reverse the removal procedures to install. Make certain that both of the switch snap clip retainers on the back of the accessory switch bezel are fully engaged.

WASHER PUMPS AND RESERVOIR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the three screws securing the washer reservoir to the inner fender (Fig. 18).

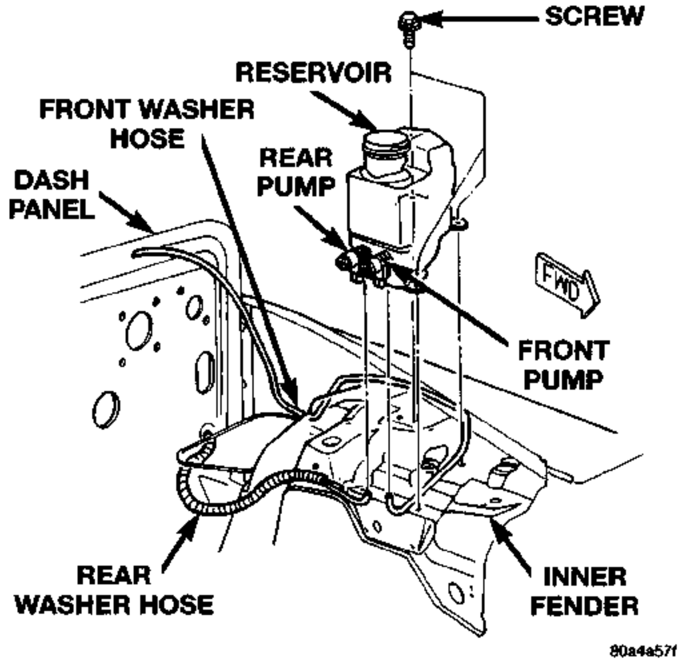


Fig. 18 Washer Reservoir & Pumps Remove/Install

(3) Lift the reservoir far enough to unplug the washer pump wiring connectors.

(4) Disconnect the hoses from the washer pumps, and drain the solvent from the reservoir into a clean container for reuse.

(5) Remove the pumps from the reservoir. They are press-fit into the reservoir grommet seals.

(6) Reverse the removal procedures to install.

LAMPS

CONTENTS

LAMP DIAGNOSIS

INDEX

GENERAL INFORMATION

GENERAL INFORMATION

Each vehicle is equipped with various lamp assemblies. A good ground is necessary for proper lighting operation. Grounding is provided by the lamp socket when it comes in contact with the metal body, or through a separate ground wire.

When changing lamp bulbs check the socket for corrosion. If corrosion is present, clean it with a wire brush and coat the inside of the socket lightly with Mopar Multi-Purpose Grease or equivalent.

SAFETY PRECAUTIONS

WARNING: EYE PROTECTION SHOULD BE USED WHEN SERVICING GLASS COMPONENTS. PERSONAL INJURY CAN RESULT.

CAUTION: Do not touch the glass of halogen bulbs with fingers or other possibly oily surface, reduced bulb life will result.

Do not use bulbs with higher candle power than indicated in the Bulb Application table at the end of this group. Damage to lamp can result.

Do not use fuses, circuit breakers or relays having greater amperage value than indicated on the fuse panel or in the Owners Manual.

When it is necessary to remove components to service another, it should not be necessary to apply excessive force or bend a component to remove it. Before damaging a trim component, verify hidden fasteners or captured edges are not holding the component in place.

DIAGNOSIS AND TESTING

DIAGNOSTIC PROCEDURES

When a vehicle experiences problems with the headlamp system, verify the condition of the battery connections, charging system, headlamp bulbs, wire connectors, relay, high beam dimmer switch and headlamp switch. Refer to Group 8W, Wiring Diagrams for component locations and circuit information.

DIAGNOSIS AND TESTING (Continued)

HEADLAMP DIAGNOSIS

HEADLAMP DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
HEADLAMPS ARE DIM WITH ENGINE IDLING OR IGNITION TURNED OFF	1. Loose or corroded battery cables. 2. Loose or worn generator drive belt. 3. Charging system output too low. 4. Battery has insufficient charge. 5. Battery is sulfated or shorted. 6. Poor lighting circuit Z1-ground. 7. Both headlamp bulbs defective.	1. Clean and secure battery cable clamps and posts. 2. Adjust or replace generator drive belt. 3. Test and repair charging system, refer to Group 8A, 4. Test battery state-of -charge , refer to Group 8A. 5. Load test battery, refer to Group 8A. 6. Test for voltage drop across Z1-ground locations, refer to Group 8W. 7. Replace both headlamp bulbs.
HEADLAMP BULBS BURN OUT FREQUENTLY	1. Charging system output too high. 2. Loose or corroded terminals or splices in circuit.	1. Test and repair charging system, refer to Group 8A. 2. Inspect and repair all connectors and splices, refer to Group 8W.
HEADLAMPS ARE DIM WITH ENGINE RUNNING ABOVE IDLE	1. Charging system output too low. 2. Poor lighting circuit Z1-ground. 3. High resistance in headlamp circuit. 4. Both headlamp bulbs defective.	1. Test and repair charging system, refer to Group 8A. 2. Test for voltage drop across Z1-ground locations, refer to Group 8W. 3. Test amperage draw of headlamp circuit. 4. Replace both headlamp bulbs.
HEADLAMPS FLASH RANDOMLY	1. Poor lighting circuit Z1-ground. 2. High resistance in headlamp circuit. 3. Faulty headlamps switch circuit breaker. 4. Loose or corroded terminals or splices in circuit.	1. Test for voltage drop across Z1-ground locations, refer to Group 8W. 2. Test amperage draw of headlamp circuit. Should not exceed 30 amps. 3. Replace headlamp switch. 4. Inspect and repair all connectors and splices, refer to Group 8W.
HEADLAMPS DO NOT ILLUMINATE	1. No voltage to headlamps. 2. No Z1-ground at headlamps. 3. Faulty headlamp switch. 4. Faulty headlamp dimmer (multi-function) switch. 5. Broken connector terminal or wire splice in headlamp circuit.	1. Repair open headlamp circuit, refer to Group 8W. 2. Repair circuit ground, refer to Group 8W. 3. Replace headlamp switch. 4. Replace multi-function switch. 5. Repair connector terminal or wire splice.

DIAGNOSIS AND TESTING (Continued)

FOG LAMP DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
FOG LAMPS ARE DIM WITH ENGINE IDLING OR IGNITION TURNED OFF.	1. Loose or corroded battery cables. 2. Loose or worn generator drive belt. 3. Charging system output too low. 4. Battery has insufficient charge. 5. Battery is sulfated or shorted. 6. Poor lighting circuit Z1-ground. 7. Both fog lamp bulbs defective.	1. Clean and secure battery cable clamps and posts. 2. Adjust or replace generator drive belt. 3. Test and repair charging system, refer to Group 8A. 4. Test battery state-of-charge, refer to Group 8A. 5. Load test battery, refer to Group 8A. 6. Test for voltage drop across Z1-ground locations, refer to Group 8W. 7. Replace both lamp bulbs.
FOG LAMP BULBS BURN OUT FREQUENTLY.	1. Charging system output too high. 2. Loose or corroded terminals or splices in circuit.	1. Test and repair charging system, refer to Group 8A. 2. Inspect and repair all connectors and splices, refer to Group 8W.
FOG LAMPS ARE DIM WITH ENGINE RUNNING ABOVE IDLE.	1. Charging system output too low. 2. Poor fog lamp circuit ground. 3. High resistance in fog lamp circuit. 4. Both fog lamp bulbs defective.	1. Test and repair charging system, refer to Group 8A. 2. Test voltage drop across Z1-ground, refer to Group 8W. 3. Test amperage draw of fog lamp circuit. 4. Replace both fog lamp bulbs.
FOG LAMPS FLASH RANDOMLY.	1. Poor fog lamp circuit ground. 2. High resistance in fog lamp circuit. 3. Faulty fog lamp switch circuit breaker. 4. Loose or corroded terminals or splices in circuit.	1. Repair circuit ground, refer to Group 8W. 2. Test amperage draw of fog lamp circuit. 3. Replace fog lamp switch. 4. Repair connector terminals or splices, refer to Group 8W.
FOG LAMPS DO NOT ILLUMINATE.	1. Blown fuse for fog lamps. 2. No ground at fog lamps. 3. Faulty fog lamp switch. 4. Broken connector terminal or wire splice in fog lamp circuit.	1. Replace fuse, refer to group 8W. 2. Repair circuit ground, refer to Group 8W. 3. Replace fog lamp switch. 4. Repair connector terminal or wire splices.

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DIAGNOSIS AND TESTING (Continued)

DAYTIME RUNNING LAMP DIAGNOSIS

DAYTIME RUNNING LAMP DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
DAYTIME RUNNING LAMPS DO NOT WORK	1. Poor connection at DRL module. 2. Parking brake engaged. 3. Parking brake circuit shorted to ground. 4. Headlamp circuit shorted to ground. 5. Defective DRL module.	1. Secure connector on DRL module. 2. Disengage parking brake. 3. Check voltage on pin 3 of module, refer to Group 8W. 4. Check L3 circuit, refer to Group 8W. 5. Replace DRL module.

HEADLAMP ALIGNMENT

INDEX

GENERAL INFORMATION

HEADLAMP ALIGNMENT

Headlamps can be aligned using the screen method provided in this section. Alignment Tool C-4466-A or equivalent can also be used. Refer to instructions provided with the tool for proper procedures. **The preferred headlamp alignment setting is 0 for the left/right adjustment and 1″ down for the up/down adjustment.**

SERVICE PROCEDURES

HEADLAMP ALIGNMENT PREPARATION

(1) Verify headlamp dimmer switch and high beam indicator operation.

(2) 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.

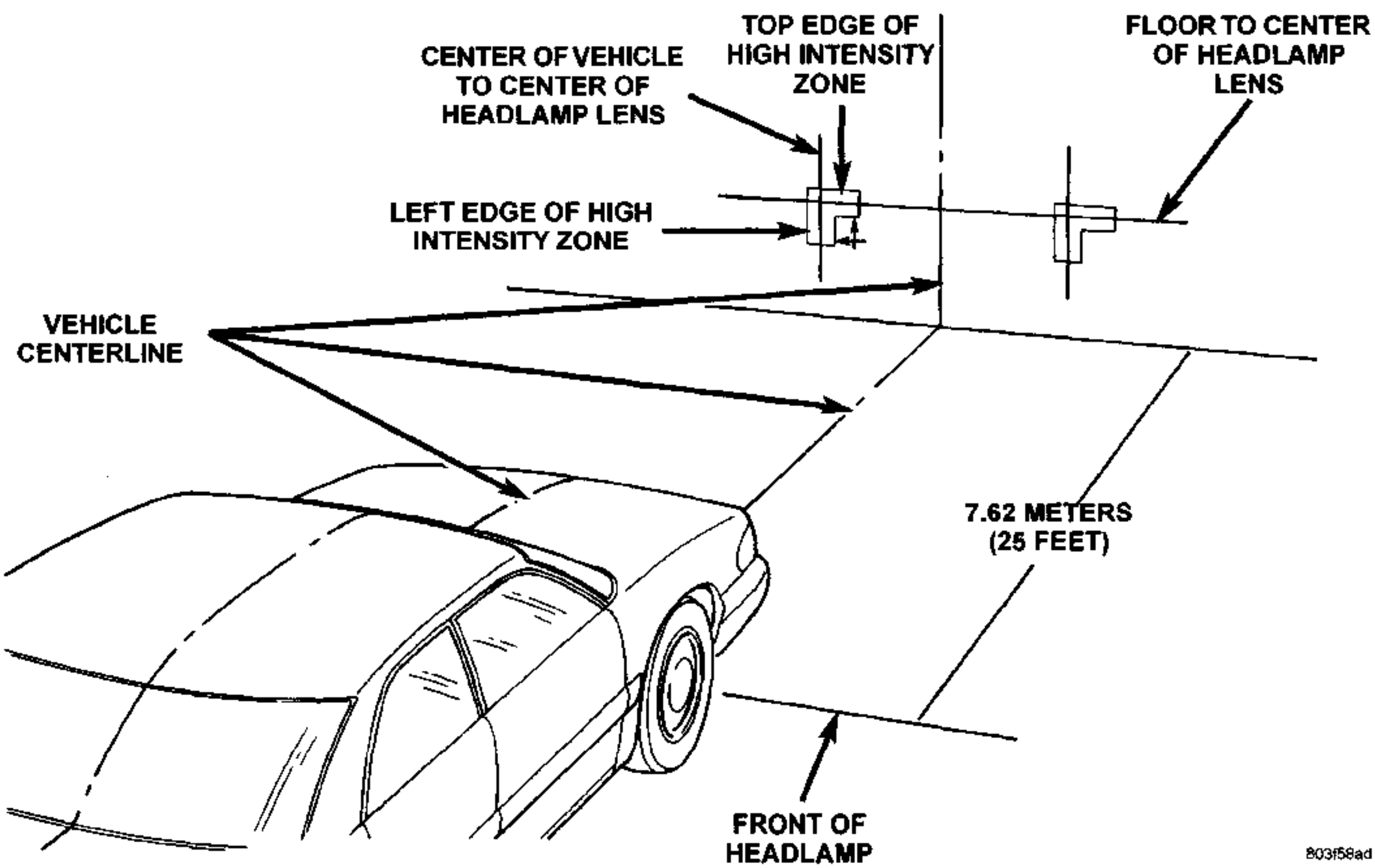


Fig. 1 Headlamp Alignment Screen—Typical

SERVICE PROCEDURES (Continued)

ALIGNMENT SCREEN PREPARATION

(1) Position vehicle on a level surface perpendicular to a flat wall 7.62 meters (25 ft) away from front of headlamp lens (Fig. 1).

(2) If necessary, tape a line on the floor 7.62 meters (25 ft) away from and parallel to the wall.

(3) Measure from the floor up 1.27 meters (5 ft) and tape a line on the wall at the centerline of the vehicle. Sight along the centerline of the vehicle (from rear of vehicle forward) to verify accuracy of the line placement.

(4) Rock vehicle side-to-side three times to allow suspension to stabilize.

(5) Jounce front suspension three times by pushing downward on front bumper and releasing.

(6) Measure the distance from the center of headlamp lens to the floor. Transfer measurement to the alignment screen (with tape). Use this line for up/down adjustment reference.

(7) Measure distance from the centerline of the vehicle to the center of each headlamp being aligned. Transfer measurements to screen (with tape) to each side of vehicle centerline. Use these lines for left/right adjustment reference.

HEADLAMP ADJUSTMENT

(1) Clean front of the headlamps.

(2) Place headlamps on LOW beam.

(3) Cover front of the headlamp that is not being adjusted.

(4) Turn the upper, outboard (up/down) adjustment screw (Fig. 2) until the headlamp beam pattern on screen/wall is similar to the pattern depicted in (Fig. 1).

NOTE: When using a headlamp aiming screen:

- Adjust the headlamps so that the beam horizontal position is at 0.
- Adjust the beam vertical position is 25 mm (1 in) downward from the lamp horizontal centerline.

(5) Rotate the lower, inboard (left/right) adjustment screw (Fig. 2) until the headlamp beam pattern on the aiming screen/wall similar to the pattern in (Fig. 1).

(6) Cover front of the headlamp that has been adjusted and adjust the other headlamp beam as instructed above.

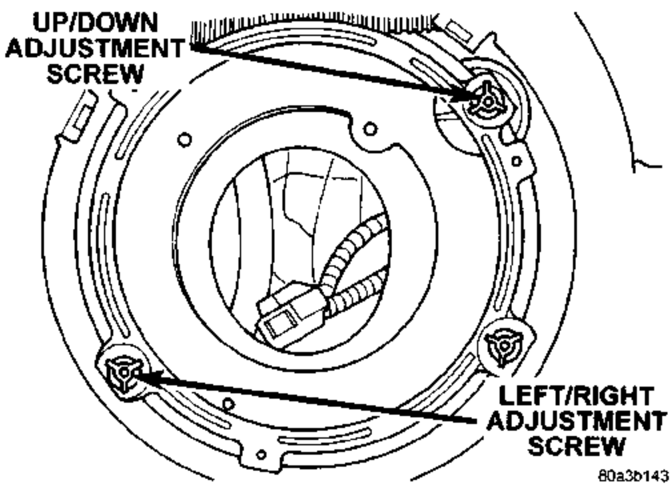


Fig. 2 Headlamp Adjustment Screws

SERVICE PROCEDURES (Continued)

FOG LAMP ADJUSTMENT

Prepare an alignment screen. Refer to Alignment Screen Preparation paragraph in this section. A properly aligned fog lamp will project a pattern on the alignment screen 100 mm (4 in.) below the fog lamp centerline and straight ahead (Fig. 3).

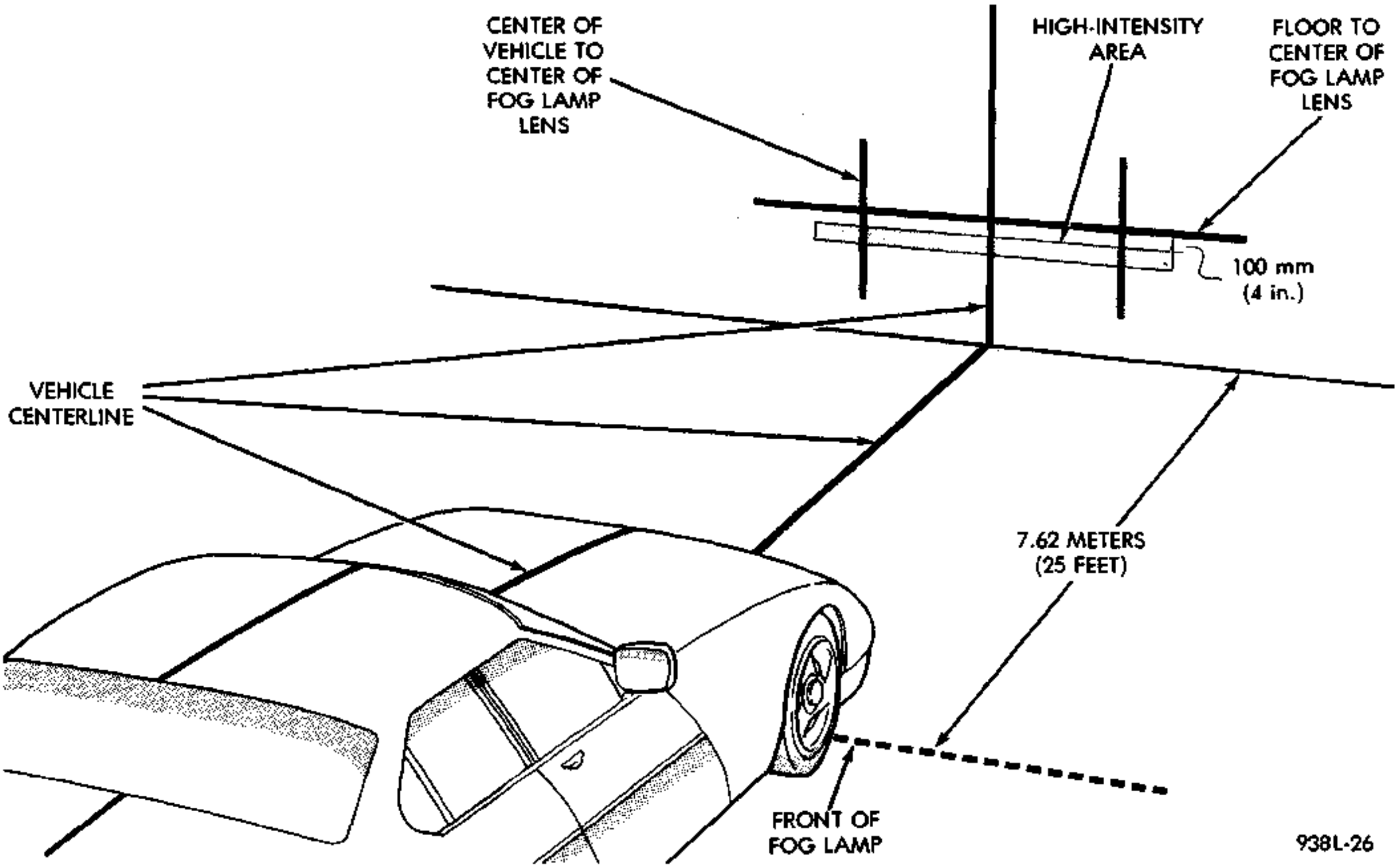
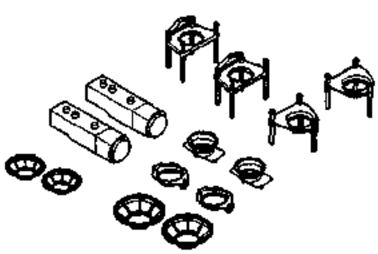


Fig. 3 Fog Lamp Alignment —Typical

SPECIAL TOOLS

SPECIAL TOOLS—HEADLAMP ALIGNMENT



Headlamp Aiming Kit C-4466–A

LAMP BULB SERVICE

INDEX

REMOVAL AND INSTALLATION

HEADLAMP BULB

The headlamp is a sealed unit. Refer to the Headlamp Removal/Installation procedure located in the Lamp Service section of this group.

FOG LAMP BULB

REMOVAL

(1) Remove the screws that attach the reflector to the lamp housing.
(2) Separate the reflector from the lamp housing.
(3) Squeeze the bulb retainer together to disengage it from the reflector.
(4) Remove the bulb/element from the reflector (Fig. 1).
(5) Disconnect the electrical connector.

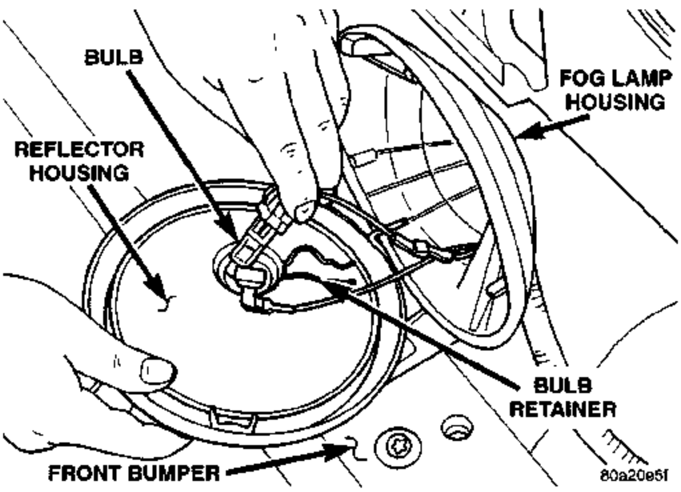


Fig. 1 Fog Lamp Bulb

INSTALLATION

CAUTION: Do not touch the bulb glass with fingers or other oily surfaces. Reduced bulb life will result.

(1) Connect the electrical connector.
(2) Position the bulb/element in the reflector.
(3) Engage the bulb retainer.
(4) Position the reflector in the lamp housing.
(5) Install the screws that attach the reflector to the lamp housing.

FRONT PARK/TURN SIGNAL LAMP BULB

REMOVAL

(1) Remove the park/turn signal lamp bulb socket via the underside of the fender. Rotate it one-third turn and separate it from the lamp housing.
(2) Turn the bulb socket and remove it from the lamp housing.
(3) Pull the bulb straight out of the socket.

INSTALLATION

(1) Install the bulb in the socket.
(2) Install the bulb and socket in the lamp housing.

SIDE MARKER LAMP BULB

REMOVAL

(1) Remove side marker bulb socket via the underside of the fender. Rotate it one-third turn and separate it from the side marker lamp housing.
(2) Remove the bulb from the socket by pulling it straight outward.

INSTALLATION

(1) Install a replacement bulb in the socket.
(2) Install the bulb and socket in the side marker lamp housing.

TAIL/TURN SIGNAL/BACK-UP LAMP BULB

REMOVAL

(1) Remove the screws attaching the lens to the tail lamp housing (Fig. 2).
(2) Separate the lens from the tail lamp housing.
(3) Remove the bulb from the lamp socket.

REMOVAL AND INSTALLATION (Continued)

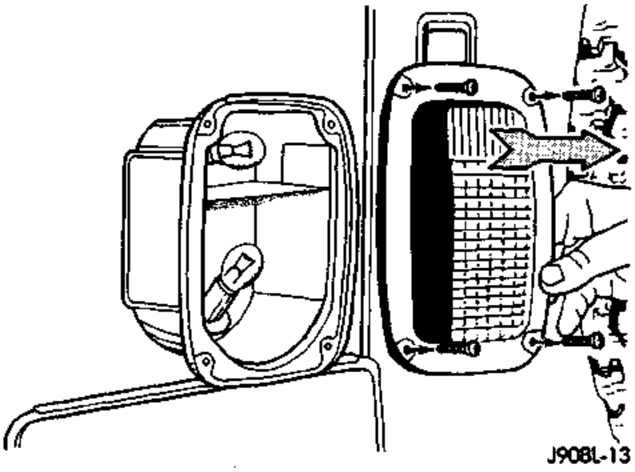


Fig. 2 Lens Removal

INSTALLATION

(1) Install a replacement bulb in the lamp socket.
(2) Position the lens on the lamp housing.
(3) Install the screws. Tighten the screws securely.

BACK-UP LAMP BULB

The back-up lamp bulb is located with-in the tail lamp. Refer to the Tail Lamp Bulb Removal/Installation procedure.

CENTER HIGH MOUNTED STOP LAMP (CHMSL) BULB

REMOVAL

(1) Remove the screws attaching the CHMSL lens to the CHMSL (Fig. 3).
(2) Remove the bulb.

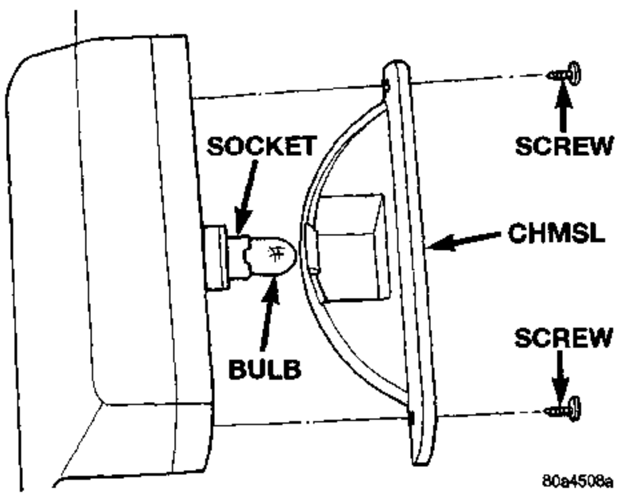


Fig. 3 CHMSL Bulb

INSTALLATION

(1) Install the bulb.
(2) Position the lens on the CHMSL and install the screws.

UNDERHOOD LAMP BULB

REMOVAL

(1) Disconnect the wire harness connector from the underhood lamp.
(2) Rotate the bulb counter-clockwise and remove it from the lamp base socket.

INSTALLATION

(1) Insert a replacement bulb in the lamp base socket and rotate it clockwise.
(2) Connect the wire harness connector to the lamp.

DOME LAMP

SOUND BAR DOME LAMP BULB REMOVAL

(1) Insert a small flat blade between the lamp and lamp lens. Carefully pry lamp lens to disengage lens retaining tabs.
(2) Separate lens from lamp.
(3) Grasp bulb and pull from lamp.

SOUND BAR DOME LAMP BULB INSTALLATION

(1) Position bulb in lamp and press into place.
(2) Position lamp lens on lamp and press into place.

CARGO AREA DOME LAMP BULB REMOVAL

(1) Remove the dome/cargo lamp lens by squeezing it at the lens at the top and bottom (Fig. 4). This will separate the lens retaining tabs from the lamp housing shoulders.
(2) Remove the lens from the lamp housing.
(3) Pull the bulb straight out to remove from the bulb holder.

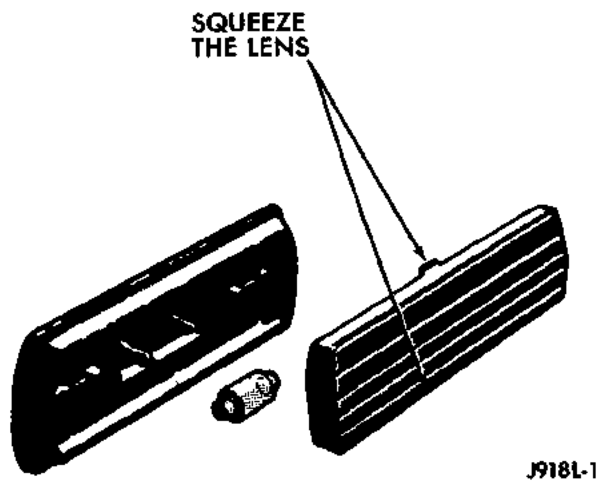


Fig. 4 Cargo Area Dome Lamp

CARGO AREA DOME LAMP BULB INSTALLATION

(1) Insert the replacement bulb in the bulb holder.
(2) Position lens at the lamp housing and press into the housing until the retainer tabs are seated.

LAMP SERVICE

INDEX

REMOVAL AND INSTALLATION

HEADLAMP

REMOVAL

(1) Remove the screws that attach the headlamp bezel (Fig. 1).

(2) Remove the screws that attach the headlamp retaining ring (Fig. 2).

(3) Disconnect the headlamp wire harness connector and remove the bulb from the bucket (Fig. 3).

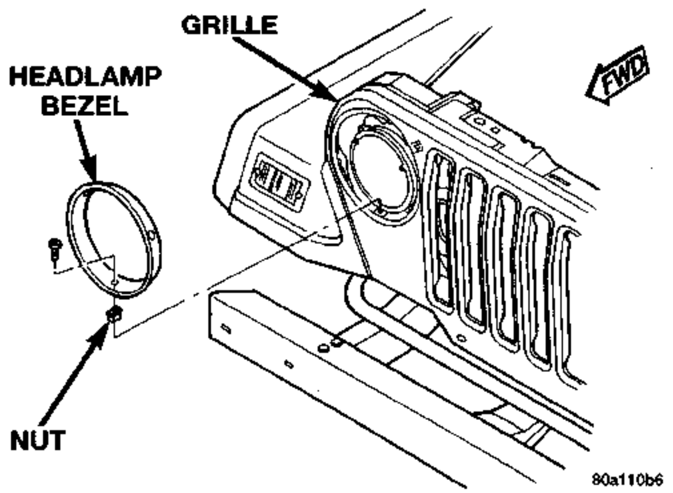


Fig. 1 Headlamp Bezel

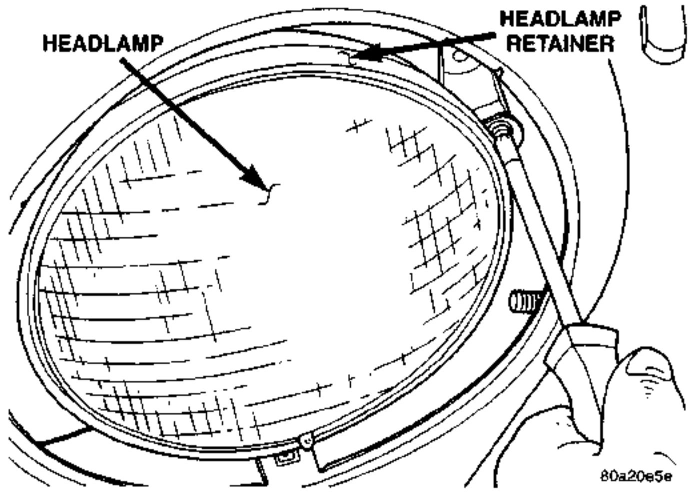


Fig. 2 Headlamp Retaining Ring

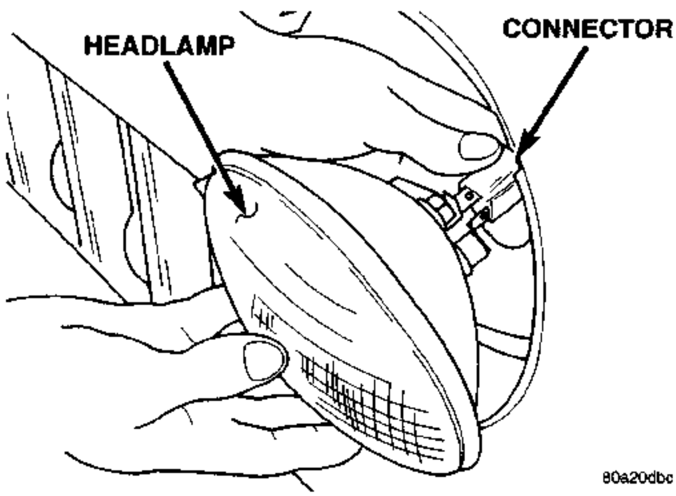


Fig. 3 Headlamp Connector

INSTALLATION

(1) Connect the wire harness connector and position the bulb in the bucket.

(2) Position retaining ring on the headlamp bulb and install screws.

(3) Install the headlamp bezel. Tighten the screws securely.

FOG LAMP

REMOVAL

(1) Disconnect the fog lamp wire harness connector.

(2) Remove the Torx screw that attach the fog lamp to the front bumper.

(3) Separate the fog lamp from the bumper.

INSTALLATION

(1) Position the fog lamp on the bumper.

(2) Install the Torx screw that attach the fog lamp to the front bumper.

REMOVAL AND INSTALLATION (Continued)

(3) Connect the fog lamp wire harness connector.

FRONT PARK/TURN SIGNAL LAMP

REMOVAL

(1) Remove the park/turn signal lamp housing screws (Fig. 4).

(2) Separate the park/turn signal lamp housing from the fender.

(3) Remove the bulb socket (Fig. 5).

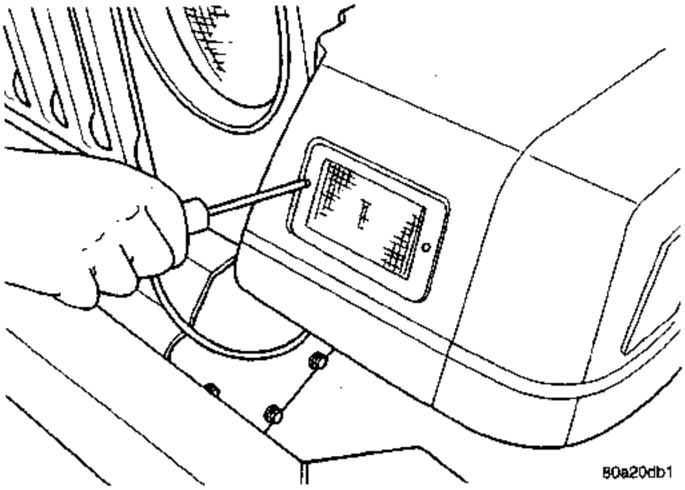


Fig. 4 Park/Turn Signal Lamp

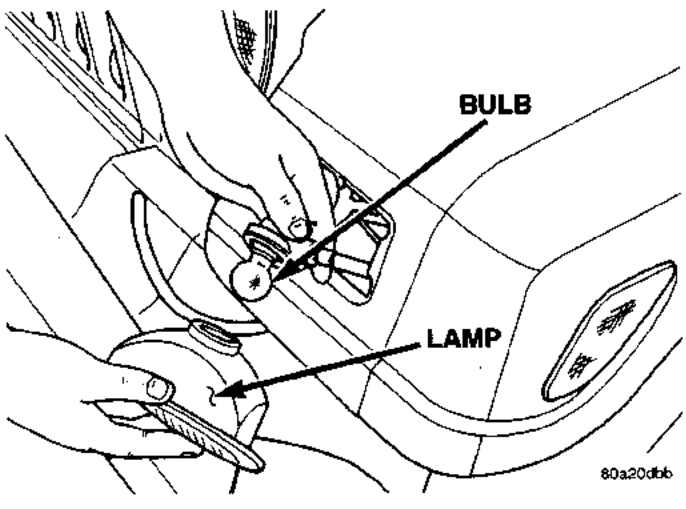


Fig. 5 Park/Turn Signal Lamp Bulb

INSTALLATION

(1) Install the bulb socket in the lamp housing.

(2) Position the park/turn signal lamp housing in the fender.

(3) Install the park/turn signal lamp housing screws.

SIDE MARKER LAMP

REMOVAL

(1) From the underside of the fender, remove the nut attaching the marker lamp to fender.

(2) Separate lamp from fender.

(3) Rotate bulb socket one-third turn and separate it from the lamp housing.

INSTALLATION

(1) Install the bulb socket in the lamp housing.

(2) Position the lamp in fender.

(3) Install the nut attaching the marker lamp to fender.

TAIL/STOP/TURN SIGNAL/BACK-UP LAMP

REMOVAL

(1) Remove the screws attaching the lens to the tail lamp housing.

(2) Remove the bolts attaching the tail lamp housing to the body (Fig. 6).

(3) Separate the lamp housing from the body.

(4) Disengage the electrical connector.

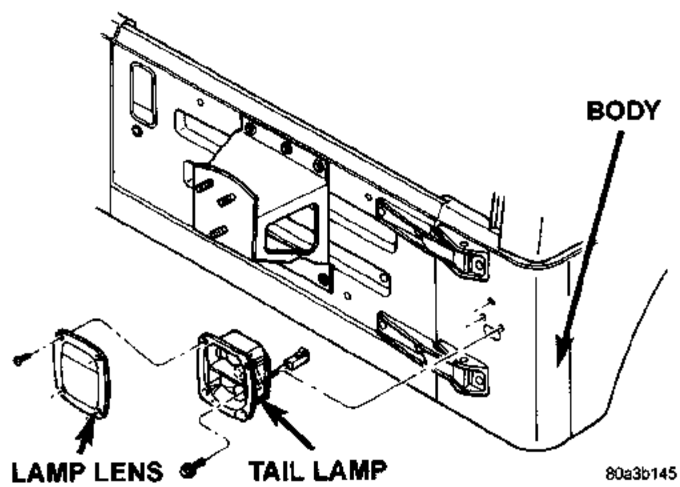


Fig. 6 Tail Lamp Housing

INSTALLATION

(1) Engage the electrical connector.

(2) Position the lamp housing on the body.

(3) Install the bolts attaching the tail lamp housing to the body.

(4) Install the screws attaching the lens to the tail lamp housing.

CENTER HIGH MOUNTED STOP LAMP (CHMSL)

REMOVAL

NOTE: It may be necessary to remove spare tire.

(1) Remove the screws attaching CHMSL lamp housing to the CHMSL bracket.

(2) Disengage the CHMSL wire harness from the retaining clips.

(3) Remove the cover from the CHMSL contact buttons.

REMOVAL AND INSTALLATION (Continued)

(4) Carefully pull the wire harness terminal ends from the contact buttons (Fig. 7).

(5) Route wire harness through tailgate and separate CHMSL from vehicle.

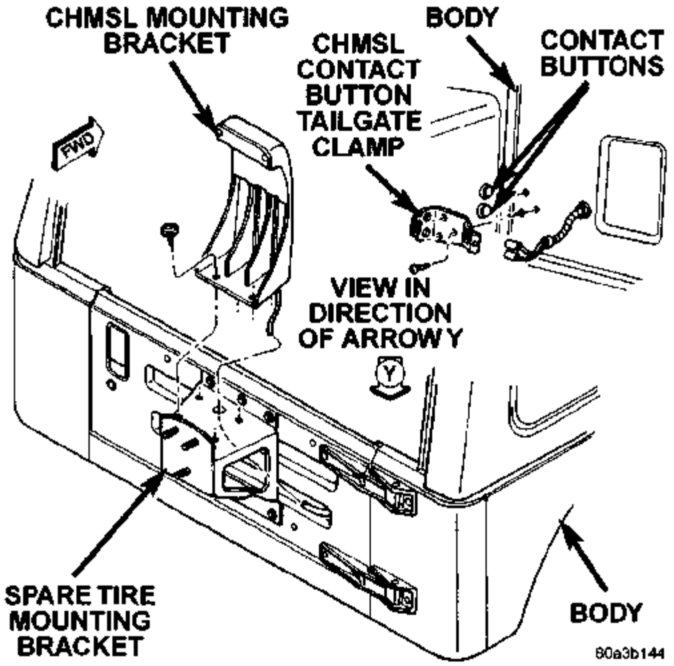


Fig. 7 CHMSL Contact Buttons

INSTALLATION

(1) Position the CHMSL lamp housing on the CHMSL bracket and install the screws.

(2) Route the wire harness through tailgate.

(3) Install the wire harness terminal ends onto the contact buttons.

(4) Install the cover over the CHMSL contact buttons.

(5) Position the CHMSL wire harness into the CHMSL bracket retaining clips and engage the clips.

UNDERHOOD LAMP

REMOVAL

(1) Disconnect the wire harness connector from the lamp.

(2) Rotate the bulb counter-clockwise and remove it from the lamp base socket.

(3) Remove the screw that attaches the lamp reflector and support bracket to the hood inner panel (Fig. 8).

(4) Remove the lamp from the hood inner panel.

INSTALLATION

(1) Position the underhood lamp on the hood inner panel.

(2) Install the attaching screw through the lamp and into the hood panel. Tighten the screw securely.

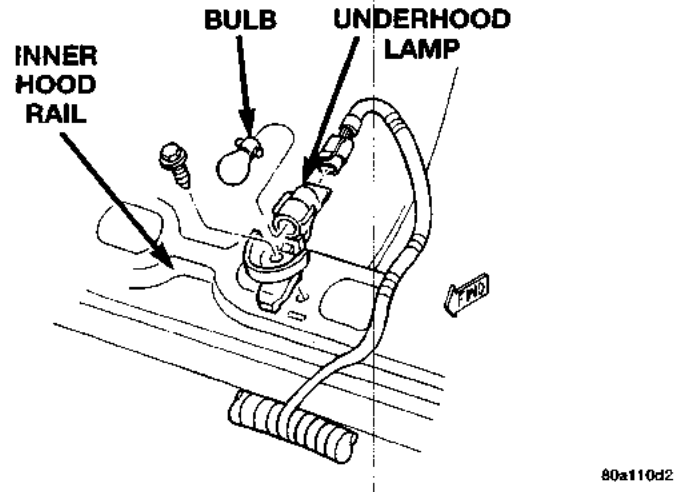


Fig. 8 Underhood Lamp

(3) Insert a replacement bulb in the lamp base socket and rotate it clockwise.

(4) Connect the wire harness connector to the lamp.

DOME LAMP

SOUND BAR DOME LAMP REMOVAL

(1) Insert a small flat blade between the lamp housing and lamp lens. Carefully pry lamp lens from the lamp housing.

(2) Separate lens from lamp.

(3) Remove the screws attaching the lamp to the sound bar (Fig. 9).

(4) Disengage lamp electrical connector.

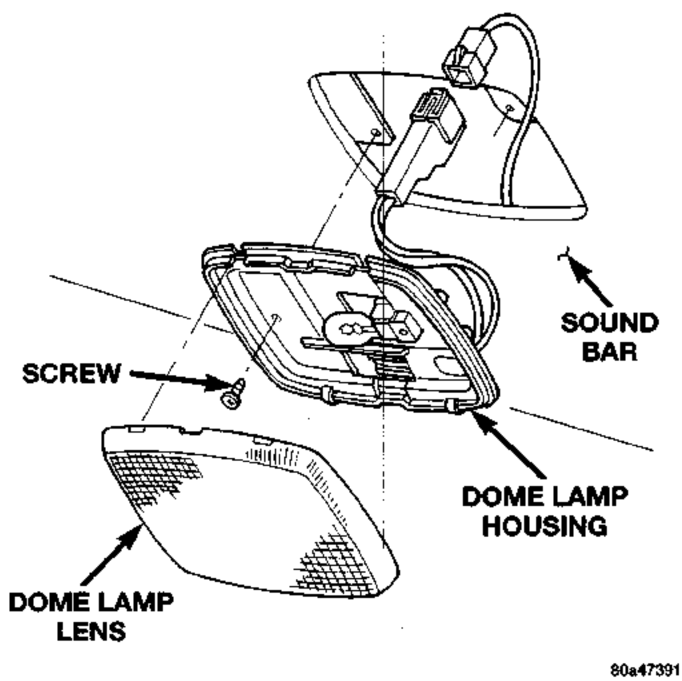


Fig. 9 Sound Bar Dome Lamp

REMOVAL AND INSTALLATION (Continued)

SOUND BAR DOME LAMP INSTALLATION

(1) Engage lamp electrical connector.

(2) Position lamp in sound bar.

(3) Install the screws attaching the lamp to the sound bar.

(4) Position lamp lens on lamp housing and press into place.

CARGO AREA DOME LAMP REMOVAL

Vehicles equipped with a hardtop have a dome lamp located above the rear window lift glass.

(1) Remove the dome/cargo lamp lens by squeezing it at the top and bottom. This will separate the lens retaining tabs from the lamp housing shoulders.

(2) Remove the lens from the lamp housing.

(3) Remove the bulb.

(4) Remove the screws that attach the lamp to the hardtop.

(5) Separate the lamp from the hardtop.

(6) Disconnect the lamp wire connector.

CARGO AREA DOME LAMP INSTALLATION

(1) Connect the lamp wire connector.

(2) Position the lamp in the hardtop.

(3) Install the screws that attach the lamp to the hardtop.

(4) Install the bulb.

(5) Position the lens on the lamp housing and press into place.

LAMP SYSTEMS

INDEX

GENERAL INFORMATION

DAYTIME RUNNING LIGHTS (CANADA ONLY)

The Daytime Running Lights (Headlamps) System is installed on vehicles manufactured for sale in Canada only. The headlamps are illuminated when the ignition switch is turned to the ON position. The DRL module receives a vehicle-moving signal from the vehicle speed sensor. This provides a constant **headlamps-on** condition as long as the vehicle is moving. The lamps are illuminated at less than 50 percent of normal intensity.

REMOVAL AND INSTALLATION

DAYTIME RUNNING LAMP (DRL) MODULE

REMOVAL

(1) Disconnect the wire harness connector from the module.

(2) Remove the screws that attach the module to the cowl (Fig. 1).

(3) Separate the module from the vehicle.

INSTALLATION

(1) Position the DRL module on the cowl.

(2) Install the screws.

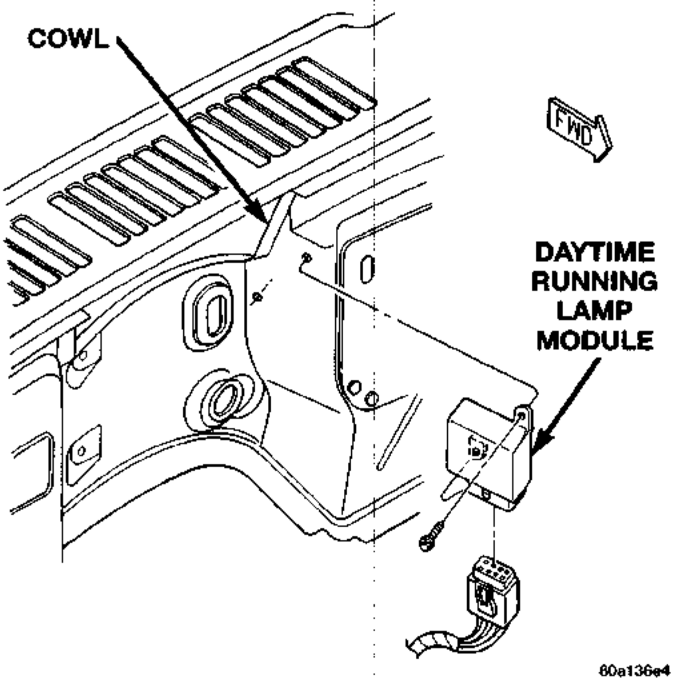


Fig. 1 DRL Module

(3) Connect the wire harness connector to the module.

BULB APPLICATION

INDEX

GENERAL INFORMATION

GENERAL INFORMATION

The following Bulb Application Tables lists the lamp title on the left side of the column and trade number or part number on the right.

CAUTION: Do not use bulbs that have a higher candle power than the bulb listed in the Bulb Application Table. Damage to lamp can result. Do not touch halogen bulbs with fingers or other oily surfaces. Bulb life will be reduced.

SPECIFICATIONS

EXTERIOR LAMPS

LAMP	BULB
Back-up	1156
Center High Mounted Stoplamp	921
Fog lamp	H3
Front Side Marker	168
Headlamp/Sealed Beam	H6024
Park/Turn Signal	3157
Tail/Stop	1157

INTERIOR LAMPS

Service procedures for most of the lamps in the instrument panel, Instrument cluster and switches are located in Group 8E, Instrument Panel and Gauges. Some components have lamps that can only be serviced by an Authorized Service Center (ASC) after the component is removed from the vehicle. Contact local dealer for location of nearest ASC.

LAMP	BULB
Dome/Cargo (Hard Top)	212–2
Dome (Sound Bar)	912
Glove Compartment	194
Under Hood	105
Underpanel Courtesy	89

PASSIVE RESTRAINT SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

A dual front airbag system is a standard equipment safety feature on this model. It is designed to protect the driver and front seat passenger from serious injury caused by a frontal impact of the vehicle. To inspect this system, refer to the proper Body Diagnostic Procedures manual. If an airbag module assembly is defective and non-deployed, refer to the Chrysler Corporation current parts return list in the Warranty Policies and Procedures manual for the proper handling procedures.

Following are general descriptions of the major components in the airbag system. Refer to 8W-43 - Airbag System in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

NOTE: This group covers both Left-Hand Drive (LHD) and Right-Hand Drive (RHD) versions of this model. Whenever required and feasible, the RHD versions of affected vehicle components have been constructed as mirror-image of the LHD versions. While most of the illustrations used in this group represent only the LHD version, the diagnostic and service procedures outlined can generally be applied to either version. Exceptions to this rule have been clearly identified as LHD or RHD, if a special illustration or procedure is required.

GENERAL INFORMATION (Continued)

WARNING:

• THIS SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE, REMOVE OR INSTALL THE AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS, YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG SYSTEM DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

• THE AIRBAG MODULE INFLATOR ASSEMBLY CONTAINS SODIUM AZIDE AND POTASSIUM NITRATE. THESE MATERIALS ARE POISONOUS AND EXTREMELY FLAMMABLE. CONTACT WITH ACID, WATER, OR HEAVY METALS MAY PRODUCE HARMFUL AND IRRITATING GASES (SODIUM HYDROXIDE IS FORMED IN THE PRESENCE OF MOISTURE) OR COMBUSTIBLE COMPOUNDS. IN ADDITION, THE PASSENGER AIRBAG CONTAINS ARGON GAS PRESSURIZED TO OVER 2500 PSI. DO NOT ATTEMPT TO DISMANTLE THE MODULE OR TAMPER WITH ITS INFLATOR. DO NOT PUNCTURE, INCINERATE, OR BRING INTO CONTACT WITH ELECTRICITY. DO NOT STORE AT TEMPERATURES EXCEEDING 93°C (200°F).

• REPLACE AIRBAG SYSTEM COMPONENTS ONLY WITH PARTS SPECIFIED IN THE CHRYSLER MOPAR PARTS CATALOG. SUBSTITUTE PARTS MAY APPEAR INTERCHANGEABLE, BUT INTERNAL DIFFERENCES MAY RESULT IN INFERIOR OCCUPANT PROTECTION. THE FASTENERS, SCREWS, AND BOLTS ORIGINALLY USED FOR THE AIRBAG SYSTEM COMPONENTS HAVE SPECIAL COATINGS AND ARE SPECIFICALLY DESIGNED FOR THE AIRBAG SYSTEM. THEY MUST NEVER BE REPLACED WITH SUBSTITUTES. ANY TIME A NEW FASTENER IS NEEDED, REPLACE IT WITH THE CORRECT FASTENERS PROVIDED IN THE SERVICE PACKAGE OR SPECIFIED IN THE CHRYSLER MOPAR PARTS CATALOG.

• WHEN A STEERING COLUMN HAS AN AIRBAG MODULE ATTACHED, NEVER PLACE THE COLUMN ON THE FLOOR OR ANY OTHER SURFACE WITH THE STEERING WHEEL OR AIRBAG MODULE FACE DOWN.

DESCRIPTION AND OPERATION

AIRBAG MODULE

DRIVER SIDE

The airbag module protective trim cover is the most visible part of the driver side airbag system. The module is mounted directly to the steering wheel. Located under the airbag module trim cover are the horn switch, the airbag cushion, and the airbag cushion supporting components. The airbag module includes a housing to which the cushion and inflator are attached and sealed. The airbag module cannot be repaired, and must be replaced if deployed or in any way damaged.

The inflator assembly is mounted to the back of the module. The inflator seals the hole in the airbag cushion so it can discharge the gas it produces directly into the cushion when supplied with the proper electrical signal. The protective trim cover is fitted to the front of the airbag module and forms a decorative cover in the center of the steering wheel. Upon airbag deployment, the trim cover will split at the predetermined breakout line around the perimeter of the horn switch.

PASSENGER SIDE

The airbag door is the most visible part of the passenger side airbag system. Under the airbag door, the airbag cushion and its supporting components are contained. The airbag module contains a housing to which the cushion and inflator are attached and sealed. The airbag module cannot be repaired, and must be replaced if deployed or in any way damaged.

The inflator assembly is mounted to the back of the airbag module. The inflator seals the hole in the airbag cushion so it can discharge the gas it produces directly into the cushion when supplied with the proper electrical signal. The airbag door on the top of the instrument panel has predetermined breakout lines concealed beneath its decorative cover. Upon airbag deployment, the air bag door will split at the breakout lines and the door will pivot out of the way.

The airbag module is mounted with two brackets to the instrument panel armature above the glove box opening, and with one bracket to the dash panel behind the glove box. Following an airbag deployment, the instrument panel assembly with the airbag door and airbag must be replaced.

STORAGE

An airbag module must be stored in its original, special container until used for service. Also, it must be stored in a clean, dry environment; away from sources of extreme heat, sparks, and high electrical energy. Always place or store an airbag module on a surface with its trim cover or airbag side facing up, to minimize movement in case of an accidental deployment.

IMPACT SENSOR

The impact sensor provides verification of the direction and severity of an impact. One impact sensor is used. It is located inside the airbag control

DESCRIPTION AND OPERATION (Continued)

module (ACM), which is mounted to a bracket on the floor transmission tunnel, under the heater-A/C housing floor duct and forward of the floor console.

The impact sensor is an accelerometer that senses the rate of deceleration. The microprocessor in the ACM monitors the impact sensor signal. A pre-programmed decision algorithm in the microprocessor determines when the deceleration rate indicates an impact that is severe enough to require airbag system protection. The ACM then sends an electrical signal to deploy the airbag system components. The sensor is calibrated for the specific vehicle.

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 side airbag module. This assembly consists of a flat, ribbon-like electrically conductive tape that winds and unwinds with the steering wheel rotation.

AIRBAG CONTROL MODULE

The Airbag Control Module (ACM) contains the impact sensor, and a microprocessor that monitors the impact sensor signals and the airbag system to determine its readiness. The ACM contains On-Board Diagnostics (OBD), and will send an airbag lamp-on message to the instrument cluster on the Chrysler Collision Detection (CCD) data bus to light the airbag indicator lamp in the instrument cluster when a monitored airbag system fault occurs.

The ACM also contains an energy-storage capacitor. This capacitor stores enough electrical energy to deploy the airbags for up to one second following a battery disconnect or failure during an impact. The purpose of the capacitor is to provide airbag system protection in a severe secondary impact, if the initial impact has damaged or disconnected the battery, but was not severe enough to deploy the airbags.

The ACM cannot be repaired and, if damaged or faulty, it must be replaced.

DIAGNOSIS AND TESTING

AIRBAG SYSTEM

A DRB scan tool is required for diagnosis of the airbag system. Refer to the proper Body Diagnostic Procedures Manual for more information.

(1) Disconnect and isolate the battery negative cable. If the airbag system is undeployed, wait two minutes for the system capacitor to discharge before further service.

(2) Connect the DRB scan tool to the 16-way data link connector. The connector is located on the lower driver side edge of the instrument panel outboard of the steering column (Fig. 1).

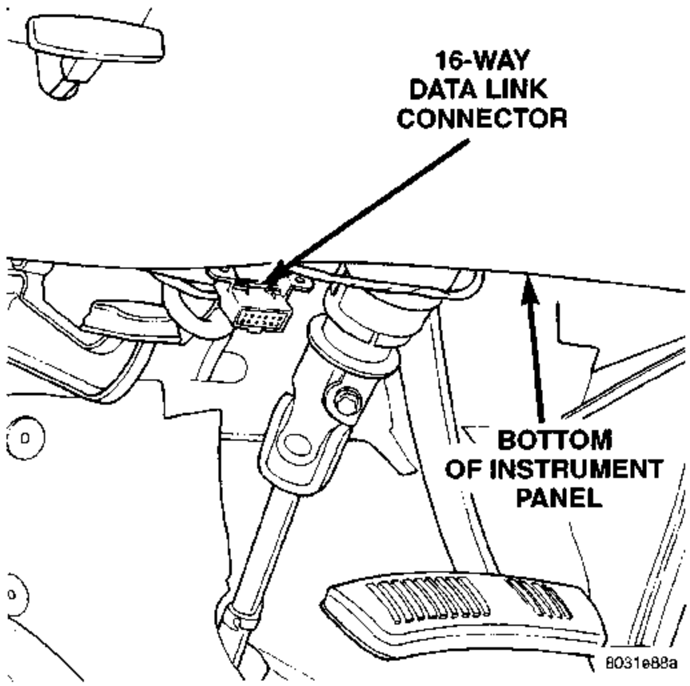


Fig. 1 16-Way Data Link Connector - Typical

(3) Turn the ignition switch to the On position. Exit the vehicle with the DRB. Use the latest version of the proper DRB cartridge.

(4) After checking that nobody is inside the vehicle, reconnect the battery negative cable.

(5) Using the DRB, read and record the active Diagnostic Trouble Code (DTC) data.

(6) Read and record any stored DTC data.

(7) Refer to the proper Body Diagnostic Procedures manual, if any DTC is found in Step 5 or Step 6.

(8) Erase the stored DTC data. If any problems remain, the stored DTC data will not erase.

(9) With the ignition switch still in the On position, make sure nobody is in the vehicle.

(10) From outside of the vehicle (away from the airbag modules in case of an accidental deployment) turn the ignition switch to the Off position for about ten seconds, and then back to the On position. Observe the airbag indicator lamp in the instrument cluster. It should light for six to eight seconds, and then go out. This indicates that the airbag system is functioning normally.

NOTE: If the airbag warning lamp fails to light, or lights and stays on, there is a system malfunction. Refer to the proper Body Diagnostic Procedures manual to diagnose the problem.

SERVICE PROCEDURES

AIRBAG SYSTEM

UNDEPLOYED

At no time should any source of electricity be permitted near the inflator on the back of an airbag module. When carrying an undeployed airbag module, the trim cover or airbag side should be pointed away from the body to minimize injury in the event of accidental deployment. If the module is placed on a bench or any other surface, the trim cover or airbag side should be face up to minimize movement in the event of an accidental deployment.

In addition, the airbag system should be disarmed whenever steering wheel, steering column, or instrument panel components require diagnosis or service. Failure to observe this warning could result in accidental airbag deployment and possible personal injury. Refer to Group 8E - Instrument Panel Systems for additional service procedures on the instrument panel. Refer to Group 19 - Steering for additional service procedures on the steering wheel and steering column.

DEPLOYED

Any vehicle which is to be returned to use after an airbag system deployment, must have the airbag modules, clockspring, instrument panel assembly, and the airbag door replaced. These are one-time components and cannot be reused. Other components are replaced as required by the extent of the damage incurred.

CLEAN-UP PROCEDURE

Following an airbag system deployment, the vehicle interior will contain a powdery residue. This residue is primarily sodium bicarbonate (baking soda), used as an airbag cushion lubricant. However, there will also be traces of sodium hydroxide powder, a chemical by-product of the generant used for airbag deployment. Since this powder can irritate the skin, eyes, nose, or throat, be sure to wear safety glasses, rubber gloves, and a long-sleeved shirt during cleanup (Fig. 2).

WARNING: IF YOU EXPERIENCE SKIN IRRITATION DURING CLEANUP, RUN COOL WATER OVER THE AFFECTED AREA. ALSO, IF YOU EXPERIENCE IRRITATION OF THE NOSE OR THROAT, EXIT THE VEHICLE FOR FRESH AIR UNTIL THE IRRITATION CEASES. IF IRRITATION CONTINUES, SEE A PHYSICIAN.

Begin by removing the airbag modules from the vehicle as described in this group.

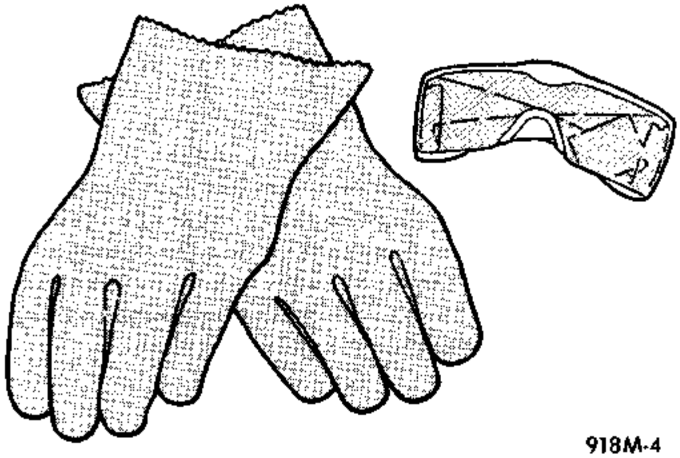


Fig. 2 Wear Safety Glasses and Rubber Gloves

Use a vacuum cleaner to remove any residual powder from the vehicle interior. Clean from outside the vehicle and work your way inside, so that you avoid kneeling or sitting on an uncleaned area.

Be sure to vacuum the heater and air conditioning outlets as well (Fig. 3). Run the heater and air conditioning blower on the lowest speed setting and vacuum any powder expelled from the outlets. You may need to vacuum the interior of the vehicle a second time to recover all of the powder.

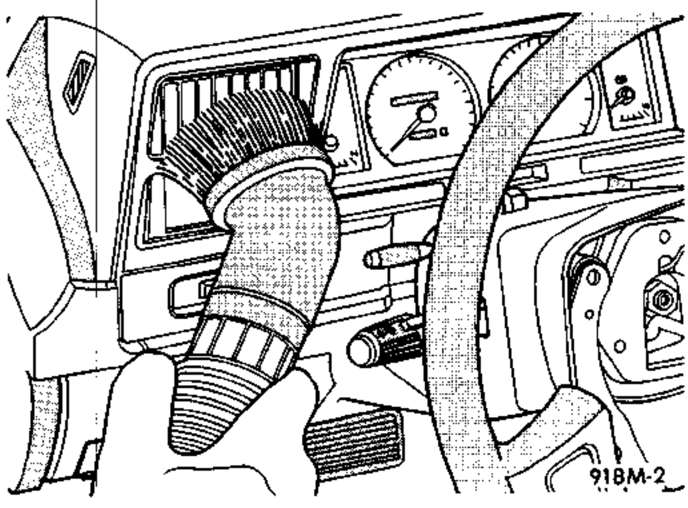


Fig. 3 Vacuum Heater and A/C Outlets

Place the deployed airbag modules in your vehicular scrap pile.

REMOVAL AND INSTALLATION

AIRBAG MODULE

WARNING:

• THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE THE AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG SYSTEM DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

• WHEN REMOVING A DEPLOYED AIRBAG MODULE, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG MODULE AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.

DRIVER SIDE

(1) Disconnect and isolate the battery negative cable. If the airbag module is undeployed, wait two minutes for the system capacitor to discharge before further service.

(2) Remove the two screws securing the driver airbag module to the steering wheel (Fig. 4).

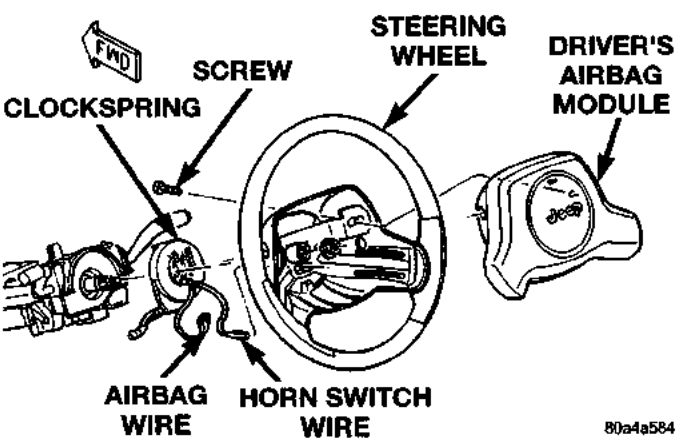


Fig. 4 Driver Airbag Module Remove/Install

(3) Unplug the airbag and horn switch wiring connectors and remove the airbag module from the steering wheel.

(4) If the airbag is deployed, see the procedure for replacing the clockspring in this group.

(5) When installing, connect the clockspring wiring connector to the module by pressing straight in on the connector. Tighten the airbag module mounting screws to 10.2 N·m (90 in. lbs.).

(6) Do not connect the battery negative cable at this time. See Airbag System in Diagnosis and Testing for the proper procedures.

PASSENGER SIDE

The following procedure is for replacement of a faulty or damaged passenger airbag module. If the passenger airbag module is deployed, the instrument panel assembly must be replaced. The instrument panel assembly includes a replacement passenger airbag module and passenger airbag door. Refer to Group 8E - Instrument Panel Systems for the procedures required for instrument panel assembly service.

(1) Disconnect and isolate the battery negative cable. If the airbag module is undeployed, wait two minutes for the system capacitor to discharge before further service.

(2) Remove the instrument panel assembly. Refer to Group 8E - Instrument Panel Systems for the procedures.

(3) With the instrument panel face down on a bench, remove the three nuts securing the airbag module to the instrument panel armature (Fig. 5).

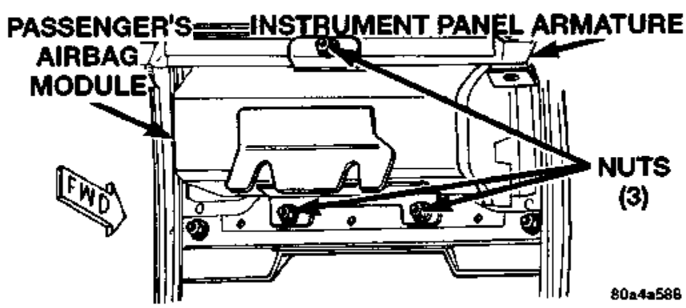


Fig. 5 Passenger Airbag Module Remove/Install

(4) Remove the airbag module from the instrument panel.

(5) When installing, be certain the airbag wiring connector halves are fully engaged.

(6) Reverse the remaining removal procedures to install. Tighten the airbag module mounting nuts to 12 N·m (105 in. lbs.). Do not connect the battery negative cable at this time. See Airbag System in Diagnosis and Testing for the proper procedures.

REMOVAL AND INSTALLATION (Continued)

DRIVER AIRBAG TRIM COVER AND HORN SWITCH

WARNING:

• THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE THE AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG SYSTEM DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

• THE HORN SWITCH IS INTEGRAL TO THE AIRBAG MODULE TRIM COVER. SERVICE OF THIS COMPONENT SHOULD BE PERFORMED ONLY BY CHRYSLER-TRAINED AND AUTHORIZED DEALER SERVICE TECHNICIANS. FAILURE TO TAKE THE PROPER PRECAUTIONS OR TO FOLLOW THE PROPER PROCEDURES COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. If the airbag module is undeployed, wait two minutes for the system capacitor to discharge before further service.

(2) Remove the driver airbag module as described in this group.

(3) Remove the two plastic horn switch feed wire retainers from the studs on the airbag housing (Fig. 6).

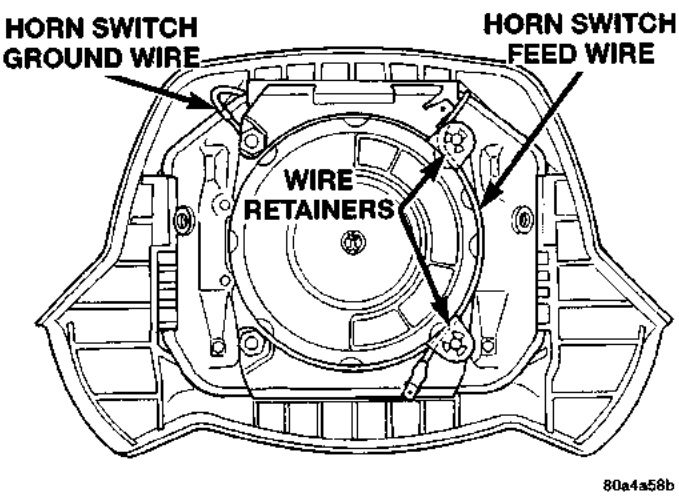


Fig. 6 Horn Switch Wires Remove/Install

(4) Remove the four nuts securing the upper and lower trim cover retainers to the studs on the airbag housing (Fig. 7).

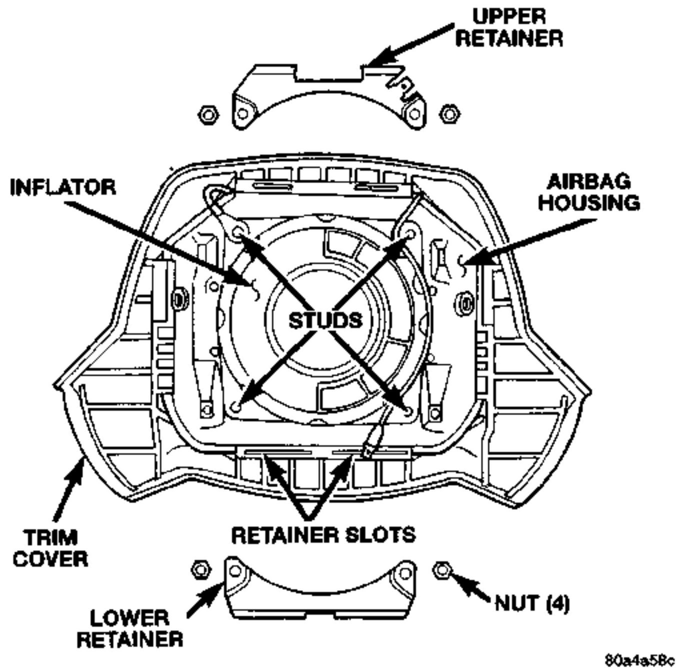


Fig. 7 Trim Cover Retainers Remove/Install

(5) Remove the upper and lower trim cover retainers from the airbag housing studs.

(6) Remove the horn switch ground wire eyelet from the upper airbag housing stud.

(7) Release the four trim cover locking blocks from the lip around the outside edge of the airbag housing and remove the housing from the cover (Fig. 8).

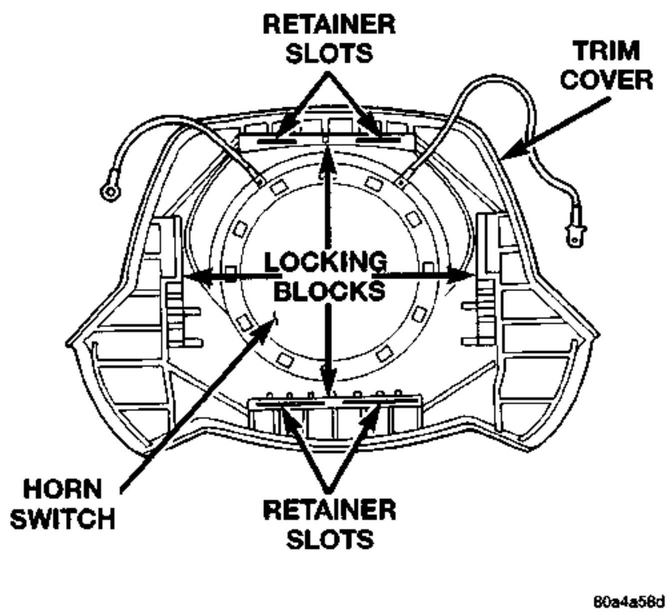


Fig. 8 Trim Cover Remove/Install

REMOVAL AND INSTALLATION (Continued)

(8) When installing the trim cover/horn switch, be certain that the locking blocks are fully engaged on the lip of the airbag housing (Fig. 9).

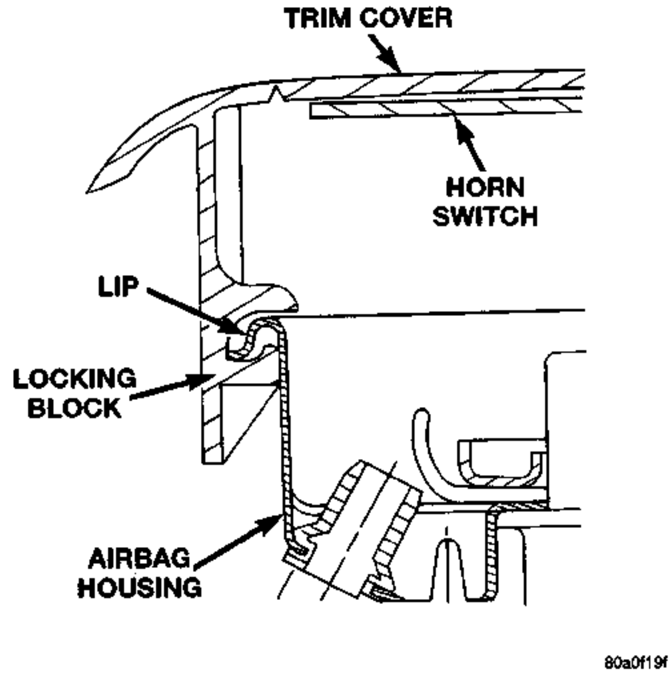


Fig. 9 Trim Cover Locking Blocks Install

(9) When installing the upper and lower trim cover retainers, be certain that the tabs on each retainer are engaged in the retainer slots of the trim cover (Fig. 8). Tighten the retainer nuts to 10 N·m (90 in. lbs.).

(10) Reverse the remaining removal procedures to complete the installation, but do not connect the battery negative cable at this time. See Airbag System in Diagnosis and Testing for the proper procedures.

PASSENGER AIRBAG DOOR

(1) Remove the instrument panel assembly as described in Group 8E - Instrument Panel Systems.

(2) Remove the three screws securing the upper edge of the airbag door to the instrument panel (Fig. 10).

(3) Remove the grab handle and grab handle bezel as described in Group 8E - Instrument Panel Systems.

(4) Remove the five screws behind the grab handle bezel securing the lower edge of the airbag door to the instrument panel.

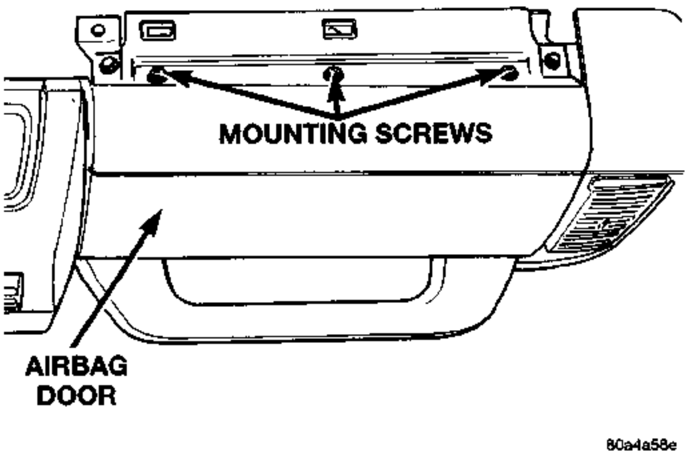


Fig. 10 Passenger Airbag Door Upper Screws Remove/Install

(5) Remove the passenger side airbag module as described in this group.

(6) Remove the two screws securing the passenger airbag door bracket to the instrument panel armature (Fig. 11).

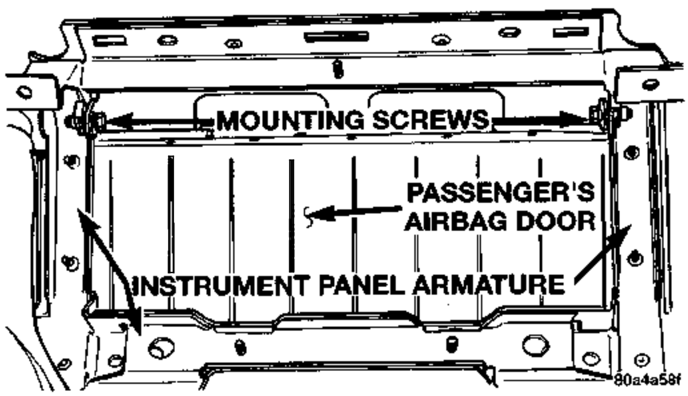


Fig. 11 Passenger Airbag Door Remove/Install

(7) With the instrument panel face up on the bench, remove the passenger airbag door from the instrument panel.

(8) Reverse the removal procedures to install.

WARNING: BE CERTAIN THAT ALL FASTENERS FOR THE AIRBAG DOOR ARE REINSTALLED. FAILURE TO DO THIS COULD RESULT IN IMPROPER OR INCOMPLETE AIRBAG DEPLOYMENT, AND POSSIBLE PERSONAL INJURY.

(9) Do not connect the battery negative cable at this time. See Airbag System in Diagnosis and Testing for the proper procedures.

REMOVAL AND INSTALLATION (Continued)

AIRBAG CONTROL MODULE

WARNING: THE AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE AIRBAG. TO AVOID ACCIDENTAL DEPLOYMENT, NEVER CONNECT THE AIRBAG CONTROL MODULE ELECTRICALLY TO THE SYSTEM UNLESS IT IS BOLTED TO THE VEHICLE. NEVER STRIKE OR KICK THE AIRBAG CONTROL MODULE. BEFORE BEGINNING ANY AIRBAG SYSTEM REMOVAL OR INSTALLATION PROCEDURES, DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE FROM THE VEHICLE BATTERY. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT, AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. If the airbag is undeployed, wait two minutes for the system capacitor to discharge before further service.

(2) Pull back the floor carpet from the area under the heater-A/C housing floor duct and forward of the center floor console.

(3) Unplug the airbag control module wiring connector.

(4) Remove the four screws securing the airbag control module mounting bracket to the floor transmission tunnel (Fig. 12).

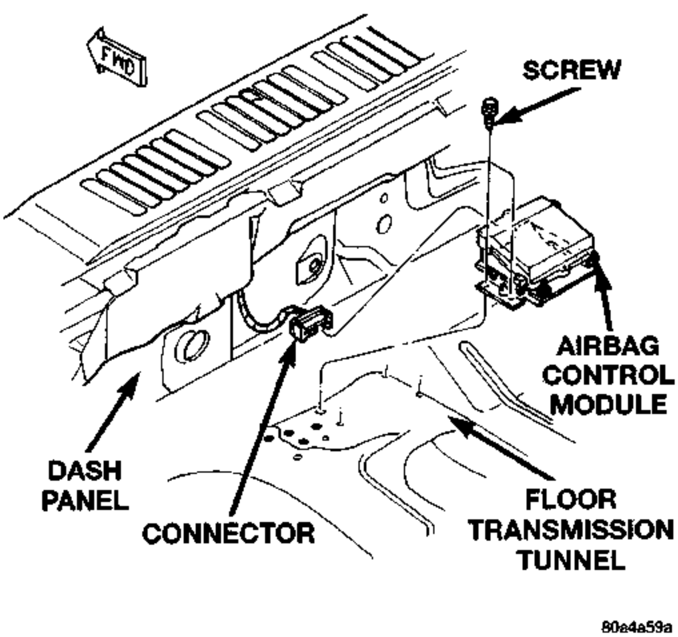


Fig. 12 Airbag Control Module Remove/Install

(5) Slide the airbag control module out from under the heater-A/C housing floor duct and remove it from the vehicle.

(6) When installing the airbag control module, position the unit with the arrow on the module housing pointing forward.

(7) Attach the airbag control module to the floor pan transmission tunnel with the four screws. Tighten the mounting screws to 10.7 N·m (95 in. lbs.).

(8) Connect the wiring to the airbag control module, making sure the connector is fully-seated and the locking tabs are engaged.

(9) Reverse the remaining removal procedures to complete the installation.

(10) Do not connect the battery negative cable at this time. See Airbag System in Diagnosis and Testing for the proper procedures.

CLOCKSPRING

WARNING: THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE THE AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG SYSTEM DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Turn the steering wheel until the front wheels are in the straight-ahead position before starting the repair.

(2) Disconnect and isolate the battery negative cable. If the airbag system is undeployed, wait two minutes for the system capacitor to discharge before further service.

(3) Remove the driver airbag module as described in this group.

(4) Remove the steering wheel with a steering wheel puller (Special Tool C-3428B).

(5) Remove the steering column cover as described in Group 8E - Instrument Panel Systems.

(6) If the vehicle is equipped with a tilt steering column, move the column to the fully raised position.

(7) Insert the key in the ignition lock cylinder and turn the ignition switch to the On position.

(8) Insert a small screwdriver or pin punch through the access hole in the lower steering column shroud and depress the ignition lock cylinder retaining tumbler (Fig. 13).

REMOVAL AND INSTALLATION (Continued)

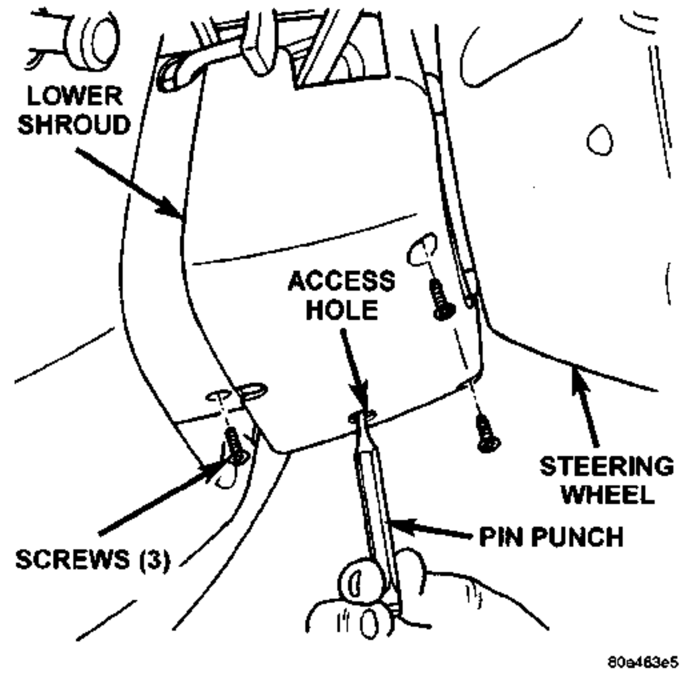


Fig. 13 Steering Column Shrouds Remove/Install

(9) While holding the retaining tumbler depressed, pull the ignition lock cylinder and key out of the ignition lock housing.

(10) Remove the three screws that secure the lower steering column shroud to the upper shroud.

(11) If the vehicle is equipped with a tilt steering column, move the column to the fully lowered position.

(12) Remove both the upper and lower shrouds from the steering column to gain access to the clockspring wiring.

(13) Unplug the two wiring connectors from the steering column side of the clockspring.

(14) To remove the clockspring, lift the locating fingers of the clockspring assembly from the steering column as necessary. The clockspring cannot be repaired. It must be replaced if faulty, or if the airbag system has been deployed.

(15) When installing the clockspring, snap the clockspring onto the steering column. If the clockspring is not properly positioned, see Clockspring Centering in this group before installing the steering wheel.

(16) Connect the two wiring connectors to the steering column side of the clockspring. Be certain that the wiring connector locking tabs are engaged.

(17) Reinstall the steering column shrouds and ignition lock cylinder.

(18) The front wheels should still be in the straight-ahead position. Install the steering wheel being certain to fit the flats on the hub of the steering wheel with the formations on the inside of the clockspring. Pull the wiring through the lower hole in the steering wheel hub. Tighten the steering wheel nut to 61 N·m (45 ft. lbs.). Be certain not to pinch the wiring between the steering wheel and the nut.

(19) Connect the horn switch wire, then the airbag wire to the airbag module.

(20) Install the airbag module and tighten the screws to 10.2 N·m (90 in. lbs.).

(21) Do not connect the battery negative cable at this time. See Airbag System in Diagnosis and Testing for the proper procedures.

ADJUSTMENTS

CLOCKSPRING CENTERING

If the rotating tape within the clockspring is not positioned properly in relation to the steering wheel and the front wheels, the clockspring may fail during use. The clockspring must be centered if it is not known to be properly positioned, or if the front wheels were moved from the straight-ahead position with the clockspring removed during any service procedure.

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(1) Turn the steering wheel until the front wheels are in the straight-ahead position before starting the centering procedure.

(2) Disconnect and isolate the battery negative cable. If the airbag system is undeployed, wait two minutes for the system capacitor to discharge before further service.

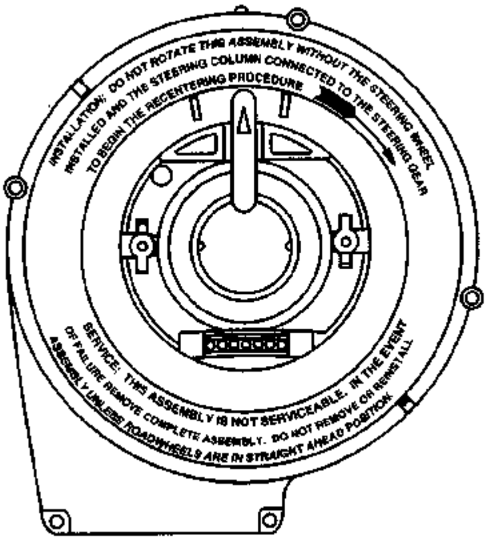
(3) Remove the driver airbag module as described in this group.

(4) Remove the steering wheel with a steering wheel puller (Special Tool C-3428B).

(5) Rotate the clockspring rotor clockwise to the end of its travel (Fig. 14). **Do not apply excessive torque.**

(6) From the end of the clockwise travel, rotate the rotor about two and one-half turns counterclockwise, until the rotor flats are horizontal. If the clockspring wiring is not at the bottom, rotate another one-half turn.

ADJUSTMENTS (Continued)



80a53484

Fig. 14 Clockspring

(7) The front wheels should still be in the straight-ahead position. Install the steering wheel being certain to fit the flats on the hub of the steering wheel with the formations on the inside of the clockspring. Pull the clockspring wiring through the lower hole in the steering wheel hub. Tighten the steering wheel nut to 61 N·m (45 ft. lbs.). Be certain not to pinch the wiring between the steering wheel and the nut.

(8) Connect the horn switch wire, then the airbag wire to the airbag module.

(9) Install the airbag module and tighten the screws to 10.2 N·m (90 in. lbs.).

(10) Do not connect the battery negative cable at this time. See Airbag System in Diagnosis and Testing for the proper procedures.

ELECTRICALLY HEATED SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

An electrically heated rear window defogger is standard factory-installed equipment on models equipped with the hardtop option. The defogger will only operate when the ignition switch is in the On position. When the defogger switch is turned On, an electric heater grid on the rear window glass is energized. This grid will produce heat to help clear the window glass of ice, snow, or fog.

The defogger system is controlled by a switch located in the accessory switch bezel, which is near the bottom of the instrument panel center bezel and next to the ash receiver. An amber indicator lamp in the switch button will light to indicate when the defogger system is turned on. The instrument cluster circuitry, which contains the defogger system timer logic, monitors the state of the defogger switch through a hard-wired input. The instrument cluster circuitry controls the defogger system through a hard-wired control output to the defogger relay.

The defogger system will be automatically turned off after a programmed time interval of about ten minutes. After the initial time interval has expired, if the defogger switch is turned on again during the same ignition cycle, the defogger system will automatically turn off after about five minutes.

The defogger system will automatically shut off if the ignition switch is turned to the Off position, or it can be turned off manually by depressing the instrument panel switch. Refer to the owner's manual for more information on the defogger system controls and operation.

Following are general descriptions of the major components in the defogger system. Refer to 8W-48 - Rear Window Defogger in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

NOTE: This group covers both Left-Hand Drive (LHD) and Right-Hand Drive (RHD) versions of this model. Whenever required and feasible, the RHD versions of affected vehicle components have been constructed as mirror-image of the LHD versions. While most of the illustrations used in this group represent only the LHD version, the diagnostic and service procedures outlined can generally be applied to either version. Exceptions to this rule have been clearly identified as LHD or RHD, if a special illustration or procedure is required.

DESCRIPTION AND OPERATION

REAR GLASS HEATING GRID

The heated rear window glass has two electrically conductive vertical bus bars and a series of horizontal grid lines made of a silver-ceramic material, which is baked on and bonded to the inside surface of the glass. The grid lines and bus bars comprise a parallel electrical circuit.

When the rear window defogger relay is energized, electrical current is directed to the rear window grid lines through the bus bars. The grid lines heat the rear window to clear the surface of fog or snow. Protection for the heated grid circuit is provided by a fuse in the Power Distribution Center.

The grid lines and bus bars are highly resistant to abrasion. However, it is possible for an open circuit to occur in an individual grid line, resulting in no current flow through the line. The grid lines can be damaged or scraped off with sharp instruments. Care should be taken when cleaning the glass or removing

DESCRIPTION AND OPERATION (Continued)

foreign materials, decals, or stickers from the glass. Normal glass cleaning solvents or hot water used with rags or toweling is recommended.

A repair kit is available to repair the grid lines and bus bars, or to reinstall the heated glass pigtail wires.

DEFOGGER SWITCH

The rear window defogger switch is mounted in the accessory switch bezel, which is located in the lower instrument panel center bezel, next to the ash receiver. The momentary-type switch provides a hard-wired ground signal to the instrument cluster each time the switch is actuated, either On or Off. The instrument cluster rear window defogger timer logic circuitry responds by energizing or de-energizing the rear window defogger relay.

Energizing the rear window defogger relay provides electrical current to the rear window defogger grid and the amber indicator lamp in the switch, which lights to indicate when the defogger system is turned On. The defogger illumination lamp and indicator lamp bulbs are serviceable. The defogger switch cannot be repaired and, if faulty, it must be replaced.

INSTRUMENT CLUSTER

The instrument cluster circuit board contains the timer and logic circuitry for the rear window defogger system. However, there are no diagnostics available for this circuitry. Therefore, diagnosis of the rear defogger timer and logic circuitry consists of confirming the presence of a switch input signal at the instrument cluster connector, and the resulting relay control output signal at the defogger relay. Refer to Group 8E - Instrument Panel Systems for the service procedures for the instrument cluster.

The rear window defogger timer and logic circuitry cannot be adjusted or repaired and, if faulty, the instrument cluster assembly must be replaced.

DEFOGGER RELAY

The rear window defogger relay is a International Standards Organization (ISO)-type relay. The defogger relay is a electro-mechanical device that switches fused battery current to the rear glass heating grid and the indicator lamp of the defogger switch, when the instrument cluster rear window defogger timer logic circuitry grounds the relay coil. See the Diagnosis and Testing section of this group for more information on the defogger relay operation.

The defogger relay is located in the Power Distribution Center in the engine compartment. The defogger relay cannot be repaired and, if faulty, it must be replaced.

DIAGNOSIS AND TESTING

DEFOGGER SYSTEM

For circuit descriptions and diagrams, refer to 8W-48 - Rear Window Defogger in Group 8W - Wiring Diagrams. Electrically heated defogger operation can be confirmed in one of the following manners:

1. Turn the ignition switch to the On position. While monitoring the instrument panel voltmeter, set the defogger switch in the On position. When the defogger switch is turned On, a distinct voltmeter needle deflection should be noted.
2. Turn the ignition switch to the On position. Set the defogger switch in the On position. The defogger system operation can be checked by feeling the glass. A distinct difference in temperature between the grid lines and the adjacent clear glass can be detected within three to four minutes of operation.
3. Using a 12-volt DC voltmeter, contact the rear glass heating grid terminal A (right side) with the negative lead, and terminal B (left side) with the positive lead (Fig. 1). The voltmeter should read battery voltage.

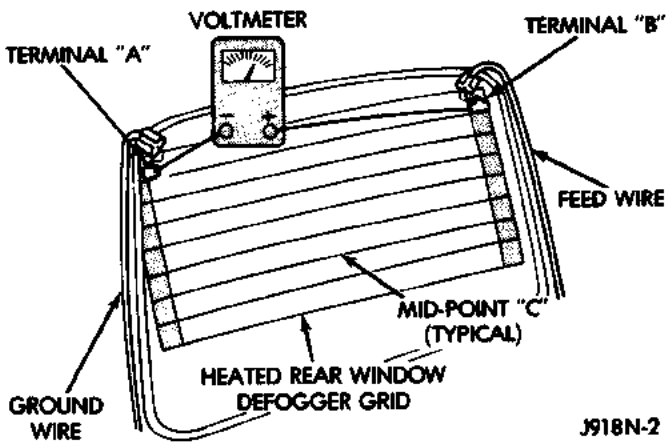


Fig. 1 Rear Glass Heating Grid Test

The above checks will confirm system operation. Illumination of the switch indicator lamp means that there is electrical current available at the output of the defogger relay, but does not confirm that the electrical current is reaching the rear glass heating grid lines.

If the defogger system does not operate, the problem should be isolated in the following manner:

(1) Confirm that the ignition switch is in the On position.

(2) Ensure that the rear glass heating grid feed and ground wires are connected to the glass. Confirm that the ground wire has continuity to ground.

(3) Check the fuses in the Power Distribution Center and in the fuseblock module. The fuses must be tight in their receptacles and all electrical connections must be secure.

DIAGNOSIS AND TESTING (Continued)

When the above steps have been completed and the rear glass heating grid is still inoperative, one or more of the following is faulty:

- Defogger switch
- Defogger relay
- Instrument cluster circuitry
- Rear window grid lines (all grid lines would have to be broken or one of the feed wires disconnected for the entire system to be inoperative).

If setting the defogger switch to the On position produces a severe voltmeter deflection, check for a short circuit between the defogger relay output and the rear glass heating grid.

REAR GLASS HEATING GRID

For circuit descriptions and diagrams, refer to 8W-48 - Rear Window Defogger in Group 8W - Wiring Diagrams. To detect breaks in the grid lines, the following procedure is required:

(1) Turn the ignition switch to the On position. Set the rear defogger switch in the On position. The indicator lamp should light. If OK, go to Step 2. If not OK, see the Defogger Relay diagnosis in this group.

(2) Using a 12-volt DC voltmeter, contact the vertical bus bar on the right side of the vehicle with the negative lead. With the positive lead, contact the vertical bus bar on the left side of the vehicle. The voltmeter should read battery voltage. If OK, go to Step 3. If not OK, repair the open circuit to the defogger relay as required.

(3) With the negative lead of the voltmeter, contact a good body ground point. The voltage reading should not change. If OK, go to Step 4. If not OK, repair the circuit to ground as required.

(4) Connect the negative lead of the voltmeter to the right side bus bar and touch each grid line at mid-point C with the positive lead. A reading of approximately six volts indicates a line is good. A reading of zero volts indicates a break in the grid line between mid-point C and the left side bus bar. A reading of 10-14 volts indicates a break between mid-point C and the right side bus bar. Move the positive lead on the grid line towards the break and the voltage reading will change as soon as the break is crossed.

DEFOGGER SWITCH

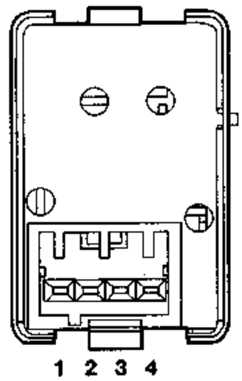
For circuit descriptions and diagrams, refer to 8W-48 - Rear Window Defogger in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the defogger switch and unplug the switch wiring connector.

(2) Check for continuity between the **ground** circuit cavity of the switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit as required.

(3) Check for continuity between the **ground** circuit and **rear window defogger switch sense** circuit terminals on the back of the switch housing (Fig. 2). There should be momentary continuity as the defogger switch button is depressed, and then no continuity. If OK, see the diagnosis for Instrument Cluster in this group. If not OK, replace the faulty switch.



SWITCH POSITION	CONTINUITY BETWEEN
OFF	LAMPS
ON	MOMENTARY 1 AND 2
ILLUMINATION LAMP	1 AND 4
INDICATOR LAMP	1 AND 3

80a50351

Fig. 2 Defogger Switch Continuity

DEFOGGER RELAY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

DIAGNOSIS AND TESTING (Continued)

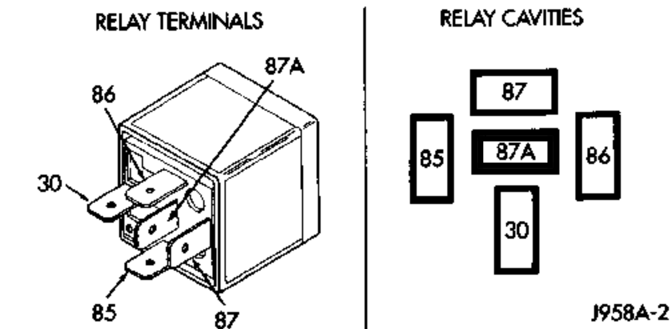
RELAY TEST

The defogger relay is located in the Power Distribution Center (PDC), in the engine compartment. Remove the defogger relay from the PDC as described in this group to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75±10 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see the Relay Circuit Test in this group. If not OK, replace the faulty relay.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Defogger Relay

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair the open circuit to the PDC fuse as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the rear glass heating grid and the defogger switch indicator lamp. There should be continuity between the cavity for relay terminal 87 and the **rear window defogger relay output** circuit cavities of the rear glass heating grid and defogger switch connectors at all times. If OK, go to Step 4. If not OK, repair the open circuit(s) as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. This terminal is provided with ground by the instrument cluster rear window defogger timer logic circuitry to energize the defogger relay. There should be continuity to ground at the cavity for relay terminal 86 when the defogger switch is turned On. However, with the defogger relay removed, the defogger switch indicator lamp will not light to show that the defogger system is turned On. Be certain that you depress the defogger switch at least twice to confirm that the system is turned on during this test. If OK, go to Step 5. If not OK, repair the open circuit to the instrument cluster as required.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. It is connected to fused ignition switch output voltage and should be hot when the ignition switch is in the On position. Check for battery voltage at the cavity for relay terminal 85 with the ignition switch in the On position. If OK, see the diagnosis for Instrument Cluster in this group. If not OK, repair the open circuit to the fuse in the fuseblock module as required.

INSTRUMENT CLUSTER

Before performing this test, complete the Defogger Switch and the Defogger Relay tests as described in this group. For circuit descriptions and diagrams, refer to 8W-48 - Rear Window Defogger in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the defogger relay from the Power Distribution Center (PDC) and unplug the defogger switch wiring connector.

(2) Remove the instrument cluster from the instrument panel. Refer to Group 8E - Instrument Panel Systems for the procedures.

(3) Check for continuity between the **rear window defogger switch sense** circuit cavity of the right (gray) instrument cluster connector and a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the short circuit as required.

(4) Check for continuity between the **rear window defogger switch sense** circuit cavities of the right (gray) instrument cluster connector and the rear defogger switch connector. There should be continuity. If OK, go to Step 5. If not OK, repair the open circuit as required.

DIAGNOSIS AND TESTING (Continued)

(5) Check for continuity between the **rear window defogger relay control** circuit cavity of the right (gray) instrument cluster connector and a good ground. There should be no continuity. If OK, go to Step 6. If not OK, repair the short circuit as required.

(6) Check for continuity between the **rear window defogger relay control** circuit cavities of the right (gray) instrument cluster connector and the rear defogger relay receptacle (ISO relay cavity 86) in the PDC. There should be continuity. If OK, replace the faulty instrument cluster. If not OK, repair the open circuit as required.

SERVICE PROCEDURES

REAR GLASS HEATING GRID REPAIRS

Repair of the grid lines, bus bars or pigtail wires can be accomplished using a Mopar Rear Window Defogger Repair Kit (P/N 4267922) or equivalent.

WARNING: MATERIALS CONTAINED IN THE REPAIR KIT MAY CAUSE SKIN OR EYE IRRITATION. THE KIT CONTAINS EPOXY RESIN AND AMINE TYPE HARDENER, WHICH ARE HARMFUL IF SWALLOWED. AVOID CONTACT WITH THE SKIN AND EYES. FOR SKIN CONTACT, WASH THE AFFECTED AREAS WITH SOAP AND WATER. FOR CONTACT WITH THE EYES, FLUSH WITH PLENTY OF WATER. DO NOT TAKE INTERNALLY. IF TAKEN INTERNALLY, INDUCE VOMITING AND CALL A PHYSICIAN IMMEDIATELY. USE WITH ADEQUATE VENTILATION. DO NOT USE NEAR FIRE OR FLAME. CONTAINS FLAMMABLE SOLVENTS. KEEP OUT OF THE REACH OF CHILDREN.

(1) Mask the repair area so that the conductive epoxy can be applied neatly. Extend the epoxy application onto the grid line or the bus bar on either side of the break (Fig. 3).

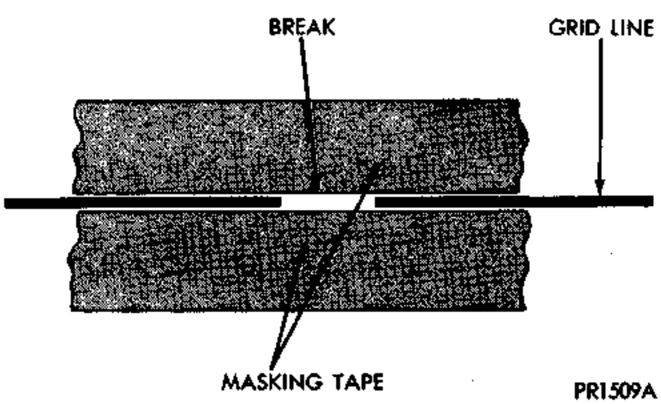


Fig. 3 Grid Line Repair - Typical

(2) Follow the instructions in the repair kit for preparing the damaged area.

(3) Remove the package separator clamp and mix the two conductive epoxy components thoroughly within the packaging. Fold the package in half and cut the center corner to dispense the epoxy.

(4) For grid line repairs, mask the area to be repaired with masking tape or a template.

(5) Apply the epoxy through the slit in the masking tape or template. Overlap both ends of the break by at least 19 mm (0.75 in.).

(6) For a terminal or pigtail replacement, mask the adjacent areas so the epoxy can be extended onto the adjacent grid line as well as the bus bar. Apply a thin layer of epoxy to the area where the terminal or pigtail was fastened and onto the adjacent grid line.

(7) Apply a thin layer of conductive epoxy to the terminal or bare wire end of the pigtail and place in the desired location. To prevent the terminal or pigtail from moving while the epoxy is curing, it must be wedged or clamped.

(8) Carefully remove the masking tape or template.

CAUTION: Do not allow the glass surface to exceed 204°C (400°F) or the glass may fracture.

(9) Allow the epoxy to cure 24 hours at room temperature, or use a heat gun with a 260°-371°C (500°-700°F) range for fifteen minutes. Hold the heat gun approximately 254 mm (10 in.) from the repair.

(10) After the conductive epoxy is properly cured, remove the wedge or clamp from the terminal or pigtail. Do not attach the connectors until the curing process is complete.

(11) Check the operation of the rear window defogger.

REMOVAL AND INSTALLATION

DEFOGGER SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Using a trim stick or another suitable wide-bladed flat tool, pry the instrument panel top cover away from the instrument panel to release the five snap clip retainers.

REMOVAL AND INSTALLATION (Continued)

(3) Remove the instrument panel top cover from the vehicle.

(4) Remove the two screws that were hidden by the instrument panel top cover securing the top of the instrument panel center bezel to the instrument panel.

(5) Remove the ash receiver from the ash receiver housing (Fig. 4).

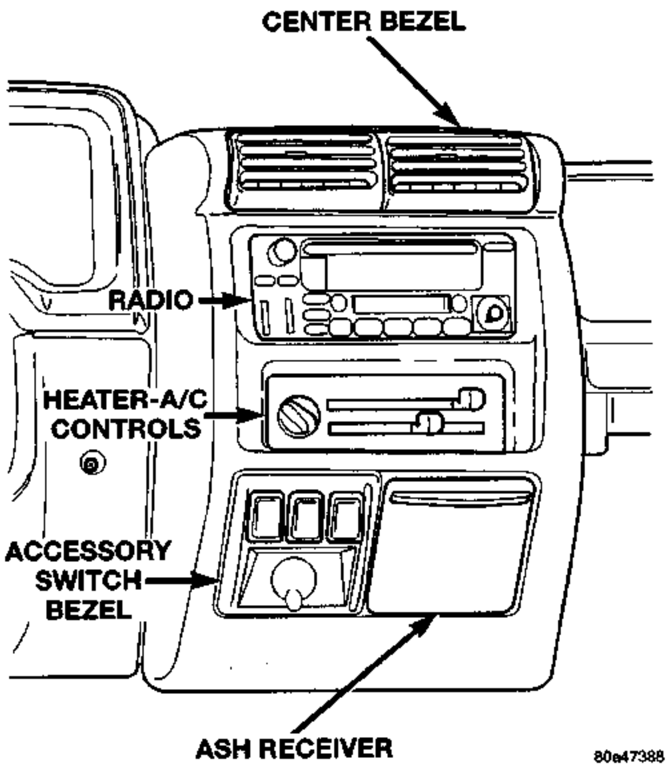


Fig. 4 Center Bezel Remove/Install

(6) Remove the one screw located in the back of the ash receiver housing securing the center bezel to the instrument panel.

(7) Pry the lower edge of the center bezel away from the instrument panel using a trim stick. Then lift the lower edge upwards to release the four snap clip retainers from the instrument panel.

(8) Remove the four screws securing the accessory switch bezel to the instrument panel (Fig. 5).

(9) Pull the accessory switch bezel out from the instrument panel far enough to unplug the wiring connectors.

(10) Remove the accessory switch bezel from the instrument panel.

(11) Carefully pry the snap clips at the top and bottom of the rear window defogger switch cavity on the back of the accessory switch bezel with a small thin-bladed screwdriver and remove the switch from the bezel.

(12) Reverse the removal procedures to install. Make certain that both of the switch snap clip retainers on the back of the accessory switch bezel are fully engaged.

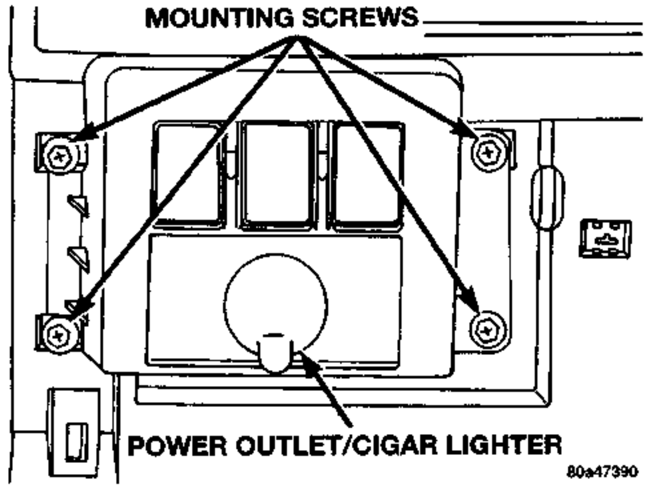


Fig. 5 Accessory Switch Bezel Remove/Install

DEFOGGER RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 6).

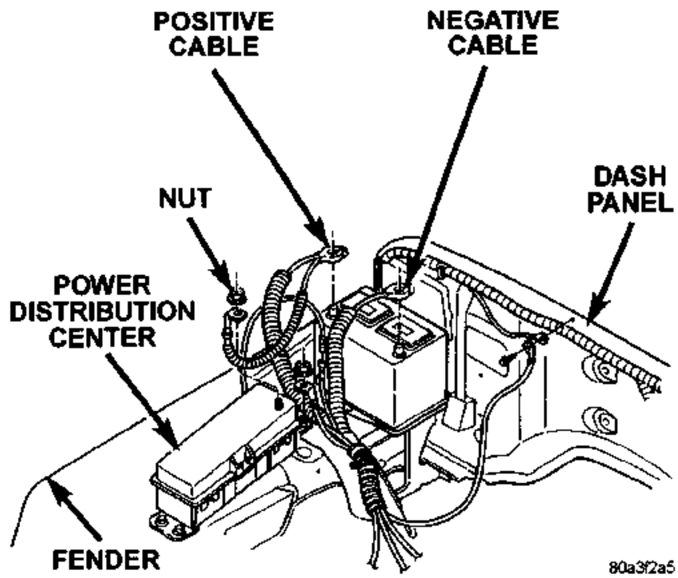


Fig. 6 Power Distribution Center

(3) Refer to the label on the PDC for defogger relay identification and location.

(4) Remove the defogger relay by unplugging it from the PDC.

(5) Install the defogger relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

CHIME/BUZZER WARNING SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

This group covers the chime warning system, which is standard factory-installed equipment on this model. The system provides an audible warning to the driver when it monitors the following conditions:

- Check gauges warning
- Head or park lamps are on with the ignition switch Off and the driver door open
- High speed warning - Gulf Coast Country export only
- Key is in the ignition switch with the ignition switch Off and the driver door open
- Low fuel warning - less than about one-eighth tank of fuel remaining
- Seat belt (driver side front) is not buckled with the ignition switch in the On position - except RHD export.

Following are general descriptions of the major components in the chime warning system. Refer to 8W-40 Instrument Cluster or 8W-44 - Interior Lighting in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

NOTE: This group covers both Left-Hand Drive (LHD) and Right-Hand Drive (RHD) versions of this model. Whenever required and feasible, the RHD versions of affected vehicle components have been constructed as mirror-image of the LHD versions. While most of the illustrations used in this group represent only the LHD version, the diagnostic and service procedures outlined can generally be applied to either version. Exceptions to this rule have been clearly identified as LHD or RHD, if a special illustration or procedure is required.

DESCRIPTION AND OPERATION

INSTRUMENT CLUSTER

The instrument cluster circuit board contains circuitry and a chime tone generator to perform the functions of the chime warning module on this model. However, there are no diagnostics available for this circuitry. Therefore, diagnosis of the chime warning system consists of confirming the presence of system inputs.

The chime warning system circuitry monitors hard-wired switch inputs, as well as message inputs received from the Powertrain Control Module on the Chrysler Collision Detection (CCD) data bus network. Diagnosis of the hard-wired inputs is covered in this group. Diagnosis of the CCD data bus and the data bus message inputs must be performed with a DRB scan tool and the proper Powertrain Diagnostic Procedures manual.

Hard-wired chime warning system inputs to the instrument cluster include the following:

- Driver door ajar switch
- Driver seat belt switch
- Headlamp switch
- Key-in ignition switch.

Refer to Group 8E - Instrument Panel Systems for the service procedures for the instrument cluster. The instrument cluster chime warning circuitry and chime tone generator cannot be repaired and, if faulty, the instrument cluster assembly must be replaced.

DRIVER DOOR AJAR SWITCH

The driver door ajar switch is mounted to the driver door hinge pillar. The switch closes a path to ground for the instrument cluster chime warning circuitry through the key-in ignition switch and/or the headlamp switch when the driver door is opened, and

DESCRIPTION AND OPERATION (Continued)

opens the ground path when the driver door is closed. This switch cannot be repaired and, if faulty, it must be replaced. Refer to Group 8L - Lamps for the service procedures.

DRIVER SEAT BELT SWITCH

The driver seat belt switch is integral to the driver seat belt buckle-half assembly. The switch is normally closed, providing a ground path to the instrument panel chime warning circuitry. When the tip-half of the seat belt is inserted into the seat belt buckle, the switch opens the ground path. The seat belt switch cannot be repaired. If faulty, the entire driver seat belt buckle-half unit must be replaced. Refer to Group 23 - Body Components for the service procedures.

KEY-IN IGNITION SWITCH

The key-in ignition switch is integral to the ignition switch, which is mounted on the left side of the steering column, opposite the ignition lock cylinder. It closes a path to ground for the instrument cluster chime warning circuitry when the ignition key is inserted in the ignition lock cylinder and the driver door ajar switch is closed (driver door is open). The key-in ignition switch opens when the key is removed from the ignition lock cylinder. This switch cannot be repaired and, if faulty, the ignition switch module must be replaced. Refer to Group 8D - Ignition Systems for the service procedures.

HEADLAMP SWITCH

The headlamp switch is located in the instrument panel, outboard of the steering column. It closes a path to ground for the instrument cluster chime warning circuitry when the park or head lamps are on and the driver door ajar switch is closed (driver door is open). The headlamp switch opens the ground path when the headlamp switch is turned off. The headlamp switch cannot be repaired and, if faulty, it must be replaced. Refer to Group 8E - Instrument Panel Systems for the service procedures.

DIAGNOSIS AND TESTING

DRIVER DOOR JAMB SWITCH

For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster or 8W-44 - Interior Lighting in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Open the driver door and note whether the interior lamps light. They should light. If OK, see the diagnosis for the Key-In Ignition Switch or the Headlamp Switch in this group. If not OK, go to Step 2.

(2) Check for continuity between the **door jamb switch output** circuit cavity of the driver door jamb switch connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the circuit to ground as required.

(3) Check for continuity between the **door jamb switch output** circuit terminal and the **left front door jamb switch sense** terminal of the door ajar switch. There should be continuity with the switch plunger released, and no continuity with the switch plunger depressed. If not OK, replace the faulty switch.

DRIVER SEAT BELT SWITCH

For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster or 8W-44 - Interior Lighting in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Unplug the seat belt switch connector on the floor under the driver seat near the seat belt buckle-half anchor. Check for continuity between the **seat belt switch sense** circuit and the **ground** circuit cavities of the seat belt half of the connector. There should be continuity with the seat belt unbuckled, and no continuity with the seat belt buckled. If OK, go to Step 2. If not OK, replace the faulty seat belt buckle-half assembly.

(2) Check for continuity between the **ground** circuit cavity in the harness half of the seat belt switch connector and a good ground. There should be continuity. If OK, see the Instrument Cluster diagnosis in this group. If not OK, repair the circuit to ground as required.

KEY-IN IGNITION SWITCH

For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster or 8W-44 - Interior Lighting in Group 8W - Wiring Diagrams.

DIAGNOSIS AND TESTING (Continued)

WARNING: ON VEHICLES EQUIPPED WITH AN AIRBAG, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL OR STEERING COLUMN COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the steering column shrouds. Refer to Group 8D - Ignition Systems for the procedures. Unplug the key-in ignition switch connector from the ignition switch.

(2) Check for continuity between the **left front door jamb switch sense** circuit cavity of the connector and a good ground. There should be continuity with the driver door open, and no continuity with the driver door closed. If OK, go to Step 3. If not OK, repair the circuit to the driver door jamb switch as required.

(3) Check for continuity between the **key-in switch sense** circuit and the **left front door jamb switch sense** circuit terminals on the key-in ignition switch. There should be continuity with the key in the ignition lock cylinder, and no continuity with the key removed. If OK, see the diagnosis for Instrument Cluster in this group. If not OK, replace the faulty ignition switch.

HEADLAMP SWITCH

For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster or 8W-44 - Interior Lighting in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Unplug the headlamp switch connector. Check for continuity between the **left front door jamb switch sense** circuit cavity of the headlamp switch connector and a good ground. There should be continuity with the driver door closed, and no continuity with the driver door open. If OK, go to Step 2. If not OK, repair the circuit to the driver door jamb switch as required.

(2) Check for continuity between the **key-in switch sense** circuit terminal and the **left front door jamb switch sense** terminal of the headlamp switch. There should be continuity with the headlamp switch turned on, and no continuity with the headlamp switch turned off. If OK, see the diagnosis for Instrument Panel in this group. If not OK, replace the faulty headlamp switch.

INSTRUMENT CLUSTER

Before performing this test, complete the testing of the hard-wired chime warning system switches as described in this group. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster or 8W-44 - Interior Lighting in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster from the instrument panel. Refer to Group 8E - Instrument Panel Systems for the procedures.

(2) Unplug the headlamp switch and key-in ignition switch connectors. Check for continuity between the **key-in switch sense** circuit cavity of the right (gray) instrument cluster connector and a good ground. There should be no continuity. If OK, go to Step 3. If not OK, repair the short circuit as required.

(3) Check for continuity between the **key-in switch sense** circuit cavities of the right (gray) instrument cluster connector and the headlamp switch connector. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Unplug the driver seat belt switch connector. Check for continuity between the **seat belt switch sense** circuit cavity of the right (gray) instrument cluster connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the short circuit as required.

(5) Check for continuity between the **seat belt switch sense** circuit cavities of the right (gray) instrument cluster connector and the driver seat belt switch connector. There should be continuity. If OK, replace the faulty instrument cluster. If not OK, repair the open circuit as required.

REMOVAL AND INSTALLATION

CHIME WARNING SYSTEM SWITCHES

Service procedures for the various hard-wired switches used in the chime warning system can be found in the appropriate group as follows:

- Driver door ajar switch - refer to Group 8L - Lamps
- Driver seat belt switch - refer to Group 23 - Body Components
- Headlamp switch - refer to Group 8E - Instrument Panel Systems
- Key-in ignition switch - refer to Group 8D - Ignition Systems.

WIRING DIAGRAMS

CONTENTS

8W-01 GENERAL INFORMATION

INDEX

DESCRIPTION AND OPERATION

HOW TO USE THIS GROUP

The purpose of this group is to show the electrical circuits in a clear, simple fashion and to make troubleshooting easier. Components that work together are shown together. All electrical components used in a specific system are shown on one diagram. The feed for a system is shown at the top of the page. All wires, connectors, splices, and components are shown in the flow of current to the bottom of the page. Wiring which is not part of the circuit represented is referenced to another page/section, where the complete circuit is shown. In addition, all switches, components, and modules are shown in the **at rest position with the doors closed and the key removed from the ignition.**

If a component is part of several different circuits, it is shown in the diagram for each. For example, the headlamp switch is the main part of the exterior lighting, but it also affects the interior lighting and the chime warning system. **It is important to realize that no attempt is made on the diagrams to represent components and wiring as they appear on the vehicle. For example, a short piece of wire is treated the same as a long one. In addition, switches and other components are shown as simply as possible, with regard to function only.**

SECTION IDENTIFICATION

Sections in Group 8W are organized by sub-systems. The sections contain circuit operation descriptions, helpful information, and system diagrams. The intention is to organize information by system, consistently from year to year.

CONNECTOR/GROUND LOCATIONS

Section 8W-90 contains connector/ground location illustrations. The illustrations contain the connector/ground number and component identification. Connector/ground location charts in Section 8W-90 reference the illustration number for components and connectors.

Section 8W-80 shows each connector and the circuits involved with that connector. The connectors are identified using the number on the Diagram pages.

SPLICE LOCATIONS

Splice Location charts in Section 8W-70 show the entire splice, and provide references to other sections the splice serves.

Section 8W-95 contains illustrations that show the general location of the splices in each harness. The illustrations show the splice by number, and provide a written location.

NOTES, CAUTIONS, and WARNINGS

Throughout this group additional important information is presented in three ways; Notes, Cautions, and Warnings.

DESCRIPTION AND OPERATION (Continued)

NOTES are used to help describe how switches or components operate to complete a particular circuit. They are also used to indicate different conditions that may appear on the vehicle. For example, an up-to and after condition.

CAUTIONS are used to indicate information that could prevent making an error that may damage the vehicle.

WARNINGS provide information to prevent personal injury and vehicle damage. Below is a list of general warnings that should be followed any time a vehicle is being serviced.

WARNING: ALWAYS WEAR SAFETY GLASSES FOR EYE PROTECTION.

WARNING: USE SAFETY STANDS ANYTIME A PROCEDURE REQUIRES BEING UNDER A VEHICLE.

WARNING: BE SURE THAT THE IGNITION SWITCH ALWAYS IS IN THE OFF POSITION, UNLESS THE PROCEDURE REQUIRES IT TO BE ON.

WARNING: SET THE PARKING BRAKE WHEN WORKING ON ANY VEHICLE. AN AUTOMATIC TRANSMISSION SHOULD BE IN PARK. A MANUAL TRANSMISSION SHOULD BE IN NEUTRAL.

WARNING: OPERATE THE ENGINE ONLY IN A WELL-VENTILATED AREA.

WARNING: KEEP AWAY FROM MOVING PARTS WHEN THE ENGINE IS RUNNING, ESPECIALLY THE FAN AND BELTS.

WARNING: TO PREVENT SERIOUS BURNS, AVOID CONTACT WITH HOT PARTS SUCH AS THE RADIATOR, EXHAUST MANIFOLD(S), TAIL PIPE, CATALYTIC CONVERTER, AND MUFFLER.

WARNING: DO NOT ALLOW FLAME OR SPARKS NEAR THE BATTERY. GASES ARE ALWAYS PRESENT IN AND AROUND THE BATTERY.

WARNING: ALWAYS REMOVE RINGS, WATCHES, LOOSE HANGING JEWELRY, AND LOOSE CLOTHING.

WIRE CODE IDENTIFICATION

Each wire shown in the diagrams contains a code (Fig. 1) 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. 2)

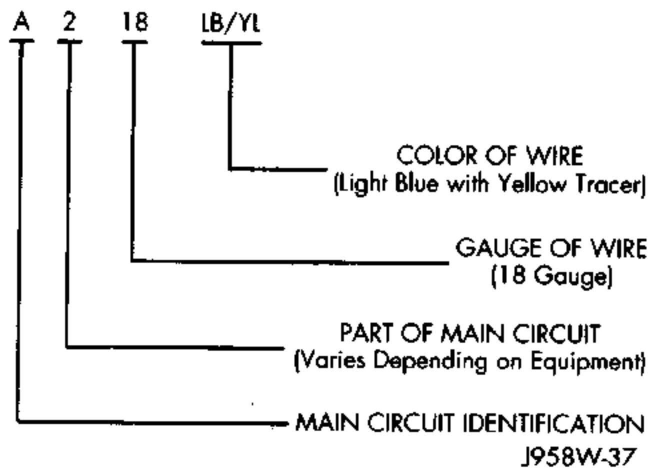


Fig. 1 Wire Code Identification

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	

918W-136

Fig. 2 Wire Color Code Chart

CIRCUIT IDENTIFICATION

All circuits in the diagrams use an alpha/numeric code to identify the wire and its function (Fig. 3). 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.

DESCRIPTION AND OPERATION (Continued)

CIRCUIT	FUNCTION
A	Battery Feed
B	Brake Controls
C	Climate Controls
D	Diagnostic Circuits
E	Dimming Illumination Circuits
F	Fused Circuits (Secondary Feed)
G	Monitoring Circuits (Gauges)
H	Open
I	Not Used
J	Open
K	Powertrain Control Module
L	Exterior Lighting
M	Interior Lighting
N	ESA Module
O	Not Used
P	Power Option (Battery Feed)
Q	Power Options (Battery Feed)
R	Passive Restraint
S	Suspension/Steering
T	Transmission/Transaxle/Transfer Case
U	Open
V	Speed Control, Washer/Wiper
W	Open
X	Audio Systems
Y	Open
Z	Grounds

948W-190

Fig. 3 Circuit Identification

CONNECTORS

Connectors shown in the diagrams are identified using the international standard arrows for male and female terminals (Fig. 4). A connector identifier is placed next to the arrows to indicate the connector number (Fig. 4).

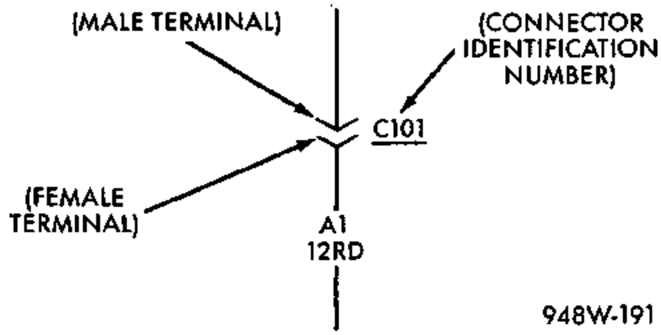


Fig. 4 Connector Identification

For viewing connector pin outs, with two terminals or greater, refer to section 8W-80. This section identifies the connector by number and provides terminal numbering, circuit identification, wire colors, and functions.

All connectors are viewed from the terminal end unless otherwise specified. To find the connector location in the vehicle refer to section 8W-90. This section uses the connector identification number from the wiring diagrams to provide a figure number reference.

TAKE OUTS

The abbreviation T/O is used in the component location section to indicate a point in which the wiring harness branches out to a component.

SYMBOLS

Various symbols are used throughout the Wiring Diagrams. These symbols can be identified by referring to the symbol identification chart (Fig. 5).

DESCRIPTION AND OPERATION (Continued)

LEGEND OF SYMBOLS USED ON WIRING DIAGRAMS			
+	POSITIVE		BY-DIRECTIONAL ZENER DIODE
–	NEGATIVE		MOTOR
	GROUND		ARMATURE AND BRUSHES
	FUSE	C100	CONNECTOR IDENTIFICATION
	GANG FUSES WITH BUSS BAR	→	MALE CONNECTOR
	CIRCUIT BREAKER		FEMALE CONNECTOR
	CAPACITOR		DENOTES WIRE CONTINUES ELSEWHERE
Ω	OHMS		DENOTES WIRE GOES TO ONE OF TWO CIRCUITS
	RESISTOR		SPLICE
	VARIABLE RESISTOR	S100	SPLICE IDENTIFICATION
	SERIES RESISTOR		THERMAL ELEMENT
	COIL	TIMER	TIMER
	STEP UP COIL		MULTIPLE CONNECTOR
	OPEN CONTACT		OPTIONAL WIRING WITH / WIRING WITHOUT
	CLOSED CONTACT		"Y" WINDINGS
	CLOSED SWITCH	88:88	DIGITAL READOUT
	OPEN SWITCH		SINGLE FILAMENT LAMP
	CLOSED GANGED SWITCH		DUAL FILAMENT LAMP
	OPEN GANGED SWITCH		L.E.D. — LIGHT EMITTING DIODE
	TWO POLE SINGLE THROW SWITCH		THERMISTOR
	PRESSURE SWITCH		GAUGE
	SOLENOID SWITCH		SENSOR
	MERCURY SWITCH		FUEL INJECTOR
	DIODE OR RECTIFIER		948W-192

Fig. 5 Symbol Identification

DESCRIPTION AND OPERATION (Continued)

ELECTROSTATIC DISCHARGE (ESD) SENSITIVE DEVICES

All ESD sensitive components are solid state and a symbol (Fig. 6) is used to indicate this. When handling any component with this symbol comply with the following procedures to reduce the possibility of electrostatic charge build up on the body and inadvertent discharge into the component. If it is not known whether the part is ESD sensitive, assume that it is.

(1) Always touch a known good ground before handling the part. This should be repeated while handling the part and more frequently after sliding across a seat, sitting down from a standing position, or walking a distance.

(2) Avoid touching electrical terminals of the part, unless instructed to do so by a written procedure.

(3) When using a voltmeter, be sure to connect the ground lead first.

(4) Do not remove the part from its protective packing until it is time to install the part.

(5) Before removing the part from its package, ground the package to a known good ground on the vehicle.

948W-193

Fig. 6 Electrostatic Discharge Symbol

DIAGNOSIS AND TESTING

TROUBLESHOOTING TOOLS

When diagnosing a problem in an electrical circuit there are several common tools necessary. These tools are listed and explained below.

• Jumper Wire - This is a test wire used to connect two points of a circuit. It can be used to bypass an open in a circuit.

WARNING: NEVER USE A JUMPER WIRE ACROSS A LOAD, SUCH AS A MOTOR, CONNECTED BETWEEN A BATTERY FEED AND GROUND.

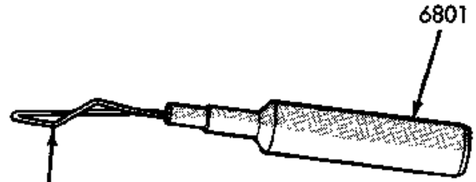
• Voltmeter - Used to check for voltage on a circuit. Always connect the black lead to a known good ground and the red lead to the positive side of the circuit.

CAUTION: Most of the electrical components used in today's vehicle are solid state. When checking voltages in these circuits use a meter with a 10-megohm or greater impedance.

• Ohmmeter - Used to check the resistance between two points of a circuit. Low or no resistance in a circuit means good continuity.

CAUTION: - Most of the electrical components used in today's vehicle are Solid State. When checking resistance in these circuits use a meter with a 10-megohm or greater impedance. In addition, make sure the power is disconnected from the circuit. Circuits that are powered up by the vehicle electrical system can cause damage to the equipment and provide false readings.

• Probing Tools - These tools are used for probing terminals in connectors (Fig. 7). Select the proper size tool from Special Tool Package 6807, and insert it into the terminal being tested. Use the other end of the tool to insert the meter probe.



948W-233

Fig. 7 Probing Tool

INTERMITTENT AND POOR CONNECTIONS

Most intermittent electrical problems are caused by faulty electrical connections or wiring. It is also possible for a sticking component or relay to cause a problem. Before condemning a component or wiring assembly check the following items.

• Connectors are fully seated

• Spread terminals, or terminal push out

• Terminals in the wiring assembly are fully seated into the connector/component and locked in position

• Dirt or corrosion on the terminals. Any amount of corrosion or dirt could cause an intermittent problem

• Damaged connector/component casing exposing the item to dirt and moisture

• Wire insulation that has rubbed through causing a short to ground

• Wiring broke inside of the insulation

DIAGNOSIS AND TESTING (Continued)

CHECKING FOR TERMINAL SPREADING

When an intermittent or open circuit is suspected it is important to check for a spread terminal. To accomplish this remove the suspect female terminal from its connector.

Check the female terminal for drag when mated with the appropriate male terminal. If the terminal is spread (no or little drag felt) replace the terminal using the procedures covered in this section of the wiring diagrams.

TROUBLESHOOTING TESTS

Before beginning any tests on a vehicles electrical system use the Wiring Diagrams and study the circuit. Also refer to the Troubleshooting Wiring Problems section in this section.

TESTING FOR VOLTAGE

(1) Connect the ground lead of a voltmeter to a known good ground (Fig. 8).

(2) Connect the other lead of the voltmeter to the selected test point. The vehicle ignition may need to be turned ON to check voltage. Refer to the appropriate test procedure.

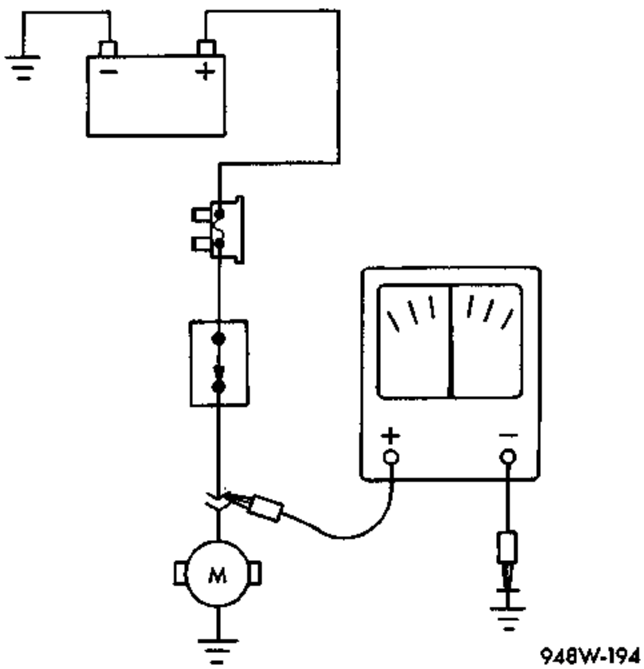


Fig. 8 Testing for Voltage

TESTING FOR CONTINUITY

(1) Remove the fuse for the circuit being checked or, disconnect the battery.

(2) Connect one lead of the ohmmeter to one side of the circuit being tested (Fig. 9).

(3) Connect the other lead to the other end of the circuit being tested. Low or no resistance means good continuity.

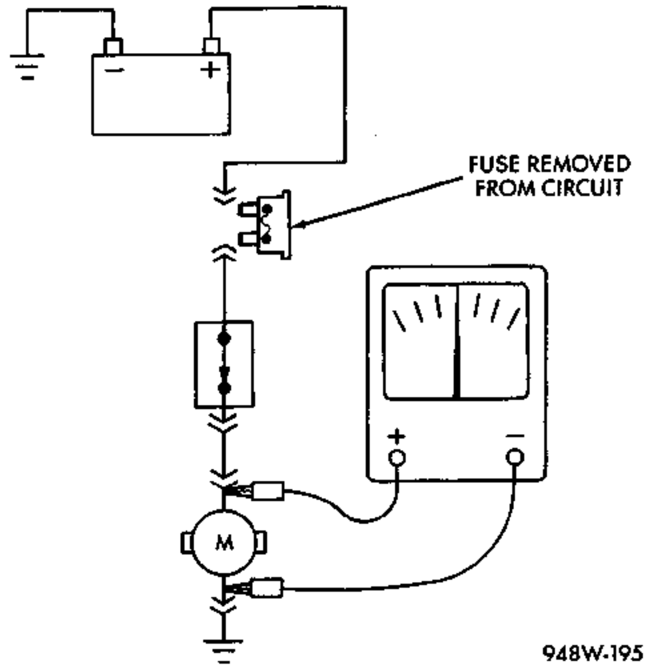


Fig. 9 Testing for Continuity

TESTING FOR A SHORT TO GROUND

(1) Remove the fuse and disconnect all items involved with the fuse.

(2) Connect a test light or a voltmeter across the terminals of the fuse.

(3) Starting at the fuse block, wiggle the wiring harness about six to eight inches apart and watch the voltmeter/test lamp.

(4) If the voltmeter registers voltage or the test lamp glows, there is a short to ground in that general area of the wiring harness.

TESTING FOR A SHORT TO GROUND ON FUSES POWERING SEVERAL LOADS

(1) Refer to the wiring diagrams and disconnect or isolate all items on the fused circuit.

(2) Replace the blown fuse.

(3) Supply power to the fuse by turning ON the ignition switch or re-connecting the battery.

(4) Start connecting the items in the fuse circuit one at a time. When the fuse blows the circuit with the short to ground has been isolated.

TESTING FOR A VOLTAGE DROP

(1) Connect the positive lead of the voltmeter to the side of the circuit closest to the battery (Fig. 10).

(2) Connect the other lead of the voltmeter to the other side of the switch or component.

(3) Operate the item.

(4) The voltmeter will show the difference in voltage between the two points.

DIAGNOSIS AND TESTING (Continued)

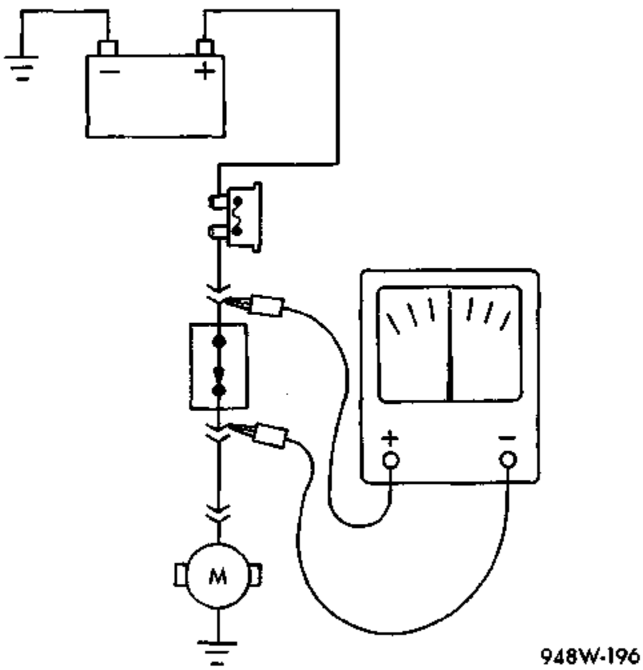


Fig. 10 Testing for Voltage Drop

TROUBLESHOOTING WIRING PROBLEMS

When troubleshooting wiring problems there are six steps which can aid in the procedure. The steps are listed and explained below. Always check for non-factory items added to the vehicle before doing any diagnosis. If the vehicle is equipped with these items, disconnect them to verify these add-on items are not the cause of the problem.

(1) Verify the problem.

(2) Verify any related symptoms. Do this by performing operational checks on components that are in the same circuit. Refer to the wiring diagrams.

(3) Analyze the symptoms. Use the wiring diagrams to determine what the circuit is doing, where the problem most likely is occurring and where the diagnosis will continue.

(4) Isolate the problem area.

(5) Repair the problem.

(6) Verify proper operation. For this step check for proper operation of all items on the repaired circuit. Refer to the wiring diagrams.

SERVICE PROCEDURES

WIRING REPAIR

When replacing or repairing a wire, it is important that the correct gauge be used as shown in the wiring diagrams. The wires must also be held securely in place to prevent damage to the insulation.

(1) Disconnect battery negative cable

(2) Remove 1 inch of insulation from each end of the wire.

(3) Place a piece of heat shrink tubing over one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.

(4) Spread the strands of the wire apart on each part of the exposed wire (example 1). (Fig. 11)

(5) Push the two ends of wire together until the strands of wire are close to the insulation (example 2) (Fig. 11)

(6) Twist the wires together (example 3) (Fig. 11)

(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.

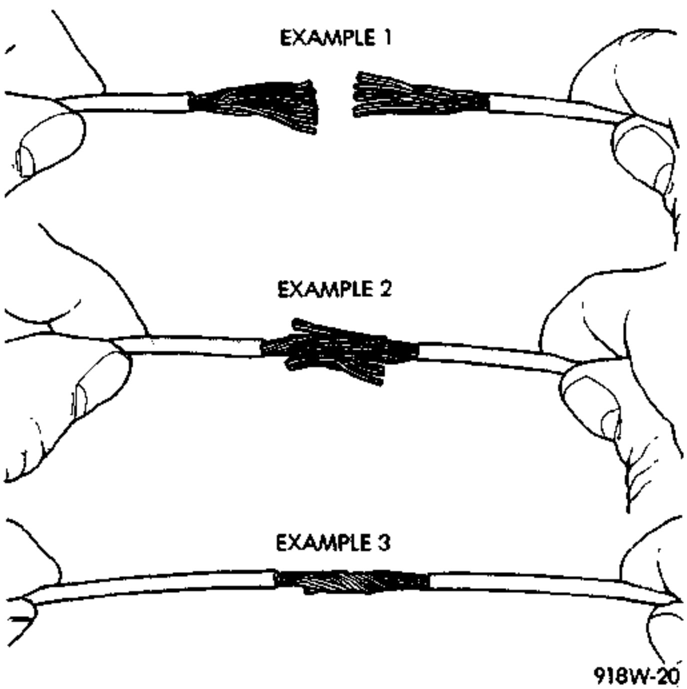


Fig. 11 Wire Repair

TERMINAL/CONNECTOR REPAIR-MOLEX CONNECTORS

(1) Disconnect battery.

(2) Disconnect the connector from its mating half/ component.

(3) Insert the terminal releasing special tool 6742 into the terminal end of the connector (Fig. 12).

(4) Using special tool 6742 release the locking fingers on the terminal (Fig. 13).

(5) Pull on the wire to remove it from the connector.

(6) Repair or replace the connector or terminal, as necessary.

SERVICE PROCEDURES (Continued)

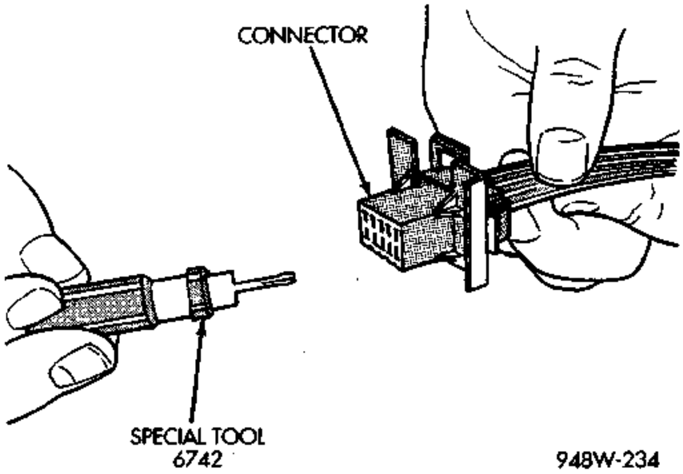


Fig. 12 Molex Connector Repair

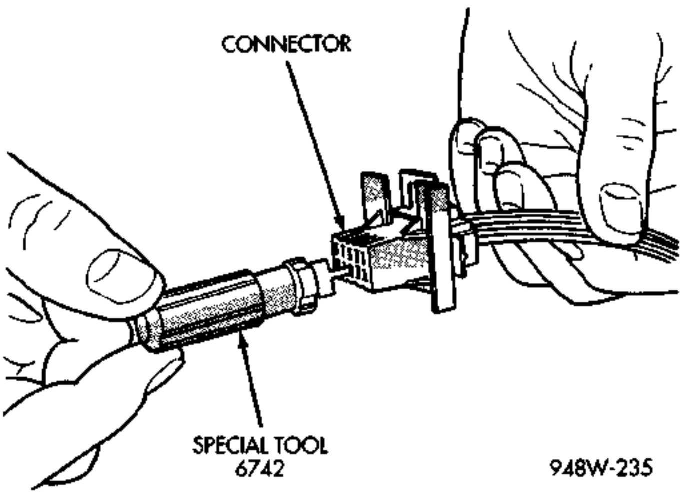


Fig. 13 Using Special Tool 6742

TERMINAL/CONNECTOR REPAIR—THOMAS AND BETTS CONNECTORS

(1) Disconnect battery.

(2) Disconnect the connector from its mating half/ component.

(3) Push in the two lock tabs on the side of the connector (Fig. 14).

(4) Insert the probe end of special tool 6934 into the back of the connector cavity (Fig. 15).

(5) Grasp the wire and tool 6934 and slowly remove the wire and terminal from the connector.

(6) Repair or replace the terminal.

(7) Install the wire and terminal in the connector. Fully seat the terminal in the connector.

(8) Push in the single lock tab on the side of the connector (Fig. 16).

CONNECTOR REPLACEMENT

(1) Disconnect battery.

(2) Disconnect the connector that is to be repaired from its mating half/component

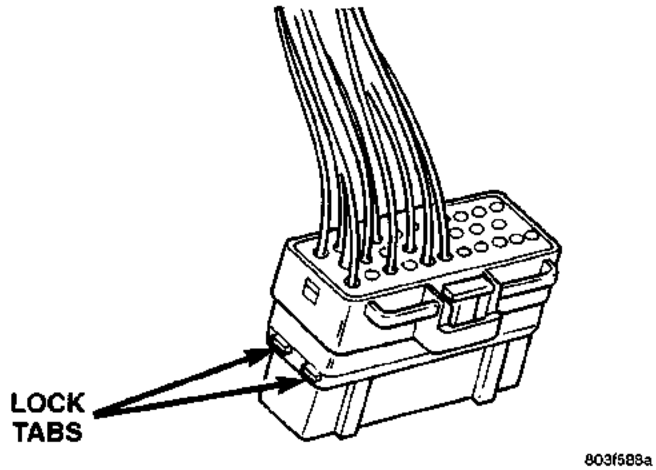


Fig. 14 Thomas and Betts Connector Lock Release Tabs

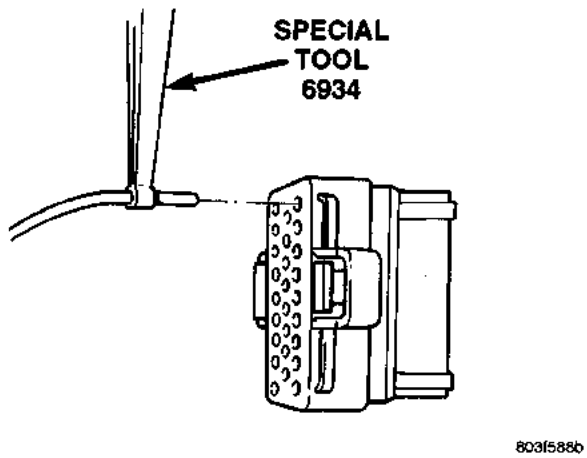


Fig. 15 Removing Wire Terminal

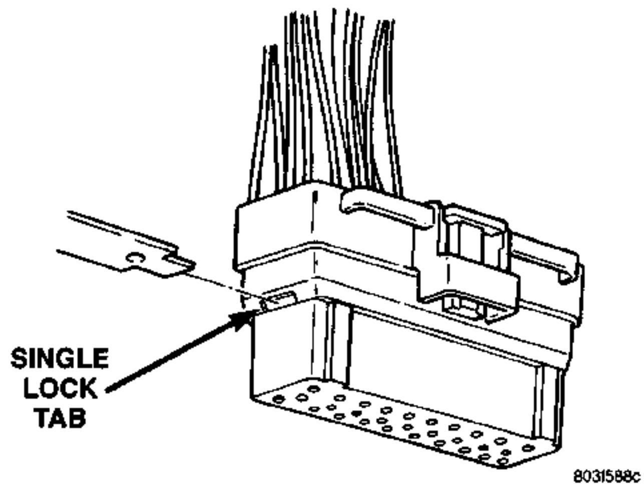


Fig. 16 Single Lock Tab

(3) Remove the connector locking wedge, if required (Fig. 17)

SERVICE PROCEDURES (Continued)

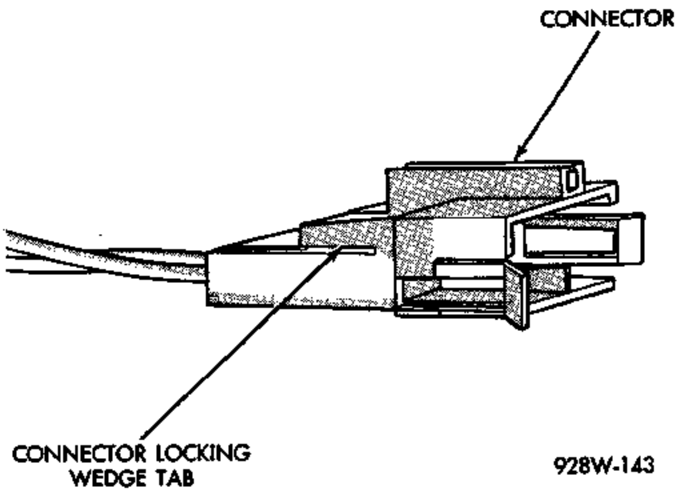


Fig. 17 Connector Locking Wedge

(4) Position the connector locking finger away from the terminal using the proper pick from special tool kit 6680. Pull on the wire to remove the terminal from the connector (Fig. 18) (Fig. 19).

(5) Reset the terminal locking tang, if it has one.

(6) Insert the removed wire in the same cavity on the repair connector.

(7) Repeat steps four through six for each wire in the connector, being sure that all wires are inserted into the proper cavities. For additional connector pin-out identification, refer to the wiring diagrams.

(8) Insert the connector locking wedge into the repaired connector, if required.

(9) Connect connector to its mating half/component.

(10) Connect battery and test all affected systems.

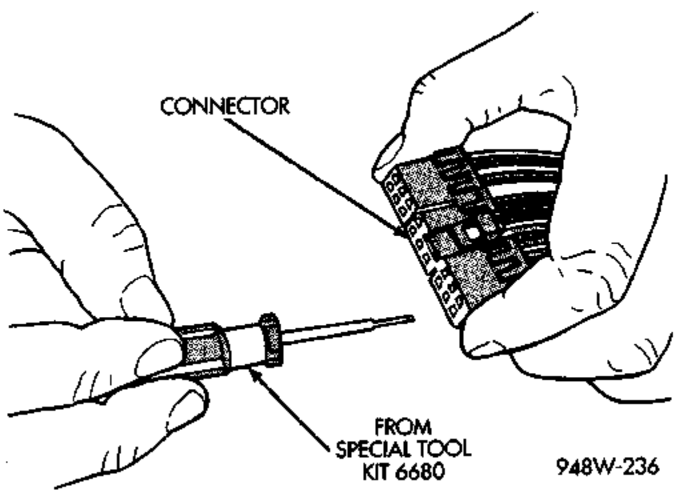


Fig. 18 Terminal Removal

CONNECTOR AND TERMINAL REPLACEMENT

(1) Disconnect battery.

(2) Disconnect the connector (that is to be repaired) from its mating half/component.

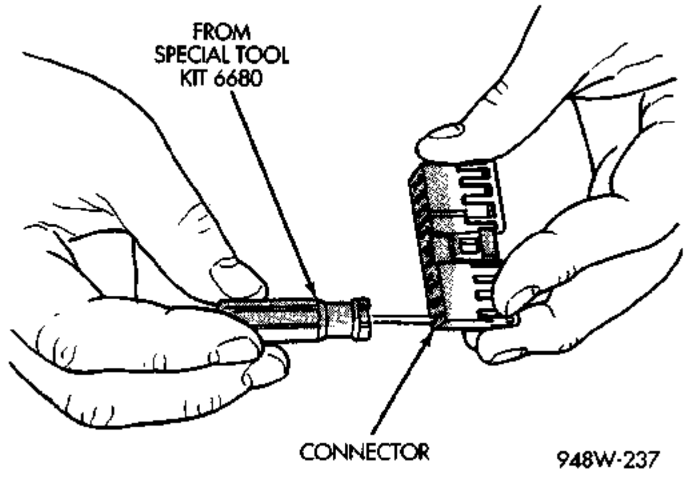


Fig. 19 Terminal Removal Using Special Tool

(3) Cut off the existing wire connector directly behind the insulator. Remove six inches of tape from the harness.

(4) Stagger cut all wires on the harness side at 1/2 inch intervals (Fig. 20).

(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. 20).

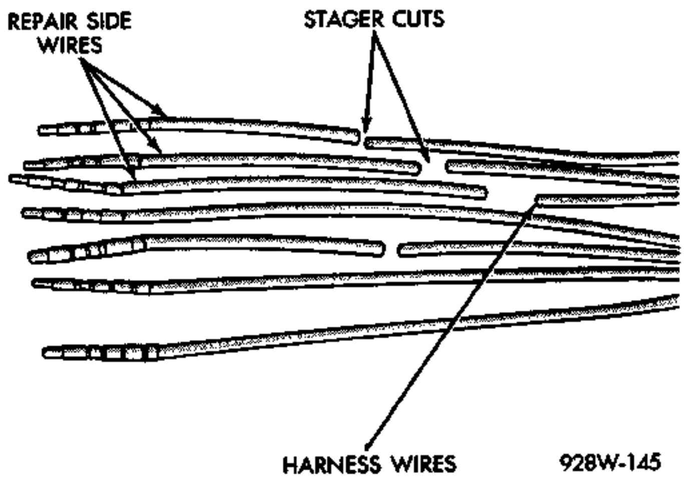


Fig. 20 Stagger Cutting Wires

(7) Remove 1 inch of insulation from each wire.

(8) Place a piece of heat shrink tubing over one side of the wire. Be sure the tubing will be long enough to cover and seal the entire repair area.

(9) Spread the strands of the wire apart on each part of the exposed wires.

(10) Push the two ends of wire together until the strands of wire are close to the insulation.

(11) Twist the wires together.

SERVICE PROCEDURES (Continued)

(12) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(13) Center the heat shrink tubing over the joint and heat using a heat gun. Heat the joint until the tubing is tightly sealed and sealant comes out of both ends of the tubing

(14) Repeat steps 8 through 13 for each wire.

(15) Re-tape the wire harness starting 1-1/2 inches behind the connector and 2 inches past the repair.

(16) Re-connect the repaired connector.

(17) Connect the battery, and test all affected systems.

TERMINAL REPLACEMENT

(1) Disconnect battery.

(2) Disconnect the connector being repaired from its mating half. Remove connector locking wedge, if required (Fig. 21).

(3) Remove connector locking wedge, if required (Fig. 21).

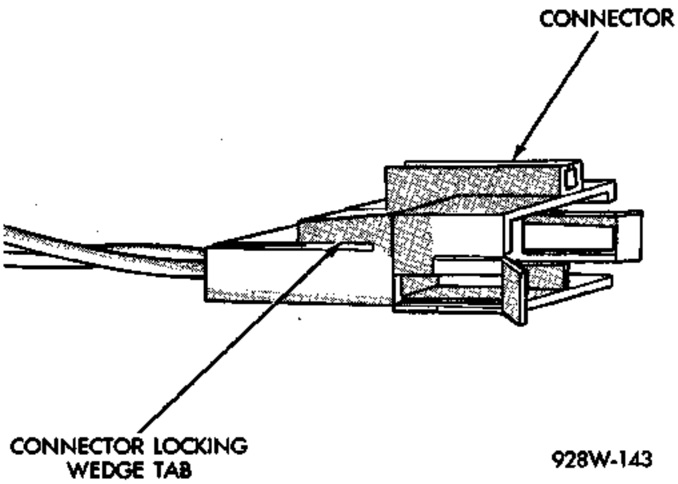


Fig. 21 Connector Locking Wedge Tab (Typical)

(4) Position the connector locking finger away from the terminal using the proper pick from special tool kit 6680. Pull on the wire to remove the terminal from the connector (Fig. 22) (Fig. 23).

(5) Cut the wire 6 inches from the back of the connector.

(6) Remove 1 inch of insulation from the wire on the harness side.

(7) Select a wire from the terminal repair assembly that best matches the color wire being repaired.

(8) Cut the repair wire to the proper length and remove 1 inch of insulation.

(9) Place a piece of heat shrink tubing over one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.

(10) Spread the strands of the wire apart on each part of the exposed wires.

(11) Spread the strands of the wire apart on each part of the exposed wires.

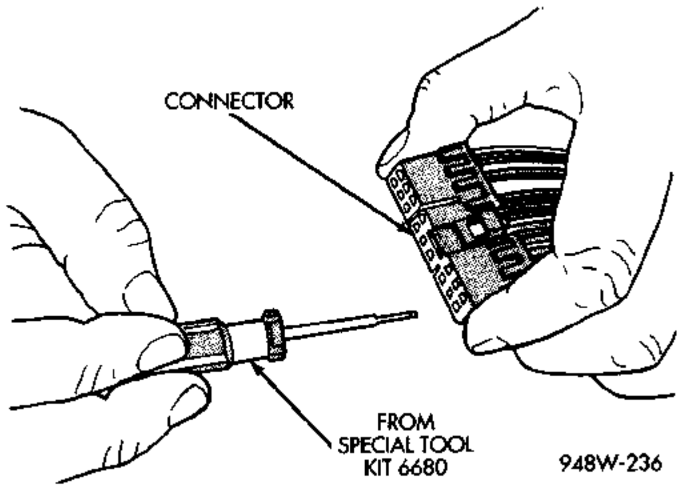


Fig. 22 Terminal Removal

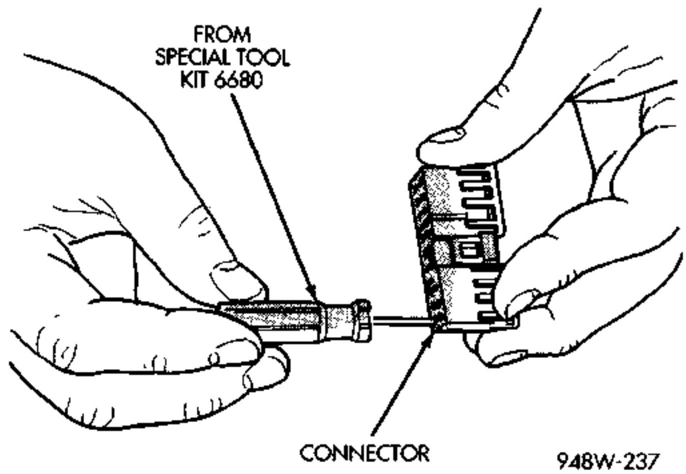


Fig. 23 Terminal Removal Using Special Tool

(12) Push the two ends of wire together until the strands of wire are close to the insulation.

(13) Twist the wires together.

(14) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(15) 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.

(16) Insert the repaired wire into the connector.

(17) Install the connector locking wedge, if required, and reconnect the connector to its mating half/component.

(18) Re-tape the wire harness starting 1-1/2 inches behind the connector and 2 inches past the repair.

(19) Connect battery, and test all affected systems.

DIODE REPLACEMENT

(1) Disconnect the battery.

(2) Locate the diode in the harness, and remove the protective covering.

SERVICE PROCEDURES (Continued)

(3) Remove the diode from the harness, pay attention to the current flow direction (Fig. 24).

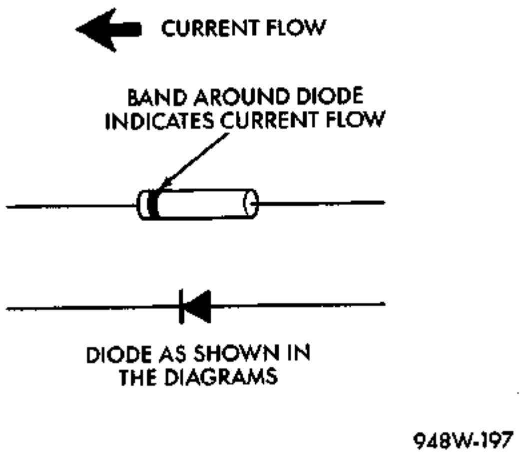


Fig. 24 Diode Identification

(4) Remove the insulation from the wires in the harness. Only remove enough insulation to solder in the new diode.

(5) Install the new diode in the harness, making sure current flow is correct. If necessary refer to the appropriate wiring diagram for current flow.

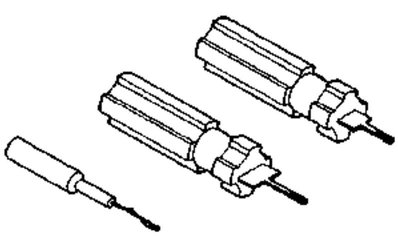
(6) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(7) Tape the diode to the harness using electrical tape making, sure the diode is completely sealed from the elements.

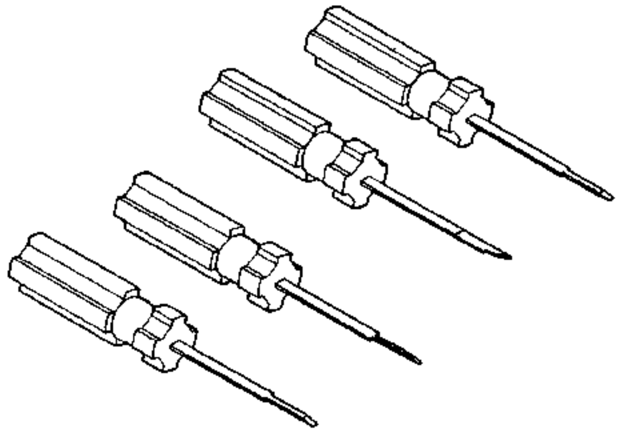
(8) Re-connect the battery, and test affected systems.

SPECIAL TOOLS

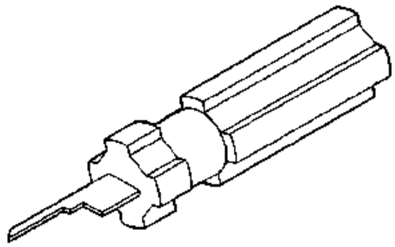
WIRING/TERMINAL



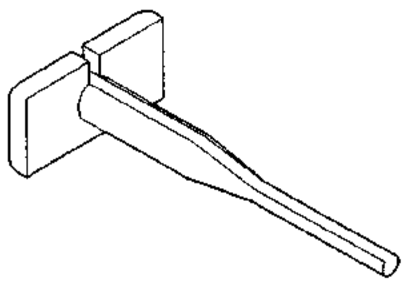
Probing Tool Package 6807



Terminal Pick 6680



Terminal Removing Tool 6932



Terminal Removing Tool 6934

8W-02 COMPONENT INDEX

GENERAL INFORMATION

INTRODUCTION

This section provides an alphabetical listing of all the components covered in group 8W. For information on system operation, refer to the appropriate section of the wiring diagrams.

COMPONENT INDEX

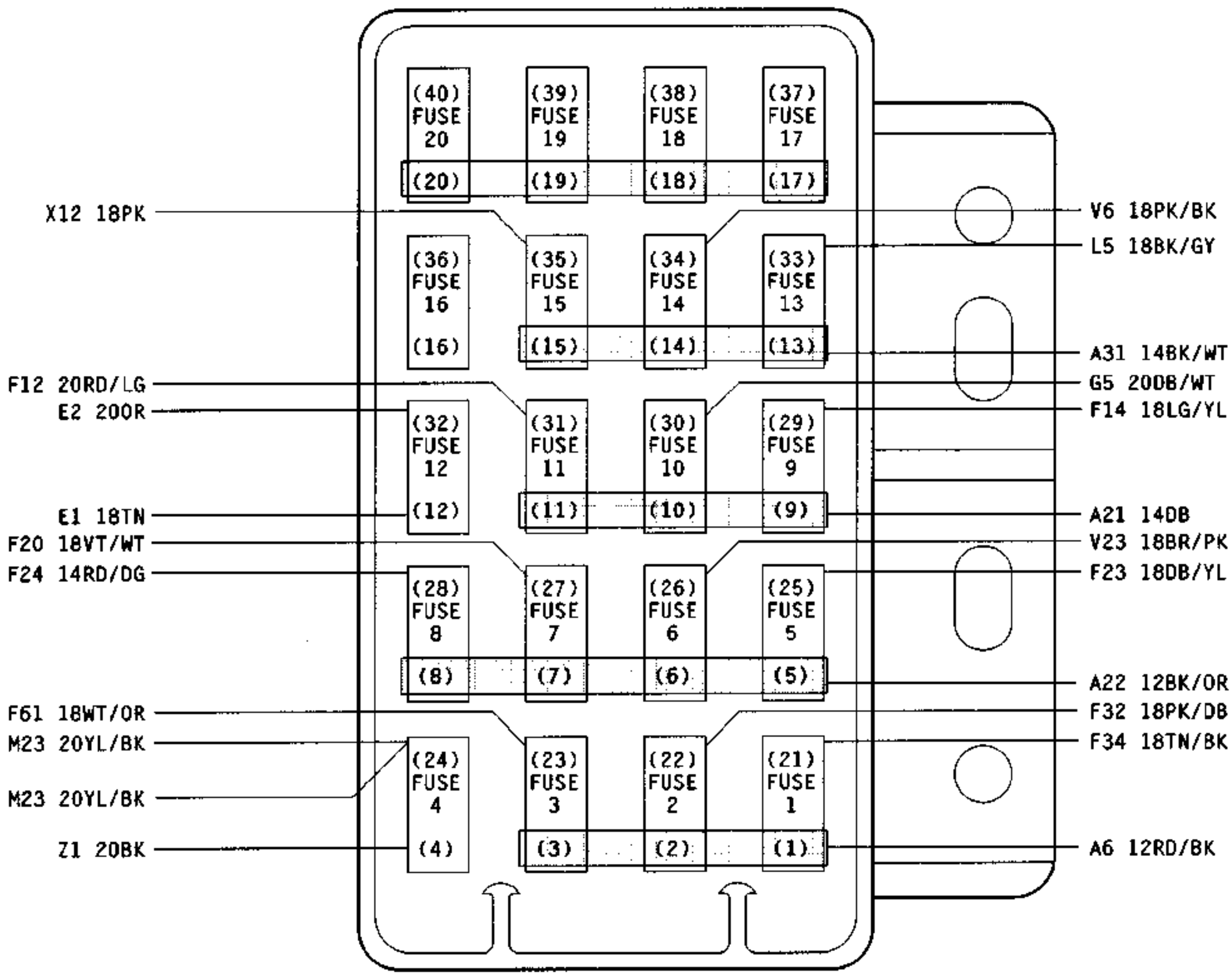
8W-10 FUSE/FUSE BLOCK

DESCRIPTION AND OPERATION

INTRODUCTION

This section covers the Fuse Block and all circuits involved with it. For additional information on system operation, refer to the appropriate section of the wiring diagrams.

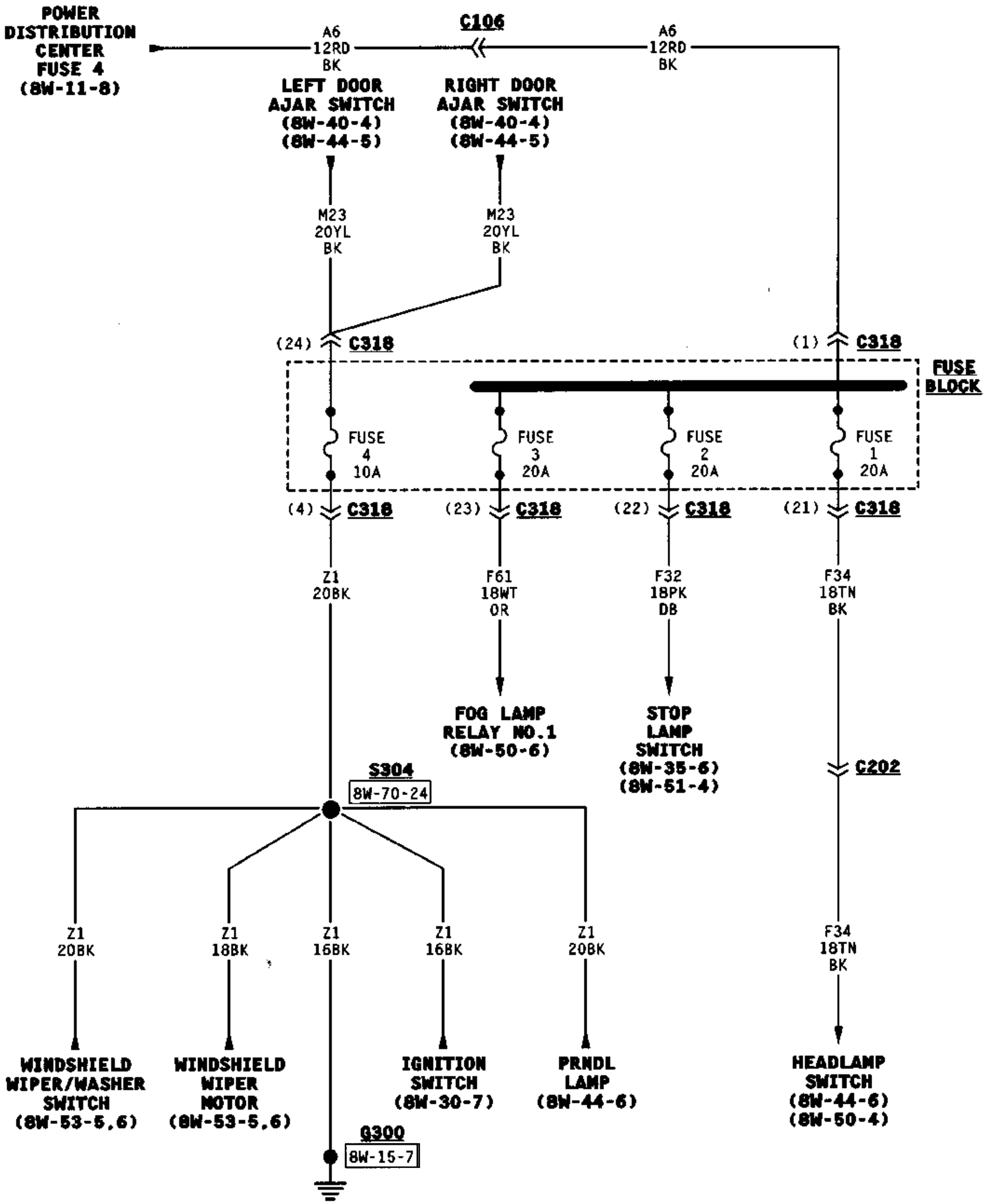
DIAGRAM INDEX

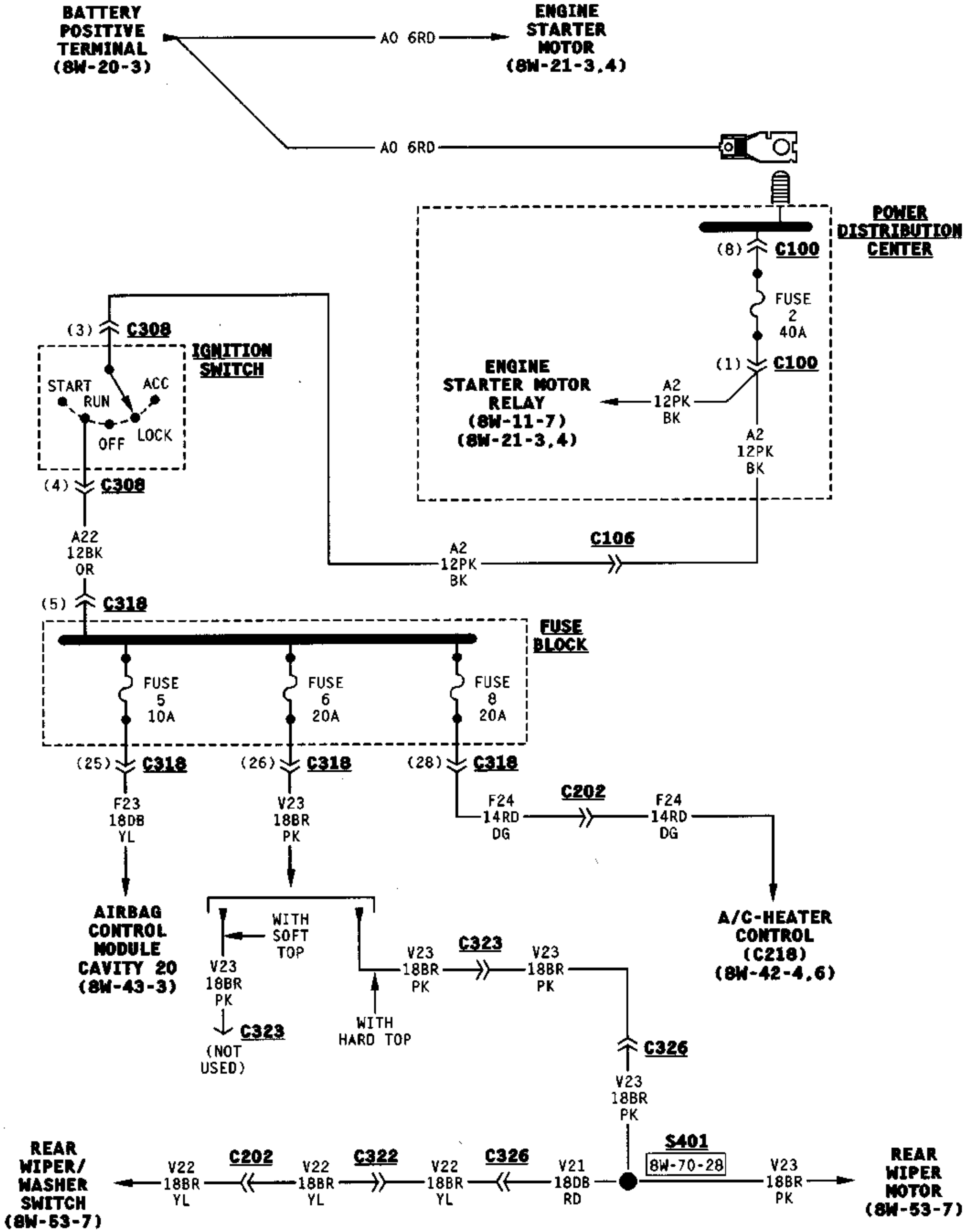


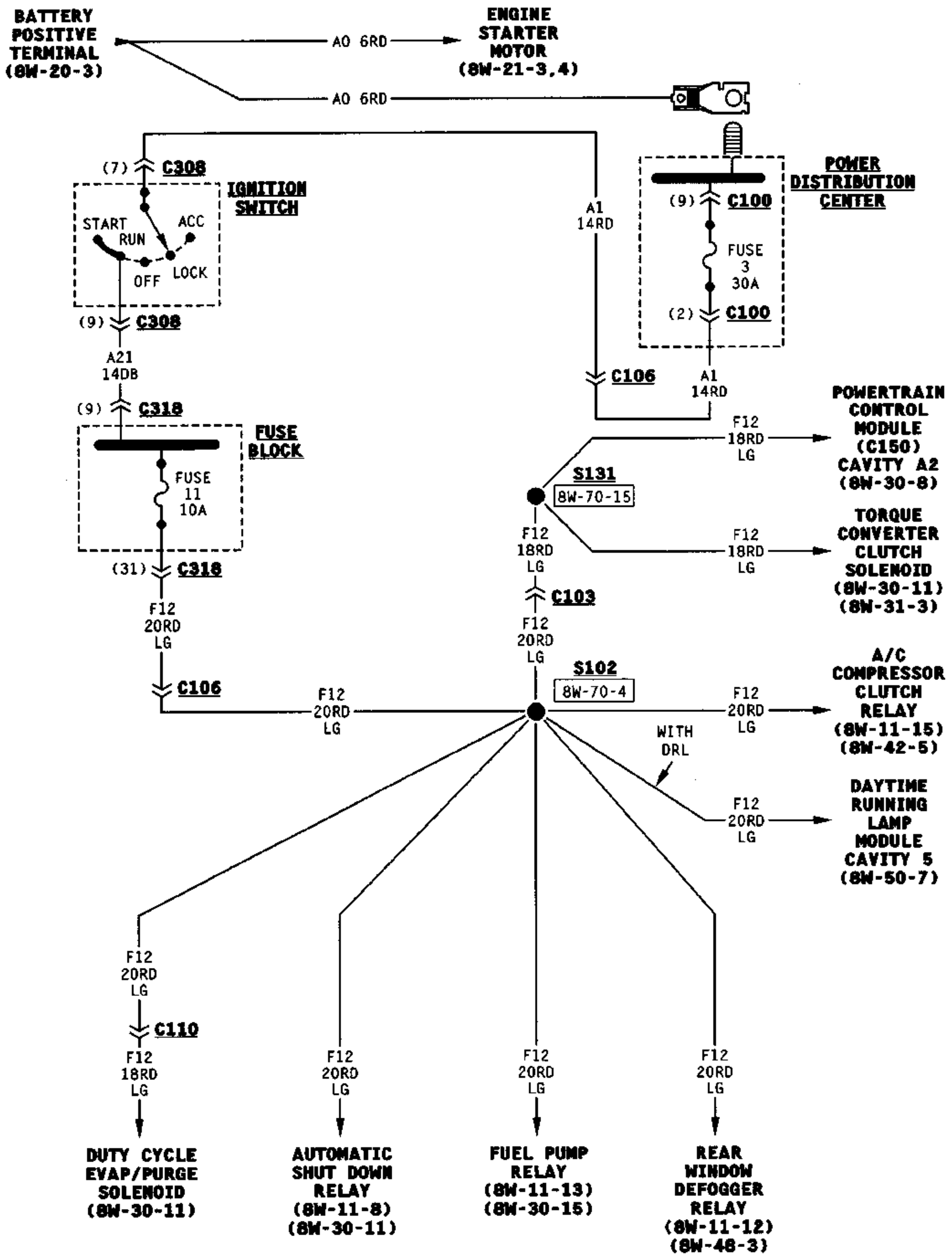
FRONT OF FUSE BLOCK

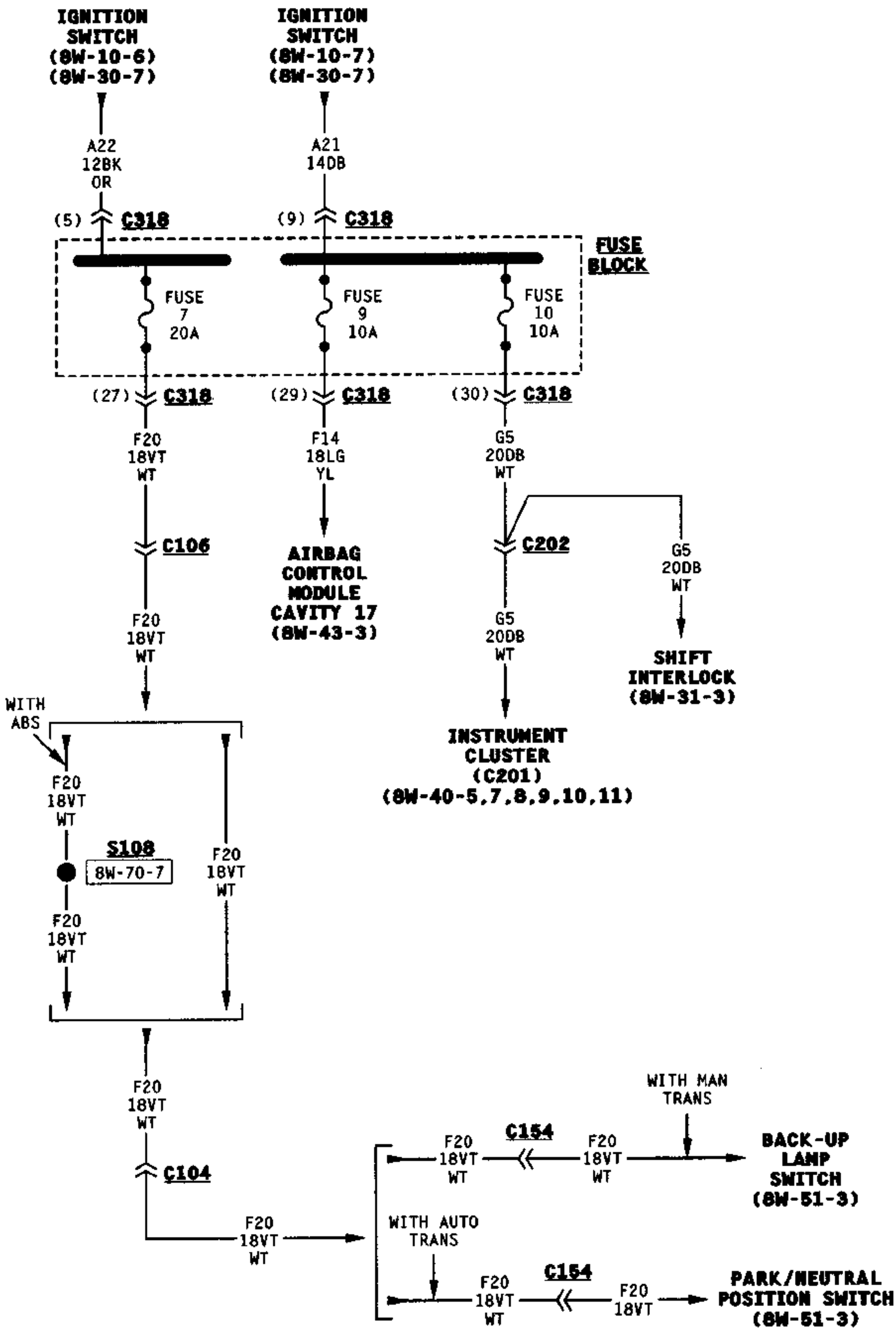
FUSE CHART

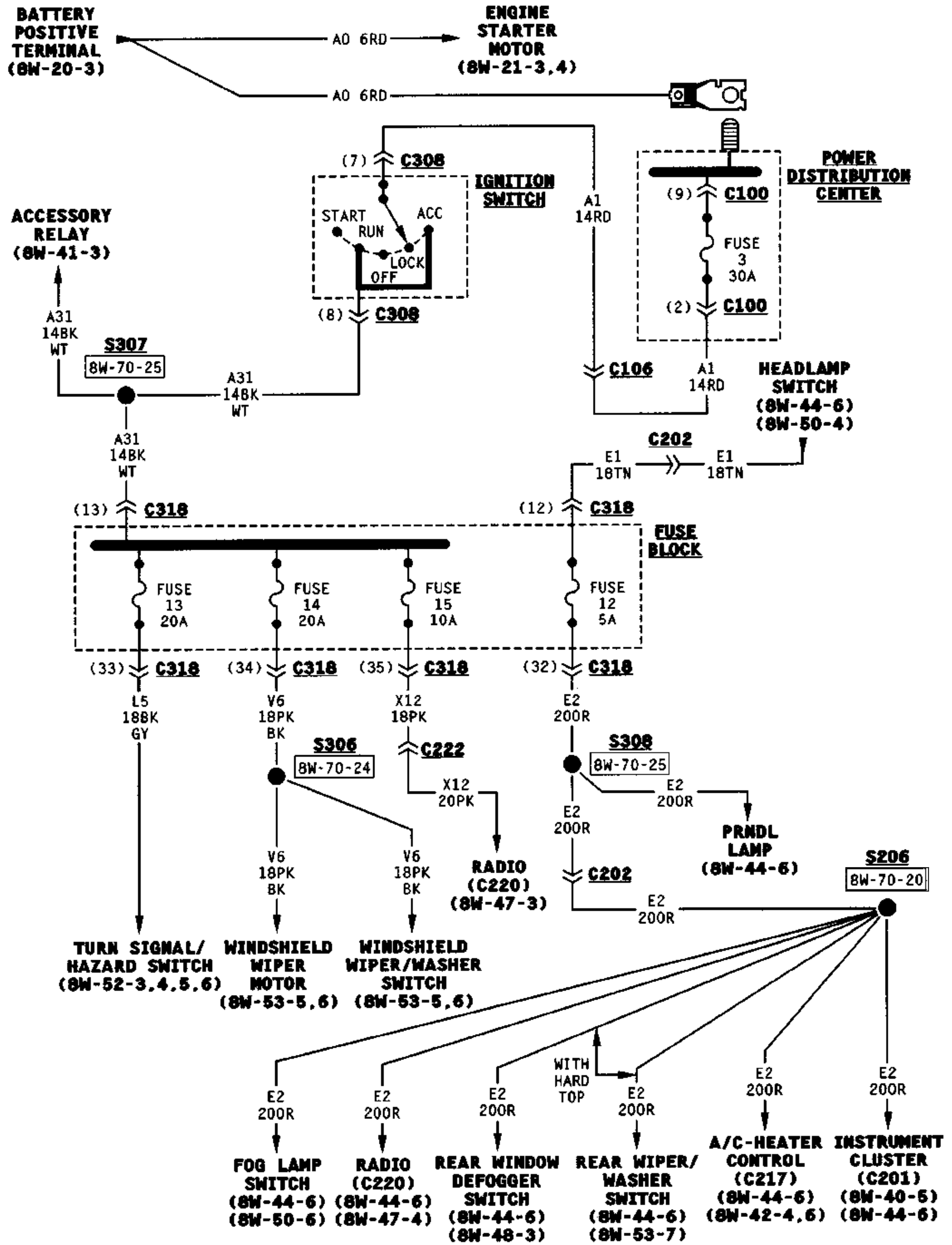
FUSE NO.	AMPS	COLOR	FUSED CIRCUIT	FEED CIRCUIT
1	20	YELLOW	F34 18TN/BK	A6 12RD/BK
2	20	YELLOW	F32 18PK/DB	
3	20	YELLOW	F61 18WT/OR	
4	10	RED	Z1 20BK	M23 20YL/BK M23 20YL/BK
5	10	RED	F23 18DB/YL	A22 12BK/OR
6	20	YELLOW	V23 18BR/PK	
7	20	YELLOW	F20 18VT/WT	
8	20	YELLOW	F24 14RD/DG	
9	10	RED	F14 18LG/YL	A21 14DB
10	10	RED	G5 20DB/WT	
11	10	RED	F12 20RD/LG	
12	5	TAN	E2 20OR	E1 18TN
13	20	YELLOW	L5 18BK/GY	A31 14BK/WT
14	20	YELLOW	V6 18PK/BK	
15	10	RED	X12 18PK	
16	–	–	–	–
17	20	YELLOW	–	–
18	20	YELLOW	–	
19	10	RED	–	
20	5	TAN	–	


POWER DISTRIBUTION CENTER FUSE 4 (8W-11-8)
A6 12RD BK
C106
A6 12RD BK
LEFT DOOR AJAR SWITCH (8W-40-4) (8W-44-5)
RIGHT DOOR AJAR SWITCH (8W-40-4) (8W-44-5)
M23 20YL BK
M23 20YL BK
(24) C318
(1) C318
FUSE BLOCK
FUSE 4 10A
FUSE 3 20A
FUSE 2 20A
FUSE 1 20A
(4) C318
(23) C318
(22) C318
(21) C318
Z1 20BK
F61 18WT OR
F32 18PK DB
F34 18TN BK
FOG LAMP RELAY NO.1 (8W-50-6)
STOP LAMP SWITCH (8W-35-6) (8W-51-4)
C202
S304
8W-70-24
Z1 20BK
Z1 18BK
Z1 16BK
Z1 16BK
Z1 20BK
F34 18TN BK
WINDSHIELD WIPER/WASHER SWITCH (8W-53-5,6)
WINDSHIELD WIPER MOTOR (8W-53-5,6)
IGNITION SWITCH (8W-30-7)
PRNDL LAMP (8W-44-6)
HEADLAMP SWITCH (8W-44-6) (8W-50-4)
G300
8W-15-7


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(8) C100
FUSE 2 40A
(1) C100
ENGINE STARTER MOTOR RELAY (8W-11-7) (8W-21-3,4)
A2 12PK BK
A2 12PK BK
(3) C308
IGNITION SWITCH
START RUN ACC
OFF LOCK
(4) C308
A22 12BK OR
A2 12PK BK
C106
(5) C318
FUSE BLOCK
FUSE 5 10A
FUSE 6 20A
FUSE 8 20A
(25) C318
(26) C318
(28) C318
F23 18DB YL
V23 18BR PK
F24 14RD DG
C202
F24 14RD DG
AIRBAG CONTROL MODULE CAVITY 20 (8W-43-3)
WITH SOFT TOP
V23 18BR PK
C323
(NOT USED)
WITH HARD TOP
V23 18BR PK
C323
V23 18BR PK
A/C-HEATER CONTROL (C218) (8W-42-4,6)
C326
V23 18BR PK
S401
8W-70-28
REAR WIPER/ WASHER SWITCH (8W-53-7)
V22 18BR YL
C202
V22 18BR YL
C322
V22 18BR YL
C326
V21 18DB RD
V23 18BR PK
REAR WIPER MOTOR (8W-53-7)


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(9) C100
FUSE 3 30A
(2) C100
A1 14RD
(7) C308
IGNITION SWITCH
START
RUN
ACC
OFF
LOCK
(9) C308
A21 14DB
(9) C318
FUSE BLOCK
FUSE 11 10A
(31) C318
F12 20RD LG
C106
A1 14RD
C106
F12 18RD LG
POWERTRAIN CONTROL MODULE (C150) CAVITY A2 (8W-30-8)
S131
8W-70-15
F12 18RD LG
F12 18RD LG
TORQUE CONVERTER CLUTCH SOLENOID (8W-30-11) (8W-31-3)
C103
F12 20RD LG
S102
8W-70-4
F12 20RD LG
F12 20RD LG
A/C COMPRESSOR CLUTCH RELAY (8W-11-15) (8W-42-5)
WITH DRL
F12 20RD LG
DAYTIME RUNNING LAMP MODULE CAVITY 5 (8W-50-7)
F12 20RD LG
C110
F12 18RD LG
DUTY CYCLE EVAP/PURGE SOLENOID (8W-30-11)
F12 20RD LG
AUTOMATIC SHUT DOWN RELAY (8W-11-8) (8W-30-11)
F12 20RD LG
FUEL PUMP RELAY (8W-11-13) (8W-30-15)
F12 20RD LG
REAR WINDOW DEFOGGER RELAY (8W-11-12) (8W-48-3)


IGNITION SWITCH (8W-10-6) (8W-30-7)
IGNITION SWITCH (8W-10-7) (8W-30-7)
A22 12BK OR
A21 14DB
(5) C318
(9) C318
FUSE BLOCK
FUSE 7 20A
FUSE 9 10A
FUSE 10 10A
(27) C318
(29) C318
(30) C318
F20 18VT WT
F14 18LG YL
G5 20DB WT
C106
AIRBAG CONTROL MODULE CAVITY 17 (8W-43-3)
C202
G5 20DB WT
SHIFT INTERLOCK (8W-31-3)
INSTRUMENT CLUSTER (C201) (8W-40-5,7,8,9,10,11)
WITH ABS
S108
8W-70-7
C104
C154
WITH MAN TRANS
BACK-UP LAMP SWITCH (8W-51-3)
WITH AUTO TRANS
F20 18VT
PARK/NEUTRAL POSITION SWITCH (8W-51-3)


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
(7) C308
IGNITION SWITCH
START
RUN
ACC
LOCK
OFF
(8) C308
A1 14RD
POWER DISTRIBUTION CENTER
(9) C100
FUSE 3 30A
(2) C100
ACCESSORY RELAY (8W-41-3)
A31 14BK WT
S307
8W-70-25
A31 14BK WT
C106
A1 14RD
HEADLAMP SWITCH (8W-44-6) (8W-50-4)
A31 14BK WT
C202
E1 18TN
E1 18TN
(13) C318
(12) C318
FUSE BLOCK
FUSE 13 20A
FUSE 14 20A
FUSE 15 10A
FUSE 12 5A
(33) C318
(34) C318
(35) C318
(32) C318
L5 18BK GY
V6 18PK BK
X12 18PK
E2 20OR
S306
8W-70-24
C222
S308
8W-70-25
X12 20PK
E2 20OR
E2 20OR
PRNDL LAMP (8W-44-6)
V6 18PK BK
V6 18PK BK
RADIO (C220) (8W-47-3)
C202
S206
8W-70-20
E2 20OR
TURN SIGNAL/ HAZARD SWITCH (8W-52-3,4,5,6)
WINDSHIELD WIPER MOTOR (8W-53-5,6)
WINDSHIELD WIPER/WASHER SWITCH (8W-53-5,6)
WITH HARD TOP
E2 20OR
FOG LAMP SWITCH (8W-44-6) (8W-50-6)
RADIO (C220) (8W-44-6) (8W-47-4)
REAR WINDOW DEFOGGER SWITCH (8W-44-6) (8W-48-3)
REAR WIPER/ WASHER SWITCH (8W-44-6) (8W-53-7)
A/C-HEATER CONTROL (C217) (8W-44-6) (8W-42-4,6)
INSTRUMENT CLUSTER (C201) (8W-40-5) (8W-44-6)

8W-11 POWER DISTRIBUTION

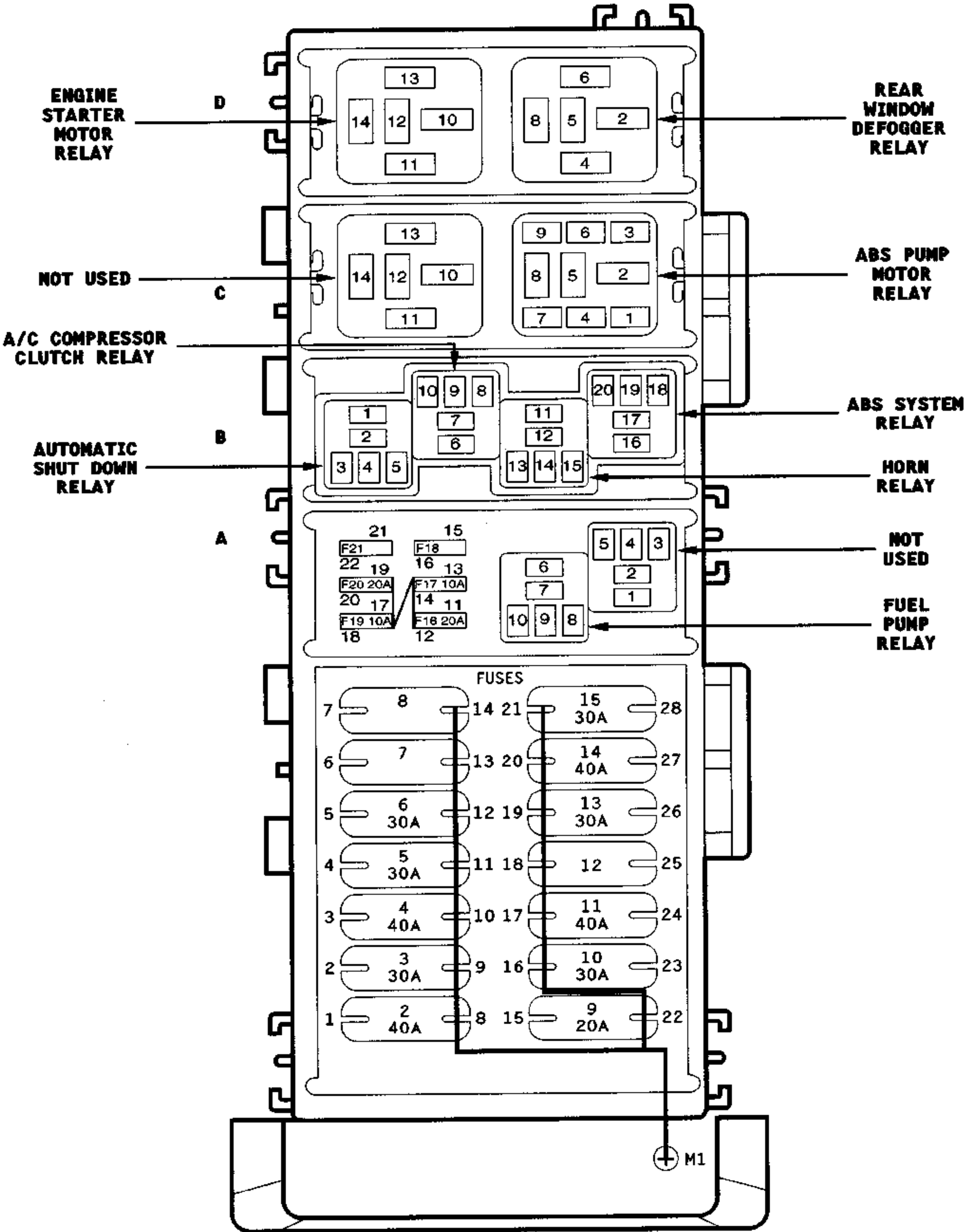
DESCRIPTION AND OPERATION

INTRODUCTION

This section covers the power distribution center and all circuits involved with it. For additional information on system operation, refer to the appropriate section of the wiring diagrams.

DIAGRAM INDEX

POWER DISTRIBUTION CENTER



FUSES

FUSE NO.	AMPS	FUSED CIRCUIT	FUNCTION
2	40	A2 12PK/BK	FUSED B(+)
		A2 12PK/BK	FUSED B(+)
3	30	A1 14RD	FUSED B(+)
4	40	A6 12RD/BK	FUSED B(+)
5	20	F30 16RD/PK	FUSED B(+)
6	30	A14 14RD/WT	FUSED B(+)
7	–	–	–
8	–	–	SPARE
9	20	L9 18BK/WT	FUSED B(+)
10	30	A3 14RD/WT	FUSED B(+)
11	40	A111 12RD/LB	FUSED B(+)
12	–	–	SPARE
13	30	A20 14RD/DB●	FUSED B(+)
14	40	A10 12RD/DG●	FUSED B(+)
15	30	A4 14BK/PK	FUSED B(+)
16	20	A61 18DG/BK	FUSED B(+)
17	10	M1 20PK/WT	FUSED B(+)
18	–	–	SPARE
19	10	A17 20RD/GY	FUSED B(+)
20	20	F31 18VT	FUSED B(+)
		F31 18VT	FUSED B(+)
21	–	–	SPARE

● WITH ABS

RELAYS

NOT USED

CAV	CIRCUIT	FUNCTION
A1	–	–
A2	–	–
A3	–	–
A4	–	–
A5	–	–

FUEL PUMP RELAY

CAV	CIRCUIT	FUNCTION
A6	A61 18DG/BK	FUSED B(+)
A7	A141 18DG/WT	FUEL PUMP RELAY OUTPUT
A8	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN/START)
A9	–	–
A10	K31 18BR	FUEL PUMP RELAY CONTROL

AUTOMATIC SHUT DOWN RELAY

CAV	CIRCUIT	FUNCTION
B1	A14 14RD/WT	FUSED B(+)
B2	A142 14DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
B3	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN/START)
B4	–	–
B5	K51 18DB/YL	AUTOMATIC SHUT DOWN RELAY CONTROL

A/C COMPRESSOR CLUTCH RELAY

CAV	CIRCUIT	FUNCTION
B6	A17 20RD/GY	FUSED B(+)
B7	C3 20DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
B8	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN/START)
B9	–	–
B10	C13 20DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL

HORN RELAY

CAV	CIRCUIT	FUNCTION
B11	F31 18VT	FUSED B(+)
B12	X2 16WT/RD	HORN RELAY OUTPUT
B13	F31 18VT	FUSED B(+)
B14	–	–
B15	X3 20RD/YL	HORN RELAY CONTROL

ABS SYSTEM RELAY

CAV	CIRCUIT	FUNCTION
B16	B47 16RD/LB	ABS MAIN RELAY OUTPUT
B17	A20 14RD/DB	FUSED B(+)
B18	B58 20GY/LB	ABS MAIN RELAY CONTROL
B19	Z1 14BK	GROUND
B20	F20 18VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)

RELAYS

ABS PUMP MOTOR RELAY

CAV	CIRCUIT	FUNCTION
C1	–	–
C2	A10 12RD/DG	FUSED B(+)
C3	Z1 14BK	GROUND
C4	B47 16RD/LB	ABS MAIN RELAY OUTPUT
C5	–	–
C6	B116 20GY	ABS PUMP MOTOR RELAY CONTROL
C7	–	–
C8	B120 12BR/WT	ABS PUMP MOTOR RELAY OUTPUT
C9	–	–

NOT USED

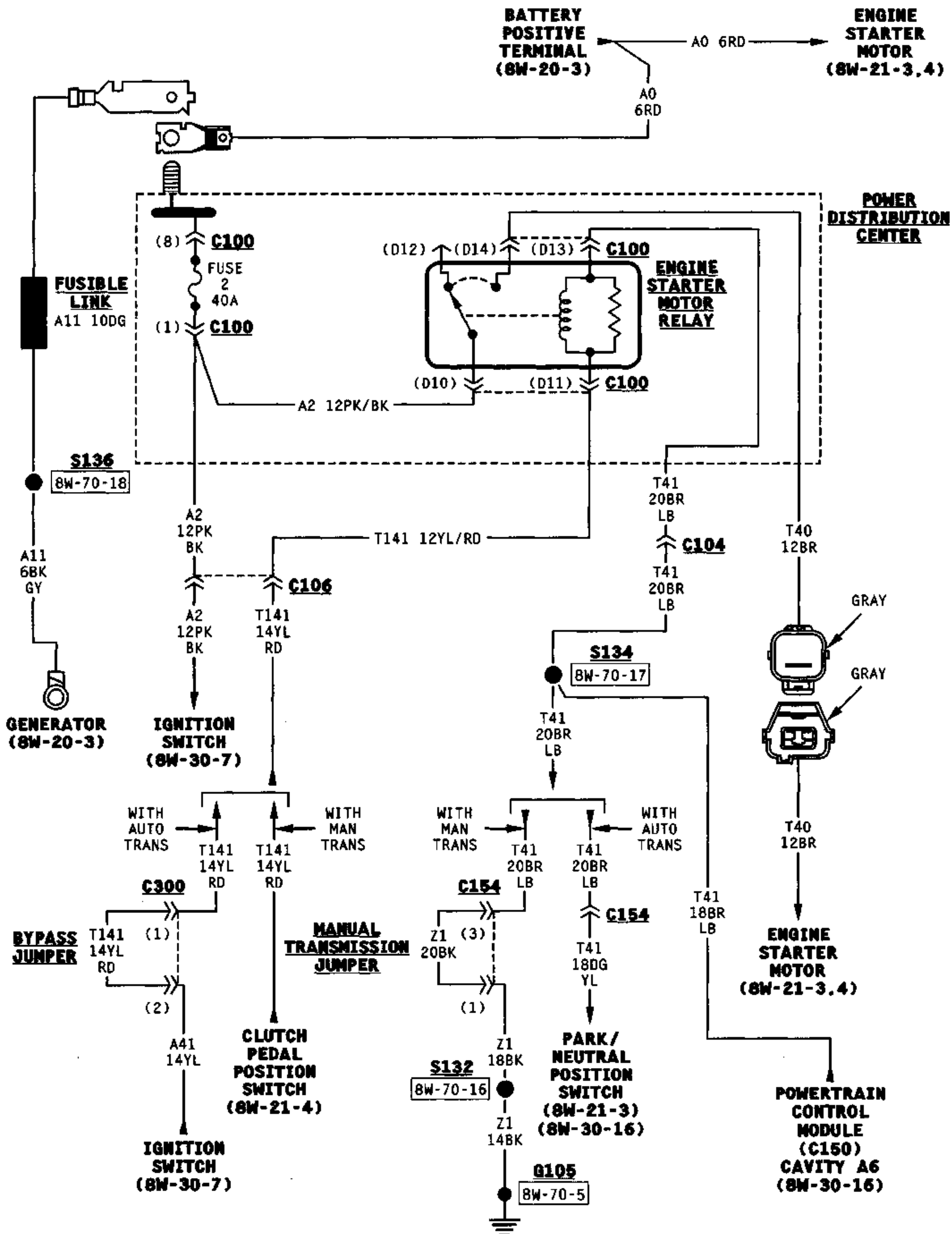
CAV	CIRCUIT	FUNCTION
C10	–	–
C11	–	–
C12	–	–
C13	–	–
C14	–	–

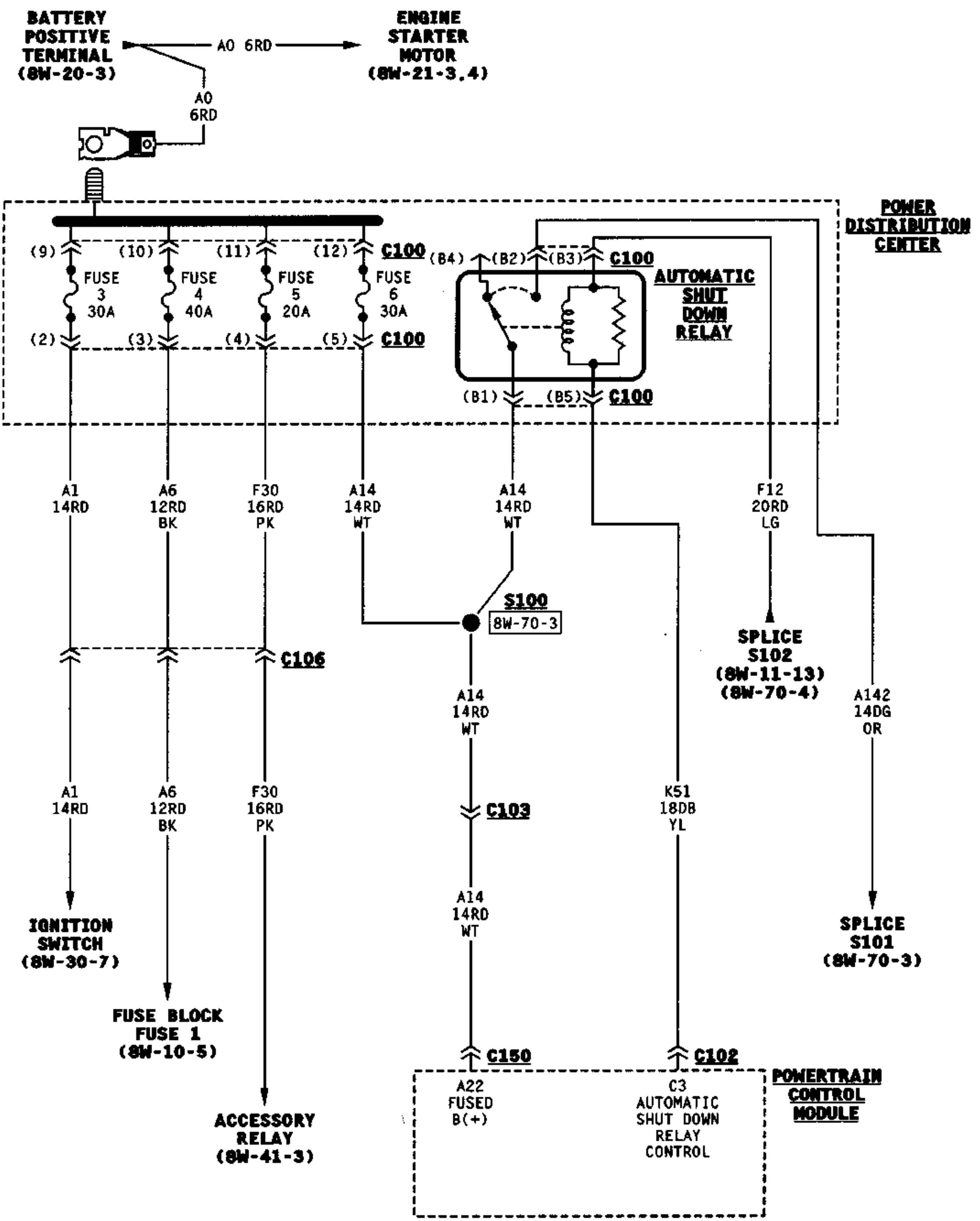
REAR WINDOW DEFOGGER RELAY

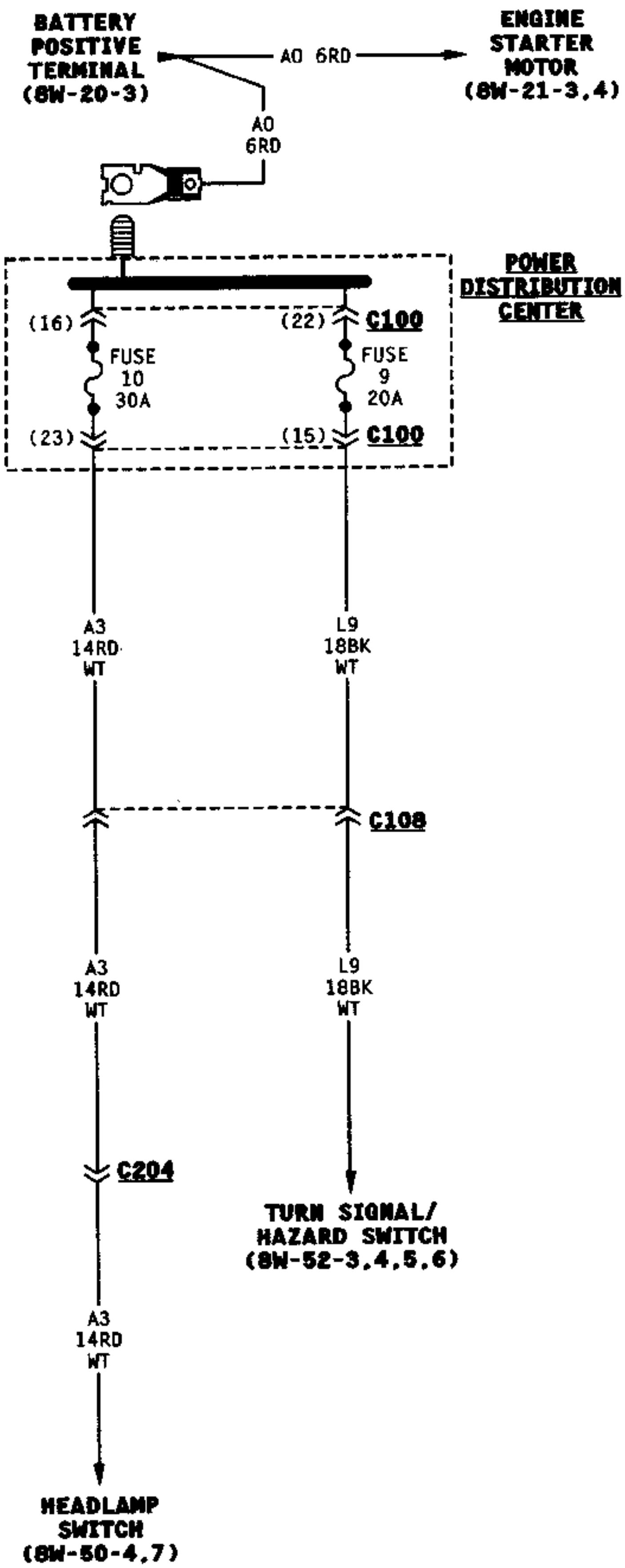
CAV	CIRCUIT	FUNCTION
D2	A4 14BK/PK	FUSED B(+)
D4	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN/START)
D5	–	–
D6	C81 20LB/WT	REAR WINDOW DEFOGGER RELAY CONTROL
D8	C15 12BK/WT	REAR WINDOW DEFOGGER RELAY OUTPUT

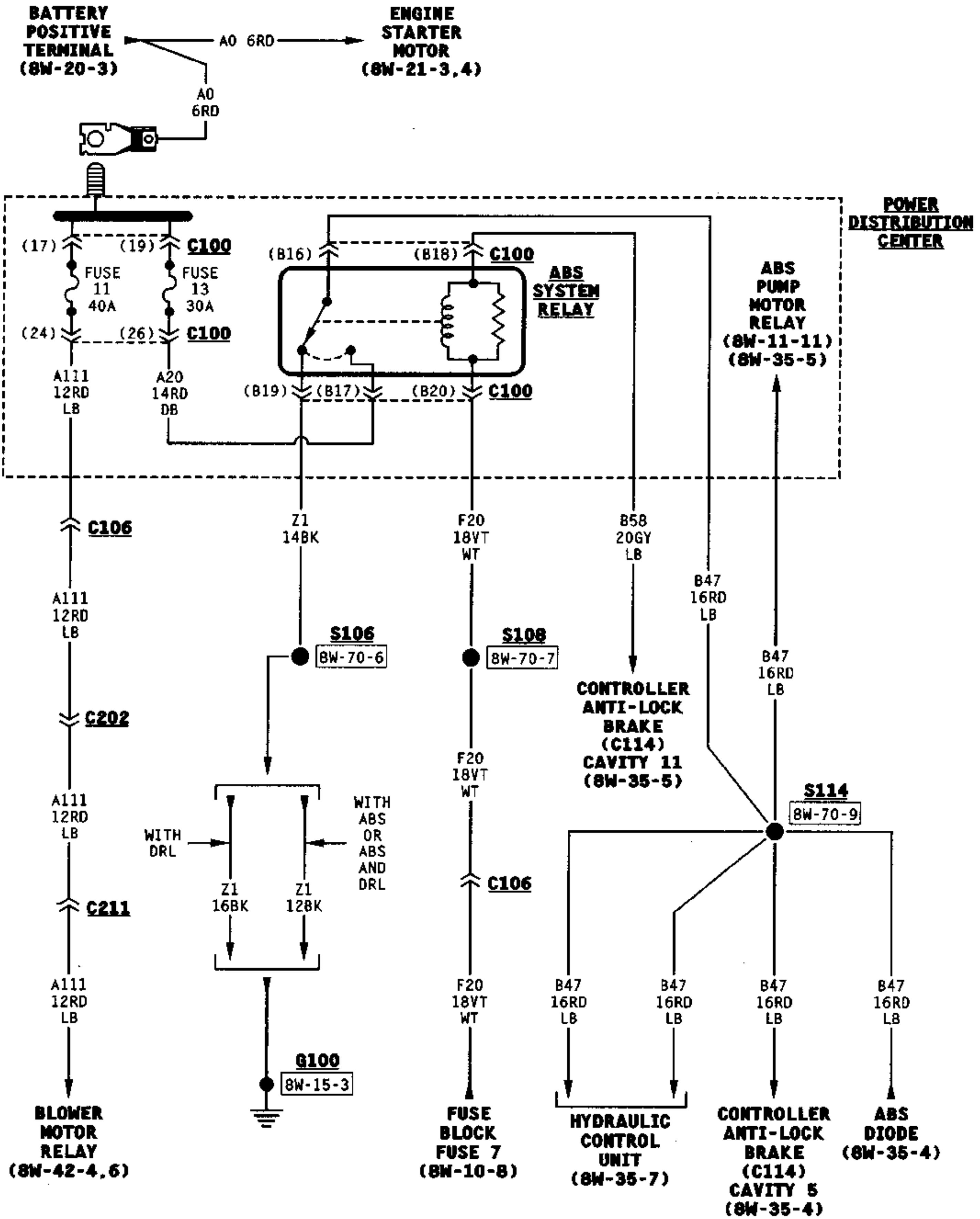
ENGINE STARTER MOTOR RELAY

CAV	CIRCUIT	FUNCTION
D10	A2 12PK/BK	FUSED B(+)
D11	T141 12YL/RD	FUSED IGNITION SWITCH OUTPUT (START)
D12	–	–
D13	T41 20BR/LB	PARK/NEUTRAL POSITION SWITCH SENSE
D14	T40 12BR	ENGINE STARTER MOTOR RELAY OUTPUT

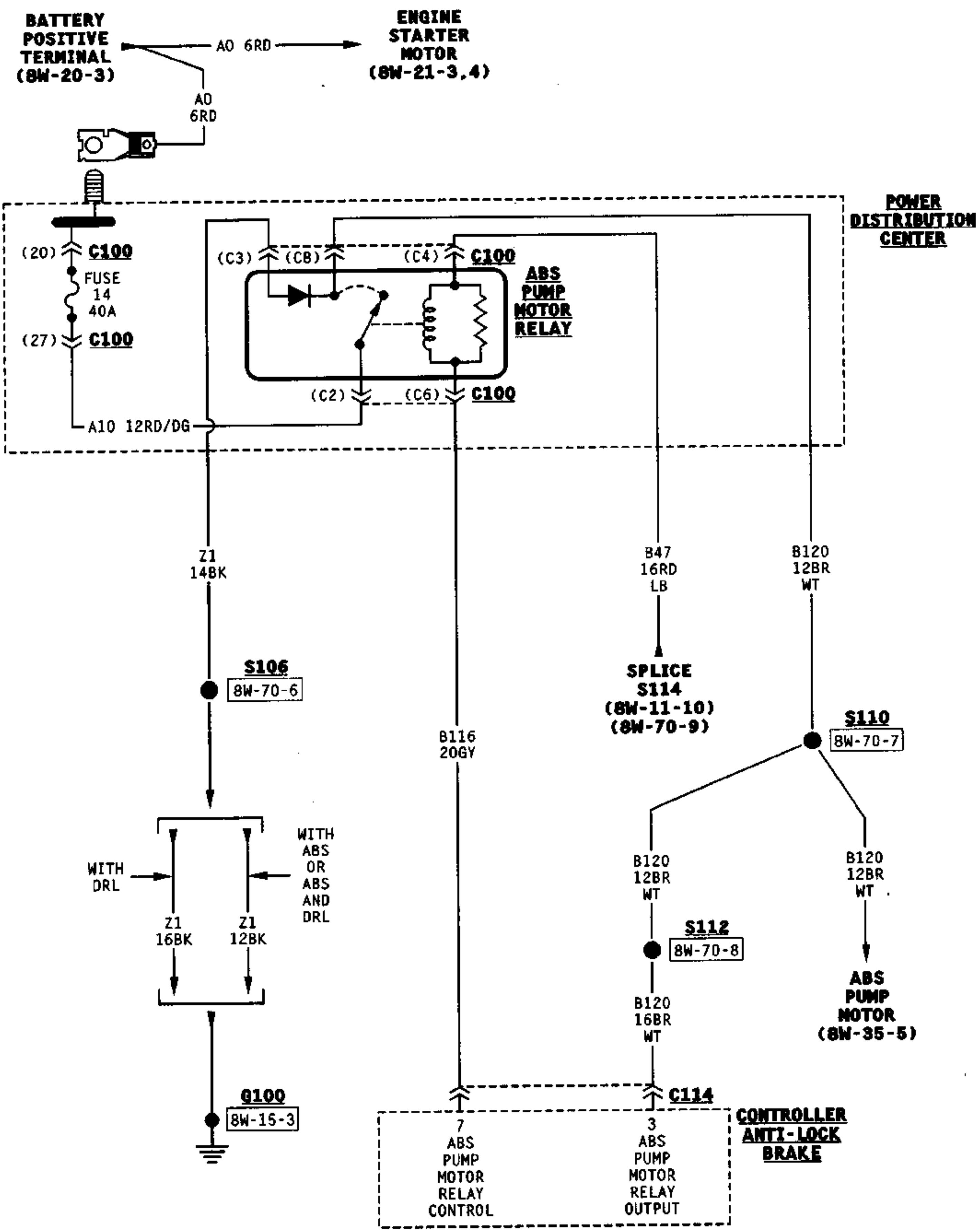

BATTERY
POSITIVE
TERMINAL
(8W-20-3)
A0 6RD
ENGINE
STARTER
MOTOR
(8W-21-3,4)
A0
6RD
POWER
DISTRIBUTION
CENTER
(8)
C100
FUSE
2
40A
(1)
C100
FUSIBLE
LINK
A11 10DG
(D12)
(D14)
(D13)
C100
ENGINE
STARTER
MOTOR
RELAY
(D10)
(D11)
C100
A2 12PK/BK
S136
8W-70-18
A11
6BK
GY
A2
12PK
BK
T141 12YL/RD
C106
A2
12PK
BK
T141
14YL
RD
T41
20BR
LB
C104
T41
20BR
LB
T40
12BR
GRAY
GRAY
S134
8W-70-17
T41
20BR
LB
GENERATOR
(8W-20-3)
IGNITION
SWITCH
(8W-30-7)
WITH
AUTO
TRANS
WITH
MAN
TRANS
T141
14YL
RD
T141
14YL
RD
WITH
MAN
TRANS
WITH
AUTO
TRANS
T41
20BR
LB
T41
20BR
LB
T40
12BR
C300
BYPASS
JUMPER
T141
14YL
RD
(1)
(2)
A41
14YL
IGNITION
SWITCH
(8W-30-7)
CLUTCH
PEDAL
POSITION
SWITCH
(8W-21-4)
MANUAL
TRANSMISSION
JUMPER
C154
Z1
20BK
(3)
(1)
Z1
18BK
S132
8W-70-16
Z1
14BK
G105
8W-70-5
C154
T41
18DG
YL
PARK/
NEUTRAL
POSITION
SWITCH
(8W-21-3)
(8W-30-16)
T41
18BR
LB
ENGINE
STARTER
MOTOR
(8W-21-3,4)
POWERTRAIN
CONTROL
MODULE
(C150)
CAVITY A6
(8W-30-16)

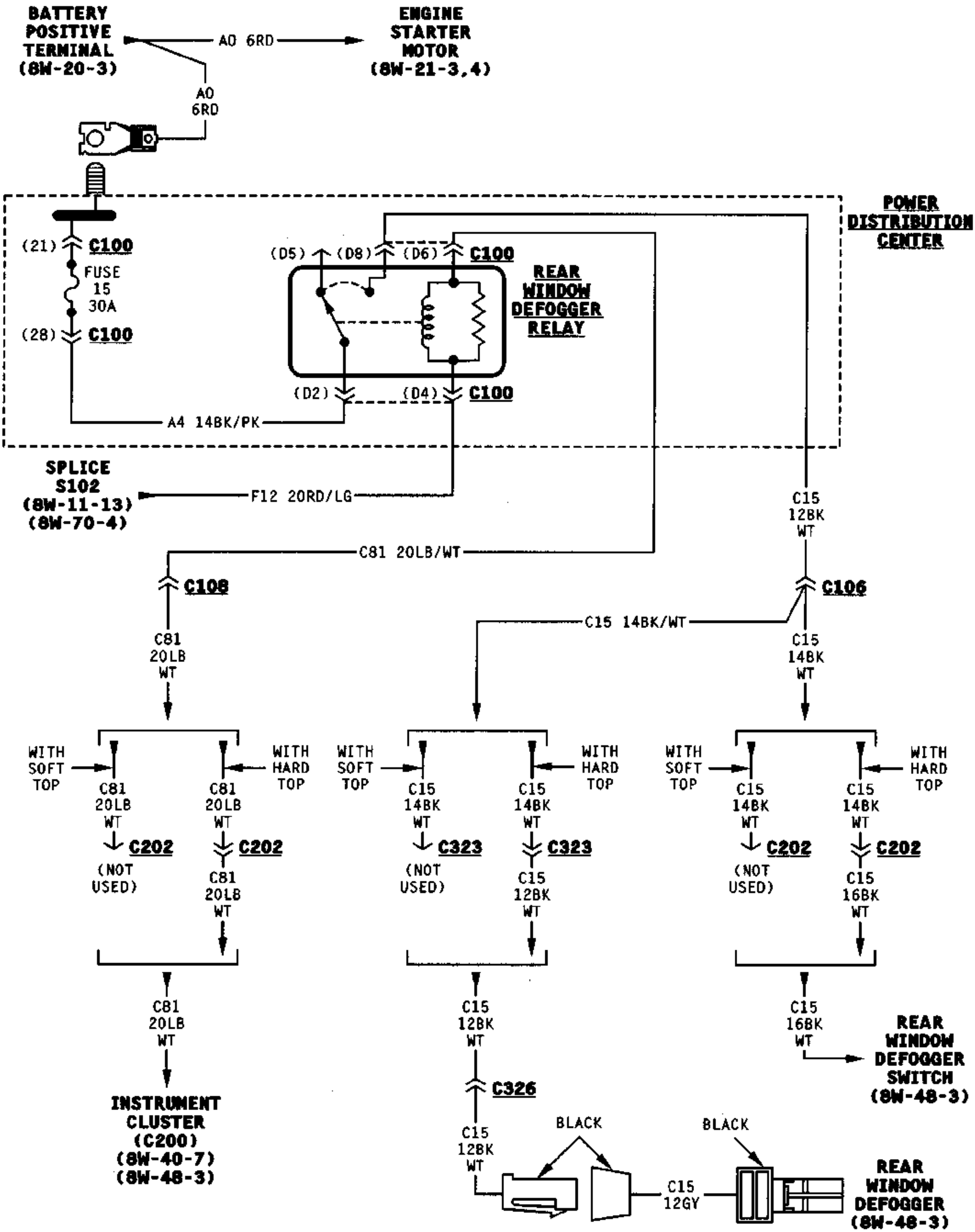

BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(9) (10) (11) (12) C100
FUSE 3 30A
FUSE 4 40A
FUSE 5 20A
FUSE 6 30A
(2) (3) (4) (5) C100
(B4) (B2) (B3) C100
AUTOMATIC SHUT DOWN RELAY
(B1) (B5) C100
A1 14RD
A6 12RD BK
F30 16RD PK
A14 14RD WT
A14 14RD WT
F12 20RD LG
S100
8W-70-3
C106
SPLICE S102 (8W-11-13) (8W-70-4)
A14 14RD WT
A142 14DG OR
A1 14RD
A6 12RD BK
F30 16RD PK
C103
K51 18DB YL
A14 14RD WT
IGNITION SWITCH (8W-30-7)
SPLICE S101 (8W-70-3)
FUSE BLOCK FUSE 1 (8W-10-5)
C150
C102
POWERTRAIN CONTROL MODULE
A22 FUSED B(+)
C3 AUTOMATIC SHUT DOWN RELAY CONTROL
ACCESSORY RELAY (8W-41-3)

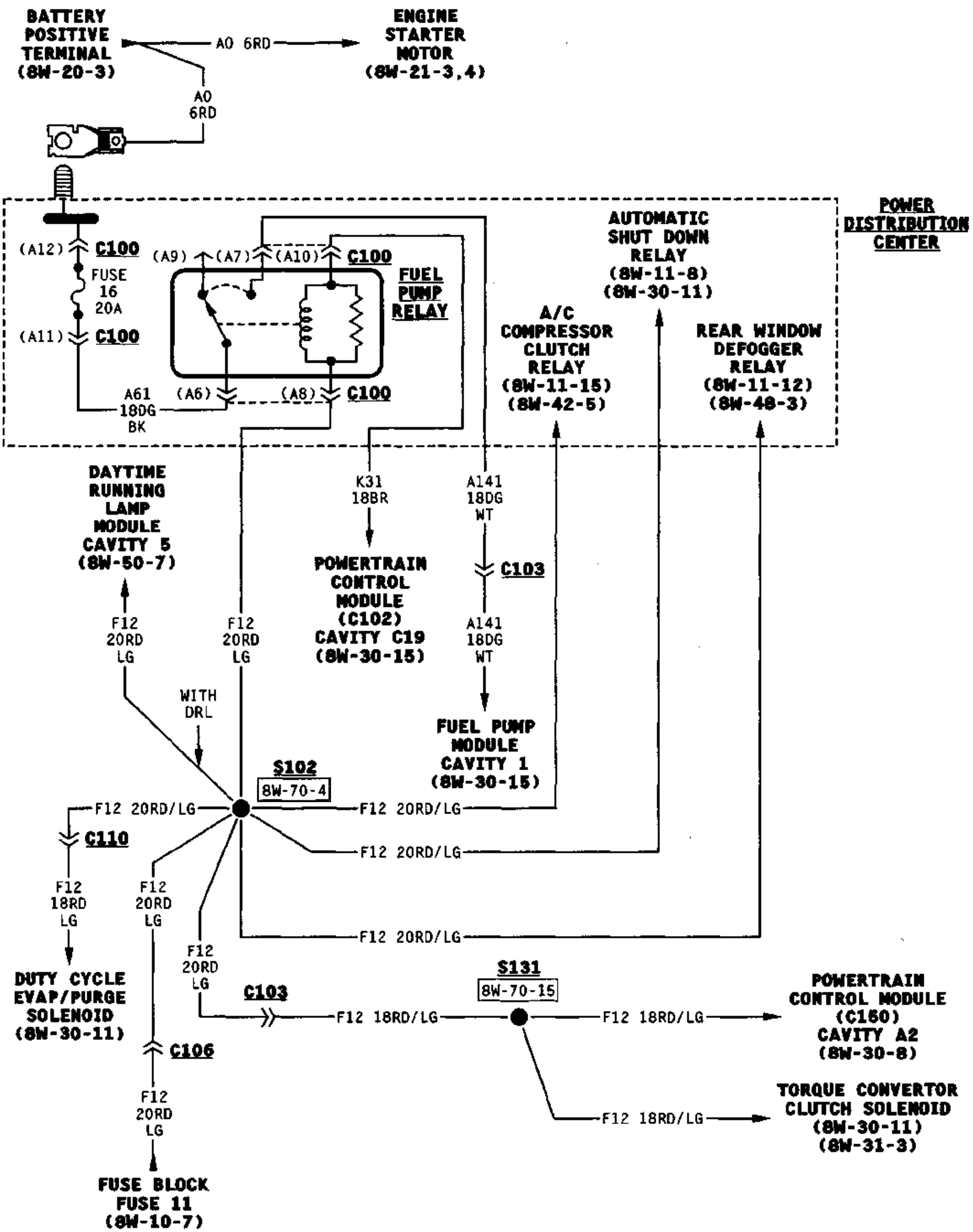

BATTERY
POSITIVE
TERMINAL
(8W-20-3)
A0 6RD
ENGINE
STARTER
MOTOR
(8W-21-3,4)
A0
6RD
POWER
DISTRIBUTION
CENTER
(16)
(22)
C100
FUSE
10
30A
FUSE
9
20A
(23)
(15)
C100
A3
14RD
WT
L9
18BK
WT
C108
A3
14RD
WT
L9
18BK
WT
C204
TURN SIGNAL/
HAZARD SWITCH
(8W-52-3,4,5,6)
A3
14RD
WT
HEADLAMP
SWITCH
(8W-50-4,7)



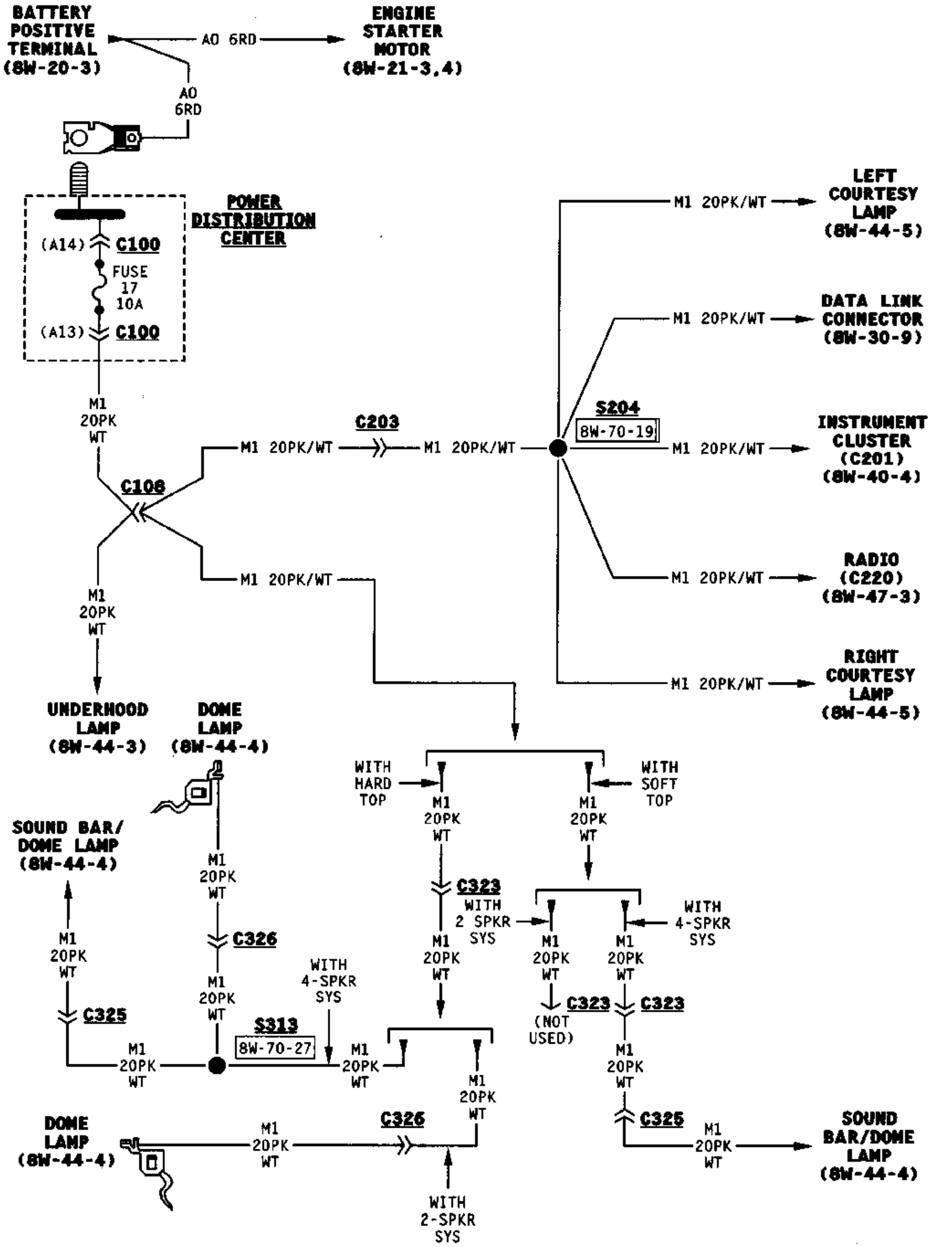
BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(17)
(19)
C100
FUSE 11 40A
FUSE 13 30A
(24)
(26)
C100
(B16)
(B18)
C100
ABS SYSTEM RELAY
(B19)
(B17)
(B20)
C100
A111 12RD LB
A20 14RD DB
ABS PUMP MOTOR RELAY (8W-11-11) (8W-35-5)
C106
A111 12RD LB
Z1 14BK
F20 18VT WT
B58 20GY LB
B47 16RD LB
S106
8W-70-6
S108
8W-70-7
B47 16RD LB
CONTROLLER ANTI-LOCK BRAKE (C114) CAVITY 11 (8W-35-5)
C202
A111 12RD LB
F20 18VT WT
S114
8W-70-9
WITH DRL
WITH ABS OR ABS AND DRL
Z1 16BK
Z1 12BK
C211
C106
A111 12RD LB
F20 18VT WT
B47 16RD LB
B47 16RD LB
B47 16RD LB
B47 16RD LB
G100
8W-15-3
BLOWER MOTOR RELAY (8W-42-4,6)
FUSE BLOCK FUSE 7 (8W-10-8)
HYDRAULIC CONTROL UNIT (8W-35-7)
CONTROLLER ANTI-LOCK BRAKE (C114) CAVITY 5 (8W-35-4)
ABS DIODE (8W-35-4)

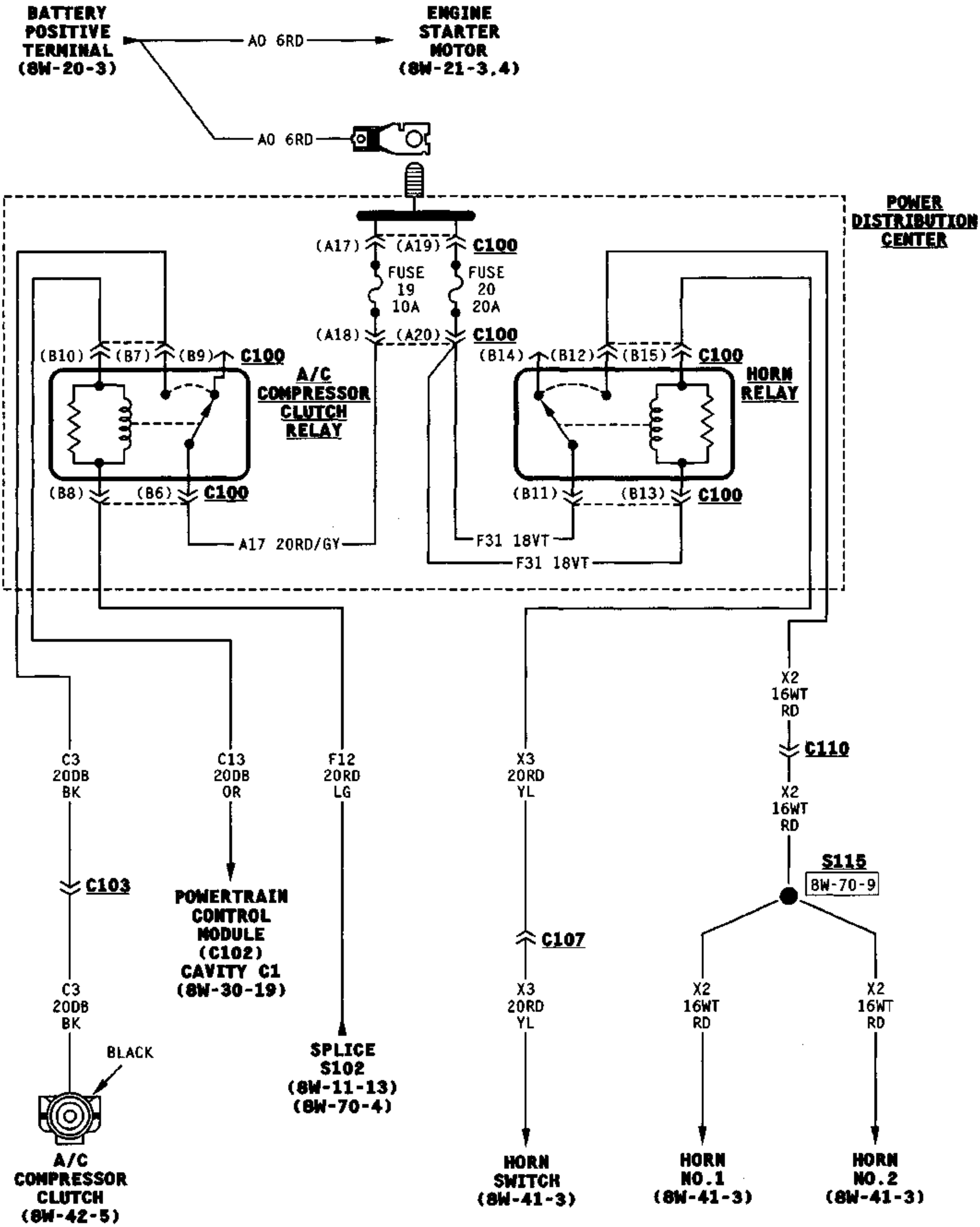

BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(20) C100
FUSE 14 40A
(27) C100
(C3)
(C8)
(C4) C100
ABS PUMP MOTOR RELAY
(C2)
(C6) C100
A10 12RD/DG
Z1 14BK
B47 16RD LB
B120 12BR WT
S106 8W-70-6
SPLICE S114 (8W-11-10) (8W-70-9)
B116 20GY
S110 8W-70-7
WITH DRL
WITH ABS OR ABS AND DRL
Z1 16BK
Z1 12BK
B120 12BR WT
B120 12BR WT
S112 8W-70-8
B120 16BR WT
ABS PUMP MOTOR (8W-35-5)
G100 8W-15-3
C114
CONTROLLER ANTI-LOCK BRAKE
7 ABS PUMP MOTOR RELAY CONTROL
3 ABS PUMP MOTOR RELAY OUTPUT


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(21) C100
FUSE 15 30A
(28) C100
(D5) (D8) (D6) C100
REAR WINDOW DEFOGGER RELAY
(D2) (D4) C100
A4 14BK/PK
SPLICE S102 (8W-11-13) (8W-70-4)
F12 20RD/LG
C81 20LB/WT
C108
C81 20LB WT
C15 12BK WT
C106
C15 14BK/WT
C15 14BK WT
WITH SOFT TOP
WITH HARD TOP
C81 20LB WT
C202
(NOT USED)
C81 20LB WT
C15 14BK WT
C323
C15 12BK WT
C15 16BK WT
INSTRUMENT CLUSTER (C200) (8W-40-7) (8W-48-3)
C326
BLACK
C15 12GY
REAR WINDOW DEFOGGER SWITCH (8W-48-3)
REAR WINDOW DEFOGGER (8W-48-3)



BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0
6RD
POWER DISTRIBUTION CENTER
(A12)
C100
FUSE 16 20A
(A11)
C100
(A9)
(A7)
(A10)
C100
FUEL PUMP RELAY
(A6)
(A8)
C100
A61 18DG BK
AUTOMATIC SHUT DOWN RELAY (8W-11-8) (8W-30-11)
A/C COMPRESSOR CLUTCH RELAY (8W-11-15) (8W-42-5)
REAR WINDOW DEFOGGER RELAY (8W-11-12) (8W-48-3)
DAYTIME RUNNING LAMP MODULE CAVITY 5 (8W-50-7)
K31 18BR
POWERTRAIN CONTROL MODULE (C102) CAVITY C19 (8W-30-15)
A141 18DG WT
C103
A141 18DG WT
FUEL PUMP MODULE CAVITY 1 (8W-30-15)
F12 20RD LG
F12 20RD LG
WITH DRL
S102
8W-70-4
F12 20RD/LG
F12 20RD/LG
F12 20RD/LG
F12 20RD/LG
C110
F12 18RD LG
DUTY CYCLE EVAP/PURGE SOLENOID (8W-30-11)
F12 20RD LG
F12 20RD LG
C103
F12 18RD/LG
S131
8W-70-15
F12 18RD/LG
POWERTRAIN CONTROL MODULE (C150) CAVITY A2 (8W-30-8)
F12 18RD/LG
TORQUE CONVERTOR CLUTCH SOLENOID (8W-30-11) (8W-31-3)
C106
F12 20RD LG
FUSE BLOCK FUSE 11 (8W-10-7)


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(A14) C100
FUSE 17 10A
(A13) C100
M1 20PK WT
C106
M1 20PK/WT
C203
M1 20PK/WT
S204
8W-70-19
LEFT COURTESY LAMP (8W-44-5)
DATA LINK CONNECTOR (8W-30-9)
INSTRUMENT CLUSTER (C201) (8W-40-4)
RADIO (C220) (8W-47-3)
RIGHT COURTESY LAMP (8W-44-5)
UNDERHOOD LAMP (8W-44-3)
DOME LAMP (8W-44-4)
WITH HARD TOP
WITH SOFT TOP
C323
WITH 2 SPKR SYS
WITH 4-SPKR SYS
C323
(NOT USED)
SOUND BAR/ DOME LAMP (8W-44-4)
C326
C325
S313
8W-70-27
WITH 4-SPKR SYS
C325
SOUND BAR/DOME LAMP (8W-44-4)
DOME LAMP (8W-44-4)
C326
WITH 2-SPKR SYS


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(A17) (A19) C100
FUSE 19 10A
FUSE 20 20A
(A18) (A20) C100
(B10) (B7) (B9) C100
A/C COMPRESSOR CLUTCH RELAY
(B8) (B6) C100
A17 20RD/GY
(B14) (B12) (B15) C100
HORN RELAY
(B11) (B13) C100
F31 18VT
F31 18VT
C3 20DB BK
C103
C3 20DB BK
BLACK
A/C COMPRESSOR CLUTCH (8W-42-5)
C13 20DB OR
POWERTRAIN CONTROL MODULE (C102) CAVITY C1 (8W-30-19)
F12 20RD LG
SPLICE S102 (8W-11-13) (8W-70-4)
X3 20RD YL
C107
X3 20RD YL
HORN SWITCH (8W-41-3)
X2 16WT RD
C110
X2 16WT RD
S115
8W-70-9
X2 16WT RD
X2 16WT RD
HORN NO.1 (8W-41-3)
HORN NO.2 (8W-41-3)

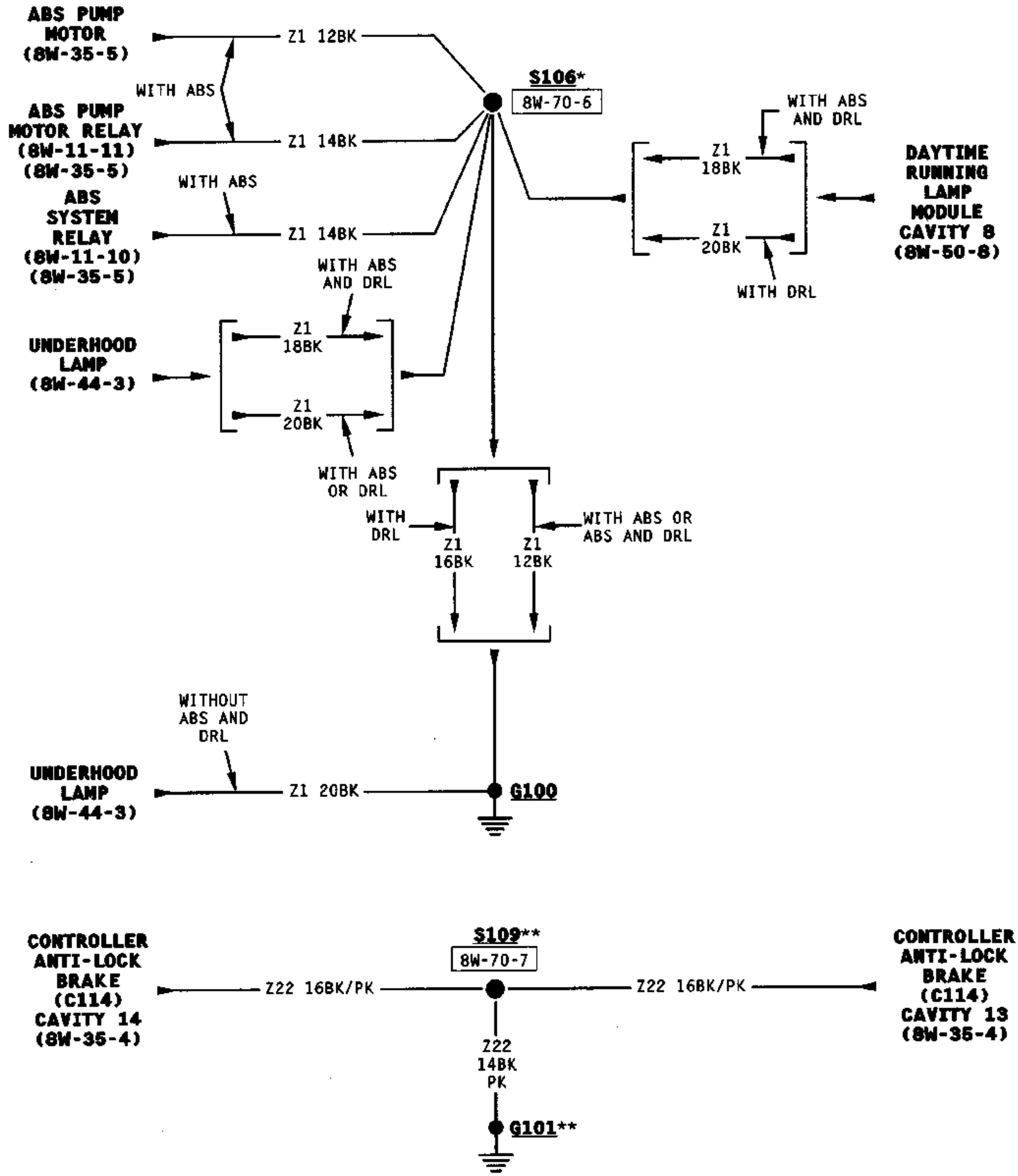
8W-15 GROUND DISTRIBUTION

DESCRIPTION AND OPERATION

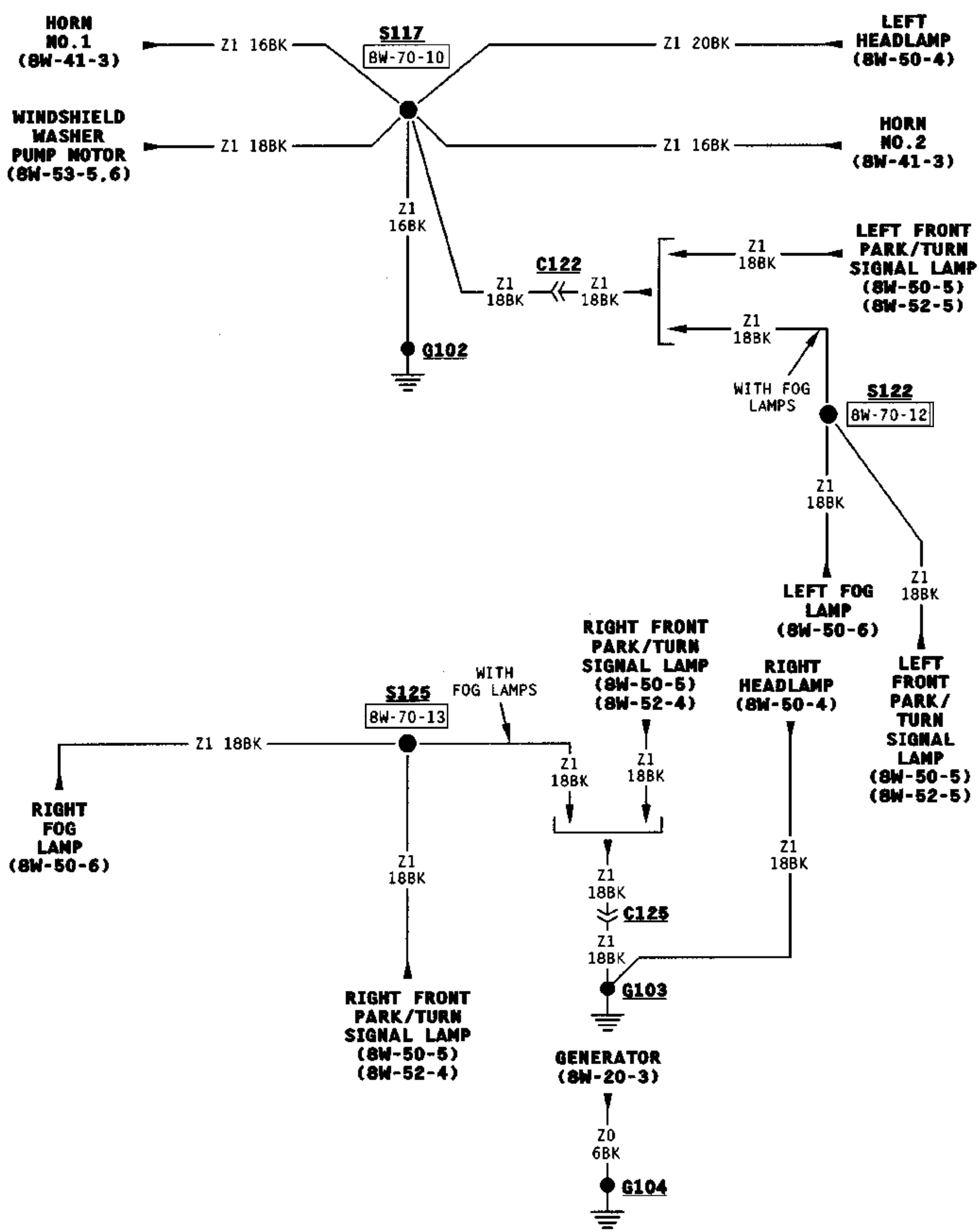
INTRODUCTION

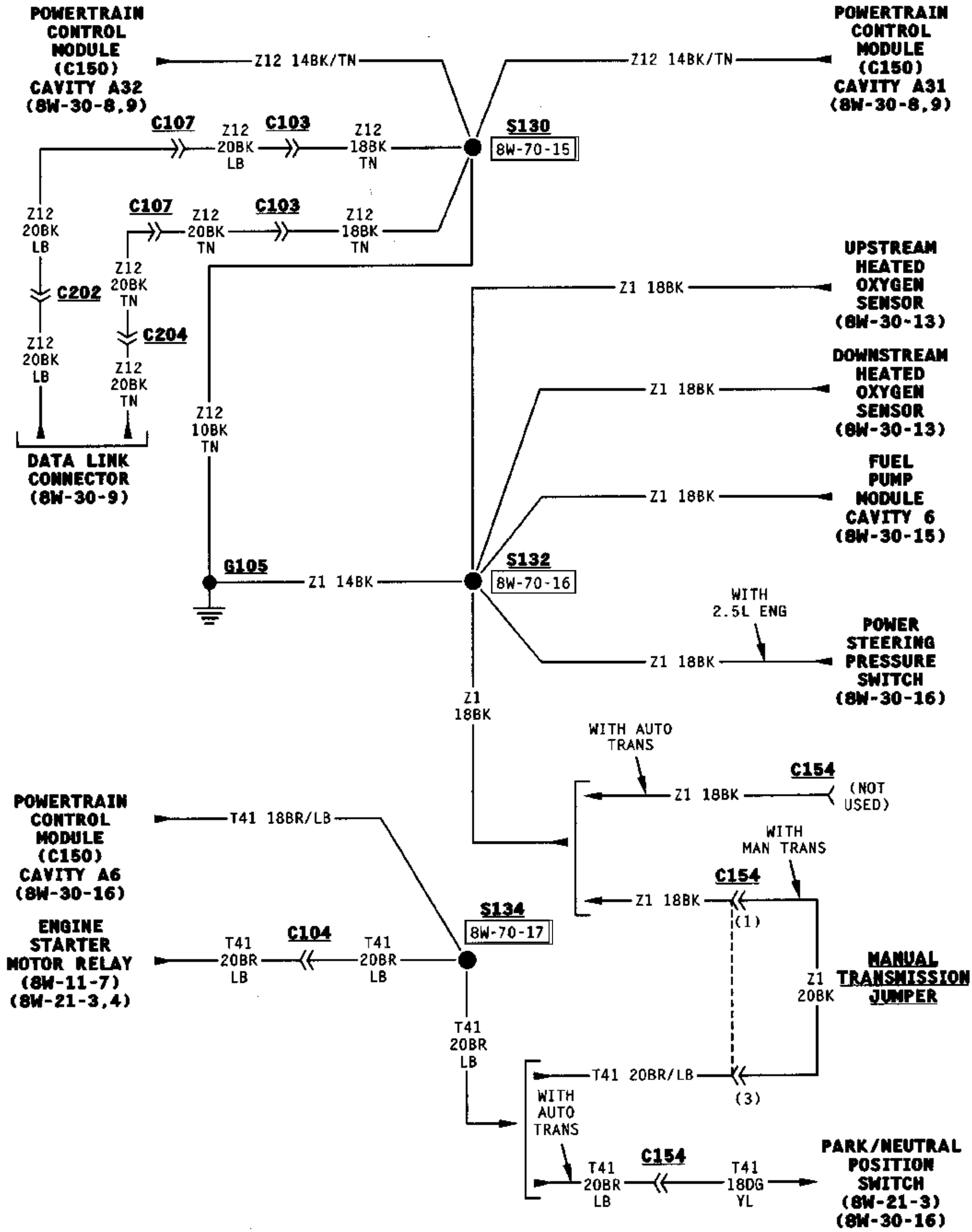
This section identifies the grounds, splices that connect to those grounds, and the components that connect those grounds. For additional information on system operation, refer to the appropriate section of the wiring diagrams. For an illustration of the physical location of each ground, refer to group 8W-90.

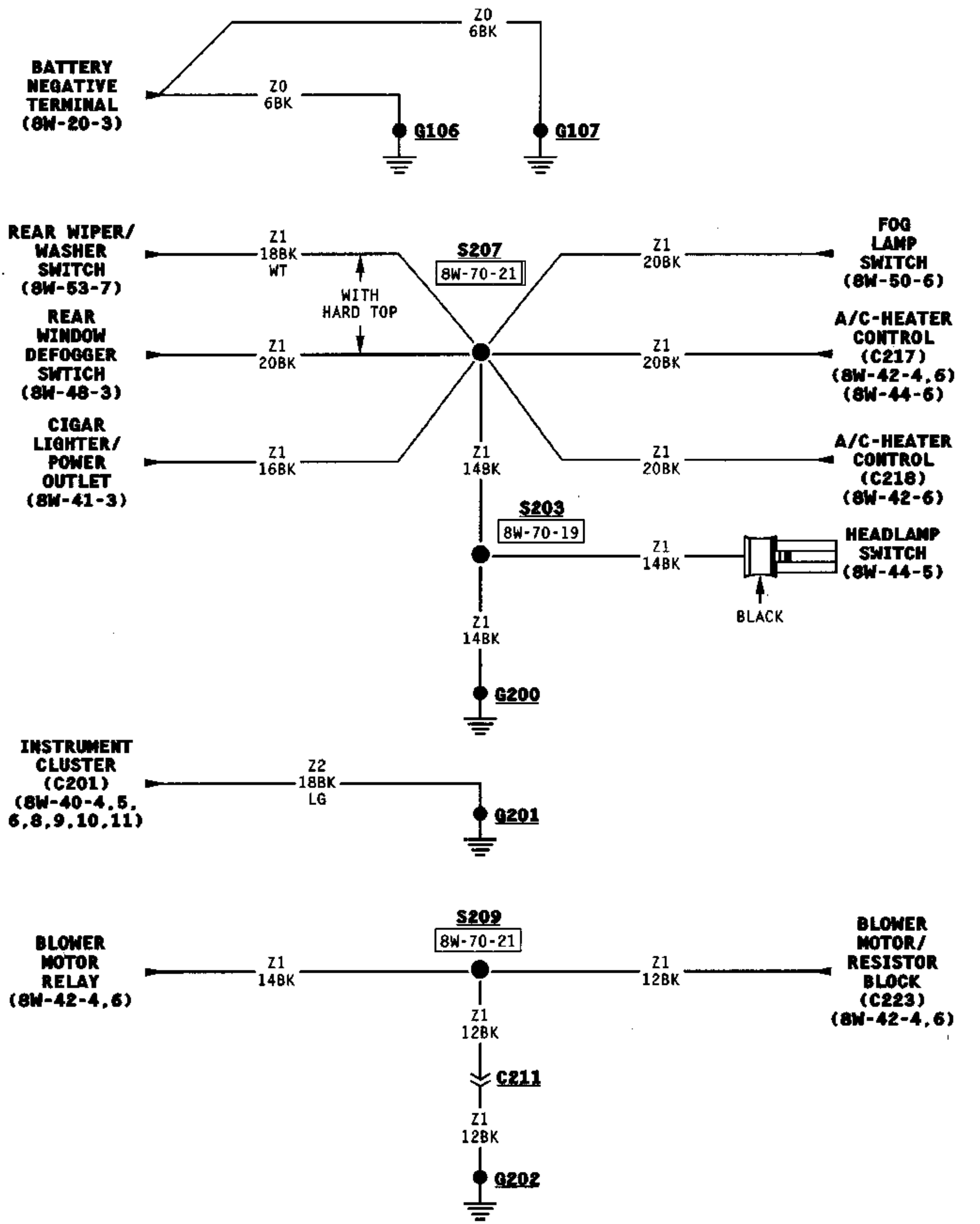
GROUND INDEX

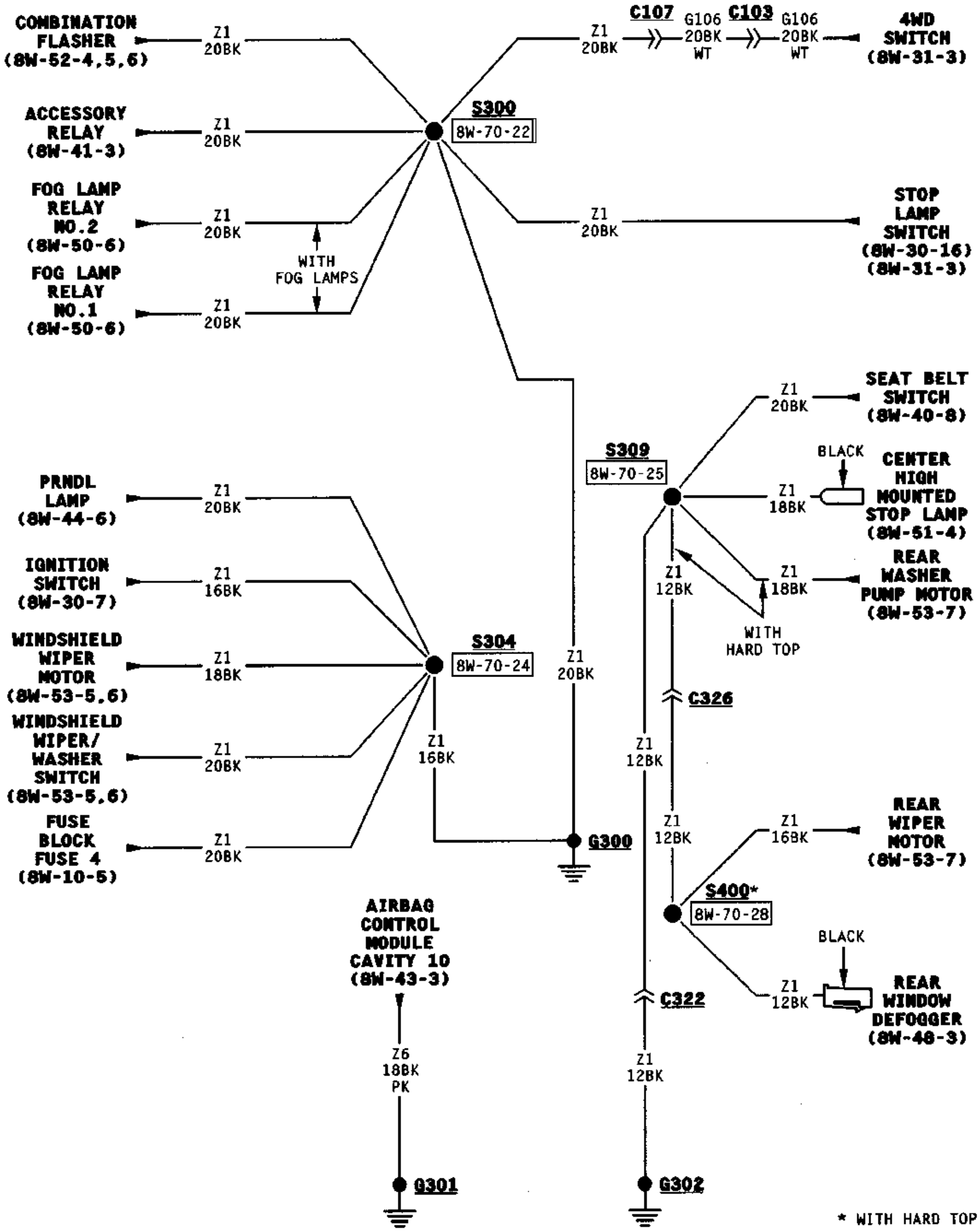


* WITH ABS AND/OR DRL
** WITH ABS


HORN
NO.1
(8W-41-3)
Z1 16BK
S117
8W-70-10
Z1 20BK
LEFT
HEADLAMP
(8W-50-4)
WINDSHIELD
WASHER
PUMP MOTOR
(8W-53-5,6)
Z1 18BK
Z1 16BK
HORN
NO.2
(8W-41-3)
Z1
16BK
C122
Z1
18BK
Z1
18BK
Z1
18BK
LEFT FRONT
PARK/TURN
SIGNAL LAMP
(8W-50-5)
(8W-52-5)
Z1
18BK
G102
WITH FOG
LAMPS
S122
8W-70-12
Z1
18BK
LEFT FOG
LAMP
(8W-50-6)
Z1
18BK
LEFT
FRONT
PARK/
TURN
SIGNAL
LAMP
(8W-50-5)
(8W-52-5)
RIGHT FRONT
PARK/TURN
SIGNAL LAMP
(8W-50-5)
(8W-52-4)
RIGHT
HEADLAMP
(8W-50-4)
WITH
FOG LAMPS
S125
8W-70-13
Z1 18BK
Z1
18BK
Z1
18BK
RIGHT
FOG
LAMP
(8W-50-6)
Z1
18BK
Z1
18BK
Z1
18BK
C125
Z1
18BK
G103
RIGHT FRONT
PARK/TURN
SIGNAL LAMP
(8W-50-5)
(8W-52-4)
GENERATOR
(8W-20-3)
Z0
6BK
G104


POWERTRAIN CONTROL MODULE (C150) CAVITY A32 (8W-30-8,9)
Z12 14BK/TN
POWERTRAIN CONTROL MODULE (C150) CAVITY A31 (8W-30-8,9)
C107
Z12 20BK LB
C103
Z12 18BK TN
S130
8W-70-15
Z12 20BK TN
C202
C204
DATA LINK CONNECTOR (8W-30-9)
Z12 10BK TN
UPSTREAM HEATED OXYGEN SENSOR (8W-30-13)
Z1 18BK
DOWNSTREAM HEATED OXYGEN SENSOR (8W-30-13)
FUEL PUMP MODULE CAVITY 6 (8W-30-15)
G105
Z1 14BK
S132
8W-70-16
WITH 2.5L ENG
POWER STEERING PRESSURE SWITCH (8W-30-16)
WITH AUTO TRANS
C154
(NOT USED)
POWERTRAIN CONTROL MODULE (C150) CAVITY A6 (8W-30-16)
T41 18BR/LB
WITH MAN TRANS
S134
8W-70-17
ENGINE STARTER MOTOR RELAY (8W-11-7) (8W-21-3,4)
T41 20BR LB
C104
(1)
Z1 20BK
MANUAL TRANSMISSION JUMPER
T41 20BR/LB
(3)
PARK/NEUTRAL POSITION SWITCH (8W-21-3) (8W-30-16)
T41 18DG YL


BATTERY NEGATIVE TERMINAL (8W-20-3)
Z0 6BK
Z0 6BK
G106
G107
REAR WIPER/ WASHER SWITCH (8W-53-7)
Z1 18BK WT
WITH HARD TOP
S207
8W-70-21
Z1 20BK
FOG LAMP SWITCH (8W-50-6)
REAR WINDOW DEFOGGER SWTICH (8W-48-3)
Z1 20BK
Z1 20BK
A/C-HEATER CONTROL (C217) (8W-42-4,6) (8W-44-6)
CIGAR LIGHTER/ POWER OUTLET (8W-41-3)
Z1 16BK
Z1 14BK
Z1 20BK
A/C-HEATER CONTROL (C218) (8W-42-6)
S203
8W-70-19
Z1 14BK
HEADLAMP SWITCH (8W-44-5)
BLACK
Z1 14BK
G200
INSTRUMENT CLUSTER (C201) (8W-40-4,5, 6,8,9,10,11)
Z2 18BK LG
G201
S209
8W-70-21
BLOWER MOTOR RELAY (8W-42-4,6)
Z1 14BK
Z1 12BK
BLOWER MOTOR/ RESISTOR BLOCK (C223) (8W-42-4,6)
Z1 12BK
C211
Z1 12BK
G202



80535561

J968W-5

8W-20 CHARGING SYSTEM

DESCRIPTION AND OPERATION

CHARGING SYSTEM

The charging system is an integral part of the battery and starting systems. Because all these systems work in conjunction, diagnose and test them together.

Circuit A11 connects to the generator output terminal and splices to the Power Distribution Center (PDC). Circuit A0 connects the battery to the PDC. Circuit Z0 provides ground for the generator.

When the ignition switch is in either the START or RUN positions, it connects circuit A1 from fuse 3 in the PDC to circuit A21. Circuit A21 feeds circuit F12 through fuse 11 in the fuse block. Circuit F12 splices to supply current to the coil side of the Automatic Shut Down (ASD) relay. The Powertrain Control Module (PCM) provides ground for the relay on circuit K51. Circuit K51 connects to cavity C3 of the PCM.

When the PCM grounds the ASD relay, contacts inside the relay close and connect circuit A14 from fuse 6 in the PDC to circuit A142. Circuit A142 splices to supply system voltage to cavity C12 of the PCM. Circuit K72 from cavity C25 of the PCM supplies current to the generator field terminal.

The PCM has an internal voltage regulator that controls generator output. The PCM controls the generator field on circuit K20. Circuit K20 connects to PCM cavity B10.

When the engine operates and there is current in the generator field, the generator produces a B+ voltage. The generator supplies B+ voltage to the battery through the A11 and A0 circuits.

HELPFUL INFORMATION

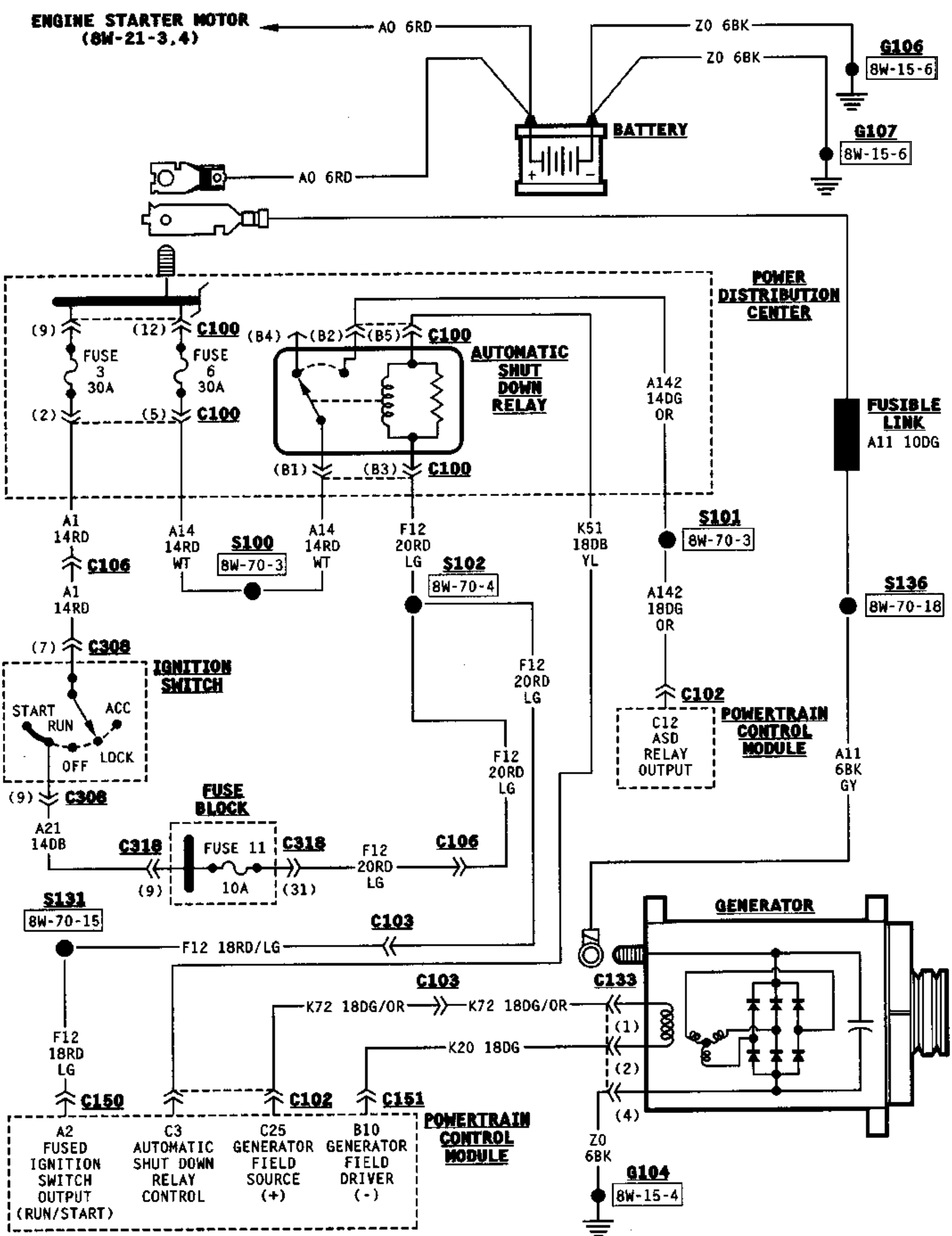
- Circuit F12 also powers the coil side of the fuel pump relay and A/C compressor clutch relay.
- The ASD relay supplies battery voltage for the fuel injectors, ignition coil, and heated oxygen sensors.

SCHEMATICS AND DIAGRAMS

WIRING DIAGRAM INDEX

The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

DIAGRAM INDEX


ENGINE STARTER MOTOR
(8W-21-3,4)
A0 6RD
Z0 6BK
Z0 6BK
G106
8W-15-6
BATTERY
G107
8W-15-6
A0 6RD
POWER
DISTRIBUTION
CENTER
(9)
(12)
C100
FUSE
3
30A
FUSE
6
30A
(2)
(5)
C100
(B4)
(B2)
(B5)
C100
AUTOMATIC
SHUT
DOWN
RELAY
(B1)
(B3)
C100
A142
14DG
OR
FUSIBLE
LINK
A11 10DG
A1
14RD
C106
A1
14RD
A14
14RD
WT
S100
8W-70-3
A14
14RD
WT
F12
20RD
LG
S102
8W-70-4
K51
18DB
YL
S101
8W-70-3
A142
18DG
OR
S136
8W-70-18
(7)
C308
IGNITION
SWITCH
START
RUN
ACC
OFF
LOCK
(9)
C308
F12
20RD
LG
F12
20RD
LG
C102
C12
ASD
RELAY
OUTPUT
POWERTRAIN
CONTROL
MODULE
A11
6BK
GY
FUSE
BLOCK
A21
14DB
C318
FUSE 11
10A
C318
(9)
(31)
F12
20RD
LG
C106
S131
8W-70-15
F12 18RD/LG
C103
GENERATOR
C103
K72 18DG/OR
K72 18DG/OR
C133
(1)
K20 18DG
(2)
(4)
F12
18RD
LG
C150
C102
C151
POWERTRAIN
CONTROL
MODULE
A2
FUSED
IGNITION
SWITCH
OUTPUT
(RUN/START)
C3
AUTOMATIC
SHUT DOWN
RELAY
CONTROL
C25
GENERATOR
FIELD
SOURCE
(+)
B10
GENERATOR
FIELD
DRIVER
(-)
Z0
6BK
G104
8W-15-4

8W-21 STARTING SYSTEM

DESCRIPTION AND OPERATION

STARTING SYSTEM—AUTOMATIC TRANSMISSIONS

Circuit A0 from the battery splices to the engine starter motor and the Power Distribution Center (PDC).

Fuse 2 in the PDC supplies battery voltage to the contact side of the engine starter motor relay on circuit A2. When the coil side of the engine starter motor relay energizes, the contacts close and connect circuit A2 to circuit T40. Circuit T40 supplies battery voltage to the starter motor solenoid.

When the ignition switch is in the START position it connects circuit A2 to circuit A41. Circuit A41 connects to circuit T141 through a jumper wire. Circuit T141 supplies battery voltage to the coil side of the starter motor relay. When the PARK/NEUTRAL position switch closes, it supplies ground for the coil side of the starter motor relay. Circuit T41 connects the coil side of the relay to the PARK/NEUTRAL position switch.

When the starter motor relay energizes and its contacts close, circuit T40 supplies battery voltage to the starter motor solenoid. Circuit A0 from the battery supplies voltage to the starter motor when the solenoid energizes.

STARTING SYSTEM—MANUAL TRANSMISSION

Circuit A0 from the battery splices to the engine starter motor and the Power Distribution Center (PDC).

Fuse 2 in the PDC supplies battery voltage to the contact side of the engine starter motor relay on circuit A2. When the coil side of the engine starter motor relay energizes, the contacts close and connect circuit A2 to circuit T40. Circuit T40 supplies battery voltage to the starter motor solenoid.

When the ignition switch is in the START position it connects circuit A2 to circuit A41. Circuit A41 connects to circuit T141 through the clutch interlock switch. Circuit T141 supplies battery voltage to the coil side of the starter motor relay. Circuit T41 from the relay coil connects to circuit Z1 through the manual transmission jumper. Circuit Z1 provides ground for the coil side of the relay.

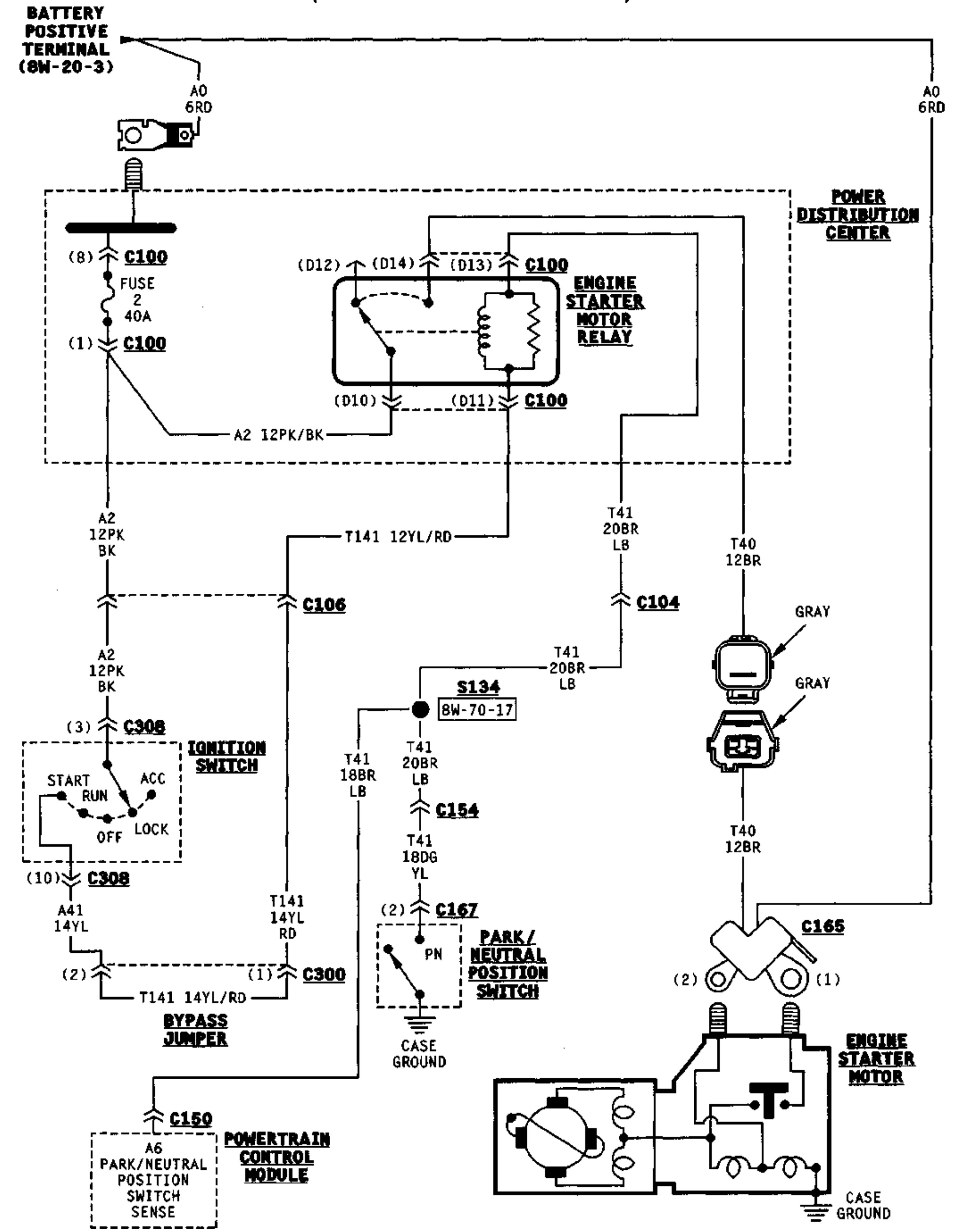
When the starter motor relay energizes and its contacts close, circuit T40 supplies battery voltage to the starter motor solenoid. Circuit A0 from the battery supplies voltage to the starter motor when the solenoid energizes.

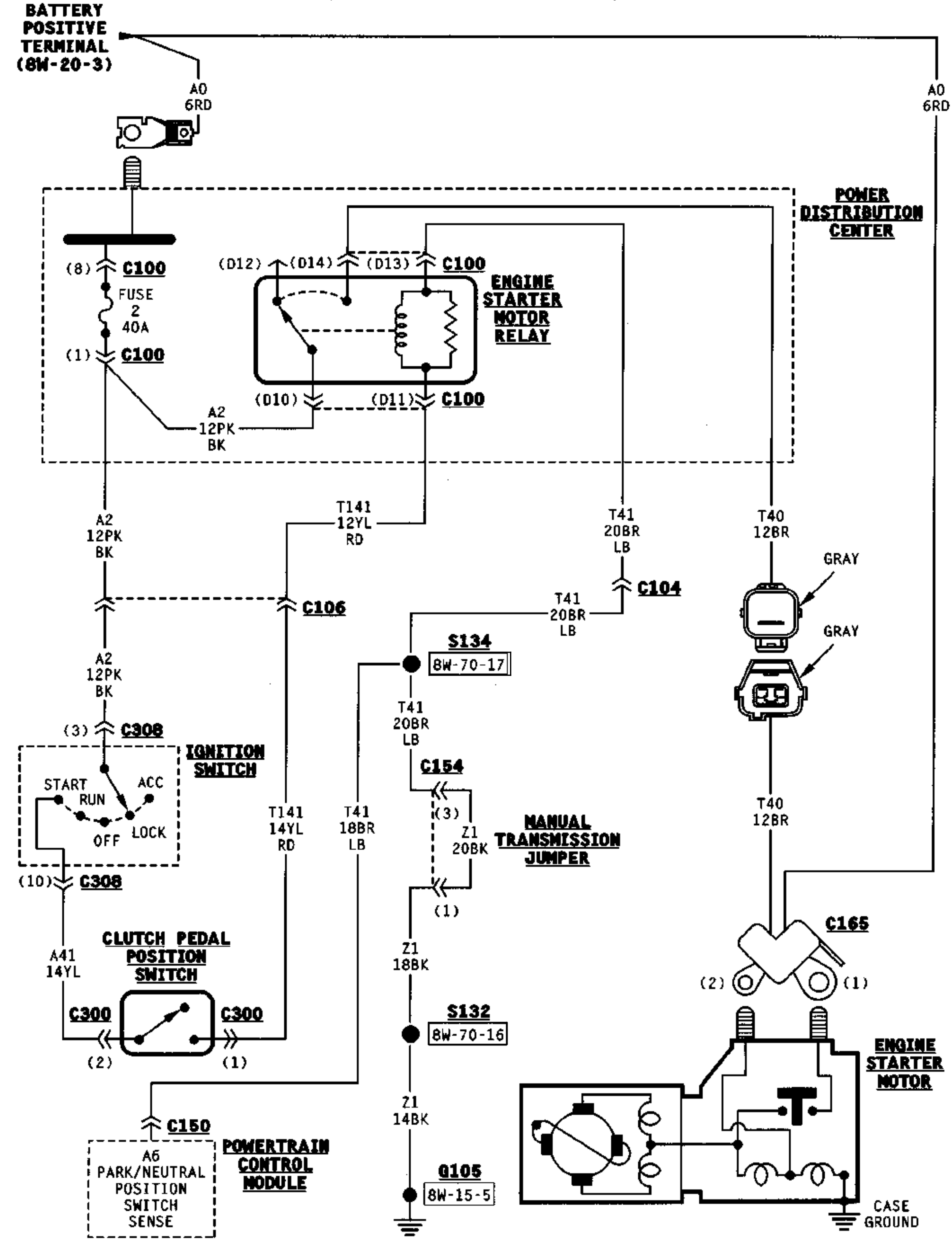
SCHEMATICS AND DIAGRAMS

WIRING DIAGRAM INDEX

The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

DIAGRAM INDEX


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
A0 6RD
POWER DISTRIBUTION CENTER
(8) C100
FUSE 2 40A
(1) C100
(D12) (D14) (D13) C100
ENGINE STARTER MOTOR RELAY
(D10) (D11) C100
A2 12PK/BK
A2 12PK BK
T141 12YL/RD
T41 20BR LB
T40 12BR
C106
C104
A2 12PK BK
T41 20BR LB
GRAY
GRAY
S134
8W-70-17
(3) C308
IGNITION SWITCH
START RUN ACC
OFF LOCK
T41 18BR LB
T41 20BR LB
C154
T40 12BR
T41 18DG YL
(10) C308
A41 14YL
T141 14YL RD
(2) C167
C165
PN
PARK/ NEUTRAL POSITION SWITCH
(2) (1) C300
(2) (1)
T141 14YL/RD
BYPASS JUMPER
CASE GROUND
ENGINE STARTER MOTOR
C150
A6 PARK/NEUTRAL POSITION SWITCH SENSE
POWERTRAIN CONTROL MODULE
CASE GROUND


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
A0 6RD
POWER DISTRIBUTION CENTER
(8) C100
FUSE 2 40A
(1) C100
(D12) (D14) (D13) C100
ENGINE STARTER MOTOR RELAY
(D10) (D11) C100
A2 12PK BK
T141 12YL RD
T41 20BR LB
T40 12BR
GRAY
GRAY
C104
C106
S134 8W-70-17
(3) C308
IGNITION SWITCH
START RUN ACC OFF LOCK
(10) C308
A41 14YL
CLUTCH PEDAL POSITION SWITCH
C300 C300
(2) (1)
T141 14YL RD
T41 18BR LB
C154
(3) (1)
Z1 20BK
MANUAL TRANSMISSION JUMPER
Z1 18BK
S132 8W-70-16
Z1 14BK
G105 8W-15-5
C150
A6 PARK/NEUTRAL POSITION SWITCH SENSE
POWERTRAIN CONTROL MODULE
C165
(2) (1)
ENGINE STARTER MOTOR
CASE GROUND

8W-30 FUEL/IGNITION SYSTEMS

INDEX

DESCRIPTION AND OPERATION

IGNITION SWITCH

Circuit A1 from fuse 3 in the Power Distribution Center (PDC) and circuit A2 from PDC fuse 2 supply battery voltage to the ignition switch. Depending upon position, the ignition switch powers circuits A21, A22, A31, or A41.

START POSITION

In the START position, the ignition switch connects circuit A2 to circuit A41. Circuit A41 connects to circuit T141 which powers the coil side of the starter motor relay.

Additionally in the START position, the case grounded ignition switch provides ground for the brake warning lamp switch.

START OR RUN POSITION

In the START or RUN position, the ignition switch connects circuit A1 to circuit A21. Circuit A21 feeds fuses 9, 10, and 11 in the fuse block.

RUN (ONLY) POSITION

When the ignition switch is in the RUN position, it connects circuit A2 to circuit A22. Circuit A22 feeds fuses 5, 6, 7, and 8 in the fuse block.

ACCESSORY OR RUN POSITIONS

In the ACCESSORY or RUN positions, the ignition switch connects circuit A1 to circuit A31. Circuit A31 feeds fuses 13, 14 and 15 in the fuse block and the accessory relay.

BATTERY FEED

Circuit A14 from fuse 6 in the Power Distribution Center (PDC) supplies battery voltage to cavity A22 of the Powertrain Control Module (PCM).

HELPFUL INFORMATION

Circuit A14 also supplies power to the contact sides of the Automatic Shut Down (ASD) relay.

PCM GROUND

Circuit Z12 connects to cavities A31 and A32 of the PCM. The Z12 circuit provides ground for PCM internal drivers that operate high current devices like the injectors and ignition coil.

Internal to the PCM, the ground circuit connects to the PCM sensor return circuit (from circuit K167).

HELPFUL INFORMATION

- The grounding point for circuit Z12 is the right rear of the engine block.
- If the system loses ground for the Z12 circuits at the rear of the engine, the vehicle will not operate. Check the connection at the ganged-ground circuit eyelet.

DATA LINK CONNECTOR

Circuit M1 from the Ignition Off Draw (IOD) fuse in cavity 17 of the Power Distribution Center (PDC) supplies battery voltage to the data link connector.

Circuit D20 connects to cavity C29 of the PCM. Circuit D20 is the SCI receive circuit for the Powertrain Control Module (PCM). Circuit D21 connects to cavity C27 of the PCM and cavity A3 of the Controller, Anti Lock Brakes (CAB). Circuit D21 is the SCI transmit circuit for the PCM. CCD Bus Circuits D1 and D2 connect to the data link connector.

DESCRIPTION AND OPERATION (Continued)

Circuit Z12 provide ground for the data link connector. Circuit Z12 also connects to cavities A31 and A32 of the PCM.

AUTOMATIC SHUT DOWN (ASD) RELAY

When the ignition switch is in either the START or RUN position, it connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A21. Circuit A21 feeds circuit F12 through fuse 11 in the fuse block. Circuit F12 powers the coil side of the Automatic Shut Down (ASD) relay. The Powertrain Control Module (PCM) provides ground for the relay coil on circuit K51. Circuit K51 connects to cavity C3 of the PCM.

When the PCM grounds the ASD relay, contacts inside the relay close and connect circuit A14 from fuse 6 in the PDC to circuit A142. Circuit A142 splices to the fuel injectors, ignition coil and the upstream and downstream heated oxygen sensors. Circuit A142 also connects to cavity C12 of the PCM.

HELPFUL INFORMATION

Circuit F12 also powers the coil side of the fuel pump relay.

FUEL PUMP RELAY

When the ignition switch is in either the START or RUN positions, it connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A21. Circuit A21 feeds circuit F12 through fuse 11 in the fuse block. Circuit F12 powers the coil side of the fuel pump relay. The Powertrain Control Module (PCM) provides ground for the relay on circuit K31. Circuit K31 connects to cavity C19 of the PCM.

When the PCM grounds the fuel pump relay, contacts inside the relay close and connect circuit A61 from fuse 16 in the PDC to circuit A141. Circuit A141 powers the fuel pump motor (part of the in-tank fuel pump module).

HELPFUL INFORMATION

Circuit F12 also powers the coils side of the Automatic Shut Down (ASD) relay.

FUEL PUMP MODULE

The in-tank fuel pump module contains the fuel pump motor and fuel level sensor.

FUEL PUMP MOTOR

When the fuel pump relay contacts close, they connect circuits A61 and A141. Circuit A141 powers the fuel pump module. Circuit Z1 provides ground for the fuel pump motor.

FUEL LEVEL SENSOR

The fuel level sensor is a variable resistor. Circuit K226 provides the fuel level signal to cavity C26 of the Powertrain Control Module (PCM). The PCM provides ground for the fuel level sensor signal on circuit K167. Circuit K167 connects to cavity A4 of the PCM. The PCM broadcasts fuel level data on the CCD bus. The microprocessor in the instrument cluster monitors the CCD bus to determine the fuel level and adjusts fuel gauge needle position accordingly.

VEHICLE SPEED SENSOR

Circuit K6 supplies 5 volts from the Powertrain Control Module (PCM) to the vehicle speed sensor. The K6 circuit connects to cavity B31 of the PCM.

Circuit G7 from the vehicle speed sensor provides an input signal to the PCM. The G7 circuit connects to cavity B27 of the PCM.

The PCM provides a ground for the vehicle speed sensor signal (circuit G7) through circuit K167. Circuit K167 connects to cavity A4 of the PCM.

HELPFUL INFORMATION

Circuit K167 splices to supply ground for the signals from the following:

- Heated oxygen sensors
- Camshaft position sensor
- Crankshaft position sensor
- Throttle position sensor
- Manifold absolute pressure sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Battery temperature sensor
- Oil pressure sensor

If the vehicle is equipped with Daytime Running Lamps (DRL), circuit G7 splices to the DRL module.

HEATED OXYGEN SENSORS

When the Automatic Shut Down (ASD) relay contacts close, they connect circuits A14 and A142. Circuit A142 splices to supply voltage to the upstream and downstream heated oxygen sensors.

Circuit K41 delivers the signal from the upstream heated oxygen sensor to the Powertrain Control Module (PCM). Circuit K41 connects to cavity A24 of the PCM. Circuit K141 supplies the signal from the downstream heated oxygen sensor to the PCM. Circuit K141 connects to PCM cavity A25.

The PCM provides a ground for the heated oxygen sensor signals (circuits K41 and K141) through circuit K167. Circuit K167 connects to cavity A4 of the PCM connector.

Circuit Z1 provides ground for the heater circuit in each sensor.

HELPFUL INFORMATION

Circuit A142 also supplies battery voltage to the fuel injectors and ignition coil.

Circuit K167 splices to supply ground for the signals from the following:

- Battery temperature sensor

DESCRIPTION AND OPERATION (Continued)

- Camshaft position sensor
- Crankshaft position sensor
- Intake air temperature sensor
- Throttle position sensor
- Manifold absolute pressure sensor
- Engine coolant temperature sensor
- Vehicle speed sensor
- Oil pressure sensor

BATTERY TEMPERATURE SENSOR

The Powertrain Control Module (PCM) determines battery temperature on circuit K118. Circuit K118 connects the PCM to the battery temperature sensor. Circuit K118 connects to cavity C15 of the PCM. Circuit K167 provides ground for the sensor and connects to PCM cavity A4.

HELPFUL INFORMATION

Circuit K167 splices to supply ground for the signals from the following:

- Battery temperature sensor
- Upstream and downstream heated oxygen sensors
- Camshaft position sensor
- Intake air temperature sensor
- Throttle position sensor
- Manifold absolute pressure sensor
- Engine coolant temperature sensor
- Vehicle speed sensor
- Oil pressure sensor

CRANKSHAFT POSITION SENSOR

The Powertrain Control Module (PCM) supplies 5 volts to the crankshaft position sensor on circuit K7. Circuit K7 connects to cavity A17 of the PCM.

The PCM receives the crankshaft position sensor signal on circuit K24. Circuit K24 connects to cavity A8 of the PCM.

The PCM provides a ground for the crankshaft position sensor (circuit K24) through circuit K167. Circuit K167 connects to cavity A4 of the PCM.

HELPFUL INFORMATION

- Circuit K7 splices to supply 5 volts to the camshaft position sensor, throttle position and manifold absolute pressure sensor.

Circuit K167 splices to supply ground for the signals from the following:

- Battery temperature sensor
- Upstream and downstream heated oxygen sensors
- Camshaft position sensor
- Intake air temperature sensor
- Throttle position sensor
- Manifold absolute pressure sensor
- Engine coolant temperature sensor
- Vehicle speed sensor
- Oil pressure sensor

CAMSHAFT POSITION SENSOR

The Powertrain Control Module (PCM) supplies 5 volts to the camshaft position sensor (in distributor) on circuit K7. Circuit K7 connects to cavity A17 of the PCM.

The PCM receives the camshaft position sensor signal on circuit K44. Circuit K44 connects to cavity A18 of the PCM.

The PCM provides a ground for the camshaft position sensor signal (circuit K44) through circuit K167. Circuit K167 connects to cavity A4 of the PCM.

HELPFUL INFORMATION

- Circuit K7 splices to supply 5 volts to the crankshaft position sensor throttle position sensor and manifold absolute pressure sensor.

Circuit K167 splices to supply ground for the signals from the following:

- Battery temperature sensor
- Upstream and downstream heated oxygen sensors
- Crankshaft position sensor
- Intake air temperature sensor
- Throttle position sensor
- Manifold absolute pressure sensor
- Engine coolant temperature sensor
- Vehicle speed sensor
- Oil pressure sensor

ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor provides an input to the Powertrain Control Module (PCM) on circuit K2. From circuit K2, the engine coolant temperature sensor draws up to 5 volts from the PCM. The sensor is a variable resistor. As coolant temperature changes, the resistance in the sensor changes, causing a change in current draw. The K2 circuit connects to cavity A16 of the PCM.

The PCM provides a ground for the engine coolant temperature sensor signal (circuit K2) through circuit K167. Circuit K167 connects to cavity A4 of the PCM connector.

HELPFUL INFORMATION

Circuit K167 splices to supply ground for the signals from the following:

- Battery temperature sensor
- Camshaft position sensor
- Crankshaft position sensor
- Intake air temperature sensor
- Throttle position sensor
- Manifold absolute pressure sensor
- Upstream and downstream heated oxygen sensor
- Vehicle speed sensor
- Oil pressure sensor

DESCRIPTION AND OPERATION (Continued)

THROTTLE POSITION SENSOR

From the Powertrain Control Module (PCM), circuit K7 supplies 5 volts to the throttle position sensor (TPS). Circuit K7 connects to cavity A17 of the PCM.

Circuit K22 delivers the TPS signal to the PCM. Circuit K22 connects to cavity A23 of the PCM.

The PCM provides a ground for the throttle position sensor signal (circuit K22) through circuit K167. Circuit K167 connects to cavity A4 of the PCM.

HELPFUL INFORMATION

Refer to Group 14 for throttle position sensor operation.

Circuit K7 splices to supply 5 volts to the manifold absolute pressure sensor, camshaft position sensor, and crankshaft position sensor.

Circuit K167 splices to supply ground for the signals from the following:

- Battery temperature sensor
- Upstream and downstream heated oxygen sensors
- Camshaft position sensor
- Crankshaft position sensor
- Intake air temperature sensor
- Manifold absolute pressure sensor
- Engine coolant temperature sensor
- Vehicle speed sensor
- Oil pressure sensor

MANIFOLD ABSOLUTE PRESSURE SENSOR

From the Powertrain Control Module (PCM), circuit K7 supplies 5 volts to the manifold absolute pressure (MAP) sensor. Circuit K7 connects to cavity A17 of the PCM.

Circuit K1 delivers the MAP signal to the PCM. Circuit K1 connects to cavity A27 of the PCM.

The PCM provides a ground for the MAP sensor signal (circuit K1) through circuit K167. Circuit K167 connects to cavity A4 of the PCM.

HELPFUL INFORMATION

Refer to Group 14 for MAP sensor operation.

Circuit K7 splices to supply 5 volts to the camshaft position sensor, crankshaft position sensor and throttle position sensor.

Circuit K167 splices to supply ground for the signals from the following:

- Battery temperature sensor
- Upstream and downstream heated oxygen sensors
- Camshaft position sensor
- Crankshaft position sensor
- Intake air temperature sensor
- Throttle position sensor
- Engine coolant temperature sensor
- Vehicle speed sensor
- Oil pressure sensor

INTAKE AIR TEMPERATURE SENSOR

The intake air temperature sensor provides an input to the Powertrain Control Module (PCM) on circuit K21. Circuit K21 connects to cavity A15 of the PCM.

From circuit K21, the intake air temperature sensor draws voltage from the PCM. The sensor is a variable resistor. As intake air temperature changes, the resistance in the sensor changes, causing a change in current draw.

The PCM provides a ground for the intake air temperature sensor signal (circuit K21) through circuit K167. Circuit K167 connects to cavity A4 of the PCM.

HELPFUL INFORMATION

Circuit K4 splices to supply ground for the signals from the following:

- Battery temperature sensor
- Upstream and downstream heated oxygen sensors
- Camshaft position sensor
- Crankshaft position sensor
- Throttle position sensor
- Manifold absolute pressure sensor
- Engine coolant temperature sensor
- Vehicle speed sensor
- Oil pressure sensor

OIL PRESSURE GAUGE

On circuit G60, the Powertrain Control Module (PCM) provides current to the oil pressure sensor. The sensor is a variable resistor. As engine oil pressure changes, the resistance in the sensor changes resulting in a change in current draw. The PCM provides ground for the sensor on circuit K167. Circuit K167 connects to cavity A4 of the PCM.

The instrument cluster microprocessor calculates engine oil pressure gauge needle position based on the oil pressure data message on the CCD bus. The Powertrain Control Module (PCM) broadcasts the data message over the CCD bus.

Circuit K167 splices to supply ground for the signals from the following:

- Battery temperature sensor
- Upstream and downstream heated oxygen sensors
- Camshaft position sensor
- Crankshaft position sensor
- Intake air temperature sensor
- Throttle position sensor
- Engine coolant temperature sensor
- Vehicle speed sensor

PARK/NEUTRAL POSITION SWITCH

When closed, the park/neutral position switch connects circuit T41 to ground. The switch provides ground for the coil side of the starter motor relay. Circuit T41 splices to provide an input to cavity A6 of the Powertrain Control Module (PCM). The park/neu-

DESCRIPTION AND OPERATION (Continued)

tral position switch is only used on vehicles equipped with an automatic transmission.

POWER STEERING PRESSURE SWITCH

The Powertrain Control Module (PCM) connects to the power steering pressure switch on circuit K10. Circuit K10 connects to cavity A12 of the PCM. Circuit Z1 provides ground for the switch. When the switch closes, it connects circuit K10 to ground. The switch closes during periods of high power steering pump load and low engine speed; such as parking maneuvers.

STOP LAMP SWITCH INPUT

Circuit K29 provides the stop lamp switch input to the PCM. Circuit K29 connects to cavity C24 of the PCM. In the normally closed position, the stop lamp switch connects circuit K29 to ground circuit Z1.

FUEL INJECTORS

When the Automatic Shut Down (ASD) relay contacts close, they connect circuits A14 and A142. Circuit A142 supplies voltage to the fuel injectors. Each injector has a separate ground circuit controlled by the Powertrain Control Module (PCM).

Circuit K11 provides ground for injector number one. The K11 circuit connects to cavity B4 of the PCM.

Circuit K12 provides ground for injector number two. The K12 circuit connects to cavity B15 of the PCM.

Circuit K13 provides ground for injector number three. The K13 circuit connects to cavity B5 of the PCM.

Circuit K14 provides ground for injector number four. The K14 circuit connects to cavity B16 of the PCM.

On the 4.0L engine, circuit K15 provides ground for injector number five. The K15 circuit connects to cavity B6 of the PCM.

Also on the 4.0L engine, circuit K16 provides ground for injector number six. The K16 circuit connects to cavity B12 of the PCM.

HELPFUL INFORMATION

• Circuit A142 splices to supply voltage to the upstream and downstream heated oxygen sensors, ignition coil, and PCM.

• For information about fuel injector operation, refer to Group 14.

IGNITION COIL

When the Automatic Shut Down (ASD) relay contacts close, they connect circuits A14 and A142. Circuit A142 splices to supply voltage to the ignition coil. The Powertrain Control Module (PCM) controls the ground path for the ignition coil on circuit K19. Circuit K19 connects to cavity A7 of the PCM.

HELPFUL INFORMATION

Circuit A142 splices to supply voltage to the fuel injectors, heated oxygen sensors, and PCM.

IDLE AIR CONTROL (IAC) MOTOR

The Powertrain Control Module (PCM) operates the idle air control motor through 4 circuits; K39, K40, K59, and K60. Each circuit connects to separate cavities in the PCM connector.

- Circuit K39 connects to cavity A19 of the PCM
- Circuit K40 connects to cavity A11 of the PCM
- Circuit K59 connects to cavity A20 of the PCM
- Circuit K60 connects to cavity A10 of the PCM

DUTY CYCLE EVAP\PURGE SOLENOID

When the ignition switch is in the START or RUN position, it connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A21. Circuit A21 powers circuit F12 through fuse 11 in the fuse block. Circuit F12 supplies power to the Duty Cycle EVAP/Purge solenoid.

The Powertrain Control Module (PCM) provides the ground path for the solenoid on circuit K52. Circuit K52 connects to cavity C20 of the PCM.

TORQUE CONVERTER CLUTCH (TCC) SOLENOID

The TCC solenoid is only used on vehicles with three-speed automatic transmissions. When the ignition switch is in the START or RUN position, it connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A21. Circuit A21 powers circuit F12 through fuse 11 in the fuse block. Circuit F12 powers the TCC solenoid. The Powertrain Control Module (PCM) provides ground for the solenoid on circuit T23. Circuit T23 connects to cavity B11 of the PCM.

CCD BUS

Circuits D1 and D2 connect the Powertrain Control Module (PCM) to the CCD Bus. Circuit D1 connects to cavity C30 of the PCM. Circuit D2 connects to cavity C28 of the PCM. Circuits D1 and D2 are a twisted pair of wires.

Several controllers and modules broadcast and receive data on the CCD Bus. Each controller or module is enabled to receive only certain messages. The PCM broadcasts the following messages on the CCD bus.

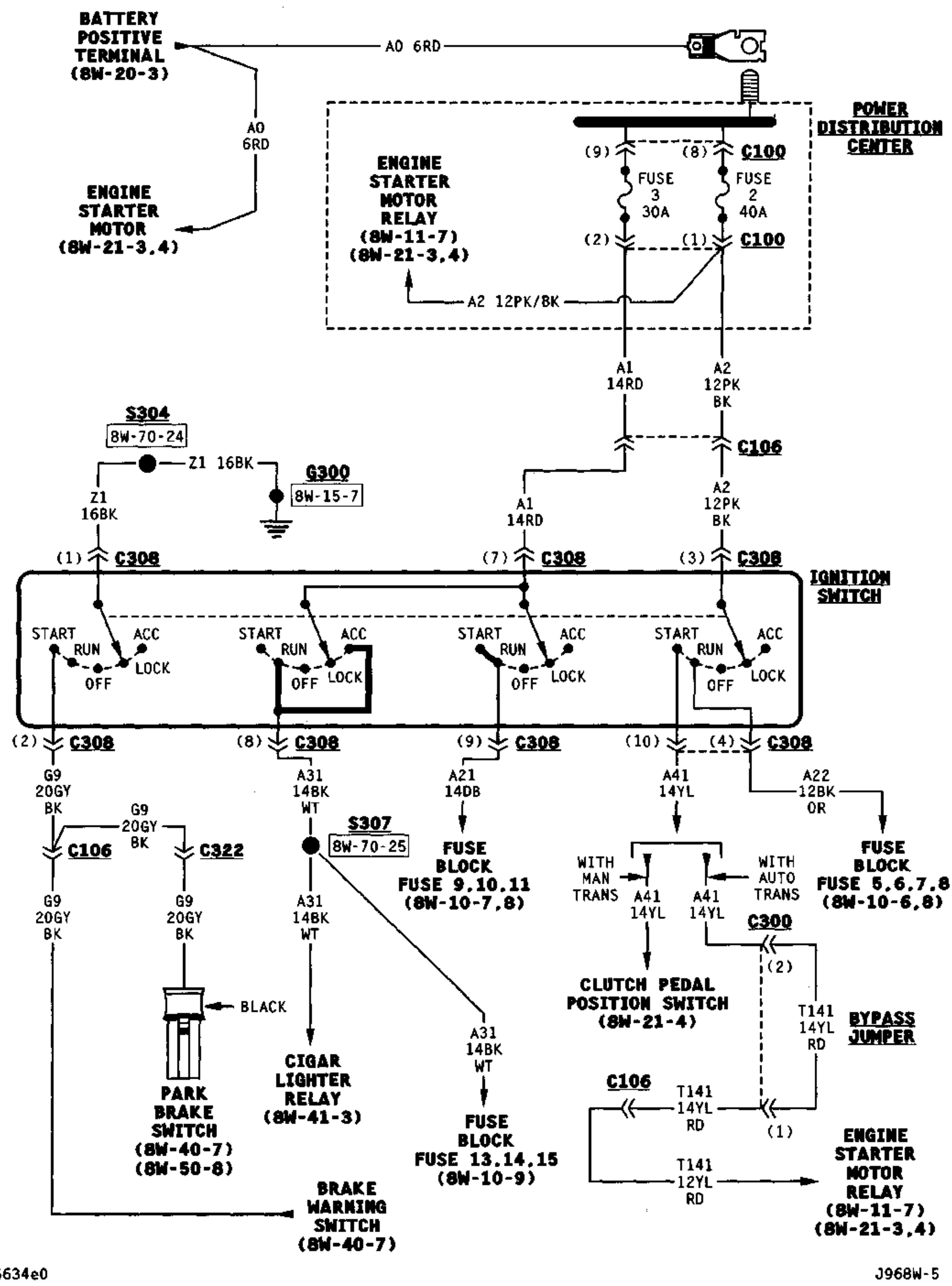
- Engine RPM
- Injector on-time and distance pulses
- Vehicle speed
- Engine oil pressure
- Engine temperature
- Fuel level
- System voltage

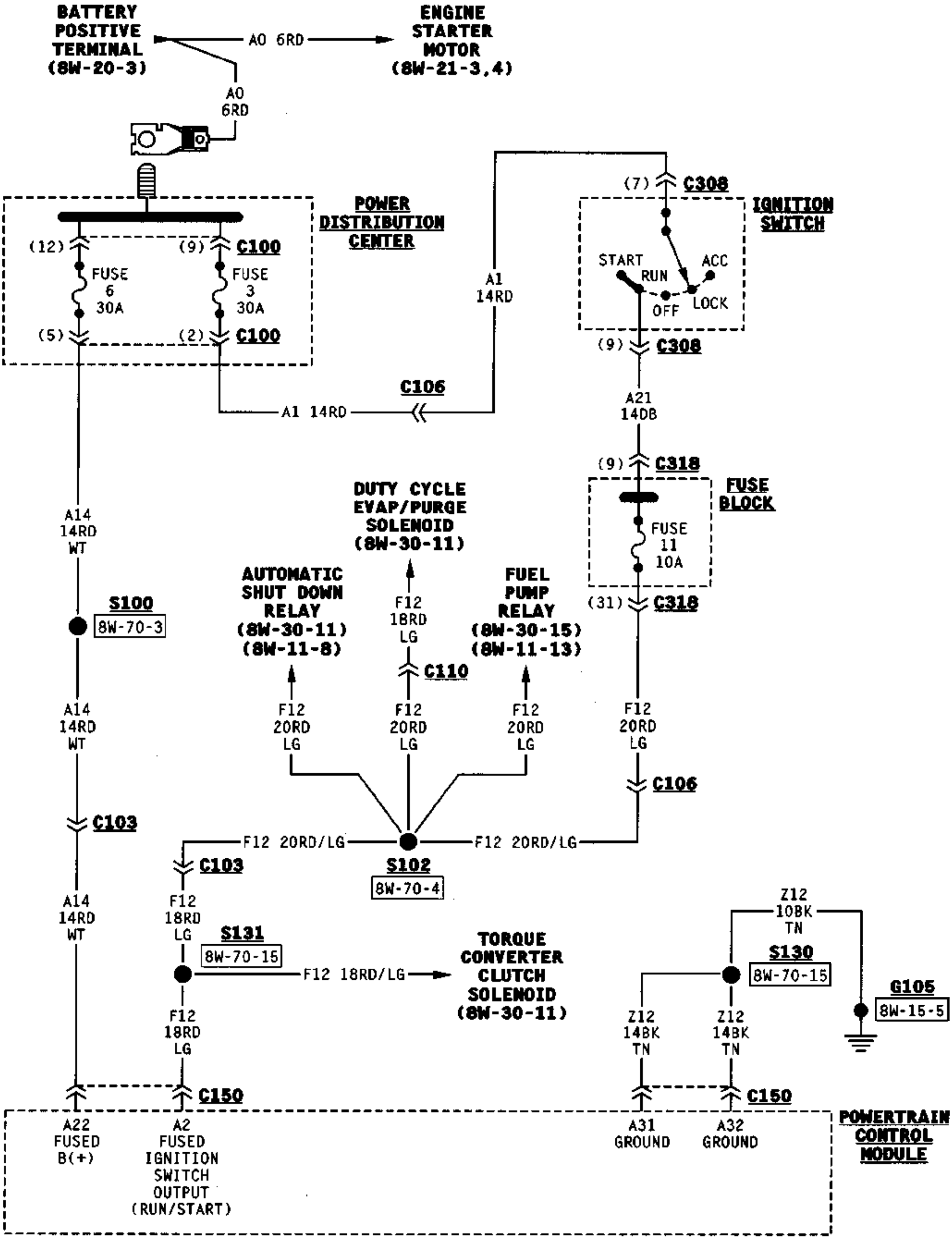
SCHEMATICS AND DIAGRAMS

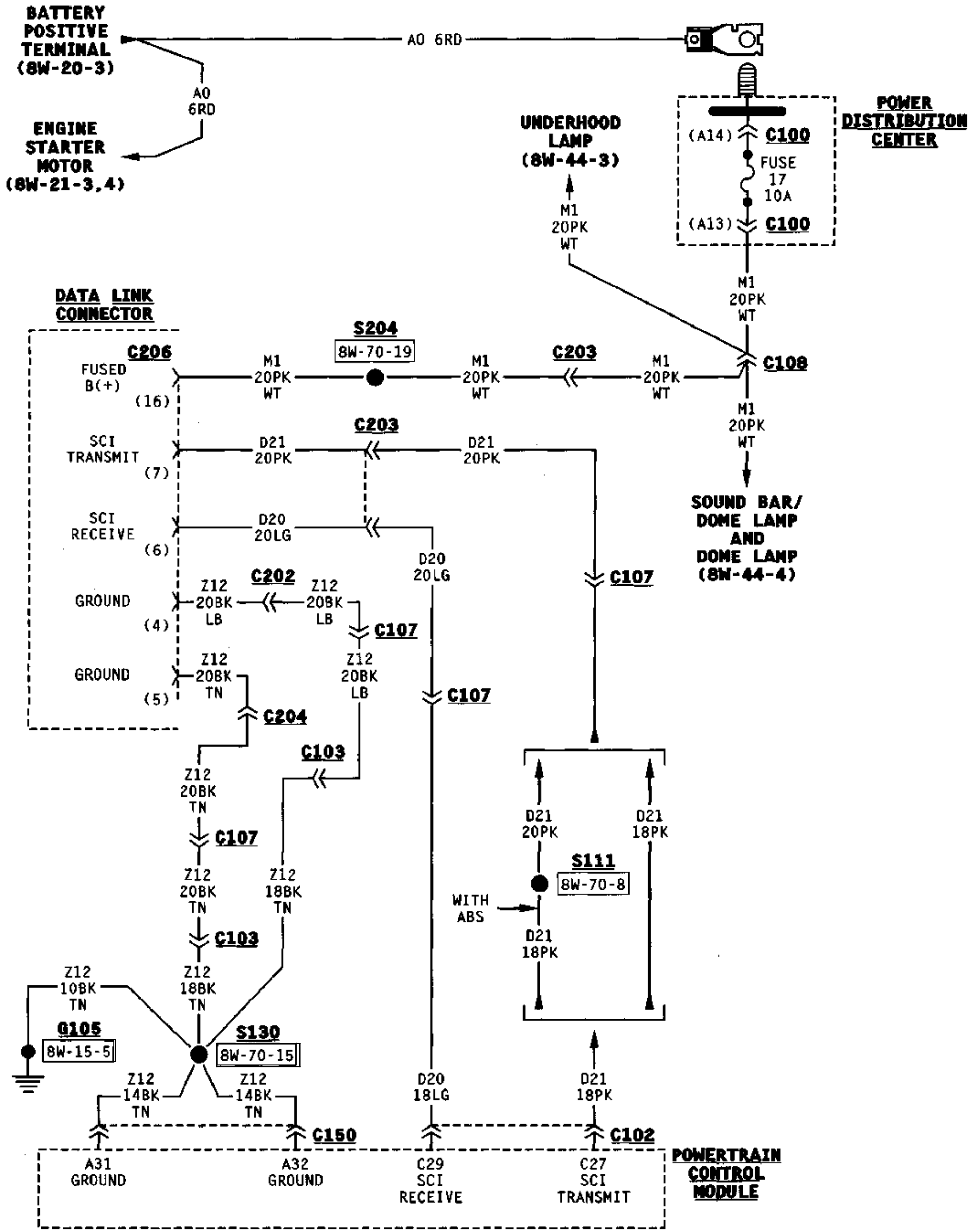
WIRING DIAGRAM INDEX

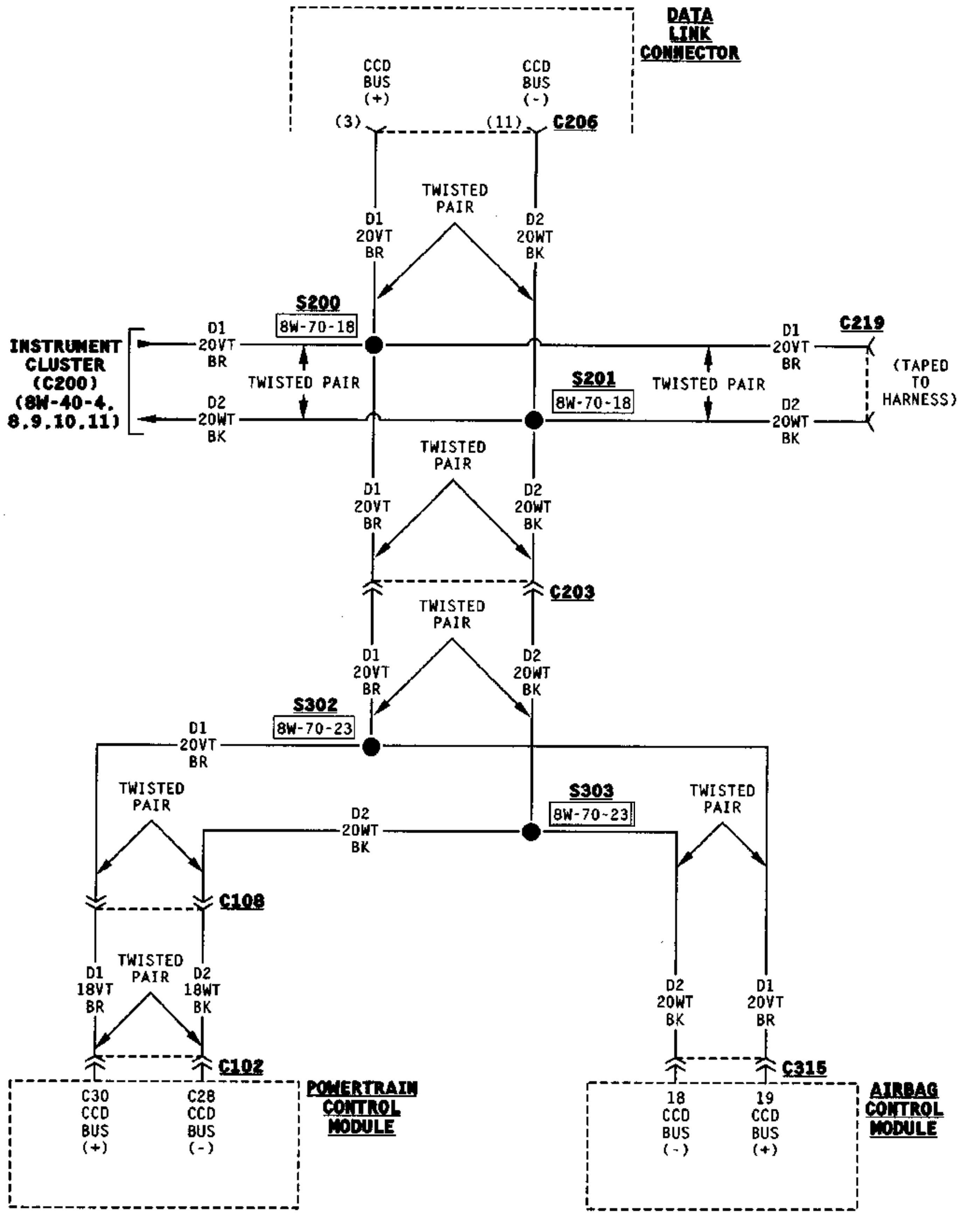
The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

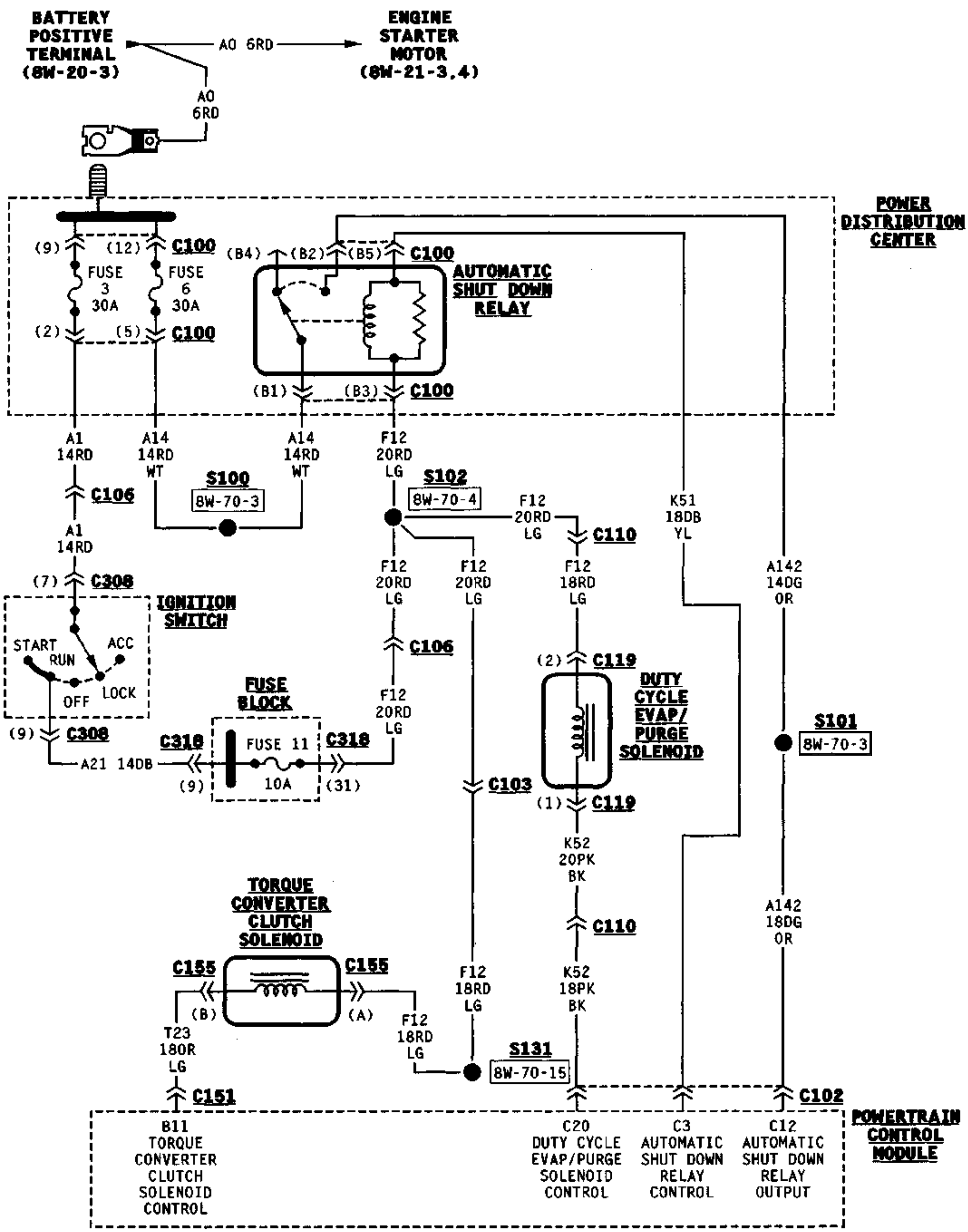
DIAGRAM INDEX


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
POWER DISTRIBUTION CENTER
ENGINE STARTER MOTOR RELAY (8W-11-7) (8W-21-3,4)
(9) (8) C100
FUSE 3 30A
FUSE 2 40A
(2) (1) C100
A2 12PK/BK
A1 14RD
A2 12PK BK
C106
A1 14RD
A2 12PK BK
S304
8W-70-24
Z1 16BK
G300
8W-15-7
Z1 16BK
(1) C308
(7) C308
(3) C308
IGNITION SWITCH
START RUN ACC OFF LOCK
(2) C308
(8) C308
(9) C308
(10) (4) C308
G9 20GY BK
G9 20GY BK
C106
C322
A31 14BK WT
S307
8W-70-25
A21 14DB
FUSE BLOCK FUSE 9,10,11 (8W-10-7,8)
A41 14YL
A22 12BK OR
FUSE BLOCK FUSE 5,6,7,8 (8W-10-6,8)
WITH MAN TRANS
WITH AUTO TRANS
A41 14YL
A41 14YL
C300
(2)
G9 20GY BK
G9 20GY BK
BLACK
PARK BRAKE SWITCH (8W-40-7) (8W-50-8)
A31 14BK WT
CIGAR LIGHTER RELAY (8W-41-3)
A31 14BK WT
FUSE BLOCK FUSE 13,14,15 (8W-10-9)
CLUTCH PEDAL POSITION SWITCH (8W-21-4)
T141 14YL RD
BYPASS JUMPER
C106
T141 14YL RD
(1)
T141 12YL RD
ENGINE STARTER MOTOR RELAY (8W-11-7) (8W-21-3,4)
BRAKE WARNING SWITCH (8W-40-7)

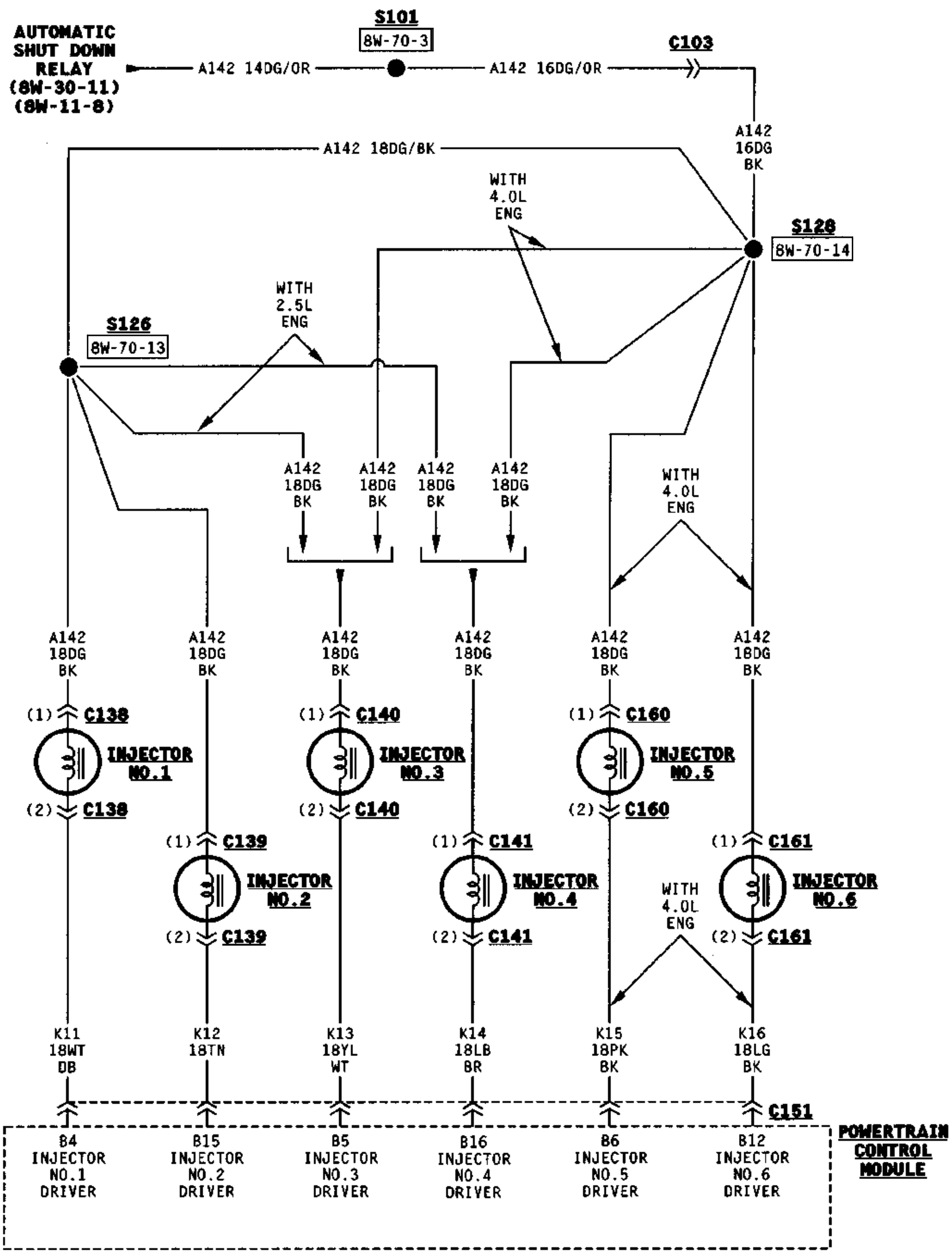

BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(12)
(9)
C100
FUSE 6 30A
FUSE 3 30A
(5)
(2)
C100
A1 14RD
C106
A1 14RD
(7)
C308
IGNITION SWITCH
START
RUN
ACC
OFF
LOCK
(9)
C308
A21 14DB
(9)
C318
FUSE BLOCK
FUSE 11 10A
(31)
C318
A14 14RD WT
S100
8W-70-3
A14 14RD WT
C103
A14 14RD WT
DUTY CYCLE EVAP/PURGE SOLENOID (8W-30-11)
AUTOMATIC SHUT DOWN RELAY (8W-30-11) (8W-11-8)
F12 18RD LG
C110
FUEL PUMP RELAY (8W-30-15) (8W-11-13)
F12 20RD LG
F12 20RD LG
F12 20RD LG
F12 20RD LG
C106
F12 20RD/LG
F12 20RD/LG
S102
8W-70-4
C103
F12 18RD LG
S131
8W-70-15
F12 18RD/LG
TORQUE CONVERTER CLUTCH SOLENOID (8W-30-11)
F12 18RD LG
Z12 10BK TN
S130
8W-70-15
G105
8W-15-5
Z12 14BK TN
Z12 14BK TN
C150
C150
A22 FUSED B(+)
A2 FUSED IGNITION SWITCH OUTPUT (RUN/START)
A31 GROUND
A32 GROUND
POWERTRAIN CONTROL MODULE

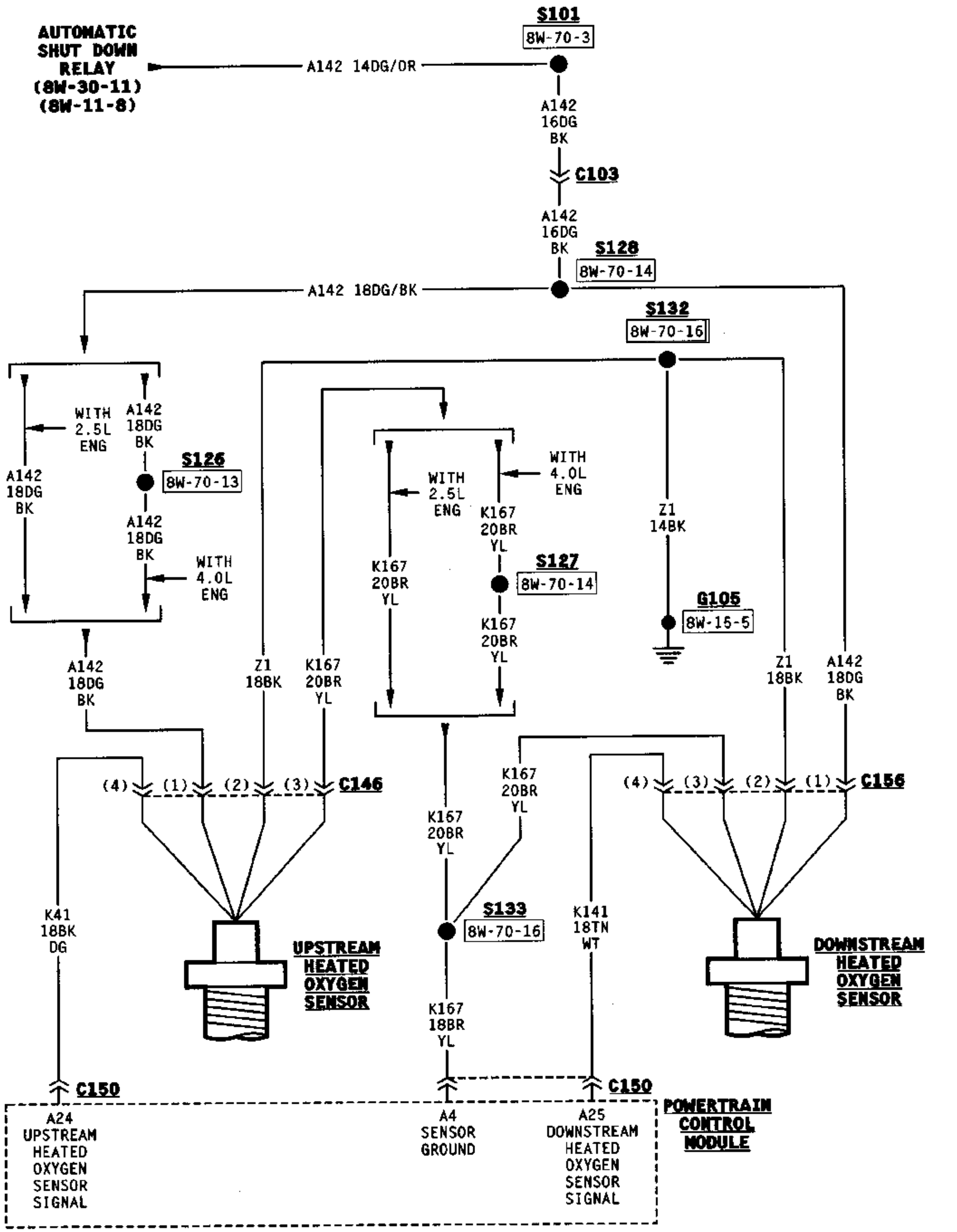

BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
POWER DISTRIBUTION CENTER
(A14) C100
FUSE 17 10A
(A13) C100
UNDERHOOD LAMP (8W-44-3)
M1 20PK WT
M1 20PK WT
C108
M1 20PK WT
SOUND BAR/ DOME LAMP AND DOME LAMP (8W-44-4)
DATA LINK CONNECTOR
C206
FUSED B(+) (16)
SCI TRANSMIT (7)
SCI RECEIVE (6)
GROUND (4)
GROUND (5)
S204
8W-70-19
M1 20PK WT
M1 20PK WT
C203
M1 20PK WT
C203
D21 20PK
D21 20PK
D20 20LG
D20 20LG
C107
C202
Z12 20BK LB
Z12 20BK LB
C107
Z12 20BK LB
Z12 20BK TN
C204
C107
C103
Z12 20BK TN
C107
Z12 20BK TN
Z12 18BK TN
C103
Z12 18BK TN
Z12 10BK TN
G105
8W-15-5
S130
8W-70-15
Z12 14BK TN
Z12 14BK TN
C150
D21 20PK
D21 18PK
S111
8W-70-8
WITH ABS
D21 18PK
D20 18LG
D21 18PK
C102
POWERTRAIN CONTROL MODULE
A31 GROUND
A32 GROUND
C29 SCI RECEIVE
C27 SCI TRANSMIT


DATA LINK CONNECTOR
CCD BUS (+)
CCD BUS (-)
(3)
(11)
C206
TWISTED PAIR
D1 20VT BR
D2 20WT BK
S200
8W-70-18
INSTRUMENT CLUSTER (C200) (8W-40-4, 8,9,10,11)
TWISTED PAIR
S201
8W-70-18
C219
(TAPED TO HARNESS)
C203
S302
8W-70-23
S303
8W-70-23
C108
D1 18VT BR
D2 18WT BK
C102
C30 CCD BUS (+)
C28 CCD BUS (-)
POWERTRAIN CONTROL MODULE
C315
18 CCD BUS (-)
19 CCD BUS (+)
AIRBAG CONTROL MODULE

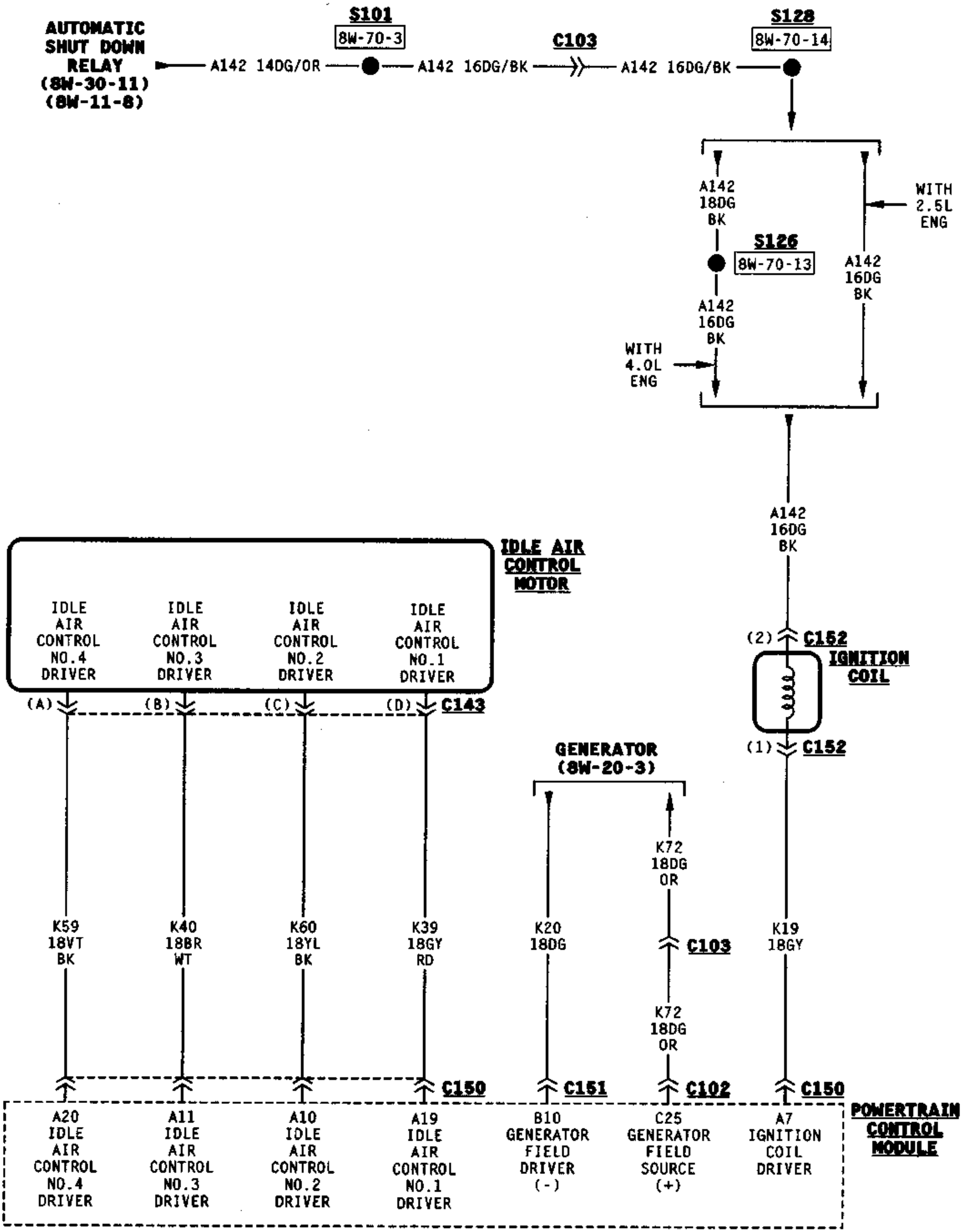


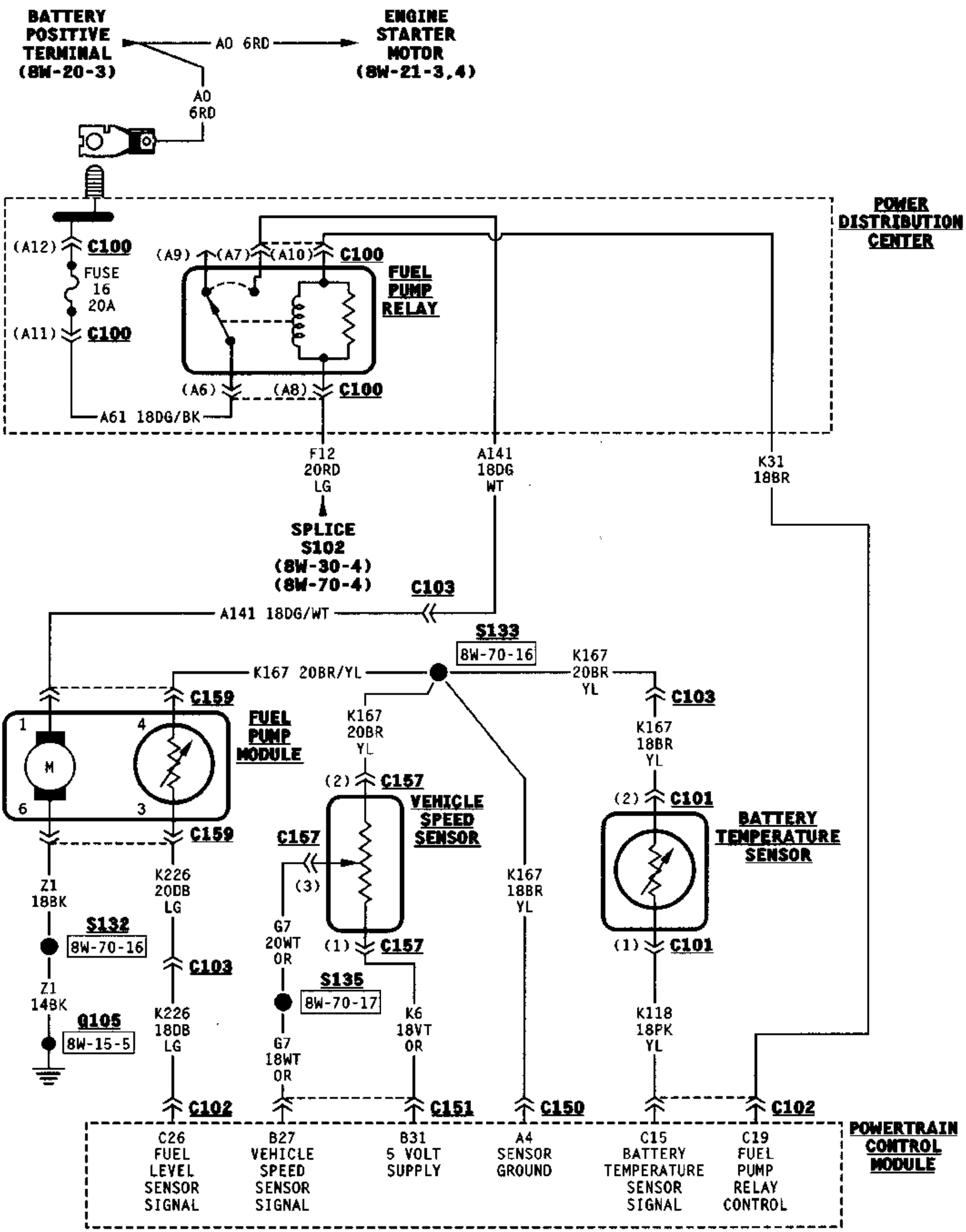
BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(9)
(12)
C100
FUSE 3 30A
FUSE 6 30A
(2)
(5)
C100
(B4)
(B2)
(B5)
C100
AUTOMATIC SHUT DOWN RELAY
(B1)
(B3)
C100
A1 14RD
A14 14RD WT
A14 14RD WT
F12 20RD LG
S100
8W-70-3
S102
8W-70-4
C106
A1 14RD
F12 20RD LG
C110
K51 18DB YL
(7)
C308
IGNITION SWITCH
START
RUN
ACC
OFF
LOCK
F12 20RD LG
F12 20RD LG
F12 18RD LG
A142 14DG OR
C106
(2)
C119
DUTY CYCLE EVAP/ PURGE SOLENOID
FUSE BLOCK
(9)
C308
C318
C318
A21 14DB
FUSE 11
10A
(9)
(31)
F12 20RD LG
S101
8W-70-3
C103
(1)
C119
K52 20PK BK
C110
A142 18DG OR
TORQUE CONVERTER CLUTCH SOLENOID
C155
C155
(B)
(A)
F12 18RD LG
K52 18PK BK
T23 18OR LG
F12 18RD LG
S131
8W-70-15
C151
C102
POWERTRAIN CONTROL MODULE
B11 TORQUE CONVERTER CLUTCH SOLENOID CONTROL
C20 DUTY CYCLE EVAP/PURGE SOLENOID CONTROL
C3 AUTOMATIC SHUT DOWN RELAY CONTROL
C12 AUTOMATIC SHUT DOWN RELAY OUTPUT


AUTOMATIC SHUT DOWN RELAY (8W-30-11) (8W-11-8)
A142 14DG/OR
S101
8W-70-3
A142 16DG/OR
C103
A142 16DG BK
A142 18DG/BK
WITH 4.0L ENG
S128
8W-70-14
WITH 2.5L ENG
S126
8W-70-13
A142 18DG BK
A142 18DG BK
A142 18DG BK
A142 18DG BK
WITH 4.0L ENG
A142 18DG BK
A142 18DG BK
A142 18DG BK
A142 18DG BK
A142 18DG BK
A142 18DG BK
(1) C138
INJECTOR NO.1
(2) C138
(1) C139
INJECTOR NO.2
(2) C139
(1) C140
INJECTOR NO.3
(2) C140
(1) C141
INJECTOR NO.4
(2) C141
(1) C160
INJECTOR NO.5
(2) C160
(1) C161
INJECTOR NO.6
(2) C161
WITH 4.0L ENG
K11 18WT DB
K12 18TN
K13 18YL WT
K14 18LB BR
K15 18PK BK
K16 18LG BK
C151
B4 INJECTOR NO.1 DRIVER
B15 INJECTOR NO.2 DRIVER
B5 INJECTOR NO.3 DRIVER
B16 INJECTOR NO.4 DRIVER
B6 INJECTOR NO.5 DRIVER
B12 INJECTOR NO.6 DRIVER
POWERTRAIN CONTROL MODULE

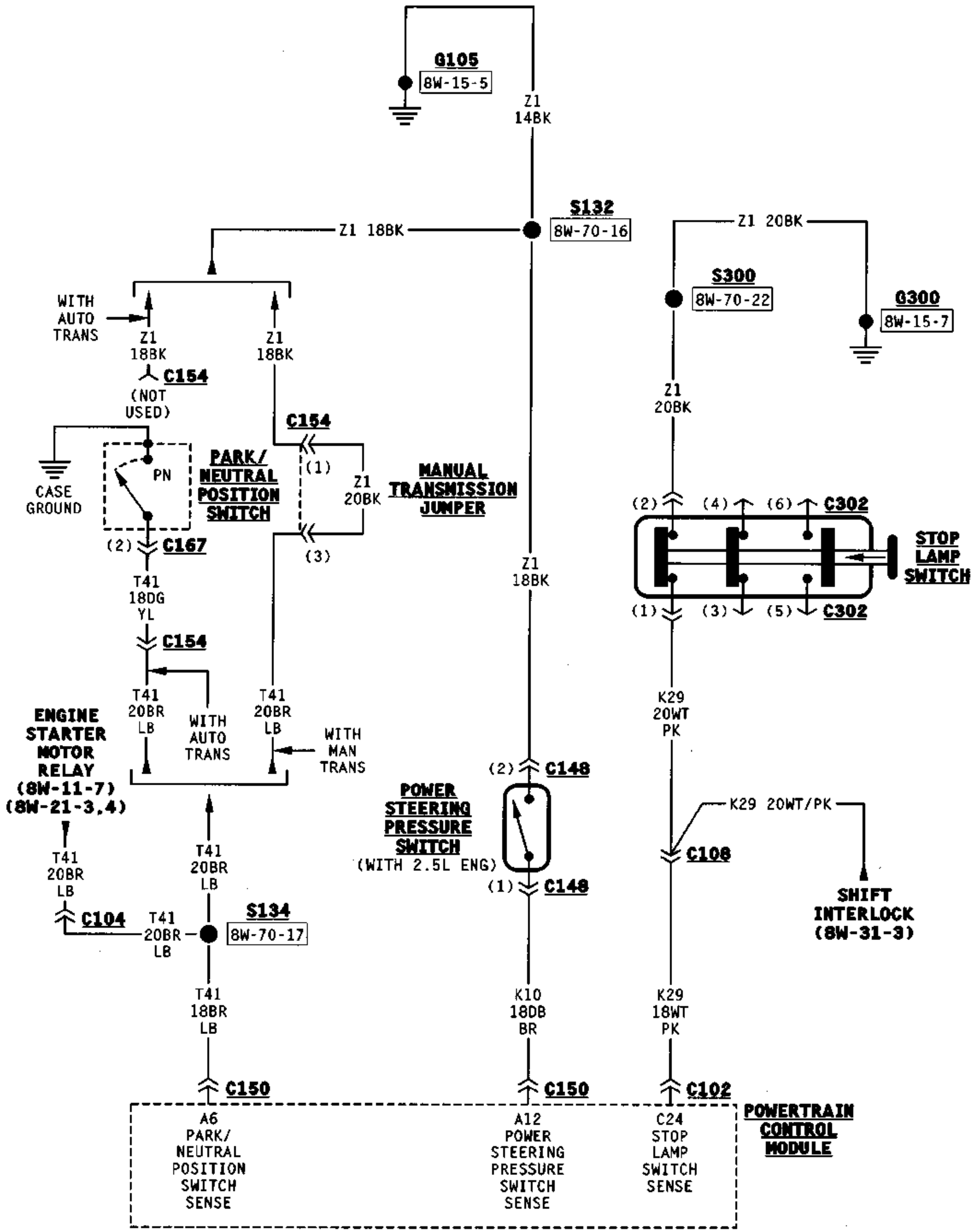

AUTOMATIC SHUT DOWN RELAY (8W-30-11) (8W-11-8)
A142 14DG/OR
S101
8W-70-3
A142 16DG BK
C103
A142 16DG BK
S128
8W-70-14
A142 18DG/BK
S132
8W-70-16
WITH 2.5L ENG
A142 18DG BK
S126
8W-70-13
A142 18DG BK
A142 18DG BK
WITH 4.0L ENG
WITH 2.5L ENG
WITH 4.0L ENG
K167 20BR YL
K167 20BR YL
S127
8W-70-14
K167 20BR YL
Z1 14BK
G105
8W-15-5
A142 18DG BK
Z1 18BK
K167 20BR YL
Z1 18BK
A142 18DG BK
(4) (1) (2) (3) C146
K167 20BR YL
(4) (3) (2) (1) C156
K167 20BR YL
K41 18BK DG
UPSTREAM HEATED OXYGEN SENSOR
S133
8W-70-16
K141 18TN WT
DOWNSTREAM HEATED OXYGEN SENSOR
K167 18BR YL
C150
C150
POWERTRAIN CONTROL MODULE
A24 UPSTREAM HEATED OXYGEN SENSOR SIGNAL
A4 SENSOR GROUND
A25 DOWNSTREAM HEATED OXYGEN SENSOR SIGNAL

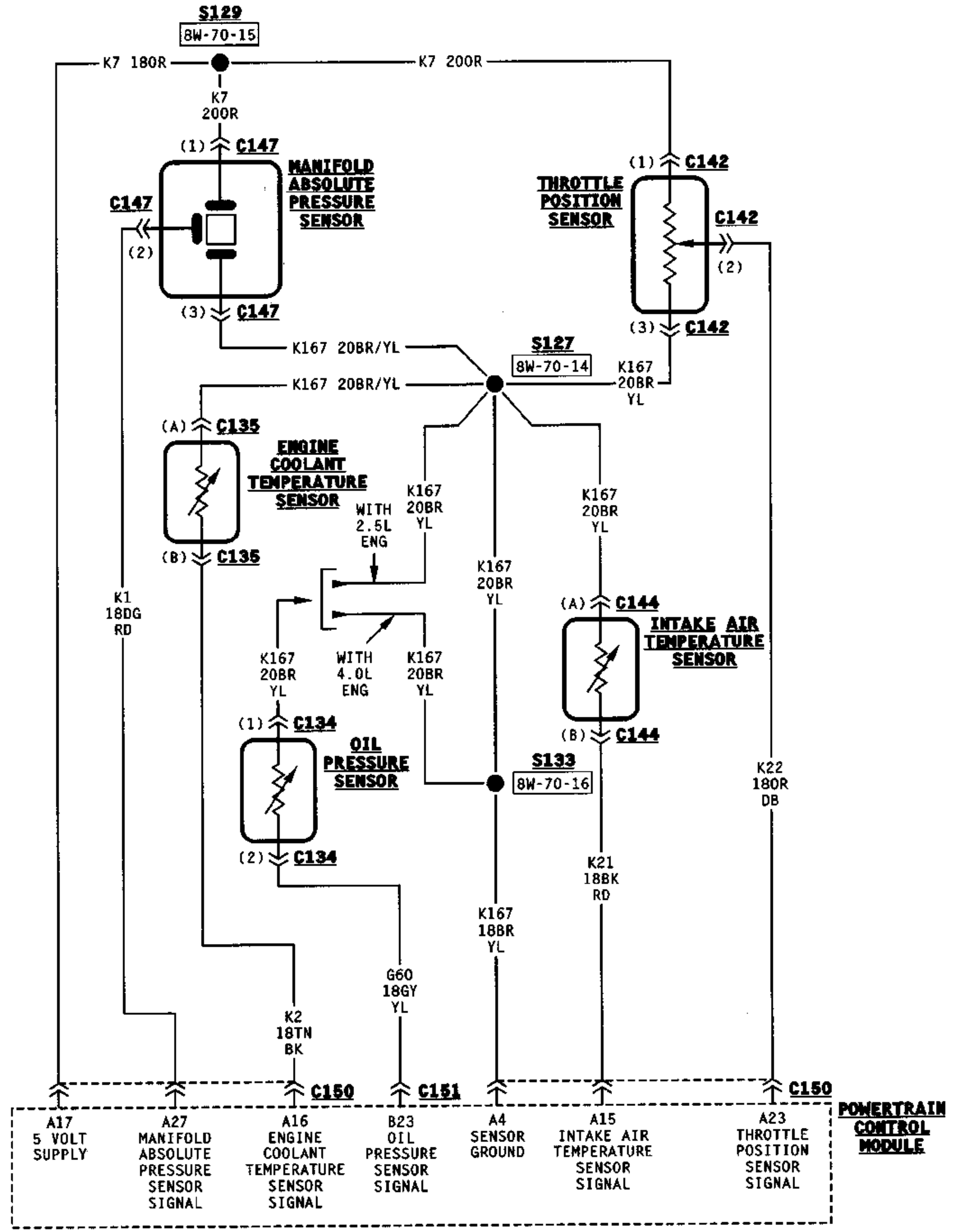
J968W-5

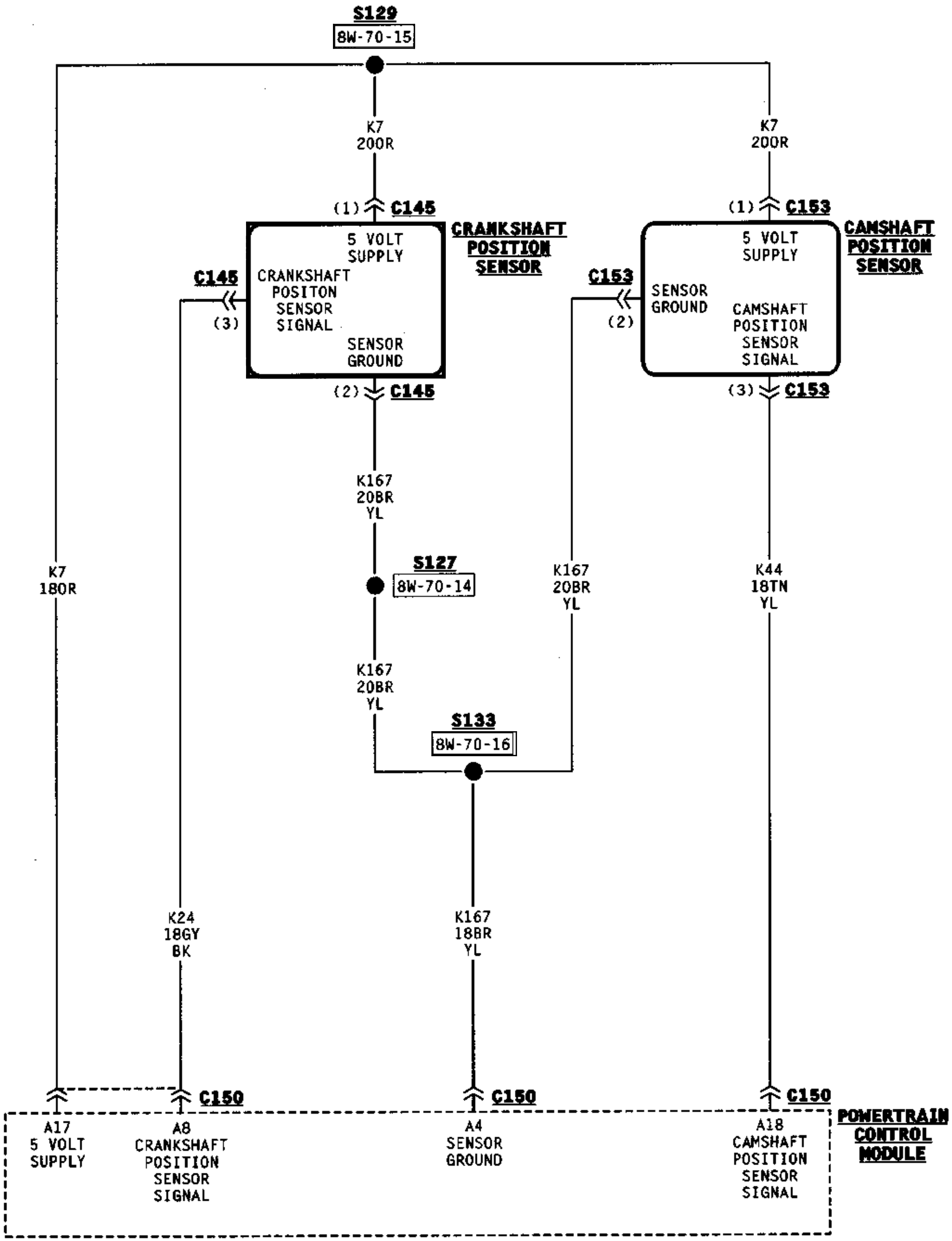

AUTOMATIC SHUT DOWN RELAY (8W-30-11) (8W-11-8)
A142 14DG/OR
S101
8W-70-3
A142 16DG/BK
C103
A142 16DG/BK
S128
8W-70-14
A142 18DG BK
S126
8W-70-13
A142 16DG BK
WITH 4.0L ENG
A142 16DG BK
WITH 2.5L ENG
A142 16DG BK
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL NO.4 DRIVER
IDLE AIR CONTROL NO.3 DRIVER
IDLE AIR CONTROL NO.2 DRIVER
IDLE AIR CONTROL NO.1 DRIVER
(A) (B) (C) (D) C143
(2) C152
IGNITION COIL
(1) C152
GENERATOR (8W-20-3)
K59 18VT BK
K40 18BR WT
K60 18YL BK
K39 18GY RD
K20 18DG
K72 18DG OR
C103
K72 18DG OR
K19 18GY
C150
C151
C102
C150
POWERTRAIN CONTROL MODULE
A20 IDLE AIR CONTROL NO.4 DRIVER
A11 IDLE AIR CONTROL NO.3 DRIVER
A10 IDLE AIR CONTROL NO.2 DRIVER
A19 IDLE AIR CONTROL NO.1 DRIVER
B10 GENERATOR FIELD DRIVER (-)
C25 GENERATOR FIELD SOURCE (+)
A7 IGNITION COIL DRIVER



BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(A12) C100
FUSE 16 20A
(A11) C100
(A9) (A7) (A10) C100
FUEL PUMP RELAY
(A6) (A8) C100
A61 18DG/BK
F12 20RD LG
SPLICE S102 (8W-30-4) (8W-70-4)
A141 18DG WT
K31 18BR
C103
A141 18DG/WT
S133
8W-70-16
K167 20BR/YL
K167 20BR YL
C159
1
4
M
6
3
FUEL PUMP MODULE
C159
K167 20BR YL
(2) C157
VEHICLE SPEED SENSOR
C157
(3)
(1) C157
K167 18BR YL
C103
K167 18BR YL
(2) C101
BATTERY TEMPERATURE SENSOR
(1) C101
Z1 18BK
S132
8W-70-16
Z1 14BK
G105
8W-15-5
K226 20DB LG
C103
K226 18DB LG
G7 20WT OR
S135
8W-70-17
G7 18WT OR
K6 18VT OR
K118 18PK YL
C102
C151
C150
C102
C26 FUEL LEVEL SENSOR SIGNAL
B27 VEHICLE SPEED SENSOR SIGNAL
B31 5 VOLT SUPPLY
A4 SENSOR GROUND
C15 BATTERY TEMPERATURE SENSOR SIGNAL
C19 FUEL PUMP RELAY CONTROL
POWERTRAIN CONTROL MODULE

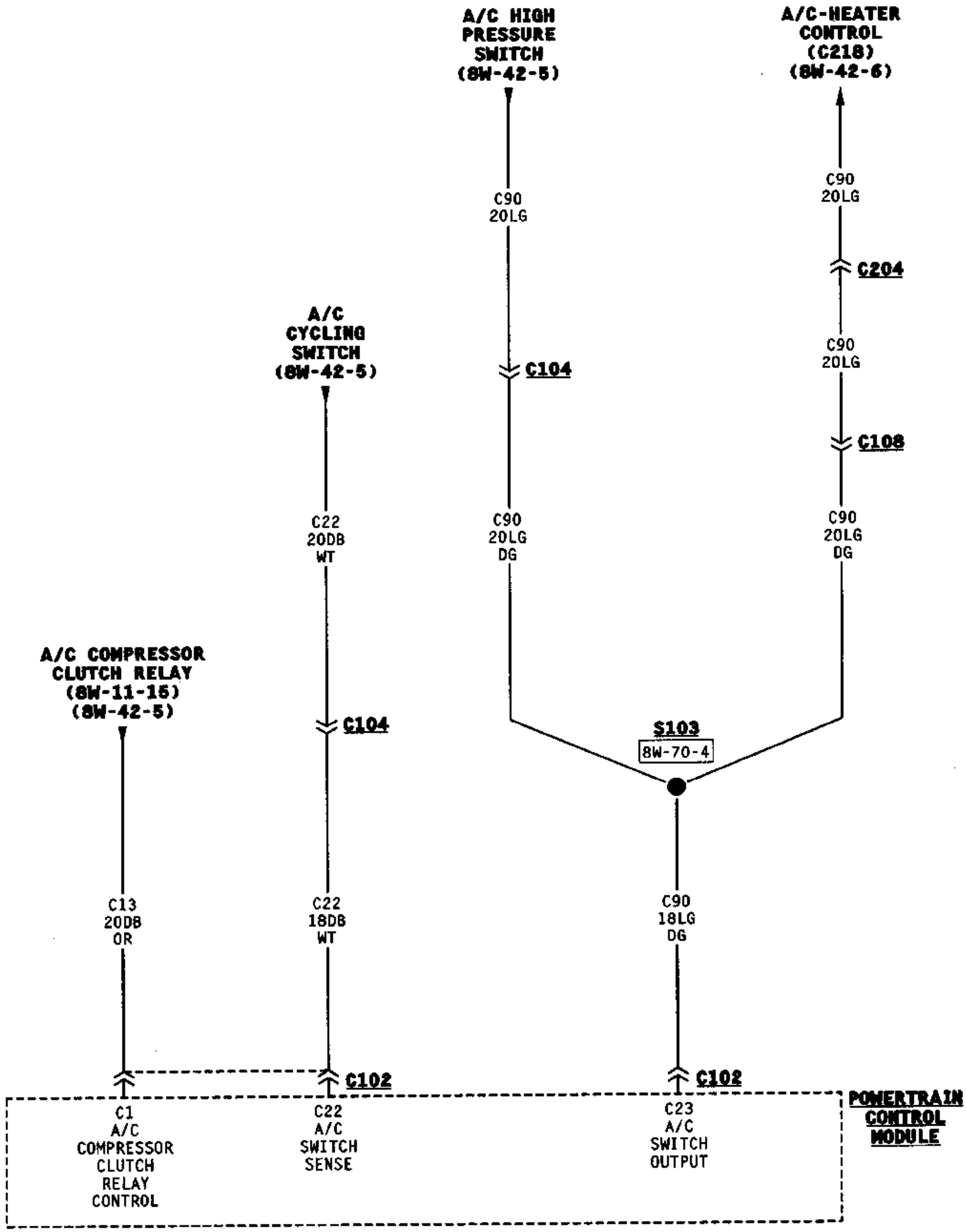

G105
8W-15-5
Z1
14BK
S132
8W-70-16
Z1 18BK
WITH
AUTO
TRANS
Z1
18BK
Z1
18BK
C154
(NOT
USED)
CASE
GROUND
PN
PARK/
NEUTRAL
POSITION
SWITCH
C154
(1)
Z1
20BK
MANUAL
TRANSMISSION
JUMPER
(3)
(2)
C167
T41
18DG
YL
C154
T41
20BR
LB
WITH
AUTO
TRANS
T41
20BR
LB
WITH
MAN
TRANS
ENGINE
STARTER
MOTOR
RELAY
(8W-11-7)
(8W-21-3,4)
T41
20BR
LB
C104
T41
20BR
LB
T41
20BR
LB
S134
8W-70-17
T41
18BR
LB
C150
Z1
18BK
(2)
C148
POWER
STEERING
PRESSURE
SWITCH
(WITH 2.5L ENG)
(1)
C148
K10
18DB
BR
C150
Z1 20BK
S300
8W-70-22
G300
8W-15-7
Z1
20BK
(2)
(4)
(6)
C302
STOP
LAMP
SWITCH
(1)
(3)
(5)
C302
K29
20WT
PK
K29 20WT/PK
C108
SHIFT
INTERLOCK
(8W-31-3)
K29
18WT
PK
C102
A6
PARK/
NEUTRAL
POSITION
SWITCH
SENSE
A12
POWER
STEERING
PRESSURE
SWITCH
SENSE
C24
STOP
LAMP
SWITCH
SENSE
POWERTRAIN
CONTROL
MODULE


S129
8W-70-15
K7 18OR
K7 20OR
K7
20OR
(1) C147
MANIFOLD ABSOLUTE PRESSURE SENSOR
C147
(2)
(3) C147
(1) C142
THROTTLE POSITION SENSOR
C142
(2)
(3) C142
K167 20BR/YL
K167 20BR/YL
S127
8W-70-14
K167
20BR
YL
(A) C135
ENGINE COOLANT TEMPERATURE SENSOR
(B) C135
WITH 2.5L ENG
K167
20BR
YL
K167
20BR
YL
K167
20BR
YL
K1
18DG
RD
(A) C144
INTAKE AIR TEMPERATURE SENSOR
(B) C144
K167
20BR
YL
WITH 4.0L ENG
K167
20BR
YL
(1) C134
OIL PRESSURE SENSOR
(2) C134
S133
8W-70-16
K22
18OR
DB
K21
18BK
RD
K167
18BR
YL
G60
18GY
YL
K2
18TN
BK
C150
C151
C150
A17
5 VOLT SUPPLY
A27
MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
A16
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
B23
OIL PRESSURE SENSOR SIGNAL
A4
SENSOR GROUND
A15
INTAKE AIR TEMPERATURE SENSOR SIGNAL
A23
THROTTLE POSITION SENSOR SIGNAL
POWERTRAIN CONTROL MODULE



806634eb

J968W-5


A/C HIGH PRESSURE SWITCH (8W-42-5)
A/C-HEATER CONTROL (C218) (8W-42-6)
C90 20LG
C90 20LG
C204
C90 20LG
A/C CYCLING SWITCH (8W-42-5)
C104
C108
C22 20DB WT
C90 20LG DG
C90 20LG DG
A/C COMPRESSOR CLUTCH RELAY (8W-11-15) (8W-42-5)
C104
S103
8W-70-4
C13 20DB OR
C22 18DB WT
C90 18LG DG
C102
C102
POWERTRAIN CONTROL MODULE
C1 A/C COMPRESSOR CLUTCH RELAY CONTROL
C22 A/C SWITCH SENSE
C23 A/C SWITCH OUTPUT

8W-31 TRANSMISSION CONTROL SYSTEM

DESCRIPTION AND OPERATION

TORQUE CONVERTER CLUTCH (TCC) SOLENOID

The TCC solenoid is only used on vehicles with three-speed automatic transmissions. When the ignition switch is in the START or RUN position, it connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A21. Circuit A21 powers circuit F12 through fuse 11 in the fuse block. Circuit F12 powers the TCC solenoid. The Powertrain Control Module (PCM) provides ground for the solenoid on circuit T23. Circuit T23 connects to cavity B11 of the PCM.

FOUR-WHEEL DRIVE (4WD) SWITCH

Circuit G5 from fuse 10 in the fuse block powers the 4WD indicator lamp. Circuit G107 connects the indicator lamp to the 4WD switch. When the 4WD switch closes, it connects circuit G107 to circuit G106. Circuit G106 connects to circuit Z1. Circuit Z1 provides ground for the 4WD indicator lamp.

SHIFT INTERLOCK

The shift interlock prevents the operator from shifting the vehicle out of PARK unless the brake pedal is pressed. When the ignition switch is in the START or RUN position, circuit A21 feeds circuit G5 through fuse 10 in the fuse block. Circuit G5 powers the shift interlock.

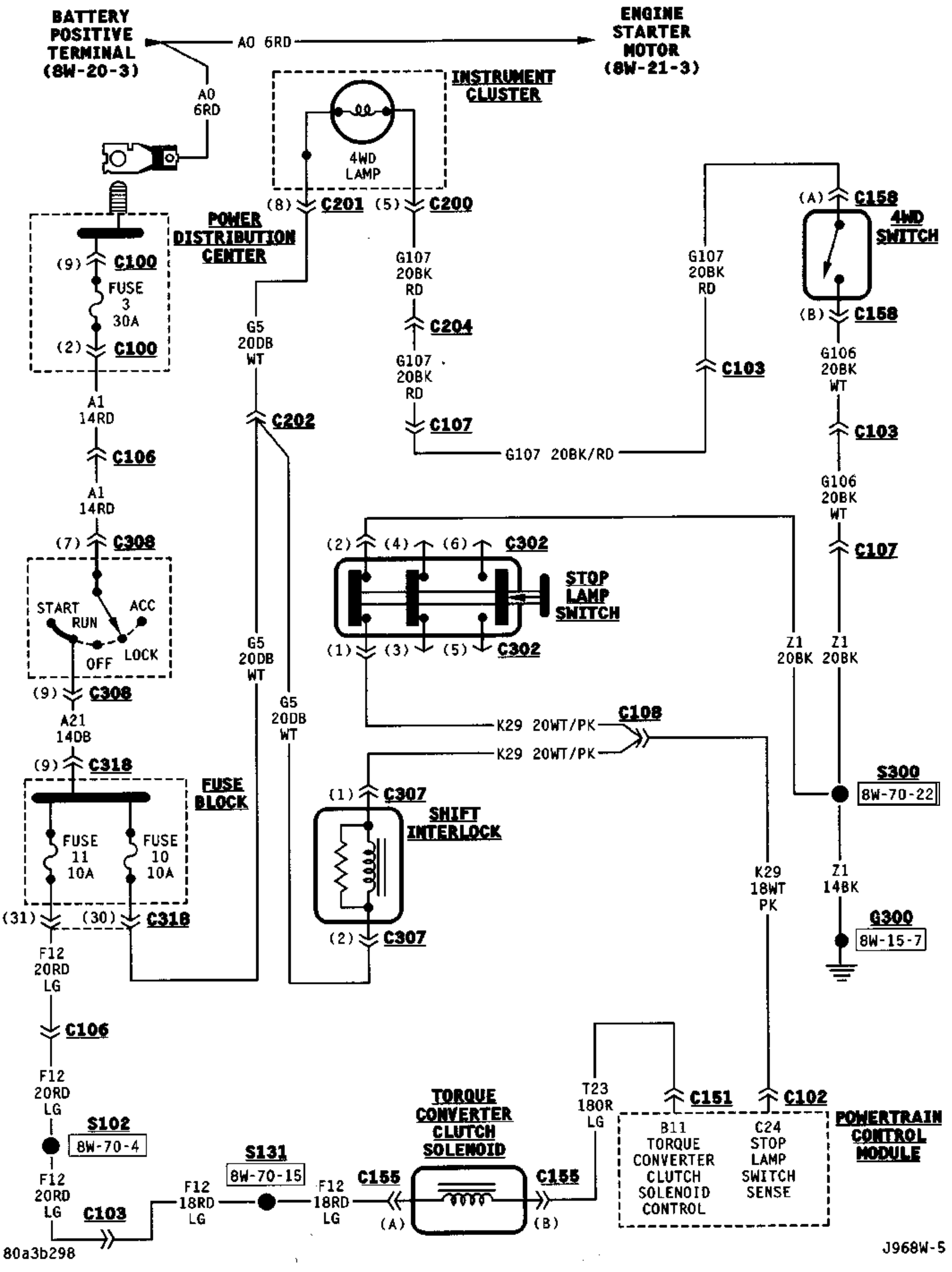
When the brake pedal is not depressed, the stop lamp switch provides ground for interlock by connecting circuit K29 to ground. When grounded, the interlock prevents shifting the transmission out of PARK. When the brake pedal is pressed, the stop lamp switch disconnects circuit K29 from ground.

SCHEMATICS AND DIAGRAMS

WIRING DIAGRAM INDEX

The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

DIAGRAM INDEX


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3)
INSTRUMENT CLUSTER
4WD LAMP
POWER DISTRIBUTION CENTER
FUSE 3 30A
C100
C201
C200
G107 20BK RD
C204
C107
G107 20BK/RD
C103
C158
4WD SWITCH
G106 20BK WT
A1 14RD
C106
C308
START RUN ACC OFF LOCK
G5 20DB WT
C202
C302
STOP LAMP SWITCH
Z1 20BK
A21 14DB
C318
FUSE BLOCK
FUSE 11 10A
FUSE 10 10A
K29 20WT/PK
C108
C307
SHIFT INTERLOCK
S300
8W-70-22
K29 18WT PK
Z1 14BK
G300
8W-15-7
F12 20RD LG
S102
8W-70-4
F12 18RD LG
S131
8W-70-15
C155
TORQUE CONVERTER CLUTCH SOLENOID
T23 18OR LG
C151
C102
B11 TORQUE CONVERTER CLUTCH SOLENOID CONTROL
C24 STOP LAMP SWITCH SENSE
POWERTRAIN CONTROL MODULE
80a3b298
J968W-5

8W-35 ALL-WHEEL ANTI-LOCK BRAKES

INDEX

DESCRIPTION AND OPERATION

INTRODUCTION

Several fuses supply power for the Anti-Lock Brake System (ABS); fuses 13 and 14 in the Power Distribution Center (PDC) and fuse 7, in the fuse block. Fuses 13 and 14 in the PDC are connected directly to battery voltage and are HOT all times. Fuse 7 in the fuse block is HOT when the ignition switch is the RUN position.

In the RUN position, the ignition switch connects circuit A2 from fuse 2 in the PDC with circuit A22. Circuit A22 feeds circuit F20 through fuse 7 in the fuse block. Circuit F20 connects to the coil side of the ABS main relay and to the Controller, Anti-Lock Brakes (CAB). Circuit Z22 provides ground for the CAB.

Refer to group 5, Brakes for operational descriptions of ABS system components.

WHEEL SPEED SENSORS

The all wheel anti-lock system uses four wheel speed sensors; one for each wheel. Each sensor converts wheel speed into an electrical signal that it transmits to the Controller, Anti-Lock Brakes (CAB). A pair of twisted wires connect to each sensor to provide signals to the CAB.

Circuits B6 and B7 provide signals to the CAB from the right front wheel speed sensor. Circuit B6 provides the LOW signal. Circuit B7 provides the HIGH signal.

Circuits B8 and B9 provide signals to the CAB from the left front wheel speed sensor. Circuit B8 provides the LOW signal. Circuit B9 provides the HIGH signal.

Circuits B1 and B2 provide signals to the CAB from right rear wheel speed sensor. Circuit B1 provides the LOW signal. Circuit B2 provides the HIGH signal.

Circuits B4 and B3 provide signals to the CAB from the left rear wheel speed sensor. Circuit B3 provides the LOW signal. Circuit B4 provides the HIGH signal.

G-SWITCH

During four-wheel drive operation, the G-switch provides deceleration data to the Controller, Anti-Lock Brakes (CAB). Refer to Group 5, Brakes for additional information.

Circuits B41, B42, and B43 connect the G-switch to the CAB. Circuits B41 and B43 provide switch states while circuit B42 provides ground.

ABS MAIN RELAY

The ABS main relay is located in the Power Distribution Center (PDC). When the Controller, Anti-Lock Brakes (CAB) grounds the ABS main relay coil on circuit B58, the relay switches to connect circuit A20 from PDC fuse 13 to circuit B47. Circuit B58 connects to cavity 11 of the CAB. Circuit F20 from fuse 7 in the fuse block splices to feed the coil side of the ABS main relay.

Circuit B47 splices to power to the coil side of the ABS pump motor relay. Other branches of circuit B47 connect to the CAB and to the hydraulic control unit.

ABS PUMP MOTOR RELAY

The ABS pump motor relay in the power distribution center (PDC) supplies voltage to the ABS pump motor. When the ABS main relay energizes, circuit B47 supplies battery voltage to the coil side of the ABS pump motor relay. The Controller, Anti-Lock Brakes (CAB) provides ground for the pump motor relay coil on circuit B116.

When the ABS pump motor energizes, it connects circuit A10 from PDC fuse 14 to circuit B120. Circuit B120 supplies battery voltage to the pump motor and also connects to the CAB. Circuit Z1 provides ground for the pump motor.

HYDRAULIC CONTROL UNIT

When the ABS main relay energizes, two branches of circuit B47 splice to supply voltage to the inlet

DESCRIPTION AND OPERATION (Continued)

valves and outlet valves in the hydraulic control unit. The hydraulic control unit contains three separate inlet valves and three separate outlet valves. The Controller, Anti-Lock Brakes (CAB) activates the inlet and outlet valves by providing separate ground paths for each.

The CAB provides a ground path for the rear inlet valve on circuit B251. For the right front inlet valve, the CAB provides a ground path on circuit B249. On circuit B245, the CAB provides ground for the left front inlet valve.

The CAB provides a ground path for the rear outlet valve on circuit B254. For the right front outlet valve, the CAB provides a ground path on circuit B248. On circuit B243, the CAB provides ground for the left front outlet valve.

ABS WARNING LAMP

Circuit G5 from fuse 10 in the fuse block provides power for the ABS warning lamp in the instrument cluster. Ground for the ABS warning lamp is provided by either the Controller, Anti-Lock Brakes (CAB) or by the ABS main relay when the relay is not energized. The CAB illuminates the lamp by providing ground on circuit G19.

Circuit G19 splices to connect to circuit B47 through a diode. When the ABS main relay is not energized, it connects circuit B47 to ground on circuit Z1. The ground path for the warning lamp is through the diode to circuit B47, through the ABS main relay to ground on circuit Z1.

The diode between circuit G19 and B47 prevents voltage from flowing to the CAB when the ABS main relay switches to supply power on circuit B47.

HELPFUL INFORMATION

When the ignition switch is in the START or RUN position, it connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A21. Circuit A21 powers circuit G5 through fuse 10 in the fuse block.

STOP LAMP SWITCH INPUT

Circuit L50 provides the stop lamp switch input to the Controller, Antilock Brakes (CAB).

DATA LINK CONNECTOR

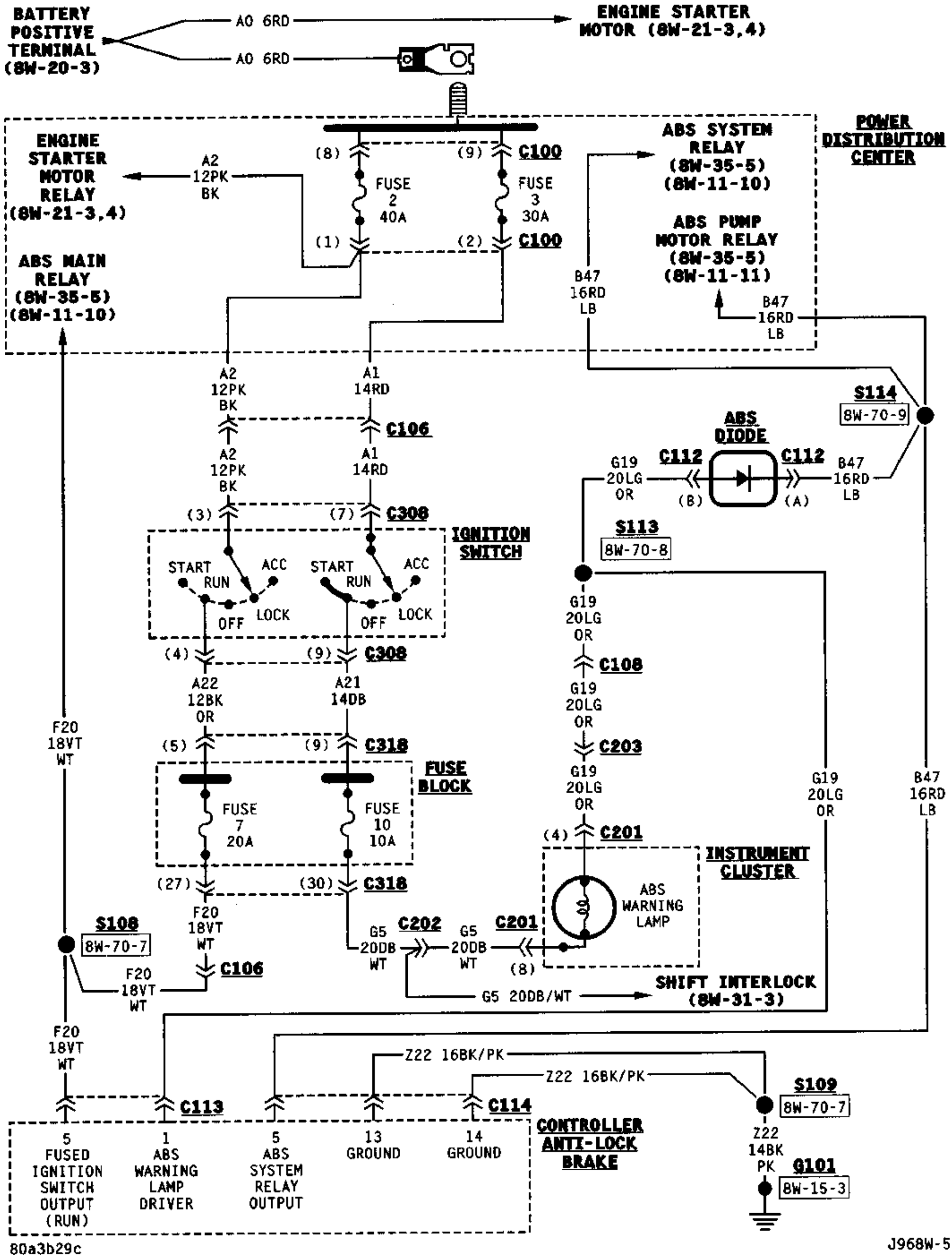
Circuit D21 from of the Controller, Anti-Lock Brakes (CAB) transmits data to the DRB scan tool through the data link connector. Through the data link connector, two branches of circuit Z12 provide ground for the DRB scan tool.

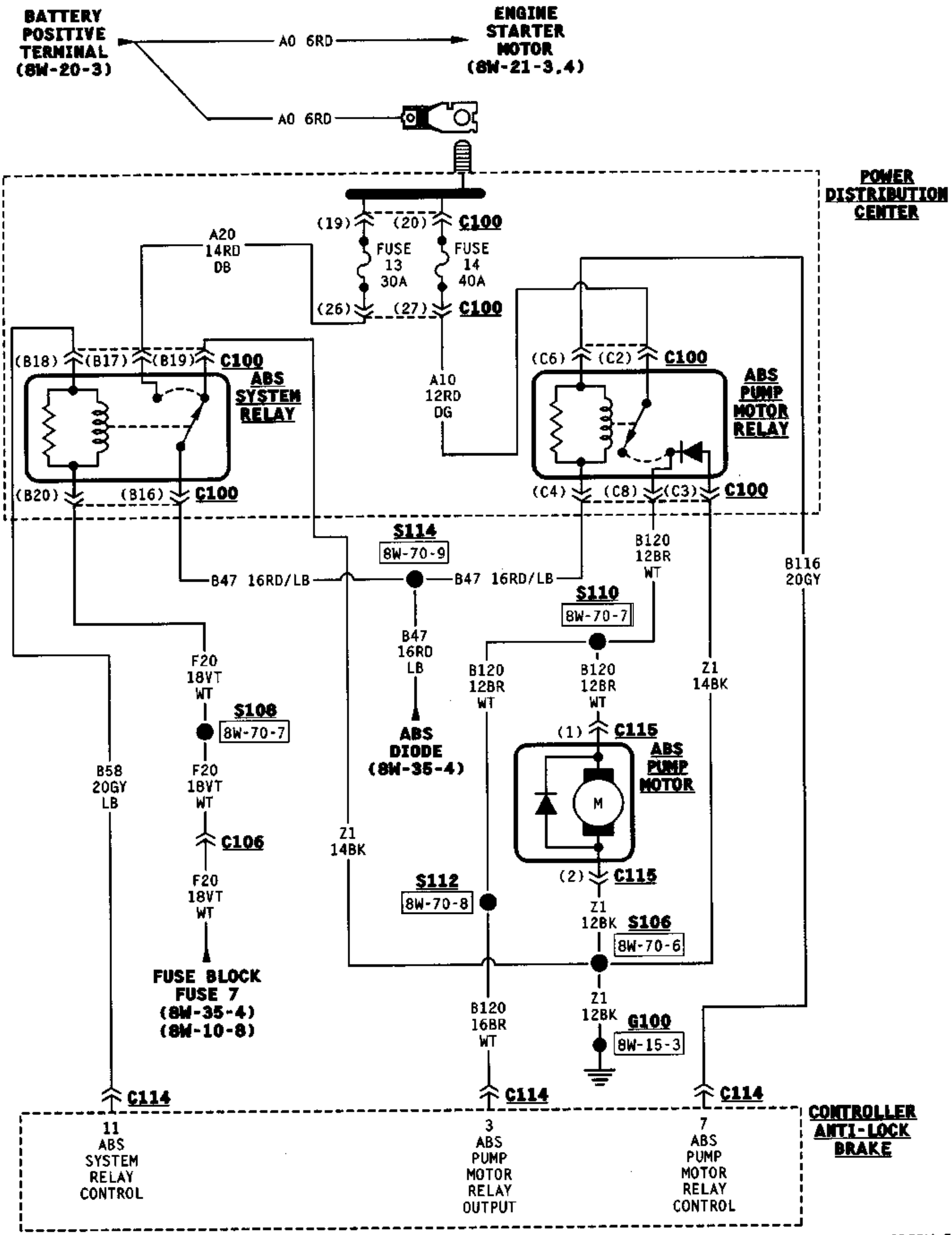
SCHEMATICS AND DIAGRAMS

WIRING DIAGRAM INDEX

The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

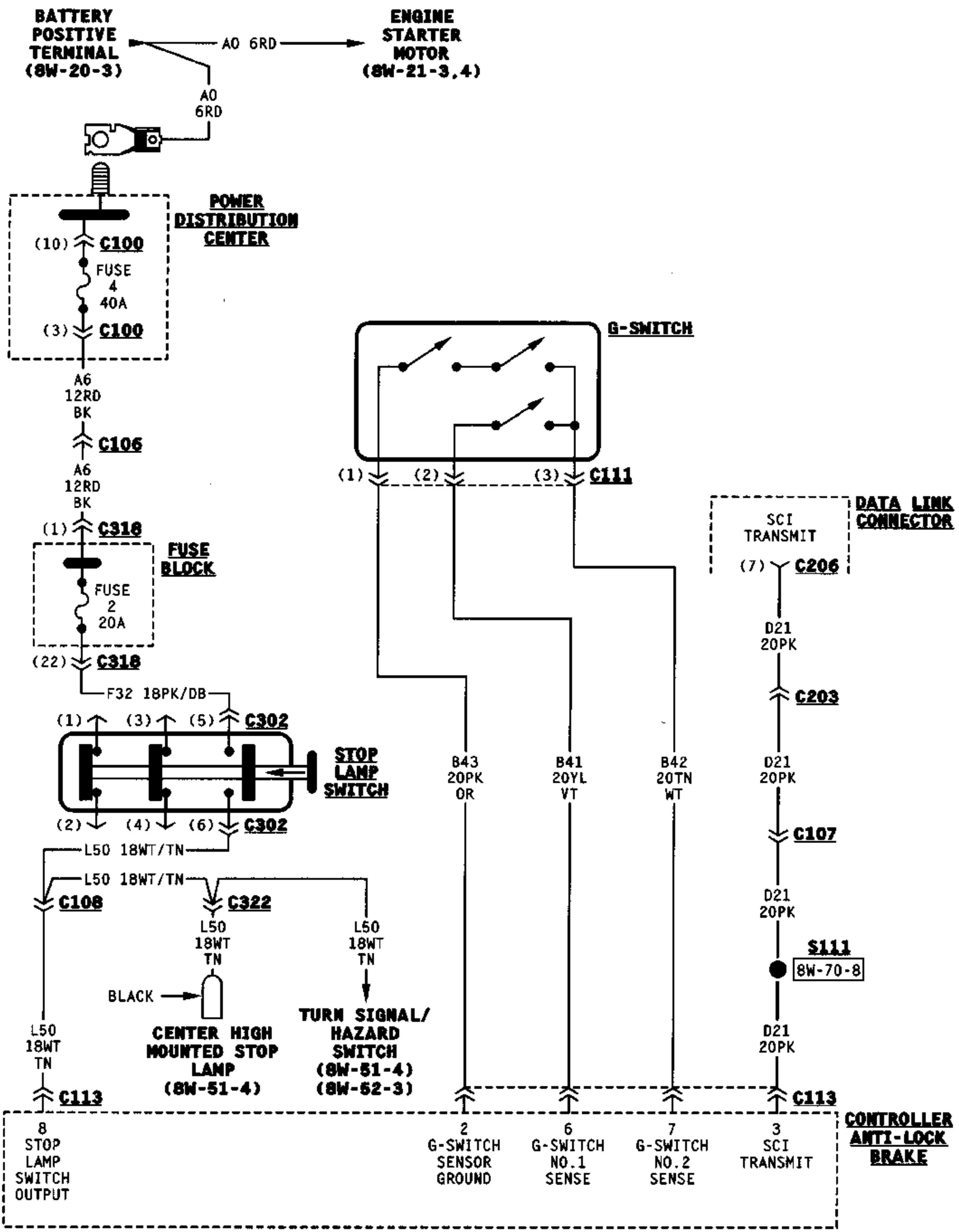
DIAGRAM INDEX


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
ENGINE STARTER MOTOR RELAY (8W-21-3,4)
A2 12PK BK
ABS MAIN RELAY (8W-35-5) (8W-11-10)
(8)
(9)
C100
FUSE 2 40A
FUSE 3 30A
(1)
(2)
C100
ABS SYSTEM RELAY (8W-35-5) (8W-11-10)
ABS PUMP MOTOR RELAY (8W-35-5) (8W-11-11)
POWER DISTRIBUTION CENTER
B47 16RD LB
B47 16RD LB
A2 12PK BK
A1 14RD
C106
A2 12PK BK
A1 14RD
S114
8W-70-9
ABS DIODE
G19 20LG OR
C112
C112
B47 16RD LB
(B)
(A)
(3)
(7)
C308
IGNITION SWITCH
START
RUN
ACC
START
RUN
ACC
OFF
LOCK
OFF
LOCK
S113
8W-70-8
G19 20LG OR
C108
G19 20LG OR
C203
G19 20LG OR
(4)
(9)
C308
A22 12BK OR
A21 14DB
F20 18VT WT
(5)
(9)
C318
FUSE BLOCK
FUSE 7 20A
FUSE 10 10A
G19 20LG OR
B47 16RD LB
(4)
C201
INSTRUMENT CLUSTER
ABS WARNING LAMP
(27)
(30)
C318
F20 18VT WT
S108
8W-70-7
G5 20DB WT
C202
G5 20DB WT
C201
(8)
C106
F20 18VT WT
G5 20DB/WT
SHIFT INTERLOCK (8W-31-3)
F20 18VT WT
Z22 16BK/PK
Z22 16BK/PK
S109
8W-70-7
C113
C114
Z22 14BK PK
G101
8W-15-3
5 FUSED IGNITION SWITCH OUTPUT (RUN)
1 ABS WARNING LAMP DRIVER
5 ABS SYSTEM RELAY OUTPUT
13 GROUND
14 GROUND
CONTROLLER ANTI-LOCK BRAKE
80a3b29c
J968W-5

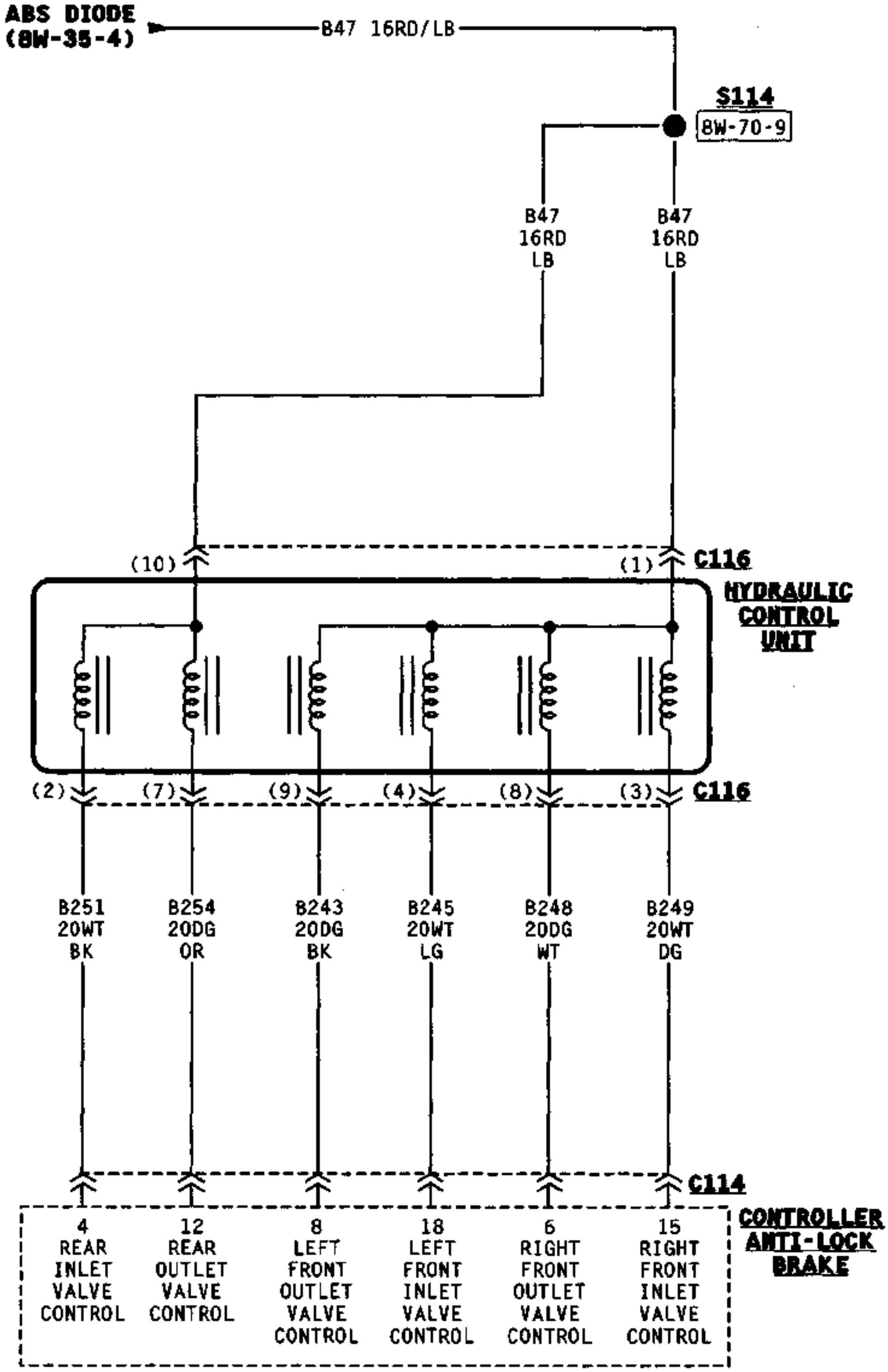


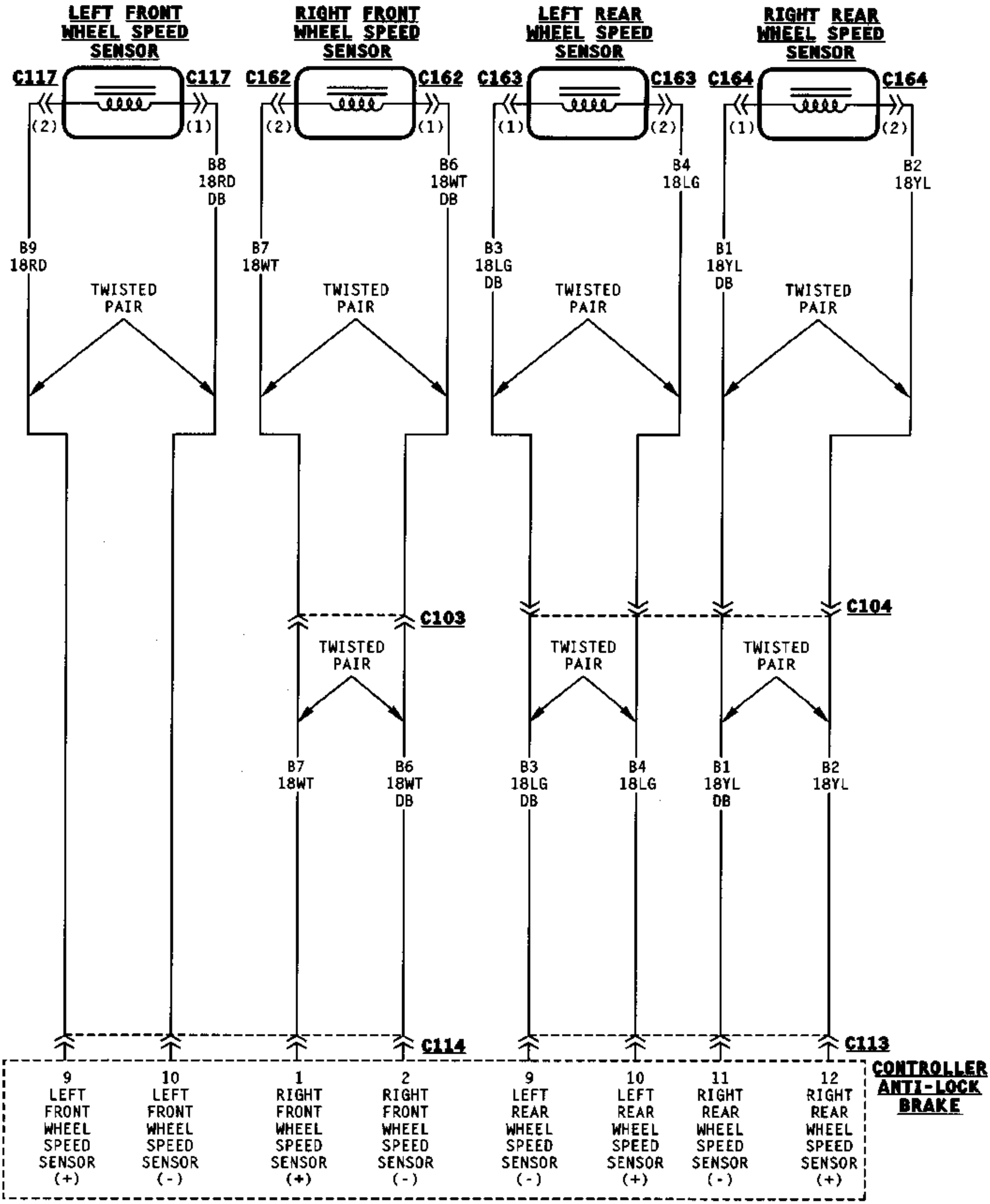
80a3b3fe

J968W-5



BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(10) C100
FUSE 4 40A
(3) C100
A6 12RD BK
C106
A6 12RD BK
(1) C318
FUSE BLOCK
FUSE 2 20A
(22) C318
F32 18PK/DB
(1) (3) (5) C302
STOP LAMP SWITCH
(2) (4) (6) C302
L50 18WT/TN
L50 18WT/TN
C108
C322
L50 18WT TN
L50 18WT TN
BLACK
CENTER HIGH MOUNTED STOP LAMP (8W-51-4)
TURN SIGNAL/ HAZARD SWITCH (8W-51-4) (8W-52-3)
L50 18WT TN
C113
G-SWITCH
(1) (2) (3) C111
B43 20PK OR
B41 20YL VT
B42 20TN WT
DATA LINK CONNECTOR
SCI TRANSMIT
(7) C206
D21 20PK
C203
D21 20PK
C107
D21 20PK
S111
8W-70-8
D21 20PK
C113
CONTROLLER ANTI-LOCK BRAKE
8 STOP LAMP SWITCH OUTPUT
2 G-SWITCH SENSOR GROUND
6 G-SWITCH NO.1 SENSE
7 G-SWITCH NO.2 SENSE
3 SCI TRANSMIT


ABS DIODE
(8W-35-4)
B47 16RD/LB
S114
8W-70-9
B47
16RD
LB
B47
16RD
LB
(10)
(1)
C116
HYDRAULIC
CONTROL
UNIT
(2)
(7)
(9)
(4)
(8)
(3)
C116
B251
20WT
BK
B254
20DG
OR
B243
20DG
BK
B245
20WT
LG
B248
20DG
WT
B249
20WT
DG
C114
4
REAR
INLET
VALVE
CONTROL
12
REAR
OUTLET
VALVE
CONTROL
8
LEFT
FRONT
OUTLET
VALVE
CONTROL
18
LEFT
FRONT
INLET
VALVE
CONTROL
6
RIGHT
FRONT
OUTLET
VALVE
CONTROL
15
RIGHT
FRONT
INLET
VALVE
CONTROL
CONTROLLER
ANTI-LOCK
BRAKE


LEFT FRONT WHEEL SPEED SENSOR
C117
C117
(2)
(1)
B8 18RD DB
B9 18RD
RIGHT FRONT WHEEL SPEED SENSOR
C162
C162
(2)
(1)
B6 18WT DB
B7 18WT
LEFT REAR WHEEL SPEED SENSOR
C163
C163
(1)
(2)
B4 18LG
B3 18LG DB
RIGHT REAR WHEEL SPEED SENSOR
C164
C164
(1)
(2)
B2 18YL
B1 18YL DB
TWISTED PAIR
C103
C104
B7 18WT
B6 18WT DB
B3 18LG DB
B4 18LG
B1 18YL DB
B2 18YL
C114
C113
CONTROLLER ANTI-LOCK BRAKE
9 LEFT FRONT WHEEL SPEED SENSOR (+)
10 LEFT FRONT WHEEL SPEED SENSOR (-)
1 RIGHT FRONT WHEEL SPEED SENSOR (+)
2 RIGHT FRONT WHEEL SPEED SENSOR (-)
9 LEFT REAR WHEEL SPEED SENSOR (-)
10 LEFT REAR WHEEL SPEED SENSOR (+)
11 RIGHT REAR WHEEL SPEED SENSOR (-)
12 RIGHT REAR WHEEL SPEED SENSOR (+)

8W-40 INSTRUMENT CLUSTER

INDEX

DESCRIPTION AND OPERATION

INTRODUCTION

The electronic instrument cluster contains a microprocessor which controls cluster functions based on data it receives from the CCD bus. Circuit M1 from fuse 17 in the Power Distribution Center (PDC) supplies power to the cluster microprocessor. When the ignition switch is in the START or RUN position, it connects circuit A1 from fuse 3 in the PDC to circuit A21. Circuit A21 powers circuit G5 through fuse 10 in the fuse block. Circuit G5 powers the cluster microprocessor plus the warning lamps in the cluster. The cluster microprocessor switches the warning lamps on and off by controlling the ground path for each lamp.

WARNING LAMPS—EXCEPT ABS and BRAKE

Circuit G5 feeds all the warning lamps in the instrument cluster. The microprocessor turns on and off all the warning lamps except the seat belt warning lamp, ABS warning lamp, and brake warning lamp based on inputs broadcast on the CCD bus. The microprocessor controls the ground path for these lamps. Circuits Z2 provide ground for the microprocessor.

Circuit G10 from the instrument cluster microprocessor connects to the seat belt switch. The switch is closed when the seat belt is removed from the seat belt clasp. When the seat belt is inserted into the clasp, it opens the switch. When closed, the seat belt switch connects circuit G10 to ground on circuit Z1. If the ignition switch is in the START or RUN position, the instrument cluster microprocessor grounds the seat belt warning lamp when if it senses a closed seat belt switch.

ABS WARNING LAMP

Circuit G5 from fuse 10 in the fuse block provides power for the ABS warning lamp in the instrument cluster. Ground for the ABS warning lamp is provided by either the Controller, Anti-Lock Brakes (CAB) or by the ABS main relay when the relay is not energized. The CAB illuminates the lamp by providing ground on circuit G19.

Circuit G19 splices to connect to circuit B47 through a diode. When the ABS main relay is not energized, it connects circuit B47 to ground on circuit Z1. The ground path for the warning lamp is through the diode to circuit B47, through the ABS main relay to ground on circuit Z1.

The diode between circuit G19 and B47 prevents voltage from flowing to the CAB when the ABS main relay switches to supply power on circuit B47.

HELPFUL INFORMATION

When the ignition switch is in the START or RUN position, it connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A21. Circuit A21 powers circuit G5 through fuse 10 in the fuse block.

BRAKE WARNING LAMP

Circuit G5 from fuse 10 in the fuse block supplies power to the brake warning lamp. Ground for the brake warning lamp is supplied through the case grounded park brake switch, ignition switch (in the START position) or brake warning switch. Circuit G99 from the lamp connects to the brake warning switch. Circuit G9 connects the brake warning switch to the park brake switch and ignition switch.

SPEEDOMETER

The instrument cluster microprocessor calculates speedometer needle position based on the vehicle speed signal broadcast on the CCD bus by the Powertrain Control Module (PCM). The PCM determines vehicle speed from the input provided by the vehicle speed sensor.

TACHOMETER

The Powertrain Control Module (PCM) broadcasts the engine RPM data on the CCD bus. From the RPM message on the CCD bus, the instrument cluster calculates tachometer needle position.

VOLTMETER

The Powertrain Control Module (PCM) broadcasts system voltage data on the CCD bus. The microproces-

DESCRIPTION AND OPERATION (Continued)

sor in the instrument cluster calculate voltmeter needle position based on the signal received from the CCD bus.

FUEL GAUGE

The Powertrain Control Module (PCM) transmits the fuel percentage data over the CCD bus. The microprocessor in the instrument cluster calculates position of the fuel gauge needle based on the signal from the PCM.

ENGINE COOLANT TEMPERATURE GAUGE

The Powertrain Control Module (PCM) broadcasts the engine coolant temperature data over the CCD bus. From the data message on the CCD bus, the instrument cluster microprocessor calculates coolant temperature gauge needle position.

OIL PRESSURE GAUGE

On circuit G60, the Powertrain Control Module (PCM) provides current to the oil pressure sensor. The sensor is a variable resistor. As engine oil pressure changes, the resistance in the sensor changes resulting in a change in current draw. The PCM provides ground for the sensor on circuit K167. Circuit K167 connects to cavity A4 of the PCM.

The instrument cluster microprocessor calculates engine oil pressure gauge needle position based on the oil pressure data message on the CCD bus. The Powertrain Control Module (PCM) broadcasts the data message over the CCD bus.

Circuit K167 splices to supply ground for the signals from the following:

- Battery temperature sensor
- Upstream and downstream heated oxygen sensors
- Camshaft position sensor
- Crankshaft position sensor
- Intake air temperature sensor
- Throttle position sensor
- Engine coolant temperature sensor
- Vehicle speed sensor

HIGH BEAM INDICATOR LAMP

When the operator selects high beam operation, the multi-function switch powers the headlamp high beams on circuit L3. Circuit L3 connects to circuit G34. Circuit G34 supplies power for the high-beam indicator lamp. Circuit Z2 provides ground for the high beam indicator lamp at the cluster.

TURN SIGNAL INDICATOR LAMPS

Circuits L60 and L61 from the turn signal/hazard flasher circuitry in the multi-function switch power the turn signal indicator lamps. Circuit L60 powers the right turn signal indicator lamp. Circuit L61 powers the left indicator lamp. Circuit Z2 provides ground for the lamps.

MANUAL TRANSMISSION UP-SHIFT LAMP

The Powertrain Control Module (PCM) broadcasts the transmission up-shift message on the CCD bus. The microprocessor in the instrument cluster monitors the CCD bus and switches the up-shift lamp on or off by supplying or removing ground from the lamp. Circuit G5 from fuse 10 in the fuse block powers the lamp.

FOUR-WHEEL DRIVE (4WD) SWITCH

Circuit G5 from fuse 10 in the fuse block powers the 4WD indicator lamp. Circuit G107 connects the indicator lamp to the 4WD switch. When the 4WD switch closes, it connects circuit G107 to circuit G106. Circuit G106 connects to circuit Z1. Circuit Z1 provides ground for the 4WD indicator lamp.

ILLUMINATION LAMPS

When the headlamp switch is in the PARK or ON position, circuit E1 from the dimmer switch circuitry feeds circuit E2 through fuse 12 in the fuse block. Circuit E2 powers the illumination lamps. Circuit Z2 provides ground for the lamps.

CHIME

The instrument cluster microprocessor sounds the audible warning chime. The chime sounds for seat belt warning and when the ignition key is in the ignition switch while the drivers door is open. The chime sounds when the ignition key is in the ON position while the drivers side seat belt is not buckled. Lastly, the chime sounds when the headlamps are ON when the ignition is OFF.

When the parking lamps or headlamps are ON, the headlamp switch connects circuit G26 from the instrument cluster microprocessor to circuit G16. Circuit G16 connects to the drivers side door jamb switch. Circuit G16 also connects to the key-in switch. When the cluster microprocessor senses ground on circuit G26, it sounds the chime.

If the headlamps are ON, and the drivers door opens, the drivers door jamb switch connects circuit G16 to circuit M23. Circuit M23 connects to ground circuit Z1 through fuse 4 in the fuse block. When the instrument cluster senses ground on circuit G26, it sounds the chime.

If the headlamps are OFF with the key in the ignition switch while the drivers side door is open, the cluster sounds the chime. In this case, the closed key-in switch and drivers door jamb connect the cluster microprocessor to ground through circuit M23, fuse 4 in the fuse block and ground circuit Z1.

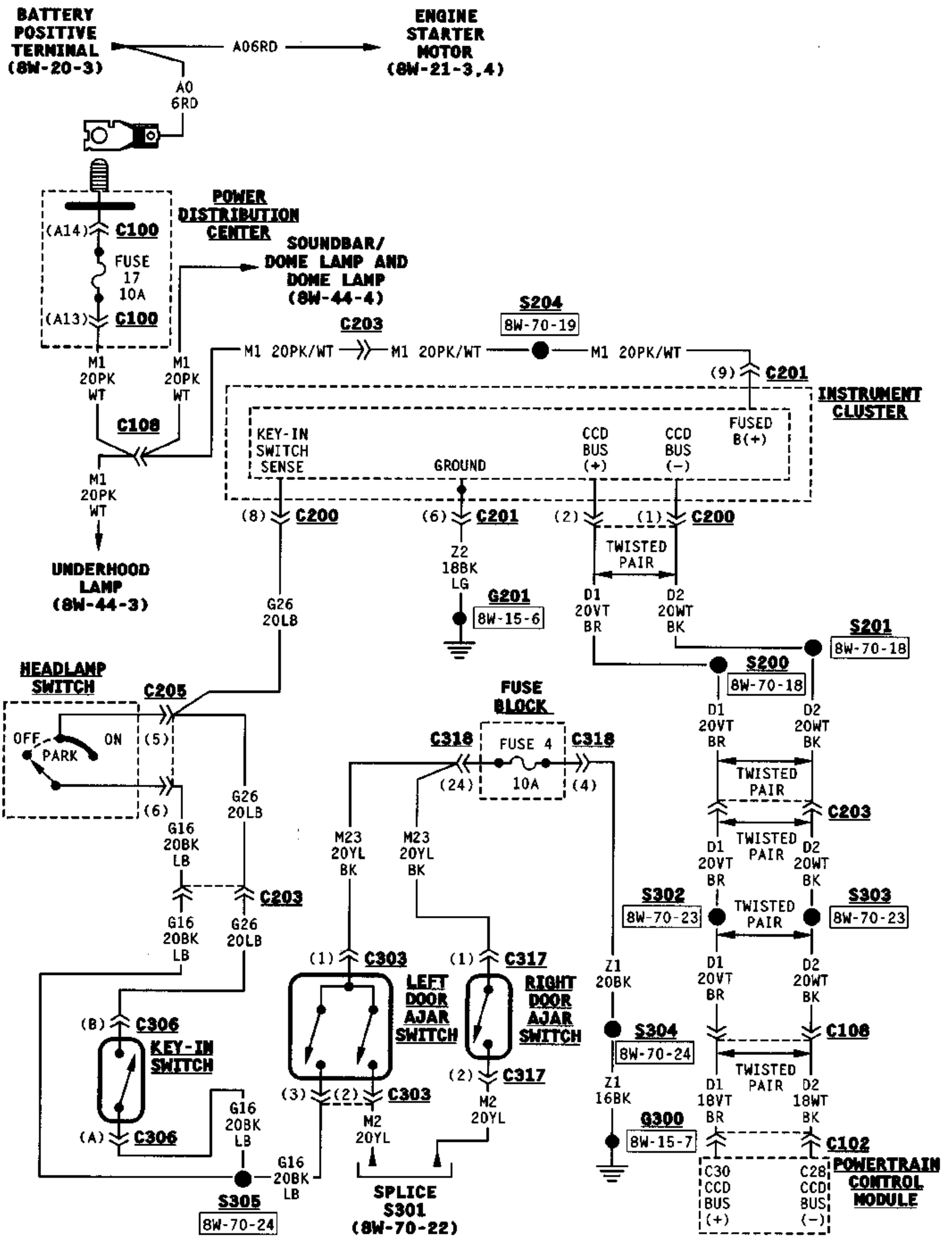
Circuit G10 connects the cluster microprocessor to the seat belt switch. When the seat belt switch closes, a path to ground is completed on circuit Z1 and the cluster momentarily sounds the chime.

SCHEMATICS AND DIAGRAMS

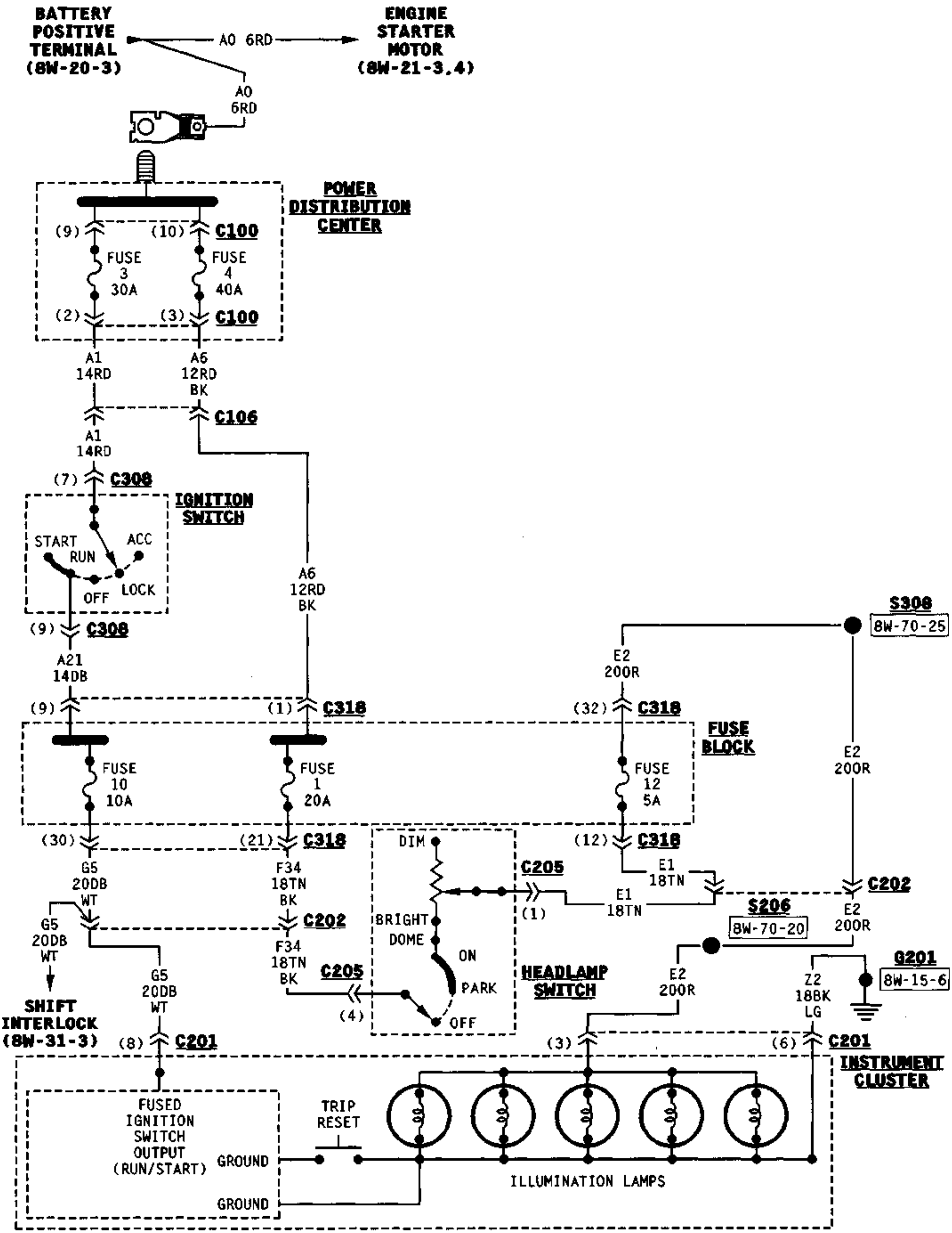
WIRING DIAGRAM INDEX

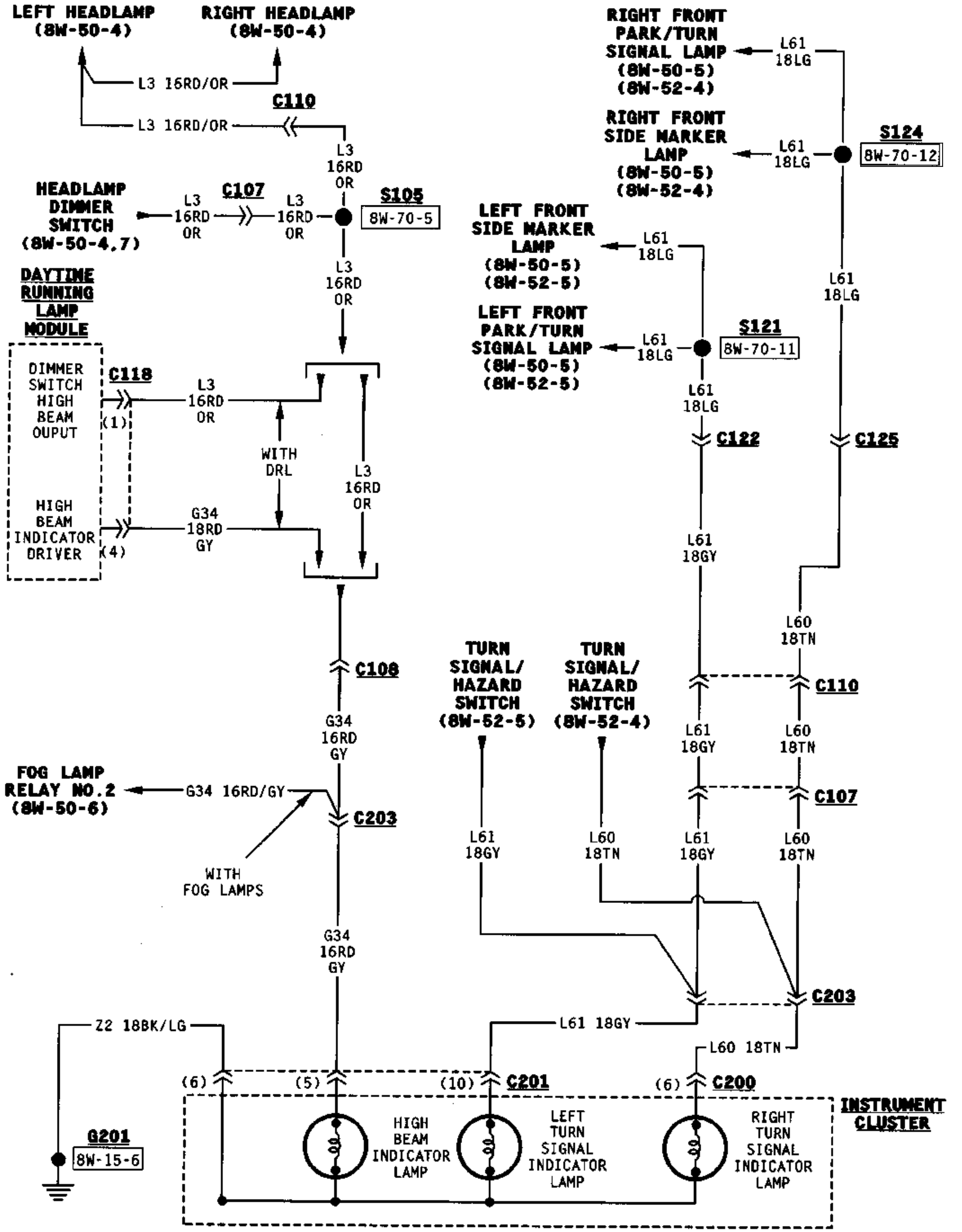
The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

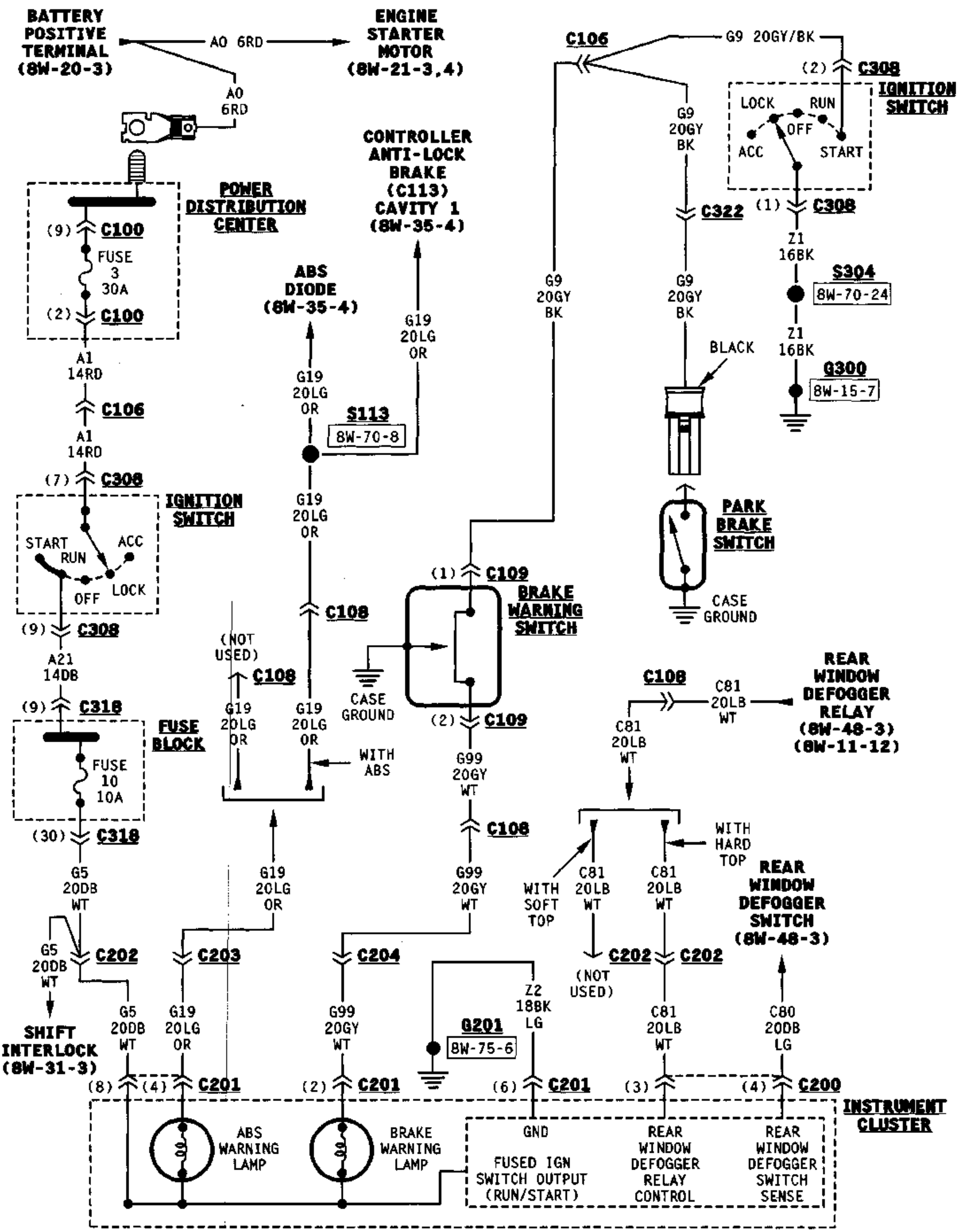
DIAGRAM INDEX

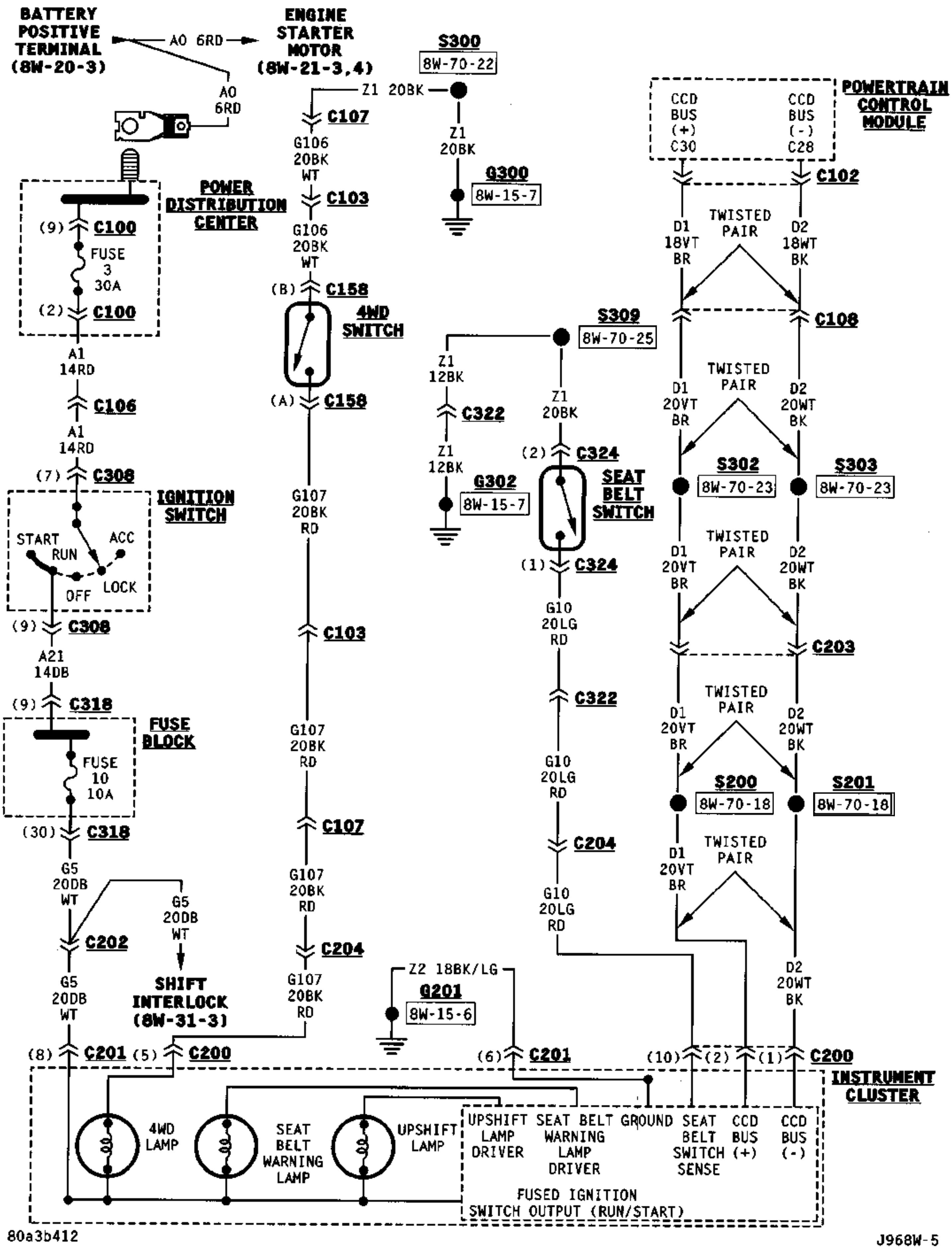


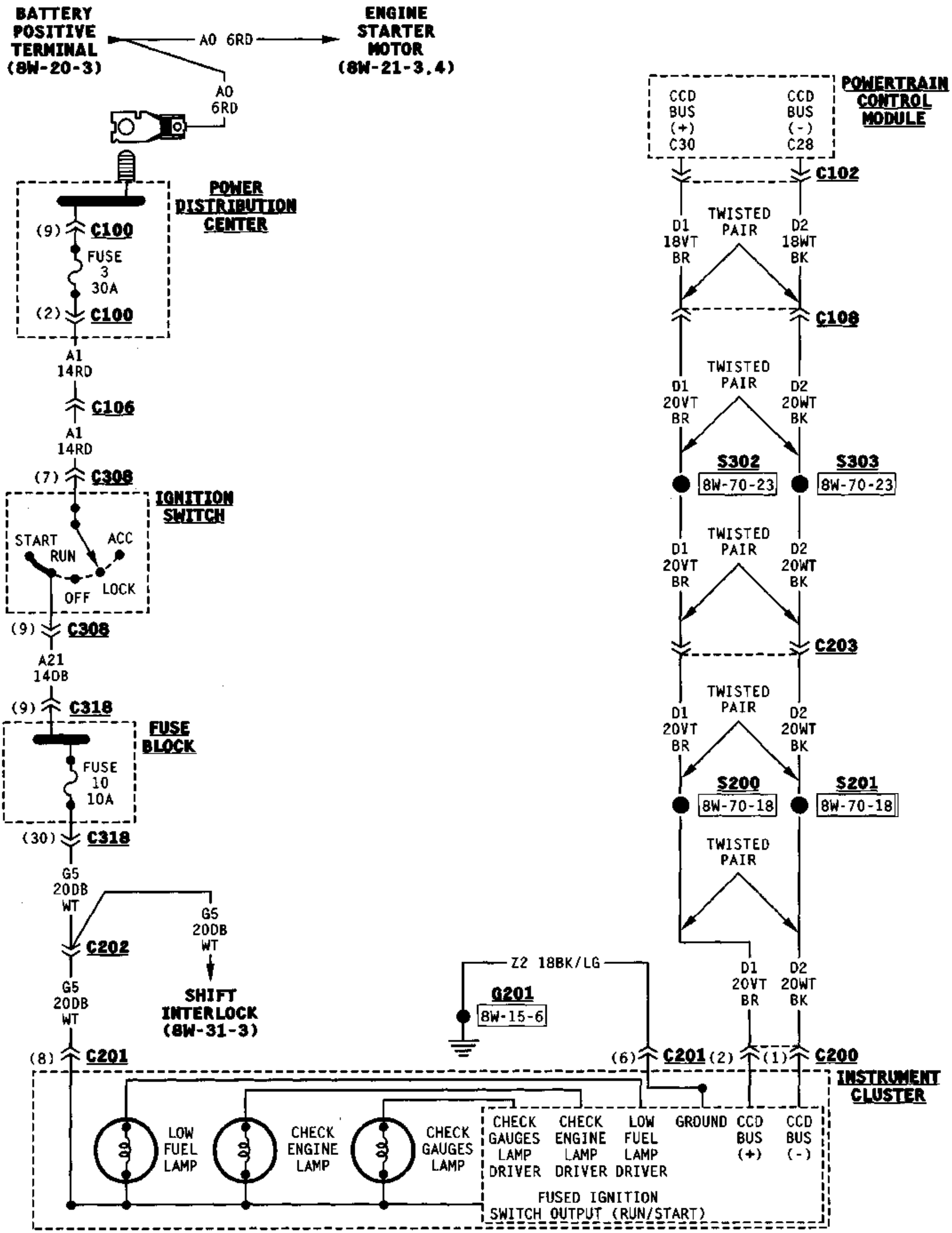
BATTERY POSITIVE TERMINAL (8W-20-3)
A06RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(A14) C100
FUSE 17 10A
(A13) C100
SOUNDBAR/ DOME LAMP AND DOME LAMP (8W-44-4)
M1 20PK WT
C108
UNDERHOOD LAMP (8W-44-3)
C203
M1 20PK/WT
S204
8W-70-19
(9) C201
INSTRUMENT CLUSTER
KEY-IN SWITCH SENSE
GROUND
CCD BUS (+)
CCD BUS (-)
FUSED B(+)
(8) C200
(6) C201
(2)
(1) C200
TWISTED PAIR
Z2 18BK LG
G201
8W-15-6
G26 20LB
D1 20VT BR
D2 20WT BK
S201
8W-70-18
S200
8W-70-18
HEADLAMP SWITCH
C205
OFF
PARK
ON
(5)
(6)
FUSE BLOCK
C318
FUSE 4
10A
(24)
(4)
G16 20BK LB
C203
M23 20YL BK
S302
8W-70-23
S303
8W-70-23
Z1 20BK
(1) C303
LEFT DOOR AJAR SWITCH
(1) C317
RIGHT DOOR AJAR SWITCH
(B) C306
KEY-IN SWITCH
(A) C306
S304
8W-70-24
C108
(3) (2) C303
(2) C317
M2 20YL
Z1 16BK
G300
8W-15-7
D1 18VT BR
D2 18WT BK
C102
S305
8W-70-24
SPLICE S301 (8W-70-22)
C30 CCD BUS (+)
C28 CCD BUS (-)
POWERTRAIN CONTROL MODULE

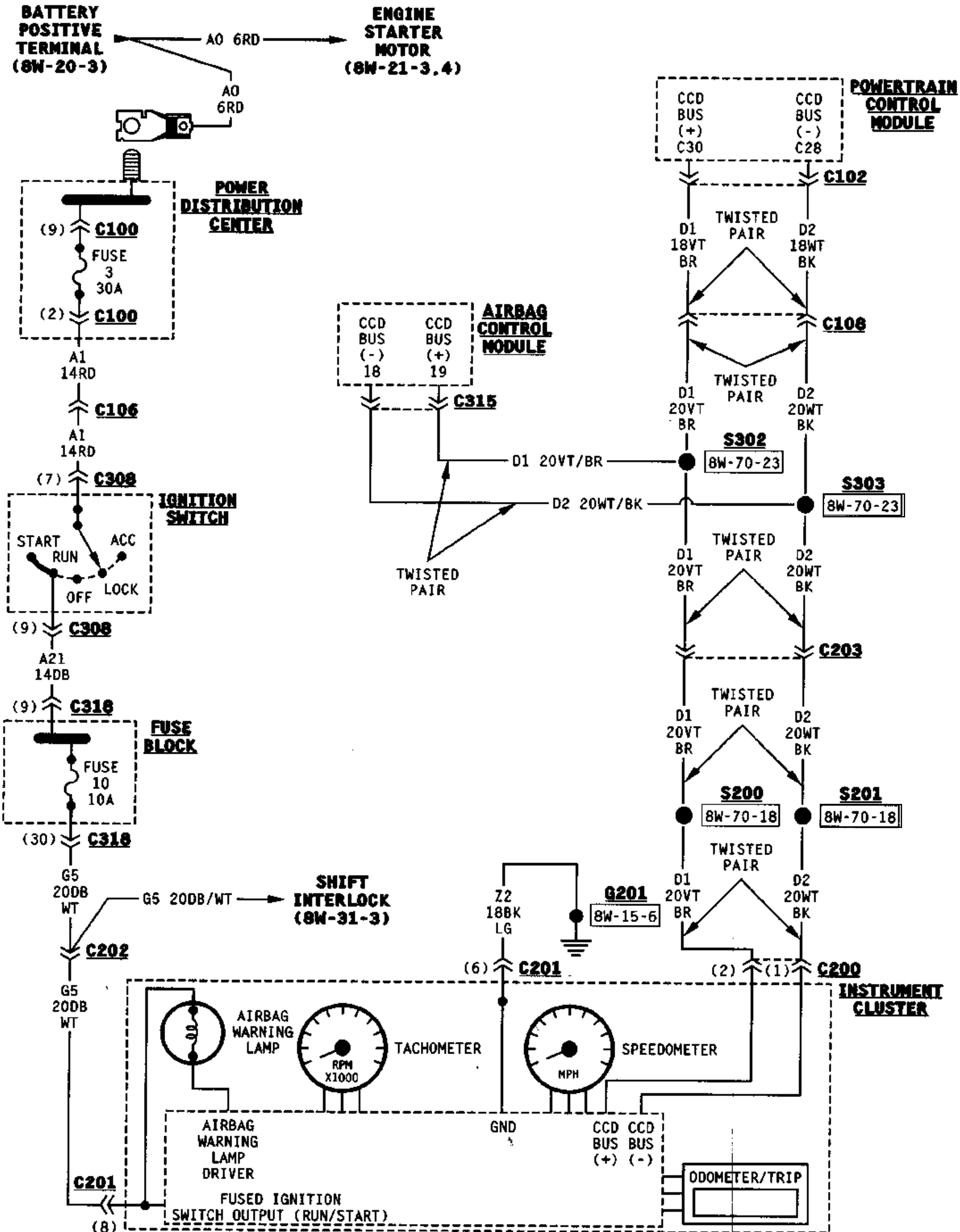

BATTERY
POSITIVE
TERMINAL
(8W-20-3)
A0 6RD
ENGINE
STARTER
MOTOR
(8W-21-3,4)
A0
6RD
POWER
DISTRIBUTION
CENTER
(9)
(10)
C100
FUSE
3
30A
FUSE
4
40A
(2)
(3)
C100
A1
14RD
A6
12RD
BK
C106
A1
14RD
(7)
C308
IGNITION
SWITCH
START
RUN
ACC
OFF
LOCK
(9)
C308
A6
12RD
BK
A21
14DB
(9)
(1)
C318
S308
8W-70-25
E2
20OR
(32)
C318
FUSE
BLOCK
FUSE
10
10A
FUSE
1
20A
FUSE
12
5A
E2
20OR
(30)
(21)
C318
(12)
C318
DIM
C205
E1
18TN
C202
G5
20DB
WT
F34
18TN
BK
BRIGHT
(1)
E1
18TN
S206
8W-70-20
E2
20OR
G5
20DB
WT
C202
DOME
ON
F34
18TN
BK
C205
HEADLAMP
SWITCH
PARK
E2
20OR
Z2
18BK
LG
G201
8W-15-6
SHIFT
INTERLOCK
(8W-31-3)
G5
20DB
WT
(4)
OFF
(8)
C201
(3)
(6)
C201
INSTRUMENT
CLUSTER
FUSED
IGNITION
SWITCH
OUTPUT
(RUN/START)
GROUND
TRIP
RESET
ILLUMINATION LAMPS
GROUND


LEFT HEADLAMP (8W-50-4)
RIGHT HEADLAMP (8W-50-4)
L3 16RD/OR
C110
L3 16RD OR
HEADLAMP DIMMER SWITCH (8W-50-4,7)
C107
S105
8W-70-5
DAYTIME RUNNING LAMP MODULE
DIMMER SWITCH HIGH BEAM OUPUT
C118
(1)
HIGH BEAM INDICATOR DRIVER
(4)
G34 18RD GY
WITH DRL
C108
G34 16RD GY
FOG LAMP RELAY NO.2 (8W-50-6)
G34 16RD/GY
C203
WITH FOG LAMPS
Z2 18BK/LG
G201
8W-15-6
RIGHT FRONT PARK/TURN SIGNAL LAMP (8W-50-5) (8W-52-4)
L61 18LG
RIGHT FRONT SIDE MARKER LAMP (8W-50-5) (8W-52-4)
S124
8W-70-12
LEFT FRONT SIDE MARKER LAMP (8W-50-5) (8W-52-5)
LEFT FRONT PARK/TURN SIGNAL LAMP (8W-50-5) (8W-52-5)
S121
8W-70-11
C122
C125
L61 18GY
L60 18TN
TURN SIGNAL/ HAZARD SWITCH (8W-52-5)
TURN SIGNAL/ HAZARD SWITCH (8W-52-4)
C110
C107
C203
(6)
(5)
(10)
C201
(6)
C200
INSTRUMENT CLUSTER
HIGH BEAM INDICATOR LAMP
LEFT TURN SIGNAL INDICATOR LAMP
RIGHT TURN SIGNAL INDICATOR LAMP

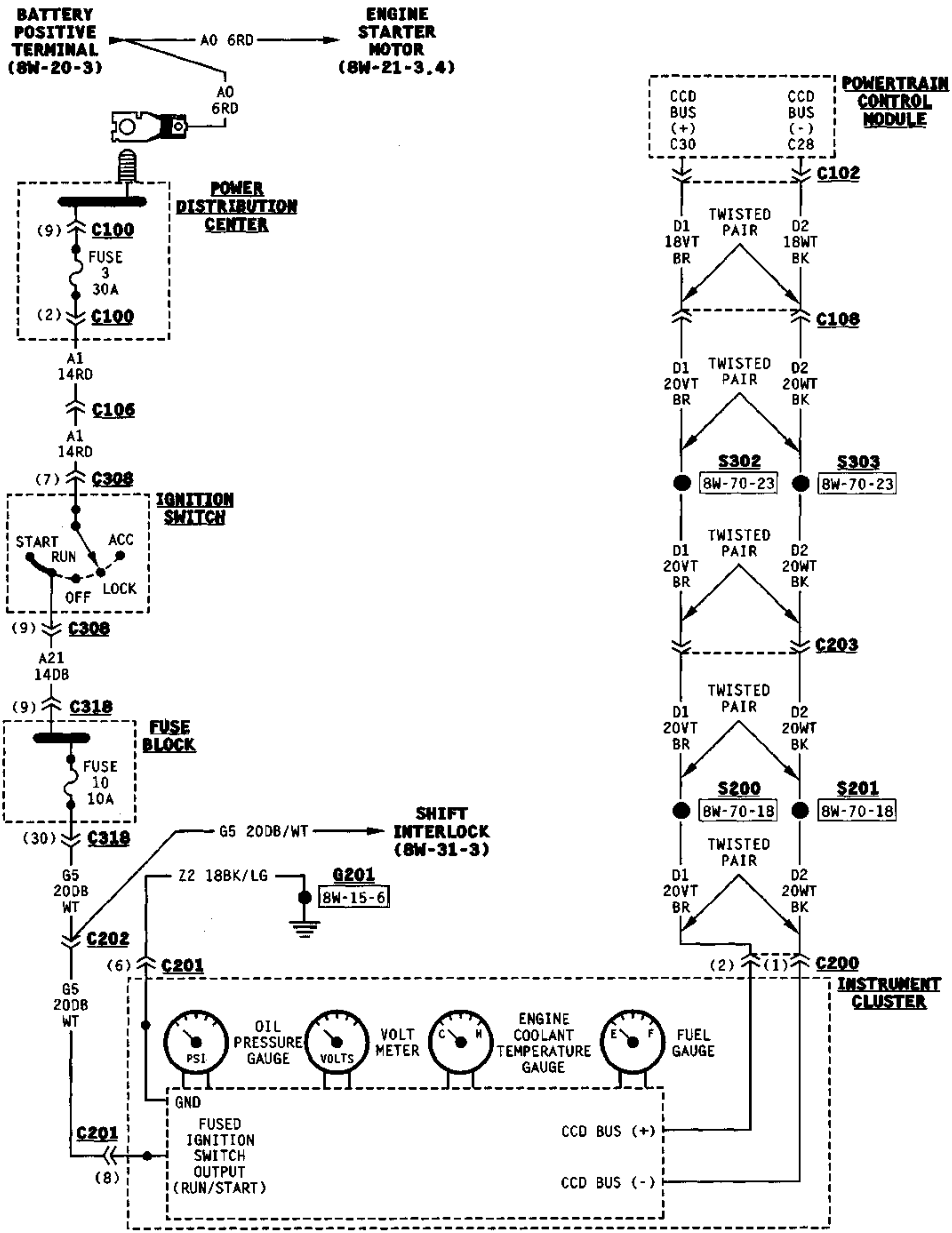

BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
POWER DISTRIBUTION CENTER
C100
FUSE 3 30A
A1 14RD
C106
C308
IGNITION SWITCH
START RUN ACC OFF LOCK
A21 14DB
C318
FUSE BLOCK
FUSE 10 10A
G5 20DB WT
C202
SHIFT INTERLOCK (8W-31-3)
ABS DIODE (8W-35-4)
CONTROLLER ANTI-LOCK BRAKE (C113) CAVITY 1 (8W-35-4)
G19 20LG OR
S113
8W-70-8
C108
(NOT USED)
WITH ABS
C203
C204
G9 20GY/BK
G9 20GY BK
C322
BLACK
C109
BRAKE WARNING SWITCH
CASE GROUND
G99 20GY WT
PARK BRAKE SWITCH
Z1 16BK
S304
8W-70-24
G300
8W-15-7
C81 20LB WT
REAR WINDOW DEFOGGER RELAY (8W-48-3) (8W-11-12)
WITH SOFT TOP
WITH HARD TOP
REAR WINDOW DEFOGGER SWITCH (8W-48-3)
C80 20DB LG
Z2 18BK LG
G201
8W-75-6
C201
C200
INSTRUMENT CLUSTER
ABS WARNING LAMP
BRAKE WARNING LAMP
GND
FUSED IGN SWITCH OUTPUT (RUN/START)
REAR WINDOW DEFOGGER RELAY CONTROL
REAR WINDOW DEFOGGER SWITCH SENSE


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(9) C100
FUSE 3 30A
(2) C100
A1 14RD
C106
A1 14RD
(7) C308
IGNITION SWITCH
START RUN ACC OFF LOCK
(9) C308
A21 14DB
(9) C318
FUSE BLOCK
FUSE 10 10A
(30) C318
G5 20DB WT
C202
G5 20DB WT
SHIFT INTERLOCK (8W-31-3)
G5 20DB WT
(8) C201
Z1 20BK
S300 8W-70-22
C107
G106 20BK WT
C103
G106 20BK WT
(B) C158
4WD SWITCH
(A) C158
G107 20BK RD
C103
G107 20BK RD
C107
G107 20BK RD
C204
G107 20BK RD
(5) C200
Z1 20BK
G300 8W-15-7
S309 8W-70-25
Z1 12BK
C322
Z1 12BK
G302 8W-15-7
Z1 20BK
(2) C324
SEAT BELT SWITCH
(1) C324
G10 20LG RD
C322
G10 20LG RD
C204
G10 20LG RD
Z2 18BK/LG
G201 8W-15-6
(6) C201
CCD BUS (+) C30
CCD BUS (-) C28
POWERTRAIN CONTROL MODULE
C102
D1 18VT BR
TWISTED PAIR
D2 18WT BK
C108
D1 20VT BR
TWISTED PAIR
D2 20WT BK
S302 8W-70-23
S303 8W-70-23
D1 20VT BR
TWISTED PAIR
D2 20WT BK
C203
D1 20VT BR
TWISTED PAIR
D2 20WT BK
S200 8W-70-18
S201 8W-70-18
D1 20VT BR
TWISTED PAIR
D2 20WT BK
(10) (2) (1) C200
INSTRUMENT CLUSTER
4WD LAMP
SEAT BELT WARNING LAMP
UPSHIFT LAMP
UPSHIFT LAMP DRIVER
SEAT BELT WARNING LAMP DRIVER
GROUND
SEAT BELT SWITCH SENSE
CCD BUS (+)
CCD BUS (-)
FUSED IGNITION SWITCH OUTPUT (RUN/START)
80a3b412
J968W-5


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(9) C100
FUSE 3 30A
(2) C100
A1 14RD
C106
A1 14RD
(7) C308
IGNITION SWITCH
START
RUN
ACC
OFF
LOCK
(9) C308
A21 14DB
(9) C318
FUSE BLOCK
FUSE 10 10A
(30) C318
G5 20DB WT
G5 20DB WT
C202
G5 20DB WT
SHIFT INTERLOCK (8W-31-3)
(8) C201
POWERTRAIN CONTROL MODULE
CCD BUS (+) C30
CCD BUS (-) C28
C102
TWISTED PAIR
D1 18VT BR
D2 18WT BK
C108
D1 20VT BR
D2 20WT BK
S302 8W-70-23
S303 8W-70-23
C203
S200 8W-70-18
S201 8W-70-18
Z2 18BK/LG
G201 8W-15-6
(6) C201
(2)
(1)
C200
INSTRUMENT CLUSTER
LOW FUEL LAMP
CHECK ENGINE LAMP
CHECK GAUGES LAMP
CHECK GAUGES LAMP DRIVER
CHECK ENGINE LAMP DRIVER
LOW FUEL LAMP DRIVER
GROUND
CCD BUS (+)
CCD BUS (-)
FUSED IGNITION SWITCH OUTPUT (RUN/START)



BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(9) C100
FUSE 3 30A
(2) C100
A1 14RD
C106
A1 14RD
(7) C308
IGNITION SWITCH
START RUN ACC
OFF LOCK
(9) C308
A21 14DB
(9) C318
FUSE BLOCK
FUSE 10 10A
(30) C318
G5 20DB WT
G5 20DB/WT
SHIFT INTERLOCK (8W-31-3)
C202
G5 20DB WT
C201
(8)
POWERTRAIN CONTROL MODULE
CCD BUS (+) C30
CCD BUS (-) C28
C102
D1 18VT BR
TWISTED PAIR
D2 18WT BK
C108
TWISTED PAIR
D1 20VT BR
D2 20WT BK
AIRBAG CONTROL MODULE
CCD BUS (-) 18
CCD BUS (+) 19
C315
D1 20VT/BR
S302
8W-70-23
D2 20WT/BK
S303
8W-70-23
TWISTED PAIR
D1 20VT BR
TWISTED PAIR
D2 20WT BK
C203
TWISTED PAIR
D1 20VT BR
D2 20WT BK
S200
8W-70-18
S201
8W-70-18
TWISTED PAIR
D1 20VT BR
D2 20WT BK
Z2 18BK LG
G201
8W-15-6
(6) C201
(2) (1) C200
INSTRUMENT CLUSTER
AIRBAG WARNING LAMP
TACHOMETER
RPM X1000
SPEEDOMETER
MPH
AIRBAG WARNING LAMP DRIVER
GND
CCD BUS (+)
CCD BUS (-)
ODOMETER/TRIP
FUSED IGNITION SWITCH OUTPUT (RUN/START)


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(9) C100
FUSE 3 30A
(2) C100
A1 14RD
C106
A1 14RD
(7) C308
IGNITION SWITCH
START
RUN
ACC
OFF
LOCK
(9) C308
A21 14DB
(9) C318
FUSE BLOCK
FUSE 10 10A
(30) C318
G5 20DB WT
G5 20DB/WT
SHIFT INTERLOCK (8W-31-3)
Z2 18BK/LG
G201 8W-15-6
C202
(6) C201
G5 20DB WT
C201
(8)
POWERTRAIN CONTROL MODULE
CCD BUS (+) C30
CCD BUS (-) C28
C102
D1 18VT BR
TWISTED PAIR
D2 18WT BK
C108
D1 20VT BR
TWISTED PAIR
D2 20WT BK
S302 8W-70-23
S303 8W-70-23
D1 20VT BR
TWISTED PAIR
D2 20WT BK
C203
D1 20VT BR
TWISTED PAIR
D2 20WT BK
S200 8W-70-18
S201 8W-70-18
TWISTED PAIR
D1 20VT BR
D2 20WT BK
(2)
(1) C200
INSTRUMENT CLUSTER
PSI
OIL PRESSURE GAUGE
VOLTS
VOLT METER
C H
ENGINE COOLANT TEMPERATURE GAUGE
E F
FUEL GAUGE
GND
FUSED IGNITION SWITCH OUTPUT (RUN/START)
CCD BUS (+)
CCD BUS (-)

8W-41 HORN/CIGAR LIGHTER

DESCRIPTION AND OPERATION

HORN

Circuit F31 from fuse 20 in the Power Distribution Center (PDC) powers the coil and contact sides of the horn relay. When the case grounded horn switch is depressed, circuit X3 provides ground for the coil side of the relay and the contacts CLOSE. When the contacts CLOSE, circuit X2 supplies voltage to the horns. Circuit Z1 provides ground for the horns.

CIGAR LIGHTER

The accessory relay powers the cigar lighter. The relay energizes when the ignition switch is in the ACCESSORY or RUN position. In the ACCESSORY or RUN position, the switch connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A31. Circuit A31 powers relay coil. Circuit Z1 provides ground for the relay coil.

When the relay energizes, its connects circuit F30 from fuse 5 in the PDC to circuit F38. Circuit F38 powers the cigar lighter.

When the operator depresses the lighter, contacts inside the lighter element close, and voltage from circuit F38 flows through the heating element to ground. Circuit Z1 provides ground for the lighter.

POWER OUTLET

When the ignition switch is in the ACCESSORY or RUN position, it connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A31. Circuit A31 powers the coil side of the accessory relay. Circuit Z1 provides ground for the relay coil.

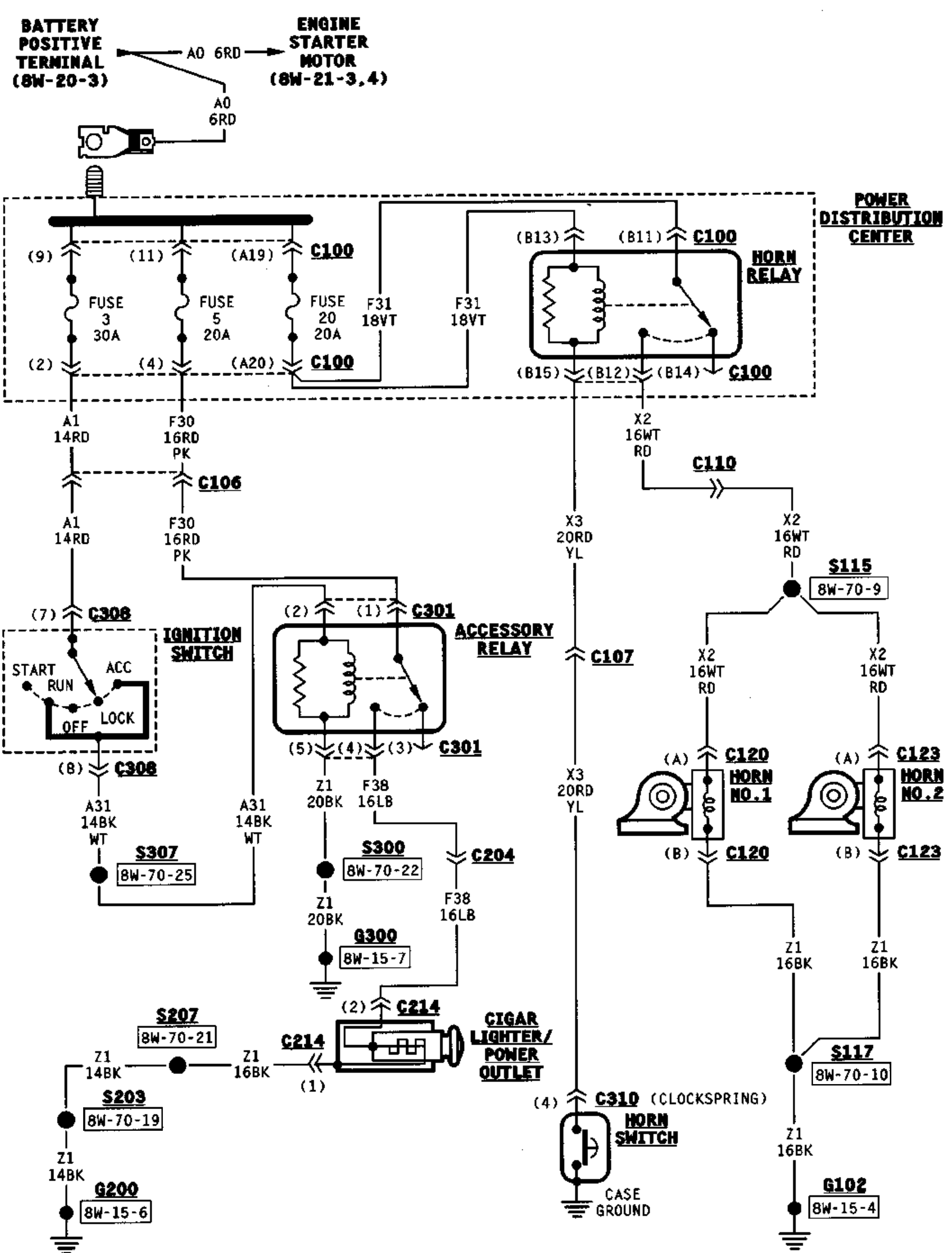
When the accessory relay energizes, it connects circuit F30 from PDC fuse 5 to circuit F38. Circuit F38 feeds the power outlet. Circuit Z1 provides ground for the power outlet.

SCHEMATICS AND DIAGRAMS

WIRING DIAGRAM INDEX

The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

DIAGRAM INDEX



BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(9) (11) (A19) C100
FUSE 3 30A
FUSE 5 20A
FUSE 20 20A
(2) (4) (A20) C100
F31 18VT
F31 18VT
(B13) (B11) C100
HORN RELAY
(B15) (B12) (B14) C100
A1 14RD
F30 16RD PK
C106
A1 14RD
F30 16RD PK
X2 16WT RD
C110
X2 16WT RD
X3 20RD YL
S115
8W-70-9
(7) C306
IGNITION SWITCH
START
RUN
ACC
OFF
LOCK
(8) C306
(2) (1) C301
ACCESSORY RELAY
(5) (4) (3) C301
C107
X2 16WT RD
X2 16WT RD
(A) C120
HORN NO.1
(B) C120
(A) C123
HORN NO.2
(B) C123
A31 14BK WT
A31 14BK WT
S307
8W-70-25
Z1 20BK
F38 16LB
C204
S300
8W-70-22
Z1 20BK
G300
8W-15-7
F38 16LB
X3 20RD YL
Z1 16BK
Z1 16BK
(2) C214
S207
8W-70-21
C214
CIGAR LIGHTER/ POWER OUTLET
Z1 14BK
Z1 16BK
(1)
S203
8W-70-19
S117
8W-70-10
(4) C310 (CLOCKSPRING)
HORN SWITCH
CASE GROUND
Z1 14BK
Z1 16BK
G200
8W-15-6
G102
8W-15-4

8W-42 AIR CONDITIONING/HEATER

INDEX

GENERAL INFORMATION

INTRODUCTION

The vehicle may be equipped with a heater only or with air conditioning and heater. The wiring diagrams contain schematics for Heater Only and A/C-Heater. The circuit descriptions address both conditions. When referring to the wiring diagrams, ensure you use the correct ones.

DESCRIPTION AND OPERATION

BLOWER MOTOR

In the RUN position, the ignition switch connects circuit A2 from fuse 2 in the Power Distribution Center (PDC) to circuit A22. Circuit A22 feeds circuit F24 through fuse 8 in the fuse block. Circuit F24 connects to the heater control switch on heater only equipped vehicles or the A/C-Heater control switch on vehicles equipped with air conditioning. The control switch connects circuit F24 to circuit C4. Circuit C4 connects to the blower motor switch to power the blower motor through the blower motor relay in all positions except HIGH.

The blower motor switch has four positions; LOW, MEDIUM 1, MEDIUM 2, AND HIGH. In the LOW position, circuit C4 passes through all three resistors in the blower motor resistor block, through the blower motor relay to the blower motor.

In the MEDIUM 1 position, the blower motor switch connect circuit C4 to circuit C5. Current on circuit C5 passes through two resistors in the blower motor resistor block through the blower motor relay to the blower motor.

In the MEDIUM 2 position, the blower motor switch connect circuit C4 to circuit C6. Current on circuit C6 passes through one resistor in the blower motor resistor block through the blower motor relay to the blower motor.

When the blower motor switch is in the HIGH position it connects circuit C4 to circuit C7. Circuit C7 powers the coil side of the blower motor relay. When voltage is present on circuit C7 the relay energizes and switches to connect circuit A11 from fuse 11 in the PDC directly to the blower motor.

Circuit Z1 provides ground for the blower motor. Circuit Z1 also supplies ground for the coil side of the blower motor relay.

A/C OPERATION

When the A/C-heater control switch is moved to an A/C position or the defrost position, it connects circuit C90 to ground on circuit Z1. Circuit C90 connects to cavity C23 of the Powertrain Control Module (PCM) and splices to the A/C high pressure switch. When circuit C90 connects to ground circuit Z1 it provides the A/C select signal to the PCM.

When the A/C high pressure switch closes, it connects circuit C90 to circuit C21. Circuit C21 connects to the A/C cycling switch. If the A/C cycling switch is closed, it connects circuit C21 to circuit C22. Circuit C22 connects to cavity C22 of the PCM. The PCM senses the A/C request signal on circuit C22 when the A/C-heater control switch is in defrost or an A/C position and the high pressure and cycling switches are closed.

After sensing the A/C request signal, the PCM supplies ground for the coil side of A/C compressor clutch relay on circuit C13. Circuit C13 originates at cavity C1 of the PCM. Circuit F12 from fuse 11 in the fuse block powers the coil side of the A/C compressor clutch relay.

When the PCM grounds the A/C compressor clutch relay, the contacts close and connect circuit A17 from fuse 19 in the PDC to circuit C3. Circuit C3 supplies power to the case grounded A/C compressor clutch.

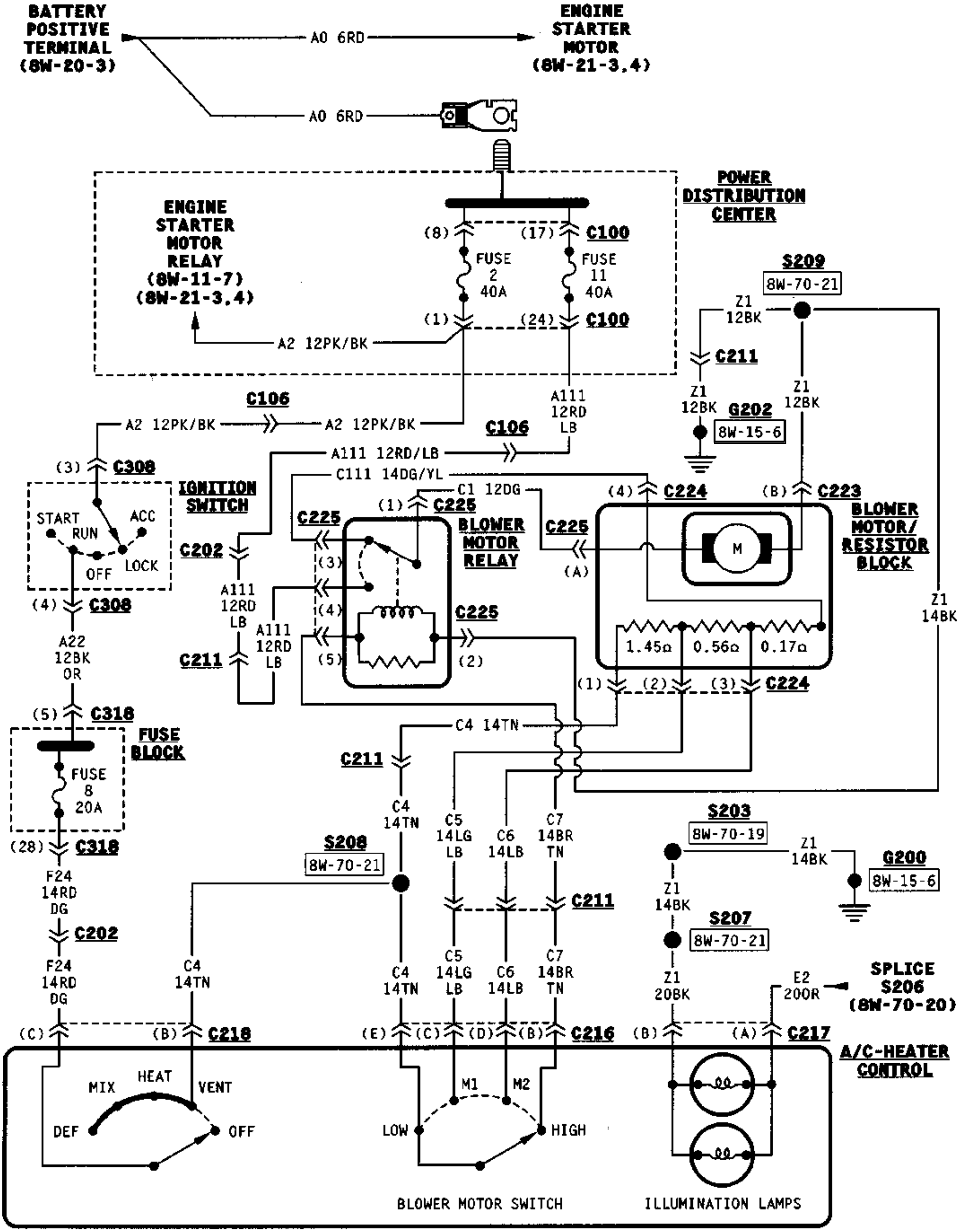
The A/C compressor clutch has a built-in diode. The diode controls the induced voltage that results from the magnetic field collapsing when the clutch disengages. The diode provides a current path to protect other components and systems.

SCHEMATICS AND DIAGRAMS

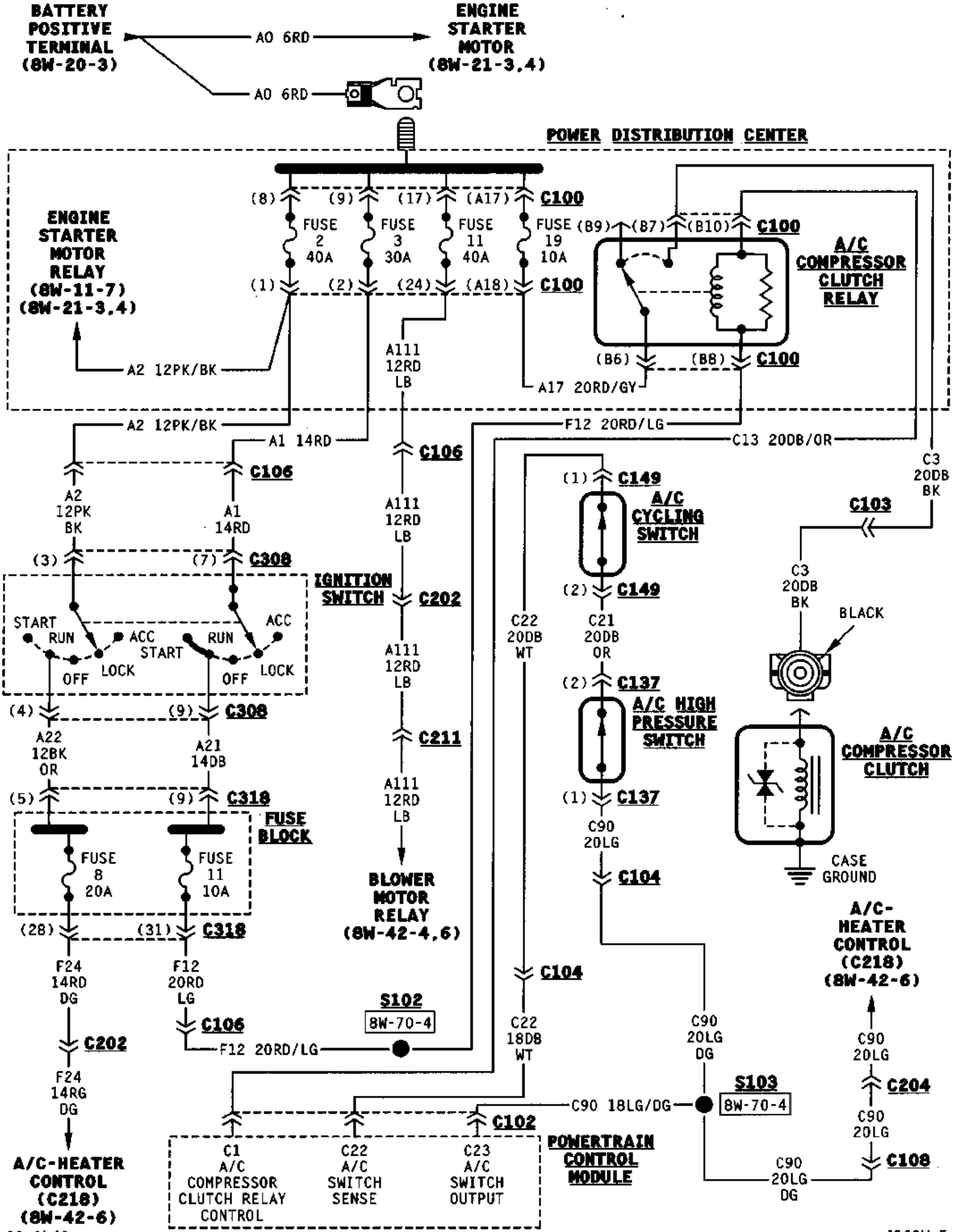
WIRING DIAGRAM INDEX

The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

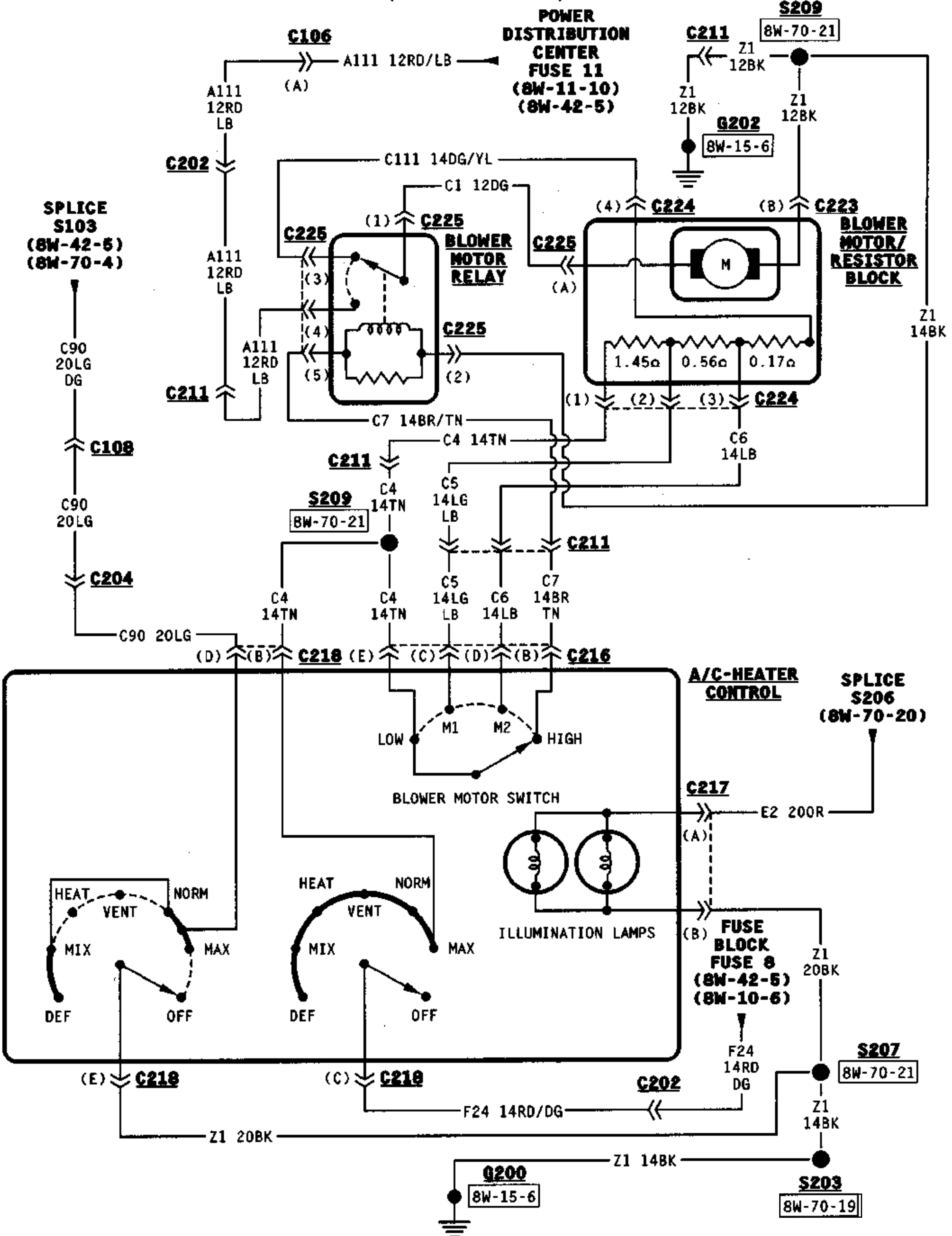
DIAGRAM INDEX



BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
ENGINE STARTER MOTOR RELAY (8W-11-7) (8W-21-3,4)
(8) (17) C100
FUSE 2 40A
FUSE 11 40A
(1) (24) C100
A2 12PK/BK
S209
8W-70-21
Z1 12BK
C211
Z1 12BK
G202
8W-15-6
Z1 12BK
C106
A2 12PK/BK
A2 12PK/BK
A111 12RD LB
C106
A111 12RD/LB
C111 14DG/YL
C1 12DG
(3) C308
IGNITION SWITCH
START RUN ACC LOCK OFF
(4) C308
A22 12BK OR
(5) C318
FUSE BLOCK
FUSE 8 20A
(28) C318
F24 14RD DG
C202
F24 14RD DG
(1) C225
C225
BLOWER MOTOR RELAY
C202
(3)
(4)
(5)
A111 12RD LB
C211
A111 12RD LB
C225
(2)
C225
(A)
(4) C224
(B) C223
BLOWER MOTOR/ RESISTOR BLOCK
M
1.45Ω 0.56Ω 0.17Ω
(1) (2) (3) C224
Z1 14BK
C4 14TN
C211
C4 14TN
C5 14LG LB
C6 14LB
C7 14BR TN
S208
8W-70-21
C211
S203
8W-70-19
Z1 14BK
G200
8W-15-6
Z1 14BK
S207
8W-70-21
Z1 20BK
E2 20OR
SPLICE S206 (8W-70-20)
C4 14TN
C4 14TN
C5 14LG LB
C6 14LB
C7 14BR TN
(C) (B) C218
(E) (C) (D) (B) C216
(B) (A) C217
A/C-HEATER CONTROL
MIX HEAT VENT DEF OFF
M1 M2 LOW HIGH
BLOWER MOTOR SWITCH
ILLUMINATION LAMPS



80a3b40a J968W-5


POWER DISTRIBUTION CENTER FUSE 11 (8W-11-10) (8W-42-5)
C106
A111 12RD/LB
(A)
A111 12RD LB
C202
C211
S209 8W-70-21
Z1 12BK
G202 8W-15-6
C111 14DG/YL
C1 12DG
C225
BLOWER MOTOR RELAY
C224
C223
BLOWER MOTOR/ RESISTOR BLOCK
1.45Ω 0.56Ω 0.17Ω
Z1 14BK
SPLICE S103 (8W-42-5) (8W-70-4)
C90 20LG DG
C108
C90 20LG
C204
C7 14BR/TN
C4 14TN
C5 14LG LB
C6 14LB
C7 14BR TN
C90 20LG
C218
C216
A/C-HEATER CONTROL
LOW M1 M2 HIGH
BLOWER MOTOR SWITCH
SPLICE S206 (8W-70-20)
C217
E2 20OR
ILLUMINATION LAMPS
HEAT VENT NORM MIX MAX DEF OFF
FUSE BLOCK FUSE 8 (8W-42-5) (8W-10-6)
Z1 20BK
F24 14RD DG
F24 14RD/DG
S207 8W-70-21
Z1 14BK
G200 8W-15-6
S203 8W-70-19

8W-43 AIRBAG SYSTEM

DESCRIPTION AND OPERATION

AIRBAG CONTROL MODULE

This vehicle has a drivers airbag and a passenger airbag. The Airbag Control Module (ACM) operates both.

In the START or RUN position, the ignition switch connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A21. Circuit A21 powers circuit F14 through fuse 9 in the fuse block. Circuit F14 connects to the ACM.

When the ignition switch is in the RUN position, it connects circuit A2 from PDC fuse 2 to circuit A22. Circuit A22 powers circuit F23 through fuse 5 in the fuse block. Circuit F23 connects to the ACM. The ACM has a dedicated ground on circuit Z6. The ACM is also case grounded.

AIRBAG SQUIB (AIRBAG IGNITER)

Circuits, R43 and R45, connect the ACM to the drivers airbag squib (igniter) after passing through the clock spring connector. Circuits, R42 and R44, connect the ACM to the passenger airbag squib.

AIRBAG WARNING LAMP

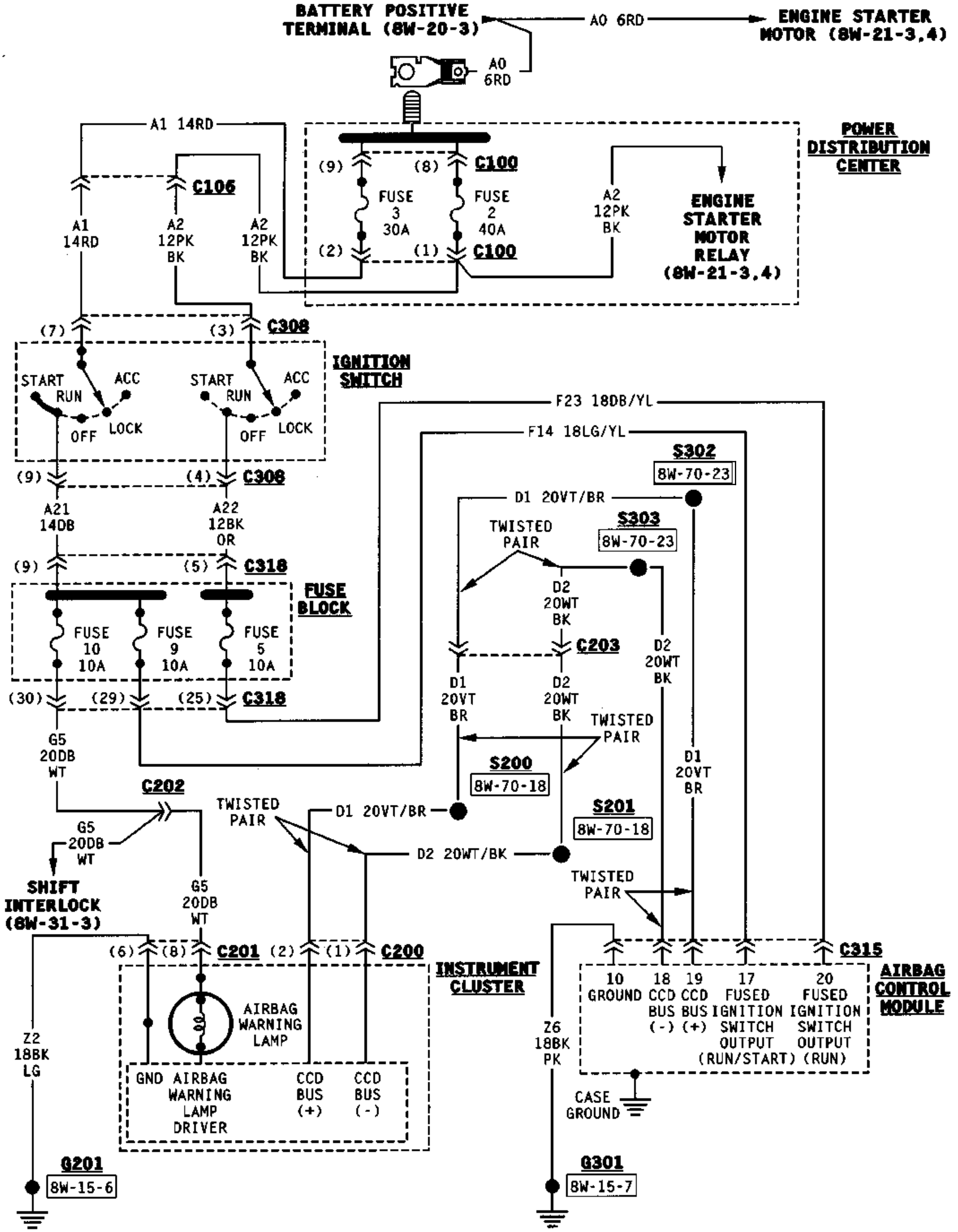
Circuit G5 from fuse 10 in the fuse block powers the airbag warning lamp. The microprocessor in the instrument cluster controls the ground for the lamp. When appropriate, the Airbag Control Module (ACM) broadcasts a message on the CCD bus to illuminate the airbag warning lamp. When the microprocessor sees the airbag message the on CCD bus, it provides ground for the warning lamp.

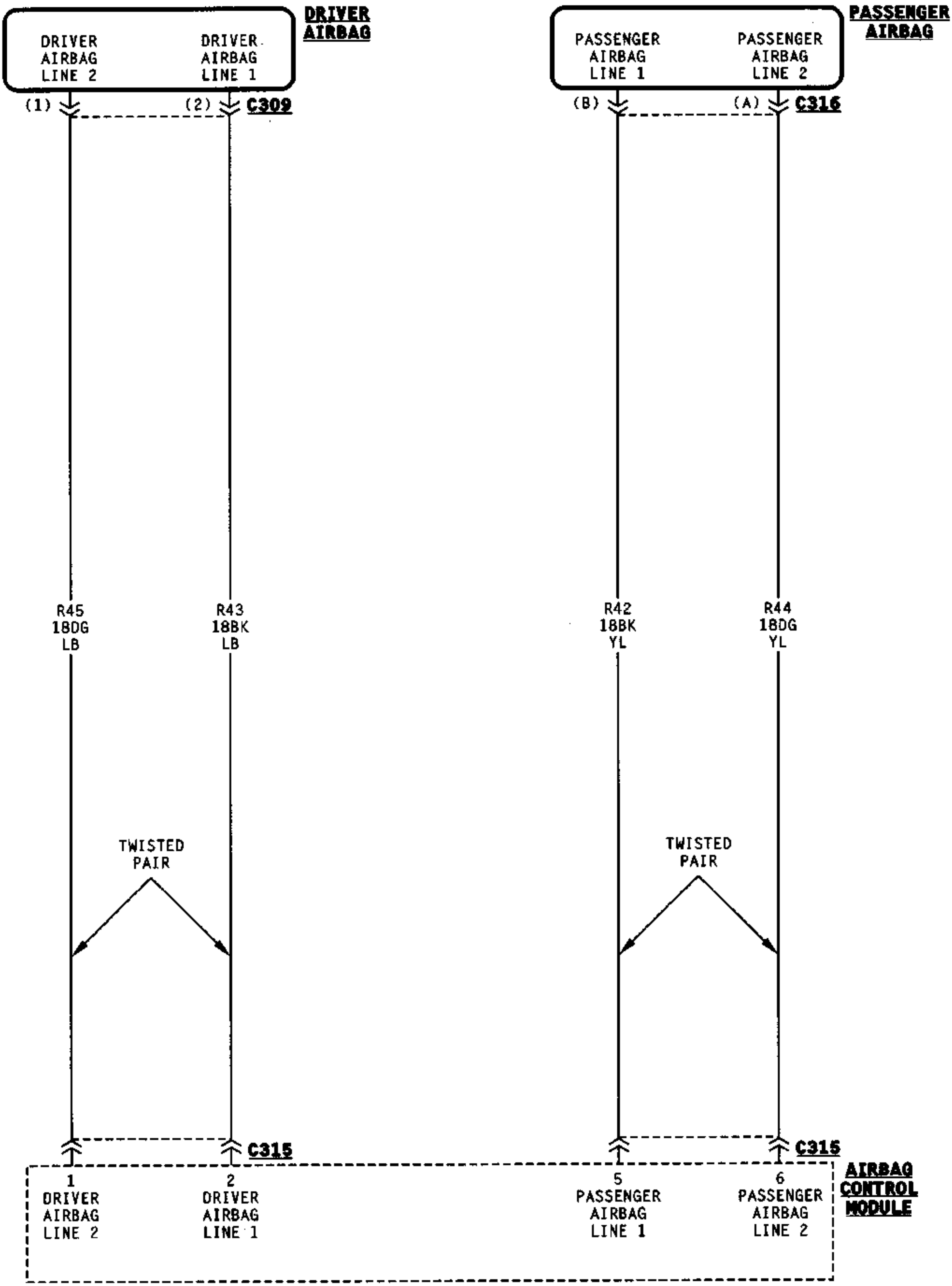
SCHEMATICS AND DIAGRAMS

WIRING DIAGRAM INDEX

The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

DIAGRAM INDEX


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
A1 14RD
POWER DISTRIBUTION CENTER
(9)
(8)
C100
FUSE 3 30A
FUSE 2 40A
(2)
(1)
C100
A2 12PK BK
ENGINE STARTER MOTOR RELAY (8W-21-3,4)
C106
A1 14RD
A2 12PK BK
A2 12PK BK
(7)
(3)
C308
IGNITION SWITCH
START
RUN
ACC
OFF
LOCK
START
RUN
ACC
OFF
LOCK
(9)
(4)
C308
A21 14DB
A22 12BK OR
(9)
(5)
C318
FUSE BLOCK
FUSE 10 10A
FUSE 9 10A
FUSE 5 10A
(30)
(29)
(25)
C318
F23 18DB/YL
F14 18LG/YL
S302
8W-70-23
D1 20VT/BR
TWISTED PAIR
S303
8W-70-23
D2 20WT BK
C203
D1 20VT BR
D2 20WT BK
D2 20WT BK
TWISTED PAIR
S200
8W-70-18
D1 20VT BR
S201
8W-70-18
G5 20DB WT
C202
G5 20DB WT
SHIFT INTERLOCK (8W-31-3)
TWISTED PAIR
D1 20VT/BR
D2 20WT/BK
TWISTED PAIR
G5 20DB WT
(6)
(8)
C201
(2)
(1)
C200
INSTRUMENT CLUSTER
AIRBAG WARNING LAMP
GND
AIRBAG WARNING LAMP DRIVER
CCD BUS (+)
CCD BUS (-)
Z2 18BK LG
G201
8W-15-6
C315
AIRBAG CONTROL MODULE
10 GROUND
18 CCD BUS (-)
19 CCD BUS (+)
17 FUSED IGNITION SWITCH OUTPUT (RUN/START)
20 FUSED IGNITION SWITCH OUTPUT (RUN)
Z6 18BK PK
CASE GROUND
G301
8W-15-7



80a3b407

J968W-5

8W-44 INTERIOR LIGHTING

DESCRIPTION AND OPERATION

INTRODUCTION

Circuit M1 from the Ignition Off Draw (IOD) fuse in cavity 17 of the Power Distribution Center (PDC) supplies power to the courtesy lamps, sound bar lamp, and dome/cargo lamp. The M1 circuit also powers the under hood lamp and feeds the radio, instrument cluster microprocessor, and data link connector.

Circuit E2 supplies power for the instrument panel illumination lamps.

INSTRUMENT PANEL ILLUMINATION LAMPS

When parking lamps or headlamps are ON, the headlamp switch connects circuit F34 from fuse 1 in the fuse block to circuit E1 through the dimmer switch circuitry. Circuit E1 feeds circuit E2 through fuse 12 in the fuse block. Circuit E2 powers to the following illumination lamps:

- Instrument cluster
- A/C-Heater control lamp
- Fog lamp switch lamp
- Rear wiper switch lamp
- Rear window defogger switch lamp
- Transmission range (PRNDL) indicator lamp
- Radio

Circuit Z1 provides ground for all of the illumination lamps except the instrument cluster and radio. Circuit Z2 provides ground for the instrument cluster illumination lamps. The radio is case grounded.

UNDERHOOD LAMP

Circuit M1 from the Ignition Off Draw fuse in cavity 17 of the Power Distribution Center (PDC) feeds the underhood lamp. The lamp contains a mercury switch which connects the lamp to ground on circuit Z1 when the hood is raised.

COURTESY LAMPS, DOME/CARGO LAMP, SOUND BAR LAMP

Circuit M1 from the Ignition Off Draw (IOD) fuse in cavity 17 of the Power Distribution Center (PDC) powers the courtesy lamps, dome/cargo lamp, and sound bar lamp. Circuit M1 is HOT at all times. The ground path for the lamp is provided in two different ways.

One way is through the door jamb switches. Circuit M2 connects the lamps to the door jamb switches. The switches are connected to circuit M23 which connects to ground circuit Z1 through fuse 4 in the fuse block. When a door is opened, the plunger in the switch CLOSES, completing a path to ground.

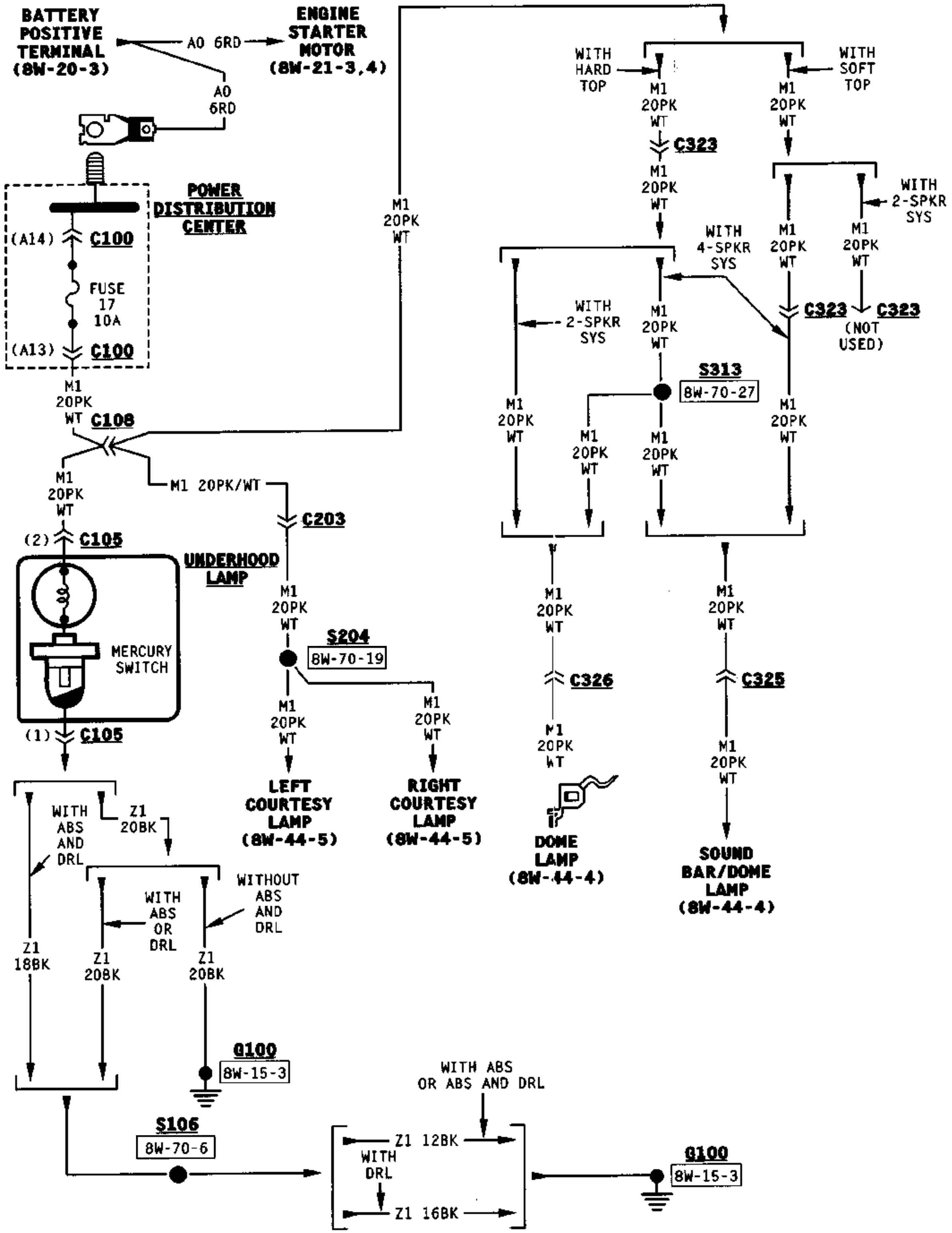
The second ground path is through the headlamp switch. Circuit M2 is spliced in with the headlamp switch. When the operator turns the headlamp switch to the dome lamp ON position, a ground path is provided through the switch.

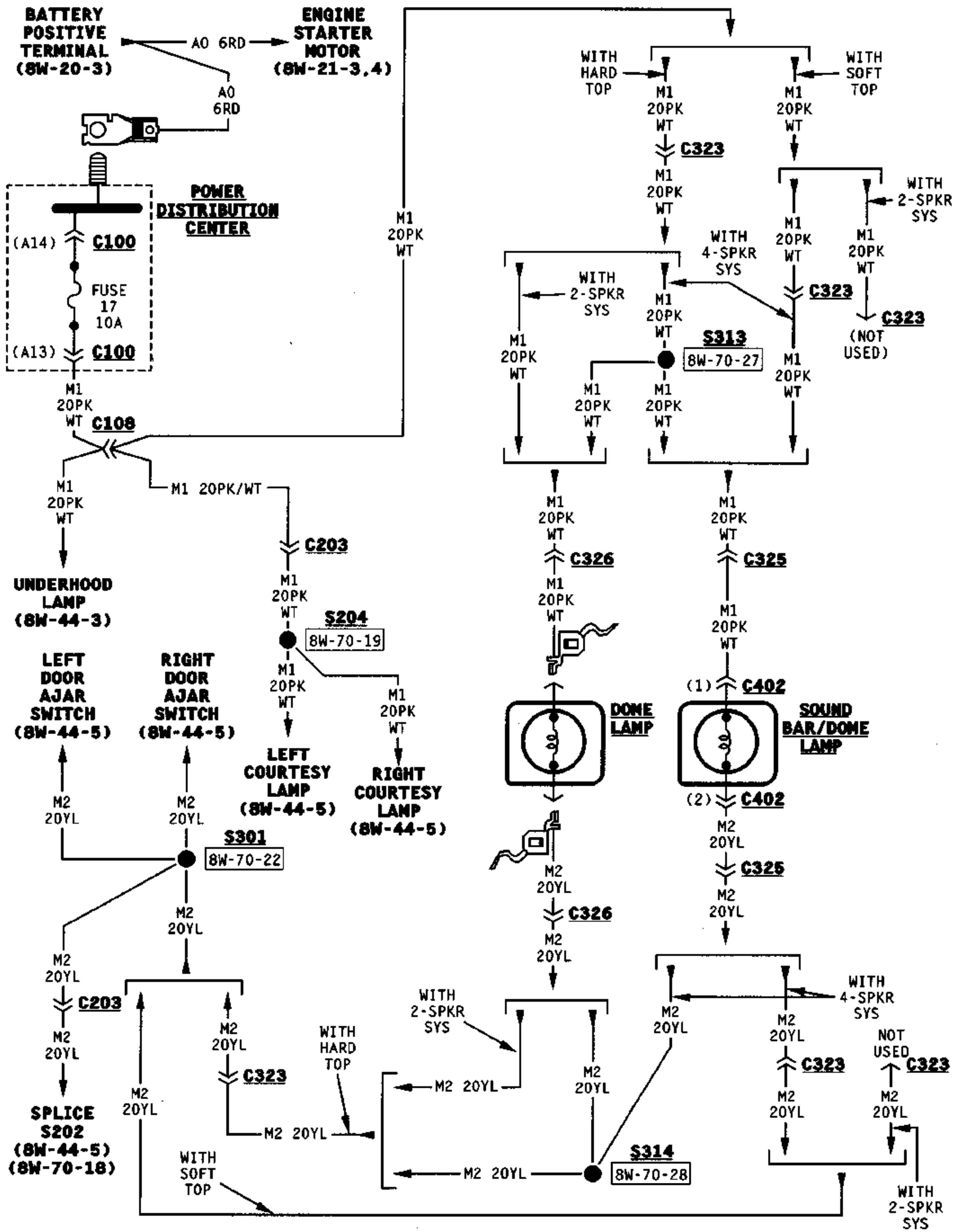
SCHEMATICS AND DIAGRAMS

WIRING DIAGRAM INDEX

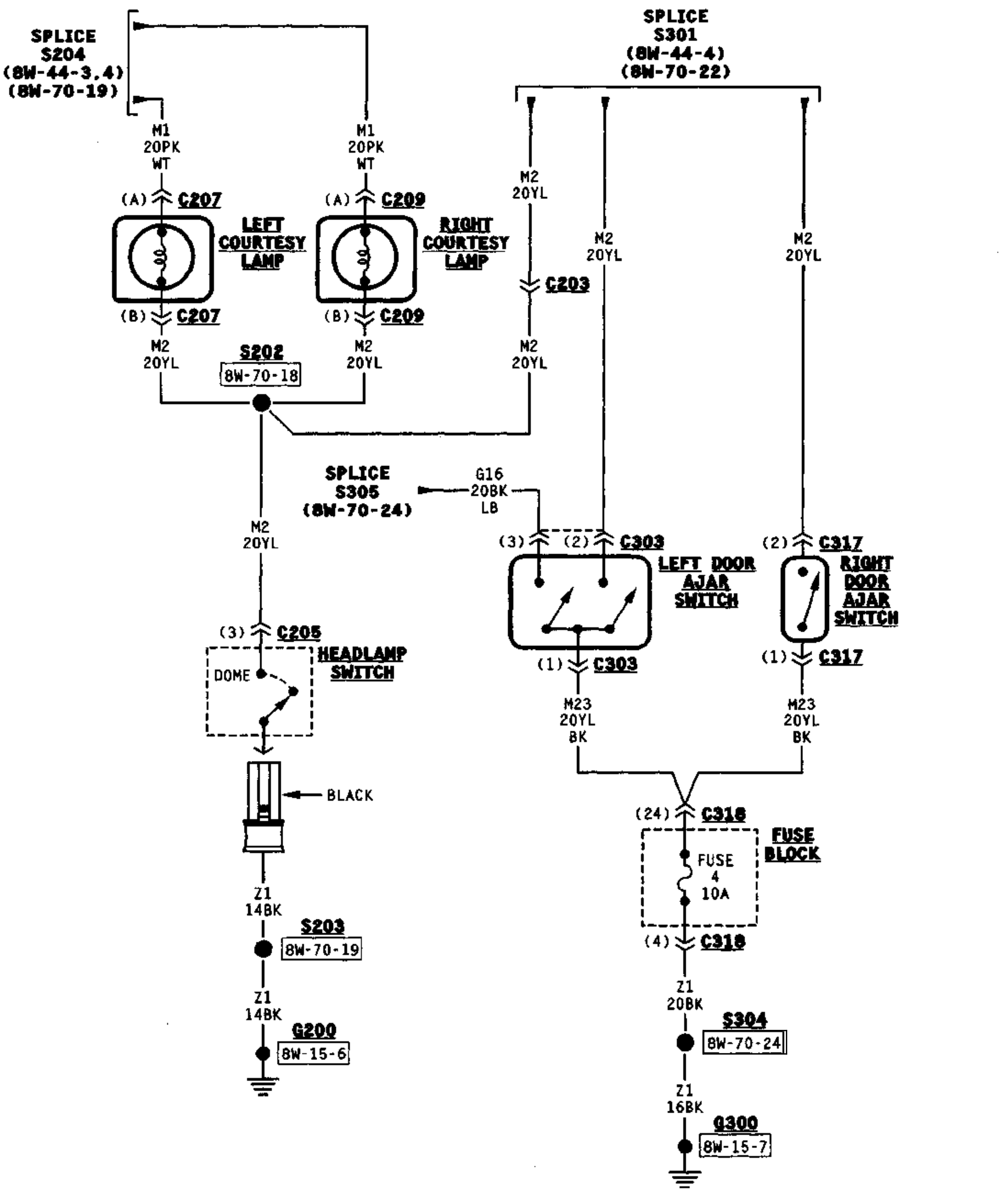
The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

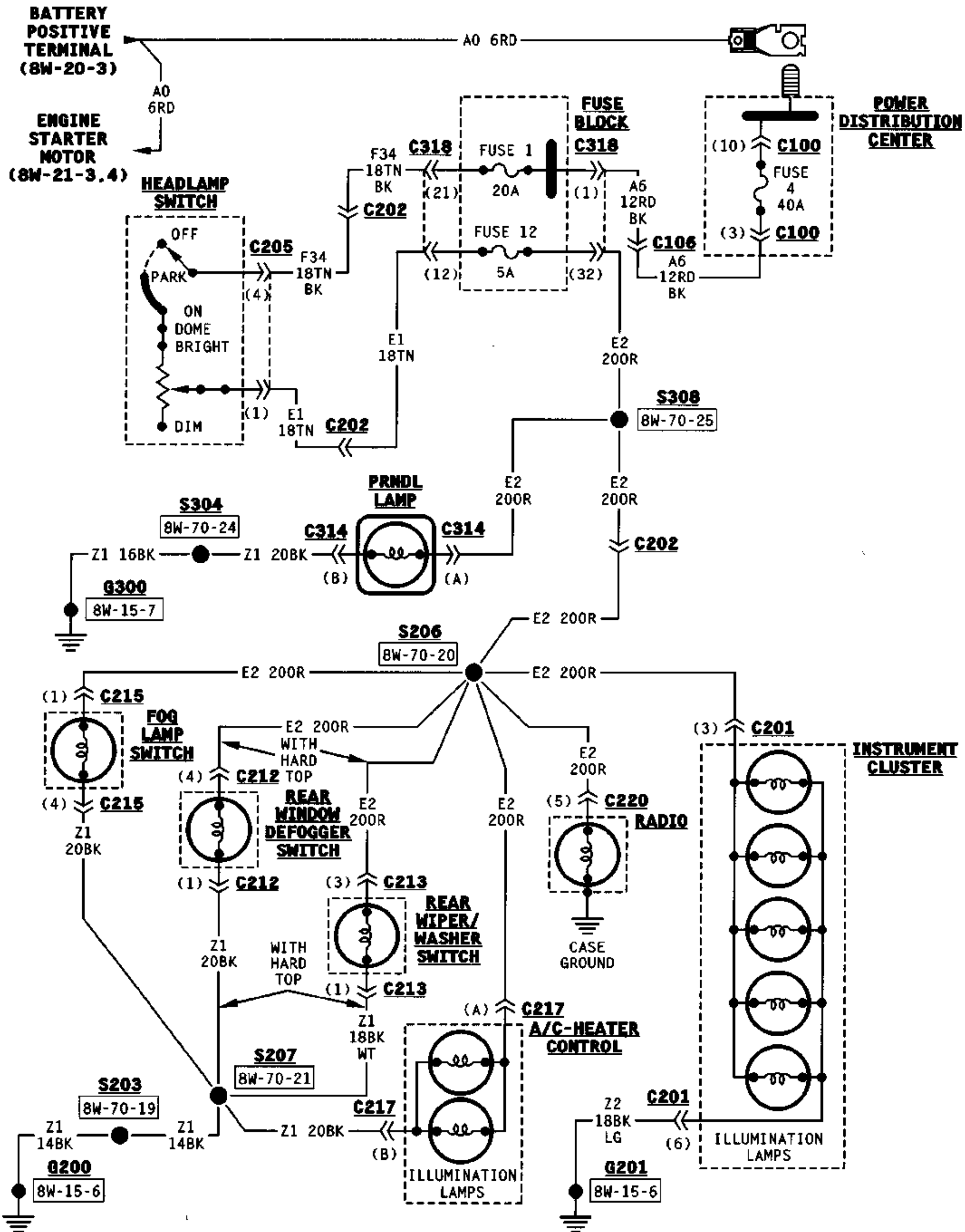
DIAGRAM INDEX


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(A14) C100
FUSE 17 10A
(A13) C100
M1 20PK WT
C108
M1 20PK WT
M1 20PK/WT
C203
(2) C105
UNDERHOOD LAMP
MERCURY SWITCH
(1) C105
S204
8W-70-19
LEFT COURTESY LAMP (8W-44-5)
RIGHT COURTESY LAMP (8W-44-5)
WITH ABS AND DRL
Z1 20BK
WITH ABS OR DRL
WITHOUT ABS AND DRL
Z1 18BK
Z1 20BK
G100
8W-15-3
S106
8W-70-6
WITH ABS OR ABS AND DRL
Z1 12BK
WITH DRL
Z1 16BK
WITH HARD TOP
WITH SOFT TOP
C323
WITH 2-SPKR SYS
WITH 4-SPKR SYS
(NOT USED)
S313
8W-70-27
C326
C325
DOME LAMP (8W-44-4)
SOUND BAR/DOME LAMP (8W-44-4)



BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
POWER DISTRIBUTION CENTER
(A14) C100
FUSE 17 10A
(A13) C100
M1 20PK WT
C108
M1 20PK/WT
UNDERHOOD LAMP (8W-44-3)
C203
S204 8W-70-19
LEFT COURTESY LAMP (8W-44-5)
RIGHT COURTESY LAMP (8W-44-5)
LEFT DOOR AJAR SWITCH (8W-44-5)
RIGHT DOOR AJAR SWITCH (8W-44-5)
M2 20YL
S301 8W-70-22
SPLICE S202 (8W-44-5) (8W-70-18)
C323
WITH HARD TOP
WITH SOFT TOP
WITH 2-SPKR SYS
WITH 4-SPKR SYS
S313 8W-70-27
(NOT USED)
C326
C325
DOME LAMP
(1) C402
(2) C402
SOUND BAR/DOME LAMP
M2 20YL
S314 8W-70-28
NOT USED


SPLICE
S204
(8W-44-3,4)
(8W-70-19)
SPLICE
S301
(8W-44-4)
(8W-70-22)
M1
20PK
WT
(A) C207
(A) C209
LEFT COURTESY LAMP
RIGHT COURTESY LAMP
(B) C207
(B) C209
M2
20YL
C203
S202
8W-70-18
SPLICE
S305
(8W-70-24)
G16
20BK
LB
(3) (2) C303
LEFT DOOR AJAR SWITCH
(2) C317
RIGHT DOOR AJAR SWITCH
(1) C303
(1) C317
M23
20YL
BK
(3) C205
HEADLAMP SWITCH
DOME
BLACK
(24) C318
FUSE BLOCK
FUSE
4
10A
(4) C318
Z1
14BK
S203
8W-70-19
G200
8W-15-6
Z1
20BK
S304
8W-70-24
Z1
16BK
G300
8W-15-7


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
FUSE BLOCK
POWER DISTRIBUTION CENTER
C318
F34 18TN BK
FUSE 1 20A
(21)
(1)
A6 12RD BK
(10) C100
FUSE 4 40A
(3) C100
C106
A6 12RD BK
C202
FUSE 12 5A
(12)
(32)
HEADLAMP SWITCH
OFF
PARK
ON
DOME
BRIGHT
DIM
C205
(4)
F34 18TN BK
(1)
E1 18TN
C202
E1 18TN
E2 200R
S308
8W-70-25
PRNDL LAMP
C314
(B)
(A)
S304
8W-70-24
Z1 16BK
Z1 20BK
G300
8W-15-7
E2 200R
C202
E2 200R
S206
8W-70-20
(1) C215
FOG LAMP SWITCH
(4) C215
Z1 20BK
WITH HARD TOP
(4) C212
REAR WINDOW DEFOGGER SWITCH
(1) C212
(3) C213
REAR WIPER/ WASHER SWITCH
(1) C213
Z1 18BK WT
(5) C220
RADIO
CASE GROUND
(3) C201
INSTRUMENT CLUSTER
ILLUMINATION LAMPS
(A) C217
A/C-HEATER CONTROL
(B)
ILLUMINATION LAMPS
S207
8W-70-21
S203
8W-70-19
Z1 14BK
G200
8W-15-6
C201
Z2 18BK LG
(6)
G201
8W-15-6

8W-47 AUDIO SYSTEM

DESCRIPTION AND OPERATION

RADIO

When the ignition switch is in the ACCESSORY or RUN position, it connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A31. Circuit A31 feeds circuit X12 through fuse 15 in the fuse block. Circuit X12 powers the radio.

The radio has a dedicated ground that connects to a lug at the rear of the radio. The antenna connects to the rear of the radio.

RADIO MEMORY

Circuit M1 from the Ignition Off Draw (IOD) fuse in cavity 17 of the Power Distribution Center (PDC) supplies power for the radio memory. Circuit M1 is HOT at all times.

The IOD fuse is removed during vehicle shipping to prevent excessive battery draw.

RADIO ILLUMINATION

When the parking lamps or headlamps are ON, circuit L7 provides the illumination signal to the radio. Also when the headlamps or parking lamps are ON, circuit E2 provides the illumination intensity signal to the radio.

SPEAKERS

There are different radio packages. The standard radio package includes 2 speakers in the instrument panel. The optional four speaker system has a sound bar with two speakers in addition to the instrument panel speakers.

Circuit X53 feeds the left speaker in the instrument panel. Circuit X55 is the return from the speaker to the radio.

Circuit X54 feeds the right speaker in the instrument panel. Circuit X56 is the return from the speaker to the radio.

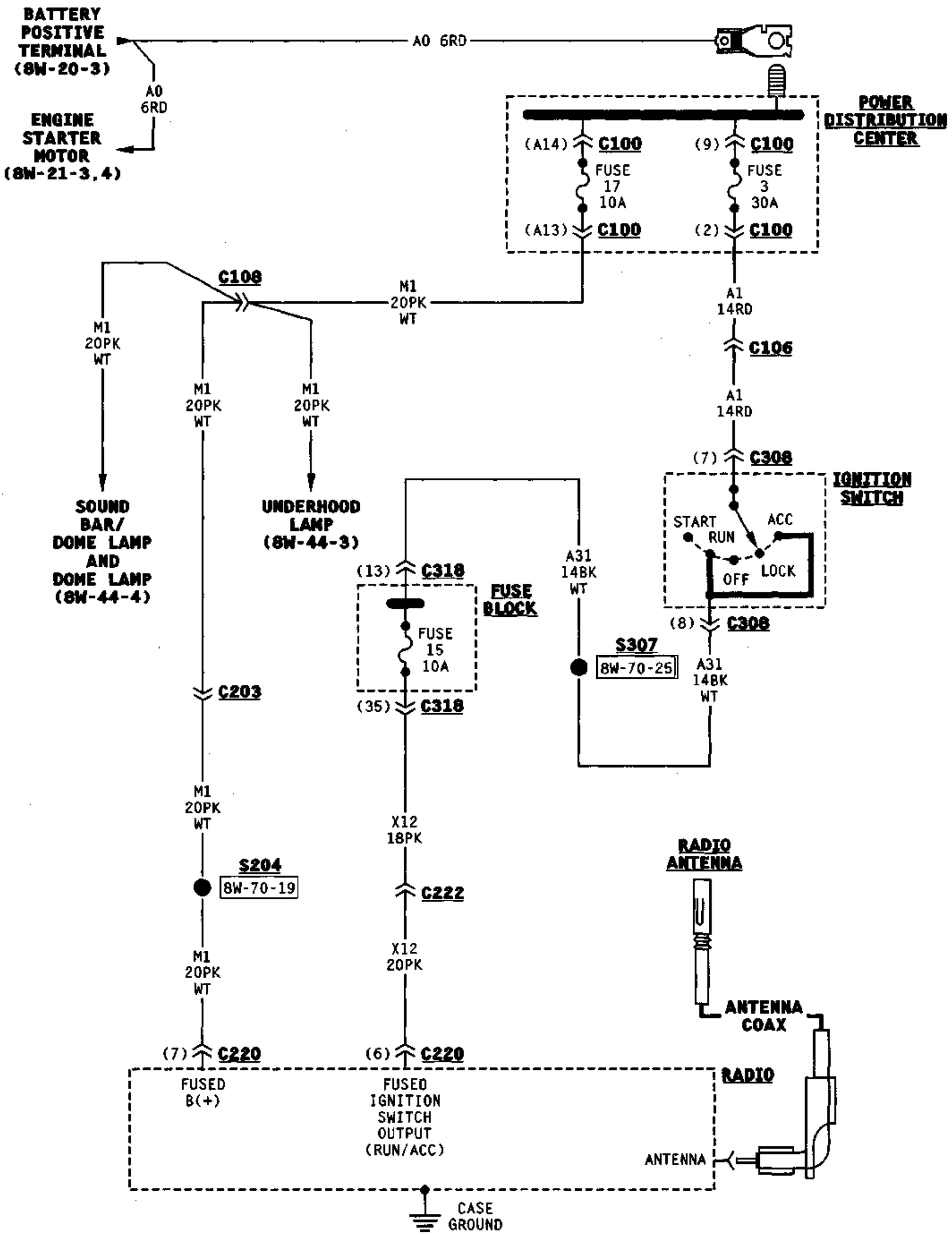
If equipped with a sound bar, circuit X51 feeds the left sound bar speaker. Circuit X57 is the return from the speaker to the radio. Circuit X52 feeds the right sound bar speaker. Circuit X58 is the return from the speaker to the radio.

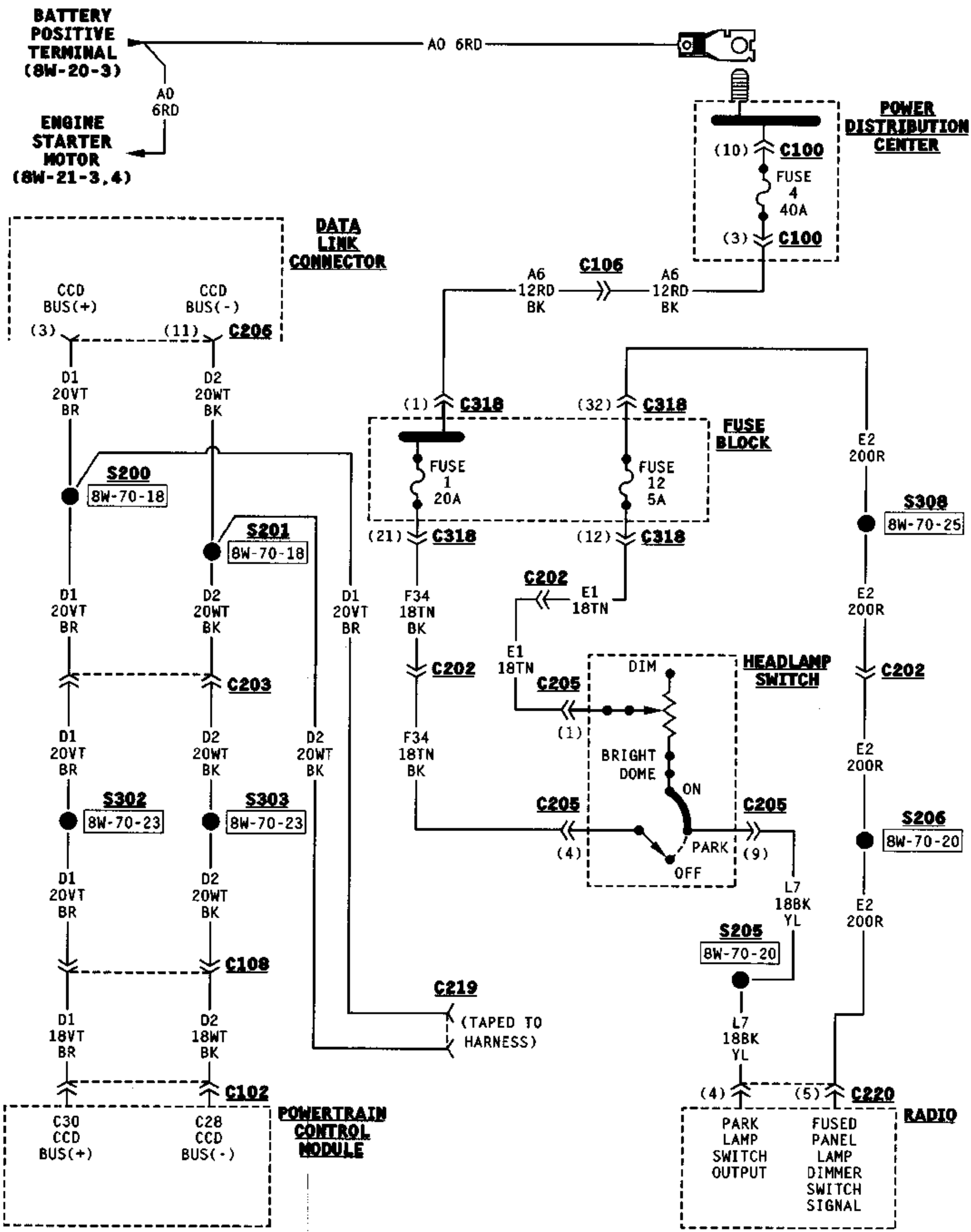
SCHEMATICS AND DIAGRAMS

WIRING DIAGRAM INDEX

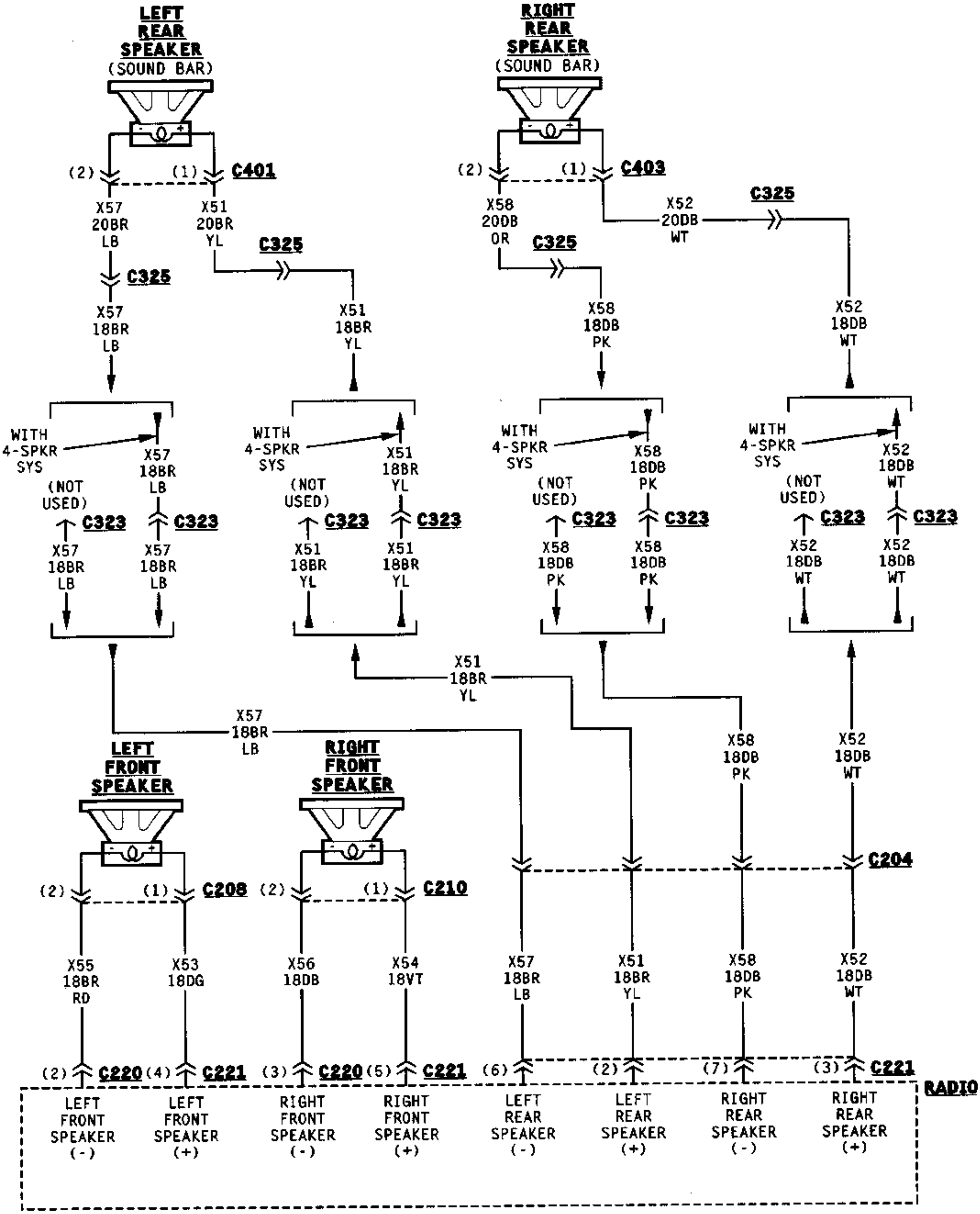
The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

DIAGRAM INDEX


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
POWER DISTRIBUTION CENTER
(A14) C100
FUSE 17 10A
(A13) C100
(9) C100
FUSE 3 30A
(2) C100
C108
M1 20PK WT
M1 20PK WT
M1 20PK WT
M1 20PK WT
SOUND BAR/ DOME LAMP AND DOME LAMP (8W-44-4)
UNDERHOOD LAMP (8W-44-3)
A1 14RD
C106
A1 14RD
(7) C308
IGNITION SWITCH
START
RUN
ACC
OFF
LOCK
(8) C308
A31 14BK WT
(13) C318
FUSE BLOCK
FUSE 15 10A
(35) C318
A31 14BK WT
S307
8W-70-25
C203
M1 20PK WT
S204
8W-70-19
M1 20PK WT
X12 18PK
C222
X12 20PK
RADIO ANTENNA
ANTENNA COAX
(7) C220
(6) C220
RADIO
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (RUN/ACC)
ANTENNA
CASE GROUND



BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
POWER DISTRIBUTION CENTER
(10) C100
FUSE 4 40A
(3) C100
A6 12RD BK
C106
DATA LINK CONNECTOR
CCD BUS(+)
CCD BUS(-)
(3)
(11) C206
D1 20VT BR
D2 20WT BK
S200 8W-70-18
S201 8W-70-18
C203
S302 8W-70-23
S303 8W-70-23
C108
D1 18VT BR
D2 18WT BK
C102
C30 CCD BUS(+)
C28 CCD BUS(-)
POWERTRAIN CONTROL MODULE
C219
(TAPED TO HARNESS)
(1) C318
(32) C318
FUSE BLOCK
FUSE 1 20A
FUSE 12 5A
(21) C318
(12) C318
F34 18TN BK
C202
E1 18TN
HEADLAMP SWITCH
DIM
C205
(1)
BRIGHT
DOME
ON
PARK
OFF
(4)
(9)
L7 18BK YL
S205 8W-70-20
E2 20OR
S308 8W-70-25
S206 8W-70-20
(4)
(5) C220
RADIO
PARK LAMP SWITCH OUTPUT
FUSED PANEL LAMP DIMMER SWITCH SIGNAL


LEFT REAR SPEAKER
(SOUND BAR)
RIGHT REAR SPEAKER
(SOUND BAR)
C401
C403
C325
C323
C204
C208
C210
C220
C221
WITH 4-SPKR SYS
(NOT USED)
X57 20BR LB
X51 20BR YL
X58 20DB OR
X52 20DB WT
X57 18BR LB
X51 18BR YL
X58 18DB PK
X52 18DB WT
LEFT FRONT SPEAKER
RIGHT FRONT SPEAKER
X55 18BR RD
X53 18DG
X56 18DB
X54 18VT
RADIO
LEFT FRONT SPEAKER (-)
LEFT FRONT SPEAKER (+)
RIGHT FRONT SPEAKER (-)
RIGHT FRONT SPEAKER (+)
LEFT REAR SPEAKER (-)
LEFT REAR SPEAKER (+)
RIGHT REAR SPEAKER (-)
RIGHT REAR SPEAKER (+)

8W-48 REAR WINDOW DEFOGGER

DESCRIPTION AND OPERATION

REAR WINDOW DEFOGGER

When the ignition switch is in the START or RUN position, it connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A21. Circuit A21 feeds circuit F12 through fuse 11 in the fuse block. Circuit F12 powers the coil side of the rear window defogger relay.

When the operator presses the rear window defogger switch, the switch contacts momentarily CLOSE. When closed, the switch contacts connect circuit C80 from the instrument cluster microprocessor to ground on circuit Z1. After it senses ground on circuit C80, the microprocessor energizes the rear window defogger relay by providing ground for the relay coil on circuit C81.

When the rear window defogger relay energizes, it connects circuit A4 from PDC fuse 15 to circuit C15. Circuit C15 splices to power the rear window defogger grid and the indicator lamp in the rear window defogger switch. Circuit Z1 provides ground for the rear window defogger grid and the indicator lamp in the rear window defogger switch.

HELPFUL INFORMATION

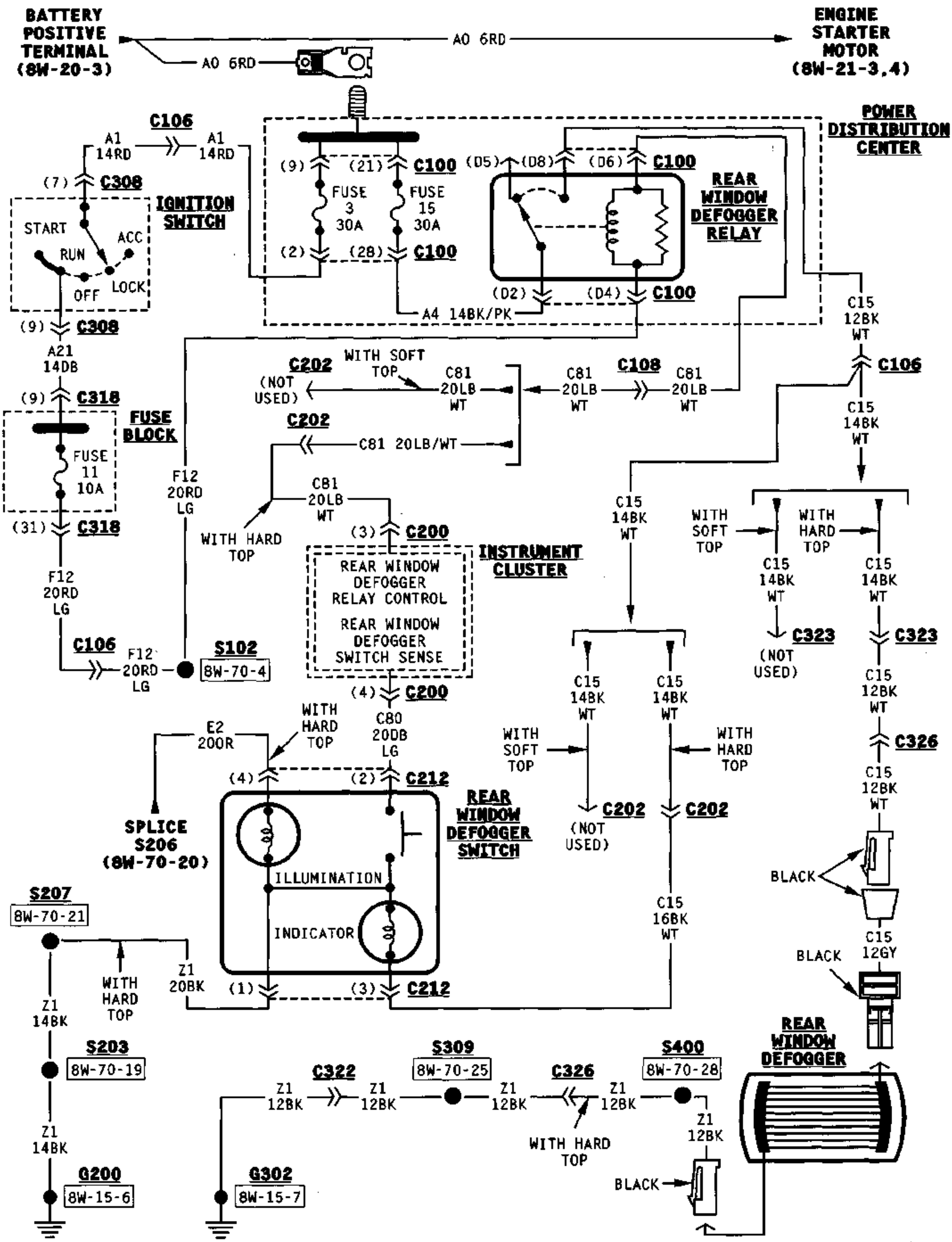
- Check for broken grid lines on the window.
- Check for a broken bus bar or disconnected leads at the rear window.
- Check for a good ground at the rear window defogger grid.

SCHEMATICS AND DIAGRAMS

WIRING DIAGRAM INDEX

The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

DIAGRAM INDEX



BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
POWER DISTRIBUTION CENTER
C106
A1 14RD
A1 14RD
(7) C308
IGNITION SWITCH
START
RUN
ACC
OFF
LOCK
(9) C308
A21 14DB
(9) C318
FUSE BLOCK
FUSE 11 10A
(31) C318
F12 20RD LG
C106
F12 20RD LG
S102
8W-70-4
F12 20RD LG
(9)
(21) C100
FUSE 3 30A
FUSE 15 30A
(2)
(28) C100
A4 14BK/PK
(D5)
(D8)
(D6) C100
REAR WINDOW DEFOGGER RELAY
(D2)
(D4) C100
C15 12BK WT
C106
C15 14BK WT
C202
(NOT USED)
WITH SOFT TOP
C81 20LB WT
C81 20LB WT
C108
C81 20LB WT
C202
C81 20LB/WT
WITH HARD TOP
C81 20LB WT
(3) C200
INSTRUMENT CLUSTER
REAR WINDOW DEFOGGER RELAY CONTROL
REAR WINDOW DEFOGGER SWITCH SENSE
(4) C200
C80 20DB LG
E2 20OR
WITH HARD TOP
SPLICE S206 (8W-70-20)
(4)
(2) C212
REAR WINDOW DEFOGGER SWITCH
ILLUMINATION
INDICATOR
(1)
(3) C212
S207
8W-70-21
WITH HARD TOP
Z1 20BK
Z1 14BK
S203
8W-70-19
Z1 14BK
G200
8W-15-6
C15 14BK WT
C15 14BK WT
C15 14BK WT
WITH SOFT TOP
WITH HARD TOP
C202
(NOT USED)
C202
C15 16BK WT
WITH SOFT TOP
WITH HARD TOP
C15 14BK WT
C15 14BK WT
C323
(NOT USED)
C323
C15 12BK WT
C326
C15 12BK WT
BLACK
C15 12GY
BLACK
REAR WINDOW DEFOGGER
C322
Z1 12BK
Z1 12BK
S309
8W-70-25
Z1 12BK
C326
Z1 12BK
S400
8W-70-28
Z1 12BK
WITH HARD TOP
BLACK
G302
8W-15-7

8W-50 FRONT LIGHTING

INDEX

DESCRIPTION AND OPERATION

PARKING LAMPS

Circuit A6 from fuse 4 in the Power Distribution Center (PDC) powers circuit F34 through fuse 1 in the fuse block. When the headlamp switch is in the PARK lamp or ON position, it connects circuit F34 to circuit L7. Circuit L7 powers the parking lamps and side marker lamps.

HELPFUL INFORMATION

Circuit L7 also provides the illumination lamp signal to radio. If the vehicle is equipped with factory installed fog lamps, circuit L7 also feeds the contact side of fog lamp relay number two (2).

HEADLAMPS

HEADLAMP SWITCH IN ON POSITION

The headlamp switch has three positions: ON, PARK (parking lamps) and OFF. In the ON position, the headlamp switch connects circuit A3 from fuse 10 in the Power Distribution Center (PDC) to circuit L2. Circuit L2 connects to circuit L4 through the dimmer switch circuitry in the multi-function switch. Circuit L4 powers the low beam of the headlamps.

When the operator selects high beam operation, the multi-function switch connects circuit L2 to circuit L3. Circuit L3 powers high beam operation. Circuit Z1 provides ground for the headlamps.

HEADLAMP SWITCH IN OFF OR PARKING LAMP POSITION

The headlamps switch contains an internal circuit breaker that connects circuit A3 to circuit L20. Circuit L20 connects to the multi-function switch. When the operator momentarily flashes the high beams of the headlamps with the turn signal lever, circuit L20 connects to circuit L3. Circuit L3 feeds the high beams of the headlamps.

FOG LAMPS

The fog lamps are controlled by the fog lamp switch and two fog lamp relays. The fog lamps operate only when the headlamp switch is in the PARK or ON position, and the operator has selected low-beam operation. When the headlamps are in high-beam operation, the fog lamps will not operate.

Circuit A6 from fuse 4 in the Power Distribution Center (PDC) feeds circuit F61 through fuse 3 in the fuse block. Circuit F61 powers the contact side of fog lamp relay number one (1).

When the headlamp switch is in the PARK or ON position, circuit L7 from the switch connects to circuit L95 through the contacts in fog lamp relay number two (2). When the fog lamp switch closes, it connects circuit L95 to circuit L35. Circuit L35 powers the coil side of fog lamp relay number one (1). Circuit Z1 provides ground for the coil side of fog lamp relay number one (1).

When the fog lamp switch CLOSES and the headlamps are on but not on high beam, the contacts in fog lamp relay number one (1) CLOSE and connect circuit F61 to circuit L39. Circuit L39 powers the fog lamps. Circuit Z1 provides ground for the fog lamps.

If the high beam lamps are ON, circuit G34 energizes fog lamp relay number two (2). When fog lamp relay number two (2) energizes, its contacts open and disconnect circuits L7 and L95. Disconnecting circuits L7 and L95 de-energizes fog lamp relay number one (1). When fog lamp relay number one (1) de-energizes, power is not supplied to the fog lamps.

Circuit E2 provides voltage for the illumination lamp in the fog lamp switch.

HELPFUL INFORMATION

Circuit L3 splices to power circuit G34. Circuit L3 powers the high beam circuit of the headlamps.

DAYTIME RUNNING LAMP (DRL) MODULE

On vehicles built for sale in Canada, the headlamps operate when the ignition switch is in the RUN position.

When the ignition switch is in the START or RUN position, circuit A1 from fuse 3 in the Power Distribution Center (PDC) connects to circuit A21. Circuit A21 powers circuit F12 through fuse 11 in the fuse

DESCRIPTION AND OPERATION (Continued)

block. Circuit F12 splices to supply power to the DRL module.

The headlamp switch connects circuit A3 from fuse 10 in the PDC to circuit L20. Circuits A3 and L20 are HOT at all times. Circuit L20 connects to the headlamp dimmer switch circuitry in the multi-function switch and to the DRL module.

The DRL module receives the vehicle speed sensor input from circuit G7. Circuit G34 from the DRL module provides power for the high beam indicator lamp in the instrument cluster.

When the headlamp switch is OFF and the ignition switch is in the START or RUN position, the DRL module powers the headlamps on circuit L3 at reduced intensity. When the headlamps are ON, the dimmer switch in the multi-function switch powers the low beams on circuit L4.

Circuit L3 feeds the high beams of the headlamps. When the operator flashes the headlamps with the stalk of the multi-function switch, the DRL senses voltage on circuit L3.

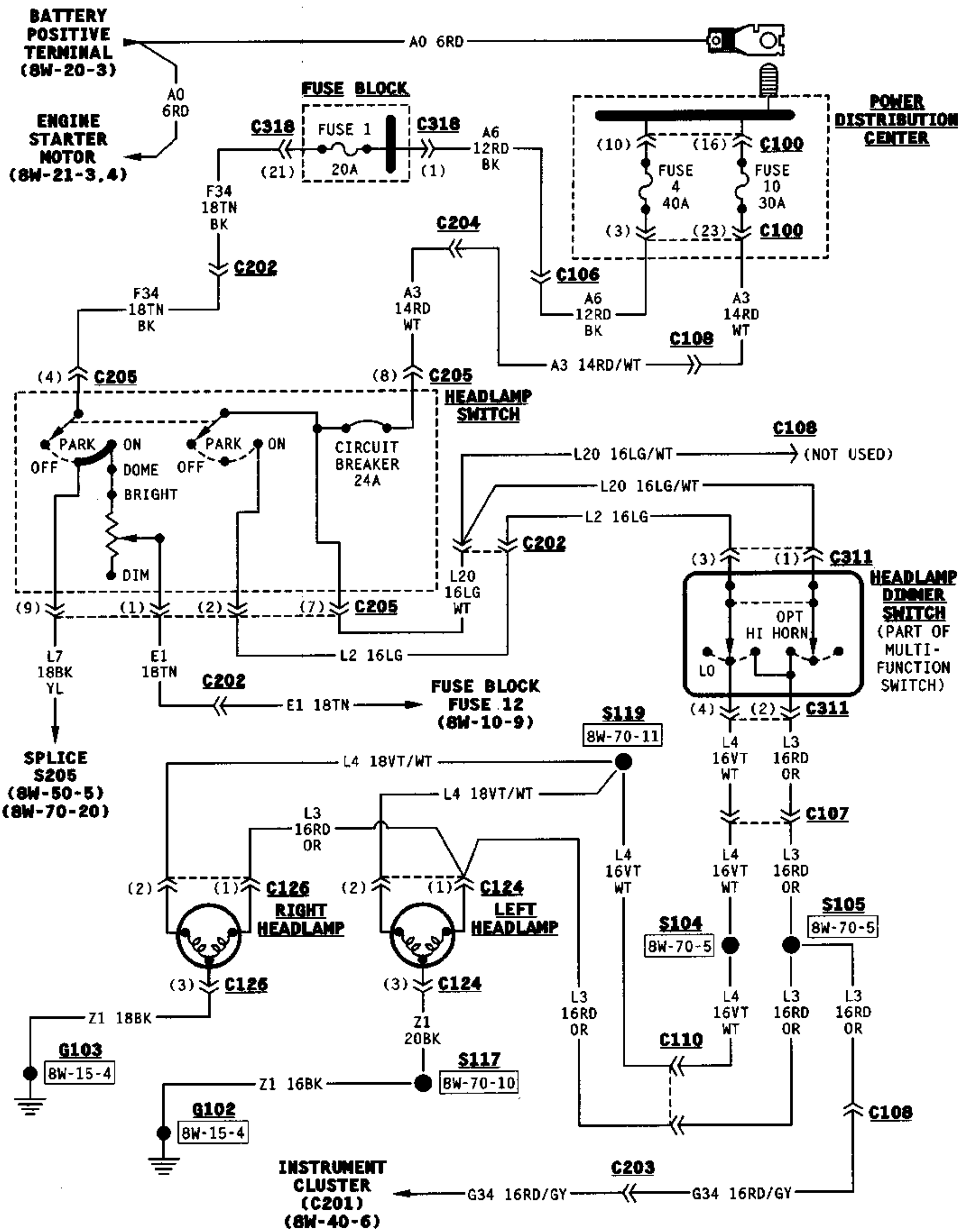
Circuit Z1 provides ground for the DRL module.

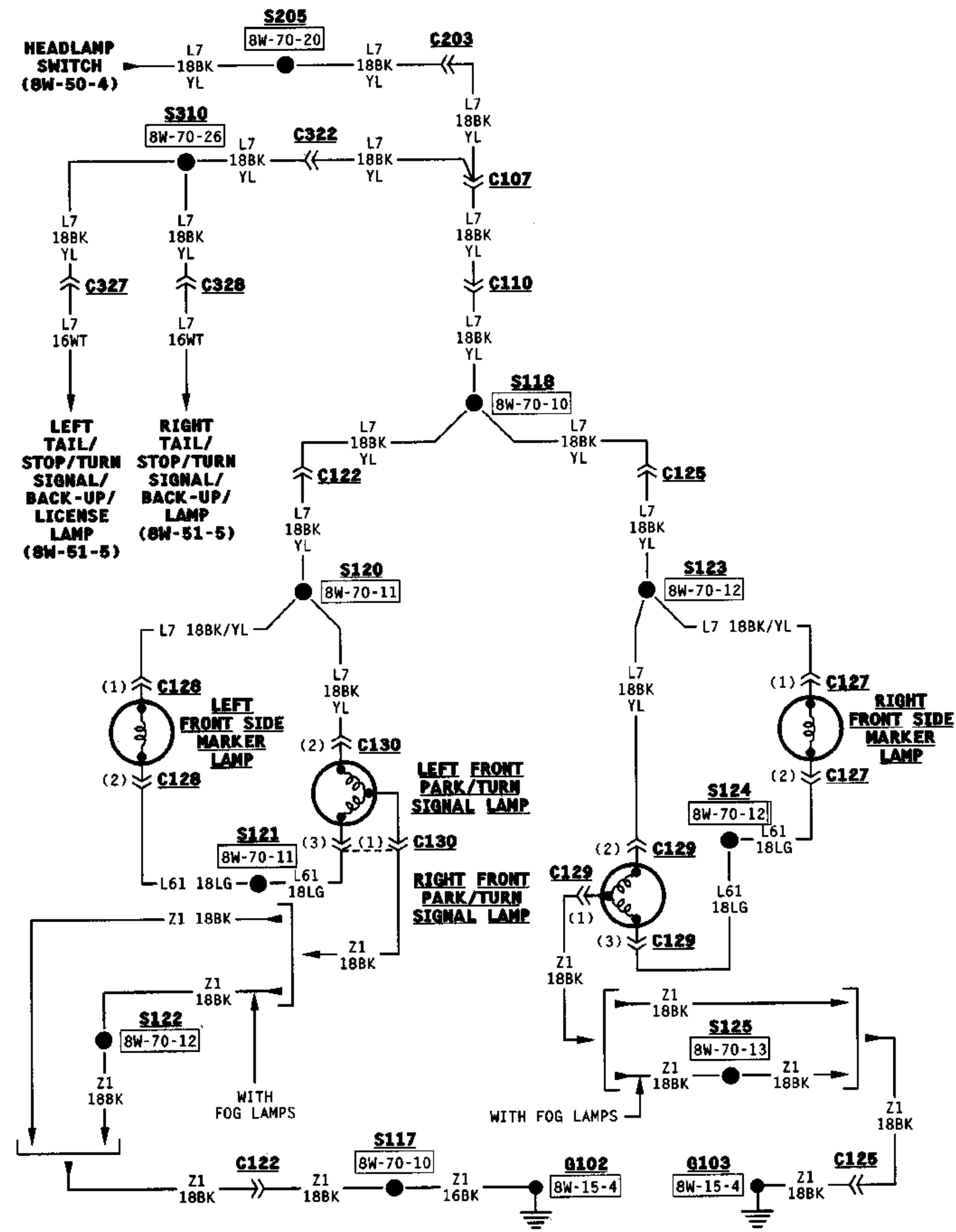
SCHEMATICS AND DIAGRAMS

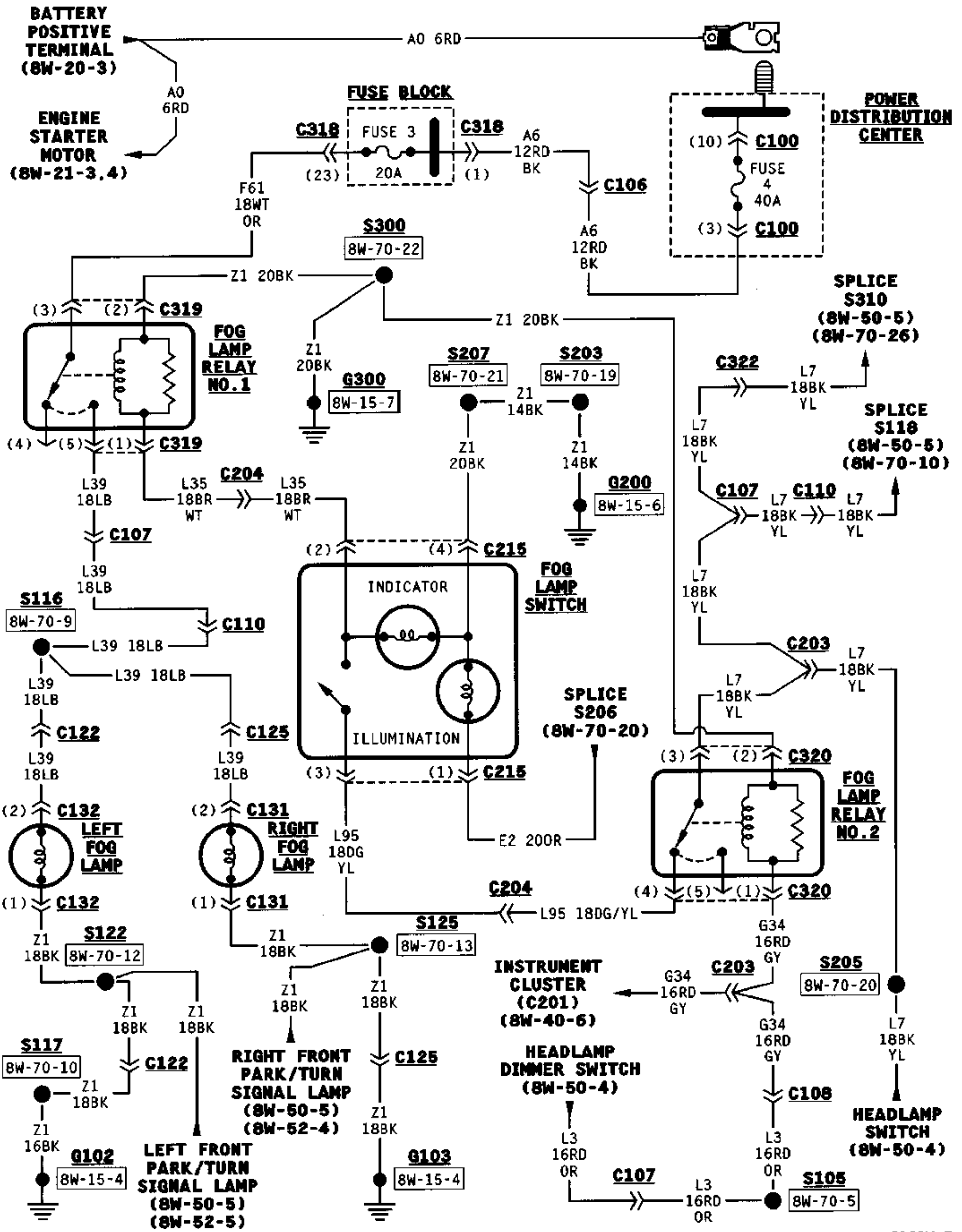
WIRING DIAGRAM INDEX

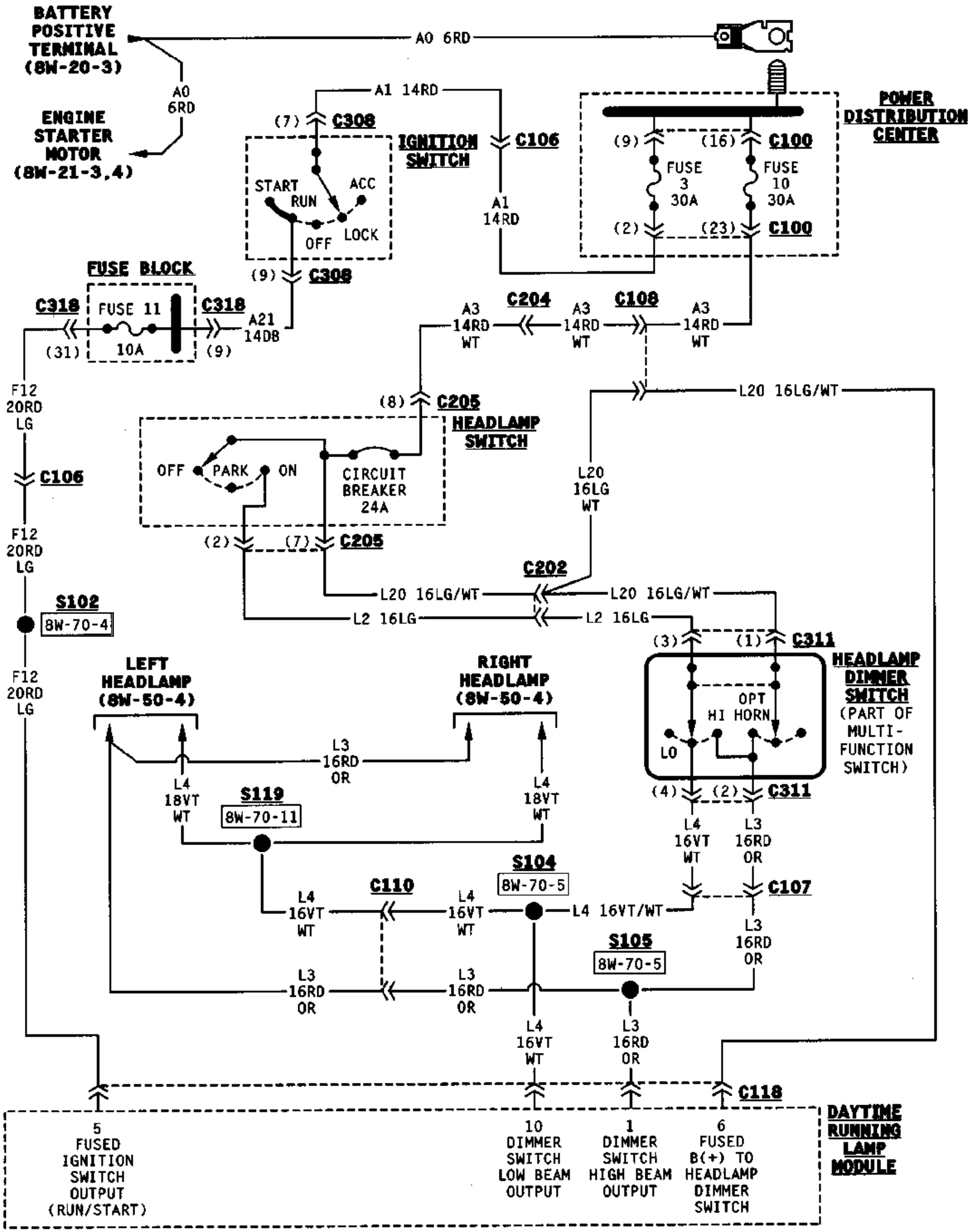
The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

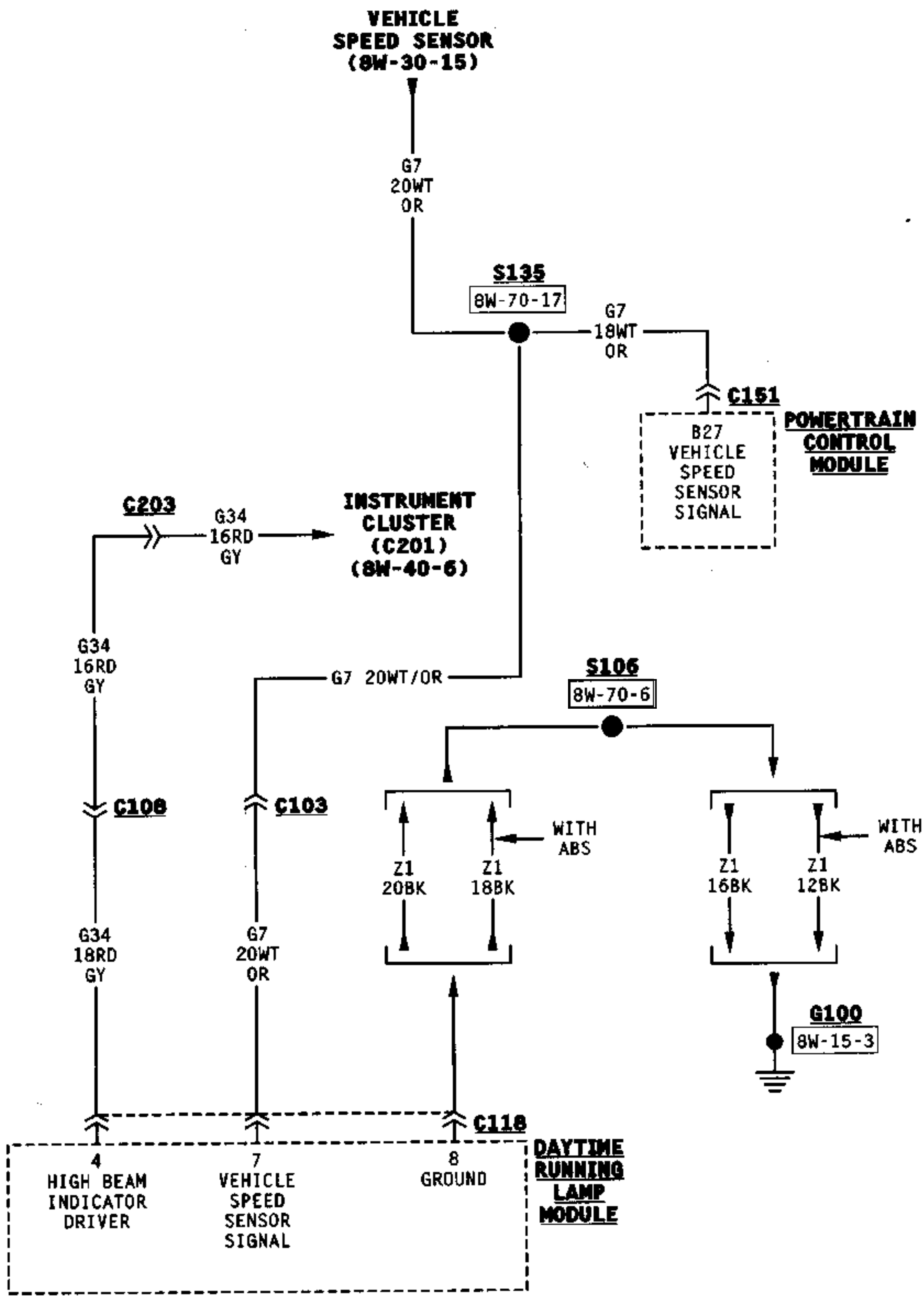
DIAGRAM INDEX


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
FUSE BLOCK
C318
FUSE 1
20A
(21)
(1)
A6 12RD BK
POWER DISTRIBUTION CENTER
(10)
(16)
C100
FUSE 4 40A
FUSE 10 30A
(3)
(23)
F34 18TN BK
C202
C204
A3 14RD WT
C106
A6 12RD BK
A3 14RD WT
C108
A3 14RD/WT
(4)
C205
(8)
HEADLAMP SWITCH
PARK
ON
OFF
DOME
BRIGHT
DIM
CIRCUIT BREAKER 24A
L20 16LG/WT
(NOT USED)
L2 16LG
(3)
(1)
C311
HEADLAMP DIMMER SWITCH (PART OF MULTI-FUNCTION SWITCH)
OPT
HI HORN
LO
(9)
(2)
(7)
L20 16LG WT
L7 18BK YL
E1 18TN
SPLICE S205 (8W-50-5) (8W-70-20)
E1 18TN
FUSE BLOCK FUSE 12 (8W-10-9)
S119
8W-70-11
L4 18VT/WT
L3 16RD OR
L4 16VT WT
C107
C126
RIGHT HEADLAMP
C124
LEFT HEADLAMP
S104
8W-70-5
S105
Z1 18BK
Z1 20BK
S117
8W-70-10
Z1 16BK
G103
8W-15-4
G102
C110
INSTRUMENT CLUSTER (C201) (8W-40-6)
C203
G34 16RD/GY


HEADLAMP SWITCH (8W-50-4)
S205
8W-70-20
C203
L7 18BK YL
S310
8W-70-26
C322
C107
C110
C327
C328
L7 16WT
LEFT TAIL/ STOP/TURN SIGNAL/ BACK-UP/ LICENSE LAMP (8W-51-5)
RIGHT TAIL/ STOP/TURN SIGNAL/ BACK-UP/ LAMP (8W-51-5)
S118
8W-70-10
C122
C125
S120
8W-70-11
S123
8W-70-12
L7 18BK/YL
C126
LEFT FRONT SIDE MARKER LAMP
C130
LEFT FRONT PARK/TURN SIGNAL LAMP
S121
8W-70-11
L61 18LG
RIGHT FRONT PARK/TURN SIGNAL LAMP
C127
RIGHT FRONT SIDE MARKER LAMP
S124
8W-70-12
C129
Z1 18BK
S122
8W-70-12
WITH FOG LAMPS
S125
8W-70-13
S117
8W-70-10
Z1 16BK
G102
8W-15-4
G103
8W-15-4


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
FUSE BLOCK
C318
FUSE 3 20A
(23)
(1)
A6 12RD BK
C106
POWER DISTRIBUTION CENTER
(10) C100
FUSE 4 40A
(3) C100
F61 18WT OR
S300 8W-70-22
Z1 20BK
G300 8W-15-7
(3) (2) C319
FOG LAMP RELAY NO.1
(4) (5) (1) C319
L39 18LB
L35 18BR WT
C204
C107
C110
S116 8W-70-9
S207 8W-70-21
S203 8W-70-19
Z1 14BK
G200 8W-15-6
(2) (4) C215
FOG LAMP SWITCH
INDICATOR
ILLUMINATION
(3) (1) C215
SPLICE S206 (8W-70-20)
E2 20OR
L95 18DG YL
L95 18DG/YL
C122
C125
(2) C132
LEFT FOG LAMP
(1) C132
(2) C131
RIGHT FOG LAMP
(1) C131
Z1 18BK
S122 8W-70-12
S125 8W-70-13
S117 8W-70-10
Z1 16BK
G102 8W-15-4
G103 8W-15-4
LEFT FRONT PARK/TURN SIGNAL LAMP (8W-50-5) (8W-52-5)
RIGHT FRONT PARK/TURN SIGNAL LAMP (8W-50-5) (8W-52-4)
SPLICE S310 (8W-50-5) (8W-70-26)
C322
L7 18BK YL
SPLICE S118 (8W-50-5) (8W-70-10)
C203
(3) (2) C320
FOG LAMP RELAY NO.2
(4) (5) (1) C320
G34 16RD GY
INSTRUMENT CLUSTER (C201) (8W-40-6)
S205 8W-70-20
HEADLAMP DIMMER SWITCH (8W-50-4)
HEADLAMP SWITCH (8W-50-4)
C108
L3 16RD OR
S105 8W-70-5


BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A1 14RD
(7) C308
IGNITION SWITCH
START
RUN
ACC
OFF
LOCK
(9) C308
C106
A1 14RD
POWER DISTRIBUTION CENTER
(9)
(16) C100
FUSE 3 30A
FUSE 10 30A
(2)
(23) C100
FUSE BLOCK
C318
FUSE 11 10A
C318
A21 14DB
(31)
(9)
A3 14RD WT
C204
A3 14RD WT
C108
A3 14RD WT
L20 16LG/WT
F12 20RD LG
(8) C205
HEADLAMP SWITCH
OFF
PARK
ON
CIRCUIT BREAKER 24A
C106
L20 16LG WT
F12 20RD LG
(2)
(7) C205
C202
L20 16LG/WT
L20 16LG/WT
L2 16LG
L2 16LG
S102
8W-70-4
F12 20RD LG
(3)
(1) C311
HEADLAMP DIMMER SWITCH (PART OF MULTI-FUNCTION SWITCH)
OPT
HI HORN
LO
LEFT HEADLAMP (8W-50-4)
RIGHT HEADLAMP (8W-50-4)
L3 16RD OR
L4 18VT WT
S119
8W-70-11
L4 18VT WT
(4)
(2) C311
L4 16VT WT
L3 16RD OR
S104
8W-70-5
C110
L4 16VT WT
L4 16VT WT
L4 16VT/WT
C107
L3 16RD OR
S105
8W-70-5
L3 16RD OR
L3 16RD OR
L4 16VT WT
L3 16RD OR
C118
DAYTIME RUNNING LAMP MODULE
5 FUSED IGNITION SWITCH OUTPUT (RUN/START)
10 DIMMER SWITCH LOW BEAM OUTPUT
1 DIMMER SWITCH HIGH BEAM OUTPUT
6 FUSED B(+) TO HEADLAMP DIMMER SWITCH


VEHICLE SPEED SENSOR (8W-30-15)
G7 20WT OR
S135
8W-70-17
G7 18WT OR
C151
B27 VEHICLE SPEED SENSOR SIGNAL
POWERTRAIN CONTROL MODULE
C203
G34 16RD GY
INSTRUMENT CLUSTER (C201) (8W-40-6)
G34 16RD GY
G7 20WT/OR
S106
8W-70-6
C108
C103
WITH ABS
Z1 20BK
Z1 18BK
Z1 16BK
Z1 12BK
WITH ABS
G34 18RD GY
G7 20WT OR
G100
8W-15-3
C118
4 HIGH BEAM INDICATOR DRIVER
7 VEHICLE SPEED SENSOR SIGNAL
8 GROUND
DAYTIME RUNNING LAMP MODULE

8W-51 REAR LIGHTING

DIAGNOSIS AND TESTING

TAIL LAMPS AND REAR LICENSE PLATE LAMPS

Circuit A6 from fuse 4 in the Power Distribution Center (PDC) powers circuit F34 through fuse 1 in the fuse block. When the headlamp switch is in the PARK lamp or ON position, it connects circuit F34 to circuit L7. Circuit L7 powers the parking lamps, tail lamps, rear license plate lamp and side marker lamps. The tail lamps are case grounded.

HELPFUL INFORMATION

Circuit L7 also provides the illumination lamp signal to the radio. If the vehicle is equipped with factory installed fog lamps, circuit L7 also feeds the contact side of fog lamp relay number two (2).

STOP LAMPS AND CHMSL LAMPS

Circuit A6 from fuse 4 in the Power Distribution Center (PDC) feeds circuit F32 through fuse 2 in the fuse block. Circuit F32 connects to the stop lamp switch.

When the operator presses the brake pedal, the stop lamp switch CLOSES and connects circuit F32 to circuit L50. Circuit L50 connects to the stop lamps and Center High Mounted Stop Lamps (CHMSL). Circuit Z1 provides a ground for the CHMSL lamps. The stop lamps are case grounded

HELPFUL INFORMATION

- Check fuse 4 in the PDC and fuse 2 in the fuse block.
- Check for continuity across the stop lamp switch when it is closed.

BACK-UP LAMPS

In the RUN position, the ignition switch connects circuit A2 from fuse 2 in the Power Distribution Center (PDC) to circuit A22. Circuit A22 feeds circuit F20 through fuse 7 in the fuse block.

Circuit F20 supplies power to the back-up lamp switch. On automatic transmission equipped vehicles, the back-up lamp switch circuitry is part of the PARK/NEUTRAL position switch. When the operator puts the transmission in REVERSE, the back-up lamp switch connects circuit F20 to circuit L1. Circuit L1 feeds the back-up lamps. Circuit Z1 provides ground for the back-up lamps.

HELPFUL INFORMATION

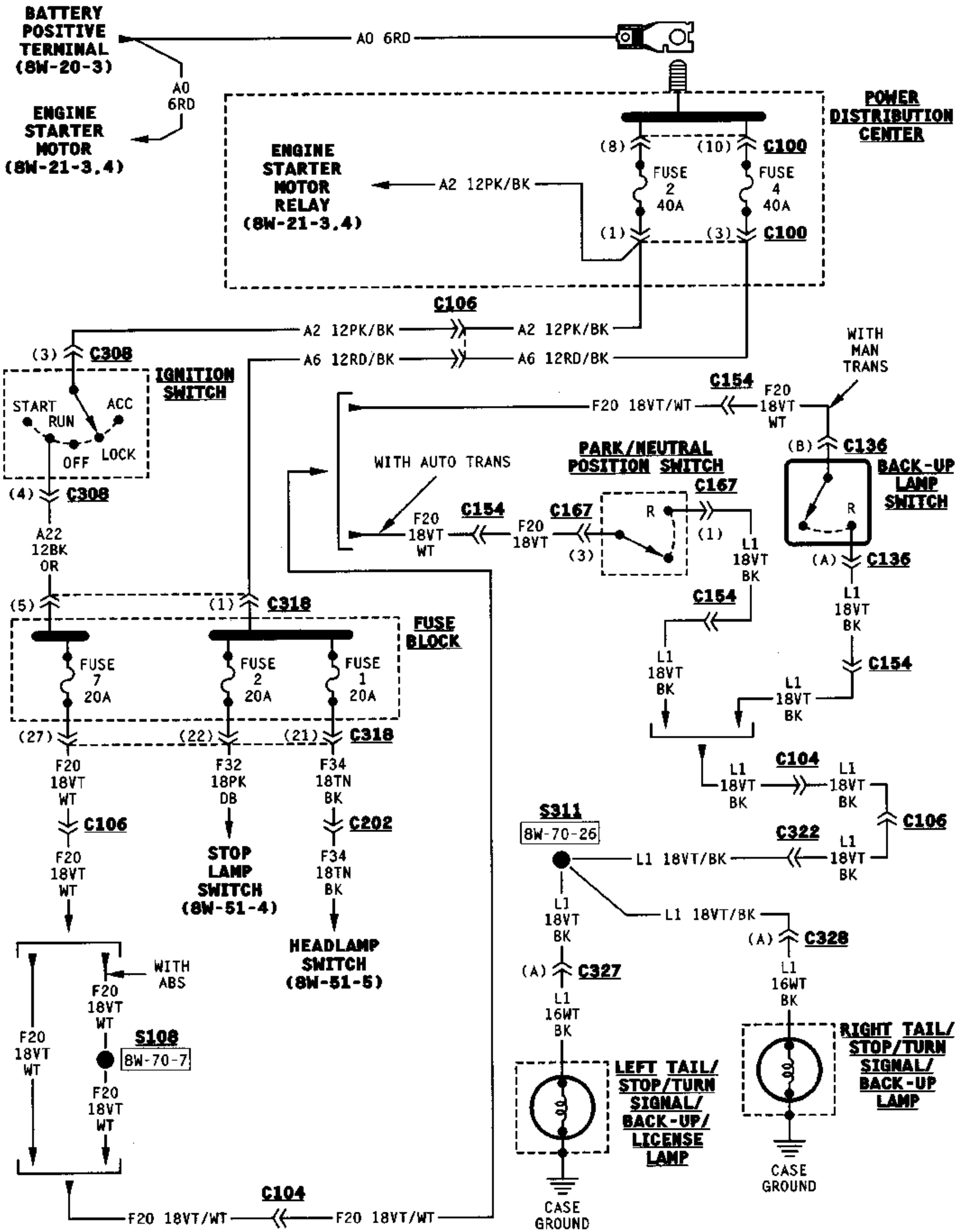
- Check fuse 2 in the PDC and fuse 7 in the fuse block.
- Check for continuity across the back-up lamp switch when it is closed.

SCHEMATICS AND DIAGRAMS

WIRING DIAGRAM INDEX

The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

DIAGRAM INDEX



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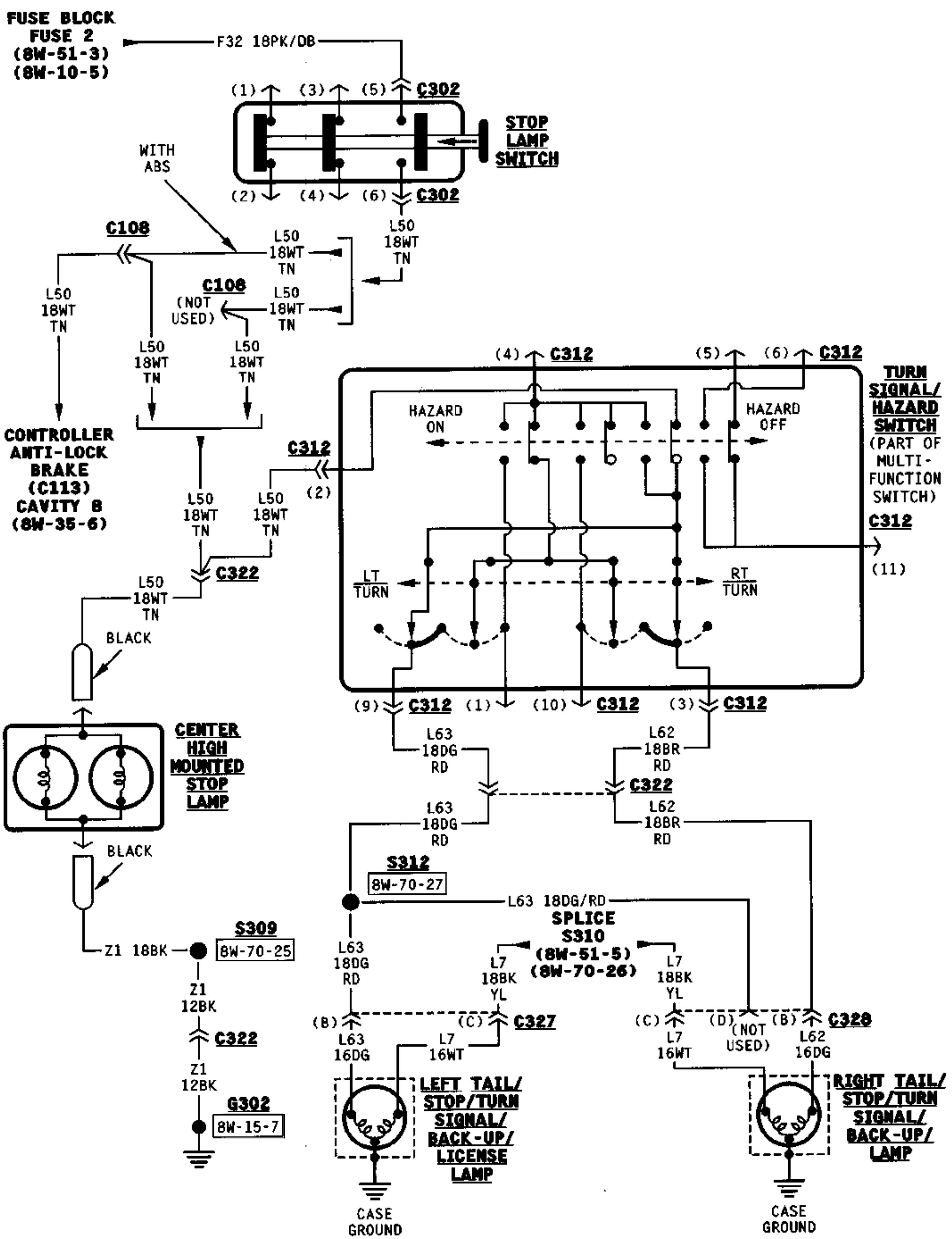

FUSE BLOCK FUSE 2 (8W-51-3) (8W-10-5)
F32 18PK/DB
(1) (3) (5) C302
STOP LAMP SWITCH
(2) (4) (6) C302
WITH ABS
C108
L50 18WT TN
C108 (NOT USED)
L50 18WT TN
CONTROLLER ANTI-LOCK BRAKE (C113) CAVITY B (8W-35-6)
C312
(2)
L50 18WT TN
C322
L50 18WT TN
BLACK
CENTER HIGH MOUNTED STOP LAMP
BLACK
Z1 18BK
S309
8W-70-25
Z1 12BK
C322
Z1 12BK
G302
8W-15-7
(4) C312
(5) (6) C312
TURN SIGNAL/ HAZARD SWITCH (PART OF MULTI-FUNCTION SWITCH)
HAZARD ON
HAZARD OFF
C312
(11)
LT TURN
RT TURN
(9) C312 (1) (10) C312 (3) C312
L63 18DG RD
L62 18BR RD
C322
L63 18DG RD
L62 18BR RD
S312
8W-70-27
L63 18DG/RD
SPLICE S310 (8W-51-5) (8W-70-26)
L63 18DG RD
L7 18BK YL
L7 18BK YL
(B) (C) C327
L63 16DG
L7 16WT
(C) (D) (NOT USED) (B) C328
L7 16WT
L62 16DG
LEFT TAIL/ STOP/TURN SIGNAL/ BACK-UP/ LICENSE LAMP
RIGHT TAIL/ STOP/TURN SIGNAL/ BACK-UP/ LAMP
CASE GROUND
CASE GROUND

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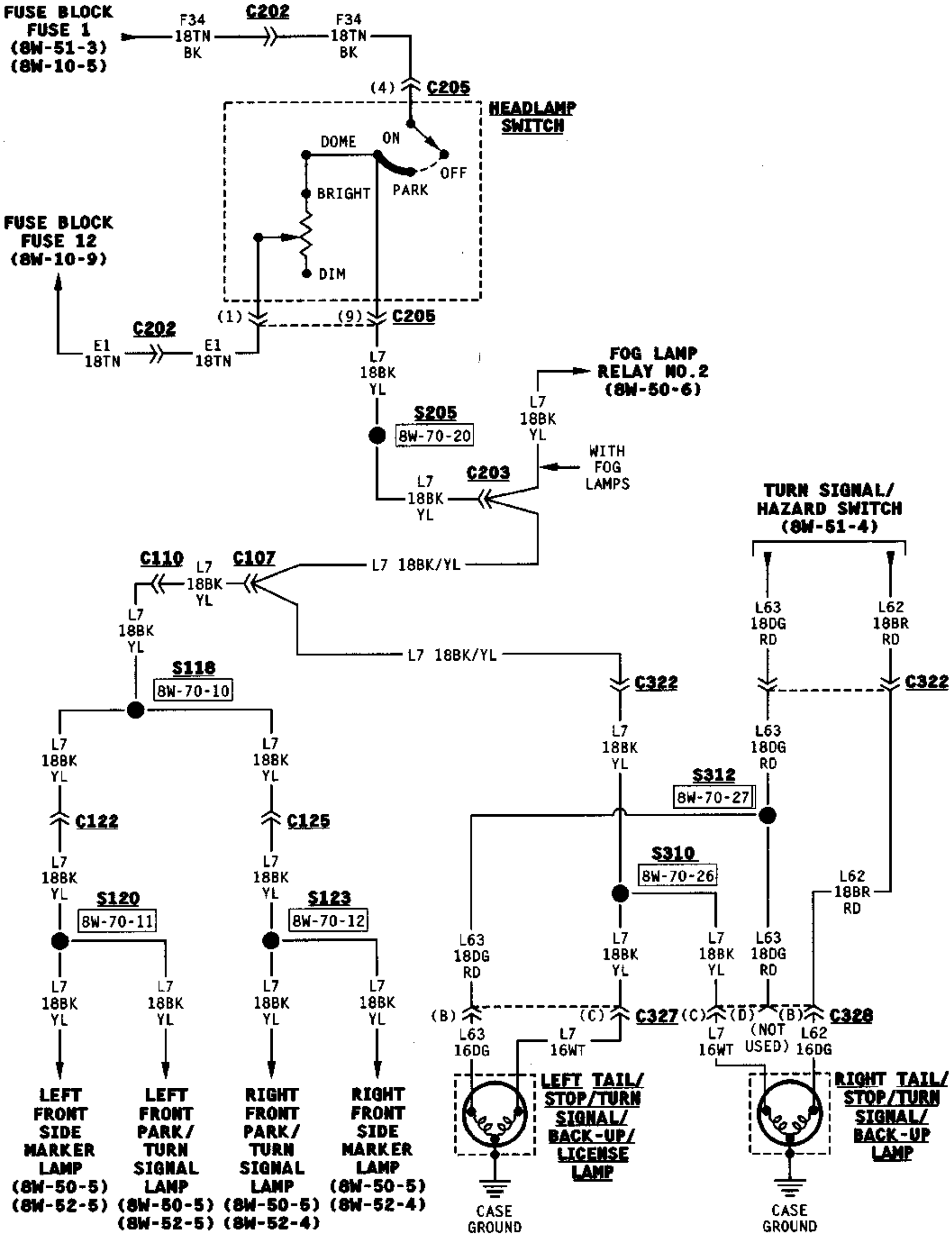

FUSE BLOCK
FUSE 1
(8W-51-3)
(8W-10-5)
F34
18TN
BK
C202
F34
18TN
BK
(4)
C205
HEADLAMP SWITCH
DOME
ON
OFF
BRIGHT
PARK
DIM
FUSE BLOCK
FUSE 12
(8W-10-9)
(1)
(9)
C205
C202
E1
18TN
E1
18TN
L7
18BK
YL
S205
8W-70-20
FOG LAMP
RELAY NO.2
(8W-50-6)
L7
18BK
YL
WITH
FOG
LAMPS
C203
L7
18BK
YL
TURN SIGNAL/
HAZARD SWITCH
(8W-51-4)
C110
C107
L7 18BK/YL
L7
18BK
YL
L63
18DG
RD
L62
18BR
RD
L7 18BK/YL
C322
C322
S118
8W-70-10
L7
18BK
YL
C122
C125
S312
8W-70-27
S310
8W-70-26
S120
8W-70-11
S123
8W-70-12
L63
18DG
RD
L7
18BK
YL
L62
18BR
RD
(B)
(C)
C327
(C)
(D)
(NOT USED)
(B)
C328
L63
16DG
L7
16WT
L62
16DG
LEFT
FRONT
SIDE
MARKER
LAMP
(8W-50-5)
(8W-52-5)
LEFT
FRONT
PARK/
TURN
SIGNAL
LAMP
(8W-50-5)
(8W-52-5)
RIGHT
FRONT
PARK/
TURN
SIGNAL
LAMP
(8W-50-5)
(8W-52-4)
RIGHT
FRONT
SIDE
MARKER
LAMP
(8W-50-5)
(8W-52-4)
LEFT TAIL/
STOP/TURN
SIGNAL/
BACK-UP/
LICENSE
LAMP
RIGHT TAIL/
STOP/TURN
SIGNAL/
BACK-UP
LAMP
CASE
GROUND
CASE
GROUND

8W-52 TURN SIGNALS

DESCRIPTION AND OPERATION

COMBINATION FLASHER

The combination flasher powers the turn signal/hazard switch circuitry in the multi-function switch. When the ignition switch is OFF, the hazard flashers will operate but the turn signals will not.

When the hazard flashers are on, circuit L9 from fuse 9 in the Power Distribution Center (PDC) powers circuit L55 through the turn signal/hazard switch circuitry in the multi-function switch. Circuit L55 supplies power to the combination flasher.

When the ignition switch is in the ACCESSORY or RUN position, it connects circuit A1 from PDC fuse 3 to circuit A31. Circuit A31 feeds circuit L5 through fuse 13 in the fuse block. Circuit L5 connects to the turn signal/hazard switch circuitry in the multi-function switch. When the hazard flashers are OFF, the multi-function switch connects circuit L5 to circuit L55. Circuit L55 powers the combination flasher.

Circuit L32 from the combination flasher connects to the multi-function switch to supply power to the turn signal and hazard flasher circuits. The multi-function switch connects to the right front turn signal lamp and side marker lamp on circuit L60 and the left front turn signal lamp and side marker lamp on circuit L61. Circuit L62 from the switch feeds the right rear turn signal lamp. Circuit L63 feeds the left rear turn signal lamp.

When the hazard flashers are activated, the multi-function switch connects to the rear turn signal lamps on circuits L62 and L63 and the front turn signal and side marker lamps on circuits L60 and L61.

TURN SIGNALS

When the operator selects the right turn signal, the multi-function switch connects circuit L32 from the combination flasher to circuits L60 and L62. Circuit L60 feeds the right front turn signal lamp and side marker lamp. Circuit L60 also splices to power the right turn signal indicator lamp in the instrument cluster. Circuit L62 feeds the right rear turn signal lamp.

When the operator selects the left turn signal, the multi-function switch connects circuit L32 from the combination flasher to circuits L61 and L63. Circuit L61 feeds the left front turn signal lamp and side marker lamp. Circuit L61 also splices to power the left turn signal indicator lamp on the instrument cluster. Circuit L63 feeds the left rear turn signal lamp and side marker lamp.

Circuit Z1 provides ground for the front turn signal lamps and side marker lamps. The rear lamps are case grounded.

HAZARD FLASHERS

When the operator selects the hazard flashers, the multi-function switch connects circuit L32 from the combination flasher to circuits L60, L61, L62 and L63.

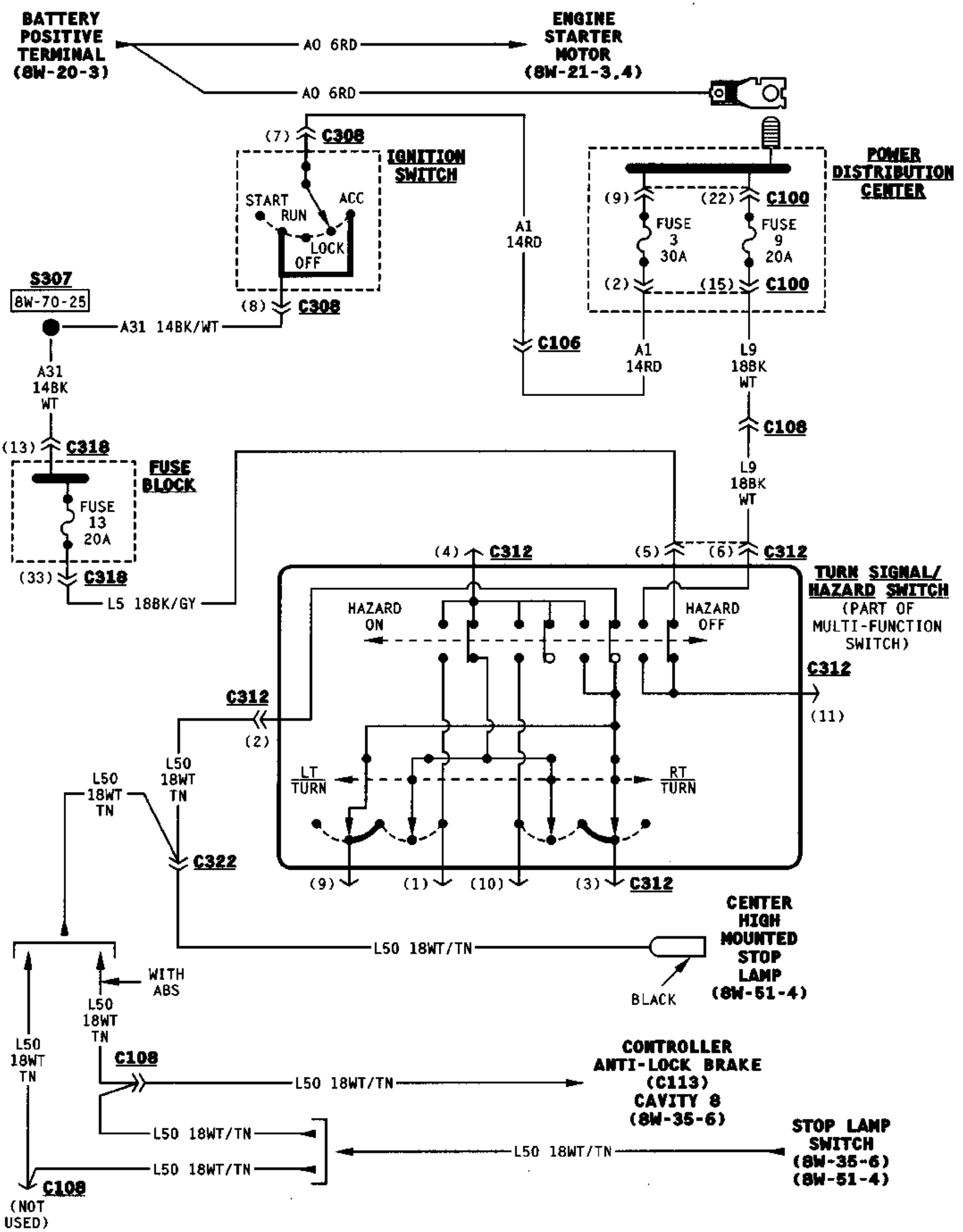
Circuit L60 feeds the right front turn signal lamp, side marker lamp and the instrument cluster indicator lamp. Circuit L61 feeds the left front turn signal lamp, side marker lamp and the instrument cluster indicator lamp. Circuit L62 feeds the right rear turn signal lamp. Circuit L63 feeds the left rear turn signal lamp.

SCHEMATICS AND DIAGRAMS

WIRING DIAGRAM INDEX

The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

DIAGRAM INDEX



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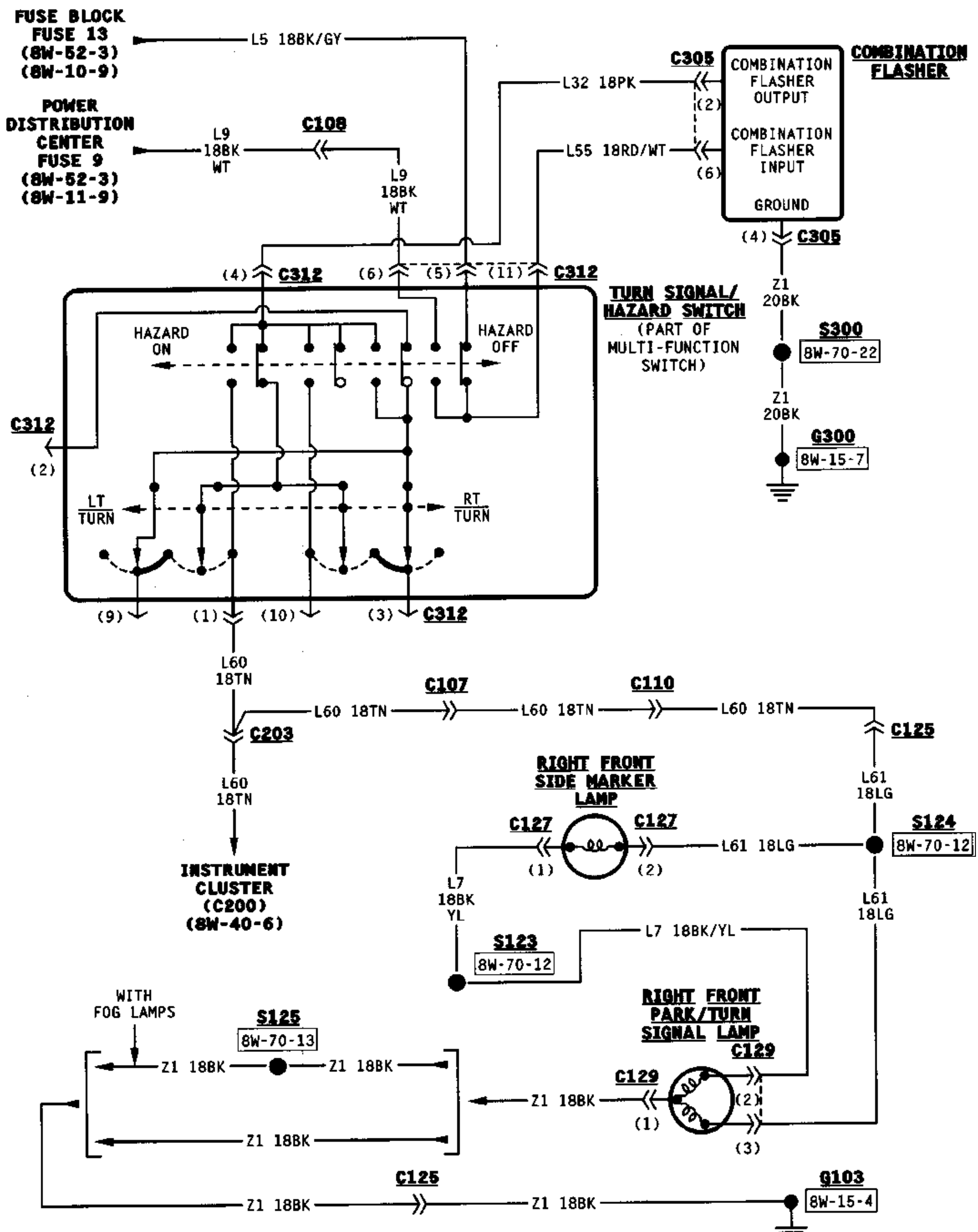
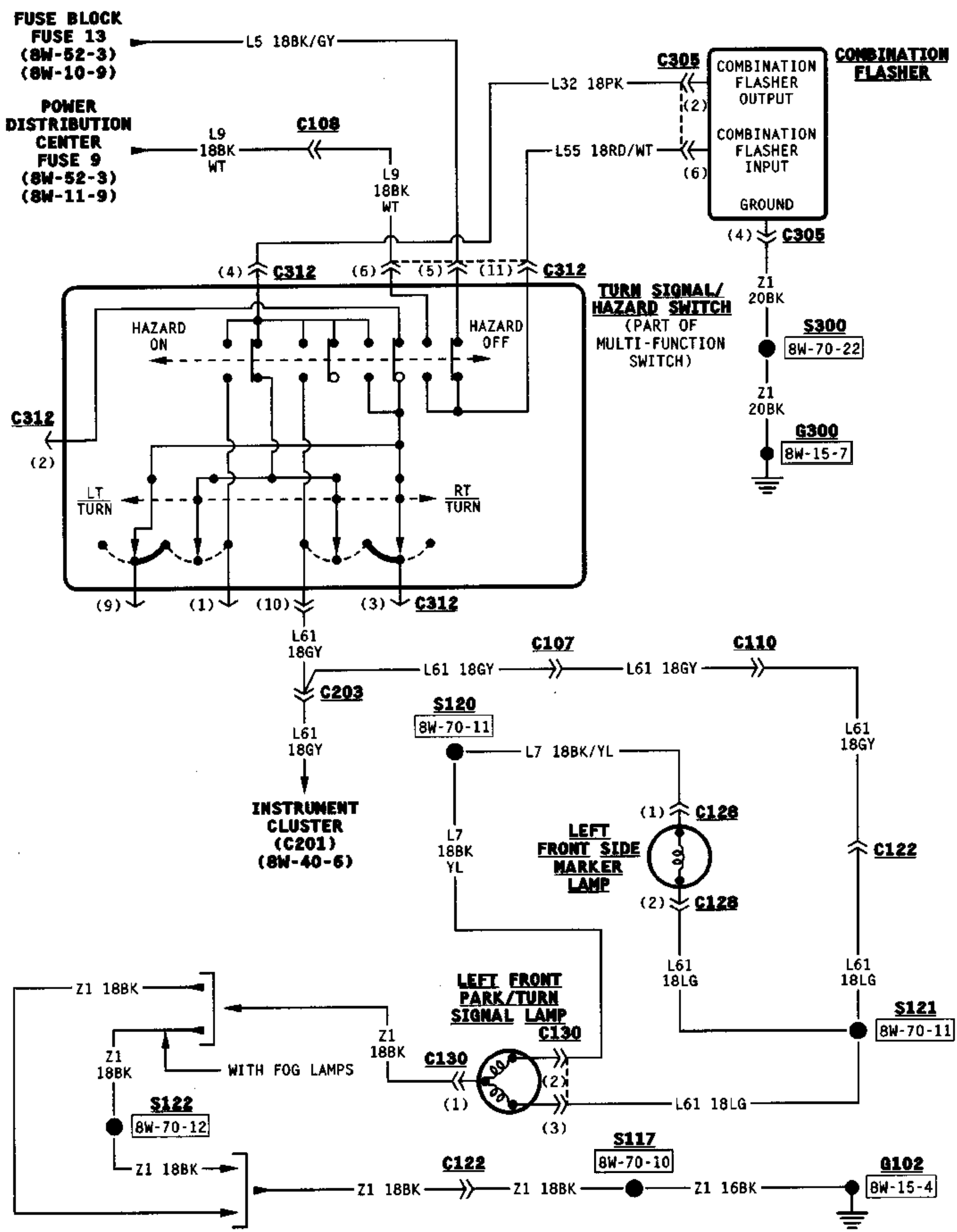
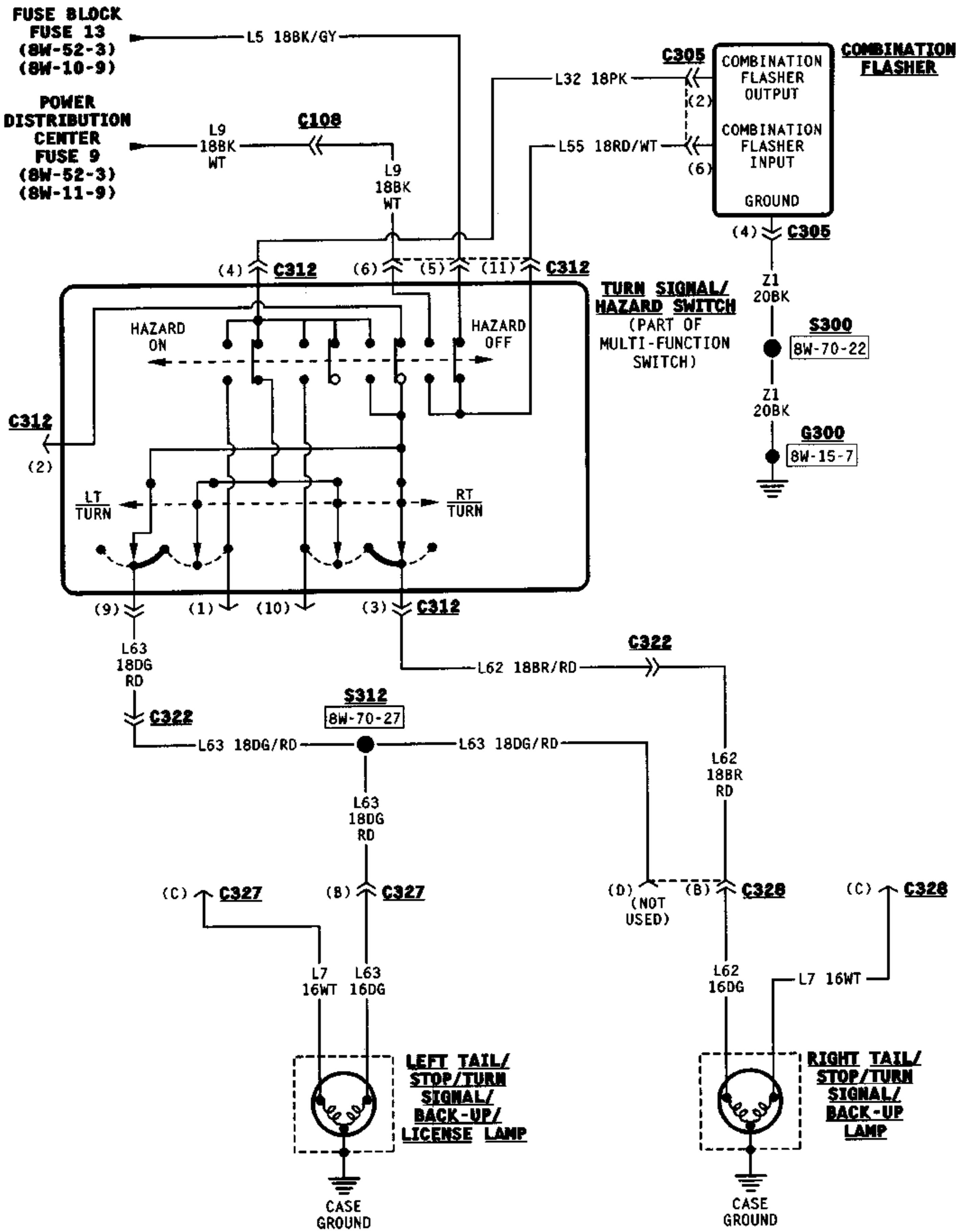

FUSE BLOCK
FUSE 13
(8W-52-3)
(8W-10-9)
L5 18BK/GY
POWER
DISTRIBUTION
CENTER
FUSE 9
(8W-52-3)
(8W-11-9)
L9
18BK
WT
C108
C305
COMBINATION
FLASHER
OUTPUT
COMBINATION
FLASHER
INPUT
GROUND
COMBINATION
FLASHER
L32 18PK
L55 18RD/WT
(2)
(6)
(4)
Z1
20BK
S300
8W-70-22
G300
8W-15-7
(4)
(6)
(5)
(11)
C312
TURN SIGNAL/
HAZARD SWITCH
(PART OF
MULTI-FUNCTION
SWITCH)
HAZARD
ON
HAZARD
OFF
LT
TURN
RT
TURN
(9)
(1)
(10)
(3)
L60
18TN
C107
C110
L60 18TN
C125
C203
L61
18LG
RIGHT FRONT
SIDE MARKER
LAMP
C127
S124
8W-70-12
L7
18BK
YL
S123
8W-70-12
L7 18BK/YL
INSTRUMENT
CLUSTER
(C200)
(8W-40-6)
WITH
FOG LAMPS
S125
8W-70-13
Z1 18BK
RIGHT FRONT
PARK/TURN
SIGNAL LAMP
C129
G103
8W-15-4


FUSE BLOCK
FUSE 13
(8W-52-3)
(8W-10-9)
L5 18BK/GY
POWER
DISTRIBUTION
CENTER
FUSE 9
(8W-52-3)
(8W-11-9)
L9
18BK
WT
C108
L32 18PK
C305
COMBINATION FLASHER OUTPUT
(2)
L55 18RD/WT
COMBINATION FLASHER INPUT
(6)
GROUND
COMBINATION FLASHER
(4) C305
Z1
20BK
S300
8W-70-22
G300
8W-15-7
(4) C312
(6)
(5)
(11) C312
TURN SIGNAL/
HAZARD SWITCH
(PART OF
MULTI-FUNCTION
SWITCH)
HAZARD ON
HAZARD OFF
C312
(2)
LT TURN
RT TURN
(9)
(1)
(10)
(3) C312
L61
18GY
L61 18GY
C107
C110
C203
INSTRUMENT
CLUSTER
(C201)
(8W-40-6)
S120
8W-70-11
L7 18BK/YL
L7
18BK
YL
(1) C128
LEFT
FRONT SIDE
MARKER
LAMP
(2) C128
C122
L61
18LG
S121
8W-70-11
Z1 18BK
WITH FOG LAMPS
LEFT FRONT
PARK/TURN
SIGNAL LAMP
C130
(1)
(2)
(3)
L61 18LG
S122
8W-70-12
C122
S117
8W-70-10
Z1 16BK
G102
8W-15-4



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8W-53 WIPERS

INDEX

GENERAL INFORMATION

INTRODUCTION

The vehicle is available with a standard two-speed wiper or intermittent wipers. There are separate wiring diagrams for each system. When referring to the circuit descriptions or wiring diagrams, ensure that you use the correct ones.

DESCRIPTION AND OPERATION

STANDARD WIPERS

When the ignition switch is in the ACCESSORY or RUN position, it connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A31. Circuit A31 feeds circuit V6 through fuse 14 in the fuse block. Circuit V6 powers the front wipers. Circuit Z1 provides ground for the front wiper motor.

In the LOW position, the wiper motor switch connects circuit V6 to circuit V3. Circuit V3 feeds the wiper motor low speed brushes. If the operator selects wiper HIGH speed operation, the wiper switch connects circuit V6 to circuit V4. Circuit V4 feeds the wiper motor high speed brushes.

As the windshield wiper motor turns, the park switch, internal to the motor, moves from its DOWN position to the UP position. When the wiper switch is in the OFF position, the park switch connects circuit V6 to circuit V5. Current on circuit V5 passes through the wiper switch to power the wiper motor low speed brushes on circuit V3 until the wipers stop in the DOWN position.

The windshield washer uses a pump motor located inside the windshield washer fluid reservoir. When the washer switch is pressed, it connects circuit V6 to circuit V10. Circuit V10 powers the washer pump motor. Circuit Z1 provide ground for the pump motor.

INTERMITTENT WIPERS

The intermittent wiper system operates at either LOW or HIGH or DELAY speeds. When the ignition switch is in the ACCESSORY or RUN position, it connects circuit A1 from fuse 3 in the Power Distribution Center (PDC) to circuit A31. Circuit A31 feeds circuit V6 through fuse 14 in the fuse block. Circuit V6 powers the front wipers. Circuit Z1 provides ground for the front wiper motor.

In the LOW position, the wiper motor switch connects circuit V6 to circuit V3. Circuit V3 feeds the wiper motor low speed brushes. If the operator selects wiper HIGH speed operation, the wiper switch connects circuit V6 to circuit V4. Circuit V4 feeds the wiper motor high speed brushes.

When DELAY operation is selected, the wiper switch signals the logic and relay control (internal to the wiper switch). After receiving the delay input, the logic and relay control cycles the wipers by periodically turning on and off the ground for the coil side of the delay relay (internal to wiper switch). When the logic and relay control grounds the delay relay coil, the relay contacts switch to connect current from circuit V6 to circuit V3. Circuit V3 powers the wiper motor low speed brushes. When the logic and relay control removes ground from the delay relay, the relay contacts disconnect circuits V6 and V3.

As the windshield wiper motor turns, the park switch, internal to the motor, moves from its DOWN position to the UP position. When the wiper switch is in the OFF position, the park switch connects circuit V6 to circuit V5. Current on circuit V5 passes through the contacts in the delay relay to power the wiper motor low speed brushes on circuit V3 until the wipers stop in the DOWN position. When the wipers are in DOWN position, the park switch disconnects circuits V6 and V5, disconnecting current form the low speed brushes.

The windshield washer uses a pump motor located inside the windshield washer fluid reservoir. When the washer switch is pressed, it connects circuit V6 to circuit V10. Circuit V10 powers the washer pump motor. Circuit Z1 provides ground for the pump motor.

HELPFUL INFORMATION

The wiper motor has an internal circuit breaker.

DESCRIPTION AND OPERATION (Continued)

REAR WIPER SYSTEM

In the RUN position, the ignition switch connects circuit A2 from fuse 2 in the PDC with circuit A22. Circuit A22 feeds circuit V23 through fuse 6 in the fuse block. Circuit V23 supplies power to the park switch in the rear wiper motor and connects to circuit V22. Circuit V22 powers the rear wiper switch.

In the WIPE or WASH positions, the rear wiper switch connects circuit V22 to circuit V13. Circuit V13 powers the rear wiper motor. Circuit Z1 provides ground for the wiper motor.

The rear windshield washer uses a pump motor located inside the windshield washer fluid reservoir. When the rear wiper switch is in the WASH position, power is supplied through the wiper switch to the rear wiper on circuit V13 and the rear washer pump motor on circuit V20. Circuit Z1 provides ground for the rear washer pump motor.

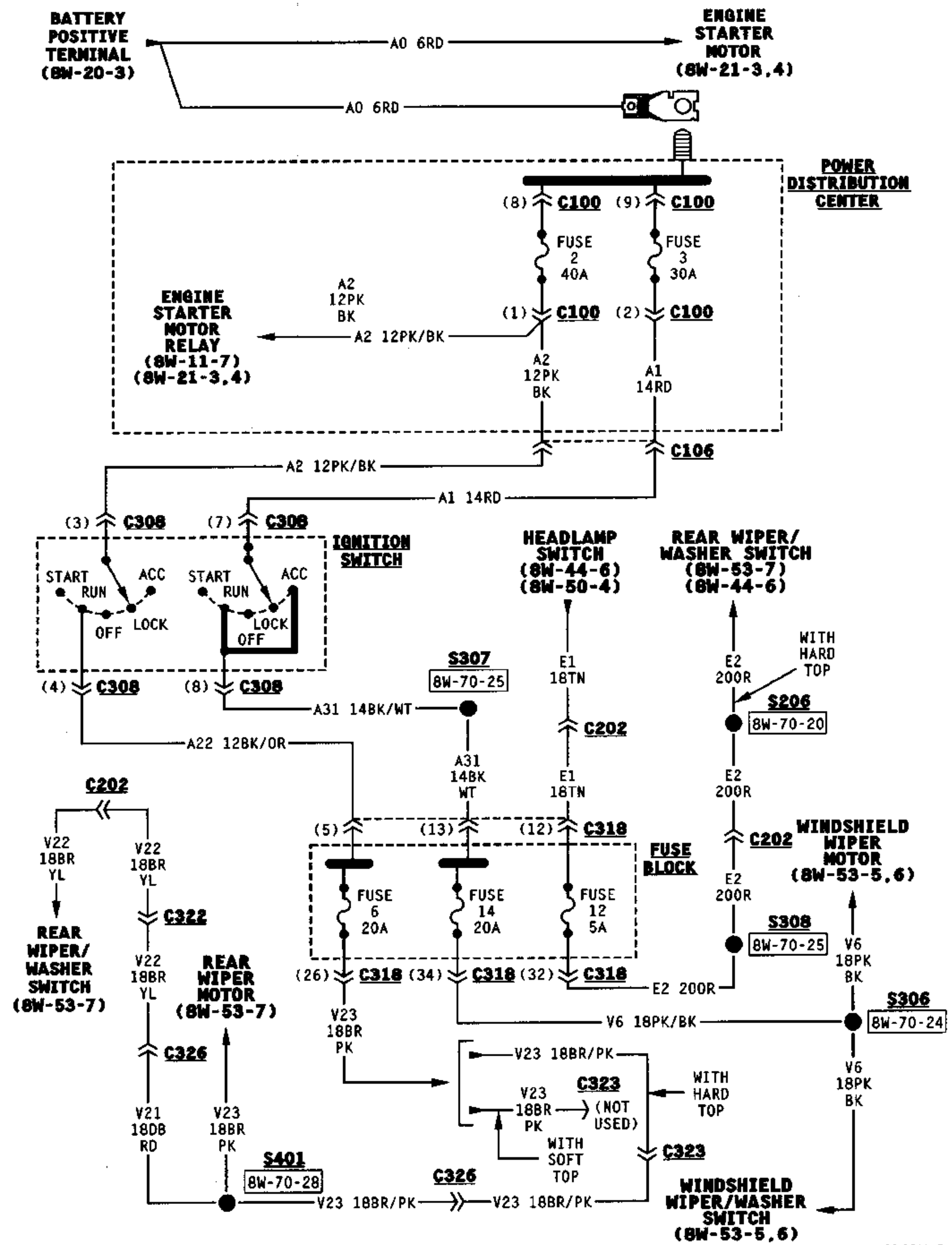
As the rear wiper motor turns, the internal park switch moves from the RUN position to the PARK position. When the wiper switch is turned OFF, the park switch connects circuit V23 to wiper motor brushes until the wiper reaches the PARK. In PARK, the park switch disconnects circuit V23 from the wiper motor brushes.

SCHEMATICS AND DIAGRAMS

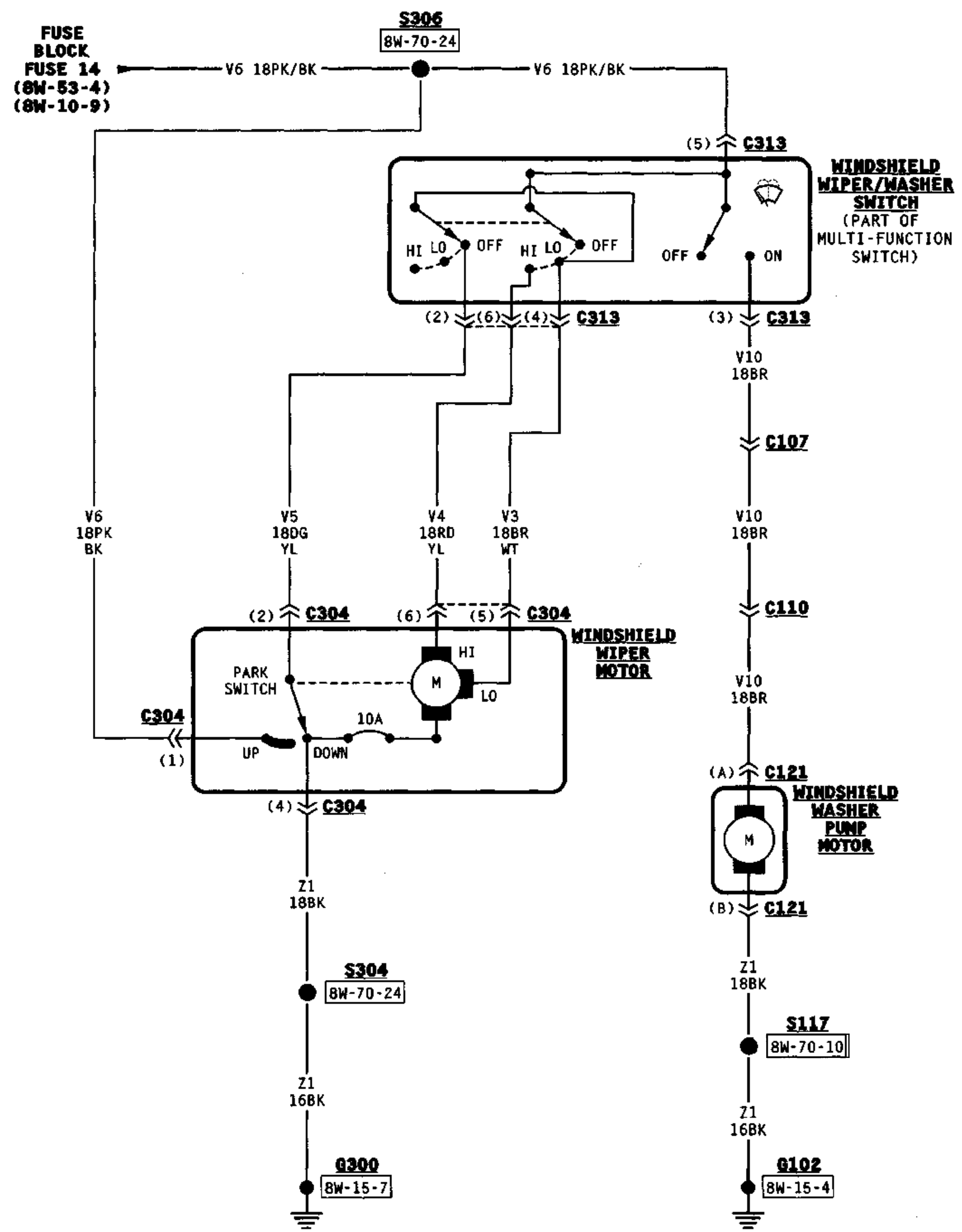
WIRING DIAGRAM INDEX

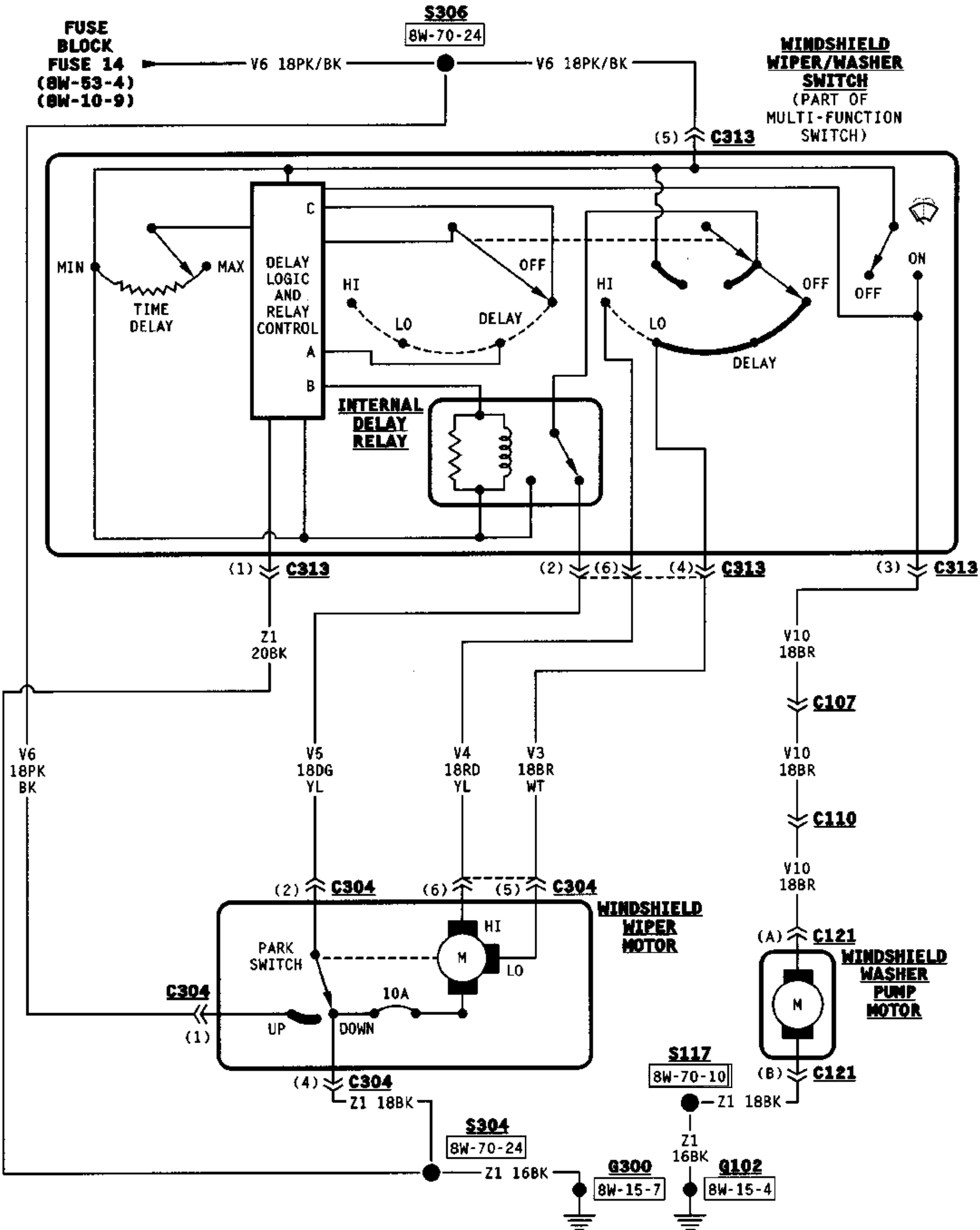
The following index covers all components found in this section of the wiring diagrams. If the component you are looking for is not found here, refer to section 8W-02 for a complete list of all components shown in the wiring diagrams.

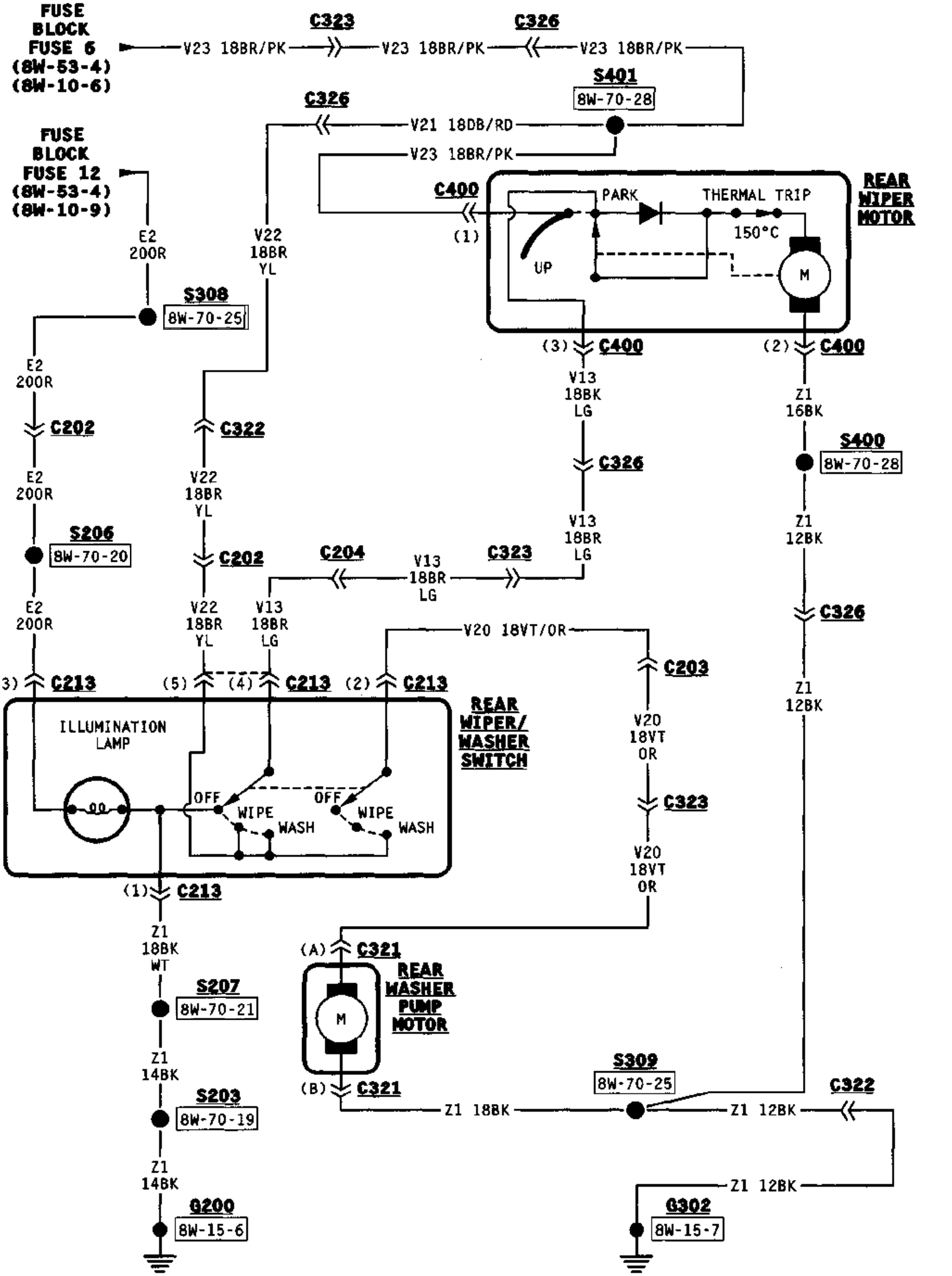
DIAGRAM INDEX



BATTERY POSITIVE TERMINAL (8W-20-3)
A0 6RD
ENGINE STARTER MOTOR (8W-21-3,4)
A0 6RD
POWER DISTRIBUTION CENTER
(8) C100
(9) C100
FUSE 2 40A
FUSE 3 30A
ENGINE STARTER MOTOR RELAY (8W-11-7) (8W-21-3,4)
A2 12PK BK
A2 12PK/BK
(1) C100
(2) C100
A2 12PK BK
A1 14RD
C106
A2 12PK/BK
A1 14RD
(3) C308
(7) C308
IGNITION SWITCH
START RUN ACC OFF LOCK
START RUN ACC LOCK OFF
(4) C308
(8) C308
A31 14BK/WT
S307 8W-70-25
A22 12BK/OR
A31 14BK WT
HEADLAMP SWITCH (8W-44-6) (8W-50-4)
E1 18TN
C202
E1 18TN
REAR WIPER/ WASHER SWITCH (8W-53-7) (8W-44-6)
E2 20OR
WITH HARD TOP
S206 8W-70-20
E2 20OR
C202
E2 20OR
S308 8W-70-25
WINDSHIELD WIPER MOTOR (8W-53-5,6)
C202
V22 18BR YL
V22 18BR YL
REAR WIPER/ WASHER SWITCH (8W-53-7)
C322
V22 18BR YL
REAR WIPER MOTOR (8W-53-7)
(5) (13) (12) C318
FUSE BLOCK
FUSE 6 20A
FUSE 14 20A
FUSE 12 5A
(26) C318 (34) C318 (32) C318
E2 20OR
V6 18PK BK
S306 8W-70-24
V6 18PK/BK
V23 18BR PK
C326
V21 18DB RD
V23 18BR PK
V23 18BR/PK
V23 18BR PK
C323
(NOT USED)
WITH HARD TOP
WITH SOFT TOP
C323
V6 18PK BK
S401 8W-70-28
V23 18BR/PK
C326
V23 18BR/PK
WINDSHIELD WIPER/WASHER SWITCH (8W-53-5,6)


FUSE BLOCK FUSE 14 (8W-53-4) (8W-10-9)
S306
8W-70-24
V6 18PK/BK
V6 18PK/BK
(5) C313
WINDSHIELD WIPER/WASHER SWITCH
(PART OF MULTI-FUNCTION SWITCH)
HI LO OFF
HI LO OFF
OFF
ON
(2) (6) (4) C313
(3) C313
V10 18BR
C107
V10 18BR
C110
V10 18BR
V6 18PK BK
V5 18DG YL
V4 18RD YL
V3 18BR WT
(2) C304
(6)
(5) C304
WINDSHIELD WIPER MOTOR
HI
PARK SWITCH
M
LO
C304
10A
(1)
UP
DOWN
(4) C304
(A) C121
WINDSHIELD WASHER PUMP MOTOR
M
(B) C121
Z1 18BK
S304
8W-70-24
Z1 16BK
G300
8W-15-7
Z1 18BK
S117
8W-70-10
Z1 16BK
G102
8W-15-4


FUSE BLOCK FUSE 14 (8W-53-4) (8W-10-9)
V6 18PK/BK
S306
8W-70-24
V6 18PK/BK
WINDSHIELD WIPER/WASHER SWITCH
(PART OF MULTI-FUNCTION SWITCH)
(5) C313
MIN
MAX
TIME DELAY
DELAY LOGIC AND RELAY CONTROL
C
A
B
HI
LO
DELAY
OFF
HI
LO
OFF
DELAY
OFF
ON
INTERNAL DELAY RELAY
(1) C313
(2) (6) (4) C313
(3) C313
Z1 20BK
V10 18BR
C107
V10 18BR
C110
V10 18BR
V6 18PK BK
V5 18DG YL
V4 18RD YL
V3 18BR WT
(2) C304
(6) (5) C304
WINDSHIELD WIPER MOTOR
PARK SWITCH
HI
M
LO
10A
C304
(1)
UP
DOWN
(4) C304
Z1 18BK
(A) C121
WINDSHIELD WASHER PUMP MOTOR
M
(B) C121
S117
8W-70-10
Z1 18BK
S304
8W-70-24
Z1 16BK
G300
8W-15-7
Z1 16BK
G102
8W-15-4


FUSE BLOCK FUSE 6 (8W-53-4) (8W-10-6)
V23 18BR/PK
C323
C326
S401
8W-70-28
V21 18DB/RD
FUSE BLOCK FUSE 12 (8W-53-4) (8W-10-9)
C400
(1)
PARK
THERMAL TRIP
150°C
UP
M
REAR WIPER MOTOR
E2 20OR
V22 18BR YL
S308
8W-70-25
(3) C400
(2) C400
V13 18BK LG
Z1 16BK
S400
8W-70-28
C202
C322
C326
S206
8W-70-20
C204
V13 18BR LG
Z1 12BK
V20 18VT/OR
C203
C213
(5)
(4)
(2)
REAR WIPER/ WASHER SWITCH
ILLUMINATION LAMP
OFF
WIPE
WASH
(1) C213
Z1 18BK WT
(A) C321
REAR WASHER PUMP MOTOR
S207
8W-70-21
Z1 14BK
(B) C321
S203
8W-70-19
S309
8W-70-25
Z1 18BK
C322
G200
8W-15-6
G302
8W-15-7

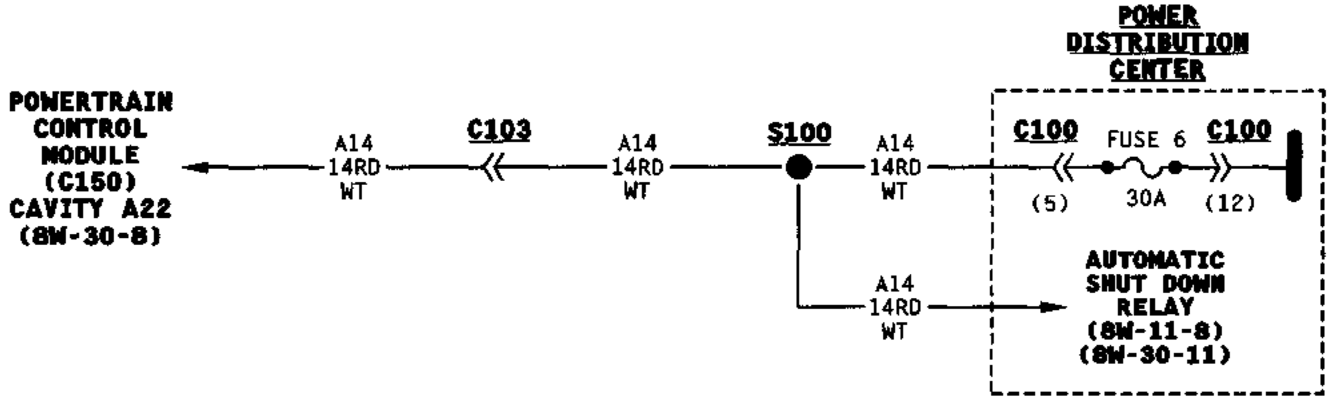
8W-70 SPLICE INFORMATION

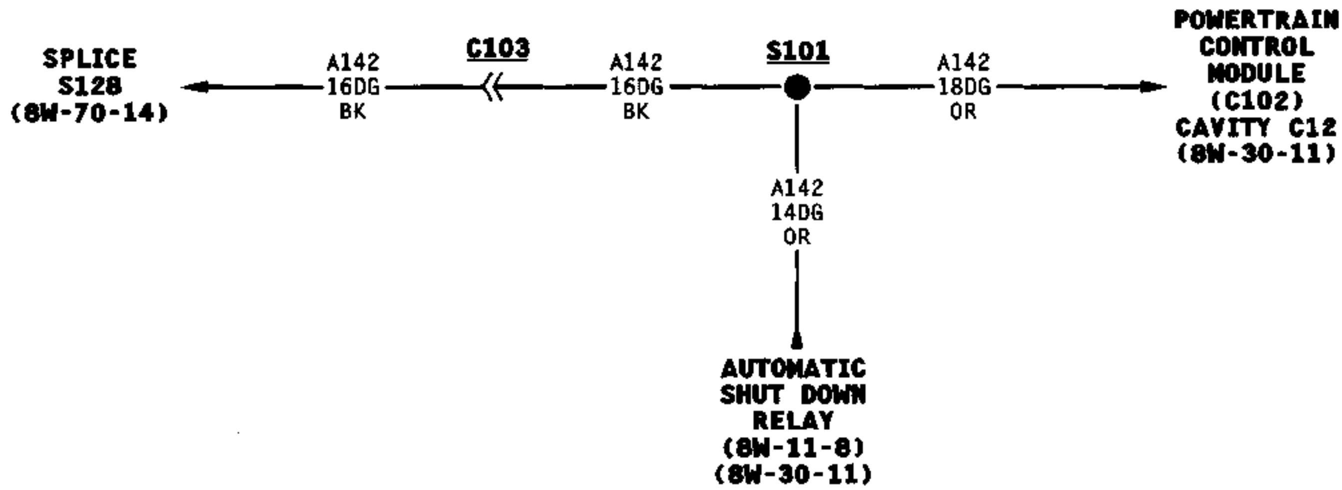
DESCRIPTION AND OPERATION

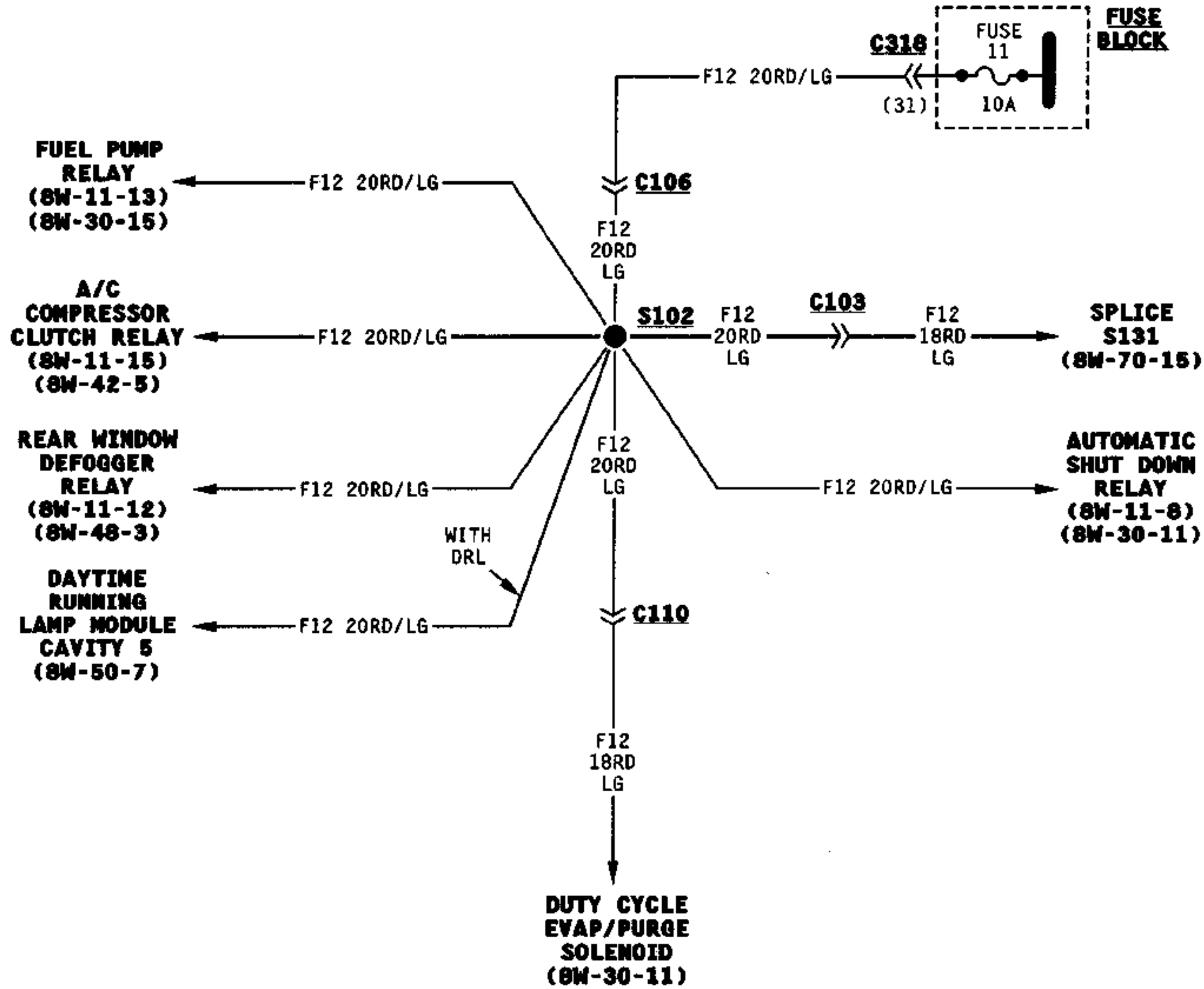
INTRODUCTION

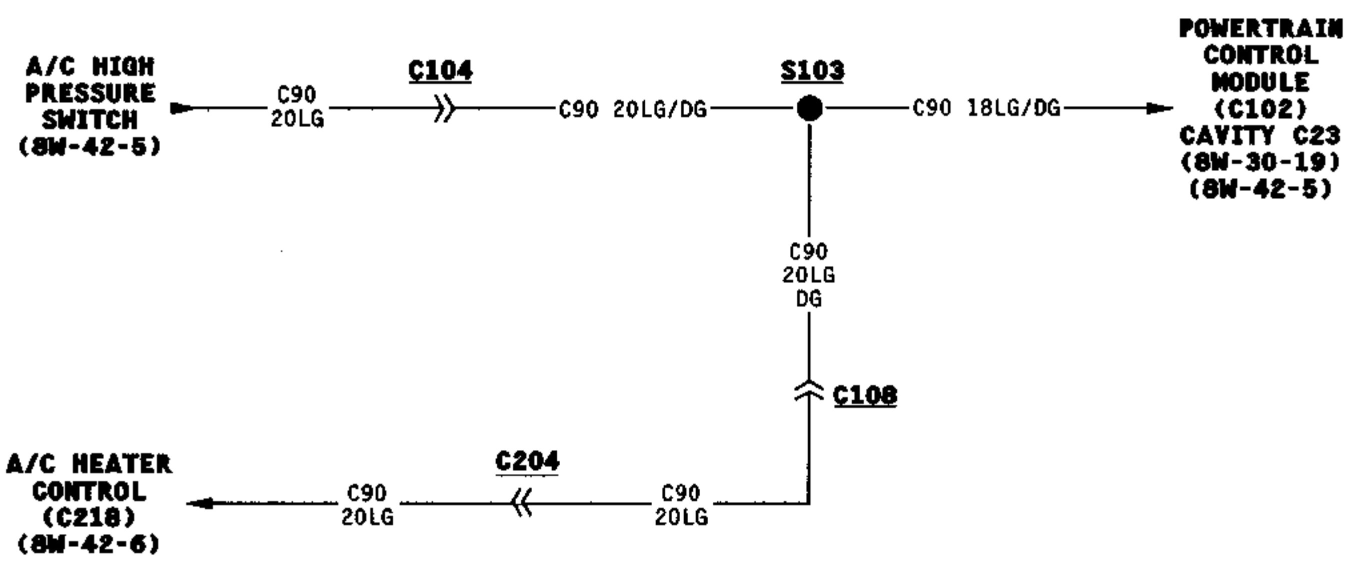
This section identifies all splices in the wiring diagrams. It also shows the splices in their entirety. All circuits that are part of the splices are shown, and the systems they affect are referenced. For viewing the location of each splice in the vehicle, refer to Section 8W-95.

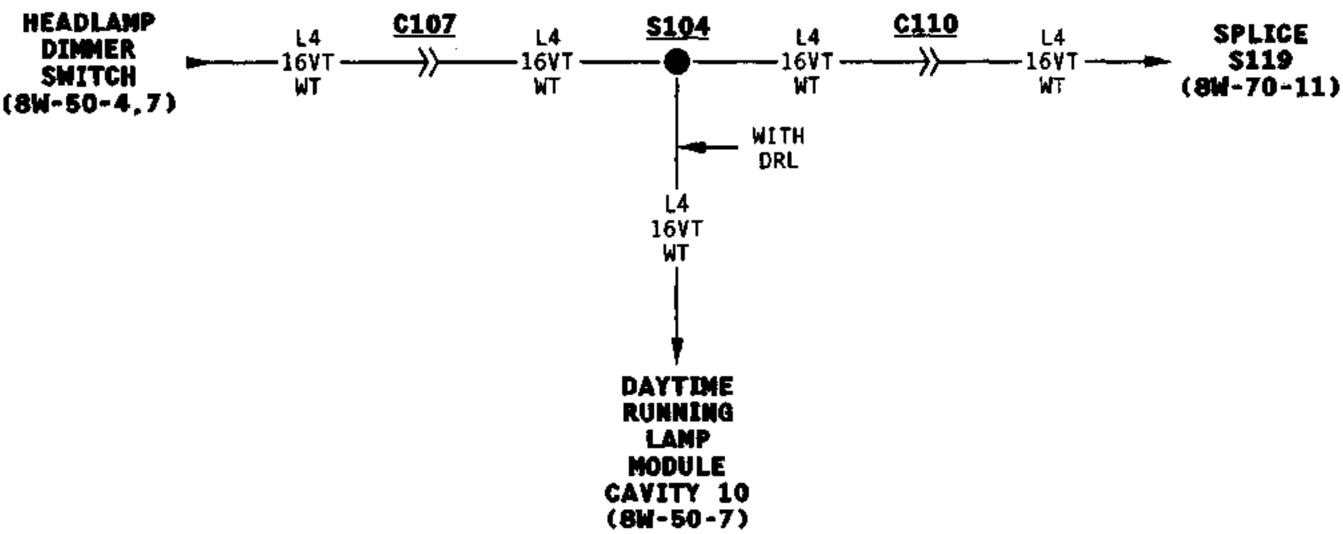
SPLICE INDEX

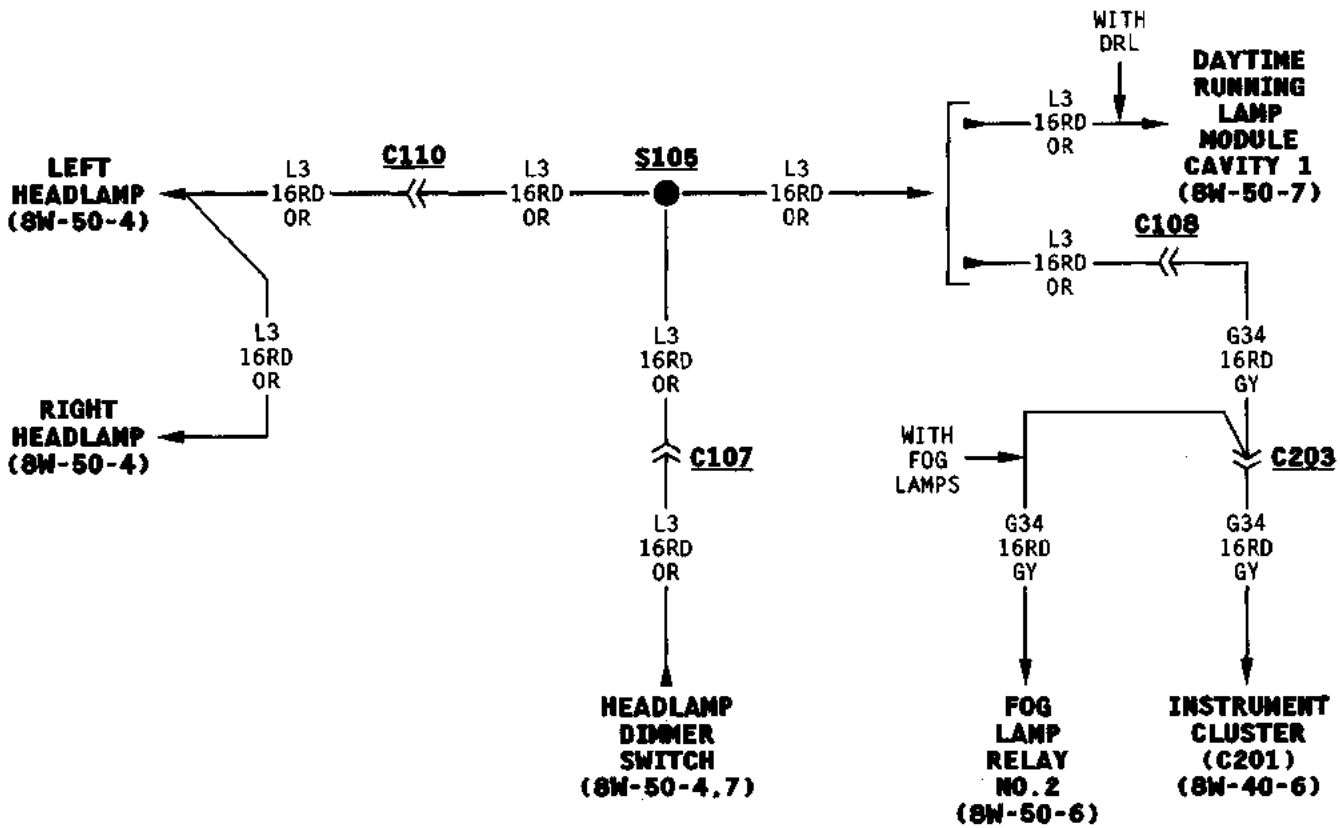

POWERTRAIN CONTROL MODULE (C150) CAVITY A22 (8W-30-8)
A14 14RD WT
C103
A14 14RD WT
S100
A14 14RD WT
POWER DISTRIBUTION CENTER
C100
(5)
FUSE 6
30A
C100
(12)
A14 14RD WT
AUTOMATIC SHUT DOWN RELAY (8W-11-8) (8W-30-11)

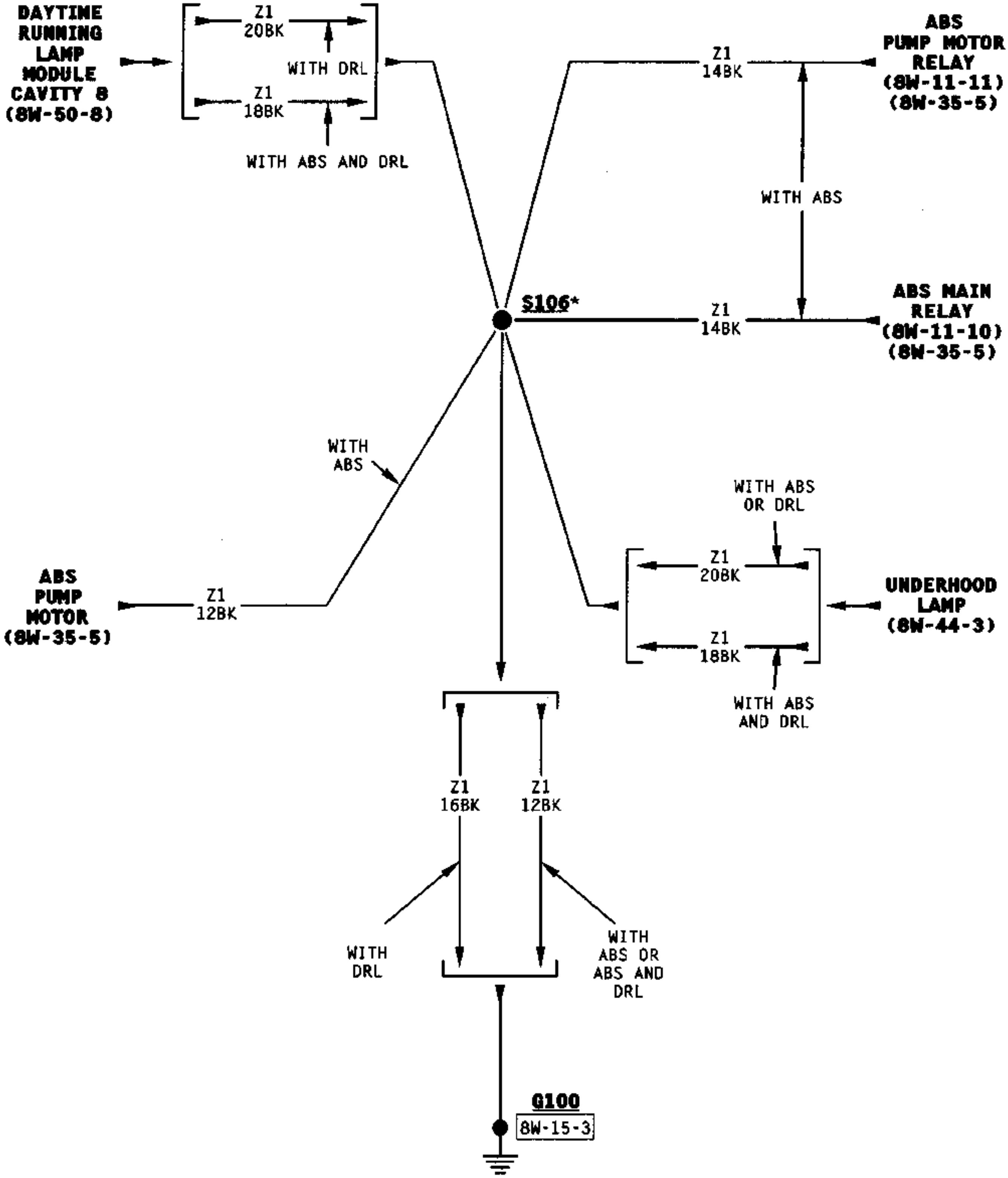

SPLICE S128 (8W-70-14)
A142 16DG BK
C103
A142 16DG BK
S101
A142 18DG OR
POWERTRAIN CONTROL MODULE (C102) CAVITY C12 (8W-30-11)
A142 14DG OR
AUTOMATIC SHUT DOWN RELAY (8W-11-8) (8W-30-11)


FUSE BLOCK
C318
FUSE 11
10A
(31)
F12 20RD/LG
C106
F12 20RD LG
FUEL PUMP RELAY (8W-11-13) (8W-30-15)
F12 20RD/LG
A/C COMPRESSOR CLUTCH RELAY (8W-11-15) (8W-42-5)
F12 20RD/LG
S102
F12 20RD LG
C103
F12 18RD LG
SPLICE S131 (8W-70-15)
REAR WINDOW DEFOGGER RELAY (8W-11-12) (8W-48-3)
F12 20RD/LG
F12 20RD LG
F12 20RD/LG
AUTOMATIC SHUT DOWN RELAY (8W-11-8) (8W-30-11)
WITH DRL
DAYTIME RUNNING LAMP MODULE CAVITY 5 (8W-50-7)
F12 20RD/LG
C110
F12 18RD LG
DUTY CYCLE EVAP/PURGE SOLENOID (8W-30-11)

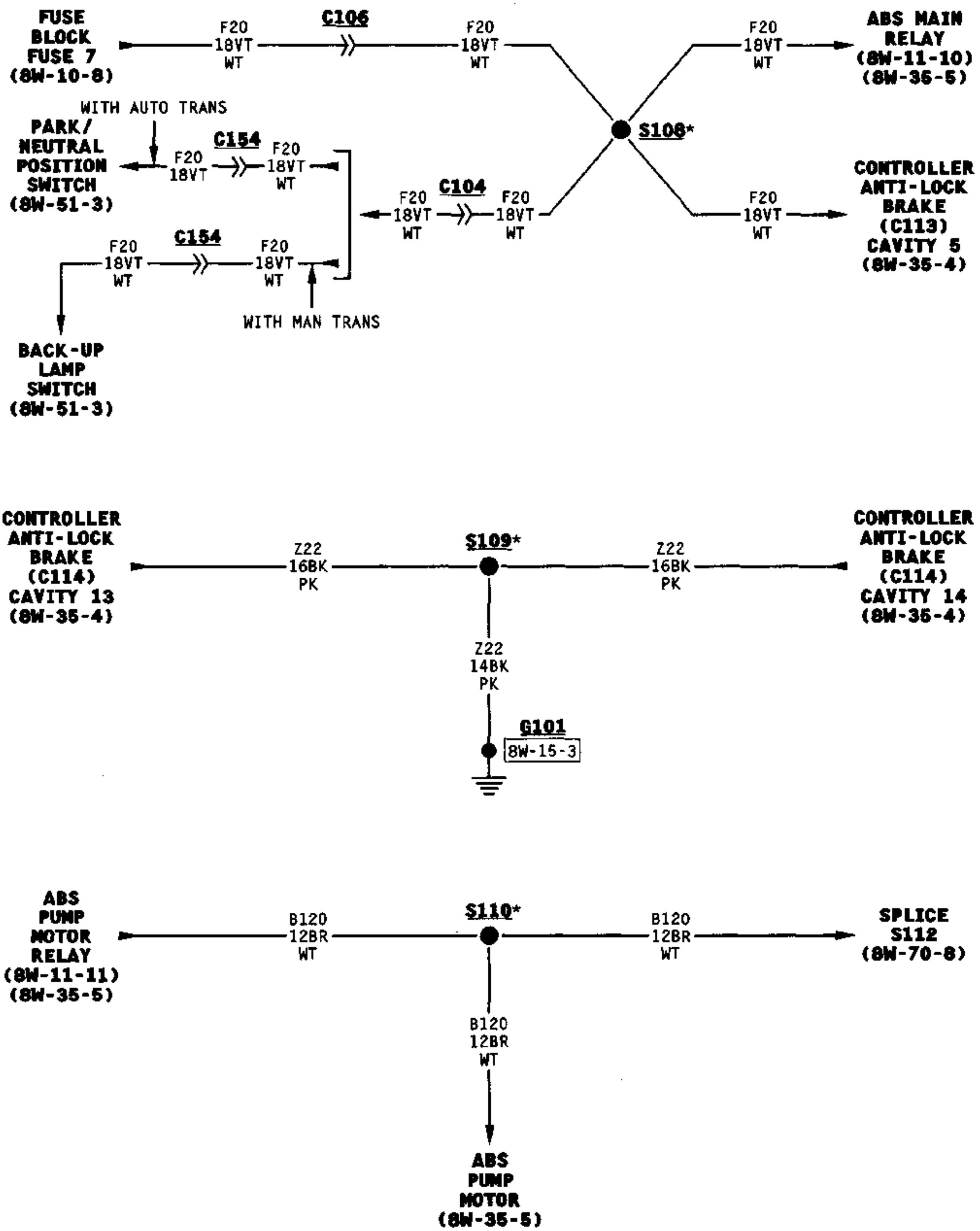

A/C HIGH PRESSURE SWITCH (8W-42-5)
C90 20LG
C104
C90 20LG/DG
S103
C90 18LG/DG
POWERTRAIN CONTROL MODULE (C102) CAVITY C23 (8W-30-19) (8W-42-5)
C90 20LG DG
C108
A/C HEATER CONTROL (C218) (8W-42-6)
C90 20LG
C204
C90 20LG


HEADLAMP DIMMER SWITCH (8W-50-4,7)
L4 16VT WT
C107
L4 16VT WT
S104
L4 16VT WT
C110
L4 16VT WT
SPLICE S119 (8W-70-11)
WITH DRL
L4 16VT WT
DAYTIME RUNNING LAMP MODULE CAVITY 10 (8W-50-7)

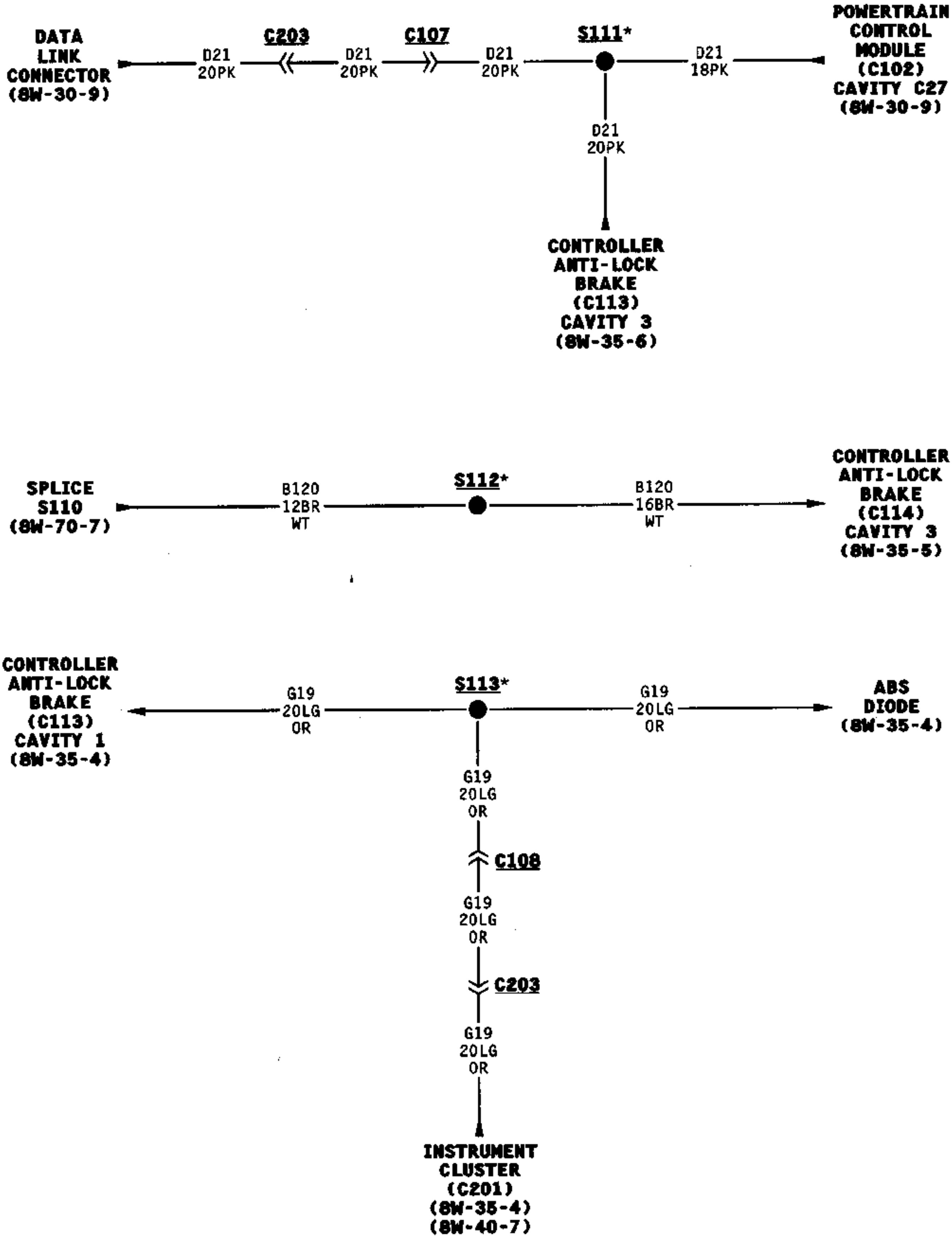

LEFT HEADLAMP (8W-50-4)
L3 16RD OR
C110
L3 16RD OR
S105
L3 16RD OR
WITH DRL
L3 16RD OR
DAYTIME RUNNING LAMP MODULE CAVITY 1 (8W-50-7)
L3 16RD OR
C108
L3 16RD OR
RIGHT HEADLAMP (8W-50-4)
L3 16RD OR
C107
L3 16RD OR
HEADLAMP DIMMER SWITCH (8W-50-4,7)
G34 16RD GY
WITH FOG LAMPS
C203
G34 16RD GY
G34 16RD GY
FOG LAMP RELAY NO.2 (8W-50-6)
INSTRUMENT CLUSTER (C201) (8W-40-6)



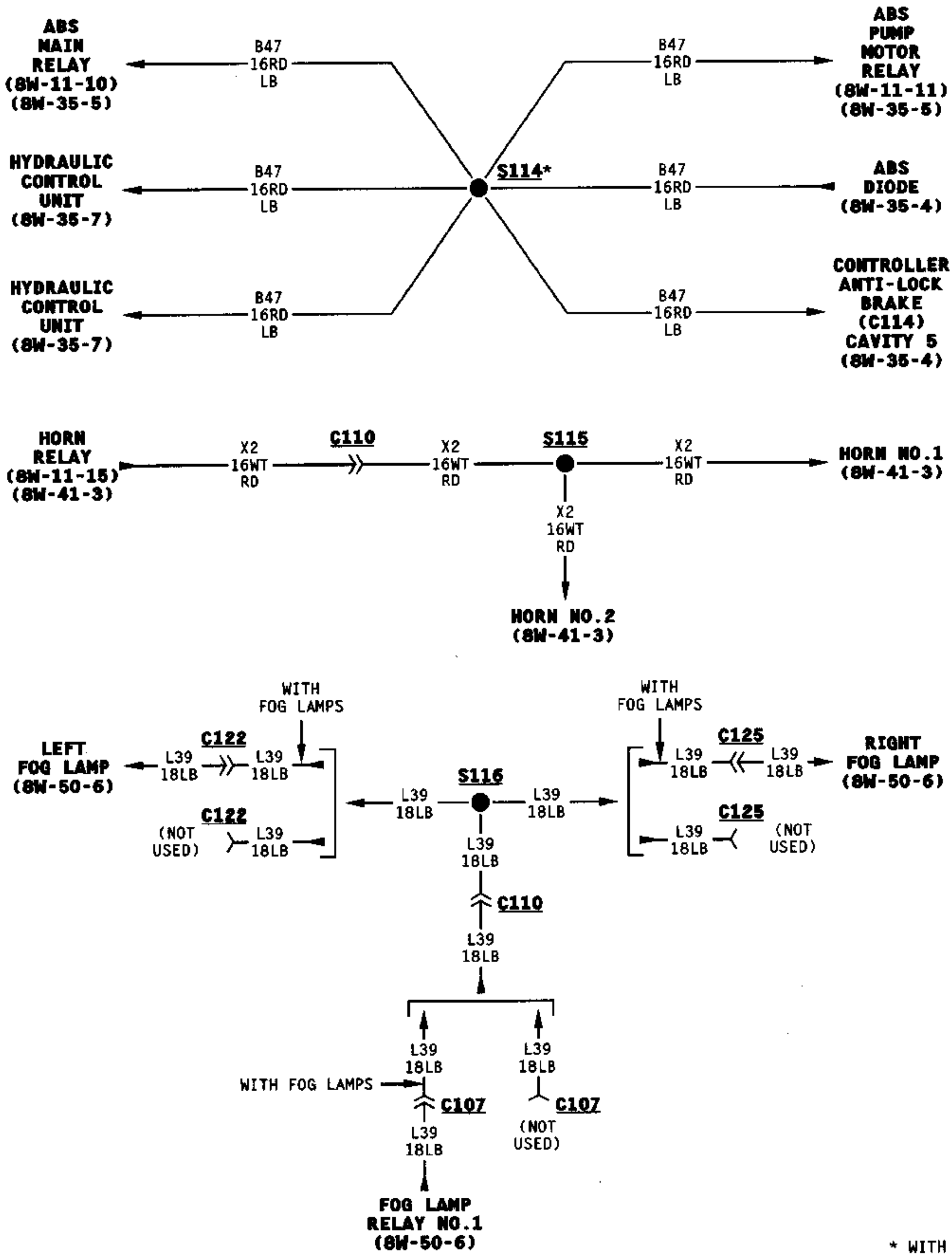
* WITH ABS AND/OR DRL


FUSE BLOCK FUSE 7 (8W-10-8)
F20 18VT WT
C106
F20 18VT WT
ABS MAIN RELAY (8W-11-10) (8W-35-5)
F20 18VT WT
WITH AUTO TRANS
PARK/ NEUTRAL POSITION SWITCH (8W-51-3)
F20 18VT
C154
F20 18VT WT
S108*
F20 18VT WT
C104
F20 18VT WT
CONTROLLER ANTI-LOCK BRAKE (C113) CAVITY 5 (8W-35-4)
F20 18VT WT
F20 18VT WT
C154
F20 18VT WT
WITH MAN TRANS
BACK-UP LAMP SWITCH (8W-51-3)
CONTROLLER ANTI-LOCK BRAKE (C114) CAVITY 13 (8W-35-4)
Z22 16BK PK
S109*
Z22 16BK PK
CONTROLLER ANTI-LOCK BRAKE (C114) CAVITY 14 (8W-35-4)
Z22 14BK PK
G101
8W-15-3
ABS PUMP MOTOR RELAY (8W-11-11) (8W-35-5)
B120 12BR WT
S110*
B120 12BR WT
SPLICE S112 (8W-70-8)
B120 12BR WT
ABS PUMP MOTOR (8W-35-5)

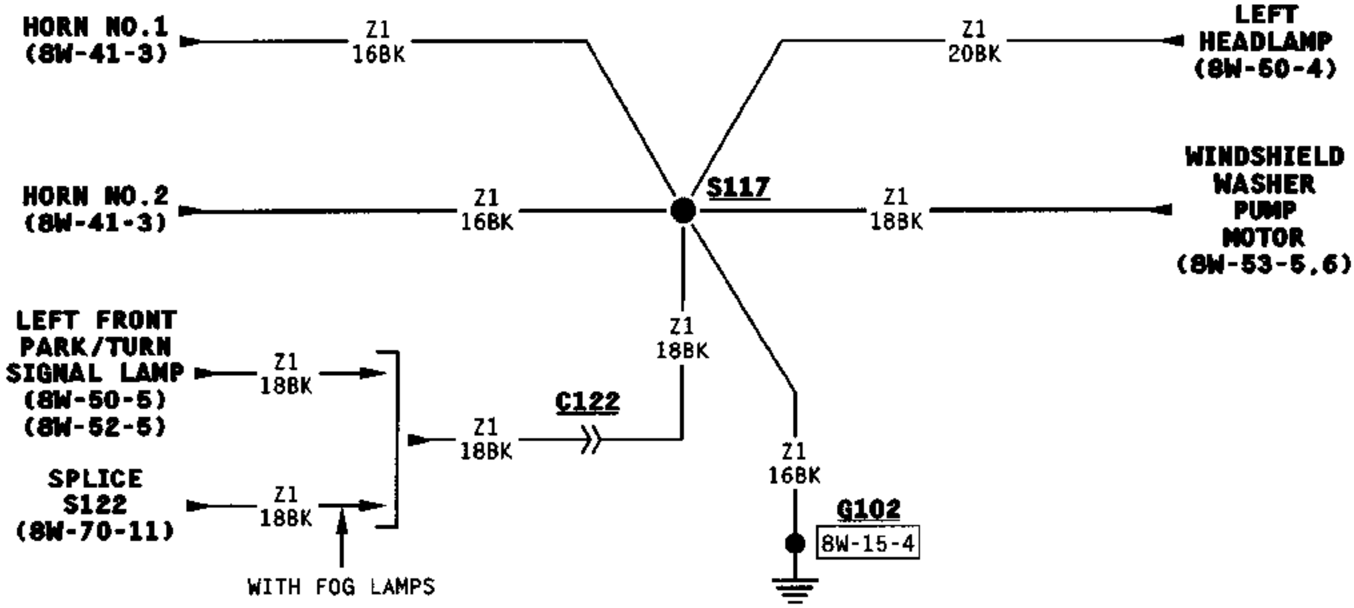
* WITH ABS

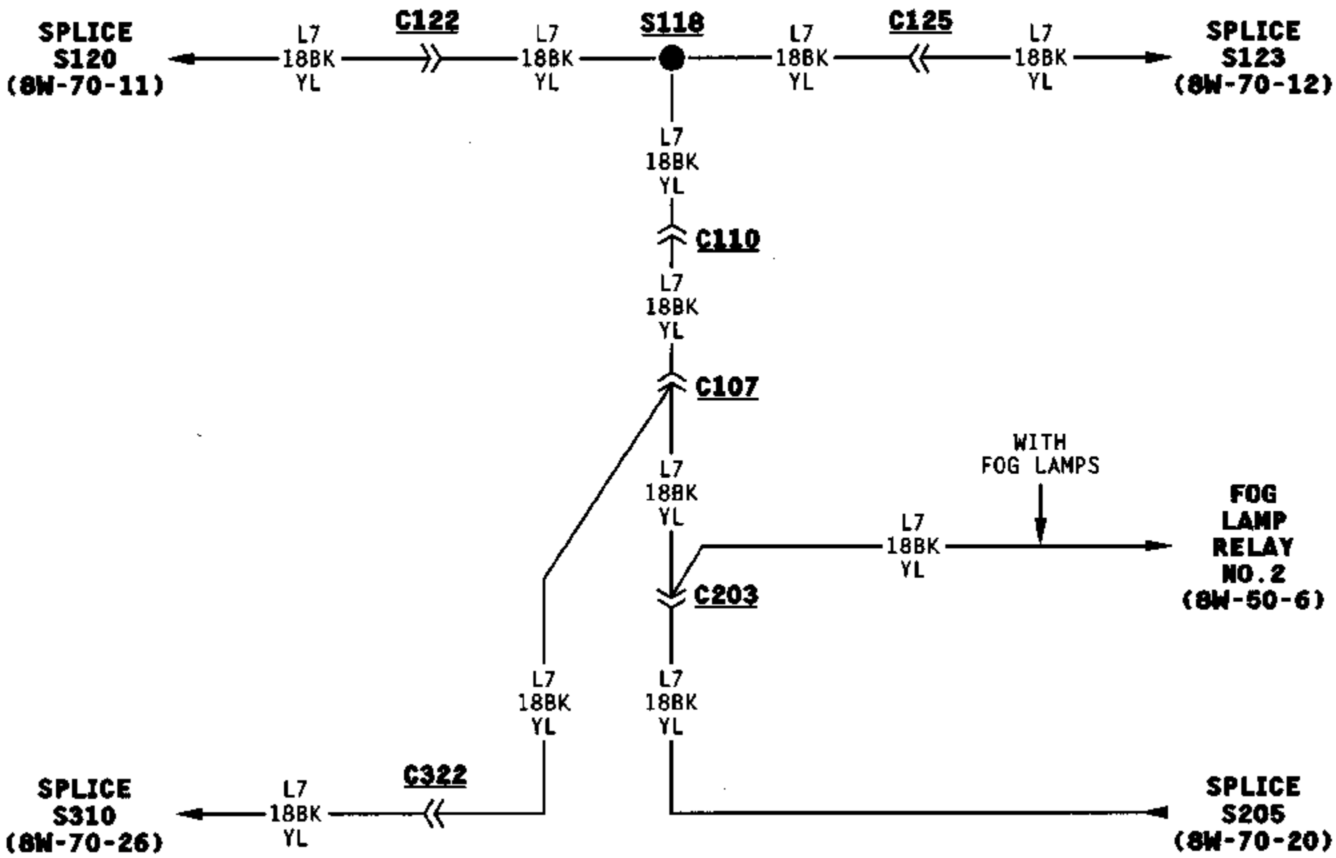

DATA LINK CONNECTOR (8W-30-9)
D21 20PK
C203
D21 20PK
C107
D21 20PK
S111*
D21 18PK
POWERTRAIN CONTROL MODULE (C102) CAVITY C27 (8W-30-9)
D21 20PK
CONTROLLER ANTI-LOCK BRAKE (C113) CAVITY 3 (8W-35-6)
SPLICE S110 (8W-70-7)
B120 12BR WT
S112*
B120 16BR WT
CONTROLLER ANTI-LOCK BRAKE (C114) CAVITY 3 (8W-35-5)
CONTROLLER ANTI-LOCK BRAKE (C113) CAVITY 1 (8W-35-4)
G19 20LG OR
S113*
G19 20LG OR
ABS DIODE (8W-35-4)
G19 20LG OR
C108
G19 20LG OR
C203
G19 20LG OR
INSTRUMENT CLUSTER (C201) (8W-35-4) (8W-40-7)

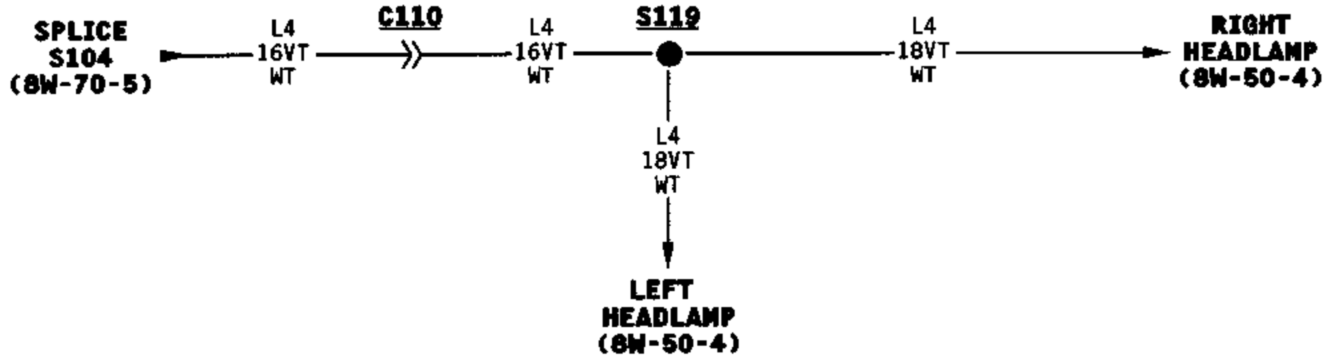
* WITH ABS

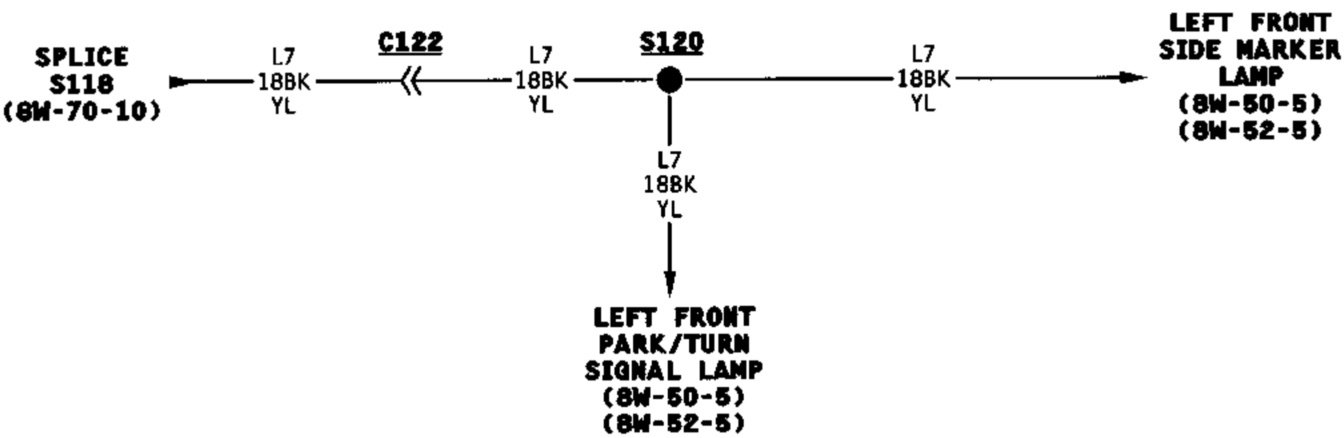

ABS MAIN RELAY (8W-11-10) (8W-35-5)
B47 16RD LB
ABS PUMP MOTOR RELAY (8W-11-11) (8W-35-5)
HYDRAULIC CONTROL UNIT (8W-35-7)
S114*
ABS DIODE (8W-35-4)
CONTROLLER ANTI-LOCK BRAKE (C114) CAVITY 5 (8W-35-4)
HORN RELAY (8W-11-15) (8W-41-3)
X2 16WT RD
C110
S115
HORN NO.1 (8W-41-3)
HORN NO.2 (8W-41-3)
WITH FOG LAMPS
LEFT FOG LAMP (8W-50-6)
L39 18LB
C122
(NOT USED)
S116
C125
RIGHT FOG LAMP (8W-50-6)
C107
FOG LAMP RELAY NO.1 (8W-50-6)

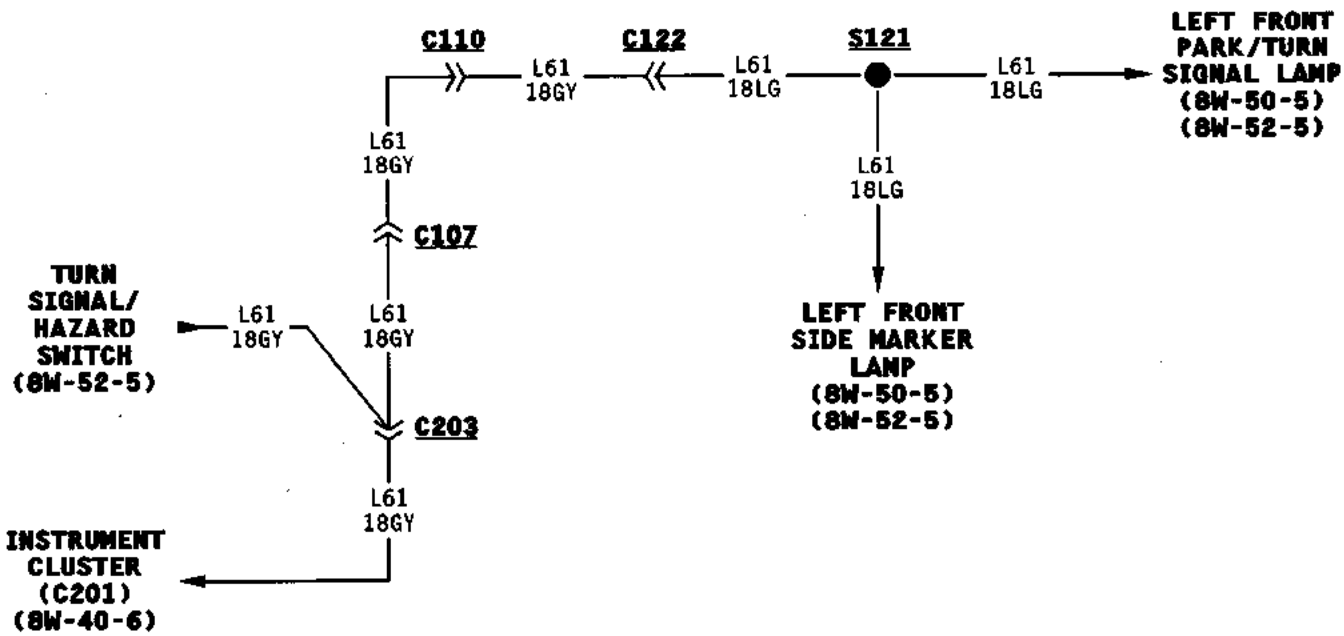
* WITH ABS


HORN NO.1
(8W-41-3)
Z1
16BK
LEFT
HEADLAMP
(8W-50-4)
Z1
20BK
HORN NO.2
(8W-41-3)
Z1
16BK
S117
Z1
18BK
WINDSHIELD
WASHER
PUMP
MOTOR
(8W-53-5,6)
LEFT FRONT
PARK/TURN
SIGNAL LAMP
(8W-50-5)
(8W-52-5)
Z1
18BK
Z1
18BK
C122
Z1
18BK
Z1
16BK
G102
8W-15-4
SPLICE
S122
(8W-70-11)
Z1
18BK
WITH FOG LAMPS


SPLICE
S120
(8W-70-11)
L7
18BK
YL
C122
L7
18BK
YL
S118
L7
18BK
YL
C125
L7
18BK
YL
SPLICE
S123
(8W-70-12)
L7
18BK
YL
C110
L7
18BK
YL
C107
L7
18BK
YL
WITH
FOG LAMPS
L7
18BK
YL
FOG
LAMP
RELAY
NO.2
(8W-50-6)
C203
L7
18BK
YL
L7
18BK
YL
SPLICE
S310
(8W-70-26)
L7
18BK
YL
C322
SPLICE
S205
(8W-70-20)

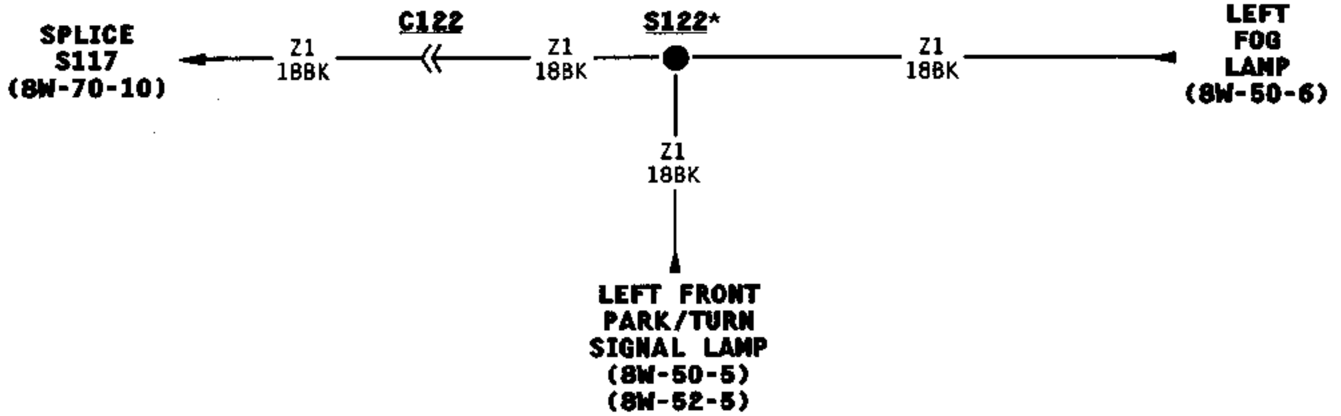


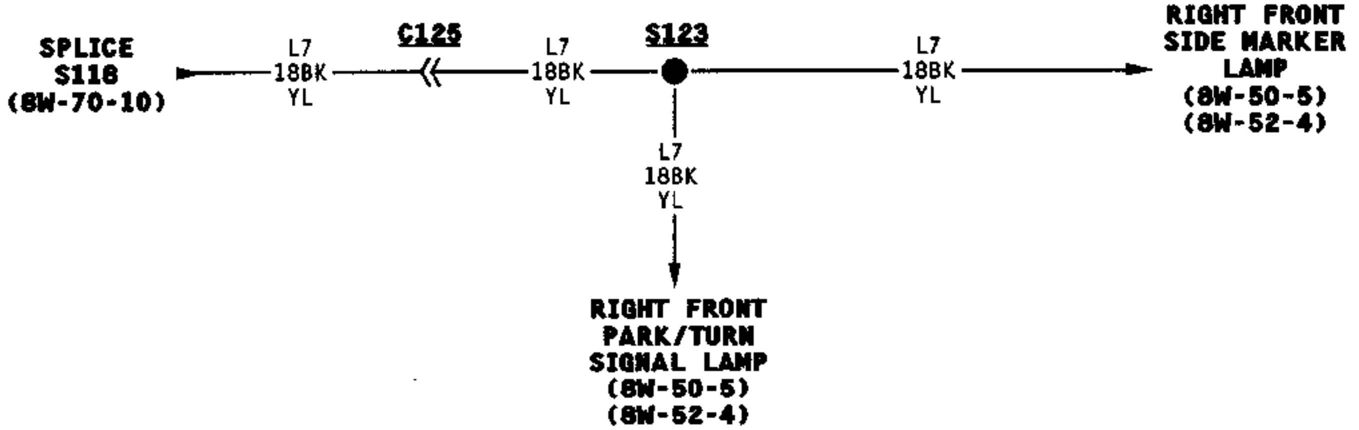


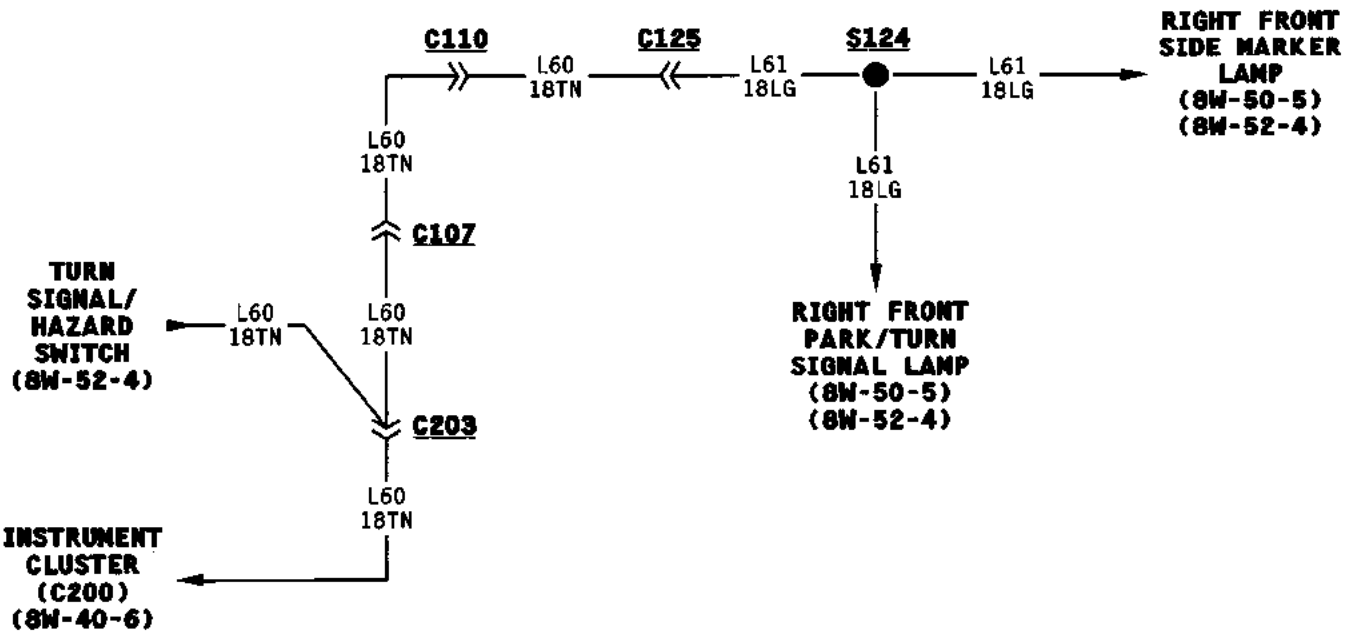


806634ca

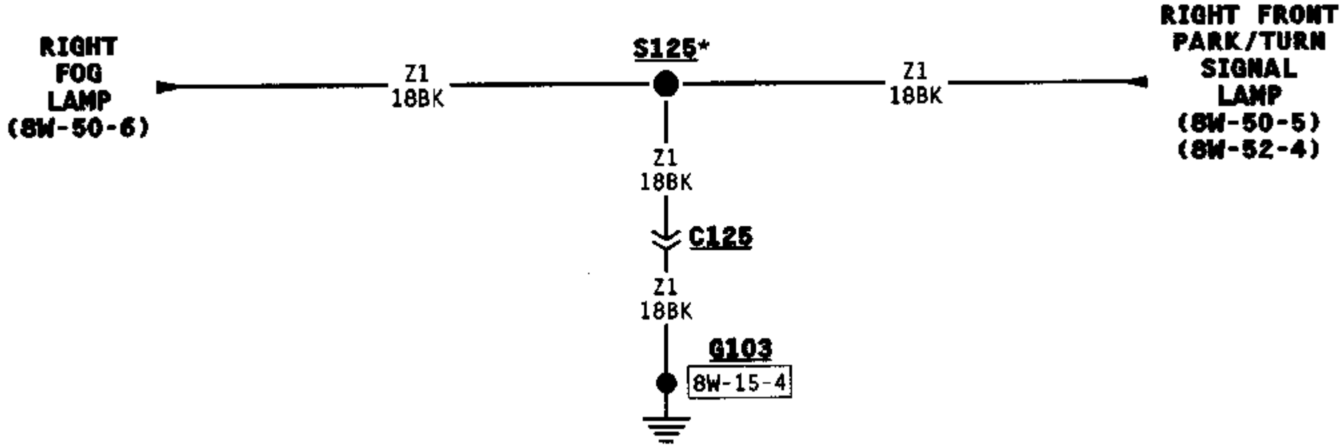
J968W-5

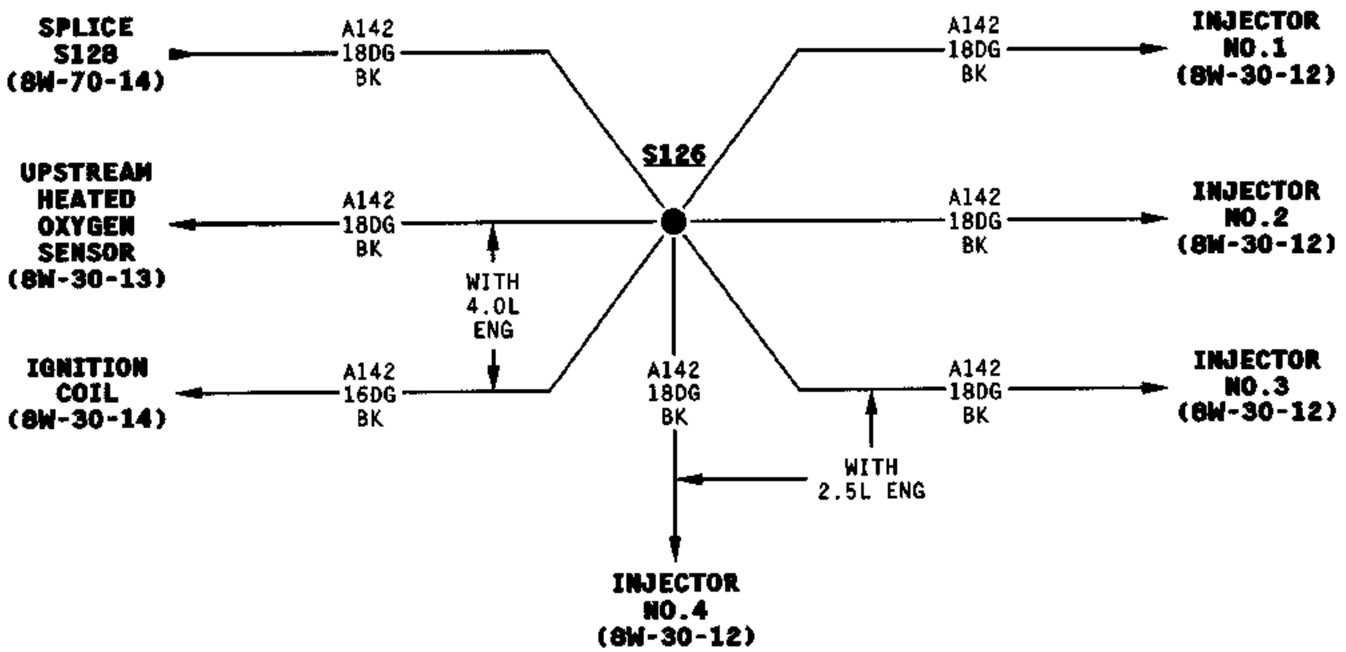




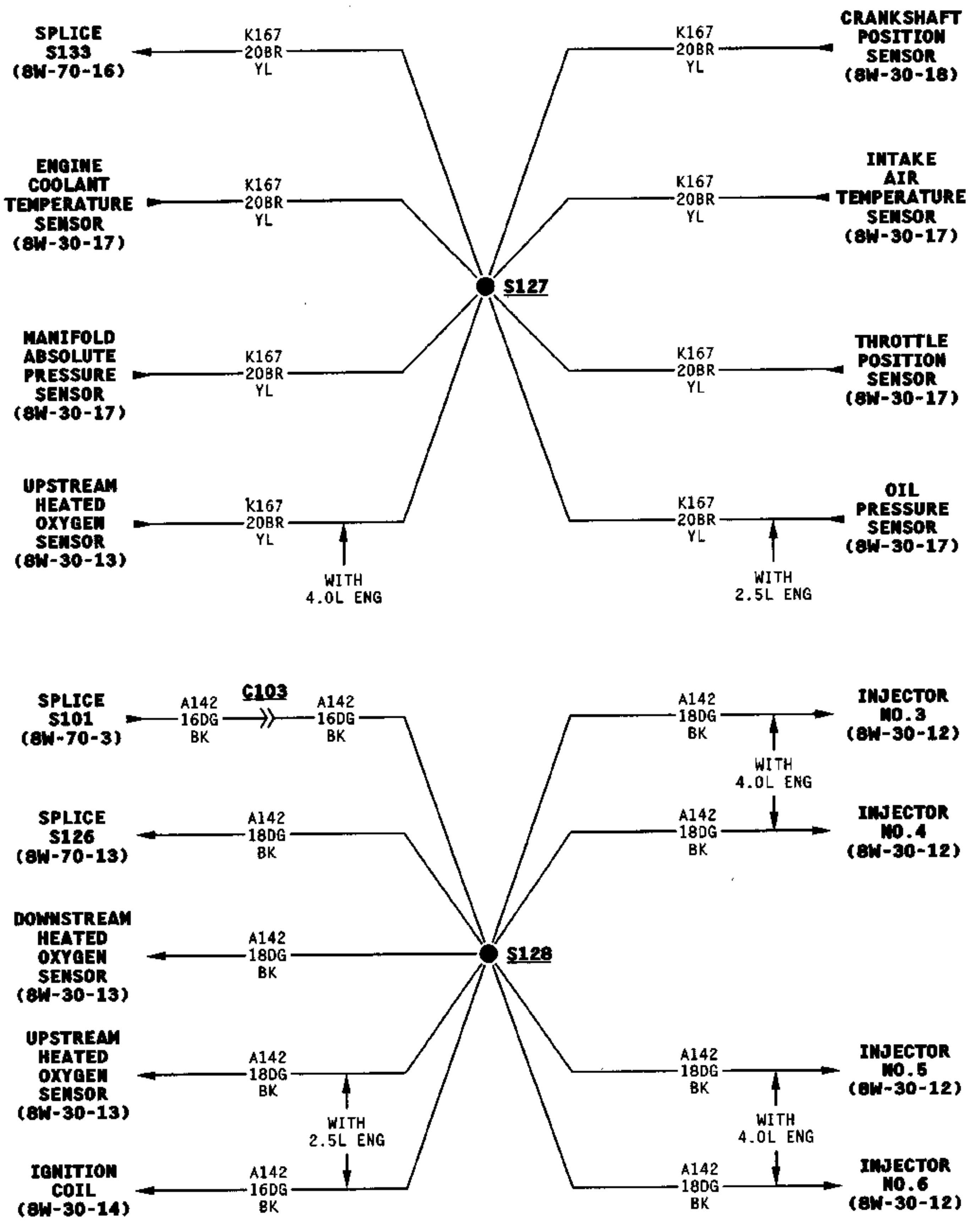


* WITH FOG LAMPS



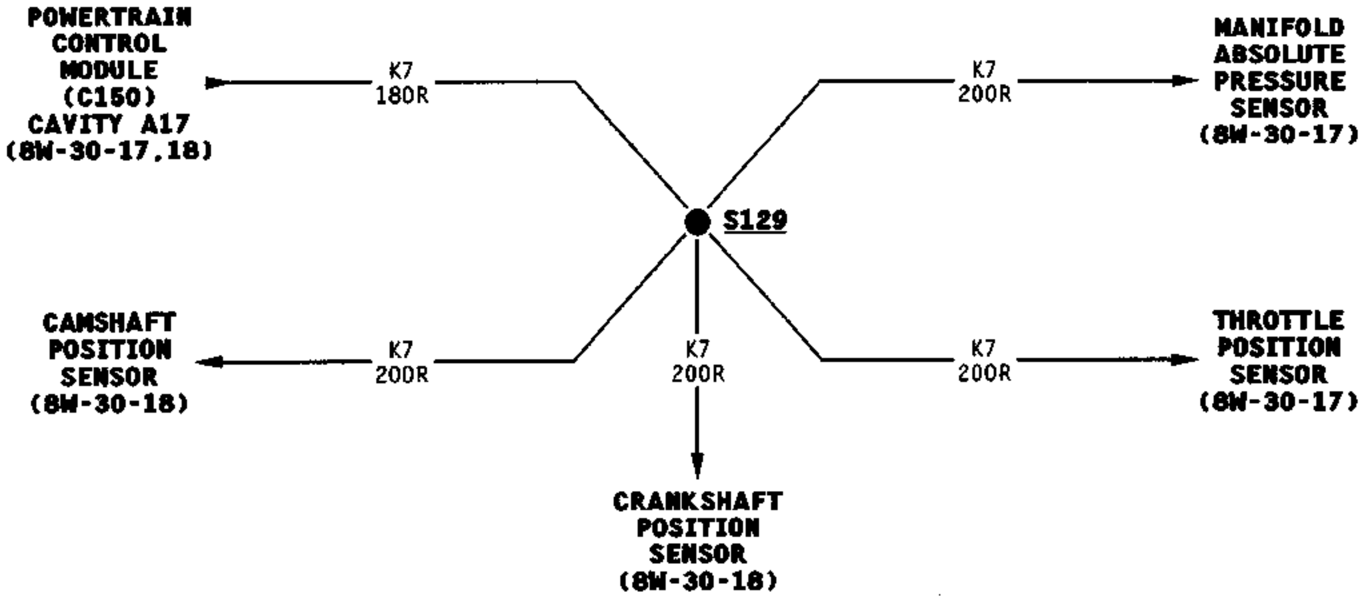


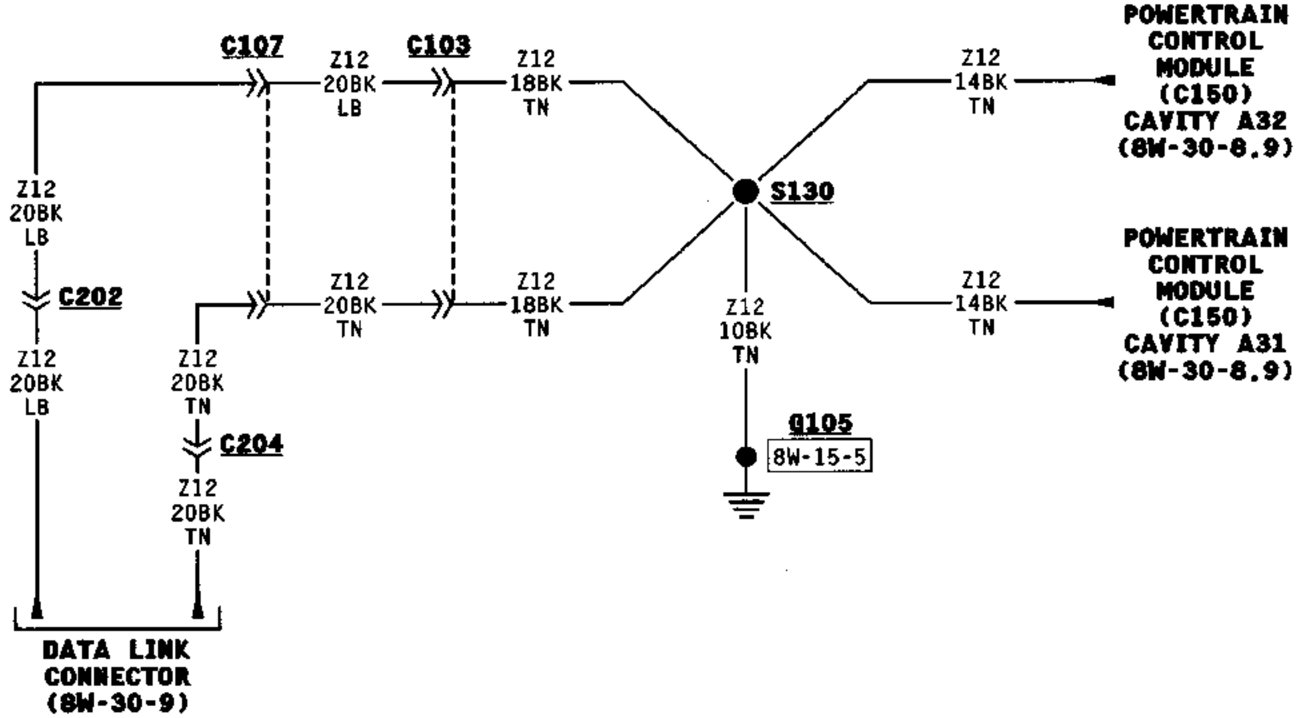
* WITH FOG LAMPS

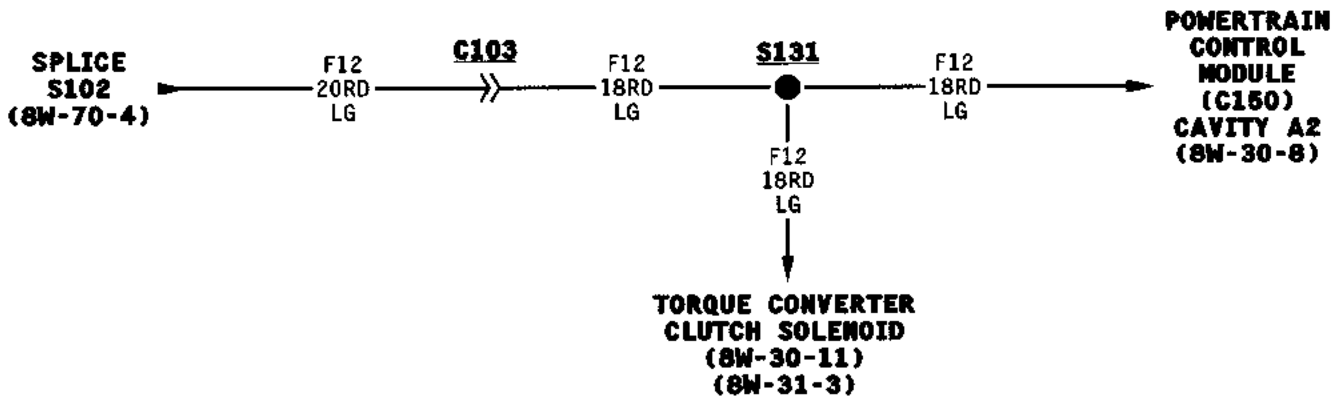


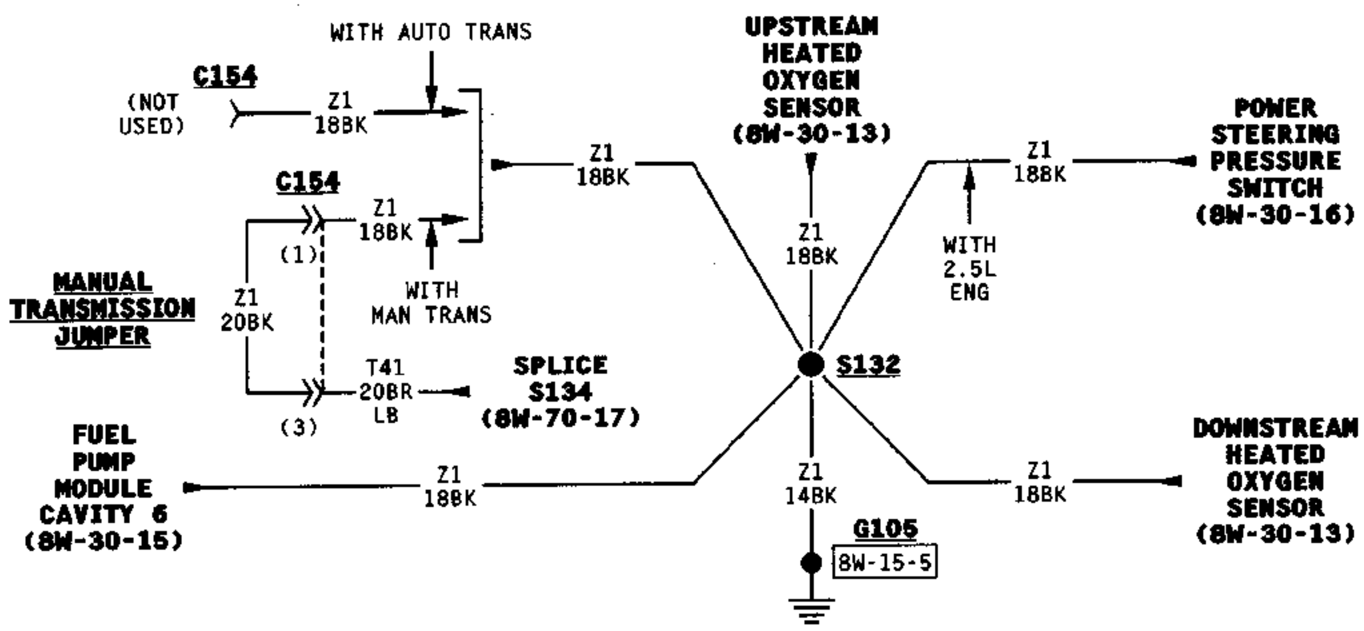
806634cd

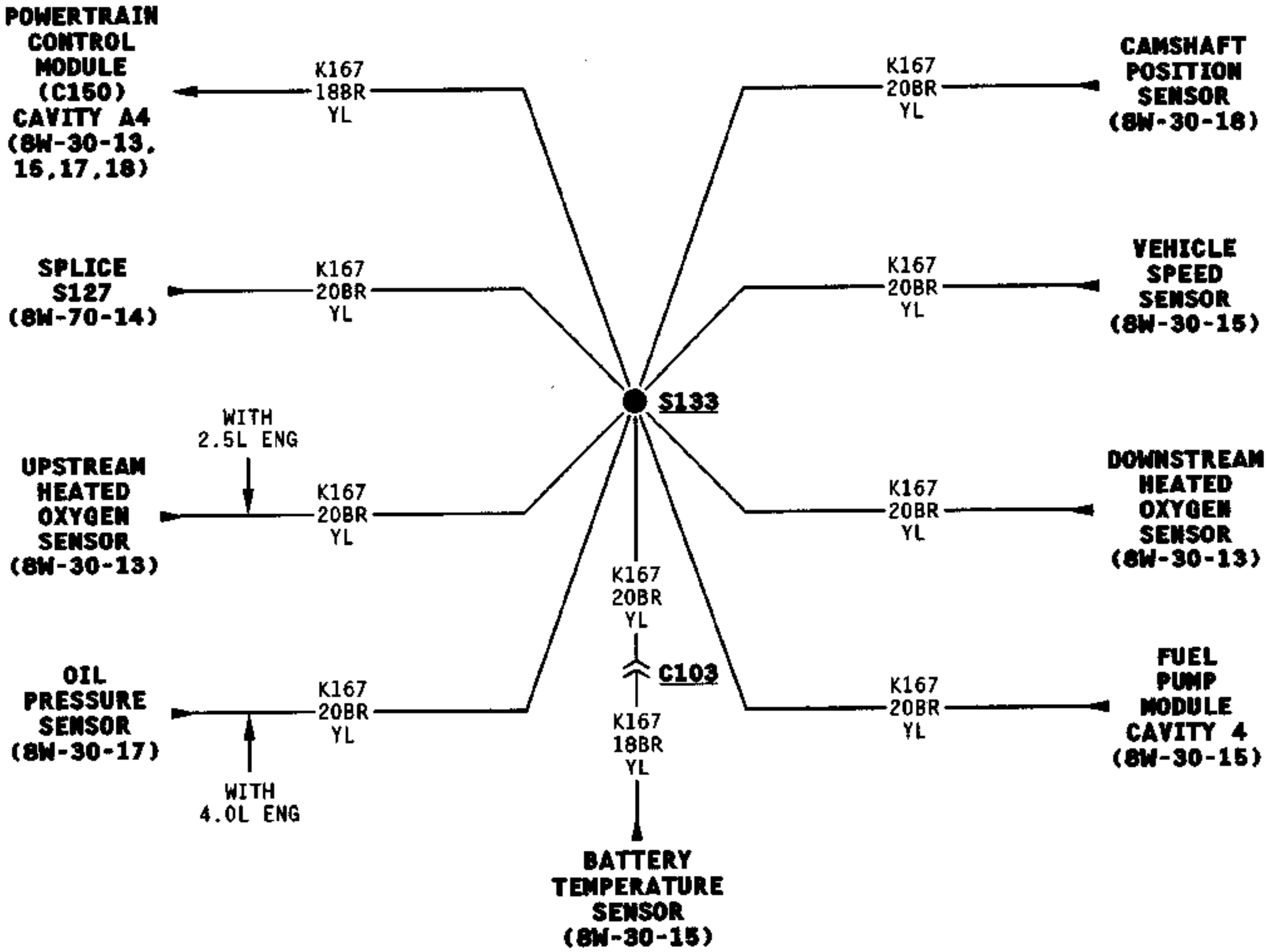
J968W-5

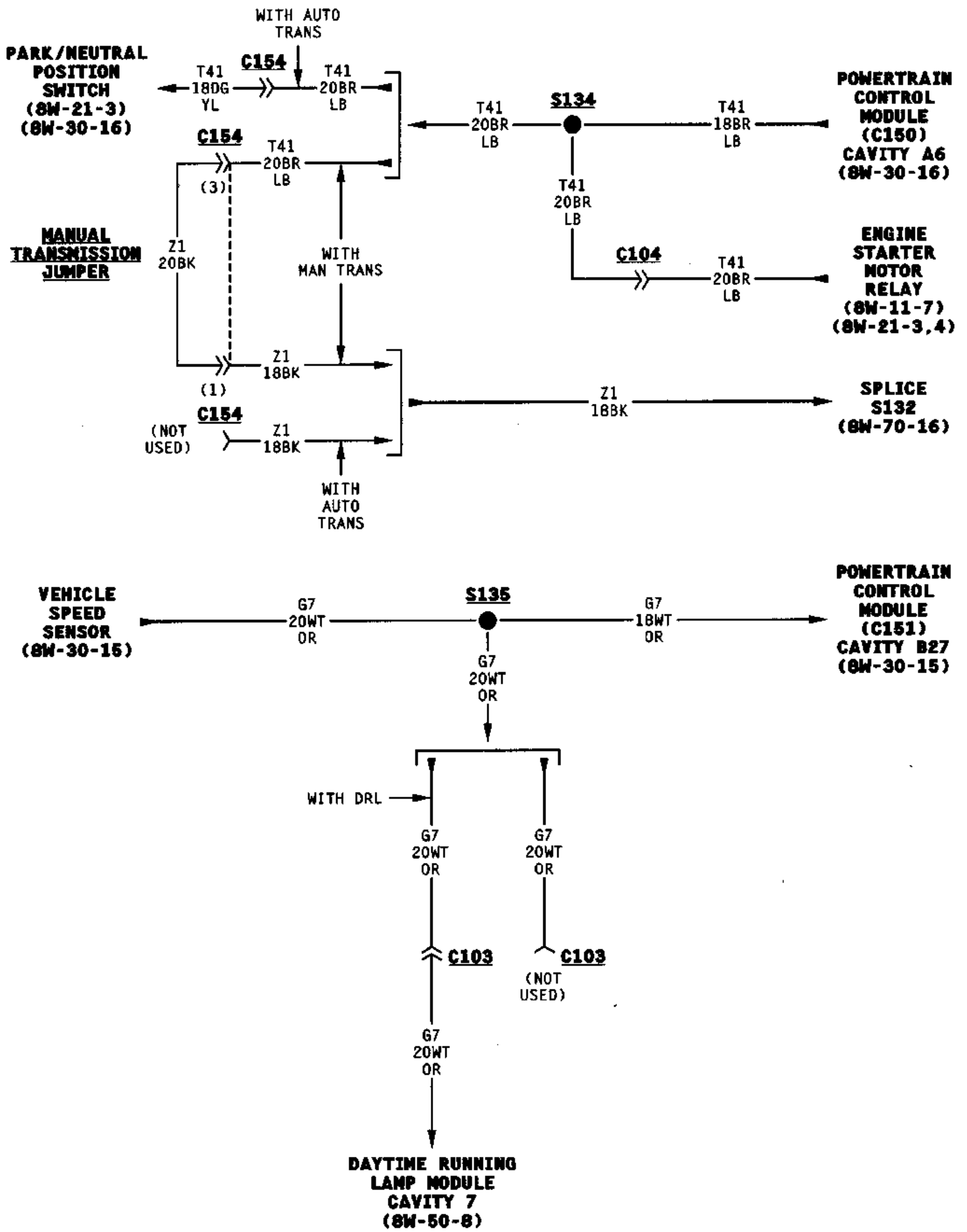

POWERTRAIN CONTROL MODULE (C150) CAVITY A17 (8W-30-17,18)
K7 18OR
K7 20OR
MANIFOLD ABSOLUTE PRESSURE SENSOR (8W-30-17)
S129
CAMSHAFT POSITION SENSOR (8W-30-18)
K7 20OR
K7 20OR
K7 20OR
THROTTLE POSITION SENSOR (8W-30-17)
CRANKSHAFT POSITION SENSOR (8W-30-18)

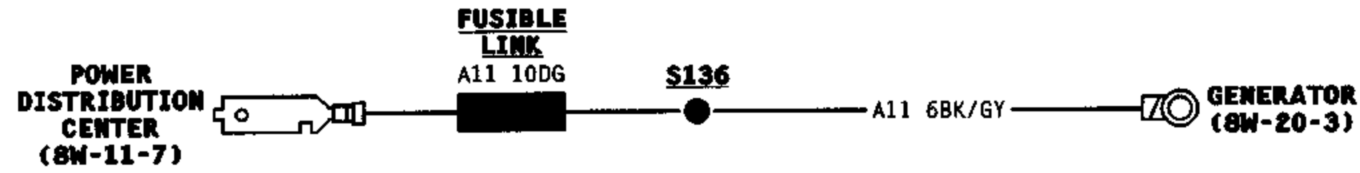

C107
Z12 20BK LB
C103
Z12 18BK TN
Z12 14BK TN
POWERTRAIN CONTROL MODULE (C150) CAVITY A32 (8W-30-8,9)
Z12 20BK LB
S130
C202
Z12 20BK TN
Z12 18BK TN
Z12 14BK TN
POWERTRAIN CONTROL MODULE (C150) CAVITY A31 (8W-30-8,9)
Z12 20BK LB
Z12 20BK TN
Z12 10BK TN
C204
G105
8W-15-5
Z12 20BK TN
DATA LINK CONNECTOR (8W-30-9)

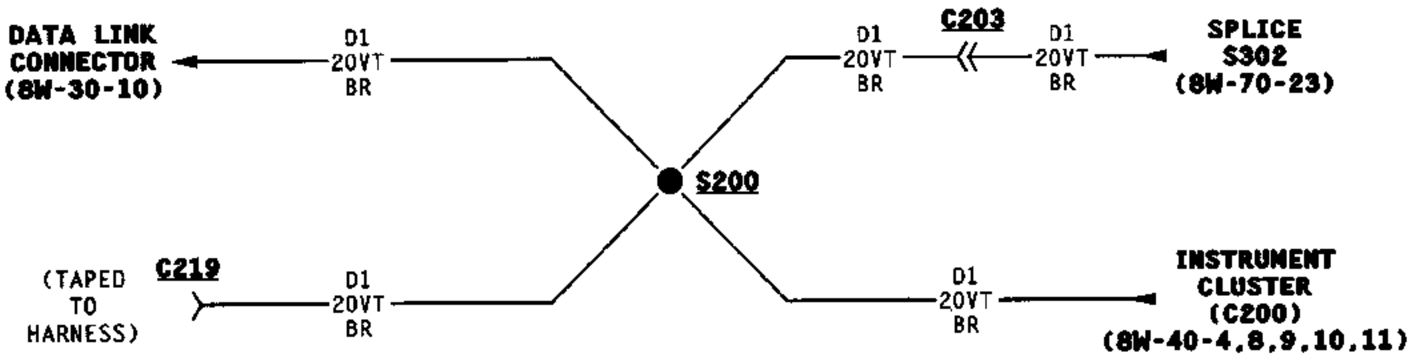

SPLICE S102 (8W-70-4)
F12 20RD LG
C103
F12 18RD LG
S131
F12 18RD LG
POWERTRAIN CONTROL MODULE (C150) CAVITY A2 (8W-30-8)
F12 18RD LG
TORQUE CONVERTER CLUTCH SOLENOID (8W-30-11) (8W-31-3)

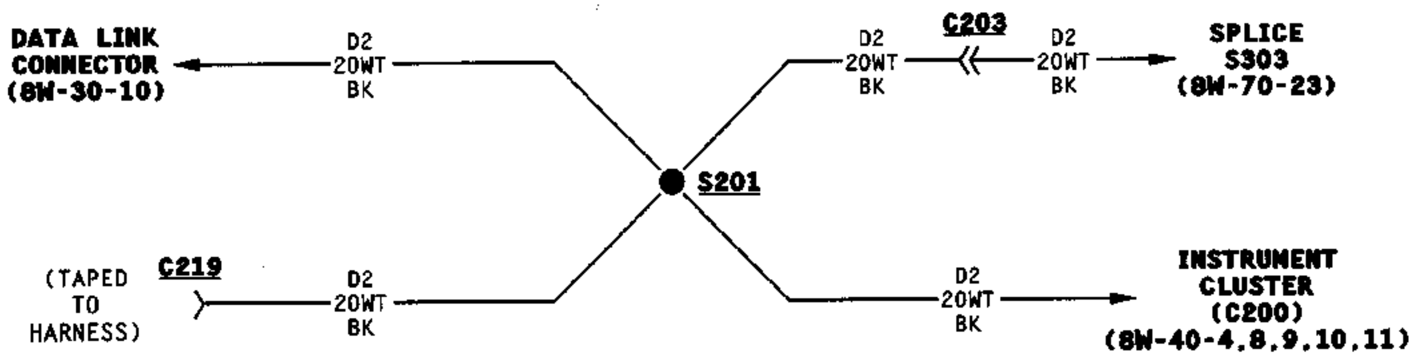

WITH AUTO TRANS
C154
(NOT USED)
Z1 18BK
C154
Z1 18BK
(1)
MANUAL TRANSMISSION JUMPER
Z1 20BK
WITH MAN TRANS
T41 20BR LB
(3)
SPLICE S134 (8W-70-17)
Z1 18BK
UPSTREAM HEATED OXYGEN SENSOR (8W-30-13)
Z1 18BK
S132
WITH 2.5L ENG
Z1 18BK
POWER STEERING PRESSURE SWITCH (8W-30-16)
FUEL PUMP MODULE CAVITY 6 (8W-30-15)
Z1 18BK
Z1 14BK
G105
8W-15-5
Z1 18BK
DOWNSTREAM HEATED OXYGEN SENSOR (8W-30-13)

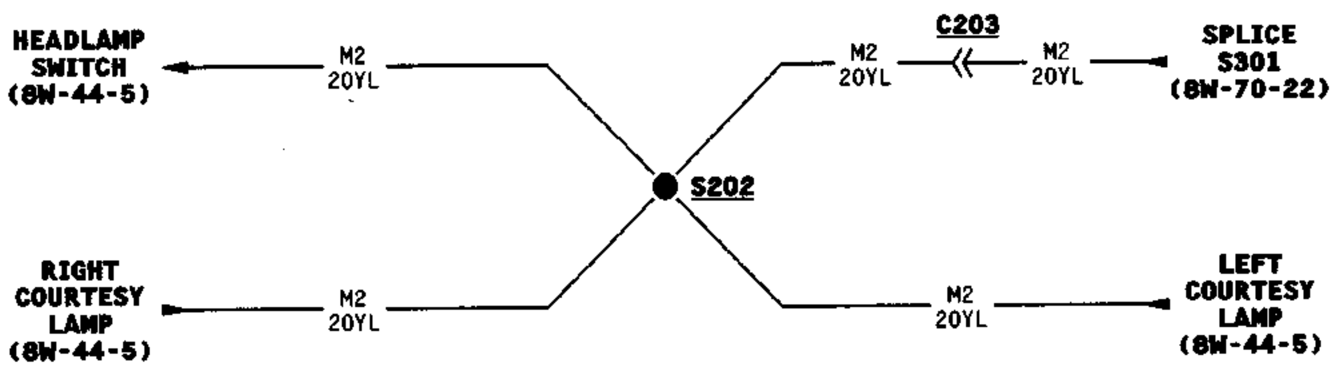

POWERTRAIN CONTROL MODULE (C150) CAVITY A4 (8W-30-13, 16,17,18)
K167 18BR YL
CAMSHAFT POSITION SENSOR (8W-30-18)
K167 20BR YL
SPLICE S127 (8W-70-14)
K167 20BR YL
VEHICLE SPEED SENSOR (8W-30-15)
K167 20BR YL
S133
WITH 2.5L ENG
UPSTREAM HEATED OXYGEN SENSOR (8W-30-13)
K167 20BR YL
DOWNSTREAM HEATED OXYGEN SENSOR (8W-30-13)
K167 20BR YL
K167 20BR YL
C103
K167 18BR YL
OIL PRESSURE SENSOR (8W-30-17)
K167 20BR YL
WITH 4.0L ENG
FUEL PUMP MODULE CAVITY 4 (8W-30-15)
K167 20BR YL
BATTERY TEMPERATURE SENSOR (8W-30-15)

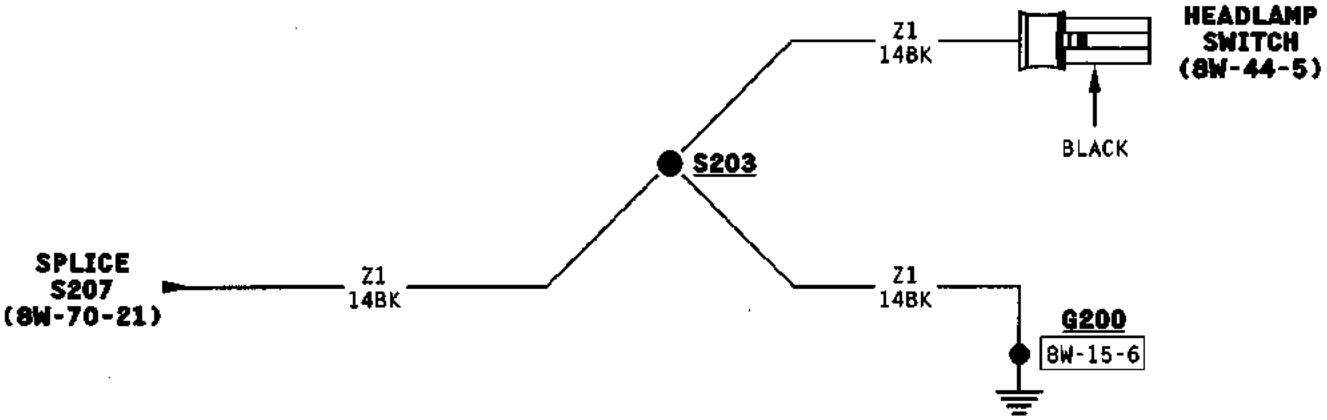

WITH AUTO TRANS
PARK/NEUTRAL POSITION SWITCH (8W-21-3) (8W-30-16)
C154
T41 18DG YL
T41 20BR LB
S134
T41 20BR LB
T41 18BR LB
POWERTRAIN CONTROL MODULE (C150) CAVITY A6 (8W-30-16)
C154
T41 20BR LB
(3)
T41 20BR LB
MANUAL TRANSMISSION JUMPER
Z1 20BK
WITH MAN TRANS
C104
T41 20BR LB
ENGINE STARTER MOTOR RELAY (8W-11-7) (8W-21-3,4)
Z1 18BK
(1)
Z1 18BK
SPLICE S132 (8W-70-16)
C154
(NOT USED)
Z1 18BK
WITH AUTO TRANS
VEHICLE SPEED SENSOR (8W-30-15)
G7 20WT OR
S135
G7 18WT OR
POWERTRAIN CONTROL MODULE (C151) CAVITY B27 (8W-30-15)
G7 20WT OR
WITH DRL
G7 20WT OR
G7 20WT OR
C103
C103
(NOT USED)
G7 20WT OR
DAYTIME RUNNING LAMP MODULE CAVITY 7 (8W-50-8)

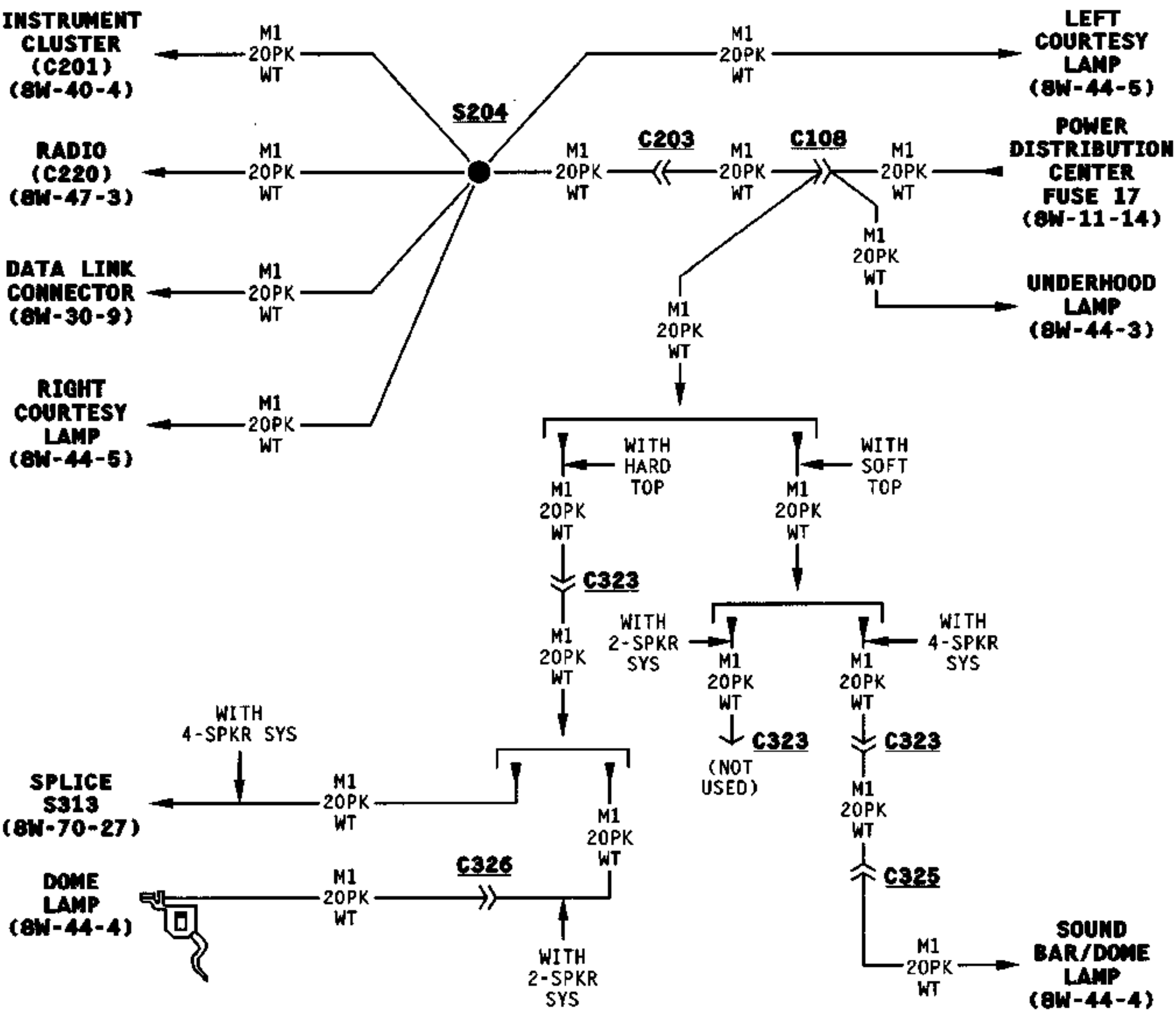

POWER DISTRIBUTION CENTER (8W-11-7)
FUSIBLE LINK
A11 10DG
S136
A11 6BK/GY
GENERATOR (8W-20-3)

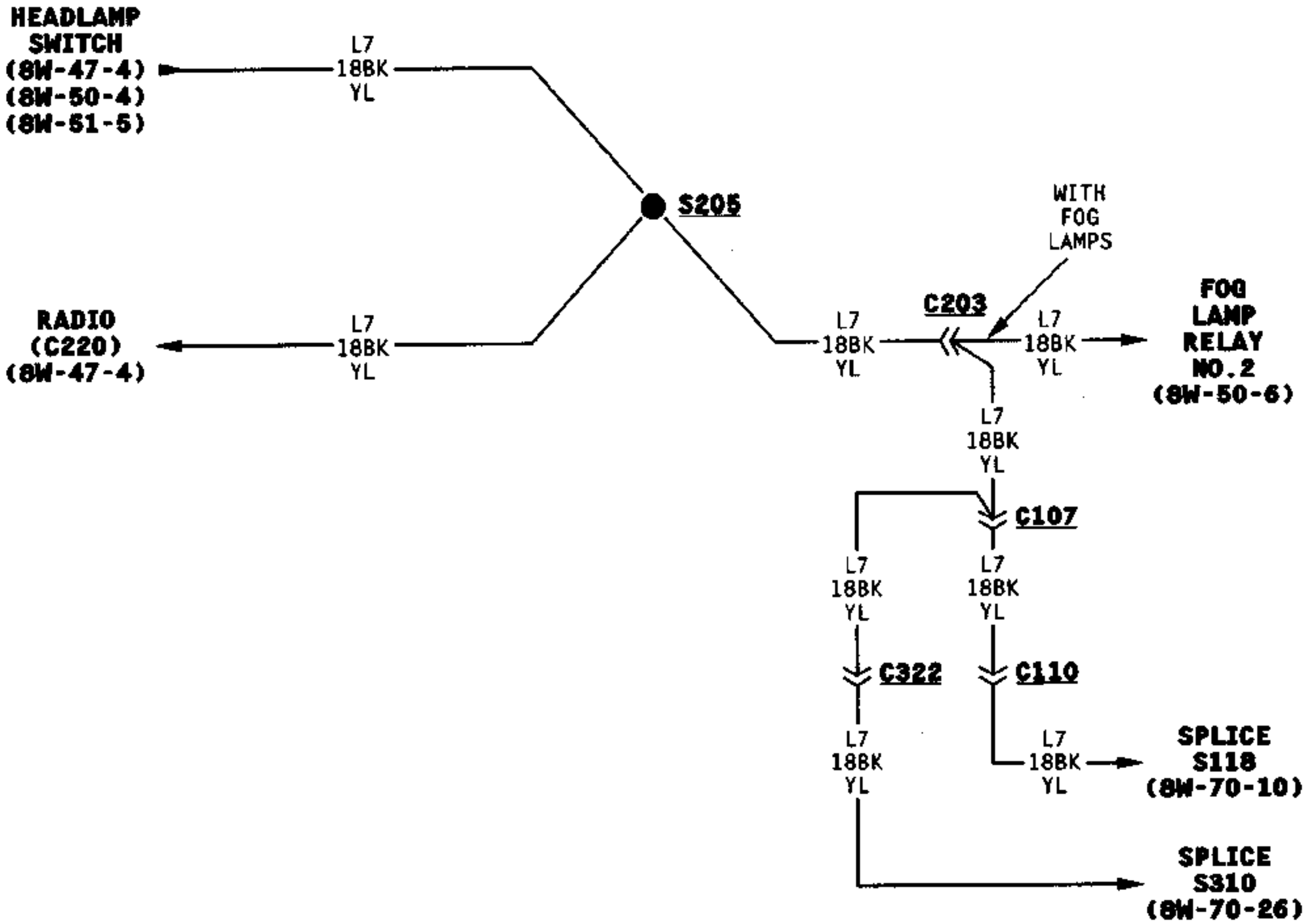

DATA LINK CONNECTOR (8W-30-10)
D1 20VT BR
C203
D1 20VT BR
D1 20VT BR
SPLICE S302 (8W-70-23)
S200
(TAPED TO HARNESS)
C219
D1 20VT BR
D1 20VT BR
INSTRUMENT CLUSTER (C200) (8W-40-4,8,9,10,11)

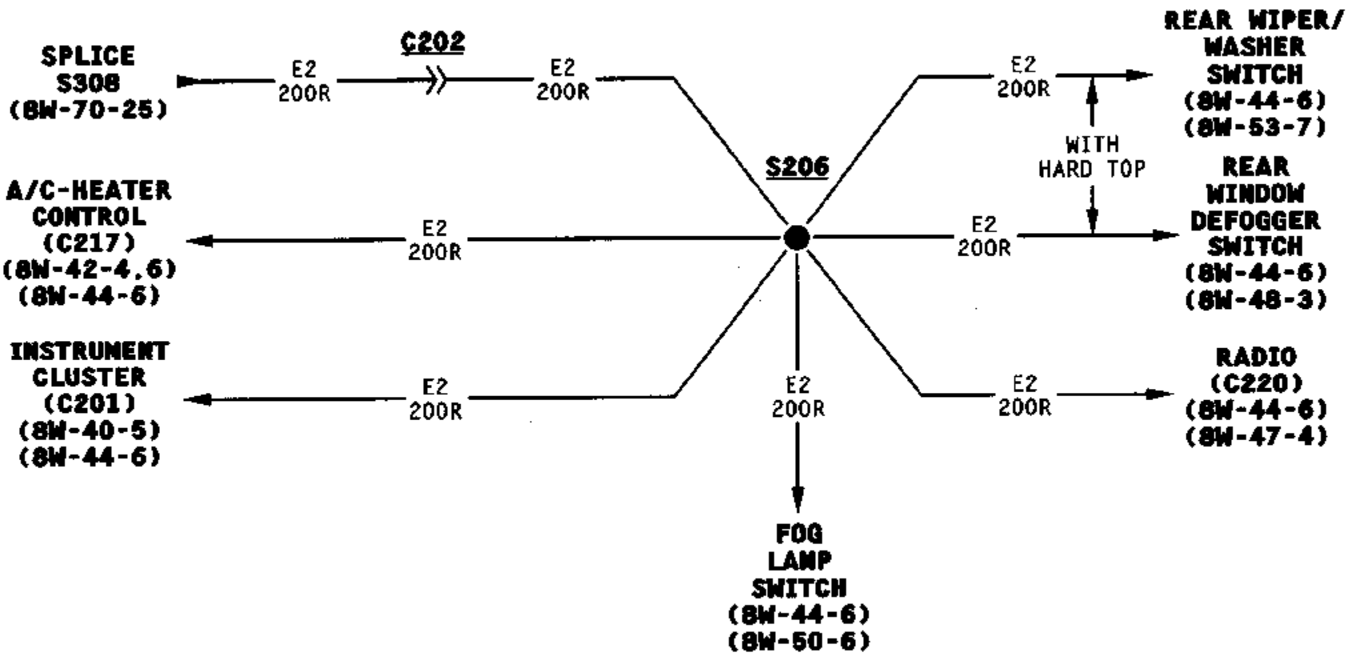

DATA LINK CONNECTOR (8W-30-10)
D2 20WT BK
C203
D2 20WT BK
D2 20WT BK
SPLICE S303 (8W-70-23)
S201
(TAPED TO HARNESS)
C219
D2 20WT BK
D2 20WT BK
INSTRUMENT CLUSTER (C200) (8W-40-4,8,9,10,11)

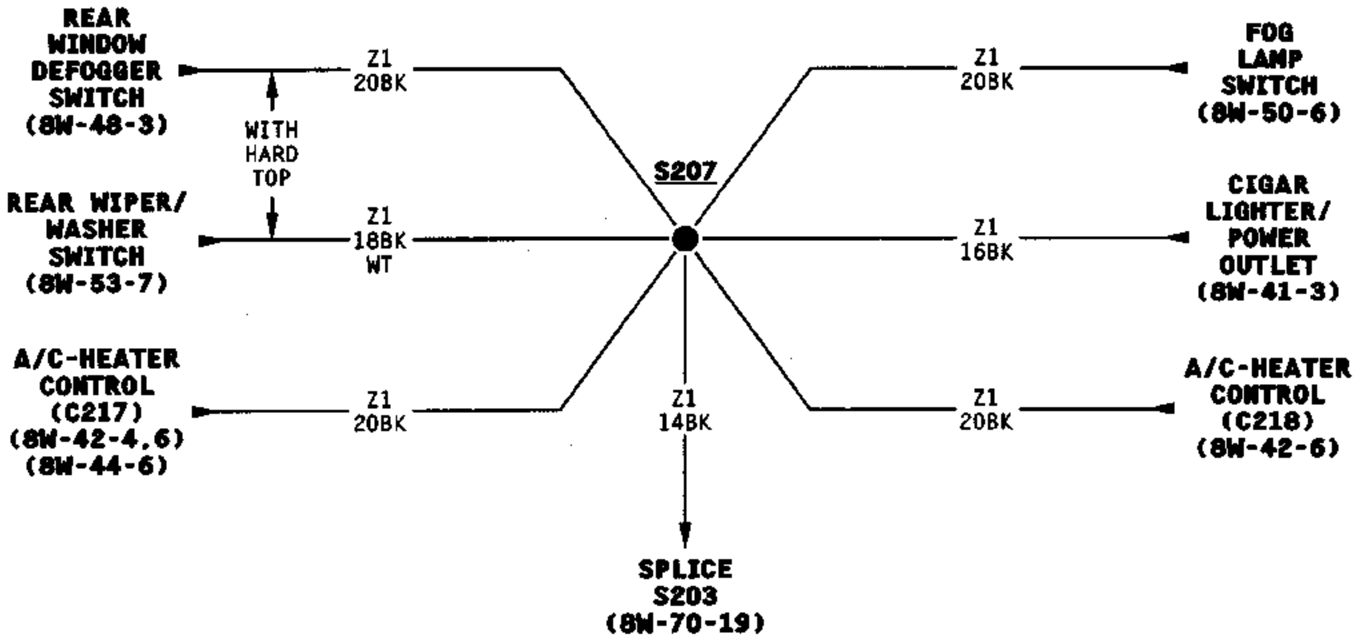

HEADLAMP SWITCH (8W-44-5)
M2 20YL
C203
M2 20YL
M2 20YL
SPLICE S301 (8W-70-22)
S202
RIGHT COURTESY LAMP (8W-44-5)
M2 20YL
M2 20YL
LEFT COURTESY LAMP (8W-44-5)

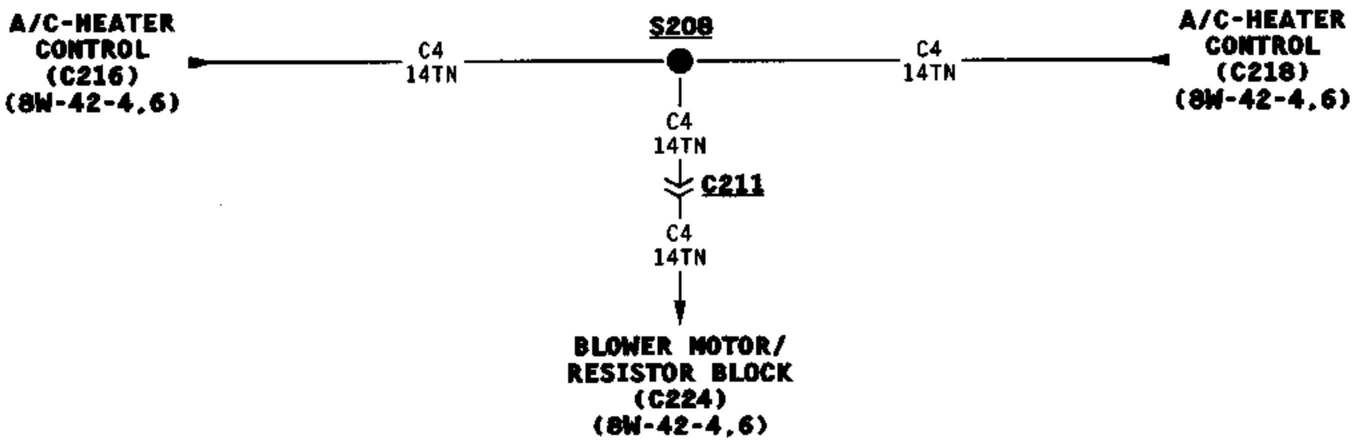

HEADLAMP SWITCH (8W-44-5)
Z1 14BK
BLACK
S203
SPLICE S207 (8W-70-21)
Z1 14BK
Z1 14BK
G200
8W-15-6

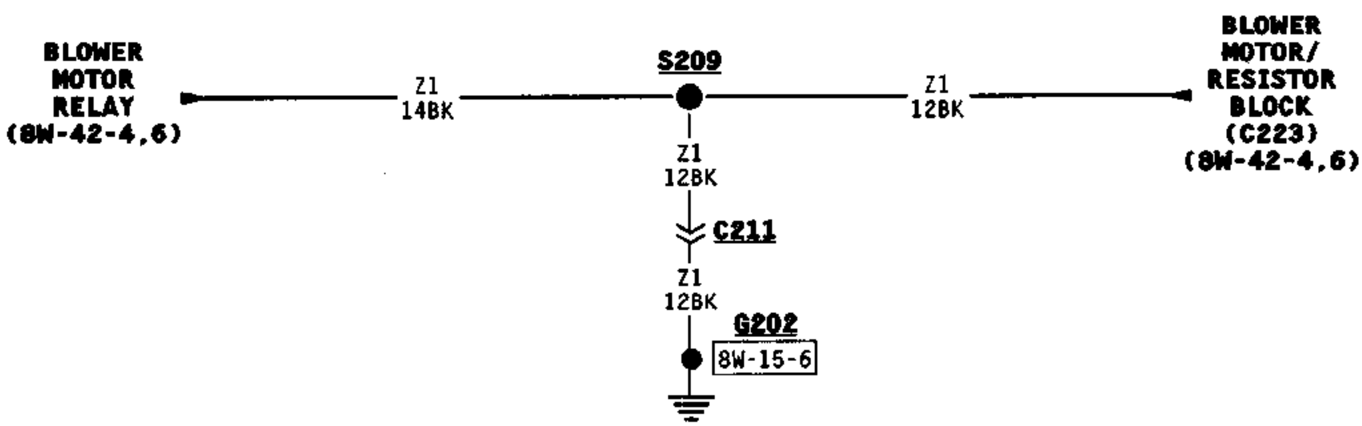

INSTRUMENT CLUSTER (C201) (8W-40-4)
M1 20PK WT
LEFT COURTESY LAMP (8W-44-5)
S204
RADIO (C220) (8W-47-3)
C203
C108
POWER DISTRIBUTION CENTER FUSE 17 (8W-11-14)
DATA LINK CONNECTOR (8W-30-9)
UNDERHOOD LAMP (8W-44-3)
RIGHT COURTESY LAMP (8W-44-5)
WITH HARD TOP
WITH SOFT TOP
C323
WITH 2-SPKR SYS
WITH 4-SPKR SYS
(NOT USED)
C325
WITH 4-SPKR SYS
SPLICE S313 (8W-70-27)
DOME LAMP (8W-44-4)
C326
WITH 2-SPKR SYS
SOUND BAR/DOME LAMP (8W-44-4)

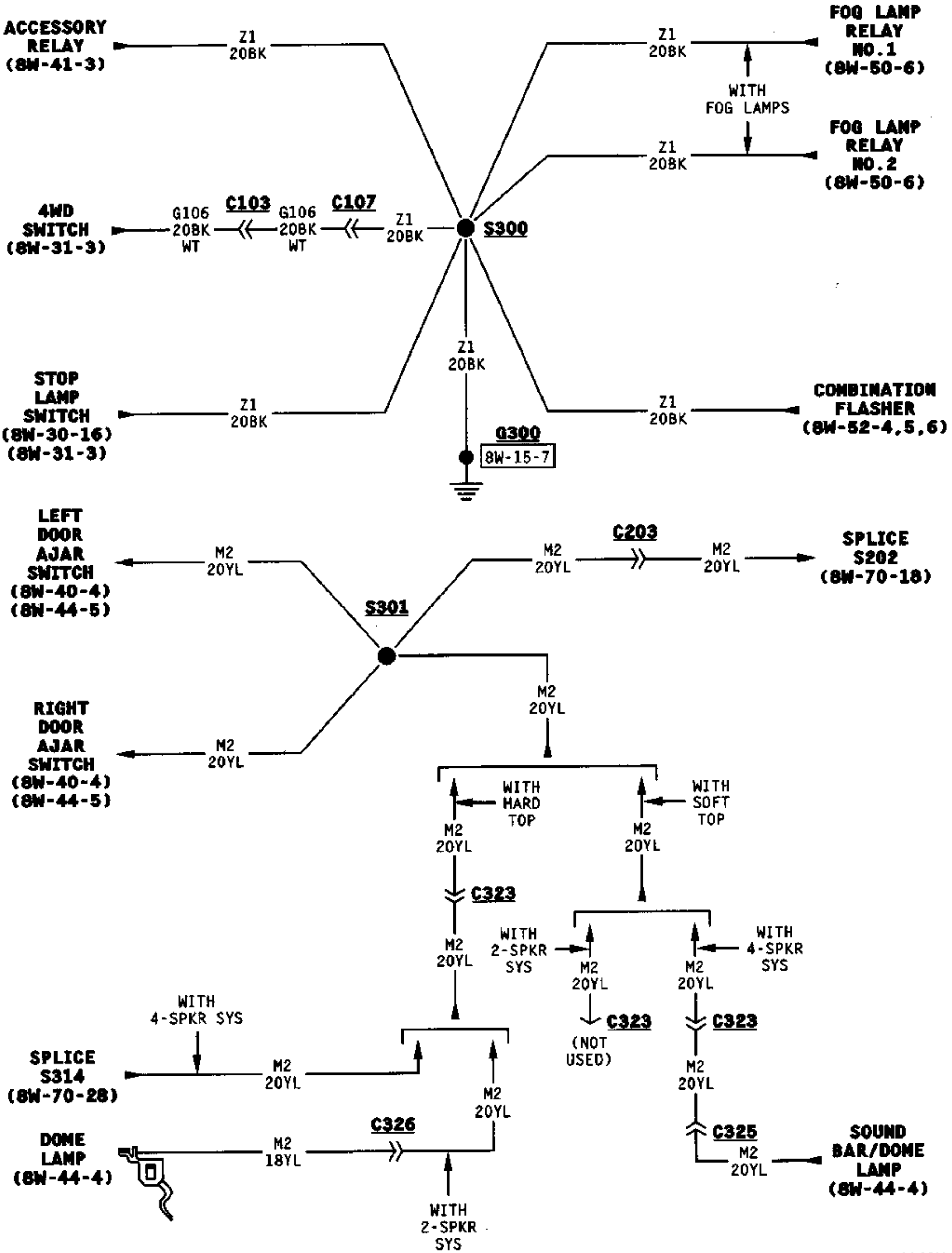

HEADLAMP SWITCH (8W-47-4) (8W-50-4) (8W-51-5)
L7 18BK YL
S205
WITH FOG LAMPS
RADIO (C220) (8W-47-4)
L7 18BK YL
L7 18BK YL
C203
L7 18BK YL
FOG LAMP RELAY NO.2 (8W-50-6)
L7 18BK YL
C107
L7 18BK YL
L7 18BK YL
C322
C110
L7 18BK YL
L7 18BK YL
SPLICE S118 (8W-70-10)
SPLICE S310 (8W-70-26)

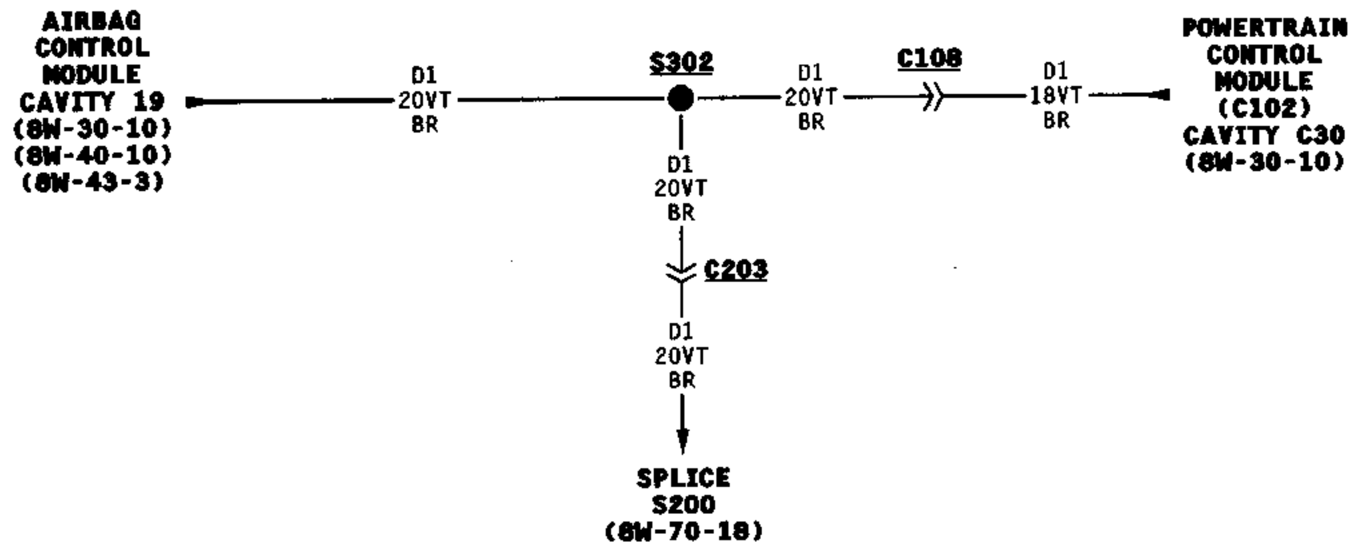

SPLICE S308 (8W-70-25)
E2 20OR
C202
E2 20OR
S206
E2 20OR
REAR WIPER/ WASHER SWITCH (8W-44-6) (8W-53-7)
WITH HARD TOP
A/C-HEATER CONTROL (C217) (8W-42-4,6) (8W-44-6)
E2 20OR
E2 20OR
REAR WINDOW DEFOGGER SWITCH (8W-44-6) (8W-48-3)
INSTRUMENT CLUSTER (C201) (8W-40-5) (8W-44-6)
E2 20OR
E2 20OR
E2 20OR
RADIO (C220) (8W-44-6) (8W-47-4)
FOG LAMP SWITCH (8W-44-6) (8W-50-6)

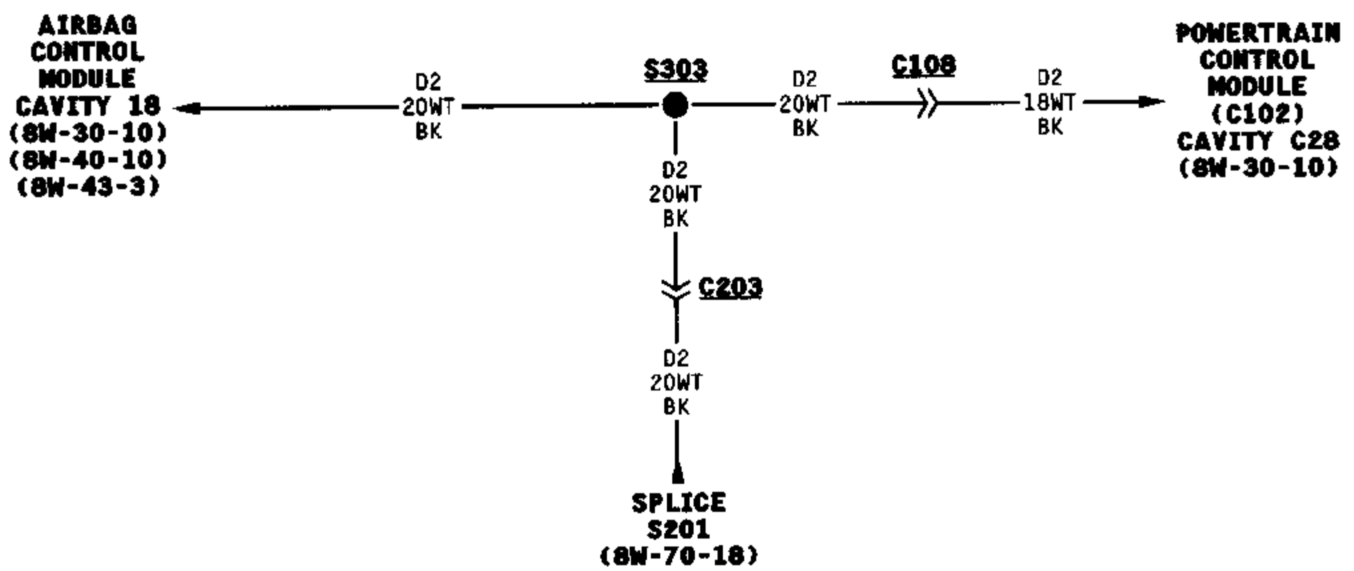

REAR WINDOW DEFOGGER SWITCH (8W-48-3)
Z1 20BK
WITH HARD TOP
REAR WIPER/ WASHER SWITCH (8W-53-7)
Z1 18BK WT
A/C-HEATER CONTROL (C217) (8W-42-4,6) (8W-44-6)
Z1 20BK
S207
Z1 14BK
SPLICE S203 (8W-70-19)
FOG LAMP SWITCH (8W-50-6)
Z1 20BK
CIGAR LIGHTER/ POWER OUTLET (8W-41-3)
Z1 16BK
A/C-HEATER CONTROL (C218) (8W-42-6)
Z1 20BK

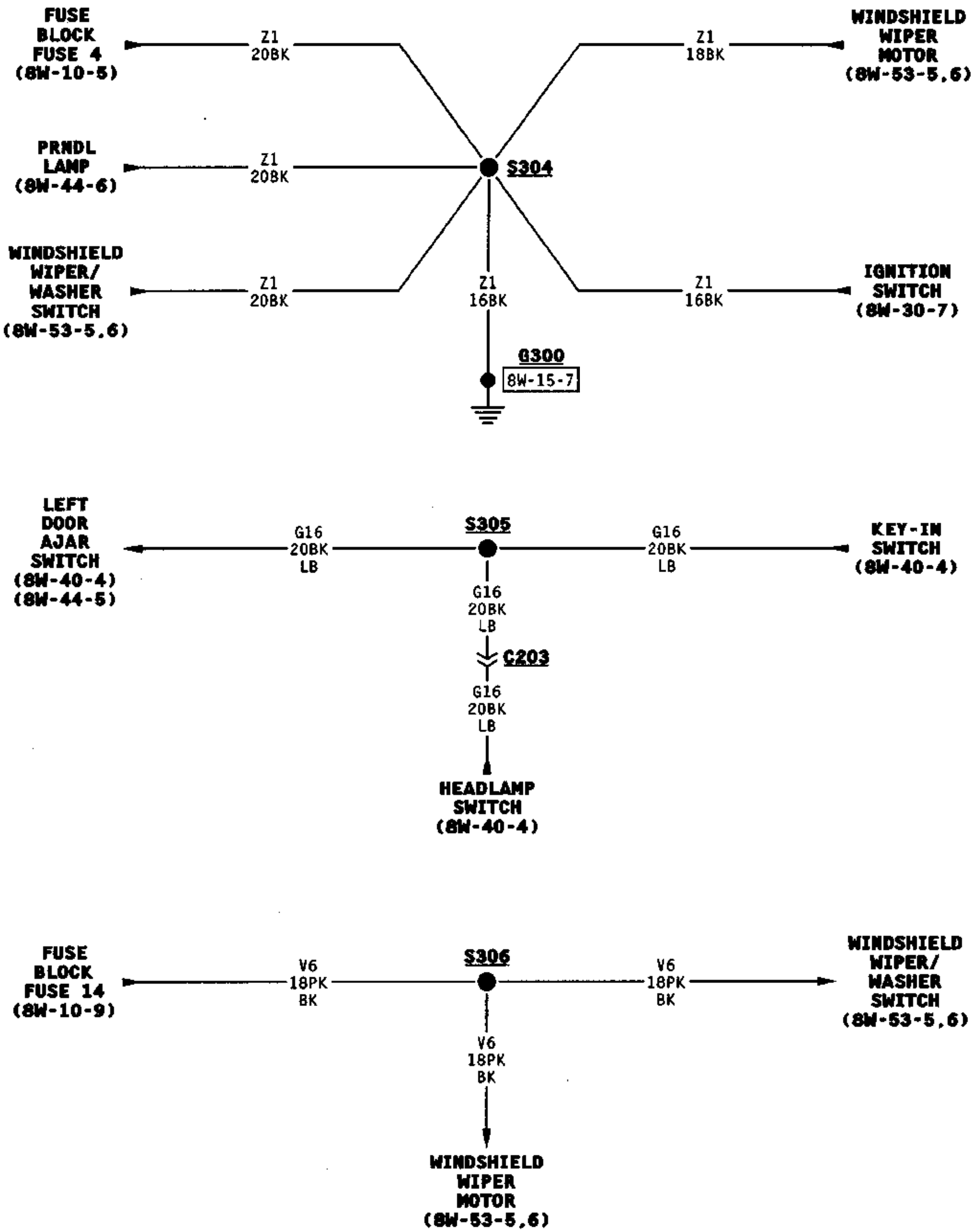

A/C-HEATER CONTROL (C216) (8W-42-4,6)
C4 14TN
S208
C4 14TN
A/C-HEATER CONTROL (C218) (8W-42-4,6)
C4 14TN
C211
C4 14TN
BLOWER MOTOR/ RESISTOR BLOCK (C224) (8W-42-4,6)


BLOWER MOTOR RELAY (8W-42-4,6)
Z1 14BK
S209
Z1 12BK
BLOWER MOTOR/ RESISTOR BLOCK (C223) (8W-42-4,6)
Z1 12BK
C211
Z1 12BK
G202
8W-15-6

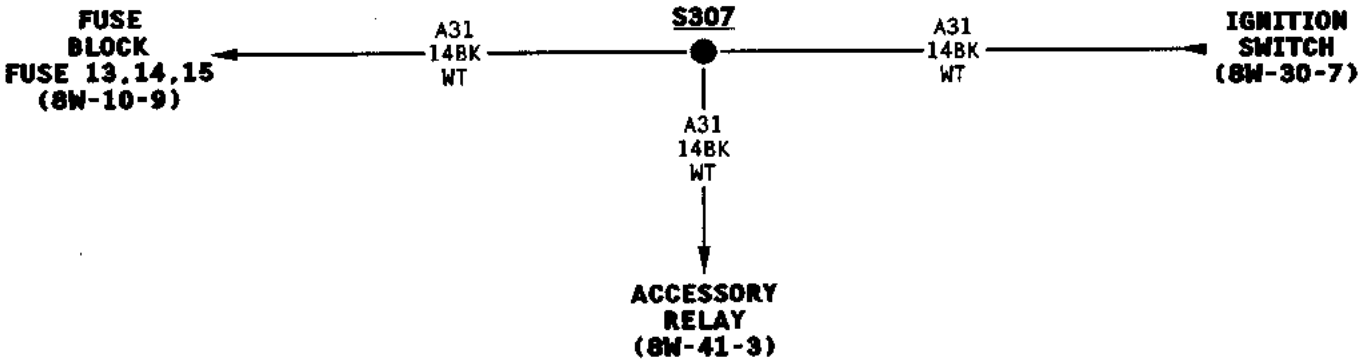

ACCESSORY RELAY (8W-41-3)
Z1 20BK
FOG LAMP RELAY NO.1 (8W-50-6)
Z1 20BK
WITH FOG LAMPS
FOG LAMP RELAY NO.2 (8W-50-6)
Z1 20BK
4WD SWITCH (8W-31-3)
G106 20BK WT
C103
G106 20BK WT
C107
Z1 20BK
S300
Z1 20BK
STOP LAMP SWITCH (8W-30-16) (8W-31-3)
Z1 20BK
COMBINATION FLASHER (8W-52-4,5,6)
Z1 20BK
G300
8W-15-7
LEFT DOOR AJAR SWITCH (8W-40-4) (8W-44-5)
M2 20YL
C203
M2 20YL
M2 20YL
SPLICE S202 (8W-70-18)
S301
RIGHT DOOR AJAR SWITCH (8W-40-4) (8W-44-5)
M2 20YL
M2 20YL
WITH HARD TOP
WITH SOFT TOP
M2 20YL
M2 20YL
C323
M2 20YL
WITH 2-SPKR SYS
WITH 4-SPKR SYS
M2 20YL
M2 20YL
C323
(NOT USED)
C323
WITH 4-SPKR SYS
SPLICE S314 (8W-70-28)
M2 20YL
M2 20YL
M2 20YL
DOME LAMP (8W-44-4)
C326
M2 18YL
C325
M2 20YL
SOUND BAR/DOME LAMP (8W-44-4)
WITH 2-SPKR SYS

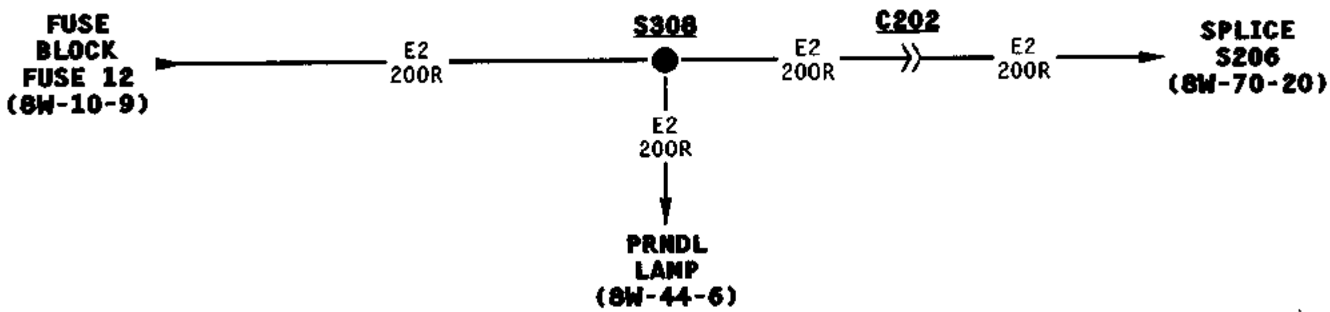

AIRBAG
CONTROL
MODULE
CAVITY 19
(8W-30-10)
(8W-40-10)
(8W-43-3)
D1
20VT
BR
S302
D1
20VT
BR
C108
D1
18VT
BR
POWERTRAIN
CONTROL
MODULE
(C102)
CAVITY C30
(8W-30-10)
D1
20VT
BR
C203
D1
20VT
BR
SPLICE
S200
(8W-70-18)

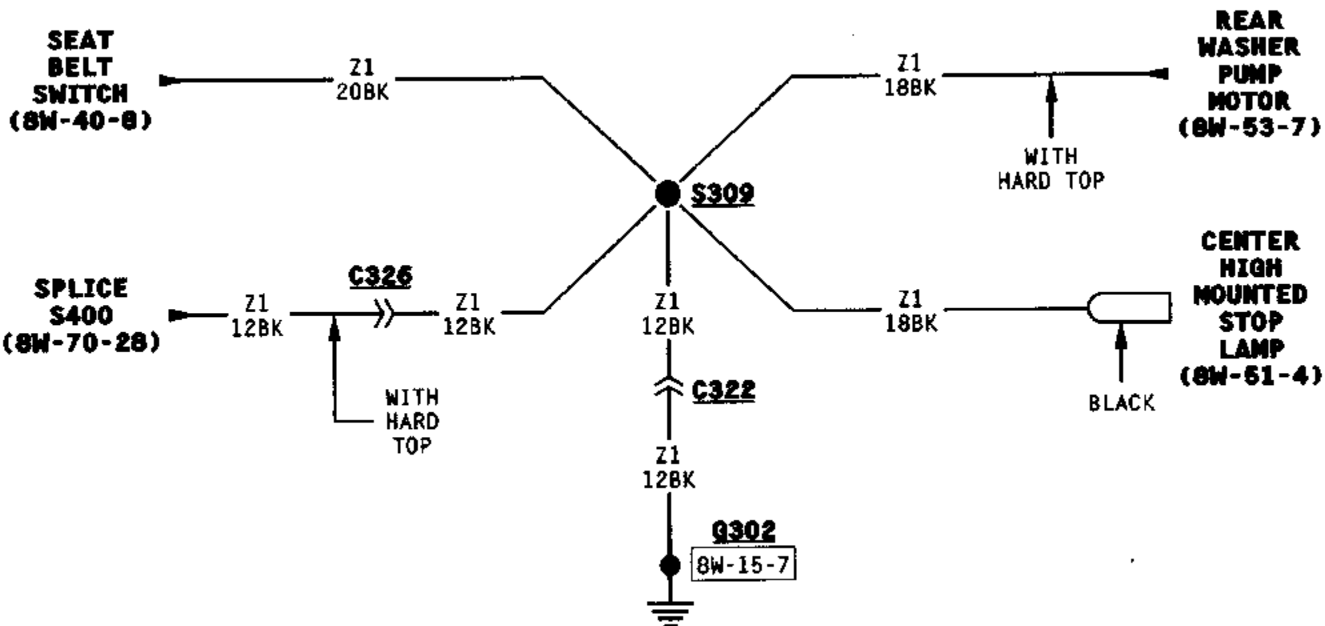

AIRBAG
CONTROL
MODULE
CAVITY 18
(8W-30-10)
(8W-40-10)
(8W-43-3)
D2
20WT
BK
S303
D2
20WT
BK
C108
D2
18WT
BK
POWERTRAIN
CONTROL
MODULE
(C102)
CAVITY C28
(8W-30-10)
D2
20WT
BK
C203
D2
20WT
BK
SPLICE
S201
(8W-70-18)

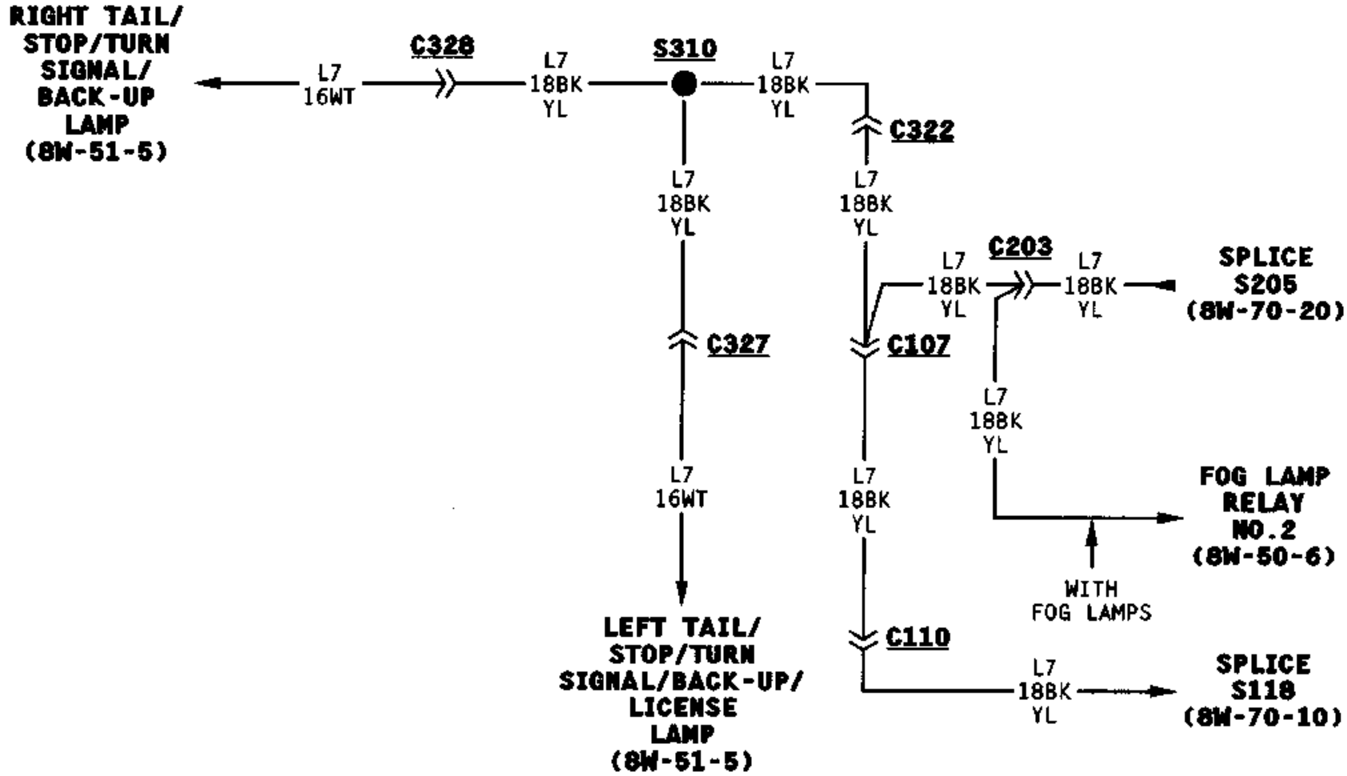


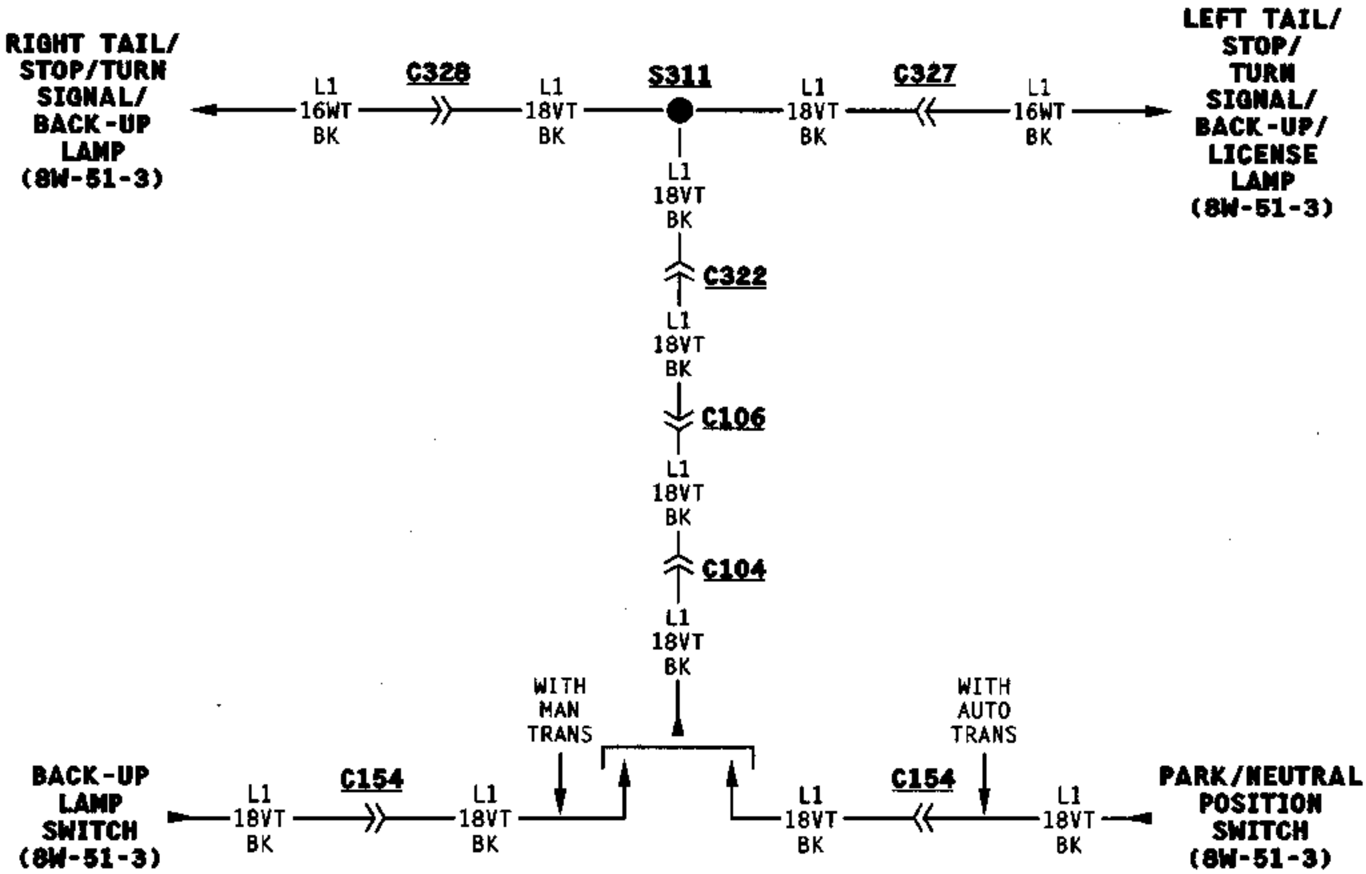
FUSE BLOCK FUSE 4 (8W-10-5)
Z1 20BK
WINDSHIELD WIPER MOTOR (8W-53-5,6)
Z1 18BK
PRNDL LAMP (8W-44-6)
Z1 20BK
S304
WINDSHIELD WIPER/ WASHER SWITCH (8W-53-5,6)
Z1 20BK
Z1 16BK
IGNITION SWITCH (8W-30-7)
Z1 16BK
G300
8W-15-7
LEFT DOOR AJAR SWITCH (8W-40-4) (8W-44-5)
G16 20BK LB
S305
G16 20BK LB
KEY-IN SWITCH (8W-40-4)
G16 20BK LB
C203
G16 20BK LB
HEADLAMP SWITCH (8W-40-4)
FUSE BLOCK FUSE 14 (8W-10-9)
V6 18PK BK
S306
V6 18PK BK
WINDSHIELD WIPER/ WASHER SWITCH (8W-53-5,6)
V6 18PK BK
WINDSHIELD WIPER MOTOR (8W-53-5,6)

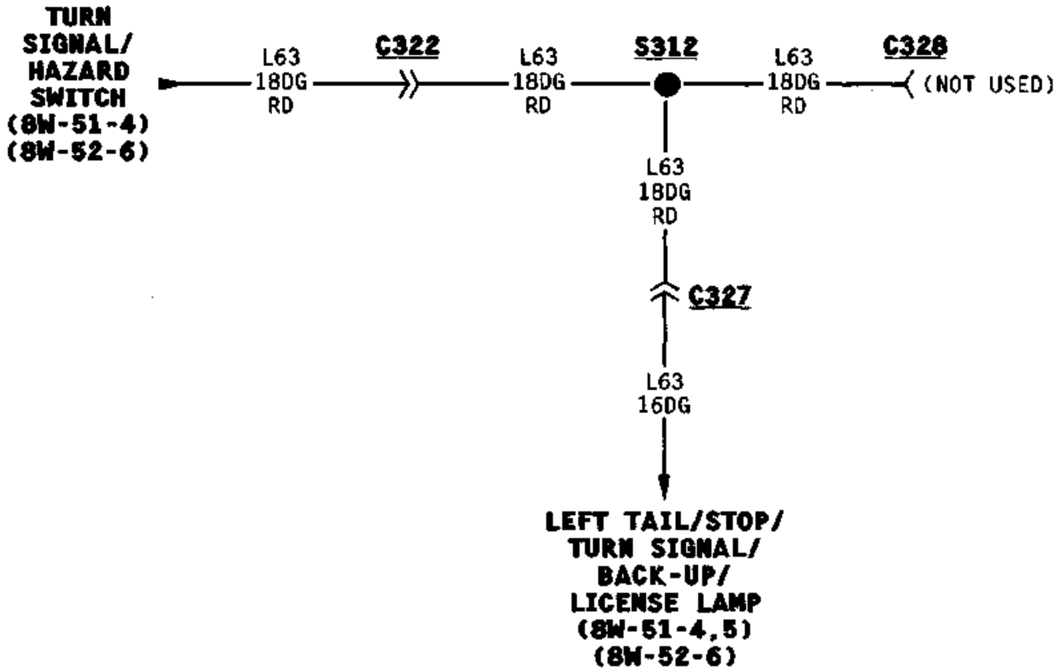

FUSE BLOCK FUSE 13,14,15 (8W-10-9)
A31 14BK WT
S307
A31 14BK WT
IGNITION SWITCH (8W-30-7)
A31 14BK WT
ACCESSORY RELAY (8W-41-3)

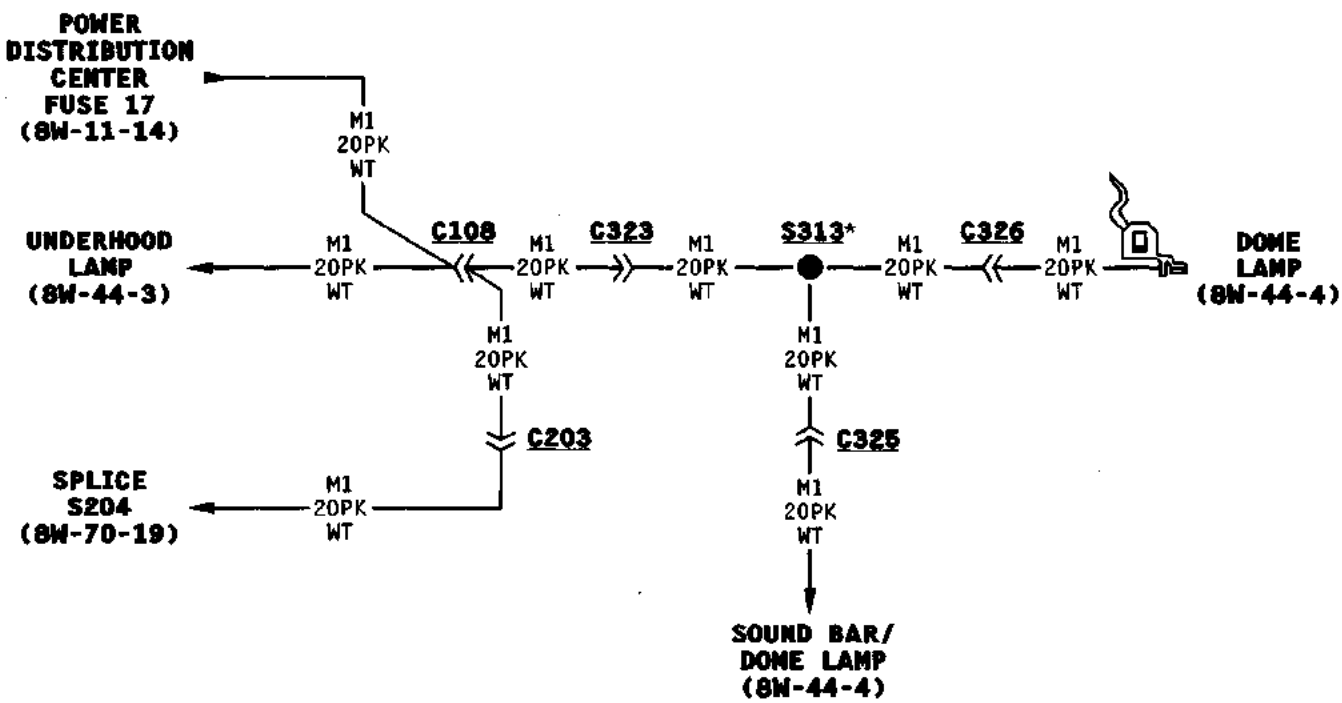

FUSE BLOCK FUSE 12 (8W-10-9)
E2 20OR
S308
E2 20OR
C202
E2 20OR
SPLICE S206 (8W-70-20)
E2 20OR
PRNDL LAMP (8W-44-6)


SEAT BELT SWITCH (8W-40-8)
Z1 20BK
Z1 18BK
REAR WASHER PUMP MOTOR (8W-53-7)
WITH HARD TOP
S309
SPLICE S400 (8W-70-28)
Z1 12BK
C326
Z1 12BK
WITH HARD TOP
Z1 12BK
C322
Z1 12BK
G302
8W-15-7
Z1 18BK
CENTER HIGH MOUNTED STOP LAMP (8W-51-4)
BLACK

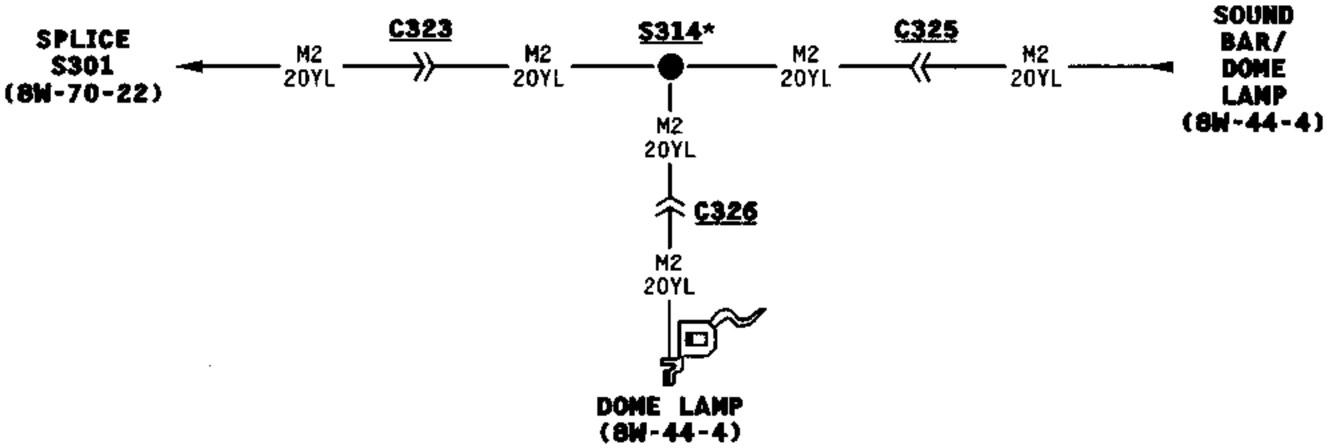

RIGHT TAIL/
STOP/TURN
SIGNAL/
BACK-UP
LAMP
(8W-51-5)
L7
16WT
C328
L7
18BK
YL
S310
L7
18BK
YL
C322
L7
18BK
YL
L7
18BK
YL
C327
L7
16WT
LEFT TAIL/
STOP/TURN
SIGNAL/BACK-UP/
LICENSE
LAMP
(8W-51-5)
L7
18BK
YL
C203
L7
18BK
YL
SPLICE
S205
(8W-70-20)
C107
L7
18BK
YL
L7
18BK
YL
FOG LAMP
RELAY
NO.2
(8W-50-6)
WITH
FOG LAMPS
C110
L7
18BK
YL
SPLICE
S118
(8W-70-10)

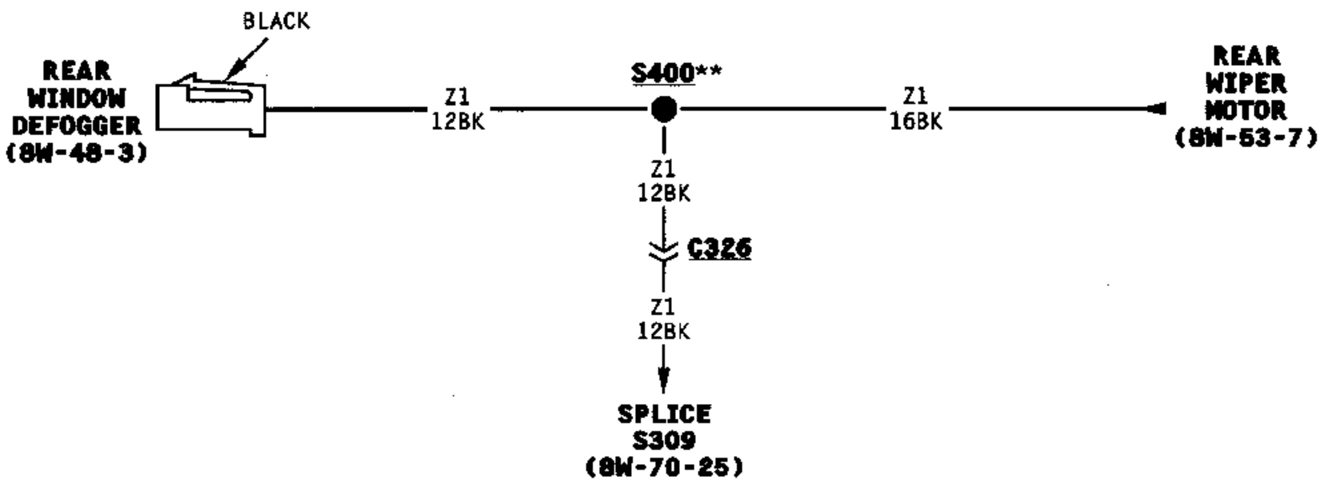

RIGHT TAIL/
STOP/TURN
SIGNAL/
BACK-UP
LAMP
(8W-51-3)
L1
16WT
BK
C328
L1
18VT
BK
S311
L1
18VT
BK
C327
L1
16WT
BK
LEFT TAIL/
STOP/
TURN
SIGNAL/
BACK-UP/
LICENSE
LAMP
(8W-51-3)
L1
18VT
BK
C322
L1
18VT
BK
C106
L1
18VT
BK
C104
L1
18VT
BK
WITH
MAN
TRANS
WITH
AUTO
TRANS
BACK-UP
LAMP
SWITCH
(8W-51-3)
L1
18VT
BK
C154
L1
18VT
BK
L1
18VT
BK
C154
L1
18VT
BK
PARK/NEUTRAL
POSITION
SWITCH
(8W-51-3)

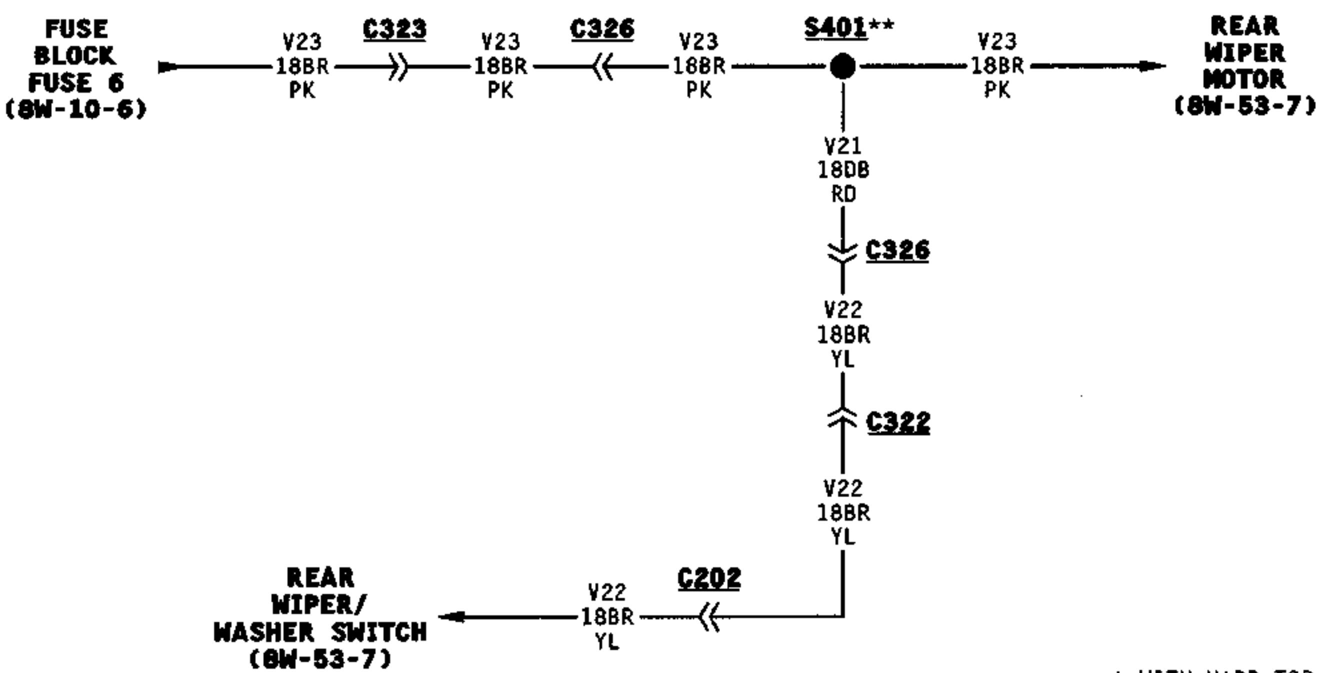




* WITH HARD TOP AND 4-SPKR SYS







* WITH HARD TOP AND
4-SPKR SYS
** WITH HARD TOP

8W-80 CONNECTOR PIN-OUTS

DESCRIPTION AND OPERATION

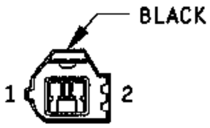
INTRODUCTION

The pages referenced in this section show the connector, the circuits in the connector, and the pin that circuit occupies. Individual connector numbers are referenced on diagram pages throughout Group 8W.

CONNECTOR PIN-OUT INDEX

CONNECTOR PIN-OUT INDEX

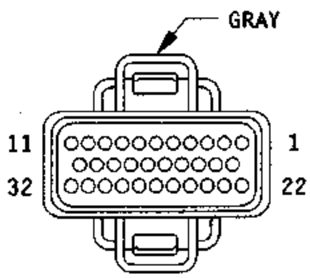
C100
POWER DISTRIBUTION CENTER
(8W-11-3)



BATTERY
TEMPERATURE SENSOR

C101

CAV	CIRCUIT	FUNCTION
1	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
2	K167 18BR/YL	SENSOR GROUND

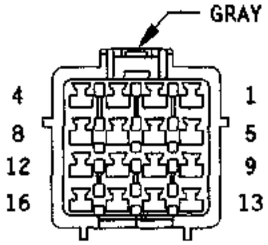


POWERTRAIN
CONTROL MODULE
(C)

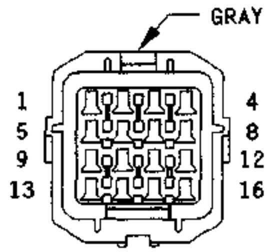
C102

CAV	CIRCUIT	FUNCTION
C1	C13 20DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
C2	-	-
C3	K51 18DB/YL	AUTOMATIC SHUT DOWN RELAY CONTROL
C4	-	-
C5	-	-
C6	-	-
C7	-	-
C8	-	-
C9	-	-
C10	-	-
C11	-	-
C12	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
C13	-	-
C14	-	-
C15	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
C16	-	-
C17	-	-
C18	-	-
C19	K31 18BR	FUEL PUMP RELAY CONTROL
C20	K52 18PK/BK	DUTY CYCLE EVAP/PURGE SOLENOID CONTROL
C21	-	-
C22	C22 18DB/WT	A/C SWITCH SENSE
C23	C90 18LG/DG	A/C SWITCH OUTPUT
C24	K29 18WT/PK	STOP LAMP SWITCH SENSE
C25	K72 18DG/OR	GENERATOR FIELD SOURCE (+)
C26	K226 18DB/LG	FUEL LEVEL SENSOR SIGNAL
C27	D21 18PK	SCI TRANSMIT
C28	D2 18WT/BK	CCD BUS(-)
C29	D20 18LG	SCI RECEIVE
C30	D1 18VT/BR	CCD BUS(+)
C31	-	-
C32	-	-

C103

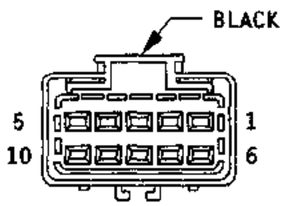


CAV	CIRCUIT
1	A142 16DG/BK
2	K72 18DG/OR
3	A14 14RD/WT
4	–
5	C3 20DB/BK
6	K226 20DB/LG
7	A141 18DG/WT
8	K167 20BR/YL
9	F12 18RD/LG
10	Z12 18BK/TN
11	Z12 18BK/TN
12	G7 20WT/OR
13	G107 20BK/RD
14	B6 18WT/DB●
15	B7 18WT●
16	G106 20BK/WT

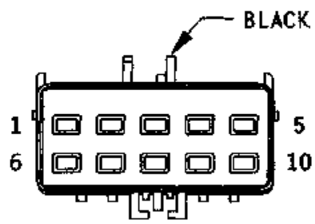


CAV	CIRCUIT
1	A142 16DG/BK
2	K72 18DG/OR
3	A14 14RD/WT
4	–
5	C3 20DB/BK
6	K226 18DB/LG
7	A141 18DG/WT
8	K167 18BR/YL
9	F12 20RD/LG
10	Z12 20BK/TN
11	Z12 20BK/LB
12	G7 20WT/OR
13	G107 20BK/RD
14	B6 18WT/DB●
15	B7 18WT●
16	G106 20BK/WT

C104

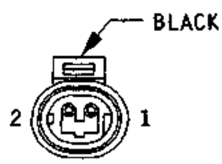


CAV	CIRCUIT
1	C90 20LG/DG
2	C22 18DB/WT
3	B4 18LG●
4	B3 18LG/DB●
5	T41 20BR/LB
6	B2 18YL●
7	B1 18YL/DB●
8	–
9	L1 18VT/BK
10	F20 18VT/WT



CAV	CIRCUIT
1	C90 20LG
2	C22 20DB/WT
3	B4 18LG●
4	B3 18LG/DB●
5	T41 20BR/LB
6	B2 18YL●
7	B1 18YL/DB●
8	–
9	L1 18VT/BK
10	F20 18VT/WT

C105

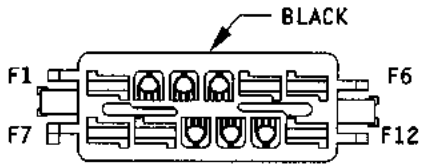


UNDERHOOD LAMP

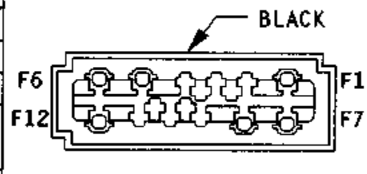
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
1	Z1 18BK**	GROUND
2	M1 20PK/WT	FUSED B(+)

** WITH DRL AND ABS
● WITH ABS

C106

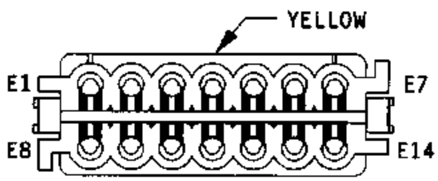


CAV	CIRCUIT
F1	F30 16RD/PK
F2	L1 18VT/BK
F3	F20 18VT/WT
F4	-
F5	A1 14RD
F6	A2 12PK/BK
F7	A6 12RD/BK
F8	C15 12BK/WT
F9	T141 12YL/RD
F10	F12 20RD/LG
F11	G9 20GY/BK
F12	A111 12RD/LB

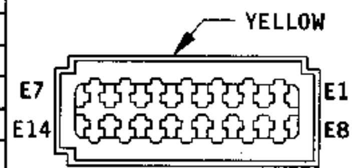


CAV	CIRCUIT
F1	F30 16RD/PK
F2	L1 18VT/BK
F3	F20 18VT/WT
F4	-
F5	A1 14RD
F6	A2 12PK/BK
F7	A6 12RD/BK
F8	C15 14BK/WT
	C15 14BK/WT
F9	T141 14YL/RD
F10	F12 20RD/LG
F11	G9 20GY/BK
	G9 20GY/BK
F12	A111 12RD/LB

C107



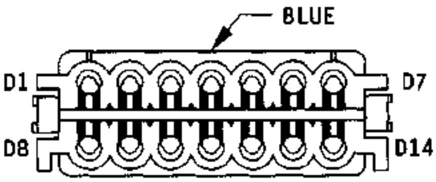
CAV	CIRCUIT
E1	L7 18BK/YL
E2	L60 18TN
E3	L61 18GY
E4	L3 16RD/OR
E5	L4 16VT/WT
E6	Z12 20BK/LB
E7	X3 20RD/YL
E8	V10 18BR
E9	Z12 20BK/TN
E10	L39 18LB
E11	G106 20BK/WT
E12	G107 20BK/RD
E13	D20 18LG
E14	D21 18PK
E14	D21 20PK**



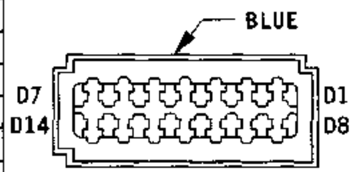
CAV	CIRCUIT
E1	L7 18BK/YL
	L7 18BK/YL
E2	L60 18TN
E3	L61 18GY
E4	L3 16RD/OR
E5	L4 16VT/WT
E6	Z12 20BK/LB
E7	X3 20RD/YL
E8	V10 18BR
E9	Z12 20BK/TN
E10	L39 18LB●
E11	Z1 20BK
E12	G107 20BK/RD
E13	D20 20LG
E14	D21 20PK

** WITH 4.0L ENG
● WITH FOG LAMPS

C108



CAV	CIRCUIT
D1	C81 20LB/WT
D2	A3 14RD/WT
D3	–
D4	D1 18VT/BR
D5	D2 18WT/BK
D6	G19 20LG/OR*
D7	L3 16RD/OR
D7	G34 18RD/GY●
D8	L20 16LG/WT●●
D9	L50 18WT/TN*
D10	G99 20GY/WT
D11	L9 18BK/WT
D12	M1 20PK/WT
	M1 20PK/WT
D13	C90 20LG/DG
D14	K29 18WT/PK



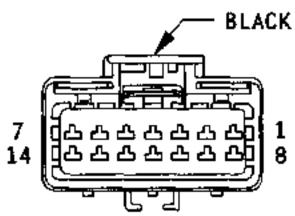
CAV	CIRCUIT
D1	C81 20LB/WT
D2	A3 14RD/WT
D3	–
D4	D1 20VT/BR
D5	D2 20WT/BK
D6	G19 20LG/OR
D7	G34 16RD/GY
D8	L20 16LG/WT
D9	L50 18WT/TN
	L50 18WT/TN
D10	G99 20GY/WT
D11	L9 18BK/WT
D12	M1 20PK/WT
	M1 20PK/WT
D13	C90 20LG
D14	K29 20WT/PK
	K29 20WT/PK

C109

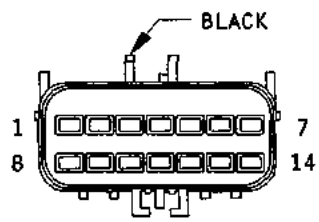
BRAKE WARNING SWITCH

CAV	CIRCUIT	FUNCTION
1	G9 20GY/BK	RED BRAKE WARNING LAMP DRIVER
2	G99 20GY/WT	RED BRAKE WARNING LAMP DRIVER

C110

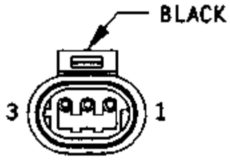


CAV	CIRCUIT
1	L7 18BK/YL
2	L60 18TN
3	L61 18GY
4	L3 16RD/OR
5	L4 16VT/WT
6	X2 16WT/RD
7	–
8	V10 18BR
9	–
10	K52 20PK/BK
11	F12 18RD/LG
12	C25 14LG††
13	L39 18LB
14	–



CAV	CIRCUIT
1	L7 18BK/YL
2	L60 18TN
3	L61 18GY
4	L3 16RD/OR
5	L4 16VT/WT
6	X2 16WT/RD
7	–
8	V10 18BR
9	–
10	K52 18PK/BK
11	F12 20RD/LG
12	C25 18LG††
13	L39 18LB
14	L13 18BR/YL◆

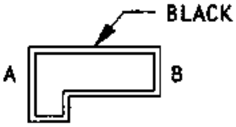
* WITH ABS
● WITH DRL AND ABS
●● WITH DRL
†† WITH 2.5L ENG
◆ WITHOUT DRL



G SWITCH

C111 (WITH ABS)

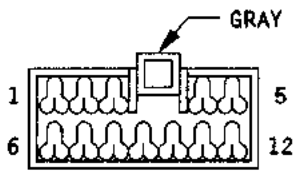
CAV	CIRCUIT	FUNCTION
1	B43 20PK/OR	G-SWITCH SENSOR GROUND
2	B41 20YL/VT	G-SWITCH NO.1 SENSE
3	B42 20TN/WT	G-SWITCH NO.2 SENSE



ABS DIODE

C112 (WITH ABS)

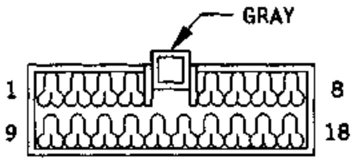
CAV	CIRCUIT	FUNCTION
A	B47 16RD/LB	ABS SYSTEM RELAY OUTPUT
B	G19 20LG/OR	ABS WARNING LAMP DRIVER



CONTROLLER
ANTI-LOCK
BRAKE

C113 (WITH ABS)

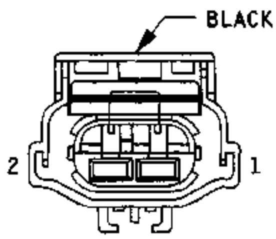
CAV	CIRCUIT	FUNCTION
1	G19 20LG/OR	ABS WARNING LAMP DRIVER
2	B43 20PK/OR	G-SWITCH SENSOR GROUND
3	D21 20PK	SCI TRANSMIT
4	-	-
5	F20 18VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
6	B41 20YL/VT	G-SWITCH NO.1 SENSE
7	B42 20TN/WT	G-SWITCH NO.2 SENSE
8	L50 18WT/TN	STOP LAMP SWITCH OUTPUT
9	B3 18LG/DB	LEFT REAR WHEEL SPEED SENSOR (-)
10	B4 18LG	LEFT REAR WHEEL SPEED SENSOR (+)
11	B1 18YL/DB	RIGHT REAR WHEEL SPEED SENSOR (-)
12	B2 18YL	RIGHT REAR WHEEL SPEED SENSOR (+)



CONTROLLER
ANTI-LOCK
BRAKE

C114 (WITH ABS)

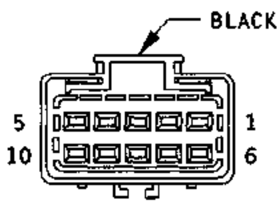
CAV	CIRCUIT	FUNCTION
1	B7 18WT	RIGHT FRONT WHEEL SPEED SENSOR (+)
2	B6 18WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
3	B120 16BR/WT	ABS PUMP MOTOR RELAY OUTPUT
4	B251 20WT/BK	REAR INLET VALVE CONTROL
5	B47 16RD/LB	ABS SYSTEM RELAY OUTPUT
6	B248 20DG/WT	RIGHT FRONT OUTLET VALVE CONTROL
7	B116 20GY	ABS PUMP MOTOR RELAY CONTROL
8	B243 20DG/BK	LEFT FRONT OUTLET VALVE CONTROL
9	B9 18RD	LEFT FRONT WHEEL SPEED SENSOR (+)
10	B8 18RD/DB	LEFT FRONT WHEEL SPEED SENSOR (-)
11	B58 20GY/LB	ABS SYSTEM RELAY CONTROL
12	B254 20DG/OR	REAR OUTLET VALVE CONTROL
13	Z22 16BK/PK	GROUND
14	Z22 16BK/PK	GROUND
15	B249 20WT/DG	RIGHT FRONT INLET VALVE CONTROL
16	–	–
17	–	–
18	B245 20WT/LG	LEFT FRONT INLET VALVE CONTROL



ABS PUMP
MOTOR

C115 (WITH ABS)

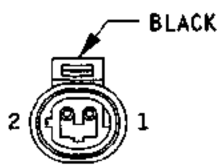
CAV	CIRCUIT	FUNCTION
1	B120 12BR/WT	ABS PUMP MOTOR RELAY OUTPUT
2	Z1 12BK	GROUND



HYDRAULIC
CONTROL UNIT

C116 (WITH ABS)

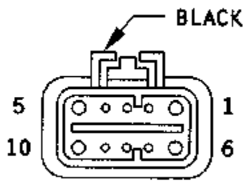
CAV	CIRCUIT	FUNCTION
1	B47 16RD/LB	ABS SYSTEM RELAY OUTPUT
2	B251 20WT/BK	REAR INLET VALVE CONTROL
3	B249 20WT/DG	RIGHT FRONT INLET VALVE CONTROL
4	B245 20WT/LG	LEFT FRONT INLET VALVE CONTROL
5	–	–
6	–	–
7	B254 20DG/OR	REAR OUTLET VALVE CONTROL
8	B248 20DG/WT	RIGHT FRONT OUTLET VALVE CONTROL
9	B243 20DG/BK	LEFT FRONT OUTLET VALVE CONTROL
10	B47 16RD/LB	ABS SYSTEM RELAY OUTPUT



LEFT FRONT
WHEEL SPEED
SENSOR

C117 (WITH ABS)

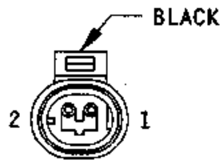
CAV	CIRCUIT	FUNCTION
1	B8 18RD/DB	LEFT FRONT WHEEL SPEED SENSOR (-)
2	B9 18RD	LEFT FRONT WHEEL SPEED SENSOR (+)



DAYTIME RUNNING LAMP MODULE

C118 (WITH DRL)

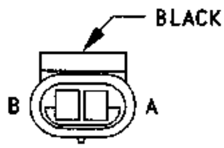
CAV	CIRCUIT	FUNCTION
1	L3 16RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
2	–	–
3	–	–
4	G34 18RD/GY	HIGH BEAM INDICATOR DRIVER
5	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN/START)
6	L20 16LG/WT	FUSED B(+) TO HEADLAMP DIMMER SWITCH
7	G7 20WT/OR	VEHICLE SPEED SENSOR SIGNAL
8	Z1 20BK	GROUND
8	Z1 18BK*	GROUND
9	–	–
10	L4 16VT/WT	DIMMER SWITCH LOW BEAM OUTPUT



DUTY CYCLE EVAP/PURGE SOLENOID

C119

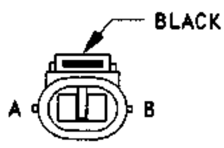
CAV	CIRCUIT	FUNCTION
1	K52 20PK/BK	DUTY CYCLE EVAP/PURGE SOLENOID CONTROL
2	F12 18RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN/START)



HORN NO.1

C120

CAV	CIRCUIT	FUNCTION
A	X2 16WT/RD	HORN RELAY OUTPUT
B	Z1 16BK	GROUND



WINDSHIELD WASHER PUMP MOTOR

C121

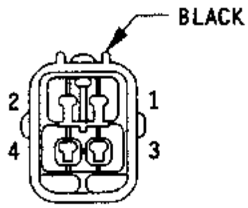
CAV	CIRCUIT	FUNCTION
A	V10 18BR	WINDSHIELD WASHER PUMP CONTROL
B	Z1 18BK	GROUND

* WITH ABS

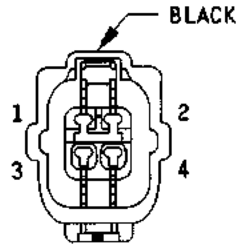
80a3b443

J968W-5

C122

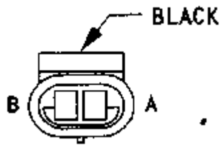


CAV	CIRCUIT
1	L7 18BK/YL
2	L61 18GY
3	L39 18LB
4	Z1 18BK



CAV	CIRCUIT
1	L7 18BK/YL
2	L61 18LG
3	L39 18LB*
4	Z1 18BK

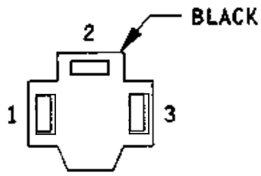
C123



HORN NO.2

CAV	CIRCUIT	FUNCTION
A	X2 16WT/RD	HORN RELAY OUTPUT
B	Z1 16BK	GROUND

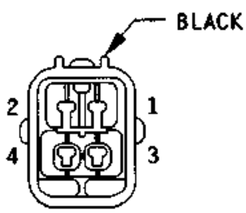
C124



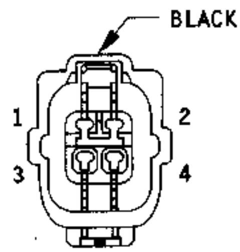
LEFT HEADLAMP

CAV	CIRCUIT	FUNCTION
1	L3 16RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
	L3 16RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
2	L4 18VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
3	Z1 20BK	GROUND

C125

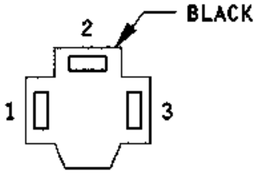


CAV	CIRCUIT
1	L7 18BK/YL
2	L60 18TN
3	L39 18LB
4	Z1 18BK



CAV	CIRCUIT
1	L7 18BK/YL
2	L61 18LG
3	L39 18LB*
4	Z1 18BK

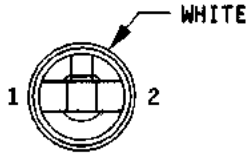
* WITH FOG LAMPS



RIGHT HEADLAMP

C126

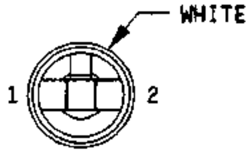
CAV	CIRCUIT	FUNCTION
1	L3 16RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
2	L4 18VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
3	Z1 18BK	GROUND



RIGHT FRONT SIDE MARKER LAMP

C127

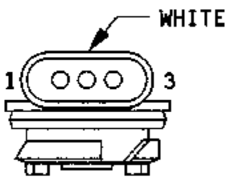
CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
2	L61 18LG	RIGHT TURN SIGNAL



LEFT FRONT SIDE MARKER LAMP

C128

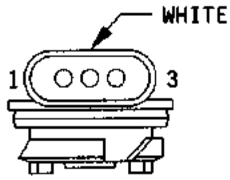
CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
2	L61 18LG	LEFT TURN SIGNAL



RIGHT FRONT PARK/TURN SIGNAL LAMP

C129

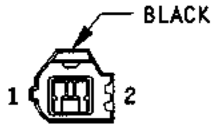
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
3	L61 18LG	RIGHT TURN SIGNAL



LEFT FRONT PARK/TURN SIGNAL LAMP

C130

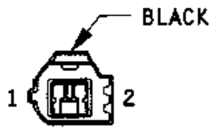
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
3	L61 18LG	LEFT TURN SIGNAL



RIGHT FOG LAMP

C131 (WITH FOG LAMPS)

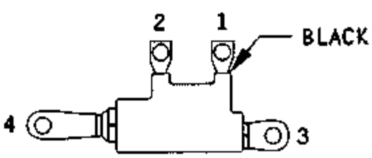
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L39 18LB	FOG LAMP RELAY NO.1 OUTPUT



LEFT FOG LAMP

C132 (WITH FOG LAMPS)

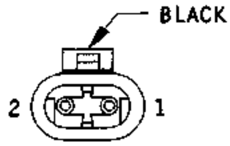
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L39 18LB	FOG LAMP RELAY NO.1 OUTPUT



GENERATOR

C133

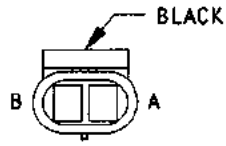
CAV	CIRCUIT	FUNCTION
1	K72 18DG/OR	GENERATOR FIELD SOURCE (+)
2	K20 18DG	GENERATOR FIELD DRIVER
3	–	–
4	Z0 6BK	GROUND



OIL PRESSURE SENSOR

C134

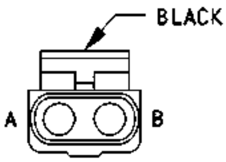
CAV	CIRCUIT	FUNCTION
1	K167 20BR/YL	SENSOR GROUND
2	G60 18GY/YL	OIL PRESSURE SENSOR SIGNAL



ENGINE COOLANT TEMPERATURE SENSOR

C135

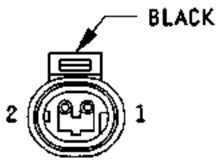
CAV	CIRCUIT	FUNCTION
A	K167 20BR/YL	SENSOR GROUND
B	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL



BACK-UP LAMP SWITCH

C136 (WITH MAN TRANS)

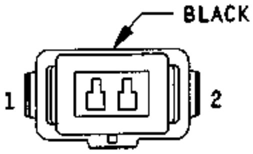
CAV	CIRCUIT	FUNCTION
A	L1 18VT/BK	BACK-UP LAMP SENSE
B	F20 18VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)



A/C HIGH PRESSURE SWITCH

C137

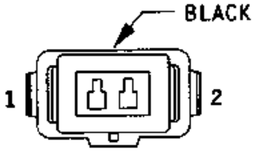
CAV	CIRCUIT	FUNCTION
1	C90 20LG	A/C SELECT SIGNAL
2	C21 20DB/OR	A/C CYCLING SWITCH SENSE



INJECTOR NO.1

C138

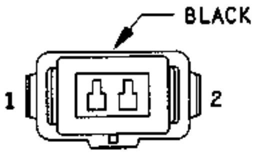
CAV	CIRCUIT	FUNCTION
1	A142 18DG/BK	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K11 18WT/DB	INJECTOR NO.1 DRIVER



INJECTOR NO.2

C139

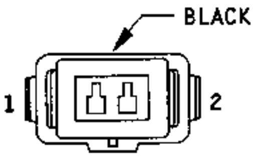
CAV	CIRCUIT	FUNCTION
1	A142 18DG/BK	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K12 18TN	INJECTOR NO.2 DRIVER



INJECTOR NO.3

C140

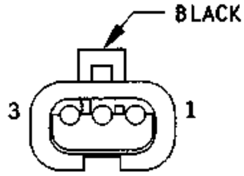
CAV	CIRCUIT	FUNCTION
1	A142 18DG/BK	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K13 18YL/WT	INJECTOR NO.3 DRIVER



INJECTOR NO.4

C141

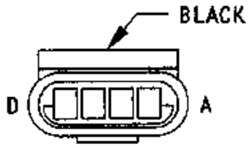
CAV	CIRCUIT	FUNCTION
1	A142 18DG/BK	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K14 18LB/BR	INJECTOR NO.4 DRIVER



THROTTLE
POSITION SENSOR

C142

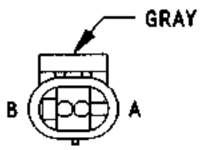
CAV	CIRCUIT	FUNCTION
1	K7 20OR	5 VOLT SUPPLY
2	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
3	K167 20BR/YL	SENSOR GROUND



IDLE AIR
CONTROL MOTOR

C143

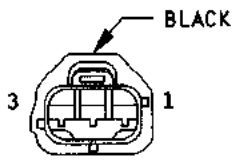
CAV	CIRCUIT	FUNCTION
A	K59 18VT/BK	IDLE AIR CONTROL NO.4 DRIVER
B	K40 18BR/WT	IDLE AIR CONTROL NO.3 DRIVER
C	K60 18YL/BK	IDLE AIR CONTROL NO.2 DRIVER
D	K39 18GY/RD	IDLE AIR CONTROL NO.1 DRIVER



INTAKE AIR
TEMPERATURE SENSOR

C144

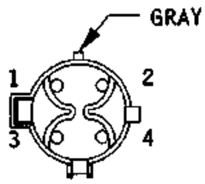
CAV	CIRCUIT	FUNCTION
A	K167 20BR/YL	SENSOR GROUND
B	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL



CRANKSHAFT
POSITION SENSOR

C145

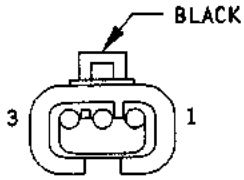
CAV	CIRCUIT	FUNCTION
1	K7 20OR	5 VOLT SUPPLY
2	K167 20BR/YL	SENSOR GROUND
3	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL



UPSTREAM HEATED OXYGEN SENSOR

C146

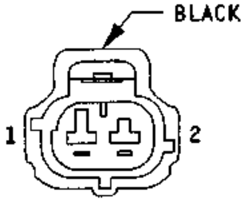
CAV	CIRCUIT	FUNCTION
1	A142 18DG/BK	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	Z1 18BK	GROUND
3	K167 20BR/YL	SENSOR GROUND
4	K41 18BK/DG	UPSTREAM HEATED OXYGEN SENSOR SIGNAL



MANIFOLD ABSOLUTE PRESSURE SENSOR

C147

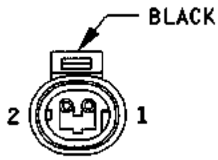
CAV	CIRCUIT	FUNCTION
1	K7 20OR	5 VOLT SUPPLY
2	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
3	K167 20BR/YL	SENSOR GROUND



POWER STEERING PRESSURE SWITCH

C148 (WITH 2.5L ENG)

CAV	CIRCUIT	FUNCTION
1	K10 18DB/BR	POWER STEERING PRESSURE SWITCH SENSE
2	Z1 18BK	GROUND



A/C CYCLING SWITCH

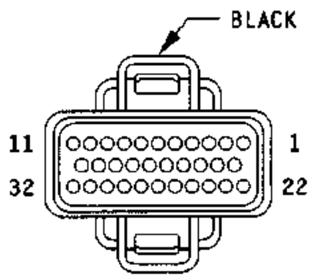
C149

CAV	CIRCUIT	FUNCTION
1	C22 20DB/WT	A/C REQUEST SIGNAL
2	C21 20DB/OR	A/C CYCLING SWITCH SENSE

* WITH 4.0L ENG

80a3b44a

J968W-5

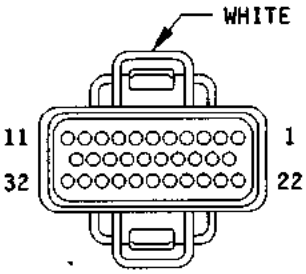


POWERTRAIN
CONTROL MODULE
(A)

C150

CAV	CIRCUIT	FUNCTION
A1	–	–
A2	F12 18RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN/START)
A3	–	–
A4	K167 18BR/YL	SENSOR GROUND
A5	–	–
A6	T41 18BR/LB	PARK/NEUTRAL POSITION SWITCH SENSE
A7	K19 18GY	IGNITION COIL DRIVER
A8	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
A9	–	–
A10	K60 18YL/BK	IDLE AIR CONTROL NO.2 DRIVER
A11	K40 18BR/WT	IDLE AIR CONTROL NO.3 DRIVER
A12	K10 18DB/BR*	POWER STEERING PRESSURE SWITCH SENSE
A13	–	–
A14	–	–
A15	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL
A16	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
A17	K7 18OR	5 VOLT SUPPLY
A18	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
A19	K39 18GY/RD	IDLE AIR CONTROL NO.1 DRIVER
A20	K59 18VT/BK	IDLE AIR CONTROL NO.4 DRIVER
A21	–	–
A22	A14 14RD/WT	FUSED B(+)
A23	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
A24	K41 18BK/DG	UPSTREAM HEATED OXYGEN SENSOR SIGNAL
A25	K141 18TN/WT	DOWNSTREAM HEATED OXYGEN SENSOR SIGNAL
A26	–	–
A27	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
A28	–	–
A29	–	–
A30	–	–
A31	Z12 14BK/TN	GROUND
A32	Z12 14BK/TN	GROUND

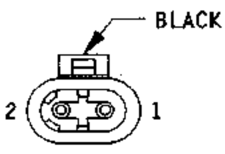
* WITH 2.5L ENG



POWERTRAIN CONTROL MODULE (B)

C151

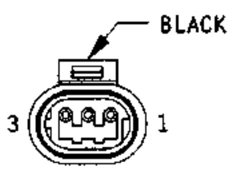
CAV	CIRCUIT	FUNCTION
B1	-	-
B2	-	-
B3	-	-
B4	K11 18WT/DB	INJECTOR NO.1 DRIVER
B5	K13 18YL/WT	INJECTOR NO.3 DRIVER
B6	K15 18PK/BK*	INJECTOR NO.5 DRIVER
B7	-	-
B8	-	-
B9	-	-
B10	K20 18DG	GENERATOR FIELD DRIVER (-)
B11	T23 18OR/LG	TORQUE CONVERTOR CLUTCH SOLENOID CONTROL
B12	K16 18LG/BK*	INJECTOR NO.6 DRIVER
B13	-	-
B14	-	-
B15	K12 18TN	INJECTOR NO.2 DRIVER
B16	K14 18LB/BR	INJECTOR NO.4 DRIVER
B17	-	-
B18	-	-
B19	-	-
B20	-	-
B21	-	-
B22	-	-
B23	G60 18GY/YL	OIL PRESSURE SENSOR SIGNAL
B24	-	-
B25	-	-
B26	-	-
B27	G7 18WT/OR	VEHICLE SPEED SENSOR SIGNAL
B28	-	-
B29	-	-
B30	-	-
B31	K6 18VT/OR	5 VOLT SUPPLY
B32	-	-



IGNITION COIL

C152

CAV	CIRCUIT	FUNCTION
1	K19 18GY	IGNITION COIL DRIVER
2	A142 16DG/BK	AUTOMATIC SHUT DOWN RELAY OUTPUT



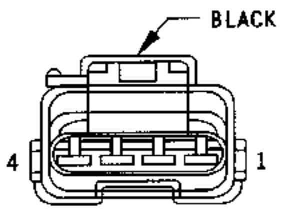
CAMSHAFT POSITION SENSOR

C153

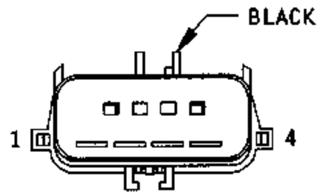
CAV	CIRCUIT	FUNCTION
1	K7 20OR	5 VOLT SUPPLY
2	K167 20BR/YL	SENSOR GROUND
3	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL

* WITH 4.0L ENG

C154

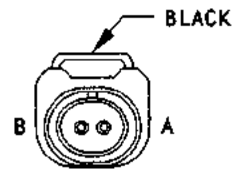


CAV	CIRCUIT
1	Z1 18BK
2	L1 18VT/BK
3	T41 20BR/LB
4	F20 18VT/WT



CAV	CIRCUIT
1	Z1 20BK*
2	L1 18VT/BK
3	T41 18DG/YL**
3	Z1 20BK*
4	F20 18VT/WT**
4	F20 18VT**

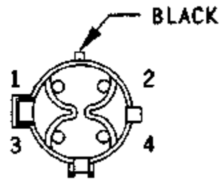
C155



TORQUE CONVERTER CLUTCH SOLENOID

CAV	CIRCUIT	FUNCTION
A	F12 18RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN/START)
B	T23 18OR/LG	TORQUE CONVERTOR CLUTCH SOLENOID CONTROL

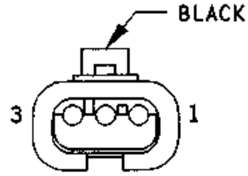
C156



DOWNSTREAM HEATED OXYGEN SENSOR

CAV	CIRCUIT	FUNCTION
1	A142 18DG/BK	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	Z1 18BK	GROUND
3	K167 20BR/YL	SENSOR GROUND
4	K141 18TN/WT	DOWNSTREAM HEATED OXYGEN SENSOR SIGNAL

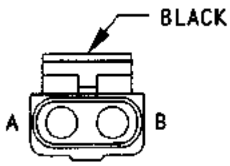
* WITH MAN TRANS
** WITH AUTO TRANS



VEHICLE SPEED SENSOR

C157

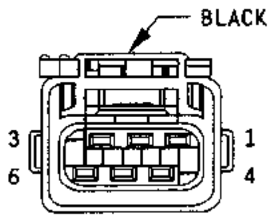
CAV	CIRCUIT	FUNCTION
1	K6 18VT/OR	5 VOLT SUPPLY
2	K167 20BR/YL	SENSOR GROUND
3	G7 20WT/OR	VEHICLE SPEED SENSOR SIGNAL



4WD SWITCH

C158

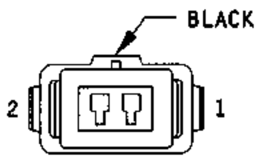
CAV	CIRCUIT	FUNCTION
A	G107 20BK/RD	4WD SENSE
B	G106 20BK/WT	GROUND



FUEL PUMP MODULE

C159

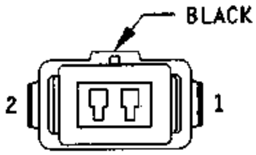
CAV	CIRCUIT	FUNCTION
1	A141 18DG/WT	FUEL PUMP RELAY OUTPUT
2	-	-
3	K226 20DB/LG	FUEL LEVEL SENSOR SIGNAL
4	K167 20BR/YL	SENSOR GROUND
5	-	-
6	Z1 18BK	GROUND



INJECTOR NO.5

C160 (WITH 4.0L ENG)

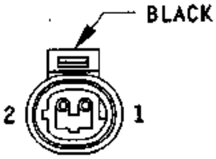
CAV	CIRCUIT	FUNCTION
1	A142 18DG/BK	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K15 18PK/BK	INJECTOR NO.5 DRIVER



INJECTOR NO.6

C161 (WITH 4.0L ENG)

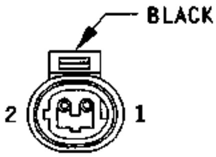
CAV	CIRCUIT	FUNCTION
1	A142 18DG/BK	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K16 18LG/BK	INJECTOR NO.6 DRIVER



RIGHT FRONT WHEEL SPEED SENSOR

C162 (WITH ABS)

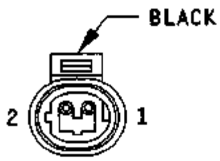
CAV	CIRCUIT	FUNCTION
1	B6 18WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
2	B7 18WT	RIGHT FRONT WHEEL SPEED SENSOR (+)



LEFT REAR WHEEL SPEED SENSOR

C163 (WITH ABS)

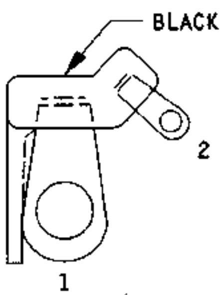
CAV	CIRCUIT	FUNCTION
1	B3 18LG/DB	LEFT REAR WHEEL SPEED SENSOR (-)
2	B4 18LG	LEFT REAR WHEEL SPEED SENSOR (+)



RIGHT REAR WHEEL SPEED SENSOR

C164 (WITH ABS)

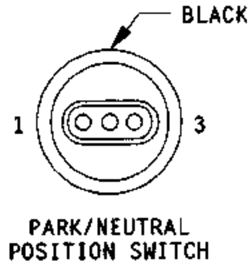
CAV	CIRCUIT	FUNCTION
1	B1 18YL/DB	RIGHT REAR WHEEL SPEED SENSOR (-)
2	B2 18YL	RIGHT REAR WHEEL SPEED SENSOR (+)



ENGINE STARTER MOTOR

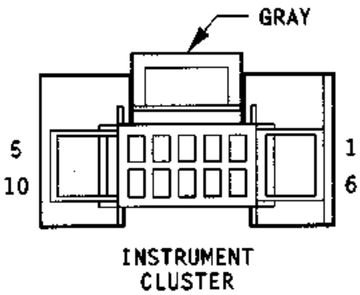
C165

CAV	CIRCUIT	FUNCTION
1	A0 6RD	B(+)
2	T40 12BR	ENGINE STARTER MOTOR RELAY OUTPUT



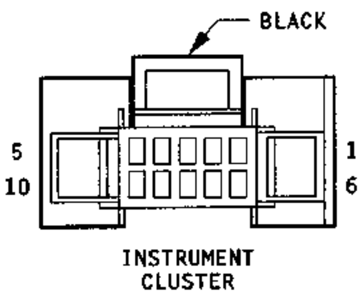
C167 (WITH AUTO TRANS)

CAV	CIRCUIT	FUNCTION
1	L1 18VT/BK	BACK-UP LAMP SENSE
2	T41 18DG/YL	PARK/NEUTRAL POSITION SWITCH SENSE
3	F20 18VT	FUSED IGNITION SWITCH OUTPUT (RUN)



C200

CAV	CIRCUIT	FUNCTION
1	D2 20WT/BK	CCD BUS(-)
2	D1 20VT/BR	CCD BUS(+)
3	C81 20LB/WT*	REAR WINDOW DEFOGGER RELAY CONTROL
4	C80 20DB/LG*	REAR WINDOW DEFOGGER SWITCH SENSE
5	G107 20BK/RD	4WD SENSE
6	L60 18TN	RIGHT TURN SIGNAL
7	-	-
8	G26 20LB	KEY-IN SWITCH SENSE
9	-	-
10	G10 20LG/RD	SEAT BELT SWITCH SENSE



C201

CAV	CIRCUIT	FUNCTION
1	-	-
2	G99 20GY/WT	RED BRAKE WARNING LAMP DRIVER
3	E2 20OR	FUSED PANEL LAMP DIMMER SWITCH SIGNAL
4	G19 20LG/OR	ABS WARNING LAMP DRIVER
5	G34 16RD/GY	HIGH BEAM INDICATOR DRIVER
6	Z2 18BK/LG	GROUND
7	-	-
8	G5 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN/START)
9	M1 20PK/WT	FUSED B(+)
10	L61 18GY	LEFT TURN SIGNAL

* WITH HARD TOP

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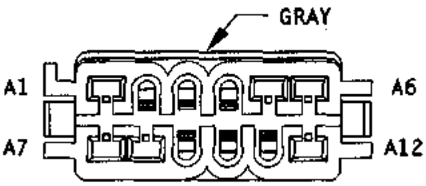
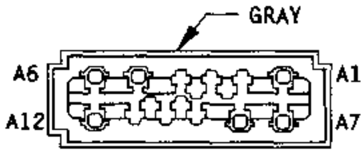
C202

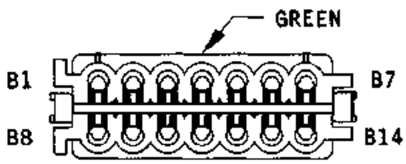


CAV	CIRCUIT
A1	F24 14RD/DG
A2	L20 16LG/WT
A3	E1 18TN
A4	E2 20OR
A5	C15 16BK/WT*
A6	Z12 20BK/LB
A7	V22 18BR/YL*
A8	L2 16LG
A9	C81 20LB/WT*
A10	G5 20DB/WT
A11	F34 18TN/BK
A12	A111 12RD/LB

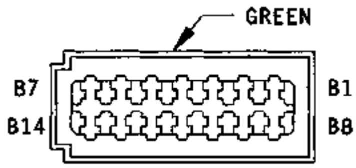


CAV	CIRCUIT
A1	F24 14RD/DG
A2	L20 16LG/WT
	L20 16LG/WT
A3	E1 18TN
A4	E2 20OR
A5	C15 14BK/WT
A6	Z12 20BK/LB
A7	V22 18BR/YL
A8	L2 16LG
A9	C81 20LB/WT
A10	G5 20DB/WT
	G5 20DB/WT
A11	F34 18TN/BK
A12	A111 12RD/LB

C203



CAV	CIRCUIT
B1	L60 18TN
B2	L61 18GY
B3	G26 20LB
B4	G16 20BK/LB
B5	G34 16RD/GY
B6	L7 18BK/YL
B7	M1 20PK/WT
B8	D20 20LG
B9	V20 18VT/OR*
B10	D21 20PK
B11	D1 20VT/BR
B12	D2 20WT/BK
B13	M2 20YL
B14	G19 20LG/OR



CAV	CIRCUIT
B1	L60 18TN
	L60 18TN
B2	L61 18GY
	L61 18GY
B3	G26 20LB
B4	G16 20BK/LB
B5	G34 16RD/GY
	G34 16RD/GY**
B6	L7 18BK/YL
	L7 18BK/YL**
B7	M1 20PK/WT
B8	D20 20LG
B9	V20 18VT/OR
B10	D21 20PK
B11	D1 20VT/BR
B12	D2 20WT/BK
B13	M2 20YL
B14	G19 20LG/OR

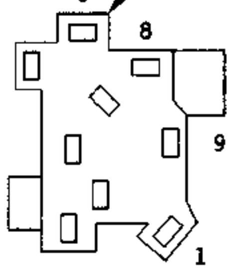
* WITH HARD TOP
** WITH FOG LAMPS

C204

CAV	CIRCUIT
C1	L95 18DG/YL
C2	V13 18BR/LG*
C3	G10 20LG/RD
C4	Z12 20BK/TN
C5	L35 18BR/WT
C6	A3 14RD/WT
C7	G107 20BK/RD
C8	G99 20GY/WT
C9	C90 20LG
C10	F38 16LB
C11	X51 18BR/YL
C12	X57 18BR/LB
C13	X52 18DB/WT
C14	X58 18DB/PK

CAV	CIRCUIT
C1	L95 18DG/YL**
C2	V13 18BR/LG
C3	G10 20LG/RD
C4	Z12 20BK/TN
C5	L35 18BR/WT**
C6	A3 14RD/WT
C7	G107 20BK/RD
C8	G99 20GY/WT
C9	C90 20LG
C10	F38 16LB
C11	X51 18BR/YL
C12	X57 18BR/LB
C13	X52 18DB/WT
C14	X58 18DB/PK

C205



HEADLAMP SWITCH

CAV	CIRCUIT	FUNCTION
1	E1 18TN	PANEL LAMP DIMMER SWITCH SIGNAL
2	L2 16LG	HEADLAMP SWITCH OUTPUT
3	M2 20YL	COURTESY LAMP DRIVER
4	F34 18TN/BK	FUSED B(+)
5	G26 20LB	KEY-IN SWITCH SENSE
	G26 20LB	KEY-IN SWITCH SENSE
6	G16 20BK/LB	LEFT DOOR AJAR SWITCH SENSE
7	L20 16LG/WT	FUSED B(+) TO HEADLAMP DIMMER SWITCH
8	A3 14RD/WT	FUSED B(+)
9	L7 18BK/YL	PARK LAMP SWITCH OUTPUT

* WITH HARD TOP
** WITH FOG LAMPS

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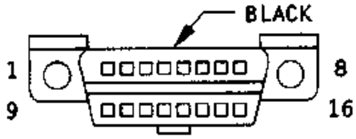
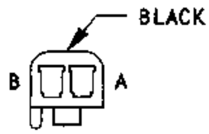


DATA LINK CONNECTOR

C206

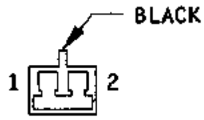
CAV	CIRCUIT	FUNCTION
1	–	–
2	–	–
3	D1 20VT/BR	CCD BUS(+)
4	Z12 20BK/LB	GROUND
5	Z12 20BK/TN	GROUND
6	D20 20LG	SCI RECEIVE
7	D21 20PK	SCI TRANSMIT
8	–	–
9	–	–
10	–	–
11	D2 20WT/BK	CCD BUS(-)
12	–	–
13	–	–
14	–	–
15	–	–
16	M1 20PK/WT	FUSED B(+)



LEFT COURTESY LAMP

C207

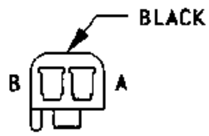
CAV	CIRCUIT	FUNCTION
A	M1 20PK/WT	FUSED B(+)
B	M2 20YL	COURTESY LAMP DRIVER



LEFT FRONT SPEAKER

C208

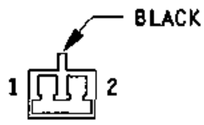
CAV	CIRCUIT	FUNCTION
1	X53 18DG	LEFT FRONT SPEAKER (+)
2	X55 18BR/RD	LEFT FRONT SPEAKER (-)



RIGHT COURTESY LAMP

C209

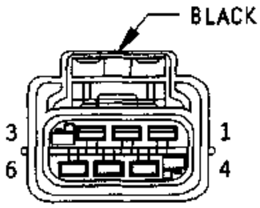
CAV	CIRCUIT	FUNCTION
A	M1 20PK/WT	FUSED B(+)
B	M2 20YL	COURTESY LAMP DRIVER



RIGHT FRONT SPEAKER

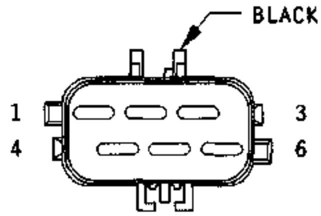
C210

CAV	CIRCUIT	FUNCTION
1	X54 18VT	RIGHT FRONT SPEAKER (+)
2	X56 18DB	RIGHT FRONT SPEAKER (-)

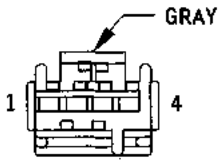


C211

CAV	CIRCUIT
1	C4 14TN
2	C5 14LG/LB
3	C6 14LB
4	Z1 12BK
5	A111 12RD/LB
6	C7 14BR/TN



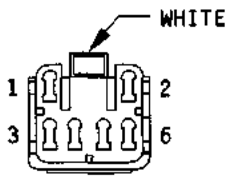
CAV	CIRCUIT
1	C4 14TN
2	C5 14LG/LB
3	C6 14LB
4	Z1 12BK
5	A111 12RD/LB
6	C7 14BR/TN



REAR WINDOW DEFOGGER SWITCH

C212 (WITH HARD TOP)

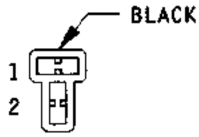
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	C80 20DB/LG	REAR WINDOW DEFOGGER SWITCH SENSE
3	C15 16BK/WT	REAR WINDOW DEFOGGER RELAY OUTPUT
4	E2 20OR	FUSED PANEL LAMP DIMMER SWITCH SIGNAL



REAR WIPER/ WASHER SWITCH

C213 (WITH HARD TOP)

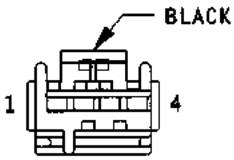
CAV	CIRCUIT	FUNCTION
1	Z1 18BK/WT	GROUND
2	V20 18VT/OR	REAR WASHER PUMP MOTOR CONTROL
3	E2 20OR	FUSED PANEL LAMP DIMMER SWITCH SIGNAL
4	V13 18BR/LG	REAR WIPER MOTOR CONTROL
5	V22 18BR/YL	REAR WASHER SWITCH OUTPUT
6	–	–



CIGAR LIGHTER/
POWER OUTLET

C214

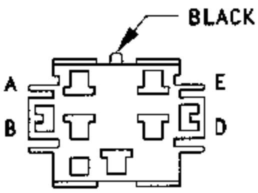
CAV	CIRCUIT	FUNCTION
1	Z1 16BK	GROUND
2	F38 16LB	ACCESSORY RELAY OUTPUT



FOG LAMP
SWITCH

C215 (WITH FOG LAMPS)

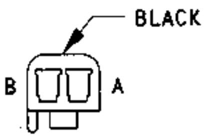
CAV	CIRCUIT	FUNCTION
1	E2 20OR	FUSED PANEL LAMP DIMMER SWITCH SIGNAL
2	L35 18BR/WT	FOG LAMP RELAY NO.1 CONTROL
3	L95 18DG/YL	FOG LAMP RELAY NO.2 OUTPUT
4	Z1 20BK	GROUND



A/C-HEATER
CONTROL

C216

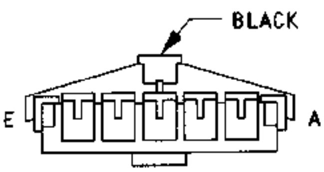
CAV	CIRCUIT	FUNCTION
A	-	-
B	C7 14BR/TN	HIGH BLOWER MOTOR RELAY CONTROL
C	C5 14LG/LB	M1 BLOWER MOTOR DRIVER
D	C6 14LB	M2 BLOWER MOTOR DRIVER
E	C4 14TN	LOW BLOWER MOTOR DRIVER



A/C-HEATER
CONTROL

C217

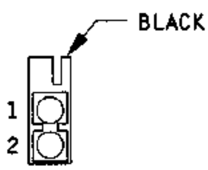
CAV	CIRCUIT	FUNCTION
A	E2 20OR	FUSED PANEL LAMP DIMMER SWITCH SIGNAL
B	Z1 20BK	GROUND



A/C-HEATER CONTROL

C218

CAV	CIRCUIT	FUNCTION
A	-	-
B	C4 14TN	LOW BLOWER MOTOR DRIVER
C	F24 14RD/DG	FUSED IGNITION SWITCH OUTPUT (RUN)
D	C90 20LG	A/C SWITCH OUTPUT
E	Z1 20BK	GROUND



RADIO

C217

CAV	CIRCUIT	FUNCTION
1	D1 20VT/BR	CCD BUS(+)
2	D2 20WT/BK	CCD BUS(-)

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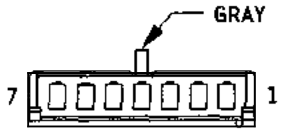
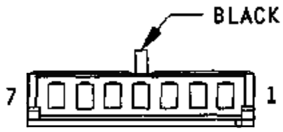
C220



RADIO

CAV	CIRCUIT	FUNCTION
1	–	–
2	X55 18BR/RD	LEFT FRONT SPEAKER (-)
3	X56 18DB	RIGHT FRONT SPEAKER (-)
4	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
5	E2 20OR	FUSED PANEL LAMP DIMMER SWITCH SIGNAL
6	X12 20PK	FUSED IGNITION SWITCH OUTPUT (RUN/ACC)
7	M1 20PK/WT	FUSED B(+)

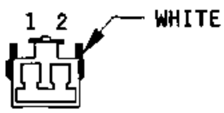
C221



RADIO

CAV	CIRCUIT	FUNCTION
1	–	–
2	X51 18BR/YL	LEFT REAR SPEAKER (+)
3	X52 18DB/WT	RIGHT REAR SPEAKER (+)
4	X53 18DG	LEFT FRONT SPEAKER (+)
5	X54 18VT	RIGHT FRONT SPEAKER (+)
6	X57 18BR/LB	LEFT REAR SPEAKER (-)
7	X58 18DB/PK	RIGHT REAR SPEAKER (-)

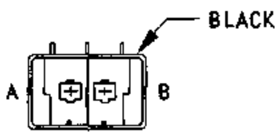
C222



CAV	CIRCUIT
1	X12 18PK
2	–

CAV	CIRCUIT
1	X12 20PK
2	–

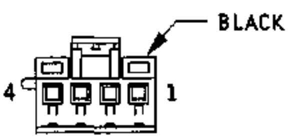
C223



BLOWER MOTOR/RESISTOR BLOCK

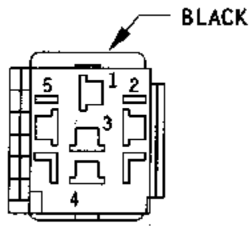
CAV	CIRCUIT	FUNCTION
A	C1 12DG	BLOWER MOTOR RELAY OUTPUT
B	Z1 12BK	GROUND

C224



BLOWER MOTOR/RESISTOR BLOCK

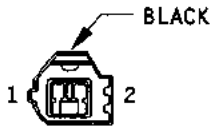
CAV	CIRCUIT	FUNCTION
1	C4 14TN	LOW BLOWER MOTOR DRIVER
2	C5 14LG/LB	M1 BLOWER MOTOR DRIVER
3	C6 14LB	M2 BLOWER MOTOR DRIVER
4	C111 14DG/YL	RESISTOR BLOCK OUTPUT



BLOWER MOTOR RELAY

C225

CAV	CIRCUIT	FUNCTION
1	C1 12DG	BLOWER MOTOR RELAY OUTPUT
2	Z1 14BK	GROUND
3	C111 14DG/YL	RESISTOR BLOCK OUTPUT
4	A111 12RD/LB	FUSED B(+)
5	C7 14BR/TN	HIGH BLOWER MOTOR RELAY CONTROL

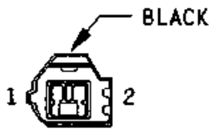


CLUTCH PEDAL POSITION SWITCH

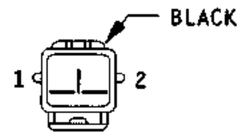
C300 (WITH MAN TRANS)

CAV	CIRCUIT	FUNCTION
1	T141 14YL/RD	FUSED IGNITION SWITCH OUTPUT (START)
2	A41 14YL	FUSED IGNITION SWITCH OUTPUT (START)

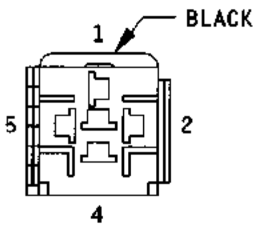
C300 (WITH AUTO TRANS)



CAV	CIRCUIT
1	T141 14YL/RD
2	A41 14YL



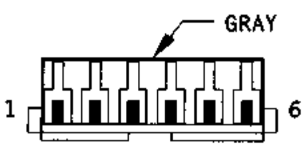
CAV	CIRCUIT
1	T141 14YL/RD
2	T141 14YL/RD



ACCESSORY RELAY

C301

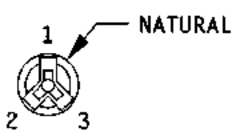
CAV	CIRCUIT	FUNCTION
1	F30 16RD/PK	FUSED B(+)
2	A31 14BK/WT	IGNITION SWITCH OUTPUT (ACC/RUN)
3	–	–
4	F38 16LB	ACCESSORY RELAY OUTPUT
5	Z1 20BK	GROUND



STOP LAMP SWITCH

C302

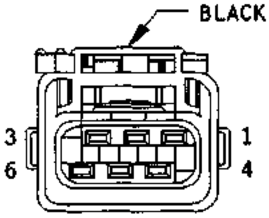
CAV	CIRCUIT	FUNCTION
1	K29 20WT/PK	STOP LAMP SWITCH SENSE
2	Z1 20BK	GROUND
3	–	–
4	–	–
5	F32 18PK/DB	FUSED B(+)
6	L50 18WT/TN	STOP LAMP SWITCH OUTPUT



LEFT DOOR AJAR SWITCH

C303

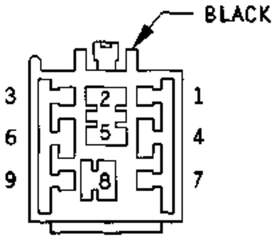
CAV	CIRCUIT	FUNCTION
1	M23 20YL/BK	DOOR AJAR SWITCH OUTPUT
2	M2 20YL	COURTESY LAMP DRIVER
3	G16 20BK/LB	LEFT DOOR AJAR SWITCH SENSE



WINDSHIELD WIPER MOTOR

C304

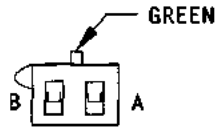
CAV	CIRCUIT	FUNCTION
1	V6 18PK/BK	FUSED IGNITION SWITCH OUTPUT (RUN/ACC)
2	V5 18DG/YL	WIPER PARK SWITCH SENSE
3	-	-
4	Z1 18BK	GROUND
5	V3 18BR/WT	WIPER SWITCH LOW SPEED OUTPUT
6	V4 18RD/YL	WIPER SWITCH HIGH SPEED OUTPUT



COMBINATION FLASHER

C305

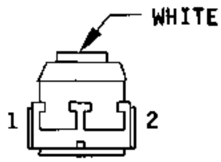
CAV	CIRCUIT	FUNCTION
1	-	-
2	L32 18PK	COMBINATION FLASHER OUTPUT
3	-	-
4	Z1 20BK	GROUND
5	-	-
6	L55 18RD/WT	COMBINATION FLASHER INPUT
7	-	-
8	-	-
9	-	-



KEY-IN SWITCH

C306

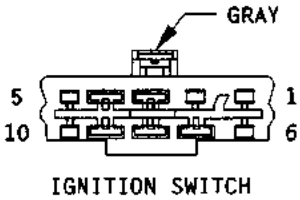
CAV	CIRCUIT	FUNCTION
A	G16 20BK/LB	LEFT DOOR AJAR SWITCH SENSE
B	G26 20LB	KEY-IN SWITCH SENSE



SHIFT INTERLOCK

C307

CAV	CIRCUIT	FUNCTION
1	K29 20WT/PK	STOP LAMP SWITCH SENSE
2	G5 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN/START)

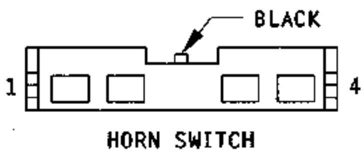


C308

CAV	CIRCUIT	FUNCTION
1	Z1 16BK	GROUND
2	G9 20GY/BK	RED BRAKE WARNING LAMP DRIVER
3	A2 12PK/BK	FUSED B(+)
4	A22 12BK/OR	IGNITION SWITCH OUTPUT (RUN)
5	–	–
6	–	–
7	A1 14RD	FUSED B(+)
8	A31 14BK/WT	IGNITION SWITCH OUTPUT (ACC/RUN)
9	A21 14DB	IGNITION SWITCH OUTPUT (RUN/START)
10	A41 14YL	IGNITION SWITCH OUTPUT (START)

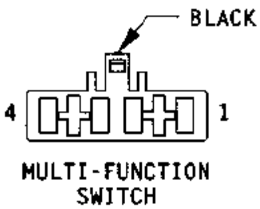
C309

CAV	CIRCUIT	FUNCTION
1	R45 18DG/LB	DRIVER AIRBAG LINE 2
2	R43 18BK/LB	DRIVER AIRBAG LINE 1



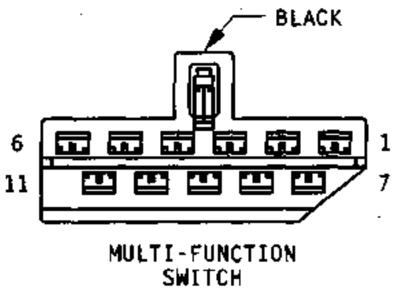
C310

CAV	CIRCUIT	FUNCTION
1	–	–
2	–	–
3	–	–
4	X3 20RD/YL	HORN RELAY CONTROL



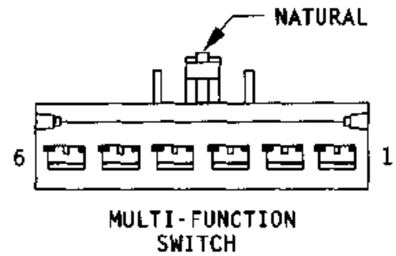
C311

CAV	CIRCUIT	FUNCTION
1	L4 16VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
2	L2 16LG	HEADLAMP SWITCH OUTPUT
3	L3 16RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
4	L20 16LG/WT	FUSED B(+) TO HEADLAMP DIMMER SWITCH



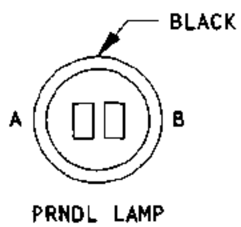
C312

CAV	CIRCUIT	FUNCTION
1	L60 18TN	RIGHT TURN SIGNAL
2	L50 18WT/TN	STOP LAMP SWITCH OUTPUT
3	L62 18BR/RD	RIGHT TURN SIGNAL
4	L32 18PK	COMBINATION FLASHER OUTPUT
5	L5 18BK/GY	FUSED IGNITION SWITCH OUTPUT (RUN/ACC)
6	L9 18BK/WT	FUSED B(+)
7	–	–
8	–	–
9	L63 18DG/RD	LEFT TURN SIGNAL
10	L61 18GY	LEFT TURN SIGNAL
11	L55 18RD/WT	COMBINATION FLASHER INPUT



C313

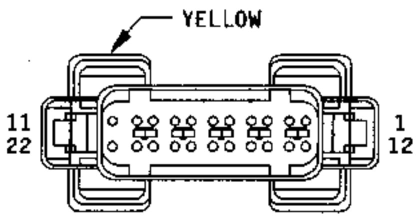
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	V5 18DG/YL	WIPER PARK SWITCH SENSE
3	V10 18BR	WINDSHIELD WASHER PUMP CONTROL
4	V3 18BR/WT	WIPER SWITCH LOW SPEED OUTPUT
5	V6 18PK/BK	FUSED IGNITION SWITCH OUTPUT (RUN/ACC)
6	V4 18RD/YL	WIPER SWITCH HIGH SPEED OUTPUT



C314

CAV	CIRCUIT	FUNCTION
A	E2 20OR	FUSED PANEL LAMP DIMMER SWITCH SIGNAL
B	Z1 20BK	GROUND

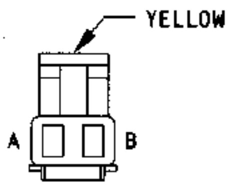
C315



AIRBAG CONTROL MODULE

CAV	CIRCUIT	FUNCTION
1	R45 18DG/LB	DRIVER AIRBAG LINE 2
2	R43 18BK/LB	DRIVER AIRBAG LINE 1
3	-	-
4	-	-
5	R42 18BK/YL	PASSENGER AIRBAG LINE 1
6	R44 18DG/YL	PASSENGER AIRBAG LINE 2
7	-	-
8	-	-
9	-	-
10	Z6 18BK/PK	GROUND
11	-	-
12	-	-
13	-	-
14	-	-
15	-	-
16	-	-
17	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN/START)
18	D2 20WT/BK	CCD BUS(-)
19	D1 20VT/BR	CCD BUS (+)
20	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
21	-	-
22	-	-

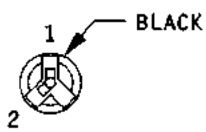
C316



PASSENGER AIRBAG

CAV	CIRCUIT	FUNCTION
A	R44 18DG/YL	PASSENGER AIRBAG LINE 2
B	R42 18BK/YL	PASSENGER AIRBAG LINE 1

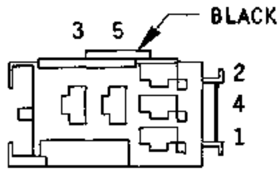
C317



RIGHT DOOR
AJAR SWITCH

CAV	CIRCUIT	FUNCTION
1	M23 20YL/BK	DOOR AJAR SWITCH OUTPUT
2	M2 20YL	COURTESY LAMP DRIVER

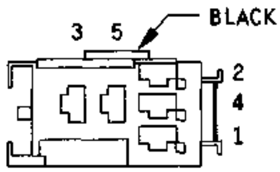
C318
FUSE BLOCK
(8W-10-3)



FOG LAMP
RELAY NO.1

C319 (WITH FOG LAMPS)

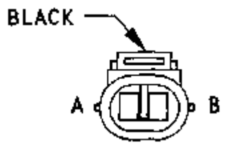
CAV	CIRCUIT	FUNCTION
1	L35 18BR/WT	FOG LAMP RELAY NO.1 CONTROL
2	Z1 20BK	GROUND
3	F61 18WT/OR	FUSED B(+)
4	–	–
5	L39 18LB	FOG LAMP RELAY NO.1 OUTPUT



FOG LAMP
RELAY NO.2

C320 (WITH FOG LAMPS)

CAV	CIRCUIT	FUNCTION
1	G34 16RD/GY	HIGH BEAM INDICATOR DRIVER
2	Z1 20BK	GROUND
3	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
4	L95 18DG/YL	FOG LAMP RELAY NO.2 OUTPUT
5	–	–

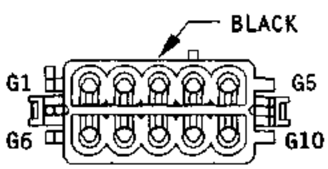


REAR WASHER
PUMP MOTOR

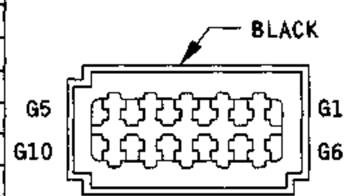
C321 (WITH HARD TOP)

CAV	CIRCUIT	FUNCTION
A	V20 18VT/OR	REAR WASHER PUMP MOTOR CONTROL
B	Z1 18BK	GROUND

C322



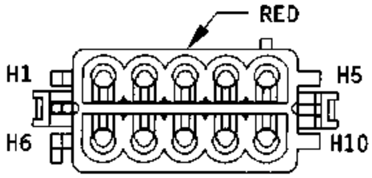
CAV	CIRCUIT
G1	L7 18BK/YL
G2	L62 18BR/RD
G3	L1 18VT/BK
G4	L63 18DG/RD
G5	Z1 12BK
G6	G10 20LG/RD
G7	L50 18WT/TN
G8	–
G9	G9 20GY/BK
G10	V22 18BR/YL*



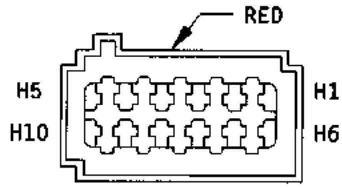
CAV	CIRCUIT
G1	L7 18BK/YL
G2	L62 18BR/RD
G3	L1 18VT/BK
G4	L63 18DG/RD
G5	Z1 12BK
G6	G10 20LG/RD
G7	L50 18WT/TN L50 18WT/TN
G8	–
G9	G9 20GY/BK
G10	V22 18BR/YL

* WITH HARD TOP

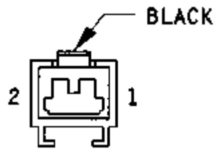
C323*



CAV	CIRCUIT
H1	C15 12BK/WT**
H2	M1 20PK/WT
H3	M2 20YL
H4	V23 18BR/PK**
H5	V13 18BR/LG**
H6	V20 18VT/OR**
H7	X51 18BR/YL●
H8	X57 18BR/LB●
H9	X52 18DB/WT●
H10	X58 18DB/PK●



CAV	CIRCUIT
H1	C15 14BK/WT
H2	M1 20PK/WT
H3	M2 20YL
H4	V23 18BR/PK
H5	V13 18BR/LG
H6	V20 18VT/OR
H7	X51 18BR/YL
H8	X57 18BR/LB
H9	X52 18DB/WT
H10	X58 18DB/PK

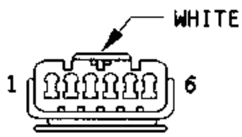


SEAT BELT SWITCH

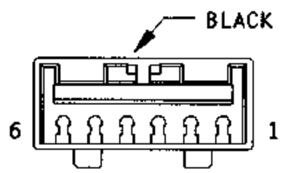
C324

CAV	CIRCUIT	FUNCTION
1	G10 20LG/RD	SEAT BELT SWITCH SENSE
2	Z1 20BK	GROUND

C325 (WITH 4-SPKR SYS)

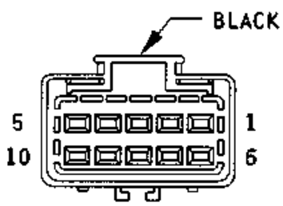


CAV	CIRCUIT
1	X57 18BR/LB
2	X51 18BR/YL
3	M1 20PK/WT
4	M2 20YL
5	X58 18DB/PK
6	X52 18DB/WT

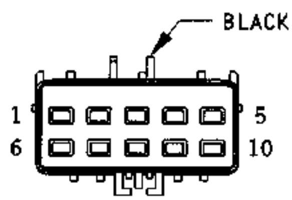


CAV	CIRCUIT
1	X57 20BR/LB
2	X51 20BR/YL
3	M1 20PK/WT
4	M2 20YL
5	X58 20DB/OR
6	X52 20DB/WT

C326 (WITH HARD TOP)



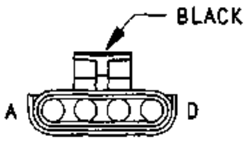
CAV	CIRCUIT
1	C15 12BK/WT
2	–
3	V13 18BR/LG
4	V22 18BR/YL
5	V23 18BR/PK
6	Z1 12BK
7	–
8	M1 20PK/WT
9	M2 20YL
10	–



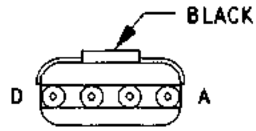
CAV	CIRCUIT
1	C15 12BK/WT
2	–
3	V13 18BK/LG
4	V21 18DB/RD
5	V23 18BR/PK
6	Z1 12BK
7	–
8	M1 20PK/WT
9	M2 20YL
10	–

* THE FEMALE SIDE OF C323 IS NOT PRESENT IN SOFT TOP 2-SPKR SYS VEHICLES
** WITH HARD TOP
● WITH 4-SPKR SYS

C327



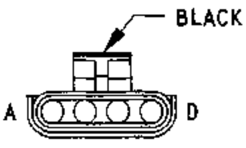
CAV	CIRCUIT
A	L1 18VT/BK
B	L63 18DG/RD
C	L7 18BK/YL
D	–



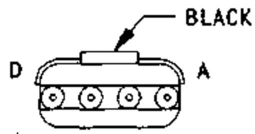
LEFT TAIL/STOP/ TURN SIGNAL/ BACK-UP/LICENSE LAMP

CAV	CIRCUIT
A	L1 16WT/BK
B	L63 16DG
C	L7 16WT
D	–

C328



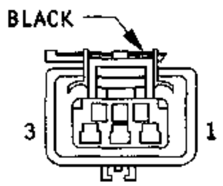
CAV	CIRCUIT
A	L1 18VT/BK
B	L62 18BR/RD
C	L7 18BK/YL
D	L63 18DG/RD



RIGHT TAIL/STOP/ TURN SIGNAL/ BACK-UP LAMP

CAV	CIRCUIT
A	L1 16WT/BK
B	L62 16DG
C	L7 16WT
D	–

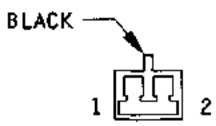
C400 (WITH HARD TOP)



REAR WIPER MOTOR

CAV	CIRCUIT	FUNCTION
1	V23 18BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
2	Z1 16BK	GROUND
3	V13 18BK/LG	REAR WIPER MOTOR CONTROL

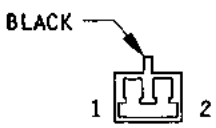
C401



LEFT REAR SPEAKER

CAV	CIRCUIT	FUNCTION
1	X51 20BR/YL	LEFT REAR SPEAKER (+)
2	X57 20BR/LB	LEFT REAR SPEAKER (-)

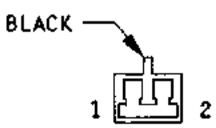
C402



SOUND BAR/DOME LAMP

CAV	CIRCUIT	FUNCTION
1	M1 20PK/WT	FUSED B(+)
2	M2 20YL	COURTESY LAMP DRIVER

C403



RIGHT REAR SPEAKER

CAV	CIRCUIT	FUNCTION
1	X52 20DB/WT	RIGHT REAR SPEAKER (+)
2	X58 20DB/OR	RIGHT REAR SPEAKER (-)

8W-90 CONNECTOR LOCATIONS

DESCRIPTION AND OPERATION

INTRODUCTION

This section provides illustrations identifying component and connector locations in the vehicle. A connector index is provided. Use the wiring diagrams in each section for connector number identification. Refer to the index for the proper figure number.

SCHEMATICS AND DIAGRAMS

CONNECTOR/GROUND LOCATIONS

For items that are not shown in this section a N/S is placed in the Fig. column.

Conn #	Color	Location	Fig.
C100	BK	Right Side of Engine Compartment	2
C101	BK	Under Battery Tray	2, 3
C102	GY	Right Side of Dash Panel	3
C103	GY	Right Side of Dash Panel	2
C104	BK	Rear of Engine	2
C105	BK	Center of Hood	2
C106	BK	Left Kick Panel	2
C107	YL	Left Kick Panel	2
C108	BL	Left Kick Panel	2
C109	BK	On Brake Master Cylinder	2
C110	BK	Left Fender Side Shield	2
C111	BK	Front of Floor Pan Tunnel	15
C112	BK	Under Instrument Panel, Center of Dash Panel	2
C113	GY	Under Instrument Panel, Center of Dash Panel	2, 11
C114	GY	Under Instrument Panel, Center of Dash Panel	2, 11
C115	BK	Left Fender Side Shield	5
C116	BK	Left Fender Side Shield	5
C117	BK	Left Fender Side Shield	5
C118	BK	Left Side of Dash Panel	3
C119	BK	Left Fender Side Shield	4
C120	BK	Left Front Fender Side Shield	4
C121	BK	Under Washer Fluid Reservoir	3
C122	BK	Left Front Fender Side Shield	4
C123	BK	Left Front Fender Side Shield	4
C124	BK	Rear of Left Headlamp	4
C125	BK	Right Front Fender Side Shield	1
C126	BK	Rear of Right Headlamp	1
C127	WT	At Right Front Side Marker Lamp	4
C128	WT	At Left Front Side Marker Lamp	N/S
C129	WT	At Right Front Park/Turn Signal Lamp	4
C130	WT	At Left Front Park/Turn Signal Lamp	N/S
C131	BK	Right Side of Bumper	1
C132	BK	Left Side of Bumper	N/S
C133	BK	Rear of Generator	10
C134	BK	Right Side of Engine Block	9
C135	BK	On Thermostat Housing - 2.5L Engine	7
C135	BK	On Thermostat Housing - 4.0L Engine	8
C136	BK	Right Side of Transmission	12
C137	BK	On A/C Compressor	10
C138	BK	Injector No. 1 - 2.5L Engine	7
C138	BK	Injector No. 1 - 4.0L Engine	8

SCHEMATICS AND DIAGRAMS (Continued)

Conn #	Color	Location	Fig.
C139	BK	Injector No. 2 - 2.5L Engine	7
C139	BK	Injector No. 2 - 4.0L Engine	8
C140	BK	Injector No. 3 - 2.5L Engine	7
C140	BK	Injector No. 3 - 4.0L Engine	8
C141	BK	Injector No. 4 - 2.5L Engine	7
C141	BK	Injector No. 4 - 4.0L Engine	8
C142	BK	Side of Throttle Body - 2.5L Engine	7
C142	BK	Side of Throttle Body - 4.0L Engine	8
C143	BK	Side of Throttle Body - 2.5L Engine	7
C143	BK	Side of Throttle Body - 4.0L Engine	8
C144	GY	Rear of Intake Manifold - 2.5L Engine	7
C144	GY	Rear of Intake Manifold - 4.0L Engine	8
C145	BK	At Rear of Intake Manifold	11
C146	GY	On Front Exhaust Pipe - 2.5L Engine	7
C146	GY	On Front Exhaust Pipe - 4.0L Engine	8
C147	BK	Side of Throttle Body - 2.5L Engine	7
C147	BK	Side of Throttle Body - 4.0L Engine	8
C148	BK	Near Power Steering Pump	7
C149	BK	On A/C Compressor	10
C150	BK	Right Rear of Engine Compartment	3
C151	WT	Right Rear of Engine Compartment	3
C152	BK	Right Side of Engine	10
C153	BK	Below Distributor	9
C154	BK	Left Side of Transmission - Auto Trans.	9
C154	BK	Right Side of Transmission - Manual Trans.	12
C155	BK	Left Side of Transmission	N/S
C156	BK	Rear of Catalytic Convertor	12
C157	BK	Left Rear of Transfer Case	12
C158	BK	Left Side of Transfer Case	12
C159	BK	Above Fuel Tank	1
C160	BK	At Injector No. 5	8
C161	BK	At Injector No. 6	8
C162	BK	Right Fender Side Shield	11
C163	BK	Left Fender Side Shield	1
C164	BK	Left Fender Side Shield	1
C165	BK	Right Side of Engine	10
C200	GY	Rear of Cluster	14
C201	BK	Rear of Cluster	14
C202	GY	Left Kick Panel	14
C203	GN	Left Kick Panel	14
C204	RD	Left Kick Panel	14
C205	BK	Rear of Switch	14
C206	BK	Left Side of Instrument Panel	14
C207	BK	Left Side of Instrument Panel	14
C208	BK	At Speaker	14
C209	BK	Right Side of Instrument Panel	17
C210	BK	At Speaker	17
C211	BK	Right Rear of Instrument Panel	17
C212	GY	Behind Rear Window Defogger Switch	14
C213	WT	Behind Rear Wiper Switch	14
C214	BK	Rear of Cigar Lighter	14
C215	BK	Rear of Fog Lamp Switch	14
C216	BK	Rear of Blower Motor Switch	14
C217	BK	Rear of Lamp	14

SCHEMATICS AND DIAGRAMS (Continued)

Conn #	Color	Location	Fig.
C218	BK	Rear of A/c-Heater Control Switch	14
C219	BK	Rear of Radio	14
C220	GY	Rear of Radio	14
C221	BK	Rear of Radio	14
C222	WT	Lower Right of Instrument Panel	17
C223	BK	On HVAC Module	N/S
C224	BK	On HVAC Module	N/S
C225	BK	On HVAC Module	N/S
C300	BK	Top of Brake Pedal Bracket	13, 18
C301	BK	Bottom Left of Instrument Panel	18
C302	GY	Top of Brake Pedal Bracket	13
C303	NAT	Left "A" Pillar	13
C304	BK	Left Side of Cowl Panel	6
C305	BK	Bottom Left of Instrument Panel	13
C306	GN	At Key-In Switch	16
C307	WT	Left Side of Steering Column	16
C308	GY	Rear of Ignition Switch	16
C309	YL	Rear of Airbag	16
C310	BK	Rear of Clockspring	16
C311	BK	Right Side of Steering Column	16
C312	BK	Right Side of Steering Column	16
C313	NAT	Right Side of Steering Column	16
C314	BK	Rear of Lamp	N/S
C315	YL	Front of Floor Pan Tunnel	15
C316	YL	Rear of Airbag	N/S
C317	BK	Right "A" Pillar	13
C318	BK	Right Rear of Instrument Panel	13
C319	BK	Bottom Left of Instrument Panel	13
C320	BK	Bottom Left of Instrument Panel	13
C321	BK	Left Fender Side Shield	3
C322	BK	Bottom Left of Instrument Panel	18
C323	RD	Left Kick Panel	18
C324	BK	At Left Seat Belt Buckle	18
C325	WT	Left Side of Sound Bar	18
C326	BK	Left Rear Quarter Panel	18
C327	BK	Right Rear Quarter Panel	19
C328	BK	Left Rear Quarter Panel	19
C400	BK	At Wiper Motor	N/S
C401	BK	At Speaker	N/S
C402	BK	At Lamp	N/S
C403	BK	At Speaker	N/S
G100		Left Side of Dash Panel	2
G101		Center of Dash Panel	2
G102		Left Radiator Closure Panel	4
G103		Right Radiator Closure Panel	2
G104		Rear of Generator	10
G105		Right Rear of Engine Block	10
G106		Right Rear of Engine Block	10
G107		Right Rear of Engine Block	10
G200		Left Rear of Instrument Panel	14
G201		Right Rear of Instrument Panel	17
G300		Left Kick Panel	13
G301		Right Kick Panel	13

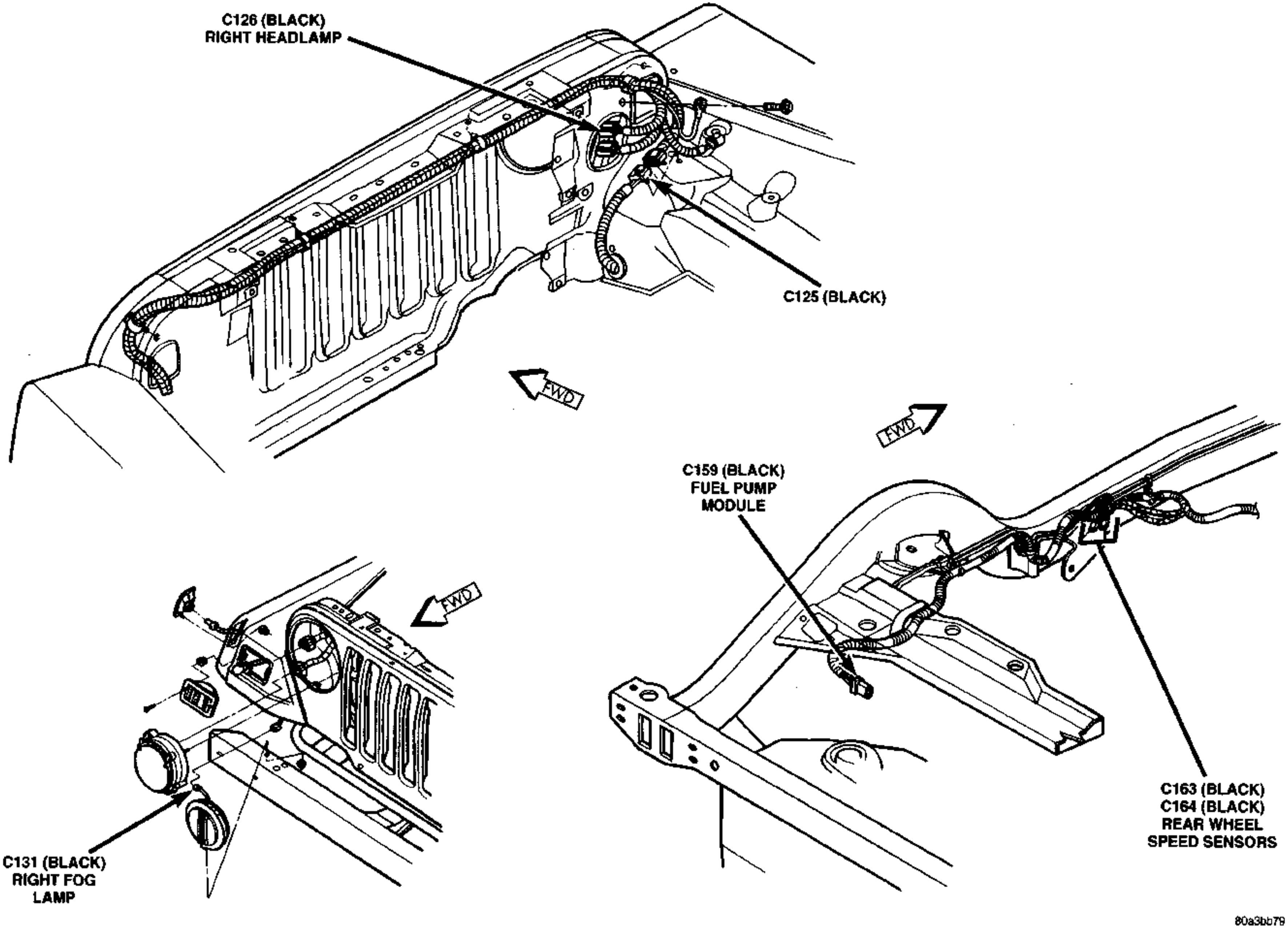


Fig. 1 Front End Wiring Connectors

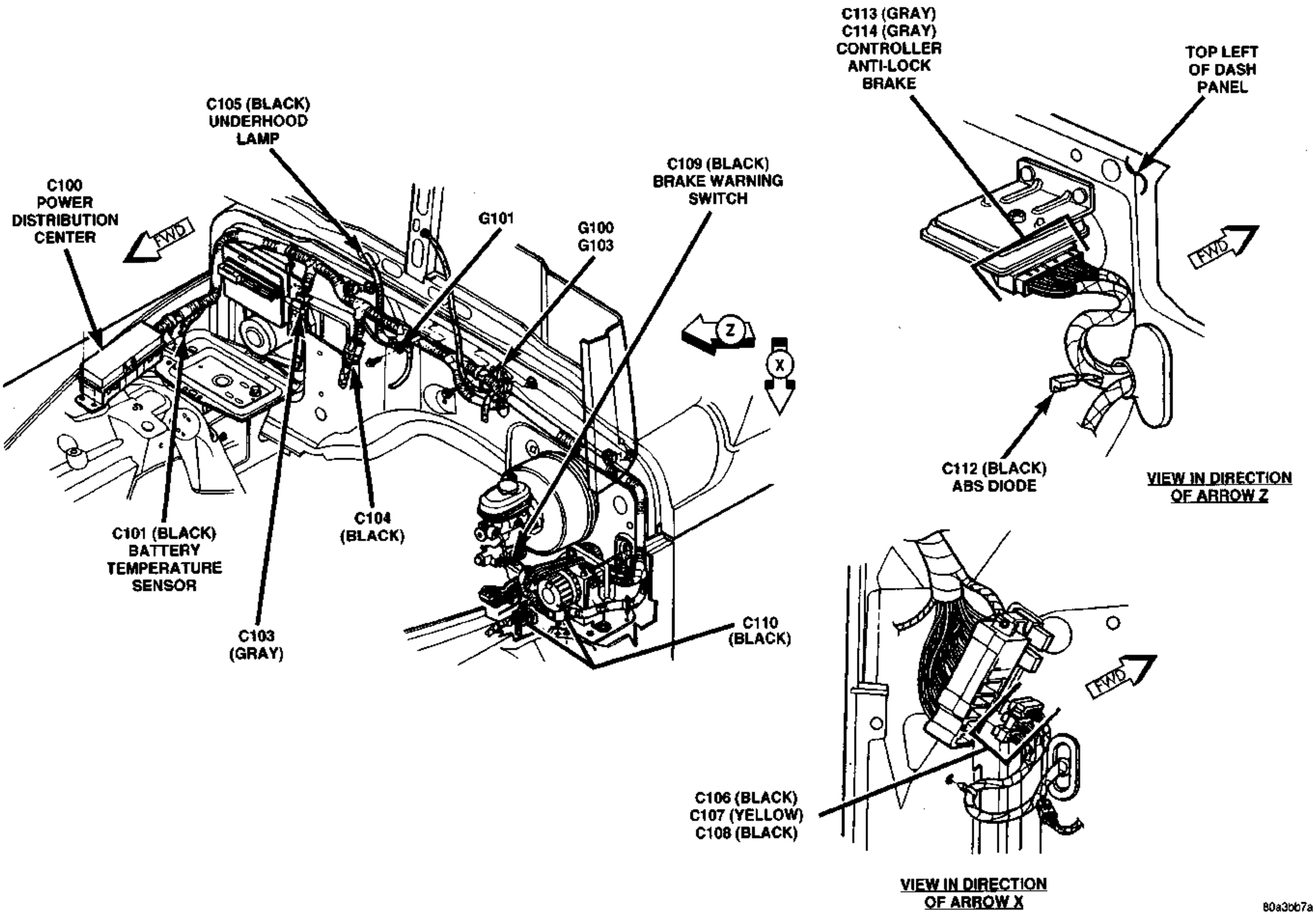


Fig. 2 Engine Compartment Connectors — Rear

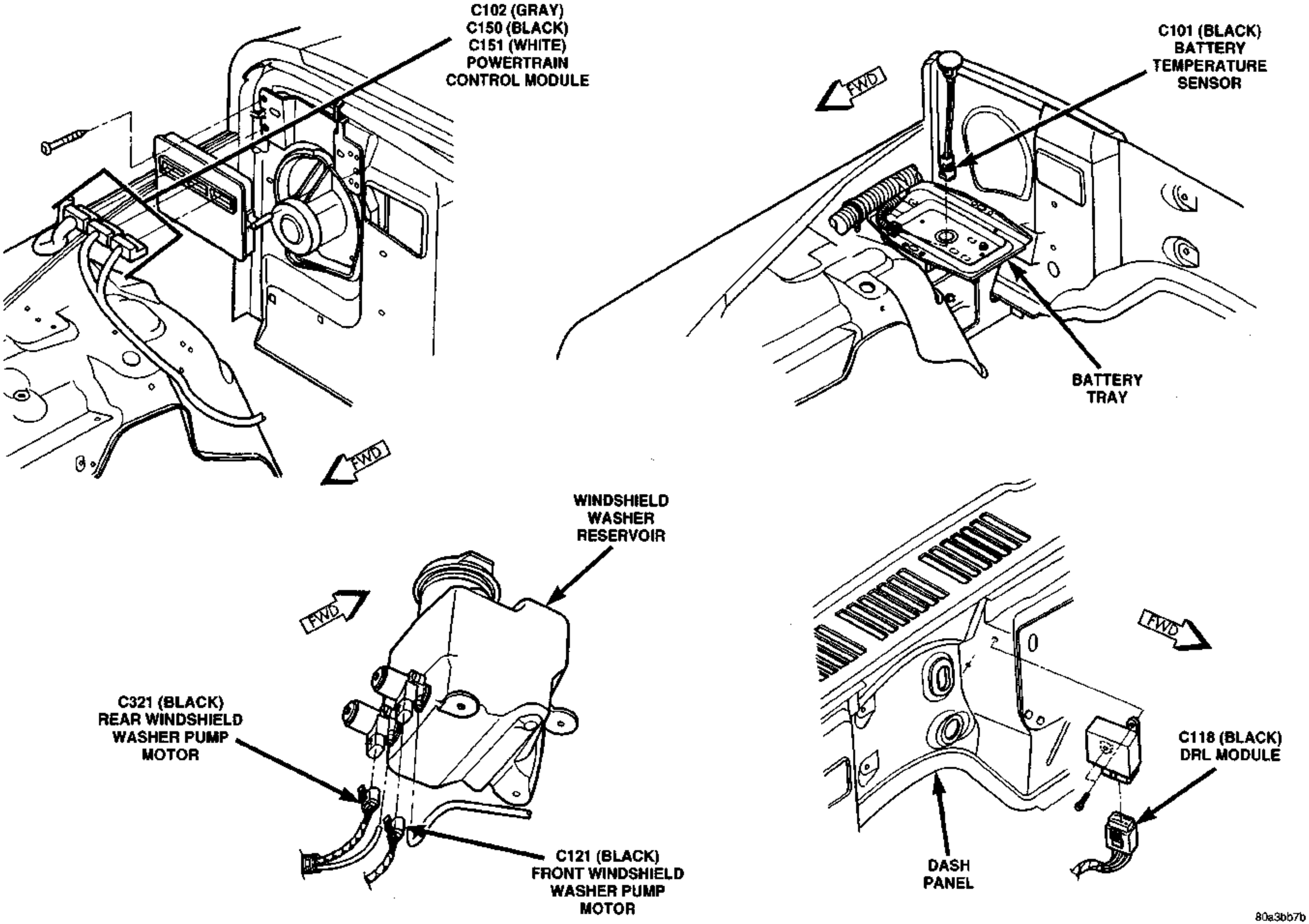


Fig. 3 Engine Compartment Connectors

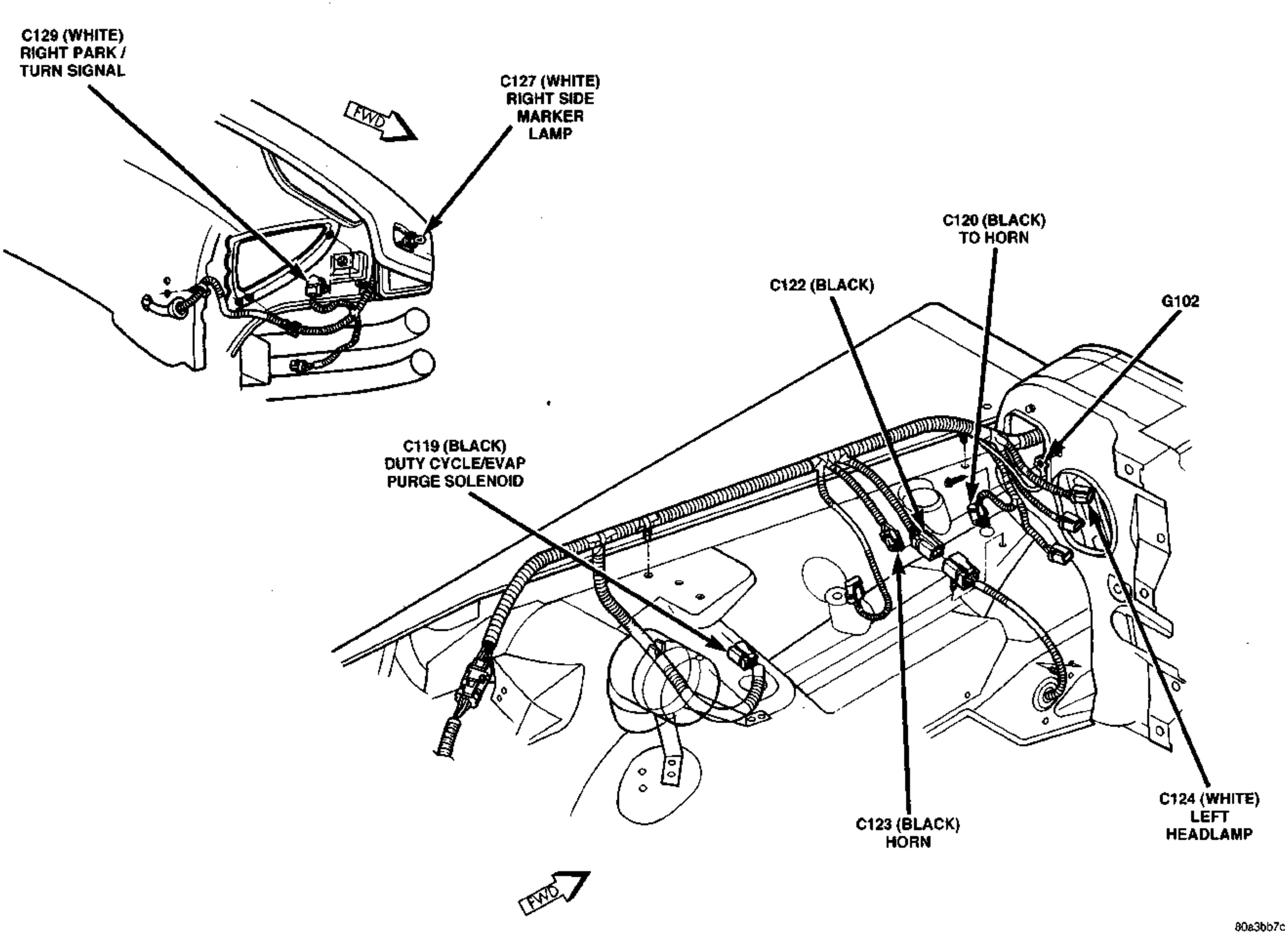


Fig. 4 Engine Compartment Connectors — Right Side

SCHEMATICS AND DIAGRAMS (Continued)

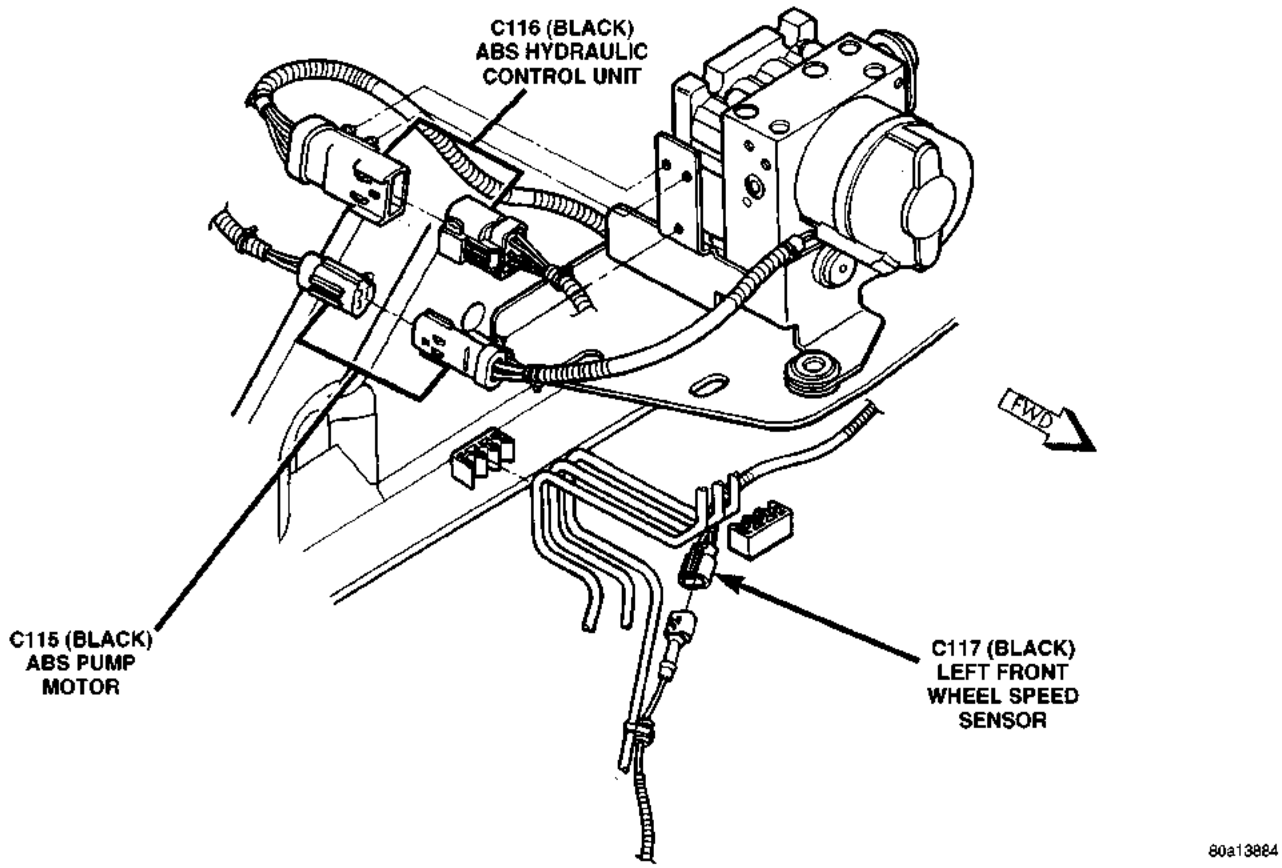


Fig. 5 ABS Hydraulic Control Unit

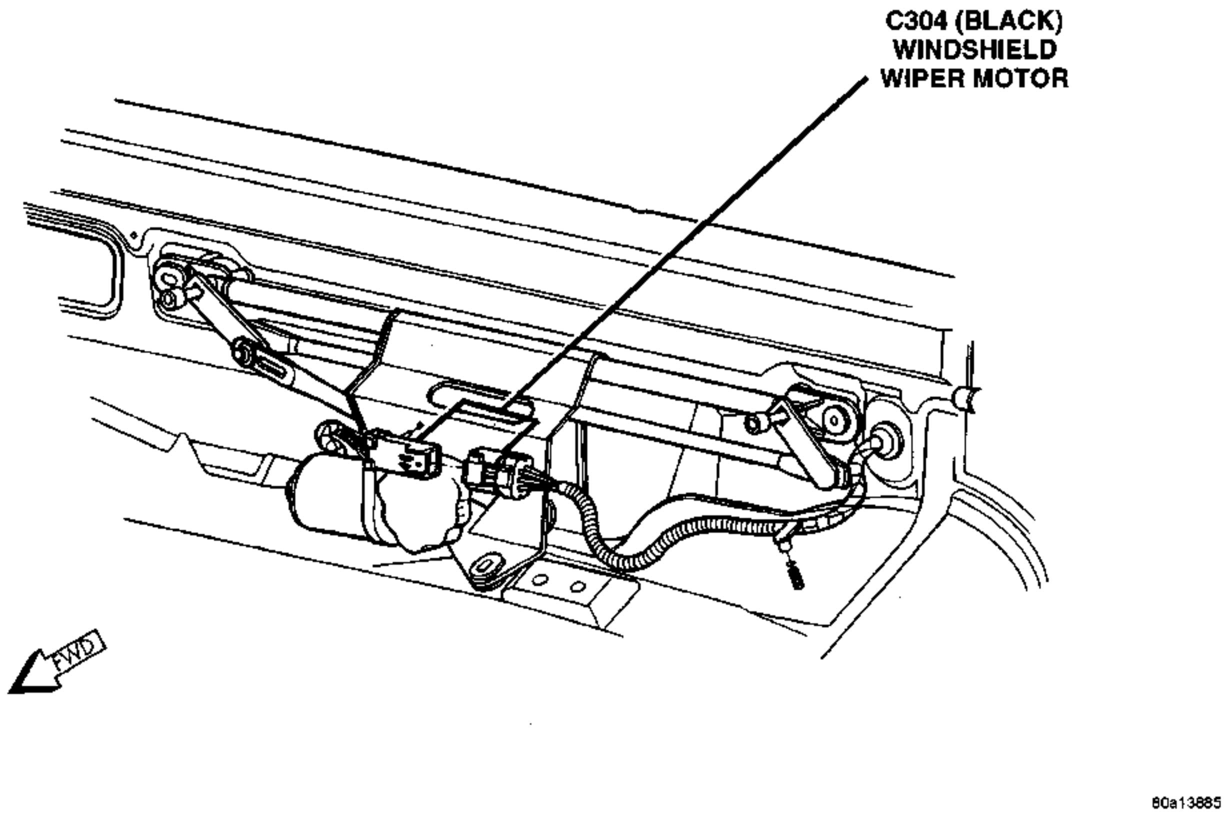


Fig. 6 Windshield Wiper Motor

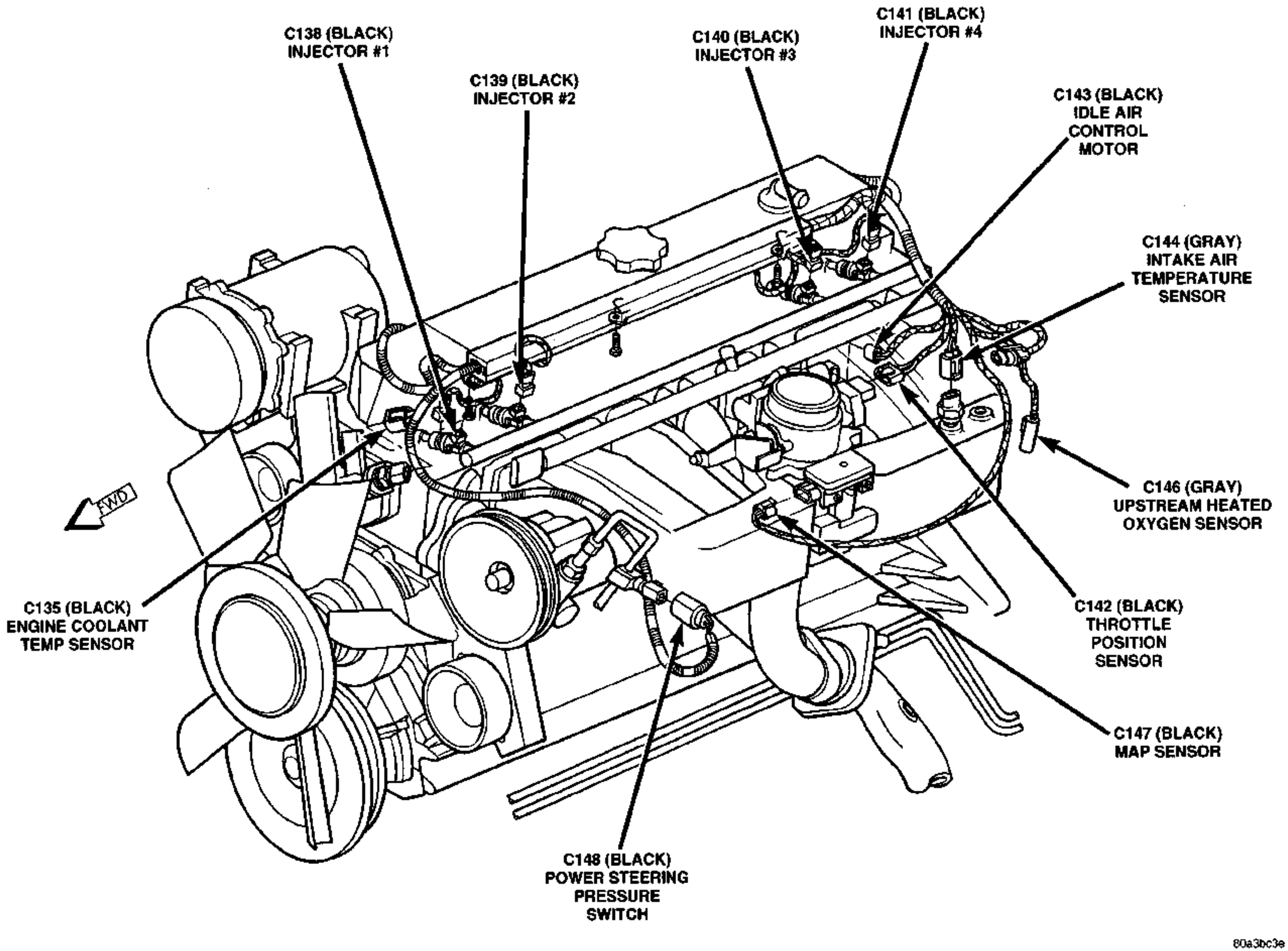


Fig. 7 Engine Harness Connectors — 2.5L Engine

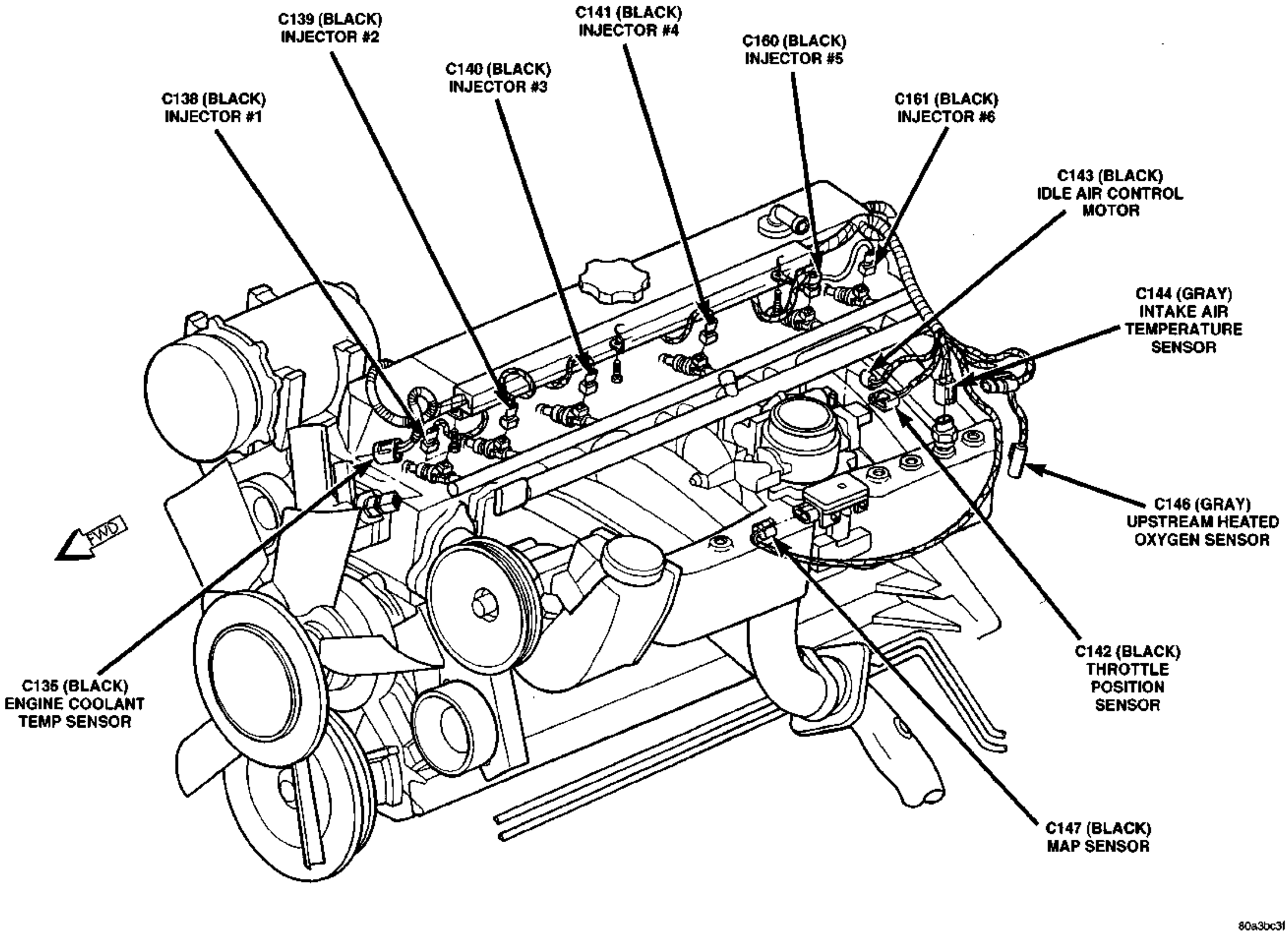


Fig. 8 Engine Harness Connectors — 4.0L Engine

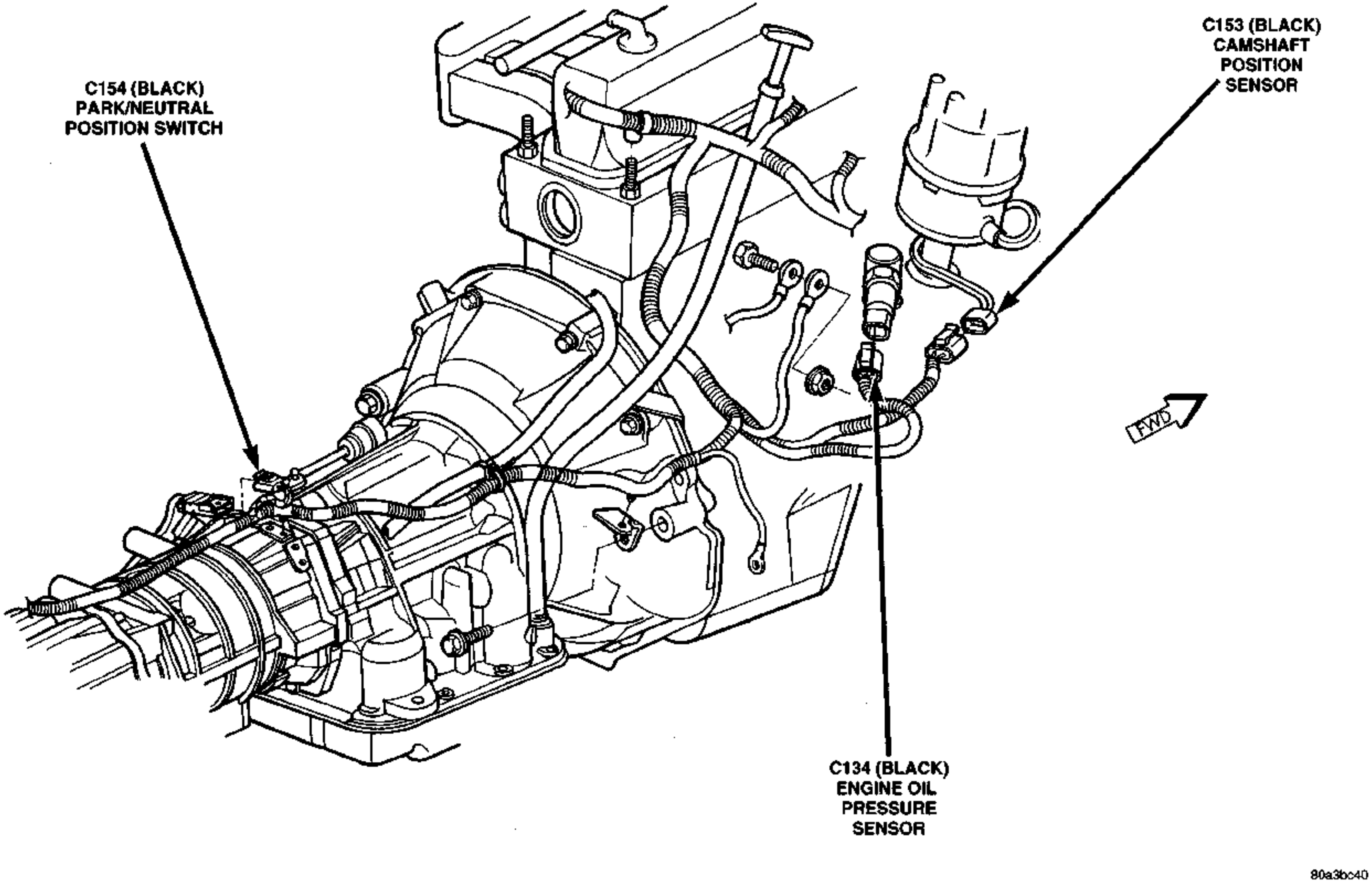


Fig. 9 Engine and Automatic Transmission Connectors

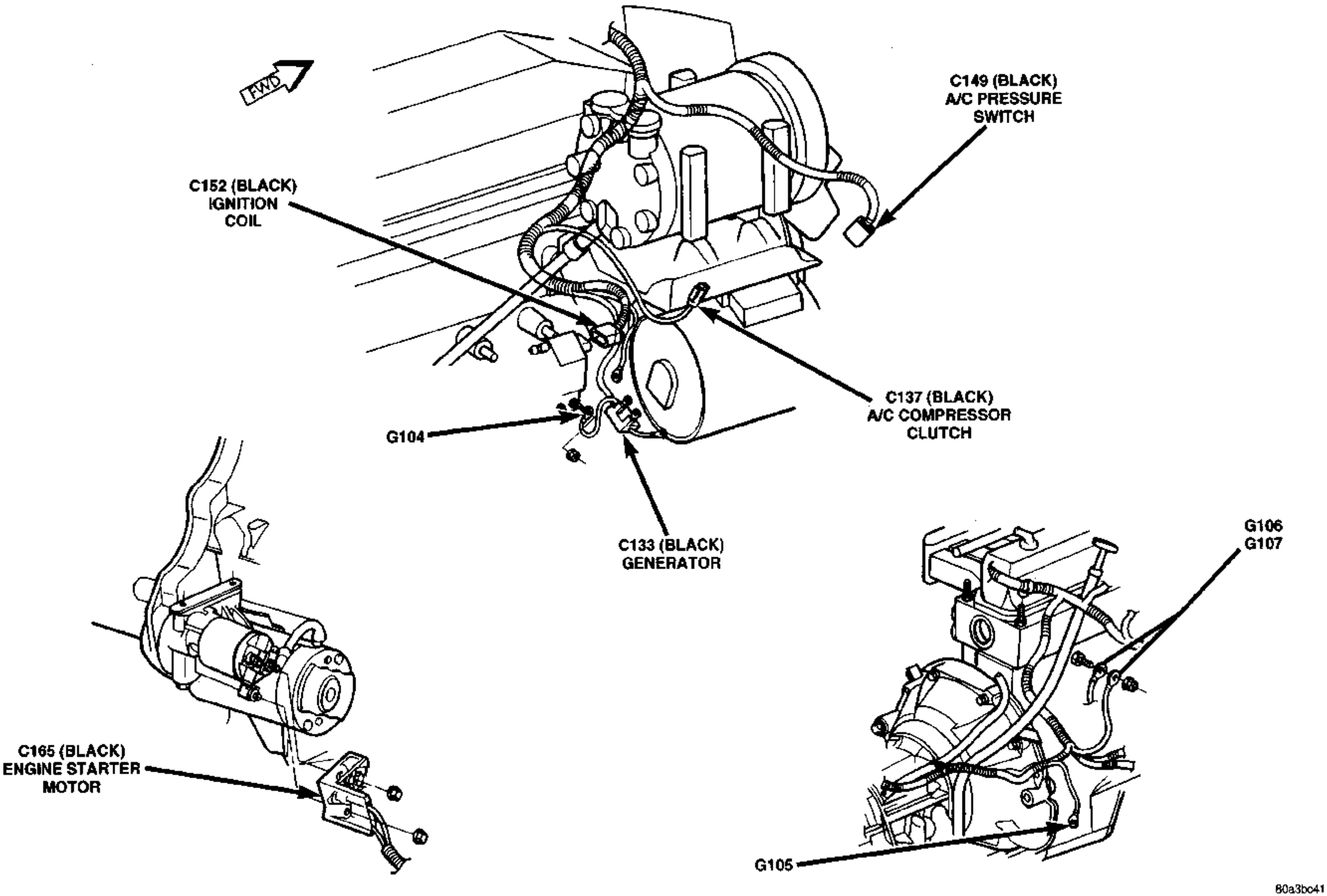


Fig. 10 Engine Grounds

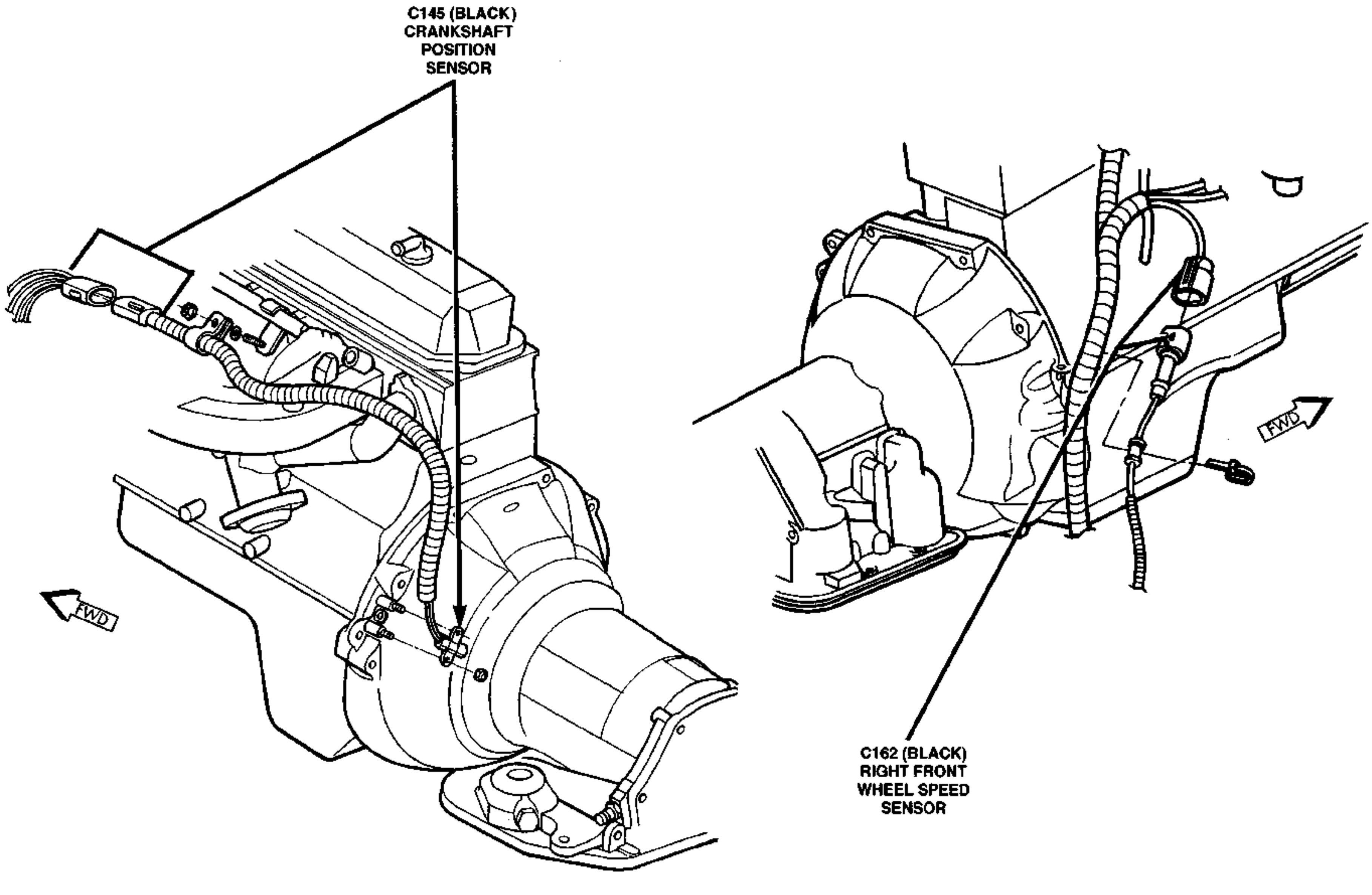


Fig. 11 Crankshaft Position Sensor and Right Front Wheel Speed Sensor

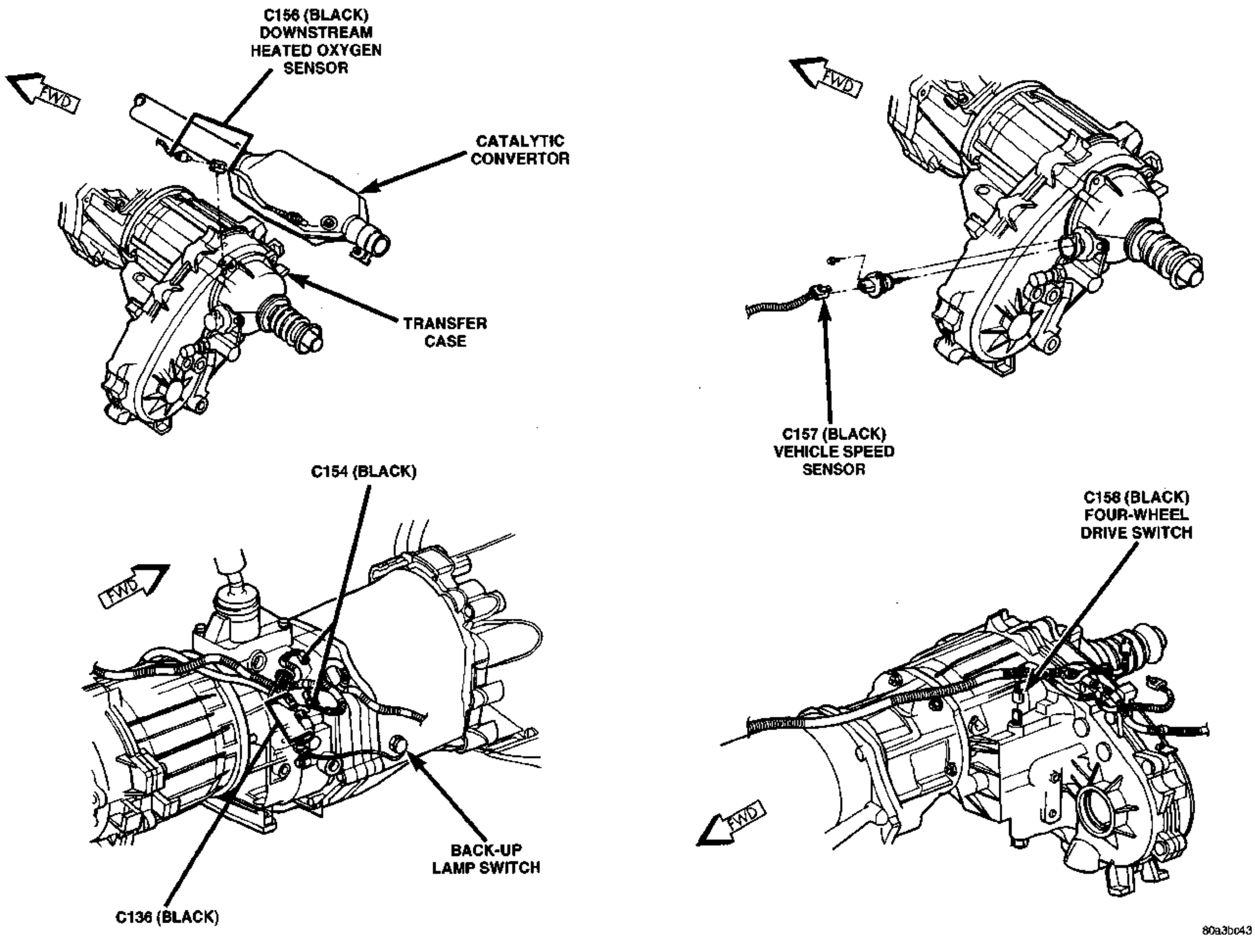


Fig. 12 Transmission and Transfer Case Connectors

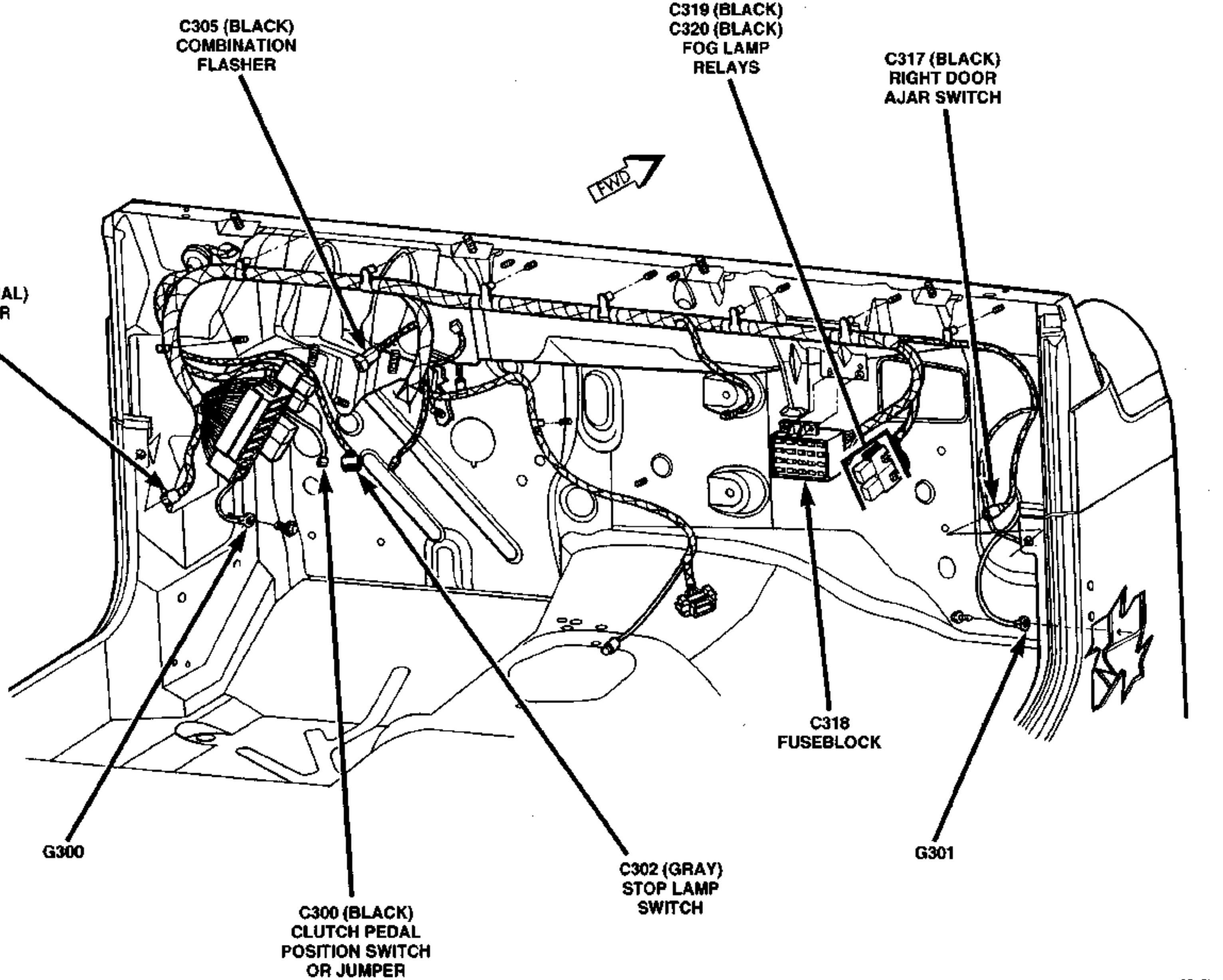


Fig. 13 Dash Panel Connectors

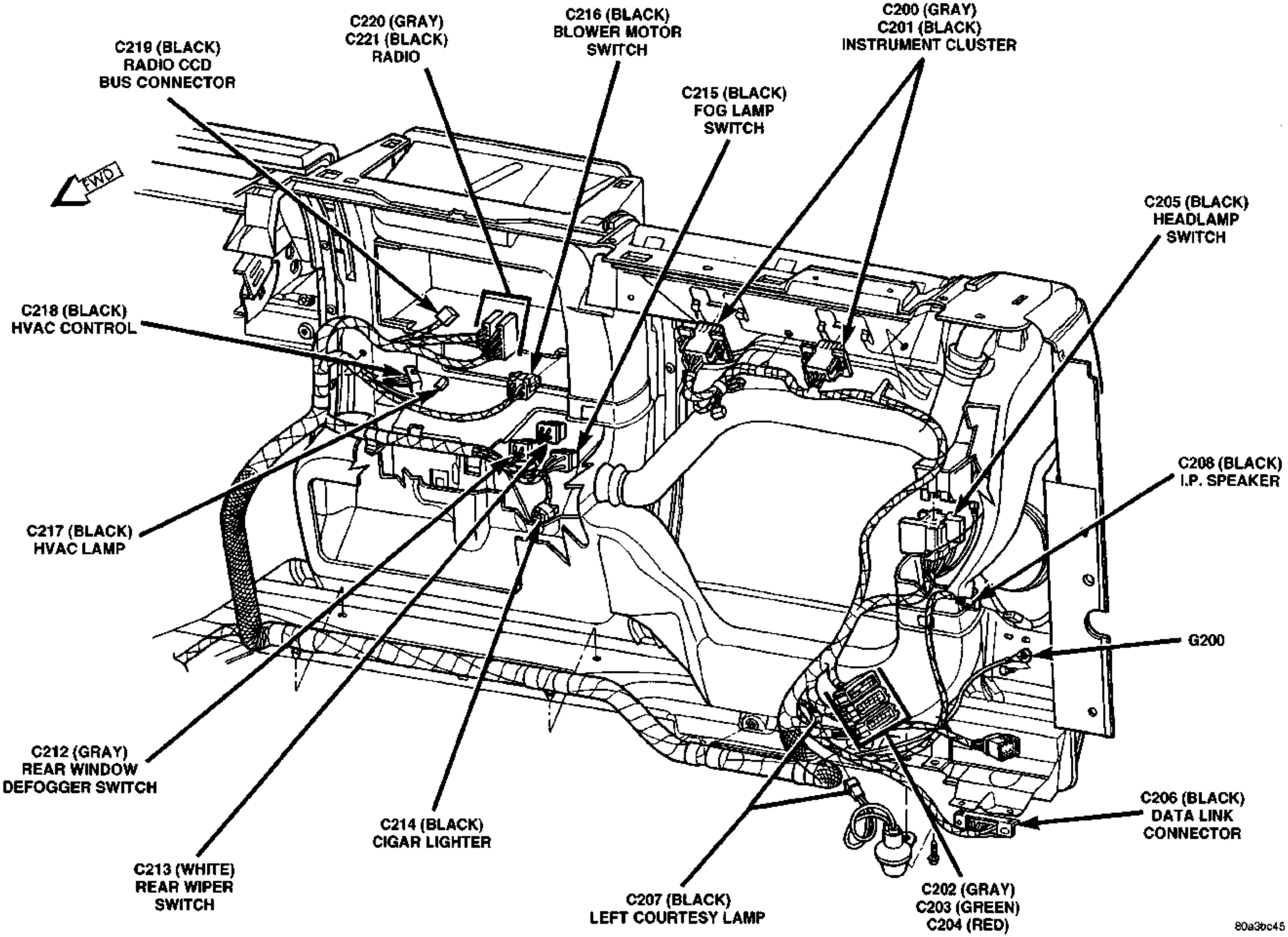


Fig. 14 Instrument Panel Wiring Connectors

SCHEMATICS AND DIAGRAMS (Continued)

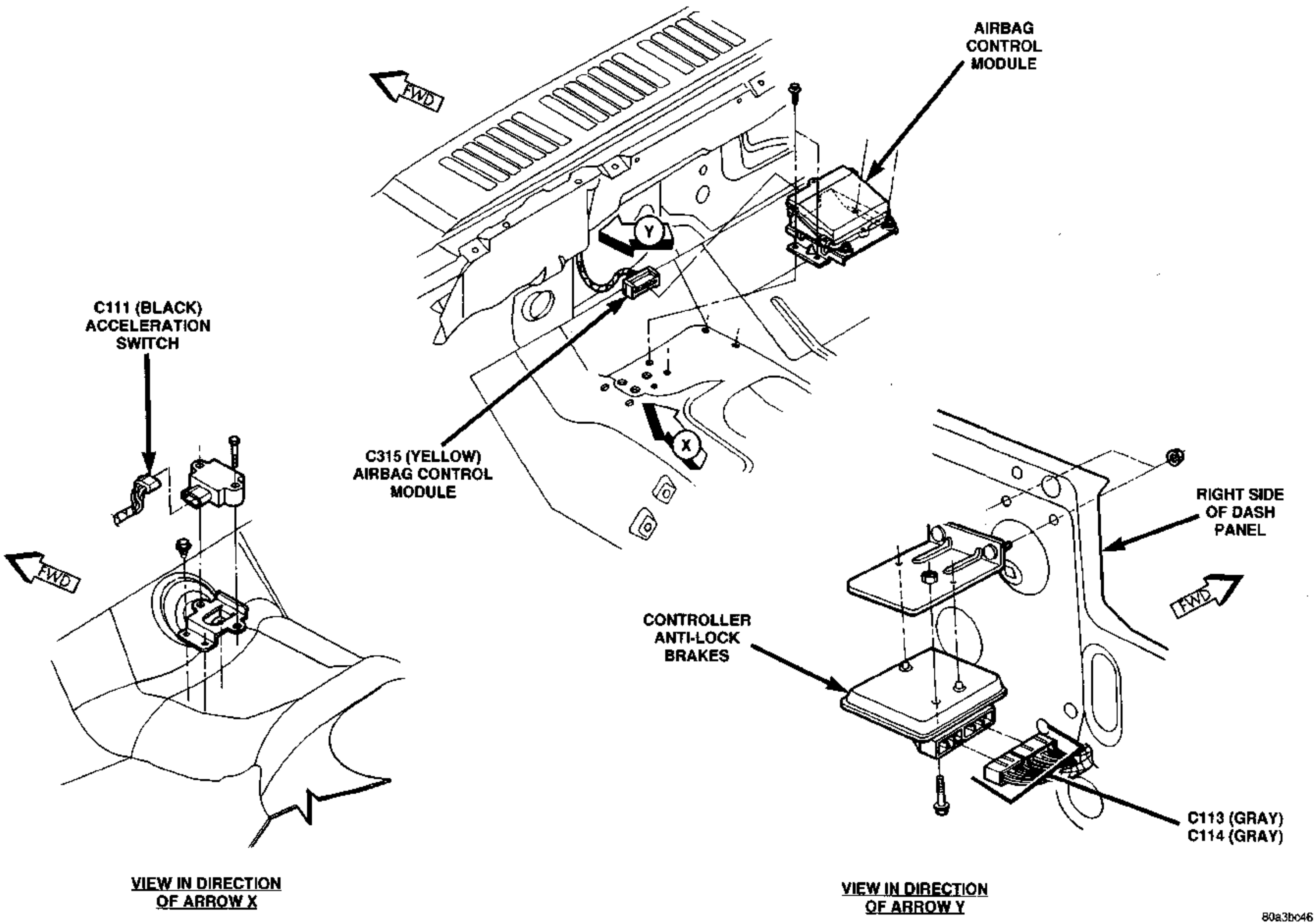


Fig. 15 Airbag Control Module and Controller, Antilock Brakes

SCHEMATICS AND DIAGRAMS (Continued)

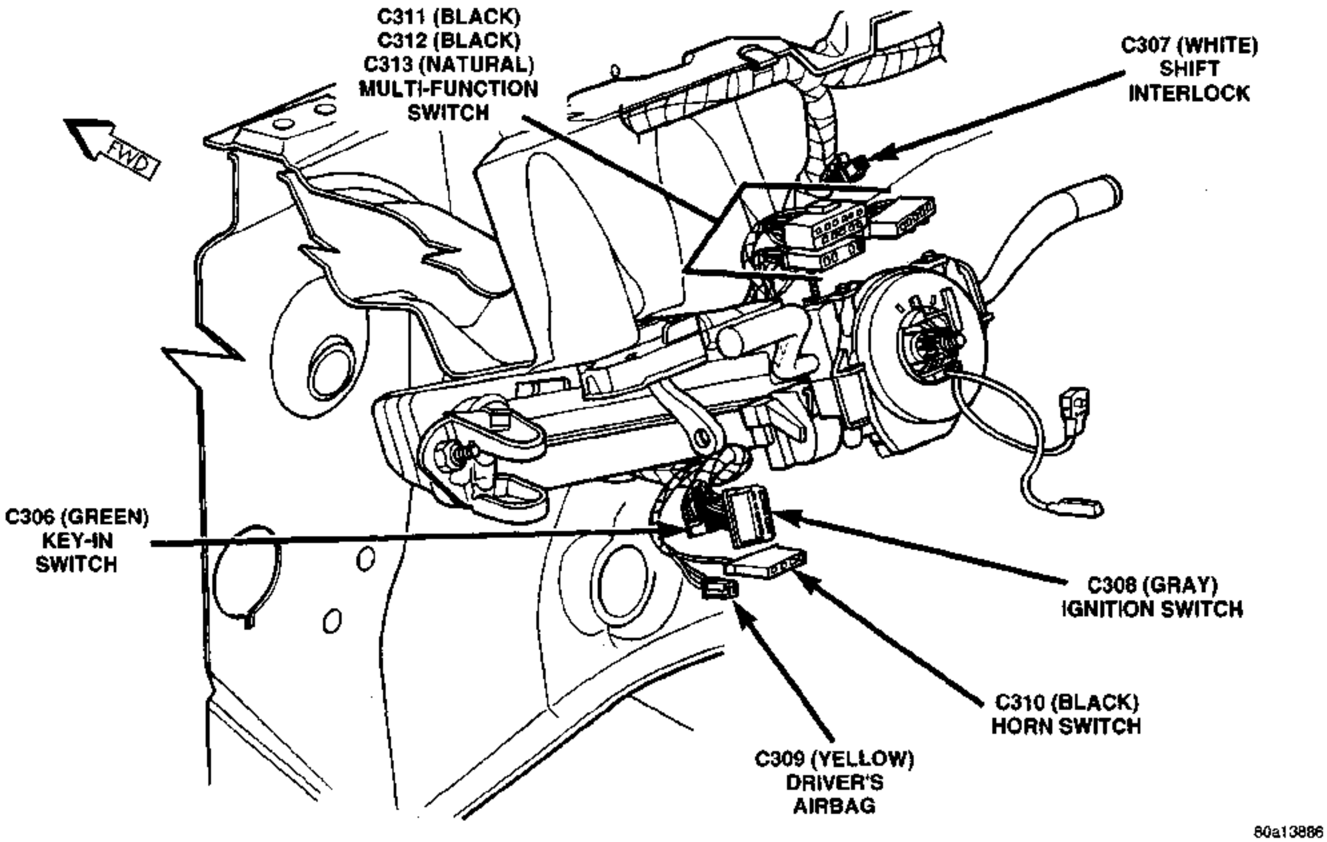


Fig. 16 Steering Column Connectors

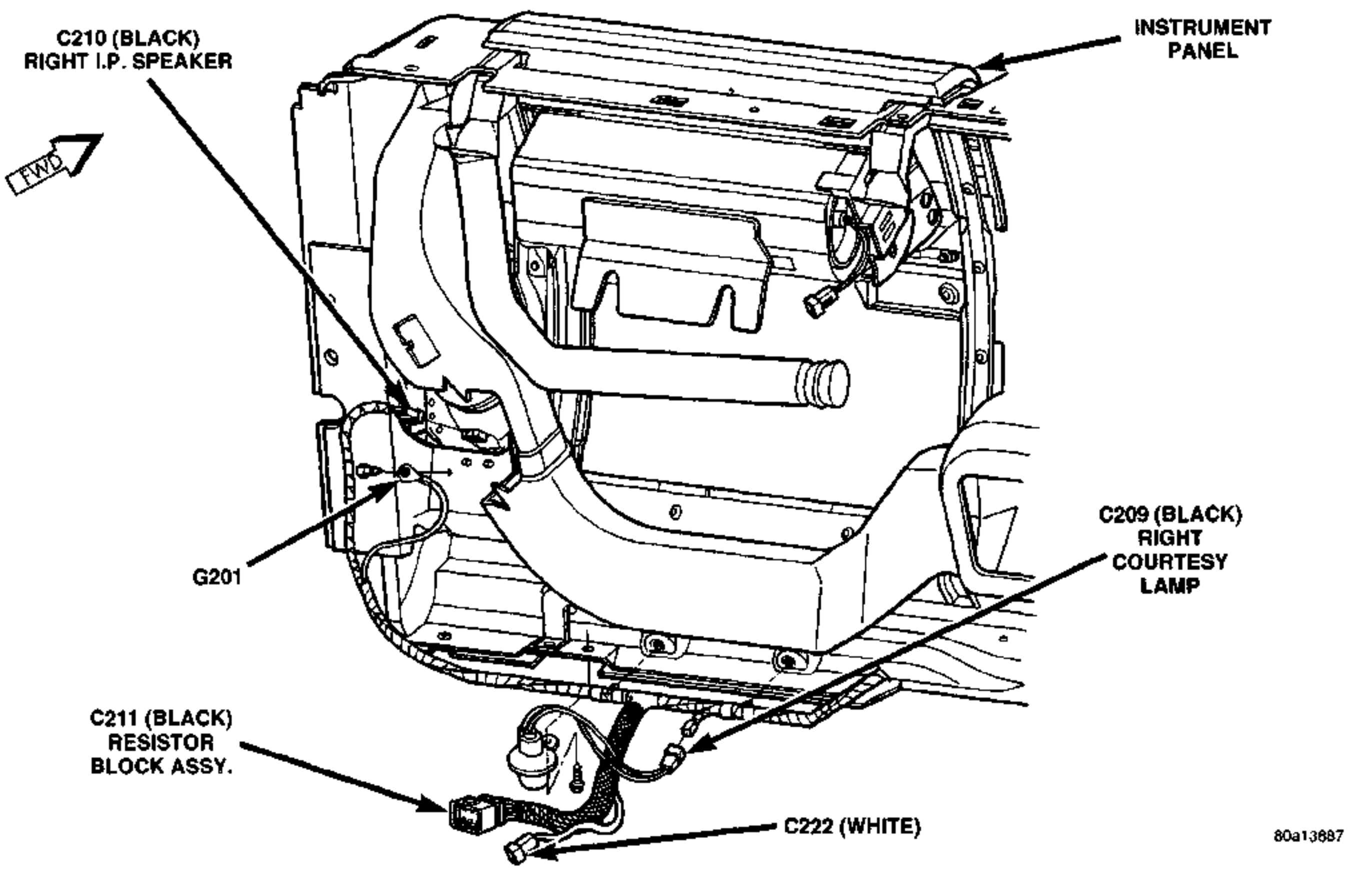


Fig. 17 Instrument Panel Connectors — Right Side

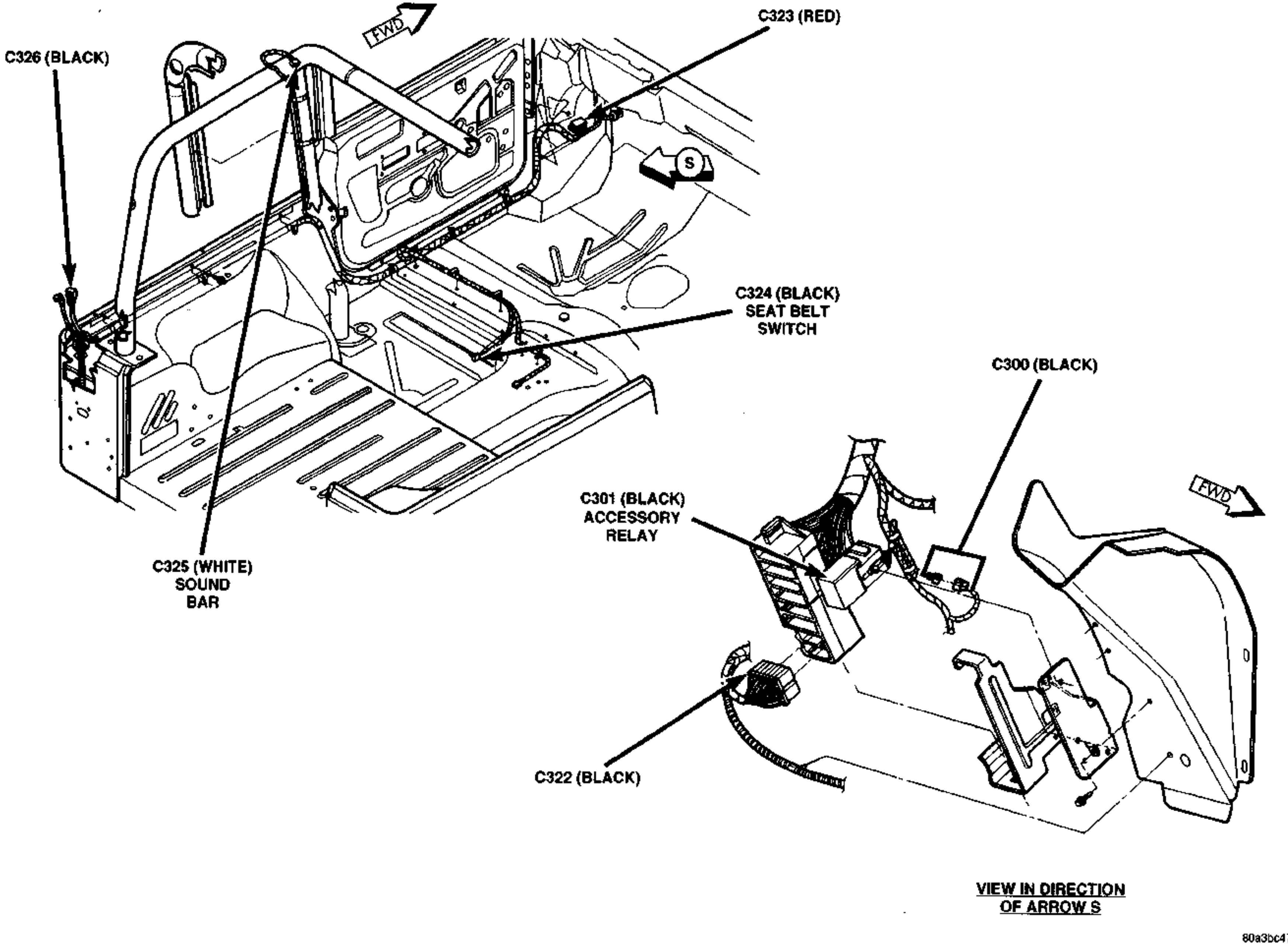


Fig. 18 Body Connectors

SCHEMATICS AND DIAGRAMS (Continued)

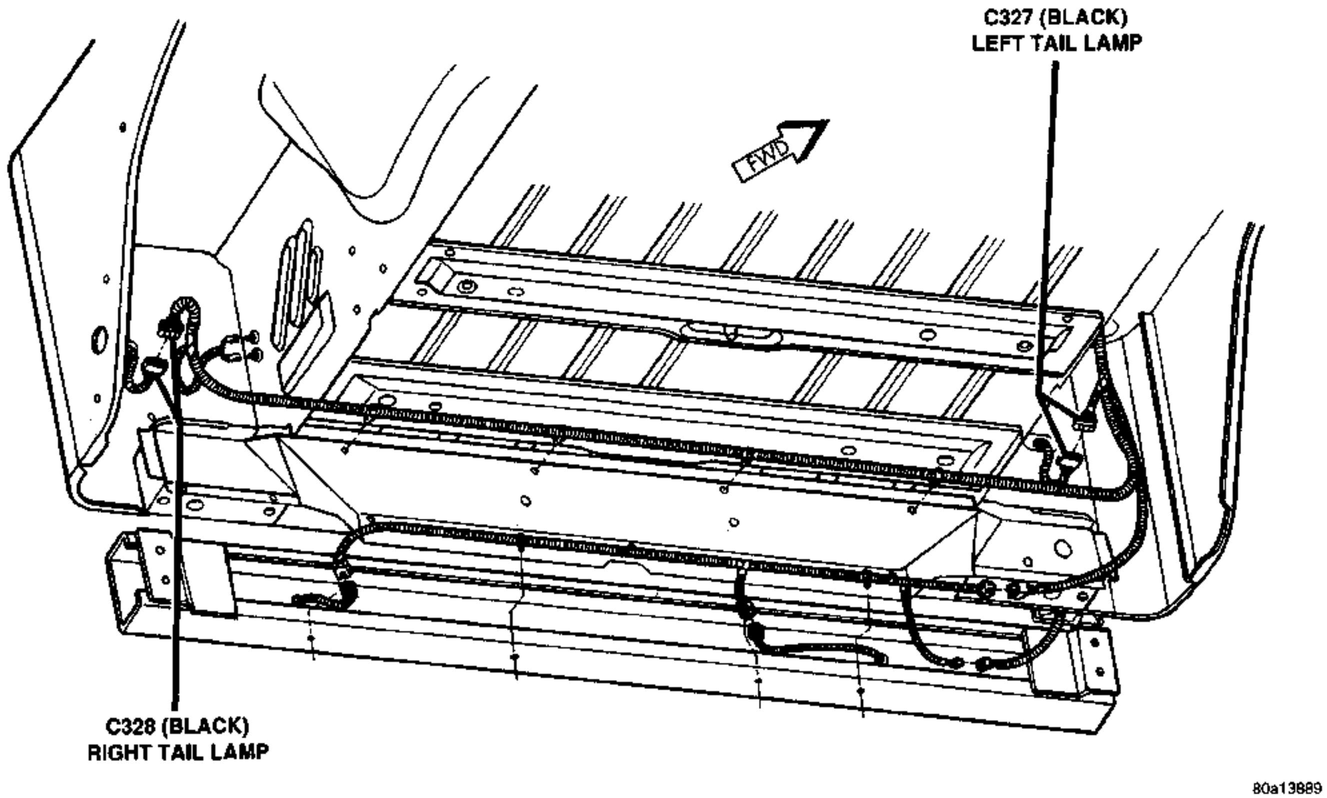


Fig. 19 Rear Body Wiring Connectors

8W-95 SPLICE LOCATIONS

DIAGNOSIS AND TESTING

INTRODUCTION

This section provides illustrations identifying the general location of the splices in this vehicle. A splice index is provided. Use the wiring diagrams in each section for splice number identification. Refer to the index for proper splice number.

SCHEMATICS AND DIAGRAMS

SPLICE LOCATIONS

For splices that are not shown in the figures in this section, an N/S is placed in the Fig. column.

Splice Number	Location	Fig.
S100	Near Battery Temperature Sensor T/O	2
S101	Near T/O for Connector C103 (Engine Harness)	2
S102	Near T/O for Connector C103 (Engine Harness)	2
S103	Near T/O for Connector C104 (Engine Harness)	2
S104	Near Grommet on Left Side of Dash Panel	2
S105	Near Grommet on Left Side of Dash Panel	2
S106	Near T/O for Ground G100	2
S107	Near Grommet on Left Side of Dash Panel	2
S108	Near Power Distribution Center (PDC)	2
S109	Near Underhood Lamp T/O	2
S110	Near T/O for Ground G100	2
S111	Near T/O for Ground G100	2
S112	Near Controller, Antilock Brakes	2
S113	Near Controller, Antilock Brakes	2
S114	Near ABS Pump Motor T/O	2
S115	Near Duty Cycle EVAP Purge Solenoid T/O	1
S116	Near T/O for Horn #1	1
S117	Near T/O for left Park/Turn Signal Lamp	1
S118	Near Left Headlamp T/O	1
S119	Left Side Radiator Closure Panel	1
S120	Near T/O for Left Park/Turn Signal Lamp	N/S

Splice Number	Location	Fig.
S121	Near T/O for Left Park/Turn Signal Lamp	N/S
S122	Near T/O for Left Park/Turn Signal Lamp	N/S
S123	Near T/O for Right Park/Turn Signal Lamp	N/S
S124	Near T/O for Right Park/Turn Signal Lamp	N/S
S125	Near T/O for Right Park/Turn Signal Lamp	N/S
S126	Between T/Os for Injectors 2 and 3	3
S127	Near T/O for IAC Motor	3
S128	Near T/O for Injector 6	3
S129	Near T/O for Injector 6	3
S130	Right Rear of Cylinder Head	4
S131	Right Rear of Cylinder Head	4
S132	Right Rear of Cylinder Head - 2.5L Engine	4
S133	Right Side of Transmission	4
S134	Near T/O for Camshaft Position Sensor	4
S135	Near T/O for Park/Neutral Position Switch	4
S200	Center Rear of I.P.	6
S201	Center Rear of I.P.	6
S202	Center Rear of I.P.	6
S203	Center Rear of I.P.	6
S204	Center Rear of I.P.	6
S205	Center Rear of I.P.	6
S206	Center Rear of I.P.	6
S207	Near Cigar Lighter T/O	6

SCHEMATICS AND DIAGRAMS (Continued)

Splice Number	Location	Fig.
S208	In A/C-Heater Blower Motor Switch T/O	6
S209	In Radio T/O	6
S300	In T/O for Stop Lamp Switch	5
S301	Between Grommeted T/O to Windshield Wiper Motor and Branch to Left Door Ajar Switch	5
S302	Near Grommeted T/O for Windshield Wiper Motor	5
S303	Near Grommeted T/O for Windshield Wiper Motor	5
S304	Above Brake Pedal Bracket	5
S305	In Combination Flasher T/O	5
S306	Center of Dash Panel	5

Splice Number	Location	Fig.
S307	Center of Dash Panel	5
S308	Center of Dash Panel	5
S309	Front of Left Rear Wheel Well	7
S310	Left Rear Quarter Panel, Near Body Grommet	7
S311	Near Left Tail Lamp Connector	7
S312	Near Left Tail Lamp Connector	7
S313	Front of Left Rear Wheel Well	7
S314	Front of Left Rear Wheel Well	7
S400	Near Rear Wiper Motor Connector	N/S
S401	Near Rear Wiper Motor Connector	N/S

SCHEMATICS AND DIAGRAMS (Continued)

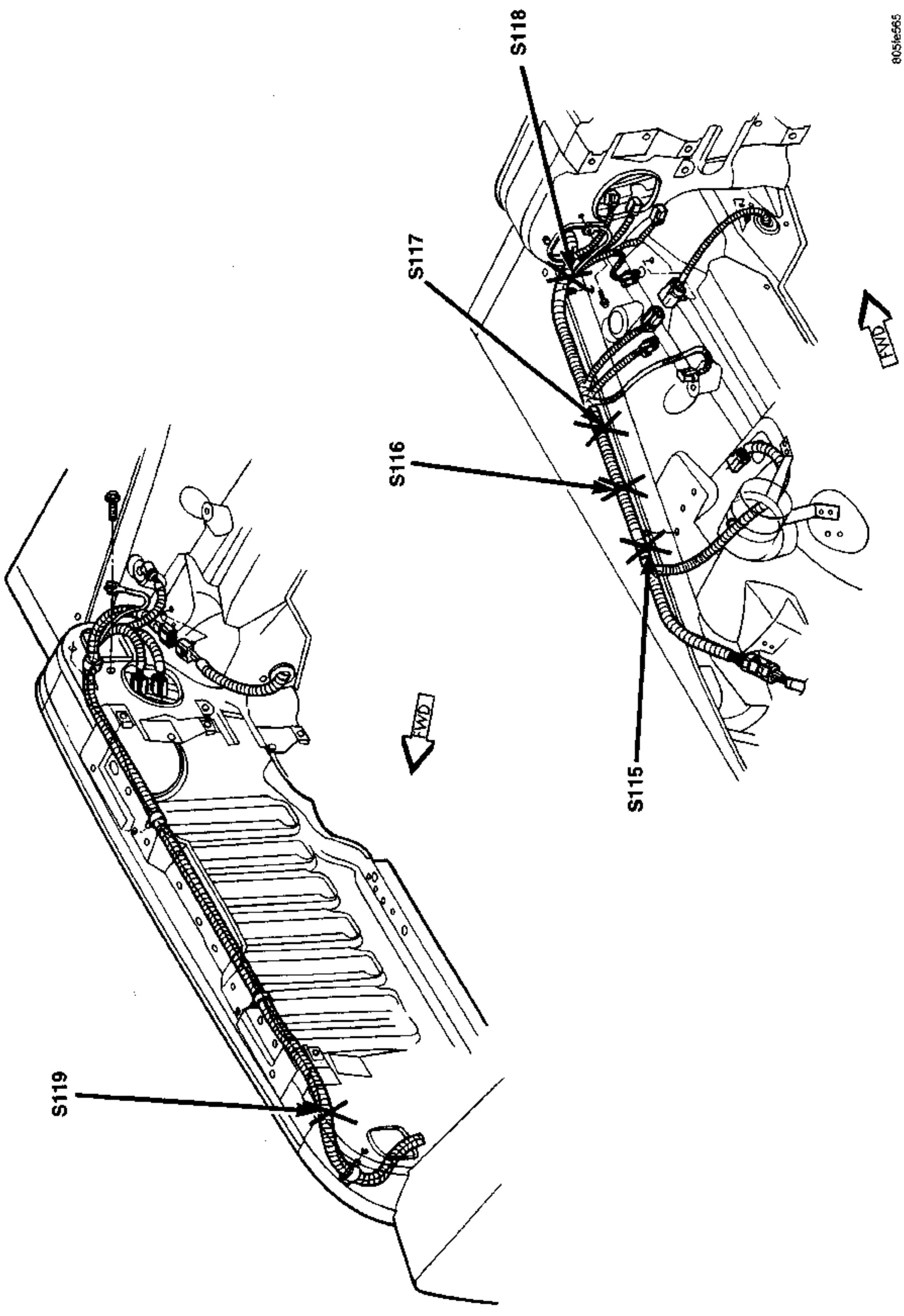


Fig. 1 Engine Compartment Splices—Front

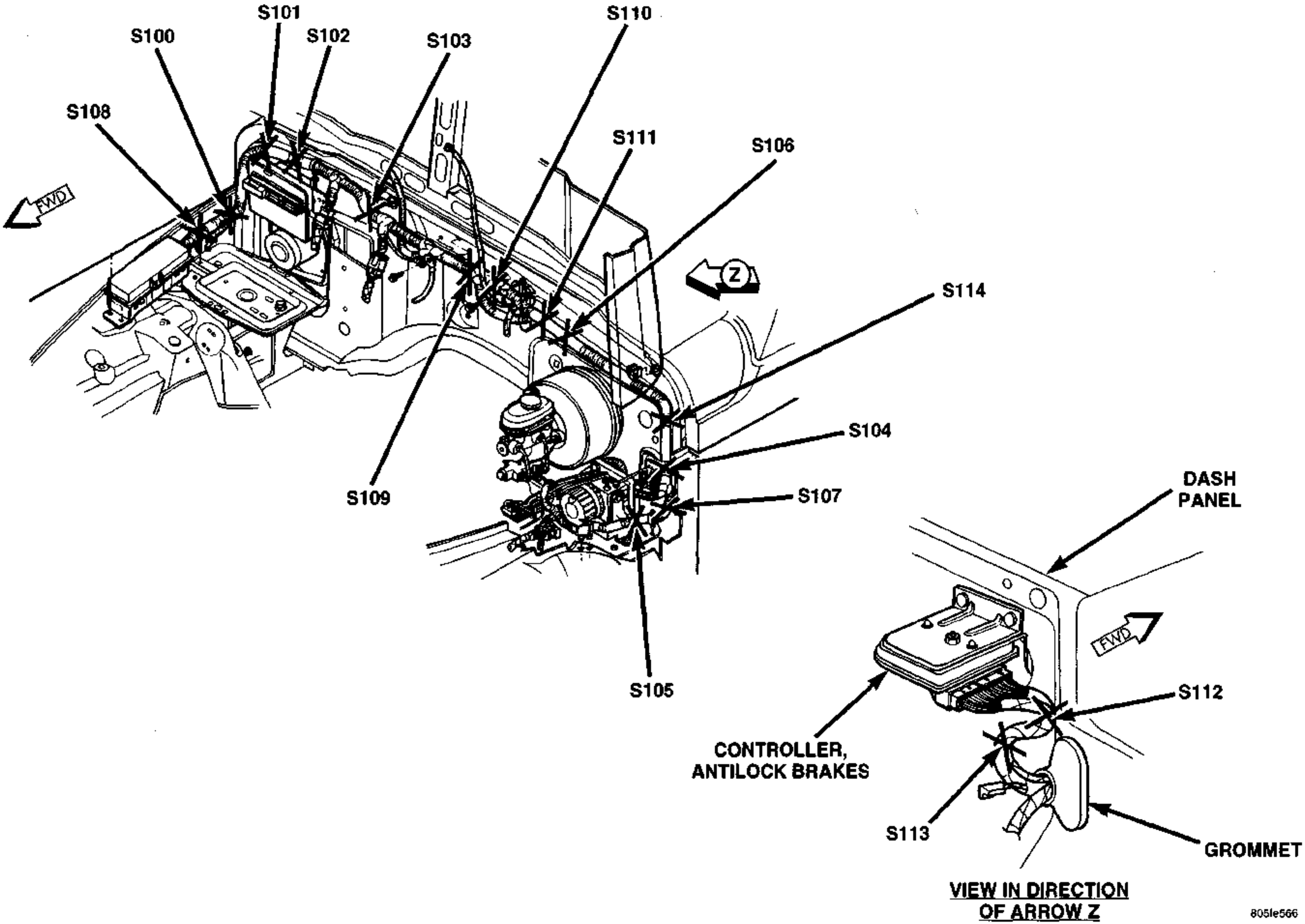


Fig. 2 Engine Compartment Splices—Rear

SCHEMATICS AND DIAGRAMS (Continued)

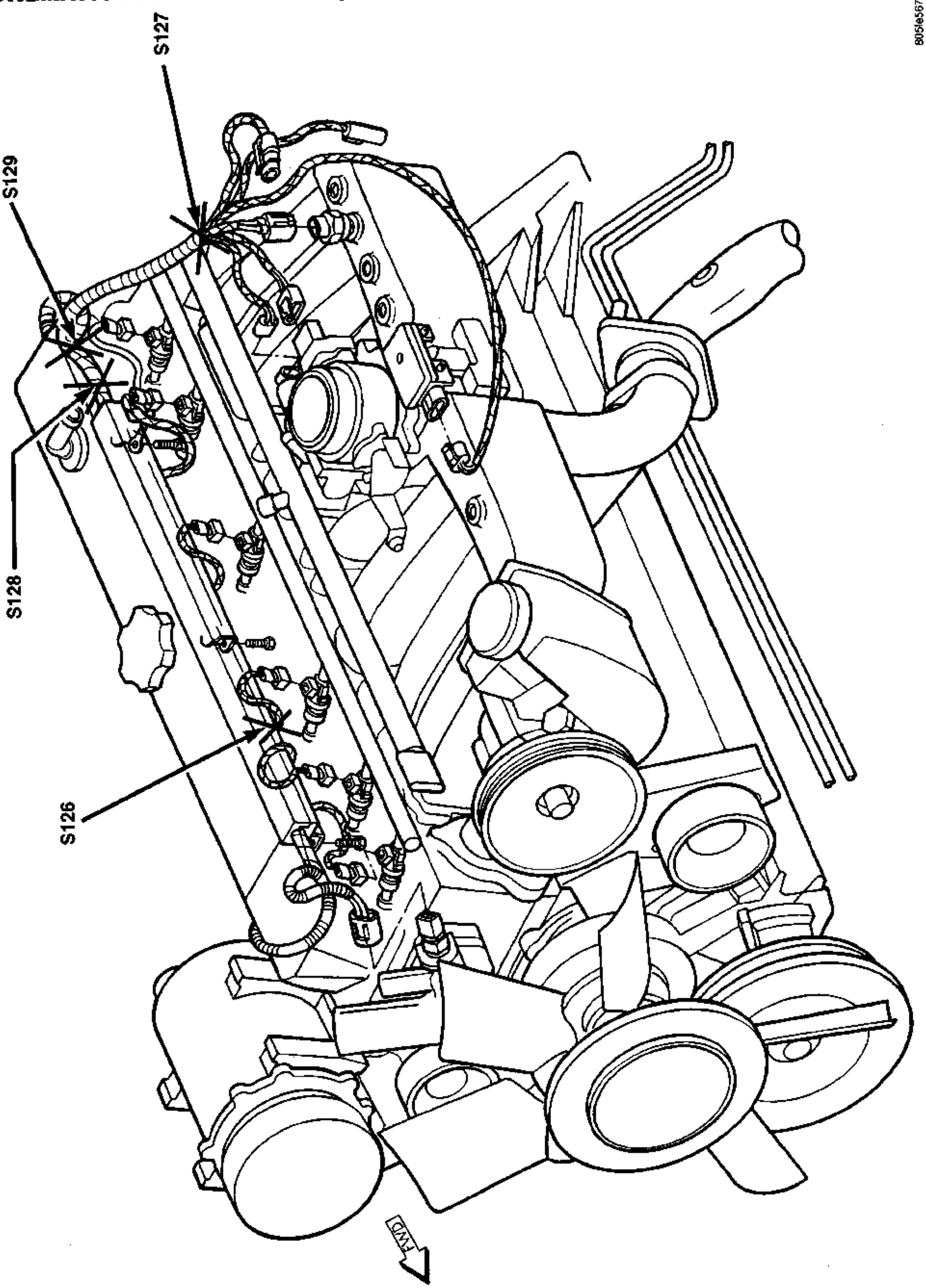


Fig. 3 Engine Wiring Splices

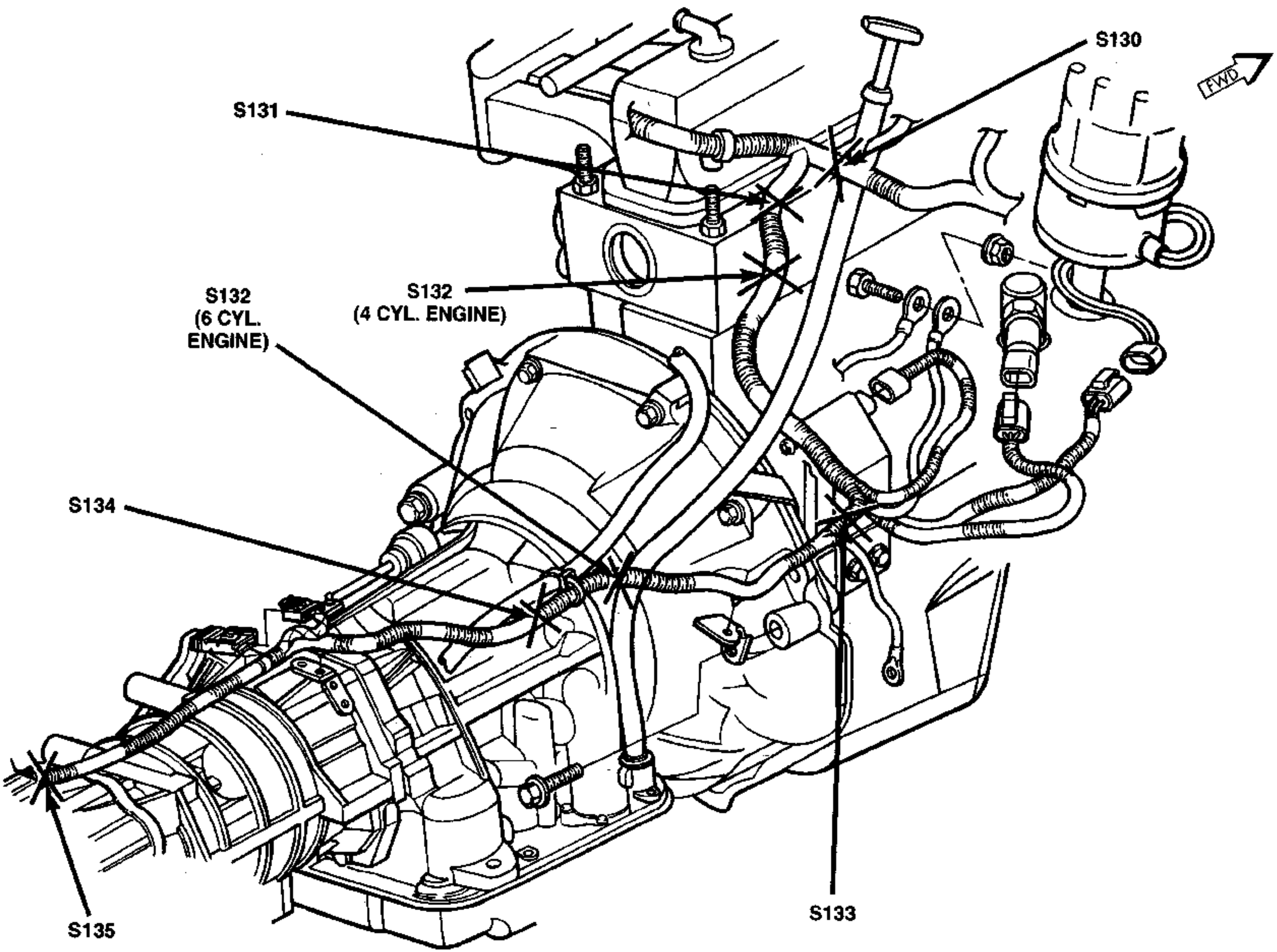


Fig. 4 Engine Wiring Splices

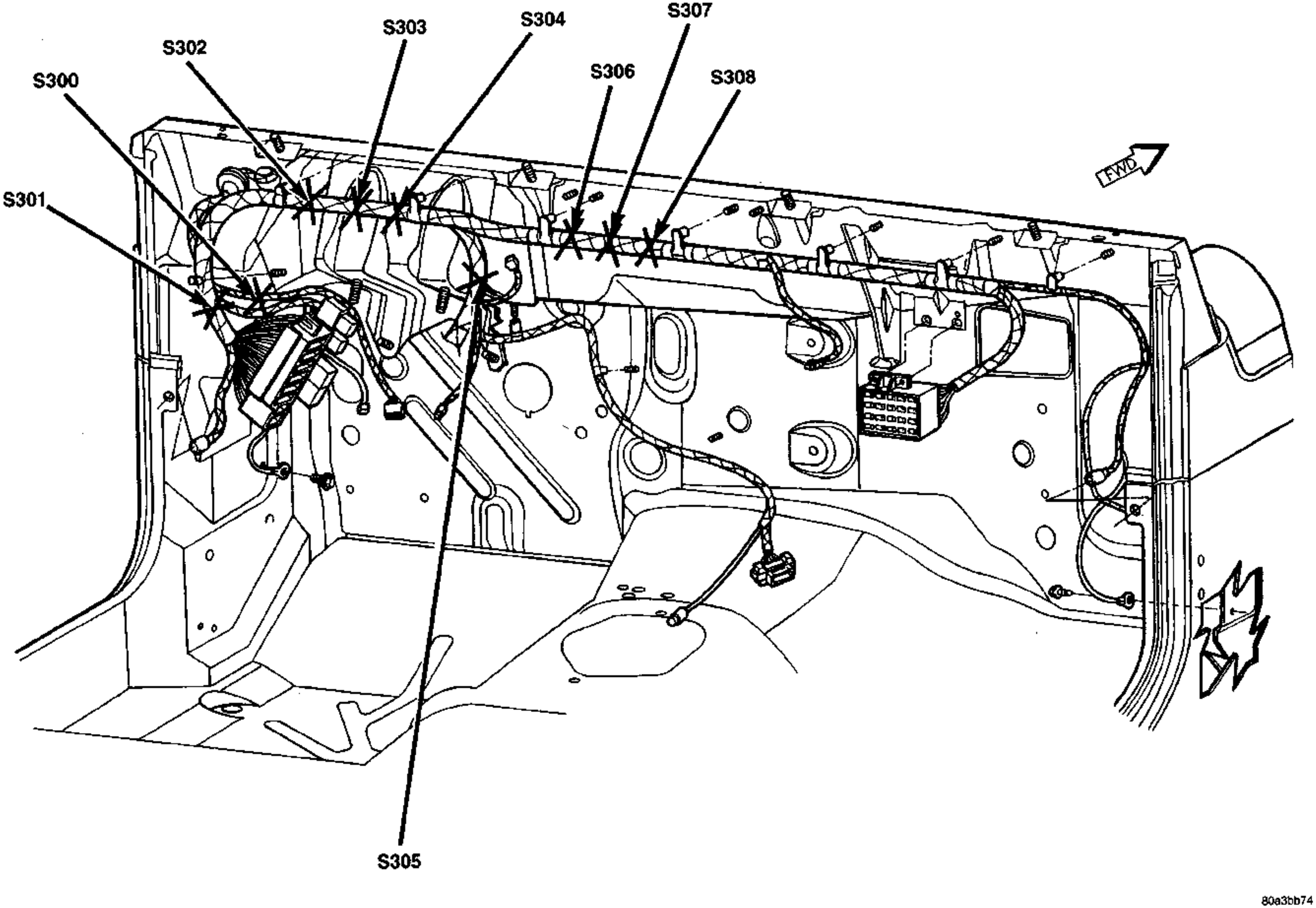


Fig. 5 Cowl Panel Wiring Splices

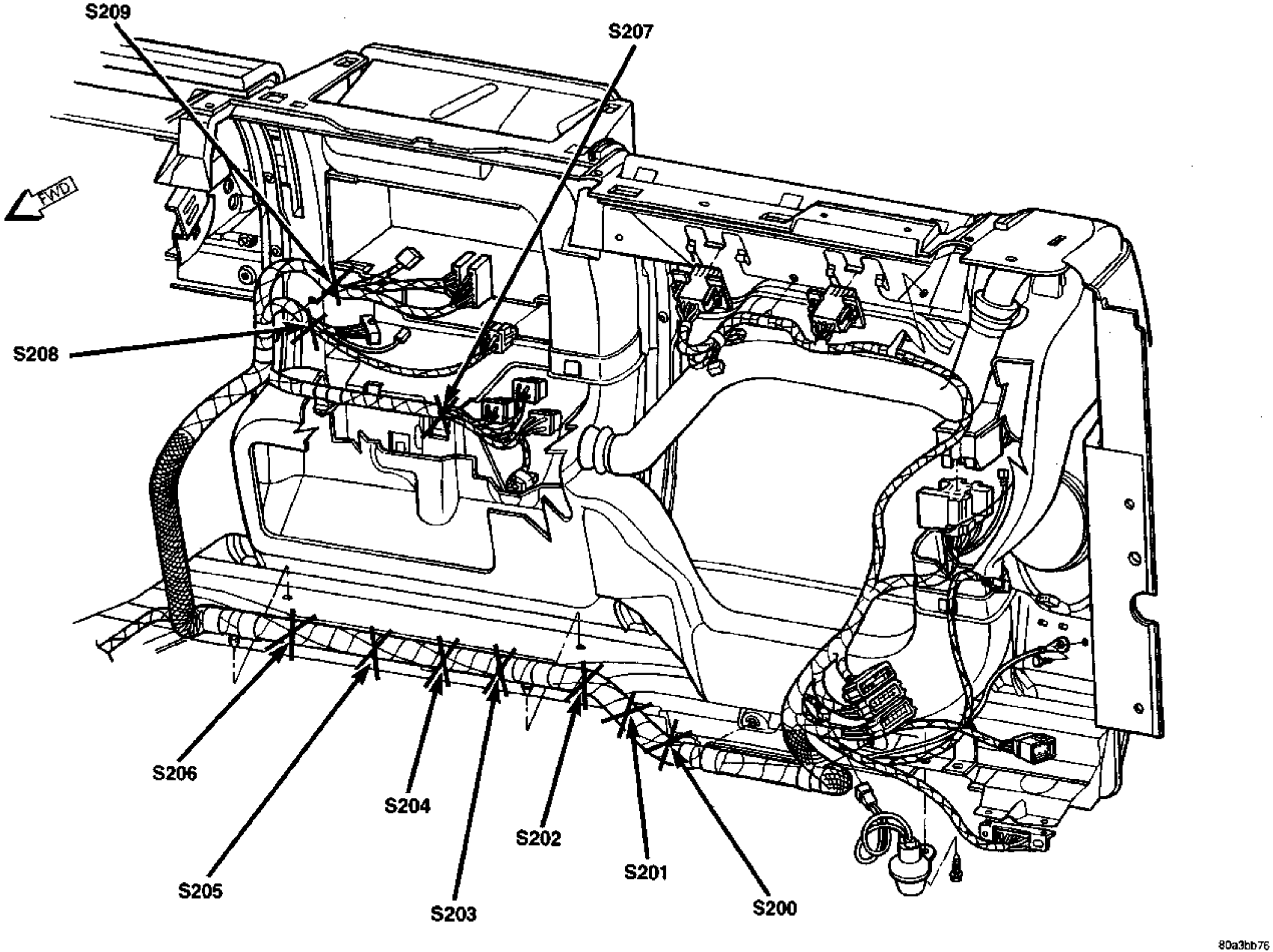


Fig. 6 Instrument Panel Wiring Splices

SCHEMATICS AND DIAGRAMS (Continued)

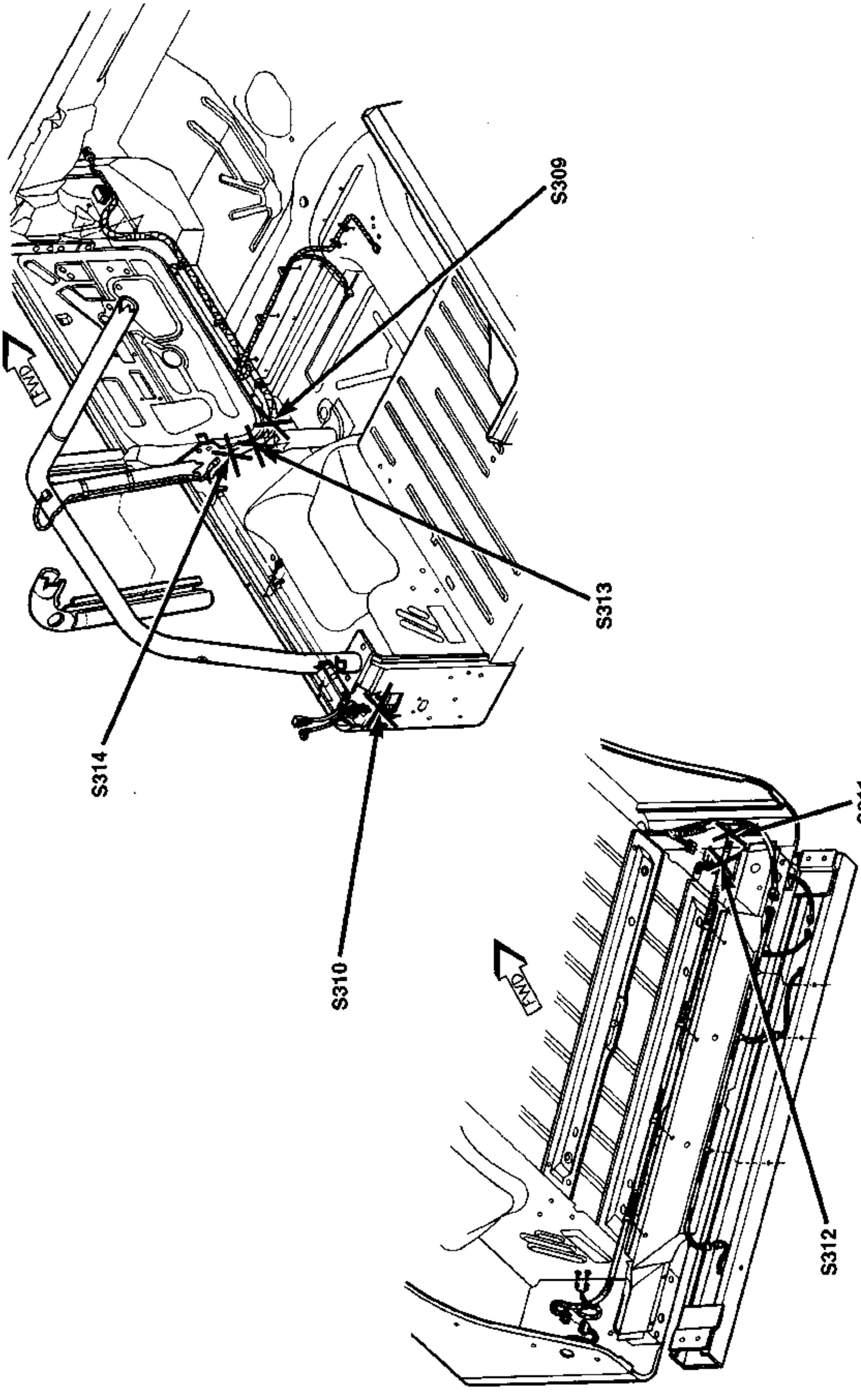


Fig. 7 Body Wiring Splices

EMISSION CONTROL SYSTEMS

CONTENTS

ON-BOARD DIAGNOSTICS

INDEX

GENERAL INFORMATION

SYSTEM DESCRIPTION

The Powertrain Control Module (PCM) monitors many different circuits in the fuel injection, ignition, emission and engine systems. If the PCM senses a problem with a monitored circuit often enough to indicate an actual problem, it stores a Diagnostic Trouble Code (DTC) in the PCM's memory. If the problem is repaired or ceases to exist, the PCM cancels the code after 40 warm-up cycles. Diagnostic trouble codes that affect vehicle emissions will cause the Malfunction Indicator (check engine) Lamp to illuminate continuously if the engine is running. Refer to Malfunction Indicator Lamp in this section.

Certain criteria must be met before the PCM stores a DTC in memory. The criteria may be a specific range of engine RPM, engine temperature, and/or input voltage to the PCM.

The PCM might not store a DTC for a monitored circuit even though a malfunction has occurred. This may happen because one of the DTC criteria for the circuit has not been met. **For example**, assume the diagnostic trouble code criteria requires the PCM to monitor the circuit only when the engine operates between 750 and 2000 RPM. Suppose the sensor's output circuit shorts to ground when engine operates above 2400 RPM (resulting in 0 volt input to the PCM). Because the condition happens at an engine speed above the maximum threshold (2000 rpm), the PCM will not store a DTC.

There are several operating conditions for which the PCM monitors and sets DTC's. Refer to Monitored Systems, Components, and Non-Monitored Circuits in this section.

NOTE: Various diagnostic procedures may actually cause a diagnostic monitor to set a DTC. For instance, pulling a spark plug wire to perform a spark test may set the misfire code. When a repair is completed and verified, connect the DRB scan tool to the 16–way data link connector (Fig. 1) to erase all DTC's and extinguish the MIL.

Technicians can display stored DTC's by two different methods. Refer to Diagnostic Trouble Codes in this section. For DTC information, refer to charts in this section.

DESCRIPTION AND OPERATION

MALFUNCTION INDICATOR LAMP (MIL)

As a functional test, the MIL (check engine) illuminates at key-on before engine cranking. Whenever the Powertrain Control Module (PCM) sets a Diagnostic Trouble Code (DTC) that affects vehicle emissions, it illuminates the MIL. If a problem is detected, the PCM sends a message to the instru-

DESCRIPTION AND OPERATION (Continued)

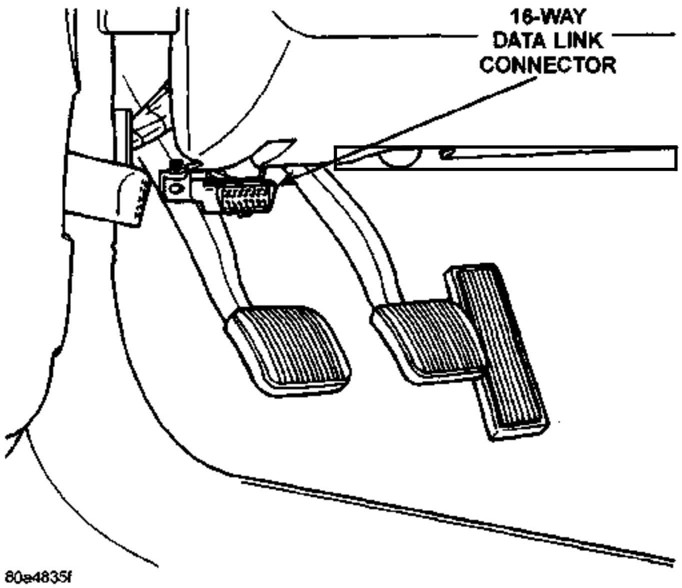


Fig. 1 Data Link (Diagnostic) Connector Location

ment cluster to illuminate the lamp. The PCM illuminates the MIL only for DTC's that affect vehicle emissions. There are some monitors that may take two consecutive trips, with a detected fault, before the MIL is illuminated. The MIL stays on continuously when the PCM has entered a Limp-In mode or identified a failed emission component. Refer to the Diagnostic Trouble Code charts in this group for emission related codes.

Also, the MIL either flashes or illuminates continuously when the PCM detects active engine misfire. Refer to Misfire Monitoring in this section.

Additionally, the PCM may reset (turn off) the MIL when one of the following occur:

- PCM does not detect the malfunction for 3 consecutive trips (except misfire and Fuel system Monitors).
- PCM does not detect a malfunction while performing three successive engine misfire or fuel system tests. The PCM performs these tests while the engine is operating within ± 375 RPM of and within 10 % of the load of the operating condition at which the malfunction was first detected.

STATE DISPLAY TEST MODE

The switch inputs to the Powertrain Control Module (PCM) have two recognized states; HIGH and LOW. For this reason, the PCM cannot recognize the difference between a selected switch position versus an open circuit, a short circuit, or a defective switch. If the State Display screen shows the change from HIGH to LOW or LOW to HIGH, assume the entire switch circuit to the PCM functions properly. Connect the DRB scan tool to the data link connector and access the state display screen. Then access either State Display Inputs and Outputs or State Display Sensors.

CIRCUIT ACTUATION TEST MODE

The Circuit Actuation Test Mode checks for proper operation of output circuits or devices the Powertrain Control Module (PCM) may not internally recognize. The PCM attempts to activate these outputs and allow an observer to verify proper operation. Most of the tests provide an audible or visual indication of device operation (click of relay contacts, fuel spray, etc.). Except for intermittent conditions, if a device functions properly during testing, assume the device, its associated wiring, and driver circuit work correctly. Connect the DRB scan tool to the data link connector and access the Actuators screen.

DIAGNOSTIC TROUBLE CODES

A Diagnostic Trouble Code (DTC) indicates the PCM has recognized an abnormal condition in the system.

The technician can display a DTC in three different ways:

- a two-digit number flashed on the Malfunction Indicator (Check Engine) Lamp
- a two-digit number displayed on the vehicle odometer
- a description of the DTC can be read using the DRB scan tool

Diagnostic trouble codes are the results of a system or circuit failure, but do not directly identify the failed component or components.

NOTE: For a list of DTC's, refer to the charts in this section.

OBTAINING DIAGNOSTIC TROUBLE CODES

USING DRB SCAN TOOL

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING ANY TEST ON AN OPERATING ENGINE.

(1) Connect the DRB scan tool to data link (diagnostic) connector located in passengers compartment, below instrument cluster near bottom of steering column (Fig. 1).

(2) Turn the ignition switch on, access Read Fault Screen. Record all the DTC's shown on the DRB scan tool. Observe the malfunction indicator (check engine) lamp on the instrument panel. The lamp should light for 2 seconds then go out (bulb check).

(3) To erase DTC's, use the Erase Trouble Code data screen on the DRB scan tool.

DESCRIPTION AND OPERATION (Continued)

USING THE MALFUNCTION INDICATOR LAMP (MIL)

(1) Cycle the ignition key On - Off - On - Off - On within 5 seconds.

(2) Count the number of times the MIL (check engine lamp) on the instrument panel flashes on and off. The number of flashes represents the trouble code. There is a slight pause between the flashes representing the first and second digits of the code. Longer pauses separate individual two digit trouble codes.

An example of a flashed DTC is as follows:

(3) Lamp flashes 1 time, pauses, and then flashes 5 more times. This indicates a DTC code number 15.

(4) Lamp flashes 5 times, pauses, and flashes 5 more times. This indicates a DTC code number 55. A DTC code number 55 will always be the last code to be displayed. This will indicate the end of all stored codes.

(5) To erase DTC's, use the Erase Trouble Code data screen on the DRB scan tool.

USING THE VEHICLE ODOMETER

(1) Cycle the ignition key On - Off - On - Off - On within 5 seconds.

(2) Read the actual DTC number displayed on the vehicle odometer. Each number will be displayed with a slight delay between numbers. A DTC code number 55 will always be the last code to be displayed. This will indicate the end of all stored codes.

(3) To erase DTC's, use the Erase Trouble Code data screen on the DRB scan tool.

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS

HEX CODE	MIL CODE	GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
	12*		Battery Disconnect	Direct battery input to PCM was disconnected within the last 50 Key-on cycles.
	55*			Completion of fault code display on Check Engine lamp.
01	54**	P0340	No Cam Signal at PCM	No camshaft signal detected during engine cranking.
02	53**	P0601	Internal Controller Failure	PCM internal fault condition detected.
05	47***		Charging System Voltage Too Low	Battery voltage sense input below target charging during engine operation. Also, no significant change detected in battery voltage during active test of generator output circuit.
06	46***		Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
0A	42*		Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the auto shutdown relay circuit.
0B	41***		Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
0C	37**	P0743	Torque Converter Clutch Soleniod CKT	An open or shorted condition detected in the torque converter part throttle unlock solenoid control circuit (3 speed auto RH trans. only).
0F	34*		Speed Control Solenoid Circuits	An open or shorted condition detected in the Speed Control vacuum or vent solenoid circuits.
10	33*		A/C Clutch Relay Circuit	An open or shorted condition detected in the A/C clutch relay circuit.
12	31**	P0443	EVAP Purge Solenoid Circuit	An open or shorted condition detected in the duty cycle purge solenoid circuit.
13	27**	P0203	Injector #3 Control Circuit	Injector #3 output driver does not respond properly to the control signal.

DESCRIPTION AND OPERATION (Continued)

HEX CODE	MIL CODE	GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
14		or P0202	Injector #2 Control Circuit	Injector #2 output driver does not respond properly to the control signal.
15		or P0201	Injector #1 Control Circuit	Injector #1 output driver does not respond properly to the control signal.
19	25**	P0505	Idle Air Control Motor Circuits	A shorted or open condition detected in one or more of the idle air control motor circuits.
1A	24**	P0122	Throttle Position Sensor Voltage Low	Throttle position sensor input below the minimum acceptable voltage
1B		or P0123	Throttle Position Sensor Voltage High	Throttle position sensor input above the maximum acceptable voltage.
1E	22**	P0117	ECT Sensor Voltage Too Low	Engine coolant temperature sensor input below minimum acceptable voltage.
1F		or P0118	ECT Sensor Voltage Too High	Engine coolant temperature sensor input above maximum acceptable voltage.
21	17*		Engine Is Cold Too Long	Engine did not reach operating temperature within acceptable limits.
23	15**	P0500	No Vehicle Speed Sensor Signal	No vehicle speed sensor signal detected during road load conditions.
24	14**	P0107	MAP Sensor Voltage Too Low	MAP sensor input below minimum acceptable voltage.
25		or P0108	MAP Sensor Voltage Too High	MAP sensor input above maximum acceptable voltage.
27	13**	P1297	No Change in MAP From Start to Run	No difference recognized between the engine MAP reading and the barometric (atmospheric) pressure reading from start-up.
28	11*		No Crank Reference Signal at PCM	No crank reference signal detected during engine cranking.
2B	43*	P0351	Ignition Coil #1 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
2C	42*		No ASD Relay Output Voltage at PCM	An Open condition Detected In The ASD Relay Output Circuit.
31	63*	P1698	PCM Failure EEPROM Write Denied	Unsuccessful attempt to write to an EEPROM location by the PCM.
39	23**	P0112	Intake Air Temp Sensor Voltage Low	Intake air temperature sensor input below the maximum acceptable voltage.
3A		or P0113	Intake Air Temp Sensor Voltage High	Intake air temperature sensor input above the minimum acceptable voltage.

DESCRIPTION AND OPERATION (Continued)

HEX CODE	MIL CODE	GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
3D	27**	P0204	Injector #4 Control Circuit	Injector #4 output driver does not respond properly to the control signal.
3E	21**	P0132	Left O2 Sensor Shorted to Voltage	Left oxygen sensor input voltage maintained above the normal operating range.
44	53*	P0600	PCM Failure SPI Communications	PCM internal fault condition detected.
45	27**	P0205	Injector #5 Control Circuit	Injector #5 output driver does not respond properly to the control signal.
		or		
46		P0206	Injector #6 Control Circuit	Injector #6 output driver does not respond properly to the control signal.
52	77*		S/C Power Relay Circuit	Malfunction detected with power feed to speed control servo solenoids.
57	34*		Speed Control Switch Always Low	Speed control switch input below the minimum acceptable voltage.
65	42*		Fuel Pump Relay Control Circuit	An open or shorted condition detected in the fuel pump relay control circuit.
66	21**	P0133	Upstream O2 Sensor Slow Response	Upstream oxygen sensor response slower than minimum required switching frequency.
		or		
67		P0135	Upstream O2 Sensor Heater Failure	Upstream oxygen sensor heating element circuit malfunction
		or		
69		P0141	Downstream O2 Sensor Heater Failure	Downstream oxygen sensor heating element circuit malfunction
6A	43**	P0300	Multiple Cylinder Misfire	Misfire detected in multiple cylinders.
		or		
6B		P0301	Cylinder #1 Misfire	Misfire detected in cylinder #1.
		or		
6C		P0302	Cylinder #2 Misfire	Misfire detected in cylinder #2.
		or		
6D		P0303	Cylinder #3 Misfire	Misfire detected in cylinder #3.
		or		
6E		P0304	Cylinder #4 Misfire	Misfire detected in cylinder #4.
70	72**	P0420	Catalytic Converter Efficency Failure	Catalyst efficiency below required level.
70	64**	P0420	Catalytic Converter Efficiency Failure	Catalyst efficiency below required level.
71	31*	P0441	Evap Purge Flow Monitor Failure	Insufficient or excessive vapor flow detected during evaporative emission system operation.
72	37**	P1899	Park/Neutral Switch Failure	Incorrect input state detected for the Park/Neutral switch, auto. trans. only.

DESCRIPTION AND OPERATION (Continued)

HEX CODE	MIL CODE	GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
73	65*	P0551	Power Steering Switch Failure	Power steering high pressure seen at high speed (2.5L only).
76	52**	P0172	Fuel System Rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
77	51**	P0171	Fuel System Lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.
7E	21**	P0138	Downstream O2 Sensor Shorted to Voltage	Downstream oxygen sensor input voltage maintained above the normal operating range.
80	17**	P0125	Closed Loop Temp Not Reached	Engine does not reach 20°F within 5 minutes with a vehicle speed signal.
84	24**	P0121	TPS Voltage Does Not Agree With MAP	TPS signal does not correlate to MAP sensor
87	14**	P1296	No 5 Volts To MAP Sensor	5 Volt output to MAP sensor open
8A	25**	P1294	Target Idle Not Reached	Actual idle speed does not equal target idle speed.
94	37*	P0740	Torq Conv Clu, No RPM Drop At Lockup	Relationship between engine speed and vehicle speed indicates no torque converter clutch engagement (auto. trans. only).
95	42*		Fuel Level Sending Unit Volts Too Low	Open circuit between PCM and fuel gauge sending unit.
		or		
96			Fuel Level Sending Unit Volts Too High	Circuit shorted to voltage between PCM and fuel gauge sending unit.
		or		
97			Fuel Level Unit No Change Over Miles	No movement of fuel level sender detected.
99	44**	P1493	Battery Temp Sensor Voltage Too Low	Battery temperature sensor input voltage below an acceptable range.
		or		
9A		P1492	Battery Temp Sensor Voltage Too High	Battery temperature sensor input voltage above an acceptable range.
9B	21**	P0131	Upstream O2s Voltage Shorted to Ground	O2 sensor voltage too low, tested after cold start.
		or		
9C		P0137	Downstream O2s Voltage Shorted to Ground	O2 sensor voltage too low, tested after cold start.
9D	11**	P1391	Intermittent Loss of CMP or CKP	Intermittent loss of either camshaft or crankshaft position sensor
AE	43**	P0305	Cylinder #5 Misfire	Misfire detected in cylinder #5.
		or		
AF		P0306	Cylinder #6 Misfire	Misfire detected in cylinder #6.

DESCRIPTION AND OPERATION (Continued)

HEX CODE	MIL CODE	GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
BA	11**	P1398	Misfire Adaptive Numerator at Limit	CKP sensor target windows have too much variation

* Check Engine Lamp (MIL) will not illuminate if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

*** Generator Lamp illuminated

MONITORED SYSTEMS

There are new electronic circuit monitors that check fuel, emission, engine and ignition performance. These monitors use information from various sensor circuits to indicate the overall operation of the fuel, engine, ignition and emission systems and thus the emissions performance of the vehicle.

The fuel, engine, ignition and emission systems monitors do not indicate a specific component problem. They do indicate that there is an implied problem within one of the systems and that a specific problem must be diagnosed.

If any of these monitors detect a problem affecting vehicle emissions, the Malfunction Indicator (Check Engine) Lamp will be illuminated. These monitors generate Diagnostic Trouble Codes that can be displayed with the check engine lamp or a scan tool.

The following is a list of the system monitors:

- Misfire Monitor
- Fuel System Monitor
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
- Catalyst Monitor

All these system monitors require two consecutive trips with the malfunction present to set a fault.

Following is a description of each system monitor, and its DTC.

Refer to the appropriate Powertrain Diagnostics Procedures manual for diagnostic procedures.

DTC 21—OXYGEN SENSOR (O2S) MONITOR

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a 14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

The O2S is also the main sensing element for the Catalyst and Fuel Monitors.

The O2S can fail in any or all of the following manners:

- slow response rate
- reduced output voltage
- dynamic shift
- shorted or open circuits

Response rate is the time required for the sensor to switch from lean to rich once it is exposed to a richer than optimum A/F mixture or vice versa. As the sensor starts malfunctioning, it could take longer to detect the changes in the oxygen content of the exhaust gas.

The output voltage of the O2S ranges from 0 to 1 volt. A good sensor can easily generate any output voltage in this range as it is exposed to different concentrations of oxygen. To detect a shift in the A/F mixture (lean or rich), the output voltage has to change beyond a threshold value. A malfunctioning sensor could have difficulty changing beyond the threshold value.

DTC 21—OXYGEN SENSOR HEATER MONITOR

If there is an oxygen sensor (O2S) shorted to voltage DTC, as well as a O2S heater DTC, the O2S fault MUST be repaired first. Before checking the O2S fault, verify that the heater circuit is operating correctly.

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572 ° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a 14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC),

DESCRIPTION AND OPERATION (Continued)

carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

The voltage readings taken from the O2S sensor are very temperature sensitive. The readings are not accurate below 300°C. Heating of the O2S sensor is done to allow the engine controller to shift to closed loop control as soon as possible. The heating element used to heat the O2S sensor must be tested to ensure that it is heating the sensor properly.

The O2S sensor circuit is monitored for a drop in voltage. The sensor output is used to test the heater by isolating the effect of the heater element on the O2S sensor output voltage from the other effects.

DTC 43—MISFIRE MONITOR

Excessive engine misfire results in increased catalyst temperature and causes an increase in HC emissions. Severe misfires could cause catalyst damage. To prevent catalytic convertor damage, the PCM monitors engine misfire.

The Powertrain Control Module (PCM) monitors for misfire during most engine operating conditions (positive torque) by looking at changes in the crankshaft speed. If a misfire occurs the speed of the crankshaft will vary more than normal.

DTC 51/52—FUEL SYSTEM MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide. The catalyst works best when the Air Fuel (A/F) ratio is at or near the optimum of 14.7 to 1.

The PCM is programmed to maintain the optimum air/fuel ratio of 14.7 to 1. This is done by making short term corrections in the fuel injector pulse width based on the O2S sensor output. The programmed memory acts as a self calibration tool that the engine controller uses to compensate for variations in engine specifications, sensor tolerances and engine fatigue over the life span of the engine. By monitoring the actual fuel-air ratio with the O2S sensor (short term) and multiplying that with the program long-term (adaptive) memory and comparing that to the limit, it can be determined whether it will pass an emissions test. If a malfunction occurs such that the PCM cannot maintain the optimum A/F ratio, then the MIL will be illuminated.

DTC 64—CATALYST MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide.

Normal vehicle miles or engine misfire can cause a catalyst to decay. A meltdown of the ceramic core can cause a reduction of the exhaust passage. This can increase vehicle emissions and deteriorate engine performance, driveability and fuel economy.

The catalyst monitor uses dual oxygen sensors (O2S's) to monitor the efficiency of the converter. The dual O2S's sensor strategy is based on the fact that as a catalyst deteriorates, its oxygen storage capacity and its efficiency are both reduced. By monitoring the oxygen storage capacity of a catalyst, its efficiency can be indirectly calculated. The upstream O2S is used to detect the amount of oxygen in the exhaust gas before the gas enters the catalytic converter. The PCM calculates the A/F mixture from the output of the O2S. A low voltage indicates high oxygen content (lean mixture). A high voltage indicates a low content of oxygen (rich mixture).

When the upstream O2S detects a lean condition, there is an abundance of oxygen in the exhaust gas. A functioning converter would store this oxygen so it can use it for the oxidation of HC and CO. As the converter absorbs the oxygen, there will be a lack of oxygen downstream of the converter. The output of the downstream O2S will indicate limited activity in this condition.

As the converter loses the ability to store oxygen, the condition can be detected from the behavior of the downstream O2S. When the efficiency drops, no chemical reaction takes place. This means the concentration of oxygen will be the same downstream as upstream. The output voltage of the downstream O2S copies the voltage of the upstream sensor. The only difference is a time lag (seen by the PCM) between the switching of the O2S's.

To monitor the system, the number of lean-to-rich switches of upstream and downstream O2S's is counted. The ratio of downstream switches to upstream switches is used to determine whether the catalyst is operating properly. An effective catalyst will have fewer downstream switches than it has upstream switches i.e., a ratio closer to zero. For a totally ineffective catalyst, this ratio will be one-to-one, indicating that no oxidation occurs in the device.

The system must be monitored so that when catalyst efficiency deteriorates and exhaust emissions increase to over the legal limit, the MIL (check engine lamp) will be illuminated.

TRIP DEFINITION

For a component monitor to erase or turn off a MIL illumination for open/short diagnostics, the PCM must first recognize that the engine has operated for 2 minutes, 3 consecutive times, with no failures.

All system monitors, component rationality and functionality monitors have their own trip counters. Once the appropriate conditions have been met, the monitor will be run. If the monitor fails its test, the MIL will be illuminated after completion of the first

DESCRIPTION AND OPERATION (Continued)

or second failed test (1 trip or 2 trips). If conditions can be repeated for 3 consecutive trips with no malfunctions, the MIL will be turned off.

Anytime the MIL is illuminated, a DTC is stored. It takes three good trips without the condition present to extinguish the MIL. The DTC remains in PCM memory even though the MIL has been extinguished. Once the MIL is extinguished, the PCM must pass the diagnostic test for the most recent DTC for 40 warm-up cycles for the DTC to be erased from memory.

A warm-up cycle can best be described by the following:

- The engine must be running
- A rise of 40°F in engine temperature must occur from the time when the engine was started
- Engine coolant temperature must reach at least 160°F

Once the above conditions occur, the PCM is considered to have passed a warm-up cycle. Due to the conditions required to extinguish the MIL and erase the DTC, it is most important that after a repair has been made, all DTC's be erased and the repair verified.

COMPONENT MONITORS

There are several components that will affect vehicle emissions if they malfunction. If one of these components malfunctions the Malfunction Indicator Lamp (Check Engine) will illuminate.

Some of the component monitors are checking for proper operation of the part. Electrically operated components now have input (rationality) and output (functionality) checks. Previously, a component like the Throttle Position sensor (TPS) was checked by the PCM for an open or shorted circuit. If one of these conditions occurred, a DTC was set. Now there is a check to ensure that the component is working. This is done by watching for a TPS indication of a greater or lesser throttle opening than MAP and engine rpm indicate. In the case of the TPS, if engine vacuum is high and engine rpm is 1600 or greater and the TPS indicates a large throttle opening, a DTC will be set. The same applies to low vacuum if the TPS indicates a small throttle opening.

All open/short circuit checks or any component that has an associated limp in will set a fault after 1 trip with the malfunction present. Components without an associated limp in will take two trips to illuminate the MIL.

Refer to the Diagnostic Trouble Codes Description Charts in this section and the appropriate Powertrain Diagnostic Procedure Manual for diagnostic procedures.

NON-MONITORED CIRCUITS

The PCM does not monitor the following circuits, systems and conditions that could have malfunctions causing driveability problems. The PCM might not store diagnostic trouble codes for these conditions. However, problems with these systems may cause the PCM to store diagnostic trouble codes for other systems or components. For example, a fuel pressure problem will not register a fault directly, but could cause a rich/lean condition or misfire. This could cause the PCM to store an oxygen sensor or misfire diagnostic trouble code

FUEL PRESSURE

The fuel pressure regulator controls fuel system pressure. The PCM cannot detect a clogged fuel pump inlet filter, clogged in-line fuel filter, or a pinched fuel supply or return line. However, these could result in a rich or lean condition causing the PCM to store an oxygen sensor or fuel system diagnostic trouble code.

SECONDARY IGNITION CIRCUIT

The PCM cannot detect an inoperative ignition coil, fouled or worn spark plugs, ignition cross firing, or open spark plug cables.

CYLINDER COMPRESSION

The PCM cannot detect uneven, low, or high engine cylinder compression.

EXHAUST SYSTEM

The PCM cannot detect a plugged, restricted or leaking exhaust system, although it may set a fuel system fault.

FUEL INJECTOR MECHANICAL MALFUNCTIONS

The PCM cannot determine if a fuel injector is clogged, the needle is sticking or if the wrong injector is installed. However, these could result in a rich or lean condition causing the PCM to store a diagnostic trouble code for either misfire, an oxygen sensor, or the fuel system.

EXCESSIVE OIL CONSUMPTION

Although the PCM monitors engine exhaust oxygen content when the system is in closed loop, it cannot determine excessive oil consumption.

THROTTLE BODY AIR FLOW

The PCM cannot detect a clogged or restricted air cleaner inlet or filter element.

VACUUM ASSIST

The PCM cannot detect leaks or restrictions in the vacuum circuits of vacuum assisted engine control system devices. However, these could cause the PCM

DESCRIPTION AND OPERATION (Continued)

to store a MAP sensor diagnostic trouble code and cause a high idle condition.

PCM SYSTEM GROUND

The PCM cannot determine a poor system ground. However, one or more diagnostic trouble codes may be generated as a result of this condition. The module should be mounted to the body at all times, also during diagnostic.

PCM CONNECTOR ENGAGEMENT

The PCM may not be able to determine spread or damaged connector pins. However, it might store diagnostic trouble codes as a result of spread connector pins.

HIGH AND LOW LIMITS

The PCM compares input signal voltages from each input device with established high and low limits for the device. If the input voltage is not within limits and other criteria are met, the PCM stores a diagnostic trouble code in memory. Other diagnostic trouble code criteria might include engine RPM limits or input voltages from other sensors or switches that must be present before verifying a diagnostic trouble code condition.

LOAD VALUE

ENGINE	IDLE/NEUTRAL	2500 RPM/NEUTRAL
All Engines	2% to 8% of Maximum Load	9% to 17% of Maximum Load

EVAPORATIVE EMISSION CONTROLS

INDEX

DESCRIPTION AND OPERATION

EVAPORATION (EVAP) CONTROL SYSTEM

The 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.

All engines use a duty cycle purge system. The PCM controls vapor flow by operating the duty cycle EVAP purge solenoid. Refer to Duty Cycle Solenoid for additional information.

The EVAP canister is a feature on all models for the storage of fuel vapors from the fuel tank.

NOTE: The hoses used in this system are specially manufactured. If replacement becomes necessary, it is important to use only fuel resistant hose.

ROLLOVER VALVE

The fuel tank is equipped with 2 interconnected rollover valves. The valves are located on the top of the fuel tank (Fig. 1). These valves will prevent fuel flow through the fuel tank vent (EVAP) hoses in the event of an accidental vehicle rollover. The EVAP canister draws fuel vapors from the fuel tank through these valves.

The valves are not serviced separately. If replacement is necessary, the fuel tank must be replaced. Refer to the Fuel Tank section of Group 14, Fuel Systems for removal and installation procedures.

EVAP CANISTER

A maintenance free, EVAP canister is used on all vehicles. The EVAP canister is located in the engine compartment on the left inner fender (Fig. 2). The EVAP canister is filled with granules of an activated carbon mixture. Fuel vapors entering the EVAP canister are absorbed by the charcoal granules.

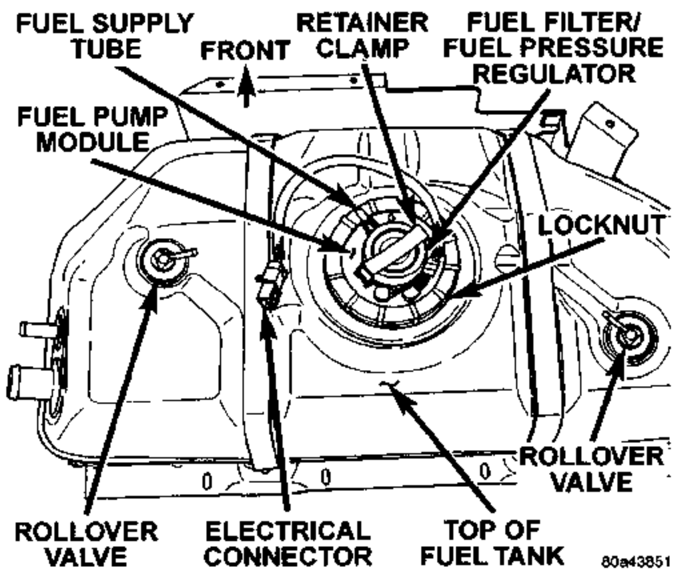


Fig. 1 Rollover Valve Location

Fuel tank pressure vents into the EVAP canister. Fuel vapors are temporarily held in the canister until they can be drawn into the intake manifold. The duty cycle EVAP canister purge solenoid allows the EVAP canister to be purged at predetermined times and at certain engine operating conditions.

DUTY CYCLE EVAP CANISTER PURGE SOLENOID

All models are equipped with a duty cycle EVAP canister purge solenoid. The solenoid regulates the rate of vapor flow from the EVAP canister to the intake manifold. The PCM operates the solenoid.

DESCRIPTION AND OPERATION (Continued)

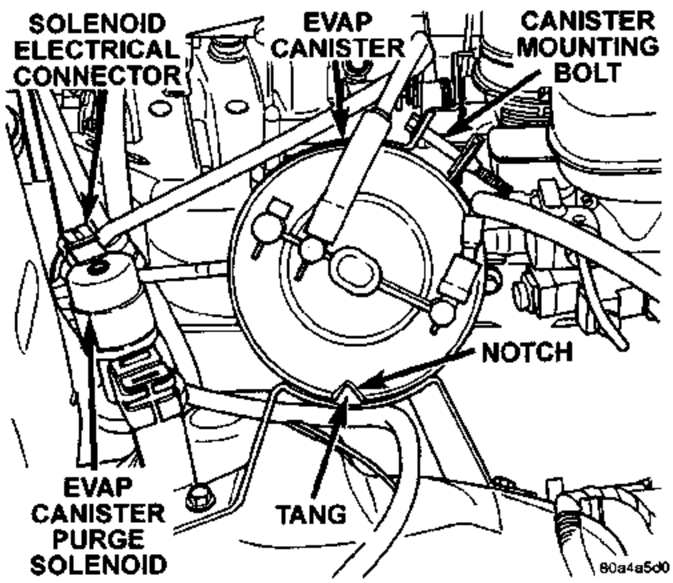


Fig. 2 EVAP Canister and Canister Purge Solenoid Location

During the cold start warm-up period and the hot start time delay, the PCM does not energize the solenoid. When de-energized, no vapors are purged. The PCM de-energizes the solenoid during open loop operation.

The engine enters closed loop operation after it reaches a specified temperature and the time delay ends. During closed loop operation, the PCM cycles (energizes and de-energizes) the solenoid 5 or 10 times per second, depending upon operating conditions. The PCM varies the vapor flow rate by changing solenoid pulse width. Pulse width is the amount of time that the solenoid is energized. The PCM adjusts solenoid pulse width based on engine operating condition.

The solenoid attaches to a bracket located in the engine compartment near the EVAP canister (Fig. 2). The top of the solenoid has the word UP or TOP on it. The solenoid will not operate properly unless it is installed correctly.

FUEL TANK FILLER TUBE CAP

The fuel tank is sealed with a pressure-vacuum relief fuel tank filler tube cap (Fig. 3). The relief valves in the cap are a safety feature. They operate only to prevent excessive pressure or vacuum in tank caused by a malfunction in system or damage to vent lines.

The cap has a threaded configuration. This allows the seal to be broken and pressure to be relieved without separation of cap from filler tube. Approximately two and a half turns are required to remove the cap.

If replacement of filler tube cap is necessary, it must be replaced with an identical cap to be sure of correct system operation.

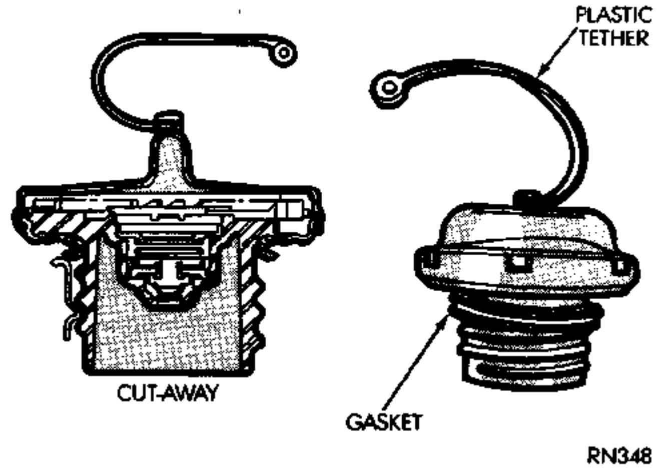


Fig. 3 Fuel Tank Filler Tube Cap—Typical

CAUTION: Remove the fuel tank filler tube cap (fuel tank cap) to relieve any fuel tank pressure. The cap must be removed prior to disconnecting any fuel system component or before draining the fuel tank.

CRANKCASE VENTILATION SYSTEM

All 2.5L 4-cylinder and 4.0L 6-cylinder engines are equipped with a Crankcase Ventilation (CCV) system (Fig. 4) or (Fig. 5). The CCV system performs the same function as a conventional PCV system, but does not use a vacuum controlled valve.

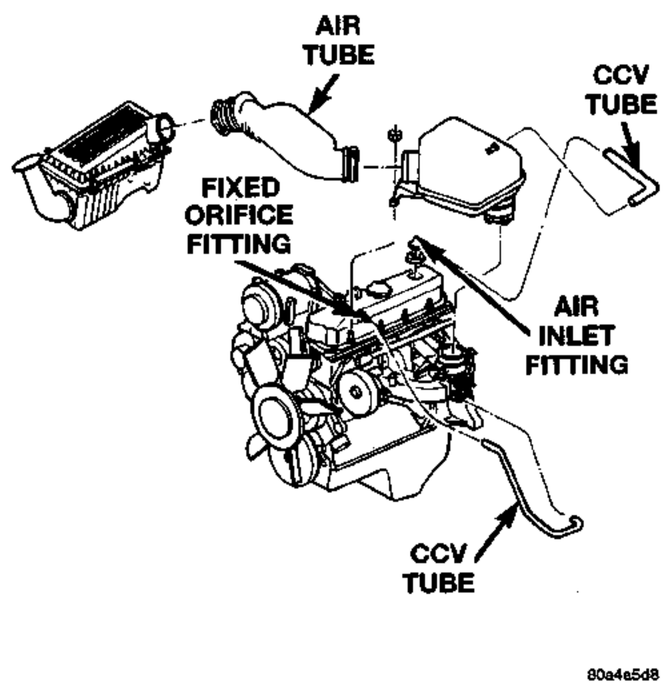


Fig. 4 CCV System—2.5L Engine

On 4.0L 6-cylinder engines, a molded vacuum tube connects manifold vacuum to top of cylinder head (valve) cover at dash panel end. The vacuum fitting

DESCRIPTION AND OPERATION (Continued)

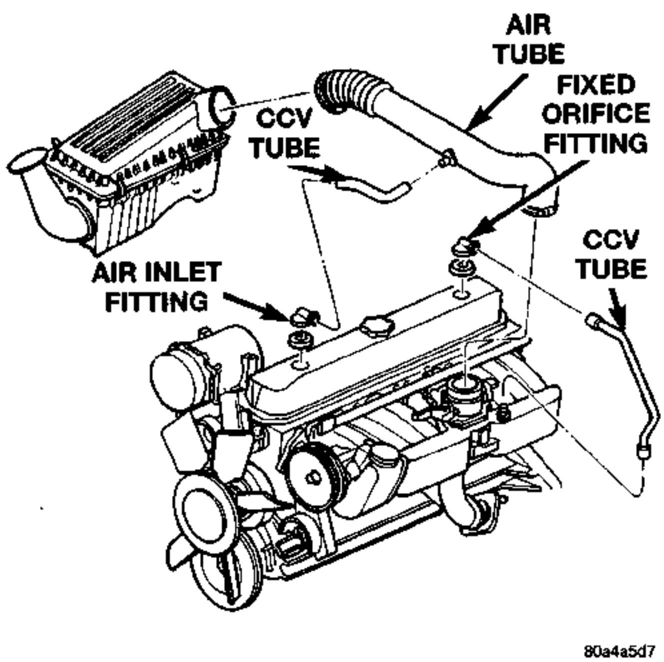


Fig. 5 CCV System—4.0L Engine

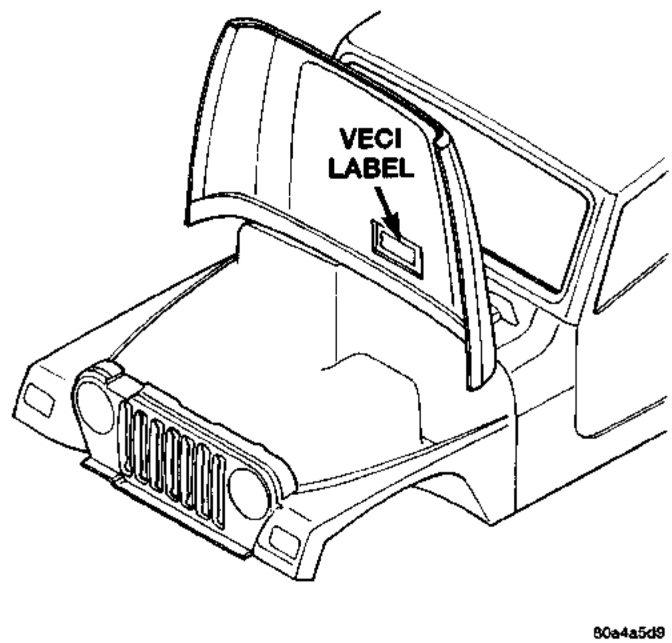


Fig. 6 VECI Label Location

contains a fixed orifice of a calibrated size. It meters the amount of crankcase vapors drawn out of the engine.

On 2.5L 4–cylinder engines, a fitting on drivers side of cylinder head (valve) cover contains the metered orifice. It is connected to manifold vacuum.

A fresh air supply CCV tube (hose) from the air cleaner is connected to front of cylinder head cover on 4.0L engines. It is connected to rear of cover on 2.5L engines.

When the engine is operating, fresh air enters the engine and mixes with crankcase vapors. Manifold vacuum draws the vapor/air mixture through the fixed orifice and into the intake manifold. The vapors are then consumed during combustion.

VEHICLE EMISSION CONTROL INFORMATION (VECI) LABEL

All vehicles are equipped with a combined VECI label. This label is located in the engine compartment (Fig. 6) and contains the following:

- Engine family and displacement
- Evaporative family
- Emission control system schematic
- Certification application
- Engine timing specifications (if adjustable)
- Idle speeds (if adjustable)
- Spark plug and gap

The 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 label.

DIAGNOSIS AND TESTING

VACUUM SCHEMATICS

A vacuum schematic for emission related items can be found on the Vehicle Emission Control Information (VECI) Label. Refer to VECI Label in this group for label location.

REMOVAL AND INSTALLATION

EVAP CANISTER

The EVAP canister is located in the engine compartment on the left front inner fender (Fig. 7).

REMOVAL/INSTALLATION

(1) Disconnect vacuum lines at EVAP canister. Note location of lines before removal.

(2) Remove canister retaining strap bolt.

(3) Remove canister from vehicle.

(4) Reverse the removal procedure for installation. Align notch (Fig. 7) on EVAP canister to locating tang on canister mounting bracket.

(5) Tighten canister strap bolt to 5 N·m (45 in. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

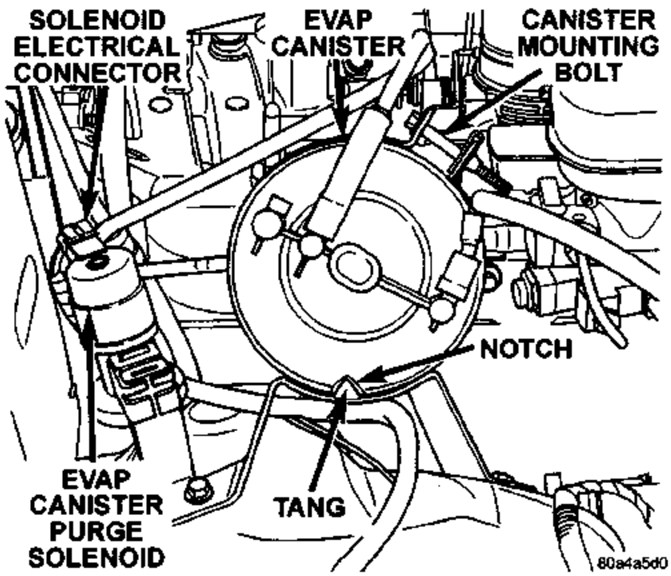


Fig. 7 EVAP Canister and Purge Solenoid Location

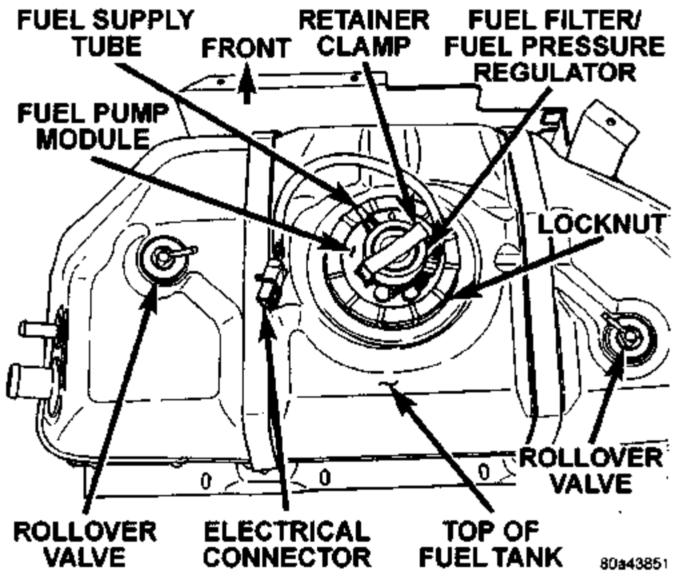


Fig. 8 Rollover Valve Location

EVAP CANISTER PURGE SOLENOID

REMOVAL

The duty cycle EVAP canister purge solenoid is located in the engine compartment near the EVAP canister (Fig. 7).

(1) Disconnect electrical wiring connector at solenoid.

(2) Disconnect vacuum harness at solenoid.

(3) Lift solenoid and rubber solenoid support from mounting bracket.

INSTALLATION

(1) Install purge solenoid and rubber support to its mounting bracket.

(2) Connect vacuum harness and wiring connector.

ROLLOVER VALVE

The fuel tank is equipped with 2 interconnected rollover valves. The valves are located on the top of the fuel tank (Fig. 8).

The valves are not serviced separately. If replacement is necessary, the fuel tank must be replaced. Refer to the Fuel Tank section of Group 14, Fuel Systems for removal and installation procedures.

FUEL TANK FILLER TUBE CAP

If replacement of the fuel tank filler tube cap (Fig. 9) is necessary, it must be replaced with an identical cap to be sure of correct system operation.

CAUTION: Remove the fuel tank filler tube cap to relieve fuel tank pressure. The cap must be removed prior to disconnecting any fuel system component or before draining the fuel tank.

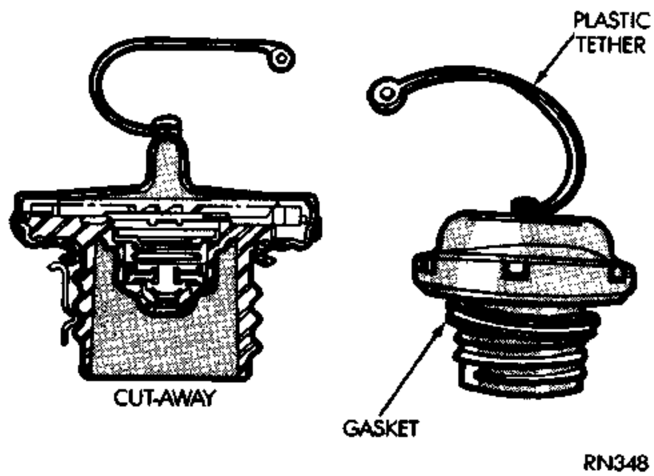


Fig. 9 Fuel Tank Filler Tube Cap—Typical

SPECIFICATIONS

TORQUE CHART

Description	Torque
EVAP Canister Mounting Bolt	5 N·m (45 in. lbs.)

ENGINE

CONTENTS

STANDARD SERVICE INFORMATION

INDEX

GENERAL INFORMATION

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

GENERAL INFORMATION (Continued)

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:

CAUTION: DO NOT overspeed the engine.

(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.

(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 procedure.

(k) If the same cylinder(s) repeat an abnormally low reading, it could indicate the existence of a problem in the cylinder.

NOTE: 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) Perform a combustion analysis.

(9) Test fuel pump for pressure (refer to Group 14, Fuel System for the proper specifications).

(10) Inspect air filter element (refer to Group 0, Lubrication and Maintenance for the proper procedure).

(11) Inspect crankcase ventilation system (refer to Group 0, Lubrication and Maintenance for the proper procedure).

(12) For emission controls refer to Group 25, Emission Controls System for service procedures.

(13) Inspect and adjust accessory belt drives (refer to Group 7, Cooling System for the proper adjustments).

(14) 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 cylin-

GENERAL INFORMATION (Continued)

der surfacing hone, Honing Tool C-3501, equipped with 280 grit stones (C-3501-3810). 20-60 strokes, depending on the bore condition, will be sufficient to provide a satisfactory surface. Using honing oil C-3501-3880 or a light honing oil available from major oil distributors.

CAUTION: DO NOT use engine or transmission oil, mineral spirits or kerosene.

(3) Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 50° to 60° for proper seating of rings (Fig. 1).

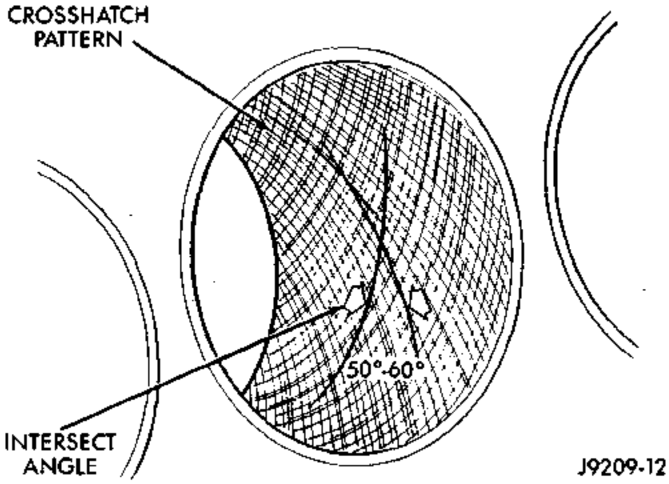


Fig. 1 Cylinder Bore Crosshatch Pattern

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

MEASURING WITH PLASTIGAGE

CRANKSHAFT MAIN BEARING CLEARANCE

Engine crankshaft bearing clearances can be determined by use of Plastigage, or equivalent. The following is the recommended procedures for the use of Plastigage:

(1) Remove oil film from surface to be checked. Plastigage is soluble in oil.

(2) The total clearance of the main bearings can only be determined by removing the weight of the crankshaft. This can be accomplished by either of two methods:

METHOD - 1 (PREFERRED)

Shim the bearings adjacent to the bearing to be checked. This will remove the clearance between upper bearing shell and the crankshaft. Place a minimum of 0.254 mm (0.010 inch) shim between the bearing shell and the adjacent bearing cap. Tighten the bolts to 18 N·m (13 ft. lbs.) torque.

- **ALL ENGINES**—When checking No.1 main bearing; shim No.2 main bearing.
- **ALL ENGINES**—When checking No.2 main bearing; shim No.1 and No.3 main bearing.
- **ALL ENGINES**—When checking No.3 main bearing; shim No.2 and No.4 main bearing.
- **ALL ENGINES**—When checking No.4 main bearing; shim No.3 and No.5 main bearing.
- **2.5L ENGINE**—When checking No.5 main bearing; shim No.4 main bearing.
- **4.0L ENGINE**—When checking No.5 main bearing; shim No.4 and No.6 main bearing.
- **4.0L ENGINE**—When checking No.6 main bearing; shim No.5 and No.7 main bearing.
- **4.0L ENGINE**—When checking No.7 main bearing; shim No.6 main bearing.

NOTE: 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.

(1) Place a piece of Plastigage across the entire width of the bearing cap shell (Fig. 2). Position the Plastigage approximately 6.35 mm (1/4 inch) off center and away from the oil holes. In addition, suspect areas can be checked by placing the Plastigage in that area. Tighten the bearing cap bolts of the bearing being checked to 108 N·m (80 ft. lbs.) torque. **DO NOT rotate the crankshaft or the Plastigage may be smeared, giving inaccurate results.**

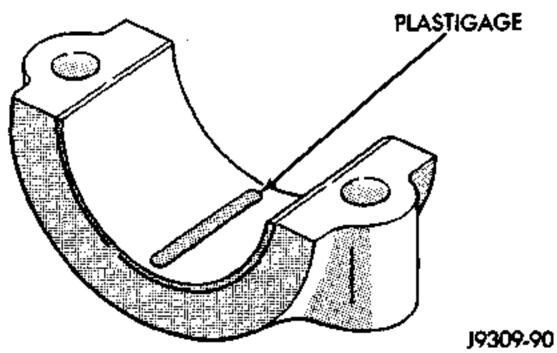


Fig. 2 Placement of Plastigage in Bearing Shell

GENERAL INFORMATION (Continued)

(2) 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).

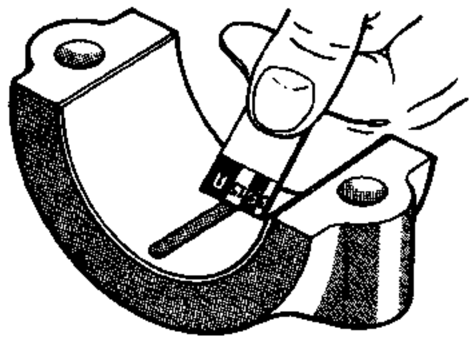


Fig. 3 Clearance Measurement

(3) 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.

CONNECTING ROD BEARING CLEARANCE

Engine connecting rod bearing clearances can be determined by use of Plastigage, or equivalent. The following is the recommended procedures for the use of Plastigage:

(1) Remove oil film from surface to be checked. Plastigage is soluble in oil.

(2) Place a piece of Plastigage across the entire width of the bearing cap shell (Fig. 2). Position the Plastigage approximately 6.35 mm (1/4 inch) off center and away from the oil holes. In addition, suspect areas can be checked by placing the Plastigage in the suspect area.

(3) The crankshaft must be turned until the connecting rod to be checked starts moving toward the top of the engine. Only then should the rod cap with Plastigage in place be assembled. Tighten the rod cap nut to 45 N·m (33 ft. lbs.) torque. **DO NOT rotate the crankshaft or the Plastigage may be smeared, giving inaccurate results.**

(4) Remove the bearing cap and compare the width of the flattened Plastigage with the scale provided on the package (Fig. 3). Plastigage generally comes in 2 scales (one scale is in inches and the other is a metric scale). Locate the band closest to the same width. This band shows the amount of clearance. Differences in readings between the ends indicate the amount of taper present. Record all readings taken (refer to Engine Specifications).

(5) Plastigage is available in a variety of clearance ranges. The 0.025-0.076 mm (0.001-0.003 inch) range is usually the most appropriate for checking engine bearing clearances.

REPAIR DAMAGED OR WORN THREADS

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.
- Installing an insert into the tapped hole to bring the hole back to its original thread size.

CAUTION: Be sure that the tapped holes maintain the original center line.

Heli-Coil tools and inserts are readily available from automotive parts jobbers.

SERVICE ENGINE ASSEMBLY (SHORT BLOCK)

A service replacement engine assembly (short block) may be installed whenever the original cylinder block is defective or damaged beyond repair. It consists of the cylinder block, crankshaft, piston and rod assemblies. If needed, the camshaft must be procured separately and installed before the engine is installed in the vehicle.

A short block is identified with the letter "S" stamped on the same machined surface where the build date code is stamped for complete engine assemblies.

Installation includes the transfer of components from the defective or damaged original engine. Follow the appropriate procedures for cleaning, inspection and torque tightening.

HYDROSTATIC LOCK

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

(1) Perform the Fuel Pressure Release Procedure (refer to Group 14, Fuel System).

(2) Disconnect the negative cable from the battery.

(3) Inspect air cleaner, induction system and intake manifold to ensure system is dry and clear of foreign material.

(4) Place a shop towel around the spark plugs to catch any fluid that may possibly be under pressure in the cylinder head. Remove the plugs from the engine.

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.

GENERAL INFORMATION (Continued)

(6) Identify the fluid in the cylinders (i.e. coolant, fuel, oil, etc.).

(7) Make sure all fluid has been removed from the cylinders.

(8) Repair engine or components as necessary to prevent this problem from occurring again.

(9) Squirt engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(10) Install new spark plugs. Tighten the spark plugs to 37 N·m (27 ft. lbs.) torque.

(11) Drain engine oil. Remove and discard the oil filter.

(12) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(13) Install a new oil filter.

(14) Fill engine crankcase with the specified amount and grade of oil (refer to Group 0, Lubrication and Maintenance).

(15) Connect the negative cable to the battery.

(16) Start the engine and check for any leaks.

ENGINE OIL

WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL FUEL, THINNER, OR SOLVENTS, HEALTH PROBLEMS CAN RESULT. DO NOT POLLUTE, DISPOSE OF USED ENGINE OIL PROPERLY.

ENGINE OIL SPECIFICATION

CAUTION: Do not use non-detergent or straight mineral oil when adding or changing crankcase lubricant. Engine failure can result.

API SERVICE GRADE CERTIFIED

Use an engine oil that is API Service Grade Certified or an oil that conforms to the API Service Grade SH or SH/CD. MOPAR provides engine oils that conform to all of these service grades.

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. SAE 30 specifies a single viscosity engine oil. Engine oils also have multiple viscosities. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation (Fig. 4).

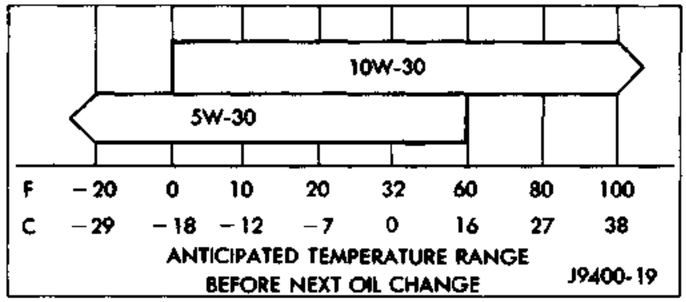


Fig. 4 Temperature/Engine Oil Viscosity

ENERGY CONSERVING OIL

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

CONTAINER IDENTIFICATION

Standard engine oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans (Fig. 5).

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Fig. 5 Engine Oil Container Standard Notations

ENGINE OIL ADDITIVES

In some instances, such as infrequent operation, short trip driving, and during break-in after a major overhaul, addition of special materials containing anti-rust and anti-scuff additives are beneficial. A suitable product for this purpose is MOPAR Engine Oil Supplement.

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator (Dipstick) is located at the right rear of both 2.5L engines and 4.0L engines (Fig. 6).

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, oil foaming and oil pressure loss can result.

Inspect engine oil level approximately every 800 kilometers (500 miles). Unless the engine has exhib-

GENERAL INFORMATION (Continued)

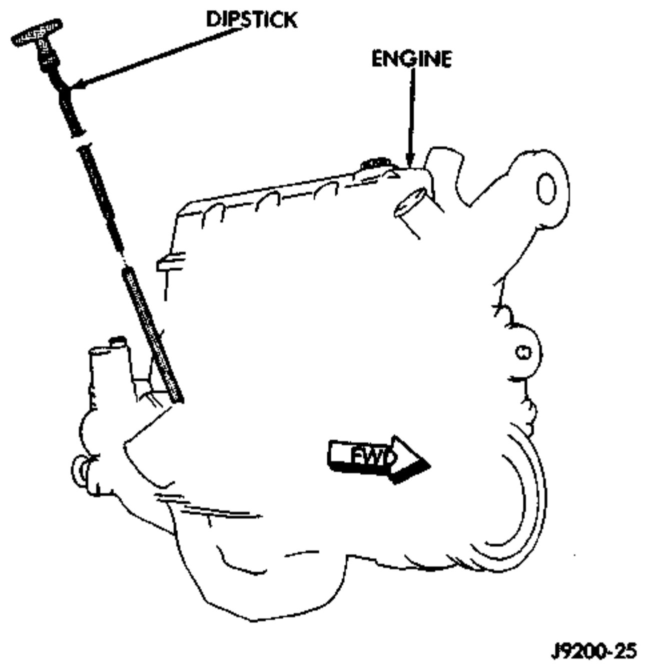

Fig. 6 Engine Oil Dipstick Location—Typical

ited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level on a cold engine is not accurate.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil dipstick (Fig. 7) (Fig. 8).

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading (Fig. 7) (Fig. 8).

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in Maintenance Schedules.

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist and support vehicle on safety stands.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for

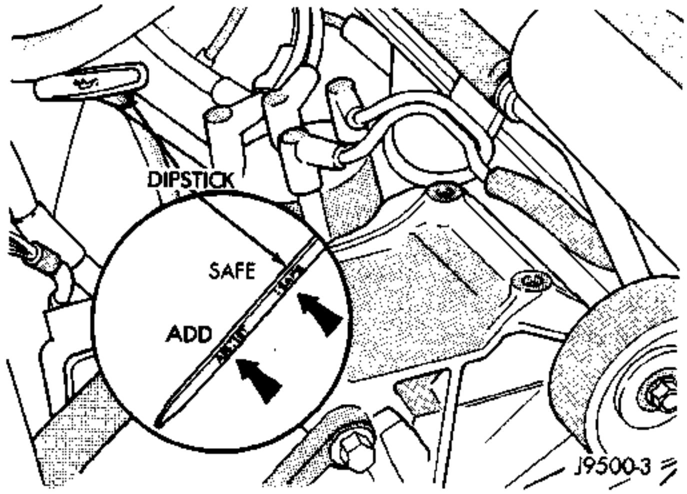

Fig. 7 Engine Oil Dipstick—2.5L Engine

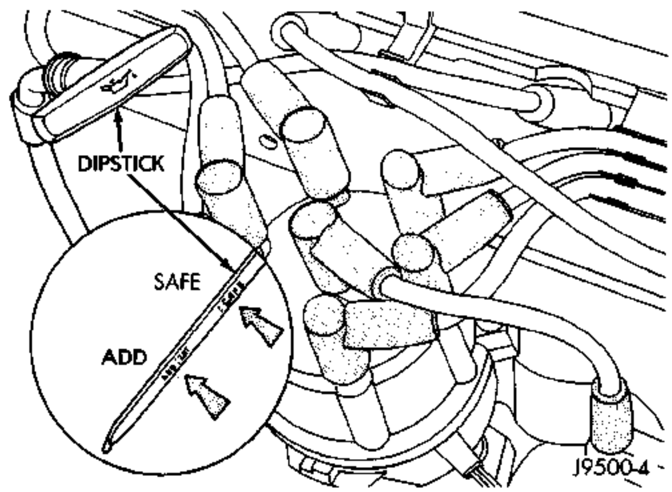

Fig. 8 Engine Oil Dipstick—4.0L Engine

stretching or other damage. Replace drain plug if damaged.

(6) Install drain plug in crankcase.

(7) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.

(8) Install oil fill cap.

(9) Start engine and inspect for leaks.

(10) Stop engine and inspect oil level.

ENGINE OIL FILTER CHANGE

FILTER SPECIFICATION

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

All Jeep engines are equipped with a high quality full-flow, throw-away type oil filter. Chrysler Corpo-

GENERAL INFORMATION (Continued)

ration recommends a Mopar or equivalent oil filter be used.

OIL FILTER REMOVAL

(1) Position a drain pan under the oil filter.
(2) Using a suitable oil filter wrench loosen filter.
(3) Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss (Fig. 9).

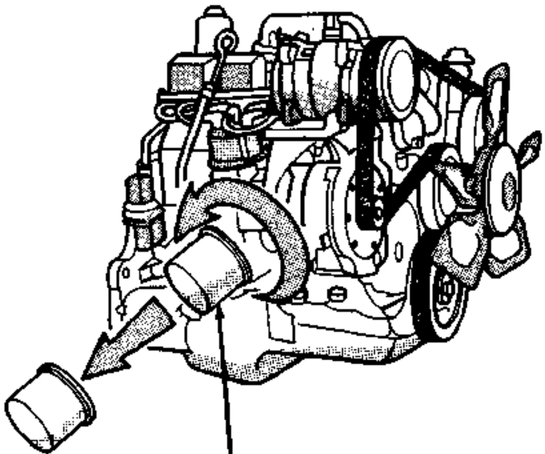

Fig. 9 Oil Filter—2.5L Engine

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.
(5) With a wiping cloth, clean the gasket sealing surface (Fig. 10) of oil and grime.

OIL FILTER INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil or chassis grease.
(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 10) hand tighten filter one full turn, do not over tighten.
(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

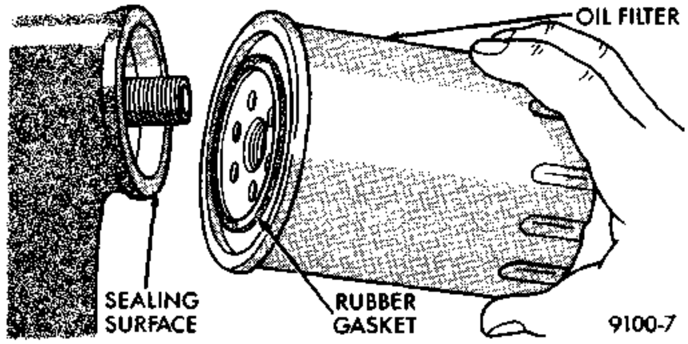

Fig. 10 Oil Filter Sealing Surface—Typical

USED ENGINE OIL DISPOSAL

Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the WARNING at beginning of this section.

ENGINE DIAGNOSIS

INDEX

DIAGNOSIS AND TESTING

GENERAL INFORMATION

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.

HYDRAULIC TAPPETS

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 1).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Leak-Down Tester.

(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.

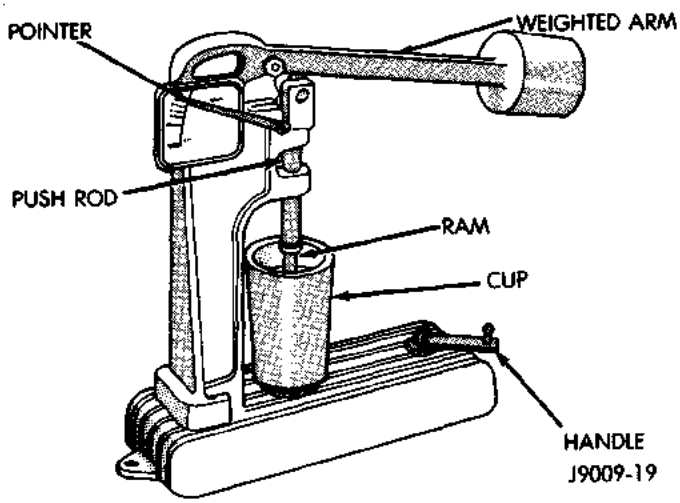

Fig. 1 Leak-Down Tester

DIAGNOSIS AND TESTING (Continued)

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

(1) Start the engine.

(2) Spray a small stream of water at the suspected leak area.

(3) If a change in RPM is observed the area of the suspected leak has been found.

(4) Repair as required.

CYLINDER COMPRESSION PRESSURE TEST

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise the indicated compression pressures may not be valid for diagnosis purposes.

(1) Clean the spark plug recesses with compressed air.

(2) Remove the spark plugs.

(3) Secure the throttle in the wide-open position.

(4) Disconnect the ignition coil.

(5) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(6) Record the compression pressure on the 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.

(1) Check the coolant level and fill as required. DO NOT install the radiator cap.

(2) Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.

(3) Remove the spark plugs.

(4) Remove the oil filler cap.

(5) Remove the air cleaner.

(6) Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1 379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.

(7) Perform the test procedures on each cylinder according to the tester manufacturer's instructions. While testing, listen for pressurized air escaping through the throttle body, tailpipe and oil filler cap opening. Check for bubbles in the radiator coolant.

DIAGNOSIS AND TESTING (Continued)

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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All gauge pressure indications should be equal, with no more than 25% leakage.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

Refer to the Cylinder Combustion Pressure Leakage Test Diagnosis chart.

INSPECTION (ENGINE OIL LEAKS IN GENERAL)

Begin with a through visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.

(2) Add an oil soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.

(3) Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair per service manual instructions.

(4) If dye is not observed, drive the vehicle at various speeds for approximately 24km (15 miles), and repeat inspection.

(5) **If the oil leak source is not positively identified at this time**, proceed with the air leak detection test method.

Air Leak Detection Test Method

(1) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(2) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(3) Attach an air hose with pressure gauge and regulator to the dipstick tube.

CAUTION: Do not subject the engine assembly to more than 20.6 kpa (3 PSI) of test pressure.

(4) Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provide the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.

(5) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(6) If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the PCV valve and breather cap hose.

(7) Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

INSPECTION FOR REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The

DIAGNOSIS AND TESTING (Continued)

following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

(a) Circular spray pattern generally indicates seal leakage or crankshaft damage.

(b) Where leakage tends to run straight down, possible causes are a porous block, distributor seal, camshaft bore cup plugs oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces.

(4) If no leaks are detected, pressurize the crankcase as outlined in the, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

(5) If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks and scratches. The crankshaft seal flange is especially machined to complement the function of the rear oil seal.

(6) For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled.

ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit.

(2) Install Oil Pressure Line and Gauge Tool C-3292. Start engine and record pressure. Refer to Oil Pressure in Engine Specifications for the proper pressures.

DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS—PERFORMANCE

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT START	1. Weak battery.	1. Test battery specific gravity. Charge or replace as necessary.
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals.
	3. Faulty starter.	3. Refer to Group 8A, Battery/Starter/Charging System Diagnostics.
	4. Moisture on ignition wires and distributor cap.	4. Wipe wires and cap clean and dry.
	5. Faulty ignition cables.	5. Replace any cracked or shorted cables.
	6. Faulty coil or control unit.	6. Test and replace, if necessary (refer to Group 8D, Ignition System).
	7. Incorrect spark plug gap.	7. Set gap (refer to Group 8D, Ignition System).
	8. Incorrect ignition timing.	8. Refer to Group 8D, Ignition System.
	9. Dirt or water in fuel system.	9. Clean system and replace fuel filter.
	10. Faulty fuel pump.	10. Install new fuel pump (refer to Group 14, Fuel System).
	11. Faulty connectors for crankshaft or camshaft position sensors.	11. Rebuild or replace the connectors.
ENGINE STALLS OR ROUGH IDLE	1. Idle speed set too low.	1. Refer to Group 14, Fuel System.
	2. Idle mixture too lean or too rich.	2. Refer to Group 14, Fuel System.
	3. Leak in intake manifold.	3. Inspect intake manifold gasket and vacuum hoses. Replace, if necessary (refer to Group 11, Exhaust System & Intake Manifold).
	4. Worn or burned distributor rotor.	4. Install new distributor rotor.
	5. Incorrect ignition wiring.	5. Install correct wiring.
	6. Faulty coil.	6. Test and replace, if necessary (refer to Group 8D, Ignition System).
	7. EGR valve leaking.	7. Test and replace, if necessary (refer to Group 25, Emissions Control System).

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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. 14. Faulty crankshaft or camshaft sensor.	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). 14. Replace sensor.
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—PERFORMANCE—CONT.

DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS—MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES	1. High or low oil level in crankcase.	1. Check for correct oil level (refer to Group 0, Lubrication and Maintenance.
	2. Thin or diluted oil.	2. Change oil (refer to Group 0, Lubrication and Maintenance).
	3. Low oil pressure.	3. Check engine oil level.
	4. Dirt in tappets/lash adjusters.	4. Clean hydraulic tappets/hydraulic lash adjusters.
	5. Bent push rods.	5. Install new push rods.
	6. Worn rocker arms.	6. Inspect oil supply to rocker arms.
	7. Worn tappets/lash adjusters.	7. Install new hydraulic tappets/ hydraulic lash adjusters.
	8. Worn valve guides.	8. Ream and install new valves with oversize stems.
	9. Excessive runout of valve seats on valve faces.	9. Grind valve seats and valves.
CONNECTING ROD NOISE	1. Insufficient oil supply.	1. Check engine oil level (refer to Group 0, Lubrication and Maintenance).
	2. Low oil pressure.	2. Check engine oil level. Inspect oil pump relief valve and spring.
	3. Thin or diluted oil.	3. Change oil to correct viscosity.
	4. Excessive bearing clearance.	4. Measure bearings for correct clearance. Repair as necessary.
	5. Connecting rod journal out-of-round.	5. Replace crankshaft or grind journals.
	6. Misaligned connecting rods.	6. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply.	1. Check engine oil level (refer to Group 0, Lubrication and Maintenance).
	2. Low oil pressure.	2. Check engine oil level. Inspect oil pump relief valve and spring.
	3. Thin or diluted oil.	3. Change oil to correct viscosity.
	4. Excessive bearing clearance.	4. Measure bearings for correct clearance. Repair as necessary.
	5. Excessive end play.	5. Check No. 3 main bearing for wear on flanges.
	6. Crankshaft journal out-of-round, worn.	6. Grind journals or replace crankshaft.
	7. Loose flywheel or torque converter.	7. Tighten to correct torque.

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DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS—LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings. (a) Misaligned, deteriorated or torn. (b) Loose fastener, broken or porous metal part.	1. (a) Replace the part. (b) Tighten, repair or replace the part.
	2. Crankshaft Rear Seal (a) Misinstalled, inverted or torn lip (b) Torn, cut or shaved seal back bead.	2. (a) Replace the seal. (b) Replace the seal.
	3. Crankshaft Seal Flange. Scratched, nicked or grooved.	3. Replace or polish if necessary.
	4. Cylinder block to Cap Mating Surface. (a) Inadequate Loctite sealant. (b) Oil hole burr.	4. (a) Apply sealant per sealant per service manual. (b) Carefully stone or chamfer hole.
	5. Oil Pan to Rear Main Cap Sealant (Slots 3.9 - 5.2 only). (a) Inadequate or mislocated sealant. (b) Torn, cut or misinstalled oil pan. (c) Cracked or damaged oil pan flange.	5. (a) Apply sealant per service manual procedures. (b) Replace the gasket. (c) Replace the oil pan.
	6. Chain Case Cover Seal. (a) Misinstalled, cocked or misaligned. (b) Torn, cut or damaged seal lips. (c) Scratched or damaged seal casing or cover bore. (d) Scratched or damaged vibration damper hub.	6. (a) Replace per service manual procedures. (b) Replace the seal. (c) Replace the seal. (d) Minor damage can be polished out; otherwise replace the part.
OIL PRESSURE DROP	1. Low oil level.	1. Check engine oil level.
	2. Faulty oil pressure sending unit.	2. Install new sending unit.
	3. Low oil pressure.	3. Check sending unit and check main bearing oil clearance.
	4. Clogged oil filter.	4. Install new oil filter.
	5. Worn parts in oil pump.	5. Replace worn parts or pump.
	6. Thin or diluted oil.	6. Change oil to correct viscosity.
	7. Excessive bearing clearance.	7. Measure bearings for correct clearance.
	8. Oil pump relief valve stuck.	8. Remove valve and inspect, clean and install.
	9. Oil pump suction tube loose, bent or cracked.	9. Remove oil pan and install new tube, if necessary.
	10. Oil pump cover warped or cracked.	10. Install new oil pump.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn, scuffed or broken rings.	1. Hone cylinder bores and install new rings.
	2. Carbon in oil ring slot.	2. Install new rings.
	3. Rings fitted too tightly in grooves.	3. Remove the rings. Check grooves. If grooves are not proper width, replace piston.
	4. Worn valve guides.	4. Ream guides and replace valves with oversize valves and seals.
	5. Leaking intake gasket (3.9L & 5.2L engines).	5. Replace gasket and tighten intake manifold to proper torque.
	6. Leaking valve guide seals (3.9L & 5.2L engines).	6. Replace seals.
	7. Dislodged valve guide seals (3.9L & 5.2L engines).	7. Seat valve guide seals or replace, as needed.

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2.5L ENGINE

INDEX

DESCRIPTION AND OPERATION

ENGINE DESCRIPTION

The 2.5 liter (150 CID) four-cylinder engine is an In-line, lightweight, overhead valve engine.

Engine Type	In-line 4 Cylinder
Bore and Stroke	98.4 x 81.0 mm (3.88 x 3.19 in.)
Displacement	2.5 (150 cu. in.)
Compression Ratio	9.2:1
Torque	190 N·m (140 ft. lbs.) @ 3500 rpm
Firing Order	1–3–4–2
Lubrication	Pressure Feed–Full Flow Filtration
Engine Oil Capacity	5.7 L (6 Quarts)
Cooling System	Liquid Cooled–Forced Circulation
Cooling System Capacity	8.5L (9 Quarts)
Cylinder Block	Cast Iron
Crankshaft	Cast Nodular Iron
Cylinder Head	Cast Nodular Iron
Camshaft	Cast Nodular Iron
Pistons	Aluminum Alloy (with Struts)
Pistons Combustion Cavity	Double Quench
Connecting Rods	Cast Nodular Iron

This engine is designed for unleaded fuel.

The engine cylinder head has dual quench-type combustion chambers that create turbulence and fast burning of the air/fuel mixture. This results in good fuel economy.

The cylinders are numbered 1 through 4 from front to rear. The firing order is 1-3-4-2 (Fig. 1).

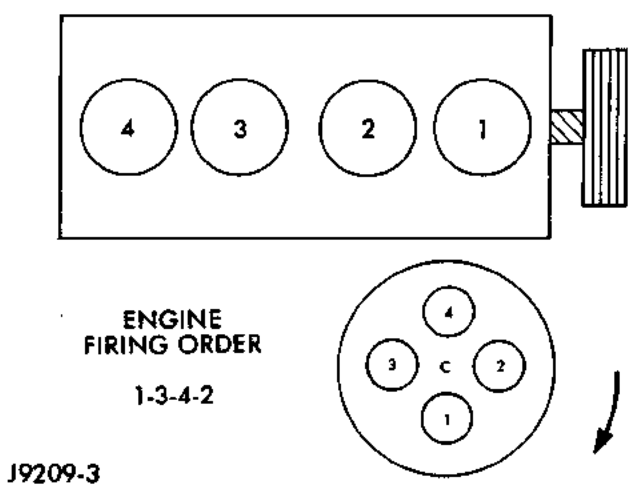


Fig. 1 Engine Firing Order

DESCRIPTION AND OPERATION (Continued)

The crankshaft rotation is clockwise, when viewed from the front of the engine. The crankshaft rotates within five main bearings and the camshaft rotates within four bearings.

BUILD DATE CODE

The engine Build Date Code is located on a machined surface on the right side of the cylinder block between the No.3 and No.4 cylinders (Fig. 2).

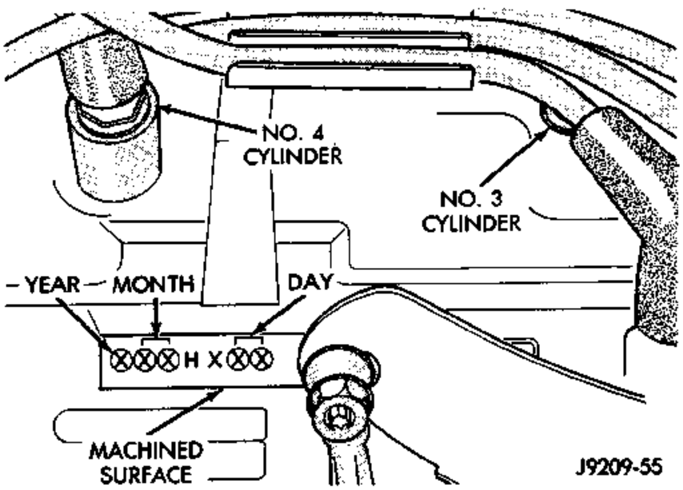


Fig. 2 Build Date Code Location

The digits of the code identify:

- 1st Digit—The year (6 = 1996).
- 2nd & 3rd Digits—The month (01 - 12).
- 4th & 5th Digits—The engine type/fuel system/ compression ratio (HX = A 2.5 liter (150 CID) 9.2:1 compression ratio engine with a multi-point fuel injection system).
- 6th & 7th Digits—The day of engine build (01 - 31).

FOR EXAMPLE: Code * 601HX23 * identifies a 2.5 liter (150 CID) engine with a multi-point fuel injection system, 9.2:1 compression ratio and built on January 23, 1996.

LUBRICATION SYSTEM

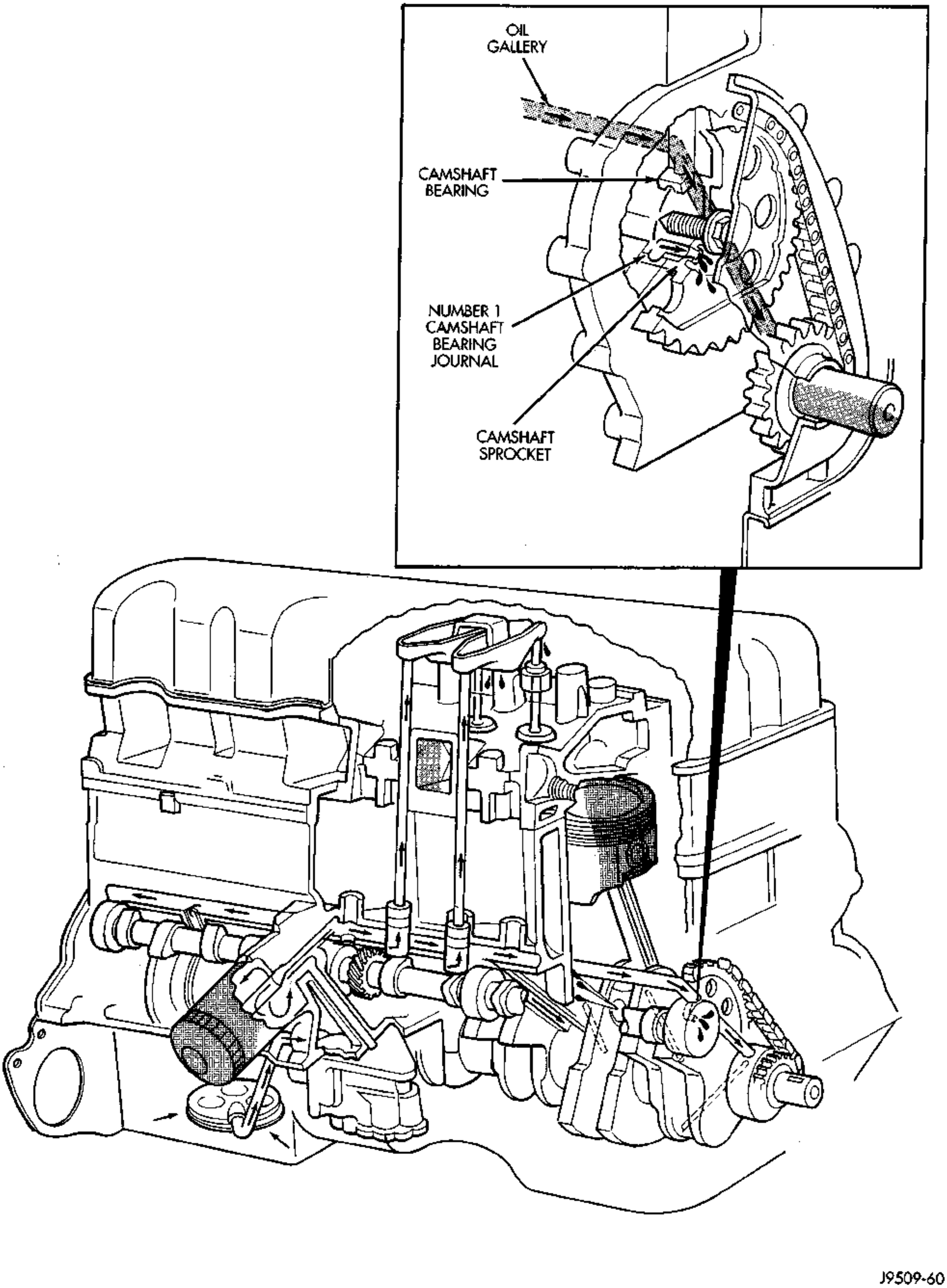
A gear—type positive displacement pump is mounted at the underside of the block opposite the No. 4 main bearing. The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and pump body, then forced through the outlet to the block. An oil gallery in the block channels the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes from the center outlet of the filter through an oil gallery that channels the oil up to the main gallery which extends the entire length of the block.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The crankshaft is drilled internally to pass oil from the main bearing journals (except number 4 main bearing journal) to the connecting rod journals. Each connecting rod bearing cap has a small squirt hole, oil passes through the squirt hole and is thrown off as the rod rotates. This oil throwoff lubricates the camshaft lobes, distributor drive gear, cylinder walls, and piston pins.

The hydraulic valve tappets receive oil directly from the main oil gallery. Oil is provided to the camshaft bearing through galleries. The front camshaft bearing journal passes oil through the camshaft sprocket to the timing chain. Oil drains back to the oil pan under the number one main bearing cap.

The oil supply for the rocker arms and bridged pivot assemblies is provided by the hydraulic valve tappets which pass oil through hollow push rods to a hole in the corresponding rocker arm. Oil from the rocker arm lubricates the valve train components, then passes down through the push rod guide holes in the cylinder head past the valve tappet area, and returns to the oil pan.

DESCRIPTION AND OPERATION (Continued)



Oil Lubrication System

DESCRIPTION AND OPERATION (Continued)

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.

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. 3) stamped on the oil filter boss near the distributor (Fig. 4).

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. 3 Oversize and Undersize Component Codes

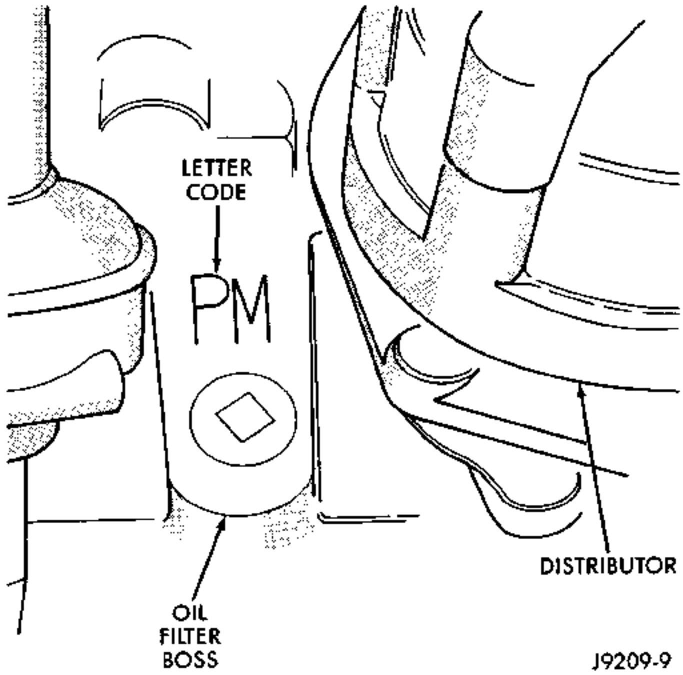


Fig. 4 Oversize and Undersize Component Code Location

SERVICE PROCEDURES

VALVE TIMING

Disconnect the spark plug wires and remove the spark plugs.

Remove the engine cylinder head cover.

Remove the capscrews, bridge and pivot assembly, and rocker arms from above the No.1 cylinder.

Alternately loosen each capscrew, one turn at a time, to avoid damaging the bridge.

Rotate the crankshaft until the No.4 piston is at top dead center (TDC) on the compression stroke.

Rotate the crankshaft counterclockwise (viewed from the front of the engine) 90°.

Install a dial indicator on the end of the No.1 cylinder intake valve push rod. Use rubber tubing to secure the indicator stem on the push rod.

Set the dial indicator pointer at zero.

Rotate the crankshaft clockwise (viewed from the front of the engine) until the dial indicator pointer indicates 0.305 mm (0.012 inch) travel distance (lift).

The timing notch index on the vibration damper should be aligned with the TDC mark on the timing degree scale.

If the timing notch is more than 13 mm (1/2 inch) away from the TDC mark in either direction, the valve timing is incorrect.

If the valve timing is incorrect, the cause may be a broken camshaft pin. It is not necessary to replace the camshaft because of pin failure. A spring pin is available for service replacement.

PISTON FITTING

BORE GAGE METHOD

(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

(2) Measure the inside diameter of the cylinder bore at a point 49.5 mm (1-15/16 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take

SERVICE PROCEDURES (Continued)

an additional bore reading 90 degrees to that at point B (Fig. 5).

(3) The coated pistons will be serviced with the piston pin and connecting rod pre-assembled. **The coated piston connecting rod assembly can be used to service previous built engines and MUST be replaced as complete sets.** Tin coated pistons should not be used as replacements for coated pistons.

(4) The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results. Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY.**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.001 mm (.0001 in.) increments is required.

(5) Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

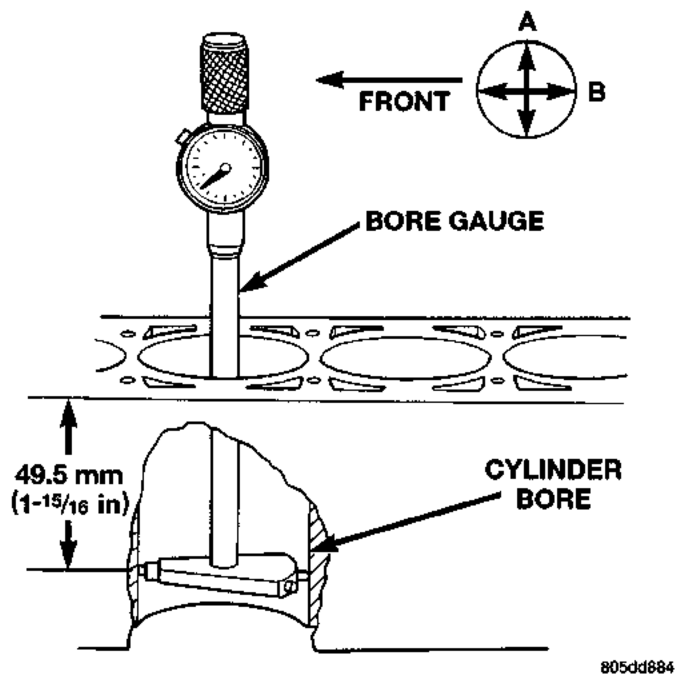


Fig. 5 Bore Gauge

PISTON SIZE CHART

CYLINDER BORE SIZE	PISTON LETTER SIZE
98.438 to 98.448 mm (3.8755 to 3.8759 in.)	A
98.448 to 98.458 mm (3.8759 to 3.8763 in.)	B
98.458 to 98.468 mm (3.8763 to 3.8767 in.)	C
98.468 to 98.478 mm (3.8767 to 3.8771 in.)	D
98.478 to 98.488 mm (3.8771 to 3.8775 in.)	E
98.488 to 98.498 mm (3.8775 to 3.8779 in.)	F

PISTON RING FITTING

(1) Carefully clean the carbon from all ring grooves. Oil drain openings in the oil ring groove and pin boss must be clear. DO NOT remove metal from the grooves or lands. This will change ring-to-groove clearances and will damage the ring-to-land seating.

(2) Be sure the piston ring grooves are free of nicks and burrs.

(3) Measure the ring side clearance with a feeler gauge fitted snugly between the ring land and ring (Fig. 6) (Fig. 7). Rotate the ring in the groove. It must move freely around circumference of the groove.

Ring Side Clearance Measurement

Top Compression Ring	0.042to 0.084 mm (0.0017 to 0.0033 in.)
Second Compression Ring	0.042to 0.084 mm (0.0017 to 0.0033 in.)
Oil Control Ring	0.06 to 0.21 mm (0.0024 to 0.0083 in.)

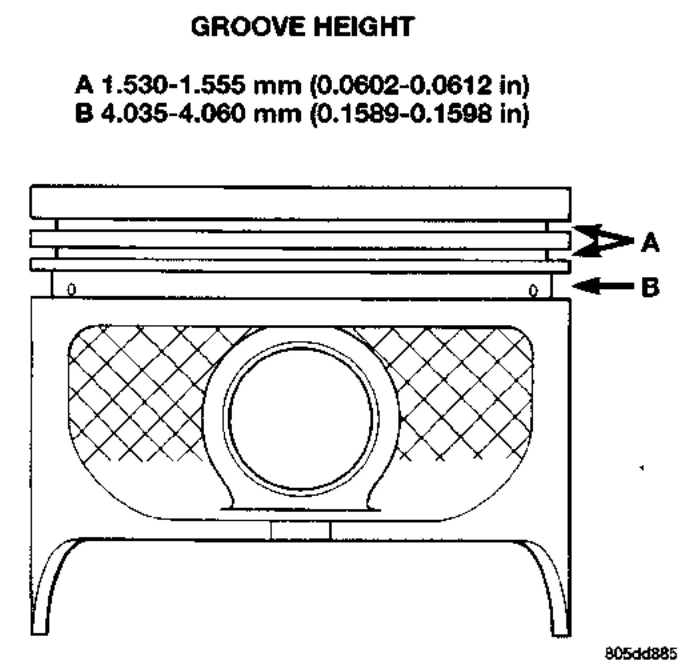


Fig. 6 Piston Dimensions

(4) Place ring in the cylinder bore and push down with inverted piston to position near lower end of the ring travel. Measure ring gap with a feeler gauge fitting snugly between ring ends (Fig. 8).

SERVICE PROCEDURES (Continued)

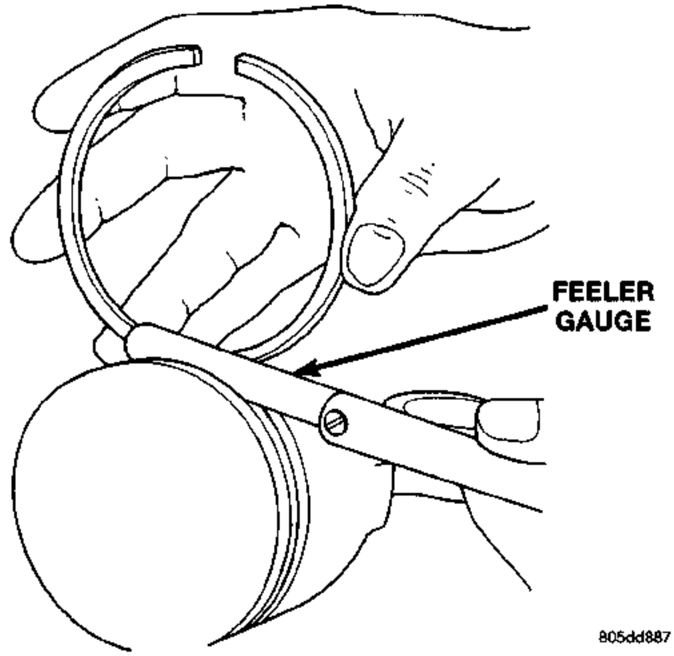


Fig. 7 Ring Side Clearance Measurement

Ring Gap Measurement

Top Compression Ring	0.229 to 0.610 mm (0.0090 to 0.0240 inch)
Second Compresion Ring	0.483 to 0.965 mm (0.0190 to 0.0380 inch)
Oil Control Ring	0.254 to 1.500 mm (0.010 to 0.060 inch)

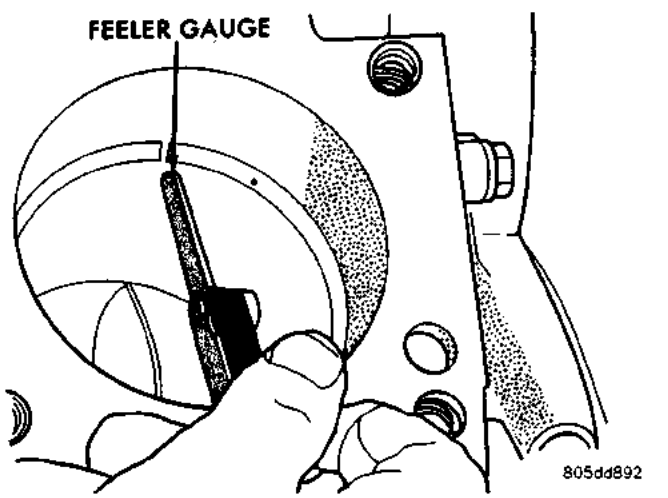


Fig. 8 Gap Measurement

(5) The oil control rings are symmetrical, no top or bottom, install anyside up. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(6) The two compression rings are different and cannot be interchanged. The TOP compression ring can be identified by the shiny coating on the outer sealing surface. This ring is symmetrical, no top or bottom, install anyside up.

(7) The second compression ring has a dot or drill mark denoting the topside of ring. There is also a slight chamfer on the inside bottom edge, therefore dot mark up chamfer face down for installationon.

(8) Using a ring installer, install the second compression ring. (Fig. 9).

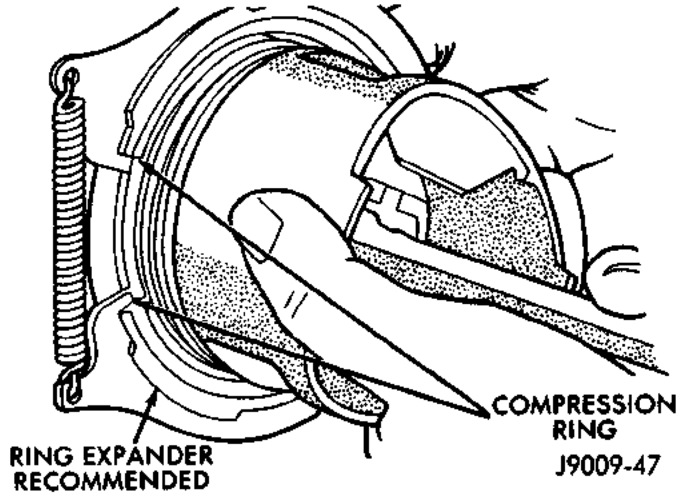


Fig. 9 Compression Ring Installation

(9) The top compression ring has a shiny coating on the outer sealing surface.

(10) Using a ring installer, install the top ring. (Fig. 9).

(11) Position top and second ring 180° apart. Split the oil rings 60° to 90° apart and away from the second ring gap. (Fig. 10) Example: Top oil ring at 12:00, expander at 3:00 or 9:00, bottom oil ring at 6:00.

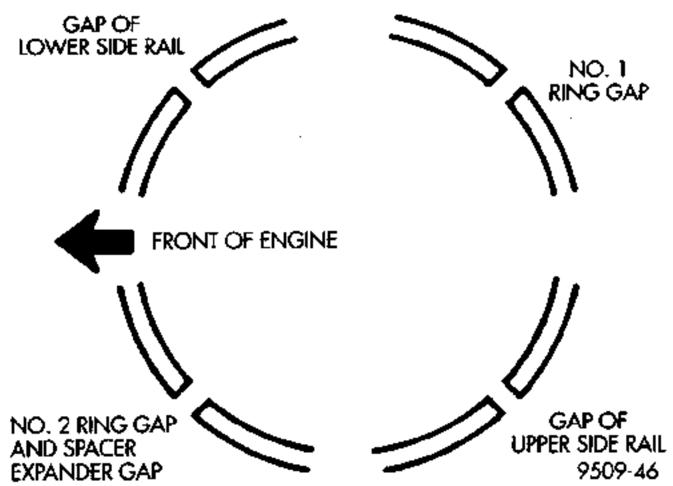


Fig. 10 Piston Ring End Gap Position

SERVICE PROCEDURES (Continued)

FITTING CONNECTING ROD BEARINGS

INSPECTION

BEARINGS

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 11) (Fig. 12). Check the 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.

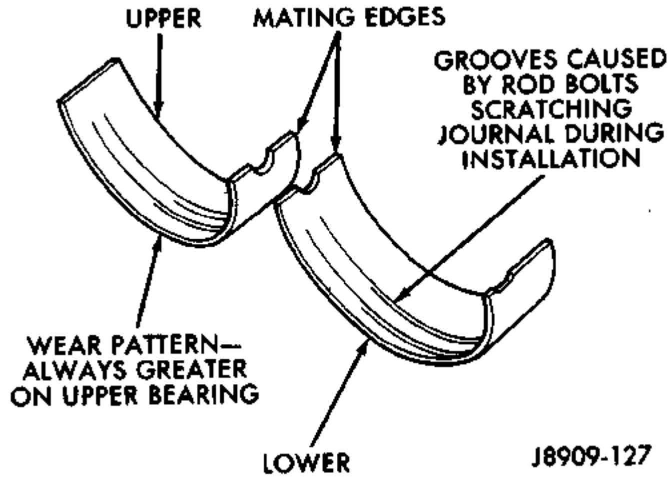


Fig. 11 Connecting Rod Bearing Inspection

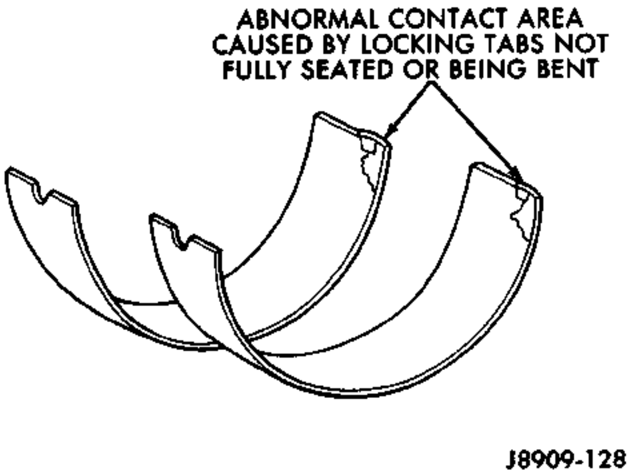


Fig. 12 Locking Tab Inspection

CONNECTING RODS

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

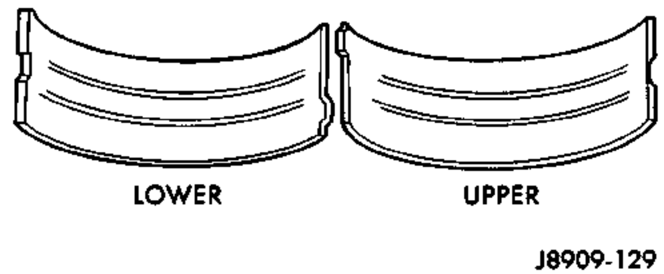


Fig. 13 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

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.

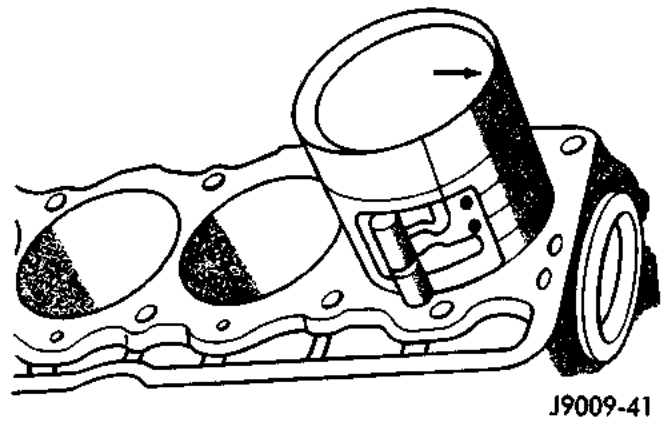


Fig. 14 Rod and Piston Assembly Installation

(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**

SERVICE PROCEDURES (Continued)

tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.

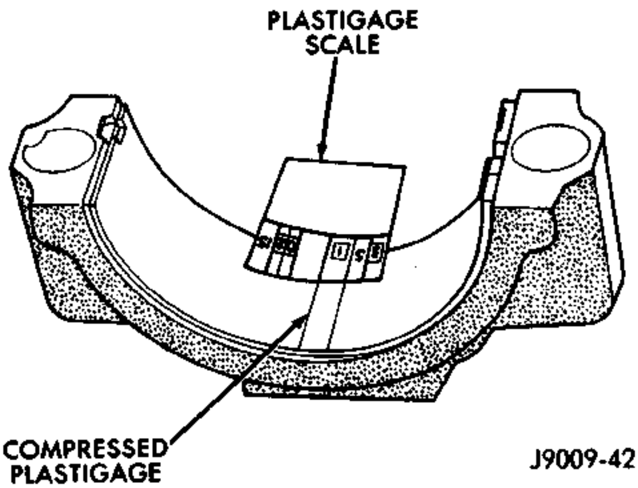


Fig. 15 Measuring Bearing Clearance with Plastigage

(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).

(11) **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).

(12) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(13) 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.

Crankshaft Journal		Corresponding Connecting Rod Bearing Insert	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	53.2257-53.2079 mm (2.0955-2.0948 in.)	Yellow - Standard	Yellow - Standard
Orange	53.2079-53.1901 mm (2.0948-2.0941 in.) 0.0178 mm (0.0007 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Blue	53.1901-53.1724 mm (2.0941-2.0934 in.) 0.0356 mm (0.0014 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Red	52.9717-52.9539 mm (2.0855-2.0848 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

J9409-24

CONNECTING ROD BEARING FITTING CHART

SERVICE PROCEDURES (Continued)

FITTING CRANKSHAFT MAIN BEARINGS

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. 16).

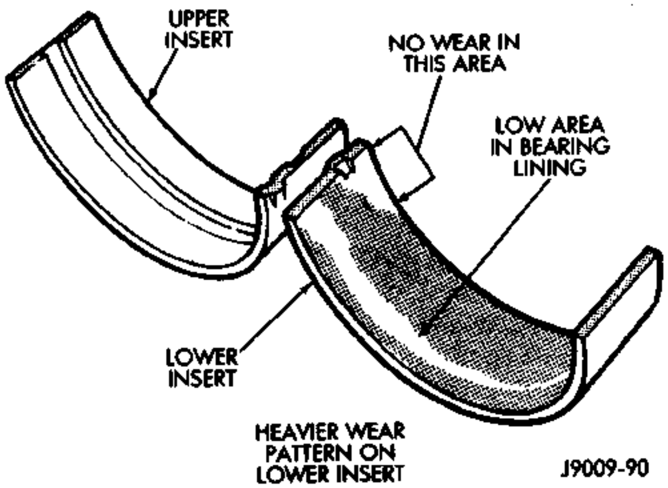


Fig. 16 Main Bearing Wear Patterns

NOTE: 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 BEARINGS (CRANKSHAFT INSTALLED)

The main bearing caps, numbered (front to rear) from 1 through 5 have an arrow to indicate the forward position. The upper main bearing inserts are grooved to provide oil channels while the lower inserts are smooth.

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. 17).**

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.025 mm (0.001 in.) Undersize	0.051 mm (0.002 in.) Undersize

J9109-179

Fig. 17 Bearing Insert Pairs

NOTE: 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.

NOTE: 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. 18). Refer to Engine Specifications for the proper clearance.

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

SERVICE PROCEDURES (Continued)

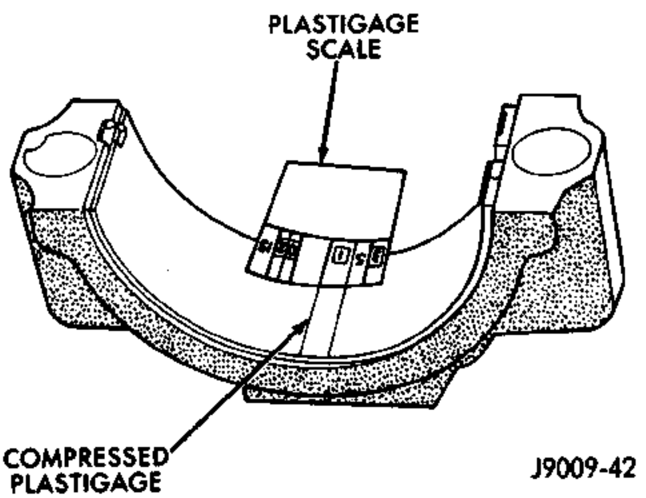


Fig. 18 Measuring Bearing Clearance with Plastigage

and measure the clearance as described in the previous steps.

The clearance indicated with the 0.025 mm (0.001 inch) undersize insert pair installed will determine if this insert size or some other combination will provide the specified clearance. **FOR EXAMPLE:** If the clearance was 0.0762 mm (0.003 inch) originally, a pair of 0.0254 mm (0.001 inch) undersize inserts would reduce the clearance by 0.0254 mm (0.001 inch). The clearance would then be 0.0508 mm (0.002 inch) and within the specification. A 0.051 mm (0.002 inch) undersize bearing insert and a 0.0254 mm (0.001 inch) undersize insert would reduce the original clearance an additional 0.0127 mm (0.0005 inch). The clearance would then be 0.0381 mm (0.0015 inch).

CAUTION: Never use a pair of inserts that differ more than one bearing size as a pair.

FOR EXAMPLE: DO NOT use a standard size upper insert and a 0.051 mm (0.002 inch) undersize lower insert.

If the clearance exceeds specification using a pair of 0.051 mm (0.002 inch) undersize bearing inserts, measure crankshaft journal diameter with a micrometer. If the journal diameter is correct, the crankshaft bore in the cylinder block may be misaligned, which requires cylinder block replacement or machining to true bore.

If journals 1 through 5 diameters are less than 63.4517 mm (2.4981 inches), replace crankshaft or grind crankshaft down to accept the appropriate undersize bearing inserts.

Once the proper clearances have been obtained, proceed to Crankshaft Main Bearing—Installation.

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Remove the crankshaft from the cylinder block (refer to Cylinder Block - Disassemble).

Clean the oil off the main bearing journal.

Determine the maximum diameter of the journal with a micrometer. Measure at two locations 90° apart at each end of the journal.

The maximum allowable taper and out of round is 0.013 mm (0.0005 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

Once the proper clearances have been obtained, proceed to Crankshaft Main Bearing—Installation.

SERVICE PROCEDURES (Continued)

MAIN BEARING FITTING CHART

CRANKSHAFT JOURNALS #1 - #4		CORRESPONDING CRANKSHAFT BEARING INSERT	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	63.5025 - 63.4898 mm (2.5001 - 2.4996 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4898 - 63.4771mm (2.4996 - 2.4991 in.) 0.0127 mm (0.0005 in.) Undersize	Yellow - Undersize 0.025 mm (0.001 in.)	Blue - Standard
Blue	63.4771 - 63.4644 mm (2.4991 - 2.4986 in.) 0.0254 mm (0.001 in.) Undersize	Blue- Undersize 0.025 mm (0.001 in.)	Blue- Undersize 0.025 mm (0.001 in.)
Green	63.4644 - 63.4517 mm (2.4986 - 2.4981 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2485 - 63.2358 mm (2.4901 - 2.4896 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)
CRANKSHAFT JOURNAL #5 ONLY		CORRESPONDING CRANKSHAFT BEARING INSERT	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	63.4873 - 63.4746 mm (2.4995 - 2.4990 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4746 - 63.4619 mm (2.4990 - 2.4985 in.) 0.0127 mm (0.0005 in. Undersize	Yellow - Undersize 0.025 mm (0.001 in.)	Blue - Standard
Blue	63.4619 - 63.4492 mm (2.4985 - 2.4980 in.) 0.0254 mm (0.001 in.) Undersize	Blue- Undersize 0.025 mm (0.001 in.)	Blue- Undersize 0.025 mm (0.001 in.)
Green	63.4492 - 63.4365 mm (2.4980- 2.4975 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2333 - 63.2206 mm (2.4895 - 2.4890 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT

The front mounts support the engine at each side. These supports are made of resilient rubber.

REMOVAL

(1) Disconnect negative cable from battery.
(2) Raise the vehicle.
(3) Support the engine.

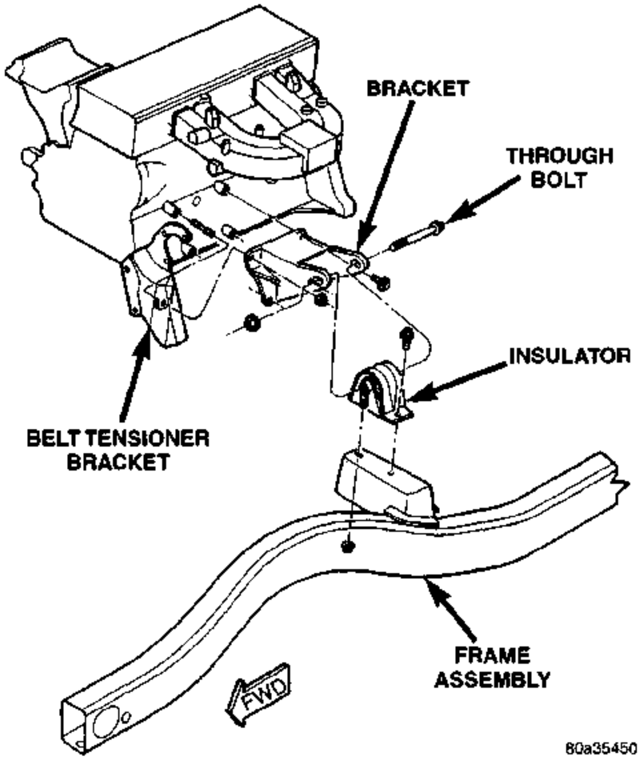


Fig. 19 Left Front Mount—2.5L Engine

(4) Remove through bolt nut (Fig. 19) (Fig. 20). DO NOT remove the through bolt.
(5) Remove the retaining bolts and nuts from the support cushions.
(6) Remove the through bolt.
(7) Remove the engine mount insulator.

INSTALLATION

(1) If the engine support bracket was removed, position the bracket onto the block and install the attaching bolts. Tighten the bolts to 62 N·m (46 ft. lbs.) torque.
(2) Place the insulator on the support bracket. Install the insulator retaining bolts and nuts. Tighten the bolts and nuts to 52 N·m (38 ft. lbs.) torque.
(3) Install the through bolt and the retaining nut. Tighten the through bolt nut to 69 N·m (51 ft. lbs.) torque.
(4) Remove the engine support.

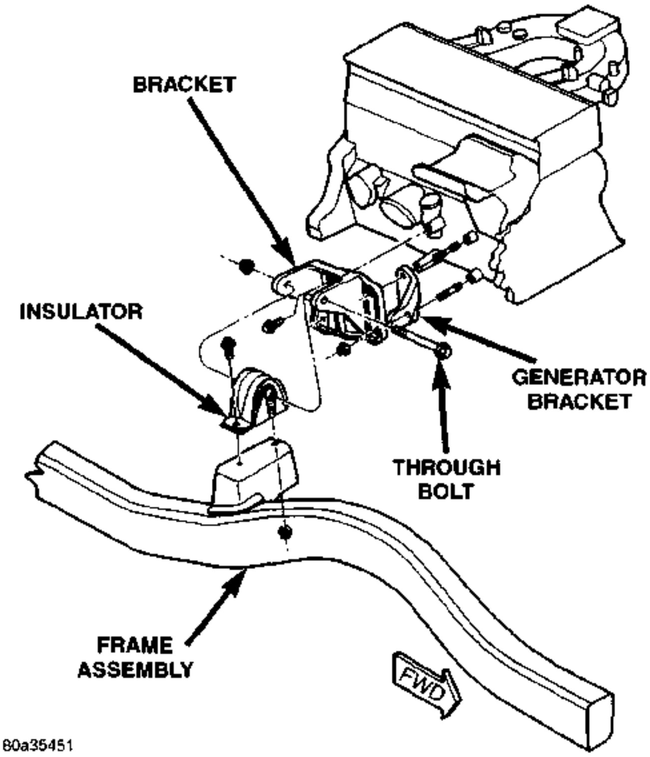


Fig. 20 Right Front Mount—2.5L Engine

(5) Lower the vehicle.
(6) Connect negative cable to battery.

ENGINE MOUNT—REAR

A resilient rubber cushion supports the transmission at the rear between the transmission extension housing and the rear support crossmember or skid plate.

REMOVAL

ALL TRANSMISSIONS

(1) Disconnect negative cable from battery.
(2) Raise the vehicle and support the transmission.
(3) Remove the nuts holding the support cushion to the skid plate (Fig. 21) (Fig. 22).
(4) Remove the skid plate bolts and the skid plate.

MANUAL TRANSMISSIONS

(1) Remove nuts holding support cushion to transmission support bracket.
(2) Remove the support cushion.
(3) Remove bolts holding transmission support bracket to transmission.
(4) Remove the transmission support bracket.

AUTOMATIC TRANSMISSIONS

(1) Remove nuts holding support cushion to transmission support bracket (Fig. 22). Remove the support cushion.

REMOVAL AND INSTALLATION (Continued)

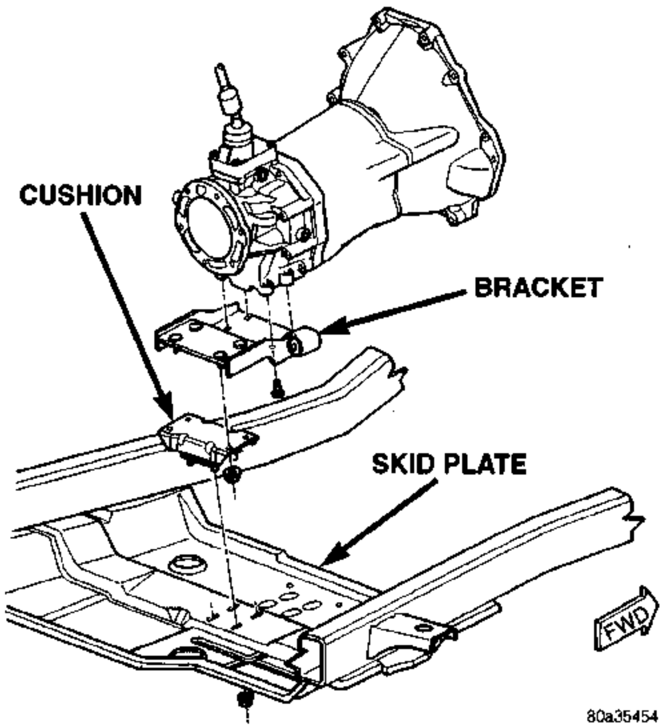


Fig. 21 Rear Mount (Manual Transmission)

(2) Remove the bolts holding the transmission support bracket to transmission.
(3) Remove the transmission support bracket.

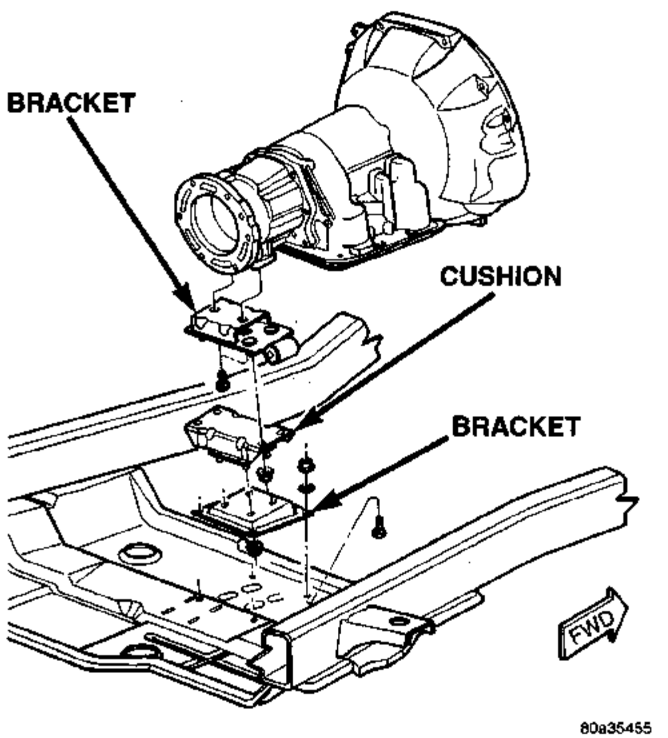


Fig. 22 Rear Mount (AutomaticTransmission)

INSTALLATION

MANUAL TRANSMISSION:

(1) Position the transmission mount bracket to the transmission and install the bolts (Fig. 21).
(2) Tighten the bolts to 54 N·m (40 ft. lbs.) torque.
(3) Position the support cushion to the transmission mount bracket and install nuts (Fig. 21).
(4) Tighten the nuts to 41 N·m (30 ft. lbs.) torque.

AUTOMATIC TRANSMISSION:

(1) Position the transmission mount bracket to the transmission and install the bolts. Tighten the bolts to 54 N·m (40 ft. lbs.) torque.
(2) Position the support cushion to the transmission mount bracket and install nuts. Tighten the nuts to 41 N·m (30 ft. lbs.) torque (Fig. 22).
(3) If the support cushion bracket was removed from the skid plate, position the bracket on the skid plate and install the nuts and bolts. Tighten the nuts to 28 N·m (21 ft. lbs.) torque.

ALL TRANSMISSIONS

(1) Position the skid plate to the studs of the support cushion and install the nuts (Fig. 21) (Fig. 22). Tighten the nuts to 28 N·m (21 ft. lbs.) torque.
(2) Install the skid plate bolts to the sill and tighten to 75 N·m (55 ft. lbs.) torque.
(3) Remove the transmission support.
(4) Lower the vehicle.
(5) Connect negative cable to battery.

ENGINE ASSEMBLY

REMOVAL

(1) Place a protective cloth over the windshield frame. Raise the hood and rest it on the windshield frame.
(2) Disconnect the battery cable clamps and remove the battery.

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. USE CARE TO PREVENT SCALDING BY HOT COOLANT. CAREFULLY RELEASE THE PRESSURE BEFORE REMOVING THE RADIATOR DRAIN COCK AND CAP.

(3) Remove the radiator drain cock and radiator cap to drain the coolant. DO NOT waste usable coolant. If the solution is clean, drain the coolant into a clean container for reuse.
(4) Disconnect the wire connectors from the generator.
(5) Disconnect the ignition coil and distributor wire connectors.
(6) Disconnect the oil pressure sender wire connector.

REMOVAL AND INSTALLATION (Continued)

(7) Disconnect the wires at the starter motor solenoid and injection wire harness connector.

(8) Disconnect the quick-connect fuel lines at the fuel rail and return line by squeezing the two retaining tabs against the fuel tube (Fig. 23). Pull the fuel tube and retainer from the quick-connect fitting (refer to Group 14, Fuel System for the proper procedure).

(9) Remove the fuel line bracket from the intake manifold.

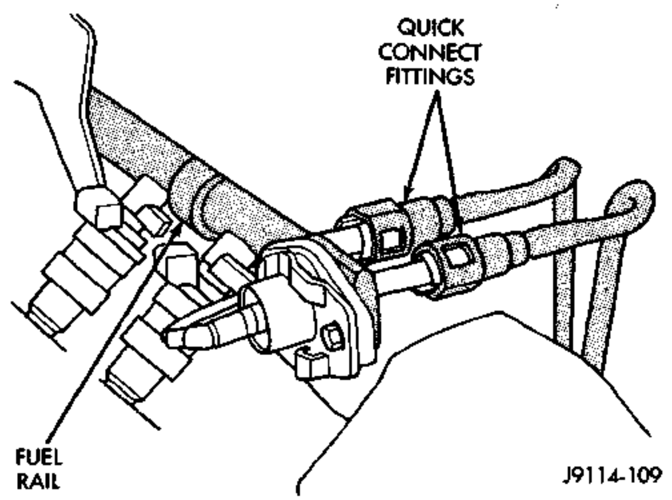


Fig. 23 Fuel Line Quick-Connect Couplings

(10) Disconnect the engine ground strap.

(11) Remove the air cleaner assembly.

(12) Disconnect the vacuum purge hose at the fuel vapor canister tee.

(13) Disconnect the idle speed actuator wire connector.

(14) Disconnect the throttle cable and remove it from the bracket.

(15) Disconnect the throttle rod at the bellcrank.

(16) Disconnect the speed control cable, if equipped.

(17) Disconnect the oxygen sensor wire connector.

(18) Disconnect the upper and lower radiator hoses at the radiator.

(19) Disconnect the coolant hoses from the rear of the intake manifold and thermostat housing.

(20) Disconnect the heater hoses.

(21) Remove the fan shroud screws.

(22) Remove the radiator attaching bolts.

(23) Remove the radiator and fan shroud.

(24) Remove the fan and spacer or Tempatrol fan assembly.

(25) Install a 5/16 X 1/2-inch SAE capscrew through fan pulley into water pump flange. This will maintain the pulley and water pump in alignment when crankshaft is rotated.

(26) Remove the power brake vacuum check valve from the booster, if equipped.

(27) If equipped with power steering:

(a) Disconnect the hoses from the fittings at the steering gear.

(b) Drain the pump reservoir.

(c) Cap the fittings on the hoses and steering gear to prevent foreign objects from entering the system.

(28) Lift the vehicle and support it with support stands.

(29) Remove the oil filter.

(30) Remove the starter motor.

(31) Remove the flywheel housing access cover.

(32) Remove the engine support cushion-to-bracket through bolts.

(33) Disconnect the exhaust pipe from the manifold.

(34) Remove the upper flywheel housing bolts and loosen the bottom bolts.

(35) Remove the engine shock damper bracket from the sill.

(36) Lower the vehicle.

(37) Attach a lifting device to the engine.

(38) Raise the engine off the front supports.

(39) Place a support stand under the flywheel housing.

(40) Remove the remaining flywheel housing bolts.

(41) Lift the engine out of the engine compartment and install on an engine stand.

(42) Install the oil filter to keep foreign material out of the engine.

INSTALLATION

(1) Remove the oil filter.

(2) Lift the engine off the stand and lower it into the engine compartment. For easier installation, it may be useful to remove the engine support cushions from the engine support brackets as an aide for alignment of the engine-to-transmission.

(3) Insert the transmission shaft into the clutch spline.

(4) Align the flywheel housing with the engine.

(5) Install and finger tighten the flywheel housing lower bolts.

(6) Install the engine support cushions (if removed).

(7) Remove the support stand from beneath the flywheel housing.

(8) Lower the engine and engine support cushions onto the engine compartment brackets. Ensure that the bolt holes are aligned. Install the bolts and tighten.

(9) Remove the engine lifting device.

(10) Raise the vehicle.

(11) Attach the engine shock damper bracket to the sill.

REMOVAL AND INSTALLATION (Continued)

(12) Attach the exhaust pipe to the manifold. Install and tighten the nuts to 31 N·m (23 ft. lbs.) torque.

(13) Install the flywheel housing access cover.

(14) Install the remaining flywheel housing bolts. Tighten the bolts to 38 N·m (28 ft. lbs.) torque.

(15) Install the starter motor and connect the cable. Tighten the bolts to 45 N·m (33 ft. lbs.) torque.

(16) Install the oil filter.

(17) Lower the vehicle.

(18) Connect the coolant hoses and tighten the clamps.

(19) If equipped with power steering:

(a) Remove the protective caps

(b) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.

(c) Fill the pump reservoir with fluid.

(20) Remove the pulley-to-water pump flange alignment capscrew and install the fan and spacer or Tempatrol fan assembly.

(21) Tighten the serpentine drive belt according to the specifications listed in Group 7, Cooling System.

(22) Install the fan shroud and radiator.

(23) Connect the radiator hoses.

(24) Connect the heater hoses.

(25) Connect the throttle valve rod and retainer.

(26) Connect the throttle cable and install the rod.

(27) Install the throttle valve rod spring.

(28) Connect the speed control cable, if equipped.

(29) Connect the oxygen sensor wire connector.

(30) Install the vacuum hose and check valve on the brake booster.

(31) Connect the coolant temperature sensor wire connector.

(32) Connect the idle speed actuator wire connector.

(33) Connect the fuel inlet and return hoses at the fuel rail. Verify that the quick-connect fitting assembly fits securely over the fuel lines by giving the fuel lines a firm tug.

(34) Install the fuel line bracket to the intake manifold.

(35) Connect all fuel injection wire connections.

(36) Install the engine ground strap.

(37) Connect the ignition coil wire connector.

(38) Remove the coolant temperature sending unit to permit air to escape from the block. Fill the cooling system with coolant. Install the coolant temperature sending unit when the system is filled.

(39) Install the battery and connect the battery cables.

(40) Install the air cleaner bonnet to the throttle body.

(41) Install the air cleaner.

(42) Lower the hood and secure in place.

(43) Start the engine and inspect for leaks.

(44) Stop the engine and check the fluid levels. Add fluid, as required.

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. 24).

(3) Disconnect the fresh air inlet hose from the engine cylinder head cover (Fig. 24).

(4) Remove the engine cylinder head cover mounting bolts.

(5) Remove the engine cylinder head cover.

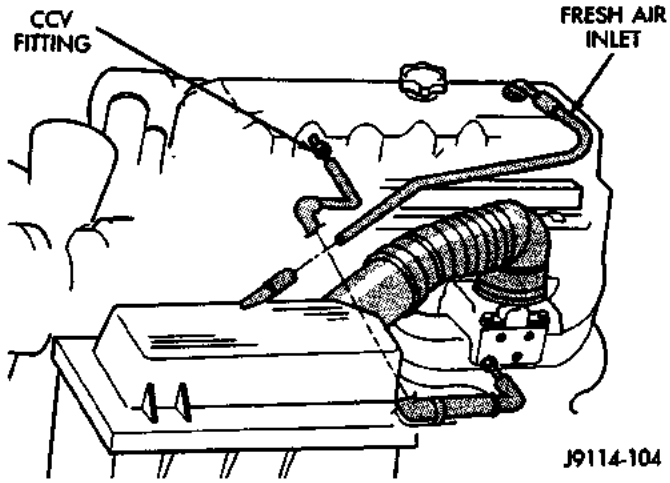


Fig. 24 Engine Cylinder Head Cover

(6) Remove any original sealer from the cover sealing surface of the engine cylinder head and clean the surface using a fabric cleaner.

(7) Remove all residue from the sealing surface using a clean, dry cloth.

INSTALLATION

(1) Inspect the engine cylinder head cover for cracks. Replace the cover, if cracked.

NOTE: The original dark 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.

REMOVAL AND INSTALLATION (Continued)

(2) If a replacement cover is installed, transfer the CCV valve grommet the oil filler cap from the original cover to the replacement cover.

(3) Install engine cylinder head cover. Tighten the mounting bolts to 14 N·m (115 in. lbs.) torque.

(4) Connect the CCV hoses (Fig. 24).

(5) Connect negative cable to battery.

ROCKER ARMS AND PUSH RODS

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. 25). 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. 25). 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.

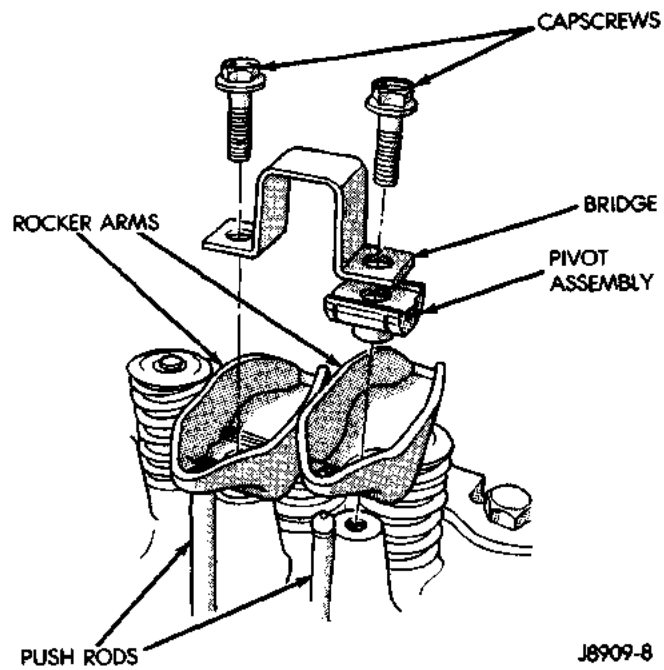


Fig. 25 Rocker Arm Assembly

(6) Clean all the components with cleaning solvent.

(7) Use compressed air to blow out the oil passages in the rocker arms and push rods.

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 original 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.

VALVE SPRINGS AND OIL SEALS

This procedure can be done with the engine cylinder head installed on the block.

REMOVAL

Each valve spring is held in place by a retainer and a set of conical valve locks. The locks can be removed only by compressing the valve spring.

(1) Remove the engine cylinder head cover.

(2) Remove capscrews, bridge and pivot assemblies and rocker arms for access to each valve spring to be removed.

(3) Remove push rods. Retain the push rods, bridges, pivots and rocker arms in the same order and position as removed.

(4) Inspect the springs and retainer for cracks and possible signs of weakening.

(5) Remove the spark plug(s) adjacent to the cylinder(s) below the valve springs to be removed.

(6) Install a 14 mm (1/2 inch) (thread size) air hose adaptor in the spark plug hole.

(7) Connect an air hose to the adapter and apply air pressure slowly. Maintain at least 621 kPa (90 psi) of air pressure in the cylinder to hold the valves against their seats. For vehicles equipped with an air conditioner, use a flexible air adaptor when servicing the No.1 cylinder.

(8) Tap the retainer or tip with a rawhide hammer to loosen the lock from the retainer. Use Valve Spring Compressor Tool MD-998772A to compress the spring and remove the locks (Fig. 26).

(9) Remove valve spring and retainer (Fig. 26).

(10) Remove valve stem oil seals (Fig. 26). 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.

INSTALLATION

Inspect the valve stems, especially the grooves. An Arkansas smooth stone should be used to remove nicks and high spots.

REMOVAL AND INSTALLATION (Continued)

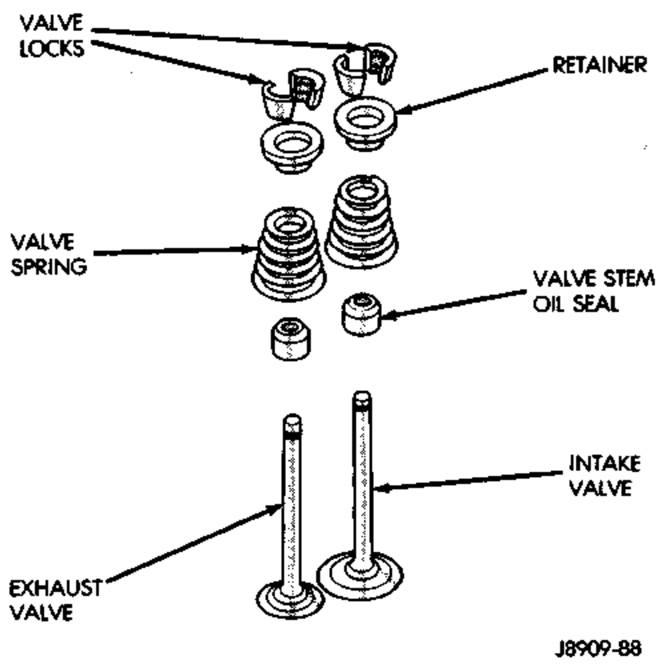


Fig. 26 Valve and Valve Components

CAUTION: Install oil seals carefully to prevent damage from the sharp edges of the valve spring lock grove.

(1) Lightly push the valve seal over the valve stem and valve guide boss. Be sure the seal is completely seated on the valve guide boss.

(2) Install valve spring and retainer.

(3) Compress the valve spring with Valve Spring Compressor Tool MD-998772A and insert the valve locks. Release the spring tension and remove the tool. Tap the spring from side-to-side to ensure that the spring is seated properly on the engine cylinder head.

(4) Disconnect the air hose. Remove the adaptor from the spark plug hole and install the spark plug.

(5) Repeat the procedures for each remaining valve spring to be removed.

(6) Install the push rods. Ensure the bottom end of each rod is centered in the plunger cap seat of the hydraulic valve tappet.

(7) Install the rocker arms, pivots and bridge at their original location.

(8) Tighten the bridge capscrews alternately, one at a time, to avoid damaging the bridge. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(9) Install the engine cylinder head cover.

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. 27).

(6) Remove the push rods (Fig. 27). **Retain the push rods, bridges, pivots and rocker arms in the same order as removed.**

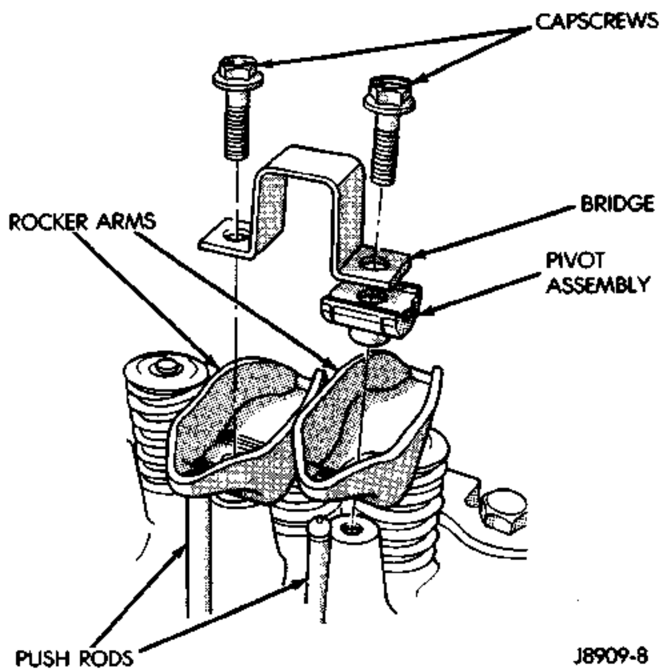


Fig. 27 Rocker Arm Assembly

(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.

REMOVAL AND INSTALLATION (Continued)

(10) Remove the fuel lines and vacuum advance hose.

(11) Remove the intake and engine exhaust manifolds from the engine cylinder head (refer to Group 11, Exhaust System and Intake Manifold for the proper procedures).

(12) Disconnect the ignition wires and remove the spark plugs.

(13) Disconnect the temperature sending unit wire connector.

(14) Remove the ignition coil and bracket assembly.

(15) Remove the engine cylinder head bolts.

(16) Remove the engine cylinder head and gasket (Fig. 28).

(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.

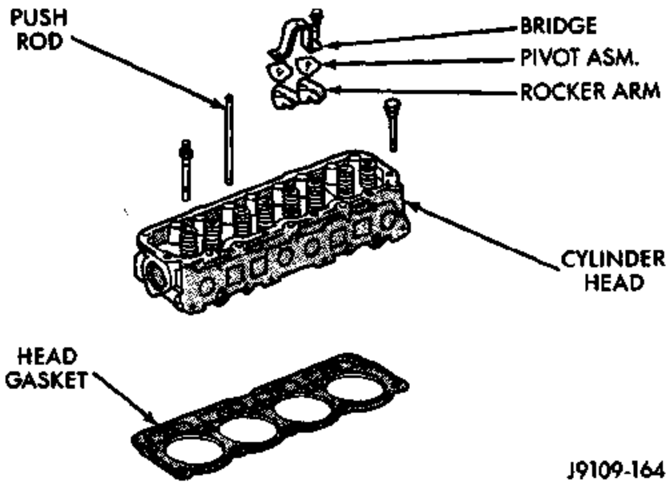


Fig. 28 Engine Cylinder Head Assembly

INSTALLATION

The engine cylinder head gasket is a composition gasket. The gasket is to be installed DRY. **DO NOT use a gasket sealing compound on the gasket.**

If the engine cylinder head is to be replaced and the original valves used, measure the valve stem diameter. Only standard size valves can be used with a service replacement engine cylinder head unless the replacement head valve stem guide bores are reamed to accommodate oversize valve stems. Remove all carbon buildup and reface the valves.

(1) Fabricate two engine cylinder head alignment dowels from used head bolts (Fig. 29). Use the longest head bolt. Cut the head of the bolt off below the hex head. Then cut a slot in the top of the dowel to allow easier removal with a screwdriver.

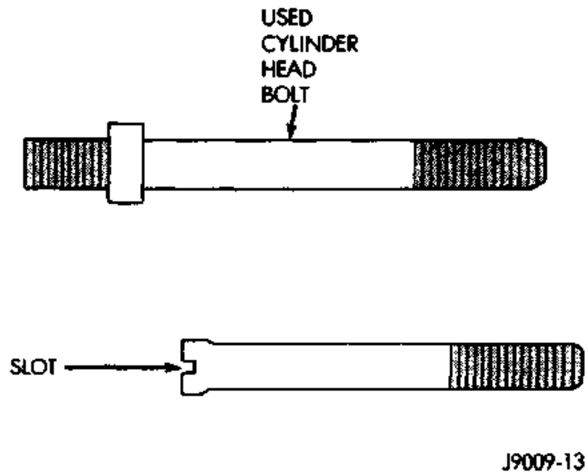


Fig. 29 Fabricate Alignment Dowels

(2) Install one dowel in bolt hole No.10 and the other dowel in bolt hole No.8 (Fig. 30).

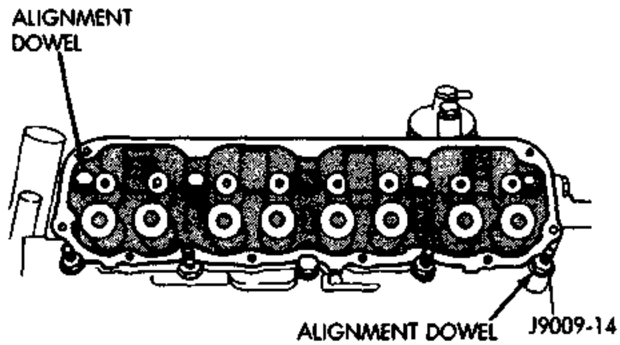


Fig. 30 Alignment Dowel Locations

(3) Remove the shop towels from the cylinder bores. Coat the bores with clean engine oil.

(4) Place the engine cylinder head gasket (with the numbers facing up) over the dowels.

(5) Place the engine cylinder head over the dowels.

CAUTION: Engine cylinder head bolts should be reused only once. Replace the head bolts if they were used before or if they have a paint dab on the top of the bolt.

(6) Coat the threads of bolt No.7, only, with Loctite PST sealant or equivalent.

(7) Install all head bolts, except No.8 and No.10.

(8) Remove the dowels.

(9) Install No.8 and No.10 head bolts.

CAUTION: During the final tightening sequence, bolt No.7 will be tightened to a lower torque than the rest of the bolts. DO NOT overtighten bolt No.7.

(10) Tighten the engine cylinder head bolts in sequence according to the following procedure (Fig. 31):

(a) Tighten all bolts in sequence (1 through 10) to 30 N·m (22 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(b) Tighten all bolts in sequence (1 through 10) to 61 N·m (45 ft. lbs.) torque.

(c) Check all bolts to verify they are set to 61 N·m (45 ft. lbs.) torque.

(d) Tighten bolts (in sequence):

- Bolts 1 through 6 to 149 N·m (110 ft. lbs.) torque.
- Bolt 7 to 136 N·m (100 ft. lbs.) torque.
- Bolts 8 through 10 to 149 N·m (110 ft. lbs.) torque.

(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.

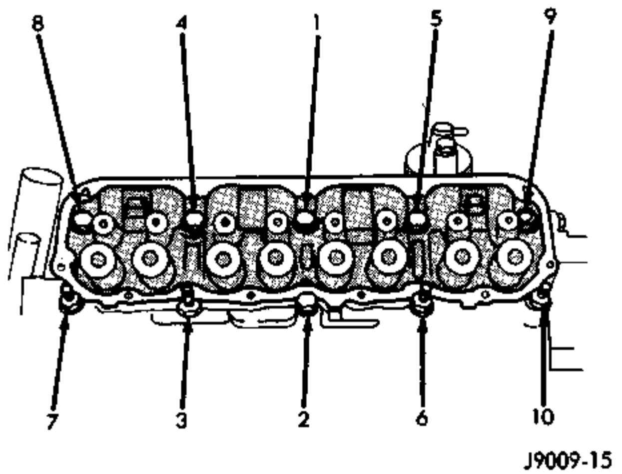


Fig. 31 Engine cylinder head Bolt Tightening Sequence

(11) Install the ignition coil and bracket assembly.

(12) Connect the temperature sending unit wire connector.

(13) Install the spark plugs and tighten to 37 N·m (27 ft. lbs.) torque. Connect the ignition wires.

(14) Install the intake and exhaust manifolds (refer to Group 11, Exhaust System and Intake Manifold for the proper procedures).

(15) Install the fuel lines and the vacuum advance hose.

(16) If equipped, attach the power steering pump and bracket.

(17) Install the push rods, rocker arms, pivots and bridges in the order they were removed.

(18) Install the engine cylinder head cover.

(19) Attach the air conditioning compressor mounting bracket to the engine cylinder head and block. Tighten the bolts to 40 N·m (30 ft. lbs.) torque.

(20) Attach the air conditioning compressor to the bracket. Tighten the bolts to 27 N·m (20 ft. lbs.) torque.

CAUTION: The serpentine drive belt must be routed correctly. Incorrect routing can cause the water pump to turn in the opposite direction causing the engine to overheat.

(21) Install the serpentine drive belt and correctly tension the belt (refer to Group 7, Cooling System for the proper procedure).

(22) Install the air cleaner and ducting.

(23) Install the engine cylinder head cover.

(24) Connect the hoses to the thermostat housing and fill the cooling system to the specified level (refer to Group 7, Cooling Systems for the proper procedure).

(25) The automatic transmission throttle linkage and cable must be adjusted after completing the engine cylinder head installation (refer to Group 21, Transmissions for the proper procedures).

(26) Install the temperature sending unit and connect the wire connector.

(27) Connect the fuel pipe and vacuum advance hose.

(28) Connect negative cable to battery.

(29) Connect the upper radiator hose and heater hose at the thermostat housing.

(30) Fill the cooling system. Check for leaks.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN DIRECT LINE WITH THE FAN. DO NOT PUT HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(31) Operate the engine with the radiator cap off. Inspect for leaks and continue operating the engine until the thermostat opens. Add coolant, if required.

VALVES AND VALVE SPRINGS

This procedure is done with the engine cylinder head removed from the block.

REMOVAL

(1) Remove the engine cylinder head from the cylinder block.

(2) Use Valve Spring Compressor Tool MD-998772A and compress each valve spring.

(3) Remove the valve locks, retainers, springs and valve stem oil seals. Discard the oil seals.

(4) Use an Arkansas smooth stone or a jewelers file to remove any burrs on the top of the valve stem, especially around the groove for the locks.

(5) Remove the valves, and place them in a rack in the same order as removed.

INSTALLATION

(1) Thoroughly clean the valve stems and the valve guide bores.

REMOVAL AND INSTALLATION (Continued)

(2) Lightly lubricate the stem.

(3) Install the valve in the original valve guide bore.

(4) Install the replacement valve stem oil seals on the valve stems. If the 0.381 mm (0.015 inch) oversize valve stems are used, oversize oil seals are required.

(5) Position the valve spring and retainer on the engine cylinder head and compress the valve spring with Valve Spring Compressor Tool MD-998772A.

(6) Install the valve locks and release the tool.

(7) Tap the valve spring from side to side with a hammer to ensure that the spring is properly seated at the engine cylinder head. Also tap the top of the retainer to seat the valve locks.

(8) Install the engine cylinder head.

HYDRAULIC TAPPETS

REMOVAL

Retain all the components in the same order as removed.

(1) Remove the engine cylinder head cover.

(2) Remove the bridge and pivot assemblies and rocker arms by removing the capscrews at each bridge. Alternately loosen each capscrew, one turn at a time, to avoid damaging the bridges.

(3) Remove the push rods.

(4) Remove the tappets through the push rod openings in the cylinder head with a Hydraulic Valve Tappet Removal/Installation Tool (Fig. 32).

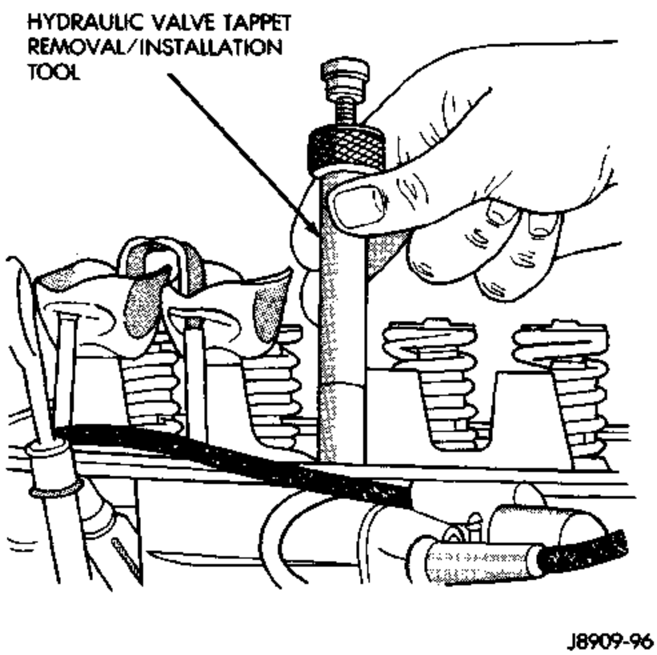


Fig. 32 Hydraulic Valve Tappet Removal/Installation Tool

INSTALLATION

It is not necessary to charge the tappets with engine oil. They will charge themselves within a very short period of engine operation.

(1) Dip each tappet in Mopar Engine Oil Supplement, or equivalent.

(2) Use Hydraulic Valve Tappet Removal/Installation Tool to install each tappet in the same bore from where it was originally removed.

(3) Install the push rods in their original locations.

(4) Install the rocker arms and bridge and pivot assemblies at their original locations. Loosely install the capscrews at each bridge.

(5) Tighten the capscrews alternately, one turn at a time, to avoid damaging the bridges. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(6) Pour the remaining Mopar Engine Oil Supplement, or equivalent over the entire valve actuating assembly. The Mopar Engine Oil Supplement, or equivalent must remain with the engine oil for at least 1 600 km (1,000 miles). The oil supplement need not be drained until the next scheduled oil change.

(7) Install the engine cylinder head cover.

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 7697 to remove the damper from the crankshaft (Fig. 33).

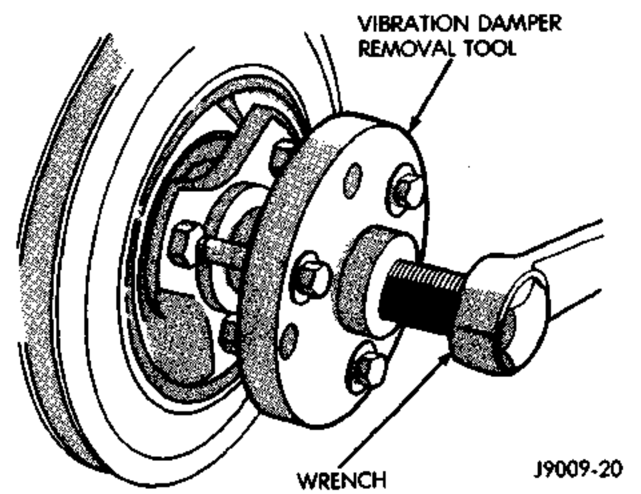


Fig. 33 Vibration Damper Removal Tool 7697

INSTALLATION

(1) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key in position, align the keyway on the

REMOVAL AND INSTALLATION (Continued)

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

REMOVAL

This procedure is done with the timing case cover installed.

(1) Disconnect negative cable from battery.

(2) Remove the serpentine drive belt.

(3) Remove the vibration damper.

(4) Remove the radiator shroud.

(5) Carefully remove the oil seal. Make sure seal bore is clean.

INSTALLATION

(1) 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.

(2) Position the tool and seal over the end of the crankshaft and insert a draw screw tool into Seal Installation Tool 6139 (Fig. 34). Tighten the nut against the tool until it contacts the cover.

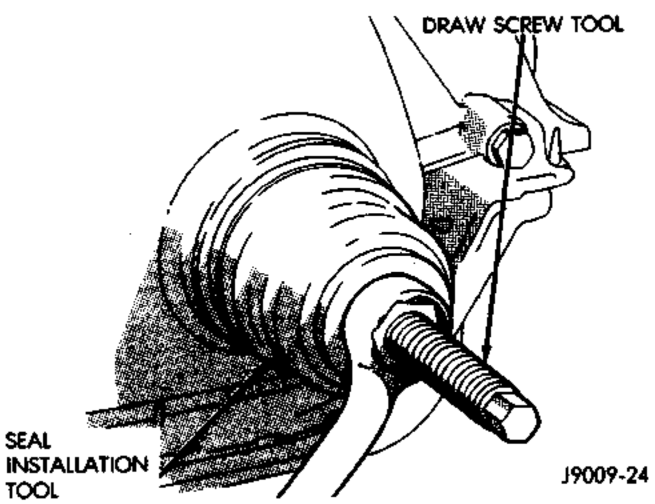


Fig. 34 Timing Case Cover Oil Seal Installation

(3) Remove the tools. Apply a light film of engine oil on the vibration damper hub contact surface of the seal.

(4) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(5) Install the serpentine belt and tighten to the specified tension (refer to Group 7, Cooling Systems for the proper specifications and procedures).

(6) Install the radiator shroud.

(7) Connect negative cable to battery.

TIMING CASE COVER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the vibration damper (Fig. 35).

(3) Remove the fan and hub assembly and remove the fan shroud.

(4) Remove the accessory drive brackets that are attached to the timing case cover.

(5) Remove the A/C compressor (if equipped) and generator bracket assembly from the engine cylinder head and move to one side.

(6) Remove the oil pan-to-timing case cover bolts and timing case cover-to-cylinder block bolts.

(7) Remove the timing case cover and gasket from the engine.

(8) Pry the crankshaft oil seal from the front of the timing case cover (Fig. 35).

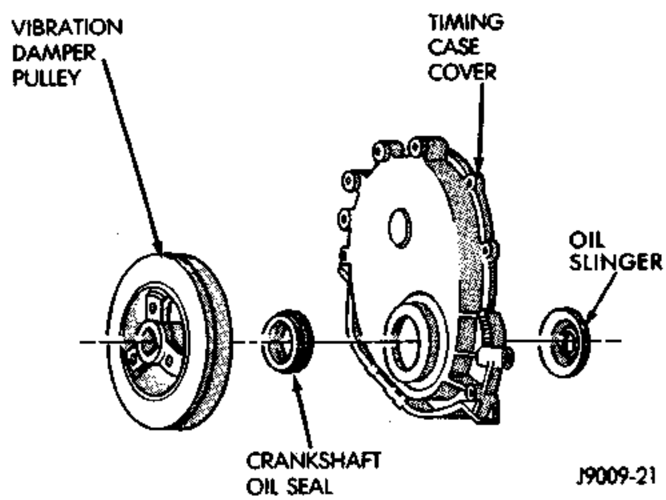


Fig. 35 Timing Case Cover Components

INSTALLATION

(1) Clean the timing case cover, oil pan and cylinder block gasket surfaces.

(2) 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.

(3) Position the gasket on the cylinder block.

REMOVAL AND INSTALLATION (Continued)

(4) Position the timing case cover on the oil pan gasket and the cylinder block.

(5) Insert Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening in the cover (Fig. 36).

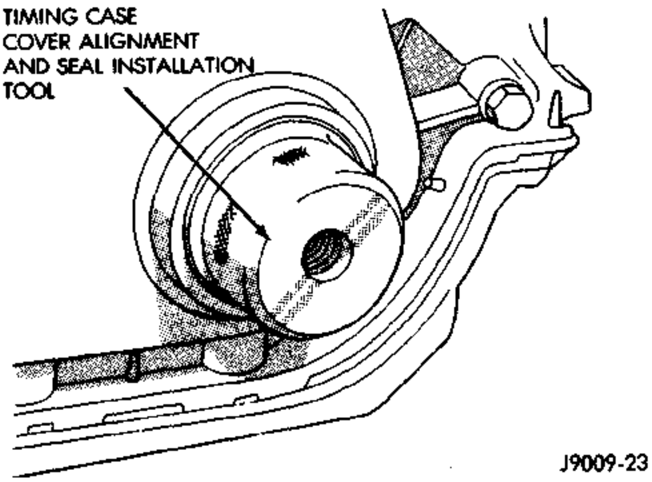


Fig. 36 Timing Case Cover Alignment and Seal Installation Tool 6139

(6) Install the timing case cover-to-cylinder block and the oil pan-to-timing case cover bolts.

(7) Tighten the 1/4 inch cover-to-block bolts to 7 N·m (60 in. lbs.) torque. Tighten the 5/16 inch front cover-to-block bolts to 22 N·m (192 in. lbs.) torque. Tighten the oil pan-to-cover 1/4 inch bolts to 14 N·m (120 in. lbs.) torque. Tighten the oil pan-to-cover 5/16 inch bolts to 9.5 N·m (84 in. lbs.) torque.

(8) Remove the cover alignment tool.

(9) Apply a light film of engine oil on the vibration damper hub contact surface of the seal.

(10) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(11) Install the A/C compressor (if equipped) and generator bracket assembly.

(12) Install the engine fan and hub assembly and shroud.

(13) Install the serpentine drive belt and tighten to obtain the specified tension.

(14) Connect negative cable to battery.

TIMING CHAIN AND SPROCKETS

The timing chain tensioner reduces noise and prolongs timing chain life. In addition, it compensates for slack in a worn or stretched chain and maintains the correct valve timing.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the fan and shroud.

(3) Remove the serpentine drive belt.

(4) Remove the crankshaft vibration damper.

(5) Remove the timing case cover.

(6) Rotate crankshaft until the "0" timing mark is closest to and on the center line with camshaft sprocket timing mark (Fig. 37).

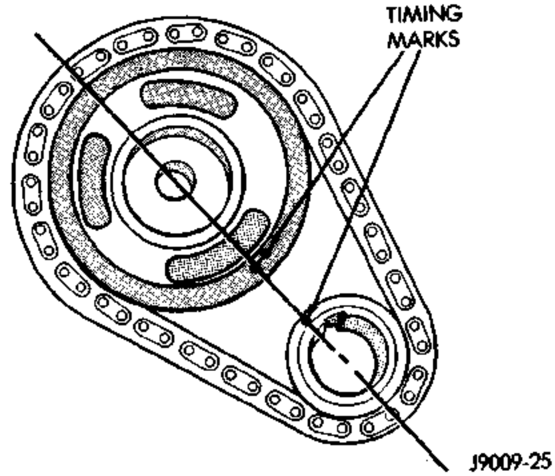


Fig. 37 Crankshaft—Camshaft Alignment

(7) Remove the oil slinger from the crankshaft.

(8) Remove the camshaft retaining bolt and remove the sprockets and chain as an assembly (Fig. 38).

(9) To replace the timing chain tensioner, the oil pan must be removed.

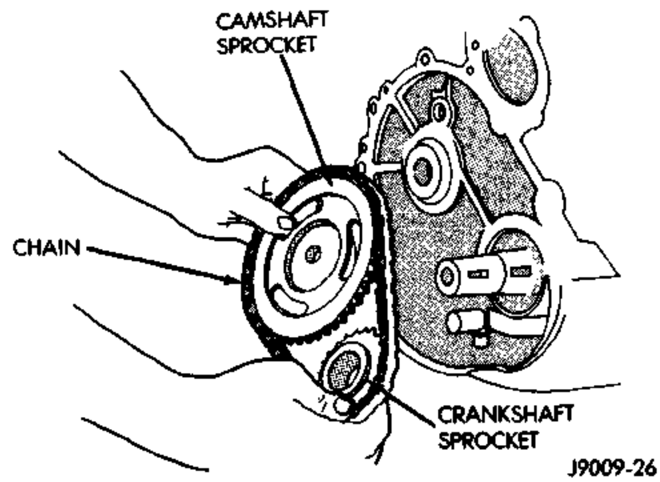


Fig. 38 Camshaft and Crankshaft Sprockets and Chain

INSTALLATION

(1) Turn the tensioner lever to the unlocked (down) position (Fig. 39).

REMOVAL AND INSTALLATION (Continued)

(2) Pull the tensioner block toward the tensioner lever to compress the spring. Hold the block and turn the tensioner lever to the lock position (Fig. 39).

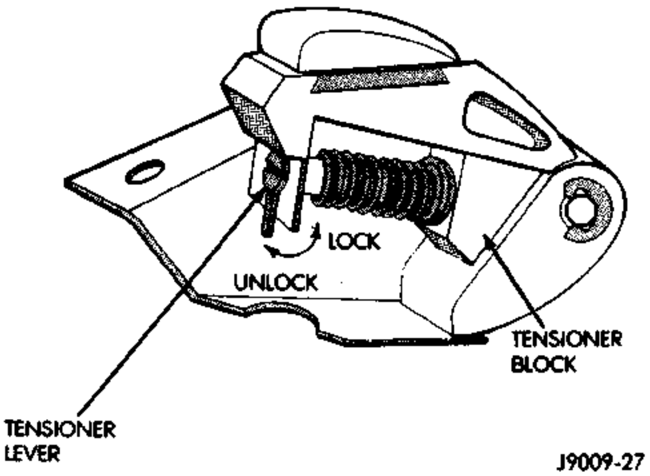


Fig. 39 Loading Timing Chain Tensioner

(3) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key in the crankshaft keyway, install the crankshaft, camshaft sprockets and timing chain. Ensure the timing marks on the sprockets are properly aligned (Fig. 37).

(4) Install the camshaft sprocket retaining bolt and washer. Tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(5) Turn the chain tensioner lever to the unlocked (down) position (Fig. 39).

(6) Install the oil slinger.

(7) Replace the oil seal in the timing case cover.

(8) Install the timing case cover and gasket.

(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 fan and shroud.

(11) Connect negative cable to battery.

CAMSHAFT

REMOVAL

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. RELEASE THE PRESSURE BEFORE REMOVING THE DRAIN COCK, CAP AND DRAIN PLUGS.

(1) Disconnect negative cable from battery.

(2) Drain the cooling system. DO NOT waste reusable coolant. If the solution is clean, drain it into a clean container for reuse.

(3) Remove the radiator or radiator and condenser, if equipped with A/C.

(4) Scribe a mark on the distributor housing in line with the lip of the rotor.

(5) Scribe a mark on the distributor housing near the clamp and continue the scribe mark on the cylinder block in line with the distributor mark.

(6) For ease of installation, note the position of the rotor and distributor housing in relation to adjacent engine components.

(7) Remove the distributor and ignition wires.

(8) Remove the engine cylinder head cover.

(9) Remove the rocker arms, bridges and pivots.

(10) Remove the push rods.

(11) Remove the hydraulic valve tappets from the engine cylinder head.

(12) Remove the vibration damper.

(13) Remove the timing case cover.

(14) Remove the timing chain and sprockets.

(15) Remove the camshaft (Fig. 40).

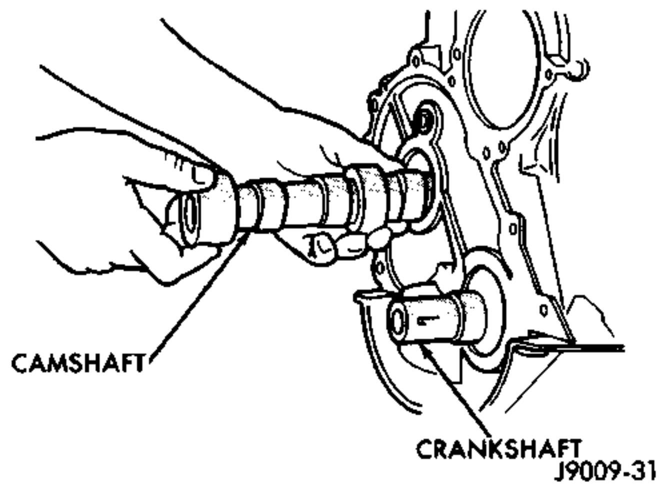


Fig. 40 Camshaft

INSTALLATION

(1) Inspect the cam lobes for wear.

(2) Inspect the bearing journals for uneven wear pattern or finish.

(3) Inspect the bearings for wear.

(4) Inspect the distributor drive gear for wear.

(5) 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.

(6) Lubricate the camshaft with Mopar Engine Oil Supplement, or equivalent.

(7) Carefully install the camshaft to prevent damage to the camshaft bearings (Fig. 40).

(8) Turn the tensioner lever to the unlocked (down) position (Fig. 41).

NOTE: Pull the tensioner block toward the tensioner lever to compress the spring. Hold the block and turn the tensioner lever to the lock position (Fig. 41).

REMOVAL AND INSTALLATION (Continued)

(9) Install the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned.

(10) Install the camshaft sprocket retaining bolt and washer. Tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(11) Install the timing case cover with a replacement oil seal (Fig. 42). Refer to Timing Case Cover Installation.

(12) Install the vibration damper.

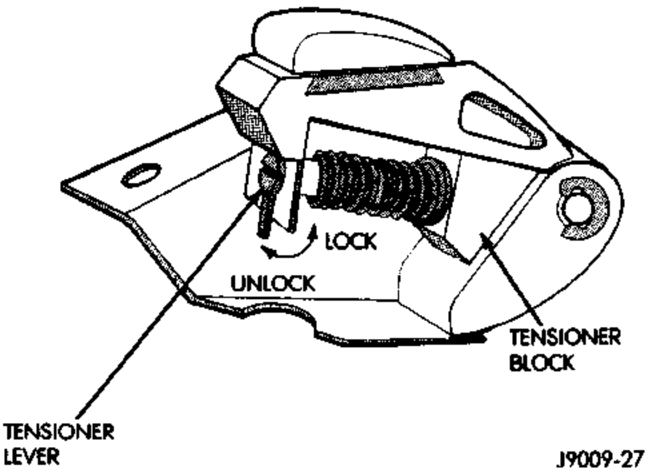


Fig. 41 Loading Timing Chain Tensioner

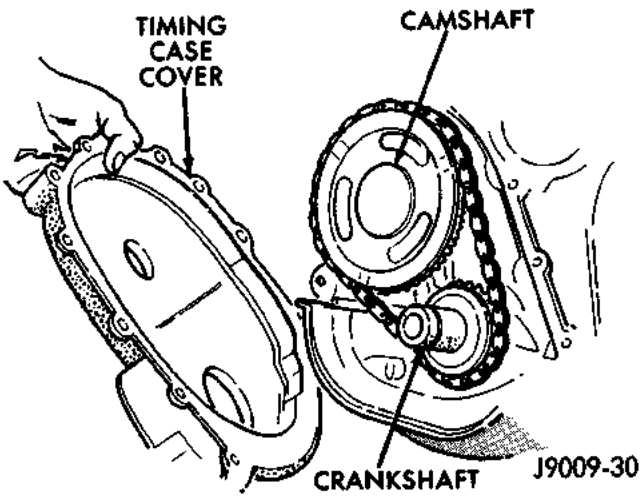


Fig. 42 Timing Case Cover

(13) Install the hydraulic valve tappets.

(14) Install the push rods.

(15) Install the rocker arms, bridges and pivots.

(16) Install the engine cylinder head cover.

(17) Position the oil pump gear. Refer to Distributor in the Component Removal/Installation section of Group 8D, Ignition Systems.

(18) Install the distributor and ignition wires. Refer to Distributor in the Component Removal/Installation section of Group 8D, Ignition Systems.

(19) Install the radiator or radiator and condenser, if equipped with A/C.

(20) Fill the cooling system.

(21) Connect negative cable to battery.

CAMSHAFT PIN REPLACEMENT

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAIN COCK WITH THE SYSTEM HOT AND PRESSURIZED BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.

(1) Disconnect negative cable from battery.

(2) Drain the radiator. DO NOT waste reusable coolant. Drain the coolant into a clean container.

(3) Remove the fan and shroud.

(4) Disconnect the radiator overflow tube, radiator hoses, automatic transmission fluid cooler pipes (if equipped).

(5) Remove the radiator.

(6) If equipped with air conditioning:

CAUTION: DO NOT loosen or disconnect any air conditioner system fittings. Move the condenser and receiver/drier aside as a complete assembly.

(a) Remove the A/C compressor serpentine drive belt idler pulley.

(b) Disconnect and remove the generator.

(c) Remove the A/C condenser attaching bolts and move the condenser and receiver/drier assembly up and out of the way.

(7) Remove the serpentine drive belt.

(8) Remove the crankshaft vibration damper.

(9) Remove the timing case cover. Clean the gasket material from the cover.

(10) Rotate crankshaft until the crankshaft sprocket timing mark is closest to and on the center line with the camshaft sprocket timing mark (Fig. 43).

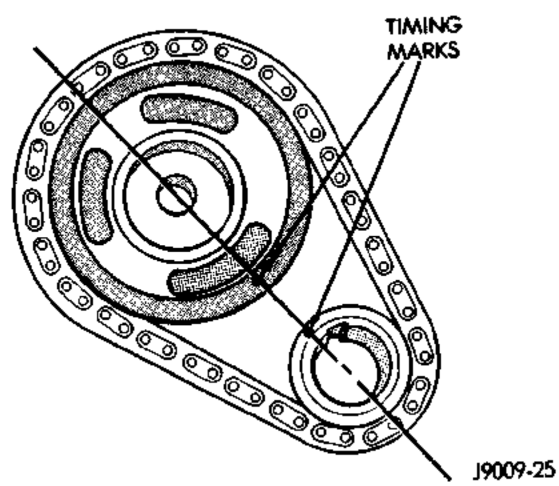


Fig. 43 Timing Chain Alignment

REMOVAL AND INSTALLATION (Continued)

(11) Remove camshaft sprocket retaining bolt.
(12) Remove the crankshaft oil slinger.
(13) Remove the sprockets and chain as an assembly (Fig. 44).

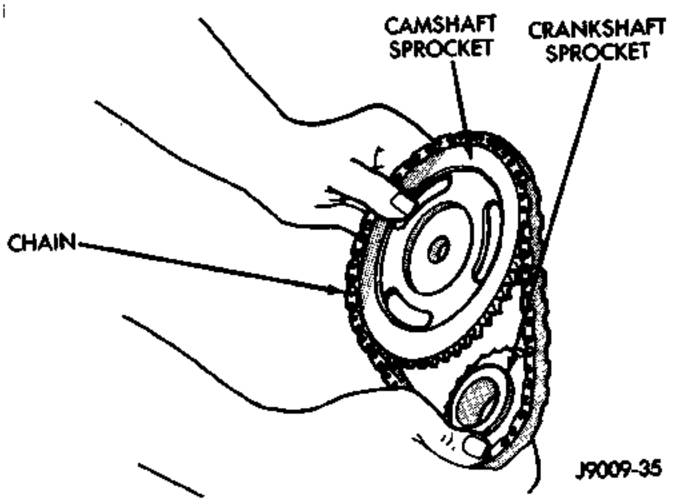


Fig. 44 Camshaft and Crankshaft Sprocket and Chain

CAUTION: The following procedural step must be accomplished to prevent the camshaft from damaging the rear camshaft plug during pin installation.

(14) Inspect the damaged camshaft pin.
(15) If the pin is a spring-type pin, remove the broken pin by inserting a self-tapping screw into the pin and carefully pulling the pin from the camshaft.
(16) If the pin is a dowel-type pin, center-punch it. Ensure the exact center is located when center-punching the pin.

CAUTION: Cover the opened oil pan area to prevent metal chips from entering the pan.

(17) Drill into the pin center with a 4 mm (5/32 inch) drill bit.
(18) Insert a self-tapping screw into the drilled pin and carefully pull the pin from the camshaft.

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. 43).
(5) Install the crankshaft oil slinger.
(6) Tighten the camshaft sprocket bolt to 108 N·m (80 ft. lbs.) torque.
(7) Check the valve timing.
(8) Coat both sides of the replacement timing case cover gasket with gasket sealer. Apply a 3 mm (1/8 inch) bead of Mopar Silicone Rubber Adhesive Sealant, or equivalent to the joint formed at the timing case cover and cylinder block.
(9) Position the timing case cover on the oil pan gasket and the cylinder block.
(10) Place Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening of the cover (Fig. 45).

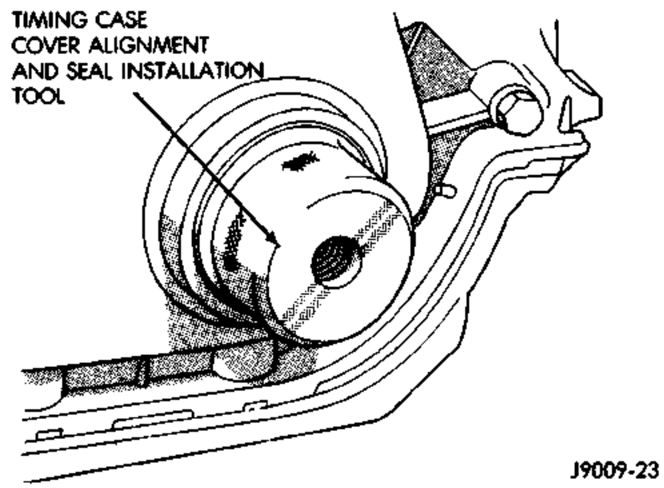


Fig. 45 Timing Case Cover Alignment and Seal Installation Tool 6139

(11) Install the timing case cover-to-cylinder block bolts. Install the oil pan-to-timing case cover bolts.
(12) Tighten the 1/4 inch cover-to-block bolts to 7 N·m (60 in. lbs.) torque. Tighten the 5/16 inch front cover-to-block bolts to 22 N·m (192 in. lbs.) torque. Tighten the oil pan-to-cover 1/4 inch bolts to 14 N·m (120 in. lbs.) torque. Tighten the oil pan-to-cover 5/16 inch bolts to 18 N·m (156 in. lbs.) torque.
(13) Remove the cover alignment tool and install a replacement oil seal into the cover.
(14) Install the vibration damper on the crankshaft.
(15) Lubricate and tighten the damper bolt to 108 N·m (80 ft. lbs.) torque.
(16) 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.
(17) Install the serpentine drive belt on the pulleys and tighten (refer to Group 7, Cooling System for the specifications and procedures).
(18) Install the radiator. Connect the radiator hoses and automatic transmission fluid cooler pipes, if equipped. Fill the cooling system.
(19) Install the fan and shroud.
(20) Connect negative cable to battery.

REMOVAL AND INSTALLATION (Continued)

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.

NOTE: It is not advisable to attempt to replace camshaft bearings unless special removal and installation tools are available.

Camshaft end play is maintained by the load placed on the camshaft by the oil pump and distributor drive gear. The helical cut of the gear holds the camshaft sprocket thrust face against the cylinder block face.

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. 46).

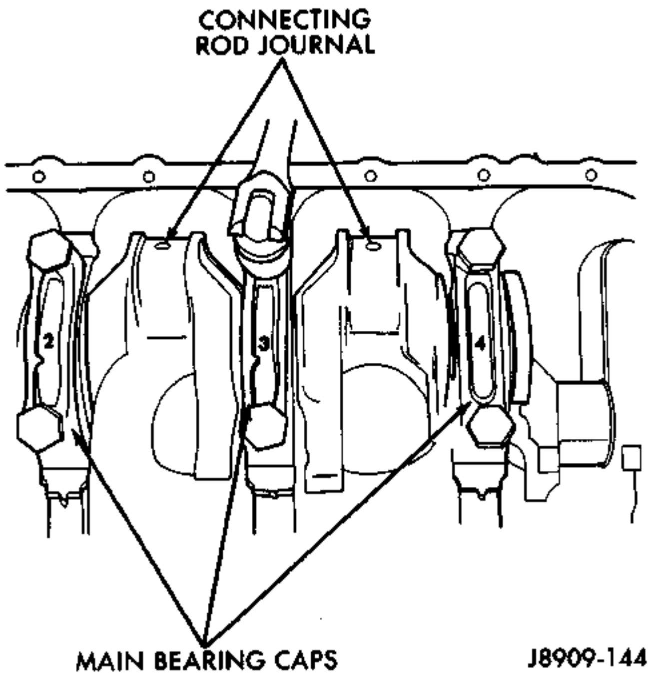


Fig. 46 Removing Main Bearing Caps and Lower Inserts

(6) Remove the lower insert from the bearing cap.

(7) Remove the upper insert by LOOSENING (DO NOT REMOVE) all of the other bearing caps. Now insert a small cotter pin tool in the crankshaft journal oil hole. Bend the cotter pin as illustrated to fabricate the tool (Fig. 47). 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. 47). After moving the insert approximately 25 mm (1 inch), it can be removed by applying pressure under the tab.

(8) Using the same procedure described above, remove the remaining bearing inserts one at a time for inspection.

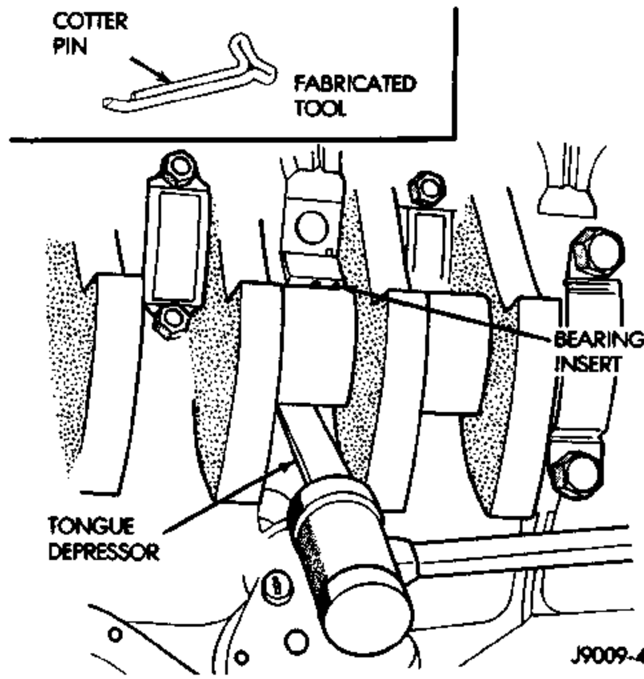


Fig. 47 Removing Upper Inserts

INSTALLATION

(1) Lubricate the bearing surface of each insert with engine oil.
(2) Loosen all the main bearing caps. Install the main bearing upper inserts.
(3) Install the lower bearing inserts into the main bearing caps.
(4) Install the main bearing cap(s) and lower insert(s).
(5) Clean the rear main bearing cap (No.5) mating surfaces.
(6) Apply Loctite 518, or equivalent on the rear bearing cap (Fig. 48). The bead should be 3 mm (0.125 in) thick. DO NOT apply Loctite 518, or equivalent to the lip of the seal.
(7) Install the rear main bearing cap. DO NOT strike the cap more than twice for proper engagement.

REMOVAL AND INSTALLATION (Continued)

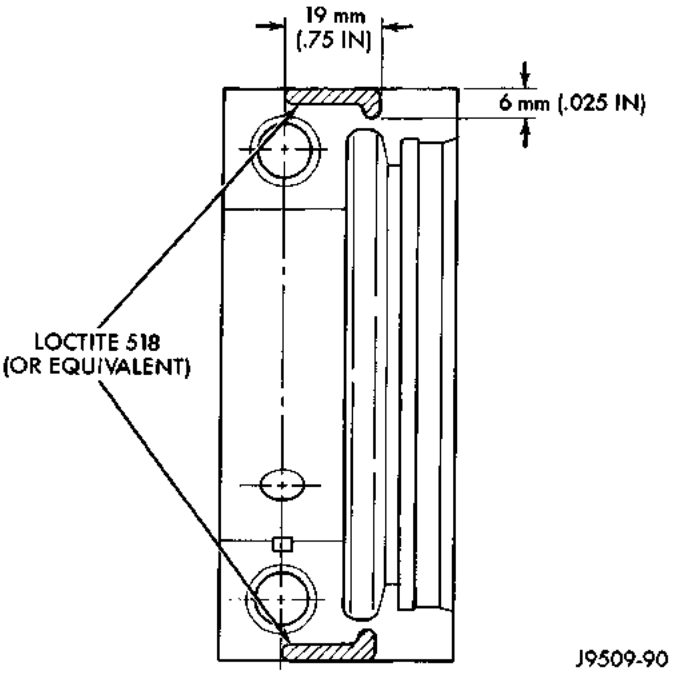


Fig. 48 Location of Loctite 518 (or equivalent)

(8) Tighten the bolts of caps 1, 3, 4 and 5 to 54 N·m (40 ft. lbs.) torque. Now tighten these bolts to 95 N·m (70 ft. lbs.) torque. Finally, tighten these bolts to 108 N·m (80 ft. lbs.) torque.

(9) Push the crankshaft forward and backward. Load the crankshaft front or rear and tighten cap bolt No.2 to 54 N·m (40 ft. lbs.) torque. Then tighten to 95 N·m (70 ft. lbs.) torque and finally tighten to 108 N·m (80 ft. lbs.) torque.

(10) Rotate the crankshaft after tightening each main bearing cap to ensure the crankshaft rotates freely.

(11) Check crankshaft end play. Crankshaft end play is controlled by the thrust bearing which is flange and installed at the No.2 main bearing position.

(a) Attach a magnetic base dial indicator to the cylinder block at either the front or rear of the engine.

(b) Position the dial indicator rod so that it is parallel to the center line of the crankshaft.

(c) Pry the crankshaft forward, position the dial indicator to zero.

(d) Pry the crankshaft forward and backward. Note the dial indicator readings. End play is the difference between the high and low measurements (Fig. 49). 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.

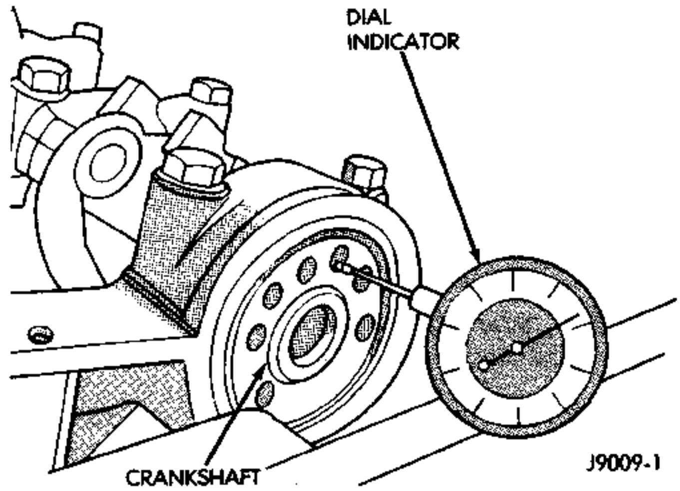


Fig. 49 Crankshaft End Play Measurement

(12) If the crankshaft was removed, install the crankshaft into the cylinder block (refer to Cylinder Block - Assemble).

(13) Install the oil pan.

(14) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(15) Lower the vehicle.

(16) Install the spark plugs. Tighten the plugs to 37 N·m (27 ft. lbs.) torque.

(17) Fill the oil pan with engine oil to the full mark on the dipstick level.

(18) 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) Remove the engine starter motor.

(5) Remove the flywheel/torque converter housing access cover.

(6) Position a jack stand directly under the engine vibration damper.

(7) Place a piece of wood (2 x 2) between the jack stand and the engine vibration damper.

(8) Remove the engine mount through bolts.

(9) Using the jack stand, raise the engine until adequate clearance is obtained to remove the oil pan.

(10) Remove the oil pan bolts. Carefully remove the oil pan and gasket.

INSTALLATION

(1) Clean the block and pan gasket surfaces.

(2) Fabricate 4 alignment dowels from 1/4 x 1 1/2 inch bolts. Cut the head off the bolts and cut a slot

REMOVAL AND INSTALLATION (Continued)

into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 50).

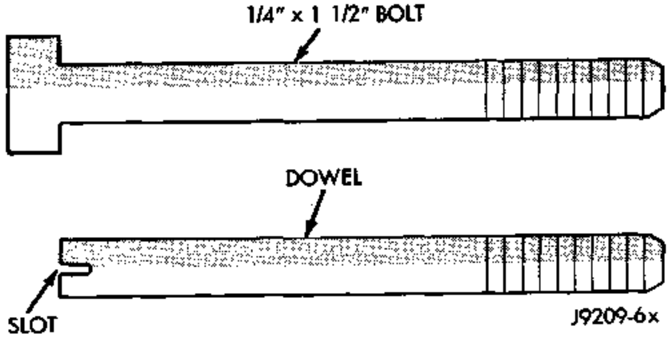


Fig. 50 Fabrication of Alignment Dowels

(3) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 51).

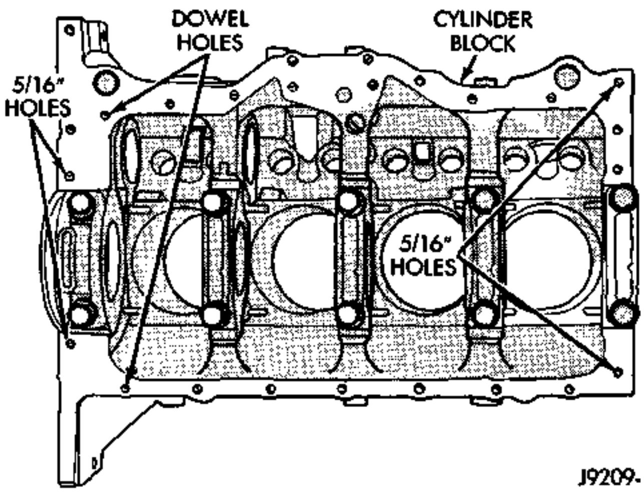


Fig. 51 Position of Dowels in Cylinder Block

(4) Slide the one-piece gasket over the dowels and onto the block and timing case cover.

(5) Position the oil pan over the dowels and onto the gasket.

(6) Install the 1/4 inch oil pan bolts. Tighten these bolts to 9.5 N·m (84 in. lbs.) torque. Install the 5/16 inch oil pan bolts (Fig. 52). Tighten these bolts to 15 N·m (132 in. lbs.) torque.

(7) Remove the dowels. Install the remaining 1/4 inch oil pan bolts. Tighten these bolts to 9.5 N·m (84 in. lbs.) torque.

(8) Lower the engine until it is properly located on the engine mounts.

(9) Install the through bolts and tighten the nuts.

(10) Lower the jack stand and remove the piece of wood.

(11) Install the flywheel and torque converter housing access cover.

(12) Install the engine starter motor.

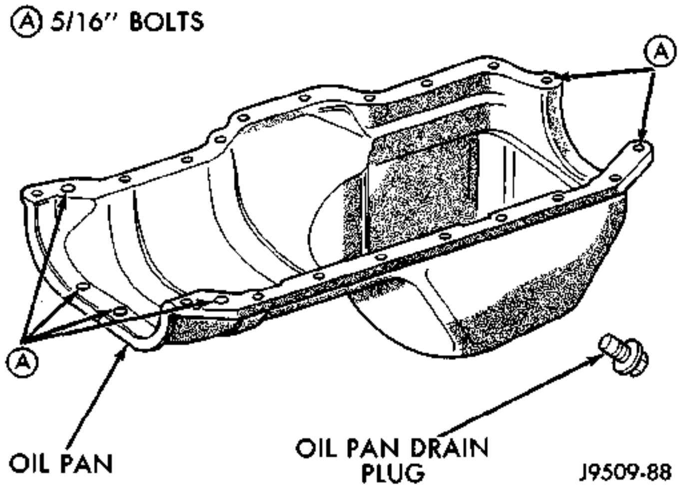


Fig. 52 Position of 5/16 inch Oil Pan Bolts

(13) Connect the exhaust pipe to the hanger and to the engine exhaust manifold.

(14) Install the oil pan drain plug (Fig. 52). Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(15) Lower the vehicle.

(16) Connect negative cable to battery.

(17) Fill the oil pan with engine oil to the specified level.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(18) Start the engine and inspect for leaks.

OIL PUMP

The positive-displacement gear-type oil pump is driven by the distributor shaft, which is driven by a gear on the camshaft. Oil is siphoned into the pump through an inlet tube and strainer assembly that is pressed into the pump body.

The pump incorporates a nonadjustable pressure relief valve to limit maximum pressure to 517 kPa (75 psi). In the relief position, the valve permits oil to bypass through a passage in the pump body to the inlet side of the pump.

Oil pump removal or replacement will not affect the distributor timing because the distributor drive gear remains in mesh with the camshaft gear.

REMOVAL

(1) Drain the engine oil.

(2) Remove the oil pan.

(3) Remove the pump-to-cylinder block attaching bolts. Remove the pump assembly with gasket (Fig. 53).

REMOVAL AND INSTALLATION (Continued)

CAUTION: If the oil pump is not to be serviced, DO NOT disturb position of oil inlet tube and strainer assembly in pump body. If the tube is moved within the pump body, a replacement tube and strainer assembly must be installed to assure an airtight seal.

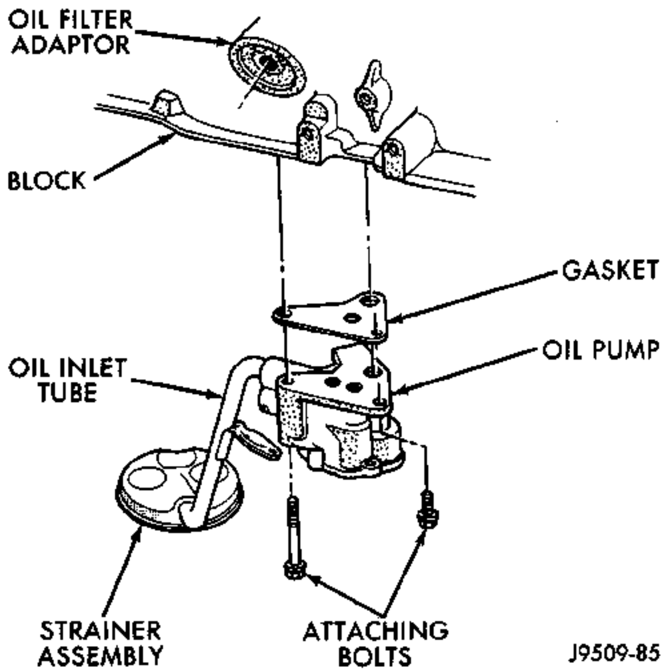


Fig. 53 Oil Pump Assembly

INSTALLATION

(1) Install the oil pump on the cylinder block using a replacement gasket. Tighten the bolts to 23 N·m (17 ft. lbs.) torque.
(2) Install the oil pan and gasket.
(3) Fill the oil pan with oil to the specified level.

PISTONS AND CONNECTING RODS

REMOVAL

(1) Remove the engine cylinder head cover.
(2) Remove the rocker arms, bridges and pivots.
(3) Remove the push rods.
(4) Remove the engine cylinder head.
(5) Position the pistons one at a time near the bottom of the stroke. Use a ridge reamer to remove the ridge from the top end of the cylinder walls. Use a protective cloth to collect the cuttings.
(6) Raise the vehicle.
(7) Drain the engine oil.
(8) Remove the oil pan and gasket.
(9) Remove the connecting rod bearing caps and inserts. Mark the caps and rods with the cylinder bore location. The connecting rods and caps are stamped with a two letter combination (Fig. 54).
(10) Lower the vehicle until it is about 2 feet from the floor.

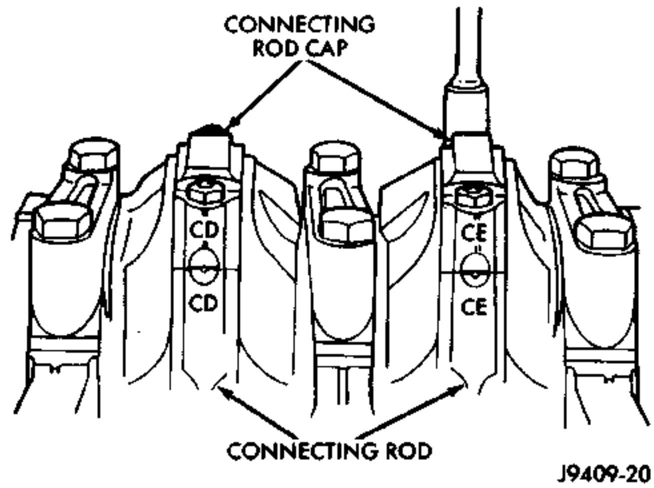


Fig. 54 Stamped Connecting Rods and Caps

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 and connecting rod assemblies up and through the top of the cylinder bores (Fig. 55).

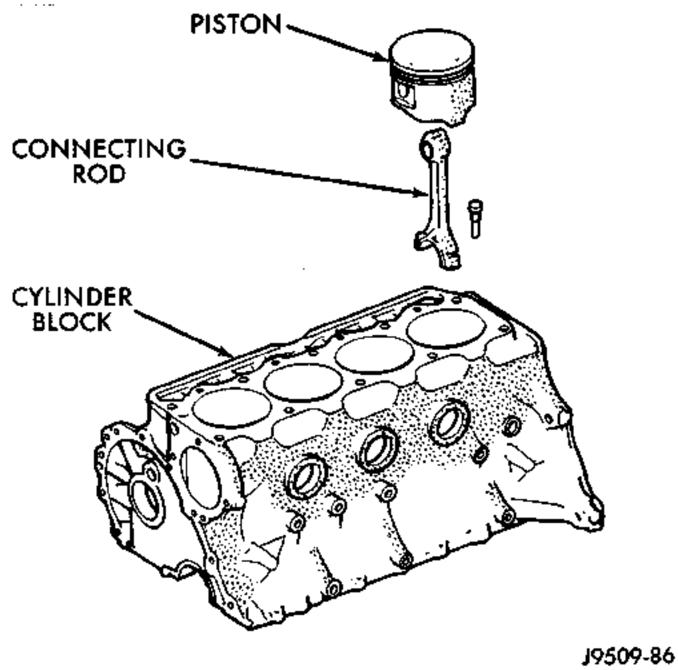


Fig. 55 Removal of Connecting Rod and Piston Assembly

INSTALLATION

(1) Clean the cylinder bores thoroughly. Apply a light film of clean engine oil to the bores with a clean lint-free cloth.
(2) Install the piston rings on the pistons if removed.

REMOVAL AND INSTALLATION (Continued)

(3) 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.

(4) Use a piston ring compressor to install the connecting rod and piston assemblies through the top of the cylinder bores (Fig. 56).

(5) Ensure the arrow on the piston top points to the front of the engine (Fig. 56).

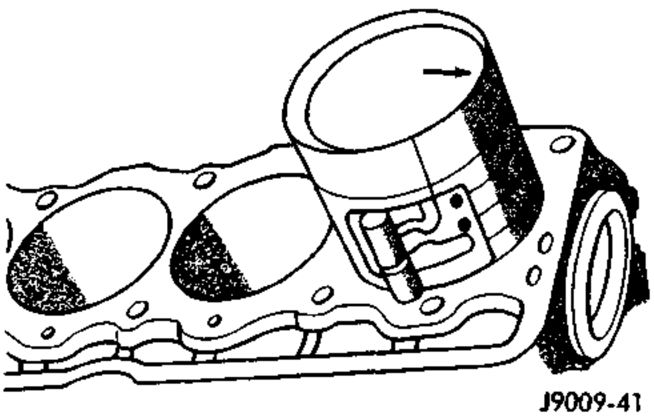


Fig. 56 Rod and Piston Assembly Installation

(6) Raise the vehicle.

(7) 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.

(8) 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.

(9) 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.

(10) 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.

(11) Install the oil pan and gaskets as outlined in the installation procedure.

(12) Lower the vehicle.

(13) Install the engine cylinder head, push rods, rocker arms, bridges, pivots and engine cylinder head cover.

(14) Fill the crankcase with engine oil.

REAR MAIN OIL SEALS

REMOVAL

(1) Remove the flywheel or converter drive plate. Discard the old bolts.

(2) Pry out the seal from around the crankshaft flange (Fig. 57).

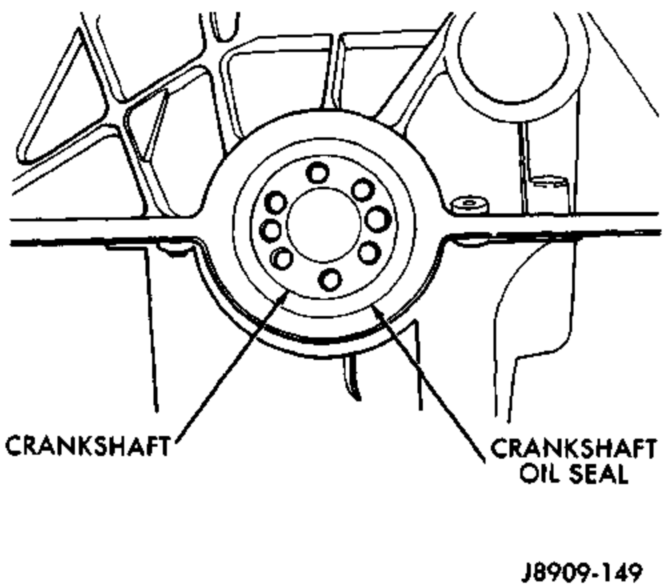


Fig. 57 Replacement of Rear Crankshaft Oil Seal

INSTALLATION

(1) Coat the outer lip of the replacement rear main bearing seal with engine oil.

(2) Carefully position the seal into place. Use rear main Seal Installer Tool 6271A to install the seal flush with the cylinder block.

CAUTION: The felt lip must be located inside the flywheel mounting surface. If the lip is not positioned correctly the flywheel could tear the seal.

(3) Install the flywheel or converter drive plate. New bolts MUST be used when installing the flywheel or converter plate. Tighten the new bolts to 68

REMOVAL AND INSTALLATION (Continued)

N·m (50 ft. lbs.) torque. Turn the bolts an additional 60°.

DISASSEMBLY AND ASSEMBLY

VALVE SERVICE

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.

Inspect for cracks in the combustion chambers and valve ports.

Inspect for cracks on the exhaust seat.

Inspect for cracks in the gasket surface at each coolant passage.

Inspect valves for burned, cracked or warped heads.

Inspect for scuffed or bent valve stems.

Replace valves displaying any damage.

VALVE REFACING

(1) Use a valve refacing machine to reface the intake and exhaust valves to the specified angle.

(2) After refacing, a margin of at least 0.787 mm (0.031 inch) must remain (Fig. 58). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

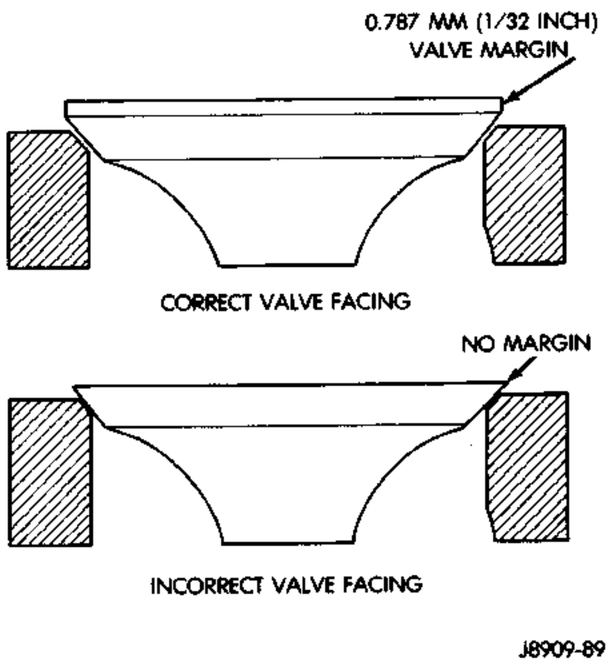


Fig. 58 Valve Facing Margin

VALVE SEAT REFACING

(1) Install a pilot of the correct size in the valve guide bore. Reface the valve seat to the specified angle with a good dressing stone. Remove only enough metal to provide a smooth finish.

(2) Use tapered stones to obtain the specified seat width when required.

(3) Control valve seat runout to a maximum of 0.0635 mm (0.0025 in.)— (Fig. 59).

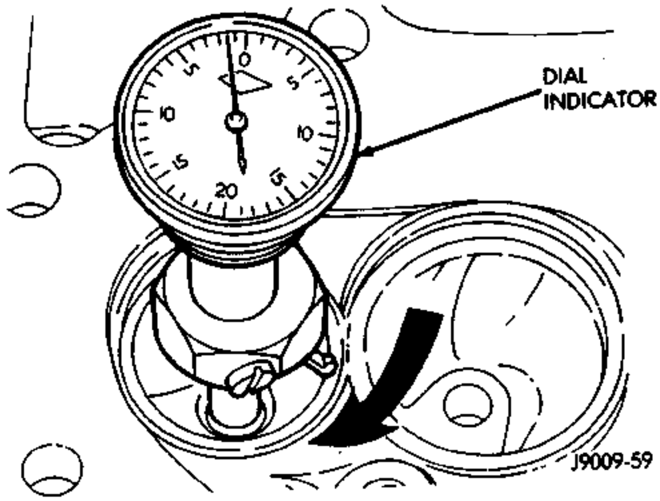


Fig. 59 Measurement of Valve Seat Runout

VALVE STEM OIL SEAL REPLACEMENT

Valve stem oil seals are installed on each valve stem to prevent rocker arm lubricating oil from entering the combustion chamber through the valve guide bores. One seal is marked INT (intake valve) and the other is marked EXH (exhaust valve).

Replace the oil seals whenever valve service is performed or if the seals have deteriorated.

VALVE GUIDES

The valve guides are an integral part of the engine cylinder head and are not replaceable.

When the valve stem guide clearance is excessive, the valve guide bores must be reamed oversize. Service valves with oversize stems are available in 0.076 mm (0.003 inch) and 0.381 mm (0.015 inch) increments.

Corresponding oversize valve stem seals are also available and must be used with valves having 0.381 mm (0.015 inch) oversize stems, 0.076mm (.003in.) oversize stems do not require oversize seals.

NOTE: 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.

DISASSEMBLY AND ASSEMBLY (Continued)

(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. 60).

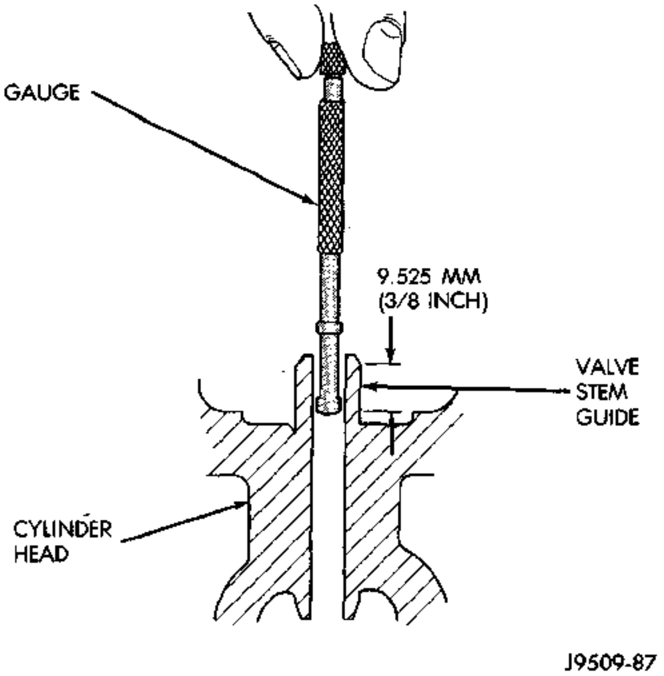


Fig. 60 Measurement of Valve Guide Bore Diameter

(4) Remove and measure telescoping gauge with a micrometer.

(5) Repeat the measurement with contacts lengthwise to engine cylinder head.

(6) Compare the crosswise to lengthwise measurements to determine out-of-roundness. If the measurements differ by more than 0.0635 mm (0.0025 in.), ream the guide bore to accommodate an oversize valve stem.

(7) Compare the measured valve guide bore diameter with specifications (7.95-7.97 mm or 0.313-0.314 inch). If the measurement differs from specification by more than 0.076 mm (0.003 inch), ream the guide bore to accommodate an oversize valve stem.

ALTERNATIVE METHOD:

(1) Use a dial indicator to measure the lateral movement of the valve stem (stem-to-guide clearance). This must be done with the valve installed in its guide and just off the valve seat (Fig. 61).

(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.

NOTE: Valve seats must be ground after reaming the valve guides to ensure that the valve seat is concentric to the valve guide.

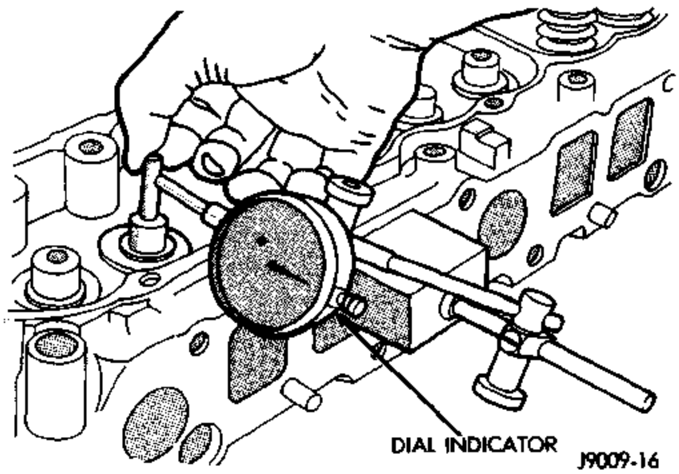


Fig. 61 Measurement of Lateral Movement Of Valve Stem

VALVE SPRING TENSION TEST

Use a Universal Valve Spring Tester and a torque wrench to test each valve spring for the specified tension value (Fig. 62).

Replace valve springs that are not within specifications.

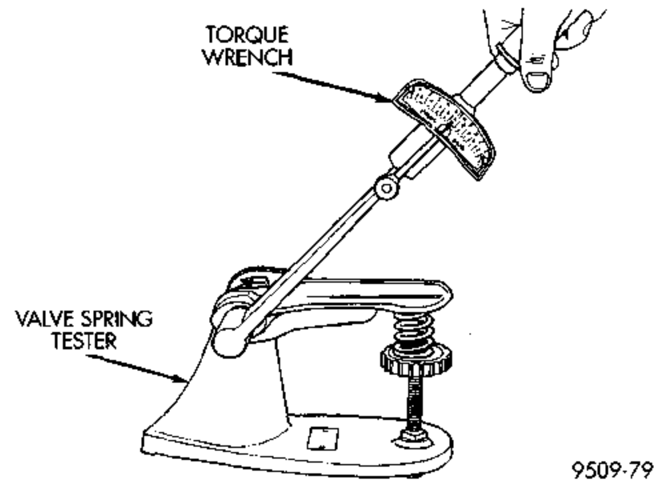


Fig. 62 Valve Spring Tester

CYLINDER BLOCK

Remove the Engine Assembly from the vehicle.

DISASSEMBLY

(1) Drain the engine oil. Remove and discard the oil filter.

(2) Remove the water pump from the cylinder block.

(3) Remove the distributor from the cylinder block.

(4) Remove the vibration damper.

(5) Remove the timing case cover and lay the cover upside down.

(6) Position a drift punch into the slot in the back of the cover and tap the old seal out.

DISASSEMBLY AND ASSEMBLY (Continued)

(7) Remove the timing chain bumper.
(8) Remove the oil slinger from crankshaft.
(9) Remove the camshaft retaining bolt and remove the sprockets and chain as an assembly.
(10) Remove the camshaft.
(11) Remove the oil pan and gasket.
(12) Remove the timing chain tensioner.
(13) Remove the front and rear oil galley plugs.
(14) Remove the connecting rods and the pistons. Remove the connecting rod and piston assemblies through the top of the cylinder bores.
(15) Remove the crankshaft.

ASSEMBLY

(1) Install the crankshaft.
(2) Install the connecting rods and the pistons through the top of the cylinder bores.
(3) Install the front and rear oil galley plugs.
(4) Install the timing chain tensioner.
(5) Install the camshaft.
(6) Install the sprockets and chain as an assembly.
(7) Install the oil slinger to the crankshaft.
(8) Install the timing chain bumper.
(9) Install the timing case cover seal.
(10) Install the timing case cover.
(11) Install the oil pan gasket and oil pan.
(12) Install the vibration damper.
(13) Install the water pump. Tighten the mounting bolts to 31 N·m (270 in. lbs.) torque.
(14) Remove the distributor from the cylinder block.
(15) Lubricate the oil filter seal with clean engine oil. Tighten oil filter to 18 N·m (13 ft. lbs.) torque.
(16) Install the engine into the vehicle.
(17) Fill the engine with clean lubrication oil.
(18) Fill the cooling system.

CLEANING AND INSPECTION

ROCKER ARMS AND PUSH RODS

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.

HYDRAULIC TAPPETS

CLEANING

Clean each tappet assembly in cleaning solvent to remove all varnish, gum and sludge deposits.

INSPECTION

Inspect for indications of scuffing on the side and base of each tappet body.

Inspect each tappet base for concave wear with a straightedge positioned across the base. If the base is concave, the corresponding lobe on the camshaft is also worn. Replace the camshaft and defective tappets.

ENGINE CYLINDER HEAD

CLEANING

Thoroughly clean the engine cylinder head and cylinder block mating surfaces. Clean the intake and exhaust manifold and engine cylinder head mating surfaces. Remove all gasket material and carbon.

Check to ensure that no coolant or foreign material has fallen into the tappet bore area.

Remove the carbon deposits from the combustion chambers and top of the pistons.

INSPECTION

Use a straightedge and feeler gauge to check the flatness of the engine cylinder head and block mating surfaces.

CYLINDER BLOCK

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

- The galley at the oil filter adaptor hole, the filter bypass hole (Fig. 63).
- The front and rear oil galley holes (Fig. 64) (Fig. 65).
- 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.

CLEANING AND INSPECTION (Continued)

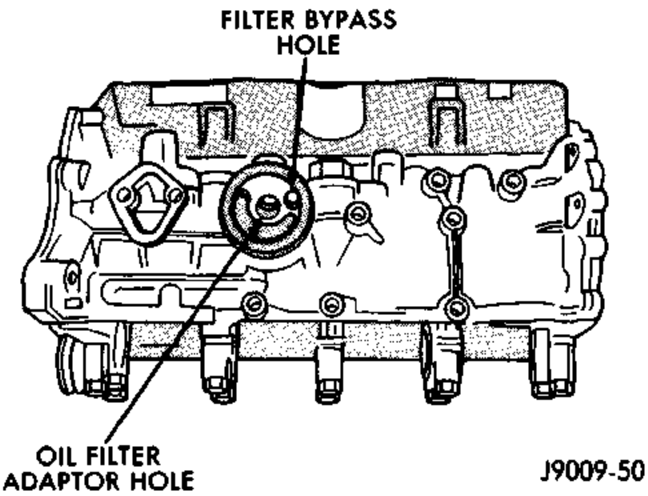


Fig. 63 Oil Filter Adaptor Hole

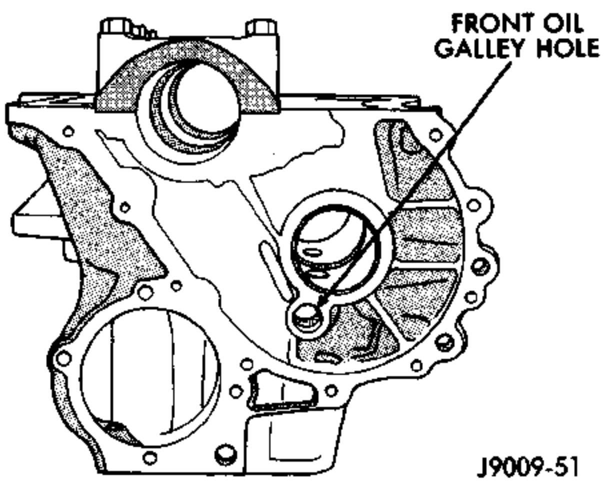


Fig. 64 Front Oil Galley Hole

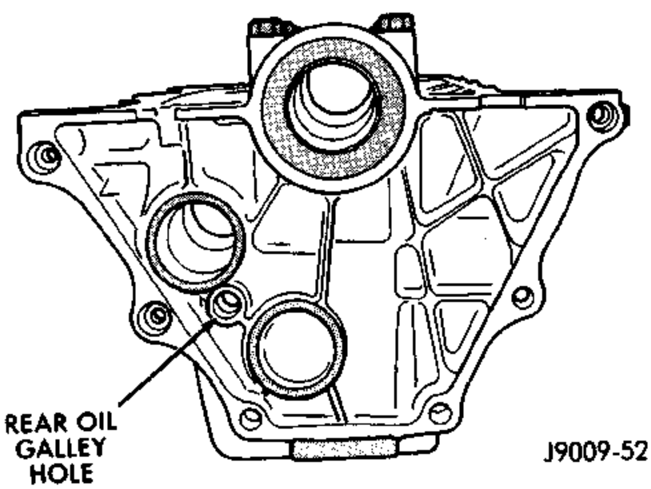


Fig. 65 Rear Oil Galley Hole

INSPECTION—CYLINDER BORE

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter (Fig. 66). To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

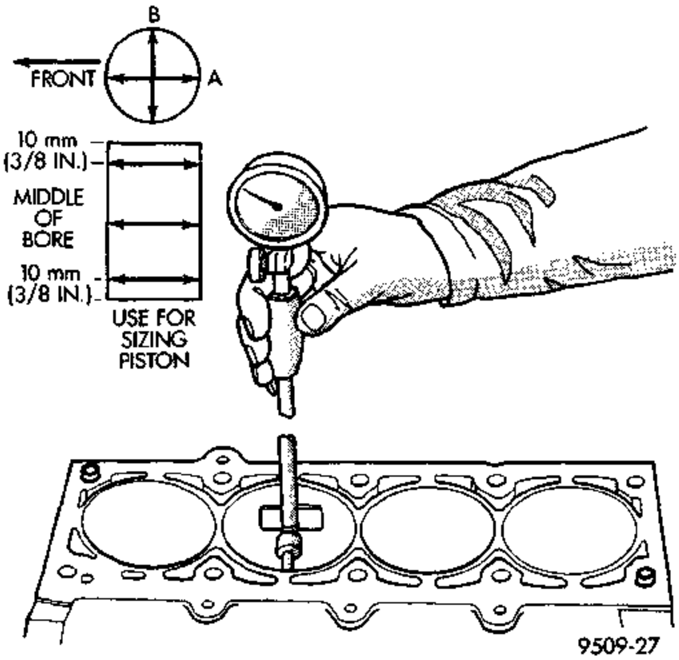


Fig. 66 Cylinder Bore Measurement

(2) Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.

(3) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the middle of the bore, then repeat the measurement near the bottom of the bore.

(4) Determine taper by subtracting the smaller diameter from the larger diameter.

(5) Rotate measuring device 90° and repeat steps above.

(6) Determine out-of-roundness by comparing the difference between each measurement.

(7) If cylinder bore taper does not exceed 0.025 mm (0.001 inch) and out-of-roundness does not exceed 0.025 mm (0.001 inch), the cylinder bore can be honed. If the cylinder bore taper or out- of-round condition exceeds these maximum limits, the cylinder 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.

SPECIFICATIONS

2.5L ENGINE SPECIFICATIONS

Camshaft
Hydraulic Tappet Clearance . . . . .Zero Lash
Bearing Clearance. . . . . .0.025 to 0.076 mm (0.001 to 0.003 in.)

Bearing Journal Diameter
No. 1 . . . . .51.54 to 51.56 mm (2.029 to 2.030 in.)
No. 2 . . . . .51.28 to 51.31 mm (2.019 to 2.020 in.)
No. 3 . . . . .51.03 to 51.05 mm (2.009 to 2.010 in.)
No. 4 . . . . .50.78 to 50.80 mm (1.999 to 2.000 in.)
Base Circle Runout . . . . .0.03 mm - max. (0.001 in. - max.)

Camshaft Lobe Lift
Exhaust . . . . .6.579 mm (0.259 in.)
Intake . . . . .6.477 mm (0.255 in.)

Valve Lift
Exhaust . . . . .10.528 mm (0.4145 in.)
Intake. . . . . .10.350 mm (0.4075 in.)

Intake Valve Timing
Opens . . . . .15.4° BTDC
Closes. . . . . .58° ABDC

Exhaust Valve Timing
Opens . . . . .52.8 BBDC
Closes. . . . . .26.2° ATDC
Valve Overlap. . . . . .41.6°
Intake Duration . . . . .253.3°
Exhaust Duration. . . . . .259.°

Crankshaft
End Play . . .0.038 to 0.165 mm (0.0015 to 0.0065 in.)
Main Bearing Journal Diameter . . . . .63.489 to 63.502 mm (2.4996 to 2.5001 in.)
Main Bearing Journal Width No. 1 . . . . . .27.58 to 27.89 mm (1.086 to 1.098 in.)
Main Bearing Journal Width No. 2 . . . . . .32.28 to 32.33 mm (1.271 to 1.273 in.)
Main Bearing Journal Width No. 3-4-5 . . .30.02 to 30.18 mm (1.182 to 1.188 in.)
Main Bearing Clearance . . . . .0.03 to 0.06 mm (0.001 to 0.0025 in.)
Main Bearing Clearance (Preferred). . . . . .0.051 mm (0.002 in.)
Connecting Rod Journal Diameter. . . . . .53.17 to 53.23 mm (2.0934 to 2.0955 in.)
Connecting Rod Journal Width . . .27.18 to 27.33 mm (1.070 to 1.076 in.)
Out-of-Round (Max. All Journals). . . . . . . .0.013 mm (0.0005 in.)
Taper (Max. – All Journals) . . .0.013 mm (0.0005 in.)

Cylinder Block
Deck Height. . . . . .236.73 mm (9.320 in.)
Deck Clearance . . . . .0.000 mm (0.000 in.)
Cylinder Bore Diameter— Standard .98.45 to 98.48 mm (3.8759 to 3.8775 in.)
Cylinder Bore Diameter— Taper (Max.) . . . . .0.025 mm (0.001 in.)
Cylinder Bore Diameter— Out-of-Round (Max.) . . . . .0.025 mm (0.001 in.)
Tappet Bore Diameter . . . . .23.000 to 23.025 mm (0.9055 to 0.9065 in.)
Flatness. . . .0.03 mm per 25 mm (0.001 in. per 1 in.)
Flatness. . .0.05 mm per 152 mm (0.002 in. per 6 in.)
Flatness Max. . . . . .0.20 mm for total length (0.008 in. for total length)
Main Bearing Bore Diameter . . . . .68.3514 to 68.3768 mm (2.691 to 2.692 in.)

Connecting Rods
Total Weight (Less Bearing) . . . . . .657 to 665 grams (23.17 to 23.45 oz.)
Length (Center-to-Center) . . . . .155.52 to 155.62 mm (6.123 to 6.127 in.)
Piston Pin Bore Diameter . . . . . . .23.59 to 23.62 mm (0.9288 to 0.9298 in.)
Bore (Less Bearings). . . . . .56.08 to 56.09 mm (2.2080 to 2.2085 in.)
Bearing Clearance. . . . . .0.025 to 0.076 mm (0.001 to 0.003 in.)
Bearing Clearance (Preferred). . . .0.044 to 0.050 mm (0.0015 to 0.0020 in.)
Side Clearance . .0.25 to 0.48 mm (0.010 to 0.019 in.)
Twist (Max.) . .0.001 mm per mm (0.001 in. per inch)
Bend Max.) . .0.001 mm per mm (0.001 in. per inch.)

Cylinder Compression Pressure
Ratio. 9.1:1
Pressure Range. . . .827 to 1,034 kPa (120 to 150 psi)
Max. Variation Between Cylinders . .206 kPa (30 psi)

Cylinder Head
Combustion Chamber . . . . .49.9 to 52.9 cc (3.04 to 3.23 cu. in.)
Valve Guide I.D. (Integral) . . . . .7.95 to 7.97 mm (0.313 to 0.314 in.)
Valve Stem-to-Guide Clearance. . .0.025 to 0.076 mm (0.001 to 0.003 in.)
Intake Valve Seat Angle. . . . . .44.5°
Exhaust Valve Seat Angle . . . . .44.5°
Valve Seat Width . . . . .1.01 to 1.52 mm (0.040 to 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.)
Flatness. . .0.05 mm per 152 mm (0.002 in. per 6 in.)

SPECIFICATIONS (Continued)

Flatness Max. . . . . .0.20 mm for total length (0.008 in. for total length)

Rocker Arms, Push Rods & Tappets

Rocker Arm Ratio 1.6:1

Push Rod Length . . . . .241.300 to 241.808 mm (9.500 to 9.520in.)

Push Rod Diameter. . . . . .7.92 to 8.00 mm (0.312 to 0.315 in.)

Hydraulic Tappet Diameter . . . .22.962 to 22.974 mm (0.904 to 0.9045 in.)

Tappet-to-Bore Clearance . . . . . . .0.025 to 0.063 mm (0.001 to 0.0025 in.)

Valves

Length (Tip-to-Gauge Dimension Line)
Intake . . . . .124.435 to 125.070 mm (4.899 to 4.924 in.)

Length (Tip-to-Gauge Dimension Line)
Exhaust . . . . .125.120 to 125.755 mm (4.927 to 4.952 in.)

Valve Stem Diameter . . . . .7.899 to 7.925 mm (0.311 to 0.312 in.)

Stem-to-Guide Clearance. . . . . . . .0.025 to 0.076 mm (0.001 to 0.003 in.)

Valve Head Diameter—
Intake . . .48.387 to 48.641 mm (1.905 to 1.915 in.)

Valve Head Diameter—
Exhaust. . . . . .37.973 to 38.227 mm (1.495 to 1.505 in.)

Valve Face Angle—Intake . . . . .45°

Valve Face Angle—Exhaust. . . . . .45°

Tip Refinishing (Max. Allowable) . . . . .0.25 mm (0.010 in.)

Valve Springs

Free Length (Approx.) . . . . .47.65 mm (1.876 in.)

Spring Tension—Valve
Closed . . . . .271 to 307 N @ 41.656 mm (61 to 69 lbf. @ 1.64 in.)

Spring Tension—Valve
Open. . . . . .818.5 to 871.9 N @ 30.89 mm (184 to 196 lbf @ 1.216 in.)

Inside Diameter . . . . .21.0 mm to 21.51 mm (0.827 to 0.847 in.)

Pistons

Weight (Less Pin) . . . . .563 to 567 grams (19.86 to 20.00 oz.)

Piston Pin Bore (Centerline to Piston
Top). . . . . . .40.61 to 40.72 mm (1.599 to 1.603 in.)

Piston-to-Bore Clearance. . . . . . . .0.033 to 0.053 mm (0.0013 to 0.0021 in.)

Piston-to-Bore Clearance
(Preferred). . . . . .0.033 to 0.038 mm (0.0013 to 0.0015 in.)

Ring Gap Clearance—Top Compression
Ring . . . .0.229 to 0.610 mm (0.0090 to 0.0240 in.)

Ring Gap Clearance—2nd Compression
Ring . . . .0.483 to 0.965 mm (0.0190 to 0.0380 in.)

Ring Gap Clearance—Oil Control Steel
Rails . . . . . .0.254 to 1.500 mm (0.010 to 0.060 in.)

Ring Side Clearance—Compression
Rings. . . .0.042 to 0.084 mm (0.0017 to 0.0033 in.)

Ring Side Clearance—Oil Control
Ring . . . . . .0.06 to 0.21 mm (0.0024 to 0.0083 in.)

Piston Ring Groove Height—Compression
Rings . . . .1.530 to 1.555mm (0.0602 to 0.0612 in.)

Piston Ring Groove Height—Oil Control
Ring . . . .4.035 to 4.060 mm (0.1589 to 0.1598 in.)

Piston Ring Groove Diameter—Compression
Rings. . . . . .87.78 to 87.90 mm (3.456 to 3.461 in.)

Piston Ring Groove Diameter—Oil Control
Ring . . . . . .87.50 to 87.75 mm (3.445 to 3.455 in.)

Piston Pin Bore Diameter . . . . .23.647 to 23.655 mm (0.9310 to 0.9313 in.)

Piston Pin Diameter . . . . .23.637 to 23.640 mm (0.9306 to 0.9307 in.)

Piston-to-Pin Clearance . . . . . . .0.0076 to 0.0178 mm (0.0003 to 0.0007 in.)

Piston-to-Pin Clearance
(Preferred) . . . . .0.015 mm—Loose (0.0006 in.—Loose)

Piston-to-Pin Connecting Rod
(Press Fit). . . . . .8.9 kN (2000 lbf.)

Oil Pump

Gear-to-Body Clearance
(Radial). . . .0.051 to 0.102 mm (0.002 to 0.004 in.)

Gear-to-Body Clearance (Radial)
(Preferred) . . . . .0.051 mm (0.002 in.)

Gear End Clearance—
Plastigage . .0.051 to 0.152 mm (0.002 to 0.006 in.)

Gear End Clearance—Plastigage
(Preferred) . . . . .0.051 mm (0.002 in.)

Gear End Clearance—Feeler
Gauge . . .0.1016 to 0.2032 mm (0.004 to 0.008 in.)

Gear End Clearance—Feeler Gauge
(Preferred) . . . . .0.1778 mm (0.007 in.)

Oil Pressure

Min. Pressure (600 rpm) . . . . .89.6 kPa (13 psi)

At Idle Speed (800 rpm) . . . . .172 to 241 kPa (25 to 35 psi)

At 1600 rpm & Higher . . . . .255 to 517 kPa (37 to 75 psi)

Oil Pressure Relief . . . . .517 kPa (75 psi)

SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
A/C Compressor Bracket-to-Engine	
Bolts	34 N·m (25 ft. lbs.)
A/C Compressor	
Mounting Bolts	27 N·m (20 ft. lbs.)
A/C Low Pressure Service Valve	
Nut	38 N·m (28 ft. lbs.)
Block Heater	
Nut	1.8 N·m (16 in. lbs.)
Camshaft Sprocket	
Bolt	108 N·m (80 ft. lbs.)
Connecting Rod	
Nuts	45 N·m (33 ft. lbs.)
Converter Plate	
Bolts	68 N·m +60° (50 ft. lbs. +60°)
Cylinder Block	
Drain Plugs	41 N·m (30 ft. lbs.)
Cylinder Head	
Bolts #1–10 & #12–14	149 N·m (110 ft. lbs.)
Bolt #11	135 N·m (100 ft. lbs.)
Cylinder Head Cover	
Bolts	13 N·m (115 in. lbs.)
Drive Plate-to-Torque Converter	
Bolts	54 N·m (40 ft. lbs.)
Engine Shock Damper	
Stud Nuts	23 N·m (17 ft. lbs.)
Engine Mounts—Front	
Cushion to Block Bracket Nuts	69 N·m (51 ft. lbs.)
Cushion to Frame Bolts	61 N·m (38 ft. lbs.)
Bracket to Engine Block Screw	61 N·m (45 ft. lbs.)
Bracket to Engine Block Nut	61 N·m (45 ft. lbs.)
Bracket to Engine Block Stud	61 N·m (45 ft. lbs.)
Engine Mounts—Rear	
Trans. Cushion to Crossmember Nut	28 N·m (21 ft. lbs.)
Trans. Bracket to Skid Plate Nut	28 N·m (21 ft. lbs.)
Trans. Mount to Trans. Bracket Nut	41 N·m (30 ft. lbs.)
Trans. Bracket to Trans.	54 N·m (40 ft. lbs.)
Exhaust Manifold/Pipe	
Nuts	27 N·m (20 ft. lbs.)
Flywheel/Converter Housing	
Bolts	38 N·m (28 ft. lbs.)

DESCRIPTION	TORQUE
Flywheel/Crankshaft	
Bolts	143 N·m (105 ft. lbs.)
Front Cover-to-Block	
Bolts 1/4–20	7N·m (60 in. lbs.)
Bolts 5/16–18	22N·m (192 in. lbs.)
Fuel Pump	
Bolts	22 N·m (16 ft. lbs.)
Generator	
Adjusting Bolt	24 N·m (18 ft. lbs.)
Pivot Bolt/Nut	38 N·m (28 ft. lbs.)
Mounting Bracket-to–Engine Bolts	38 N·m (28 ft. lbs.)
Mounting/Head Bolts	45 N·m (33 ft. lbs.)
Main Bearing	
Bolts	108 N·m (80 ft. lbs.)
Oil Filter	
Filter	18 N·m (13 ft. lbs.)
Oil Filter	
Connector	54 N·m (40 ft. lbs.)
Oil Galley	
Plug	41 N·m (30 ft. lbs.)
Oil Pan	
1/4–20 Bolts	9.5 N·m (84 in. lbs.)
5/16–18 Bolts	15 N·m (132 in. lbs.)
Drain Plug	34 N·m (25 ft. lbs.)
Oil Pump	
Short Attaching Bolts	23 N·m (17 ft. lbs.)
Long Attaching Bolts	23 N·m (17 ft. lbs.)
Cover Bolts	8 N·m (70 in. lbs.)
Power Steering Pump Pressure Hose	
Nut	52 N·m (38 ft. lbs.)
Rocker Arm Assembly-to-Cylinder Head	
Capscrews	28 N·m (21ft. lbs.)
Spark Plugs	
Plugs	37 N·m (27 ft. lbs.)
Starting Motor	
Mounting Bolts	45 N·m (33 ft. lbs.)
Thermostat Housing	
Bolts	18 N·m (13 ft. lbs.)
Vibration Damper	
Bolts	108 N·m (80 ft. lbs.)
Water Pump/Block	
Bolts	31 N·m (270 in. lbs.)

4.0L ENGINE

INDEX

DESCRIPTION AND OPERATION

ENGINE DESCRIPTION

The 4.0 Liter (242 CID) six-cylinder engine is an In-line, lightweight, overhead valve engine.

Engine Type	In-line 6 Cylinder
Bore and Stroke	98.4 x 86.69 mm (3.88 x 3.413 in.)
Displacement	4.0 (242 cu. in.)
Compression Ratio	8.8:1
Torque	301 N·m (222 ft. lbs.) @ 2800 rpm
Firing Order	1–5–3–6–2–4
Lubrication	Pressure Feed–Full Flow Filtration
Engine Oil Capacity	3.8 L (4 Quarts)
Cooling System	Liquid Cooled–Forced Circulation
Cooling System Capacity	9.9 L (10.5 Quarts)
Cylinder Block	Cast Iron
Crankshaft	Cast Nodular Iron
Cylinder Head	Cast Iron
Camshaft	Cast Iron
Pistons	Aluminum Alloy (with Struts)
Pistons Combustion Cavity	Double Quench
Connecting Rods	Cast Iron

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. 1).

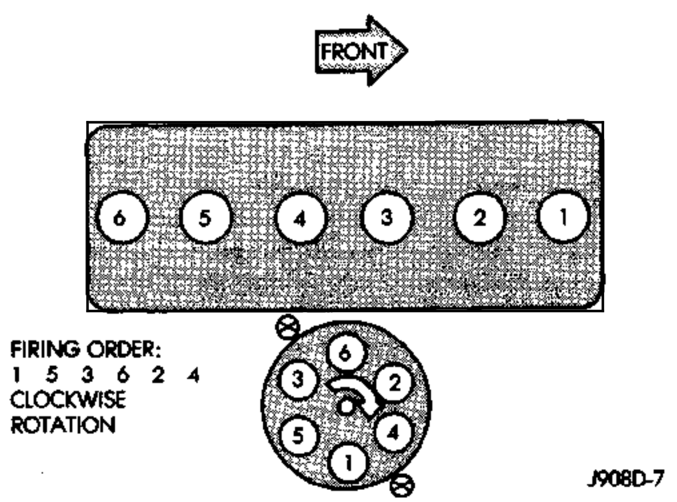


Fig. 1 Engine Firing Order

DESCRIPTION AND OPERATION (Continued)

The crankshaft rotation is clockwise, when viewed from the front of the engine. The crankshaft rotates within seven main bearings. The camshaft rotates within four bearings.

BUILD DATE CODE

The engine Build Date Code is located on a machined surface on the right side of the cylinder block between the No.2 and No.3 cylinders (Fig. 2).

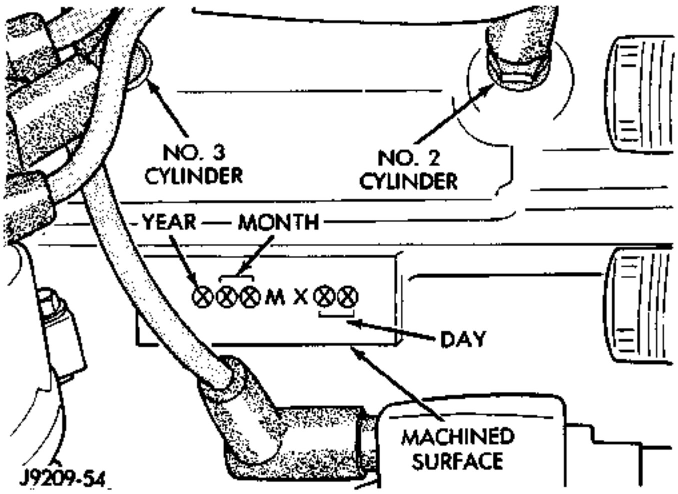


Fig. 2 Build Date Code Location

The digits of the code identify:

- 1st Digit—The year (6 = 1996).
- 2nd & 3rd Digits—The month (01 - 12).
- 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).
- 6th & 7th Digits—The day of engine build (01 - 31).

(1) **FOR EXAMPLE:** Code * 601MX12 * 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, 1996.

LUBRICATION SYSTEM

A gear—type positive displacement pump is mounted at the underside of the block opposite the No. 4 main bearing. The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and pump body, then forced through the outlet to the block. An oil gallery in the block channels the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes from the center outlet of the filter through an oil gallery that channels the oil up to the main gallery which extends the entire length of the block.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The crankshaft is drilled internally to pass oil from the main bearing journals (except number 4 main bearing journal) to the connecting rod journals. Each connecting rod bearing cap has a small squirt hole, oil passes through the squirt hole and is thrown off as the rod rotates. This oil throwoff lubricates the camshaft lobes, distributor drive gear, cylinder walls, and piston pins.

The hydraulic valve tappets receive oil directly from the main oil gallery. Oil is provided to the camshaft bearing through galleries. The front camshaft bearing journal passes oil through the camshaft sprocket to the timing chain. Oil drains back to the oil pan under the number one main bearing cap.

The oil supply for the rocker arms and bridged pivot assemblies is provided by the hydraulic valve tappets which pass oil through hollow push rods to a hole in the corresponding rocker arm. Oil from the rocker arm lubricates the valve train components, then passes down through the push rod guide holes in the cylinder head past the valve tappet area, and returns to the oil pan.

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.

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. 3) stamped on a boss between the ignition coil and the distributor (Fig. 4).

SERVICE PROCEDURES

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.

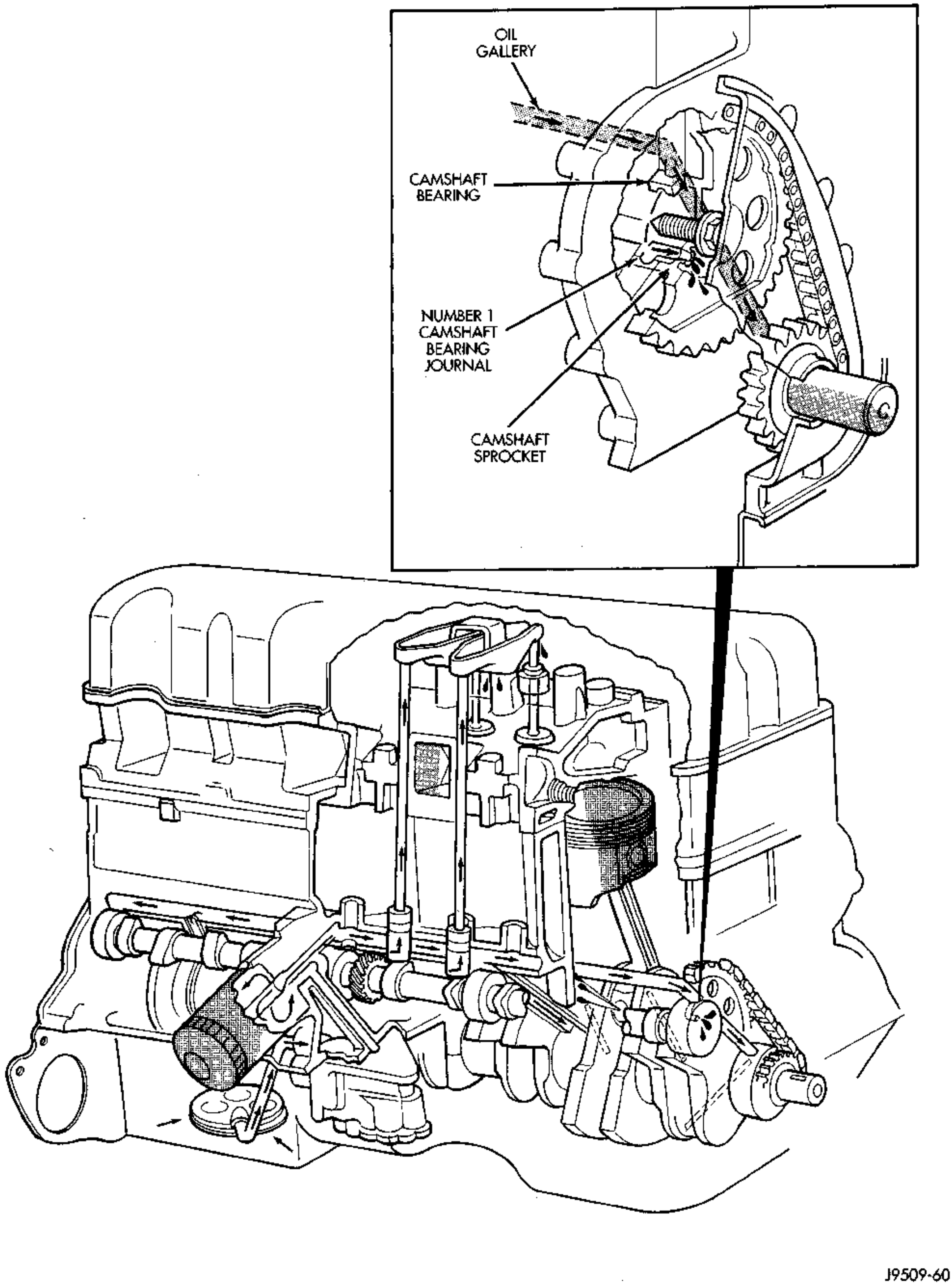
Rotate the crankshaft until the No.6 piston is at top dead center (TDC) on the compression stroke.

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.

SERVICE PROCEDURES (Continued)



Oil Lubrication System

SERVICE PROCEDURES (Continued)

CODE	COMPONENT	UNDERSIZE
P	One or more connecting rod bearing journals	0.254 mm (0.010 in)
M	All crankshaft main bearing journals	0.254 mm (0.010 in)
PM	All crankshaft main bearing journals and one or more connecting rod journals	0.254 mm (0.010 in)
CODE	**COMPONENT**	**OVERSIZE**
B	All cylinder bores	0.254 mm (0.010 in)
C	All camshaft bearing bores	0.254 mm (0.010 in)

J8909-54

Fig. 3 Oversize and Undersize Component Codes

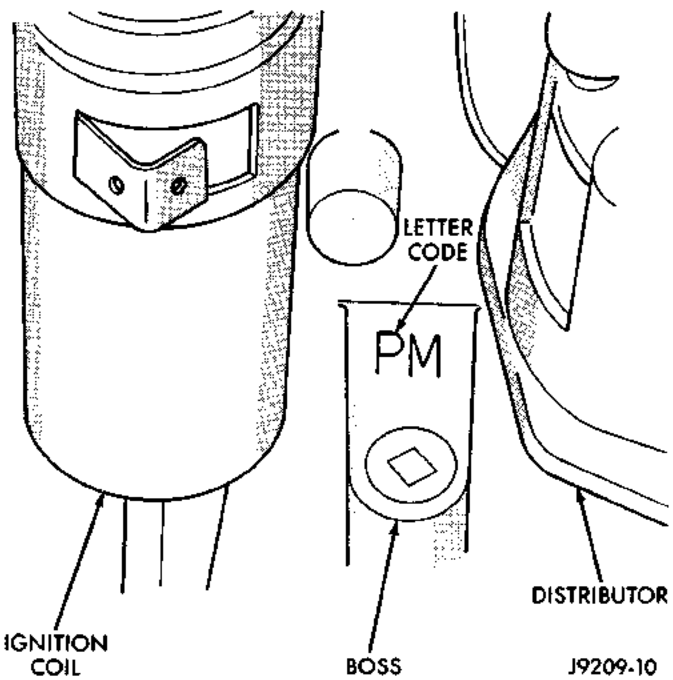


Fig. 4 Oversize and Undersize Component Code Location

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.

PISTON FITTING

BORE GAGE METHOD

(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

(2) Measure the inside diameter of the cylinder bore at a point 49.5 mm (1-15/16 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B (Fig. 5).

(3) The coated pistons will be serviced with the piston pin and connecting rod pre-assembled. **The coated piston connecting rod assembly can be used to service previous built engines and MUST be replaced as complete sets.** Tin coated pistons should not be used as replacements for coated pistons.

(4) The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results. Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY.**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.

(5) Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

PISTON SIZE CHART

CYLINDER BORE SIZE	PISTON LETTER SIZE
98.438 to 98.448 mm (3.8755 to 3.8759 in.)	A
98.448 to 98.458 mm (3.8759 to 3.8763 in.)	B
98.458 to 98.468 mm (3.8763 to 3.8767 in.)	C
98.468 to 98.478 mm (3.8767 to 3.8771 in.)	D
98.478 to 98.488 mm (3.8771 to 3.8775 in.)	E
98.488 to 98.498 mm (3.8775 to 3.8779 in.)	F

SERVICE PROCEDURES (Continued)

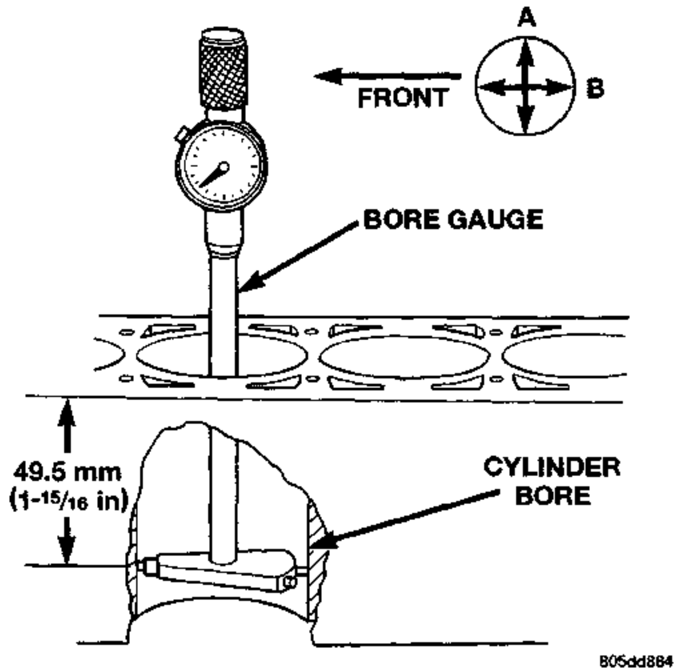


Fig. 5 Bore Gauge

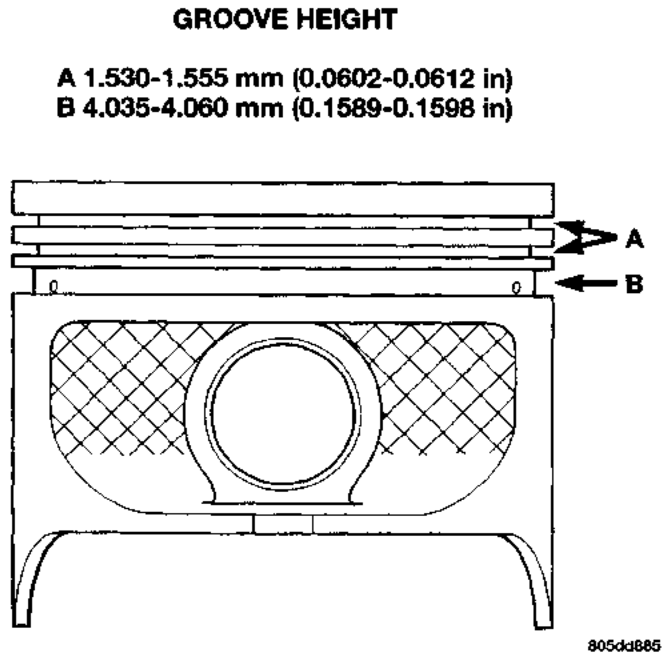


Fig. 6 Piston Dimensions

PISTON RING FITTING

(1) Carefully clean the carbon from all ring grooves. Oil drain openings in the oil ring groove and pin boss must be clear. DO NOT remove metal from the grooves or lands. This will change ring-to-groove clearances and will damage the ring-to-land seating.

(2) Be sure the piston ring grooves are free of nicks and burrs.

(3) Measure the ring side clearance with a feeler gauge fitted snugly between the ring land and ring (Fig. 6) (Fig. 7). Rotate the ring in the groove. It must move freely around circumference of the groove.

Ring Side Clearance Measurement

Top Compression Ring . . . . .0.042to 0.084 mm (0.0017 to 0.0033 in.)
Second Compression Ring. . . . . . . .0.042to 0.084 mm (0.0017 to 0.0033 in.)
Oil Control Ring . . . . .0.06 to 0.21 mm (0.0024 to 0.0083 in.)

(4) Place ring in the cylinder bore and push down with inverted piston to position near lower end of the ring travel. Measure ring gap with a feeler gauge fitting snugly between ring ends (Fig. 8).

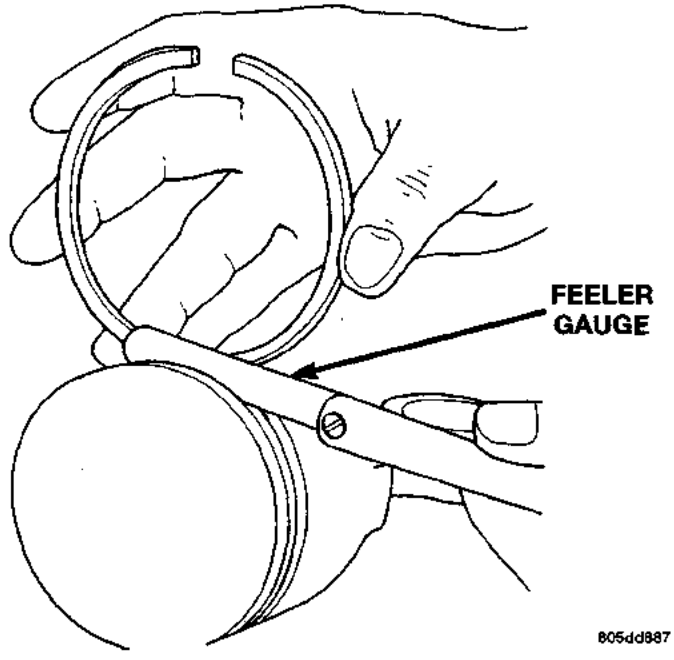


Fig. 7 Ring Side Clearance Measurement

Ring Gap Measurement

Top Compression Ring . . . . 0.229 to 0.610 mm (0.0090 to 0.0240 inch)
Second Compresion Ring. . . . . . . .0.483 to 0.965 mm (0.0190 to 0.0380 inch)
Oil Control Ring . . . . .0.254 to 1.500 mm (0.010 to 0.060 inch)

SERVICE PROCEDURES (Continued)

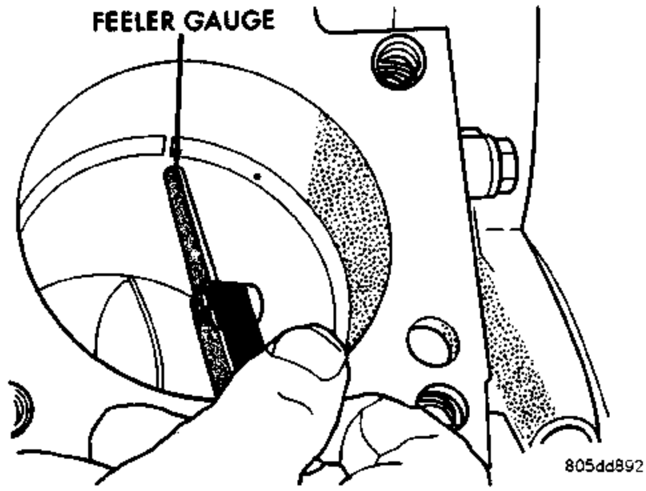


Fig. 8 Gap Measurement

(5) The oil control rings are symmetrical, no top or bottom, install anyside up. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(6) The two compression rings are different and cannot be interchanged. The TOP compression ring can be identified by the shiny coating on the outer sealing surface. This ring is symmetrical, no top or bottom, install anyside up.

(7) The second compression ring has a dot or drill mark denoting the topside of ring. There is also a slight chamfer on the inside bottom edge, therefore dot mark up chamfer face down, for installationon.

(8) Using a ring installer, install the second compression ring. (Fig. 9).

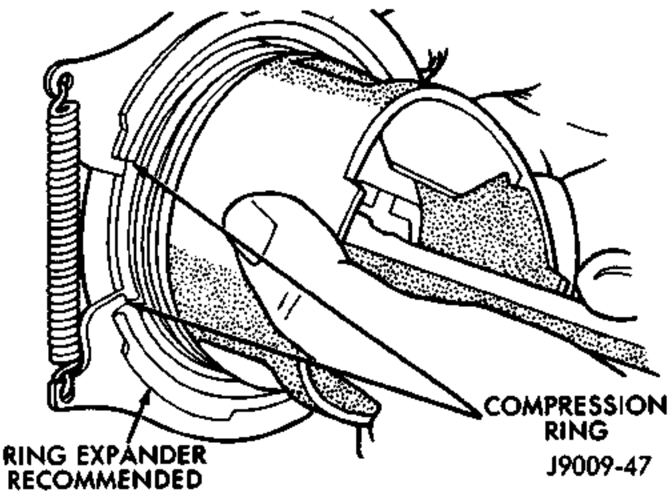


Fig. 9 Compression Ring Installation

(9) The top compression ring has a shiny coating on the outer sealing surface.

(10) Using a ring installer, install the top ring. (Fig. 9).

(11) Position top and second ring 180° apart. Split the oil rings 60° to 90° apart and away from the second ring gap. (Fig. 10) Example: Top oil ring at 12:00, expander at 3:00 or 9:00, bottom oil ring at 6:00.

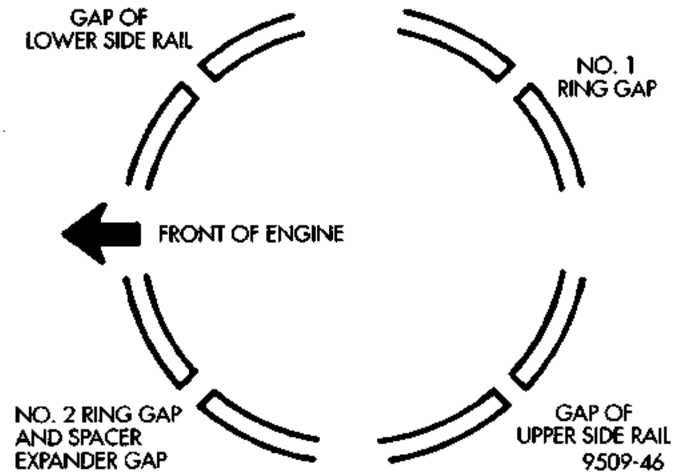


Fig. 10 Piston Ring End Gap Position

FITTING CONNECTING ROD BEARINGS

INSPECTION

BEARINGS

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 11) (Fig. 12). Check the 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.

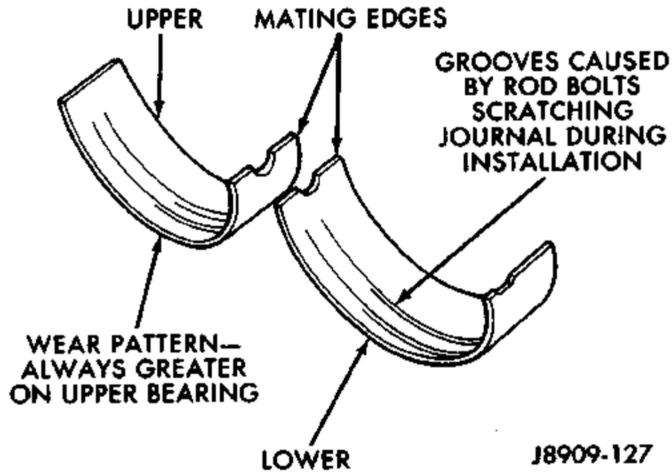


Fig. 11 Connecting Rod Bearing Inspection

CONNECTING RODS

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a

SERVICE PROCEDURES (Continued)

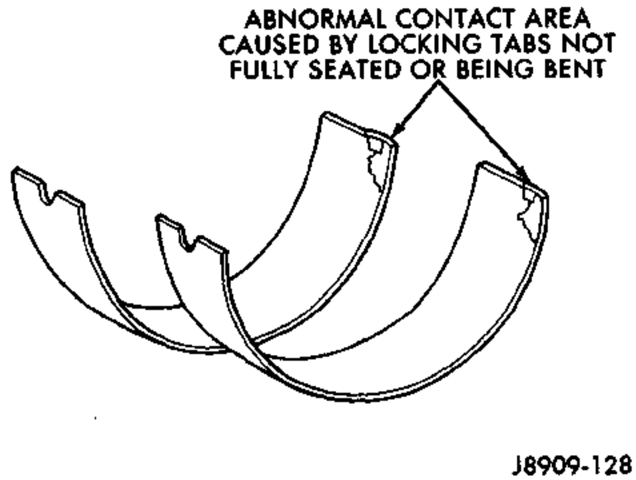


Fig. 12 Locking Tab Inspection

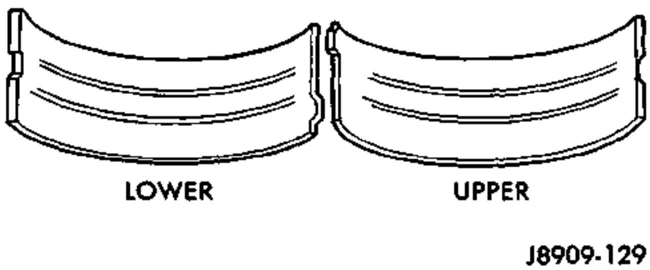


Fig. 13 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

BEARING-TO-JOURNAL CLEARANCE

(1) Wipe the oil from the connecting rod journal.

(2) Use short rubber hose sections over rod bolts during installation.

(3) Lubricate the upper bearing insert and install in connecting rod.

(4) Use piston ring compressor to install the rod and piston assemblies. The oil squirt holes in the rods must face the camshaft. The arrow on the piston crown should point to the front of the engine (Fig. 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.

(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

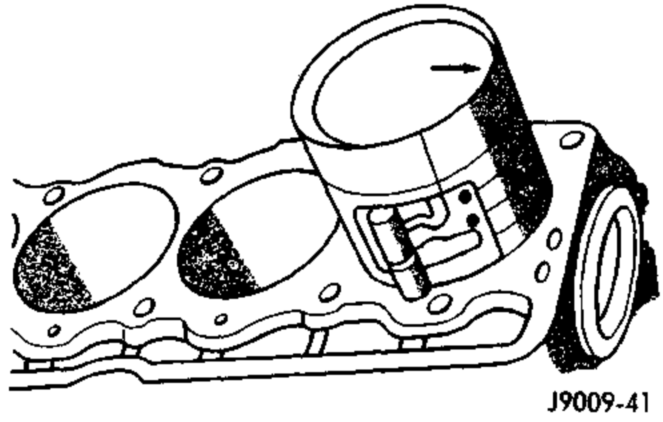


Fig. 14 Rod and Piston Assembly Installation

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.**

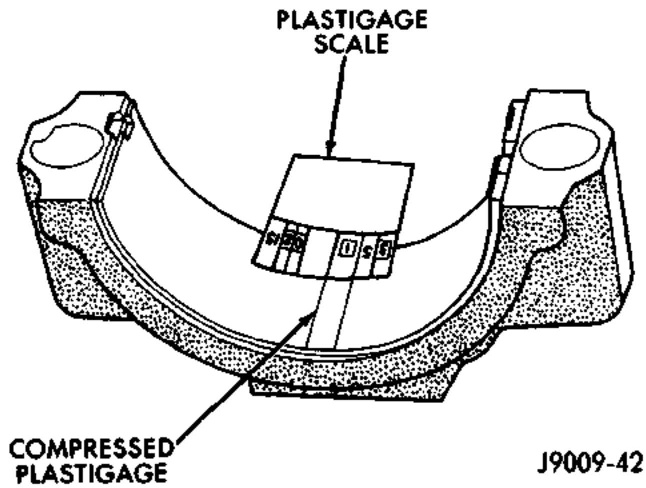


Fig. 15 Measuring Bearing Clearance with Plastigage

(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

SERVICE PROCEDURES (Continued)

Crankshaft Journal		Corresponding Connecting Rod Bearing Insert	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	53.2257-53.2079 mm (2.0955-2.0948 in.)	Yellow - Standard	Yellow - Standard
Orange	53.2079-53.1901 mm (2.0948-2.0941 in.) 0.0178 mm (0.0007 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Blue	53.1901-53.1724 mm (2.0941-2.0934 in.) 0.0356 mm (0.0014 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Red	52.9717-52.9539 mm (2.0855-2.0848 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

J9409-24

CONNECTING ROD BEARING FITTING CHART

is needed to provide the correct clearance (refer to Connecting Rod Bearing Fitting Chart).

(11) **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).

(12) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(13) 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.

FITTING CRANKSHAFT MAIN BEARINGS

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. 16).

NOTE: If any of the crankshaft journals are scored, remove the engine for crankshaft repair.

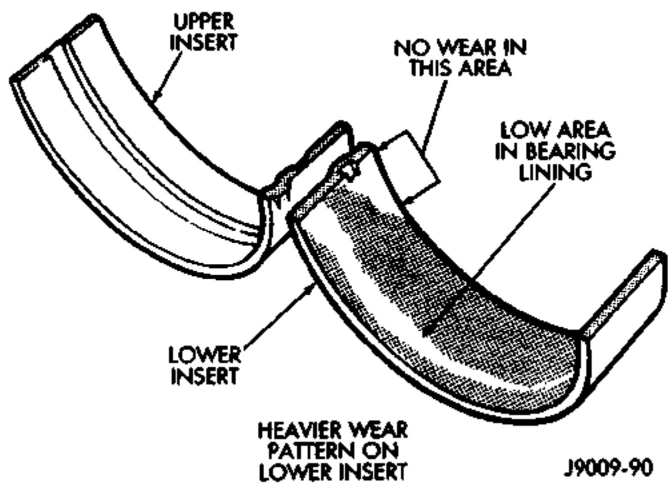


Fig. 16 Main Bearing Wear Patterns

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 BEARINGS (CRANKSHAFT INSTALLED)

The main bearing caps, numbered (front to rear) from 1 through 7 have an arrow to indicate the forward position. The upper main bearing inserts are grooved to provide oil channels while the lower inserts are smooth.

Each bearing insert pair is selectively fitted to its respective journal to obtain the specified operating clearance. In production, the select fit is obtained by

SERVICE PROCEDURES (Continued)

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. 17).**

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.025 mm (0.001 in.) Undersize	0.051 mm (0.002 in.) Undersize

J9109-179

Fig. 17 Bearing Insert Pairs

NOTE: 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.

NOTE: 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. 18). Refer to Engine Specifications for the proper clearance.

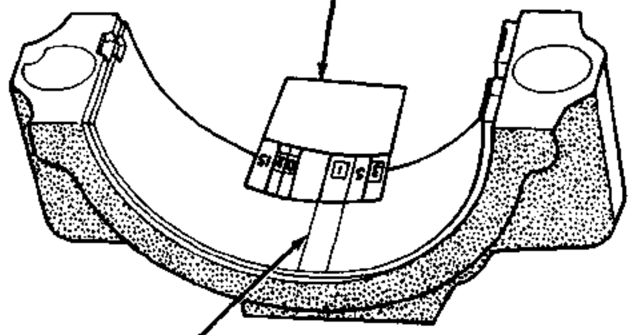


Fig. 18 Measuring Bearing Clearance with Plastigage

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 indicate 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 0q762 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,

SERVICE PROCEDURES (Continued)

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).

MAIN BEARING FITTING CHART

CRANKSHAFT JOURNALS #1 - #6		CORRESPONDING CRANKSHAFT BEARING INSERT	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	63.5025 - 63.4898 mm (2.5001 - 2.4996 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4898 - 63.4771mm (2.4996 - 2.4991 in.) 0.0127 mm (0.0005 in.) Undersize	Yellow - Undersize 0.025 mm (0.001 in.)	Blue - Standard
Blue	63.4771 - 63.4644 mm (2.4991 - 2.4986 in.) 0.0254 mm (0.001 in.) Undersize	Blue- Undersize 0.025 mm (0.001 in.)	Blue- Undersize 0.025 mm (0.001 in.)
Green	63.4644 - 63.4517 mm (2.4986 - 2.4981 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2485 - 63.2358 mm (2.4901 - 2.4896 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)
CRANKSHAFT JOURNAL #7 ONLY		CORRESPONDING CRANKSHAFT BEARING INSERT	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	63.4873 - 63.4746 mm (2.4995 - 2.4990 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4746 - 63.4619 mm (2.4990 - 2.4985 in.) 0.0127 mm (0.0005 in. Undersize	Yellow - Undersize 0.025 mm (0.001 in.)	Blue - Standard
Blue	63.4619 - 63.4492 mm (2.4985 - 2.4980 in.) 0.0254 mm (0.001 in.) Undersize	Blue- Undersize 0.025 mm (0.001 in.)	Blue- Undersize 0.025 mm (0.001 in.)
Green	63.4492 - 63.4365 mm (2.4980- 2.4975 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2333 - 63.2206 mm (2.4895 - 2.4890 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT

The front mounts support the engine at each side. These supports are made of resilient rubber.

REMOVAL

(1) Disconnect negative cable from battery.
(2) Raise the vehicle.
(3) Support the engine.
(4) Remove the nut from the through bolt (Fig. 19) (Fig. 20). DO NOT remove the through bolt.

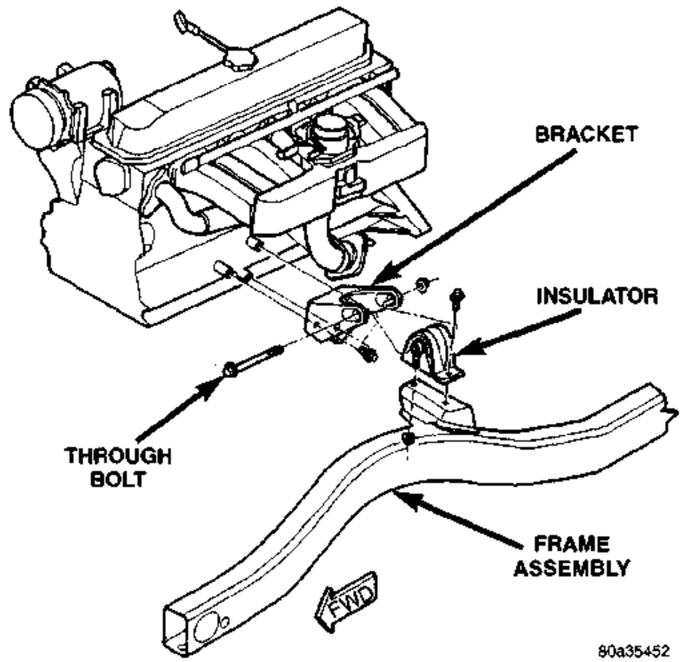


Fig. 19 Left Front Engine Mount

(5) Remove the retaining bolts and nuts from the insulator.
(6) Remove the through bolt.
(7) Remove the insulator.

INSTALLATION

(1) If the engine support bracket was removed, position the bracket onto the block and install the attaching bolts (Fig. 19) (Fig. 20). Tighten the bolts to 62 N·m (46 ft. lbs.) torque.
(2) Place the insulator on the support bracket. Install the insulator retaining bolts and nuts. Tighten the bolts and nuts to 52 N·m (38 ft. lbs) torque.
(3) Install the through bolt and the retaining nut. Tighten the through bolt nut to 69 N·m (51 ft. lbs.) torque.
(4) Remove the engine support.
(5) Lower the vehicle.
(6) Connect negative cable to battery.

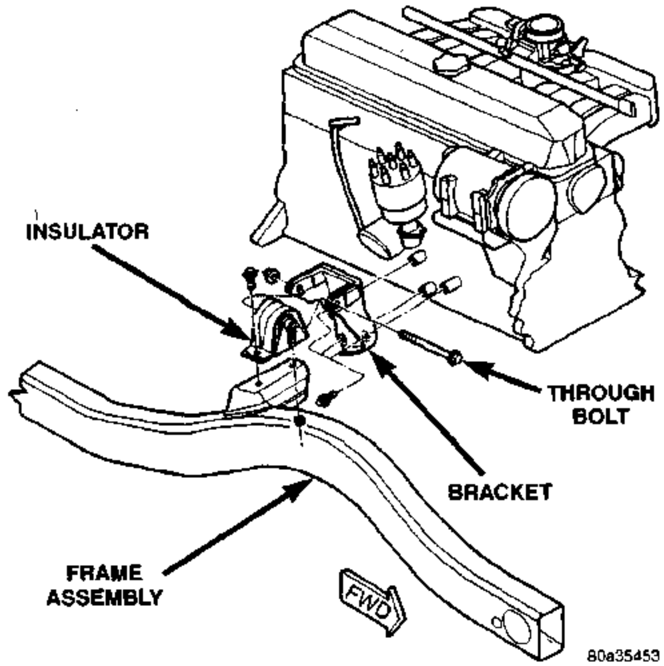


Fig. 20 Right Front Engine Mount

ENGINE MOUNT—REAR

A resilient rubber cushion supports the transmission at the rear between the transmission extension housing and the rear support crossmember or skid plate.

REMOVAL

ALL TRANSMISSIONS

(1) Disconnect negative cable from battery.
(2) Raise the vehicle and support the transmission.
(3) Remove the nuts holding the support cushion to the skid plate (Fig. 21) (Fig. 21).
(4) Remove the skid plate bolts and the skid plate.

MANUAL TRANSMISSIONS

(1) Remove nuts holding support cushion to transmission support bracket.
(2) Remove the support cushion.
(3) Remove bolts holding transmission support bracket to transmission.
(4) Remove the transmission support bracket.

AUTOMATIC TRANSMISSIONS

(1) Remove nuts holding support cushion to transmission support bracket (Fig. 21). Remove the support cushion.
(2) Remove the bolts holding the transmission support bracket to transmission.
(3) Remove the transmission support bracket.

REMOVAL AND INSTALLATION (Continued)

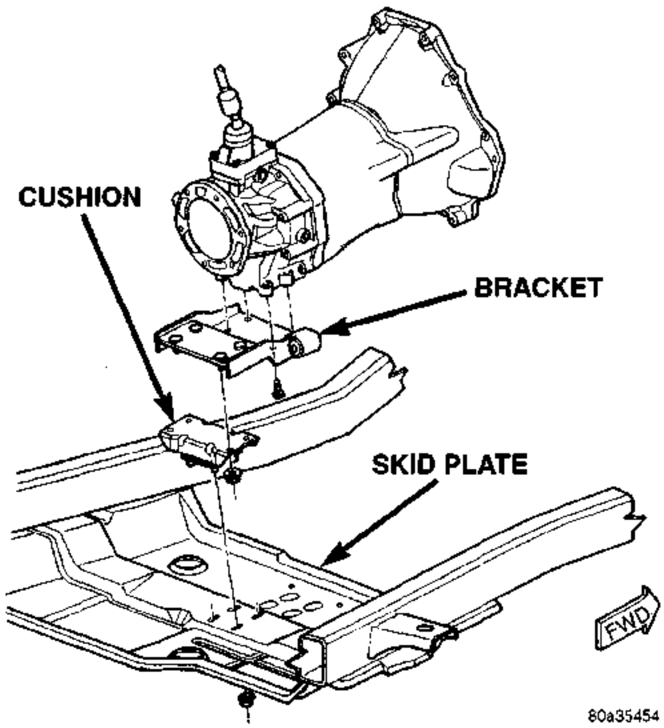


Fig. 21 Rear Mount (Manual Transmission)

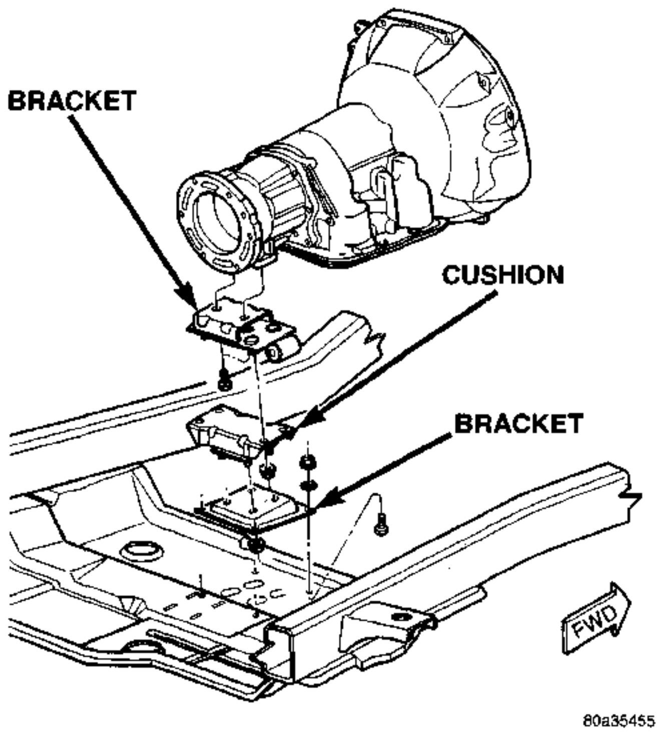


Fig. 22 Rear Mount (AutomaticTransmission)

INSTALLATION

MANUAL TRANSMISSION:

(1) Position the transmission mount bracket to the transmission and install the bolts (Fig. 21).

(2) Tighten the bolts to 54 N·m (40 ft. lbs.) torque.

(3) Position the support cushion to the transmission mount bracket and install nuts (Fig. 21).

(4) Tighten the nuts to 41 N·m (30 ft. lbs.) torque.

AUTOMATIC TRANSMISSION:

(1) Position the transmission mount bracket to the transmission and install the bolts. Tighten the bolts to 54 N·m (40 ft. lbs.) torque.

(2) Position the support cushion to the transmission mount bracket and install nuts. Tighten the nuts to 41 N·m (30 ft. lbs.) torque (Fig. 21).

(3) If the support cushion bracket was removed from the skid plate, position the bracket on the skid plate and install the nuts and bolts. Tighten the nuts to 28 N·m (21 ft. lbs.) torque.

ALL TRANSMISSIONS

(1) Position the skid plate to the studs of the support cushion and install the nuts (Fig. 21) (Fig. 21). Tighten the nuts to 28 N·m (21 ft. lbs.) torque.

(2) Install the skid plate bolts to the sill and tighten to 75 N·m (55 ft. lbs.) torque.

(3) Remove the transmission support.

(4) Lower the vehicle.

(5) Connect negative cable to battery.

ENGINE ASSEMBLY

REMOVAL

(1) Place a protective cloth over the windshield frame. Raise the hood and rest it on the windshield frame.

(2) Disconnect the battery cables. Remove the battery.

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. USE CARE TO PREVENT SCALDING BY HOT COOLANT. CAREFULLY RELEASE THE PRESSURE BEFORE REMOVING THE RADIATOR DRAIN COCK AND CAP.

(3) Remove the radiator drain cock and radiator cap to drain the coolant. DO NOT waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(4) Disconnect the wire connectors from the generator.

(5) If equipped with air conditioning, remove the air conditioning compressor, (refer to Group 24, Heating and Air Conditioning).

(6) Disconnect the ignition coil and distributor wire connectors.

(7) Disconnect the oil pressure sender wire connector.

(8) Disconnect the wires at the starter motor solenoid and injection wire harness connector.

REMOVAL AND INSTALLATION (Continued)

(9) Perform the Fuel System Pressure Release procedure (refer to Group 14, Fuel System).

(10) Disconnect the quick-connect fuel lines at the fuel rail and return line by squeezing the retaining tabs against the fuel tube. Pull the fuel tube and retainer from the quick- connect fitting (refer to Group 14, Fuel System for the proper procedure).

(11) Remove the fuel line bracket from the intake manifold.

(12) Disconnect the engine ground strap.

(13) Remove the air cleaner.

(14) Disconnect the vacuum purge hose at the fuel vapor canister tee.

(15) Disconnect the idle speed actuator wire connector.

(16) Disconnect the throttle cable and remove it from the bracket.

(17) Disconnect the throttle rod at the bellcrank.

(18) Disconnect the speed control cable, if equipped.

(19) Disconnect the oxygen sensor wire connector.

(20) Remove the upper radiator hose and coolant recovery hose.

(21) Disconnect lower radiator hoses at the radiator.

(22) Disconnect the coolant hoses from the rear of the intake manifold and thermostat housing.

(23) Remove the fan shroud screws.

(24) Remove the radiator attaching bolts.

(25) Remove the radiator and fan shroud. Refer to Group 7, Cooling System for the proper procedure.

(26) Remove the fan and spacer or Tempatrol fan assembly.

(27) Install a 5/16 X 1/2-inch SAE capscrew through fan pulley into water pump flange. This will maintain the pulley and water pump in alignment when crankshaft is rotated.

(28) Remove the power brake vacuum check valve from the booster, if equipped.

(29) If equipped with power steering:

(a) Disconnect the hoses from the fittings at the steering gear.

(b) Drain the pump reservoir.

(c) Cap the fittings on the hoses and steering gear to prevent foreign objects from entering the system.

(30) Lift the vehicle and support it with support stands.

(31) Remove the starter motor.

(32) Remove the flywheel housing access cover.

(33) Remove the engine support cushion-to-bracket through bolts.

(34) Disconnect the exhaust pipe from the manifold.

(35) Remove the upper flywheel housing bolts and loosen the bottom bolts.

(36) Lower the vehicle.

(37) Attach a lifting device to the engine.

(38) Raise the engine off the front supports.

(39) Place a support stand under the flywheel housing.

(40) Remove the remaining flywheel housing bolts.

(41) Lift the engine out of the engine compartment and install on an engine stand.

INSTALLATION

(1) Lift the engine off the stand and lower it into the engine compartment. For easier installation, it may be useful to remove the engine support cushions from the engine support brackets as an aide for alignment of the engine-to-transmission.

(2) Insert the transmission shaft into the clutch spline.

(3) Align the flywheel housing with the engine.

(4) Install and finger tighten the flywheel housing lower bolts.

(5) Install the engine support cushions (if removed).

(6) Remove the support stand from beneath the flywheel housing.

(7) Lower the engine and engine support cushions onto the engine compartment brackets. Ensure that the bolt holes are aligned. Install the bolts and tighten the nuts.

(8) Remove the engine lifting device.

(9) Raise the vehicle.

(10) Attach the exhaust pipe to the manifold. Install and tighten the nuts to 31 N·m (23 ft. lbs.) torque.

(11) Install the flywheel housing access cover.

(12) Install the remaining flywheel housing bolts. Tighten the bolts to 38 N·m (28 ft. lbs.) torque.

(13) Install the starter motor and connect the cable. Tighten the bolts to 45 N·m (33 ft. lbs.) torque.

(14) Lower the vehicle.

(15) Connect the coolant hoses and tighten the clamps.

(16) Remove the pulley-to-water pump flange alignment capscrew and install the fan and spacer or Tempatrol fan assembly.

(17) Tighten the serpentine drive belt according to the specifications listed in Group 7, Cooling System.

(18) Install the fan shroud and radiator (refer to Group 7, Cooling System for the proper procedure).

(19) Connect the radiator hoses.

(20) Connect the throttle valve rod and retainer.

(21) Connect the throttle cable and install the rod.

(22) Install the throttle valve rod spring.

(23) Connect the speed control cable, if equipped.

(24) Connect the oxygen sensor wire connector.

(25) Install the vacuum hose and check valve on the brake booster.

REMOVAL AND INSTALLATION (Continued)

(26) Connect the coolant temperature sensor wire connector.

(27) Connect the idle speed actuator wire connector.

(28) Connect the fuel inlet and return hoses at the fuel rail. Verify that the quick-connect fitting assembly fits securely over the fuel lines by giving the fuel lines a firm tug.

(29) Install the fuel line bracket to the intake manifold.

(30) Connect all fuel injection wire connections.

(31) Install the engine ground strap.

(32) Connect the ignition coil wire connector.

(33) Remove the coolant temperature sending unit to permit air to escape from the block. Fill the cooling system with coolant. Install the coolant temperature sending unit when the system is filled.

(34) If equipped with power steering:

(a) Remove the protective caps

(b) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.

(c) Fill the pump reservoir with fluid.

(35) If equipped with air conditioning, install air compressor and charge A/C system (refer to Group 24 Heating and Air Conditioning).

(36) Install the battery and connect the battery cables.

(37) Install the air cleaner bonnet to the throttle body.

(38) Install the air cleaner.

(39) Lower the hood and secure in place.

(40) Start the engine and inspect for leaks.

(41) Stop the engine and check the fluid levels. Add fluid, as required.

ENGINE CYLINDER HEAD COVER

The cylinder head cover is isolated from the cylinder head via grommets and a molded rubber gasket. The grommet and limiter are retained in the cylinder head cover.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Disconnect the Crankcase Ventilation (CCV) vacuum hose from engine cylinder head cover (Fig. 23).

(3) Disconnect the fresh air inlet hose from the engine cylinder head cover (Fig. 23).

(4) Remove the engine cylinder head cover mounting bolts.

(5) Remove the engine cylinder head cover.

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.

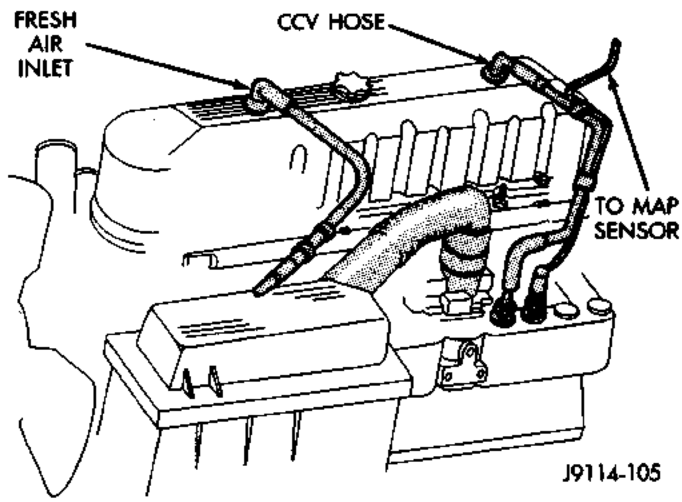


Fig. 23 Engine Cylinder Head Cover

(2) Install engine cylinder head cover. Tighten the mounting bolts to 9.6 N·m (85 in. lbs.) torque.

(3) Connect the CCV hoses (Fig. 23).

(4) Connect negative cable to battery.

ROCKER ARMS AND PUSH RODS

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. 24). 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. 24). 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.

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.

REMOVAL AND INSTALLATION (Continued)

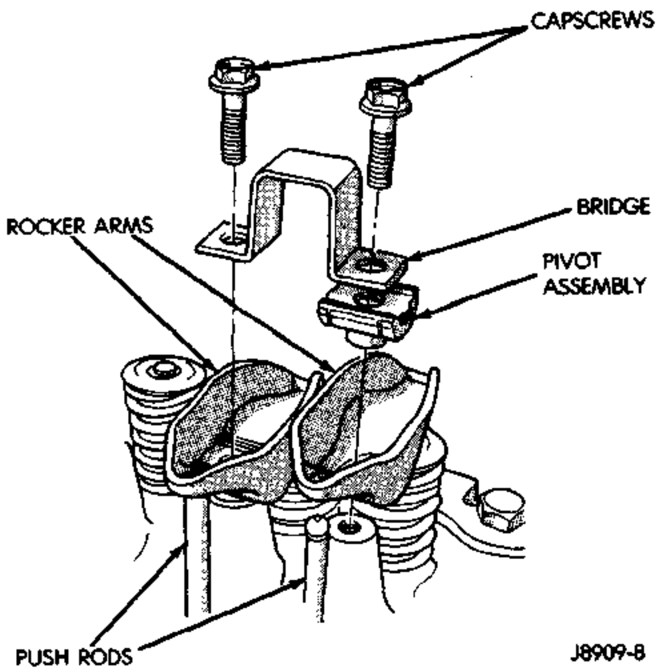


Fig. 24 Rocker Arm Assembly

VALVE STEM SEAL AND SPRING

This procedure can be done with the engine cylinder head installed on the block.

REMOVAL

Inspect the valve stems, especially the grooves. An Arkansas smooth stone should be used to remove nicks and high spots.

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) 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.

(7) Tap the retainer or tip with a rawhide hammer to loosen the lock from the retainer. Use Valve Spring Compressor Tool MD-998772A to compress the spring and remove the locks (Fig. 25).

(8) Remove valve spring and retainer (Fig. 25).

(9) Remove valve stem oil seals (Fig. 25). 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.

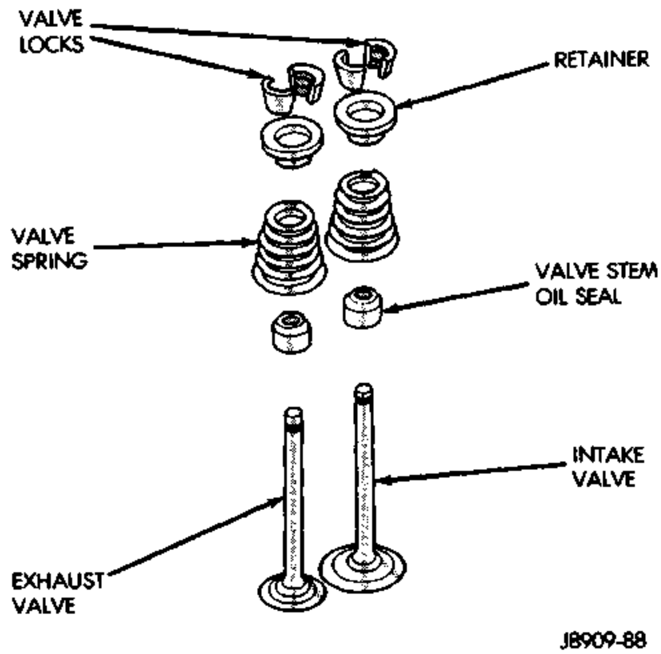


Fig. 25 Valve and Valve Components

INSTALLATION

CAUTION: Install oil seals carefully to prevent damage from the sharp edges of the valve spring lock grove.

(1) Lightly push the valve seal over the valve stem and valve guide boss. Be sure the seal is completely seated on the valve guide boss.

(2) Install valve spring and retainer.

(3) Compress the valve spring with Valve Spring Compressor Tool MD-998772A and insert the valve locks. Release the spring tension and remove the tool. Tap the spring from side-to-side to ensure that the spring is seated properly on the engine cylinder head.

(4) Disconnect the air hose. Remove the adaptor from the spark plug hole and install the spark plug.

(5) Repeat the procedures for each remaining valve spring to be removed.

(6) Install the push rods. Ensure the bottom end of each rod is centered in the plunger cap seat of the hydraulic valve tappet.

(7) Install the rocker arms, pivots and bridge at their original location.

(8) Tighten the bridge capscrews alternately, one at a time, to avoid damaging the bridge. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(9) Install the engine cylinder head cover.

REMOVAL AND INSTALLATION (Continued)

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.

(6) Remove the push rods. **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, remove the air conditioning compressor, (refer to Group 24, Heating and Air Conditioning).

(9) If equipped, disconnect the power steering pump bracket. Set the pump and bracket aside. DO NOT disconnect the hoses.

(10) Perform the Fuel System Pressure Release procedure (refer to Group 14, Fuel System).

(11) Remove the fuel lines and vacuum advance hose.

(12) 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).

(13) Disconnect the ignition wires and remove the spark plugs.

(14) Disconnect the temperature sending unit wire connector.

(15) Remove the ignition coil and bracket assembly.

(16) Remove the engine cylinder head bolts. Bolt No.14 cannot be removed until the head is moved forward (Fig. 26). Pull bolt No.14 out as far as it will go and then suspend the bolt in this position (tape around the bolt).

(17) Remove the engine cylinder head and gasket (Fig. 26).

(18) 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.

(19) Stuff clean lint free shop towels into the cylinder bores.

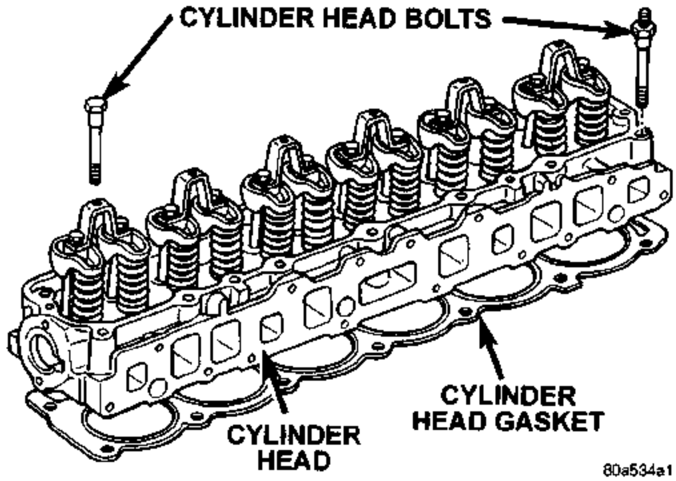


Fig. 26 Engine Cylinder Head Assembly

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) using the alignment dowels in the cylinder block, to position the gasket.

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 over the same dowels used to locate the gasket. 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. 27).

REMOVAL AND INSTALLATION (Continued)

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.

(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 13 N·m (100 ft. lbs.) torque.
- Bolts 12 through 14 to 149 N·m (110 ft. lbs.) torque.

CYLINDER HEAD BOLTS

POSITION	DESCRIPTION
1,4,5,12,13	1/2 in.-13 BOLT
8,9	1/2 in.-13 BOLT WITH DOWEL POINT
2,3,6,7,10,11,14	1/2 in.-13 WITH 7/16 in.-14 STUD END
All bolts are 12 point drives for rocker cover clearance	

(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.

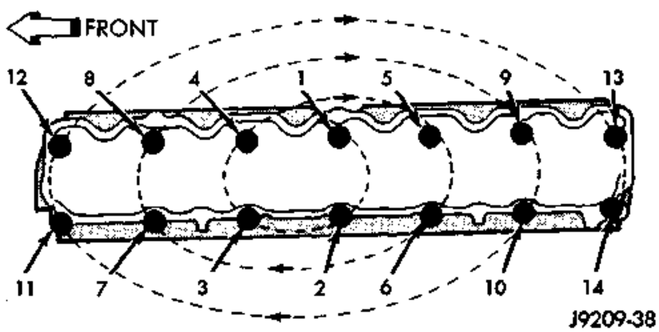


Fig. 27 Engine Cylinder Head Bolt Tightening Sequence

(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 (refer to Rocker Arms and Push Rods in this section).

(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 line.

(23) If equipped with air conditioning, install air compressor and charge A/C system (refer to Group 24 Heating and Air Conditioning).

(24) Connect negative cable to battery.

(25) Connect the upper radiator hose and heater hose at the engine thermostat housing.

(26) 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.

(27) 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.

REMOVAL AND INSTALLATION (Continued)

VALVES AND VALVE SPRINGS

This procedure is done with the engine cylinder head removed from the block.

REMOVAL

(1) Remove the engine cylinder head from the cylinder block.

(2) Use Valve Spring Compressor Tool MD-998772A and compress each valve spring.

(3) Remove the valve locks, retainers, springs and valve stem oil seals. Discard the oil seals.

(4) Use a 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.

INSTALLATION

(1) Thoroughly clean the valve stems and the valve guide bores.

(2) Lightly lubricate the stem.

(3) Install the valve in the original valve guide bore.

(4) Install the replacement valve stem oil seals on the valve stems. If the 0.381 mm (0.015 inch) oversize valve stems are used, oversize oil seals are required.

(5) Position the valve spring and retainer on the engine cylinder head and compress the valve spring with Valve Spring Compressor Tool MD-998772A.

(6) Install the valve locks and release the tool.

(7) Tap the valve spring from side to side with a hammer to ensure that the spring is properly seated at the engine cylinder head. Also tap the top of the retainer to seat the valve locks.

(8) Install the engine cylinder head.

HYDRAULIC TAPPETS

Retain all the components in the same order as removed.

REMOVAL

(1) Remove the engine cylinder head cover.

(2) Remove the bridge and pivot assemblies and rocker arms by removing the capscrews at each bridge. Alternately loosen each capscrew, one turn at a time, to avoid damaging the bridges.

(3) Remove the push rods.

(4) Remove cylinder head and gasket.

(5) Remove the tappets through the push rod openings in the cylinder block with a Hydraulic Valve Tappet Removal/Installation Tool (Fig. 28).

INSTALLATION

It is not necessary to charge the tappets with engine oil. They will charge themselves within a very short period of engine operation.

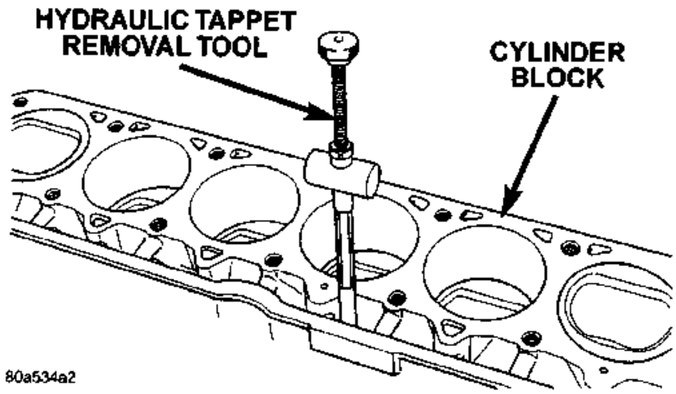


Fig. 28 Hydraulic Valve Tappet Removal—Installation Tool

(1) Dip each tappet in Mopar Engine Oil Supplement, or equivalent.

(2) Use Hydraulic Valve Tappet Removal/Installation Tool to install each tappet in the same bore from where it was originally removed.

(3) Install cylinder head and gasket.

(4) Install the push rods in their original locations.

(5) Install the rocker arms and bridge and pivot assemblies at their original locations. Loosely install the capscrews at each bridge.

(6) 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.

(7) 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.

(8) Install the engine cylinder head cover.

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 7697 to remove the damper from the crankshaft (Fig. 29).

INSTALLATION

(1) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key in position, align the keyway on the vibration damper hub with the crankshaft key and tap the damper onto the crankshaft.

(2) Install the vibration damper retaining bolt and washer.

REMOVAL AND INSTALLATION (Continued)

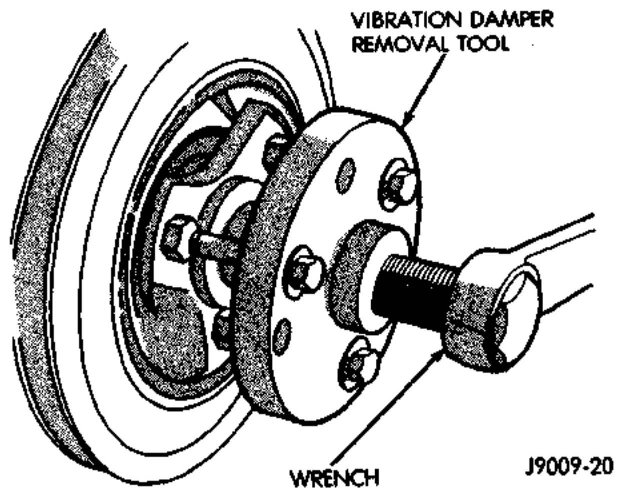


Fig. 29 Vibration Damper Removal Tool 7697

(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

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the vibration damper.

(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. 30).

INSTALLATION

Clean the timing case cover, oil pan and cylinder block gasket surfaces.

(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.

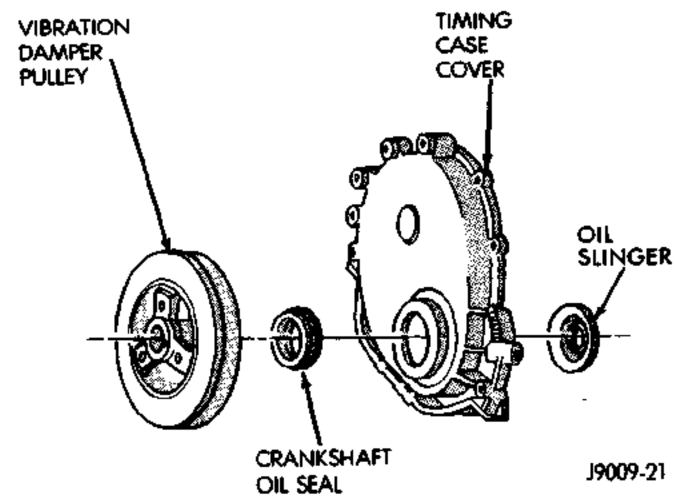


Fig. 30 Timing Case Cover Components

(4) Insert Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening in the cover (Fig. 31).

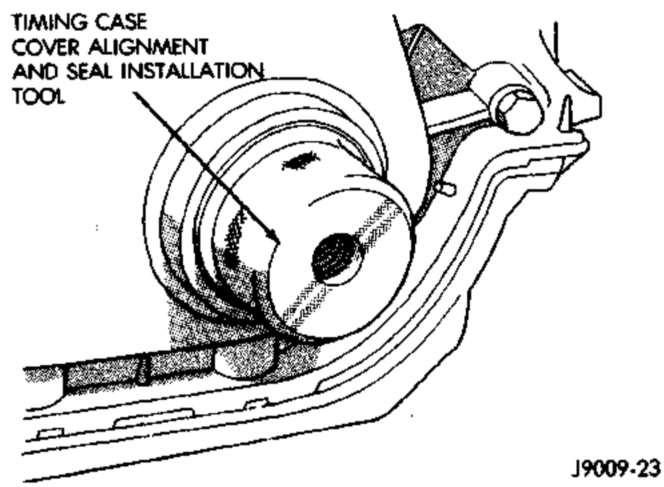


Fig. 31 Timing Case Cover Alignment and Seal Installation Tool 6139

(5) Install the timing case cover-to-cylinder block and the oil pan-to-timing case cover bolts.

(6) Tighten the 1/4 inch cover-to-block bolts to 7 N·m (60 in. lbs.) torque. Tighten the 5/16 inch front cover-to-block bolts to 22 N·m (192 in. lbs.) torque. Tighten the oil pan-to-cover 1/4 inch bolts to 9.5 N·m (84 in. lbs.) torque. Tighten the oil pan-to-cover 5/16 inch bolts to 15 N·m (132 in. lbs.) torque.

(7) Remove the cover alignment tool.

(8) Apply a light film of engine oil on the vibration damper hub contact surface of the seal.

(9) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt.

REMOVAL AND INSTALLATION (Continued)

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. 32).

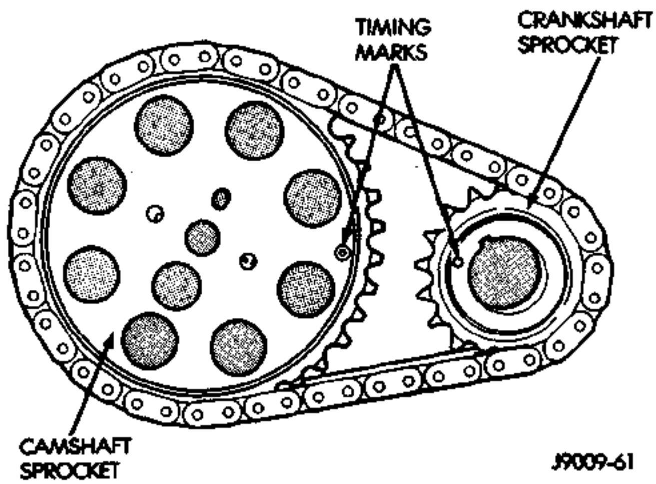


Fig. 32 Crankshaft—Camshaft Alignment—Typical

(7) Remove the oil slinger from the crankshaft.

(8) Remove the tension spring and thrust pin from the preload bolt (Fig. 33). Remove the camshaft sprocket retaining preload bolt and washer.

(9) Remove the crankshaft sprocket, camshaft sprocket and timing chain as an assembly.

(10) 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.

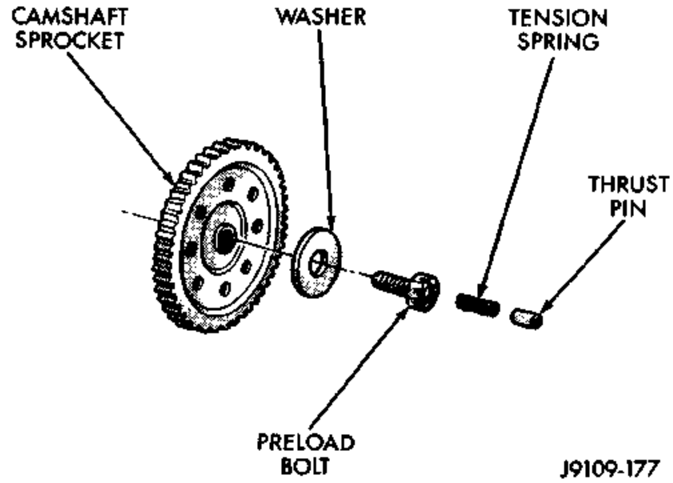


Fig. 33 Camshaft Sprocket Preload Bolt

INSTALLATION

Assemble the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned (Fig. 32).

(1) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key in the keyway on the crankshaft, install the assembly on the crankshaft and camshaft.

(2) Install the camshaft sprocket retaining preload bolt and washer (Fig. 33). Tighten the preload bolt to 108 N·m (80 ft. lbs.) torque.

(3) Install the crankshaft oil slinger.

(4) Replace the oil seal in the timing case cover.

(5) 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. 33).

(6) Install the timing case cover and gasket.

(7) With the key installed in the crankshaft keyway, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(8) Install the serpentine drive belt and tighten to the specified tension (refer to Group 7, Cooling System for the proper procedure).

(9) Install the fan and hub assembly. Install the shroud.

(10) Connect negative cable to battery.

CAMSHAFT

REMOVAL

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. RELEASE THE PRESSURE BEFORE REMOVING THE DRAIN COCK, CAP AND DRAIN PLUGS.

(1) Disconnect negative cable from battery.

REMOVAL AND INSTALLATION (Continued)

(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 and 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. 34).

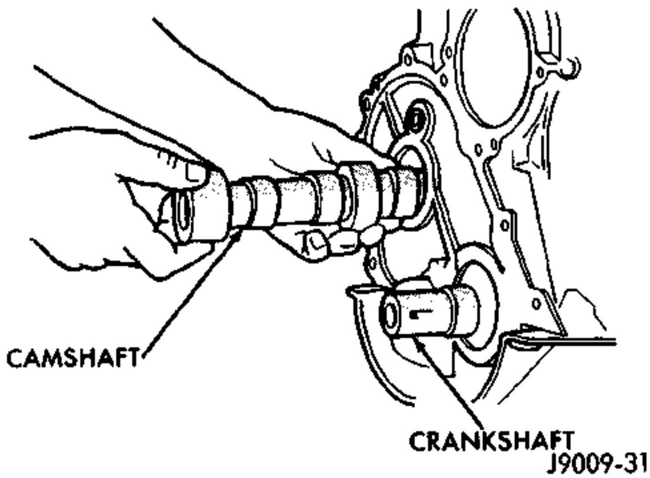


Fig. 34 Camshaft

INSTALLATION

(1) Inspect the cam lobes for wear.

(2) Inspect the bearing journals for uneven wear pattern or finish.

(3) Inspect the bearings for wear.

(4) Inspect the distributor drive gear for wear.

(5) 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.

(6) Lubricate the camshaft with Mopar Engine Oil Supplement, or equivalent.

(7) Carefully install the camshaft to prevent damage to the camshaft bearings (Fig. 34).

(8) Install the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned.

(9) Install the camshaft sprocket retaining preload bolt. Tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(10) 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.

(11) Install the timing case cover with a replacement oil seal (Fig. 35). Refer to Timing Case Cover Installation.

(12) Install the vibration damper (Fig. 35).

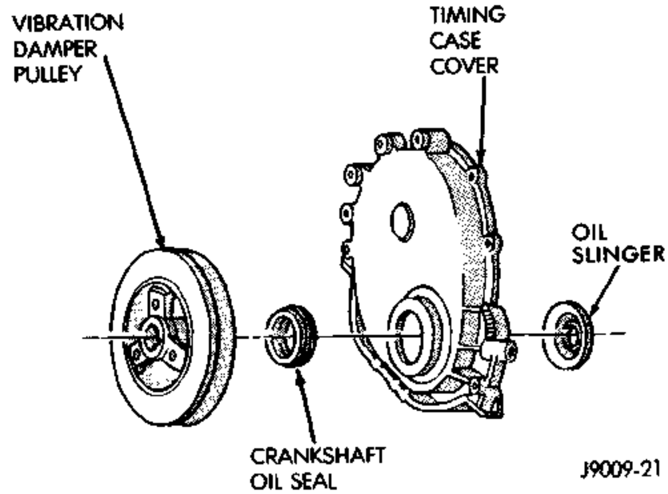


Fig. 35 Timing Case Cover Components

(13) Install the hydraulic valve tappets.

(14) Install the engine cylinder head.

(15) Install the push rods.

(16) 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.

(17) Install the engine cylinder head cover.

(18) Position the oil pump gear. Refer to Distributor in the Component Removal/Installation section of Group 8D, Ignition Systems.

(19) Install the distributor and ignition wires. Refer to Distributor in the Component Removal/Installation section of Group 8D, Ignition Systems.

(20) Install the serpentine drive belt and tighten to the specified tension (refer to Group 7, Cooling System for the proper procedure).

NOTE: 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.

REMOVAL AND INSTALLATION (Continued)

(21) 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.

(22) 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).
(23) Check the ignition timing and adjust as necessary.
(24) Install the grille and bumper, if removed.
(25) 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. 36).
(12) Remove the camshaft sprocket preload retaining bolt and washer.
(13) Remove the crankshaft oil slinger.

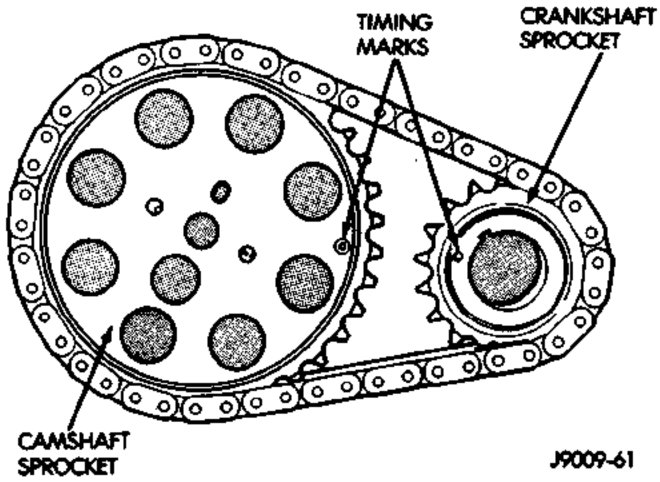


Fig. 36 Timing Chain Alignment—Typical

(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.

NOTE: It is not advisable to attempt to replace camshaft bearings unless special removal and installation tools are available.

REMOVAL AND INSTALLATION (Continued)

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. 36).

(5) Install the crankshaft oil slinger.

(6) Tighten the camshaft sprocket preload bolt to 108 N·m (80 ft. lbs.) torque.

(7) Check the valve timing.

(8) 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.

(9) Coat both sides of the replacement timing case cover gasket with gasket sealer. Apply a 3 mm (1/8 inch) bead of Mopar Silicone Rubber Adhesive Sealant, or equivalent to the joint formed at the oil pan and cylinder block.

(10) Position the timing case cover on the oil pan gasket and the cylinder block.

(11) Place Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening in the cover (Fig. 37).

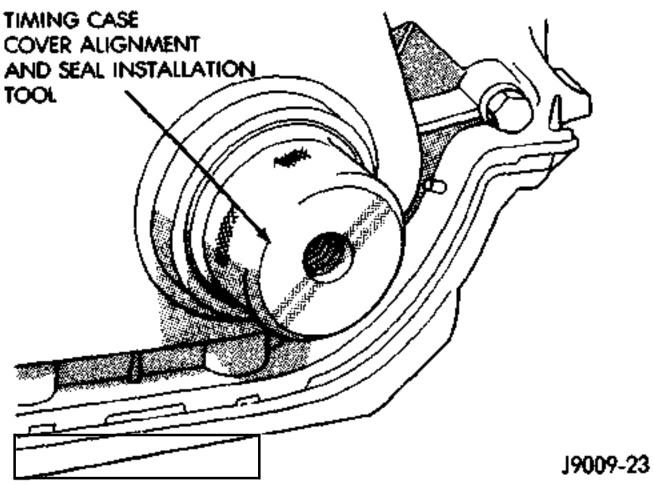


Fig. 37 Timing Case Cover Alignment and Seal Installation Tool 6139

(12) Install the timing case cover-to-cylinder block bolts. Install the oil pan-to-timing case cover bolts.

(13) Tighten the 1/4 inch cover-to-block bolts to 7 N·m (60 in. lbs.) torque. Tighten the 5/16 inch front cover-to-block bolts to 22 N·m (192 in. lbs.) torque. Tighten the oil pan-to-cover 1/4 inch bolts to 14 N·m (120 in. lbs.) torque. Tighten the oil pan-to-cover 5/16 inch bolts to 18 N·m (156 in. lbs.) torque.

(14) Remove the cover alignment tool and install a replacement oil seal into the cover.

(15) Install the vibration damper on the crankshaft.

(16) Lubricate and tighten the damper bolt to 108 N·m (80 ft. lbs.) torque.

(17) If equipped with air conditioning:

(a) Install the A/C compressor serpentine drive belt idler pulley.

(b) Install the generator.

(c) Install the A/C condenser and receiver/drier assembly.

(18) Install the serpentine drive belt on the pulleys and tighten (refer to Group 7, Cooling System for the specifications and procedures).

(19) Install the radiator. Connect the radiator hoses and automatic transmission fluid cooler pipes, if equipped. Fill the cooling system.

(20) Install the fan and shroud.

(21) Connect negative cable to battery.

OIL PAN

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise the vehicle.

(3) Remove the oil pan drain plug and drain the engine oil.

(4) Disconnect the exhaust pipe at the exhaust manifold.

(5) Disconnect the exhaust hanger at the catalytic converter and lower the pipe.

(6) Remove the starter motor.

(7) Remove the engine flywheel and 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.

INSTALLATION

(1) Clean the block and pan gasket surfaces.

(2) 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. 38).

REMOVAL AND INSTALLATION (Continued)

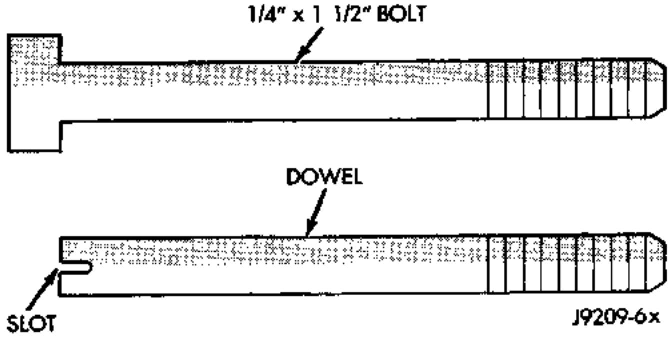


Fig. 38 Fabrication of Alignment Dowels

(3) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 39).

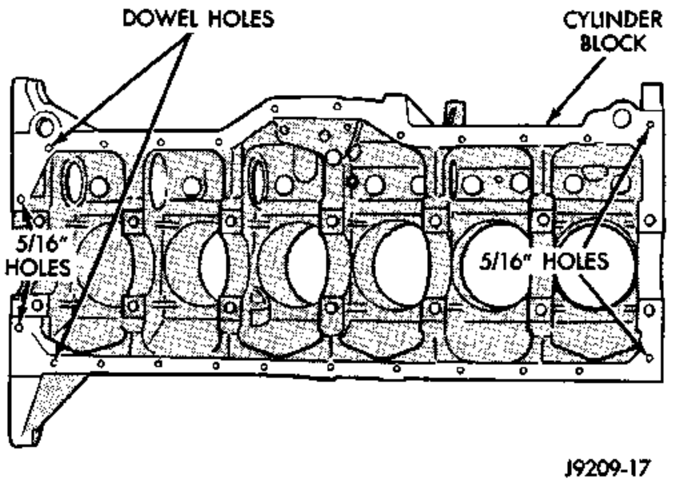


Fig. 39 Position of Dowels in Cylinder Block

(4) Slide the one-piece gasket over the dowels and onto the block and timing case cover.

(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 1/4 inch oil pan bolts. Tighten these bolts to 9.5 N·m (84 in. lbs.) torque. Install the 5/16 inch oil pan bolts (Fig. 40). Tighten these bolts to 15 N·m (132 in. lbs.) torque.

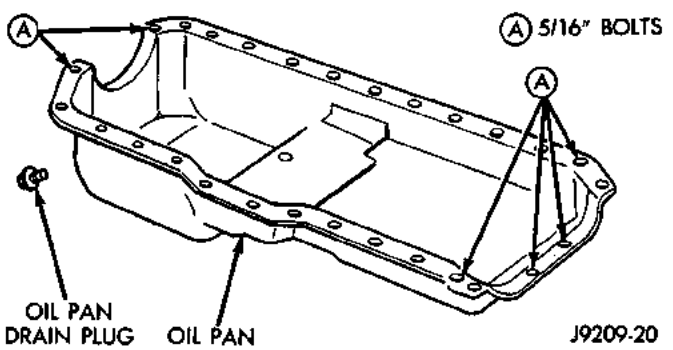


Fig. 40 Position of 5/16 inch Oil Pan Bolts

(7) Remove the dowels. Install the remaining 1/4 inch oil pan bolts. Tighten these bolts to 9.5 N·m (84 in. lbs.) torque.

(8) Lower the engine until it is properly located on the engine mounts.

(9) Install the through bolts and tighten the nuts.

(10) Lower the jack stand and remove the piece of wood.

(11) Install the engine flywheel and 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. 40). Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(15) Lower the vehicle.

(16) Connect negative cable to battery.

(17) Fill the oil pan with engine oil to the specified level.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(18) Start the engine and inspect for leaks.

OIL PUMP

A gear-type oil pump is mounted at the underside of the cylinder block opposite the No.4 main bearing.

The pump incorporates a nonadjustable pressure relief valve to limit maximum pressure to 517 kPa (75 psi). In the relief position, the valve permits oil to bypass through a passage in the pump body to the inlet side of the pump.

Oil pump removal or replacement will not affect the distributor timing because the distributor drive gear remains in mesh with the camshaft gear.

REMOVAL

(1) Drain the engine oil.

(2) Remove the oil pan.

(3) Remove the pump-to-cylinder block attaching bolts. Remove the pump assembly with gasket (Fig. 41).

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.

REMOVAL AND INSTALLATION (Continued)

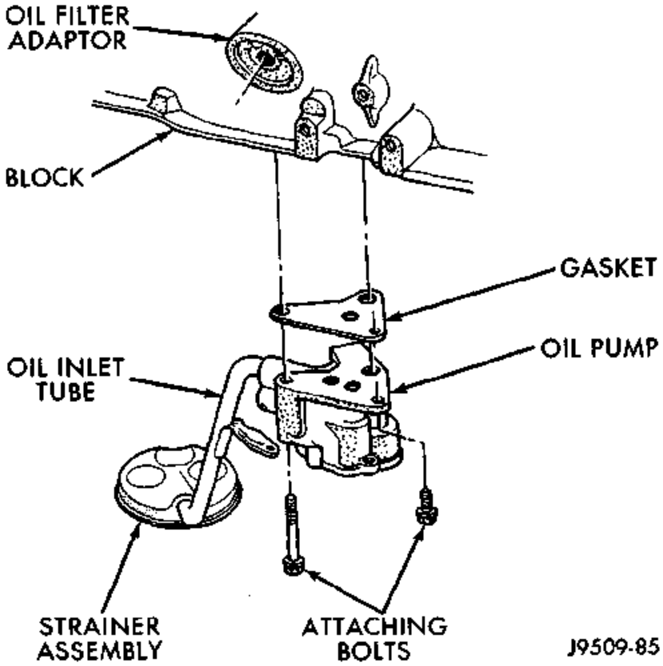


Fig. 41 Oil Pump Assembly

INSTALLATION

(1) Install the oil pump on the cylinder block using a replacement gasket. Tighten the bolts to 23 N·m (17 ft. lbs.) torque.

(2) Install the oil pan.

(3) Fill the oil pan with oil to the specified level.

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 main bearing cap brace (Fig. 42).

(6) Remove only one main bearing cap and lower insert at a time (Fig. 43).

(7) Remove the lower insert from the bearing cap.

(8) 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. 44). 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. 44). After moving the insert approximately 25 mm (1 inch), it can be removed by applying pressure under the tab.

(9) Using the same procedure described above, remove the remaining bearing inserts one at a time for inspection.

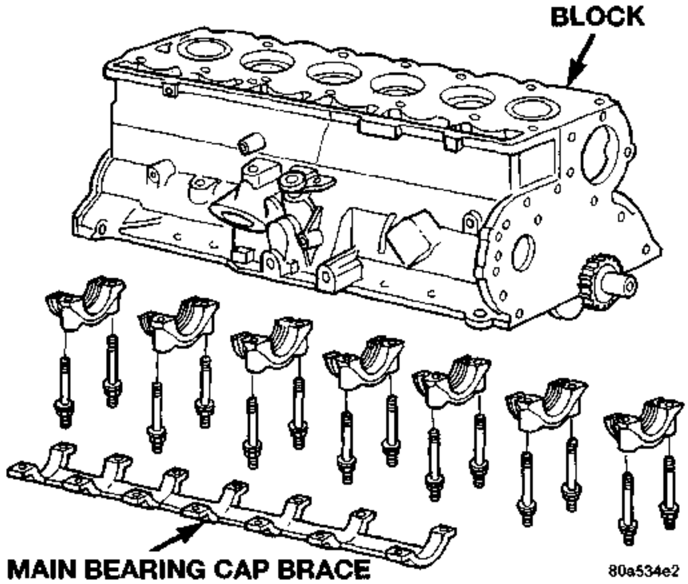


Fig. 42 Main Bearing Caps and Brace.

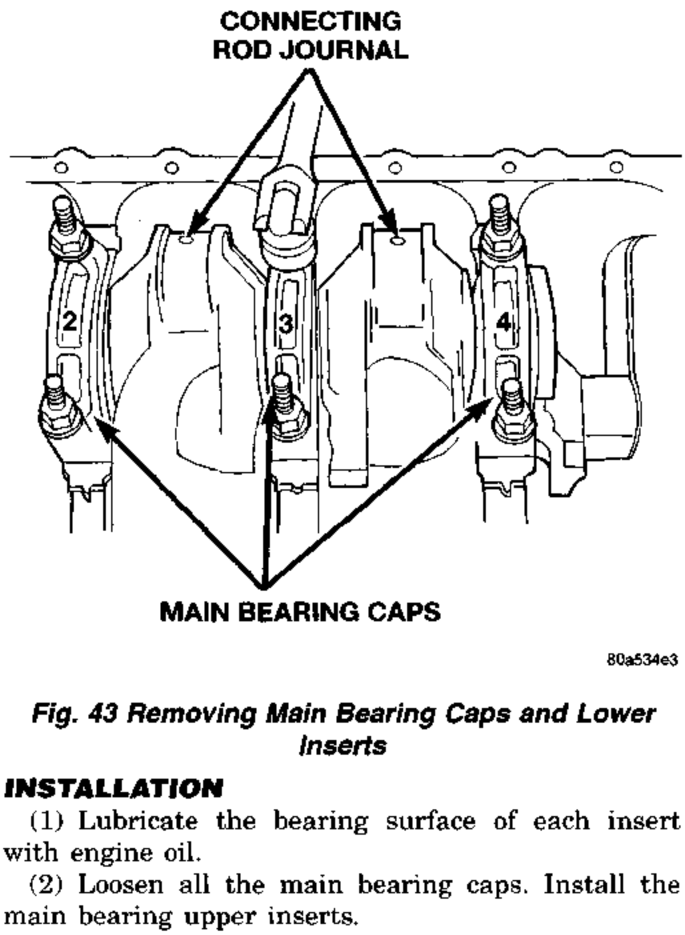


Fig. 43 Removing Main Bearing Caps and Lower Inserts

INSTALLATION

(1) Lubricate the bearing surface of each insert with engine oil.

(2) Loosen all the main bearing caps. Install the main bearing upper inserts.

(3) Install the lower bearing inserts into the main bearing caps.

(4) Install the main bearing cap(s) and lower insert(s).

(5) Tighten the bolts of caps 1, 2, 4, 5, 6, and 7 to 54 N·m (40 ft. lbs.) torque. Now tighten these bolts to

REMOVAL AND INSTALLATION (Continued)

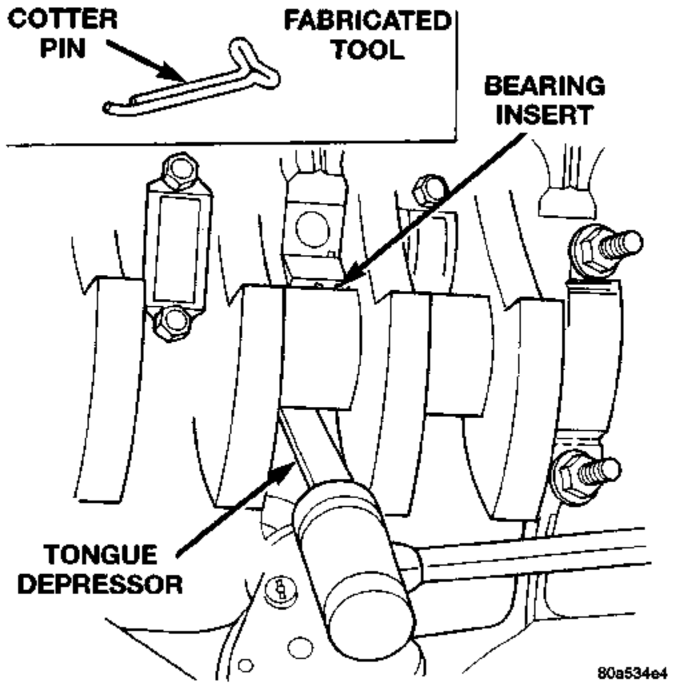


Fig. 44 Removing Upper Inserts

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. 45). 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.

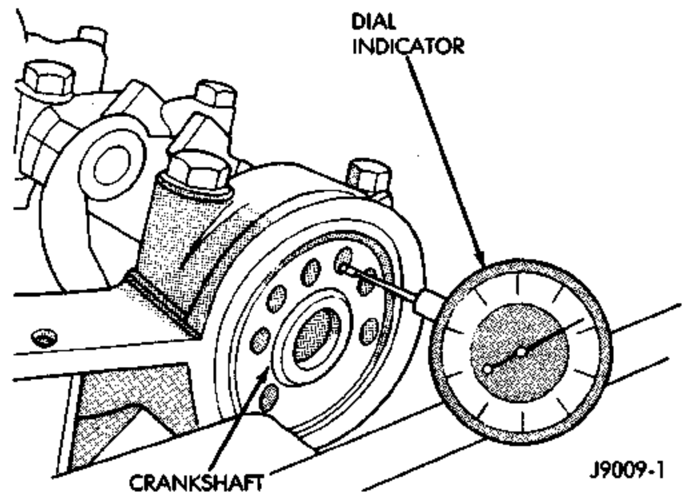


Fig. 45 Crankshaft End Play Measurement

(9) If the crankshaft was removed, install the crankshaft into the cylinder block (refer to Cylinder Block - Assemble).

(10) Install main bearing cap brace tighten nuts to 47 N·m (35 ft. lbs.) torque.

(11) Install the oil pan.

(12) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(13) Lower the vehicle.

(14) Install the spark plugs. Tighten the plugs to 37 N·m (27 ft. lbs.) torque.

(15) Fill the oil pan with engine oil to the full mark on the dipstick level.

(16) Connect negative cable to battery.

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 main bearing cap brace (Fig. 46).

(10) Remove the connecting rod bearing caps and inserts. Mark the caps and rods with the cylinder bore location. The connecting rods and caps are stamped with a two letter combination (Fig. 47).

(11) Lower the vehicle until it is about 2 feet from the floor.

REMOVAL AND INSTALLATION (Continued)

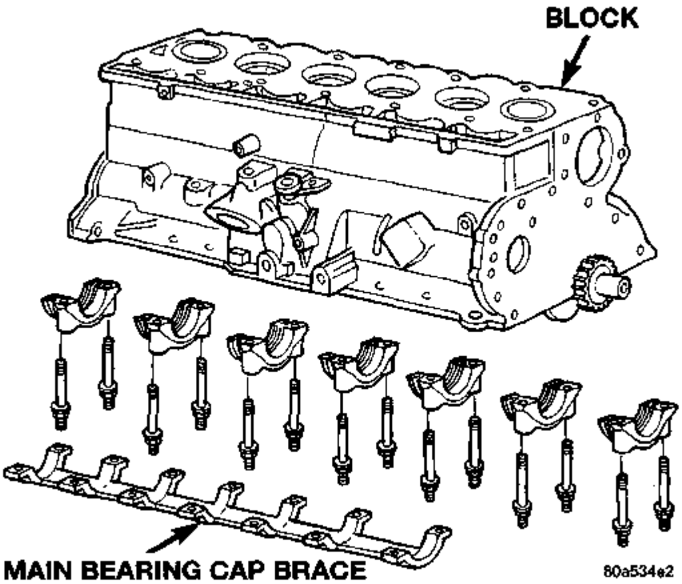


Fig. 46 Main Bearing Caps and Brace.

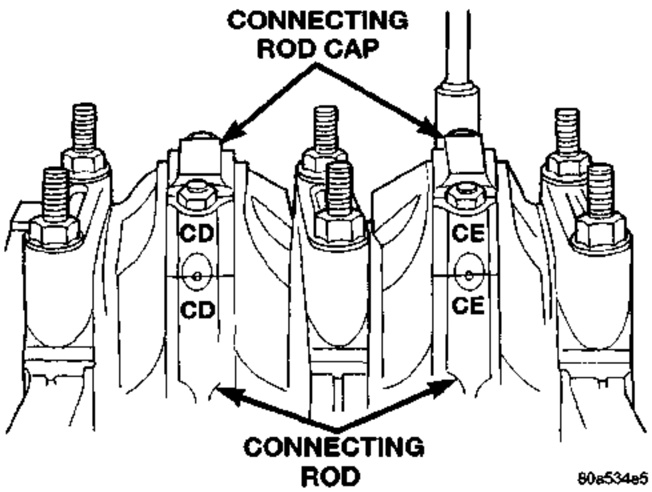


Fig. 47 Stamped Connecting Rods and Caps

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.

(12) Have an assistant push the piston and connecting rod assemblies up and through the top of the cylinder bores (Fig. 48).

INSTALLATION

(1) Clean the cylinder bores thoroughly. Apply a light film of clean engine oil to the bores with a clean lint-free cloth.

(2) Install the piston rings on the pistons if removed.

(3) Lubricate the piston and rings with clean engine oil.

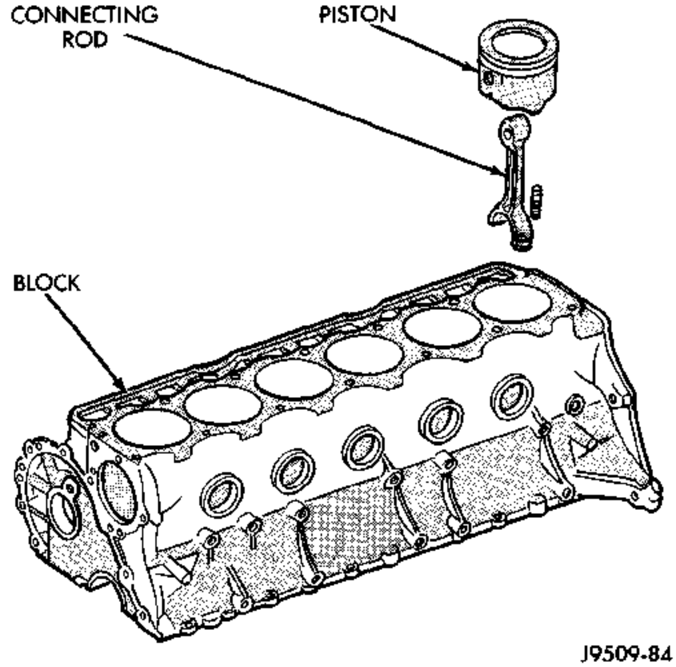


Fig. 48 Removal of Connecting Rod and Piston Assembly

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.

(4) Use a piston ring compressor to install the connecting rod and piston assemblies through the top of the cylinder bores (Fig. 49).

(5) Ensure the arrow on the piston top points to the front of the engine (Fig. 49).

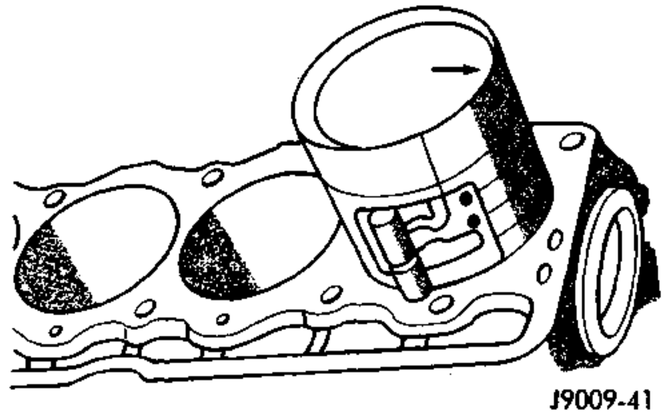


Fig. 49 Rod and Piston Assembly Installation

(6) Raise the vehicle.

(7) 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

REMOVAL AND INSTALLATION (Continued)

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.

(8) 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.

(9) 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.

(10) 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.

(11) Install main bearing cap brace tighten nuts to 47 N·m (35 ft. lbs.) torque.

(12) Install the oil pan and gaskets as outlined in the installation procedure.

(13) Lower the vehicle.

(14) Install the engine cylinder head, push rods, rocker arms, bridges, pivots and engine cylinder head cover.

(15) Fill the crankcase with engine oil.

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 transmission inspection cover.

(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. 50).

(6) Coat the outer curved surface of the lower seal with soap and the lip of the seal with engine oil (Fig. 50).

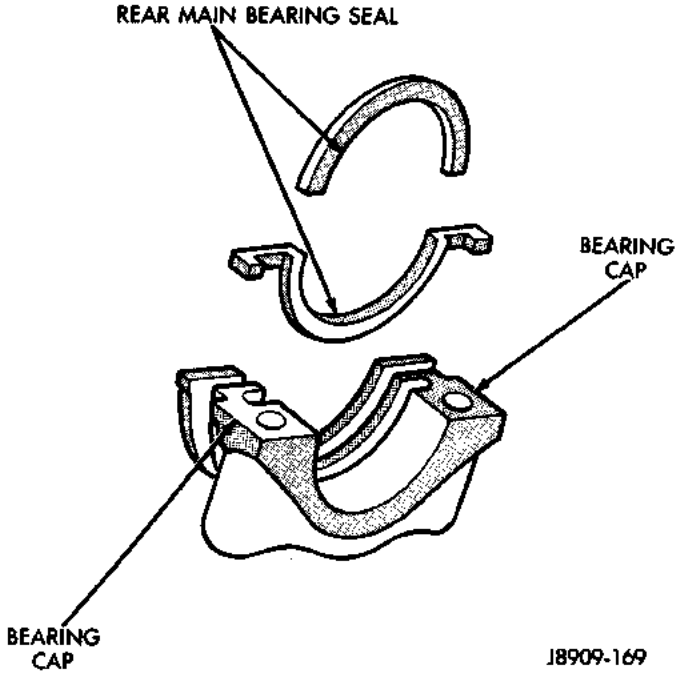


Fig. 50 Rear Main Bearing Oil Seal

(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 518, or equivalent on the rear bearing cap (Fig. 51). The bead should be 3 mm (0.125 in) thick. DO NOT apply Loctite 518, or equivalent to the lip of the seal.

(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.

TIMING CASE COVER OIL SEAL

This procedure is done with the timing case cover installed.

REMOVAL AND INSTALLATION (Continued)

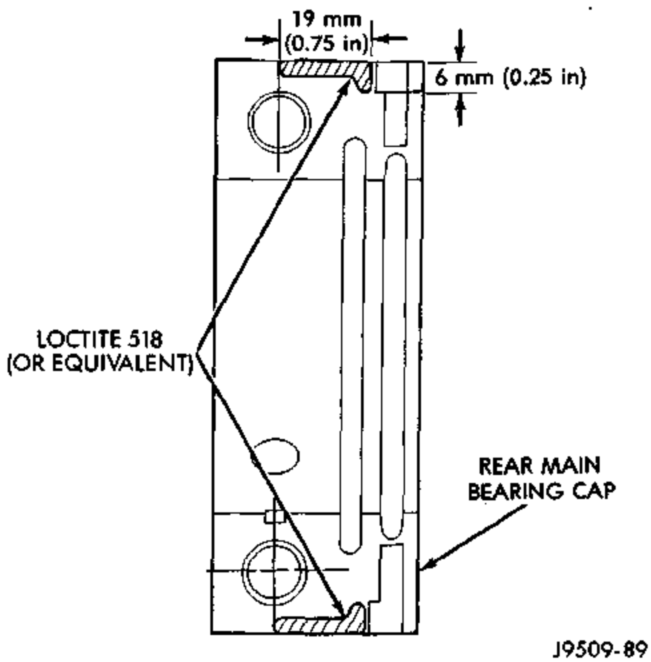


Fig. 51 Location of Loctite 518 (or equivalent)

REMOVAL

(1) Disconnect negative cable from battery.
(2) Remove the serpentine drive belt.
(3) Remove the vibration damper.
(4) Remove the radiator shroud.
(5) Carefully remove the oil seal. Make sure seal bore is clean.

INSTALLATION

(1) 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.

(2) Position the tool and seal over the end of the crankshaft and insert a draw screw tool into Seal Installation Tool 6139 (Fig. 52). Tighten the nut against the tool until it contacts the cover.

(3) Remove the tools. Apply a light film of engine oil on the vibration damper hub contact surface of the seal.

(4) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(5) Install the serpentine belt and tighten to the specified tension (refer to Group 7, Cooling Systems for the proper specifications and procedures).

(6) Install the radiator shroud.

(7) Connect negative cable to battery.

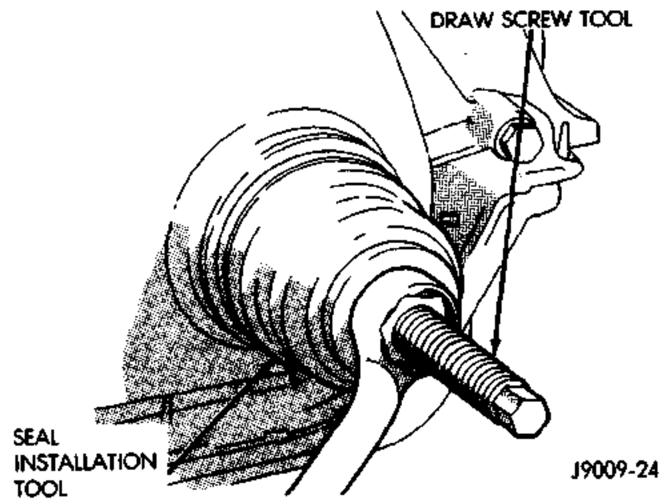


Fig. 52 Timing Case Cover Oil Seal Installation

DISASSEMBLY AND ASSEMBLY

VALVE SERVICE

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.

Inspect for cracks in the combustion chambers and valve ports.

Inspect for cracks on the exhaust seat.

Inspect for cracks in the gasket surface at each coolant passage.

Inspect valves for burned, cracked or warped heads.

Inspect for scuffed or bent valve stems.

Replace valves displaying any damage.

VALVE REFACING

(1) Use a valve refacing machine to reface the intake and exhaust valves to the specified angle.

(2) After refacing, a margin of at least 0.787 mm (0.031 inch) must remain (Fig. 53). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

VALVE SEAT REFACING

(1) Install a pilot of the correct size in the valve guide bore. Reface the valve seat to the specified angle with a good dressing stone. Remove only enough metal to provide a smooth finish.

(2) Use tapered stones to obtain the specified seat width when required.

(3) Control valve seat runout to a maximum of 0.0635 mm (0.0025 in.) (Fig. 54).

VALVE STEM OIL SEAL REPLACEMENT

Valve stem oil seals are installed on each valve stem to prevent rocker arm lubricating oil from

DISASSEMBLY AND ASSEMBLY (Continued)

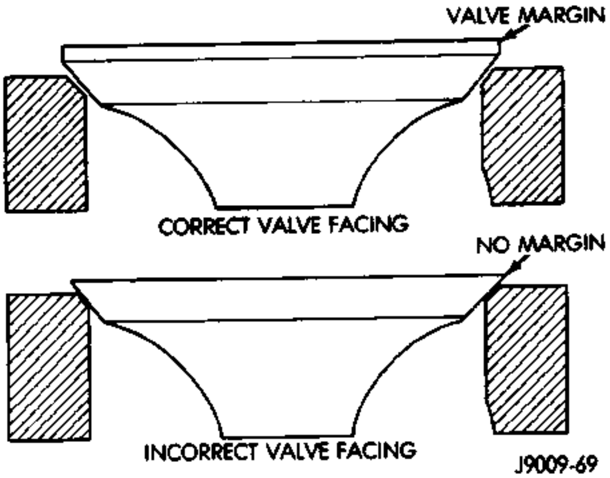


Fig. 53 Valve Facing Margin

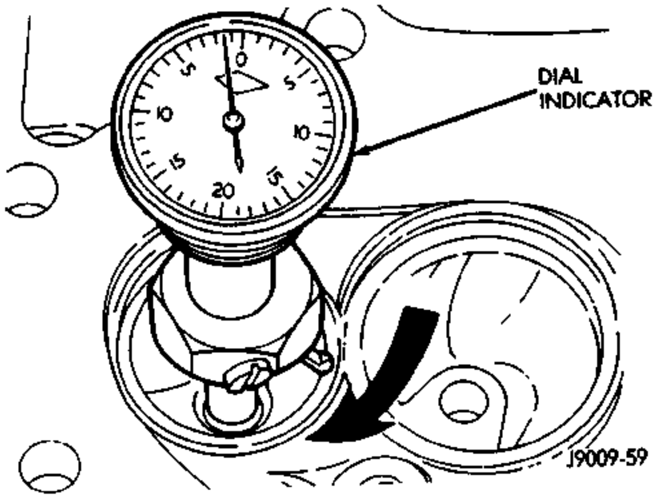


Fig. 54 Measurement of Valve Seat Runout

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.

NOTE: 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. 55).

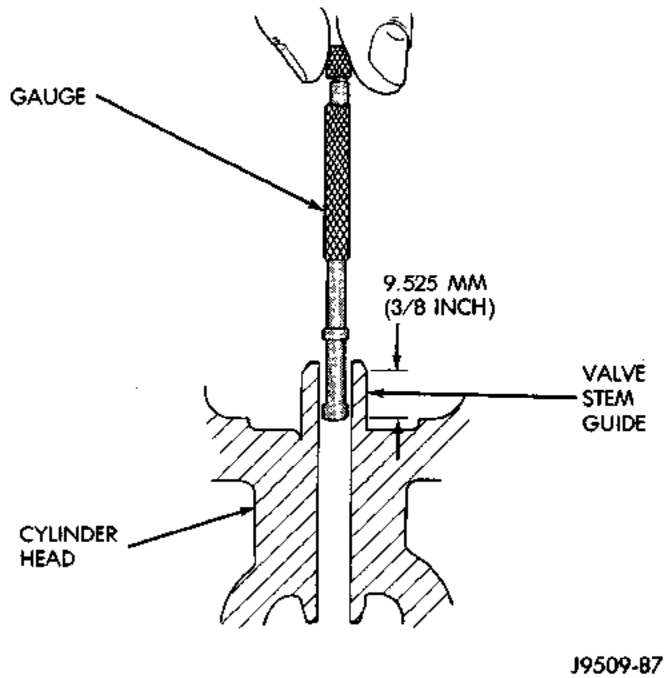


Fig. 55 Measurement of Valve Guide Bore Diameter

(4) Remove and measure telescoping gauge with a micrometer.

(5) Repeat the measurement with contacts lengthwise to engine cylinder head.

(6) Compare the crosswise to lengthwise measurements to determine out-of-roundness. If the measurements differ by more than 0.0635 mm (0.0025 in.), ream the guide bore to accommodate an oversize valve stem.

(7) Compare the measured valve guide bore diameter with specifications (7.95-7.97 mm or 0.313-0.314 inch). If the measurement differs from specification by more than 0.076 mm (0.003 inch), ream the guide bore to accommodate an oversize valve stem.

ALTERNATIVE METHOD

(1) Use a dial indicator to measure the lateral movement of the valve stem (stem-to-guide clearance). This must be done with the valve installed in its guide and just off the valve seat (Fig. 56).

DISASSEMBLY AND ASSEMBLY (Continued)

(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.

NOTE: Valve seats must be ground after reaming the valve guides to ensure that the valve seat is concentric to the valve guide.

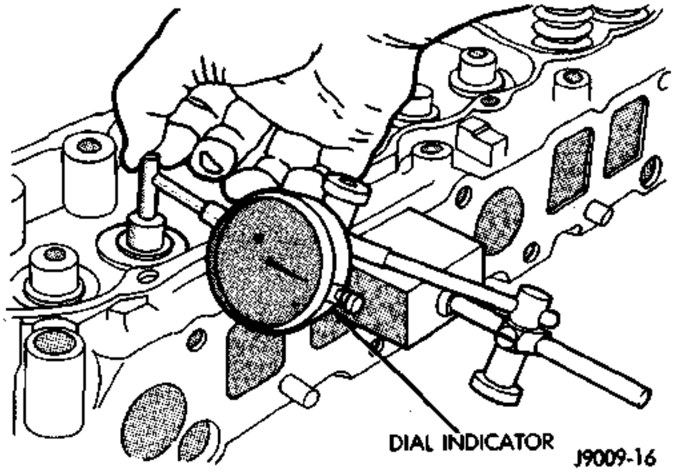


Fig. 56 Measurement of Lateral Movement of Valve Stem

VALVE SPRING TENSION TEST

Use a universal Valve Spring Tester and a torque wrench to test each valve spring for the specified tension value (Fig. 57).

Replace valve springs that are not within specifications.

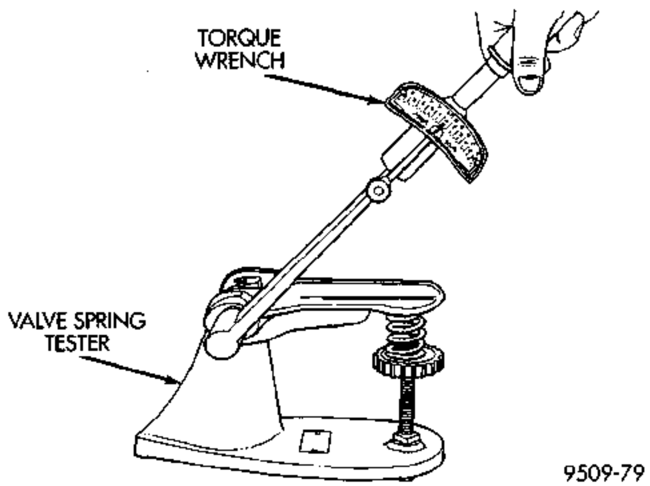


Fig. 57 Valve Spring Tester

CYLINDER BLOCK

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.

ASSEMBLY

Refer to the applicable sections for detailed instructions.

(1) Install the crankshaft.

(2) Install the connecting rods and the pistons through the top of the cylinder bores.

(3) Install the oil pump.

(4) Install the oil pan and gasket.

(5) Install the camshaft.

(6) Install the sprockets and chain as an assembly.

(7) Install the oil slinger from the crankshaft.

(8) Install the timing case cover seal.

(9) Install the timing case cover.

(10) Install the vibration damper.

(11) Install the water pump. Tighten the mounting bolts to 31 N·m (270 in. lbs.) torque.

(12) Lubricate the oil filter seal with clean engine oil. Tighten oil filter to 18 N·m (13 ft. lbs.) torque.

(13) Install the engine into the vehicle.

(14) Fill the engine with clean lubrication oil (refer to Group 0, Lubrication and Maintenance).

(15) Fill the cooling system.

CLEANING AND INSPECTION

ENGINE CYLINDER HEAD

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.

CLEANING AND INSPECTION (Continued)

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.

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 dark 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.

ROCKER ARMS AND PUSH RODS

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.

HYDRAULIC TAPPETS

CLEANING

Clean each tappet assembly in cleaning solvent to remove all varnish, gum and sludge deposits.

INSPECTION

Inspect for indications of scuffing on the side and base of each tappet body.

Inspect each tappet base for concave wear with a straightedge positioned across the base. If the base is concave, the corresponding lobe on the camshaft is also worn. Replace the camshaft and defective tappets.

CYLINDER BLOCK

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) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter (Fig. 58). To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

(2) Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.

(3) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the middle of the bore, then repeat the measurement near the bottom of the bore.

(4) Determine taper by subtracting the smaller diameter from the larger diameter.

(5) Rotate measuring device 90° and repeat steps above.

(6) Determine out-of-roundness by comparing the difference between each measurement.

(7) If cylinder bore taper does not exceed 0.025 mm (0.001 inch) and out-of-roundness does not exceed 0.025 mm (0.001 inch), the cylinder bore can be honed. If the cylinder bore taper or out- of-round condition exceeds these maximum limits, the cylinder must be bored and then honed to accept an oversize

CLEANING AND INSPECTION (Continued)

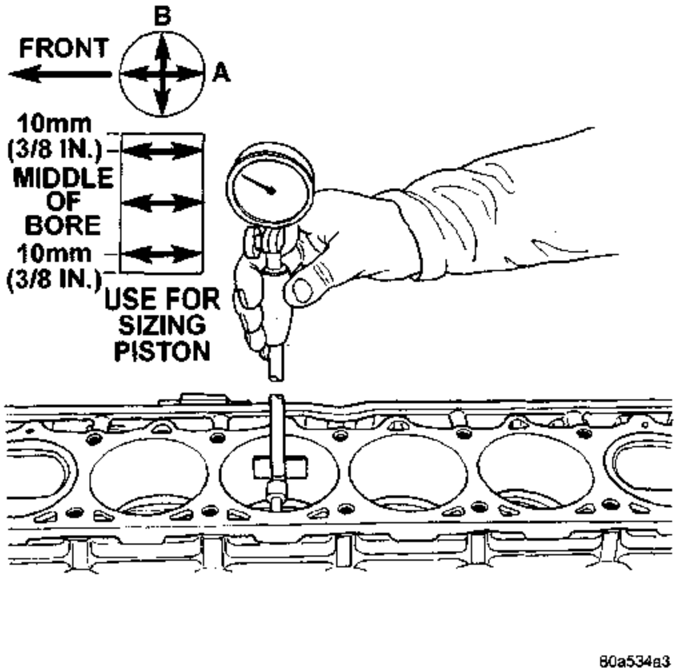


Fig. 58 Cylinder Bore Measurement

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.

SPECIFICATIONS

4.0L ENGINE SPECIFICATIONS

Camshaft

Hydraulic Tappet Clearance . . . . .Zero Lash

Bearing Clearance . . . . .0.025 to 0.076 mm (0.001 to 0.003 in.)

Bearing Journal Diameter

No. 1 . . . . .51.54 to 51.56 mm (2.029 to 2.030 in.)

No. 2 . . . . .51.28 to 51.31 mm (2.019 to 2.020 in.)

No. 3 . . . . .51.03 to 51.05 mm (2.009 to 2.010 in.)

No. 4 . . . . .50.78 to 50.80 mm (1.999 to 2.000 in.)

Base Circle Runout . . . . .0.03 mm - max. (0.001 in. - max.)

Valve Lift . . . . .10.29 mm (0.405 in.)

Intake Valve Timing

Opens . . . . .12.4° BTDC

Closes . . . . .60.9° ABDC

Exhaust Valve Timing

Opens . . . . .49.8 BBDC

Closes. . . . . .29.2° ATDC

Valve Overlap. . . . . .42.6°

Intake Duration . . . . .253.3°

Exhaust Duration. . . . . .259.°

Crankshaft

End Play . . .0.038 to 0.165 mm (0.0015 to 0.0065 in.)

Main Bearing Journal Diameter
No. 1-6.63.489 to 63.502 mm (2.4996 to 2.5001 in.)

Main Bearing Journal Diameter
No. 7 . .63.449 to 63.487 mm (2.4980 to 2.4995 in.)

Main Bearing Journal Width
No. 1. . . . . .27.58 to 27.89 mm (1.086 to 1.098 in.)

Main Bearing Journal Width
No. 3. . . . . .32.28 to 32.33 mm (1.271 to 1.273 in.)

Main Bearing Journal Width
No. 2-4-5-6-7 . . . . .30.02 to 30.18 mm (1.182 to 1.188 in.)

Main Bearing Clearance . . . . .0.03 to 0.06 mm (0.001 to 0.0025 in.)

Main Bearing Clearance (Preferred) . . . . . .0.051 mm (0.002 in.)

Connecting Rod Journal
Diameter. . . . . .53.17 to 53.23 mm (2.0934 to 2.0955 in.)

Connecting Rod Journal Width . . .27.18 to 27.33 mm (1.070 to 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 to 240.18 mm (9.450 to 9.456 in.)

Deck Clearance (Below Block) . . . . .0.546 mm (0.0215 in.)

SPECIFICATIONS (Continued)

Cylinder Bore Diameter—
Standard . . . . .98.45 to 98.48 mm (3.8759 to 3.8775 in.)
Cylinder Bore Diameter— Taper (Max.) . . .0.025 mm (0.001 in.)
Cylinder Bore Diameter—
Out-of-Round . . . . .0.025 mm (0.001 in.)
Tappet Bore Diameter . . . . .23.000 to 23.025 mm (0.9055 to 0.9065 in.)
Flatness. . . .0.03 mm per 25 mm (0.001 in. per 1 in.)
Flatness. . .0.05 mm per 152 mm (0.002 in. per 6 in.)
Flatness Max. . . . . . . .0.20 mm max. for total length (0.008 in. max. for total length)
Main Bearing Bore
Diameter . . . . .68.3514 to 68.3768 mm (2.691 to 2.692 in.)

Connecting Rods

Total Weight (Less Bearing) . . . . . .657 to 665 grams (23.17 to 23.45 oz.)
Length (Center-to-Center) . . . . .155.52 to 155.62 mm (6.123 to 6.127 in.)
Piston Pin Bore Diameter . . . . . . .23.59 to 23.62 mm (0.9288 to 0.9298 in.)
Bore (Less Bearings) . . . . .56.08 to 56.09 mm (2.2080 to 2.2085 in.)
Bearing Clearance. . . . . .0.025 to 0.076 mm (0.001 to 0.003 in.)
Bearing Clearance (Preferred). . . .0.044 to 0.050 mm (0.0015 to 0.0020 in.)
Side Clearance . .0.25 to 0.48 mm (0.010 to 0.019 in.)
Twist (Max.) . .0.001 mm per mm (0.001 in. per inch)
Bend Max.) . .0.001 mm per mm (0.001 in. per inch.)

Cylinder Compression Pressure

Ratio. 8.7:1
Pressure Range. . . .827 to 1,034 kPa (120 to 150 psi)
Max. Variation Between Cylinders . .206 kPa (30 psi)

Cylinder Head

Combustion Chamber. . . . . .52.22 to 58.22 cc (3.37 to 3.55 cu. in.)
Valve Guide I.D. (Integral). . . . . . .7.9 mm (0.312 in.)
Valve Stem-to-Guide Clearance. . .0.025 to 0.076 mm (0.001 to 0.003 in.)
Intake Valve Seat Angle . . . . .44.5°
Exhaust Valve Seat Angle . . . . .44.5°
Valve Seat Width . . . . .1.02 to 1.52 mm (0.040 to 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.)
Flatness. . .0.05 mm per 152 mm (0.002 in. per 6 in.)
Flatness Max. . . . . . .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 to 245.364 mm (9.640 to 9.660 in.)
Push Rod Diameter. . . . . .7.92 to 8.00 mm (0.312 to 0.315 in.)
Hydraulic Tappet Diameter . . . .22.962 to 22.974 mm (0.904 to 0.9045 in.)
Tappet-to-Bore Clearance . . . . . . .0.025 to 0.063 mm (0.001 to 0.0025 in.)

Valves

Length (Tip-to-Gauge Dimension Line)
Intake . . . . .122.479 to 122.860 mm (4.822 to 4.837 in.)
Length (Tip-to-Gauge Dimension Line)
Exhaust . . . . .122.860 to 123.241 mm (4.837 to 4.852 in.)
Valve Stem Diameter . . . . .7.899 to 7.925 mm (0.311 to 0.312 in.)
Stem-to-Guide Clearance. . . . . . . .0.025 to 0.076 mm (0.001 to 0.003 in.)
Valve Head Diameter—Intake . .48.387 to 48.641 mm (1.905 to 1.915 in.)
Valve Head Diameter—
Exhaust. .37.973 to 38.227 mm (1.495 to 1.505 in.)
Valve Face Angle—Intake . . . . .45°
Valve Face Angle—Exhaust. . . . . .45°
Tip Refinishing (Max. Allowable) .0.25 mm (0.010 in.)

Valve Springs

Free Length (Approx.) . . . . .47.65 mm (1.876 in.)
Spring Tension—Valve
Closed . . . . .271 to 307 N @ 41.656 mm (61 to 69 lbf. @ 1.64 in.)
Spring Tension—Valve
Open. . . . . .818.5 to 871.9 N @ 30.89 mm (184 to 196 lbf @ 1.216 in.)
Inside Diameter . . . . .21.0 mm to 21.51 mm (0.827 to 0.847 in.)

Pistons

Weight (Less Pin) . . . . .563 to 567 grams (19.86 to 20.00 oz.)
Piston Pin Bore (Centerline to Piston
Top). . . . . . .40.61 to 40.72 mm (1.599 to 1.603 in.)
Piston-to-Bore Clearance. . . . . . . .0.033 to 0.053 mm (0.0013 to 0.0021 in.)
Piston-to-Bore Clearance
(Preferred). . . . . .0.033 to 0.038 mm (0.0013 to 0.0015 in.)
Ring Gap Clearance— Top Compression
Ring . . . . .0.229 to 0.610mm (0.0090 to 0.0240 in.)
Ring Gap Clearance— 2nd Compression
Ring . . . .0.483 to 0.965 mm (0.0190 to 0.0380 in.)
Ring Gap Clearance—Oil Control Steel
Rails . . . . . .0.254 to 1.500 mm (0.010 to 0.060 in.)
Ring Side Clearance—Compression
Rings. . . .0.042 to 0.084 mm (0.0017 to 0.0033 in.)
Ring Side Clearance—Oil Control
Rings. . . . . .0.06 to 0.21 mm (0.0024 to 0.0083 in.)

SPECIFICATIONS (Continued)

Piston Ring Groove Height—Compression Rings. . . .1.530 to 1.555 mm (0.0602 to 0.0612 in.)
Piston Ring Groove Height—Oil Control Ring . . . .4.035 to 4.060 mm (0.1589 to 0.1598 in.)
Piston Ring Groove Diameter—Compression Rings . . . . . .88.3 to 88.55 mm (3.476 to 3.486 in.)
Piston Ring Groove Diameter—Oil Control Ring . . . . . .90.35 to 90.60 mm (3.557 to 3.566 in.)
Piston Pin Bore Diameter . . . . .23.647 to 23.655 mm (0.9310 to 0.9313 in.)
Piston Pin Diameter . . . . .23.637 to 23.640 mm (0.9306 to 0.9307 in.)
Piston-to-Pin Clearance . . . . .0.0076 to 0.0178 mm—Loose (0.0003 to 0.0007 in. Loose)
Piston-to-Pin Clearance (Preferred) . . . . .0.013 mm (0.0005 in.)
Piston-to-Pin Connecting Rod (Press Fit). . . . .8.9 kN (2000 lbf.)

Oil Pump
Gear-to-Body Clearance (Radial). .0.051 to 0.102 mm (0.002 to 0.004 in.)
Gear-to-Body Clearance (Radial) (Preferred) . . . . .0.051 mm (0.002 in.)
Gear End Clearance—Plastigage . .0.051 to 0.152 mm (0.002 to 0.006 in.)
Gear End Clearance—Plastigage (Preferred) . . . . .0.051 mm (0.002 in.)
Gear End Clearance—Feeler Gauge . . .0.1016 to 0.2032 mm (0.004 to 0.008 in.)
Gear End Clearance—Feeler Gauge (Preferred) . . . . .0.1778 mm (0.007 in.)

Oil Pressure
At Idle Speed (600 rpm). . . . . .89.6 kPa (13 psi)
At 1600 rpm & Higher .255 to 517 kPa (37 to 75 psi)
Oil Pressure Relief . . . . .517 kPa (75 psi)

TORQUE SPECIFICATIONS

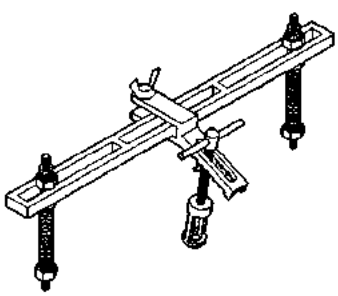
DESCRIPTION	TORQUE
A/C Compressor Bracket-to-Engine	
Bolts	34 N·m (25 ft. lbs.)
A/C Compressor	
Mounting Bolts	27 N·m (20 ft. lbs.)
A/C Low Pressure Service Valve	
Nut	38 N·m (28 ft. lbs.)
Block Heater	
Nut	1.8 N·m (16 in. lbs.)
Camshaft Sprocket	
Bolt	108 N·m (80 ft. lbs.)
Connecting Rod	
Nuts	45 N·m (33 ft. lbs.)
Cylinder Block	
Drain Plugs	41 N·m (30 ft. lbs.)
Cylinder Head	
Bolts #1–10 & #12–14	149 N·m (110 ft. lbs.)
Bolt #11	135 N·m (100 ft. lbs.)
Cylinder Head Cover	
Bolts	13 N·m (115 in. lbs.)
Engine Mounts—Front	
Support Bracket Bolts	61 N·m (45 ft. lbs.)
Support Cushion Bolts/Nuts	41 N·m (30 ft. lbs.)
Support Cushion Bracket Bolts	54 N·m (40 ft. lbs.)
Support Cushion Bracket Stud Nuts	41 N·m (30 ft. lbs.)
Support Cushion Thru-Bolt	65 N·m (48 ft. lbs.)
Engine Mounts—Rear	
Crossmember-to-Sill Bolts (Automatic)	41 N·m (30 ft. lbs.)
Insulator Stud Assembly Nut	41 N·m (30 ft. lbs.)
Support Cushion/Crossmember Nuts	22 N·m (192 in. lbs.)
Support Cushion/Bracket Nuts (Manual)	75 N·m (55 ft. lbs.)
Transmission Support Bracket Bolt (Manual)	46 N·m (34 ft. lbs.)
Transmission Support Bracket/Cushion Bolt (4WD Auto)	75N·m (55 ft. lbs.)
Transmission Support Adaptor Bracket Bolts (2WD Auto)	75N·m (55 ft. lbs.)
Exhaust Manifold/Pipe	
Nuts	27 N·m (20 ft. lbs.)
Flywheel/Converter Housing	
Bolts	38 N·m (28 ft. lbs.)
Flywheel/Crankshaft	
Bolts	143 N·m (105 ft. lbs.)
Front Cover-to-Block	
Bolts 1/4–20	7N·m (60 in. lbs.)
Bolts 5/16–18	22N·m (192 in. lbs.)
Fuel Pump	
Bolts	22 N·m (16 ft. lbs.)
Generator	
Adjusting Bolt	24 N·m (18 ft. lbs.)
Pivot Bolt/Nut	38 N·m (28 ft. lbs.)
Main Bearing	
Bolts	108 N·m (80 ft. lbs.)
Oil Filter	
Filter	18 N·m (13 ft. lbs.)
Oil Galley	
Plug	41 N·m (30 ft. lbs.)

SPECIFICATIONS (Continued)

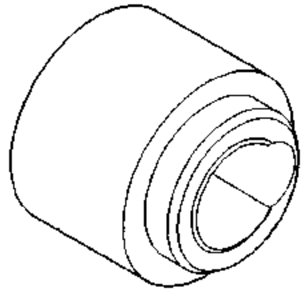
DESCRIPTION	TORQUE
Oil Pan	
1/4–20 Bolts	9.5 N·m (84 in. lbs.)
5/16–18 Bolts	15 N·m (132 in. lbs.)
Drain Plug	34 N·m (25 ft. lbs.)
Oil Pump	
Short Attaching Bolts	23 N·m (17 ft. lbs.)
Long Attaching Bolts	23 N·m (17 ft. lbs.)
Cover Bolts	8 N·m (70 in. lbs.)
Power Steering Pump Pressure Hose	
Nut	52 N·m (38 ft. lbs.)
Rocker Arm Assembly-to-Cylinder Head	
Capscrews	28 N·m (21ft. lbs.)
Spark Plugs	
Plugs	37 N·m (27 ft. lbs.)
Starting Motor	
Mounting Bolts	45 N·m (33 ft. lbs.)
Thermostat Housing	
Bolts	18 N·m (13 ft. lbs.)
Vibration Damper	
Bolts	108 N·m (80 ft. lbs.)
Water Pump/Block	
Bolts	31 N·m (270 in. lbs.)

SPECIAL TOOLS

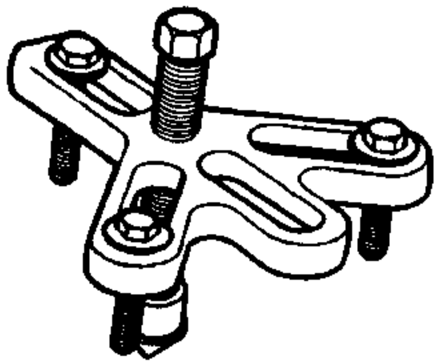
2.5L/4.0L ENGINE



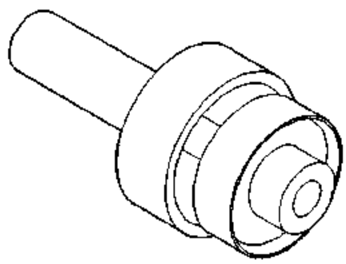
Valve Spring Compressor Tool MD-998772A



Timing Case Cover Alignment and Seal Installation Tool 6139



Vibration Damper Removal Tool 7697



Rear Main Seal Installer Tool 6271A

EXHAUST SYSTEM AND INTAKE MANIFOLD

CONTENTS

GENERAL INFORMATION

EXHAUST SYSTEM

The basic exhaust system consists of an engine exhaust manifold, exhaust pipe with oxygen sensor, catalytic converter with oxygen sensor, exhaust heat shield(s), muffler and exhaust tailpipe (Fig. 1) (Fig. 2).

The exhaust system uses a single muffler with a catalytic converter consisting of dual ceramic monoliths.

The 4.0L engines use a seal between the engine exhaust manifold and exhaust pipe to assure a tight seal and strain free connections (Fig. 2).

The exhaust system must be properly aligned to prevent stress, leakage and body contact. If the system contacts any body panel, it may amplify objectionable noises originating from the engine or body.

When inspecting an exhaust system, critically inspect for cracked or loose joints, stripped screw or bolt threads, corrosion damage and worn, cracked or broken hangers. Replace all components that are badly corroded or damaged. DO NOT attempt to repair.

When replacement is required, use original equipment parts (or their equivalent). This will assure proper alignment and provide acceptable exhaust noise levels.

CAUTION: Avoid application of rust prevention compounds or undercoating materials to exhaust system floor pan exhaust heat shields. Light overspray near the edges is permitted. Application of coating will result in excessive floor pan temperatures and objectionable fumes.

CATALYTIC CONVERTER

The stainless steel catalytic converter body is designed to last the life of the vehicle. Excessive heat can result in bulging or other distortion, but excessive heat will not be the fault of the converter. If unburned fuel enters the converter, overheating may occur. If a converter is heat-damaged, correct the cause of the damage at the same time the converter is replaced. Also, inspect all other components of the exhaust system for heat damage.

Unleaded gasoline must be used to avoid contaminating the catalyst core.

EXHAUST HEAT SHIELDS

Exhaust heat shields are needed to protect both the vehicle and the environment from the high temperatures developed by the catalytic converter. The catalytic converter releases additional heat into the exhaust system. Under severe operating conditions, the temperature increases in the area of the 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.

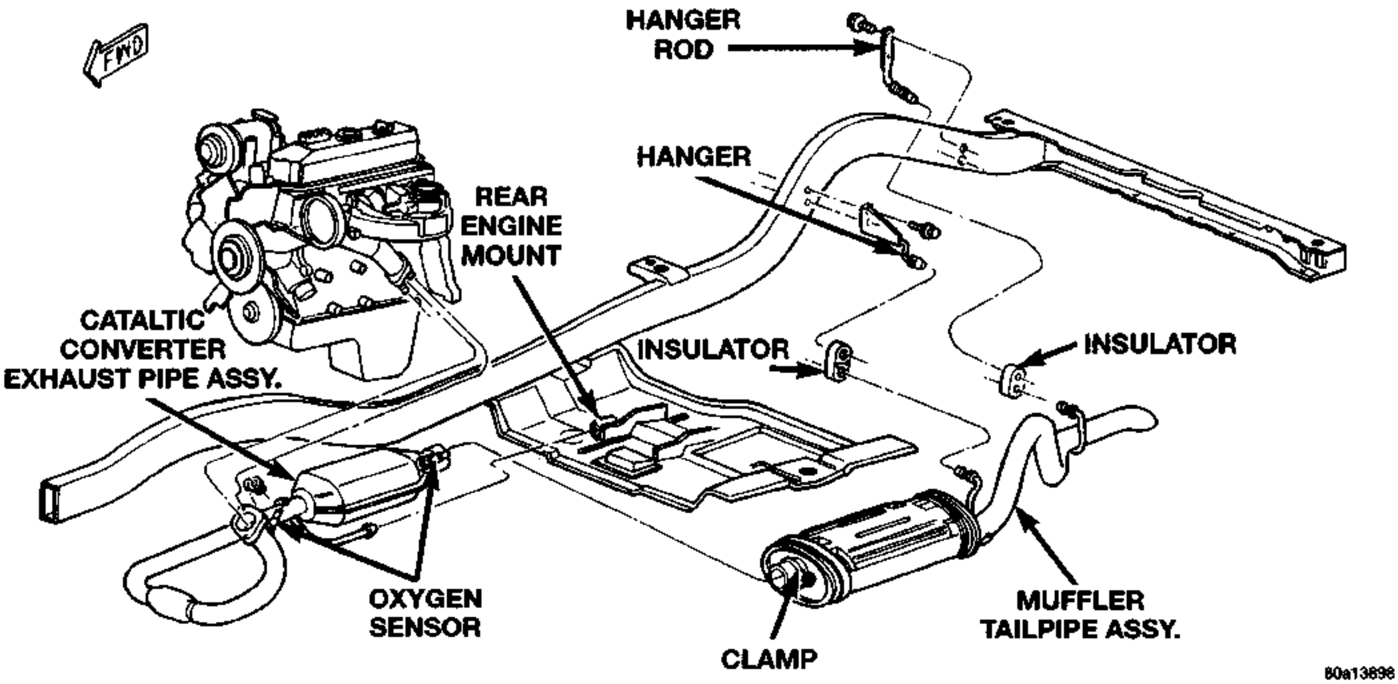


Fig. 1 Exhaust System 2.5 liter Engine

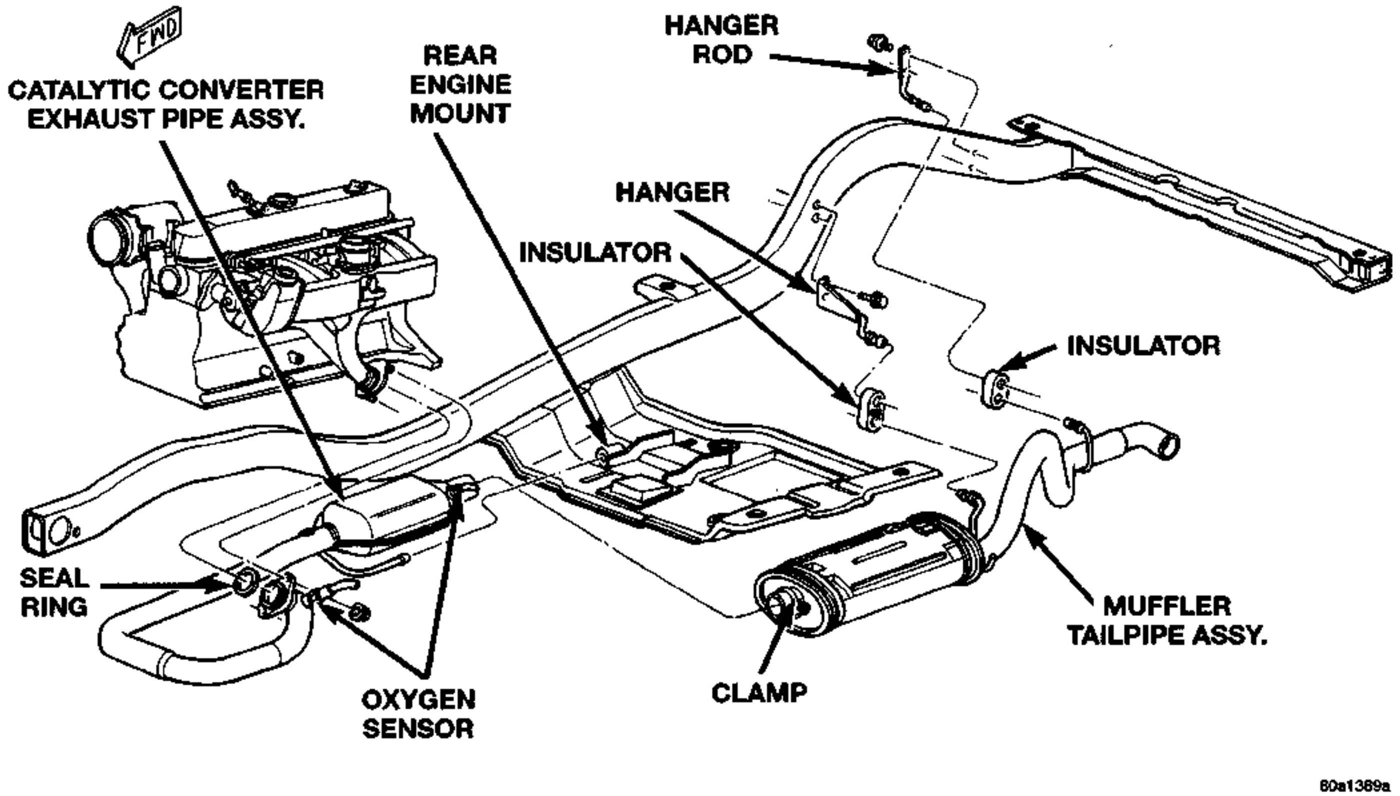


Fig. 2 Exhaust System 4.0 liter Engine

DIAGNOSIS AND TESTING

EXHAUST SYSTEM DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE	1. Leaks at pipe joints. 2. Burned or blown-out muffler. 3. Burned or rusted-out exhaust pipe. 4. Exhaust pipe leaking at manifold flange. 5. Exhaust manifold cracked or broken. 6. Leak between exhaust manifold and cylinder head. 7. Restriction in muffler or tail pipe.	1. Tighten clamps at leaking joints. 2. Replace muffler assembly. Check exhaust system. 3. Replace exhaust pipe. 4. Tighten connection attaching nuts. 5. Replace exhaust manifold. 6. Tighten exhaust manifold to cylinder head stud nuts or bolts. 7. Remove restriction, if possible. Replace muffler or tail pipe, as necessary.
LEAKING EXHAUST GASES	1. Leaks at pipe joints. 2. Damaged or improperly installed gaskets.	1. Tighten clamps at leaking joints. 2. Replace gaskets, as necessary.
ENGINE HARD TO WARM UP OR WILL NOT RETURN TO NORMAL IDLE	1. Blocked crossover passage in intake manifold. 2. Thermostat broken.	1. Remove restriction or replace intake manifold. 2. Replace thermostat.

J9311-13

Exhaust System Diagnosis

REMOVAL AND INSTALLATION

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 studs and nuts with heat valve lubricant. Allow 5 minutes for penetration (Fig. 3) (Fig. 4).

(3) Remove the oxygen sensors from the exhaust pipe and the catalytic converter (Fig. 3) (Fig. 4).

(4) Disconnect the exhaust pipe from the engine exhaust manifold. Discard the seal (4.0L engine, only) (Fig. 4).

(5) Support the transmission and remove the rear crossmember.

(6) Remove the clamp from the catalytic converter and muffler connection.

(7) Heat the catalytic converter and muffler connection with an oxyacetylene torch until the metal becomes cherry red.

(8) While the metal is still cherry red, twist the muffler assembly back and forth to seperate it from the catalytic converter.

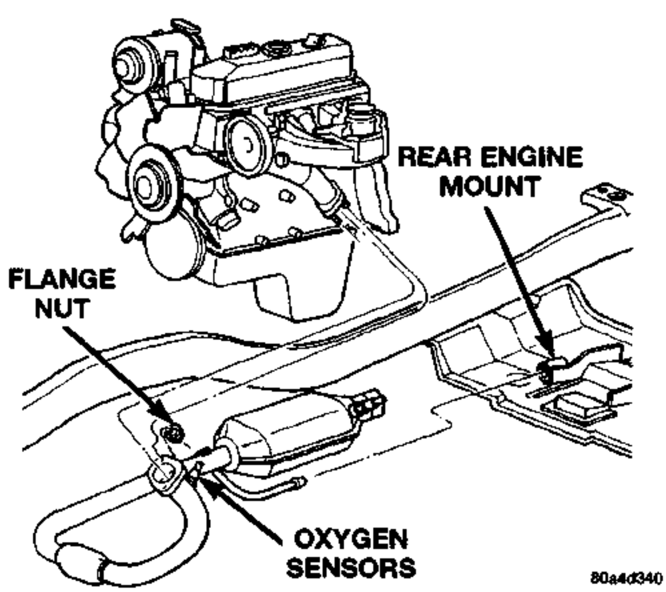


Fig. 3 Exhaust Pipe with Catalytic Converter 2.5 L Engine

INSTALLATION

(1) Assemble catalytic converter and muffler loosely to permit proper alignment of all parts.

(2) Use a new clamp and tighten the nut to 71 N·m (52 ft. lbs.) torque.

(3) Connect the exhaust pipe to the engine exhaust manifold. Install a new seal between the exhaust

REMOVAL AND INSTALLATION (Continued)

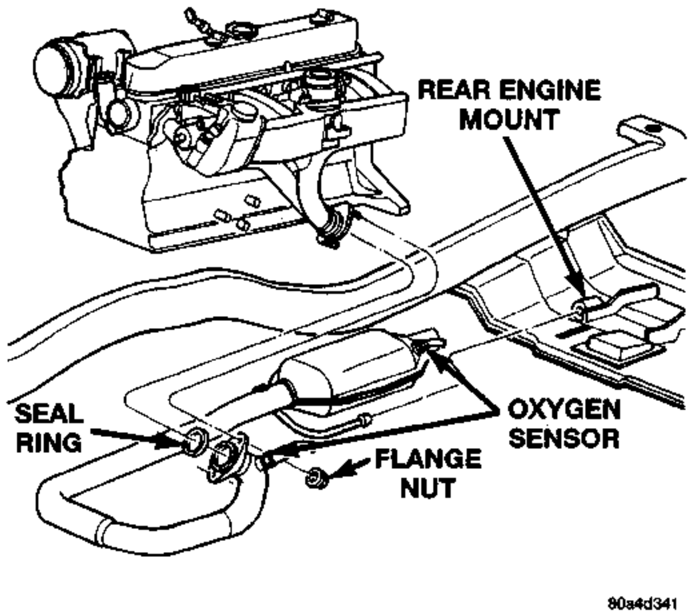


Fig. 4 Exhaust Pipe with Catalytic Converter 4.0 L Engine

manifold and the exhaust pipe (4.0L engine, only). Tighten the nuts to 31 N·m (23 ft. lbs.) torque.

(4) Install the rear crossmember. Tighten the crossmember-to-sill bolts to 41 N·m (30 ft. lbs.) torque. Remove the support from the transmission.

(5) Coat the oxygen sensors with anti-seize compound. Install the sensors and tighten the nut to 48 N·m (35 ft. lbs.) torque.

(6) Lower the vehicle.

(7) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

MUFFLER TAILPIPE ASSEMBLY

All original equipment exhaust systems are manufactured with the exhaust tailpipe welded to the muffler. Service replacement mufflers and exhaust tailpipes are either clamped together or welded together.

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

REMOVAL

(1) Raise the vehicle and support the rear of the vehicle by the side rails and allow the axle to hang free.

(2) Remove the clamp from the catalytic converter and muffler connection (Fig. 5).

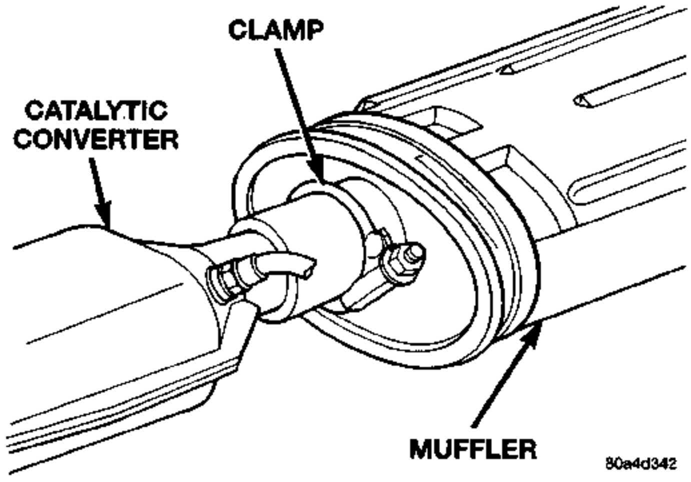


Fig. 5 Catalytic Converter to Muffler Connection

(3) Remove the tailpipe hangers from the insulators (Fig. 6).

(4) Heat the catalytic converter-to-muffler connection with an oxyacetylene torch until the metal becomes cherry red.

(5) While the metal is still cherry red, twist the exhaust tailpipe/muffler assembly back and forth to seperate it from the catalytic converter.

• To separate an original equipment exhaust tailpipe/muffler combination, cut the exhaust tailpipe close to the muffler. Collapse the part remaining in the muffler and remove.

• To remove a service exhaust tailpipe/muffler combination, apply heat until the metal becomes cherry red. Remove the exhaust tailpipe/muffler clamp and twist the exhaust tailpipe out of the muffler.

INSTALLATION

(1) Assemble catalytic converter and muffler loosely to permit proper alignment of all parts.

(2) Install the exhaust tailpipe into the rear of the muffler.

(3) Install the exhaust tailpipe/muffler assembly on the rear exhaust tailpipe hanger. Make sure that the exhaust tailpipe has sufficient clearance from the floor pan.

(4) Tighten the nut on the muffler-to-catalytic converter clamp to 48 N·m (35 ft. lbs.) torque.

(5) Insert rods into isolators.

(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.

INTAKE MANIFOLD—2.5L ENGINE

REMOVAL

(1) Disconnect the battery negative cable.

REMOVAL AND INSTALLATION (Continued)

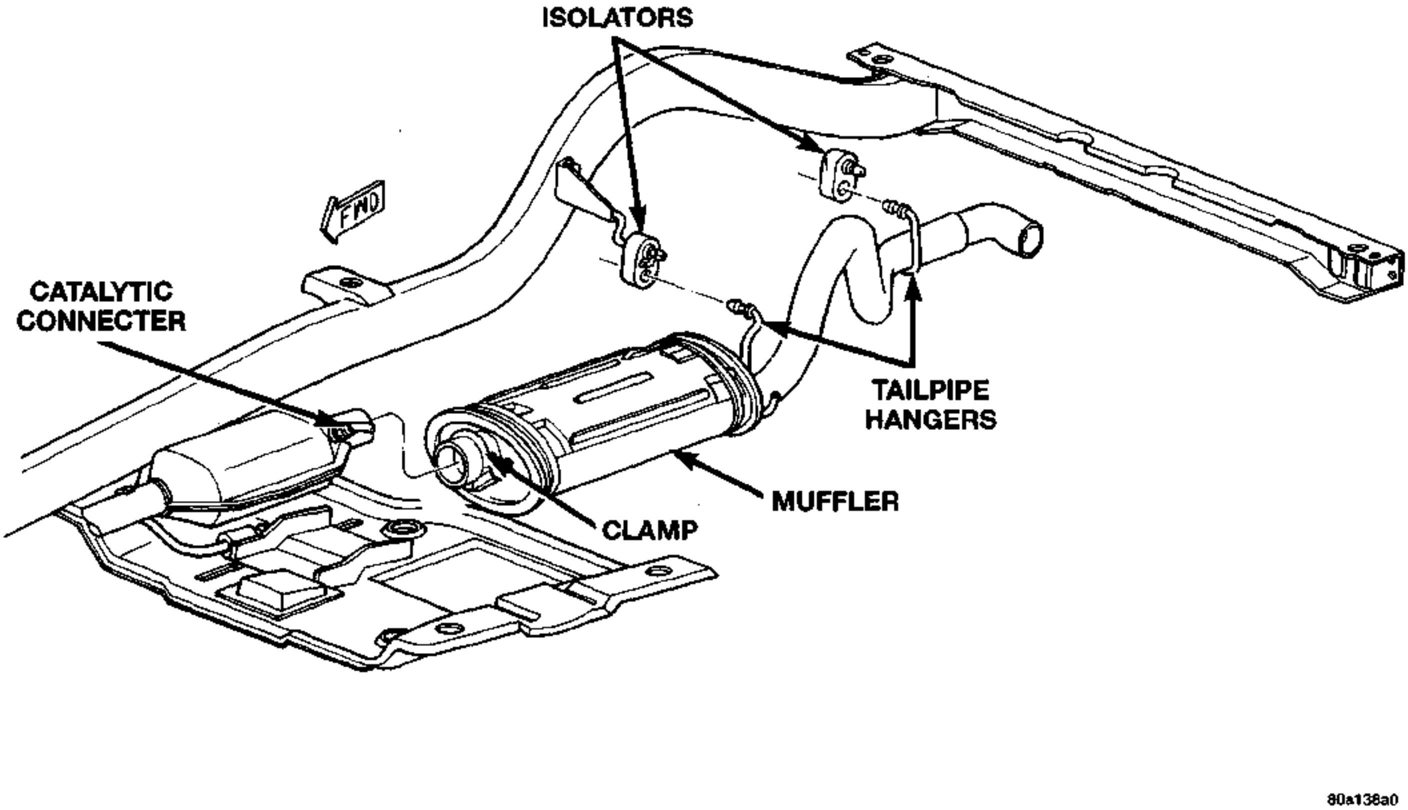


Fig. 6 Muffler Tailpipe Assembly

(2) Remove the air inlet hose from the throttle body and air cleaner.

(3) Loosen the accessory drive belt tension and remove the belt from the power steering pump.

(4) Remove the power steering pump and brackets from the water pump and intake manifold. Support power steering pump and bracket with mechanics wire attached to the radiator upper crossmember.

(5) Remove the fuel tank filler cap to relieve the fuel tank pressure.

(6) Install the fuel tank filler cap.

(7) Disconnect fuel supply and return tube from the fuel rail (refer to Group 14, Fuel System - Quick Connect Fittings).

(8) Disconnect the accelerator cable from the throttle body and the holddown bracket.

CAUTION: When disconnecting the cruise control connector at the throttle body, DO NOT pry the connector off with pliers or screwdriver. Use finger pressure only. Prying the connector off could break it.

(9) Disconnect the electrical connectors. Pull the harnesses away from the manifold.

- The throttle position sensor.
- The idle speed control motor.
- The coolant temperature sensor at the thermostat.
- The manifold air temperature sensor at the intake manifold.
- The fuel injectors.
- The oxygen sensor.

(10) Disconnect the crankcase ventilation (CCV) vacuum hose and manifold absolute pressure (MAP) sensor vacuum hose connector at the intake manifold.

(11) Disconnect vacuum hose from vacuum port on the intake manifold.

(12) Disconnect CCV hose at the cylinder head cover (Fig. 7).

(13) Remove the molded vacuum harness.

(14) Disconnect the vacuum brake booster hose at the intake manifold.

(15) Remove bolts 2 through 5 securing the intake manifold to the cylinder head (Fig. 8). Slightly loosen bolt No.1 and nuts 6 and 7.

(16) Remove the intake manifold and gaskets. Drain the coolant from the manifold.

INSTALLATION

(1) Clean the intake manifold and cylinder head mating surfaces. **DO NOT allow foreign material to enter either the intake manifold or the ports in the cylinder head.**

(2) Install the new intake manifold gasket over the locating dowels.

REMOVAL AND INSTALLATION (Continued)

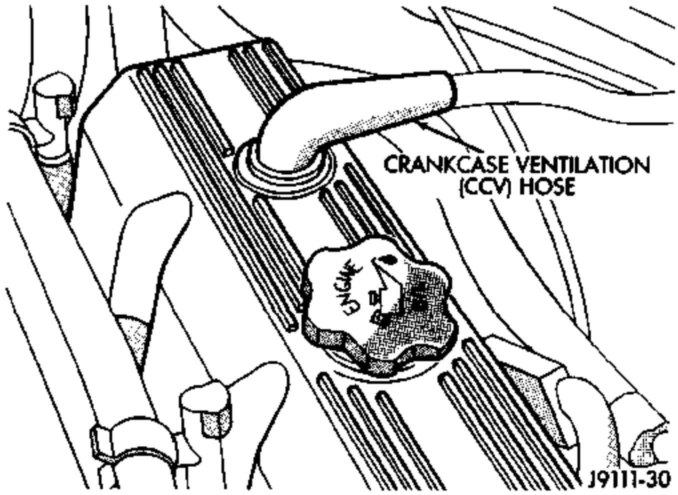


Fig. 7 Crankcase Ventilation (CCV) Hose (2.5L Engine)

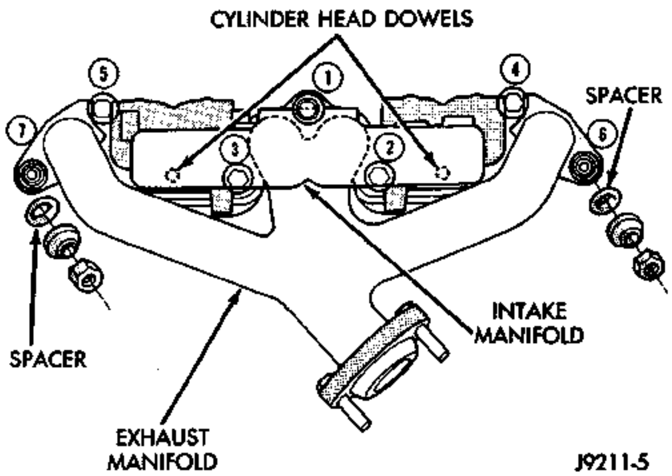


Fig. 8 Intake/Exhaust Manifold 2.5L Engine

(3) Position the manifold in place and finger tighten the mounting bolts.

(4) Tighten the fasteners in sequence and to the specified torque (Fig. 8).

• Fastener No.1—Tighten to 41 N·m (30 ft. lbs.) torque.

• Fasteners Nos.2 through 7—Tighten to 31 N·m (23 ft. lbs.) torque.

(5) Connect the fuel return and supply tube to the connector next to the fuel rail. Push them into the fitting until a click is heard. Verify that the connections are complete.

• First, ensure only the retainer tabs protrude from the connectors.

• Second, pull out on the fuel tubes to ensure they are locked in place.

(6) Connect the molded vacuum hoses to the vacuum port on the intake manifold and the cylinder head cover.

(7) Connect the electrical connectors.

• The throttle position sensor.

• The automatic idle speed control motor.

• The coolant temperature sensor at the thermostat housing.

• The fuel injectors.

• The air manifold temperature sensor.

• The oxygen sensor.

(8) Connect the CCV vacuum hose and MAP sensor vacuum hose connectors to the throttle body.

(9) Install the power steering pump and bracket assembly to the water pump and intake manifold.

(10) Connect the accelerator cable and cruise control cable to the holddown bracket and the throttle arm.

CAUTION: Ensure that the accessory drive belt is routed correctly. Failure to do so can cause the water pump to turn in the opposite direction resulting in engine overheating. Refer to Group 7, Cooling System for the proper procedure.

(11) Tension the accessory drive belt. Refer to Group 7, Cooling System for the proper procedure.

(12) Connect the air inlet hose to the throttle body and the air cleaner.

(13) Connect the battery negative cable.

(14) Start the engine and check for leaks.

INTAKE MANIFOLD—4.0L ENGINE

The intake and engine exhaust manifolds on the 4.0L engine must be removed and installed together. The two manifolds use a common gasket at the cylinder head.

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove air cleaner inlet hose from throttle plate assembly.

(3) Remove the air cleaner assembly.

(4) Remove the throttle cable, cruise control cable (if equipped) and the transmission line pressure cable.

(5) Disconnect all electrical connectors on the intake manifold.

(6) Disconnect and remove the fuel supply and return lines from the fuel rail assembly (refer to Group 14, Fuel System).

(7) Loosen the accessory drive belt (refer to Group 7, Cooling System). Loosen the tensioner.

(8) Remove the power steering pump and bracket from the intake manifold and set aside.

(9) Remove the fuel rail and injectors (refer to Group 14, Fuel System).

(10) Raise the vehicle.

(11) Disconnect the exhaust pipe from the engine exhaust manifold. Discard the seal.

(12) Lower the vehicle.

REMOVAL AND INSTALLATION (Continued)

(13) Remove the intake manifold and engine exhaust manifold.

INSTALLATION

(1) Clean the mating surfaces of the cylinder head and the manifold if the original manifold is to be installed.

(2) If the manifold is being replaced, ensure all the fitting, etc. are transferred to the replacement manifold.

(3) Install a new exhaust/intake manifold gasket over the alignment dowels on the cylinder head.

(4) Position the engine exhaust manifold to the cylinder head. Install fastener No.3 and finger tighten at this time (Fig. 9).

(5) Install intake manifold on the cylinder head dowels.

(6) Install washers and fasteners Nos.1, 2, 4, 5, 8, 9, 10 and 11 (Fig. 9).

(7) Install washers and fasteners Nos.6 and 7 (Fig. 9).

(8) Tighten the fasteners in sequence and to the specified torque (Fig. 9).

- Fasteners Nos.1 through 5—Tighten to 33 N·m (24 ft. lbs.) torque.
- Fasteners Nos.6 and 7—Tighten to 31 N·m (23 ft. lbs.) torque.
- Fasteners Nos.8 through 11—Tighten to 33 N·m (24 ft. lbs.) torque.

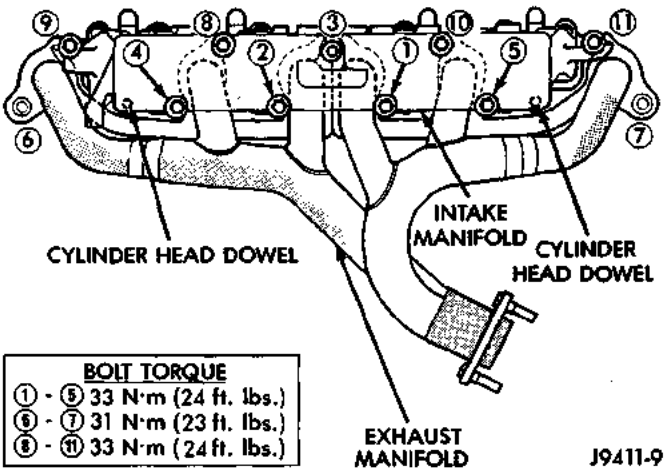


Fig. 9 Intake/Engine Exhaust Manifold Installation 4.0L Engine

(9) Install the fuel rail and injectors.

(10) 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.

(11) Install the fuel supply and return lines to the fuel rail assembly. **Before connecting the fuel lines to the fuel rail replace the O-rings in the quick-connect fuel line couplings.** Refer to Group 14, Fuel System for the proper procedure.

(12) Connect all electrical connections on the intake manifold.

(13) Connect the vacuum connector on the intake manifold and install it in the bracket.

(14) Install throttle cable, cruise control cable (if equipped).

(15) Install the transmission line pressure cable (if equipped). Refer to Group 21, Transmission for the adjustment procedures.

(16) Install air cleaner assembly.

(17) Connect air inlet hose to the throttle plate assembly.

(18) Raise the vehicle on a side mounted hoist.

(19) Using a new seal, connect the exhaust pipe to the engine exhaust manifold. Tighten the bolts to 31 N·m (23 ft. lbs.) torque.

(20) Lower the vehicle.

(21) Connect the battery negative cable.

(22) Start the engine and check for leaks.

EXHAUST MANIFOLD—2.5L ENGINE

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove all components attached to the intake manifold.

(3) Raise the vehicle.

(4) Disconnect the exhaust pipe from the engine exhaust manifold.

(5) Lower the vehicle.

(6) Remove Intake Manifold refer to procedure in this section.

(7) Remove fasteners 2 through 5 and remove the intake manifold (Fig. 10).

(8) Remove fasteners 1, 6 and 7 and remove the engine exhaust manifold (Fig. 10).

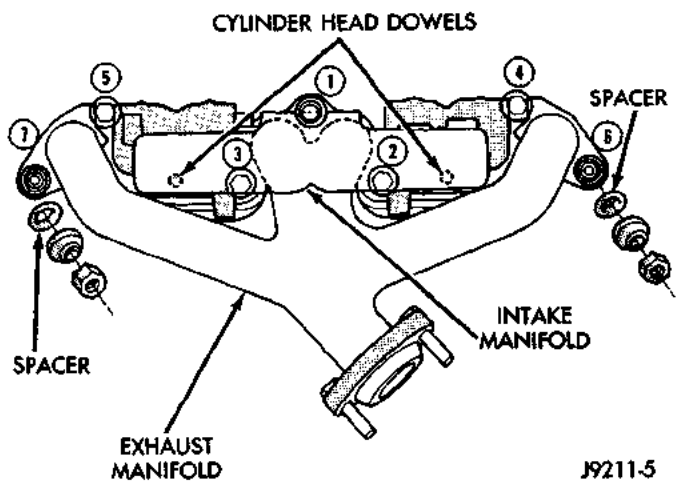


Fig. 10 Intake/Engine Exhaust Manifold Installation 2.5L Engine

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Clean the intake and engine exhaust manifolds and cylinder head mating surfaces. **DO NOT allow foreign material to enter either the intake manifold or the ports in the cylinder head.**

(2) Install a new intake manifold gasket over the alignment dowels on the cylinder head.

(3) Install the engine exhaust manifold assembly. **Exhaust manifold must be centrally located over the end studs and spacer (Fig. 10).**

(4) Tighten bolt No.1 to 41 N·m (30 ft. lbs.) torque (Fig. 10).

(5) Install the intake manifold on the cylinder head dowels (Fig. 10).

(6) Install bolts 2 through 5 (Fig. 10). Tighten these bolts to 31 N·m (23 ft. lbs.) torque.

(7) Install new engine exhaust manifold spacers over the engine exhaust manifold mounting studs in the cylinder head (Fig. 10).

(8) Tighten nuts 6 and 7 to 31 N·m (23 ft. lbs.) torque (Fig. 10).

(9) Install all components to the intake manifold.

(10) Raise the vehicle.

(11) Connect the exhaust pipe to the engine exhaust manifold. Tighten the bolts to 31 N·m (23 ft. lbs.) torque.

(12) Lower the vehicle.

(13) Connect the battery negative cable.

(14) Start the engine and check for leaks.

EXHAUST MANIFOLD—4.0L ENGINE

The intake and engine exhaust manifolds on the 4.0L engine must be removed and installed together. The manifolds use a common gasket at the cylinder head.

Refer to Intake Manifold—4.0L Engine in this section for the proper removal and installation procedures.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	Torque
Exhaust Pipe to Manifold Nuts	31 N·m (23 ft. lbs.)
Exhaust Manifold 2.5L Engine Bolt #1	41 N·m (30 ft. lbs.)
Exhaust Manifold 2.5L Engine Bolts #2–5	31 N·m (23 ft. lbs.)
Exhaust Manifold 4.0L Engine Nuts/Bolts #1–5 & #8–11	33 N·m (24 ft. lbs.)
Exhaust Manifold 2.5L Engine Nuts #6&7	31 N·m (23 ft. lbs.)
Exhaust Manifold 4.0L Engine Nuts #6&7	31 N·m (23 ft. lbs.)
Intake Manifold 2.5L Engine Bolt #1	41 N·m (30 ft. lbs.)
Intake Manifold 2.5L Engine Bolt #2–5	31 N·m (23 ft. lbs.)
Mufler to Catalytic Converter Clamp Nut	48 N·m (35 ft. lbs.)
Oxygen Sensors Nut	48 N·m (35 ft. lbs.)

FRAME AND BUMPERS

CONTENTS

BUMPERS

INDEX

REMOVAL AND INSTALLATION

FRONT TOW HOOK

Some Jeep vehicles are equipped with front emergency tow hooks. The tow hooks should be used for **EMERGENCY** purposes only.

REMOVAL

(1) Remove the torx bolts that attach the tow hook to the bumper (Fig. 1).

(2) Separate the tow hook from the bumper.

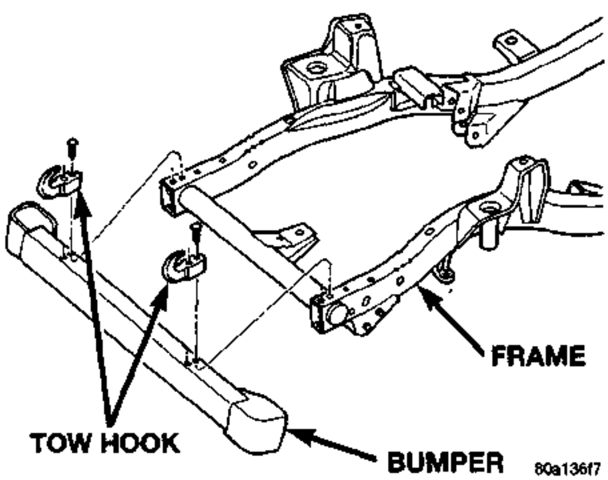


Fig. 1 Front Tow Hook

INSTALLATION

(1) Position the tow hook on the bumper.

(2) Install the torx bolts that attach the tow hook to the bumper. Tighten the bolts to 108 N·m (80 ft. lbs.) torque.

FRONT TOW EYE

REMOVAL

(1) Remove the cap from the tow eye.

(2) Remove the screws that attach the tow eye to the bumper (Fig. 2).

(3) Separate the tow eye from the bumper.

INSTALLATION

(1) Position the tow eye on the bumper.

(2) Install the screws that attach the tow eye to the bumper. Tighten screws to 98 N·m (73 ft. lbs.) torque.

(3) Install the cap on the tow eye.

FRONT BUMPER EXTENSION

REMOVAL

(1) If equipped, remove the extension cover (Fig. 2).

(2) Remove the screws attaching the bumper extension to the bumper (Fig. 3).

(3) Separate the extension from the bumper.

INSTALLATION

(1) Position the extension on the bumper.

(2) Install the screws attaching the bumper extension to the bumper.

(3) If equipped, install the extension cover.

REMOVAL AND INSTALLATION (Continued)

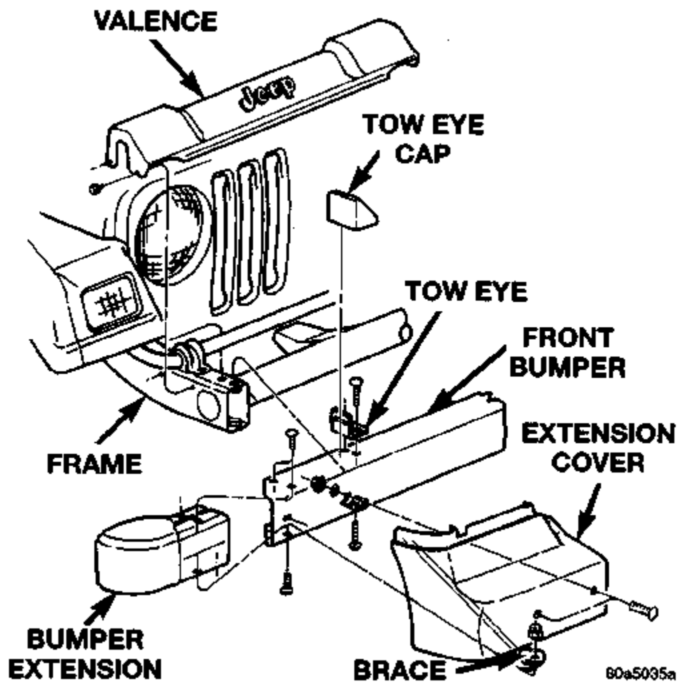


Fig. 2 Front Bumper Components

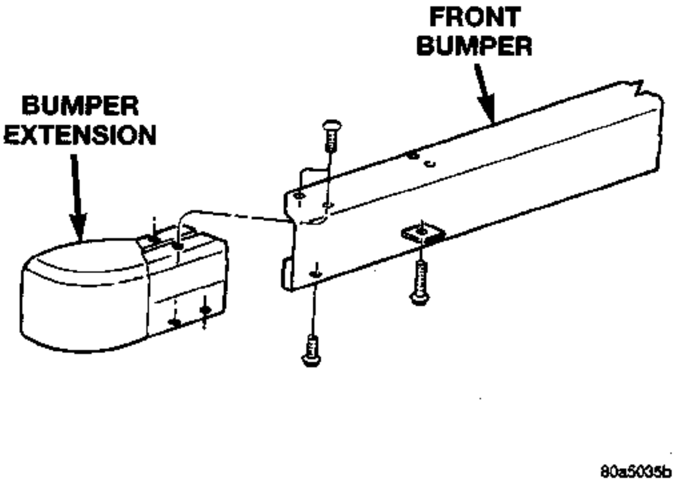


Fig. 3 Bumper Extension

FRONT BUMPER

REMOVAL

(1) If equipped, disconnect the fog lamp harness connector.

(2) Remove the screws that attach the bumper to the frame rail (Fig. 2).

(3) If equipped, separate the tow hook or tow eye from the bumper.

(4) Separate the bumper from the vehicle.

INSTALLATION

(1) Position the bumper on the vehicle.

(2) If equipped, position the tow hook or tow eye on the bumper.

(3) Install the screws that attach the bumper to the frame rail. Tighten the screws to 104 N·m (77 ft. lbs.) torque.

(4) If equipped, Connect the fog lamp harness connector.

REAR TOW EYE

REMOVAL

(1) Remove the screw attaching the tow eye to the frame rail (Fig. 4).

(2) Separate the tow eye from the vehicle.

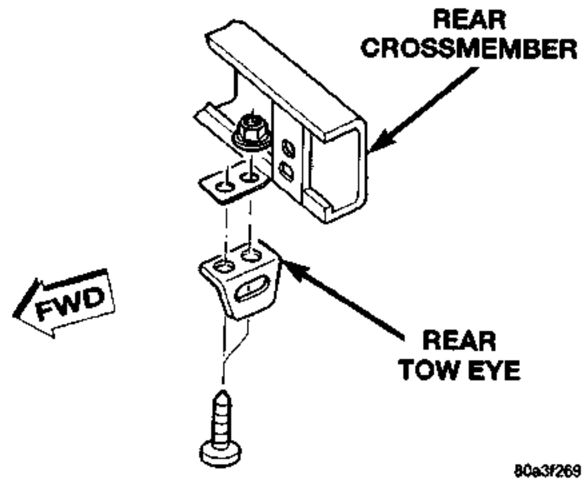


Fig. 4 Rear Tow Eye

INSTALLATION

(1) Position the tow eye on the vehicle.

(2) Install the screw attaching the tow eye to the frame rail. Tighten the screw to 47 N·m (35 ft. lbs.) torque.

REAR BUMPER EXTENSION

REMOVAL

(1) Remove the screws attaching the bumper extension to the bumper (Fig. 5).

(2) Separate the extension from the bumper.

INSTALLATION

(1) Position the extension on the bumper.

(2) Install the screws attaching the bumper extension to the bumper.

REAR BUMPER

REMOVAL

(1) Remove the bolt attaching the bumper to frame rail (Fig. 5).

(2) If equipped, separate the rear tow eye from the bumper.

REMOVAL AND INSTALLATION (Continued)

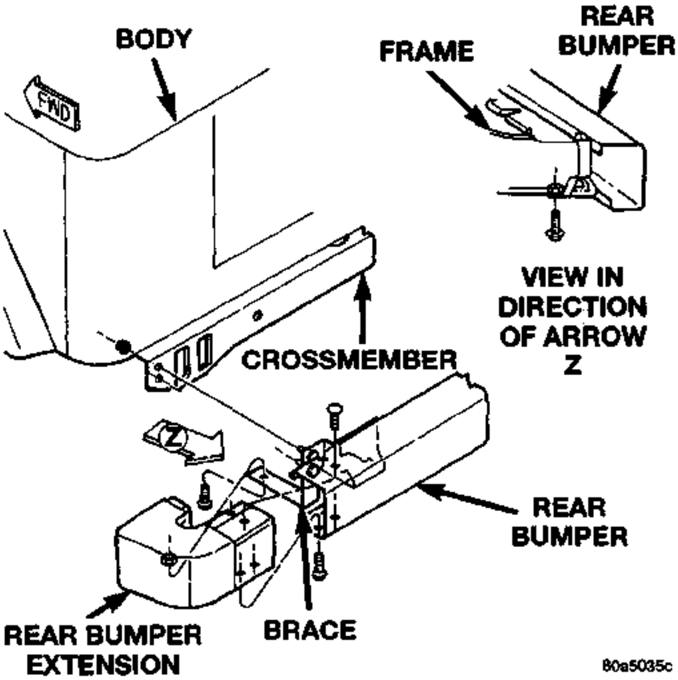


Fig. 5 Bumper Components

(3) Remove the nuts attaching the bumper to the rear frame crossmember.

(4) Separate the bumper from the vehicle.

INSTALLATION

(1) Position the bumper on the vehicle.

(2) Install the nuts attaching the bumper to the rear frame crossmember. Tighten the nuts to 67 N·m (50 ft.lbs.) torque.

(3) If equipped, position the rear tow eye on the bumper.

(4) Install the bolt attaching the bumper to frame rail. Tighten the bolts to 67 N·m (50 ft.lbs.) torque.

FRAME

INDEX

GENERAL INFORMATION

GENERAL INFORMATION

The Jeep TJ frame is the structural center of the vehicle. In addition to supporting the body and payload, the frame provides a station for the engine. The vehicle body is attached to the frame with holddowns (Fig. 1).

The frame is constructed of mild-strength rectangular tubing and crossmembers. The crossmembers join the siderails and retain them in alignment in relation to each other. This provides resistance to frame twists and strains.

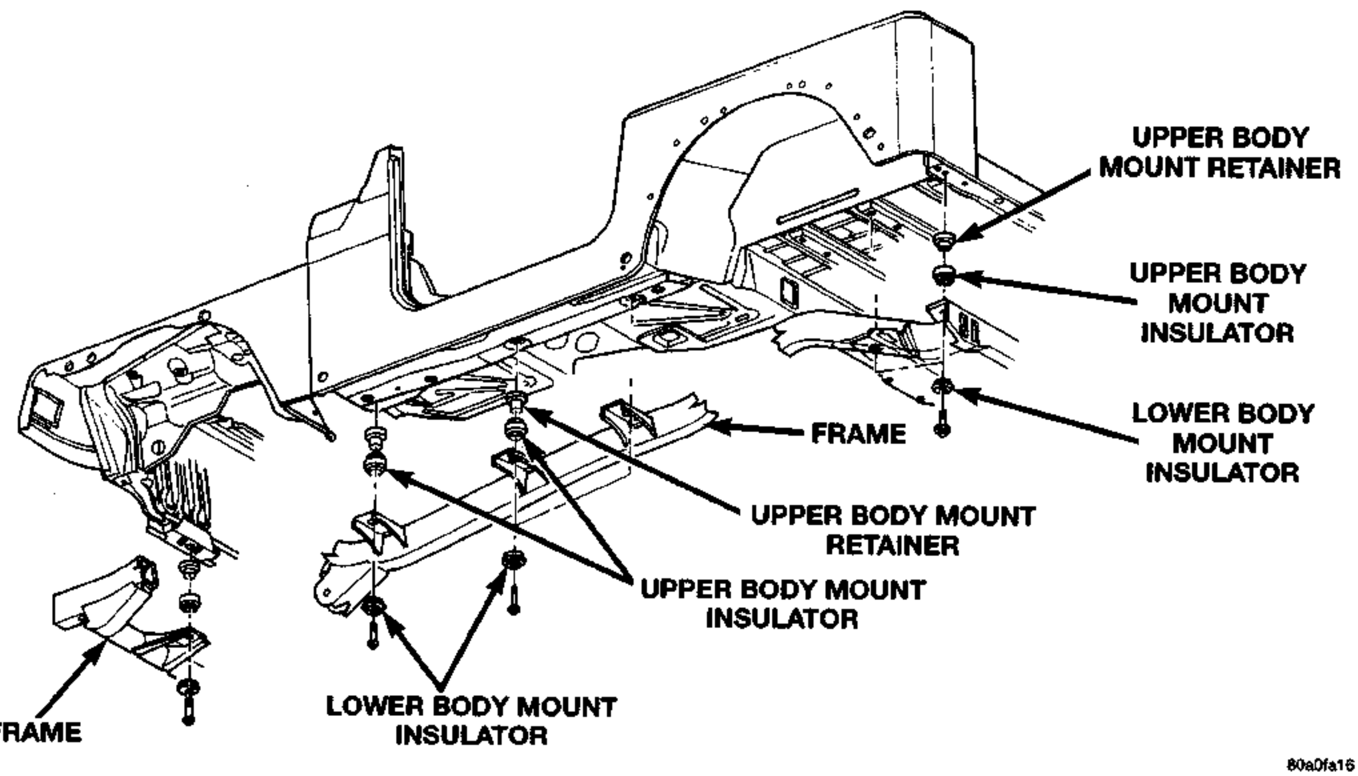


Fig. 1 Body Holddowns

SERVICE PROCEDURES

FRAME SERVICE

SAFETY PRECAUTIONS AND WARNINGS

WARNING: USE EYE PROTECTION WHEN GRINDING OR WELDING METAL, SERIOUS EYE INJURY CAN RESULT. BEFORE PROCEEDING WITH FRAME REPAIR INVOLVING GRINDING OR WELDING, VERIFY THAT VEHICLE FUEL SYSTEM IS NOT LEAKING OR IN CONTACT WITH REPAIR AREA, PERSONAL INJURY CAN RESULT. DO NOT ALLOW OPEN FLAME TO CONTACT PLASTIC BODY PANELS. FIRE OR EXPLOSION CAN RESULT. WHEN WELDED FRAME COMPONENTS ARE REPLACED, 100% PENETRATION WELD MUST BE ACHIEVED DURING INSTALLATION. IF NOT, DANGEROUS OPERATING CONDITIONS CAN RESULT. STAND CLEAR OF CABLES OR CHAINS ON PULLING EQUIPMENT DURING FRAME STRAIGHTENING OPERATIONS, PERSONAL INJURY CAN RESULT. DO NOT VENTURE UNDER A HOISTED VEHICLE THAT IS NOT SUPPORTED ON SAFETY STANDS, PERSONAL INJURY CAN RESULT.

CAUTION: Do not reuse damaged fasteners, quality of repair would be suspect. Do not drill holes in top or bottom frame rail flanges, frame rail failure can result. Do Not use softer than Grade 3 bolts to replace production fasteners, loosening or failure can result. When using heat to straighten frame components do not exceed 566°C (1050°F), metal fatigue can result. Welding the joints around riveted cross members and frame side rails can weaken frame.

FRAME STRAIGHTENING

When necessary, a conventional frame that is bent or twisted can be straightened by application of heat. The temperature must not exceed 566°C (1050°F). The metal will have a dull red glow at the desired temperature. Excessive heat will decrease the strength of the metal and result in a weakened frame.

Welding the joints around riveted cross members and frame side rails is not recommended.

A straightening repair process should be limited to frame members that are not severely damaged. The replacement bolts, nuts and rivets that are used to join the frame members should conform to the same specifications as the original bolts, nuts and rivets.

FRAME REPAIRS

DRILLING HOLES

Do not drill holes in the top and bottom of frame rail, metal fatigue can result causing frame failure. Holes drilled in the side of the frame rail must be at least 38 mm (1.5 in.) from the top and bottom flanges.

Additional drill holes should be located away from existing holes.

WELDING

Use MIG, TIG or arc welding equipment to repair welded frame components.

Frame components that have been damaged should be inspected for cracks before returning the vehicle to use. If cracks are found in accessible frame components perform the following procedures.

(1) Drill a hole at each end of the crack with a 3 mm (0.125 in.) diameter drill bit.

(2) Using a suitable die grinder with 3 inch cut off wheel, V-groove the crack to allow 100% weld penetration.

(3) Weld the crack.

(4) If necessary when a side rail is repaired, grind the weld smooth and install a reinforcement channel (Fig. 2) over the repaired area.

CAUTION: A reinforcement should never be used on the front section of the frame. The frame section forward of the suspension mounts contains energy management holes (Fig. 3). Reinforcing this area may effect energy management.

NOTE: If a reinforcement is required, it should completely cover the repaired area. The reinforcement should also overlap the top and bottom of the frame by more than 50% of its width. Weld as indicated (Fig. 2).

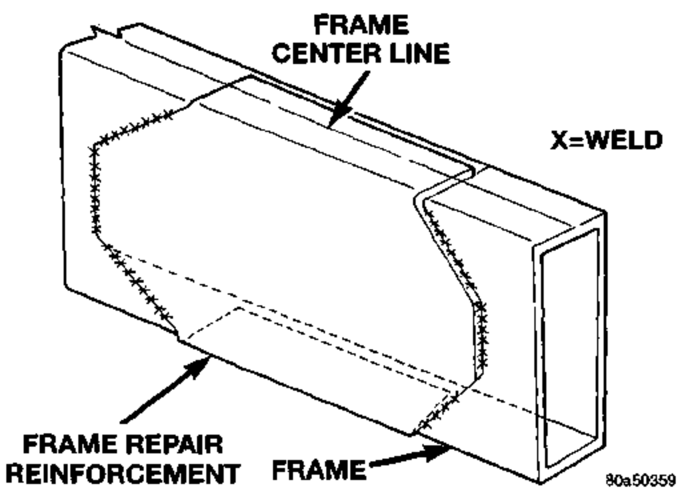


Fig. 2 Frame Reinforcement

SERVICE PROCEDURES (Continued)

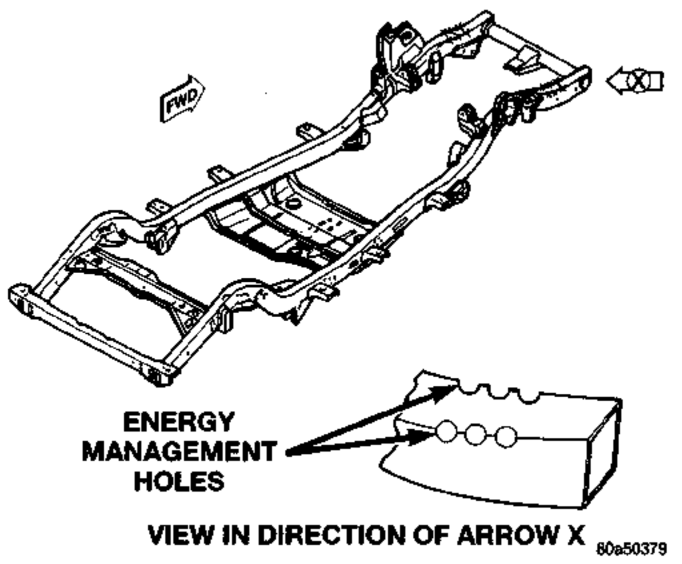


Fig. 3 Energy Management Holes

FRAME FASTENERS

Bolts and nuts and can be used to repair frames or to install a reinforcement section on the frame.

Conical-type washers are preferred over the split-ring type lock washers. Normally, grade-5 bolts are adequate for frame repair. **Grade-3 bolts or softer should not be used.** Tightening bolts/nuts with the correct torque, refer to the Introduction Group at the front of this manual for tightening information.

REMOVAL AND INSTALLATION

TRANSFER CASE SKID PLATE

The transmission and transfer case crossmember is integrated with the transfer case skid plate.

REMOVAL

WARNING: THE TRANSFER CASE AND TRANSMISSION ARE SUPPORTED BY THE TRANSFER CASE SKID PLATE. BEFORE REMOVING THE TRANSFER CASE SKID PLATE, ENSURE THAT THE TRANSMISSION IS PROPERLY SUPPORTED.

(1) Raise and support the vehicle.

(2) Place a support under the transmission.

(3) Remove the nuts attaching the transmission mount to the skid plate (Fig. 4) and (Fig. 5).

(4) Remove the bolts attaching the skid plate to the frame (Fig. 6).

(5) Separate the skid plate from the vehicle.

INSTALLATION

(1) Position the skid plate on the vehicle.

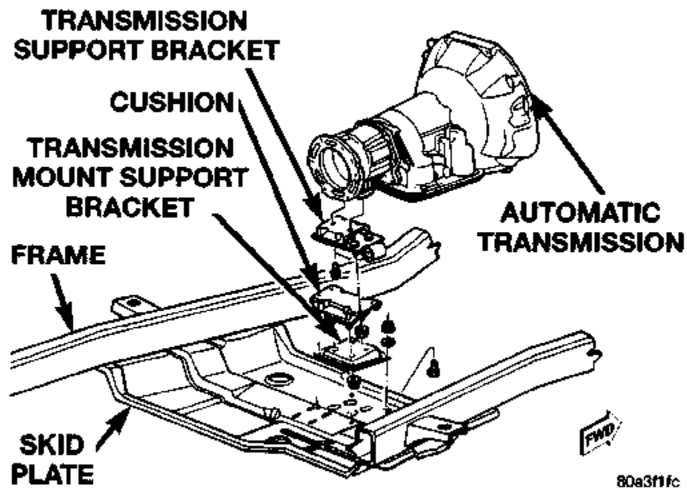


Fig. 4 Transmission Mount—Automatic Transmission

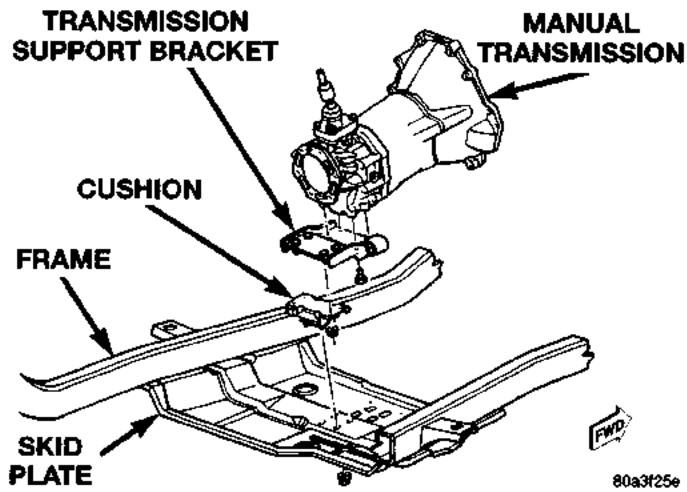


Fig. 5 Transmission Mount—Manual Transmission

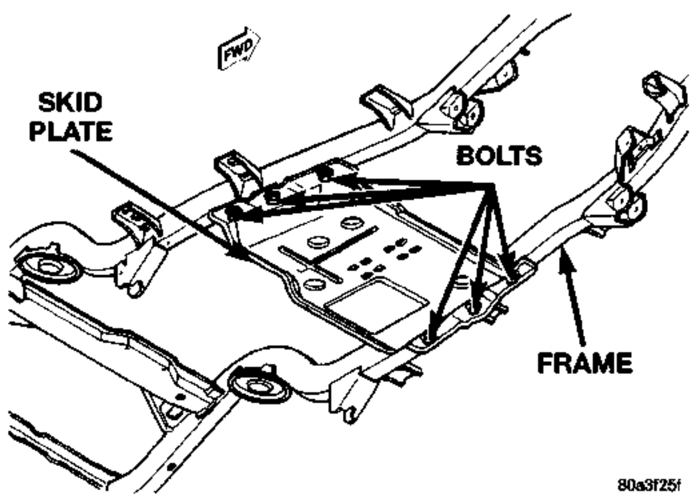


Fig. 6 Transfer Case Skid Plate

(2) Install the bolts attaching the skid plate to the frame. Tighten the bolts to 74 N·m (55 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(3) Install the nuts attaching the transmission mount to the skid plate. Tighten the nuts to 28 N·m (21 ft. lbs.) torque.

(4) Remove the support under the transmission.

(5) Remove the support from under the vehicle and lower the vehicle.

FUEL TANK SKID PLATE

REMOVAL

(1) Position a support under the fuel tank skid plate.

(2) Remove the protective caps from the end of the strap studs.

(3) Remove the nuts that attach the skid plate to the straps and to the crossmembers (Fig. 7).

(4) Separate the fuel tank strap from the skid plate.

(5) Support the fuel tank and remove the skid plate from the vehicle.

INSTALLATION

(1) Attach the skid plate to the fuel tank strap.

(2) Position and support the skid plate under the fuel tank.

(3) Install the nuts to attach the skid plate to the straps and to the frame crossmembers. Tighten the fuel tank strap nuts to 5 N·m (40 in. lbs.) torque. Tighten the skid plate-to-crossmember nuts with 16 N·m (138 in. lbs.) torque.

(4) Install the protective caps on the end of the strap studs.

(5) Remove the support from under the skid plate.

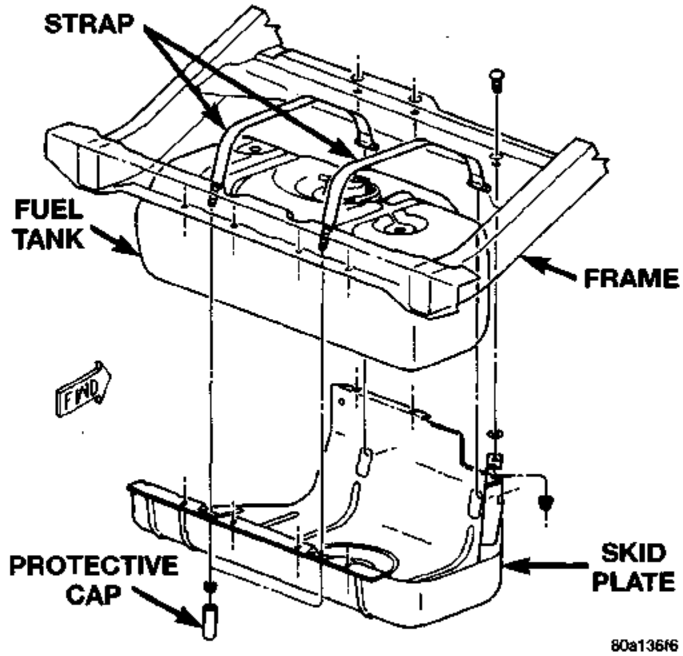


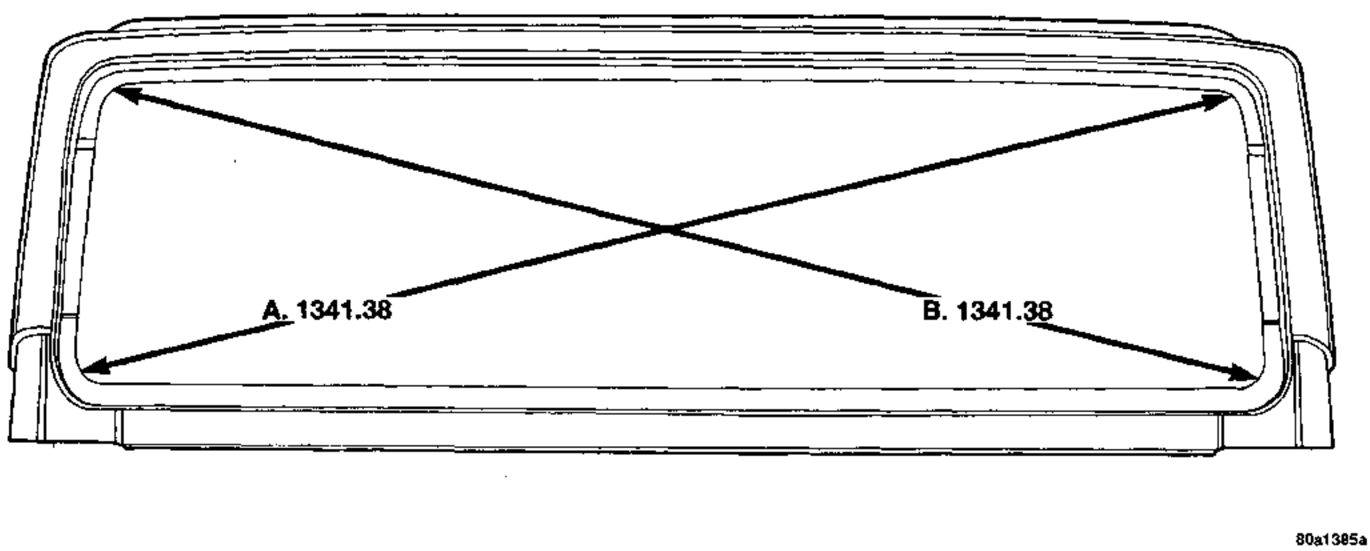
Fig. 7 Fuel Tank Skid Plate

SPECIFICATIONS

VEHICLE DIMENSIONS

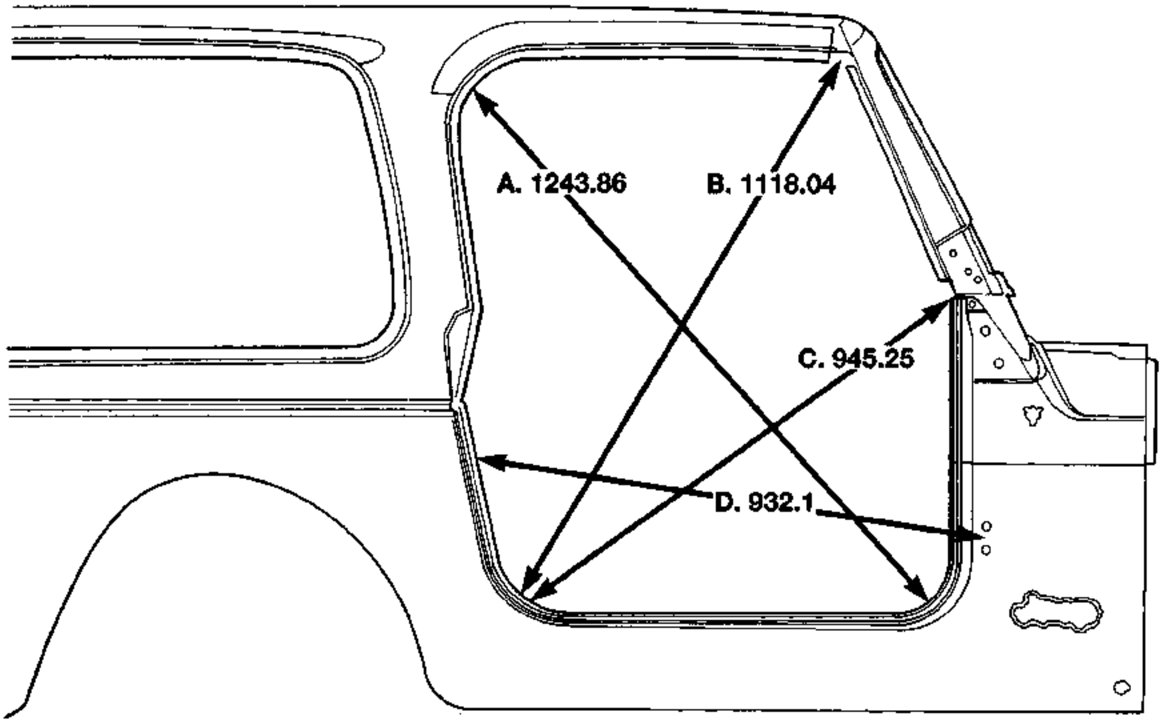
WINDSHIELD OPENING

• A & B. Center of radius at bottom to center of radius top.



SPECIFICATIONS (Continued)

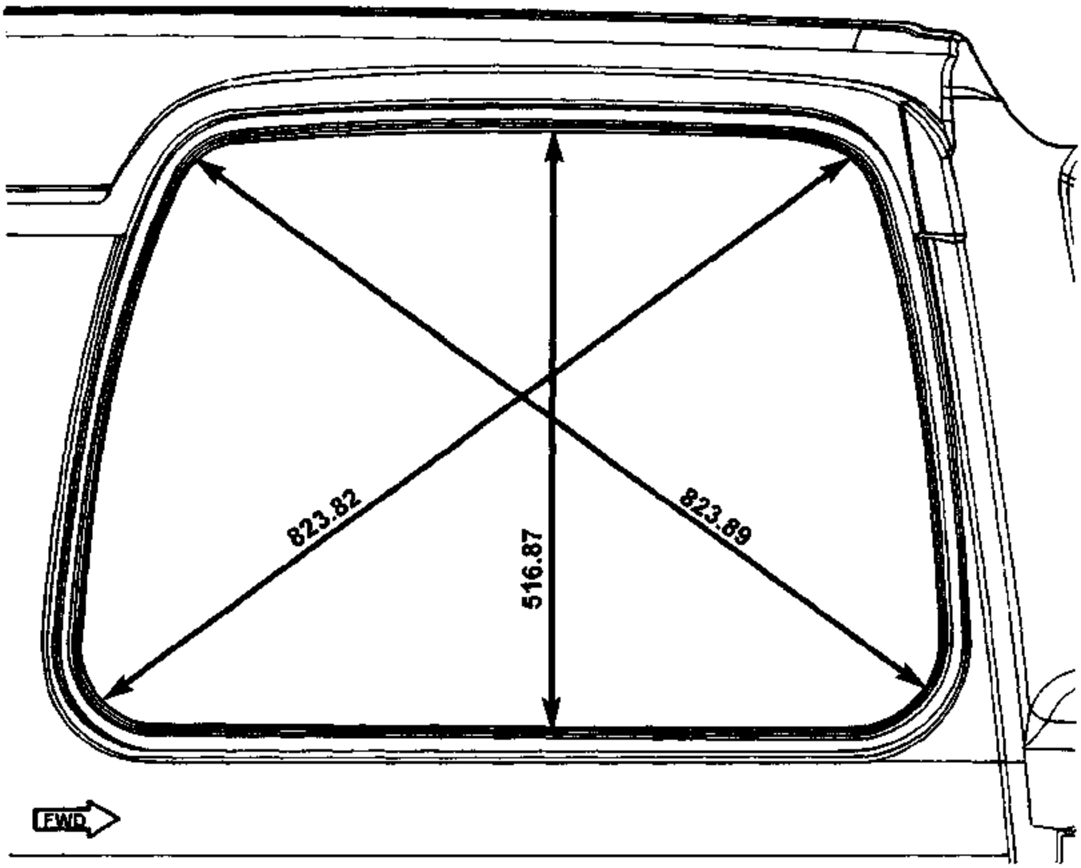
DOOR OPENING



- A. Center of radius at bottom front to center of radius at top rear.
- B. Center of door lower rear corner to center of top of windshield frame.
- C. Center of door lower rear corner to top of cowl.
- D. Center of door hinge mount to center of door striker mount.

SPECIFICATIONS (Continued)

QUARTER WINDOW OPENING



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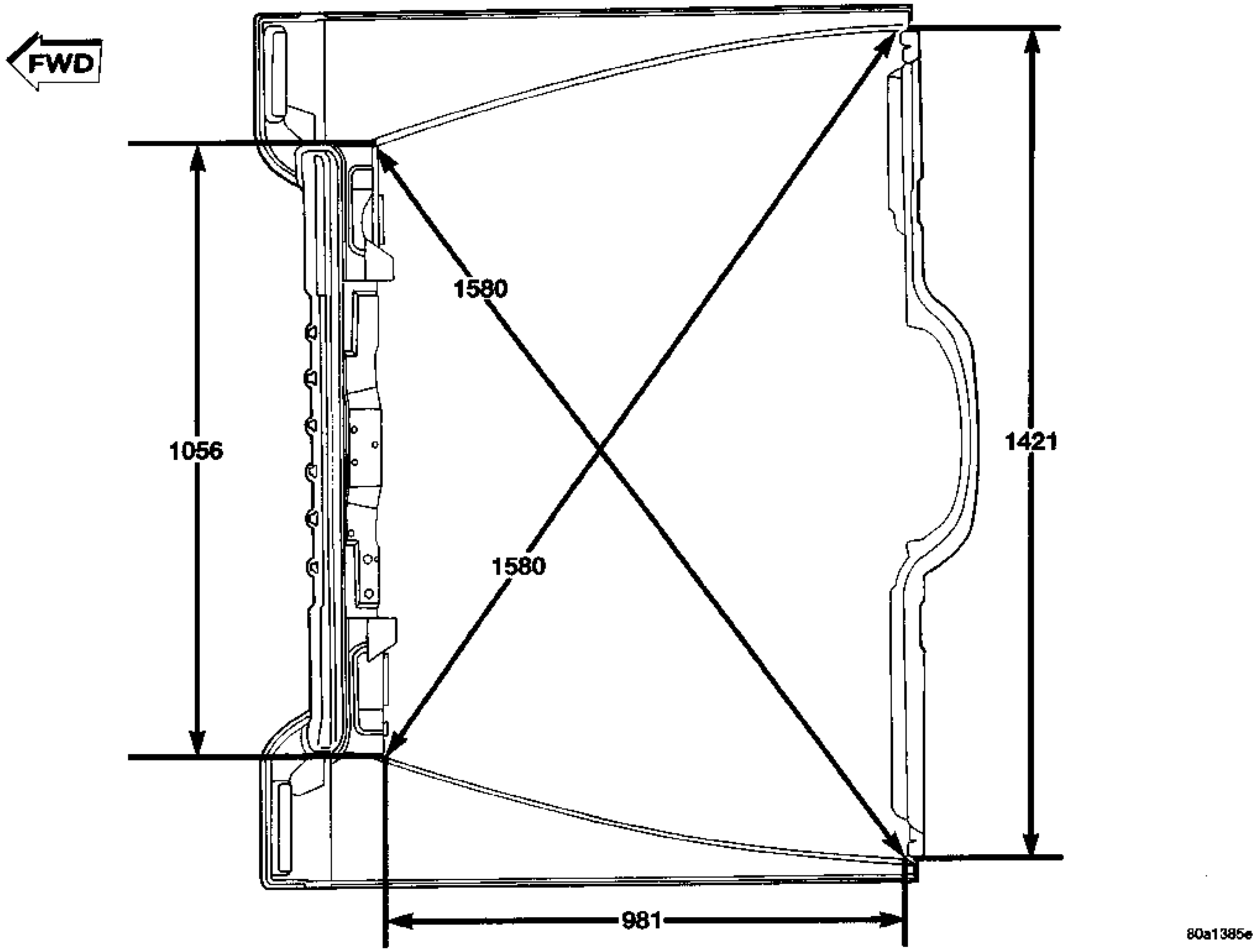
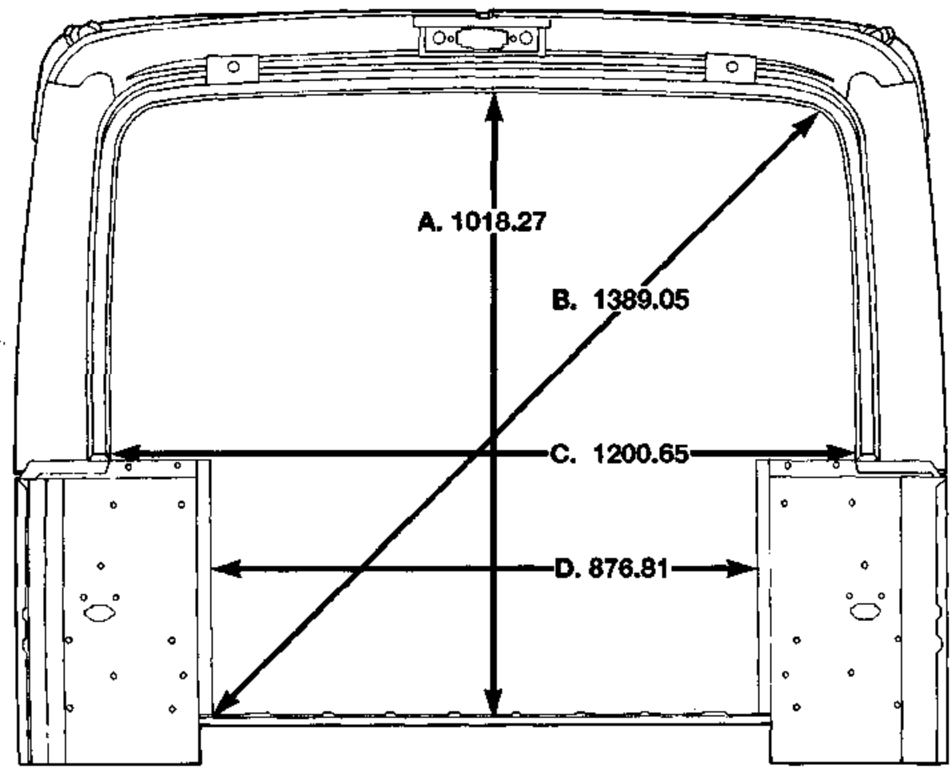
SPECIFICATIONS (Continued)

ENGINE COMPARTMENT



SPECIFICATIONS (Continued)

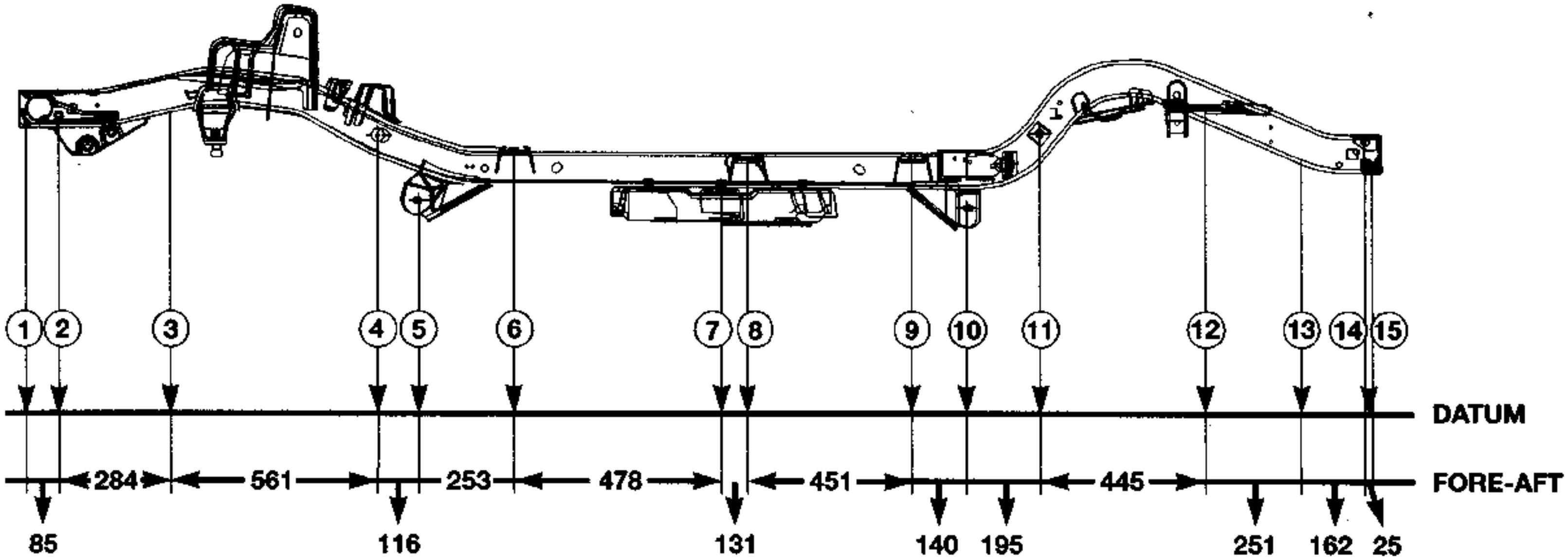
TAILGATE AND LIFTGATE OPENING



- A. Center of liftgate opening to floor.
- B. Center of radius upper corner to center of body and floor corner.
- C. Liftgate opening distance.
- D. Tailgate opening distance.

SPECIFICATIONS (Continued)

FRAME SIDE VIEW



POINT #	DISTANCE TO DATUM (mm)	
1.	500	BOTTOM OF SIDERAIL
2.	534	CENTER OF HOLE
3.	543	BOTTOM OF SIDERAIL, CENTER OF SLOT
4.	494	CENTER OF HOLE, OUTBOARD
5.	317	CENTER OF HOLE, OUTBOARD
6.	460	BOTTOM OF BRACKET
7.	359	BOTTOM OF SIDERAIL
8.	445	BOTTOM OF BRACKET
9.	445	BOTTOM OF BRACKET
10.	309	CENTER OF HOLE, OUTBOARD
11.	512	CENTER OF HOLE, INBOARD
12.	577	BOTTOM OF CROSSMEMBER
13.	474	CENTER OF HOLE, OUTBOARD
14.	505	BOTTOM OF BRACKET
15.	406	BOTTOM OF FRAME

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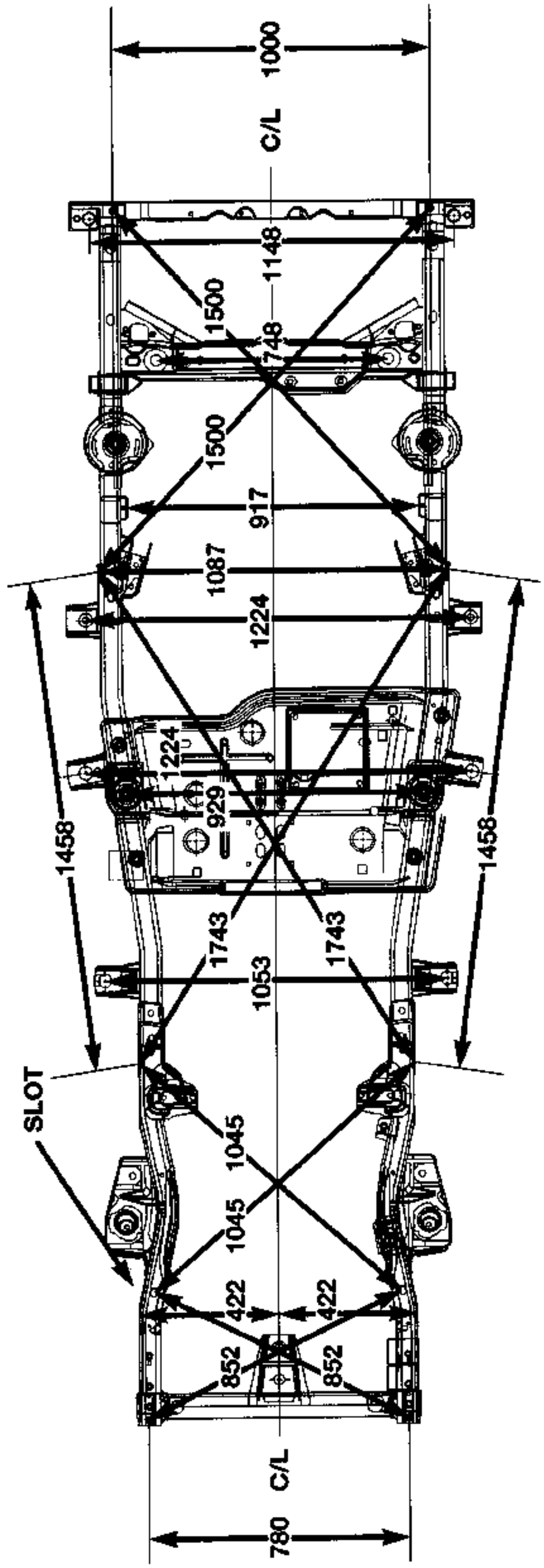
SPECIFICATIONS (Continued)

FRAME TOP VIEW



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SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Front Bumper Screw	104 N·m (77 ft. lbs.)
Front Tow Hook Screw	108 N·m (80 ft. lbs.)
Front Tow Eye Screw	108 N·m (80 ft. lbs.)
Fuel Tank Skid Plate Nuts	16 N·m (138 in. lbs.)
Fuel Tank Strap Nuts	5 N·m (40 in. lbs.)
Rear Bumper Bolt	67 N·m (50 ft. lbs.)
Rear Bumper Nut	67 N·m (50 ft. lbs.)
Rear Tow Eye Screw	47 N·m (35 ft. lbs.)
Transfer Case Skid Plate Bolts	74 N·m (55 ft. lbs.)
Transmission Mount Nuts	28 N·m (21 ft. lbs.)

FUEL SYSTEM

CONTENTS

GENERAL INFORMATION

INDEX

GENERAL INFORMATION

INTRODUCTION

Throughout this group, references may be made to a particular vehicle by letter or number designation. A chart showing the breakdown of these designations is included in the Introduction Section at the front of this service manual.

The Evaporation Control System, is also considered part of the fuel system. The system reduces the emission of fuel vapor into the atmosphere.

The description and function of the Evaporation Control System is found in Group 25 of this manual.

FUEL REQUIREMENTS

Light spark knock at low engine speeds is not harmful to your engine. However, continued heavy spark knock at high speeds can cause damage and should be reported to your dealer immediately. Engine damage resulting from operating with a heavy spark knock may not be covered by the new vehicle warranty.

In addition to using unleaded gasoline with the proper octane rating, gasolines 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.

Poor quality gasoline can cause problems such as hard starting, stalling, and stumble. If you experience these problems, try another brand of gasoline before considering service for the vehicle.

GASOLINE/OXYGENATE BLENDS

Some fuel suppliers blend gasoline with materials that contain oxygen such as alcohol, MTBE (Methyl Tertiary Butyl Ether) and ETBE (Ethyl Tertiary Butyl Ether). Oxygenates are required in some areas of the country during winter months to reduce carbon monoxide emissions. The type and amount of oxygenate used in the blend is important.

The following are generally used in gasoline blends:

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

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

Do not use gasolines containing Methanol.

Use of methanol/gasoline blends may result in starting and driveability problems and damage critical fuel system components.

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

MTBE/ETBE - Gasoline and MTBE (Methyl Tertiary Butyl Ether) blends are a mixture of unleaded gasoline blended and up to 15 percent MTBE. Gaso-

GENERAL INFORMATION (Continued)

line and ETBE (Ethyl Tertiary Butly Ether) are blends of gasoline and up to 17 percent ETBE. Gasoline blended with MTBE or ETBE may be used in your vehicle.

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

Reformulated Gasoline

Many areas of the country are requiring the use of cleaner-burning fuel referred to as **Reformulated Gasoline**. Reformulated gasolines are specially blended to reduce vehicle emissions and improve air quality.

Chrysler Corporation strongly supports the use of reformulated gasolines whenever available. Although your vehicle was designed to provide optimum performance and lowest emissions operating on high quality unleaded gasoline, it will perform equally well and produce even lower emissions when operating on reformulated gasoline.

Materials Added to Fuel

Indiscriminate use of fuel system cleaning agents should be avoided. Many of these materials intended for gum and varnish removal may contain active solvents of similar ingredients that can be harmful to fuel system gasket and diaphragm materials.

FUEL DELIVERY SYSTEM

INDEX

DESCRIPTION AND OPERATION

FUEL DELIVERY SYSTEM

The fuel delivery system consists of: the electric fuel pump, fuel filter, fuel pressure regulator, fuel pump module, fuel gauge sending unit, fuel tubes/lines/hoses, quick-connect fittings, fuel rail, fuel injectors, fuel tank, accelerator pedal, fuel tank filler cap and throttle cable.

A fuel return system is used on all models (all engines). Fuel is returned through the fuel pump module and back into the fuel tank through the fuel pressure regulator. A separate fuel return line from the engine to the tank is not used with any 2.5L or 4.0L engine.

The fuel tank assembly consists of: the fuel tank, filler tubes/hoses, fuel gauge sending unit/electric fuel pump module, two interconnected pressure relief/rollover valves 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. Description and function of the Evaporative Control System can be found in Group 25, Emission Control Systems.

FUEL PUMP MODULE

The fuel pump module on all models is installed into the top of the fuel tank (Fig. 1). The fuel pump module contains the following components (Fig. 1) or (Fig. 2):

- A combination fuel filter/fuel pressure regulator
- A separate fuel pick-up filter (strainer)
- An electric fuel pump
- A threaded locknut to retain module to tank
- Fuel gauge sending unit (fuel level sensor)
- Fuel supply tube (line) connection

The fuel gauge sending unit, pick-up filter and fuel filter/fuel pressure regulator may be serviced separately. If the electrical fuel pump requires service, the entire fuel pump module must be replaced.

FUEL PUMP

The fuel pump used in this system has a permanent magnet electric motor. The pump is part of the fuel pump module. The fuel pump module is suspended in fuel in the fuel tank. Fuel is drawn in through a filter and pushed through the electric motor to the outlet. The pump contains a check valve. This valve is located near the pump outlet. It restricts fuel movement in either direction to maintain fuel supply line pressure when the pump is not operational. Voltage to operate the pump is supplied through the fuel pump relay.

DESCRIPTION AND OPERATION (Continued)

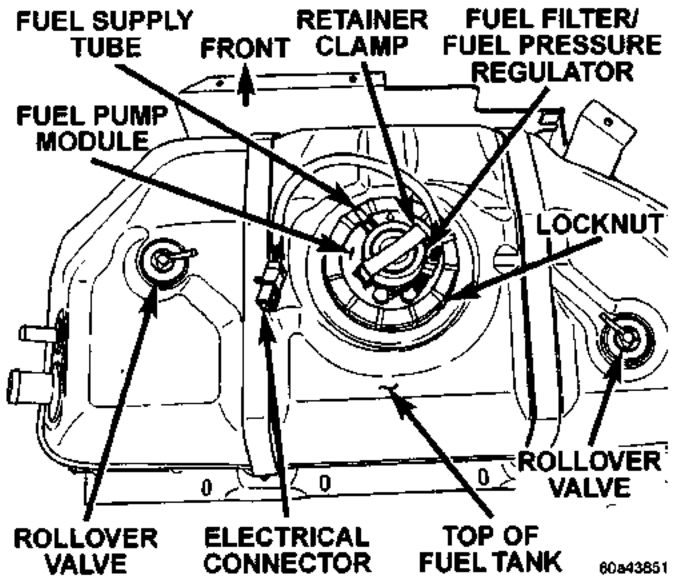


Fig. 1 Fuel Tank/Fuel Pump Module (Top View)

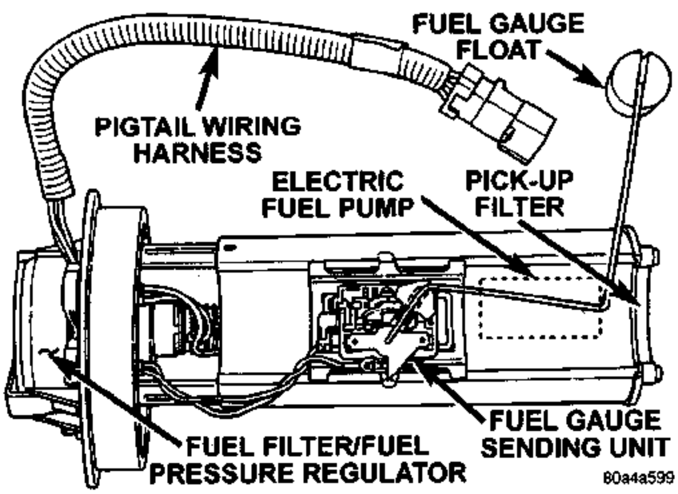


Fig. 2 Fuel Pump Module Components

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit is attached to the side of the fuel pump module (Fig. 2). The sending unit consists of a float, an arm, and a variable resistor (track). The resistor track is used to send electrical signals to the Powertrain Control Module (PCM) for fuel gauge operation and for OBD II emission requirements.

For fuel gauge operation: As fuel level increases, the float and arm move up. This decreases the sending unit resistance, causing the fuel gauge to read full. As fuel level decreases, the float and arm move down. This increases the sending unit resistance causing the fuel gauge to read empty.

After this fuel level signal is sent to the PCM, the PCM will transmit the data across the CCD bus circuits to the instrument panel. Here it is translated into the appropriate fuel gauge level reading.

For OBD II emission requirements: The voltage signal is sent from the resistor track to the PCM to indicate fuel level. The purpose of this feature is to prevent a false setting of misfire and fuel system monitor trouble codes if the fuel level in the tank is less than 15 percent of its rated capacity.

FUEL FILTER/FUEL PRESSURE REGULATOR

A combination fuel filter and fuel pressure regulator is used on all engines. It is located on the top of fuel pump module (Fig. 1). A separate frame mounted fuel filter is not used with any engine.

Fuel Pressure Regulator Operation: The pressure regulator is a mechanical device that is not controlled by engine vacuum or the Powertrain Control Module (PCM).

The regulator is calibrated to maintain fuel system operating pressure of approximately 338 kPa (49 psi) at the fuel injectors. It contains a diaphragm, calibrated springs and a fuel return valve. The internal fuel filter is also part of the assembly.

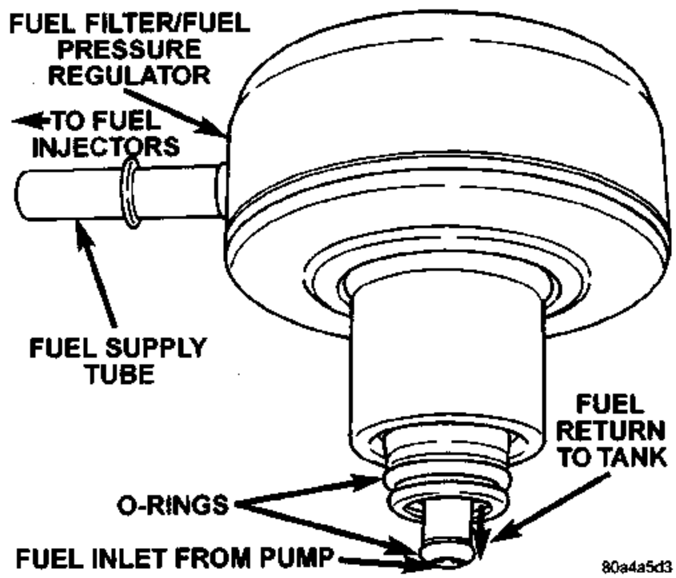


Fig. 3 Fuel Filter/Fuel Pressure Regulator

Fuel is supplied to the filter/regulator by the electric fuel pump through an opening tube at the bottom of filter/regulator (Fig. 3).

The fuel pump module contains a check valve to maintain some fuel pressure when the engine is not operating. This will help to start the engine.

If fuel pressure at the pressure regulator exceeds approximately 49 psi, an internal diaphragm closes and excess fuel pressure is routed back into the tank through the pressure regulator. A separate fuel return line is not used with any engine.

FUEL TANK

All models pass a full 360 degree rollover test without fuel leakage. To accomplish this, fuel and

DESCRIPTION AND OPERATION (Continued)

vapor flow controls are required for all fuel tank connections.

All models are equipped with two rollover valves mounted into the top of the fuel tank (Fig. 1).

An evaporation control system is used to reduce emissions of fuel vapors into atmosphere by evaporation and to reduce unburned hydrocarbons emitted by vehicle engine. When fuel evaporates from fuel tank, vapors pass through vent hoses or tubes to a charcoal canister. The are temporarily held in the canister. When the engine is running, the vapors are drawn into the intake manifold. Refer to Group 25, Emission Control System for additional information.

FUEL INJECTORS

Six individual fuel injectors are used with the 4.0L 6-cylinder engine. Four individual fuel injectors are used with the 2.5L 4-cylinder engine. The injectors are attached to the fuel rail (Fig. 4).

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.

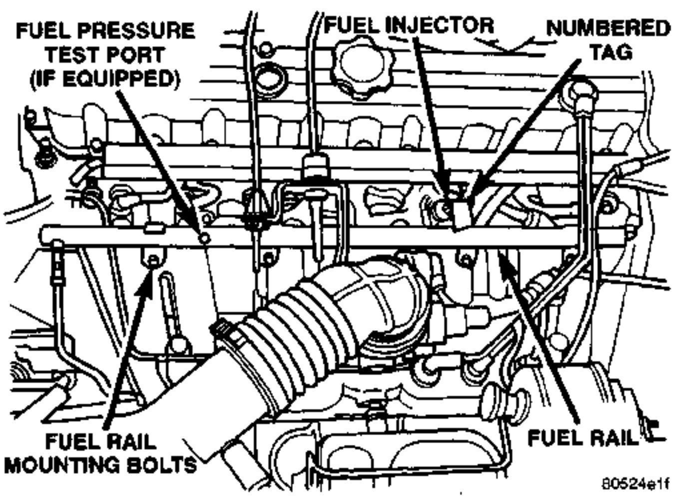


Fig. 4 Fuel Injectors—Typical—4.0L Shown

FUEL RAIL

The fuel rail supplies the necessary fuel to each individual fuel injector and is mounted to the intake manifold (Fig. 4).

Certain engines are equipped with a fuel pressure test port (Fig. 4). **Not all engines are equipped with this test port.**

The fuel rail is not repairable.

FUEL TANK FILLER TUBE CAP

The loss of any fuel or vapor out of filler neck is prevented by the use of a pressure-vacuum fuel tank filler tube cap. Relief valves inside cap will release only under significant pressure of 6.58 to 8.44 kPa (1.95 to 2.5 psi). The vacuum release for all fuel filler tube caps is between .97 and 2.0 kPa (.14 and .29 psi). This cap must be replaced by a similar unit if replacement is necessary. This is in order for the system to remain effective.

CAUTION: Remove fuel tank filler tube cap before servicing any fuel system component. This is done to help relieve tank pressure.

QUICK-CONNECT FITTINGS

Two different types of quick-connect fittings are used to attach various fuel system components. These are: a two-tab type or a plastic retainer ring type. The plastic retainer type will require a special tool for disconnection. Some quick-connect fittings are equipped with safety latch clips. Refer to Quick-Connect Fittings in the Removal/Installation section for more information.

CAUTION: The interior components (o-rings, spacers) of quick-connect fitting are not serviced separately. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube (line) assembly.

DIAGNOSIS AND TESTING

FUEL PUMP PRESSURE TEST—2.5L ENGINE

NOTE: The fuel pressure test port is used on certain engines only. If equipped, the test port will be located on the fuel rail. If not equipped, refer to the following procedure:

All fuel systems are equipped with a fuel tank module mounted, combination fuel filter/fuel pressure regulator. The fuel pressure regulator is not controlled by engine vacuum.

With engine at idle speed, system fuel pressure should be 338 kPa ± 5 kPa (49.0 psi ± 2 psi).

DIAGNOSIS AND TESTING (Continued)

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. BEFORE DISCONNECTING FUEL LINE AT FUEL RAIL, THIS PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

(1) Release fuel pressure. Refer to the Fuel System Pressure Release Procedure.

(2) Disconnect latch clip and fuel line at fuel rail. Refer to Quick-Connect Fittings for procedures. This can be found in this section of the group.

(3) Connect adapter tool number 6539 or 6631 (Fig. 5) into fuel rail. **Be sure adapter tool is fully seated into fuel rail.**

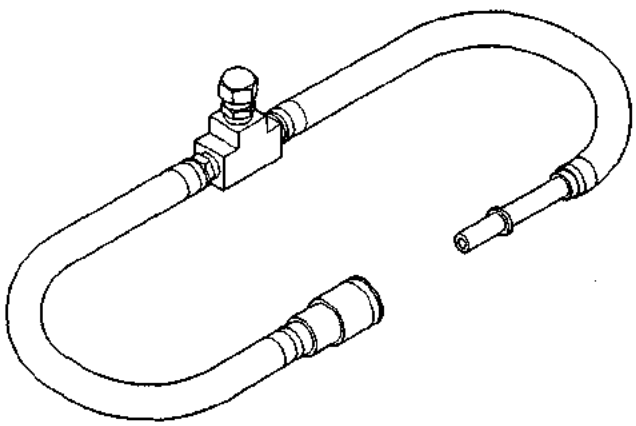


Fig. 5 Adapter Tool 6539 or 6631

(4) Install latch clip to fuel rail. If latch clip can not be fully seated into fuel rail, check for adapter tool not fully seated to fuel rail.

(5) Connect vehicle fuel line into adapter tool. Be sure fuel line is fully seated into adapter tool.

(6) Remove protective cap at test port "T" on adapter tool.

(7) Connect the 0–414 kPa (0-60 psi) fuel pressure gauge (from gauge set 5069) to the test port "T".

(8) Start engine and note pressure gauge reading. Fuel pressure should be 338 kPa ± 5 kPa (49.0 psi ± 2 psi) at idle.

(9) If pressure is at 0 psi, connect DRB scan tool and refer to the appropriate Powertrain Diagnostics Procedures service manual.

(10) If operating pressure is above 51.0 psi, fuel pump is OK but pressure regulator is defective. Replace fuel filter/fuel pressure regulator assembly.

(11) After performing pressure test, install fuel line into fuel rail. Install latch clip into fuel rail. Refer to Quick-Connect Fittings in the Removal/Installation section of this group for procedures.

FUEL PUMP PRESSURE TEST–4.0L ENGINE

NOTE: The fuel pressure test port is used on certain engines only. If equipped, the test port will be located on the fuel rail (Fig. 4). A sealing cap is screwed onto the test port.

All fuel systems are equipped with a fuel tank module mounted, combination fuel filter/fuel pressure regulator. The fuel pressure regulator is not controlled by engine vacuum.

With engine at idle speed, system fuel pressure should be 338 kPa ± 5 kPa (49.0 psi ± 2 psi).

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.

WARNING: WEAR PROPER EYE PROTECTION WHEN TESTING FUEL SYSTEM PRESSURE.

(1) Remove protective cap at fuel rail test port. Connect the 0–414 kPa (0-60 psi) fuel pressure gauge (from gauge set 5069) to test port pressure fitting on fuel rail (Fig. 6).

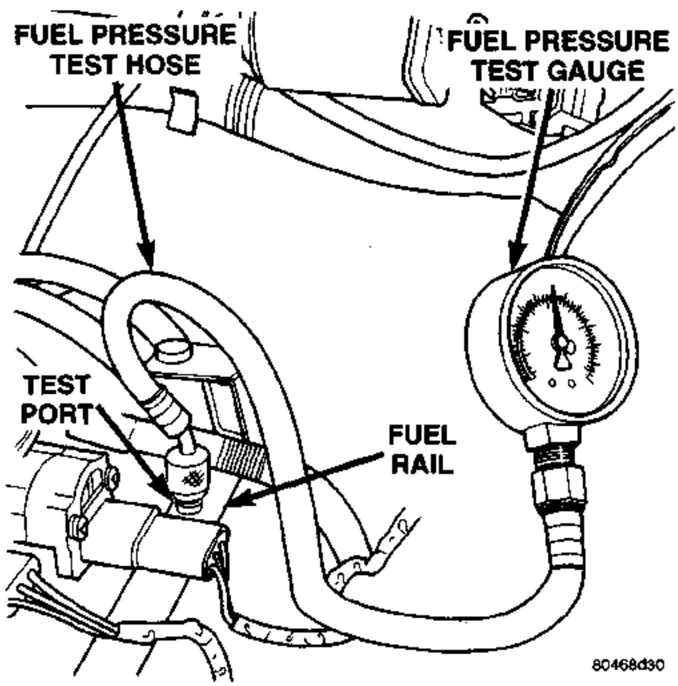


Fig. 6 Fuel Pressure Gauge Installation—Typical Test Port Shown

(2) Start engine and note pressure gauge reading. Fuel pressure should be 338 kPa ± 5 kPa (49.0 psi ± 2 psi) at idle.

DIAGNOSIS AND TESTING (Continued)

(3) If pressure is at O psi, connect DRB scan tool and refer to the appropriate Powertrain Diagnostics Procedures service manual.

(4) If operating pressure is above 51.0 psi, fuel pump is OK but pressure regulator is defective. Replace fuel filter/fuel pressure regulator assembly.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit contains a variable resistor (track). As the float moves up or down, electrical resistance will change. Refer to Group 8E, Instrument Panel and Gauges for Fuel Gauge testing. To test the gauge sending unit only, it must be removed from vehicle. The unit is part of the fuel pump module. Refer to Fuel Pump Module Removal/Installation for procedures. Measure the resistance across the sending unit terminals. With float in up position, resistance should be 20 ohms. With float in down position, resistance should be 220 ohms.

FUEL INJECTOR TEST

To perform a complete test of the fuel injectors and their circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the injector only, refer to the following:

Disconnect the fuel injector wire harness connector from the injector. Place an ohmmeter across the injector electrical terminals. Resistance reading should be approximately 14.5 ohms ±1.2 ohms at 20°C (68°F).

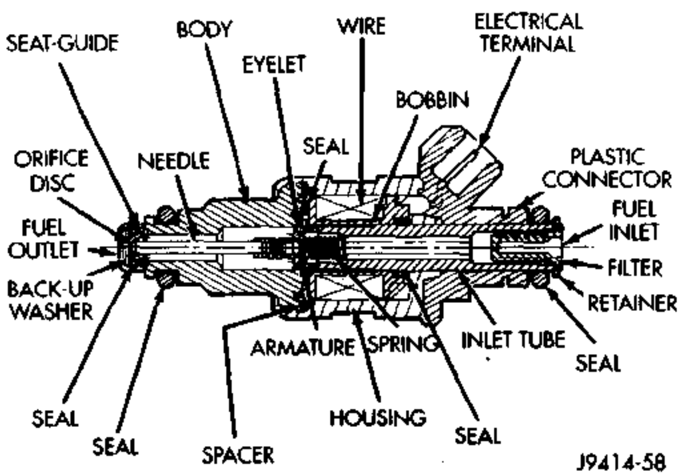


Fig. 7 Fuel Injector Internal Components—Typical

SERVICE PROCEDURES

FUEL SYSTEM PRESSURE RELEASE PROCEDURE—WITHOUT TEST PORT

Use the following procedure if the fuel rail is not equipped with a fuel pressure test port.

(1) Remove fuel pump relay from Power Distribution Center (PDC). For location of relay, refer to label on underside of PDC cover.

(2) Start and run engine it stalls.

(3) Attempt restarting engine until it will no longer run.

(4) Turn ignition key to OFF position.

CAUTION: Steps 1, 2, 3 and 4 must be performed to relieve high pressure fuel from within the fuel rail. Do not attempt to use the following steps to relieve this pressure as excessive fuel will be forced into a cylinder chamber.

(5) Unplug connector from any injector.

(6) Attach one end of a jumper wire with alligator clips (18 gauge or smaller) to either injector terminal.

(7) Connect other end of jumper wire to positive side of battery.

(8) Connect one end of a second jumper wire to remaining injector terminal.

CAUTION: Supplying power to an injector for more than 4 seconds will permanently damage the injector. Do not leave the injector connected to power for more than 4 seconds.

(9) Momentarily touch the other end of this jumper wire to negative terminal of battery for no more than 4 seconds.

(10) Place a rag or towel below fuel line at quick connect to rail.

(11) Disconnect quick connect fitting to rail. Refer to Quick-Connect Fittings in this section.

(12) Return fuel pump relay to PDC.

(13) One or more Diagnostic Trouble Codes (DTC's) may have been stored in the PCM memory due to fuel pump relay removal. The DRB scan tool must be used to erase a DTC. Refer to Group 25, Emission Control System. See On-Board Diagnostics.

FUEL SYSTEM PRESSURE RELEASE PROCEDURE–WITH TEST PORT

NOTE: The fuel pressure test port is used on certain engines only. If equipped, the test port will be located on the fuel rail (Fig. 4). A sealing cap is screwed onto the test port.

The fuel system is under constant fuel pressure (even with the engine off).

WARNING: BECAUSE THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE, THE PRESSURE MUST BE RELEASED BEFORE SERVICING ANY FUEL SYSTEM COMPONENT. THIS DOES NOT APPLY TO THROTTLE BODY REMOVAL.

SERVICE PROCEDURES (Continued)

(1) Disconnect negative battery cable at battery.

(2) Remove fuel tank filler tube cap to release fuel tank pressure.

(3) Remove protective cap from pressure test port on fuel rail.

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.

(4) Obtain the fuel pressure gauge/hose assembly from fuel pressure gauge tool set 5069. Remove gauge from hose.

(5) Place one end of hose (gauge end) into an approved gasoline container.

(6) Place a shop towel under test port.

(7) To release fuel pressure, screw other end of hose onto fuel pressure test port.

(8) After fuel pressure has been released, remove hose from test port.

(9) Install protective cap to fuel test port.

FUEL TUBES/LINES/HOSES AND CLAMPS

Also refer to the section on Quick-Connect Fittings.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE IN THIS GROUP.

Inspect all hose connections such as clamps, couplings and fittings to make sure they are secure and leaks are not present. The component should be replaced immediately if there is any evidence of degradation that could result in failure.

Never attempt to repair a plastic fuel line/tube. Replace as necessary.

Avoid contact of any fuel tubes/hoses with other vehicle components that could cause abrasions or scuffing. Be sure that the plastic fuel lines/tubes are properly routed to prevent pinching and to avoid heat sources.

The lines/tubes/hoses used on fuel injected vehicles are of a special construction. This is due to the higher fuel pressures and the possibility of contaminated fuel in this system. If it is necessary to replace these lines/tubes/hoses, only those marked EFM/EFI may be used.

When Used: The hose clamps used to secure rubber hoses on fuel injected vehicles are of a special rolled edge construction. This construction is used to prevent the edge of the clamp from cutting into the hose. Only these rolled edge type clamps may be used in this system. All other types of clamps may cut into the hoses and cause high-pressure fuel leaks.

When Used: Use new original equipment type hose clamps. Tighten hose clamps to 1 N·m (15 in. lbs.) torque.

QUICK-CONNECT FITTINGS

Also refer to the Fuel Tubes/Lines/Hoses and Clamps section.

Two different types of quick-connect fittings are used to attach various fuel system components. These are: a two-tab type, or a plastic retainer ring type using a latch clip.

TWO-TAB TYPE FITTING

This type of fitting is equipped with tabs located on both sides of the fitting (Fig. 8). These tabs are supplied for disconnecting the quick-connect fitting from component being serviced.

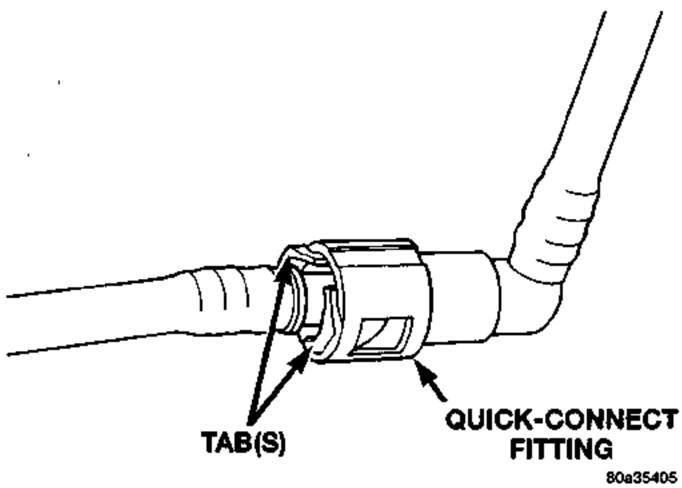


Fig. 8 Typical Two-Tab Type Quick-Connect Fitting

CAUTION: The interior components (o-rings, spacers) of this type of quick-connect fitting are not serviced separately, but new plastic retainers are available. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

SERVICE PROCEDURES (Continued)

DISCONNECTION/CONNECTION

(1) Disconnect negative battery cable from the battery.

(2) Perform the fuel pressure release procedure. Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) To disconnect the quick-connect fitting, squeeze the plastic retainer tabs (Fig. 8) against the sides of the quick-connect fitting with your fingers. Tool use is not required for removal and may damage plastic retainer. Pull the fitting from the fuel system component being serviced. The plastic retainer will remain on the component being serviced after fitting is disconnected. The o-rings and spacer will remain in the quick-connect fitting connector body.

(5) Inspect the quick-connect fitting body and component for damage. Replace as necessary.

CAUTION: When the quick-connect fitting was disconnected, the plastic retainer will remain on the component being serviced. If this retainer must be removed, very carefully release the retainer from the component with two small screwdrivers. After removal, inspect the retainer for cracks or any damage.

(6) Prior to connecting the quick-connect fitting to component being serviced, check condition of fitting and component. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(7) Insert the quick-connect fitting to the component being serviced and into the plastic retainer. When a connection is made, a click will be heard.

(8) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(9) Connect negative cable to battery.

(10) Start engine and check for leaks.

FUEL LINE AT FUEL RAIL

A plastic retainer ring type quick-connect fitting is used at the fuel rail. A latch clip is used to secure the fuel line to the fuel rail on certain engines (Fig. 9). A special tool will be necessary to separate the fuel line from the fuel rail after the latch clip is removed.

DISCONNECTION/CONNECTION AT FUEL RAIL

(1) Disconnect the negative battery cable from battery.

(2) Perform the fuel pressure release procedure. Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) Pry up on the latch clip with a screwdriver (Fig. 9).

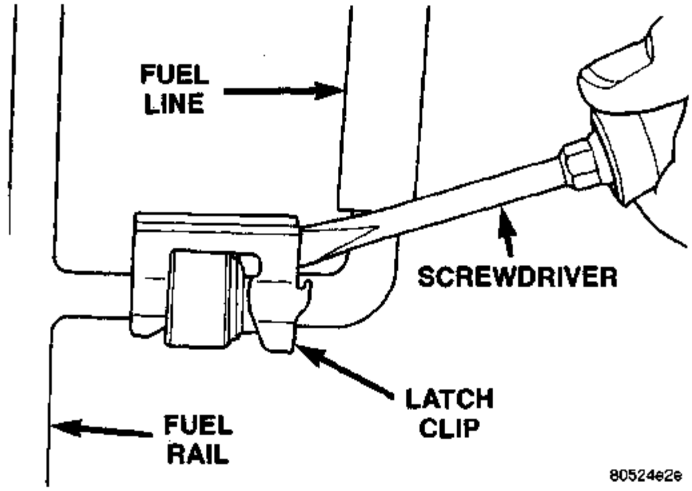


Fig. 9 Latch Clip Removal—Typical

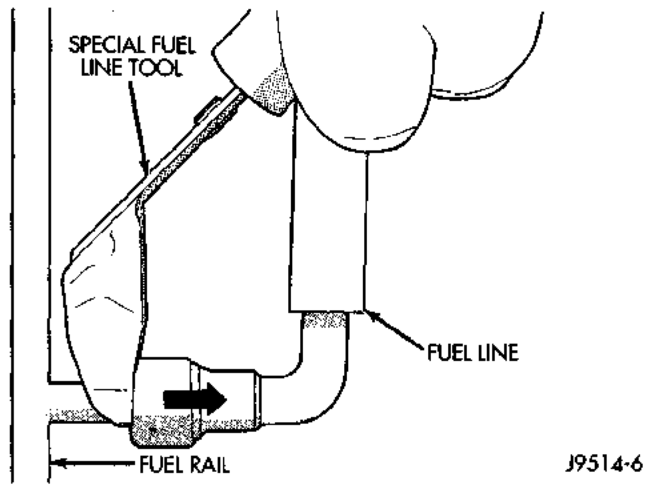


Fig. 10 Fuel Line Disconnection—Typical

(5) Slide the latch clip toward the fuel rail while lifting with the screwdriver.

(6) Insert special fuel line removal tool (Snap-On number FIH 9055-1 or equivalent) into the fuel line (Fig. 10). Use this tool to release the locking fingers in the end of the line.

(7) With the special tool still inserted, pull the fuel line from the fuel rail.

(8) After disconnection, the locking fingers will remain within the quick-connect fitting at the end of the fuel line.

(9) Inspect fuel line fitting, locking fingers and fuel rail fitting for damage. Replace as necessary.

(10) Prior to connecting the fuel line to the fuel rail, check condition of both fittings. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(11) Insert the fuel line onto the fuel rail until a click is felt.

(12) Verify a locked condition by firmly pulling on fuel line and fitting (15-30 lbs.).

SERVICE PROCEDURES (Continued)

(13) Install latch clip (snaps into position). **If the latch clip will not fit, this indicates the fuel line is not properly installed to the fuel rail. Recheck the fuel line connection.**

(14) Connect negative battery cable to battery.

(15) Start engine and check for leaks.

REMOVAL AND INSTALLATION

FUEL FILTER/FUEL PRESSURE REGULATOR

The combination Fuel Filter/Fuel Pressure Regulator is located on the fuel pump module. The fuel pump module is located on top of fuel tank.

The filter/regulator may be removed without removing fuel pump module although fuel tank must be removed.

REMOVAL

(1) Remove fuel tank. Refer to Fuel Tank Removal/ Installation.

(2) Clean area around filter/regulator.

(3) Remove retainer clamp from top of filter/regulator (Fig. 11). Clamp snaps to tabs on pump module. Discard old clamp.

(4) Pry filter/regulator from top of pump module with 2 screwdrivers. Unit is snapped into module.

(5) Discard gasket below filter/regulator (Fig. 12).

(6) Discard o-rings on bottom of filter/regulator (Fig. 13). If the smallest of the two o-rings can not be found on bottom of filter/regulator, it may be necessary to remove it from the fuel inlet passage in fuel pump module.

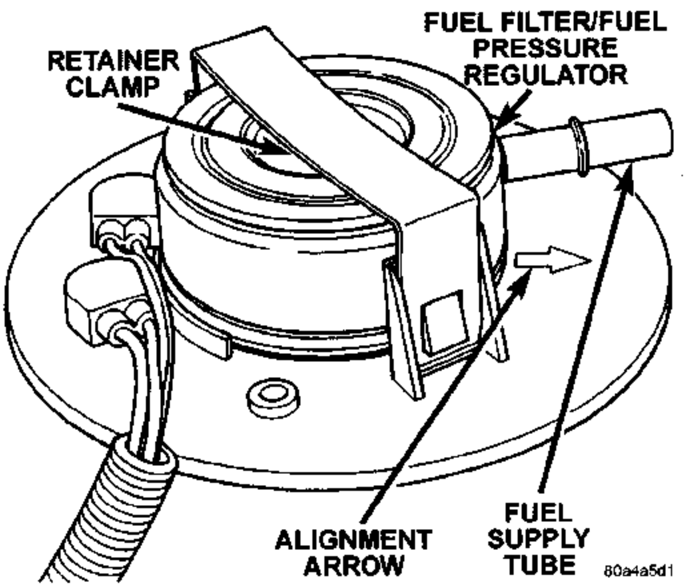


Fig. 11 Fuel Filter/Fuel Pressure Regulator

INSTALLATION

(1) Install new o-rings to grooves on filter/regulator. Apply a small amount of clean engine oil to o-rings. **Do not install o-rings separately into fuel pump module. They will be damaged when installing filter/regulator.**

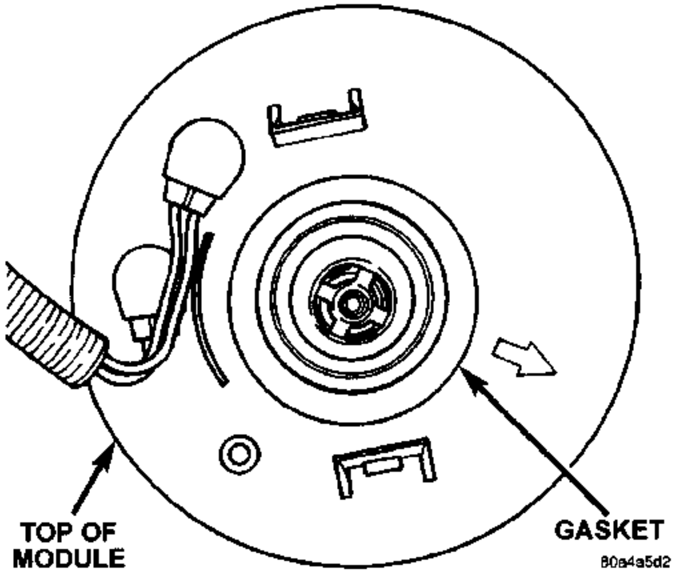


Fig. 12 Fuel Filter/Fuel Pressure Regulator Gasket

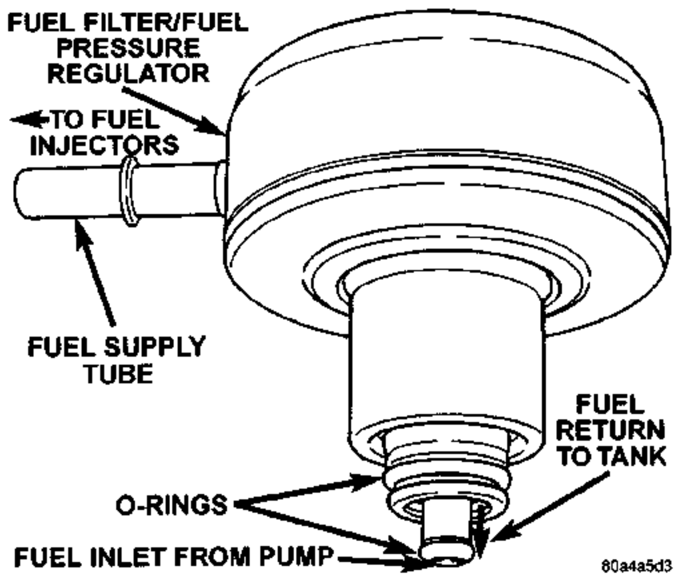


Fig. 13 Fuel Filter/Fuel Pressure Regulator O-Rings

(2) Install new gasket to top of fuel pump module.

(3) Press filter/regulator into top of pump module until it snaps into position (a positive click must be heard or felt).

(4) The arrow (Fig. 11) on top of fuel pump module should be pointed towards front of vehicle (12 o'clock position).

(5) Rotate filter/regulator until fuel supply tube (fitting) is pointed to 10 o'clock position.

(6) Install new retainer clamp (snaps) to top of filter/regulator.

(7) Install fuel tank. Refer to Fuel Tank Removal/ Installation.

REMOVAL AND INSTALLATION (Continued)

FUEL PUMP MODULE

Fuel tank removal will be necessary for fuel pump module removal.

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.

(1) Drain fuel tank and remove tank. Refer to the Fuel Tank Removal/Installation section of this group.

(2) The plastic fuel pump module locknut is threaded onto fuel tank (Fig. 14). Install Special Tool 6856 to fuel pump module locknut and remove locknut (Fig. 15). The fuel pump module will spring up when locknut is removed.

(3) Remove module from fuel tank.

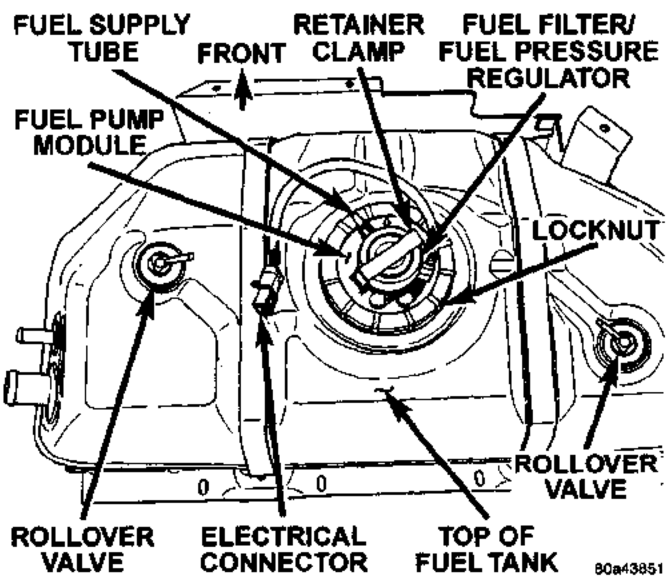


Fig. 14 Top View of Fuel Tank and Fuel Pump Module

INSTALLATION

CAUTION: Whenever the fuel pump module is serviced, the module gasket must be replaced.

(1) Using a new gasket, position fuel pump module into opening in fuel tank.

(2) Position locknut over top of fuel pump module.

(3) Rotate module until arrow (Fig. 11) is pointed toward front of vehicle (12 o'clock position). This step must be done to prevent float/float rod assembly from contacting sides of fuel tank.

(4) Install Special Tool 6856 to locknut.

(5) Tighten locknut to 34 N·m (25 ft. lbs.) torque.

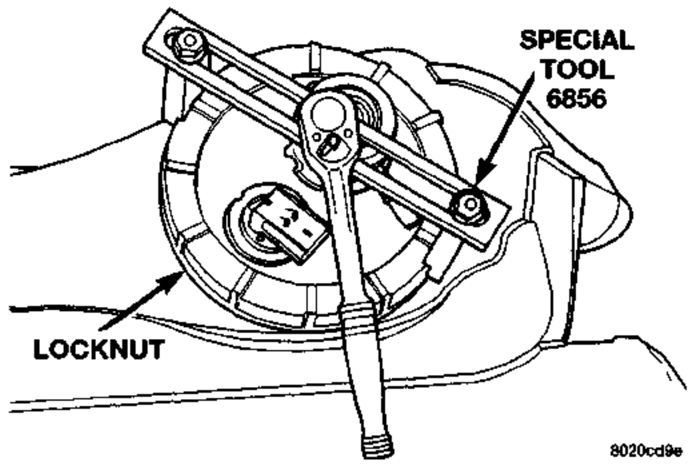


Fig. 15 Locknut Removal/Installation—Typical

(6) Rotate fuel filter/fuel pressure regulator until its fitting is pointed to 10 o'clock position.

(7) Install fuel tank. Refer to Fuel Tank Installation in this section.

FUEL PUMP INLET FILTER

The fuel pump inlet filter (strainer) is located on the bottom of fuel pump module (Fig. 16). The fuel pump module is located on top of fuel tank.

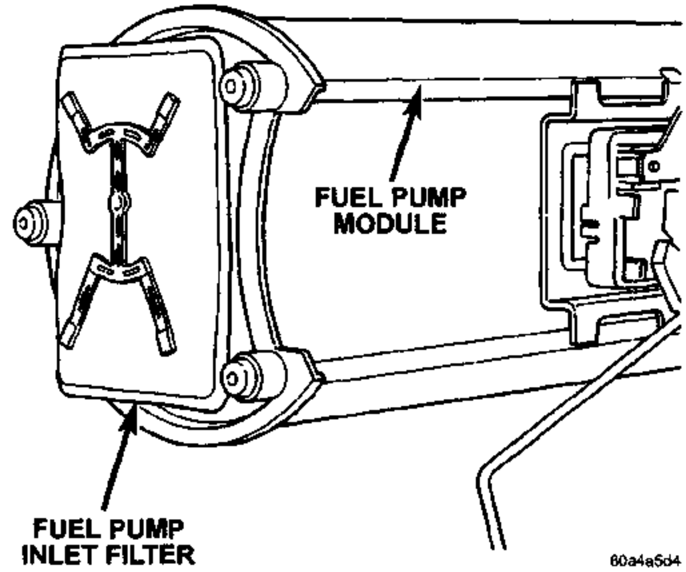


Fig. 16 Fuel Pump Inlet Filter

REMOVAL

(1) Remove fuel tank. Refer to Fuel Tank Removal/ Installation.

(2) Remove fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(3) Remove filter by prying from bottom of module with 2 screwdrivers. Filter is snapped to module.

(4) Clean bottom of pump module.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Snap new filter to bottom of module.

(2) Install fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(3) Install fuel tank. Refer to Fuel Tank Removal/ Installation.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit (fuel level sensor) and float assembly is located on the side of fuel pump module (Fig. 17). The fuel pump module is located on top of fuel tank.

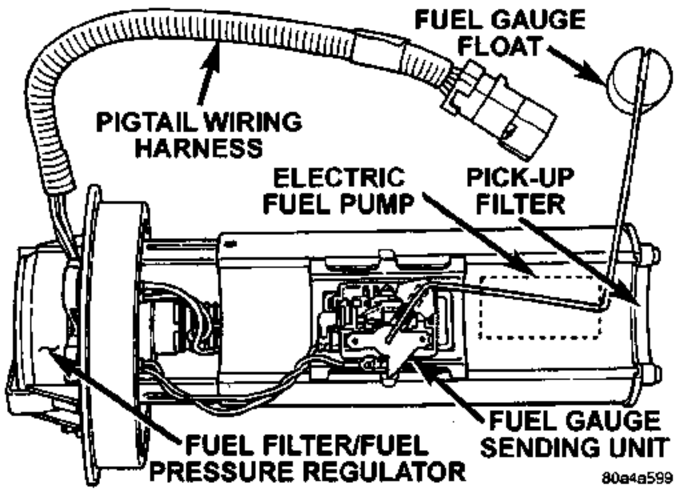


Fig. 17 Fuel Gauge Sending Unit Location

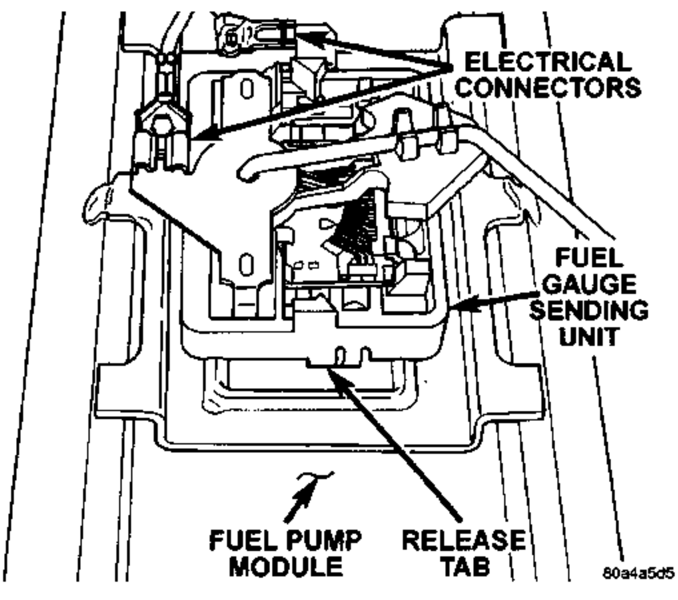


Fig. 18 Fuel Gauge Sending Unit Release Tab

REMOVAL

(1) Remove fuel tank. Refer to Fuel Tank Removal/ Installation.

(2) Remove fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(3) Remove electrical wire connector at sending unit terminals.

(4) Press on release tab (Fig. 18) to remove sending unit from pump module.

INSTALLATION

(1) Position sending unit to pump module and snap into place.

(2) Connect electrical connector to terminals.

(3) Install fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(4) Install fuel tank. Refer to Fuel Tank Removal/ Installation.

FUEL INJECTOR RAIL

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. THIS PRESSURE MUST BE RELEASED BEFORE SERVICING THE FUEL RAIL.

(1) Remove fuel tank filler tube cap.

(2) Disconnect negative battery cable from battery.

(3) Perform the Fuel System Pressure Release Procedure as described in this Group.

(4) Remove air cleaner crossover tube above fuel rail.

(5) Remove and numerically attach a tag (if fuel injector is not already tagged), the injector harness connectors. Do this at each injector (Fig. 19).

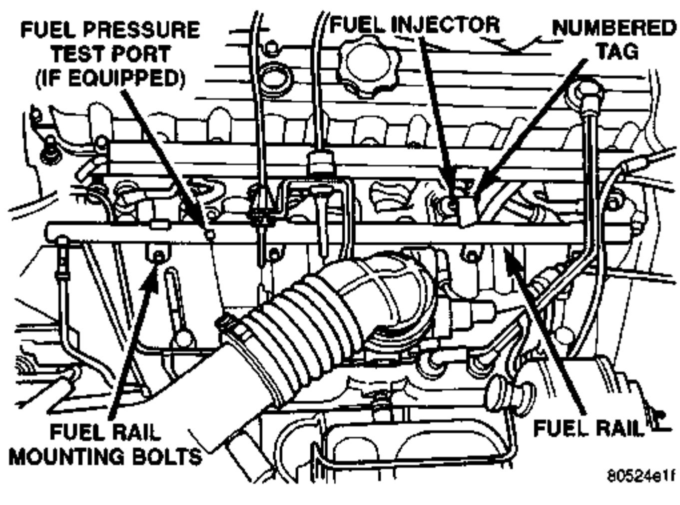


Fig. 19 Fuel Rail Mounting—Typical

(6) Disconnect fuel supply line latch clip and fuel line at fuel rail. Refer to Fuel Tubes/Lines/Hoses and Clamps, and/or Quick-Connect Fittings. These can both be found in the Fuel Delivery section of this group.

(7) Remove fuel rail mounting bolts (Fig. 19).

REMOVAL AND INSTALLATION (Continued)

(8) 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.

(9) Remove fuel rail by gently rocking until all fuel injectors are out of intake manifold.

INSTALLATION

(1) Apply a small amount of clean engine oil to each injector o-ring. This will aid in installation.

(2) Position tips of all fuel injectors into corresponding injector bore in intake manifold. Seat injectors into manifold.

(3) Tighten fuel rail mounting bolts and nuts to 11 N·m (100 ft. lbs.) torque.

(4) Connect injector harness connectors to appropriate (tagged) injector.

(5) Connect fuel line and fuel line latch clip to fuel rail. Refer to this group for procedures.

(6) Install protective cap to pressure test port fitting (if equipped).

(7) Install air cleaner crossover tube.

(8) Install fuel tank cap.

(9) Connect negative battery cable to battery.

(10) Start engine and check for fuel leaks.

FUEL INJECTORS

REMOVAL

(1) Remove fuel rail. Refer to Fuel Rail Removal in this section.

(2) Remove clip(s) that retain fuel injector(s) to fuel rail (Fig. 20) or (Fig. 21).

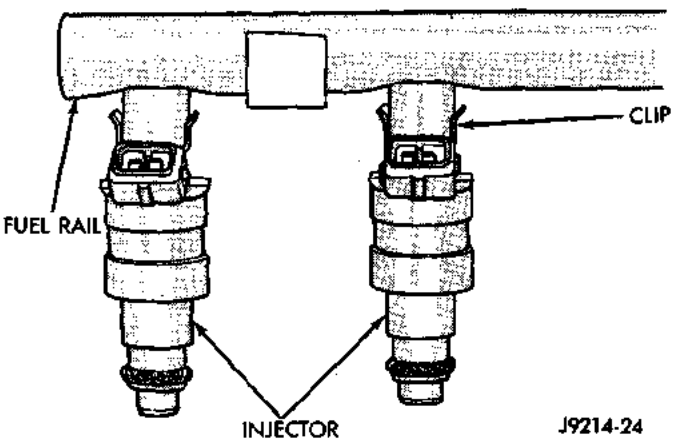


Fig. 20 Injector Mounting

INSTALLATION

(1) Install fuel injector(s) into fuel rail assembly and install retaining clip(s).

(2) If same injector(s) is being reinstalled, install new o-ring(s).

(3) Apply a small amount of clean engine oil to each injector o-ring. This will aid in installation.

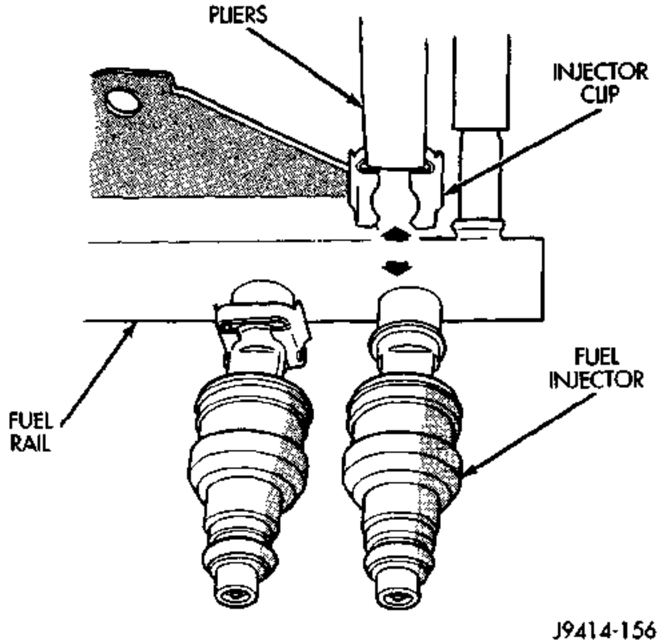


Fig. 21 Injector Retaining Clips—Typical Injector

(4) Install fuel rail. Refer to Fuel Rail Installation in this section.

(5) Start engine and check for fuel leaks.

FUEL TANK

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. THIS PRESSURE MUST BE RELEASED BEFORE SERVICING FUEL TANK.

REMOVAL

WARNING: KEEP OPEN FLAME AWAY FROM FUEL SYSTEM COMPONENTS.

(1) Disconnect negative battery cable.

(2) Remove fuel filler cap.

(3) Perform the Fuel System Pressure Release Procedure as described elsewhere in this group.

(4) Remove 8 screws retaining plastic fuel filler bezel to body (Fig. 22). Remove fuel filler bezel.

(5) To prevent contaminants from entering tank, temporarily install fuel cap to fill hoses.

(6) Cut plastic tie wrap securing rear axle vent hose to fuel filler hoses.

(7) Disconnect electrical connector at front of fuel tank (Fig. 23).

(8) Disconnect EVAP hose from EVAP line at front of fuel tank (Fig. 23).

(9) Disconnect quick-connect fitting from fuel line at front of fuel tank (Fig. 23). Refer to Quick-Connect Fittings in this group for procedures.

REMOVAL AND INSTALLATION (Continued)

(10) The fuel tank and skid plate are removed as an assembly. Centrally position a transmission jack (or equivalent lifting device) under skid plate/fuel tank assembly. Secure tank assembly to jack.

(11) Remove three skid plate-to-body nuts at front of tank (Fig. 25). Remove one of the nuts through access hole on skid plate (Fig. 25).

(12) Remove four skid plate-to-body nuts at rear of tank (Fig. 24). **Do not loosen tank strap nuts (Fig. 24).**

(13) Lower the tank assembly.

(14) If fuel pump module is to be removed, refer to Fuel Pump Module Removal/Installation.

(15) Disconnect fuel filler hoses at tank. Before disconnecting, mark and note the hose rotational position in relation to tank fittings.

(16) Using an approved portable gasoline siphon/storage tank, drain fuel from tank. To drain fuel, position drain hose into vent fitting (smallest of 2) on side of tank.

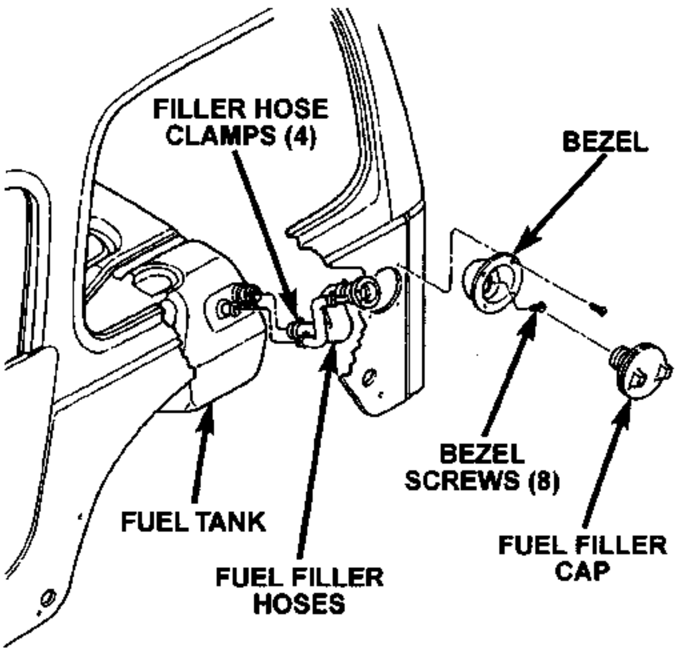


Fig. 22 Fuel Filler Hoses/Fuel Fill Cap

(17) To separate tank from skid plate, remove two protective caps at tank strap studs (Fig. 24) and remove tank strap nuts.

(18) Remove both straps and remove tank from skid plate.

INSTALLATION

(1) Place fuel tank into skid plate. Wrap straps around tank with strap studs inserted through holes in skid plate. Tighten strap nuts to attain 30 mm (±2 mm) between bottom of nut to end of strap stud (Fig. 24). **Do not over tighten nuts.**

(2) Install two protective caps to tank strap studs.

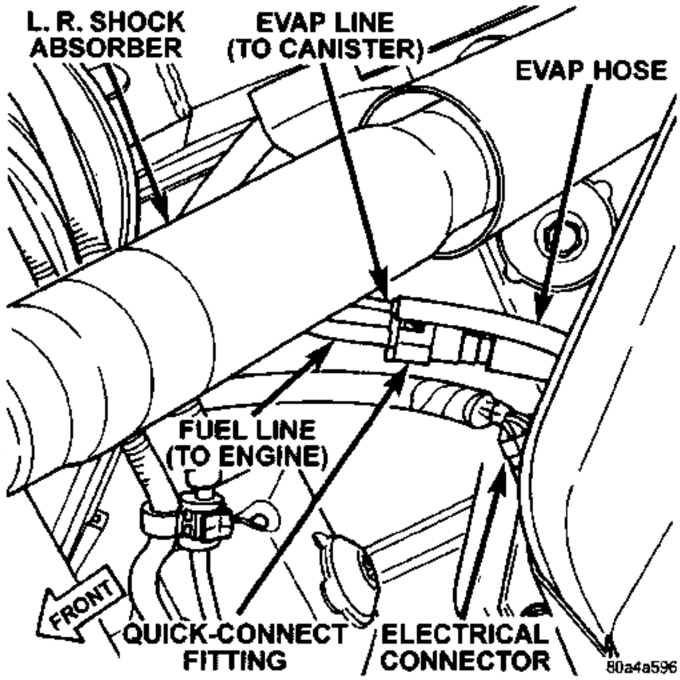


Fig. 23 Fuel Tank Connections

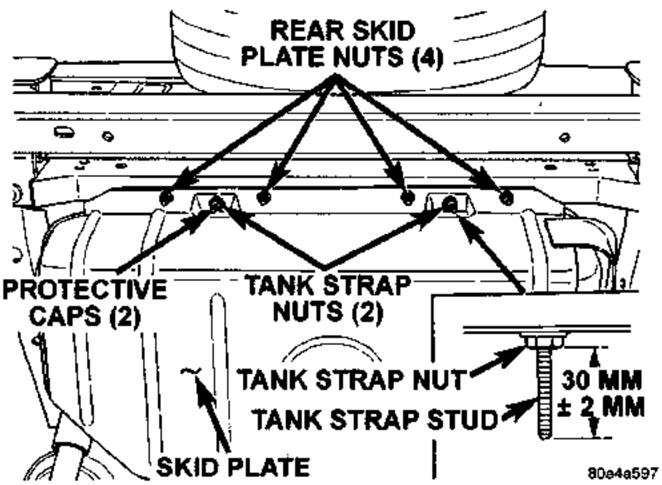


Fig. 24 Fuel Tank Mounting Nuts—Rear

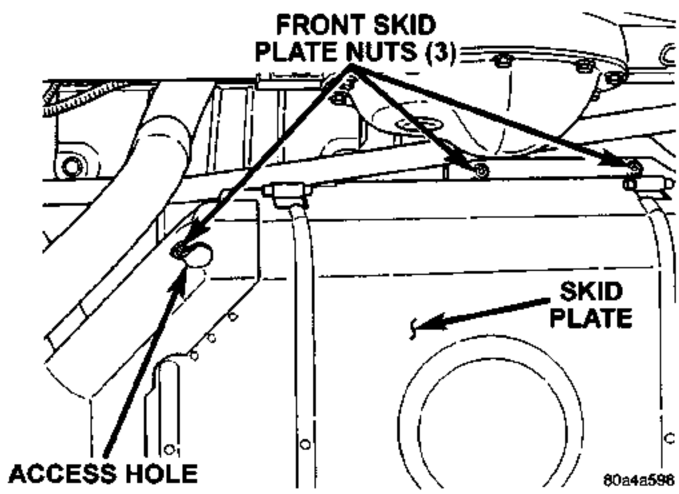


Fig. 25 Fuel Tank Mounting Nuts—Front

REMOVAL AND INSTALLATION (Continued)

(3) Connect fuel filler hoses at tank. Tighten hose clamps.

(4) Raise skid plate/fuel tank assembly into position on body while guiding filler hoses.

(5) Install 7 skid plate mounting nuts. Tighten to 16 N·m (141 in. lbs.) torque.

(6) Remove tank jacking device.

(7) Connect electrical connector at front of fuel tank.

(8) Connect EVAP hose to EVAP line at front of fuel tank.

(9) Connect quick-connect fitting to fuel line at front of fuel tank. Refer to Quick-Connect Fittings in this group for procedures.

(10) Use a new plastic tie wrap to secure rear axle vent hose to fuel filler hoses.

(11) Position fuel filler bezel to body. Install 8 screws and tighten.

(12) Fill fuel tank. Install filler cap.

(13) Connect negative battery cable to battery.

(14) Start vehicle and inspect for leaks.

ACCELERATOR PEDAL

The accelerator pedal is connected to the throttle body linkage by the throttle cable. The cable is protected by a plastic sheathing and is connected to the throttle body linkage by a ball socket. It is connected to the upper part of the accelerator pedal arm by a plastic retainer (clip) (Fig. 26). This retainer (clip) snaps into the top of the accelerator pedal arm. Retainer tabs (built into the cable sheathing) (Fig. 26) fasten the cable to the dash panel.

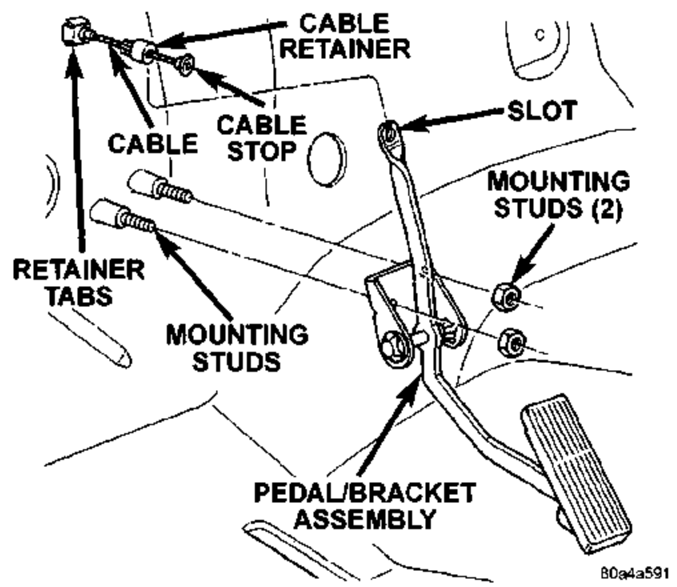


Fig. 26 Accelerator Pedal Mounting

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing the accelerator pedal or throttle cable.

REMOVAL

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of accelerator pedal arm (Fig. 26). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove accelerator pedal mounting bracket nuts.

(3) Remove accelerator pedal assembly.

INSTALLATION

(1) Place accelerator pedal assembly over mounting studs protruding from floor pan. Tighten mounting nuts to 8.5 N·m (75 in. lbs.) torque.

(2) Slide throttle cable into opening (slot) in top of pedal arm. An index tab is located on pedal arm. Rotate and push plastic cable retainer (clip) into accelerator pedal arm opening until it snaps into place on index tab.

(3) Before starting engine, operate accelerator pedal to check for any binding.

THROTTLE CABLE

REMOVAL

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of accelerator pedal arm (Fig. 26). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove cable core wire at pedal arm.

(3) From inside vehicle, pinch both sides of cable housing retainer tabs (Fig. 26) at dash panel. Remove cable housing from dash panel and pull into engine compartment.

(4) Remove cable from clip guides on engine cylinder head (valve) cover (Fig. 27).

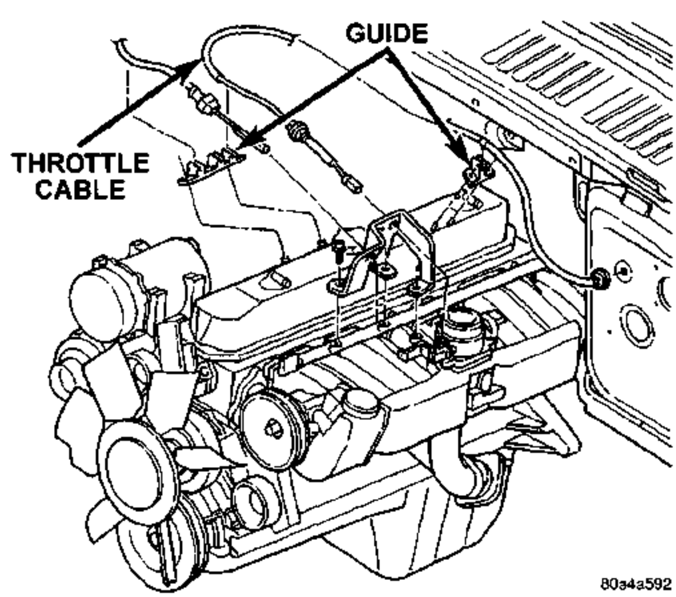


Fig. 27 Throttle Cable Routing

REMOVAL AND INSTALLATION (Continued)

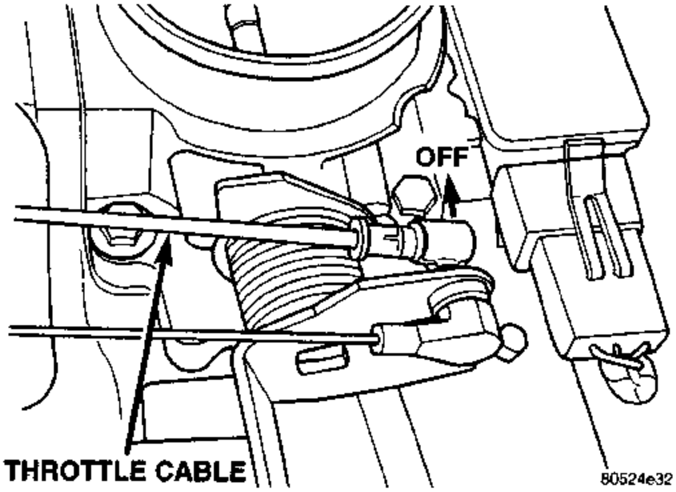


Fig. 28 Throttle Cable at Throttle Body—Typical

(5) Remove throttle cable ball end socket at throttle body linkage (snaps off) (Fig. 28).

(6) Remove throttle cable from throttle body mounting bracket by compressing retainer tabs and pushing cable through hole in bracket.

(7) Remove throttle cable from vehicle.

INSTALLATION

(1) Slide throttle cable through hole in throttle body bracket until retainer tabs lock into bracket. Connect cable ball end to throttle body linkage ball (snaps on).

(2) Snap cable into clip guides on engine cylinder head (valve) cover.

(3) Push other end of cable through opening in dash panel until retaining tabs lock into panel.

(4) From inside drivers compartment, slide throttle cable core wire into opening in top of accelerator pedal arm. An index tab is located on pedal arm. Rotate and push cable retainer (clip) into pedal arm opening until it snaps in place on index tab.

(5) Before starting engine, operate accelerator pedal to check for any binding.

SPECIFICATIONS

VECI LABEL SPECIFICATIONS

If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label. The VECI label is located in the engine compartment.

FUEL TANK CAPACITY

Models	Liters	U.S. Gallons
All	57L	15
All	72L	19
Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.		

FUEL SYSTEM PRESSURE

338 kPa ± 5 kPa (49.0 psi ± 2 psi).

TORQUE CHART

DESCRIPTION	TORQUE
Accelerator Pedal Bracket Mounting Nuts	8.5 N·m (75 in. lbs.)
Fuel Pump Module Locknut	34 N·m (25 ft. lbs.)
Fuel Rail Mounting Bolts or Nuts	11 N·m (100 in. lbs.)
Fuel Tank Skidplate Bolts	16 N·m (141 in. lbs.)
Fuel Tank Mounting Strap Bolts	Refer to manual text

FUEL INJECTION SYSTEM

INDEX

GENERAL INFORMATION

INTRODUCTION

All engines are equipped with sequential Multi-Port Fuel Injection (MFI). The MFI system provides precise air/fuel ratios for all driving conditions.

The Powertrain Control Module (PCM) (Fig. 1) operates the fuel system.

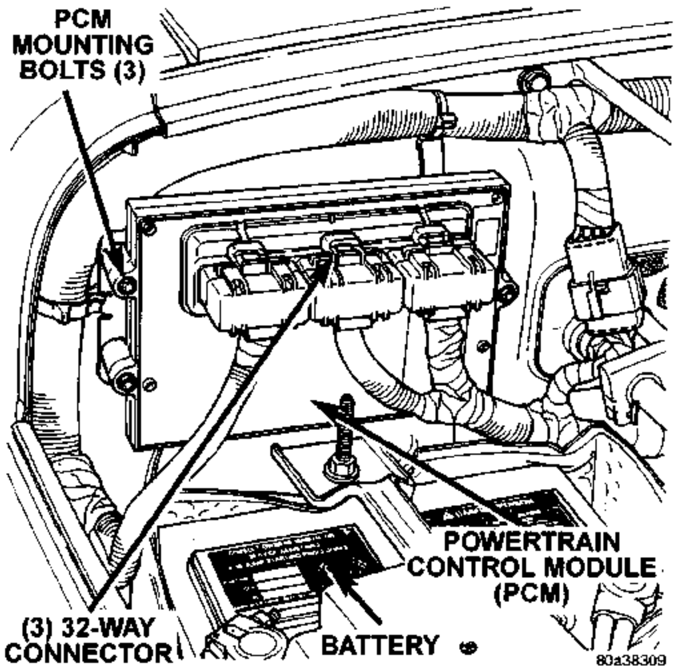


Fig. 1 Powertrain Control Module (PCM) Location

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 two different areas of operation: Open Loop and Closed Loop.

During Open Loop modes, the PCM receives input signals and responds only according to preset PCM programming. Input from the oxygen (O2S) sensor is not monitored during Open Loop modes.

During Closed Loop modes, the PCM will monitor the oxygen (O2S) sensor input. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio. This ratio is 14.7 parts air-to-1 part fuel. By monitoring the exhaust oxygen content through the O2S sensor, the PCM can fine tune the injector pulse width. This is done to achieve optimum fuel economy combined with low emission engine performance.

The fuel injection system has the following modes of operation:

- Ignition switch ON
- Engine start-up (crank)
- Engine warm-up
- Idle
- Cruise
- Acceleration
- Deceleration
- Wide Open Throttle (WOT)
- Ignition switch OFF

The ignition switch On, engine start-up (crank), engine warm-up, acceleration, deceleration and wide open throttle modes are Open Loop modes. The idle and cruise modes, (with the engine at operating temperature) are Closed Loop modes.

IGNITION SWITCH (KEY-ON) MODE

This is an Open Loop mode. When the fuel system is activated by the ignition switch, the following actions occur:

- The PCM pre-positions the Idle Air Control (IAC) motor.
- The PCM determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
- The PCM monitors the engine coolant temperature sensor input. The PCM modifies fuel strategy based on this input.
- Intake manifold air temperature sensor input is monitored
- Throttle Position Sensor (TPS) is monitored
- The Auto Shutdown (ASD) relay is energized by the PCM for approximately three seconds.
- The fuel pump is energized through the fuel pump relay by the PCM. The fuel pump will operate for approximately three seconds unless the engine is operating or the starter motor is engaged
- The O2S sensor heater element is energized through the ASD relay. The O2S sensor input is not used by the PCM to calibrate air-fuel ratio during this mode of operation.
- The up-shift indicator lamp 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 PCM receives inputs from:

- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold Absolute Pressure (MAP) sensor
- Throttle Position Sensor (TPS)
- Camshaft position sensor signal

The PCM monitors the crankshaft position sensor. If the PCM does not receive a crankshaft position sensor signal within 3 seconds of cranking the engine, it will shut down the fuel injection system.

GENERAL INFORMATION (Continued)

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 PCM receives inputs from:

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold Absolute Pressure (MAP) sensor
- Throttle Position Sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)

Based on these inputs the following occurs:

- Voltage is applied to the fuel injectors with the 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 lamp is operated by the PCM.
- When engine has reached operating temperature, the PCM will begin monitoring O2S sensor input. The system will then leave the warm-up mode and go into closed loop operation.

IDLE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At idle speed, the PCM receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold Absolute Pressure (MAP) sensor
- Throttle Position Sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Battery voltage
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen sensor

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the PCM. The PCM will then control injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM monitors the O2S sensor input and adjusts air-fuel ratio by varying injector pulse width. It also adjusts engine idle speed through the Idle Air Control (IAC) motor.
- The PCM adjusts ignition timing by increasing and decreasing spark advance.
- The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

CRUISE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At cruising speed, the PCM receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold Absolute Pressure (MAP) sensor
- Throttle Position Sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen (O2S) sensor

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the PCM. The PCM will then adjust the injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM monitors the O2S sensor input and adjusts air-fuel ratio. It also adjusts engine idle speed through the Idle Air Control (IAC) motor.
- The PCM adjusts ignition timing by turning the ground path to the coil on and off.
- The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

ACCELERATION MODE

This is an Open Loop mode. The PCM recognizes an abrupt increase in throttle position or MAP pres-

GENERAL INFORMATION (Continued)

sure as a demand for increased engine output and vehicle acceleration. The PCM increases injector pulse width in response to increased throttle opening.

DECELERATION MODE

When the engine is at operating temperature, this is an Open Loop mode. During hard deceleration, the PCM receives the following inputs.

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold Absolute Pressure (MAP) sensor
- Throttle Position Sensor (TPS)
- Camshaft position sensor signal (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 ground to the injectors. If a hard deceleration does not exist, the PCM will determine the proper injector pulse width and continue injection.

Based on the above inputs, the PCM will adjust engine idle speed through the Idle Air Control (IAC) motor.

The PCM adjusts ignition timing by turning the ground path to the coil on and off.

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 PCM receives the following inputs.

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold Absolute Pressure (MAP) sensor
- Throttle Position Sensor (TPS)
- Camshaft position sensor signal (in the distributor)

During wide open throttle conditions, the following occurs:

- Voltage is applied to the fuel injectors with the 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 lamp 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.

DESCRIPTION AND OPERATION

SYSTEM DIAGNOSIS

The Powertrain Control Module (PCM) can test many of its own input and output circuits. If the PCM senses a fault in a major system, it stores a Diagnostic Trouble Code (DTC) in its memory.

Technicians can display stored DTC's with different methods. One way is using the DRB scan tool. Another way is using the malfunction indicator (check engine) lamp. On certain models the vehicle odometer can be used to display the numeric DTC.

For DTC information, refer to Group 25, Emission Control Systems. See On-Board Diagnostics.

POWERTRAIN CONTROL MODULE (PCM)

The PCM (Fig. 1) operates the fuel system. The PCM was formerly referred to as the SBEC or engine controller. The PCM is a pre-programmed, digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, speed control (if equipped), 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 PCM Outputs. The sensors and switches that provide inputs to the PCM are considered PCM Inputs.

The PCM adjusts ignition timing based upon inputs it receives from sensors that react to: engine rpm, manifold absolute pressure, engine coolant temperature, throttle position, transmission gear selection (automatic transmission), vehicle speed and the brake switch.

The PCM adjusts idle speed based on inputs it receives from sensors that react to: throttle position, vehicle speed, transmission gear selection, engine

DESCRIPTION AND OPERATION (Continued)

coolant temperature and from inputs it receives from the air conditioning clutch switch and brake switch.

Based on inputs that it receives, the PCM adjusts ignition coil dwell. The PCM also adjusts the generator charge rate through control of the generator field and provides speed control operation.

NOTE: Powertrain Control Module (PCM) Inputs:

- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Auto shutdown (ASD) sense
- Battery temperature
- Battery voltage
- Brake switch
- Camshaft position sensor signal
- Crankshaft position sensor
- Engine coolant temperature sensor
- Fuel level
- Ignition circuit sense (ignition switch in run position)
- Intake manifold air temperature sensor
- Manifold Absolute Pressure (MAP) sensor
- Oxygen sensors
- Oil pressure
- Park/neutral switch (auto. trans. only)
- Power ground
- SCI receive (DRB scan tool 16–way connection)
- Sensor return
- Signal ground
- Throttle position sensor
- Vehicle speed sensor

NOTE: Powertrain Control Module (PCM) Outputs:

- A/C clutch relay
- Auto Shutdown (ASD) relay
- CCD bus (+) circuits
- CCD bus (-) circuits
- Duty cycle EVAP canister purge solenoid
- Fuel injectors
- Fuel pump relay
- Generator field driver (-)
- Generator field source (+)
- Idle Air Control (IAC) motor
- Ignition coil
- SCI transmit (DRB scan tool 16–way connection)
- Transmission convertor clutch solenoid

The PCM contains a voltage convertor. This converts battery voltage to a regulated 5.0 volts.

AIR CONDITIONING (A/C) CONTROLS—PCM INPUT

The A/C control system information applies to factory installed air conditioning units.

A/C SELECT SIGNAL: When the A/C switch is in the ON position, an input signal is sent to the powertrain control module (PCM). The signal informs the PCM that the A/C has been selected. The PCM adjusts idle speed to a pre-programmed rpm through the idle air control (IAC) motor to compensate for increased engine load.

A/C REQUEST SIGNAL: Once A/C has been selected, the powertrain control module (PCM) receives the A/C request signal from the 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 receive 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 SHUTDOWN (ASD) RELAY SENSE—PCM INPUT

A 12 volt signal at this input indicates to the powertrain control module (PCM) that the ASD has been activated. The ASD relay is located in the Power Distribution Center (PDC). The PDC is located in the engine compartment (Fig. 2). Refer to label on PDC cover for relay location. The ASD relay is used to connect the oxygen sensor heater elements, ignition coil, and fuel injectors to the 12 volt + power supply. Jeep models of previous years had used the ASD relay to apply the 12 volt + power supply to the generator field source (+) circuit. This generator circuit is now supplied 12 volts + directly from the PCM.

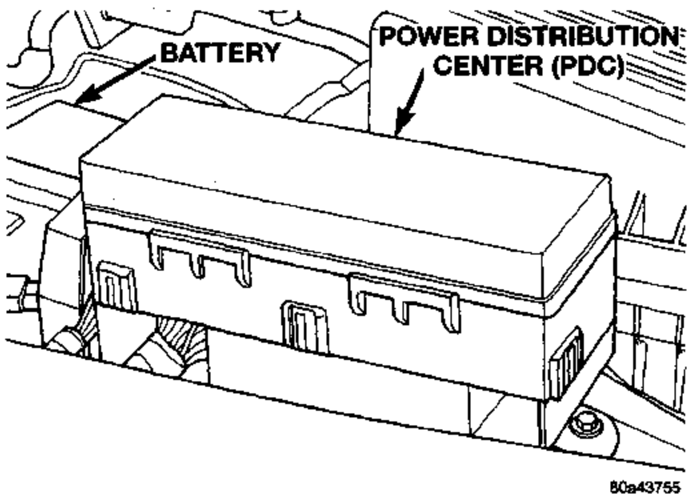


Fig. 2 Power Distribution Center (PDC)

DESCRIPTION AND OPERATION (Continued)

This input is used only to sense that the ASD relay is energized. If the PCM does not see 12 volts at this input when the ASD should be activated, it will set a Diagnostic Trouble Code (DTC).

BATTERY TEMPERATURE SENSOR—PCM INPUT

Provides a signal to the PCM corresponding to the battery temperature. Refer to Group 8C, Charging System for additional information.

BATTERY VOLTAGE—PCM INPUT

The battery voltage input provides power to the Powertrain Control Module (PCM). It also informs 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.

FIVE VOLT SENSOR SUPPLY—PRIMARY

Supplies the required 5 volt power source to the crankshaft position sensor, camshaft position sensor, MAP sensor and throttle position sensor.

FIVE VOLT SENSOR SUPPLY—SECONDARY

Supplies the required 5 volt source to the vehicle speed sensor.

FUEL LEVEL SENSOR—PCM INPUT

The fuel level sensor (fuel gauge sending unit) sends a variable voltage to the PCM to indicate fuel level. The purpose of this feature is to prevent a false setting of misfire and fuel system monitor trouble codes if the fuel level is less than 15 percent of its rated capacity.

Refer to Fuel Gauge Sending Unit Description and Operation in the Fuel Delivery section of this group for additional information.

BRAKE SWITCH—PCM INPUT

When the brake light switch is activated, the Powertrain Control Module (PCM) receives an input indicating that the brakes are being applied. After receiving this input, the PCM 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 provide by the camshaft position sensor located in the distributor (Fig. 3). The sync signal from this sensor works in conjunction with the crankshaft position sensor to provide the Powertrain Control Module (PCM) with inputs. This is done to establish and maintain correct injector firing order.

Refer to Camshaft Position Sensor in Group 8D, Ignition System for more information.

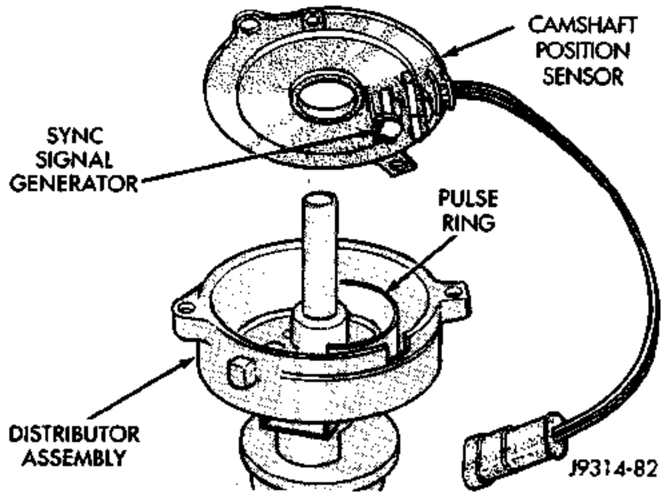


Fig. 3 Camshaft Position Sensor—Typical

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 transmission bellhousing.

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 engine coolant temperature sensor is installed in the thermostat housing (Fig. 4) 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.

DESCRIPTION AND OPERATION (Continued)

Refer to Open Loop/Closed Loop Modes of Operation in this section of the group for more information.

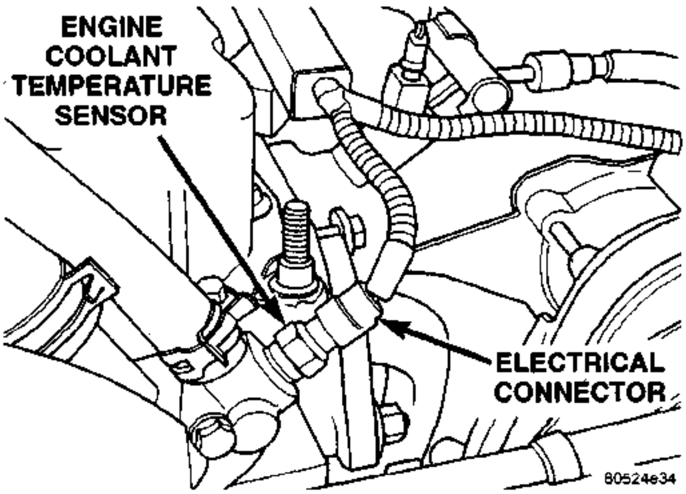


Fig. 4 Engine Coolant Temperature Sensor—Typical

OXYGEN SENSOR (O2S)—PCM INPUT

Two heated O2S sensors are used. When the key is turned ON, and the engine is cold, the sensors will have an initial voltage of 5 volts. The sensors themselves produce voltages from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air/fuel mixture), the sensors produces a low voltage. When there is a lesser amount present (rich air/fuel mixture) it produces a higher voltage. By monitoring the oxygen content and converting it to electrical voltage, the sensors act as a rich-lean switch.

Both oxygen sensors are equipped with a heating element that reduces the time required for the sensors to reach operating temperature allowing the system to enter into closed loop operation sooner. Maintaining correct sensor temperature at all times allows the system to remain in closed loop operation during periods of extended idle. The Automatic Shutdown (ASD) relay supplies battery voltage to both the upstream and downstream oxygen sensor heating elements.

In Closed Loop operation, the Powertrain Control Module (PCM) monitors both O2S sensor inputs (along with other inputs) and adjusts the injector pulse width accordingly. During Open Loop operation, the PCM ignores the O2 sensor input. The PCM adjusts injector pulse width based on preprogrammed (fixed) values and inputs from other sensors.

For more O2S information, refer to Monitored Systems in Group 25, Emission Control Systems.

UPSTREAM HEATED OXYGEN SENSOR

The upstream O2S sensor is located in the exhaust downpipe (Fig. 5). It provides an input voltage to the PCM. The input tells the PCM the oxygen content of the exhaust gas. The PCM uses this information to fine tune the air/fuel ratio by adjusting injector pulse width.

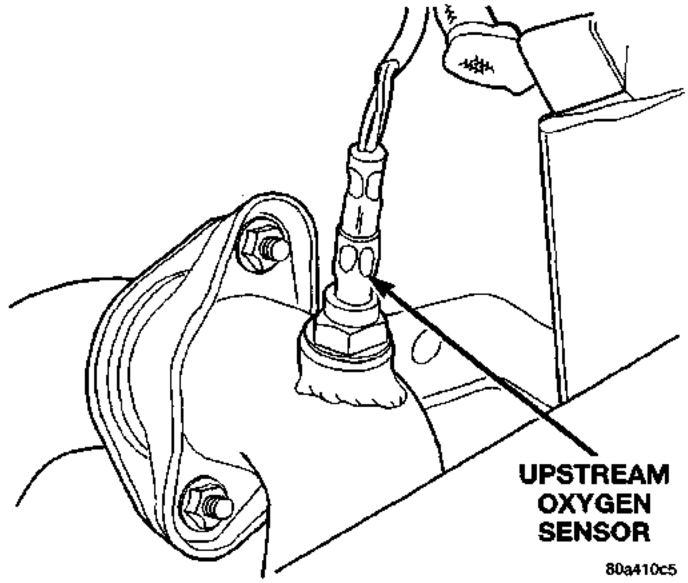


Fig. 5 Upstream Oxygen Sensor

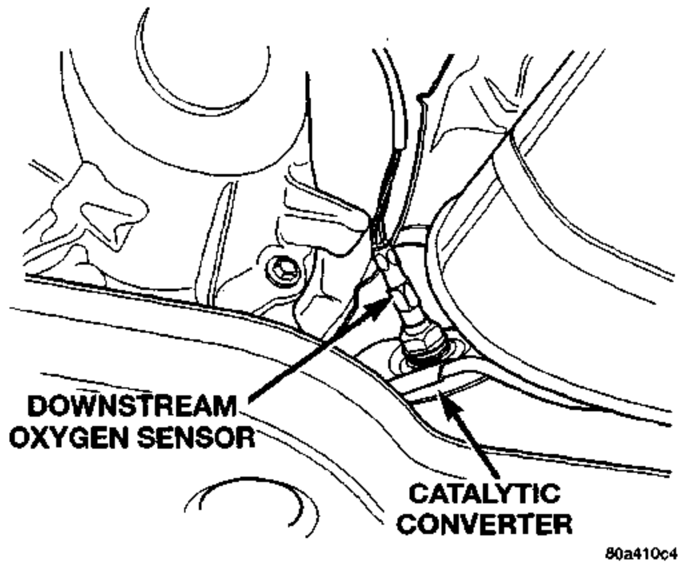


Fig. 6 Downstream Oxygen Sensor

DOWNSTREAM HEATED OXYGEN SENSOR

The downstream heated oxygen sensor is located near the outlet end of the catalytic convertor (Fig. 6). The downstream heated oxygen sensor input is used to detect catalytic convertor deterioration and provide fuel adjustment information.

As the convertor deteriorates, the input from the downstream sensor begins to match the upstream sensor input except for a slight time delay. By comparing the downstream heated oxygen sensor input

DESCRIPTION AND OPERATION (Continued)

to the input from the upstream sensor, the PCM calculates catalytic convertor efficiency.

When the catalytic converter efficiency drops below emission standards, the PCM stores a diagnostic trouble code and illuminates the Malfunction Indicator (MIL) (or Check Engine) lamp. For more information, refer to Group 25, Emission Control Systems.

The downstream sensor input is also used to adjust the upstream O2S goal voltage. This allows a better control of the exhaust gases as the catalytic convertor ages.

The upstream and downstream sensors may look exactly alike, but are not interchangeable.

IGNITION CIRCUIT SENSE—PCM INPUT

The ignition circuit sense input tells the Powertrain Control Module (PCM) the ignition switch has energized the ignition circuit. Refer to the wiring diagrams for circuit information.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—PCM INPUT

The intake manifold air temperature sensor is installed in the intake manifold with the sensor element extending into the air stream (Fig. 7). 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.

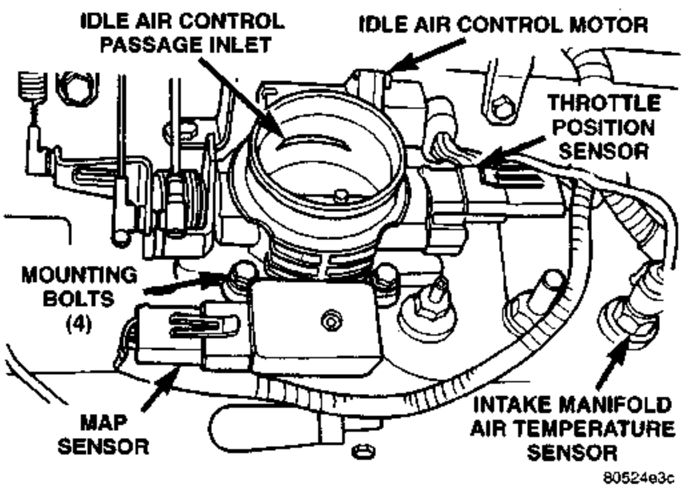


Fig. 7 Intake Air Temp. Sensor Location—Typical

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.

TRANSMISSION PARK/NEUTRAL SWITCH—PCM INPUT

The park/neutral switch is located on the transmission housing and provides an input to the Powertrain Control Module (PCM). This will indicate that the automatic transmission is in Park, Neutral or a drive gear selection. This input is used to determine idle speed (varying with gear selection), fuel injector pulse width and ignition timing advance. Refer to Group 21, Transmissions, for testing, replacement and adjustment information.

THROTTLE POSITION SENSOR (TPS)—PCM INPUT

The TPS is mounted on the throttle body (Fig. 7). 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 AND DISTANCE SENSOR—PCM INPUT

The vehicle speed sensor is located on the speedometer pinion gear adapter (Fig. 8). The pinion gear adapter is located on the extension housing of the transfer case (drivers side). 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

DESCRIPTION AND OPERATION (Continued)

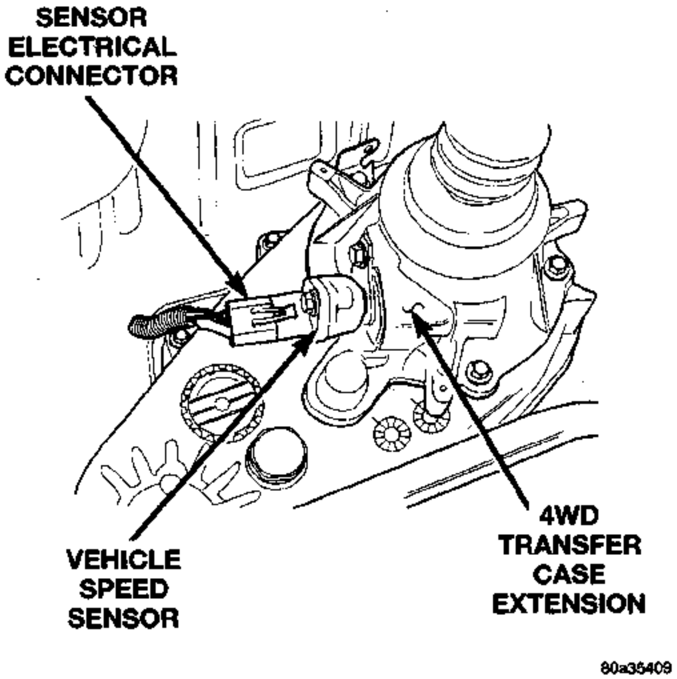


Fig. 8 Vehicle Speed Sensor Location—Typical

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.

POWER STEERING PRESSURE SWITCH—PCM INPUT

A pressure sensing switch is included in the power steering system (mounted on the high-pressure line). This switch will be on vehicles equipped with a 2.5L engine and power steering. The switch (Fig. 9) provides an input to the Powertrain Control Module (PCM). This input is provided during periods of high pump load and low engine rpm; such as during parking maneuvers. The PCM will then increase the idle speed through the Idle Air Control (IAC) motor. This is done to prevent the engine from stalling under the increased load.

When steering pump pressure exceeds 1896 kPa ± 345 kPa (275 psi ± 50 psi), the normally closed switch will open and the PCM will increase the engine idle speed. This will prevent the engine from stalling.

When steering pump pressure drops below approximately 70 psi, the switch circuit will close and engine idle speed will return to its previous setting.

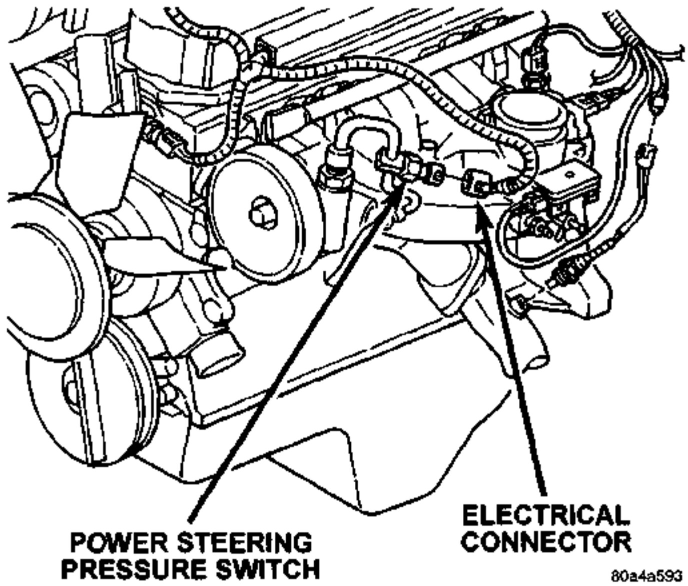


Fig. 9 Power Steering Pump Pressure Switch—2.5L Engine

POWER GROUND

The power ground is used to control ground circuits for the following Powertrain Control Module (PCM) loads:

- Generator field winding
- Fuel injectors
- Ignition coil

AIR CONDITIONING (A/C) CLUTCH RELAY—PCM OUTPUT

The A/C relay is located in the Power Distribution Center (PDC). The PDC is located in the engine compartment (Fig. 2). Refer to label on PDC cover for relay location.

The Powertrain Control Module (PCM) activates the A/C compressor through the A/C clutch relay. The PCM regulates A/C compressor operation by switching the ground circuit for the A/C clutch relay on and off.

When the PCM receives a request for A/C 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 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

DESCRIPTION AND OPERATION (Continued)

PCM will also de-energize the relay if coolant temperature exceeds 125°C (257°F).

CCD BUS (+/-) CIRCUITS-PCM OUTPUTS

The Powertrain Control Module (PCM) sends certain output signals through the CCD bus circuits. These signals are used to control certain instrument panel located items and to determine certain identification numbers.

Refer to Group 8E, Instrument Panel and Gauges for additional information.

GENERATOR FIELD SOURCE (+)—PCM OUTPUT

This output from the Powertrain Control Module (PCM) regulates charging system voltage to the generator field source (+) circuit. The voltage range is 12.9 to 15.0 volts. Jeep models of previous years had used the ASD relay to apply the 12 volt + power supply to the generator field source (+) circuit. Refer to Groups 8A and 8C for charging system information.

GENERATOR FIELD DRIVER (-)—PCM OUTPUT

This output from the Powertrain Control Module (PCM) regulates charging system ground control to the generator field driver (-) circuit. Refer to Groups 8A and 8C for charging system information.

AUTO SHUTDOWN (ASD) RELAY—PCM OUTPUT

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 2).

The ASD relay supplies battery voltage to the fuel pump, fuel injector, ignition coil and both oxygen (O2S) sensor heating elements. The ground circuit for the coil in the ASD relay is controlled by the Powertrain Control Module (PCM). The PCM operates the ASD relay by switching the ground circuit on and off.

FUEL PUMP RELAY-PCM OUTPUT

The PCM energizes the electric fuel pump through the fuel pump relay. Battery voltage is applied to the fuel pump relay when the ignition key is ON. The relay is energized when a ground signal is provided by the PCM.

The fuel pump will operate for approximately one second unless the engine is operating or the starter motor is engaged.

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 2).

IDLE AIR CONTROL (IAC) MOTOR—PCM OUTPUT

The IAC motor is mounted on the throttle body (Fig. 7) 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 and regulates air flow through it. Based on various sensor inputs, the 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.

DUTY CYCLE EVAP PURGE SOLENOID VALVE-PCM OUTPUT

Refer to Group 25, Emission Control System for information.

DATA LINK CONNECTOR—PCM INPUT AND OUTPUT

The 16–way data link connector (diagnostic scan tool connector) links the Diagnostic Readout Box (DRB) scan tool or the Mopar Diagnostic System (MDS) with the powertrain control module (PCM). The data link connector is located under the instrument panel to the left of the steering column (Fig. 10). For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

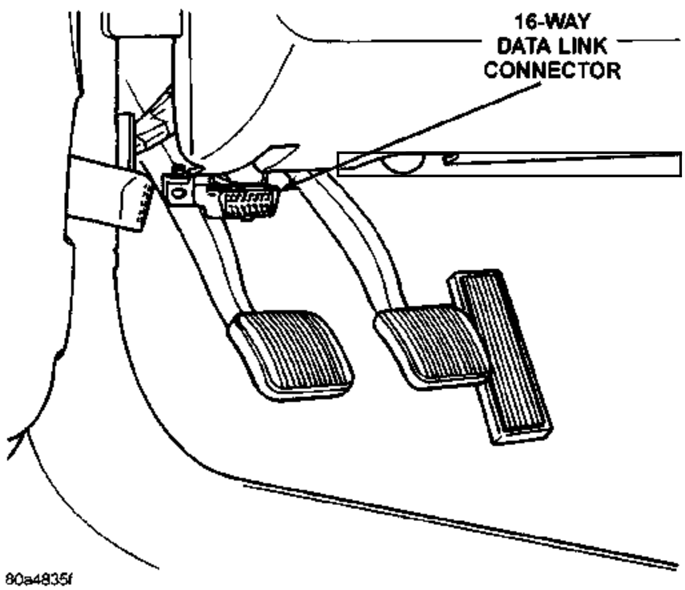


Fig. 10 Data Link Connector Location

FUEL INJECTORS—PCM OUTPUT

Six individual fuel injectors are used with the 4.0L 6-cylinder engine. Four individual fuel injectors are used with the 2.5L 4-cylinder engine. The injectors are attached to the fuel rail (Fig. 11).

The nozzle ends of the injectors are positioned into openings in the intake manifold just above the intake

DESCRIPTION AND OPERATION (Continued)

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.

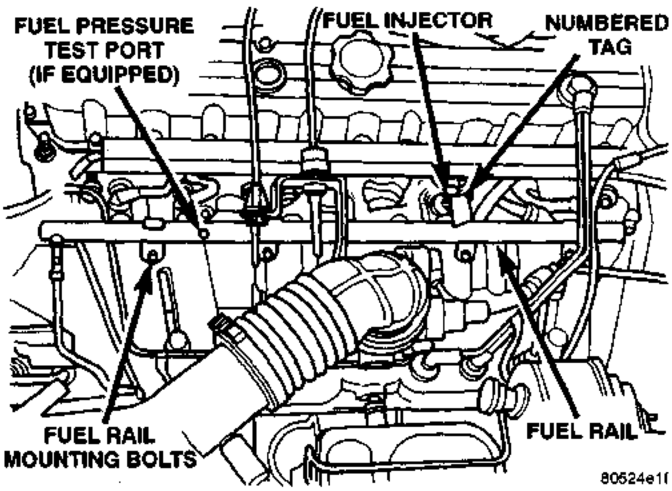


Fig. 11 Fuel Injectors—Typical 4.0L Shown

IGNITION COIL—PCM OUTPUT

System voltage from the Automatic Shutdown (ASD) relay is supplied to the ignition coil positive terminal. The Powertrain Control Module (PCM) operates the ignition coil. **Ignition timing is not adjustable.** The PCM adjusts ignition timing to meet changing engine operating conditions.

Refer to Group 8D, Ignition System for additional information.

MALFUNCTION INDICATOR LAMP—PCM OUTPUT

The malfunction indicator lamp illuminates each time the ignition key is turned on. It will stay on for approximately three seconds as a bulb test. The lamp is displayed on the instrument panel as the CHECK ENGINE lamp (Fig. 12).

The signals needed to activate the lamp are sent from the Powertrain Control Module (PCM) to the instrument panel through the CCD bus circuits.

If the 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.

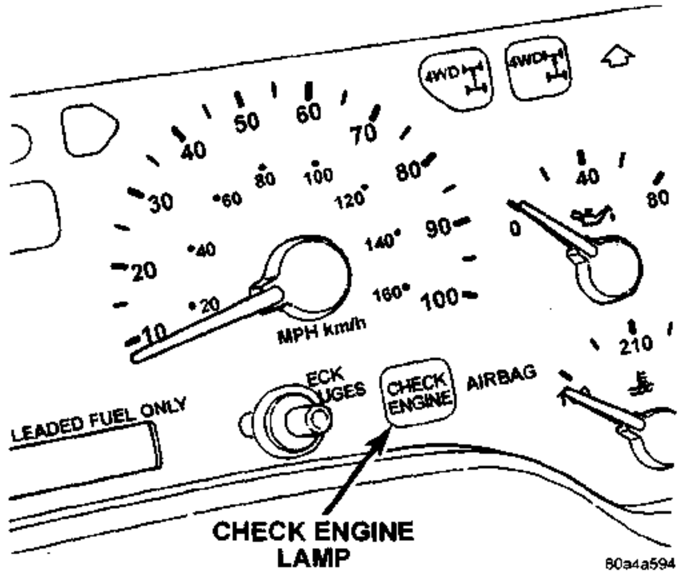


Fig. 12 Check Engine Lamp——Typical

The lamp can also be used to display a Diagnostic Trouble Code (DTC). Refer to On-Board Diagnostics in Group 25, Emission Control System for additional information.

The lamp is also used to display certain engine misfires. Refer to Group 25, Emission Control System for additional information.

TACHOMETER—PCM OUTPUT

The Powertrain Control Module (PCM) supplies engine rpm values to the instrument cluster tachometer through the PCM's CCD bus circuits. Refer to Group 8E, Instrument Panel and Gauges for tachometer information.

THROTTLE BODY

Filtered air from the air cleaner enters the intake manifold through the throttle body (Fig. 13). 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. 13) 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), IAC motor and Manifold Absolute Pressure sensor (MAP) are attached to the throttle body. The accelerator pedal cable, speed control cable (when equipped) and auto-

DESCRIPTION AND OPERATION (Continued)

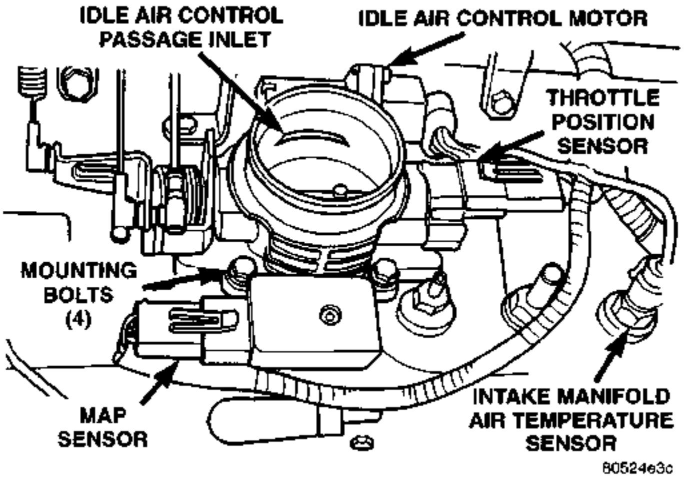


Fig. 13 Throttle Body

matic 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.

DIAGNOSIS AND TESTING

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 three 32–way electrical connectors are fully inserted into connector of Powertrain Control Module (PCM) (Fig. 14).

(2) Inspect battery cable connections. Be sure that they are clean and tight.

(3) Inspect fuel pump relay and ASD relay connections. Inspect starter motor relay connections. Inspect relays for signs of physical damage and corrosion. The relays are located in Power Distribution Center (PDC) (Fig. 15). Refer to label on PDC cover for relay location.

(4) Inspect ignition coil connections. Verify that coil secondary cable is firmly connected to coil (Fig. 16).

(5) Verify that distributor cap is correctly attached to distributor. Be sure that spark plug cables are firmly connected to the distributor cap and spark plugs are in their correct firing order (Fig. 17). Be sure that coil cable is firmly connected to distributor cap and coil. Be sure that camshaft position sensor

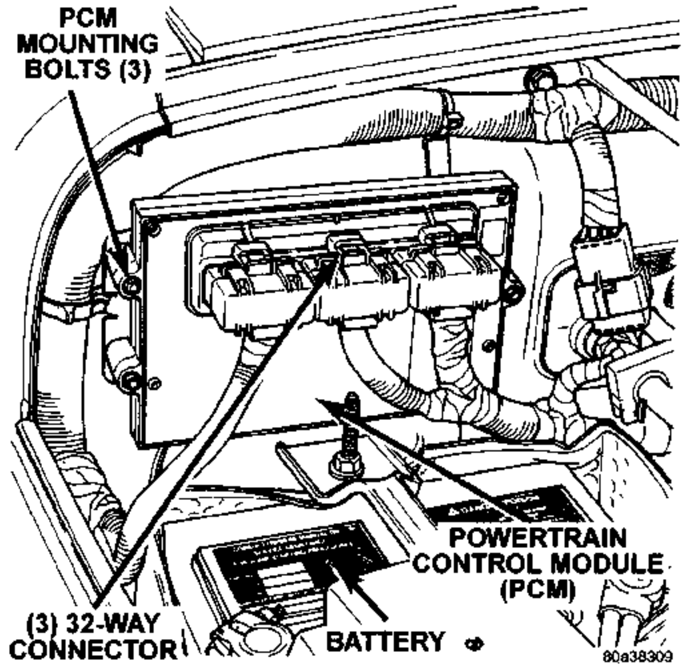


Fig. 14 Powertrain Control Module (PCM)

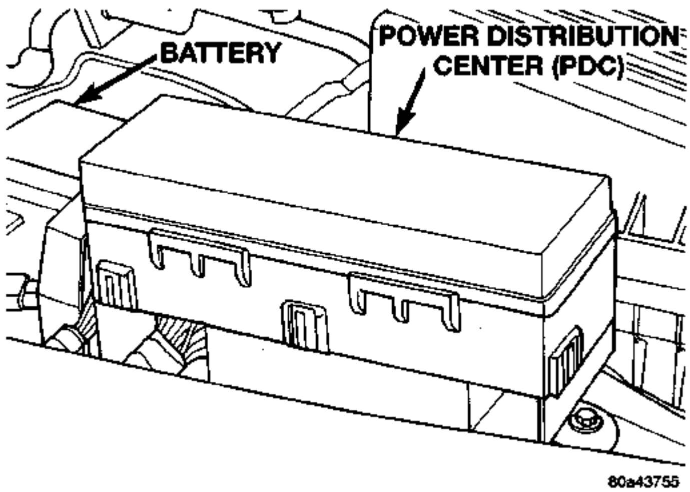


Fig. 15 Power Distribution Center (PDC)

wire connector (at distributor) is firmly connected to harness connector. Inspect spark plug condition. Refer to Group 8D, Ignition. Connect vehicle to an oscilloscope and inspect spark events for fouled or damaged spark plugs or cables.

(6) Verify that generator output wire, generator connector and ground wire are firmly connected to the generator.

(7) Inspect system body grounds for loose or dirty connections. Refer to Group 8, Wiring for ground locations.

(8) Verify Crankcase Ventilation (CCV) operation. Refer to Group 25, Emission Control System for additional information.

(9) Inspect fuel tube quick-connect fitting-to-fuel rail connections.

DIAGNOSIS AND TESTING (Continued)

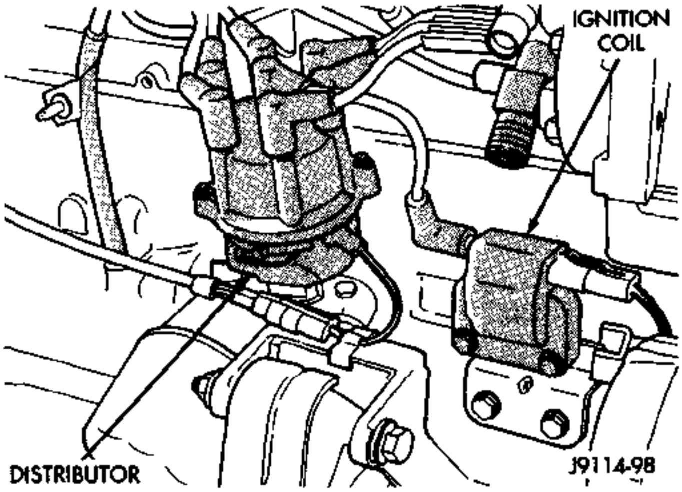


Fig. 16 Ignition Coil—Typical (4.0L Engine Shown)

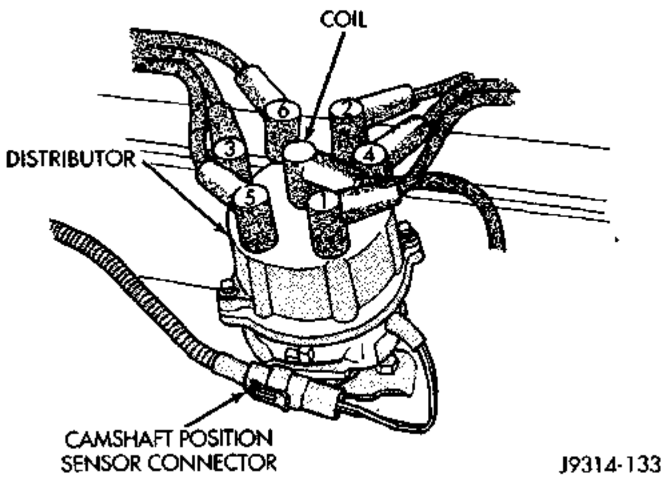


Fig. 17 Distributor and Wiring—Typical (4.0L Engine Shown)

(10) Verify that hose connections to all ports of vacuum fittings on intake manifold are tight and not leaking.

(11) Inspect accelerator cable and transmission throttle cable (if equipped). Check their connections to throttle arm of throttle body for any binding or restrictions.

(12) If equipped with vacuum brake booster, verify that vacuum booster hose is firmly connected to fitting on intake manifold. Also check connection to brake vacuum booster.

(13) Inspect air cleaner inlet and air cleaner element for dirt or restrictions.

(14) Inspect radiator grille area, radiator fins and air conditioning condenser for restrictions.

(15) Verify that intake manifold air temperature sensor wire connector is firmly connected to harness connector (Fig. 18).

(16) Verify that MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 18). Also verify

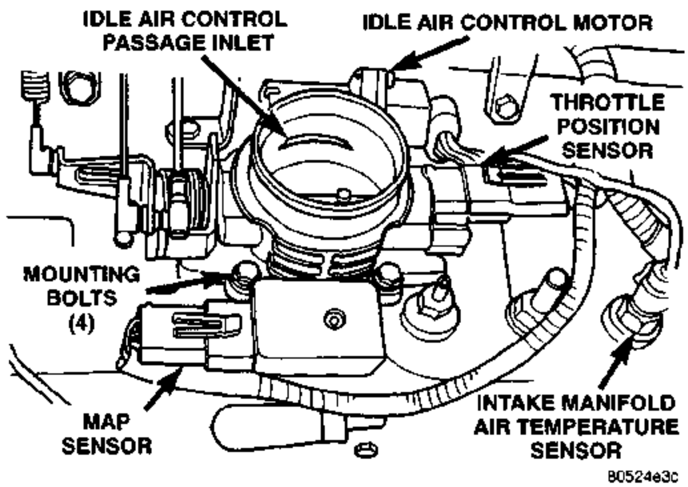


Fig. 18 Sensor Locations—4.0L Engine Shown

that rubber L-shaped fitting from MAP sensor to throttle body is firmly connected (Fig. 19).

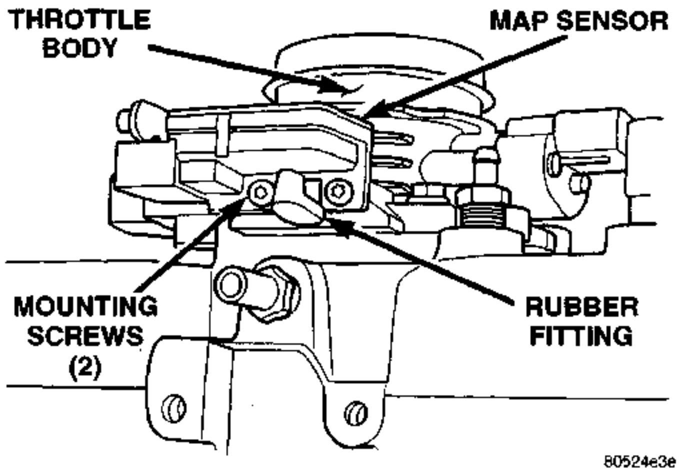


Fig. 19 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

(17) Verify that fuel injector wire harness connectors are firmly connected to injectors in the correct order. Each harness connector is numerically tagged with injector number (INJ 1, INJ 2 etc.) of its corresponding fuel injector and cylinder number.

(18) Verify harness connectors are firmly connected to Idle Air Control (IAC) motor and Throttle Position Sensor (TPS) (Fig. 18).

(19) Verify that wire harness connector is firmly connected to engine coolant temperature sensor (Fig. 20).

(20) Raise and support vehicle.

(21) Verify that both oxygen sensor wire connectors are firmly connected to sensors. Inspect sensors and connectors for damage (Fig. 21) or (Fig. 22).

(22) Inspect for pinched or leaking fuel tubes. Inspect for pinched, cracked or leaking fuel hoses.

DIAGNOSIS AND TESTING (Continued)

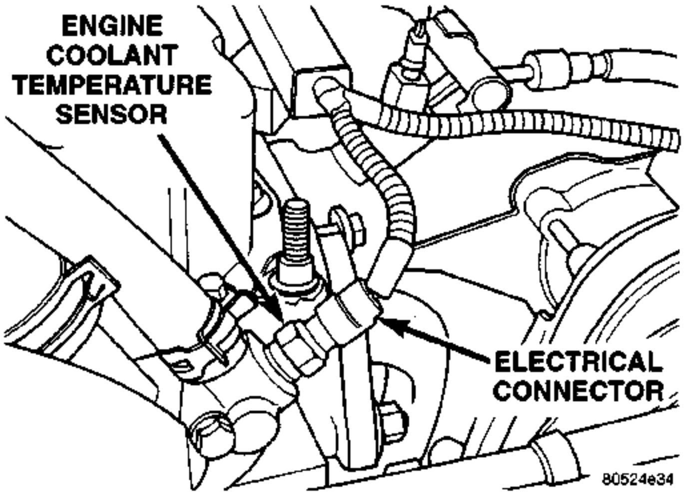


Fig. 20 Engine Coolant Temp. Sensor—4.0L Shown

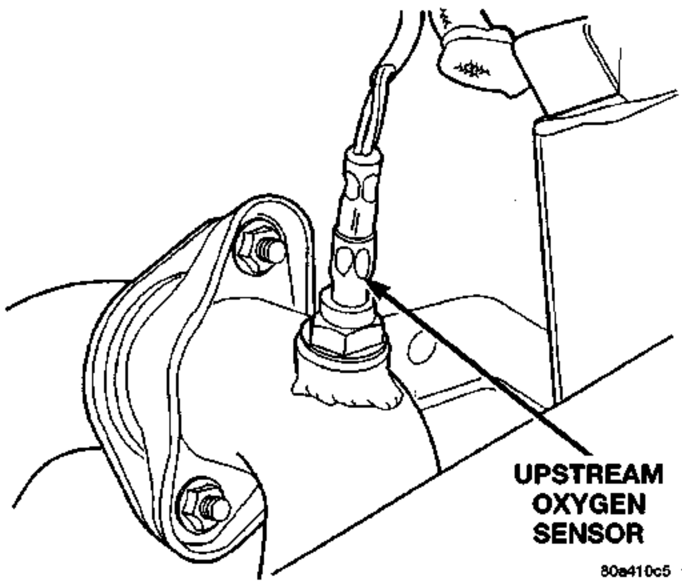


Fig. 21 Upstream Oxygen Sensor

(23) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(24) If equipped with automatic transmission, verify that electrical harness is firmly connected to park/neutral switch. Refer to Automatic Transmission section of Group 21.

(25) Verify that electrical harness connector is firmly connected to the vehicle speed sensor (Fig. 23).

(26) Verify that fuel pump/gauge sender unit wire connector is firmly connected to harness connector.

(27) Inspect fuel hoses at fuel pump/gauge sender unit for cracks or leaks.

(28) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

(29) Verify that battery cable and solenoid feed wire connections to starter solenoid are tight and

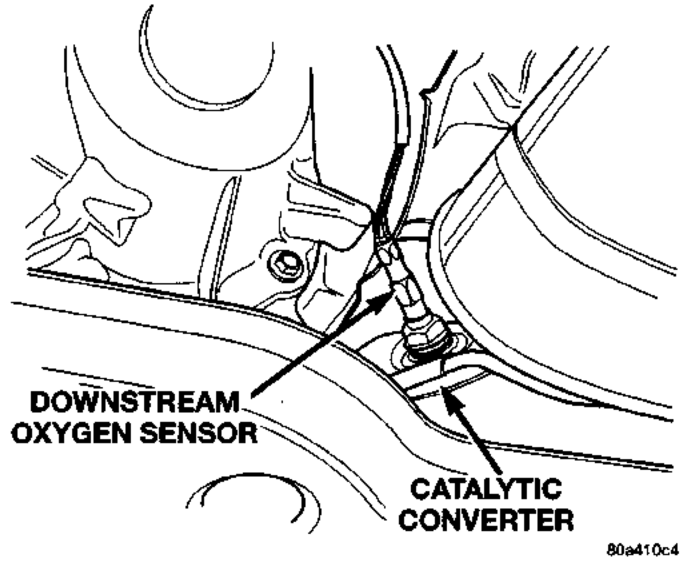


Fig. 22 Downstream Oxygen Sensor

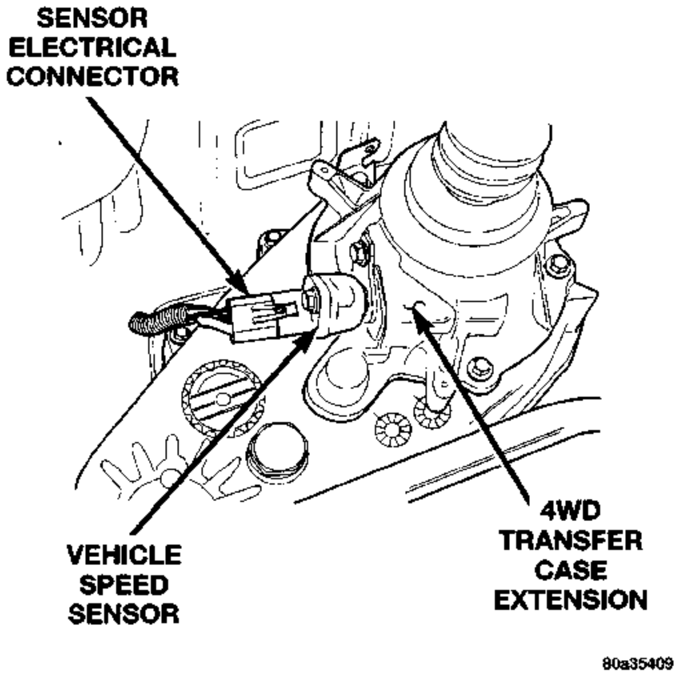


Fig. 23 Vehicle Speed Sensor—Typical

clean. Inspect for chaffed wires or wires rubbing up against other components.

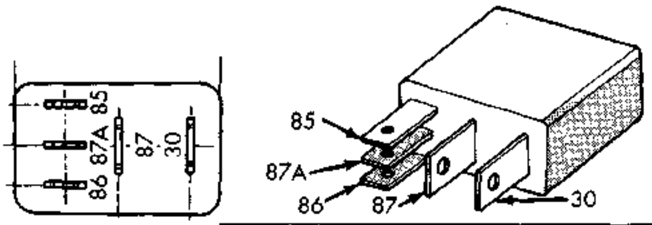
ASD AND FUEL PUMP RELAYS

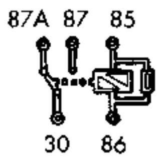
The following description of operation and tests apply only to the Automatic Shutdown (ASD) and fuel pump relays. The terminals on the bottom of each relay are numbered (Fig. 24).

OPERATION

- Terminal number 30 is connected to battery voltage. For both the ASD and fuel pump relays, terminal 30 is connected to battery voltage at all times.

DIAGNOSIS AND TESTING (Continued)





TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

9514-16

Fig. 24 ASD and Fuel Pump Relay Terminals

- The PCM grounds the coil side of the relay through terminal number 85.
- Terminal number 86 supplies voltage to the coil side of the relay.
- When the PCM de-energizes the ASD and fuel pump relays, terminal number 87A connects to terminal 30. This is the Off position. In the off position, voltage is not supplied to the rest of the circuit. Terminal 87A is the center terminal on the relay.
- When the PCM energizes the ASD and fuel pump relays, terminal 87 connects to terminal 30. This is the On position. Terminal 87 supplies voltage to the rest of the circuit.

TESTING

The following procedure applies to the ASD and fuel pump relays.

(1) Remove relay from connector before testing.

(2) With the relay removed from the vehicle, use an ohmmeter to check the resistance between terminals 85 and 86. The resistance should be between 75 ±5 ohms.

(3) Connect the ohmmeter between terminals 30 and 87A. The ohmmeter should show continuity between terminals 30 and 87A.

(4) Connect the ohmmeter between terminals 87 and 30. The ohmmeter should not show continuity at this time.

(5) Connect one end of a jumper wire (16 gauge or smaller) to relay terminal 85. Connect the other end of the jumper wire to the ground side of a 12 volt power source.

(6) Connect one end of another jumper wire (16 gauge or smaller) to the power side of the 12 volt power source. **Do not attach the other end of the jumper wire to the relay at this time.**

WARNING: DO NOT ALLOW OHMMETER TO CONTACT TERMINALS 85 OR 86 DURING THIS TEST.

(7) Attach the other end of the jumper wire to relay terminal 86. This activates the relay. The ohmmeter should now show continuity between relay terminals 87 and 30. The ohmmeter should not show continuity between relay terminals 87A and 30.

(8) Disconnect jumper wires.

(9) Replace the relay if it did not pass the continuity and resistance tests. If the relay passed the tests, it operates properly. Check the remainder of the ASD and fuel pump relay circuits. Refer to group 8W, Wiring Diagrams.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST

To perform a complete test of MAP sensor (Fig. 25) and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the MAP sensor only, refer to the following:

(1) Inspect rubber L-shaped fitting from MAP sensor to throttle body (Fig. 26). Repair as necessary.

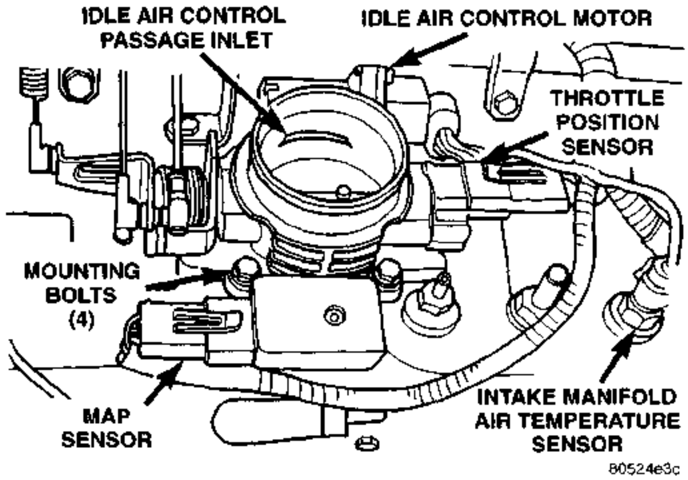


Fig. 25 Sensor Location—4.0L Shown

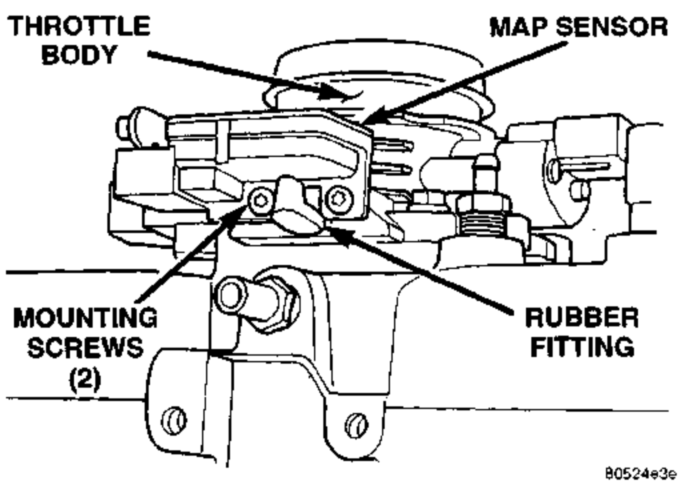


Fig. 26 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

DIAGNOSIS AND TESTING (Continued)

CAUTION: When testing the MAP sensor, be sure that the harness wires are not damaged by the test meter probes.

(2) Test MAP sensor output voltage at MAP sensor connector between terminals A and B (Fig. 27). With ignition switch ON and 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.

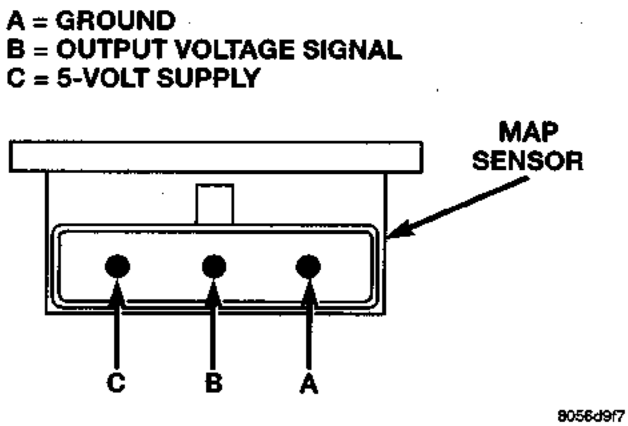


Fig. 27 MAP Sensor Connector Terminals—Typical

(3) Test Powertrain Control Module (PCM) cavity A-27 for same voltage described above to verify wire harness condition. Repair as necessary.

(4) Test MAP sensor supply voltage at sensor connector between terminals A and C (Fig. 27) with ignition ON. The voltage should be approximately 5 volts (±0.5V). Five volts (±0.5V) should also be at cavity A-17 of the PCM wire harness connector. Repair or replace wire harness as necessary.

(5) Test the MAP sensor ground circuit at sensor connector terminal—A (Fig. 27) and PCM connector A-4. Repair wire harness if necessary.

Refer to Group 8W, Wiring Diagrams for cavity locations.

OXYGEN (O2S) SENSORS

To perform a complete test of the O2S sensors and their circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the O2S sensors only, refer to the following:

The upstream O2S sensor is located on the exhaust downpipe (Fig. 28).

The downstream O2S sensor is located near the outlet end of the catalytic converter (Fig. 29).

Each O2S heating element can be tested with an ohmmeter as follows:

Disconnect the O2S sensor connector. Connect the ohmmeter test leads across the white wire terminals of the sensor connector. Resistance should be between 5 and 7 ohms. Replace the sensor if the ohmmeter displays an infinity (open) reading.

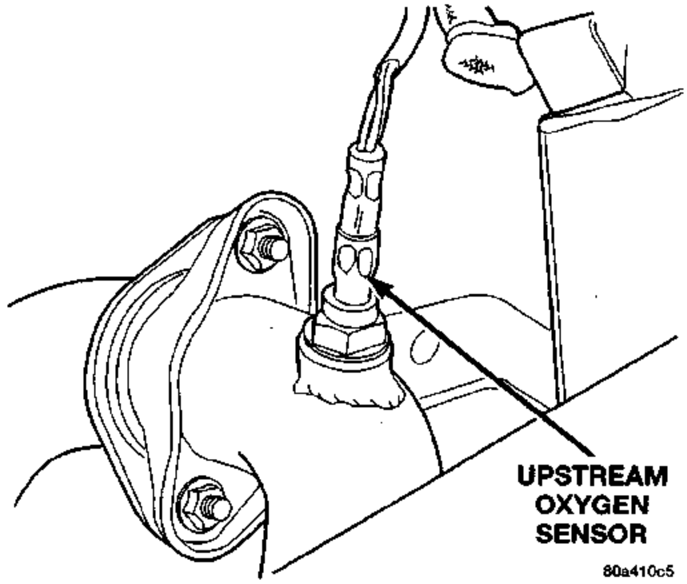


Fig. 28 Upstream Oxygen Sensor Location

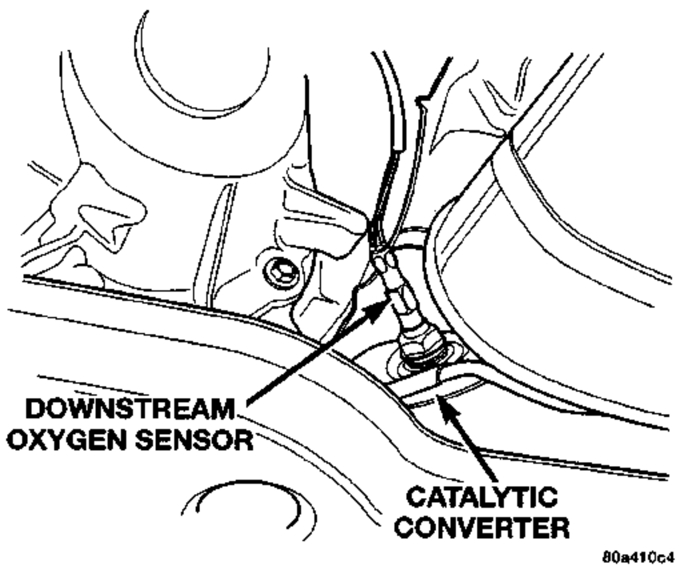


Fig. 29 Downstream Oxygen Sensor Location

CAMSHAFT AND CRANKSHAFT POSITION SENSORS

Refer to Group 8D, Ignition System for information.

ENGINE COOLANT TEMPERATURE SENSOR

To perform a complete test of the engine coolant temperature sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

DIAGNOSIS AND TESTING (Continued)

(1) Disconnect wire harness connector from coolant temperature sensor (Fig. 30).

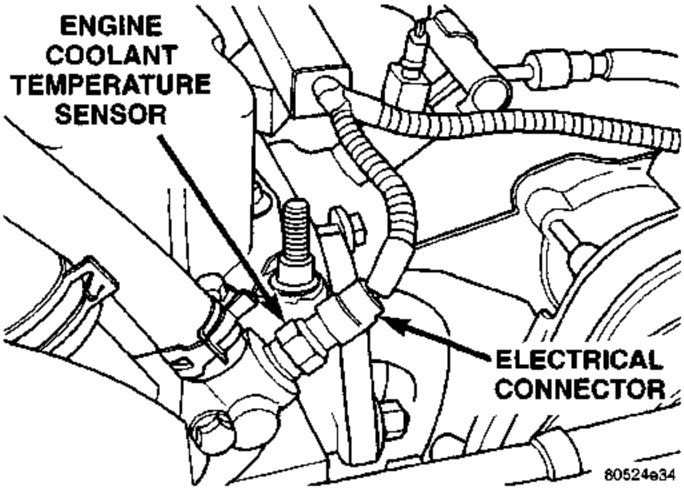


Fig. 30 Engine Coolant Temperature Sensor—Typical

(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 as shown in the Coolant Temperature Sensor/Intake Air Temperature Sensor resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

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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SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR

(3) Test continuity of the wire harness between the PCM wire harness connector and the coolant sensor connector terminals. Refer to Group 8, Wiring for terminal/cavity locations. Repair the wire harness if an open circuit is indicated.

IDLE AIR CONTROL (IAC) MOTOR

To perform a complete test of the IAC motor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR

To perform a complete test of the intake manifold air temperature sensor and its circuitry, refer to DRB tester and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect wire harness connector from intake manifold air temperature sensor (Fig. 31).

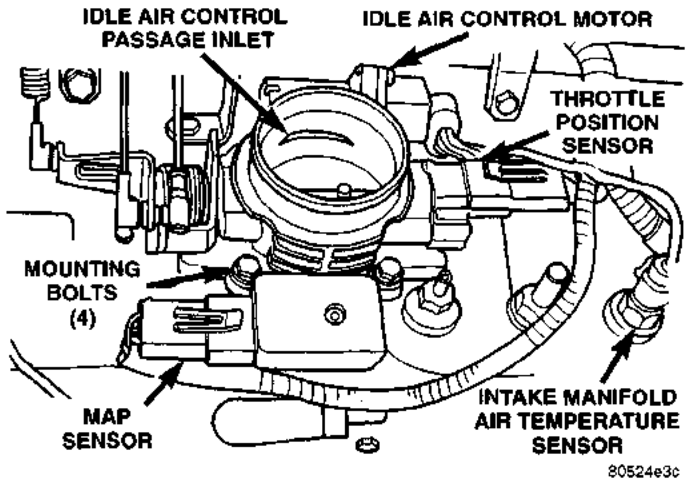


Fig. 31 Intake Manifold Air Temperature Sensor—Typical

(2) Test resistance of sensor with an input impedance (digital) volt-ohmmeter. The resistance (as measured across the sensor terminals) should be as shown in the Coolant Temperature Sensor/Intake Air Temperature Sensor resistance chart. Replace sensor if it is not within range of resistance specified in chart.

(3) Test resistance of wire harness. Do this between PCM wire harness connector A-15 and sensor connector terminal. Also check between PCM connector A-4 to sensor connector terminal. Repair wire harness as necessary if resistance is greater than 1 ohm.

POWER STEERING PRESSURE SWITCH

2.5L 4-Cylinder Engine Only

This switch (Fig. 32) provides an input to the Powertrain Control Module (PCM). The input is provided during periods of high pump load and low engine rpm; such as during parking maneuvers. The PCM will then increase idle speed through the Idle Air

DIAGNOSIS AND TESTING (Continued)

Control (IAC) motor. This is done to prevent the engine from stalling under the increased load.

When steering pump pressure exceeds 1896 kPa ± 345 kPa (275 psi ± 50 psi), the normally closed switch circuit will open and the PCM will increase the engine idle speed.

When power steering pump pressure drops below approximately 70 psi, the switch circuit will close and idle speed will return to normal.

To test switch:

(1) Disconnect electrical connector at switch.

(2) Connect a pair of jumper wires to switch terminals. Route and secure jumper wires away from fan blades and fan belt.

(3) Connect an ohmmeter to jumper wires and observe continuity. Circuit should be closed with engine not running. If continuity is observed, switch is OK. If switch circuit is open, replace switch.

(4) Start engine and observe ohmmeter. With engine at idle speed, continuity should be observed until steering wheel has been turned to left or right position. **Do not hold steering wheel in full left or right position for more than a few seconds. Damage to power steering pump may occur.**

(5) If continuity is still observed after turning wheel (circuit did not open), replace switch.

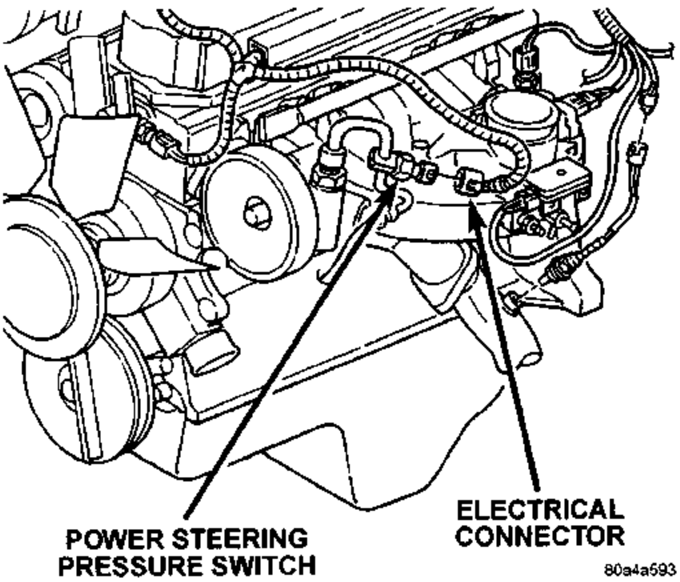


Fig. 32 Power Steering Pump Pressure Switch

VEHICLE SPEED SENSOR

To perform a complete test of the sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual.

THROTTLE POSITION SENSOR (TPS)

To perform a complete test of the TPS (Fig. 31) and its circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the TPS only, refer to the following:

The TPS can be tested with a digital voltmeter. The center terminal of the TPS is the output terminal.

With the ignition key in the ON position, check the TPS output voltage at the center terminal wire of the connector. Check this at idle (throttle plate closed) and at Wide Open Throttle (WOT). At idle, TPS output voltage should 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.

REMOVAL AND INSTALLATION

AUTOMATIC SHUTDOWN (ASD) RELAY

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 33). Refer to label on PDC cover for relay location. Check condition of relay terminals and connector terminals for corrosion and for pin height (pin height should be the same for all terminals within the connector). Repair if necessary before installing relay.

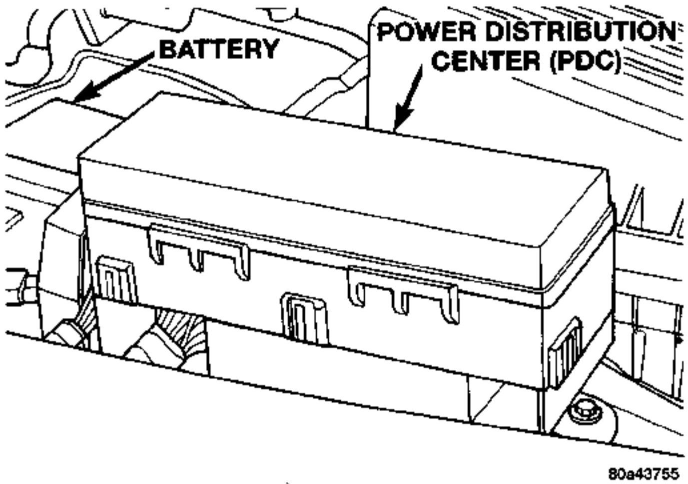


Fig. 33 Power Distribution Center (PDC)

FUEL PUMP RELAY

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 33). Refer to label on PDC cover for relay location. Check condition of relay terminals and connector terminals for corrosion and for pin height (pin height should be the same for all terminals within the connector). Repair if necessary before installing relay.

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**

REMOVAL AND INSTALLATION (Continued)

speed using this screw. All idle speed functions are controlled by the Powertrain Control Module (PCM).

REMOVAL

(1) Remove air cleaner tube at throttle body.

(2) Disconnect throttle body electrical connectors at MAP sensor, IAC motor and TPS (Fig. 34).

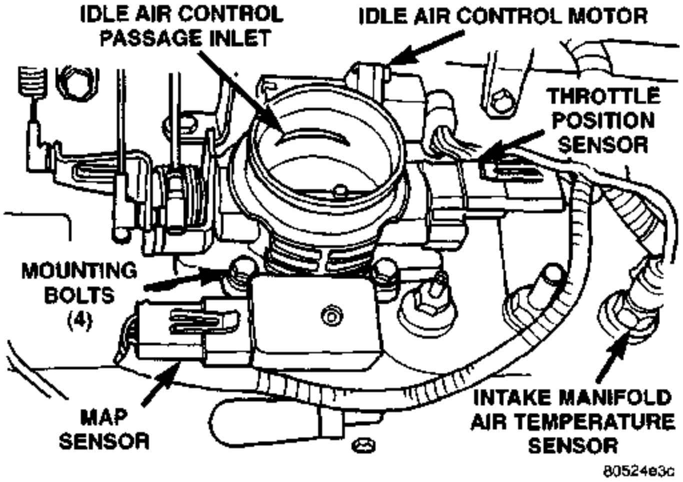


Fig. 34 Throttle Body and Sensor Locations—4.0L Shown

(3) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section of this group for additional information.

(4) Remove four throttle body mounting bolts.

(5) Remove throttle body from intake manifold.

(6) Discard old throttle body-to-intake manifold gasket.

INSTALLATION

(1) Clean mating surfaces of throttle body and 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 12 N·m (108 in. lbs.) torque.

(5) Install control cables.

(6) Install electrical connectors.

(7) Install air cleaner at throttle body.

THROTTLE POSITION SENSOR (TPS)

The TPS is mounted to the throttle body (Fig. 34).

REMOVAL

(1) Disconnect TPS electrical connector.

(2) Remove TPS mounting screws (Fig. 35).

(3) Remove TPS.

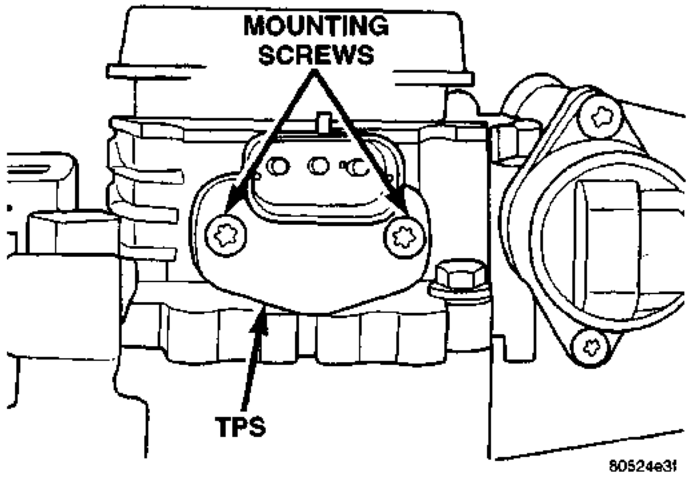


Fig. 35 TPS Mounting Screws

INSTALLATION

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 36). The TPS must be installed so that it can be rotated a few degrees. (If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs). The TPS will be under slight tension when rotated.

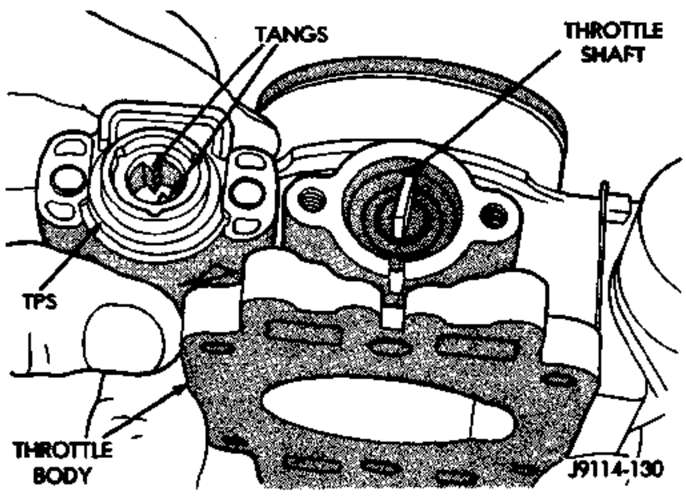


Fig. 36 Throttle Position Sensor—Installation

(1) Install TPS and retaining screws.

(2) Tighten screws to 7 N·m (60 in. lbs.) torque.

(3) Connect TPS electrical connector to TPS.

(4) Manually operate throttle (by hand) to check for any TPS binding before starting engine.

IDLE AIR CONTROL (IAC) MOTOR

The IAC motor is located on the side of the throttle body (Fig. 34).

REMOVAL

(1) Remove air cleaner tube at throttle body.

(2) Disconnect electrical connector from IAC motor.

(3) Remove two mounting bolts (screws) (Fig. 37).

REMOVAL AND INSTALLATION (Continued)

(4) Remove IAC motor from throttle body.

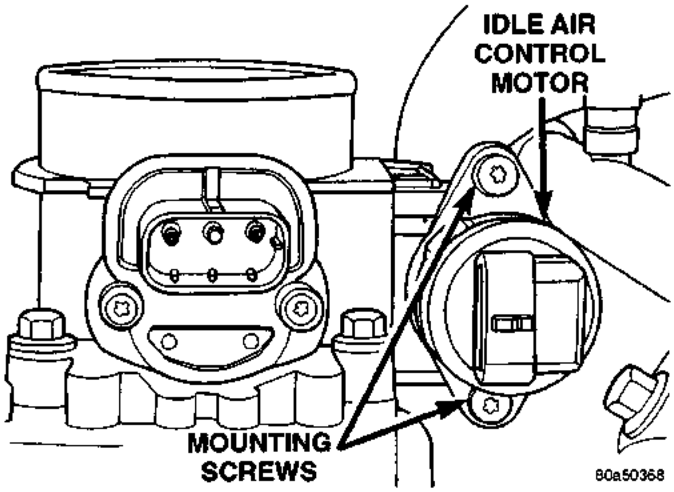


Fig. 37 Mounting Bolts (Screws)—IAC Motor

INSTALLATION

(1) Install IAC motor to throttle body.

(2) Install and tighten two mounting bolts (screws) to 7 N·m (60 in. lbs.) torque.

(3) Install electrical connector.

(4) Install air cleaner tube to throttle body.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The MAP sensor is mounted to the side of the throttle body (Fig. 34). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 38).

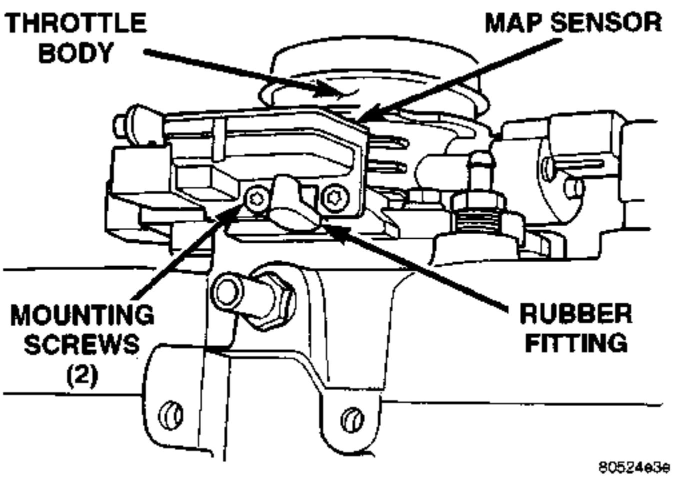


Fig. 38 MAP Sensor Mounting

REMOVAL

(1) Remove air cleaner intake tube at throttle body.

(2) Remove two MAP sensor mounting bolts (screws) (Fig. 38).

(3) While removing MAP sensor, slide the rubber L-shaped fitting (Fig. 38) from throttle body.

(4) Remove rubber L-shaped fitting from MAP sensor.

INSTALLATION

(1) Install rubber L-shaped fitting to MAP sensor.

(2) Position sensor to throttle body while guiding rubber fitting over throttle body vacuum nipple.

(3) Install MAP sensor mounting bolts (screws). Tighten screws to 3 N·m (25 in. lbs.) torque.

(4) Install air cleaner intake tube.

DUTY CYCLE EVAP CANISTER PURGE SOLENOID

Refer to Group 25, Emission Control System for removal/installation procedures.

POWERTRAIN CONTROL MODULE (PCM)

The PCM is located in the engine compartment (Fig. 39).

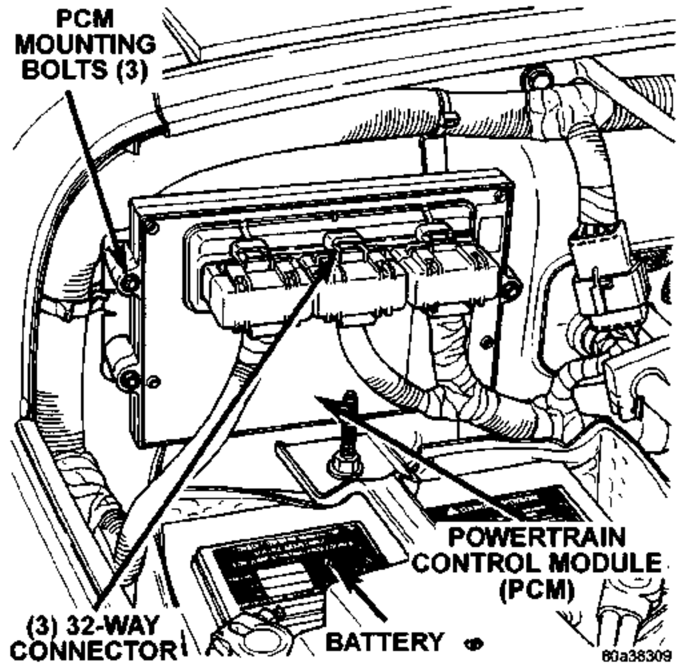


Fig. 39 PCM Location

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Remove plastic shield from over 32–way connectors. Shield snaps to connectors.

(3) Carefully unplug three 32–way connectors (Fig. 39) from PCM.

(4) Remove three PCM mounting bolts and remove PCM from vehicle.

INSTALLATION

(1) Install PCM and mounting bolts to vehicle.

(2) Tighten bolts to 4 N·m (35 in. lbs.).

(3) Check pin connectors in PCM and three 32–way connectors for corrosion or damage. Also check pin heights in connectors. Pin heights should

REMOVAL AND INSTALLATION (Continued)

all be the same. Repair as necessary before installing 32–way connectors.

(4) Install three 32–way connectors.

(5) Install plastic shield to 32–way connectors. Shield snaps to connectors.

(6) Install battery cable.

POWER STEERING PRESSURE SWITCH—2.5L ENGINE

This switch is not used with 4.0L six-cylinder engines.

The power steering pressure switch is installed in the power steering high-pressure hose (line) (Fig. 40).

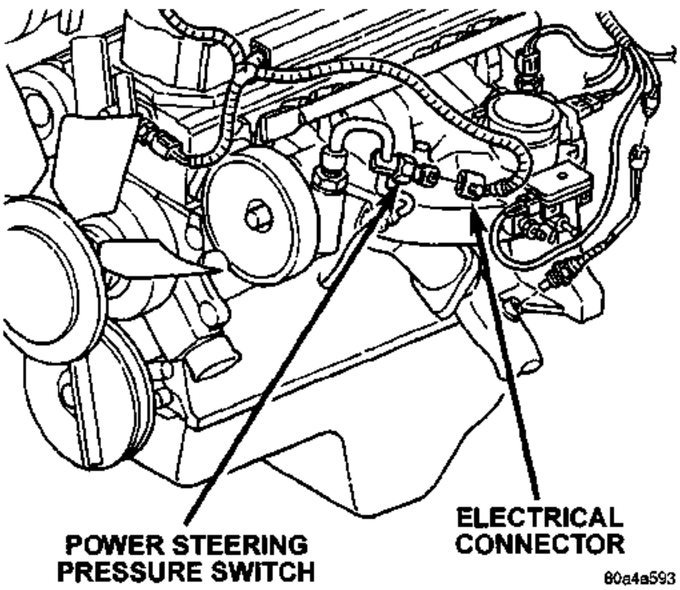


Fig. 40 Power Steering Pressure Switch

REMOVAL

(1) Disconnect electrical connector from power steering pressure switch.

(2) Place a small container or shop towel beneath switch to collect any excess fluid.

(3) Remove switch. Use a back-up wrench on power steering line to prevent bending line.

INSTALLATION

(1) Install power steering switch into power steering line.

(2) Tighten to 28 N·m (252 in. lbs.) torque.

(3) Connect electrical connector to switch.

(4) Check power steering fluid and add as necessary.

(5) Start engine and again check power steering fluid. Add fluid if necessary.

CRANKSHAFT POSITION SENSOR

Refer to Group 8D, Ignition System for removal/installation procedures.

CAMSHAFT POSITION SENSOR

For removal/installation procedures, refer to Group 8D, Ignition System. See Camshaft Position Sensor.

OXYGEN SENSOR

The upstream O2S sensor is located in the exhaust downpipe (Fig. 41). The downstream sensor is located near outlet end of catalytic converter. Refer to (Fig. 42).

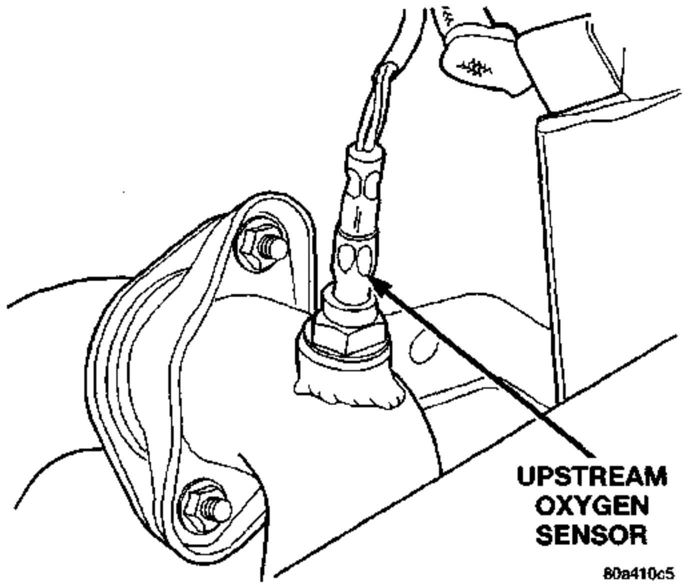


Fig. 41 Upstream Oxygen Sensor Location

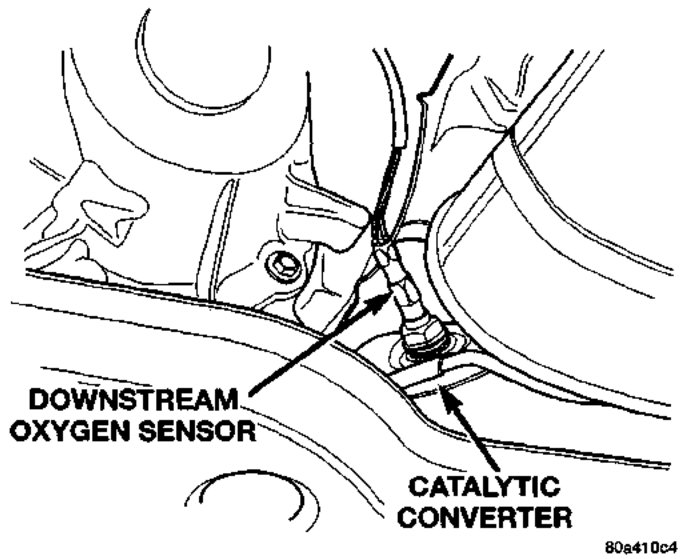


Fig. 42 Downstream Oxygen Sensor Location

REMOVAL AND INSTALLATION (Continued)

REMOVAL

WARNING: THE EXHAUST MANIFOLD, EXHAUST PIPES AND CATALYTIC CONVERTER BECOME VERY HOT DURING ENGINE OPERATION. ALLOW ENGINE TO COOL BEFORE REMOVING OXYGEN SENSOR.

(1) Raise and support vehicle.
(2) Disconnect wire connector from O2S sensor.

CAUTION: When disconnecting sensor electrical connector, do not pull directly on wire going into sensor.

(3) Remove O2S sensor. Snap-On oxygen sensor wrench number YA 8875 (or equivalent) may be used for removal and installation.

INSTALLATION

Threads of new oxygen sensors are factory coated with anti-seize compound to aid in removal. **DO NOT add any additional anti-seize compound to the threads of a new oxygen sensor.**

(1) Install O2S sensor. Tighten to 30 N·m (22 ft. lbs.) torque.
(2) Connect O2S sensor wire connector.
(3) Lower vehicle.

AIR CLEANER ELEMENT

REMOVAL/INSTALLATION

(1) Loosen air tube clamp at housing cover (Fig. 43).
(2) Disconnect air tube at cover.
(3) Pry back the clips retaining air cleaner cover to air cleaner housing.
(4) Lift cover up to expose air cleaner element.
(5) Remove air cleaner element.
(6) Clean inside of air cleaner housing and its cover before installing new element.
(7) Reverse the preceding operation for installation. Be sure air cleaner cover is properly seated to air cleaner housing.

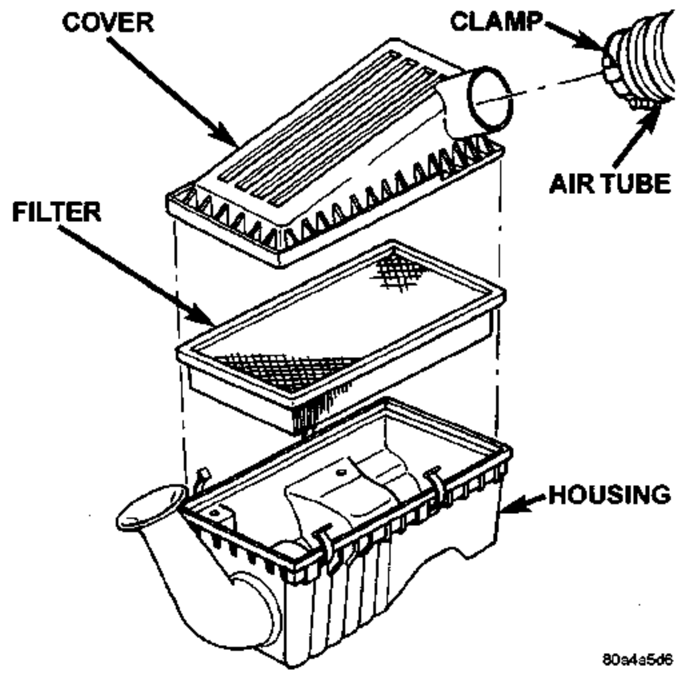


Fig. 43 Air Cleaner Element

ENGINE COOLANT TEMPERATURE SENSOR

The coolant temperature sensor is installed in the thermostat housing (Fig. 44).

REMOVAL

(1) Partially drain cooling system until coolant level is below cylinder head. Observe the **WARNINGS** in Group 7, Cooling.
(2) Disconnect coolant temperature sensor wire connector.
(3) Remove sensor from thermostat housing.

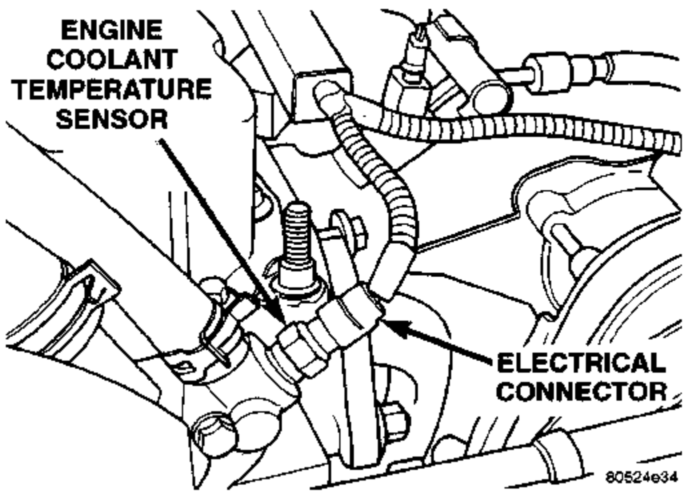


Fig. 44 Engine Coolant Temperature Sensor—Typical

INSTALLATION

(1) Apply sealant to sensor threads (new replacement sensors will have sealant already applied).
(2) Install coolant temperature sensor into thermostat housing. Tighten to 11 N·m (8 ft. lbs.) torque.
(3) Connect wire connector.
(4) Fill cooling system. Refer to Group 7, Cooling System.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR

The intake manifold air temperature sensor is installed into the intake manifold plenum near the throttle body (Fig. 45).

REMOVAL AND INSTALLATION (Continued)

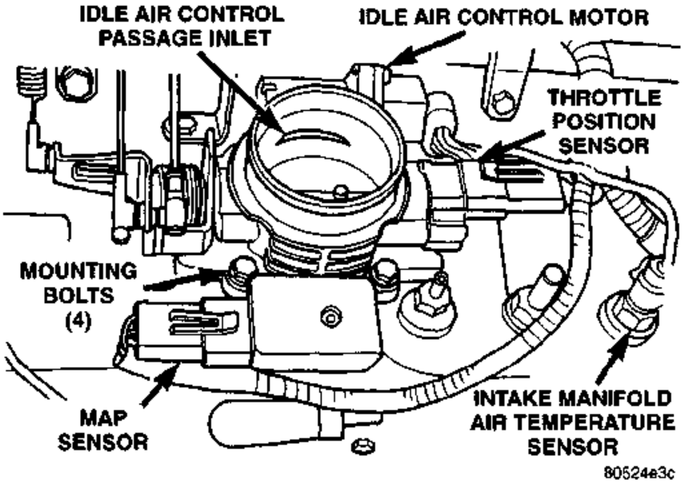


Fig. 45 Intake Air Sensor Location—Typical—4.0L Shown

REMOVAL

(1) Disconnect electrical connector from sensor.
(2) Remove sensor from intake manifold.

INSTALLATION

(1) Install sensor into intake manifold. Tighten sensor to 28 N·m (20 ft. lbs.) torque.
(2) Connect electrical connector to sensor.

VEHICLE SPEED SENSOR

The vehicle speed sensor is located on the speedometer pinion gear adapter. The pinion gear adapter is located on the transfer case extension (drivers side) (Fig. 46).

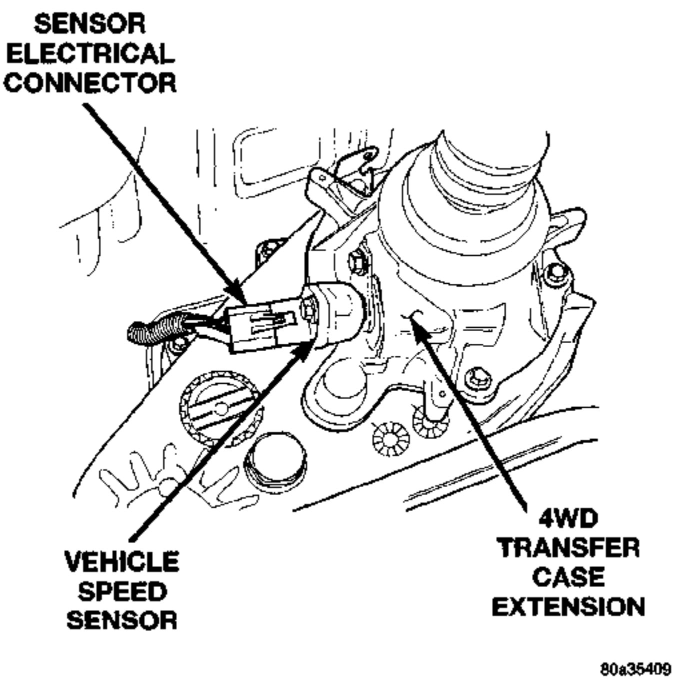


Fig. 46 Vehicle Speed Sensor Location—Typical

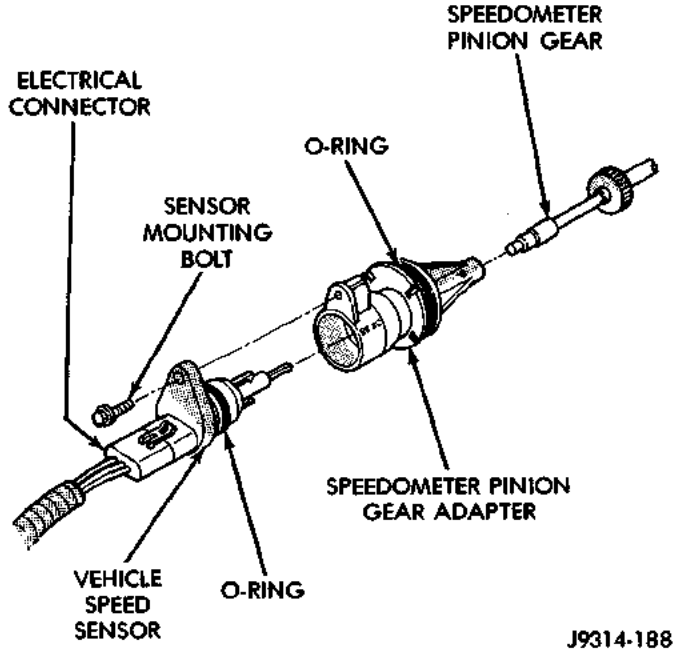


Fig. 47 Sensor Removal/Installation

REMOVAL

(1) Raise and support vehicle.
(2) Disconnect electrical connector from sensor.
(3) Remove sensor mounting bolt (Fig. 47).
(4) Remove sensor (pull straight out) from speedometer pinion gear adapter (Fig. 47). Do not remove gear adapter from transmission.

INSTALLATION

(1) Clean inside of speedometer pinion gear adapter before installing speed sensor.
(2) Install sensor into speedometer gear adapter and install mounting bolt. **Before tightening bolt, verify speed sensor is fully seated (mounted flush) to speedometer pinion gear adapter.**
(3) Tighten sensor mounting bolt to 2.2 N·m (20 in. lbs.) torque.
(4) Connect electrical connector to sensor.

SPECIFICATIONS

VECI LABEL SPECIFICATIONS

If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label. The VECI label is located in the engine compartment.

TORQUE CHART

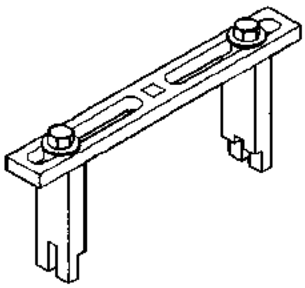
DESCRIPTION	TORQUE
Accelerator Pedal Bracket Mounting Nuts. . .	8.5 N·m (75 in. lbs.)

SPECIFICATIONS (Continued)

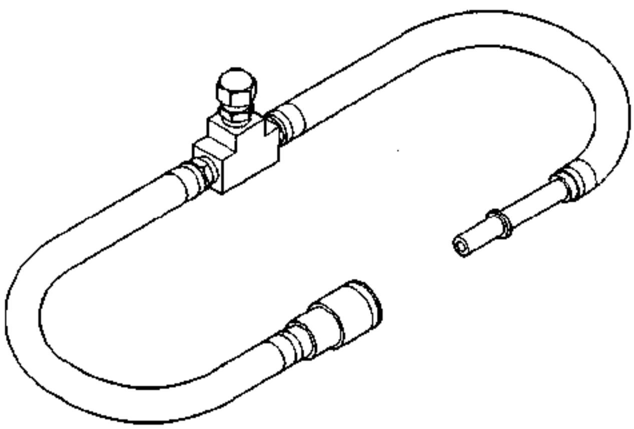
DESCRIPTION	TORQUE
Engine Coolant Temperature Sensor	11 N·m (96 in. lbs.)
Fuel Tank Mounting Nuts	Refer to manual text
Fuel Hose Clamps	1 N·m (10 in. lbs.)
IAC Motor-To-Throttle Body Bolts	7 N·m (60 in. lbs.)
Intake Manifold Air Temp. Sensor	28 N·m (20 ft. lbs.)
MAP Sensor Mounting Screws	3 N·m (25 in. lbs.)
Oxygen Sensor	30 N·m (22 ft. lbs.)
PCM Mounting Screws	4 N·m (35 in. lbs.)
Power Steering Pressure Switch	28 N·m (252 in. lbs.)
Throttle Body Mounting Bolts	12 N·m (108 in. lbs.)
Throttle Position Sensor Mounting Screws	7 N·m (60 in. lbs.)
Vehicle Speed Sensor Mounting Bolt	2.2 N·m (20 in. lbs.)

SPECIAL TOOLS

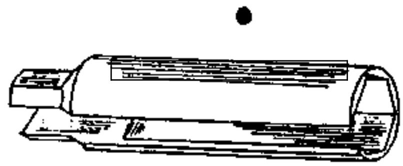
FUEL SYSTEM



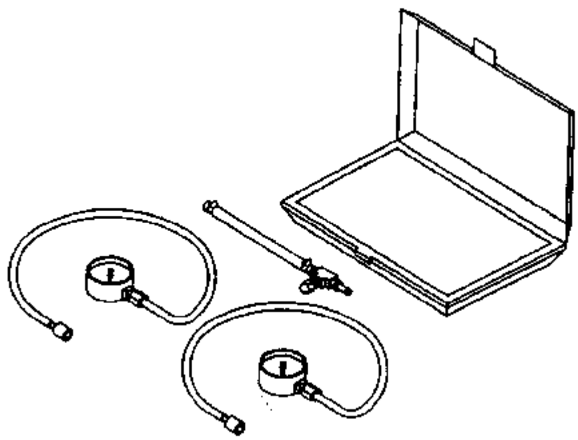
Spanner Wrench—6856



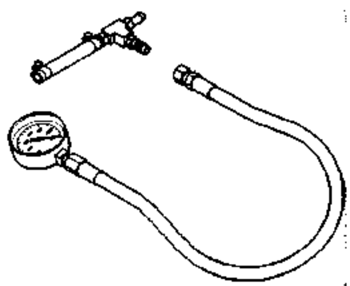
Adapters, Fuel Pressure Test—6541, 6539, 6631 or 6923



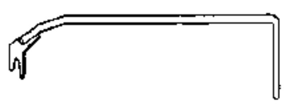
O2S (Oxygen Sensor) Remover/Installer—C-4907



Test Kit, Fuel Pressure—5069



Test Kit, Fuel Pressure—C-4799-B



Fuel Line Removal Tool—6782

STEERING

CONTENTS

POWER STEERING

INDEX

GENERAL INFORMATION

STEERING SYSTEM

The vehicle uses manual steering or optional power steering.

The power steering system has a hydraulic pump. The pump is a constant flow rate and displacement, vane-type pump. The pump on the 4.0L engine has a reservoir mounted to it (Fig. 1). The 2.5L engine has a separate pump reservoir mounted to the fan shroud (Fig. 2).

The steering gear used is a recirculating ball type gear. The gear acts as a rolling thread between the worm shaft and rack piston. The worm shaft is supported by a thrust bearing at the lower end and a bearing assembly at the upper end. When the worm shaft is turned the rack piston moves. The rack piston teeth mesh with the pitman shaft. Turning the worm shaft turns the pitman shaft, which turns the steering linkage. This gear is used on all models.

The power steering system consists of:

- Hydraulic pump
- Recirculating ball steering gear
- Steering column
- Steering linkage

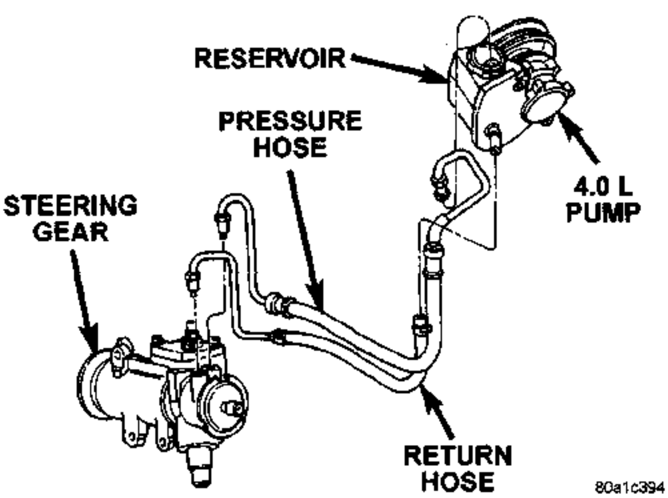


Fig. 1 Power Steering Gear & Pump—4.0L

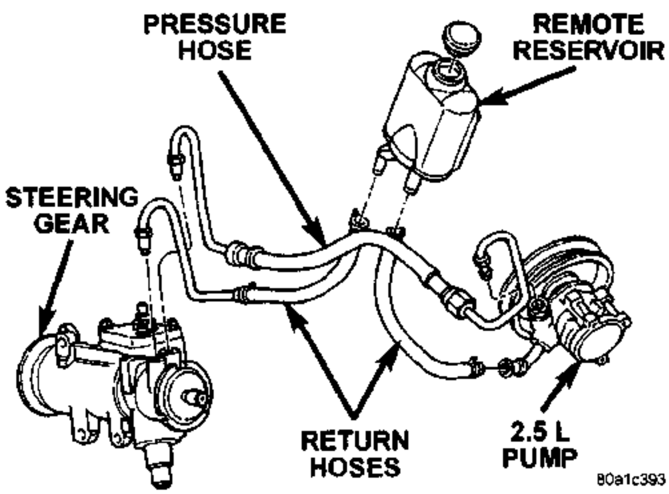


Fig. 2 Power Steering Gear & Pump—2.5L

DIAGNOSIS AND TESTING

POWER STEERING SYSTEM DIAGNOSIS CHARTS

STEERING NOISE

There is some noise in all power steering systems. One of the most common is a hissing sound evident at a standstill parking. Or when the steering wheel is at the end of it's travel. Hiss is a high frequency noise similar to that of a water tap being closed slowly. The noise is present in all valves that have a high velocity fluid passing through an orifice. There is no relationship between this noise and steering performance.

CONDITION	POSSIBLE CAUSES	CORRECTION
OBJECTIONAL HISS OR WHISTLE	1. Steering intermediate shaft to dash panel seal. 2. Noisy valve in power steering gear.	1. Check and repair seal at dash panel. 2. Replace steering gear.
RATTLE OR CLUNK	1. Gear mounting bolts loose. 2. Loose or damaged suspension components. 3. Loose or damaged steering linkage. 4. Internal gear noise. 5. Pressure hose in contact with other components.	1. Tighten bolts to specification. 2. Inspect and repair suspension. 3. Inspect and repair steering linkage. 4. Replace gear. 5. Reposition hose.
CHIRP OR SQUEAL	1. Loose belt.	1. Adjust or replace.
WHINE OR GROWL	1. Low fluid level. 2. Pressure hose in contact with other components. 3. Internal pump noise.	1. Fill to proper level. 2. Reposition hose. 3. Replace pump.
SUCKING AIR SOUND	1. Loose return line clamp. 2. O-ring missing or damaged on hose fitting. 3. Low fluid level. 4. Air leak between pump and reservoir.	1. Replace clamp. 2. Replace o-ring. 3. Fill to proper level. 4. Repair as necessary.
SCRUBBING OR KNOCKING	1. Wrong tire size. 2. Wrong gear.	1. Verify tire size. 2. Verify gear.

BINDING AND STICKING

CONDITION	POSSIBLE CAUSE	CORRECTION
DIFFICULT TO TURN WHEEL STICKS OR BINDS	1. Low fluid level. 2. Tire pressure. 3. Steering components 4. Loose belt. 5. Low pump pressure. 6. Column shaft coupler binding. 7. Steering gear worn or out of adjustment.	1. Fill to proper level. 2. Adjust tire pressure. 3. Inspect and lube. 4. Adjust or replace. 5. Pressure test and replace if necessary. 6. Replace coupler. 7. Repair or replace gear.

DIAGNOSIS AND TESTING (Continued)

INSUFFICIENT ASSIST OR POOR RETURN TO CENTER

CONDITION	POSSIBLE CAUSE	CORRECTION
HARD TURNING OR MOMENTARY INCREASE IN TURNING EFFORT	1. Tire pressure. 2. Low fluid level. 3. Loose belt. 4. Lack of lubrication. 5. Low pump pressure. 6. Internal gear leak.	1. Adjust tire pressure. 2. Fill to proper level. 3. Adjust or replace. 4. Inspect and lubricate steering and suspension compnents. 5. Pressure test and repair as necessary. 6. Pressure and flow test, and repair as necessary.
STEERING WHEEL DOES NOT WANT TO RETURN TO CENTER POSITION	1. Tire pressure. 2. Wheel alignment. 3. Lack of lubrication. 4. High friction in steering gear.	1. Adjust tire pressure. 2. Align front end. 3. Inspect and lubricate steering and suspension compnents. 4. Test and adjust as necessary.

LOOSE STEERING AND VEHICLE LEAD

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE PLAY IN STEERING WHEEL	1. Worn or loose suspension or steering components. 2. Worn or loose wheel bearings. 3. Steering gear mounting. 4. Gear out of adjustment. 5. Worn or loose steering coupler.	1. Inspect and repair as necessary. 2. Inspect and repair or adjust bearings. 3. Tighten gear mounting bolts to specification. 4. Adjust gear to specification. 5. Inspect and replace as necessary.
VEHICLE PULLS OR LEADS TO ONE SIDE.	1. Tire Pressure. 2. Radial tire lead. 3. Brakes dragging. 4. Wheel alignment.	1. Adjust tire pressure. 2. Rotate tires. 3. Repair as necessary. 4. Align front end.

POWER STEERING PUMP

INDEX

DESCRIPTION AND OPERATION

POWER STEERING PUMP

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 fitting. The pressure relief valve inside the flow control valve limits the pump pressure. The reservoir is attached to the pump body with spring clips on the 4.0 L engine. On the 2.5 L engine the reservoir is separate from the pump. It is mounted to the fan shroud.

The power steering pump is connected to the steering gear by the pressure and return hoses. The pump shaft has a pressed-on drive pulley that is belt driven by the crankshaft pulley (Fig. 1).

NOTE: Power steering pumps have different pressure rates and are not interchangeable with other pumps.

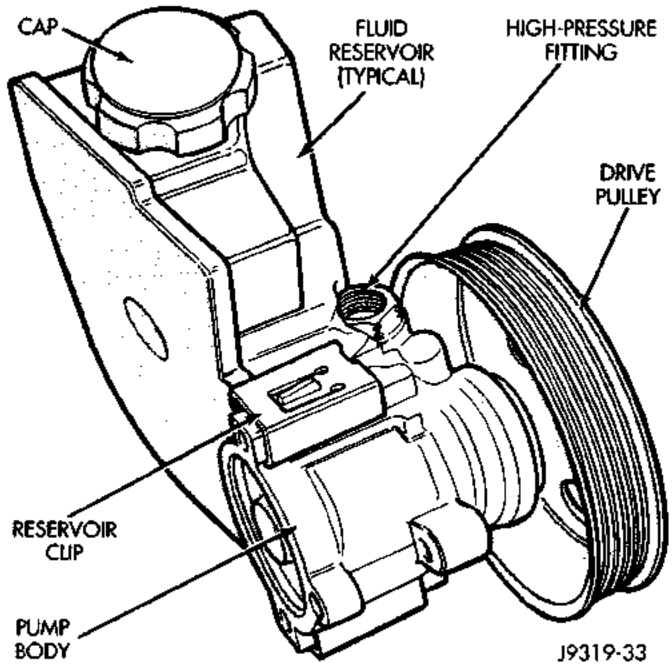


Fig. 1 Typical TC Series Pump With Integral Reservoir

DIAGNOSIS AND TESTING

POWER STEERING PUMP PRESSURE TEST

The following procedure is used to test the operation of the power steering system on the vehicle. This test will provide the flow rate of the power steering pump along with the maximum relief pressure. Perform test any time a power steering system problem is present. This test will determine if the power steering pump or power steering gear is not functioning properly. The following pressure and flow test is performed using Pressure/Flow tester, Special Tool 6815 (Fig. 2).

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 Pressure Gauge/Flow Meter Tool 6815 between the pump pressure fitting and pressure hose using adapters from Adapter Kit 6893.

(4) Open the test valve completely.

(5) Start engine and let idle long enough to circulate power steering fluid through flow/pressure test

DIAGNOSIS AND TESTING (Continued)

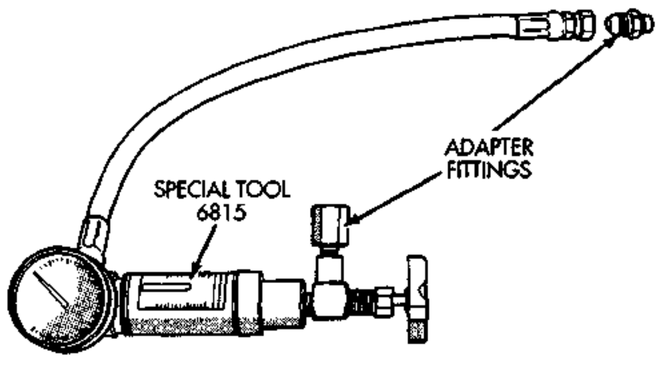


Fig. 2 Pressure Test Gauge

gauge and to get air out of the fluid. Then shut off engine.

(6) Check fluid level, add fluid as necessary. Start engine again and let idle.

(7) Gauge should read below 862 kPa (125 psi), if above, inspect the hoses for restrictions and repair as necessary. The initial pressure reading should be in the range of 345-552 kPa (50-80 psi).

CAUTION: The following test procedure involves testing maximum pump pressure output and flow control valve operation. Do not leave valve closed for more than three seconds as the pump could be damaged.

(8) Close valve fully three times for three seconds and record highest pressure indicated each time. **All three readings must be above specifications and within 345 kPa (50 psi) of each other.**

- Pressures above specifications but not within 345 kPa (50 psi) of each other, replace pump.
- Pressures within 345 kPa (50 psi) of each other but below specifications, replace pump.

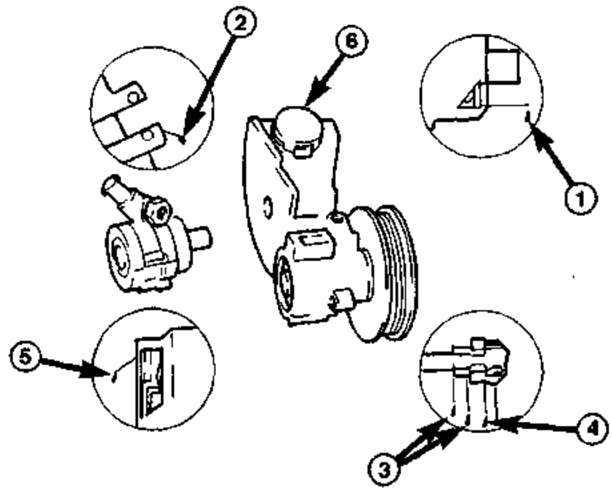
NOTE: Refer to pump relief pressure chart.

CAUTION: Do not force the pump to operate against the stops for more than 2 to 4 seconds at a time because, 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 within 50 psi. against either stop, the gear is leaking internally and must be repaired.

ENGINE	RELIEF PRESSURE ± 50
2.5L	9653 kPa (1400 psi)
4.0L	9653 kPa (1400 psi)

PUMP LEAKAGE DIAGNOSIS



SERVICE PROCEDURES

POWER STEERING PUMP—INITIAL OPERATION

WARNING: THE FLUID LEVEL SHOULD BE CHECKED WITH ENGINE OFF TO PREVENT INJURY FROM MOVING COMPONENTS.

CAUTION: Use MOPAR Power Steering Fluid or equivalent. Do not use automatic transmission fluid and do not overfill.

Wipe filler cap clean, then check the fluid level. The dipstick should indicate **COLD** when the fluid is at normal temperature.

(1) Fill the pump fluid reservoir to the proper level and let the fluid settle for at least two (2) minutes.

(2) Start the engine and let run for a few seconds then turn engine off.

(3) Add fluid if necessary. Repeat the above procedure until the fluid level remains constant after running the engine.

(4) Raise the front wheels off the ground.

(5) Slowly turn the steering wheel right and left, lightly contacting the wheel stops at least 20 times.

SERVICE PROCEDURES (Continued)

(6) Check the fluid level add if necessary.

(7) Lower the vehicle, start the engine and turn the steering wheel slowly from lock to lock.

(8) Stop the engine and check the fluid level and refill as required.

(9) If the fluid is extremely foamy or milky looking, allow the vehicle to stand a few minutes and repeat the procedure.

CAUTION: Do not run a vehicle with foamy fluid for an extended period. This may cause pump damage.

REMOVAL AND INSTALLATION

POWER STEERING PUMP

REMOVAL

(1) Remove serpentine drive belt, refer to Group 7 Cooling.

(2) Remove pressure and return hoses from pump, and drain pump.

(3) Remove 3 pump mounting bolts through pulley access holes.

(4) Loosen the 3 pump bracket bolts (Fig. 3).

(5) Tilt pump downward and remove from engine.

(6) Remove pulley from pump.

INSTALLATION

(1) Install pulley on pump.

(2) Install pump on engine.

(3) Tighten pump bracket bolts to 47 N·m (35 ft. lbs.).

(4) Install 3 pump mounting bolts and tighten to 27 N·m (20 ft. lbs.).

(5) Install the pressure and return hoses on pump.

(6) Install drive belt, refer to Group 7 Cooling.

(7) Add power steering fluid. Refer to Power Steering Pump Initial Operation in this section.

PUMP REMOTE RESERVOIR–2.5L

REMOVAL

(1) Remove the pump return hoses from the reservoir and drain the reservoir.

(2) Remove the reservoir mounting bolt (Fig. 4).

(3) Slide the reservoir up out of the fan shroud mount.

INSTALLATION

(1) Slide reservoir down onto the fan shroud mount until it clicks in place.

(2) Install the reservoir mounting bolt.

(3) Install the pump return hoses.

(4) Fill reservoir to proper level. Refer to Power Steering Pump Initial Operation in this section.

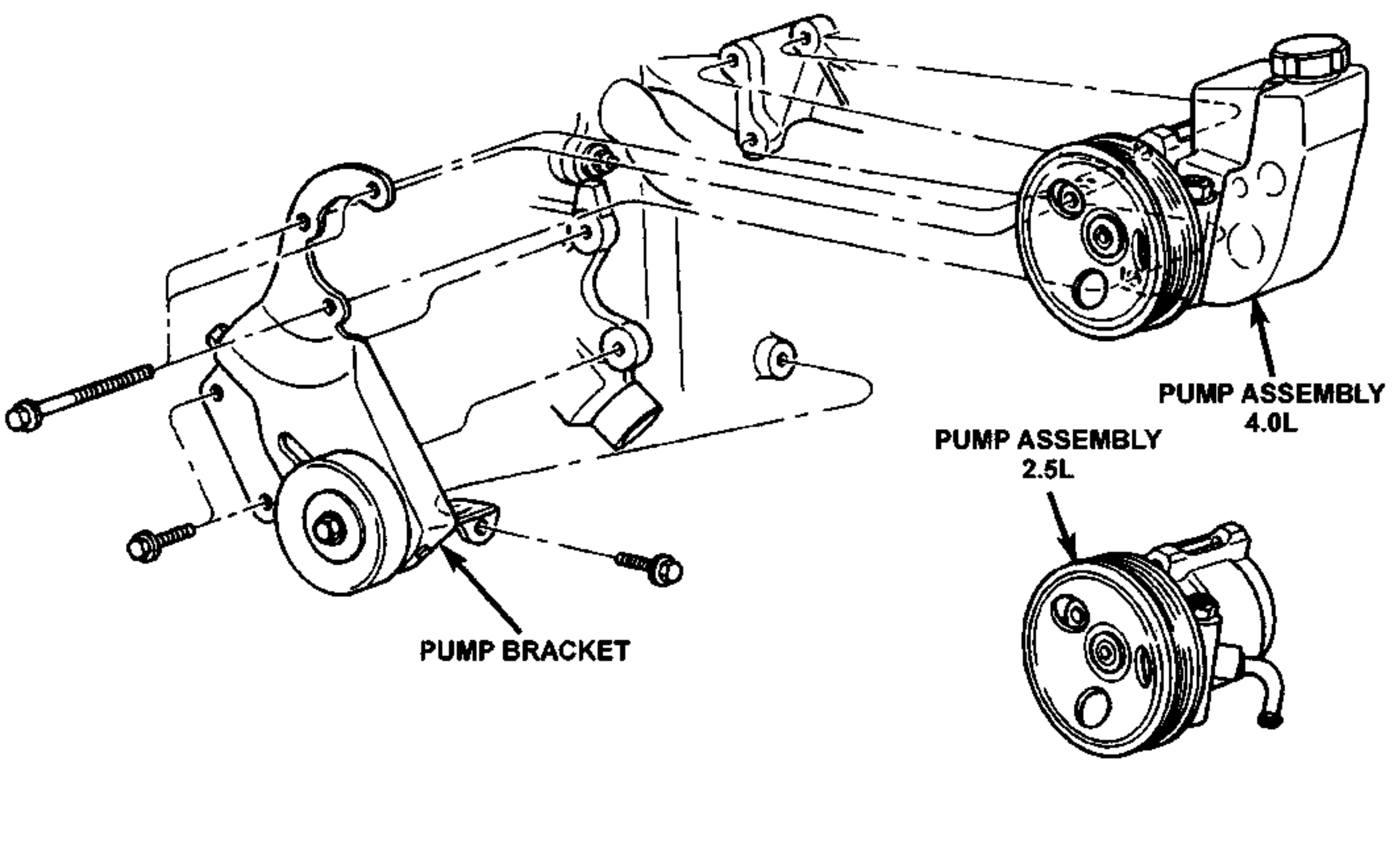


Fig. 3 Pump Mounting

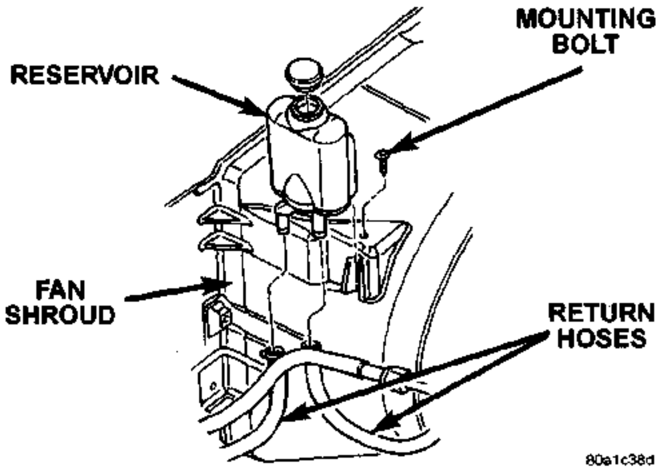


Fig. 4 Pump Reservoir–2.5L

DISASSEMBLY AND ASSEMBLY

TC-SERIES PUMP PULLEY

DISASSEMBLY

(1) Remove pump assembly.

(2) Remove pulley from pump with Puller C-4333 (Fig. 5).

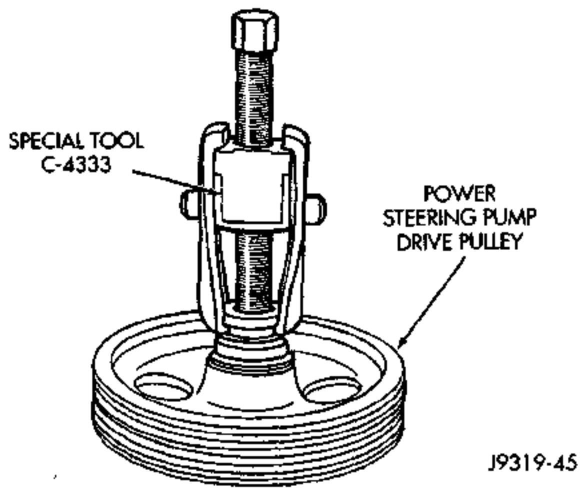


Fig. 5 Pulley Removal

ASSEMBLY

(1) Replace pulley if bent, cracked, or loose.

(2) Install pulley on pump with Installer C-4063-B (Fig. 6) flush with the end of the shaft. Ensure the tool and pulley remain aligned with the pump shaft.

(3) Install pump assembly.

(4) With Serpentine Belts; Run engine until warm (5 min.) and note any belt chirp. If chirp exists, move pulley outward approximately 0.5 mm (0.020 in.). If noise increases, press on 1.0 mm (0.040 in.). **Be careful that pulley does not contact mounting bolts.**

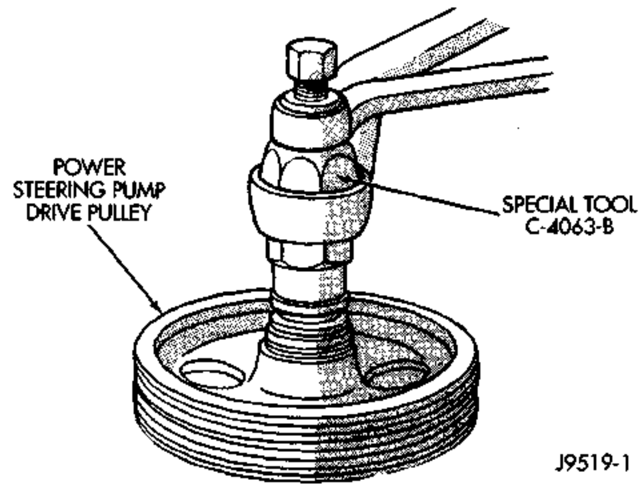


Fig. 6 Pulley Installation

TC-SERIES PUMP RESERVOIR

DISASSEMBLY

(1) Remove power steering pump.

(2) Clean exterior of pump.

(3) Clamp the pump body in a soft jaw vice.

(4) Pry up tab and slide the retaining clips off (Fig. 7).

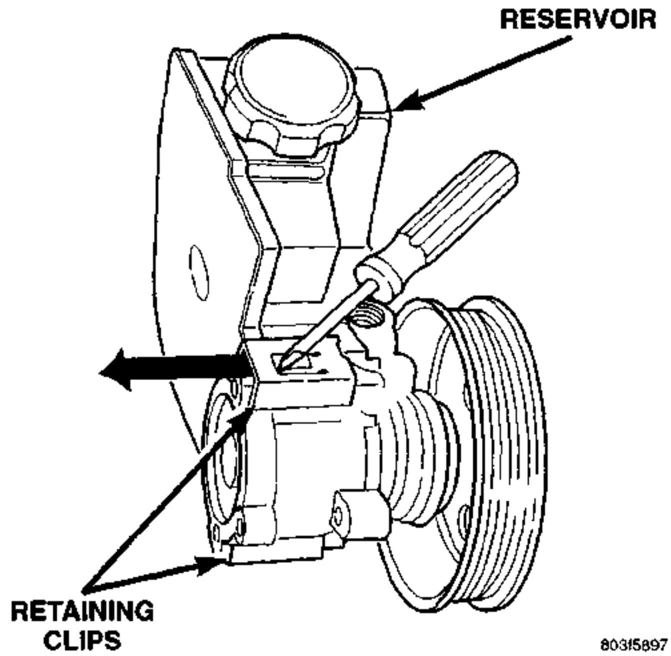


Fig. 7 Pump Reservoir Clips

(5) Remove fluid reservoir from pump body. Remove and discard O-ring seal.

ASSEMBLY

(1) Lubricate new O-ring Seal with Mopar Power Steering Fluid or equivalent.

(2) Install O-ring seal in housing.

DISASSEMBLY AND ASSEMBLY (Continued)

(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

DISASSEMBLY

(1) Clean area around fitting to prevent dirt from entering pump. Remove pressure hose from pump fitting.

(2) Remove fitting from pump housing (Fig. 8). **Prevent flow control valve and spring from sliding out of housing bore.**

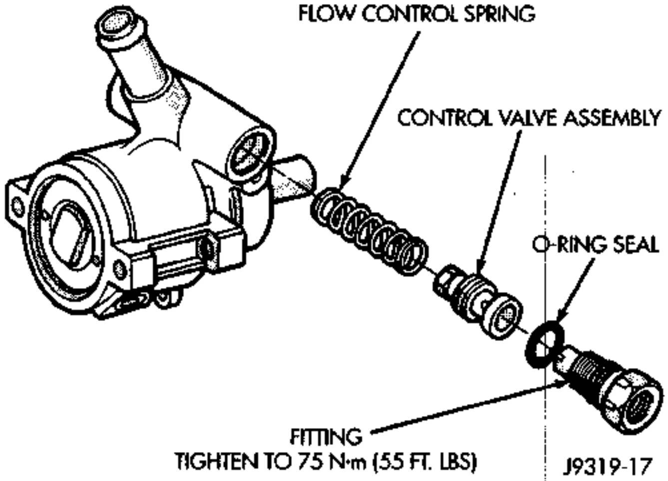


Fig. 8 Flow Control Valve

(3) Remove and discard O-ring seal.

ASSEMBLY

(1) Install spring and flow control valve into pump housing bore. **Be sure the hex nut end of the valve is facing in toward pump.**

(2) Install O-ring seal onto fitting.

(3) Install flow control valve in pump housing and tighten to 75 N·m (55 ft. lbs.).

(4) Install pressure hose to valve.

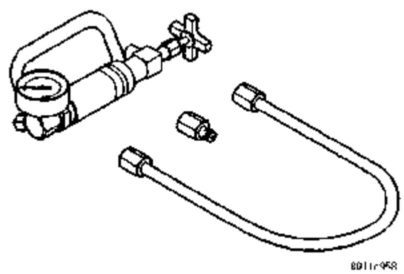
SPECIFICATIONS

TORQUE CHART

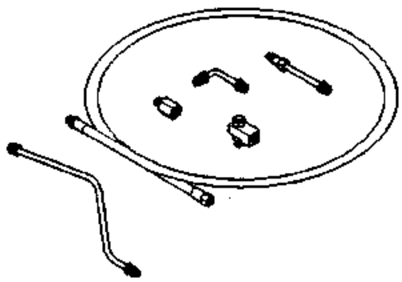
DESCRIPTION	TORQUE
Power Steering Pump	
Bracket to Pump	28 N·m (21 ft. lbs.)
Bracket to Engine	47 N·m (35 ft. lbs.)
Flow Control Valve	75 N·m (55 ft. lbs.)
Pressure Line	28 N·m (21 ft. lbs.)

SPECIAL TOOLS

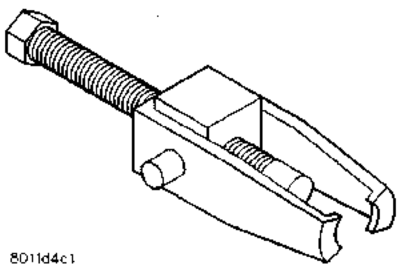
POWER STEERING PUMP



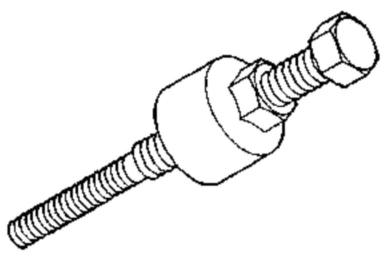
Analyzer Set, Power Steering Flow/Pressure 6815



Adapters, Power Steering Flow/Pressure Tester 6893



Puller C-4333



Installer, Power Steering Pulley C-4063–B

POWER STEERING GEAR

INDEX

DESCRIPTION AND OPERATION

POWER STEERING GEAR

The power steering gear is a recirculating ball type gear (Fig. 1). The gear acts as a rolling thread between the worm shaft and rack piston. The worm shaft is supported by a thrust bearing at the lower end and a bearing assembly at the upper end. When the worm shaft is turned the rack piston moves. The rack piston teeth mesh with the pitman shaft. Turning the worm shaft turns the pitman shaft, which turns the steering linkage.

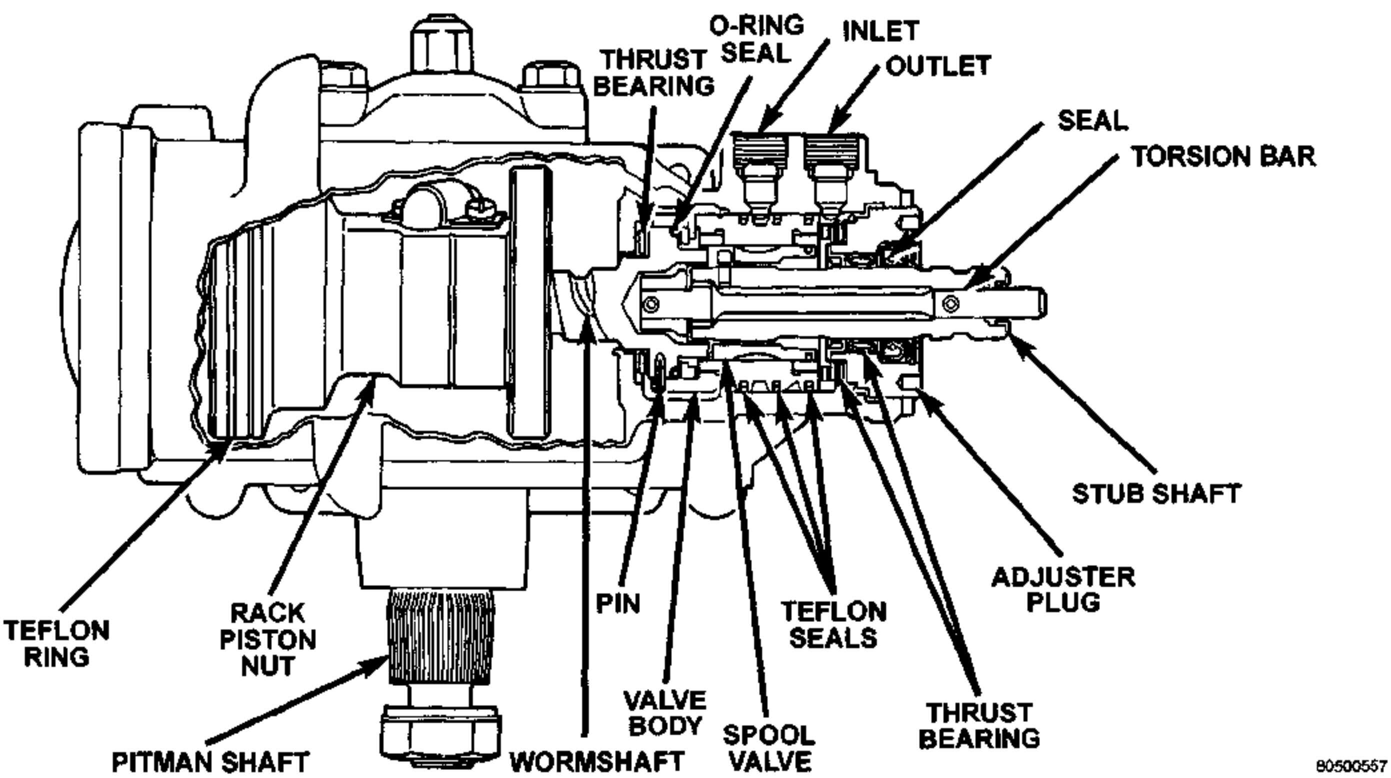
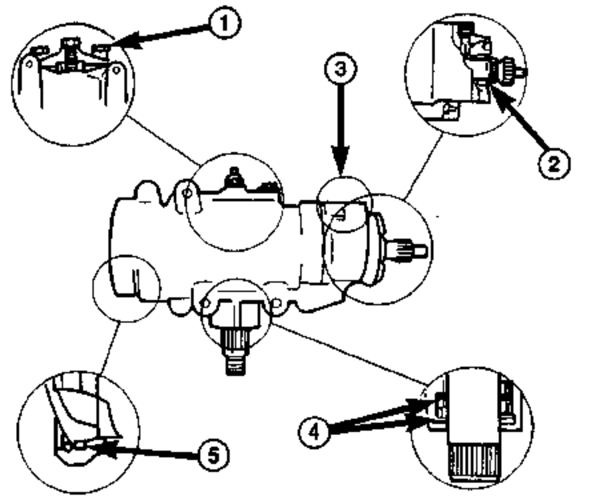


Fig. 1 Power Steering Gear

DIAGNOSIS AND TESTING

POWER STEERING GEAR LEAKAGE DIAGNOSIS



REMOVAL AND INSTALLATION

PITMAN SHAFT SEALS–IN VEHICLE

REMOVAL

CAUTION: Use care not to score the housing bore when prying out seals and washers.

(1) Remove pitman arm from gear.
(2) Clean exposed end of pitman shaft and housing. Use a wire brush to clean the shaft splines.
(3) Remove dust seal.
(4) Remove retaining ring with snap ring pliers (Fig. 2).
(5) Remove backup washer with screwdriver.
(6) Start the engine and turn steering wheel fully to the LEFT. Hydraulic pressure will force the oil seal out.
(7) Turn off engine and remove oil seal with screwdriver.
(8) Inspect the housing for burrs and remove if necessary. Inspect the pitman shaft seal surface for roughness and pitting. If shaft is damaged it will have to be replaced.

INSTALLATION

(1) Coat the seals and washers with grease.
(2) Install oil seal with a suitable size deep socket.

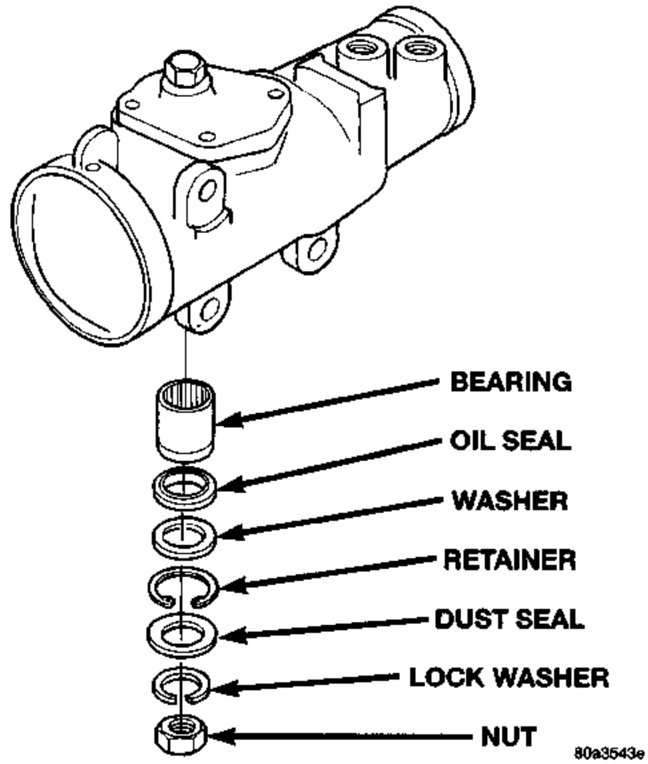


Fig. 2 Pitman Shaft Seal

(3) Install backup washer.
(4) Install the retainer ring with snap ring pliers.
(5) Install dust seal with a suitable size deep socket.
(6) Center the steering gear and install pitman arm.
(7) Add power steering fluid, refer to Power Steering Initial Operation.

POWER STEERING GEAR

REMOVAL

(1) Place the front wheels in the straight ahead position with the steering wheel centered.
(2) Disconnect and cap the fluid hoses/tubes from power steering pump.
(3) Remove the column coupler shaft from the gear.
(4) Remove pitman arm from gear.
(5) Remove the steering gear retaining bolts and remove the gear (Fig. 3).
(6) Remove power steering hoses/tubes from steering gear.

INSTALLATION

(1) Install power steering hoses/tubes to steering gear and tighten to 28 N·m (21 ft. lbs.).
(2) Install steering gear on the frame rail and tighten bolts to 95 N·m (70 ft. lbs.)

REMOVAL AND INSTALLATION (Continued)

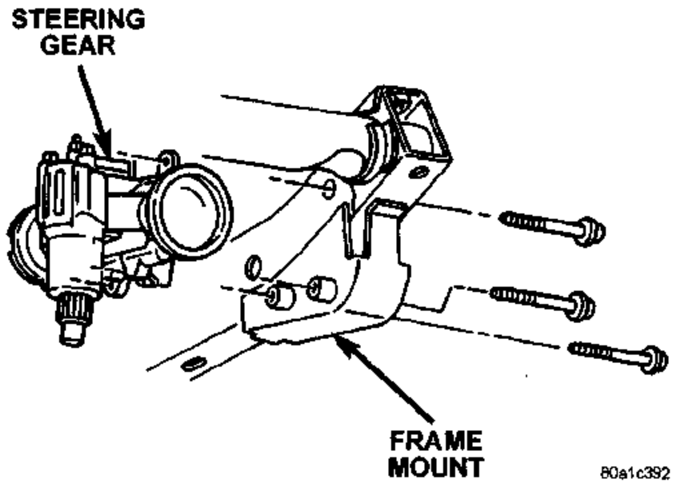


Fig. 3 Steering Gear Mounting

(3) Align the column coupler shaft to steering gear and tighten coupler bolt.

(4) Align and install the pitman arm and tighten nut to 251 N·m (185 ft. lbs.).

(5) Install power steering hoses/tubes to power steering pump.

(6) Fill power steering system to proper level, refer to Steering Pump Initial Operation.

DISASSEMBLY AND ASSEMBLY

PITMAN SHAFT

Steering gear must be removed from the vehicle for this procedure.

DISASSEMBLY

(1) Clean exposed end of pitman shaft and housing with a wire brush.

(2) Remove preload adjuster nut.

(3) Rotate stub shaft with socket to center gear.

(4) Remove side cover bolts and remove side cover, gasket and pitman shaft as an assembly.

(5) Remove pitman shaft from the side cover (Fig. 4).

ASSEMBLY

(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.

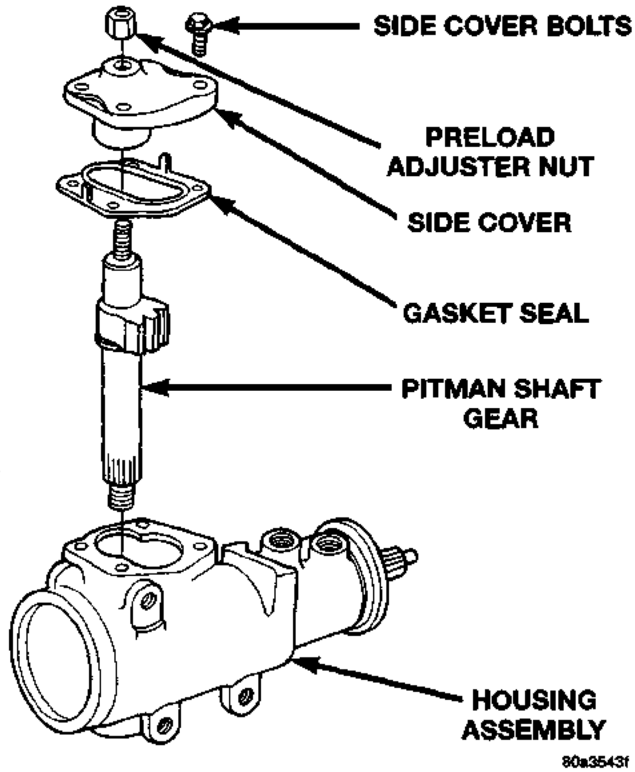


Fig. 4 Side Cover and Pitman Shaft

HOUSING END PLUG

Steering gear must be removed from the vehicle for this procedure.

DISASSEMBLY

(1) Rotate retaining ring until one end is under the hole in the housing. Unseat and force ring from groove (Fig. 5).

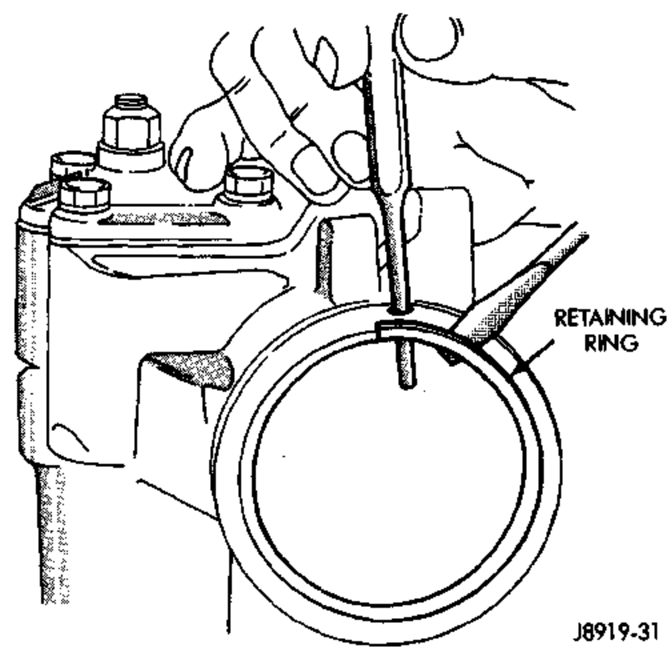


Fig. 5 End Plug Retaining Ring

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Rotate stub shaft slowly COUNTER-CLOCKWISE to remove end plug out from housing.

CAUTION: Do not turn stub shaft any further 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. 6).

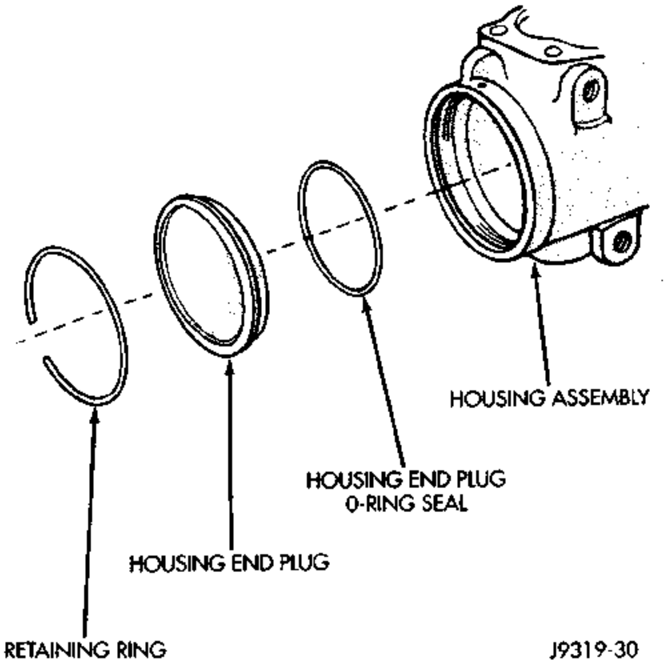


Fig. 6 End Plug Components

ASSEMBLY

(1) Lubricate O-ring seal with power steering fluid.
(2) Install O-ring into housing.
(3) Install plug, tap lightly with a plastic mallet to seat it.
(4) Install retaining ring with open end 25 mm (1 inch) from access hole (Fig. 7).
(5) Adjust pitman arm shaft, refer to Over-Center Adjustment.

ADJUSTER PLUG ASSEMBLY

Steering gear must be removed from the vehicle for this procedure.

DISASSEMBLY

(1) Remove adjuster plug lock nut from housing.
(2) Remove adjuster plug from housing with Spanner Wrench C-4381 (Fig. 8).
(3) Remove thrust washer bearing retainer from adjuster plug with screwdriver (Fig. 9).
(4) Remove bearing spacer, races and thrust bearing (Fig. 10).
(5) Remove O-ring seal and retaining snap ring.

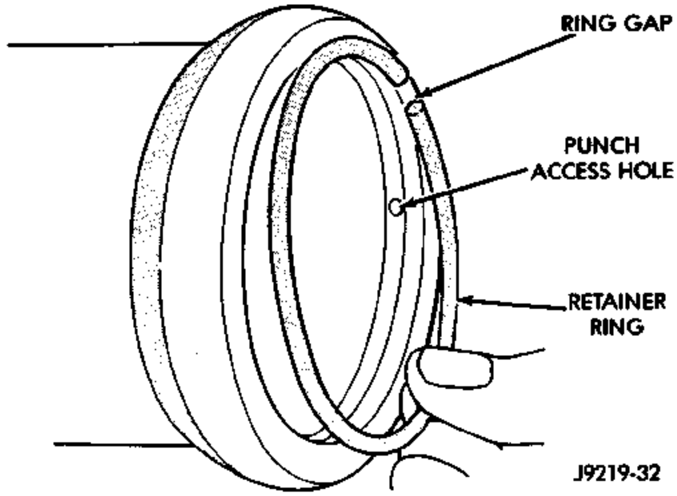


Fig. 7 Installing The Retaining Ring

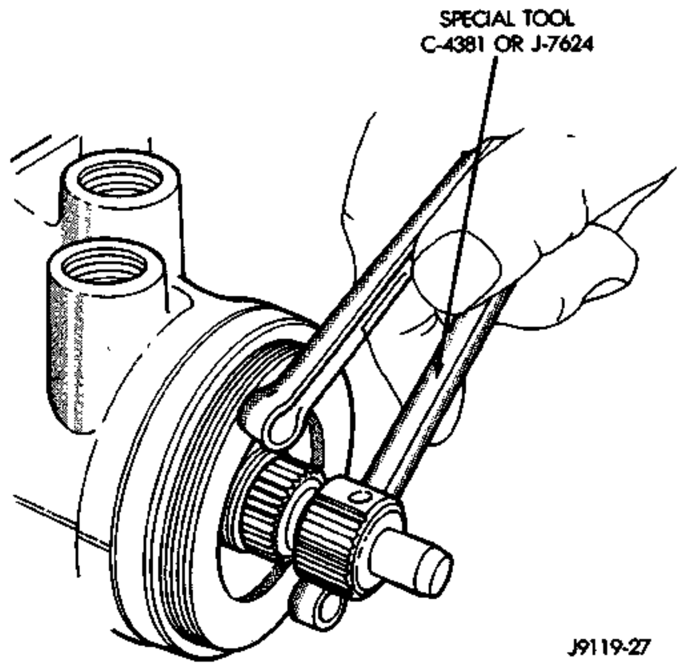


Fig. 8 Adjustment Plug

(6) Remove needle bearing, dust seal and oil seal with remover/installer C-4177 and handle C-4171 (Fig. 11).

ASSEMBLY

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 remover/install C-4177 and handle C-4171.
(2) Apply white petroleum grease on oil seal. Install oil seal into adjuster plug with remover/installer C-4177 and handle C-4171.

DISASSEMBLY AND ASSEMBLY (Continued)

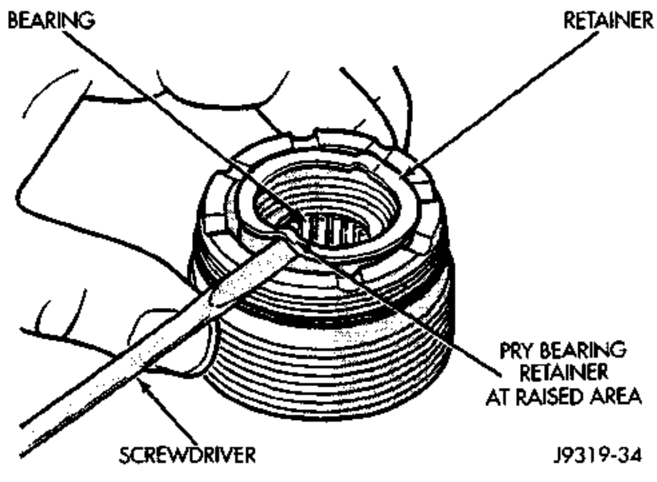


Fig. 9 Bearing Retainer

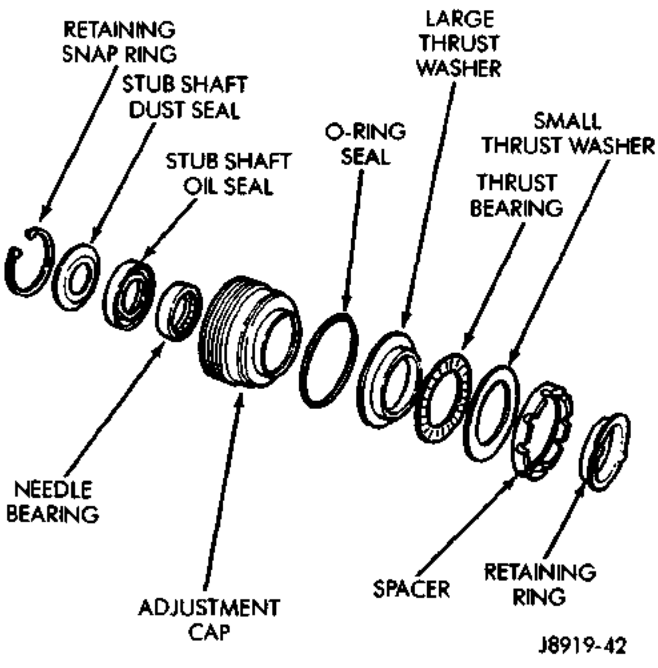


Fig. 10 Adjustment Plug Components

(3) Apply white petroleum grease to dust seal cavity and install dust seal into adjuster plug with remover/installer C-4177 and handle C-4171.

(4) Install retainer snap ring.

(5) Install O-ring seal to adjuster plug.

(6) Install large bearing race, thrust bearing, small bearing race and bearing spacer to adjuster plug.

(7) Install thrust washer bearing retainer to adjuster plug (Fig. 12).

CAUTION: When installing adjuster plug, care should be taken not to cut the seals.

(8) Install adjuster plug into housing with Spanner Wrench C-4381.

(9) Adjust bearing preload, refer to Thrust Bearing Preload Adjustment.

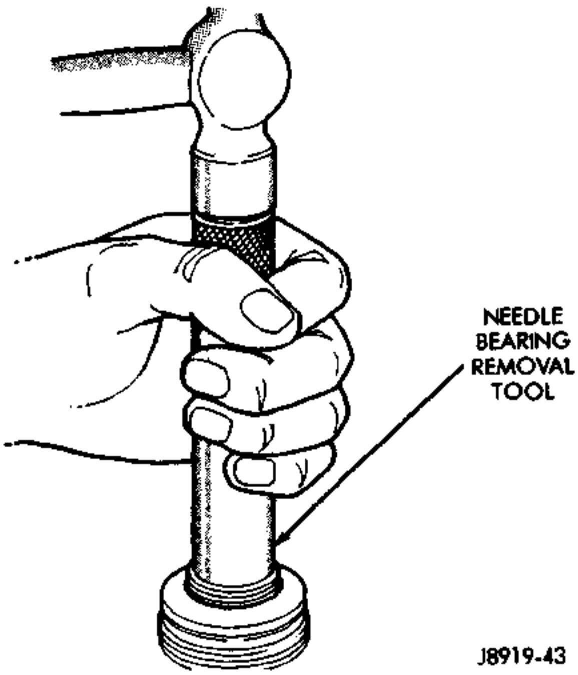


Fig. 11 Needle Bearing Removal

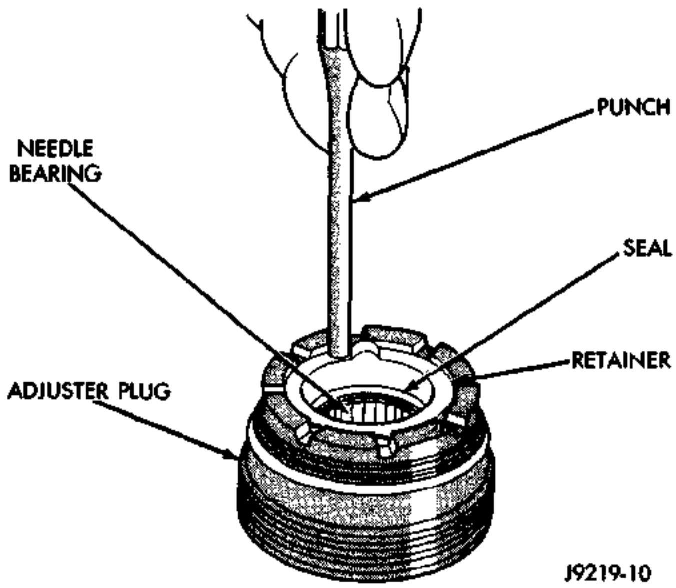


Fig. 12 Install Retainer

(10) Install adjuster plug lock nut, and using a punch (drift) in a notch, tighten securely (Fig. 13). **Hold adjuster plug to maintain alignment of the marks.**

(11) Adjust pitman shaft, refer to Over-Center Adjustment.

SPOOL VALVE

Steering gear must be removed from the vehicle for this procedure.

DISASSEMBLY AND ASSEMBLY (Continued)

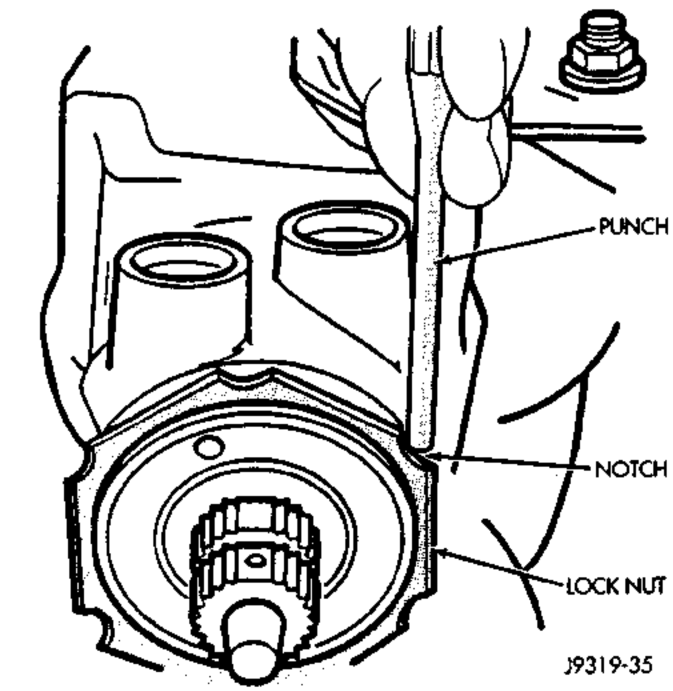


Fig. 13 Tighten Lock Nut

DISASSEMBLY

(1) Remove adjuster plug, refer to Adjuster Plug Assembly Replacement.

(2) Remove stub shaft and valve assembly (Fig. 14).

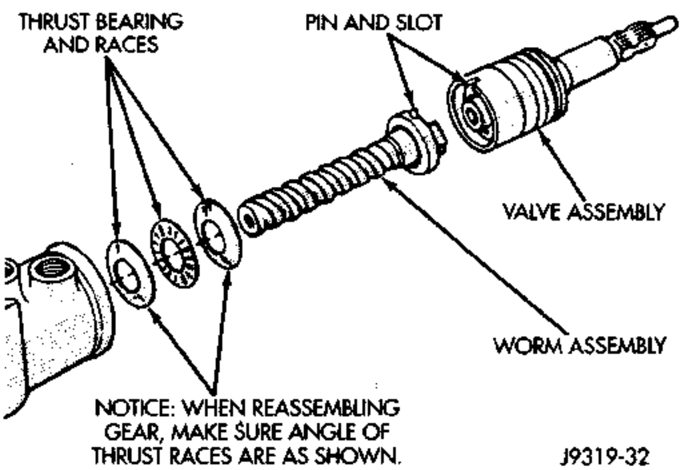


Fig. 14 Bearing, Worm and Valve Assembly

(3) Remove stub shaft from valve assembly by lightly tapping on a block of wood to loosen shaft cap. Then pull cap and valve body and disengage stub shaft pin from hole in valve body (Fig. 15).

(4) Remove valve spool by pulling and rotating from valve body (Fig. 16).

(5) Remove valve spool O-ring seal and valve body teflon rings and O-ring seals (Fig. 17).

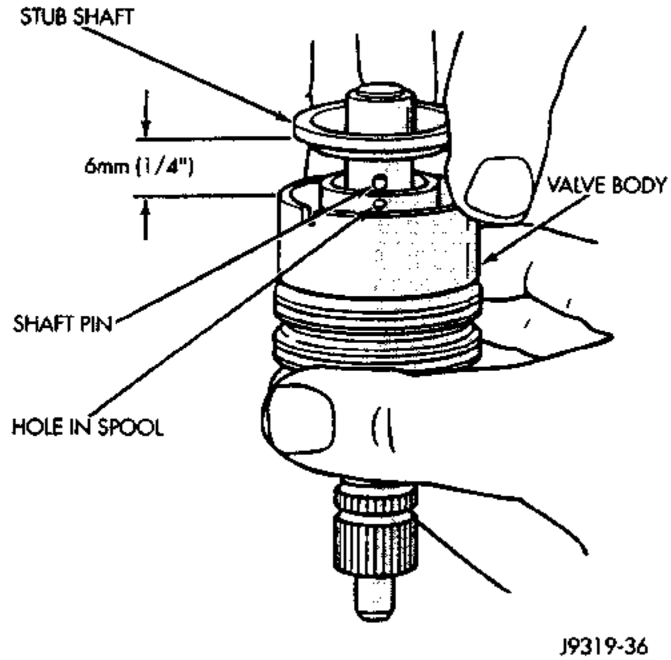


Fig. 15 Stub Shaft

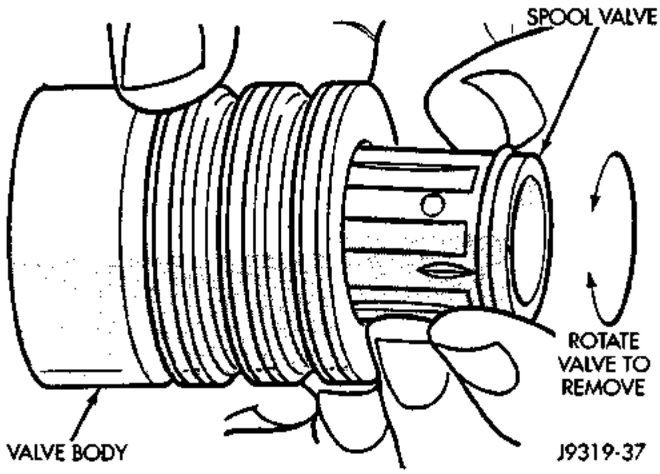


Fig. 16 Spool Valve

ASSEMBLY

(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. 18).

NOTE: 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.

DISASSEMBLY AND ASSEMBLY (Continued)

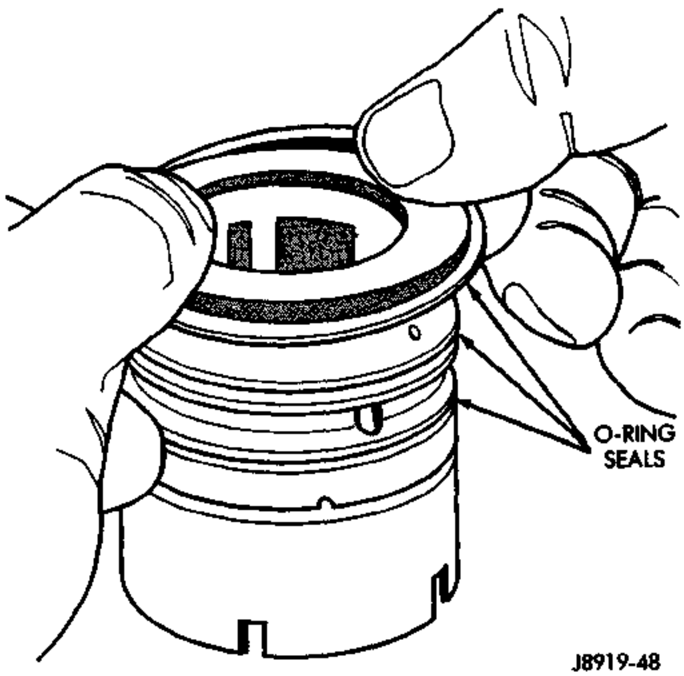


Fig. 17 Valve Seals

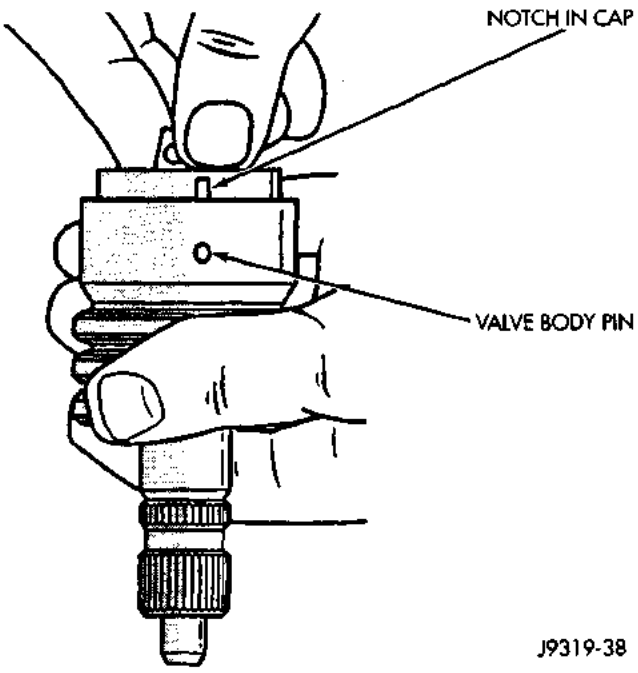


Fig. 18 Stub Shaft Installation

(6) Lubricate O-ring seals and teflon rings with power steering fluid.

(7) Install stub shaft and valve assembly to worm shaft. Line up worm shaft to slot in the valve assembly.

(8) Install adjuster plug.

(9) Adjust Thrust Bearing Preload Adjustment and Over-Center Adjustment.

RACK PISTON AND WORM SHAFT

Steering gear must be removed from the vehicle for this procedure.

DISASSEMBLY

(1) Remove pitman shaft and side cover.

(2) Remove housing end plug.

(3) Turn stub shaft COUNTERCLOCKWISE until the rack piston begins to come out of the housing.

(4) Remove rack piston plug (Fig. 19).

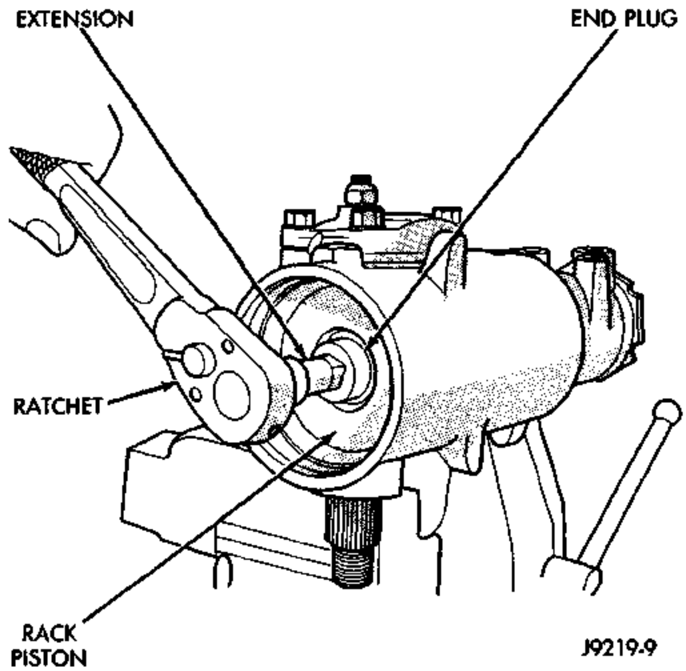


Fig. 19 Rack Piston End Plug

(5) Insert Arbor C-4175 into bore of rack piston (Fig. 20). Hold tool tightly against worm shaft while turning the stub shaft COUNTERCLOCKWISE.

(6) The rack piston will be forced onto the tool and hold the rack piston balls in place.

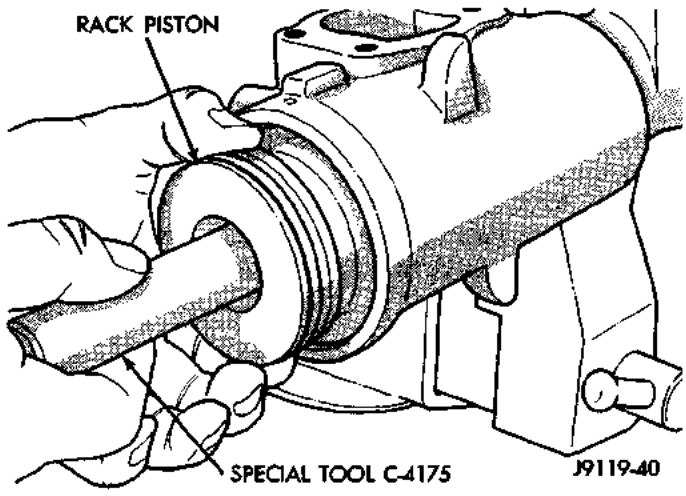


Fig. 20 Rack Piston

DISASSEMBLY AND ASSEMBLY (Continued)

(7) Remove the rack piston, rack balls, and tool together from housing.

(8) Remove valve, worm shaft and thrust bearing and races.

(9) Remove tool from rack piston.

(10) Remove rack piston balls.

(11) Remove screws, clamp and ball guide.

(12) Remove teflon ring and O-ring seal (Fig. 21).

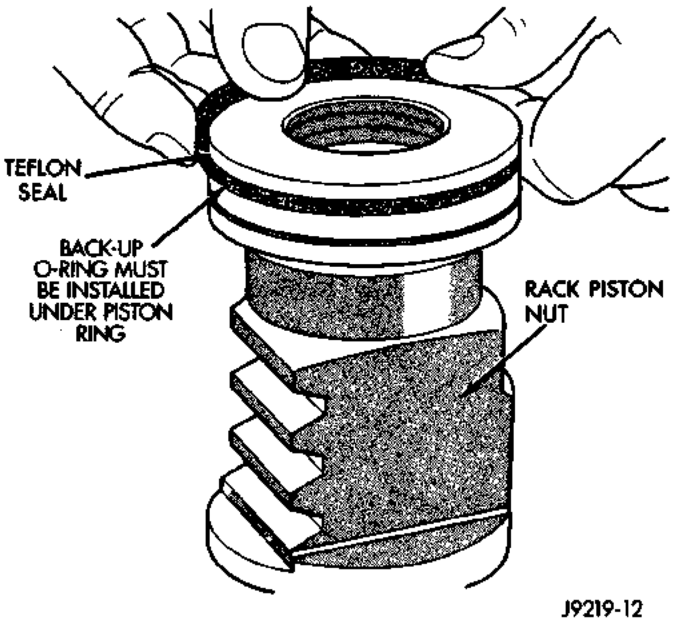


Fig. 21 Rack Piston Teflon Ring and O-Ring

ASSEMBLY

(1) Clean all components in 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.

(3) Install O-ring seal and teflon ring and lubricate with power steering fluid.

(4) Install worm shaft to rack piston outside of housing. Fully seat worm shaft to rack piston. Align worm shaft spiral groove with rack piston ball guide hole (Fig. 22).

NOTE: There are 12 black and 12 silver (Chrome) balls in the rack piston circuit. The black balls are smaller than the silver balls. The balls must be installed alternately into the rack piston and ball guide. This procedure will maintain worm shaft preload.

(5) Lubricate and install rack piston balls through return guide hole while turning worm shaft COUNTERCLOCKWISE.

WARNING: MAKE SURE ALL RACK PISTON BALLS ARE INSTALLED PROPERLY. IMPROPER INSTALLATION MAY RESULT IN PERSONAL INJURY.

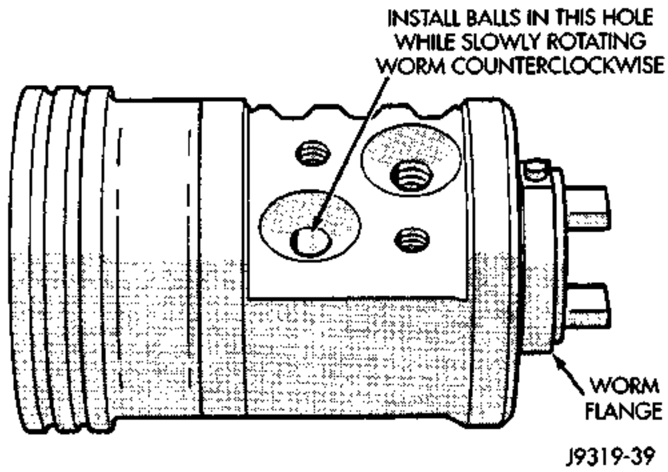


Fig. 22 Installing Balls in Rack Piston

(6) Install remaining balls to guide using grease or petroleum jelly at each end to hold in place (Fig. 23).

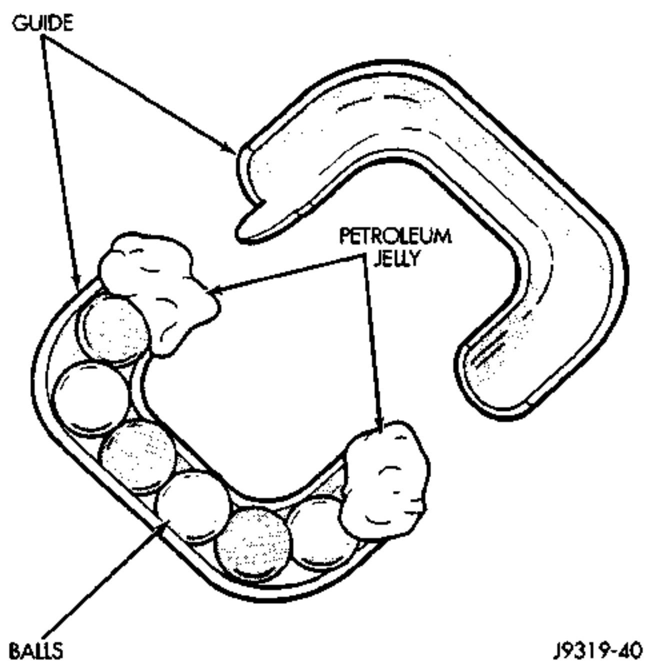


Fig. 23 Balls in the Return Guide

(7) Install guide onto rack piston and return with clamp and screws. Tighten screws to 58 N·m (43 ft. lbs.).

(8) Insert Arbor C-4175 into bore of rack piston. Hold tool tightly against worm shaft while turning the stub shaft COUNTERCLOCKWISE.

(9) The rack piston will be forced onto the tool and hold the rack piston balls in place.

(10) Install the races and thrust bearing to worm shaft (Fig. 24).

(11) Install worm shaft to housing.

(12) Install valve

(13) Install rack piston to worm shaft from tool, compress seals.

DISASSEMBLY AND ASSEMBLY (Continued)

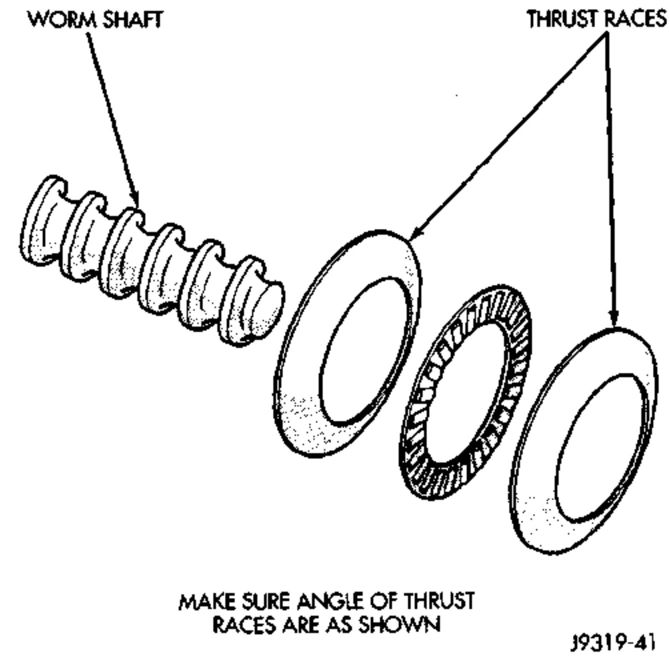


Fig. 24 Worm Shaft and Bearing

(14) Hold Arbor tightly against worm shaft and turn stub shaft CLOCKWISE until rack piston is seated on worm shaft.

(15) Install rack piston plug and tighten to 150 N·m (111 ft. lbs.).

(16) Install housing end plug.

(17) Install pitman shaft and side cover.

(18) Adjust steering gear.

PITMAN SHAFT SEALS AND BEARING

DISASSEMBLY

(1) Remove pitman arm from gear.

(2) Clean exposed end of pitman shaft and housing with a wire brush.

(3) Remove dust seal.

(4) Remove retaining ring with snap ring pliers (Fig. 25).

(5) Remove backup washer with screwdriver.

CAUTION: Use care not to score the housing bore when prying out seals and washers.

(6) Remove oil seal with screwdriver.

(7) Inspect the housing for burrs and remove if necessary.

(8) Remove needle bearing from housing (Fig. 26).

ASSEMBLY

(1) Install needle bearing into housing (Fig. 25).

(2) Coat the oil seal and washers with grease.

(3) Install the oil seal with a suitable size deep socket.

(4) Install backup washer.

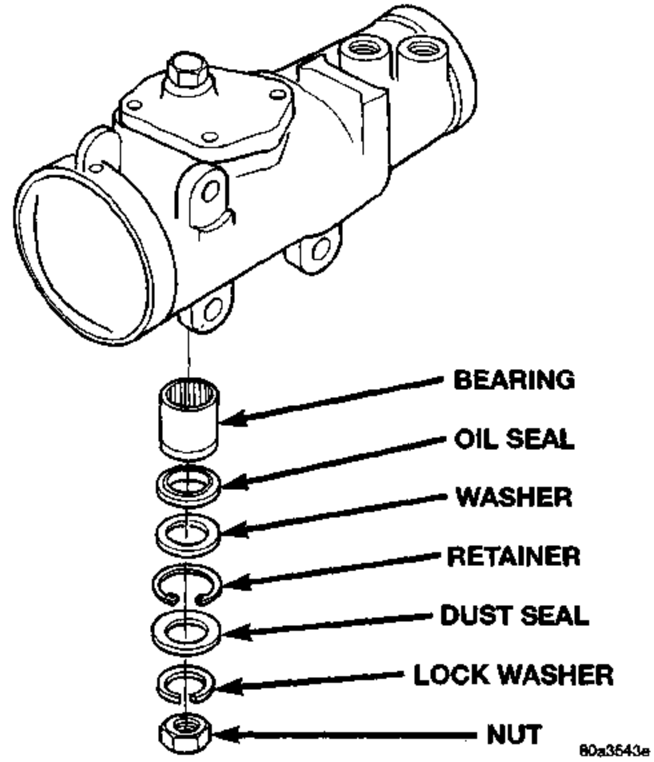


Fig. 25 Pitman Shaft Seals & Bearing

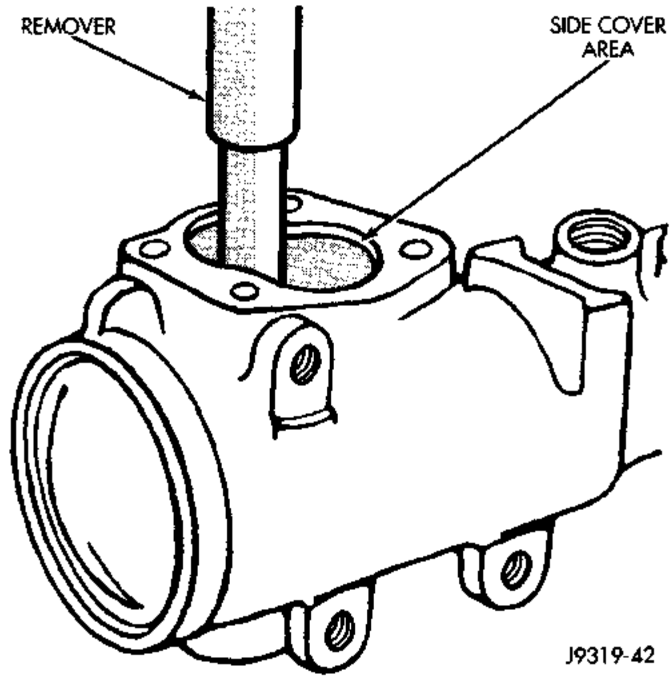


Fig. 26 Needle Bearing Removal

(5) Install the retainer ring with snap ring pliers.

(6) Install dust seal with a suitable size deep socket.

ADJUSTMENTS

STEERING GEAR

CAUTION: Steering gear must be adjusted in the proper order. If adjustments are not performed in order, gear damage and improper steering response may result.

NOTE: Adjusting the steering gear in the vehicle is not recommended. Remove gear from the vehicle and drain the fluid. Then mount gear in a vise to perform adjustments.

WORM THRUST BEARING PRELOAD

(1) Remove adjuster plug locknut (Fig. 27).

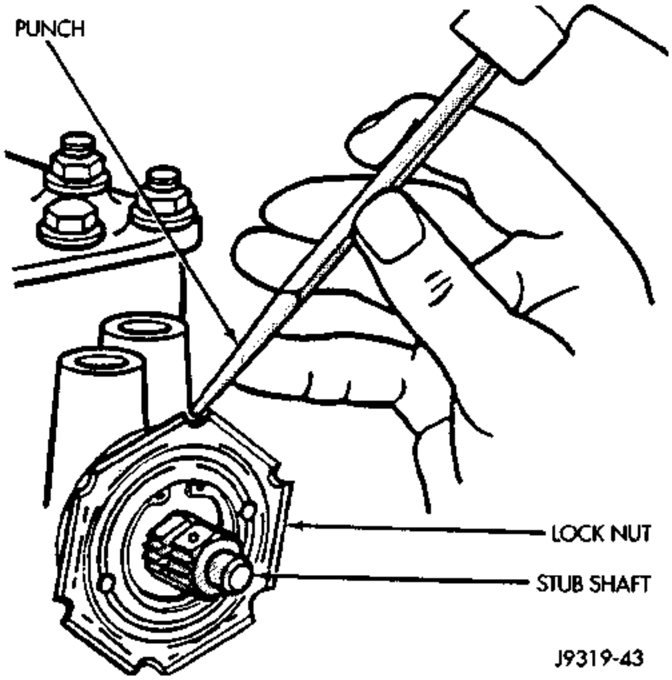


Fig. 27 Loosening the Adjuster Plug

(2) Turn the adjuster in with Spanner Wrench C-4381. 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. 28).

(4) Measure back (counterclockwise) 13 mm (0.50 in) and mark housing (Fig. 29).

(5) Rotate adjustment cap back (counterclockwise) with spanner wrench until hole is aligned with the second mark (Fig. 30).

(6) Install and tighten locknut to 108 N·m (80 ft. lbs.). Be sure adjustment cap does not turn while tightening the locknut.

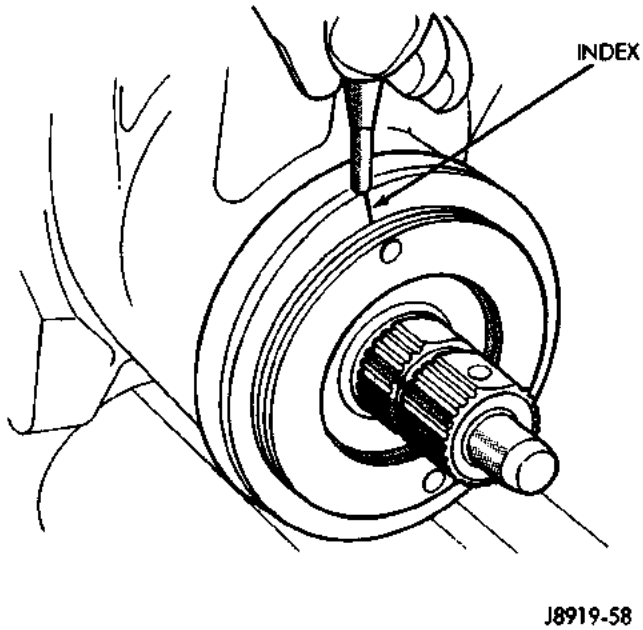


Fig. 28 Alignment Marking On Housing

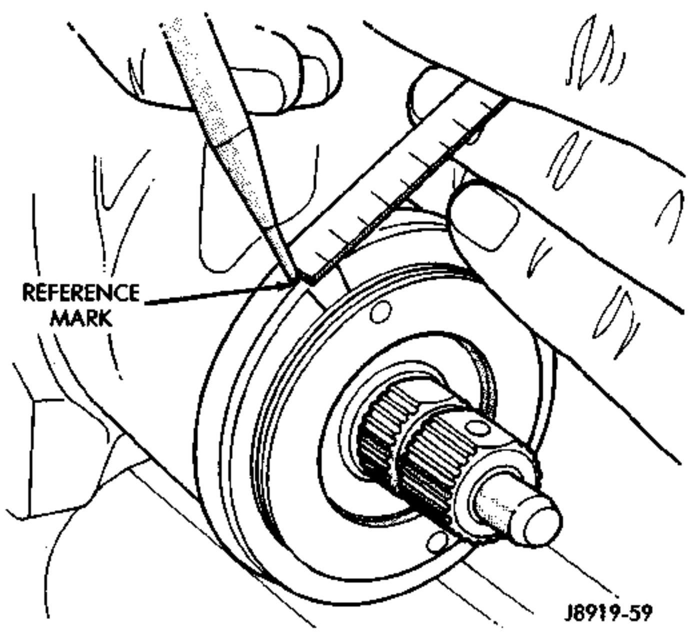


Fig. 29 Remarking The Housing

OVER-CENTER

(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. 31).

(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

ADJUSTMENTS (Continued)

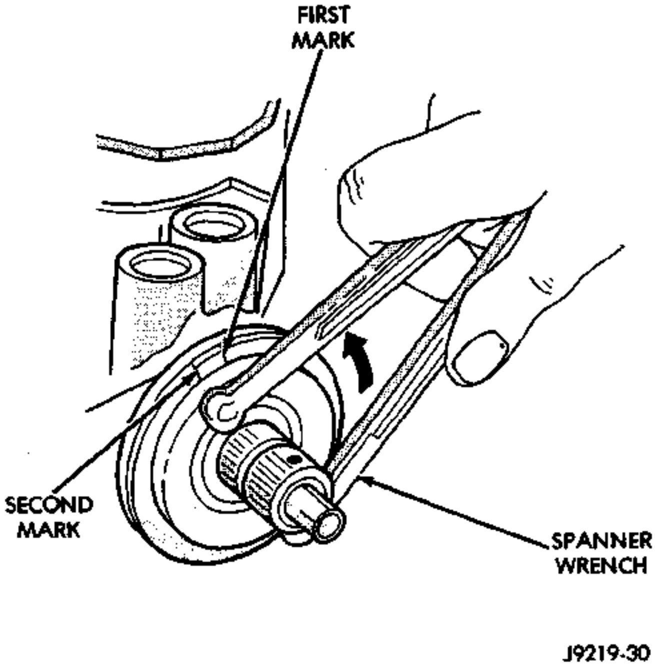


Fig. 30 Aligning To The Second Mark

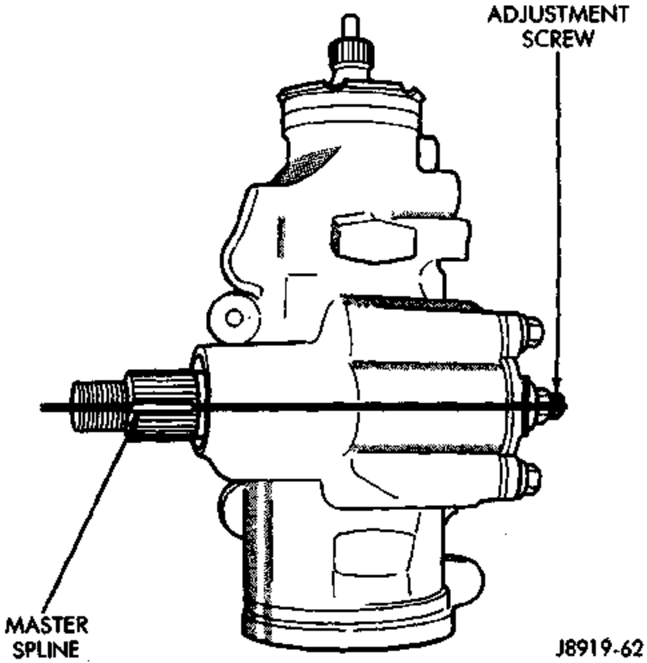


Fig. 31 Steering Gear Centered

side of the center and record the highest rotational torque on center (Fig. 32).

(5) Turn the adjuster in until torque to turn stub shaft is 0.6 to 1.2 N·m (6.0 to 10.0 in. lbs.) more than previous reading recorded.

(6) Prevent the adjuster screw from turning while tightening adjuster lock nut. Tighten the adjuster lock nut to 27 N·m (20 ft. lbs.).

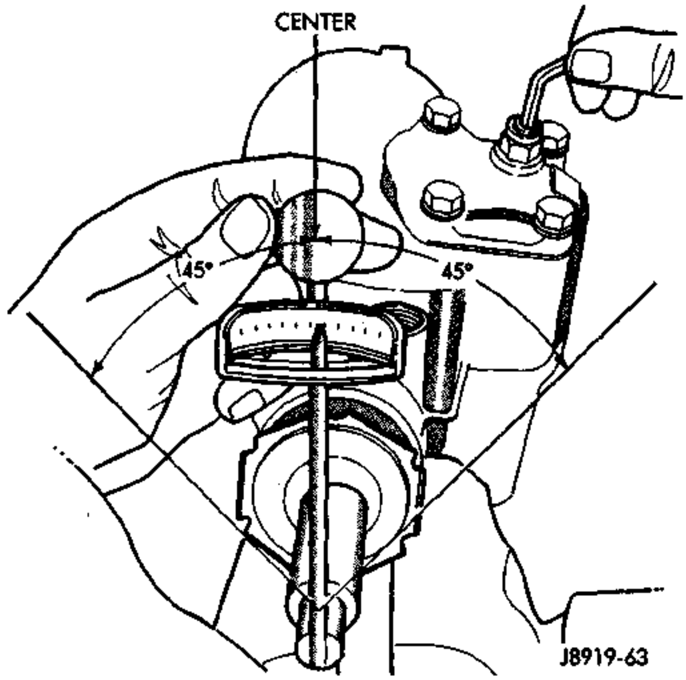


Fig. 32 Checking Over-center Rotation Torque

SPECIFICATIONS

POWER STEERING GEAR

Steering Gear
Type . . . . .Recirculating Ball
Gear Ratio 14:1
Worm Shaft Bearing
Preload. . . . . .0.45–1.13 N·m (4–10 in. lbs.)
Pitman Shaft Over-Center Drag
New Gear (under 400 miles). . .0.45–0.90 N·m (4–8 in. lbs.) + Worm Shaft Preload
Used Gear (over 400 miles). . .0.5–0.6 N·m (4–5 in. lbs.) + Worm Shaft Preload

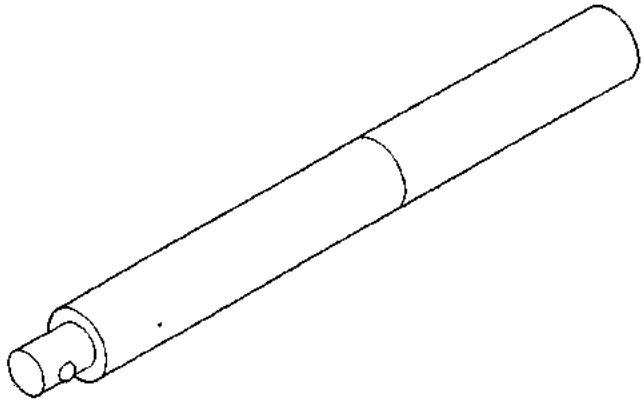
TORQUE CHART

DESCRIPTION	TORQUE
Power Steering Gear	
Adjustment Cap Locknut	108 N·m (80 ft. lbs.)
Adjustment Screw Locknut	49 N·m (36 ft. lbs.)
Gear to Frame Bolts	95 N·m (70 ft. lbs.)
Pitman Shaft Nut	251 N·m (185 ft. lbs.)
Rack Piston Plug	102 N·m (75 ft. lbs.)
Side Cover Bolts	60 N·m (44 ft. lbs.)
Pressure Line	28 N·m (21 ft. lbs.)
Return Line	28 N·m (21 ft. lbs.)

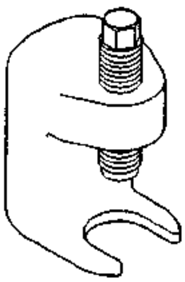
SPECIAL TOOLS

POWER STEERING GEAR

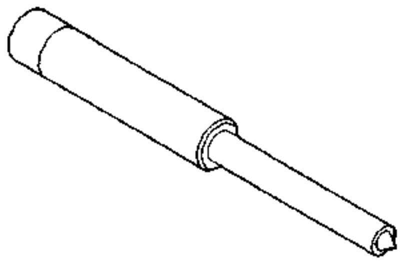
Remover/Installer, Steering Plug C-4381



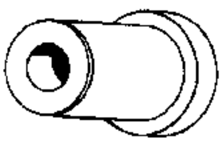
Handle C-4171



Remover, Pitman Arm C-4150A



Remover/Installer Steering Rack Piston C-4175



Remover, Pitman Shaft Bearing C-4177

MANUAL STEERING GEAR

INDEX

DESCRIPTION AND OPERATION

MANUAL STEERING GEAR

The manual steering gear is a recirculating-ball, nut and worm type (Fig. 1). The worm is located on the lower end of the worm shaft. The ball nut is mounted on the worm and the balls act as a rolling thread between the worm and nut. Teeth on the ball nut engage teeth on the pitman shaft. The teeth on the ball nut are made to fit tighter between the ball nut and pitman shaft when the front wheels are position straight ahead.

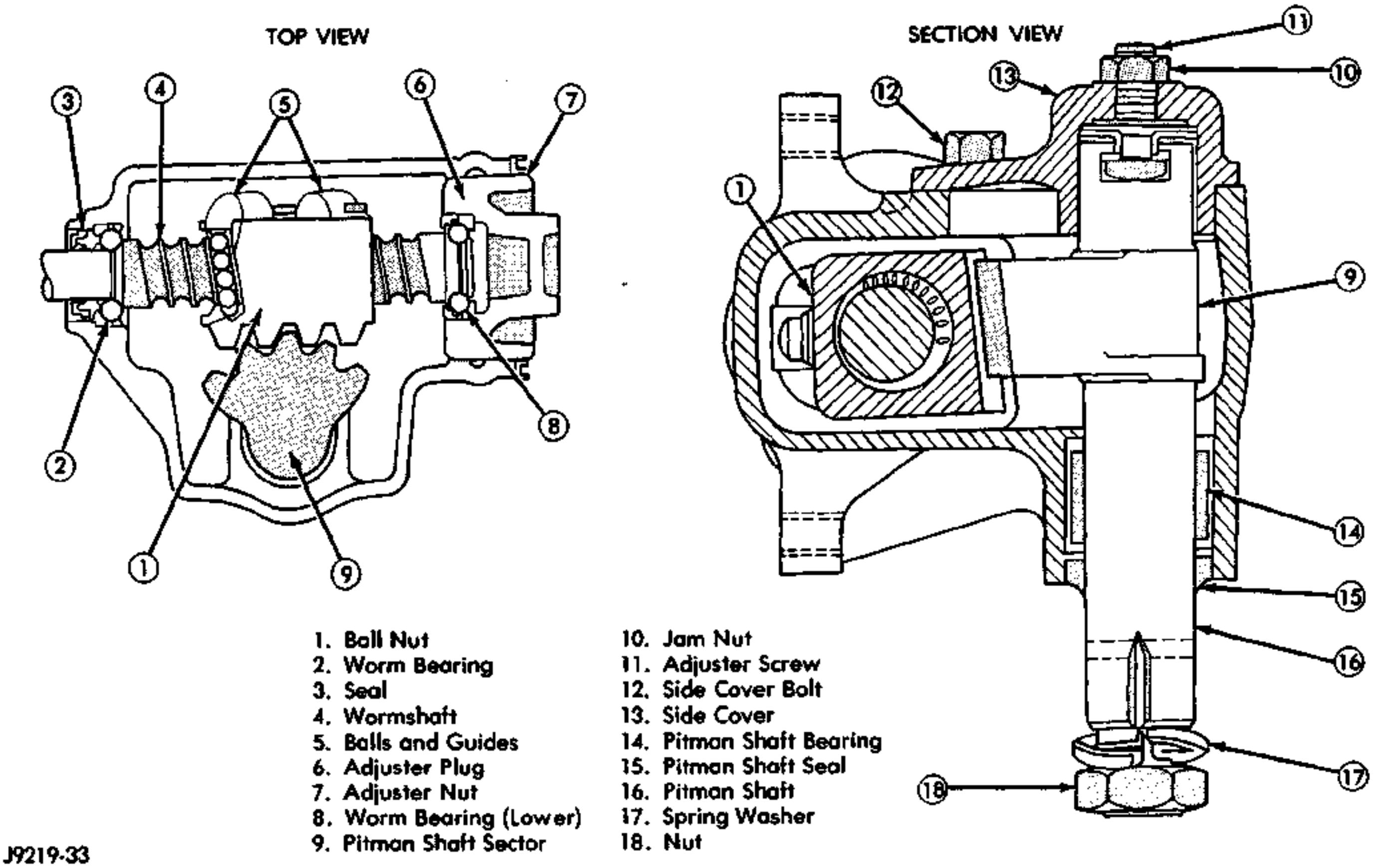


Fig. 1 Manual Steering Gear

DIAGNOSIS AND TESTING

MANUAL STEERING SYSTEM

NOTE: On turns a slight rattle may occur from the steering gear. This is caused by increased gear tooth clearance between the ball nut and pitman shaft as the gear moves off center of the high point position. This is normal and lash must not be reduced to eliminate this slight rattle.

CONDITION	POSSIBLE CAUSES	CORRECTION
RATTLE OR CHUCKLE IN STEERING GEAR.	1. Insufficient lubricant in gear. 2. Loose or damaged suspension components. 3. Pitman arm or steering gear loose. 4. Loose or worn steering shaft bearing. 5. Excessive over-center lash.	1. Add lubricant as required. 2. Inspect and repair as necessary. 3. Tighten to specifications. 4. Replace bearing. 5. Adjust steering to specifications.
POOR STEERING WHEEL RETURN.	1. Insufficient lubricate. 2. Steering gear adjusted too tight. 3. Vehicle out of alignment. 4. Worn or binding steering linkage.	1. Add lubricate as required. 2. Adjust steering gear to specifications. 3. Align vehicle to specifications. 4. Inspect and repair as necessary.
EXCESSIVE STEERING WHEEL PLAY	1.Vehicle out of alignment. 2. Worn or loose wheel bearings. 3. Worn or loose steering components. 4. Improper steering gear adjustment.	1. Align vehicle to specifications. 2. Replace or adjust wheel bearings. 3. Inspect and repair as necessary. 4. Adjust steering gear to specifications.
EXCESSIVE STEERING WHEEL EFFORT.	1. Low or uneven tire pressure. 2. Vehicle out of alignment. 3. Improper steering gear adjustment. 4. Lack of lubricant to steering linkage or suspension components.	1. Inflate tires to specifications. 2. Align vehicle to specifications. 3. Adjust steering gear to specifications. 4. Lubricate steering linkage and suspension components.

REMOVAL AND INSTALLATION

PITMAN SHAFT SEAL

REMOVAL

(1) Raise and support vehicle.
(2) Mark the pitman arm and shaft position for installation reference.
(3) Remove pitman arm retaining nut and remove the pitman arm with Puller C-4150A (Fig. 2).
(4) Remove pitman shaft seal with a seal pick.

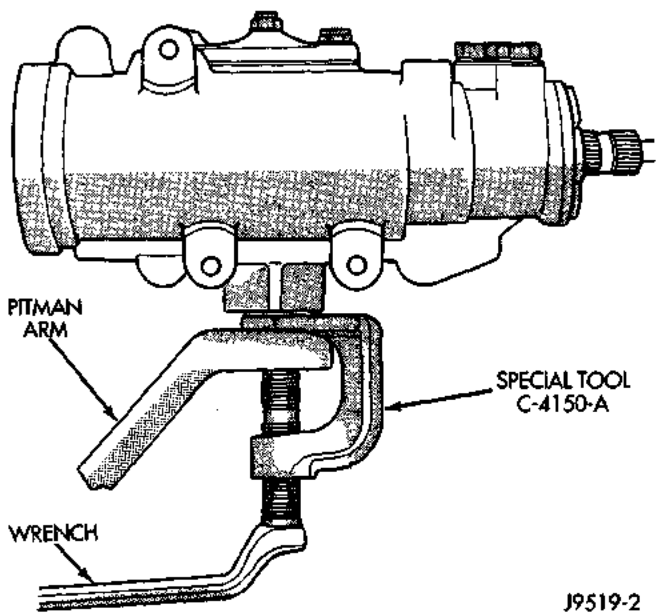


Fig. 2 Pitman Arm Puller

INSTALLATION

NOTE: Tape pitman shaft threads and spline with plastic tape, to protect the seal during installation.

(1) Coat new seal with grease and install seal with suitable size socket.
(2) Remove tape from the pitman arm shaft.
(3) Align pitman arm with the shaft reference mark and install pitman arm.
(4) Install washer and retaining nut and tighten to 251 N·m (185 ft. lbs.).
(5) Remove support and lower vehicle.

MANUAL STEERING GEAR

REMOVAL

(1) Raise and support vehicle.
(2) Remove tie rod from pitman arm with puller (Fig. 3).
(3) Remove pitman arm with Remover C-4150A.
(4) Remove gear mounting bolts and remove gear (Fig. 4).

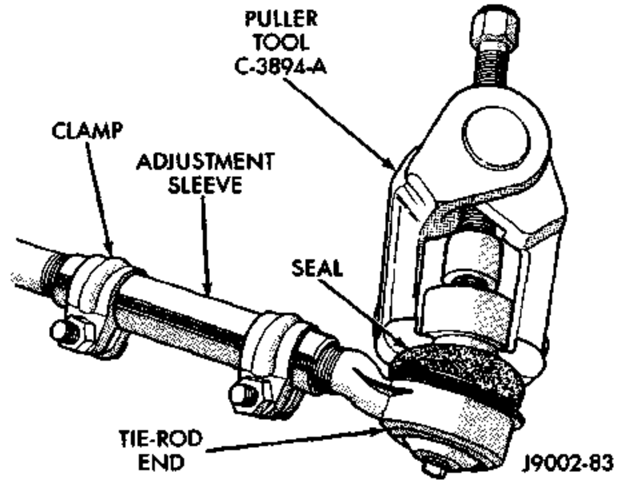


Fig. 3 Tie Rod End

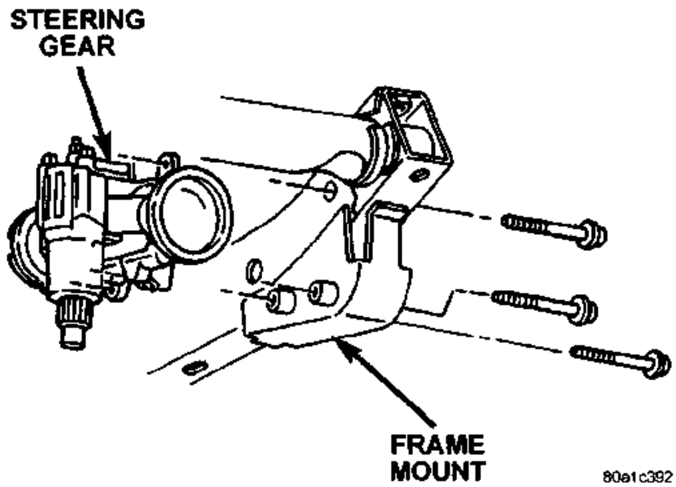


Fig. 4 Steering Gear

INSTALLATION

(1) Install gear on frame rail and install mounting bolts.
(2) Tighten mounting bolts to 95 N·m (70 ft. lbs.).
(3) Install pitman arm and tighten mounting nut to 251 N·m (185 ft. lbs.).
(4) Install tie rod end on pitman arm and tighten nut to 74 N·m (55 ft. lbs.). Install cotter pin.
(5) Remove support and lower vehicle.

DISASSEMBLY AND ASSEMBLY

PITMAN SHAFT AND COVER

DISASSEMBLY

(1) Remove steering gear from the vehicle.
(2) Center the steering gear.
(3) Remove pitman shaft preload adjustment locknut (Fig. 5).

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Remove cover bolts and remove cover.

(5) Remove preload adjuster and shim(s) from pitman shaft T-slot (Fig. 5).

(6) Remove pitman shaft from the gear housing.

(7) Pry out pitman shaft seal (Fig. 6).

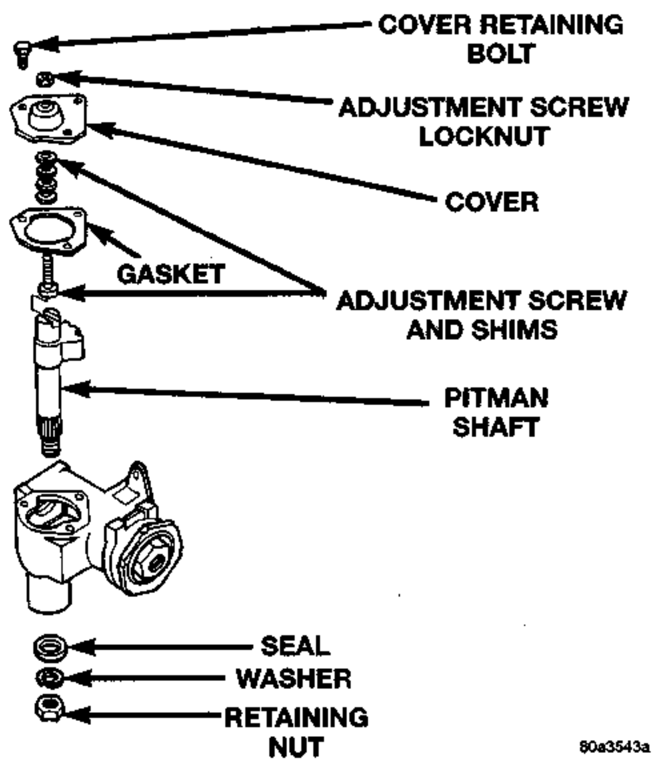


Fig. 5 Manual Steering Gear

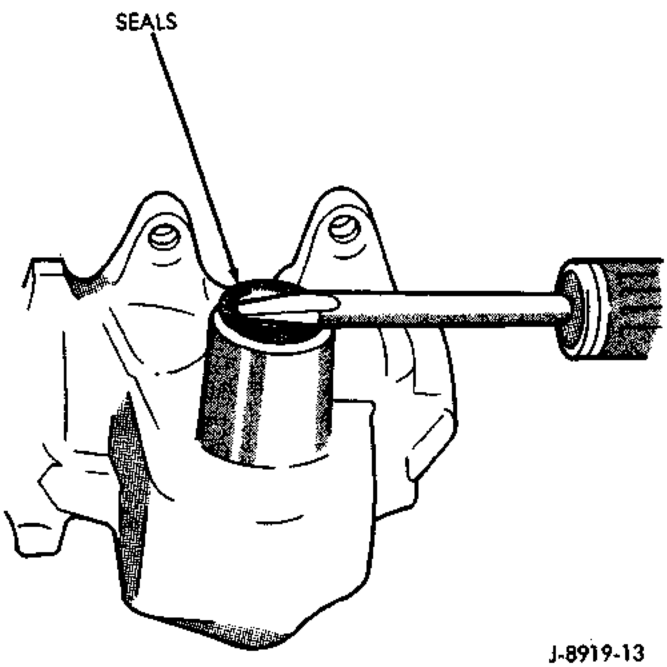


Fig. 6 Pitman Shaft Seal

ASSEMBLY

(1) Install new pitman shaft seal with suitable size socket.

(2) Install preload adjuster in pitman shaft T-slot.

(3) Measure the end-play of preload adjuster with a feeler gauge (Fig. 7). End-play must not exceed .05 mm (.002 in.). If end-play exceeds specifications install replacement shim to obtain correct end-play.

(4) Tape threads and spline of the pitman shaft to protect the seal during shaft installation.

(5) Lubricate the pitman shaft and install the shaft into the gear housing. The pitman shaft center tooth must be engaged with the center groove of the ball nut (Fig. 8).

(6) Install the cover gasket and cover on the housing. Thread preload adjuster counter-clockwise into the cover until the cover makes contact with the housing.

(7) Install cover bolts finger tight, then back off adjuster 1/2 turn.

(8) Tighten cover bolts to 61 N·m (45 ft. lbs.).

(9) Adjust over-center preload.

(10) Install steering gear.

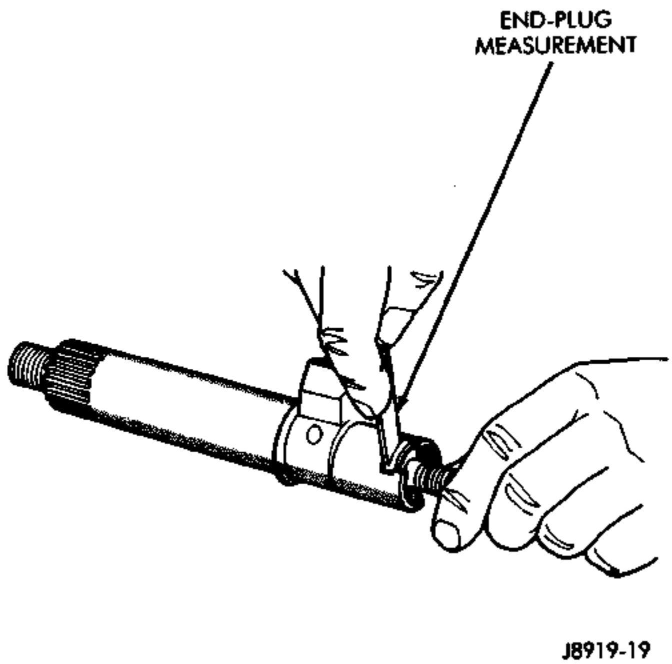


Fig. 7 Preload Adjuster End-Play

WORM SHAFT AND BALL NUT

DISASSEMBLY

(1) Remove the pitman shaft.

(2) Remove the worm bearing adjuster locknut and adjuster (Fig. 9).

(3) Remove worm shaft and ball nut.

DISASSEMBLY AND ASSEMBLY (Continued)

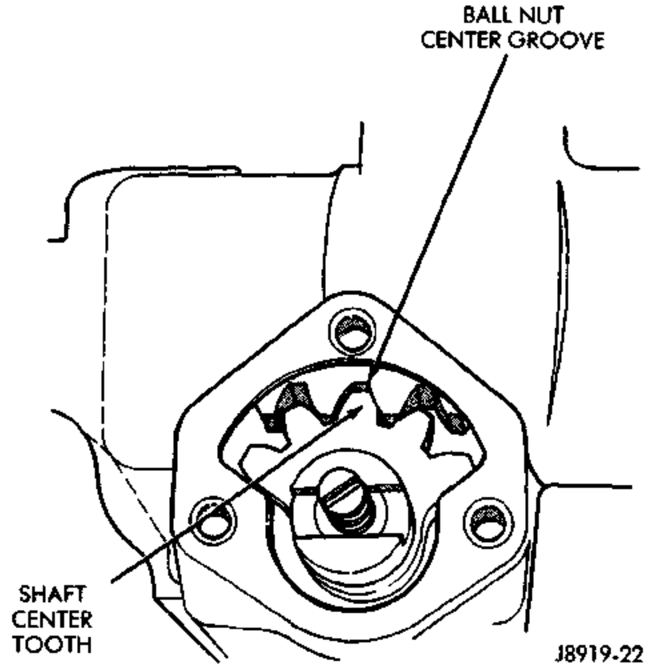


Fig. 8 Pitman Shaft and Ball Nut

CAUTION: Do not allow ball nut to run down to either end of the worm shaft. The ball guides may be damaged if ball nut is stopped by the end of the worm.

(4) Pry worm shaft seal out of the gear housing.

(5) Remove ball guide clamp screws and clamp.

(6) Separate the guides and remove balls from the guides. Remove the remaining balls by rotating the worm shaft back and forth.

NOTE: There are 50 balls, 25 in each circuit of the ball nut.

(7) Remove the ball nut from the worm shaft.

(8) Remove upper worm shaft bearing cup from the gear housing with a brass punch (Fig. 10).

(9) Clean and inspect all components for wear, scoring, and pitting.

ASSEMBLY

(1) Install ball nut onto the worm shaft until an equal amount of threads are showing on either side of the ball nut (Fig. 11).

(2) Install one ball into each ball nut guide hole. Move worm shaft around until the balls roll to the bottom of the worm shaft and support the shaft.

(3) Assemble and install ball guides into ball nut.

(4) Install the remaining balls into the guide holes (Fig. 12). Each guide has a total of 25 balls.

(5) Install the guide clamp and tighten screws to 14 N·m (10 ft. lbs.)

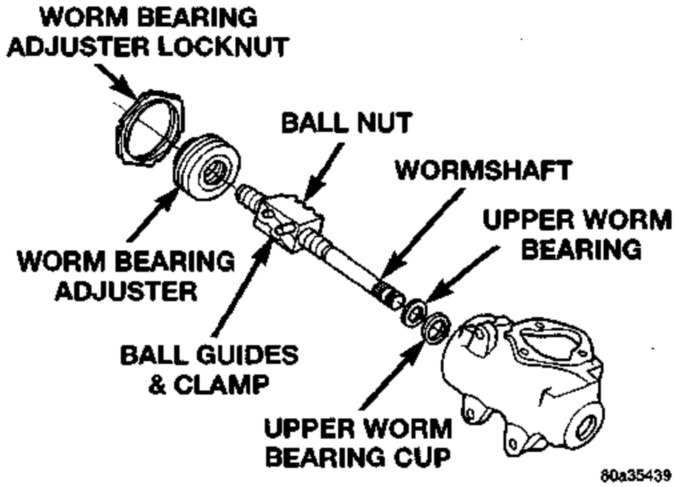


Fig. 9 Worm Shaft and Ball Nut

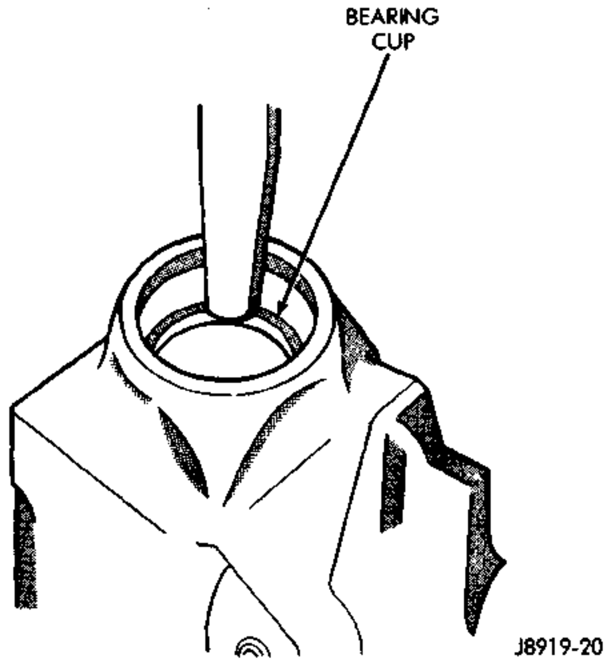


Fig. 10 Upper Bearing Cup

(6) Lubricate worm shaft with chassis lubricate and thread worm shaft in and out of the ball nut to lubricate balls.

(7) Install upper bearing cup into gear housing with a bearing cup driver (Fig. 13).

(8) Install worm shaft seal into gear housing.

(9) Lubricate upper bearing and install on the worm shaft.

(10) Install worm shaft into the steering gear.

NOTE: Wide/deep side of the ball nut teeth face the cover opening.

(11) Install worm shaft adjuster cap and adjust shaft to zero end-play. Install adjuster locknut.

DISASSEMBLY AND ASSEMBLY (Continued)

(12) Install pitman shaft and fill gear with lubricate.

(13) Adjust worm bearing preload and over-center preload.

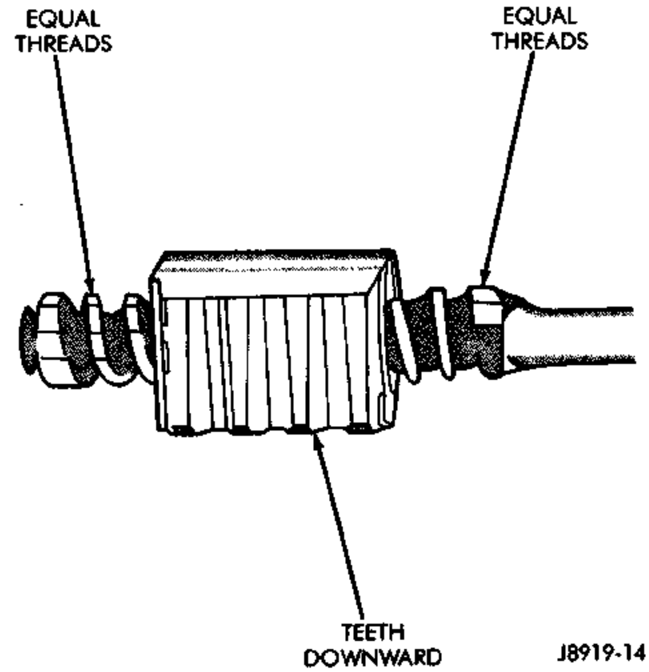


Fig. 11 Worm Shaft and Ball Nut

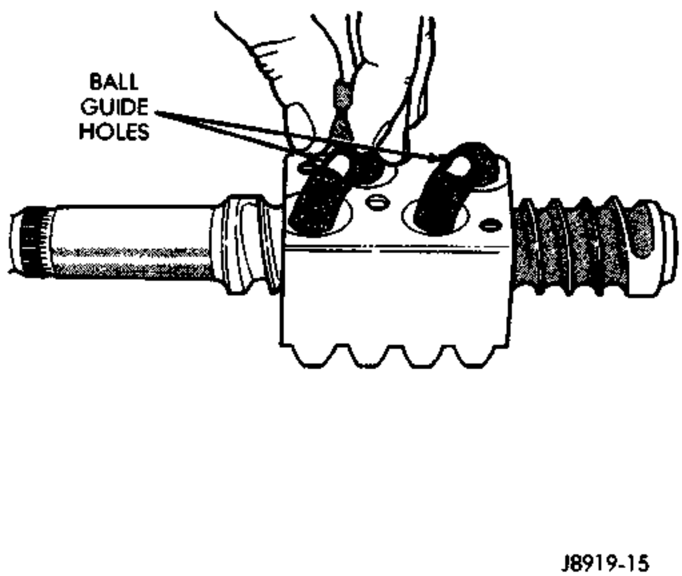


Fig. 12 Ball Nut Guide Holes

WORM BEARING ADJUSTER

DISASSEMBLY

(1) Pry out the lower bearing retainer (Fig. 14).

(2) Remove lower bearing (Fig. 15).

(3) Place locknut on the adjuster and place in a vise. Remove lower bearing cup with Puller 7794–A and a slid hammer.

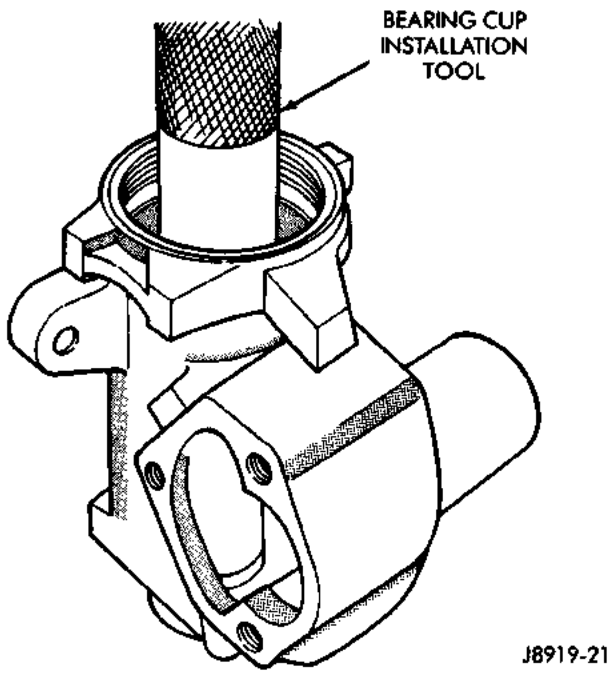


Fig. 13 Upper Bearing Cup Installation

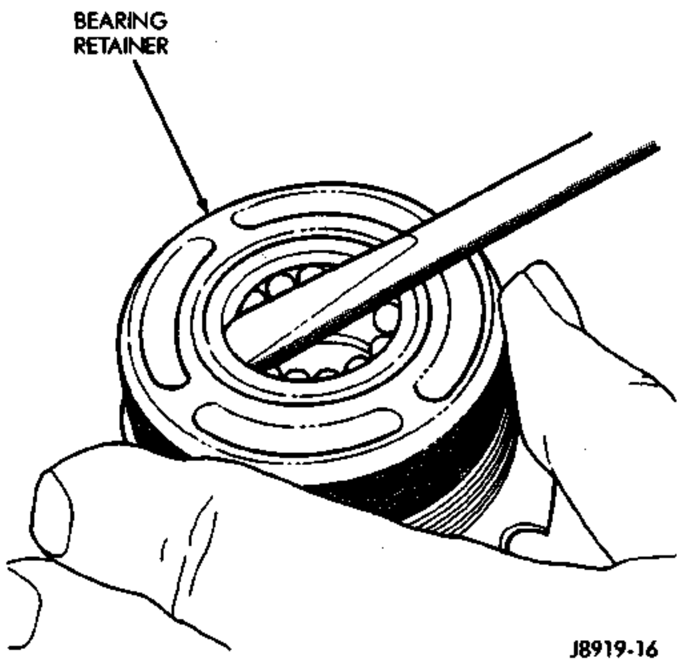


Fig. 14 Lower Bearing Retainer

ASSEMBLY

(1) Install lower bearing cup with a bearing cup driver.

(2) Lubricate lower bearing and install into the adjuster.

(3) Install the retainer by tapping it in with a plastic hammer.

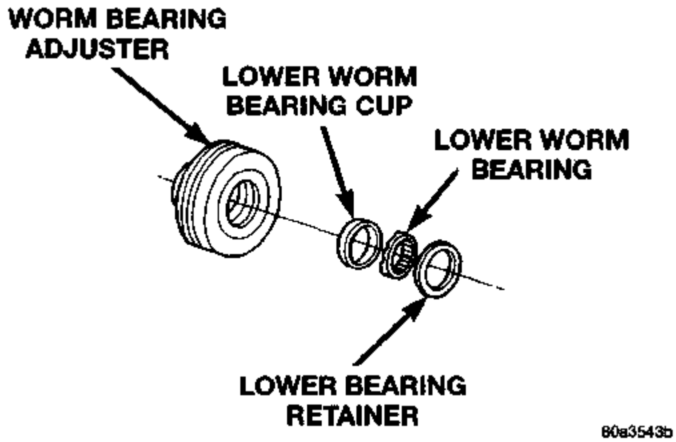


Fig. 15 Lower Bearing Cup

ADJUSTMENTS

WORM BEARING PRELOAD

(1) Tighten the worm bearing adjuster plug until it bottoms, then loosen 1/4 turn.

(2) Carefully turn the worm shaft all the way to the end of travel, then turn back 1/2 turn.

(3) Tighten adjuster plug until torque wrench indicates 0.6 to 1.0 N·m (5 to 8 in. lbs.) torque (Fig. 16).

(4) Tighten the adjuster plug locknut to 68 N·m (50 ft. lbs.).

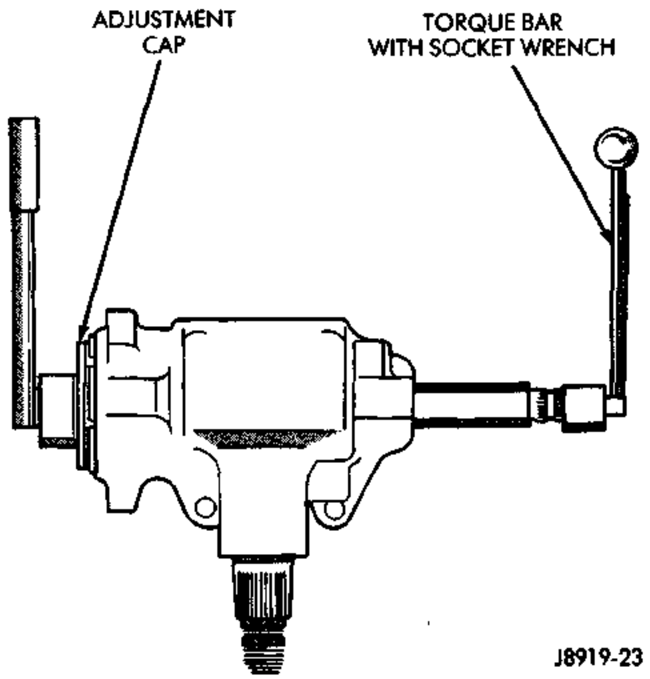


Fig. 16 Worm Bearing Preload

OVER-CENTER PRELOAD

NOTE: Adjust worm bearing preload before adjusting over-center preload if worm shaft was serviced.

(1) Back off preload adjuster until it stops, then turn it in one full turn.

(2) With gear at center of travel, check torque to turn stub shaft and record this reading (Fig. 17).

(3) Turn adjuster in until torque to turn stub shaft is 0.5 to 1 N·m (4 to 10 in. lbs.) more than recorded reading.

(4) Hold pitman shaft adjustment screw and tighten adjuster lock nut to 34 N·m (25 ft. lbs.).

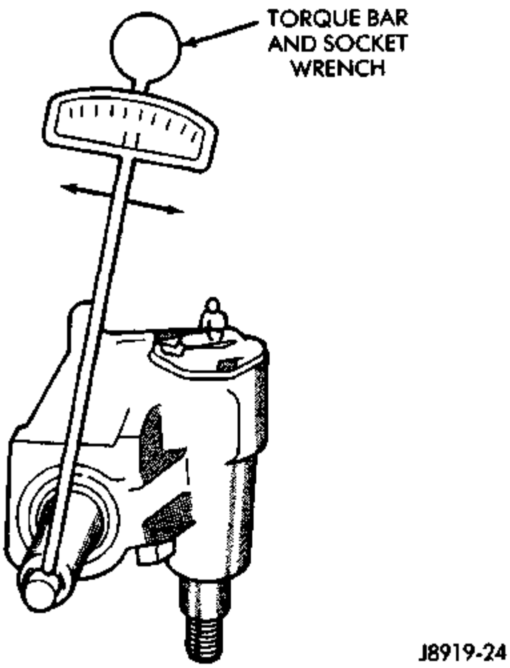


Fig. 17 Over-Center Preload

SPECIFICATIONS

MANUAL STEERING GEAR

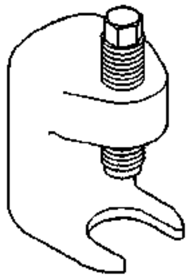
Steering Gear
Type . . . . .Recirculating Ball
Gear Ratio 24:1
Worm Shaft Bearing
Preload . . . . .0.6–1.0 N·m (5–8 in. lbs.)
Pitman Shaft Over-Center Drag
Preload . . . . .0.5–1.0 N·m (4–10 in. lbs.)
+ Worm Shaft Preload

TORQUE CHART

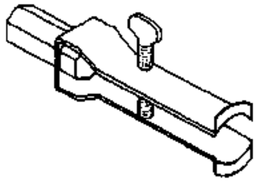
DESCRIPTION	TORQUE
Manual Steering Gear	
Adjustment Cap Locknut	68 N·m (50 ft. lbs.)
Adjustment Screw Locknut	34 N·m (25 ft. lbs.)
Pitman Shaft Nut	251 N·m (185 ft. lbs.)
Guide Clamp Screws	14 N·m (10 ft. lbs.)
Cover Bolts	61 N·m (45 ft. lbs.)
Gear to Frame Bolts	105 N·m (78 ft. lbs.)

SPECIAL TOOLS

MANUAL STEERING GEAR



Remover C-41509A



Puller 7794–A

STEERING COLUMN

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GENERAL INFORMATION

STEERING COLUMN

The standard non-tilt and tilt steering column has been designed to be serviced as an assembly. The key cylinder, switches, clock spring, trim shrouds and steering wheel are serviced separately.

The column is connected to the steering gear with an upper and lower shaft. The lower shaft has a support bearing mounted to a bracket. The bracket mounts to the frame rail with two bolts. These shafts and bearing are serviceable.

REMOVAL AND INSTALLATION

STEERING COLUMN

WARNING: BEFORE SERVICING THE STEERING COLUMN THE AIRBAG SYSTEM MUST BE DISARMED. REFER TO GROUP 8M RESTRAINT SYSTEMS FOR SERVICE PROCEDURES. FAILURE TO DO SO MAY RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Position front wheels **straight ahead.**

(2) Remove negative ground cable from the battery.

(3) Remove the airbag, refer to Group 8M Restraint Systems for service procedures.

(4) Remove the steering wheel with an appropriate puller (Fig. 1).

(5) Turn ignition cylinder to the on position and remove cylinder by pressing release through lower shroud access hole (Fig. 2).

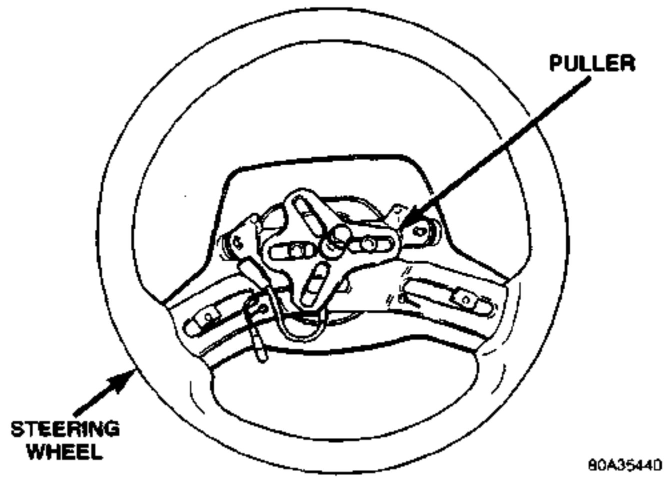


Fig. 1 Steering Wheel

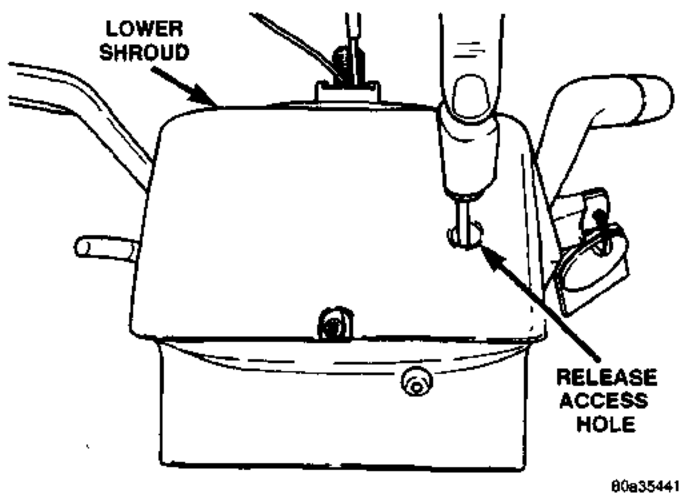


Fig. 2 Key Cylinder Release Access Hole

REMOVAL AND INSTALLATION (Continued)

(6) Remove knee blocker cover and knee blocker.
(7) Remove lower column shroud (Fig. 3).
(8) Remove the steering coupler bolt and column mounting nuts (Fig. 5) and lower column.
(9) Remove upper column shroud (Fig. 3).
(10) Disconnect and remove the wiring harness from the column (Fig. 4).

NOTE: If vehicle is equipped with automatic transmission remove shifter interlock cable. Refer to Group 3 Differential and Driveline for procedure.

(11) Remove column.
(12) Remove switches and clock spring refer to Group 8 Electrical for service procedures.

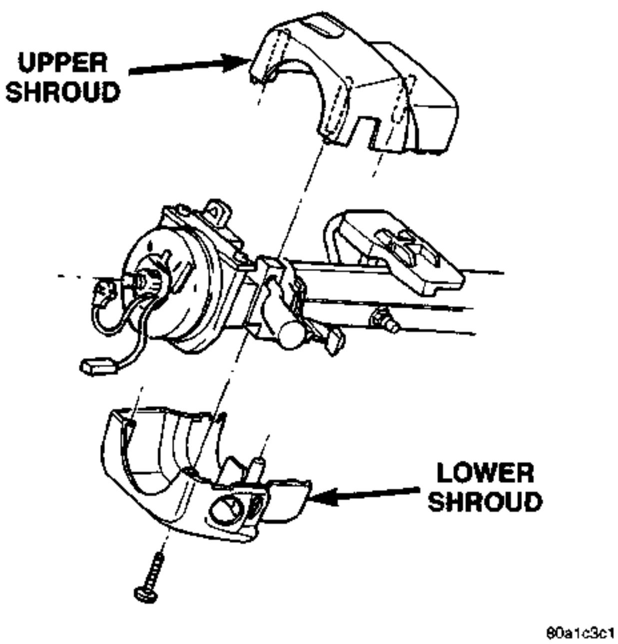


Fig. 3 Column Shrouds

INSTALLATION

(1) Install switches and clock spring refer to Group 8 Electrical for service procedures.
(2) Align and install column into the steering coupler.
(3) Install column harness and connect harness to switches.
(4) If vehicle is equipped with automatic transmission install shifter interlock cable. Refer to Group 3 Differential and Driveline for procedure.
(5) Install upper column shrouds.
(6) Install column onto the mounting studs.
(7) Install mounting nuts and tighten to 23 N·m (17 ft. lbs.).

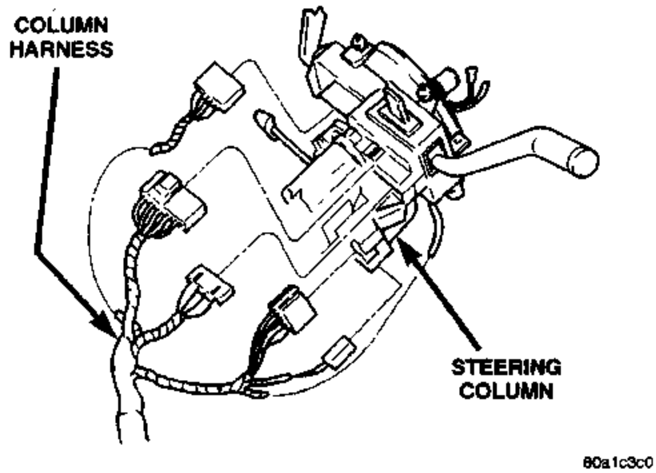


Fig. 4 Steering Column Harness

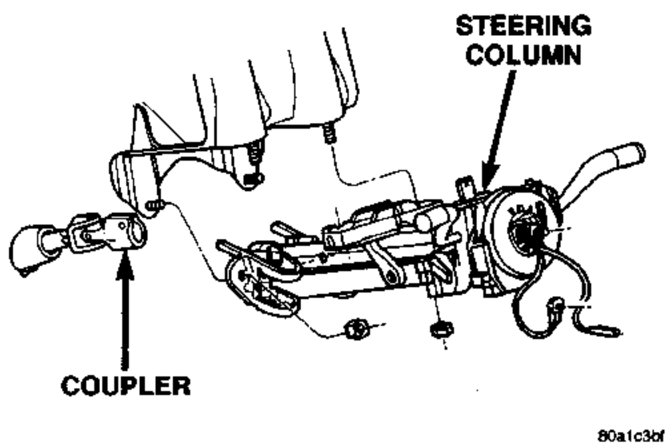


Fig. 5 Steering Column Mounting

(8) Install steering column coupler bolt and tighten to 49 N·m (36 ft. lbs.).
(9) Install lower column shrouds.
(10) Install ignition cylinder.
(11) Install knee blocker and knee blocker cover.
(12) Install steering wheel.
(13) Install airbag, refer to Group 8M Restraint Systems for service procedures.
(14) Install negative battery terminal.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Steering Column	
Mounting Nuts	23 N·m (17 ft. lbs.)
Coupler Bolt	49 N·m (36 ft. lbs.)

STEERING LINKAGE

INDEX

GENERAL INFORMATION

STEERING LINKAGE

The steering linkage consists of a pitman arm, drag link, tie rod, and steering dampener (Fig. 1). Adjustment sleeves are used on the tie rod and drag link for toe and steering wheel alignment.

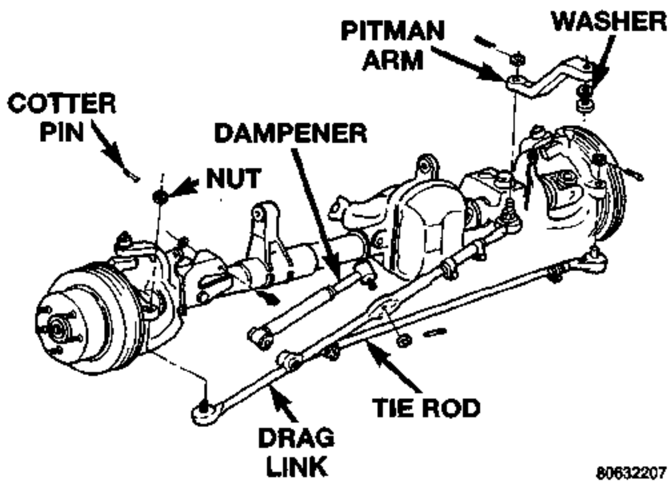


Fig. 1 Steering Linkage

SERVICE PROCEDURES

STEERING LINKAGE

The tie rod end and ball stud seals should be inspected during all oil changes. If a seal is damaged, it should be replaced. Before installing a new seal, inspect 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.

CAUTION: Use a Puller tool C-3894-A for tie rod removal. Failure to use this tool could damage the ball stud and seal (Fig. 2).

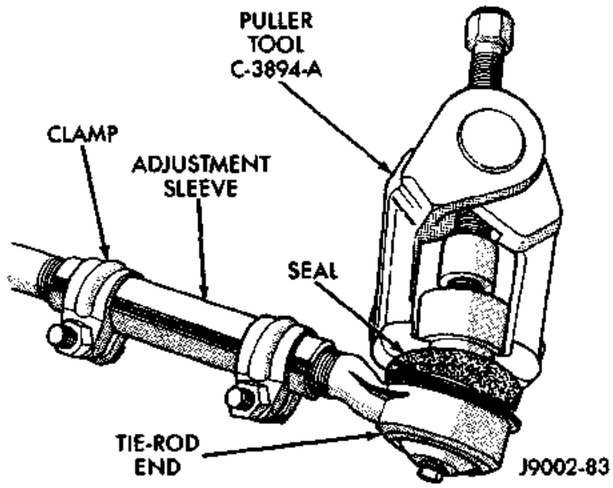


Fig. 2 Ball Stud Removal

REMOVAL AND INSTALLATION

TIE ROD

REMOVAL

(1) Remove the cotter pins and nuts at the steering knuckle and drag link (Fig. 1).

(2) Remove the ball studs with puller tool.

(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. Position the tie rod clamp (Fig. 3) and tighten to 27 N·m (20 ft. lbs.).

(2) Install the tie rod on the drag link and steering knuckle.

(3) Tighten the ball stud nut on the steering knuckle to 47 N·m (35 ft. lbs.). Tighten the ball stud nut to drag link to 47 N·m (35 ft. lbs.) torque. Install new cotter pins.

REMOVAL AND INSTALLATION (Continued)

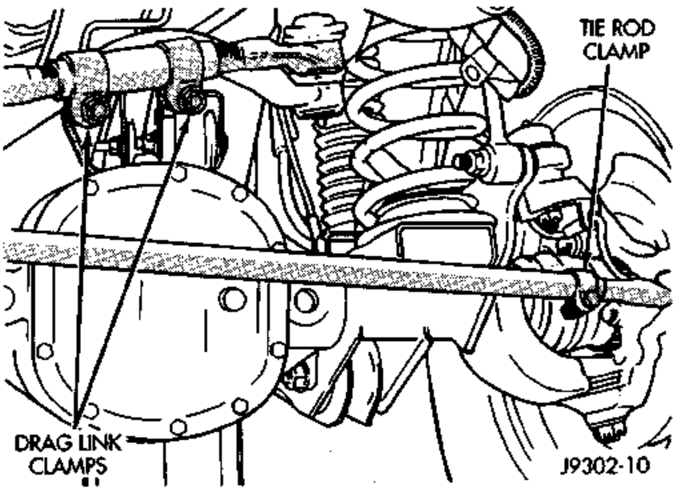


Fig. 3 Tie Rod/Drag Link Clamp Bolt

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 C-4150A (Fig. 4).

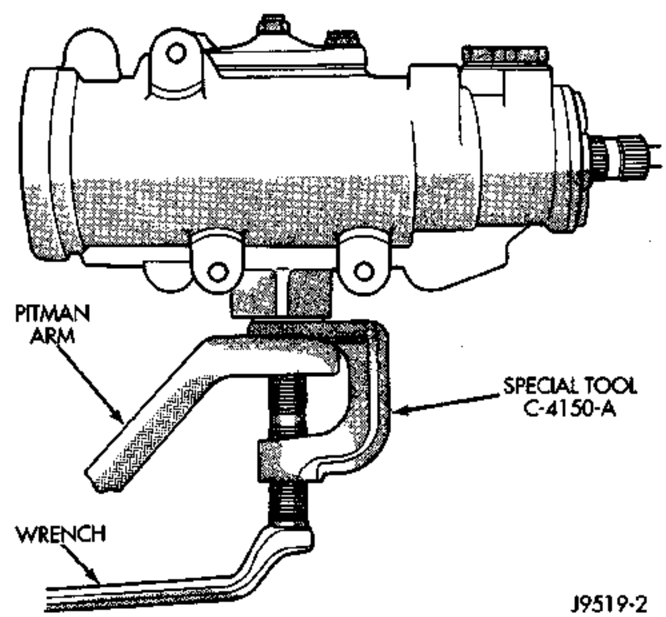


Fig. 4 Pitman Arm Removal

INSTALLATION

(1) Align and install the pitman arm on steering gear shaft.

(2) Install the washer and nut on the shaft and tighten the nut to 251 N·m (185 ft. lbs.).

(3) Install drag link ball stud to pitman arm. Install nut and tighten to 81 N·m (60 ft. lbs.). Install a new cotter pin.

DRAG LINK

REMOVAL

(1) Remove the cotter pins and nuts at the steering knuckle and drag link (Fig. 1).

(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 (Fig. 3).

(2) Position the drag link at the steering linkage. 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 47 N·m (35 ft. lbs.). Tighten the pitman nut to 81 N·m (60 ft. lbs.) and tie rod ball stud nut to 47 N·m (35 ft. lbs.). Install new cotter pins and bend end 60°.

(4) Install the steering dampener onto the drag link and tighten the nut to 74 N·m (55 ft. lbs.). Install a new cotter pin and bend end 60°.

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. 1).

(3) Remove the cotter pin and nut from the ball stud at the drag link.

(4) Remove the steering dampener ball stud from the drag link using C-3894-A puller.

INSTALLATION

(1) Install the steering dampener to the axle bracket and drag link.

(2) Install the steering dampener bolt in the axle bracket and tighten nut to 74 N·m (55 ft. lbs.).

(3) Install the ball stud nut at the drag link and tighten nut to 74 N·m (55 ft. lbs.). Install a new cotter pin.

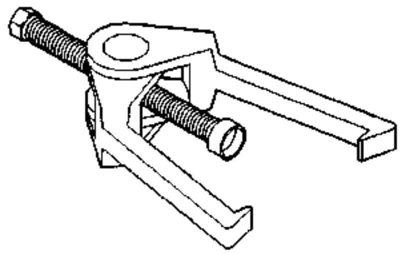
SPECIFICATIONS

TORQUE CHART

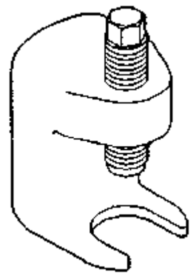
DESCRIPTION	TORQUE
Pitman Arm	
Shaft	251 N·m (185 ft. lbs.)
Drag Link	
Ball Studs	74 N·m (55 ft. lbs.)
Clamp	49 N·m (36 ft. lbs.)
Tie Rod Ends	
Ball Studs	74 N·m (55 ft. lbs.)
Clamp	27 N·m (20 ft. lbs.)
Tie Rod	
Ball Stud	88 N·m (65 ft. lbs.)
Steering Damper	
Frame	74 N·m (55 ft. lbs.)
Drag Link	74 N·m (55 ft. lbs.)

SPECIAL TOOLS

STEERING LINKAGE



Puller C-3894–A



Remover Pitman C-4150A

BODY

CONTENTS

GENERAL SERVICE INFORMATION

GENERAL INFORMATION

SAFETY PRECAUTIONS AND WARNINGS

WARNING: EYE PROTECTION SHOULD BE USED WHEN SERVICING GLASS COMPONENTS. PERSONAL INJURY CAN RESULT.

USE A OSHA APPROVED BREATHING FILTER WHEN SPRAYING PAINT OR SOLVENTS IN A CONFINED AREA. PERSONAL INJURY CAN RESULT.

AVOID PROLONGED SKIN CONTACT WITH PETROLEUM OR ALCOHOL– BASED CLEANING SOLVENTS. PERSONAL INJURY CAN RESULT.

DO NOT STAND UNDER A HOISTED VEHICLE THAT IS NOT PROPERLY SUPPORTED ON SAFETY STANDS. PERSONAL INJURY CAN RESULT.

CAUTION: When holes must be drilled or punched in an inner body panel, verify depth of space to the outer body panel, electrical wiring, or other components. Damage to vehicle can result.

Do not weld exterior panels unless combustible material on the interior of vehicle is removed from the repair area. Fire or hazardous conditions, can result.

Always have a fire extinguisher ready for use when welding.

Disconnect the negative (-) cable clamp from the battery when servicing electrical components that are live when the ignition is OFF. Damage to electrical system can result.

Do not use abrasive chemicals or compounds on painted surfaces. Damage to finish can result.

Do not use harsh alkaline based cleaning solvents on painted or upholstered surfaces. Damage to finish or color can result.

Do not hammer or pound on plastic trim panel when servicing interior trim. Plastic panels can break.

Chrysler Corporation uses many different types of push-in fasteners to secure the interior and exterior trim to the body. Most of these fasteners can be reused to assemble the trim during various repair procedures. At times, a push-in fastener cannot be removed without damaging the fastener or the component it is holding. If it is not possible to remove a fastener without damaging a component or body, cut or break the fastener and use a new one when installing the component. Never pry or pound on a plastic or pressed-board trim component. Using a suitable fork-type prying device, pry the fastener from the retaining hole behind the component being removed. When installing, verify fastener alignment with the retaining hole by hand. Push directly on or over the fastener until it seats. Apply a low-force pull to the panel to verify that it is secure.

When it is necessary to remove components to service another, it should not be necessary to apply excessive force or bend a component to remove it. Before damaging a trim component, verify hidden fasteners or captured edges holding the component in place.

PAINT

INDEX

GENERAL INFORMATION

PAINT CODE

Exterior vehicle body colors are identified on the Body Code plate. The plate is located on the floor pan under the driver's seat. Refer to the Introduction section at the front of this manual for, body code plate description. The paint code is also identified on the Vehicle Safety Certification Label, which is located on the driver's door shut face The color names, provided in the Paint and Trim Code Description chart, are the color names used on most repair product containers.

BASE COAT/CLEAR COAT FINISH

On most vehicles a two-stage paint application (base coat/clear coat) is used. Color that is applied to primer is called base coat. The clear coat protects the base coat from ultraviolet light and provides a durable high-gloss finish.

FINESSE SANDING, BUFFING, AND POLISHING

Minor acid etching, orange peel, or surface scratches in clear coat or single-stage finishes can be reduced with light finesse sanding, buffing, and polishing.**If the finish has been wet sanded in the past, it cannot be repeated. Wet sanding operation should be performed by a trained automotive paint technician.**

CAUTION: Do not remove clear coat finish more than .5 mils, if equipped (Use a paint thickness gauge to verify paint thickness). Base coat paint must retain clear coat for durability.

PAINTED SURFACE TOUCH-UP

When a painted metal surface has been scratched or chipped, it should be touched-up as soon as possible to avoid corrosion. For best results, use Mopar® Scratch Filler/Primer, Touch-Up Paints and Clear Top Coat. Refer to Introduction group of this manual for Body Code Plate information.

TOUCH-UP PROCEDURE

(1) Scrape loose paint and corrosion from inside scratch or chip.

(2) Clean affected area with Mopar® Tar/Road Oil Remover, and allow to dry.

(3) Fill the inside of the scratch or chip with a coat of filler/primer. Do not overlap primer onto good surface finish. The applicator brush should be wet enough to puddle-fill the defect without running. Do not stroke brush applicator on body surface. Allow the filler/primer to dry hard.

(4) Cover the filler/primer with color touch-up paint. Do not overlap touch-up color onto the original color coat around the scratch or chip. Butt the new color to the original color, if possible. Do not stroke applicator brush on body surface. Allow touch-up paint to dry hard.

(5) On vehicles without clear coat, the touch-up color can be lightly wet sanded (1500 grit) and polished with rubbing compound.

(6) On vehicles with clear coat, apply clear top coat to touch-up paint with the same technique as described in Step 4. Allow clear top coat to dry hard. If desired, Step 5 can be performed on clear top coat.

GENERAL INFORMATION (Continued)

AFTERMARKET PAINT REPAIR PRODUCTS

EXTERIOR COLOR

EXTERIOR COLOR	CHRY CODE *	PPG	BASF	DuPONT	SHERWIN WILLIAMS	AKZO NOBEL SIKKENS
Flame Red Clear Coat	PR4	4679	23043	B9326	46916	CHA93:PR4
Chili Pepper Red	VEA	5361	28060	B9823	54470	CHA98:VEA
Citron Pearl Coat	SJV	47694	26081	B9672	51524	CHA96:SJV
Deep Amethyst Pearl Coat	TCN	5246	27038	B9736	52566	CHA97:TCN
Moss Green Pearl Coat	RJN	47383	25036	B9533	50277	CHA95:RJN
Bright Jade Satin Glow	SQP	47586	26088	B9636	51533	CHA96:SQP
Lapis Blue Clear Coat	RC4	4935	24098	B9531	50218	CHA95:RC4
Gun Metal Pearl Coat	TQ7	5248	27035	B9735	52952	CHA97:TQ7
Black Clear Coat	DX8	9700	15214	99	34858 90-5950	CHA85:DX8
Stone White Clear Coat	SW1	83542	26089	B9622	51539	CHA96:SW1

HARD TOP

HARD TO	CHRY CODE*	PPG	BASF	DuPONT	SHERWIN-WILLIAMS	AKZO NOBEL SIKKENS
Spice	LTB	27315	22155	C9523	46487	CHA90:LTB
Black	HCX	9857	20200	C8823	42860	CHA90:HCX
Stone White	SW1	5072	26125	C9622	52779	CHASWM1

INTERIOR COLOR

INTERIOR COLOR	CHRY CODE	PPG	BASF	DuPONT	SHERWIN-WILLIAMS	AKZO NOBEL SIKKENS
Mist Gray	C3	35799 / 2-1576	25065	C9507	50508	CARC3I
Saddle	T6	27917 / 2-1594	26121	C9604	51542	CHART6I
Saddle / Moss Green	TJ	N/A	26121 25069	C9604 C9513	51542 50512	CHART6I CHARJ4I

NOTE: * Herberts Standox and Spies Hecker use the Chrysler paint code as listed on the Body Code Plate.

SERVICE PROCEDURES

HARD TOP REPAIR

The hard top fiberglass material can be repaired. The required repair materials include:

- Fiberglass mat or cloth.
- Fiberglass resin and hardener.
- structural adhesive (3M brand or an equivalent product).
- Glazing putty.
- Plastic spreader.

HARD TOP HOLE REPAIR

(1) Use a grinder to remove the paint and outline the damaged area. Use a grade 24 grit disc for paint removal.

(2) Grind the outlined surface area again with a 50 grit disc to prevent coarse scratches from appearing in the final finish.

(3) If cracks extend from the hole, it will be necessary to stop-drill the crack(s) with a 3-mm (1/8-in) diameter drill bit.

(4) Position a fiberglass mat or cloth on the repair surface area. Cut the mat to allow a 2.5-cm (1-in) overlap of the repair surface area.

(5) Clean the repair surface area.

(6) Place the fiberglass cloth on aluminum foil.

(7) Pour the fiberglass resin into a clean container.

(8) Mix the appropriate amount of hardener and resin. Follow the manufacturers instructions.

(9) Apply the hardener/resin mixture to both sides of the fiberglass cloth.

(10) Place the fiberglass cloth over the repair surface area. Next, place the aluminum foil over the cloth. Use a plastic spreader to smooth-out the cloth and resin. Use firm pressure to remove air bubbles and to smooth-out the cloth.

(11) Allow the resin to cure.

(12) Smooth-out the surface area to the contour of the hard top with a 50-grit disc.

(13) Apply plastic filler to complete the repair. Finish smoothing the surface area with 80-grit paper.

(14) Repeat the previous step on the inside surface area of the hard top.

(15) Featheredge the repaired surface area.

(16) Prime the repaired surface area with PPG Epoxy Primer, or an equivalent product.

(17) Apply surface primer to the surface area.

(18) Prime the surface area for the color coat.

(19) Apply color coat to the repaired surface area.

FRACTURE REPAIR

(1) Use a grinder to remove the paint (from both, the inner and outer surface areas of the hard top) and to outline the damaged area.

(2) Stop-drill the crack(s) with a 3-mm (1/8-in) diameter drill bit.

(3) Bevel the edges of the crack(s) on both sides with a rotary file.

NOTE: The edges should be beveled on the inside and outside of the top to ensure sufficient surface area for good bonding.

(4) Complete the repairs with fiberglass cloth and resin as described above in the hard top hole repair procedure.

STATIONARY GLASS

INDEX

GENERAL INFORMATION

SAFETY PRECAUTIONS

WARNING: DO NOT OPERATE THE VEHICLE WITHIN 24 HOURS OF WINDSHIELD INSTALLATION. IT TAKES AT LEAST 24 HOURS FOR URETHANE ADHESIVE TO CURE. IF IT IS NOT CURED, THE WINDSHIELD MAY NOT PERFORM PROPERLY IN AN ACCIDENT.

URETHANE ADHESIVES ARE APPLIED AS A SYSTEM. USE GLASS CLEANER, GLASS PREP SOLVENT, GLASS PRIMER, PVC (VINYL) PRIMER AND PINCHWELD (FENCE) PRIMER PROVIDED BY THE ADHESIVE MANUFACTURER. IF NOT, STRUCTURAL INTEGRITY COULD BE COMPROMISED.

CHRYSLER DOES NOT RECOMMEND GLASS ADHESIVE BY BRAND. TECHNICIANS SHOULD REVIEW PRODUCT LABLES AND TECHNICAL DATA SHEETS, AND USE ONLY ADHESIVES THAT THEIR MANUFACTURES WARRANT WILL RESTORE A VEHICLE TO THE REQUIREMENTS OF FMVSS 212. TECHNICIANS SHOULD ALSO INSURE THAT PRIMERS AND CLEANERS ARE COMPATIBLE WITH THE PARTICULAR ADHESIVE USED.

BE SURE TO REFER TO THE URETHANE MANUFACTURER'S DIRECTIONS FOR CURING TIME SPECIFICATIONS, AND DO NOT USE ADHESIVE AFTER ITS EXPIRATION DATE.

VAPORS THAT ARE EMITTED FROM THE URETHANE ADHESIVE OR PRIMER COULD CAUSE PERSONAL INJURY. USE THEM IN A WELL-VENTILATED AREA.

SKIN CONTACT WITH URETHANE ADHESIVE SHOULD BE AVOIDED. PERSONAL INJURY MAY RESULT.

ALWAYS WEAR EYE AND HAND PROTECTION WHEN WORKING WITH GLASS.

CAUTION: Protect all painted and trimmed surfaces from coming in contact with urethane or primers.

Be careful not to damage painted surfaces when removing moldings or cutting urethane around windshield.

It is difficult to salvage a windshield during the removal operation. The windshield is part of the structural support for the roof. The urethane bonding used to secure the windshield to the fence is difficult to cut or clean from any surface. If the moldings are set in urethane, it would also be unlikely they could be salvaged. Before removing the windshield, check the availability of the windshield and moldings from the parts supplier.

REMOVAL AND INSTALLATION

WINDSHIELD

The windshield is positioned in the reveal molding and is bonded to the windshield frame with urethane adhesive. The windshield interior trim molding is positioned onto the inner windshield frame pinchweld.

REMOVAL

(1) Cover body surface areas with protective covering to avoid paint damage and extra clean-up time.

(2) Remove the windshield wiper arms and the rearview mirror.

(3) Using a razor knife, slide the blade between the windshield glass and the inboard edge of the reveal molding.

(4) Cut around the interior perimeter of the reveal molding and sever the cap of the reveal molding.

REMOVAL AND INSTALLATION (Continued)

(5) Using a cold knife, cut the urethane around the perimeter of the windshield (Fig. 1).

(6) Remove the windshield glass from the frame (Fig. 2).

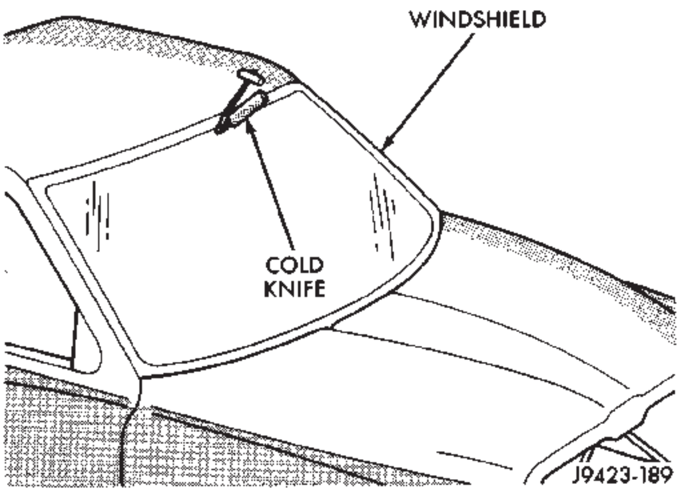


Fig. 1 Cutting Urethane Around Windshield—Typical

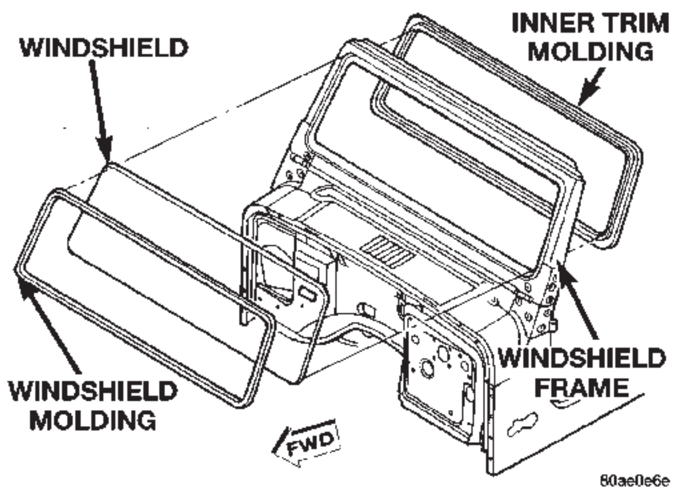


Fig. 2 Windshield

INSTALLATION

(1) Trim the urethane from the pinchweld flanges. Leave a 3 mm (0.1 in.) level base of urethane on the pinchweld flanges.

(2) Place replacement windshield into windshield opening and position glass in the center of the opening against pinchweld flange.

(3) Verify the glass lays evenly against the pinch weld fence at the sides, top and bottom of the replacement windshield. If not, the pinchweld flange must be formed to the shape of the new glass. Next, make alignment marks on glass and body with a grease pencil.

(4) Remove replacement windshield from windshield opening.

(5) 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. 3).

WARNING: DO NOT USE SOLVENT BASED GLASS CLEANER TO CLEAN WINDSHIELD BEFORE APPLYING GLASS PREP AND PRIMER. POOR ADHESION CAN RESULT.

(6) Clean inside of windshield with ammonia based glass cleaner and lint-free cloth.

(7) Apply molding to perimeter of windshield. The butt weld of the molding should be centered at the bottom edge of the windshield.

(8) Apply Glass Prep adhesion promoter 25 mm (1 in.) wide around perimeter of windshield and wipe with clean/dry lint-free cloth until no streaks are visible.

(9) Apply Glass Primer 25 mm (1 in.) wide around perimeter of windshield. Allow at least three minutes drying time.

(10) Apply Pinchweld primer 15 mm (.75 in.) wide around the windshield fence. Allow at least three minutes drying time.

(11) Apply a 10 mm (0.4 in.) diameter bead of urethane on the pinchweld flange surface area 6 mm (.25 in.) from the outboard edge.

CAUTION: Be prepared to install the windshield glass immediately after applying the adhesive. The adhesive begins to cure within 10-15 minutes.

(12) Align the windshield with the grease pencil marks and position windshield on pinchweld flanges.

(13) Push the windshield glass inward until the reveal molding is seated on the windshield frame. Use care to avoid excessive squeeze-out of adhesive.

(14) Open windows and liftgate to prevent pressure build-up while the urethane is curing.

(15) Apply 150 mm (6 in.) lengths of 50 mm (2 in.) masking tape spaced 250 mm (10 in.) apart to hold windshield in place until urethane cures.

(16) Install the rearview mirror on the mirror button.

(17) Install the wiper arms.

(18) After urethane has cured, remove tape strips and water test windshield to verify repair.

QUARTER GLASS

REMOVAL

(1) Cover surface areas with protective covering to avoid paint damage and extra clean-up time.

(2) Using a razor knife, slide the blade between the quarter glass and the inboard edge of the reveal molding.

(3) Cut around the interior perimeter of the reveal molding and sever the cap of the reveal molding.

REMOVAL AND INSTALLATION (Continued)

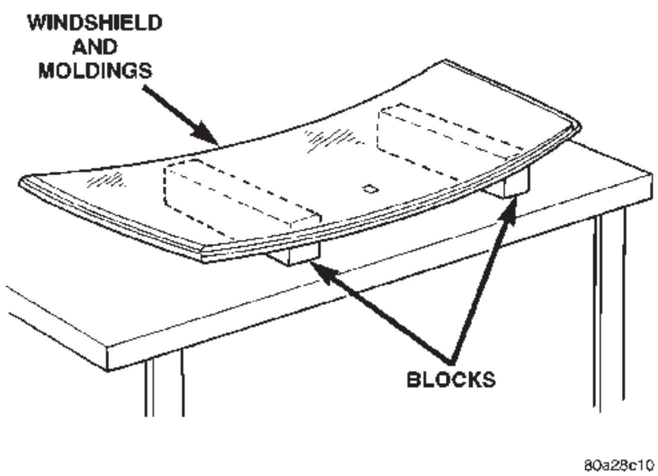


Fig. 3 Work Surface Set up and Molding Installation

(4) Using a cold knife, cut the urethane around the perimeter of the quarter glass.

(5) Remove the quarter glass from the opening (Fig. 4).

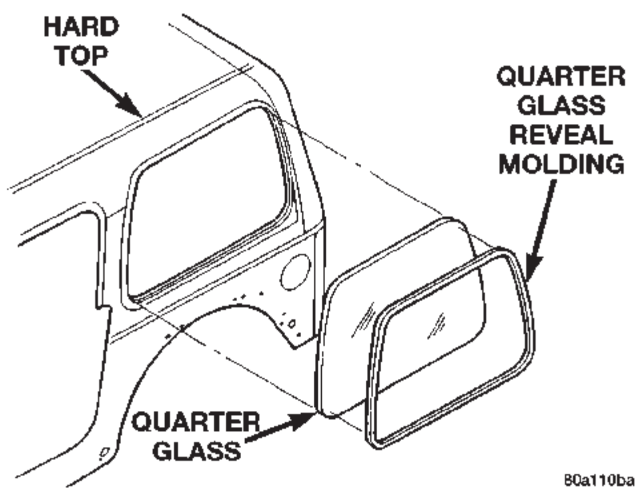


Fig. 4 Hard Top Quarter Glass

INSTALLATION

(1) Trim the urethane from the quarter glass opening fence. Leave a 3 mm (0.1 in.) level base of urethane on the quarter glass opening fence.

(2) Place replacement quarter glass into quarter glass opening and position glass in the center of the opening against fence.

(3) Verify the glass lays evenly against the fence at the sides, top and bottom of the replacement quarter glass. Next, make alignment marks on glass and top with a grease pencil.

(4) Remove replacement quarter glass from opening.

(5) Position the quarter glass inside up on a suitable work surface.

WARNING: DO NOT USE SOLVENT BASED GLASS CLEANER TO CLEAN QUARTER GLASS BEFORE APPLYING GLASS PREP AND PRIMER. POOR ADHESION CAN RESULT.

(6) Clean inside of quarter glass with ammonia based glass cleaner and lint-free cloth.

(7) Clean the outer edge of the window glass with naphtha or a similar product.

(8) Apply molding to perimeter of quarter glass. The butt weld of the molding should be centered at the bottom edge of the quarter glass.

(9) Apply Glass Prep adhesion promoter 25 mm (1 in.) wide around perimeter of the quarter glass and wipe with clean/dry lint-free cloth until no streaks are visible.

(10) Apply Glass Primer 25 mm (1 in.) wide around perimeter of quarter glass. Allow at least three minutes drying time.

(11) Apply Pinchweld primer 15 mm (.75 in.) wide around the quarter glass fence. Allow at least three minutes drying time.

(12) Apply a 10 mm (0.4 in.) diameter bead of urethane to the center of the quarter glass fence surface area.

CAUTION: Be prepared to install the quarter glass immediately after applying the adhesive. The adhesive begins to cure within 10-15 minutes.

(13) Align the quarter glass with the grease pencil marks and position quarter glass on fence.

(14) Push the quarter glass inward until the reveal molding is seated on the hardtop. Use care to avoid excessive squeeze-out of adhesive.

(15) Open windows and liftgate to prevent pressure build-up while the urethane is curing.

(16) Apply 150 mm (6 in.) lengths of 50 mm (2 in.) masking tape spaced 250 mm (10 in.) apart to hold quarter glass in place until urethane cures.

(17) After urethane has cured, remove tape strips and water test quarter glass to verify repair.

SEATS

INDEX

REMOVAL AND INSTALLATION

BUCKET SEATBACK

REMOVAL

(1) Remove seat.
(2) Remove the inboard seatback pivot bolt.
(3) Disengage the retainers attaching the cushion cover to the outboard seat cushion frame (Fig. 1).
(4) Disengage the seat cushion corner cover zipper.
(5) Remove the bolts attaching the recliner to the seat cushion frame (Fig. 2).
(6) Passenger seat only:
(a) From the underside of the seat cushion, disengage the seat track release cable (Fig. 3).
(b) Disengage recliner release cable (Fig. 4) from the seat back pivot bracket.
(7) Route the recliner handle through the seat cushion cover and separate the seatback from the seat cushion.

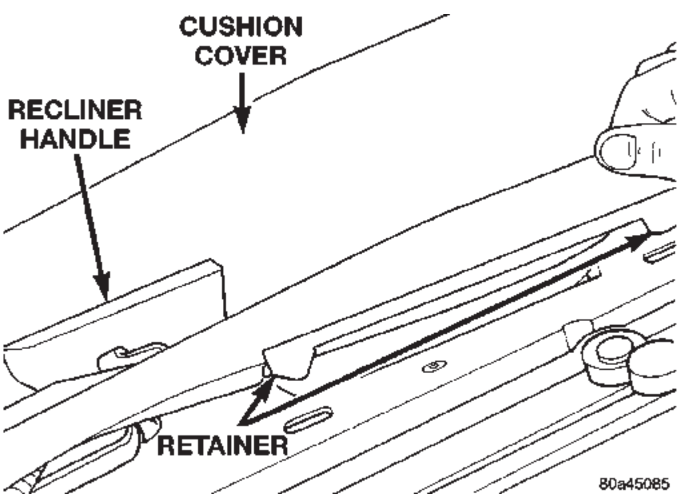


Fig. 1 Cushion Cover Retainers

INSTALLATION

(1) Position the seatback on the seat cushion while routing the recliner handle through the cushion cover opening.

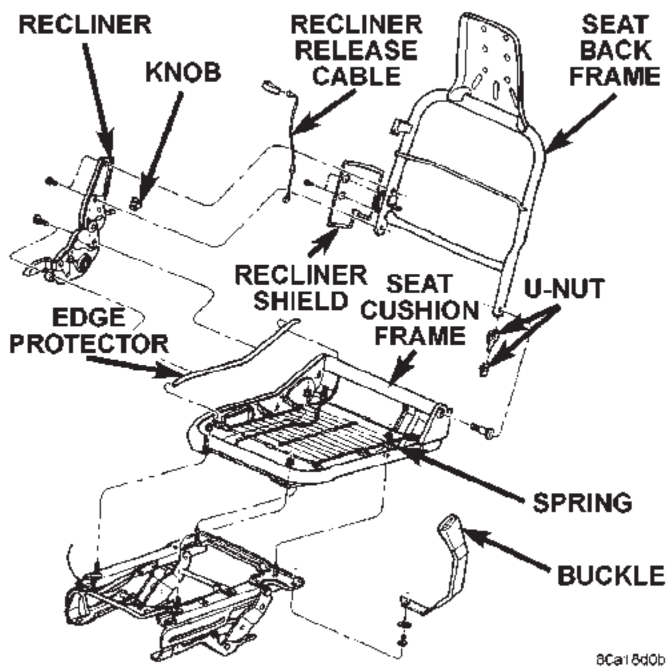


Fig. 2 Passenger Seat

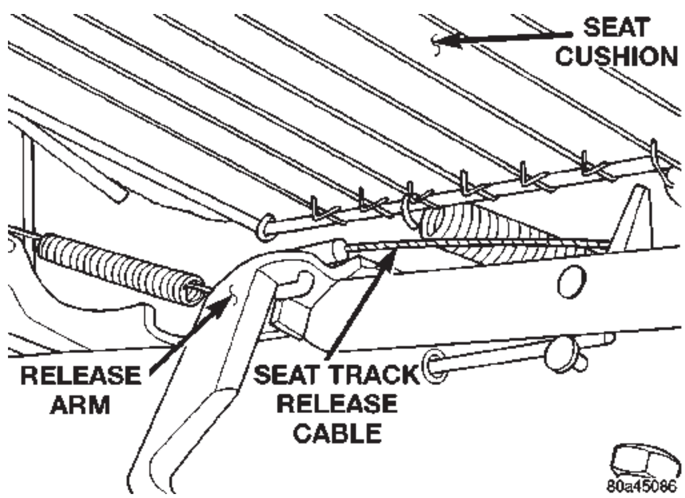


Fig. 3 Seat Track Release Cable

(2) Passenger seat only:
(a) Engage recliner release cable to the seat back pivot bracket.

REMOVAL AND INSTALLATION (Continued)

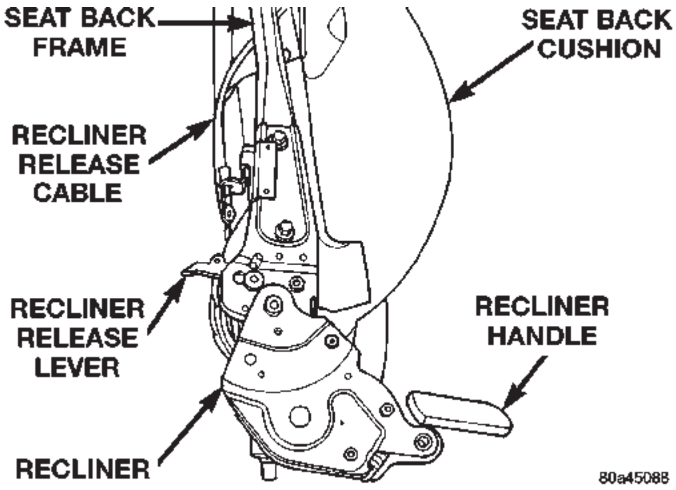


Fig. 4 Recliner Release Cable

(b) From the underside of the seat cushion, engage the seat track release cable.

(3) Install the bolts attaching the recliner to the seat cushion frame.

(4) Engage the seat cushion corner cover zipper.

(5) Engage the retainers attaching the cushion cover to the outboard seat cushion frame.

(6) Install the inboard seatback pivot bolt.

(7) Install seat.

BUCKET SEATBACK COVER

REMOVAL

(1) Remove seat.

(2) Remove seatback.

(3) Disengage zipper at seatback base.

(4) Using a trim stick, carefully pry off tilt release knob.

(5) Roll cover upward and over tilt release lever.

(6) Continue to roll cover upward and disengage hook and loop fastener (Fig. 5).

(7) Passenger seat only:

(a) Route recliner release cable/strap through cover.

(8) Separate cover from seatback.

INSTALLATION

(1) Position cover on seatback.

(2) Passenger seat only:

(a) Route recliner release cable/strap through cover.

(3) Roll cover downward and engage hook and loop fastener.

(4) Roll cover over tilt release lever.

(5) Install tilt release knob.

(6) Engage zipper at seatback base.

(7) Install seatback.

(8) Install seat.

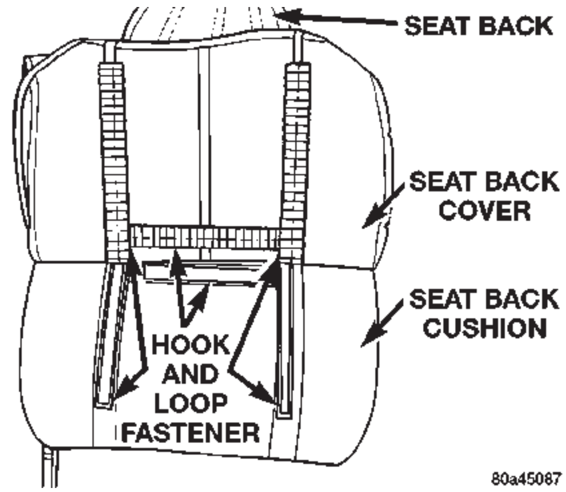


Fig. 5 Seat Back Cover

BUCKET SEAT CUSHION COVER

REMOVAL

(1) Remove seat.

(2) Remove seatback.

(3) Disengage inboard J-strap.

(4) Disengage front J-strap.

(5) Roll cover up to access hog rings.

(6) Disengage inboard, outboard and front hog rings.

(7) From the underside of the cushion, disengage the rear hog rings (Fig. 6).

(8) Separate cover from cushion.

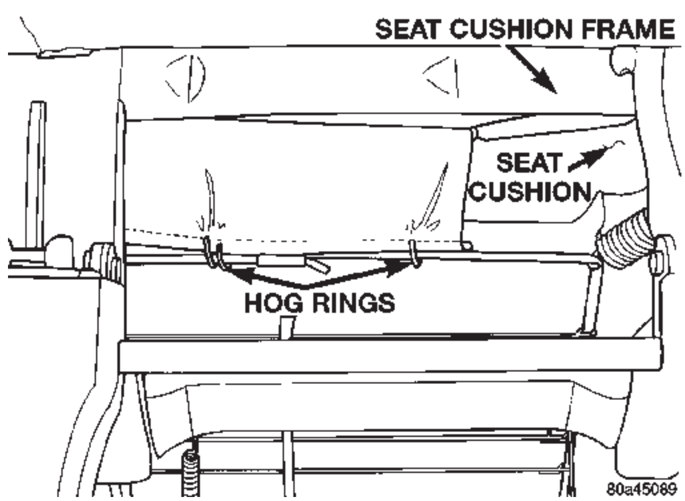


Fig. 6 Rear Hog Rings

INSTALLATION

(1) Position cover on cushion and align seams.

(2) From the underside of the cushion, engage the rear hog rings.

(3) Engage inboard, outboard and front hog rings.

(4) Roll cover over cushion edges.

(5) Engage inboard J-strap.

(6) Engage front J-strap.

(7) Install seatback.
(8) Install seat.

REAR SEATBACK

REMOVAL

(1) Remove rear seat from vehicle.
(2) Remove torx bolts attaching seatback to seat cushion (Fig. 7).
(3) Separate the seat back from the seat cushion.

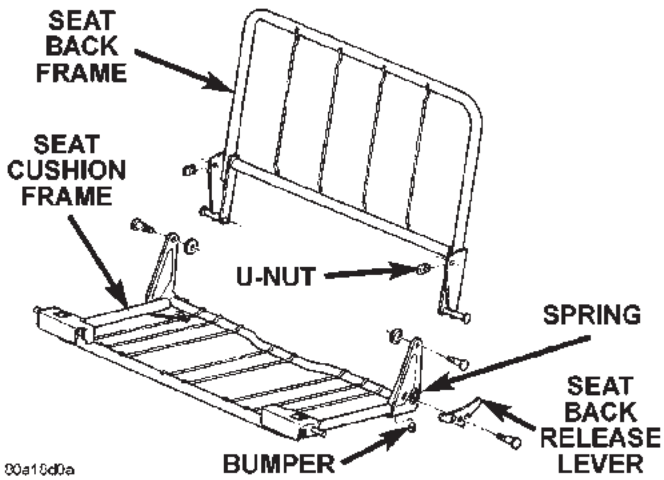


Fig. 7 Rear Seat Components

INSTALLATION

(1) Position the seat back on the seat cushion.
(2) Install the torx bolts attaching seatback to seat cushion.
(3) Install rear seat.

REAR SEATBACK COVER

REMOVAL

(1) Remove rear seat.
(2) Remove the seatback.
(3) Disengage the hook and loop fasteners at the seatback lower corners (Fig. 8).
(4) Disengage the seatback cover zipper.
(5) Carefully, remove the seatback frame from the cushion/cover.
(6) Roll the seatback cover upward and disengage the hook and loop fasteners.

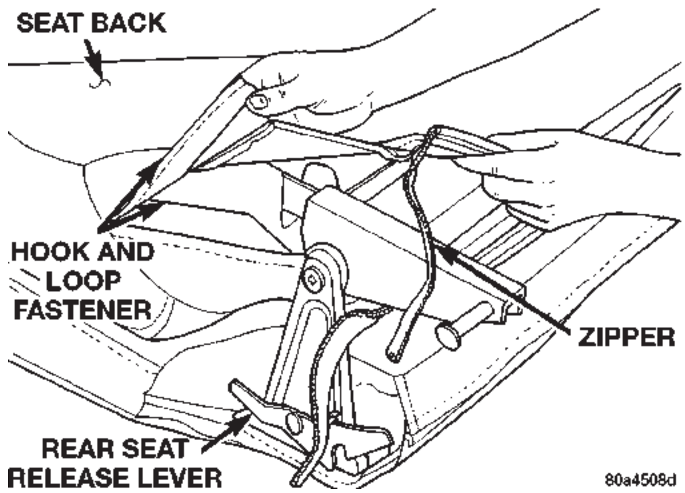


Fig. 8 Seat Back Cover

INSTALLATION

(1) Position the cover on the seatback cushion.
(2) Roll the seatback cover downward over the cushion.
(3) Install the seatback frame into the cushion/cover.
(4) Engage the seatback cover zipper.
(5) Engage the hook and loop fasteners at the seat-back lower corners.
(6) Install the seatback.
(7) Install rear seat.

REMOVAL AND INSTALLATION (Continued)

REAR SEAT CUSHION COVER

REMOVAL

(1) Remove rear seat.
(2) Remove the seatback.
(3) Disengage the J-straps at the rear cushion corners.
(4) Disengage the seat cushion cover zipper.
(5) Carefully, remove the seat cushion frame from the cushion/cover.
(6) Roll the cover from seat cushion and disengage the hook and loop fasteners (Fig. 9).

INSTALLATION

(1) Position the cover on the cushion and roll cover downward over the corners.
(2) Install the seat cushion frame into the cushion/cover.
(3) Engage the seat cushion cover zipper.
(4) Engage the J-straps at the rear cushion corners.

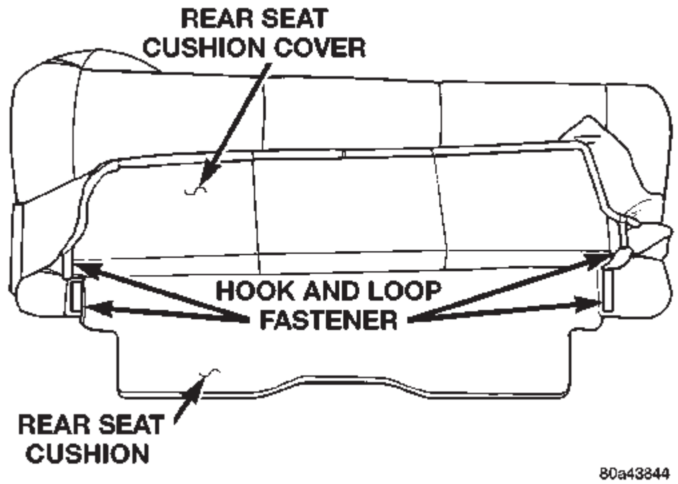


Fig. 9 Hook And Loop Fasteners

(5) Install the seatback.
(6) Install rear seat.

BODY COMPONENT SERVICE

INDEX

SERVICE PROCEDURES

BODY LUBRICATION

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

All applicable exterior and interior vehicle operating mechanisms should be inspected and cleaned. Pivot/sliding contact areas on the mechanisms should then be lubricated.

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

(2) Apply silicone lubricant to a cloth and wipe it on door seals to avoid over-spray that can soil passenger's clothing.

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

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

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

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

REMOVAL AND INSTALLATION

RADIATOR GRILLE PANEL

REMOVAL

(1) Remove the front crossmember cover.

(2) Remove the crossmember valence cover.

(3) Remove the radiator overflow bottle.

(4) Remove the bolts that attach the radiator and shroud from the grille panel.

(5) If A/C equipped:

(a) Evacuate the system.

(b) Disconnect the high and low pressure lines at the quick disconnect couplings.

(c) Cover (cap) the lines to prevent contamination.

(6) Remove the bolts attaching the radiator support rods to the grille panel.

(7) Disconnect the head lamp, turn signal, marker lamp and horn wire harness connectors.

(8) Remove the bolts attaching the fenders to the grille panel.

(9) Remove the bolt attaching the grille to the frame mount.

(10) Separate the grille from the vehicle.

INSTALLATION

Transfer all related components.

(1) Position the grille panel on the vehicle. Ensure the rubber support bumpers are aligned (Fig. 1).

(2) Install the bolt attaching the grille to the frame mount.

(3) Install the bolts attaching the fenders to the grille panel.

REMOVAL AND INSTALLATION (Continued)

(4) Connect the head lamp, turn signal, marker lamp and horn wire harness connectors.

(5) Install the bolts attaching the radiator support rods to the grille panel.

(6) If A/C equipped:

(a) Connect the high and low pressure lines at the quick disconnect couplings.

(b) Evacuate and charge the system.

(7) Install the radiator and shroud to the grille panel.

(8) Install the radiator overflow bottle.

(9) Install the crossmember valence cover.

(10) Install the front crossmember cover.

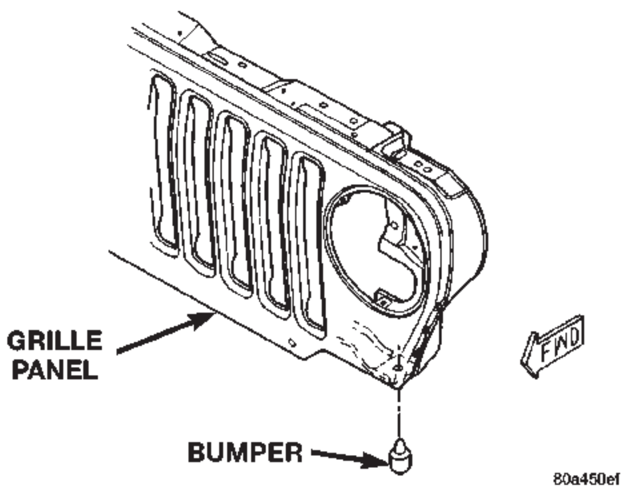


Fig. 1 Grille Bumpers

HOOD

REMOVAL

(1) Raise and support the hood.

(2) Disconnect the underhood lamp wire harness connector.

(3) Disconnect the windshield washer nozzles.

(4) Disconnect the ground strap.

(5) Mark the position of the hinges on the hood for installation alignment reference.

(6) Remove the screws attaching the hood to the hinge and remove the hood (Fig. 2).

(7) If the hood must be replaced, remove and transfer the insulator panel, hinges, latches, bumpers, brackets, footman loop, hood lamp, support rod, and safety latch to the replacement hood (Fig. 2).

INSTALLATION

(1) Position the hood on the vehicle and install the screws attaching the hinge to the hood.

(2) Align the hinges with the installation reference marks on the hood and tighten the hinge screws securely.

(3) Connect the underhood lamp wire harness connector.

(4) Connect the windshield washer nozzles.

(5) Connect the ground strap.

(6) Close the hood.

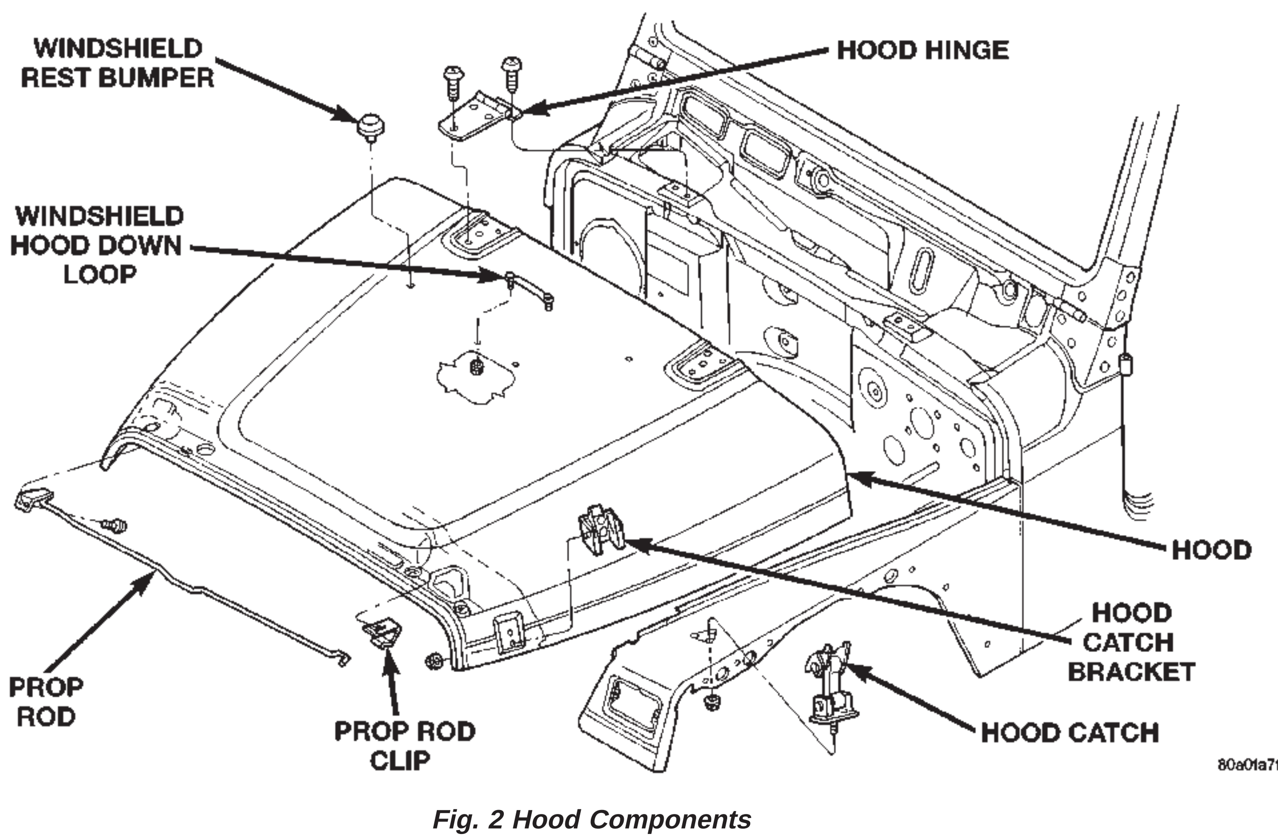


Fig. 2 Hood Components

REMOVAL AND INSTALLATION (Continued)

HOOD INSULATION PANEL

REMOVAL

(1) Raise and support the hood.

(2) Remove the insulation panel fasteners (Fig. 3).

(3) Remove the insulation panel from the hood.

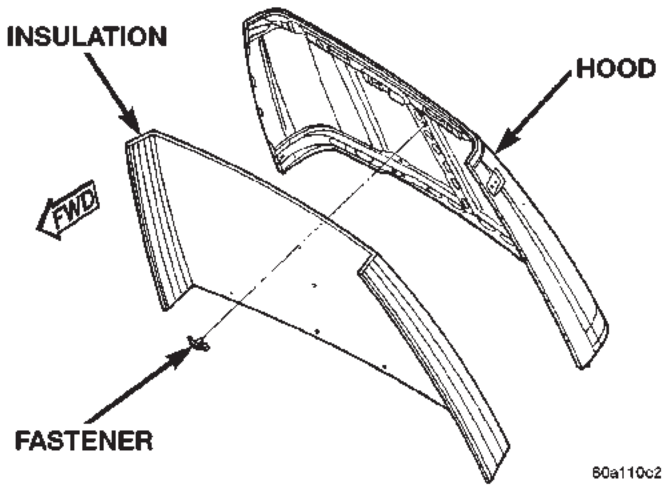


Fig. 3 Hood Insulation Panel

INSTALLATION

(1) Position the insulation panel on the hood.

(2) Install the insulation panel fasteners.

(3) Remove the support rod and close the hood.

HOOD HINGE

REMOVAL

(1) Remove the wiper arms.

(2) Remove the cowl panel and screen.

(3) Remove the bolts attaching the hinge to the cowl.

(4) Using a wax pencil, mark the position of the hinge on the hood for installation alignment reference.

(5) Remove the screws attaching the hinge to the hood (Fig. 2).

(6) Separate the hinge from the hood.

INSTALLATION

(1) Prepare and paint the replacement hinge to match the body paint color.

(2) Align the hinge with the installation reference marks on the hood

(3) Install the screws attaching the hinge to the hood and cowl. Tighten the screws to 17 N·m (155 in. lbs.) torque.

(4) Install the bolts attaching the hinge to the cowl.

(5) Install the cowl panel and screen.

(6) Install the wiper arms.

HOOD SAFETY LATCH

REMOVAL

(1) Raise and support the hood.

(2) Remove the bolt attaching the safety latch to the hood (Fig. 4).

(3) Remove the latch from the hood.

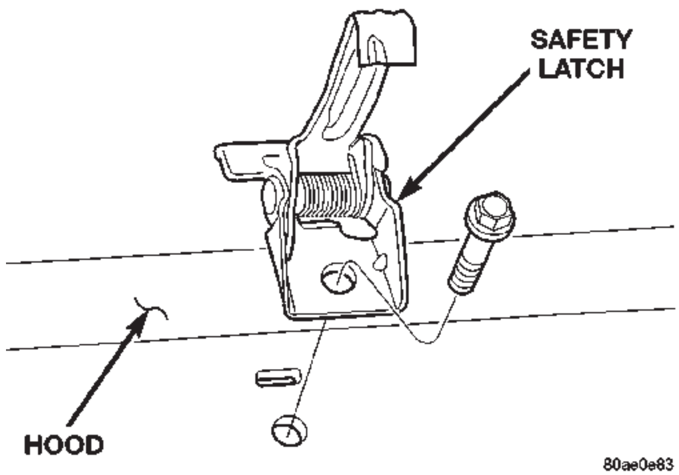


Fig. 4 Hood Safety Latch

INSTALLATION

(1) Position the latch on the hood.

(2) Install the bolt attaching the safety latch to the hood.

(3) Remove the support rod and close the hood.

COWL WEATHERSTRIP

REMOVAL

(1) Carefully separate the weatherstrip from the cowl flange (Fig. 5).

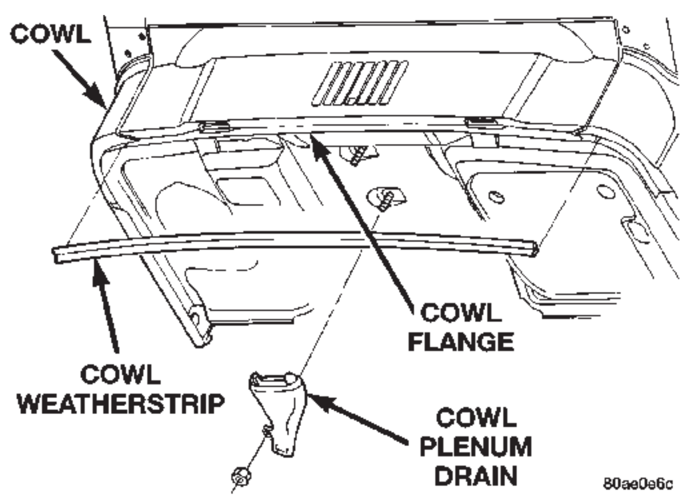


Fig. 5 Cowl Weatherstrip

INSTALLATION

(1) Position the weatherstrip on the cowl flange and press it into place.

REMOVAL AND INSTALLATION (Continued)

COWL GRILLE AND SCREEN

REMOVAL

(1) Open the hood and remove the screws that attach the cowl grille and screen to the cowl (Fig. 6).

(2) Remove the grille and screen from the cowl.

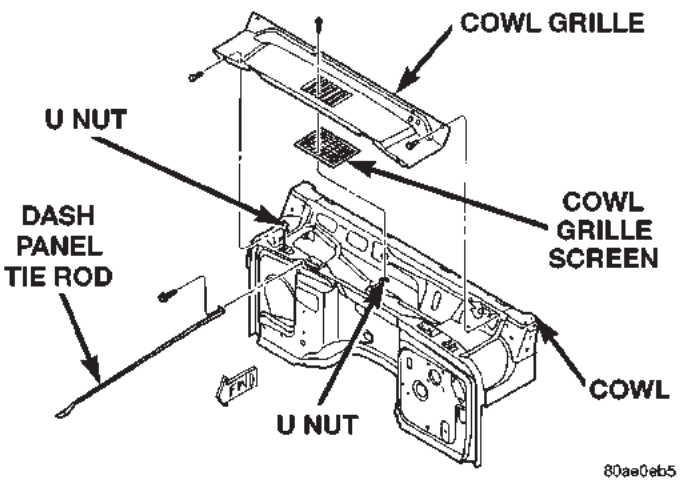


Fig. 6 Cowl Grille And Screen

INSTALLATION

NOTE: When installing the cowl grille, ensure the foam seals on the underside of the cowl grille (Fig. 7) are positioned correctly and in good condition. Misaligned or damaged seals may allow water to enter the HEVAC.

(1) Position the cowl screen and grille on the cowl.

(2) Install the screws that attach the grille and screen to the cowl.

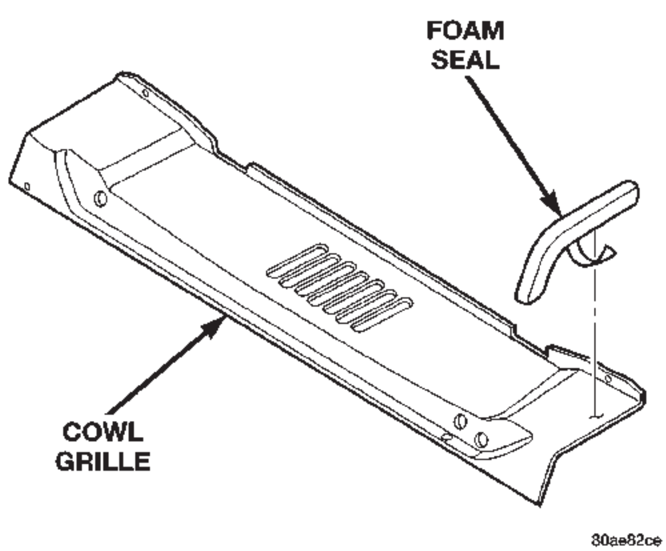


Fig. 7 Cowl Grille Foam Seal

WINDSHIELD FRAME

REMOVAL

(1) Unlatch top.

(2) Remove the bolts attaching the sport bar to the windshield frame.

(3) Remove the windshield wiper arms.

(4) Remove the torx screw closest to the hinge pivot point and tilt the windshield forward.

(5) Remove the torx screws attaching the windshield hinge to the windshield frame (Fig. 8).

(6) Separate the windshield frame from the vehicle.

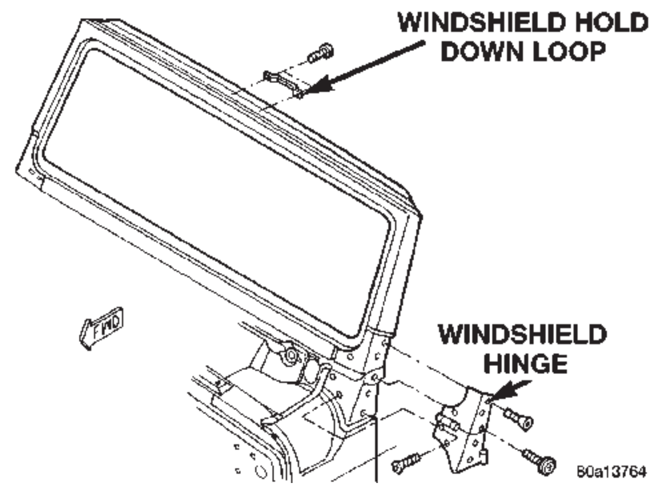


Fig. 8 Windshield Frame

INSTALLATION

(1) Position the windshield frame on the vehicle.

(2) Install the torx screws attaching the windshield hinge to the windshield frame.

(3) Tilt the windshield rearward.

(4) Install the torx screw closest to the hinge pivot point and lock the windshield in the upright position.

(5) Install the windshield wiper arms.

(6) Install the bolts attaching the sport bar to the windshield frame.

(7) Latch top.

WINDSHIELD FRAME WEATHERSTRIP

UPPER FRAME WEATHERSTRIP REMOVAL

(1) Disconnect the top from the windshield frame.

(2) Disengage the push-in fasteners attaching the weatherstrip to the windshield frame.

(3) Peel the weatherstrip from the frame.

UPPER FRAME WEATHERSTRIP INSTALLATION

(1) Clean the seal contact surface on the windshield frame with isopropyl alcohol or equivalent.

REMOVAL AND INSTALLATION (Continued)

NOTE: Ensure that the contact surface is dry and free from any residue, poor adhesion will result.

(2) Position the weatherstrip on the windshield frame, align the push-in fasteners and press it into place (Fig. 9).

(3) Remove adhesive backing from the bottom of the weatherstrip.

(4) Using forceful hand pressure, seat the adhesive on the contact surface.

NOTE: If tape surface becomes contaminated, it will not adhere to the windshield frame.

(5) Connect the top to the windshield frame.

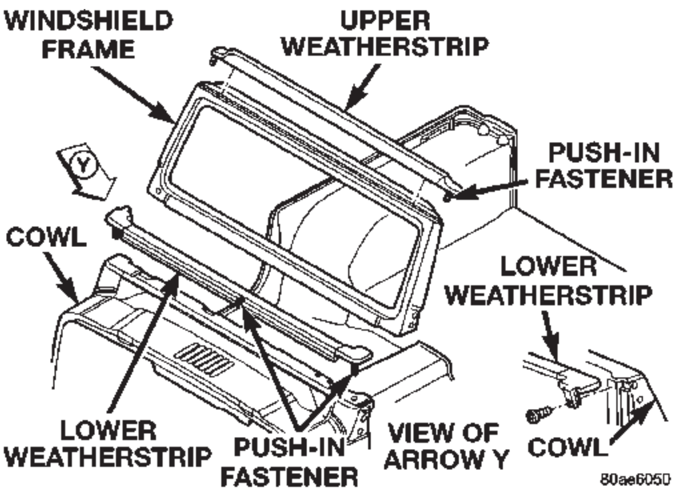


Fig. 9 Windshield Frame Weatherstrip

LOWER FRAME WEATHERSTRIP REMOVAL

The lower windshield frame weatherstrip can be removed with the frame tilted forward to the full horizontal position.

(1) Mark the position of the wiper arms and remove the arms.

(2) Disconnect the top from the windshield frame.

(3) Remove the cowl grille.

(4) Remove the torx screws on each side of the windshield frame allowing the windshield frame to tilt to the full horizontal position.

(5) Disengage the outboard push-in fasteners at the top of cowl and unscrew the fasteners that hold the weatherstrip on each hinge pillar (Fig. 9).

(6) Disengage the push-in fastener at the center of cowl.

(7) Remove the weatherstrip from the cowl.

LOWER FRAME WEATHERSTRIP INSTALLATION

(1) Position the weatherstrip on the cowl, align the center push-in fastener and press it into place.

(2) Align the outer push-in fasteners and press it into place.

(3) Install the screws attaching the lower weatherstrip to the hinge pillars.

(4) Tilt the windshield frame rearward to the full vertical position.

(5) Install the torx screws on each side of the windshield securing the windshield frame.

(6) Connect the top to the windshield frame.

(7) Install cowl grille and wiper arms.

WINDSHIELD HINGE

REMOVAL

If both hinges are to be replaced, the windshield must be tilted to the full forward position. Refer to the Windshield Frame Removal/Installation procedure in this group for windshield frame lowering information.

(1) Remove door.

(2) Remove the bolts attaching the hinge to the cowl (Fig. 10).

(3) Remove the bolts attaching the hinge to the windshield frame.

(4) Separate the hinge from the vehicle.

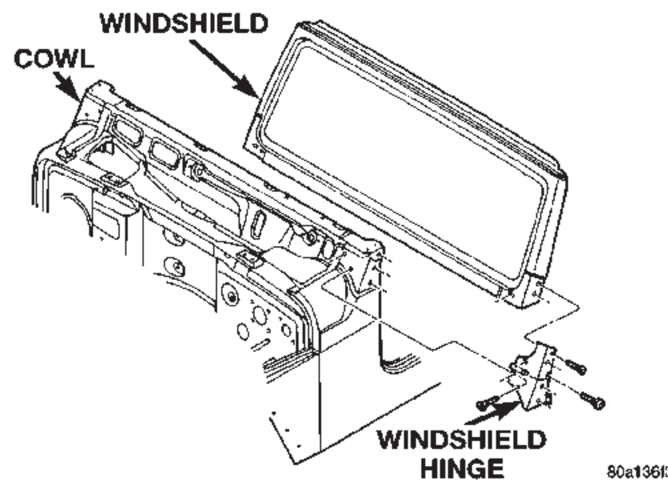


Fig. 10 Windshield Hinge

INSTALLATION

(1) Paint as required.

(2) Clean the contact surface of the hinge and cowl with isopropyl alcohol or equivalent.

(3) Apply a 4 mm bead of Mopar Vinyl Acrylic Sealant or equivalent around the perimeter of the hinge contact surface. The bead should be 10 mm inboard of the edge.

(4) Position the hinge on the vehicle.

(5) Install the bolts attaching the hinge to the windshield frame.

(6) Install the bolts attaching the hinge to the cowl.

(7) Ensure that the sealant provides complete coverage. Wipe away excess sealant.

(8) Install door.

REMOVAL AND INSTALLATION (Continued)

BODY DECALS

TJ decals (Fig. 11) are durable tape decals with a adhesive backing.

To eliminate blisters and air bubbles in a decal, pierce them with a needle or pin. Force the trapped air out of the hole.

A heat gun can also be used to remove small wrinkles and irregularities in a decal.

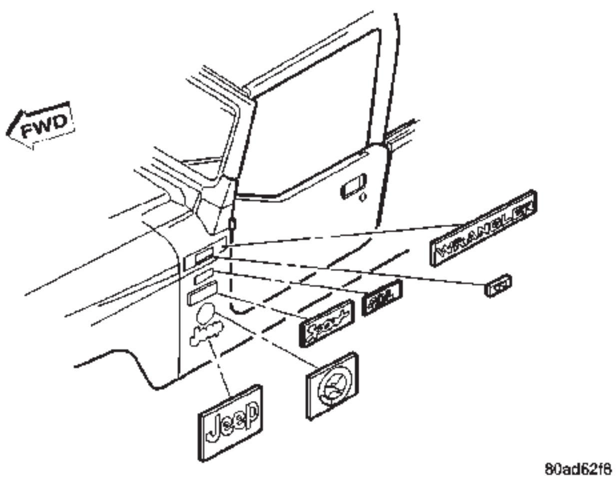


Fig. 11 TJ—Decals

REMOVAL

NOTE: The key to successful decal removal is to apply heat to area and slowly peel the decal from panel.

(1) Clean the surface as necessary.

(2) Place a piece of masking tape above or below the decal as a reference mark.

(3) Start at one end of the decal and apply heat with a heat gun. Slowly peel the decal from the panel by pulling it back. **Do not pull the decal outward from the panel.**

INSTALLATION

(1) The area that will be covered by the decal must be cleaned with an cleaning solution to remove any residue paint. Freshly painted surfaces must be thoroughly dry.

(2) Clean painted surface with a commercial wax and silicone removal solution. Wipe surface with a clean cloth and allow to dry.

(3) Position decal and carrier on panel and hold it in-place with pieces masking tape.

(4) Lift the bottom edge of the decal and carrier, use the tape sections as hinges, and reverse the position of the decal and carrier.

CAUTION: Always remove the carrier from the tape stripe/decal, never remove the tape stripe/decal from the carrier.

(5) Bend a corner of the carrier outward, separate the corner of the carrier from the decal.

(6) Using the masking tape on the body panel, align the decal.

(7) Separate the carrier from one end of the decal.

(8) Hold tape decal firmly against the panel surface while separating the carrier from the decal.

(9) Inspect tape decal with reflected light to check for defects that could have developed during the installation process. Remove all air and/or moisture bubbles.

REMOVAL AND INSTALLATION (Continued)

SIDE VIEW MIRROR

REMOVAL

(1) Remove the screws attaching the mirror to the door hinge (Fig. 12).

(2) Remove the mirror from the door hinge.

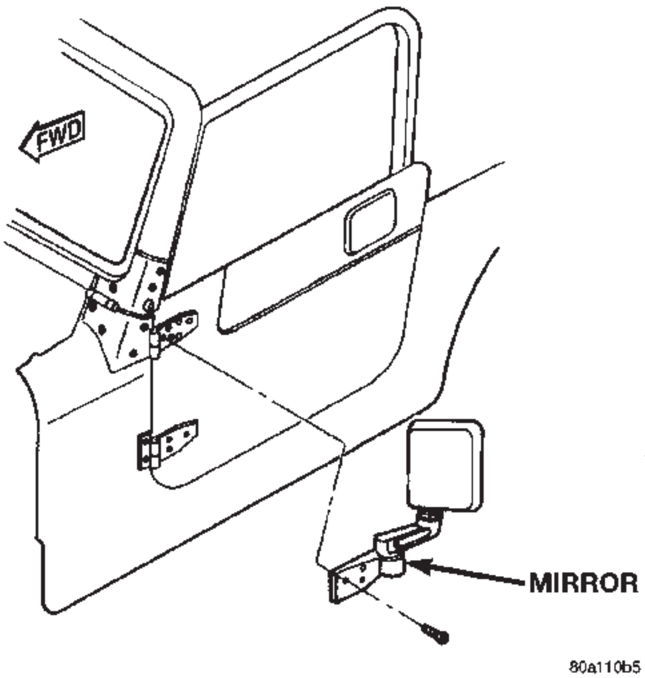


Fig. 12 Side View Mirror

INSTALLATION

(1) Clean the door hinge-mirror base contact surface.

(2) Position the mirror base at the door hinge.

(3) Install the screws attaching the mirror base to the door hinge.

FENDER FLARE

REMOVAL

(1) Remove the side marker lamp.

(2) Remove the screws that attach the flare to the front fender or rear wheelhouse (Fig. 13).

(3) Separate the flare from the body.

INSTALLATION

(1) Clean the contact surface on the body.

(2) Clean the contact surface on the flare and position it on the front fender or wheelhouse.

(3) Install the screws attaching the flares to the front fender or wheelhouse.

(4) If removed, install the side marker lamp.

FRONT FENDER

RIGHT FENDER REMOVAL

(1) Disconnect and remove the battery.

(2) Remove the air cleaner housing.

(3) Remove the bolts attaching the Power Distribution Center (PDC) to the fender.

(4) Disengage the PDC wire harness retainers on the battery tray and fender.

(5) Move and secure the PDC.

(6) Disengage the high pressure air conditioning line retainer on the fender.

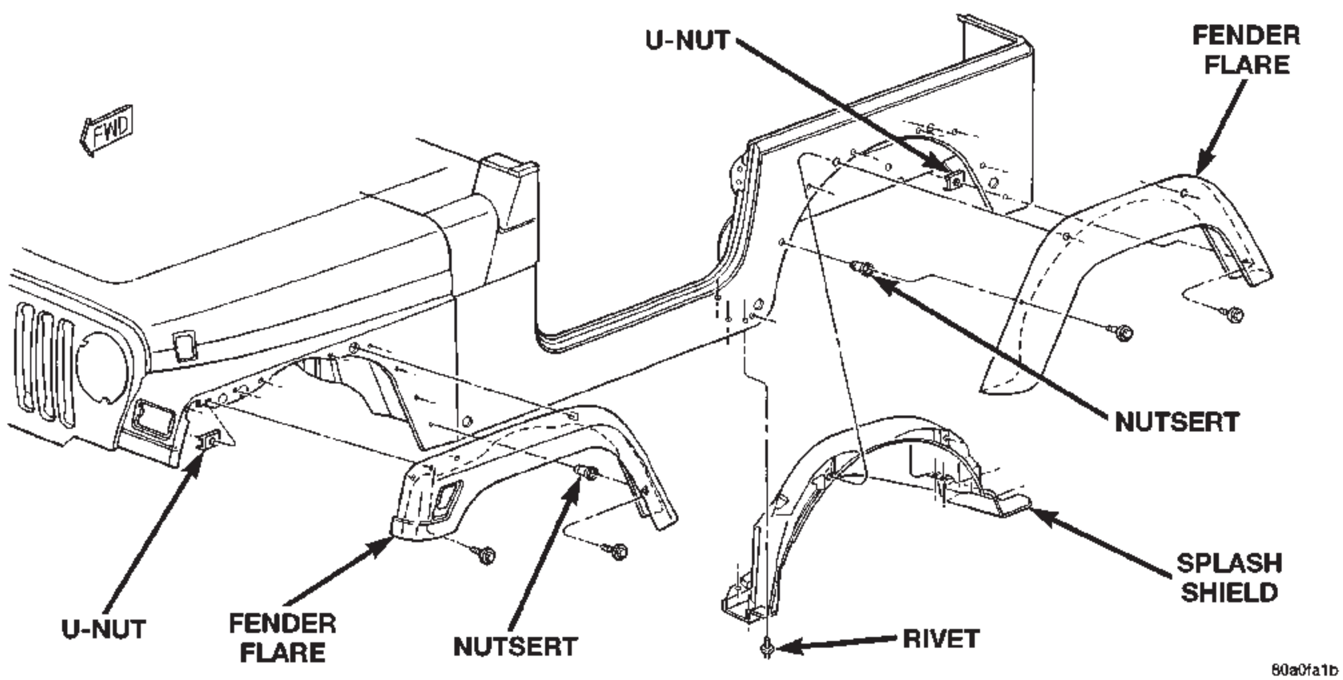


Fig. 13 FENDER FLARES

REMOVAL AND INSTALLATION (Continued)

(7) Disengage the front end lighting wire harness retainers on the fender.

(8) Remove the battery tray.

(9) Disengage the battery temperature sensor connector.

(10) Disengage the vacuum line at the reservoir under the battery tray reinforcement bracket.

(11) Disengage the headlamp wire connector.

(12) Route the fog lamp (if equipped), park lamp and side marker wire harness through the access hole in the fender well.

(13) If equipped, remove the fender flare extension and body side molding (Fig. 14).

(14) Remove the bolts attaching the fender to the cowl (Fig. 15).

(15) Remove the bolts attaching the fender to the battery tray reinforcement bracket.

(16) Remove the bolts attaching the fender to the grille.

(17) Separate the fender from the vehicle.

RIGHT FENDER INSTALLATION

Transfer all related components. Replace harness retainers if damaged.

(1) Position the fender on the vehicle.

(2) Install the bolts attaching the fender to the grille.

(3) Install the bolts attaching the fender to the battery tray reinforcement bracket.

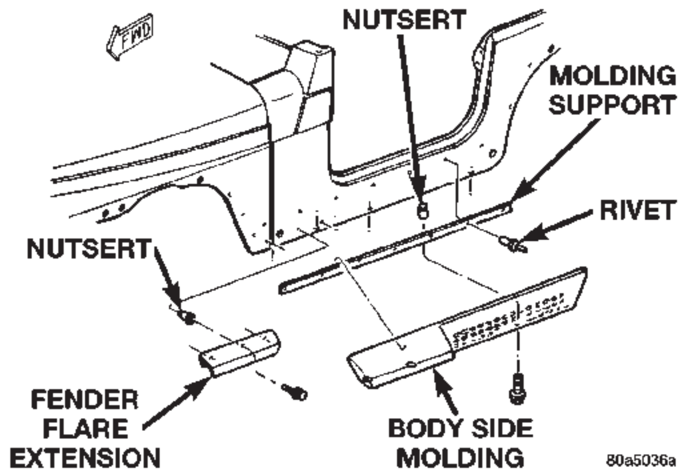


Fig. 14 Body Side Molding

(4) Install the bolts attaching the fender to the cowl.

(5) If equipped, install the fender flare extension and body side molding.

(6) Route the fog lamp (if equipped), park lamp and side marker wire harness through the access hole in the fender well. Seat the grommet

(7) Engage the headlamp wire connector.

(8) Engage the battery temperature sensor connector.

(9) Engage the vacuum line at the reservoir under the battery tray reinforcement bracket.

(10) Install the battery tray.

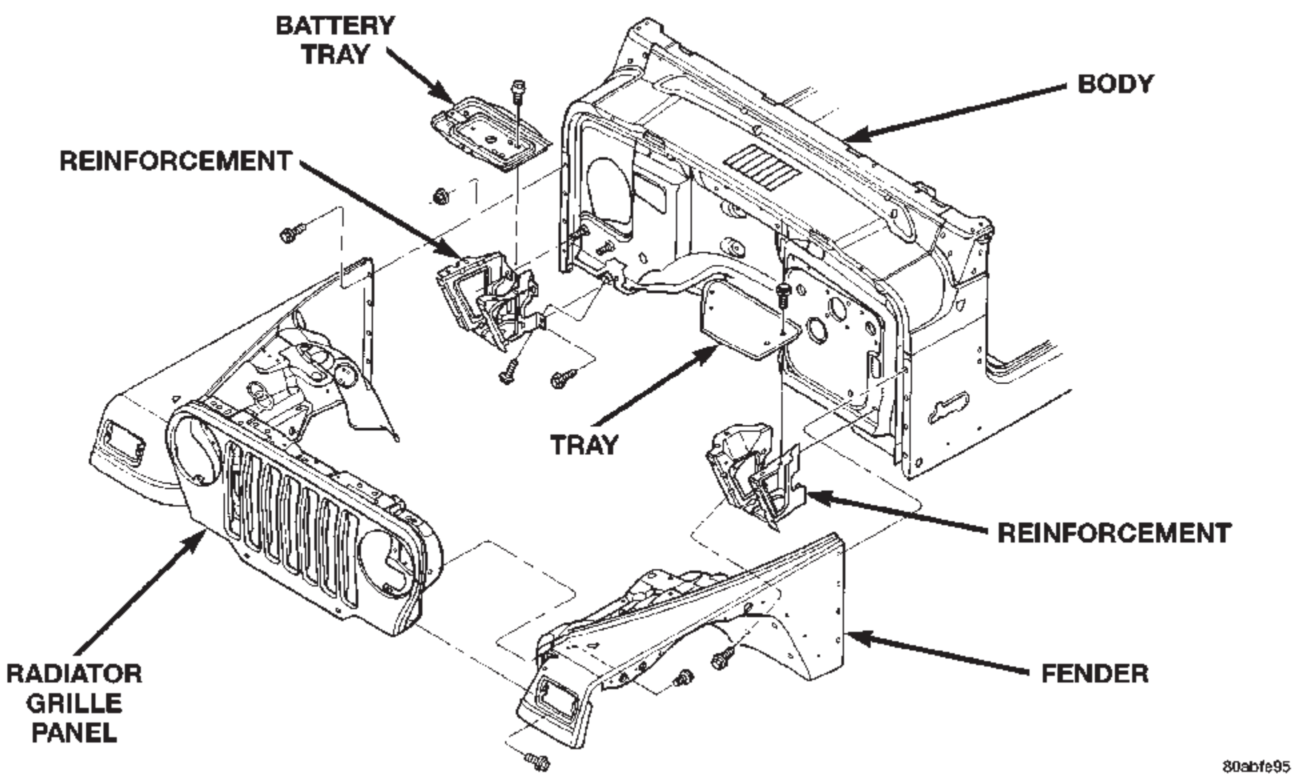


Fig. 15 Front Fender

REMOVAL AND INSTALLATION (Continued)

(11) Position the front end lighting wire harness into the retainers on the fender. Engage the retainers to secure.

(12) Position the high pressure air conditioning line into the retainer on the fender. Engage the retainer to secure.

(13) Position the PDC on the fender and install the bolts.

(14) Position the PDC wire harness into the retainers on the fender and battery tray. Engage the retainers to secure.

(15) Install the air cleaner housing.

(16) Install and connect the battery.

LEFT FENDER REMOVAL

(1) Disconnect the negative terminal on the battery.

(2) Remove the windshield washer reservoir.

(3) Disengage horn wire connectors.

(4) Remove horns.

(5) Remove EVAP canister.

(6) Remove the bolts attaching the ABS Hydraulic Control Unit (HCU) to the support tray.

(7) Secure the HCU.

(8) Remove the HCU tray.

(9) Disengage the front end lighting wire harness retainers on the fender.

(10) Disengage the headlamp wire connector.

(11) Route the fog lamp (if equipped), park lamp and side marker wire harness through the access hole in the fender well.

(12) If equipped, remove the body side molding (Fig. 14).

(13) Remove the bolts attaching the fender to the cowl (Fig. 15).

(14) Remove the bolts attaching the fender to the HCU tray reinforcement bracket.

(15) Remove the bolts attaching the fender to the grille.

(16) Separate the fender from the vehicle.

LEFT FENDER INSTALLATION

Transfer all related components. Replace harness retainers if damaged.

(1) Position the fender on the vehicle.

(2) Install the bolts attaching the fender to the grille.

(3) Position the front end lighting wire harness into the retainers on the fender. Engage the retainers to secure.

(4) Install the bolts attaching the fender to the HCU tray reinforcement bracket.

(5) Install the bolts attaching the fender to the cowl.

(6) If equipped, install the body side molding.

(7) Route the fog lamp (if equipped), park lamp and side marker wire harness through the access hole in the fender well. Seat the grommet

(8) Engage the headlamp wire connector.

(9) Install the HCU tray.

(10) Position the HCU on the support tray and install the bolts.

(11) Install EVAP canister.

(12) Install horns.

(13) Engage horn wire connectors.

(14) Install the windshield washer reservoir.

(15) Connect the negative terminal on the battery.

BODY SIDE MOLDING

REMOVAL

(1) Remove the bolts from underside of the body side molding (Fig. 16).

(2) Lift the molding upward to release it from the molding support.

(3) Remove the molding support by drilling out the rivets.

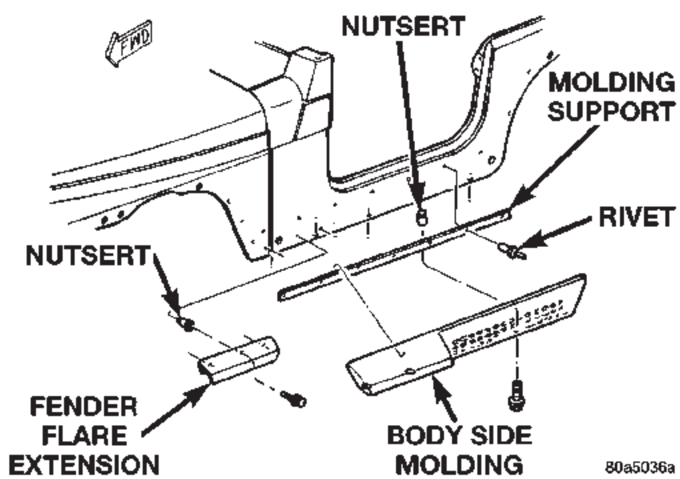


Fig. 16 Body Side Molding

INSTALLATION

(1) If removed, position the molding support on the body and install the rivets.

(2) Place the upper edge of the molding over the top of the molding support and slide it downward.

(3) Install the bolts into the underside of the body side molding.

SIDE STEP

REMOVAL

(1) Remove the bolts that attach the side step to the frame (Fig. 17).

(2) Separate the side step from the frame.

INSTALLATION

(1) Position the side step on the frame.

REMOVAL AND INSTALLATION (Continued)

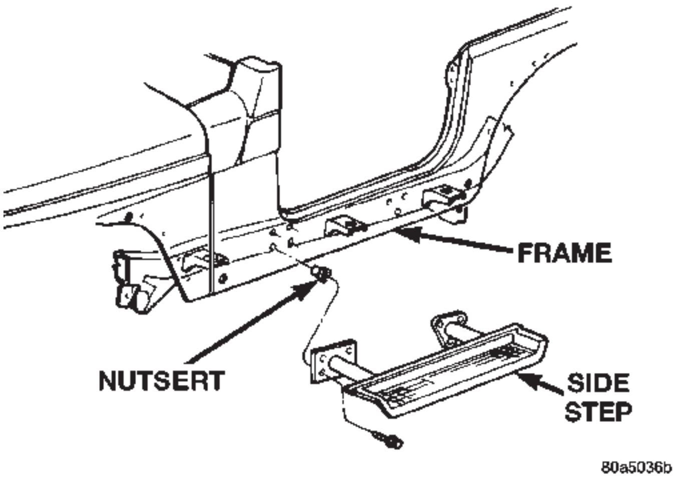


Fig. 17 Side Step

(2) Install the bolts that attach the side step to the frame.

FULL DOOR TRIM PANEL

REMOVAL

(1) Lower the window.

(2) Remove the clip attaching the window glass regulator handle to the regulator. Remove the handle.

(3) Remove the screws attaching trim panel to door (Fig. 18).

(4) Remove push-in fasteners attaching trim panel to door with special tool C-4829.

(5) Lift the trim panel upward and separate the trim panel from the door.

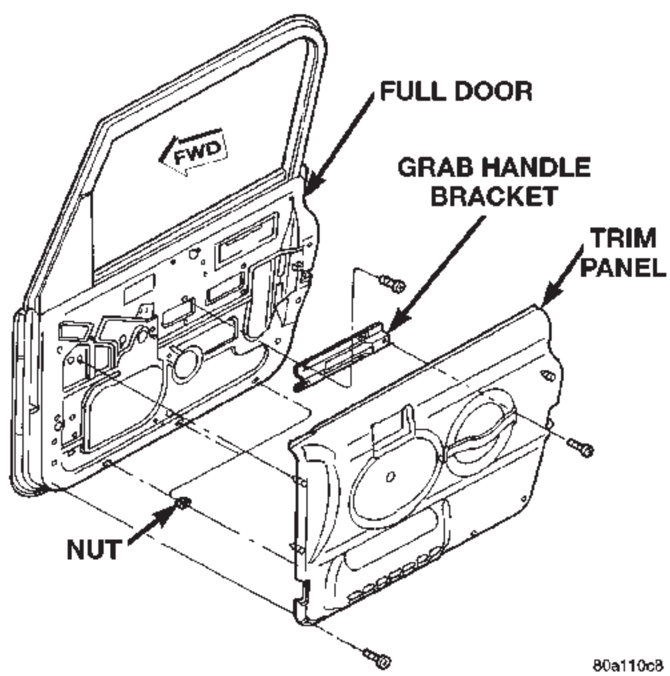


Fig. 18 Full Door Trim Panel

INSTALLATION

(1) Position the trim panel on the door.

(2) Press the push-in fasteners attaching trim panel to door into place.

(3) Install the screws attaching trim panel to door.

(4) Position the clip on regulator handle and install the handle on the regulator.

FULL DOOR

REMOVAL

(1) Open the door.

(2) Disconnect the door restraint strap from the pin (Fig. 19).

(3) Remove the nuts at the door hinge pivots and lift the door from the body.

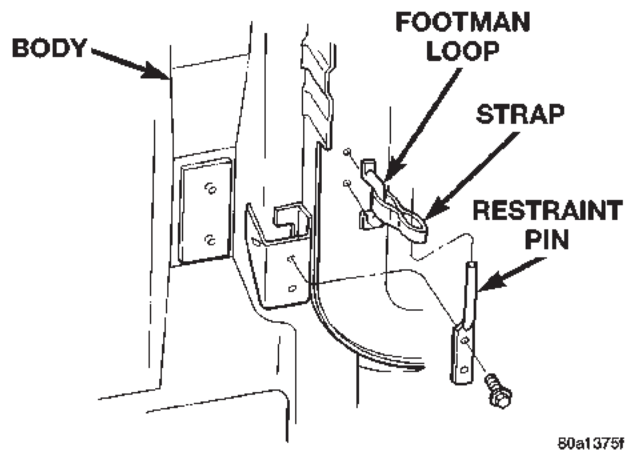


Fig. 19 Restraint Strap

INSTALLATION

(1) Position the door in the hinge and install the nuts.

(2) Connect the door restraint strap at the pin.

FULL DOOR HINGE

REMOVAL

(1) Remove the door.

(2) Mark the outline of the existing hinge on the body and the door with a wax pencil for installation alignment reference.

(3) Remove the nut from the upper hinge pin (Fig. 20).

NOTE: When removing the door or hinge DO NOT discard the plastic shims or the hinge pin.

(4) Remove the hinge-to-body screws and the hinge-to-door screws. Remove the hinge from the door and body. Support the door as necessary.

REMOVAL AND INSTALLATION (Continued)

The upper hinge is integrated with the windshield hinge. When removing it, support the windshield frame with an appropriate device prior to removal.

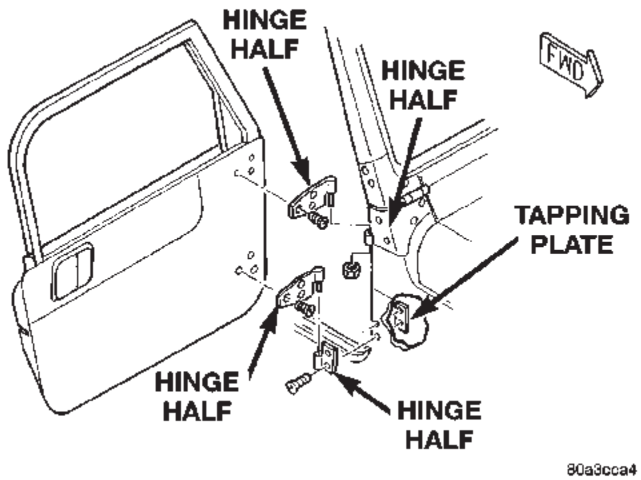


Fig. 20 Full Door Hinge

INSTALLATION

(1) Clean the replacement hinge with an appropriate solvent and dry it with compressed air.

(2) Paint the hinge to match the vehicle body.

(3) Lubricate the hinge with spray lubricant.

(4) Position the hinge on the door, align carefully with the wax pencil installation alignment reference marks, and install the screws.

(5) Position the hinge on the vehicle body. Align the wax pencil marks installation alignment reference marks. Install the screws.

(6) Install the door,

(7) Inspect the windshield alignment after hinge installation.

(8) Inspect the door alignment. Adjust, if necessary.

FULL DOOR OUTSIDE RELEASE HANDLE

REMOVAL

(1) Remove the door trim panel.

(2) Position the window in the full upward position.

(3) Remove the grab handle support bracket (Fig. 21).

(4) Peel back the waterdam from the door inner panel to access the door latch.

(5) Disconnect from the latch, the inside lock knob to latch rod and, the outside release handle to latch rod (Fig. 22).

(6) Using a long flat blade, tap the handle keepers upward and remove from the door handle (Fig. 23).

(7) Remove the latch release rod from the door handle.

(8) Separate the handle and gasket from the door.

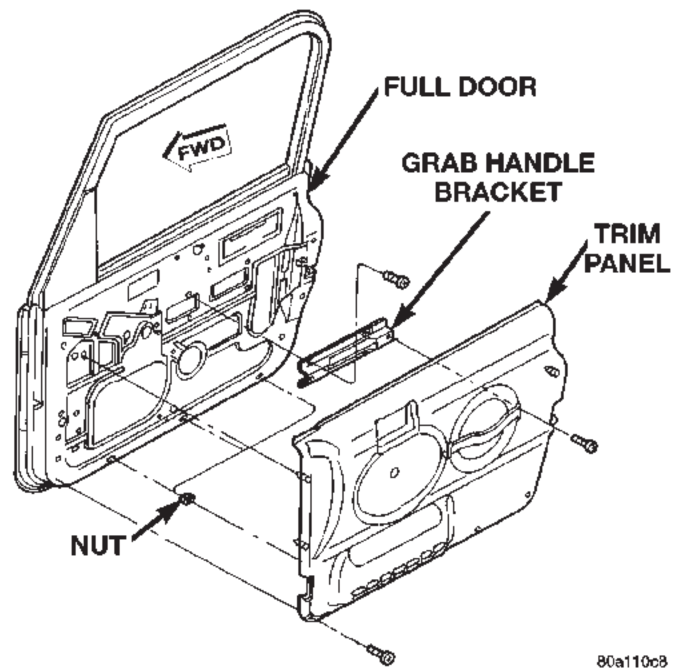


Fig. 21 Grab Handle Support Bracket

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

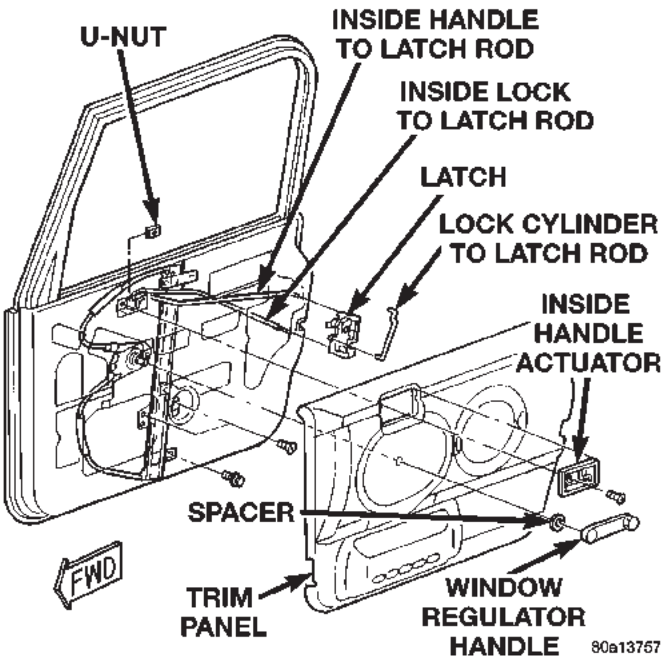


Fig. 22 Latch Rods

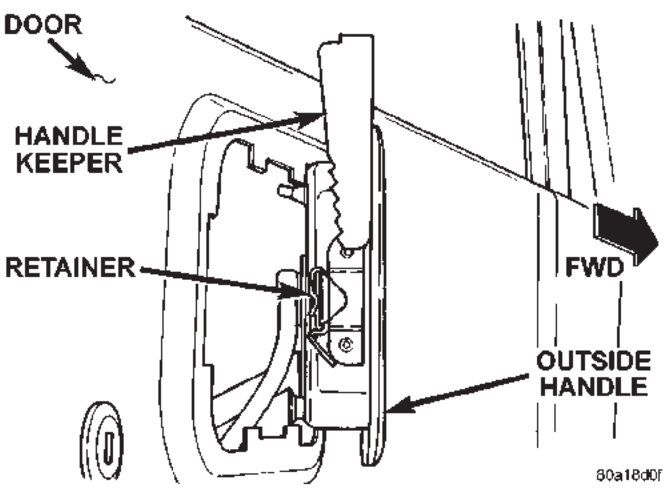


Fig. 23 Outside Door Handle Removal

(1) Engage the latch release rod to the door handle.

(2) Position the gasket and handle in the door.

(3) Slide the keepers into the door handle from the top.

(4) Lower the window.

(5) Using a long flat blade, lightly tap the handle keepers downward to secure the handle.

(6) Raise the window.

(7) Connect to the latch, the inside lock knob to latch rod and, the outside release handle to latch rod.

(8) Install the waterdam

(9) Install the grab handle support bracket.

(10) Install the door trim panel.

FULL DOOR LOCK CYLINDER

REMOVAL

(1) Remove trim panel.

(2) Peel back waterdam.

(3) Disconnect lock cylinder to latch rod.

(4) Remove lock cylinder retaining clip.

(5) Remove the lock cylinder from the door.

INSTALLATION

(1) Install the lock cylinder in the door. Install lock cylinder retaining clip.

(2) Connect lock cylinder to latch rod.

(3) Install the lock cylinder in the door. Install lock cylinder retaining clip.

(4) Connect lock cylinder to latch rod.

(5) Secure the waterdam to the door.

(6) Install trim panel.

FULL DOOR LATCH

REMOVAL

(1) Remove trim panel.

(2) Roll window to full upward position.

(3) Disconnect the lock cylinder to latch rod (Fig. 24).

(4) Disconnect the lock knob to latch rod.

(5) Disconnect the outside handle to latch rod.

(6) Remove the screws attaching the latch to the door (Fig. 25).

(7) Lower the latch in the door and disconnect the inside handle to latch rod.

(8) Remove the latch from the door.

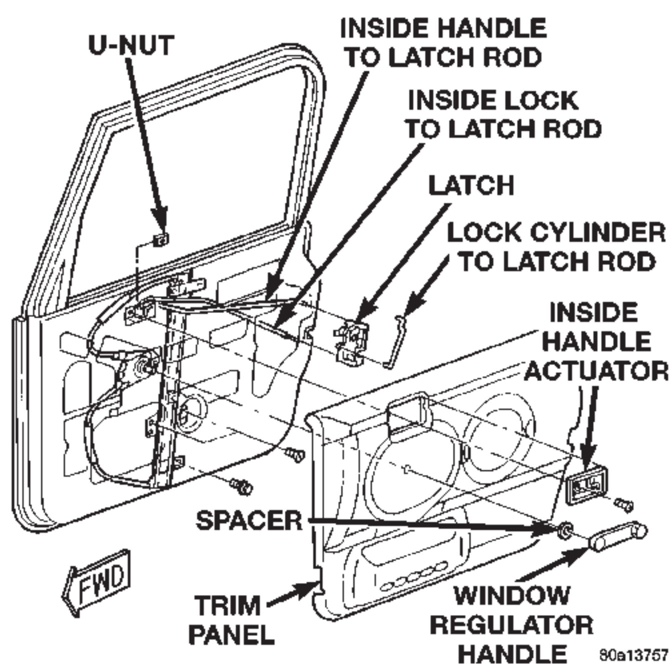


Fig. 24 Latch Rods

REMOVAL AND INSTALLATION (Continued)

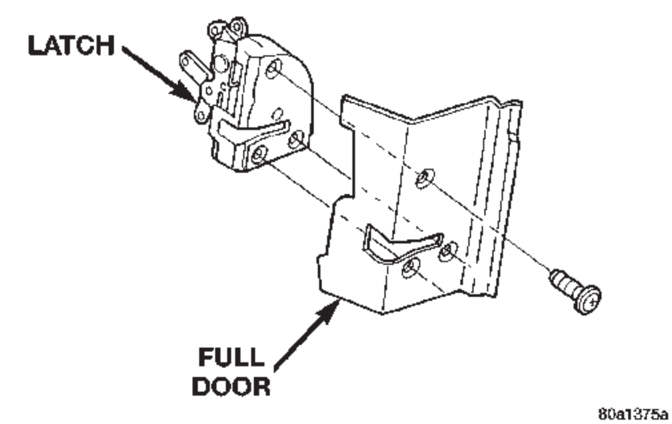


Fig. 25 Full Door Latch

INSTALLATION

(1) Position the latch in the door.
(2) Connect the inside handle to latch rod.
(3) Install the screws attaching the latch to the door.
(4) Position the door weatherstrip in place, apply adhesive as necessary.
(5) Connect the outside handle to latch rod.
(6) Connect the lock knob to latch rod.
(7) Connect the lock cylinder to latch rod.
(8) Install trim panel.

FULL DOOR LATCH STRIKER

REMOVAL

(1) Remove the screws attaching the striker to the body.
(2) Separate the striker and the spacer from the body (Fig. 26).

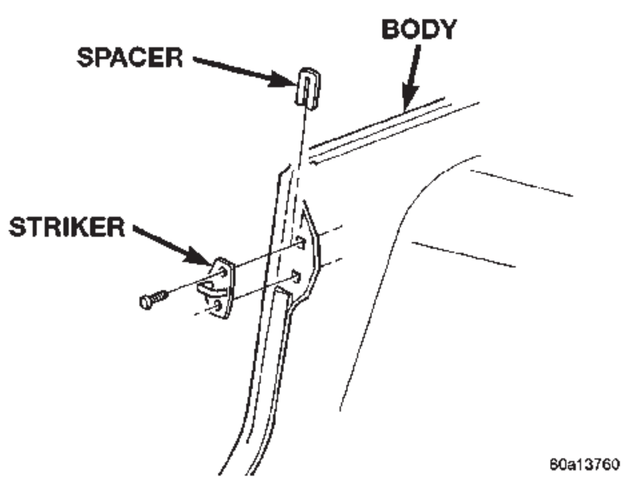


Fig. 26 Latch Striker

INSTALLATION

(1) Position the striker and the spacer on the body.
(2) Install the screws attaching the striker and spacer to the body.

FULL DOOR INSIDE HANDLE ACTUATOR

REMOVAL

(1) Remove the torx screw attaching the inside handle to the door.
(2) Carefully pull the handle from the door.
(3) Disconnect the latch rods from the handle (Fig. 27).

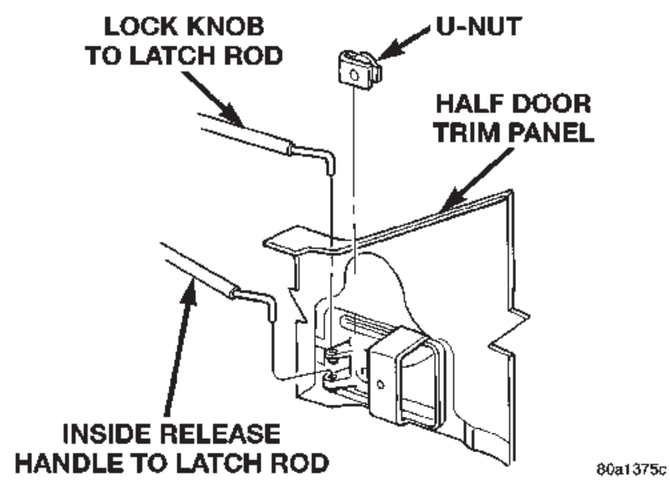


Fig. 27 Inside Handle Actuator

INSTALLATION

INSTALLATION

(1) Connect the latch rods to the handle.
(2) Position handle and seal in door.
(3) Install the torx screw attaching the inside handle the to door.

REMOVAL AND INSTALLATION (Continued)

FULL DOOR GLASS

REMOVAL

(1) Remove the door trim panel and the waterdam.

(2) Pull the door glass run channel from the door sail.

(3) Roll glass fully downward.

(4) Remove the door sail panel (Fig. 28) and (Fig. 29).

(5) Roll glass 1/4 upward to access regulator arm guide.

(6) Remove the screws that attach the regulator arm guide to the glass.

(7) Lift the glass upward while tilting inward and remove from the door.

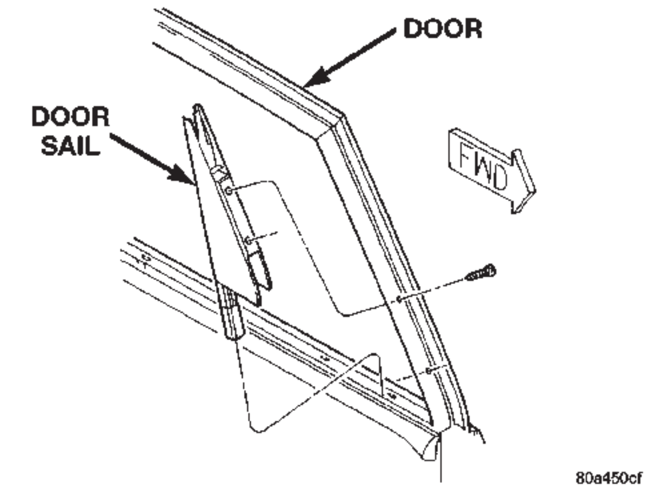


Fig. 28 Door Sail Screws

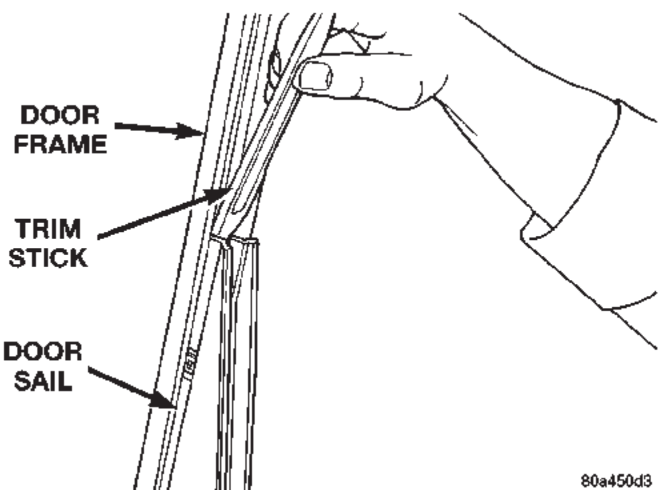


Fig. 29 Door Sail Removal

INSTALLATION

(1) Position the glass in the door ensuring the glass is aligned in the glass run channel.

(2) Install the screws that attach the regulator arm guide to the glass.

(3) Install the door sail panel.

(4) Install the run channel in the door sail.

(5) Install the waterdam and the door trim panel.

FULL DOOR INNER BELT WEATHERSTRIP

The inner belt weatherstrip is attached to the door trim panel and is not serviceable. If the inner belt weatherstrip needs to be replaced, replace the door trim panel.

FULL DOOR OUTER BELT SEAL

REMOVAL

(1) Remove the door sail panel.

(2) Disengage the clips attaching the outer belt seal to the door (Fig. 30).

(3) Separate the seal from the door.

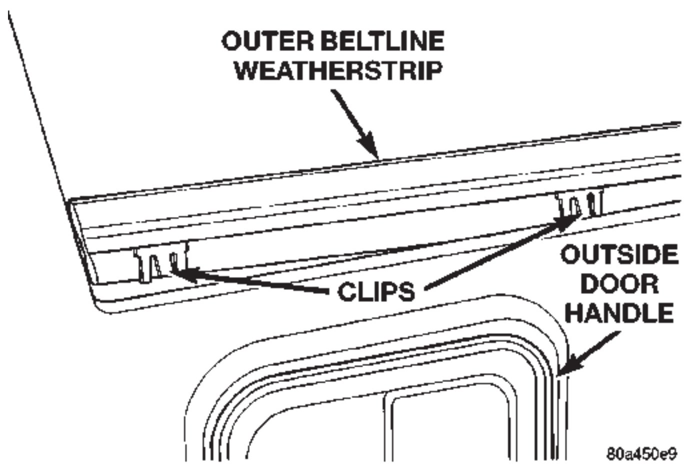


Fig. 30 Full Door Outer Belt Seal

INSTALLATION

(1) Position the seal on the door.

(2) Engage the clips attaching the outer belt seal to the door.

(3) Install the door sail panel.

REMOVAL AND INSTALLATION (Continued)

FULL DOOR GLASS RUN CHANNEL WEATHERSTRIP

REMOVAL

(1) Lower the window.

(2) Using a trim stick, carefully pry the glass run channel weatherstrip from the window opening frame.

(3) Remove the door glass.

(4) Grasp the glass run channel weatherstrip in the door (Fig. 31) and pull from the channel.

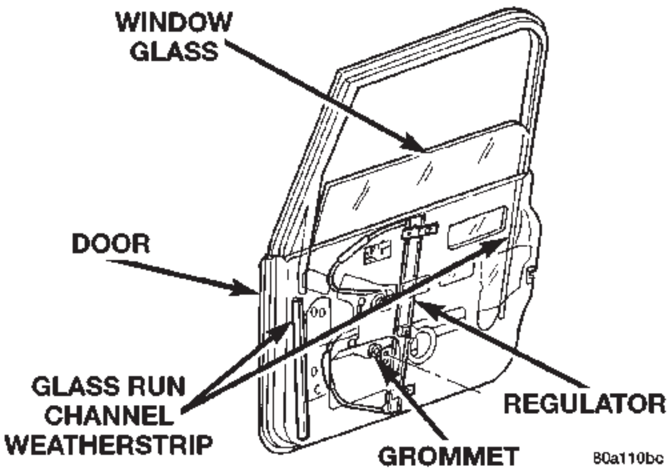


Fig. 31 Full Door Glass Run Channel Weatherstrip

INSTALLATION

Applying a small amount of lubricant to the weatherstrip may ease the installation.

(1) Position the weatherstrip in the door channels and press into place.

(2) Install the door glass.

(3) Position the weatherstrip in the window opening frame and press into place.

NOTE: Ensure that the glass is seated properly. Improperly seated door glass will result in high glass roll-up/roll-down effort.

FULL DOOR WEATHERSTRIP

The upper portion of the weatherstrip is seated into a channel around the window opening frame. The channel that seats the lower portion of the weatherstrip is attached to the door with push-in fasteners and double sided tape.

REMOVAL

(1) Peel the weatherstrip from the channel.

(2) Separate the weatherstrip from the door.

(3) If necessary, remove the push-in fasteners attaching the weatherstrip channel to the door and peel the channel from the door (Fig. 32).

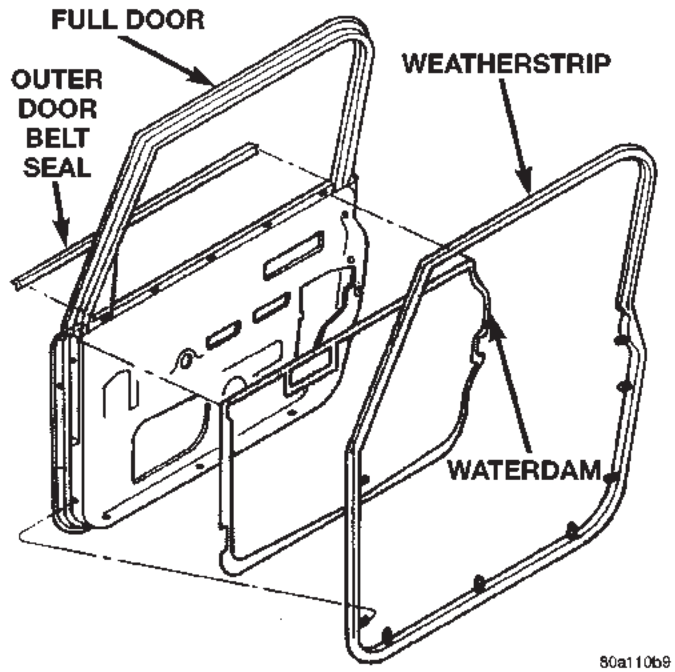


Fig. 32 Full Door Weatherstrip

INSTALLATION

(1) If the weatherstrip channel has been removed, clean the contact surfaces with isopropyl alcohol or equivalent.

(2) Remove backing from the weatherstrip channel, position the channel on the door and install the push-in fasteners. Use a roller or forceful hand pressure to ensure good adhesive contact.

(3) Install the weatherstrip in the upper and lower weatherstrip channels ensuring that the weatherstrip is completely engaged to the weatherstrip channels.

REMOVAL AND INSTALLATION (Continued)

FULL DOOR WINDOW REGULATOR

REMOVAL

(1) Remove door trim panel.

(2) Remove door glass.

(3) Loosen the bolts in the slotted holes (Fig. 33).

(4) Remove the bolts attaching the regulator to the door inner panel.

(5) Lift the regulator upward to free it from the slotted holes in the door inner panel.

(6) Lower the regulator and remove it through the access hole in the door inner panel (Fig. 34).

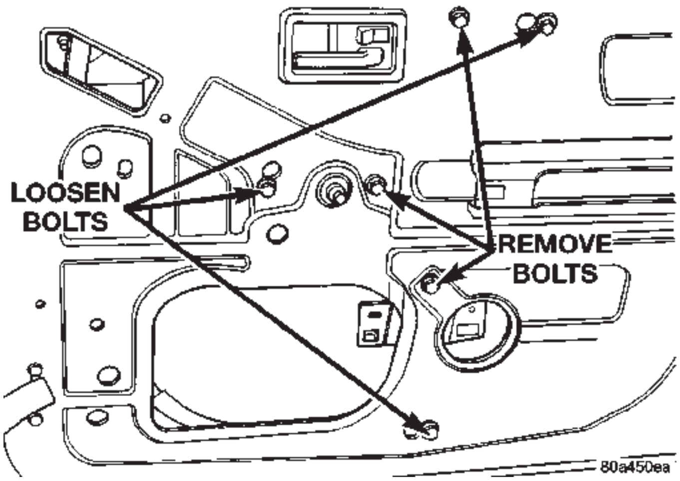


Fig. 33 Window Regulator Bolts

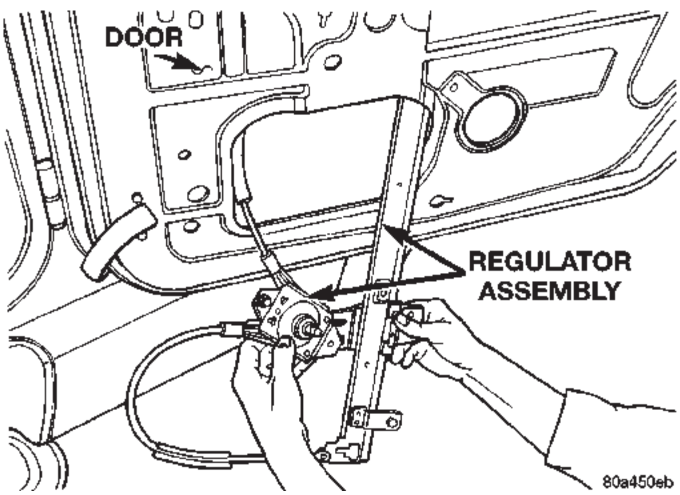


Fig. 34 Regulator Removal

INSTALLATION

(1) Position the regulator in the door.

(2) Align regulator bolts into slotted holes.

(3) Install bolts attaching regulator to the inner door panel.

(4) Tighten the bolts in the slotted holes.

(5) Install door glass.

(6) Install door trim panel.

HALF DOOR TRIM PANEL

REMOVAL

(1) Remove half door window.

(2) Rotate window retainer sleeves 90°. Using a trim stick, pry sleeve retainers from door.

(3) Remove the screws attaching trim panel to door.

(4) Remove push-in fasteners attaching trim panel to door with special tool C-4829.

(5) Separate the trim panel from the door.

INSTALLATION

(1) Position the trim panel on the door.

(2) Press the push-in fasteners attaching trim panel to door into place.

(3) Install the screws attaching trim panel to door.

(4) Position retainer sleeves into door. Rotate retainer sleeves 90° to secure into place.

(5) Install half door window.

HALF DOOR

REMOVAL

(1) Open the door.

(2) Disconnect the door restraint strap from the pin (Fig. 35).

(3) Remove the nuts at the door hinge pivots and lift the door from the body.

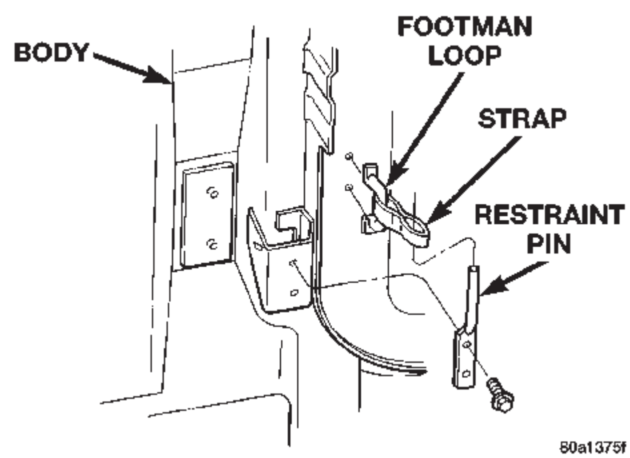


Fig. 35 Restraint Strap

INSTALLATION

(1) Position the door in the hinge and install the nuts.

(2) Connect the door restraint strap at the pin.

HALF DOOR HINGE

The service procedures for the half door hinge are the same as the full door hinge. Refer to, Full Door Hinge Removal/Installation procedures in this group.

REMOVAL AND INSTALLATION (Continued)

HALF DOOR OUTSIDE HANDLE

REMOVAL

(1) Remove trim panel.

(2) Disconnect the outside handle to latch rod (Fig. 36).

(3) Remove screws attaching the outside handle to the door.

(4) Separate the outside handle and seal from the door.

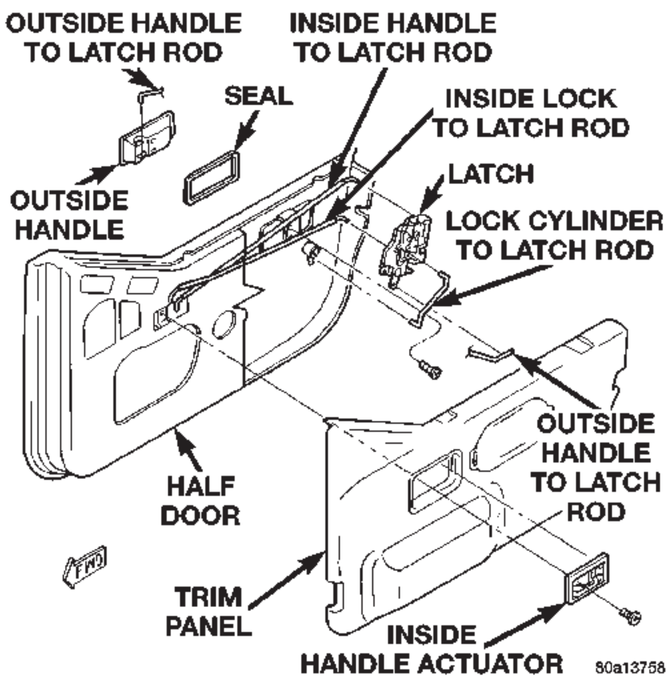


Fig. 36 Outside Handle

INSTALLATION

(1) Position the outside handle and seal in the door.

(2) Install screws attaching the outside handle to the door.

(3) Connect the outside handle to latch rod.

(4) Install trim panel.

HALF DOOR LOCK CYLINDER

REMOVAL

(1) Remove trim panel.

(2) Peel back the waterdam.

(3) Disconnect lock cylinder to latch rod (Fig. 37).

(4) Remove lock cylinder retaining clip.

(5) Remove the lock cylinder from the door.

INSTALLATION

(1) Install the lock cylinder in the door.
Install lock cylinder retaining clip.

(2) Connect lock cylinder to latch rod.

(3) Secure the waterdam.

(4) Install trim panel.

HALF DOOR LATCH

REMOVAL

(1) Remove trim panel.

(2) Disconnect the lock cylinder to latch rod (Fig. 37).

(3) Disconnect the lock knob to latch rod.

(4) Disconnect the outside handle to latch rod.

(5) Using a trim stick or equivalent, pry back the door weatherstrip at the latch to access the screw attaching the latch to the door.

(6) Remove the screws attaching the latch to the door (Fig. 38).

(7) Lower the latch in the door and disconnect the inside handle to latch rod.

(8) Remove the latch from the door.

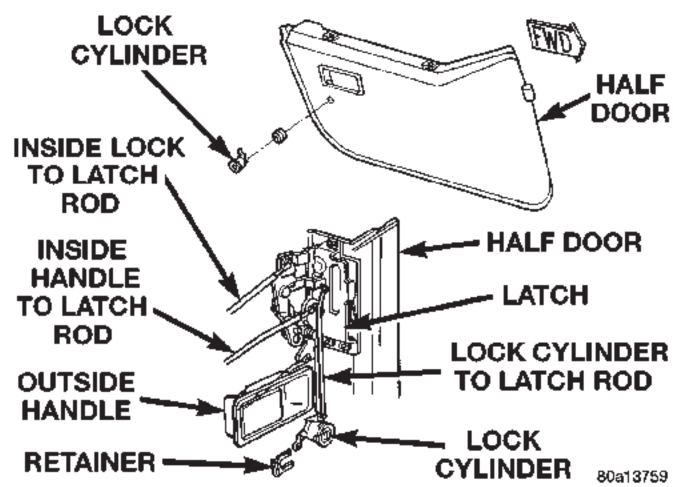


Fig. 37 Half Door Latch Rods

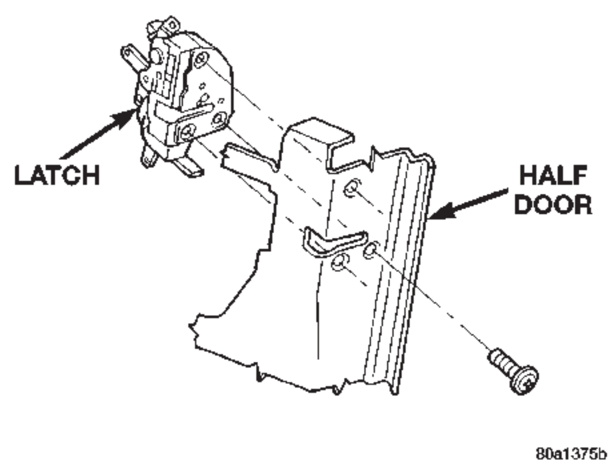


Fig. 38 Door Latch

INSTALLATION

(1) Position the latch in the door.

(2) Connect the inside handle to latch rod.

(3) Install the screws attaching the latch to the door.

REMOVAL AND INSTALLATION (Continued)

(4) Position the door weatherstrip in place, apply adhesive as necessary.
(5) Connect the outside handle to latch rod.
(6) Connect the lock knob to latch rod.
(7) Connect the lock cylinder to latch rod (Fig. 37).
(8) Install trim panel.

HALF DOOR LATCH STRIKER

REMOVAL

(1) Remove the screws attaching the striker to the body.
(2) Separate the striker and the spacer from the body (Fig. 39).

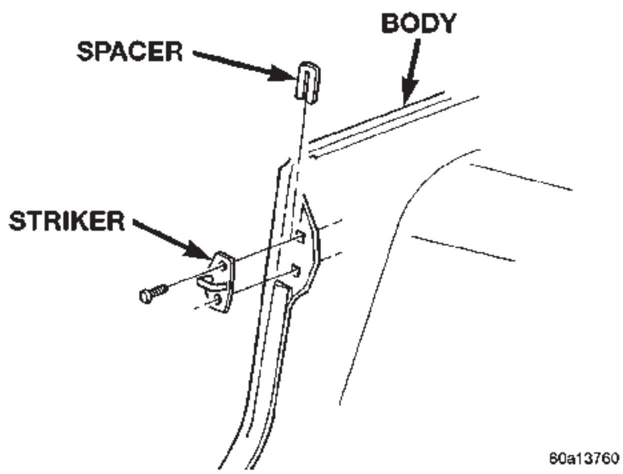


Fig. 39 Latch Striker

INSTALLATION

(1) Position the striker and the spacer on the body.
(2) Install the screws attaching the striker and spacer to the body.

HALF DOOR INSIDE HANDLE ACTUATOR

REMOVAL

(1) Remove the torx screw attaching the inside handle to the door.
(2) Carefully pull handle from door.
(3) Disconnect the latch rods from the handle (Fig. 40).

INSTALLATION

(1) Connect the latch rods to the handle.
(2) Position handle and seal in door.
(3) Install the torx screw attaching the inside handle the to door.

HALF DOOR WEATHERSTRIP

The weatherstrip is seated into a channel around the door. The channel that seats the weatherstrip is attached to the door with push-in fasteners and double sided tape.

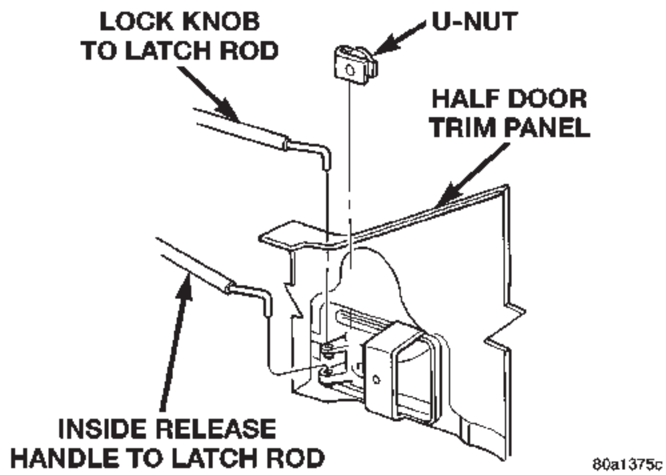


Fig. 40 Inside Handle Actuator

REMOVAL

(1) Remove trim panel.
(2) Remove window retaining sleeve.
(3) Remove the push-in fasteners attaching the weatherstrip to the top of the door.
(4) Peel the weatherstrip from the channel.
(5) If necessary, remove the push-in fasteners attaching the weatherstrip channel to the door and peel the channel from the door (Fig. 41).

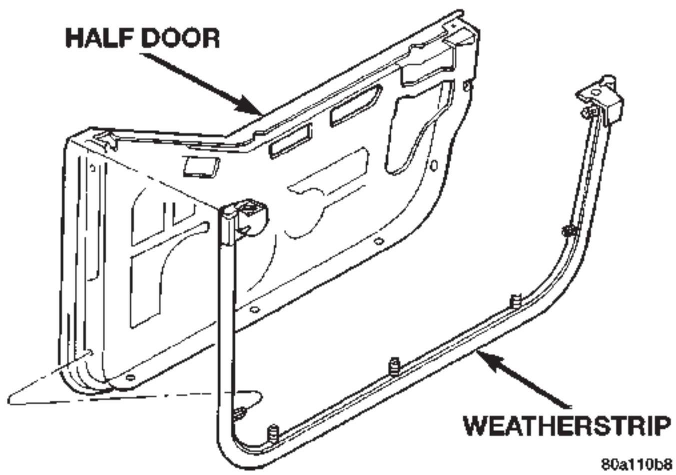


Fig. 41 Half Door Weatherstrip

INSTALLATION

(1) If the weatherstrip channel has been removed, clean the contact surfaces with isopropyl alcohol or equivalent.
(2) Remove the backing from the weatherstrip channel, position the channel on the door and install the push-in fasteners. Use a roller or forceful hand pressure to ensure good adhesive contact.
(3) Position the seal on the door and press it into place.

REMOVAL AND INSTALLATION (Continued)

(4) Install the weatherstrip in the weatherstrip channel ensuring that the weatherstrip is fully engaged in the weatherstrip channel.

(5) Install window retaining sleeve.

(6) Install trim panel.

HALF DOOR WINDOW

REMOVAL

(1) Open the door.

(2) Grasp the window at both front and rear edges and firmly lift upward (Fig. 42).

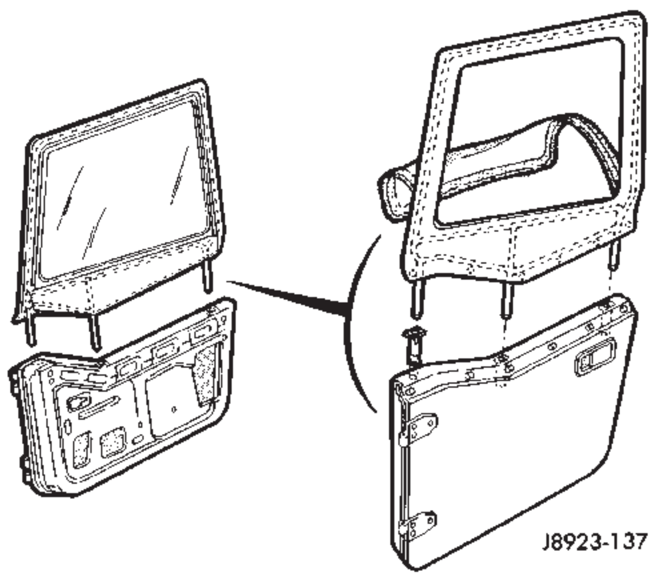


Fig. 42 Half Window

INSTALLATION

(1) Starting at the most forward alignment pin, position the window alignment pins into the restraint sleeves and push downward until seated.

HARD TOP

REMOVAL

(1) Disengage latches at windshield frame (Fig. 43).

(2) Remove the bolts that attach the hard top to the body (Fig. 44).

(3) Using a flat blade or equivalent, disconnect the rear wiper wire harness connector (Fig. 45).

(4) Disconnect the rear washer fluid hose. Cap the hose to prevent washer fluid leakage (Fig. 46).

(5) Remove the hard top from the vehicle.

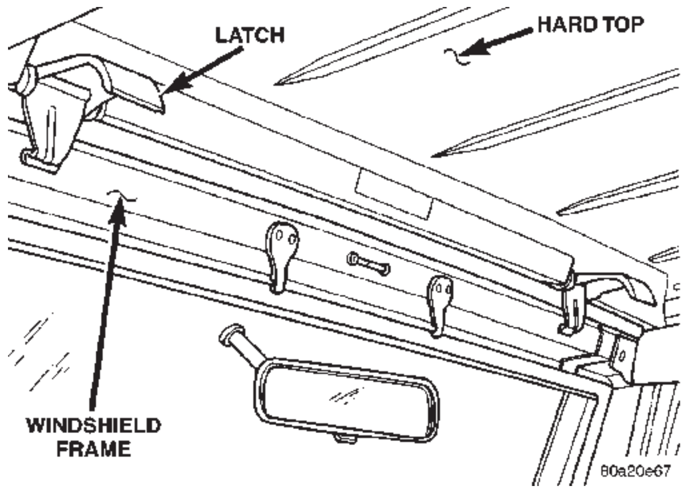


Fig. 43 Hard Top Latch

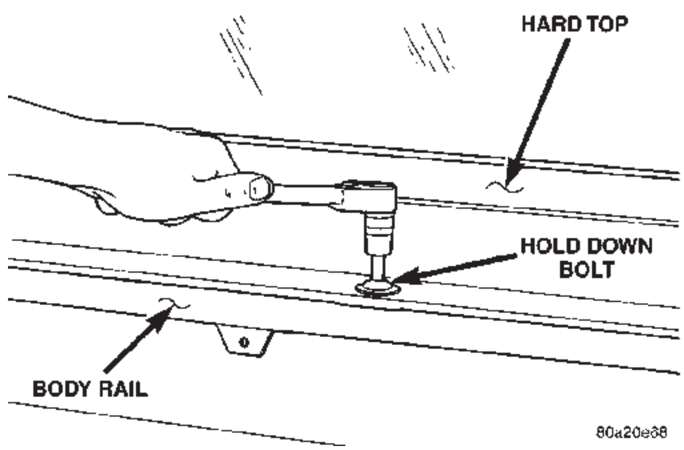


Fig. 44 Hard Top Removal

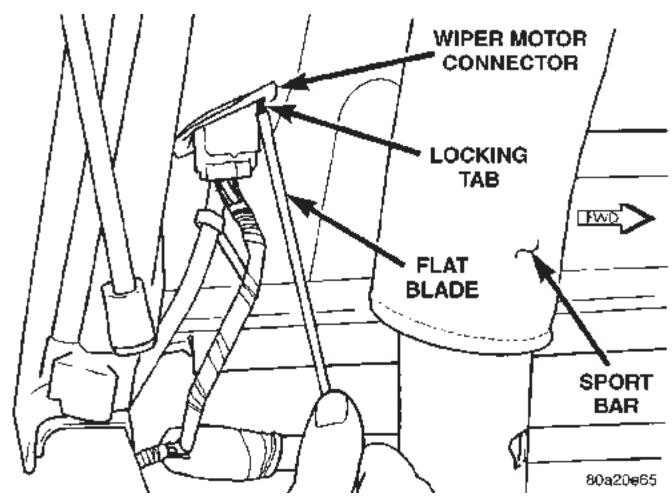


Fig. 45 Rear Wiper Wire Harness Connector

REMOVAL AND INSTALLATION (Continued)

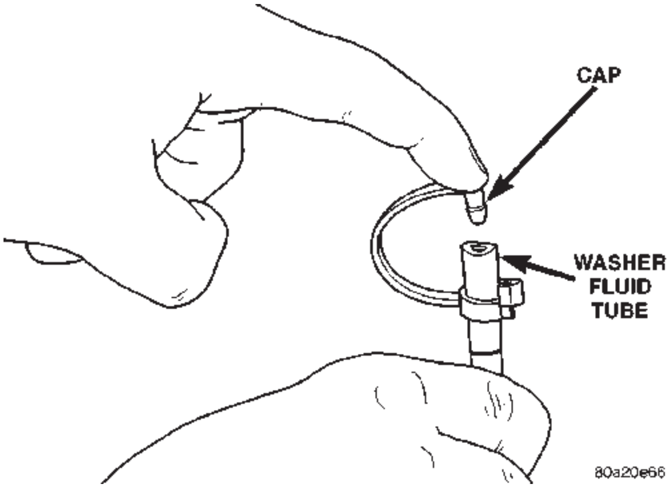


Fig. 46 Rear Washer Fluid Tube

INSTALLATION

(1) Inspect the hard top seals for damage and replace, if necessary.

(2) Carefully position the hard top on the vehicle. Ensure that the latches are not pinched between the top and windshield frame.

(3) Loosely install the bolts. Ensure that the top is centered on the vehicle. Tighten the bolts securely.

(4) Connect the wire harness connector.

(5) Connect the rear washer fluid hose.

(6) Engage the latches at windshield frame.

HARD TOP AIR EXHAUSTER

The hard top air exhauster fits very tightly into the hard top and generally cannot be removed without being damaged. It is recommended that availability of a replacement air exhauster is determined prior to attempting to remove it.

REMOVAL

(1) Using a trim stick, C-4755, between air exhauster and hard top, disengage one edge of exhauster from hard top.

(2) Separate the air exhauster from the hard top.

INSTALLATION

(1) Position the air exhauster on the hard top.

(2) Press air exhauster into opening in hard top until fully seated.

SOFT TOP

REMOVAL

(1) Disengage the retainers attaching the rear window to the body.

(2) Remove rear window, unzipping from right to left.

(3) Disengage J-straps at soft top rear corners (Fig. 47).

(4) Unzip quarter windows, disengage J-strap and remove quarter windows.

(5) Starting at the rear of the upper door opening frame and working forward, disengage J-straps attaching the soft top to the door opening frame.

(6) Unlatch top at windshield frame.

(7) Lower the top to the rearward position.

(8) Remove the screws attaching the roof bows to the pivot bracket (Fig. 48).

(9) Lift up bows at pivot bracket to disengage from pivot bracket.

(10) Remove the top (Fig. 49).

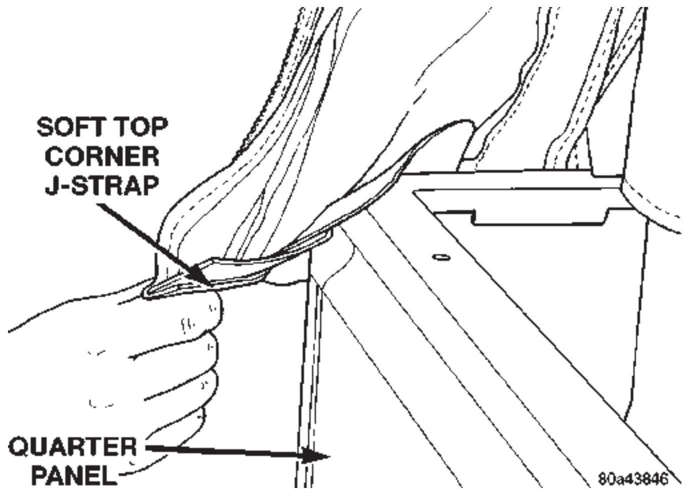


Fig. 47 Soft Top J-Straps

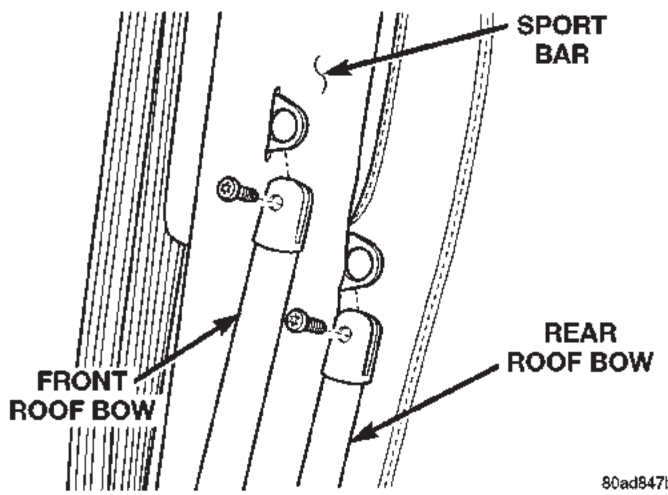


Fig. 48 Roof Bow Removal

INSTALLATION

(1) Position the top on the vehicle.

(2) Install the screws attaching the roof bows to the pivot bracket. (The front bow is attached to the pivot bracket on the upper outward location).

(3) Raise the top.

(4) Latch top at windshield frame.

(5) Install the quarter windows.

REMOVAL AND INSTALLATION (Continued)

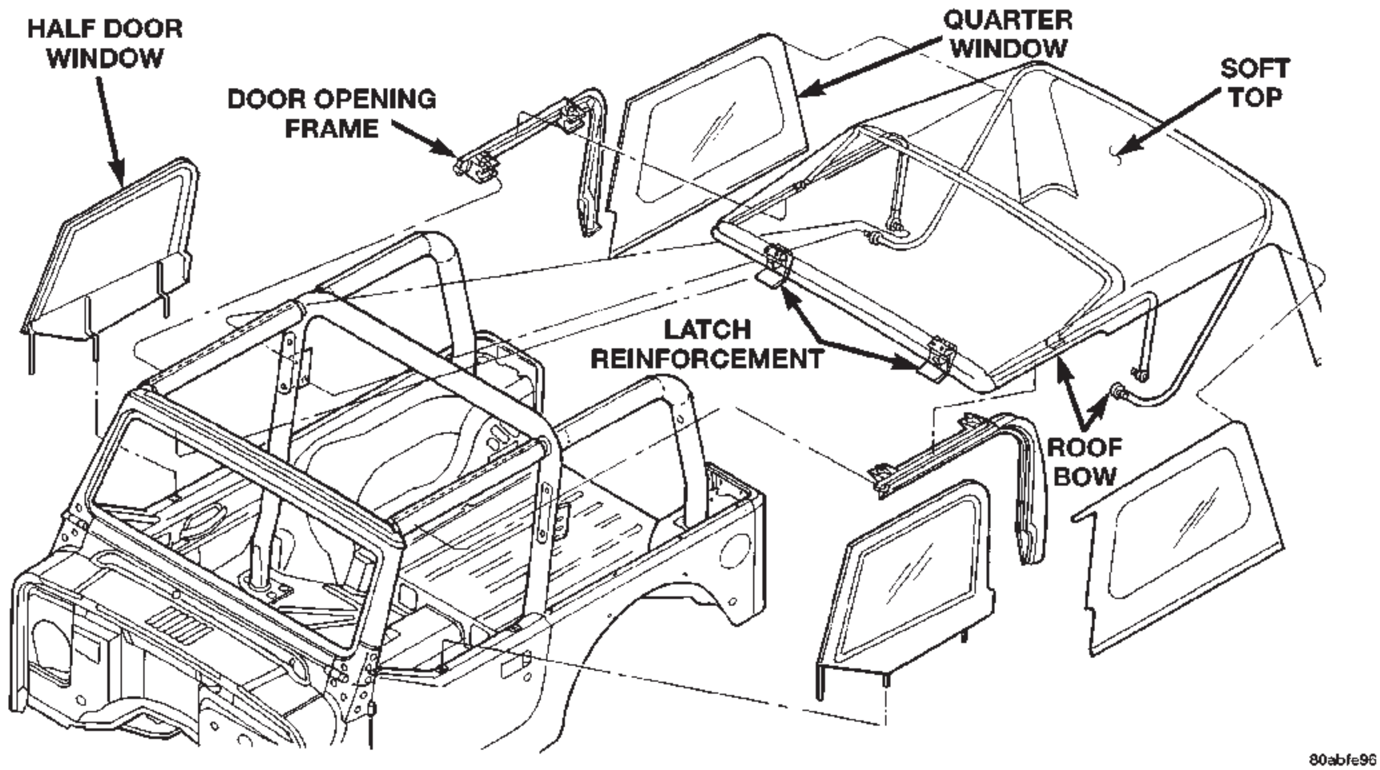


Fig. 49 Soft Top

(6) Working from front to rear, engage the J-straps attaching the quarter window to the body.
(7) Install rear window.
(8) Engage J-straps above door opening frame.
(9) Working from front to rear, engage J-straps at soft top rear corners.
(10) Engage the retainers attaching the rear window to the body.

SOFT TOP FABRIC

REMOVAL

(1) Disengage the snaps attaching the soft top fabric to the rear roof bow.
(2) Disengage the hook and loop fastener attaching soft top fabric to the center roof bow.
(3) Lower the soft top.
(4) Remove the screws attaching the soft top fabric to the front roof bow and fold back fabric.
(5) Separate the soft top fabric from the frame.

INSTALLATION

(1) Position the soft top fabric on the frame.
(2) Install the screws attaching the soft top fabric to the front roof bow.
(3) Engage the hook and loop fastener attaching soft top fabric to the center roof bow.
(4) Engage the snaps attaching the soft top fabric to the rear roof bow.
(5) Raise and secure the soft top.

HARD/SOFT TOP LATCH

REMOVAL

(1) Unlatch the top (Fig. 50).
(2) Using a wax pencil, mark the position of the latch on the top.
(3) Remove the screws attaching the latch to the top.

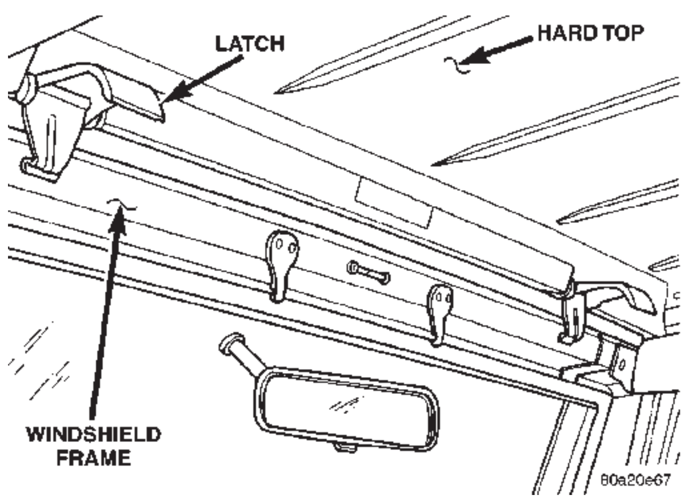


Fig. 50 Hard/Soft Top Latch

INSTALLATION

(1) Position the latch on the top and install the screws.

REMOVAL AND INSTALLATION (Continued)

DOOR OPENING FRAME

Vehicles equipped with a soft top require a door opening frame to complete the seal for the soft top door assembly.

REMOVAL

(1) Lower the top to the rearward position.

(2) Turn the knobs located on top of the door opening frame counter clockwise and remove completely (Fig. 51).

(3) Pull door opening frame outward and up. Separate from vehicle.

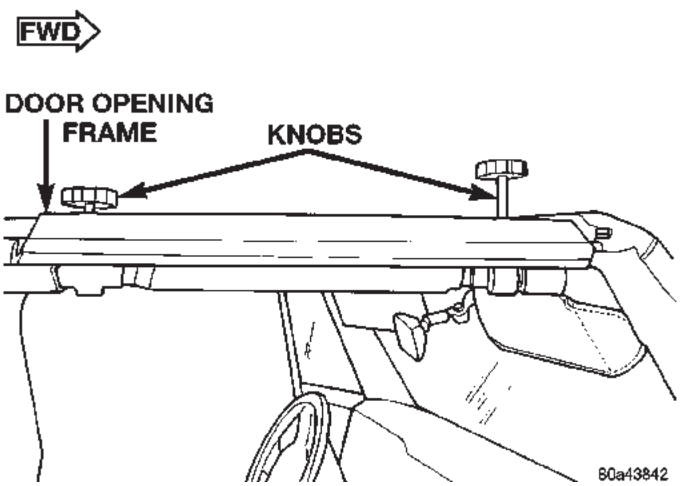


Fig. 51 Door Opening Frame

INSTALLATION

(1) Install the alignment pin at the base of the door opening frame into the hole at the top of the quarter panel.

(2) Position the door opening frame on the side support bar and install the knobs.

(3) Raise and secure the top.

FRONT SHOULDER/LAP BELT AND BUCKLE

WARNING: INSPECT THE SHOULDER BELT, RETRACTOR AND BUCKLE. REPLACE THE BELT OR BUCKLE THAT IS EITHER CUT, FRAYED, TORN OR DAMAGED. REPLACE THE BELT IF THE RETRACTOR IS INOPERATIVE.

FRONT SHOULDER/LAP BELT AND RETRACTOR REMOVAL

(1) Move front seat to the full forward position.

(2) Remove the bolt attaching the retractor to the sport bar (Fig. 52).

(3) Using a small flat blade, pry the cover from the turning loop.

(4) Remove the bolt attaching the turning loop to the height adjuster (Fig. 53).

(5) Separate the belt assembly from the vehicle.

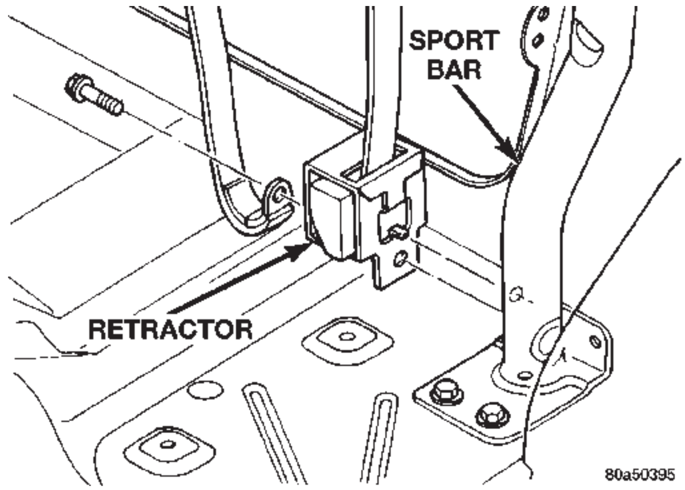


Fig. 52 Front Retractor

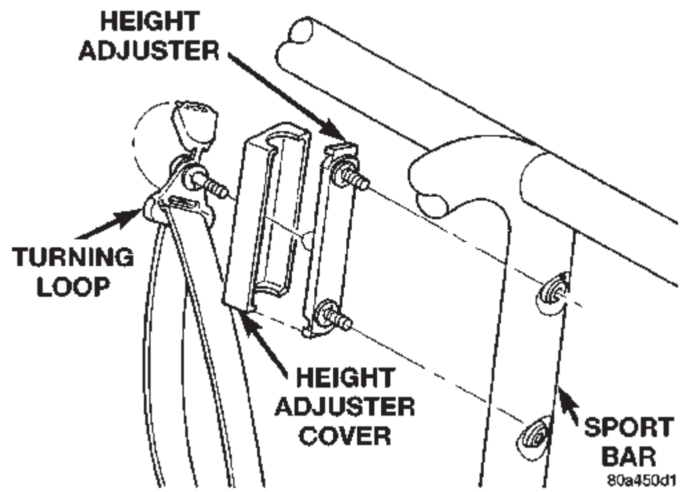


Fig. 53 Front Turning Loop

FRONT SHOULDER/LAP BELT AND RETRACTOR INSTALLATION

(1) Position the turning loop on the height adjuster and install the bolt. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

(2) Close the cover on the turning loop.

(3) Install the bolt attaching the retractor to the sport bar. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

FRONT SEAT BELT BUCKLE REMOVAL

(1) Remove the bolt attaching the seat belt buckle to the seat track/seat riser (Fig. 54).

(2) Disengage seat belt harness connector (driver's seat only).

(3) Remove buckle from vehicle.

FRONT SEAT BELT BUCKLE INSTALLATION

(1) Position the buckle on the seat track/seat riser and install the bolt.

(2) Engage seat belt harness connector (driver's seat only).

REMOVAL AND INSTALLATION (Continued)

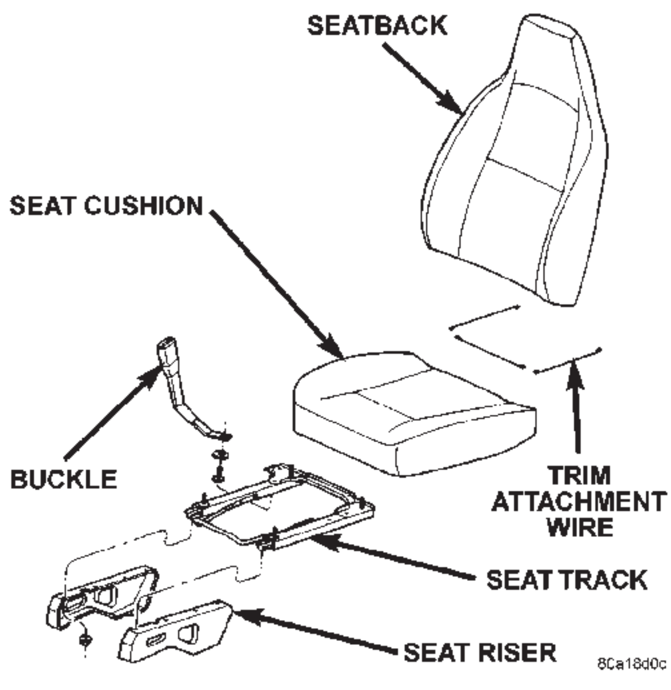


Fig. 54 Seat Belt Buckle

REAR SHOULDER/LAP BELT AND BUCKLE

WARNING: INSPECT THE SHOULDER BELT, RETRACTOR AND BUCKLE. REPLACE THE BELT OR BUCKLE THAT IS EITHER CUT, FRAYED, TORN OR DAMAGED. REPLACE THE BELT IF THE RETRACTOR IS INOPERATIVE.

SEAT/LAP BELT AND RETRACTOR REMOVAL

(1) Move the rear seat to the forward tumble position.

(2) Remove the anchor bolt attaching the belt to the wheelhouse (Fig. 57).

(3) Using a flat blade, pry the cover off the turning loop (Fig. 55).

(4) Remove the bolt attaching the turning loop to the sport bar (Fig. 56).

(5) Remove the bolt attaching the retractor to the sport bar.

(6) Separate the belt assembly from the vehicle.

SEAT/LAP BELT AND RETRACTOR INSTALLATION

(1) Position the retractor on the sport bar and install the bolt. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

(2) Position the turning loop on the sport bar and install the bolt. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

(3) Close cover on turning loop.

(4) Position the belt anchor on the wheelhouse and install the bolt. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

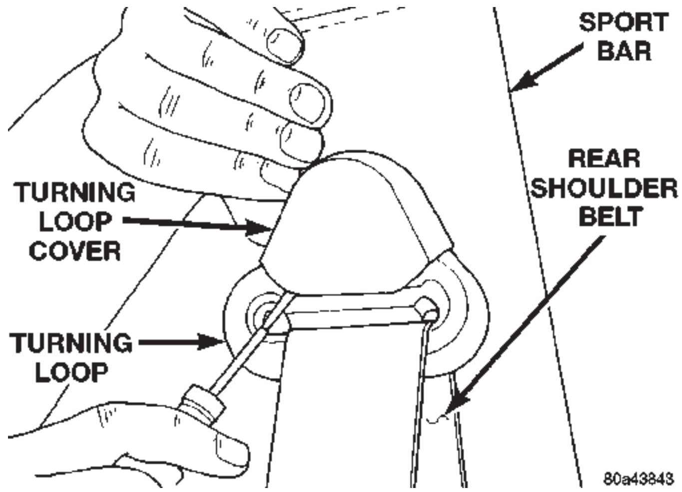


Fig. 55 Turning Loop Cover

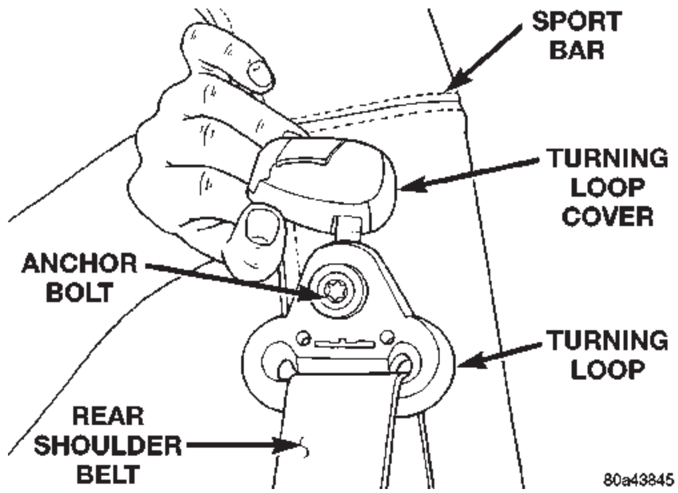


Fig. 56 Turning Loop

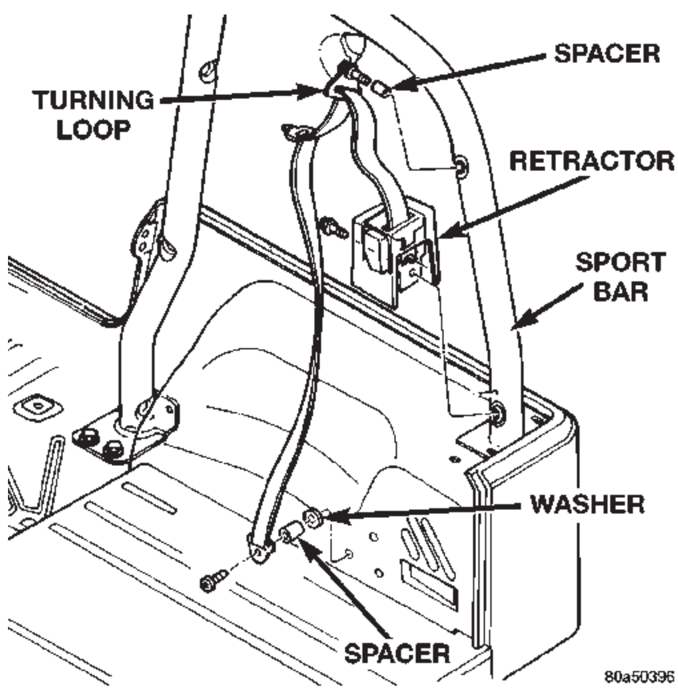


Fig. 57 Rear Belt Assembly

REMOVAL AND INSTALLATION (Continued)

(5) Move the rear seat back to the latch position.

REAR BUCKLE REMOVAL

(1) Move the rear seat to the forward tumble position.

(2) Grasp the carpet between the buckles and lift to access the anchor bolt.

(3) Remove the anchor bolt and separate the buckle from the vehicle (Fig. 58).

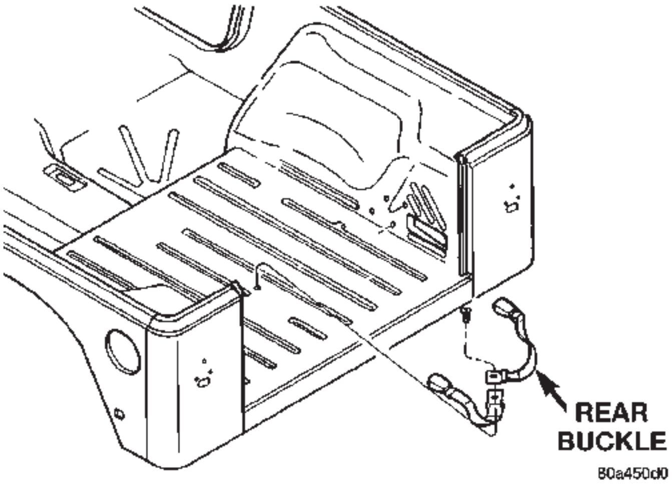


Fig. 58 Rear Buckle

REAR BUCKLE INSTALLATION

(1) Route the buckle through the carpet and align the holes.

(2) Install the anchor bolt. Tighten the bolt to 43 N·m (32 ft. lbs.) torque.

(3) Move the rear seat back to the latch position.

BUCKET SEAT

REMOVAL

(1) Disengage seat belt electrical connector (Fig. 59).

(2) Remove the bolts attaching the seat frame to the floor panel (Fig. 60).

(3) Remove the seat from the vehicle.

INSTALLATION

(1) Position the seat in the vehicle.

(2) Install the bolts attaching the rear of seat frame to the floor panel. Tighten outboard bolt to 33 N·m (25 ft. lbs.) torque. Tighten inboard bolt to 74 N·m (55 ft. lbs.) torque.

(3) Install the bolts attaching the front of seat frame to the floor panel. Tighten bolts to 33 N·m (25 ft. lbs.) torque.

(4) Engage seat belt electrical connector.

MINI FLOOR CONSOLE

REMOVAL

(1) Move the seats to the full rearward position.

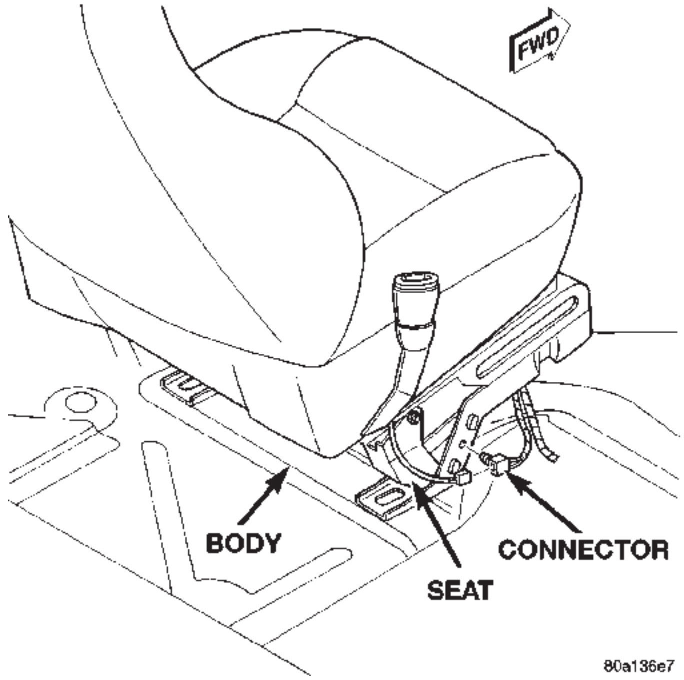


Fig. 59 Bucket Seat

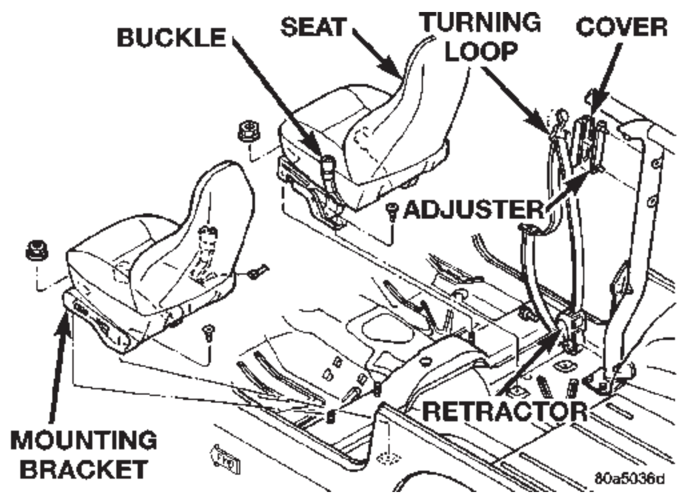


Fig. 60 Bucket Seat Removal

(2) Grasp shift handle (auto trans only) and firmly pull upward to remove.

(3) Using a small flat blade, pry up shift indicator bezel, disengage bezel lamp connector and remove bezel (auto trans only).

(4) Using a trim stick, pry up shift boot and remove (manual trans only).

(5) Remove the trim disc from the bottom of the cup holder.

(6) Remove the bolts attaching the console to the floor pan (Fig. 61).

(7) Shift transfer case to four low position.

(8) Lift the console upward and shift transmission to L (2nd gear for man. trans.).

(9) Remove console through the passenger door.

REMOVAL AND INSTALLATION (Continued)

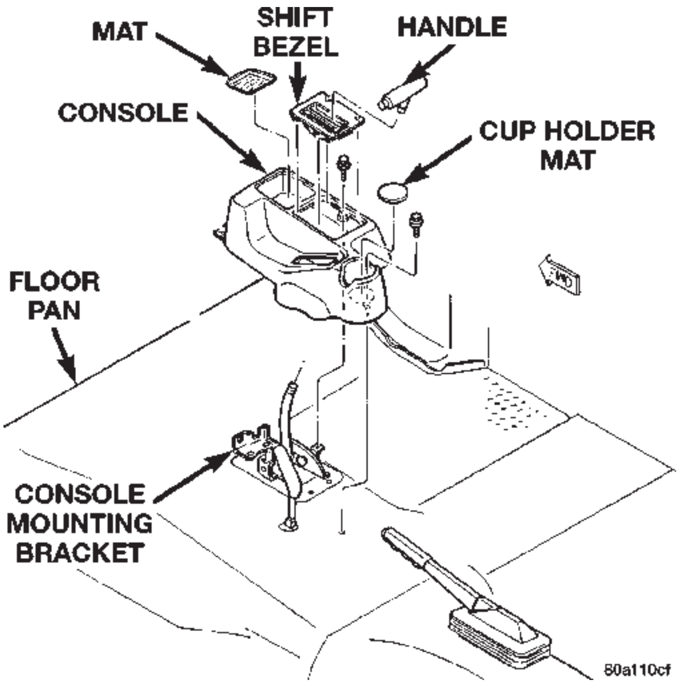


Fig. 61 Mini Floor Console

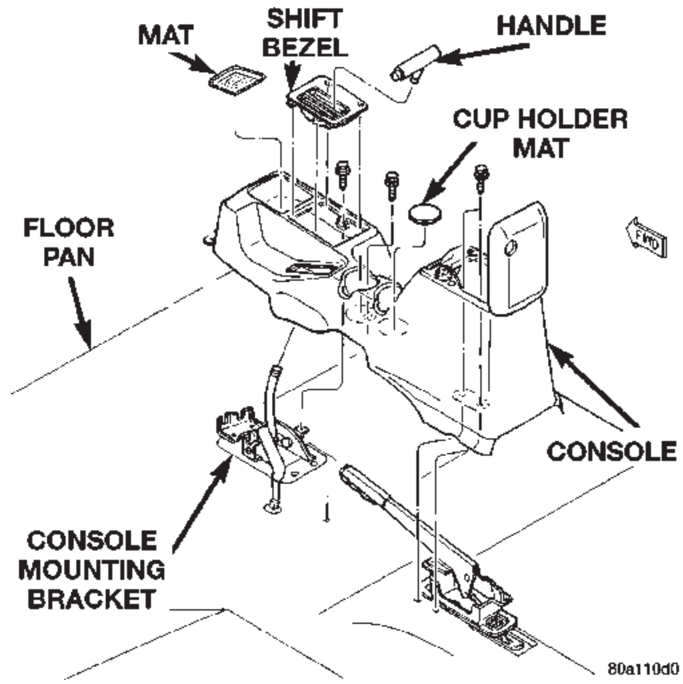


Fig. 62 Full Floor Console

INSTALLATION

(1) Position and align the console in the vehicle.

(2) Install the bolts attaching the console to the floor pan.

(3) Install the trim disc

(4) Install shift boot/indicator bezel.

(5) Return seats to normal position.

(6) Install the shift handle.

FULL FLOOR CONSOLE

REMOVAL

(1) Move the seats to the full rearward position.

(2) Move the passenger seat in the full recline position.

(3) Grasp shift handle (auto trans only) and firmly pull upward to remove.

(4) Using a small flat blade, pry up shift indicator bezel, disengage bezel lamp connector and remove bezel (auto trans only).

(5) Using a trim stick, pry up shift boot and remove (manual trans only).

(6) Remove the bolts attaching the console to the floor pan (Fig. 62).

(7) Shift transfer case to four low position.

(8) Engage parking brake.

(9) Lift the console upward and rotate to remove through the passenger door.

INSTALLATION

(1) Position and align the console in the vehicle.

(2) Install the bolts attaching the console to the floor pan.

(3) Install shift boot/indicator bezel.

(4) Return seats to normal position.

(5) Install the shift handle.

CONSOLE LOCK CYLINDER

REMOVAL

(1) Open the console cover.

(2) Remove the screw that attaches the retainer to the lock and then remove the retainer from the lock (Fig. 63).

(3) Remove the lock cylinder from the console cover.

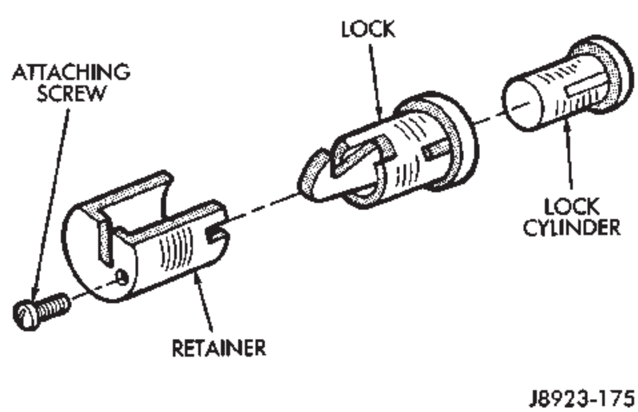


Fig. 63 Console Lock Cylinder

INSTALLATION

(1) Insert the assembled lock in the console cover hole and position the retainer on the lock and install the screw.

REMOVAL AND INSTALLATION (Continued)

SHIFT BOOT

REMOVAL

(1) Using a trim stick, pry the shift boot from the bezel.

(2) Using a small flat blade, pry the shift pattern insert from the shift knob.

(3) Remove the nut attaching the shift knob to the shift lever (Fig. 64).

(4) Remove the knob and slide the shift boot from the shift lever.

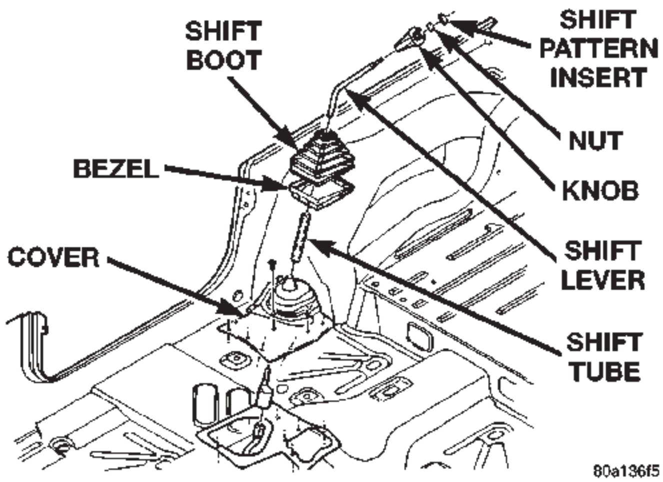


Fig. 64 Shift Boot

INSTALLATION

(1) Slide the shift boot over the shift lever.

(2) Position the shift knob on the lever and install the nut.

(3) Position the shift pattern insert on the knob and press into place.

REAR SEAT

REMOVAL

(1) Move the front seats to the full forward position.

(2) Pull on the rear seat latch to disengage the rear seat from the striker.

(3) Lift the rear seat to the forward tumble position.

(4) Remove the hitch pins from the seat frame pivot pins.

(5) Slide the seat to the left to disengage the pivot pin from the pivot bracket.

(6) Slide the seat to the right to disengage the opposite pivot pin from the pivot bracket (Fig. 65).

(7) Remove the seat through the passenger door opening.

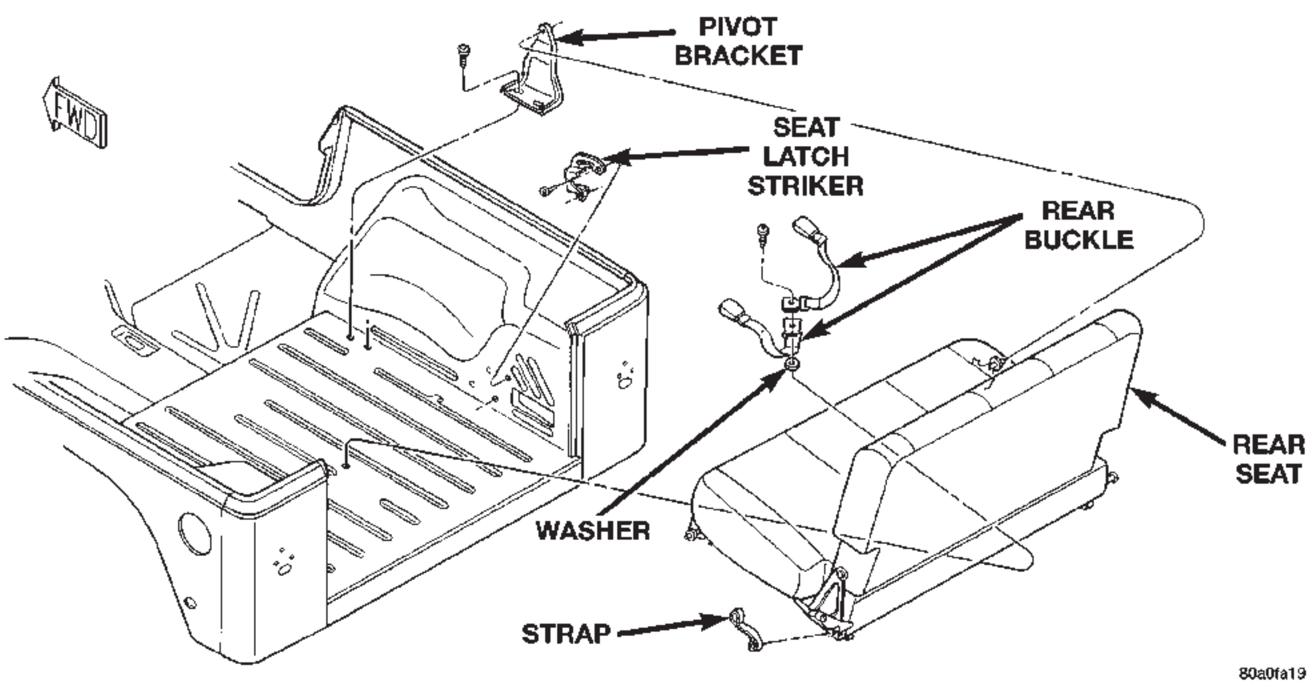


Fig. 65 Rear Seat

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position the seat on the rear floor panel and engage the seat frame pivot pins with the pivot brackets.

(2) Install the hitch pins on the seat frame pivot pins.

(3) Move the seat back to the latch position and engage the strikers with the latch brackets.

ADD-A-TRUNK

REMOVAL

(1) Release latches under trunk panel and lift panel up.

(2) Remove bolts attaching trunk to inner body panel (Fig. 66).

(3) Separate trunk from vehicle.

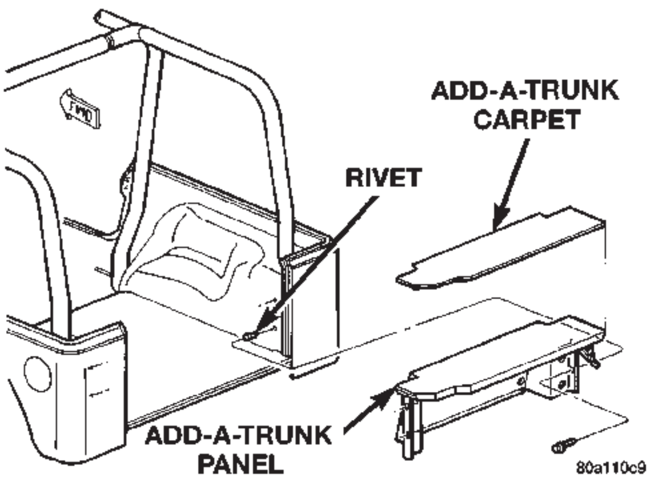


Fig. 66 Add-A-Trunk

INSTALLATION

(1) Position the trunk in the cargo space.

(2) Install the bolts.

FRONT CARPET

REMOVAL

(1) Remove the screws attaching the console to the floor pan.

(2) Remove the retainers attaching the carpet to the dash panel (Fig. 67).

(3) Disengage the snaps around the perimeter of the seats.

(4) Remove carpet from the vehicle

INSTALLATION

(1) Position the carpet in the vehicle

(2) Engage the snaps around the perimeter of the seats.

(3) If equipped, Install the retainers attaching the carpet to the dash panel.

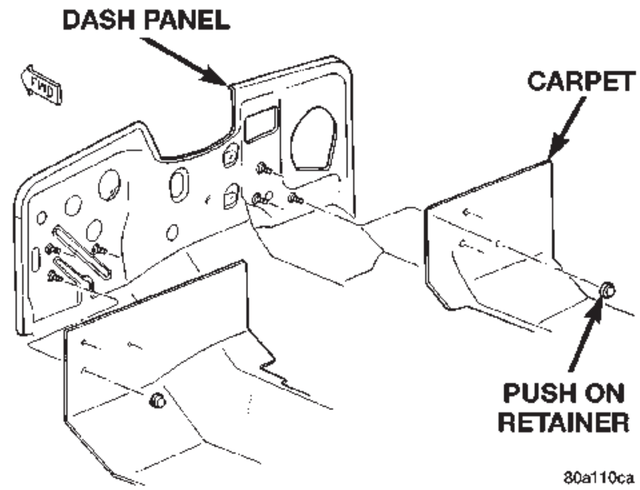


Fig. 67 Front Carpet

(4) Install the screws attaching the console to the floor pan.

CENTER CARPET

REMOVAL

(1) Disengage the snaps around the perimeter of the front seats.

(2) Remove the carpet.

INSTALLATION

(1) Position the carpet in the vehicle.

(2) Engage the snaps around the perimeter of the front seats.

CARGO AREA CARPET

REMOVAL

(1) Position the rear seat in the full forward position.

(2) Pull the carpet from under the rear seat.

(3) If equipped, remove the Add-A-Trunk.

(4) Route the rear seat belt buckles through the cargo area carpet.

(5) Separate the carpet from the vehicle (Fig. 68).

INSTALLATION

(1) Position the carpet in the vehicle.

(2) Route the rear seat belt buckles through the cargo area carpet.

(3) If equipped, install the Add-A-Trunk.

(4) Return the rear seat to the full rearward position.

WHEELHOUSE CARPET

REMOVAL

(1) Position the rear seat in the full forward position.

(2) If equipped, remove the Add-A-trunk.

REMOVAL AND INSTALLATION (Continued)

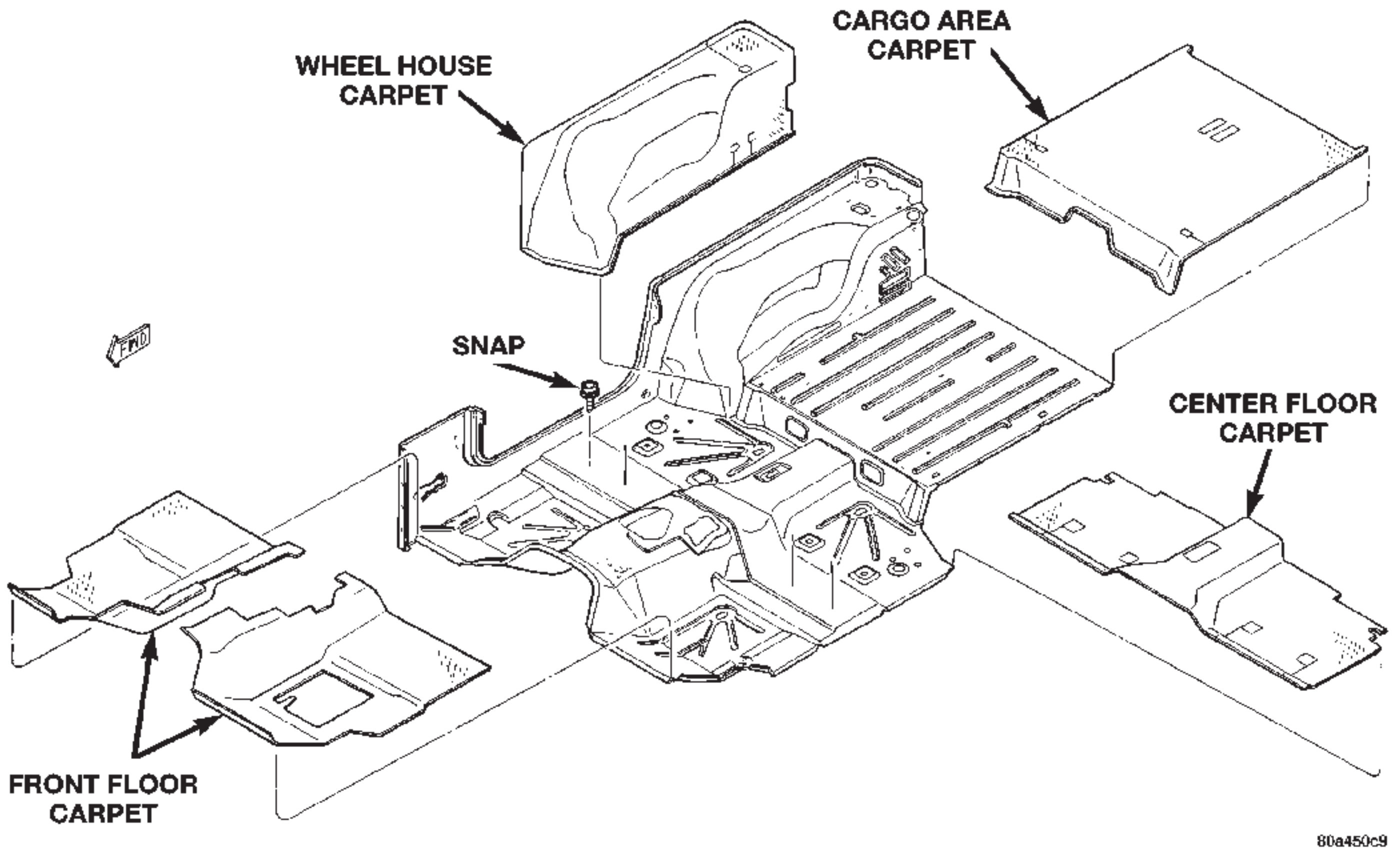


Fig. 68 Vehicle Carpet

(3) Grasp wheelhouse carpet and remove from vehicle (Fig. 68).

INSTALLATION

(1) Position wheelhouse carpet in vehicle and adjust as necessary.

(2) If equipped, install the Add-A-trunk.

(3) Return the rear seat to the full rearward position.

SPORT BAR

REMOVAL

(1) Remove hard top and/or soft top.

(2) Remove the door opening frames.

(3) Remove the sunvisors.

(4) Remove the A-pillar weatherstrips strips (Fig. 69).

(5) Disengage center support bar cover zipper.

(6) Remove the bolts attaching the side support bars to the center support bar (Fig. 70).

(7) Remove the bolts attaching the side support bars to the windshield frame.

(8) Separate the side support bars from the vehicle.

(9) Pull back the center section of the carpet and remove the bolts attaching the sport bar to the cargo floor panel.

(10) Lower the rear seat and lift rear seat to the full forward position.

(11) Pull back wheelhouse carpet and remove bolts attaching the directional cross bars to the wheelhouse.

(12) Remove the bolts attaching the seatbelt anchors to the wheelhouse.

(13) Disconnect sound bar. Refer to Group 8F, Audio Systems for removal and installation procedures.

(14) Carefully lift the sport bar upward and remove it from the vehicle.

REMOVAL AND INSTALLATION (Continued)

(15) If necessary, remove the pads and covers from the sport bar.

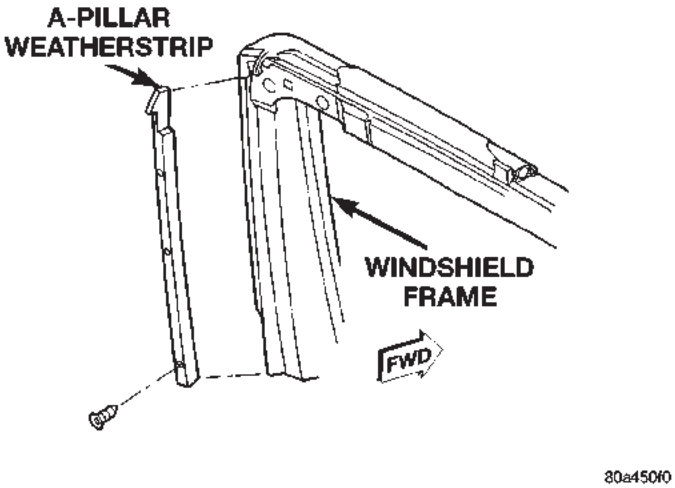


Fig. 69 A-Pillar Weatherstrip

INSTALLATION

(1) If necessary, transfer all attached components.

(2) Clean the base plate contact surface areas on the floor and wheelhouse panels.

(3) Apply epoxy chromate primer to the attaching hole edges for protection against corrosion.

(4) Position the sport bar base plates on the floor and wheelhouse panels with the holes aligned.

NOTE: To prevent water seepage, apply 3M Drip-Chek Sealant (or an equivalent product) to the underside of the sport bar base flanges and all the bolt heads before installation.

(5) Connect sound bar. Refer to Group 8F, Audio Systems for removal and installation procedures.

(6) Install the bolts attaching the seatbelt anchors to the wheelhouse.

(7) Install the bolts attaching the directional cross bars to the wheelhouse and install the wheelhouse carpet. Tighten the bolts to 40 N·m (30 ft. lbs.) torque.

(8) Return seat back to upright position.

(9) Install the bolts attaching the sport bar to the cargo floor panel and install the center carpet. Tighten the bolts to 40 N·m (30 ft. lbs.) torque.

(10) Position side supports at the windshield and install the bolts attaching the side support bars to the windshield frame. Tighten the bolts to 32 N·m (24 ft. lbs.) torque.

(11) Install the bolts attaching the side support bars to the center support bar. Tighten the bolts to 71 N·m (53 ft. lbs.) torque.

(12) Engage center support bar cover zipper.

(13) Install the A-pillar windshield strips.

(14) Install the door opening frames.

(15) Install hard top and/or soft top.

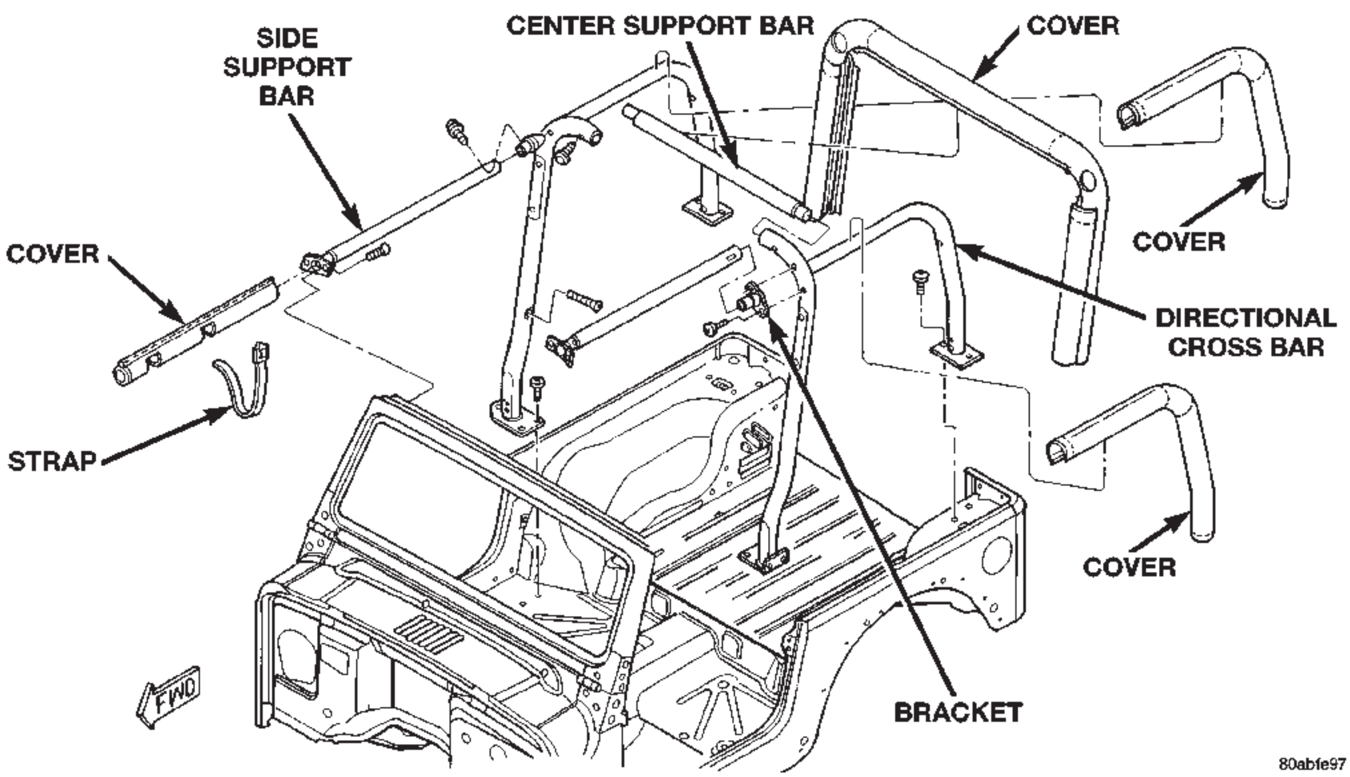


Fig. 70 Sport Bar

REMOVAL AND INSTALLATION (Continued)

REAR VIEW MIRROR

REMOVAL

(1) Loosen the mirror set screw.

(2) Slide the mirror up and off the support button (bracket) (Fig. 71).

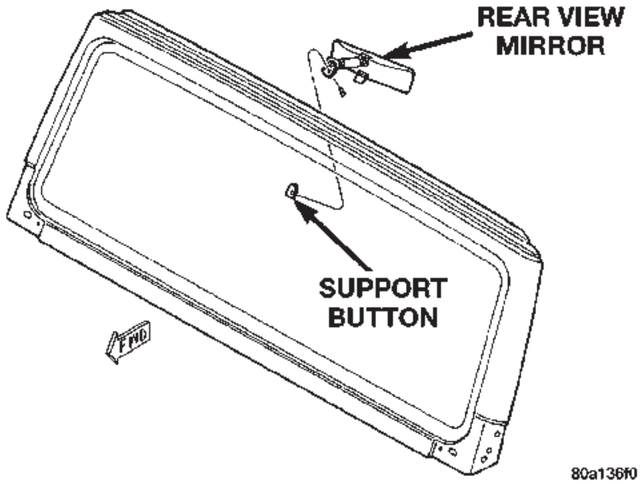


Fig. 71 Rear View Mirror

INSTALLATION

(1) Slide the mirror onto the support button (bracket).

CAUTION: Do not over-tighten the setscrew because glass chipping and/or breakage could result.

(2) Tighten the mirror setscrew to 1 N·m (9 in. lbs.) torque.

REARVIEW MIRROR SUPPORT BRACKET

INSTALLATION

(1) Mark the position for the mirror bracket on the outside of the windshield glass with a wax pencil.

(2) Clean the bracket contact area on the glass. Use a mild powdered cleanser on a cloth saturated with isopropyl (rubbing) alcohol. Finally, clean the glass with a paper towel dampened with alcohol.

(3) Sand the surface on the support bracket with fine grit-sandpaper. Wipe the bracket surface clean with a paper towel.

(4) Apply accelerator to the surface on the bracket according to the following instructions:

- Crush the vial to saturate the felt applicator.
- Remove the paper sleeve.
- Apply accelerator to the contact surface on the bracket.
- Allow the accelerator to dry for five minutes.
- Do not touch the bracket contact surface after the accelerator has been applied.

(5) Apply adhesive accelerator to the bracket contact surface on the windshield glass. Allow the accelerator to dry for one minute. Do not touch the glass contact surface after the accelerator has been applied.

(6) Install the bracket according to the following instructions:

- Apply one drop of adhesive at the center of the bracket contact-surface on the windshield glass.
- Apply an even coat of adhesive to the contact surface on the bracket.
- Align the bracket with the marked position on the windshield glass.
- Press and hold the bracket in place for at least one minute.

NOTE: Verify that the mirror support bracket is correctly aligned, because the adhesive will cure rapidly.

(7) Allow the adhesive to cure for 8-10 minutes. Remove any excess adhesive with an alcohol-dampened cloth.

(8) Allow the adhesive to cure for an additional 8-10 minutes before installing the mirror.

SUNVISOR

REMOVAL

(1) Remove the screws that attach the sunvisor arm support brackets to the windshield frame (Fig. 72).

(2) Remove the sunvisor from the windshield frame

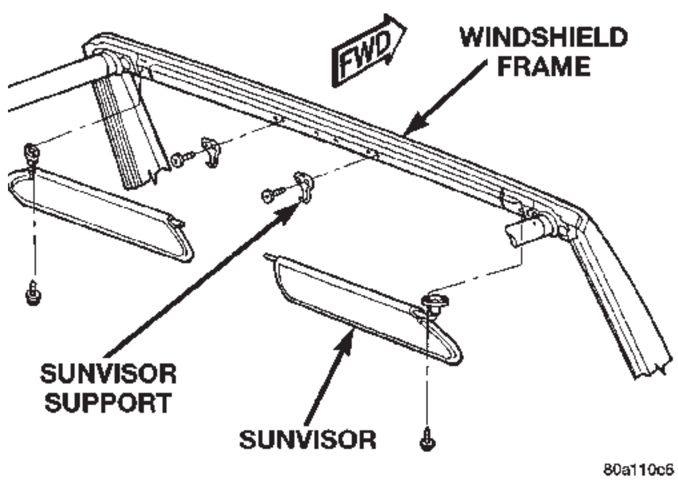


Fig. 72 Sunvisor

INSTALLATION

(1) Position the sunvisor on the windshield frame and align the arm support bracket holes with the frame.

REMOVAL AND INSTALLATION (Continued)

(2) Install the screws that attach the sunvisor arm support brackets to the frame. Tighten the screws securely.

WHEELHOUSE SPLASH SHIELD

REMOVAL

(1) Remove the plastic rivets that attach the splash shield to the wheelhouse (Fig. 73).

(2) Remove the push-in fasteners attaching the splash shield to the wheelhouse. (The push-in fasteners are molded into the splash shield.)

(3) Remove the splash shield from the wheelhouse.

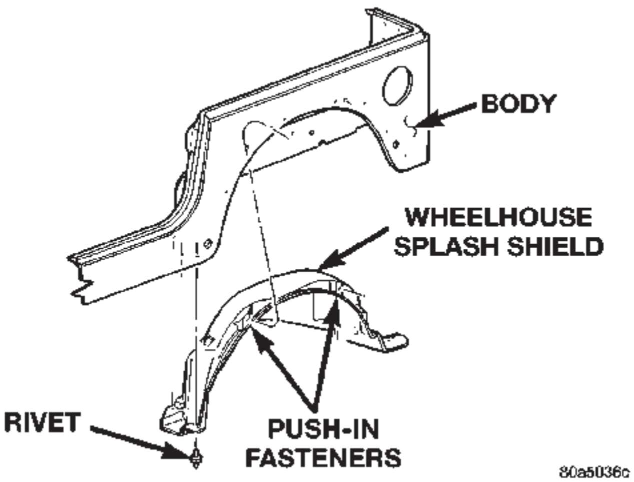


Fig. 73 Wheelhouse Splash Shield

INSTALLATION

(1) Position the splash shield in the wheelhouse.

(2) Press the splash shield push-in fasteners into place.

(3) Attach the splash shield to the wheelhouse with rivets.

LIFTGATE GLASS SUPPORT CYLINDER

REMOVAL

WARNING: DO NOT REMOVE THE LIFTGATE SUPPORT RODS WITH THE LIFTGATE CLOSED. THE SUPPORT ROD PISTONS ARE OPERATED BY HIGH PRESSURE GAS AND COULD CAUSE PERSONAL INJURY AND/OR VEHICLE DAMAGE IF THEY ARE REMOVED WITH THE PISTONS COMPRESSED (LIFTGATE CLOSED). ONCE REMOVED, DO NOT ATTEMPT TO DISASSEMBLE OR REPAIR THE SUPPORT RODS.

(1) Open and support the liftgate glass.

(2) Remove the support rod cylinder retaining clips at both ends of each support rod cylinder (Fig. 74).

(3) Pull the support rods off the ball studs (Fig. 75).

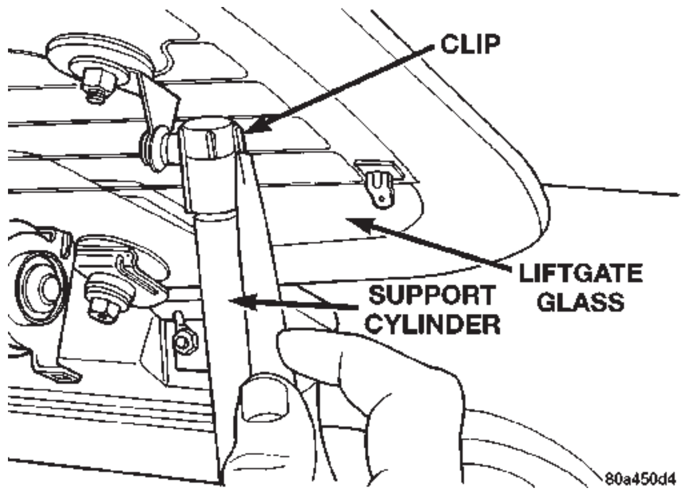


Fig. 74 Support Rod Cylinder

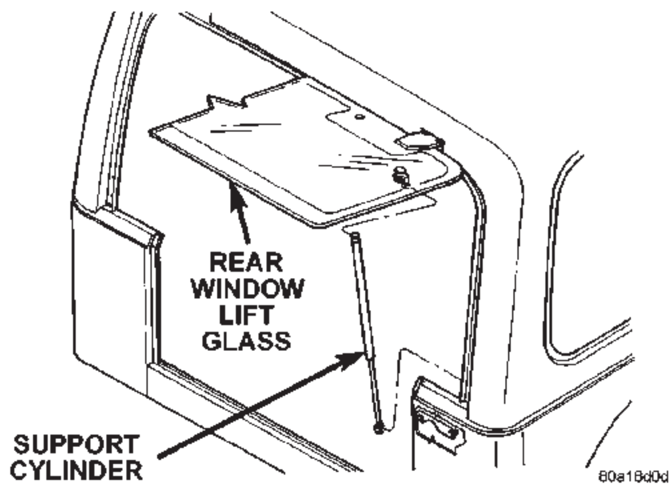


Fig. 75 Support Rod Cylinder Removal

INSTALLATION

(1) Position the support rod cylinders on the ball studs.

(2) Install the support rod cylinder retainer clips.

LIFTGATE GLASS

REMOVAL

(1) If equipped, disconnect the rear defroster harness connectors (Fig. 76).

(2) If equipped, disconnect the wiper motor harness connectors.

WARNING: DO NOT REMOVE THE LIFTGATE SUPPORT RODS WITH THE LIFTGATE CLOSED. THE SUPPORT ROD PISTONS ARE OPERATED BY HIGH PRESSURE GAS AND COULD CAUSE PERSONAL INJURY AND/OR VEHICLE DAMAGE IF THEY ARE REMOVED WITH THE PISTONS COMPRESSED (LIFTGATE CLOSED). ONCE REMOVED, DO NOT ATTEMPT TO DISASSEMBLE OR REPAIR THE SUPPORT RODS.

REMOVAL AND INSTALLATION (Continued)

(3) Open the tailgate and liftgate.
(4) Remove support rod cylinders.
(5) Remove the bolts attaching the liftgate hinge to the hardtop (Fig. 77).
(6) Separate the liftgate glass from the hard top.

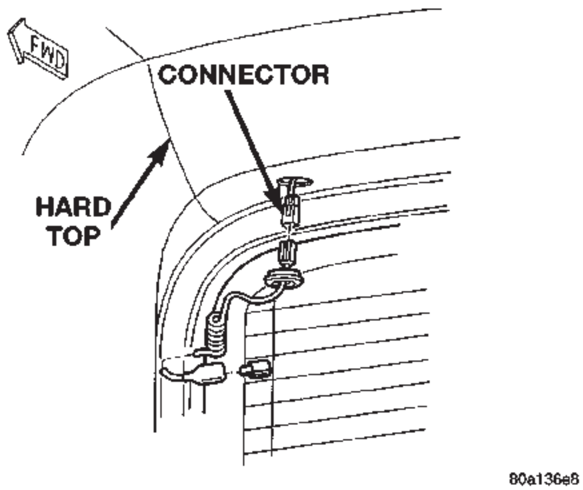


Fig. 76 Rear Defroster Connectors

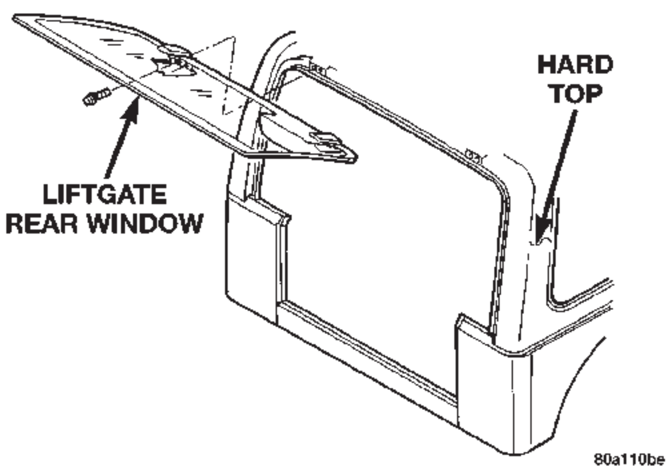


Fig. 77 Liftgate Glass

INSTALLATION

Transfer all related components

(1) If removed, install support rod ball studs. Tighten the nut to 12 N·m (112 in. lbs.) torque.
(2) Position the liftgate glass at the hard top.
(3) Install the bolts attaching the liftgate hinge to the hardtop. Tighten the bolts to 10 N·m (95 in. lbs.) torque.
(4) Position the support rod cylinders on the ball studs and install the clips.

LIFTGATE GLASS HINGE

REMOVAL

(1) Open tailgate.
(2) Open and support liftgate glass.
(3) Remove wiper motor cover (right hinge only).
(4) Remove the nut attaching the liftgate hinge to the liftgate glass.
(5) Mark the position of the hinge in the top and remove the bolts attaching the hinge to the top (Fig. 78).

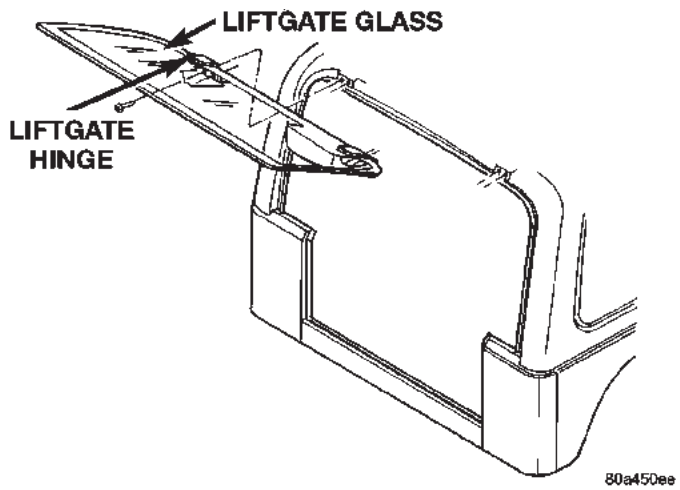


Fig. 78 Liftgate Hinge

INSTALLATION

(1) Align and position the hinge on the top and install the bolts.
(2) Install the nut attaching the liftgate hinge to the liftgate glass. Tighten the nut to 6 N·m (53 in. lbs.) torque.
(3) If removed, install wiper motor cover.

LIFTGATE GLASS WEATHERSTRIP

The liftgate glass weatherstrip is attached to the liftgate glass and is not serviceable. If the liftgate glass weatherstrip needs to be replaced, replace the liftgate glass.

SPARE TIRE CARRIER

REMOVAL

(1) Remove the spare tire from the wheel bracket (Fig. 79).
(2) Remove the bolts that attach the tire bracket to the tailgate (Fig. 80).
(3) Disconnect CHMSL.
(4) Remove the bracket and the gaskets from the tailgate.

INSTALLATION

(1) Position the gaskets and the tire bracket on the tailgate and install the bolts. Tighten the bolts to 24 N·m (17 ft. lbs.) torque.
(2) Connect CHMSL connector.
(3) Install the spare tire on the tire bracket.

REMOVAL AND INSTALLATION (Continued)

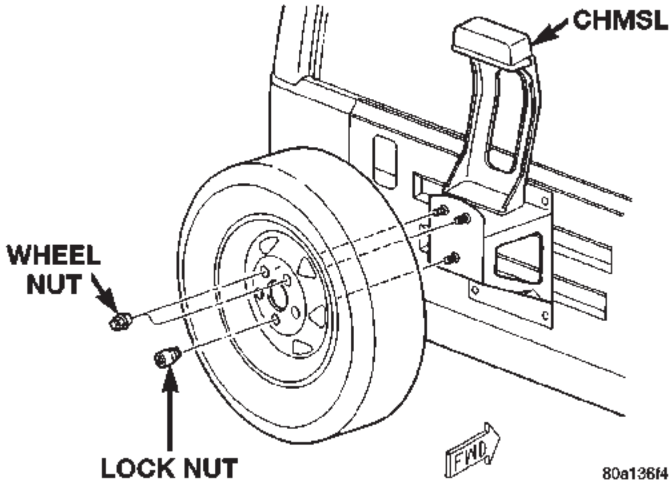


Fig. 79 Spare Tire

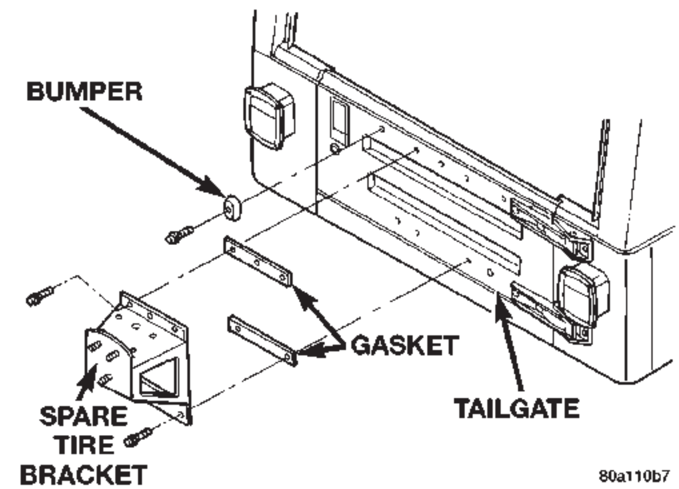


Fig. 80 Spare Tire Bracket

LICENSE PLATE BRACKET

REMOVAL

(1) If installed, remove the license plate.

(2) Remove the screws attaching the license plate bracket to the body (Fig. 81).

(3) Separate the bracket from the body.

INSTALLATION

(1) Position the bracket on the body.

(2) Install the screws attaching the license plate bracket to the body.

(3) If removed, install the license plate.

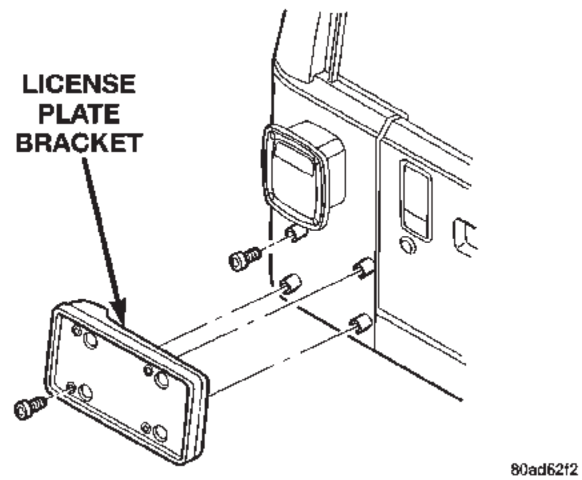


Fig. 81 License Plate Bracket

TAILGATE

REMOVAL

(1) Remove the spare tire.

(2) Open the tailgate and remove the CHMSL contact cover (Fig. 82).

(3) Disengage the CHMSL electrical connectors.

(4) Remove the screws that attach the tailgate hinge to the tailgate.

(5) Separate the tailgate from the vehicle.

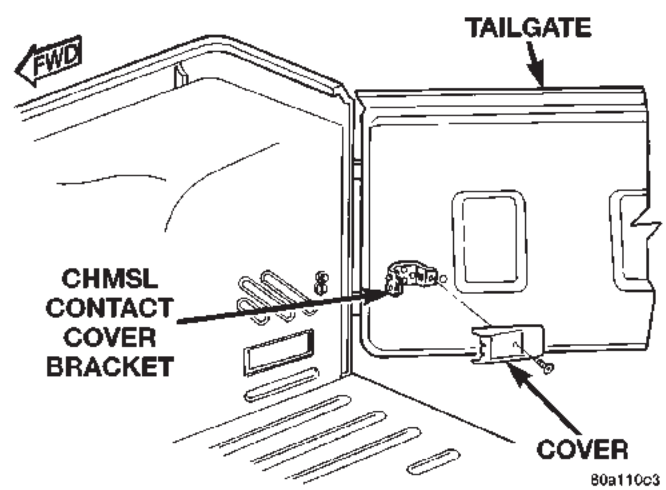


Fig. 82 CHMSL Contact Cover

INSTALLATION

If necessary, transfer tailgate related components.

(1) Install the screws that attach the tailgate hinge to the tailgate.

(2) Engage the CHMSL electrical connectors.

(3) Install the CHMSL contact cover.

(4) Close the tailgate and install the spare tire.

REMOVAL AND INSTALLATION (Continued)

TAILGATE HINGE

Hinges may be serviced individually. If both are to be serviced, remove/install hinges one at a time.

REMOVAL

(1) Using a wax pencil, mark the position of the hinge on the body.
(2) Remove the screws attaching the hinge to the body and tailgate (Fig. 83).
(3) Separate the hinge from the tailgate.

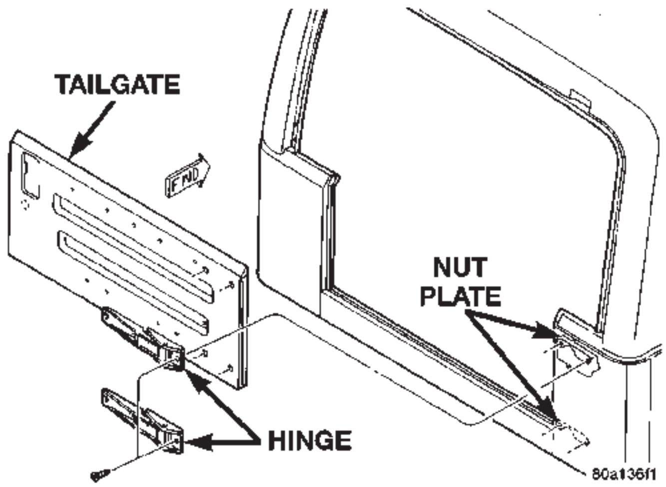


Fig. 83 Tailgate Hinge

INSTALLATION

(1) Prepare and paint the replacement hinge to match the body paint color.
(2) Lubricate the hinge with spray lubricant.
(3) Align and position the hinge on the body and tailgate.
(4) Install the screws. Tighten the screws to 23 N·m (200 in. lbs.) torque

TAILGATE OUTSIDE HANDLE

REMOVAL

(1) Remove the latch from the tailgate.
(2) Remove the screws attaching the outside handle to the tailgate (Fig. 84).
(3) Separate the outside handle and seal from the tailgate.

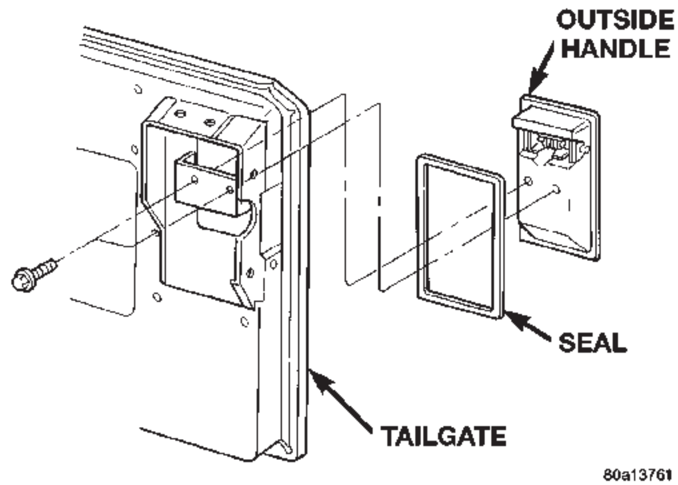


Fig. 84 Tailgate Outside Handle

INSTALLATION

(1) Position the seal and outside release handle on the tailgate. and install screws.
(2) Install the screws attaching the outside handle to the tailgate.
(3) Install the latch.

TAILGATE LOCK CYLINDER

REMOVAL

(1) Open the tailgate.
(2) Remove the latch cover.
(3) Remove the lock cylinder retainer clip.
Remove the lock cylinder from the tailgate opening.

INSTALLATION

(1) Position the lock cylinder in the tailgate opening.
(2) Connect the lock cylinder to latch rod.
(3) Install the lock cylinder retainer clip.
(4) Install the latch cover.

TAILGATE LATCH

REMOVAL

(1) Open the tailgate and remove the latch trim cover (Fig. 85).
(2) Disconnect the outside handle to latch rod.
(3) Disconnect the lock cylinder to latch rod.
(4) Remove the screw attaching latch to tailgate.
(5) Separate the latch from the tailgate.

REMOVAL AND INSTALLATION (Continued)

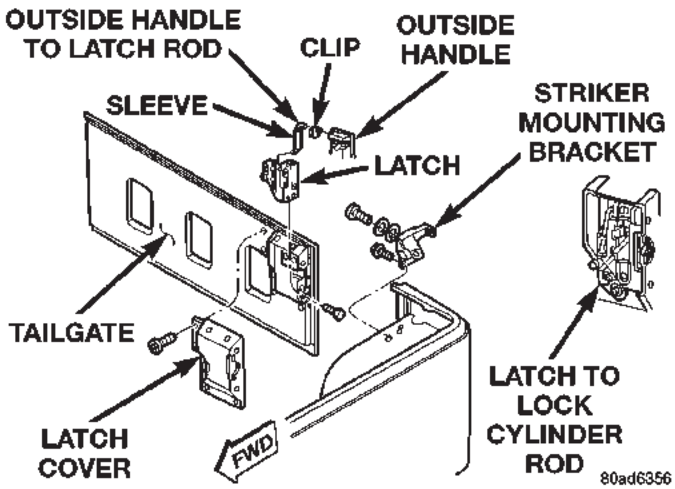


Fig. 85 Tailgate Latch Cover

INSTALLATION

(1) Position the latch in the tailgate.

(2) Install the screw attaching latch to tailgate. Do not tighten screw.

(3) Connect the lock cylinder to latch rod.

(4) Connect the outside handle to latch rod.

(5) Install the latch trim cover. Tighten all screws.

TAILGATE LATCH STRIKER

REMOVAL

(1) Remove the striker from the bracket with a Torx bit.

(2) Remove the shim washers from the bracket.

(3) Remove the screws attaching the striker bracket to the body.

INSTALLATION

(1) Position the striker bracket on the body and install the screws.

(2) Position the striker and shim washers on the striker bracket.

(3) Install the striker in the bracket with a Torx bit. Tighten the striker to 71 N·m (52 ft. lbs.) torque.

TAILGATE WEATHERSTRIP AND CHANNEL

REMOVAL

(1) Open the tailgate.

(2) Remove the push-in fasteners attaching the weatherstrip to the top corners of the tailgate (Fig. 86).

(3) Peel the weatherstrip from the upper tailgate corners.

(4) Slide the weatherstrip out of the tailgate.

(5) If the weatherstrip channel requires replacement, peel the weatherstrip channel from the tailgate.

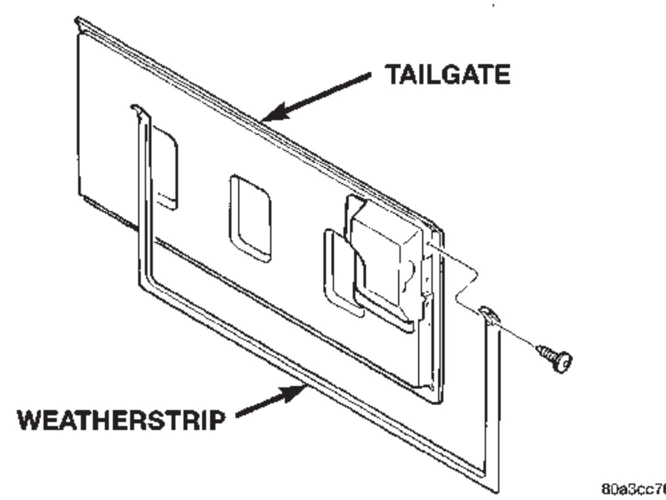


Fig. 86 Tailgate Weatherstrip

INSTALLATION

(1) If the weatherstrip channel is being replaced;

(a) Clean the channel contact surface on the tailgate with isopropyl alcohol, or equivalent.

(b) Peel the paper backing from the weatherstrip channel.

(c) Position weatherstrip channel to the tailgate and press into place.

(d) Use hand pressure or a roller to wet out the tape adhesive holding the weatherstrip channel to the tailgate.

REMOVAL AND INSTALLATION (Continued)

(2) Slide the weatherstrip into the weatherstrip channel.

(3) Clean the weatherstrip contact surface on the tailgate with isopropyl alcohol, or equivalent.

(4) Remove paper backing from upper ends of weatherstrip.

(5) Position the weatherstrip to the tailgate and press it into place.

(6) Install the push-in fasteners attaching the weatherstrip to the tailgate.

(7) Use hand pressure or a roller to wet out the tape adhesive holding the weatherstrip to the tailgate.

ADJUSTMENTS

HOOD ADJUSTMENT

The hood hinge screw holes are oversized to facilitate hood adjustment movement.

(1) Loosen the screws.

(2) Move the hood in the direction(s) required for correct alignment.

(3) Tighten the screws.

DOOR ADJUSTMENT

The doors are adjusted at the hinge attaching locations on either the body or the door. Enlarged holes are located in the body (lower hinge only) for fore, aft and tilt adjustments. Enlarged holes are also located in the door (upper and lower hinges) for up, down, fore, aft and tilt adjustments.

Prior to door adjustment or alignment, the door latch must be removed to allow the door to close freely and be properly aligned.

The door latch striker should be adjusted in or out to allow the door latch to be fully engaged. The door should be flush with the adjacent body panels.

TAILGATE ADJUSTMENT

(1) Loosen the tailgate hinge-to-body screws.

(2) Align the tailgate in the body opening and tighten the hinge screws.

SPECIFICATIONS

BODY LUBRICANTS

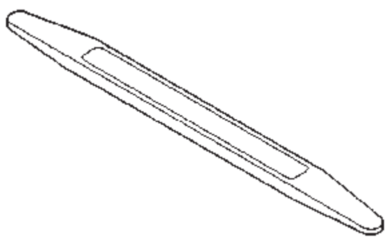
COMPONENT	SERVICE INTERVAL	LUBRICANT
Door Latches	As Required	Multi-Purpose Grease NLGI GC-LB (Water Resistant) (1)
Hood Latch, Release Mechanism & Safety Latch	As Required (When Performing Other Underhood Service)	Multi-Purpose Grease NLGI GC-LB 2 EP (2)
Hood Hinges	As Required	Engine Oil
Seat Track & 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)
Liftgate Support Arms	As Required	Engine Oil
Tailgate Latches	As Required	White Spray Lubricant (3)
Tailgate Release Handle	As Required	Multi-Purpose Grease NLGI GC-LB 2 EP (2)
Window System Components	As Required	White Spray Lubricant (3)
Lock Cylinders	Twice A Year	Lock Cylinder Lubricant (4)
Parking Brake Mechanism	As Required	Multi-Purpose Grease NLGI GC-LB 2 EP (1)
1 = Mopar Wheel Bering Grease (High Temp) 2 = Mopar Multi-Mileage Lubricant 3 = Mopar Spray White Lube 4 = Mopar Lock Cylinder Lubricant		

TORQUE SPECIFICATIONS

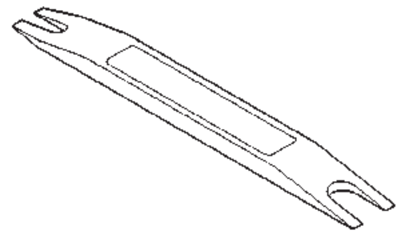
DESCRIPTION	TORQUE
Hood hinge screws	17 N·m (155 in. lbs.)
Bucket seat front anchor bolt	47 N·m (35 ft. lbs.)
Bucket seat rear inboard anchor bolt	74 N·m (55 ft. lbs.)
Bucket seat rear outboard anchor bolt	33 N·m (25 ft. lbs.)
Liftgate glass ball stud nut	12 N·m (112 in. lbs.)
Liftgate glass hinge nut	6 N·m (53 in. lbs.)
Liftgate hinge to hardtop bolt	10 N·m (95 in. lbs.)
Front turning loop bolt	47 N·m (35 ft. lbs.)
Front retractor bolt	47 N·m (35 ft. lbs.)
Rear retractor bolt	47 N·m (35 ft. lbs.)
Rear turning loop bolt	47 N·m (35 ft. lbs.)
Rear belt anchor bolt	47 N·m (35 ft. lbs.)
Rearview mirror setscrew	1 N·m (9 in. lbs.)
Rear buckle anchor bolt	43 N·m (32 ft. lbs.)
Side support bar to sport bar bolts	71 N·m (53 ft. lbs.)
Sport bar to wheelhouse bolts	40 N·m (30 ft. lbs.)
Sport bar to cargo floor bolts	40 N·m (30 ft. lbs.)
Sport bar to windshield frame bolts	32 N·m (24 ft. lbs.)
Tailgate hinge screws	23 N·m (200 in. lbs.)
Tailgate striker	71 N·m (52 ft. lbs.)

SPECIAL TOOLS

BODY



Trim Stick C-4755



Remover, Moldings C-4829

TIRES AND WHEELS

CONTENTS

TIRES

INDEX

DESCRIPTION AND OPERATION

TIRE INFORMATION

Tires are designed and engineered for each specific vehicle. They provide the best overall performance for normal operation. The ride and handling characteristics match the vehicle's requirements. With proper care they will give excellent reliability, traction, skid resistance, and tread life.

Driving habits have more effect on tire life than any other factor. Careful drivers will obtain in most cases, much greater mileage than severe use or careless drivers. A few of the driving habits which will shorten the life of any tire are:

- Rapid acceleration
- Severe brake applications
- High speed driving
- Excessive speeds on turns
- Striking curbs and other obstacles

Radial-ply tires are more prone to irregular tread wear. It is important to follow the tire rotation interval shown in the section on Tire Rotation. This will help to achieve a greater tread life.

TIRE IDENTIFICATION

Tire type, size, aspect ratio and speed rating are encoded in the letters and numbers imprinted on the side wall of the tire. Refer to the chart to decipher the tire identification code (Fig. 1).

Performance tires have a speed rating letter after the aspect ratio number. The speed rating is not always printed on the tire sidewall. 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.

TIRE CHAINS

Tire snow chains may be used on **certain** models. Refer to the Owner's Manual for more information.

DESCRIPTION AND OPERATION (Continued)

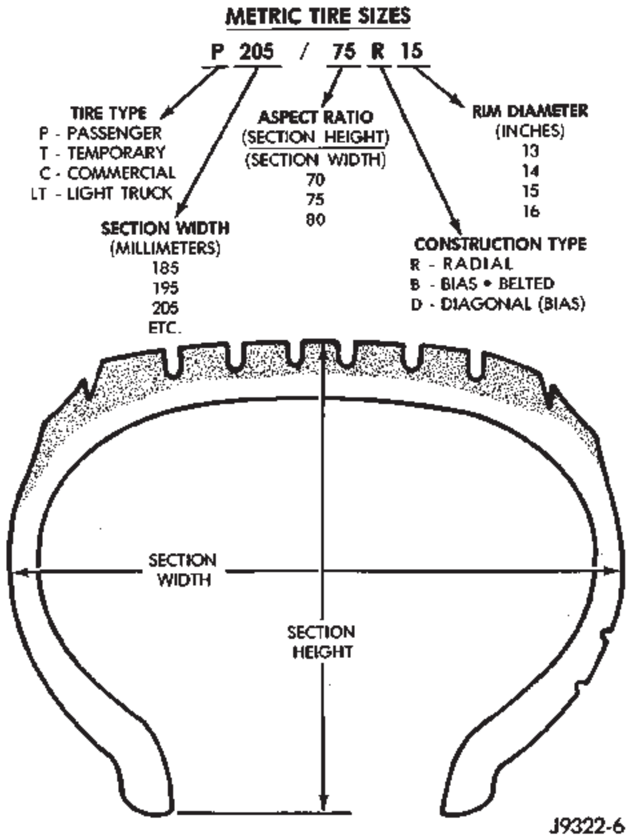


Fig. 1 Tire Identification

RADIAL-PLY TIRES

Radial-ply tires improve handling, tread life, ride quality and decrease rolling resistance.

Radial-ply tires must always be used in sets of four. Under no circumstances should they be used on the front only. They may be mixed with temporary spare tires when necessary. A maximum speed of 50 MPH is recommended while a temporary spare is in use.

Radial-ply tires have the same load-carrying capacity as other types of tires of the same size. They also use the same recommended inflation pressures.

The use of oversized tires, either in the front or rear of the vehicle, can cause vehicle drive train failure. This could also cause inaccurate wheel speed signals when the vehicle is equipped with Anti-Lock Brakes.

The use of tires from different manufactures on the same vehicle is NOT recommended. The proper tire pressure should be maintained on all four tires. For proper tire pressure refer to the Tire Inflation Pressure Chart provided with the vehicle.

SPARE TIRE–TEMPORARY

The temporary spare tire is designed for emergency use only. The original tire should be repaired or replaced at the first opportunity and reinstall. Do not exceed speeds of 50 MPH. Refer to Owner's Manual for complete details.

TIRE INFLATION PRESSURES

Under inflation will cause rapid shoulder wear, tire flexing, and possible tire failure (Fig. 2).

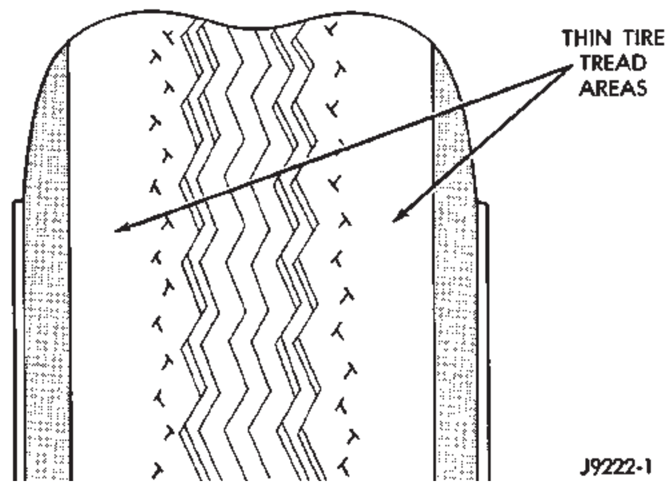


Fig. 2 Under Inflation Wear

Over inflation will cause rapid center wear and loss of the tire's ability to cushion shocks (Fig. 3).

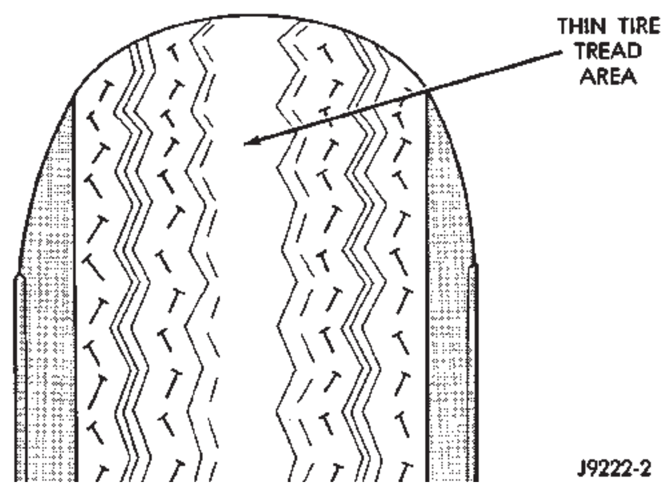


Fig. 3 Over Inflation Wear

Improper inflation can cause:
- Uneven wear patterns
- Reduced tread life
- Reduced fuel economy
- Unsatisfactory ride
- Vehicle drift

For proper tire pressure specification refer to the Tire Inflation Pressure Chart provided with the vehicle.

Tire pressures have been chosen to provide safe operation, vehicle stability, and a smooth ride. Tire pressure should be checked cold once a month. Tire pressure decreases as the ambient temperature

DESCRIPTION AND OPERATION (Continued)

drops. Check tire pressure frequently when ambient temperature varies widely.

Inflation pressures specified on the placards are cold inflation pressure. The vehicle must sit for at least 3 hours to obtained the correct cold inflation pressure reading. Or driven less than one mile after sitting for 3 hours. Tire inflation pressures may increase from 2 to 6 pounds per square inch (psi) during operation. Do not reduce this normal pressure build-up.

WARNING: OVER OR UNDER INFLATED TIRES CAN AFFECT VEHICLE HANDLING AND TREAD WEAR. THIS MAY CAUSE THE TIRE TO FAIL SUDDENLY, RESULTING IN LOSS OF VEHICLE CONTROL.

TIRE PRESSURE FOR HIGH SPEED OPERATION

Chrysler Corporation advocates driving at safe speeds within posted speed limits. Where speed limits allow the vehicle to be driven at high speeds, correct tire inflation pressure is very important. For speeds up to and including 120 km/h (75 mph), tires must be inflated to the pressures shown on the tire placard. For continuous speeds in excess of 120 km/h (75 mph), tires must be inflated to the maximum pressure specified on the tire sidewall.

Vehicles loaded to the maximum capacity should not be driven at continuous speeds above 75 mph (120 km/h).

For emergency vehicles that are driven at speeds over 90 mph (144 km/h), special high speed tires must be used. Consult tire manufacturer for correct inflation pressure recommendations.

REPLACEMENT TIRES

The original equipment tires provide a proper balance of many characteristics such as:

- Ride
- Noise
- Handling
- Durability
- Tread life
- Traction
- Rolling resistance
- Speed capability

It is recommend that tires equivalent to the original equipment tires be used when replacement is needed.

Failure to use equivalent replacement tires may adversely affect the safety and handling of the vehicle.

The use of oversize tires not listed in the specification charts may cause interference with vehicle components. Under extremes of suspension and steering travel, interference with vehicle components may cause tire damage.

WARNING: FAILURE TO EQUIP THE VEHICLE WITH TIRES HAVING ADEQUATE SPEED CAPABILITY CAN RESULT IN SUDDEN TIRE FAILURE.

DIAGNOSIS AND TESTING

PRESSURE GAUGES

A quality air pressure gauge is recommended to check tire pressure. After checking the air pressure, replace valve cap finger tight.

TREAD WEAR INDICATORS

Tread wear indicators are molded into the bottom of the tread grooves. When tread depth is 1.6 mm (1/16 in.), the tread wear indicators will appear as a 13 mm (1/2 in.) band.

Tire replacement is necessary when indicators appear in two or more grooves or if localized balding occurs (Fig. 4).

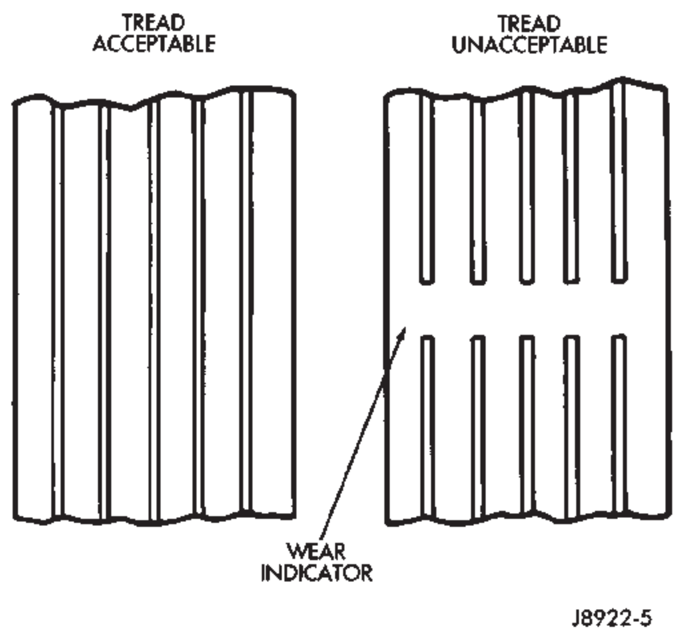


Fig. 4 Tread Wear Indicators

TIRE WEAR PATTERNS

Under inflation will cause wear on the shoulders of tire. Over inflation will cause wear at the center of tire.

Excessive camber causes the tire to run at an angle to the road. One side of tread is then worn more than the other (Fig. 5).

Excessive toe-in or toe-out causes wear on the tread edges and a feathered effect across the tread (Fig. 5).

DIAGNOSIS AND TESTING (Continued)

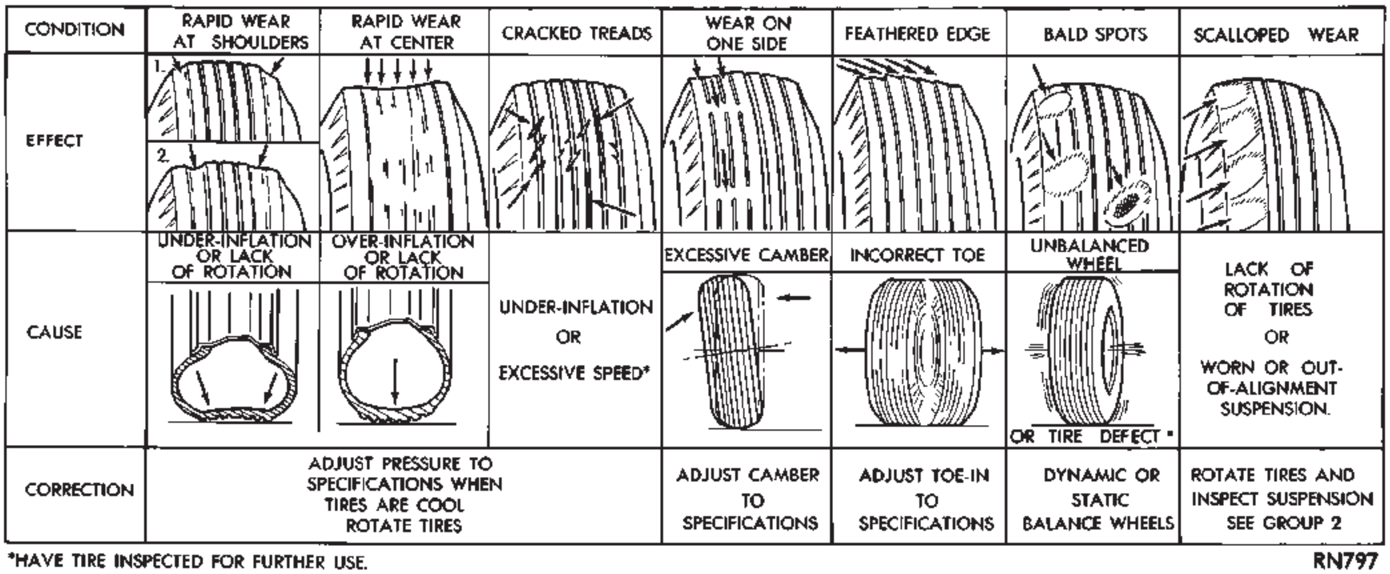


Fig. 5 Tire Wear Patterns

TIRE NOISE OR VIBRATION

Radial-ply tires are sensitive to force impulses caused by improper mounting, vibration, wheel defects, or possibly tire imbalance.

To find out if tires are causing the noise or vibration, drive the vehicle over a smooth road at varying speeds. Note the noise level during acceleration and deceleration. The engine, differential and exhaust noises will change as speed varies, while the tire noise will usually remain constant.

SERVICE PROCEDURES

ROTATION

Tires on the front and rear operate at different loads and perform different steering, driving, and braking functions. For these reasons they wear at unequal rates and tend to develop irregular wear patterns. These effects can be reduced by rotating the tires at regular intervals. The benefits of tire rotation are:

- Increase tread life
- Maintain traction levels
- A smooth, quiet ride

The suggested method of tire rotation is (Fig. 6). Other rotation methods can be used, but they will not provide all the tire longevity benefits.

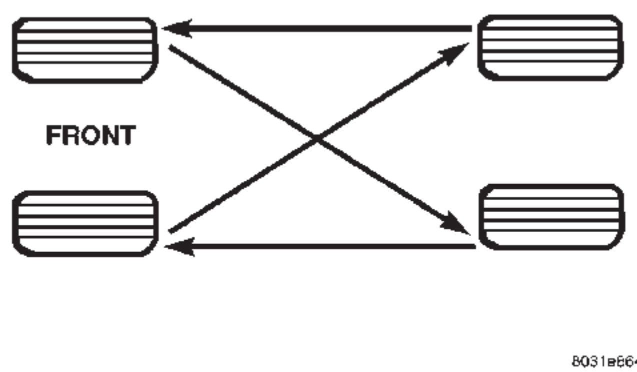


Fig. 6 Tire Rotation Pattern

MATCH MOUNTING

Tires and wheels are currently match mounted at the factory. Match mounting is a technique used to reduce runout in the wheel/tire assembly. This means that the high spot of the tire is aligned with the low spot on the wheel rim. The high spot on the tire is marked with a paint mark or a bright colored adhesive label on the outboard sidewall. The low spot on the rim is identified with a label on the outside of the rim and a dot on the inside of the rim. If the outside label has been removed the tire will have to be removed to locate the dot on the inside of the rim.

Before dismounting a tire from its wheel, a reference mark should be placed on the tire at the valve stem location. This reference will ensure that it is remounted in the original position on the wheel.

(1) Use a dial indicator to locate the high spot of the tire on the center tread rib (Fig. 7). Record the indicator reading and mark the high spot on the tire. Place a mark on the tire at the valve stem location (Fig. 8).

(2) Break down the tire and remount it 180 degrees on the rim (Fig. 9).

(3) Measure the total runout again and mark the tire to indicate the high spot.

SERVICE PROCEDURES (Continued)

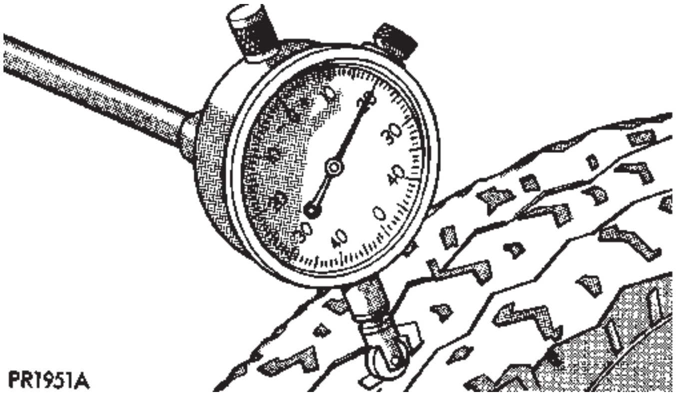


Fig. 7 Dial Indicator

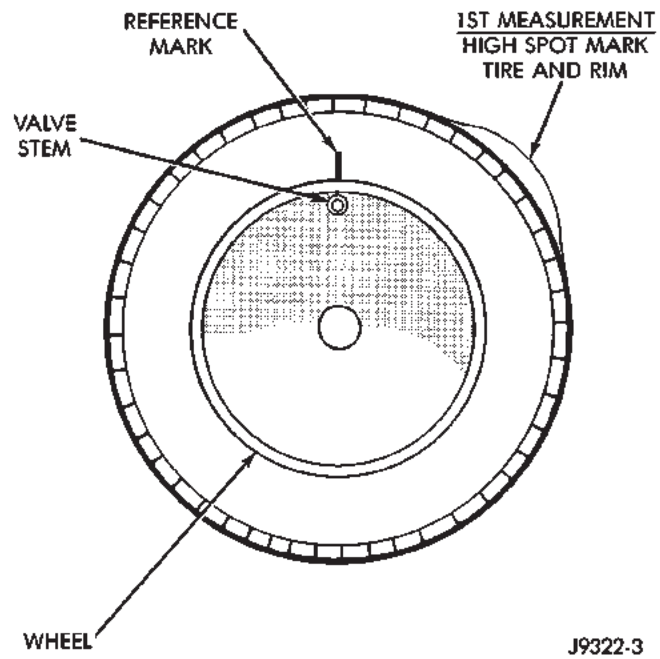


Fig. 8 First Measurement On Tire

(4) If runout is still excessive use the following procedures.

(a) If the high spot is within 101.6 mm (4.0 in.) of the first spot and is still excessive, replace the tire.

(b) If the high spot is within 101.6 mm (4.0 in.) of the first spot on the wheel, the wheel may be out of specifications. Refer to Wheel and Tire Runout.

(c) If the high spot is NOT within 101.6 mm (4.0 in.) of either high spot, draw an arrow on the tread from second high spot to first. Break down the tire and remount it 90 degrees on rim in that direction (Fig. 10). This procedure will normally reduce the runout to an acceptable amount.

REPAIRING LEAKS

For proper repairing, a radial tire must be removed from the wheel. Repairs should only be made if the defect, or puncture, is in the tread area (Fig. 11). The tire should be replaced if the puncture is located in the sidewall.

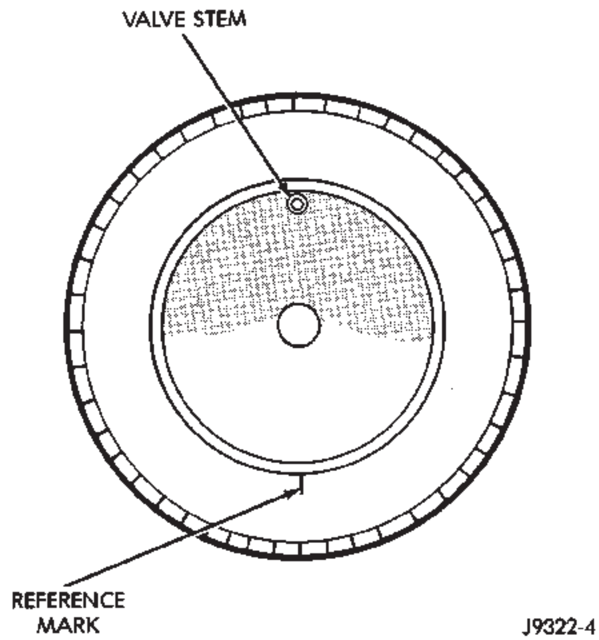


Fig. 9 Remount Tire 180 Degrees

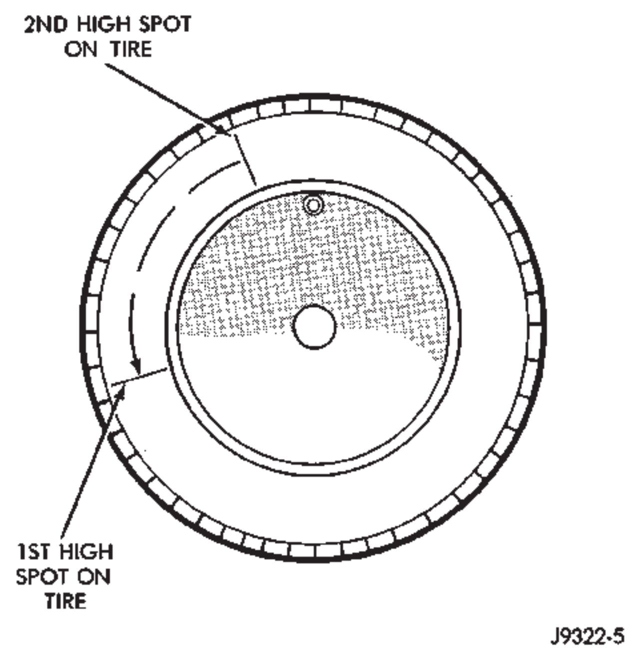


Fig. 10 Remount Tire 90 Degrees In Direction of Arrow

Deflate tire completely before removing the tire from the wheel. Use lubrication such as a mild soap solution when dismounting or mounting tire. Use tools free of burrs or sharp edges which could damage the tire or wheel rim.

Before mounting tire on wheel, make sure all rust is removed from the rim bead and repaint if necessary.

SERVICE PROCEDURES (Continued)

Install wheel on vehicle, and tighten to proper torque specification.

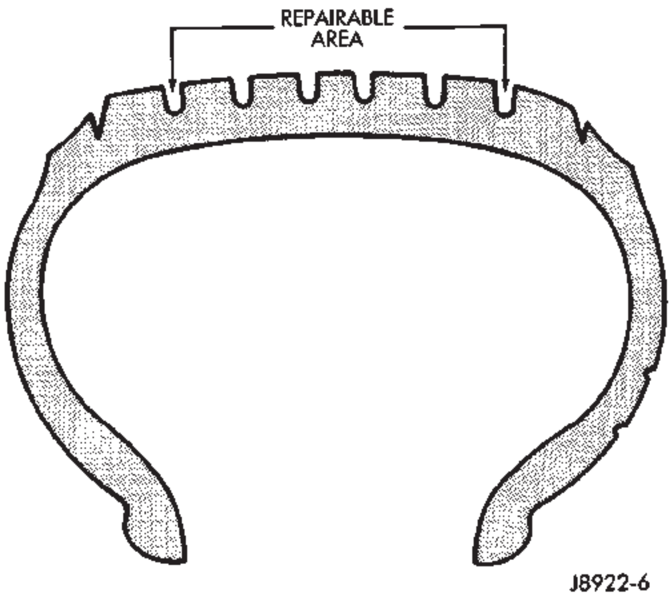


Fig. 11 Tire Repair Area

CLEANING AND INSPECTION

CLEANING TIRES

Remove protective coating on tires before delivery of vehicle. This coating may cause deterioration of tires.

To remove the protective coating applying warm water and let it soak for a few minutes. Then scrub the coating away with a soft bristle brush. Steam cleaning may also be used to remove the coating.

NOTE: DO NOT use gasoline, mineral oil, oil-based solvent or wire brush for cleaning.

WHEELS

INDEX

DESCRIPTION AND OPERATION

WHEEL

The rim size is on the vehicle safety certification label located on the drivers door shut face. The size of the rim is determined by the drivetrain package. Original equipment wheels/rims are designed for operation up to the specified maximum vehicle capacity.

All models use steel or cast aluminum wheels. Every wheel has raised sections between the rim flanges and rim drop well called safety humps (Fig. 1).

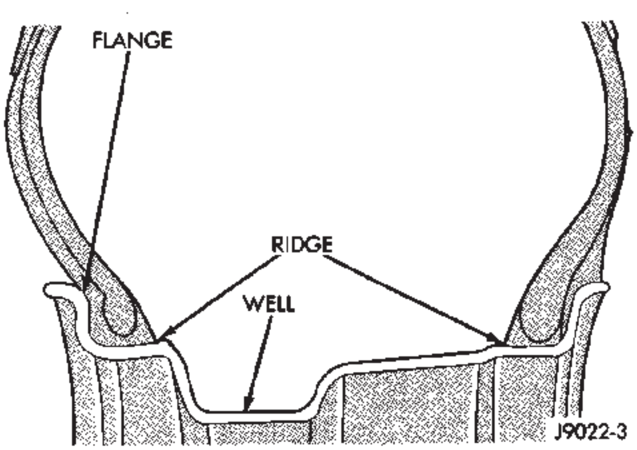


Fig. 1 Safety Rim

Initial inflation of the tire forces the bead over these raised sections. In case of rapid loss of air pressure, the raised sections help hold the tire on the wheel.

The wheel studs and nuts are designed for specific applications. All aluminum and some steel wheels have wheel stud nuts with an enlarged nose. This enlarged nose is necessary to ensure proper retention of the wheels. Do not use replacement studs or nuts with a different design or lesser quality.

DIAGNOSIS AND TESTING

WHEEL INSPECTION

Inspect wheels for:
- Excessive run out
- Dents or cracks
- Damaged wheel lug nut holes
- Air Leaks from any area or surface of the rim

NOTE: Do not attempt to repair a wheel by hammering, heating or welding.

If a wheel is damaged an original equipment replacement wheel should be used. When obtaining replacement wheels, they should be equivalent in load carrying capacity. The diameter, width, offset, pilot hole and bolt circle of the wheel should be the same as the original wheel.

WARNING: FAILURE TO USE EQUIVALENT REPLACEMENT WHEELS MAY ADVERSELY AFFECT THE SAFETY AND HANDLING OF THE VEHICLE. USED WHEELS ARE NOT RECOMMENDED. THE SERVICE HISTORY OF THE WHEEL MAY HAVE INCLUDED SEVERE TREATMENT OR VERY HIGH MILEAGE. THE RIM COULD FAIL WITHOUT WARNING.

TIRE AND WHEEL RUNOUT

Radial runout is the difference between the high and low points on the tire or wheel (Fig. 2).

Lateral runout is the **wobble** of the tire or wheel.

Radial runout of more than 1.5 mm (.060 inch) measured at the center line of the tread may cause the vehicle to shake.

Lateral runout of more than 2.0 mm (.080 inch) measured near the shoulder of the tire may cause the vehicle to shake.

Sometimes radial runout can be reduced. Relocate the wheel and tire assembly on the mounting studs (See Method 1). If this does not reduce runout to an

DIAGNOSIS AND TESTING (Continued)

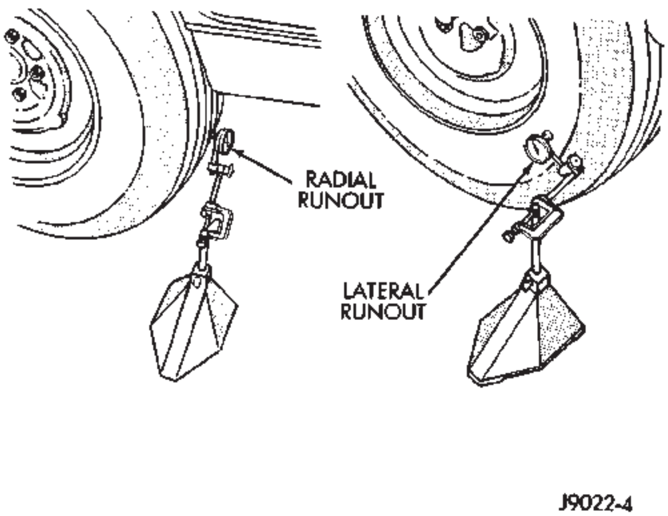


Fig. 2 Checking Tire/Wheel/Hub Runout

acceptable level, the tire can be rotated on the wheel. (See Method 2).

METHOD 1 (RELOCATE WHEEL ON HUB)

(1) Drive vehicle a short distance to eliminate tire flat spotting from a parked position.

(2) Check wheel bearings and adjust if adjustable or replace if necessary.

(3) Check the wheel mounting surface.

(4) Relocate wheel on the mounting, two studs over from the original position.

(5) Tighten wheel nuts until all are properly torqued, to eliminate brake distortion.

(6) Check radial runout. If still excessive, mark tire sidewall, wheel, and stud at point of maximum runout and proceed to Method 2.

METHOD 2 (RELOCATE TIRE ON WHEEL)

NOTE: Rotating the tire on wheel is particularly effective when there is runout in both tire and wheel.

(1) Remove tire from wheel and mount wheel on service dynamic balance machine.

(2) Check wheel radial runout (Fig. 3) and lateral runout (Fig. 4).

- STEEL WHEELS: Radial runout 0.040 in., Lateral runout 0.045 in.
- ALUMINUM WHEELS: Radial runout 0.030 in., Lateral runout 0.035 in.

(3) If point of greatest wheel lateral runout is near original chalk mark, remount tire 180 degrees. Recheck runout, Refer to match mounting procedure.

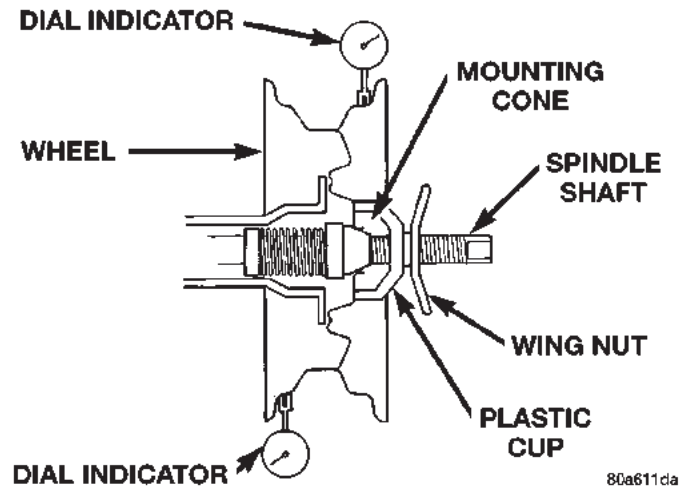


Fig. 3 Radial Runout

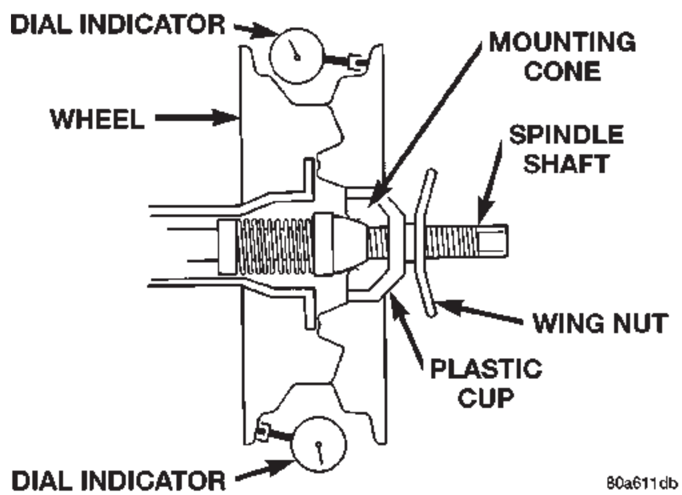


Fig. 4 Lateral Runout

SERVICE PROCEDURES

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.

To install the wheel, first position it properly on the mounting surface. All wheel nuts should then be tightened just snug. Gradually tighten them in sequence to the proper torque specification (Fig. 5).

SERVICE PROCEDURES (Continued)

WARNING: NEVER USE OIL OR GREASE ON STUDS OR NUTS. INSTALLING WHEELS WITHOUT GOOD METAL-TO-METAL CONTACT OR USING CHROME PLATED LUG NUTS WITH CHROME PLATED WHEELS COULD CAUSE LOOSENING OF WHEEL NUTS. THIS COULD AFFECT THE SAFETY AND HANDLING OF THE VEHICLE.

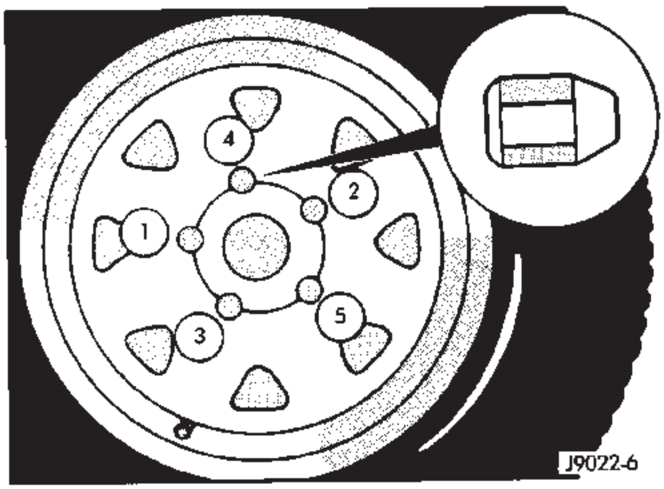


Fig. 5 Lug Nut Tightening Pattern

WHEEL REPLACEMENT

Wheels must be replaced if they have:

- Excessive runout
- Bent or dented
- Leak air through welds
- Have damaged bolt holes

Wheel repairs employing hammering, heating, or welding are not allowed.

Original equipment wheels are available through your dealer. Replacement wheels from any other source should be equivalent in:

- Load carrying capacity
- Diameter
- Width
- Offset
- Mounting configuration

Failure to use equivalent replacement wheels may affect the safety and handling of your vehicle. Replacement with **used** wheels is not recommended. Their service history may have included severe treatment.

TIRE AND WHEEL BALANCE

It is recommended that a two plane service dynamic balancer be used when a tire and wheel assembly require balancing. Refer to balancer operation instructions for proper cone mounting procedures. Typically use front cone mounting method for steel wheels. For aluminum wheel use back cone mounting method without cone spring.

NOTE: Static should be used only when a two plane balancer is not available.

NOTE: Cast aluminum wheels require coated balance weights and special alignment equipment.

Wheel balancing can be accomplished with either on or off vehicle equipment. When using on-vehicle balancing equipment, remove the opposite wheel/tire. Off-vehicle balancing is recommended.

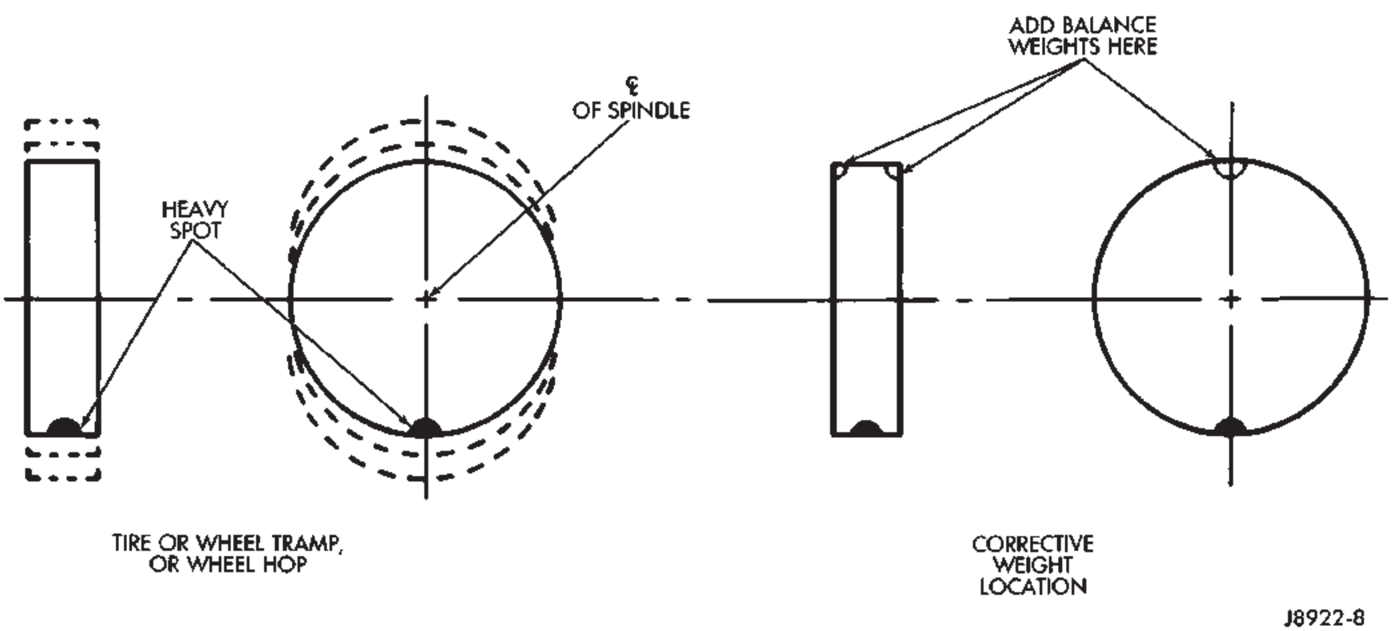


Fig. 6 Static Unbalance & Balance

SERVICE PROCEDURES (Continued)

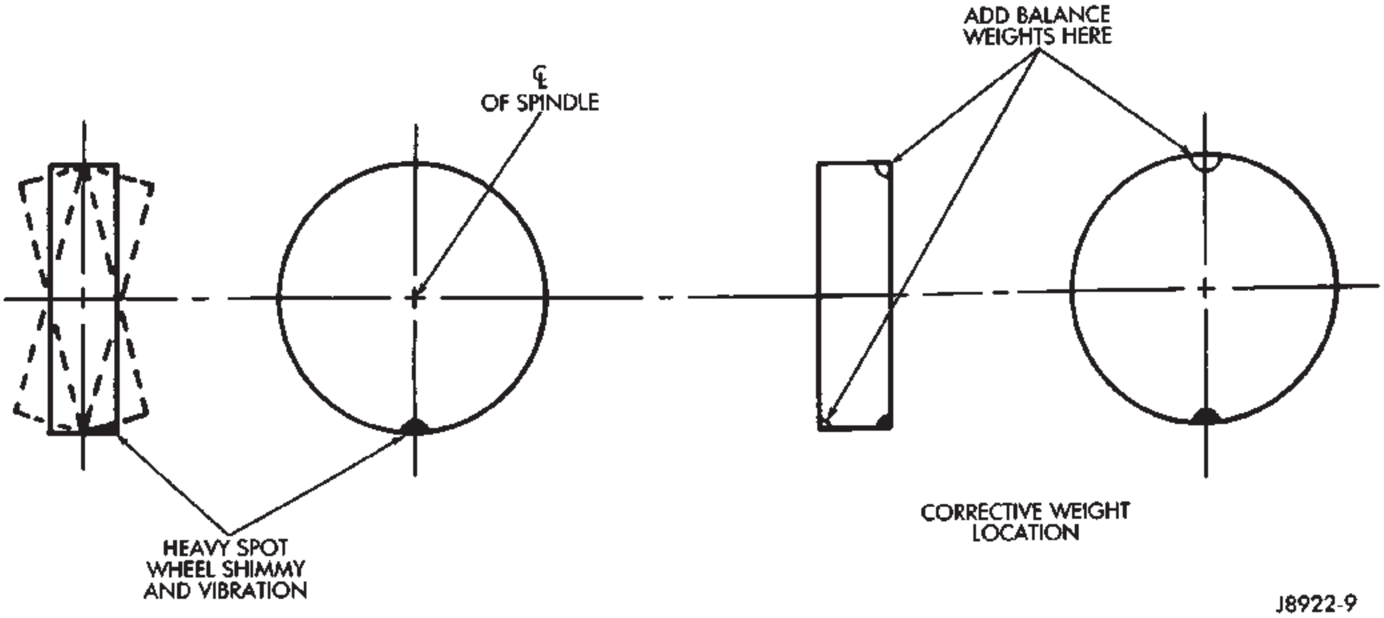


Fig. 7 Dynamic Unbalance & Balance

For static balancing, find location of heavy spot causing the imbalance. Counter balance wheel directly opposite the heavy spot. Determine weight required to counter balance the area of imbalance. Place half of this weight on the **inner** rim flange and the other half on the **outer** rim flange (Fig. 6).

For dynamic balancing, the balancing equipment is designed to locate the amount of weight to be applied to both the inner and outer rim flange (Fig. 7).

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Lug Nut	
1/2 X 20 with 60° Cone	115 to 156 N·m (85 to 115 ft. lbs.)

TRANSMISSION AND TRANSFER CASE

CONTENTS

AX5 MANUAL TRANSMISSION

INDEX

GENERAL INFORMATION

AX5 MANUAL TRANSMISSION

The AX5 is a five speed manual transmission with fifth gear being the overdrive range. An adapter housing is used to attach the transmission to the transfer case on 4-wheel drive applications. A standard style extension housing is used for the 2-wheel drive applications. The shift mechanism is integral to the transmission assembly and mounted in the shift tower portion of the adapter/extension housing (Fig. 1).

TRANSMISSION IDENTIFICATION

The AX5 identification code is on the bottom surface of the transmission case near the fill plug (Fig. 2). The first number is year of manufacture. The second and third numbers indicate month of manufacture. The next series of numbers is the transmission serial number.

GENERAL INFORMATION (Continued)

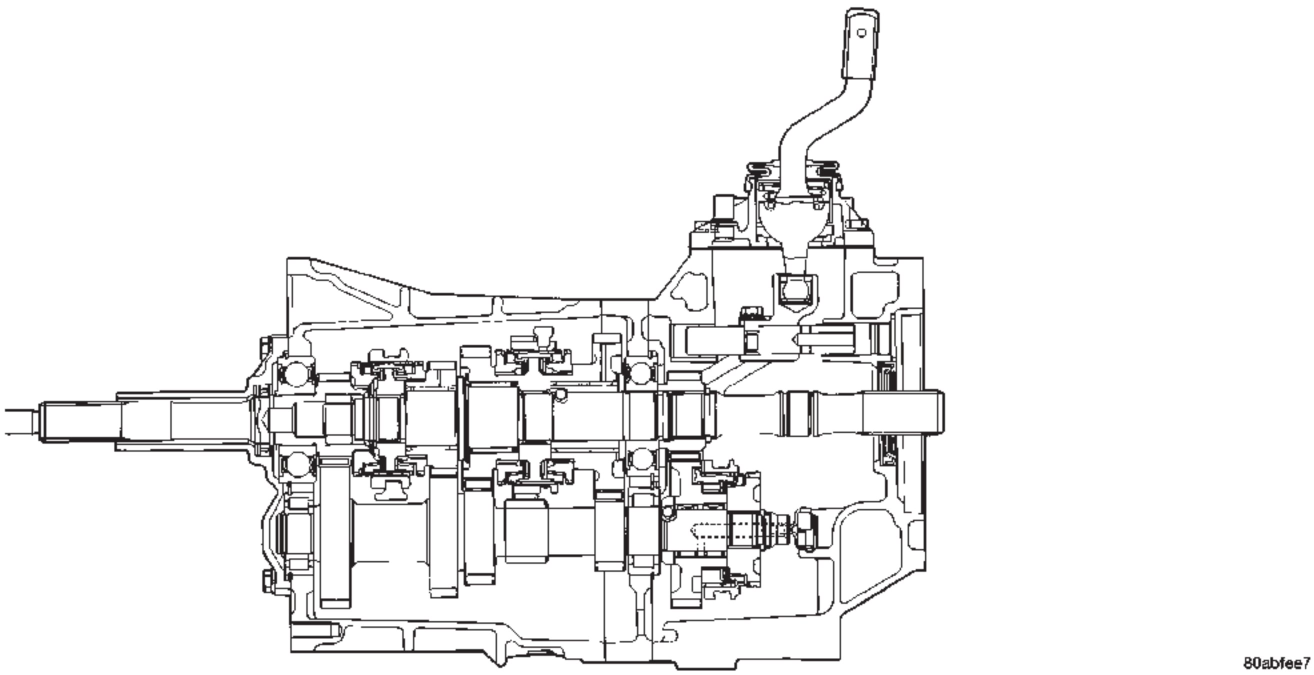


Fig. 1 AX5 Manual Transmission

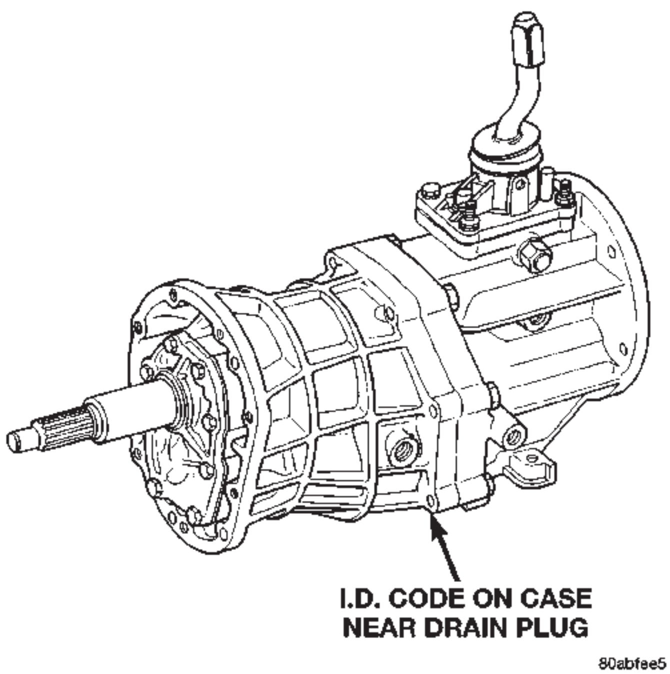


Fig. 2 Transmission Identification

GEAR RATIOS

Gear ratios for the AX5 manual transmission are as follows:

- First gear: 3.93:1
- Second gear: 2.33:1
- Third gear: 1.45:1
- Fourth gear: 1.00:1
- Fifth gear: 0.85:1
- Reverse gear: 4.74:1

RECOMMENDED LUBRICANT

Recommended lubricant for AX5 transmissions is Mopar® 75W–90, API Grade GL–3 gear lubricant, or equivalent.

Correct lubricant level is from the bottom edge, to no more than 6 mm (1/4 in.) below the bottom edge of the fill plug hole.

The fill plug is on the passenger side of the adapter housing (Fig. 3). The drain plug is on the bottom of the case.

Approximate dry fill lubricant capacity is:

- 3.3 liters (3.49 quarts) for 4–wheel drive applications.
- 3.5 liters (3.70 quarts) for 2–wheel drive applications.

TRANSMISSION ASSEMBLY INFORMATION

Lubricate the transmission components with Mopar® 75W–90, GL 3 gear lubricant during assembly. Use petroleum jelly to lubricate seal lips and/or hold parts in place during installation.

Refer to (Fig. 4) during assembly for AX5 gear assembly identification.

DIAGNOSIS AND TESTING

LOW LUBRICANT LEVEL

A low transmission lubricant level is generally the result of a leak, inadequate lubricant fill, or an incorrect lubricant level check.

Leaks can occur at the mating surfaces of the gear case, intermediate plate and adaptor or extension

DIAGNOSIS AND TESTING (Continued)

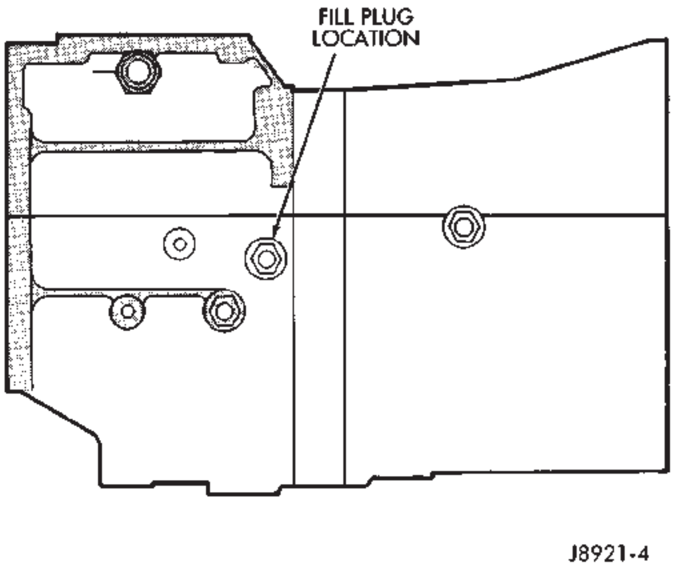


Fig. 3 Fill Plug Location

housing, or from the front/rear seals. A suspected leak could also be the result of an overfill condition.

Leaks at the rear of the extension or adapter housing will be from the housing oil seals. Leaks at component mating surfaces will probably be the result of inadequate sealer, gaps in the sealer, incorrect bolt tightening, or use of a non–recommended sealer.

A leak at the front of the transmission will be from either the front bearing retainer or retainer seal. Lubricant may be seen dripping from the clutch housing after extended operation. If the leak is severe, it may also contaminate the clutch disc causing the disc to slip, grab, and/or chatter.

A correct lubricant level check can only be made when the vehicle is level. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an underfill or overfill condition. Always check the lubricant level after any addition of fluid to avoid an incorrect lubricant level condition.

HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper, or contaminated lubricants. The consequence of using non–recommended lubricants is noise, excessive wear, internal bind, and hard shifting. Substantial lubricant leaks can result in gear, shift rail, synchro, and bearing damage. If a leak goes undetected for an extended period, the first indications of component damage are usually hard shifting and noise.

Component damage, incorrect clutch adjustment, or a damaged clutch pressure plate or disc are additional probable causes of increased shift effort. Incorrect

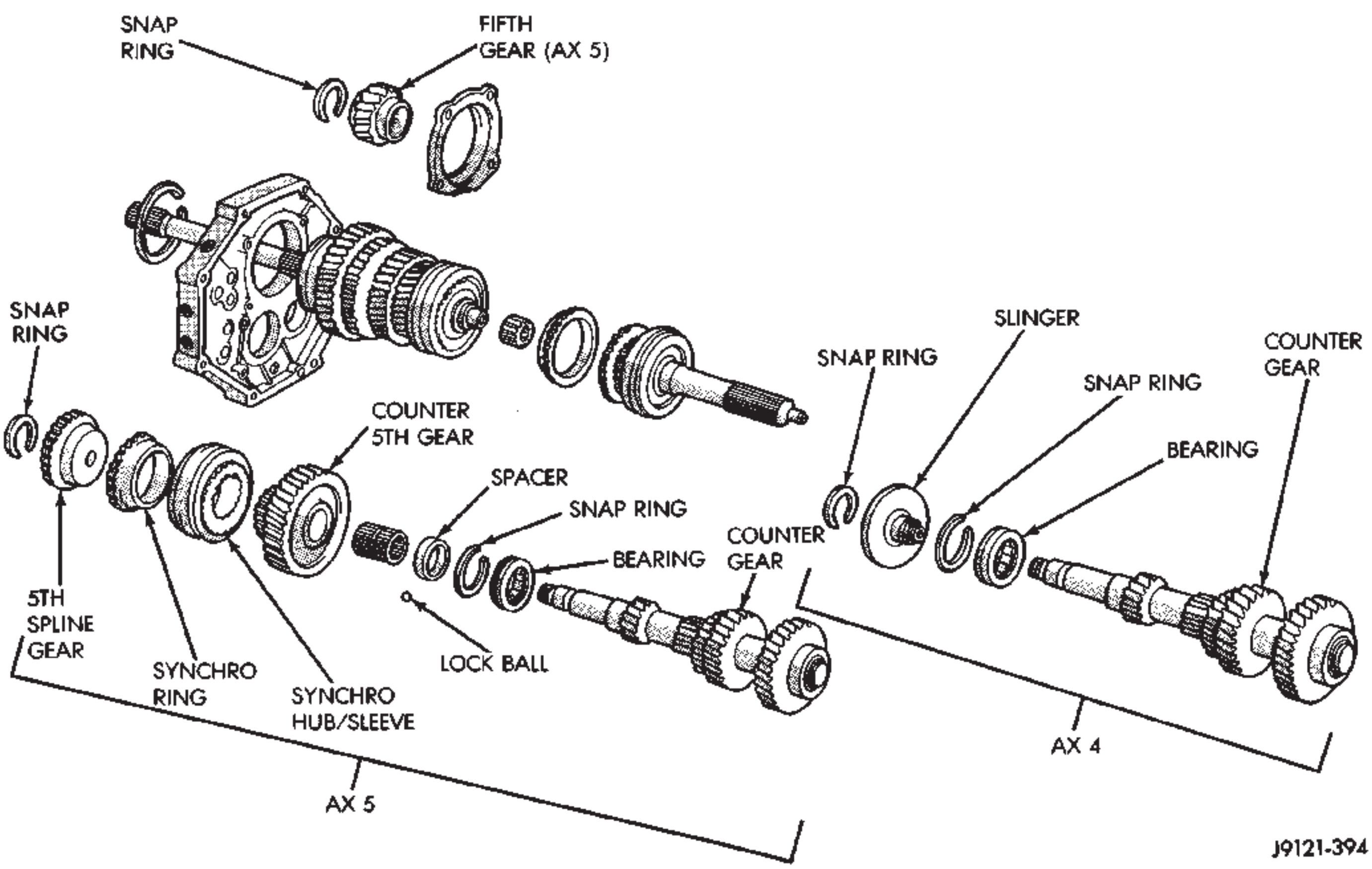


Fig. 4 Geartrain Components

DIAGNOSIS AND TESTING (Continued)

adjustment or a worn/damaged pressure plate or disc can cause incorrect release. If the clutch problem is advanced, gear clash during shifts can result. Worn or damaged synchro rings can cause gear clash when shifting into any forward gear. In some new or rebuilt transmissions, new synchro rings may tend to stick slightly causing hard or noisy shifts. In most cases, this condition will decline as the rings wear–in.

TRANSMISSION NOISE

Most manual transmissions make some noise during normal operation. Rotating gears generate a mild whine that is audible, but generally only at extreme speeds.

Severe, highly audible transmission noise is generally the initial indicator of a lubricant problem. Insufficient, improper, or contaminated lubricant will promote rapid wear of gears, synchros, shift rails, forks and bearings. The overheating caused by a lubricant problem, can also lead to gear breakage.

REMOVAL AND INSTALLATION

TRANSMISSION

REMOVAL

(1) Shift transmission into first or third gear.
(2) Raise and support vehicle on suitable safety stands.
(3) Disconnect necessary exhaust system components.
(4) Remove skid plate, if equipped.
(5) Remove slave cylinder from clutch housing.
(6) Mark rear propeller shaft and rear axle yokes for installation alignment (Fig. 5).

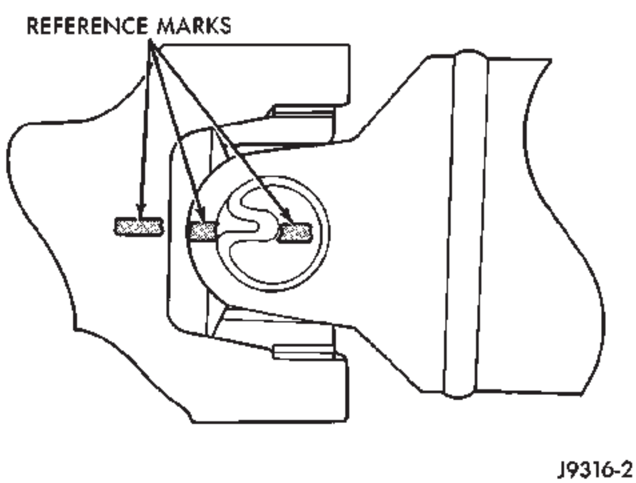


Fig. 5 Marking Propeller Shaft And Axle Yokes

(7) Mark front propeller shaft, axle, and transfer case yokes for installation alignment, if equipped.
(8) Remove propeller shaft(s).
(9) Unclip wire harnesses from transmission and transfer case, if equipped.
(10) Disconnect transfer case vent hose, if equipped.
(11) Disengage any wire connectors attached to transmission or transfer case, if equipped, components.
(12) Support transfer case, if equipped, with transmission jack.
(13) Secure transfer case, if equipped, to jack with safety chains.
(14) Disconnect transfer case shift linkage at transfer case, if equipped.
(15) Remove nuts attaching transfer case to transmission, if equipped.
(16) Remove transfer case, if equipped.
(17) Remove crankshaft position sensor (Fig. 6), (Fig. 7).

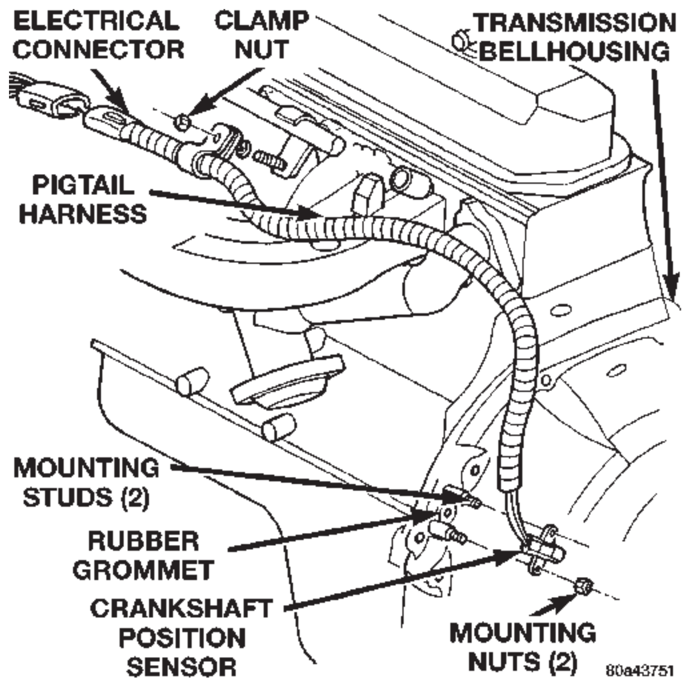


Fig. 6 Crankshaft Position Sensor—2.5L Engine

CAUTION: It is important that the crankshaft position sensor be removed prior to transmission removal. The sensor can easily be damaged if left in place during removal operations.

(18) Support engine with adjustable jack stand. Position wood block between jack and oil pan to avoid damaging pan.
(19) Support transmission with transmission jack.
(20) Secure transmission to jack with safety chains.
(21) Disconnect rear cushion and bracket from transmission.
(22) Remove rear crossmember.
(23) Disconnect transmission shift lever as follows:
(a) Lower transmission–transfer case assembly approximately 7–8 cm (3 in.) for access to shift lever.
(b) Reach up and around transmission case and unseat shift lever dust boot from transmission shift tower (Fig. 8). Move boot upward on shift lever for access to retainer that secures lever in shift tower.

REMOVAL AND INSTALLATION (Continued)

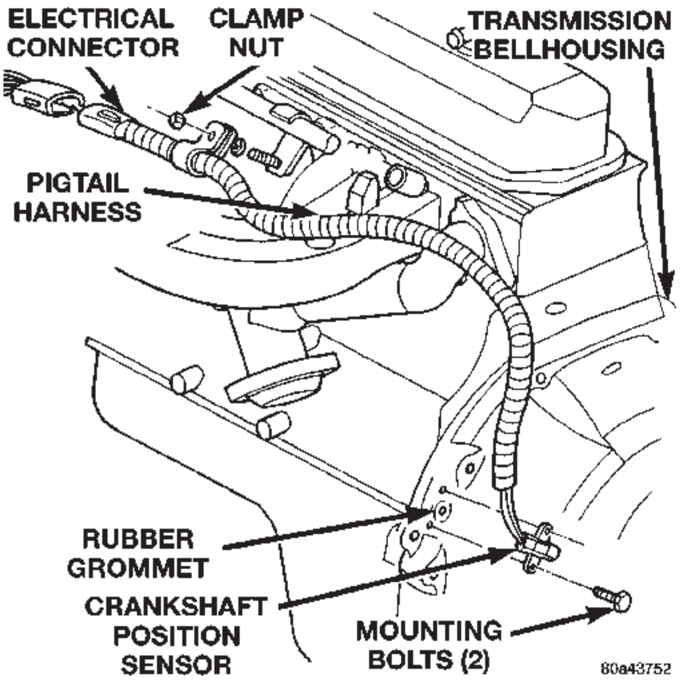


Fig. 7 Crankshaft Position Sensor —4.0L Engine

(c) Reach up and around transmission case and press shift lever retainer downward with finger pressure. Turn retainer counterclockwise to release it.

(d) Lift lever and retainer out of shift tower (Fig. 8). Do not remove the shift lever from the floor console shifter boots. Leave the lever in place for transmission installation.

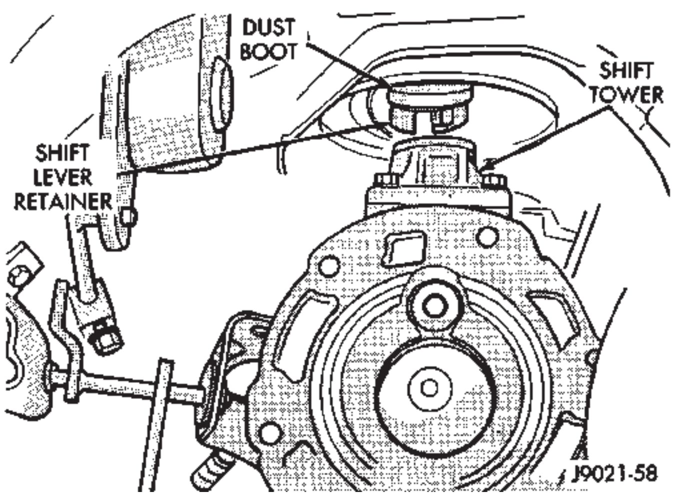


Fig. 8 Removing/Installing Shift Lever

(24) Remove clutch housing brace rod.

(25) Remove clutch housing-to-engine bolts.

(26) Pull transmission jack rearward until input shaft clears clutch. Then slide transmission out from under vehicle.

(27) Remove clutch release bearing, release fork, and retainer clip.

(28) Remove clutch housing from transmission (Fig. 9).

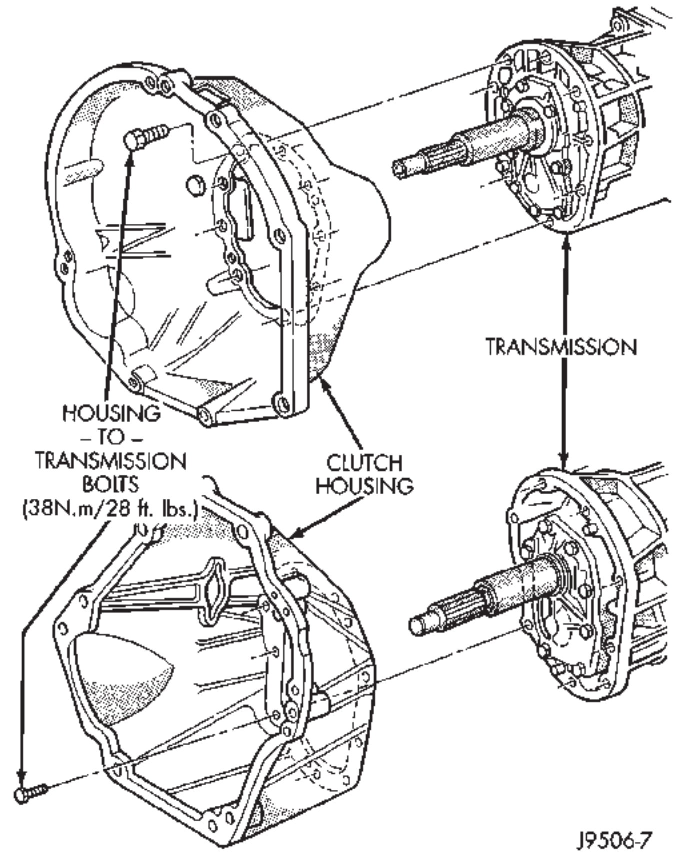


Fig. 9 Clutch Housing

INSTALLATION

(1) Install clutch housing on transmission. Tighten housing bolts to 37 N·m (27 ft. lbs.) torque.

(2) Lubricate contact surfaces of release fork pivot ball stud and release fork with high temp grease.

(3) Install release bearing, fork, and retainer clip.

(4) Position and secure transmission on transmission jack.

(5) Lightly lubricate pilot bearing and transmission input shaft splines with Mopar® high temp grease.

(6) Raise transmission and align transmission input shaft and clutch disc splines. Then slide transmission into place.

(7) Install and tighten clutch housing-to-engine bolts to 38 N·m (28 ft. lbs.) torque (Fig. 9). **Be sure the housing is properly seated on engine block before tightening bolts.**

(8) Install clutch housing brace rod.

(9) Lower transmission approximately 7–8 cm (3 in.) for access to shift tower. Be sure transmission is in first or third gear.

(10) Reach up and around transmission and insert shift lever in shift tower. Press lever retainer down-

REMOVAL AND INSTALLATION (Continued)

ward and turn it clockwise to lock it in place. Then install lever dust boot on shift tower.

(11) Install rear crossmember. Tighten crossmember-to-frame bolts to 41 N·m (31 ft. lbs.) torque.

(12) Install fasteners to hold rear cushion and bracket to transmission. Then tighten transmission-to-rear support bolts/nuts to 45 N·m (33 ft. lbs.) torque.

(13) Remove support stands from engine and transmission.

(14) Install and connect crankshaft position sensor.

(15) Position transfer case on transmission jack, if equipped.

(16) Secure transfer case to jack with safety chains, if equipped.

(17) Raise transfer case, if equipped, and align transfer case input shaft to the transmission output shaft.

(18) Slide transfer case forward until case is seated on transmission, if necessary.

(19) Install nuts to attach transfer case to transmission, if equipped. Tighten transfer case-to-transmission nuts to 35 N·m (26 ft. lbs.) torque.

(20) Connect transfer case shift linkage at transfer case, if equipped.

(21) Connect transfer case vent hose, if equipped.

(22) Secure wire harnesses in clips/tie straps on transmission and transfer case, if equipped.

(23) Engage wire connectors attached to all necessary transmission or transfer case, if equipped, components.

(24) Install rear propeller shaft slip yoke to transmission or transfer case, if equipped, output shaft.

(25) Align marks on rear propeller shaft and rear axle yokes (Fig. 10).

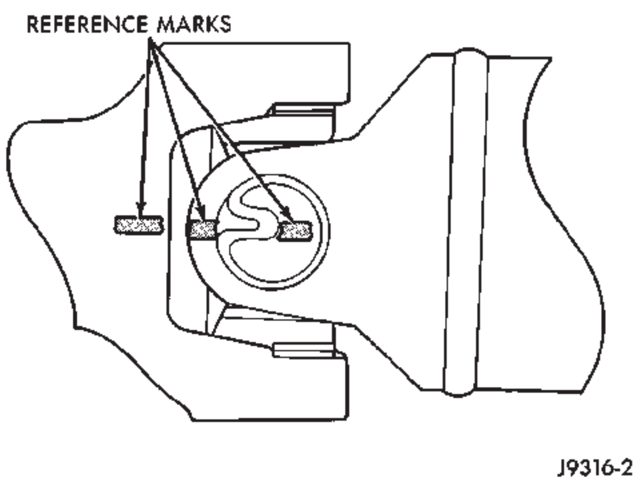


Fig. 10 Align Propeller Shaft And Rear Axle Yokes Alignment Marks

(26) Install and tighten propeller shaft U–joint clamp bolts to 19 N·m (170 in. lbs.) torque.

(27) Align marks on front propeller shaft, axle, and transfer case yokes, if equipped.

(28) Install and tighten propeller shaft U–joint clamp bolts to 19 N·m (170 in. lbs.) torque.

(29) Install slave cylinder in clutch housing.

(30) Install skid plate, if equipped. Tighten bolts to 42 N·m (31 ft. lbs.) torque. Tighten stud nuts to 17 N·m (150 in. lbs.) torque.

(31) Fill transmission and transfer case, if equipped, with recommended lubricants. Refer to the Lubricant Recommendation sections of the appropriate component for correct fluid.

(32) Lower vehicle.

FRONT BEARING RETAINER SEAL

REMOVAL

(1) Remove release bearing and lever from the transmission.

(2) Remove the bolts holding the front bearing retainer to the transmission case.

(3) Remove the front bearing retainer from the transmission case.

(4) Using a suitable pry tool, remove the front bearing retainer seal.

INSTALLATION

(1) Using Tool Handle C-4171 and Seal Installer 8211, install new seal in to the front bearing retainer (Fig. 11).

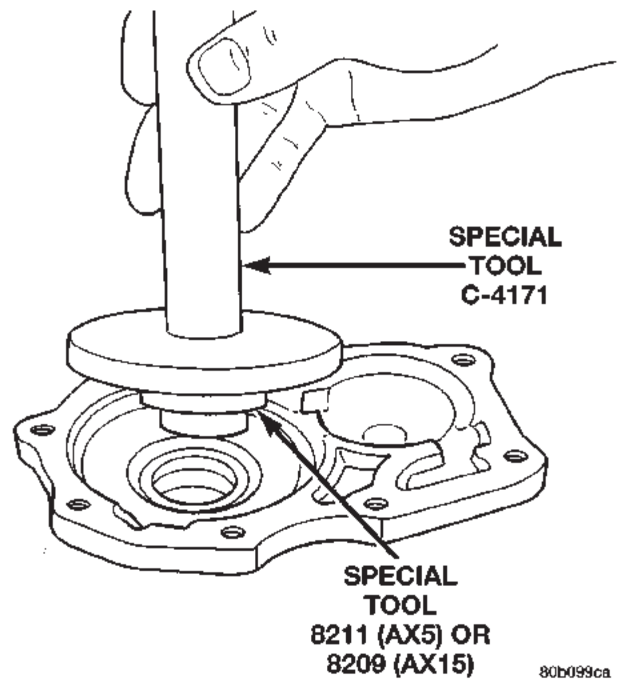


Fig. 11 Install Front Bearing Retainer Seal

(2) Remove any residual gasket material from the sealing surfaces of the bearing retainer and the transmission case.

(3) Install new front bearing retainer gasket to the front bearing retainer.

(4) Install the front bearing retainer onto the transmission case.

(5) Install the bolts to hold the bearing retainer onto the transmission case.

REMOVAL AND INSTALLATION (Continued)

(6) Tighten the bolts to 17 N·m (12 ft. lbs.).

(7) Install release bearing and lever onto the transmission.

EXTENSION HOUSING SEAL

REMOVAL

(1) Raise and support vehicle.

(2) Remove propeller shaft. Refer to Group 3, Differential and Driveline, for proper procedures.

(3) Using a suitable seal puller or screw with a slide hammer, remove the extension housing seal (Fig. 12).

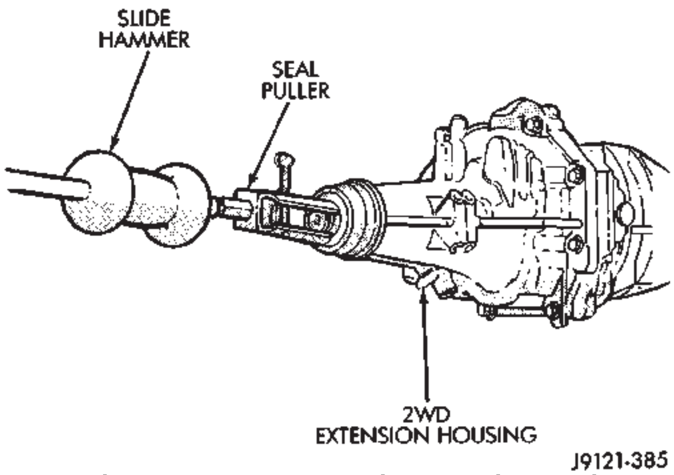


Fig. 12 Remove Extension Housing Seal

INSTALLATION

(1) Clean seal bore of extension housing of any residual sealer material from original seal.

(2) Using Tool Handle C-4171 and Seal Installer 8212, install new extension housing seal so that the seal is located 0 ± 0.5 mm (0 ± 0.02 in.) to the face of the extension housing (Fig. 13).

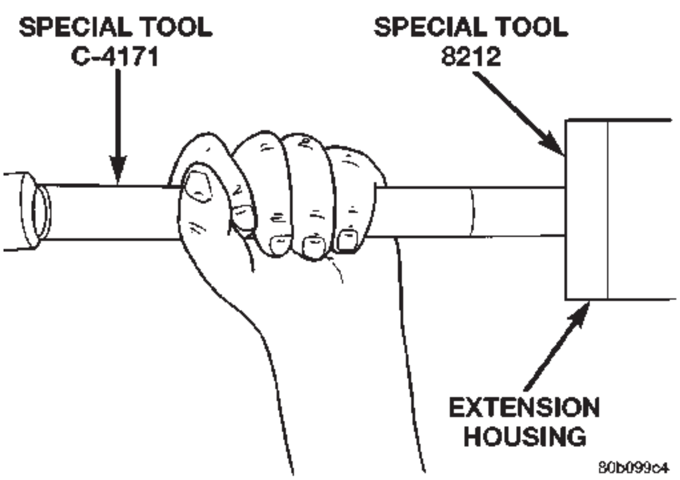


Fig. 13 Install Extension Housing Seal

(3) Install propeller shaft. Refer to Group 3, Differential and Driveline, for proper procedures.

(4) Check and add fluid to transmission as necessary. Refer to the Recommended Lubricant section for proper fluid requirements.

(5) Lower vehicle.

ADAPTER HOUSING SEAL

REMOVAL

(1) Hoist and support vehicle.

(2) Remove transfer case.

(3) Using a suitable pry tool, or a slide hammer mounted screw, remove the adapter housing seal (Fig. 14).

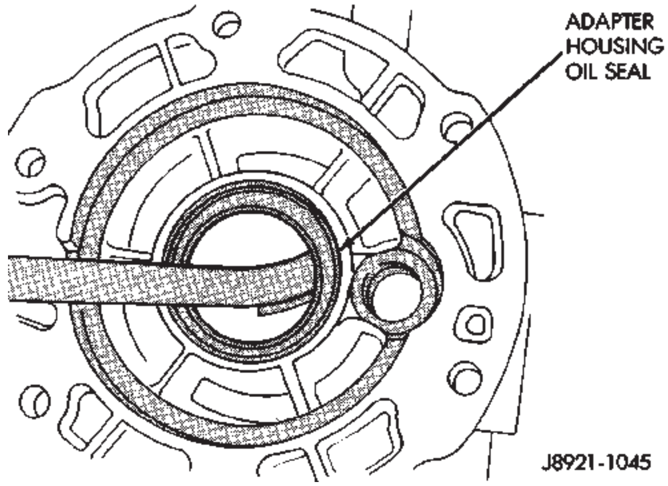


Fig. 14 Remove Adapter Housing Seal

INSTALLATION

(1) Clean seal bore of adapter housing of any residual sealer material from original seal.

(2) Using Tool Handle C-4171 and Seal Installer 8208, install new seal so that the seal is located 0 ± 0.2 mm (0 ± 0.008 in.) to the seal bore face of adapter housing (Fig. 15).

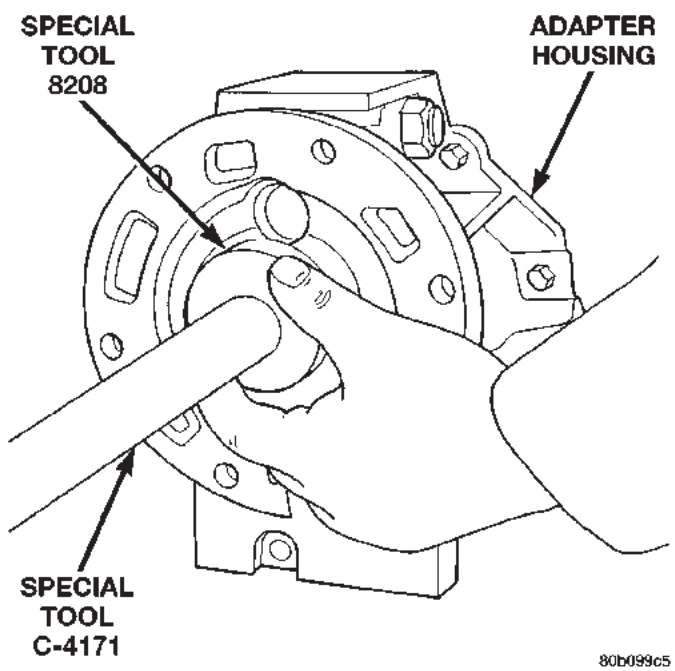


Fig. 15 Install Adapter Housing Seal

REMOVAL AND INSTALLATION (Continued)

(3) Install transfer case.

(4) Check and add fluid to transmission as necessary. Refer to the Recommended Lubricant section for proper fluid requirements.

(5) Lower vehicle.

DISASSEMBLY AND ASSEMBLY

ADAPTER/EXTENSION HOUSING AND FRONT BEARING RETAINER

DISASSEMBLY

(1) Drain transmission lubricant, if necessary.

(2) Remove release bearing and lever.

(3) Remove clutch housing bolts and remove housing (Fig. 18).

(4) Remove vehicle speed sensor and speedometer adapter, if necessary.

(5) Remove bolts holding shift tower to transmission case.

(6) Remove shift tower from transmission case (Fig. 16).

(7) Remove shift tower gasket from shift tower or transmission case (Fig. 17).

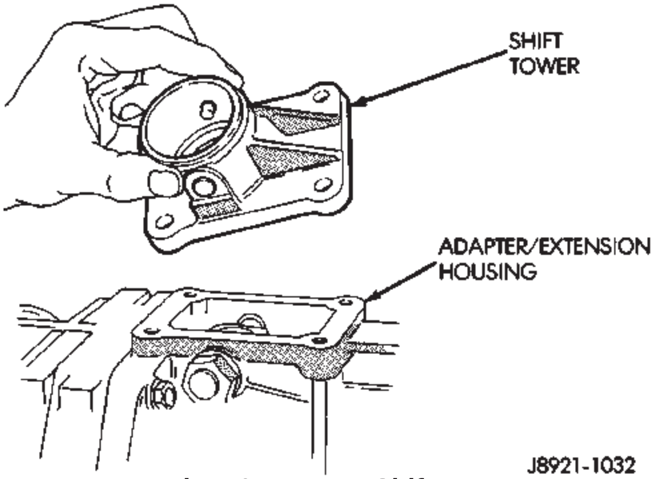


Fig. 16 Remove Shift Tower

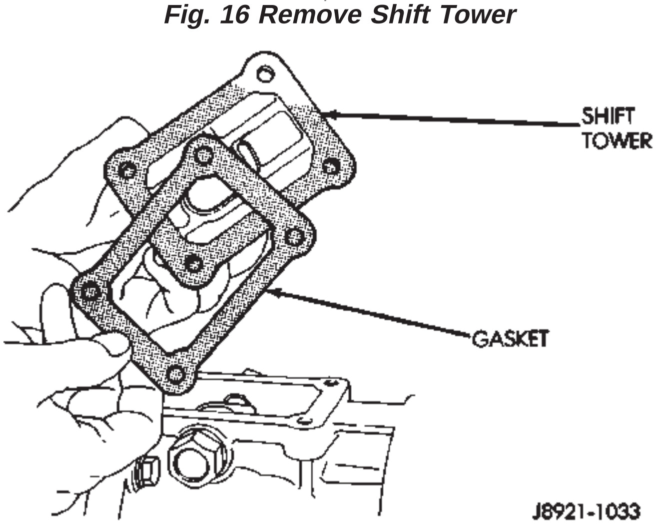


Fig. 17 Remove Shift Tower Gasket

(8) Remove detent ball plug (Fig. 19).

(9) Remove detent spring and ball with pencil magnet (Fig. 20), (Fig. 21).

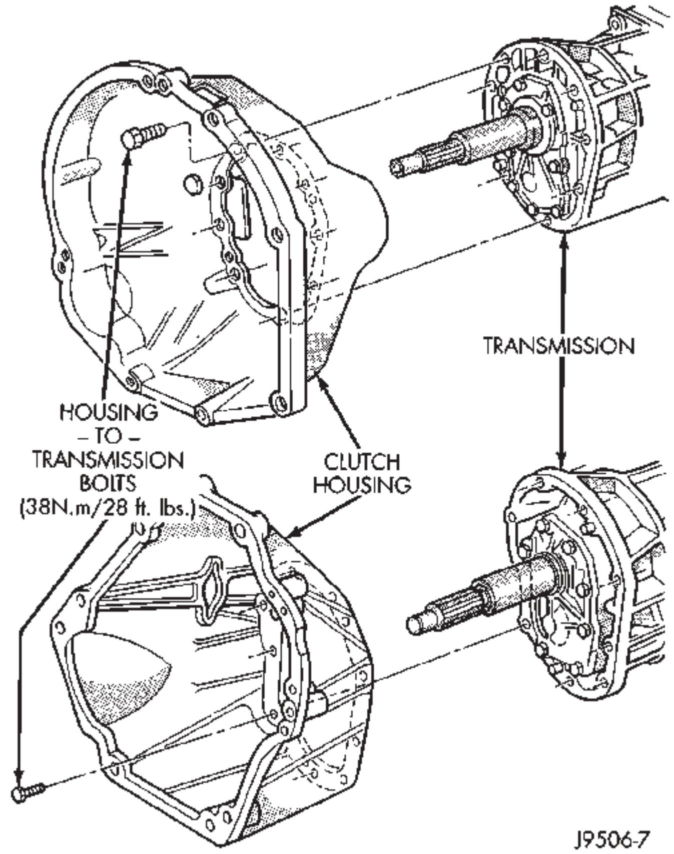


Fig. 18 Clutch Housing

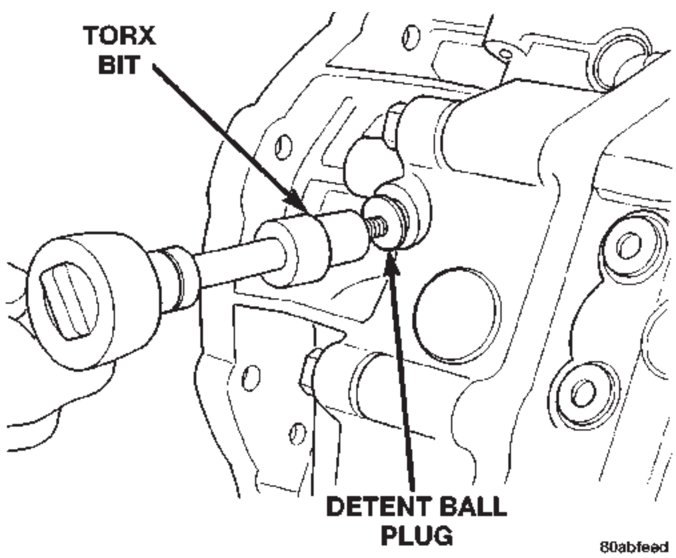


Fig. 19 Remove Detent Ball Plug

(10) Remove shift arm retainer bolt (Fig. 22).

(11) Remove shift arm restrictor pins (Fig. 23).

(12) Remove shift lever shaft plug (Fig. 24).

(13) Remove shifter shaft with large magnet (Fig. 25).

(14) Remove the shift arm from the adapter housing.

DISASSEMBLY AND ASSEMBLY (Continued)

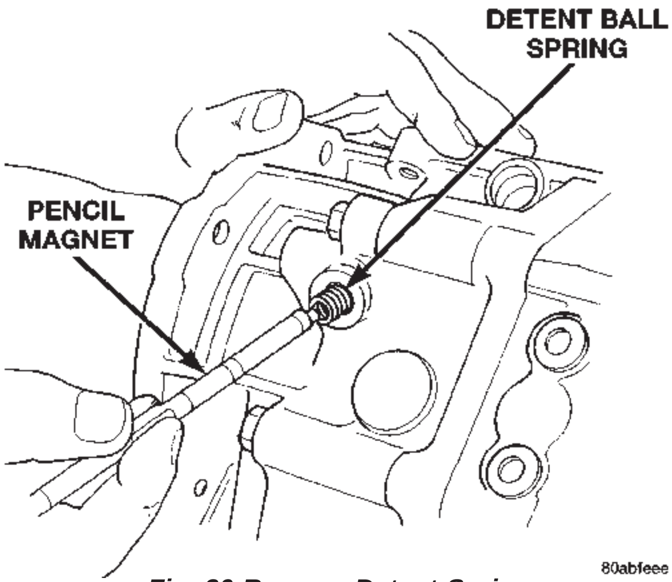


Fig. 20 Remove Detent Spring

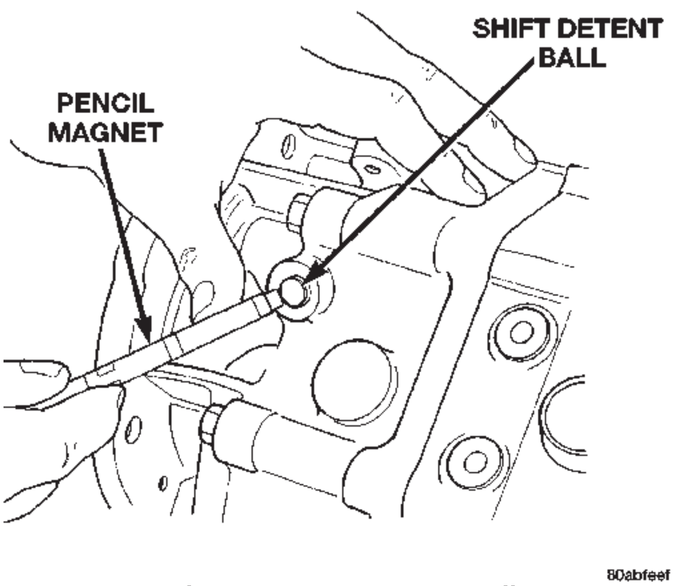


Fig. 21 Remove Detent Ball

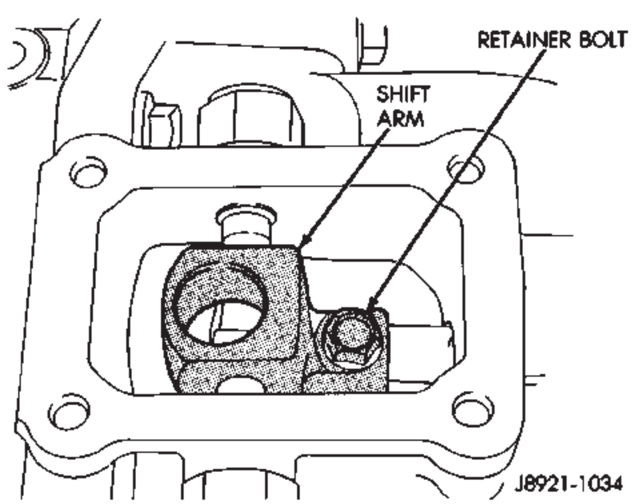


Fig. 22 Shift Arm Retainer Bolt Removal

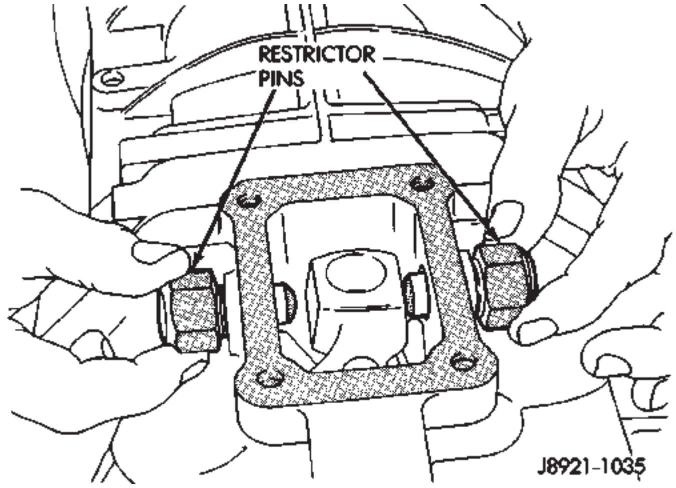


Fig. 23 Shift Arm Rstrictor Pins

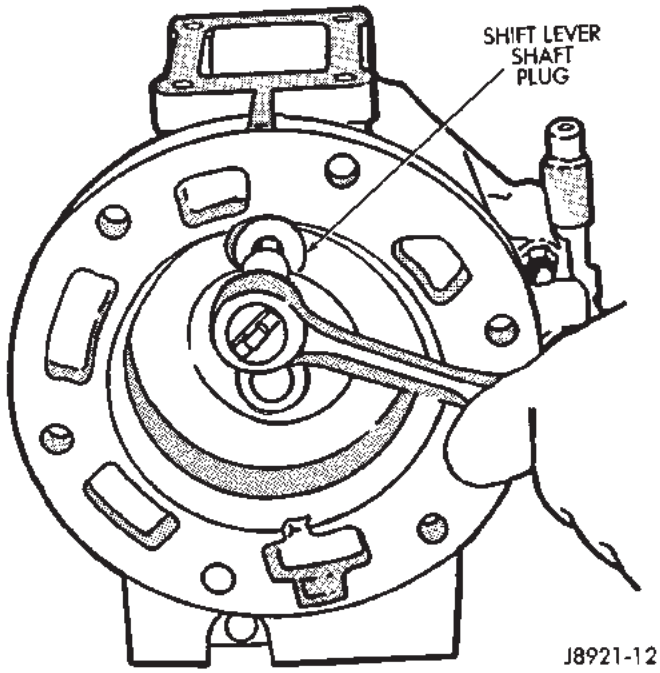


Fig. 24 Removing Shift Lever Shaft Plug

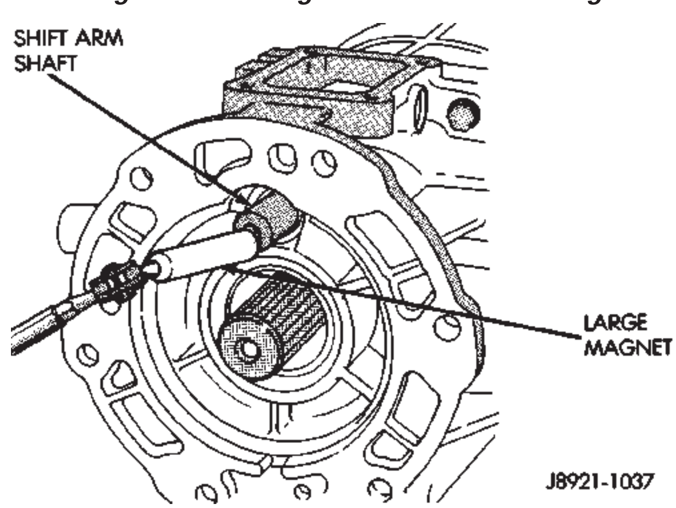


Fig. 25 Remove Shifter Shaft

DISASSEMBLY AND ASSEMBLY (Continued)

(15) Remove adapter/extension housing bolts.

(16) Loosen adapter/extension housing by tapping it loose with plastic mallet (Fig. 26).

(17) Remove adapter/extension housing (Fig. 27).

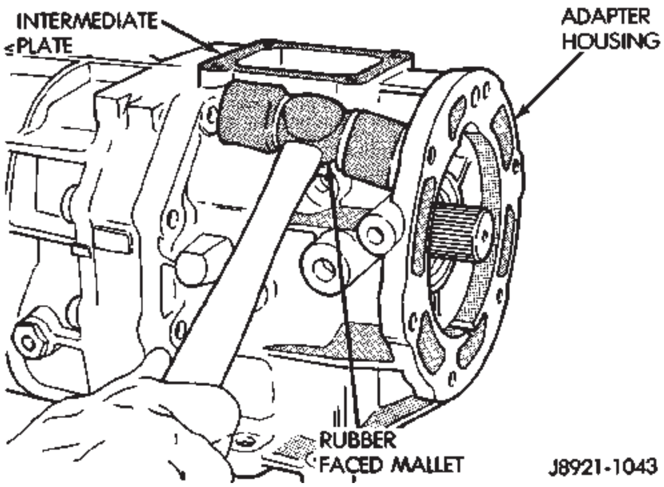


Fig. 26 Loosen Adapter/Extension Housing

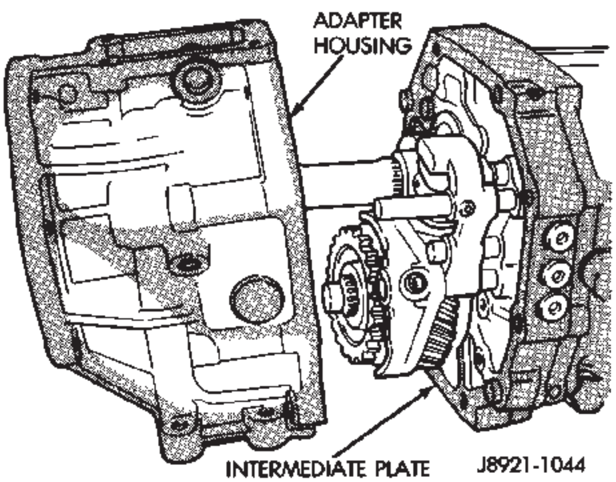


Fig. 27 Remove Adapter/Extension Housing–Typical

(18) On 4x2 transmissions;

(a) Remove speedometer gear retaining snap-ring from output shaft.

(b) Remove speedometer gear from output shaft and remove speedometer gear lock ball from output shaft.

(c) Remove speedometer drive gear locating snap-ring (Fig. 28).

(19) Remove the bolts holding the front bearing retainer to the transmission case.

(20) Remove the bearing retainer from transmission case (Fig. 29).

(21) Remove input shaft bearing snap-ring (Fig. 30).

(22) Remove countershaft front bearing snap-ring.

(23) Separate intermediate plate and transmission case by tapping them loose with plastic mallet (Fig. 31).

(24) Separate the intermediate plate from the transmission case (Fig. 32).

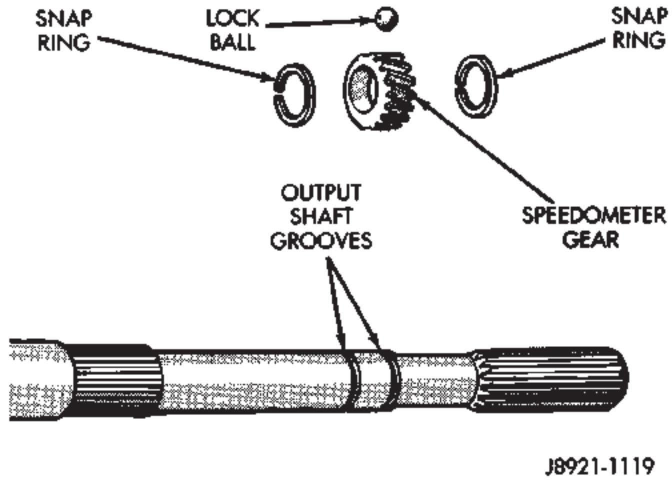


Fig. 28 Speedometer Drive Gear Assembly

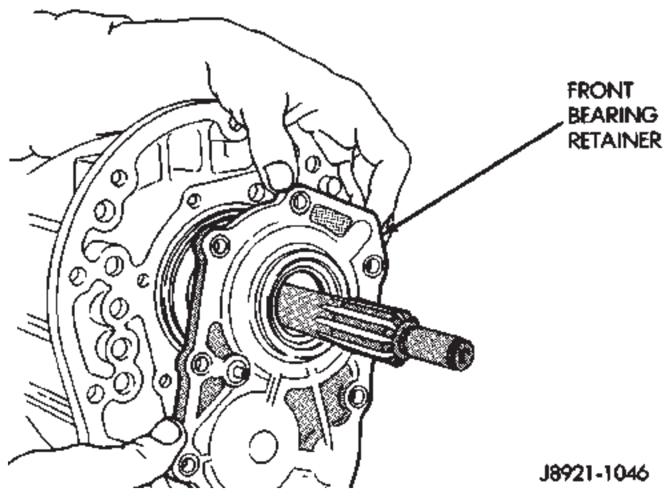


Fig. 29 Remove Front Bearing Retainer

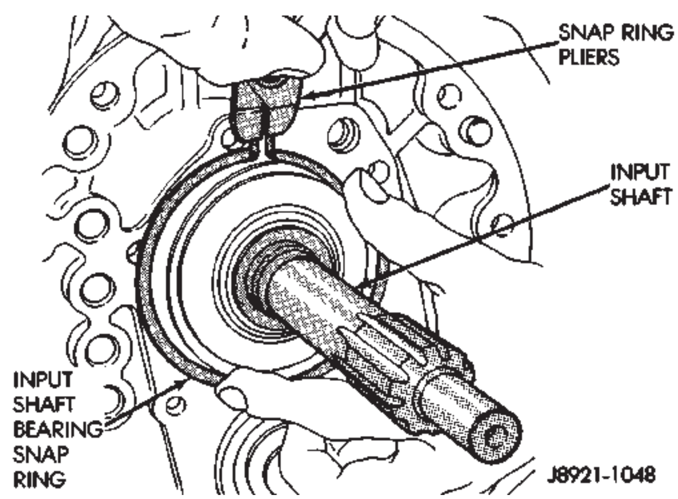


Fig. 30 Remove Input Shaft Bearing Snap-ring

ASSEMBLY

(1) Remove any residual sealer from transmission case, intermediate plate, and adapter/extension housing.

(2) Apply a 1/8 to 3/16 inch wide bead of Threebond® Liquid Gasket TB1281, P/N 83504038, as shown, making sure to keep sealer bead to inside of bolt holes (Fig. 33).

DISASSEMBLY AND ASSEMBLY (Continued)

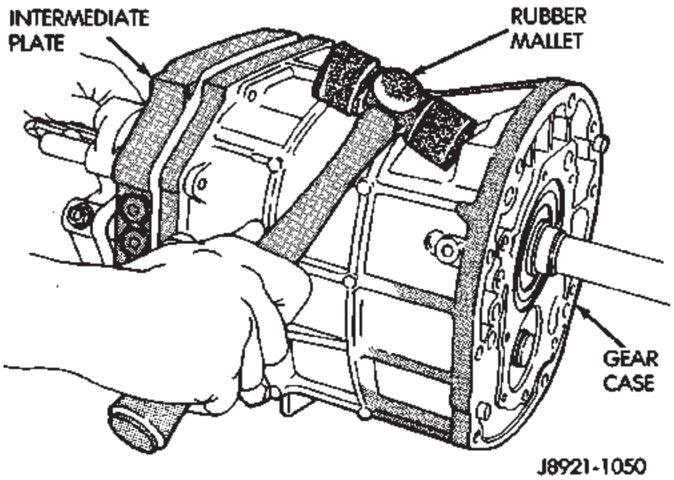


Fig. 31 Separate Intermediate Plate and Transmission Case

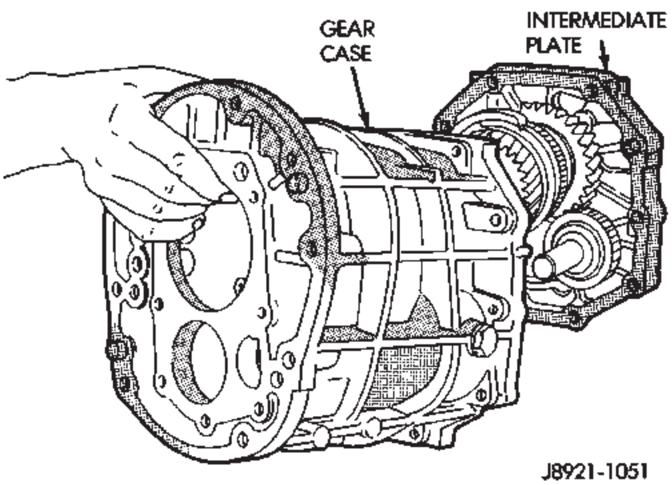


Fig. 32 Remove Intermediate Plate from Transmission Case

(3) Align geartrain and shift rails with mating holes in transmission case and install transmission case to the intermediate plate (Fig. 34). Verify that the transmission case is seated on the intermediate plate locating pins.

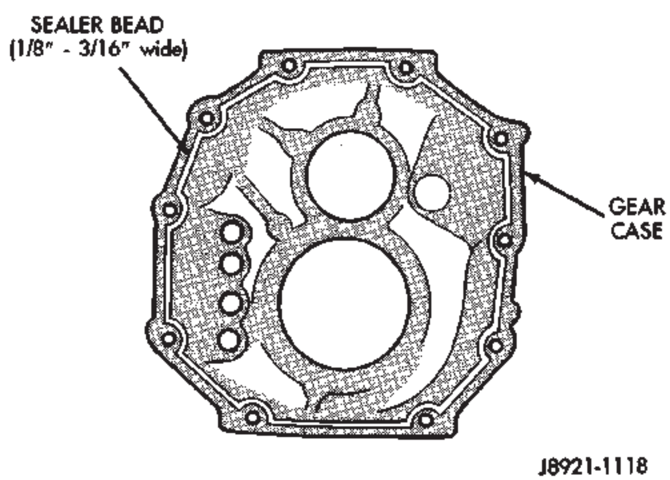


Fig. 33 Apply Sealer to Transmission Gear Case

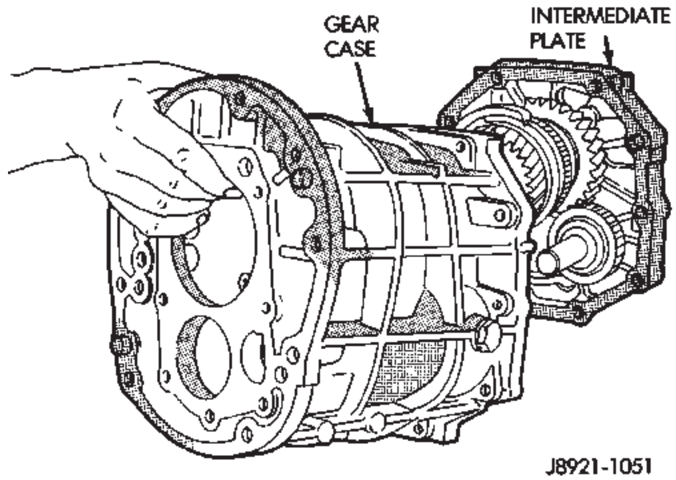


Fig. 34 Install Transmission Gear Case to the Intermediate Plate

(4) Install new front bearing snap rings (Fig. 35).

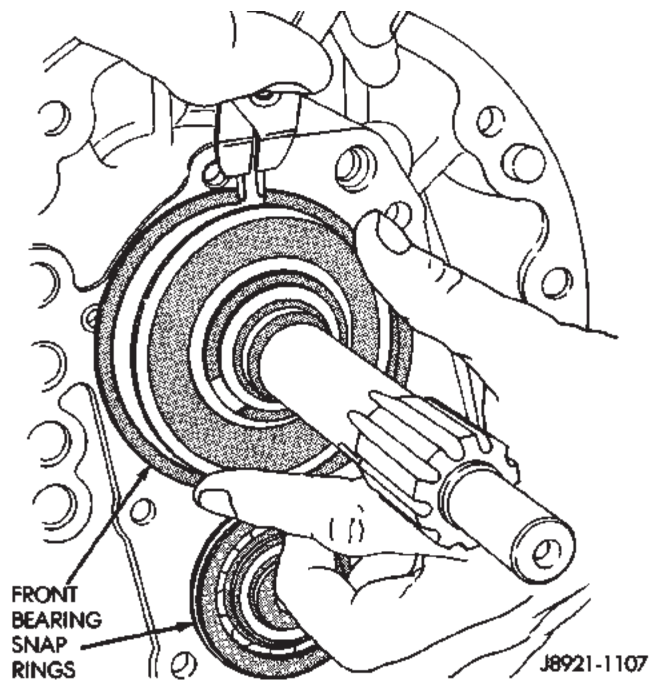


Fig. 35 Install Front Bearing Snap-rings

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Install front bearing retainer gasket to front bearing retainer.

(6) Install the front bearing retainer (Fig. 36) and tighten bolts to 17 N·m (12 ft. lbs.).

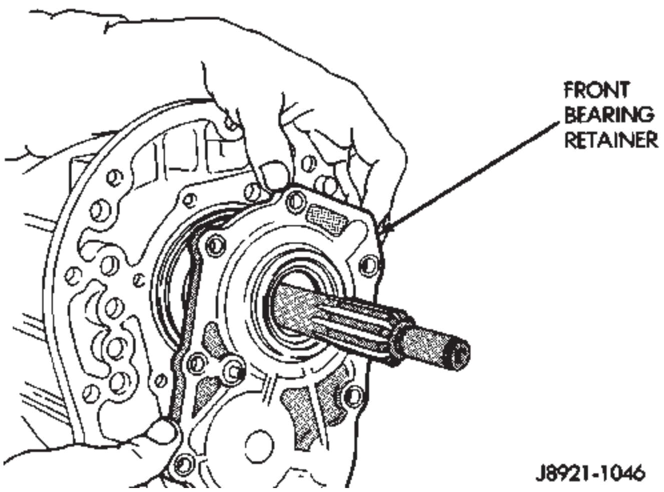


Fig. 36 Install Front Bearing Retainer

(7) On 4x2 transmissions;

(a) Install speedometer drive gear locating snap-ring (Fig. 37).

(b) Install speedometer gear lock ball in output shaft and install speedometer gear onto output shaft.

(c) Install speedometer gear retaining snap-ring onto output shaft.

(8) Apply a 1/8 to 3/16 inch wide bead of Threebond® Liquid Gasket TB1281, P/N 83504038, to sealing surface of adapter/extension housing, making sure to keep sealer bead to inside of bolt holes.

(9) Install adapter or extension housing on intermediate plate (Fig. 38). Tighten housing bolts to 34 N·m (25 ft. lbs.) torque.

(10) Position shift arm in shifter tower opening of adapter or extension housing (Fig. 39). Be sure that the shifter arm is engaged into the shift rails.

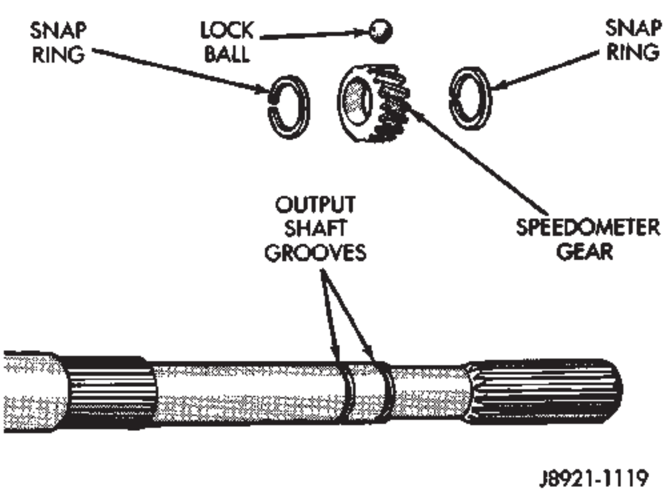


Fig. 37 Speedometer Drive Gear Assembly

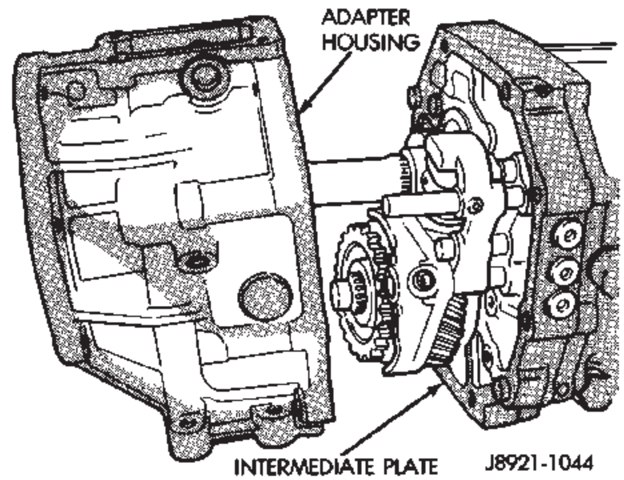


Fig. 38 Install Adapter/Extension Housing–Typical

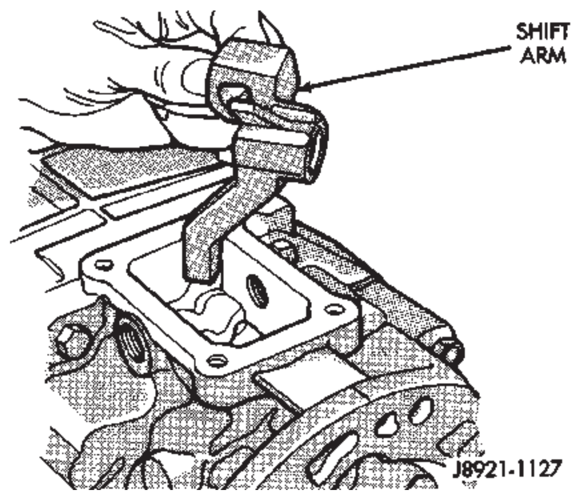


Fig. 39 Position Shift Arm in Adapter or Extension Housing

(11) Start shifter arm shaft in hole in back of adapter or extension housing. Align shift arm and shifter arm shaft and insert shifter arm shaft through the shifter arm and into the forward portion of the adapter or extension housing (Fig. 40).

(12) Rotate the shifter arm shaft until the hole in the shift arm is aligned with the hole in the shaft.

(13) Install the shift arm retainer bolt and tighten to 38 N·m (28 ft. lbs.) (Fig. 41).

DISASSEMBLY AND ASSEMBLY (Continued)

(14) Install and tighten shifter arm shaft plug to 18 N·m (13 ft. lbs.) torque (Fig. 42).

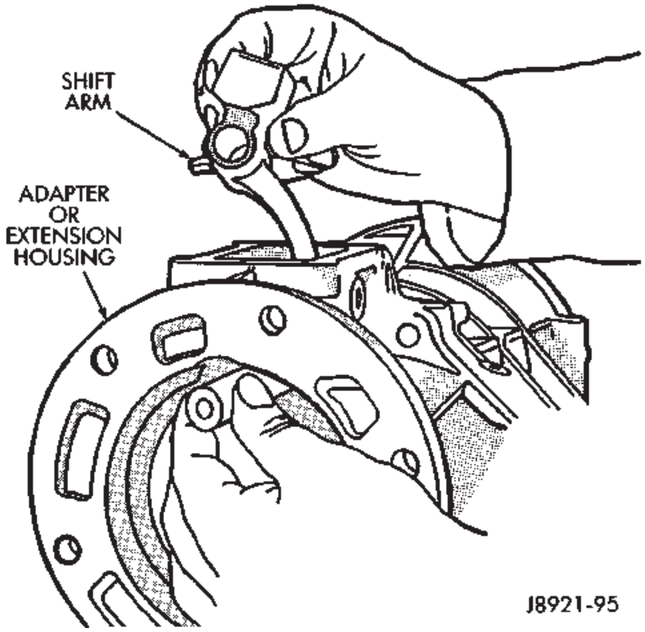


Fig. 40 Install Shifter Arm Shaft

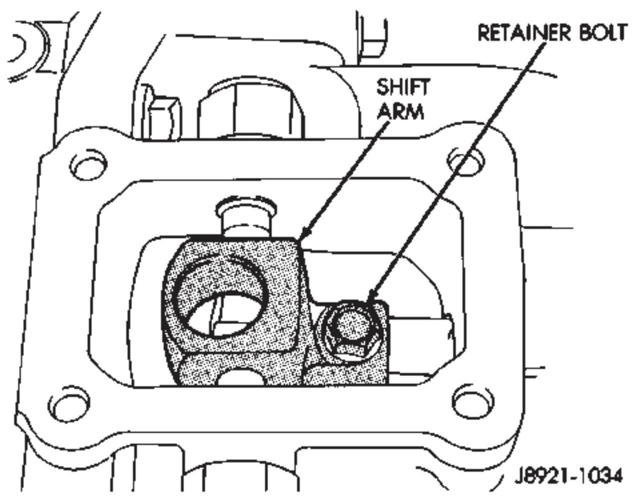


Fig. 41 Install Shift Arm Retainer Bolt

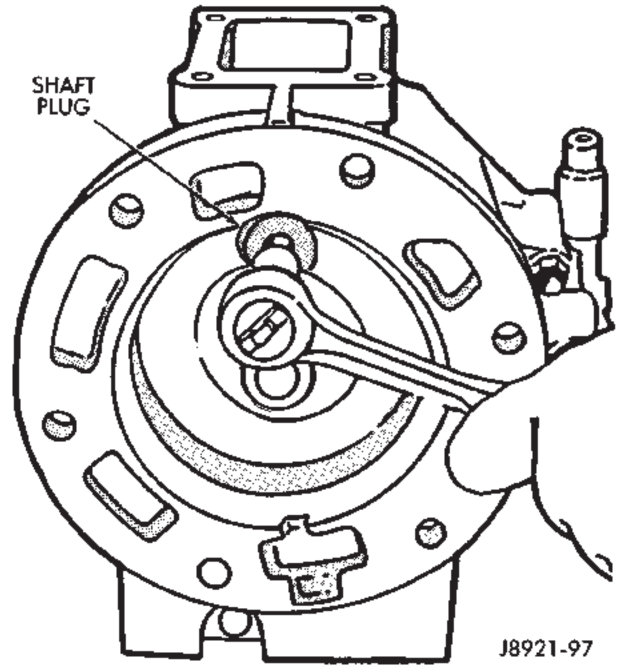


Fig. 42 Shifter Arm Shaft Plug Installation

(15) Install shift restrictor pins in shift tower and tighten to 27 N·m (20 ft. lbs.) (Fig. 43).

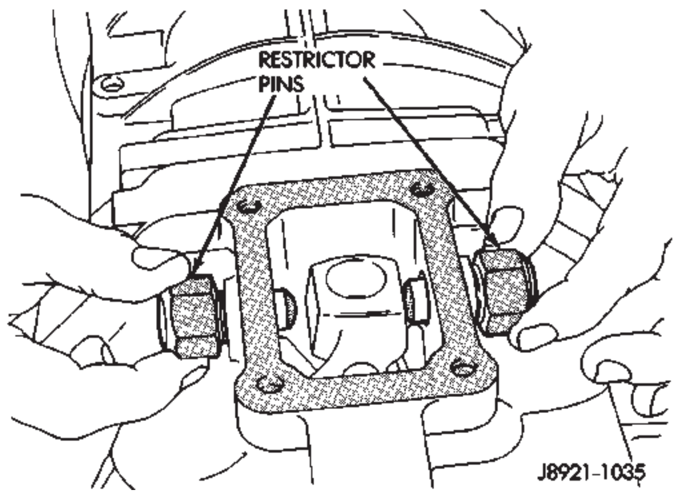


Fig. 43 Install Shifter Restrictor Pins

(16) Install shift detent ball in detent opening of case (Fig. 44).

(17) Install detent spring in case (Fig. 45).

DISASSEMBLY AND ASSEMBLY (Continued)

(18) Install detent plug and tighten to 19 N·m (14 ft. lbs.) (Fig. 46).

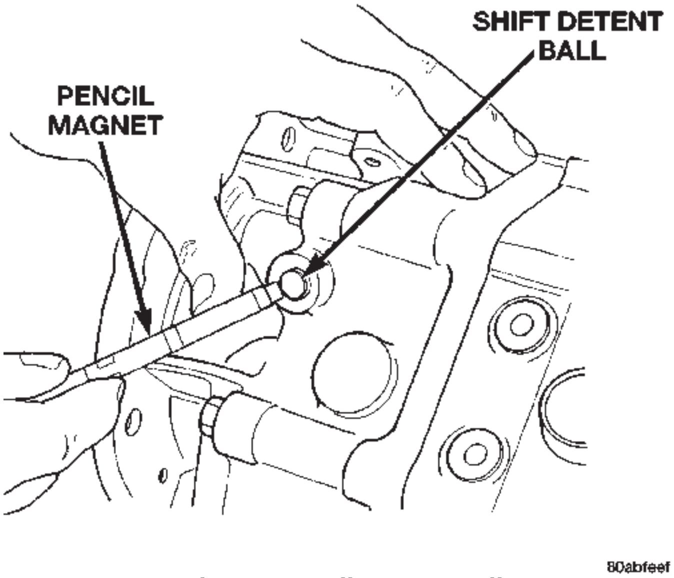


Fig. 44 Install Detent Ball

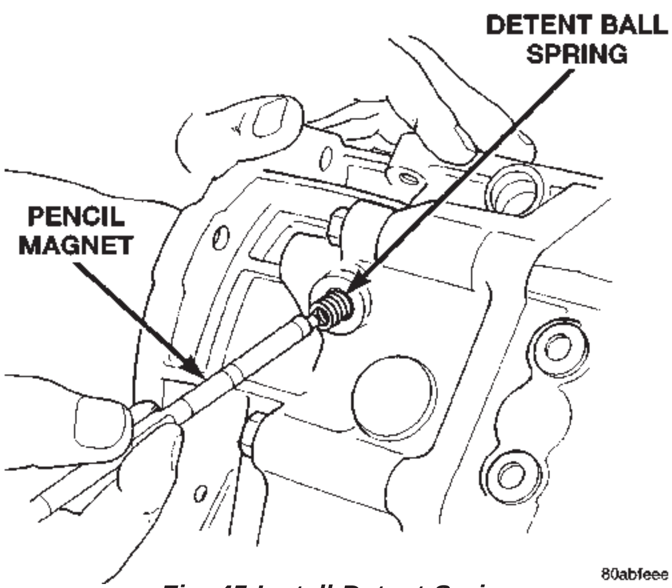


Fig. 45 Install Detent Spring

(19) Install shift tower gasket onto shift tower.

(20) Install the shift tower oil deflector and gasket onto the adapter or extension housing.

(21) Install shift tower onto transmission case (Fig. 47).

(22) Install bolts to hold shift tower to transmission case. Tighten tower bolts to 18 N·m (13 ft. lbs.) torque.

(23) Install new metal o-ring onto the backup lamp switch.

(24) Install backup lamp switch (Fig. 48). Tighten switch to 44 N·m (32.5 ft. lbs.) torque.

(25) Install new seal in adapter/extension housing.

(26) Install vehicle speed sensor, if necessary.

(27) Install clutch housing, release bearing, release fork and retainer clip.

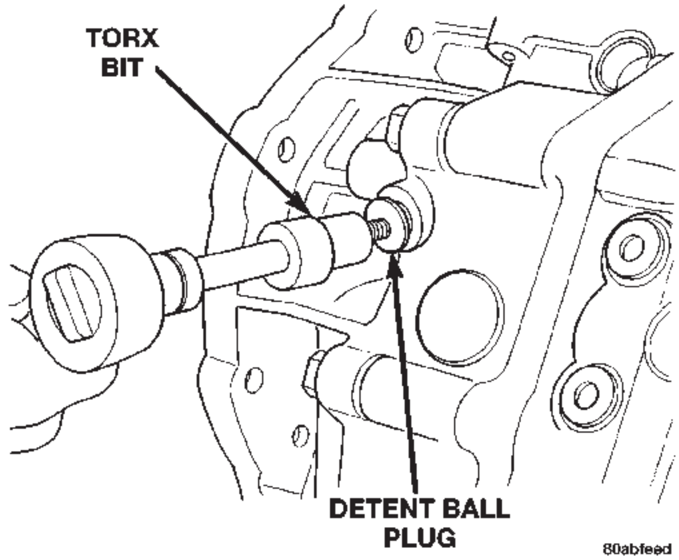


Fig. 46 Install Detent Ball Plug

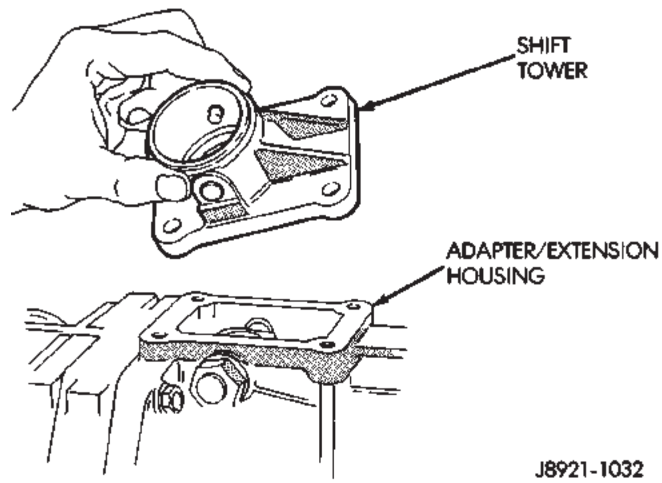


Fig. 47 Install Shift Tower

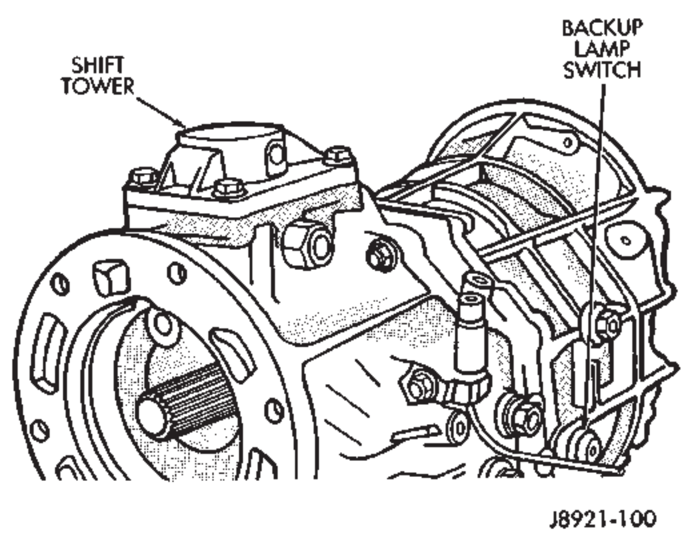


Fig. 48 Install Backup Lamp Switch

DISASSEMBLY AND ASSEMBLY (Continued)

SHIFT MECHANISM AND GEARTRAIN

DISASSEMBLY

(1) Install suitable bolts and washers in intermediate plate (Fig. 49). Then clamp plate and gear assembly in vise. Use enough washers to prevent bolts from touching. Also be sure vise jaws are clamped on bolt heads.

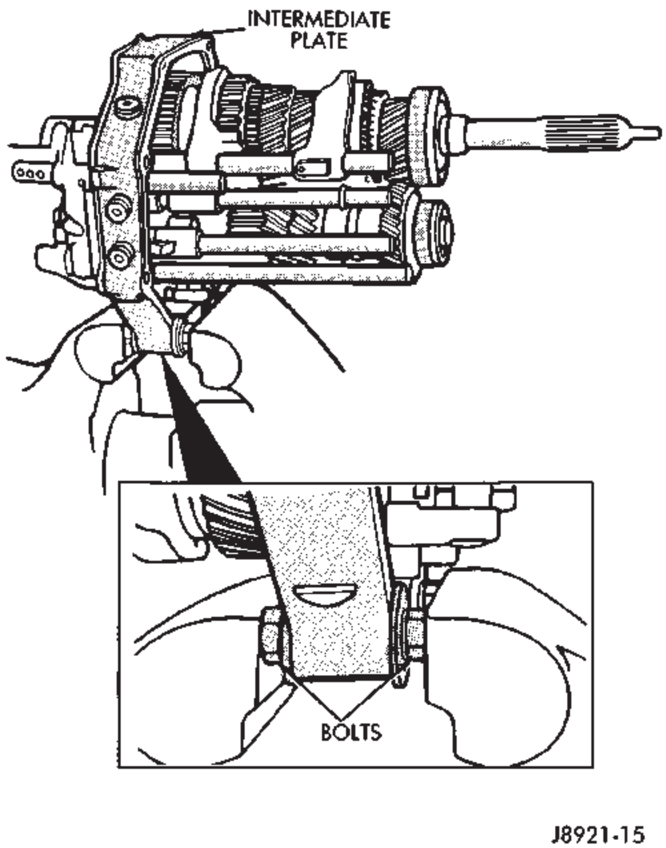


Fig. 49 Positioning Intermediate Plate In Vise

(2) Remove countershaft fifth gear retaining snap-ring (Fig. 50).

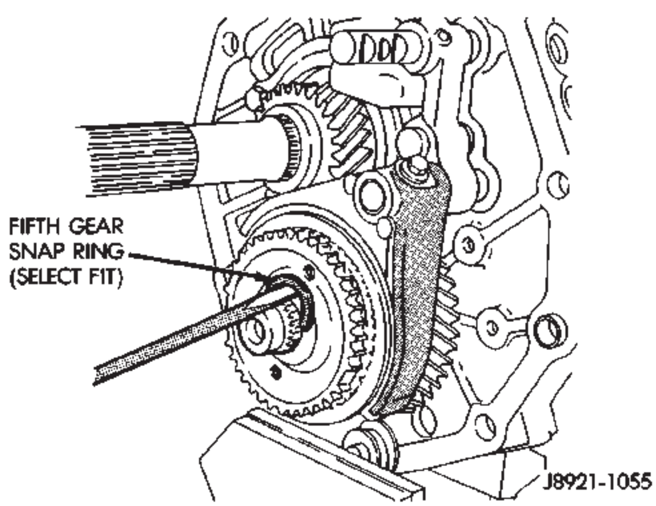


Fig. 50 Remove Fifth Gear Snap-ring

(3) Remove bolt holding fifth gear shift fork to shift rail (Fig. 51).

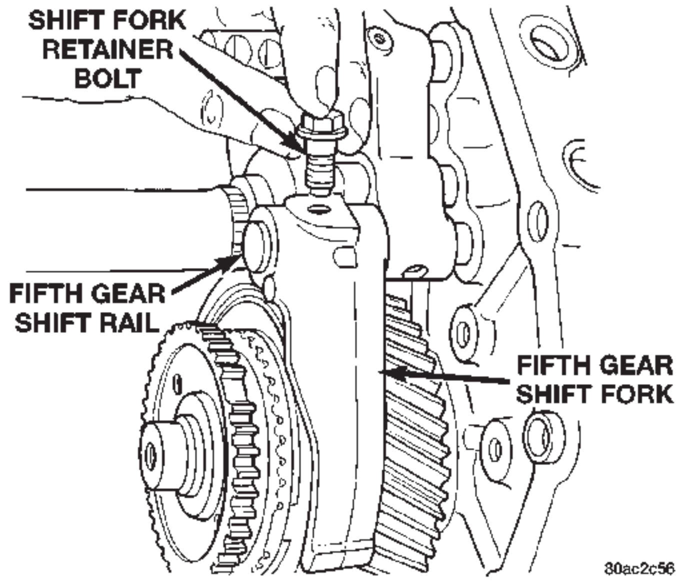


Fig. 51 Remove Shift Fork Retainer Bolt

(4) Remove fifth gear blocker ring from countershaft assembly with Puller L-4407 (Fig. 52).

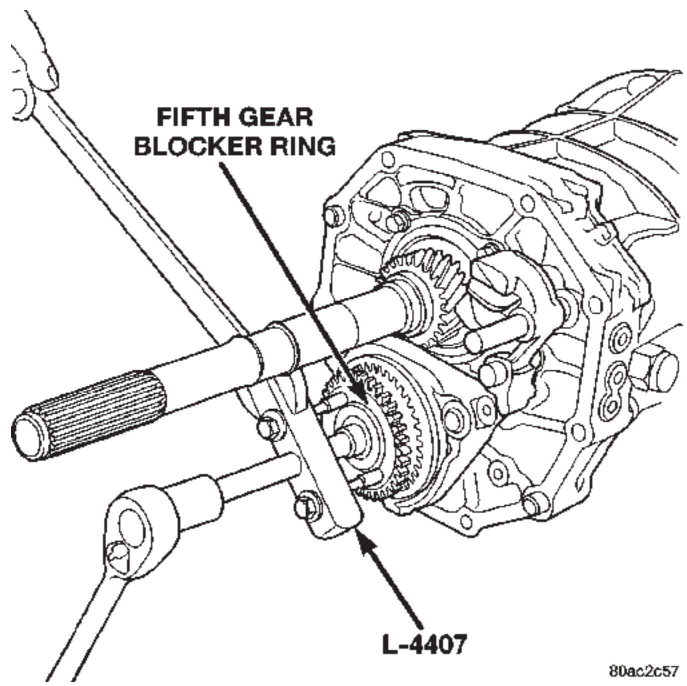


Fig. 52 Remove Fifth Gear Blocker Ring

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Remove fifth gear synchro ring (Fig. 53).

(6) Remove the countershaft fifth gear assembly from countershaft (Fig. 54).

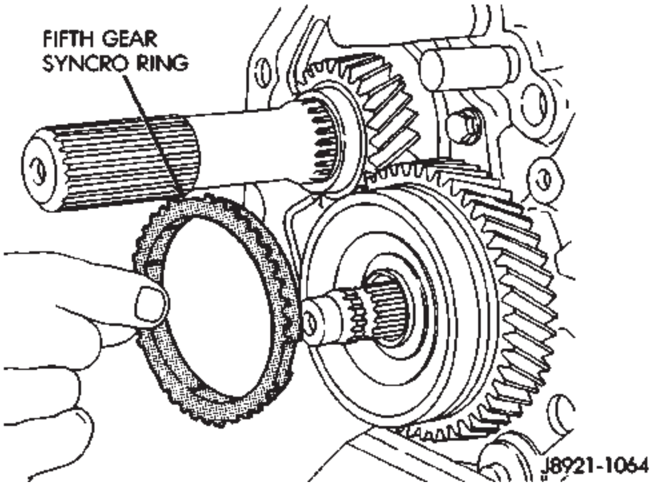


Fig. 53 Remove Fifth Gear Synchro Ring

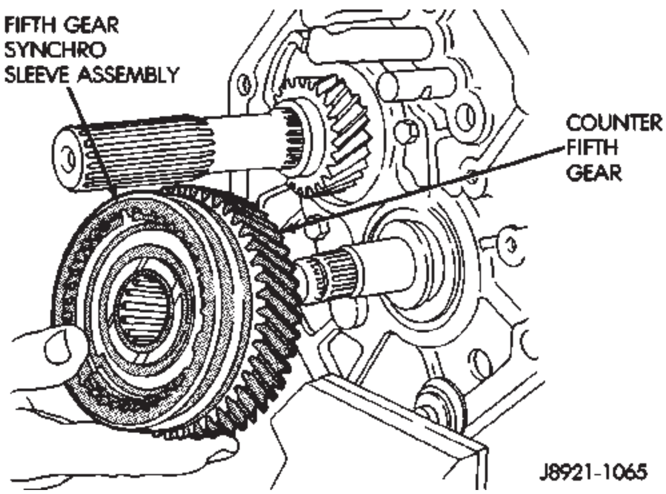


Fig. 54 Remove Fifth Gear and Synchro Assembly

(7) Remove fifth gear thrust ring from countershaft (Fig. 55).

(8) Remove fifth gear thrust ring lock ball from countershaft (Fig. 56).

NOTE: There are many lock balls, check balls, interlock balls, and interlock pins used in various places in the transmission. Whenever a pin or ball is removed, it should be identified in such a way that it can be reinstalled in the same location from which it was removed.

(9) Remove bolt holding reverse idler gear shaft lock plate to the intermediate plate.

(10) Remove reverse idler gear shaft and reverse idler gear assembly (Fig. 57).

NOTE: Be sure to retrieve the pin and compression spring from the reverse idler shaft.

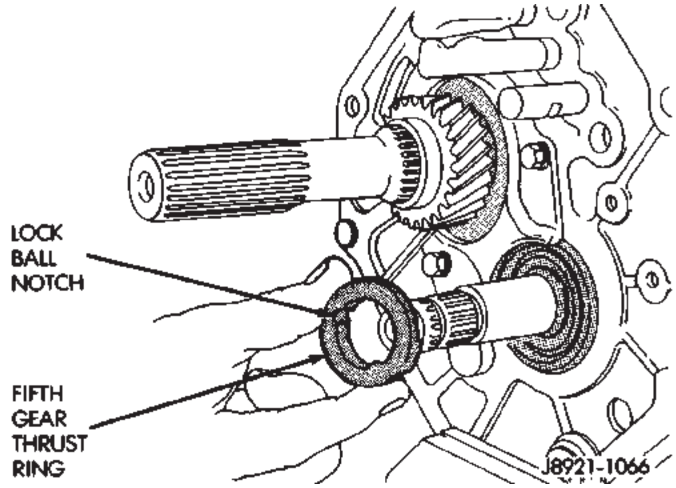


Fig. 55 Remove Fifth Gear Thrust Ring

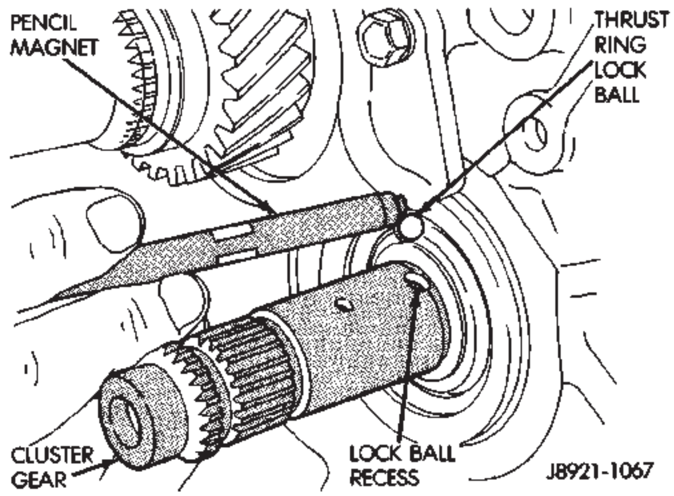


Fig. 56 Remove Fifth Gear Thrust Ring Lock Ball

(11) Remove bolts holding output shaft rear bearing retainer to the intermediate plate and remove retainer (Fig. 58).

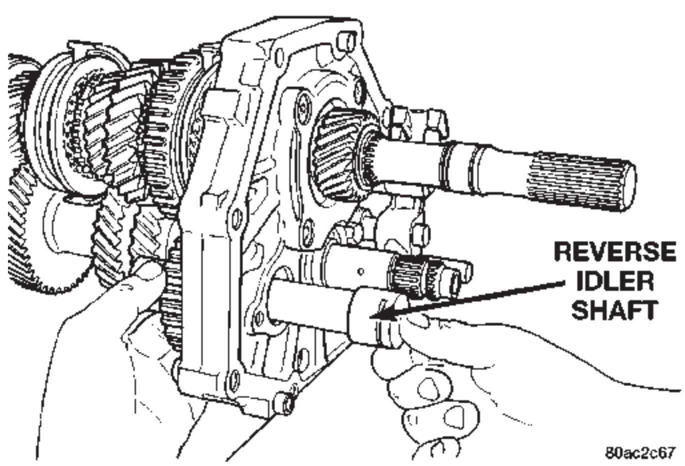


Fig. 57 Remove Reverse Idler Shaft

DISASSEMBLY AND ASSEMBLY (Continued)

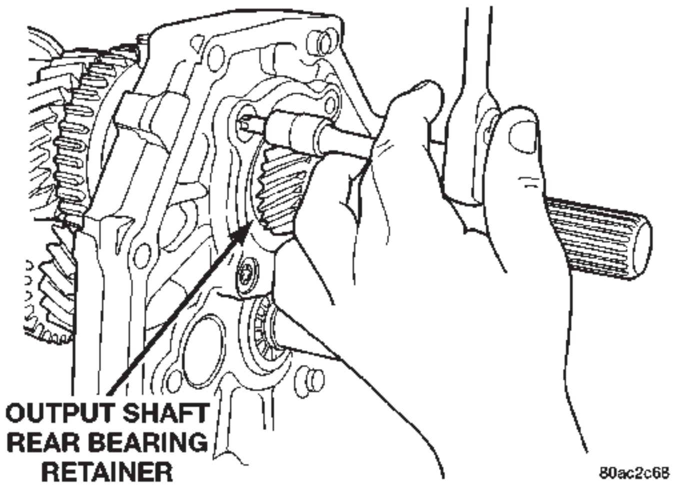


Fig. 58 Remove Output Shaft Rear Bearing Retainer

(12) Remove bolts holding 1–2 and 3–4 shift forks to the shift rails (Fig. 59) and discard bolts.

(13) Remove bolts holding reverse shift arm bracket to intermediate plate (Fig. 60).

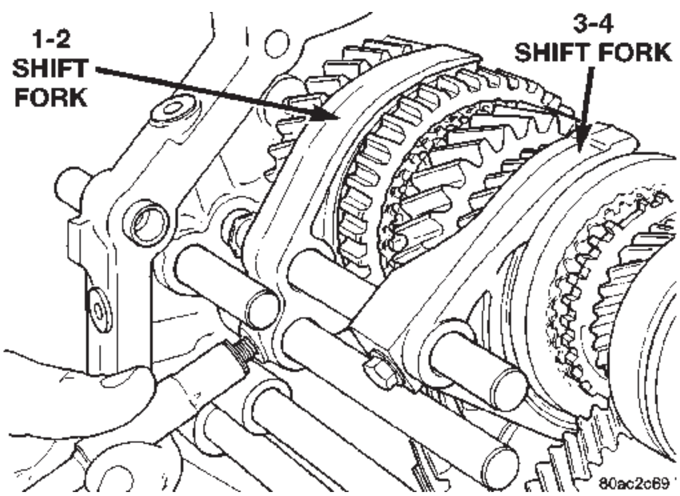


Fig. 59 Remove Shift Fork To Shift Rail Bolts

(14) Remove snap-ring holding output shaft rear bearing into the intermediate plate (Fig. 61).

(15) Remove countershaft rear bearing snap-ring.

(16) With aid of an assistant, support the mainshaft and countershaft. Tap on the rear of the mainshaft and countershaft with a suitable plastic mallet. This will release the countershaft from the countershaft rear bearing and the mainshaft rear bearing from the intermediate plate. The countershaft will release from the countershaft bearing first and can be removed by moving the countershaft rearward and downward (Fig. 62).

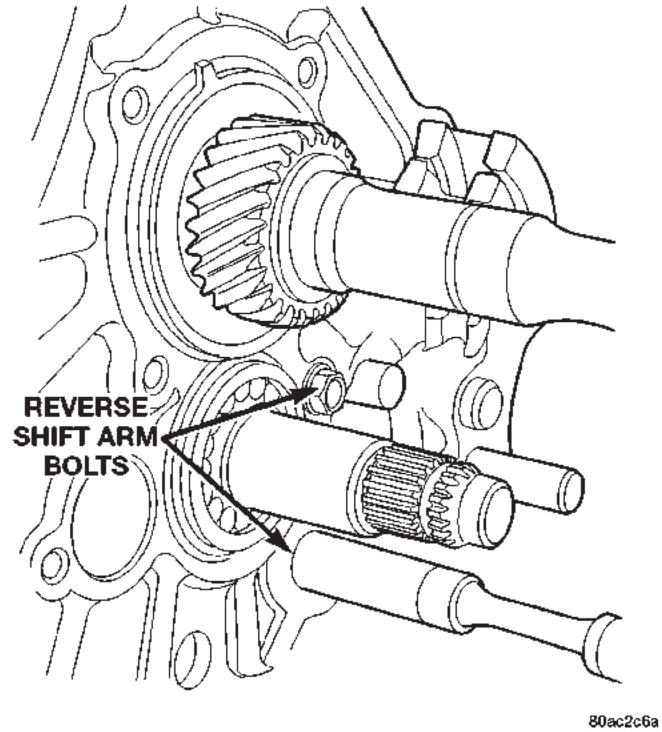


Fig. 60 Remove Reverse Shift Arm Bracket Bolts

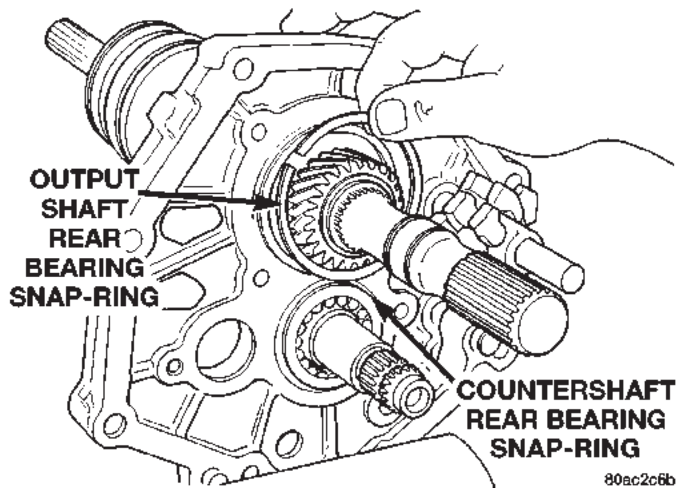


Fig. 61 Remove Output Shaft Rear Bearing Snap-ring

DISASSEMBLY AND ASSEMBLY (Continued)

(17) Remove the mainshaft by moving the mainshaft forward until the mainshaft rear bearing is clear of the intermediate plate and then rotating the mainshaft downward out of the shift forks (Fig. 63).

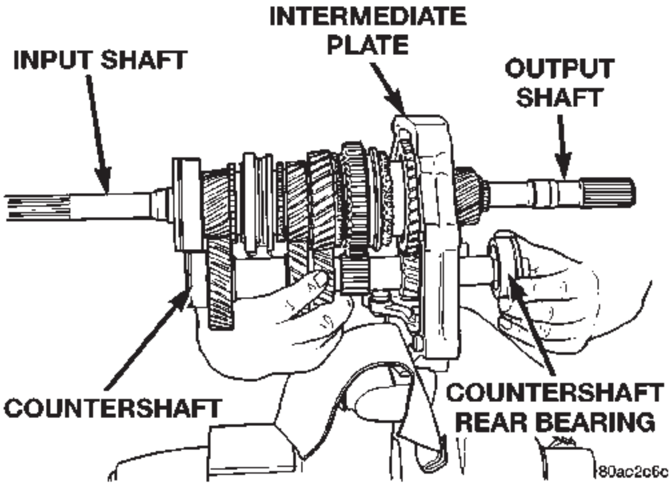


Fig. 62 Remove Countershaft and Countershaft Rear Bearing

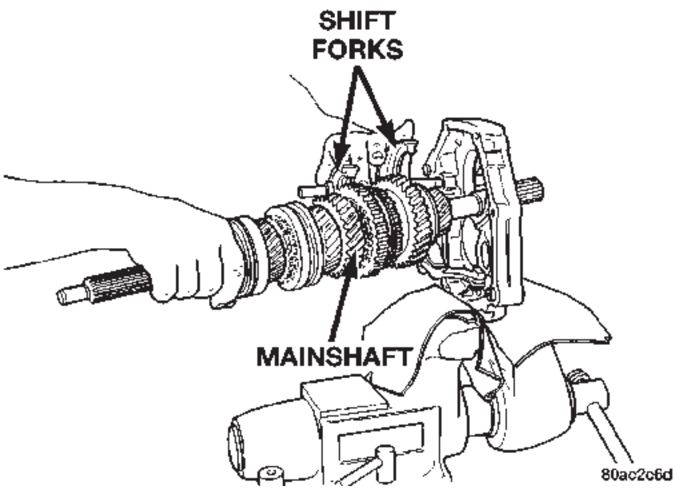


Fig. 63 Remove Mainshaft

(18) Remove the 3–4 shift fork from the 3–4 shift rail (Fig. 64).

(19) Remove the snap-ring from near the end of the 1–2 shift rail to allow the removal of the 1–2 shift fork.

(20) Remove the 1–2 shift fork from the 1–2 and the 3–4 shift rails (Fig. 65).

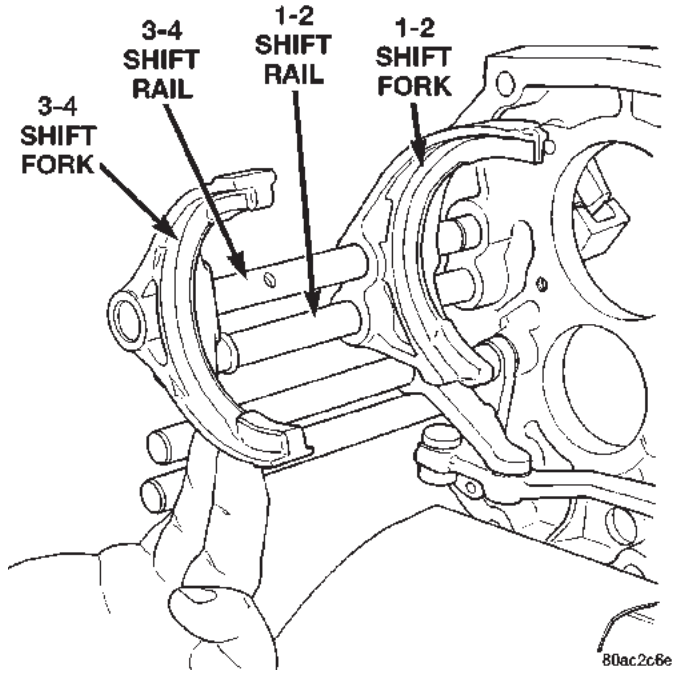


Fig. 64 Remove 3–4 Shift Fork

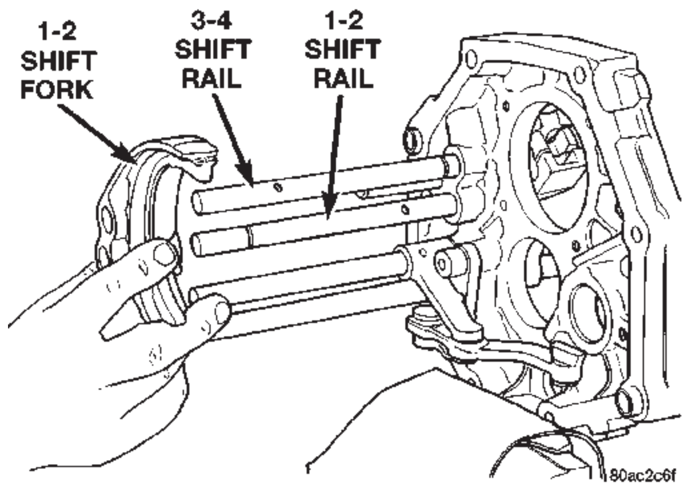


Fig. 65 Remove 1–2 Shift Fork

(21) Remove threaded plugs from intermediate plate. Then remove lock ball and spring from plug holes with pencil magnet (Fig. 66). Note that the bottom spring is shorter in length than the other two springs.

(22) Remove the intermediate plate from the vise, rotate the plate 180°, and reinstall the plate in the vise using the same bolt and washer mounting set-up.

DISASSEMBLY AND ASSEMBLY (Continued)

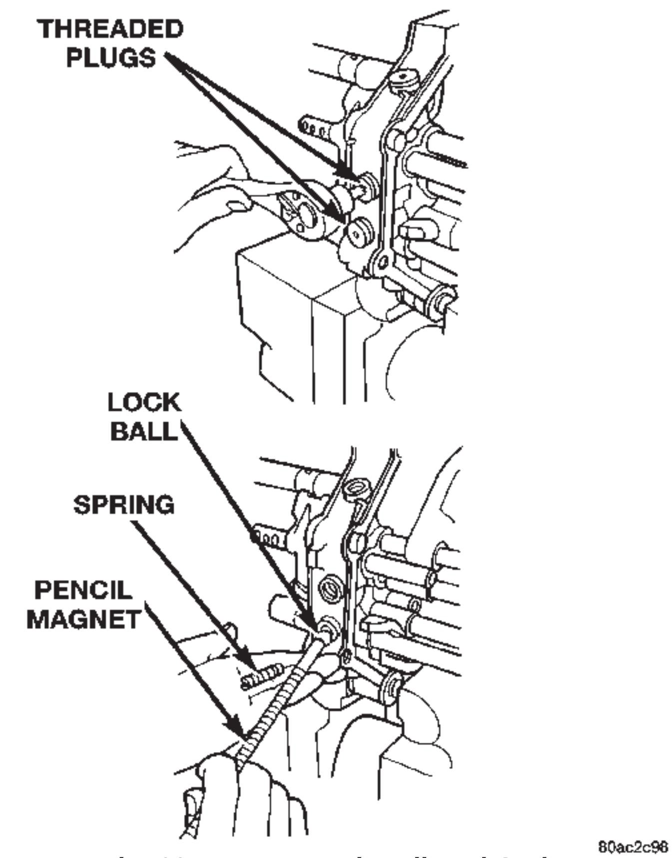


Fig. 66 Remove Lock Ball And Spring

CAUTION: The interlock balls and pins are different sizes and shapes. Be sure to correctly identify which position an item is removed from to ensure that it is reinstalled in the same location.

(23) Remove fifth gear shift rail (Fig. 67).

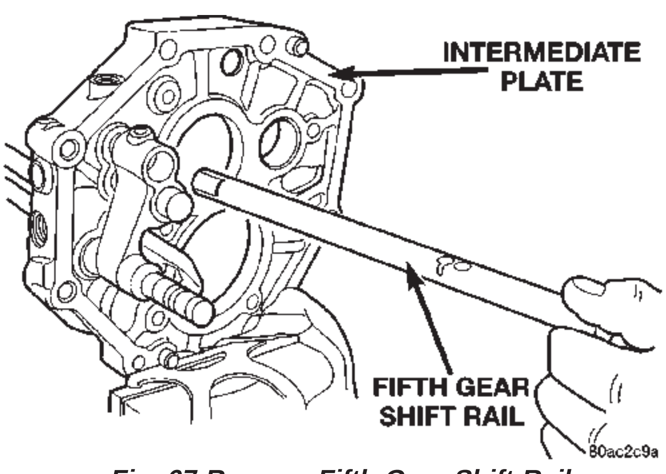


Fig. 67 Remove Fifth Gear Shift Rail

(24) Remove fifth gear check ball (Fig. 68) and interlock pin.

(25) Remove reverse shift head and rail assembly (Fig. 69).

(26) Remove snap-ring holding reverse shift rail into intermediate plate.

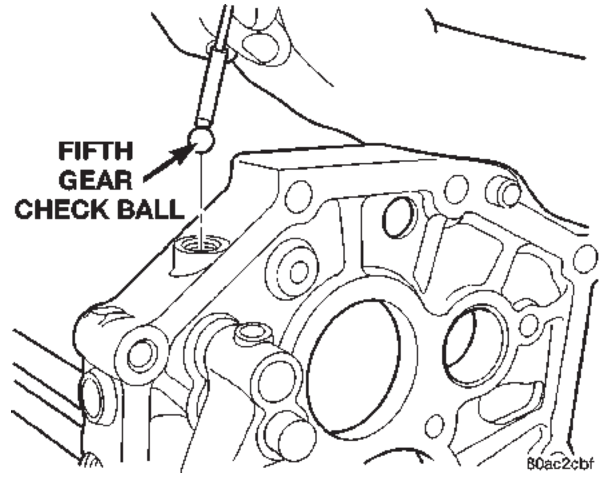


Fig. 68 Remove Fifth Gear Check Ball

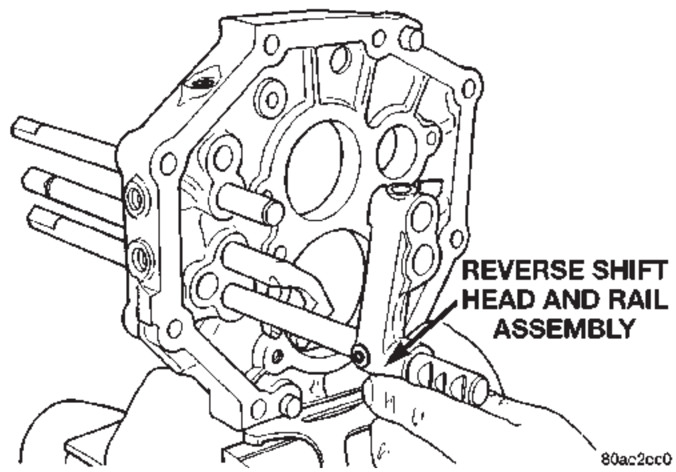


Fig. 69 Remove Reverse Shift Head And Rail Assembly

(27) Remove reverse shift rail and reverse shift fork and arm assembly from intermediate plate (Fig. 70).

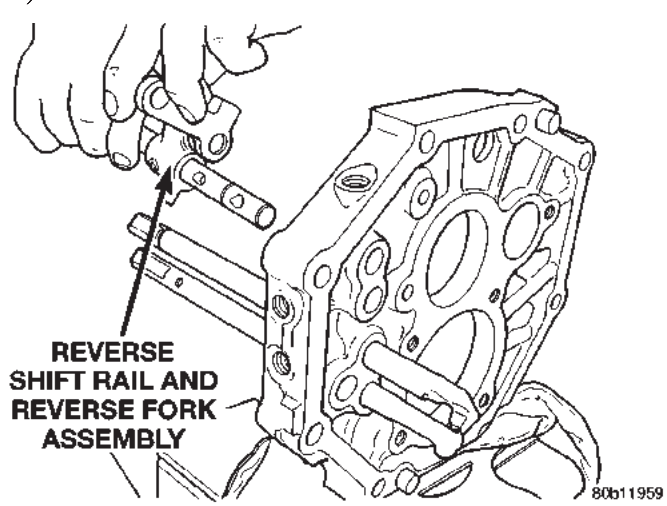


Fig. 70 Remove Reverse Shift Rail

DISASSEMBLY AND ASSEMBLY (Continued)

(28) Remove interlock pin from reverse shift rail (Fig. 71).

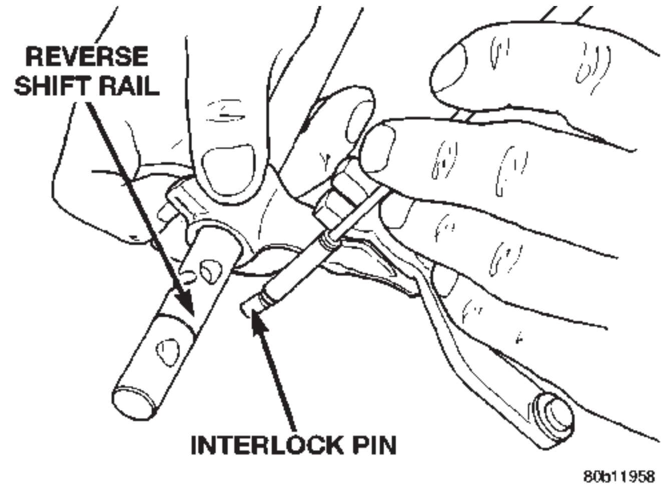


Fig. 71 Remove Interlock Pin From Reverse Shift Rail

(29) Remove reverse elongated check ball (Fig. 72).

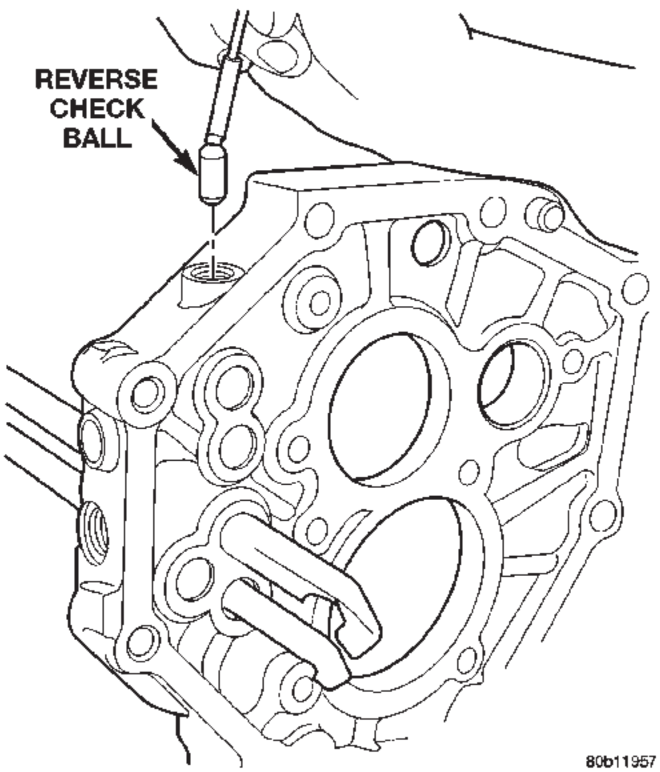


Fig. 72 Remove Reverse Check Ball

(30) Remove snap-ring on 3–4 shift rail.

(31) Remove 1–2 shift rail from intermediate plate.

(32) Remove interlock pin from 1–2 shift rail (Fig. 73).

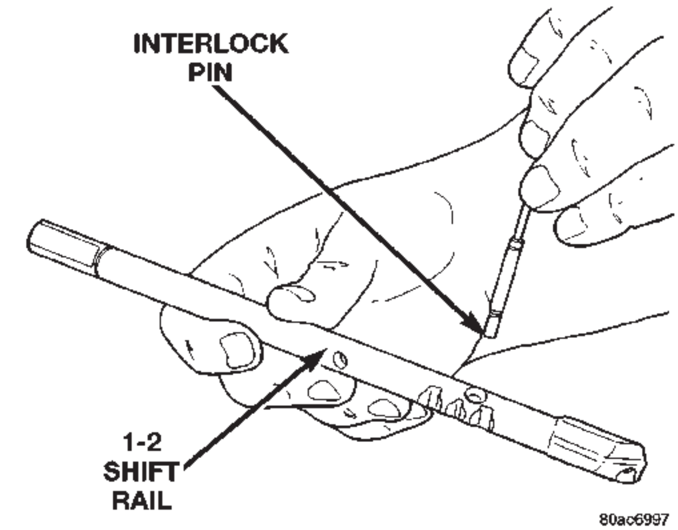


Fig. 73 Remove 1–2 Shift Rail Interlock Pin

(33) Remove 1–2 shift rail elongated check ball from intermediate plate (Fig. 74).

(34) Remove 3–4 shift rail from intermediate plate.

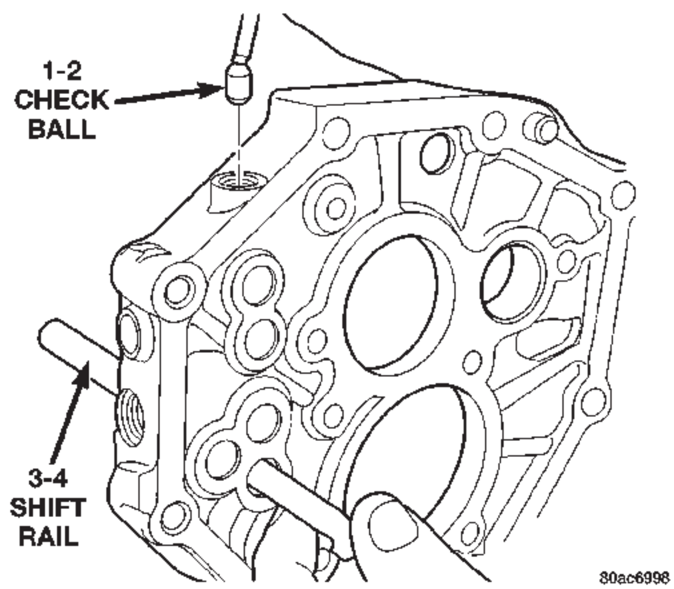


Fig. 74 Remove 1–2 Check Ball

DISASSEMBLY AND ASSEMBLY (Continued)

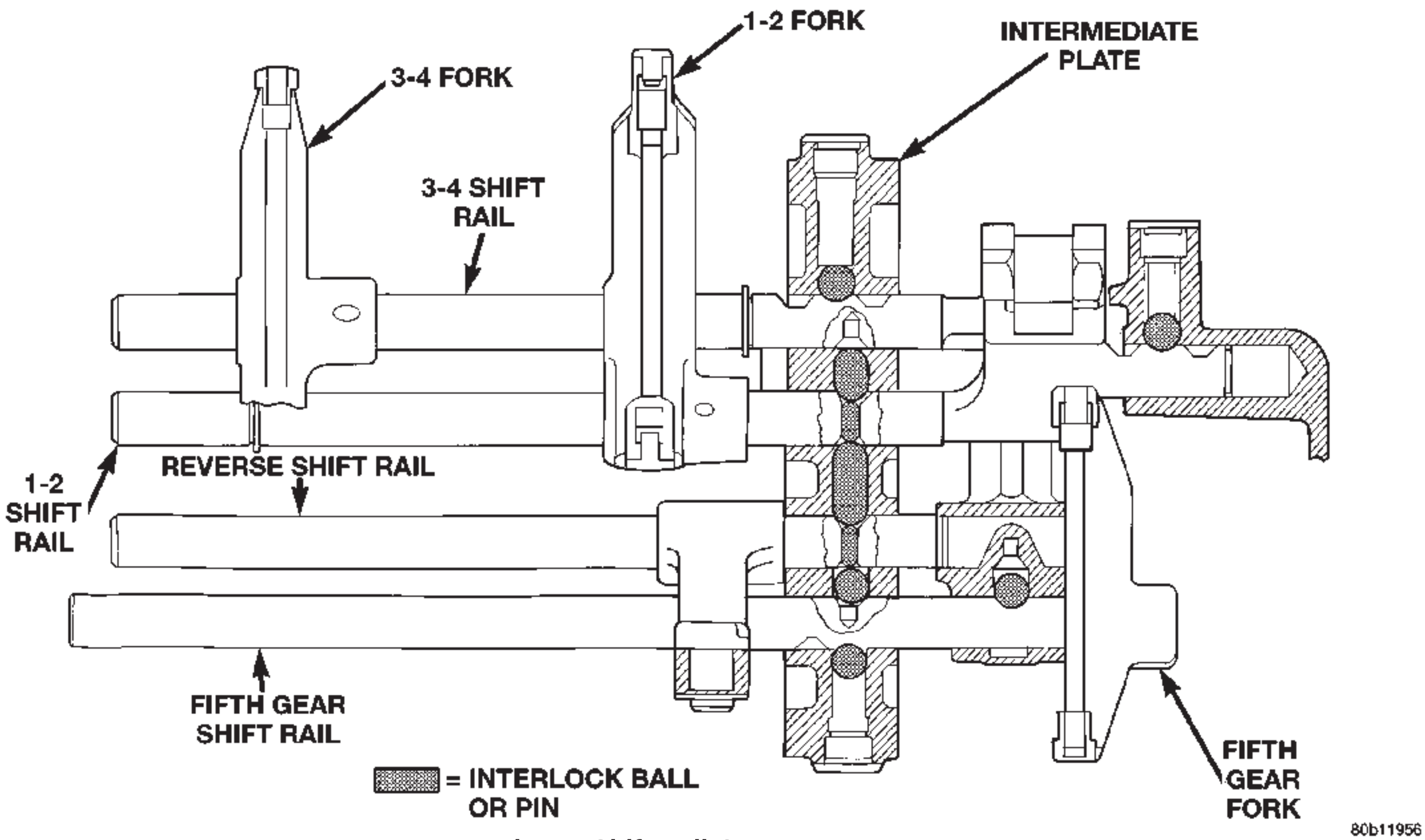


Fig. 75 Shift Rail Components

ASSEMBLY

Refer to (Fig. 75) while assembling and installing the shift rail components. Also, verify that all shift rail components are in their neutral position when installing the check balls and interlock pins.

(1) Install the 3–4 shift rail into the intermediate plate.

(2) Install the 1–2 elongated check ball into the intermediate plate (Fig. 76).

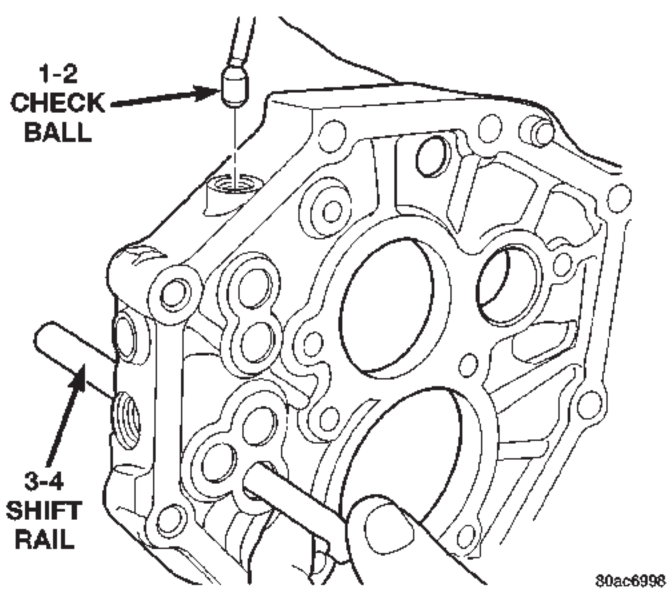


Fig. 76 Install 1–2 Check Ball

(3) Install the interlock pin into the 1–2 shift rail (Fig. 77).

(4) Install the 1–2 shift rail into the intermediate plate.

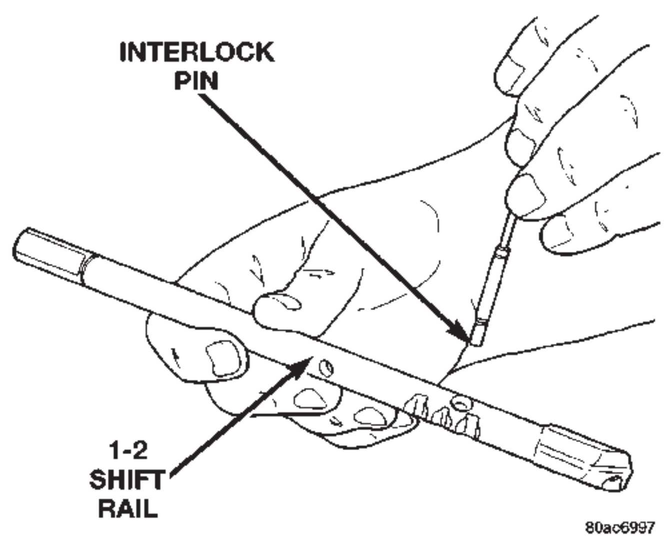


Fig. 77 Install 1–2 Shift Rail Interlock Pin

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Install snap-ring onto 3–4 shift rail.

(6) Install the reverse check ball into the intermediate plate (Fig. 78).

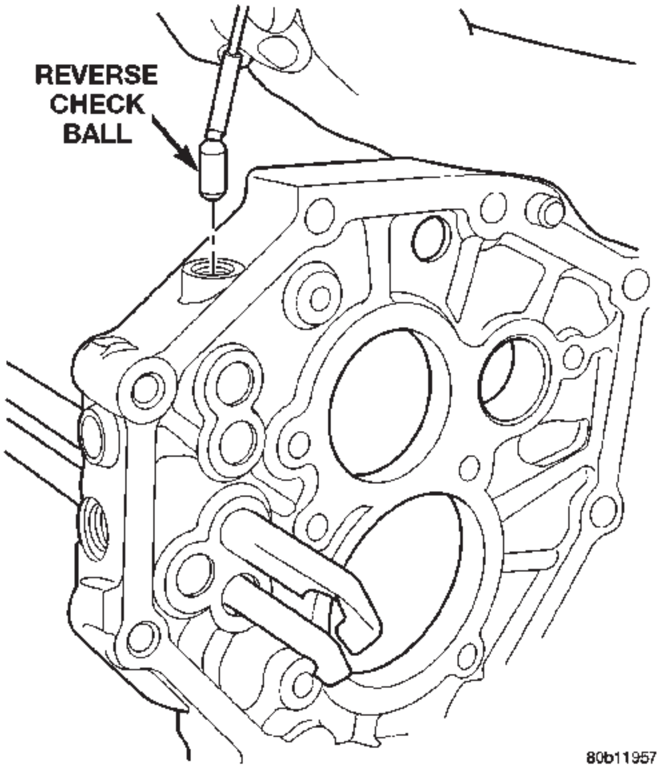


Fig. 78 Install Reverse Check Ball

(7) Install the interlock pin into the reverse shift rail (Fig. 79).

(8) Assemble the reverse arm bracket to the reverse fork (Fig. 80).

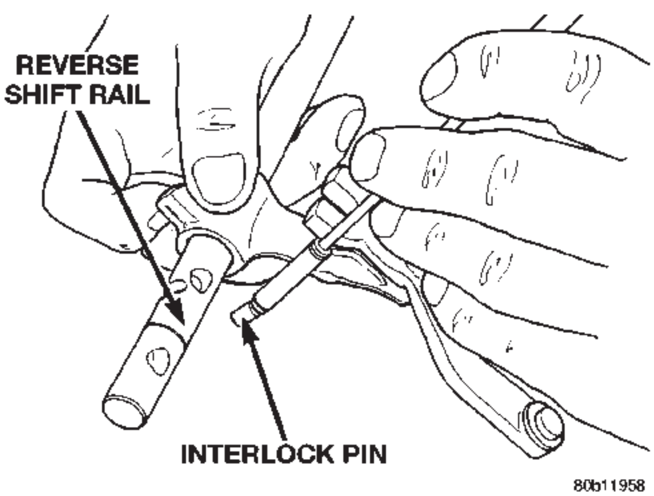


Fig. 79 Install Reverse Interlock Pin

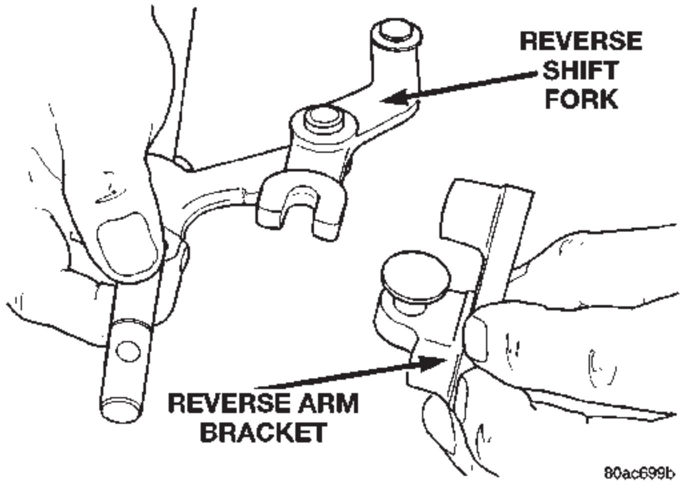


Fig. 80 Install Reverse Arm Bracket to Fork

(9) Install reverse shift rail into intermediate plate and position reverse arm bracket to intermediate plate (Fig. 81).

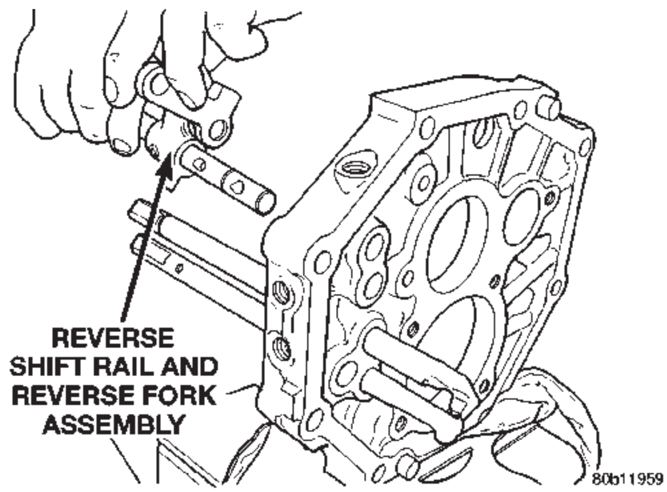


Fig. 81 Install Reverse Shift Rail

(10) Install snap-ring onto reverse shift rail (Fig. 82).

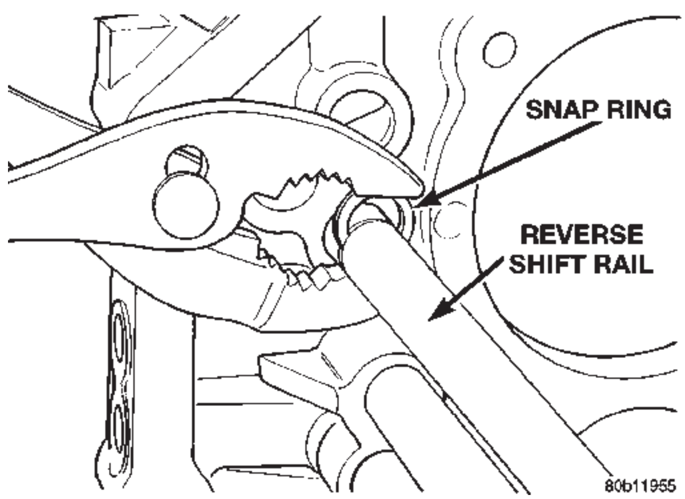


Fig. 82 Install Reverse Snap-ring

DISASSEMBLY AND ASSEMBLY (Continued)

(11) Install reverse shift head and rail assembly into the intermediate plate.

(12) Install the fifth gear interlock ball and check ball (Fig. 83).

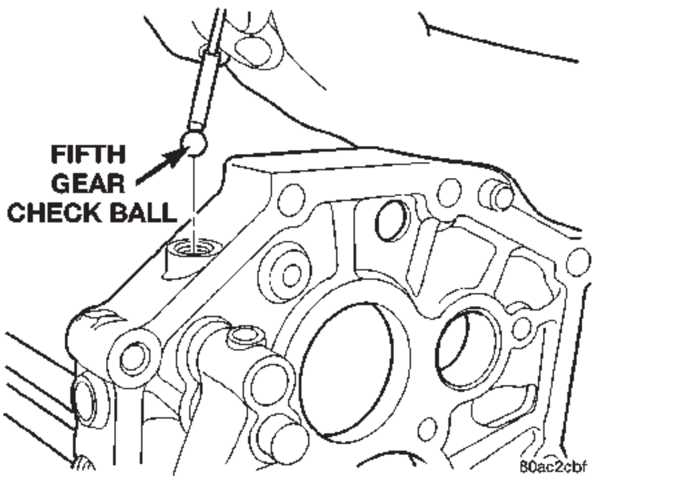


Fig. 83 Install Fifth Gear Check Ball

(13) Install fifth gear shift rail (Fig. 84).

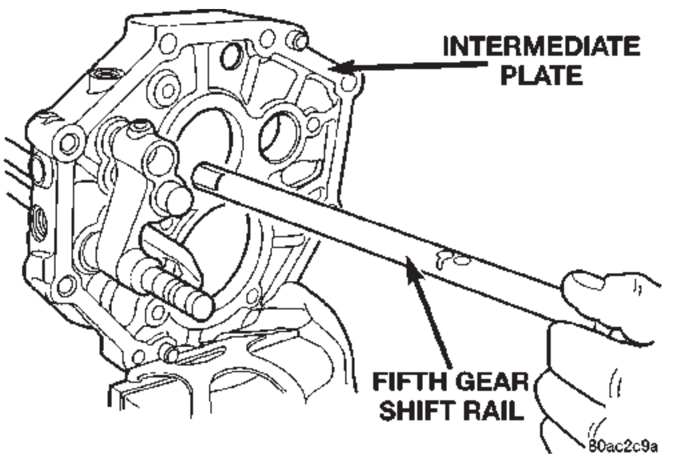


Fig. 84 Install Fifth Gear Shift Rail

(14) Remove the intermediate plate from the vise, rotate the plate 180°, and reinstall the plate in the vise using the same bolt and washer mounting set-up.

(15) Install the shift rail detent balls in the intermediate plate.

(16) Install the shift rail detent springs in the intermediate plate. Note that the bottom detent spring is shorter than the others.

(17) Install the shift rail detent plugs in the intermediate plate.

(18) Install the 1–2 shift fork onto the 1–2 and 3–4 shift rails (Fig. 85).

(19) Install the snap-ring onto the 1–2 shift rail.

(20) Install the 3–4 shift fork onto the 3–4 shift rail (Fig. 86).

(21) Install mainshaft into the intermediate plate by guiding the output shaft through opening in intermediate plate until the shift forks are aligned with

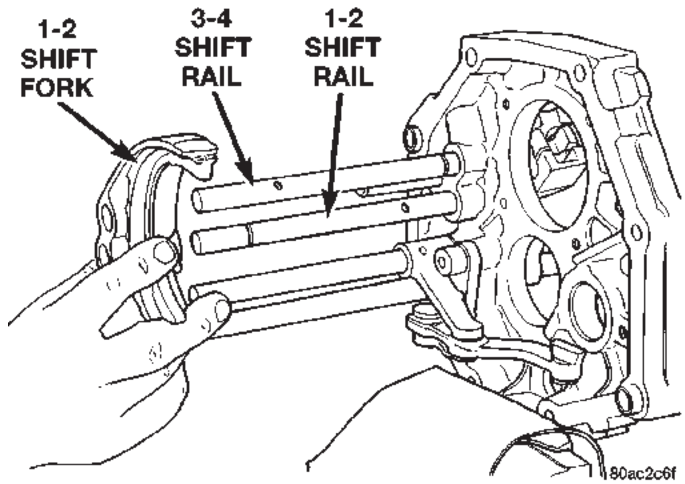


Fig. 85 Install 1–2 Shift Fork

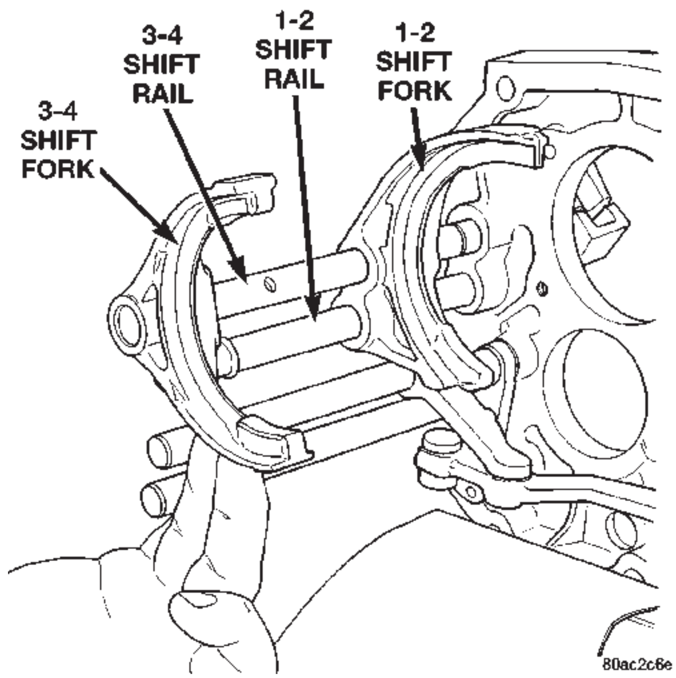


Fig. 86 Install 3–4 Shift Fork

the appropriate synchronizer sleeves. The mainshaft rear bearing will be started in the intermediate plate but not fully driven in at this point.

(22) While an assistant supports the mainshaft, align rear of countershaft with inner race of countershaft rear bearing.

(23) Raise countershaft upward until gears mesh with the mating gears on the mainshaft.

(24) Using a suitable rubber mallet, tap on the input shaft and the front of the countershaft equally to install the mainshaft rear bearing into the intermediate plate and the rear of the countershaft into the rear countershaft bearing. It may be necessary to occasionally hold the countershaft into the intermediate plate and tap the countershaft rear bearing onto the countershaft and into the intermediate plate.

DISASSEMBLY AND ASSEMBLY (Continued)

(25) Install snap-rings onto the rear mainshaft and countershaft bearings.

(26) Install the bolts to hold the reverse shift arm bracket to the intermediate plate.

(27) Install new bolts to hold the shift forks to the shift rails (Fig. 87).

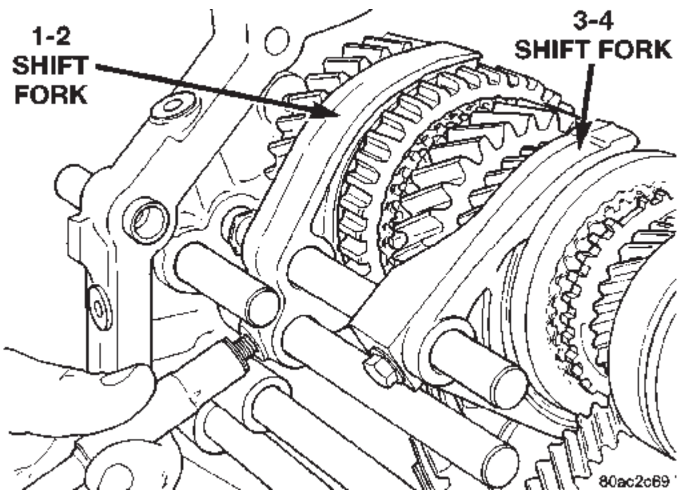


Fig. 87 Install Shift Fork Bolts

(28) Position the mainshaft rear bearing retainer over the output shaft and onto the intermediate plate.

(29) Install new bolts to hold the bearing retainer to the intermediate plate.

(30) Move the reverse shift arm into the reverse gear position. The reverse gear position is with the arm moved away from the intermediate plate (Fig. 88).

(31) Install the reverse idler gear assembly into position on the mainshaft and reverse shift arm.

(32) Install the compression spring and pin into the reverse idler gear shaft (Fig. 89).

(33) Install the reverse idler shaft through the intermediate plate and reverse idler gear assembly (Fig. 90) until the idler shaft pin contacts the gear assembly. Make sure that the notched cut-out in the idler shaft is to the rear of the transmission.

(34) Align the pin with the alignment notch in the reverse idler gear assembly (Fig. 91). The alignment notch in the reverse idler gear race/hub is a small relief cut above one of the main longitudinal slots. Be sure that the pin is aligned with the proper slot, the opposite slot has an oil drain hole which the pin will drop into. The assembly will then be locked onto the shaft and will need to be disassembled in order to be removed.

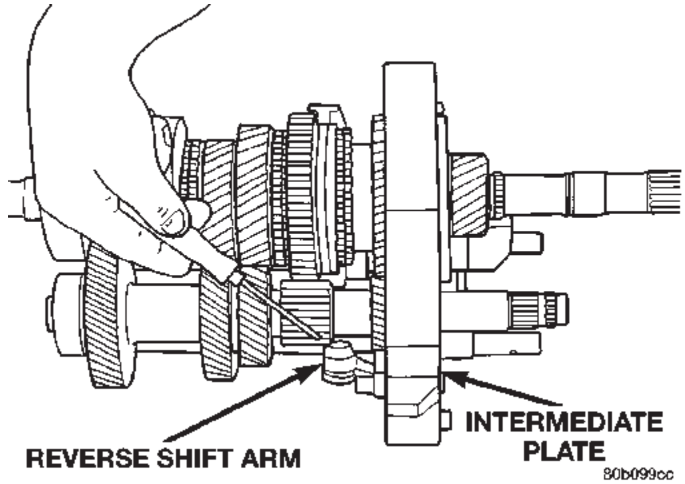


Fig. 88 Reverse Shift Arm Position

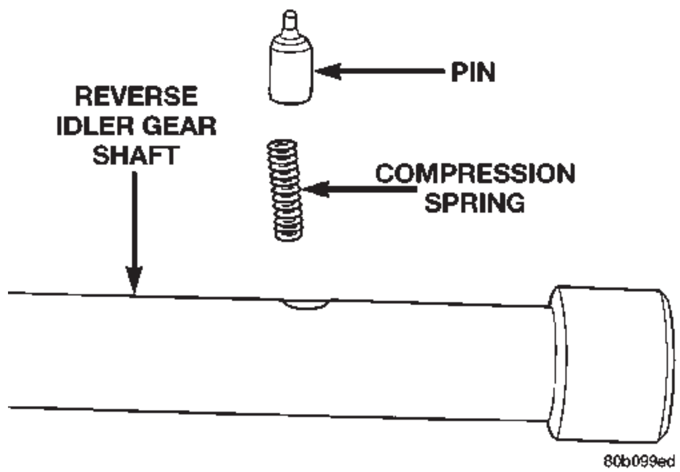


Fig. 89 Install Compression Spring And Pin

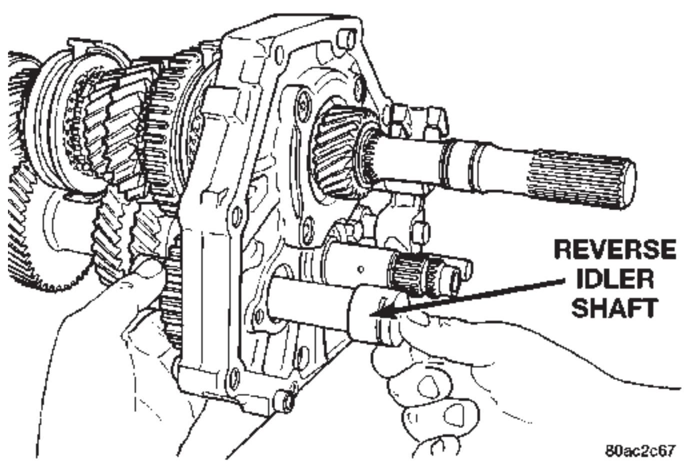


Fig. 90 Install Reverse Idler Shaft

DISASSEMBLY AND ASSEMBLY (Continued)

(35) Depress compression spring and pin in reverse idler gear shaft (Fig. 92).

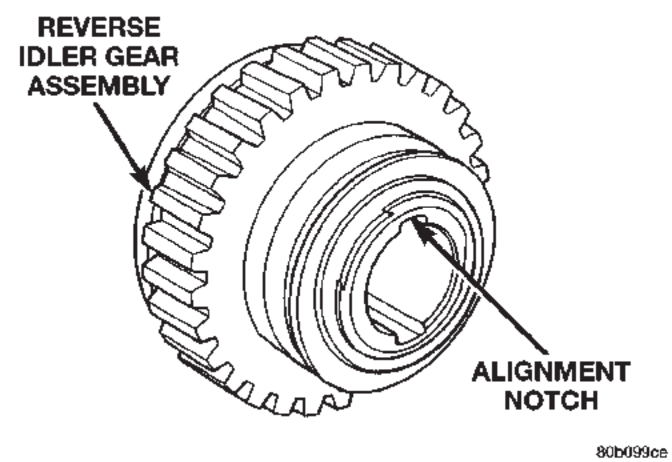


Fig. 91 Align Idler Shaft Pin

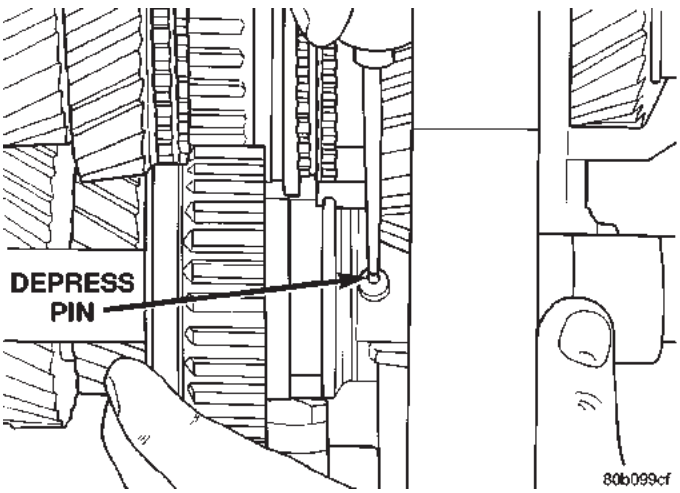


Fig. 92 Depress Pin In Reverse Idler Gear Shaft

(36) Install the reverse idler gear shaft the remainder of the way through the reverse idler gear assembly.

(37) Position the reverse idler gear shaft lock plate onto the intermediate plate.

(38) Install a new bolt to hold the idler gear shaft lock plate to the intermediate plate.

(39) Install the fifth gear thrust ring lock ball to the countershaft (Fig. 93).

(40) Install the fifth gear thrust ring onto the countershaft and over the lock ball (Fig. 94).

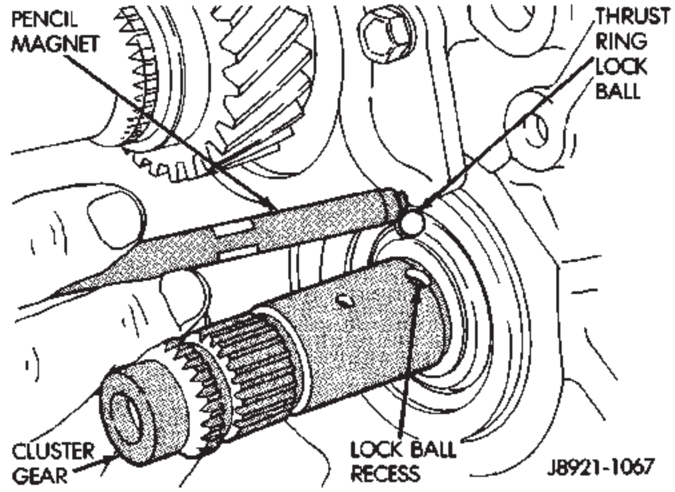


Fig. 93 Install Fifth Gear Thrust Ring Lock Ball

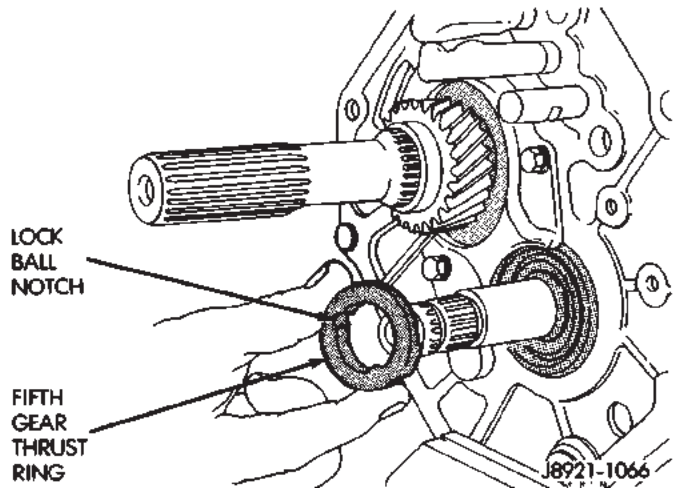


Fig. 94 Install Fifth Gear Thrust Ring

(41) Install fifth gear shift fork to the countershaft fifth gear assembly.

(42) Install the countershaft fifth gear bearings into the countershaft fifth gear assembly.

(43) Position the countershaft fifth gear assembly on the countershaft. Ensure that the fifth gear fork is installed onto the fifth gear shift rail.

(44) Install the fifth gear synchro ring.

DISASSEMBLY AND ASSEMBLY (Continued)

(45) Position the fifth gear blocker ring onto the countershaft.

(46) Using a suitable mallet and spacer, tap the fifth gear blocker ring onto the countershaft.

(47) Install new bolt to hold fifth gear shift fork to the fifth gear shift rail (Fig. 95).

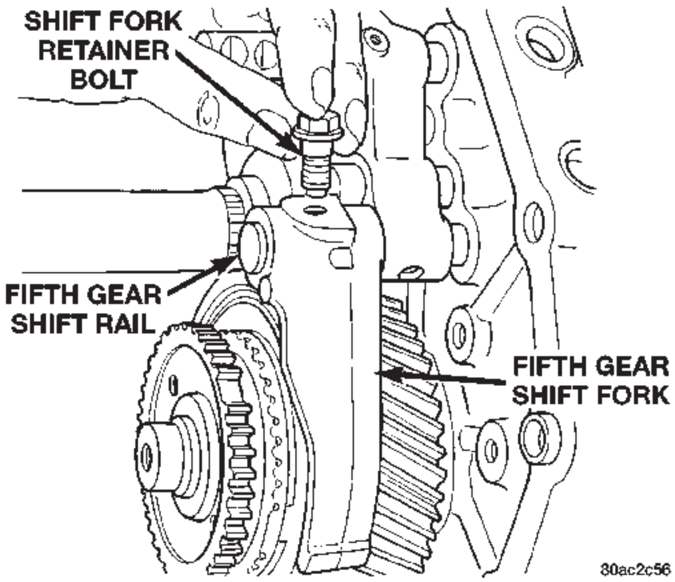


Fig. 95 Install Fifth Gear Retainer Bolt

(48) Measure countershaft fifth gear thrust clearance.

(49) Select a snap-ring so that the thrust clearance is 0.10–0.30 mm (0.004–0.010 in.).

(50) Install snap-ring to hold fifth gear blocker ring onto countershaft.

(51) Remove intermediate plate from vise and remove bolts and washers from intermediate.

COUNTERSHAFT

DISASSEMBLY

(1) Remove select fit snap-ring holding the countershaft front bearing onto the countershaft (Fig. 96).

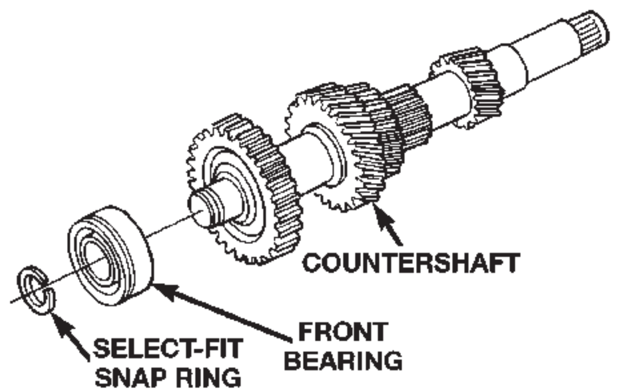
(2) Using Bearing Splitter P-334, a suitable spacer on center of countershaft, and a shop press, remove the countershaft front bearing from the countershaft.

ASSEMBLY

(1) Remove any nicks or burrs on countershaft hub with fine emery or crocus cloth.

(2) Position countershaft front bearing on end of countershaft.

(3) Using Special Tool 8109 and a shop press, press bearing onto countershaft.



I.D. MARK	SNAP RING THICKNESS MM (IN.)	
1	2.05 - 2.10	(0.0807 - 0.0827)
2	2.10 - 2.15	(0.0827 - 0.0846)
3	2.15 - 2.20	(0.0846 - 0.0866)
4	2.20 - 2.25	(0.0866 - 0.0886)
5	2.25 - 2.30	(0.0886 - 0.0906)
6	2.30 - 2.35	(0.0906 - 0.0925)

80ac6a0a

Fig. 96 Countershaft Front Bearing Snap-ring

(4) Select the thickest snap-ring that will fit into the snap-ring groove of the countershaft (Fig. 96).

(5) Install snap-ring to hold countershaft front bearing onto countershaft.

INPUT SHAFT

DISASSEMBLY

(1) Verify that the 3–4 synchronizer is in the neutral position.

(2) Separate input shaft from output shaft (Fig. 97). Note that the output shaft pilot bearing is an uncaged roller type bearing.

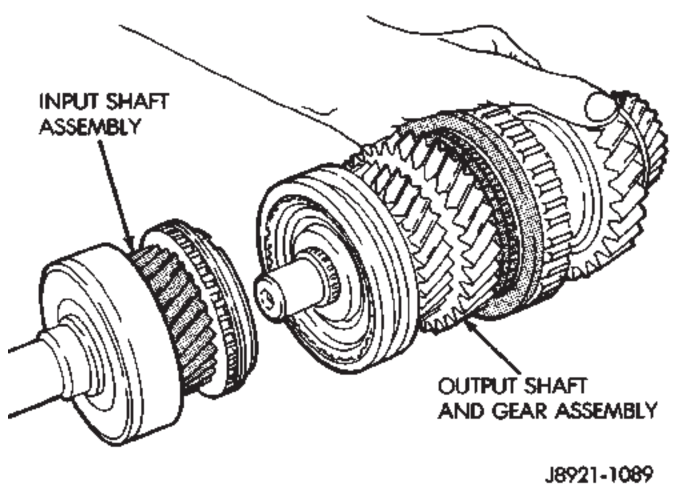


Fig. 97 Separate Input and Output Shafts

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Remove the output shaft pilot bearing rollers from the input shaft and the output shaft.

(4) Remove the fourth gear synchronizer ring from the input shaft (Fig. 98).

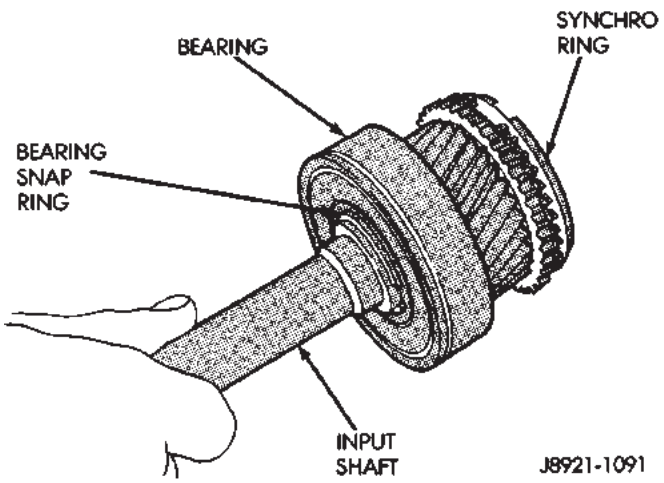


Fig. 98 Input Shaft Components

(5) Remove the select fit snap-ring holding the input shaft bearing onto the input shaft.

(6) Using Bearing Splitter P-334 and a shop press, remove the bearing from the input shaft.

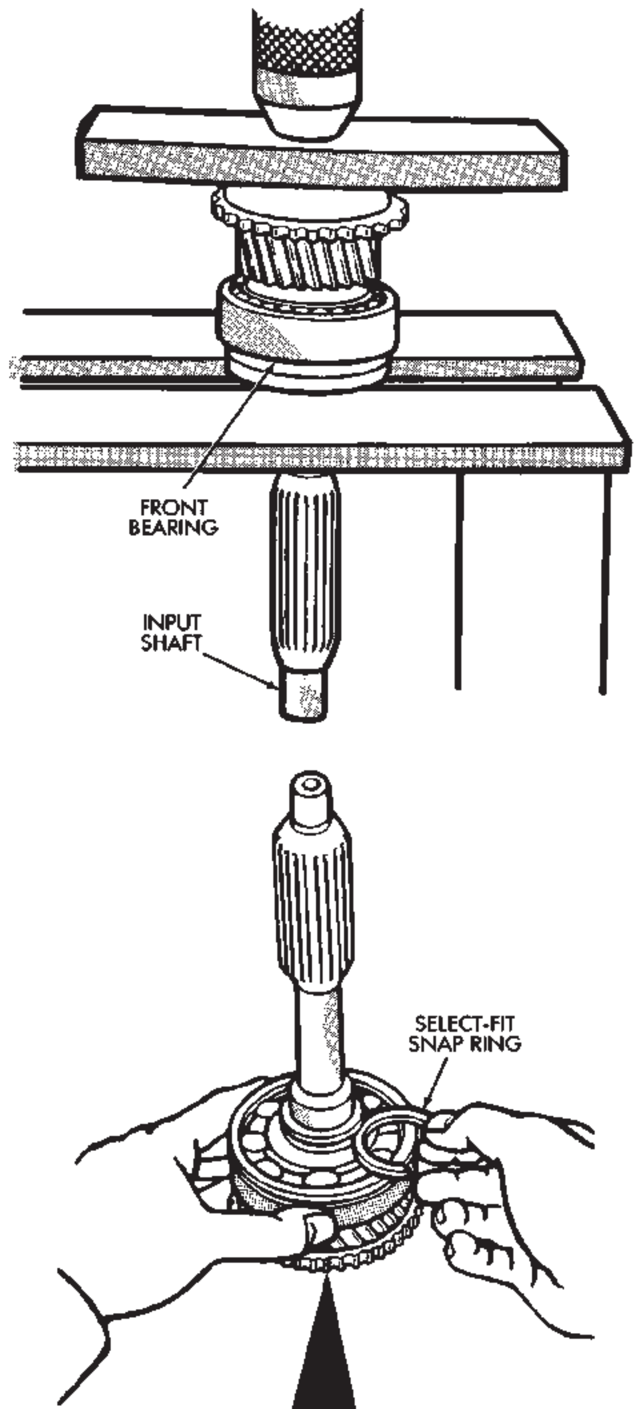
ASSEMBLY

(1) Position input shaft bearing onto input shaft.

(2) Using Driver L-4507, drive bearing onto input shaft.

(3) Select the thickest snap-ring that will fit into the snap-ring groove of the input shaft (Fig. 99).

(4) Lubricate output shaft pilot bearing bore of input shaft with petroleum jelly.



I.D. Mark	Snap Ring Thickness mm (in.)
0	2.05-2.10 (0.0807-0.0827)
1	2.10-2.15 (0.0827-0.0846)
2	2.15-2.20 (0.0846-0.0866)
3	2.20-2.25 (0.0866-0.0886)
4	2.25-2.30 (0.0886-0.0906)
5	2.30-2.35 (0.0906-0.0925)

J8921-50

Fig. 99 Select Input Shaft Bearing Snap-ring

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Install output shaft pilot bearing rollers in input shaft bore (Fig. 100). Ensure to use sufficient petroleum jelly to hold rollers in position.

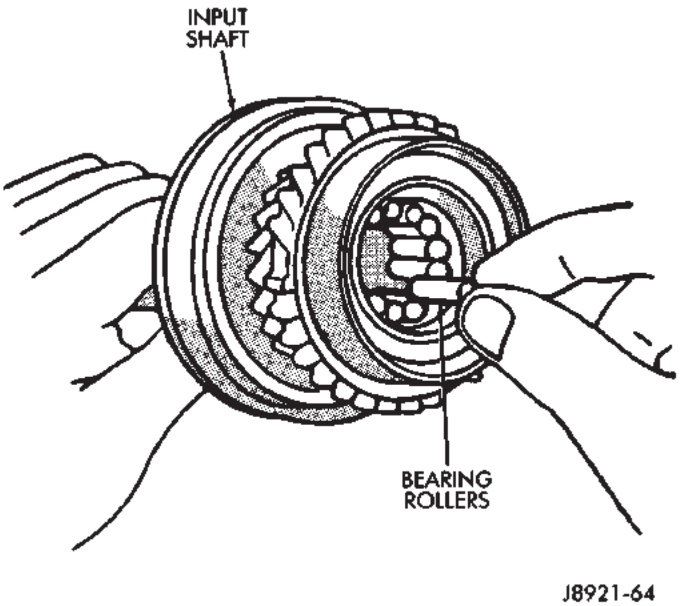


Fig. 100 Install Output Shaft Pilot Bearing Rollers

(6) Install the fourth gear synchronizer ring onto the input shaft.

(7) Install input shaft to output shaft. Use care when mating the two shafts not to displace any output shaft pilot bearing rollers.

OUTPUT SHAFT

DISASSEMBLY

(1) Remove input shaft and output shaft pilot bearing rollers from output shaft.

(2) Measure and note thrust clearance of output shaft gears (Fig. 101). Clearance should be 0.10 – 0.25 mm (0.004 – 0.010 in.).

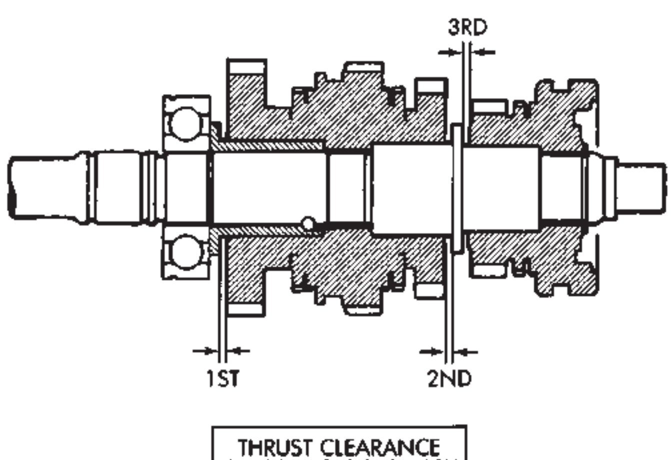


Fig. 101 Check Output Shaft Gear Thrust Clearance

(3) Remove output shaft fifth gear snap ring with two screwdrivers (Fig. 102).

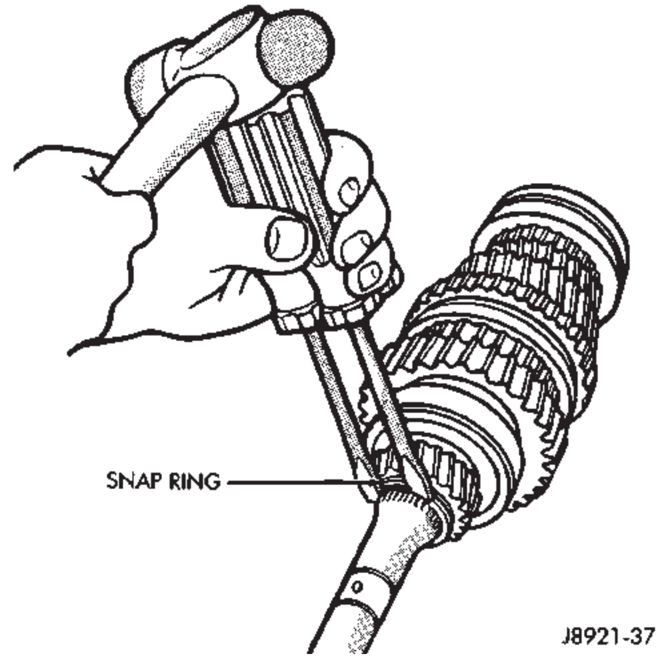


Fig. 102 Remove Fifth Gear Snap-ring

(4) Using Bearing Splitter P-334 or suitable press plates positioned under first gear, press fifth gear, rear bearing, first gear, and first gear bearing inner race off output shaft (Fig. 103).

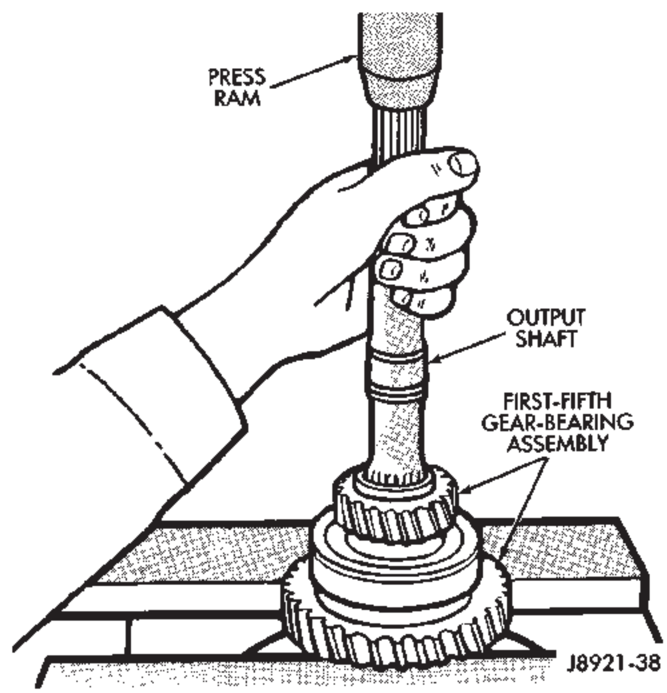


Fig. 103 Remove Fifth Gear, First Gear Bearing, And Race

(5) Remove first gear needle roller bearing from output shaft.

DISASSEMBLY AND ASSEMBLY (Continued)

(6) Remove first gear bearing inner race lock ball with pencil magnet (Fig. 104).

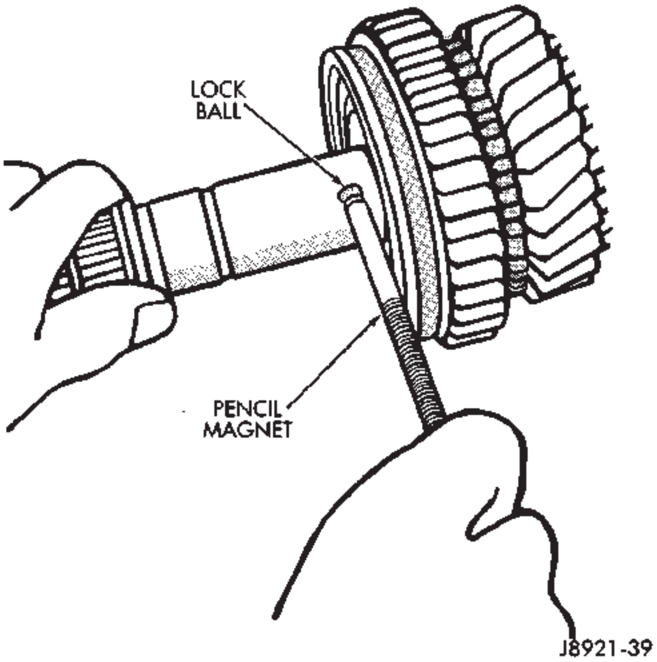


Fig. 104 Remove First Gear Bearing Inner Race Lock Ball

(7) Remove first gear synchronizer ring.

(8) Using Bearing Splitter P-334 or suitable press plates positioned under second gear, press 1–2 synchronizer, reverse gear, and second gear from output shaft (Fig. 105).

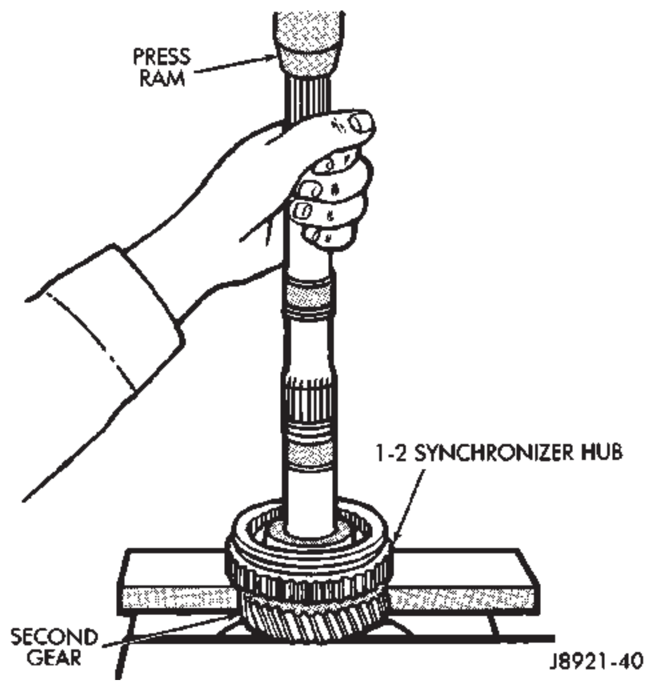


Fig. 105 Remove Second Gear, Reverse Gear, And 1–2 Synchronizer

(9) Remove second gear needle roller bearing from the output shaft or second gear.

(10) Remove select fit snap-ring holding the 3–4 synchronizer onto the output shaft (Fig. 106).

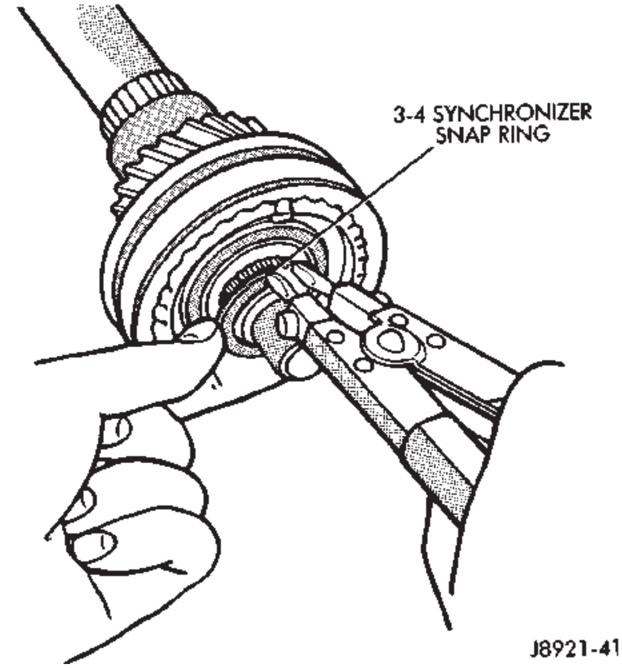


Fig. 106 Remove 3–4 Synchronizer Snap Ring

(11) Using Bearing Splitter P-334 or suitable press plates positioned under third gear, press the 3–4 synchronizer and third gear from output shaft (Fig. 107).

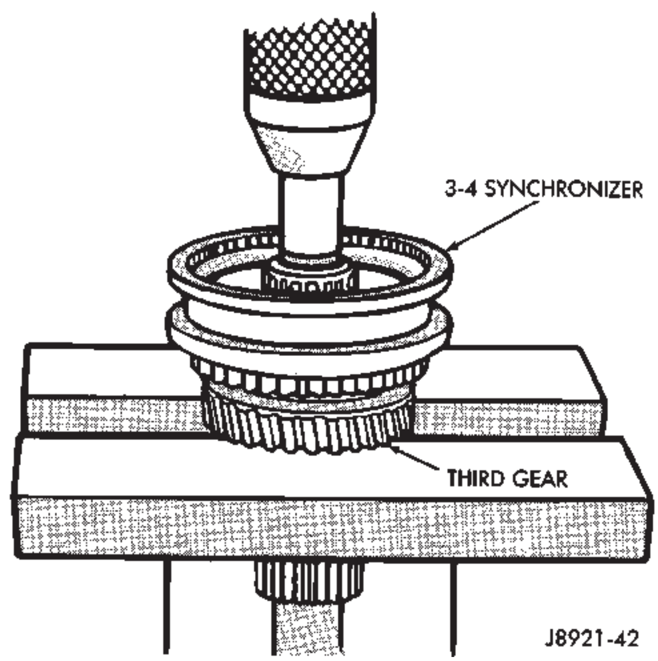


Fig. 107 Remove 3–4 Synchronizer And Third Gear

(12) Remove third gear needle roller bearing from output shaft or gear.

ASSEMBLY

(1) Lubricate transmission components with specified gear lubricant.

DISASSEMBLY AND ASSEMBLY (Continued)

(2) If necessary, assemble 1–2 and 3–4 synchronizer hubs, sleeves, springs and key inserts (Fig. 108).

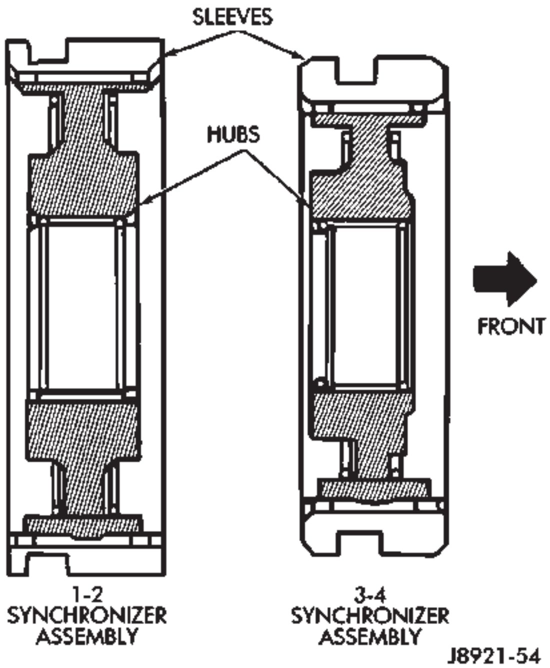


Fig. 108 Synchronizer Identification

(3) Install third gear needle bearing onto the output shaft.

(4) Install third gear over bearing and onto output shaft flange.

(5) Install third gear synchronizer ring to third gear.

(6) Position the 3–4 synchronizer onto the output shaft.

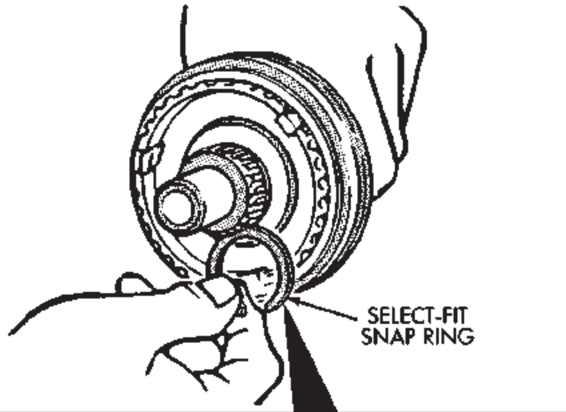
(7) Using Adapter 6747-1A and a shop press, press the 3–4 synchronizer onto the output shaft.

(8) Select the thickest snap-ring that will fit into the snap-ring groove of the output shaft (Fig. 109).

(9) Install snap-ring to hold 3–4 synchronizer onto output shaft.

(10) Verify third gear thrust clearance with feeler gauge (Fig. 110). Clearance should be 0.10 – 0.25 mm (0.004 – 0.010 in.). If clearance is out of specification, refer to Cleaning and Inspection section within this group.

(11) Install second gear needle bearing onto output shaft.



I.D. Mark	Snap Ring Thickness mm (in.)
C-1	1.75-1.80 (0.0689-0.0709)
D	1.80-1.85 (0.0709-0.0728)
D-1	1.85-1.90 (0.0728-0.0748)
E	1.90-1.95 (0.0748-0.0768)
E-1	1.95-2.00 (0.0768-0.0787)
F	2.00-2.05 (0.0788-0.0807)
F-1	2.05-2.10 (0.0807-0.0827)

J8921-55

Fig. 109 Select 3–4 Synchronizer Snap-ring

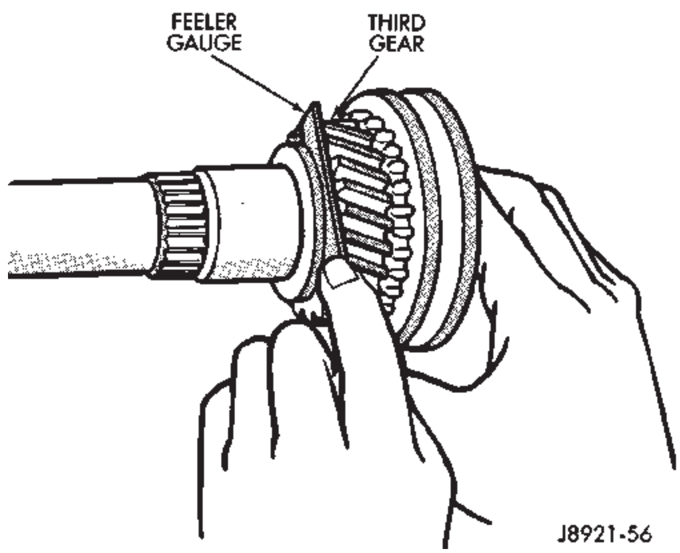


Fig. 110 Check Third Gear Clearance

(12) Install second gear over bearing and onto output shaft flange.

(13) Install second gear synchronizer ring onto second gear.

(14) Position 1–2 synchronizer assembly onto splines of output shaft.

DISASSEMBLY AND ASSEMBLY (Continued)

(15) Using Driver MD-998805, Adapter 6747-1A, and a shop press, press the 1–2 synchronizer onto the output shaft.

(16) Install first gear synchronizer ring into 1–2 synchronizer.

(17) Install first gear bearing inner race lock ball in output shaft (Fig. 111).

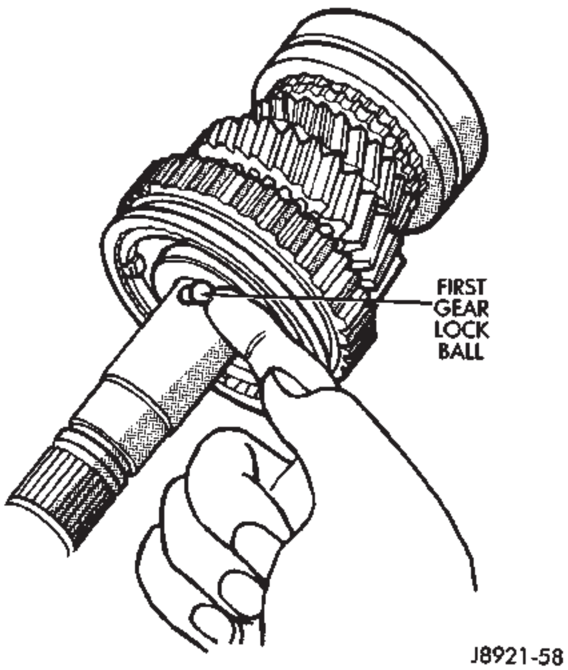


Fig. 111 Install First Gear Bearing Inner Race Lock Ball

(18) Install first gear needle bearing onto output shaft (Fig. 112).

(19) Install first gear onto output shaft and over bearing.

(20) Install first gear bearing inner race onto output shaft and inside first gear bearing. Rotate bearing race until race installs over lock ball.

(21) Position output shaft rear bearing onto output shaft. Ensure that the snap ring groove in bearing outer race is toward rear of output shaft.

(22) Using Driver L-4507 and suitable mallet, drive bearing onto output shaft.

(23) Install snap-ring onto output shaft rear bearing outer race.

(24) Check first–second gear thrust clearance (Fig. 113). Standard clearance is 0.10 – 0.25 mm (0.004 – 0.010 in.). If clearance is out of specification, refer to Cleaning and Inspection section within this group.

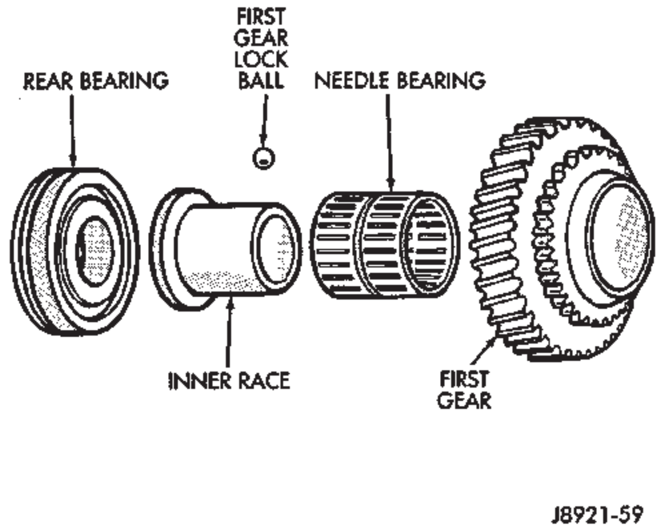


Fig. 112 First Gear Components

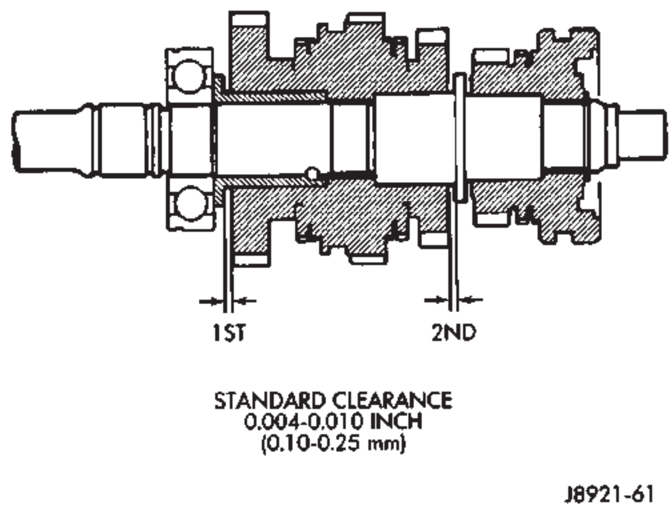


Fig. 113 Check First–Second Gear Thrust Clearance

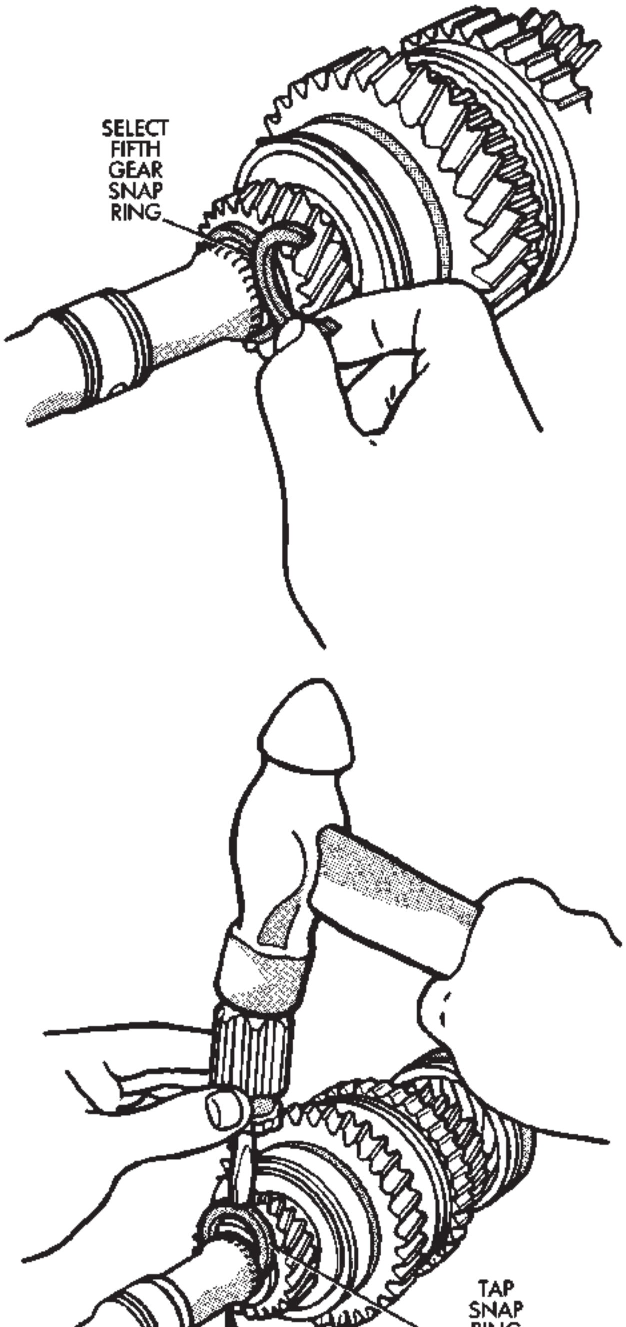
(25) Position fifth gear onto output shaft with the gear's short shoulder toward the rear of shaft. Ensure that the gear and output shaft splines are aligned.

(26) Using Adapter 6747-1A, Driver L-4507, and a shop press, press fifth gear onto output shaft.

(27) Select the thickest snap-ring that will fit into the snap-ring groove of the output shaft (Fig. 114).

(28) Install snap-ring to hold fifth gear onto output shaft.

DISASSEMBLY AND ASSEMBLY (Continued)



I.D. Mark	Snap Ring Thickness mm (in.)
A	2.67-2.72 (0.1051-0.1071)
B	2.73-2.78 (0.1075-0.1094)
C	2.79-2.84 (0.1098-0.1118)
D	2.85-2.90 (0.1122-0.1142)
E	2.91-2.96 (0.1146-0.1165)
F	2.97-3.02 (0.1169-0.1189)
G	3.03-3.08 (0.1193-0.1213)
H	3.09-3.14 (0.1217-0.1236)
J	3.15-3.20 (0.1240-0.1260)
K	3.21-3.26 (0.1264-0.1283)
L	3.27-3.32 (0.1287-0.1307)

J8921-63

Fig. 114 Select/Install Fifth Gear Snap Ring

SEMI-SYNCHRONIZED REVERSE IDLER GEAR

DISASSEMBLY

(1) Remove snap-ring holding the reverse idler gear onto the reverse idler gear hub/race (Fig. 115).

(2) Remove the plate washer from the reverse idler gear hub/race (Fig. 116).

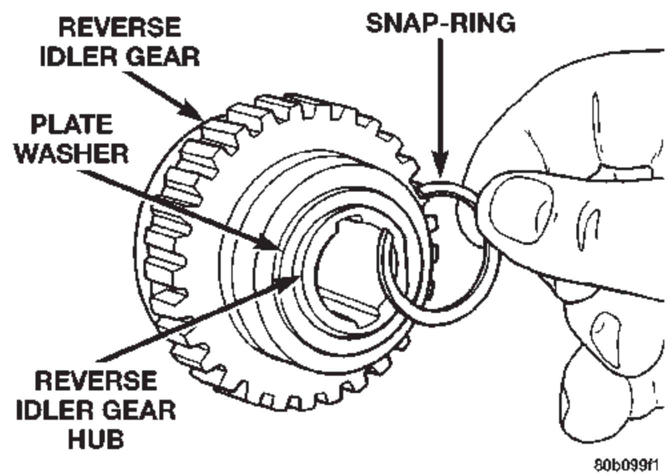


Fig. 115 Remove Reverse Idler Gear Snap-ring

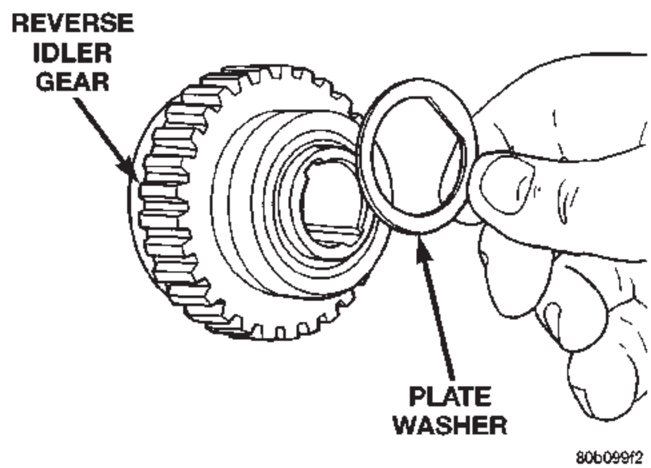


Fig. 116 Remove Reverse Idler Gear Plate Washer

(3) Remove the reverse idler gear from the reverse idler gear hub/race (Fig. 117).

(4) Remove the reverse idler gear synchronizer ring from the reverse idler gear hub/race (Fig. 118).

ASSEMBLY

(1) Install the reverse idler gear synchronizer ring onto the reverse idler gear hub/race. Apply a film of 75W-90 GL-3 transmission oil to the contact surface of the synchronizer ring prior to assembly.

(2) Install the reverse idler gear onto the reverse idler gear hub/race. Apply a film of 75W-90 GL-3 transmission oil to the reverse idler gear bushing prior to assembly-.Verify that the teeth on the synchronizer ring are properly engaged into the recesses of the reverse idler gear.

(3) Install the plate washer over the reverse idler gear hub/race and onto the reverse idler gear.

DISASSEMBLY AND ASSEMBLY (Continued)

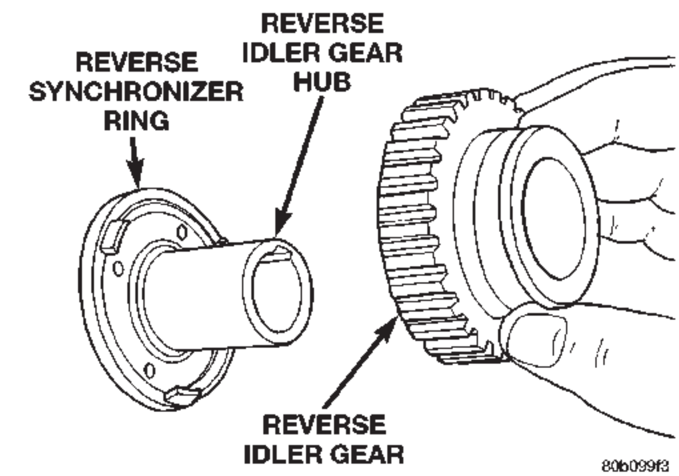


Fig. 117 Remove Reverse Idler Gear

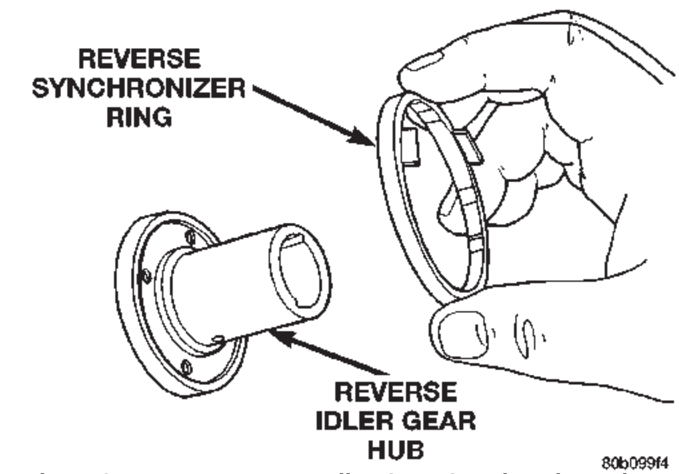


Fig. 118 Remove Reverse Idler Gear Synchronizer Ring

(4) Install the snap-ring to hold the reerse idler gear onto the reverse idler hub/race.

CLEANING AND INSPECTION

AX5 MANUAL TRANSMISSION COMPONENTS

GENERAL INFORMATION

Clean the transmission components in solvent. Dry the cases, gears, shift mechanism and shafts with compressed air. Dry the bearings with clean, dry shop towels only. Never use compressed air on the bearings. This could cause severe damage to the bearing roller and race surfaces.

If output shaft or inner race flange thickness is within specification but any gear thrust clearance is out of specification, replace the necessary gear and gear needle bearing as an assembly.

GEAR CASE, ADAPTER/EXTENSION HOUSING, INTERMEDIATE PLATE

Clean the case, housing, and intermediate plate with solvent and dry with compressed air. Replace the case if cracked, porous, or if any of the bearing and gear bores are damaged.

Inspect the threads in the case, housing, and plate. Minor thread damage can be repaired with steel thread inserts, if necessary. Do not attempt to repair any threads which show evidence of cracks around the threaded hole.

OUTPUT SHAFT

Check thickness of the output shaft and inner bearing race flanges with a micrometer or vernier calipers (Fig. 119).

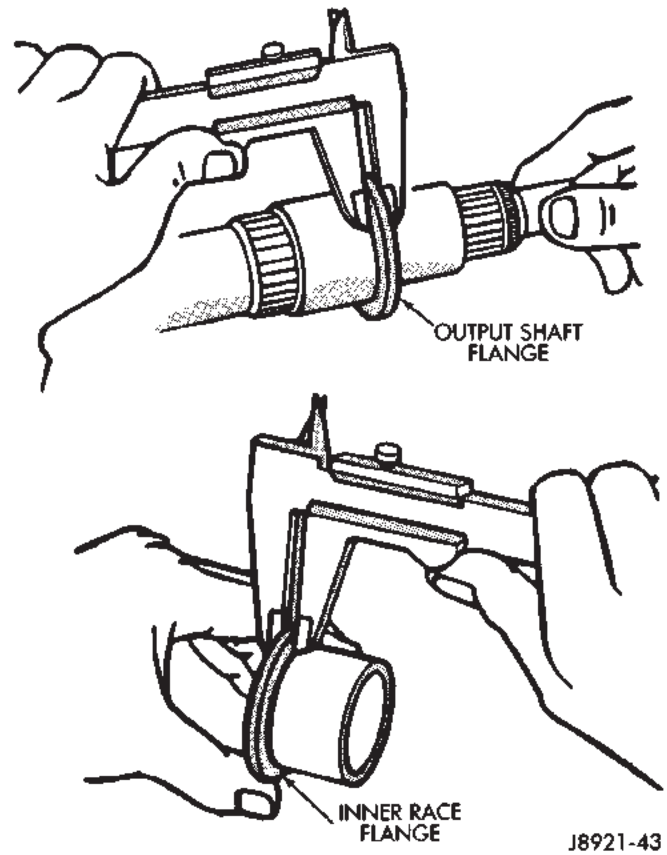


Fig. 119 Check Shaft And Bearing Race Flange Thickness

- Minimum thickness for shaft flange is 4.80 mm (0.189 in.)
- Minimum thickness for first gear bearing inner race flange is 3.99 mm (0.157 in.)

Measure diameter of the output shaft journal surfaces with a micrometer. Replace the shaft if either of these surfaces are worn beyond specified limits.

- Second gear surface minimum diameter is 37.964 mm (1.495 in.)
- Third gear surface minimum diameter is 34.984 mm (1.377 in.)

Measure diameter of the first gear bearing inner race. Minimum diameter is 38.985 mm (1.535 in.).

CLEANING AND INSPECTION (Continued)

Measure output shaft runout with a dial indicator (Fig. 120). Runout should not exceed 0.05 mm (0.002 in.).

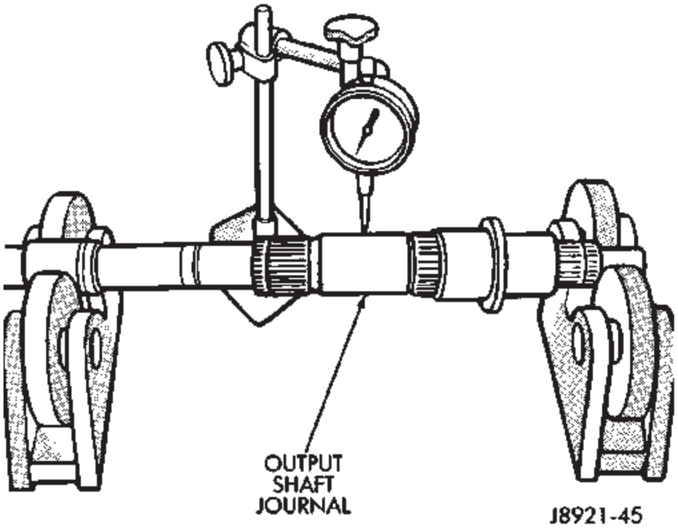


Fig. 120 Check Output Shaft Runout

Replace output shaft or first gear inner bearing race if measurement of any surface is out of specification. Do not attempt to repair out of specification components.

COUNTERSHAFT

Inspect the countershaft gear teeth. Replace the countershaft if any teeth are worn or damaged. Inspect the bearing surfaces and replace shaft if any surface shows damage or wear.

Check condition of the countershaft front bearing. Replace the bearing if worn, noisy, or damaged.

GEAR AND SYNCHRONIZER

Install the needle bearing and inner race in the first gear. Then check oil clearance between the gear and inner race (Fig. 121). Clearance should be 0.009 – 0.032 mm (0.0004 – 0.0013 in.).

Install the needle bearings and the second, third and counter fifth gears on the output shaft. Then check oil clearance between the gears and shaft with a dial indicator (Fig. 122). Oil clearance for all three gears is 0.009 – 0.0013 mm (0.0004 – 0.0013 in.).

Check synchronizer ring wear (Fig. 123). Insert each ring in matching gear. Measure clearance between each ring and gear with feeler gauge. Replace ring if clearance exceeds 2.0 mm (0.078 in.).

Check shift fork–to–synchronizer hub clearance with a feeler gauge (Fig. 124). Replace the fork if clearance exceeds 1.0 mm (0.039 in.).

(1) Inspect all mainshaft gear teeth. Replace any gear which shows any worn or damaged teeth.

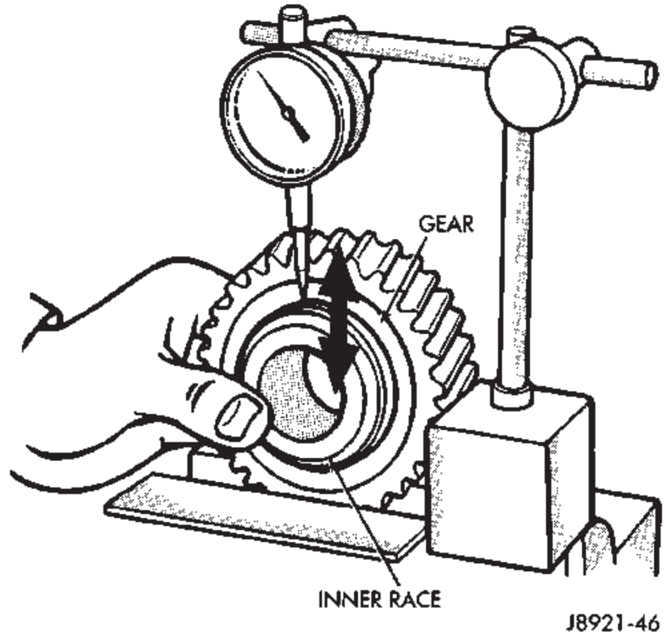


Fig. 121 Check Gear–To–Race Clearance

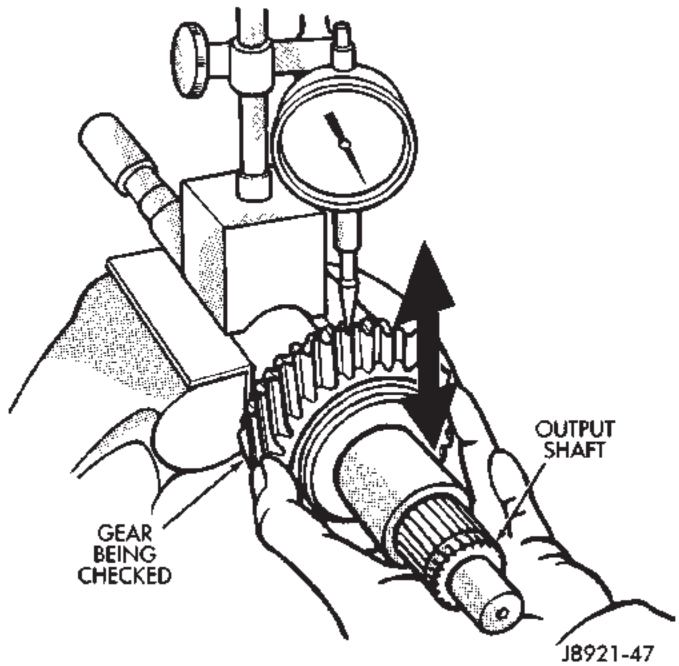


Fig. 122 Check Gear–To–Shaft Oil Clearance

CLEANING AND INSPECTION (Continued)

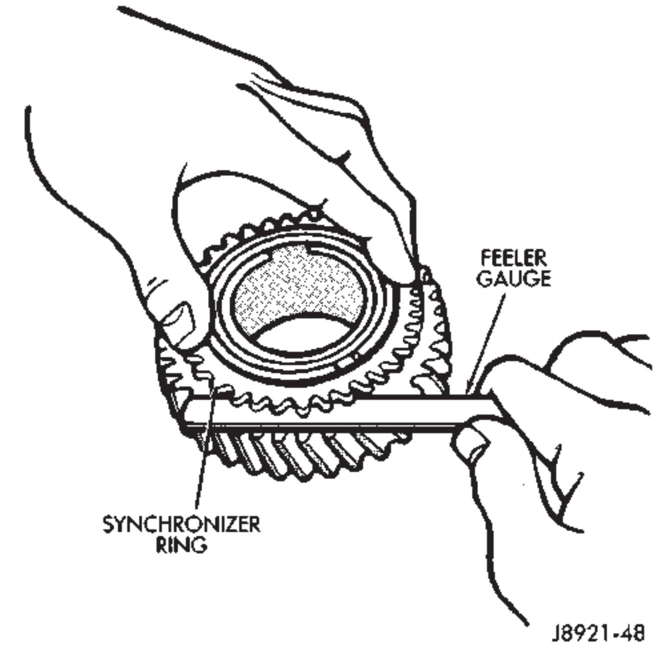


Fig. 123 Check Synchronizer Ring Wear

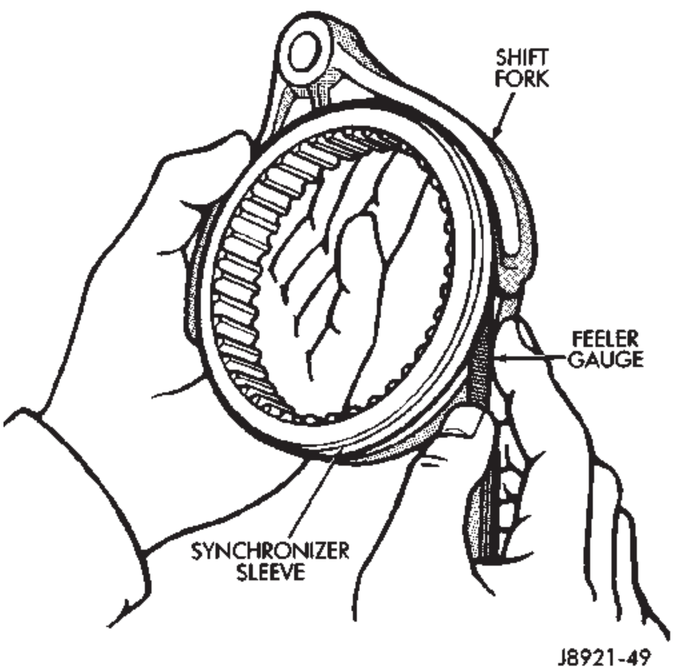


Fig. 124 Check Fork–To–Hub Clearance

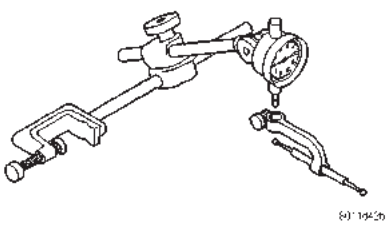
SPECIFICATIONS

TORQUE

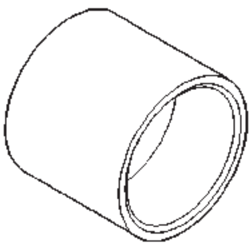
DESCRIPTION	TORQUE
Plugs, Access	19 N·m (14 ft.lbs.)
Bolts, Adapter Housing	34 N·m (25 ft.lbs.)
Switch, Back-up Light	44 N·m (32.5 ft.lbs.)
Plugs, Drain and Fill	44 N·m (32.5 ft.lbs.)
Bolts, Front Bearing Retainer	17 N·m (12 ft.lbs.)
Plugs, Interlock and Detent	19 N·m (14 ft.lbs.)
Screws, Propeller Shaft Clamp	16–23 N·m (140–200 in.lbs.)
Bolts, Rear Mount to Transmission	33–60 N·m (24–44 ft.lbs.)
Nut, Rear Mount Clevis	54–75 N·m (40–55 ft.lbs.)
Nuts, Rear Mount to Crossmember	33–49 N·m (24–36 ft.lbs.)
Pins, Restrictor	27.4 N·m (20 ft.lbs.)
Bolts, Reverse Shift Arm Bracket	18 N·m (13 ft.lbs.)
Screw, Shift Arm Set	38 N·m (28 ft.lbs.)
Screws, Shift Fork Set	20 N·m (15 ft.lbs.)
Nut, Shift Knob	20–34 N·m (15–25 ft.lbs.)
Screws, Shifter Floor Cover	2–3 N·m (17–30 in.lbs.)
Bolts, Shift Tower	18 N·m (13 ft.lbs.)
Nuts, Transfer Case Mounting	30–41 N·m (22–30 ft.lbs.)

SPECIAL TOOLS

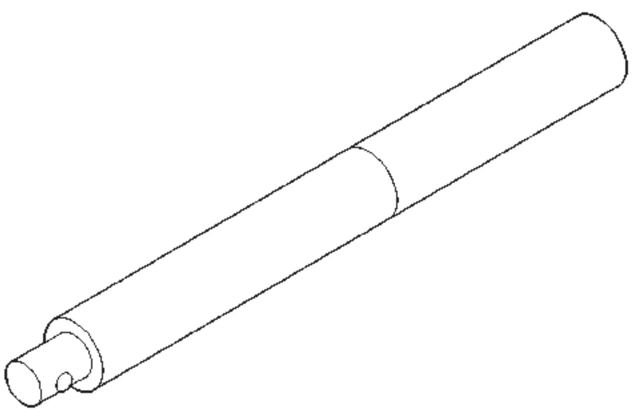
AX5



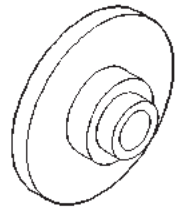
C-3339 Dial Indicator Set



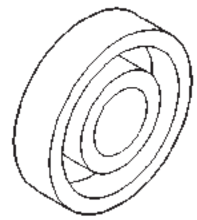
C-3995-A Installer, Extension Housing Seal



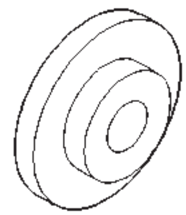
C-4171 Handle, Universal Tool



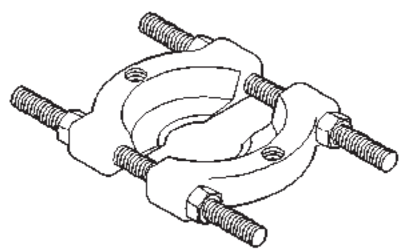
8211 Installer, Seal



8212 Installer, Seal

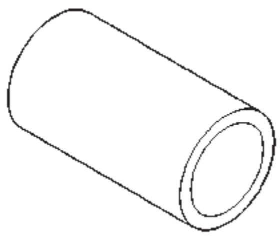


8208 Installer, Seal



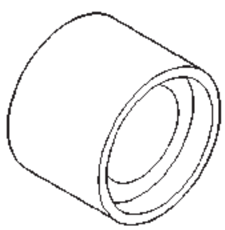
P-334 Splitter, Bearing

SPECIAL TOOLS (Continued)

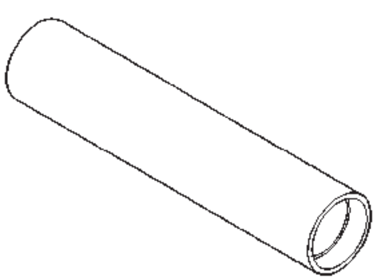


8109 Cup, Installer

L-4507 Tube, Driver



6747–1A Adapter, Fixture



MD-998805 Installer, Seal

AX15 MANUAL TRANSMISSION

INDEX

GENERAL INFORMATION

AX15 MANUAL TRANSMISSION

The AX15 is a 5–speed, synchromesh, manual transmission. Fifth gear is an overdrive range with a ratio of 0.79:1. An adapter housing is used to attach the transmission to the transfer case on 4–wheel drive models. A standard extension housing is used on 2–wheel drive models. The shift mechanism is integral and mounted in the shift tower portion of the adapter housing (Fig. 1).

TRANSMISSION IDENTIFICATION

The AX15 identification code numbers are on the bottom surface of the intermediate plate (Fig. 2).

The first number is year of manufacture. The second and third numbers indicate month of manufacture. The next series of numbers is the transmission serial number.

TRANSMISSION GEAR RATIOS

Gear ratios for the AX15 manual transmission are as follows:

- First gear: 3.83:1
- Second gear: 2.33:1
- Third gear: 1.44:1
- Fourth gear: 1.00:1
- Fifth gear: 0.79:1
- Reverse: 4.22:1

RECOMMENDED LUBRICANT

Recommended lubricant for AX15 transmissions is Mopar® 75W–90, API Grade GL–3 gear lubricant, or equivalent.

Correct lubricant level is from the bottom edge, to no more than 6 mm (1/4 in.) below the bottom edge of the fill plug hole.

The fill plug is located on the driver's side of the transmission case (Fig. 3). The drain plug is located on the passenger side of the transmission case near the bottom (Fig. 4).

Approximate dry fill lubricant capacity is:

- 3.10 liters (3.27 qts.) for 4–wheel drive applications.
- 3.15 liters (3.32 qts.) for 2–wheel drive applications.

TRANSMISSION ASSEMBLY INFORMATION

Lubricate the transmission components with Mopar® 75W–90, GL 3 gear lubricant during assembly. Use petroleum jelly to lubricate seal lips and/or hold parts in place during installation.

Refer to (Fig. 5) during assembly for AX15 gear assembly identification.

DIAGNOSIS AND TESTING

LOW LUBRICANT LEVEL

A low transmission lubricant level is generally the result of a leak, inadequate lubricant fill, or an incorrect lubricant level check.

DIAGNOSIS AND TESTING (Continued)

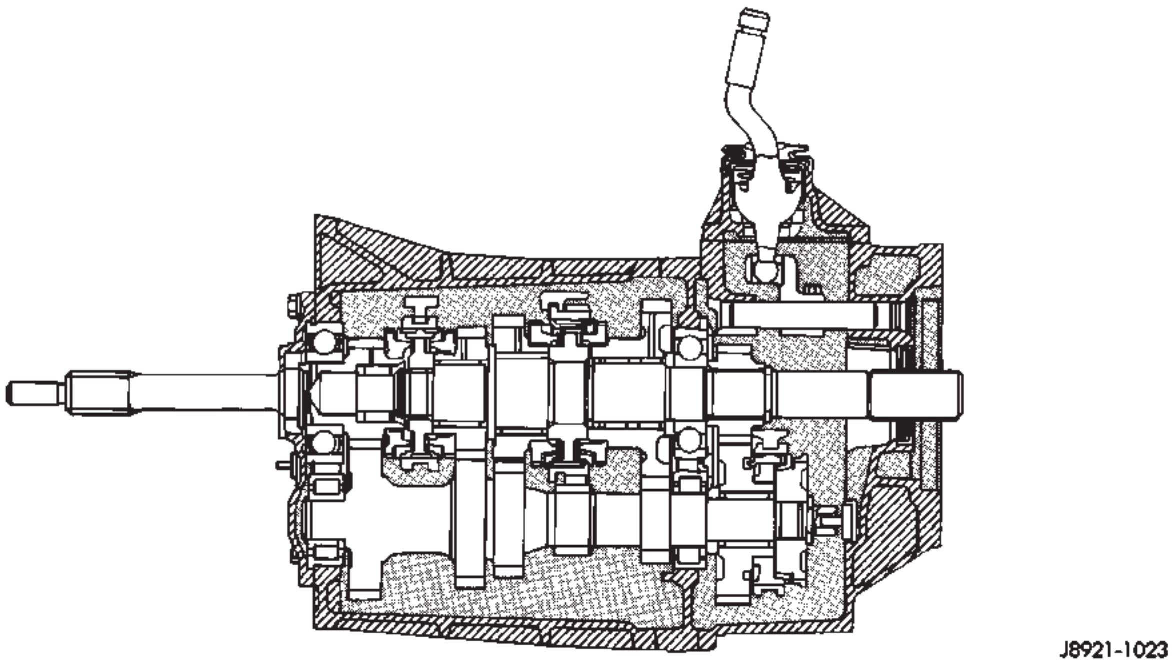


Fig. 1 AX15 Manual Transmission

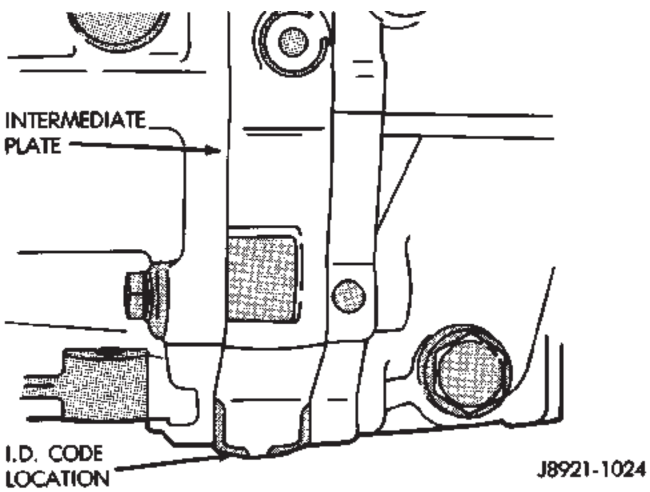


Fig. 2 Identification Code Number Location

Leaks can occur at the mating surfaces of the gear case, intermediate plate and adaptor or extension housing, or from the front/rear seals. A suspected leak could also be the result of an overfill condition.

Leaks at the rear of the extension or adapter housing will be from the housing oil seals. Leaks at component mating surfaces will probably be the result of inadequate sealer, gaps in the sealer, incorrect bolt tightening, or use of a non–recommended sealer.

A leak at the front of the transmission will be from either the front bearing retainer or retainer seal. Lubricant may be seen dripping from the clutch housing after extended operation. If the leak is severe, it may also contaminate the clutch disc causing the disc to slip, grab, and/or chatter.

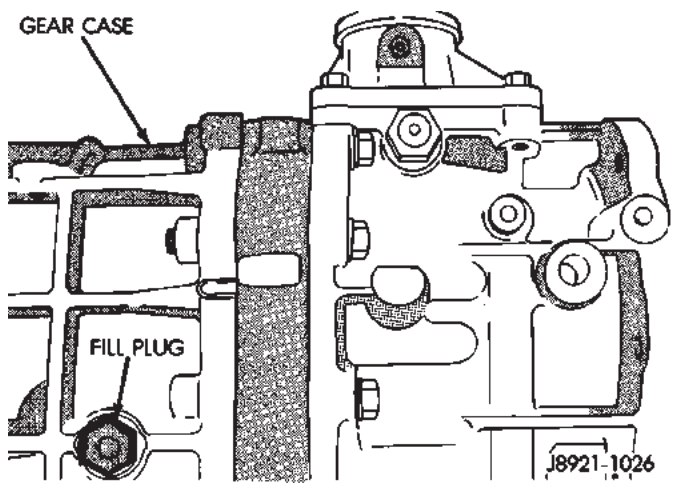


Fig. 3 Fill Plug Location

A correct lubricant level check can only be made when the vehicle is level. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an underfill or overfill condition. Always check the lubricant level after any addition of fluid to avoid an incorrect lubricant level condition.

HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper, or contaminated lubricants. The consequence of using non–recommended lubricants is noise, excessive wear, internal bind, and hard shifting. Substantial lubricant leaks can result in gear, shift rail, synchro, and bearing damage. If a leak goes undetected for an extended period, the first indi-

DIAGNOSIS AND TESTING (Continued)

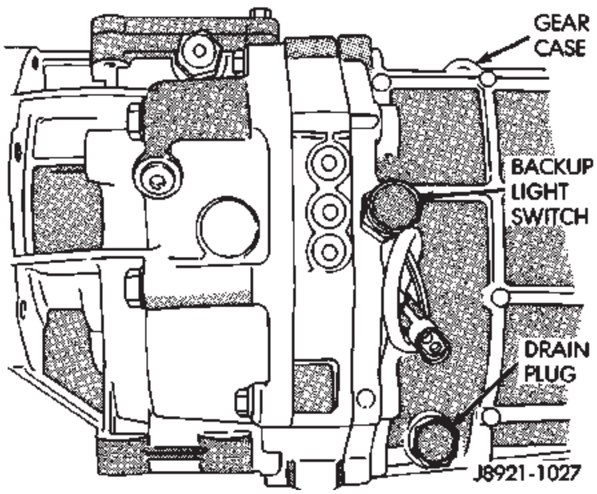


Fig. 4 Drain Plug Location

cations of component damage are usually hard shifting and noise.

Component damage, incorrect clutch adjustment, or a damaged clutch pressure plate or disc are additional probable causes of increased shift effort. Incorrect adjustment or a worn/damaged pressure plate or disc can cause incorrect release. If the clutch problem is advanced, gear clash during shifts can result. Worn or damaged synchro rings can cause gear clash when shifting into any forward gear. In some new or rebuilt transmissions, new synchro rings may tend to stick slightly causing hard or noisy shifts. In most cases, this condition will decline as the rings wear–in.

TRANSMISSION NOISE

Most manual transmissions make some noise during normal operation. Rotating gears generate a mild whine that is audible, but generally only at extreme speeds.

Severe, highly audible transmission noise is generally the initial indicator of a lubricant problem. Insufficient, improper, or contaminated lubricant will promote rapid wear of gears, synchros, shift rails, forks and bearings. The overheating caused by a lubricant problem, can also lead to gear breakage.

REMOVAL AND INSTALLATION

TRANSMISSION

REMOVAL

(1) Shift transmission into first or third gear.

(2) Raise and support vehicle on suitable safety stands.

(3) Disconnect necessary exhaust system components.

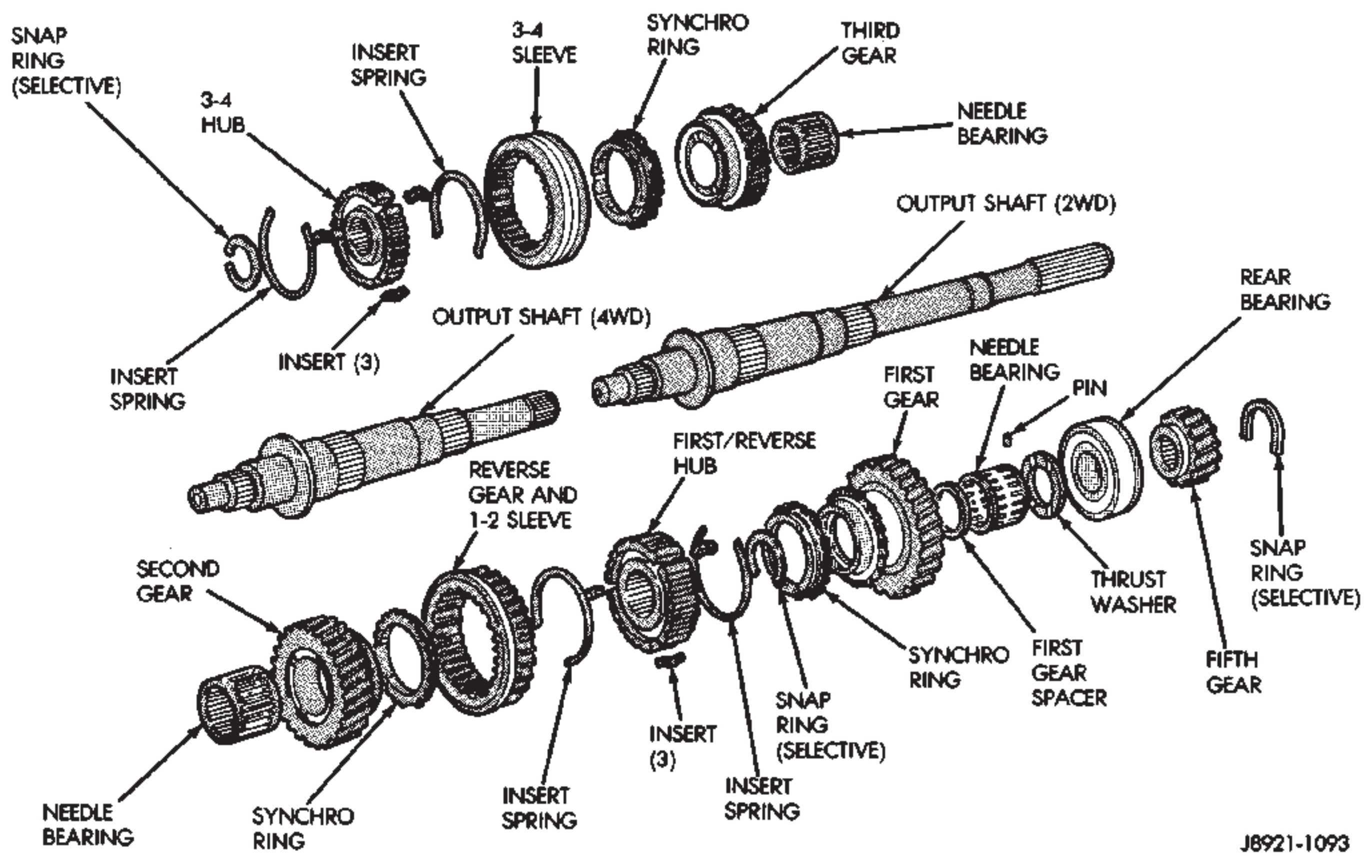


Fig. 5 Output Shaft and Gears

REMOVAL AND INSTALLATION (Continued)

(4) Remove skid plate, if equipped.

(5) Remove slave cylinder from clutch housing.

(6) Mark rear propeller shaft and rear axle yokes for installation alignment (Fig. 6).

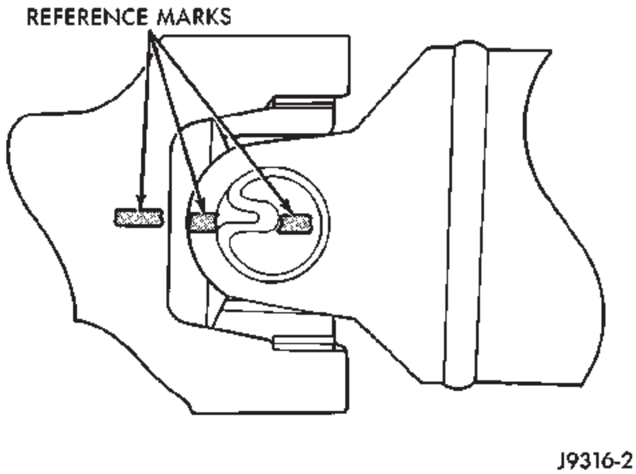


Fig. 6 Marking Propeller Shaft And Axle Yokes

(7) Mark front propeller shaft, axle, and transfer case yokes for installation alignment, if equipped.

(8) Remove propeller shaft(s).

(9) Unclip wire harnesses from transmission and transfer case, if equipped.

(10) Disconnect transfer case vent hose, if equipped.

(11) Disengage any wire connectors attached to transmission or transfer case, if equipped, components.

(12) Support transfer case, if equipped, with transmission jack.

(13) Secure transfer case, if equipped, to jack with safety chains.

(14) Disconnect transfer case shift linkage at transfer case, if equipped.

(15) Remove nuts attaching transfer case to transmission, if equipped.

(16) Remove transfer case, if equipped.

(17) Remove crankshaft position sensor (Fig. 7), (Fig. 8).

CAUTION: It is important that the crankshaft position sensor be removed prior to transmission removal. The sensor can easily be damaged if left in place during removal operations.

(18) Support engine with adjustable jack stand. Position wood block between jack and oil pan to avoid damaging pan.

(19) Support transmission with transmission jack.

(20) Secure transmission to jack with safety chains.

(21) Disconnect rear cushion and bracket from transmission.

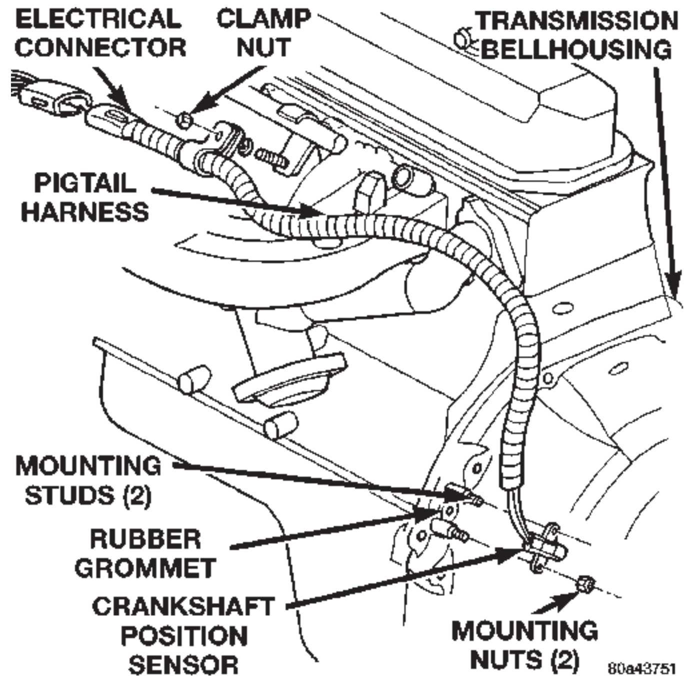


Fig. 7 Crankshaft Position Sensor—2.5L Engine

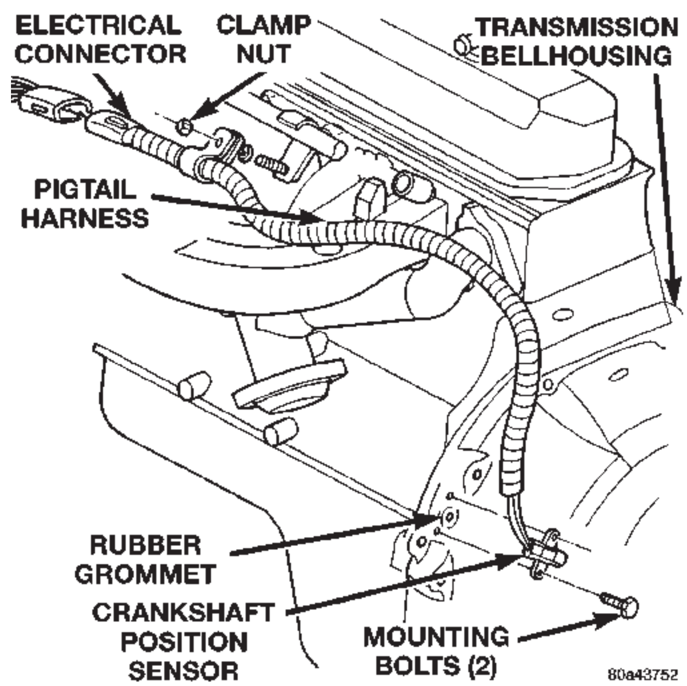


Fig. 8 Crankshaft Position Sensor —4.0L Engine

(22) Remove rear crossmember.

(23) Disconnect transmission shift lever as follows:

(a) Lower transmission–transfer case assembly approximately 7–8 cm (3 in.) for access to shift lever.

REMOVAL AND INSTALLATION (Continued)

(b) Reach up and around transmission case and unseat shift lever dust boot from transmission shift tower (Fig. 9). Move boot upward on shift lever for access to retainer that secures lever in shift tower.

(c) Reach up and around transmission case and press shift lever retainer downward with finger pressure. Turn retainer counterclockwise to release it.

(d) Lift lever and retainer out of shift tower (Fig. 9). Do not remove the shift lever from the floor console shifter boots. Leave the lever in place for transmission installation.

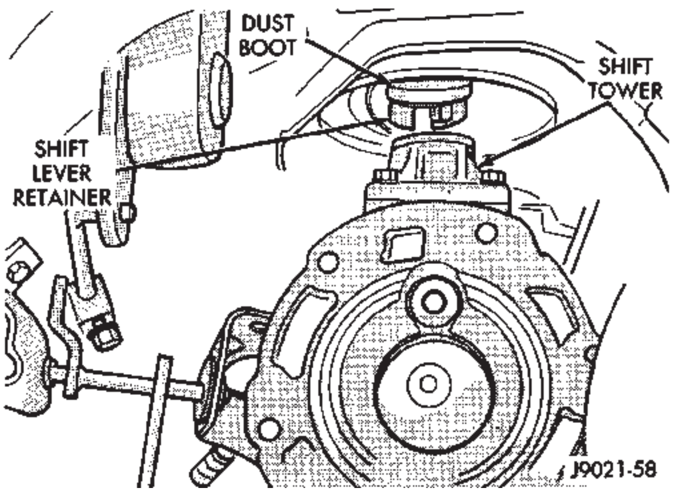


Fig. 9 Removing/Installing Shift Lever

(24) Remove clutch housing brace rod.

(25) Remove clutch housing-to-engine bolts.

(26) Pull transmission jack rearward until input shaft clears clutch. Then slide transmission out from under vehicle.

(27) Remove clutch release bearing, release fork, and retainer clip.

(28) Remove clutch housing from transmission (Fig. 10).

INSTALLATION

(1) Install clutch housing on transmission. Tighten housing bolts to 37 N·m (27 ft. lbs.) torque.

(2) Lubricate contact surfaces of release fork pivot ball stud and release fork with high temp grease.

(3) Install release bearing, fork, and retainer clip.

(4) Position and secure transmission on transmission jack.

(5) Lightly lubricate pilot bearing and transmission input shaft splines with Mopar® high temp grease.

(6) Raise transmission and align transmission input shaft and clutch disc splines. Then slide transmission into place.

(7) Install and tighten clutch housing-to-engine bolts to 38 N·m (28 ft. lbs.) torque (Fig. 10). **Be sure the housing is properly seated on engine block before tightening bolts.**

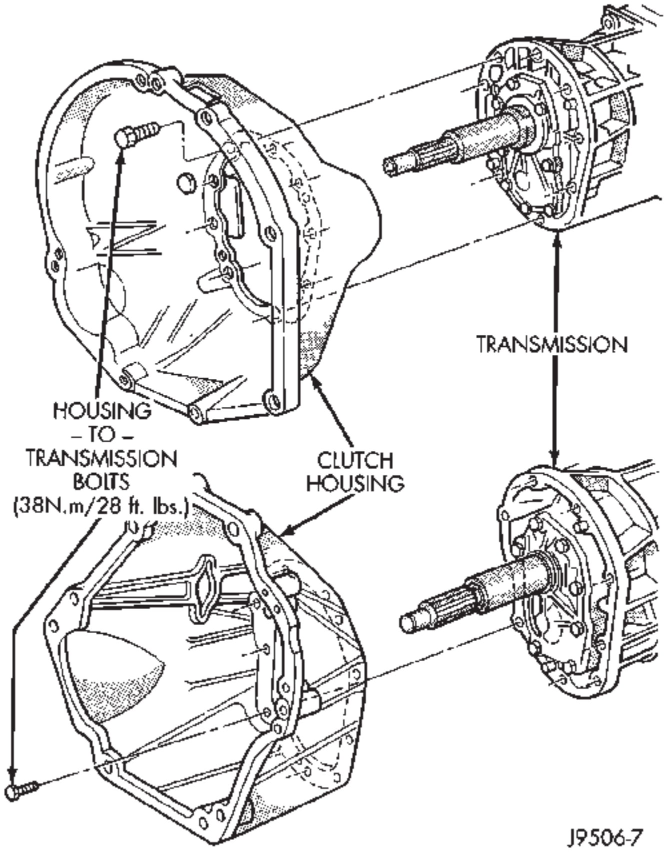


Fig. 10 Clutch Housing

(8) Install clutch housing brace rod.

(9) Lower transmission approximately 7–8 cm (3 in.) for access to shift tower. Be sure transmission is in first or third gear.

(10) 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.

(11) Install rear crossmember. Tighten crossmember-to-frame bolts to 41 N·m (31 ft. lbs.) torque.

(12) Install fasteners to hold rear cushion and bracket to transmission. Then tighten transmission-to-rear support bolts/nuts to 45 N·m (33 ft. lbs.) torque.

(13) Remove support stands from engine and transmission.

(14) Install and connect crankshaft position sensor.

(15) Position transfer case on transmission jack, if equipped.

(16) Secure transfer case to jack with safety chains, if equipped.

(17) Raise transfer case, if equipped, and align transfer case input shaft to the transmission output shaft.

REMOVAL AND INSTALLATION (Continued)

(18) Slide transfer case forward until case is seated on transmission, if necessary.

(19) Install nuts to attach transfer case to transmission, if equipped. Tighten transfer case-to-transmission nuts to 35 N·m (26 ft. lbs.) torque.

(20) Connect transfer case shift linkage at transfer case, if equipped.

(21) Connect transfer case vent hose, if equipped.

(22) Secure wire harnesses in clips/tie straps on transmission and transfer case, if equipped.

(23) Engage wire connectors attached to all necessary transmission or transfer case, if equipped, components.

(24) Install rear propeller shaft slip yoke to transmission or transfer case, if equipped, output shaft.

(25) Align marks on rear propeller shaft and rear axle yokes (Fig. 11).

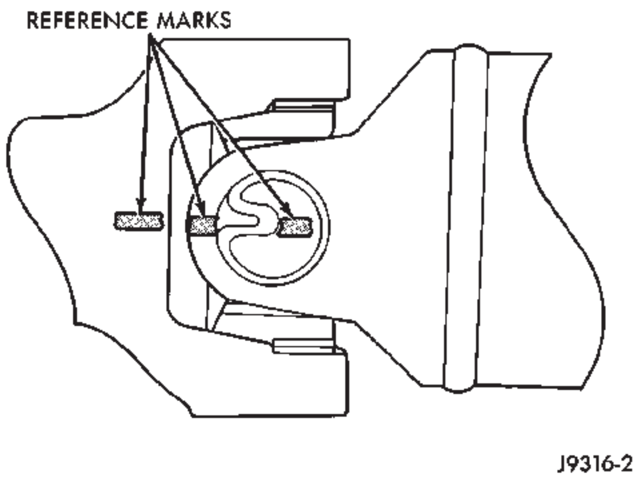


Fig. 11 Align Propeller Shaft And Rear Axle Yokes Alignment Marks

(26) Install and tighten propeller shaft U–joint clamp bolts to 19 N·m (170 in. lbs.) torque.

(27) Align marks on front propeller shaft, axle, and transfer case yokes, if equipped.

(28) Install and tighten propeller shaft U–joint clamp bolts to 19 N·m (170 in. lbs.) torque.

(29) Install slave cylinder in clutch housing.

(30) Install skid plate, if equipped. Tighten bolts to 42 N·m (31 ft. lbs.) torque. Tighten stud nuts to 17 N·m (150 in. lbs.) torque.

(31) Fill transmission and transfer case, if equipped, with recommended lubricants. Refer to the Lubricant Recommendation sections of the appropriate component for correct fluid.

(32) Lower vehicle.

FRONT BEARING RETAINER SEAL

REMOVAL

(1) Remove release bearing and lever from the transmission.

(2) Remove the bolts holding the front bearing retainer to the transmission case.

(3) Remove the front bearing retainer from the transmission case.

(4) Using a suitable pry tool, remove the front bearing retainer seal.

INSTALLATION

(1) Using Tool Handle C-4171 and Seal Installer 8209, install new seal in to the front bearing retainer (Fig. 12).

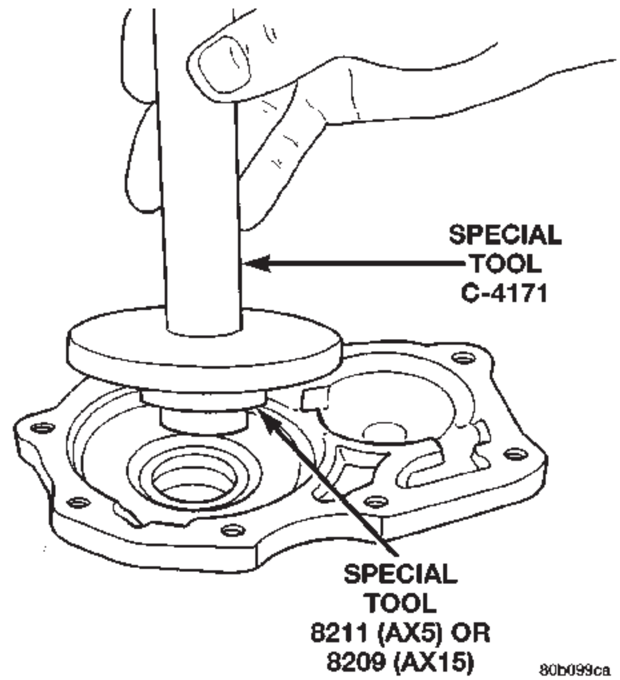


Fig. 12 Install Front Bearing Retainer Seal

(2) Remove any residual gasket material from the sealing surfaces of the bearing retainer and the transmission case.

(3) Install new front bearing retainer gasket to the front bearing retainer.

(4) Install the front bearing retainer onto the transmission case.

(5) Install the bolts to hold the bearing retainer onto the transmission case.

(6) Tighten the bolts to 17 N·m (12 ft. lbs.).

(7) Install release bearing and lever onto the transmission.

REMOVAL AND INSTALLATION (Continued)

EXTENSION HOUSING SEAL

REMOVAL

(1) Raise and support vehicle.

(2) Remove propeller shaft. Refer to Group 3, Differential and Driveline, for proper procedures.

(3) Using a suitable seal puller or screw with a slide hammer, remove the extension housing seal (Fig. 13).

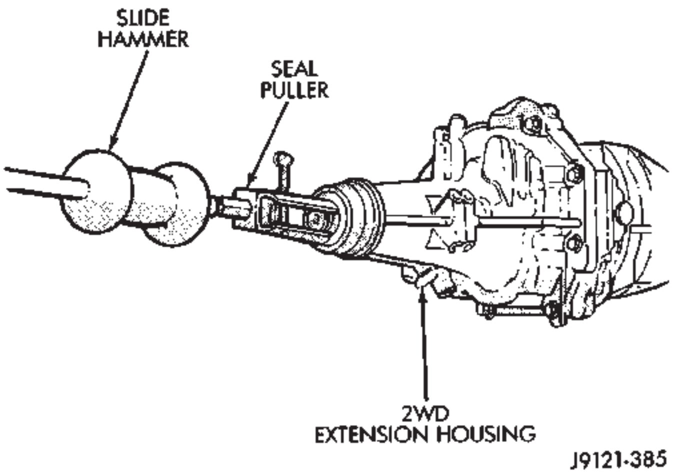


Fig. 13 Remove Extension Housing Seal

INSTALLATION

(1) Clean seal bore of extension housing of any residual sealer material from original seal.

(2) Using Tool Handle C-4171 and Seal Installer 8212, install new extension housing seal so that the seal is located 0 ± 0.5 mm (0 ± 0.02 in.) to the face of the extension housing (Fig. 14).

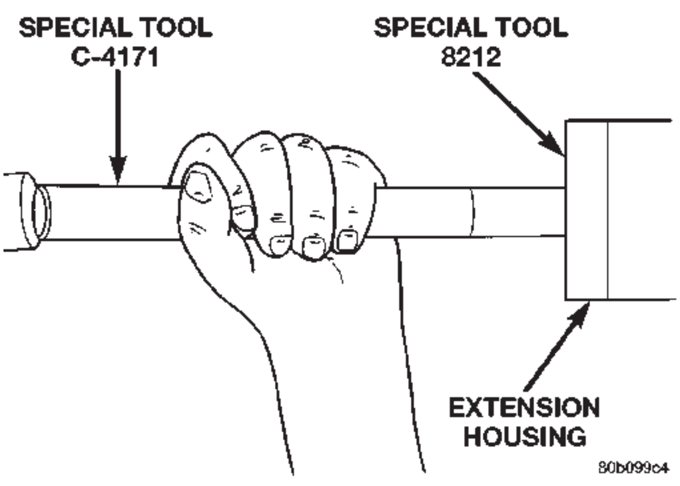


Fig. 14 Install Extension Housing Seal

(3) Install propeller shaft. Refer to Group 3, Differential and Driveline, for proper procedures.

(4) Check and add fluid to transmission as necessary. Refer to the Recommended Lubricant section for proper fluid requirements.

(5) Lower vehicle.

ADAPTER HOUSING SEAL

REMOVAL

(1) Hoist and support vehicle.

(2) Remove transfer case.

(3) Using a suitable pry tool, or a slide hammer mounted screw, remove the adapter housing seal (Fig. 15).

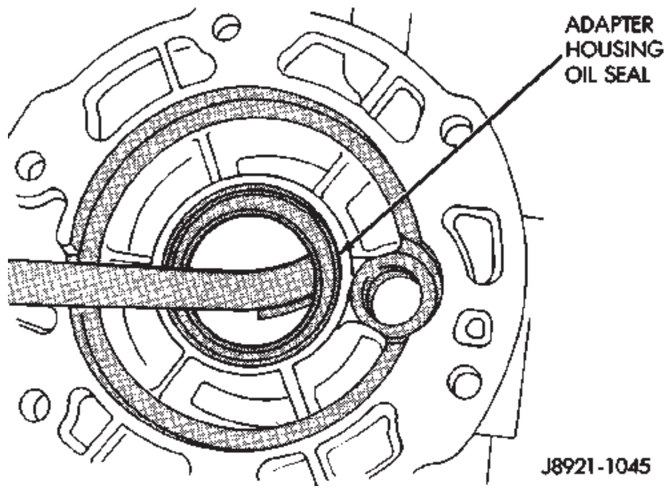


Fig. 15 Remove Adapter Housing Seal

INSTALLATION

(1) Clean seal bore of adapter housing of any residual sealer material from original seal.

(2) Using Tool Handle C-4171 and Seal Installer 8208, install new seal so that the seal is located 0 ± 0.2 mm (0 ± 0.008 in.) to the seal bore face of adapter housing (Fig. 16).

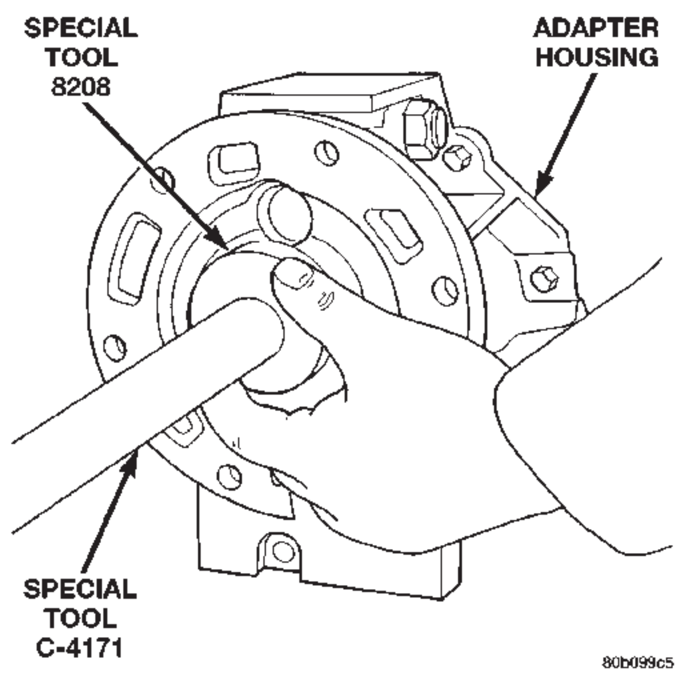


Fig. 16 Install Adapter Housing Seal

REMOVAL AND INSTALLATION (Continued)

(3) Install transfer case.

(4) Check and add fluid to transmission as necessary. Refer to the Recommended Lubricant section for proper fluid requirements.

(5) Lower vehicle.

DISASSEMBLY AND ASSEMBLY

ADAPTER/EXTENSION HOUSING AND FRONT BEARING RETAINER

DISASSEMBLY

(1) Drain transmission lubricant, if necessary.

(2) Remove release bearing and lever.

(3) Remove clutch housing bolts and remove housing (Fig. 19).

(4) Remove vehicle speed sensor and speedometer adapter, if necessary.

(5) Remove bolts holding shift tower to transmission case.

(6) Remove shift tower from transmission case (Fig. 17).

(7) Remove shift tower gasket from shift tower or transmission case (Fig. 18).

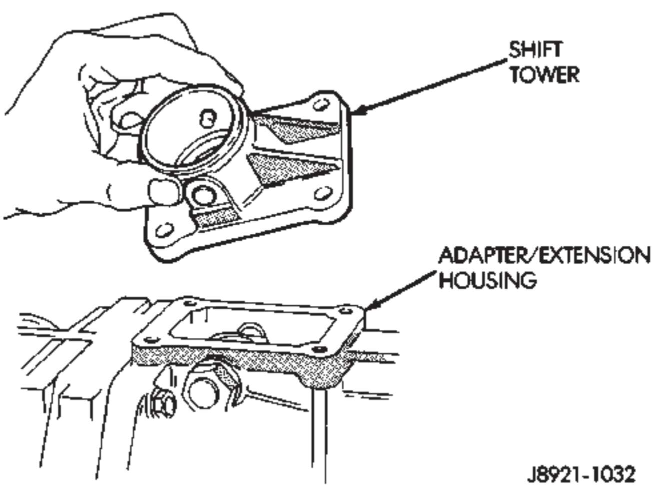


Fig. 17 Remove Shift Tower

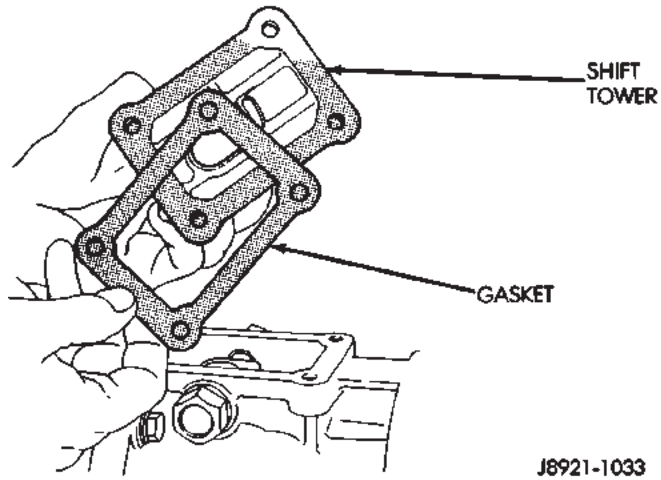


Fig. 18 Remove Shift Tower Gasket

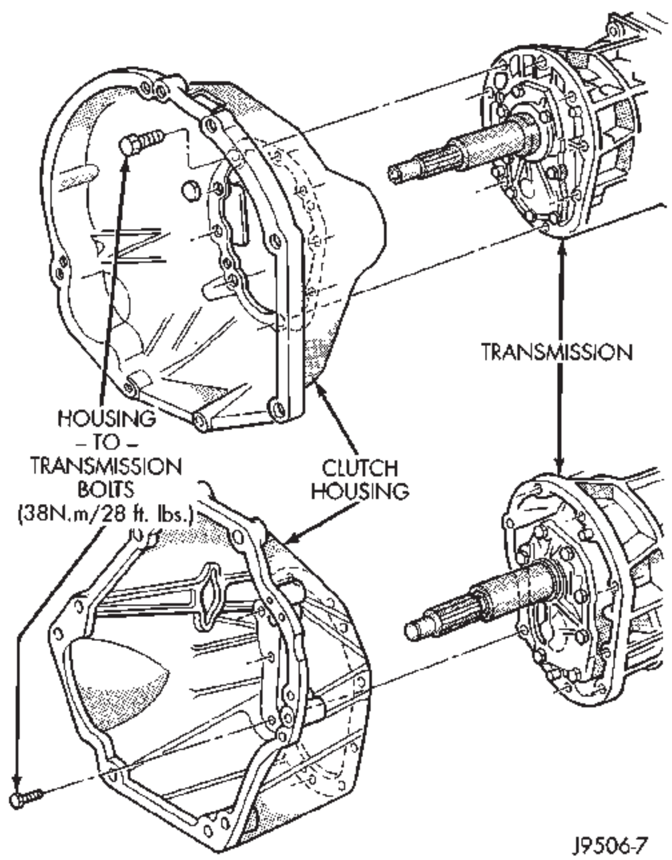


Fig. 19 Clutch Housing

DISASSEMBLY AND ASSEMBLY (Continued)

(8) Remove reverse shift head detent ball plug (Fig. 20).

(9) Remove detent ball spring and ball with pencil magnet (Fig. 21), (Fig. 22).

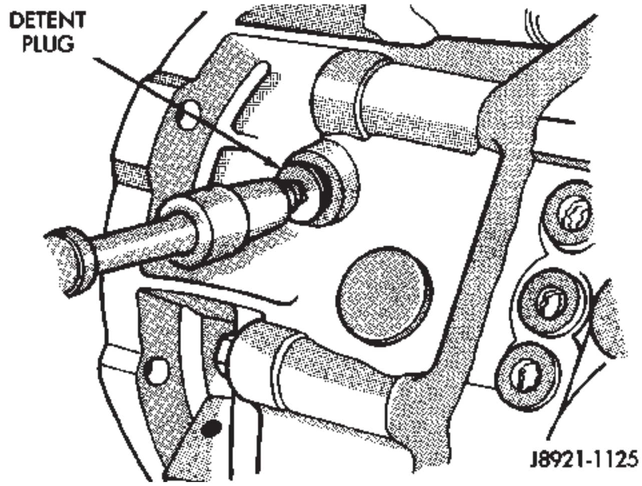


Fig. 20 Remove Detent Ball Plug

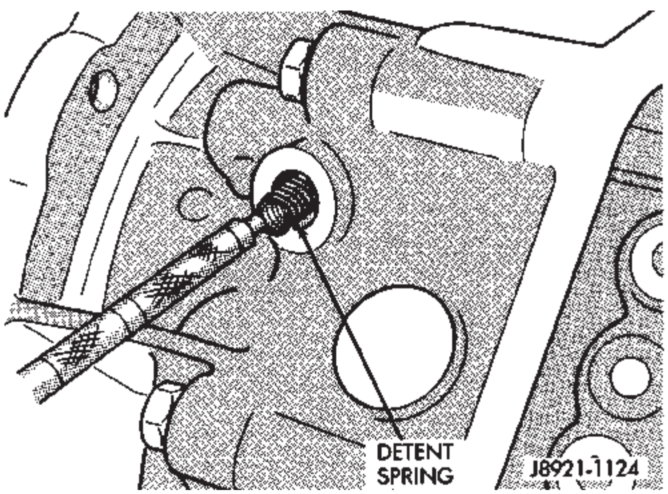


Fig. 21 Remove Detent Spring

(10) Remove shift arm retainer bolt (Fig. 23).

(11) Remove shift arm restrictor pins (Fig. 24).

(12) Remove shift lever shaft plug (Fig. 25).

(13) Remove shifter shaft with large magnet (Fig. 26).

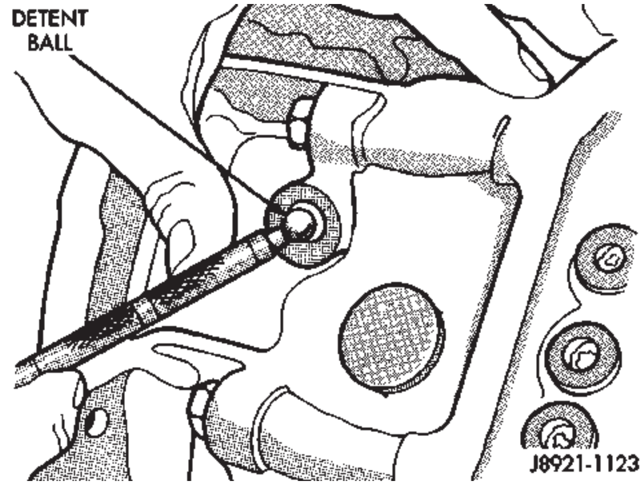


Fig. 22 Remove Detent Ball

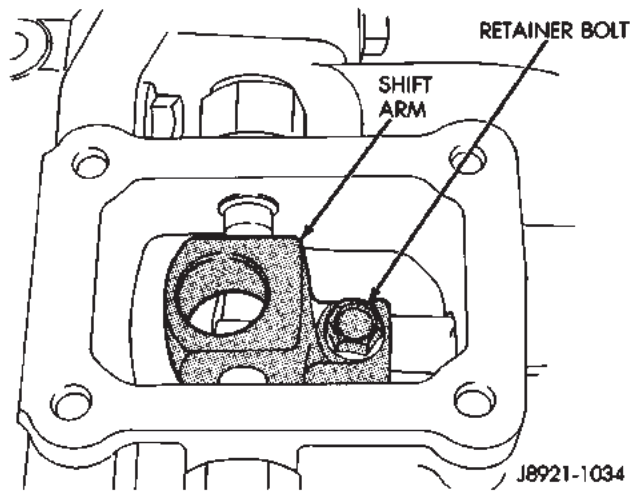


Fig. 23 Shift Arm Retainer Bolt Removal

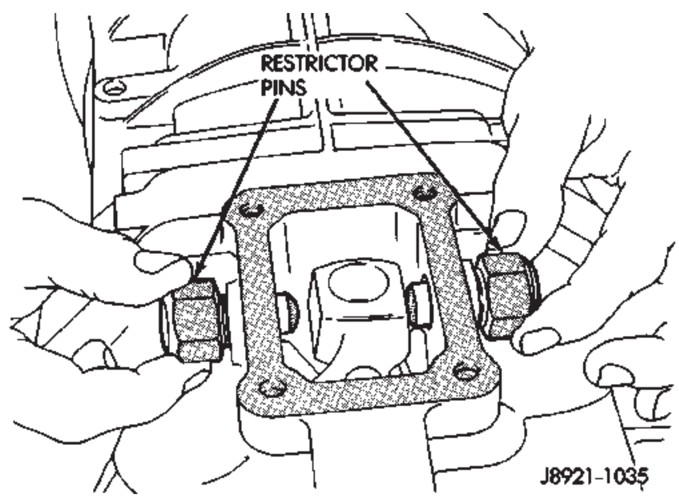


Fig. 24 Shift Arm Rstrictor Pins

DISASSEMBLY AND ASSEMBLY (Continued)

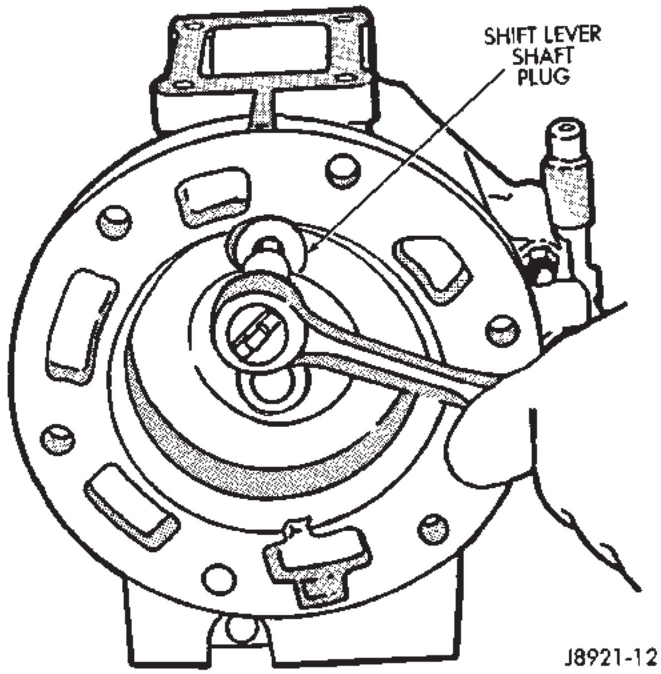


Fig. 25 Removing Shift Lever Shaft Plug

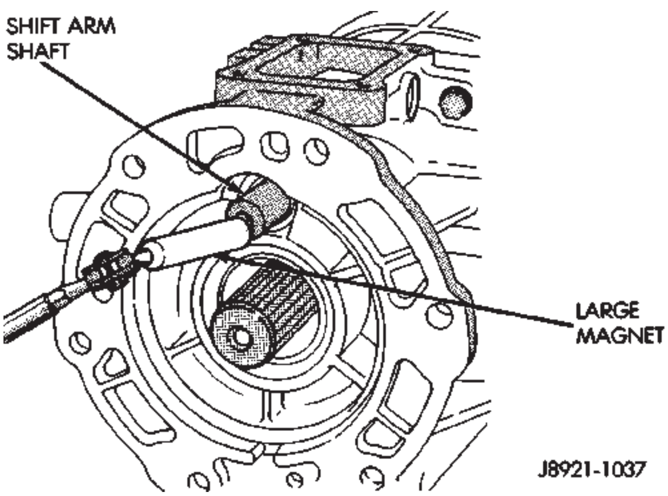


Fig. 26 Remove Shifter Shaft

(14) Remove the shift arm from the adapter housing.

(15) Remove adapter/extension housing bolts (Fig. 27).

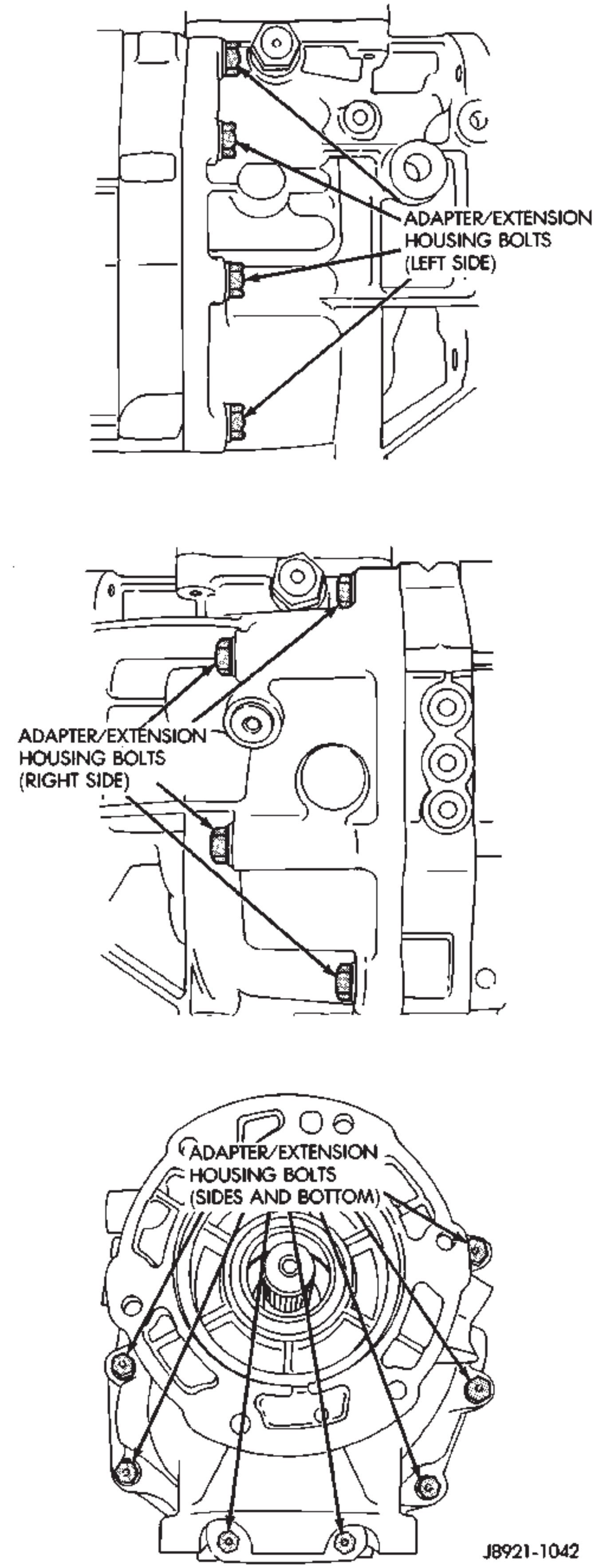


Fig. 27 Adapter/Extension Housing Bolts

DISASSEMBLY AND ASSEMBLY (Continued)

(16) Loosen adapter/extension housing by tapping it loose with plastic mallet (Fig. 28).

(17) Remove adapter/extension housing (Fig. 29).

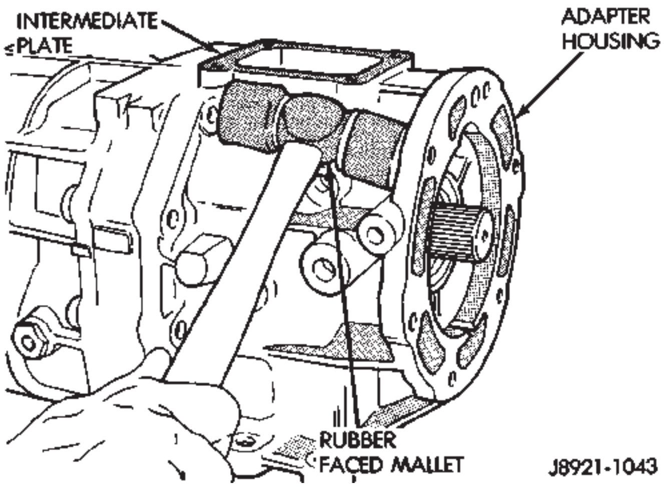


Fig. 28 Loosen Adapter/Extension Housing

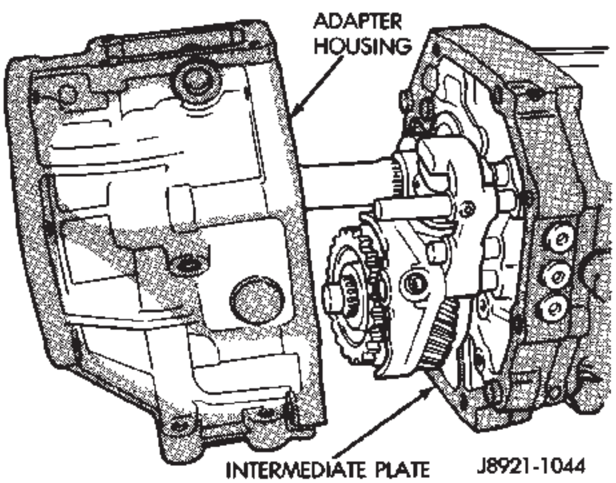


Fig. 29 Remove Adapter/Extension Housing

(18) On 4x2 transmissions;

(a) Remove speedometer gear retaining snap-ring from output shaft.

(b) Remove speedometer gear from output shaft and remove speedometer gear lock ball from output shaft.

(c) Remove speedometer drive gear locating snap-ring (Fig. 30).

(19) Remove the bolts holding the front bearing retainer to the transmission case.

(20) Remove the bearing retainer from transmission case (Fig. 31).

(21) Remove input shaft bearing snap-ring (Fig. 32).

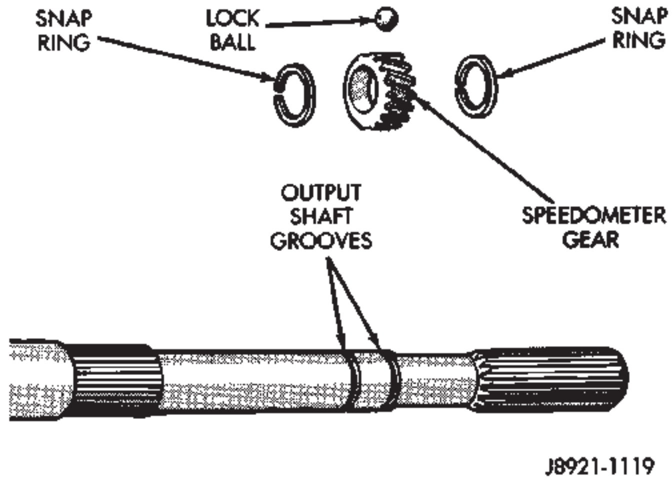


Fig. 30 Speedometer Drive Gear Assembly

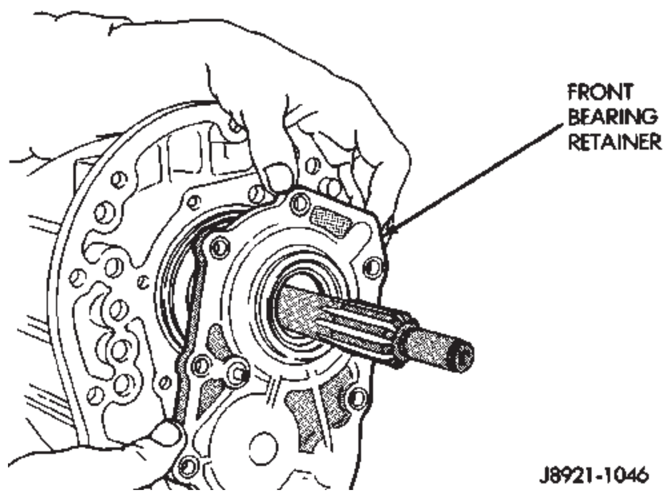


Fig. 31 Remove Front Bearing Retainer

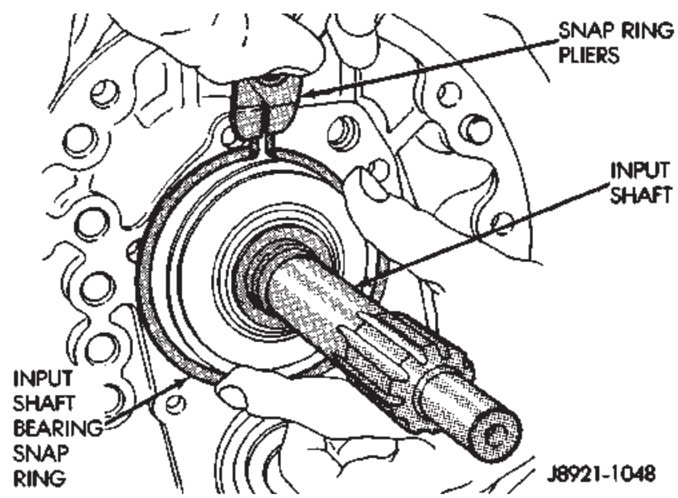


Fig. 32 Remove Input Shaft Bearing Snap-ring

DISASSEMBLY AND ASSEMBLY (Continued)

(22) Remove cluster gear bearing snap-ring (Fig. 33).

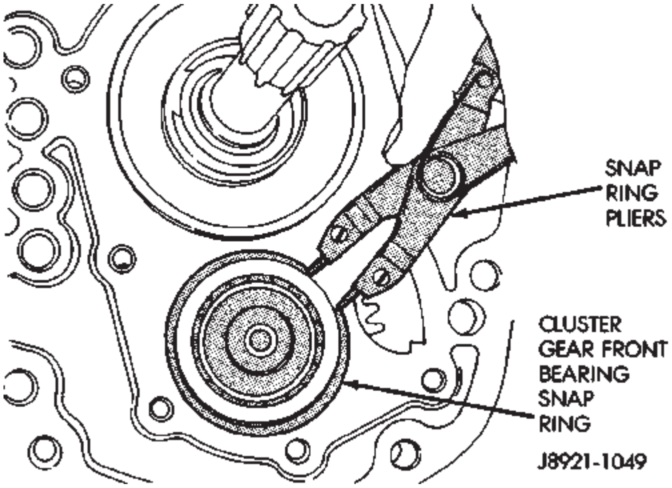


Fig. 33 Remove Cluster Gear Snap-ring

(23) Separate intermediate plate and transfer case by tapping them loose with plastic mallet (Fig. 34).

(24) Separate the intermediate plate from the transmission case (Fig. 35).

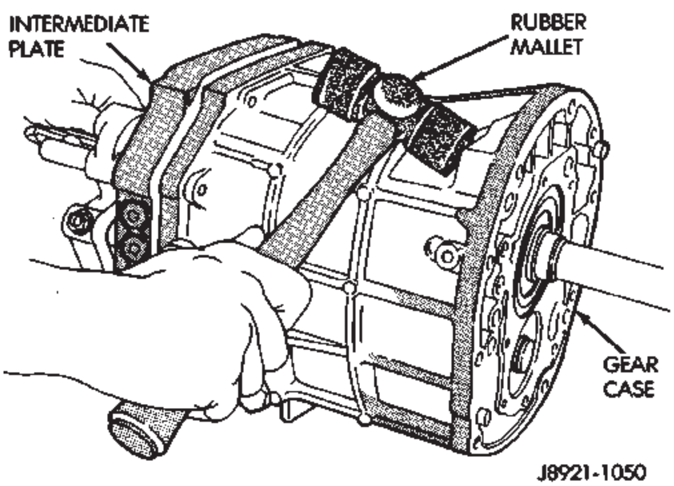


Fig. 34 Separate Intermediate Plate and Transmission Case

ASSEMBLY

(1) Remove any residual sealer from transmission case, intermediate plate, adapter/extension housing, and front bearing retainer.

(2) Apply a 1/8 to 3/16 inch wide bead of Threebond® Liquid Gasket TB1281, P/N 83504038, as shown, making sure to keep sealer bead to inside of bolt holes (Fig. 36).

(3) Align geartrain and shift rails with mating holes in transmission case and install transmission case to the intermediate plate (Fig. 37). Verify that the transmission case is seated on the intermediate plate.

(4) Install new front bearing snap rings (Fig. 38).

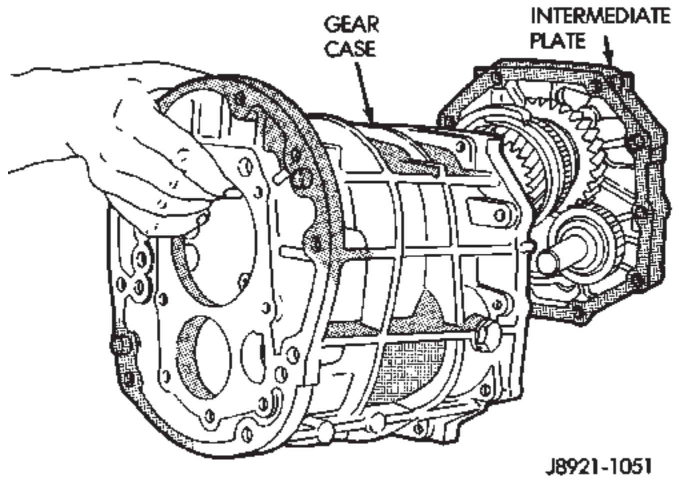


Fig. 35 Remove Intermediate Plate from Transmission Case

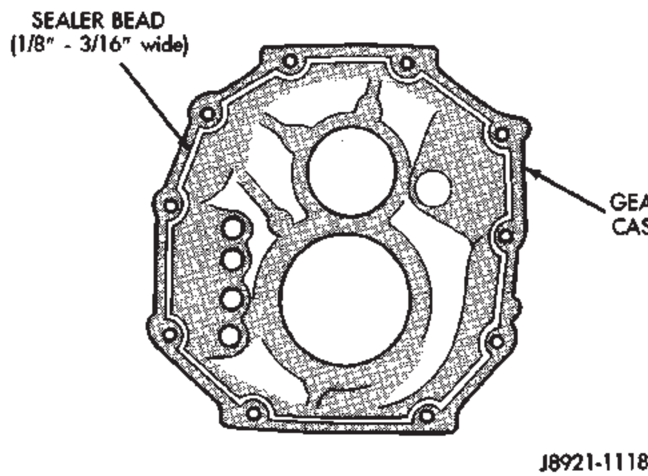


Fig. 36 Apply Sealer to Transmission Gear Case

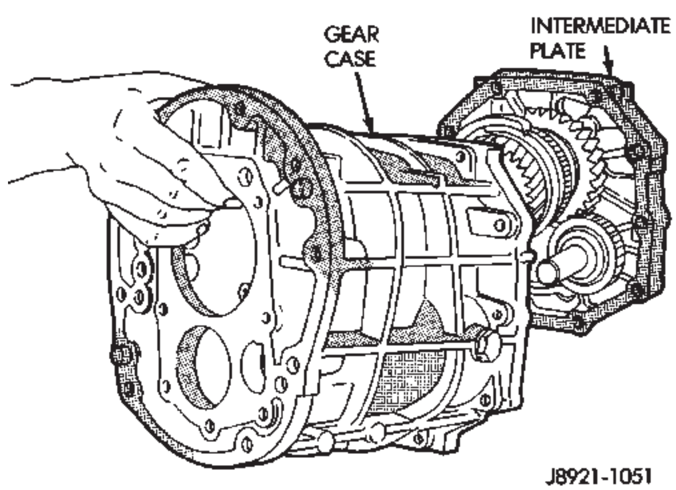


Fig. 37 Install Transmission Gear Case to the Intermediate Plate

DISASSEMBLY AND ASSEMBLY (Continued)

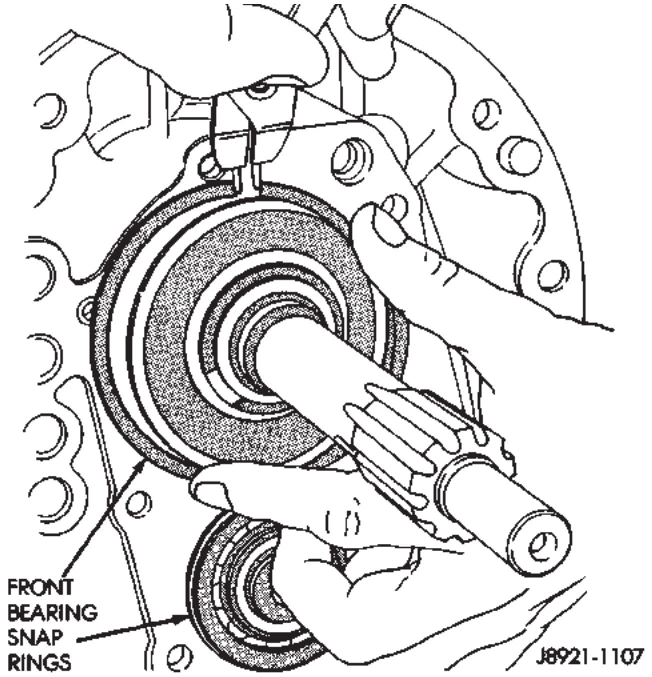


Fig. 38 Install Front Bearing Snap-rings

(5) Apply 1/8 inch wide bead of Threebond® Liquid Gasket TB1281, P/N 83504038, to the front bearing retainer sealing surface.

(6) Install the front bearing retainer (Fig. 39) and tighten bolts to 17 N·m (12 ft. lbs.).

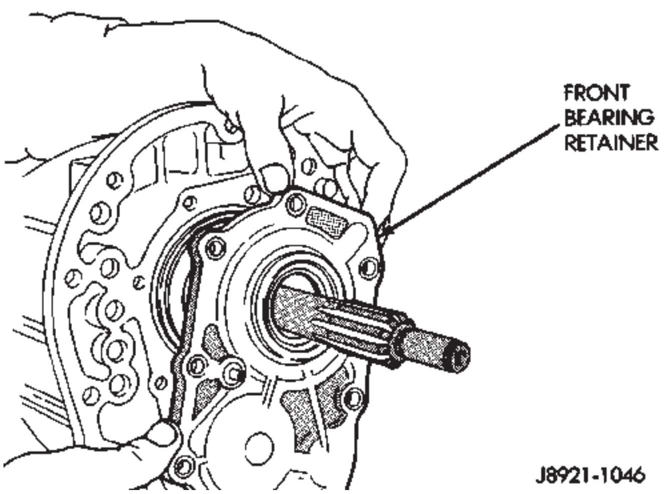


Fig. 39 Install Front Bearing Retainer

(7) On 4x2 transmissions;

(a) Install speedometer drive gear locating snap-ring (Fig. 40).

(b) Install speedometer gear lock ball in output shaft and install speedometer gear onto output shaft.

(c) Install speedometer gear retaining snap-ring onto output shaft.

(8) Apply a 1/8 to 3/16 inch wide bead of Threebond® Liquid Gasket TB1281, P/N 83504038, to sealing surface of adapter/extension housing, making sure to keep sealer bead to inside of bolt holes.

(9) Install adapter or extension housing on intermediate plate (Fig. 41). Tighten housing bolts to 37 N·m (27 ft. lbs.) torque.

(10) Position shift arm in shifter tower opening of adapter\extension housing (Fig. 42). Be sure that the shifter arm is engaged into the shift rails.

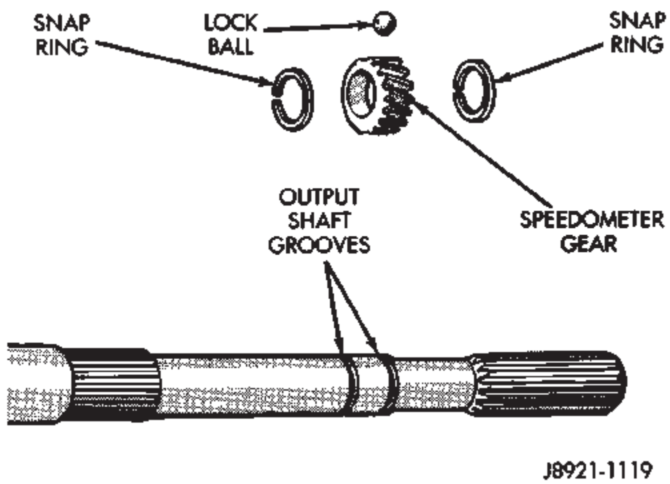


Fig. 40 Speedometer Drive Gear Assembly

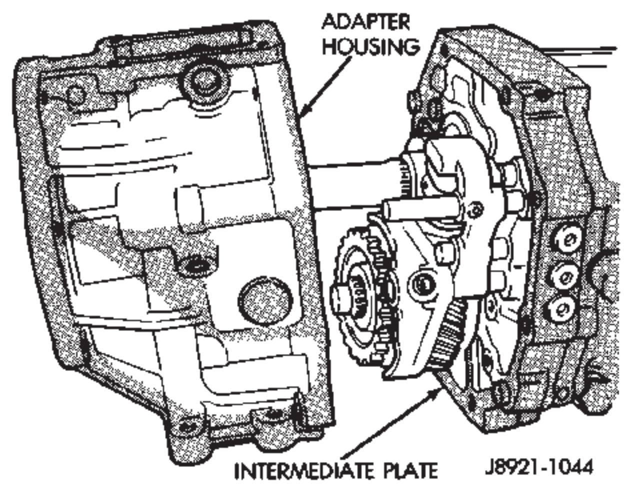


Fig. 41 Install Adapter/Extension Housing

DISASSEMBLY AND ASSEMBLY (Continued)

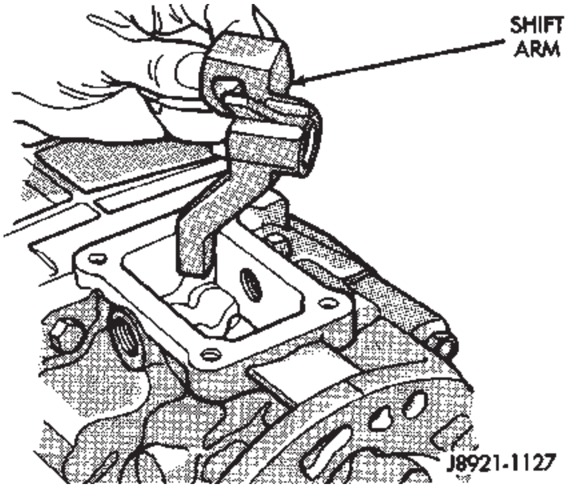


Fig. 42 Position Shift Arm in Transmission Case

(11) Start shifter arm shaft in hole in back of adapter\extension housing. Align shift arm and shifter arm shaft and insert shifter arm shaft through the shifter arm and into the forward portion of the adapter\extension housing (Fig. 43).

(12) Rotate the shifter arm shaft until the hole in the shift arm is aligned with the hole in the shaft.

(13) Install the shift arm retainer bolt and tighten to 38 N·m (28 ft. lbs.) (Fig. 44).

(14) Install and tighten shifter arm shaft plug to 18 N·m (13 ft. lbs.) torque (Fig. 45).

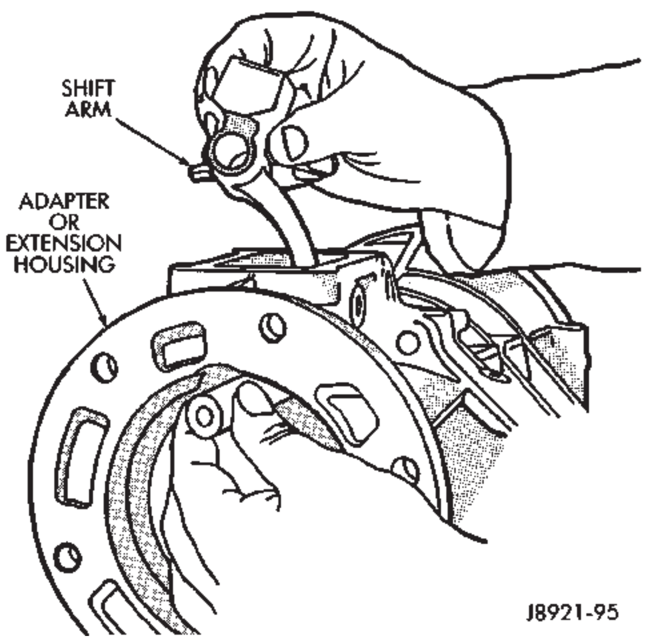


Fig. 43 Install Shifter Arm Shaft

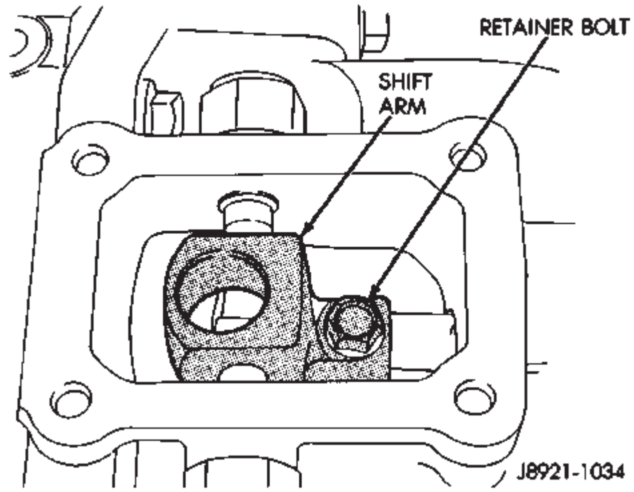


Fig. 44 Install Shift Arm Retainer Bolt

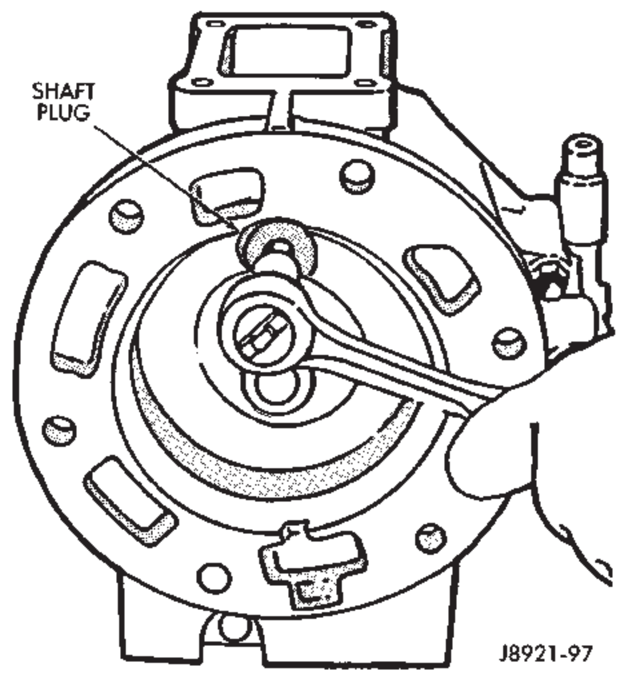


Fig. 45 Shifter Arm Shaft Plug Installation

(15) Install shifter restrictor pins in shift tower and tighten to 27 N·m (20 ft. lbs.) (Fig. 46).

(16) Install shift detent ball in detent opening (Fig. 47).

(17) Install detent spring (Fig. 48).

(18) Install detent plug and tighten to 19 N·m (14 ft. lbs.) (Fig. 49).

(19) Install shift tower and new gasket on housing (Fig. 50). Tighten tower bolts to 18 N·m (13 ft. lbs.) torque.

DISASSEMBLY AND ASSEMBLY (Continued)

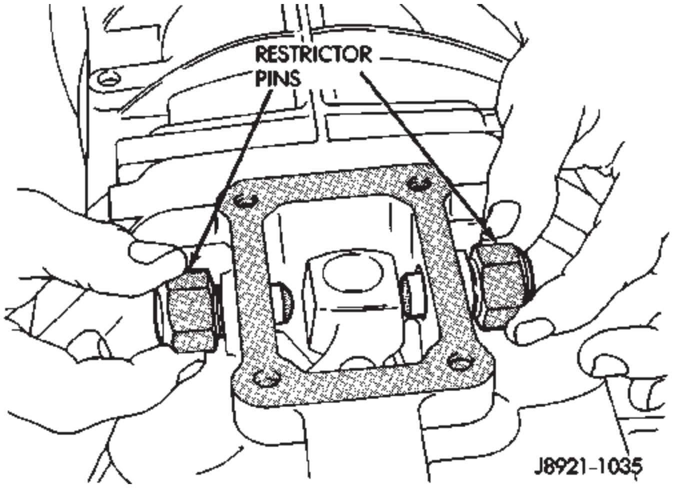


Fig. 46 Install Shifter Restrictor Pins

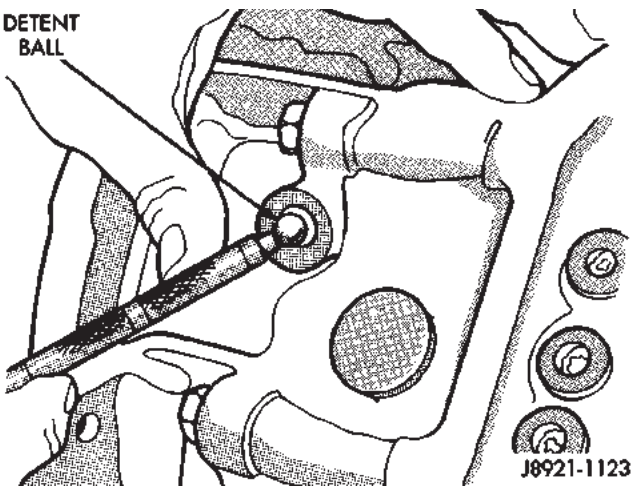


Fig. 47 Install Detent Ball

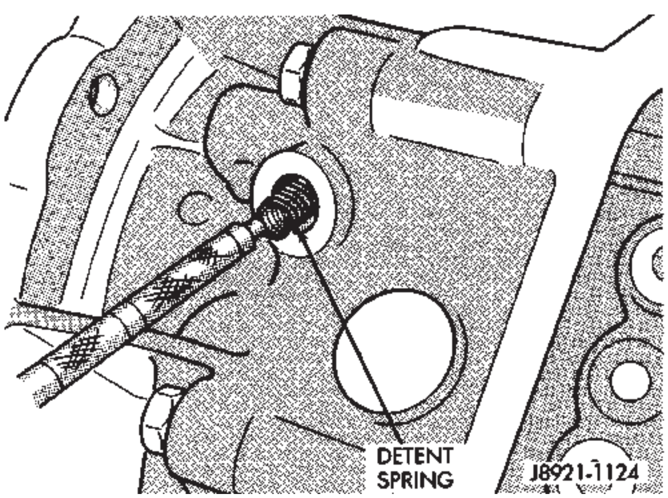


Fig. 48 Install Detent Spring

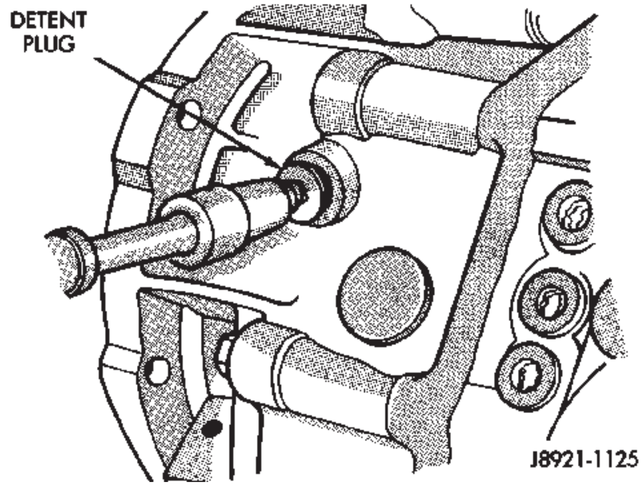


Fig. 49 Install Detent Ball Plug

(20) Install new metal o-ring to the backup lamp switch.

(21) Install backup lamp switch (Fig. 50). Tighten switch to 37 N·m (27 ft. lbs.) torque.

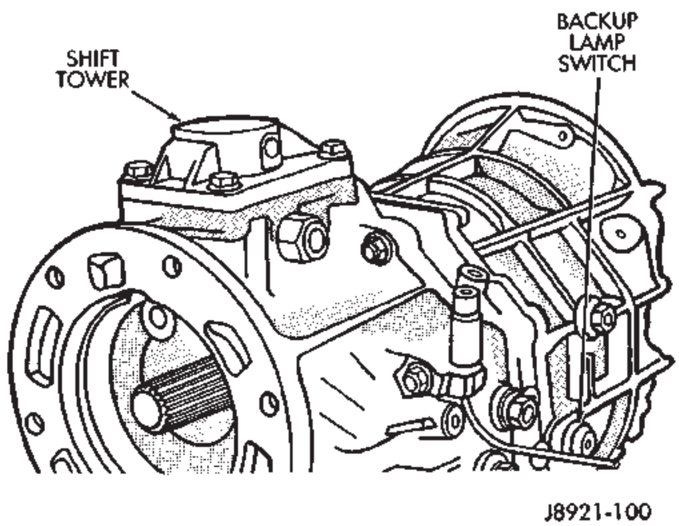


Fig. 50 Installing Shift Tower And Backup Lamp Switch

(22) Install new seal in adapter/extension housing.

(23) Install vehicle speed sensor, if necessary.

(24) Install clutch housing, release bearing, release fork and retainer clip.

DISASSEMBLY AND ASSEMBLY (Continued)

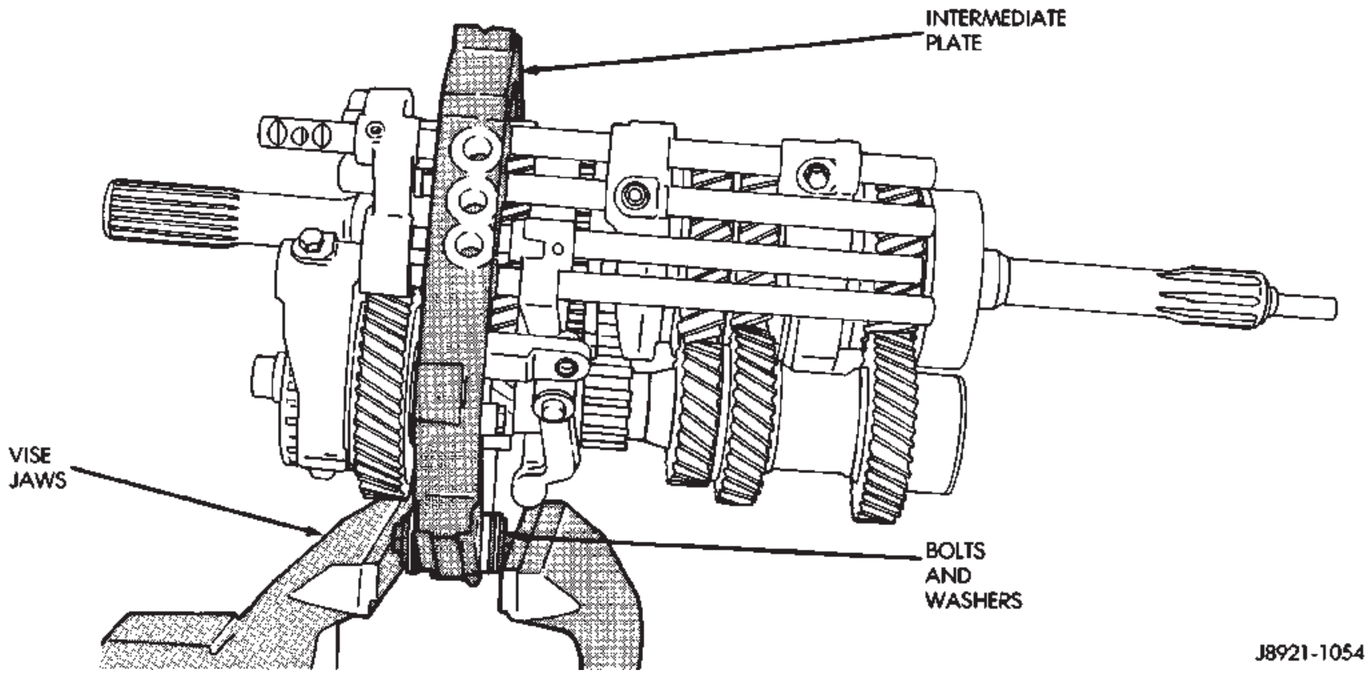


Fig. 51 Positioning Intermediate Plate In Vise

SHIFT MECHANISM AND GEARTRAIN

DISASSEMBLY

(1) Install suitable bolts and washers in intermediate plate (Fig. 51). Then clamp plate and gear assembly in vise. Use enough washers to prevent bolts from touching. Also be sure vise jaws are clamped on bolt heads.

(2) Measure thrust clearance between countershaft 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.

(3) Remove countershaft fifth gear retaining snap-ring (Fig. 52).

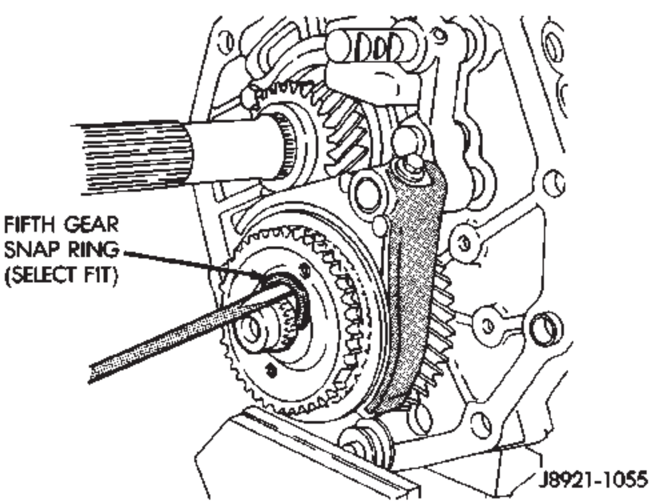


Fig. 52 Remove Fifth Gear Snap-ring

(4) Remove bolt holding fifth gear shift fork to shift rail (Fig. 53).

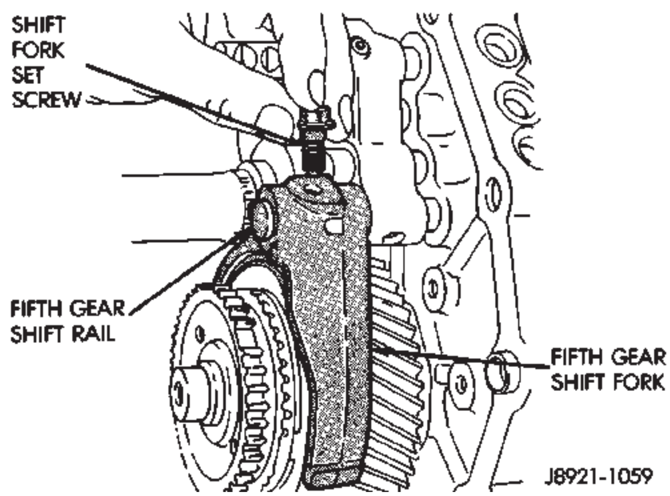


Fig. 53 Remove Fifth Gear Shift Fork Retainer Bolt

(5) Move fifth gear shift rail forward until the rail is clear of the shift fork.

(6) Remove the fifth gear shift fork from the synchronizer sleeve (Fig. 54).

(7) Remove the reverse shift head and rail assembly from the intermediate plate (Fig. 55).

DISASSEMBLY AND ASSEMBLY (Continued)

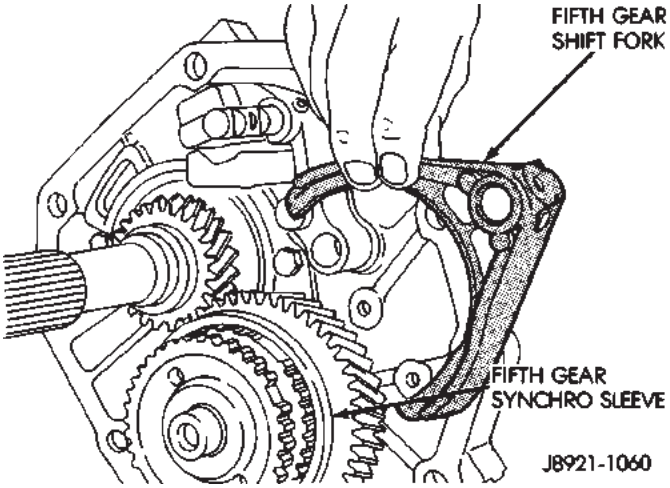


Fig. 54 Remove Fifth Gear Shift Fork

(8) Remove fifth gear blocker ring from countershaft assembly with Puller L-4407 (Fig. 56).

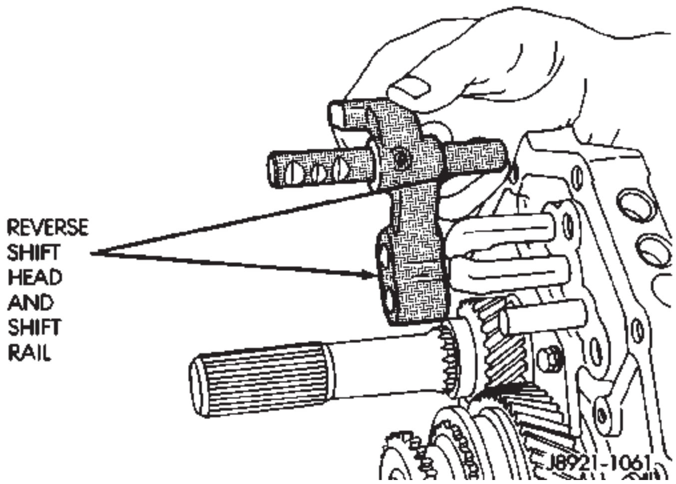


Fig. 55 Remove Reverse Shift Head Assembly

(9) Remove fifth gear synchro ring (Fig. 57).

(10) Remove the countershaft fifth gear assembly from countershaft (Fig. 58).

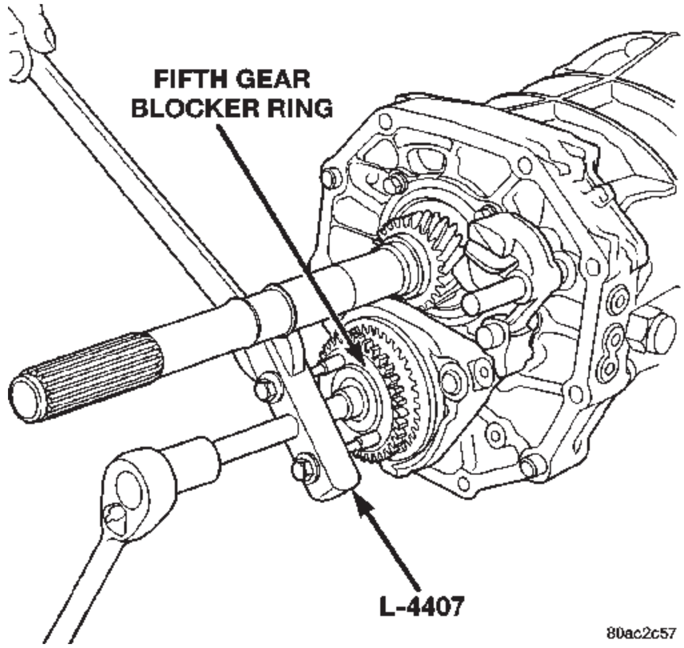


Fig. 56 Remove Fifth Gear Blocker Ring

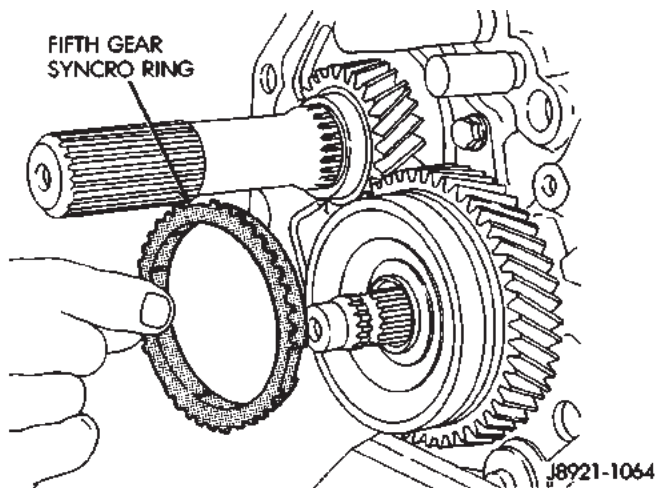


Fig. 57 Remove Fifth Gear Synchro Ring

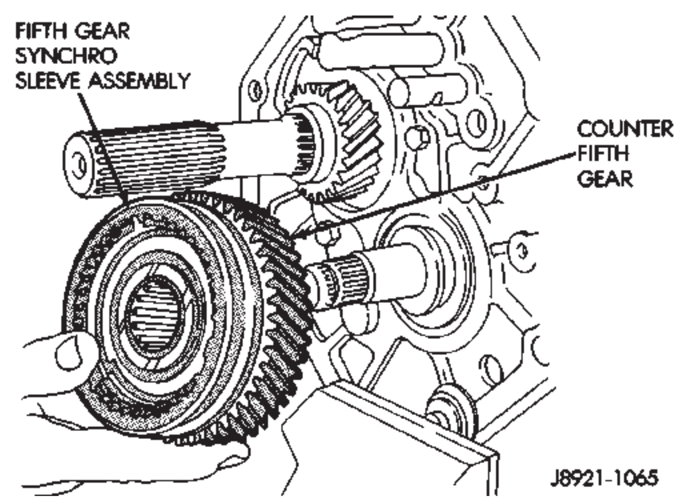


Fig. 58 Remove Fifth Gear And Synchro Assembly

DISASSEMBLY AND ASSEMBLY (Continued)

(11) Remove fifth gear thrust ring from countershaft (Fig. 59).

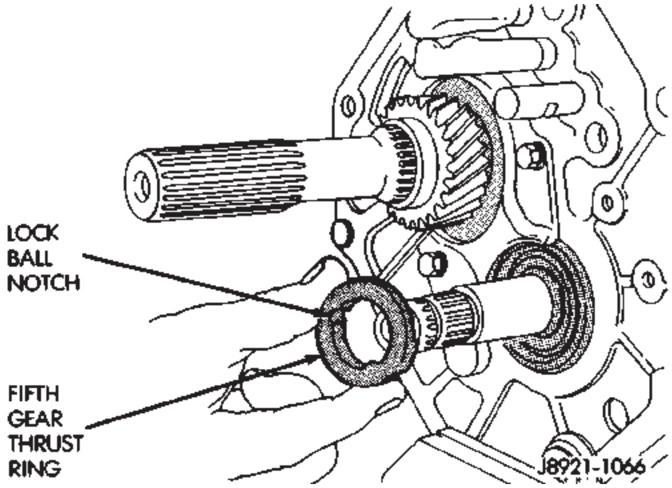


Fig. 59 Remove Fifth Gear Thrust Ring

(12) Remove fifth gear thrust ring lock ball from countershaft (Fig. 60).

NOTE: There are many lock balls, check balls, interlock balls, and interlock pins used in various places in the transmission. Whenever a pin or ball is removed, it should be identified in such a way that it can be reinstalled in the same location from which it was removed.

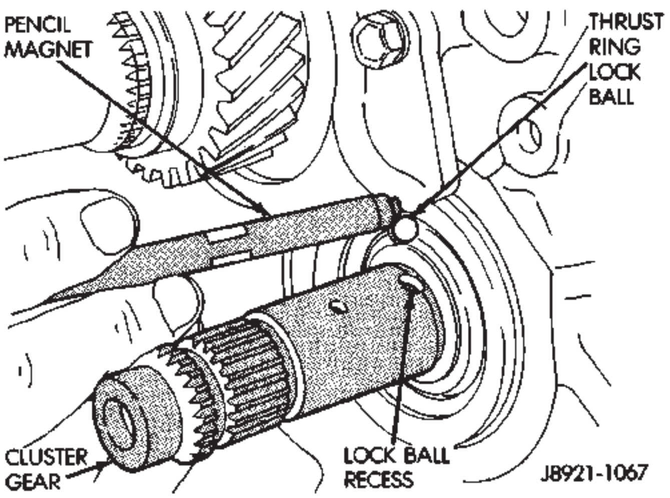


Fig. 60 Remove Fifth Gear Thrust Ring Lock Ball

(13) Remove bolts holding output shaft rear bearing retainer to intermediate plate (Fig. 61).

(14) Remove rear bearing retainer (Fig. 62).

(15) Remove reverse idler gear shaft and gear (Fig. 63).

(16) Remove bolts holding reverse shift arm bracket to intermediate plate (Fig. 64).

(17) Remove threaded lock ball plugs from intermediate plate (Fig. 65).

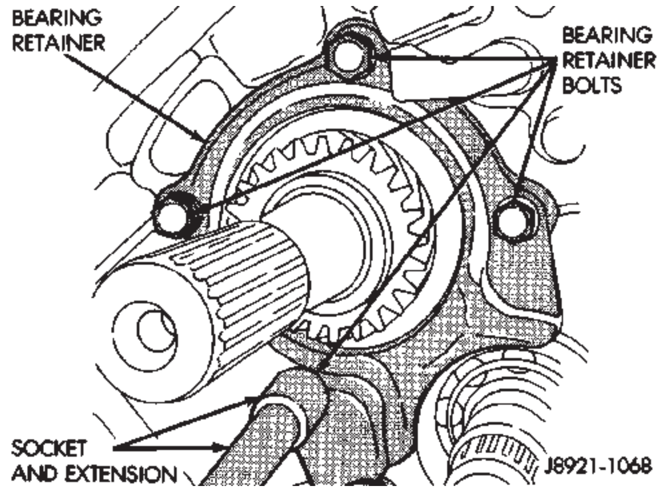


Fig. 61 Remove Output Shaft Rear Bearing Retainer Bolts

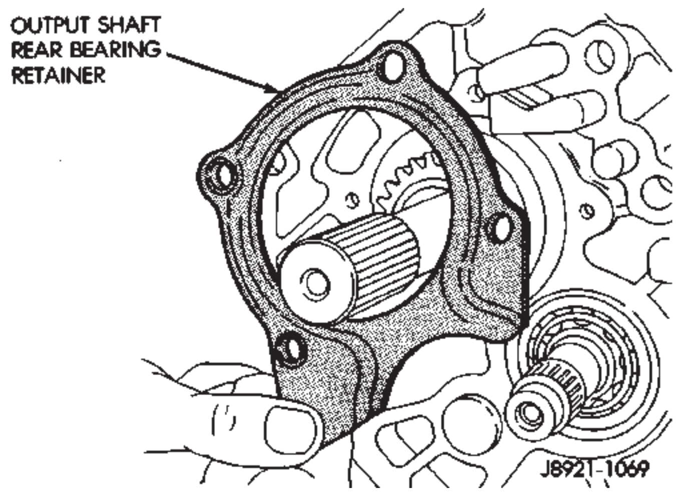


Fig. 62 Remove Output Shaft Rear Bearing Retainer

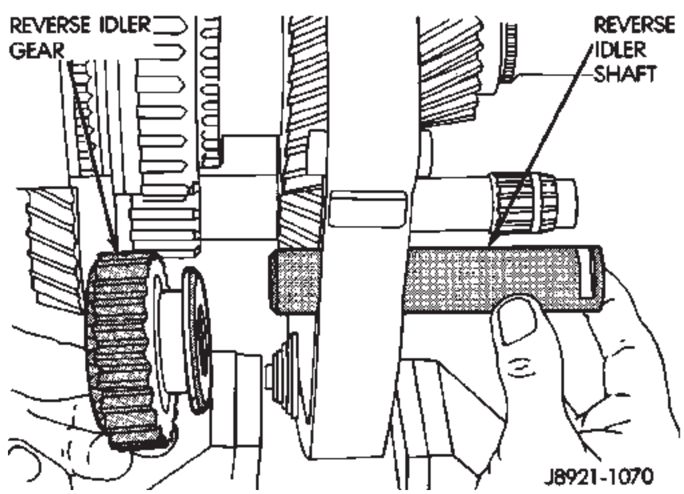


Fig. 63 Remove Reverse Idler Shaft And Gear

DISASSEMBLY AND ASSEMBLY (Continued)

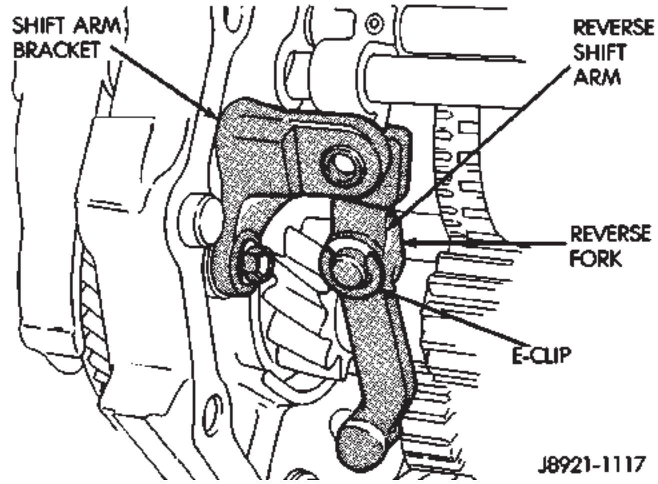


Fig. 64 Reverse Shift Arm Components

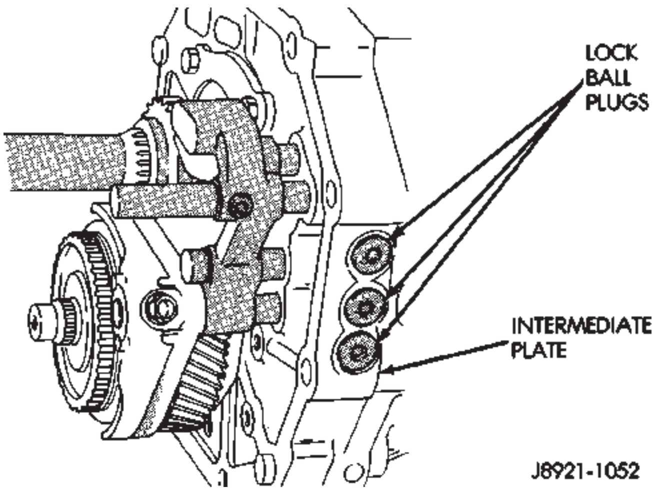


Fig. 65 Lock Ball Plug Locations

(18) Then remove lock ball and spring from plug holes with pencil magnet (Fig. 66).

(19) Remove the fifth gear shift rail (Fig. 67).

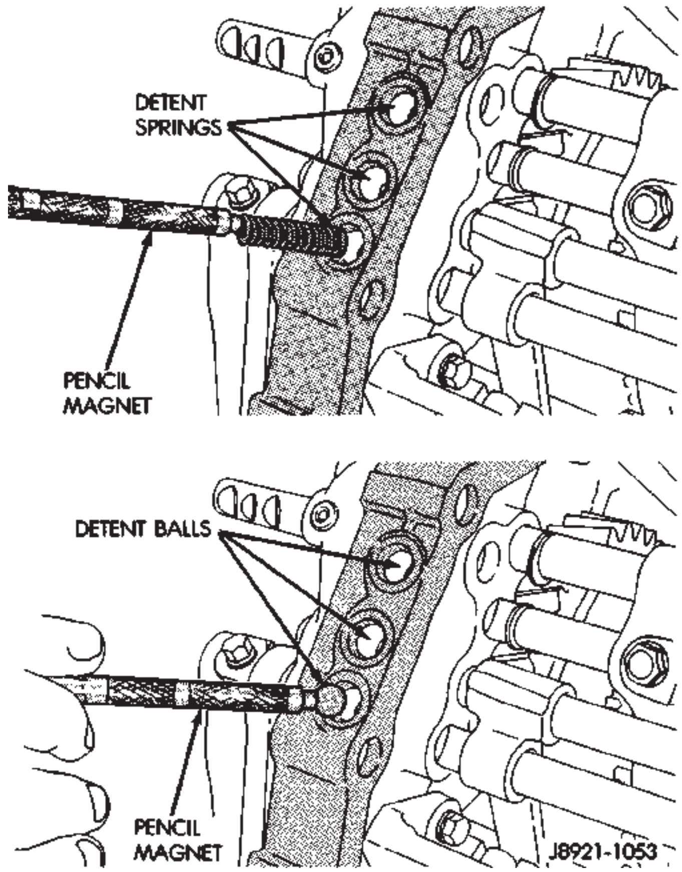


Fig. 66 Remove Lock Ball And Spring

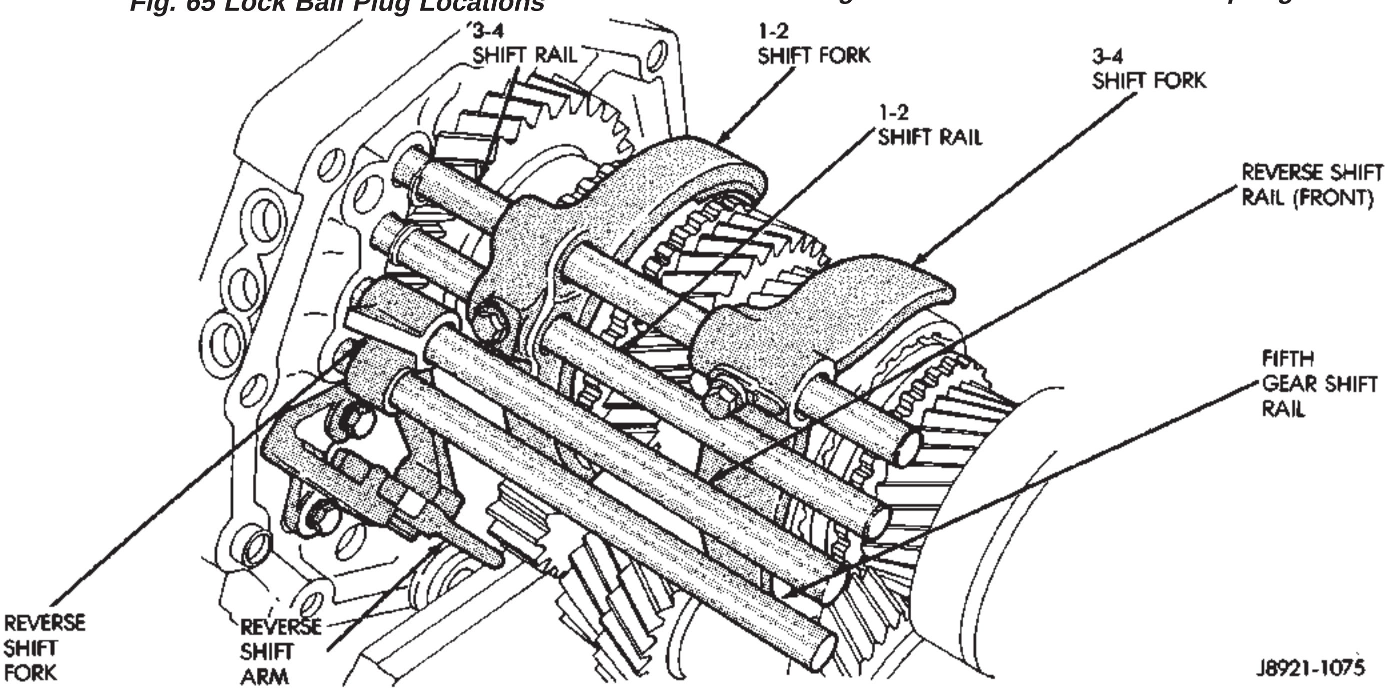


Fig. 67 Shift Rail Identification

DISASSEMBLY AND ASSEMBLY (Continued)

(20) Retrieve the fifth gear shift rail lock ball from the intermediate plate using a magnet (Fig. 68).

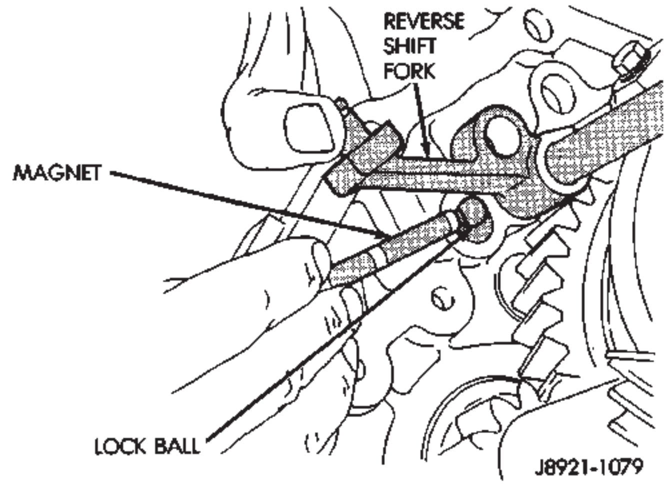


Fig. 68 Remove Fifth Gear Shift Rail Lock Ball

(21) Remove the 1–2 and 3–4 shift rail c-rings using two equally sized screwdrivers (Fig. 69).

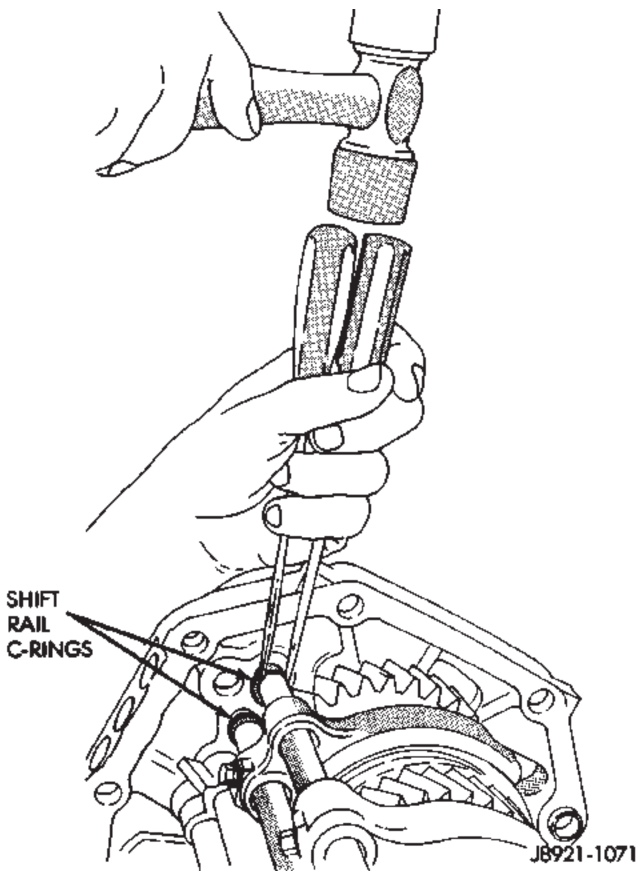


Fig. 69 Remove Shift Rail C-rings

(22) Remove bolts holding 1–2 and 3–4 shift forks to the shift rails (Fig. 70) and discard bolts.

(23) Remove the 3–4 shift rail from the 1–2 and 3–4 shift forks and the intermediate plate (Fig. 71).

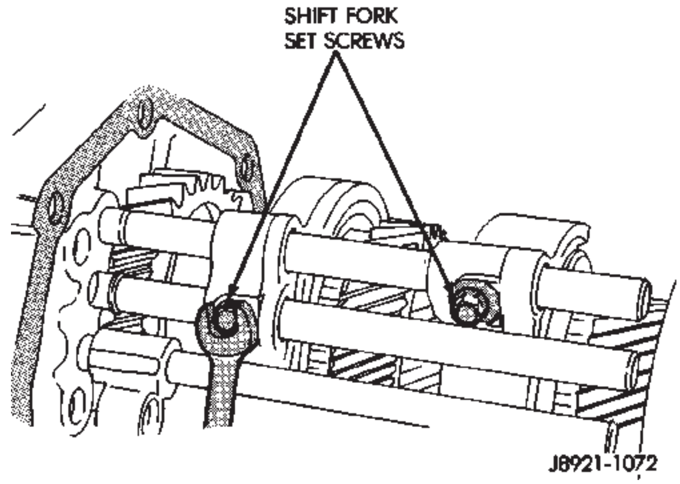


Fig. 70 Remove Shift Fork To Shift Rail Bolts

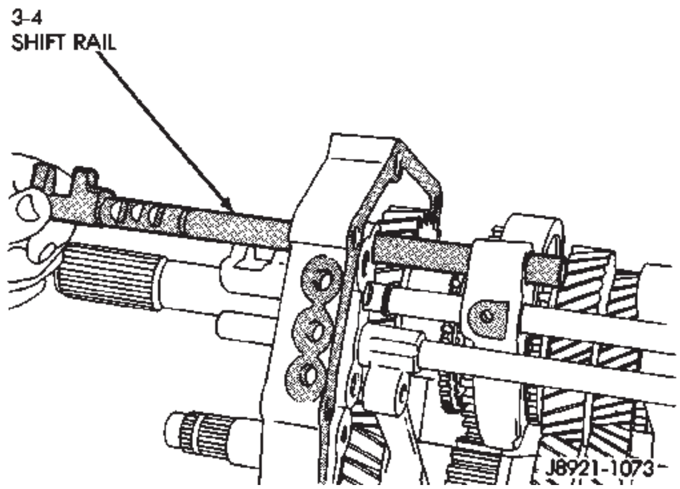


Fig. 71 Remove 3–4 Shift Rail

(24) Remove the 3–4 shift rail interlock plug from the intermediate plate with a small magnet (Fig. 72).

(25) Remove the 3–4 shift fork (Fig. 73).

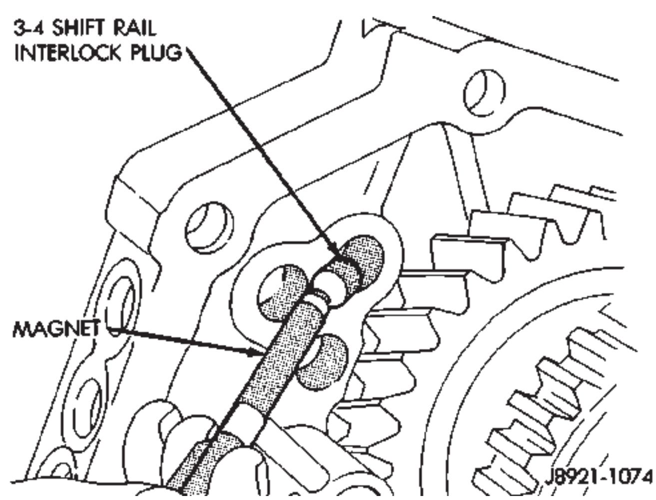


Fig. 72 Remove 3–4 Shift Rail Interlock Plug

DISASSEMBLY AND ASSEMBLY (Continued)

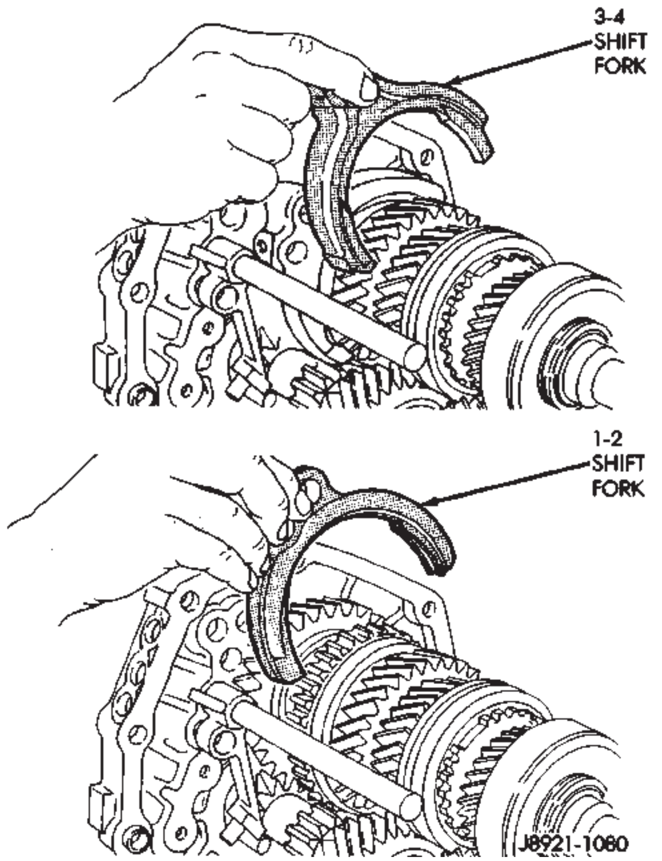


Fig. 73 Remove Shift Forks

(26) Remove the 1–2 shift rail from the 1–2 shift fork and the intermediate plate (Fig. 74).

(27) Remove the 1–2 shift rail interlock pin from the 1–2 shift rail (Fig. 75).

(28) Remove the 1–2 shift rail interlock plug from the intermediate plate (Fig. 76).

(29) Remove the 1–2 shift fork (Fig. 73).

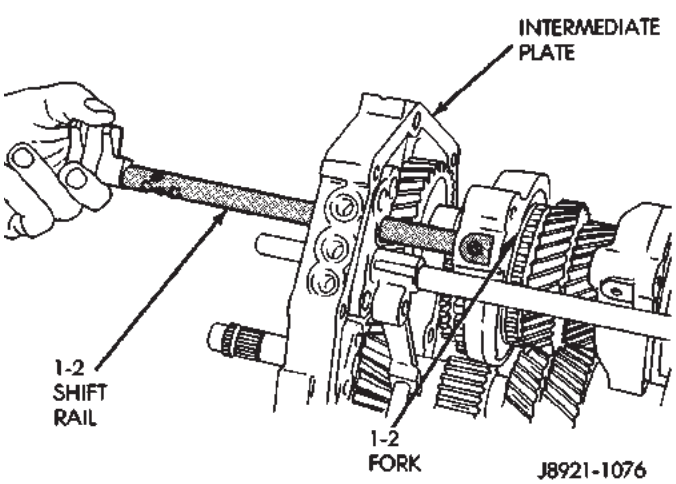


Fig. 74 Remove 1–2 Shift Rail

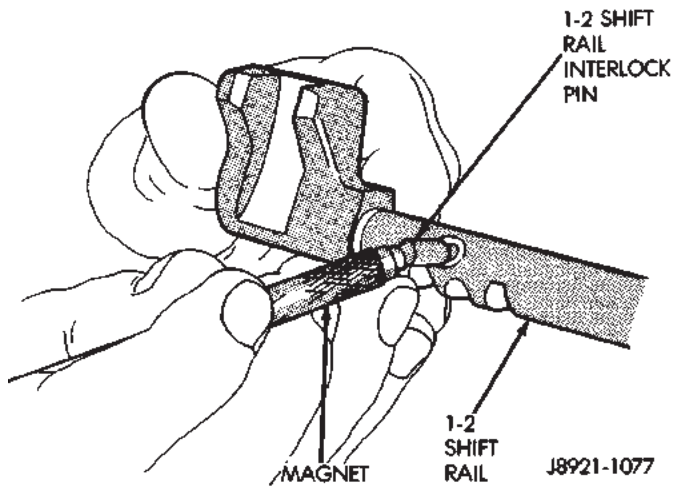


Fig. 75 Remove 1–2 Shift Rail Interlock Pin

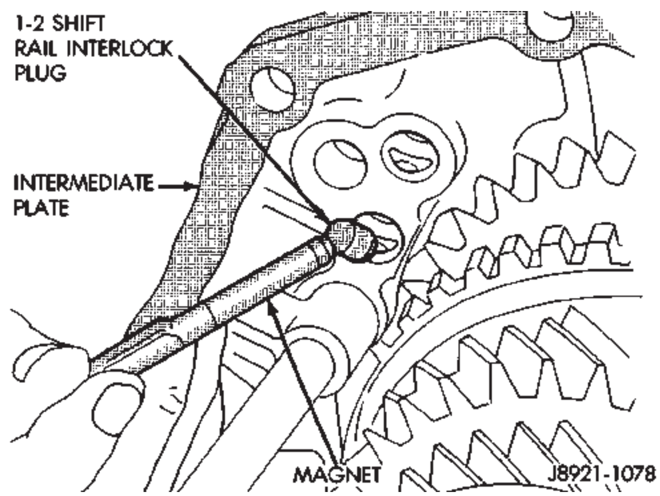


Fig. 76 Remove 1–2 Shift Rail Interlock Plug

(30) Remove the c-ring holding the reverse shift rail into the intermediate plate using two equally sized screwdrivers (Fig. 77).

(31) Remove the reverse shift rail and fork from the intermediate plate (Fig. 78).

(32) Remove the interlock pin from the reverse shift rail (Fig. 79).

(33) Remove snap-ring holding output shaft rear bearing into the intermediate plate (Fig. 80).

(34) Remove countershaft rear bearing snap-ring.

(35) With aid of an assistant, support the mainshaft and countershaft. Tap on the rear of the mainshaft and countershaft with a suitable rubber mallet. This will release the countershaft from the countershaft rear bearing and the mainshaft rear bearing from the intermediate plate. The mainshaft will release from the intermediate plate first and can be removed by moving the mainshaft rearward and upward (Fig. 81).

DISASSEMBLY AND ASSEMBLY (Continued)

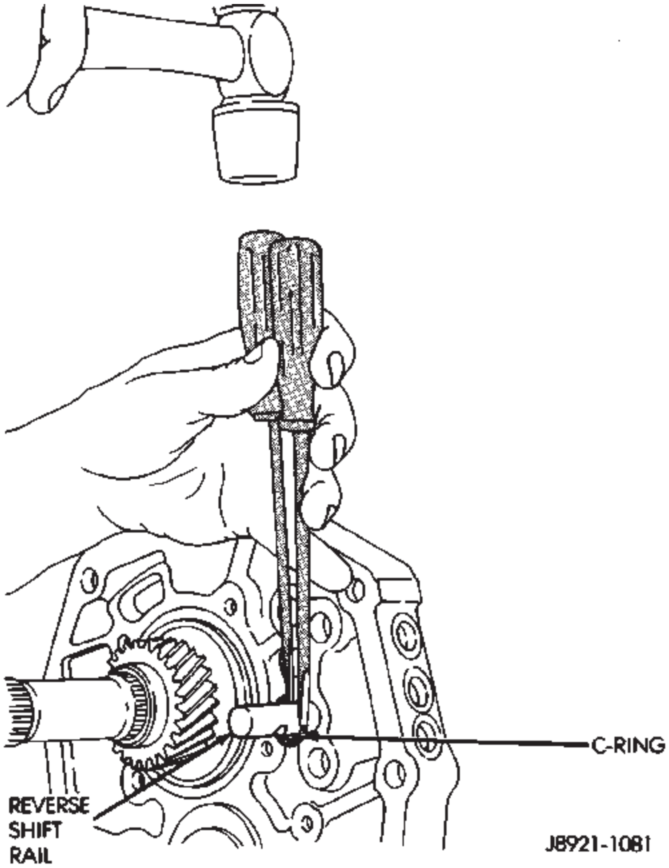


Fig. 77 Remove Reverse Shift Rail C-ring

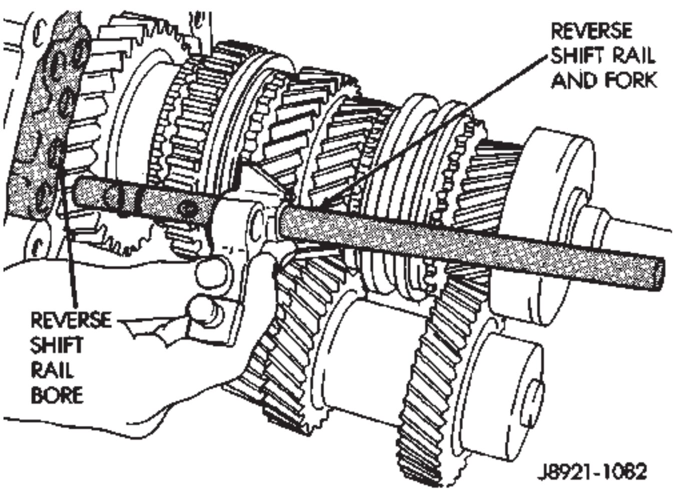


Fig. 78 Remove Reverse Shift Rail

(36) Remove the countershaft by moving the countershaft rearward until the countershaft is clear of the intermediate plate.

(37) Remove the countershaft rear bearing from the intermediate plate.

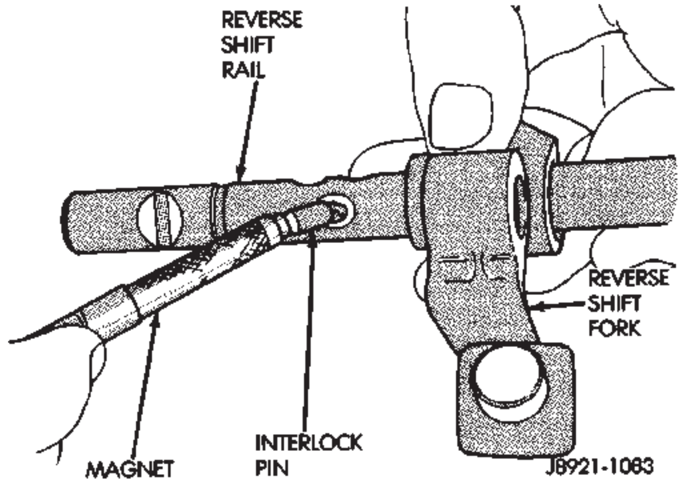


Fig. 79 Remove Reverse Shift Rail Interlock Pin

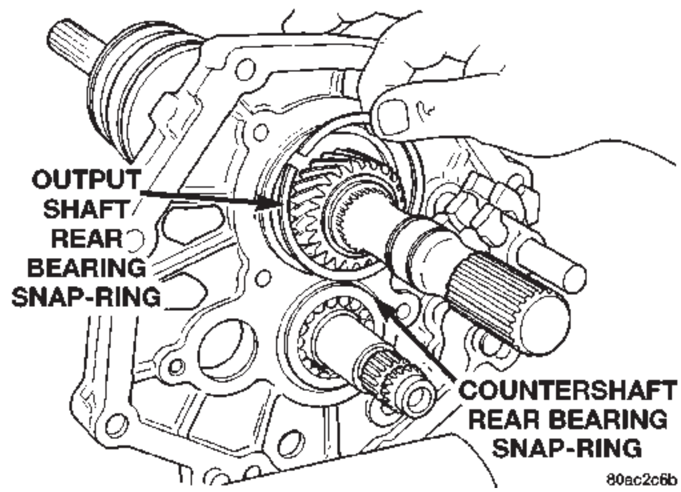


Fig. 80 Remove Output Shaft Rear Bearing Snap-ring

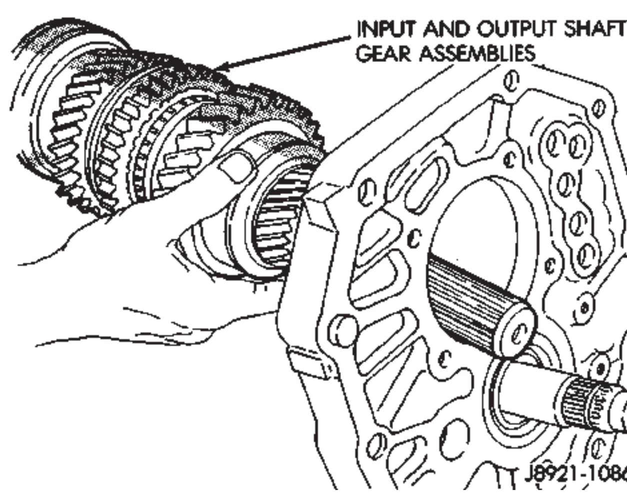


Fig. 81 Remove Mainshaft

DISASSEMBLY AND ASSEMBLY (Continued)

ASSEMBLY

(1) Lubricate countershaft journal and rear bearing with petroleum jelly or gear lubricant.

(2) Position the mainshaft into the intermediate plate.

(3) Tap the mainshaft assembly rear bearing into the intermediate plate with a suitable rubber mallet.

(4) Install the countershaft thru the countershaft rear bearing journal of the intermediate plate.

(5) Align and mesh the mainshaft and countershaft gears as much as possible.

(6) Install the countershaft bearing over the countershaft bearing boss and into the intermediate plate. Be sure to leave the snap-ring groove in the bearing facing the rear of the unit. It may be necessary to tap on the bearing with a plastic mallet to fully seat the bearing into intermediate plate.

(7) Verify that the mainshaft and countershaft gears are correctly meshed and rotate properly.

(8) Install snap-ring to hold output shaft rear bearing into the intermediate plate (Fig. 66).

(9) Install countershaft rear bearing snap-ring.

NOTE: Coat all shift components with petroleum jelly during assembly. Petroleum jelly will hold components in position during installation.

(10) Install interlock pin in reverse shift rail (Fig. 82).

(11) Install the reverse shift rail in the intermediate plate (Fig. 83).

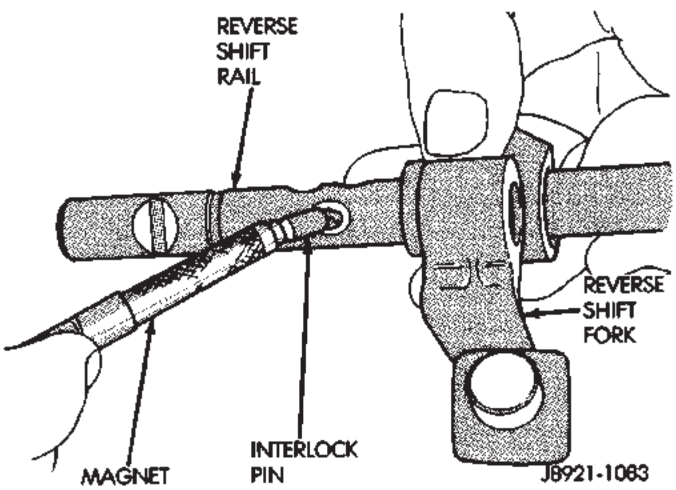


Fig. 82 Install Reverse Shift Rail Interlock Pin

(12) Install c-ring to hold the reverse shift rail into the intermediate plate.

(13) Install the 1–2 and 3–4 shift forks into the synchronizer sleeves (Fig. 84).

(14) Install 1–2 shift rail interlock plug in the intermediate plate (Fig. 85).

(15) Install interlock pin in 1–2 shift rail (Fig. 86).

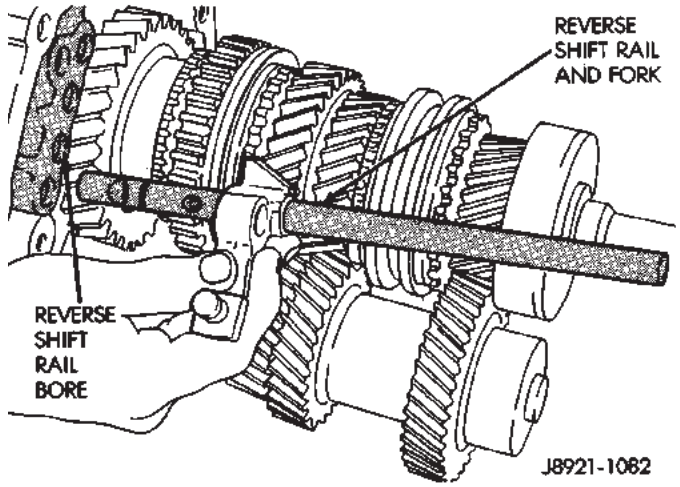


Fig. 83 Install Reverse Shift Rail

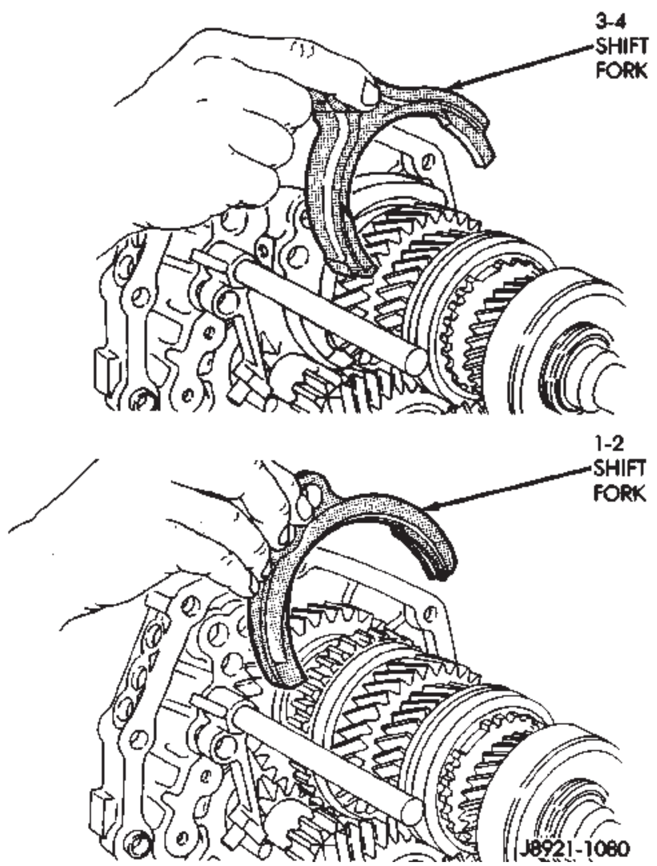


Fig. 84 Install Shift Forks

DISASSEMBLY AND ASSEMBLY (Continued)

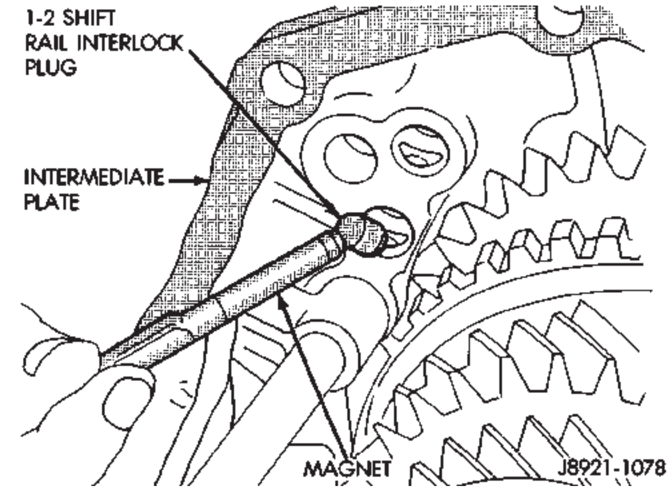


Fig. 85 Install 1–2 Shift Rail Interlock Plug

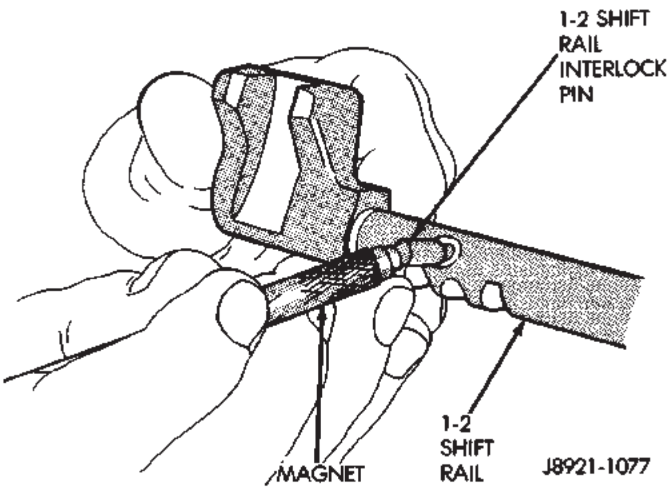


Fig. 86 Install 1–2 Shift Rail Interlock Pin

(16) Install 1–2 shift rail through intermediate plate and 1–2 shift fork (Fig. 87).

(17) Install 3–4 shift rail interlock plug into the intermediate plate (Fig. 88).

(18) Install the 3–4 shift rail through the intermediate plate, 1–2 and 3–4 shift forks (Fig. 89).

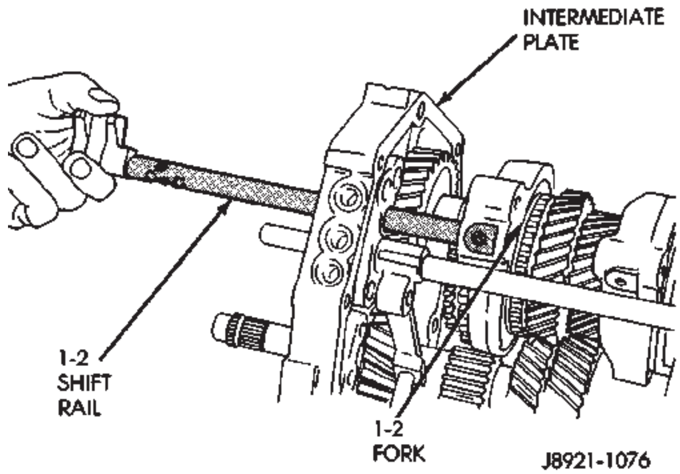


Fig. 87 Install 1–2 Shift Rail

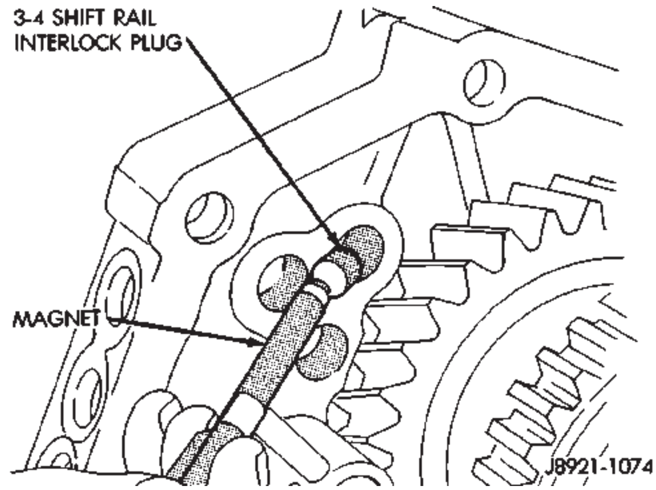


Fig. 88 Install 3–4 Shift Rail Interlock Plug

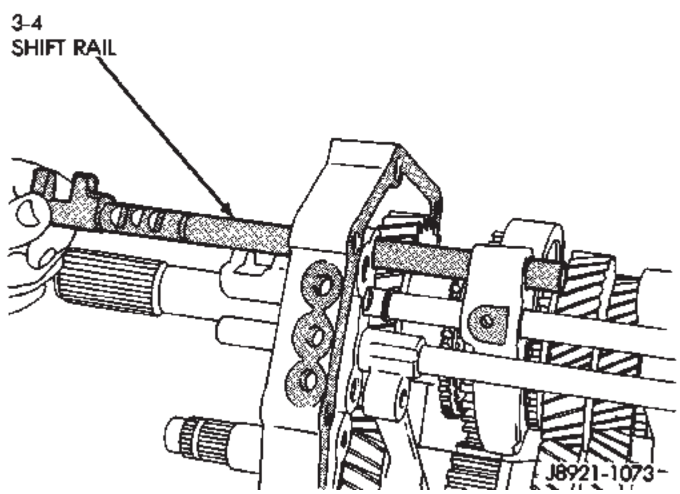


Fig. 89 Install 3–4 Shift Rail

DISASSEMBLY AND ASSEMBLY (Continued)

(19) Install new bolts to hold the shift forks to the shift rails (Fig. 90).

(20) Install c-rings to 1–2 and 3–4 shift rails (Fig. 91).

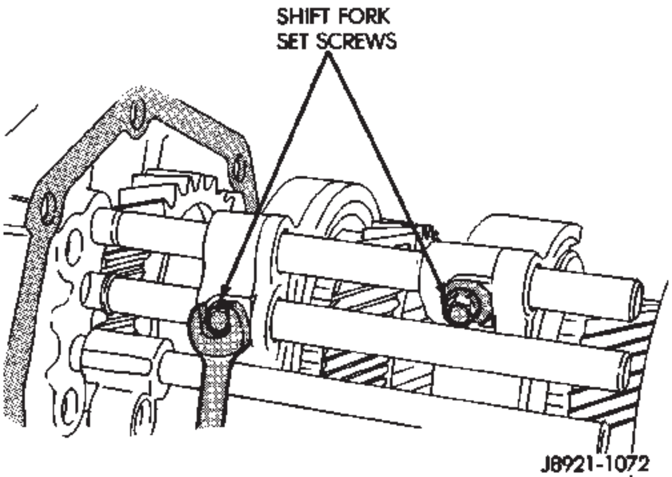


Fig. 90 Install Shift Fork To Shift Rail Bolts

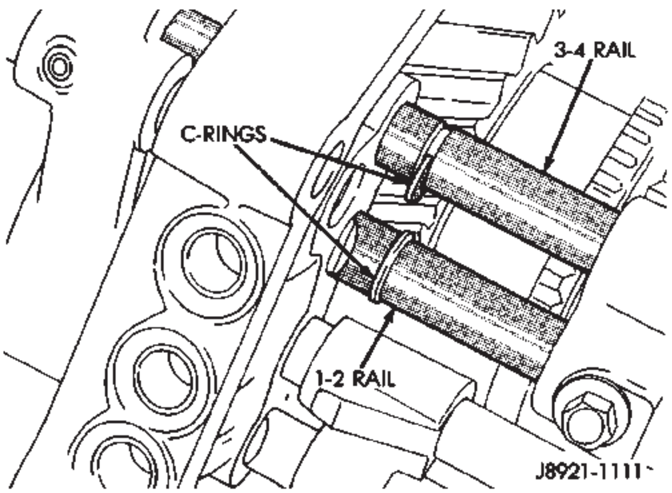


Fig. 91 Install Shift Rail C-rings

(21) Install the fifth gear shift rail lock ball in the intermediate plate (Fig. 94).

(22) Install the fifth gear shift rail into the intermediate plate.

(23) Install reverse idler gear and idler gear shaft (Fig. 92). Verify that the notch in the idler shaft is to the rear of the transmission.

(24) Position output shaft rear bearing retainer on intermediate plate and into reverse idler shaft notch.

(25) Install new bolts to hold retainer to intermediate plate (Fig. 93).

(26) Install the fifth gear thrust ring lock ball into the countershaft (Fig. 95).

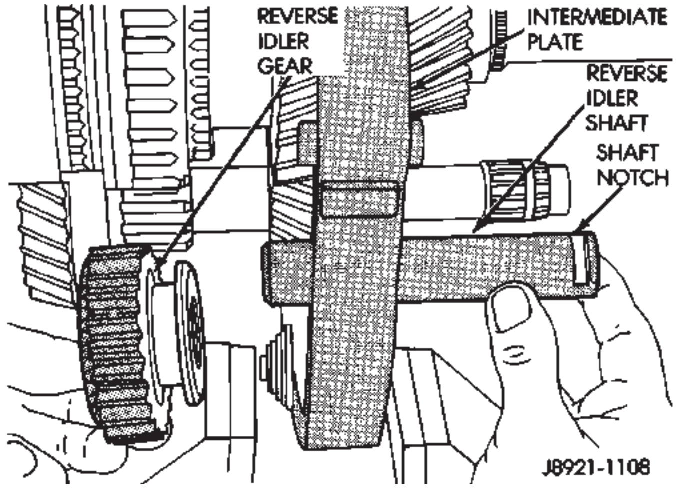


Fig. 92 Install Reverse Idler Gear And Shaft

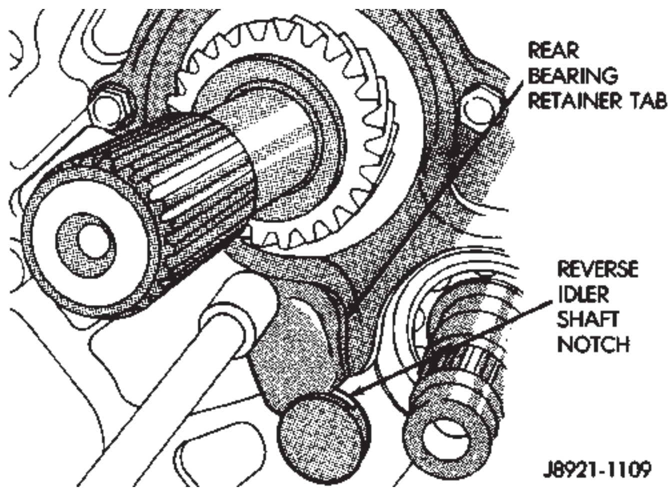


Fig. 93 Install Output Shaft Rear Bearing Retainer

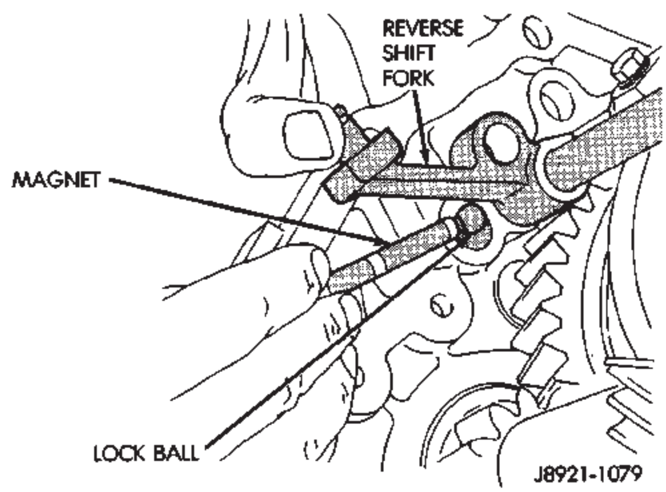


Fig. 94 Install Fifth Gear Shift Rail Lock Ball

DISASSEMBLY AND ASSEMBLY (Continued)

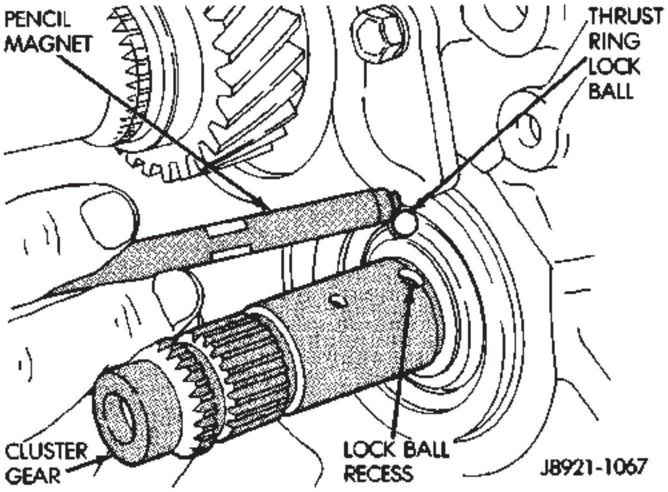


Fig. 95 Install Fifth Gear Thrust Ring Lock Ball

(27) Install fifth gear thrust ring onto countershaft and over lock ball (Fig. 96).

(28) Install countershaft fifth gear bearing halves into countershaft fifth gear assembly (Fig. 97).

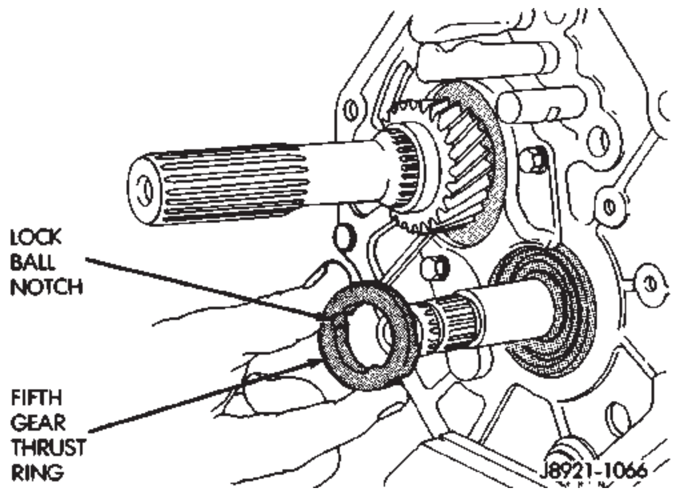


Fig. 96 Install Fifth Gear Thrust Ring

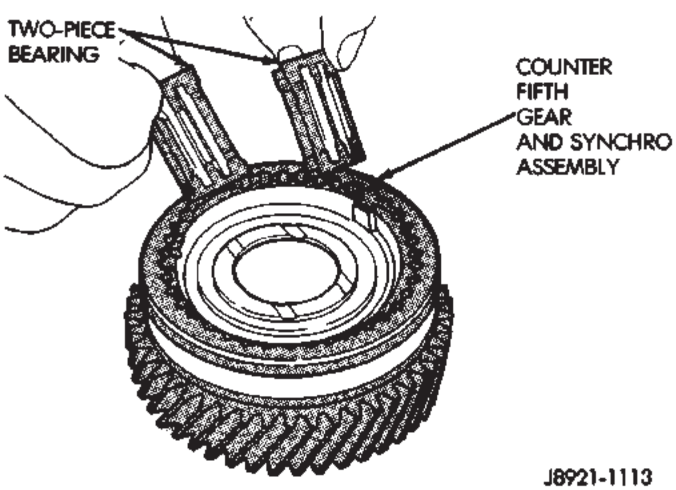


Fig. 97 Install Countershaft Fifth Gear Bearings

(29) Install countershaft fifth gear assembly onto countershaft (Fig. 98).

(30) Install fifth gear synchronizer ring (Fig. 99).

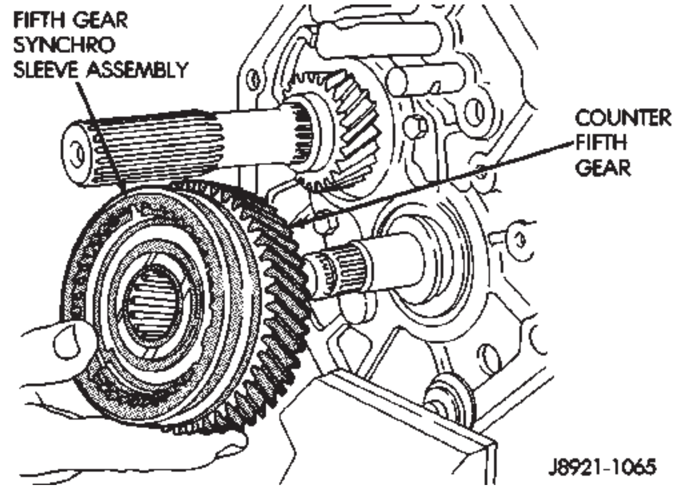


Fig. 98 Install Countershaft Fifth Gear Assembly

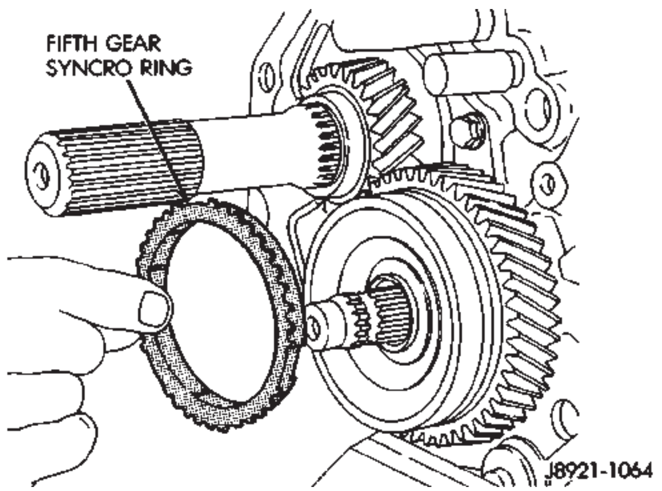


Fig. 99 Install Fifth Gear Synchronizer Ring

(31) Position fifth gear blocker ring onto countershaft. Verify that blocker ring and countershaft splines are aligned.

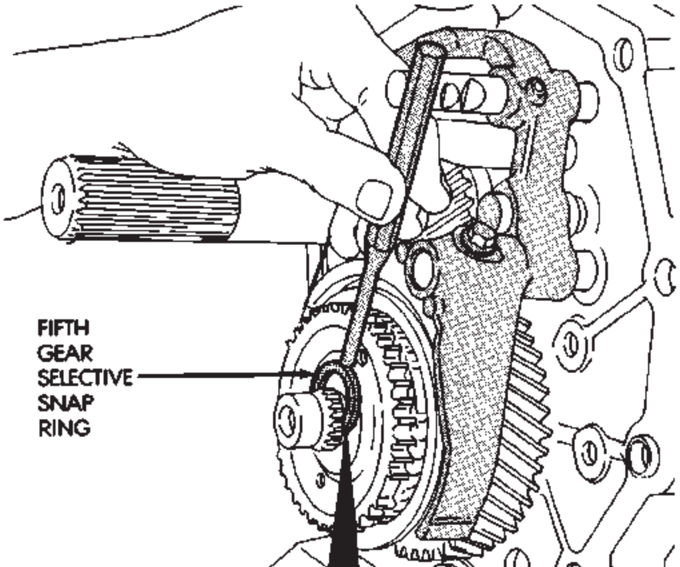
(32) Using a suitable driver and mallet, seat the blocker ring onto the countershaft.

(33) Select the thickest snap-ring the will fit into the snap–ring groove of the countershaft.

DISASSEMBLY AND ASSEMBLY (Continued)

(34) Install snap-ring to hold the countershaft fifth gear assembly onto the countershaft (Fig. 100).

(35) Install the reverse shift head and rail assembly (Fig. 101).



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)

J8921-1114

Fig. 100 Install Fifth Gear Snap-ring

(36) Move reverse shift rail forward as far as possible and install fifth gear shift fork onto synchronizer sleeve (Fig. 102).

(37) Install new bolt to hold fifth gear shift fork to shift rail (Fig. 103).

(38) Install detent balls and springs into openings in the intermediate plate (Fig. 104).

(39) Install new lock ball plugs into the intermediate plate. Tighten plugs to 19 N·m (14 ft. lbs.).

(40) Install bolts to hold reverse shift arm to the intermediate plate. Tighten bolts to 18 N·m (13 ft. lbs.).

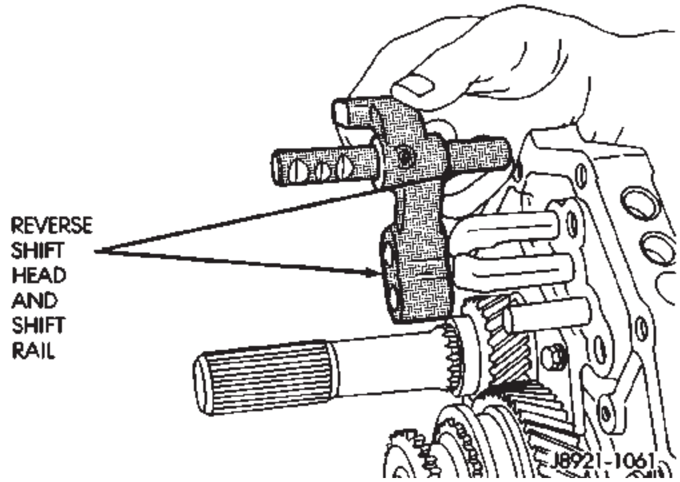


Fig. 101 Install Reverse Shift Head And Rail Assembly

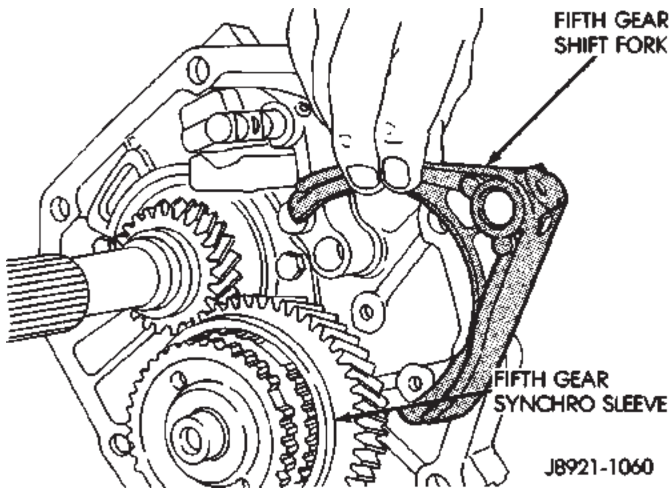


Fig. 102 Install Fifth Gear Shift Fork

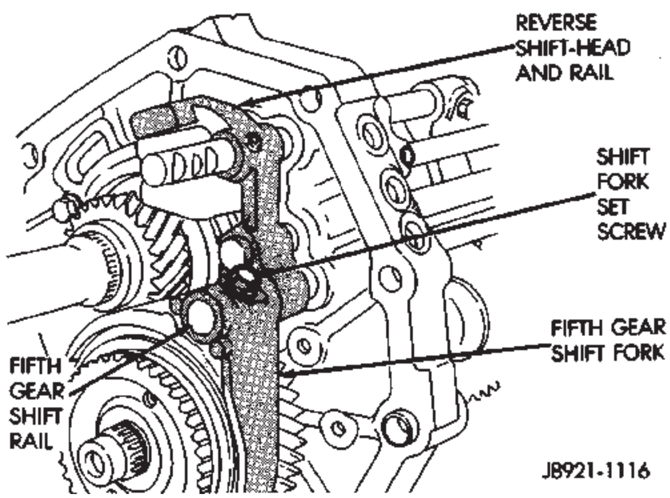


Fig. 103 Install Fifth Gear Shift Fork Retainer Bolt

DISASSEMBLY AND ASSEMBLY (Continued)

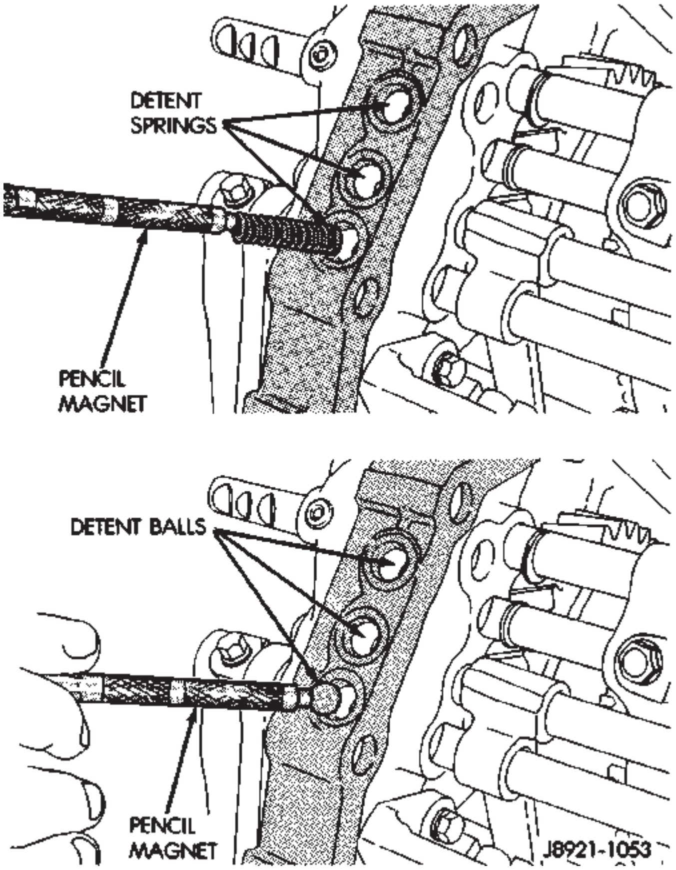


Fig. 104 Install Detent Balls And Springs

COUNTERSHAFT

DISASSEMBLY

(1) Remove select fit snap-ring holding the countershaft front bearing onto the countershaft (Fig. 105).

(2) Using Bearing Splitter P-334, a suitable spacer on center of countershaft, and a shop press, remove the countershaft front bearing from the countershaft.

ASSEMBLY

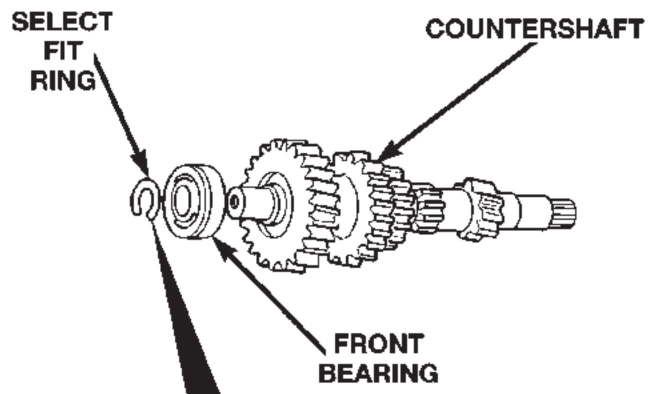
(1) Remove any nicks or burrs on countershaft hub with fine emery or crocus cloth.

(2) Position countershaft front bearing on end of countershaft. Be sure the snap-ring groove in bearing is facing forward.

(3) Using Special Tool 8109 and a shop press, press bearing onto countershaft.

(4) Select the thickest snap-ring that will fit into the snap-ring groove of the countershaft (Fig. 105).

(5) Install snap-ring to hold countershaft front bearing onto countershaft.



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)

80ac6a0b

Fig. 105 Countershaft Front Bearing Snap-ring

INPUT SHAFT

DISASSEMBLY

(1) Verify that the 3–4 synchronizer is in the neutral position.

(2) Separate input shaft from output shaft (Fig. 106).

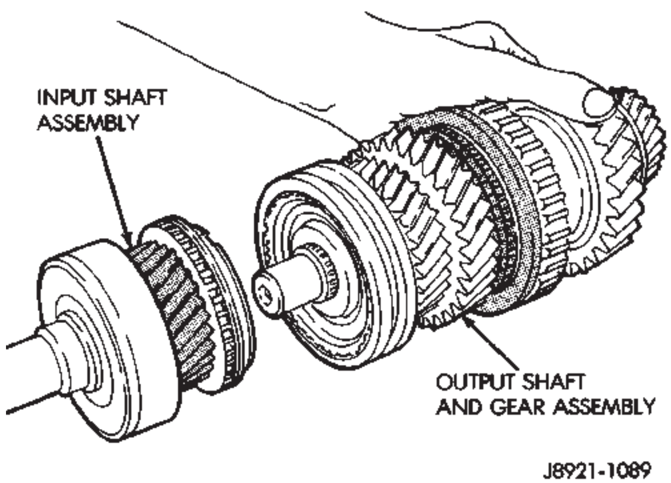


Fig. 106 Separate Input and Output Shafts

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Remove the output shaft pilot bearing from the input shaft or output shaft (Fig. 107).

(4) Remove the fourth gear synchronizer ring from the input shaft (Fig. 108).

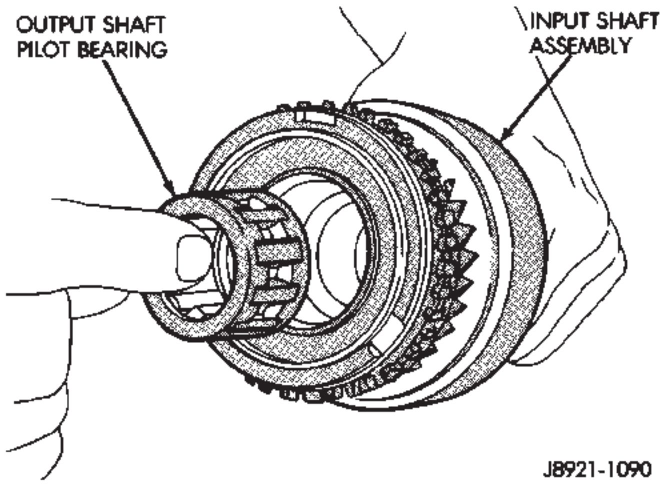


Fig. 107 Remove Output Shaft Pilot Bearing

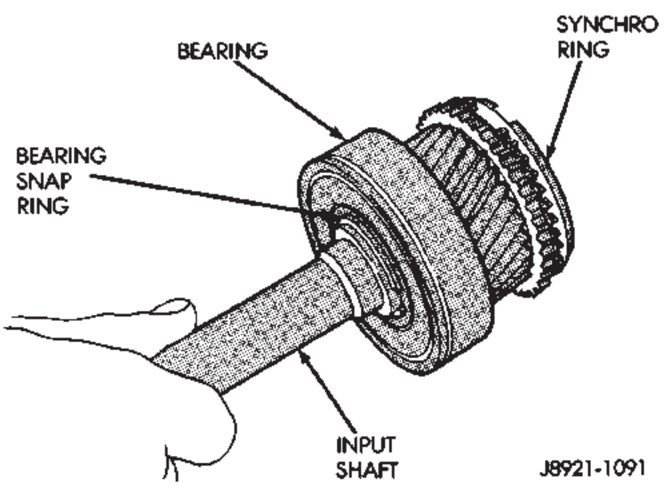


Fig. 108 Input Shaft Components

(5) Remove the select fit snap-ring holding the input shaft bearing onto the input shaft.

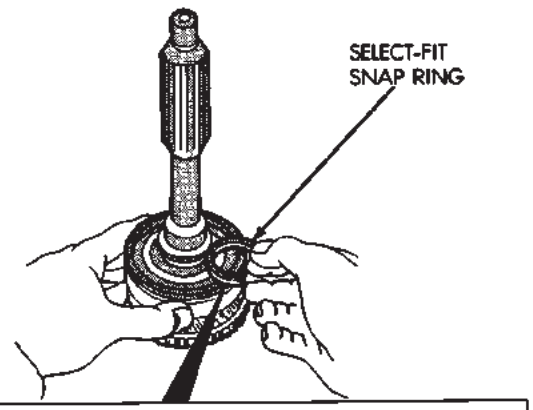
(6) Using Bearing Splitter P-334 and a shop press, remove the bearing from the input shaft.

ASSEMBLY

(1) Position input shaft bearing onto input shaft. Be sure that the snap-ring groove in the bearing is facing forward.

(2) Using Driver 6052, drive bearing onto input shaft.

(3) Select the thickest snap-ring that will fit into the snap-ring groove of the input shaft (Fig. 109).



I.D. MARK	SNAP RING THICKNESS	MM (IN.)
A	2.10 - 2.15	(0.0827 - 0.0846)
B	2.15 - 2.20	(0.0846 - 0.0866)
C	2.20 - 2.25	(0.0866 - 0.0886)
D	2.25 - 2.30	(0.0886 - 0.0906)
E	2.30 - 2.35	(0.0906 - 0.0925)
F	2.35 - 2.40	(0.0925 - 0.0945)
G	2.40 - 2.45	(0.0945 - 0.0965)

J8921-1097

Fig. 109 Select Input Shaft Bearing Snap-ring

(4) Lubricate output shaft pilot bearing bore of input shaft with petroleum jelly.

(5) Install output shaft pilot bearing in input shaft bore (Fig. 107).

(6) Install the fourth gear synchronizer ring onto the input shaft.

(7) Install input shaft to output shaft.

OUTPUT SHAFT

Refer to (Fig. 110) for parts identification during disassembly and assembly of the output shaft.

DISASSEMBLY AND ASSEMBLY (Continued)

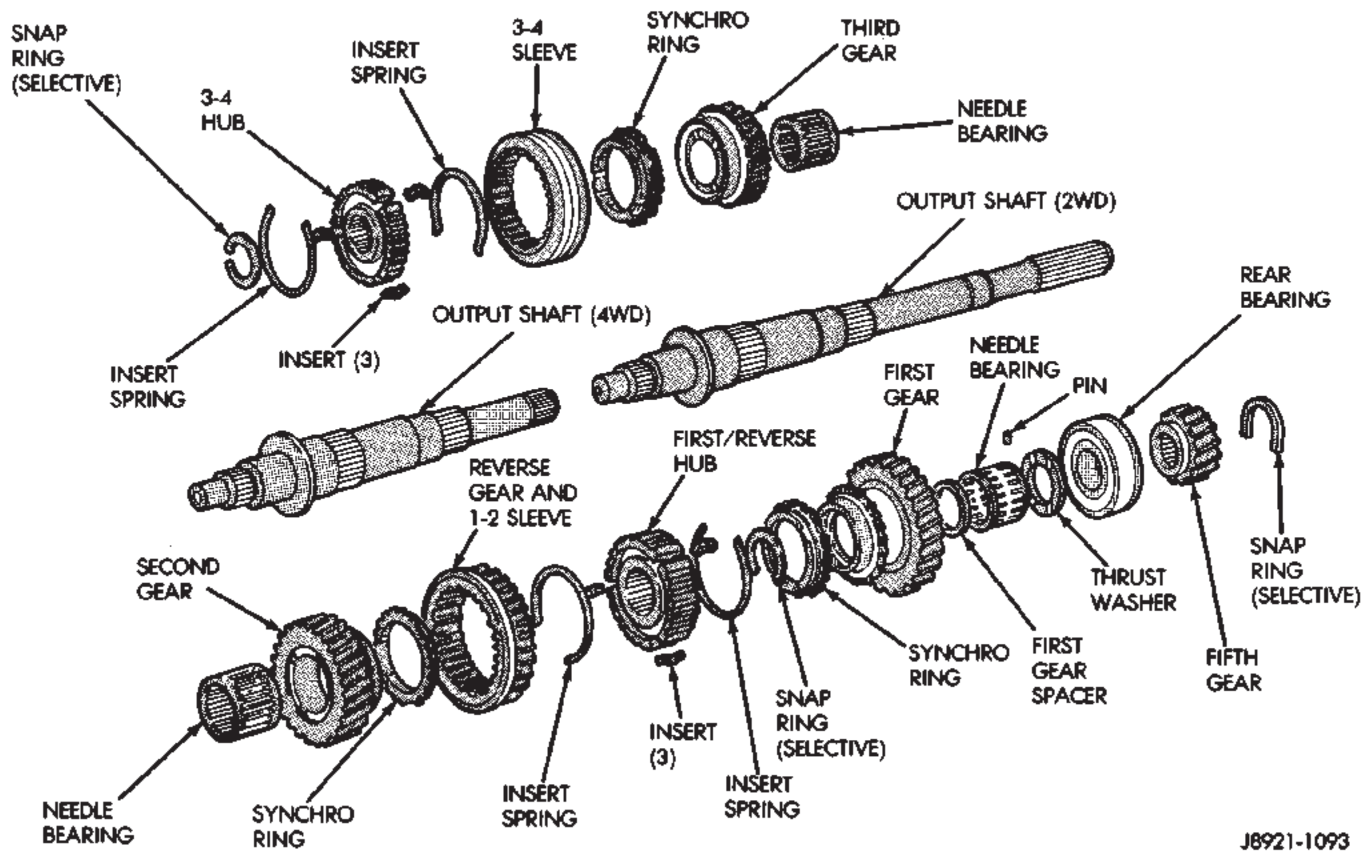


Fig. 110 Output Shaft And Gears

DISASSEMBLY

(1) Remove input shaft and output shaft pilot bearing from output shaft (Fig. 111), if necessary.

(2) Measure and note thrust clearance of output shaft gears (Fig. 112). First gear clearance should be 0.10 – 0.40 mm (0.004 – 0.0197 in.). Second and third gear clearance should be 0.10 – 0.30 mm (0.003 – 0.0118 in.).

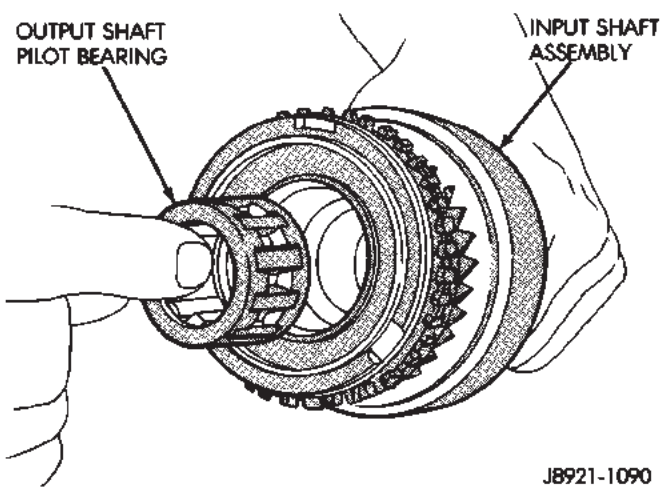


Fig. 111 Remove Output Shaft Pilot Bearing

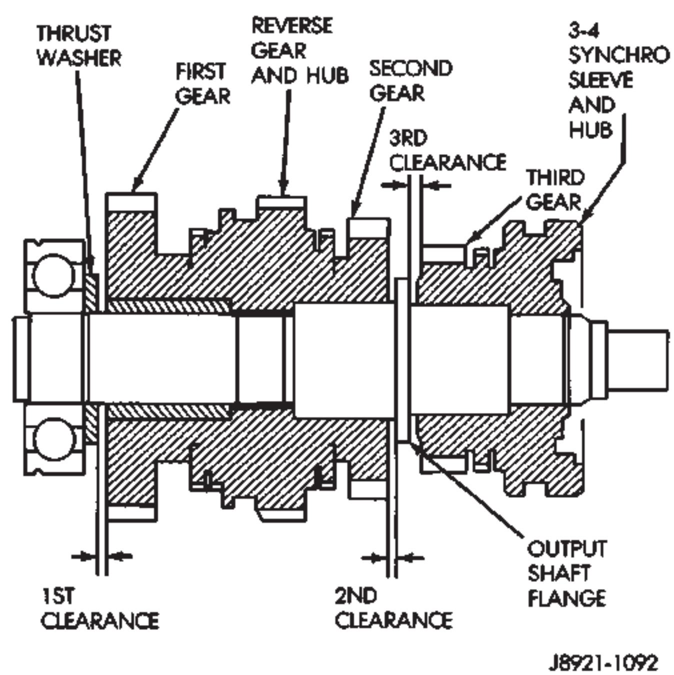


Fig. 112 Check Output Shaft Gear Thrust Clearance

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Remove output shaft fifth gear snap ring with two screwdrivers (Fig. 113).

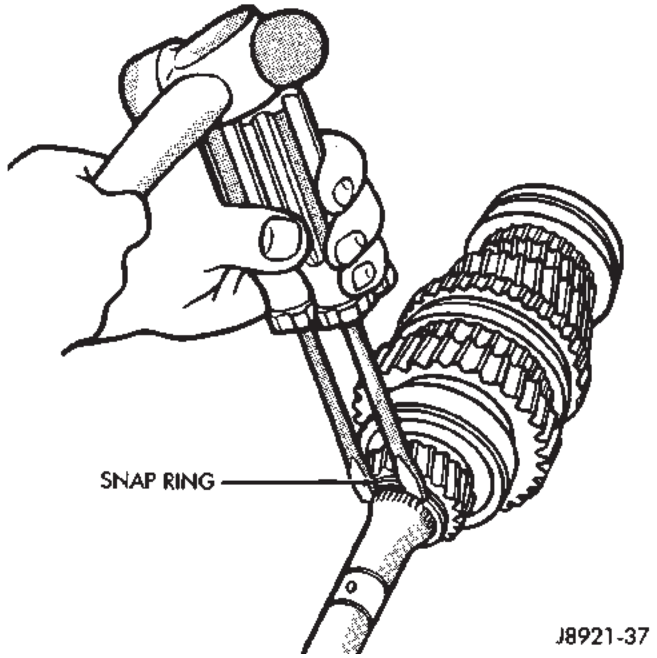


Fig. 113 Remove Fifth Gear Snap-ring

(4) Using Bearing Splitter P-334 or suitable press plates positioned under first gear, press fifth gear, rear bearing, first gear, and first gear thrust washer off output shaft (Fig. 114).

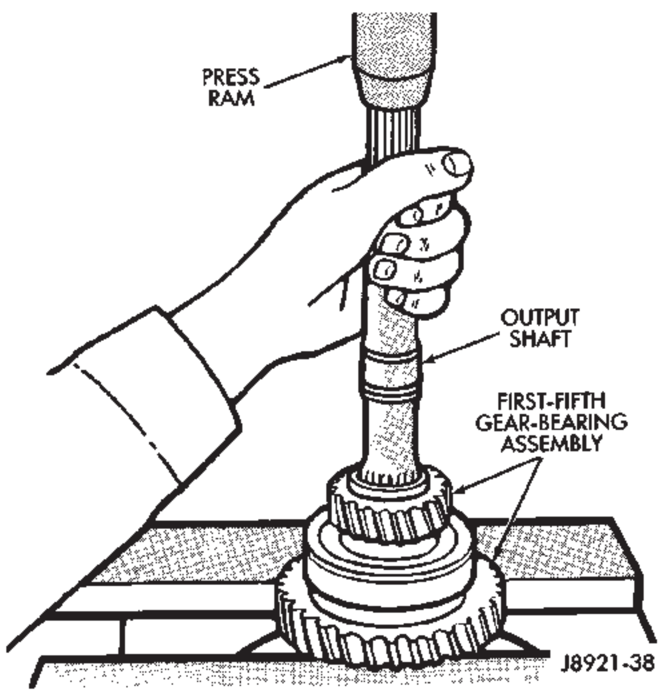


Fig. 114 Remove Fifth Gear, First Gear Bearing, And Thrust Washer

(5) Remove first gear thrust washer locating pin from output shaft.

(6) Remove first gear needle roller bearing from output shaft.

(7) Remove first gear spacer from output shaft.

(8) Remove first gear synchronizer ring.

(9) Remove select fit snap-ring holding the 1–2 synchronizer/reverse gear onto the output shaft.

(10) Using Bearing Splitter P-334 or suitable press plates positioned under second gear, press 1–2 synchronizer/reverse gear and second gear from output shaft (Fig. 115).

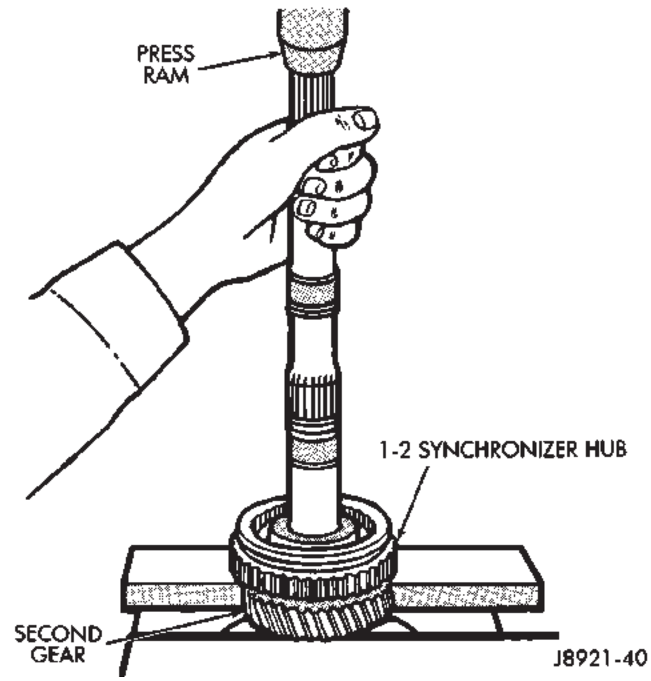


Fig. 115 Remove Second Gear And 1–2 Synchronizer/Reverse Gear

(11) Remove second gear needle roller bearing from the output shaft or second gear.

(12) Remove select fit snap-ring holding the 3–4 synchronizer onto the output shaft (Fig. 116).

(13) Using Bearing Splitter P-334 or suitable press plates positioned under third gear, press the 3–4 synchronizer and third gear from output shaft (Fig. 117).

(14) Remove third gear needle roller bearing from output shaft or gear.

ASSEMBLY

(1) Lubricate transmission components with specified gear lubricant during assembly.

(2) If necessary, assemble 1–2 and 3–4 synchronizer hubs, sleeves, springs and key inserts (Fig. 118).

(3) Install third gear needle bearing onto the output shaft.

(4) Install third gear over bearing and onto output shaft flange.

(5) Install third gear synchronizer ring to third gear.

DISASSEMBLY AND ASSEMBLY (Continued)

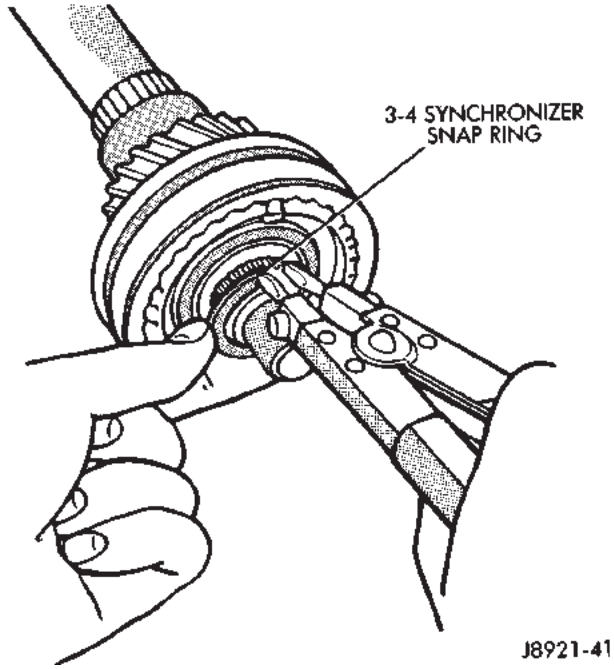


Fig. 116 Remove 3–4 Synchronizer Snap Ring

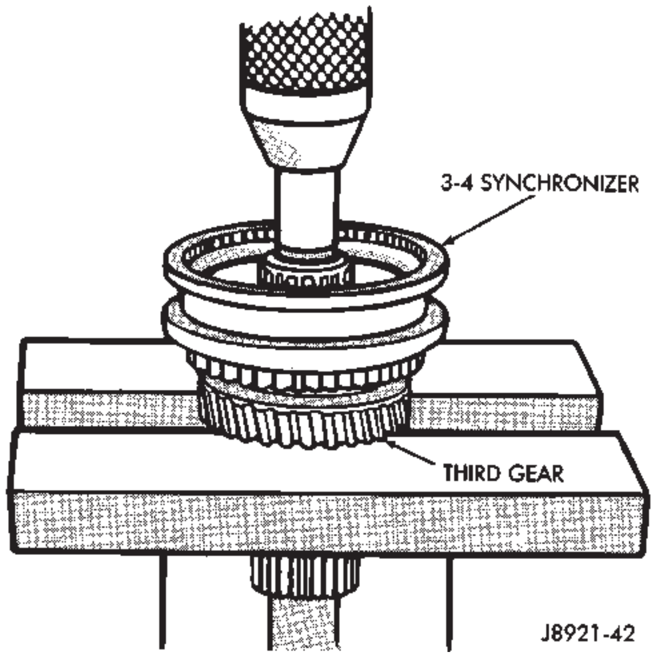


Fig. 117 Remove 3–4 Synchronizer And Third Gear

(6) Position the 3–4 synchronizer onto the output shaft.

(7) Using Adapter 6761 and a shop press, press the 3–4 synchronizer onto the output shaft.

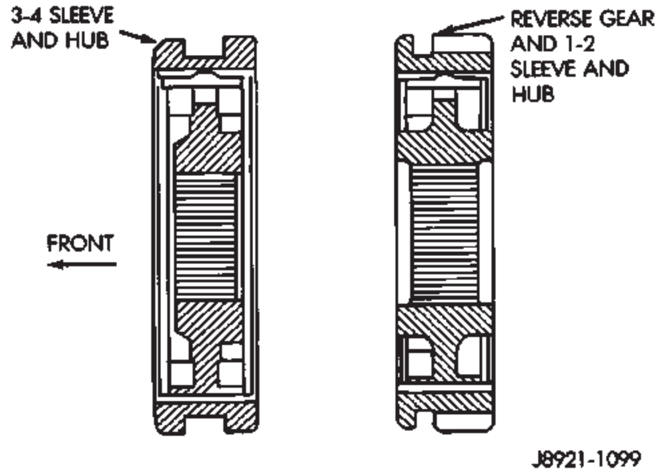
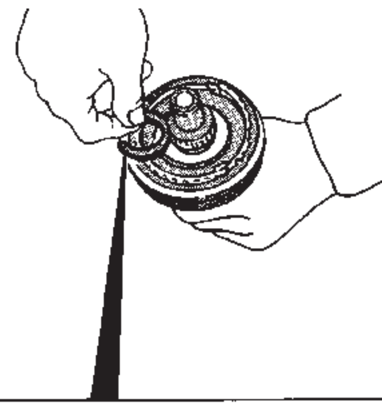


Fig. 118 Synchronizer Identification

(8) Select the thickest snap-ring that will fit into the snap-ring groove of the output shaft (Fig. 119).



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)

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Fig. 119 Select 3–4 Synchronizer Snap-ring

(9) Install snap-ring to hold 3–4 synchronizer onto output shaft.

DISASSEMBLY AND ASSEMBLY (Continued)

(10) Verify third gear thrust clearance with feeler gauge (Fig. 120). Clearance should be 0.10 – 0.30 mm (0.003 – 0.0118 in.). If clearance is out of specification, refer to Cleaning and Inspection section within this group.

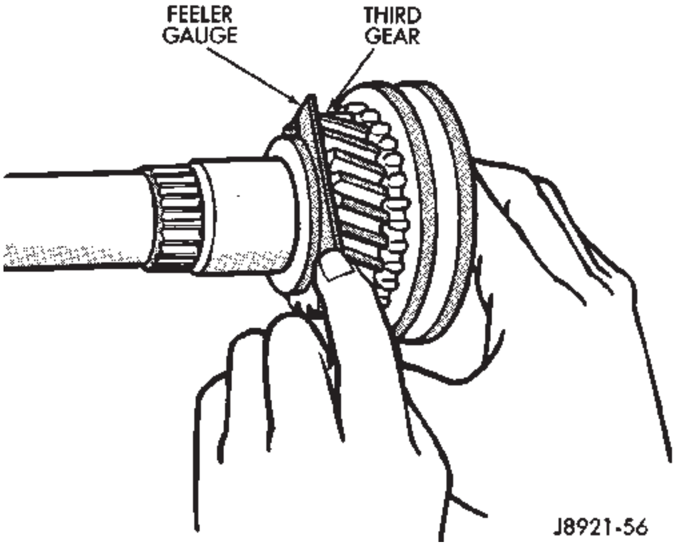


Fig. 120 Check Third Gear Clearance

(11) Install second gear needle bearing onto output shaft.

(12) Install second gear over bearing and onto output shaft flange.

(13) Install second gear synchronizer ring onto second gear.

(14) Position 1–2 synchronizer/reverse gear assembly onto splines of output shaft.

(15) Using Driver MD-998805, Adapter 6761, and a shop press, press the 1–2 synchronizer/reverse gear onto the output shaft.

(16) Select the thickest snap-ring that will fit into the snap-ring groove of the output shaft (Fig. 121).

(17) Install snap-ring to hold 1–2 synchronizer/reverse gear onto output shaft.

(18) Install first gear synchronizer ring into 1–2 synchronizer/reverse gear.

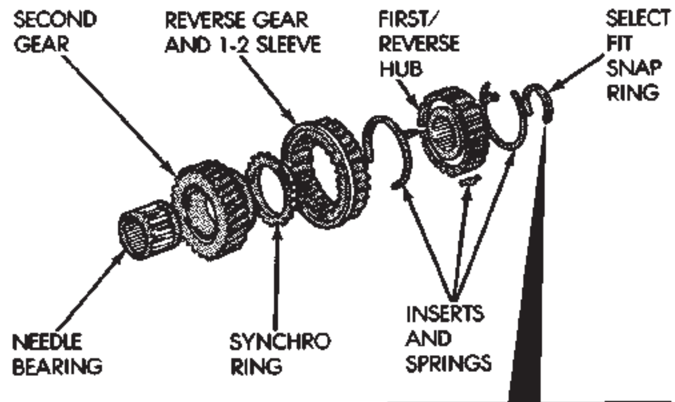
(19) Install the first gear spacer onto the input shaft and against the 1–2 synchronizer/reverse gear snap-ring.

(20) Install first gear needle bearing onto output shaft (Fig. 122).

(21) Install first gear onto output shaft and over bearing.

(22) Install the first gear thrust washer locating pin into the output shaft.

(23) Install the first gear thrust washer onto the output shaft. Rotate the thrust washer until the washer locating pin aligns with the notch in the washer.



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. 121 Second Gear And Synchronizer Assembly

(24) Position output shaft rear bearing onto output shaft. Ensure that the snap ring groove in bearing outer race is toward rear of output shaft.

(25) Using Driver L-4507 and suitable mallet, drive bearing onto output shaft.

(26) Install snap-ring onto output shaft rear bearing outer race.

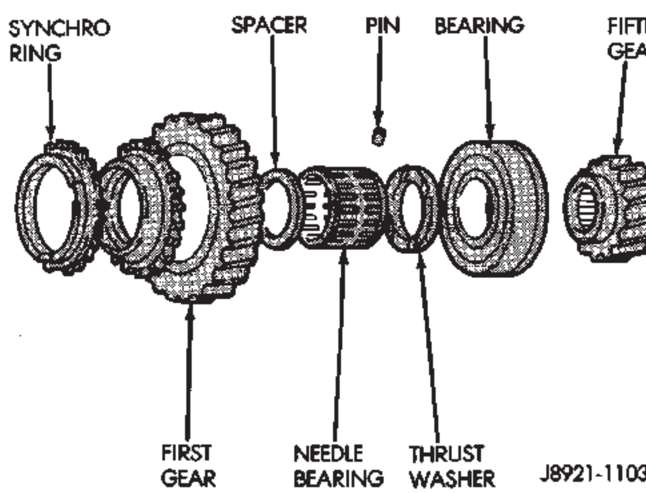


Fig. 122 First And Fifth Gear Components

(27) Check first and second gear thrust clearance (Fig. 123). First gear clearance should be 0.10 – 0.40 mm (0.003 – 0.0197 in.). Second gear clearance should be 0.10 – 0.30 mm (0.003 – 0.0118 in.). If clearance is out of specification, refer to Cleaning and Inspection section within this group.

DISASSEMBLY AND ASSEMBLY (Continued)

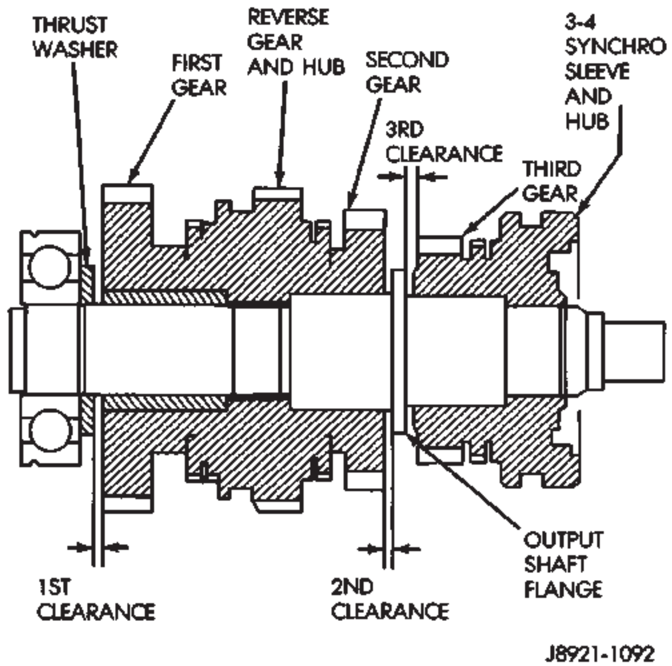


Fig. 123 Check First–Second Gear Thrust Clearance

(28) Position fifth gear onto output shaft with the gear's long shoulder toward the rear of shaft. Ensure that the gear and output shaft splines are aligned.

(29) Using Adapter 6761, Driver L-4507, and a shop press, press fifth gear onto output shaft.

(30) Select the thickest snap-ring that will fit into the snap-ring groove of the output shaft (Fig. 124).

(31) Install snap-ring to hold fifth gear onto output shaft.

(32) Install output shaft pilot bearing into the input shaft.

(33) Install the input shaft to the output shafts.

CLEANING AND INSPECTION

AX15 MANUAL TRANSMISSION COMPONENTS

GENERAL INFORMATION

Clean the transmission components in solvent. Dry the cases, gears, shift mechanism and shafts with compressed air. Dry the bearings with clean, dry shop towels only. Never use compressed air on the bearings. This could cause severe damage to the bearing roller and race surfaces.

If output shaft flange thickness is within specification but any gear thrust clearance is out of specification, replace the necessary gear and gear needle bearing as an assembly.

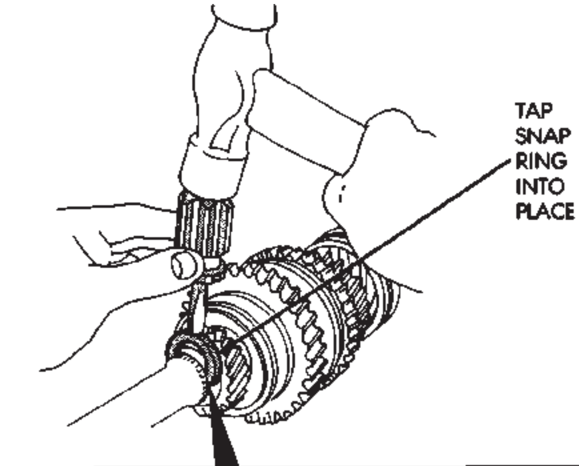
GEAR CASE, ADAPTER/EXTENSION HOUSING, INTERMEDIATE PLATE

Clean the case, housing, and intermediate plate with solvent and dry with compressed air. Replace the case if cracked, porous, or if any of the bearing and gear bores are damaged.

Inspect the threads in the case, housing, and plate. Minor thread damage can be repaired with steel thread inserts, if necessary. Do not attempt to repair any threads which show evidence of cracks around the threaded hole.

OUTPUT SHAFT

Check thickness of the output shaft flange with a micrometer or vernier calipers (Fig. 125). Minimum allowable flange thickness is 4.70 mm (0.185 in.).



I.D. MARK	SNAP RING THICKNESS	MM (IN.)
A	2.75 - 2.80	(0.1083 - 0.1102)
B	2.80 - 2.85	(0.1002 - 0.1122)
C	2.85 - 2.90	(0.1122 - 0.1142)
D	2.90 - 2.95	(0.1142 - 0.1161)
E	2.95 - 3.00	(0.1161 - 0.1181)
F	3.00 - 3.05	(0.1181 - 0.1201)
G	3.05 - 3.10	(0.1201 - 0.1220)
H	3.10 - 3.15	(0.1220 - 0.1240)
J	3.15 - 3.20	(0.1240 - 0.1260)
K	3.20 - 3.25	(0.1260 - 0.1280)
L	3.25 - 3.30	(0.1280 - 0.1299)
M	3.30 - 3.35	(0.1299 - 0.1319)

J8921-1104

Fig. 124 Select/Install Fifth Gear Snap Ring

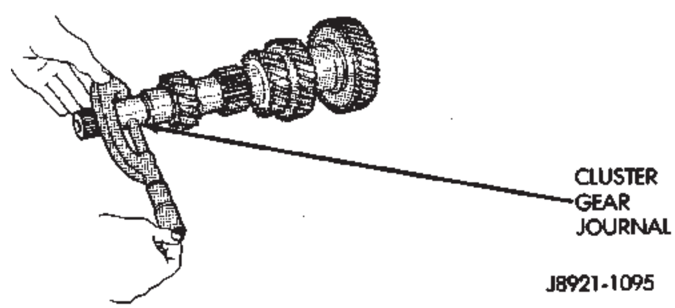


Fig. 125 Check Output Shaft Tolerances

Check diameter of the first, second, and third gear bearing surfaces on the output shaft. Minimum diameters are as follows:

CLEANING AND INSPECTION (Continued)

• First gear bearing surface is 38.86 mm (1.529 in.).
• Second gear bearing surface is 46.86 mm (1.844 in.).
• Third gear bearing surface is 37.86 mm (1.490 in.).

Measure output shaft runout with a dial indicator and V-blocks (Fig. 125). Runout should not exceed 0.06 mm (0.0024 in.).

Replace output shaft if measurement of any surface is out of specification. Do not attempt to repair out of specification components.

COUNTERSHAFT

Inspect the countershaft gear teeth. Replace the countershaft if any teeth are worn or damaged. Inspect the bearing surfaces and replace shaft if any surface shows damage or wear.

Check condition of the countershaft front bearing. Replace the bearing if worn, noisy, or damaged.

GEAR AND SYNCHRONIZER

Install the needle bearings in the first, second, third and counter fifth gears. Install the gears on the output shaft. Then check oil clearance between the gears and shaft with a dial indicator (Fig. 126). Oil clearance for all three gears is 0.16 mm (0.0063 in.) maximum.

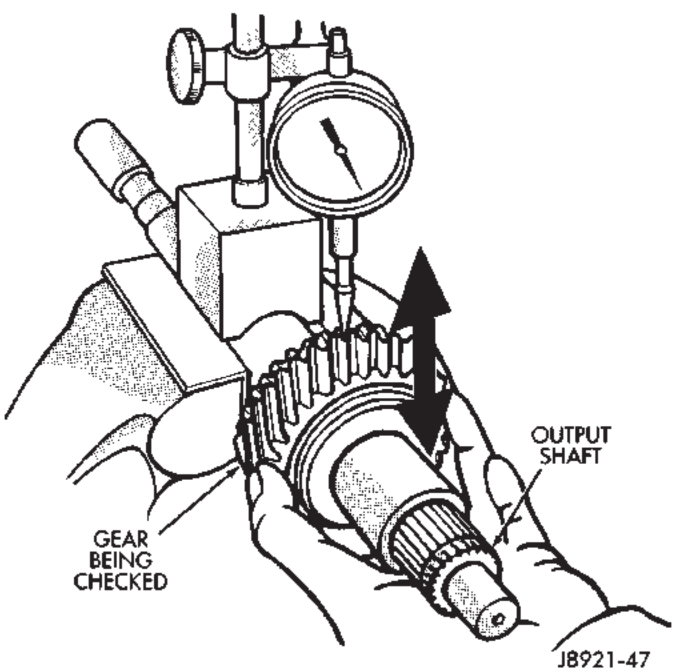


Fig. 126 Check Gear–To–Shaft Oil Clearance

Check synchronizer ring wear (Fig. 127). Insert each ring in matching gear. Measure clearance between each ring and gear with feeler gauge. Clearance should be 0.06 – 1.6 mm (0.024 – 0.063 in.).

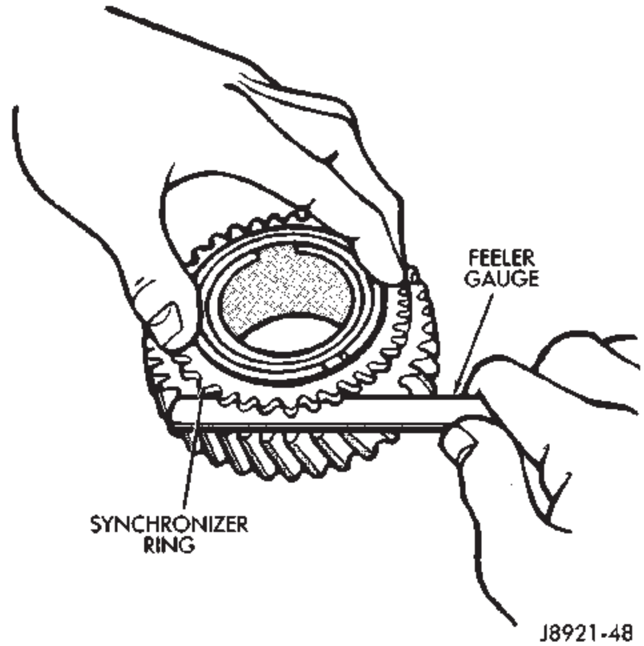


Fig. 127 Check Synchronizer Ring Wear

Check shift fork–to–synchronizer hub clearance with a feeler gauge (Fig. 128). Replace the fork if clearance exceeds 1.0 mm (0.039 in.).

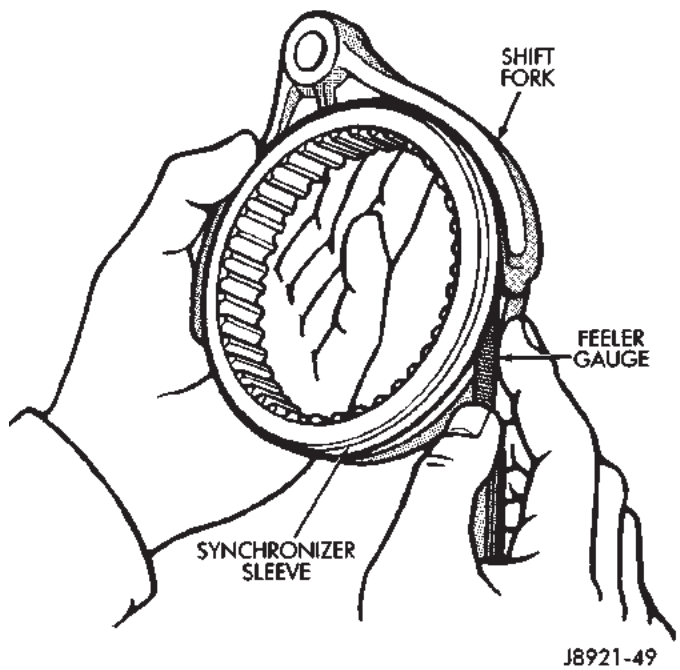


Fig. 128 Check Fork–To–Hub Clearance

CLEANING AND INSPECTION (Continued)

Check the condition of the reverse idler gear bushing (Fig. 129). Replace the gear if the bushing is damaged or worn.

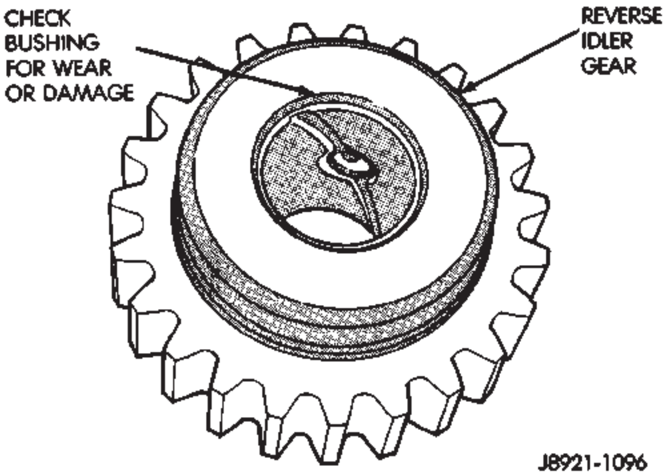


Fig. 129 Reverse Idler Gear Bushing

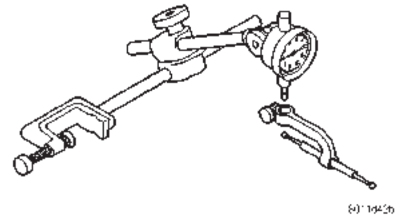
SPECIFICATIONS

TORQUE

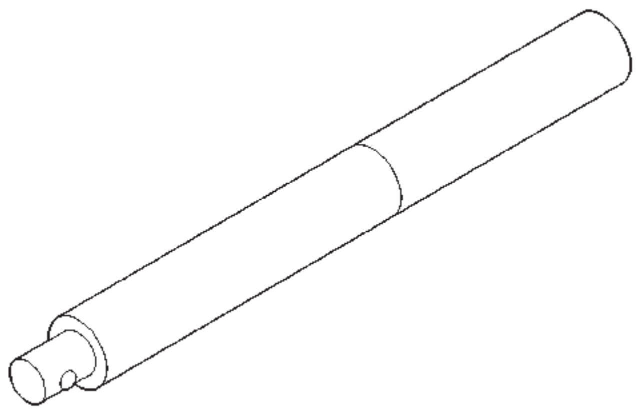
DESCRIPTION	TORQUE
Plugs, Access	19 N·m (14 ft.lbs.)
Bolts, Adapter Housing	34 N·m (25 ft.lbs.)
Switch, Back-up Light	44 N·m (32.5 ft.lbs.)
Plugs, Drain and Fill	44 N·m (32.5 ft.lbs.)
Bolts, Front Bearing Retainer	17 N·m (12 ft.lbs.)
Plugs, Interlock and Detent	19 N·m (14 ft.lbs.)
Screws, Propeller Shaft Clamp	16–23 N·m (140–200 in.lbs.)
Bolts, Rear Mount to Transmission	33–60 N·m (24–44 ft.lbs.)
Nut, Rear Mount Clevis	54–75 N·m (40–55 ft.lbs.)
Nuts, Rear Mount to Crossmember	33–49 N·m (24–36 ft.lbs.)
Pins, Restrictor	27.4 N·m (20 ft.lbs.)
Bolts, Reverse Shift Arm Bracket	18 N·m (13 ft.lbs.)
Screw, Shift Arm Set	38 N·m (28 ft.lbs.)
Screws, Shift Fork Set	20 N·m (15 ft.lbs.)
Nut, Shift Knob	20–34 N·m (15–25 ft.lbs.)
Screws, Shifter Floor Cover	2–3 N·m (17–30 in.lbs.)
Bolts, Shift Tower	18 N·m (13 ft.lbs.)
Nuts, Transfer Case Mounting	30–41 N·m (22–30 ft.lbs.)

SPECIAL TOOLS

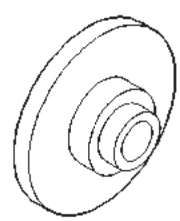
AX15



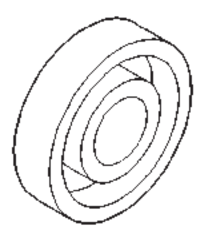
C-3339 Dial Indicator Set



C-4171 Handle, Universal Tool

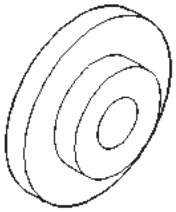


8209 Installer, Seal

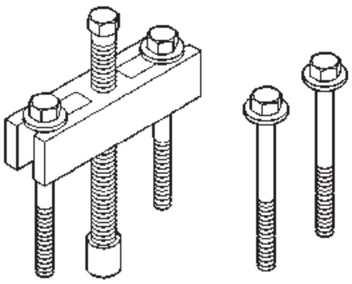


8212 Installer, Seal

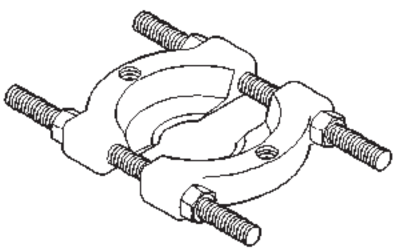
SPECIAL TOOLS (Continued)



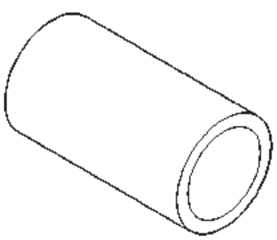
8208 Installer, Seal



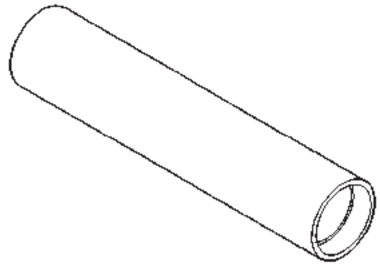
L-4407A Puller, Gear



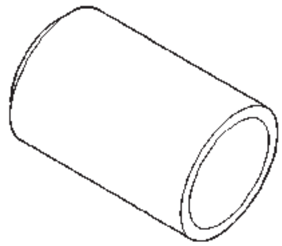
P-334 Splitter, Bearing



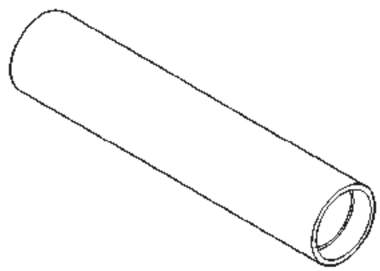
8109 Cup, Installer



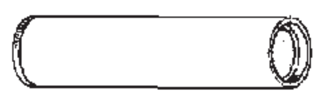
6052 Tube, Driver



6761 Adapter, Installer



MD-998805 Tube, Driver



L-4507 Tube, Driver

AUTOMATIC TRANSMISSION—30/32RH

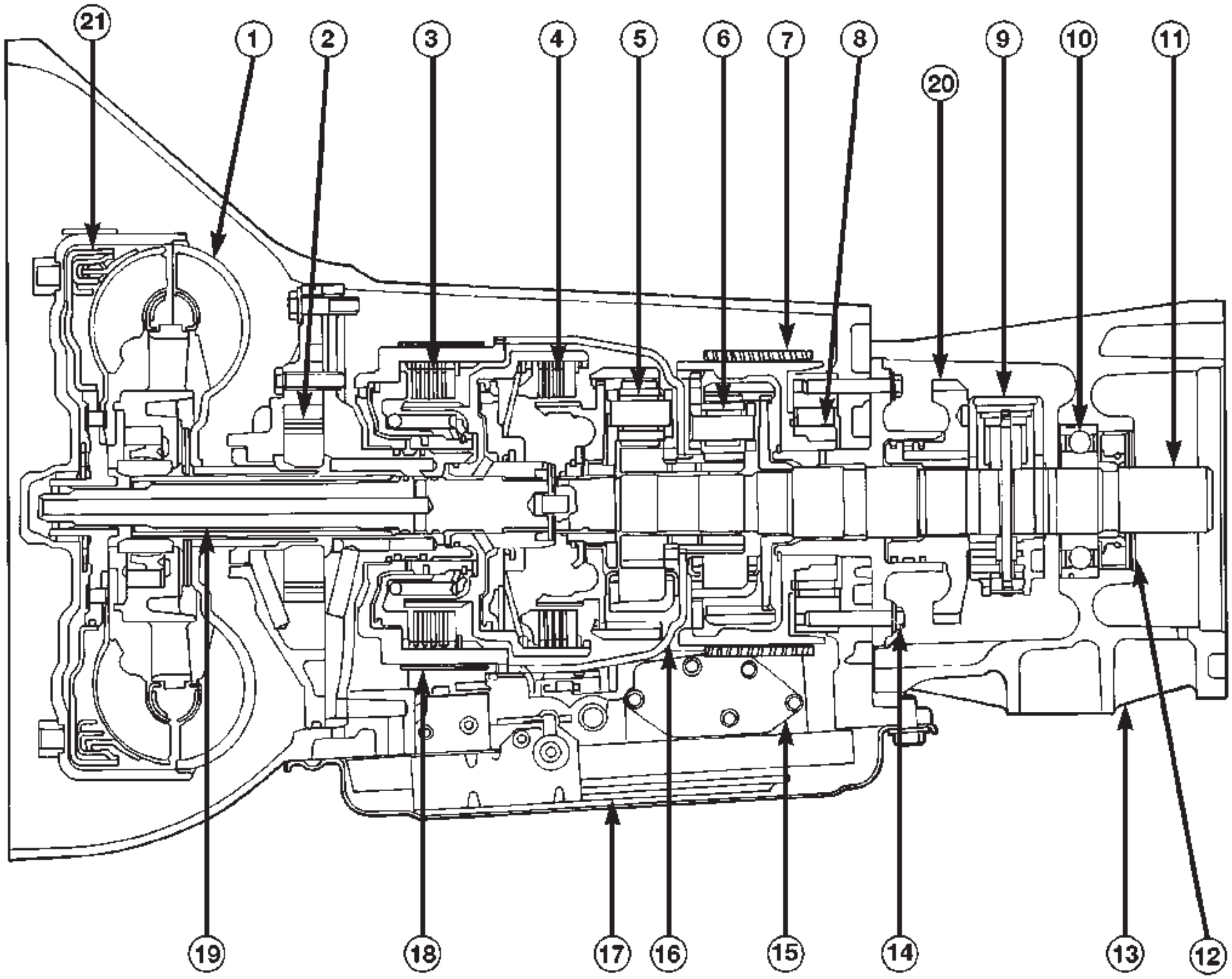
INDEX

GENERAL INFORMATION

30/32RH AUTOMATIC TRANSMISSION

The 30RH automatic transmission is used with the 2.5L engine. The 32RH automatic transmission (Fig. 1) is used with the 4.0L engine. The 30/32RH are three speed transmissions with a lock-up clutch in the torque converter. The torque converter clutch is controlled by the Powertrain Control Module (PCM). The torque converter clutch is hydraulically applied and is released when fluid is vented from the hydraulic circuit by the torque converter control (TCC) solenoid on the valve body. The torque converter clutch engages in third gear when the vehicle is cruising on a level plane after the vehicle has warmed up. The torque converter clutch will disengage when the vehicle begins to go uphill or the accelerator is applied. The torque converter clutch feature increases fuel economy and reduces the transmission fluid temperature. The 30/32RH transmission is cooled by an integral fluid cooler inside the radiator.

GENERAL INFORMATION (Continued)



(1) CONVERTER
(2) OIL PUMP
(3) FRONT CLUTCH
(4) REAR CLUTCH
(5) FRONT PLANETARY GEAR SET
(6) REAR PLANETARY GEAR SET
(7) LOW AND REVERSE (REAR) BAND
(8) OVERRUNNING CLUTCH
(9) GOVERNOR
(10) BEARING
(11) OUTPUT SHAFT
(12) SEAL
(13) ADAPTER HOUSING
(14) PARK LOCK ROD
(15) VALVE BODY
(16) SUN GEAR DRIVING SHELL
(17) OIL FILTER
(18) KICK DOWN (FRONT) BAND
(19) INPUT SHAFT
(20) PARK GEAR
(21) CONVERTER CLUTCH

80a13873

Fig. 1 30/32 RH Automatic Transmission

GENERAL INFORMATION (Continued)

TRANSMISSION IDENTIFICATION

Transmission identification numbers are stamped on the left side of the case just above the oil pan gasket surface (Fig. 2). Refer to this information when ordering replacement parts.

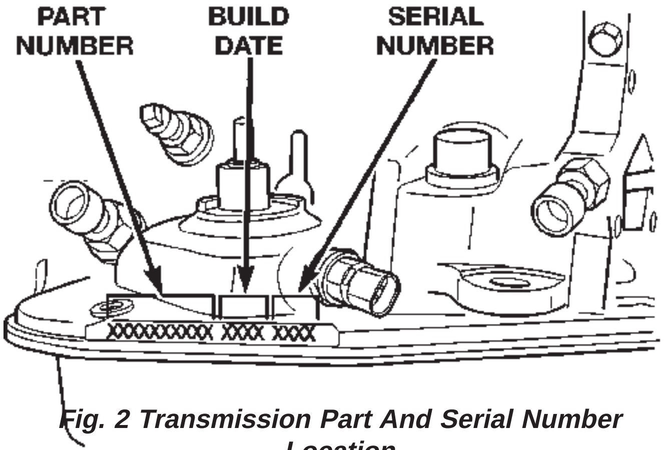


Fig. 2 Transmission Part And Serial Number Location

RECOMMENDED FLUID

Mopar® ATF Plus 3, Type 7176 automatic transmission fluid is the recommended fluid for Chrysler automatic transmissions.

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

EFFECTS OF INCORRECT FLUID LEVEL

A low fluid level allows the pump to take in air along with the fluid. Air in the fluid will cause fluid pressures to be low and develop slower than normal. If the transmission is overfilled, the gears churn the fluid into foam. This aerates the fluid and causing the same conditions occurring with a low level. In either case, air bubbles cause fluid overheating, oxidation and varnish buildup which interferes with valve, clutch and servo operation. Foaming also causes fluid expansion which can result in fluid overflow from the transmission vent or fill tube. Fluid overflow can easily be mistaken for a leak if inspection is not careful.

CAUSES OF BURNT FLUID

Burnt, discolored fluid is a result of overheating which has two primary causes.

(1) A result of restricted fluid flow through the main and/or auxiliary cooler. This condition is usually the result of a faulty or improperly installed drainback valve, a damaged main cooler, or severe restrictions in the coolers and lines caused by debris or kinked lines.

(2) Heavy duty operation with a vehicle not properly equipped for this type of operation. Trailer towing or similar high load operation will overheat the transmission fluid if the vehicle is improperly equipped. Such vehicles should have an auxiliary transmission fluid cooler, a heavy duty cooling system, and the engine/axle ratio combination needed to handle heavy loads.

FLUID CONTAMINATION

Transmission fluid contamination is generally a result of:

- adding incorrect fluid
- failure to clean dipstick and fill tube when checking level
- engine coolant entering the fluid
- internal failure that generates debris
- overheat that generates sludge (fluid breakdown)
- failure to reverse flush cooler and lines after repair
- failure to replace contaminated converter after repair

The use of non recommended fluids can result in transmission failure. The usual results are erratic shifts, slippage, abnormal wear and eventual failure due to fluid breakdown and sludge formation. Avoid this condition by using recommended fluids only.

The dipstick cap and fill tube should be wiped clean before checking fluid level. Dirt, grease and other foreign material on the cap and tube could fall into the tube if not removed beforehand. Take the time to wipe the cap and tube clean before withdrawing the dipstick.

Engine coolant in the transmission fluid is generally caused by a cooler malfunction. The only remedy is to replace the radiator as the cooler in the radiator is not a serviceable part. If coolant has circulated through the transmission for some time, an overhaul may also be necessary; especially if shift problems had developed.

The transmission cooler and lines should be reverse flushed whenever a malfunction generates sludge and/or debris. The torque converter should also be replaced at the same time.

Failure to flush the cooler and lines will result in recontamination. Flushing applies to auxiliary coolers as well. The torque converter should also be replaced whenever a failure generates sludge and debris. This is necessary because normal converter flushing procedures will not remove all contaminants.

TORQUE CONVERTER—ELECTRONIC CLUTCH

The torque converter is a hydraulic device that couples the engine crankshaft to the transmission. The torque converter consists of an outer shell with an internal turbine, a stator, an overrunning clutch, an impeller and an electronically applied converter

GENERAL INFORMATION (Continued)

clutch. Torque multiplication is created when the stator directs the hydraulic flow from the turbine to rotate the impeller in the direction the engine crankshaft is turning. The turbine transfers power to the planetary gear sets in the transmission. The transfer of power into the impeller assists torque multiplication. At low vehicle speed, the overrunning clutch holds the stator (during torque multiplication) and allows the stator to free wheel at high vehicle speed. The converter clutch provides reduced engine speed and greater fuel economy when engaged. Clutch engagement also provides reduced transmission fluid temperatures. The converter clutch engages in third gear. The torque converter hub drives the transmission oil (fluid) pump.

The torque converter is a sealed, welded unit that is not repairable and is serviced as an assembly.

CAUTION: The torque converter must be replaced if a transmission failure resulted in large amounts of metal or fiber contamination in the fluid. If the fluid is contaminated, flush the fluid cooler and lines.

TRANSMISSION GEAR RATIOS

Forward gear ratios are:
- 2.74:1 (first gear)
- 1.54:1 (second gear)
- 1.00:1 (third gear)

GEARSHIFT MECHANISM

The shift mechanism is cable operated and provides six shift positions. The shift indicator is located on the console next to the gear shift. The shift positions are:
- Park (P)
- Reverse (R)
- Neutral (N)
- Drive (D)
- Manual Second (2)
- Manual Low (1)

Manual low (1) range provides first gear only. Over run braking is also provided in this range. Manual second (2) range provides first and second gear only. Drive range provides first, second, and third gear ranges.

DESCRIPTION AND OPERATION

HYDRAULIC CONTROL SYSTEM

The transmission hydraulic control system performs four basic functions.
- pressure supply
- pressure regulation
- flow control and lubrication
- clutch/band application

PRESSURE SUPPLY

The oil pump develops fluid pressure for clutch/band application and for lubrication. The pump is driven by the torque converter. The converter is driven by a driveplate attached to the engine crankshaft.

Pressure Regulation

The pressure regulator valve maintains line (operating) 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 throttle 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.

Flow Control And Lubrication

The manual valve is operated by the gearshift linkage and provides the operating range selected by the driver.

The switch valve controls line pressure to the converter clutch. The valve also directs oil to the cooling and lubrication circuits. The switch valve regulates oil pressure to the torque converter by limiting maximum oil pressure to 130 psi.

The 1-2 shift valve provide 1-2 and 2-1 shifts and the 2-3 shift valve provide 2-3 and 3-2 shifts.

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 2-3 valve throttle pressure plug provides 3-2 downshifts at varying throttle openings depending on vehicle speed.

The kickdown valve provides forced 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 limit valve determines maximum speed at which a 3-2 part throttle kickdown can be made. Some transmissions do not have the limit valve and maximum speed for a 3-2 kickdown is at the detent position.

The shuttle valve has two functions. First is fast front band release and smooth engagement during “lift foot” 2-3 upshifts. Second is to regulate front clutch release and band application during 3-2 downshifts.

The fail safe valve restricts feed to the converter clutch if front clutch pressure drops. It permits clutch engagement only in direct (third) gear and provides fast clutch release during kickdown.

DESCRIPTION AND OPERATION (Continued)

Clutch/Band Application

The front/rear clutch pistons and servo pistons are actuated by line pressure. When line pressure is removed, the pistons are released by spring tension.

On 2-3 upshifts, the front servo piston is released by spring tension and hydraulic pressure. The accumulator controls hydraulic pressure on the apply side of the front servo during 1-2 upshifts and at all throttle openings.

CONVERTER CLUTCH ENGAGEMENT

Converter clutch engagement in third gear is controlled by sensor inputs to the powertrain control module. Inputs that determine clutch engagement are: coolant temperature, vehicle speed and throttle position. The torque converter clutch is engaged by the clutch solenoid on the valve body. The clutch will engage at approximately 56 km/h (35 mph) with light throttle, after the shift to third gear.

CONVERTER DRAINBACK VALVE

The drainback valve is located in the transmission cooler outlet (pressure) line. The valve prevents fluid from draining from the converter into the cooler and lines when the vehicle is shut down for lengthy periods. Production valves have a hose nipple at one end, while the opposite end is threaded for a flare fitting. All valves have an arrow (or similar mark) to indicate direction of flow through the valve.

BRAKE TRANSMISSION SHIFT INTERLOCK MECHANISM

The Brake Transmission Shifter/Ignition Interlock (BTSI), is a cable and solenoid operated system. It interconnects the automatic transmission floor mounted shifter to the steering column ignition switch (Fig. 3). The system locks the shifter into the PARK position. The Interlock system is engaged whenever the ignition switch is in the LOCK or ACCESSORY position. An additional electrically activated feature will prevent shifting out of the PARK position unless the brake pedal is depressed at least one-half an inch. A magnetic holding device in line with the park/brake interlock cable is energized when the ignition is in the RUN position. When the key is in the RUN position and the brake pedal is depressed, the shifter is unlocked and will move into any position. The interlock system also prevents the ignition switch from being turned to the LOCK or ACCESSORY position (Fig. 4) unless the shifter is fully locked into the PARK position.

DIAGNOSIS AND TESTING

AUTOMATIC TRANSMISSION DIAGNOSIS

Automatic transmission problems can be a result of poor engine performance, incorrect fluid level, incorrect linkage or cable adjustment, band or hydraulic control pressure adjustments, hydraulic system malfunctions or electrical/mechanical component malfunctions. Begin diagnosis by checking the easily accessible items such as: fluid level and condition, linkage adjustments and electrical connections. A road test will determine if further diagnosis is necessary.

PRELIMINARY DIAGNOSIS

Two basic procedures are required. One procedure for vehicles that are drivable and an alternate procedure for disabled vehicles (will not back up or move forward).

VEHICLE IS DRIVEABLE

(1) Check for transmission fault codes using DRB scan tool.

(2) Check fluid level and condition.

(3) Adjust throttle and gearshift linkage if complaint was based on delayed, erratic, or harsh shifts.

(4) Road test and note how transmission upshifts, downshifts, and engages.

(5) Perform stall test if complaint is based on sluggish acceleration. Or, if abnormal throttle opening is needed to maintain normal speeds with a properly tuned engine.

(6) Perform hydraulic pressure test if shift problems were noted during road test.

(7) Perform air-pressure test to check clutch-band operation.

VEHICLE IS DISABLED

(1) Check fluid level and condition.

(2) Check for broken or disconnected gearshift or throttle linkage.

(3) Check for cracked, leaking cooler lines, or loose or missing pressure-port plugs.

(4) Raise and support vehicle on safety stands, start engine, shift transmission into gear, and note following:

(a) If propeller shaft turns but wheels do not, problem is with differential or axle shafts.

(b) If propeller shaft does not turn and transmission is noisy, stop engine. Remove oil pan, and check for debris. If pan is clear, remove transmission and check for damaged drive plate, converter, oil pump, or input shaft.

(c) If propeller shaft does not turn and transmission is not noisy, perform hydraulic-pressure test to determine if problem is hydraulic or mechanical.

DIAGNOSIS AND TESTING (Continued)

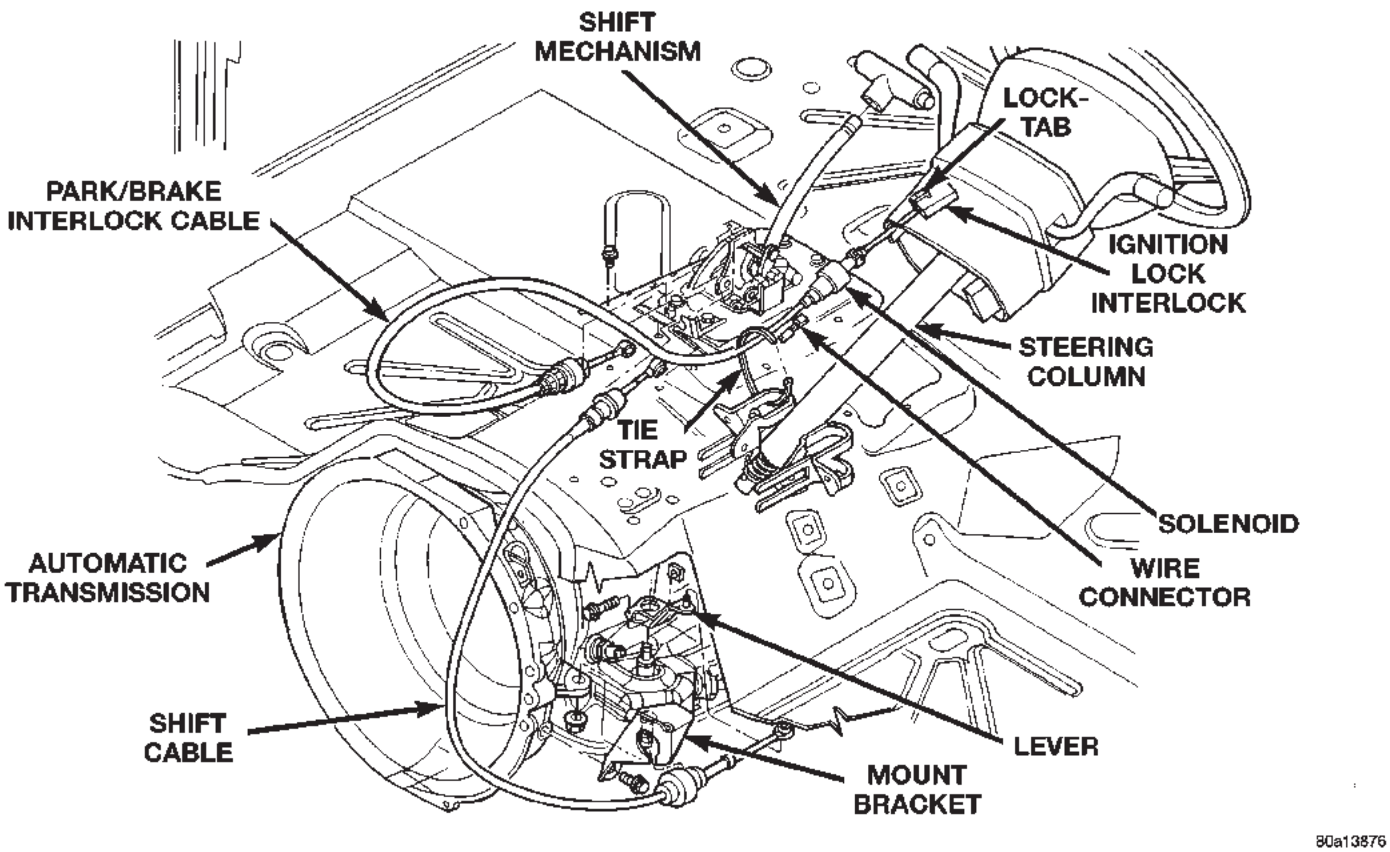


Fig. 3 Ignition Interlock Cable Routing

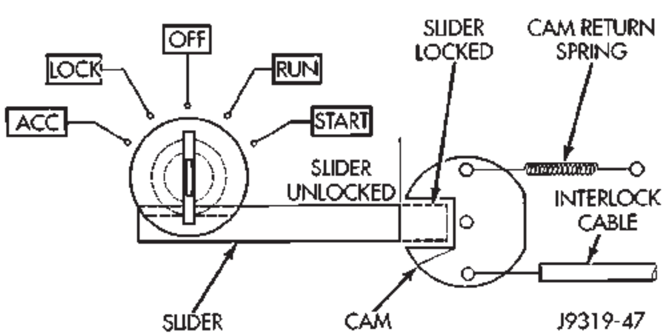


Fig. 4 Ignition Key Cylinder Actuation

PARK/NEUTRAL POSITION SWITCH

The center terminal of the park/neutral position switch is the starter-circuit terminal. It provides the ground for the starter solenoid circuit through the selector lever in PARK and NEUTRAL positions only. The outer terminals on the switch are for the backup lamp circuit.

SWITCH TEST

To test the switch, remove the wiring connector. Test for continuity between the center terminal and the transmission case. Continuity should exist only when the transmission is in PARK or NEUTRAL.

Shift the transmission into REVERSE and test continuity at the switch outer terminals. Continuity should exist only when the transmission is in REVERSE. Continuity should not exist between the outer terminals and the case.

Check gearshift linkage adjustment before replacing a switch that tests faulty.

GEARSHIFT CABLE

(1) The floor shifter lever and gate positions should be in alignment with all transmission PARK, NEUTRAL, and gear detent positions.

(2) Engine starts must be possible with floor shift lever in PARK or NEUTRAL gate positions only. Engine starts must not be possible in any other gear position.

(3) With floor shift lever handle push-button not depressed and lever in:

(a) PARK position—Apply forward force on center of handle and remove pressure. Engine starts must be possible.

(b) PARK position—Apply rearward force on center of handle and remove pressure. Engine starts must be possible.

(c) NEUTRAL position—Normal position. Engine starts must be possible.

DIAGNOSIS AND TESTING (Continued)

(d) NEUTRAL position—Engine running and brakes applied, apply forward force on center of shift handle. Transmission shall not be able to shift from neutral to reverse.

THROTTLE VALVE CABLE

Transmission throttle valve cable adjustment is extremely important to proper operation. This adjustment positions the throttle valve, which controls shift speed, quality, and part-throttle downshift sensitivity.

If cable setting is too loose, early shifts and slippage between shifts may occur. If the setting is too tight, shifts may be delayed and part throttle downshifts may be very sensitive. Refer to the Adjustments section for adjustment procedure.

ROAD TESTING

Before road testing, be sure the fluid level and control cable adjustments have been checked and adjusted if necessary. Verify that diagnostic trouble codes have been resolved.

Observe engine performance during the road test. A poorly tuned engine will not allow accurate analysis of transmission operation.

Operate the transmission in all gear ranges. Check for shift variations and engine flare which indicates slippage. Note if shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Slippage indicated by engine flare, usually means clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul will be necessary to restore normal operation.

A slipping clutch or band can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch and Band Application chart provides a basis for analyzing road test results.

ANALYZING ROAD TEST

Refer to the Clutch and Band Application chart and note which elements are in use in the various gear ranges.

Verify 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.

Verify 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, verify that the front and rear clutches are applied simultaneously only in D range third gear. If the transmission slips in third gear, either the front clutch or the rear clutch is slipping.

	Gearshift Lever Position								
DRIVE ELEMENTS	P	R	N	D			2		1
				1	2	3	1	2	
FRONT CLUTCH		•				•			
FRONT BAND (KICKDOWN)					•			•	
REAR CLUTCH				•	•	•	•	•	•
REAR BAND (LOW-REV.)		•							•
OVER-RUNNING CLUTCH				•			•		•

J9021-33

Fig. 5 Clutch And Band Application

If slippage occurs during the third gear and 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 forward gears, the transmission rear clutch is probably slipping.

This process of elimination can be used to identify a slipping unit and check operation. Proper use of the Clutch and Band Application Chart is the key.

Although road test analysis will help determine the slipping unit, the actual cause of a malfunction usually cannot be determined until hydraulic and air pressure tests are performed. Practically any condition can be caused by leaking hydraulic circuits or sticking valves.

Unless a malfunction is obvious, such as no drive in D range first gear, do not disassemble the transmission. Perform the hydraulic and air pressure tests to help determine the probable cause.

HYDRAULIC PRESSURE TEST

Hydraulic test pressures range from a low of one psi (6.895 kPa) governor pressure, to 300 psi (2068 kPa) at the rear servo pressure port in reverse.

An accurate tachometer and 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, and front servo pressure ports. Test Gauge C-3293-SP has a 300 psi range and is used at the rear servo port and overdrive test ports where pressures are higher. In cases where two test gauges are

DIAGNOSIS AND TESTING (Continued)

required, the 300 psi gauge can be used at any of the other test ports.

Pressure Test Port Locations

Pressure test ports locations are provided at the accumulator, front servo, and rear servo, governor passage, and overdrive clutch pressure passage (Fig. 6), (Fig. 7) and (Fig. 8).

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.

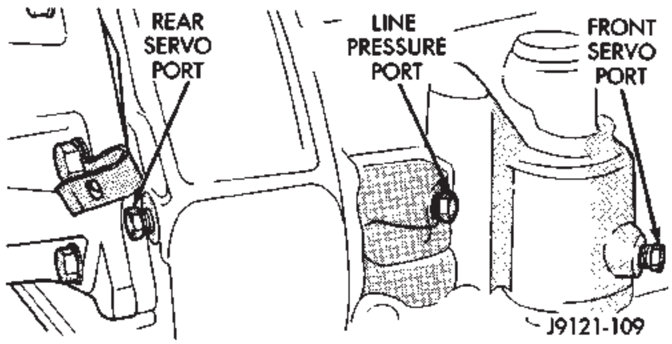


Fig. 6 Pressure Test Ports At Side Of Case

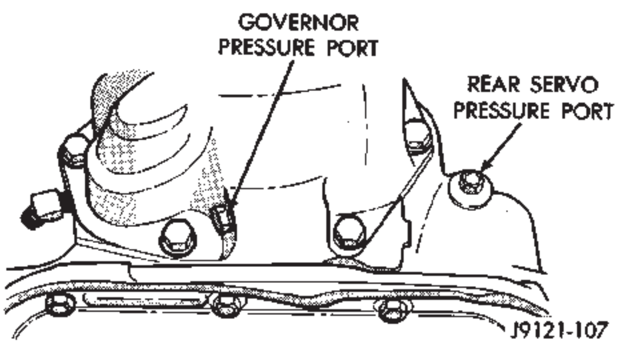


Fig. 7 Pressure Test Ports At Rear Of Case—2WD

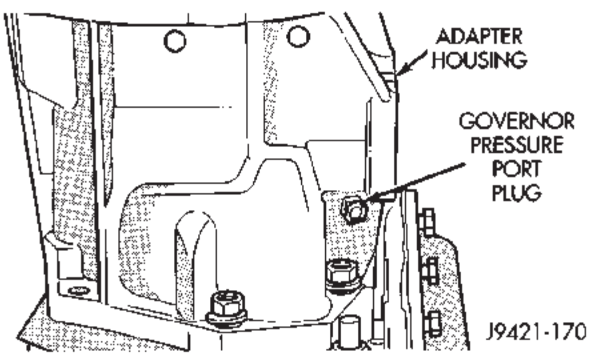


Fig. 8 Pressure Test Ports At Rear Of Case—4WD

Connect a tachometer to the engine. Position the tachometer so it can be observed from under the vehicle. Raise the vehicle on a hoist that will allow the wheels to rotate freely.

PRESSURE TEST PROCEDURE

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-SP are required for this test. Gauge C-3292 has a 100 psi range. Gauge C-3293-SP has a 300 psi range.

(1) Connect 100 psi Gauge C-3292 to accumulator port.

(2) Connect 300 psi Gauge C-3293-SP to rear servo port (Fig. 6) and (Fig. 7).

(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. 6) and (Fig. 7).

(2) Start and run engine at 1000 rpm.

(3) Move shift lever on valve body manual lever shaft, 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-SP for this test.

(1) Connect test gauges to accumulator and front servo ports (Fig. 6) and (Fig. 7). Use either test gauge at the two ports.

(2) Start and run engine at 1600 rpm for this test.

(3) Move selector lever to D range. This is two detents rearward from full forward position.

(4) Read pressures on both gauges as transmission throttle lever is moved from full forward to full rearward position.

DIAGNOSIS AND TESTING (Continued)

(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-SP for this test.

(1) Connect 300 psi gauge to rear servo port (Fig. 6) and (Fig. 7).

(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. 6) and (Fig. 7).

(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 1.5 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.

(5) Pressure rise should be smooth and drop back to 0 to 1.5 psi when wheels stop rotating.

(6) Compare results of pressure tests with analysis charts (Fig. 9).

CONVERTER STALL TEST

Stall testing involves determining maximum engine speed obtainable at full throttle with the rear wheels locked and the transmission in D range. This test checks the holding ability of the converter overrunning and transmission clutches.

WARNING: NEVER ALLOW ANYONE TO STAND DIRECTLY IN LINE WITH THE VEHICLE FRONT OR REAR DURING A STALL TEST. ALWAYS BLOCK THE WHEELS AND FULLY APPLY THE SERVICE AND PARKING BRAKES DURING THE TEST.

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 on park gear)
Pressure OK in 1, 2 but low in D3 and R	Leakage in front clutch area (servo, clutch seals, retainer bore, pump seal rings)
Pressure OK in 2 but low in R and 1	Leakage in rear servo
Front servo pressure in 2	Leakage in servo (broken servo ring or cracked servo piston)
Pressure low in all positions	Clogged filter, stuck pressure regulator valve, worn or defective pump
Governor pressure too high at idle speed	Governor valve sticking open
Governor pressure low at all mph figures	Governor valve sticking closed
Lubrication pressure low at all throttle positions	Clogged drainback valve, oil cooler or lines, seal rings leaking, output shaft plugged with debris, worn bushings in pump or clutch retainer

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Fig. 9 Pressure Test Analysis

STALL TEST PROCEDURE

(1) Connect tachometer to engine. Position tachometer so it can be viewed from driver's seat.

(2) Drive vehicle to bring transmission fluid up to normal operating temperature. Vehicle can be driven on road or on chassis dynamometer, if available.

(3) Check transmission fluid level. Add fluid if necessary.

(4) Block front wheels.

(5) Fully apply service and parking brakes.

(6) Open throttle completely and record maximum engine speed registered on tachometer. It takes 4-10 seconds to reach max rpm. **Once max rpm has been achieved, do not hold wide open throttle for more than 4-5 seconds.**

CAUTION: Stalling the converter causes a rapid increase in fluid temperature. To avoid fluid overheating, hold the engine at maximum rpm for no more than 5 seconds. If engine exceeds 2500 rpm during the test, release the accelerator pedal immediately; transmission clutch slippage is occurring.

DIAGNOSIS AND TESTING (Continued)

(7) If a second stall test is required, cool down fluid before proceeding. Shift into NEUTRAL and run engine at 1000 rpm for 20-30 seconds to cool fluid.

STALL TEST ANALYSIS

Stall Speed Too High

If the stall speed exceeds 2500 rpm, transmission clutch slippage is indicated.

Stall Speed Low

Low stall speed with a properly tuned engine indicate a torque converter overrunning clutch problem. The condition should be confirmed by road testing. A stall speed 250-350 rpm below normal indicates the converter overrunning clutch is slipping. The vehicle also exhibits poor acceleration but operates normally once highway cruise speeds are reached. Torque converter replacement will be necessary.

Stall Speed Normal But Acceleration Poor

If stall speeds are normal (1800-2300 rpm) but abnormal throttle opening is required for acceleration, or to maintain cruise speed, the converter overrunning clutch is seized. The torque converter will have to be replaced.

Converter Noise During Test

A whining noise caused by fluid flow is normal during a stall test. However, loud metallic noises indicate a damaged converter. To confirm that the noise is originating from the converter, operate the vehicle at light throttle in DRIVE and NEUTRAL on a hoist and listen for noise coming from the converter housing.

AIR TESTING TRANSMISSION CLUTCH AND BAND OPERATION

Air-pressure testing can be used to check transmission front/rear clutch and band operation. The test can be conducted with the transmission either in the vehicle or on the work bench, as a final check, after overhaul.

Air-pressure testing requires that the oil pan and valve body be removed from the transmission. The servo and clutch apply passages are shown (Fig. 10).

Front Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Rear Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage.

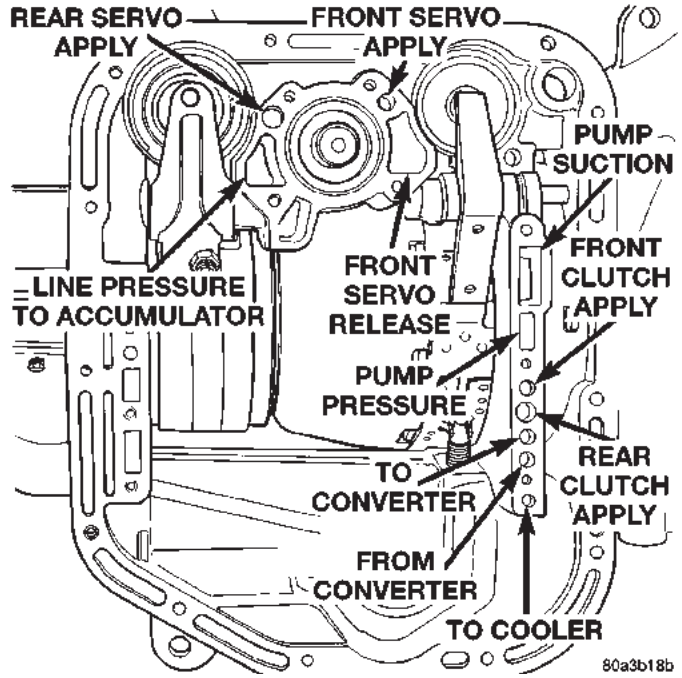


Fig. 10 Air Pressure Test Passages

Piston movement can be felt and a soft thump heard as the clutch applies.

Front Servo Apply Air Test

Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

Rear Servo Air Test

Apply air pressure to the rear servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

CONVERTER HOUSING FLUID LEAK DIAGNOSIS

When diagnosing converter housing fluid leaks, two items must be established before repair.

(1) Verify that a leak condition actually exists.

(2) Determined the true source of the leak.

Some suspected converter housing fluid leaks may not be leaks at all. They may only be the result of residual fluid in the converter housing, or excess fluid spilled during factory fill or fill after repair. Converter housing leaks have several potential sources. Through careful observation, a leak source can be identified before removing the transmission for repair. Pump seal leaks tend to move along the drive hub and onto the rear of the converter. Pump O-ring or pump body leaks follow the same path as a seal leak (Fig. 11). Pump vent or pump attaching bolt leaks are generally deposited on the inside of the

DIAGNOSIS AND TESTING (Continued)

converter housing and not on the converter itself (Fig. 11). 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.

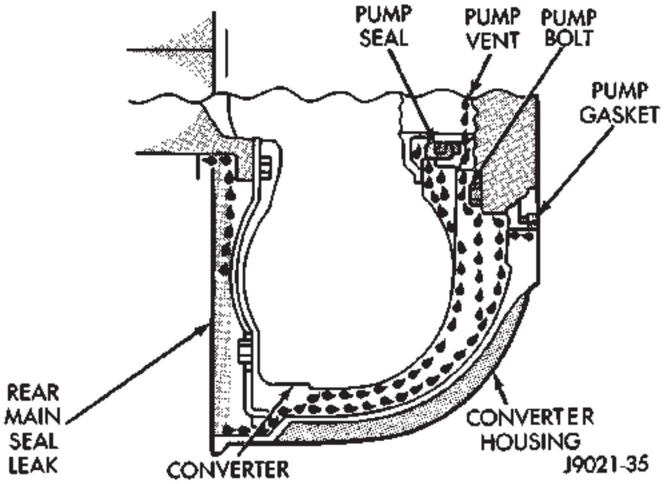


Fig. 11 Converter Housing Leak Paths

TORQUE CONVERTER LEAK POINTS

Possible sources of converter leaks are:

(1) Leaks at the weld joint around the outside diameter weld (Fig. 12).

(2) Leaks at the converter hub weld (Fig. 12).

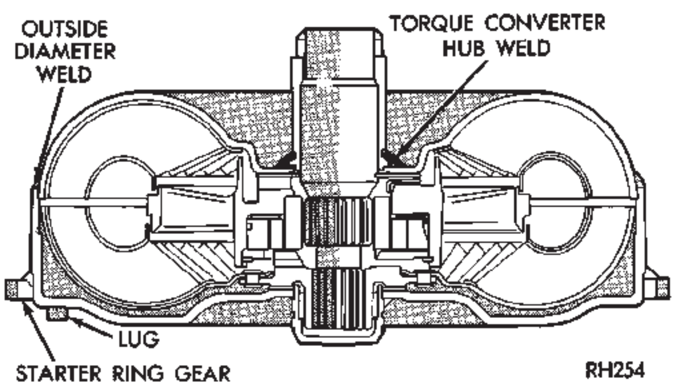


Fig. 12 Converter Leak Points—Typical

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove converter.

(2) Tighten front band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out when oil pump is removed.

(3) Remove oil pump and remove pump seal. Inspect pump housing drainback and vent holes for obstructions. Clear holes with solvent and wire.

(4) Inspect pump bushing and converter hub. If bushing is scored, replace it. If converter hub is scored, either polish it with crocus cloth or replace converter.

(5) Install new pump seal, O-ring, and gasket. Replace oil pump if cracked, porous or damaged in any way. Be sure to loosen the front band before installing the oil pump, damage to the oil pump seal may occur if the band is still tightened to the front clutch retainer.

(6) Loosen kickdown lever pin access plug three turns. Apply Loctite 592, or Permatex No. 2 to plug threads and tighten plug to 17 N·m (150 in. lbs.) torque.

(7) Adjust front band.

(8) Lubricate pump seal and converter hub with transmission fluid or petroleum jelly and install converter.

(9) Install transmission and converter housing dust shield.

(10) Lower vehicle.

DIAGNOSIS 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 converter clutch fault conditions.

The hydraulic flow charts, in the Schematics and Diagrams section of this group, outline fluid flow and hydraulic circuitry. Circuit operation is provided for neutral, third, fourth and reverse gear ranges. Normal working pressures are also supplied for each of the gear ranges.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
HARSH ENGAGEMENT FROM NEUTRAL TO DRIVE OR REVERSE	1. Fluid Level Low	1. Add Fluid
	2. Throttle Linkage Misadjusted	2. Adjust linkage - setting may be too long.
	3. Mount and Driveline Bolts Loose	3. Check engine mount, transmission mount, propeller shaft, rear spring to body bolts, rear control arms, crossmember and axle bolt torque. Tighten loose bolts and replace missing bolts.
	4. U-Joint Worn/Broken	4. Remove propeller shaft and replace U-Joint.
	5. Axle Backlash Incorrect	5. Check per Service Manual. Correct as needed.
	6. Hydraulic Pressure Incorrect	6. Check pressure. Remove, overhaul or adjust valve body as needed.
	7. Band Misadjusted.	7. Adjust rear band.
	8. Valve Body Check Balls Missing.	8. Inspect valve body for proper check ball installation.
	9. Axle Pinion Flange Loose.	9. Replace nut and check pinion threads before installing new nut. Replace pinion gear if threads are damaged.
	10. Clutch, band or planetary component Damaged.	10. Remove, disassemble and repair transmission as necessary.
	11. Converter Clutch (if equipped) Faulty.	11. Replace converter and flush cooler and line before installing new converter.
DELAYED ENGAGEMENT FROM NEUTRAL TO DRIVE OR REVERSE	1. Fluid Level Low.	1. Correct level and check for leaks.
	2. Filter Clogged.	2. Change filter.
	3. Gearshift Linkage Misadjusted.	3. Adjust linkage and repair linkage if worn or damaged.
	4. Rear Band Misadjusted.	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/Damaged.	6. Remove transmission and replace oil pump.
	7. Hydraulic Pressure Incorrect.	7. Perform pressure test, remove transmission and repair as needed.
	8. Reaction Shaft Seal Rings Worn/Broken.	8. Remove transmission, remove oil pump and replace seal rings.
	9. Rear Clutch/Input Shaft, Rear Clutch Seal Rings Damaged.	9. Remove and disassemble transmission and repair as necessary.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART (CONTINUED)

CONDITION	POSSIBLE CAUSES	CORRECTION
	10. Governor Valve Stuck.	10. Remove and inspect governor components. Replace worn or damaged parts.
	11. Regulator Valve Stuck.	11. Clean.
	12. Cooler Plugged.	12. Flush transmission cooler and inspect convertor drainback valve.
NO DRIVE RANGE (REVERSE OK)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/ Misadjusted.	2. Repair or replace linkage components.
	3. Rear Clutch Burnt.	3. Remove and disassemble transmission and rear clutch and seals. Repair/replace worn or damaged parts as needed.
	4. Valve Body Malfunction.	4. Remove and disassemble valve body. Replace assembly if any valves or bores are damaged.
	5. Transmission Overrunning Clutch Broken.	5. Remove and disassemble transmission. Replace overrunning clutch.
	6. Input Shaft Seal Rings Worn/ Damaged.	6. Remove and disassemble transmission. Replace seal rings and any other worn or damaged parts.
	7. Front Planetary Failed Broken.	7. Remove and repair.
NO DRIVE OR REVERSE (VEHICLE WILL NOT MOVE)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/ Misadjusted.	2. Inspect, adjust and reassemble linkage as needed. Replace worn/ damaged parts.
	3. U-Joint/Axle/Transfer Case Broken.	3. Perform preliminary inspection procedure for vehicle that will not move. Refer to procedure in diagnosis section.
	4. Filter Plugged.	4. Remove and disassemble transmission. Repair or replace failed components as needed. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary. Perform lube flow test. Flush oil. Replace cooler as necessary.
	5. Oil Pump Damaged.	5. Perform pressure test to confirm low pressure. Replace pump body assembly if necessary.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART (CONTINUED)

CONDITION	POSSIBLE CAUSES	CORRECTION
	6. Valve Body Malfunctioned.	6. Check press and inspect valve body. Replace valve body (as assembly) if any valve or bore is damaged. Clean and reassemble correctly if all parts are in good condition.
	7. Transmission Internal Component Damaged.	7. Remove and disassemble transmission. Repair or replace failed components as needed. Remove and disassemble transmission. Repair or replace failed components as needed.
	8. Park Sprag not Releasing	8. Remove, disassemble, repair.
	9. Torque Converter Damage.	9. Check Stall Speed, Worn/Damaged/ Stuck. Inspect and replace as required.
SHIFTS DELAYED OR ERRATIC (SHIFTS ALSO HARSH AT TIMES)	1. Fluid Level Low/High.	1. Correct fluid level and check for leaks if low.
	2. Throttle Linkage Misadjusted.	2. Adjust linkage as described in service section.
	3. Throttle Linkage Binding.	3. Check cable for binding. Check for return to closed throttle at transmission.
	4. Gearshift Linkage/Cable Misadjusted.	4. Adjust linkage/cable as described in service section.
	5. Fluid Filter Clogged.	5. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary. Perform lube flow test.
	6. Governor Valve Sticking.	6. Inspect, clean or repair.
	7. Governor Seal Rings Worn/ Damaged.	7. Inspect/replace.
	8. Clutch or Servo Failure.	8. Remove valve body and air test clutch, and band servo operation. Disassemble and repair transmission as needed.
	9. Front Band Misadjusted.	9. Adjust band.
	10. Pump Suction Passage Leak.	10. Check for excessive foam on dipstick after normal driving. Check for loose pump bolts, defective gasket. Replace pump assembly if needed.
NO REVERSE (D RANGES OK)	1. Gearshift Linkage/Cable Misadjusted/Damaged.	1. Repair or replace linkage parts as needed.
	2. Park Sprag Sticking.	2. Inspect and replace as necessary.
	3. Rear Band Misadjusted/Worn.	3. Adjust band; replace.
	4. Valve Body Malfunction.	4. Remove and service valve body. Replace valve body if any valves or valve bores are worn or damaged.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART (CONTINUED)

CONDITION	POSSIBLE CAUSES	CORRECTION
	5. Rear Servo Malfunction.	5. Remove and disassemble transmission. Replace worn/damaged servo parts as necessary.
	6. Front Clutch Burnt.	6. Remove and disassemble transmission. Replace worn, damaged clutch parts as required.
HAS FIRST/REVERSE ONLY (NO 1-2 OR 2-3 UPSHIFT)	1. Governor Valve, Shaft, Weights or Body Damaged/Stuck.	1. Remove governor assembly and clean or repair as necessary.
	2. Valve Body Malfunction.	2. Stuck 1-2 shift valve or governor plug.
	3. Front Servo/Kickdown Band Damaged/Burned.	3. Repair/replace.
MOVES IN 2ND OR 3RD GEAR, ABRUPTLY DOWNSHIFTS TO LOW	1. Valve Body Malfunction.	1. Remove, clean and inspect. Look for stuck 1-2 valve or governor plug.
	2. Governor Valve Sticking.	2. Remove, clean and inspect. Replace faulty parts.
NO LOW GEAR (MOVES IN 2ND OR 3RD GEAR ONLY)	1. Governor Valve Sticking.	1. Remove governor, clean, inspect and repair as required.
	2. Valve Body Malfunction.	2. Remove, clean and inspect. Look for sticking 1-2 shift valve, 2-3 shift valve, governor plug or broken springs.
	3. Front Servo Piston Cocked in Bore.	3. Inspect servo and repair as required.
	4. Front Band Linkage Malfunction	4. Inspect linkage and look for bind in linkage.
NO KICKDOWN OR NORMAL DOWNSHIFT	1. Throttle Linkage Misadjusted.	1. Adjust linkage.
	2. Accelerator Pedal Travel Restricted.	2. Floor mat under pedal, accelerator cable worn or brackets bent.
	3. Governor/Valve Body Hydraulic Pressures Too High or Too Low Due to Sticking Governor, Valve Body Malfunction or Incorrect Hydraulic Control Pressure Adjustments.	3. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required.
	4. Valve Body Malfunction.	4. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required.
	5. Valve Body Malfunction.	5. Sticking 1-2, 2-3 shift valves, or governor plugs.
STUCK IN LOW GEAR (WILL NOT UPSHIFT)	1. Throttle Linkage Misadjusted/Stuck.	1. Adjust linkage and repair linkage if worn or damaged. Check for binding cable or missing return spring.
	2. Gearshift Linkage Misadjusted.	2. Adjust linkage and repair linkage if worn or damaged.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART (CONTINUED)

CONDITION	POSSIBLE CAUSES	CORRECTION
	3. Governor/Valve Body, Governor Valve Stuck Closed; Loose Output Shaft Support or Governor Housing Bolts, Leaking Seal Rings or Valve Body Problem (i.e., Stuck 1- 2 Shift Valve/Gov. Plug).	3. Check line and governor pressures to determine cause. Correct as required.
	4. Front Band Out of Adjustment.	4. Adjust Band.
	5. Clutch or Servo Malfunction.	5. Air pressure check operation of clutches and bands. Repair faulty component.
CREEPS IN NEUTRAL	1. Gearshift Linkage Misadjusted.	1. Adjust linkage.
	2. Rear Clutch Dragging/Warped Welded.	2. Disassemble and repair.
	3. Valve Body Malfunction.	3. Perform hydraulic pressure test to determine cause and repair as required.
BUZZING NOISE	1. Fluid Level Low	1. Add fluid and check for leaks.
	2. Shift Cable Misassembled.	2. Route cable away from engine and bell housing.
	3. Valve Body Misassembled.	3. Remove, disassemble, inspect valve body. Reassemble correctly if necessary. Replace assembly if valves or springs are damaged. Check for loose bolts or screws.
	4. Pump Passages Leaking	4. Check pump for porous casting, scores on mating surfaces and excess rotor clearance. Repair as required. Loose pump bolts.
	5. Cooling System Cooler Plugged.	5. Flow check cooler circuit. Repair as needed.
	6.Overrunning Clutch Damaged.	6. Replace clutch.
SLIPS IN REVERSE ONLY	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Gearshift Linkage Misadjusted.	2. Adjust linkage.
	3. Rear Band Misadjusted.	3. Adjust band.
	4. Rear Band Worn.	4. Replace as required.
	5. Hydraulic Pressure Too Low.	5. Perform hydraulic pressure tests to determine cause.
	6. Rear Servo Leaking.	6. Air pressure check clutch-servo operation and repair as required.
	7. Band Linkage Binding.	7. Inspect and repair as required.
SLIPS IN FORWARD DRIVE RANGES	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Fluid Foaming.	2. Check for high oil level, bad pump gasket or seals, dirt between pump halves and loose pump bolts. Replace pump if necessary.
	3. Throttle Linkage Misadjusted.	3. Adjust linkage.
	4. Gearshift Linkage Misadjusted.	4. Adjust linkage.
	5. Rear Clutch Worn.	5. Inspect and replace as needed.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART (CONTINUED)

CONDITION	POSSIBLE CAUSES	CORRECTION
	6. Low Hydraulic Pressure 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	6. Perform hydraulic and air pressure tests to determine cause.
	7. Rear Clutch Malfunction, Leaking Seals or Worn Plates.	7. Air pressure check clutch-servo operation and repair as required.
	8. Overrunning Clutch Worn, Not Holding (Slips in 1 Only).	8. Replace Clutch.
SLIPS IN LOW GEAR ″D″ ONLY, BUT NOT IN 1 POSITION	Overrunning Clutch Faulty.	Replace overrunning clutch.
GROWLING, GRATING OR SCRAPING NOISES	1. Drive Plate Broken.	1. Replace.
	2. Torque Converter Bolts Hitting Dust Shield.	2. Dust shield bent. Replace or repair.
	3. Planetary Gear Set Broken/Seized.	3. Check for debris in oil pan and repair as required.
	4. Overrunning Clutch Worn/Broken.	4. Inspect and check for debris in oil pan. Repair as required.
	5. Oil Pump Components Scored/ Binding.	5. Remove, inspect and repair as required.
	6. Output Shaft Bearing or Bushing Damaged.	6. Remove, inspect and repair as required.
	7. Clutch Operation Faulty.	7. Perform air pressure check and repair as required.
	8. Front and Rear Bands Misadjusted.	8. Adjust bands.
DRAGS OR LOCKS UP	1. Fluid Level Low.	1. Check and adjust level.
	2. Clutch Dragging/Failed	2. Air pressure check clutch operation and repair as required.
	3. Front or Rear Band Misadjusted.	3. Adjust bands.
	4. Case Leaks Internally.	4. Check for leakage between passages in case.
	5. Servo Band or Linkage Malfunction.	5. Air pressure check servo operation and repair as required.
	6. Overrunning Clutch Worn.	6. Remove and inspect clutch. Repair as required.
	7. Planetary Gears Broken.	7. Remove, inspect and repair as required (look for debris in oil pan).
	8. Converter Clutch Dragging.	8. Check for plugged cooler. Perform flow check. Inspect pump for excessive side clearance. Replace pump as required.
WHINE/NOISE RELATED TO ENGINE SPEED	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Shift Cable Incorrect Routing.	2. Check shift cable for correct routing. Should not touch engine or bell housing.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART (CONTINUED)

CONDITION	POSSIBLE CAUSES	CORRECTION
TORQUE CONVERTER LOCKS UP IN SECOND AND/OR THIRD GEAR	Lockup Solenoid, Relay or Wiring Shorted/Open.	Test solenoid, relay and wiring for continuity, shorts or grounds. Replace solenoid and relay if faulty. Repair wiring and connectors as necessary.
HARSH 1-2 OR 2-3 SHIFTS	Lockup Solenoid Malfunction.	Remove valve body and replace solenoid assembly.
NO START IN PARK OR NEUTRAL	1. Gearshift Linkage/Cable Misadjusted.	1. Adjust linkage/cable.
	2. Neutral Switch Wire Open/Cut.	2. Check continuity with test lamp. Repair as required.
	3. Neutral Switch Faulty.	3. Refer to service section for test and replacement procedure.
	4. Neutral Switch Connect Faulty.	4. Connectors spread open. Repair.
	5. Valve Body Manual Lever Assembly Bent/Worn/Broken.	5. Inspect lever assembly and replace if damaged.
NO REVERSE (OR SLIPS IN REVERSE)	1. Direct Clutch Pack (front clutch) Worn.	1. Disassemble unit and rebuild clutch pack.
	2. Rear Band Misadjusted.	2. Adjust band.
	3. Front Clutch Malfunctioned/Burnt.	3. Air pressure test clutch operation. Remove and rebuild if necessary.
OIL LEAKS (ITEMS LISTED REPRESENT POSSIBLE LEAK POINTS AND SHOULD ALL BE CHECKED.	1. Speedometer Adapter Leaks.	1. Replace both adapter seals.
	2. Fluid Lines and Fittings Loose/ Leaks/Damaged.	2. Tighten fittings. If leaks persist, replace fittings and lines if necessary.
	3. Filler Tube (where tube enters case) Leaks/Damaged.	3. Replace O-ring seal. Inspect tube for cracks in tube.
	4. Pressure Port Plug Loose Loose/ Damaged.	4. Tighten to correct torque. Replace plug or reseal if leak persists.
	5. Pan Gasket Leaks.	5. Tighten pan screws to 150 inch pounds. If leaks persist, replace gasket. Do no over tighten screws.
	6. Valve Body Manual Lever Shaft Seal Leaks/Worn.	6. Replace shaft seal.
	7. Rear Bearing Access Plate Leaks.	7. Replace gasket. Tighten screws.
	8. Gasket Damaged or Bolts are Loose.	8. Replace bolts or gasket or tighten both.
	9. Adapter/Extension Gasket Damaged Leaks/Damaged.	9. Replace gasket.
	10. Neutral Switch Leaks/Damaged.	10. Replace switch and gasket.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART (CONTINUED)

CONDITION	POSSIBLE CAUSES	CORRECTION
	11. Converter Housing Area Leaks.	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. Pump Seal Leaks/Worn/Damaged.	12. Replace seal.
	13. Torque Converter Weld Leak/ Cracked Hub.	13. Replace converter.
	14. Case Porosity Leaks.	14. Replace case.

SERVICE PROCEDURES

FLUID LEVEL CHECK

Transmission fluid level should be checked monthly under normal operation. If the vehicle is used for trailer towing or similar heavy load hauling, check fluid level and condition weekly. Fluid level is checked with the engine running at curb idle speed, the transmission in NEUTRAL and the transmission fluid at normal operating temperature.

FLUID LEVEL CHECK PROCEDURE

(1) Transmission fluid must be at normal operating temperature for accurate fluid level check. Drive vehicle if necessary to bring fluid temperature up to normal hot operating temperature of 82°C (180°F).

(2) Position vehicle on level surface.

(3) Start and run engine at curb idle speed.

(4) Apply parking brakes.

(5) Shift transmission momentarily into all gear ranges. Then shift transmission back to Neutral.

(6) Clean top of filler tube and dipstick to keep dirt from entering tube.

(7) Remove dipstick (Fig. 13) and check fluid level as follows:

(a) Correct acceptable level is in crosshatch area.

(b) Correct maximum level is to MAX arrow mark.

(c) Incorrect level is at or below MIN line.

(d) If fluid is low, add only enough Mopar® ATF Plus 3 to restore correct level. Do not overfill.

CAUTION: Do not overfill the transmission. Overfilling may cause leakage out the pump vent which can be mistaken for a pump seal leak. Overfilling will also cause fluid aeration and foaming as the excess fluid is picked up and churned by the gear train. This will significantly reduce fluid life.

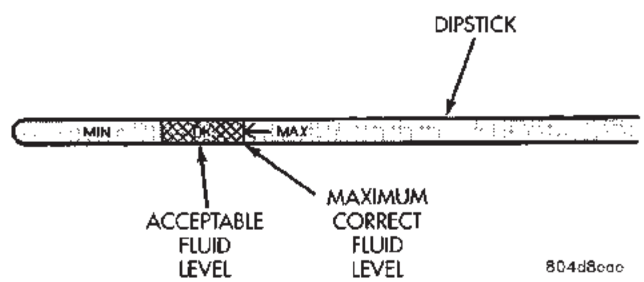


Fig. 13 Dipstick Fluid Level Marks—Typical

FLUID AND FILTER REPLACEMENT

Refer to the Maintenance Schedules in Group 0, Lubrication and Maintenance, for proper service intervals. The service fluid fill after a filter change is approximately 3.8 liters (4.0 quarts).

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Place a large diameter shallow drain pan beneath the transmission pan.

(3) Remove bolts holding front and sides of pan to transmission (Fig. 14).

(4) Loosen bolts holding rear of pan to transmission.

(5) Slowly separate front of pan away from transmission allowing the fluid to drain into drain pan.

(6) Hold up pan and remove remaining bolts holding pan to transmission.

(7) While holding pan level, lower pan away from transmission.

(8) Pour remaining fluid in pan into drain pan.

(9) Remove screws holding filter to valve body (Fig. 15).

(10) Separate filter from valve body and pour fluid in filter into drain pan.

(11) Dispose used trans fluid and filter properly.

SERVICE PROCEDURES (Continued)

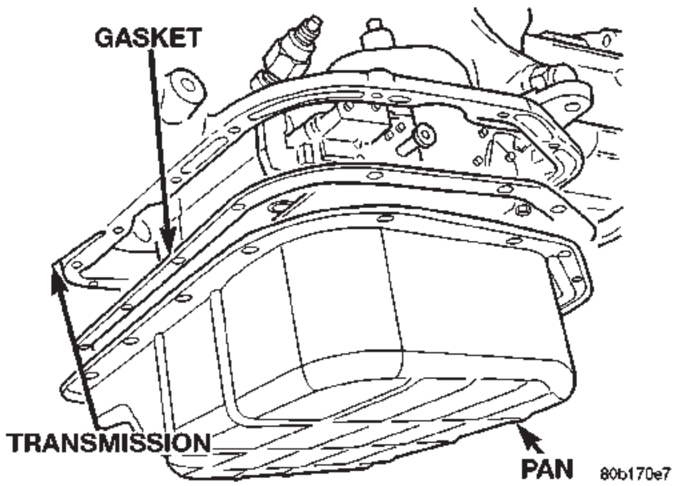


Fig. 14 Transmission Pan

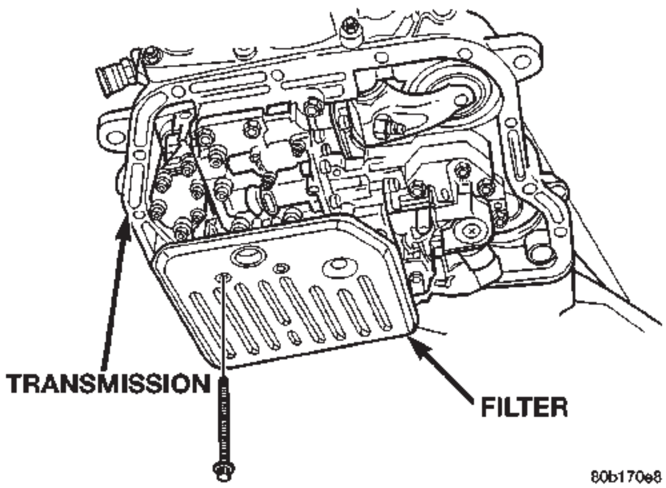


Fig. 15 Transmission Filter

INSPECTION

Inspect bottom of pan and magnet for excessive amounts of metal or fiber contamination. A light coating of clutch or band material on the bottom of the pan does not indicate a problem unless accompanied by slipping condition or shift lag. If fluid and pan are contaminated with excessive amounts or debris, refer to the diagnosis section of this group.

Check the adjustment of the front and rear bands, adjust if necessary. Refer to Adjustment section of this group for proper procedure.

CLEANING

(1) Using a suitable solvent, clean pan and magnet.

(2) Using a suitable gasket scraper, clean gasket material from gasket surface of transmission case and the gasket flange around the pan.

INSTALLATION

(1) Place replacement filter in position on valve body.

(2) Install screws to hold filter to valve body (Fig. 15). Tighten screws to 4 N·m (35 in. lbs.) torque.

(3) Place new gasket in position on pan. and install pan on transmission.

(4) Place pan in position on transmission.

(5) Install screws to hold pan to transmission (Fig. 14). Tighten bolts to 17 N·m (150 in. lbs.) torque.

(6) Lower vehicle and fill transmission with Mopar® ATF Plus 3, type 7176 fluid.

TRANSMISSION FILL PROCEDURE

To avoid overfilling transmission after a fluid change or overhaul, perform the following procedure:

(1) Remove dipstick and insert clean funnel in transmission fill tube.

(2) Add following initial quantity of Mopar® ATF Plus 3 to transmission:

- (a) If only fluid and filter were changed, add **3 pints (1-1/2 quarts)** of ATF Plus 3 to transmission.
- (b) If transmission was completely overhauled, torque converter was replaced or drained, and cooler was flushed, add **12 pints (6 quarts)** of ATF Plus 3 to transmission.

(3) Apply parking brakes.

(4) Start and run engine at normal curb idle speed.

(5) Apply service brakes, shift transmission through all gear ranges then back to NEUTRAL, set parking brake, and leave engine running at curb idle speed.

(6) Remove funnel, insert dipstick and check fluid level. If level is low, **add fluid to bring level to MIN mark on dipstick.** Check to see if the oil level is equal on both sides of the dipstick. If one side is noticably higher than the other, the dipstick has picked up some oil from the dipstick tube. Allow the oil to drain down the dipstick tube and re-check.

(7) Drive vehicle until transmission fluid is at normal operating temperature.

(8) With the engine running at curb idle speed, the gear selector in NEUTRAL, and the parking brake applied, check the transmission fluid level.

CAUTION: Do not overfill transmission, fluid foaming and shifting problems can result.

(9) Add fluid to bring level up to MAX arrow mark.

When fluid level is correct, shut engine off, release park brake, remove funnel, and install dipstick in fill tube.

CONVERTER DRAINBACK CHECK VALVE SERVICE

The converter drainback check valve is located in the cooler outlet (pressure) line near the radiator lower tank. The valve prevents fluid drainback when

SERVICE PROCEDURES (Continued)

the vehicle is parked for lengthy periods. The valve check ball is spring loaded and has an opening pressure of approximately 2 psi.

The valve is serviced as an assembly; it is not repairable. Do not clean the valve if restricted, or contaminated by sludge, or debris. If the valve fails, or if a transmission malfunction occurs that generates sludge and/or clutch particles and metal shavings, the valve must be replaced.

The valve must be removed whenever the cooler and lines are reverse flushed. The valve can be flow tested when necessary. The procedure is exactly the same as for flow testing a cooler.

If the valve is restricted, installed backwards, or in the wrong line, it will cause an overheating condition and possible transmission failure.

CAUTION: The drainback valve is a one-way flow device. It must be properly oriented in terms of flow direction for the cooler to function properly. The valve must be installed in the pressure line. Otherwise flow will be blocked and would cause an overheating condition and eventual transmission failure.

OIL COOLER FLOW CHECK

After the new or repaired transmission has been installed and filled, the oil cooler flow should be checked using the following procedure:

(1) Disconnect the **From cooler** line at the transmission and place a collecting container under the disconnected line.

(2) Run the engine at curb idle speed, with the shift selector in neutral.

(3) If the fluid flow is intermittent or takes more than 20 seconds to collect one quart, the cooler should be replaced.

CAUTION: With the fluid set at the proper level, fluid collection should not exceed (1) quart or internal damage to the transmission may occur.

(4) If flow is found to be within acceptable limits, reconnect the cooler line. Then fill transmission to the proper level, using the approved type of automatic transmission fluid.

FLUSHING COOLERS AND TUBES

When a transmission failure has contaminated the fluid, the oil cooler(s) must be flushed. The cooler bypass valve in the transmission must be replaced also. The torque converter must also be replaced. This will insure that metal particles or sludged oil are not later transferred back into the reconditioned (or replaced) transmission.

The only recommended procedure for flushing coolers and lines is to use Tool 6906 Cooler Flusher.

WARNING: WEAR PROTECTIVE EYEWEAR THAT MEETS THE REQUIREMENTS OF OSHA AND ANSI Z87.1–1968. WEAR STANDARD INDUSTRIAL RUBBER GLOVES.

KEEP LIGHTED CIGARETTES, SPARKS, FLAMES, AND OTHER IGNITION SOURCES AWAY FROM THE AREA TO PREVENT THE IGNITION OF COMBUSTIBLE LIQUIDS AND GASES. KEEP A CLASS (B) FIRE EXTINGUISHER IN THE AREA WHERE THE FLUSHER WILL BE USED.

KEEP THE AREA WELL VENTILATED.

DO NOT LET FLUSHING SOLVENT COME IN CONTACT WITH YOUR EYES OR SKIN: IF EYE CONTAMINATION OCCURS, FLUSH EYES WITH WATER FOR 15 TO 20 SECONDS. REMOVE CONTAMINATED CLOTHING AND WASH AFFECTED SKIN WITH SOAP AND WATER. SEEK MEDICAL ATTENTION.

COOLER FLUSH USING TOOL 6906

(1) Remove cover plate filler plug on Tool 6906. Fill reservoir 1/2 to 3/4 full of fresh flushing solution. Flushing solvents are petroleum based solutions generally used to clean automatic transmission components. **DO NOT** use solvents containing acids, water, gasoline, or any other corrosive liquids.

(2) Reinstall filler plug on Tool 6906.

(3) Verify pump power switch is turned OFF. Connect red alligator clip to positive (+) battery post. Connect black (-) alligator clip to a good ground.

(4) Disconnect the cooler lines at the transmission.

NOTE: When flushing transmission cooler and lines, ALWAYS reverse flush.

(5) Connect the BLUE pressure line to the OUTLET (From) cooler line.

(6) Connect the CLEAR return line to the INLET (To) cooler line

(7) Turn pump ON for two to three minutes to flush cooler(s) and lines. Monitor pressure readings and clear return lines. Pressure readings should stabilize below 20 psi. for vehicles equipped with a single cooler and 30 psi. for vehicles equipped with dual coolers. If flow is intermittent or exceeds these pressures, replace cooler.

(8) Turn pump OFF.

(9) Disconnect CLEAR suction line from reservoir at cover plate. Disconnect CLEAR return line at cover plate, and place it in a drain pan.

(10) Turn pump ON for 30 seconds to purge flushing solution from cooler and lines. Turn pump OFF.

SERVICE PROCEDURES (Continued)

(11) Place CLEAR suction line into a one quart container of Mopar® ATF Plus 3, type 7176 automatic transmission fluid.

(12) Turn pump ON until all transmission fluid is removed from the one quart container and lines. This purges any residual cleaning solvent from the transmission cooler and lines. Turn pump OFF.

(13) Disconnect alligator clips from battery. Reconnect flusher lines to cover plate, and remove flushing adapters from cooler lines.

ALUMINUM THREAD REPAIR

Damaged or worn threads in the aluminum transaxle case and valve body can be repaired by the use of Heli-Coils, or equivalent. This repair consists of drilling out the worn-out damaged threads. Then tap the hole with a special Heli-Coil tap, or equivalent, and installing a Heli-Coil insert, or equivalent, into the hole. This brings the hole back to its original thread size.

Heli-Coil, or equivalent, tools and inserts are readily available from most automotive parts suppliers.

REMOVAL AND INSTALLATION

TRANSMISSION

CAUTION: The transmission and torque converter must be removed as an assembly to avoid component damage. The converter drive plate, pump bushing, or oil seal can be damaged if the converter is left attached to the driveplate during removal.

REMOVAL

(1) Disconnect battery negative cable.

(2) Disconnect and lower or remove necessary exhaust components.

(3) Remove engine-to-transmission bending braces.

(4) Disconnect fluid cooler lines at transmission.

(5) Remove starter motor.

(6) Disconnect and remove crankshaft position sensor. Retain sensor attaching bolts.

CAUTION: The crankshaft position sensor can be damaged during transmission removal (or installation) if the sensor is still bolted to the engine block. To avoid damage, remove the sensor before removing the transmission.

(7) Remove torque converter access cover.

(8) If transmission is being removed for overhaul, remove transmission oil pan, drain fluid and reinstall pan.

(9) Remove skid plate for access, if necessary.

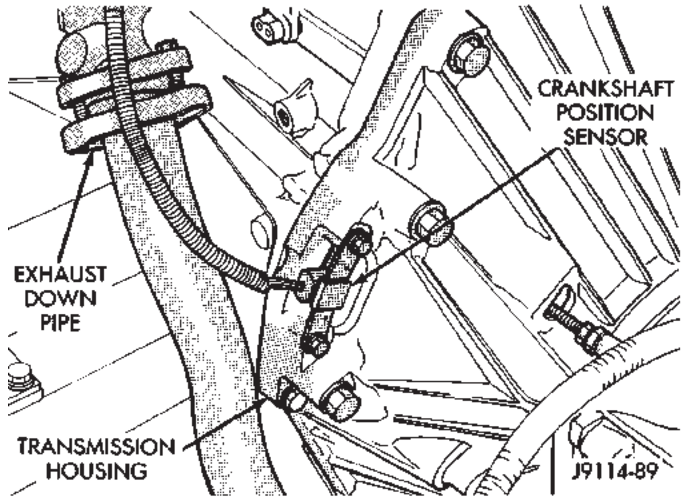


Fig. 16 Crankshaft Position Sensor—2.5L Engine

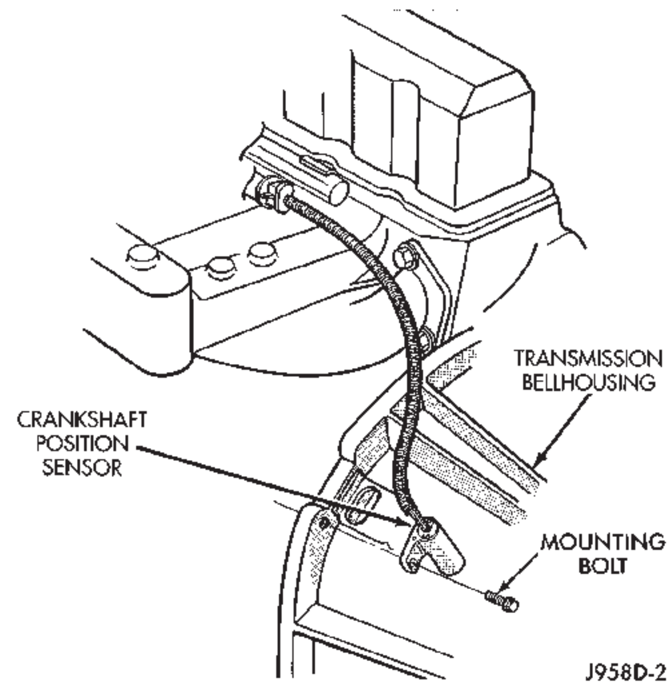


Fig. 17 Crankshaft Position Sensor—4.0L Engine

(10) Remove fill tube bracket bolts and pull tube out of transmission. Retain fill tube seal. On 4 x 4 models, it will also be necessary to remove bolt attaching transfer case vent tube to converter housing.

(11) Mark torque converter and drive plate for assembly alignment. Note that bolt holes in crankshaft flange, drive plate and torque converter all have one offset hole.

(12) Rotate crankshaft in clockwise direction until converter bolts are accessible. Then remove bolts one at a time. Rotate crankshaft with socket wrench on dampener bolt.

(13) Mark propeller shaft and axle yokes for assembly alignment. Then disconnect and remove

REMOVAL AND INSTALLATION (Continued)

propeller shaft. On 4 x 4 models, remove both propeller shafts.

(14) Disconnect wires from park/neutral position switch and vehicle speed sensor.

(15) Disconnect gearshift cable from transmission manual valve lever.

(16) Disconnect throttle valve cable from transmission bracket and throttle valve lever.

(17) On 4 x 4 models, disconnect shift rod from transfer case shift lever or remove shift lever from transfer case.

(18) Support rear of engine with safety stand or jack.

(19) Raise transmission slightly with service jack to relieve load on crossmember and supports.

(20) Remove bolts securing rear support and cushion to transmission and crossmember. Raise transmission slightly, slide exhaust hanger arm from bracket and remove rear support.

(21) Remove bolts attaching crossmember to frame and remove crossmember.

(22) Disconnect transfer case vent hose. Then disconnect vacuum switch harness.

(23) On 4 x 4 models, remove transfer case.

(24) Remove all converter housing bolts.

(25) Carefully work transmission and torque converter assembly rearward off engine block dowels.

(26) Hold torque converter in place during transmission removal.

(27) Lower transmission and remove assembly from under the vehicle.

(28) To remove torque converter, carefully slide torque converter out of the transmission.

INSTALLATION

(1) Check torque converter hub and hub drive notches for sharp edges burrs, scratches, or nicks. Polish the hub and notches with 320/400 grit paper and crocus cloth if necessary. The hub must be smooth to avoid damaging pump seal at installation.

(2) Lubricate converter drive hub and oil pump seal lip with transmission fluid.

(3) Lubricate converter pilot hub with transmission fluid.

(4) Align converter and oil pump.

(5) Carefully insert converter in oil pump. Then rotate converter back and forth until fully seated in pump gears.

(6) Check converter seating with steel scale and straightedge (Fig. 18). Surface of converter lugs should be 1/2 in. to rear of straightedge when converter is fully seated.

(7) Temporarily secure converter with C-clamp.

(8) Position transmission on jack and secure it with safety chains.

(9) Check condition of converter driveplate. Replace the plate if cracked, distorted or damaged.

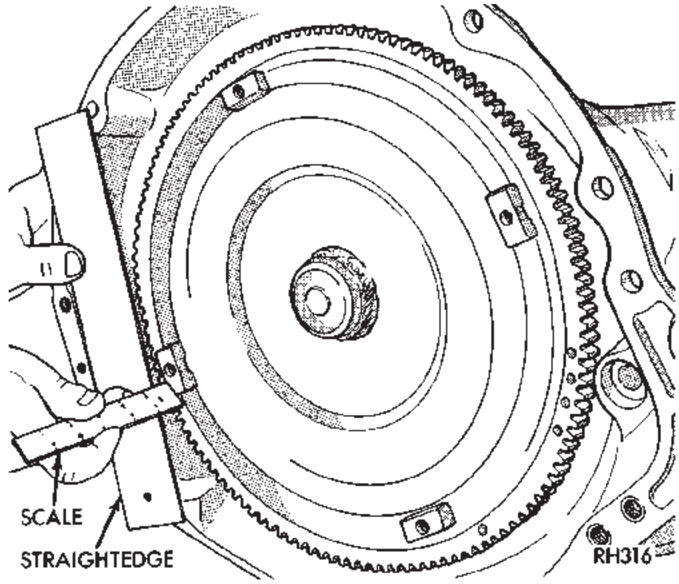


Fig. 18 Typical Method Of Checking Converter Seating

Also be sure transmission dowel pins are seated in engine block and protrude far enough to hold transmission in alignment.

(10) Raise transmission and align converter with drive plate and converter housing with engine block.

(11) Move transmission forward. Then raise, lower or tilt transmission to align converter housing with engine block dowels.

(12) Rotate converter so alignment marks scribed on converter are aligned with mark on driveplate.

(13) Carefully work transmission forward and over engine block dowels until converter hub is seated in crankshaft.

(14) Install and tighten bolts that attach transmission converter housing to engine block (Fig. 19).

CAUTION: Be sure the converter housing is fully seated on the engine block dowels before tightening any bolts.

(15) Install torque converter attaching bolts. Tighten bolts to following torque.

- 54 N·m (40 ft. lbs.) with 9.5 in. 3-lug converter
- 74 N·m (55 ft. lbs.) with 9.5 in. 4-lug converter
- 74 N·m (55 ft. lbs.) with 10.0 in. 4-lug converter
- 31 N·m (270 in. lbs.) with 10.75 in. 4-lug converter

(16) Install crankshaft position sensor.

(17) Install transmission fill tube and seal. Install new fill tube seal in transmission before installation.

(18) Connect transmission cooler lines to transmission.

(19) Install transfer case onto transmission.

(20) Install rear crossmember and attach transmission rear support to crossmember.

REMOVAL AND INSTALLATION (Continued)

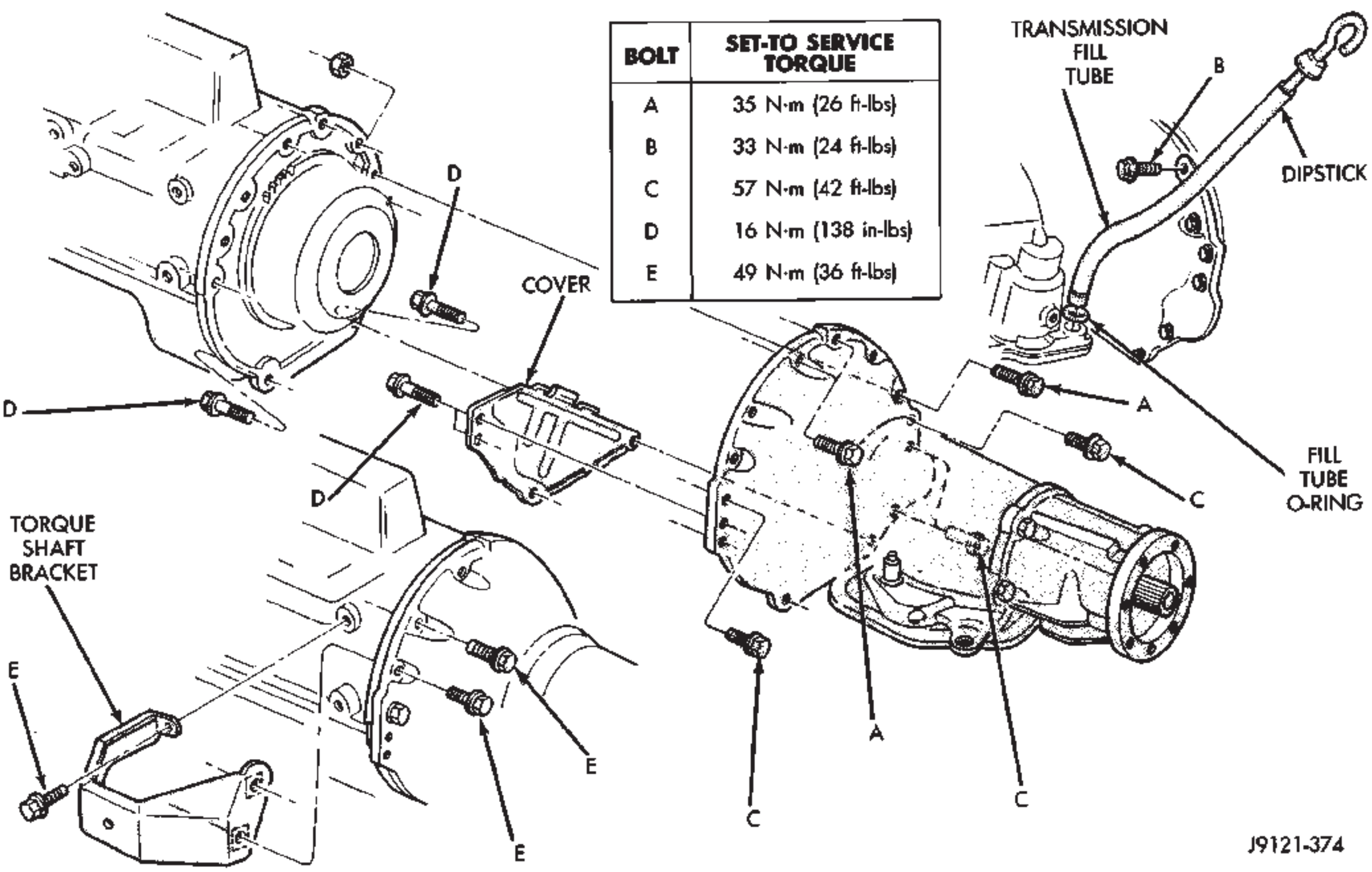


Fig. 19 Transmission Attachment

(21) Remove engine support fixture.

(22) Remove transmission jack.

(23) Connect vehicle speed sensor wires.

(24) Connect wires to park/neutral position switch.

(25) Install crankshaft position sensor.

(26) Install converter housing access cover.

(27) Install exhaust pipes and support brackets, if removed.

(28) Install starter motor and cooler line bracket.

(29) Install new plastic retainer grommet on any shift linkage rod or lever that was disconnected. Grommets should not be reused. Use pry tool to remove rod from grommet and cut away old grommet. Use pliers to snap new grommet into lever and to snap rod into grommet at assembly.

(30) Connect gearshift and linkage and throttle cable.

(31) Connect transfer case shift linkage.

(32) Adjust gearshift linkage and throttle valve cable if necessary.

(33) Align and connect propeller shaft(s).

(34) Install skid plate, rear cushion and bracket, if removed.

(35) Fill transfer case to bottom edge of fill plug hole.

(36) Lower vehicle and fill transmission to correct level with Mopar® ATF Plus 3, type 7176 fluid.

TORQUE CONVERTER

REMOVAL

(1) Remove transmission and torque converter from vehicle.

(2) Place a suitable drain pan under the converter housing end of the transmission.

CAUTION: Verify that transmission is secure on the lifting device or work surface, the center of gravity of the transmission will shift when the torque converter is removed creating an unstable condition.

The torque converter is a heavy unit. Use caution when separating the torque converter from the transmission.

(3) Pull the torque converter forward until the center hub clears the oil pump seal.

(4) Separate the torque converter from the transmission.

INSTALLATION

Check converter hub and drive notches for sharp edges, burrs, scratches, or nicks. Polish the hub and notches with 320/400 grit paper or crocus cloth if necessary. The hub must be smooth to avoid damaging the pump seal at installation.

REMOVAL AND INSTALLATION (Continued)

(1) Lubricate converter hub and oil pump seal lip with transmission fluid.

(2) Place torque converter in position on transmission.

CAUTION: Do not damage oil pump seal or bushing while inserting torque converter into the front of the transmission.

(3) Align torque converter to oil pump seal opening.

(4) Insert torque converter hub into oil pump.

(5) While pushing torque converter inward, rotate converter until converter is fully seated in the oil pump gears.

(6) Check converter seating with a scale and straightedge (Fig. 20). Surface of converter lugs should be 1/2 in. to rear of straightedge when converter is fully seated.

(7) If necessary, temporarily secure converter with C-clamp attached to the converter housing.

(8) Install the transmission in the vehicle.

(9) Fill the transmission with the recommended fluid.

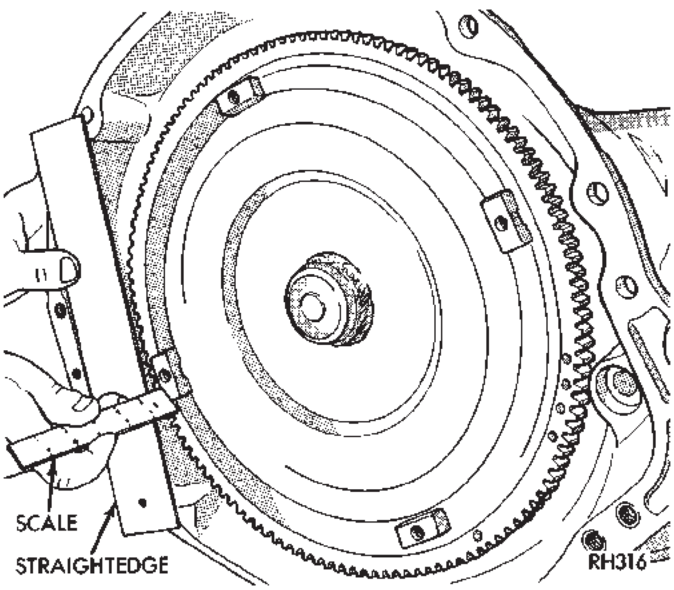


Fig. 20 Checking Torque Converter Seating

EXTENSION HOUSING

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Support transmission with a suitable lifting device.

(3) Remove transmission skid plate. Refer to Group 13, Frame and Bumpers, for proper procedure.

(4) Remove propeller shafts. Refer to Group 3, Differential and Driveline, for proper procedure.

(5) Remove transfer case.

(6) Remove bolts holding extension housing to transmission case (Fig. 21).

(7) Separate extension housing from transmission.

(8) Slide extension housing rearward and off output shaft (Fig. 21).

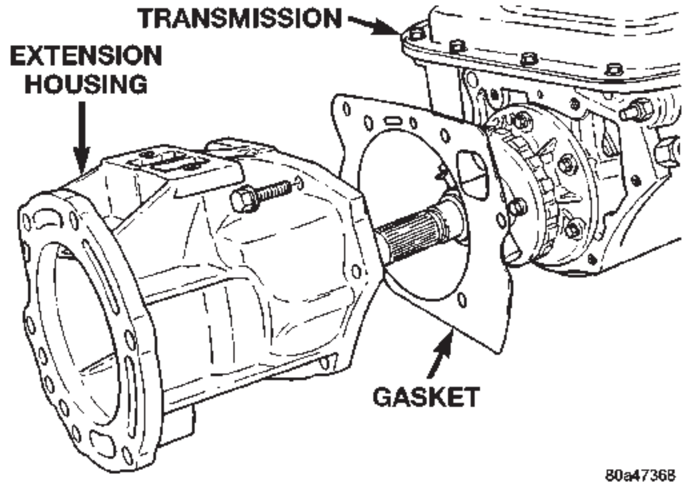


Fig. 21 Extension Housing

INSTALLATION

Clear gasket material from sealing surfaces on extension housing and rear of transmission. Replace output shaft bearing, if necessary.

(1) Install new rear seal in extension housing. Use Tool Handle C-4171 and Seal Installer C-3860-A to install seal.

(2) Place extension housing gasket in position on rear of transmission.

(3) Slide extension housing forward and over output shaft (Fig. 21).

(4) Guide park shaft into park sprag and push extension housing forward until rod passes through opening behind sprag. It may be necessary to use a wire to hold sprag to the side for rod to pass through.

(5) Install bolts to hold extension housing to rear of transmission.

(6) Install transfer case.

(7) Install propeller shafts.

(8) Install rear transmission mount and skid plate.

(9) Lower vehicle and verify transmission fluid level. Add fluid as necessary.

SPEEDOMETER ADAPTER

Rear axle gear ratio and tire size determine speedometer pinion requirements.

REMOVAL

(1) Raise vehicle.

(2) Disconnect wires from vehicle speed sensor.

(3) Remove adapter clamp and screw (Fig. 22).

(4) Remove speed sensor and speedometer adapter as assembly.

REMOVAL AND INSTALLATION (Continued)

(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. 22). 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.

INSTALLATION

(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. 22).

(3) Lubricate sensor and adapter O-rings with transmission fluid.

(4) Install vehicle speed sensor in speedometer adapter. Tighten sensor attaching screw to 2-3 N·m (15-27 in. lbs.) torque.

(5) Install speedometer pinion in adapter.

(6) Count number of teeth on speedometer pinion. Do this before installing assembly in housing. Then lubricate pinion teeth with transmission fluid.

(7) Note index numbers on adapter body (Fig. 23). 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.

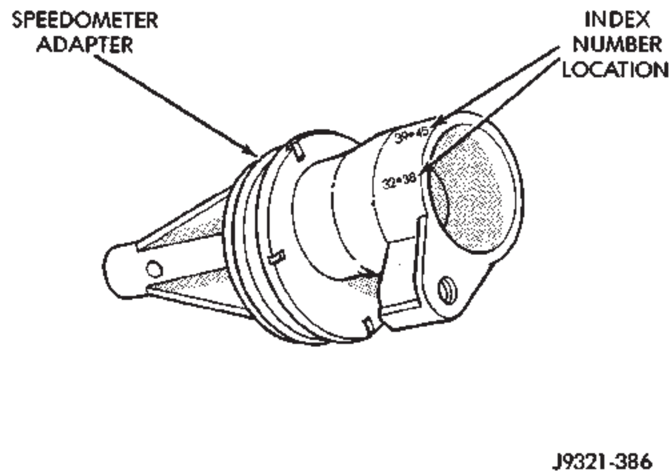


Fig. 23 Index Numbers On Speedometer Pinion Adapter

ITEM	TORQUE
A	2-3 N•m (15-27 in. lbs.)
B	10-12 N•m (90-110 in. lbs.)

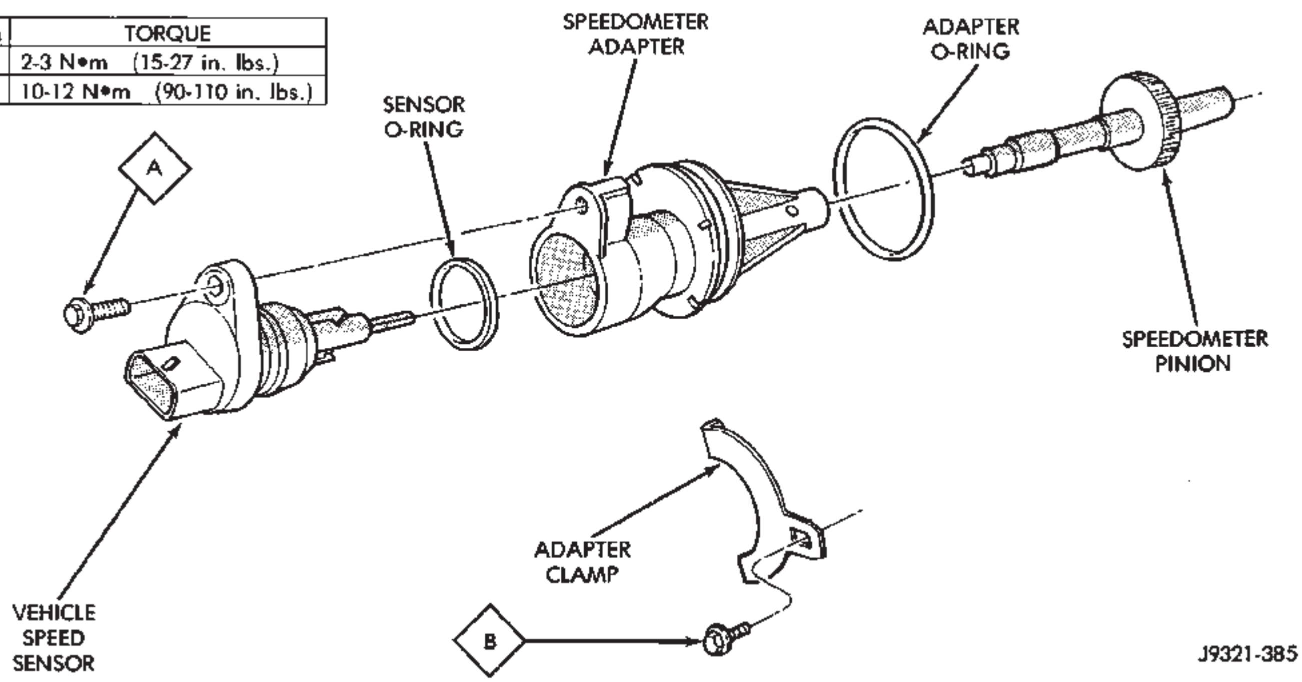


Fig. 22 Speedometer Pinion Adapter Components

REMOVAL AND INSTALLATION (Continued)

PARK/NEUTRAL POSITION SWITCH

REMOVAL

(1) Raise vehicle and position drain pan under switch.

(2) Disconnect switch wires.

(3) Remove switch from case.

INSTALLATION

(1) Move shift lever to Park and Neutral positions. Verify that switch operating lever fingers are centered in switch opening in case (Fig. 24).

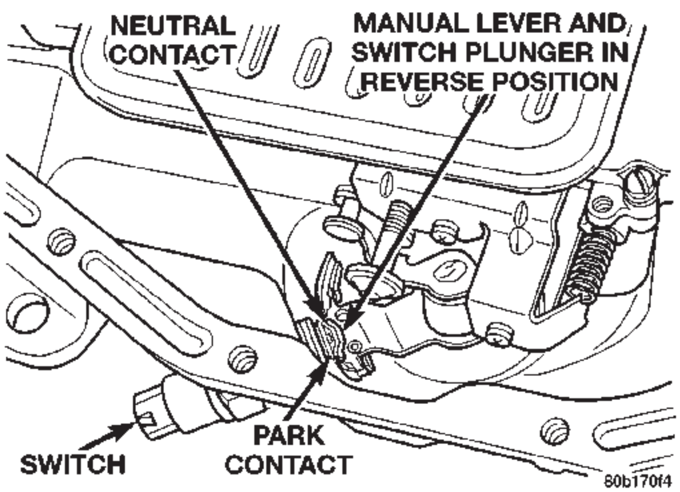


Fig. 24 Park/Neutral Position Switch

(2) Install new seal on switch and install switch in case. Tighten switch to 34 N·m (25 ft. lbs.) torque.

(3) Test continuity of new switch with 12V test lamp.

(4) Connect switch wires and lower vehicle.

(5) Top off transmission fluid level.

GEARSHIFT CABLE

REMOVAL

(1) Shift transmission into Park.

(2) Remove shift lever bezel and necessary console parts for access to shift lever assembly.

(3) Disconnect cable at shift lever and feed cable through dash panel opening to underside of vehicle.

(4) Raise vehicle.

(5) Disengage cable eyelet at transmission shift lever and pull cable adjuster out of mounting bracket. Then remove old cable from vehicle.

INSTALLATION

(1) Route cable through hole in dash panel. Fully seat cable grommet into dash panel.

(2) Place the auto transmission manual shift control lever in “Park” detent (rearmost) position and rotate prop shaft to ensure transmission is in park.

(3) Connect shift cable to shifter mechanism by snapping cable retaining ears into shifter bracket and press cable end fitting onto lever ball stud.

(4) Place the floor shifter lever in park position. Ensure that the pawl is seated within the confines of the adjustment gauge clip.

(5) Snap the cable into the transmission bracket so the retaining ears are engaged and connect cable end fitting onto the manual control lever ball stud.

(6) Lock shift cable into position by pushing upward on the adjusting lock button.

(7) Remove and discard the shift cable adjustment gauge clip from the park gate of the shifter.

BRAKE TRANSMISSION SHIFT INTERLOCK

REMOVAL

(1) Remove lower steering column cover. Refer to Group 8E, Instrument Panel and Gauges, for proper procedure.

(2) Remove lower steering column shroud. Refer to Group 19, Steering, for proper procedure.

(3) Remove tie strap near the solenoid retaining the brake transmission interlock cable to the steering column.

(4) Disengage wire connector from solenoid.

(5) With the ignition removed or in the unlocked position, disengage lock tab holding cable end to steering column (Fig. 25).

(6) Pull cable end from steering column.

(7) Remove the floor console and related trim. Refer to Group 23, Body, for proper procedure.

(8) Disconnect the cable eyelet from the bellcrank (Fig. 26).

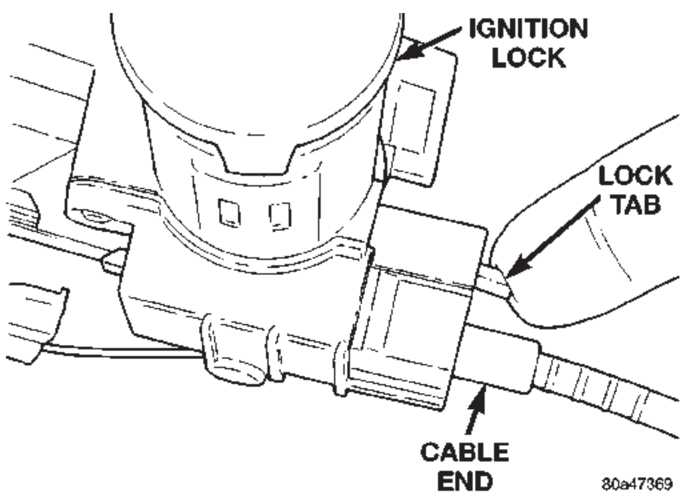


Fig. 25 Brake/Park Interlock Cable

(9) Disconnect and remove the cable from the shift bracket.

INSTALLATION

(1) Route replacement cable behind instrument panel and under floor console area to shift mechanism (Fig. 26).

REMOVAL AND INSTALLATION (Continued)

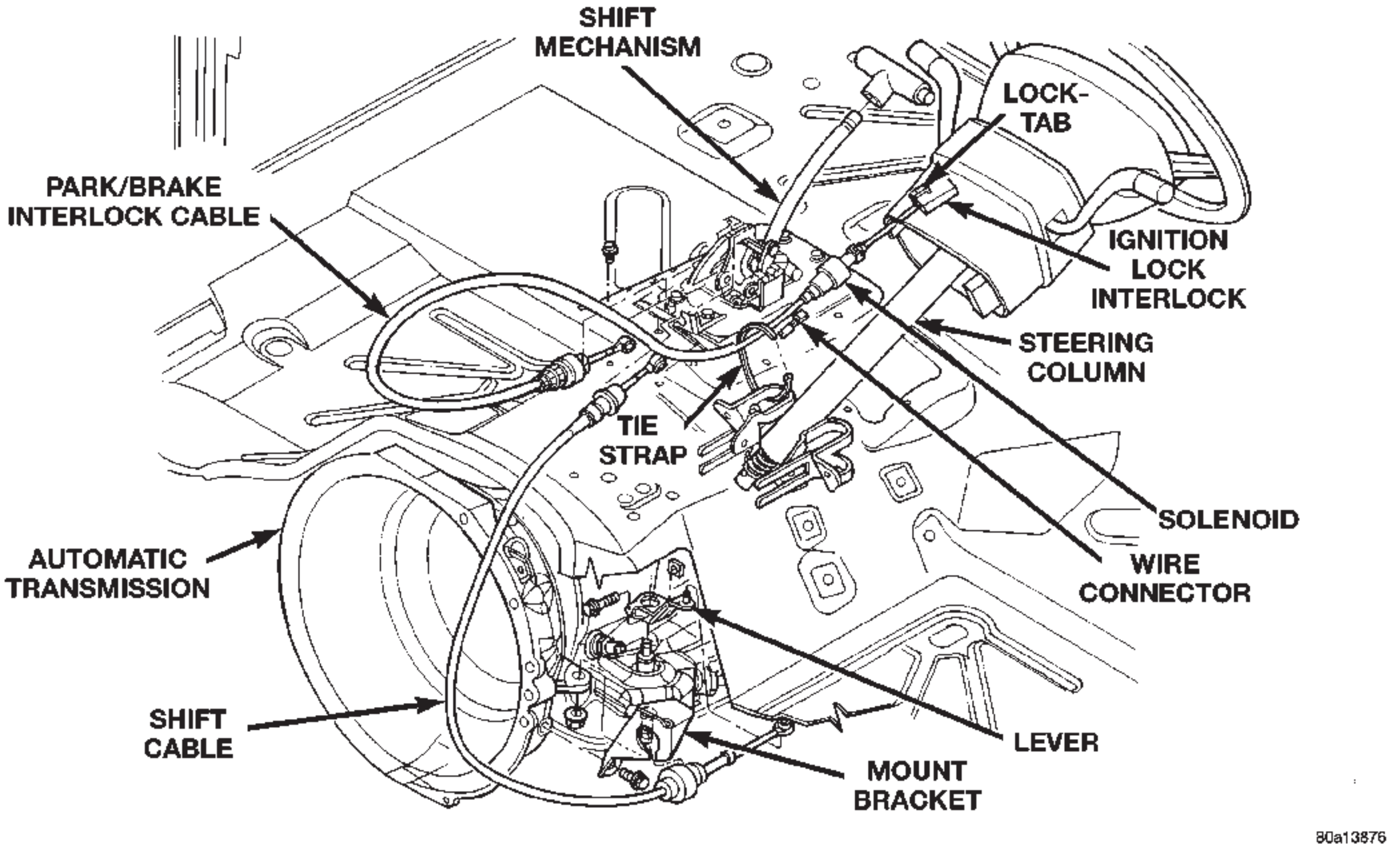


Fig. 26 Cable and Shifter

(2) Insert cable end into opening in steering column hub under ignition lock. Push cable inward until lock tab engages.

(3) Connect the cable end eyelet onto shifter bellcrank pin.

(4) Place gear selector in PARK.

(5) Push the spring-loaded cable adjuster forward and snap cable into bracket.

(6) Adjust the brake transmission shifter interlock cable. Refer to the Adjustment portion of this section for proper procedures.

(7) Verify that the cable adjuster lock clamp is pushed downward to the locked position.

(8) Test the park-lock cable operation.

(9) Install the floor console and related trim.

(10) Install tie strap to hold cable to base of steering column.

(11) Install lower steering column shroud and ignition lock.

(12) Install lower steering column cover.

VALVE BODY

REMOVAL

(1) Raise vehicle.

(2) Remove oil pan and drain fluid.

(3) Loosen clamp bolts and remove throttle and manual valve levers from manual lever shaft.

(4) Remove park/neutral position switch.

(5) Remove filter from valve body.

(6) Depress retaining clip and pull solenoid wire from case connector (Fig. 27).

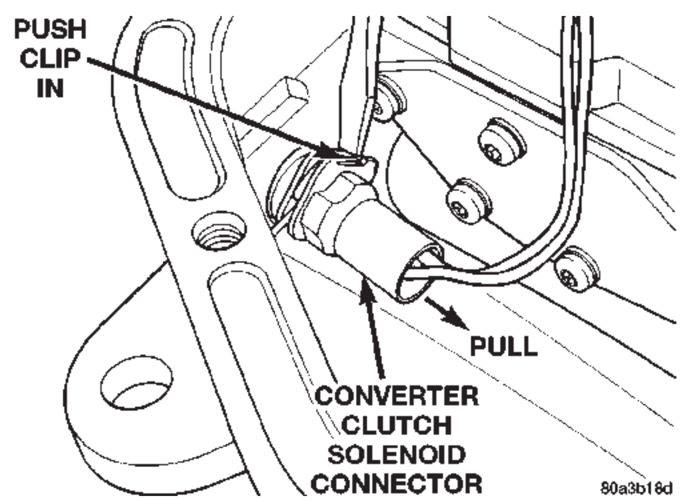


Fig. 27 Solenoid Wire Connector

REMOVAL AND INSTALLATION (Continued)

(7) Remove valve body attaching screws.

(8) Lower valve body enough to remove accumulator piston and piston spring (Fig. 28).

(9) Pull valve body forward to disengage park rod.

(10) Push manual lever shaft and solenoid case connector out of transmission case.

(11) Lower valve body, rotate it away from case, pull park lock rod out of sprag, and remove valve body (Fig. 29).

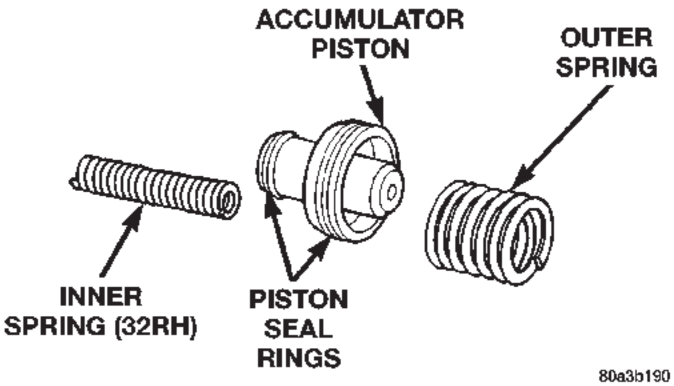


Fig. 28 Accumulator Piston And Springs

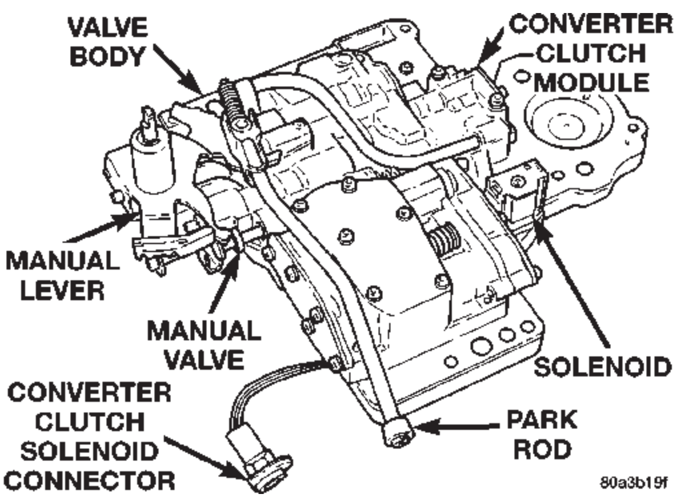


Fig. 29 Valve Body

INSTALLATION

(1) Verify that park/neutral position switch is **NOT** installed. Valve body cannot be installed with switch in place. Remove switch if necessary.

(2) Install new seals on accumulator piston if necessary, and install piston in case. Use small amount of petroleum jelly to hold piston in place.

(3) Place valve body manual lever in low (1 position) to ease inserting park rod into sprag.

(4) Use screwdriver to push park sprag into engagement with park gear. This makes clearance for knob on lock rod to move past sprag when valve body is installed. Rotate output shaft to verify sprag engagement.

(5) Position accumulator spring between accumulator piston and valve body.

(6) Position valve body on transmission and work knob on park lock rod past sprag. Be sure accumulator piston and spring remain in position.

(7) Hold valve body in position and install valve body screws finger tight.

(8) Install park/neutral position switch.

(9) Tighten valve body screws alternately and evenly to 11 N·m (100 in. lbs.) torque.

(10) Install new fluid filter on valve body. Install and tighten filter screws to 4 N·m (35 in. lbs.) torque.

(11) Connect solenoid wire to case connector.

(12) Install manual and throttle levers on throttle lever shaft. Tighten lever clamp screws and check for free operation. Shaft and levers must operate freely without any bind.

(13) Install oil pan and new gasket. Tighten pan bolts to 17 N·m (150 in. lbs.) torque. Install gasket dry; do not use sealer.

(14) Connect park/neutral position switch and converter clutch solenoid wires.

(15) Install speedometer pinion gear, adapter and speed sensor.

(16) Lower vehicle.

(17) Fill transmission with Mopar® ATF Plus 3, Type 7176 fluid.

(18) Adjust gearshift and throttle cable if necessary.

OUTPUT SHAFT REAR BEARING

REMOVAL

(1) Remove extension housing.

(2) Remove snap ring that retains rear bearing on output shaft (Fig. 30).

(3) Remove bearing from output shaft.

INSTALLATION

(1) Install bearing on output shaft. Be sure retaining ring groove in outer circumference of bearing is toward the governor.

(2) Install rear bearing retaining snap ring (Fig. 30).

(3) Install extension housing.

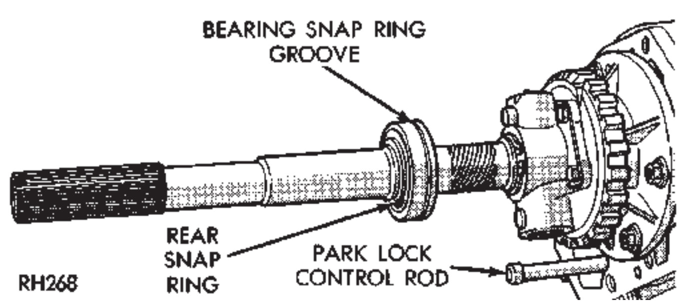


Fig. 30 Output Shaft Rear Bearing—Typical

REMOVAL AND INSTALLATION (Continued)

GOVERNOR AND PARK GEAR

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Mark propeller shaft and axle yoke for assembly reference. Then disconnect and remove shaft.

(3) Disconnect parking brake cable at equalizer and disconnect exhaust components as necessary.

(4) Support transmission on a suitable lifting device.

(5) Remove skid plate and rear transmission mount.

(6) Remove extension housing.

(7) Loosen but do not remove bolts that hold governor body to park gear.

(8) Rotate transmission output shaft until governor weight assembly is accessible.

(9) Remove E-clip at end of governor valve shaft (Fig. 31).

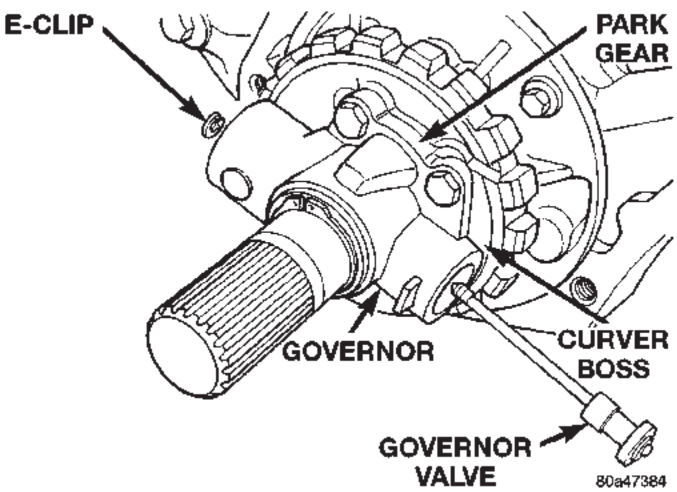


Fig. 31 Governor Valve

(10) Remove governor valve and shaft from governor body (Fig. 31).

(11) Remove snap rings and spacer that retain governor body and park gear assembly on output shaft (Fig. 32).

(12) Remove bolts holding governor body to park gear (Fig. 33).

(13) Separate governor from park gear.

(14) Pull park gear from rear support.

INSTALLATION

(1) Install park gear into rear support so crown on curved boss is in line with hole through output shaft.

(2) Install governor filter in park gear.

(3) Slip governor body over output shaft and align port to filter.

(4) Install bolts to hold governor body to park gear. Tighten bolts to 11 N·m (95 in. lbs.) torque (Fig. 33).

(5) Install governor body-park gear snap rings and washer on output shaft as follows:

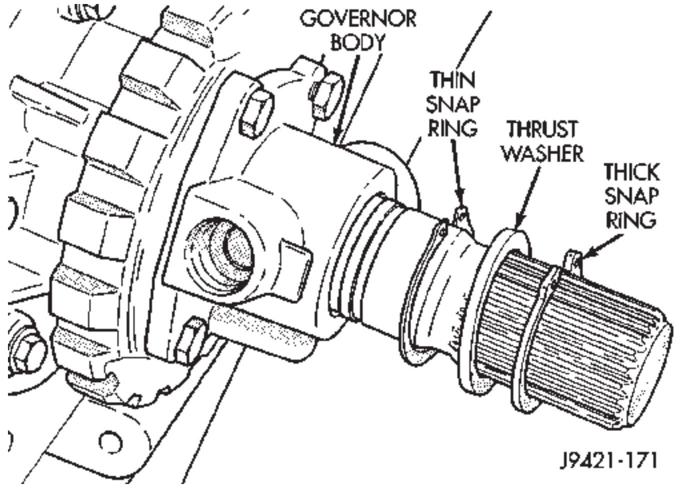


Fig. 32 Snap Rings And Spacer

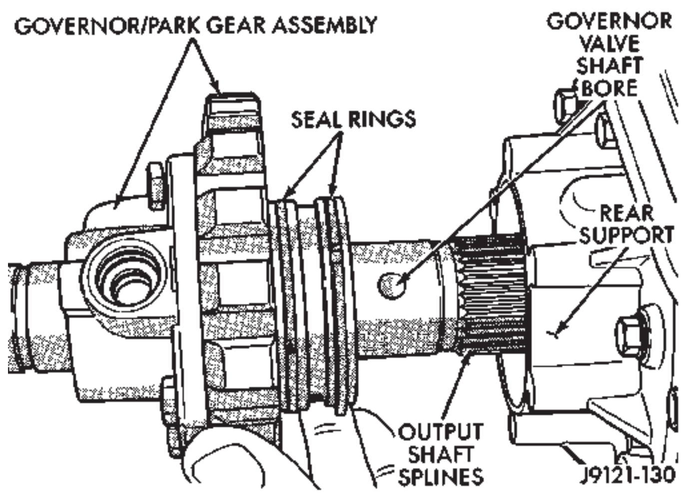


Fig. 33 Governor Body

(a) Install thin snap ring first. Then install thrust washer second, and thick snap ring last (Fig. 32).

(b) Verify correct position of snap rings. **Be sure flat side of each snap ring is toward governor body.**

(6) Insert governor valve and shaft through governor and install E-clip (Fig. 31).

(7) Install extension housing and gasket on transmission. Tighten housing bolts to 32 N·m (24 ft. lbs.).

(8) Install rear transmission mount and skid plate.

(9) Install speed sensor and speedometer components and connect speed sensor wires.

(10) Connect exhaust components and brake cable, if removed.

(11) Install propeller shaft.

(12) Remove supports and lower vehicle.

(13) Check transmission fluid level. Add fluid if necessary.

REMOVAL AND INSTALLATION (Continued)

PARK LOCK

REMOVAL

(1) Raise vehicle and remove propeller shaft.

(2) Remove extension housing.

(3) Slide sprag shaft out of extension housing and remove sprag and spring (Fig. 34).

(4) Remove snap ring and slide reaction plug and pin assembly out of housing.

(5) If park rod requires service, it will be necessary to remove valve body.

INSTALLATION

(1) Inspect sprag shaft for scores and free movement in housing and sprag. Inspect sprag and control rod springs for distortion and loss of tension. replace worn, damaged parts as necessary.

(2) Inspect square lug on sprag for broken edges. Check lugs on park gear for damage. Inspect knob on end of control rod for wear grooves, or being seized on rod. Replace rod if bent, if knob is worn/grooved, or it has seized on rod. Replace park gear if lugs are damaged. Replace the park lock rod if it is suspected that the rod is not the correct length.

(3) Install reaction plug and pin assembly in housing and secure with new snap ring (Fig. 34).

(4) Position sprag and spring in housing and insert sprag shaft. Be sure square lug on sprag is toward park gear. Also be sure spring is positioned so it moves sprag away from gear.

(5) Install extension housing.

(6) Install propeller shaft and lower vehicle.

(7) Check transmission fluid level. Add fluid if necessary.

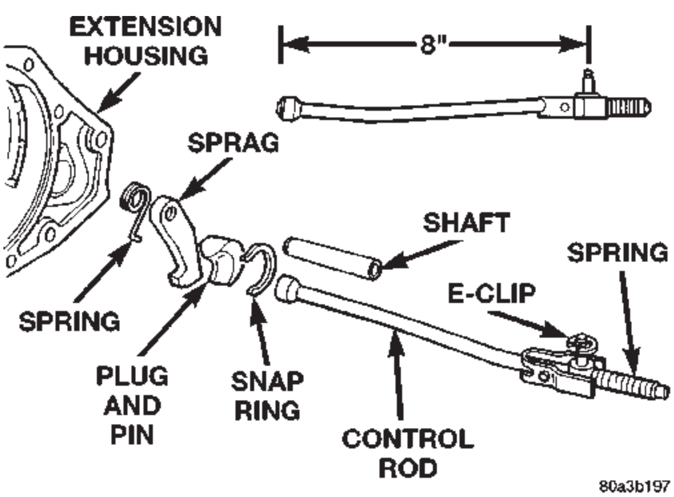


Fig. 34 Park Lock

DISASSEMBLY AND ASSEMBLY

GOVERNOR AND PARK GEAR

DISASSEMBLY

(1) Remove governor body from transmission.

(2) Clean and inspect governor filter (Fig. 35).

(3) Remove snap ring and washer that secure governor weight assembly in body (Fig. 36).

(4) Remove governor weight assembly from governor body bore.

(5) Slide intermediate and inner weight from outer weight.

(6) Position intermediate weight on suitable size socket (Fig. 37).

(7) Push inner weight downward with nut driver. Then remove inner weight snap ring with Miller Plier Tool 6823 (Fig. 37).

(8) Remove inner weight and spring from intermediate weight.

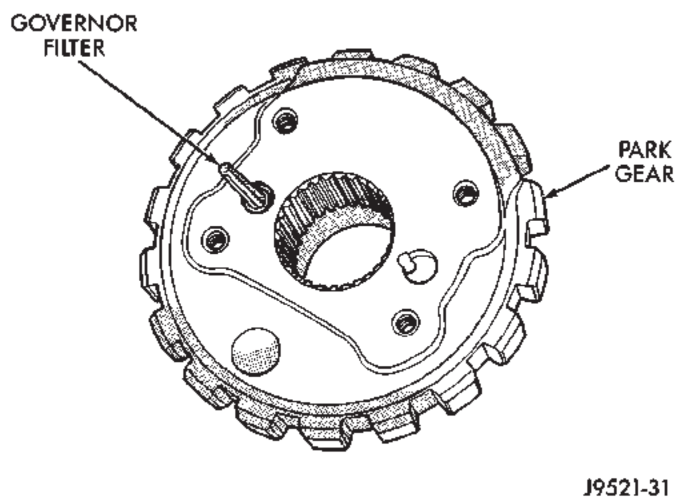


Fig. 35 Governor Filter

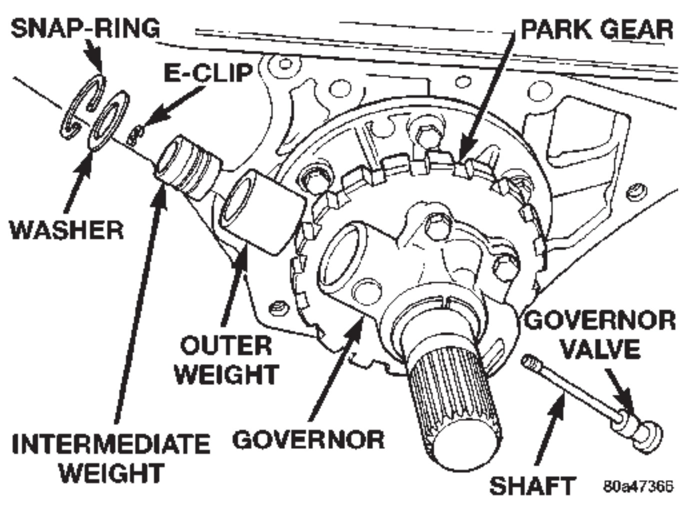


Fig. 36 Snap Ring, Washer, and Outer Weight

DISASSEMBLY AND ASSEMBLY (Continued)

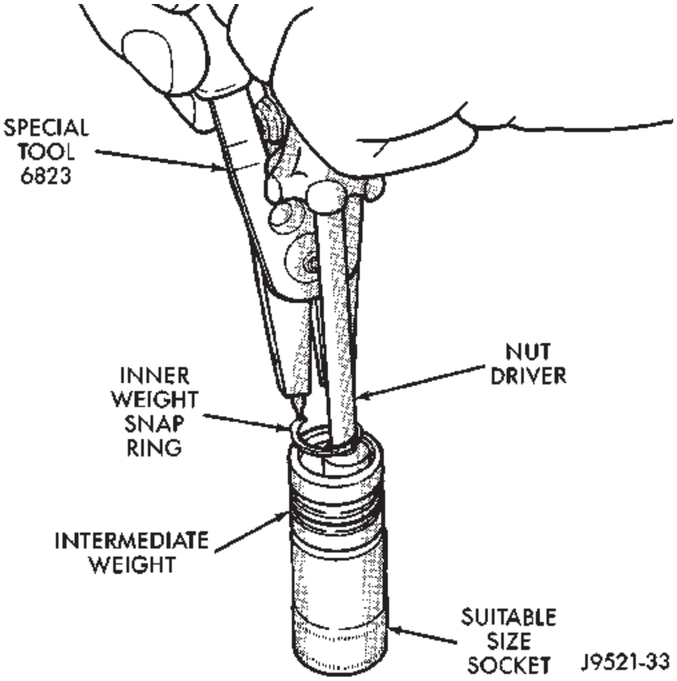


Fig. 37 Inner Weight Snap Ring

ASSEMBLY

CAUTION: Exercise care when installing the rings. They are easily broken if overspread or twisted during installation.

If it was necessary to remove the park gear, inspect the seal rings and bore in rear support. Install new seal rings on park gear hub only if original rings are damaged, or worn. Install ring with interlock ends first and ring with plain ends last. Slip each ring on hub and seat them in grooves. Verify that rear ring ends are securely interlocked before proceeding. If the bore in rear support is damaged, replace the rear support.

(1) Lubricate governor components with Mopar® ATF Plus 3, Type 7176 transmission fluid before assembly.

(2) Clean and inspect governor weights and bores for scoring or wear. Replace the governor body and weights if damaged. Refer to Cleaning and Inspection section of this group for proper procedure.

(3) Insert spring into intermediate weight.

(4) Insert inner weight into intermediate weight and install snap-ring (Fig. 38). Verify snap-ring is fully seated in groove in intermediate weight (Fig. 37).

(5) Assemble governor weights into governor body (Fig. 36).

(6) Install washer and snap ring to hold weights in governor body.

(7) Install governor body in transmission

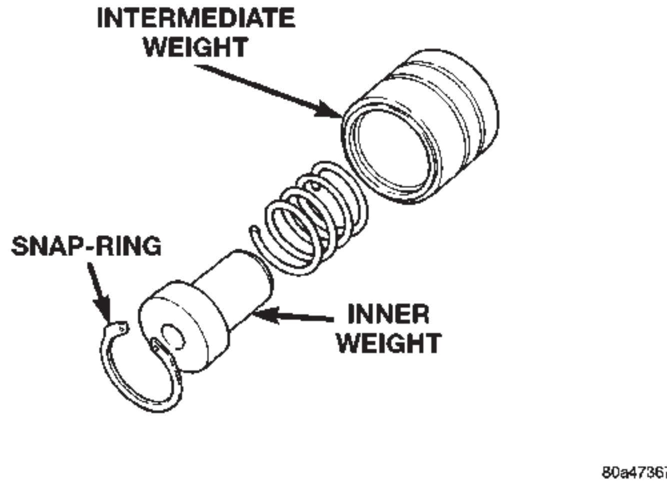


Fig. 38 Intermediate and Inner Governor Weights

VALVE BODY

DISASSEMBLY

Position the valve body on a clean work surface to avoid contamination.

CAUTION: Do not clamp any part of the valve body assembly (Fig. 39) in a vise. This practice will distort the valve body and transfer plate resulting in valve bind. Slide valves and plugs out carefully. Do not use force at any time. The valves and valve body will be damaged if force is used. Also tag or mark the valve body springs for reference as they are removed. Do not allow them to become intermixed.

(1) Remove screws attaching adjusting screw bracket to valve body and transfer plate. Hold bracket firmly against spring force while removing last screw.

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Remove adjusting screw bracket, line pressure adjusting screw (Fig. 40).

(3) Remove switch valve and spring, pressure regulator valve and spring, kickdown valve and spring, and throttle valve from valve body (Fig. 40).

(4) Secure detent ball and spring in housing with Retainer Tool 6583 (Fig. 41).

(5) Remove manual shaft E-clip, washer, and seal (Fig. 42).

(6) Pull manual shaft and park rod assembly upward out of valve body and off throttle lever (Fig. 42).

(7) Remove manual valve from valve body (Fig. 43)

(8) Remove Retainer Tool 6583. Then remove and retain detent ball and spring (Fig. 42).

(9) Remove throttle lever (Fig. 42).

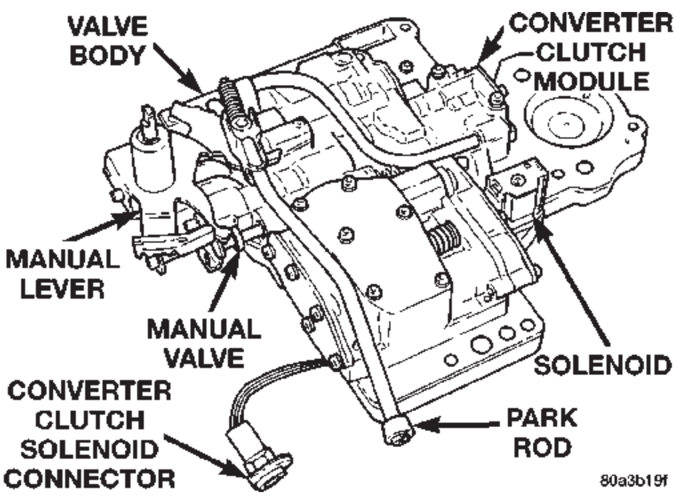


Fig. 39 Valve Body Assembly

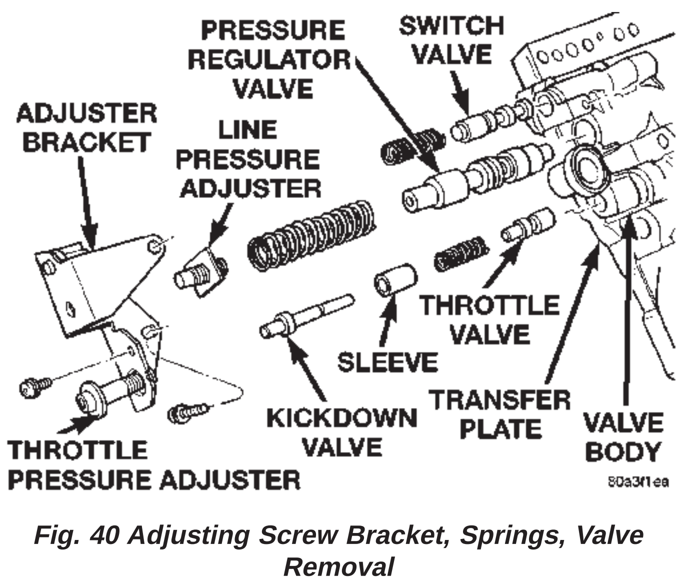


Fig. 40 Adjusting Screw Bracket, Springs, Valve Removal

(10) Remove park rod E-clip and separate rod from manual lever (Fig. 44).

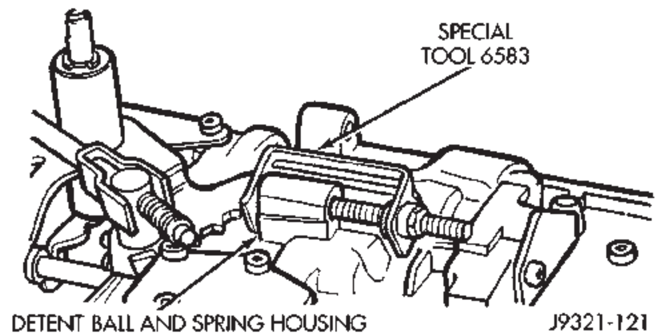


Fig. 41 Securing Detent Ball And Spring With Retainer Tool

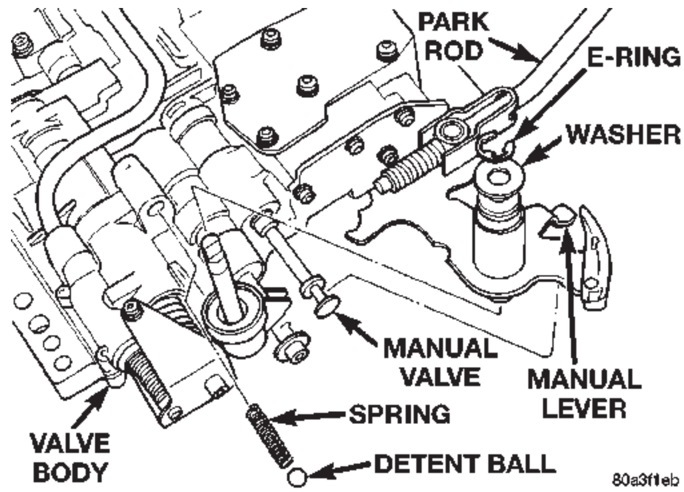


Fig. 42 Manual And Throttle Levers

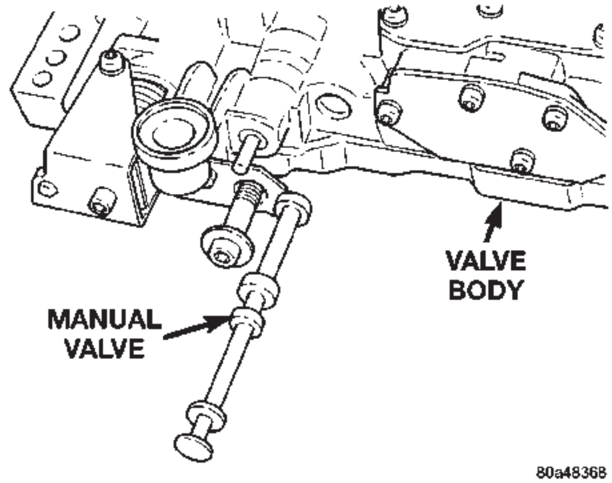


Fig. 43 Manual Valve

(11) Remove converter clutch solenoid from separator plate (Fig. 45). A T25 torx bit is required to remove solenoid attaching screw.

(12) Remove screws attaching converter clutch module to valve body and remove module and connecting tube (Fig. 46).

(13) Remove screws attaching end cover plate to torque converter module (Fig. 47).

DISASSEMBLY AND ASSEMBLY (Continued)

(14) Remove converter clutch valve, fail safe valve, and springs (Fig. 47)

(15) Turn valve body over so transfer plate is facing upward (Fig. 48). With valve body in this position, valve body check balls will remain in place and not fall out when transfer plate is removed.

(16) Remove screws attaching transfer plate to valve body (Fig. 48).

(17) Remove transfer plate and separator plate from valve body (Fig. 48). Note position of filter and clutch solenoid for reference. Remove valve body check balls.

(18) Position transfer plate on bench so separator plate, and filter are facing up. This will avoid having rear clutch and rear servo check balls fall out when plates are separated.

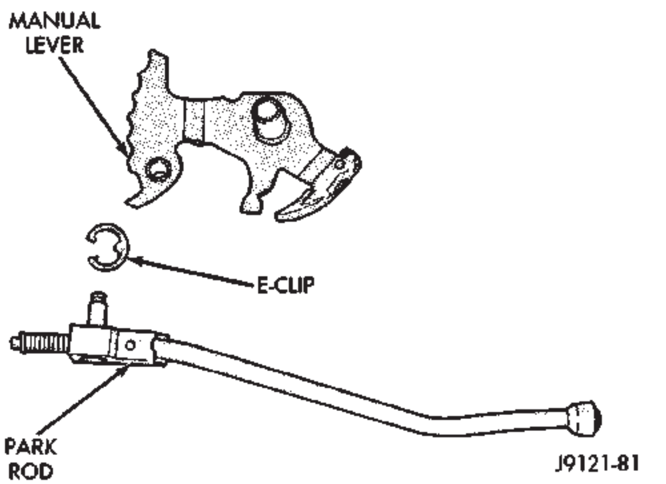


Fig. 44 Park Rod

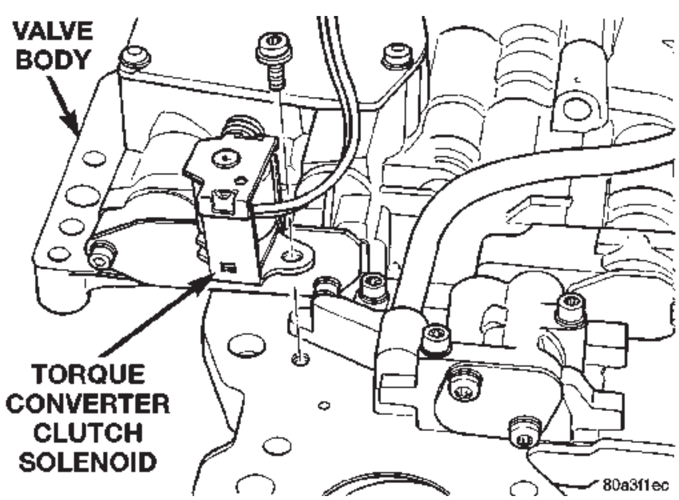


Fig. 45 Converter Clutch Solenoid

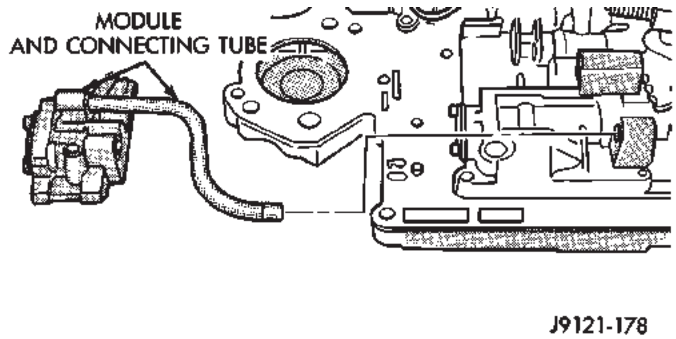


Fig. 46 Clutch Module And Connecting Tube

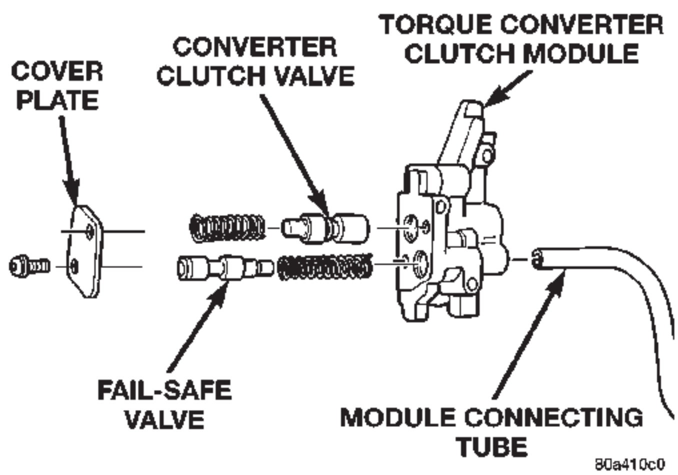


Fig. 47 Converter Clutch and Fail Safe Valves

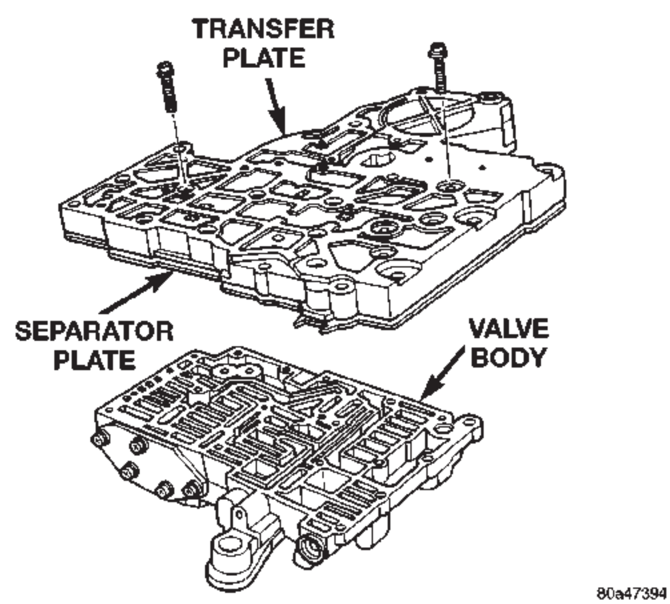


Fig. 48 Valve Body Transfer Plate Screws

DISASSEMBLY AND ASSEMBLY (Continued)

(19) Remove screws attaching separator plate to transfer plate (Fig. 49).

(20) Note position of filter, rear clutch servo and rear servo check balls for assembly reference (Fig. 49) and (Fig. 50).

(21) Remove shuttle valve end plate (Fig. 51).

(22) Remove shuttle valve E-clip and remove secondary spring and spring guides from end of valve (Fig. 52).

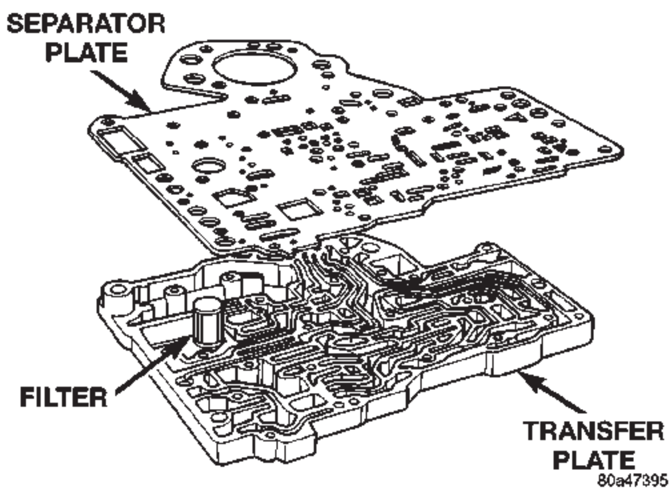


Fig. 49 Transfer And Separator Plates

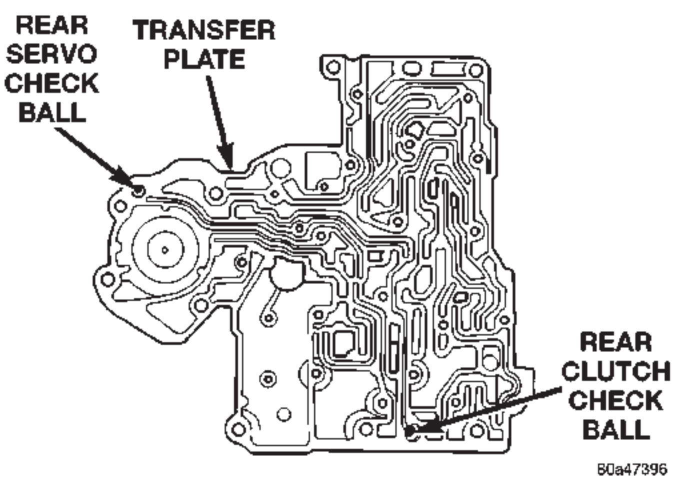


Fig. 50 Rear Servo and Rear Clutch Check Balls

(23) Remove governor plug end plate (Fig. 53).

(24) Remove 1-2 and 2-3 shift valve governor plugs from valve body (Fig. 53).

(25) Remove shuttle valve throttle plug, primary spring and shuttle valve from valve body (Fig. 53).

(26) Remove screws attaching kickdown limit valve body to valve body (Fig. 53).

(27) Remove 1-2 shift control valve and spring from valve body (Fig. 53).

(28) Remove 2-3 shift valve and spring from valve body (Fig. 53).

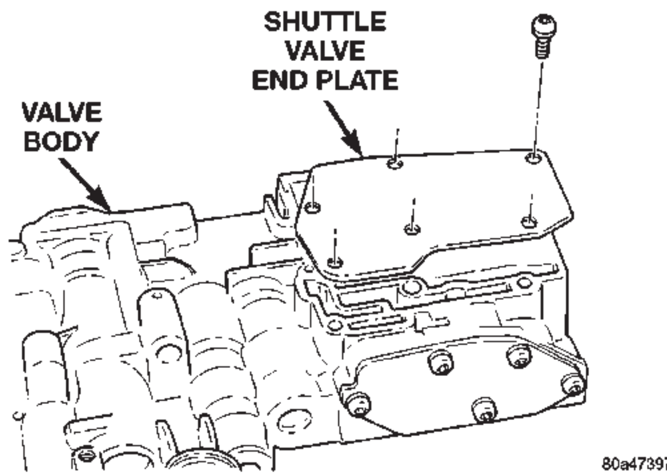


Fig. 51 Shuttle Valve End Plate

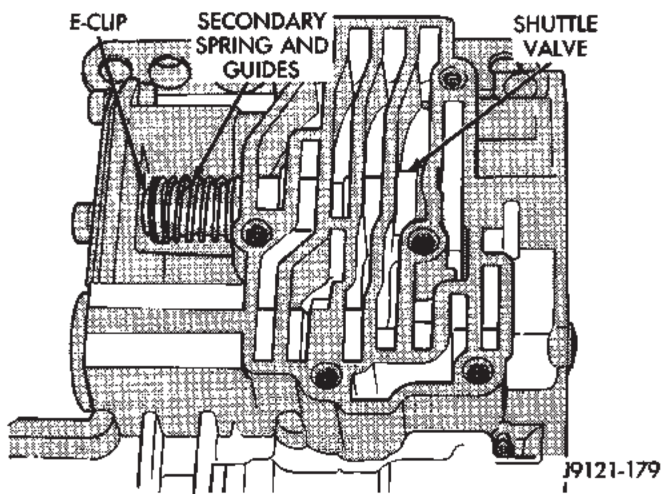


Fig. 52 Shuttle Valve E-Clip And Secondary Spring

(29) Remove 1-2 shift valve and spring from valve body (Fig. 53).

(30) Remove throttle pressure plug from kickdown limit valve body (Fig. 53).

(31) Remove retainer from end of kickdown limit valve body (Fig. 53).

(32) Remove kickdown limit valve and spring from kickdown limit valve body (Fig. 53).

(33) Remove regulator valve end plate from valve body (Fig. 53).

(34) Remove regulator valve line pressure plug, pressure plug sleeve, regulator valve throttle pressure plug and spring (Fig. 53).

ASSEMBLY

Clean and inspect all valve body components for damage or wear. Refer to the Cleaning and Inspection section of this group for proper procedure.

DISASSEMBLY AND ASSEMBLY (Continued)

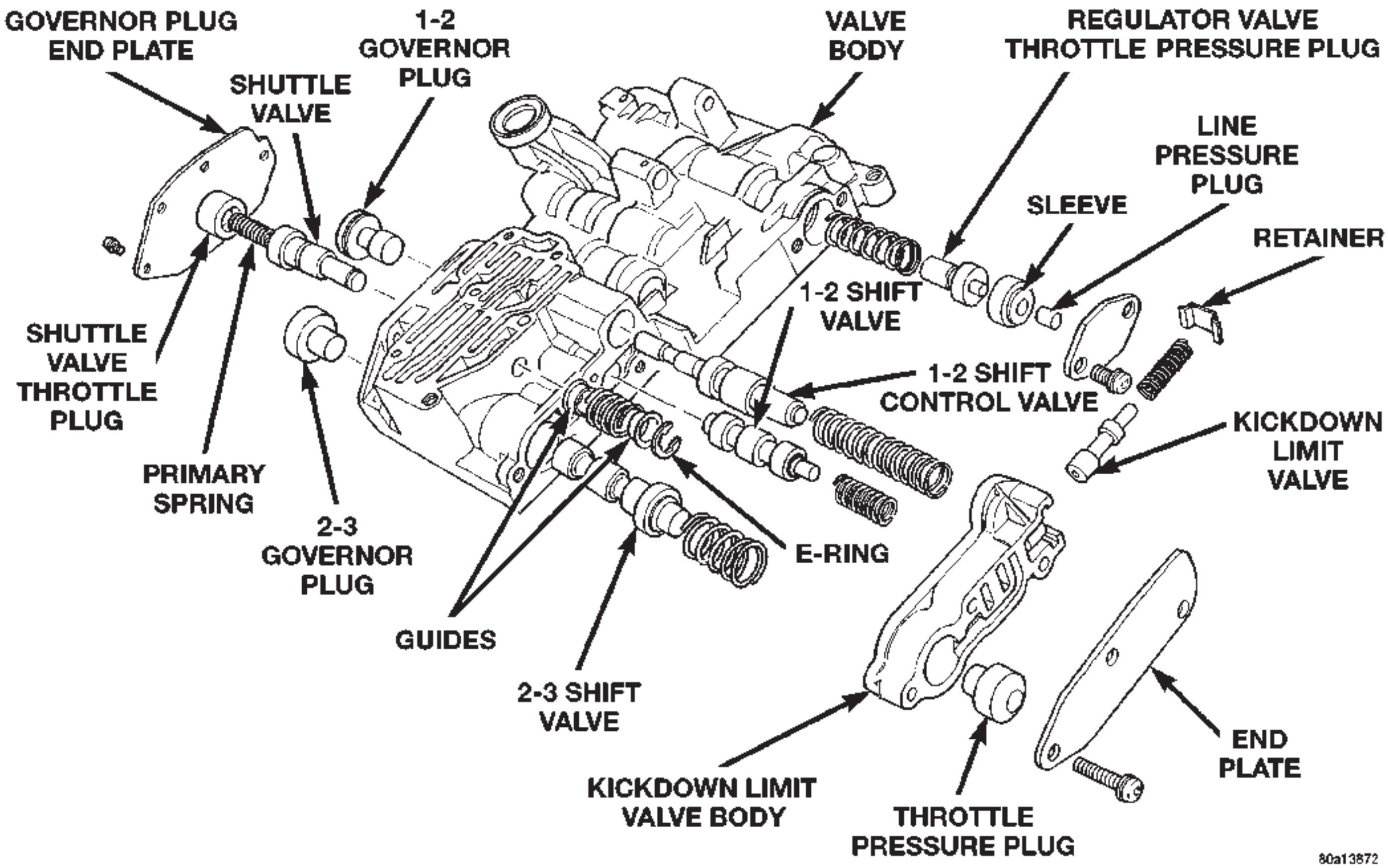


Fig. 53 Control Valves, Shift Valves, And Governor Plugs

CAUTION: Do not force valves or plugs into place during reassembly. If the valve body bores, valves, and plugs are free of distortion or burrs, the valve body components should all slide into place easily. In addition, do not overtighten the transfer plate and valve body screws during reassembly. Overtightening can distort the valve body resulting in valve sticking, cross leakage and unsatisfactory operation. Tighten valve body screws to recommended torque only.

(1) Lubricate valve body bores, valves and plugs with Mopar® ATF Plus 3, Type 7176, transmission fluid.

(2) Install regulator valve line pressure plug, pressure plug sleeve, regulator valve throttle pressure plug, and spring into valve body (Fig. 53). Verify valve components slide freely.

(3) Install regulator valve end plate on valve body (Fig. 53).

(4) Install kickdown limit valve and spring in kickdown limit valve body (Fig. 53). Verify valve components slide freely.

(5) Compress spring into kickdown limit valve body.

(6) Install retainer in grooves at end of kickdown limit valve body (Fig. 53).

(7) Install throttle pressure plug in kickdown limit valve body (Fig. 53).

(8) Install 1-2 shift valve and spring into valve body (Fig. 53).

(9) Install 2-3 shift valve and spring into valve body (Fig. 53).

(10) Install 1-2 shift control valve and spring into valve body (Fig. 53).

(11) Verify valve components slide freely.

(12) Place kickdown limit valve body and end plate in position on valve body and compress springs (Fig. 53).

(13) Install screws to attach kickdown limit valve body to valve body (Fig. 53).

(14) Install shuttle valve throttle plug, primary spring and shuttle valve into valve body (Fig. 53). Verify valve components slide freely.

(15) Install 1-2 and 2-3 shift valve governor plugs into valve body (Fig. 53). Verify valve components slide freely.

(16) Place governor plug end plate in position on valve body and compress spring.

(17) Install screws to attach governor plug end plate to valve body (Fig. 53).

(18) Assemble shuttle valve spring and guides (Fig. 53). Place spring and guides in position on shuttle valve stem.

DISASSEMBLY AND ASSEMBLY (Continued)

(19) Compress spring and install E-clip in groove on shuttle valve stem (Fig. 54).

(20) Place shuttle valve end plate in position on valve body (Fig. 55).

(21) Install screws to attach shuttle valve end plate to valve body (Fig. 55).

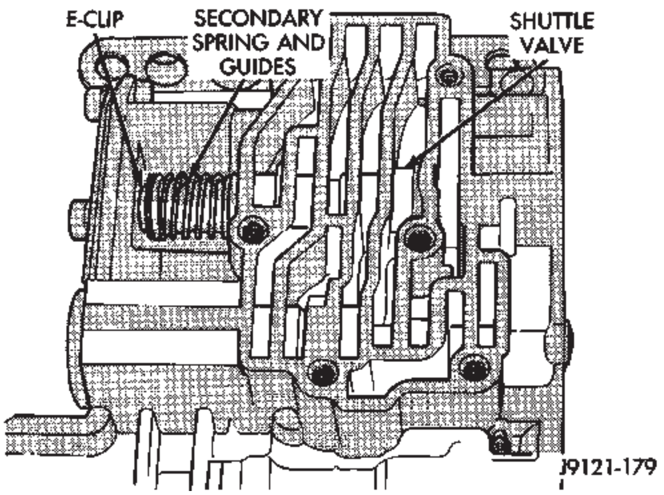


Fig. 54 Shuttle Valve E-Clip And Secondary Spring

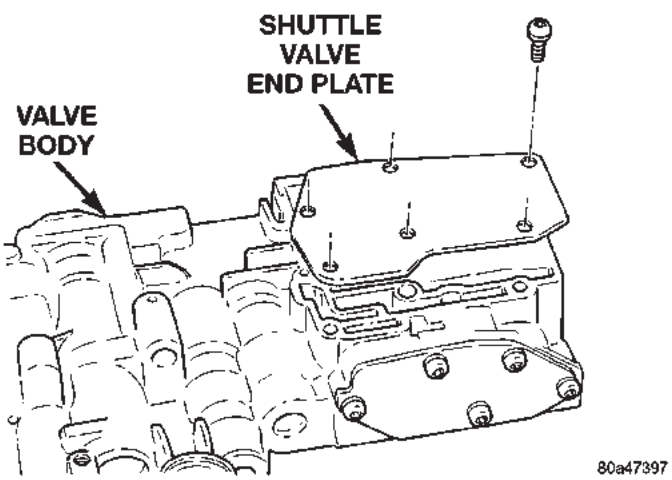


Fig. 55 Shuttle Valve End Plate

(22) Install rear clutch servo and rear servo check balls in proper cavities in transfer plate (Fig. 56).

(23) Insert filter into opening in separator plate (Fig. 57).

(24) Place separator plate in position on transfer plate and install screws to attach separator plate to transfer plate (Fig. 57).

(25) Place one 11/32 in. check ball and six 1/4 in. check balls in the proper cavities in the valve body (Fig. 58).

(26) Place transfer plate in position on valve body (Fig. 59).

(27) Install screws to attach transfer plate to valve body (Fig. 59).

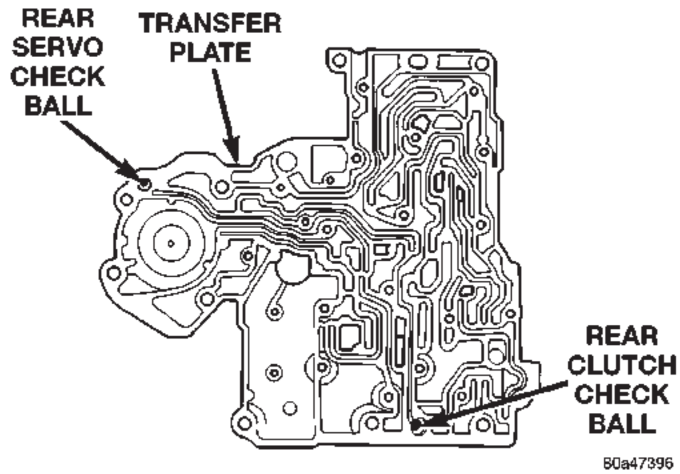


Fig. 56 Rear Servo and Rear Clutch Check Balls

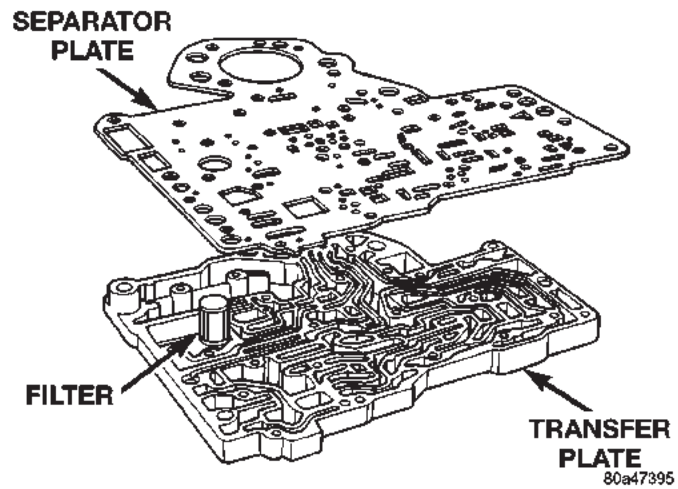


Fig. 57 Transfer And Separator Plates

(28) Turn valve body over to expose the separator plate.

(29) Insert converter clutch valve and spring into converter clutch valve module (Fig. 60). Verify valve components slide freely.

(30) Insert spring and fail-safe valve into converter clutch valve module (Fig. 60). Verify valve components slide freely.

(31) Place cover plate in position on converter clutch valve module (Fig. 60).

(32) Install screws to attach cover to converter clutch valve module (Fig. 60).

(33) Insert connecting tube into converter clutch valve module (Fig. 60).

(34) Insert connecting tube into valve body opening (Fig. 61).

(35) Place converter clutch valve module in position on separator plate. Install screws to attach converter clutch module to valve body (Fig. 61).

(36) If necessary, install a new O-ring on converter clutch solenoid (Fig. 62).

DISASSEMBLY AND ASSEMBLY (Continued)

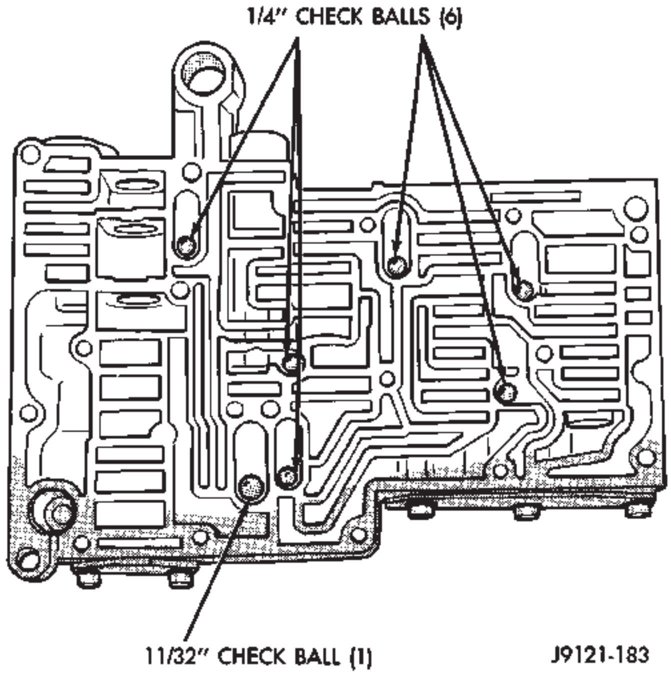


Fig. 58 Correct Position Of Valve Body Check Balls

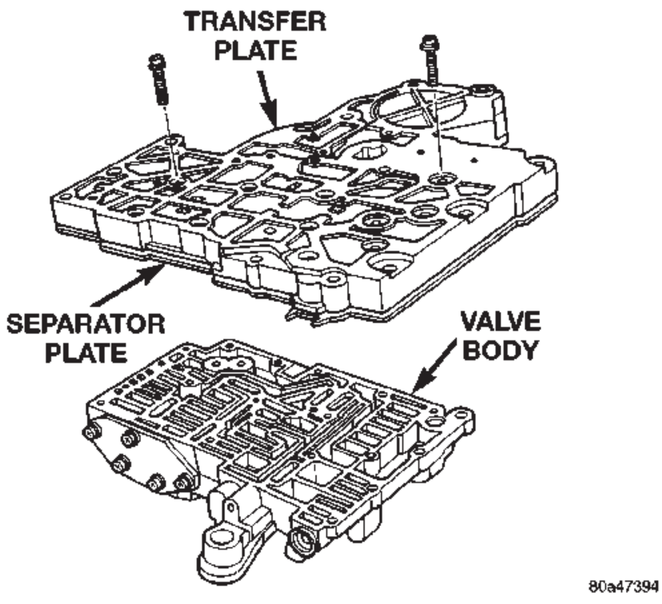


Fig. 59 Valve Body Transfer Plate Screws

(37) Insert converter clutch solenoid into transfer plate (Fig. 62).

(38) Install screw to attach solenoid to transfer plate (Fig. 62).

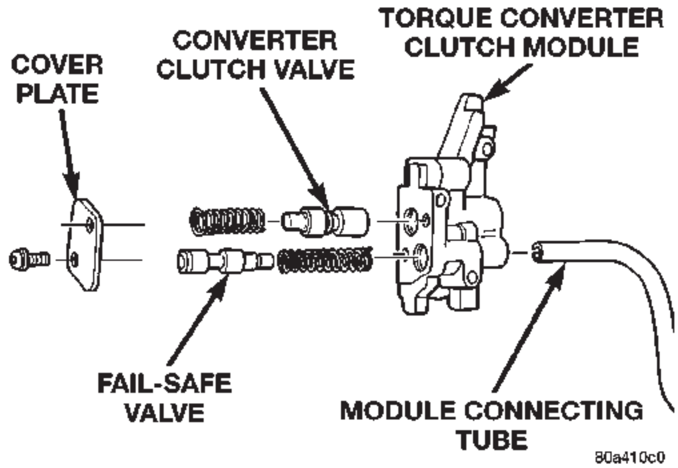


Fig. 60 Converter Clutch Valve Module

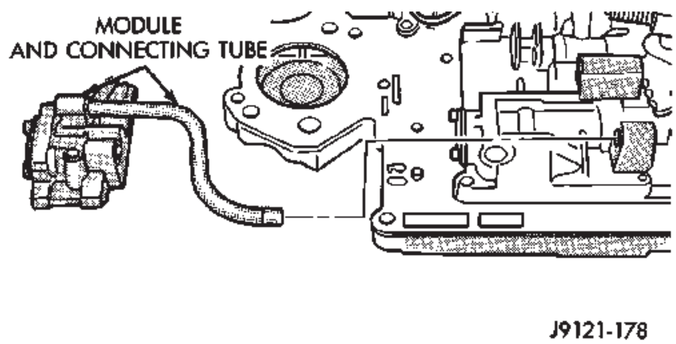


Fig. 61 Clutch Module And Connecting Tube

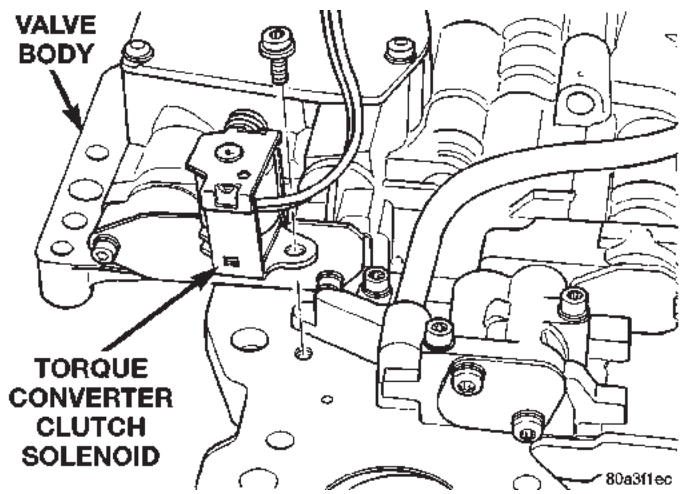


Fig. 62 Converter Clutch Solenoid

DISASSEMBLY AND ASSEMBLY (Continued)

(39) If necessary, insert park rod end into manual lever and install E-clip (Fig. 63).

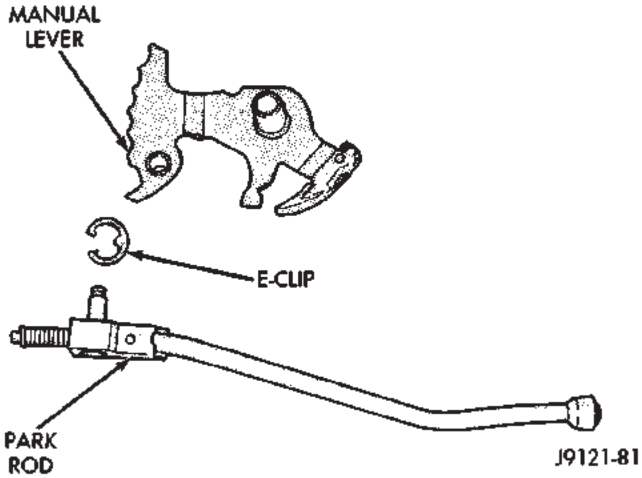


Fig. 63 Park Rod

(40) Insert detent spring and ball into opening in valve body and install Retainer Tool 6583 (Fig. 64).

(41) Install manual valve into valve body (Fig. 65).

(42) Insert throttle lever through transfer plate side of valve body and upward (Fig. 66).

(43) Insert throttle lever into groove in manual valve (Fig. 67).

(44) Install seal, washer, and E-clip to retain manual shaft to valve body (Fig. 66).

(45) Install switch valve and spring, pressure regulator valve and spring, kickdown valve and spring, and throttle valve into valve body (Fig. 68).

(46) Place adjusting screw bracket and line pressure adjusting screw in position on valve body and compress springs (Fig. 40).

(47) Install screws to attach adjuster bracket to valve body.

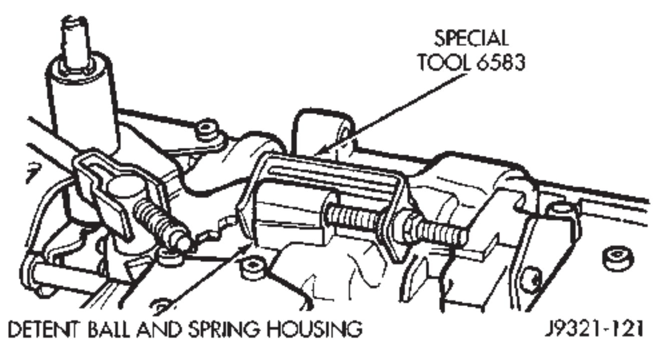


Fig. 64 Securing Detent Ball And Spring With Retainer Tool

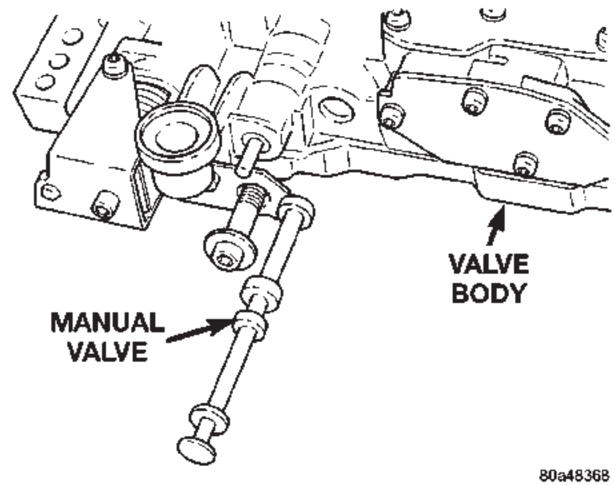


Fig. 65 Manual Valve

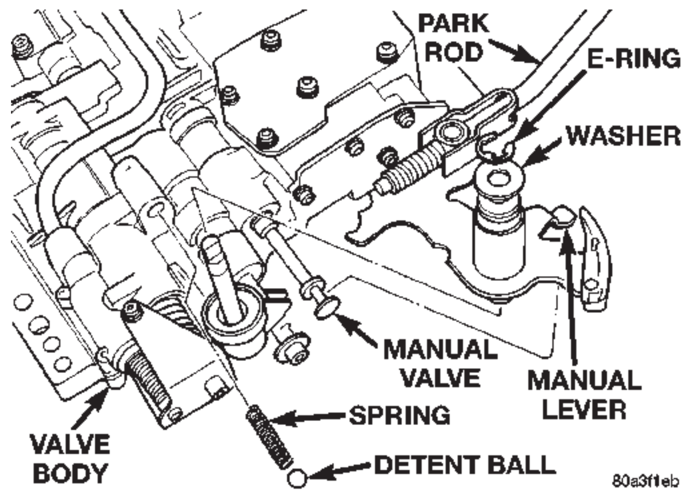


Fig. 66 Manual And Throttle Levers

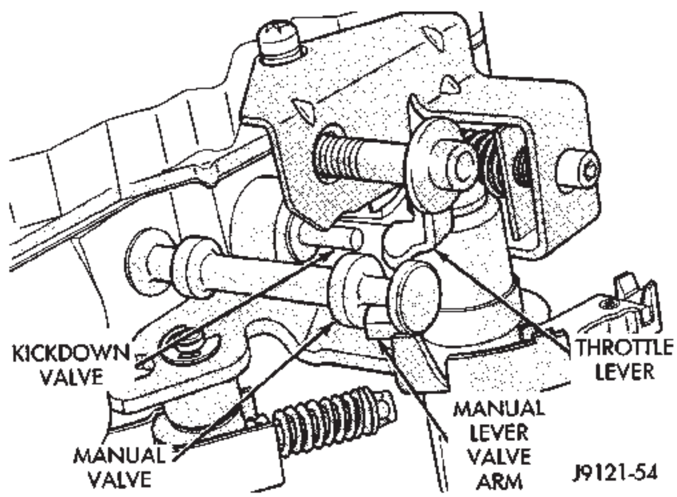


Fig. 67 Manual Valve And Throttle Lever Alignment

DISASSEMBLY AND ASSEMBLY (Continued)

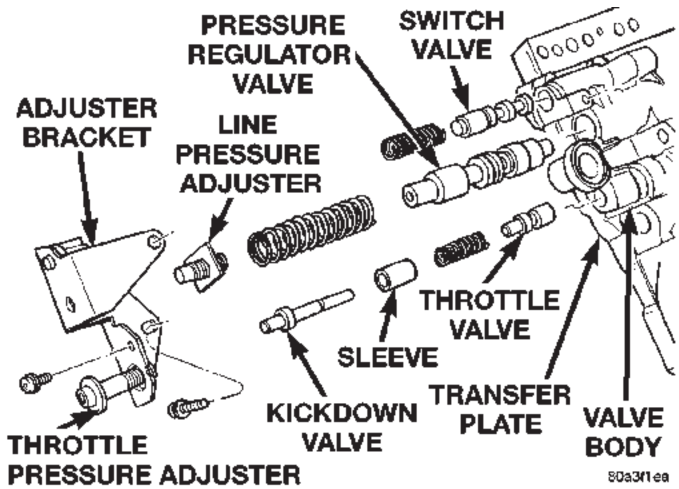


Fig. 68 Adjusting Screw Bracket, Springs, and Valves

TRANSMISSION

DISASSEMBLY

(1) Remove transmission from vehicle.

(2) Install a suitable tail shaft housing plug to avoid contaminating internal components with cleaning solvents.

(3) Clean exterior of transmission with suitable solvent or pressure washer.

(4) Remove torque converter from transmission.

(5) Remove throttle and shift levers from valve body manual shaft and throttle lever shaft.

(6) Mount transmission in repair stand C-3750-B or similar type stand (Fig. 69).

(7) Remove extension housing.

(8) Remove fluid pan.

(9) Remove park/neutral position switch and seal (Fig. 70).

(10) Remove valve body.

(11) Remove accumulator spring and piston (Fig. 71).

NOTE: The 32RH is equipped with an additional spring under the accumulator piston.

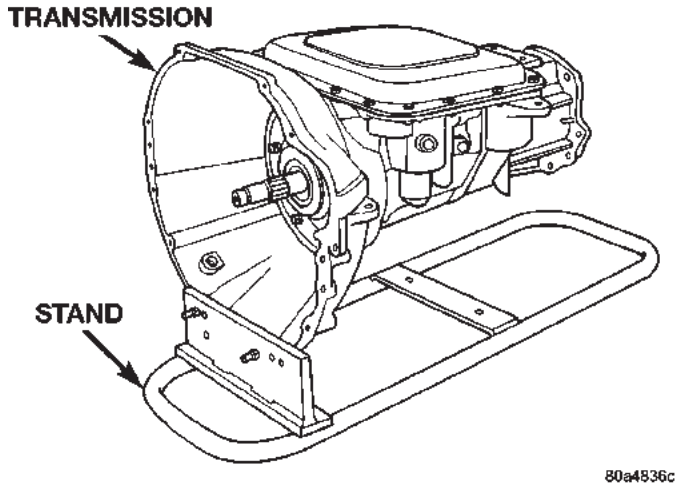


Fig. 69 Repair Stand

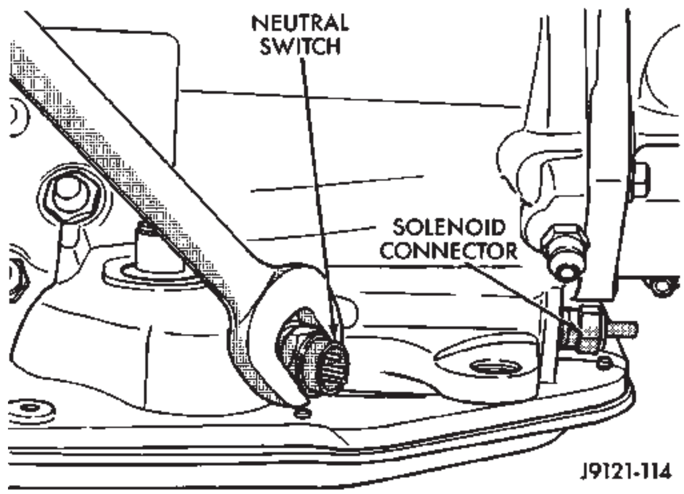


Fig. 70 Park/Neutral Position Switch

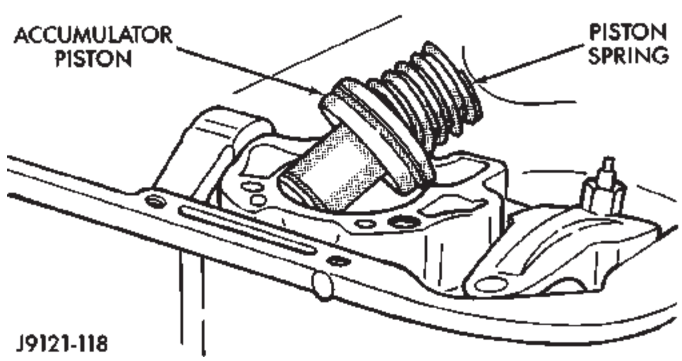


Fig. 71 Accumulator Piston And Spring

DISASSEMBLY AND ASSEMBLY (Continued)

(12) Loosen front band adjusting screw lock nut (Fig. 72) 4-5 turns. Then tighten band adjusting screw until band is tight around front clutch. This prevents front/rear clutches from coming out with pump and possibly damaging clutch or pump components.

(13) Remove oil pump bolts.

(14) Thread bolts of Slide Hammer Tools C-3752 into threaded holes in pump body flange (Fig. 73).

(15) Bump slide hammer weights outward to remove pump and reaction shaft support assembly from case (Fig. 73).

(16) Loosen front band adjusting screw until band is completely loose (Fig. 72).

(17) Squeeze front band together and remove band strut (Fig. 74).

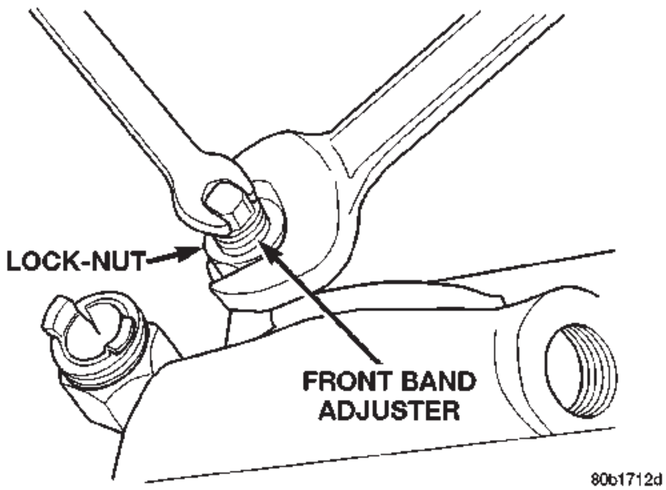


Fig. 72 Front Band Adjusting Screw Lock Nut

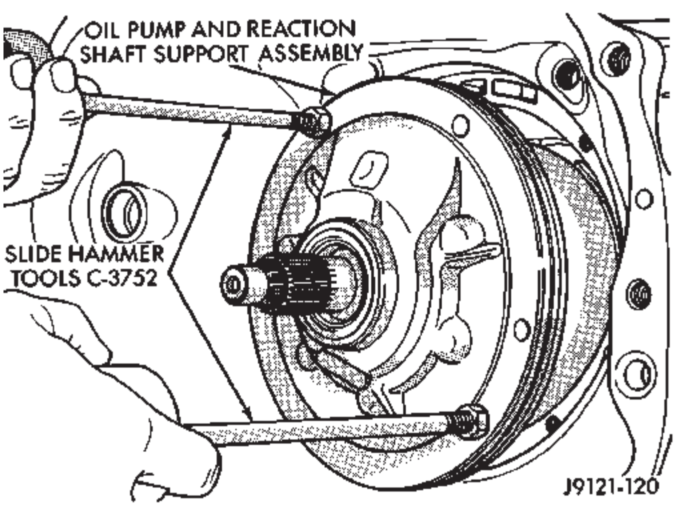


Fig. 73 Oil Pump/Reaction Shaft Support

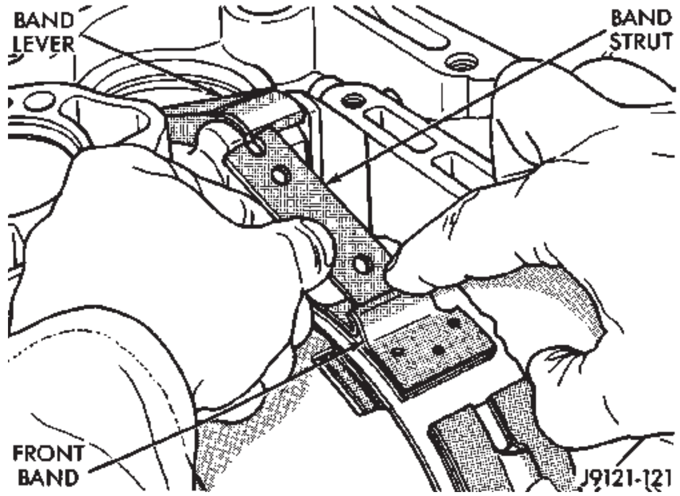


Fig. 74 Front Band Strut

(18) Remove front and rear clutch units as an assembly. Grasp input shaft, hold clutch units together and remove them from case (Fig. 75).

(19) Lift front clutch off rear clutch (Fig. 76). Set clutch units aside for overhaul.

(20) Remove output shaft thrust washer from output shaft (or from rear clutch hub) (Fig. 77).

(21) Remove output shaft thrust plate and washer from output shaft hub (Fig. 77).

(22) Remove front band from case (Fig. 78).

(23) Remove extension housing from transmission case.

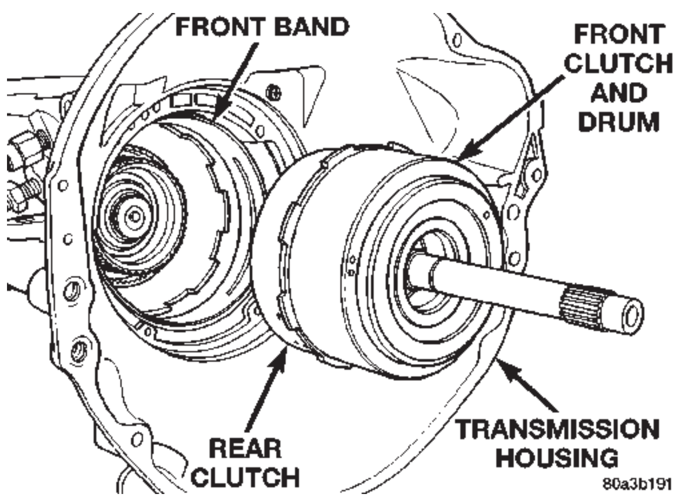


Fig. 75 Front/Rear Clutch Assemblies

DISASSEMBLY AND ASSEMBLY (Continued)

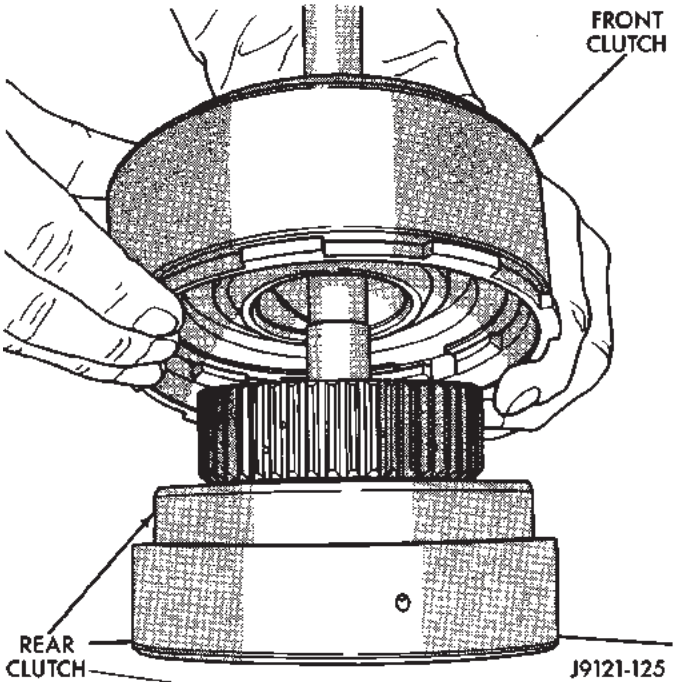


Fig. 76 Separating Front Clutch From Rear Clutch

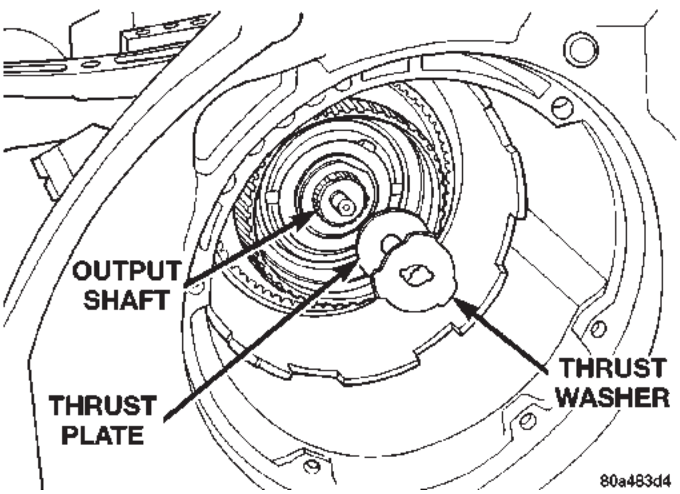


Fig. 77 Output Shaft Thrust Plate and Washer

(24) Remove governor body and park gear from output shaft.

(25) Remove output shaft and planetary geartrain as assembly (Fig. 79). Support geartrain with both hands during removal. Do not allow machined surfaces on output shaft to become nicked or scratched.

(26) Loosen rear band adjusting screw 4-5 turns (Fig. 80).

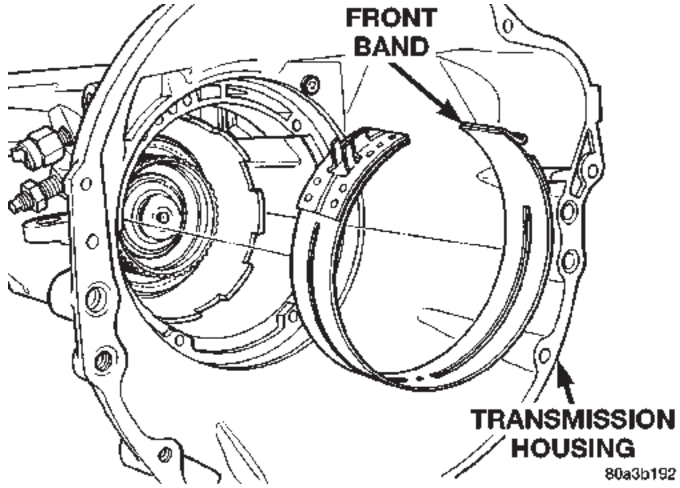


Fig. 78 Front Band

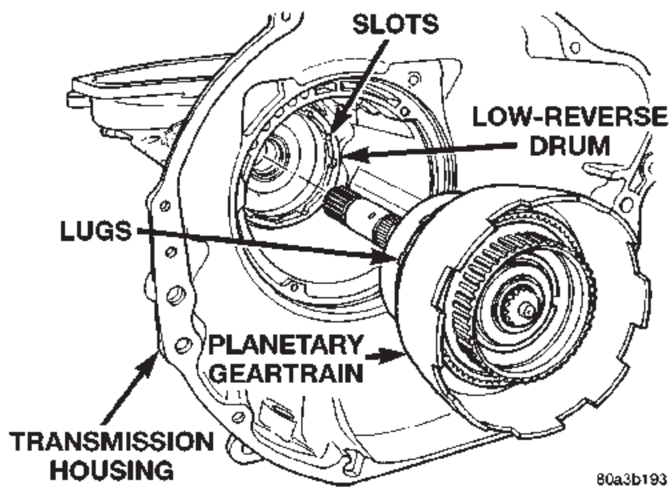


Fig. 79 Planetary Geartrain

(27) Remove snap ring that secures low-reverse drum to rear support hub, however do not remove drum (Fig. 81).

(28) Remove bolts attaching rear support to transmission case and pull support from low-reverse drum (Fig. 82).

(29) Remove bolts attaching overrunning clutch cam and low-reverse drum to transmission case (Fig. 83).

DISASSEMBLY AND ASSEMBLY (Continued)

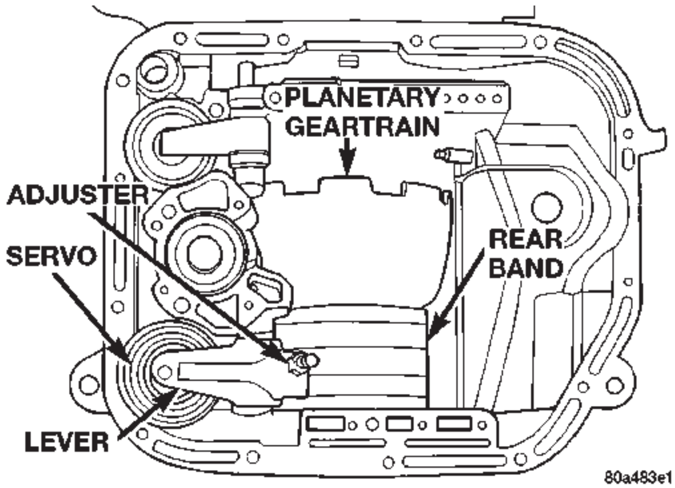


Fig. 80 Rear Band Adjuster Location

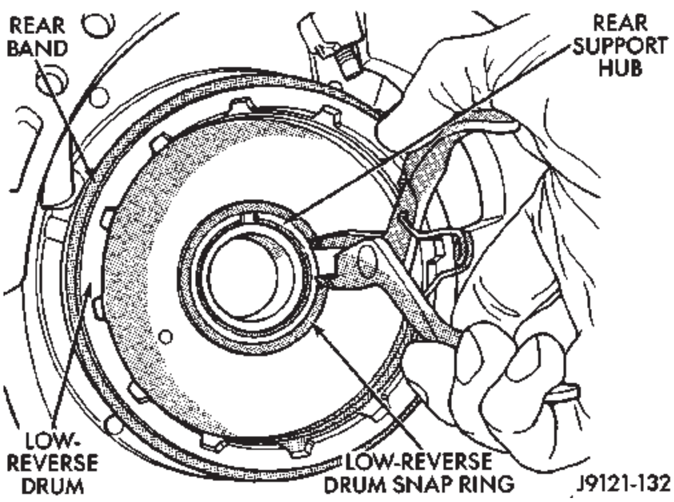


Fig. 81 Low-Reverse Drum Snap Ring

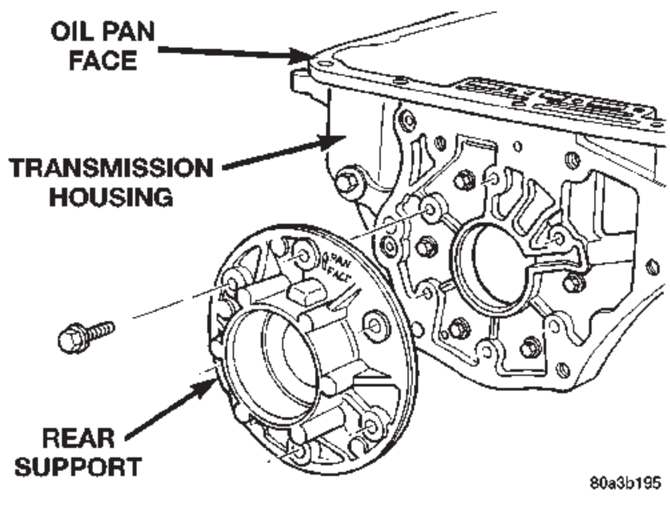


Fig. 82 Rear Support

REAR BAND—32RH.

(30) Remove rear band. The 32RH transmission is equipped with a double-wrap band that does not require a link bar.

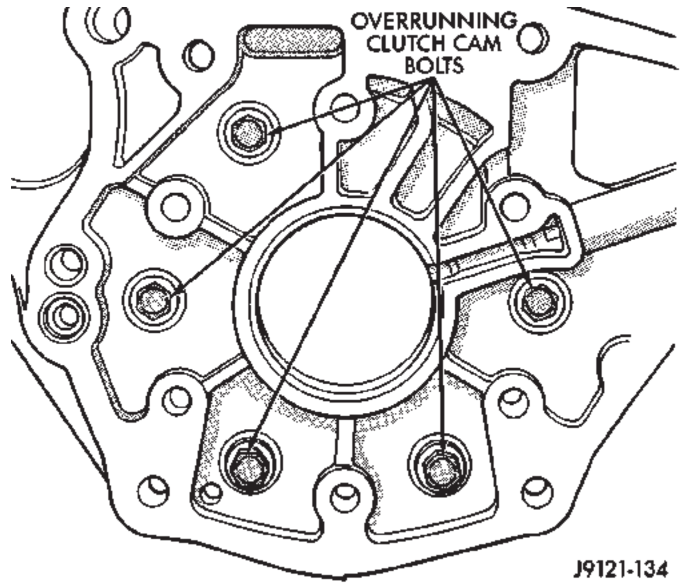


Fig. 83 Overrunning Clutch Cam Bolt Locations

(a) Remove low-reverse drum and overrunning clutch as assembly. Slide drum and clutch through rear band and out of case (Fig. 84). Set drum and clutch assembly aside for cleaning and inspection.

(b) Remove rear band from case (Fig. 84).

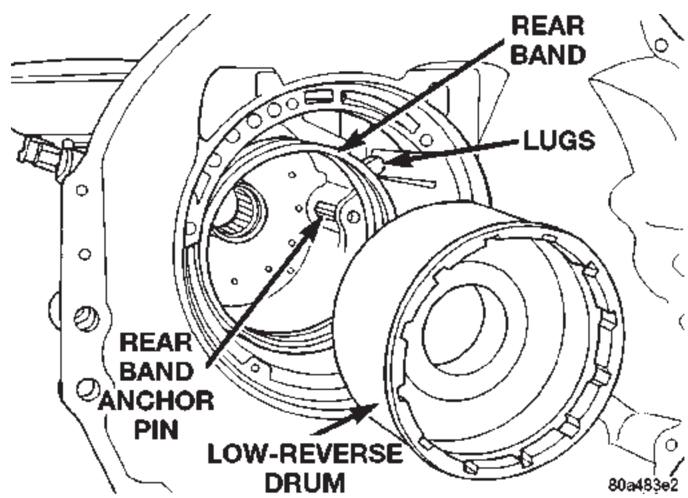


Fig. 84 Low- Reverse Band and Drum—32RH

DISASSEMBLY AND ASSEMBLY (Continued)

REAR BAND—30RH

(31) Remove rear band. The 30RH transmission is equipped with a single-wrap band with a link bar.

(a) Using snap-ring plier, pull rear band anchor pin (located on the servo side of the rear support) from transmission case.

(b) Remove rear band and link from transmission (Fig. 85).

(c) Separate rear band from link (Fig. 86).

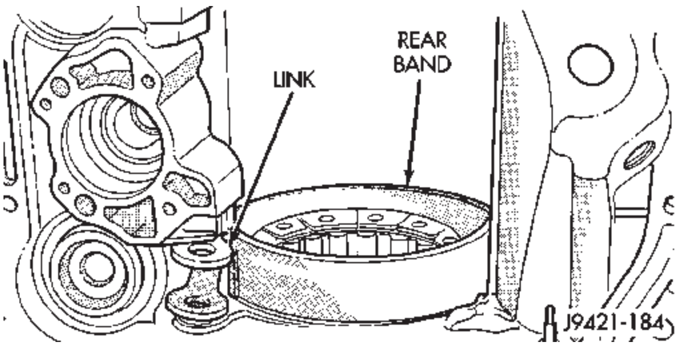


Fig. 85 Rear Band and Link—30RH

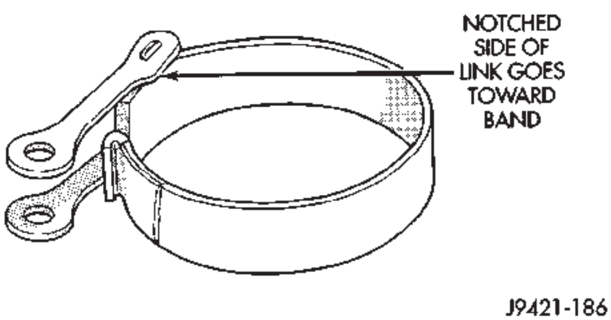


Fig. 86 Rear Band and Link—30RH

(32) If necessary remove front and rear band servo levers. All transmission components can be serviced without removing the levers.

(a) Using a 1/4 inch drive extension remove front band reaction pin access plug (Fig. 87).

(b) Remove front band reaction pin with pencil magnet. Pin is accessible from converter housing side of case (Fig. 88).

(c) Remove front band lever (Fig. 89).

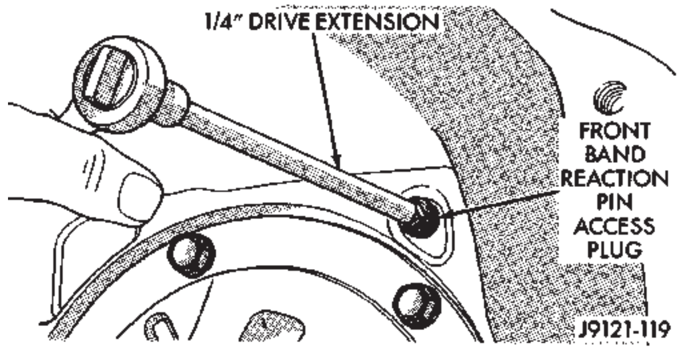


Fig. 87 Front Band Reaction Pin Access Plug

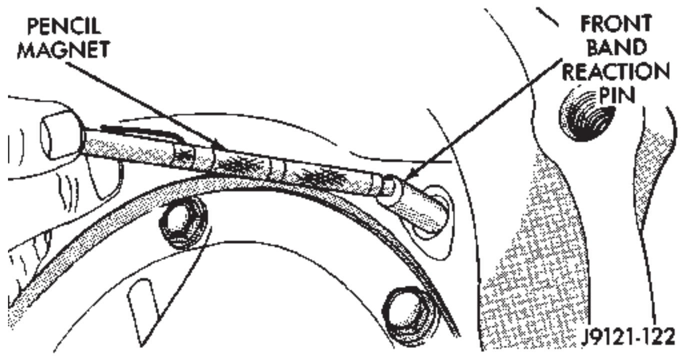


Fig. 88 Front Band Reaction Pin

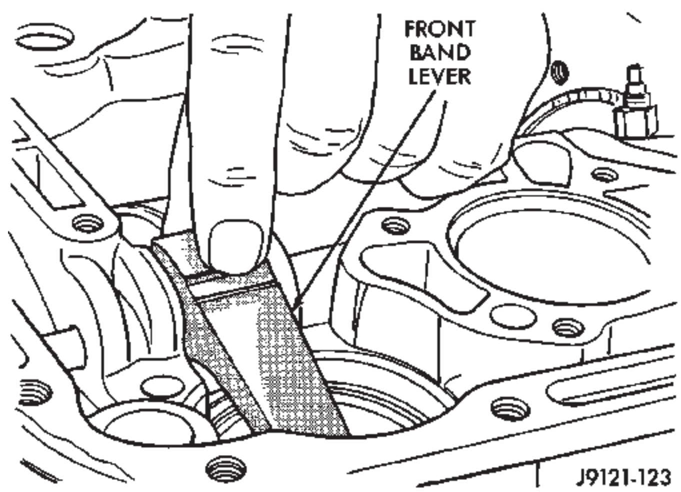


Fig. 89 Front Band Lever

DISASSEMBLY AND ASSEMBLY (Continued)

(d) Using snap-ring plier, pull rear band lever pivot from transmission case (Fig. 90).

(e) Separate rear band servo lever from transmission.

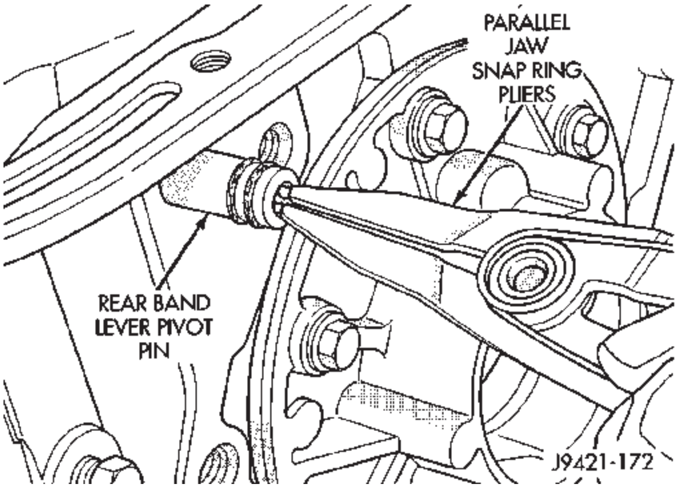


Fig. 90 Rear Band Servo Lever Pin

(33) Compress front servo rod guide about 1/8 in. with large C-clamp and Tool C-4470, or Spring Compressor Tool C-3422-B (Fig. 91).

(34) Remove front servo rod guide snap ring (Fig. 91). **Exercise caution when removing snap ring. Servo bore can be scratched or nicked if care is not exercised.**

(35) Remove compressor tools and remove front servo rod guide, spring and servo piston.

(36) Compress rear servo spring retainer about 1/16 in. with C-clamp and Tool C-4470 or SP-5560 (Fig. 92). Valve Spring Compressor C-3422-B can also be used to compress spring retainer.

(37) Remove rear servo spring retainer snap ring. Then remove compressor tools and remove rear servo spring and piston.

ASSEMBLY

(1) Install rear servo piston, spring and spring retainer. Compress rear servo spring and retainer with Compressor Tool C-3422-B (Fig. 92) or a large C-clamp.

(2) Install front servo piston, spring, and rod guide. Compress front servo rod guide with Valve Spring Compressor C-3422-B and install servo snap ring (Fig. 91).

REAR BAND—32RH

(3) Install rear band

(a) Insert rear band through pan opening in transmission case. Single lug toward pan face.

(b) Place single lug under adjuster screw and two lugs over anchor pin in transmission case (Fig. 84).

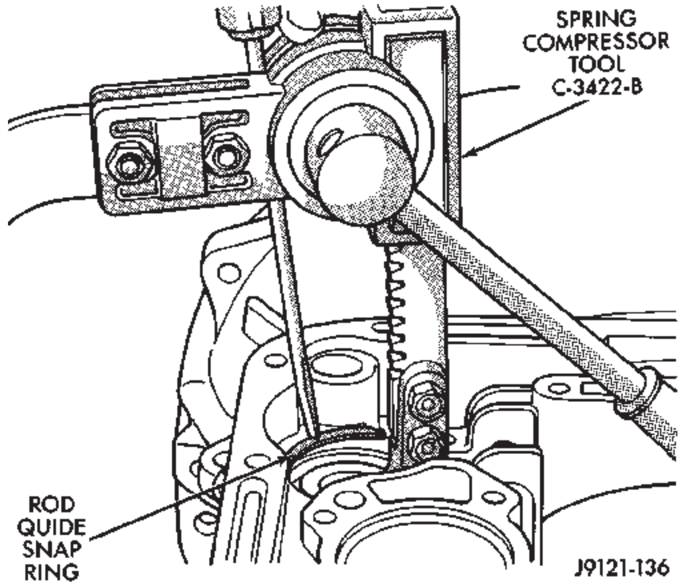


Fig. 91 Compressing Front Servo

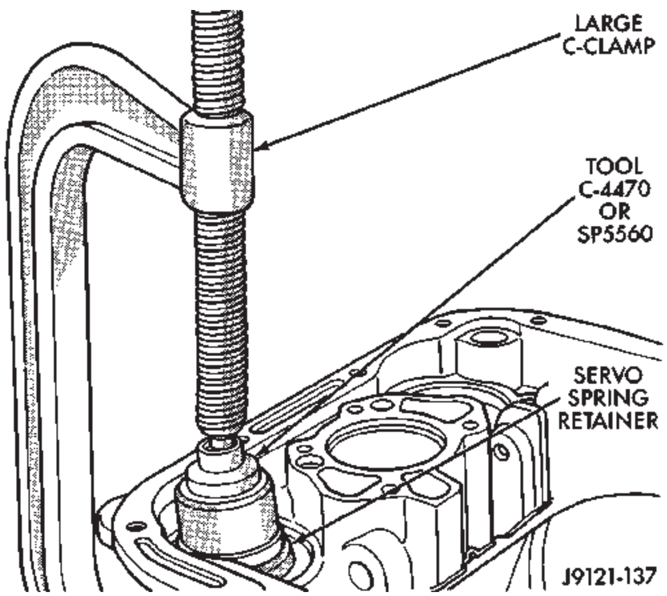


Fig. 92 Compressing Rear Servo Spring

REAR BAND—30RH

(4) Install rear band.

(a) Assemble link bar to band. Notched side of link toward band (Fig. 90).

(b) Insert rear band through pan opening in transmission case.

(c) Insert hook on band onto adjuster lever.

(d) Align holes in link bar with hole in transmission case outboard of rear support opening (Fig. 89).

(e) Insert anchor pin into case through link bar.

(5) Examine bolt holes in overrunning clutch cam. Note that one hole is **not threaded** (Fig. 93). This hole must align with blank area in clutch cam bolt circle.

DISASSEMBLY AND ASSEMBLY (Continued)

NOTE: The bolt holes in cam are slightly countersunk on one side. This side of cam faces rearward (toward rear support).

(6) Lubricate overrunning clutch rollers, springs and cam with Mopar® ATF Plus 3, type 7176, transmission fluid.

(7) Position overrunning clutch on a clean, flat work surface with countersunk holes downward.

(8) Place rear of low-reverse drum over overrunning clutch and align clutch rollers to hub of drum.

(9) While slightly pivoting low-reverse drum, push hub of drum into overrunning clutch. Verify that countersunk holes are facing outward. **Cam should be able to rotate in the drum clockwise only.**

(10) Insert a suitable awl through the rear support mounting hole closest to the pan sealing face. The awl should be next to the wide space area at the back of transmission case.

(11) Insert low-reverse drum and overrunning clutch into front of transmission case and into rear band.

(12) Insert awl tip into the threaded hole next to the non-threaded hole in the overrunning clutch cam. Verify that non-threaded hole is aligned with wide space area on transmission case.

(13) Push low-reverse drum rearward to close gap between cam and case.

(14) Install overrunning clutch cam bolts. **Clutch cam bolts are shorter than rear support bolts.** Tighten cam bolts to 17 N·m (150 in. lbs. or 13 ft. lbs.) torque.

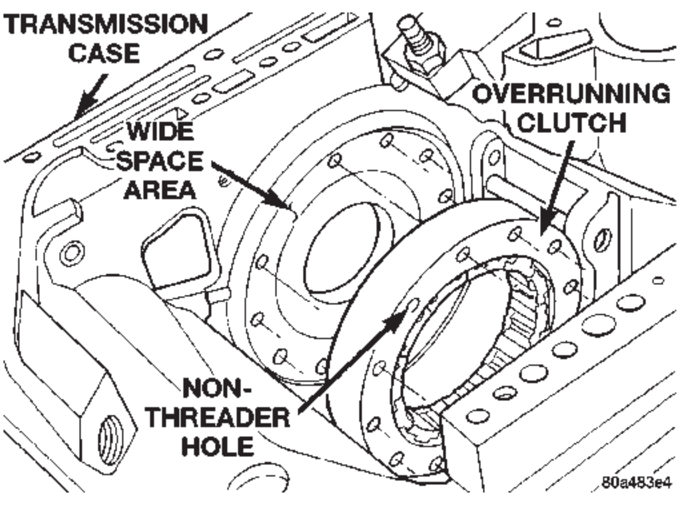


Fig. 93 Clutch Cam Alignment

(15) Hold low-reverse drum in position so rear support will not push it out of overrunning clutch.

(16) Insert rear support into opening at rear of transmission case (Fig. 94).

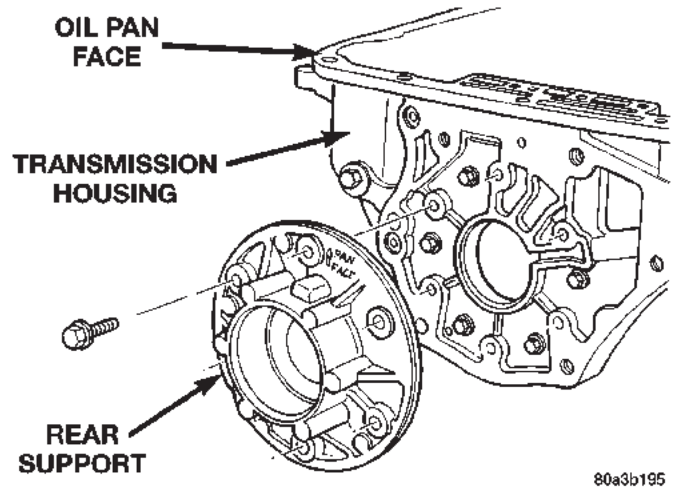


Fig. 94 Rear Support

(17) Align support with the embossed arrow in the direction of the pan face.

(18) Install and tighten rear support bolts to 17 N·m (150 in. lbs.) torque.

(19) Install snap ring to retain low-reverse drum to hub of rear support (Fig. 95).

(20) Lubricate output shaft, rear support bore and low-reverse drum hub with transmission fluid.

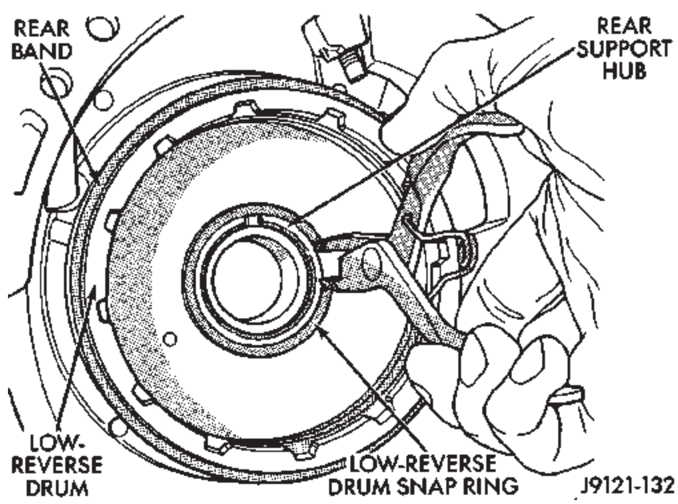


Fig. 95 Low-Reverse Drum Snap Ring

DISASSEMBLY AND ASSEMBLY (Continued)

(21) Install assembled output shaft and planetary geartrain in case (Fig. 96).

(22) Align drive lugs on rear planetary gear with slots in low-reverse drum (Fig. 96). Then seat planetary assembly in drum.

(23) Install governor on output shaft.

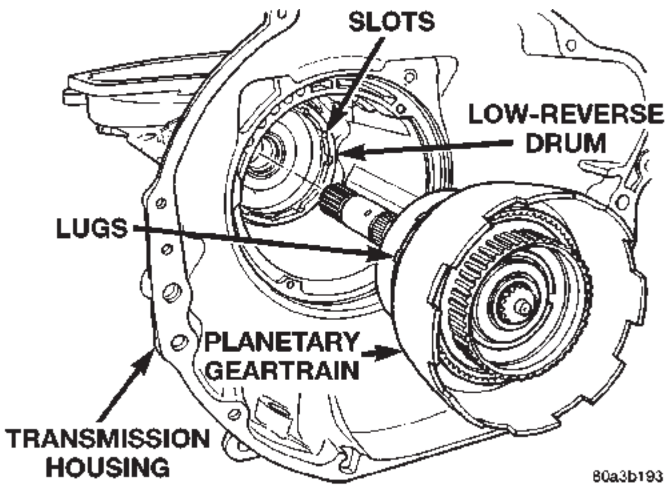


Fig. 96 Output Shaft And Planetary Geartrain

(24) Turn and secure transmission so that front opening is upward.

(25) Assemble front and rear clutches together.

(a) Check input shaft seal rings (Fig. 97). Verify that diagonal-cut ends of Teflon™ seal ring are properly joined and ends of metal ring are correctly hooked together. Also be sure rings are installed in sequence shown.

(b) Align teeth on clutch discs in line.

(c) Insert input shaft on rear clutch into center of front clutch (Fig. 98).

(d) Engage teeth on rear clutch hub into teeth on clutch (Fig. 100). Rotate front clutch retainer back and forth until completely seated on rear clutch.

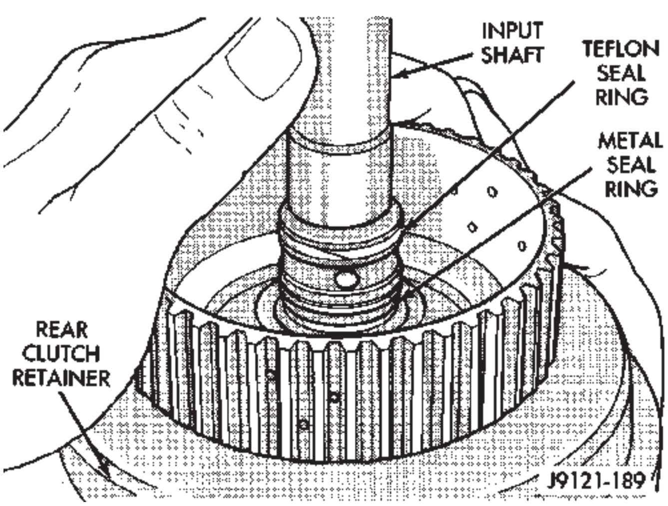


Fig. 97 Input Shaft Seal Ring Location

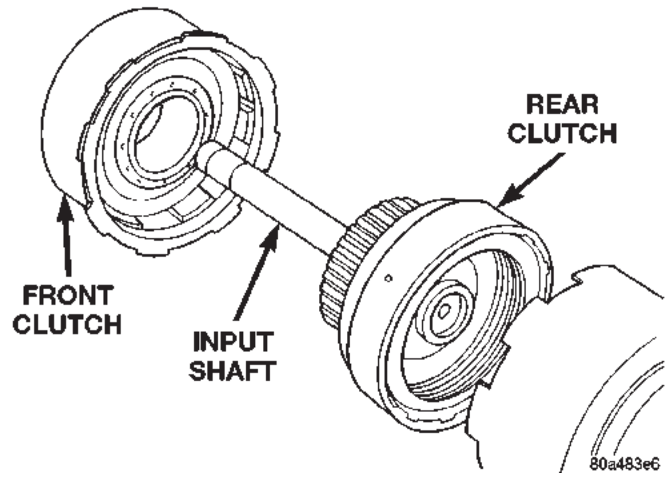


Fig. 98 Front and Rear Clutches

(26) Install output shaft thrust plate on shaft hub in planetary geartrain driving shell (Fig. 99). Use petroleum jelly to hold thrust plate in place.

(27) Check rear clutch thrust washer. Use additional petroleum jelly to hold washer in place if necessary.

(28) Coat output shaft thrust washer with petroleum jelly. Install washer in rear clutch hub (Fig. 101). 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.**

(29) Align drive teeth on rear clutch discs with small screwdriver (Fig. 102). This will make installation into front of planetary geartrain easier.

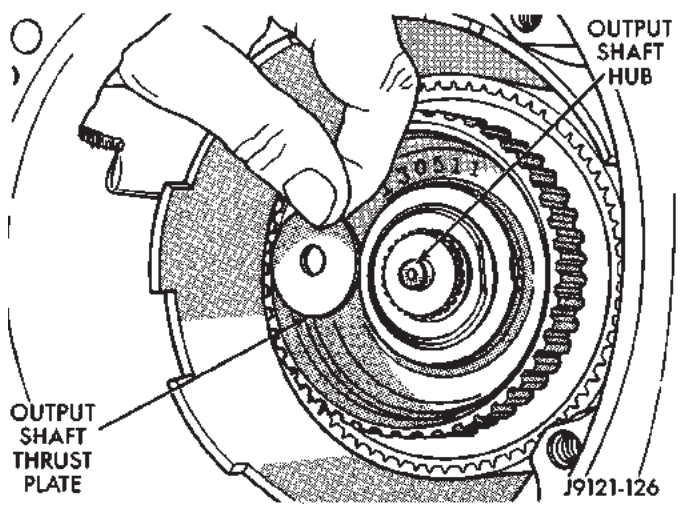


Fig. 99 Output Shaft Thrust Plate

DISASSEMBLY AND ASSEMBLY (Continued)

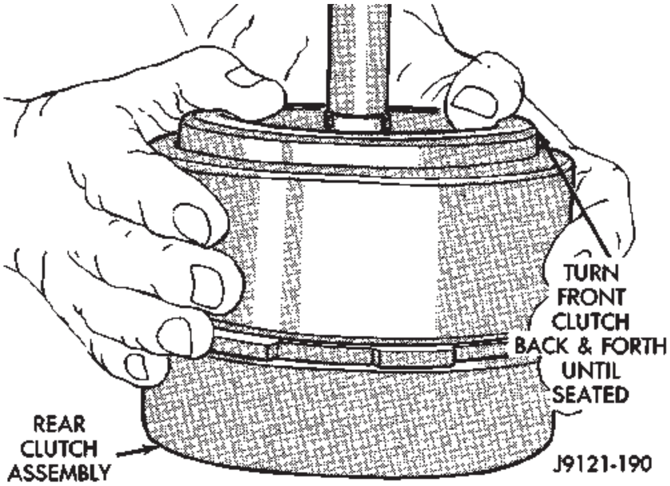


Fig. 100 Assembling Front And Rear Clutch Units

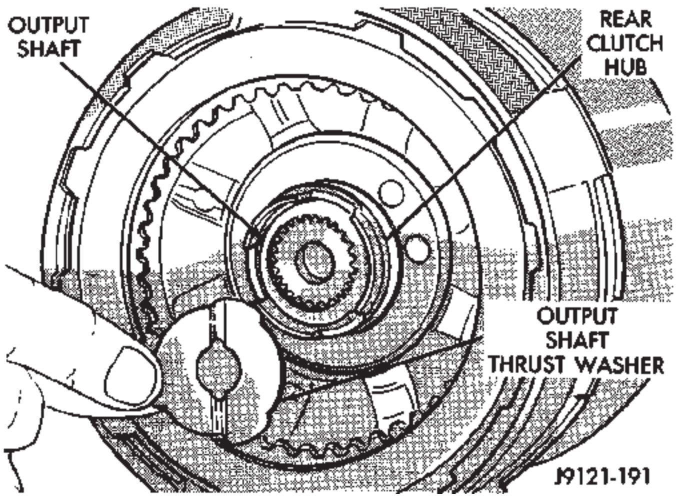


Fig. 101 Output Shaft Thrust Washer

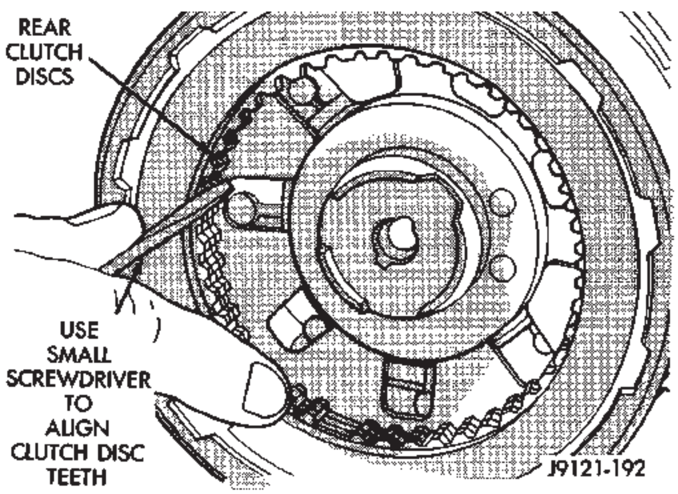


Fig. 102 Aligning Rear Clutch Disc Lugs

(30) Insert front band into opening at front of transmission case (Fig. 103).

(31) Install front and rear clutch units as assembly (Fig. 104). 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.**

(32) Carefully work assembled clutches back and forth to engage and seat rear clutch discs on front annulus gear. Verify that front clutch drive lugs are fully engaged in slots of driving shell after installation.

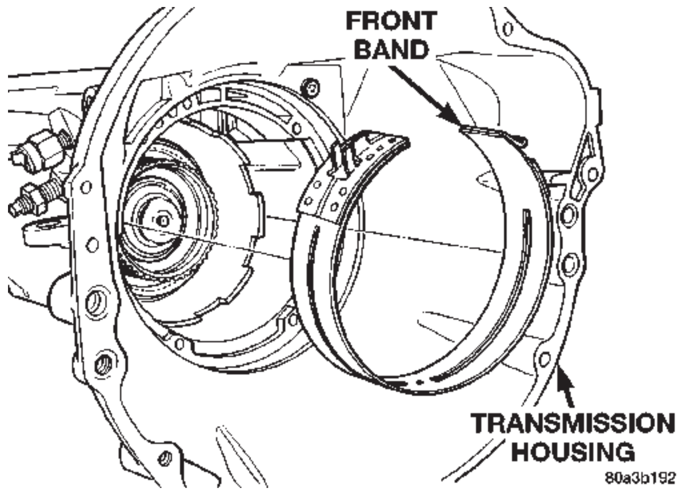


Fig. 103 Front Band

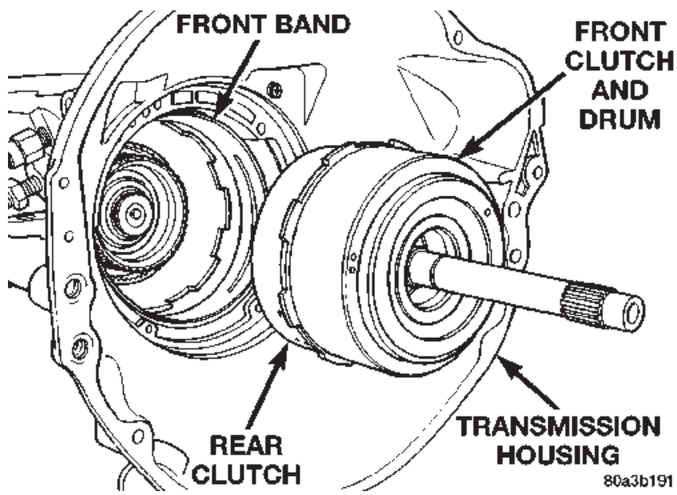


Fig. 104 Installing Front/Rear Clutch

DISASSEMBLY AND ASSEMBLY (Continued)

(33) Engage front band on adjusting screw and hold band in place.

(34) Install strut between band lever and front band (Fig. 105).

(35) Tighten front band adjusting screw until band just grips clutch retainer. Verify that front/rear clutches are still seated before continuing.

(36) Verify that reaction shaft support hub seal rings are hooked together (Fig. 106).

(37) Coat front clutch thrust washer with petroleum jelly to hold it in place. Then install washer over reaction shaft hub and seat it on pump (Fig. 107).

CAUTION: The thrust washer bore (I.D.), is chamfered on one side. Make sure the chamfered side is installed so it faces the pump.

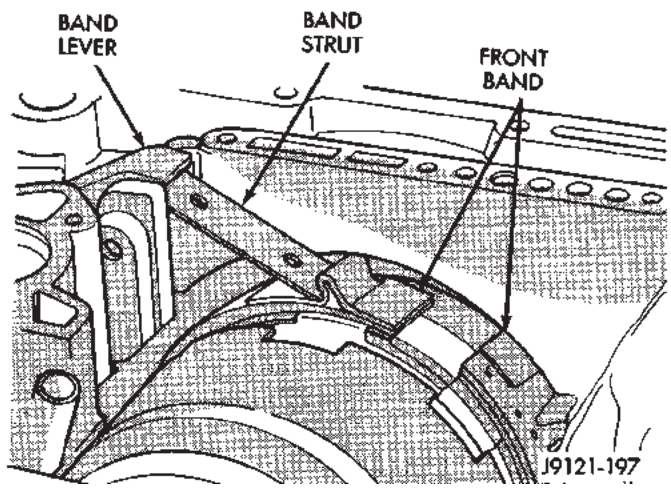


Fig. 105 Front Band Linkage Installation

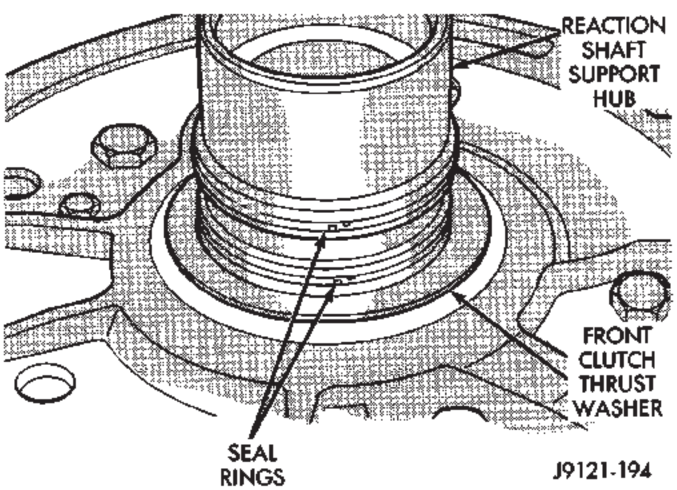


Fig. 106 Reaction Shaft Support Seal Rings

(38) Thread two Pilot Stud Tools C-3288-B into bolt holes in oil pump flange (Fig. 108).

(39) Align and install oil pump gasket (Fig. 108).

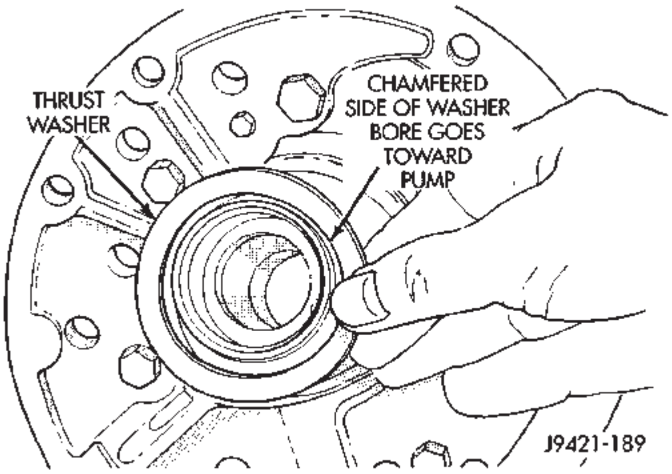


Fig. 107 Front Clutch Thrust Washer Installation

(40) Lubricate oil pump seals with Mopar® Door-Ease, or Ru-Glyde, Door Eze, or ATF Plus 3.

(41) Install oil pump (Fig. 109). Align and position pump on pilot studs. Slide pump down studs and work it into front clutch hub and case by hand. Then install two or three pump bolts to hold pump in place.

(42) Remove pilot stud tools and install remaining oil pump bolts. Tighten bolts alternately in diagonal pattern to 20 N·m (15 ft. lbs.).

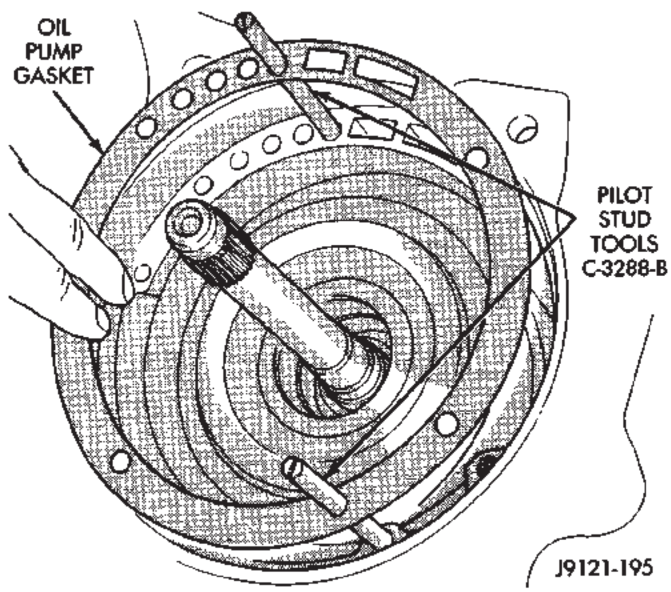


Fig. 108 Installing Pilot Studs And Oil Pump Gasket

(43) Measure input shaft end play (Fig. 110).

NOTE: If end play is incorrect, transmission is incorrectly assembled, or output shaft thrust washer and/or thrust plate are worn and need to be changed.

DISASSEMBLY AND ASSEMBLY (Continued)

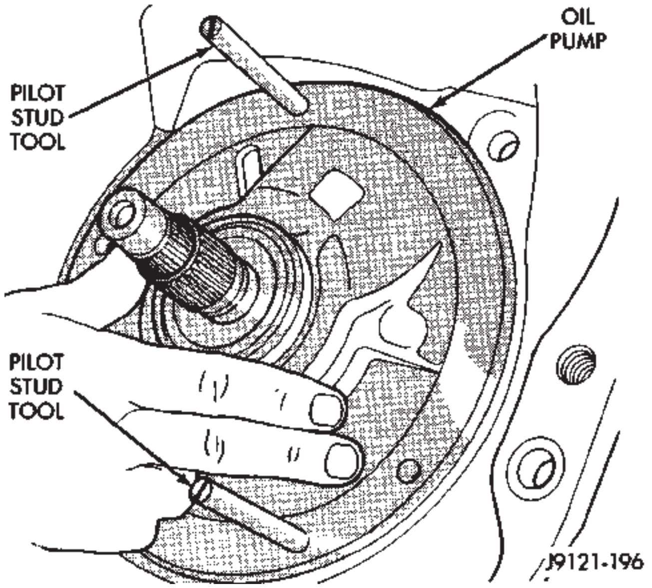


Fig. 109 Installing Oil Pump And Reaction Shaft Support

(a) Attach dial indicator (C-3339) to converter housing. Position indicator plunger against input shaft and zero indicator.

(b) Move input shaft in and out and record reading. End play should be 0.56 - 2.31 mm (0.022 - 0.091 in.).

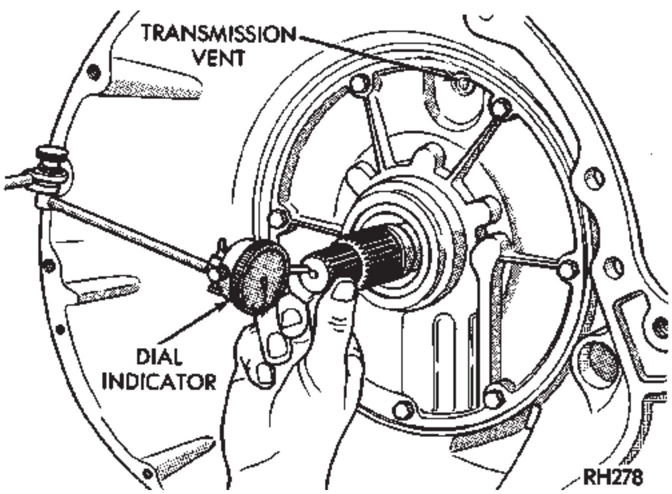


Fig. 110 Checking Input Shaft End Play

(44) Position transmission on work surface with pan face upward.

(45) Install valve body.

(46) Adjust front and rear bands.

(47) Install fluid filter and pan.

(48) Install rear extension housing.

(49) Install torque converter.

OVERRUNNING CLUTCH/LOW-REVERSE DRUM

DISASSEMBLY

(1) If the clutch assembly came out with the low-reverse drum, thread two clutch cam bolts into the cam. Then lift the cam out of the drum with the bolts (Fig. 111). Rotate the cam back and forth to ease removal if necessary.

(2) Remove the clutch roller and spring assembly from the overrunning clutch race.

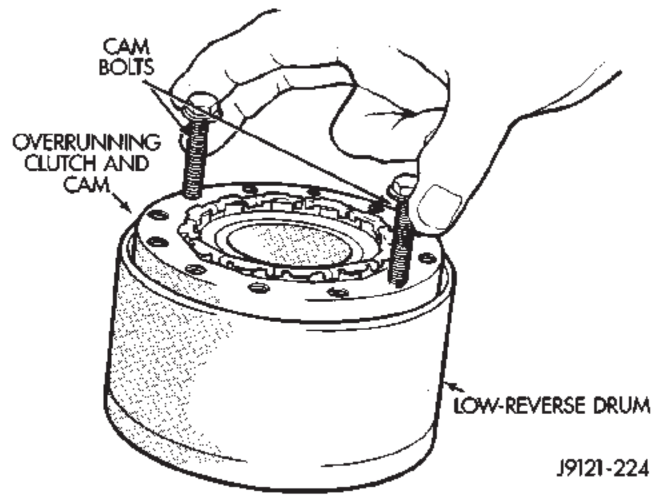


Fig. 111 Removing Overrunning Clutch From Low-Reverse Drum

DISASSEMBLY AND ASSEMBLY (Continued)

ASSEMBLY

(1) Assemble clutch rollers and springs in retainer if necessary (Fig. 112).

(2) Install overrunning clutch roller, spring and retainer assembly in clutch cam (Fig. 113).

(3) Temporarily assemble and check overrunning clutch operation as follows:

(a) Assemble cam and clutch.

(b) Install clutch assembly on low-reverse drum with twisting motion (Fig. 114).

(c) Install drum-clutch assembly in case and install clutch cam bolts.

(d) Install rear support and support attaching bolts.

(e) Check low-reverse drum rotation. **Drum should rotate freely in clockwise direction and lock when turned in counterclockwise direction (as viewed from front of case).**

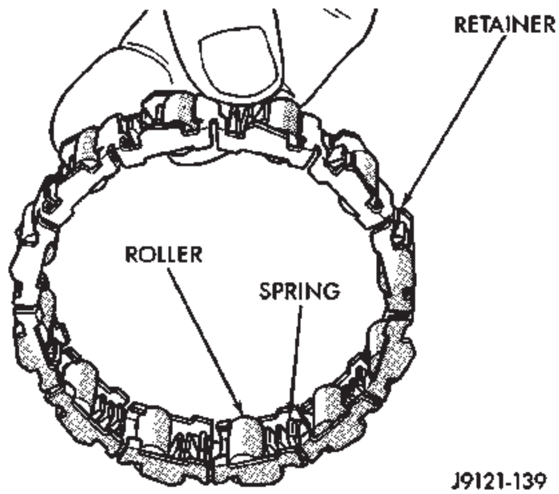


Fig. 112 Overrunning Clutch Rollers, Springs, Retainer

FRONT SERVO PISTON

DISASSEMBLY

(1) Remove seal ring from rod guide (Fig. 116).

(2) Remove small snap ring from servo piston rod. Then remove piston rod, spring and washer from piston.

(3) Remove and discard servo component O-ring and seal rings.

ASSEMBLY

(1) Lubricate new O-ring and seal rings with petroleum jelly and install them on piston, guide and rod.

(2) Install rod in piston. Install spring and washer on rod. Compress spring and install snap ring (Fig. 116).

(3) Set servo components aside for installation during transmission reassembly.

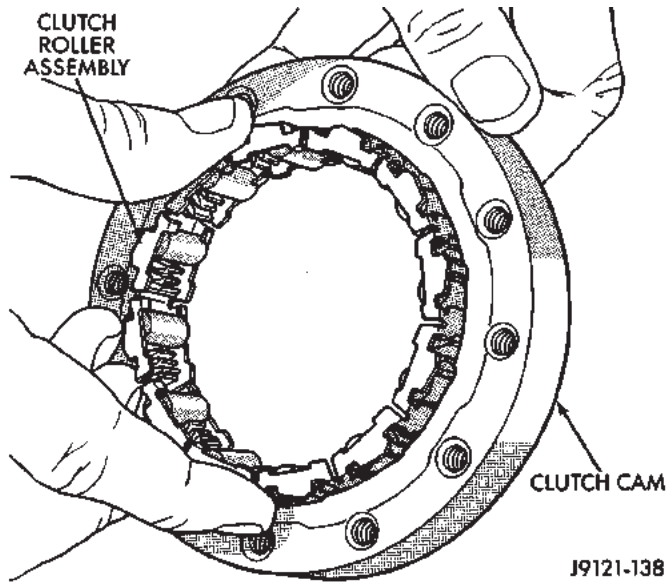


Fig. 113 Assembling Overrunning Clutch And Cam

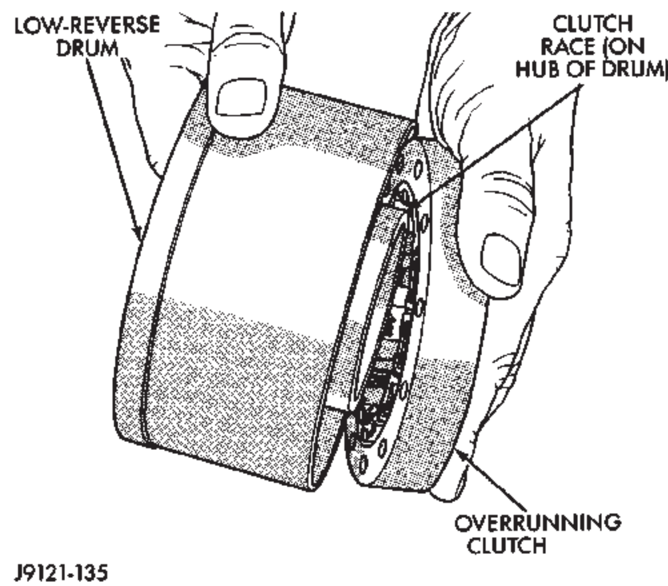


Fig. 114 Temporary Assembly Of Clutch And Drum To Check Operation

REAR SERVO PISTON

DISASSEMBLY

(1) Remove small snap ring and remove plug and spring from servo piston (Fig. 117).

(2) Remove and discard servo piston seal ring.

ASSEMBLY

(1) Lubricate piston and guide seals with petroleum jelly. Lubricate other servo parts with Mopar® ATF Plus 3, Type 7176, transmission fluid.

(2) Install new seal ring on servo piston.

(3) Assemble piston, plug, spring and new snap ring.

(4) Lubricate piston seal lip with petroleum jelly.

DISASSEMBLY AND ASSEMBLY (Continued)

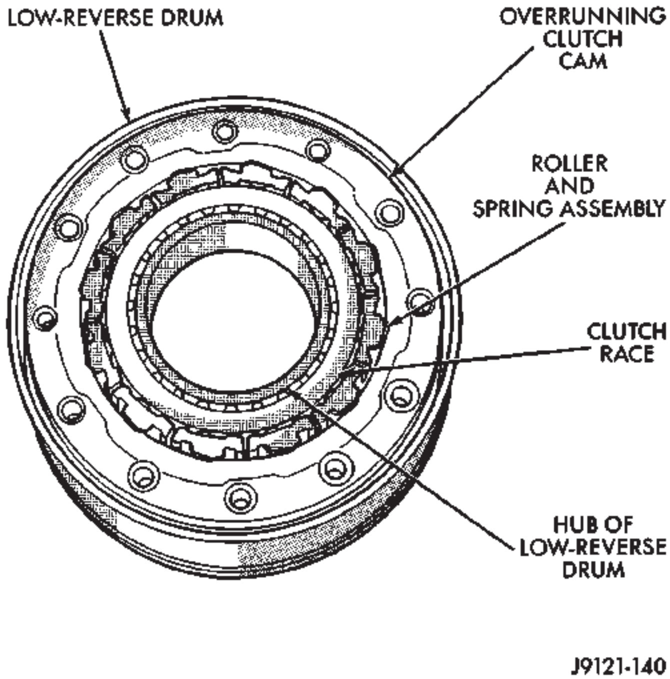


Fig. 115 Assembled Overrunning Clutch

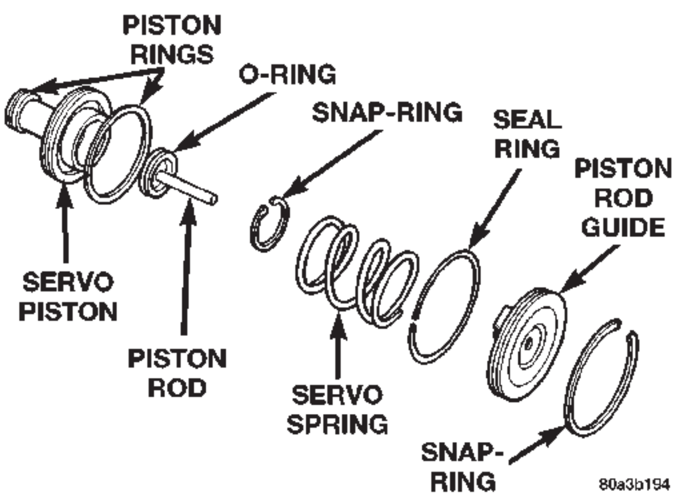


Fig. 116 Front Servo

(5) Set servo components aside for assembly installation.

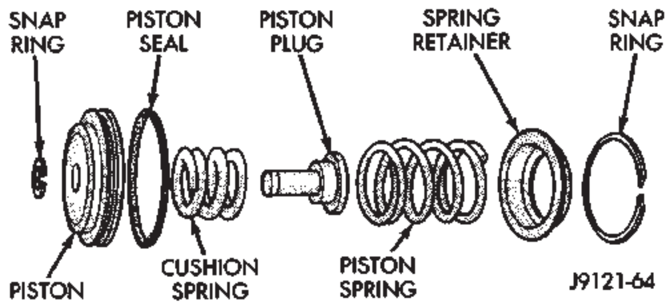


Fig. 117 Rear Servo Components

OIL PUMP AND REACTION SHAFT SUPPORT

DISASSEMBLY

(1) Remove seal ring from housing and reaction shaft support (Fig. 118).

(2) Mark pump housing and support assembly for alignment reference.

(3) Remove bolts attaching pump body to support (Fig. 119).

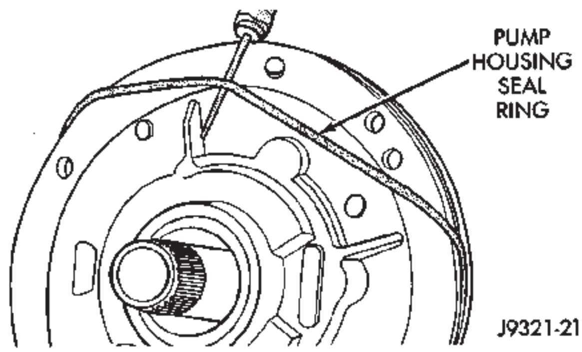


Fig. 118 Removing Pump Seal Ring

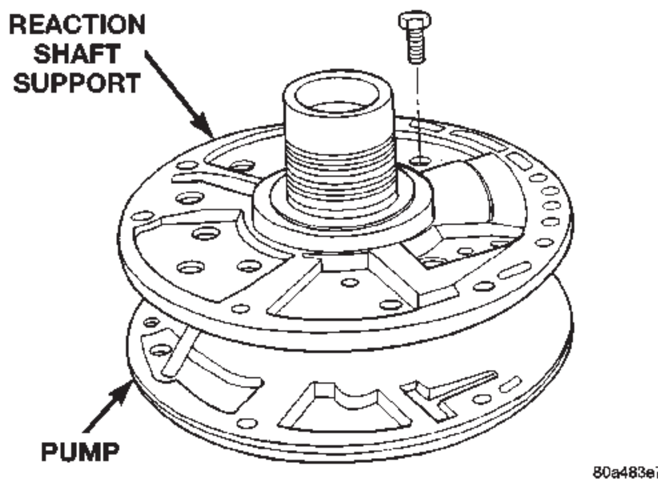


Fig. 119 Pump Support Bolts

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Separate support from pump housing (Fig. 120).

(5) Remove inner and outer gears from reaction shaft support (Fig. 121).

(6) If pump seal was not removed during transmission disassembly, remove seal with punch and hammer.

(7) Remove front clutch thrust washer from support hub (Fig. 122).

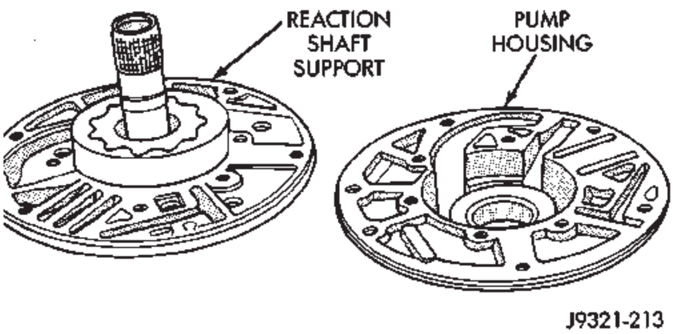


Fig. 120 Separating Pump Housing From Reaction Shaft Support

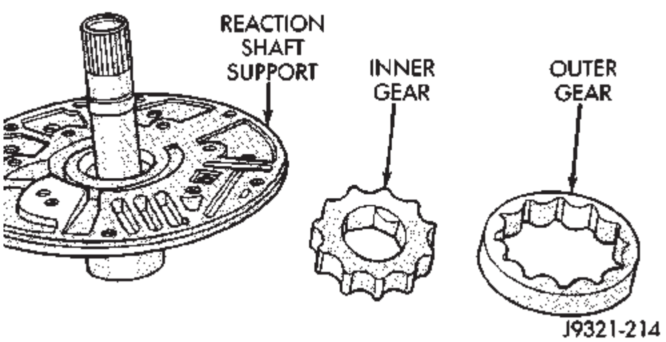


Fig. 121 Pump Gear Removal

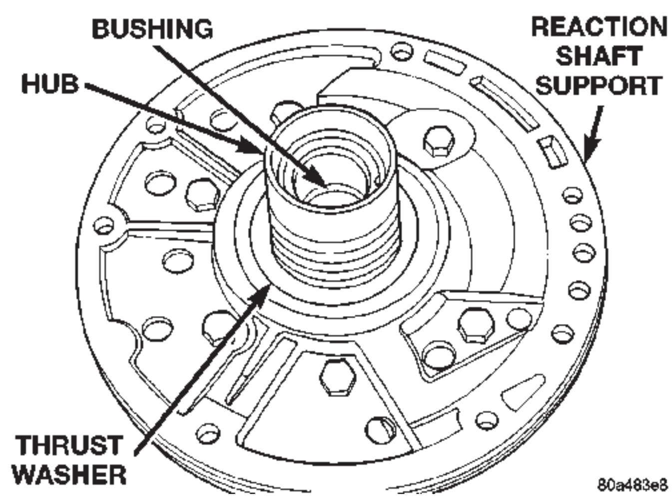


Fig. 122 Support Hub Thrust Washer

OIL PUMP BUSHING REPLACEMENT

(1) Remove pump bushing with Tool Handle C-4171 and Bushing Remover SP-3551 from Tool Set C-3887-J (Fig. 123).

(2) Install new pump bushing with Tool Handle C-4171 and Bushing Installer SP-5117 (Fig. 123). Bushing should be flush with pump housing bore.

(3) Stake new pump bushing in two places with blunt punch (Fig. 124). Remove burrs from stake points with knife blade afterward.

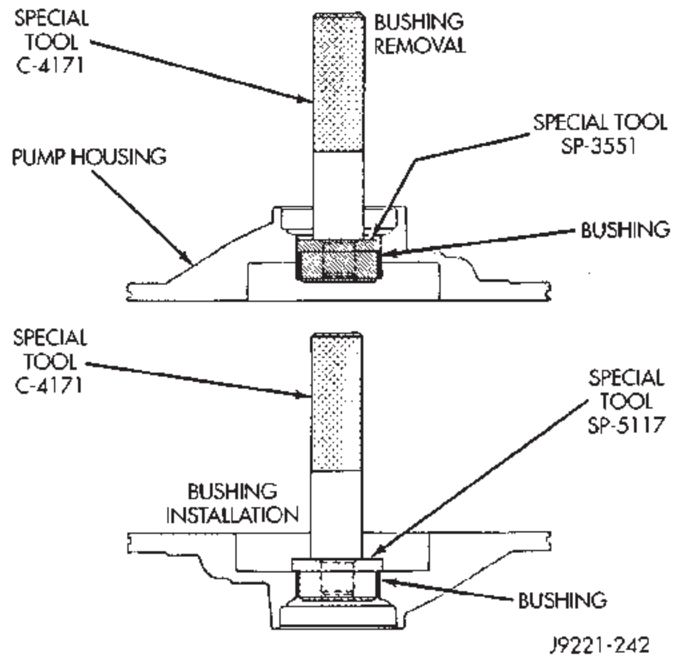


Fig. 123 Removing Oil Pump Bushing

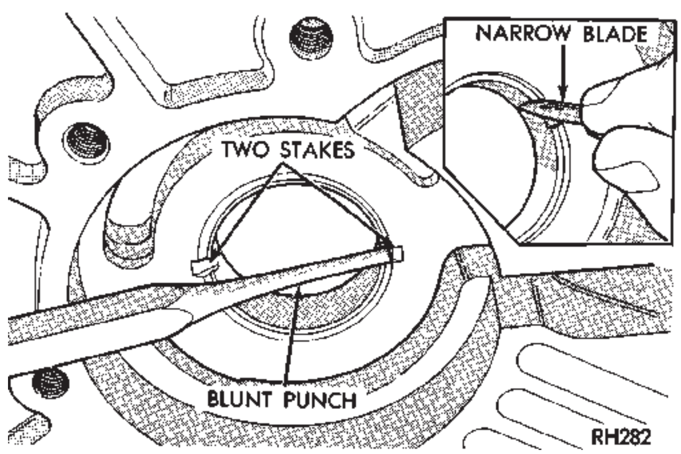


Fig. 124 Staking Oil Pump Bushing

REACTION SHAFT SUPPORT BUSHING REMOVAL

(1) Assemble Bushing Remover Tools SP-1191, 3633 and 5324 (Fig. 125). **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

DISASSEMBLY AND ASSEMBLY (Continued)

far as possible by hand. Then thread remover tool 3-4 additional turns into bushing with a wrench.

(3) Turn remover tool hex nut down against remover cup to pull bushing from shaft. Clean all chips from shaft after bushing removal.

(4) Lightly grip old bushing in vise or with pliers and back remover tool out of bushing.

(5) Assemble Bushing Installer Tools C-4171 and SP-5325 (Fig. 125).

(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.

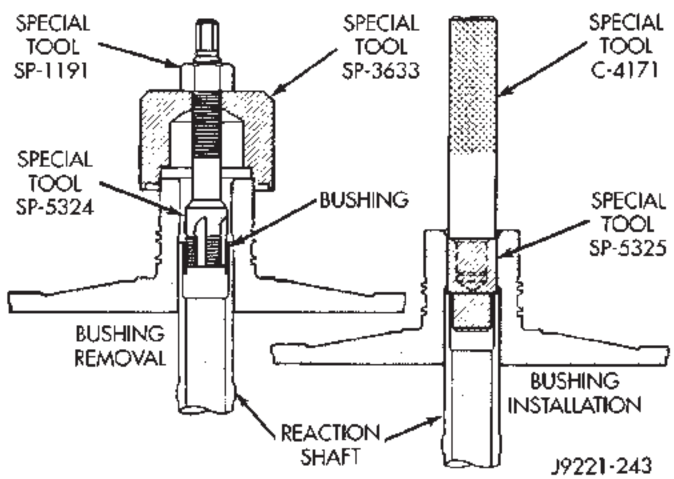


Fig. 125 Replacing Reaction Shaft Support Bushing

ASSEMBLY

(1) Lubricate gear bore in pump housing with transmission fluid.

(2) Lubricate pump gears with transmission fluid.

(3) Support pump housing on wood blocks (Fig. 126).

(4) Install outer gear in pump housing (Fig. 126). Gear can be installed either way (it is not a one-way fit).

(5) Install pump inner gear (Fig. 127).

CAUTION: The pump inner gear is a one way fit. The bore on one side of the gear inside diameter (I.D.) is chamfered. Be sure the chamfered side faces forward (to front of pump).

(6) Install new thrust washer on hub of reaction shaft support. Lubricate washer with transmission fluid or petroleum jelly.

(7) If reaction shaft seal rings are being replaced, install new seal rings on support hub (Fig. 128). Lubricate seal rings with transmission fluid or petroleum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

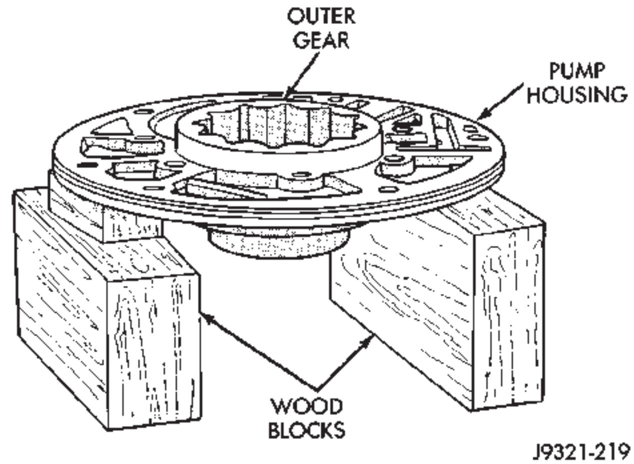


Fig. 126 Supporting Pump And Installing Outer Gear

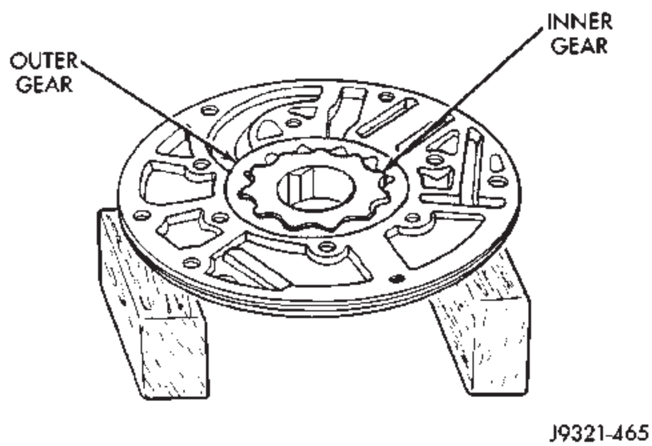


Fig. 127 Pump Inner Gear Installation

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.

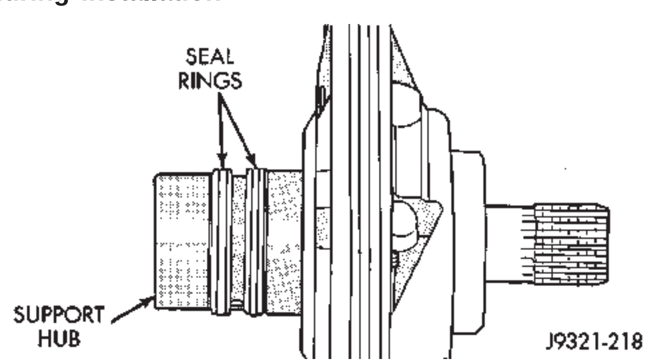


Fig. 128 Hub Seal Ring Position

DISASSEMBLY AND ASSEMBLY (Continued)

(8) Install reaction shaft support on pump housing (Fig. 129).

(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).

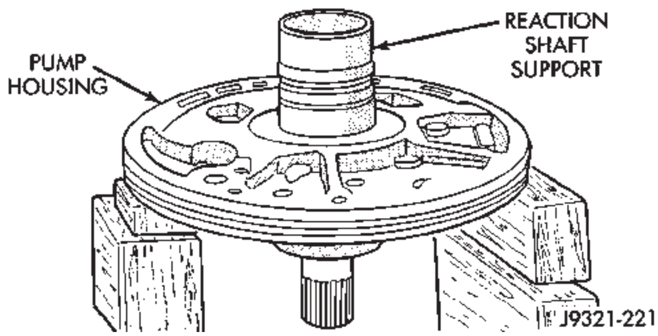


Fig. 129 Assembling Reaction Shaft Support And Pump Housing

(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. 130). Be sure seal lip faces inward.

(13) Install new seal ring around pump housing. Be sure seal is properly seated in groove.

(14) Lubricate lip of pump oil seal and O-ring seal with transmission fluid.

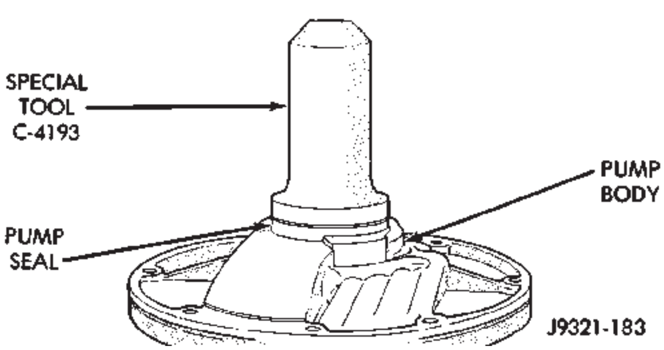


Fig. 130 Pump Oil Seal Installation

FRONT CLUTCH

DISASSEMBLY

(1) Remove waved snap ring and remove pressure plate, clutch plates and clutch discs (Fig. 131).

(2) Compress clutch piston spring with Compressor Tool C-3575-A (Fig. 132). Be sure legs of tool are seated squarely on spring retainer before compressing spring.

(3) Remove retainer snap ring and remove compressor tool.

(4) Remove spring retainer and clutch spring. Note position of retainer on spring for assembly reference.

(5) Remove clutch piston from clutch retainer. Remove piston by rotating it up and out of retainer.

(6) Remove seals from clutch piston and clutch retainer hub. Discard both seals as they are not reusable.

ASSEMBLY

(1) Soak clutch discs in transmission fluid while assembling other clutch parts.

(2) Install new seals on piston and in hub of retainer. Be sure lip of each seal faces interior of clutch retainer.

(3) Lubricate lips of piston and retainer seals with liberal quantity of Mopar® Door Ease, or Ru-Glyde. Then lubricate retainer hub, bore and piston with light coat of transmission fluid.

(4) Install clutch piston in retainer (Fig. 133). Use twisting motion to seat piston in bottom of retainer. A thin strip of plastic (about 0.020″ thick), can be used to guide seals into place if necessary.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip. In addition, never use any type of metal tool to help ease the piston seals into place. Metal tools will cut, shave, or score the seals.

DISASSEMBLY AND ASSEMBLY (Continued)

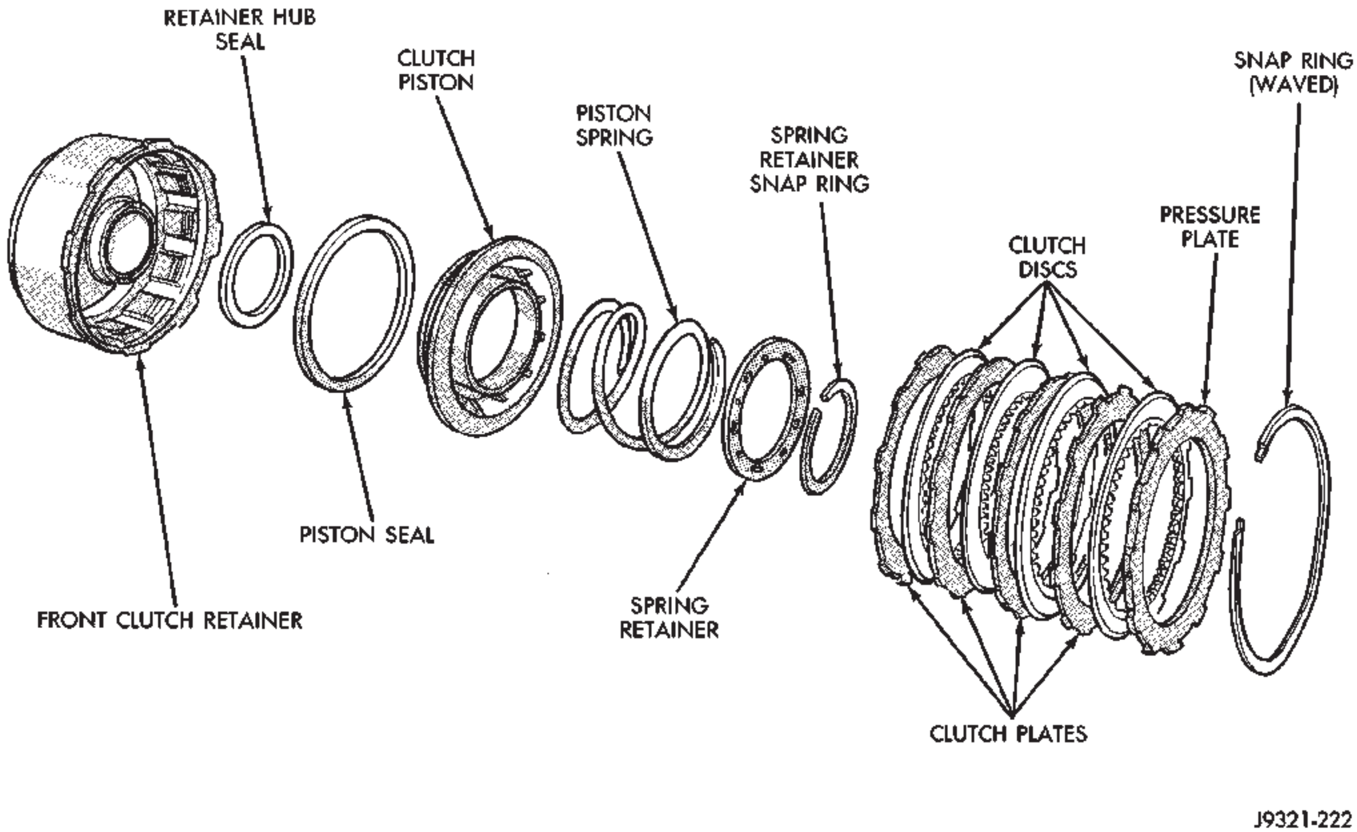


Fig. 131 Front Clutch Components

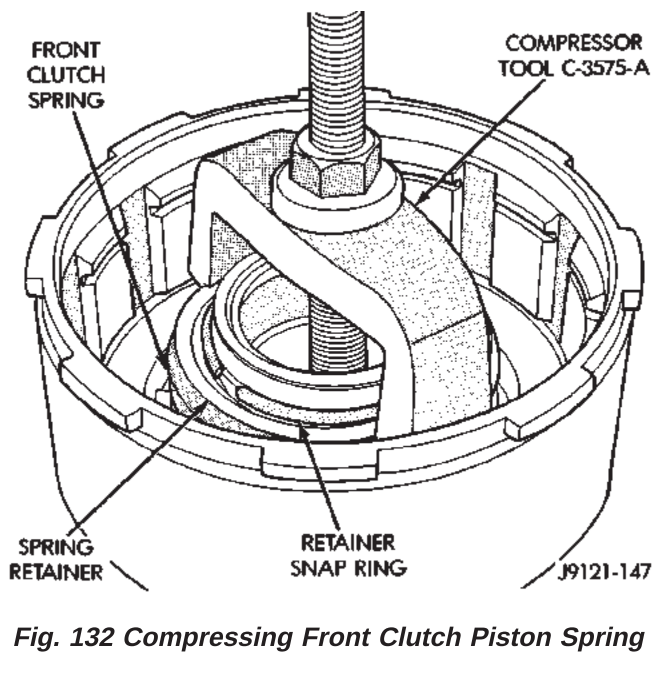


Fig. 132 Compressing Front Clutch Piston Spring

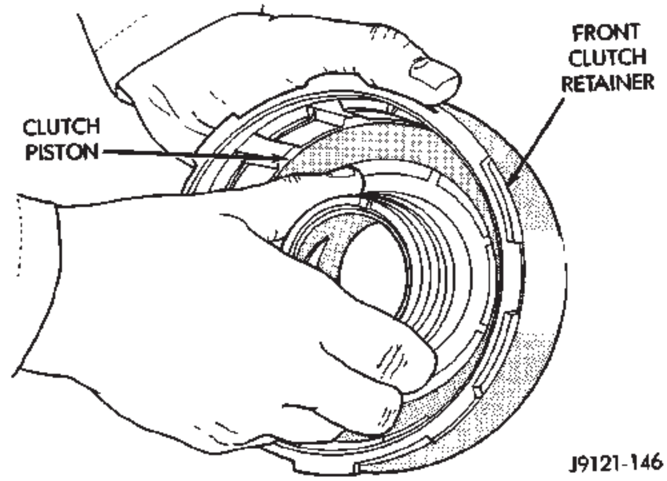


Fig. 133 Front Clutch Piston Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Position spring in clutch piston (Fig. 134).

(6) Position spring retainer on top of piston spring (Fig. 135). **Make sure retainer is properly installed. Small raised tabs should be facing upward. Semicircular lugs on underside of retainer are for positioning retainer in spring.**

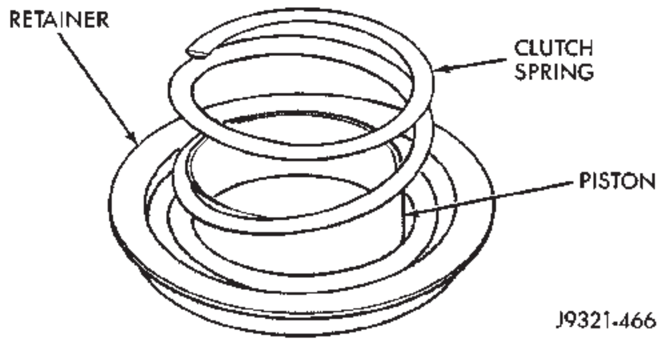


Fig. 134 Clutch Piston Spring Installation

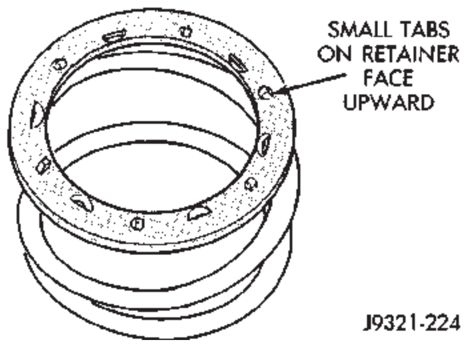


Fig. 135 Correct Spring Retainer Installed Position

(7) Compress piston spring and retainer with Compressor Tool C-3575-A (Fig. 132). Then install new snap ring to secure spring retainer and spring.

(8) Install clutch plates and discs (Fig. 131). Install steel plate then disc until all plates and discs are installed. The front clutch uses 4 clutch discs.

(9) Install pressure plate and waved snap ring (Fig. 131).

(10) Using a suitable gauge bar and dial indicator, measure clutch plate clearance (Fig. 136).

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 136).

(b) Using two small screw drivers, lift the pressure plate and compress the waved snap-ring. This will assure that the snap-ring is at the top of the groove.

(c) Release the pressure plate and zero the dial indicator.

(d) Lift the pressure plate until it contacts the waved snap-ring and record the dial indicator reading.

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.

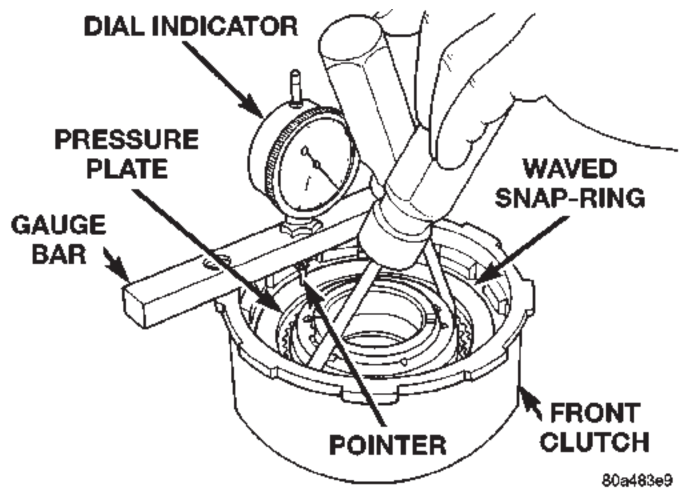


Fig. 136 Measuring Front Clutch Pack Clearance

REAR CLUTCH

DISASSEMBLY

(1) Remove thrust washer from forward side of clutch retainer.

(2) Remove input shaft front/rear seal rings.

(3) Remove selective clutch pack snap ring (Fig. 137).

(4) Remove top pressure plate, clutch discs, steel plates, bottom pressure plate and wave snap ring and wave spring (Fig. 137).

(5) Remove clutch piston with rotating motion.

(6) Remove and discard piston seals.

(7) Remove input shaft snap-ring (Fig. 138). It may be necessary to press the input shaft in slightly to relieve tension on the snap-ring

(8) Press input shaft out of retainer with shop press and suitable size press tool. Use a suitably sized press tool to support the retainer as close to the input shaft as possible.

DISASSEMBLY AND ASSEMBLY (Continued)

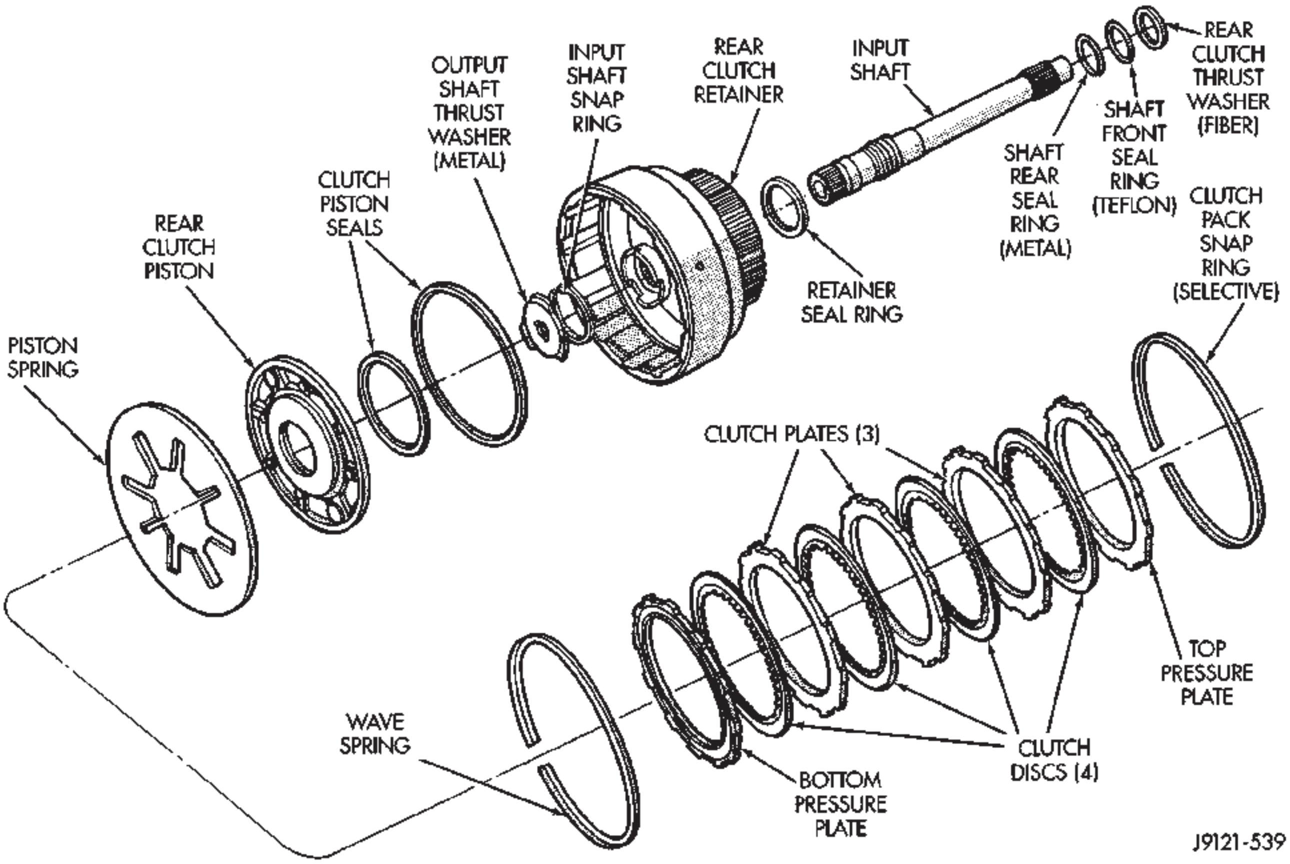


Fig. 137 Rear Clutch Components

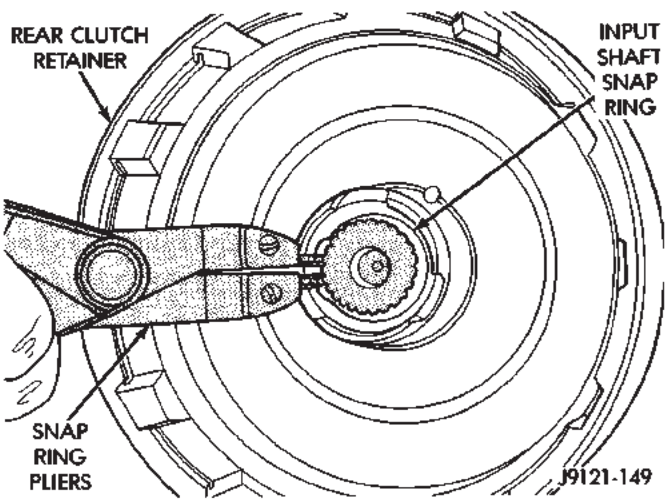


Fig. 138 Removing/Installing Input Shaft Snap-Ring

ASSEMBLY

(1) Soak clutch discs in transmission fluid while assembling other clutch parts.

(2) Install new seal rings on clutch retainer hub and input shaft if necessary (Fig. 139).

(a) Be sure clutch hub seal ring is fully seated in groove and is not twisted.

(3) Lubricate splined end of input shaft and clutch retainer with transmission fluid. Then press input shaft into retainer. Use a suitably sized press tool to support retainer as close to input shaft as possible.

(4) Install input shaft snap-ring (Fig. 138).

(5) Invert retainer and press input shaft in opposite direction until snap-ring is seated.

(6) Install new seals on clutch piston. Be sure lip of each seal faces interior of clutch retainer.

(7) Lubricate lip of piston seals with generous quantity of Mopar® Door Ease. Then lubricate retainer hub and bore with light coat of transmission fluid.

(8) Install clutch piston in retainer. Use twisting motion to seat piston in bottom of retainer. A thin strip of plastic (about 0.020″ thick), can be used to guide seals into place if necessary.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip. In addition, never use any type of metal tool to help ease the piston seals into place. Metal tools will cut, shave, or score the seals.

DISASSEMBLY AND ASSEMBLY (Continued)

(9) Install piston spring in retainer and on top of piston (Fig. 142). Concave side of spring faces downward (toward piston).

(10) Install wave spring in retainer (Fig. 142). Be sure spring is completely seated in retainer groove.

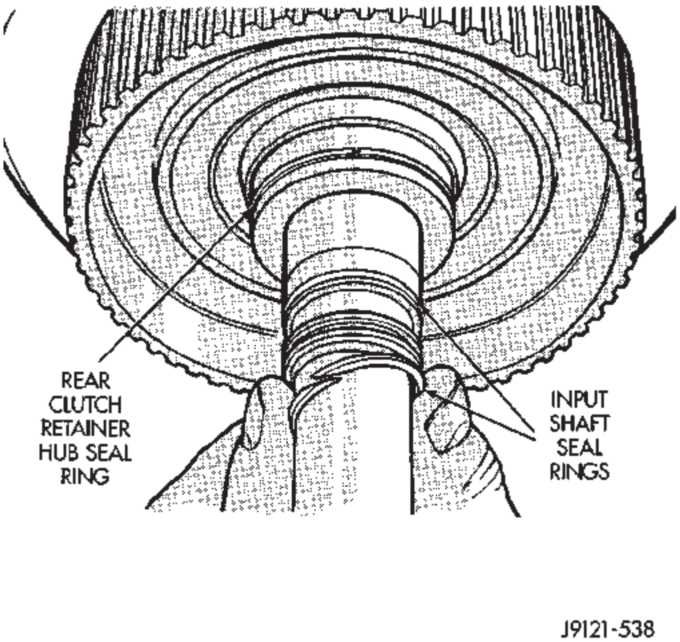


Fig. 139 Rear Clutch Retainer And Input Shaft Seal Ring Installation

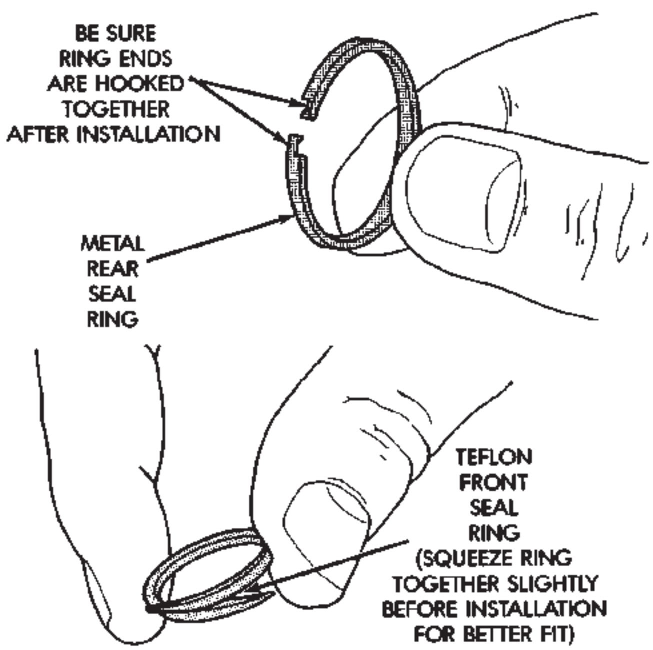


Fig. 140 Input Shaft Seal Ring Identification

(11) Install bottom pressure plate (Fig. 137). Ridged side of plate faces downward (toward piston) and flat side toward clutch pack.

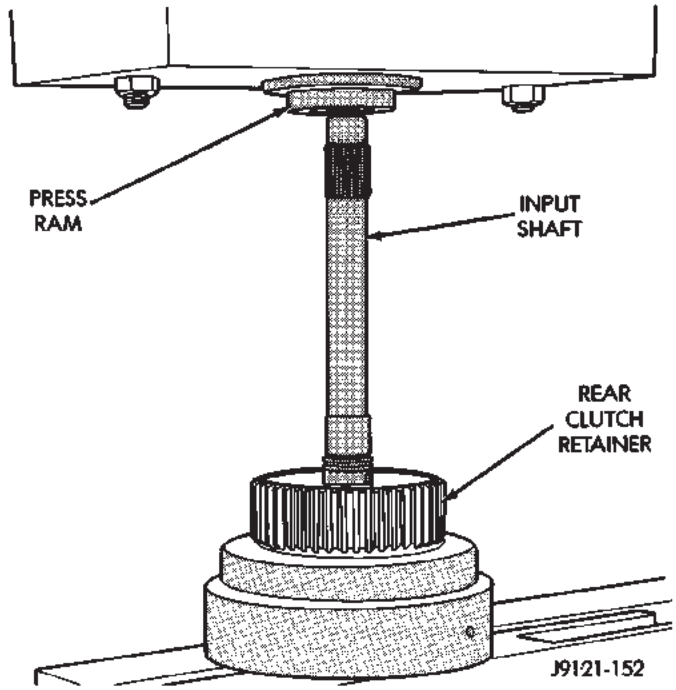


Fig. 141 Pressing Input Shaft Into Rear Clutch Retainer

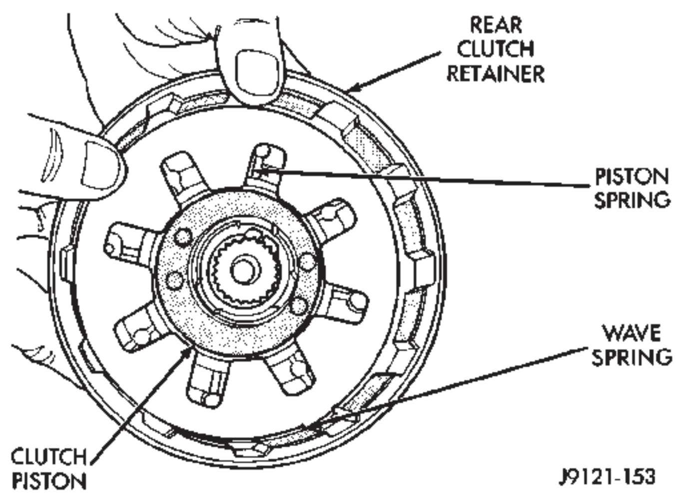


Fig. 142 Piston Spring/Wave Spring Position

(12) Install first clutch disc in retainer on top of bottom pressure plate. Then install a clutch plate followed by a clutch disc until entire clutch pack is installed (4 discs and 3 plates are required) (Fig. 137).

(13) Install top pressure plate.

(14) Install selective snap ring. Be sure snap ring is fully seated in retainer groove.

(15) Using a suitable gauge bar and dial indicator, measure clutch pack clearance (Fig. 143).

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 143).

DISASSEMBLY AND ASSEMBLY (Continued)

(b) Using two small screw drivers, lift the pressure plate and release it.

(c) Zero the dial indicator.

(d) Lift the pressure plate until it contacts the snap-ring and record the dial indicator reading.

Clearance should be 0.64 - 1.14 mm (0.025 - 0.045 in.). If clearance is incorrect, steel plates, discs, selective snap ring and pressure plates may have to be changed.

The selective snap ring thicknesses are:

- .107–.109 in.
- .098–.100 in.
- .095–.097 in.
- .083–.085 in.
- .076–.078 in.
- .071–.073 in.
- .060–.062 in.

(16) Coat rear clutch thrust washer with petroleum jelly and install washer over input shaft and into clutch retainer (Fig. 144). Use enough petroleum jelly to hold washer in place.

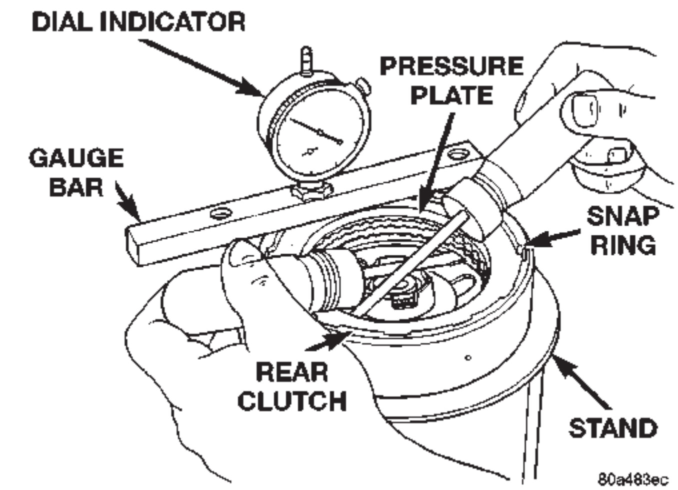


Fig. 143 Checking Rear Clutch Pack Clearance

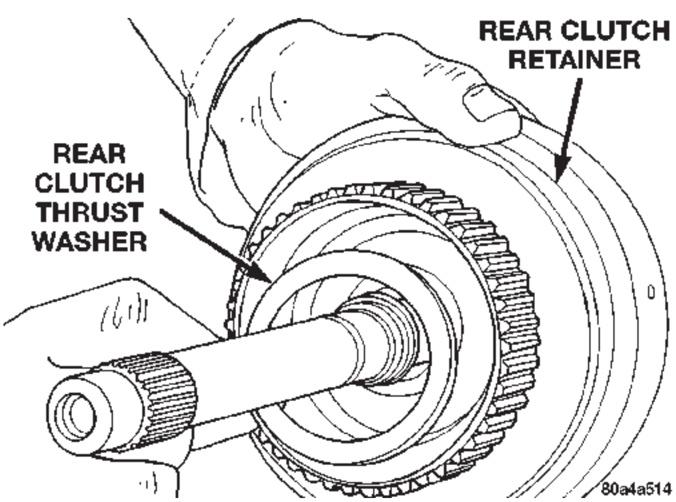


Fig. 144 Installing Rear Clutch Thrust Washer

PLANETARY GEARTRAIN/OUTPUT SHAFT

DISASSEMBLY

(1) Remove planetary snap ring (Fig. 145).

(2) Remove front annulus and planetary assembly from driving shell (Fig. 145).

(3) Remove snap ring that retains front planetary gear in annulus gear (Fig. 146).

(4) Remove tabbed thrust washer and tabbed thrust plate from hub of front annulus (Fig. 147).

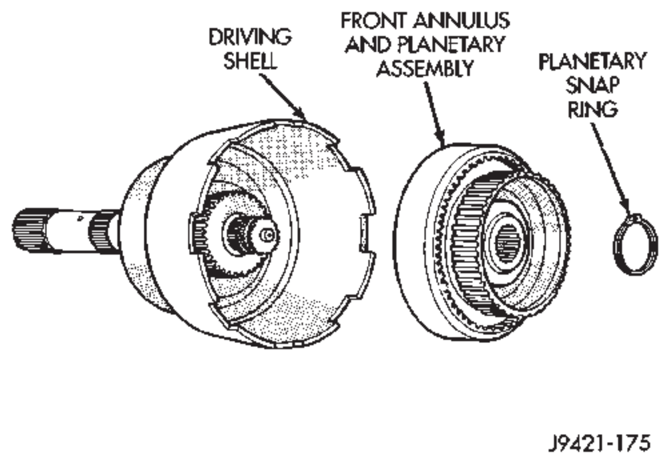


Fig. 145 Front Annulus And Planetary Assembly Removal

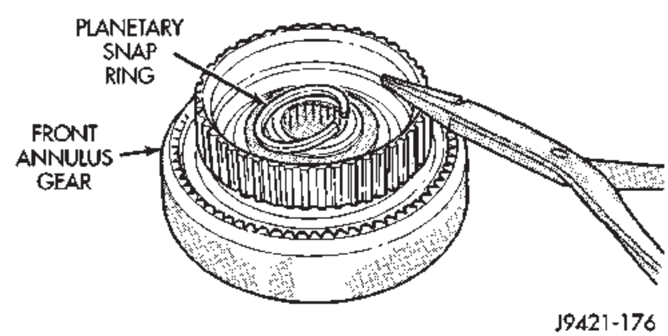


Fig. 146 Front Planetary Snap Ring Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Separate front annulus and planetary gears (Fig. 147).

(6) Remove front planetary gear front thrust washer from annulus gear hub.

(7) Separate and remove driving shell, rear planetary and rear annulus from output shaft (Fig. 148).

(8) Remove front planetary rear thrust washer from driving shell.

(9) Remove tabbed thrust washers from rear planetary gear.

(10) Remove lock ring that retains sun gear in driving shell. Then remove sun gear, spacer and thrust plates.

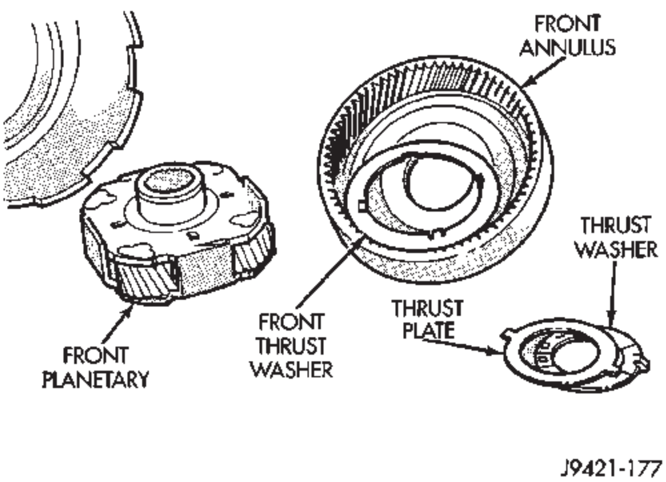


Fig. 147 Front Planetary And Annulus Gear Disassembly

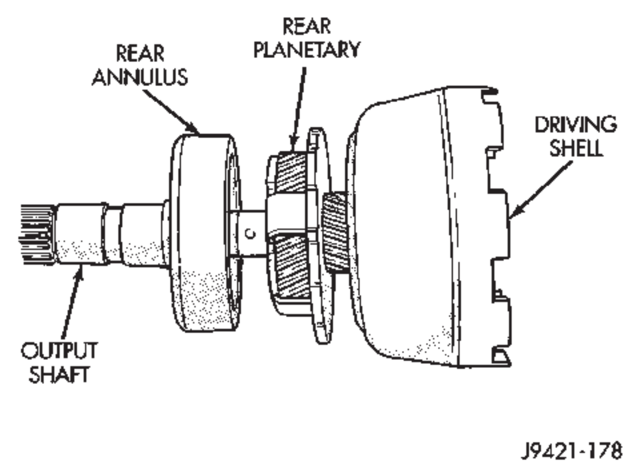


Fig. 148 Removing Driving Shell, Rear Planetary And Rear Annulus

ASSEMBLY

(1) Lubricate output shaft and planetary components with transmission fluid. Use petroleum jelly to lubricate and hold thrust washers and plates in position.

(2) Assemble rear annulus gear and support if disassembled. Be sure support snap ring is seated and that shoulder-side of support faces rearward (Fig. 149).

(3) Install rear thrust washer on rear planetary gear. Use enough petroleum jelly to hold washer in place. Also be sure all four washer tabs are properly engaged in gear slots.

(4) Install rear annulus over and onto rear planetary gear (Fig. 149).

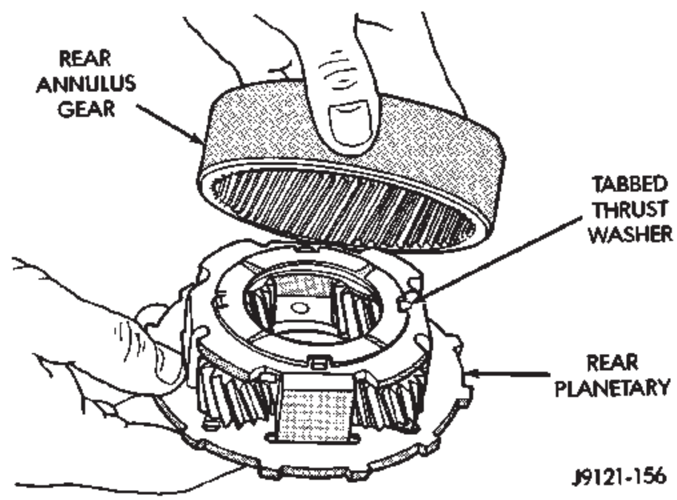


Fig. 149 Assembling Rear Annulus And Planetary Gear

(5) Install assembled rear planetary and annulus gear on output shaft (Fig. 150). Verify that assembly is fully seated on shaft.

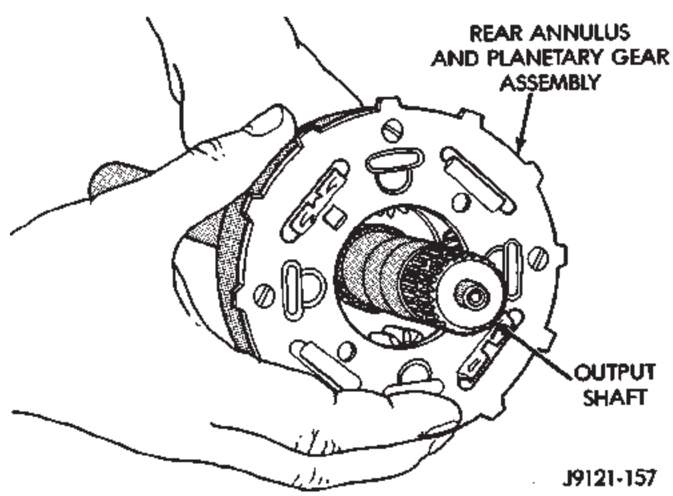


Fig. 150 Installing Rear Annulus And Planetary On Output Shaft

DISASSEMBLY AND ASSEMBLY (Continued)

(6) Install front thrust washer on rear planetary gear (Fig. 151). Use enough petroleum jelly to hold washer on gear. Be sure all four washer tabs are seated in slots.

(7) Install spacer on sun gear (Fig. 152).

(8) Install thrust plate on sun gear (Fig. 153). Note that driving shell thrust plates are interchangeable. Use either plate on sun gear and at front/rear of shell.

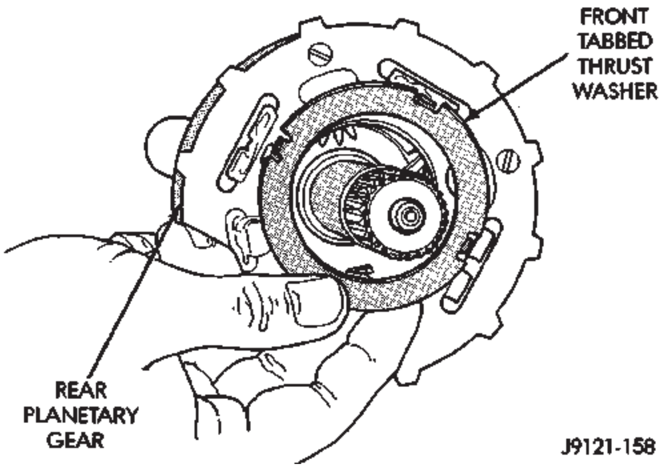


Fig. 151 Installing Rear Planetary Front Thrust Washer

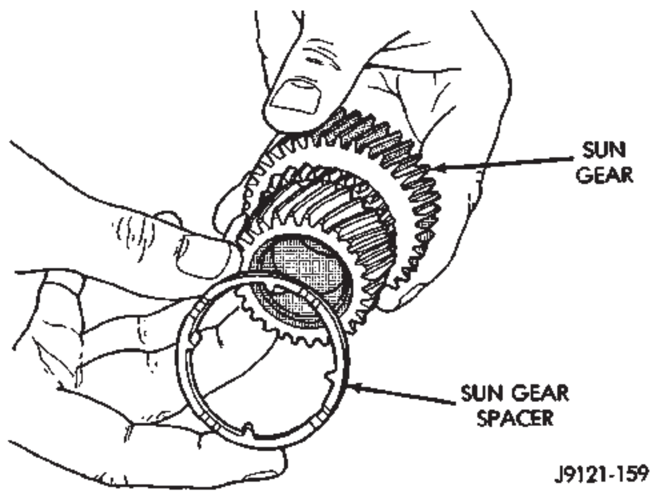


Fig. 152 Installing Spacer On Sun Gear

(9) Hold sun gear in place and install thrust plate over sun gear at rear of driving shell (Fig. 154).

(10) Position wood block on bench and support sun gear on block (Fig. 155). 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.

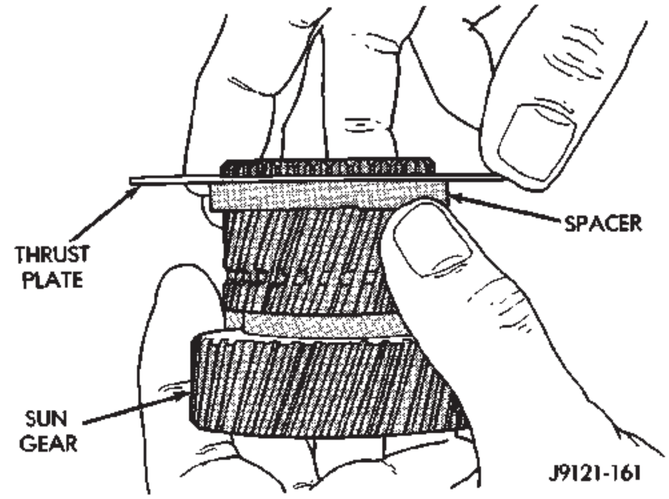


Fig. 153 Installing Driving Shell Front Thrust Plate On Sun Gear

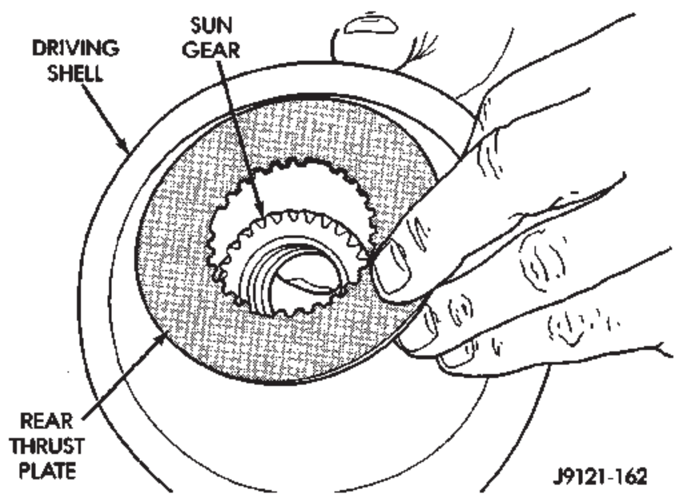


Fig. 154 Installing Driving Shell Rear Thrust Plate

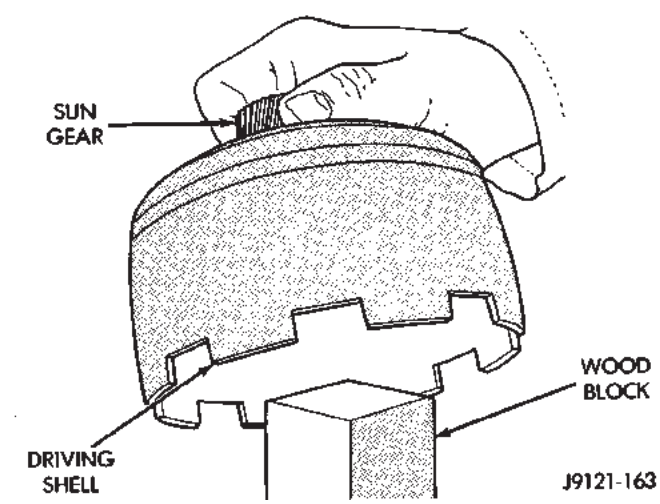


Fig. 155 Supporting Sun Gear On Wood Block

DISASSEMBLY AND ASSEMBLY (Continued)

(11) Align rear thrust plate on driving shell and install sun gear lock ring. Be sure ring is fully seated in sun gear ring groove (Fig. 156).

(12) Install assembled driving shell and sun gear on output shaft (Fig. 157).

(13) Install rear thrust washer on front planetary gear (Fig. 158). Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

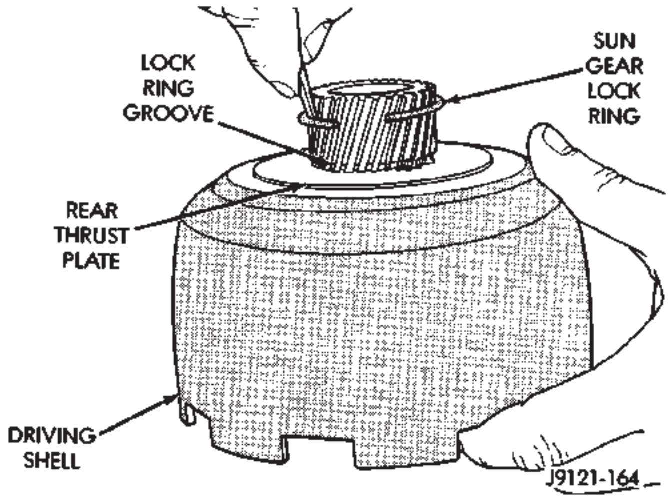


Fig. 156 Installing Sun Gear Lock Ring

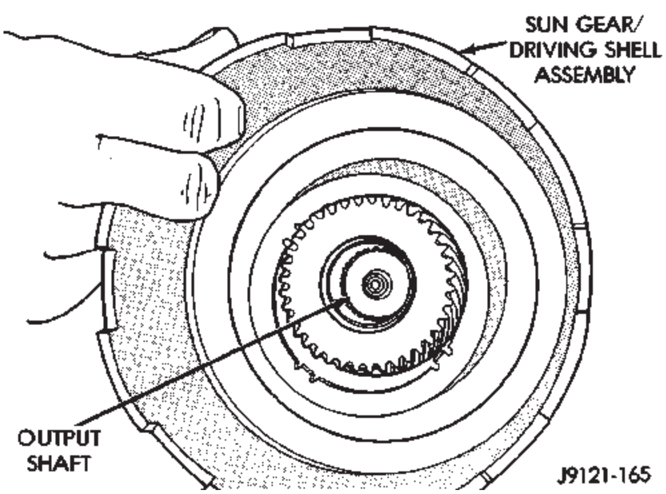


Fig. 157 Installing Assembled Sun Gear And Driving Shell On Output Shaft

(14) Install front planetary gear on output shaft and in driving shell (Fig. 159).

(15) Install front thrust washer on front planetary gear. Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

(16) Assemble front annulus gear and support, if necessary. Be sure support snap ring is seated.

(17) Install front annulus on front planetary (Fig. 159).

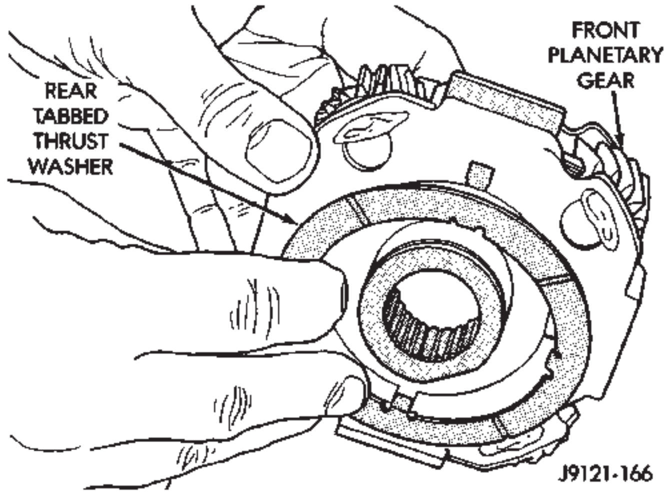


Fig. 158 Installing Rear Thrust Washer On Front Planetary Gear

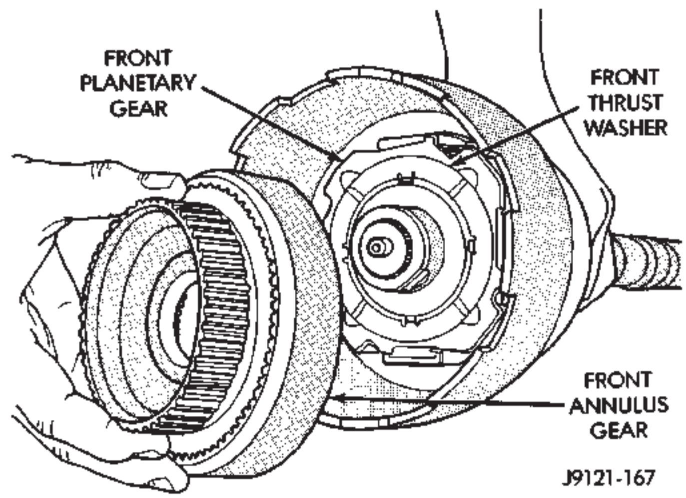


Fig. 159 Installing Front Planetary And Annulus Gears

(18) Position thrust plate on front annulus gear support (Fig. 160). **Note that plate has two tabs on it. These tabs fit in notches of annulus hub.**

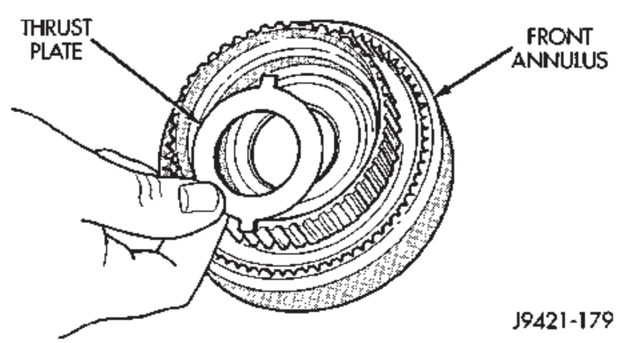


Fig. 160 Positioning Thrust Plate On Front Annulus Support

DISASSEMBLY AND ASSEMBLY (Continued)

(19) Install thrust washer in front annulus (Fig. 161). **Align flat on washer with flat on planetary hub. Also be sure washer tab is facing up.**

(20) Install front annulus snap ring (Fig. 162). Use snap ring pliers to avoid distorting ring during installation. Also be sure ring is fully seated.

(21) Install planetary selective snap ring with snap ring pliers (Fig. 163). Be sure ring is fully seated.

(22) Turn planetary geartrain assembly over so driving shell is facing workbench. Then support geartrain on wood block positioned under forward end of output shaft. This allows geartrain components to move forward for accurate end play check.

(23) Check planetary geartrain end play with feeler gauge (Fig. 164). Gauge goes between shoulder on output shaft and end of rear annulus support.

(24) Geartrain end play should be 0.12 to 1.22 mm (0.005 to 0.048 in.). If end play is incorrect, snap ring (or thrust washers) may have to be replaced. Snap ring is available in three different thicknesses for adjustment purposes.

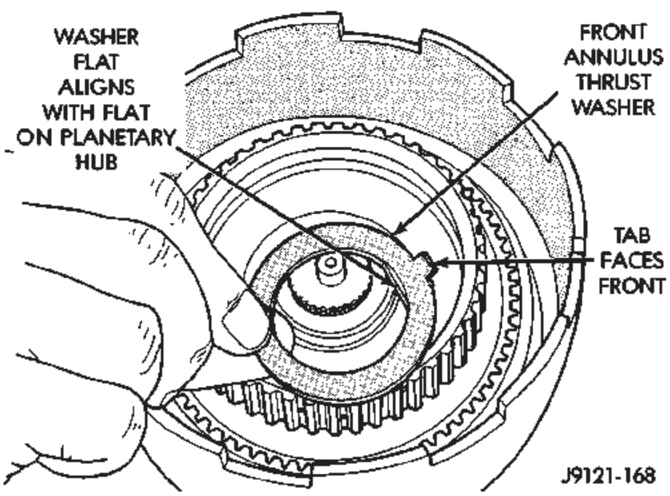


Fig. 161 Installing Front Annulus Thrust Washer

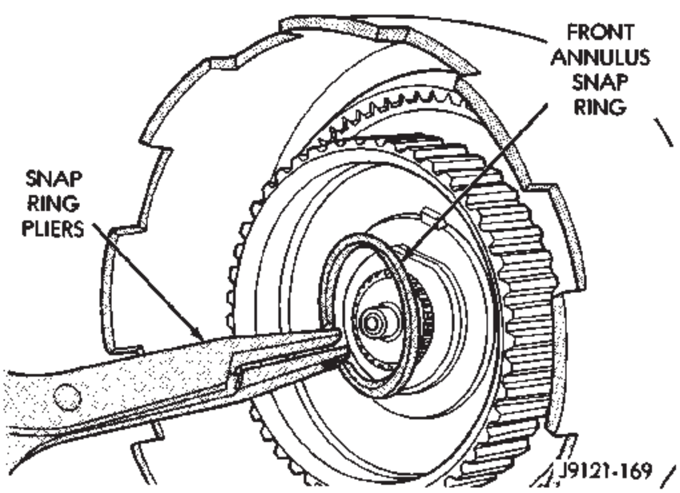


Fig. 162 Installing Front Annulus Snap Ring

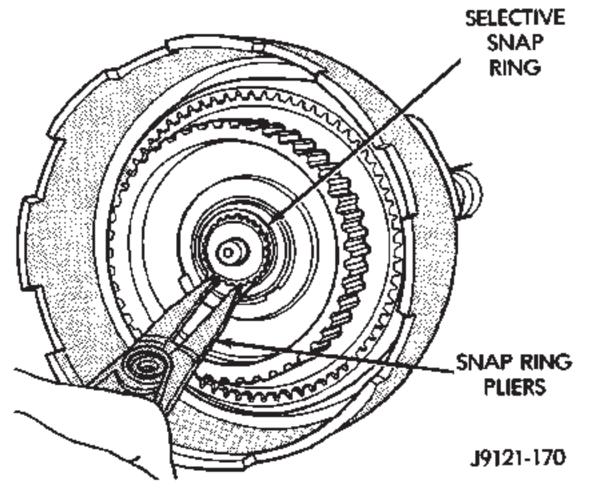


Fig. 163 Installing Planetary Selective Snap Ring

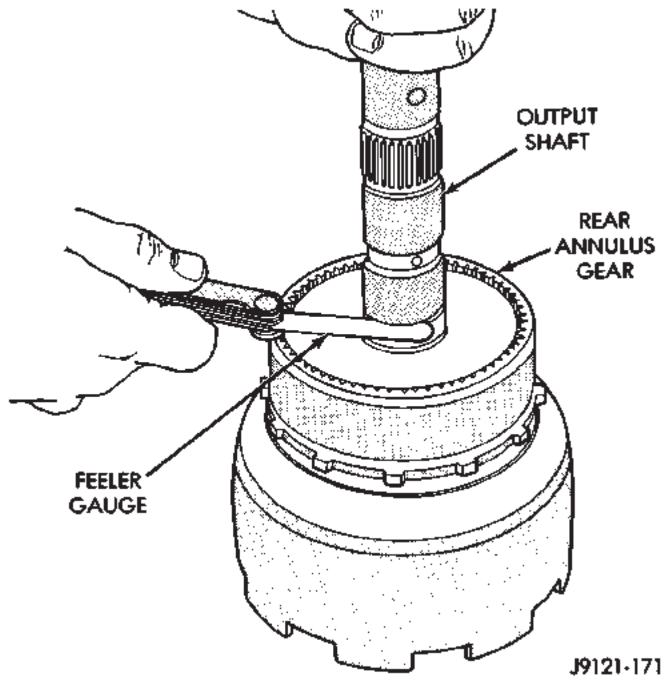


Fig. 164 Checking Planetary Geartrain End Play

CLEANING AND INSPECTION

GOVERNOR AND PARK GEAR

Thoroughly clean all the governor parts in a suitable cleaning solution but do not use any type of caustic cleaning agents.

The governor weight components (Fig. 165) and the governor valve (Fig. 166), must slide freely in their bores when clean and dry. Minor surface scratches and burrs can be smoothed with crocus cloth.

The aluminum governor valve and outer weight have a hard coating on them. Check condition of this coating carefully. Do not reuse either part if the coating is damaged.

CLEANING AND INSPECTION (Continued)

Inspect the governor weight spring for distortion. Replace the spring, if distorted, collapsed, or broken. Clean the filter in solvent and dry it with compressed air. Replace the filter, if damaged. Inspect the park

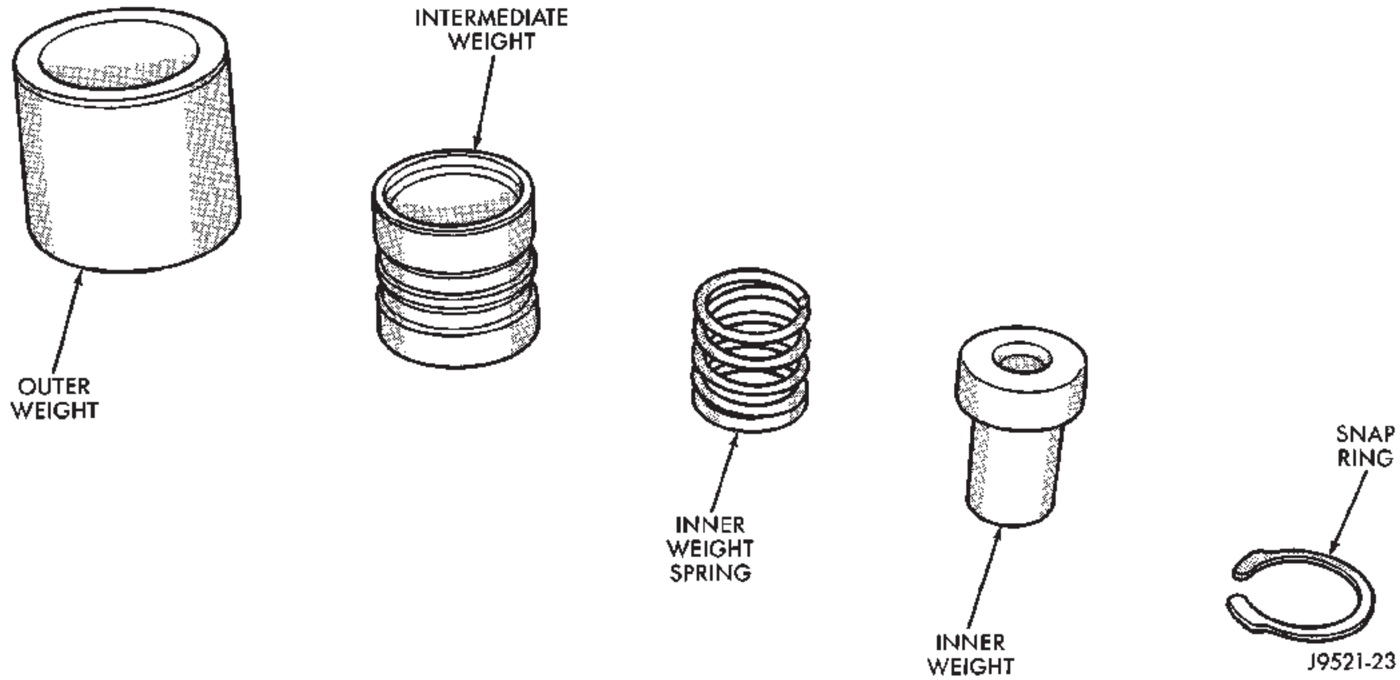


Fig. 165 Governor Weights

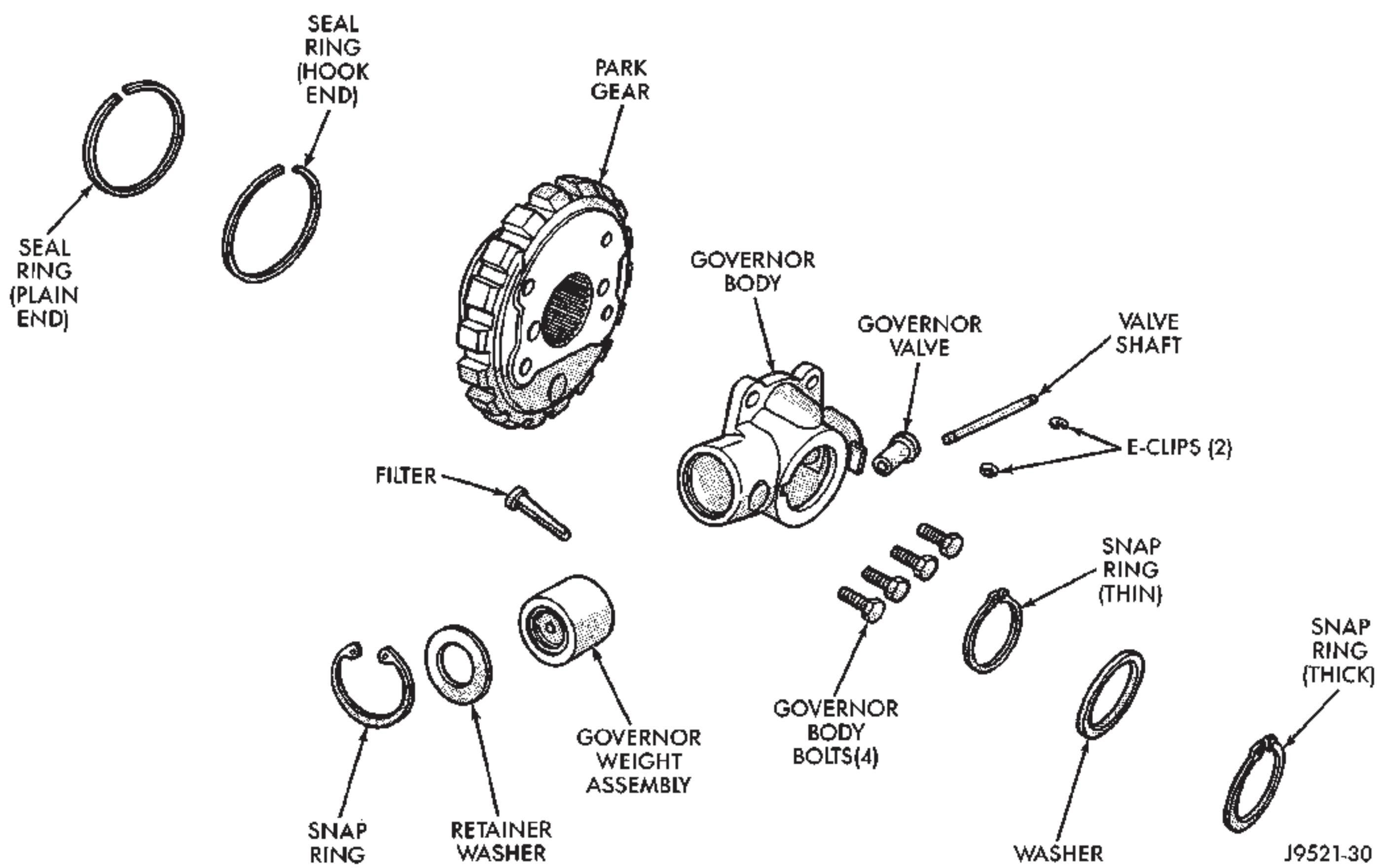


Fig. 166 Governor Components

CLEANING AND INSPECTION (Continued)

gear for chipped or worn gear teeth or damaged ring grooves. Replace the gear, if damaged.

Check the teeth on the park gear for wear or damage. Replace the gear if necessary. Inspect the metal seal rings on the park gear hub. Replace the rings only if severely worn, or broken.

EXTENSION HOUSING AND PARK LOCK

Clean the housing and park lock components in solvent and dry them with compressed air.

Examine the park lock components in the housing. If replacement is necessary, remove the shaft with parallel jaw snap ring pliers (Fig. 167) and remove the sprag and spring. Then remove the spring clip and reaction plug (Fig. 168). **Compress the reaction plug spring clip only enough to remove and install it. Do not distort the clip during removal or installation.**

Be sure a replacement sprag is installed so the sprag locking lug will face the park gear (Fig. 169). Also be sure the spring is correctly positioned as shown (Fig. 169). The sprag may not retract if the spring is improperly installed.

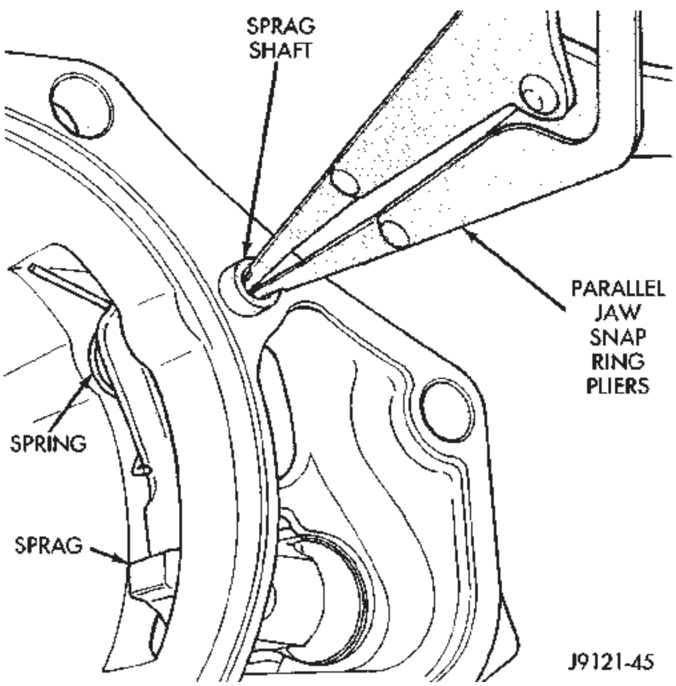


Fig. 167 Park Sprag, Shaft And Spring

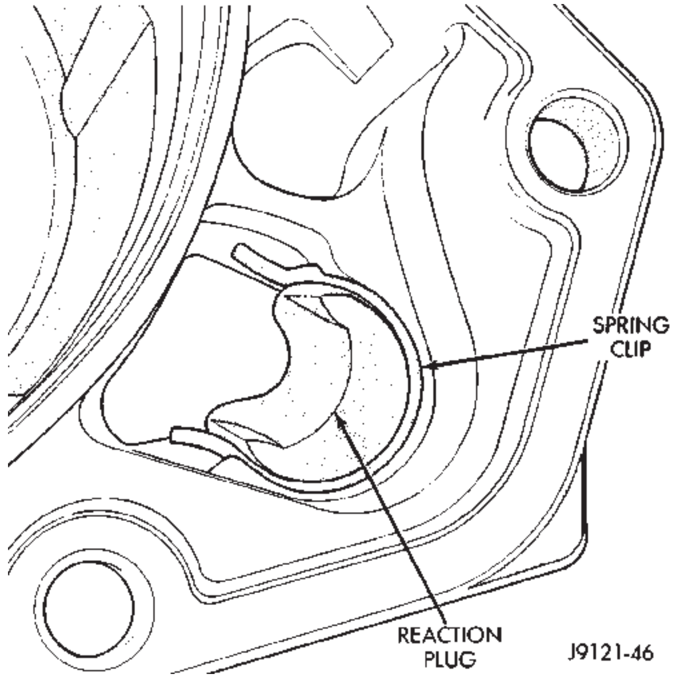


Fig. 168 Park Sprag Reaction Plug And Spring Location

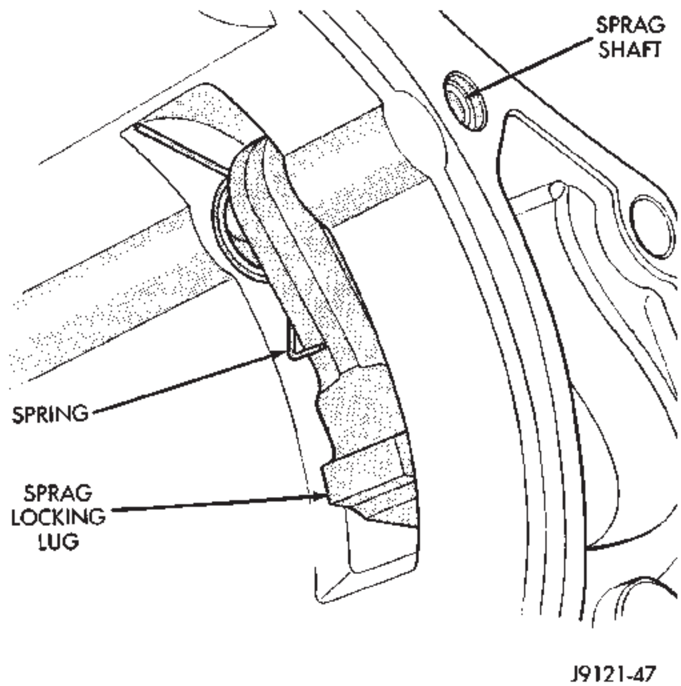


Fig. 169 Correct Position Of Sprag And Spring

VALVE BODY

Serviceable valve body components are:

- park lock rod and E-clip
- switch valve and spring
- pressure adjusting screw bracket
- throttle valve lever
- manual lever
- manual lever shaft seal, washer, E-clip and detent ball
- fluid filter
- converter clutch solenoid

The remaining valve body components are serviced only as part of a complete valve body assembly.

Clean the valve body components in a parts cleaning solution only. Do not use gasoline, kerosene, or any type of caustic solution. Dry the parts with compressed air. Make sure all passages are clean and free from obstructions.

CLEANING AND INSPECTION (Continued)

NOTE: Do not use rags or shop towels to wipe off valve body components. Lint from these materials will adhere to the valve body components. Lint will interfere with valve operation and may clog filters and fluid passages.

Inspect the throttle and manual valve levers and shafts. Do not attempt to straighten a bent shaft or correct a loose lever. Replace these components if worn, bent, loose or damaged in any way.

Inspect all of the valve body mating surfaces for scratches, nicks, burrs, or distortion. Use a straightedge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with crocus cloth. The cloth should be in sheet form and be positioned on a surface plate, sheet of plate glass, or equally flat surface. However, if distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CAUTION: Many of the valve body valves and plugs are made of coated aluminum. Aluminum components can be identified by the dark color of the special coating applied to the surface (or by testing with a magnet). DO NOT polish or sand aluminum valves or plugs with any type of material, or under any circumstances. This practice might damage the special coating and cause the valves and plugs to stick and bind.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Also inspect the coating on the aluminum valves and plugs (Fig. 170). If the coating is damaged or worn through, the valve (or valve body) should be replaced.

Aluminum valves and plugs should not be sanded or polished under any circumstances. However, minor burrs or scratches on steel valves and plugs can be removed with crocus cloth but do not round off the valve or plug edges. Squareness of these edges is vitally important. These edges prevent foreign matter from lodging between the valves, plugs and bore.

Inspect all the valve and plug bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or scored. Inspect all of the valve body springs. The springs must be free of distortion, warpage or broken coils.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores. Valve body bores do not change dimensionally with use. If the valve body functioned correctly when new, it will continue to operate properly after cleaning and inspection. It should not be necessary to replace a valve body assembly unless it is damaged in handling.

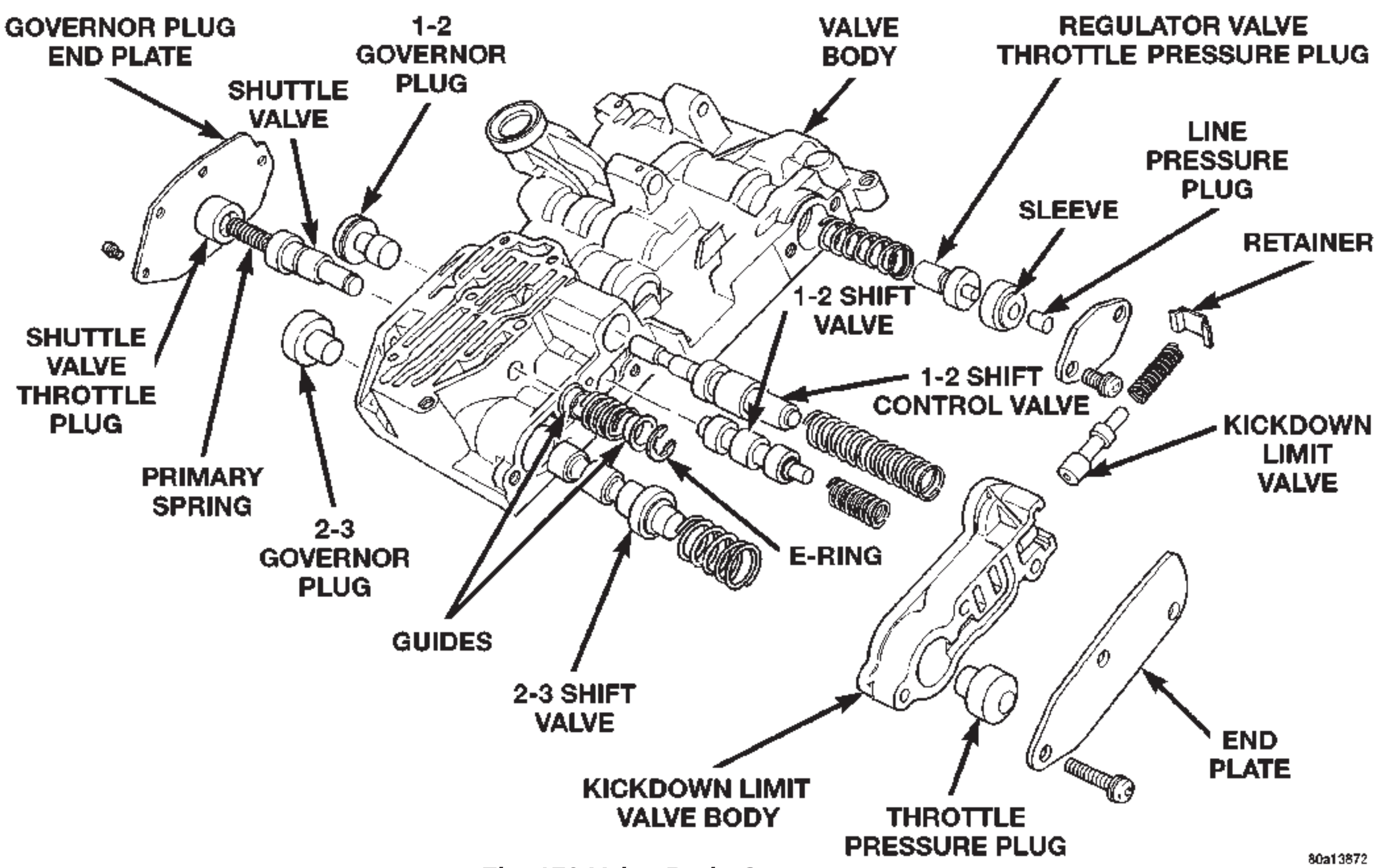


Fig. 170 Valve Body Components

CLEANING AND INSPECTION (Continued)

TRANSMISSION

Clean the case in a solvent tank. Flush the case bores and fluid passages thoroughly with solvent. Dry the case and all fluid passages with compressed air. Be sure all solvent is removed from the case and that all fluid passages are clear.

NOTE: Do not use shop towels or rags to dry the case (or any other transmission component) unless they are made from lint-free materials. Lint will readily adhere to case surfaces and transmission components and will circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

Inspect the case for cracks, porous spots, worn servo bores, or damaged threads. 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.

Inspect all 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. Replace worn, or scored bushings, 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 Sets C-3887-B, or C-3887-J.

Pre-sized service bushings are available for replacement purposes. Only the sun gear bushings are not serviced. Replace the gear as an assembly if the bushings are severely scored, or worn.

Heli-Coil inserts are recommended for repairing damaged, stripped or worn threads in aluminum parts. 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 3, Type 7176 transmission fluid during assembly. Use Mopar® Door Ease, or Ru-Glyde to lubricate piston seals and O-rings. Use petroleum jelly on thrust washers and to hold parts in place during reassembly.

OVERRUNNING CLUTCH/LOW-REVERSE DRUM/OVERDRIVE PISTON RETAINER

Clean the overrunning clutch assembly, clutch cam, low-reverse drum, and overdrive piston retainer in solvent. Dry them with compressed air after cleaning.

Inspect condition of each clutch part after cleaning. Replace the overrunning clutch roller and spring assembly if any rollers or springs are worn or damaged, or if the roller cage is distorted, or damaged. Replace the cam if worn, cracked or damaged.

Replace the low-reverse drum if the clutch race, roller surface or inside diameter is scored, worn or damaged. **Do not remove the clutch race from the low-reverse drum under any circumstances. Replace the drum and race as an assembly if either component is damaged.**

Examine the overdrive piston retainer carefully for wear, cracks, scoring or other damage. Be sure the retainer hub is a snug fit in the case and drum. Replace the retainer if worn or damaged.

FRONT SERVO

Clean the servo piston components with solvent and dry them with compressed air. Wipe the band clean with lint free shop towels.

Replace the front band if distorted, lining is burned, flaking off, or worn to the point where the grooves in the lining material are no longer visible.

Inspect the servo components (Fig. 171). Replace the springs if collapsed, distorted or broken. Replace the guide, rod and piston if cracked, bent, or worn. Discard the servo snap ring if distorted or warped.

Check the servo piston bore for wear. If the bore is severely scored, or damaged, it will be necessary to replace the case.

Replace any servo component if doubt exists about condition. Do not reuse suspect parts.

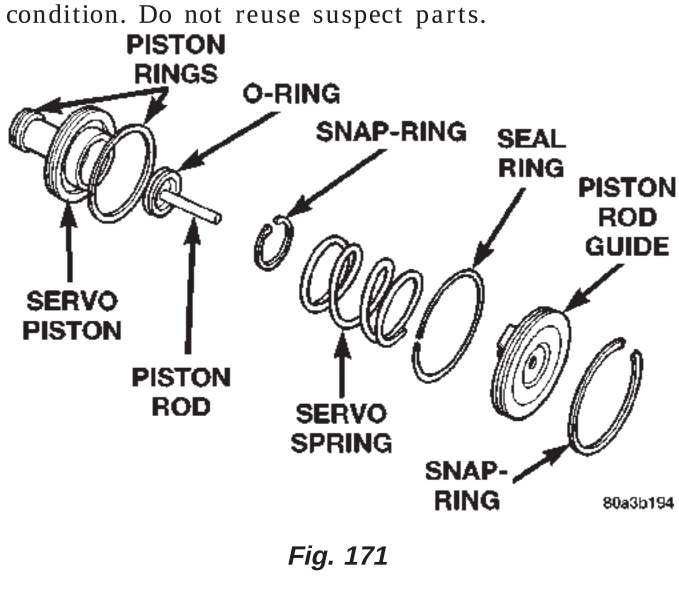


Fig. 171

CLEANING AND INSPECTION (Continued)

REAR SERVO

Remove and discard the servo piston seal ring (Fig. 172). Then clean the servo components with solvent and dry with compressed air. Replace either spring if collapsed, distorted or broken. Replace the plug and piston if cracked, bent, or worn. Discard the servo snap rings and use a new ones at assembly.

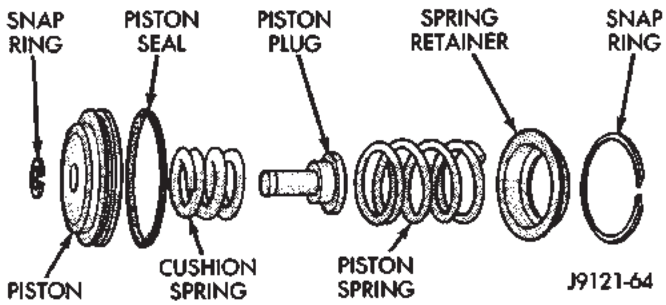


Fig. 172 Rear Servo Components

OIL PUMP AND REACTION SHAFT SUPPORT

(1) Clean pump and support components with solvent and dry them with compressed air.

(2) Check condition of the seal rings and thrust washer on the reaction shaft support. The seal rings do not need to be replaced unless cracked, broken, or severely worn.

(3) Inspect the pump and support components. Replace the pump or support if the seal ring grooves or machined surfaces are worn, scored, pitted, or damaged. Replace the pump gears if pitted, worn chipped, or damaged.

(4) Inspect the pump bushing. Then check the reaction shaft support bushing. Replace either bushing only if heavily worn, scored or damaged. It is not necessary to replace the bushings unless they are actually damaged.

(5) Install the gears in the pump body and measure pump component clearances as follows:

(a) Clearance between outer gear and reaction shaft housing should be 0.010 to 0.063 mm (0.0004 to 0.0025 in.). Clearance between inner gear and reaction shaft housing should be 0.010 to 0.063 mm (0.0004 to 0.0025 in.). Both clearances can be measured at the same time by:

(I) Installing the pump gears in the pump housing.

(II) Position an appropriate piece of Plastigage™ across both gears.

(III) Align the plastigage to a flat area on the reaction shaft housing.

(IV) Install the reaction shaft to the pump housing.

(V) Separate the reaction shaft housing from the pump housing and measure the Plastigage™ following the instructions supplied with it.

(b) Clearance between inner gear tooth and outer gear should be 0.08 to 0.19 mm (0.0035 to 0.0075 in.). Measure clearance with an appropriate feeler gauge.

(c) Clearance between outer gear and pump housing should also be 0.010 to 0.19 mm (0.0035 to 0.0075 in.). Measure clearance with an appropriate feeler gauge.

FRONT CLUTCH

Clean and inspect the front clutch components. Replace the clutch discs if warped, worn, scored, burned or charred, or if the facing is flaking off. Replace the steel plates if heavily scored, warped, or broken. Be sure the driving lugs on the plates are in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the clutch spring and spring retainer if either is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The steel plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged.

Check action of the check ball in the retainer (Fig. 173). The ball must move freely and not stick.

NOTE: Inspect the clutch retainer bushings carefully (Fig. 174). 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.

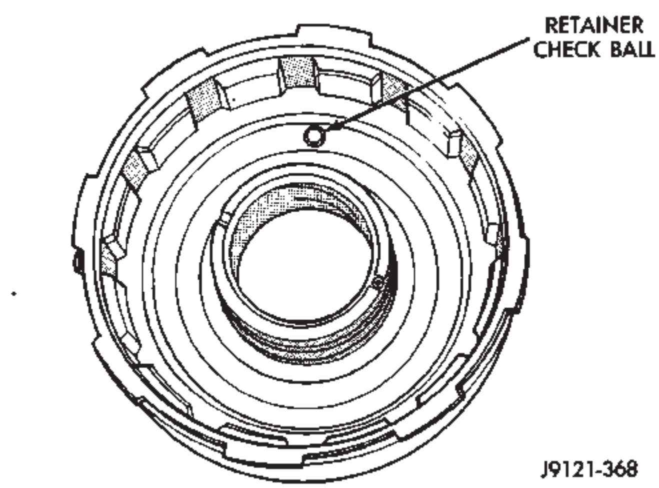


Fig. 173 Front Clutch Piston Retainer Check Ball Location

CLEANING AND INSPECTION (Continued)

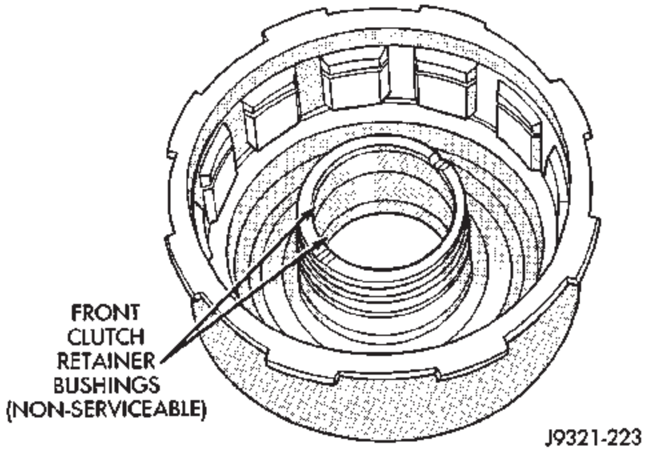


Fig. 174 Retainer Bushing Location/Inspection

REAR CLUTCH

Clean the clutch components with solvent and dry them with compressed air.

Check condition of the input shaft seal rings. It is not necessary to remove or replace rings unless they are broken, cracked, or no longer securely hooked together.

Inspect the input shaft splines and machined surfaces. Very minor nicks or scratches can be smoothed off with crocus cloth. replace the shaft if the splines are damaged, or any of the machined surfaces are severely scored.

Replace the clutch discs if warped, worn, scored, burned/charred, the lugs are damaged, or if the facing is flaking off.

Replace the steel plates and the pressure plate if heavily scored, warped, or broken. Be sure the driving lugs on the discs and plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston spring and wave spring if either part is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The steel plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged. Also check action of the retainer check ball. The ball must move freely and not stick.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously damaged.

Check thrust washer condition. Washer thickness should be 1.55 to 1.60 mm (0.061 to 0.063 in.). Replace the washer if worn or damaged.

Check condition of the two seal rings on the input shaft and the single seal ring on the piston retainer hub. Replace the seal rings only if severely worn, cracked, or cannot be hooked together.

PLANETARY GEARTRAIN/OUTPUT SHAFT

Clean the intermediate shaft and planetary components in solvent and dry them with compressed air. Do not spin the planetary pinion gears with compressed air.

Inspect the planetary gear sets and annulus gears. The planetary pinions, shafts, washers, and retaining pins are serviceable. However, if a pinion carrier is damaged, the entire planetary gear set must be replaced as an assembly.

Replace the annulus gears if the teeth are chipped, broken, or worn, or the gear is cracked. Replace the planetary thrust plates and the tabbed thrust washers if cracked, scored or worn.

Inspect the machined surfaces of the output shaft. Be sure the oil passages are open and clear. Replace the shaft if scored, pitted, or damaged.

Inspect the sun gear and driving shell. If either component is worn or damaged, remove the sun gear rear retaining ring and separate the sun gear and thrust plate from the driving shell. Then replace the necessary component.

Replace the sun gear as an assembly if the gear teeth are chipped or worn. Also replace the gear as an assembly if the bushings are scored or worn. The sun gear bushings are not serviceable. Replace the thrust plate if worn, or severely scored. Replace the driving shell if distorted, cracked, or damaged in any way.

Replace all snap rings during geartrain assembly. Reusing snap rings is not recommended.

ADJUSTMENTS

GEARSHIFT CABLE

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.

ADJUSTMENTS (Continued)

(4) Unsnap cable from cable mounting bracket on transmission (Fig. 175).

(5) Slide cable eyelet off transmission shift lever.

(6) Verify transmission shift lever is in Park detent by moving lever fully rearward. Last rearward detent is Park position.

(7) Verify positive engagement of transmission park lock by attempting to rotate propeller shaft. Shaft will not rotate when park lock is engaged.

(8) Slide cable eyelt onto transmission shift lever.

(9) Snap shift cable adjuster into mounting bracket on transmission.

(10) Lock shift cable by pressing cable adjuster clamp down until it snaps into place.

(11) Lower vehicle and check engine starting. Engine should start only in Park and Neutral.

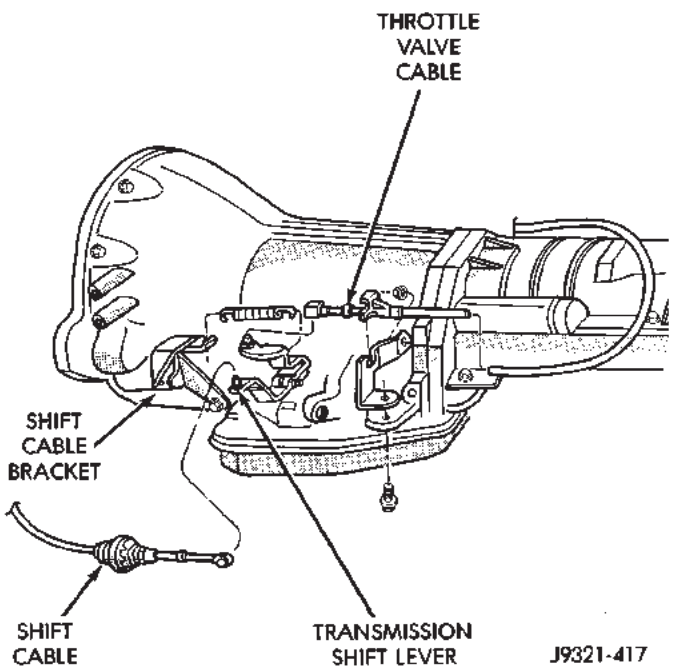


Fig. 175 Shift Cable Attachment At Transmission–Typical

BRAKE TRANSMISSION SHIFT INTERLOCK CABLE ADJUSTMENT

(1) Shift transmission into PARK.

(2) Remove shift lever bezel and console screws. Raise bezel and console for access to cable.

(3) Pull cable lock button up to release cable (Fig. 176).

(4) Turn ignition switch to LOCK position.

(5) Use a spacer to create a one millimeter gap between the shifter pawl and top of the shift gate.

(6) Pull cable forward. Then release cable and press cable lock button down until it snaps in place.

(7) Check adjustment as follows:

(a) Check movement of release shift handle button (floor shift) or release lever (column shift). You

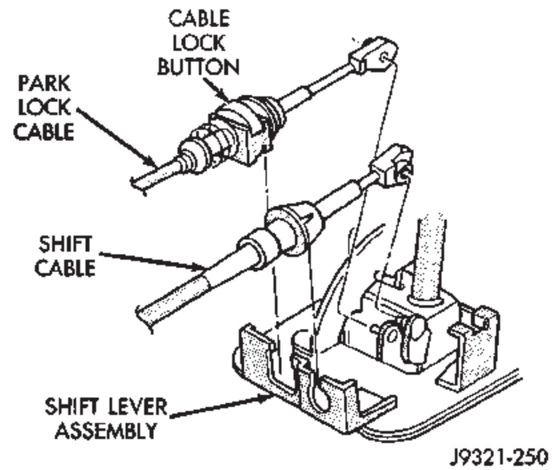


Fig. 176 Park Lock Cable Attachment

should not be able to press button inward or move column lever.

(b) Turn ignition switch to RUN position.

(c) Shifting out of park should not be possible.

(d) Apply the brake and attempt to shift out of PARK. Shifting should be possible.

(e) While the transmission is shifted out of PARK, release the brake and attempt to shift through all gears. Release the shift button at least once during this procedure. The ignition key should not go to the LOCK position.

(f) Return transmission to the PARK position without applying the brake.

(8) 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 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. 177). The cable is attached to an arm mounted on the throttle lever shaft. A retaining clip at the engine-end of the cable is removed to provide for cable adjustment. The retaining clip is then installed back onto the throttle valve cable to lock in the adjustment.

A correctly adjusted throttle valve cable will cause the throttle lever on the transmission to move simultaneously with the throttle body lever from the idle position. Proper adjustment 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.

ADJUSTMENTS (Continued)

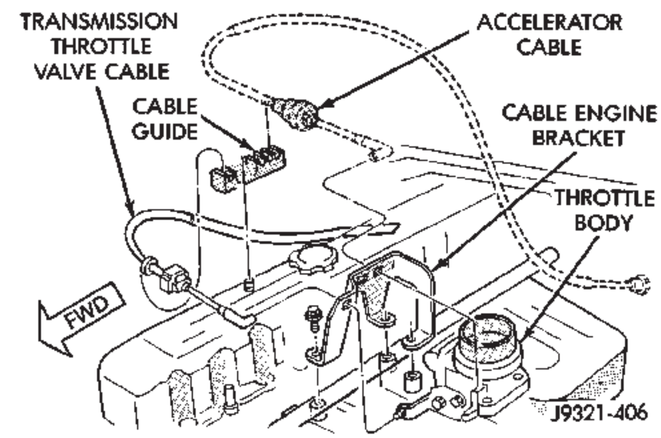


Fig. 177 Throttle Cable Attachment At Engine

(3) Verify that lever on throttle body is at curb idle position. Then verify that transmission throttle lever (Fig. 178) is also at idle (fully forward) position.

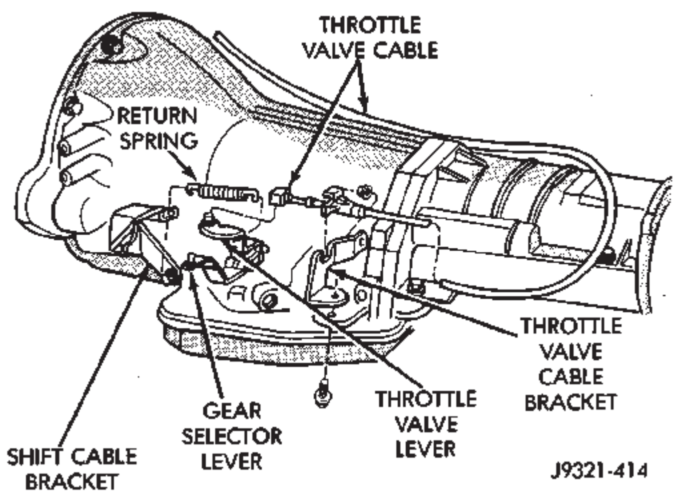


Fig. 178 Throttle Cable Attachment At Transmission

(4) Slide cable off attachment stud on throttle body lever.

(5) Compare position of cable end to attachment stud on throttle body lever:

• Cable end and attachment stud should be aligned (or centered on one another) to within 1 mm (0.039 in.) in either direction.

• 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.

• If both levers move simultaneously from idle to half-throttle and back to idle position, adjustment is correct.

• 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) Insert a small screwdriver under edge of retaining clip and remove retaining clip.

(6) Center cable end on attachment stud to within 1 mm (0.039 in.).

(7) Install retaining clip onto cable housing.

(8) Check cable adjustment. Verify transmission throttle lever and lever on throttle body move simultaneously.

FRONT BAND ADJUSTMENT

The front (kickdown) band adjusting screw is located on the left side of the transmission case above the manual valve and throttle valve levers.

(1) Raise vehicle.

(2) Loosen band adjusting screw locknut (Fig. 179). Then back locknut off 3-5 turns. Be sure adjusting screw turns freely in case. Apply lubricant to screw threads if necessary.

(3) Tighten band adjusting screw to 8 N·m (72 in. lbs.) torque with Inch Pound Torque Wrench C-3380-A, a 3-in. extension and 5/16 socket.

CAUTION: If Adapter C-3705 is needed to reach the adjusting screw (Fig. 180), tighten the screw to only 5 N·m (47-50 in. lbs.) torque.

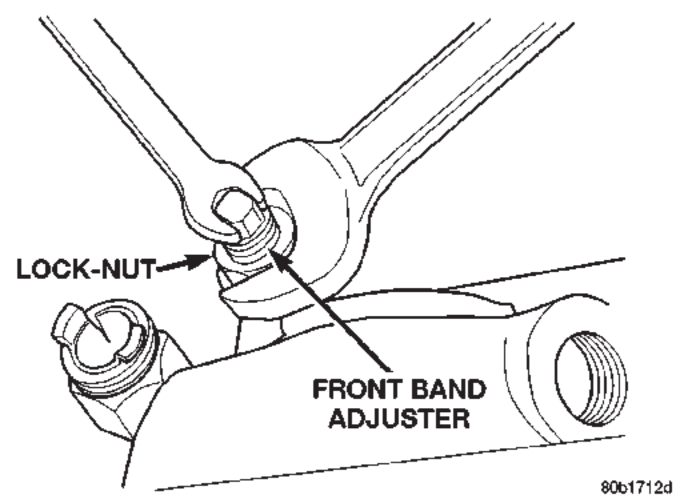


Fig. 179 Front Band Adjustment Screw Location

ADJUSTMENTS (Continued)

(4) Back off front band adjusting screw 2-1/2 turns for the 30RH and 2-1/4 turns for the 32RH.

(5) Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.

(6) Lower vehicle. ;bal

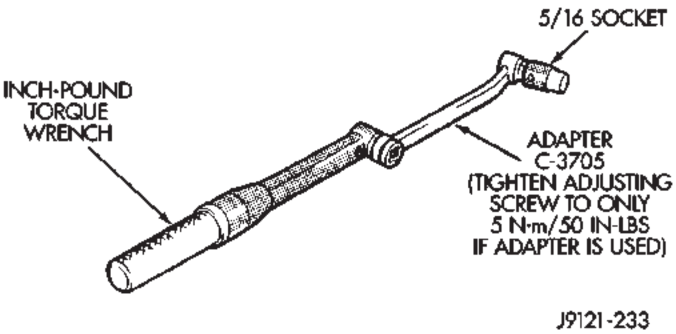


Fig. 180 Band Adjustment Adapter Tool

REAR BAND ADJUSTMENT

The transmission oil pan must be removed for access to the rear band adjusting screw.

(1) Raise vehicle.

(2) Remove transmission oil pan and drain fluid.

(3) Loosen band adjusting screw locknut 5-6 turns. Be sure adjusting screw turns freely in lever.

(4) Tighten adjusting screw to 5 N·m (41 in. lbs.) for the 30RH and 8 N·m (72 in. lbs.) torque for the 32RH (Fig. 181).

(5) Back off adjusting screw 7 turns for the 30RH and 4 turns for the 32RH.

(6) Hold adjusting screw in place and tighten locknut to 34 N·m (25 ft. lbs.) torque.

(7) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(8) Lower vehicle and refill transmission with Mopar® ATF Plus 3, Type 7176, fluid.

VALVE BODY

CONTROL PRESSURE ADJUSTMENTS

There are two control pressure adjustments on the valve body;

- Line Pressure
- Throttle Pressure

Line and throttle pressures are interdependent because each affects shift quality and timing. As a result, both adjustments must be performed properly and in the correct sequence. Adjust line pressure first and throttle pressure last.

LINE PRESSURE ADJUSTMENT

Measure distance from the valve body to the inner edge of the adjusting screw with an accurate steel scale (Fig. 182).

Distance should be 33.4 mm (1-5/16 in.).

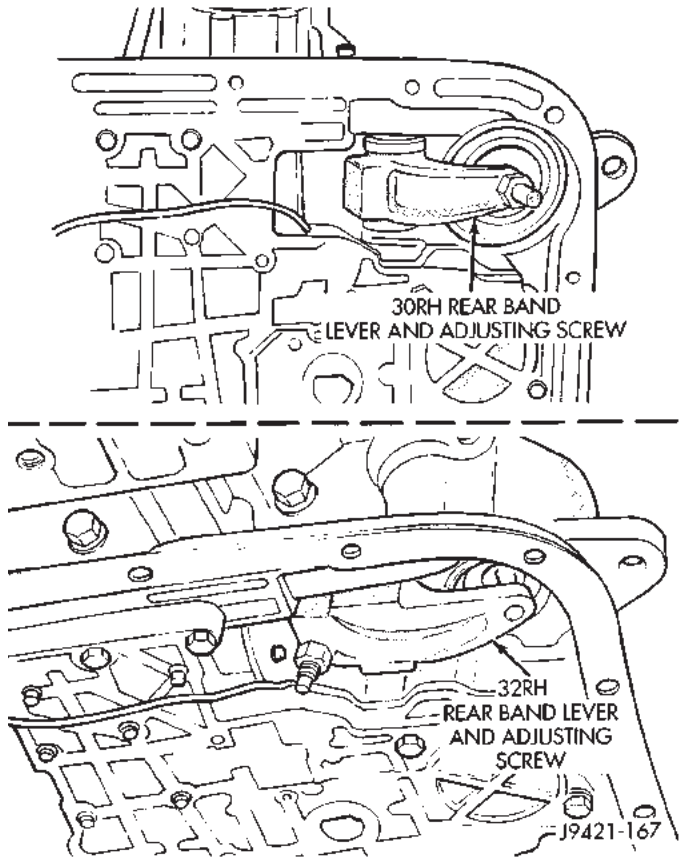


Fig. 181 Rear Band Adjustment Screw Location

If adjustment is required, turn the adjusting screw in, or out, to obtain required distance setting.

NOTE: The 33.4 mm (1-5/16 in.) setting is an approximate setting. Manufacturing tolerances may make it necessary to vary from this dimension to obtain desired pressure.

One complete turn of the adjusting screw changes line pressure approximately 1-2/3 psi (9 kPa).

Turning the adjusting screw counterclockwise increases pressure while turning the screw clockwise decreases pressure.

THROTTLE PRESSURE ADJUSTMENT

Insert Gauge Tool C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 183).

Push the gauge tool inward to compress the kickdown valve against the spring and bottom the throttle valve.

Maintain pressure against kickdown valve spring. Turn throttle lever stop screw until the screw head touches throttle lever tang and the throttle lever cam touches gauge tool.

NOTE: The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed to obtain correct adjustment.

ADJUSTMENTS (Continued)

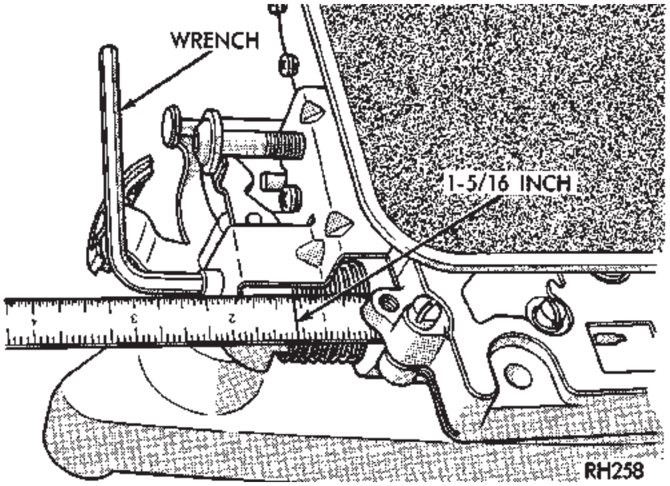


Fig. 182 Line Pressure Adjustment

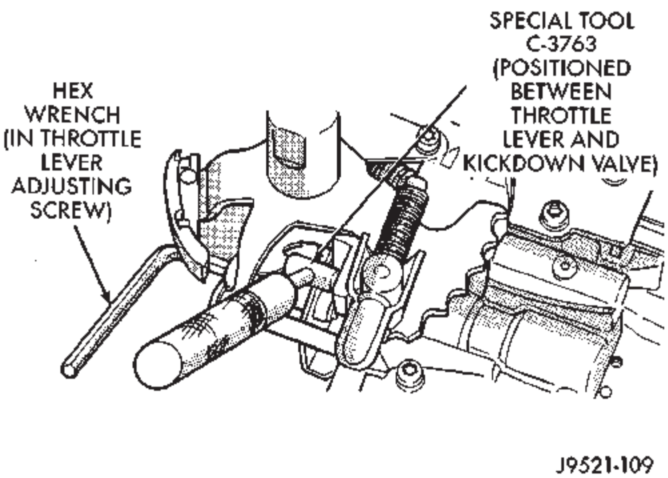
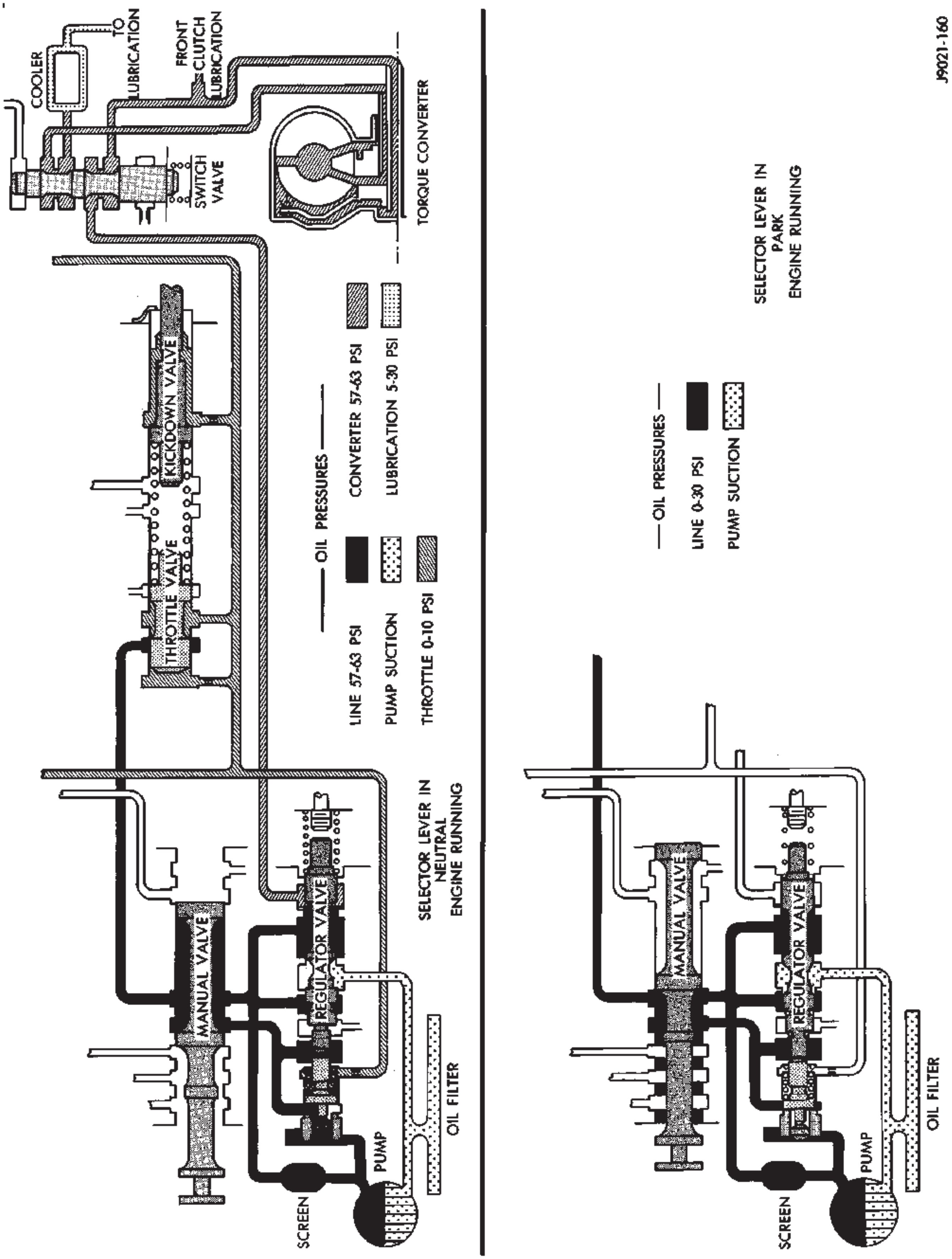


Fig. 183 Throttle Pressure Adjustment

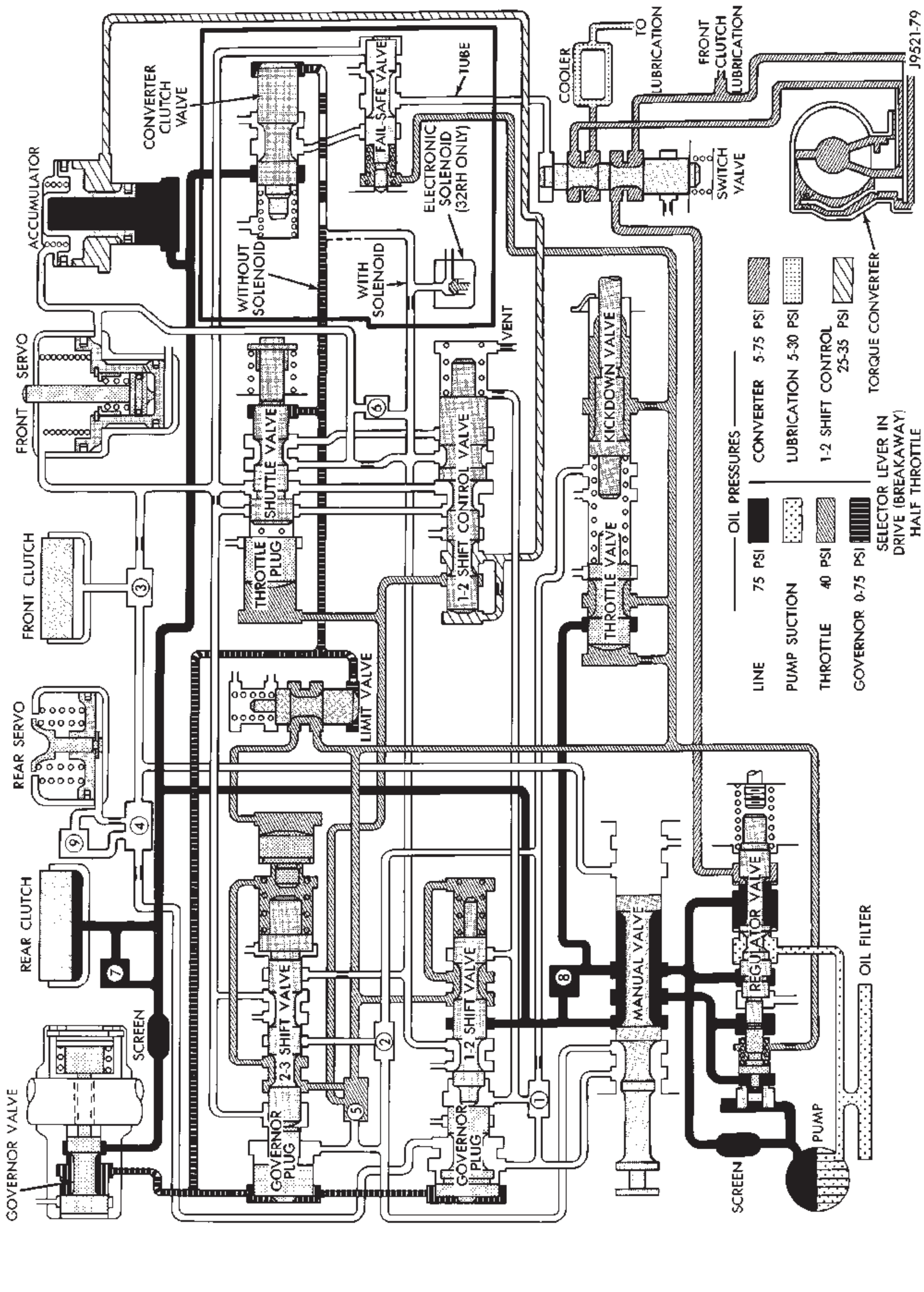
SCHEMATICS AND DIAGRAMS

HYDRAULIC SCHEMATICS



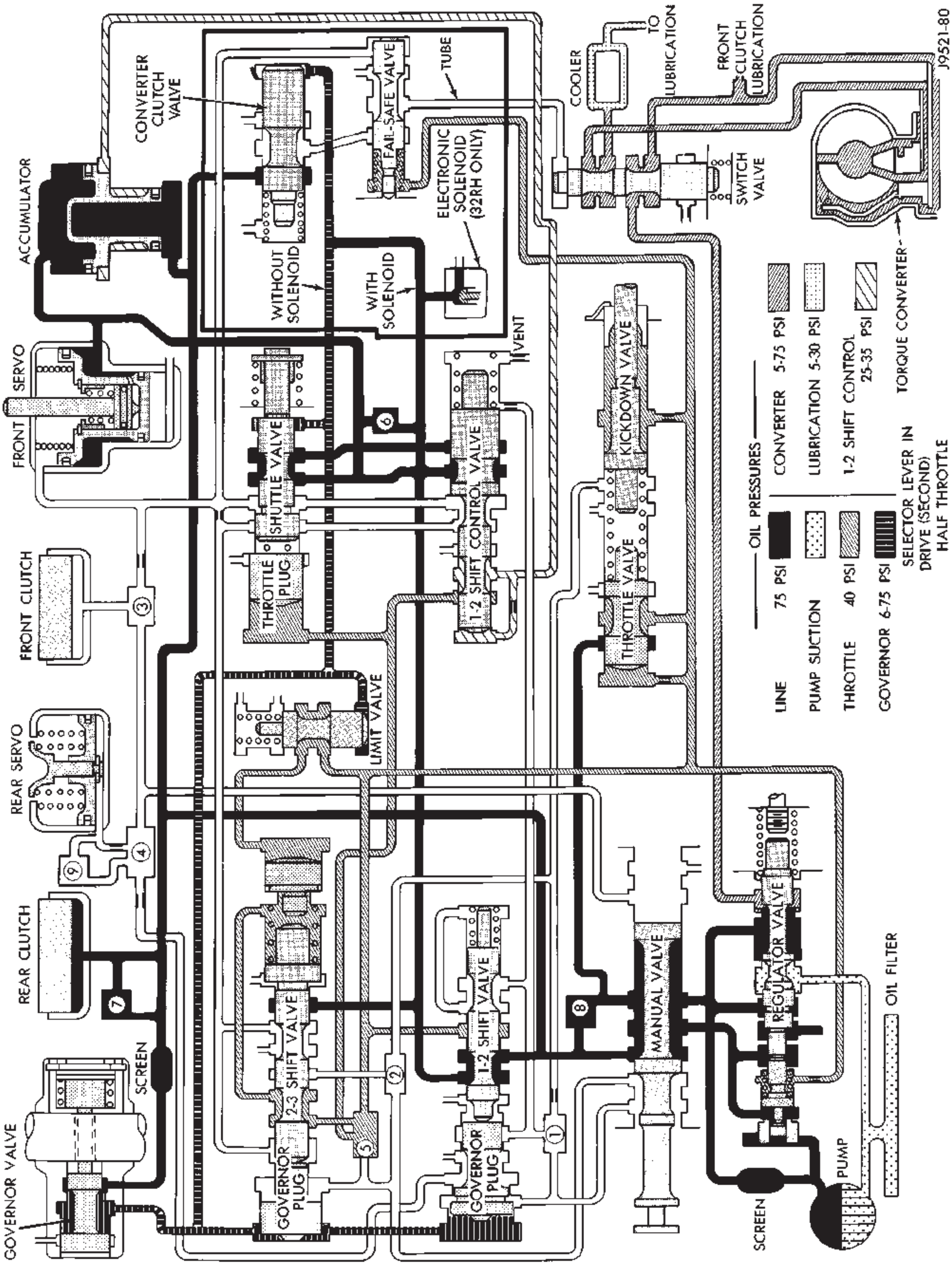
HYDRAULIC FLOW IN PARK/NEUTRAL

SCHEMATICS AND DIAGRAMS (Continued)



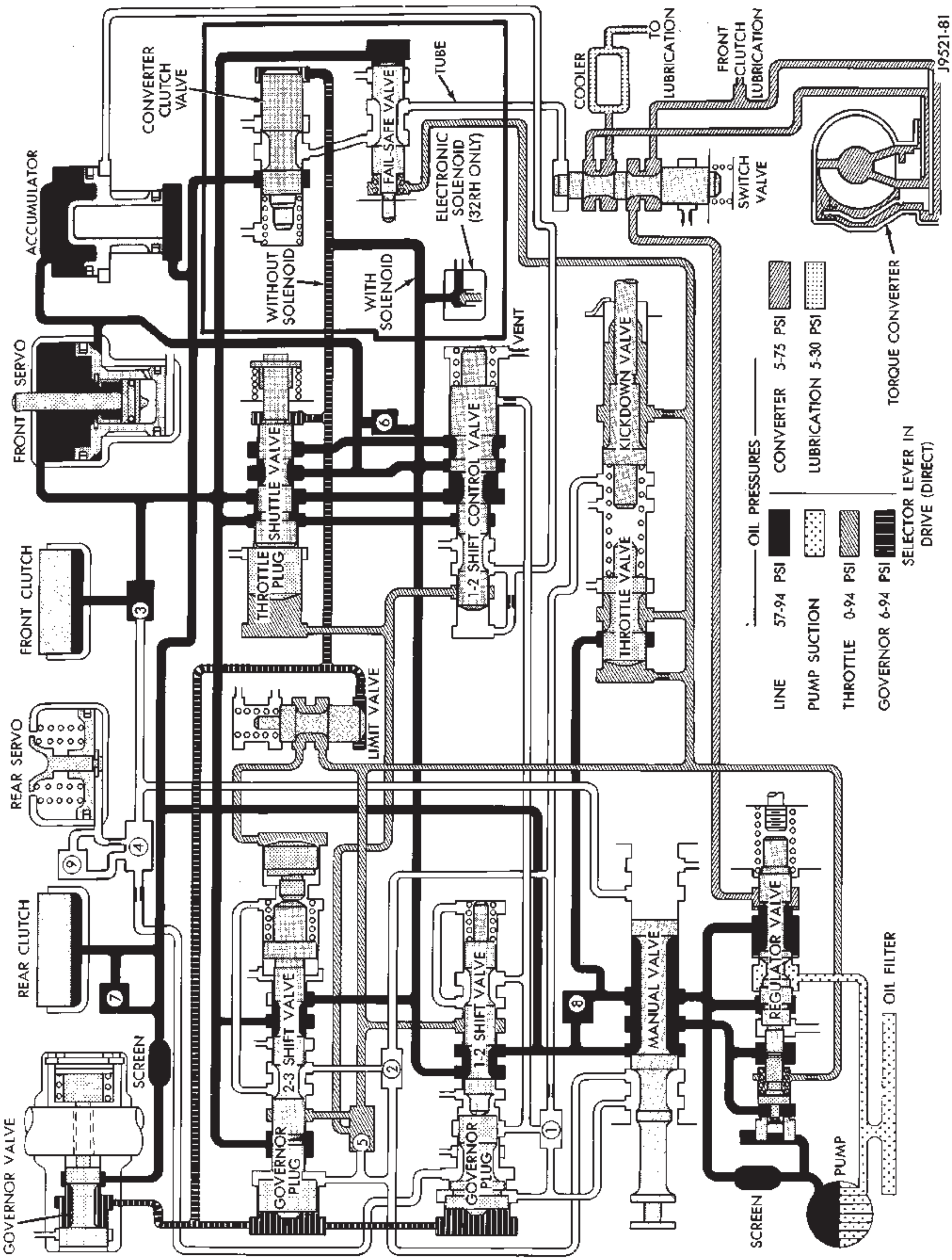
HYDRAULIC FLOW IN D-FIRST GEAR

SCHEMATICS AND DIAGRAMS (Continued)



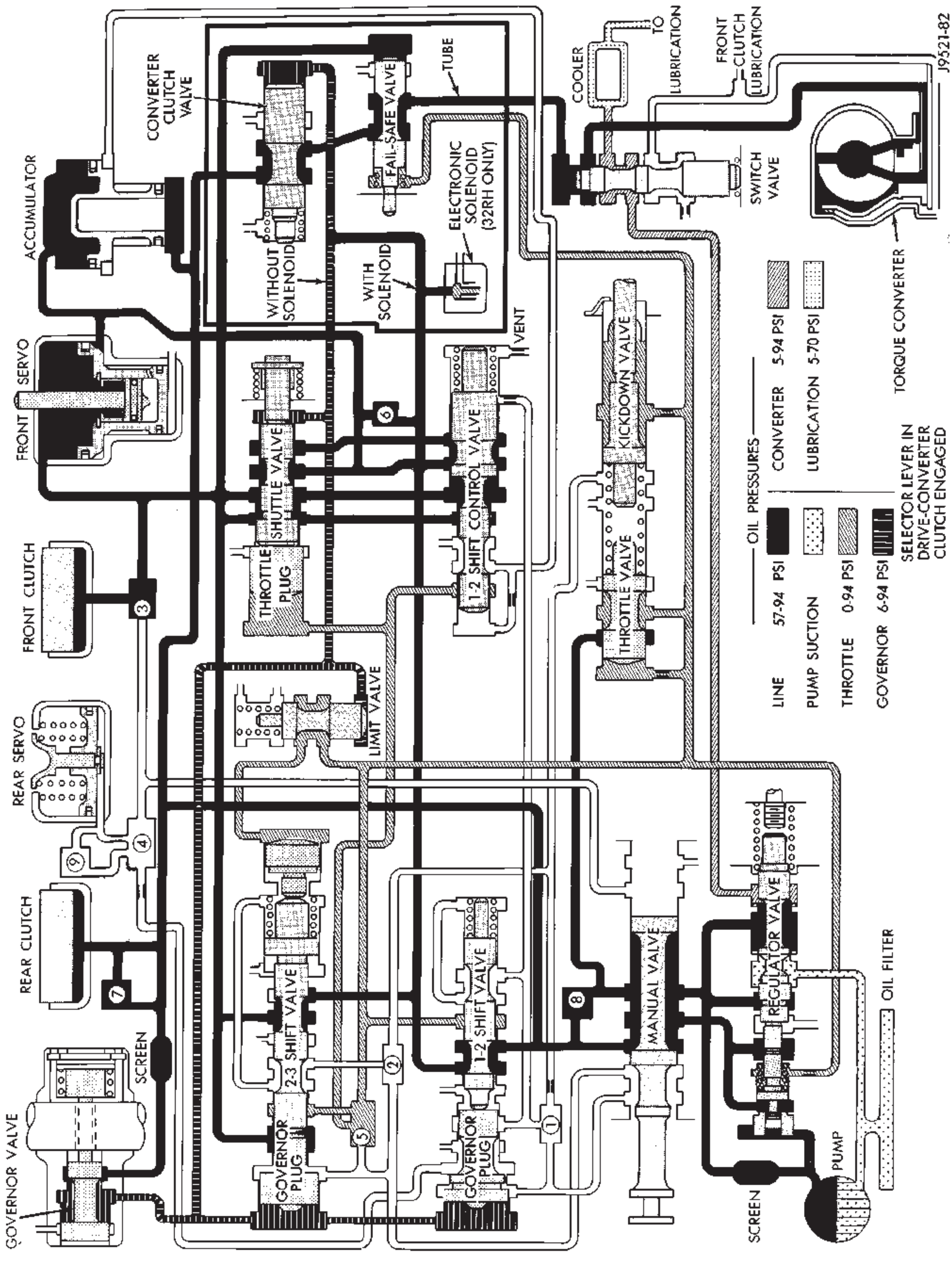
HYDRAULIC FLOW IN D-SECOND GEAR

SCHEMATICS AND DIAGRAMS (Continued)



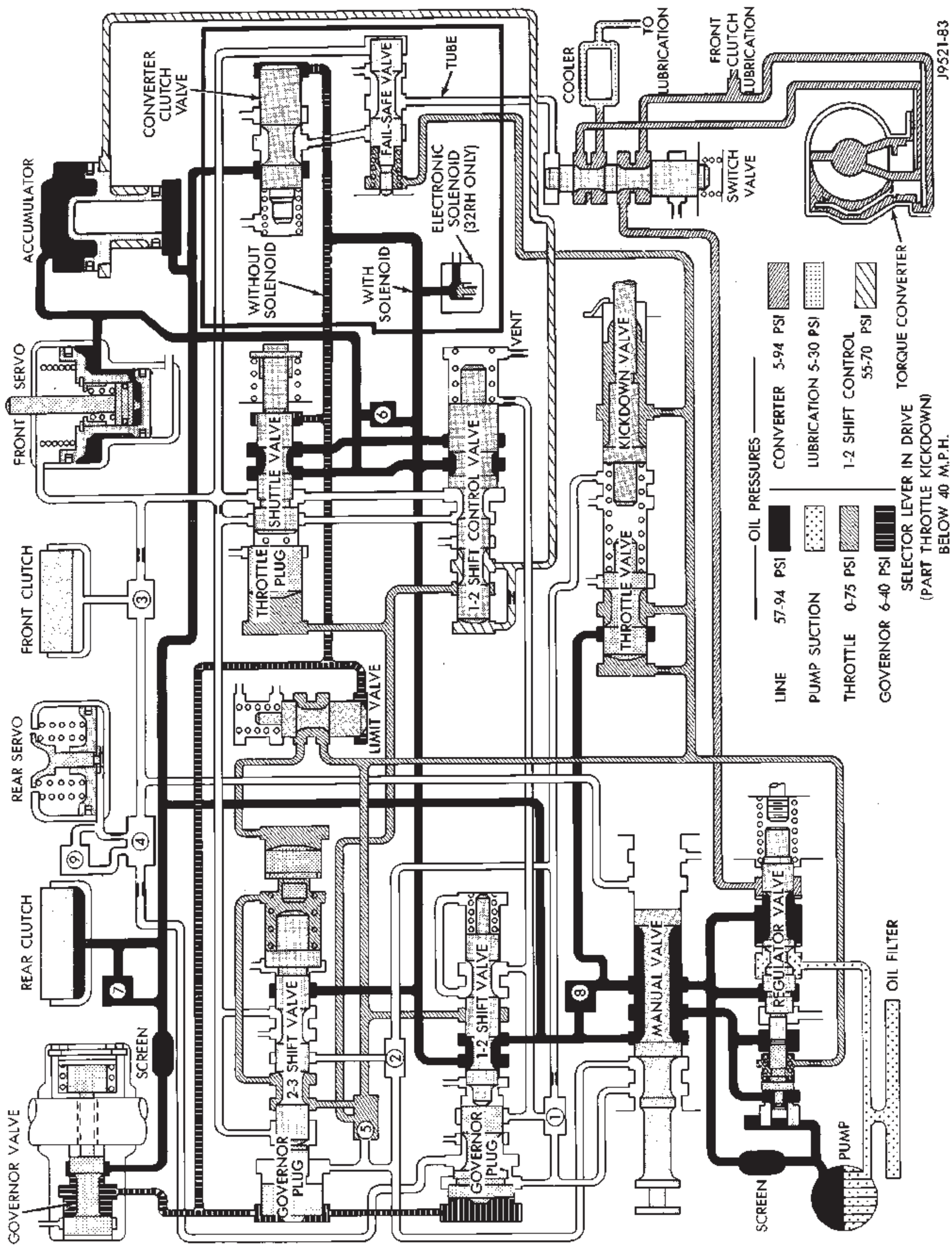
HYDRAULIC FLOW IN D-THIRD GEAR

SCHEMATICS AND DIAGRAMS (Continued)



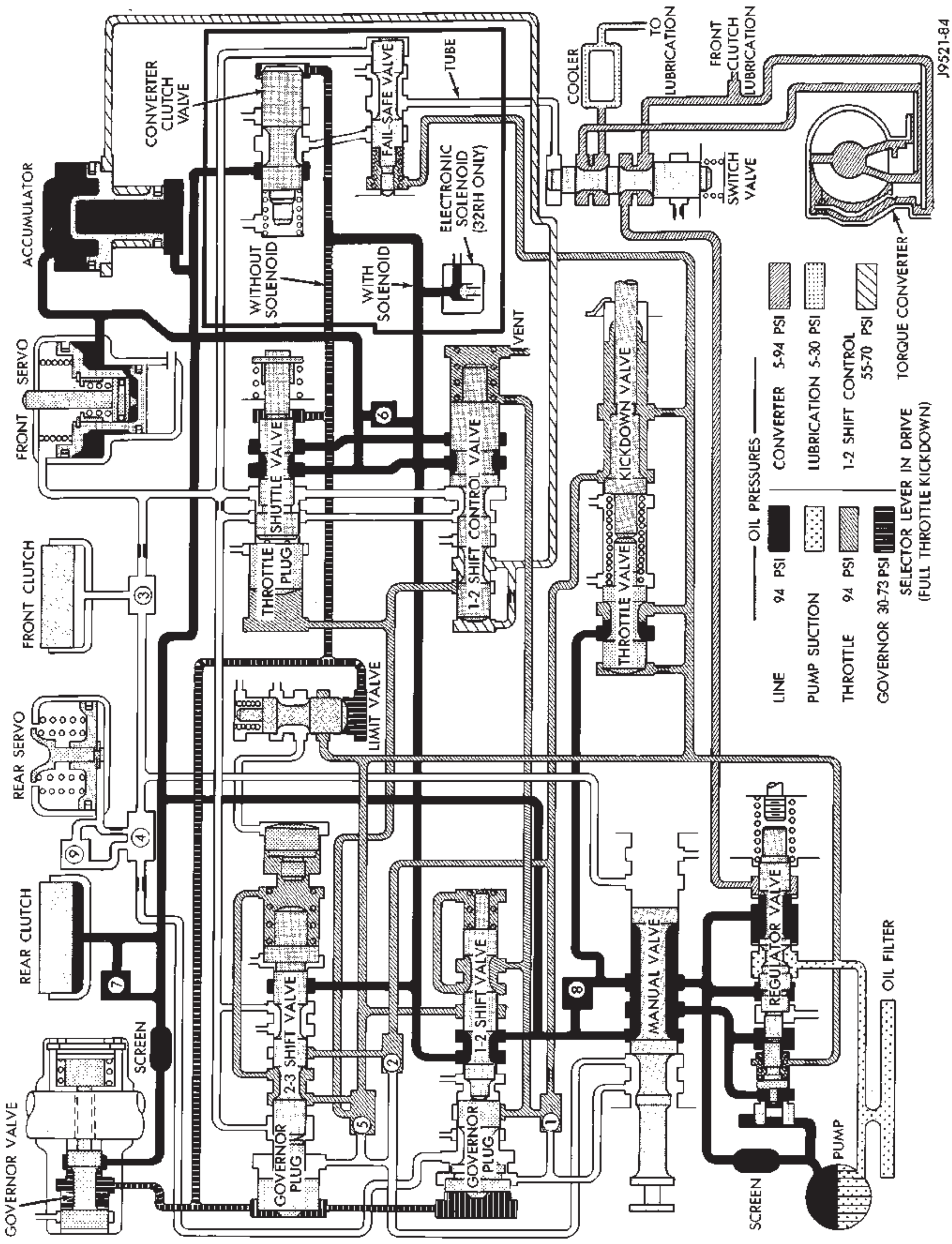
HYDRAULIC FLOW IN D-THIRD GEAR (CONVERTER CLUTCH APPLIED)

SCHEMATICS AND DIAGRAMS (Continued)



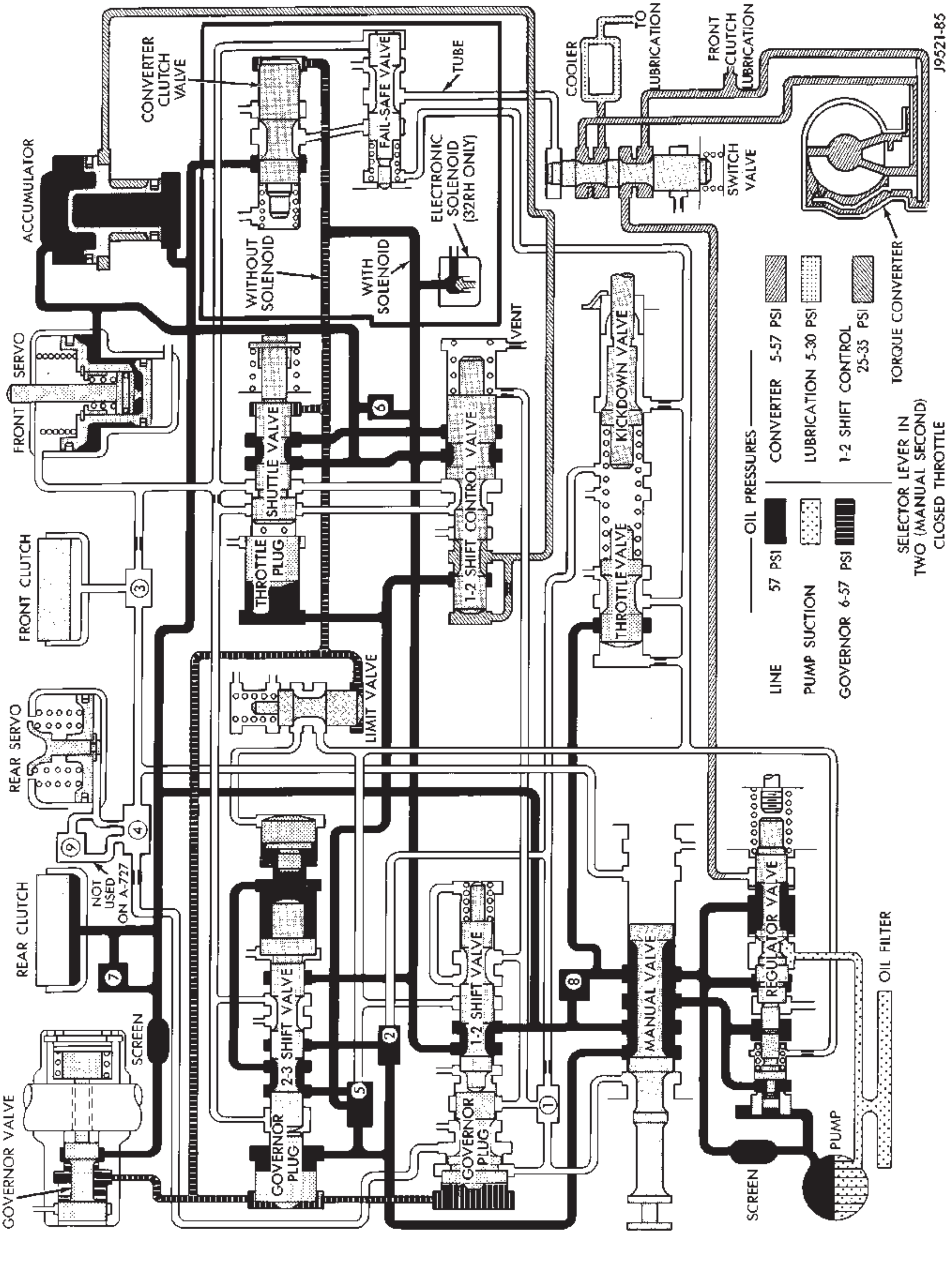
HYDRAULIC FLOW AT PART THROTTLE 3-2 KICKDOWN

SCHEMATICS AND DIAGRAMS (Continued)



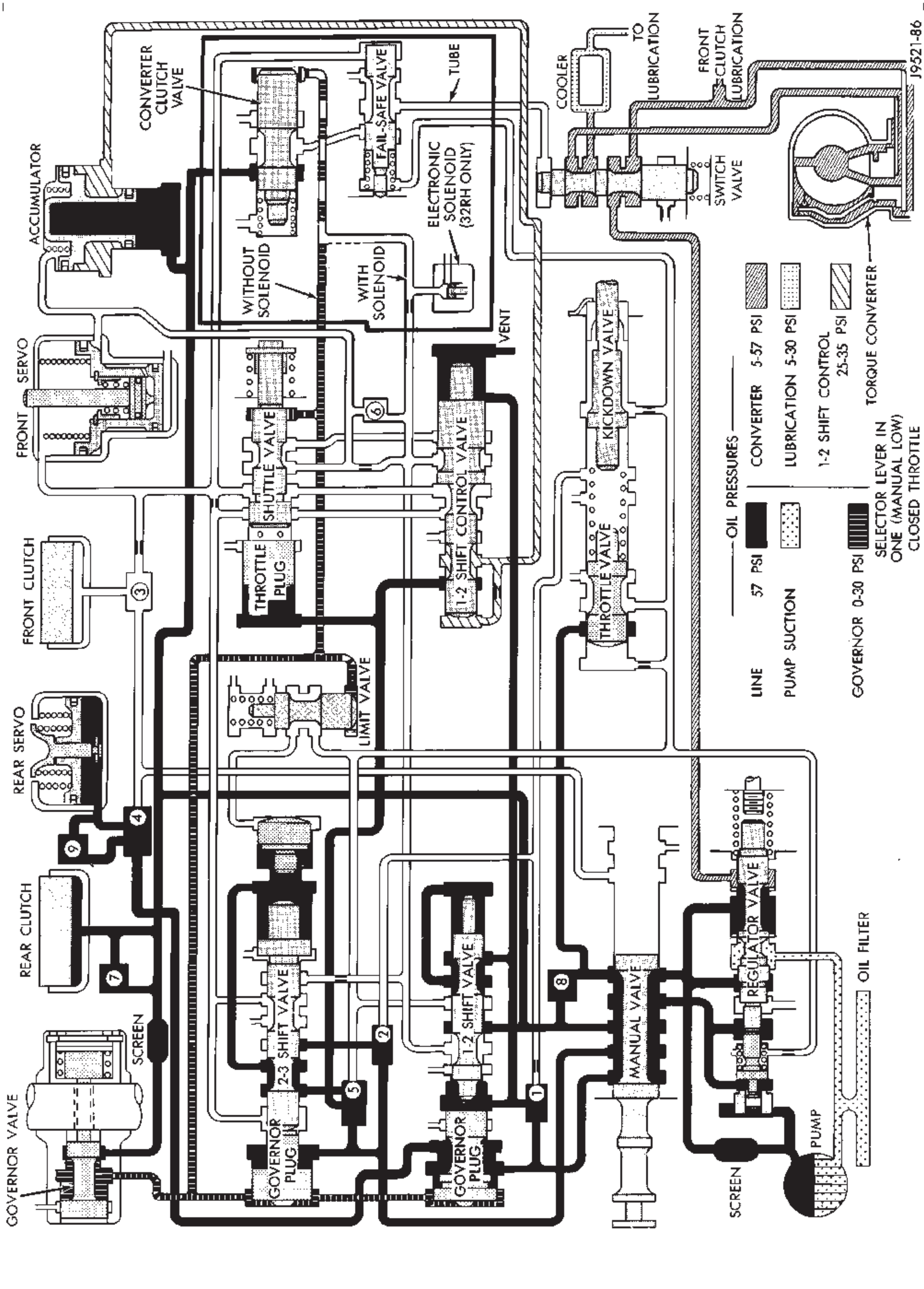
HYDRAULIC FLOW AT FULL THROTTLE 3-2 KICKDOWN

SCHEMATICS AND DIAGRAMS (Continued)



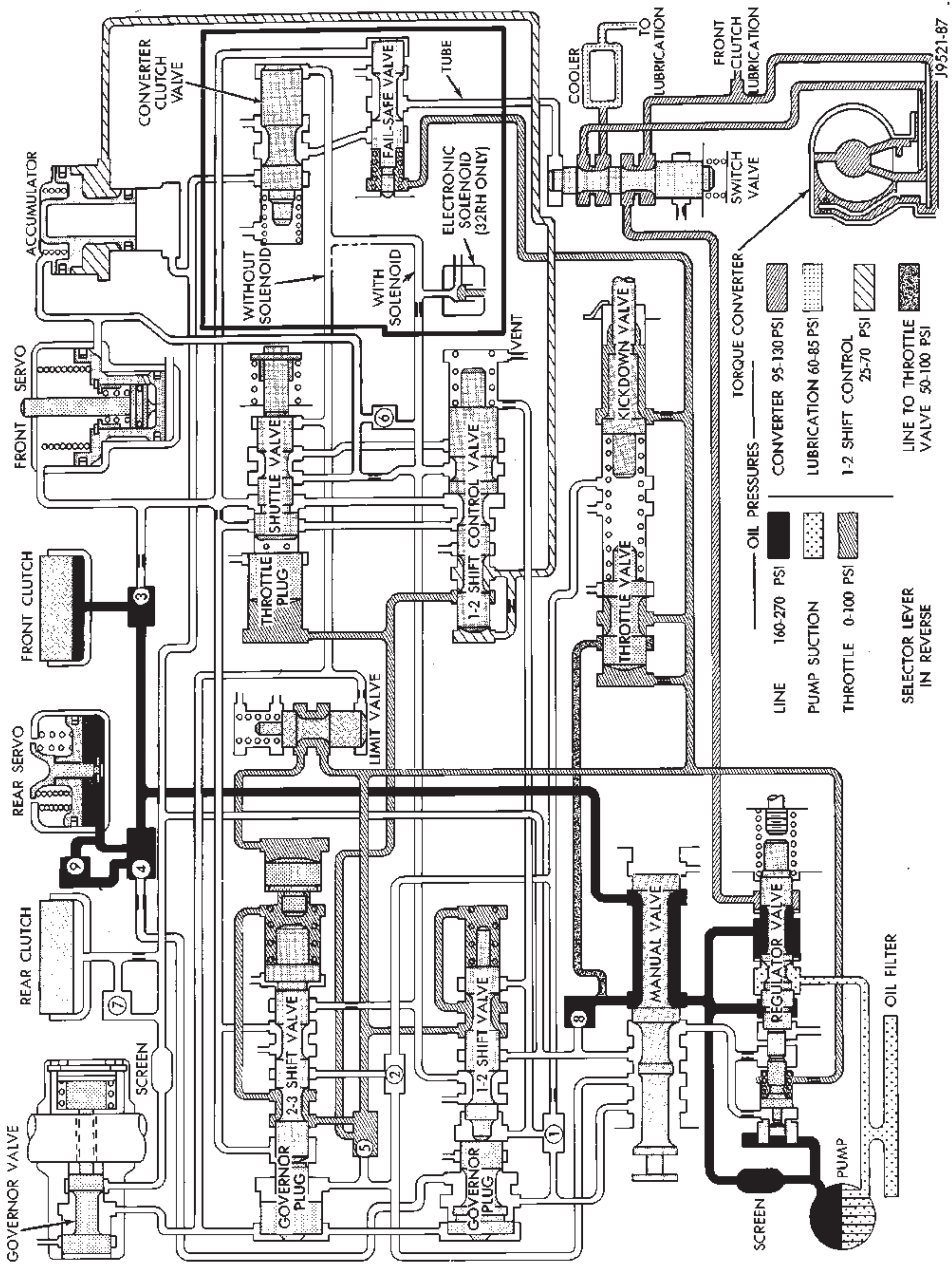
HYDRAULIC FLOW IN MANUAL SECOND

SCHEMATICS AND DIAGRAMS (Continued)



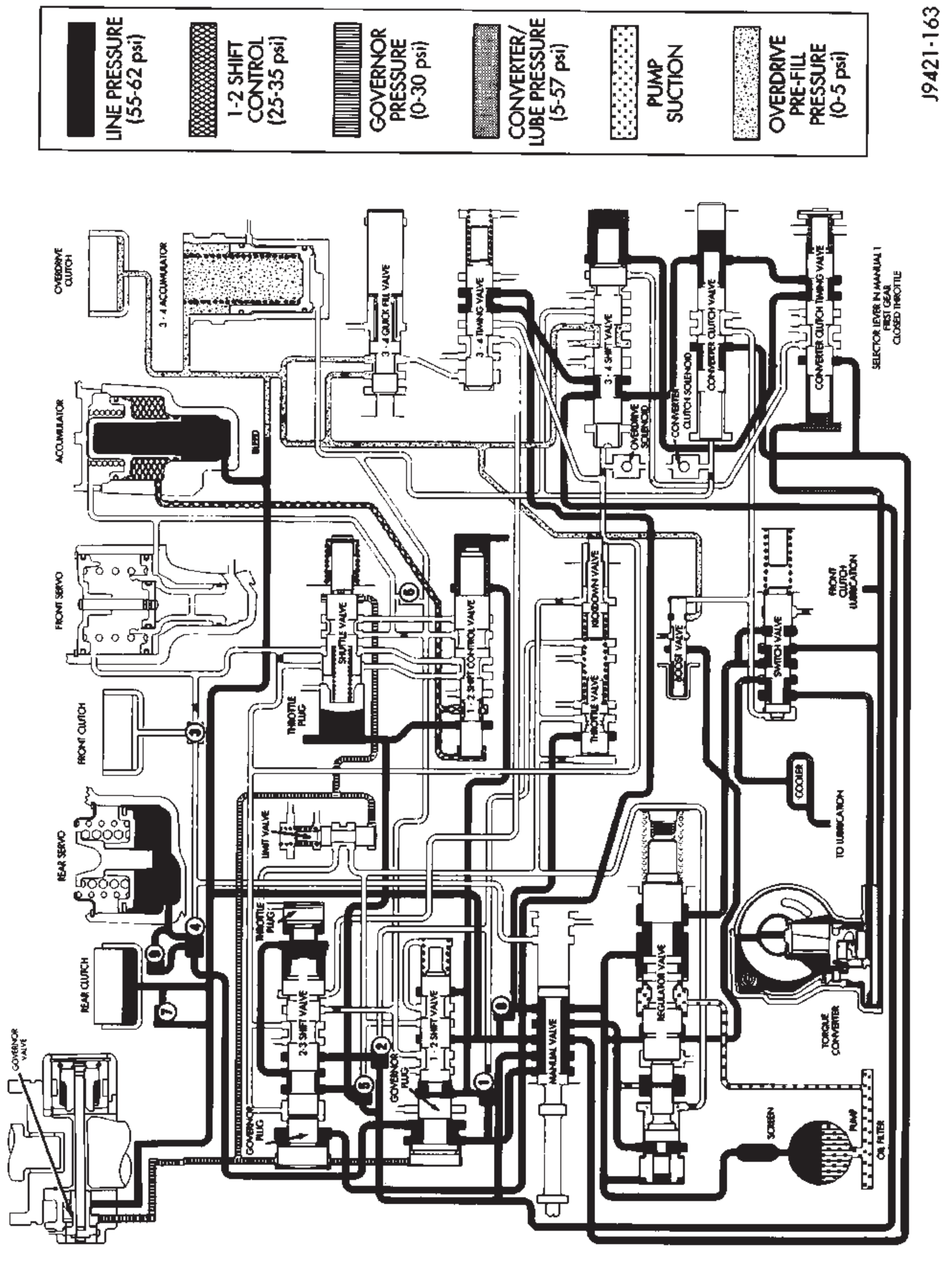
HYDRAULIC FLOW IN MANUAL LOW

SCHEMATICS AND DIAGRAMS (Continued)



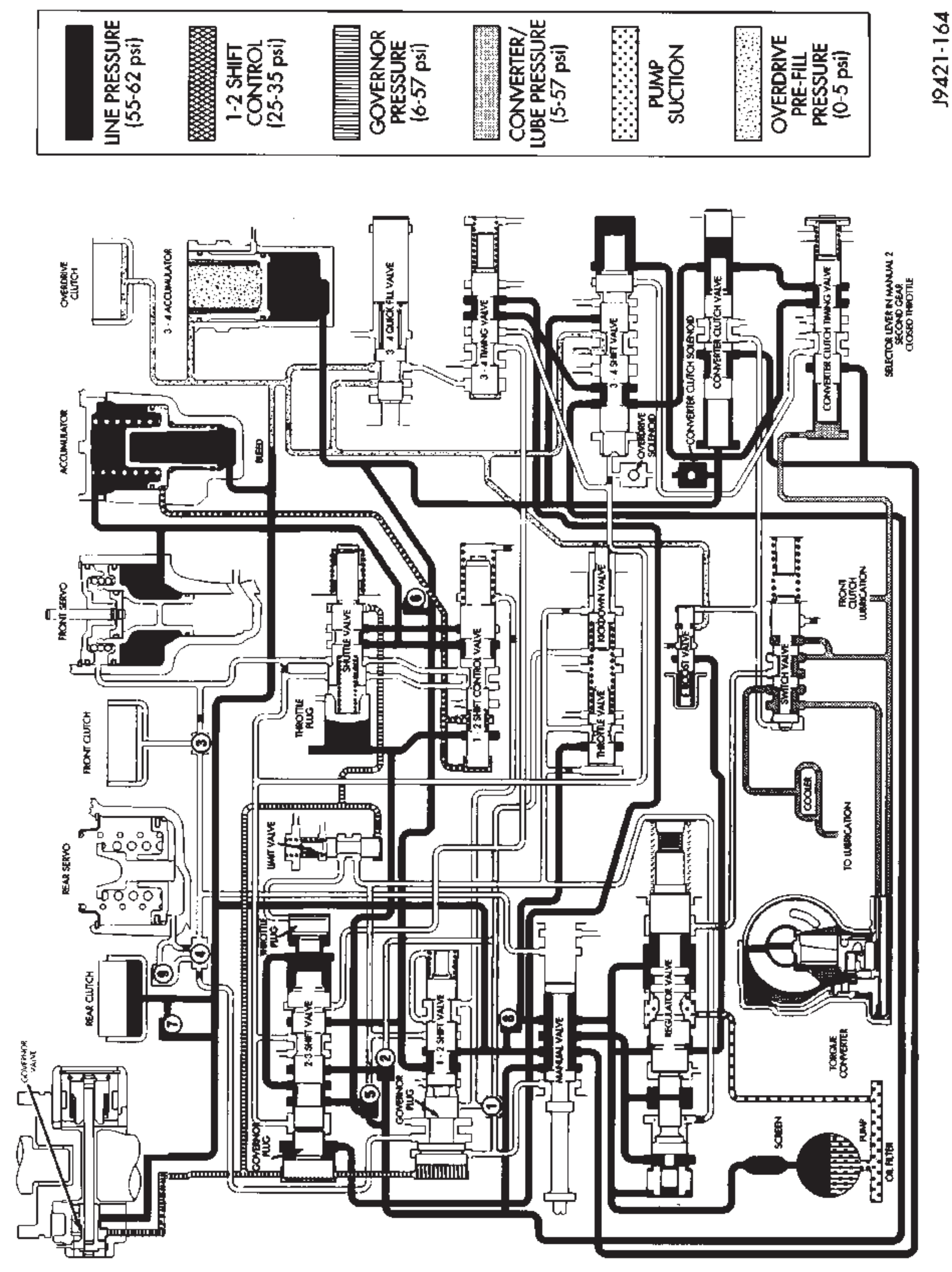
HYDRAULIC FLOW IN REVERSE

SCHEMATICS AND DIAGRAMS (Continued)



HYDRAULIC FLOW IN MANUAL FIRST GEAR (1)

SCHEMATICS AND DIAGRAMS (Continued)



HYDRAULIC FLOW IN MANUAL SECOND GEAR (2)

SPECIFICATIONS

30/32RH AUTOMATIC TRANSMISSION

GENERAL

COMPONENT	METRIC	INCH
Oil pump gear tip clearance	0.089-0.190 mm	0.0035-0.0075 in.
Planetary end play	0.125-1.19 mm	0.001-0.047 in.
Input shaft end play	0.56-2.31 mm	0.022-0.091 in.
Clutch pack clearance/Front 4-disc.	1.70-3.40 mm	0.067-0.134 in.
Clutch pack clearance/Rear 4-disc.	0.559-0.940 mm	0.022-0.037 in.
Front clutch spring usage	1 spring	
32RH-Front Band adjustment from 72 in. lbs.	Back off 2.25 turns	
32RH-Rear Band adjustment from 72 in. lbs.	Back off 4 turns	
30RH-Front Band adjustment from 72 in. lbs.	Back off 2.5 turns	
30RH-Rear Band adjustment from 41 in. lbs.	Back off 7 turns	
Recommended fluid	Mopar®, ATF Plus 3, Type 7176	

THRUST WASHER/SPACER/SNAP RING DIMENSIONS

COMPONENT	METRIC	INCH
Front clutch thrust washer (reaction shaft support hub)	1.55 mm	0.061 in.
Rear clutch thrust washer (clutch retainer)	1.55 mm	0.061 in.
Output shaft thrust plate (output shaft pilot hub)	1.5-1.6mm	0.060-0.063 in.
Output shaft thrust washer (rear clutch hub)	1.3-1.4 mm	0.052-0.054 in.
	1.7-1.8 mm	0.068-0.070 in.
	2.1-2.2 mm	0.083-0.086 in.
Rear clutch pack snap ring	1.5-1.6 mm	0.06-0.062 in.
	1.7-1.8 mm	0.068-0.070 in.
	1.9-2.0 mm	0.076-0.078 in.
Planetary geartrain snap ring (at front of output shaft)	1.0-1.1 mm	0.040-0.044 in.
	1.6-1.7 mm	0.062-0.066 in.
	2.1-2.2 mm	0.082-0.086 in.

SPECIFICATIONS (Continued)

PRESSURE TEST—ALL

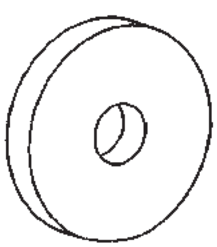
ITEM	RANGE	PRESSURE
Line pressure (at accumulator)	Closed throttle	372-414 kPa (54-60 psi).
Front servo	Third gear only	No more than 21 kPa (3 psi) lower than line pressure.
Rear servo	1 range R range	No more than 21 kPa (3 psi) lower than line pressure. 1103 kPa (160 psi) at idle, builds to 1862 kPa (270 psi) at 1600 rpm.
Governor	D range closed throttle	Pressure should respond smoothly to changes in mph and return to 0-7 kPa (0-1.5 psi) when stopped with transmission in D, 1, 2. Pressure above 7 kPa (1.5 psi) at stand still will prevent transmission from downshifting.

TORQUE

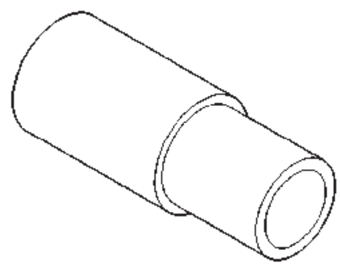
DESCRIPTION **TORQUE**
Bolt, torque convertor . . . . .31 N·m (23 ft. lbs.)
Bolt/nut, crossmember . . . . .68 N·m (50 ft. lbs.)
Bolt, driveplate to crankshaft . . . .75 N·m (55 ft. lbs.)
Plug, front band reaction . . . . . . .17 N·m (13 ft. lbs.)
Locknut, front band adj. . . . . .34 N·m (25 ft. lbs.)
Switch, park/neutral . . . . .34 N·m (25 ft. lbs.)
Bolt, fluid pan. . . . . .17 N·m (13 ft. lbs.)
Bolt, oil pump . . . . .20 N·m (15 ft. lbs.)
Bolt, overrunning clutch cam . . . .17 N·m (13 ft. lbs.)
Plug, pressure test port . . . . .14 N·m (10 ft. lbs.)
Bolt, reaction shaft support . . . . .20 N·m (15 ft. lbs.)
Locknut, rear band . . . . .41 N·m (30 ft. lbs.)
Bolt. speedometer adapter . . . . . . .11 N·m (8 ft. lbs.)
Screw, fluid filter . . . . .4 N·m (35 in. lbs.)
Bolt, valve body to case . . . . . . .12 N·m (100 in. lbs.)

SPECIAL TOOLS

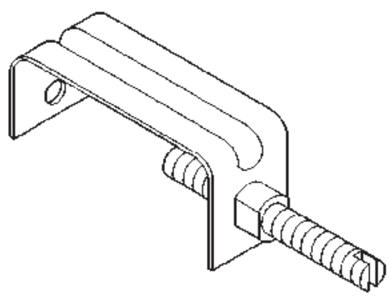
30/32RH TRANSMISSIONS



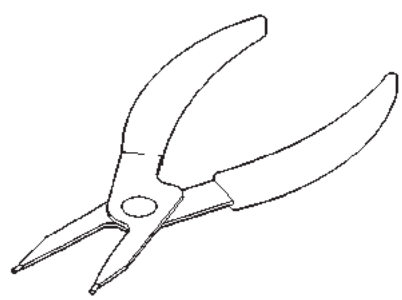
Remover—6957



Installer—6951

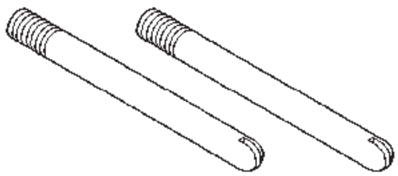


Retainer, Detent Ball and Spring—6583

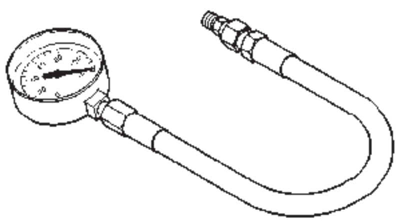


Snap-ring Plier—6823

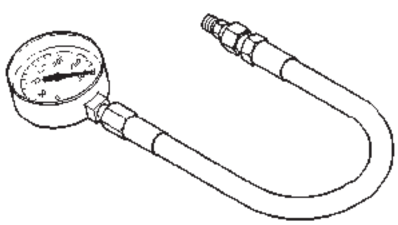
SPECIAL TOOLS (Continued)



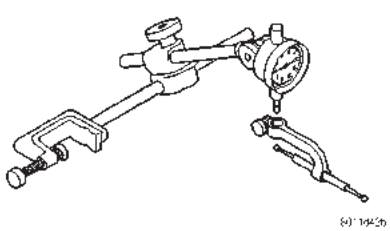
Pilot Stud—C-3288-B



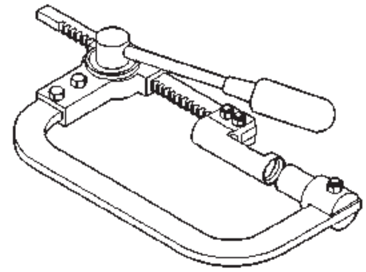
Pressure Gauge—C-3292



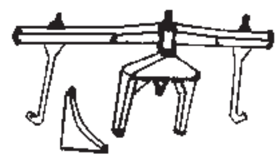
Pressure Gauge—C-3293SP



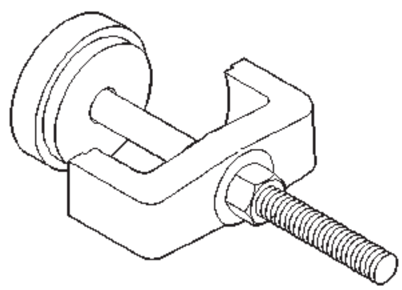
Dial Indicator—C-3339



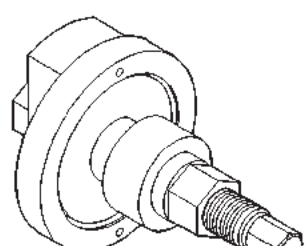
Spring Compressor—C-3422-B



Fixture, Engine Support—C-3487-A



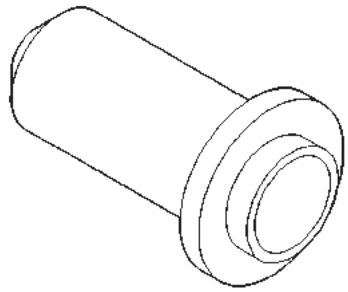
Spring Compressor—C-3575-A



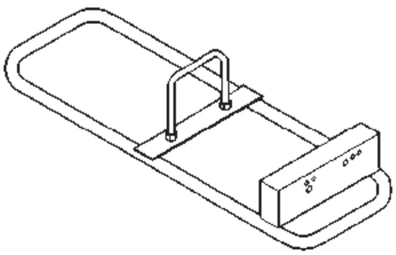
Spring Compressor—C-3863-A

SPECIAL TOOLS (Continued)

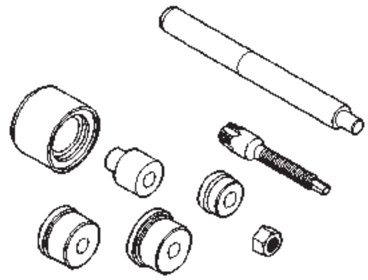
Adapter, Band Adjuster—C-3705



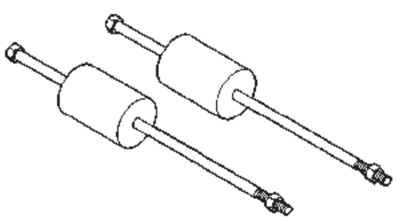
Seal Installer—C-3860-A



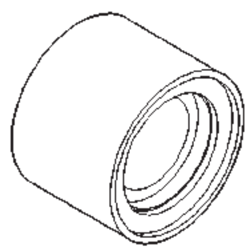
Transmission Repair Stand—C-3750-B



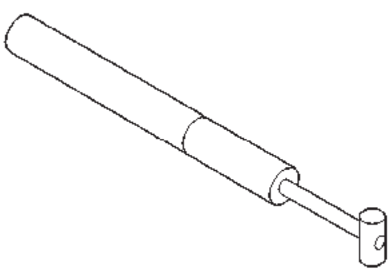
Bushing Remover/Installer—C-3887-J



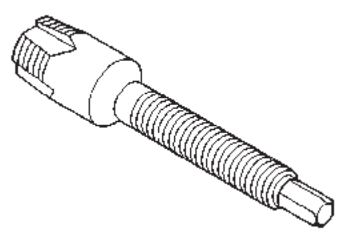
Puller, Slide Hammer—C-3752



Cup, Remover—SP-3633

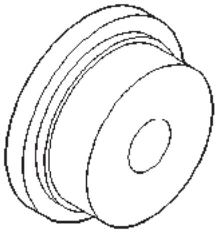


Gauge, Throttle Setting—C-3763

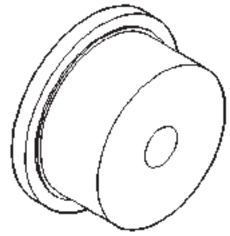


Remover, Bushing—SP-5301

SPECIAL TOOLS (Continued)



Installer, Bushing—SP-5118



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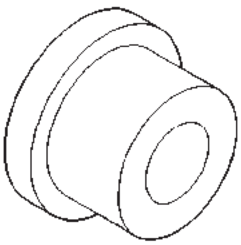
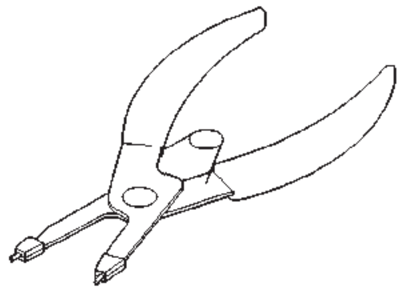
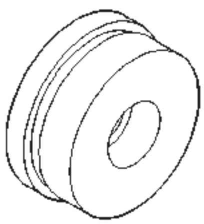


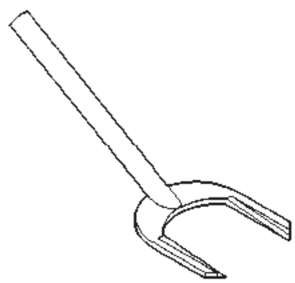
Installer, Bushing—SP-5302



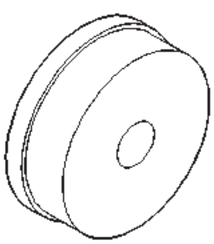
Snap-ring Plier—C-3915



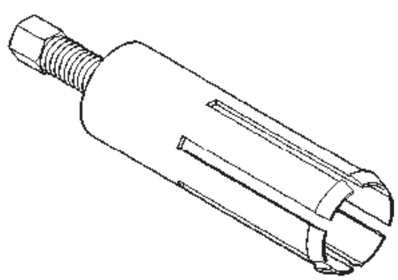
Remover, Bushing—SP-3550



Seal Remover—C-3985-B

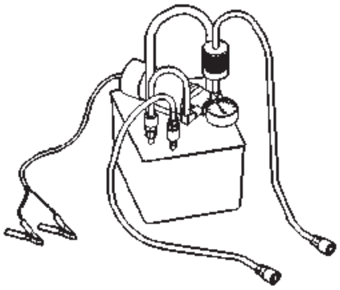


Remover, Bushing—SP-3629

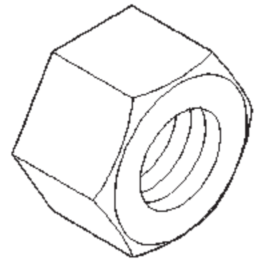


Bushing, Remover—6957

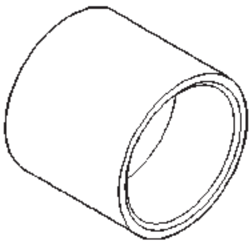
SPECIAL TOOLS (Continued)



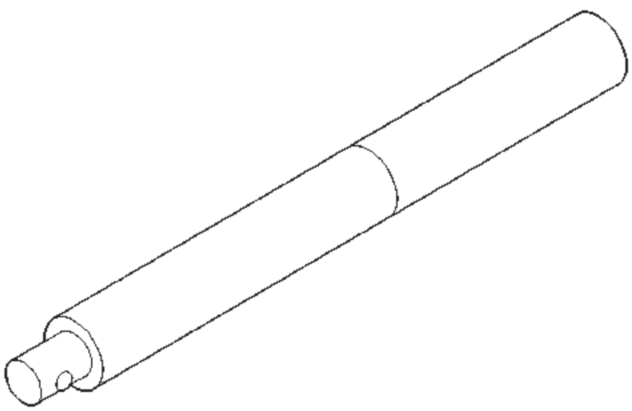
Flusher, Oil Cooler—6906



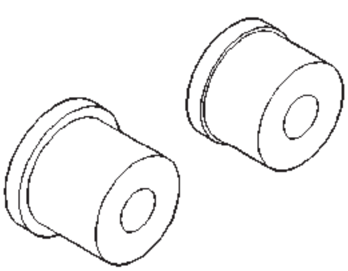
Nut, Bushing Remover—SP-1191



Installer—C-3995-A



Universal Handle—C-4171



Remover/Installer—C-4470

NV231 TRANSFER CASE

INDEX

GENERAL INFORMATION

NV231 TRANSFER CASE

The NV231 is a part-time transfer case with a low range reduction gear system. The NV231 has three operating ranges plus a Neutral position. A low range system provides a reduction ratio for increased low speed torque capability.

The input gear is splined to the transmission output shaft. The input gear drives the mainshaft through the planetary assembly and range hub. The front output shaft is operated by a drive chain that connects the shaft to a drive sprocket on the mainshaft. The drive sprocket is engaged/disengaged by the mode fork, which operates the mode sleeve and hub. The sleeve and hub are not equipped with a synchronizer mechanism for shifting.

The geartrain is mounted in two aluminum case halves attached with bolts. The mainshaft front and rear bearings are mounted in aluminum retainer housings bolted to the case halves.

OPERATING RANGES

Transfer case operating ranges are:
- 2WD (2-wheel drive)
- 4x4 (4-wheel drive)
- 4 Lo (4-wheel drive low range

The 2WD range is for use on any road surface at any time.

The 4x4 and 4 Lo ranges are for off road use only. They are not for use on hard surface roads. The only exception being when the road surface is wet or slippery or covered by ice and snow.

The low range reduction gear system is operative in 4 Lo range only. This range is for extra pulling power in off road situations. Low range reduction ratio is 2.72:1.

SHIFT MECHANISM

Operating ranges are selected with a floor mounted shift lever. The shift lever is connected to the transfer case range lever by an adjustable linkage rod. A straight line shift pattern is used. Range positions are marked on the shifter bezel cover plate.

TRANSFER CASE IDENTIFICATION

A circular ID tag is attached to the rear case of each transfer case (Fig. 1). The ID tag provides the transfer case model number, assembly number, serial number, and low range ratio.

The transfer case serial number also represents the date of build.

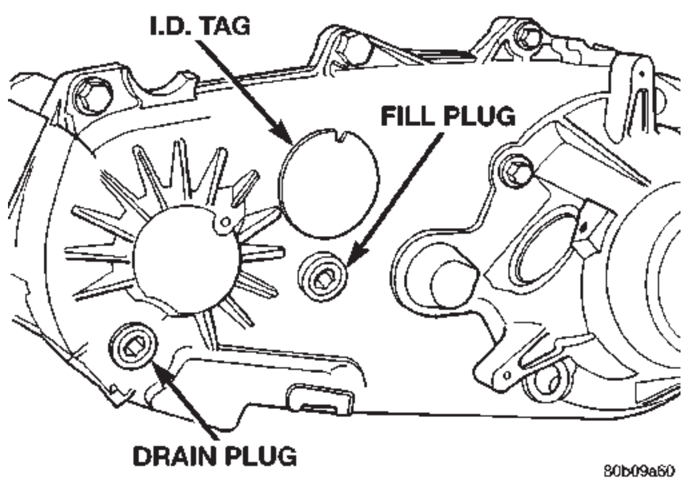


Fig. 1 Fill/Drain Plug And I.D. Tag Locations

RECOMMENDED LUBRICANT AND FILL LEVEL

Recommended lubricant for the NV231 transfer case is Mopar® Dexron II, or ATF Plus. Approximate lubricant fill capacity is 1.2 liters (2.5 pints).

The fill and drain plugs are both in the rear case (Fig. 1). Correct fill level is to the bottom edge of the fill plug hole. Be sure the vehicle is level to ensure an accurate fluid level check.

DIAGNOSIS AND TESTING

NV231 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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REMOVAL AND INSTALLATION

TRANSFER CASE

REMOVAL

(1) Shift transfer case into Neutral.
(2) Raise vehicle.
(3) Drain transfer case lubricant.
(4) Mark front and rear propeller shaft yokes for alignment reference.
(5) Support transmission with jack stand.
(6) Remove rear crossmember, or skid plate.
(7) Disconnect front/rear propeller shafts at transfer case.
(8) Disconnect vehicle speed sensor wires.
(9) Disconnect transfer case linkage rod from range lever.
(10) Disconnect transfer case vent hose (Fig. 2) and indicator switch harness, if necessary.
(11) Support transfer case with transmission jack.
(12) Secure transfer case to jack with chains.
(13) Remove nuts attaching transfer case to transmission.
(14) Pull transfer case and jack rearward to disengage transfer case.
(15) Remove transfer case from under vehicle.

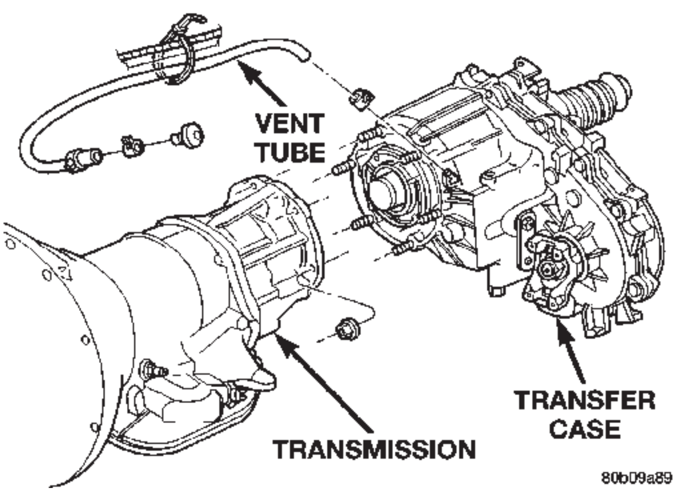


Fig. 2 Transfer Case Mounting

INSTALLATION

(1) Mount transfer case on a transmission jack.
(2) Secure transfer case to jack with chains.
(3) Position transfer case under vehicle.
(4) Align transfer case and transmission shafts and install transfer case on transmission.
(5) Install and tighten transfer case attaching nuts to 35 N·m (26 ft. lbs.) torque (Fig. 2).
(6) Connect vehicle speed sensor wires, and vent hose.
(7) Connect indicator switch harness to transfer case switch, if necessary. Secure wire harness to clips on transfer case.
(8) Align and connect propeller shafts. Refer to Group 3, Differential and Driveline, for proper procedures and specifications.
(9) Fill transfer case with correct fluid. Check transmission fluid level. Correct as necessary.
(10) Install rear crossmember, or skid plate. Tighten crossmember bolts to 41 N·m (30 ft. lbs.) torque.
(11) Remove transmission jack and support stand.
(12) Connect shift rod to transfer case range lever.
(13) Adjust transfer case shift linkage.
(14) Lower vehicle and verify transfer case shift operation.

SHIFT LEVER

REMOVAL

(1) Shift transfer case into 4L.
(2) Raise vehicle.
(3) Loosen adjusting trunnion locknut and slide shift rod out of trunnion (Fig. 3). If rod lacks enough travel to come out of trunnion, push trunnion out of torque shaft.
(4) Lower vehicle.
(5) Remove console. Refer to Group 23, Body, for proper procedures.
(6) Remove screws attaching lever assembly to floorpan and remove assembly and shift rod (if left attached).

INSTALLATION

(1) If shift rod was not removed from lever assembly, work rod down through floorpan opening. Then position lever assembly on floorpan and install assembly attaching screws.
(2) Install console. Refer to Group 23, Body, for proper procedures.
(3) Raise vehicle.
(4) Connect trunnion to torque shaft arm. Or, slide shift rod into trunnion on range lever. Be sure shift rod slides freely in trunnion.
(5) Verify that range lever is in 4L position. Then tighten trunnion lock bolt.
(6) Lower vehicle and check transfer case shift operation.

SPEEDOMETER

REMOVAL

(1) Raise vehicle.
(2) Disconnect wires from vehicle speed sensor.
(3) Remove adapter clamp and screw (Fig. 4).
(4) Remove speed sensor and speedometer adapter as an assembly.
(5) Remove speed sensor retaining screw and remove sensor from adapter.

REMOVAL AND INSTALLATION (Continued)

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.)

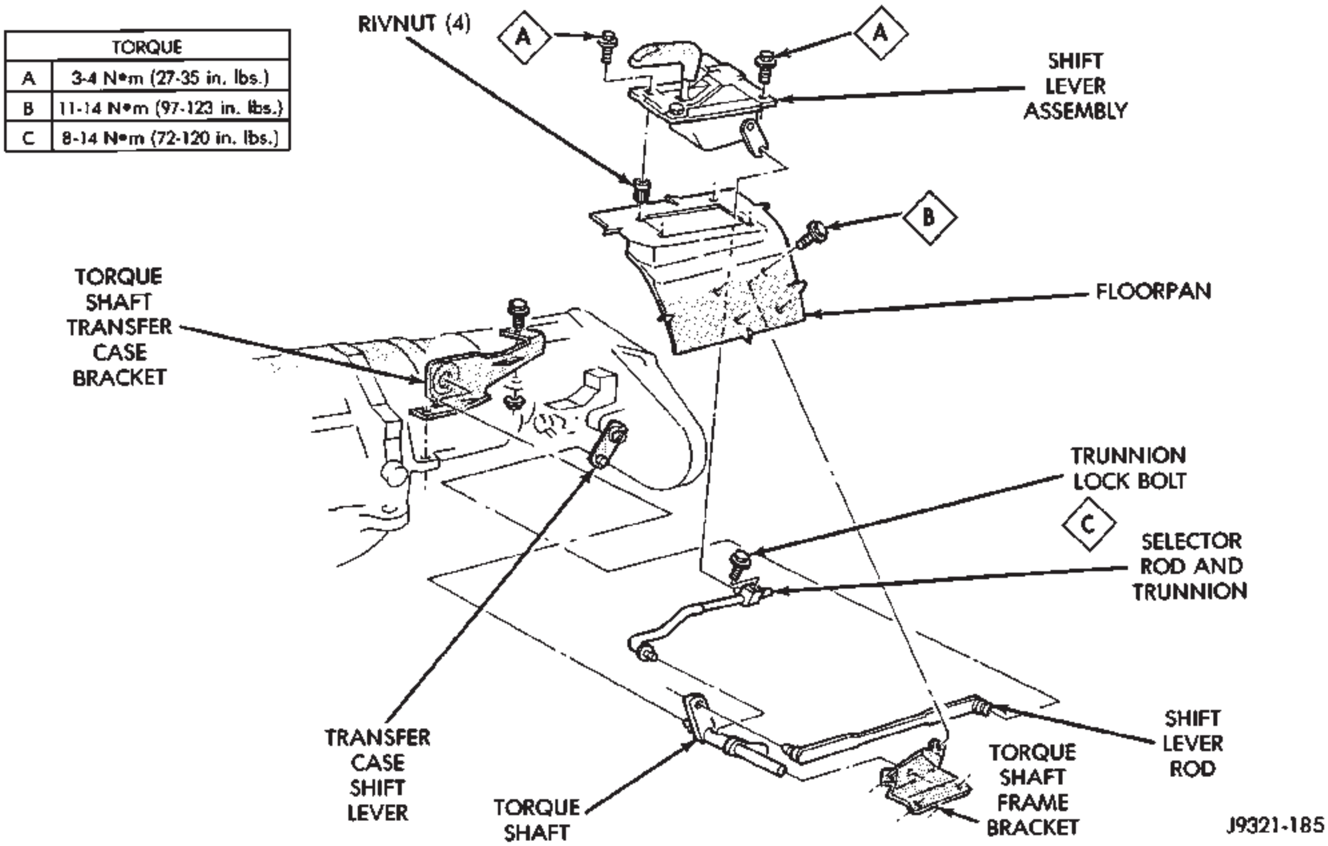


Fig. 3 Shift Linkage

(6) Remove speedometer pinion from adapter. Replace pinion if chipped, cracked, or worn.

(7) Inspect sensor and adapter O-rings (Fig. 4). 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 if pins are loose, severely corroded, or damaged.

ITEM	TORQUE
A	2-3 N•m (15-27 in. lbs.)
B	10-12 N•m (90-110 in. lbs.)

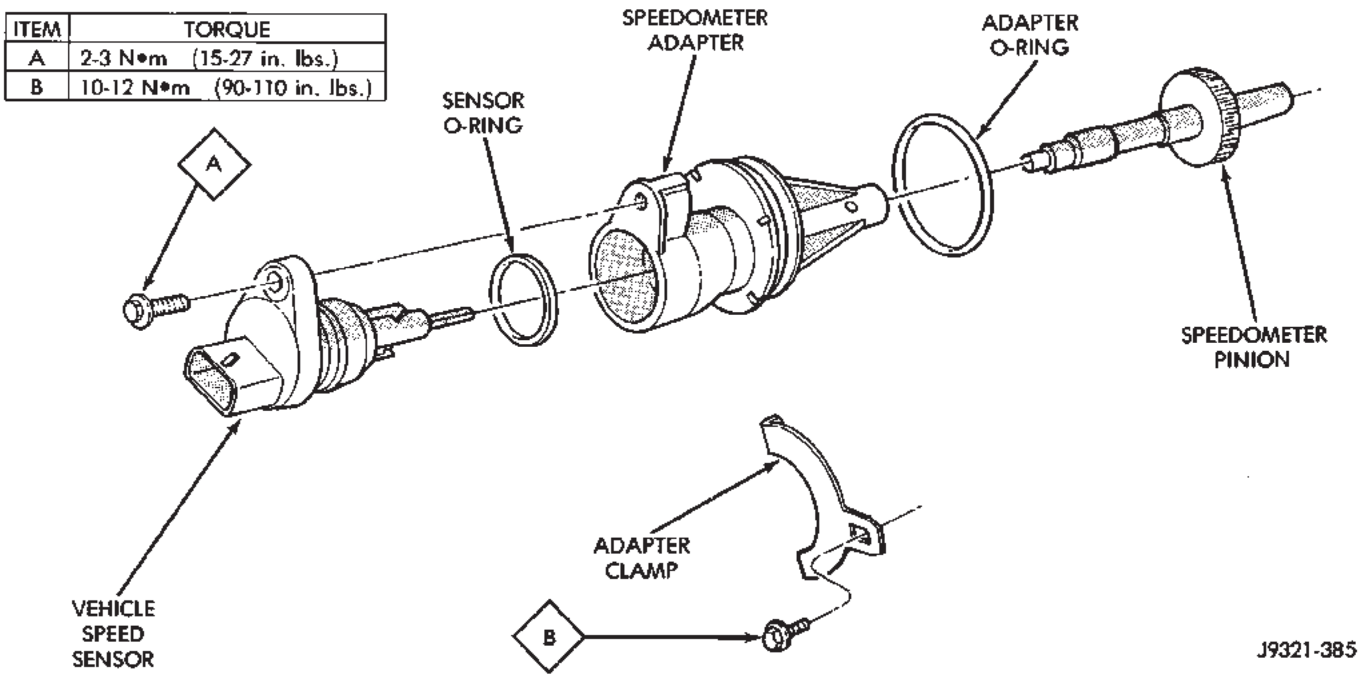


Fig. 4 Speedometer Components

REMOVAL AND INSTALLATION (Continued)

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 (Fig. 4), if necessary.

(3) Lubricate sensor and adapter O-rings with transmission fluid.

(4) Install vehicle speed sensor in speedometer adapter. Tighten sensor attaching screw to 2-3 N·m (15-27 in. lbs.) torque.

(5) Install speedometer pinion in adapter.

(6) Count number of teeth on speedometer pinion. Do this before installing assembly in housing. Then lubricate pinion teeth with transmission fluid.

(7) Note index numbers on adapter body (Fig. 5). 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.

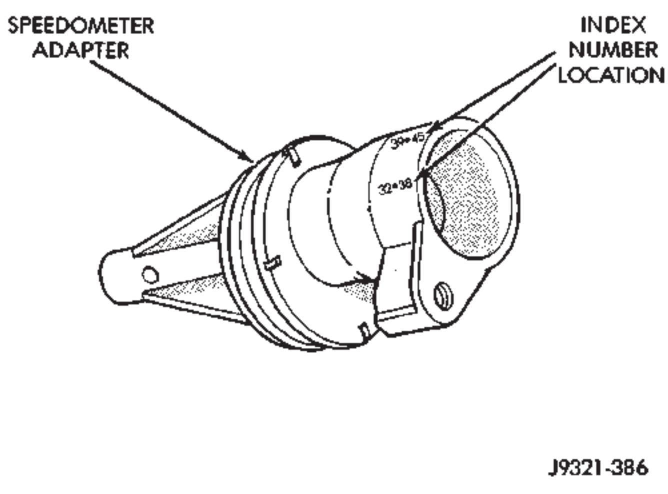


Fig. 5 Location Of Index Numbers On Speedometer Adapter

FRONT OUTPUT SHAFT SEAL

REMOVAL

(1) Raise vehicle.

(2) Remove front propeller shaft. Refer to Group 3, Differential and Driveline, for proper procedure.

(3) Remove front output shaft yoke.

(4) Remove seal from front case with pry tool (Fig. 6).

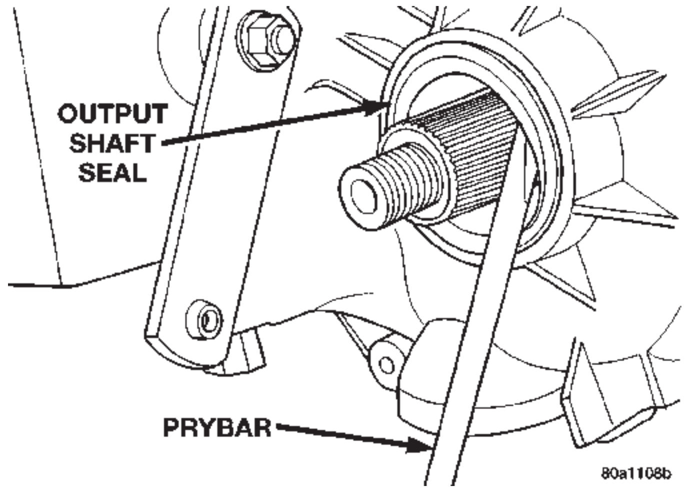


Fig. 6 Remove Front Output Shaft Seal

INSTALLATION

(1) Install new front output seal in front case with Installer Tool 8143 as follows:

(a) Place new seal on tool. Garter spring on seal goes toward interior of case.

(b) Start seal in bore with light taps from hammer (Fig. 7). Once seal is started, continue tapping seal into bore until installer tool seats against case.

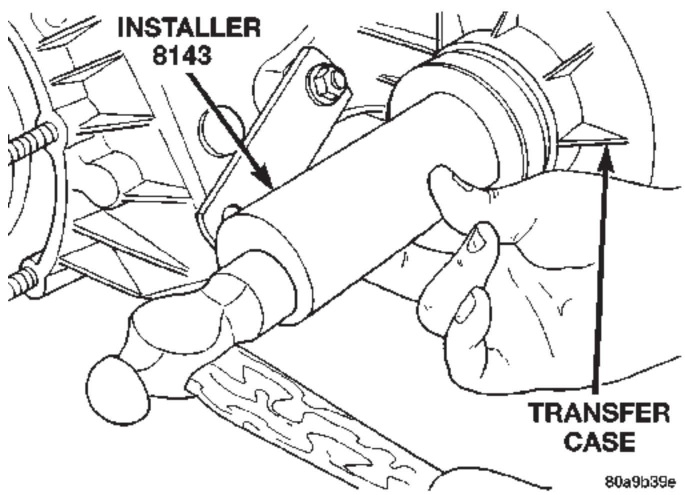


Fig. 7 Front Output Seal Installation

DISASSEMBLY AND ASSEMBLY

NV231 TRANSFER CASE

DISASSEMBLY

Position transfer case on shallow drain pan. Remove drain plug and drain lubricant remaining in case.

REAR RETAINER AND OIL PUMP REMOVAL

(1) Remove the speedometer adapter.

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Spread band clamp which holds output shaft boot to slinger with a suitable awl, or equivalent.

(3) Remove output shaft boot from slinger and output shaft.

(4) Using Puller MD-998056-A, remove rear slinger (Fig. 8).

(5) Remove slinger stop spacer and snap-ring from output shaft (Fig. 9).

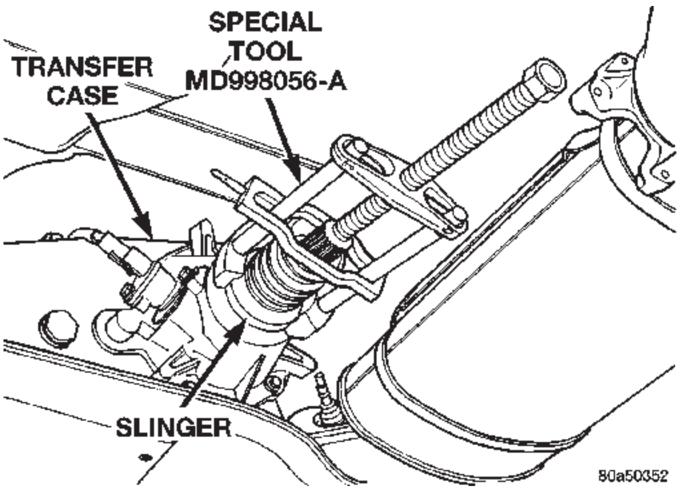


Fig. 8 Rear Slinger Removal

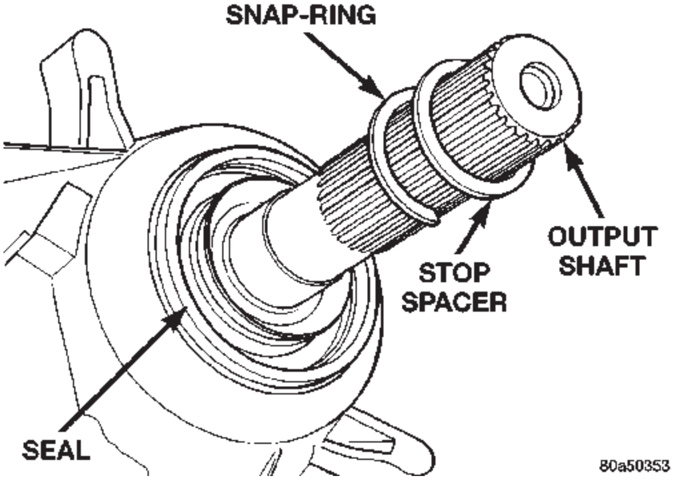


Fig. 9 Slinger Stop Spacer and Snap-ring

(6) Use a suitable pry tool, or a slide hammer mounted screw, to remove the seal from the rear retainer (Fig. 10).

(7) Remove the rear output bearing I.D. retaining ring (Fig. 11).

(8) Remove the bolts holding the rear retainer to the rear case half.

(9) Tap rear retainer with rawhide or rubber mallet to loosen sealer bead.

(10) Remove rear retainer from rear case half (Fig. 12).

(11) Remove snap-ring holding oil pump in position on output shaft.

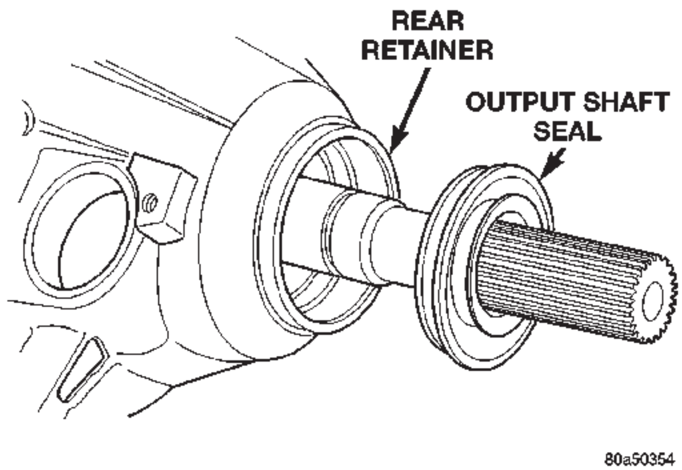


Fig. 10 Rear Retainer Seal

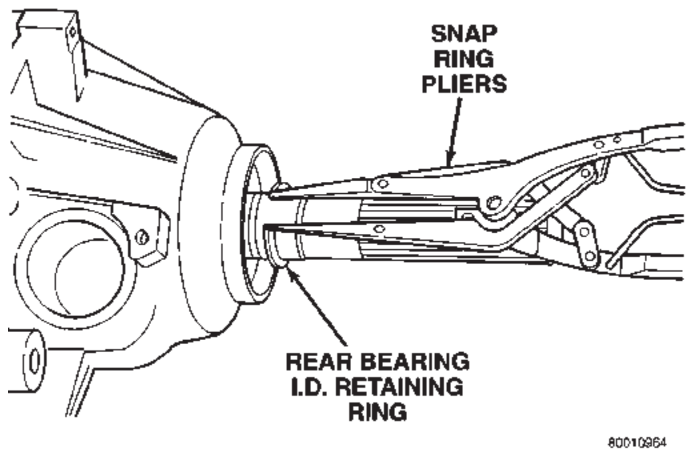


Fig. 11 Output Shaft Rear Bearing Retaining Ring

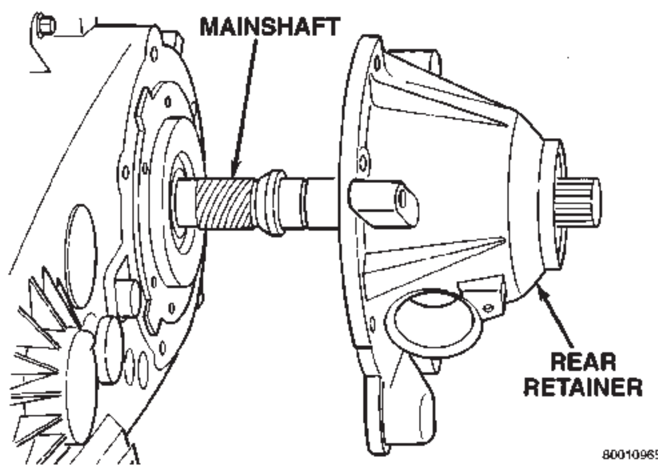


Fig. 12 Rear Retainer Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(12) Disengage oil pickup tube from oil pump and remove oil pump assembly. Remove oil pump by tilting the edge of the oil pump from under the edge of the rear case half and sliding the pump (Fig. 13).

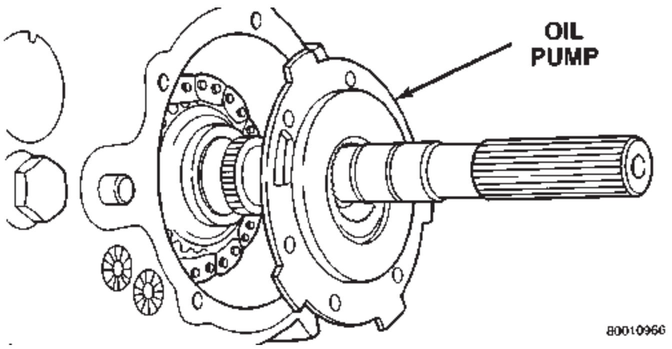


Fig. 13 Oil Pump Removal

(13) Remove pick-up tube o-ring from oil pump (Fig. 14), if necessary. Do not disassemble the oil pump, it is not serviceable.

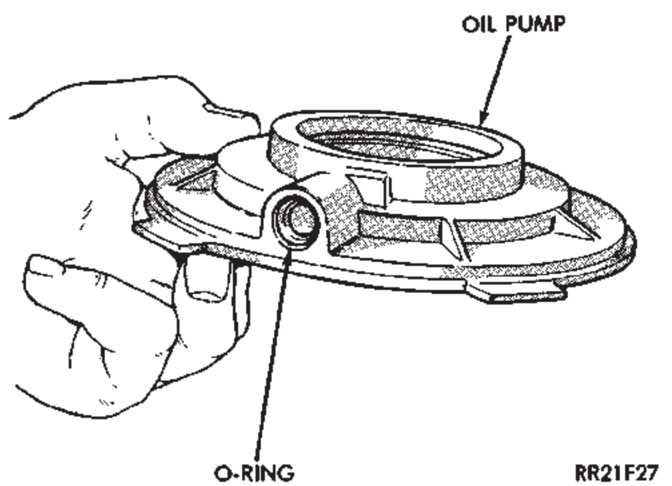


Fig. 14 Pick-up Tube O-ring Location

YOKE AND RANGE LEVER REMOVAL

(1) Remove transfer case indicator switch.

(2) Remove front yoke nut as follows:

(a) Move range lever to 4L position.

(b) Then remove nut with socket and impact wrench (Fig. 15).

(3) Remove yoke. If yoke is difficult to remove by hand, remove it with bearing splitter, or with standard two jaw puller (Fig. 16). Be sure puller tool is positioned on yoke and not on slinger as slinger will be damaged.

(4) Remove seal washer from front output shaft. Discard washer as it should not be reused.

(5) Remove nut and washer that attach range lever to sector shaft. Then move sector to neutral position and remove range lever from shaft (Fig. 17).

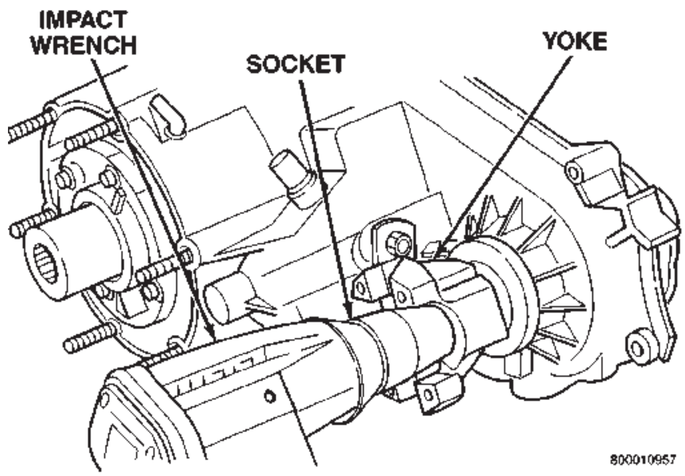


Fig. 15 Yoke Nut Removal

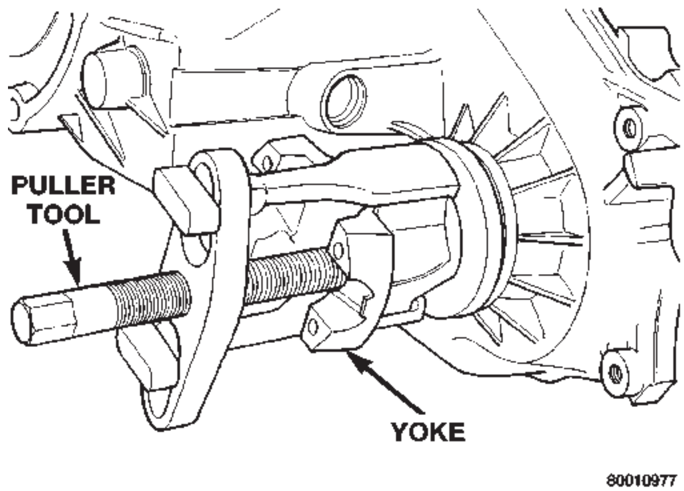


Fig. 16 Yoke Removal

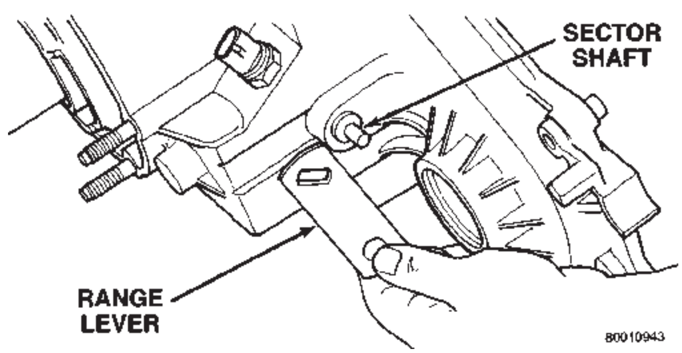


Fig. 17 Range Lever Removal

FRONT OUTPUT SHAFT AND DRIVE CHAIN REMOVAL

(1) Support transfer case so rear case is facing upward.

(2) Remove bolts holding front case to rear case. The case alignment bolts require flat washers (Fig. 18).

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Loosen rear case with flat blade screwdriver to break sealer bead. Insert pry tool blade only into notches provided at each end of case (Fig. 19).

(4) Remove rear case from front case.

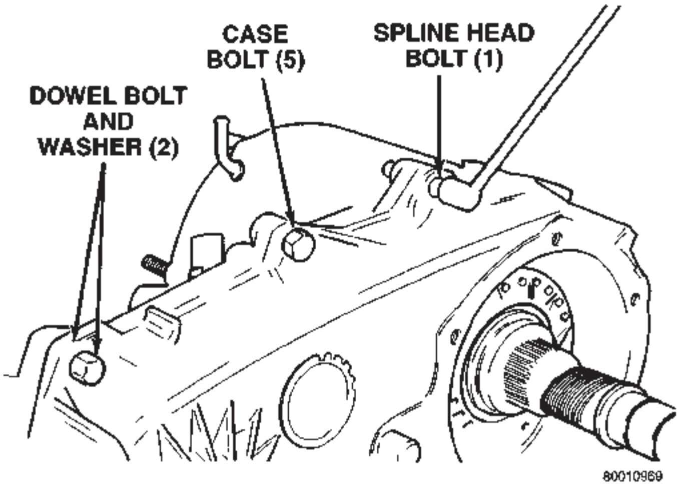


Fig. 18 Rear Case Alignment Bolt Locations

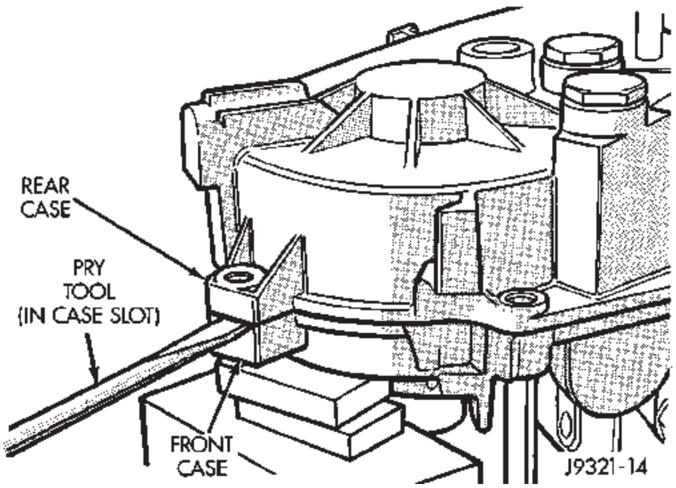


Fig. 19 Loosening Rear Case

(5) Remove oil pickup tube from rear case (Fig. 20).

(6) Remove mode fork spring (Fig. 21).

(7) Pull front output shaft upward and out of front output shaft bearing (Fig. 22).

(8) Remove front output shaft and chain.

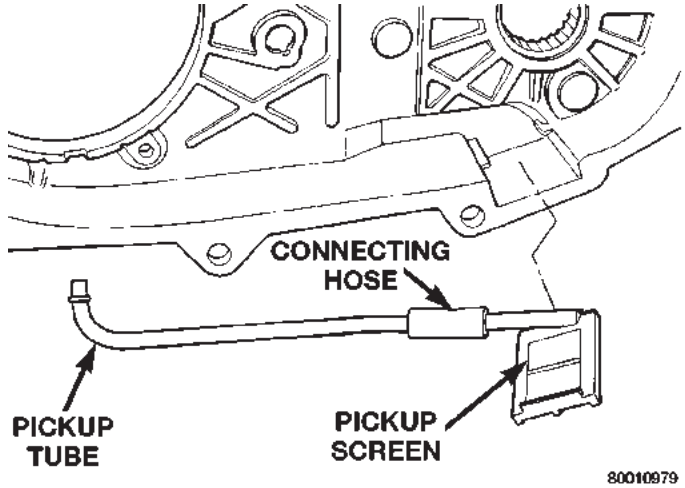


Fig. 20 Oil Pickup Tube Removal

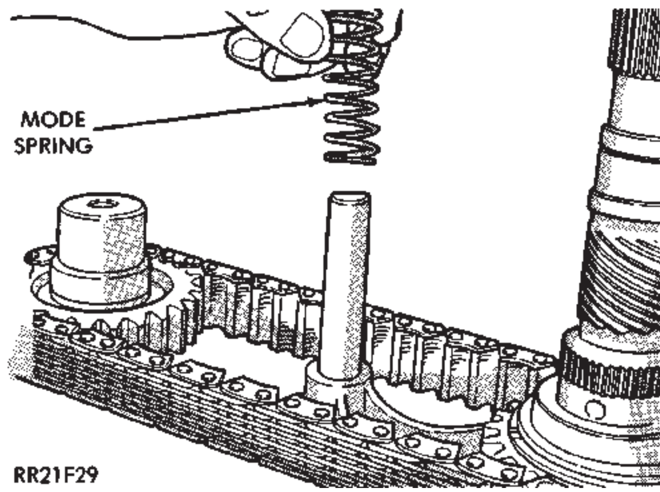


Fig. 21 Mode Fork Spring Removal

DISASSEMBLY AND ASSEMBLY (Continued)

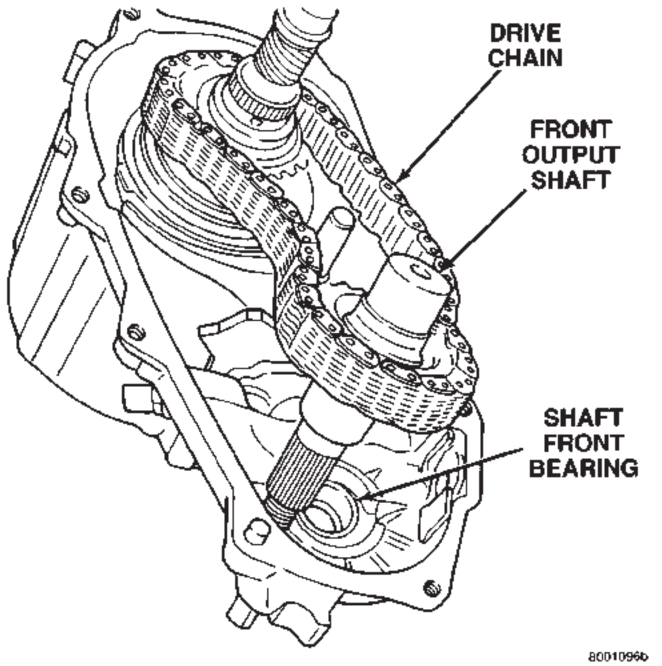


Fig. 22 Remove Front Output Shaft And Chain

SHIFT FORKS AND MAINSHAFT REMOVAL

(1) Remove detent plug, O-ring, detent spring and detent plunger (Fig. 23).

(2) Remove mainshaft from mode sleeve and input gear pilot bearing.

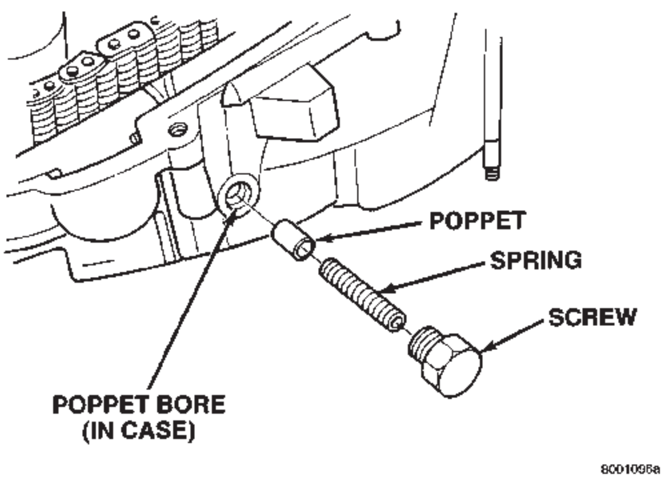


Fig. 23 Detent Plug, Spring And Plunger Removal

(3) Remove mode fork and sleeve as an assembly (Fig. 24). Note position of sleeve for assembly reference. The short side of the sleeve faces upward.

(4) Remove range fork and hub as an assembly (Fig. 25). Note fork position for installation reference.

(5) Remove shift sector from front case (Fig. 26).

(6) Remove shift sector bushing and O-ring (Fig. 27).

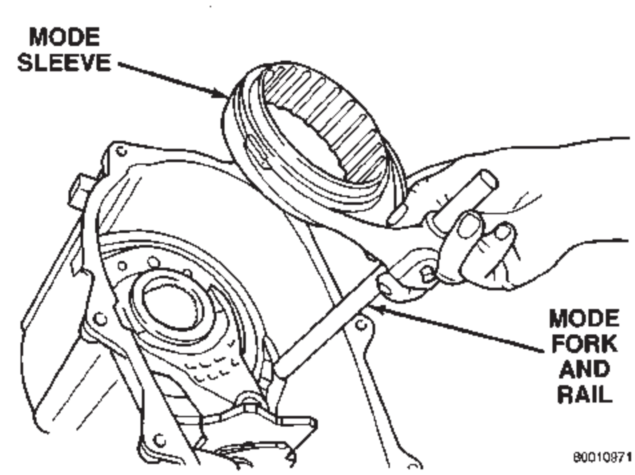


Fig. 24 Mode Fork And Sleeve Removal

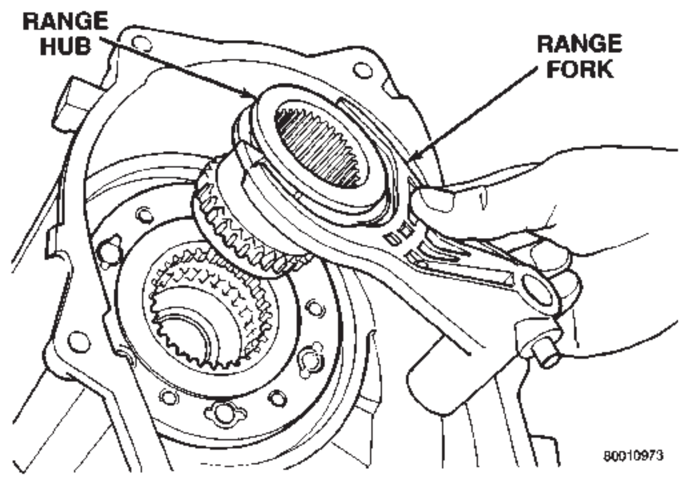


Fig. 25 Range Fork And Hub Removal

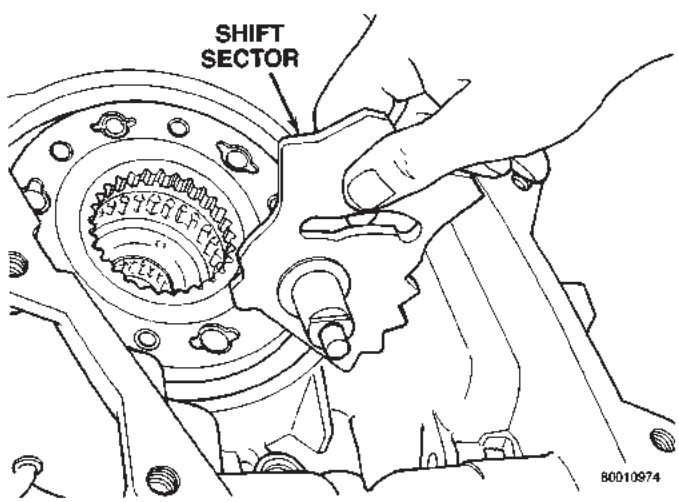


Fig. 26 Shift Sector Removal

DISASSEMBLY AND ASSEMBLY (Continued)

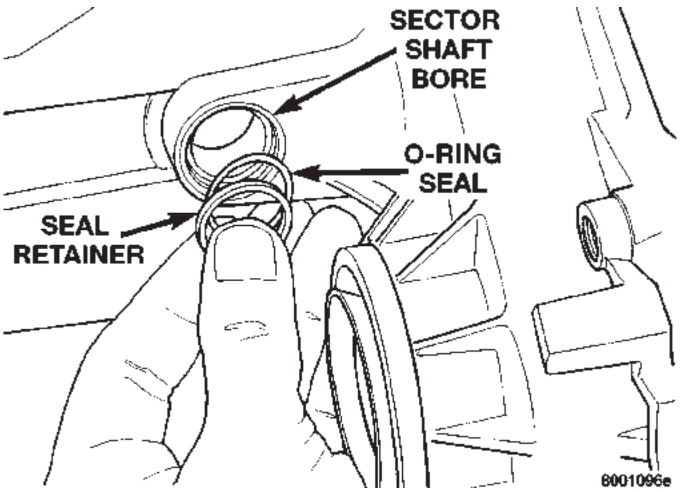


Fig. 27 Sector Bushing And O-Ring Removal

MAINSHAFT DISASSEMBLY

(1) Remove mode hub retaining ring with heavy duty snap-ring pliers (Fig. 28).

(2) Slide mode hub off mainshaft (Fig. 29).

(3) Slide drive sprocket off mainshaft (Fig. 30).

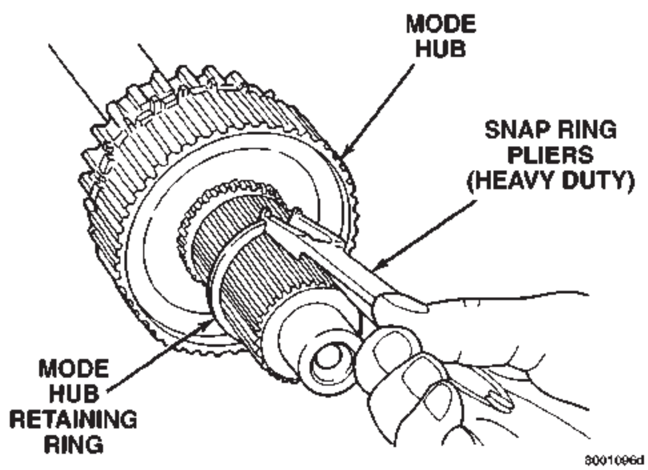


Fig. 28 Mode Hub Retaining Ring Removal

INPUT GEAR AND LOW RANGE GEAR REMOVAL

(1) Remove front bearing retainer attaching bolts (Fig. 31).

(2) Remove front bearing retainer. Pry retainer loose with pry tool positioned in slots at each end of retainer (Fig. 32).

(3) Remove front bearing retainer seal. Tap seal out with drift and hammer.

(4) Remove input gear retaining ring with heavy duty snap-ring pliers (Fig. 33)

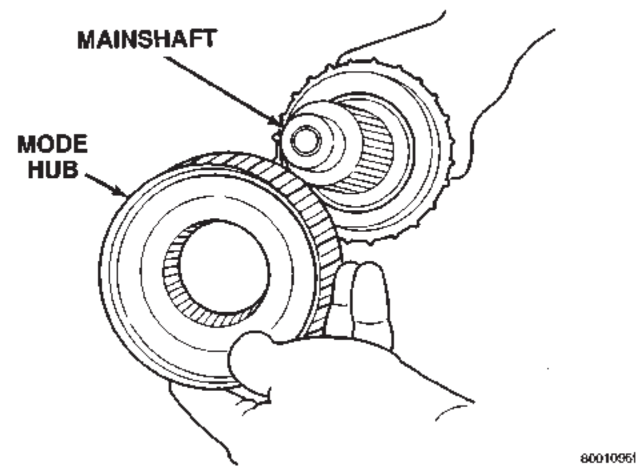


Fig. 29 Mode Hub Removal

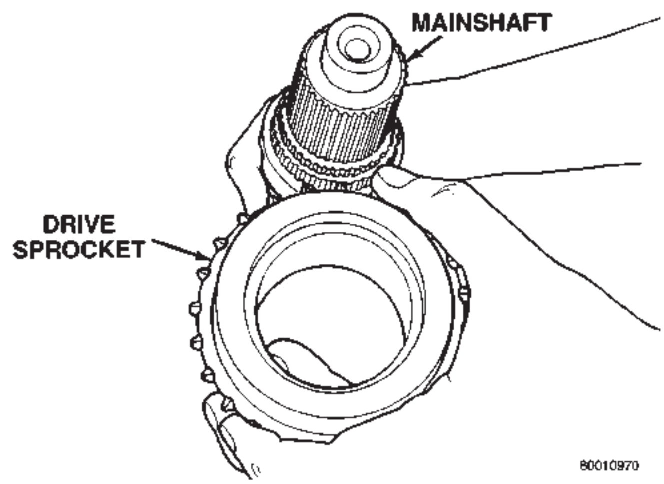


Fig. 30 Drive Sprocket Removal

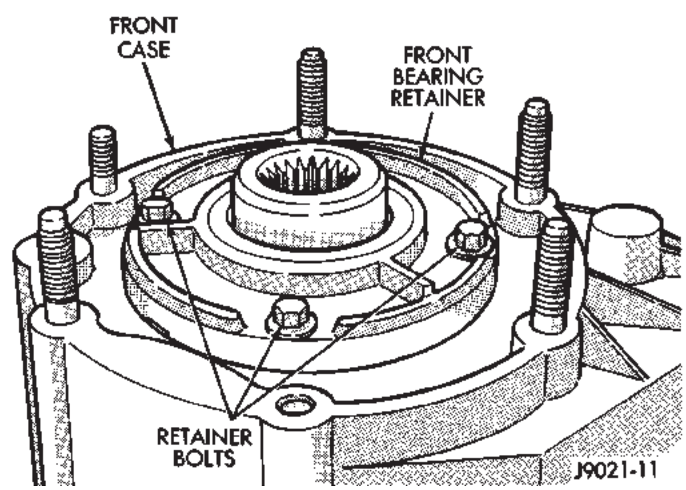


Fig. 31 Front Bearing Retainer Bolts

DISASSEMBLY AND ASSEMBLY (Continued)

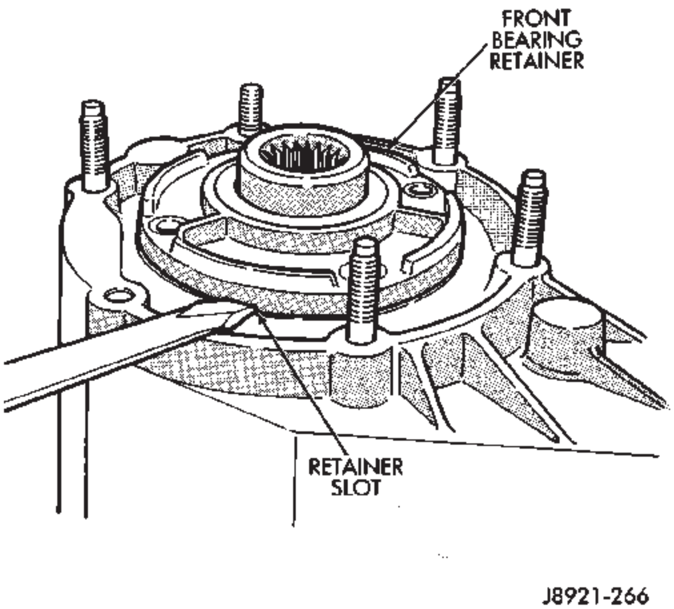


Fig. 32 Front Bearing Retainer Removal

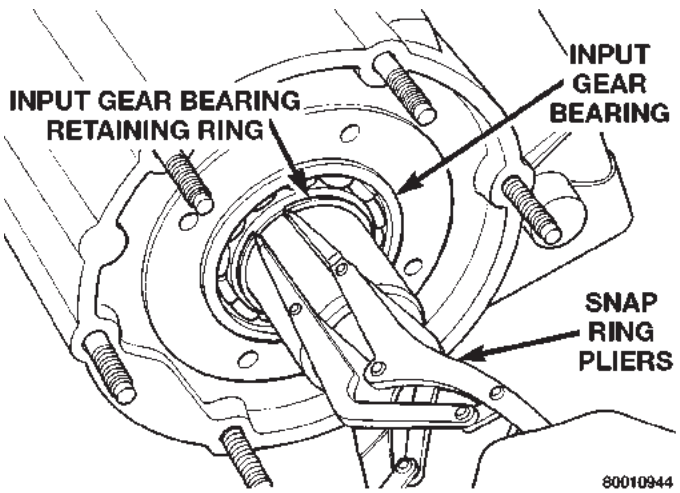


Fig. 33 Removing Input Gear Retaining Ring

(5) Place front case in horizontal position. Then remove input gear and low range gear as an assembly (Fig. 34). Tap gear out of bearing with plastic mallet if necessary.

INPUT AND LOW RANGE GEAR DISASSEMBLY

(1) Remove snap-ring that retains input gear in low range gear (Fig. 35).
(2) Remove retainer (Fig. 36).
(3) Remove front tabbed thrust washer (Fig. 37).
(4) Remove input gear (Fig. 38).
(5) Remove rear tabbed thrust washer from low range gear (Fig. 39).

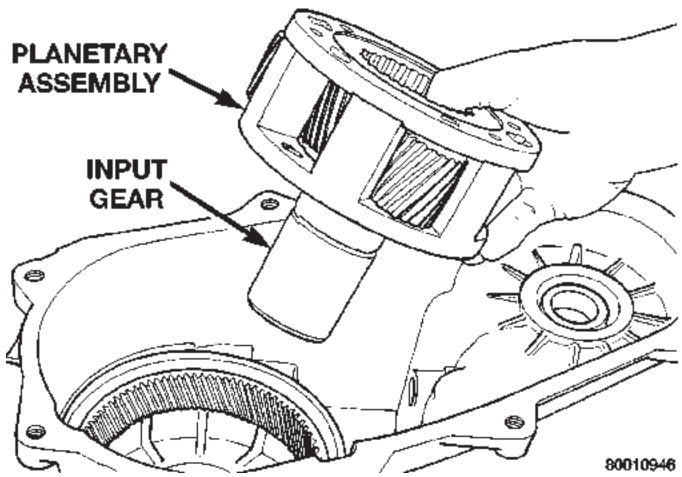


Fig. 34 Input Gear And Planetary Carrier Removal

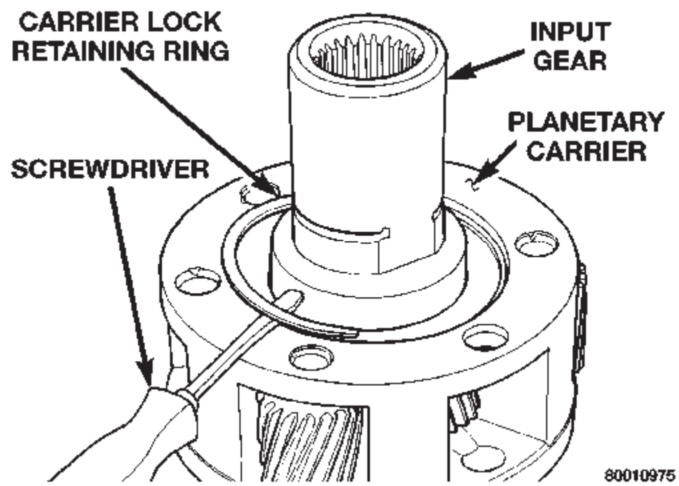


Fig. 35 Input Gear Snap-Ring Removal

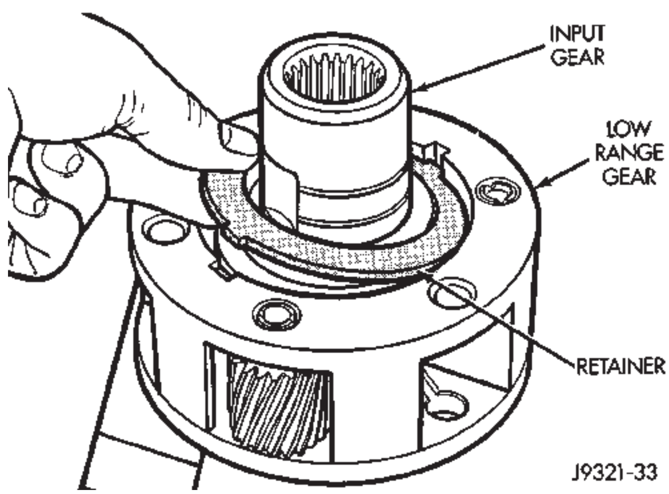


Fig. 36 Input Gear Retainer Removal

DISASSEMBLY AND ASSEMBLY (Continued)

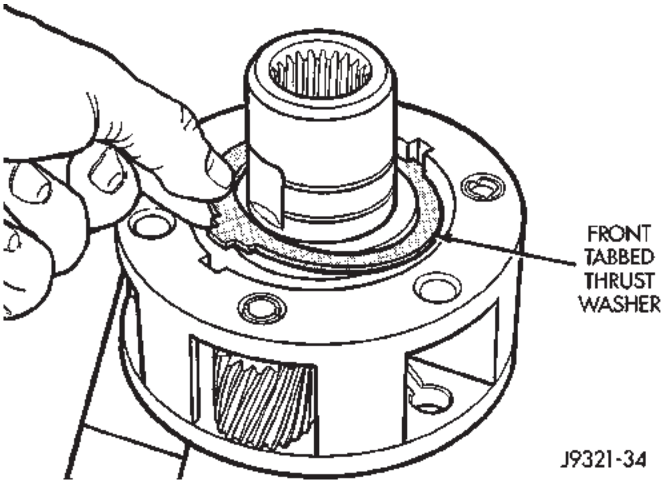


Fig. 37 Front Tabbed Thrust Washer Removal

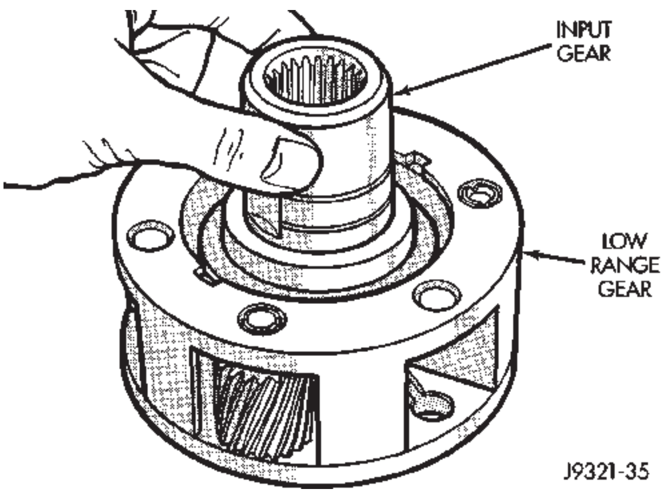


Fig. 38 Input Gear Removal

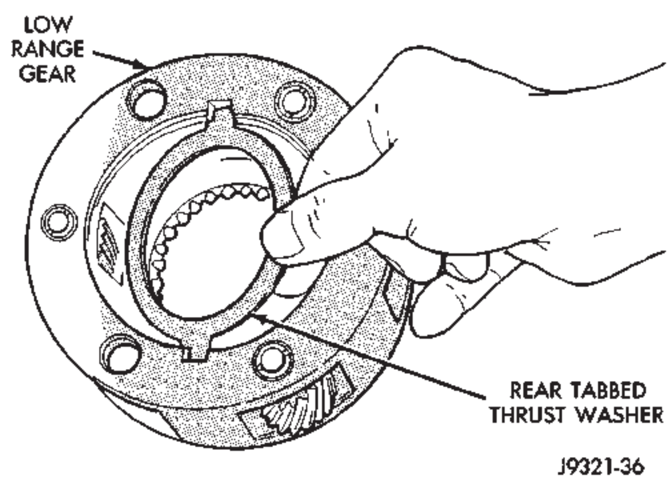


Fig. 39 Rear Tabbed Thrust Washer Removal

ASSEMBLY

Lubricate transfer case components with Mopar® Dexron II automatic transmission fluid or petroleum jelly (where indicated) during assembly.

BEARING AND SEAL INSTALLATION

CAUTION: The bearing bores in various transfer case components contain oil feed holes. Make sure replacement bearings do not block the holes.

(1) Remove the front output shaft seal from case with pry tool (Fig. 40).

(2) Remove the front output shaft bearing retaining ring with screwdriver (Fig. 41).

(3) Remove bearing with Tool Handle C-4171 and Tool 5065 (Fig. 42).

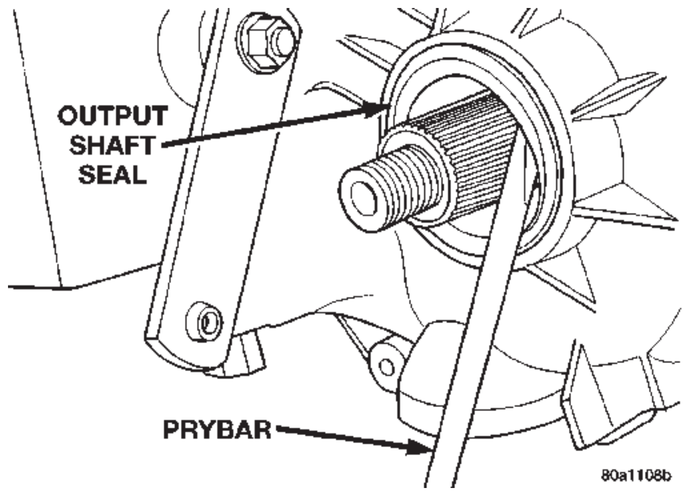


Fig. 40 Front Output Seal Removal

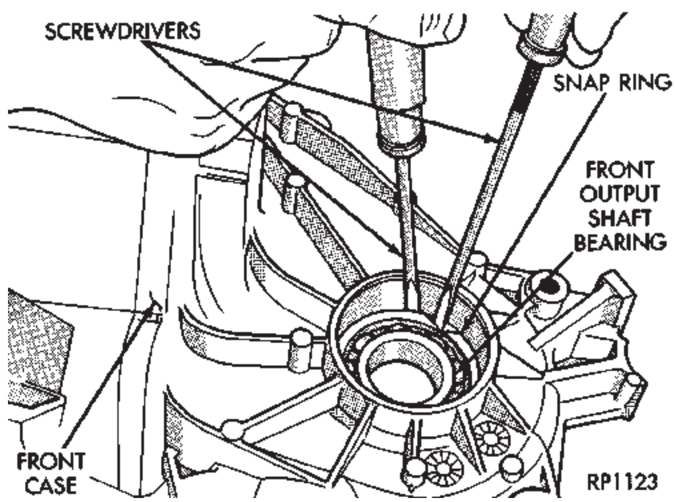


Fig. 41 Front Output Shaft Bearing Retaining Ring Removal

DISASSEMBLY AND ASSEMBLY (Continued)

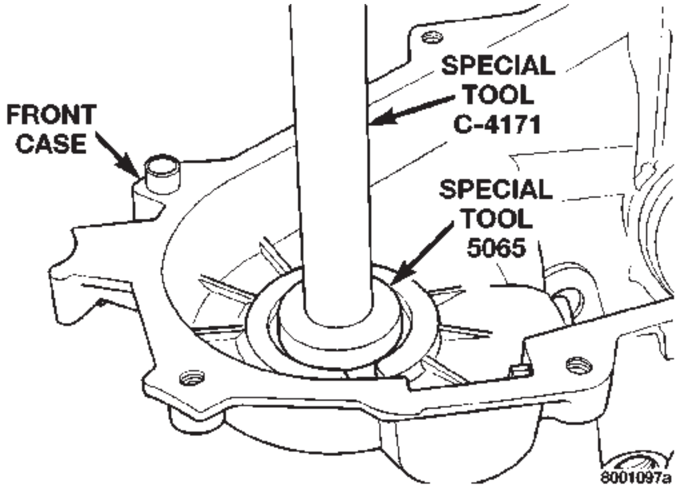


Fig. 42 Front Output Shaft Bearing Removal

(4) Install front output shaft front bearing in case with Tool Handle C-4171 and Installer 5064 (Fig. 43).

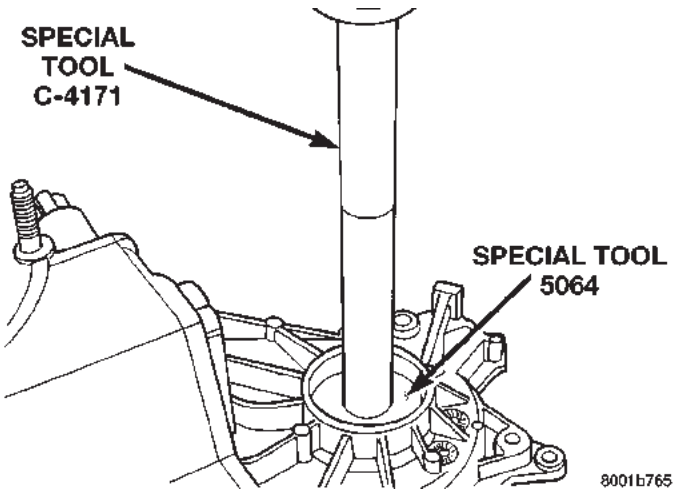


Fig. 43 Front Output Shaft Bearing Installation

(5) Install output shaft front bearing retaining ring (Fig. 44). Start ring into place by hand. Then use small screwdriver to work ring into case groove. Be sure ring is fully seated before proceeding.

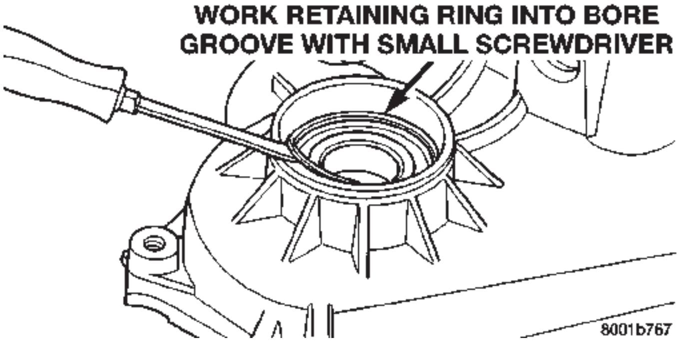


Fig. 44 Installing Output Shaft Front Bearing Retaining Ring

(6) Install new front output seal in front case with Installer Tool 8143 as follows:

(a) Place new seal on tool. **Garter spring on seal goes toward interior of case.**

(b) Start seal in bore with light taps from hammer (Fig. 45). Once seal is started, continue tapping seal into bore until installer tool bottoms against case.

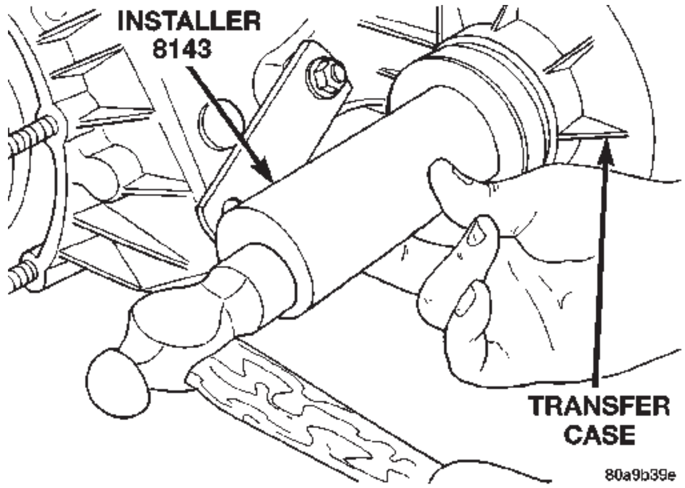


Fig. 45 Front Output Seal Installation

(7) Remove the output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 46).

(8) Install new bearing with Tool Handle C-4171 and Installer 5066 (Fig. 47). The bearing bore is chamfered at the top. Install the bearing so it is flush with the lower edge of this chamfer (Fig. 48).

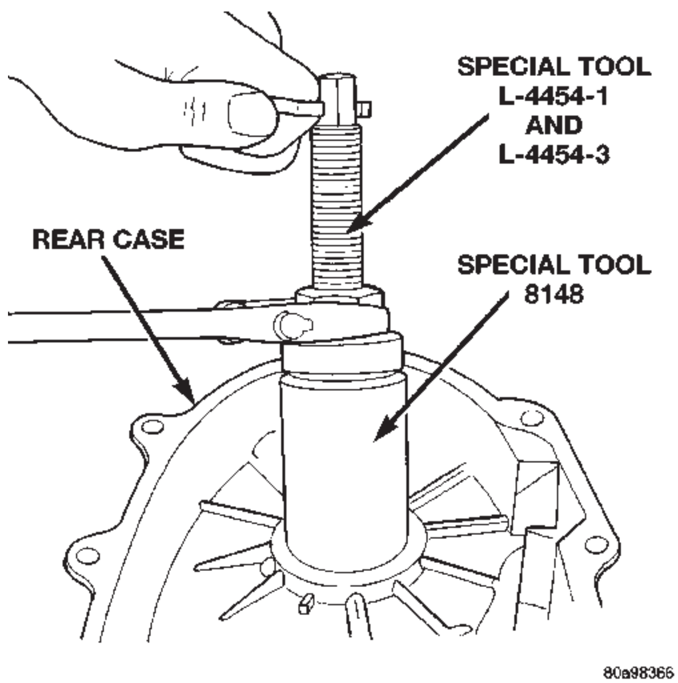


Fig. 46 Output Shaft Rear Bearing Removal

DISASSEMBLY AND ASSEMBLY (Continued)

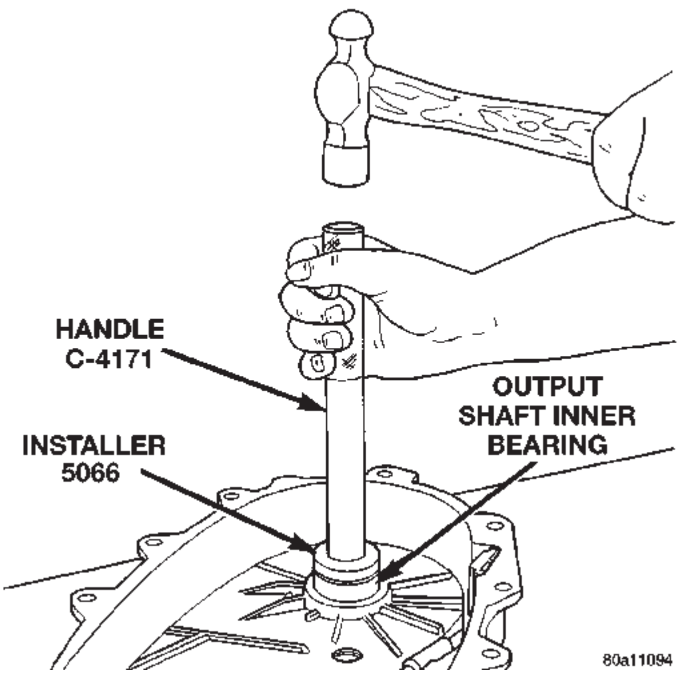


Fig. 47 Output Shaft Rear Bearing Installation

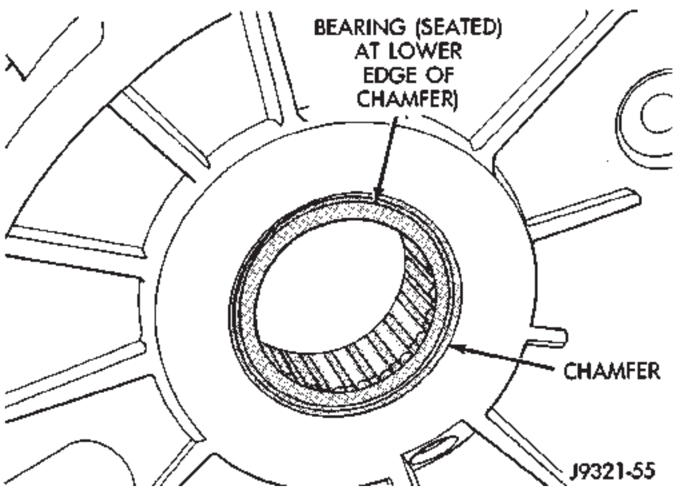


Fig. 48 Output Shaft Rear Bearing Installation Depth

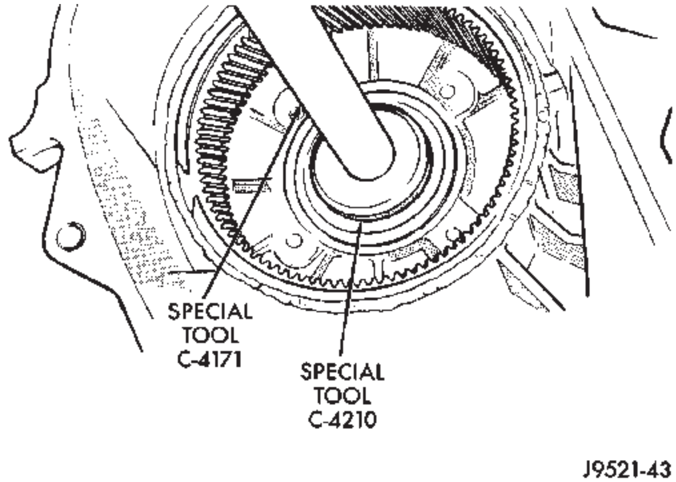


Fig. 49 Input Shaft Bearing Removal

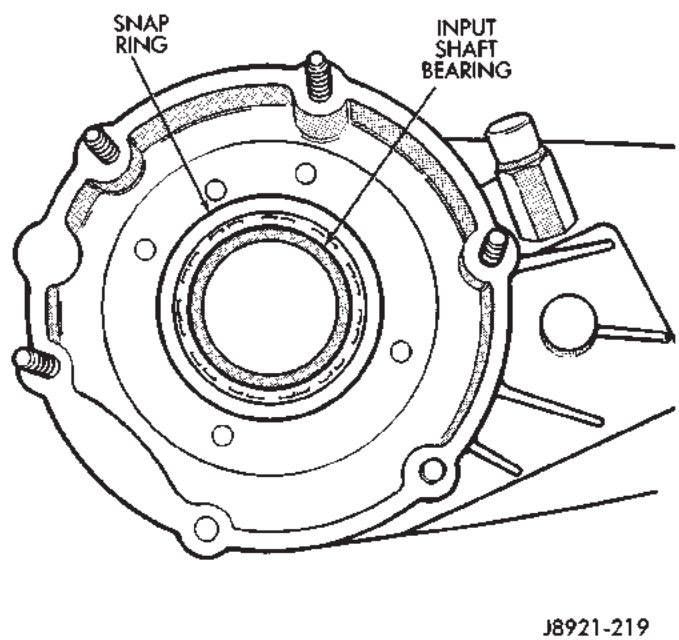


Fig. 50 Seating Input Shaft Bearing

(9) Using Remover C-4210 and Handle C-4171, drive input shaft bearing from inside the annulus gear opening in the case. (Fig. 49).

(10) Install locating ring on new bearing.

(11) Position case so forward end is facing upward.

(12) Using Remover C-4210 and Handle C-4171, drive input shaft bearing into case. The bearing locating ring must be fully seated against case surface (Fig. 50).

(13) Remove input gear pilot bearing by inserting a suitably sized drift into the splined end of the input gear and driving the bearing out with the drift and a hammer (Fig. 51).

(14) Install new pilot bearing with Installer 5065 and Handle C-4171 (Fig. 52).

(15) Remove front bearing retainer seal with suitable pry tool.

(16) Install new front bearing retainer seal with Installer 7884 (Fig. 53).

DISASSEMBLY AND ASSEMBLY (Continued)

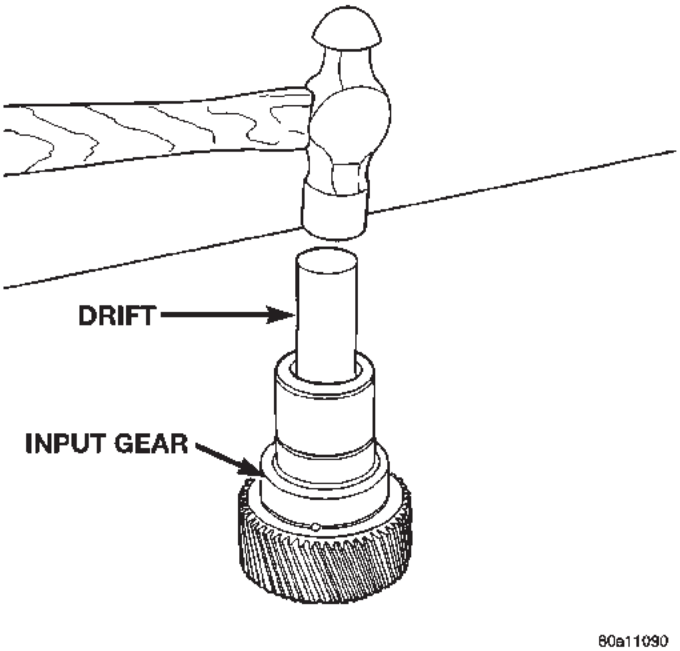


Fig. 51 Remove Input Gear Pilot Bearing

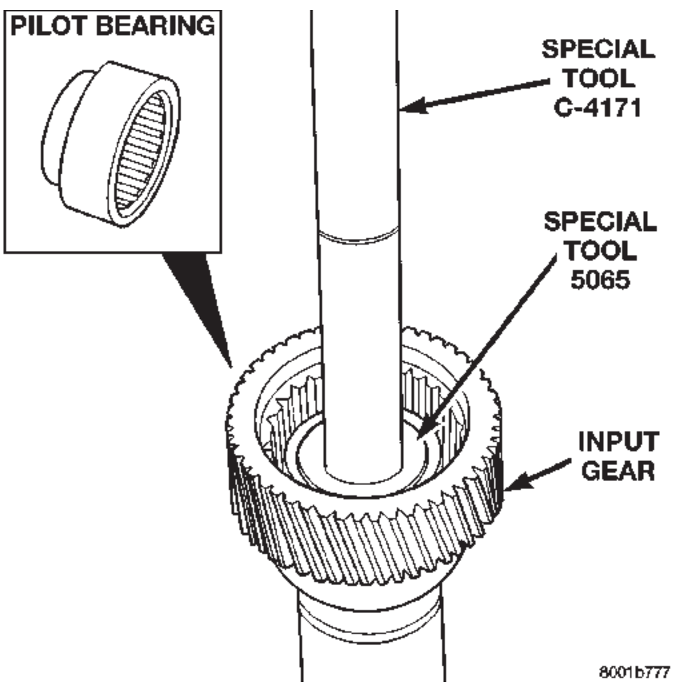


Fig. 52 Install Input Gear Pilot Bearing

(17) Remove seal from oil pump housing with a suitable pry tool

(18) Install new seal in oil pump housing with Installer 7888 (Fig. 54).

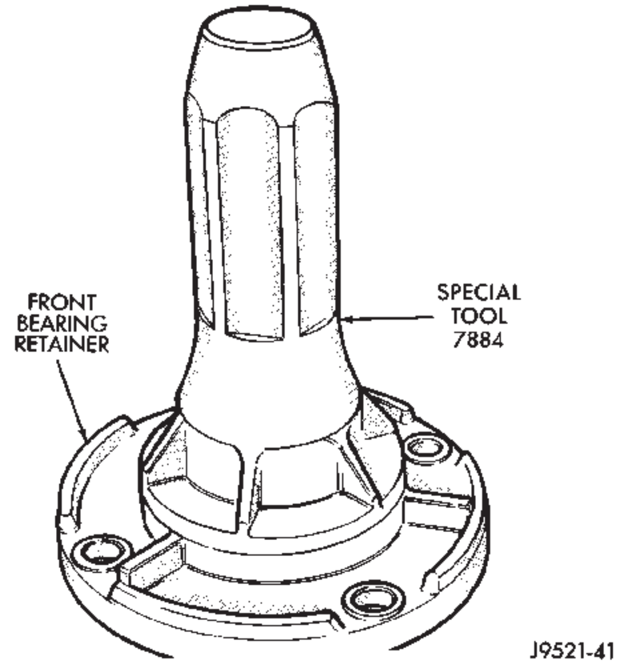


Fig. 53 Install Front Bearing Retainer Seal

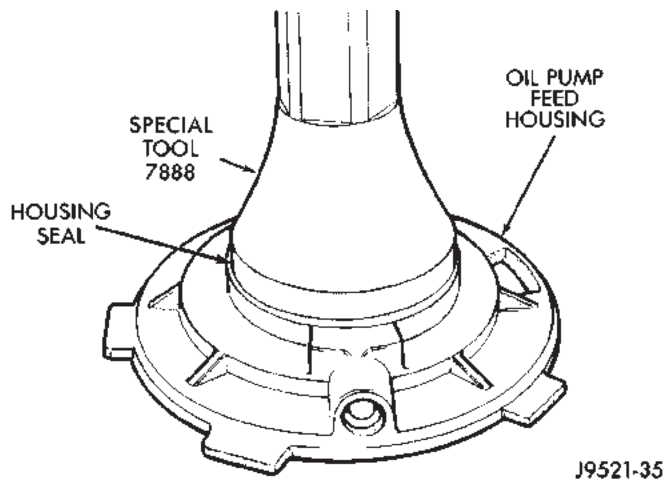


Fig. 54 Oil Pump Seal Installation

(19) Remove rear retainer bearing with Installer 8128 and Handle C-4171.

(20) Install rear bearing in retainer with Handle C-4171 and Installer 5064 (Fig. 55).

INPUT AND LOW RANGE GEAR ASSEMBLY

(1) Lubricate gears and thrust washers (Fig. 56) with recommended transmission fluid.

(2) Install first thrust washer in low range gear (Fig. 56). Be sure washer tabs are properly aligned in gear notches.

DISASSEMBLY AND ASSEMBLY (Continued)

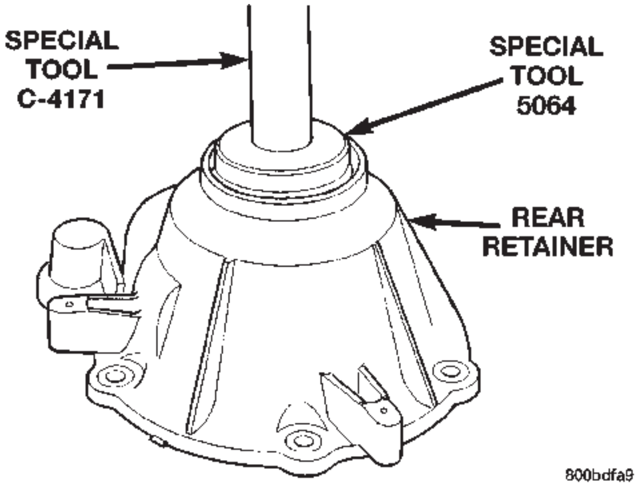


Fig. 55 Installing Rear Bearing In Retainer

(3) Install input gear in low range gear. Be sure input gear is fully seated.

(4) Install remaining thrust washer in low range gear and on top of input gear. Be sure washer tabs are properly aligned in gear notches.

(5) Install retainer on input gear and install snap-ring.

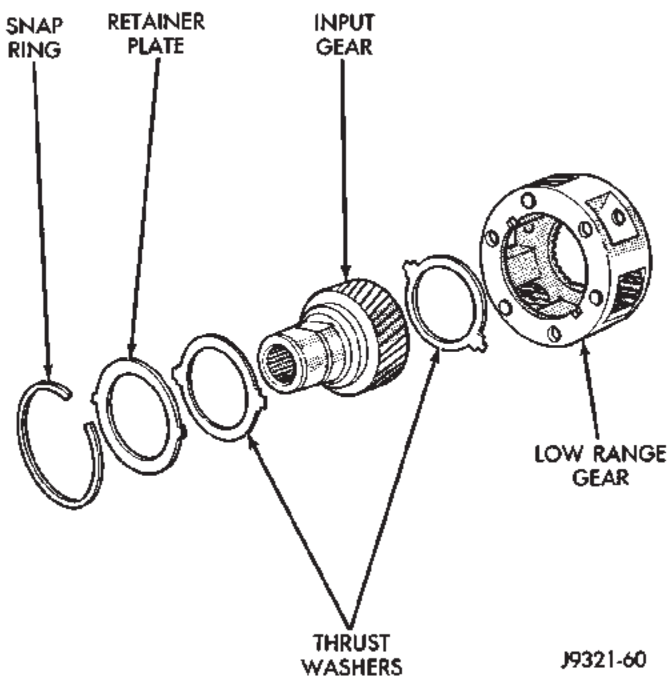


Fig. 56 Input/Low Range Gear Components

INPUT GEAR AND LOW RANGE GEAR INSTALLATION

(1) Align and install low range/input gear assembly in front case (Fig. 57). Be sure low range gear pinions are engaged in annulus gear and that input gear shaft is fully seated in front bearing.

(2) Install snap-ring to hold input/low range gear into front bearing (Fig. 58).

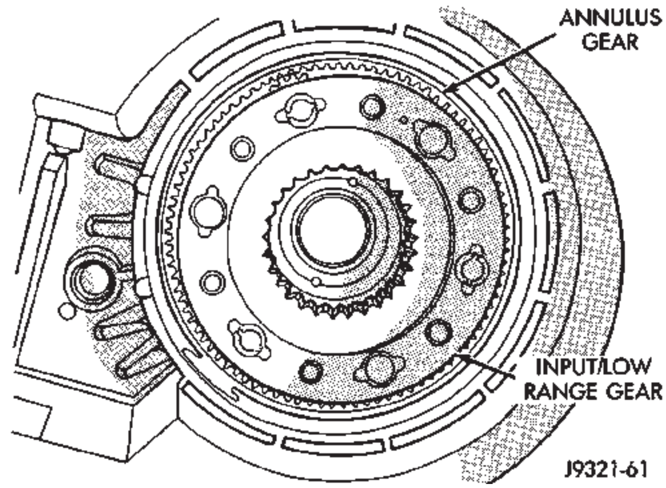


Fig. 57 Input/Low Range Gear Installation

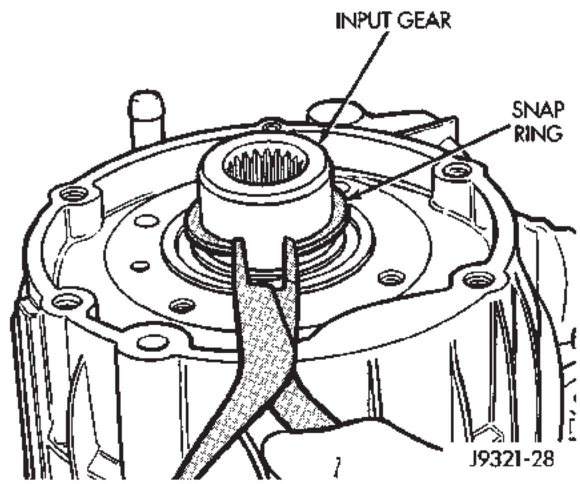


Fig. 58 Install Snap-Ring

(3) Clean gasket sealer residue from retainer and inspect retainer for cracks or other damage.

(4) Apply a 3 mm (1/8 in.) bead of Mopar® gasket maker or silicone adhesive to sealing surface of retainer.

(5) Align cavity in seal retainer with fluid return hole in front of case.

DISASSEMBLY AND ASSEMBLY (Continued)

CAUTION: Do not block fluid return cavity on sealing surface of retainer when applying Mopar® gasket maker or silicone adhesive sealer. Seal failure and fluid leak can result.

(6) Install bolts to hold retainer to transfer case (Fig. 59). Tighten to 21 N·m (16 ft. lbs.) of torque.

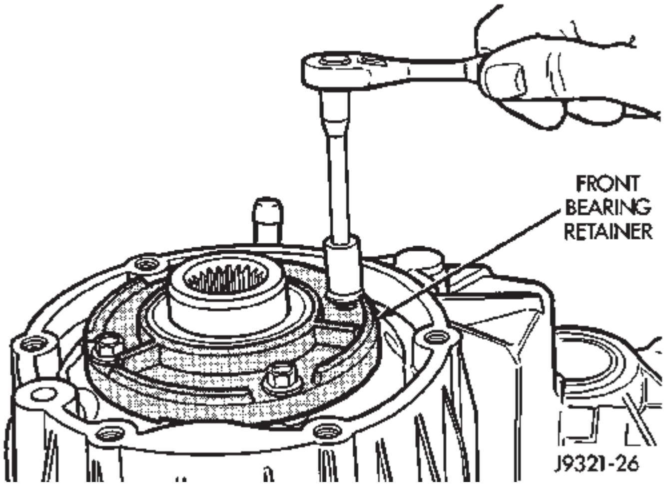


Fig. 59 Install Front Bearing Retainer

MAINSHAFT ASSEMBLY

(1) Lubricate mainshaft splines with recommended transmission fluid.

(2) Slide drive sprocket onto mainshaft.

(3) Slide mode hub onto mainshaft.

(4) Install mode hub retaining ring. Verify that the retaining ring is fully seated in mainshaft groove.

SHIFT FORKS AND MAINSHAFT INSTALLATION

(1) Install new sector shaft O-ring and bushing (Fig. 60).

(2) Install shift sector in case (Fig. 61). Lubricate sector shaft with transmission fluid before installation.

(3) Install range lever, washer, and nut on sector shaft (Fig. 62). Tighten range lever nut to 27–34 N.m (20–25 ft. lbs.) torque.

(4) Assemble and install range fork and hub (Fig. 63). Be sure hub is properly seated in low range gear and engaged to the input gear.

(5) Align and insert range fork pin in shift sector slot.

(6) Install assembled mainshaft (Fig. 64). Be sure shaft is seated in pilot bearing and input gear.

(7) Install new pads on mode fork if necessary.

(8) Insert mode sleeve in mode fork mode fork. Be sure long side of sleeve is toward long end of shift rail (Fig. 65).

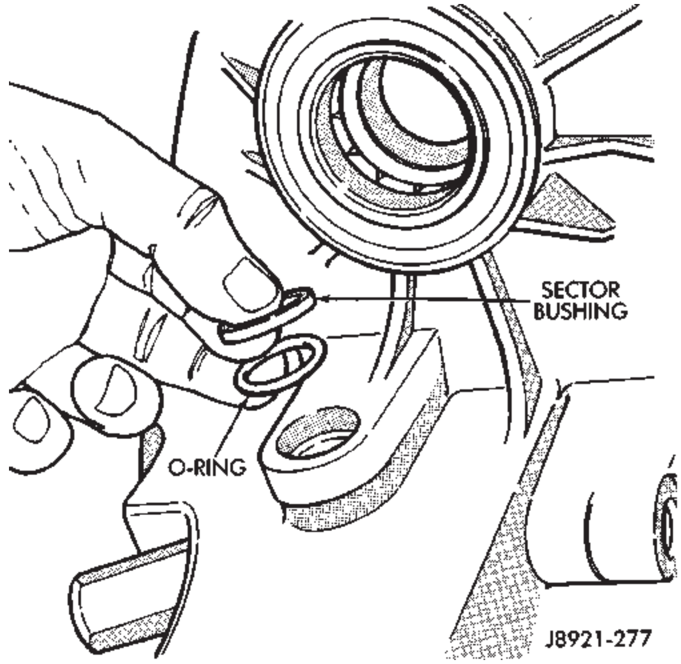


Fig. 60 Sector O-Ring And Bushing Installation

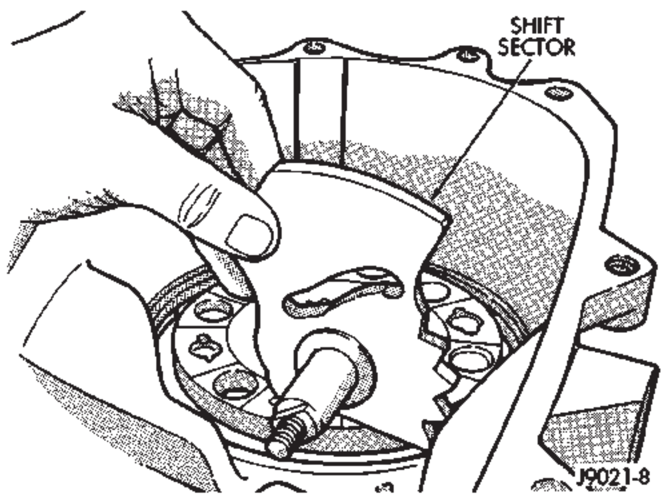


Fig. 61 Shift Sector Installation

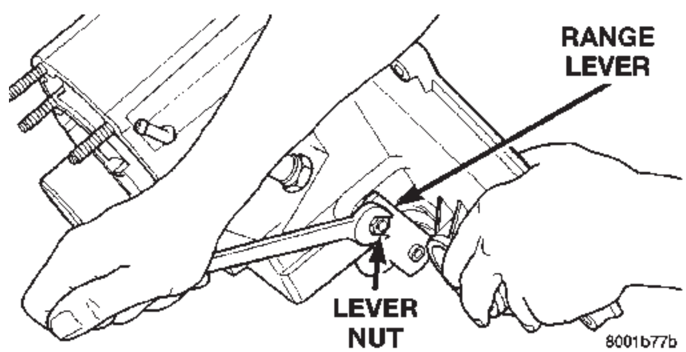


Fig. 62 Range Lever Installation

DISASSEMBLY AND ASSEMBLY (Continued)

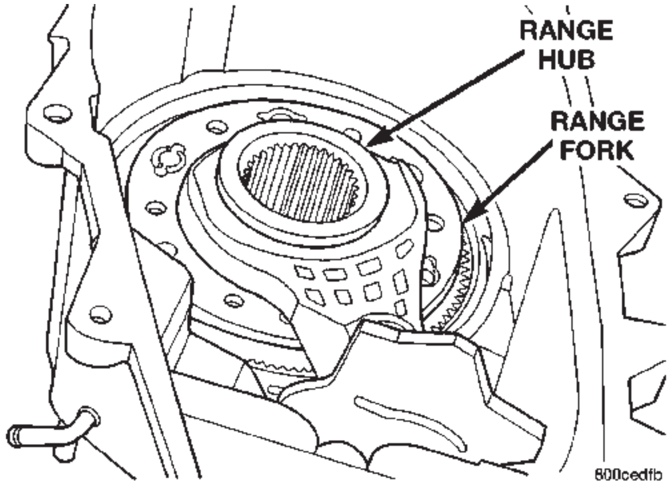


Fig. 63 Install Range Fork And Hub Assembly

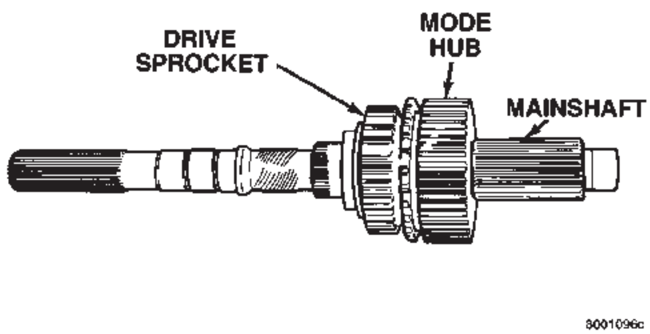


Fig. 64 Mainshaft Assembly Installation

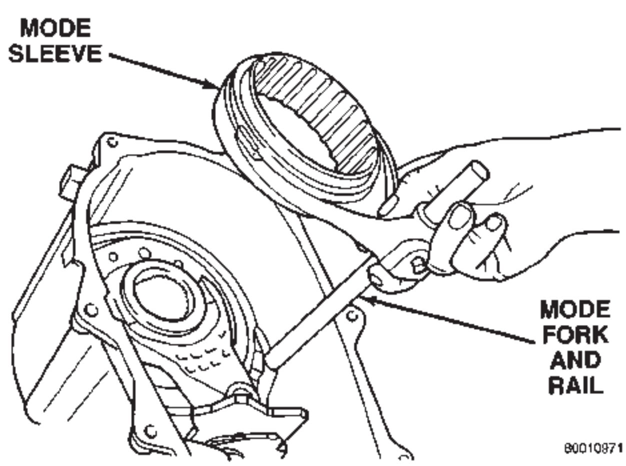


Fig. 65 Assembling Mode Fork And Sleeve

(9) Install assembled mode fork and sleeve (Fig. 66). Be sure fork rail goes through range fork and into case bore. Also be sure sleeve is aligned and seated on mainshaft hub.

(10) Rotate sector to Neutral position.

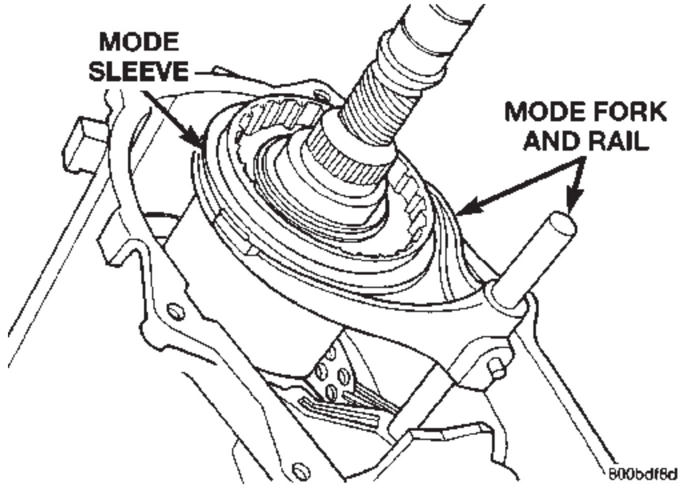


Fig. 66 Mode Fork And Sleeve Installation

(11) Install new O-ring on detent plug (Fig. 67).

(12) Lubricate detent plunger with transmission fluid or light coat of petroleum jelly.

(13) Install detent plunger, spring and plug (Fig. 67).

(14) Verify that plunger is properly engaged in sector.

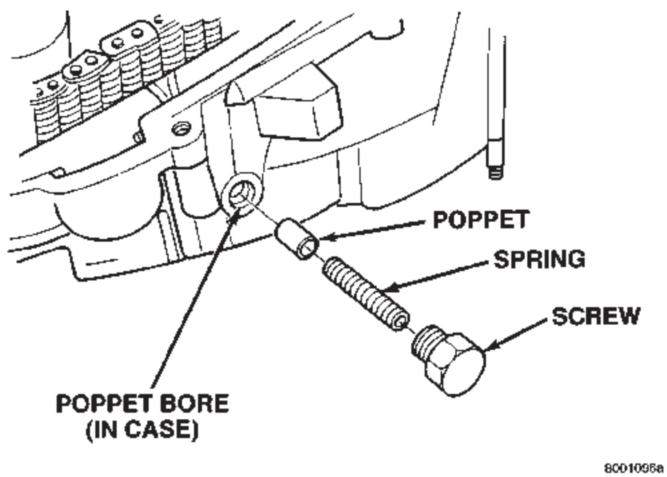


Fig. 67 Shift Detent Components

FRONT OUTPUT SHAFT AND DRIVE CHAIN INSTALLATION

(1) Lubricate front output shaft-sprocket assembly, drive chain, and drive sprocket with transmission fluid.

(2) Assemble drive chain and front output shaft (Fig. 68).

(3) Start chain on mainshaft drive sprocket.

(4) Guide front shaft into bearing and drive sprocket onto mainshaft drive gear (Fig. 68).

(5) Install mode spring on upper end of mode fork shift rail (Fig. 69).

DISASSEMBLY AND ASSEMBLY (Continued)

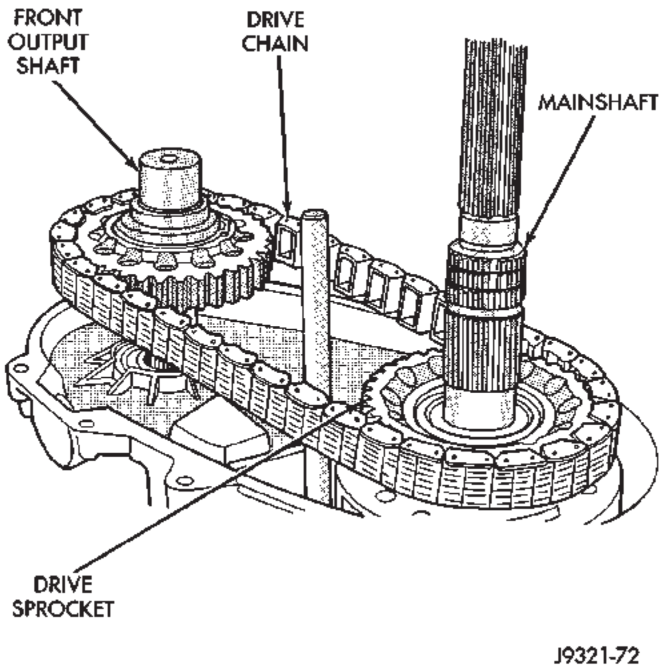


Fig. 68 Installing Drive Chain And Front Output Shaft

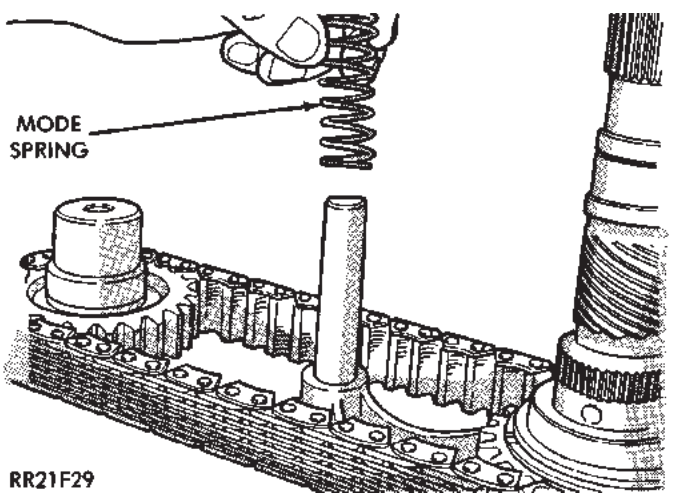


Fig. 69 Install Mode Fork Spring

OIL PUMP AND REAR CASE ASSEMBLY/INSTALLATION

(1) Install magnet in front case pocket (Fig. 70).

(2) Assemble oil pickup screen, connecting hose, and tube.

(3) Install new pickup tube O-ring in oil pump (Fig. 71).

(4) Insert oil pickup tube in oil pump inlet.

(5) Position assembled oil pump and pickup tube in rear case. Be sure pickup screen is securely seated in case slot. Also be sure oil pump locating tabs are outside rear case (Fig. 72).

(6) Apply 3 mm (1/8 in.) wide bead of Mopar® gasket maker or silicone adhesive sealer to mounting flange of front case. Work sealer bead around bolt holes.

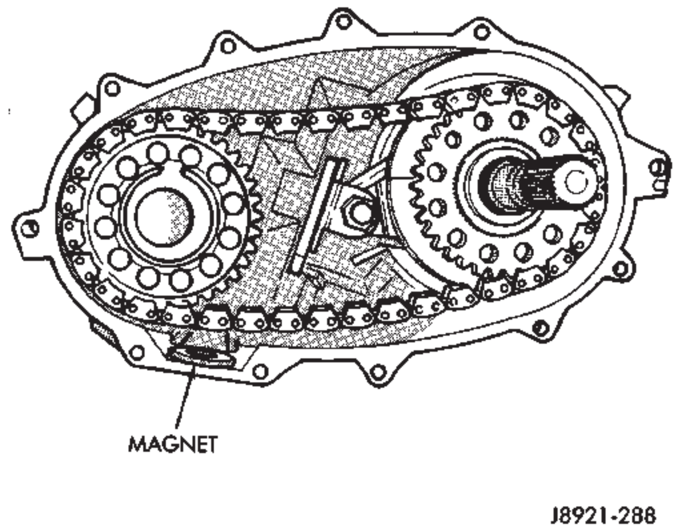


Fig. 70 Installing Case Magnet

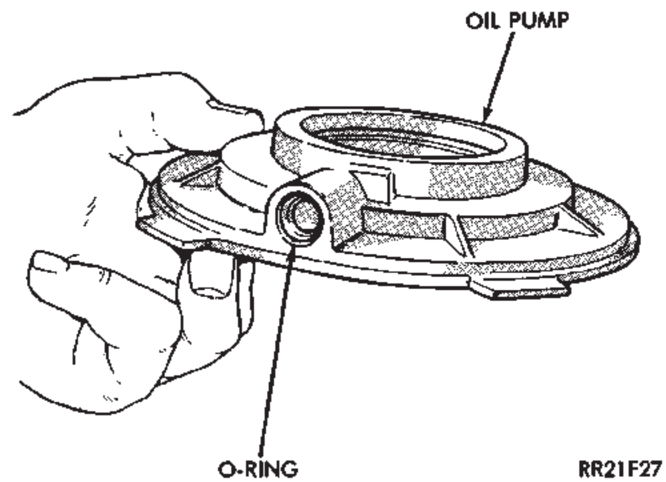


Fig. 71 Pickup Tube O-Ring Position

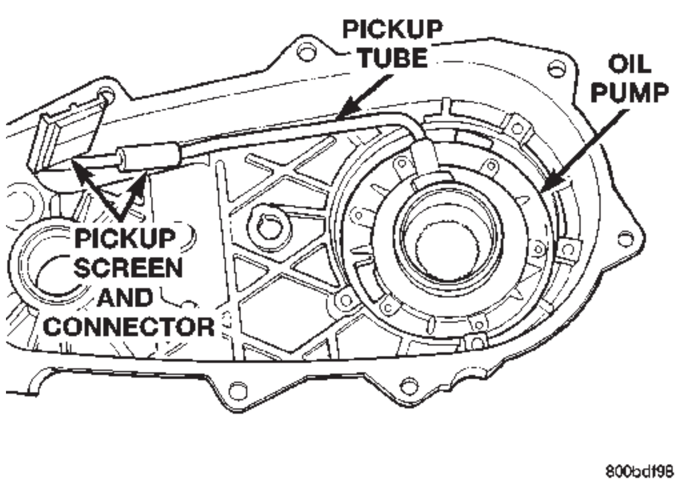


Fig. 72 Oil Pump And Pickup Tube Installation

(7) Lift rear case and oil pump and carefully position assembly on front case. Be sure case dowels are

DISASSEMBLY AND ASSEMBLY (Continued)

aligned and that mode fork rail extends through rear case before seating rear case on front case.

(8) Install case attaching bolts. Alignment bolts at each end of case are only ones requiring washers (Fig. 73).

(9) Tighten case bolts to 27-34 N·m (20-25 ft. lbs.) torque.

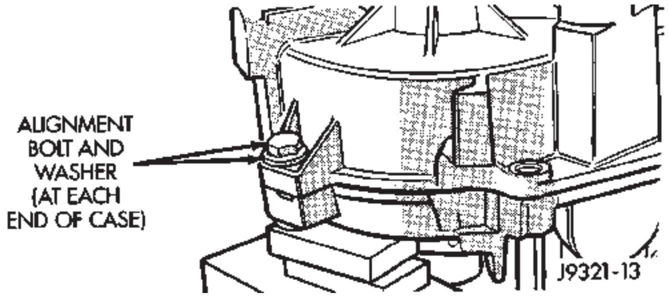


Fig. 73 Alignment Bolt Location

YOKE AND RANGE LEVER INSTALLATION

(1) Install indicator switch in front case. Tighten switch to 20–34 N·m (15–25 ft. lbs.) torque.

(2) Install range lever, washer and locknut on sector shaft (Fig. 74). Tighten locknut to 27-34 N·m (20-25 ft. lbs.) torque.

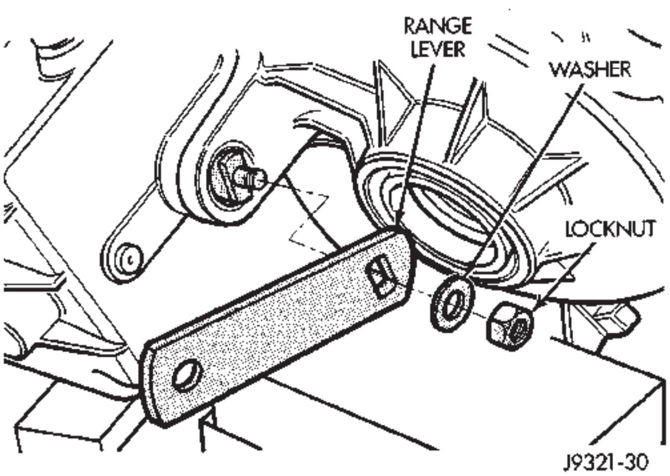


Fig. 74 Range Lever Installation

(3) Install new seal washer on front output shaft (Fig. 76).

(4) Lubricate yoke hub with transmission fluid and install yoke on front shaft.

(5) Install new seal washer on front shaft.

(6) Install yoke and new yoke nut on front output shaft (Fig. 75).

(7) 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.

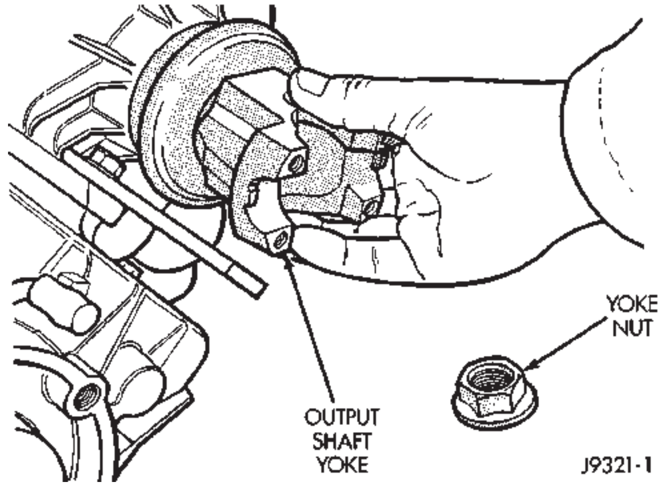


Fig. 75 Output Shaft Yoke Installation

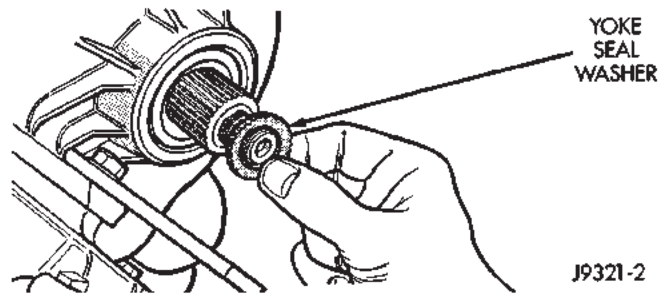


Fig. 76 Yoke Seal Washer Installation

REAR RETAINER INSTALLATION

(1) Apply bead of Mopar® Sealer P/N 82300234, or Loctite™ Ultra Gray, to mating surface of rear retainer. Sealer bead should be a maximum of 3/16 inch.

(2) Install rear retainer on rear case. Tighten retainer bolts to 20–27 N·m (15–20 ft. lbs.) torque.

(3) Install rear bearing I.D. retaining ring and spacer on output shaft.

(4) Apply liberal quantity of petroleum jelly to new rear seal and to output shaft. Petroleum jelly is needed to protect seal lips during installation.

(5) Slide seal onto Seal Protector 6992 (Fig. 77). Slide seal protector and seal onto output shaft.

(6) Slide Installer C-4076-B onto seal protector with the recessed side of the tool toward the seal. Drive seal into rear bearing retainer with installer C-4076-B and handle MD-998323 (Fig. 78).

(7) Install rear slinger with installer C-4076-A and handle MD-998323 (Fig. 78).

(8) Install boot on output shaft slinger and crimp retaining clamp with tool C-4975-A (Fig. 79).

DISASSEMBLY AND ASSEMBLY (Continued)

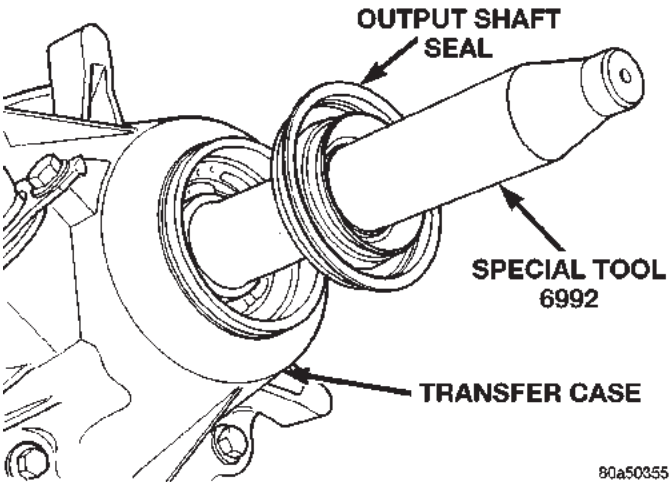


Fig. 77 Output Shaft Seal and Protector

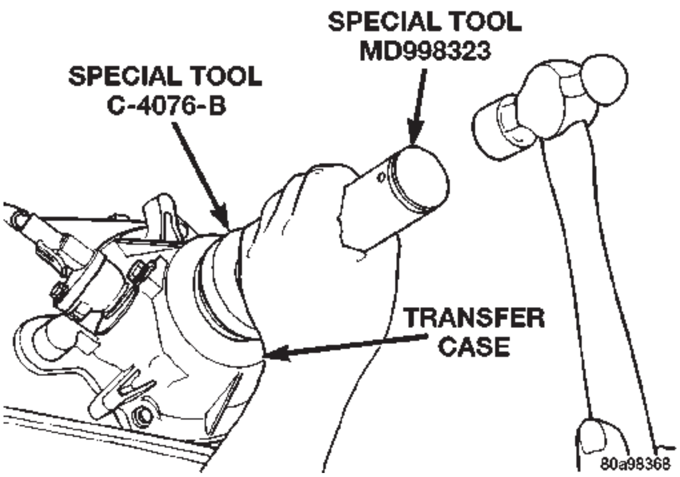


Fig. 78 Rear Seal Installation

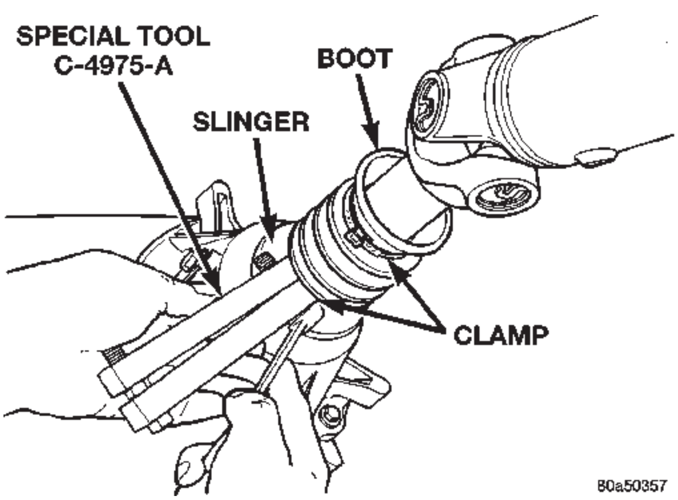


Fig. 79 Slinger Boot Installation

CLEANING AND INSPECTION

NV231 TRANSFER CASE

Clean the transfer case parts with a standard parts cleaning solvent. Remove all traces of sealer from the cases and retainers with a scraper and 3M all purpose cleaner. Use compressed air to remove solvent residue from oil feed passages in the case halves, retainers, gears, and shafts.

The oil pickup screen can be cleaned with solvent. Shake excess solvent from the screen after cleaning and allow it to air dry. Do not use compressed air.

MAINSHAFT/SPROCKET/HUB INSPECTION

Inspect the splines on the hub and shaft and the teeth on the sprocket (Fig. 80). Minor nicks and scratches can be smoothed with an oilstone. However, replace any part that is damaged.

Check the contact surfaces in the sprocket bore and on the mainshaft. Minor nicks and scratches can be smoothed with 320–400 grit emery cloth but do not try to salvage the shaft if nicks or wear is severe.

INPUT GEAR AND PLANETARY CARRIER

Check the teeth on the gear (Fig. 81). Minor nicks can be dressed off with an oilstone but replace the gear if any teeth are broken, cracked, or chipped. The bearing surface on the gear can be smoothed with 300–400 grit emery cloth if necessary.

Examine the carrier body and pinion gears for wear or damage. The carrier will have to be replaced as an assembly if the body, pinion pins, or pinion gears are damaged.

Check the lock ring and both thrust washers for wear or cracks. Replace them if necessary. Also replace the lock retaining ring if bent, distorted, or broken.

SHIFT FORKS/HUBS/SLEEVES

Check condition of the shift forks and mode fork shift rail (Fig. 82). Minor nicks on the shift rail can be smoothed with 320–400 grit emery cloth.

Inspect the shift fork wear pads (Fig. 83). The mode fork pads are serviceable and can be replaced if necessary. The range fork pads are not serviceable. The fork must be replaced as an assembly if the pads are worn or damaged.

Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

CLEANING AND INSPECTION (Continued)

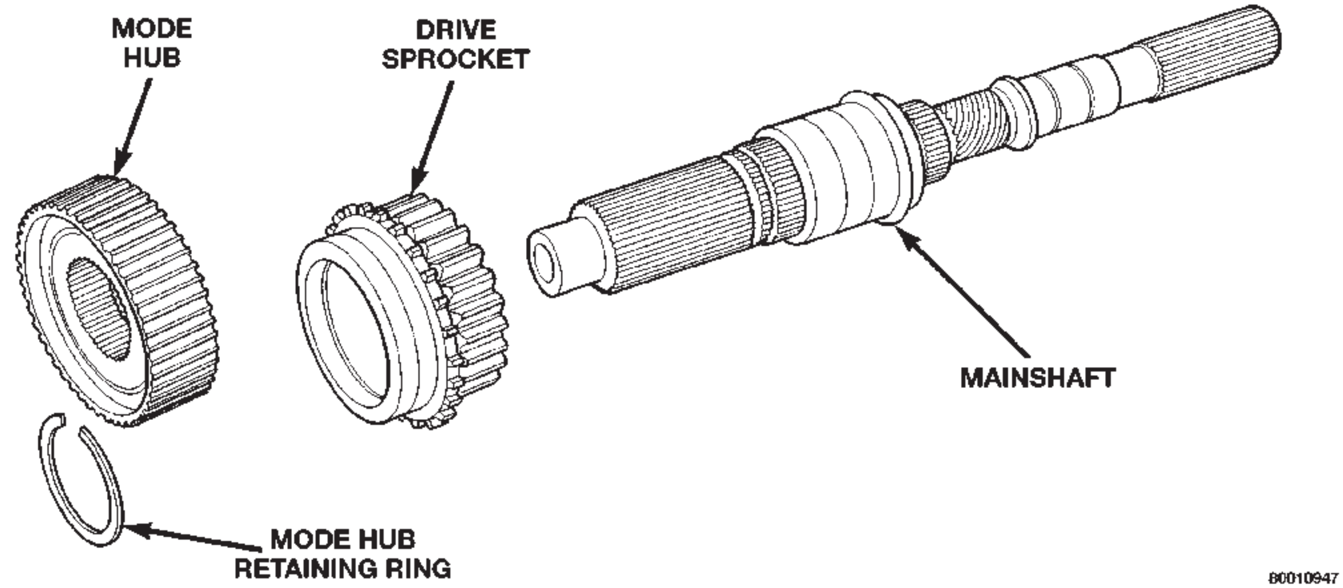


Fig. 80 Mainshaft, Mode Hub, And Drive Sprocket

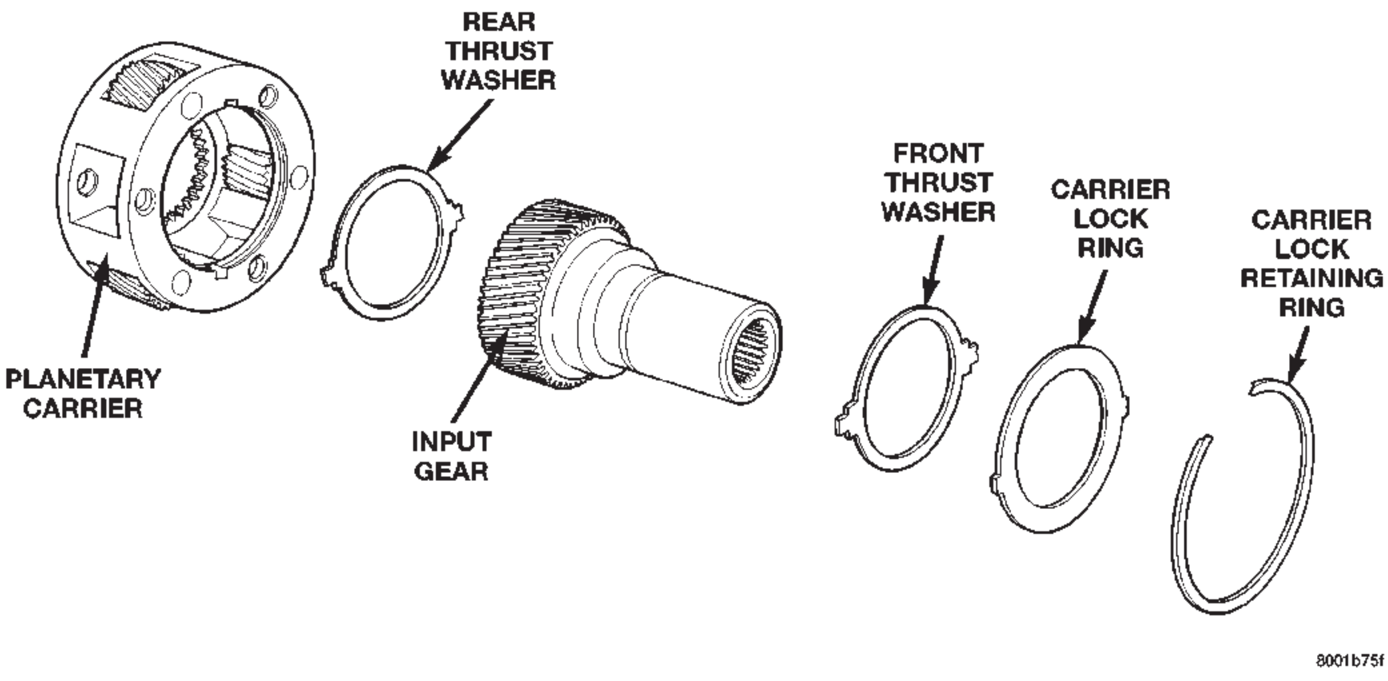


Fig. 81 Input Gear And Carrier Components

REAR RETAINER/BEARING/ SEAL/SLINGER/ BOOT

Inspect the retainer components (Fig. 84). Replace the bearing if rough or noisy. Check the retainer for cracks or wear in the bearing bore. Clean the retainer sealing surfaces with a scraper and 3M all purpose cleaner. This will ensure proper adhesion of the sealer during reassembly.

Replace the slinger and seal outright; do not reuse either part.

Inspect the retaining rings and washers. Replace any part if distorted, bent, or broken. Reuse is not recommended. Also replace the boot if cut or torn. Replace the boot band clamps, do not reuse them.

CLEANING AND INSPECTION (Continued)

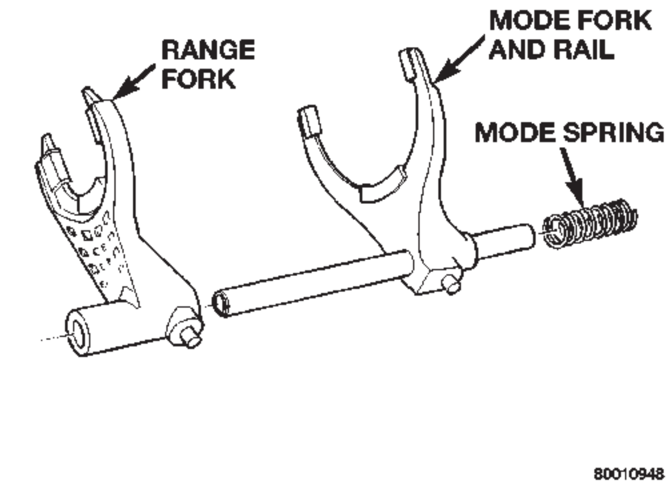


Fig. 82 Shift forks

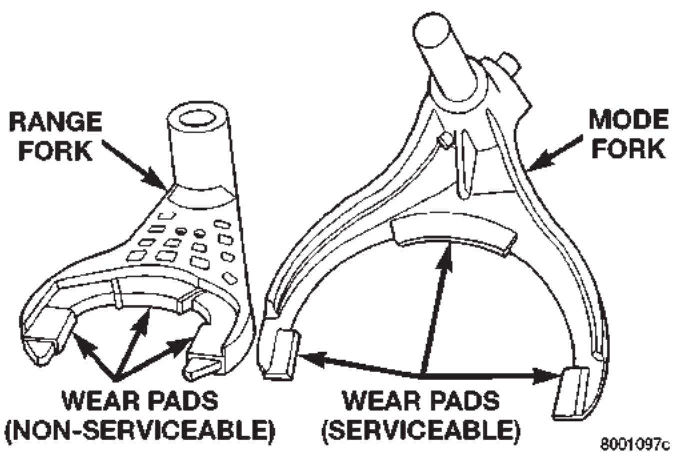


Fig. 83 Shift Fork And Wear Pad Locations

REAR OUTPUT SHAFT/YOKE/DRIVE CHAIN

Check condition of the seal contact surfaces of the yoke slinger (Fig. 85). This surface must be clean and smooth to ensure proper seal life. Replace the yoke nut and seal washer as neither part should be reused.

Inspect the shaft threads, sprocket teeth, and bearing surfaces. Minor nicks on the teeth can be smoothed with an oilstone. Use 320–400 grit emery to smooth minor scratches on the shaft bearing surfaces. Rough threads on the shaft can be chased if necessary. Replace the shaft if the threads are damaged, bearing surfaces are scored, or if any sprocket teeth are cracked or broken.

Examine the drive chain and shaft bearings. Replace the chain and both sprockets if the chain is stretched, distorted, or if any of the links bind. Replace the bearings if rough, or noisy.

LOW RANGE ANNULUS GEAR

Inspect annulus gear condition carefully. The gear is only serviced as part of the front case. If the gear is damaged, it will be necessary to replace the gear and front case as an assembly. Do not attempt to remove the gear (Fig. 86)

FRONT-REAR CASES AND FRONT RETAINER

Inspect the cases and retainer for wear and damage. Clean the sealing surfaces with a scraper and 3M all purpose cleaner. This will ensure proper sealer adhesion at assembly. Replace the input retainer seal; do not reuse it.

Check case condition. If leaks were a problem, look for gouges and severe scoring of case sealing surfaces. Also make sure the front case mounting studs are in good condition.

Check the front case mounting studs and vent tube. The tube can be secured with Loctite 271 or 680 if loose. The stud threads can be cleaned up with a die if necessary. Also check condition of the fill/drain plug threads in the rear case. The threads can be repaired with a thread chaser or tap if necessary. Or the threads can be repaired with Helicoil stainless steel inserts if required.

OIL PUMP/OIL PICKUP

Examine the oil pump pickup parts. Replace the pump if any part appears to be worn or damaged. Do not disassemble the pump as individual parts are not available. The pump is only available as a complete assembly. The pickup screen, hose, and tube are the only serviceable parts and are available separately.

ADJUSTMENTS

SHIFT LINKAGE ADJUSTMENT

(1) Shift transfer case into 4L position.

(2) Raise vehicle.

(3) Loosen lock bolt on adjusting trunnion (Fig. 87).

(4) Be sure linkage rod slides freely in trunnion. Clean rod and apply spray lube if necessary.

(5) Verify that transfer case range lever is fully engaged in 4L position.

(6) Tighten adjusting trunnion lock bolt.

(7) Lower vehicle.

ADJUSTMENTS (Continued)

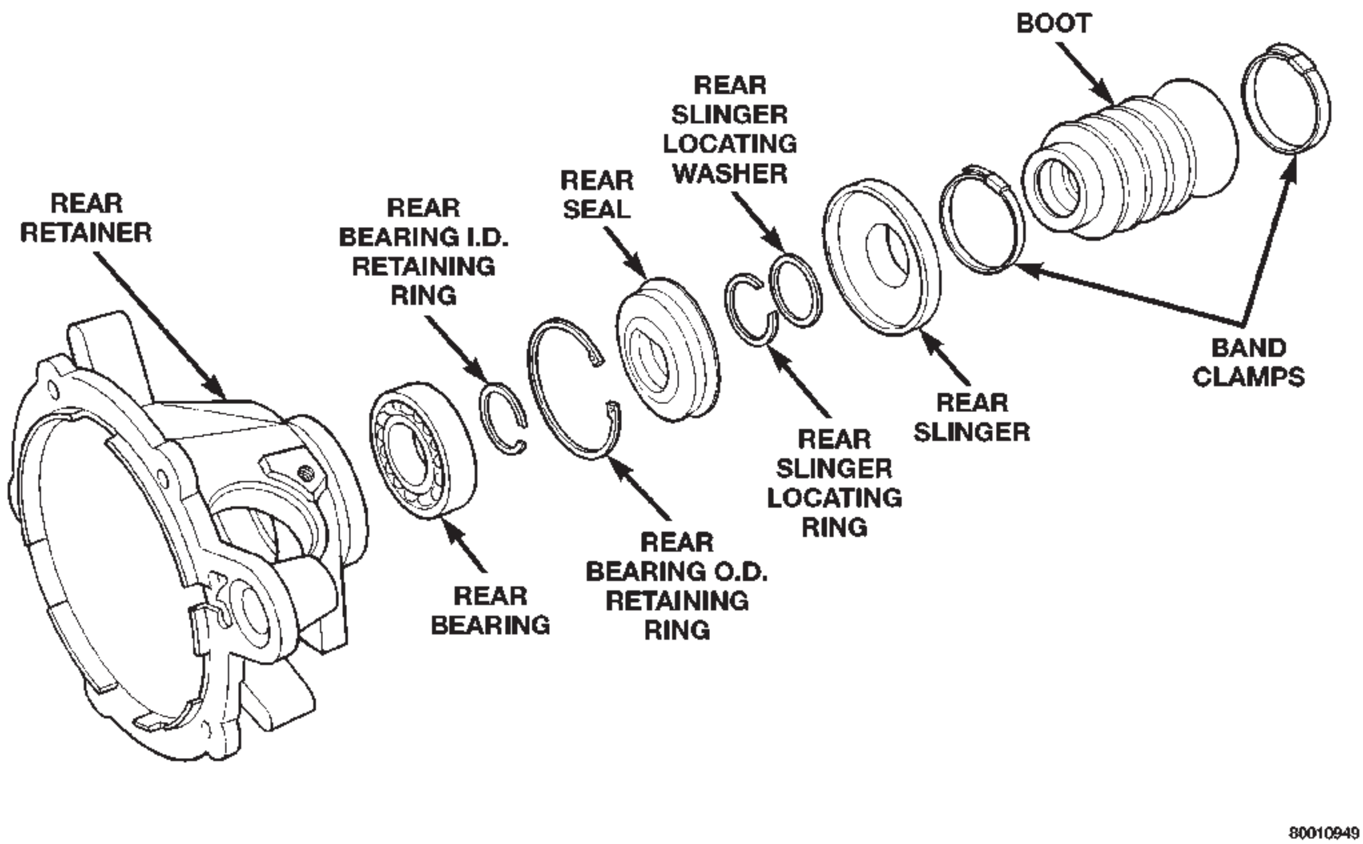


Fig. 84 Rear Retainer Components

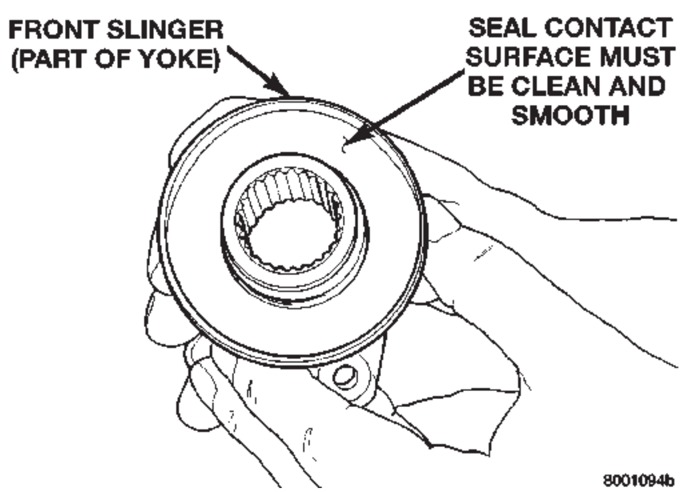


Fig. 85 Seal Contact Surface Of Yoke Slinger

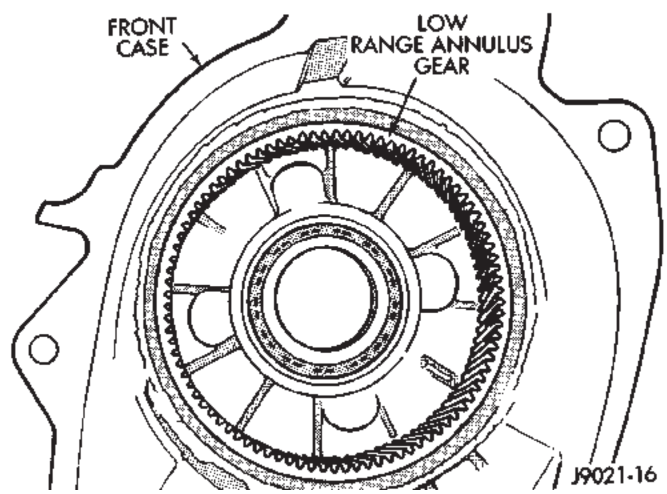


Fig. 86 Low Range Annulus Gear

ADJUSTMENTS (Continued)

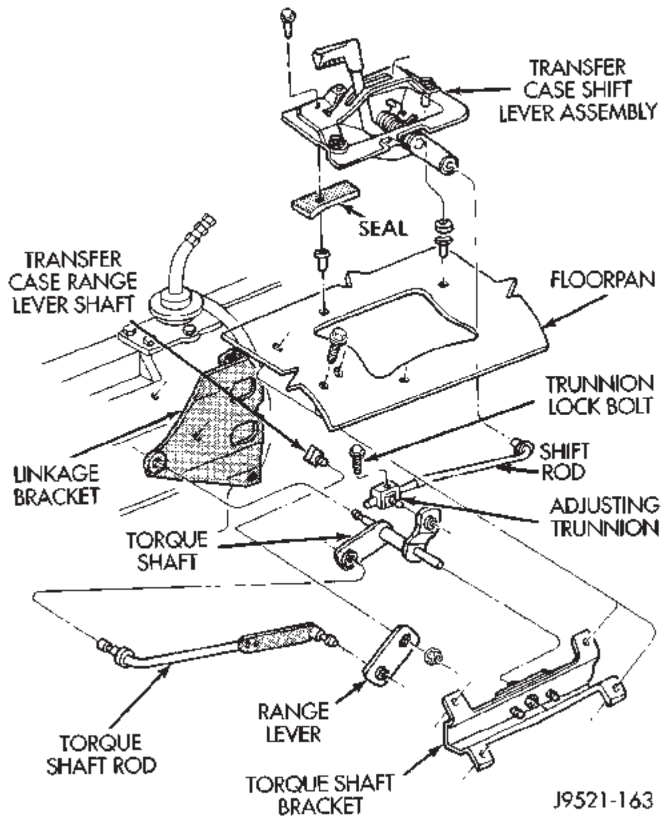


Fig. 87 Shift Linkage

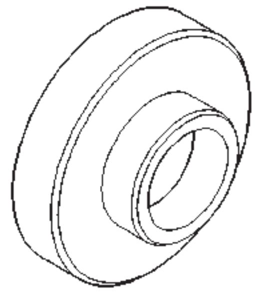
SPECIFICATIONS

TORQUE

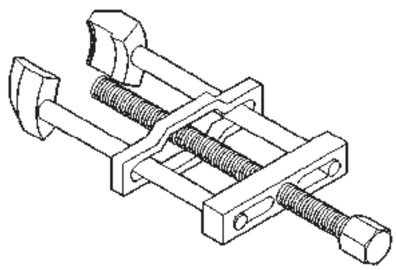
DESCRIPTION	TORQUE
Plug, Detent	16–24 N·m (12–18 ft. lbs.)
Plug, Drain/Fill	20–34 N·m (15–20 ft. lbs.)
Plug, Drain/Fill	40–45 N·m (30–40 ft. lbs.)
Bolt, Extension Housing	35–46 N·m (26–34 ft. lbs.)
Bolt, Front Brg. Retainer	21 N·m (16 ft. lbs.)
Bolt, Case Half	27–34 N·m (20–25 ft. lbs.)
Nut, Front Yoke	122–176 N·m (90–130 ft. lbs.)
Nut, Range Lever	27–34 N·m (20–25 ft. lbs.)
Bolt, Rear Retainer	35–46 N·m (26–34 ft. lbs.)
Nuts, Mounting	29–40 N·m (22–30 ft. lbs.)
Switch, Indicator	20–34 N·m (15–25 ft. lbs.)

SPECIAL TOOLS

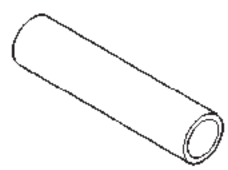
SPECIAL TOOLS—NV231



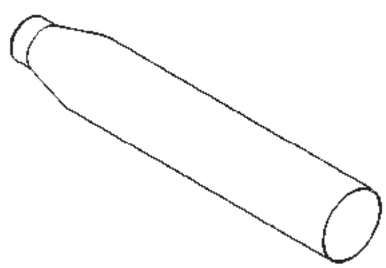
Installer—C-4076-B



Puller, Slinger—MD-998056–A

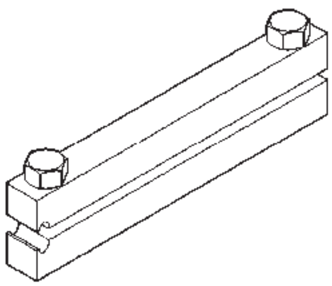


Installer—MD-998323

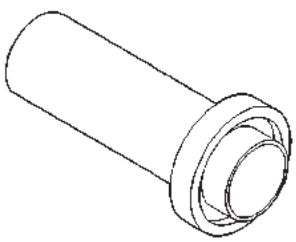


Seal Protector—6992

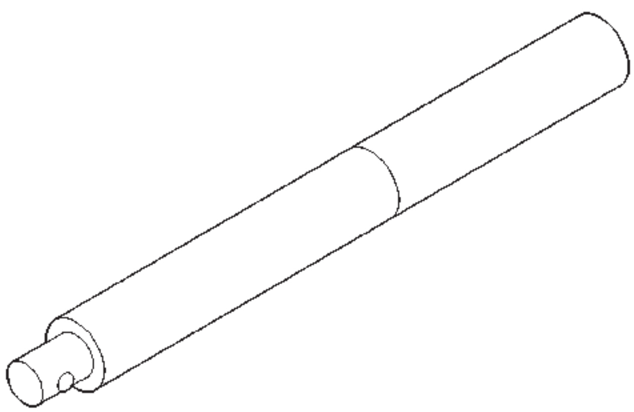
SPECIAL TOOLS (Continued)



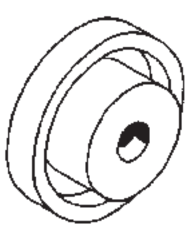
Installer, Boot Clamp—C-4975-A



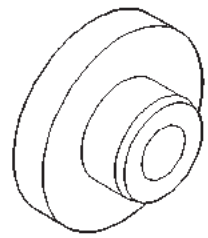
Installer, Seal—8143



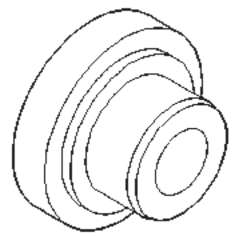
Handle, Universal—C-4171



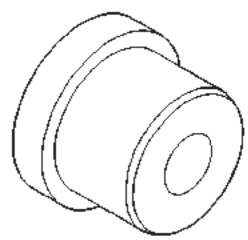
Installer, Seal—C-4210



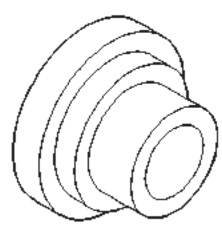
Installer, Bearing—5064



Installer, Bearing—5065

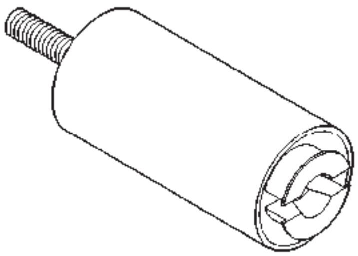


Installer, Bushing—5066

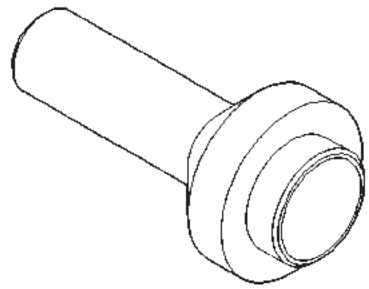


Installer, Bearing—8128

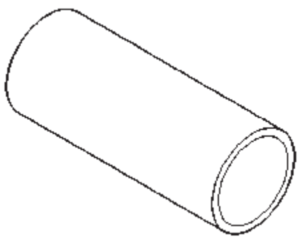
SPECIAL TOOLS (Continued)



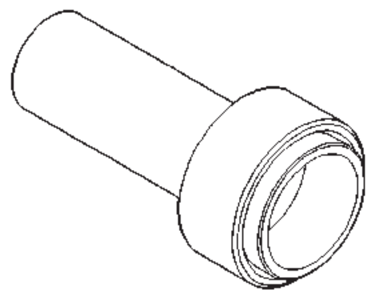
Remover—L-4454



Installer, Seal—7884



Cup—8148



Installer, Pump Housing Seal—7888

HEATING AND AIR CONDITIONING

CONTENTS

GENERAL INFORMATION

HEATER AND AIR CONDITIONER

All vehicles are equipped with a common heater-A/C housing assembly (Fig. 1). The system combines air conditioning, heating, and ventilating capabilities in a single unit housing mounted under the instrument panel. On heater-only systems, the evaporator coil and recirculating air door are omitted from the housing.

Outside fresh air enters the vehicle through the cowl top opening at the base of the windshield, and

GENERAL INFORMATION (Continued)

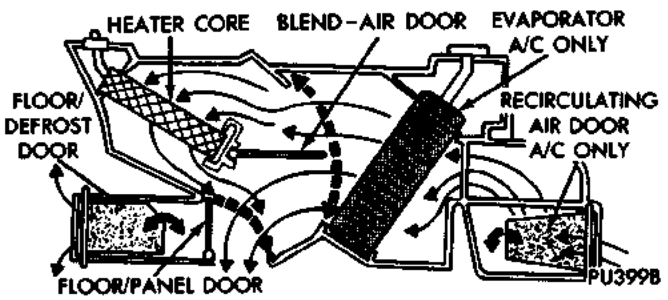


Fig. 1 Common Blend-Air Heater-Air Conditioner System - Typical

passes through a plenum chamber to the heater-A/C system blower housing. Air flow velocity can then be adjusted with the blower motor speed selector switch on the heater-A/C control panel. The air intake openings must be kept free of snow, ice, leaves, and other obstructions for the heater-A/C system to receive a sufficient volume of outside air.

The heater and optional air conditioner are blend-air type systems. In a blend-air system, a blend-air door controls the amount of unconditioned air (or cooled air from the evaporator on models with air conditioning) is allowed to flow through, or around, the heater core. A temperature control lever on the heater-A/C control panel determines the discharge air temperature by moving a cable, which operates the blend-air door. This allows an almost immediate manual control of the system's output air temperature.

The mode control lever on the heater-A/C control panel is used to direct the conditioned air to the selected system outlets. Both mode control switches use engine vacuum to control the mode doors, which are operated by vacuum actuator motors.

On air conditioned vehicles, the outside air intake can be shut off by selecting the Recirculation Mode with the mode control lever. This will open a vacuum actuated recirculating air door and recirculate the air that is already inside the vehicle.

The optional air conditioner for all models is designed for the use of non-CFC, R-134a refrigerant. The air conditioning system has an evaporator to cool and dehumidify the incoming air prior to blending it with the heated air. This system uses a fixed orifice tube in the liquid line near the condenser outlet tube to meter refrigerant flow to the evaporator coil. To maintain minimum evaporator temperature, a fixed pressure setting switch on the accumulator cycles the compressor clutch.

HEATER AND AIR CONDITIONER CONTROLS

Both the heater and heater-A/C systems use a combination of mechanical, electrical, and vacuum controls. These controls provide the vehicle operator with a number of setting options to help control the climate and comfort within the vehicle. Refer to the Owner's Manual for more information on the suggested operation and use of these controls.

The heater-only or heater-A/C control panel is located in the instrument panel center bezel below the radio and above the accessory switch bezel and ash receiver. The control panel contains a sliding-type temperature control knob, a sliding-type mode control switch knob, and a rotary-type blower motor speed switch knob.

SERVICE WARNINGS AND PRECAUTIONS

WARNING:

• THE AIR CONDITIONING SYSTEM CONTAINS REFRIGERANT UNDER HIGH PRESSURE. SEVERE PERSONAL INJURY MAY RESULT FROM IMPROPER SERVICE PROCEDURES. REPAIRS SHOULD ONLY BE PERFORMED BY QUALIFIED SERVICE PERSONNEL.

• AVOID BREATHING THE REFRIGERANT AND REFRIGERANT OIL VAPOR OR MIST. EXPOSURE MAY IRRITATE EYES, NOSE, AND/OR THROAT. WEAR EYE PROTECTION WHEN SERVICING THE AIR CONDITIONING REFRIGERANT SYSTEM. SERIOUS EYE INJURY CAN RESULT FROM DIRECT CONTACT WITH THE REFRIGERANT. IF EYE CONTACT OCCURS, SEEK MEDICAL ATTENTION IMMEDIATELY.

• DO NOT EXPOSE THE REFRIGERANT TO OPEN FLAME. POISONOUS GAS IS CREATED WHEN REFRIGERANT IS BURNED. AN ELECTRONIC LEAK DETECTOR IS RECOMMENDED.

• IF ACCIDENTAL SYSTEM DISCHARGE OCCURS, VENTILATE THE WORK AREA BEFORE RESUMING SERVICE. LARGE AMOUNTS OF REFRIGERANT RELEASED IN A CLOSED WORK AREA WILL DISPLACE THE OXYGEN AND CAUSE SUFFOCATION.

• THE EVAPORATION RATE OF R-134a REFRIGERANT AT AVERAGE TEMPERATURE AND ALTITUDE IS EXTREMELY HIGH. AS A RESULT, ANYTHING THAT COMES IN CONTACT WITH THE REFRIGERANT WILL FREEZE. ALWAYS PROTECT THE SKIN OR DELICATE OBJECTS FROM DIRECT CONTACT WITH THE REFRIGERANT.

• THE R-134a SERVICE EQUIPMENT OR THE VEHICLE REFRIGERANT SYSTEM SHOULD NOT BE PRESSURE TESTED OR LEAK TESTED WITH COMPRESSED AIR. SOME MIXTURES OF AIR AND R-134a HAVE BEEN SHOWN TO BE COMBUSTIBLE AT ELEVATED PRESSURES. THESE MIXTURES ARE POTENTIALLY DANGEROUS, AND MAY RESULT IN FIRE OR EXPLOSION CAUSING INJURY OR PROPERTY DAMAGE.

GENERAL INFORMATION (Continued)

CAUTION:

• Liquid refrigerant is corrosive to metal surfaces. Follow the operating instructions supplied with the service equipment being used.

• Never add R-12 to a refrigerant system designed to use R-134a. Damage to the system will result.

• R-12 refrigerant oil must not be mixed with R-134a refrigerant oil. They are not compatible.

• Do not use R-12 equipment or parts on the R-134a system. Damage to the system will result.

• Do not overcharge the refrigerant system. This will cause excessive compressor head pressure and can cause noise and system failure.

In addition to the warnings and cautions listed above, the following precautions must also be observed whenever servicing the air conditioning system:

• Recover the refrigerant before opening any fitting or connection. Open the fittings with caution, even after the system has been discharged. Never open or loosen a connection before recovering the refrigerant.

• The refrigerant system must always be evacuated before charging.

• Do not open the refrigerant system or uncap a replacement component until you are ready to service the system. This will prevent contamination in the system.

• Before disconnecting a component, clean the outside of the fittings thoroughly to prevent contamination from entering the refrigerant system.

• Immediately after disconnecting a component from the refrigerant system, seal the open fittings with a cap or plug.

• Before connecting an open refrigerant fitting, always install a new seal or gasket. Coat the fitting and seal with clean refrigerant oil before connecting.

• Do not remove the sealing caps from a replacement component until it is installed.

• When installing a refrigerant line, avoid sharp bends that may restrict refrigerant flow. Position the refrigerant lines away from exhaust system components or any sharp edges, which may damage the line.

• Tighten refrigerant fittings only to the specified torque. The aluminum fittings used in the refrigerant system will not tolerate overtightening.

• When disconnecting a refrigerant fitting, use a wrench on both halves of the fitting. This will prevent twisting of the refrigerant lines or tubes.

• Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open a container of refrigerant oil until you are ready to use it. Replace the cap on the oil container immediately after using. Store refrigerant oil only in a clean, airtight, and moisture-free container.

• Keep service tools and the work area clean. Contamination of the refrigerant system through careless work habits must be avoided.

COOLING SYSTEM REQUIREMENTS

To maintain the performance level of the heating-air conditioning system, the engine cooling system must be properly maintained.

The use of a bug screen is not recommended. Any obstructions in front of the radiator or condenser will reduce the performance of the air conditioning and engine cooling systems.

COOLANT PRECAUTIONS

WARNING:

• ANTIFREEZE IS AN ETHYLENE GLYCOL BASED COOLANT AND IS HARMFUL IF SWALLOWED OR INHALED. IF SWALLOWED, DRINK TWO GLASSES OF WATER AND INDUCE VOMITING. IF INHALED, MOVE TO A FRESH AIR AREA. SEEK MEDICAL ATTENTION IMMEDIATELY.

• WASH THE SKIN AND CLOTHING THOROUGHLY AFTER COMING IN CONTACT WITH ETHYLENE GLYCOL.

• KEEP OUT OF THE REACH OF CHILDREN AND PETS.

• DO NOT OPEN A COOLING SYSTEM WHEN THE ENGINE IS AT OPERATING TEMPERATURE. PERSONAL INJURY MAY RESULT.

• DO NOT STORE ENGINE COOLANT IN OPEN OR UNMARKED CONTAINERS.

• HOT ENGINE COOLANT CAN CAUSE SEVERE BURNS. DO NOT OPEN THE RADIATOR DRAIN COCK WHEN THE COOLING SYSTEM IS HOT AND PRESSURIZED. ALLOW THE COOLANT TO DECREASE TO ROOM TEMPERATURE BEFORE STARTING REPAIR OPERATIONS.

The engine cooling system is designed to develop internal pressures of 97 to 124 kPa (14 to 18 psi). Allow the vehicle 15 minutes to cool down, or wait until a safe temperature and pressure are attained, before opening the cooling system. Refer to Group 7 - Cooling System for more information.

REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS

Kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire system. High pressures are produced in the system when it is operating. Extreme care must be exercised to make sure that all refrigerant system connections are pressure tight.

GENERAL INFORMATION (Continued)

A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. Sharp bends will reduce the flow of refrigerant. The flexible hose lines should be routed so they are at least 80 mm (3 inches) from the exhaust manifold. It is a good practice to inspect all flexible refrigerant system hose lines at least once a year to make sure they are in good condition and properly routed.

There are two types of refrigerant fittings:

- All fittings with O-rings need to be coated with refrigerant oil before installation. Use only O-rings approved for use with R-134a refrigerant. Failure to do so may result in a leak.
- Unified plumbing connections with aluminum gaskets cannot be serviced with O-rings. The gaskets are not reusable and new gaskets do not require lubrication before installing.

Using the proper tools when making a refrigerant plumbing connection is very important. Improper tools or improper use of the tools can damage the refrigerant fittings. Always use two wrenches when loosening or tightening tube fittings. Use one wrench to hold one side of the connection stationary, while loosening or tightening the other side of the connection with a second wrench.

The refrigerant must be recovered completely from the system before opening any fitting or connection. Open the fittings with caution, even after the refrigerant has been recovered. If any pressure is noticed as a fitting is loosened, tighten the fitting and recover the refrigerant from the system again.

Do not discharge refrigerant into the atmosphere. Use an R-134a refrigerant recovery/recycling device that meets SAE Standard J2210.

The refrigerant system will remain chemically stable as long as pure, moisture-free R-134a refrigerant oil is used. Dirt, moisture, or air can upset this chemical stability. Operational troubles or serious damage can occur if foreign material is present in the refrigerant system.

When it is necessary to open the refrigerant system, have everything needed to service the system ready. The refrigerant system should not be left open to the atmosphere any longer than necessary. Cap or plug all lines and fittings as soon as they are opened to prevent the entrance of dirt and moisture. All lines and components in parts stock should be capped or sealed until they are installed.

All tools, including the refrigerant recycling equipment, the manifold gauge set, and test hoses should be kept clean and dry. All tools and equipment must be designed for R-134a refrigerant.

DESCRIPTION AND OPERATION

ACCUMULATOR

The accumulator is mounted in the engine compartment between the evaporator coil outlet tube and the compressor inlet. Refrigerant enters the accumulator canister as a low pressure vapor through the inlet tube. Any liquid, oil-laden refrigerant falls to the bottom of the canister, which acts as a separator. A desiccant bag is mounted inside the accumulator canister to absorb any moisture which may have entered and become trapped in the refrigerant system (Fig. 2).

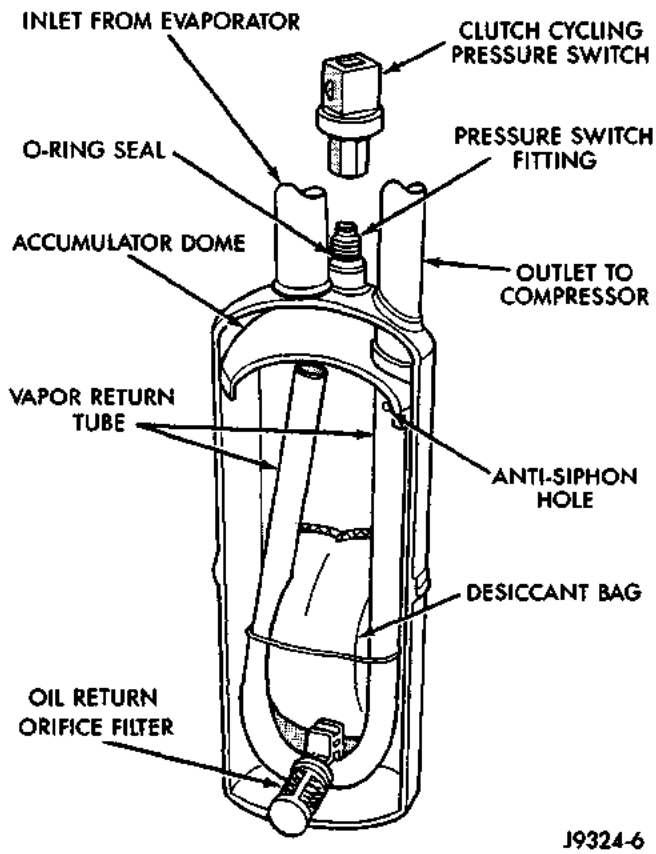


Fig. 2 Accumulator - Typical

BLOWER MOTOR

The blower motor and blower wheel are located in the passenger side end of the heater-A/C housing, below the glove box. The blower motor controls the velocity of air flowing through the heater-A/C housing by spinning a squirrel cage-type blower wheel within the housing at the selected speed. The blower motor and wheel can be removed from the engine compartment side of the housing without heater-A/C housing removal.

The blower motor will only operate when the ignition switch is in the On position, and the heater-A/C mode control switch knob is in any position, except Off. The blower motor receives a ground feed at all

DESCRIPTION AND OPERATION (Continued)

times. The blower motor battery feed circuit is protected by a fuse in the fuseblock module. Blower motor speed is controlled by regulating the battery feed through the blower motor switch, blower motor resistor, and high speed blower motor relay.

The blower motor and blower motor wheel cannot be repaired and, if faulty, they must be replaced. The blower motor and blower wheel are serviced only as a unit.

BLOWER MOTOR RESISTOR

The blower motor resistor is mounted to the bottom of the heater-A/C housing on the passenger side of the vehicle under the instrument panel. On models with the optional air conditioning, it can be accessed by removing the recirculation air door actuator kick cover.

The resistor has multiple resistor wires, each of which reduce the current flow to the blower motor, to change the blower motor speed. The blower motor switch directs the current through the correct resistor wire to obtain the selected speed.

The blower motor resistor cannot be repaired and, if faulty, it must be replaced.

BLOWER MOTOR SWITCH

The heater or heater-A/C blower motor is controlled by a four position rotary-type blower motor switch, mounted in the heater-A/C control panel. The switch allows the selection of one of four blower motor speeds, but can only be turned off by selecting the Off position with the heater-A/C mode control switch knob.

The blower motor switch receives ignition-switched battery feed through the mode control switch from a fuse in the fuseblock module. The switch directs the current to the blower motor resistor, or to the high speed blower motor relay, as required to achieve the selected blower motor speed.

The blower motor switch cannot be repaired and, if faulty, it must be replaced.

COMPRESSOR

The air conditioning system uses a Sanden SD7H15 fixed displacement compressor on all models. A label identifying the use of R-134a refrigerant is located on the compressor. The purpose of the compressor is to compress the low-pressure refrigerant vapor from the evaporator into a high-pressure, high-temperature vapor. The compressor is serviced only as an assembly.

COMPRESSOR CLUTCH

The compressor clutch assembly consists of a stationary electromagnetic coil, a hub bearing and pulley assembly, and a clutch plate (Fig. 3). The electromagnetic coil and pulley are retained on the compressor with snap rings. The clutch plate is mounted on the compressor shaft and secured with a nut.

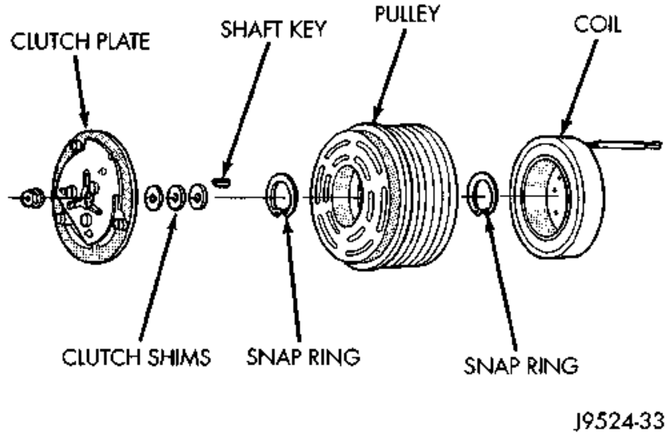


Fig. 3 Compressor Clutch

These components provide the means to engage and disengage the compressor from the engine serpentine accessory drive belt. When the clutch coil is energized, it magnetically draws the clutch into contact with the pulley and drives the compressor shaft. When the coil is not energized, the pulley freewheels on the clutch hub bearing, which is part of the pulley. The compressor clutch and coil are the only serviced parts on the compressor.

The compressor clutch is controlled by several components: the heater-A/C mode control switch, the low pressure cycling clutch switch, the high pressure cut-off switch, the compressor clutch relay, and the Powertrain Control Module (PCM). The PCM may delay compressor clutch engagement for up to 30 seconds. Refer to Group 14 - Fuel System for more information on the PCM controls.

COMPRESSOR CLUTCH RELAY

The compressor clutch relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (footprint) is different, current capacity is lower, and the relay case dimensions are smaller than on the conventional ISO relay.

The compressor clutch relay is a electro-mechanical device that switches current to the compressor clutch coil when the Powertrain Control Module (PCM) grounds the coil side of the relay. The PCM responds to inputs from the heater-A/C mode control switch, the low pressure cycling clutch switch, and the high pressure cut-off switch.

The compressor clutch relay is located in the Power Distribution Center (PDC) in the engine compart-

DESCRIPTION AND OPERATION (Continued)

ment. Refer to the PDC label for relay identification and location.

CONDENSER

The condenser is located in front of the engine cooling radiator. It is a heat exchanger that allows the high-pressure refrigerant gas to give up its heat to the air passing over the condenser fins. This causes the refrigerant gas to condense into a high-pressure liquid refrigerant. The condenser is serviced only as an assembly.

EVAPORATOR COIL

The evaporator coil is located in the heater-A/C housing, under the instrument panel. Refrigerant enters the evaporator as a low-temperature, low-pressure liquid. As air passes over the fins of the evaporator, the humidity in the air condenses on the fins, and the heat from the air is absorbed by the refrigerant. Heat absorption causes the refrigerant to become a low-pressure gas before it leaves the evaporator.

The evaporator coil cannot be repaired and, if faulty, it must be replaced.

FIXED ORIFICE TUBE

The fixed orifice tube is installed in the liquid line between the outlet tube of the condenser and the inlet tube of the evaporator. The fixed orifice tube is located in the end of the liquid line that connects to the condenser outlet tube.

The inlet and outlet ends of the tube have a screen to filter the refrigerant. O-rings on the tube body prevent the refrigerant from bypassing the fixed orifice. The fixed orifice tube is used to meter the flow of liquid refrigerant into the evaporator coil.

The fixed orifice tube cannot be repaired and, if faulty or plugged, it must be replaced.

HEATER CORE

The heater core is located in the heater-A/C housing, under the instrument panel. It is a heat exchanger made of rows of tubes and fins. Engine coolant is circulated through heater hoses to the heater core at all times. As the coolant flows through the heater core, heat removed from the engine is transferred to the heater core fins and tubes.

Air directed through the heater core picks up the heat from the heater core fins. The blend air door allows control of the heater output air temperature by controlling how much of the air flowing through the heater-A/C housing is directed through the heater core. The blower motor speed controls the amount of air flowing through the heater-A/C housing.

The heater core cannot be repaired and, if faulty, it must be replaced.

HIGH PRESSURE CUT-OFF SWITCH

The high pressure cut-off switch is located on the discharge line near the compressor. This switch is connected in series with the low pressure cycling clutch switch between ground and the Powertrain Control Module (PCM). The switch contacts open and close causing the PCM to turn the compressor clutch on and off. This prevents compressor operation when the discharge line pressure approaches high levels.

The high pressure cut-off switch contacts are open when the discharge line pressure rises above 3100-3375 kPa (450-490 psi). The switch contacts will close when the discharge line pressure drops to 1860-2275 kPa (270-330 psi).

The high pressure cut-off switch is a factory-calibrated unit. The switch cannot be adjusted or repaired and, if faulty, it must be replaced.

HIGH PRESSURE RELIEF VALVE

The high pressure relief valve is located on the compressor. The valve is used to prevent excessive refrigerant system pressure. The valve vents the system when a pressure of 3445 to 4135 kPa (500 to 600 psi), and above, is reached. This prevents damage to the compressor and other system components due to condenser air flow being restricted or an overcharge of refrigerant. The valve closes with a minimum pressure of 2756 kPa (400 psi).

The high pressure relief valve vents only enough refrigerant to reduce system pressure, and then re-seats itself. The majority of the refrigerant is conserved in the system. If the valve vents refrigerant, it does not mean the valve is faulty. The valve is part of the compressor assembly and must not be removed or otherwise disturbed.

HIGH SPEED BLOWER MOTOR RELAY

The high speed blower motor relay is a International Standards Organization (ISO)-type relay. The relay is a electro-mechanical device that switches battery current from a fuse in the Power Distribution Center (PDC) to the blower motor, bypassing the remainder of the blower motor feed circuit. The relay is energized when the relay coil is provided a voltage signal by the blower motor switch. See the Diagnosis and Testing section of this group for more information on the relay's operation.

The high speed blower motor relay is located near the passenger side end of the heater-A/C housing, next to the heater-A/C wire harness connector. The relay cannot be repaired and, if faulty, it must be replaced.

DESCRIPTION AND OPERATION (Continued)

LOW PRESSURE CYCLING CLUTCH SWITCH

The low pressure cycling clutch switch is mounted on top of the accumulator. The switch is connected in series with the high pressure cut-off switch, between ground and the Powertrain Control Module (PCM). The switch contacts open and close causing the PCM to turn the compressor clutch on and off. This regulates the system pressure and controls evaporator temperature. Controlling evaporator temperature prevents condensate water on the evaporator fins from freezing and obstructing air conditioning system air flow.

The low pressure cycling clutch switch contacts are open when the suction pressure is approximately 141 kPa (20.5 psi) or lower. The switch contacts will close when the suction pressure rises to approximately 234-262 kPa (34-38 psi) or above. Lower ambient temperatures, below approximately -1°C (30°F) during cold weather will also open the switch contacts. This is due to the pressure/temperature relationship of the refrigerant in the system.

The low pressure cycling clutch switch is a factory-calibrated unit. It cannot be adjusted or repaired and, if faulty, it must be replaced.

REFRIGERANT

The R-134a refrigerant used in this air conditioning system is a non-toxic, non-flammable, clear, and colorless liquefied gas. R-134a refrigerant is not compatible with R-12 refrigerant in an air conditioning system. Even a small amount of R-12 added to a R-134a refrigerant system, will cause compressor failure, refrigerant oil sludge, or poor air conditioning system performance.

The refrigerant system service ports have been designed to ensure that the system is not accidentally filled with the wrong refrigerant (R-12).

REFRIGERANT LINES

The refrigerant lines are used to carry the refrigerant between the various air conditioning system components. A barrier hose design is used for the air conditioning system on this vehicle. The ends of the refrigerant hoses are made from lightweight aluminum, and use braze-less fittings. The refrigerant lines and hoses cannot be repaired and, if faulty, they must be replaced.

REFRIGERANT LINE COUPLERS

Spring-locking refrigerant line couplers are used to connect refrigerant lines and other components to the refrigerant system. The coupling is held together by a garter spring inside a circular cage.

When the coupling halves are connected, the flared end of the female fitting slips behind 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. Secondary clips are installed over the coupling at the factory for added blowoff protection.

O-rings are used to seal the coupling. These O-rings are compatible with R-134a refrigerant and must be replaced with O-rings made of the same material.

REFRIGERANT OIL

The oil used in the SD7H15 compressor is a polyalkylene glycol, synthetic (SP-20 PAG), wax-free refrigerant oil. Use only refrigerant oil of the same type to service the system.

Refrigerant oil will absorb any moisture it comes in contact with, even moisture in the air. The oil container should be kept tightly capped until it is ready to be used. Then, cap the oil immediately after using, to prevent contamination.

REFRIGERANT SYSTEM SERVICE EQUIPMENT

WARNING: EYE PROTECTION MUST BE WORN WHEN SERVICING AN AIR CONDITIONING REFRIGERANT SYSTEM. TURN OFF (ROTATE CLOCKWISE) ALL VALVES ON THE EQUIPMENT BEING USED, BEFORE CONNECTING TO OR DISCONNECTING FROM THE REFRIGERANT SYSTEM. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY.

When servicing the air conditioning system, a refrigerant charging station and a recovery/recycling device for R-134a must be used. This device must meet SAE Standard J2210. Contact an automotive service equipment supplier for refrigerant charging and recycling/recovering equipment. Refer to the operating instructions provided with the equipment for proper operation.

A manifold gauge set may be needed with some charging and/or recovery/recycling devices (Fig. 4). The service hoses on the gauge set being used should have manual (turn wheel), or automatic back-flow valves at the service port connector ends. This will prevent refrigerant from being released into the atmosphere.

MANIFOLD GAUGE SET CONNECTIONS

CAUTION: Do not use an R-12 manifold gauge set on an R-134a system. The refrigerants are not compatible and system damage will result.

LOW PRESSURE GAUGE HOSE

The low pressure hose (Blue with Black stripe) attaches to the suction service port. This port is

DESCRIPTION AND OPERATION (Continued)

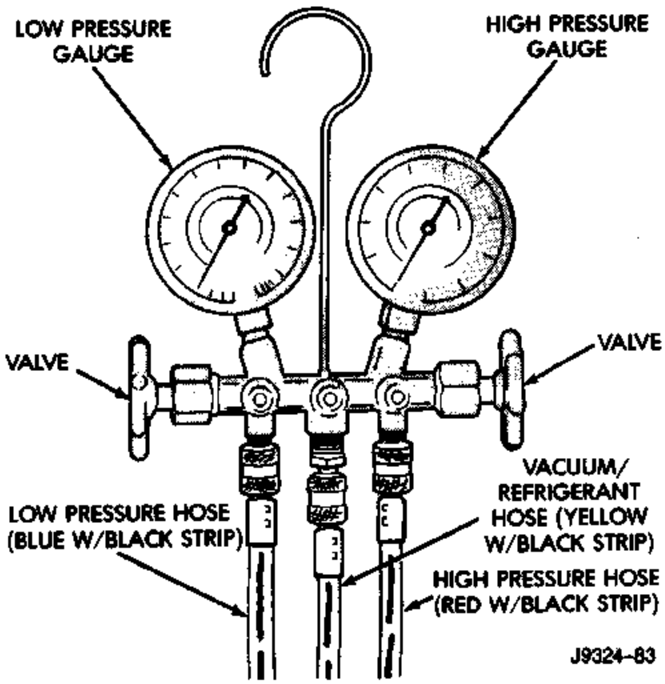


Fig. 4 Manifold Gauge Set

located on the liquid line near the evaporator inlet tube at the rear of the engine compartment.

HIGH PRESSURE GAUGE HOSE

The high pressure hose (Red with Black stripe) attaches to the discharge service port. This port is located on the discharge line between the compressor and the condenser.

RECOVERY/RECYCLING/EVACUATION/CHARGING HOSE

The center manifold hose (Yellow, or White, with Black stripe) is used to recover, evacuate, and charge the refrigerant system. When the low or high pressure valves on the manifold gauge set are opened, the refrigerant in the system will escape through this hose.

REFRIGERANT SYSTEM SERVICE PORTS

The refrigerant system service ports are used to charge, recover/recycle, evacuate, and test the air conditioning refrigerant system. Unique service port coupler sizes are used on the R-134a system, to ensure that the refrigerant system is not accidentally contaminated by the use of the wrong refrigerant (R-12), or refrigerant system service equipment.

The high pressure service port is located on the compressor manifold or plumbing. The low pressure service port is located on the liquid line. After servicing the refrigerant system, always reinstall the service port caps.

VACUUM CHECK VALVE

A one-way vacuum check valve is installed in the accessory vacuum supply line near the vacuum tap on the engine intake manifold. This check valve helps to maintain the system vacuum needed to retain the selected heater-A/C mode settings by preventing the engine from bleeding down system vacuum through the intake manifold during extended heavy engine load (low engine vacuum) operation.

The vacuum check valve cannot be repaired and, if faulty, it must be replaced.

VACUUM RESERVOIR

The vacuum reservoir is mounted in the engine compartment on the rear of the front wheelhouse inner panel and under the battery tray. Vacuum stored in the reservoir is used to operate the vacuum-controlled vehicle accessories during periods of low engine vacuum, such as when the vehicle is climbing a steep grade or under other high engine load operating conditions.

The vacuum reservoir cannot be repaired and, if faulty, it must be replaced.

DIAGNOSIS AND TESTING

A/C PERFORMANCE

The air conditioning system is designed to provide the passenger compartment with low temperature and low humidity air. The evaporator, located in the heater-A/C housing on the dash panel below the instrument panel, is cooled to temperatures near the freezing point. As warm damp air passes over the fins in the evaporator, the air is cooled and the moisture is removed as it condenses on the fins. During periods of high heat and humidity, an air conditioning system will be more effective in the Recirculation Mode. With the system in the Recirculation Mode, only air from the passenger compartment passes through the evaporator. As the passenger compartment air dehumidifies, the air conditioning system performance levels improve.

Humidity has an important bearing on the temperature of the air delivered to the interior of the vehicle. It is important to understand the effect that humidity has on the performance of the air conditioning system. When humidity is high, the evaporator has to perform a double duty. It must lower the air temperature, and it must lower the temperature of the moisture in the air that condenses on the evaporator fins. Condensing the moisture in the air transfers heat energy into the evaporator fins and tubing. This reduces the amount of heat the evaporator can absorb from the air. High humidity greatly reduces the ability of the evaporator to lower the temperature of the air.

DIAGNOSIS AND TESTING (Continued)

However, evaporator capacity used to reduce the amount of moisture in the air is not wasted. Wringing some of the moisture out of the air entering the vehicle adds to the comfort of the passengers. Although, an owner may expect too much from their air conditioning system on humid days. A performance test is the best way to determine whether the system is performing up to standard. This test also provides valuable clues as to the possible cause of trouble with the air conditioning system.

Review the Service Warnings and Precautions in the front of this group before performing this procedure. The air temperature in the test room and in the vehicle must be a minimum of 21°C (70°F) for this test.

(1) Connect a tachometer and a manifold gauge set.

(2) Set the heater-A/C mode control switch knob in the Recirculation Mode position, the temperature control knob in the full cool position, and the blower motor switch knob in the highest speed position.

(3) Start the engine and hold the idle at 1,000 rpm with the compressor clutch engaged.

(4) The engine should be at operating temperature. The doors and windows must be open.

(5) Insert a thermometer in the driver's side center A/C (panel) outlet. Operate the engine for five minutes.

(6) The compressor clutch may cycle, depending upon the ambient temperature and humidity. If the clutch cycles, remove the low pressure cycling clutch switch connector from the switch located on the accumulator (Fig. 5). Place a jumper wire across the terminals of the low pressure cycling clutch switch connector.

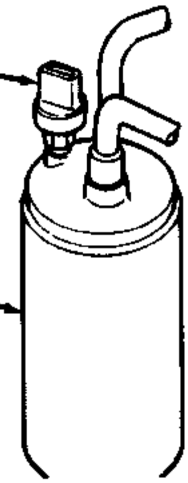


Fig. 5 Low Pressure Cycling Clutch Switch

(7) With the compressor clutch engaged, record the discharge air temperature and the compressor discharge pressure.

(8) Compare the discharge air temperature to the Performance Temperature and Pressure chart. If the discharge air temperature is high, see Refrigerant System Leaks and Refrigerant System Charge in this group.

(9) Compare the compressor discharge pressure to the Performance Temperature and Pressure chart. If the compressor discharge pressure is high, see the Pressure Diagnosis chart.

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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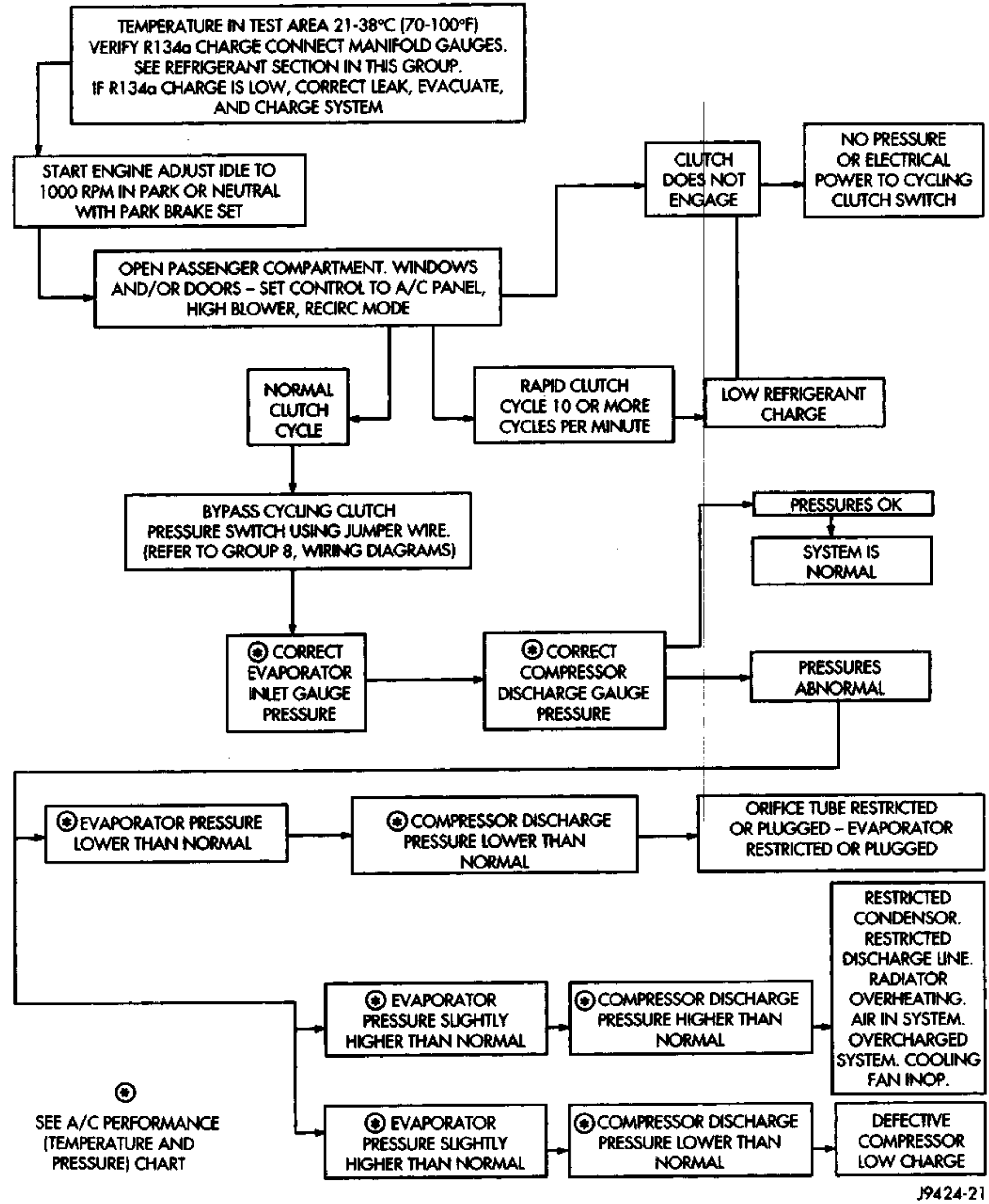
Performance Temperature and Pressure Chart

DIAGNOSIS AND TESTING (Continued)



Pressure Diagnosis

DIAGNOSIS AND TESTING (Continued)

HEATER PERFORMANCE

PREPARATIONS

Review the Service Warnings and Precautions in the front of this group before performing the following procedures.

Check the radiator coolant level, serpentine drive belt tension, and engine vacuum line connections. Also check the radiator air flow and the radiator fan operation. Start the engine and allow it to warm up to normal operating temperature.

WARNING: DO NOT REMOVE THE RADIATOR PRESSURE CAP WHEN THE ENGINE IS AT OPERATING TEMPERATURE, PERSONAL INJURY MAY RESULT.

If the vehicle has been operated recently, wait 15 minutes or longer before removing the radiator pressure cap. Place a rag over the cap and turn it to the first safety stop. Allow any pressure to escape through the overflow tube. When the system stabilizes, remove the cap completely.

MAXIMUM HEATER OUTPUT

Engine coolant is delivered to the heater core through two heater hoses. With the engine idling at normal operating temperature, set the temperature control knob in the full hot position, the mode control switch knob in the Floor position, and the blower motor switch knob in the highest speed position. Using a test thermometer, check the air temperature coming from the floor outlets, refer to the 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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Temperature Reference Chart

If the floor outlet air temperature is low, refer to Group 7 - Cooling System for the coolant temperature specifications. Both of the heater hoses should be hot to the touch. The coolant return hose should be slightly cooler than the supply hose. If the coolant return hose is much cooler than the supply hose, locate and repair the engine coolant flow obstruction in the heater system.

OBSTRUCTED COOLANT FLOW

Possible locations or causes of obstructed coolant flow:

- Pinched or kinked heater hoses.
- Improper heater hose routing.
- Plugged heater hoses or supply and return ports at the cooling system connections (refer to Group 7 - Cooling System).
- A plugged heater core.

If proper coolant flow through the heater system is verified, and outlet air temperature is still low, a mechanical problem may exist.

MECHANICAL PROBLEMS

Possible locations or causes of insufficient heat:

- An obstructed cowl air intake.
- Obstructed heater system outlets.
- A blend-air door not functioning properly.

TEMPERATURE CONTROL

If the heater discharge air temperature cannot be adjusted with the temperature control knob on the heater-A/C control panel, the following could require service:

- The heater-A/C control.
- The temperature control cable.
- The blend-air door.
- Improper engine coolant temperature.

VACUUM SYSTEM

Vacuum control is used to operate the mode doors in the heater-A/C housing. Testing of the heater-A/C mode control switch operation will determine if the vacuum, and mechanical controls are functioning. However, it is possible that a vacuum control system that operates perfectly at engine idle (high engine vacuum) may not function properly at high engine speeds or loads (low engine vacuum). This can be caused by leaks in the vacuum system, or a faulty vacuum check valve.

A vacuum system test will help to identify the source of poor vacuum system performance, or vacuum system leaks. Before starting this test, stop the engine and make certain that the problem isn't a disconnected vacuum supply tube at the engine intake manifold vacuum tap or the vacuum reservoir.

Use an adjustable vacuum test set (Special Tool C-3707) and a suitable vacuum pump to test the heater-A/C vacuum control system. With a finger placed over the end of the vacuum test hose probe (Fig. 6), adjust the bleed valve on the test set gauge to obtain a vacuum of exactly 27 kPa (8 in. Hg.). Release and block the end of the probe several times to verify that the vacuum reading returns to the exact 27 kPa (8 in. Hg.) setting. Otherwise, a false reading will be obtained during testing.

DIAGNOSIS AND TESTING (Continued)

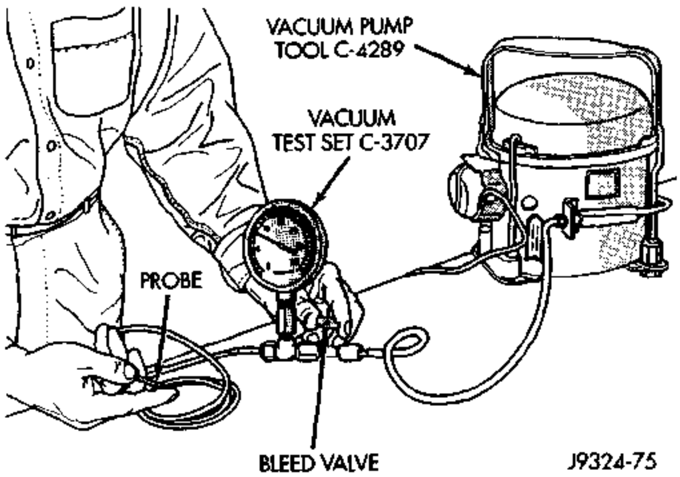


Fig. 6 Adjust Vacuum Test Bleed Valve

VACUUM CHECK VALVE

(1) Remove the vacuum check valve. The valve is located in the (black) vacuum supply tube at the intake manifold vacuum tap.

(2) Connect the test set vacuum supply hose to the heater (natural color) side of the valve. When connected to this side of the check valve, no vacuum should pass and the test set gauge should return to the 27 kPa (8 in. Hg.) setting. If OK, go to Step 3. If not OK, replace the faulty valve.

(3) Connect the test set vacuum supply hose to the engine vacuum (black color) side of the valve. When connected to this side of the check valve, vacuum should flow through the valve without restriction. If not OK, replace the faulty valve.

HEATER-A/C CONTROLS

(1) Connect the test set vacuum probe to the heater-A/C vacuum supply (black) tube in the engine compartment. Position the test set gauge so that it can be viewed from the passenger compartment.

(2) Place the heater-A/C mode control switch knob in each mode position, one at a time, and pause after each selection. The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each selection is made. If not OK, a component or vacuum line in the selected mode's vacuum circuit has a leak. See the procedure in Locating Vacuum Leaks.

CAUTION: Do not use lubricant on the switch ports or in the holes in the plug, as lubricant will ruin the vacuum valve in the switch. A drop of clean water in the connector plug holes will help the connector slide onto the switch ports.

LOCATING VACUUM LEAKS

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect the vacuum connector from the back of the heater-A/C mode control switch on the control panel.

(2) Connect the test set vacuum hose probe to each port in the vacuum harness connector, one at a time, and pause after each connection (Fig. 7). The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each connection is made. If OK, replace the faulty mode control switch. If not OK, go to Step 3.

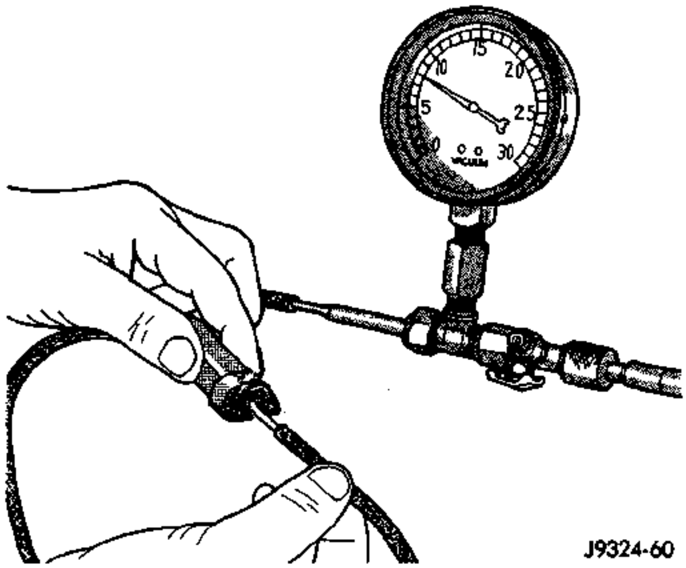


Fig. 7 Vacuum Circuit Test

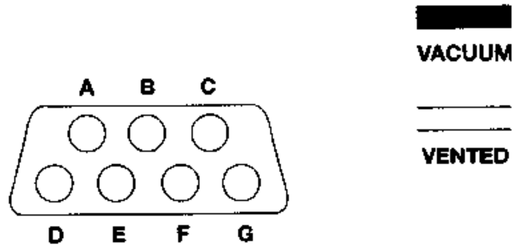
(3) Determine the vacuum line color of the vacuum circuit that is leaking. To determine the vacuum line colors, refer to the Vacuum Circuits chart (Fig. 8) or (Fig. 9).

(4) Disconnect and plug the vacuum line from the component (fitting, actuator, valve, switch, or reservoir) on the other end of the leaking circuit. Instrument panel disassembly or removal may be necessary to gain access to some components.

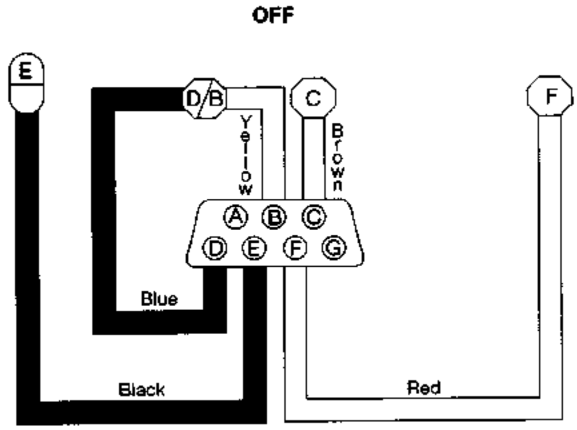
(5) Connect the test set hose or probe to the open end of the leaking circuit. The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each connection is made. If OK, replace the faulty disconnected component. If not OK, go to Step 6.

(6) To locate a leak in a vacuum line, leave one end of the line plugged and connect the test set hose or probe to the other end. Run your fingers slowly along the line while watching the test set gauge. The

DIAGNOSIS AND TESTING (Continued)



VACUUM CIRCUIT LEGEND		
I.D.	Function	Color
A	Not Used	N/A
B	Defrost Actuator (Mid-Position)	Yellow
C	Floor Actuator	Brown
D	Defrost Actuator (Full Position)	Blue
E	Vacuum Supply (Reservoir)	Black
F	Not Used	N/A



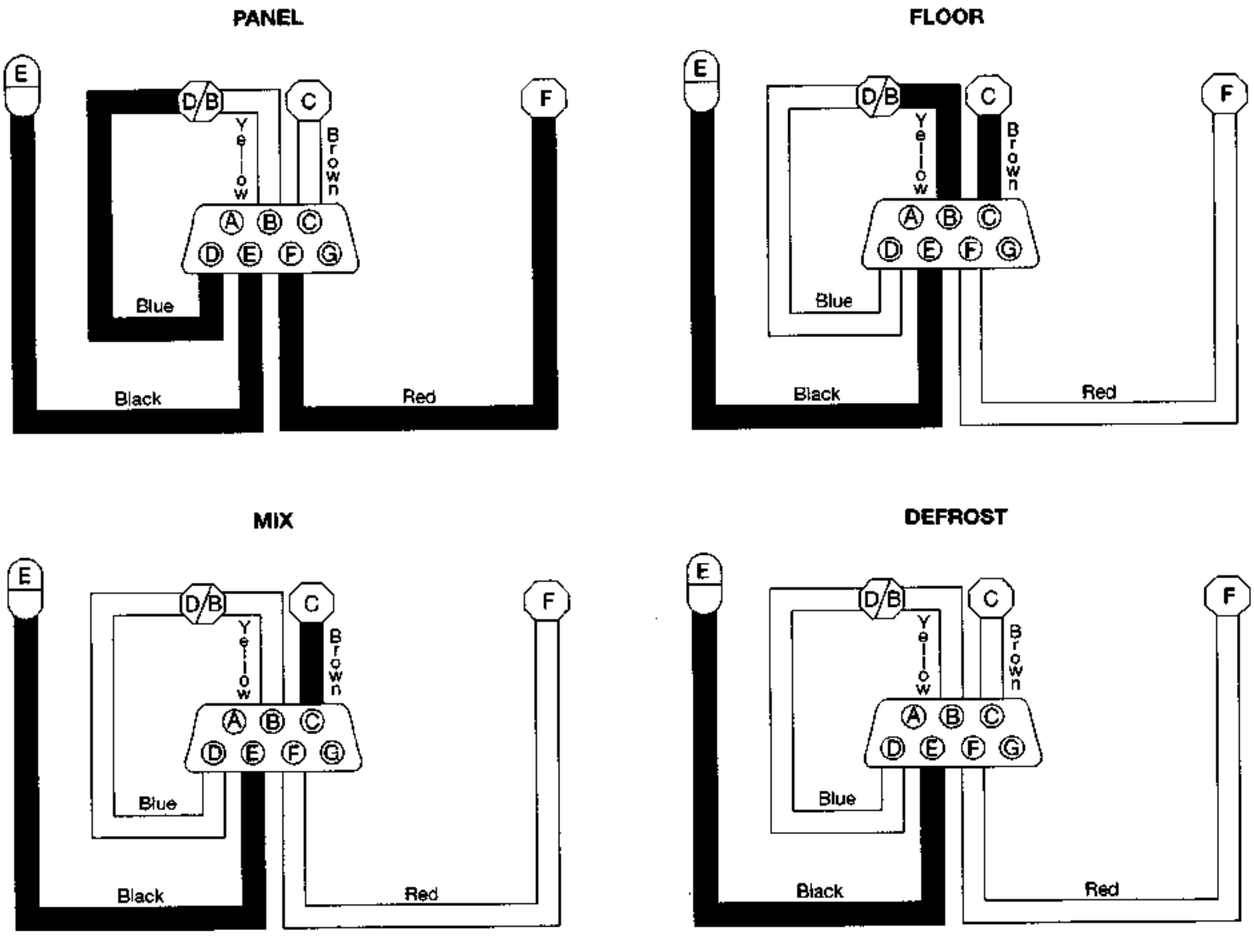


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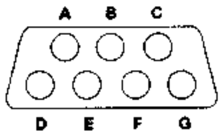
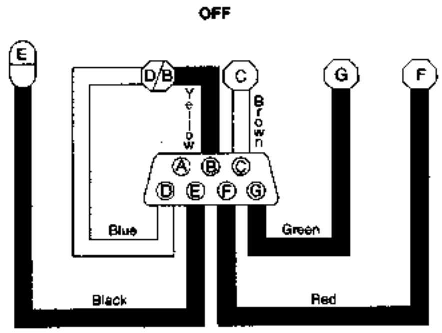
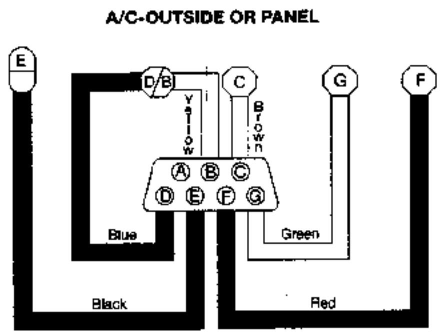
Fig. 8 Vacuum Circuits - Heater Only

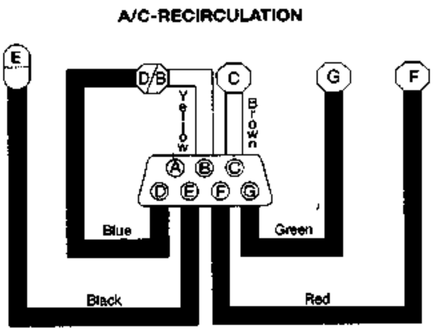
DIAGNOSIS AND TESTING (Continued)

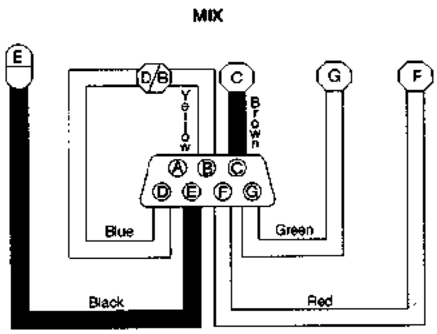


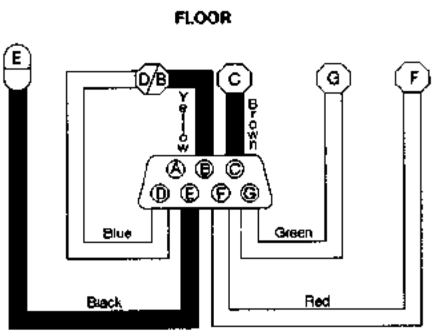
VACUUM CIRCUIT LEGEND		
I.D.	Function	Color
A	Not Used	N/A
B	Defrost Actuator (Mid-Position)	Yellow
C	Floor Actuator	Brown
D	Defrost Actuator (Full Position)	Blue
E	Vacuum Supply (Reservoir)	Black
F	Recirculation Actuator	Red











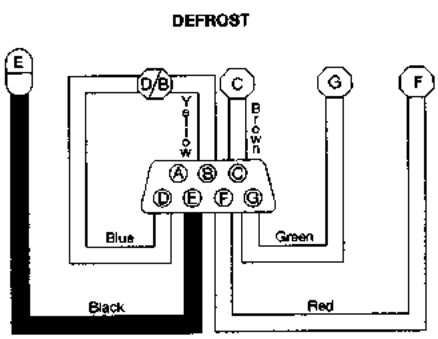


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Fig. 9 Vacuum Circuits - Heater-A/C

DIAGNOSIS AND TESTING (Continued)

vacuum reading will fluctuate when your fingers contact the source of the leak. To repair the vacuum line, cut out the leaking section of the line. Then, insert the loose ends of the line into a suitable length of 3 mm (1/8-inch) inside diameter rubber hose.

BLOWER MOTOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams. Possible causes of an inoperative blower motor include:

- Faulty fuse
- Faulty blower motor ground circuit wiring or connectors
- Faulty blower motor resistor
- Faulty high speed blower motor relay
- Faulty blower motor switch
- Faulty heater-A/C mode control switch
- Faulty blower motor feed circuit wiring or connectors
- Faulty blower motor.

Possible causes of the blower motor not operating in all speeds include:

- Faulty fuse
- Faulty blower motor switch
- Faulty blower motor resistor
- Faulty high speed blower motor relay
- Faulty blower motor circuit wiring or connectors.

VIBRATION

Possible causes of blower motor vibration include:

- Improper blower motor mounting
- Improper blower wheel mounting
- Blower wheel out of balance or bent
- Blower motor faulty.

NOISE

To verify that the blower is the source of the noise, disconnect the blower motor connector and operate the heater-A/C system. If the noise goes away, possible causes include:

- Foreign material in the heater-A/C housing
- Improper blower motor mounting
- Improper blower wheel mounting
- Blower motor faulty.

BLOWER MOTOR RESISTOR

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

To test the blower motor resistor, unplug the resistor connector. Each blower motor switch input terminal on the resistor must have continuity to the resistor output terminal, which is connected to the circuit going to the blower motor. If the blower motor resistor continuity does not check OK, replace the faulty resistor.

BLOWER MOTOR SWITCH

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Turn the ignition switch to the On position and check for battery voltage at the fuse in the fuseblock module. If OK, go to Step 2. If not OK, replace the faulty fuse.

(2) Turn the ignition switch to the Off position. Remove the heater-A/C control from the instrument panel, but do not unplug the wiring connectors. Turn the ignition switch to the On position. Check for battery voltage at the **fused ignition switch output (run)** circuit cavity of the heater-A/C mode control switch connector. If OK, go to Step 3. If not OK, repair the open circuit to the fuseblock module as required.

(3) Select any one of the heater-A/C mode control positions except Off to turn the system on. Check for battery voltage at the **low blower motor driver** circuit cavity of the heater-A/C mode control switch connector. If OK, go to Step 4. If not OK, replace the faulty heater-A/C mode control switch.

DIAGNOSIS AND TESTING (Continued)

(4) Check for battery voltage at the **low blower motor driver** circuit cavity of the blower motor switch connector. If OK, go to Step 5. If not OK, repair the open circuit to the heater-A/C mode control switch connector as required.

(5) Check for battery voltage at each of the remaining blower motor switch connector cavities as you move the switch to each blower motor speed position. Voltage should be present in each cavity at only one switch position. If OK, see the diagnosis for the blower motor resistor and/or the high speed blower motor relay. If not OK, replace the faulty blower motor switch.

COMPRESSOR

When investigating an air conditioning related noise, you must first know the conditions under which the noise occurs. These conditions include: weather, vehicle speed, transmission in gear or neutral, engine temperature, and any other special conditions.

Noises that develop during air conditioning operation can often be misleading. For example: What sounds like a failed front bearing or connecting rod, may be caused by loose bolts, nuts, mounting brackets, or a loose clutch assembly. Verify serpentine drive belt tension. Improper belt tension can cause a misleading noise when the compressor is engaged. The noise may not occur when the compressor is disengaged.

Drive belts are speed sensitive. At different engine speeds and depending upon belt tension, belts can develop noises that are mistaken for a compressor noise.

(1) Select a quiet area for testing. Duplicate the complaint conditions as much as possible. Switch the compressor on and off several times to clearly identify the compressor noise. Listen to the compressor clutch while engaged and disengaged.

(2) To duplicate a high-ambient temperature condition (high head pressure), restrict the air flow through the condenser. Install a manifold gauge set to make sure that the discharge pressure does not exceed 2070 kPa (300 psi).

(3) Tighten all compressor mounting bolts, the clutch mounting nut, the clutch coil mounting screw or nut, and the serpentine drive belt to the correct specifications.

(4) Check the refrigerant system plumbing for rubbing or interference, which can cause unusual noises.

(5) Check the refrigerant system charge. See Charging Refrigerant System in this group.

(6) Check the compressor noise as in Step 1.

(7) If the noise still exists, loosen the compressor mounting bolts and tighten again. Repeat Step 1.

(8) If the noise continues, replace the compressor and repeat Step 1.

COMPRESSOR CLUTCH COIL

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams. The battery must be fully-charged before performing the following tests. Refer to Group 8A - Battery for more information.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Connect an ammeter (0-10 ampere scale) in series with the clutch coil terminal. Use a voltmeter (0-20 volt scale) with clip-type leads for measuring the voltage across the battery and the compressor clutch coil.

(2) With the heater-A/C mode control switch in any A/C mode, and the blower motor switch in the lowest speed position, start the engine and run it at normal idle.

(3) The compressor clutch coil voltage should read within two volts of the battery voltage. If there is voltage at the clutch coil, but the reading is not within two volts of the battery voltage, test the clutch coil feed circuit for excessive voltage drop and repair as required. If there is no voltage reading at the clutch coil, refer to the proper Powertrain Diagnostic Procedures manual for testing of the compressor clutch circuit. The following components must be checked and repaired as required before you can complete testing of the clutch coil:

- Fuses in the fuseblock module and the Power Distribution Center
- Heater-A/C mode control switch
- Compressor clutch relay
- High pressure cut-off switch
- Low pressure cycling clutch switch
- Powertrain Control Module.

(4) The compressor clutch coil is acceptable if the current draw measured at the clutch coil is 2.0 to 3.9 amperes with the electrical system voltage at 11.5 to 12.5 volts. This should only be checked with the work area temperature at 21°C (70°F). If system voltage is more than 12.5 volts, add electrical loads by turning on electrical accessories until the system voltage drops below 12.5 volts.

DIAGNOSIS AND TESTING (Continued)

(a) If the clutch coil current reading is four amperes or more, the coil is shorted and should be replaced.

(b) If the clutch coil current reading is zero, the coil is open and should be replaced.

COMPRESSOR CLUTCH RELAY

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

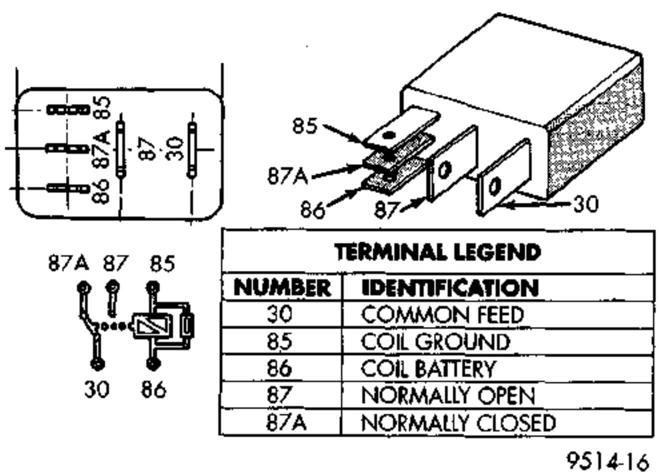
WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The compressor clutch relay is located in the Power Distribution Center (PDC). Refer to the PDC label for relay identification and location. Remove the relay from the PDC to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75±5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see the Circuit Test in this group. If not OK, replace the faulty relay.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Compressor Clutch Relay

CIRCUIT TEST

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) The relay common feed terminal cavity (30) is connected to fused battery feed. There should be battery voltage at the cavity for relay terminal 30 at all times. If OK, go to Step 2. If not OK, repair the open circuit to the PDC fuse as required.

(2) The relay normally closed terminal (87A) is not used in this application. Go to Step 3.

(3) The relay normally open terminal cavity (87) is connected to the compressor clutch coil. There should be continuity between this cavity and the **A/C compressor clutch relay output** circuit cavity of the compressor clutch coil connector. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) The relay coil battery terminal (86) is connected to the **fused ignition switch output (run/start)** circuit. There should be battery voltage at the cavity for relay terminal 86 with the ignition switch in the On position. If OK, go to Step 5. If not OK, repair the open circuit to the fuseblock module as required.

(5) The coil ground terminal cavity (85) is switched to ground through the Powertrain Control Module (PCM). There should be continuity between this cavity and the **A/C compressor clutch relay control** circuit cavity of the PCM connector at all times. If not OK, repair the open circuit as required.

HIGH PRESSURE CUT-OFF SWITCH

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) Verify that the refrigerant system is properly charged.

(2) Unplug the high pressure switch connector and test for continuity between the switch terminals. There should be continuity. If OK, refer to the wiring diagrams and repair the circuits as required. If not OK, replace the faulty switch.

HIGH SPEED BLOWER MOTOR RELAY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

DIAGNOSIS AND TESTING (Continued)

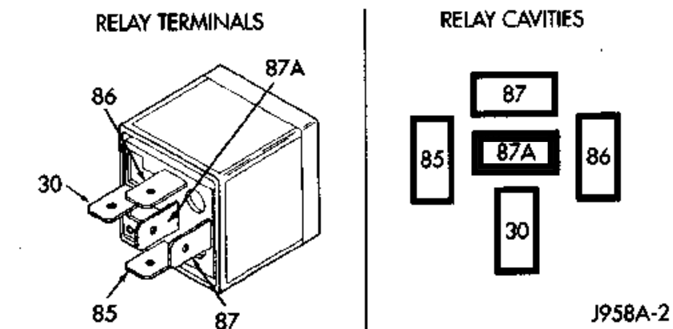
RELAY TEST

The high speed blower motor relay is located near the passenger side end of the heater-A/C housing next to the heater-A/C wire harness connector under the instrument panel. Remove the relay from its connector to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75±5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see the Relay Circuit Test in this group. If not OK, replace the faulty relay.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

High Speed Blower Motor Relay

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to the blower motor. This terminal supplies fused battery feed directly from a fuse in the Power Distribution Center (PDC) when the relay is energized, and ignition switched battery feed from a fuse in the fuseblock module through the blower motor resistor when the relay is de-energized. There should be continuity between this cavity and the **blower motor feed** circuit cavity of the blower motor connector at all times. If OK, go to Step 2. If not OK, repair the open circuit as required.

(2) The relay normally closed terminal cavity (87A) is connected to the blower motor resistor output. When the relay is de-energized, terminal 87A is connected to terminal 30 and provides the blower motor resistor output to the **blower motor feed** circuit. There should be continuity between this cavity and the **blower resistor outputs** circuit cavity of the blower motor resistor connector at all times. If OK, go to Step 3. If not OK, repair the open circuit as required.

(3) The relay normally open terminal cavity (87) is connected to a fused battery feed from the PDC. When the relay is energized, terminal 87 is connected to terminal 30 and provides full battery current to the **blower motor feed** circuit. There should be battery voltage at this cavity at all times. If OK, go to Step 4. If not OK, repair the open circuit to the PDC as required.

(4) The coil battery terminal cavity (86) is connected to the high speed output contacts of the blower motor switch. When the blower motor switch is placed in the high speed position, fused ignition switch output is directed to the relay electromagnetic coil to energize the relay. There should be continuity between the cavity for relay terminal 86 and the **high blower motor relay control** circuit cavity of the blower motor switch connector at all times. If OK, go to Step 5. If not OK, repair the open circuit as required.

(5) The coil ground terminal cavity (85) is connected to ground. This terminal supplies the ground for the relay electromagnet coil. There should be continuity between the cavity for relay terminal 85 and a good ground at all times. If not OK, repair the open circuit as required.

LOW PRESSURE CYCLING CLUTCH SWITCH

Verify that the refrigerant system has the correct refrigerant charge. For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) Unplug the low pressure cycling clutch switch connector from the switch on the accumulator, and install a jumper wire between the two connector cavities.

(2) Connect a manifold gauge set to the refrigerant system service ports.

(3) Place the heater-A/C mode control switch knob in any A/C position and start the engine.

(4) Check the continuity between the two terminals of the low pressure switch. There should be continuity with a suction pressure reading of 262 kPa (38 psi) or above, and no continuity with a suction pressure reading of 141 kPa (20.5 psi) or below. If OK, test and repair the **A/C switch sense** circuit as required. If not OK, replace the faulty switch.

REFRIGERANT SYSTEM LEAKS

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE LEAK TESTING THE SYSTEM.

If the air conditioning system is not cooling properly, determine if the refrigerant system is fully-charged. See A/C Performance in this group. If the refrigerant system is low or empty, a leak at a line, fitting, or component seal is likely. Fittings, lines, or

DIAGNOSIS AND TESTING (Continued)

components that appear to be oily indicate a possible refrigerant leak. To detect a leak in the refrigerant system, perform one of the following procedures:

SYSTEM EMPTY

(1) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group.

(2) Connect and dispense 0.283 kPa (0.6 lbs. or 10 oz.) of R-134a refrigerant into the evacuated refrigerant system. See Refrigerant System Charge in this group.

(3) Position the vehicle in a wind-free work area. This will aid in detecting small leaks.

(4) With the engine not running, use a electronic R-134a leak detector and search for leaks. Move the leak detector probe slowly along the bottom side of all lines and fittings, because R-134a is heavier than air.

(5) To inspect the evaporator coil for leaks, insert the leak detector probe into the center panel outlet. Set the blower motor switch to the lowest speed position, and the mode control switch in the Recirculation Mode.

SYSTEM LOW

(1) Position the vehicle in a wind-free work area. This will aid in detecting small leaks.

(2) Bring the refrigerant system up to operating temperature and pressure. This is done by allowing the engine to run with the air conditioning system on for five minutes.

(3) With the engine not running, use a electronic R-134a leak detector and search for leaks. Move the leak detector probe slowly along the bottom side of all lines and fittings, because R-134a is heavier than air.

(4) To inspect the evaporator coil for leaks, insert the leak detector probe into the center panel outlet. Set the blower motor switch to the lowest speed position, and the mode control switch in the Recirculation Mode.

SERVICE PROCEDURES

REFRIGERANT RECOVERY

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE RECOVERING REFRIGERANT.

R-134a refrigerant is a hydrofluorocarbon (HFC) that does not contain chlorine. A R-134a refrigerant recovery/recycling station that meets SAE Standard J2210 must be used to recover the refrigerant. Refer to the operating instructions provided with the equipment for proper operation.

REFRIGERANT SYSTEM EVACUATE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE EVACUATING THE SYSTEM.

If the refrigerant system has been open to the atmosphere, it must be evacuated before the system can be charged. 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. Evacuating will boil the moisture out of the refrigerant system at near room temperature. To evacuate the refrigerant system, use the following procedure:

(1) Connect a suitable charging station and manifold gauge set to the vehicle.

(2) Open the low and high side valves and start the vacuum pump. When the suction gauge reads 88 kPa (26 in. Hg.) vacuum or greater, close all of the valves and turn off the vacuum pump. If the system fails to reach the specified vacuum, the system has a leak that must be corrected. If the system maintains the specified vacuum for five minutes, restart the vacuum pump. Then open the suction and discharge valves and evacuate an additional ten minutes.

(3) Close all of the valves. Turn off and disconnect the vacuum pump.

(4) The refrigerant system is now ready to be charged with refrigerant.

REFRIGERANT SYSTEM CHARGE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE CHARGING THE REFRIGERANT SYSTEM.

After the system has been tested for leaks and evacuated, a refrigerant charge can be injected into the system. See Refrigerant Charge Capacity for the proper amount of the refrigerant charge. Charge the system using a recovery/recycling/charging station approved for R-134a refrigerant. This device must meet SAE Standard J2210. Refer to the instructions provided with the equipment for proper operation.

REFRIGERANT CHARGE CAPACITY

The R-134a system charge capacity is 0.567 kg (1.25 lbs.).

REFRIGERANT OIL LEVEL

When an air conditioning system is assembled at the factory, all components (except the compressor) are refrigerant oil free. After the system has been charged and operated, the oil in the compressor is dispersed through the refrigerant system. The accu-

SERVICE PROCEDURES (Continued)

mulator, evaporator, condenser, and compressor will retain a significant amount of oil.

It is important to have the correct amount of oil in the refrigerant system. This will ensure proper lubrication of the compressor. Too little oil will result in damage to the compressor. Too much oil will reduce the cooling capacity of the system.

It will not be necessary to check oil level in the compressor or to add oil, unless there has been an oil loss. This may be due to a rupture or leak from a refrigerant line, a compressor shaft seal, an evaporator, or a condenser. If a rupture occurs, add 1 ounce of oil to the system after the repair has been made. Oil loss at a leak point will be evident by the presence of a wet, shiny surface around the leak.

Refrigerant oil must be added when a accumulator, evaporator, or condenser are replaced. Refer to the Refrigerant Oil Capacities chart. When a compressor is replaced, the oil must be drained from the old compressor and measured. Drain all the oil from the new compressor, then fill the new compressor with the same amount of oil that was drained out of the old compressor.

Refrigerant Oil Capacities		
Component	**ml**	**oz**
A/C System	240	8.1
Accumulator	120	4
Condenser	30	1
Evaporator	60	2
Compressor	drain and measure the oil from the old compressor - see text.	

REMOVAL AND INSTALLATION

REFRIGERANT LINE COUPLERS

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Recover the refrigerant from the refrigerant system as described in this group.

(2) Remove the secondary clip from the coupling. Fit the appropriate spring lock coupling tool from the A/C Tool Kit (Special Tool 6125) (Fig. 10).

(3) Close the tool and push it into the open side of the cage to expand the garter spring and release the female fitting.

NOTE: The garter spring may not release if the tool is cocked while pushing it into the cage opening.

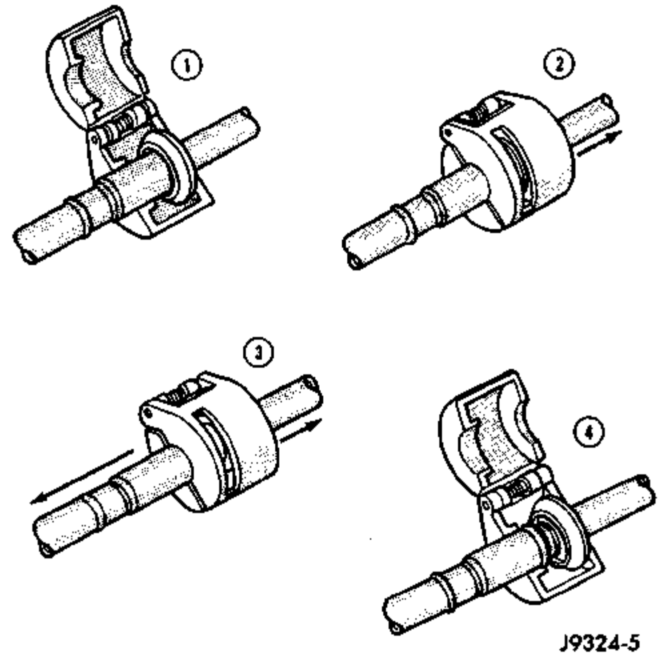


Fig. 10 Spring Lock Coupling Disconnect

(4) After the garter spring is expanded, pull the fittings apart within the tool.

(5) Remove the tool from the disconnected coupling.

(6) Separate the two ends of the coupling.

INSTALLATION

(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 garter spring.

(2) Clean any dirt or foreign material from both halves 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 other O-ring may allow the connection to leak intermittently during vehicle operation.

(4) Lubricate the male fitting and O-ring, and the inside of the female fitting with clean R-134a (SP20 PAG) refrigerant oil.

(5) Fit the female fitting to the male fitting and push together until the garter spring snaps over the flared end of the female fitting.

(6) Ensure the coupling is fully engaged by pulling back on the lines on either side of the coupling.

REMOVAL AND INSTALLATION (Continued)

(7) Install the secondary clip on the coupling.

COMPRESSOR

The compressor may be removed and repositioned without disconnecting the refrigerant lines or discharging the refrigerant system. Discharging is not necessary if servicing the compressor clutch or clutch coil, the engine, the cylinder head, or the generator.

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Loosen and remove the serpentine drive belt. Refer to Group 7 - Cooling System for the procedures.

(3) Unplug the compressor clutch coil and high pressure cut-off switch wiring connectors.

(4) Recover the refrigerant from the refrigerant system as described in this group.

(5) Remove the manifold and refrigerant lines from the compressor. Install plugs in, or tape over, all of the open refrigerant fittings (Fig. 11).

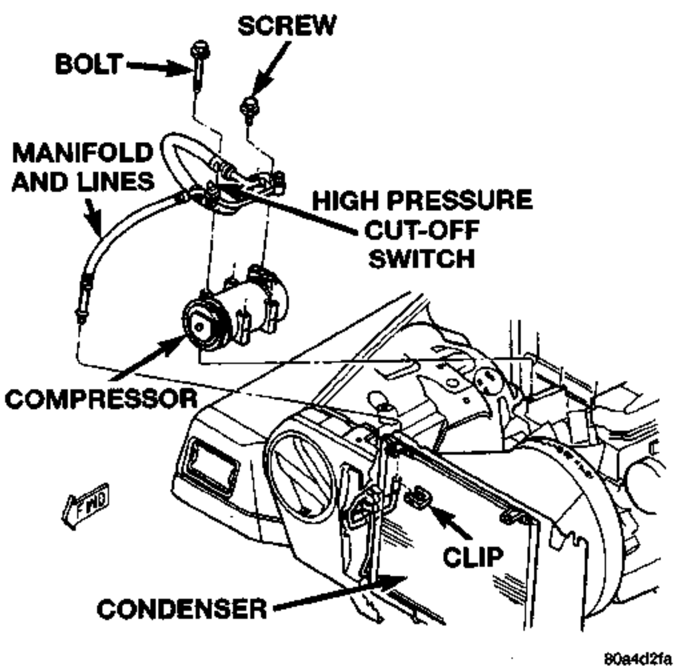


Fig. 11 Compressor Remove/Install

(6) Remove the compressor mounting bolts, and lift the compressor from the mounting bracket.

INSTALLATION

NOTE: If a replacement compressor is being installed, be certain to check the oil level. See Refrigerant Oil Level in this group.

(1) If the compressor mounting bracket was removed, install the bracket to the engine. Tighten the mounting bolts to 27 N·m (20 ft. lbs.).

(2) Install the compressor on the mounting bracket. Tighten the bolts to 28 N·m (21 ft. lbs.).

(3) Remove the tape or plugs from all of the refrigerant fittings, and install the manifold and refrigerant lines on the compressor.

(4) Install the serpentine drive belt. Refer to Group 7 - Cooling System for the procedures.

(5) Connect the compressor clutch coil and high pressure cut-off switch wiring.

(6) Connect the battery negative cable.

(7) Evacuate and charge the refrigerant system as described in this group.

COMPRESSOR CLUTCH

The refrigerant system can remain fully-charged during compressor clutch, pulley, or coil replacement. The compressor clutch can be serviced in the vehicle.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the serpentine drive belt. Refer to Group 7 - Cooling System for the procedures.

(3) Remove the compressor mounting bolts and lift the compressor from the mounting bracket. Support the compressor to work on the clutch.

(4) Insert the two pins of the spanner wrench (Special Tool C-4489) into the holes of the clutch plate. Hold the clutch plate stationary and remove the hex nut (Fig. 12).

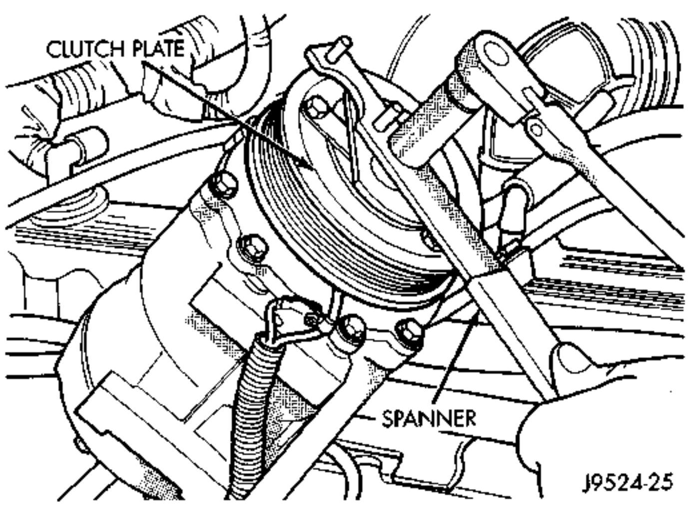


Fig. 12 Clutch Nut Remove

REMOVAL AND INSTALLATION (Continued)

(5) Remove the clutch plate with a puller (Special Tool C-6461) (Fig. 13).

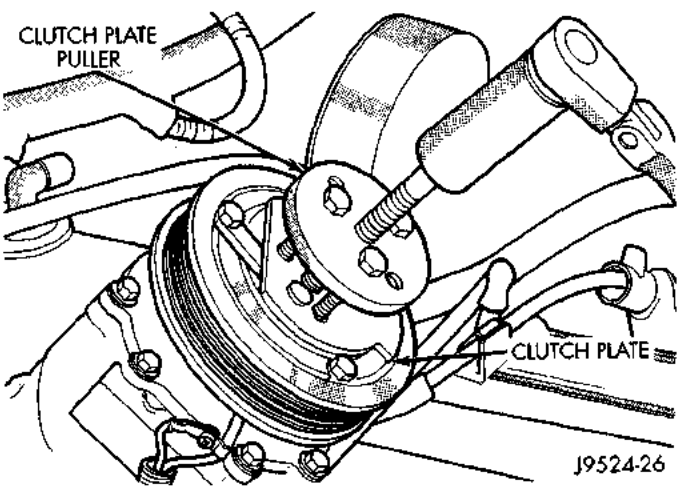


Fig. 13 Clutch Plate Remove

(6) Remove the compressor shaft key and the clutch shims.

(7) Remove the external front housing snap ring with snap ring pliers (Fig. 14).

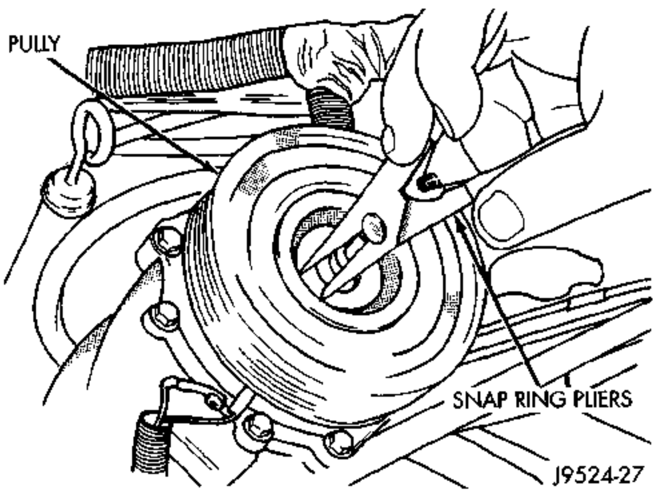


Fig. 14 External Snap Ring Remove

(8) Install the lip of the rotor puller (Special Tool C-6141-1) into the snap ring groove exposed in the previous step, and install the shaft protector (Special Tool C-6141-2) (Fig. 15).

(9) Install the puller through-bolts (Special Tool C-6461) through the puller flange and into the jaws of the rotor puller and tighten (Fig. 16). Turn the puller center bolt clockwise until the rotor pulley is free.

(10) Remove the screw and retainer from the clutch coil lead wire on the compressor front housing (Fig. 17).

(11) Remove the snap ring from the compressor hub and remove the clutch field coil (Fig. 18). Slide the clutch field coil off of the compressor hub.

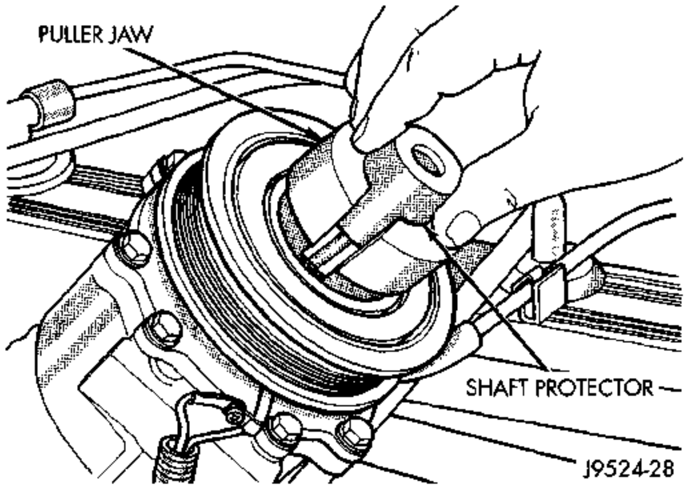


Fig. 15 Shaft Protector and Puller

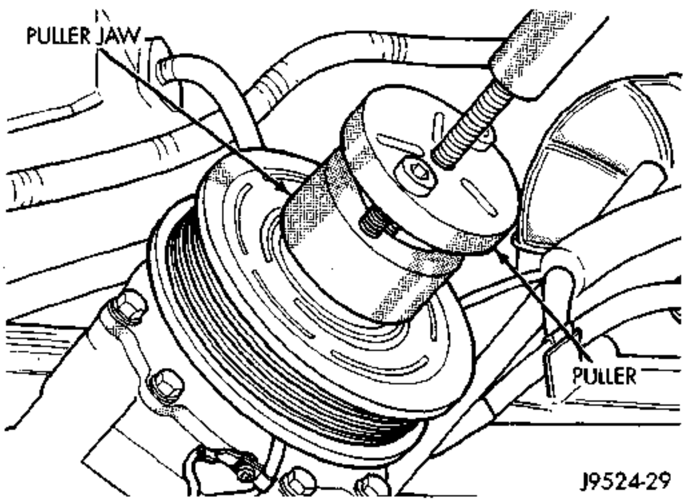


Fig. 16 Install Puller Plate

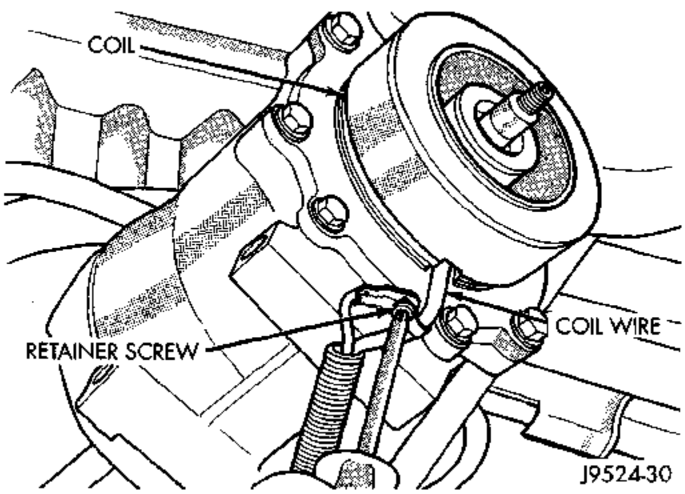


Fig. 17 Clutch Coil Lead Wire

INSPECTION

Examine the friction surfaces of the clutch pulley and the front plate for wear. The pulley and front

REMOVAL AND INSTALLATION (Continued)

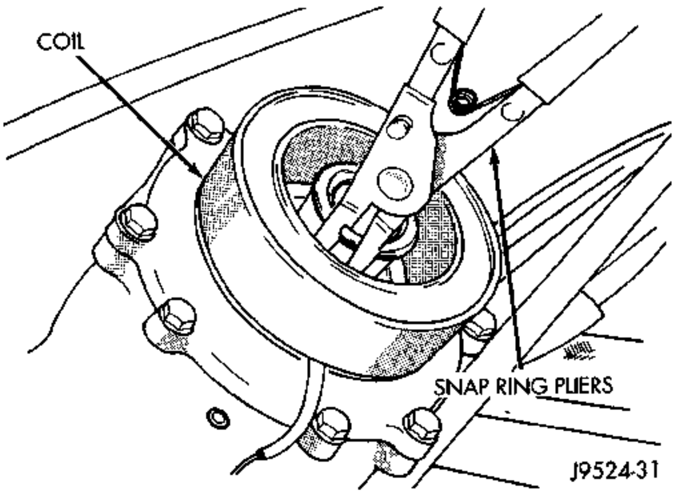


Fig. 18 Clutch Field Coil Snap Ring Remove

plate should be replaced if there is excessive wear or scoring.

If the friction surfaces are oily, inspect the shaft and nose area of the compressor for oil. Remove the felt from the front cover. If the felt is saturated with oil, the shaft seal is leaking and the compressor must be replaced.

Check the clutch pulley bearing for roughness or excessive leakage of grease. Replace the bearing, if required.

INSTALLATION

(1) Install the clutch field coil and snap ring.

(2) Install the clutch coil wire lead retaining clip on the compressor front housing and tighten the retaining screw.

(3) Align the rotor assembly squarely on the front compressor housing hub.

(4) Install the pulley bearing assembly with the installer (Special Tool C-6871) (Fig. 19). Thread the installer on the shaft, then turn the nut until the pulley assembly is seated.

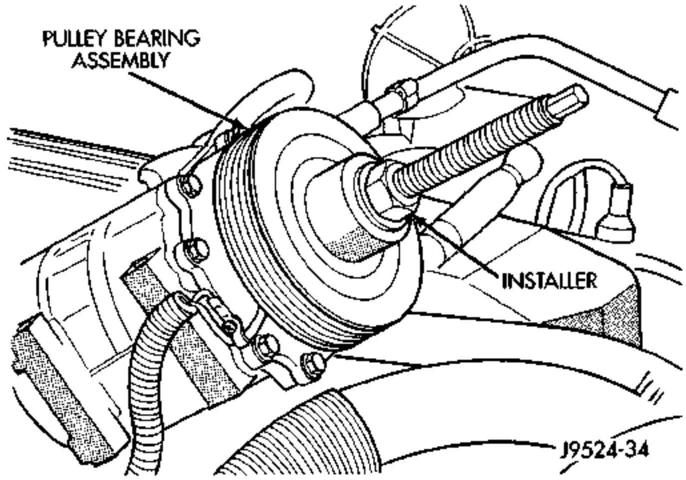


Fig. 19 Clutch Pulley Install

(5) Install the external front snap ring with snap ring pliers. The bevel side of the snap ring must be facing outward. Press the snap ring to make sure it is properly seated in the groove.

CAUTION: If the snap ring is not fully seated in the groove it will vibrate out, resulting in a clutch failure and severe damage to the front housing of the compressor.

(6) Install the compressor shaft key and the original clutch shims on the compressor shaft.

(7) Install the clutch plate with the driver (Special Tool C-6463) (Fig. 20). Install the shaft hex nut and tighten to 14.4 N·m (10.5 ft. lbs.).

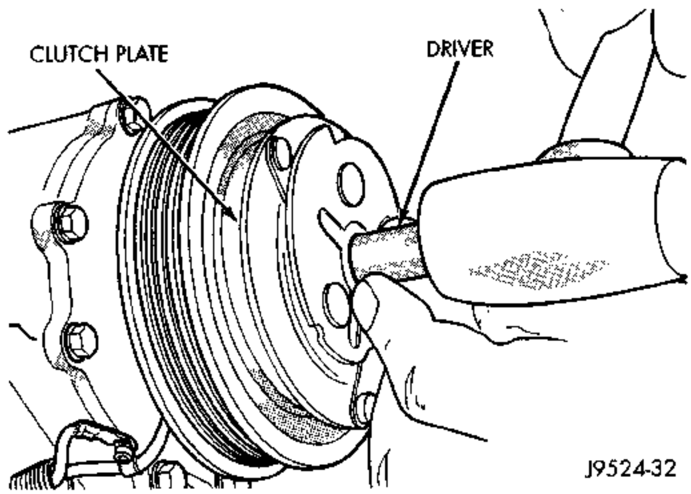


Fig. 20 Clutch Plate Driver

(8) Check the clutch air gap with a feeler gauge (Fig. 21). If the air gap does not meet the specification, add or subtract shims as required. The air gap specification is 0.41-0.79 mm (0.016-0.031 inch). If the air gap is not consistent around the circumference of the clutch, lightly pry up at the minimum variations. Lightly tap down at the points of maximum variation.

NOTE: The air gap is determined by the spacer shims. When installing an original, or a new clutch assembly, try the original shims first. When installing a new clutch onto a compressor that previously did not have a clutch, use 0.040, 0.020, and 0.005 shims from the clutch hardware package that is provided with the new clutch.

(9) Reverse the remaining removal procedures to complete the installation.

CLUTCH BREAK-IN

After a new compressor clutch has been installed, cycle the compressor clutch approximately twenty times (5 seconds on, then 5 seconds off). During this

REMOVAL AND INSTALLATION (Continued)

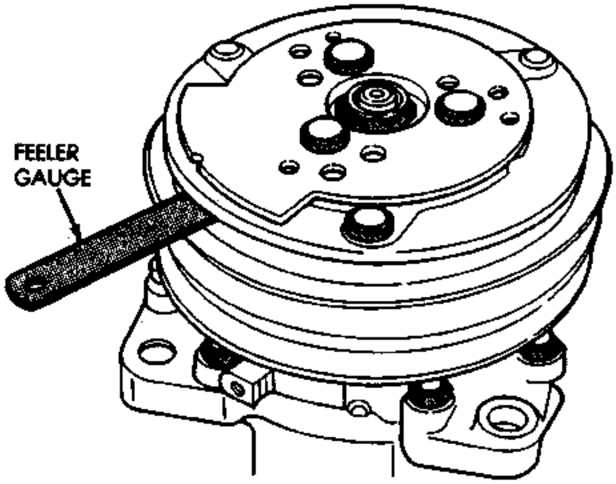


Fig. 21 Check Clutch Air Gap

procedure, set the heater-A/C control to the Recirculation Mode, the blower motor switch in the highest speed position, and the engine speed at 1500 - 2000 rpm. This procedure (burnishing) will seat the opposing friction surfaces and provide a higher compressor clutch torque capability.

COMPRESSOR CLUTCH RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 22).

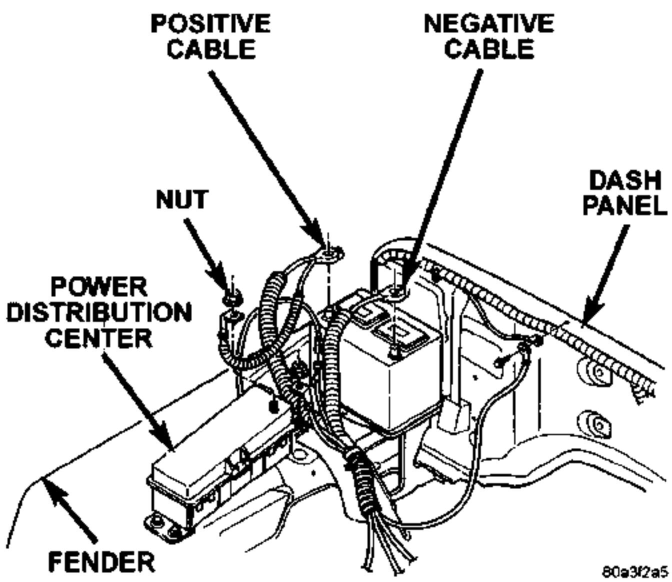


Fig. 22 Power Distribution Center

(3) Refer to the label on the PDC for compressor clutch relay identification and location.

(4) Remove the compressor clutch relay by unplugging it from the PDC.

(5) Install the compressor clutch relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

HIGH PRESSURE CUT-OFF SWITCH

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wiring connector from the switch (Fig. 23).

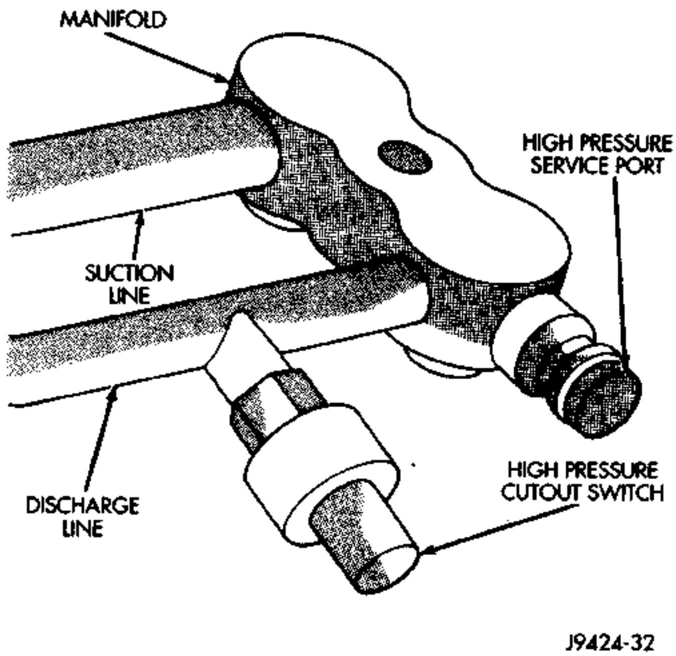


Fig. 23 High Pressure Cut-Off Switch - Typical

(3) Unscrew the switch from the discharge line fitting.

INSTALLATION

(1) Install and tighten the switch.

(2) Plug the wiring connector into the switch.

(3) Connect the battery negative cable.

CONDENSER

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL AND INSTALLATION (Continued)

CAUTION: When removing the condenser note the locations of all of the radiator and condenser air seals. These seals are used to direct air through the condenser and radiator. They must be installed in their original locations to prevent engine overheating.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system as described in this group.

(3) Remove the two retainers securing the upper condenser air seal to the grille panel and remove the air seal (Fig. 24).

(4) Remove the two screws securing the upper condenser mounting brackets to the grille panel.

(5) Reach through the grille panel opening from the front of the vehicle to remove the two screws securing the condenser refrigerant tube and flange unit to the condenser. Install plugs in, or tape over, all of the open refrigerant fittings.

(6) Remove the four retainers securing the lower condenser air seal to the frame rails and the grille panel and remove the air seal.

(7) Remove the two screws securing the lower condenser mounting bracket to the grille panel.

(8) Remove the three screws on each side of the radiator securing the radiator mounting brackets to the grille panel.

(9) Tilt the radiator and shroud unit back towards the engine using care to prevent the cooling fan blades from damaging the radiator.

(10) Carefully lift the condenser out of the vehicle.

INSTALLATION

(1) Carefully position the condenser in the vehicle.

(2) Install and tighten the two screws securing the upper condenser mounting brackets to the grille panel.

(3) Align the holes of the radiator mounting brackets to the grille panel. Install and tighten the six screws securing the radiator and shroud unit to the grille panel.

(4) Install the upper condenser air seal to the grille panel with two retainers.

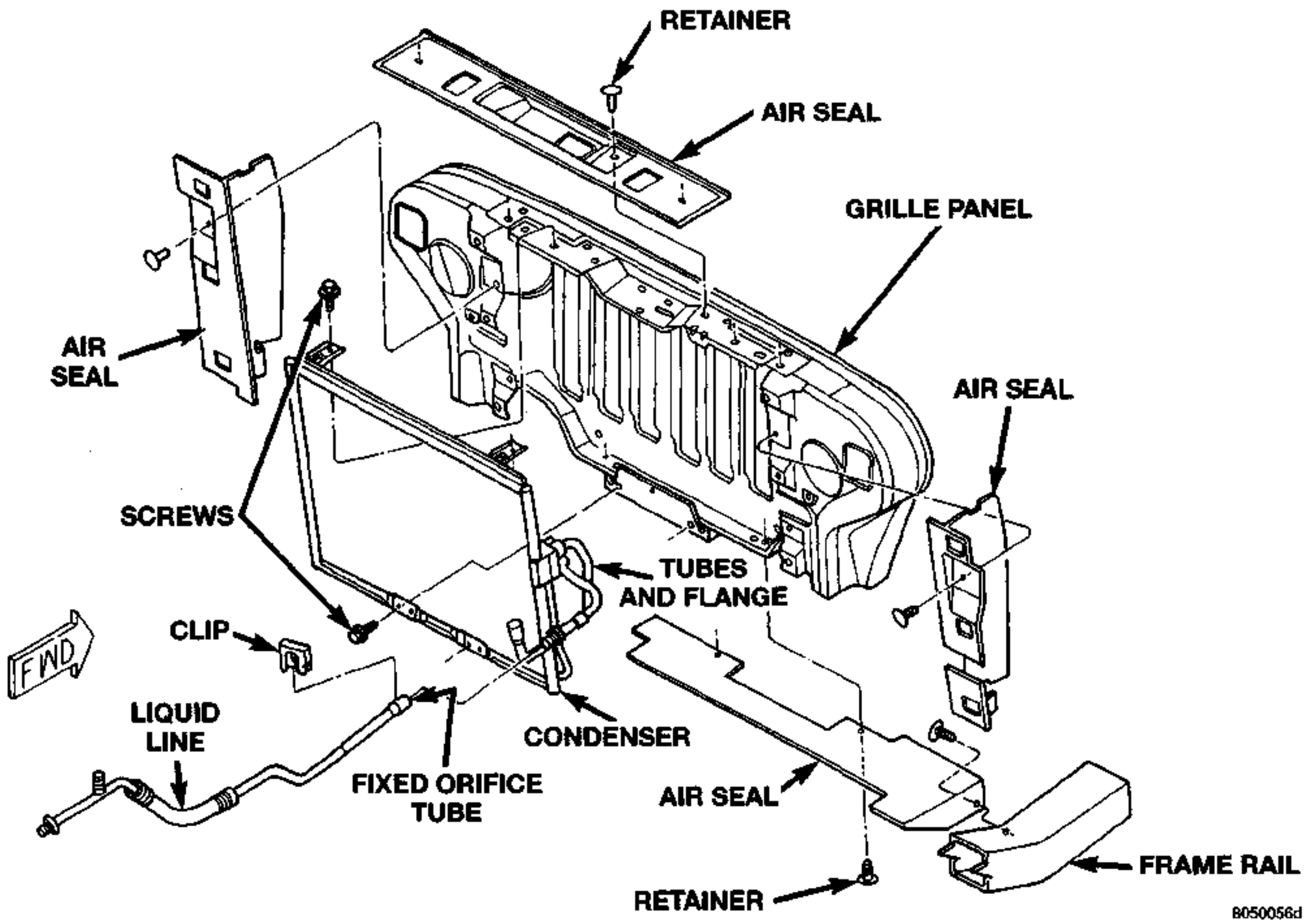


Fig. 24 Condenser Remove/Install

REMOVAL AND INSTALLATION (Continued)

(5) Remove the tape or plugs from the refrigerant fittings. Reach through the grille opening to install the condenser tubes and flange to the condenser with two screws.

(6) Install and tighten the two screws securing the lower condenser bracket to the grille panel.

(7) Install the lower condenser air seal to the grille panel and the frame rails with four retainers.

(8) Evacuate the refrigerant system as described in this group.

(9) Charge the refrigerant system as described in this group.

(10) Connect the battery negative cable.

NOTE: If the condenser is replaced, add 30 ml (1 oz.) of refrigerant oil to the refrigerant system.

FIXED ORIFICE TUBE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system as described in this group.

(3) Disconnect the liquid line refrigerant line coupler at the condenser outlet tube.

(4) Remove the fixed orifice tube using a needle nose pliers. Note the orientation of the fixed orifice tube for correct reinstallation.

INSTALLATION

(1) Install the fixed orifice tube in the liquid line.

(2) Connect the liquid line to the condenser outlet tube.

(3) Evacuate and charge the refrigerant system as described in this group.

(4) Connect the battery negative cable.

ACCUMULATOR

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system as described in this group.

(3) Disconnect the two refrigerant line couplers from the accumulator tubes. Install plugs in, or tape over, all of the open refrigerant fittings (Fig. 25).

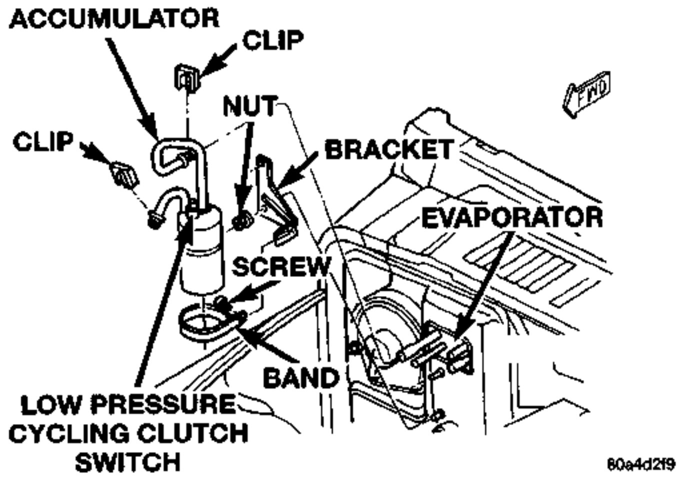


Fig. 25 Accumulator Remove/Install

(4) Unplug the wire harness connector from the low pressure cycling clutch switch.

(5) Loosen the screw securing the accumulator and band to the mounting bracket.

(6) Slide the accumulator and band unit screw out of the slotted hole in the mounting bracket.

INSTALLATION

(1) Install the accumulator and band unit screw into the slotted mounting bracket hole.

(2) Tighten the screw.

(3) Plug the wire harness connector into the low pressure cycling clutch switch.

(4) Remove the plugs or tape from the refrigerant line fittings. Connect the refrigerant lines to the accumulator tubes.

(5) Evacuate and charge the refrigerant system as described in this group.

(6) Connect the battery negative cable.

NOTE: If the accumulator is replaced, add 120 ml (4 oz.) of refrigerant oil to the refrigerant system.

LOW PRESSURE CYCLING CLUTCH SWITCH

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the switch on the top of the accumulator.

(3) Unscrew the switch from the fitting on the accumulator.

(4) Reverse the removal procedures to install.

REMOVAL AND INSTALLATION (Continued)

BLOWER MOTOR

REMOVAL

(1) Remove the battery from the battery tray. Refer to Group 8A - Battery for the procedures.

(2) Remove the three screws securing the Powertrain Control Module (PCM) to the mounting bracket on the engine compartment side of the dash panel. Move the PCM away from the blower motor opening in the dash panel (Fig. 26).

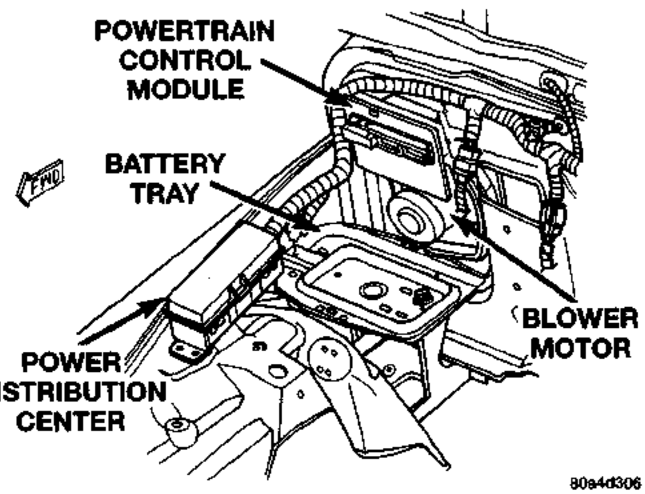


Fig. 26 Blower Motor Remove/Install

(3) Unplug the blower motor wiring connector.

(4) Remove the three blower motor and wheel assembly mounting screws.

(5) Remove the blower motor and wheel from the heater-A/C housing.

(6) Remove the blower motor wheel retainer clip and remove the wheel from the blower motor shaft

INSTALLATION

(1) Install the blower motor and wheel into the heater-A/C housing.

(2) Install and tighten the three blower motor mounting screws.

(3) Connect the blower motor wiring connector.

(4) Install the PCM to the mounting bracket with three screws.

(5) Install the battery in the battery tray. Refer to Group 8A - Battery for the procedures.

VACUUM CHECK VALVE

(1) Unplug the vacuum supply line at the intake manifold.

(2) Note the orientation of the check valve in the vacuum line for correct installation. The black colored end of the valve should be oriented towards the intake manifold, and the natural colored end towards the vacuum reservoir.

(3) Unplug the valve from the vacuum supply line fittings.

(4) Reverse the removal procedures to install.

VACUUM RESERVOIR

(1) Remove the battery and battery tray as described in Group 8A - Battery.

(2) Disconnect the vacuum supply line from the vacuum reservoir (Fig. 27).

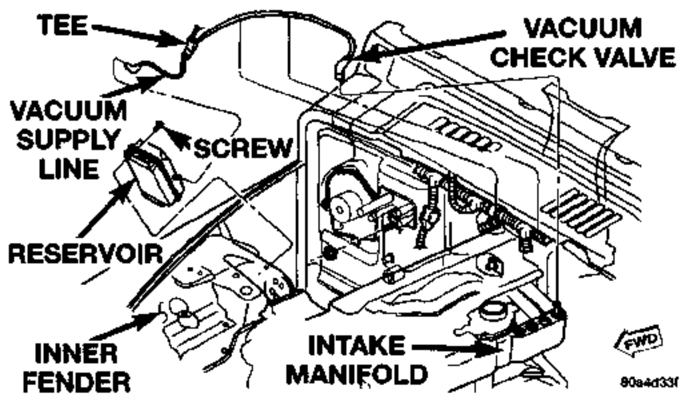


Fig. 27 Vacuum Reservoir Remove/Install

(3) Remove the one screw securing the reservoir to the inner fender panel beneath the battery tray.

(4) Remove the vacuum reservoir.

(5) Reverse the removal procedures to install.

HEATER-A/C CONTROL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel center bezel and the glove box. Refer to Group 8E - Instrument Panel Systems for the procedures.

(3) Reach through the glove box opening and unplug the two halves of the vacuum harness connector.

(4) Remove the four screws securing the heater-A/C control to the instrument panel (Fig. 28).

(5) Pull the heater-A/C control out from the instrument panel far enough to access the connectors on the back of the control.

(6) Unplug the three electrical connectors from the back of the heater-A/C control (Fig. 29).

REMOVAL AND INSTALLATION (Continued)

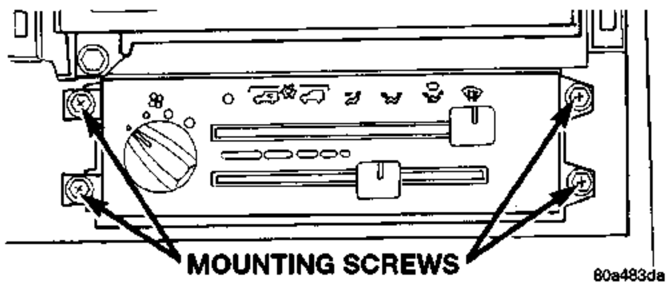


Fig. 28 Heater-A/C Control Remove/Install

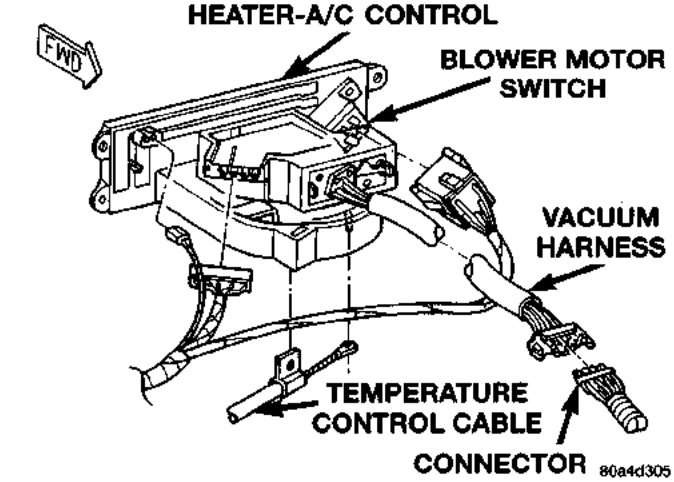


Fig. 29 Heater-A/C Control Connectors

(7) Disconnect the temperature control cable and cable housing from the heater-A/C control.

(8) Remove the heater-A/C control from the instrument panel.

INSTALLATION

(1) Connect the temperature control cable and cable housing to the heater-A/C control.

(2) Plug the three electrical connectors into the heater-A/C control.

(3) Install the heater-A/C control to the instrument panel with four screws.

(4) Reach through the glove box opening and plug the two halves of the vacuum harness together.

(5) Install the glove box and the instrument panel center bezel. Refer to Group 8E - Instrument Panel Systems for the procedures.

(6) Connect the battery negative cable.

BLOWER MOTOR SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Pull the blower motor switch knob on the front of the heater-A/C control off of the blower motor switch stem.

(3) Remove the heater-A/C control as described in this group.

(4) Remove the two screws securing the blower motor switch to the rear of the heater-A/C control and remove the switch (Fig. 30).

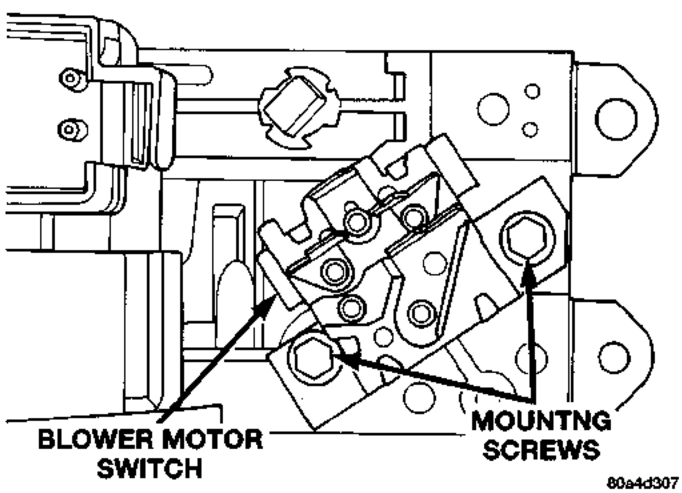


Fig. 30 Blower Motor Switch Remove/Install

(5) Reverse the removal procedures to install.

TEMPERATURE CONTROL CABLE

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the heater-A/C control as described in this group.

(3) Disconnect the cable retainer from the heater-A/C housing (Fig. 31).

(4) Remove the push nut attaching the cable to the blend air door crank arm and remove the cable.

(5) Reach through the glove box opening to route the cable through the strap retaining it to the heater-A/C housing support bracket on the dash panel, and

REMOVAL AND INSTALLATION (Continued)

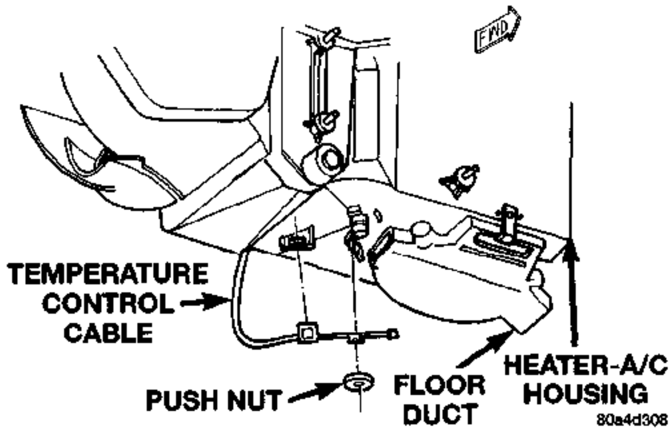


Fig. 31 Temperature Control Cable Remove/Install

to remove the cable from the retainer clips on the heater-A/C housing.

(6) Reverse the removal procedures to install. Be certain that the push nut is reinstalled.

HIGH SPEED BLOWER MOTOR RELAY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box as described in Group 8E - Instrument Panel Systems.

(3) Locate the relay near the right end of the heater-A/C housing under the instrument panel (Fig. 32).

(4) Unplug the relay from the connector.

(5) To install the relay, align the terminals with the cavities in the relay center and push the relay firmly into place.

(6) Install the glove box.

(7) Connect the battery negative cable.

(8) Test the relay operation.

BLOWER MOTOR RESISTOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

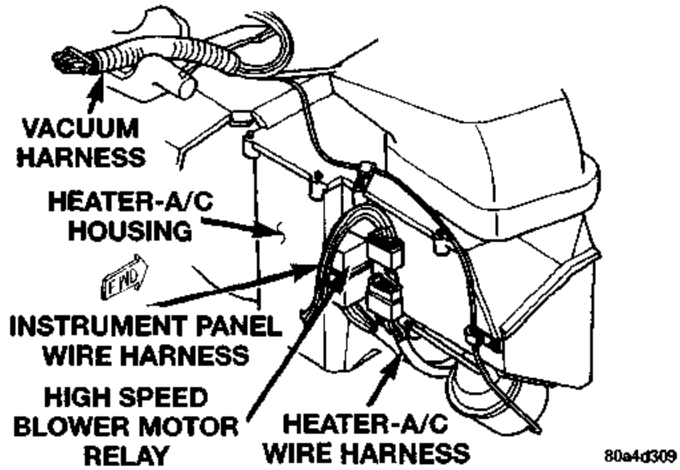


Fig. 32 High Speed Blower Motor Relay

(1) Disconnect and isolate the battery negative cable.

(2) Remove the kick cover from the passenger side outboard end of the heater-A/C housing under the instrument panel. There are two screws securing the outboard end of the cover to the housing, and one screw secures the inboard end of the cover to the housing.

(3) Pull out on the blower motor resistor wiring connector latch and unplug the connector from the resistor (Fig. 33).

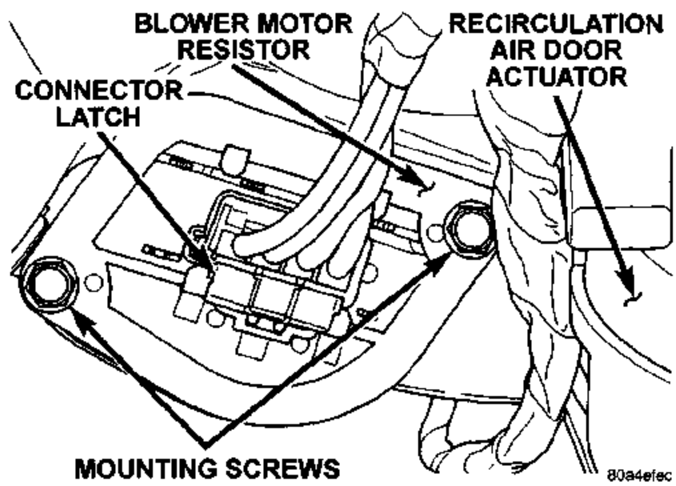


Fig. 33 Blower Motor Resistor Remove/Install

(4) Remove the two screws securing the resistor to the heater-A/C housing.

(5) Remove the resistor from the housing.

(6) Reverse the removal procedures to install.

REMOVAL AND INSTALLATION (Continued)

MODE DOOR VACUUM ACTUATORS

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DEFROST/DEMIST DOOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column cover and knee blocker as described in Group 8E - Instrument Panel Systems.

(3) Unplug the two actuator vacuum lines from the actuator (Fig. 34).

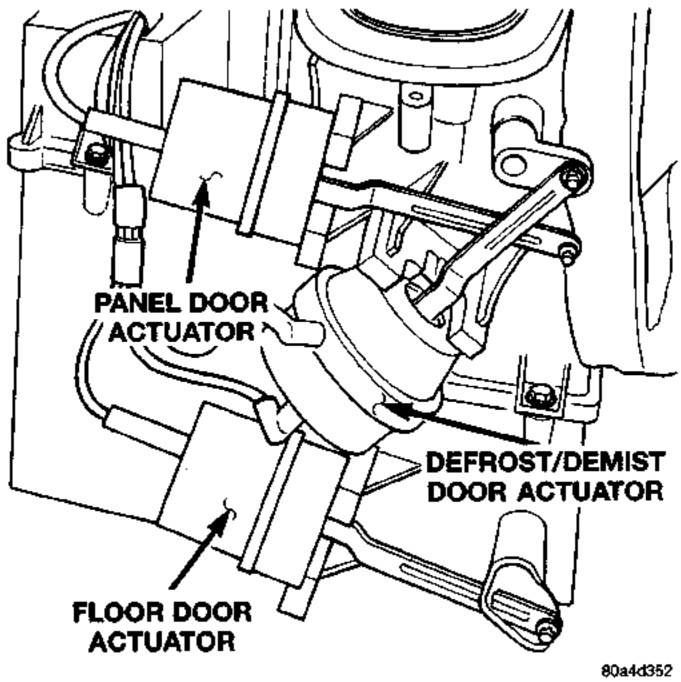

Fig. 34 Defrost/Demist, Floor, and Panel Door Vacuum Actuators

(4) Remove the push nut securing the actuator arm to the stud on the defrost/demist door lever.

(5) Pull firmly outwards on the actuator to release the snap-fit actuator mounts from the mounting stanchions molded into the heater-A/C housing.

(6) Remove the actuator from the heater-A/C housing.

(7) Reverse the removal procedures to install. Be certain that the push nut is reinstalled.

FLOOR DOOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column cover and knee blocker as described in Group 8E - Instrument Panel Systems.

(3) Unplug the actuator vacuum line from the actuator (Fig. 34).

(4) Remove the push nut securing the actuator arm to the stud on the floor door lever.

(5) Pull firmly outwards on the actuator to release the snap-fit actuator mounts from the mounting stanchions molded into the heater-A/C housing.

(6) Remove the actuator from the heater-A/C housing.

(7) Reverse the removal procedures to install. Be certain that the push nut is reinstalled.

PANEL DOOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column cover and knee blocker as described in Group 8E - Instrument Panel Systems.

(3) Remove the defrost/demist door actuator as described in this group.

(4) Unplug the actuator vacuum line from the actuator (Fig. 34).

(5) Remove the push nut securing the actuator arm to the stud on the panel door lever.

(6) Pull firmly outwards on the actuator to release the snap-fit actuator mounts from the mounting stanchions molded into the heater-A/C housing.

(7) Remove the actuator from the heater-A/C housing.

(8) Reverse the removal procedures to install. Be certain that the push nut is reinstalled.

RECIRCULATION AIR DOOR

A recirculation air door and actuator are used only on models with the optional air conditioning system.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the kick cover from the passenger side outboard end of the heater-A/C housing under the instrument panel. There are two screws securing the outboard end of the cover to the housing, and one screw secures the inboard end of the cover to the housing.

(3) Unplug the actuator vacuum line from the actuator (Fig. 35).

(4) Remove the push nut securing the actuator arm to the stud on the recirculation air door lever.

(5) Pull firmly downwards on the actuator to release the snap-fit actuator mounts from the mounting stanchions molded into the heater-A/C housing.

REMOVAL AND INSTALLATION (Continued)

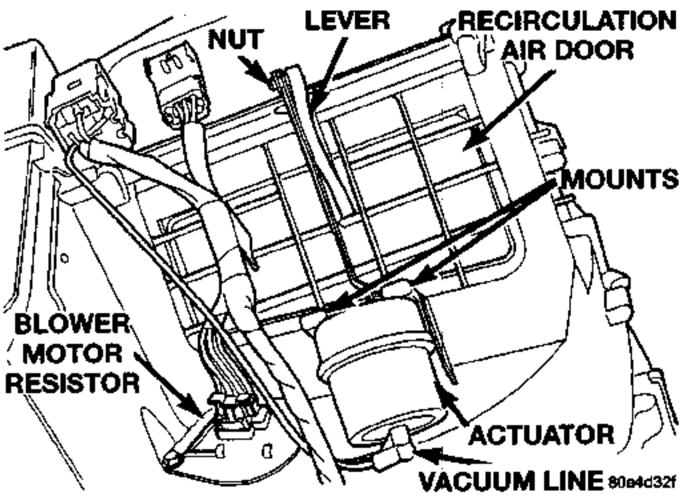

Fig. 35 Recirculation Air Door Vacuum Actuator Remove/Install

(6) Remove the actuator from the heater-A/C housing.

(7) Reverse the removal procedures to install. Be certain that the push nut is reinstalled.

HEATER-A/C HOUSING

The heater-A/C housing assembly must be removed from the vehicle and the two halves of the housing separated for service access of the heater core, evaporator coil, blend-air door, and each of the various mode control doors.

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REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel assembly as described in Group 8E - Instrument Panel Systems.

(3) If the vehicle is not equipped with air conditioning, go to Step 5. If the vehicle is equipped with air conditioning, recover the refrigerant from the refrigerant system as described in this group.

(4) Disconnect the refrigerant lines from the evaporator tubes. Install plugs in, or tape over all of the open refrigerant fittings.

(5) Drain the cooling system. Refer to Group 7 - Cooling System for the procedures.

(6) Disconnect the heater hoses from the heater core tubes.

(7) Disconnect the heater-A/C system vacuum supply line from the tee fitting near the heater core tubes.

(8) Remove the five heater-A/C housing mounting nuts from the studs on the engine compartment side of the dash panel (Fig. 36). Loosen the battery hold-downs and reposition the battery for access, if required.

(9) Remove the cowl plenum drain tube from the stud directly behind the engine.

(10) Remove one screw securing the heater-A/C housing to the bracket on the dash panel.

(11) Pull the heater-A/C housing rearward and down far enough for the mounting studs to clear the dash panel holes and the housing to clear the defrost/demist and fresh air ducts.

(12) Remove the heater-A/C housing from the vehicle.

DISASSEMBLY

(1) Disengage the heater-A/C wiring and high speed blower motor relay connector retainers from their mounting holes in the heater-A/C housing.

(2) Unplug the vacuum harness connectors at the recirculation air door and floor door actuators.

(3) Remove the three screws securing the blower motor and wheel unit to the heater-A/C housing.

(4) Unplug the blower motor wire connector and remove the blower motor and wheel from the heater-A/C housing.

(5) Remove the screws and snap clips holding the upper and lower heater-A/C housing halves together.

(6) Separate the upper heater-A/C housing half from the lower half.

ASSEMBLY

(1) Assemble the upper heater-A/C housing half to the lower half. Be certain that the upper blend-air door pivot is engaged in its hole in the upper housing half.

(2) Install the screws and snap clips holding the upper and lower heater-A/C housing halves together.

(3) Plug the blower motor wire connector into the heater-A/C wire harness and install the blower motor and wheel into the heater-A/C housing.

(4) Install the three screws securing the blower motor and wheel unit to the heater-A/C housing.

(5) Plug in the vacuum harness connectors at the recirculation air door and floor door actuators.

(6) Engage the heater-A/C wiring and high speed blower motor relay connector retainers with their mounting holes in the heater-A/C housing.

INSTALLATION

(1) Position the heater-A/C housing to the dash panel. Be sure the drain tube is installed through the dash panel drain hole and that the defrost/demist and fresh air ducts are in their proper positions.

REMOVAL AND INSTALLATION (Continued)

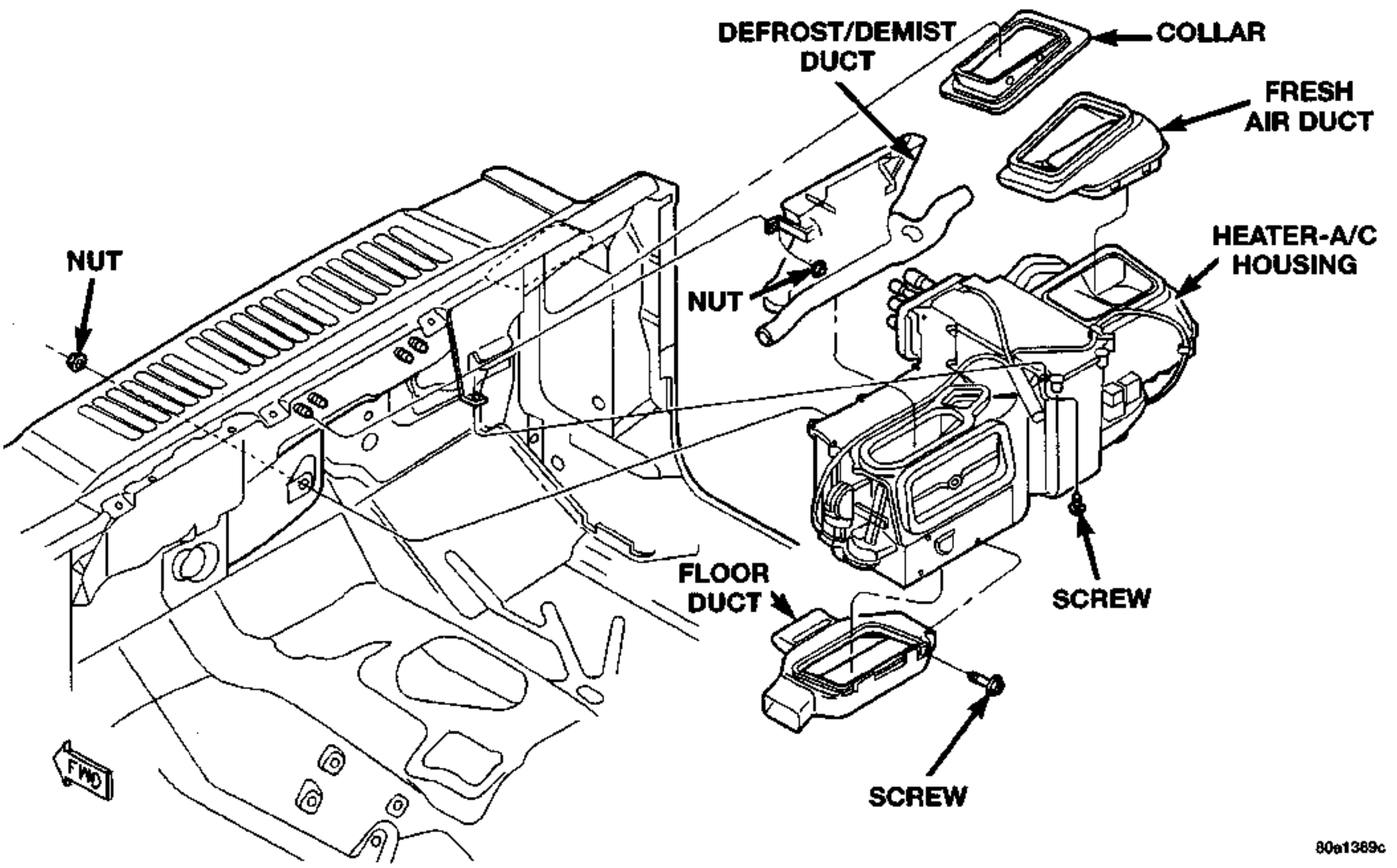

Fig. 36 Heater-A/C Housing Remove/Install

(2) Install the one mounting screw to secure the heater-A/C housing to the dash panel bracket.

(3) Install the cowl drain tube onto the stud located directly behind the engine.

(4) Install the five nuts to the mounting studs on the engine compartment side of the dash panel. If the battery was repositioned during the removal procedure, position the battery and tighten the hold-downs.

(5) Connect the heater-A/C system vacuum supply tube to the tee fitting near the heater core tubes.

(6) Connect the heater hoses to the heater core tubes.

(7) Unplug or remove the tape from the refrigerant fittings, and connect the refrigerant lines to the evaporator tubes.

(8) Install the instrument panel assembly as described in Group 8E - Instrument Panel Systems.

(9) Connect the battery negative cable.

(10) Fill the cooling system. Refer to Group 7 - Cooling System for the procedures.

(11) Evacuate and charge the refrigerant system as described in this group.

(12) Start the vehicle and check for proper operation of the heating and air conditioning systems.

HEATER-A/C HOUSING DOORS

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BLEND-AIR DOOR

(1) Remove and disassemble the heater-A/C housing as described in this group.

(2) Pry the blend-air door lever out of the door pivot from the outside of the lower housing half.

(3) Lift the door pivot out of the pivot hole from the inside of the lower housing half.

(4) Reverse the removal procedures to install.

DEFROST/DEMIST DOOR

(1) Remove and disassemble the heater-A/C housing as described in this group.

(2) Remove the defrost/demist door vacuum actuator as described in this group.

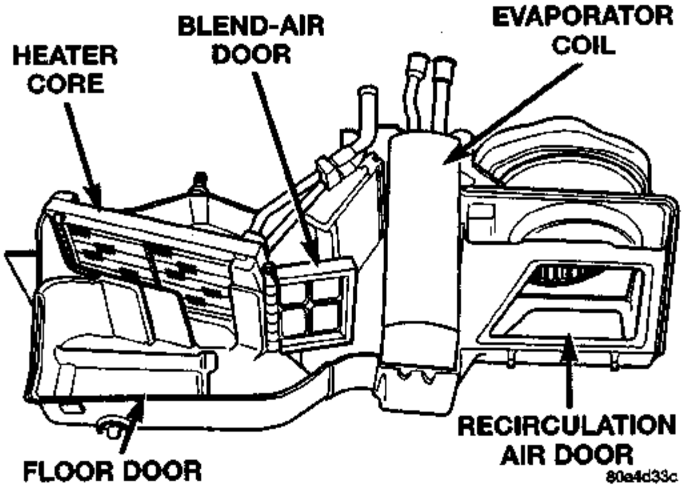
REMOVAL AND INSTALLATION (Continued)

(3) Pry the defrost/demist door lever out of the door pivot from the outside of the inboard end of the upper housing half.

(4) Reach inside the upper housing half and gently flex the doors enough so that the door pivot clears the pivot hole in the housing.

(5) Remove the defrost/demist doors from the housing as a unit.

(6) Reverse the removal procedures to install.



Lower Heater-A/C Housing

FLOOR DOOR

(1) Remove and disassemble the heater-A/C housing as described in this group.

(2) Remove the floor door vacuum actuator as described in this group.

(3) Pry the floor door lever out of the door pivot from the outside of the inboard end of the lower housing half.

(4) Reach inside the lower housing half and gently flex the door enough so that the door pivot clears the pivot hole in the housing.

(5) Remove the floor door from the housing.

(6) Reverse the removal procedures to install.

PANEL DOOR

(1) Remove and disassemble the heater-A/C housing as described in this group.

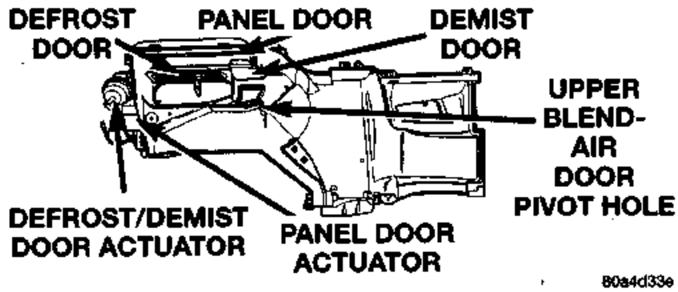
(2) Remove the panel door vacuum actuator as described in this group.

(3) Pry the panel door lever out of the door pivot from the outside of the inboard end of the upper housing half.

(4) Reach inside the upper housing half and gently flex the door enough so that the door pivot clears the pivot hole in the housing.

(5) Remove the panel door from the housing.

(6) Reverse the removal procedures to install.



Upper Heater-A/C Housing

RECIRCULATION AIR DOOR

(1) Remove and disassemble the heater-A/C housing as described in this group.

(2) Remove the recirculation air door vacuum actuator as described in this group.

(3) Reach inside the lower housing half and gently flex the door enough so that the door pivot clears the pivot hole in the housing.

(4) Remove the recirculation air door from the housing.

(5) Reverse the removal procedures to install.

EVAPORATOR COIL

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(1) Remove and disassemble the heater-A/C housing as described in this group.

(2) Lift the evaporator coil out of the lower half of the heater-A/C housing.

(3) Reverse the removal procedures to install. Be certain that the evaporator foam insulator is reinstalled.

NOTE: If the evaporator is replaced, add 60 ml (2 oz.) of refrigerant oil to the refrigerant system.

HEATER CORE

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REMOVAL AND INSTALLATION (Continued)

(1) Remove and disassemble the heater-A/C housing as described in this group.

(2) Lift the heater core out of the lower half of the heater-A/C housing.

(3) Reverse the removal procedures to install. Be certain that the heater core foam insulator is reinstalled.

DUCTS AND OUTLETS

Only the demister hoses and the panel outlet barrels can be removed without instrument panel assembly removal. Removal of the fresh air duct and collar require that the heater-A/C housing also be partially removed. The panel outlet housings and demister outlets are serviced only as a part of the instrument panel or instrument panel center bezel.

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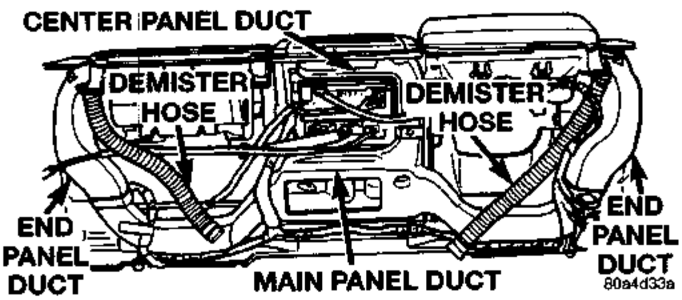

Heater-A/C Ducts and Outlets Remove/Install

DEFROST/DEMIST DUCT

(1) Remove the instrument panel assembly as described in Group 8E - Instrument Panel Systems.

(2) Remove the two screws securing the defrost/demist duct to the studs on the dash panel.

(3) Remove the defrost/demist duct.

(4) Reverse the removal procedures to install.

DEMISTER HOSES

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box to service the passenger side demister hose. Remove the steering column cover and knee blocker to service the driver side demister hose. Refer to Group 8E - Instrument Panel Systems for the procedures.

(3) Disconnect the ends of the demister hose from the demister outlet and the defrost/demist duct.

(4) Reverse the removal procedures to install.

FLOOR DUCT

(1) Remove the instrument panel as described in Group 8E - Instrument Panel Systems.

(2) Remove the two screws securing the rear of the duct to the heater-A/C housing.

(3) Release the front of the duct from the snap clip securing it to the heater-A/C housing.

(4) Slide the floor duct out from under the heater-A/C housing.

(5) Reverse the removal procedures to install.

FRESH AIR DUCT

(1) Remove the instrument panel assembly as described in Group 8E - Instrument Panel Systems.

(2) Remove the five nuts from the heater-A/C housing studs on the engine compartment side of the dash panel.

(3) Remove the one screw securing the heater-A/C housing to the bracket on the passenger compartment side of the dash panel.

(4) Push gently down on the top of the heater-A/C housing until sufficient clearance is obtained to remove the fresh air duct from the housing.

(5) Remove the fresh air duct collar from the cowl plenum panel by reaching up above the heater-A/C housing fresh air duct opening and pulling the collar downward. The collar is retained by a light snap fit.

(6) Reverse the removal procedures to install.

PANEL DUCTS

(1) Remove the instrument panel assembly as described in Group 8E - Instrument Panel Systems.

(2) Remove the demister hoses as described in this group.

(3) Remove the two screws from the rearward facing side of the instrument panel securing the main panel duct to the instrument panel base.

(4) Remove the one screw securing each end panel duct and/or the center panel duct to the instrument panel base.

(5) Remove the panel ducts from the instrument panel.

(6) Reverse the removal procedures to install.

PANEL OUTLET BARRELS

(1) Use a trim stick or other suitable flat wide-blade tool to pry the panel outlet barrel out of the panel outlet housing. The barrel is retained by a light snap fit.

(2) To install, position the barrel in the panel outlet housing and press firmly until the barrel snaps into place.

1996 SERVICE MANUAL COMMENTS

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