Welcome to the
1999 Jeep Cherokee
Electronic Service Manual

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CHRYSLER

GROUP TAB LOCATOR

INTRODUCTION

CONTENTS

GENERAL INFORMATION

VEHICLE IDENTIFICATION NUMBER

The Vehicle Identification Number (VIN) plate is located on the lower windshield fence near the left A-pillar. 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	F = 4001-5000 lbs.
5	Vehicle Line	F= Cherokee 4X4 (LHD) N = Cherokee 4X4 (RHD) B = Cherokee 4X2 (RHD) T = Cherokee 4X2 (LHD)
6	Series	2 = SE 6 = Sport/Classic 7 = Limited
7	Body Style	7 = 2dr Sport Utility 8 = 4dr Sport Utility
8	Engine	P = 2.5L Gasoline S = 4.0L Gasoline
9	Check Digit	
10	Model Year	X = 1999
11	Assembly Plant	L = Toledo #1
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.

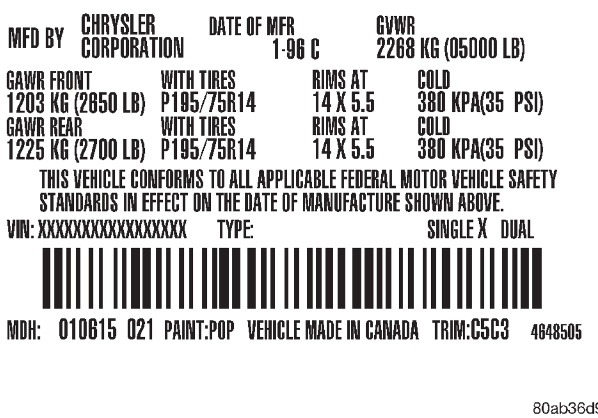


Fig. 1 Vehicle Safety Certification Label—Typical

BODY CODE PLATE

LOCATION AND DECODING

A metal body code plate is attached to the left (driver's side) of the dash panel in the engine compartment. 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. 2).

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.

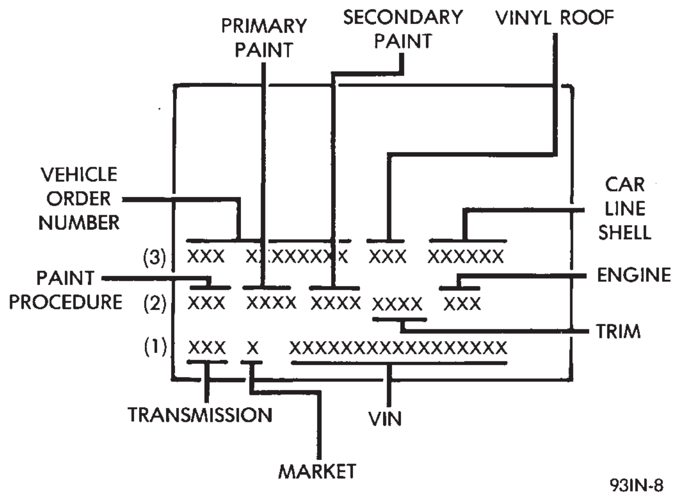


Fig. 2 Body Code Plate Decoding

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

- XJT = Cherokee 2WD (LHD)
- XJJ = Cherokee 4WD (LHD)
- XJB = Cherokee 2WD (RHD)
- XJU = Cherokee 4WD (RHD)

DIGIT 19

Price Class

- L = Cherokee (All)

DIGITS 20 AND 21

Body Type

- 72 = 2–Door
- 74 = 4–Door

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

GENERAL INFORMATION (Continued)

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
- DGS = AW4 4–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.

INTERNATIONAL VEHICLE CONTROL AND DISPLAY SYMBOLS

INTERNATIONAL VEHICLE CONTROL AND DISPLAY SYMBOLS

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

INTERNATIONAL CONTROL AND DISPLAY SYMBOLS

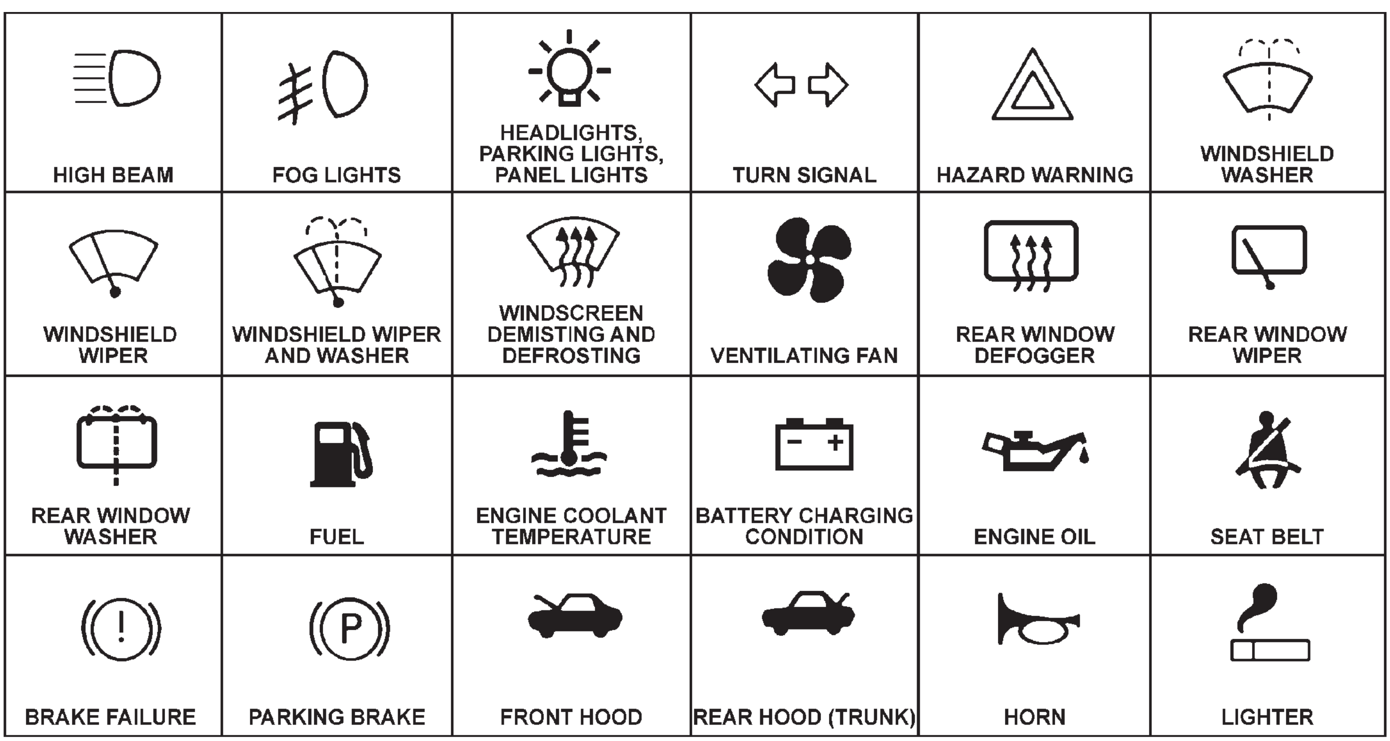


Fig. 3

GENERAL INFORMATION (Continued)

FASTENER IDENTIFICATION

FASTENER IDENTIFICATION

THREAD IDENTIFICATION

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

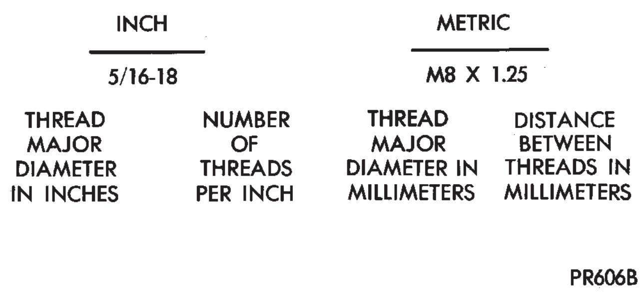


Fig. 4 Thread Notation Chart – SAE and Metric

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.

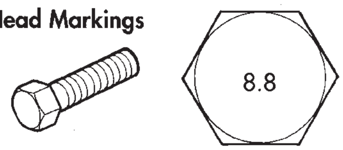
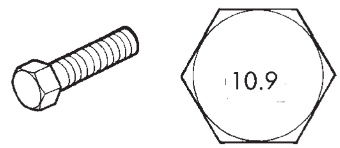
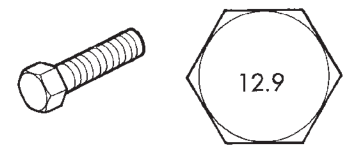
GENERAL INFORMATION (Continued)

FASTENER IDENTIFICATION

Bolt Markings and Torque - Metric

Commercial Steel Class

Bolt Head Markings

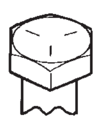
	8.8	10.9	12.9
Bolt Head Markings			

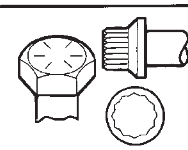
Body Size	8.8 Torque				10.9 Torque				12.9 Torque			
Diam.	Cast Iron		Aluminum		Cast Iron		Aluminum		Cast Iron		Aluminum	
mm	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
6	9	5	7	4	14	9	11	7	14	9	11	7
7	14	9	11	7	18	14	14	11	23	18	18	14
8	25	18	18	14	32	23	25	18	36	27	28	21
10	40	30	30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

Bolt Markings and Torque Values - U.S. Customary

SAE Grade Number 5 8

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





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

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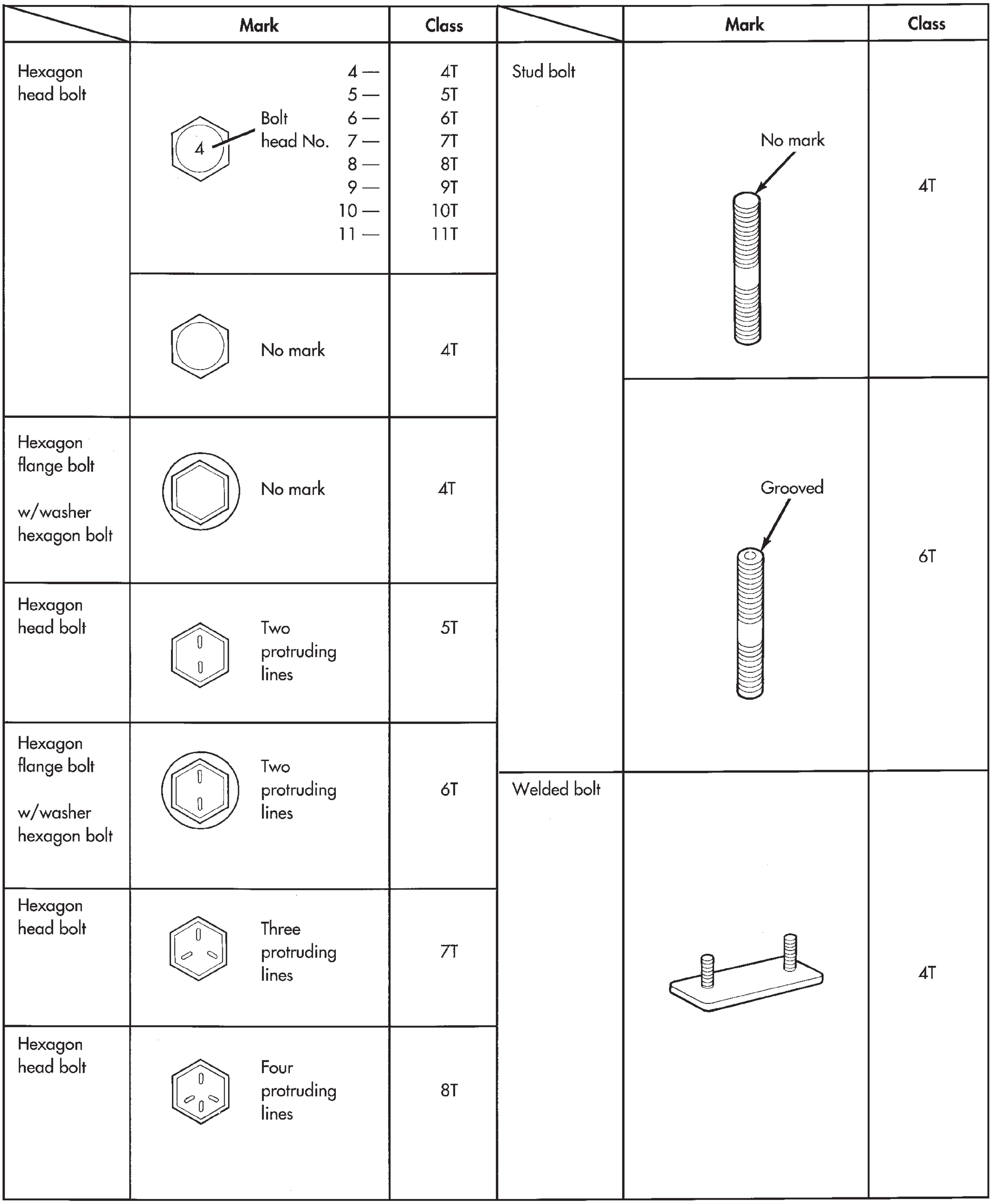
GENERAL INFORMATION (Continued)

FASTENER STRENGTH

HOW TO DETERMINE BOLT STRENGTH



	Mark	Class
Hexagon head bolt	Bolt head No. 4 —	4T
	5 —	5T
	6 —	6T
	7 —	7T
	8 —	8T
	9 —	9T
	10 —	10T
	11 —	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
Stud bolt	No mark	4T
	Grooved	6T
Welded bolt		4T

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GENERAL INFORMATION (Continued)

FASTENER USAGE

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

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

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

THREADED HOLE REPAIR

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

METRIC SYSTEM

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

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

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

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

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

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Fig. 5 Metric Prefixes

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

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

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

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GENERAL INFORMATION (Continued)

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.

TORQUE SPECIFICATIONS

SPECIFIED TORQUE FOR STANDARD BOLTS

Class	Diameter mm	Pitch mm	Specified torque: Hexagon head bolt N•m	Hexagon head bolt kgf-cm	Hexagon head bolt ft-lbf	Hexagon flange bolt N•m	Hexagon flange bolt kgf-cm	Hexagon flange bolt 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

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	F = 4001-5000 lbs.
5	Vehicle Line	J = Cherokee 4X4 (LHD) J = Cherokee 4X4 (RHD) EXPORT N = Cherokee 4X4 (RHD) B = Cherokee 4X2 (RHD) T = Cherokee 4X2 (LHD)
6	Transmission	N = 5 Speed Manual A = 3 Speed Auto B = 4 Speed Auto
7	Body Style	7 = 2dr Sport Utility 8 = 4dr Sport Utility
8	Engine	M = 2.5L Diesel P = 2.5L Gasoline S = 4.0L Gasoline
9	Check Digit	
10	Model Year	X = 1999
11	Assembly Plant	L = Toledo Assembly#1
12 thru 17	Vehicle Build Sequence	

GENERAL INFORMATION (Continued)

E-MARK LABEL

An E-mark Label (Fig. 1) is located on the rear shut face of the driver's door. The label contains the following information:

- Date of Manufacture
- Month-Day-Hour (MDH)
- Vehicle Identification Number (VIN)
- Country Codes
- Regulation Number
- Regulation Amendment Number
- Approval Number

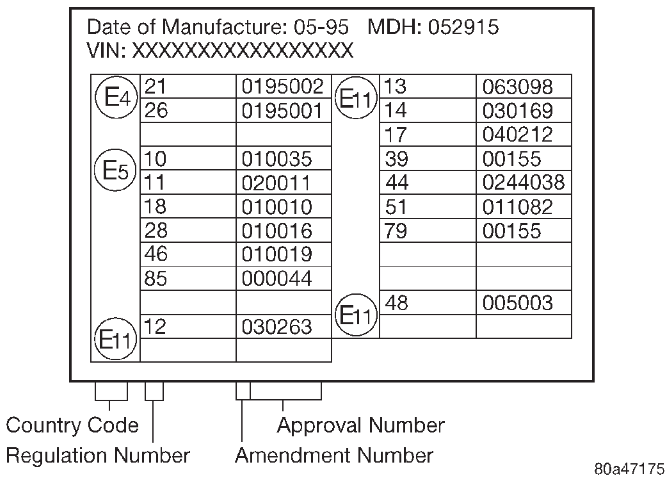

Fig. 1 E-Mark Label

MANUFACTURER PLATE

The Manufacturer Plate (Fig. 2) is located in the engine compartment on the radiator closure panel crossmember adjacent to the Body Code Plate. The plate contains five lines of information:

1. Vehicle Identification Number (VIN)
2. Gross Vehicle Mass (GVM)
3. Gross Train Mass (GTM)
4. Gross Front Axle Rating (GFAR)
5. Gross Rear Axle Rating (GRAR)

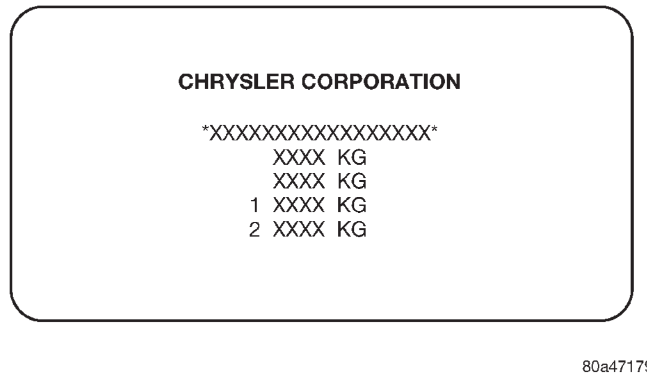

Fig. 2 Manufacturer Plate

LUBRICATION AND MAINTENANCE

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GENERAL INFORMATION

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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).

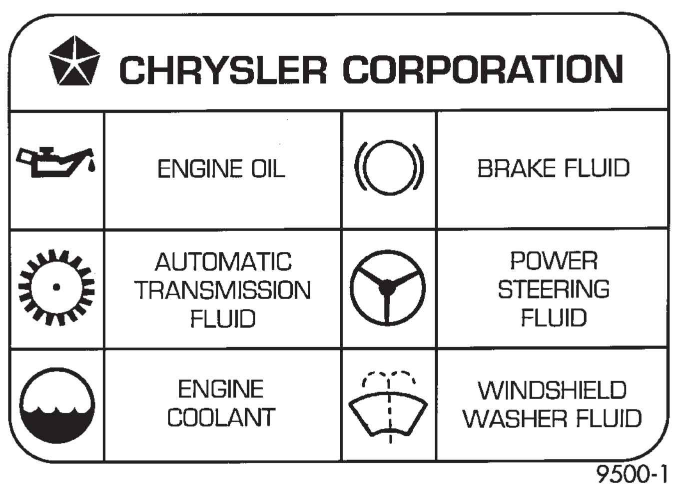

Fig. 1 International Symbols

GENERAL INFORMATION (Continued)

CLASSIFICATION OF LUBRICANTS

Only lubricants bearing designations defined by the following organization should be used to service a Chrysler Corporation vehicle.

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

ENGINE OIL

SAE VISCOSITY RATING INDICATES ENGINE OIL VISCOSITY

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

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

Chrysler Corporation only recommends multiple grade engine oils.

API QUALITY CLASSIFICATION

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

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

Fig. 2 API Symbol

GEAR LUBRICANTS

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

LUBRICANTS AND GREASES

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

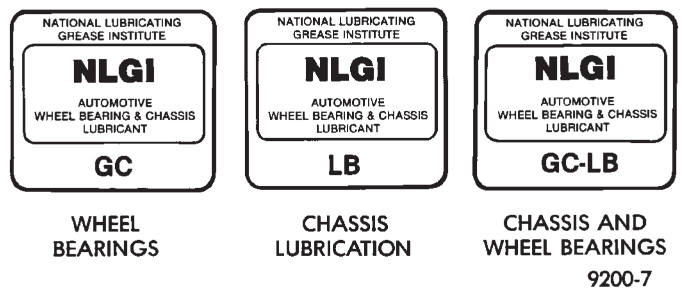

Fig. 3 NLGI Symbol

GENERAL INFORMATION (Continued)

FLUID CAPACITIES

FUEL TANK

All . . . . 76.4 L (20.2 gal.)

ENGINE OIL

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

COOLING SYSTEM

2.5L . . . . 9.5 L (10 qts.)*
4.0L . . . . 11.4 L (12 qts.)**

*Includes 2.2 L (2.3 qts) for coolant recovery reservoir.
**Includes 0.9 L (1.0 qt) for coolant recovery reservoir.

AUTOMATIC TRANSMISSION

Dry fill capacity*

AW4 . . . . 7.8 L (16.5 pts.)
30RH . . . . 4.67 L (9.86pts.)

*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 (4X2) . . . . 3.5 L (3.7 qts.)
AX5 (4X4) . . . . 3.3 L (3.5 qts.)
AX15 (4X2) . . . . 3.15 L (3.3 qts.)
AX15 (4X4) . . . . 3.15 L (3.3 qts.)

TRANSFER CASE

SELEC-TRAC 242 . . . . 1.3 L (2.85 pts.)
COMMAND-TRAC 231 . . . . 1.0 L (2.2 pts.)

FRONT AXLE

181–FBI . . . . 1.48 L (3.13 pts.)

REAR AXLE

194–RBI . . . . 1.66 L (3.5 pts.*)
8-1/4 . . . . 2.08 L (4.4 pts.**)

* When equipped with TRAC-LOK, include 3.5 ounces of Friction Modifier Additive.
** When equipped with TRAC-LOK, include 4 ounces of Friction Modifier Additive.

POWER STEERING

Power steering fluid capacities are dependent on engine/chassis options as well as steering gear/cooler options. Depending on type and size of internal cooler, length and inside diameter of cooler lines, or use of an auxiliary cooler, these capacities may vary. Refer to Section 19 of the service manual for proper fill and bleed procedures.

MAINTENANCE SCHEDULES

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GENERAL INFORMATION

MAINTENANCE SCHEDULES

There are two maintenance schedules that show proper service for the Cherokee.

First is Schedule **“A”** . It lists all the scheduled maintenance to be performed under “normal” operating conditions.

Second is Schedule **“B”** . It is a schedule for vehicles that are operated under these 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 driving is at sustained high speeds during hot weather, above 90°F (32°C)
- Off-road driving
- Desert operation

Use the schedule that best describes the driving conditions.

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

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

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.

FLUID FILL LOCATIONS AND LUBRICATION POINTS

The fluid fill/check locations and lubrication points are located in each applicable group.

SCHEDULE “A”

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage (4x4 only).

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Lubricate steering and suspension ball joints.

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

- Change engine oil.
- Replace engine oil filter.
- Inspect brake linings.
- Lubricate steering linkage (4x4 only).

GENERAL INFORMATION (Continued)

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

- Change engine oil.
- Replace engine oil filter.
- **Replace air cleaner element.**
- **Replace spark plugs.**
- Inspect drive belt, adjust tension as necessary.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill transfer case fluid.
- Lubricate steering and suspension ball joints.

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage (4x4 only).
- 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.
- Lubricate steering and suspension ball joints.

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

- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant if not done at 36 months.
- Lubricate steering linkage (4x4 only).

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 belt, adjust tension as necessary.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill transfer case fluid.
- Lubricate steering and suspension ball joints.

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

- Change engine oil.
- Replace engine oil filter.
- Inspect brake linings.
- Lubricate steering linkage (4x4 only).

75,000 Miles (120 000 km) or at 60 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.
- Lubricate steering and suspension ball joints.
- Drain and refill manual transmission fluid.

82,500 Miles (133 000 km) or at 66 months

- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Lubricate steering linkage (4x4 only).

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 belt, adjust tension as necessary.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill transfer case fluid.
- Inspect brake linings.
- Lubricate steering and suspension ball joints.

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage (4x4 only).

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.
- Lubricate steering and suspension ball joints.

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

- Change engine oil.
- Replace engine oil filter.
- Inspect brake linings.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Lubricate steering linkage (4x4 only).
- Drain and refill manual transmission fluid.

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 belt, adjust tension as necessary.

GENERAL INFORMATION (Continued)

- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill transfer case fluid.
- Lubricate steering and suspension ball joints.

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

SCHEDULE "B"

3,000 Miles (5 000 km)

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

6,000 Miles (10 000 km)

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Lubricate steering and suspension ball joints.

9,000 Miles (14 000 km)

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

12,000 Miles (19 000 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.
- Lubricate steering and suspension ball joints.

15,000 Miles (24 000 km)

- Change engine oil.
- Replace engine oil filter.
- **Inspect engine air cleaner element, replace as necessary.**
- Lubricate steering linkage.

18,000 Miles (29 000 km)

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

21,000 Miles (34 000 km)

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

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.
- Lubricate steering and suspension ball joints.

27,000 Miles (43 000 km)

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

30,000 Miles (48 000 km)

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- Inspect drive belt, adjust tension as necessary.
- Lubricate steering linkage.
- Drain and refill transfer case fluid.
- Lubricate steering and suspension ball joints.

33,000 Miles (53 000 km)

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

36,000 Miles (58 000 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.
- Lubricate steering and suspension ball joints.
- Drain and refill manual transmission fluid.

39,000 Miles (62 000 km)

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

42,000 Miles (67 000 km)

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Lubricate steering and suspension ball joints.

45,000 Miles (72 000 km)

- Change engine oil.
- Replace engine oil filter.
- **Inspect engine air cleaner element, replace as necessary.**
- Lubricate steering linkage.

48,000 Miles (77 000 km)

- Change engine oil.
- Replace engine oil filter.

GENERAL INFORMATION (Continued)

- Lubricate steering linkage.
- Drain and refill automatic transmission fluid.
- Drain and refill front and rear axles.‡
- Inspect brake linings.
- Lubricate steering and suspension ball joints.

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

54,000 Miles (86 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Lubricate steering and suspension ball joints.
- Drain and refill manual transmission fluid.

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

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 belt, adjust tension as necessary.
- 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.
- Lubricate steering and suspension ball joints.

63,000 Miles (101 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.

66,000 Miles (106 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Lubricate steering and suspension ball joints.

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

72,000 Miles (115 000 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.
- Lubricate steering and suspension ball joints.
- Drain and refill manual transmission fluid.

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

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

81,000 Miles (134 000 km)
- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) since last change.
- Lubricate steering linkage.

84,000 Miles (134 000 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.
- Lubricate steering and suspension ball joints.

87,000 Miles (139 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.

90,000 Miles (144 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- Inspect drive belt, adjust tension as necessary.
- Lubricate steering linkage.
- Drain and refill transfer case fluid.
- Lubricate steering and suspension ball joints.
- Drain and refill manual transmission fluid.

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

GENERAL INFORMATION (Continued)

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.
- Lubricate steering and suspension ball joints.

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

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

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

108,000 Miles (173 000 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.
- Lubricate steering and suspension ball joints.
- Drain and refill manual transmission fluid.

111,000 Miles (178 000 km)
- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) since last change.
- Lubricate steering linkage.

114,000 Miles (182 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Lubricate steering and suspension ball joints.

117,000 Miles (187 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.

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 belt, adjust tension as necessary.
- 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.
- Lubricate steering and suspension ball joints.

‡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 usually operated under these conditions.

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

JUMP STARTING, TOWING AND HOISTING

INDEX

SERVICE PROCEDURES

JUMP STARTING PROCEDURE

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

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

TO JUMP START A DISABLED VEHICLE:

(1) Raise hood on disabled vehicle and visually inspect engine compartment for:
- Battery cable clamp condition, clean if necessary.
- Frozen battery.
- Yellow or bright color test indicator, if equipped.
- Low battery fluid level.
- Generator drive belt condition and tension.
- Fuel fumes or leakage, correct if necessary.

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

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

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

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

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

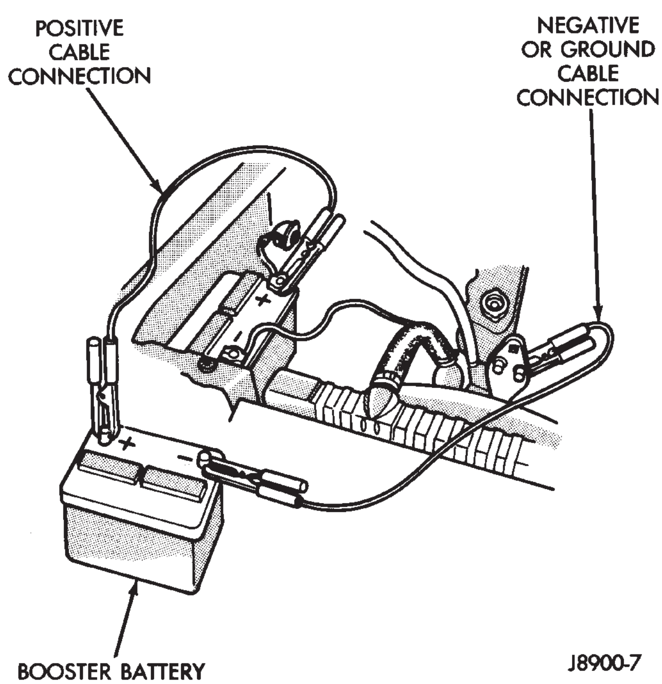

Fig. 1 Jumper Cable Connections—Typical

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

SERVICE PROCEDURES (Continued)

(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.

DISCONNECT CABLE CLAMPS AS FOLLOWS:

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

TOWING RECOMMENDATIONS

A vehicle equipped with an SAE approved Wheel-lift towing device can be used to tow all Cherokee vehicles (Fig. 2). When towing a 4WD vehicle, use tow dollies under the opposite end of the vehicle. A vehicle with a flat-bed device can also be used to transport a disabled vehicle.

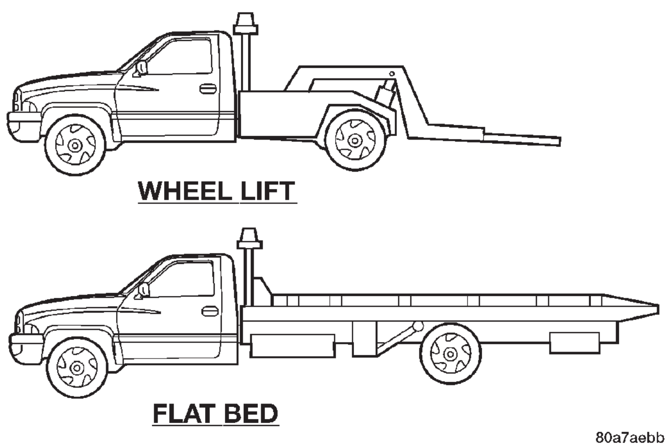

Fig. 2 Tow Vehicles With Approved Equipment

NOTE: A vehicle equipped with a SAE approved sling type towing device can be used to tow a Cherokee with the rear end lifted, provided the Cherokee is not equipped with a factory installed trailer tow package. Damage to the harness connector bracket may result from sling contact.

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.

TWO-WHEEL-DRIVE VEHICLE TOWING

TOWING-REAR END LIFTED (SLING-TYPE)

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

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

2WD XJ vehicles can be towed with the front wheels on the surface for extended distances at speeds not exceeding 48 km/h (30 mph). If the vehicle is equipped with a factory installed trailer tow package, use a SAE approved wheel lift device.

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

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

(3) Attach safety chains around the frame rails.

SERVICE PROCEDURES (Continued)

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

(5) Secure steering wheel in the straight ahead position with a clamp device designed for towing.

(6) Verify that steering components are in good condition.

(7) Shift the transmission to NEUTRAL.

TOWING-REAR END LIFTED (WHEEL LIFT)

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

(2) Attach wheel lift to rear wheels.

(3) Place transmission in neutral.

(4) Raise vehicle to towing height.

(5) Place transmission in park (automatic transmission) or fist gear (manual transmission).

TOWING-FRONT END LIFTED

To prevent damage to front fascia components, use only a Wheel-Lift type towing device or Flat-Bed hauling equipment.

If using the wheel-lift towing method:

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

(2) Attach wheel lift to front wheels.

(3) Place transmission in neutral.

(4) Raise vehicle to towing height.

(5) Place transmission in park (automatic transmission) or fist gear (manual transmission).

FOUR-WHEEL-DRIVE VEHICLE TOWING

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

If the vehicle is equipped with a factory installed trailer tow package, use a SAE approved wheel lift device.

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

TOWING-REAR END LIFTED (SLING TYPE)

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

(2) Attach J-hooks around rear axle shaft tube outboard of shock absorber.

(3) Place sling crossbar under and forward of bumper.

(4) Attach safety chains around frame rails.

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

(6) Secure steering wheel in the straight ahead position with a clamp device designed for towing.

(7) Shift transfer case to neutral.

TOWING-REAR END LIFTED (WHEEL LIFT)

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

(2) Attach wheel lift to rear wheels.

(3) Place transmission in neutral.

(4) Raise vehicle to towing height.

(5) Place transmission in park (automatic transmission) or first gear (manual transmission).

TOWING-FRONT END LIFTED

To prevent damage to front fascia components, use only a Wheel-Lift type towing device or Flat-Bed hauling equipment.

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

(2) Attach wheel lift to front wheels.

(3) Place transmission in neutral.

(4) Raise vehicle to towing height.

(5) Place transmission in park (automatic transmission) or first gear (manual transmission).

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 and rear 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. 3) and (Fig. 4). Support the vehicle in the raised position with jack stands at the front and rear ends of the frame rails.

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.

SERVICE PROCEDURES (Continued)

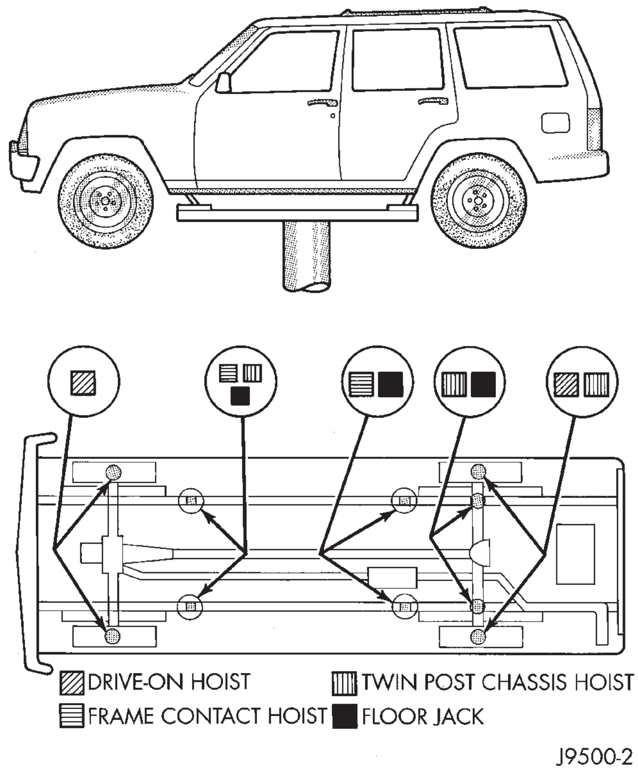

Fig. 3 Vehicle Lifting Locations

- 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.

HOIST

A vehicle can be lifted with:

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

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

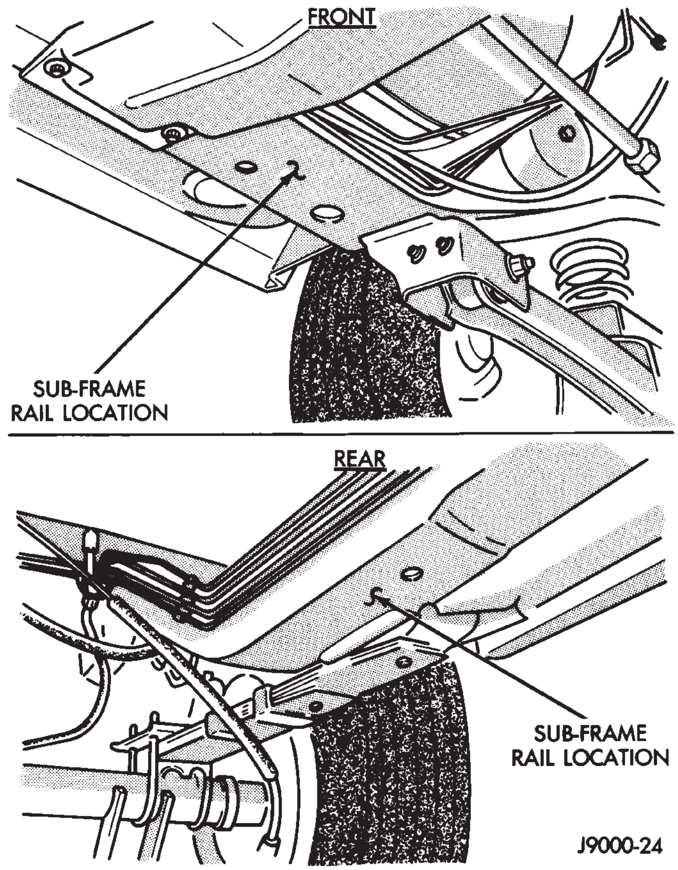

Fig. 4 Correct Vehicle Lifting Locations

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.

LUBRICATION AND MAINTENANCE

CONTENTS

GENERAL INFORMATION

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SPECIFICATIONS

ENGINE OIL—DIESEL ENGINES

Use only Diesel Engine Oil meeting standard **MIL-2104C** or API Classification **SG/CD** or **CCMC PD2**.

SAE VISCOSITY GRADE

CAUTION: Low viscosity oils must have the proper API quality or the CCMC G5 designation.

To assure of properly formulated engine oils, it is recommended that SAE Grade 15W-40 engine oils that meet Chrysler material standard MS-6395, be used. European Grade 10W-40 oils are also acceptable.

Oils of the SAE 5W-30 or 10W-30 grade number are preferred when minimum temperatures consistently fall below -12°C.

FLUID CAPACITIES

FUEL TANK

Diesel Engine Equipped Vehicles . . . . 76.4 L

ENGINE OIL

2.5L Diesel Engine (includes filter) . . . . 6.5 L

COOLING SYSTEM

2.5L Diesel . . . . 8.0 L

MANUAL TRANSMISSION

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.

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.

TRANSFER CASE

COMMAND-TRAC 231 . . . . 1.3 L

FRONT AXLE

Model 181 . . . . 1.2 L

REAR AXLE

Model 194 . . . . 1.6 L*
8-1/4 . . . . 2.3 L**

* When equipped with TRAC-LOK, include 4 ounces of Friction Modifier Additive.

** When equipped with TRAC-LOK, include 5 ounces of Friction Modifier Additive.

MAINTENANCE SCHEDULE

INDEX

GENERAL INFORMATION

MAINTENANCE SCHEDULE—DIESEL ENGINE

The following are engine related Maintenance items which are unique to Diesel engine-equipped vehicles. Refer to the 1997 XJ Service Manual for gasoline engine and non-engine related Maintenance Schedules.

The service intervals are based on odometer readings in kilometers. There are two maintenance schedules that show proper service intervals. Use the schedule that best describes the conditions the vehicle is operated under. **Schedule-A** lists all the scheduled maintenance to be performed under normal operating conditions. **Schedule-B** is the schedule for vehicles that are operated under one or more of the following conditions:

- Day and night temperatures are below freezing.
- Stop and go driving.
- Long periods of engine idling.
- Driving in dusty conditions.
- Short trips of less than 8 kilometers (5 miles).
- Operation at sustained high speeds during hot weather above 32°C (90°F).
- Taxi, police or delivery service.
- Trailer towing.

AT EACH STOP FOR FUEL OR SCHEDULED SERVICE STOP

- Check engine oil level.
- Check engine coolant level.
- Inspect drive belt.
- Visually inspect intercooler for obstruction. Clean as necessary.
- Visually inspect radiator for obstruction. Clean as necessary.
- Inspect for fuel, oil or coolant leaks.
- Inspect battery cable connection and excessive corrosion.
- Inspect for presence of water in fuel filter/water separator, drain if necessary.

SCHEDULE—A

1 000 KM

- Change engine oil.
- Change engine oil filter.
- Check all fluid levels.
- Check correct torque, intake manifold mounting nuts.
- Check correct torque, exhaust manifold mounting nuts.
- Check correct torque, turbocharger mounting nuts.
- Check correct torque, water manifold bolts.

10 000 KM

- Change engine oil.
- Change engine oil filter.

20 000 KM

- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.
- **Retorque cylinder head bolts.***

***** Engines equipped with a steel head gasket do not need this service procedure performed. Refer to Group 9, Engines for head gasket identification.

30 000 KM

- Change engine oil.
- Change engine oil filter.

40 000 KM

- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.
- Replace fuel filter/water separator element.**

50 000 KM

- Change engine oil.
- Change engine oil filter.

GENERAL INFORMATION (Continued)

60 000 KM

- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check glow plug operation.
- Replace drive belt.
- Check engine smoke.
- Replace engine coolant.

70 000 KM

- Change engine oil.
- Change engine oil filter.

80 000 KM

- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.
- Replace fuel filter/water separator element.**

90 000 KM

- Change engine oil.
- Change engine oil filter.

100 000 KM

- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.

EVERY 40 000 KM AFTER 80 000 KM

- Replace fuel filter/water separator element.**

**The fuel filter/water separator element should be replaced once a year if the vehicle is driven less than 40 000 km annually or if power loss from fuel starvation is detected.

EVERY 10 000 KM AFTER 100 000 KM

- Change engine oil.
- Change engine oil filter.

EVERY 20 000 KM AFTER 100 000 KM

- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.

SCHEDULE—B

500 KM

- Check correct torque, intake manifold mounting nuts.
- Check correct torque, exhaust manifold mounting nuts.
- Check correct torque, turbocharger mounting nuts.
- Check correct torque, water manifold bolts.

1 000 KM

- Change engine oil.
- Change engine oil filter.
- Check all fluid levels.

5 000 KM

- Change engine oil.
- Change engine oil filter.

10 000 KM

- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.

15 000 KM

- Change engine oil.
- Change engine oil filter.

20 000 KM

- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.
- **Retorque cylinder head bolts.***

***** Engines equipped with a steel head gasket do not need this service procedure performed. Refer to Group 9, Engines for head gasket identification.

25 000 KM

- Change engine oil.
- Change engine oil filter.

30 000 KM

- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check glow plug operation.
- Replace drive belt.
- Check engine smoke.
- Replace engine coolant.

35 000 KM

- Change engine oil.
- Change engine oil filter.

GENERAL INFORMATION (Continued)

40 000 KM
- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.
- Replace fuel filter/water separator element.

45 000 KM
- Change engine oil.
- Change engine oil filter.

50 000 KM
- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.

55 000 KM
- Change engine oil.
- Change engine oil filter.

60 000 KM
- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.
- Replace fuel filter/water separator element.

65 000 KM
- Change engine oil.
- Change engine oil filter.

70 000 KM
- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.

75 000 KM
- Change engine oil.
- Change engine oil filter.

80 000 KM
- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check glow plug operation.
- Replace drive belt.
- Check engine smoke.
- Replace engine coolant.

85 000 KM
- Change engine oil.
- Change engine oil filter.

90 000 KM
- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.

95 000 KM
- Change engine oil.
- Change engine oil filter.

100 000 KM
- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.
- Replace fuel filter/water separator element.

EVERY 5 000 KM AFTER 100 000 KM
- Change engine oil.
- Change engine oil filter.

EVERY 10 000 KM AFTER 100 000 KM
- Change engine oil.
- Change engine oil filter.
- Replace air filter element.
- Check drive belt tension.
- Check glow plug operation.

EVERY 20 000 KM AFTER 100 000 KM
- Replace fuel filter/water separator element.

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 minimize tire wear. The most important measurements of an alignment are caster, camber and toe position (Fig. 1).

- **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, damaged component(s) must be replaced to correct the camber angle.
- **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, damaged component(s) must be replaced to correct the steering axis inclination angle.
- **THRUST ANGLE** is the angle of the rear axle relative to the centerline of the vehicle. Incorrect thrust angle can cause off-center steering and excessive tire wear. This angle is not adjustable, damaged component(s) must be replaced to correct the thrust angle.

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

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

GENERAL INFORMATION (Continued)

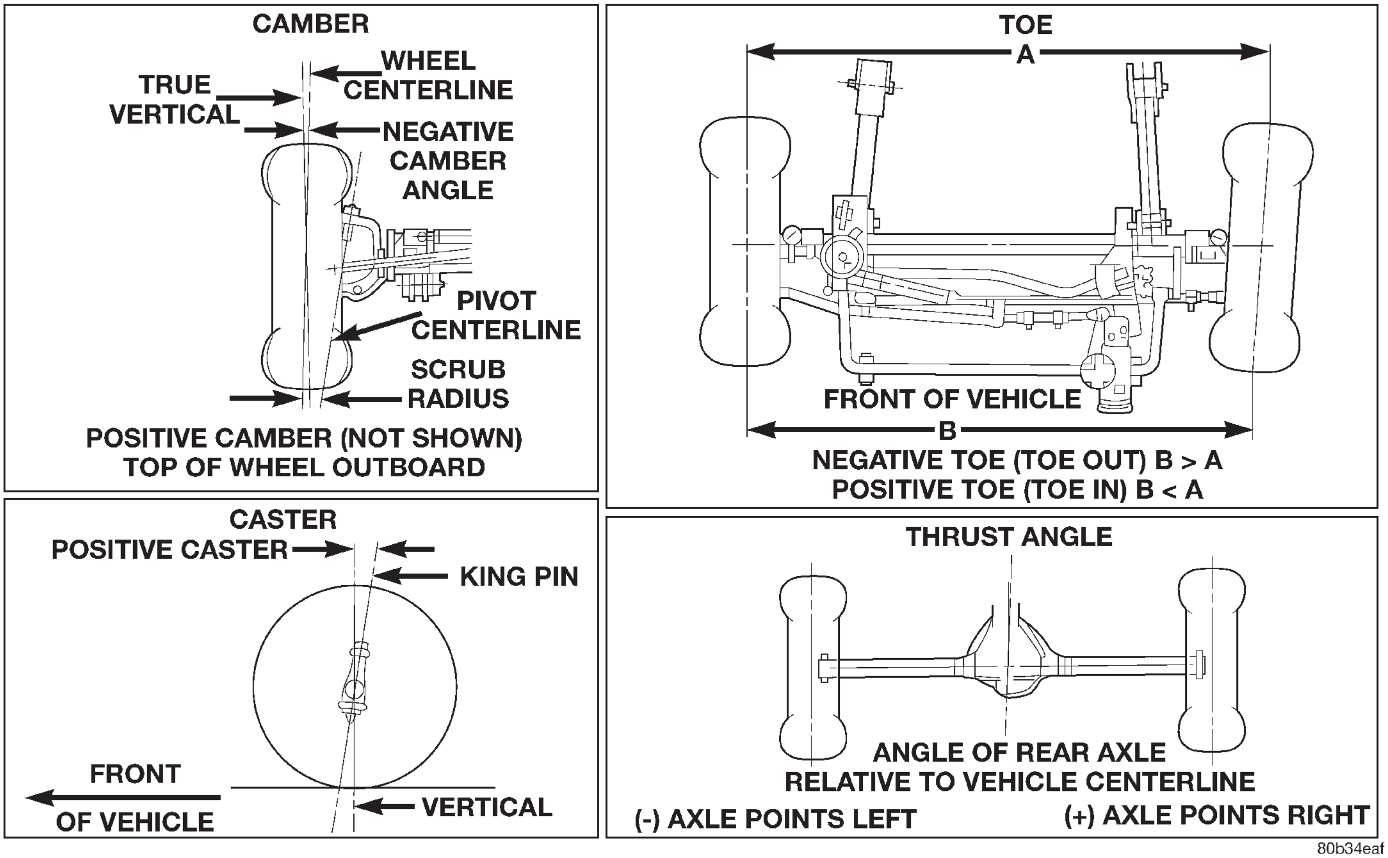


Fig. 1 Wheel Alignment Measurements

DIAGNOSIS AND TESTING

SUSPENSION AND STEERING SYSTEM

CONDITION	POSSIBLE CAUSES	CORRECTION
FRONT END NOISE	1. Loose or worn wheel bearings. 2. Loose or worn steering or suspension components.	1. 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. 5. Leaking steering dampener.	1. Adjust or replace wheel bearings. 2. Tighten or replace components as necessary. 3. Replace or balance tires. 4. Align vehicle to specifications. 5. Replace steering dampener.
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. Power steering fluid low. 3. Column coupler binding. 4. Tire pressure. 5. Alignment.	1. Adjust or replace steering gear. 2. Add fluid and repair leak. 3. Replace coupler. 4. Adjust tire pressure. 5. Align vehicle to specifications.
VEHICLE PULLS TO ONE SIDE	1. Tire pressure. 2. Alignment. 3. Loose or worn steering or suspension components. 4. Radial tire lead. 5. Brake pull. 6. Weak or broken spring.	1. Adjust tire pressure. 2. Align vehicle to specifications. 3. Tighten or replace components as necessary. 4. Rotate or replace tire as necessary. 5. Repair brake as necessary. 6. Replace spring.

SERVICE PROCEDURES

PRE-ALIGNMENT

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

(1) Inspect tires for size and tread wear.

(2) Set tire air pressure.

(3) Inspect front wheel bearings for wear.

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

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

(6) Inspect suspension components for wear and noise.

WHEEL ALIGNMENT

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

CAMBER

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

CASTER

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

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

Caster can be adjusted by installing the appropriate size shims (Fig. 2).

NOTE: Changing caster angle will also change the front propeller shaft angle. The propeller shaft angle has priority over caster. Refer to Group 3 Differential & Driveline for additional information.

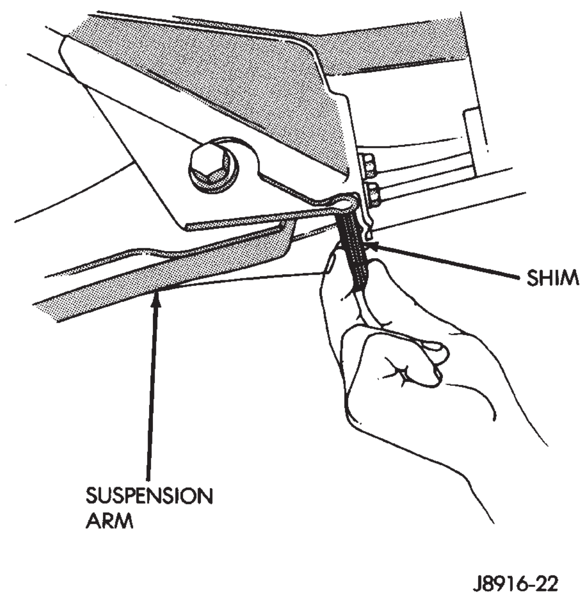


Fig. 2 Caster Adjustment

TOE POSITION (LHD)

NOTE: The wheel toe position adjustment is the final adjustment. The engine must remain running during the entire toe position adjustment.

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

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

(3) Adjust the right wheel toe position with the drag link. Turn the sleeve until the right wheel is at correct TOE-IN specifications. Position the clamp bolts as shown (Fig. 4) and tighten to 49 N·m (36 ft. lbs.).

NOTE: Make sure the toe setting does not change during clamp tightening.

(4) Adjust the left wheel toe position with the tie rod. Turn the sleeve until the left wheel is at specifications. Position the clamp bolts as shown (Fig. 4) and tighten to 27 N·m (20 ft. lbs.).

NOTE: Make sure the toe setting does not change during clamp tightening.

(5) Verify the right toe setting and turn off engine.

(6) Road test the vehicle on a flat level road to verify the steering wheel is centered.

NOTE: Once the toe setting is correct, the steering wheel can be re-centered by adjusting only the drag link.

SERVICE PROCEDURES (Continued)

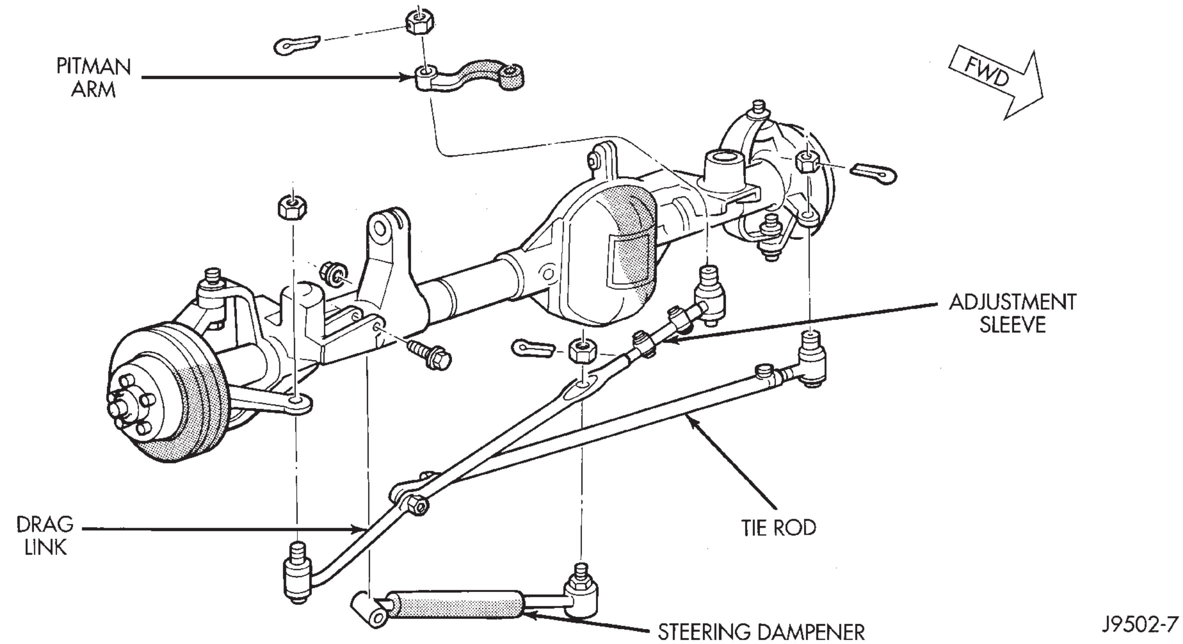


Fig. 3 Steering Linkage (LHD)

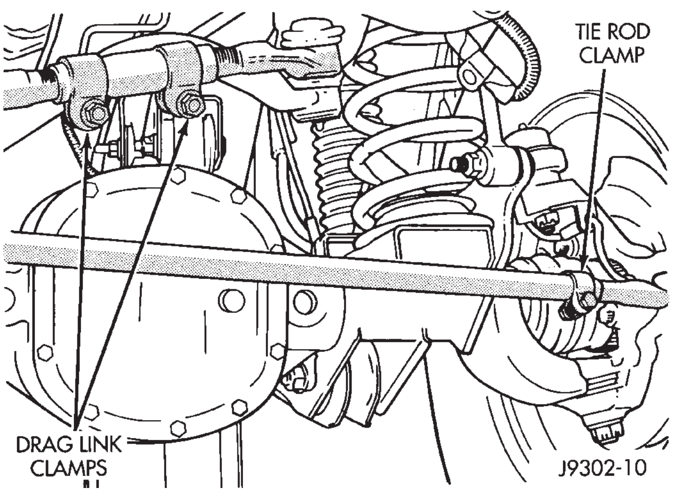


Fig. 4 Drag Link and Tie Rod Clamp (LHD)

TOE POSITION (RHD)

NOTE: The wheel toe position adjustment is the final adjustment. The engine must remain running during the entire toe position adjustment.

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

(2) Loosen the adjustment sleeve clamp bolts (Fig. 5).

(3) Adjust the left wheel toe position with the drag link. Turn the sleeve until the left wheel is at the correct TOE-IN specifications. Position the clamp bolts to their original position and tighten to 49 N·m (36 ft. lbs.).

NOTE: Make sure the toe setting does not change during clamp tightening.

(4) Adjust the right wheel toe position with the tie rod. Turn the sleeve until the right wheel is at correct TOE-IN specifications. Position the clamp bolts to their original position and tighten to 27 N·m (20 ft. lbs.).

NOTE: Make sure the toe setting does not change during clamp tightening.

(5) Verify the right toe setting and turn off engine.

(6) Road test the vehicle on a flat level road to verify the steering wheel is centered.

NOTE: Once the toe setting is correct, the steering wheel can be re-centered by adjusting only the drag link.

SPECIFICATIONS (Continued)

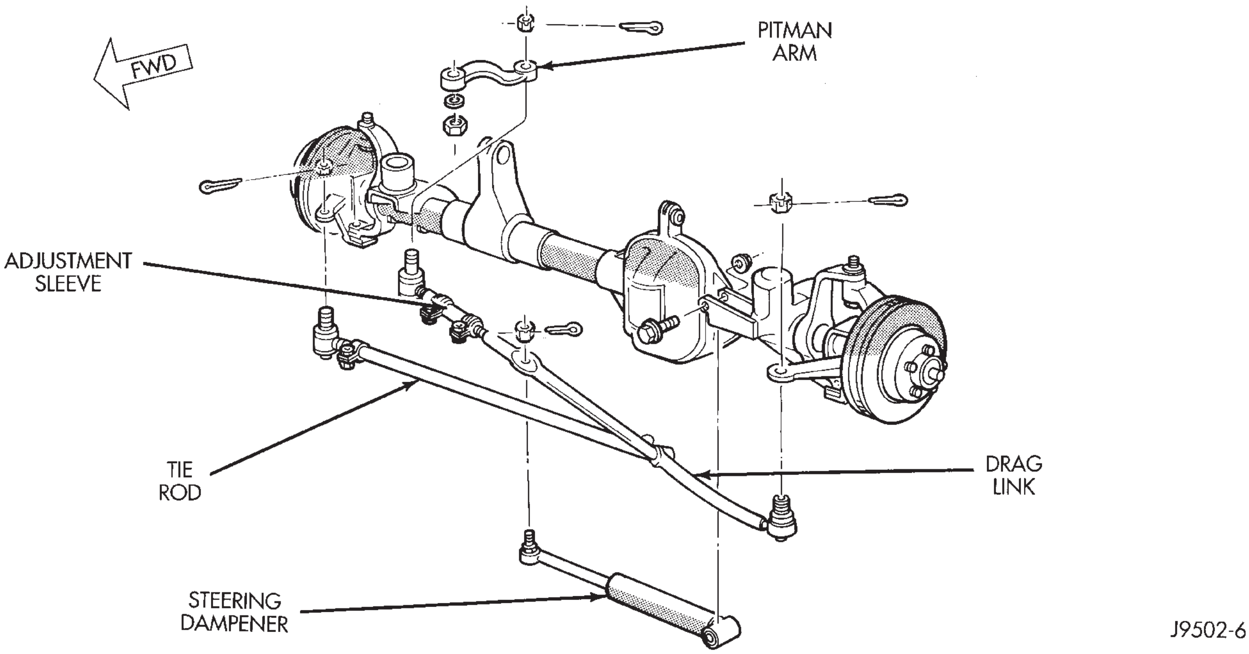


Fig. 5 Steering Linkage (RHD)

SPECIFICATIONS

ALIGNMENT

NOTE: All alignment specifications are in degrees.

ADJUSTMENT	PREFERRED	RANGE	MAX RT/LT DIFFERENCE
CASTER	+ 7.0°	+ 5.25° to + 8.5°	1.25°

ADJUSTMENT	PREFERRED	RANGE	MAX RT/LT DIFFERENCE
CAMBER (fixed angle)	− 0.25°	− 0.75° to + 0.5°	1.0°
TOTAL TOE-IN	+ 0.25°	0° to + 0.45°	.05°
THRUST ANGLE 0° ± 0.15°			

FRONT SUSPENSION

INDEX

DESCRIPTION AND OPERATION

SUSPENSION COMPONENTS

The front suspension is a link/coil design (Fig. 1). This suspension is use on Left Hand Drive (LHD) and Right Hand Drive (RHD) vehicles. The suspension is comprised of:

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

Link/Coil Suspension: This suspension allows each wheel to adapt to different road surfaces with-

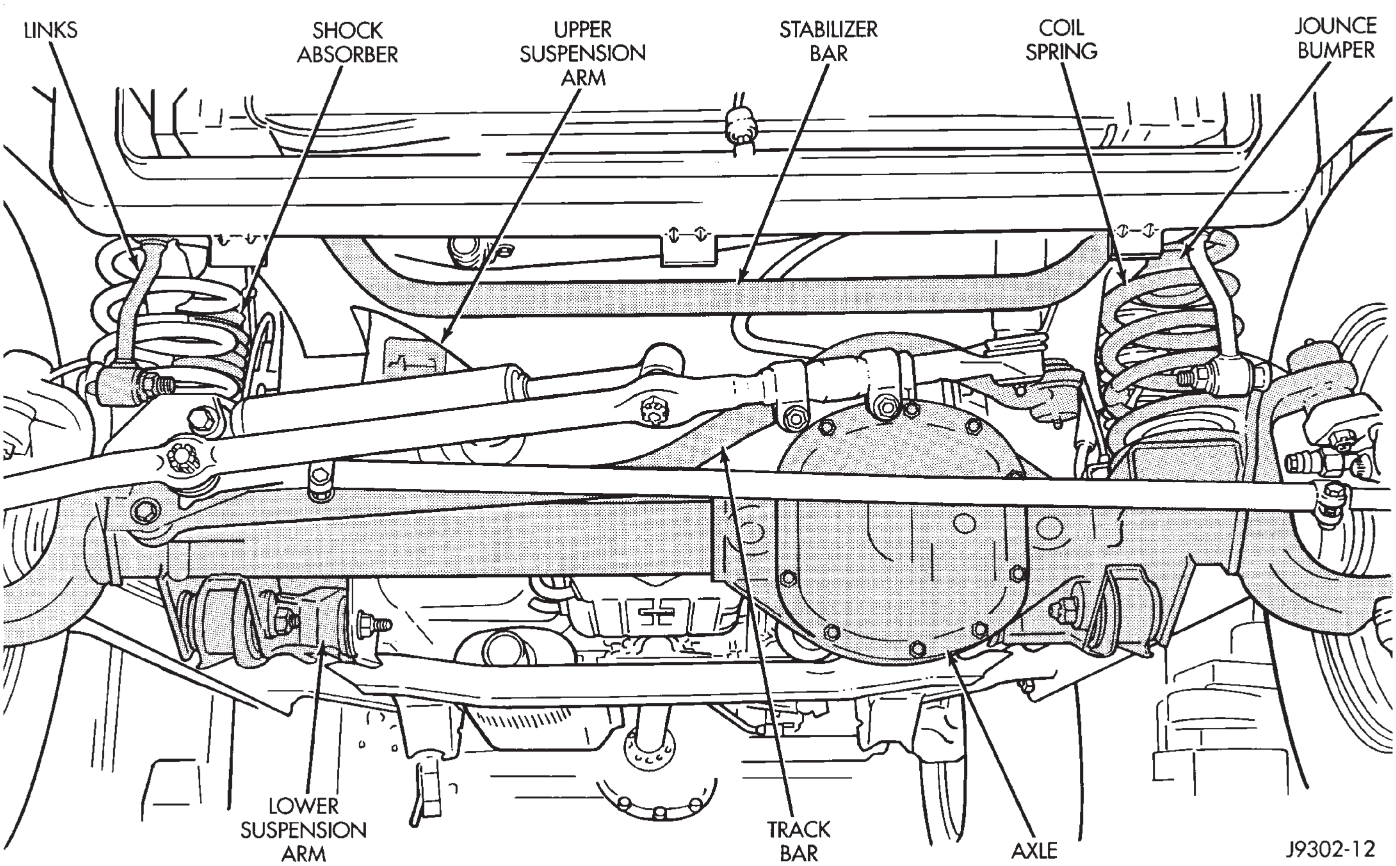


Fig. 1 Suspension Components (LHD)

DESCRIPTION AND OPERATION (Continued)

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

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

Upper & Lower Suspension Arms: The suspension arms are different lengths, with bushings at both ends. They bolt the axle assembly to the body. The lower arms use shims at the body mount to allow for adjustment of caster and drive shaft pinion angle. 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 minimize 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 front underside of the chassis and connects to the body rails. Links are connected from the bar to the axle brackets. Stabilizer bar mounts are isolated by rubber bushings.

Track Bar: The track bar is used to locate the axle laterally. The bar is attached to a body rail bracket with a ball stud and isolated with a bushing at the axle bracket.

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

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

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

DIAGNOSIS AND TESTING

SHOCK DIAGNOSIS

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

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

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

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

REMOVAL AND INSTALLATION

SHOCK ABSORBER

REMOVAL

(1) Remove the nut, retainer and grommet from the upper stud in the engine compartment (Fig. 2).

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

(3) Remove the shock absorber.

INSTALLATION

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

(2) Install the lower bolts and nuts. Tighten nuts to 23 N·m (17 ft. lbs.).

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

COIL SPRING/JOUNCE BUMPER

REMOVAL

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

(2) Remove the wheel and tire assemblies.

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

(4) Remove lower suspension arms mounting nuts and bolts from the axle (Fig. 2).

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

(6) Remove the track bar from the body rail bracket.

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

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

(9) Pull jounce bumper out of mount.

INSTALLATION

(1) Install jounce bumper into mount.

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

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

(4) Install the stabilizer bar links and shock absorbers to the axle bracket.

(5) Install the track bar to the body rail bracket.

(6) Install the lower suspension arms to the axle. Install mounting bolts and nuts finger tight.

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

(8) Install the wheel and tire assemblies.

(9) Remove the supports and lower the vehicle.

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

STEERING KNUCKLE

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

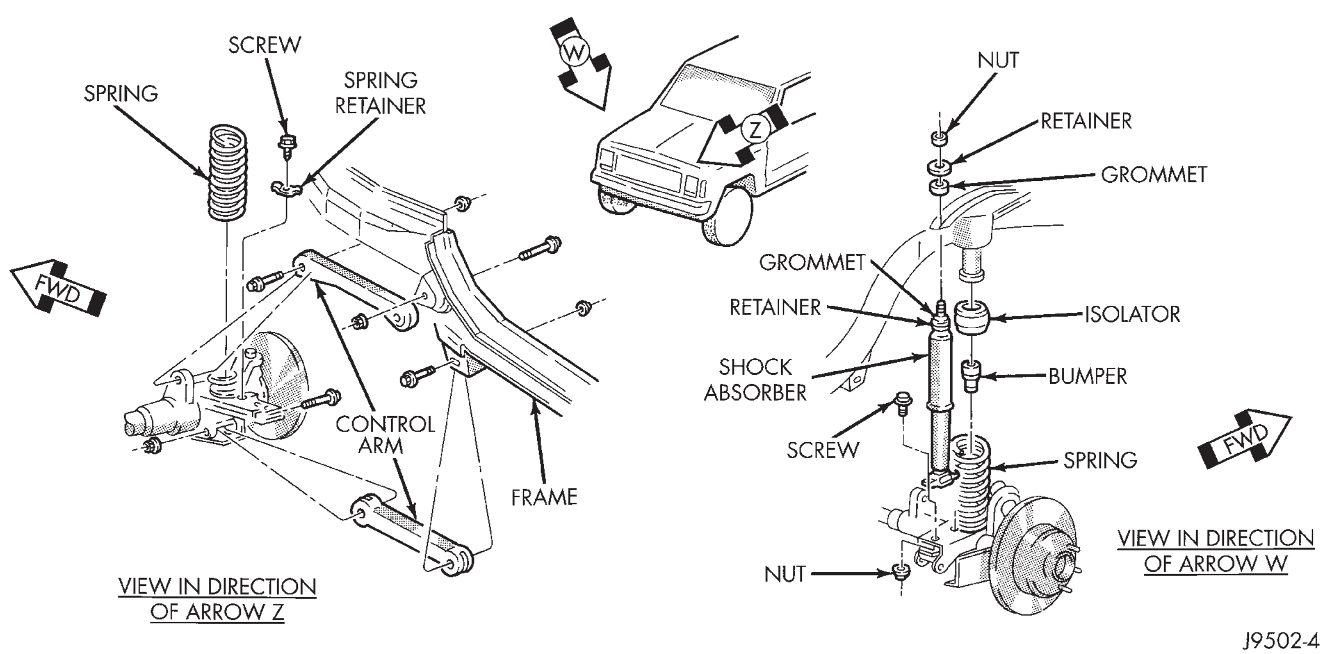


Fig. 2 Coil Spring & Shock Absorber

REMOVAL AND INSTALLATION (Continued)

LOWER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.

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

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

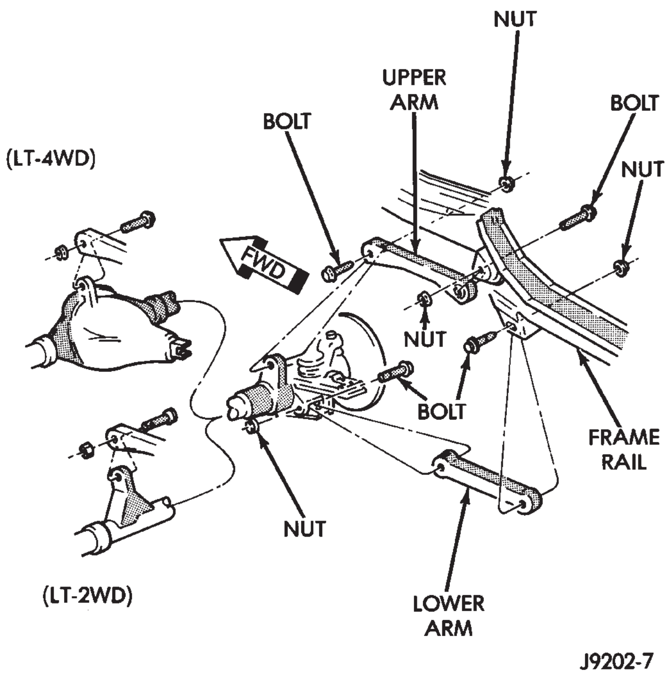


Fig. 3 Upper and Lower Suspension Arms

INSTALLATION

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

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

(3) Remove support and lower the vehicle.

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

UPPER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.

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

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

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 to 75 N·m (55 ft. lbs.). Tighten the nut at the frame bracket to 90 N·m (66 ft. lbs.).

FRONT AXLE BUSHING

REMOVAL

(1) Remove the upper suspension arm from axle.

(2) Position Spacer 7932-3 over the axle bushing on a 4x2 vehicle and right side on a 4x4 vehicle.

(3) Place Receiver 7932-1 over flanged end of the bushing. (Fig. 4).

(4) Place small end of Remover/Install 7932-2 against other side of the bushing.

(5) Install bolt 7604 through remover, bushing and receiver.

(6) Install Long Nut 7603 and tighten nut too pull bushing out of the axle bracket.

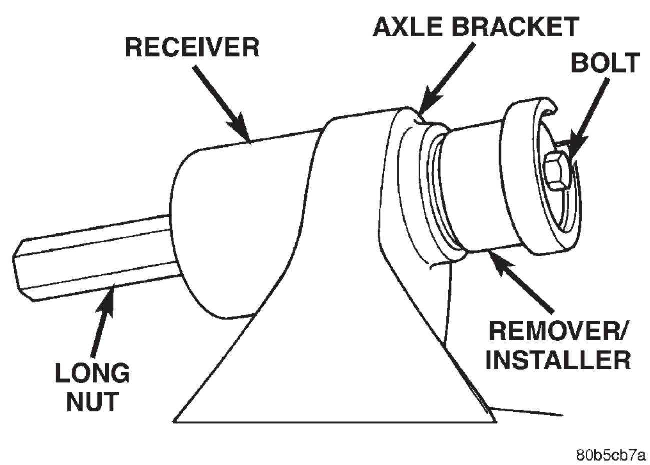


Fig. 4 Bushing Removal

(7) Remove nut, bolt, receiver, remover and bushing.

NOTE: On 4x2 vehicle and right side of 4x4 vehicle, leave Spacer 7932-3 in position for bushing installation.

INSTALLATION

(1) Place Receiver 7932-1on the other side of the axle bracket.

(2) Position new bushing up to the axle bracket, and large end of Remover/Install 7932-2 against the bushing (Fig. 5).

(3) Install bolt 7604 through receiver, bushing and installer.

(4) Install Long Nut 7603 and tighten nut to draw the bushing into the axle bracket.

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

REMOVAL AND INSTALLATION (Continued)

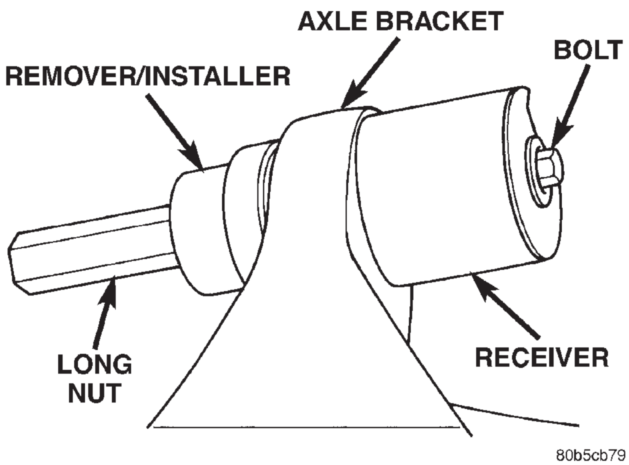


Fig. 5 Bushing Installation

STABILIZER BAR

REMOVAL

(1) Raise and support the vehicle.

(2) Remove nuts, retainers and grommets from the links at the stabilizer bar (Fig. 6).

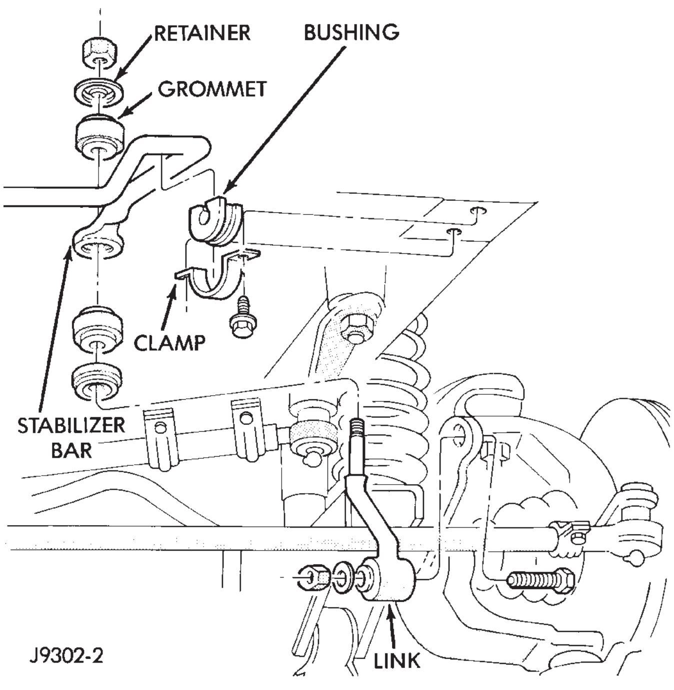


Fig. 6 Stabilizer Bar (LHD)

(3) Remove the links mounting nuts and bolts from the axle brackets.

(4) Remove the stabilizer bar clamps from the body rails. Remove the stabilizer bar.

INSTALLATION

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

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

(3) Install the links and grommets onto the stabilizer bar and axle brackets.

(4) Tighten the link nuts at the axle bracket to 95 N·m (70 ft. lbs.).

(5) Tighten the link nuts at the stabilizer bar to 36 N·m (27 ft. lbs.).

(6) Remove the supports and lower the vehicle.

TRACK BAR

REMOVAL

(1) Raise and support the vehicle.

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

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

(4) Remove the bolt and flag nut from the axle shaft tube bracket (Fig. 7).

(5) Remove the track bar.

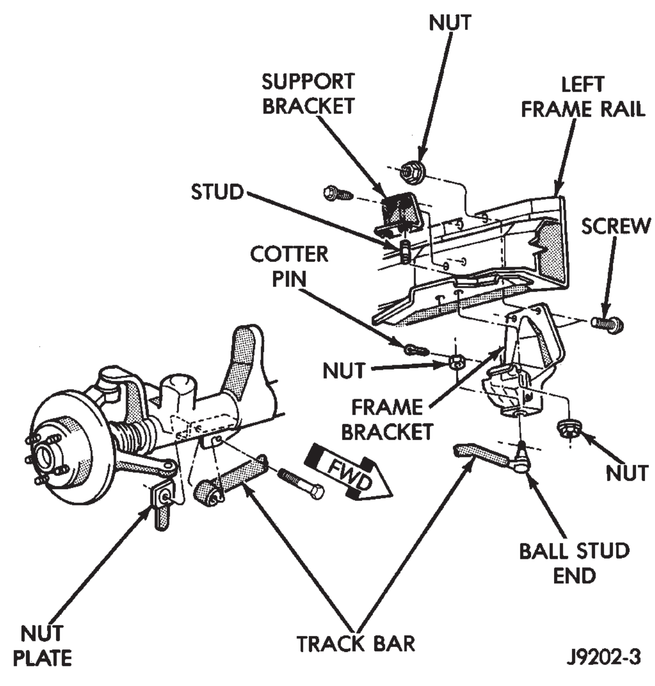


Fig. 7 Track Bar (LHD)

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 body rail. Install track bar at the body rail bracket. Install the retaining nut on the stud.

(3) Remove the supports and lower the vehicle.

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

REMOVAL AND INSTALLATION (Continued)

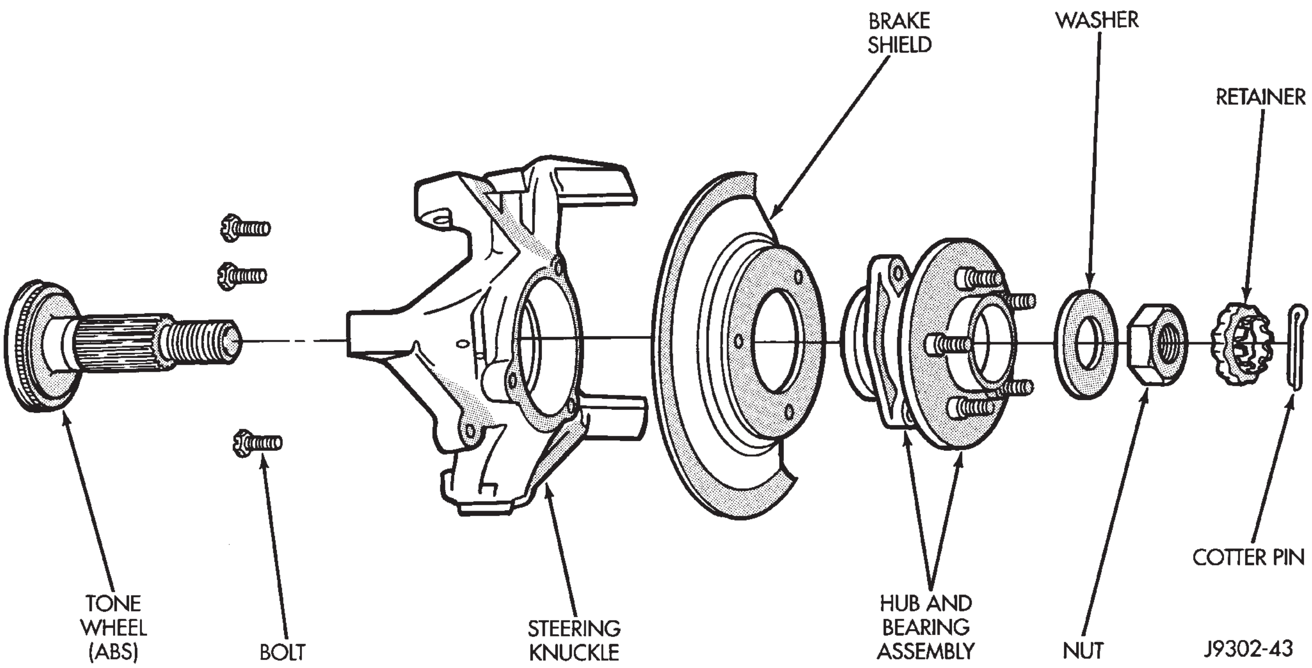


Fig. 8 Hub Bearing & Knuckle

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

FRONT HUB BEARING

REMOVAL

(1) Raise and support the vehicle.
(2) Remove the wheel and tire assembly.
(3) Remove the brake caliper, rotor and ABS wheel speed sensor, refer to Group 5 Brakes.
(4) Remove the cotter pin, nut retainer and axle hub nut (Fig. 8).
(5) Remove the hub bearing mounting bolts from the back of the steering knuckle. Remove hub bearing from the steering knuckle and off the axle shaft.

INSTALLATION

(1) Install the hub bearing and brake dust shield to the knuckle.
(2) Install the hub bearing 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 rotor, caliper and ABS wheel speed sensor, refer to Group 5 Brakes.
(5) Install the wheel and tire assembly.
(6) Remove support and lower the vehicle.

WHEEL MOUNTING STUDS-FRONT

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).

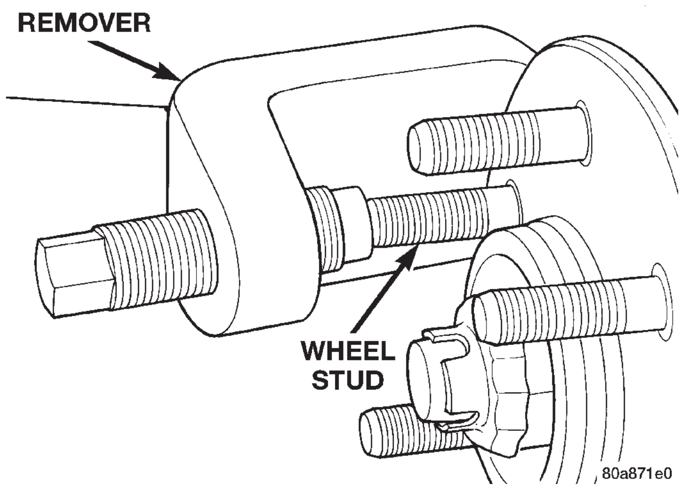


Fig. 9 Wheel Stud Removal

INSTALLATION

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

REMOVAL AND INSTALLATION (Continued)

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

(4) Remove lug nut and washers.

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

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

(7) Remove support and lower vehicle.

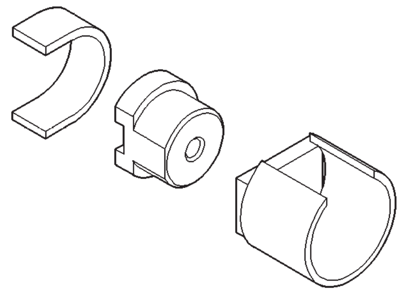
SPECIFICATIONS

TORQUE CHART

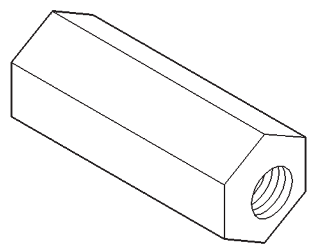
DESCRIPTION	TORQUE
Shock Absorber	
Upper Nut	11 N·m (8 ft. lbs.)
Lower Nut	23 N·m (17 ft. lbs.)
Suspension Arm Upper	
Front Nut	74 N·m (55 ft. lbs.)
Rear Nut	89 N·m (66 ft. lbs.)
Suspension Arm Lower	
Front Nut	115 N·m (85 ft. lbs.)
Rear Nut	115 N·m (85 ft. lbs.)
Stabilizer Bar	
Clamp Bolt	54 N·m (40 ft. lbs.)
Link Upper Nut	36 N·m (27 ft. lbs.)
Link Lower Nut	95 N·m (70 ft. lbs.)
Track Bar	
Ball Stud Nut	81 N·m (60 ft. lbs.)
Axle Bracket Bolt	100 N·m (74 ft. lbs.)
Track Bar Bracket	
Bolts	125 N·m (92 ft. lbs.)
Nut	100 N·m (74 ft. lbs.)
Support Bolts	42 N·m (31 ft. lbs.)
Hub/Bearing	
Bolts	102 N·m (75 ft. lbs.)
Axle Nut	237 N·m (175 ft. lbs.)

SPECIAL TOOLS

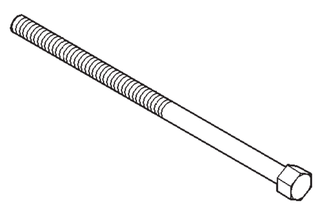
FRONT SUSPENSION



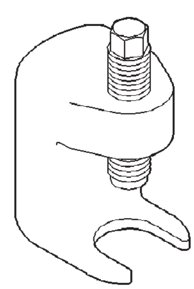
Remover/Installer Suspension Bushing 7932



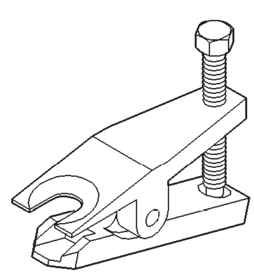
Nut, Long 7603



Bolt, Special 7604



Remover C-4150A



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Remover Tie Rod End MB-990635

REAR SUSPENSION

INDEX

DESCRIPTION AND OPERATION

SUSPENSION COMPONENT

The rear suspension is comprised of:

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

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

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

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

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

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

DIAGNOSIS AND TESTING

SPRING AND SHOCK DIAGNOSIS

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

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

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

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

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

DIAGNOSIS AND TESTING (Continued)

SPRING AND SHOCK ABSORBER DIAGNOSIS

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

REMOVAL AND INSTALLATION

SHOCK ABSORBER

REMOVAL

(1) Remove the shock absorber upper bolts from the body bracket (Fig. 1).

(2) Remove lower attaching nut and washer from the bracket stud. Remove the shock absorber.

INSTALLATION

(1) Install the shock absorber lower eye on the spring bracket stud. Install the shock absorber and upper bolts on the body bracket.

(2) Tighten the lower nut to 62 N·m (46 ft. lbs.).

(3) Tighten the upper bolts to 23 N·m (17 ft. lbs.).

STABILIZER BAR

REMOVAL

(1) Raise and support the vehicle.

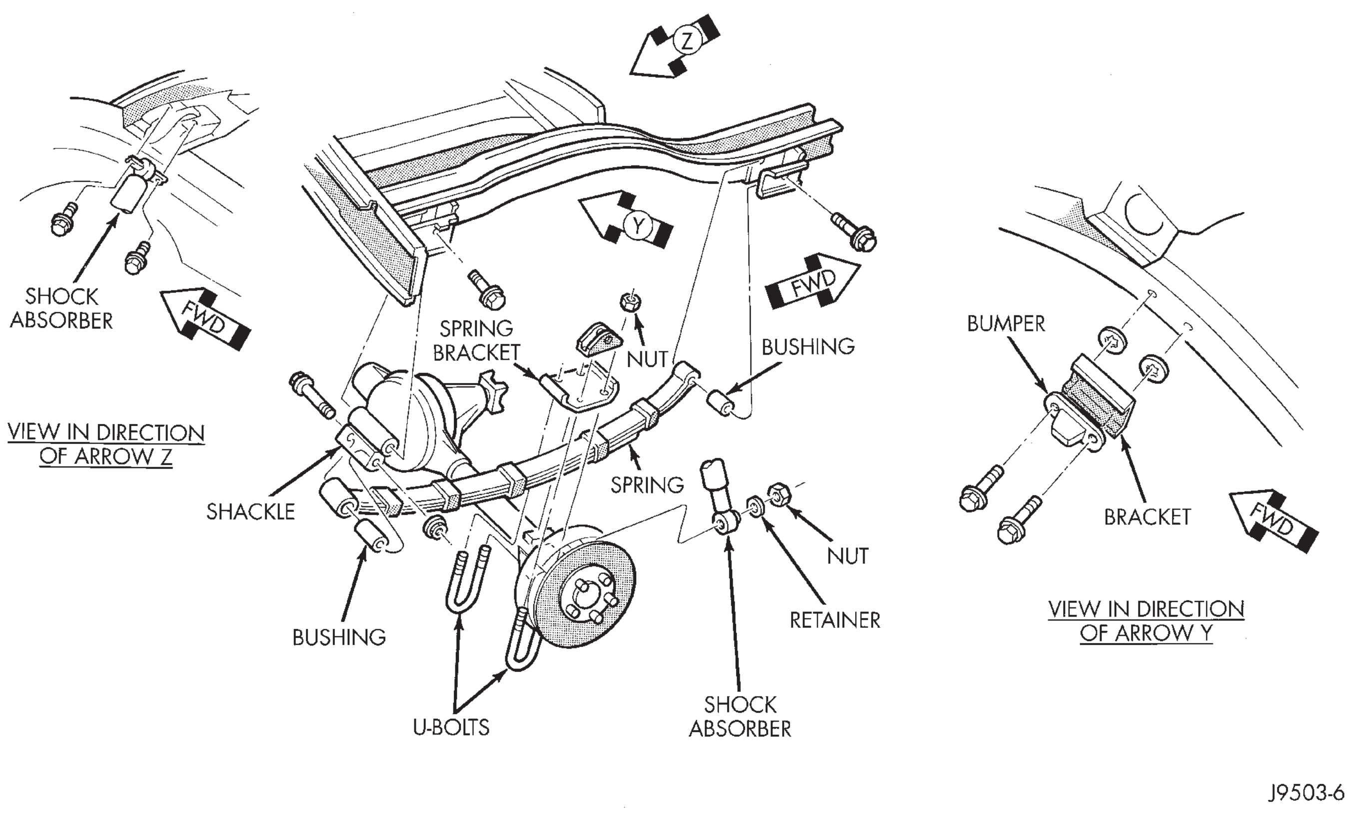

Fig. 1 Rear Suspension Components

REMOVAL AND INSTALLATION (Continued)

(2) Disconnect stabilizer bar links from spring brackets (Fig. 2).

(3) Disconnect the stabilizer bar brackets from the body rails. Remove the stabilizer bar and links.

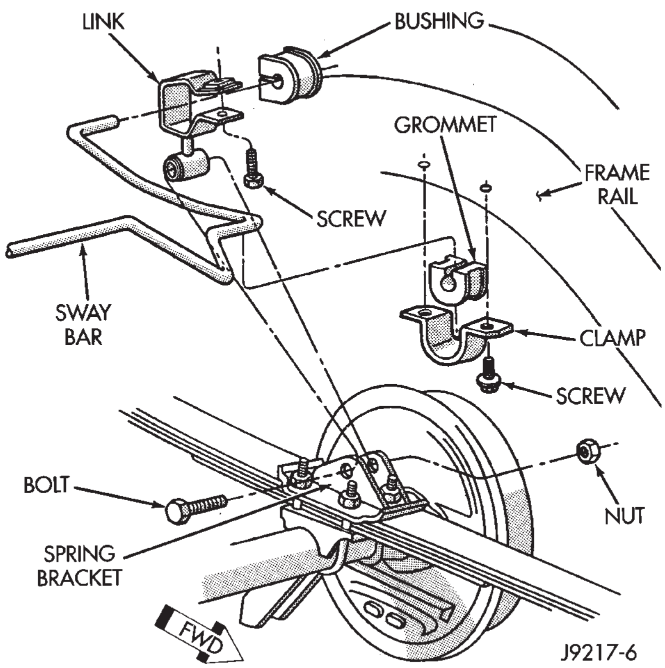

Fig. 2 Stabilizer Bar

INSTALLATION

(1) Position the stabilizer bar links at the spring brackets. Install the attaching bolts and nuts and tighten to 74 N·m (55 ft. lbs.).

(2) Attach the stabilizer bar to the body rail brackets with the bolts. Tighten to 54 N·m (40 ft. lbs.).

(3) Remove the supports and lower the vehicle.

LEAF SPRING

REMOVAL

(1) Raise vehicle at body rails.

(2) Remove the wheel and tire assemblies.

(3) Support axle with hydraulic jack to relieve axle weight.

(4) Disconnect the stabilizer bar link from the spring bracket stud.

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

(6) Remove nut and bolt attaching spring front eye to shackle.

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

(8) Remove spring from vehicle.

INSTALLATION

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

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

(3) Position the axle. Install the spring bracket, U-bolts and nuts. Tighten the nuts to 70 N·m (52 ft. lbs.).

(4) Connect the stabilizer bar link to the spring bracket.

(5) Remove the hydraulic jack.

(6) Lower the vehicle.

(7) Tighten the spring front eye attaching bolts to 156 N·m (115 ft. lbs.).

(8) Tighten the spring rear eye attaching bolts to 108 N·m (80 ft. lbs.).

(9) Tighten the stabilizer bar link to 74 N·m (55 ft. lbs.).

LEAF SPRING AND SHACKLE BUSHING

For front bushings bend tabs DOWN before removal. Use an appropriate driver tool and force the original bushing out of the spring eye.

(1) Assemble tools shown (Fig. 3). Tighten nut at the socket wrench end of the threaded rod until the bushing is forced out.

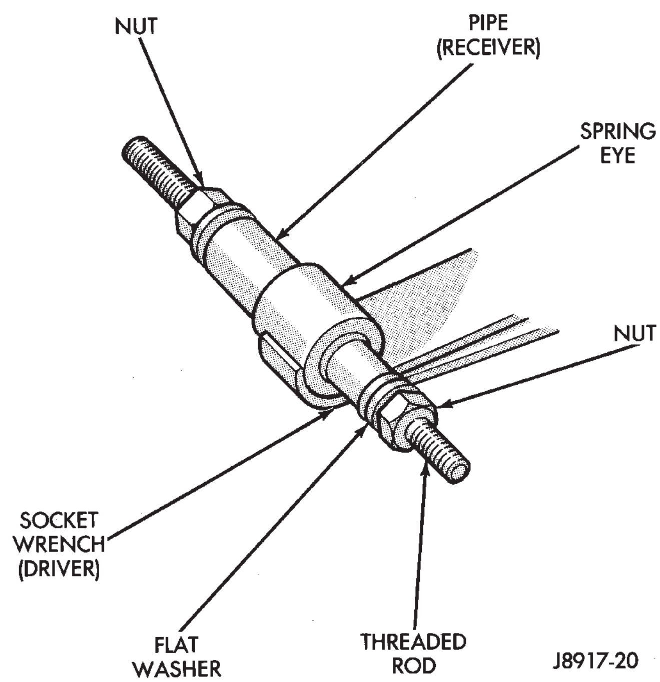

Fig. 3 Spring Eye Bushing Removal

(2) Assemble and align the bushing installation tools.

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

REMOVAL AND INSTALLATION (Continued)

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

(4) For front bushings bend tabs up after installation.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Shock Absorber	
Upper Bolt	23 N·m (17 ft. lbs.)
Lower Nut	62 N·m (46 ft. lbs.)
Stabilizer Bar	
Clamp Bolt	54 N·m (40 ft. lbs.)
Link Upper Bolt	12 N·m (9 ft. lbs.)
Link Lower Nut	74 N·m (55 ft. lbs.)
Spring	
U-Bolt Nut	70 N·m (52 ft. lbs.)
Front Pivot Bolt	156 N·m (115 ft. lbs.)
Upper Shackle Bolt	156 N·m (115 ft. lbs.)
Lower Shackle Bolt	108 N·m (80 ft. lbs.)

DIFFERENTIAL AND DRIVELINE

CONTENTS

PROPELLER SHAFTS

INDEX

GENERAL INFORMATION

PROPELLER SHAFTS

The propeller shaft (Fig. 1) transmits power from one point to another in a smooth and continuous action. The shaft is designed to send torque through an angle from the transmission (transfer case on 4WD vehicles) to the axle.

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

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

The propeller shaft is designed and built with the yoke lugs in line with each other. This is called phasing. This design produces the smoothest running condition. An out of phase shaft can cause a vibration.

Before undercoating a vehicle, the propeller shaft and the U-joints should be covered. This will prevent the undercoating from causing an unbalanced condition.

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

LUBRICATION

The slip yoke on the front propeller shaft is equipped with a lubrication fitting. Use a multi-pur-

GENERAL INFORMATION (Continued)

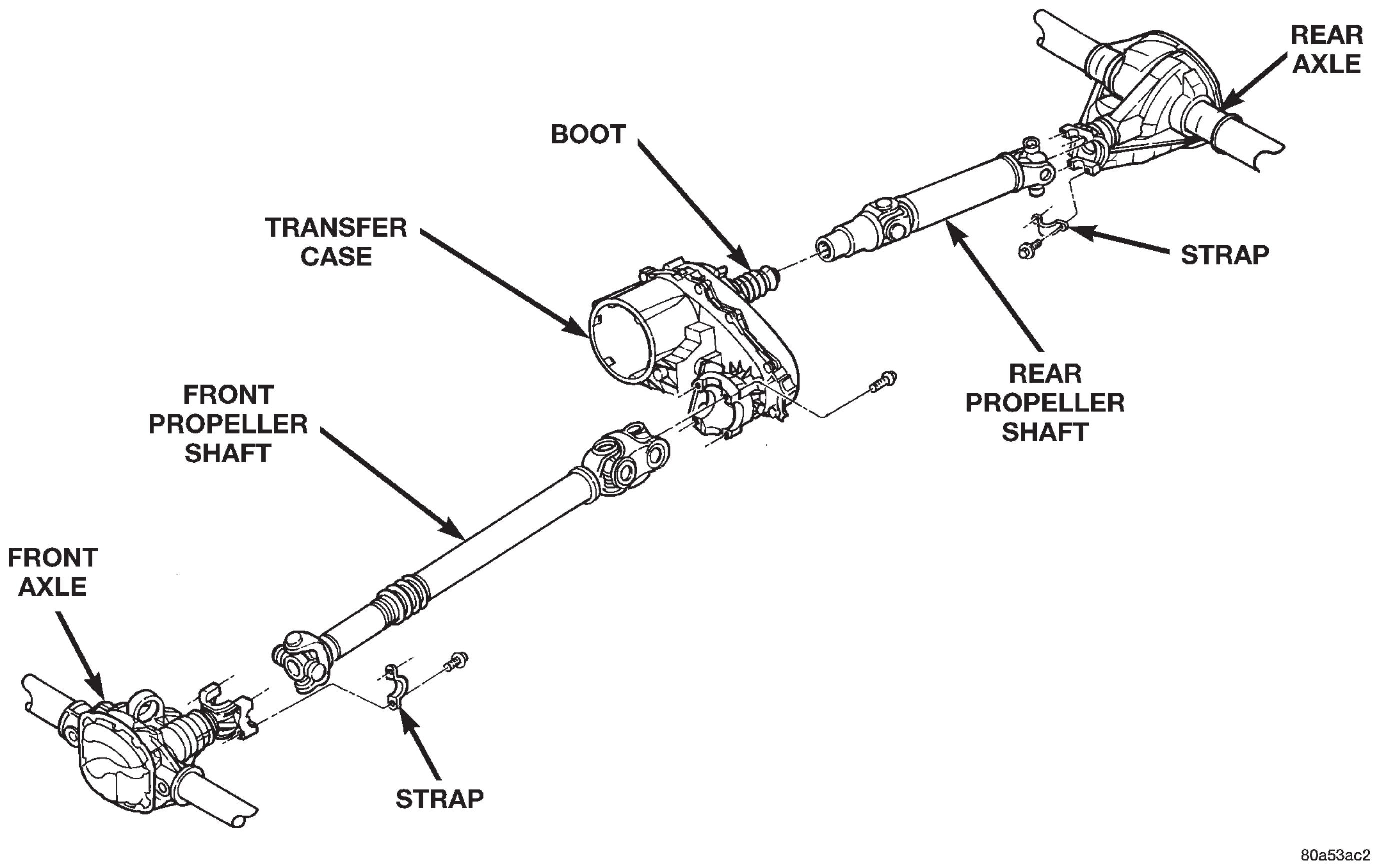

Fig. 1 Front & Rear Propeller Shafts—4WD

pose NLGI Grade 2 EP lubricant. The factory installed universal joints are lubricated for the life of the vehicle and do not need lubrication. All universal joints should be inspected for leakage and damage each time the vehicle is serviced. If seal leakage or damage exists, the universal joint should be replaced. Refer to Group 0, Lubrication and Maintenance, for additional information.

PROPELLER SHAFT JOINT ANGLE

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

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

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

Ideally the driveline system should have;

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

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

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

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Fig. 2 Maximum Angles And Engine Speed

PROPELLER SHAFT JOINTS

Two different types of propeller shaft joints are used:

- Single cardan universal joint (Fig. 3)

GENERAL INFORMATION (Continued)

• Double cardan (CV) universal joint (Fig. 4)

None of the universal joints are servicible. If one becomes worn or damaged, the complete universal joint assembly must be replaced.

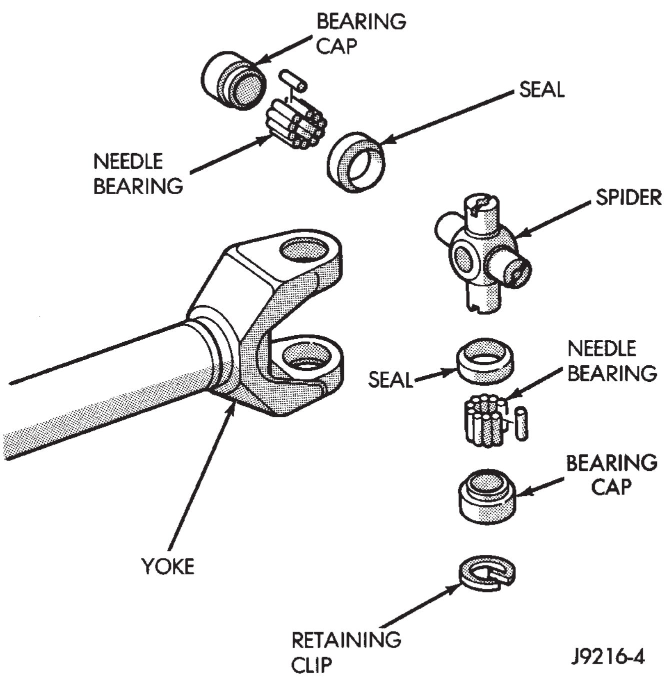

Fig. 3 Single Cardan Universal Joint

DIAGNOSIS AND TESTING

VIBRATION

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

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

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

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

UNBALANCE

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

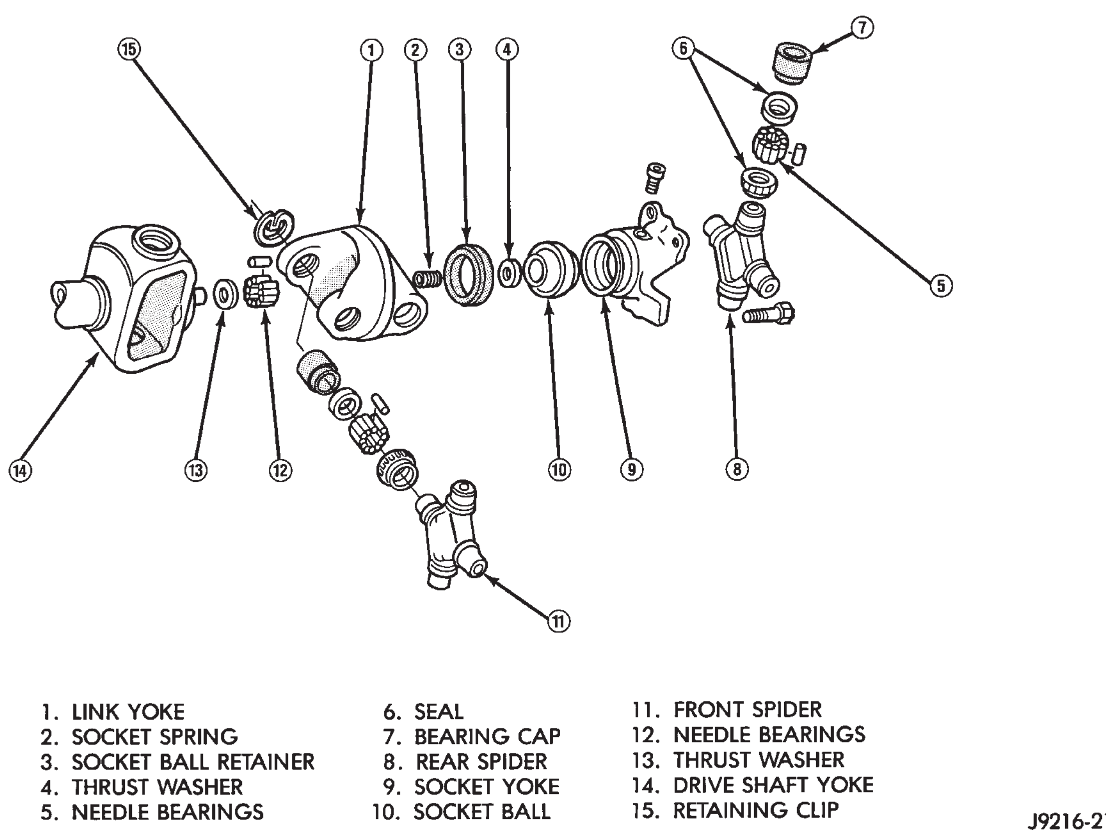

Fig. 4 Double Cardan (CV) Universal Joint

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

(1) Raise the vehicle.

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

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

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

(5) Check the universal joint clamp screws torque.

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

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

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

(9) Install a screw clamp at position 1 (Fig. 5).

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

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

(12) If the vibration decreased, install a second clamp (Fig. 6) and repeat the test.

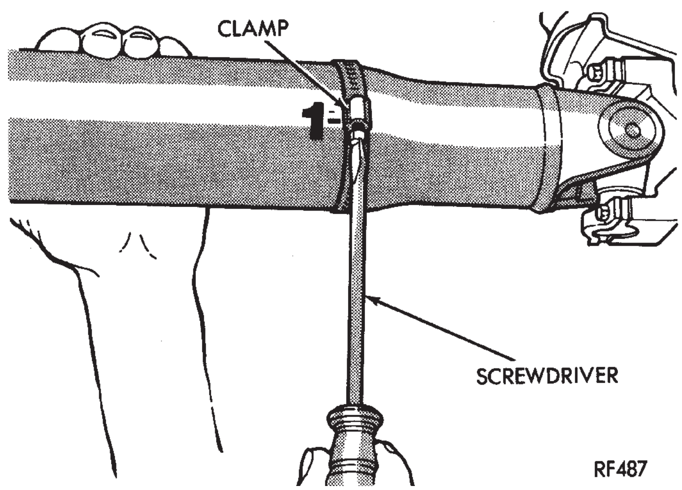


Fig. 5 Clamp Screw At Position 1

(13) If the additional clamp causes an additional vibration, separate the clamps (1/4 inch above and below the mark). Repeat the vibration test (Fig. 7).

(14) Increase distance between the clamp screws and repeat the test until the amount of vibration is at the lowest level. Bend the slack end of the clamps so the screws will not loosen.

(15) If the vibration remains unacceptable, apply the same steps to the front end of the propeller shaft.

(16) Install the wheel and tires. Lower the vehicle.

DIAGNOSIS AND TESTING (Continued)

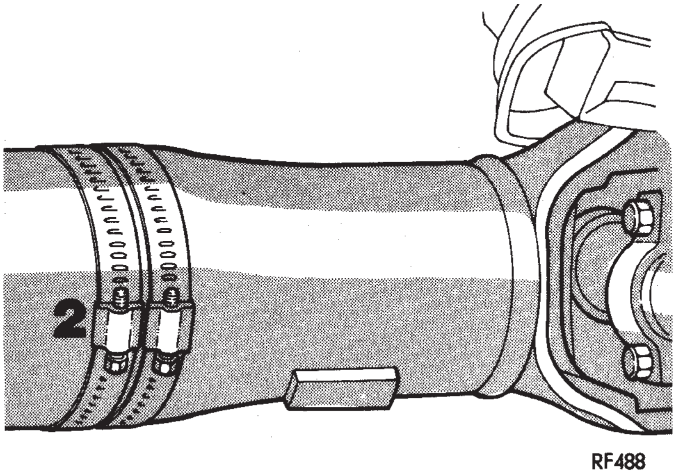


Fig. 6 Two Clamp Screws At The Same Position

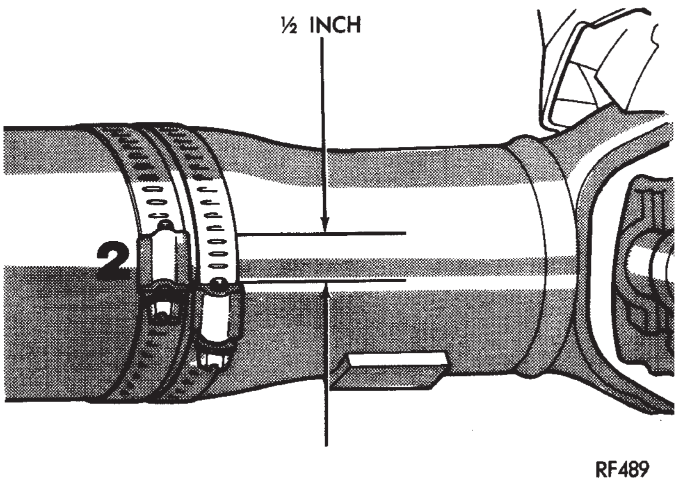


Fig. 7 Clamp Screws Separated

RUNOUT

(1) Remove dirt, rust, paint, and undercoating from the propeller shaft surface where the dial indicator will contact the shaft.

(2) The dial indicator must be installed perpendicular to the shaft surface.

(3) Measure runout at the center and ends of the shaft sufficiently far away from weld areas to ensure that the effects of the weld process will not enter into the measurements.

(4) Refer to Runout Specifications chart.

(5) If the propeller shaft runout is out of specification, remove the propeller shaft, index the shaft 180°, and re-install the propeller shaft. Measure shaft runout again.

(6) If the propeller shaft runout is now within specifications, mark the shaft and yokes for proper orientation.

(7) If the propeller shaft runout is not within specifications, verify that the runout of the transmission/transfer case and axle are within specifications. Correct as necessary and re-measure propeller shaft runout.

(8) Replace the propeller shaft if the runout still exceeds the limits.

RUNOUT SPECIFICATIONS

Front of Shaft	0.020 in. (0.50 mm)
Center of Shaft	0.025 in. (0.63 mm)
Rear of Shaft	0.020 in. (0.50 mm)
Measure front/rear runout approximately 3 inches (76 mm) from the weld seam at each end of the shaft tube for tube lengths over 30 inches. For tube lengths under 30 inches, the maximum allowed runout is 0.020 in. (0.50 mm) for the full length of the tube.	

SERVICE PROCEDURES

DRIVELINE ANGLE MEASUREMENT PREPARATION

Before measuring universal joint angles, the following must be done;

- Inflate all tires to correct pressure.
- Check the angles in the same loaded or unloaded condition as when the vibration occurred. Propeller shaft angles change according to the amount of load in the vehicle.
- Check the condition of all suspension components and verify all fasteners are torqued to specifications.
- Check the condition of the engine and transmission mounts and verify all fasteners are torqued to specifications.

PROPELLER SHAFT ANGLE MEASUREMENT

To accurately check driveline alignment, raise and support the vehicle at the axles as level as possible. Allow the wheels and propeller shaft to turn. Remove any external bearing snap rings (if equipped) from universal joint so that the inclinometer base sits flat.

(1) Rotate the shaft until transmission/transfer case output yoke bearing cap is facing downward.

Always make measurements from front to rear.

(2) Place Inclinometer on yoke bearing cap (A) parallel to the shaft (Fig. 8). Center bubble in sight glass and record measurement.

SERVICE PROCEDURES (Continued)

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

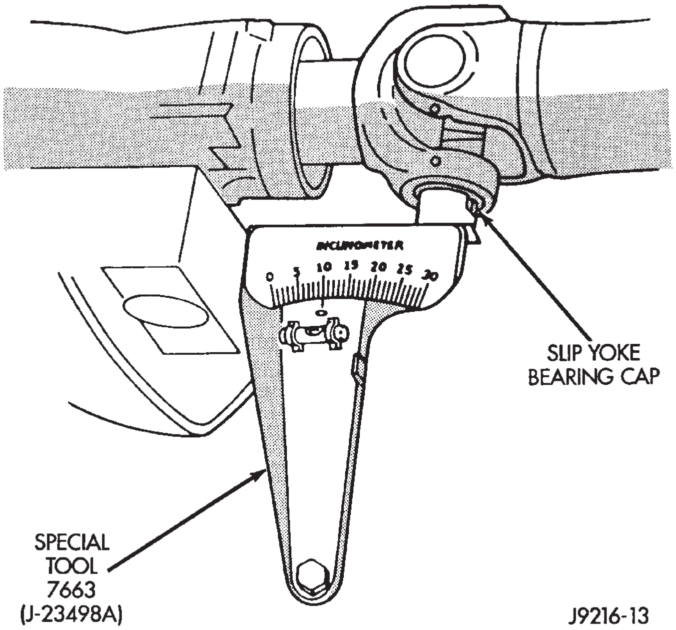


Fig. 8 Front (Output) Angle Measurement (A)

(3) Rotate propeller shaft 90 degrees and place Inclinometer on yoke bearing cap parallel to the shaft (Fig. 9). Center bubble in sight glass and record measurement. This measurement can also be taken at the rear end of the shaft.

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

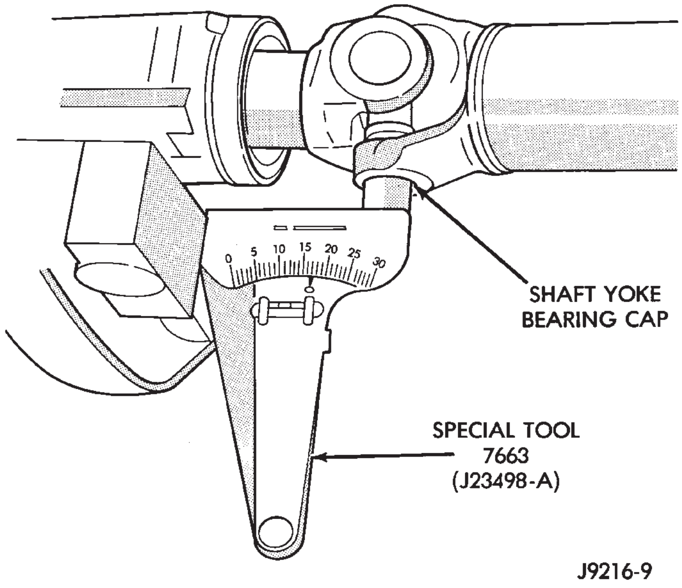


Fig. 9 Propeller Shaft Angle Measurement (C)

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

(5) Rotate propeller shaft 90 degrees and place Inclinometer on pinion yoke bearing cap parallel to the shaft (Fig. 10). Center bubble in sight glass and record measurement.

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

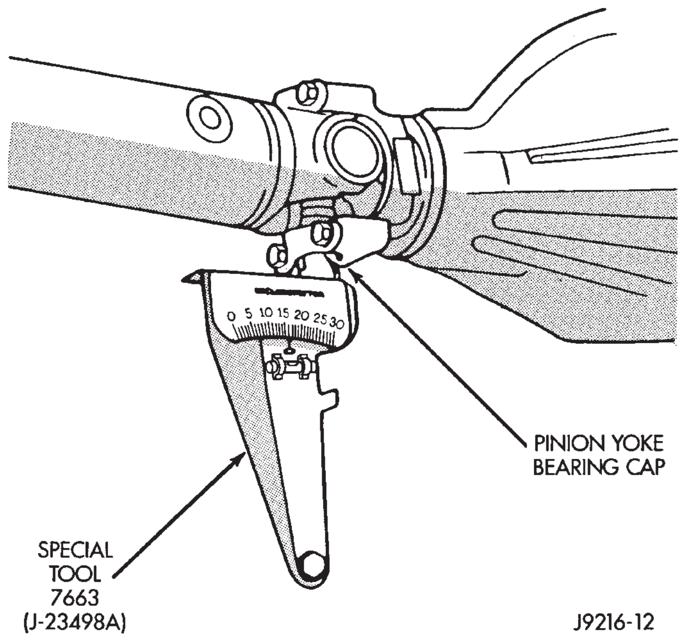


Fig. 10 Rear (Input) Angle Measurement (B)

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

Refer to rules given below and the example in for additional information.

- Good cancellation of U–joint operating angles (within 1°).
- Operating angles less than 3°.
- At least 1/2 of one degree continuous operating (propeller shaft) angle.

SERVICE PROCEDURES (Continued)

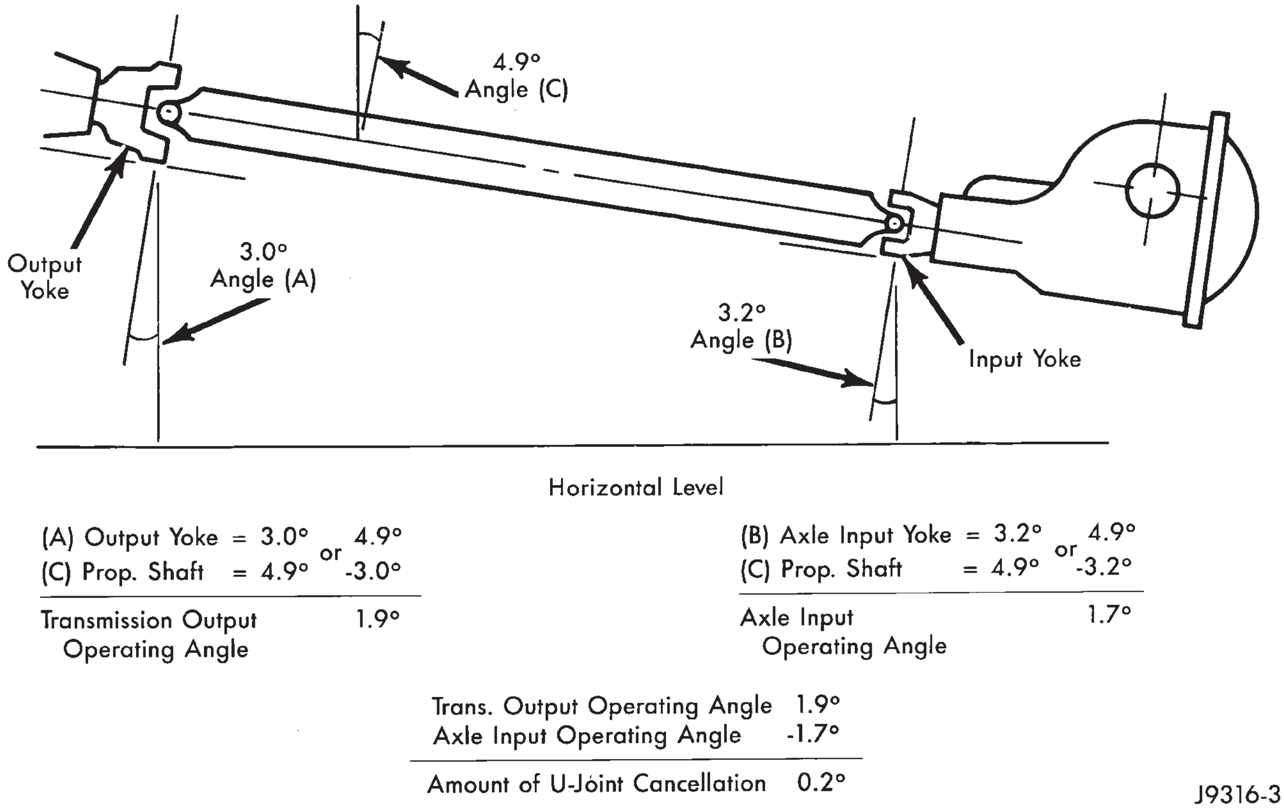


Fig. 11 Universal Joint Angle Example

REMOVAL AND INSTALLATION

FRONT PROPELLER SHAFT

REMOVAL

(1) Hoist and support vehicle on safety stands.

(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. 12).

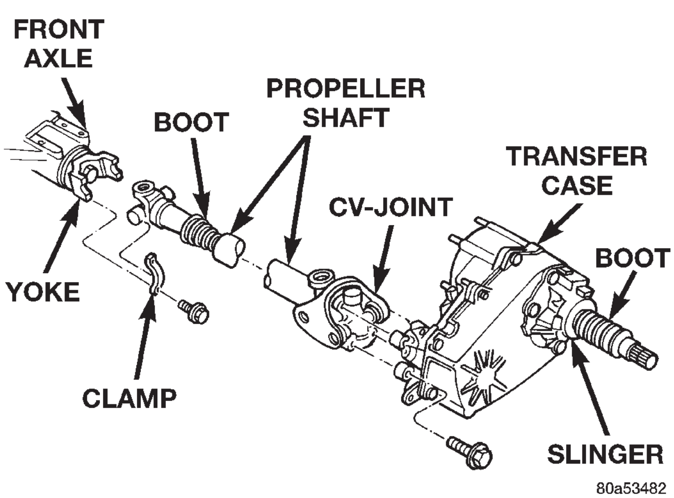


Fig. 12 Front Propeller Shaft

(3) Remove the universal 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. 13). Install the propeller shaft.

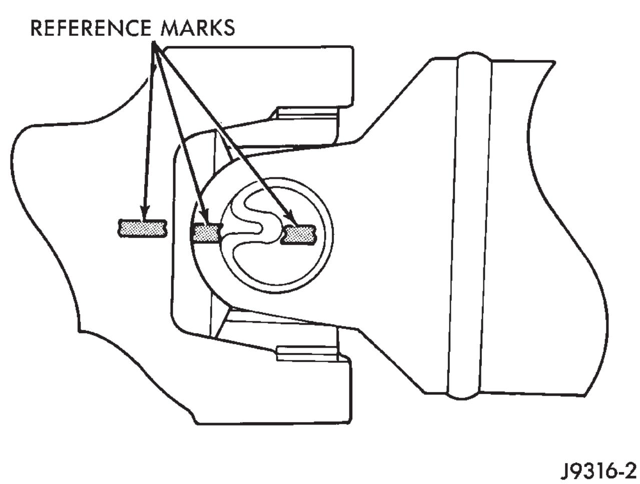


Fig. 13 Reference Marks on Yokes

REMOVAL AND INSTALLATION (Continued)

Replacement universal joint straps and bolts must be installed.

(2) Tighten the universal 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.

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 universal joint strap bolts at the pinion shaft yoke.

(5) Pry open clamp holding the dust boot to propeller shaft yoke (Fig. 14).

(6) Slide the slip yoke off of the transmission/transfer case output shaft and remove the propeller shaft (Fig. 15).

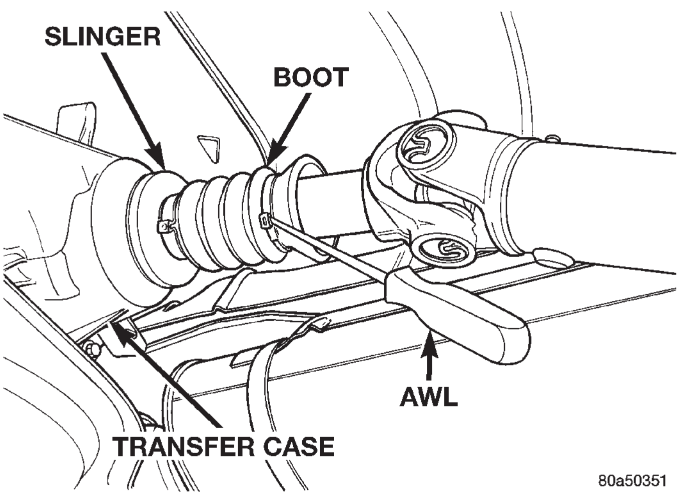


Fig. 14 Dust Boot Clamp

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. 15).

Replacement universal joint straps and bolts must be installed.

(2) Tighten the universal 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. 16).

(4) Lower the vehicle.

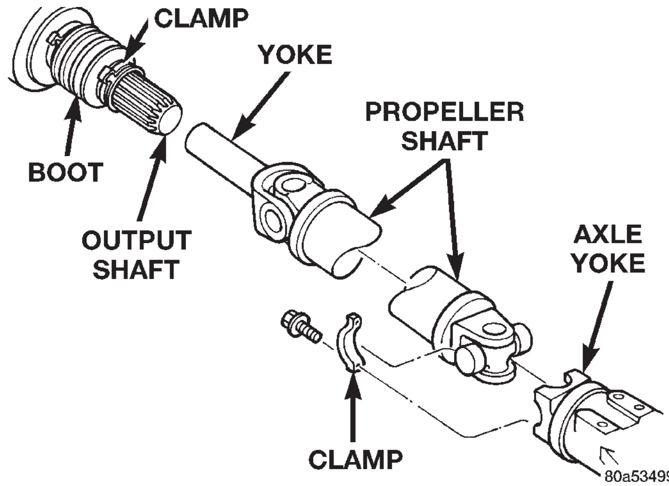


Fig. 15 Rear Propeller Shaft

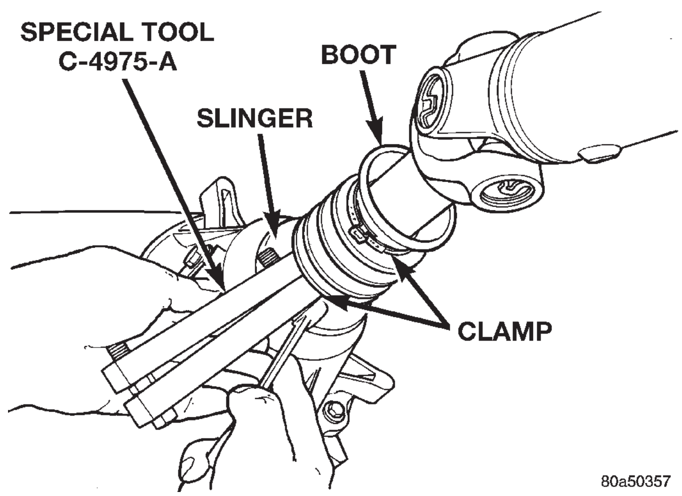


Fig. 16 Crimping Dust Boot Clamp—Typical

DISASSEMBLY AND ASSEMBLY

SINGLE CARDAN UNIVERSAL JOINT

DISASSEMBLY

Individual components of cardan universal joints are not serviceable. If worn or leaking, they must be replaced as an assembly.

(1) Remove the propeller shaft.

(2) Using a soft drift, tap the outside of the bearing cap assembly to loosen snap ring.

(3) Remove snap rings from both sides of yoke (Fig. 17).

(4) Set the yoke in an arbor press or vise with a socket whose inside diameter is large enough to receive the bearing cap positioned beneath the yoke.

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

DISASSEMBLY AND ASSEMBLY (Continued)

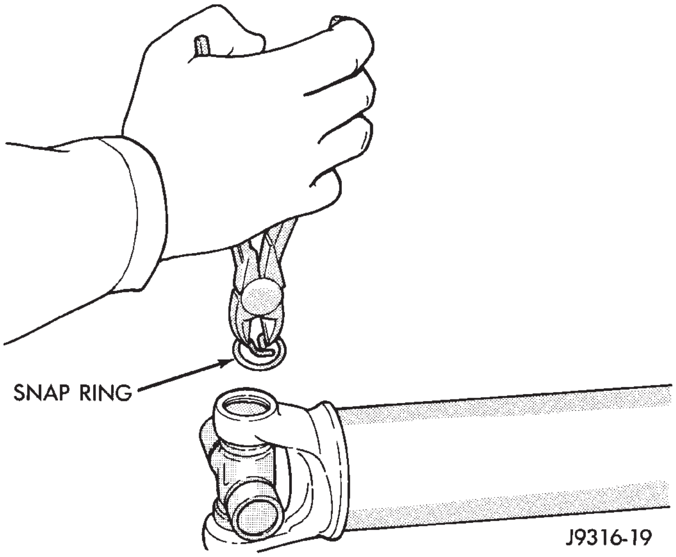


Fig. 17 Remove Snap Ring

(6) Place a socket with an outside diameter smaller than the upper bearing cap on the upper bearing cap and press the cap through the yoke to release the lower bearing cap (Fig. 18).

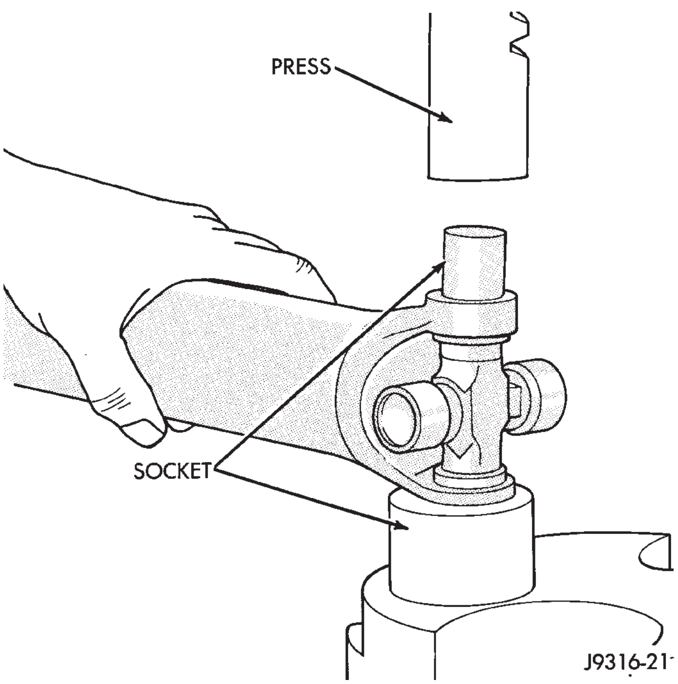


Fig. 18 Press Out Bearing

(7) If the bearing cap will not pull out of the yoke by hand after pressing, tap the yoke ear near the bearing cap to dislodge the cap.

(8) To remove the opposite bearing cap, turn the yoke over and straighten the cross in the open hole. Then, carefully press the end of the cross until the remaining bearing cap can be removed (Fig. 19).

CAUTION: If the cross or bearing cap are not straight during installation, the bearing cap will score the walls of the yoke bore and damage can occur.

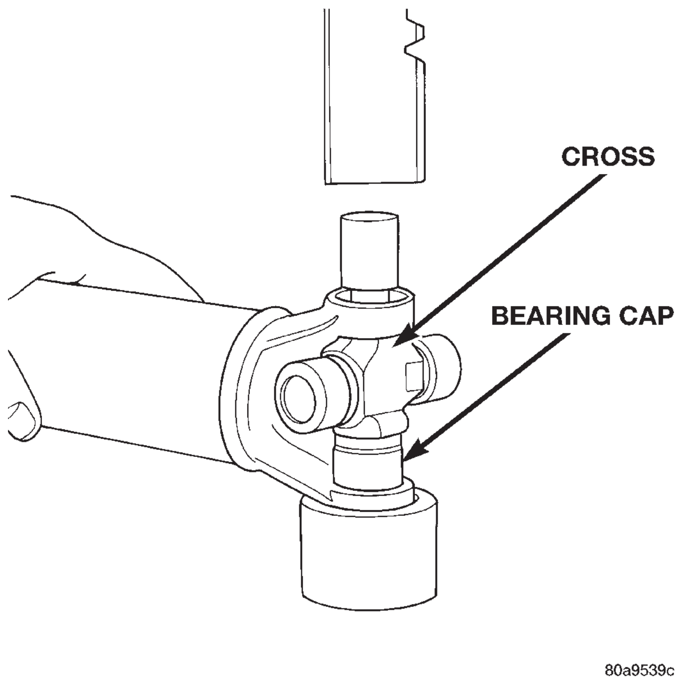


Fig. 19 Press Out Remaining Bearing

ASSEMBLY

(1) Apply extreme pressure (EP) N.L.G.I. Grade 1 or 2 grease to inside of yoke bores to aid in installation.

(2) Position the cross in the yoke with its lube fitting, if equipped, pointing up (Fig. 20).

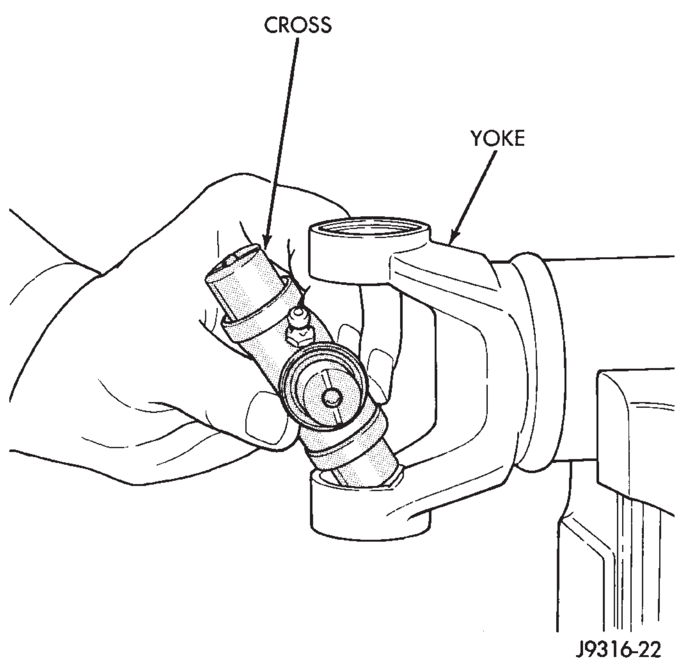


Fig. 20 Install Cross In Yoke

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Place a bearing cap over the trunnion and align the cap with the yoke bore (Fig. 21). Keep the needle bearings upright in the bearing assembly. A needle bearing lying at the bottom of the cap will prevent proper assembly.

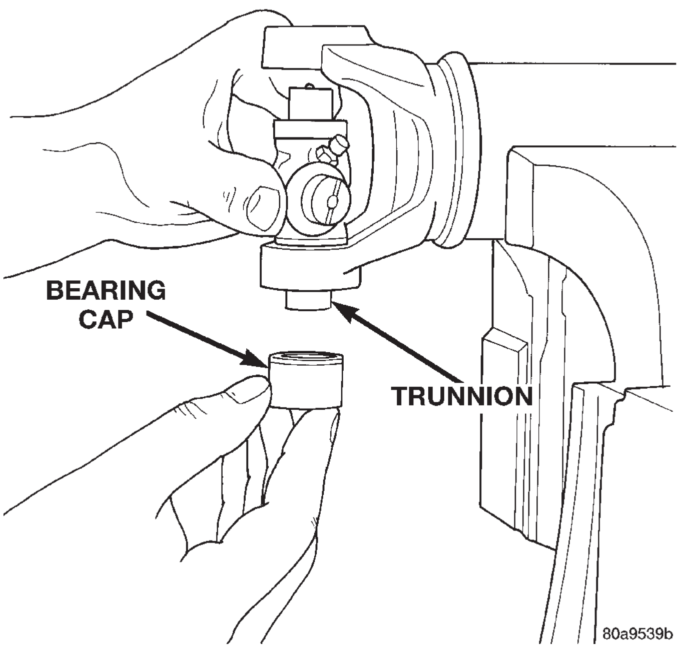


Fig. 21 Install Bearing On Trunnion

(4) Press the bearing cap into the yoke bore enough to install a snap ring.
(5) Install a snap ring.
(6) Repeat Step 3 and Step 4 to install the opposite bearing cap. If the joint is stiff or binding, strike the yoke with a soft hammer to seat the needle bearings.
(7) Add grease to lube fitting, if equipped.
(8) Install the propeller shaft.

DOUBLE CARDAN JOINT

DISASSEMBLY

Individual components of cardan universal joints are not serviceable. If worn or leaking, they must be replaced as an assembly.
(1) Remove the propeller shaft.
(2) Using a soft drift, tap the outside of the bearing cap assembly to loosen snap ring.
(3) Remove all the bearing cap snap rings (Fig. 22).
(4) Set the joint in an arbor press or vise with a socket whose inside diameter is large enough to receive the bearing cap positioned beneath the link yoke.
(5) Place a socket with an outside diameter smaller than the upper bearing cap on the upper bearing cap and partially press one bearing cap from

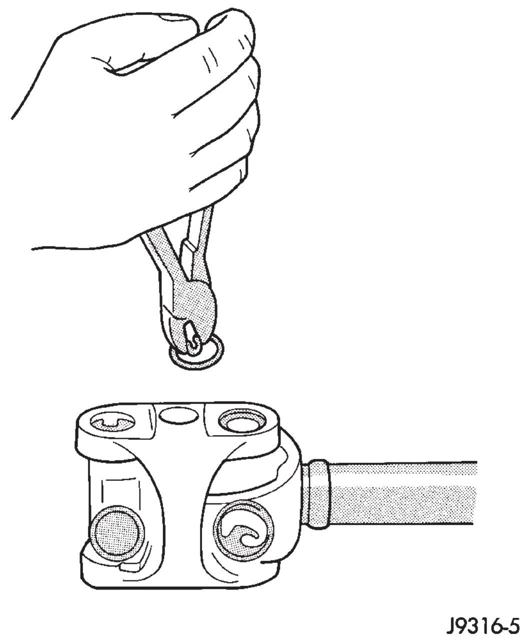


Fig. 22 Remove Snap Rings

the outboard side of the link yoke enough to grasp the bearing cap with vise jaws (Fig. 23). Be sure to remove grease fittings that interfere with removal.

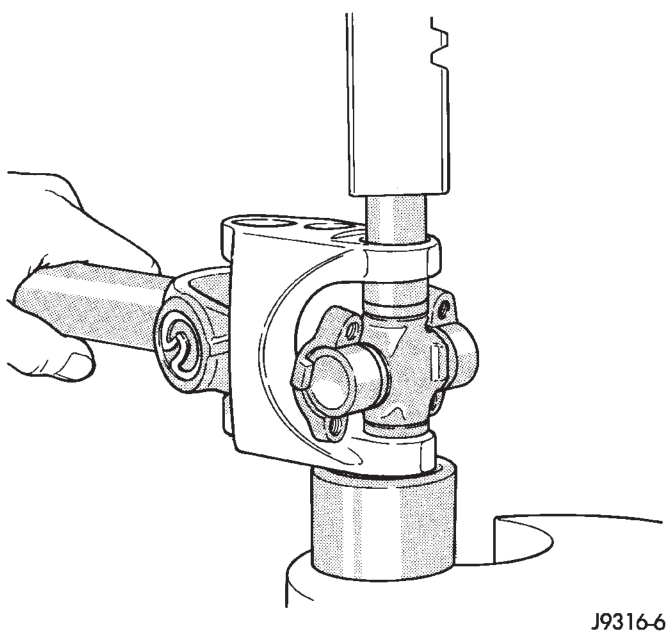


Fig. 23 Press Out Bearing

(6) Grasp the protruding bearing by vise jaws. Tap the link yoke with a mallet and drift to dislodge the bearing cap from the yoke (Fig. 24).
(7) Flip assembly and repeat Step 4, Step 5, and Step 6 to remove the opposite bearing cap. This will then allow removal of the cross centering kit assembly and spring (Fig. 25).

DISASSEMBLY AND ASSEMBLY (Continued)

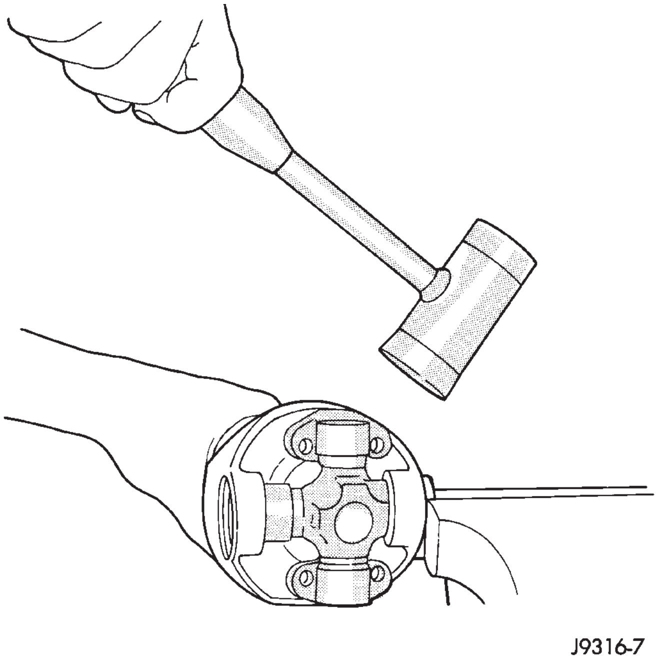


Fig. 24 Remove Bearing From Yoke

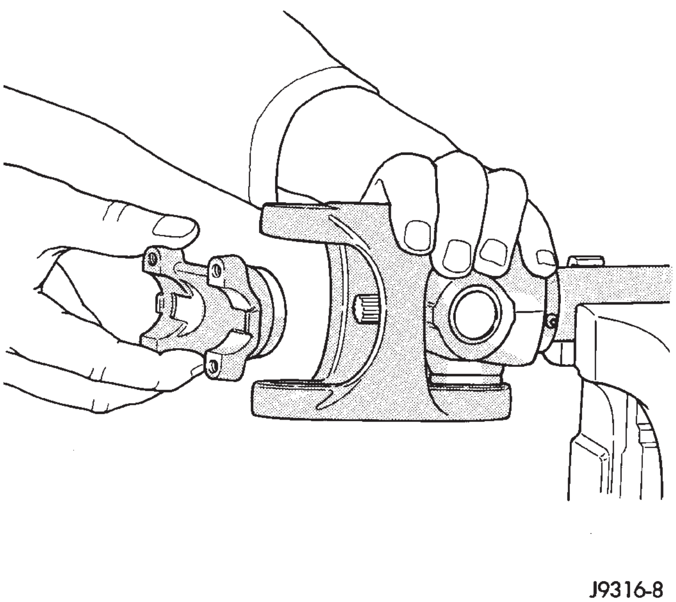


Fig. 25 Remove Centering Kit

(8) Press the remaining bearing caps out the other end of the link yoke as described above to complete the disassembly.

ASSEMBLY

During assembly, ensure that the alignment marks on the link yoke and propeller shaft yoke are aligned.

(1) Apply extreme pressure (EP) N.L.G.I. Grade 1 or 2 grease to inside of yoke bores to aid in installation.

(2) Fit a cross into the propeller shaft yoke (Fig. 26).

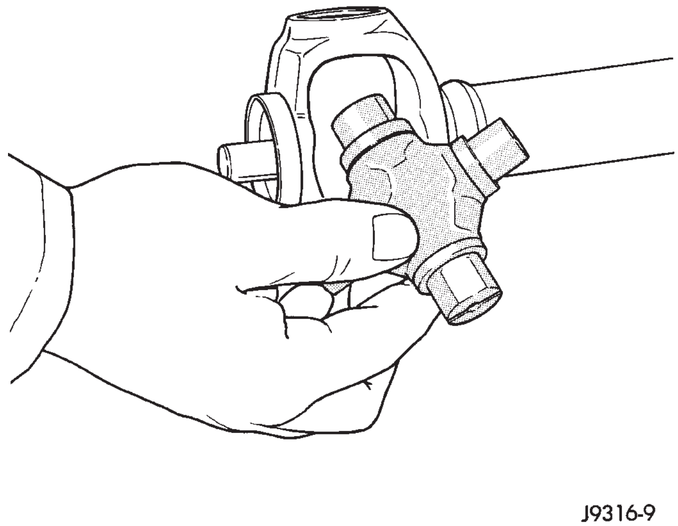


Fig. 26 Install Cross In Yoke

(3) Place a bearing cap over the trunnion and align the cap with the yoke bore (Fig. 27). Keep the needle bearings upright in the bearing assembly. A needle bearing lying at the bottom of the cap will prevent proper assembly.

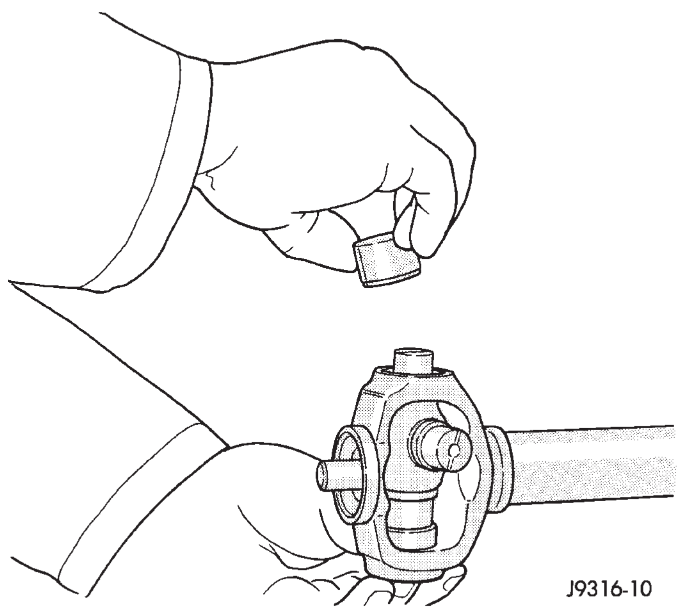


Fig. 27 Install Bearing Cap

(4) Press the bearing cap into the yoke bore enough to install a snap ring (Fig. 28).

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Install a snap ring.

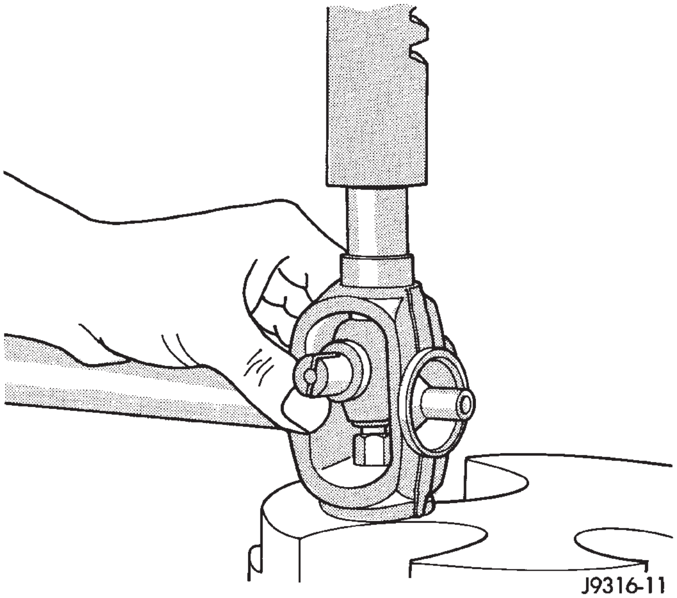


Fig. 28 Press In Bearing Cap

(6) Flip the propeller shaft yoke and install the bearing cap onto the opposite trunnion. Install a snap ring (Fig. 29).

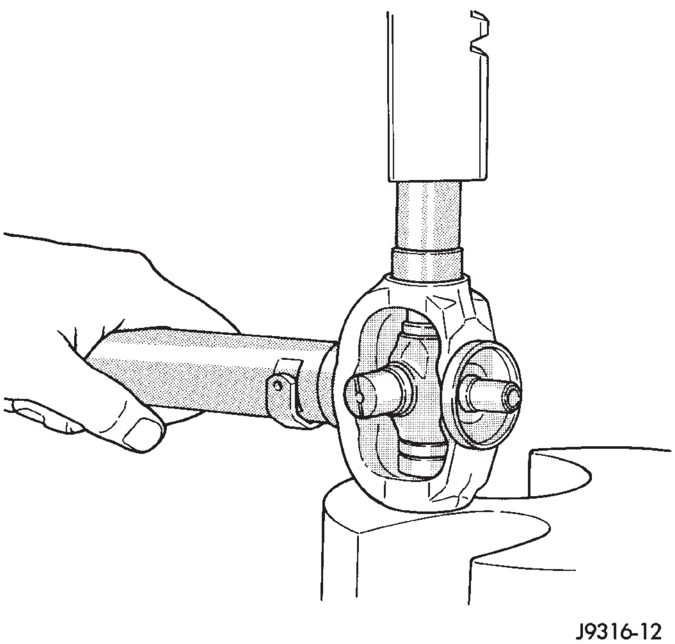


Fig. 29 Press In Bearing Cap

(7) Fit the link yoke on the remaining two trunnions and press both bearing caps into place (Fig. 30).

(8) Install snap rings.

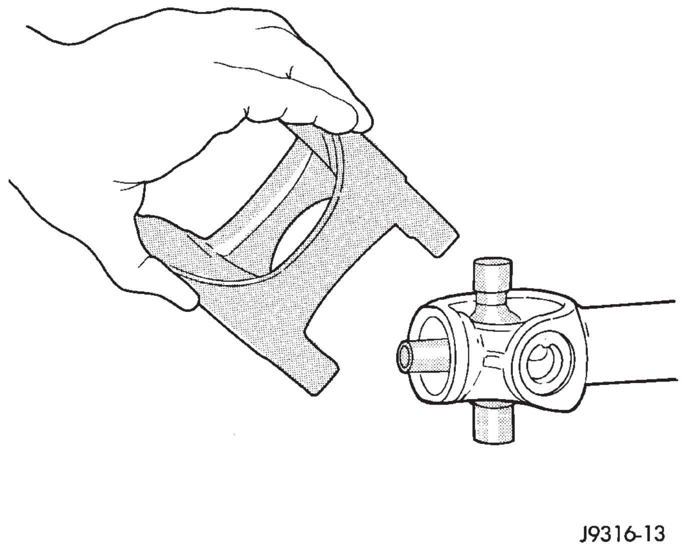


Fig. 30 Install Link Yoke

(9) Install the centering kit assembly inside the link yoke making sure the spring is properly positioned (Fig. 31).

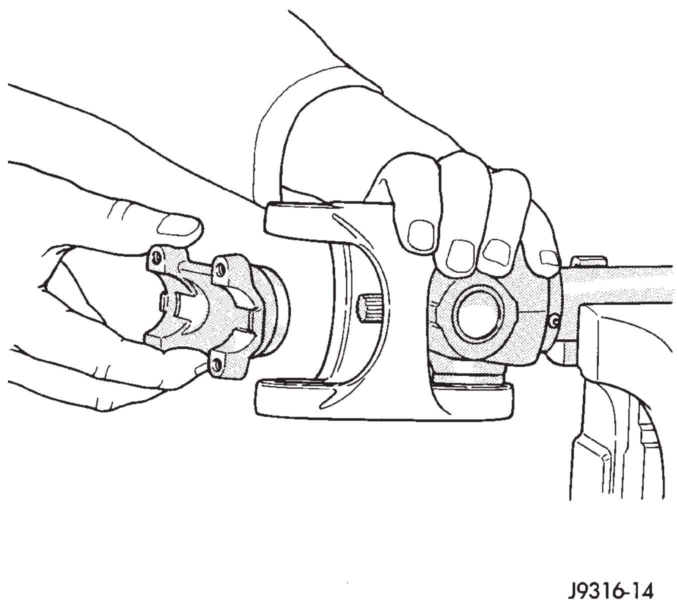


Fig. 31 Install Centering Kit

DISASSEMBLY AND ASSEMBLY (Continued)

(10) Place two bearing caps on opposite trunnions of the remaining cross. Fit the open trunnions into the link yoke bores and the bearing caps into the centering kit (Fig. 32).

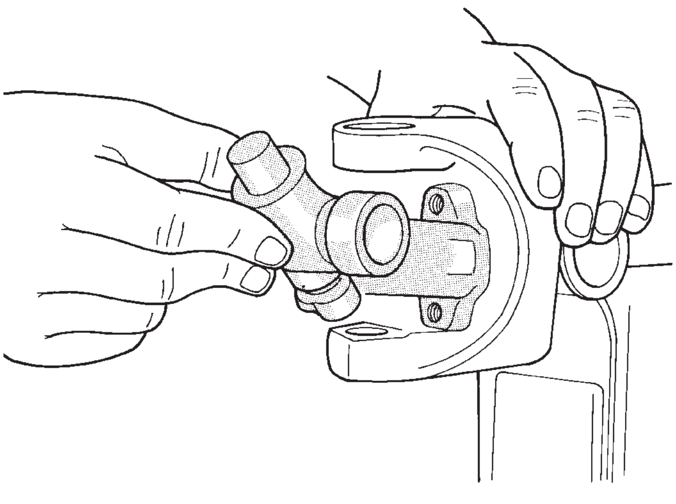


Fig. 32 Install Remaining Cross

(11) Press the remaining two bearing caps into place and install snap rings (Fig. 33).

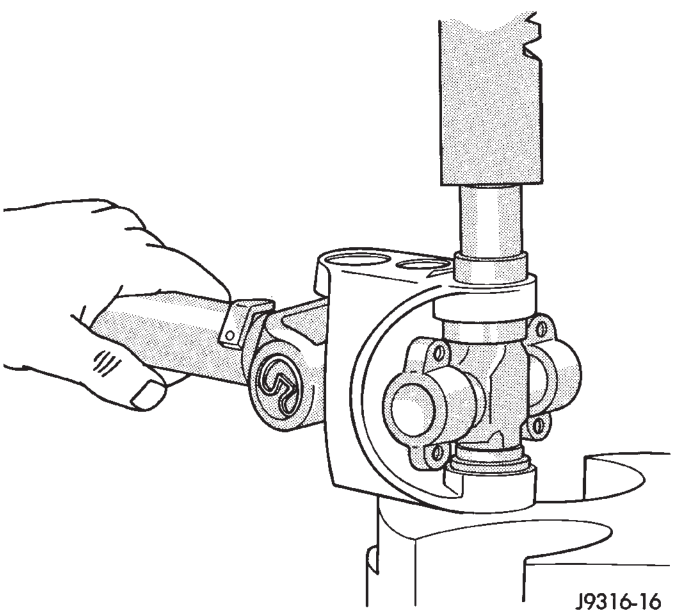


Fig. 33 Press In Bearing Cap

(12) Tap the snap rings to allow them to seat into the grooves (Fig. 34).

(13) Check for proper assembly. Flex the joint beyond center, it should snap over-center in both directions when correctly assembled (Fig. 35).

(14) Install the propeller shaft.

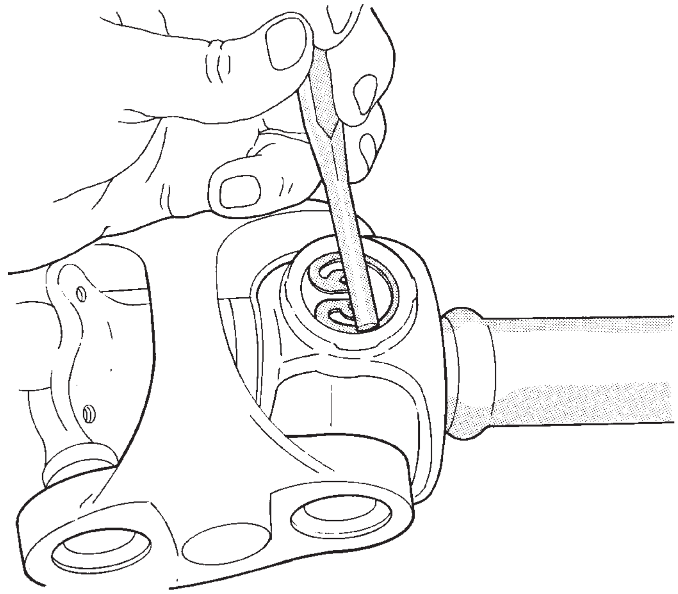


Fig. 34 Seat Snap Rings In Groove

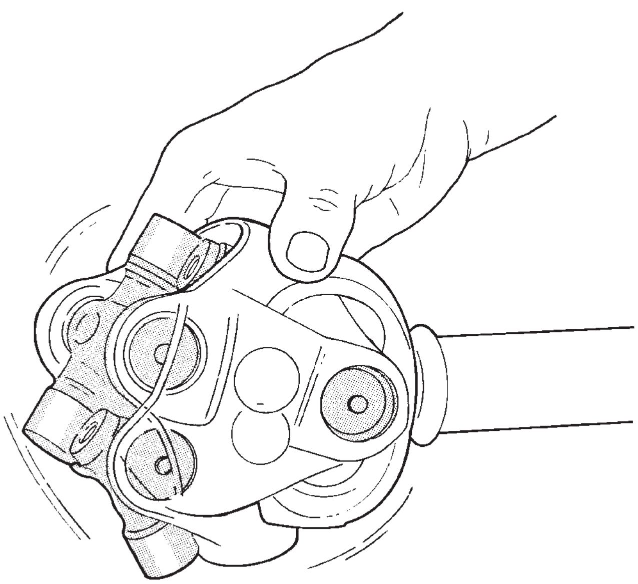


Fig. 35 Check Assembly

CLEANING AND INSPECTION

PROPELLER SHAFT

(1) Clean all universal joint bores with cleaning solvent and a wire brush.

(2) Inspect the yokes for distortion, cracks, and worn bearing cap bores.

ADJUSTMENTS

ADJUSTMENT AT AXLE WITH LEAF SPRINGS

Adjust the pinion shaft angle at the springs with tapered shims (Fig. 36). Install tapered shims between the springs and axle pad to correct the angle. Refer to Group 2, Suspension, for additional information.

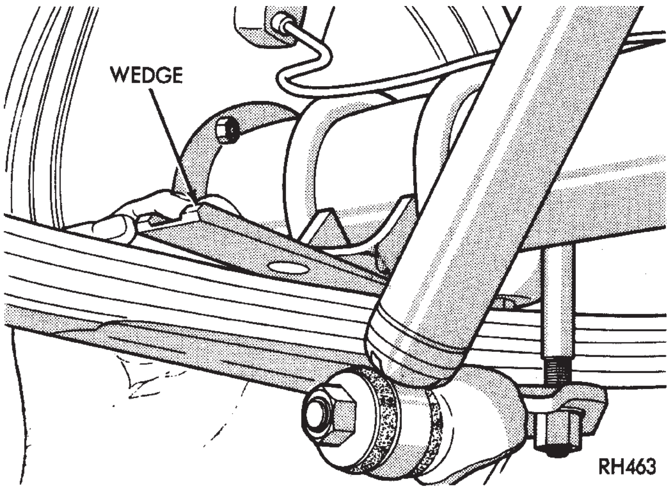


Fig. 36 Angle Adjustment at Leaf Springs

FRONT AXLE ANGLE ADJUSTMENT

Adjust the pinion gear angle at the lower suspension arms with shims (Fig. 37). Adding shims will decrease the pinion gear shaft angle but will increase the caster angle. The pinion gear shaft angle has priority over the caster angle. Refer to Group 2, Suspension, for additional information.

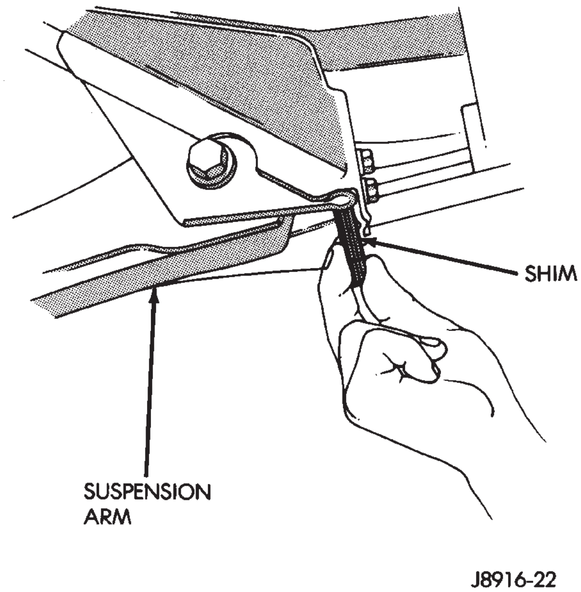


Fig. 37 Front Axle Angle Adjustment

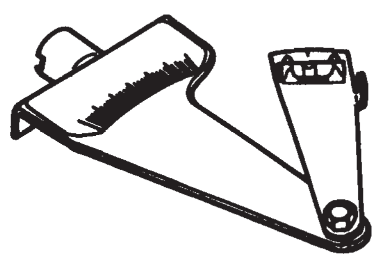
SPECIFICATIONS

PROPELLER SHAFTS AND U–JOINTS

DESCRIPTION	TORQUE
Bolts, Transfer Case Yoke	27 N·m (20 ft. lbs.)
Bolts, Axle Yoke	19 N·m (14 ft. lbs.)
Bolts, Axle Yoke	19 N·m (14 ft. lbs.)

SPECIAL TOOLS

PROPELLER SHAFT



Inclinometer—7663

TUBE AND 181 FBI AXLE

INDEX

GENERAL INFORMATION

181 FBI AXLE

The 181 Front Beam-design Iron (FBI) 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.

For vehicles with ABS brakes, the ABS wheel speed sensors are attached to the knuckle assemblies. The tone rings for the ABS system are pressed onto 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 by a cover bolt. Build date identification codes are stamped on the cover side of the axle shaft tube.

The differential case is a one–piece design. The differential pinion mate shaft is retained with a roll pin. Differential bearing preload and ring gear backlash is adjusted by the use of shims (select thickness). The shims are located between the differential bearing cones and case. Pinion bearing preload is set and maintained by the use of shims (select thickness).

LUBRICANT SPECIFICATIONS

A multi–purpose, hypoid gear lubricant which conforms to the following specifications should be used. Mopar® Hypoid Gear Lubricant conforms to all of these specifications.

- The lubricant should have MIL–L–2105C and API GL 5 quality specifications.
- Lubricant is a thermally stable SAE 80W–90 gear lubricant.

GENERAL INFORMATION (Continued)

• Lubricant for axles intended for heavy-duty or trailer tow use is SAE 75W–140 SYNTHETIC gear lubricant.

The 181 FBI axle lubricant capacity is 1.48 L (3.13 pts.).

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

DESCRIPTION AND OPERATION

STANDARD DIFFERENTIAL

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

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

In operation, power flow occurs as follows:

• The pinion gear rotates the ring gear

• The ring gear (bolted to the differential case) rotates the case

• The differential pinion gears (mounted on the pinion mate shaft in the case) rotate the side gears

• The side gears (splined to the axle shafts) rotate the shafts

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 1).

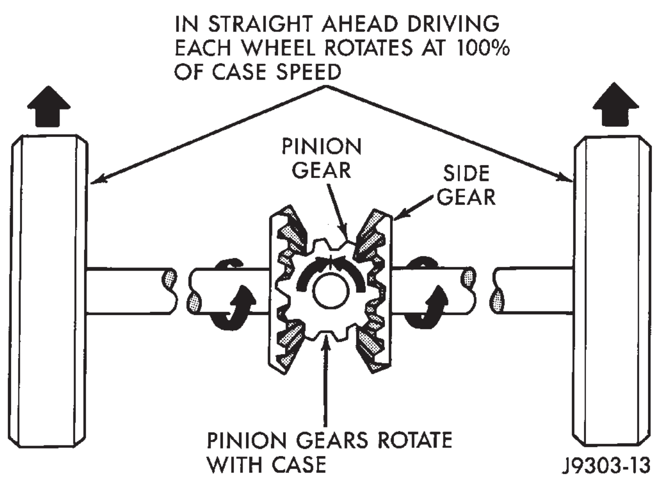


Fig. 1 Differential Operation—Straight Ahead Driving

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. The difference must be compensated for to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 2). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

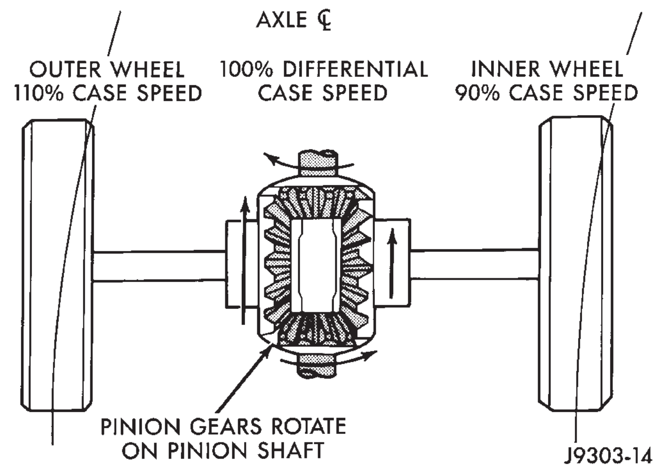


Fig. 2 Differential Operation—On Turns

DIAGNOSIS AND TESTING

GENERAL INFORMATION

Axle bearing problem conditions are usually caused by:

• Insufficient or incorrect lubricant.
• Foreign matter/water contamination.
• Incorrect bearing preload torque adjustment.
• Incorrect backlash.

Axle gear problem conditions are usually the result of:

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

Axle component breakage is most often the result of:

• Severe overloading.
• Insufficient lubricant.
• Incorrect lubricant.
• Improperly tightened components.

GEAR NOISE

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

Gear noise usually happens at a specific speed range. The range is 30 to 40 mph, or above 50 mph.

DIAGNOSIS AND TESTING (Continued)

The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak–noise range. If the noise stops or changes greatly:

- Check for insufficient lubricant.
- Incorrect ring gear backlash.
- Gear damage.

Differential side and pinion gears can be checked by turning the vehicle. They usually do not cause noise during straight–ahead driving when the gears are unloaded. The side gears are loaded during vehicle turns. A worn pinion gear mate shaft can also cause a snapping or a knocking noise.

BEARING NOISE

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

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

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

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

LOW SPEED KNOCK

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

VIBRATION

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

- Damaged drive shaft.
- Missing drive shaft balance weight(s).
- Worn or out–of–balance wheels.
- Loose wheel lug nuts.
- Worn U–joint(s).
- Loose/broken springs.
- Damaged axle shaft bearing(s).
- Loose pinion gear nut.
- Excessive pinion yoke run out.
- Bent axle shaft(s).

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

All driveline components should be examined before starting any repair.

Refer to Group 22, Wheels and Tires, for additional vibration information.

DRIVELINE SNAP

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

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

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

DIAGNOSIS AND TESTING (Continued)

FRONT AXLES

DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
WHEEL NOISE	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	1. Misaligned axle shaft tube. 2. Bent or sprung axle shaft. 3. End play in drive pinion bearings. 4. Excessive gear backlash between ring gear and pinion gear. 5. Improper adjustment of drive pinion gear shaft bearings. 6. Loose drive pinion gearshaft yoke nut. 7. Improper wheel bearing adjustment. 8. Scuffed gear tooth contact surfaces.	1. Inspect axle shaft tube alignment. Correct as necessary. 2. Replace bent or sprung axle shaft. 3. Refer to Drive Pinion Bearing Pre-Load Adjustment. 4. Check adjustment of ring gear backlash and pinion gear. Correct as necessary. 5. Adjust drive pinion shaft bearings. 6. Tighten drive pinion gearshaft yoke nut with specified torque. 7. Readjust as necessary. 8. If necessary, replace scuffed gears.
AXLE SHAFT BROKE	1. Misaligned axle shaft tube. 2. Vehicle overloaded. 3. Erratic clutch operation. 4. Grabbing clutch.	1. Replace broken axle shaft after correcting axle shaft tube alignment. 2. Replace broken axle shaft. Avoid excessive weight on vehicle. 3. Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch. 4. Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	1. Improper adjustment of differential bearings. 2. Excessive ring gear backlash. 3. Vehicle overloaded. 4. Erratic clutch operation.	1. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly. 2. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly. 3. Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle. 4. Replace cracked case. After inspecting for other possible causes, examine gears and bearings for possible damage. Avoid erratic use of clutch.
DIFFERENTIAL GEARS SCORED	1. Insufficient lubrication. 2. Improper grade of lubricant. 3. Excessive spinning of one wheel/tire.	1. Replace scored gears. Scoring marks on the drive face of gear teeth or in the bore are caused by instantaneous fusing of the mating surfaces. Scored gears should be replaced. Fill rear differential housing to required capacity with proper lubricant. Refer to Specifications. 2. Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant. 3. Replace scored gears. Inspect all gears, pinion bores and shaft for damage. Service as necessary.
LOSS OF LUBRICANT	1. Lubricant level too high.	1. Drain excess lubricant by removing fill plug and allow lubricant to level at lower edge of fill plug hole.

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DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS – 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

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SERVICE PROCEDURES

LUBRICANT CHANGE

(1) Raise and support the vehicle.

(2) Remove the lubricant fill hole plug from the differential housing cover.

(3) Remove the differential housing cover and drain the lubricant from the housing.

(4) Clean the housing cavity with a flushing oil, light engine oil or lint free cloth. **Do not use water, steam, kerosene or gasoline for cleaning.**

(5) Remove the sealant from the housing and cover surfaces. Use solvent to clean the mating surfaces.

(6) Apply a bead of Mopar® Silicone Rubber Sealant, or equivalent, to the housing cover (Fig. 3).

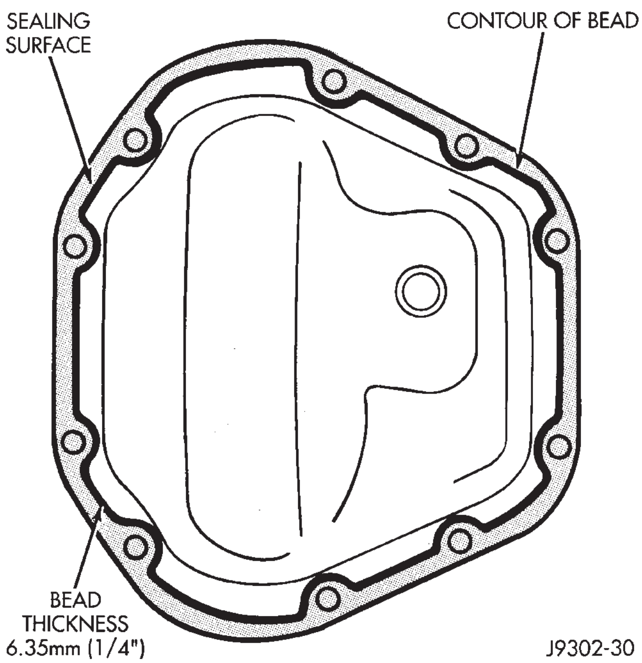


Fig. 3 Typical Housing Cover With Sealant

Install the housing cover within 5 minutes after applying the sealant.

(7) Install the cover and any identification tag. Tighten the cover bolts in a criss–cross pattern to 41 N·m (30 ft. lbs.) torque.

(8) Refill the differential with Mopar® Hypoid Gear Lubricant, or equivalent, to bottom of the fill plug hole. Refer to the Lubricant Specifications in this group for the quantity necessary.

(9) Install the fill hole plug and lower the vehicle. Tighten fill plug to 34 N·m (25 ft. lbs.).

REMOVAL AND INSTALLATION

DRIVE AXLE ASSEMBLY

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 rotors and calipers from the axle. Refer to Group 5, Brakes, for proper procedures.

(6) Disconnect the wheel sensor wiring harness from the vehicle wiring harness, if necessary.

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

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

(9) Remove propeller shaft.

(10) Disconnect stabilizer bar links at the axle.

(11) Disconnect shock absorbers from axle brackets.

(12) Disconnect track bar.

(13) Disconnect the tie rod and drag link from the steering knuckle. Refer to Group 2, Suspension, for proper procedures.

(14) Disconnect the steering damper from the axle bracket.

(15) Disconnect the upper and lower suspension arms from the axle brackets.

(16) Lower the lifting device enough to remove the axle. The coil springs will drop with the axle.

(17) Remove the coil springs from the axle.

INSTALLATION

CAUTION: 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, ride height and handling could be affected.

(1) Install the springs and retainer clips. Tighten the retainer bolts to 21 N·m (16 ft. lbs.) torque.

(2) Support the axle on a suitable lifting device and position axle under the vehicle.

(3) Raise the axle and align it with the spring pads.

(4) Position the upper and lower suspension arms in the axle brackets. Loosely install bolts and nuts to hold suspension arms to the axle brackets.

(5) Connect the vent hose to the axle shaft tube.

(6) Connect the track bar to the axle bracket. Loosely install the bolt to hold the track bar to the axle bracket.

REMOVAL AND INSTALLATION (Continued)

(7) Install the shock absorbers and tighten the bolts to 23 N·m (17 ft. lbs.) torque.

(8) Install the stabilizer bar links to the axle brackets. Tighten the nut to 95 N·m (70 ft. lbs.) torque.

(9) Install the drag link and tie rod to the steering knuckles. Refer to Group 2, Suspension, for proper procedures.

(10) Install the steering damper to the axle bracket and tighten the nut to 75 N·m (55 ft. lbs.) torque.

(11) Install the brake rotors and calipers. Refer to Group 5, Brakes, for the proper procedures.

(12) Connect the wheel speed sensor wiring harness to the vehicle wiring harness, if necessary.

(13) Align the previously made marks on the propeller shaft and the yoke.

(14) Install the straps and bolts to hold the propeller shaft to the yoke.

(15) Check and fill axle lubricant. Refer to the Lubricant Specifications in this group for the quantity necessary.

(16) Install the wheel and tire assemblies.

(17) Remove the lifting device from the axle and lower the vehicle.

(18) 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.

(19) Tighten the track bar bolt at the axle bracket to 100 N·m (74 ft. lbs.) torque.

(20) Check the front wheel alignment.

TUBE AXLE ASSEMBLY

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 rotors and calipers from the axle. Refer to Group 5, Brakes, for proper procedures.

(6) Disconnect the wheel sensor wiring harness from the vehicle wiring harness, if necessary.

(7) Disconnect stabilizer bar links at the axle.

(8) Disconnect shock absorbers from axle brackets.

(9) Disconnect track bar.

(10) Disconnect the tie rod and drag link from the steering knuckle. Refer to Group 2, Suspension, for proper procedures.

(11) Disconnect the steering damper from the axle bracket.

(12) Disconnect the upper and lower suspension arms from the axle brackets.

(13) Lower the lifting device enough to remove the axle. The coil springs will drop with the axle.

(14) Remove the coil springs from the axle.

INSTALLATION

CAUTION: 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, ride height and handling could be affected.

(1) Install the springs and retainer clips. Tighten the retainer bolts to 21 N·m (16 ft. lbs.) torque.

(2) Support the axle on a suitable lifting device and position axle under the vehicle.

(3) Raise the axle and align it with the spring pads.

(4) Position the upper and lower suspension arms in the axle brackets. Loosely install bolts and nuts to hold suspension arms to the axle brackets.

(5) Connect the track bar to the axle bracket. Loosely install the bolt to hold the track bar to the axle bracket.

(6) Install the shock absorbers and tighten the bolts to 23 N·m (17 ft. lbs.) torque.

(7) Install the stabilizer bar links to the axle brackets. Tighten the nut to 95 N·m (70 ft. lbs.) torque.

(8) Install the drag link and tie rod to the steering knuckles. Refer to Group 2, Suspension, for proper procedures.

(9) Install the steering damper to the axle bracket and tighten the nut to 75 N·m (55 ft. lbs.) torque.

(10) Install the brake rotors and calipers. Refer to Group 5, Brakes, for the proper procedures.

(11) Connect the wheel speed sensor wiring harness to the vehicle wiring harness, if necessary.

(12) Install the wheel and tire assemblies.

(13) Remove the lifting device from the axle and lower the vehicle.

(14) 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.

(15) Tighten the track bar bolt at the axle bracket to 100 N·m (74 ft. lbs.) torque.

(16) Check the front wheel alignment.

AXLE SHAFT—CARDAN U-JOINT

Single cardan U–joint components are not serviceable. If defective, they must be replaced as a unit. If the bearings, seals, spider, or bearing caps are damaged or worn, replace the complete U–joint.

REMOVAL

CAUTION: Clamp only the narrow forged portion of the yoke in the vise. Also, to avoid distorting the yoke, do not over tighten the vise jaws.

REMOVAL AND INSTALLATION (Continued)

(1) Remove axle shaft.

(2) Remove the bearing cap retaining snap rings (Fig. 4).

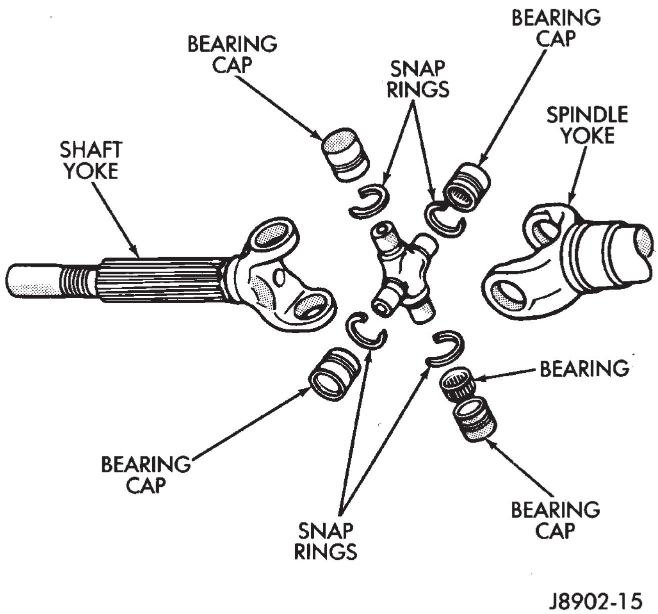


Fig. 4 Axle Shaft Outer U–Joint

It can be helpful to saturate the bearing caps with penetrating oil prior to removal.

(3) Locate a socket where the inside diameter is larger in diameter than the bearing cap. Place the socket (receiver) against the yoke and around the perimeter of the bearing cap to be removed.

(4) Locate a socket where the outside diameter is smaller in diameter than the bearing cap. Place the socket (driver) against the opposite bearing cap.

(5) Position the yoke with the sockets in a vise (Fig. 5).

(6) Compress the vise jaws to force the bearing cap into the larger socket (receiver).

(7) Release the vise jaws. Remove the sockets and bearing cap that was partially forced out of the yoke.

(8) Repeat the above procedure for the remaining bearing cap.

(9) Remove the remaining bearing cap, bearings, seals and spider from the propeller shaft yoke.

INSTALLATION

(1) Pack the bearing caps 1/3 full of wheel bearing lubricant. Apply extreme pressure (EP), lithium–base lubricant to aid in installation.

(2) Position the spider in the yoke. Insert the seals and bearings. Tap the bearing caps into the yoke bores far enough to hold the spider in position.

(3) Place the socket (driver) against one bearing cap. Position the yoke with the socket wrench in a vise.

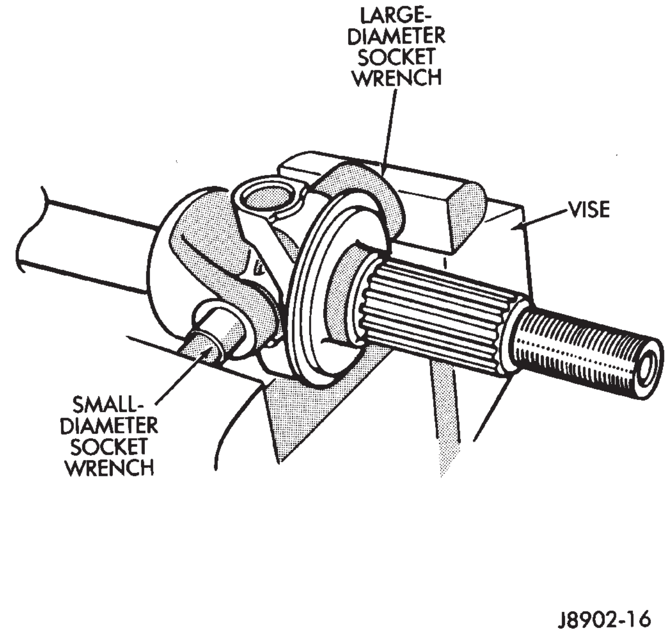


Fig. 5 Yoke Bearing Cap Removal

(4) Compress the vise to force the bearing caps into the yoke. Force the caps enough to install the retaining clips.

(5) Install the bearing cap retaining clips.

(6) Install axle shaft.

PINION SHAFT SEAL

REMOVAL

(1) Raise and support the vehicle.

(2) Remove wheel and tire assemblies.

(3) Remove brake rotors and calipers. Refer to Group 5, Brakes, for proper procedures.

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

(5) Remove the propeller shaft from the yoke.

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

(7) Measure the amount of torque necessary to rotate the pinion gear with a (in. lbs.) dial-type torque wrench. Record the torque reading for installation reference.

(8) Using Holder 6958 to hold the pinion yoke, remove the pinion nut and washer.

(9) Use Remover C-452 and Wrench C-3281 to remove the pinion yoke (Fig. 6).

(10) Use a suitable pry tool or a slide hammer mounted screw to remove the pinion shaft seal.

INSTALLATION

(1) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer C-3972-A and Handle C-4171 (Fig. 7).

(2) Install yoke on the pinion gear with Installer W-162–D, Cup 8109, and Holder 6958 (Fig. 8).

REMOVAL AND INSTALLATION (Continued)

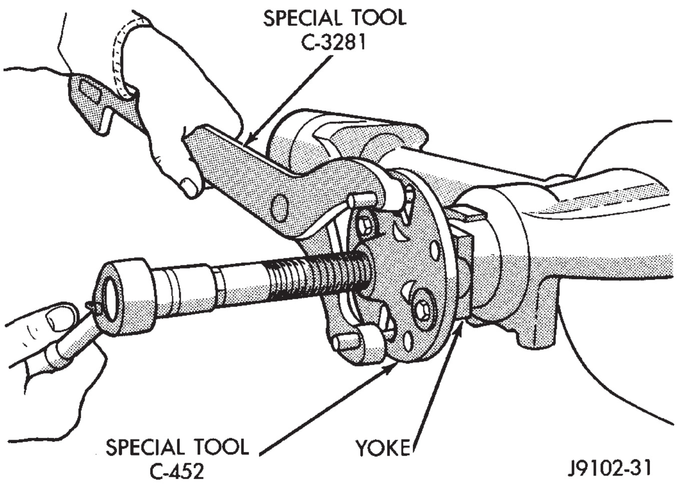


Fig. 6 Pinion Yoke Removal

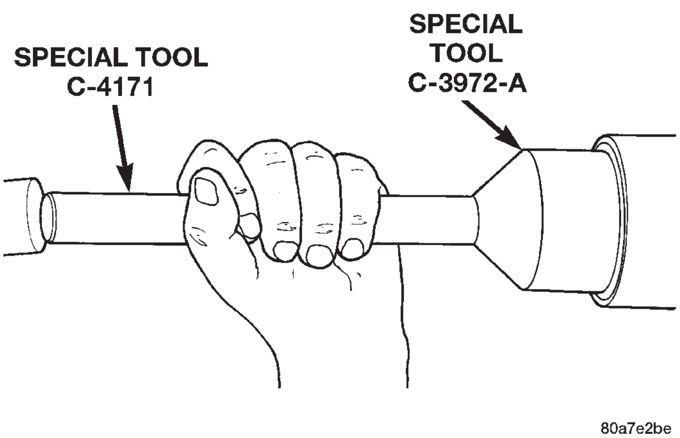


Fig. 7 Pinion Seal Installation

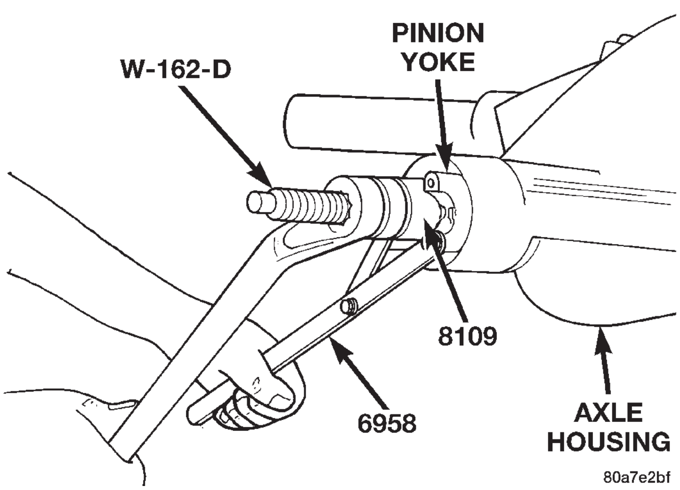


Fig. 8 Pinion Yoke Installation

CAUTION: Do not exceed the minimum tightening torque when installing the pinion yoke retaining nut at this point. Damage to the pinion bearings may result.

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

(4) Tighten pinion nut to 217 N·m (160 ft. lbs.).

(5) Rotate the pinion shaft using a (in. lbs.) torque wrench. Rotating torque should be equal to the reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.) (Fig. 9).

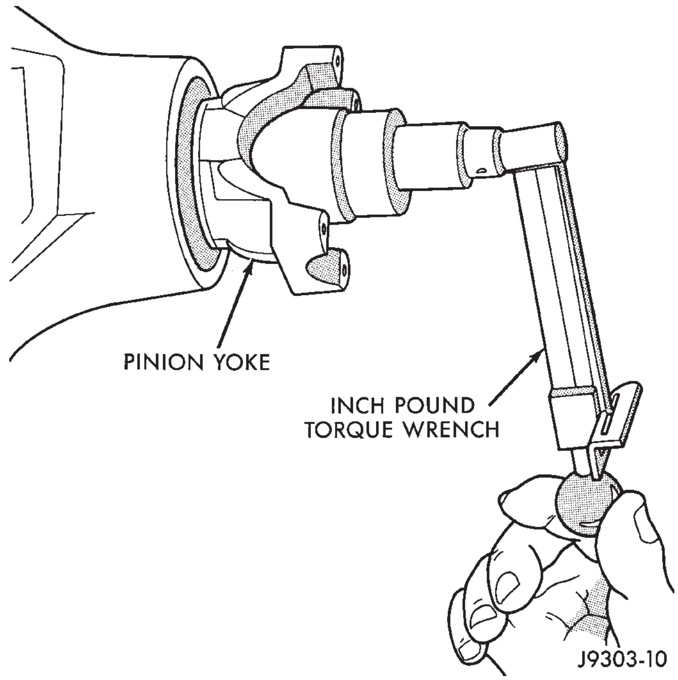


Fig. 9 Check Pinion Rotation Torque

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

(7) Align the installation reference marks on the propeller shaft and yoke, and install the propeller shaft.

(8) Check and fill the gear lubricant. Refer to the Lubricant Specifications for gear lubricant requirements.

(9) Install the brake rotors and calipers. Refer to Group 5, Brakes, for proper procedures.

(10) Install wheel and tire assemblies.

(11) Lower the vehicle.

HUB BEARING AND AXLE SHAFT

If the axle shaft and hub bearing are being removed in order to service another component, the axle shaft and hub bearing can be removed as an assembly.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

REMOVAL AND INSTALLATION (Continued)

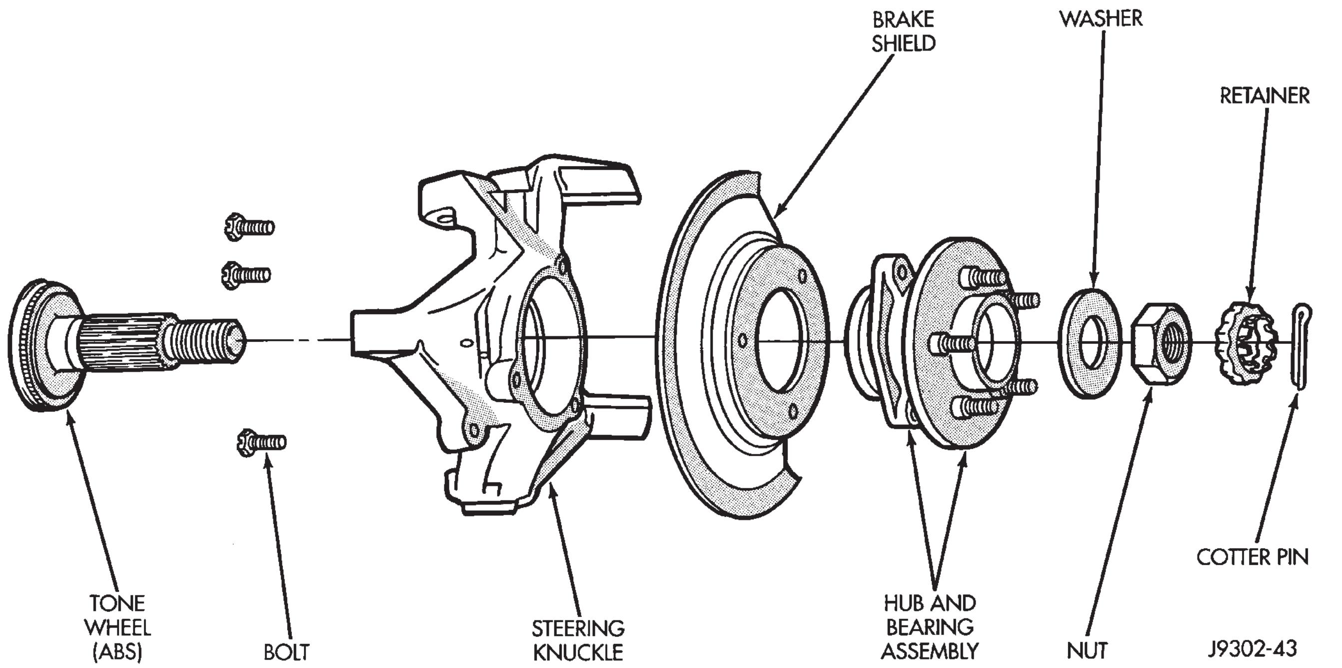


Fig. 10 Hub, Knuckle and Axle Shaft

(3) Remove the brake caliper and rotor. Refer to Group 5, Brakes, for proper procedures.

(4) Remove ABS wheel speed sensor, if necessary. Refer to Group 5, Brakes, for proper procedures.

(5) Remove the cotter pin, nut retainer, and axle hub nut (Fig. 10), if necessary.

(6) Remove the hub to knuckle bolts (Fig. 11).

(7) Remove the hub from the steering knuckle and axle shaft, if necessary.

(8) Remove hub bearing and axle shaft assembly (Fig. 12), or axle shaft from axle. **Avoid damaging the axle shaft oil seals in the axle housing.**

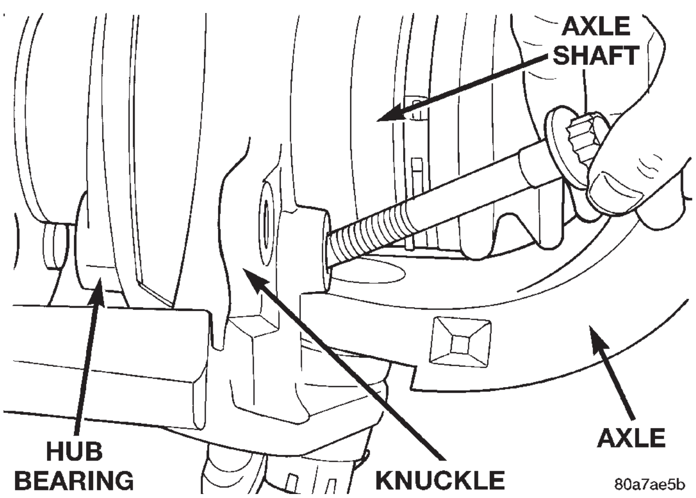


Fig. 11 Hub Bearing Bolts

(9) Remove the brake rotor shield from the hub bearing or knuckle (Fig. 10).

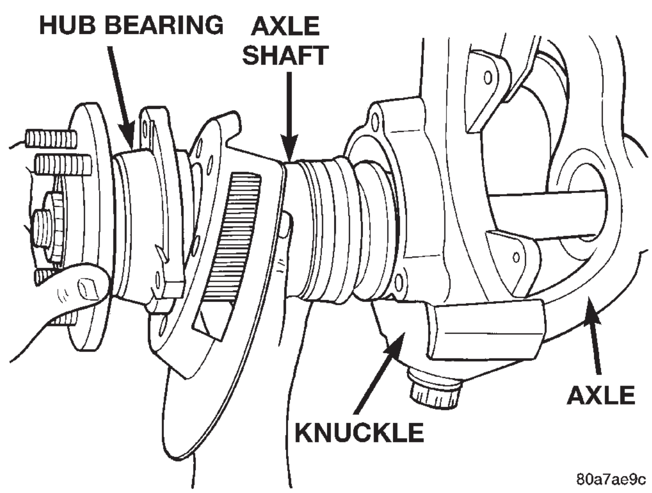


Fig. 12 Hub Bearing and Axle Assembly

INSTALLATION

(1) Thoroughly clean the axle shaft (Fig. 10) and apply a thin film of Mopar® Wheel Bearing Grease, or equivalent, to the shaft splines, seal contact surface, and hub bore.

(2) Install the brake rotor shield to the knuckle.

(3) Install the hub bearing and axle shaft assembly, or axle shaft, into the housing and differential side gears. Avoid damaging the axle shaft oil seals in the axle housing.

(4) Install the hub bearing, if necessary.

(5) Install the hub to knuckle bolts and tighten to 102 N·m (75 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(6) Install the hub washer and nut, if necessary. Tighten the hub nut to 237 N·m (175 ft. lbs.) torque. Install the nut retainer and a new cotter pin (Fig. 10).

(7) Install ABS wheel speed sensor, if necessary. Refer to Group 5, Brakes, for proper procedures.

(8) Install the brake rotor and caliper. Refer to Group 5, Brakes, for proper procedures.

(9) Install the wheel and tire assembly.

(10) 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 studs require the use of Tool Kit 6289.

KNUCKLE REMOVAL

(1) Remove hub bearing and axle shaft.

(2) Disconnect the tie-rod or drag link from the steering knuckle arm. Refer to Group 2, Suspension, for proper procedures.

(3) Remove the cotter pins from the upper and lower ball studs.

(4) Remove the upper and lower ball stud nuts.

(5) Strike the steering knuckle with a brass hammer to loosen knuckle from the ball studs. Remove knuckle from ball studs (Fig. 13).

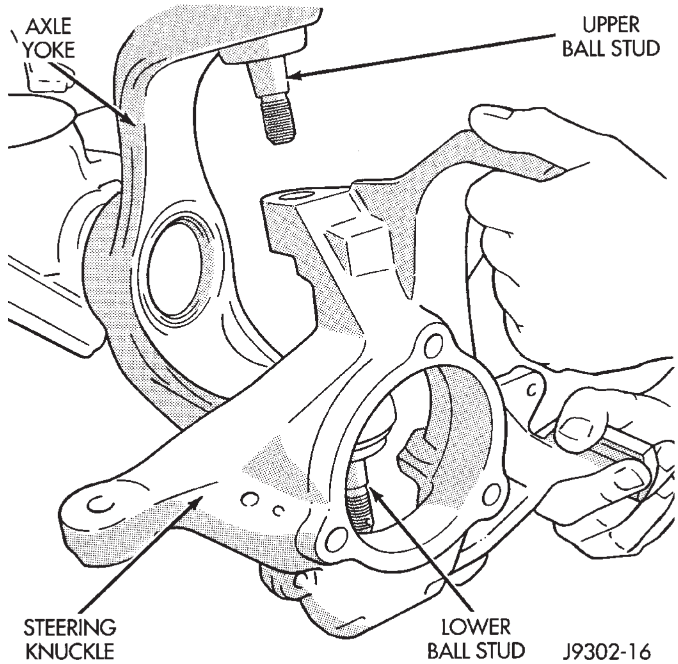


Fig. 13 Steering Knuckle Removal/Installation

UPPER BALL STUD REPLACEMENT

(1) Position tools as shown to remove and install ball stud (Fig. 14).

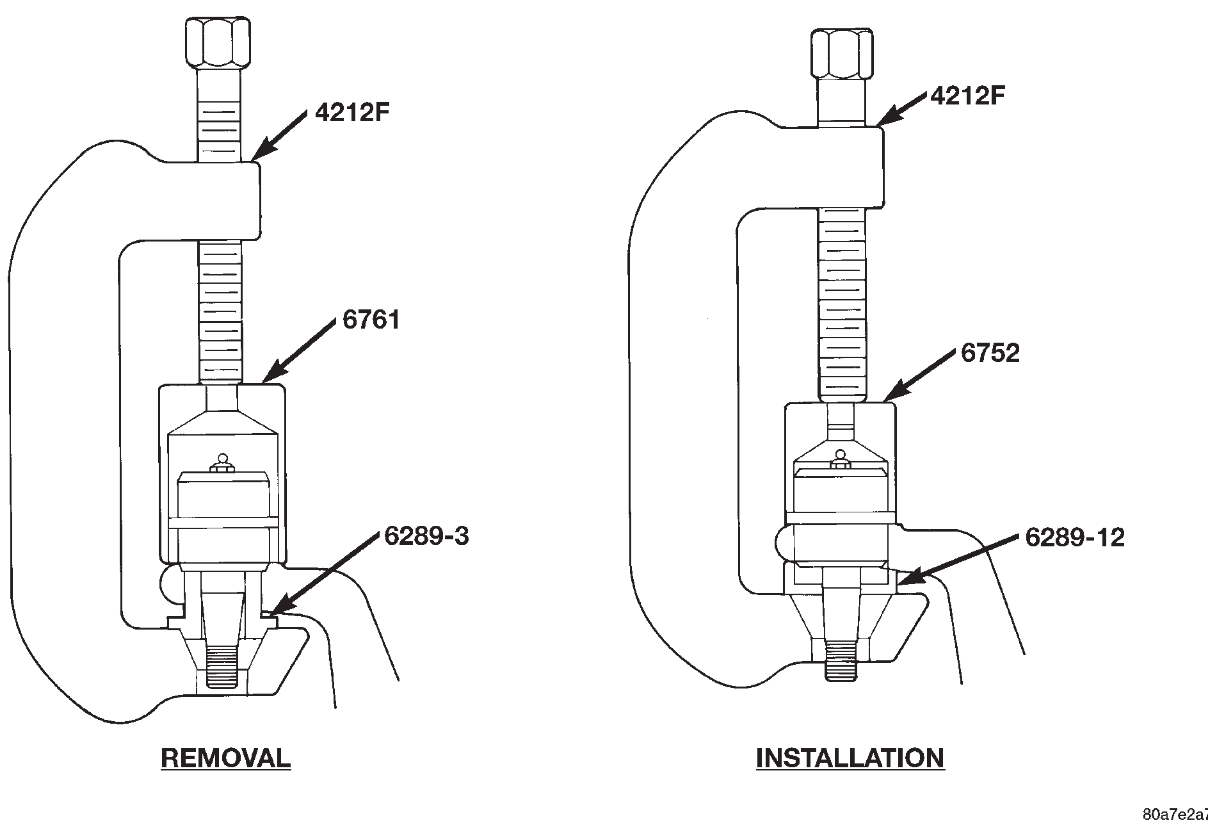


Fig. 14 Upper Ball Stud Remove/Install

REMOVAL AND INSTALLATION (Continued)

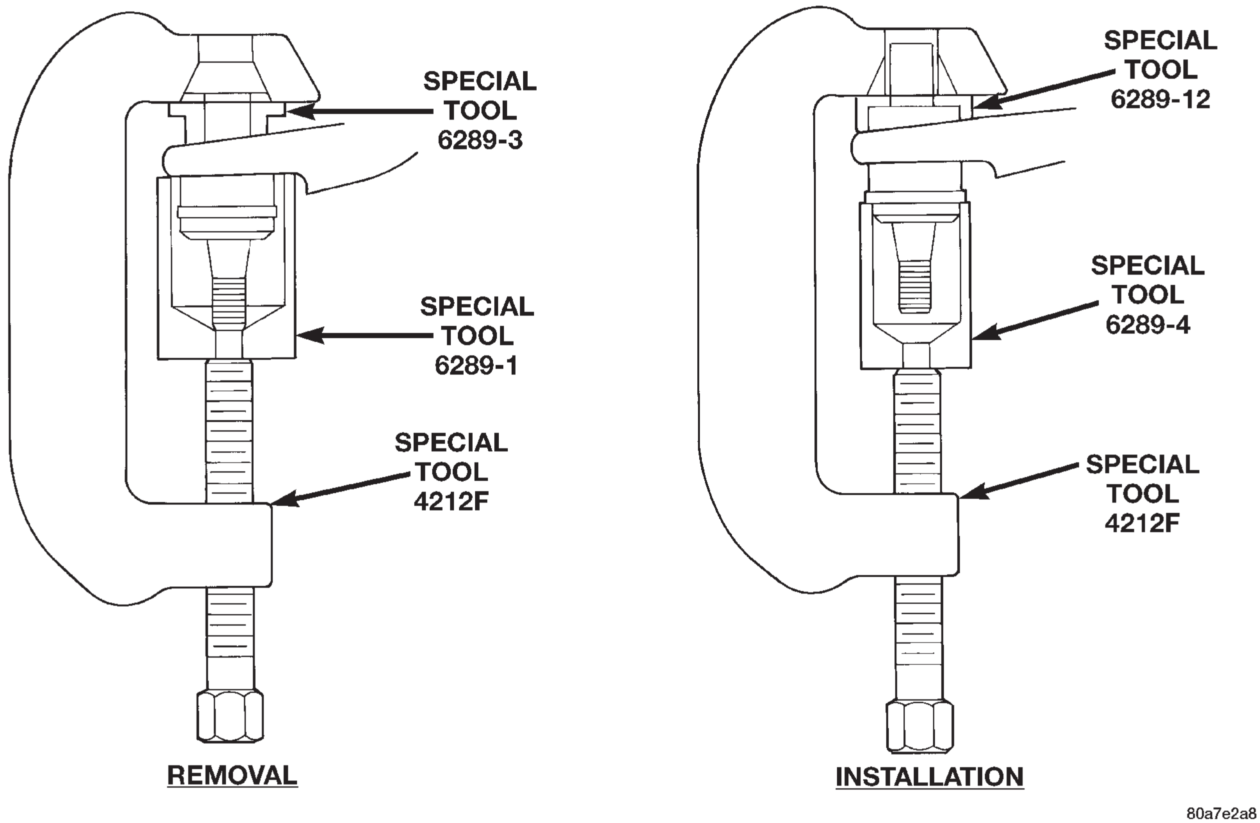


Fig. 15 Lower Ball Stud Remove/Install

LOWER BALL STUD REPLACEMENT

(1) Position tools as shown to remove and install ball stud (Fig. 15).

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.

(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.

(5) Connect the tie-rod or drag link end to the steering knuckle arm. Refer to Group 2, Suspension, for proper procedures.

AXLE BUSHING REPLACEMENT

Refer to Group 2, Suspension, for the proper axle bushing procedures.

DIFFERENTIAL

REMOVAL

(1) Raise and support vehicle.

(2) Remove the lubricant fill hole plug from the differential housing cover.

(3) Remove the differential housing cover and allow fluid to drain.

(4) Remove hub bearings and axle shafts.

(5) Note the installation reference letters stamped on the bearing caps and housing machined sealing surface (Fig. 16).

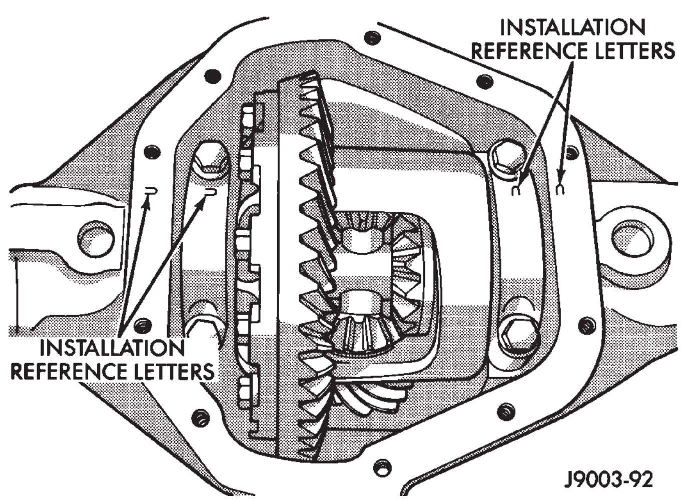


Fig. 16 Bearing Cap Identification

(6) Loosen the differential bearing cap bolts.

(7) Position Spreader W–129–B, utilizing some items from Adapter Kit 6987, with the tool dowel pins seated in the locating holes (Fig. 17). Install the

REMOVAL AND INSTALLATION (Continued)

holddown clamps and tighten the tool turnbuckle finger–tight.

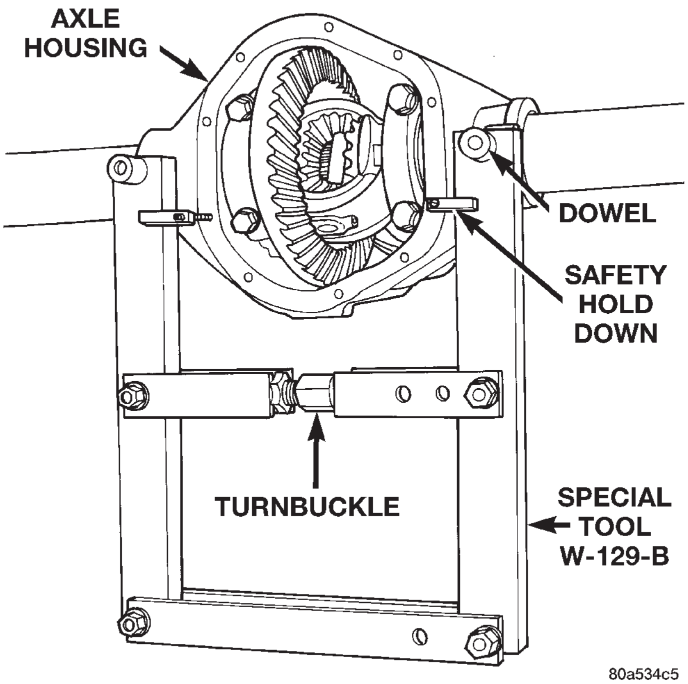


Fig. 17 Install Axle Housing Spreader

(8) Install a Guide Pin C-3288-B at the left side of the differential housing. Attach Dial Indicator C-3339 to guide pin. Load the lever adapter against the opposite side of the housing (Fig. 18) and zero the indicator.

CAUTION: Do not spread over 0.50 mm (0.020 in). If the housing is over-spread, it could be distorted or damaged.

(9) Spread the housing enough to remove the differential case from the housing. Measure the distance with the dial indicator (Fig. 19).

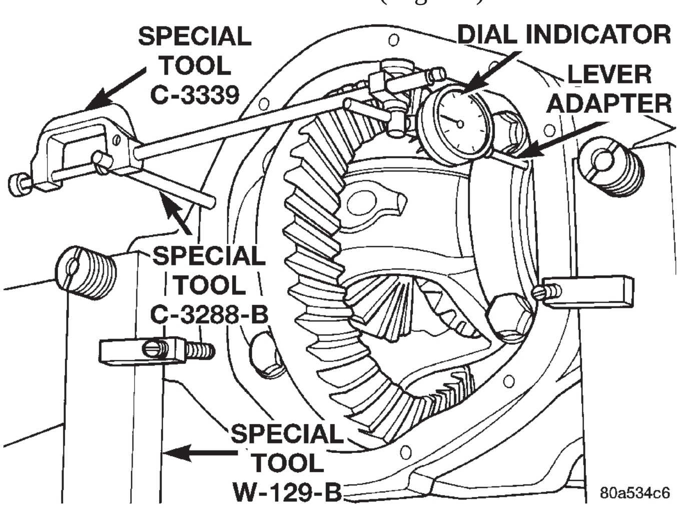


Fig. 18 Install Dial Indicator

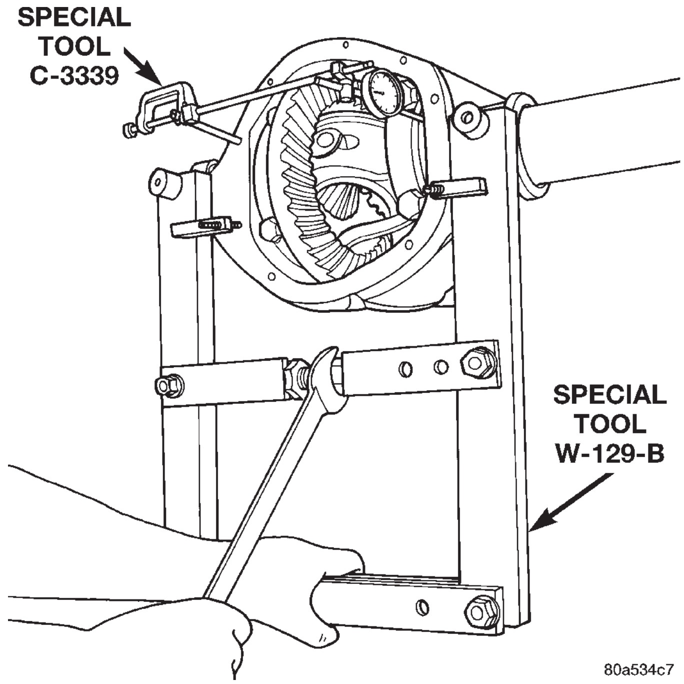


Fig. 19 Spread Axle Housing

(10) Remove the dial indicator.

(11) While holding the differential case in position, remove the differential bearing cap bolts and caps.

(12) Remove the differential from the housing. Ensure that the differential bearing cups remain in position on the differential bearings (Fig. 20).

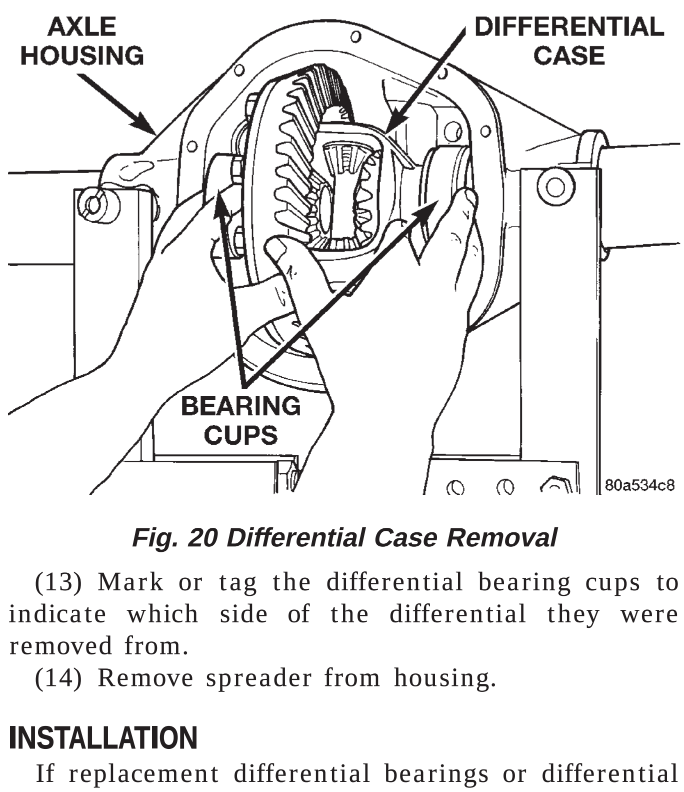


Fig. 20 Differential Case Removal

(13) Mark or tag the differential bearing cups to indicate which side of the differential they were removed from.

(14) Remove spreader from housing.

INSTALLATION

If replacement differential bearings or differential case are being installed, differential side bearing shim requirements may change. Refer to the Differ-

REMOVAL AND INSTALLATION (Continued)

ential Bearing Preload and Gear Backlash procedures in this section to determine the proper shim selection.

(1) Position Spreader W-129-B, utilizing some items from Adapter Kit 6987, with the tool dowel pins seated in the locating holes (Fig. 21). Install the holddown clamps and tighten the tool turnbuckle finger–tight.

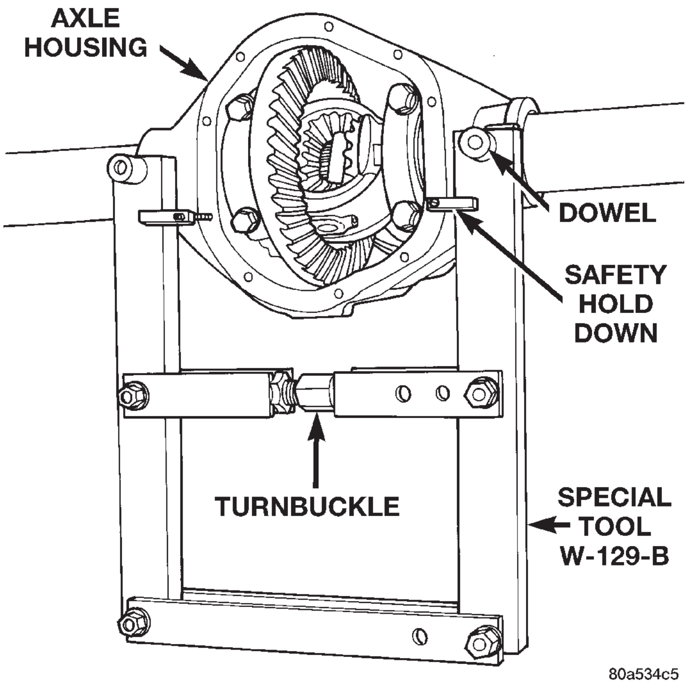


Fig. 21 Install Axle Housing Spreader

(2) Install a Guide Pin C-3288-B at the left side of the differential housing. Attach Dial Indicator C-3339 to guide pin. Load the lever adapter against the opposite side of the housing (Fig. 18) and zero the indicator.

CAUTION: Do not spread over 0.50 mm (0.020 in). If the housing is over-spread, it could be distorted or damaged.

(3) Spread the housing enough to install the case in the housing. Measure the distance with the dial indicator (Fig. 19).

(4) Remove the dial indicator.

(5) Install differential case in the housing. Ensure that the differential bearing cups remain in position on the differential bearings. Tap the differential case to ensure the bearings cups are fully seated in the housing.

(6) Install the bearing caps at their original locations (Fig. 22).

(7) Loosely install differential bearing cap bolts.

(8) Remove axle housing spreader.

(9) Tighten the bearing cap bolts to 61 N·m (45 ft. lbs.) torque.

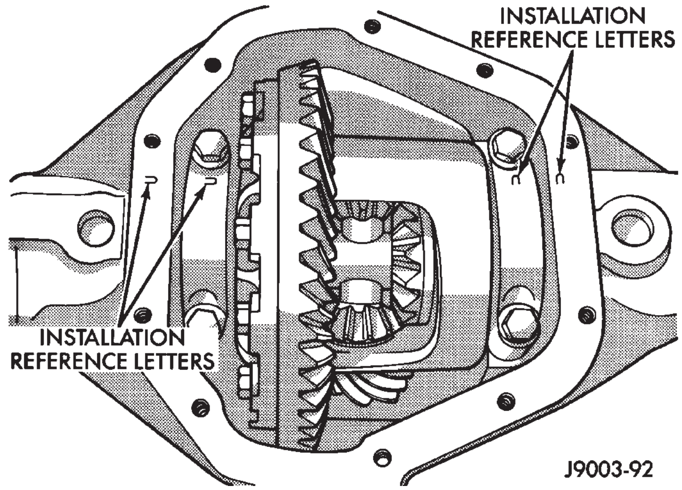


Fig. 22 Differential Bearing Cap Reference Letters

(10) Install the hub bearings and axle shafts.

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 Adapter Blocks, and Plug SP-3289 (Fig. 23).

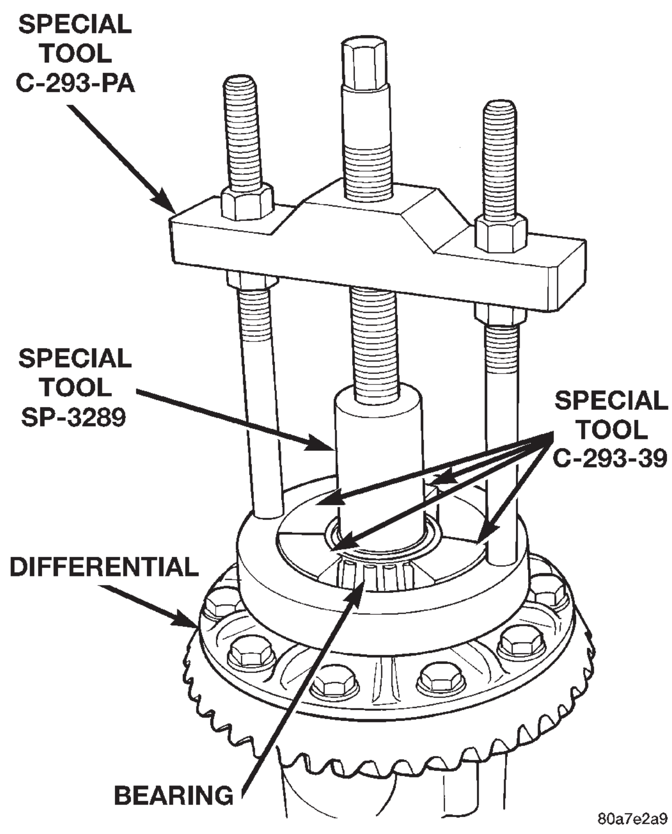


Fig. 23 Differential Bearing Removal

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

If replacement differential side bearings or differential case are being installed, differential side bearing shim requirements may change. Refer to the Differential Bearing Preload and Gear Backlash procedures in this section to determine the proper shim selection.

(1) Install differential side bearing shims onto differential case hubs.

(2) Using Installer C-3716-A and Handle C-4171, install differential side bearings (Fig. 24).

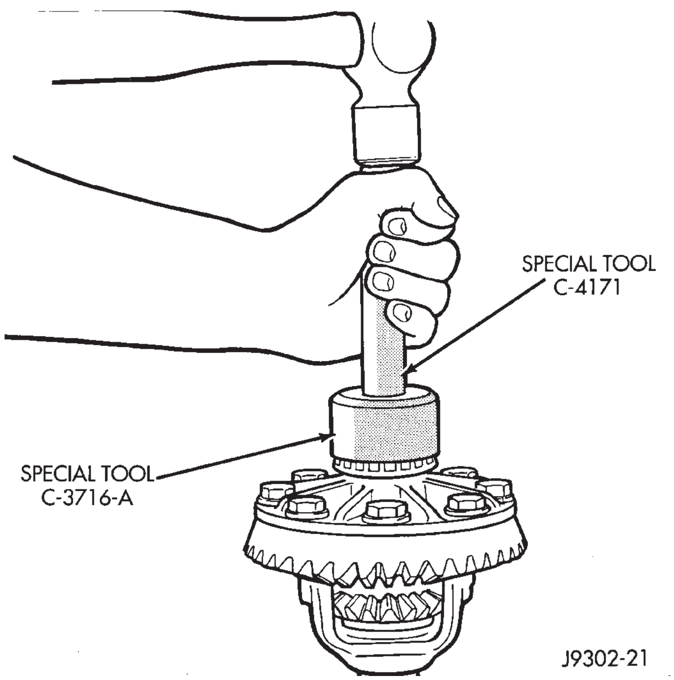


Fig. 24 Differential Side Bearing Installation

(3) Install differential in axle housing.

AXLE SHAFT OIL SEAL

REMOVAL

(1) Raise and support vehicle.

(2) Remove differential assembly.

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

INSTALLATION

(1) Remove any sealer remaining from original seals.

(2) Remove sealer from axle tube to housing junction, if necessary.

(3) Install oil seals with Discs 8110 and Turnbuckle 6797 (Fig. 25). Tighten tool until disc bottoms in housing.

(4) Install differential assembly.

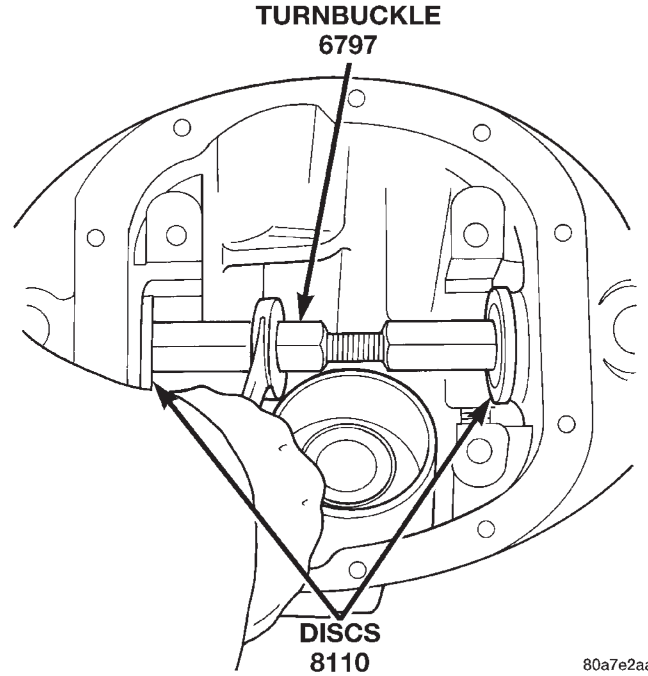


Fig. 25 Axle Seal Installation

RING GEAR

NOTE: The ring and pinion gears are service in a matched set. Do not replace the ring gear without replacing the pinion gear.

REMOVAL

(1) Remove differential from axle housing.

(2) Place differential case in a suitable vise with soft metal jaw protectors (Fig. 26).

(3) Remove bolts holding ring gear to differential case.

(4) Using a soft hammer, drive ring gear from differential case (Fig. 26).

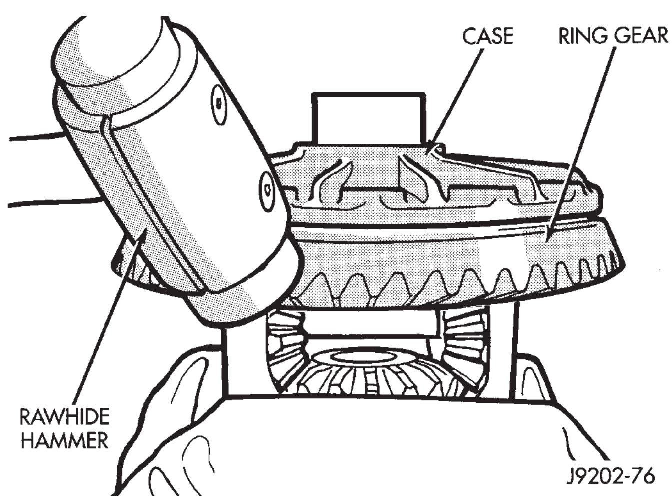


Fig. 26 Ring Gear Removal

REMOVAL AND INSTALLATION (Continued)

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) Invert the differential case in the vise.

(3) Install new ring gear bolts and alternately tighten to 95–122 N·m (70–90 ft. lbs.) torque (Fig. 27).

(4) Install differential in axle housing and verify gear mesh and contact pattern.

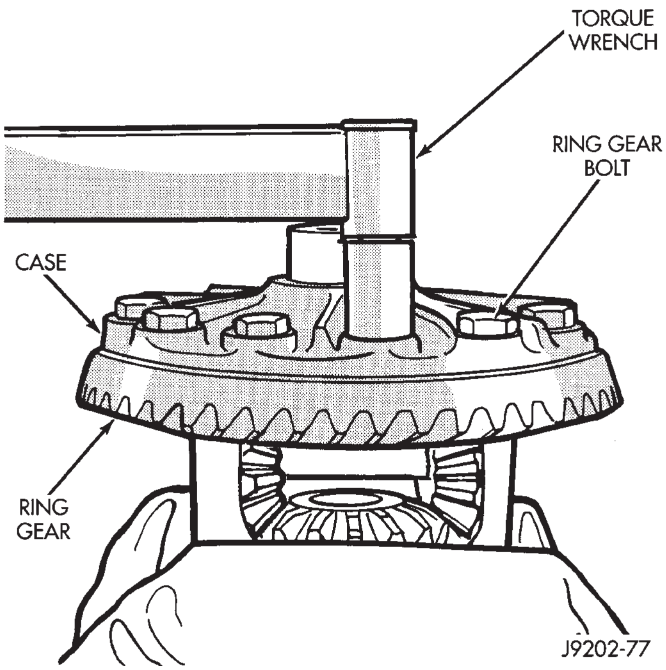


Fig. 27 Ring Gear Bolt Installation

PINION GEAR

The ring and pinion gears are serviced as a matched set. Do not replace the pinion gear without replacing the ring gear.

REMOVAL

(1) Remove differential assembly from axle housing.

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

(3) Disconnect propeller shaft from pinion yoke. Using suitable wire, tie propeller shaft to underbody.

(4) Using Holder 6958 to hold yoke, remove the pinion nut and washer.

(5) Using Remover C-452 and Holder C-3281, remove the pinion yoke from pinion shaft (Fig. 28).

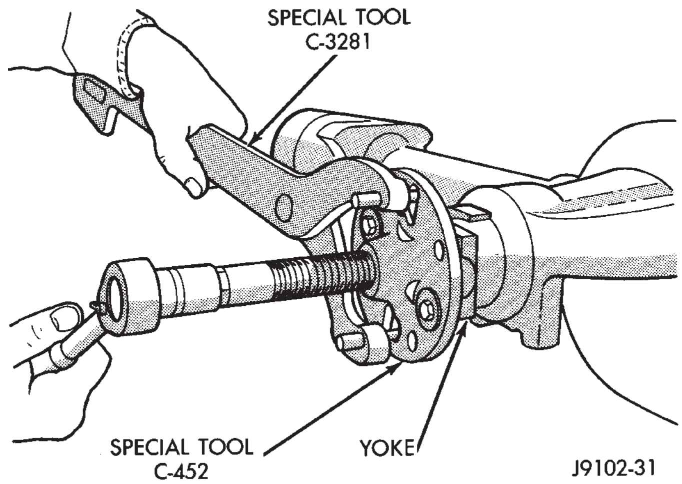


Fig. 28 Pinion Yoke Removal

(6) Remove the pinion gear and preload shims from housing (Fig. 29). Catch the pinion with your hand to prevent it from falling and being damaged.

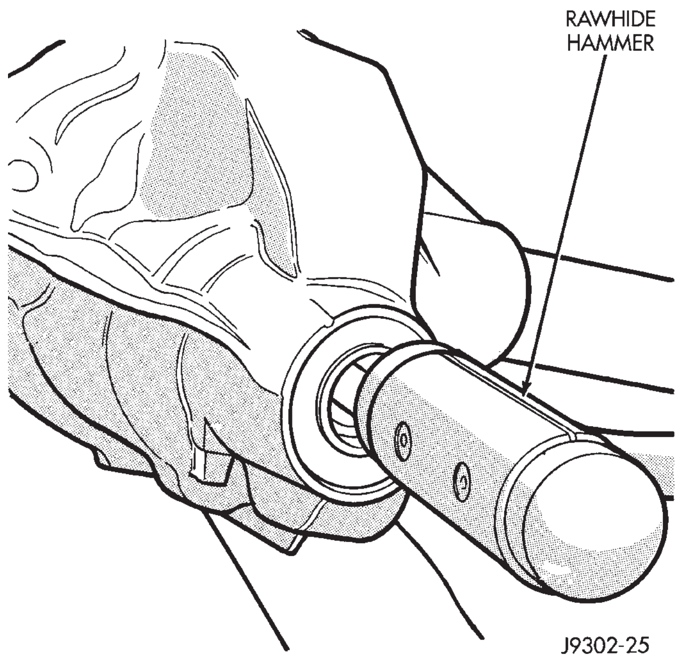


Fig. 29 Remove Pinion Gear

(7) Remove the front pinion bearing cup, bearing, oil slinger, if equipped, and pinion seal with Remover D-147 and Handle C–4171 (Fig. 30).

(8) Remove the rear pinion bearing cup from axle housing (Fig. 31). Use Remover D-149 and Handle C–4171.

REMOVAL AND INSTALLATION (Continued)

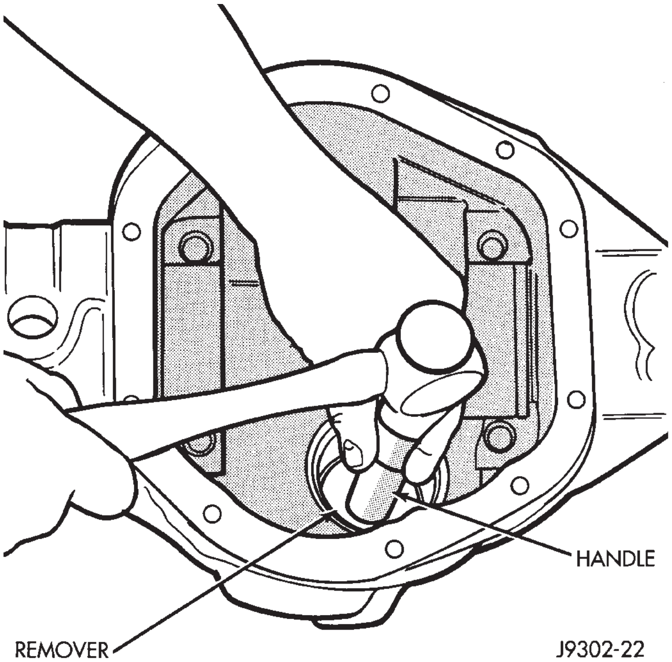


Fig. 30 Front Bearing Cup Removal

(9) Remove the depth shims from rear pinion bearing cup bore in axle housing. Record the thickness of the depth shims.

NOTE: The pinion depth shims can be very thin. Verify that all shims have been removed before proceeding.

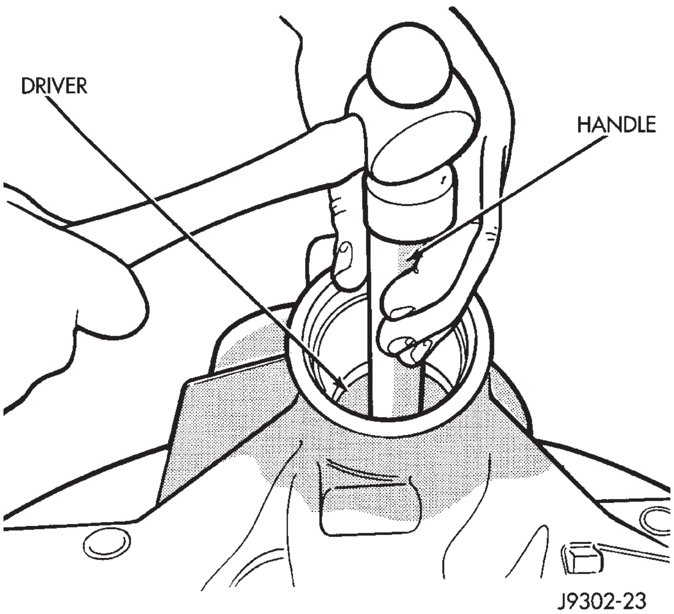


Fig. 31 Rear Bearing Cup Removal

(10) Remove the rear pinion bearing from the pinion with Puller/Press C–293-PA and Adapters C-293-39 (Fig. 32).

Place 4 adapter blocks so they do not damage the bearing cage.

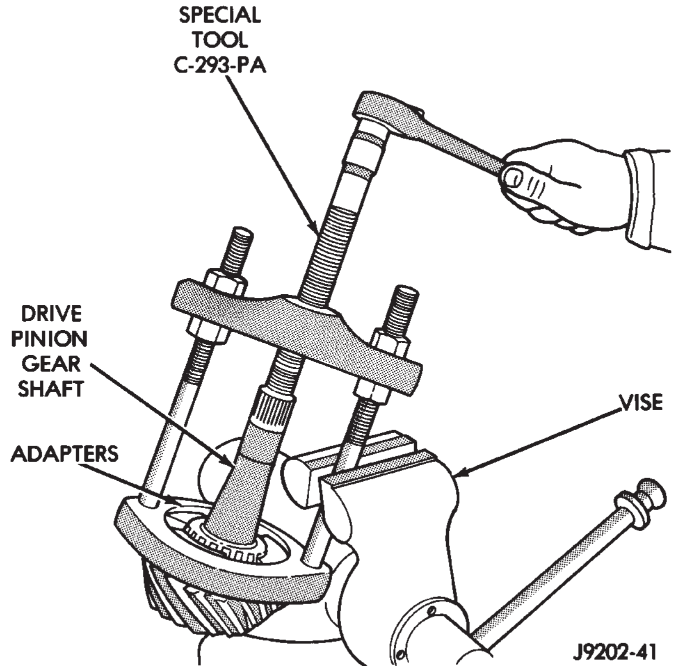


Fig. 32 Inner Bearing Removal

INSTALLATION

NOTE: Pinion depth shims are placed between the rear 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 before installing pinion gear.

(1) Place proper thickness depth shim in rear pinion bearing cup bore in the axle housing.

(2) Apply Mopar® Door Ease, or equivalent, stick lubricant to outside surface of rear pinion bearing cup. Install the bearing cup with Installer D-146 and Handle C–4171 (Fig. 33). Verify cup is correctly seated.

(3) Apply Mopar® Door Ease, or equivalent, stick lubricant to outside surface of front pinion bearing cup. Install the bearing cup with Installer D-144 and Handle C–4171 (Fig. 34).

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

REMOVAL AND INSTALLATION (Continued)

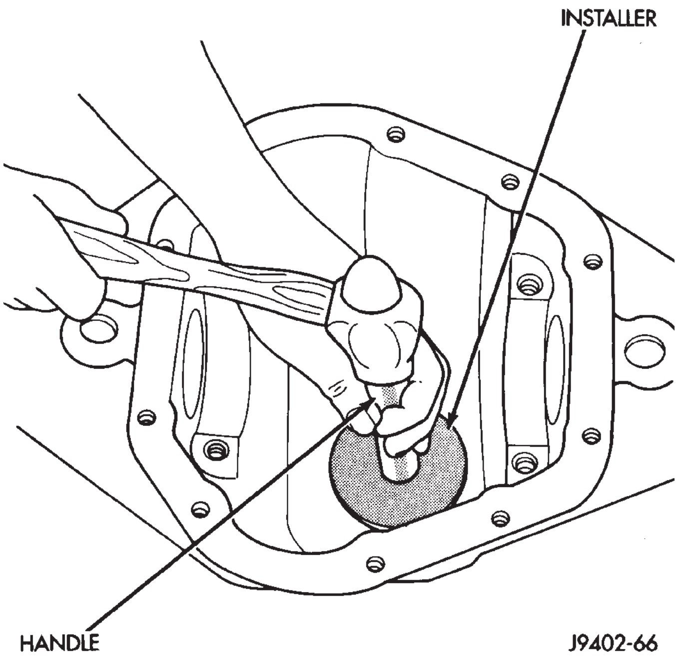


Fig. 33 Rear Pinion Bearing Cup Installation

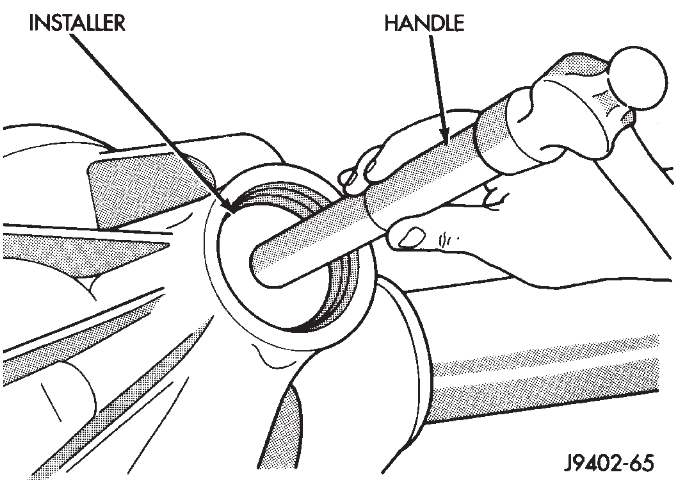


Fig. 34 Pinion Outer Bearing Cup Installation

(5) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer C-3972-A and Handle C–4171 (Fig. 35).

(6) Install the rear pinion bearing and oil slinger, if equipped, on the pinion gear with Installer W-262 and a shop press (Fig. 36).

(7) Install pinion bearing preload shims onto the pinion gear (Fig. 37).

(8) Install pinion gear in housing.

(9) Install yoke with Installer W-162-B, Cup 8109, and Holder 6958 (Fig. 38).

(10) Install the pinion washer and a new nut on the pinion gear. Tighten the nut to 217 N·m (160 ft. lbs.).

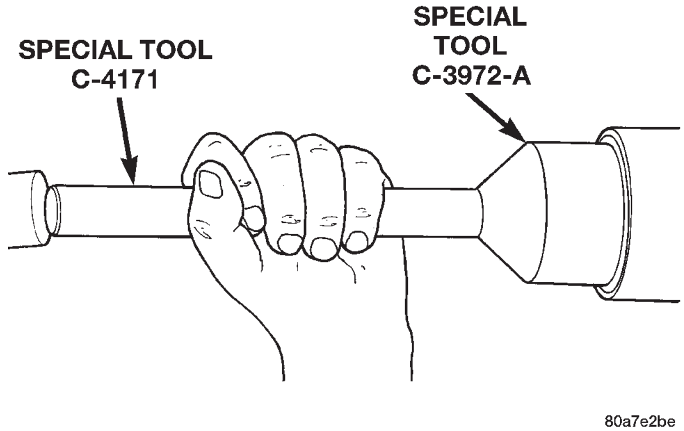


Fig. 35 Pinion Seal Installation

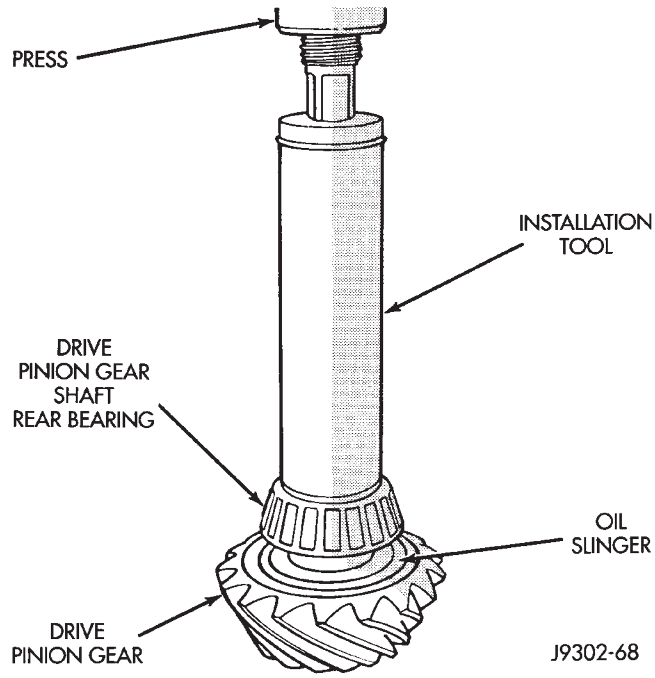


Fig. 36 Rear Pinion Bearing Installation

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing rotating torque and never exceed specified preload rotating torque.

(11) Check bearing preload torque with an inch pound torque wrench (Fig. 39). The torque necessary to rotate the pinion gear should be:

- Original Bearings—1 to 3 N·m (10 to 20 in. lbs.).
- New Bearings—2 to 5 N·m (15 to 35 in. lbs.).

(12) If rotating torque is above the desired amount, remove the pinion yoke and increase the preload shim pack thickness. Increasing the shim pack thickness 0.025 mm (0.001 in.) will decrease the rotating torque approximately 0.9 N·m (8 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

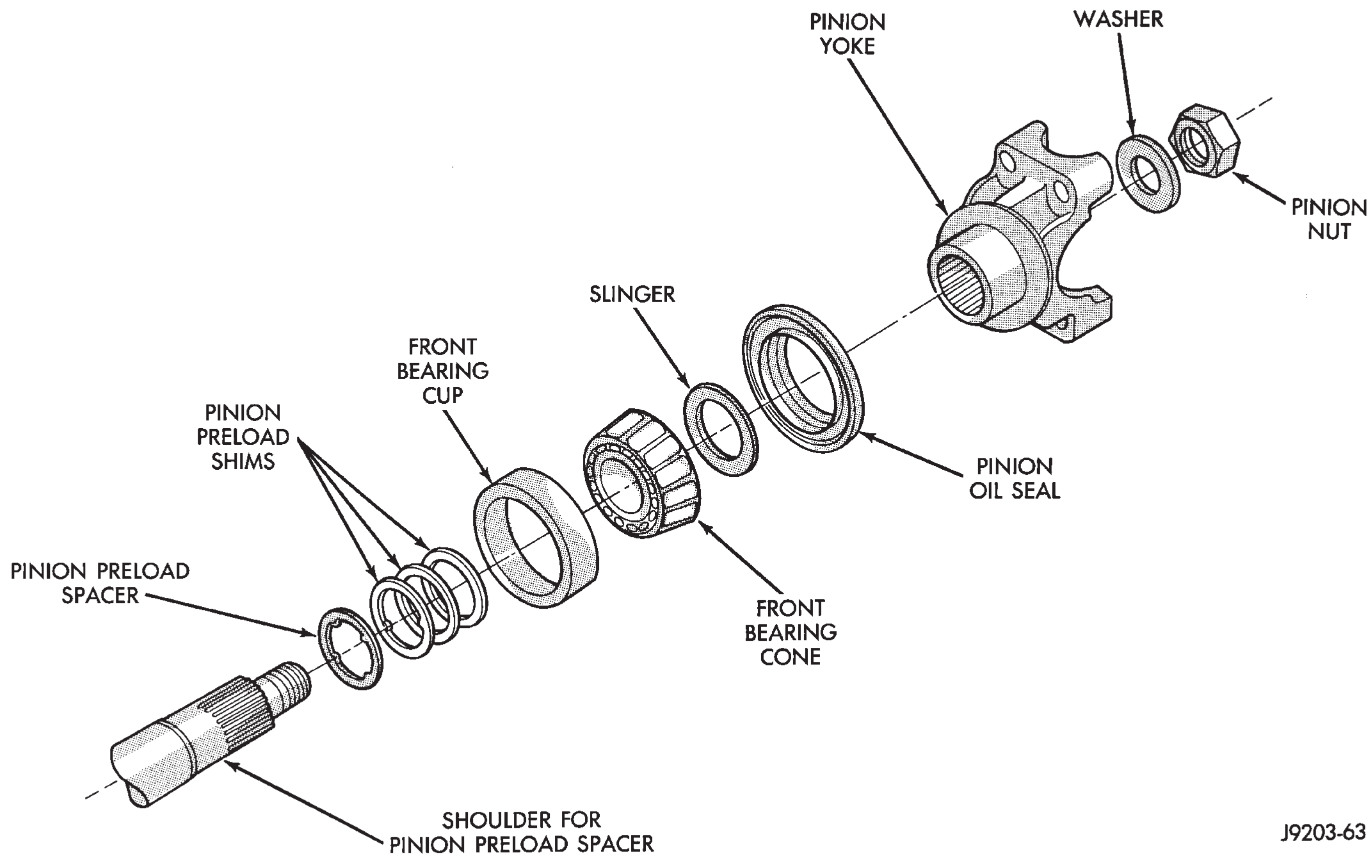


Fig. 37 Pinion Preload Shims–Typical

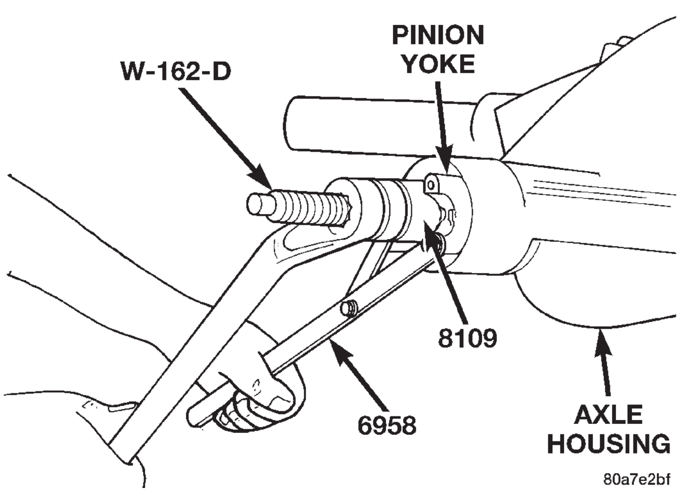


Fig. 38 Pinion Yoke Installation

(13) Tighten pinion shaft nut in 6.8 N·m (5 ft. lbs.) increments until the maximum tightening or desired rotating torque is reached.

(14) If the maximum tightening torque is reached prior to achieving the desired rotating torque, remove the pinion yoke and decrease the thickness of the preload shim pack. Decreasing the shim pack thickness 0.025 mm (0.001 in.) will increase the rotating torque approximately 0.9 N·m (8 in. lbs.).

(15) Install differential assembly.

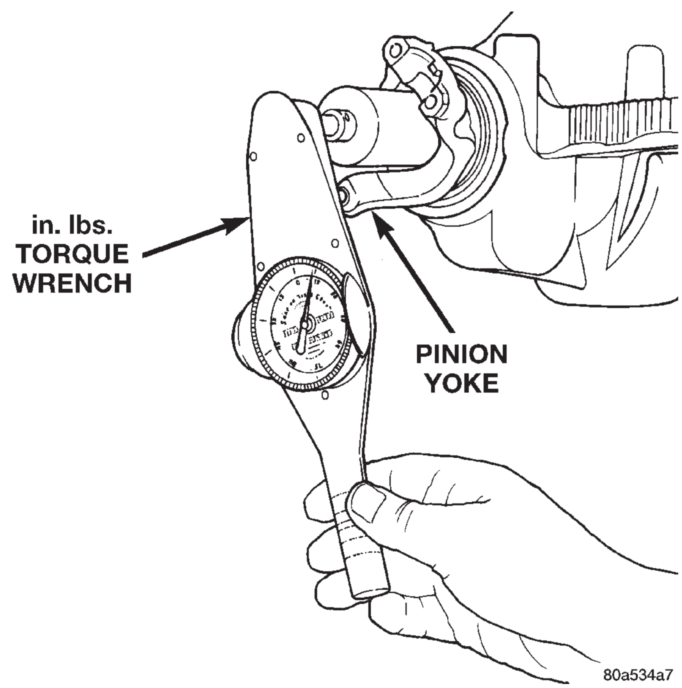


Fig. 39 Check Pinion Gear Rotating Torque

DISASSEMBLY AND ASSEMBLY

STANDARD DIFFERENTIAL

DISASSEMBLY

(1) Remove the ring gear.

(2) Using a suitable roll pin punch, drive out the roll pin holding pinion gear mate shaft in the differential case (Fig. 40).

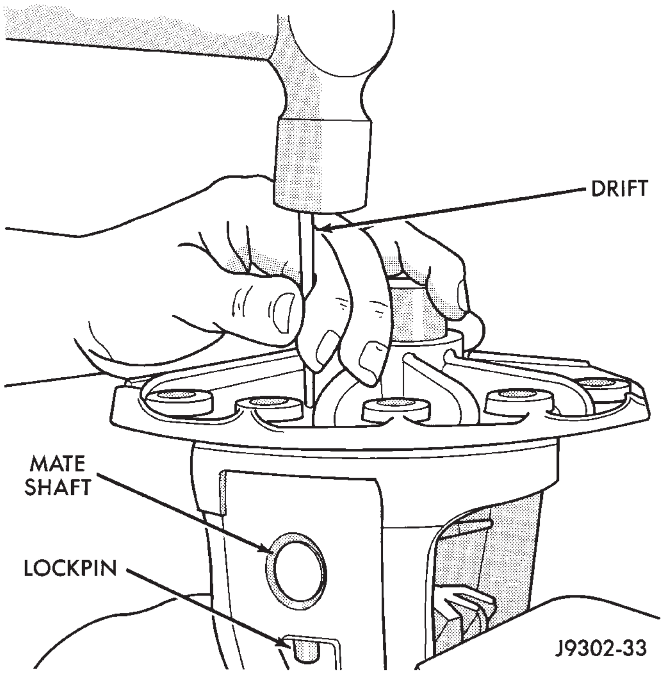


Fig. 40 Mate Shaft Roll Pin Removal

(3) Remove the pinion gear mate shaft from the differential case and the pinion mate gears.

(4) Rotate differential side gears and remove the pinion mate gears and thrust washers (Fig. 41).

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

ASSEMBLY

(1) Install the differential side gears and thrust washers.

(2) Install the pinion mate gears and thrust washers.

(3) Install the pinion gear mate shaft. Align the roll pin holes in shaft and the differential case.

(4) Install the roll pin to hold the pinion mate shaft in the differential case (Fig. 42).

(5) Install the ring gear.

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

FINAL ASSEMBLY

(1) Scrape the residual sealant from the housing and cover mating surfaces. Clean the mating surfaces

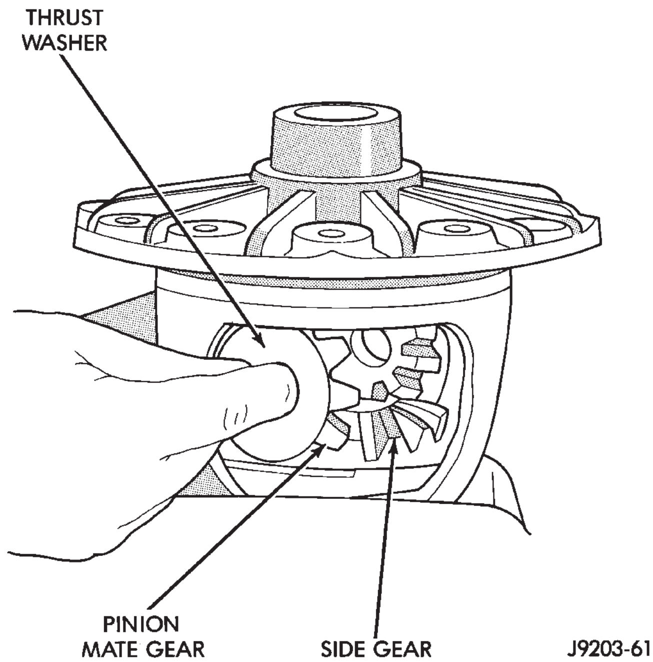


Fig. 41 Pinion Mate Gear Removal

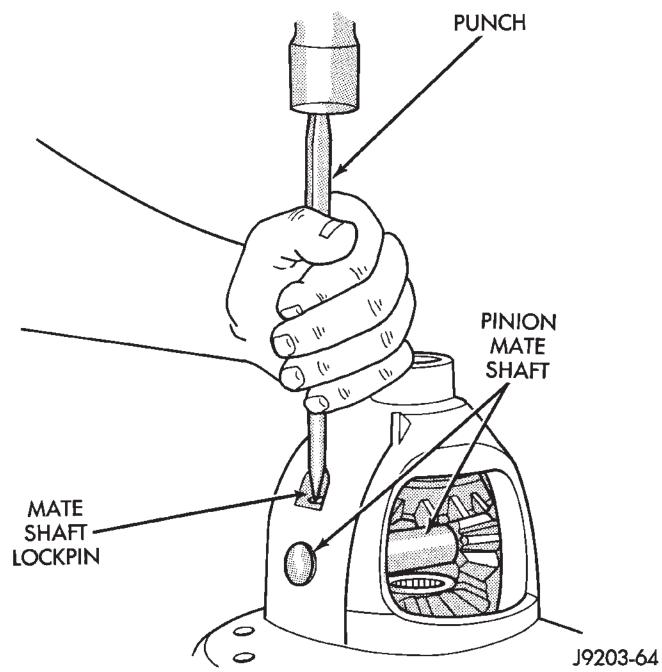


Fig. 42 Mate Shaft Roll Pin Installation

with mineral spirits. Apply a bead of Mopar® Silicone Rubber Sealant, or equivalent, on the housing cover (Fig. 43).

Install the housing cover within 5 minutes after applying the sealant.

(2) Install the cover on the differential with the attaching bolts. Install the identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

DISASSEMBLY AND ASSEMBLY (Continued)

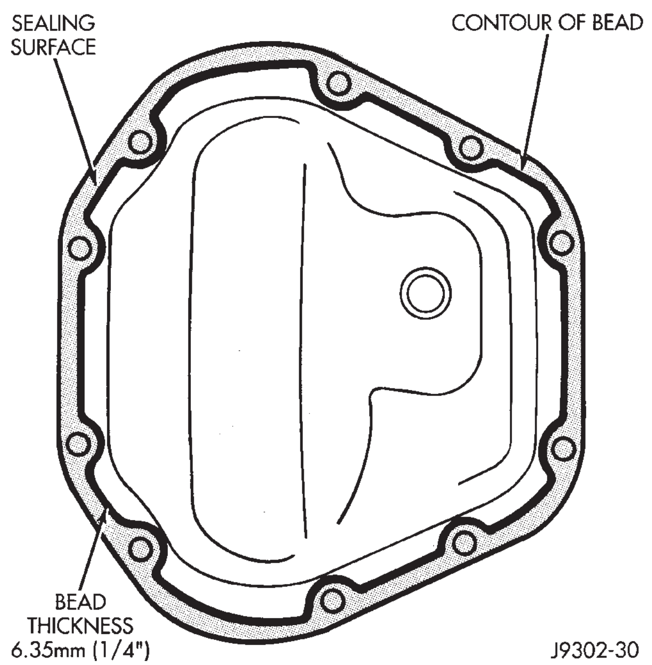


Fig. 43 Typical Housing Cover With Sealant

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

(3) Refill the differential housing with gear lubricant. Refer to the Lubricant Specifications section of this group for the gear lubricant requirements.

(4) Install the fill hole plug.

CLEANING AND INSPECTION

CARDAN U-JOINT

Clean all the U–joint yoke bores with cleaning solvent and a wire brush. Ensure that all the rust and foreign matter are removed from the bores.

Inspect the yokes for distortion, cracks and worn bearing cap bores.

Replace the complete U–joint if any of the components are defective.

AXLE COMPONENTS

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

Wash bearings with solvent and towel dry, or dry with compressed air. DO NOT spin bearings with compressed air. **Cup and bearing must be replaced as matched sets only.**

Clean axle shaft tubes and oil channels in housing. Inspect for;

- Smooth appearance with no broken/dented surfaces on the bearing rollers or the roller contact surfaces.
- Bearing cups must not be distorted or cracked.
- Machined surfaces should be smooth and without any raised edges.
- Raised metal on shoulders of cup bores should be removed with a hand stone.
- Wear and damage to pinion gear mate shaft, pinion gears, side gears and thrust washers. Replace as a matched set only.
- Ring and pinion gear for worn and chipped teeth.
- Ring gear for damaged bolt threads. Replaced as a matched set only.
- Pinion yoke for cracks, worn splines, pitted areas, and a rough/corroded seal contact surface. Repair or replace as necessary.
- Preload shims for damage and distortion. Install new shims, if necessary.

ADJUSTMENTS

PINION GEAR DEPTH

GENERAL INFORMATION

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and pinion gear are etched into the face of each gear (Fig. 44). 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.

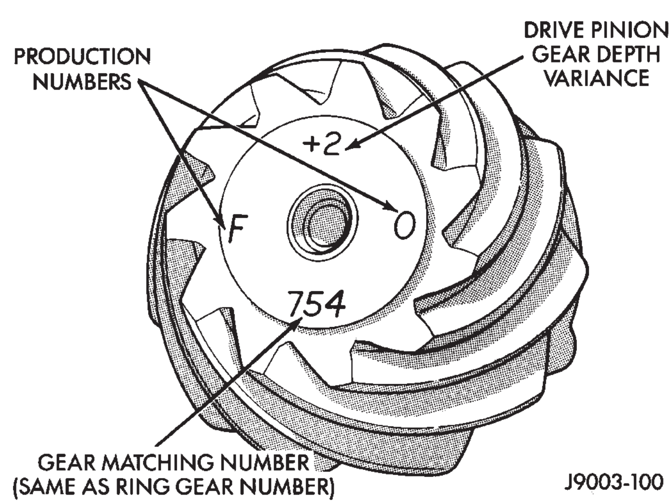


Fig. 44 Pinion Gear ID Numbers

ADJUSTMENTS (Continued)

Compensation for pinion depth variance is achieved with select shims. The shims are placed behind the rear pinion bearing cup (Fig. 45).

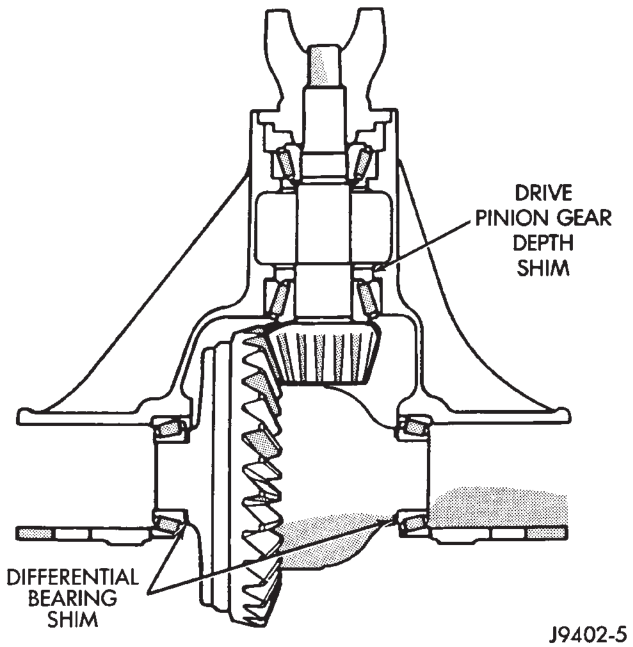


Fig. 45 Shim Locations

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 the 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. If the number is positive, subtract that value from the thickness of the depth shim. 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

Measurements are taken with pinion bearing cups and pinion bearings installed in the axle housing without any shims placed behind the rear pinion bearing cup. Take measurements with Pinion Gauge Set 6774 and Dial Indicator C-3339 (Fig. 46).

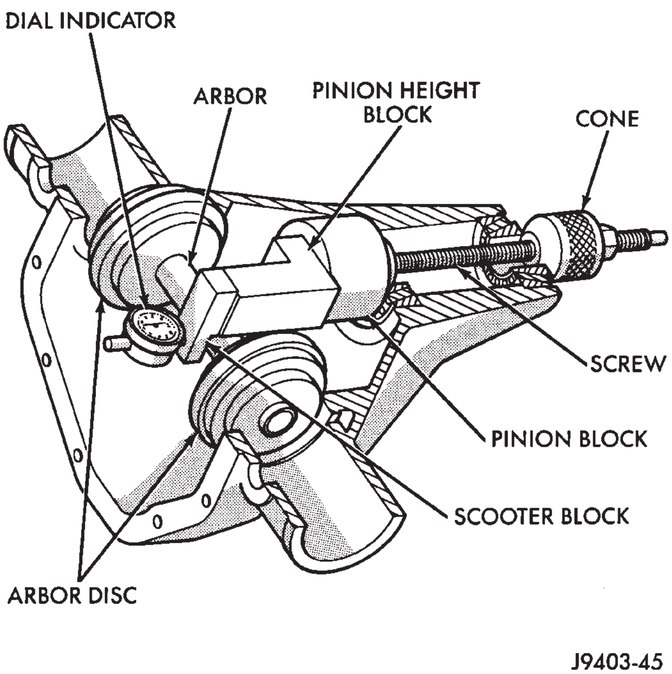


Fig. 46 Pinion Gear Depth Gauge Tools—Typical

(1) Assemble Pinion Height Block 6739, Pinion Block 6733, and rear pinion bearing onto Screw 6741 (Fig. 46).

(2) Insert assembled height gauge components, rear bearing and screw into axle housing through pinion bearing cups (Fig. 47).

(3) Install front pinion bearing and Cone-nut 6740 hand tight (Fig. 46).

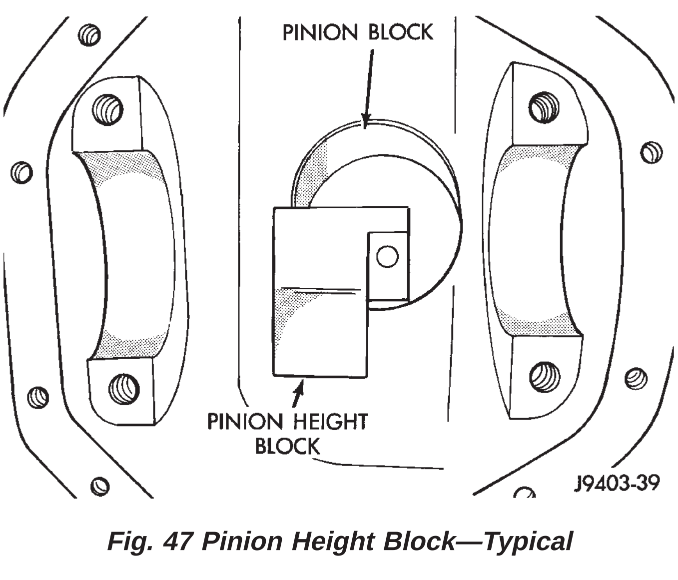


Fig. 47 Pinion Height Block—Typical

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in axle housing side bearing cradles (Fig. 48). 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.

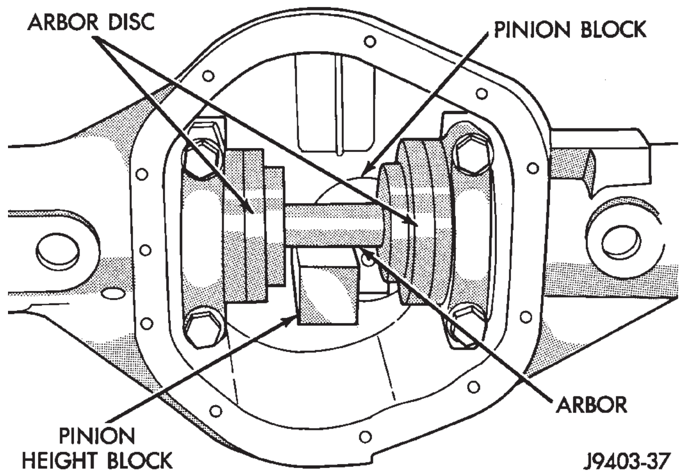


Fig. 48 Gauge Tools In Housing—Typical

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

(6) Place Scooter Block/Dial Indicator in position in axle housing so dial probe and scooter block are flush against the rearward surface of the pinion height block (Fig. 46). 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.

(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. 49). When the dial probe contacts the arbor bar, the dial pointer will turn clockwise. Bring dial pointer back to zero against the arbor bar, do not turn dial face. Continue moving the dial probe to the crest of the arbor bar and record the highest reading. If the dial indicator can not achieve the zero reading, the rear bearing cup or the pinion depth gauge set is not installed correctly.

(9) Select a shim equal to the dial indicator reading plus the drive pinion gear depth variance number etched in the face of the pinion gear (Fig. 44). For example, if the depth variance is –2, add +0.002 in. to the dial indicator reading.

ADJUSTMENTS (Continued)

NOTE: If an oil slinger is used behind the inner pinion bearing, deduct the thickness of the slinger from the dial indicator reading and use that total for shim selection.

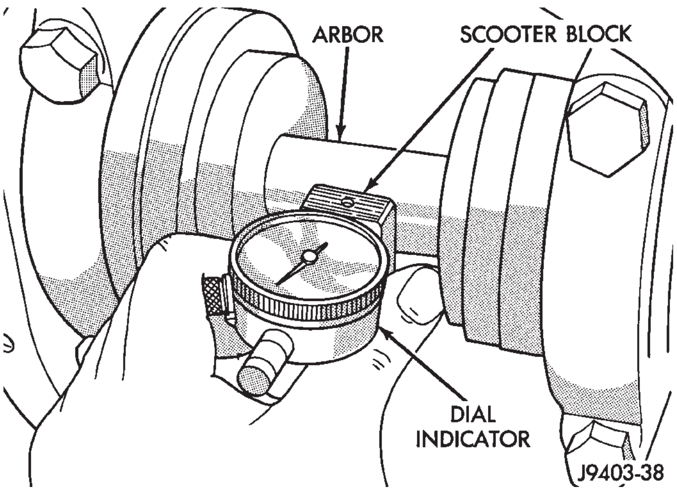


Fig. 49 Pinion Gear Depth Measurement—Typical

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

INTRODUCTION

Differential side bearing preload and gear backlash is achieved by selective shims positioned behind the differential side bearing cones. The proper shim thickness can be determined using slip-fit dummy bearings D-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. 50). Differential shim measurements are performed with axle spreader W-129-B removed.

SHIM SELECTION

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

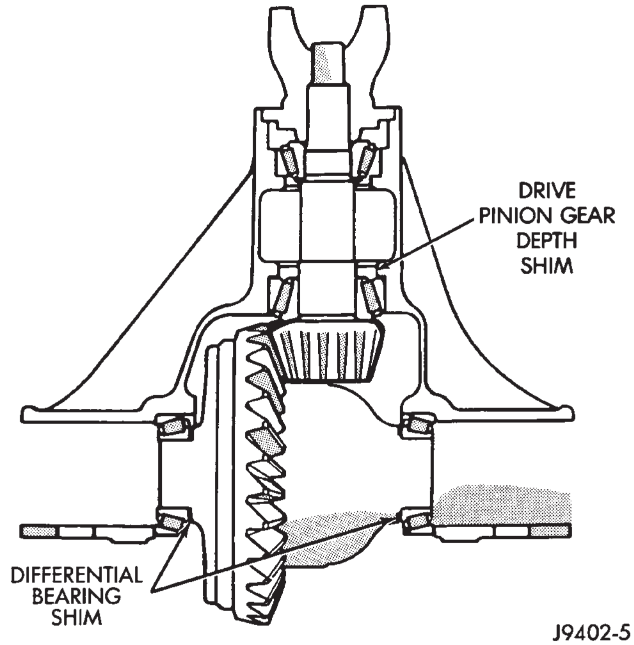


Fig. 50 Axle Adjustment Shim Locations

(1) Remove differential side bearings from differential case.

(2) Remove factory installed shims from differential case.

(3) Install ring gear on differential case and tighten bolts to specification.

(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. 51).

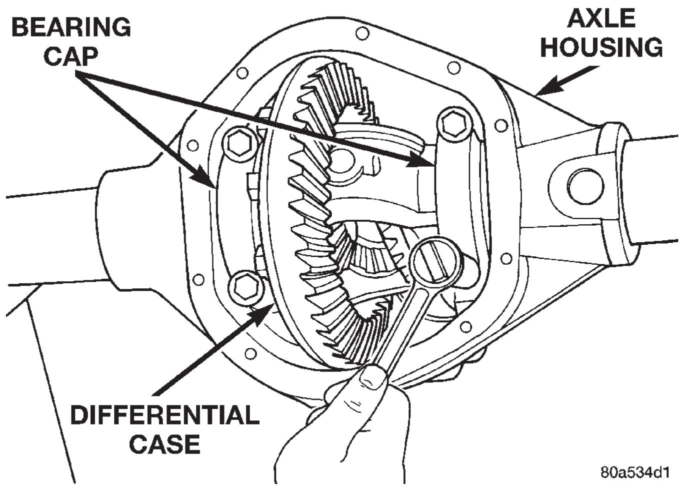


Fig. 51 Tighten Bolts Holding Bearing Caps

ADJUSTMENTS (Continued)

(7) Using a dead-blow type mallet, seat the differential dummy bearings to each side of the axle housing (Fig. 52) and (Fig. 53).

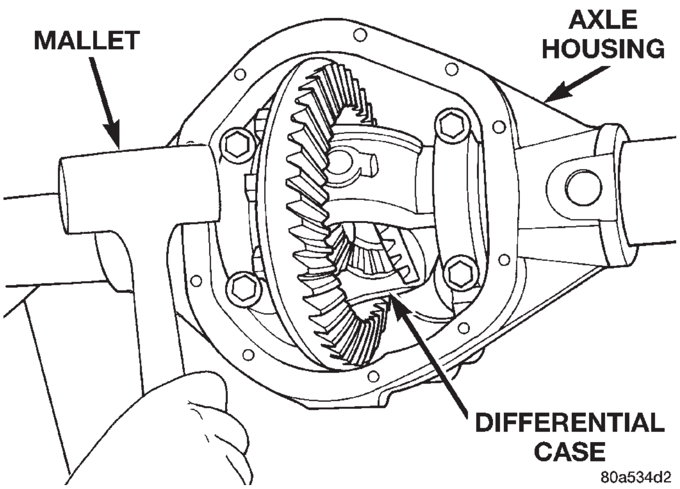


Fig. 52 Seat Pinion Gear Side Differential Dummy Side Bearing

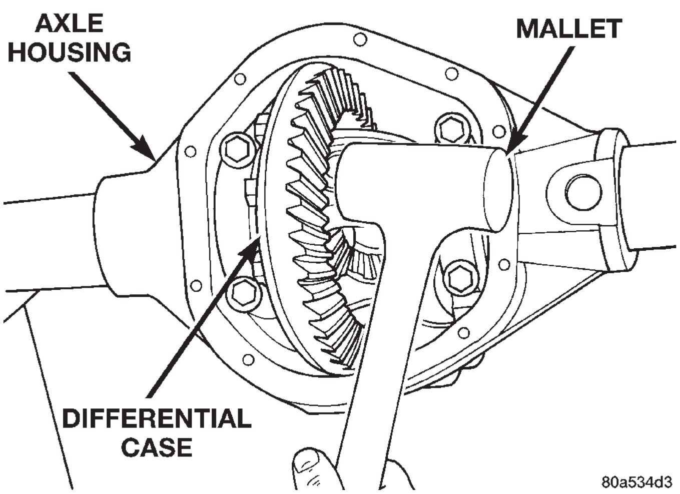


Fig. 53 Seat Ring Gear Side Differential Dummy Side Bearing

(8) Thread guide stud C-3288-B into rear cover bolt hole below ring gear (Fig. 54).

(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. 54).

(10) Push and hold differential case to pinion gear side of axle housing (Fig. 55).

(11) Zero dial indicator face to pointer (Fig. 55).

(12) Push and hold differential case to ring gear side of the axle housing (Fig. 56).

(13) Record dial indicator reading (Fig. 56).

(14) 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.

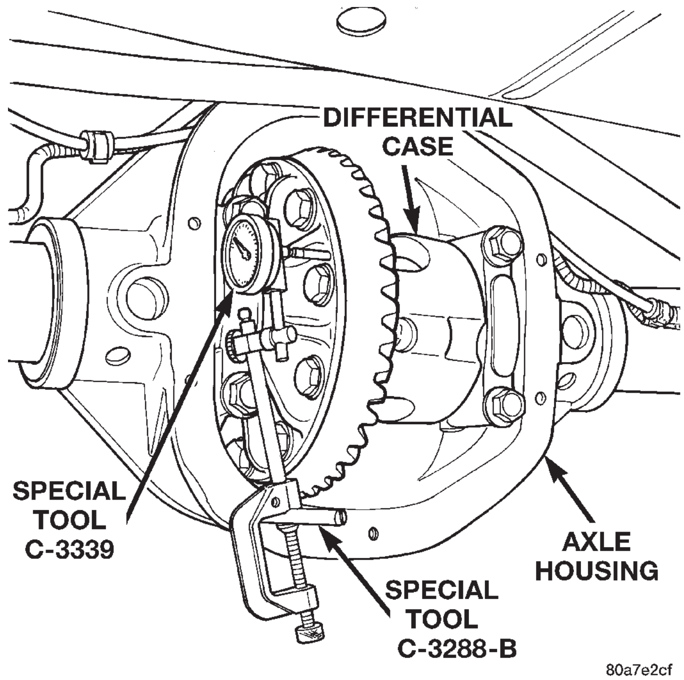


Fig. 54 Differential Side play Measurement

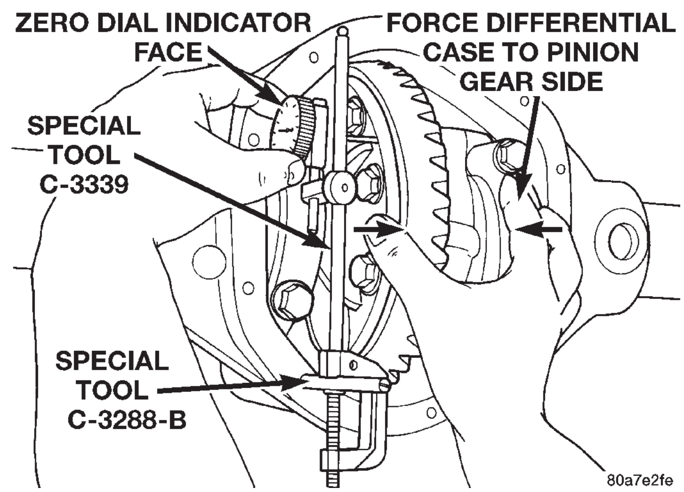


Fig. 55 Hold Differential Case and Zero Dial Indicator

(15) Rotate dial indicator out of the way on the guide stud.

(16) Remove differential case and dummy bearings from axle housing.

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

(18) Install differential case and dummy bearings D-348 in axle housing (without shims), install bearing caps and tighten bolts snug.

(19) Seat ring gear side dummy bearing (Fig. 53).

(20) Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 54).

(21) Push and hold differential case toward pinion gear (Fig. 57).

ADJUSTMENTS (Continued)

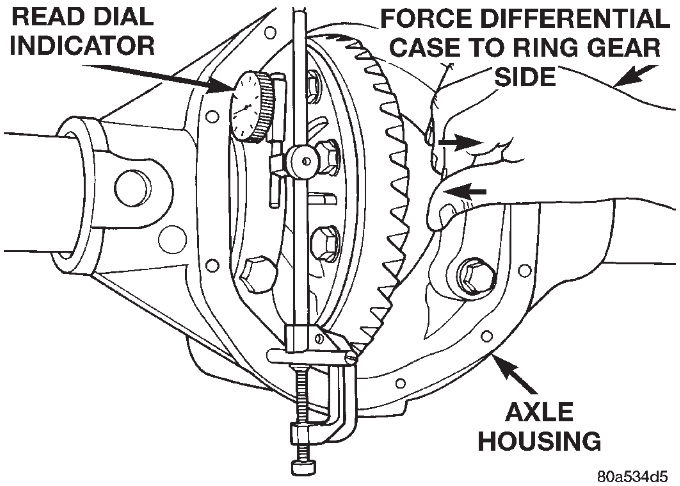


Fig. 56 Hold Differential Case and Read Dial Indicator

(22) Zero dial indicator face to pointer (Fig. 57).

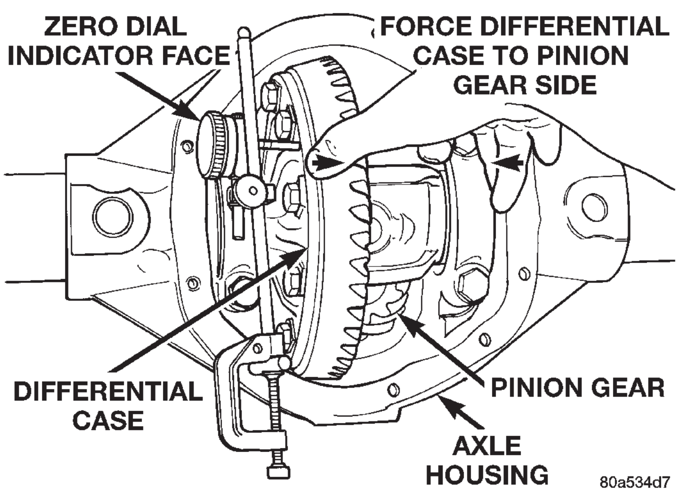


Fig. 57 Hold Differential Case and Zero Dial Indicator

(23) Push and hold differential case to ring gear side of the axle housing (Fig. 58).

(24) Record dial indicator reading (Fig. 58).

(25) 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.

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

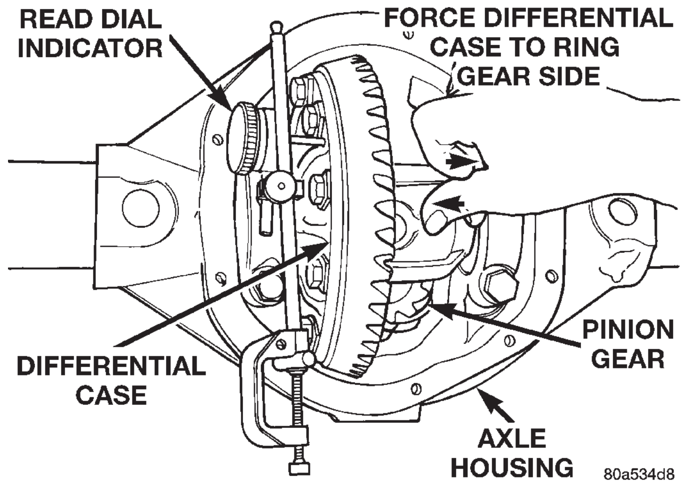


Fig. 58 Hold Differential Case and Read Dial Indicator

(27) Rotate dial indicator out of the way on guide stud.

(28) Remove differential case and dummy bearings from axle housing.

(29) Install side bearing shims on differential case hubs.

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

(31) Install spreader W-129-B, utilizing some items from Adapter Set 6987, on axle housing and spread axle opening enough to receive differential case.

(32) Install differential case in axle housing.

(33) Remove spreader from axle housing.

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

(35) Position the indicator plunger against a ring gear tooth (Fig. 59).

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

(37) Zero dial indicator face to pointer.

(38) Push and hold ring gear downward while not allowing the pinion gear to rotate. Dial indicator reading should be between 0.12 mm (0.005 in.) and 0.20 mm (0.008 in.). If backlash is not within specifications transfer the necessary amount of shim thickness from one side of the axle housing to the other (Fig. 60).

(39) Verify differential case and ring gear runout by measuring ring to pinion gear backlash at several locations around the ring gear. Readings should not vary more than 0.05 mm (0.002 in.). If readings vary more than specified, the ring gear or the differential case is defective.

ADJUSTMENTS (Continued)

After the proper backlash is achieved, perform Gear Contact Pattern Analysis procedure.

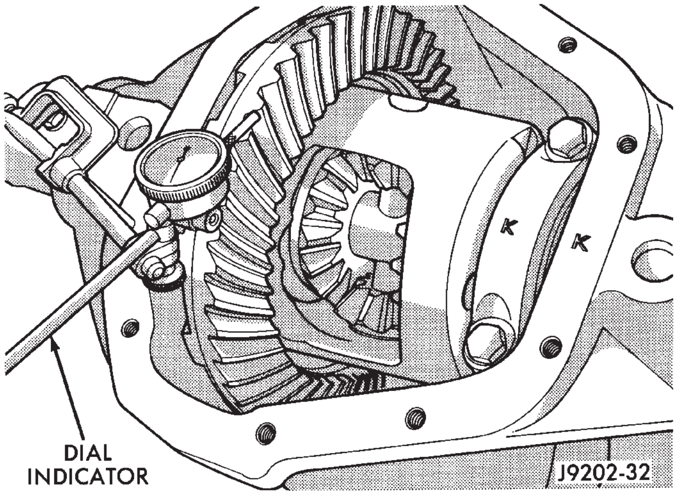


Fig. 59 Ring Gear Backlash Measurement

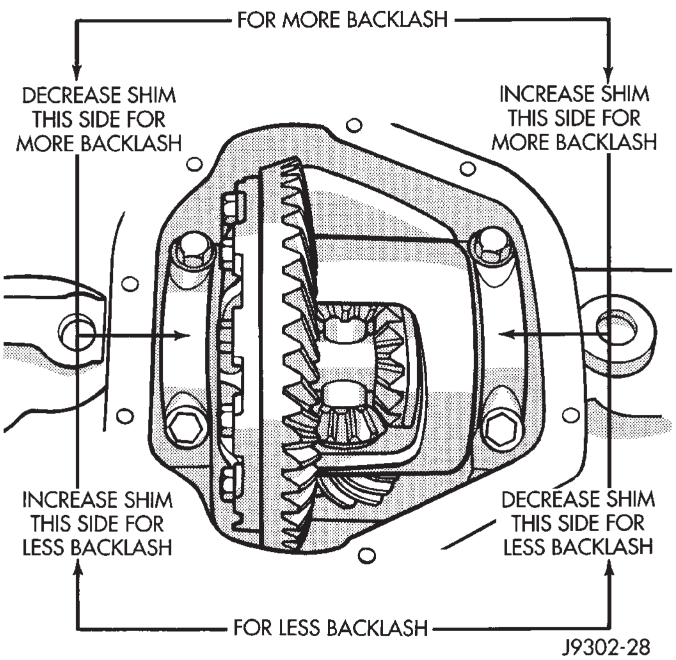


Fig. 60 Backlash Shim Adjustment

GEAR CONTACT PATTERN ANALYSIS

The ring and pinion gear teeth contact patterns will show if the pinion gear depth is correct in the axle housing. It will also show if the ring gear backlash has been adjusted correctly. The backlash can be adjusted within specifications to achieve desired tooth contact patterns.

(1) Apply a thin coat of hydrated ferric oxide, or equivalent, to the drive and coast side of the ring gear teeth.

(2) Wrap, twist, and hold a shop towel around the pinion yoke to increase the turning resistance of the pinion gear. This will provide a more distinct contact pattern.

(3) Using a boxed end wrench on a ring gear bolt, Rotate the differential case one complete revolution in both directions while a load is being applied from shop towel.

The areas on the ring gear teeth with the greatest degree of contact against the pinion gear teeth will squeegee the compound to the areas with the least amount of contact. Note and compare patterns on the ring gear teeth to Gear Tooth Contact Patterns chart (Fig. 61) and adjust pinion depth and gear backlash as necessary.

ADJUSTMENTS (Continued)

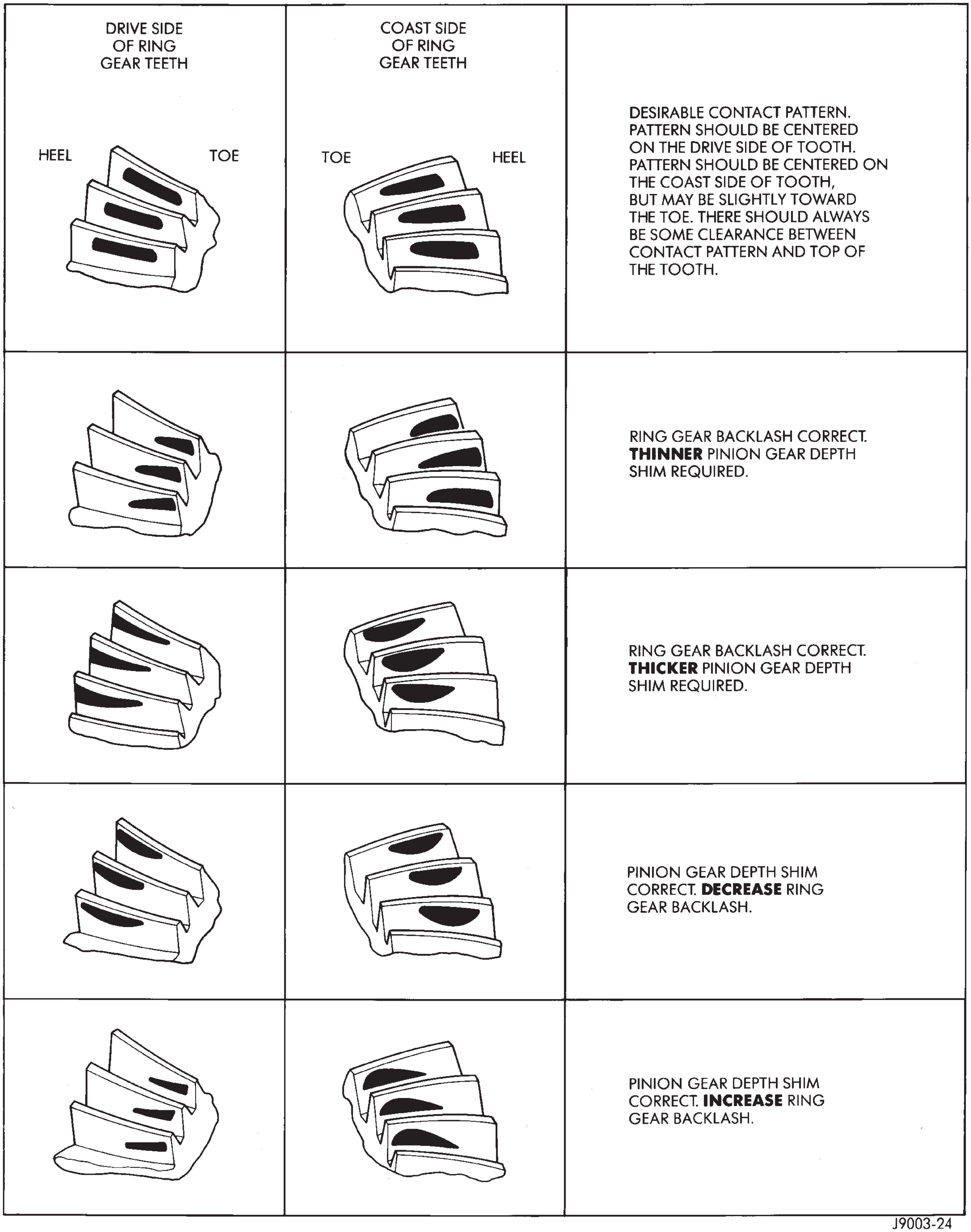


Fig. 61 Gear Tooth Contact Patterns

SPECIFICATIONS

181 FBI AXLE

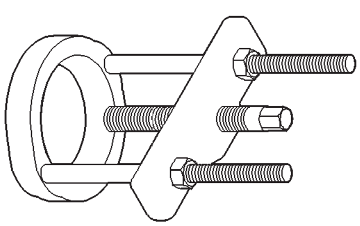
Axle Type	Hypoid
Lubricant	SAE Thermally Stable 80W–90
Lube Capacity	1.48 L (3.13 pts.)
Axle Ratio	3.07, 3.55, 3.73, 4.10
Differential Side Gear Clearance	0.12–0.20 mm (0.005–0.008 in.)
Ring Gear Diameter	18.09 cm (7.125 in.)
Backlash	0–0.15 mm (0.005–0.008 in.)
Pinion Std. Depth	92.1 mm (3.625 in.)
Pinion Bearing Rotating Torque	
Original Bearings	1–2 N·m (10–20 in. lbs.)
New Bearings	1.5–4 N·m (15–35 in. lbs.)

181 FBI AXLE

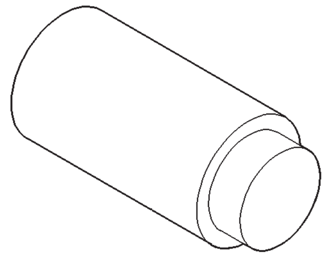
DESCRIPTION	TORQUE
Fill Hole Plug	34 N·m (25 ft. lbs.)
Diff. Cover Bolt	41 N·m (30 ft. lbs.)
Bearing Cap Bolt	61 N·m (45 ft. lbs.)
Ring Gear Bolt	95–122 N·m (70–90 ft. lbs.)
Axle Nut	237 N·m (175 ft. lbs.)
Hub Brg. Bolt	102 N·m (75 ft. lbs.)
Lower Ball Stud	108 N·m (80 ft. lbs.)
Upper Ball Stud	101 N·m (75 ft. lbs.)

SPECIAL TOOLS

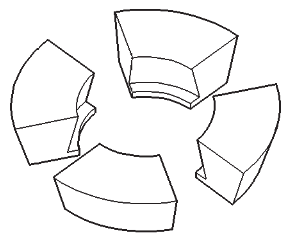
181 FBI AXLE



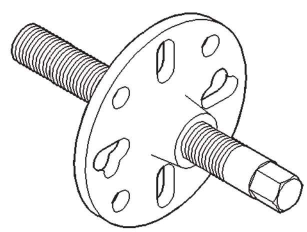
Puller—C-293-PA



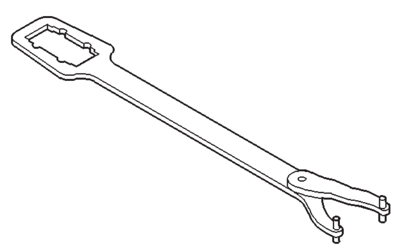
Plug—SP-3289



Adapter—C-293-39

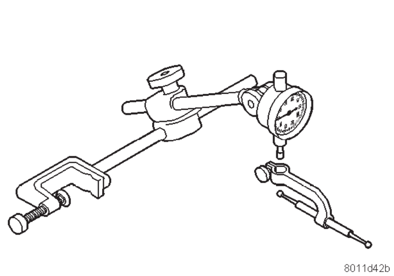


Puller—C-452

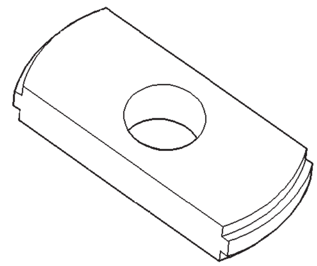


Wrench—C-3281

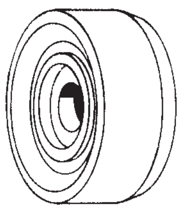
SPECIAL TOOLS (Continued)



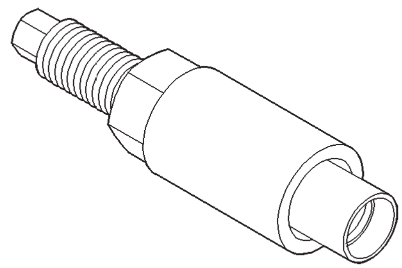
Dial Indicator—C-3339



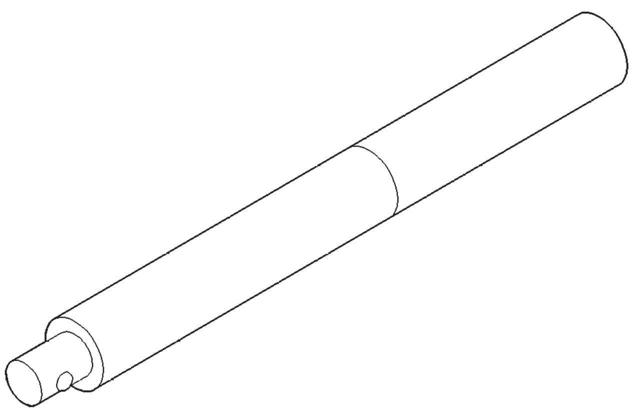
Remover—D-149



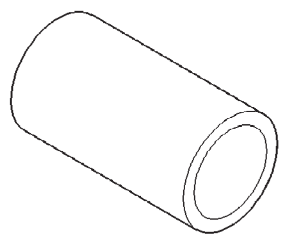
Driver—C-3716-A



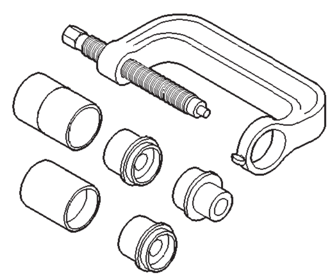
Installer—W-162-D



Handle—C-4171



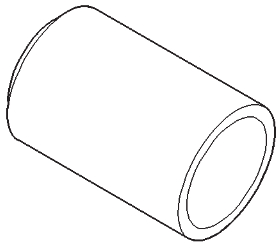
Cup—8109



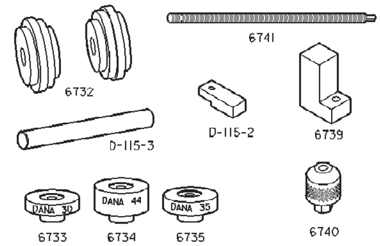
Remover/Installer—6289

Installer—D-146

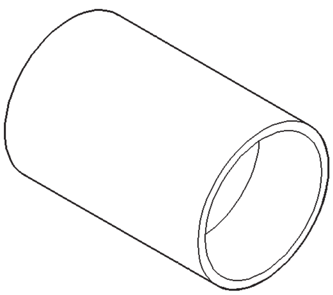
SPECIAL TOOLS (Continued)



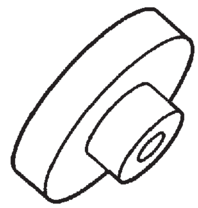
Installer—6761



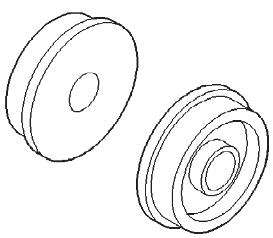
Tool Set, Pinion Depth—6774



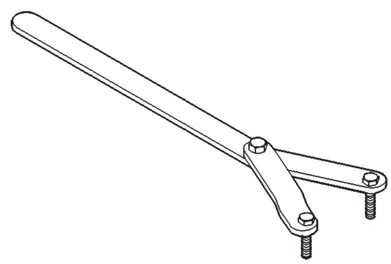
Installer—6752



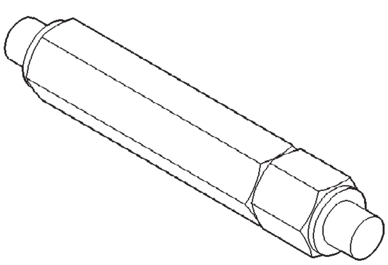
Gauge Block—6733



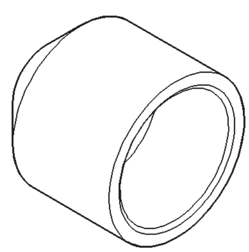
Installer Discs—8110



Spanner—6958

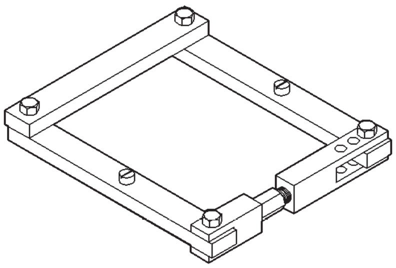


Turnbuckle—6797

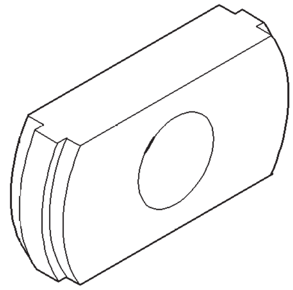


Installer—C-3972-A

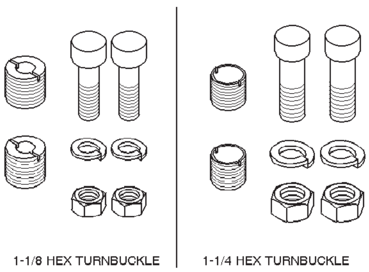
SPECIAL TOOLS (Continued)



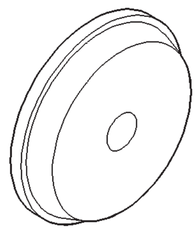
Spreader—W-129-B



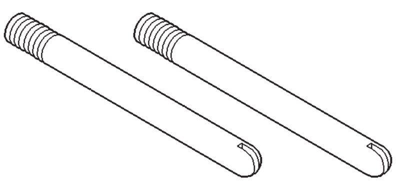
Remover—D-147



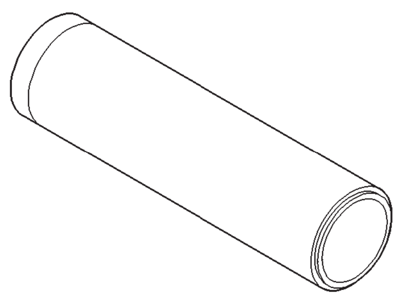
Adapter Kit—6987



Installer—D-144



Pilot Stud—C-3288-B



Installer—W-262

194 RBI AXLE

INDEX

GENERAL INFORMATION

194 RBI AXLE

The 194 Rear Beam-design Iron (RBI) axle housing has an iron center casting (differential housing) with axle shaft tubes extending from either side. The tubes are pressed into and welded to the differential housing to form a one-piece axle housing.

The integral type, hypoid gear design, housing has the centerline of the pinion set below the centerline 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, meaning that loads are supported by the axle shaft and bearings. The axle shafts are retained by C–clips in the differential side gears.

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

For vehicles equipped with ABS brakes, the axles have a tone ring pressed onto the axle shaft. Use care when removing axle shafts to ensure that the tone wheel or the wheel speed sensor are not damaged.

The 194 RBI axle has the assembly part number and gear ratio listed on a tag. The tag is attached to the differential housing by a cover bolt. Build date identification codes are stamped on the cover side of an axle shaft tube.

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 the use of selective spacer shims. Pinion bearing preload is set and maintained by the use of a collapsible spacer (Fig. 1).

LUBRICANT SPECIFICATIONS

A multi-purpose, hypoid gear lubricant which conforms to the following specifications should be used. Mopar® Hypoid Gear Lubricant conforms to all of these specifications.

- The lubricant should have MIL–L–2105C and API GL 5 quality specifications.
- Lubricant is a thermally stable SAE 80W–90 gear lubricant.
- Lubricant for axles intended for heavy-duty or trailer tow use is SAE 75W–140 SYNTHETIC gear lubricant.

Trac-lok differentials require the addition of 3.5 oz. of friction modifier to the axle lubricant. The 194 RBI

GENERAL INFORMATION (Continued)

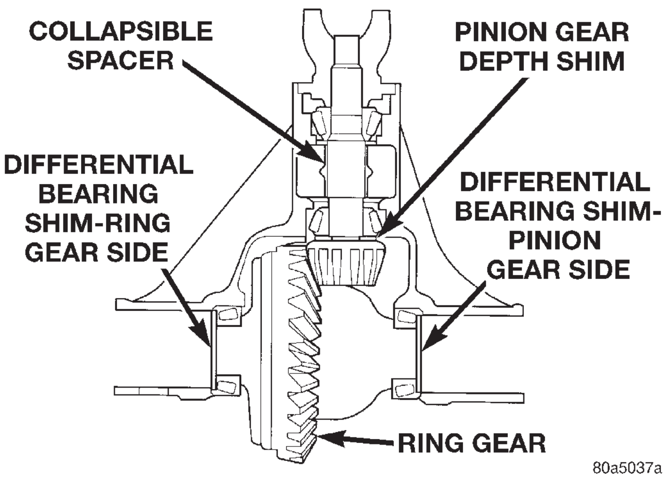


Fig. 1 Shim Locations

axle lubricant capacity is 1.66L (3.50 pts.) total, including the friction modifier if necessary.

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

DESCRIPTION AND OPERATION

STANDARD DIFFERENTIAL

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

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

In operation, power flow occurs as follows:

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

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 2).

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. The difference must be compensated for to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential

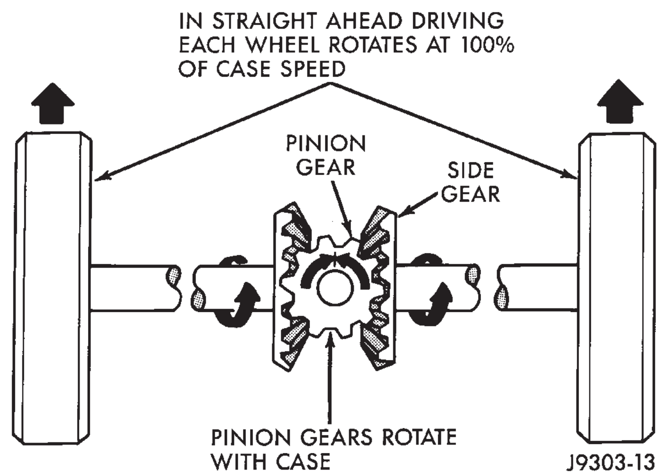


Fig. 2 Differential Operation—Straight Ahead Driving

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.

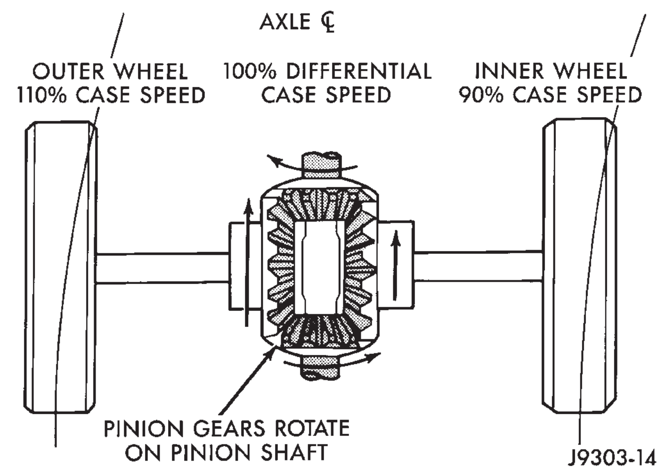


Fig. 3 Differential Operation—On Turns

TRAC-LOK™ OPERATION

In a conventional differential, if one wheel spins, the opposite wheel will generate only as much torque as the spinning wheel.

In the Trac-lok™ differential, part of the ring gear torque is transmitted through clutch packs which contain multiple discs. The clutches will have radial grooves on the plates, and concentric grooves on the discs or bonded fiber material that is smooth in appearance.

In operation, the Trac-lok™ clutches are engaged by two concurrent forces. The first being the preload force exerted through Belleville spring washers within the clutch packs. The second is the separating

DESCRIPTION AND OPERATION (Continued)

forces generated by the side gears as torque is applied through the ring gear (Fig. 4).

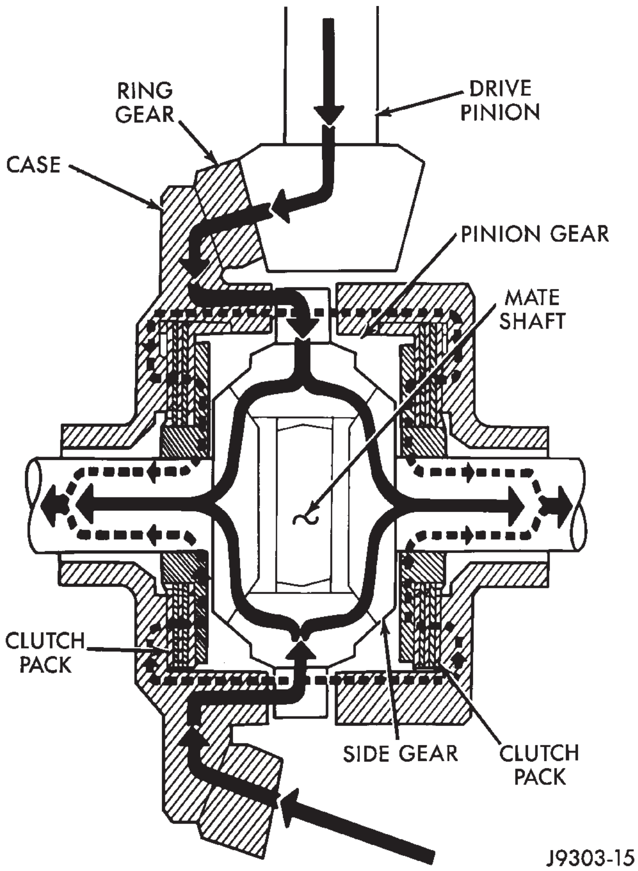


Fig. 4 Trac-lok™ Limited Slip Differential Operation

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

DIAGNOSIS AND TESTING

GENERAL INFORMATION

Axle bearing problem conditions are usually caused by:

- Insufficient or incorrect lubricant.
- Foreign matter/water contamination.
- Incorrect bearing preload torque adjustment.
- Incorrect backlash.

Axle gear problem conditions are usually the result of:

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

Axle component breakage is most often the result of:

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

GEAR NOISE

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

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

When road testing, accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak–noise range. If the noise stops or changes greatly:

- Check for insufficient lubricant.
- Incorrect ring gear backlash.
- Gear damage.

Differential side and pinion gears can be checked by turning the vehicle. They usually do not cause noise during straight–ahead driving when the gears are unloaded. The side gears are loaded during vehicle turns. A worn pinion gear mate shaft can also cause a snapping or a knocking noise.

BEARING NOISE

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

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

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

DIAGNOSIS AND TESTING (Continued)

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

LOW SPEED KNOCK

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

VIBRATION

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

- Damaged drive shaft.
- Missing drive shaft balance weight(s).
- Worn or out–of–balance wheels.
- Loose wheel lug nuts.
- Worn U–joint(s).
- Loose/broken springs.
- Damaged axle shaft bearing(s).
- Loose pinion gear nut.
- Excessive pinion yoke run out.
- Bent axle shaft(s).

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

All driveline components should be examined before starting any repair.

Refer to Group 22, Wheels and Tires, for additional vibration information.

DRIVELINE SNAP

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

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

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

TRAC–LOK™ DIFFERENTIAL NOISE

The most common problem is a chatter noise when turning corners. Before removing a Trac-lok™ unit for repair, drain, flush and refill the axle with the specified lubricant. Refer to Lubricant change in this Group.

A container of Mopar® Trac-lok™ Lubricant (friction modifier) should be added after repair service or during a lubricant change.

After changing the lubricant, drive the vehicle and make 10 to 12 slow, figure-eight turns. This maneuver will pump lubricant through the clutches. This will correct the condition in most instances. If the chatter persists, clutch damage could have occurred.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
WHEEL NOISE	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	1. Misaligned axle shaft tube. 2. Bent or sprung axle shaft. 3. End play in drive pinion bearings. 4. Excessive gear backlash between ring gear and pinion gear. 5. Improper adjustment of drive pinion gear shaft bearings. 6. Loose drive pinion gearshaft yoke nut. 7. Improper wheel bearing adjustment. 8. Scuffed gear tooth contact surfaces.	1. Inspect axle shaft tube alignment. Correct as necessary. 2. Replace bent or sprung axle shaft. 3. Refer to Drive Pinion Bearing Pre-Load Adjustment. 4. Check adjustment of ring gear backlash and pinion gear. Correct as necessary. 5. Adjust drive pinion shaft bearings. 6. Tighten drive pinion gearshaft yoke nut with specified torque. 7. Readjust as necessary. 8. If necessary, replace scuffed gears.
AXLE SHAFT BROKE	1. Misaligned axle shaft tube. 2. Vehicle overloaded. 3. Erratic clutch operation. 4. Grabbing clutch.	1. Replace broken axle shaft after correcting axle shaft tube alignment. 2. Replace broken axle shaft. Avoid excessive weight on vehicle. 3. Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch. 4. Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	1. Improper adjustment of differential bearings. 2. Excessive ring gear backlash. 3. Vehicle overloaded. 4. Erratic clutch operation.	1. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly. 2. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly. 3. Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle. 4. Replace cracked case. After inspecting for other possible causes, examine gears and bearings for possible damage. Avoid erratic use of clutch.
DIFFERENTIAL GEARS SCORED	1. Insufficient lubrication. 2. Improper grade of lubricant. 3. Excessive spinning of one wheel/tire.	1. Replace scored gears. Scoring marks on the drive face of gear teeth or in the bore are caused by instantaneous fusing of the mating surfaces. Scored gears should be replaced. Fill rear differential housing to required capacity with proper lubricant. Refer to Specifications. 2. Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant. 3. Replace scored gears. Inspect all gears, pinion bores and shaft for damage. Service as necessary.
LOSS OF LUBRICANT	1. Lubricant level too high.	1. Drain excess lubricant by removing fill plug and allow lubricant to level at lower edge of fill plug hole.

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DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART – 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

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DIAGNOSIS AND TESTING (Continued)

TRAC–LOK™ TEST

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

The differential can be tested without removing the differential case by measuring rotating torque. Make sure brakes are not dragging during this measurement.

(1) Place blocks in front and rear of both front wheels.

(2) Raise one rear wheel until it is completely off the ground.

(3) Engine off, transmission in neutral, and parking brake off.

(4) Remove wheel and bolt Special Tool 6790 to studs.

(5) Use torque wrench on special tool to rotate wheel and read rotating torque (Fig. 5).

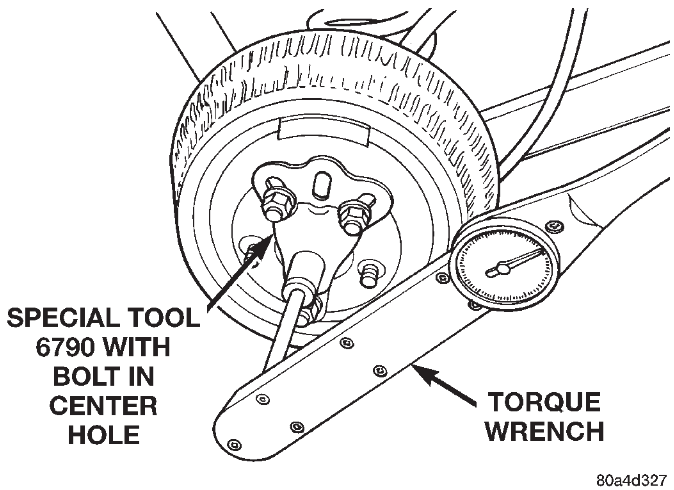

Fig. 5 Trac-lok™ Test —Typical

(6) If rotating torque is less than 22 N·m (30 ft. lbs.) or more than 271 N·m (200 ft. lbs.) on either wheel the unit should be serviced.

SERVICE PROCEDURES

LUBRICANT CHANGE

(1) Raise and support the vehicle.

(2) Remove the lubricant fill hole plug from the differential housing cover.

(3) Remove the differential housing cover and drain the lubricant from the housing.

(4) Clean the housing cavity with a flushing oil, light engine oil, or lint free cloth. **Do not use water, steam, kerosene, or gasoline for cleaning.**

(5) Remove the original sealant from the housing and cover surfaces.

(6) Apply a bead of Mopar® Silicone Rubber Sealant, or equivalent, to the housing cover (Fig. 6).

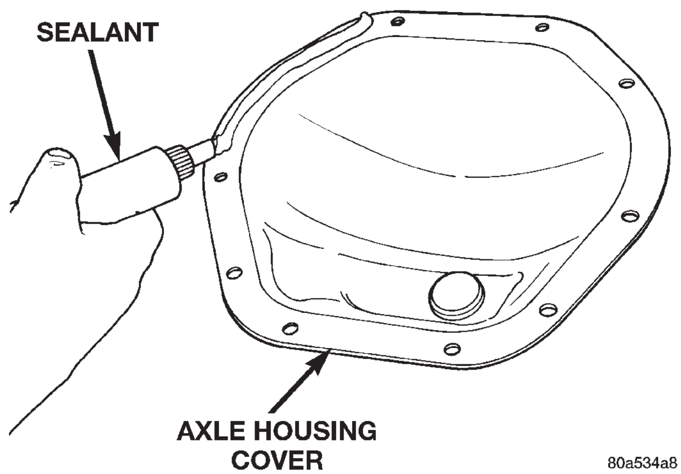

Fig. 6 Apply Sealant

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) For Trac–lok™ differentials, a quantity of Mopar® Trac–lok™ lubricant (friction modifier), or equivalent, must be added after repair service or a lubricant change. Refer to the Lubricant Specifications section of this group for the quantity necessary.

(9) Fill differential with Mopar® Hypoid Gear Lubricant, or equivalent, to bottom of the fill plug hole. Refer to the Lubricant Specifications section of this group for the quantity necessary.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

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

(11) Trac–lok™ differential equipped vehicles should be road tested by making 10 to 12 slow figure-eight turns. This maneuver will pump the lubricant through the clutch discs to eliminate a possible chatter noise complaint.

REMOVAL AND INSTALLATION

REAR AXLE

REMOVAL

(1) Raise and support the vehicle.
(2) Position a suitable lifting device under the axle.
(3) Secure axle to device.
(4) Remove the wheels and tires.
(5) Remove the brake drums from the axle. Refer to Group 5, Brakes, for proper procedures.
(6) Disconnect parking brake cables from brackets and lever.
(7) Remove wheel speed sensors, if necessary. Refer to Group 5, Brakes, for proper procedures.
(8) Disconnect the brake hose at the axle junction block. Do not disconnect the brake hydraulic lines at the wheel cylinders. Refer to Group 5, Brakes, for proper procedures.
(9) Disconnect the vent hose from the axle shaft tube.
(10) Mark the propeller shaft and yokes for installation alignment reference.
(11) Remove propeller shaft.
(12) Disconnect stabilizer bar links.
(13) Disconnect shock absorbers from axle.
(14) Remove the U-bolts which hold the axle to the spring brackets.
(15) 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 lifting device and align the spring centering bolts with the mating holes in the axle spring perch.
(2) Install the U-bolts which hold the axle to the spring brackets. Tighten nuts to 70 N·m (52 ft. lbs.).
(3) Install shock absorbers and tighten nuts to 60 N·m (44 ft. lbs.) torque.
(4) Install stabilizer bar links and tighten nuts to 74 N·m (55 ft. lbs.) torque.
(5) Install the wheel speed sensors, if necessary. Refer to Group 5, Brakes, for proper procedures.
(6) Connect parking brake cable to brackets and lever.
(7) Install the brake drums. Refer to Group 5, Brakes, for proper procedures.
(8) Connect the brake hose to the axle junction block. Refer to Group 5, Brakes, for proper procedures.
(9) Install axle vent hose.
(10) Align propeller shaft and pinion yoke reference marks. Install U-joint straps and bolts. Tighten to 19 N·m (14 ft. lbs.) torque.
(11) Install the wheels and tires.
(12) Add gear lubricant, if necessary. Refer to Lubricant Specifications in this section for lubricant requirements.
(13) Remove lifting device from axle and lower the vehicle.

PINION SHAFT SEAL

REMOVAL

(1) Raise and support the vehicle.
(2) Remove wheel and tire assemblies.
(3) Remove the brake drums. Refer to Group 5, Brakes, for proper procedures.
(4) Mark the propeller shaft and pinion yoke for installation alignment reference.
(5) Remove the propeller shaft from the yoke.
(6) Rotate the pinion gear three or four times.
(7) Measure the amount of torque necessary to rotate the pinion gear with a (in. lbs.) dial-type torque wrench. Record the torque reading for installation reference.
(8) Using Holder 6958 to hold the pinion yoke, remove the pinion nut and washer.
(9) Use Remover C-452 and Wrench C-3281 to remove the pinion yoke (Fig. 7).

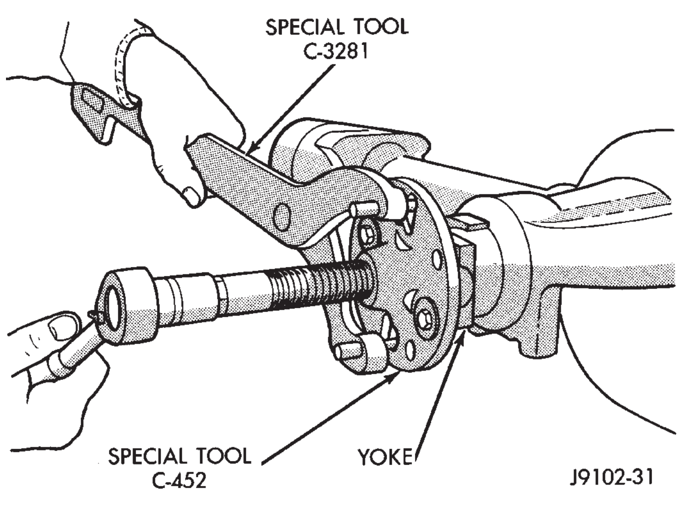

Fig. 7 Pinion Yoke Removal

(10) Use a suitable pry tool or slide hammer mounted screw to remove the pinion gear seal.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer C-3972-A and Handle C-4171 (Fig. 8).

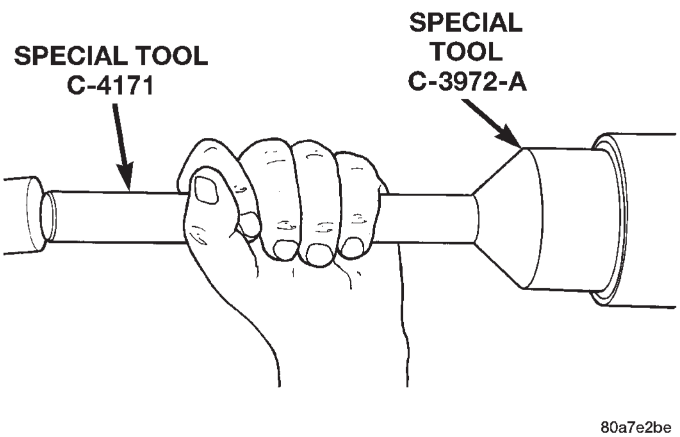

Fig. 8 Pinion Seal Installation

(2) Install yoke on the pinion gear with Screw 8112, Cup 8109, and Holder 6958 (Fig. 9).

CAUTION: Do not exceed the minimum tightening torque when installing the pinion yoke at this point. Damage to the collapsible spacer or bearings may result.

(3) Install the yoke washer and a new nut on the pinion gear and tighten the pinion nut until there is zero bearing end-play.

(4) Tighten the nut to 271 N·m (200 ft. lbs.).

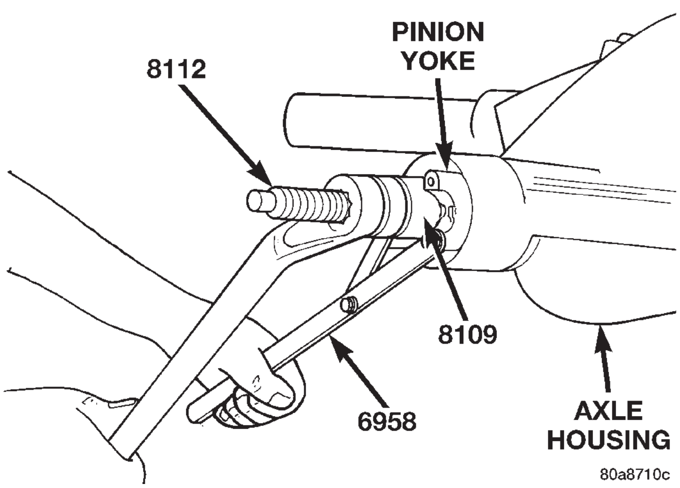

Fig. 9 Pinion Yoke Installation

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing rotating torque and never exceed specified preload torque. If preload torque or rotating torque is exceeded a new collapsible spacer must be installed. The torque sequence will then have to be repeated.

(5) Rotate the pinion shaft using a (in. lbs.) torque wrench. Rotating torque should be equal to the reading recorded during removal plus an additional 0.56 N·m (5 in. lbs.) (Fig. 10).

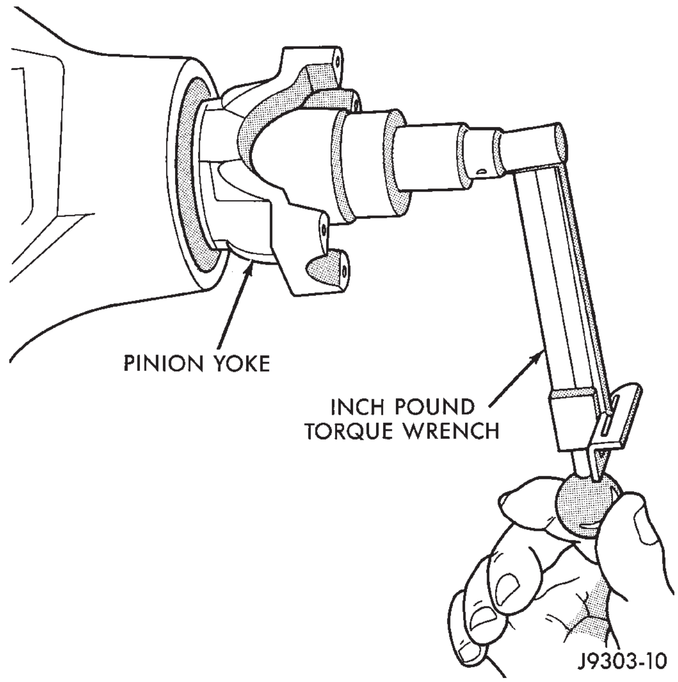

Fig. 10 Check Pinion Rotation Torque

(6) If the rotating torque is low, use Holder 6958 to hold the pinion yoke (Fig. 11), and tighten the pinion shaft nut in 6.8 N·m (5 ft. lbs.) increments until the proper rotating torque is achieved.

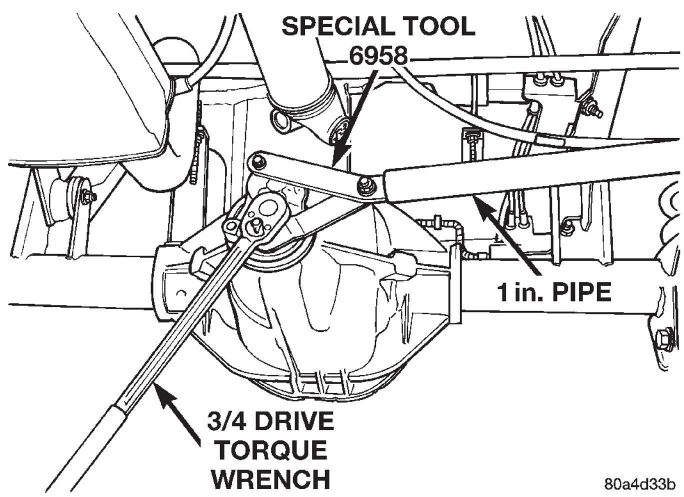

Fig. 11 Tightening Pinion Shaft Nut–Typical

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

REMOVAL AND INSTALLATION (Continued)

(7) Align the installation reference marks on the propeller shaft and yoke and install the propeller shaft.

(8) Add gear lubricant to the differential housing, if necessary. Refer to the Lubricant Specifications for gear lubricant requirements.

(9) Install the brake drums. Refer to Group 5, Brakes, for proper procedures.

(10) Install wheel and tire assemblies.

(11) Lower the vehicle.

COLLAPSIBLE SPACER

REMOVAL W/PINION INSTALLED

(1) Raise and support the vehicle.

(2) Remove wheel and tire assemblies.

(3) Remove rear brake drums. Refer to Group 5, Brakes, for proper procedures.

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

(5) Remove the propeller shaft from the yoke.

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

(7) Measure the amount of torque necessary to rotate the pinion gear with a (in. lbs.) dial-type torque wrench. Record the torque reading for installation reference.

(8) Using Holder 6958 to hold the pinion yoke, remove the pinion nut and washer.

(9) Use Remover C-452 and Wrench C-3281 to remove the pinion yoke (Fig. 12).

(10) Use a suitable pry tool or a slide hammer mounted screw to remove the pinion shaft seal.

(11) Remove the front pinion bearing using a pair of suitable pick tools to pull the bearing straight off the pinion gear shaft. It may be necessary to lightly tap the end of the pinion gear with a rawhide or rubber mallet if the bearing becomes bound on the pinion shaft.

(12) Remove the collapsible spacer.

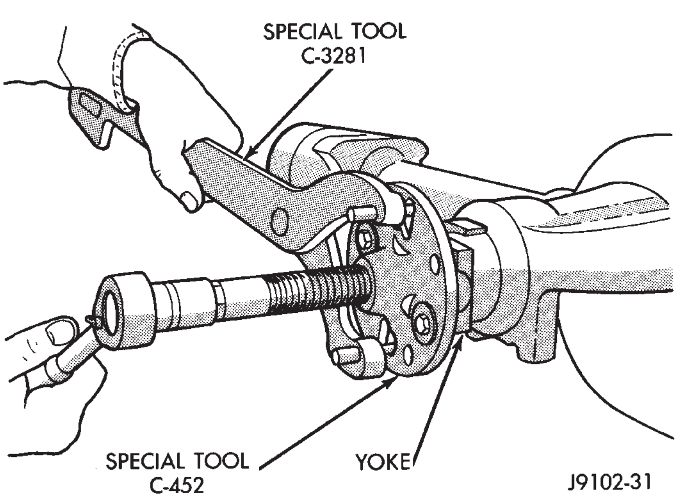

Fig. 12 Pinion Yoke Removal

REMOVAL W/PINION REMOVED

(1) Raise and support the vehicle.

(2) Remove wheel and tire assemblies.

(3) Remove rear brake drums. Refer to Group 5, Brakes, for proper procedures.

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

(5) Remove the propeller shaft from the yoke.

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

(7) Measure the amount of torque necessary to rotate the pinion gear with a (in. lbs.) dial-type torque wrench. Record the torque reading for installation reference.

(8) Remove differential assembly from axle housing.

(9) Using Holder 6958 to hold yoke, remove the pinion yoke nut and washer.

(10) Using Remover C–452 and Wrench C–3281, remove the pinion yoke from pinion shaft (Fig. 12).

(11) Remove the pinion gear from housing (Fig. 13). Catch the pinion with your hand to prevent it from falling and being damaged.

(12) Remove collapsible spacer from pinion shaft.

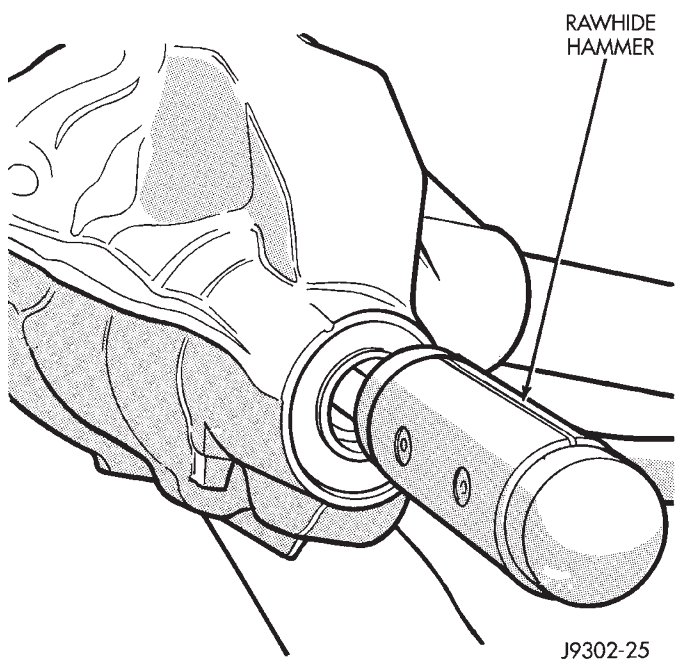

Fig. 13 Remove Pinion Gear

INSTALLATION

(1) Install a new collapsible preload spacer on pinion shaft (Fig. 14).

(2) If pinion gear was removed, install pinion gear in housing.

(3) Install pinion front bearing, if necessary.

(4) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer C-3972-A and Handle C–4171 (Fig. 15).

REMOVAL AND INSTALLATION (Continued)

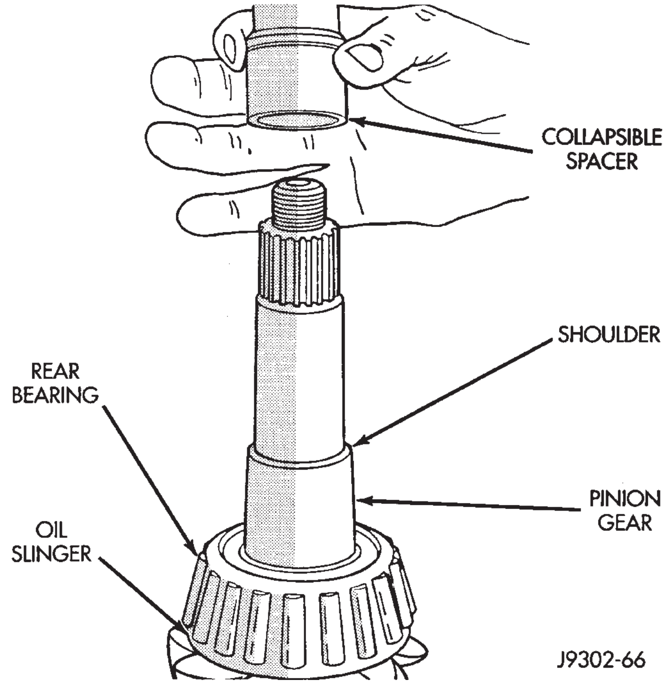

Fig. 14 Collapsible Preload Spacer

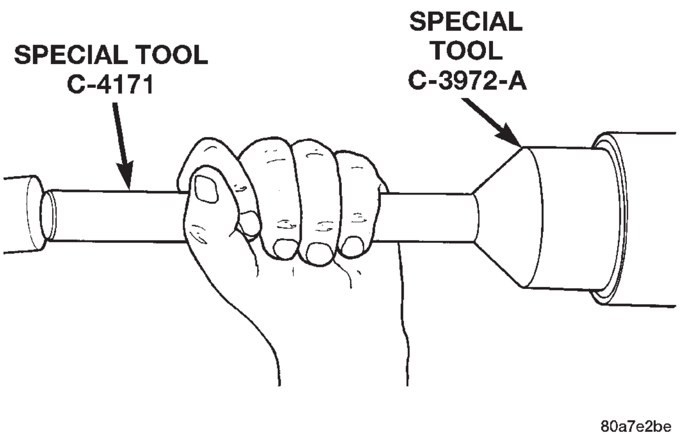

Fig. 15 Pinion Seal Installation

(5) Install yoke with Screw 8112, Cup 8109, and Holder 6958 (Fig. 16).

(6) If the original pinion bearings are being used, install differential assembly and axle shafts, if necessary.

NOTE: If new pinion bearings were installed, do not install the differential assembly and axle shafts until after the pinion bearing preload and rotating torque are set.

(7) Install the yoke washer and a new nut on the pinion gear. Tighten the pinion nut until there is zero bearing end-play.

(8) Tighten the nut to 271 N·m (200 ft. lbs.).

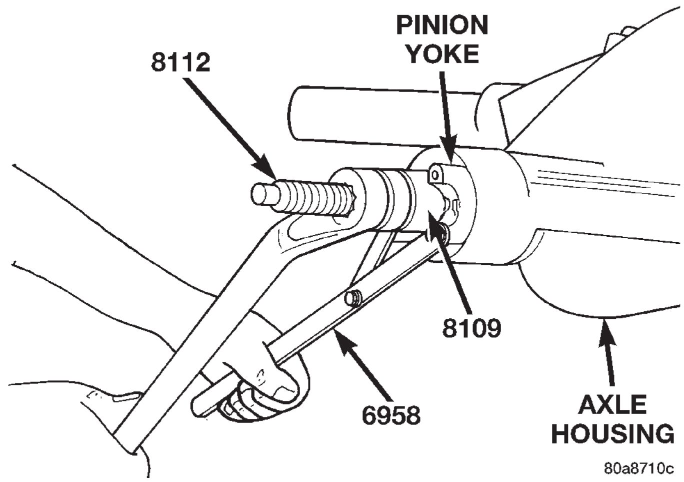

Fig. 16 Pinion Yoke Installation

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing rotating torque and never exceed specified preload torque. If preload torque or rotating torque is exceeded a new collapsible spacer must be installed. The torque sequence will then have to be repeated.

(9) Using yoke holder 6958 and a torque wrench set at 474 N·m (350 ft. lbs.), crush collapsible spacer until bearing end play is taken up (Fig. 17).

NOTE: If more than 474 N·m (350 ft. lbs.) of torque is necessary to remove the bearing end play, the collapsible spacer is defective and must be replaced.

(10) Slowly tighten the nut in 6.8 N·m (5 ft. lbs.) increments until the rotating torque is achieved. Measure the rotating torque frequently to avoid over crushing the collapsible spacer (Fig. 18).

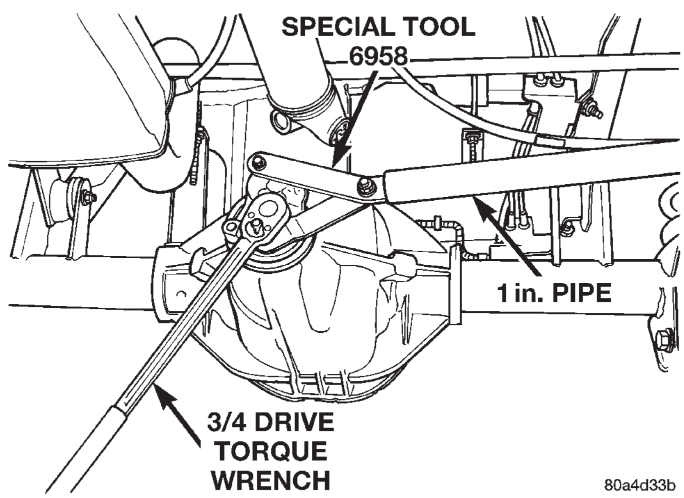

Fig. 17 Tightening Pinion Nut–Typical

REMOVAL AND INSTALLATION (Continued)

(11) Check rotating torque with a (in. lbs.) torque wrench (Fig. 18). The torque necessary to rotate the pinion gear should be:

- Original Bearings — The reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.).
- New Bearings — 2 to 5 N·m (15 to 35 in. lbs.).

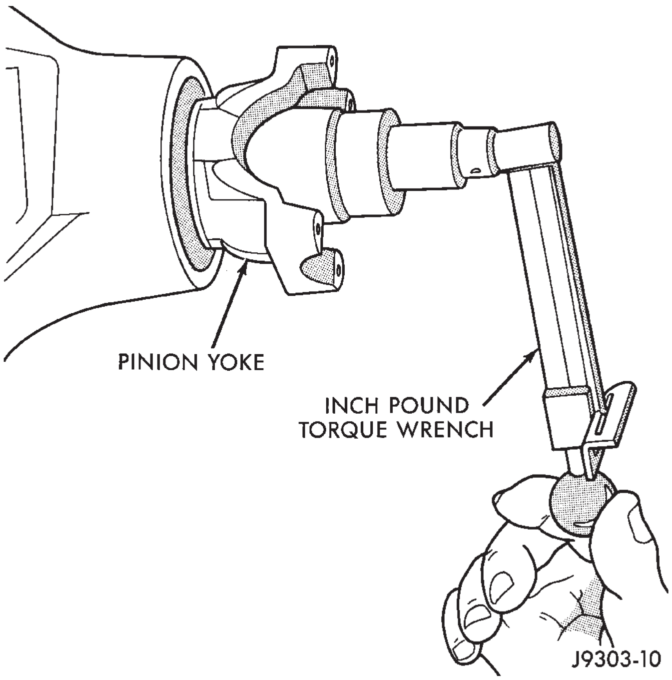

Fig. 18 Check Pinion Gear Rotation Torque

(12) Install differential assembly and axle shafts, if necessary.

(13) Align marks made previously on yoke and propeller shaft and install propeller shaft.

(14) Install rear brake drums. Refer to Group 5, Brakes, for proper procedures.

(15) Add gear lubricant, if necessary. Refer to Lubricant Specifications of this section for lubricant requirements.

(16) Install wheel and tire assemblies.

(17) Lower vehicle.

AXLE SHAFT

REMOVAL

(1) Raise and support vehicle. Ensure that the transmission is in neutral.

(2) Remove wheel and tire assembly.

(3) Remove brake drum. Refer to Group 5, Brakes, for proper procedure.

(4) Clean all foreign material from housing cover area.

(5) Loosen housing cover bolts. Drain lubricant from the housing and axle shaft tubes. Remove housing cover.

(6) Rotate differential case so that pinion mate gear shaft lock screw is accessible. Remove lock screw and pinion mate gear shaft from differential case (Fig. 19).

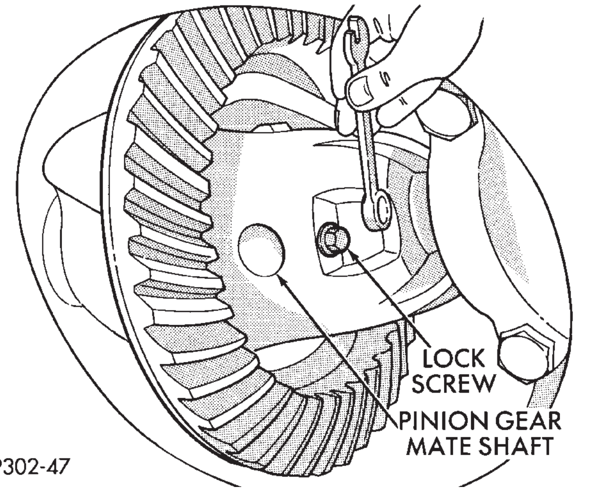

Fig. 19 Mate Shaft Lock Screw

(7) Push axle shaft inward and remove axle shaft C–clip lock from the axle shaft (Fig. 20).

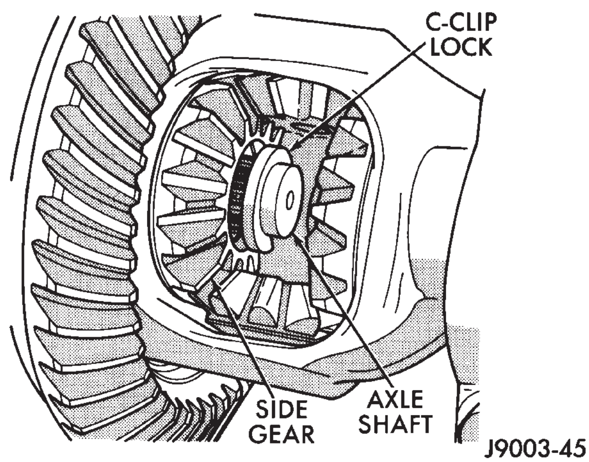

Fig. 20 Axle Shaft C–Clip Lock

(8) Remove axle shaft. Use care to prevent damage to axle shaft bearing and seal, which will remain in axle shaft tube. Also, exercise care not to damage the wheel speed sensor on vehicles equipped with ABS brakes.

(9) Inspect axle shaft seal for leakage or damage.

(10) Inspect roller bearing contact surface on axle shaft for signs of brinelling, galling and pitting. If any of these conditions exist, the axle shaft and/or bearing and seal must be replaced.

INSTALLATION

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

REMOVAL AND INSTALLATION (Continued)

NOTE: Use care to prevent shaft splines from damaging axle shaft seal lip. Also, exercise care not to damage the wheel speed sensor on vehicles equipped with ABS brakes.

(2) Insert C–clip lock in end of axle shaft. Push axle shaft outward to seat C–clip lock in side gear.
(3) Insert pinion mate shaft into differential case and through thrust washers and pinion gears.
(4) Align hole in shaft with hole in the differential case and install lock screw with Loctite® on the threads. Tighten lock screw to 19 N·m (14 ft. lbs.) torque.
(5) Install cover and add fluid. Refer to Lubricant Change procedure in this section for procedure and lubricant requirements.
(6) Install brake drum. Refer to Group 5, Brakes, for proper procedures.
(7) Install wheel and tire.
(8) Lower vehicle.

AXLE SHAFT SEAL AND BEARING

REMOVAL

(1) Remove the axle shaft.
(2) Remove the axle shaft seal from the end of the axle shaft tube with a small pry bar.

NOTE: The seal and bearing can be removed at the same time with the bearing removal tool.

(3) Remove the axle shaft bearing from the axle tube with Bearing Removal Tool Set 6310 using Adapter Foot 6310-5 (Fig. 21).
(4) Inspect the axle shaft tube bore for roughness and burrs. Remove as necessary.

INSTALLATION

Do not install the original axle shaft seal. Always install a new seal.
(1) Wipe the axle shaft tube bore clean.
(2) Install axle shaft bearing with Installer 6436 and Handle C–4171. Ensure that the part number on the bearing is against the installer.
(3) Install the new axle shaft seal with Installer 6437 and Handle C–4171 (Fig. 22).
(4) Install the axle shaft.

DIFFERENTIAL

REMOVAL

(1) Raise and support vehicle.
(2) Remove the lubricant fill hole plug from the differential housing cover.
(3) Remove the differential housing cover and allow fluid to drain.
(4) Remove axle shafts.

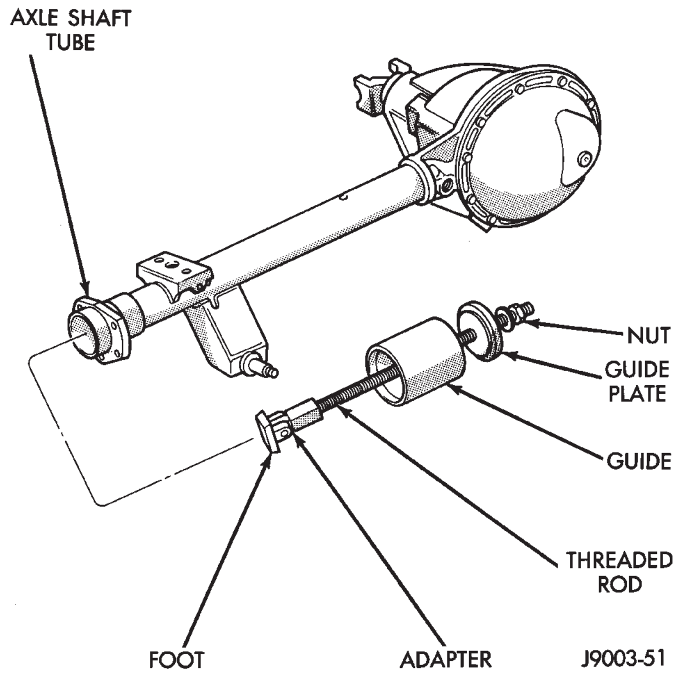

Fig. 21 Axle Shaft Bearing Removal

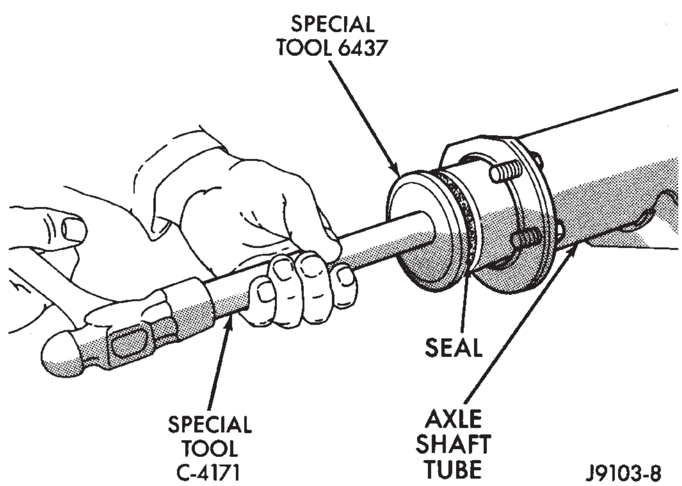

Fig. 22 Axle Shaft Seal Installation

(5) Note the installation reference letters stamped on the bearing caps and housing machined sealing surface (Fig. 23).
(6) Loosen the differential bearing cap bolts.
(7) Position Spreader W–129–B, utilizing some items from Adapter set 6987, with the tool dowel pins seated in the locating holes (Fig. 24). Install the hold-down clamps and tighten the tool turnbuckle finger–tight.
(8) Install a Pilot Stud C-3288-B at the left side of the differential housing. Attach Dial Indicator C-3339 to pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 25) and zero the indicator.

REMOVAL AND INSTALLATION (Continued)

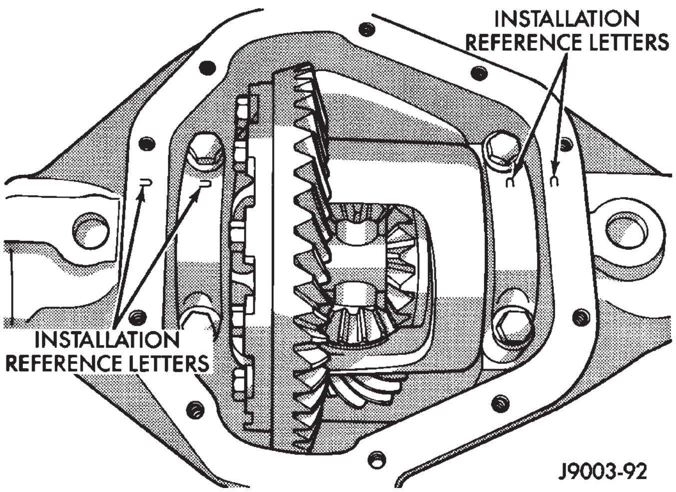

Fig. 23 Bearing Cap Identification

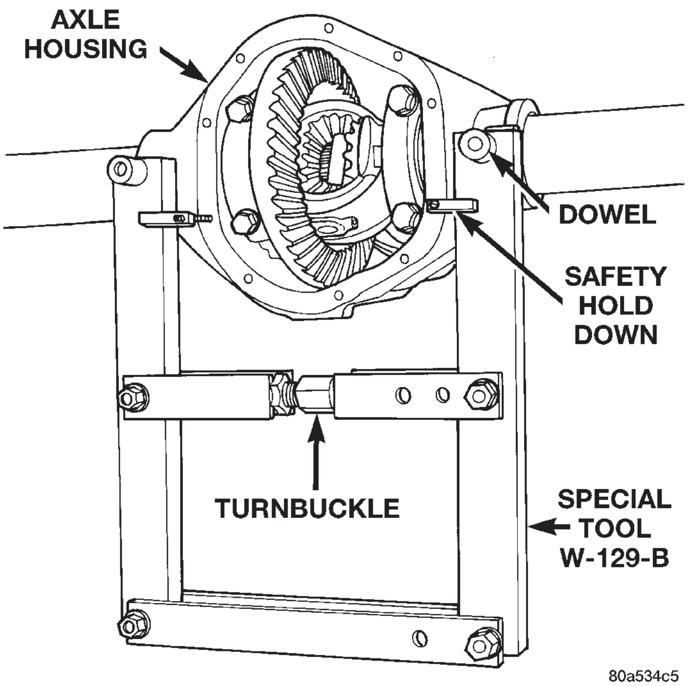

Fig. 24 Install Axle Housing Spreader

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

(9) Spread the housing enough to remove the differential case from the housing. Measure the distance with the dial indicator (Fig. 26).

(10) Remove the dial indicator.

(11) While holding the differential case in position, remove the differential bearing cap bolts and caps.

(12) Remove the differential from the housing. Ensure that the differential bearing cups remain in position on the differential bearings (Fig. 27).

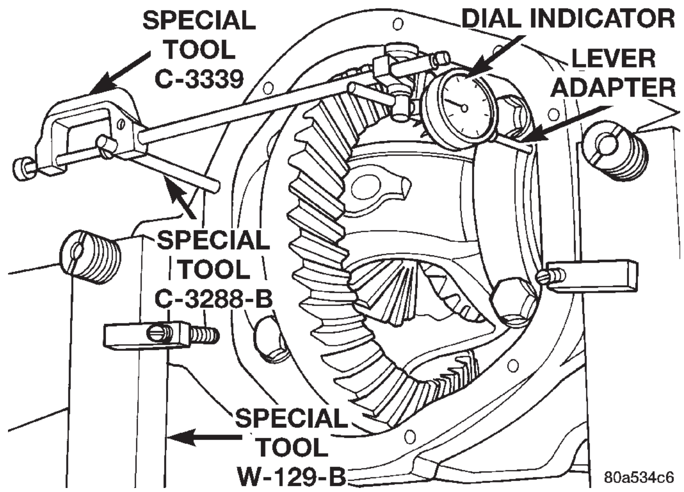

Fig. 25 Install Dial Indicator

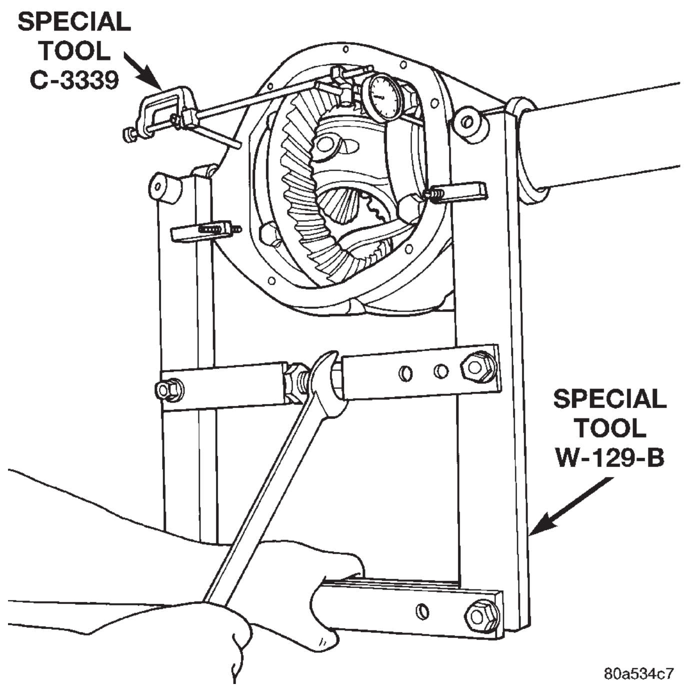

Fig. 26 Spread Axle Housing

(13) Mark or tag the differential bearing cups to indicate which side of the differential they were removed from.

(14) Retrieve differential case preload shims from axle housing. Mark or tag the differential case preload shims to indicate which side of the differential they were removed from.

(15) Remove spreader from housing.

INSTALLATION

If replacement differential bearings or differential case are being installed, differential side bearing shim requirements may change. Refer to the Differential Bearing Preload and Gear Backlash procedures in this section to determine the proper shim selection.

REMOVAL AND INSTALLATION (Continued)

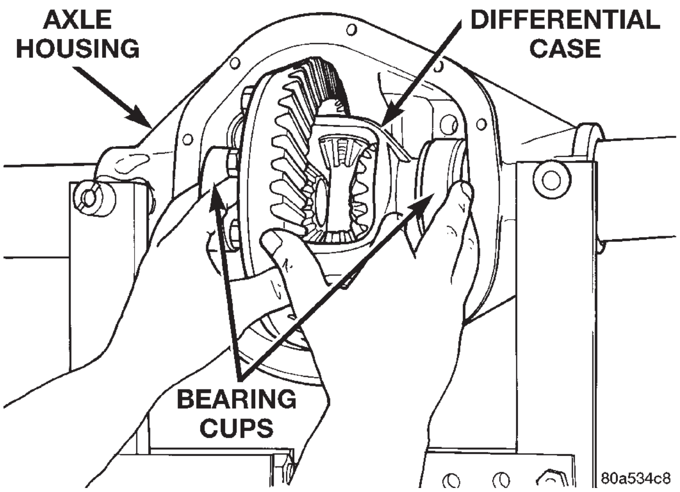

Fig. 27 Differential Case Removal

(1) Position Spreader W–129–B, utilizing some items from Adapter set 6987, with the tool dowel pins seated in the locating holes (Fig. 28). Install the hold-down clamps and tighten the tool turnbuckle finger–tight.

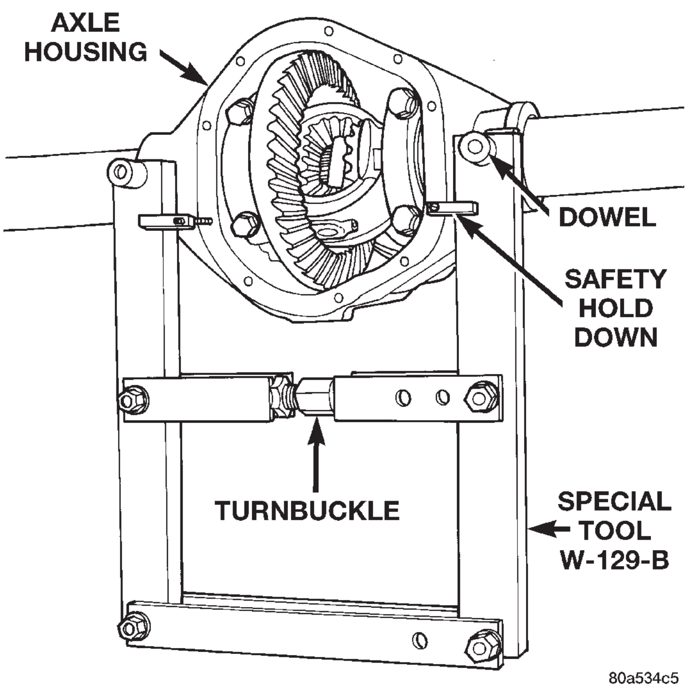

Fig. 28 Install Axle Housing Spreader

(2) Install a Pilot Stud C-3288-B at the left side of the differential housing. Attach Dial Indicator C-3339 to pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 25) and zero the indicator.

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

(3) Spread the housing enough to install the case in the housing. Measure the distance with the dial indicator (Fig. 26).

(4) Remove the dial indicator.

(5) Install differential case in the housing. Ensure that the differential bearing cups remain in position on the differential bearings and that the preload shims remain between the face of the bearing cup and the housing. Tap the differential case to ensure the bearings cups and shims are fully seated in the housing.

(6) Install the bearing caps at their original locations (Fig. 29).

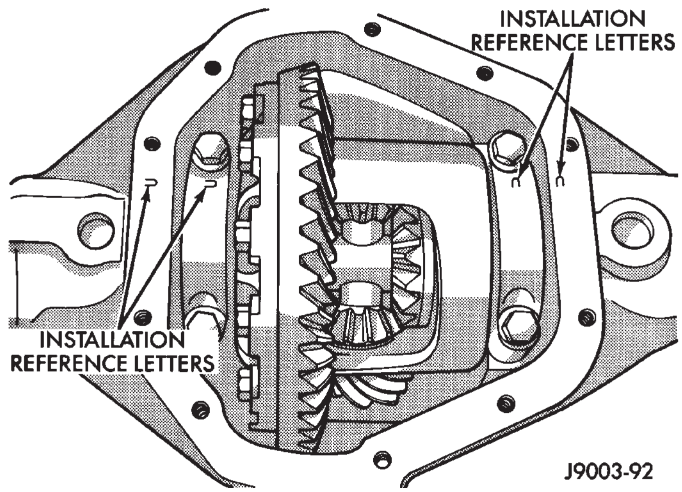

Fig. 29 Differential Bearing Cap Reference Letters

(7) Loosely install differential bearing cap bolts.

(8) Remove axle housing spreader.

(9) Tighten the bearing cap bolts to 77 N·m (57 ft. lbs.) torque.

(10) Install the axle shafts.

DIFFERENTIAL SIDE BEARINGS

REMOVAL

(1) Remove differential from axle housing.

(2) Remove the bearings from the differential case with Puller/Press C-293-PA, C-293-39 Blocks, and Plug SP-3289 (Fig. 30).

INSTALLATION

(1) Using tool C-3716-A with handle C-4171, install differential side bearings (Fig. 31).

(2) Install differential in axle housing.

RING GEAR

NOTE: The ring and pinion gears are service in a matched set. Do not replace the ring gear without replacing the pinion gear.

REMOVAL AND INSTALLATION (Continued)

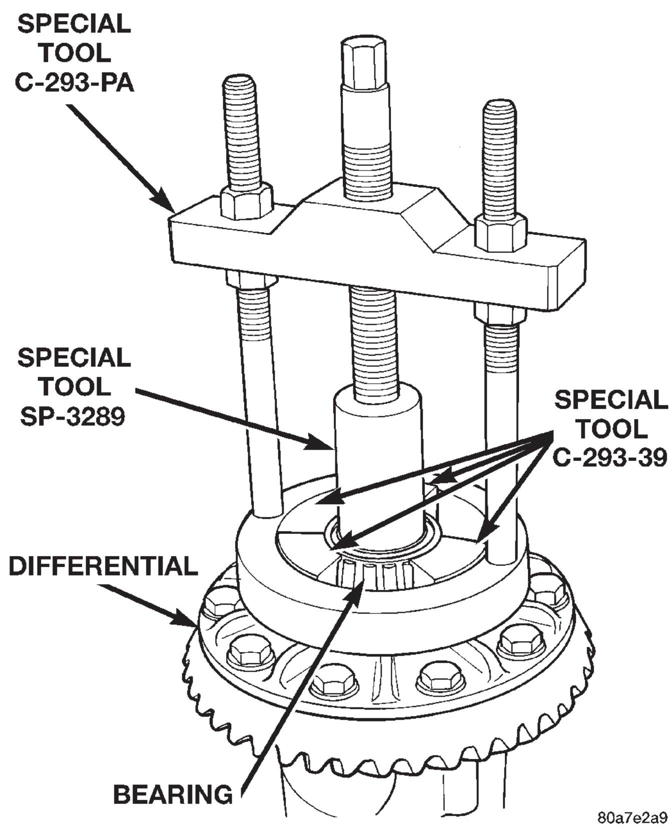

Fig. 30 Differential Bearing Removal

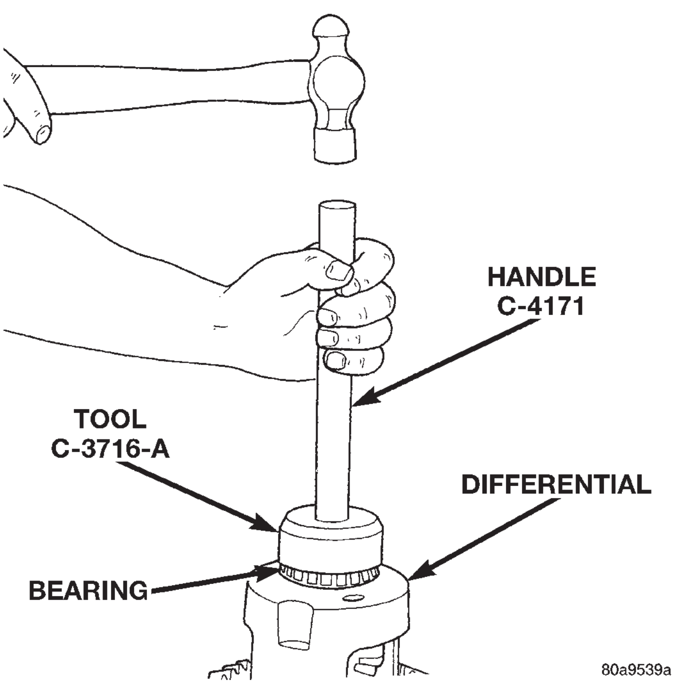

Fig. 31 Install Differential Side Bearings

REMOVAL

(1) Remove differential from axle housing.

(2) Place differential case in a suitable vise with soft metal jaw protectors (Fig. 32).

(3) Remove bolts holding ring gear to differential case.

(4) Using a soft hammer, drive ring gear from differential case (Fig. 32).

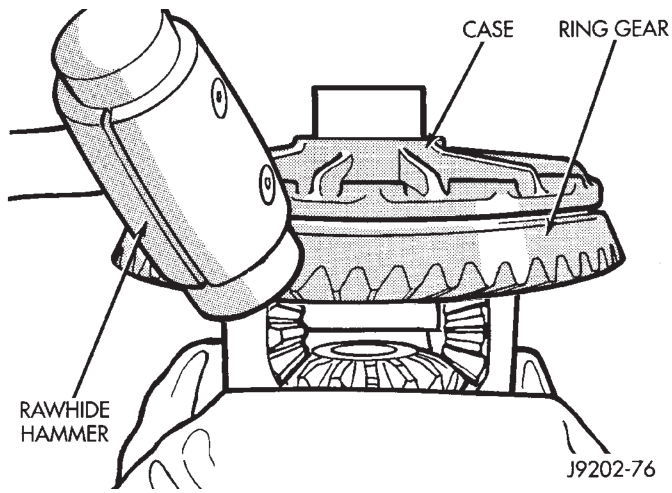

Fig. 32 Ring Gear Removal

INSTALLATION

CAUTION: Do not reuse the bolts that held the ring gear to the differential case. The bolts can fracture causing extensive damage.

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

(2) Invert the differential case in the vise.

(3) Install new ring gear bolts and alternately tighten to 95–122 N·m (70–90 ft. lbs.) torque (Fig. 33).

(4) Install differential in axle housing and verify gear mesh and contact pattern.

PINION GEAR

The ring and pinion gears are serviced in a matched set. Do not replace the pinion gear without replacing the ring gear.

REMOVAL

(1) Remove differential from the axle housing.

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

(3) Disconnect propeller shaft from pinion yoke. Using suitable wire, tie propeller shaft to underbody.

(4) Using Holder 6958 to hold yoke, remove the pinion yoke nut and washer.

(5) Using Remover C–452 and Wrench C–3281, remove the pinion yoke from pinion shaft (Fig. 34).

(6) Remove the pinion gear from housing (Fig. 35). Catch the pinion with your hand to prevent it from falling and being damaged.

REMOVAL AND INSTALLATION (Continued)

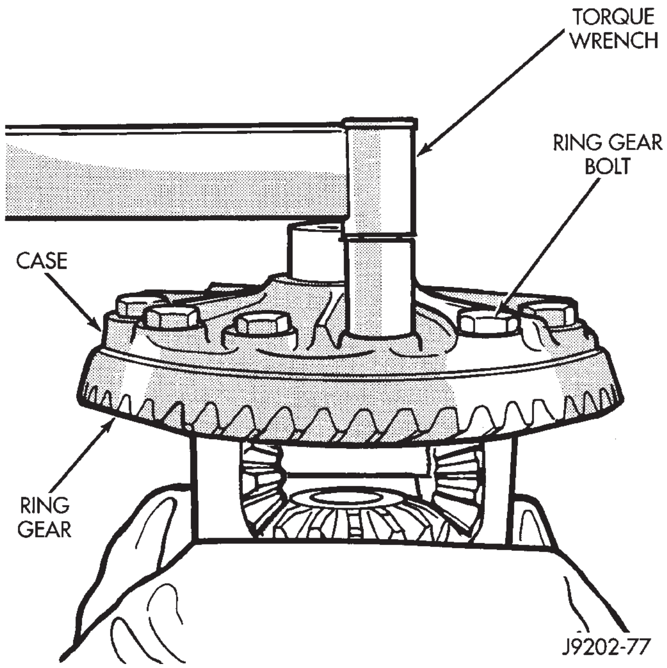

Fig. 33 Ring Gear Bolt Installation

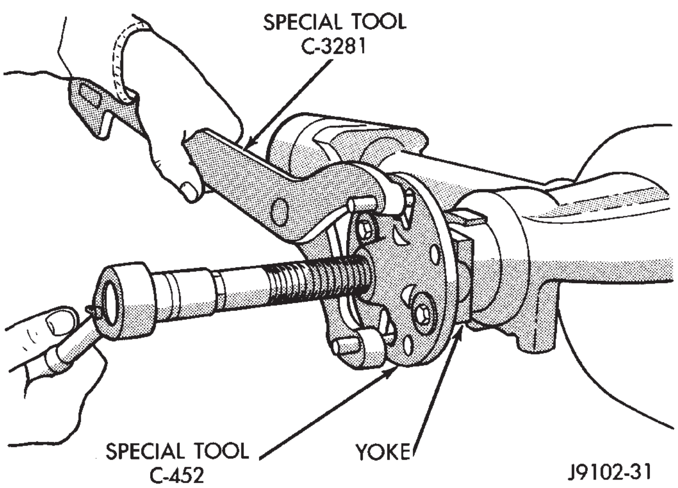

Fig. 34 Pinion Yoke Removal

(7) Use a suitable pry tool or a slide hammer mounted screw to remove the pinion shaft seal.

(8) Remove oil slinger, if equipped, and front pinion bearing.

(9) Remove the front pinion bearing cup with Remover C-4345 and Handle C–4171 (Fig. 36).

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

(11) Remove the collapsible preload spacer (Fig. 38).

(12) Remove the rear bearing from the pinion with Puller/Press C-293-PA and Adapters C-293-40 (Fig. 39).

Place 4 adapter blocks so they do not damage the bearing cage.

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

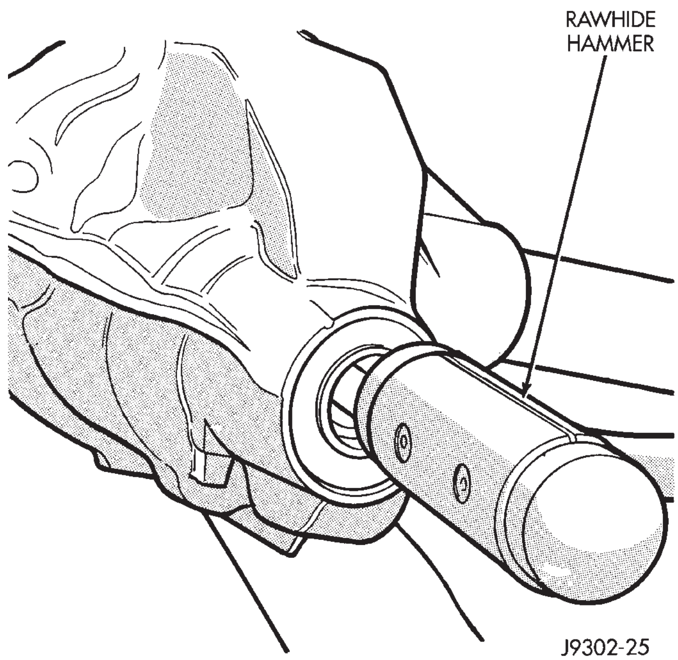

Fig. 35 Remove Pinion Gear

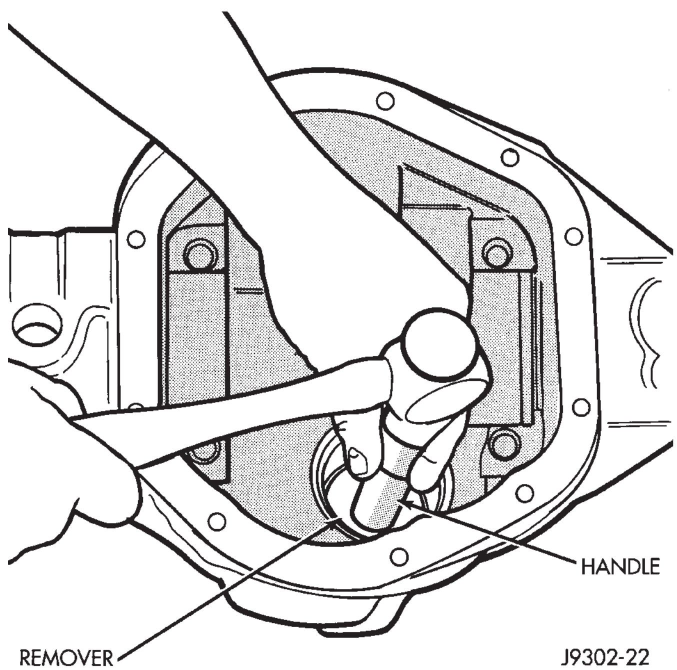

Fig. 36 Front Bearing Cup Removal

INSTALLATION

(1) Apply Mopar® Door Ease, or equivalent, stick lubricant to outside surface of bearing cup.

(2) Install the pinion rear bearing cup with Installer D-146 and Driver Handle C–4171 (Fig. 40). Ensure cup is correctly seated.

(3) Apply Mopar® Door Ease, or equivalent, stick lubricant to outside surface of bearing cup.

(4) Install the pinion front bearing cup with Installer D–130 and Handle C–4171 (Fig. 41).

REMOVAL AND INSTALLATION (Continued)

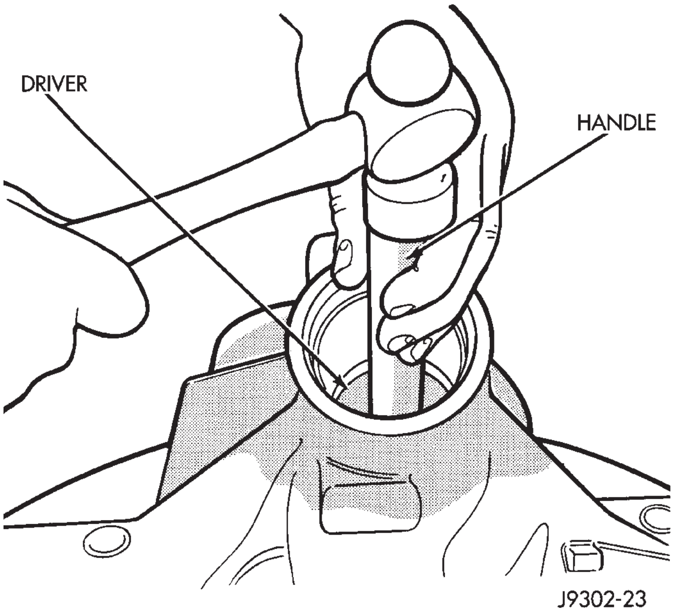

Fig. 37 Rear Bearing Cup Removal

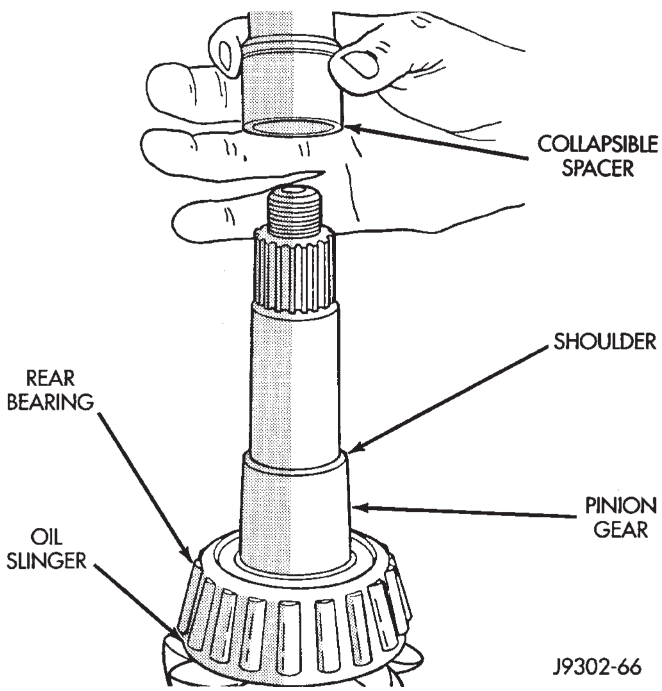

Fig. 38 Collapsible Spacer

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

(6) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer C-3972-A and Handle C–4171 (Fig. 42).

NOTE: Pinion depth shims are placed between the rear pinion bearing cone and pinion gear to achieve proper ring and pinion gear mesh. If the factory installed ring and pinion gears are reused, the pinion depth shim should not require replacement. If required, refer to Pinion Gear Depth to select the proper thickness shim before installing rear pinion bearing.

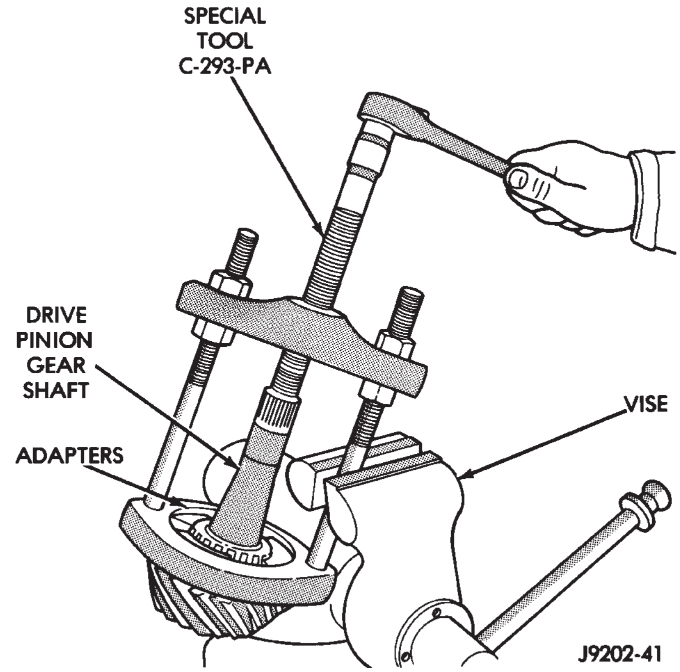

Fig. 39 Rear Bearing Removal

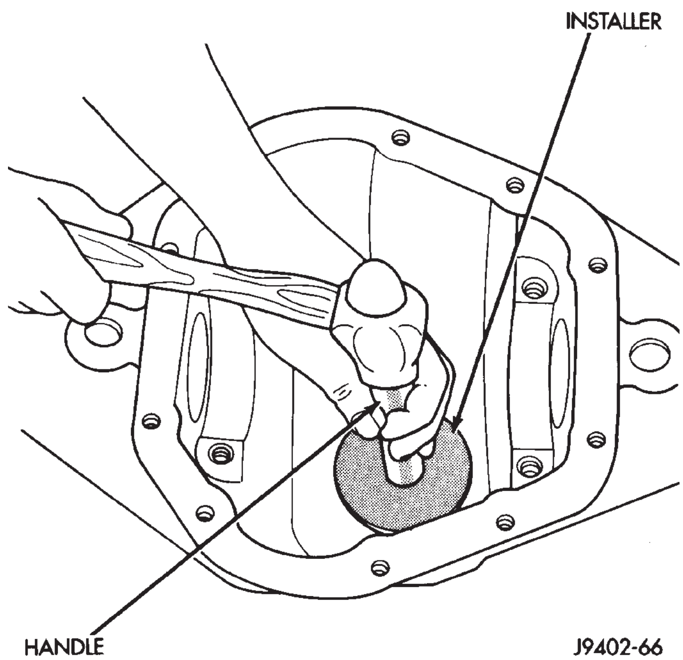

Fig. 40 Pinion Rear Bearing Cup Installation

(7) Place the proper thickness depth shim on the pinion gear.

(8) Install the rear bearing and slinger, if equipped, on the pinion gear with Installer W-262 (Fig. 43).

(9) Install a new collapsible preload spacer on pinion shaft and install pinion gear in housing (Fig. 44).

REMOVAL AND INSTALLATION (Continued)

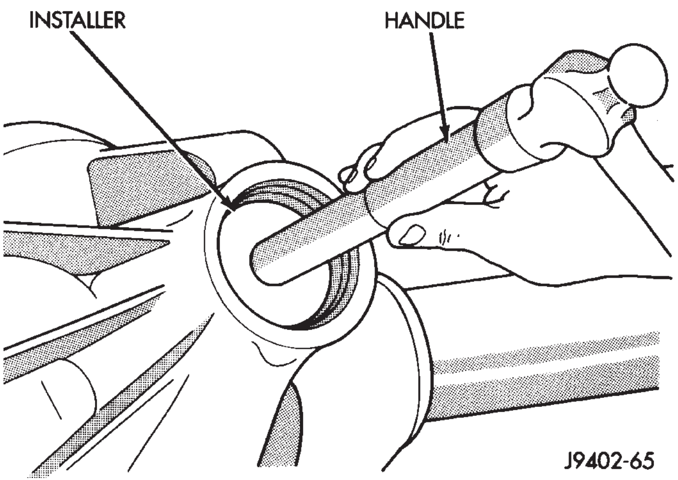

Fig. 41 Pinion Front Bearing Cup Installation

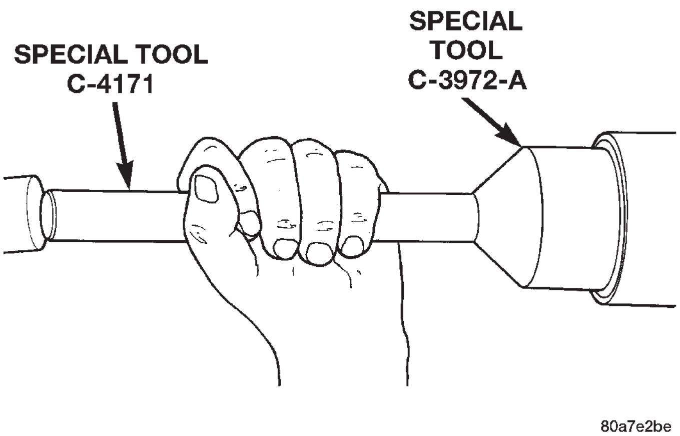

Fig. 42 Pinion Seal Installation

(10) Install pinion gear in housing.

(11) Install yoke with Installer Screw 8112, Cup 8109, and holder 6958 (Fig. 45).

(12) Install the yoke washer and a new nut on the pinion gear and tighten the pinion nut until there is zero bearing end-play.

(13) Tighten the nut to 271 N·m (200 ft. lbs.).

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing rotating torque and never exceed specified preload torque. If preload torque or rotating torque is exceeded a new collapsible spacer must be installed. The torque sequence will then have to be repeated.

(14) Using yoke holder 6958 and a torque wrench set at 474 N·m (350 ft. lbs.), crush collapsible spacer until bearing end play is taken up (Fig. 46).

NOTE: If the spacer requires more than 474 N·m (350 ft. lbs.) torque to crush, the collapsible spacer is defective and must be replaced.

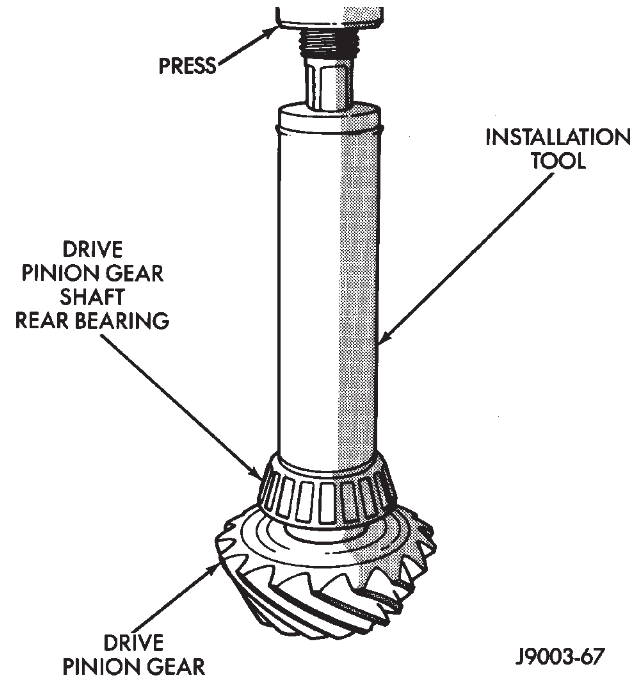

Fig. 43 Shaft Rear Bearing Installation

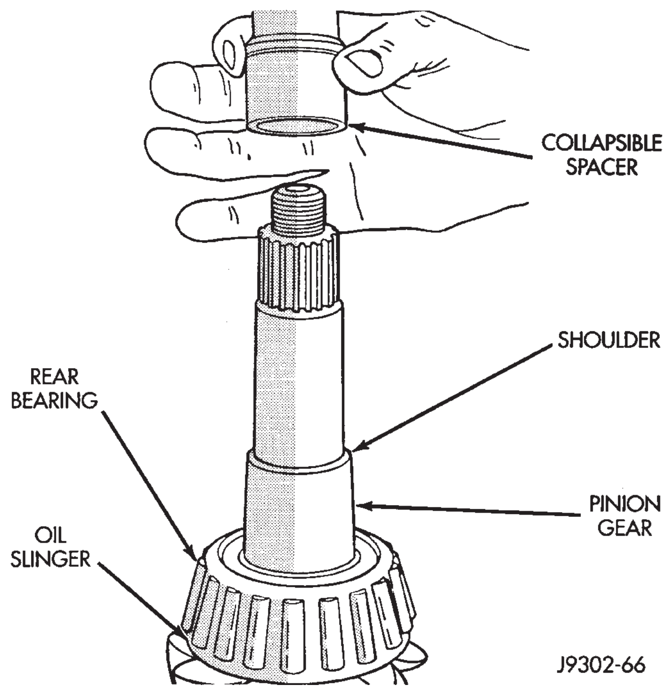

Fig. 44 Collapsible Preload Spacer

(15) Slowly tighten the nut in 6.8 N·m (5 ft. lbs.) increments until the rotating torque is achieved. Measure the rotating torque frequently to avoid over crushing the collapsible spacer (Fig. 47).

(16) Check bearing rotating torque with a (in. lbs.) torque wrench (Fig. 47). The torque necessary to rotate the pinion gear should be:

- Original Bearings — 1 to 3 N·m (10 to 20 in. lbs.).
- New Bearings — 2 to 5 N·m (15 to 35 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

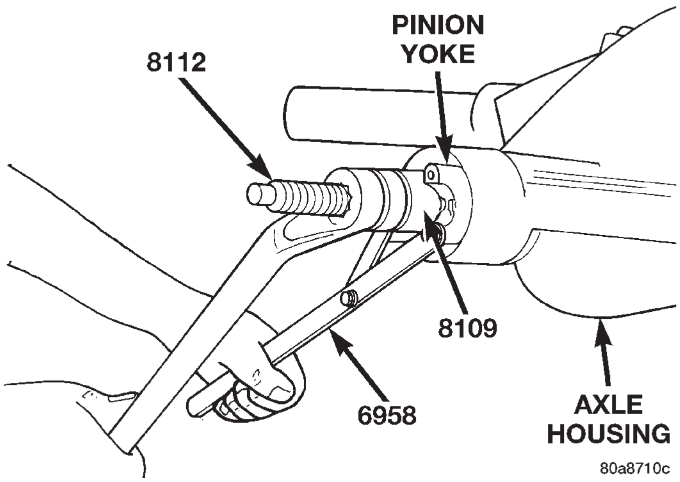

Fig. 45 Pinion Yoke Installation

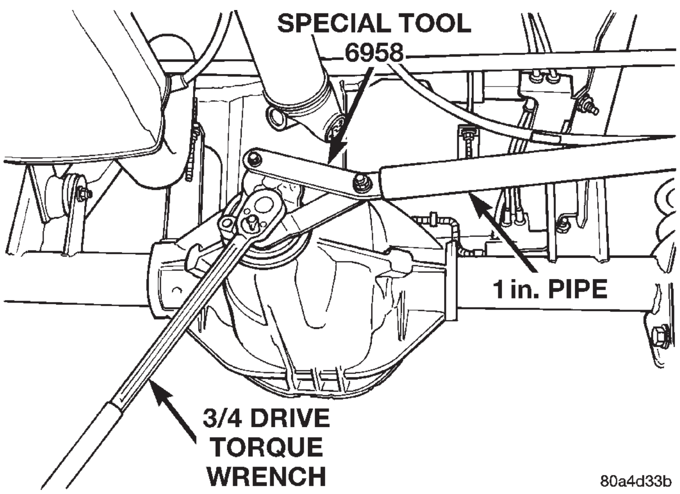

Fig. 46 Tightening Pinion Nut–Typical

(17) Install differential in housing.

FINAL ASSEMBLY

(1) Scrape the residual sealant from the housing and cover mating surfaces. Clean the mating surfaces with mineral spirits. Apply a bead of Mopar® Silicone Rubber Sealant, or equivalent, on the housing cover (Fig. 48).

Install the housing cover within 5 minutes after applying the sealant.

(2) Install the cover on the differential with the attaching bolts. Install the identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

(3) Refill the differential housing with gear lubricant. Refer to the Lubricant Specifications section of this group for the gear lubricant requirements.

(4) Install the fill hole plug.

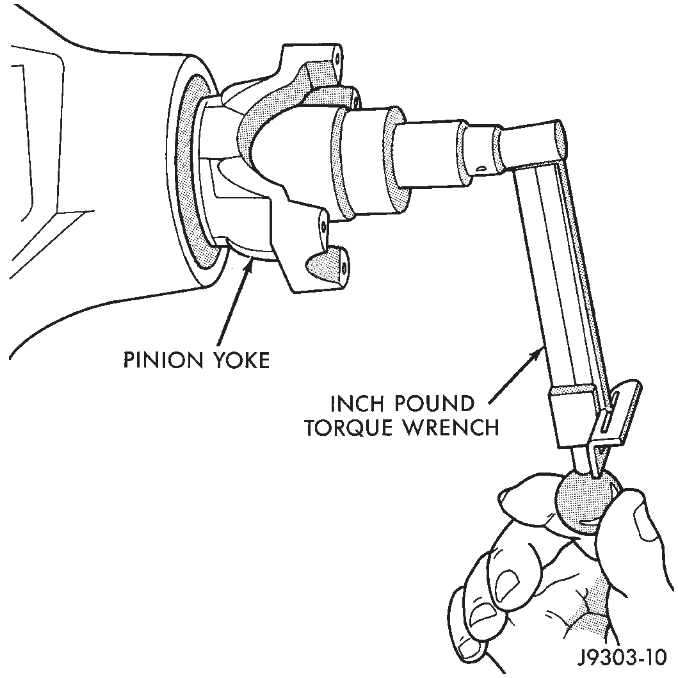

Fig. 47 Check Pinion Gear Rotating Torque

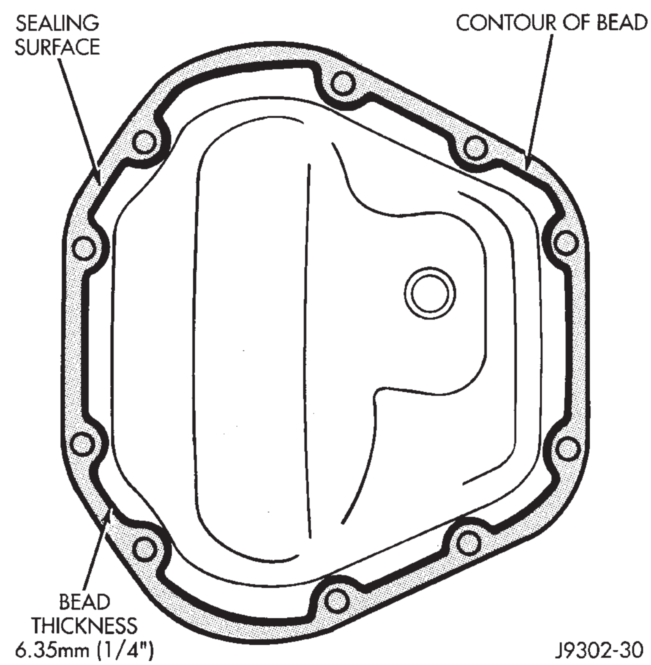

Fig. 48 Typical Housing Cover With Sealant

DISASSEMBLY AND ASSEMBLY

STANDARD DIFFERENTIAL

DISASSEMBLY

(1) Remove pinion gear mate shaft lock screw (Fig. 49).

(2) Remove pinion gear mate shaft.

(3) Rotate the differential side gears and remove the pinion mate gears and thrust washers (Fig. 50).

DISASSEMBLY AND ASSEMBLY (Continued)

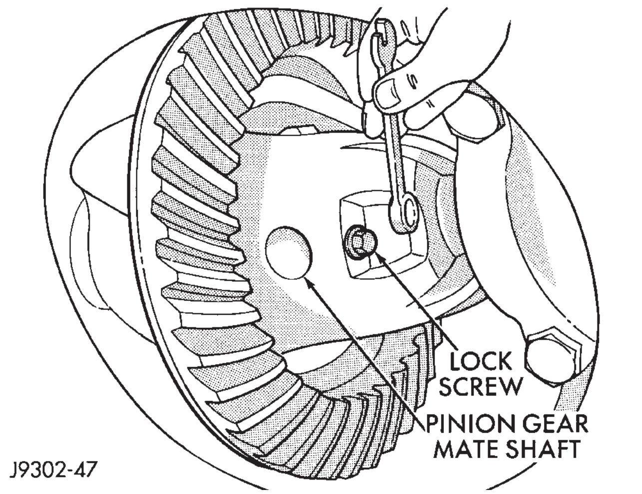

Fig. 49 Pinion Gear Mate Shaft Lock Screw

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

ASSEMBLY

(1) Install the differential side gears and thrust washers.

(2) Install the pinion mate gears and thrust washers.

(3) Install the pinion gear mate shaft.

(4) Align the hole in the pinion gear mate shaft with the hole in the differential case and install the pinion gear mate shaft lock screw.

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

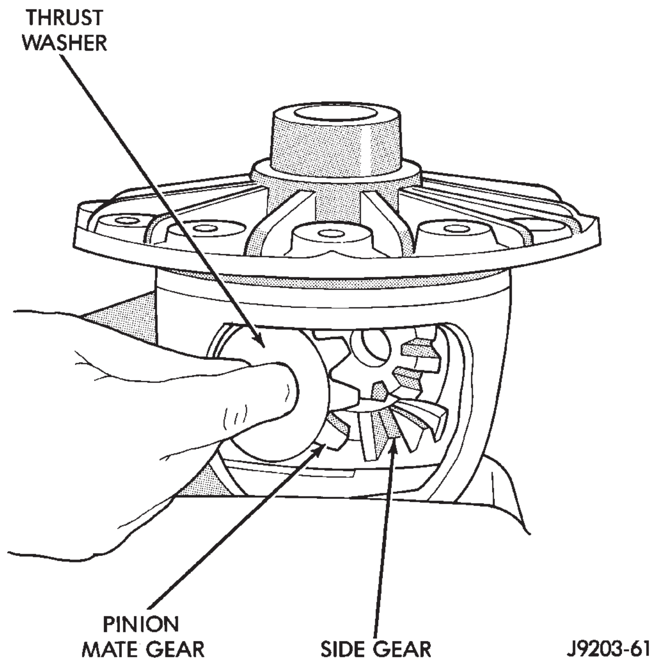

Fig. 50 Pinion Mate Gear Removal

TRAC-LOK™ DIFFERENTIAL

The Trac–lok™ differential components are illustrated in (Fig. 51). Refer to this illustration during repair service.

DISASSEMBLY

(1) Clamp Side Gear Holding Tool 6965 in a vise.

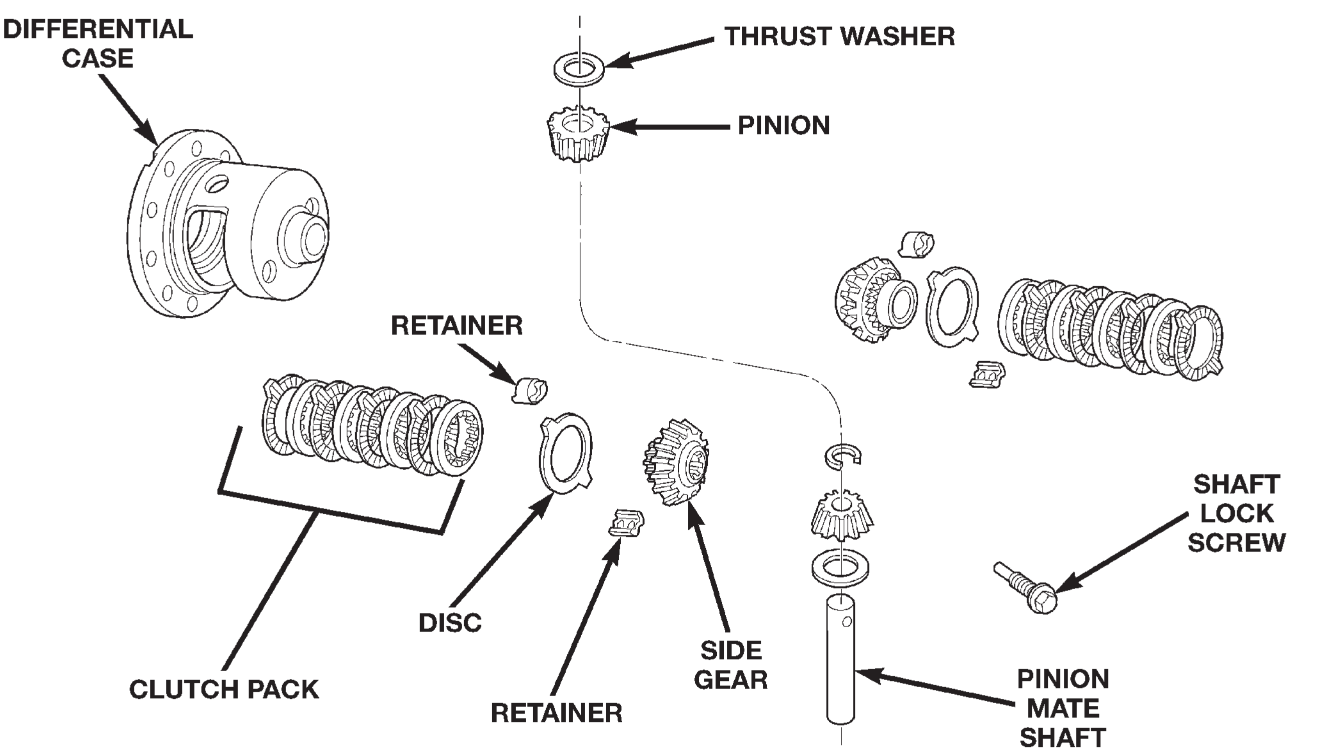

Fig. 51 Trac–lok™ Differential Components

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Position the differential case on Side Gear Holding Tool 6965 (Fig. 52).

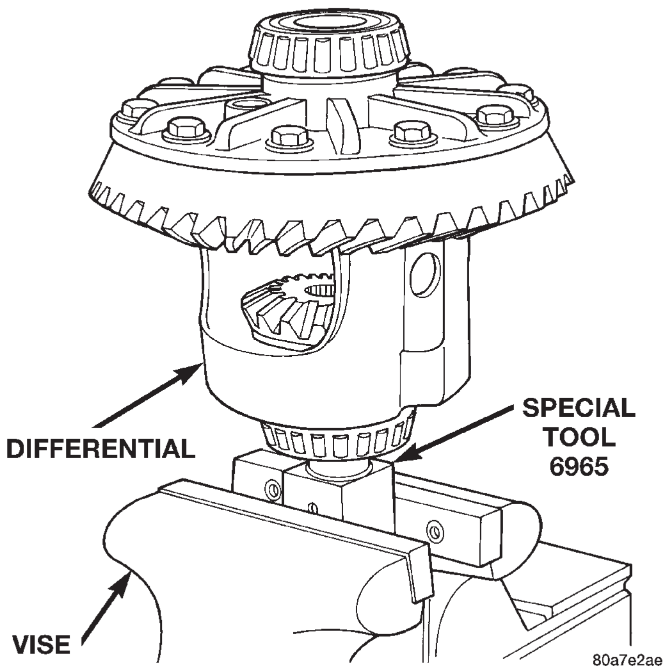

Fig. 52 Differential Case Holding Tool

(3) Remove ring gear, if necessary. Ring gear removal is necessary only if the ring gear is to be replaced. The Trac-lok™ differential can be serviced with the ring gear installed.

(4) Remove the pinion gear mate shaft lock screw (Fig. 53).

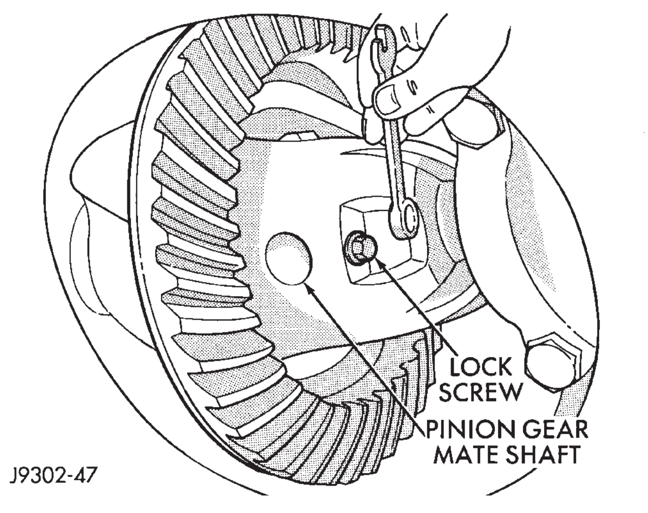

Fig. 53 Mate Shaft Lock Screw

(5) Remove the pinion gear mate shaft. If necessary, use a drift and hammer (Fig. 54).

(6) Install and lubricate Step Plate C-6960-3 (Fig. 55).

(7) Assemble Threaded Adapter C-6960-1 into top side gear. Thread Forcing Screw C-6960-4 into adapter until it becomes centered in adapter plate.

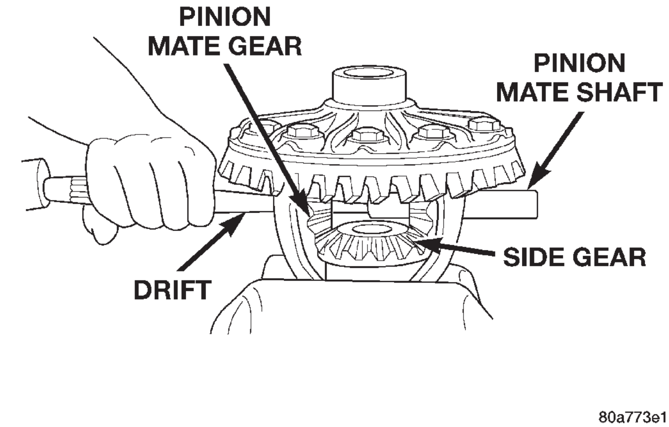

Fig. 54 Mate Shaft Removal

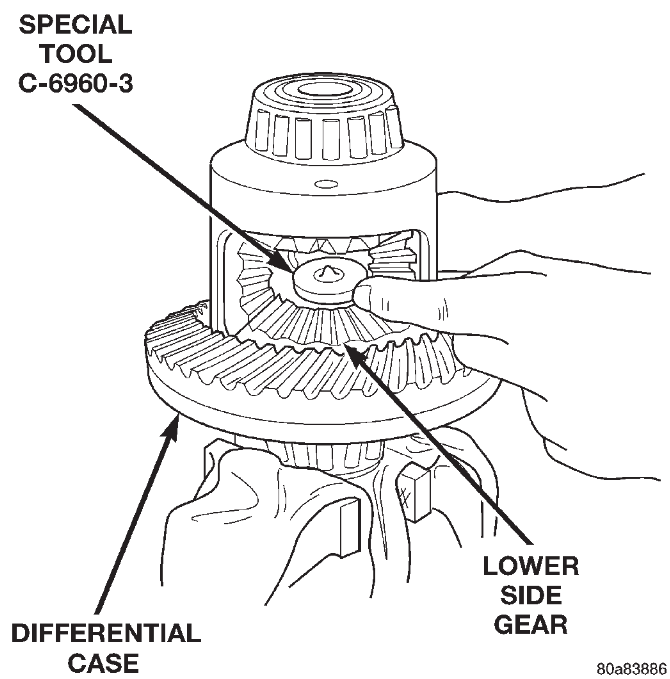

Fig. 55 Step Plate Tool Installation

(8) Position a small screw driver in slot of Threaded Adapter C-6960-1 (Fig. 56) to prevent adapter from turning.

(9) Tighten forcing screw tool 122 N·m (90 ft. lbs.) maximum to compress Belleville springs in clutch packs (Fig. 57).

(10) Using an appropriate size feeler gauge, remove thrust washers from behind the pinion gears (Fig. 58).

(11) Insert Turning Bar C-6960-2 in case (Fig. 59).

(12) Loosen the Forcing Screw C-6960-4 in small increments until the clutch pack tension is relieved and the differential case can be turned using Turning Bar C-6960-2.

(13) Rotate differential case until the pinion gears can be removed.

DISASSEMBLY AND ASSEMBLY (Continued)

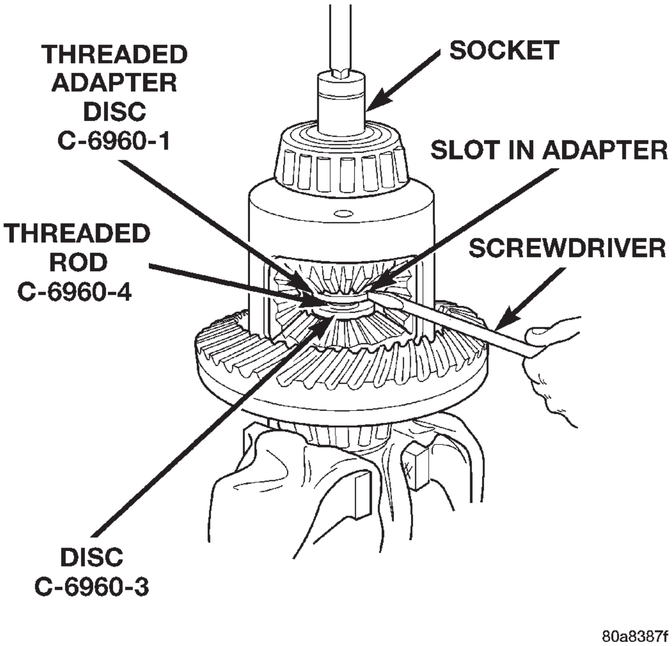

Fig. 56 Threaded Adapter Installation

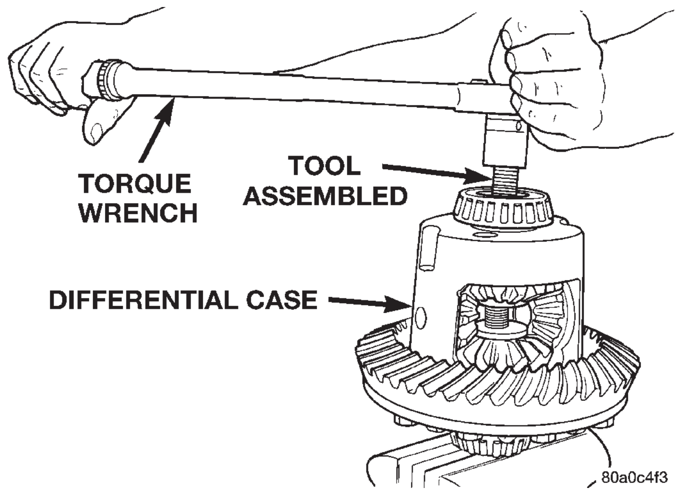

Fig. 57 Tighten Belleville Spring Compressor Tool

(14) Remove pinion gears from differential case.

(15) Remove Forcing Screw C-6960-4, Step Plate C-6960-3, and Threaded Adapter C-6960-1.

(16) Remove top side gear, clutch pack retainer, and clutch pack. Keep plates in correct order during removal (Fig. 60).

(17) Remove differential case from Side Gear Holding Tool 6965. Remove side gear, clutch pack retainer, and clutch pack. Keep plates in correct order during removal.

ASSEMBLY

NOTE: The clutch discs are replaceable as complete sets only. If one clutch disc pack is damaged, both packs must be replaced.

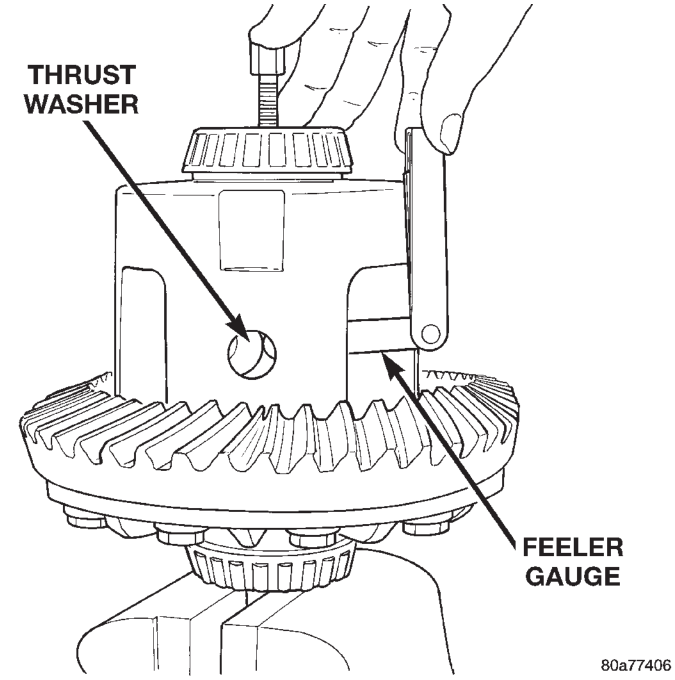

Fig. 58 Remove Pinion Gear Thrust Washer

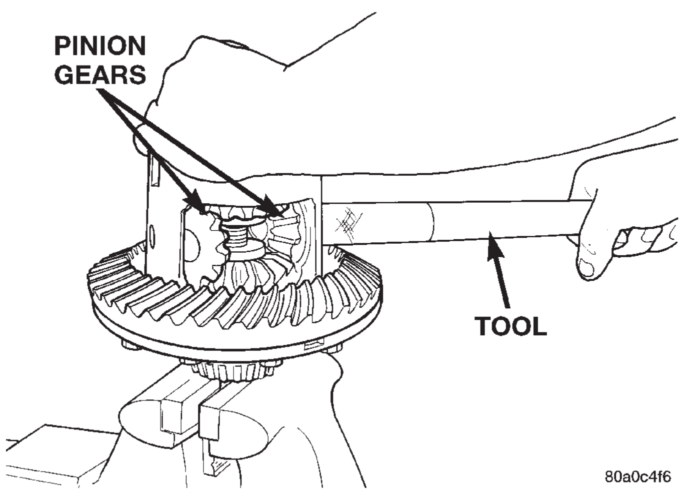

Fig. 59 Pinion Gear Removal

Lubricate each component with gear lubricant before assembly.

(1) Assemble the clutch discs into packs and secure disc packs with retaining clips (Fig. 61).

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

(3) Install clutch pack and side gear in the ring gear side of the differential case (Fig. 62). **Be sure clutch pack retaining clips remain in position and are seated in the case pockets.**

(4) Position the differential case on Side Gear Holding Tool 6965.

(5) Install lubricated Step Plate C-6960-3 in lower side gear (Fig. 63).

(6) Install the upper side gear and clutch disc pack (Fig. 63).

DISASSEMBLY AND ASSEMBLY (Continued)

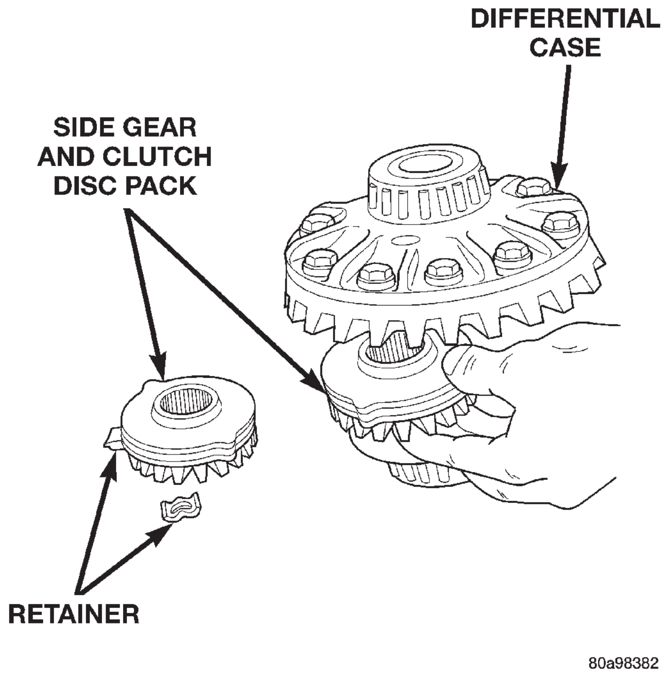

Fig. 60 Side Gear & Clutch Disc Removal

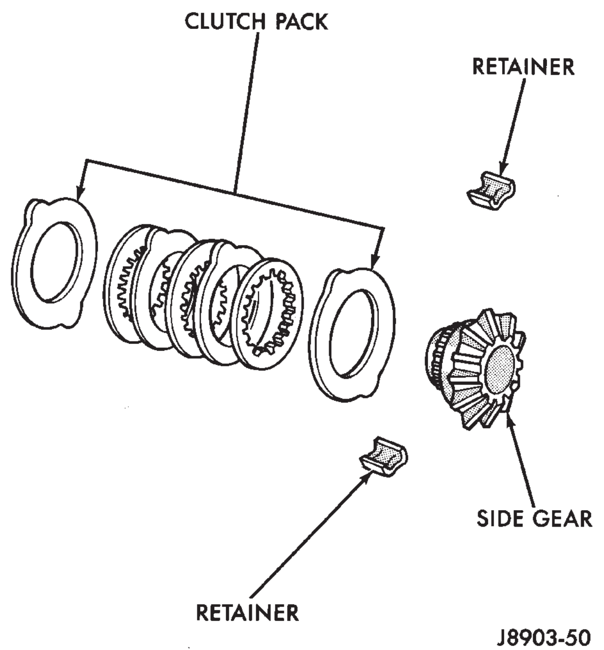

Fig. 61 Clutch Disc Pack

(7) Hold assembly in position. Insert Threaded Adapter C-6960-1 into top side gear.

(8) Insert Forcing Screw C-6960-4.

(9) Tighten forcing screw tool to slightly compress clutch discs.

(10) Place pinion gears in position in side gears and verify that the pinion mate shaft hole is aligned.

(11) Rotate case with Turning Bar C-6960-2 until the pinion mate shaft holes in pinion gears align with holes in case. It may be necessary to slightly tighten the forcing screw in order to install the pinion gears.

(12) Tighten forcing screw to 122 N·m (90 ft. lbs.) maximum to compress the Belleville springs.

(13) Lubricate and install thrust washers behind pinion gears and align washers with a small screw driver. Insert mate shaft into each pinion gear to verify alignment.

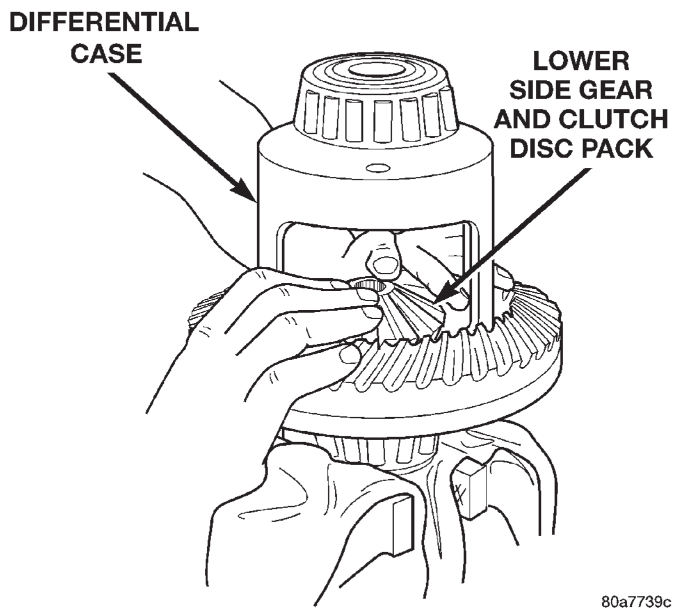

Fig. 62 Clutch Discs & Lower Side Gear Installation

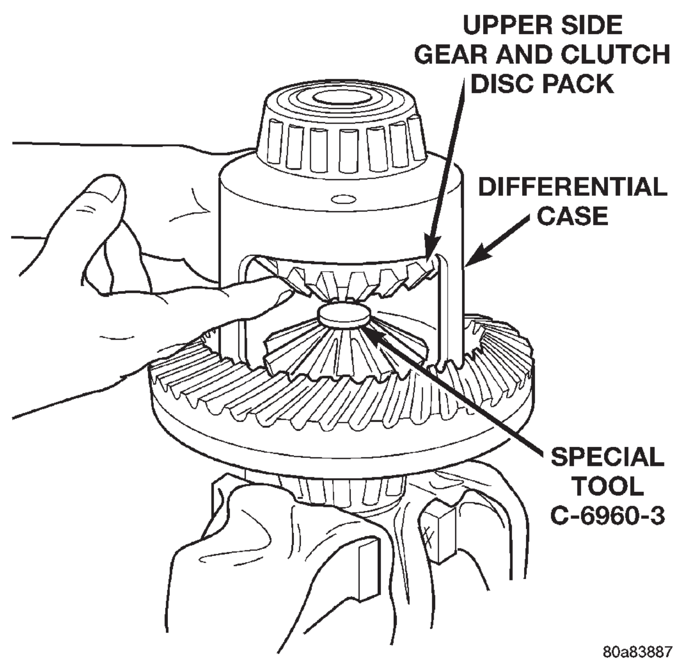

Fig. 63 Upper Side Gear & Clutch Disc Pack Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(14) Remove Forcing Screw C-6960-4, Step Plate C-6960-3, and Threaded Adapter C-6960-1.

(15) Install pinion gear mate shaft and align holes in shaft and case.

(16) Install the pinion mate shaft lock screw finger tight to hold shaft during differential installation.

If replacement gears and thrust washers were installed, it is not necessary to measure the gear backlash. Correct fit is due to close machining tolerances during manufacture.

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

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™

Clean all components in cleaning solvent. Dry components with compressed air. Inspect clutch pack plates for wear, scoring or damage. Replace both clutch packs if any one component in either pack is damaged. Inspect side and pinion gears. Replace any gear that is worn, cracked, chipped or damaged. Inspect differential case and pinion shaft. Replace if worn or damaged.

PRESOAK PLATES AND DISC

Plates and discs with fiber coating (no grooves or lines) must be presoaked in Friction Modifier before assembly. Soak plates and discs for a minimum of 20 minutes.

ADJUSTMENTS

PINION GEAR DEPTH

GENERAL INFORMATION

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and pinion gear are etched into the face of each gear (Fig. 64). A plus (+) number, minus (–) number or zero (0) is etched into the face of the pinion gear. This number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion etched with a (0). The standard setting from the center line of the ring gear to the back face of the pinion is 96.850 mm (3.813 in.). The standard depth provides the best teeth contact pattern. Refer to Backlash and Contact Pattern Analysis Paragraph in this section for additional information.

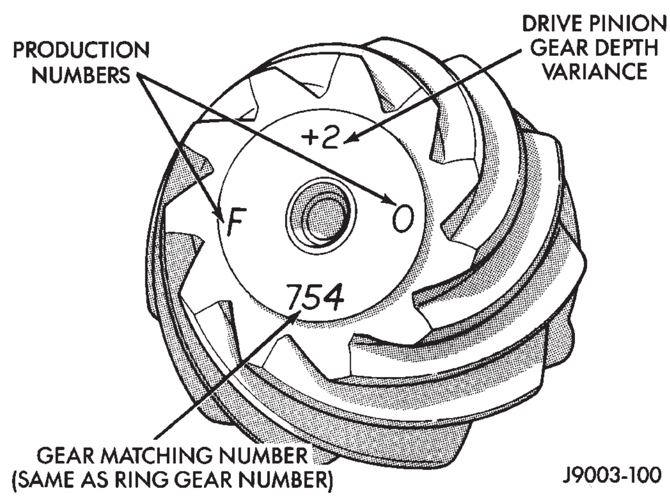

Fig. 64 Pinion Gear ID Numbers

Compensation for pinion depth variance is achieved with select shims. The shims are placed under the inner pinion bearing cone (Fig. 65).

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

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

ADJUSTMENTS (Continued)

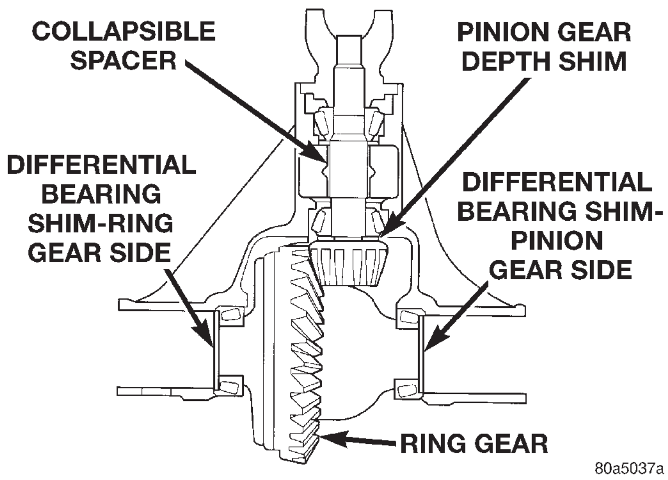

Fig. 65 Shim Locations

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 shim(s). If the number is positive, subtract that value from the thickness of the depth shim(s). If the number is 0 no change is necessary. Refer to the Pinion Gear Depth Variance Chart.

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Measurements are taken with pinion cups and pinion bearings installed in housing. Take measurements with a Pinion Gauge Set, Pinion Block 6735, Arbor Discs 6732, and Dial Indicator C-3339 (Fig. 66).

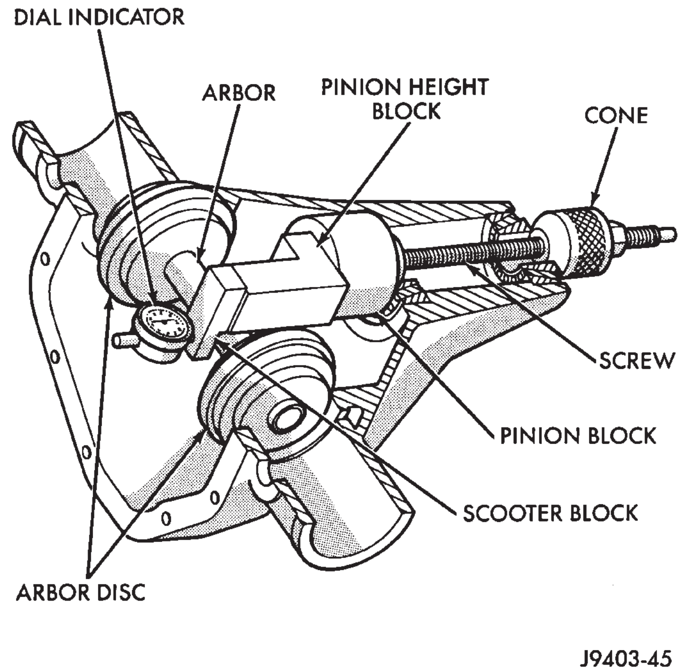

Fig. 66 Pinion Gear Depth Gauge Tools—Typical

(1) Assemble Pinion Height Block 6739, Pinion Block 6735, and rear pinion bearing onto Screw 6741 (Fig. 66).

(2) Insert assembled height gauge components, rear bearing and screw into axle housing through pinion bearing cups (Fig. 67).

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)

(3) Install front pinion bearing and Cone 6740 hand tight (Fig. 66).

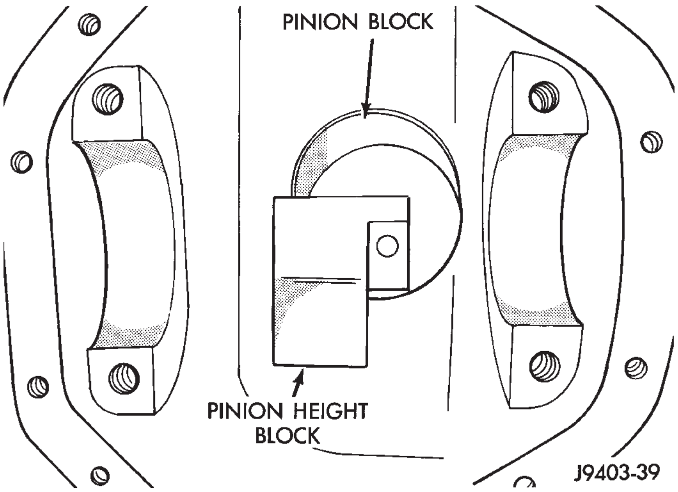


Fig. 67 Pinion Height Block—Typical

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in axle housing side bearing cradles (Fig. 68). Install differential bearing caps on Arbor Discs and tighten cap bolts. Refer to the Torque Specifications in this section.

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

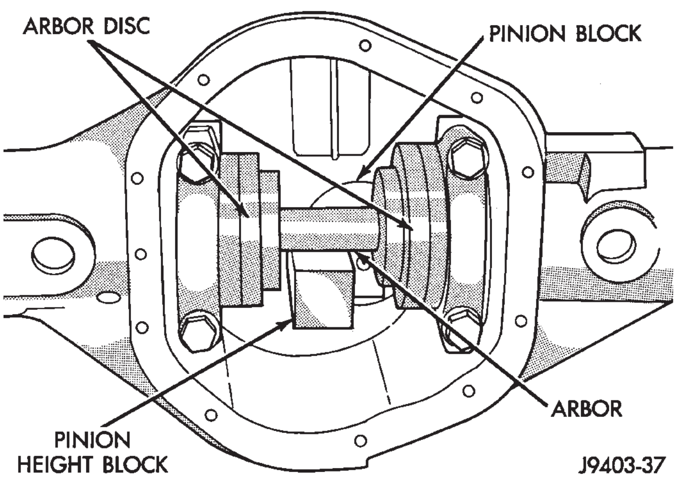


Fig. 68 Gauge Tools In Housing—Typical

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

(6) Place Scooter Block/Dial Indicator in position in axle housing so dial probe and scooter block are flush against the surface of the pinion height block. Hold scooter block in place and zero the dial indicator face to the pointer. Tighten dial indicator face lock screw.

(7) With scooter block still in position against the pinion height block, slowly slide the dial indicator probe over the edge of the pinion height block. Observe how many revolutions counterclockwise the dial pointer travels (approximately 0.125 in.) to the out-stop of the dial indicator.

(8) Slide the dial indicator probe across the gap between the pinion height block and the arbor bar with the scooter block against the pinion height block (Fig. 69). When the dial probe contacts the arbor bar, the dial pointer will turn clockwise. Bring dial pointer back to zero against the arbor bar, do not turn dial face. Continue moving the dial probe to the crest of the arbor bar and record the highest reading. If the dial indicator can not achieve the zero reading, the rear bearing cup or the pinion depth gauge set is not installed correctly.

(9) Select a shim equal to the dial indicator reading plus the drive pinion gear depth variance number etched in the face of the pinion gear (Fig. 64) using the opposite sign on the variance number. For example, if the depth variance is –2, add +0.002 in. to the dial indicator reading.

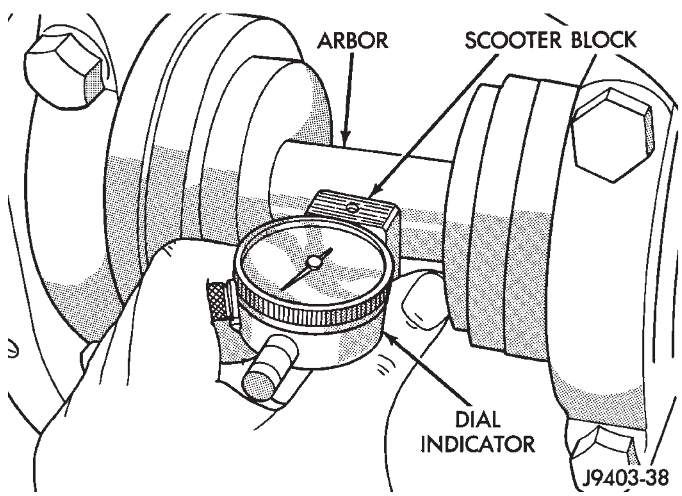


Fig. 69 Pinion Gear Depth Measurement—Typical

(10) Remove the pinion depth gauge components from the axle housing.

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-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 differen-

ADJUSTMENTS (Continued)

tial side play is measured, the pinion gear is installed, and the gear backlash shim thickness is measured. The overall shim thickness is the total of the dial indicator reading, starting point shim thickness, and the 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. 70).

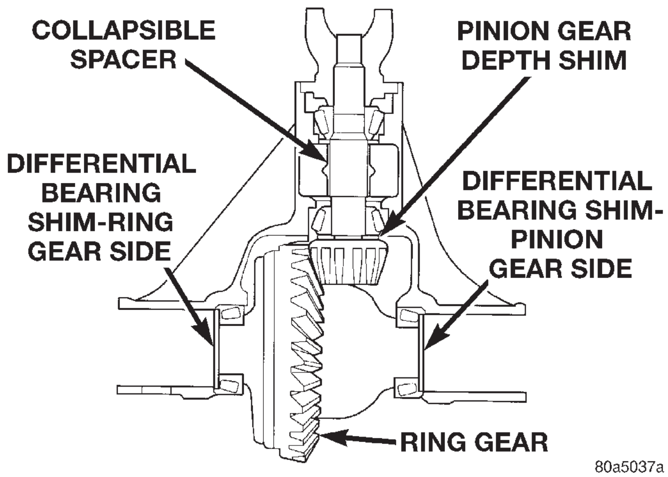


Fig. 70 Axle Adjustment Shim Locations

SHIM SELECTION

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

(1) Remove side bearings from differential case.

(2) Install ring gear, if necessary, on differential case and tighten bolts to specification.

(3) Install dummy side bearings D-348 on differential case.

(4) Install differential case in axle housing.

(5) Insert Dummy Shims 8107 (0.118 in. (3.0 mm)) starting point shims between the dummy bearing and the axle housing (Fig. 71).

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

(7) Using a dead-blow type mallet, seat the differential dummy bearings to each side of the axle housing (Fig. 72) and (Fig. 73).

(8) Thread guide stud C-3288-B into rear cover bolt hole below ring gear (Fig. 74).

(9) Attach dial indicator C-3339 to guide stud. Position the dial indicator plunger on a flat surface on a ring gear bolt head (Fig. 74).

(10) Push firmly and hold differential case to pinion gear side of axle housing (Fig. 75).

(11) Zero dial indicator face to pointer.

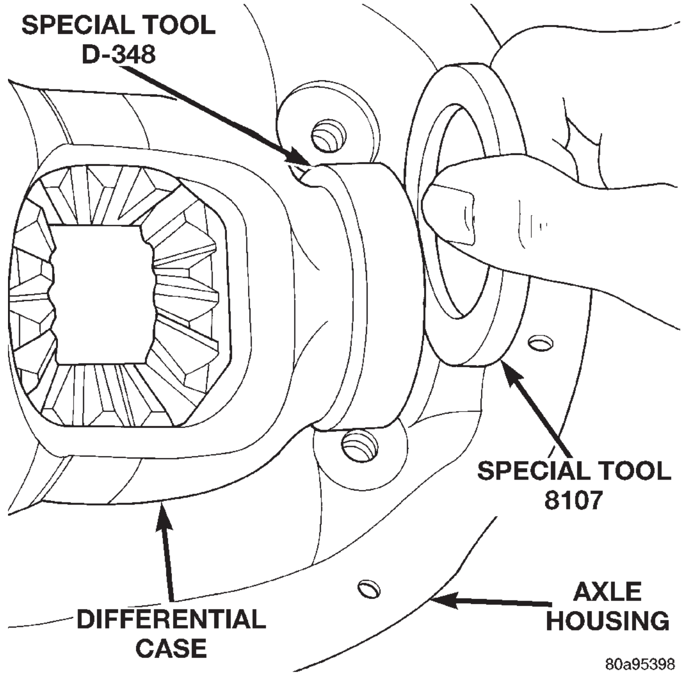


Fig. 71 Insert Starting Point Shims

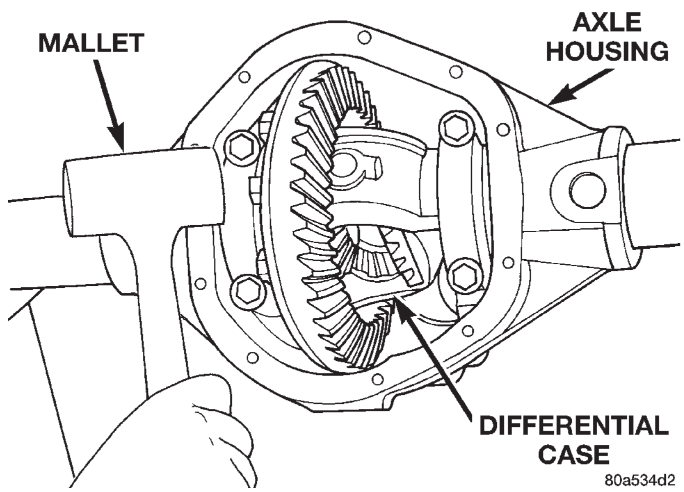


Fig. 72 Seat Pinion Gear Dummy Side Bearing

(12) Push firmly and hold differential case to ring gear side of the axle housing (Fig. 76).

(13) Record dial indicator reading.

(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, dummy bearings, and starting point shims from axle housing.

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

ADJUSTMENTS (Continued)

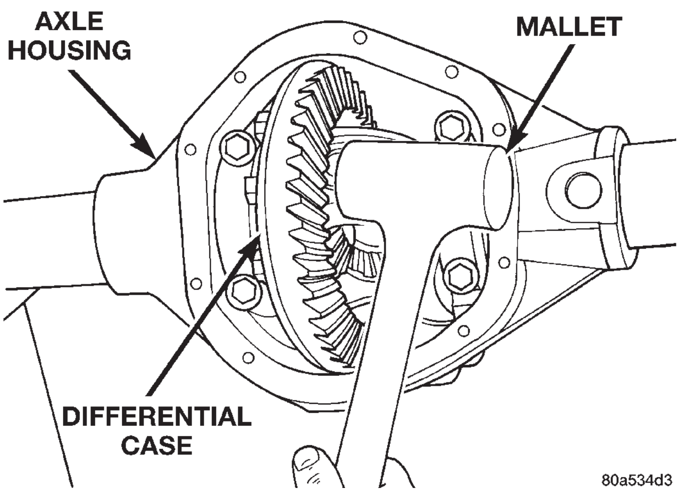


Fig. 73 Seat Ring Gear Side Dummy Bearing

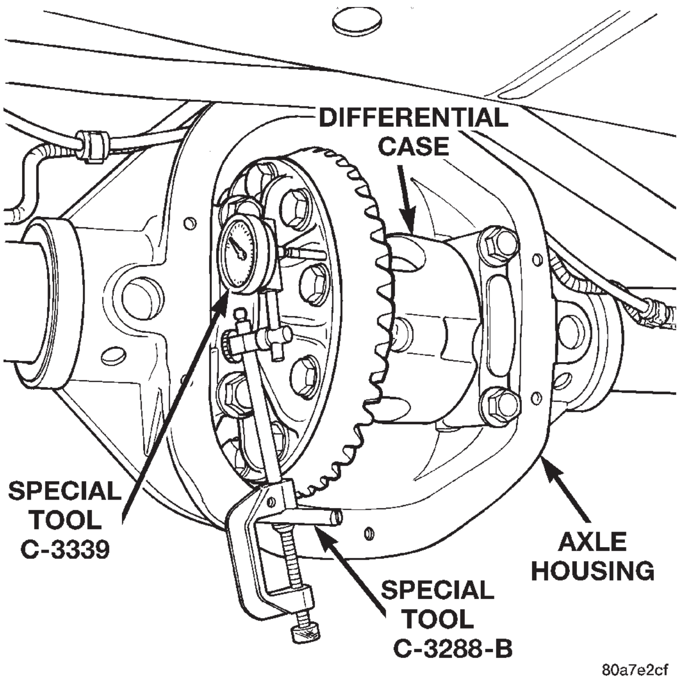


Fig. 74 Differential Side play Measurement

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

(20) Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 74).

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

(22) Zero dial indicator face to pointer.

(23) Push and hold differential case to ring gear side of the axle housing.

(24) Record dial indicator reading.

(25) 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 of shim required to achieve proper backlash.

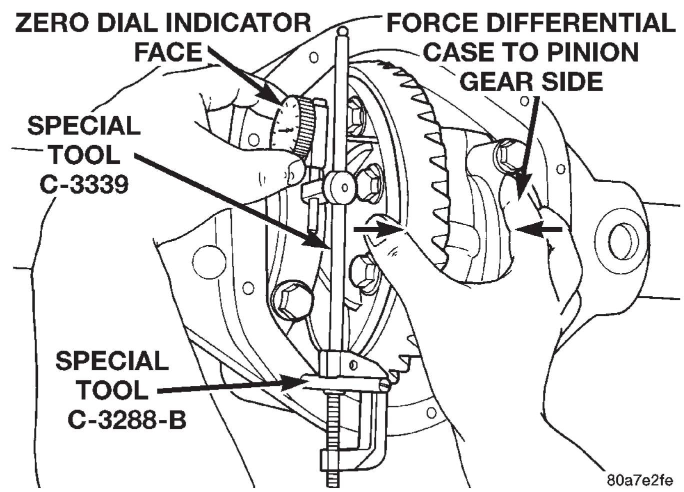


Fig. 75 Hold Differential Case and Zero Dial Indicator

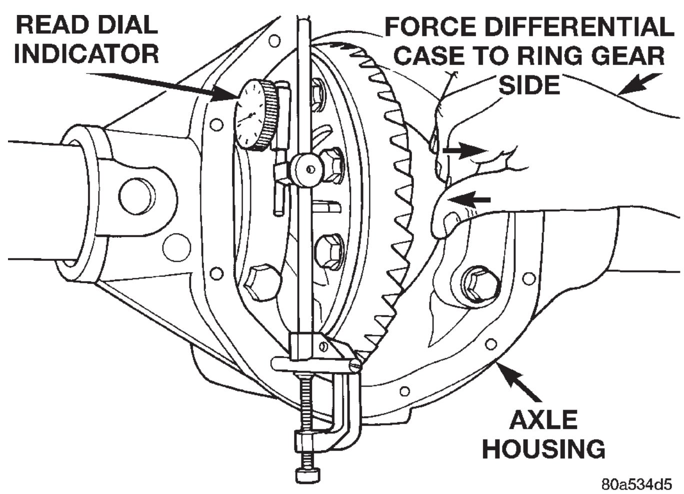


Fig. 76 Hold Differential Case and Read Dial Indicator

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

(27) Rotate dial indicator out of the way on guide stud.

(28) Remove differential case and dummy bearings from axle housing.

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

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

(31) Place side bearing shims in axle housing against axle tubes.

(32) Install differential case in axle housing.

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

ADJUSTMENTS (Continued)

(34) Position the indicator plunger against a ring gear tooth (Fig. 77).

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

(36) Zero dial indicator face to pointer.

(37) Push and hold ring gear downward while not allowing the pinion gear to rotate. Dial indicator reading should be between 0.12 mm (0.005 in.) and 0.20 mm (0.008 in.). If backlash is not within specifications transfer the necessary amount of shim thickness from one side of the differential housing to the other (Fig. 78).

(38) 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 the Gear Contact Pattern Analysis procedure.

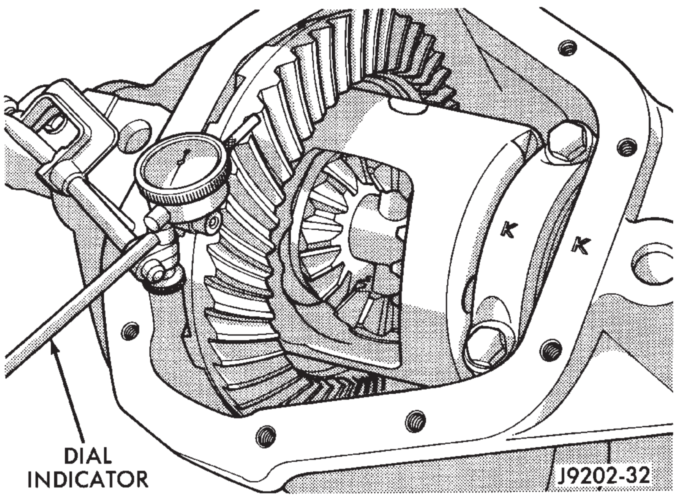


Fig. 77 Ring Gear Backlash Measurement

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.

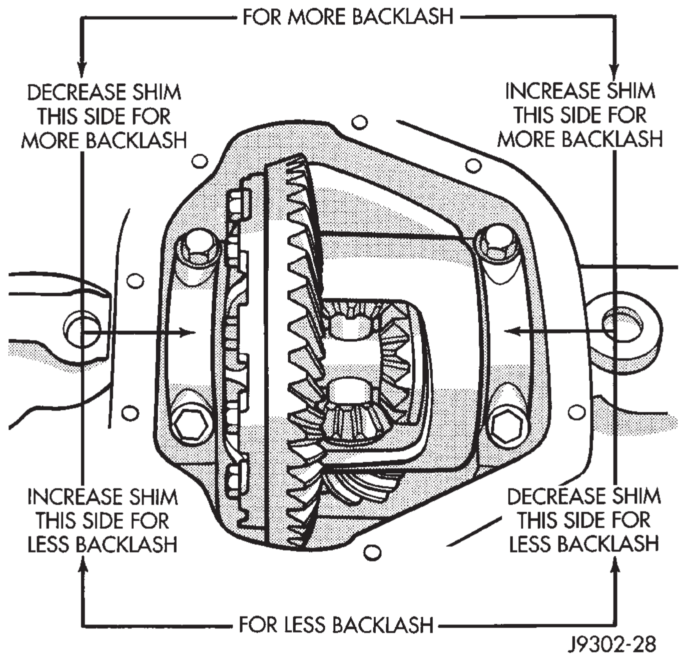


Fig. 78 Backlash Shim Adjustment

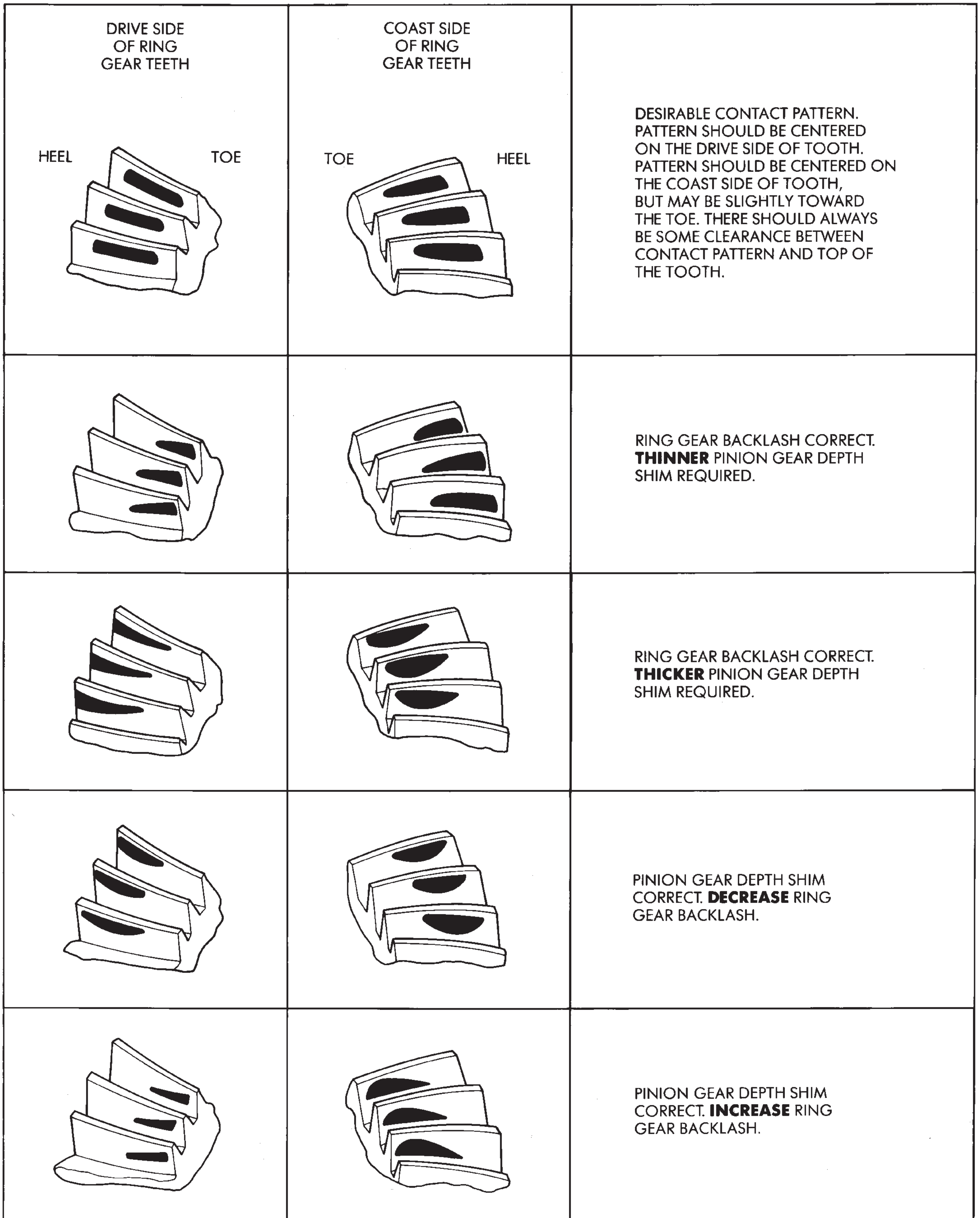
(1) Apply a thin coat of hydrated ferric oxide, or equivalent, to the drive and coast side of the ring gear teeth.

(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 (Fig. 79) and adjust pinion depth and gear backlash as necessary.

ADJUSTMENTS (Continued)



J9003-24

Fig. 79 Gear Tooth Contact Patterns

SPECIFICATIONS

194 RBI AXLE

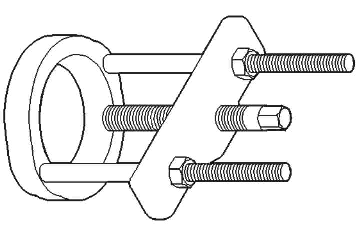
DESCRIPTION	SPECIFICATION
Axle Type	Semi–Floating Hypoid
Lubricant	SAE Thermally Stable 80W–90
Lubricant Trailer Tow	Synthetic 75W–140
Lube Capacity	1.66 L (3.50 pts.)
Axle Ratios	3.07, 3.55, 3.73
Differential Bearing Preload	0.1 mm (0.004 in.)
Differential Side Gear Clearance	0–0.15 mm (0–0.006 in.)
Ring Gear Diameter	19.2 cm (7.562 in.)
Ring Gear Backlash	0–0.15 mm (0.005–0.008 in.)
Pinion Std. Depth	92.08 mm (3.625 in.)
Pinion Bearing Preload-Original Bearings	1–2 N·m (10–20 in. lbs.)
Pinion Bearing Preload-New Bearings	1.5–4 N·m (15–35 in. lbs.)

TORQUE – 194 RBI AXLE

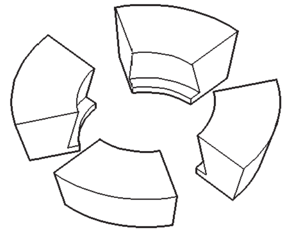
DESCRIPTION	TORQUE
Bolt, Diff. Cover	41 N·m (30 ft. lbs.)
Bolot, Bearing Cap	77 N·m (57 ft. lbs.)
Nut, Pinion	271–474 N·m (200–350 ft. lbs.)
Screw, Pinion Mate Shaft Lock	16.25 N·m (12 ft. lbs.)
Bolt, Ring Gear	95–122 N·m (70–90 ft. lbs.)
Bolt, RWAL/ABS Sensor	8 N·m (70 in. lbs.)

SPECIAL TOOLS

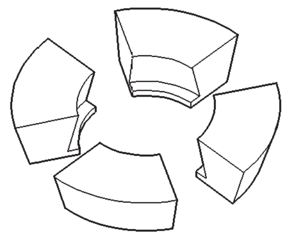
194 RBI AXLE



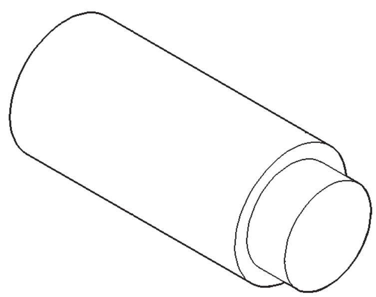
Puller—C-293-PA



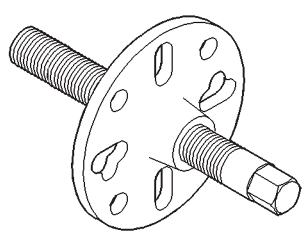
Adapter—C-293-39



Adapter—C-293-40

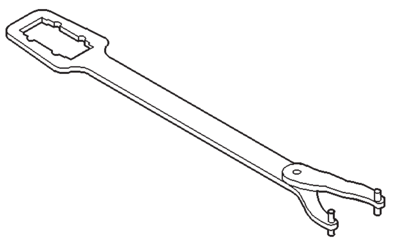


Plug—SP-3289

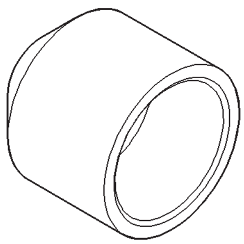


Puller—C-452

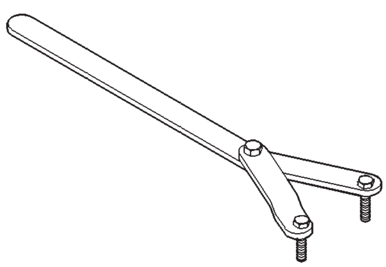
SPECIAL TOOLS (Continued)



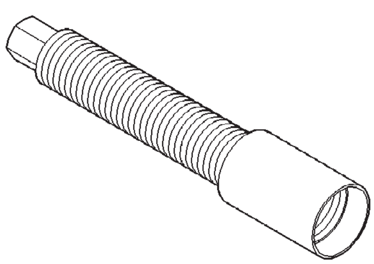
Wrench—C-3281



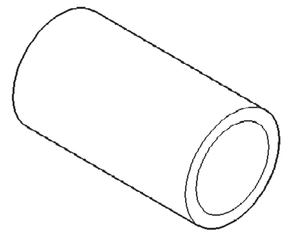
Installer—C-3972-A



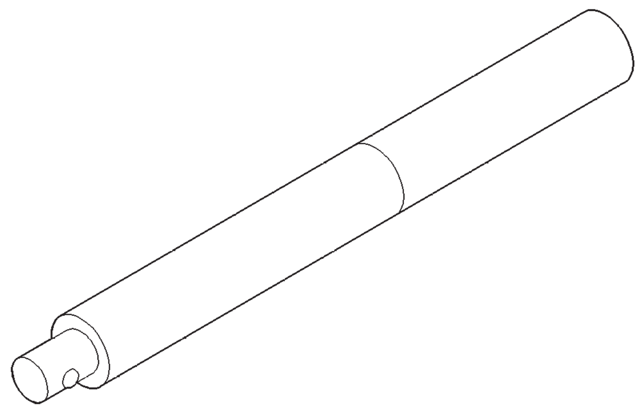
Spanner—6958



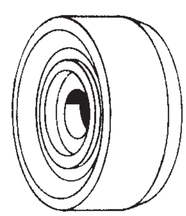
Installer Screw—8112



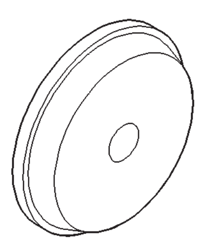
Cup—8109



Handle—C-4171

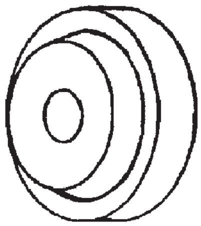


Driver—C-3716-A

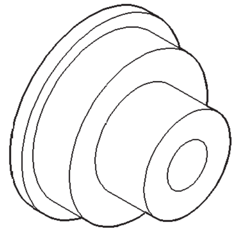


Installer—D-130

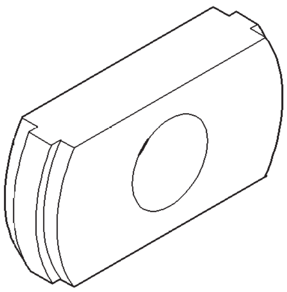
SPECIAL TOOLS (Continued)



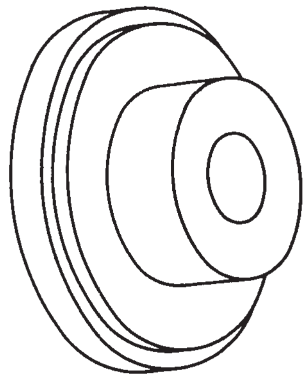
Installer—D-146



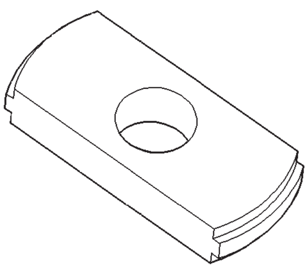
Installer—6436



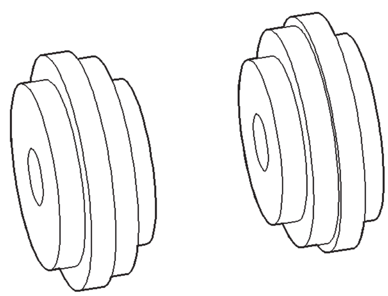
Remover—C-4345



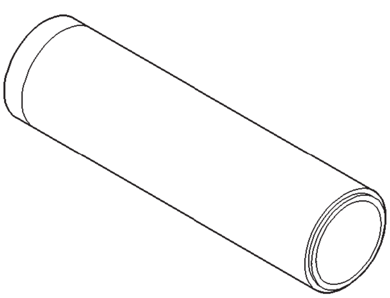
Installer—6437



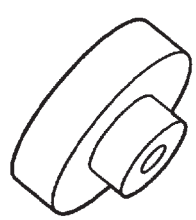
Remover—D-149



Disc, Axle Arbor—6732

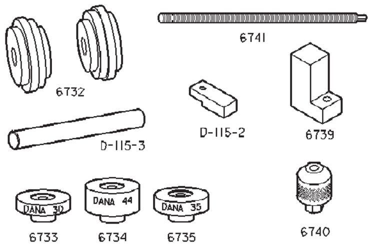


Installer—W-262

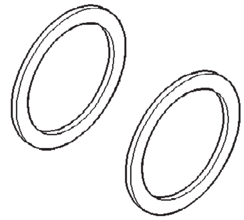


Gauge Block—6735

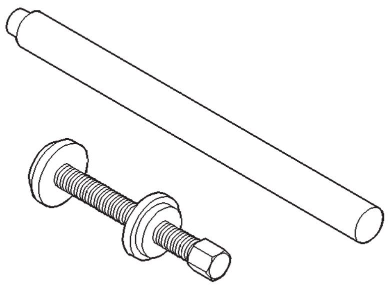
SPECIAL TOOLS (Continued)



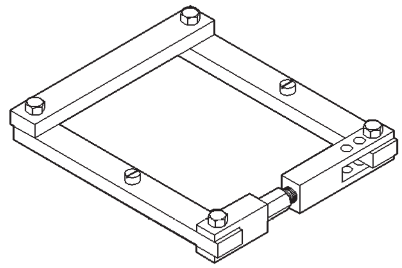
Tool Set, Pinion Depth—6774



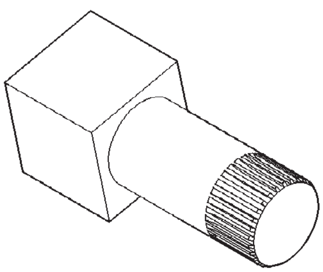
Starting Point Shim—8107



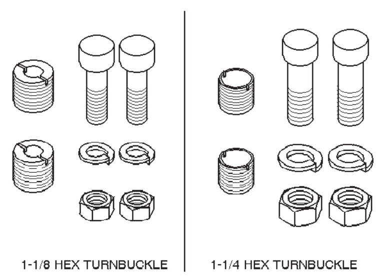
Trac-lok Tool Set—6960



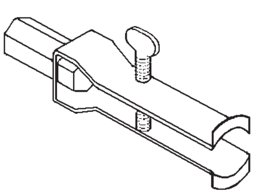
Spreader—W-129-B



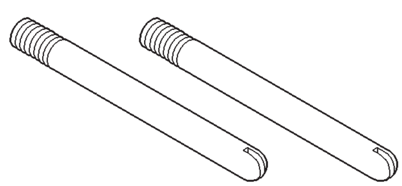
Holder—6965



Adapter Kit—6987

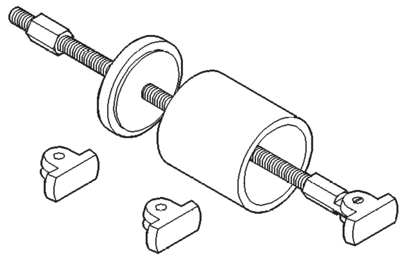


Puller—7794-A

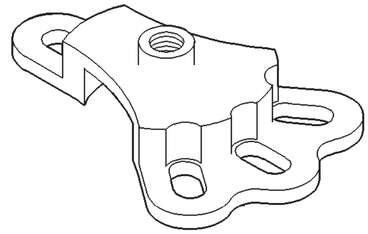


Guide Pin—C-3288-B

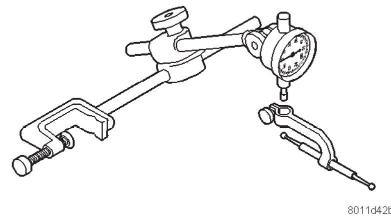
SPECIAL TOOLS (Continued)



Bearing Remover Tool Set—6310



Hub Puller—6790



Dial Indicator—C-3339

8 1/4 REAR AXLE

INDEX

GENERAL INFORMATION

8 1/4 AXLES

The 8 1/4 inch axle housings consist of a cast iron center section with axle shaft tubes extending from either side. The tubes are pressed into and welded to the differential housing to form a one-piece axle housing (Fig. 1).

The axles have a vent hose to relieve internal pressure caused by lubricant vaporization and internal expansion.

The axles are equipped with semi-floating axle shafts, meaning vehicle loads are supported by the axle shaft and bearings. The axle shafts are retained by C-clips in the differential side gears.

The removable, stamped steel cover provides a means for inspection and service without removing the complete axle from the vehicle.

The 8 1/4 axle have the assembly part number and gear ratio listed on tag. The tag is attached to the differential housing by a cover bolt.

The differential case is a one-piece design. The differential pinion mate shaft is retained with a threaded pin. Differential bearing preload and ring gear backlash are set and maintained by threaded adjusters at the outside of the differential housing. Pinion bearing preload is set and maintained by the use of a collapsible spacer.

Axles equipped with a Trac-Lok™ differential are optional. A Trac-Lok differential has a one-piece differential case, and the same internal components as a standard differential, plus two clutch disc packs.

AXLE IDENTIFICATION

The axle differential cover can be used for identification of the axle (Fig. 2). A tag is also attached to the cover.

LUBRICANT SPECIFICATIONS

Multi-purpose, hypoid gear lubricant should be used for rear axles with a standard differential. The lubricant should have a MIL-L-2105C and API GL 5 quality specifications.

Trac-Lok differentials require the addition of 4 oz. of friction modifier to the axle lubricant after service. The 8 1/4 axle lubricant capacity is 2.08 L (4.4 pts.) total, including the friction modifier, if necessary.

GENERAL INFORMATION (Continued)

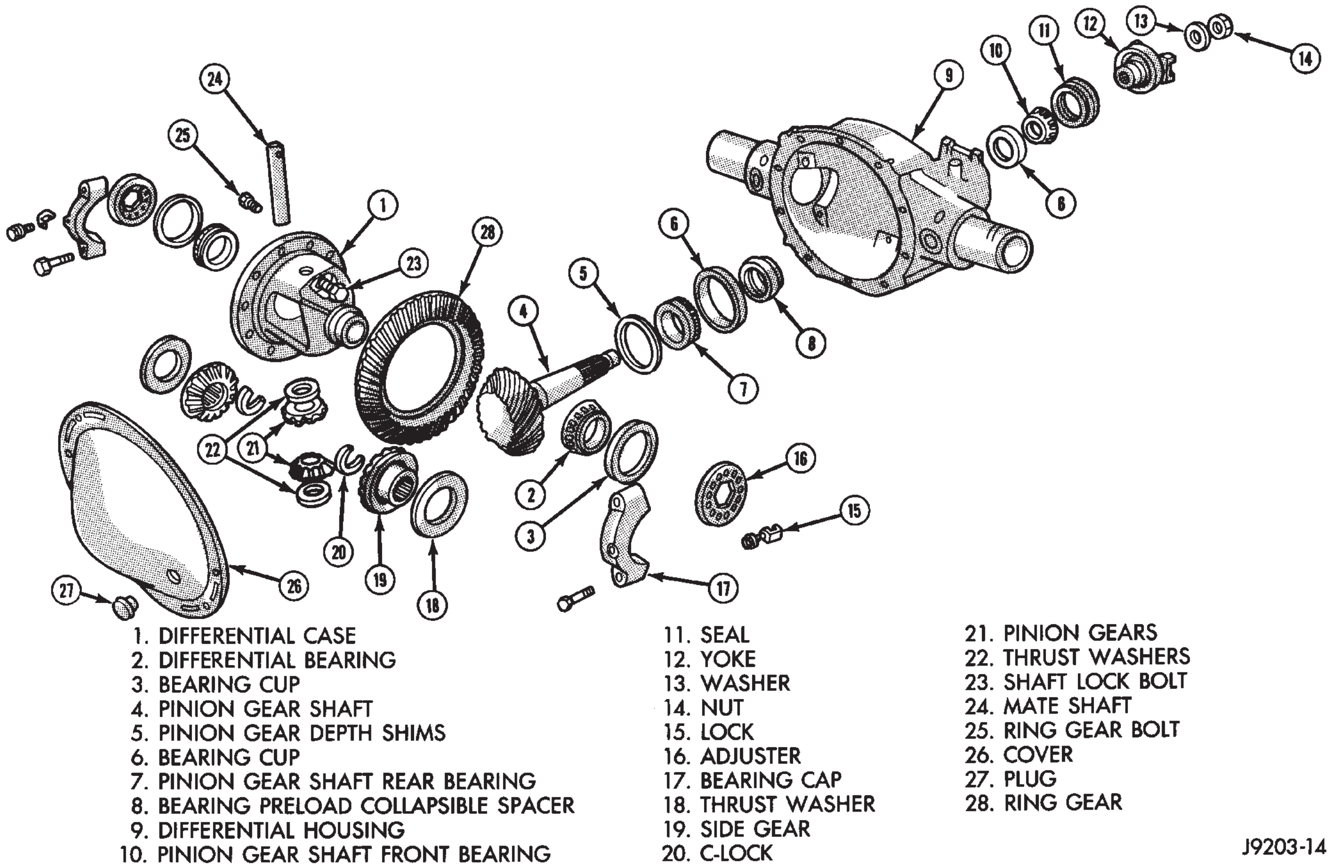


Fig. 1 8 1/4 Axle

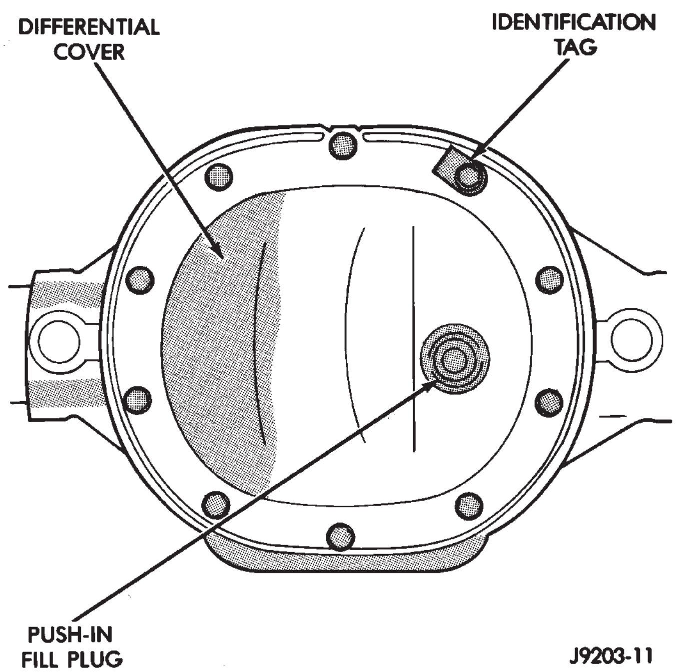


Fig. 2 Differential Cover 8 1/4 Inch Axle

NOTE: If the rear axle is submerged in water, the lubricant must be replaced immediately. Avoid the possibility of premature axle failure resulting from water contamination of the lubricant.

DESCRIPTION AND OPERATION

STANDARD DIFFERENTIAL

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

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

In operation, power flow occurs as follows:

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

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 3).

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a

DESCRIPTION AND OPERATION (Continued)

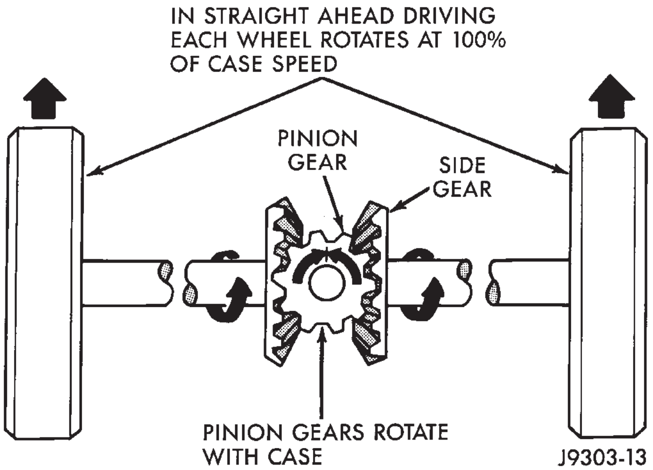


Fig. 3 Differential Operation—Straight Ahead Driving

turn. The difference must be compensated for to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 4). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

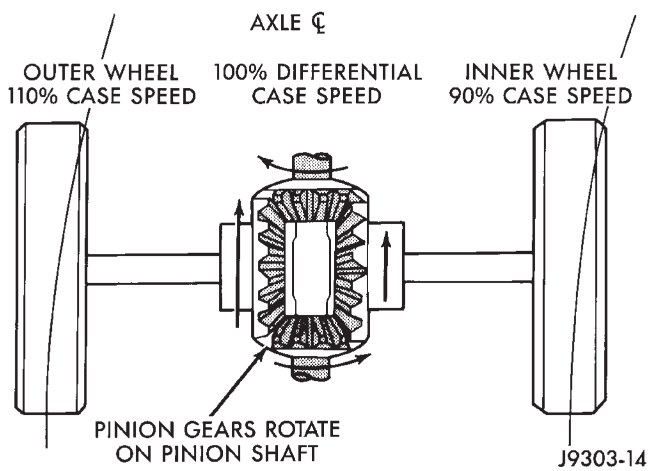


Fig. 4 Differential Operation—On Turns

TRAC-LOK™ OPERATION

In a conventional differential, if one wheel spins, the opposite wheel will generate only as much torque as the spinning wheel.

In the Trac-lok™ differential, part of the ring gear torque is transmitted through clutch packs which contain multiple discs. The clutches will have radial grooves on the plates, and concentric grooves on the discs or bonded fiber material that is smooth in appearance.

In operation, the Trac-lok™ clutches are engaged by two concurrent forces. The first being the preload force exerted through Belleville spring washers within the clutch packs. The second is the separating forces generated by the side gears as torque is applied through the ring gear (Fig. 5).

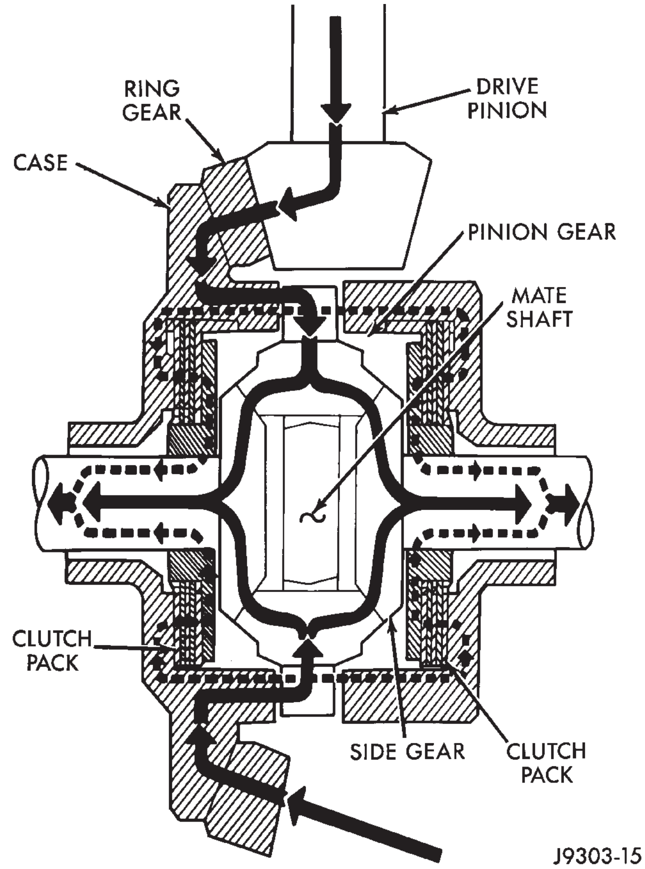


Fig. 5 Trac-lok™ Limited Slip Differential Operation

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

DIAGNOSIS AND TESTING

GENERAL INFORMATION

Axle bearing problem conditions are usually caused by:
- Insufficient or incorrect lubricant.
- Foreign matter/water contamination.
- Incorrect bearing preload torque adjustment.
- Incorrect backlash.

Axle gear problem conditions are usually the result of:
- Insufficient lubrication.
- Incorrect or contaminated lubricant.
- Overloading (excessive engine torque) or exceeding vehicle weight capacity.
- Incorrect clearance or backlash adjustment.

DIAGNOSIS AND TESTING (Continued)

Axle component breakage is most often the result of:
- Severe overloading.
- Insufficient lubricant.
- Incorrect lubricant.
- Improperly tightened components.

GEAR NOISE

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

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

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

Differential side and pinion gears can be checked by turning the vehicle. They usually do not cause noise during straight–ahead driving when the gears are unloaded. The side gears are loaded during vehicle turns. A worn pinion gear mate shaft can also cause a snapping or a knocking noise.

BEARING NOISE

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

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

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

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

LOW SPEED KNOCK

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

VIBRATION

Vibration at the rear of the vehicle is usually caused by a:
- Damaged drive shaft.
- Missing drive shaft balance weight(s).
- Worn or out–of–balance wheels.
- Loose wheel lug nuts.
- Worn U–joint(s).
- Loose/broken springs.
- Damaged axle shaft bearing(s).
- Loose pinion gear nut.
- Excessive pinion yoke run out.
- Bent axle shaft(s).

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

All driveline components should be examined before starting any repair.

Refer to Group 22, Wheels and Tires, for additional vibration information.

DRIVELINE SNAP

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

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

TRAC–LOK™ DIFFERENTIAL NOISE

The most common problem is a chatter noise when turning corners. Before removing a Trac-lok™ unit for repair, drain, flush and refill the axle with the specified lubricant. Refer to Lubricant change in this Group.

A container of Mopar® Trac-lok™ Lubricant (friction modifier) should be added after repair service or during a lubricant change.

After changing the lubricant, drive the vehicle and make 10 to 12 slow, figure-eight turns. This maneuver will pump lubricant through the clutches. This will correct the condition in most instances. If the chatter persists, clutch damage could have occurred.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
WHEEL NOISE	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	1. Misaligned axle shaft tube. 2. Bent or sprung axle shaft. 3. End play in drive pinion bearings. 4. Excessive gear backlash between ring gear and pinion gear. 5. Improper adjustment of drive pinion gear shaft bearings. 6. Loose drive pinion gearshaft yoke nut. 7. Improper wheel bearing adjustment. 8. Scuffed gear tooth contact surfaces.	1. Inspect axle shaft tube alignment. Correct as necessary. 2. Replace bent or sprung axle shaft. 3. Refer to Drive Pinion Bearing Pre-Load Adjustment. 4. Check adjustment of ring gear backlash and pinion gear. Correct as necessary. 5. Adjust drive pinion shaft bearings. 6. Tighten drive pinion gearshaft yoke nut with specified torque. 7. Readjust as necessary. 8. If necessary, replace scuffed gears.
AXLE SHAFT BROKE	1. Misaligned axle shaft tube. 2. Vehicle overloaded. 3. Erratic clutch operation. 4. Grabbing clutch.	1. Replace broken axle shaft after correcting axle shaft tube alignment. 2. Replace broken axle shaft. Avoid excessive weight on vehicle. 3. Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch. 4. Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	1. Improper adjustment of differential bearings. 2. Excessive ring gear backlash. 3. Vehicle overloaded. 4. Erratic clutch operation.	1. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly. 2. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly. 3. Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle. 4. Replace cracked case. After inspecting for other possible causes, examine gears and bearings for possible damage. Avoid erratic use of clutch.
DIFFERENTIAL GEARS SCORED	1. Insufficient lubrication. 2. Improper grade of lubricant. 3. Excessive spinning of one wheel/tire.	1. Replace scored gears. Scoring marks on the drive face of gear teeth or in the bore are caused by instantaneous fusing of the mating surfaces. Scored gears should be replaced. Fill rear differential housing to required capacity with proper lubricant. Refer to Specifications. 2. Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant. 3. Replace scored gears. Inspect all gears, pinion bores and shaft for damage. Service as necessary.
LOSS OF LUBRICANT	1. Lubricant level too high.	1. Drain excess lubricant by removing fill plug and allow lubricant to level at lower edge of fill plug hole.

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DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART – 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

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DIAGNOSIS AND TESTING (Continued)

TRAC–LOK™ TEST

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

The differential can be tested without removing the differential case by measuring rotating torque. Make sure brakes are not dragging during this measurement.

(1) Place blocks in front and rear of both front wheels.

(2) Raise one rear wheel until it is completely off the ground.

(3) Engine off, transmission in neutral, and parking brake off.

(4) Remove wheel and bolt Special Tool 6790 to studs.

(5) Use torque wrench on special tool to rotate wheel and read rotating torque (Fig. 6).

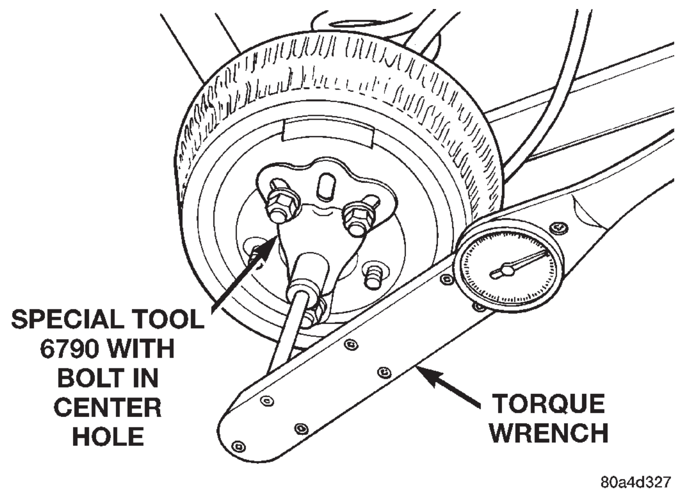

Fig. 6 Trac-lok™ Test —Typical

(6) If rotating torque is less than 22 N·m (30 ft. lbs.) or more than 271 N·m (200 ft. lbs.) on either wheel the unit should be serviced.

SERVICE PROCEDURES

LUBRICANT CHANGE

(1) Raise and support the vehicle.

(2) Remove the lubricant fill hole plug from the differential housing cover.

(3) Remove the differential housing cover and drain the lubricant from the housing.

(4) Clean the housing cavity with a flushing oil, light engine oil, or lint free cloth. **Do not use water, steam, kerosene, or gasoline for cleaning.**

(5) Remove the original sealant from the housing and cover surfaces.

(6) Apply a bead of Mopar® Silicone Rubber Sealant, or equivalent, to the housing cover (Fig. 7).

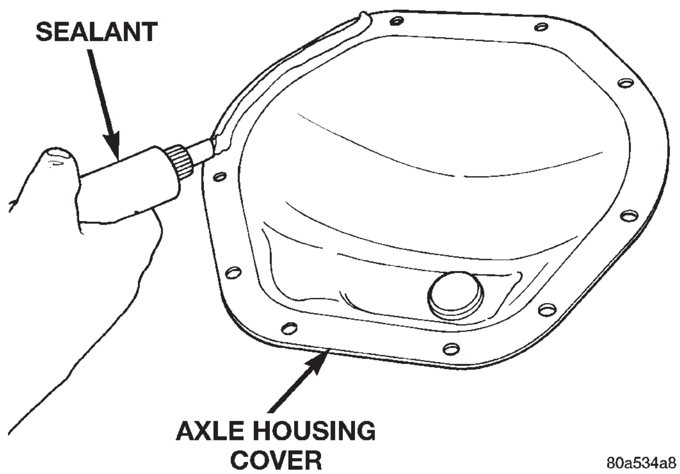

Fig. 7 Apply Sealant

Install the housing cover within 5 minutes after applying the sealant.

(7) Install the cover and any identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

(8) For Trac–lok™ differentials, a quantity of Mopar® Trac–lok™ lubricant (friction modifier), or equivalent, must be added after repair service or a lubricant change. Refer to the Lubricant Specifications section of this group for the quantity necessary.

(9) Fill differential with Mopar® Hypoid Gear Lubricant, or equivalent, to bottom of the fill plug hole. Refer to the Lubricant Specifications section of this group for the quantity necessary.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

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

(11) Trac–lok™ differential equipped vehicles should be road tested by making 10 to 12 slow figure-eight turns. This maneuver will pump the lubricant through the clutch discs to eliminate a possible chatter noise complaint.

REMOVAL AND INSTALLATION

REAR AXLE

REMOVAL

(1) Raise and support the vehicle.

REMOVAL AND INSTALLATION (Continued)

(2) Position a suitable lifting device under the axle.
(3) Secure axle to device.
(4) Remove the wheels and tires.
(5) Secure brake drums to the axle shaft.
(6) Disconnect the brake hose at the axle junction block. Do not disconnect the brake hydraulic lines at the wheel cylinders. Refer to Group 5, Brakes, for proper procedures.
(7) Disconnect the parking brake cables and cable brackets.
(8) Disconnect the vent hose from the axle shaft tube.
(9) Mark the propeller shaft and yoke for installation alignment reference.
(10) Remove propeller shaft.
(11) Disconnect shock absorbers from axle.
(12) Remove the stabilizer links.
(13) Remove the spring clamps and spring brackets. Refer to Group 2, Suspension, for proper procedures.
(14) Separate the axle from the vehicle.

INSTALLATION

(1) Raise the axle with lifting device and align to the leaf spring centering bolts.
(2) Install the spring clamps and spring brackets. Refer to Group 2, Suspension, for proper procedures.
(3) Install shock absorbers and tighten nuts to 60 N·m (44 ft. lbs.) torque.
(4) Install the stabilizer links. Tighten sway bar links to 74 N·m (55 ft. lbs.).
(5) Connect the parking brake cables and cable brackets.
(6) Install the brake drums. Refer to Group 5, Brakes, for proper procedures.
(7) Connect the brake hose to the axle junction block. Refer to Group 5, Brakes, for proper procedures.
(8) Install axle vent hose.
(9) Align propeller shaft and pinion yoke reference marks. Install universal joint straps and bolts. Tighten to 19 N·m (14 ft. lbs.) torque.
(10) Install the wheels and tires.
(11) Add gear lubricant, if necessary. Refer to Lubricant Specifications in this section for lubricant requirements.
(12) Remove lifting device from axle and lower the vehicle.

AXLE SHAFT

REMOVAL

(1) Raise and support vehicle. Ensure that the transmission is in neutral.
(2) Remove wheel and tire assembly.
(3) Remove brake drum. Refer to Group 5, Brakes, for proper procedure.
(4) Clean all foreign material from housing cover area.
(5) Loosen housing cover bolts. Drain lubricant from the housing and axle shaft tubes. Remove housing cover.
(6) Rotate differential case so that pinion mate gear shaft lock screw is accessible. Remove lock screw and pinion mate gear shaft from differential case (Fig. 8).

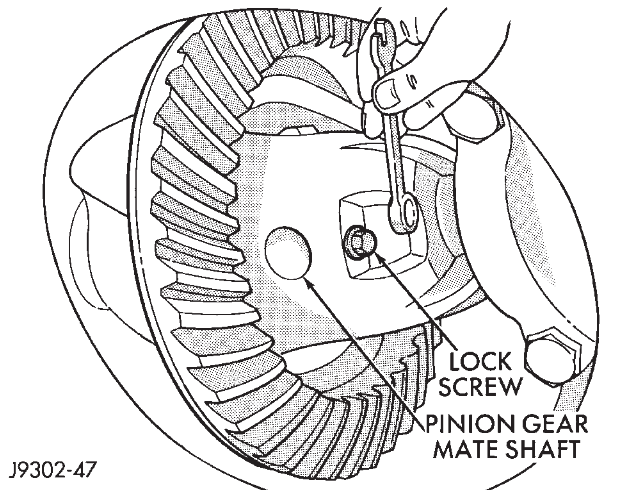

Fig. 8 Mate Shaft Lock Screw

(7) Push axle shaft inward and remove axle shaft C–clip lock from the axle shaft (Fig. 9).

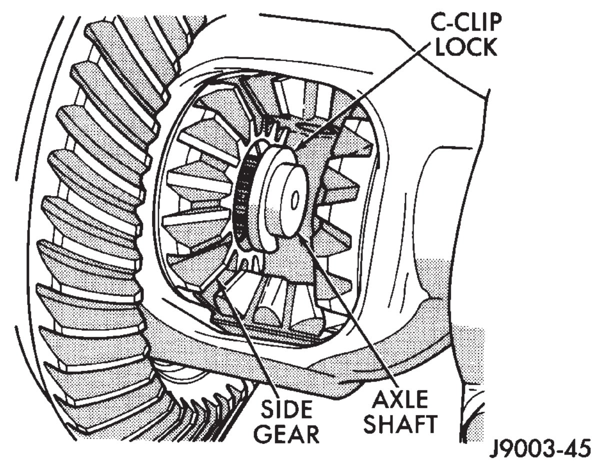

Fig. 9 Axle Shaft C–Clip Lock

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

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

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

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

(2) Insert C–clip lock in end of axle shaft. Push axle shaft outward to seat C–clip lock in side gear.

(3) Insert pinion mate shaft into differential case and through thrust washers and pinion gears.

(4) Align hole in shaft with hole in the differential case and install lock screw with Loctite® on the threads. Tighten lock screw to 11 N·m (8 ft. lbs.) torque.

(5) Install cover and add fluid. Refer to Lubricant Change procedure in this section for procedure and lubricant requirements.

(6) Install brake drum. Refer to Group 5, Brakes, for proper procedures.

(7) Install wheel and tire.

(8) Lower vehicle.

AXLE SEAL AND BEARING

REMOVAL

(1) Remove axle shaft.

(2) Remove axle shaft seal from the end of the axle tube with a small pry bar (Fig. 10).

NOTE: The seal and bearing can be removed at the same time with the bearing removal tool.

(3) Remove the axle shaft bearing from the axle tube with Bearing Removal Tool Set 6310, using Adapter Foot 6310-9 (Fig. 11).

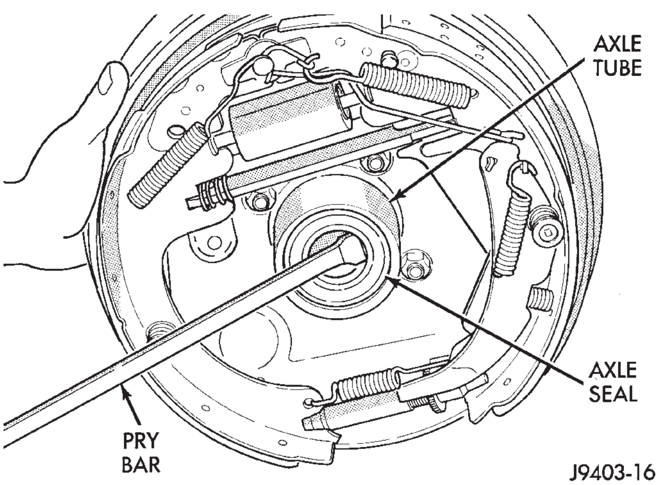

Fig. 10 Axle Seal Removal

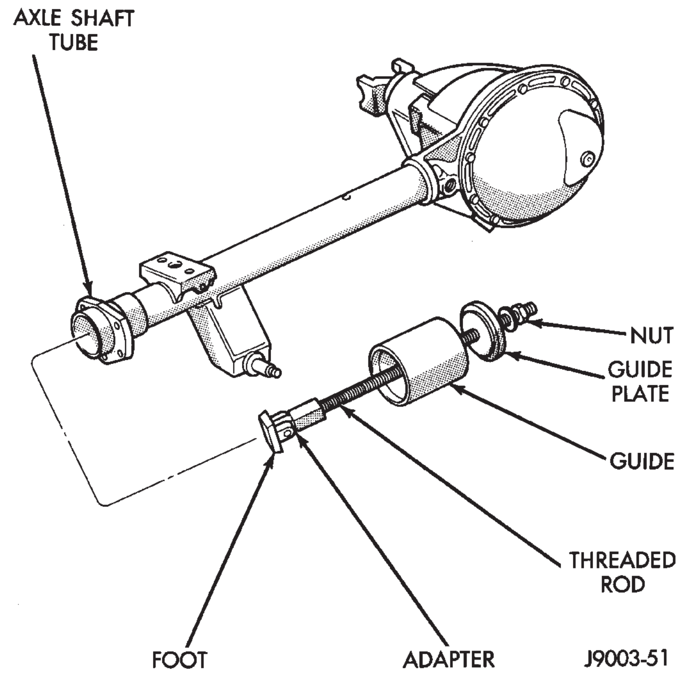

Fig. 11 Axle Shaft Bearing Removal Tool

INSTALLATION

NOTE: Do not install the original axle shaft seal. Always install a new seal.

(1) Wipe the axle tube bore clean. Remove any old sealer or burrs from the tube.

(2) Install the axle shaft bearing with Installer C-4198 and Handle C-4171 (Fig. 12). Ensure that the bearing part number is against the installer. Verify that the bearing in installed straight and the tool fully contacts the axle tube when seating the bearing.

(3) Install a new axle seal with Installer C-4076-B and Handle C-4735-1. When the tool contacts the axle tube, the seal is installed to the correct depth.

(4) Coat the lip of the seal with axle lubricant for protection prior to installing the axle shaft.

(5) Install the axle shaft.

PINION SEAL

REMOVAL

(1) Raise and support the vehicle.

(2) Scribe a mark on the universal joint, pinion yoke, and pinion shaft for reference.

(3) Disconnect the propeller shaft from the pinion yoke. Secure the propeller shaft in an upright position to prevent damage to the rear universal joint.

(4) Remove the wheel and tire assemblies.

(5) Remove the brake drums to prevent any drag. The drag may cause a false bearing preload torque measurement.

(6) Rotate the pinion yoke three or four times.

REMOVAL AND INSTALLATION (Continued)

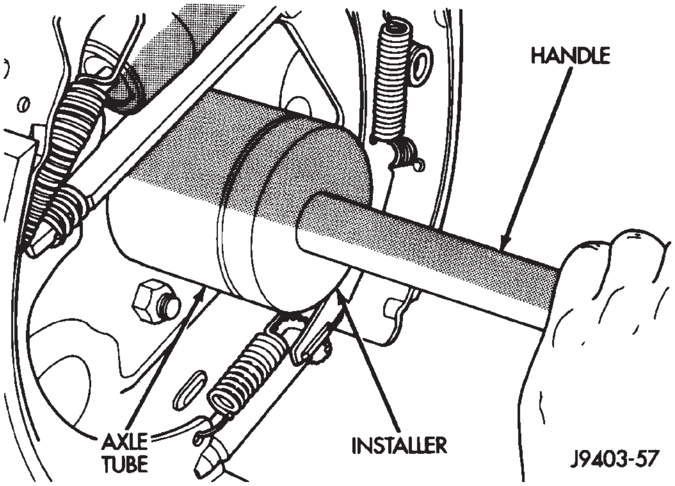

Fig. 12 Axle Shaft Seal and Bearing Installation

(7) Measure the amount of torque necessary to rotate the pinion gear with a (in. lbs.) dial-type torque wrench. Record the torque reading for installation reference.

(8) Hold the yoke with Wrench 6719. Remove the pinion shaft nut and washer.

(9) Remove the yoke with Remover C-452 (Fig. 13).

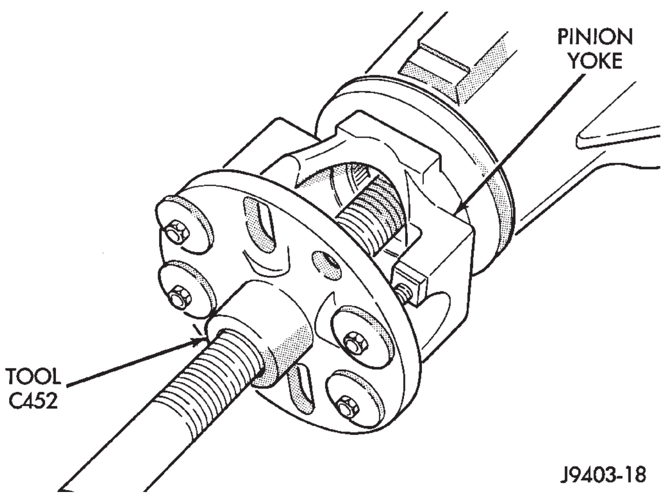

Fig. 13 Yoke Removal

(10) Remove the pinion shaft seal with suitable pry tool or slide-hammer mounted screw.

INSTALLATION

(1) Clean the seal contact surface in the housing bore.

(2) Examine the splines on the pinion shaft for burrs or wear. Remove any burrs and clean the shaft.

(3) Inspect pinion yoke for cracks, worn splines and worn seal contact surface. Replace yoke if necessary.

NOTE: The outer perimeter of the seal is pre-coated with a special sealant. An additional application of sealant is not required.

(4) Apply a light coating of gear lubricant on the lip of pinion seal.

(5) Install the new pinion shaft seal with Installer C-4076-B and Handle C-4735-1 (Fig. 14).

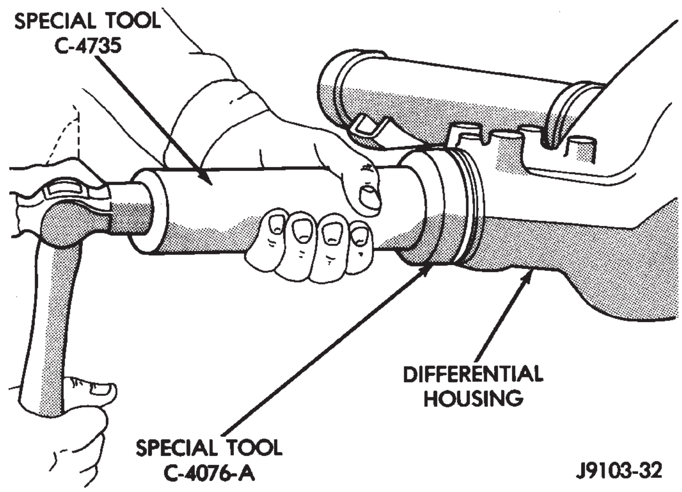

Fig. 14 8 1/4 Axle Pinion Seal Installation

NOTE: The seal is correctly installed when the seal flange contacts the face of the differential housing flange.

(6) Position the pinion yoke on the end of the shaft with the reference marks aligned.

(7) Seat yoke on pinion shaft with Installer C-3718 and Wrench 6719.

(8) Remove the tools and install the pinion yoke washer. The convex side of the washer must face outward.

CAUTION: Do not exceed the minimum tightening torque when installing the pinion yoke retaining nut at this point. Damage to collapsible spacer or bearings may result.

(9) Hold pinion yoke with Yoke Holder 6719 and tighten shaft nut to 285 N·m (210 ft. lbs.) (Fig. 15). Rotate pinion shaft several revolutions to ensure the bearing rollers are seated.

(10) Rotate the pinion shaft using an (in. lbs.) torque wrench. Rotating torque should be equal to the reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.) (Fig. 16).

REMOVAL AND INSTALLATION (Continued)

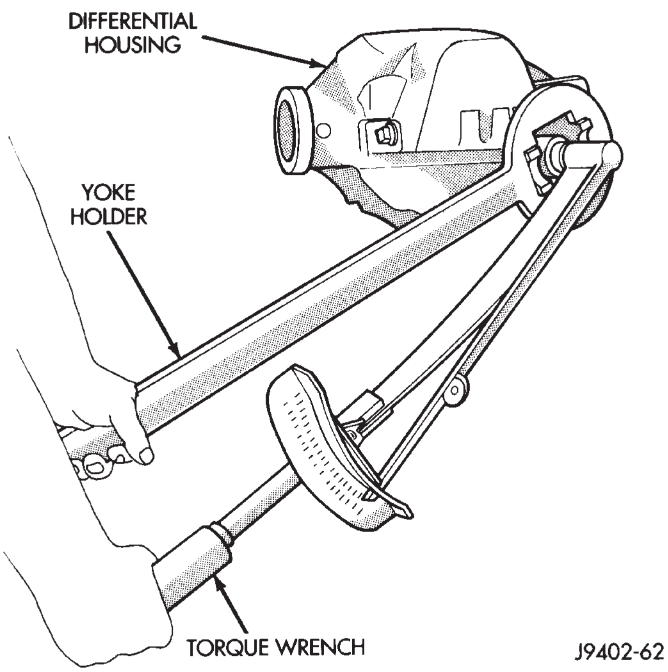

Fig. 15 Tightening Pinion Shaft Nut

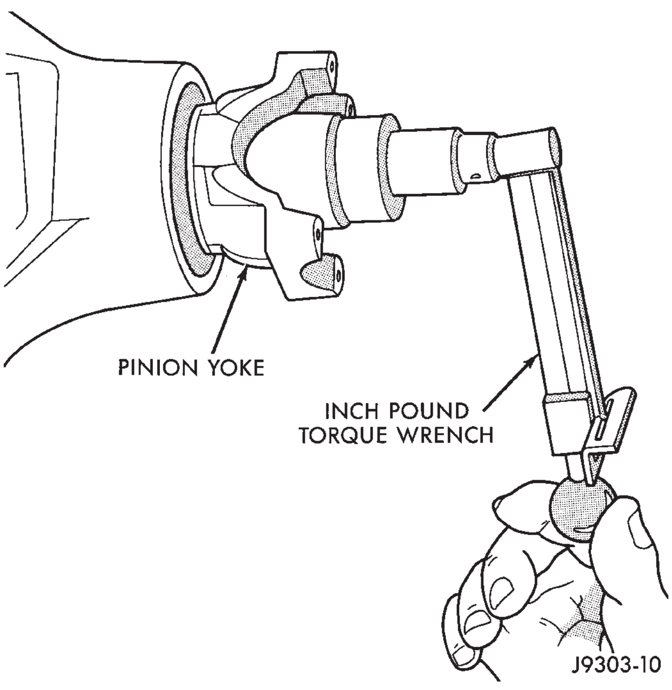

Fig. 16 Check Pinion Rotation Torque

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing rotating torque and never exceed specified preload torque. If preload torque is exceeded a new collapsible spacer must be installed. The torque sequence will then have to be repeated.

(11) If the rotating torque is low, use Yoke Holder 6719 to hold the pinion yoke (Fig. 15) and tighten the pinion shaft nut in 6.8 N·m (5 ft. lbs.) increments until proper rotating torque is achieved.

NOTE: The bearing rotating torque should be constant during a complete revolution of the pinion. If the rotating torque varies, this indicates a binding condition.

(12) The seal replacement is unacceptable if the final pinion nut torque is less than 285 N·m (210 ft. lbs.).

(13) Install the propeller shaft with the installation reference marks aligned.

(14) Tighten the universal joint yoke clamp screws to 19 N·m (14 ft. lbs.).

(15) Install the brake drums.

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

(17) Check the differential housing lubricant level.

DIFFERENTIAL

REMOVAL

(1) Remove the axle shafts.

NOTE: Side play resulting from bearing races being loose on case hubs requires replacement of the differential case.

(2) Mark the differential housing and the differential bearing caps for installation reference (Fig. 17).

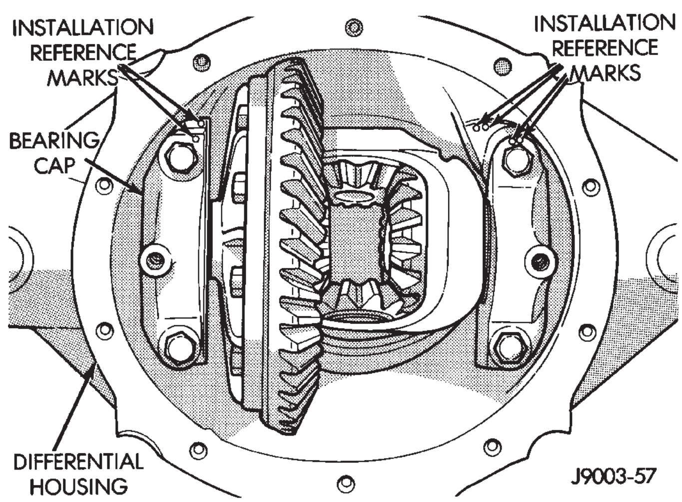

Fig. 17 Mark For Installation Reference

(3) Remove bearing threaded adjuster lock from each bearing cap. Loosen the bolts, but do not remove the bearing caps.

(4) Loosen the threaded adjusters with Wrench C-4164 (Fig. 18).

(5) Hold the differential case while removing bearing caps and adjusters.

REMOVAL AND INSTALLATION (Continued)

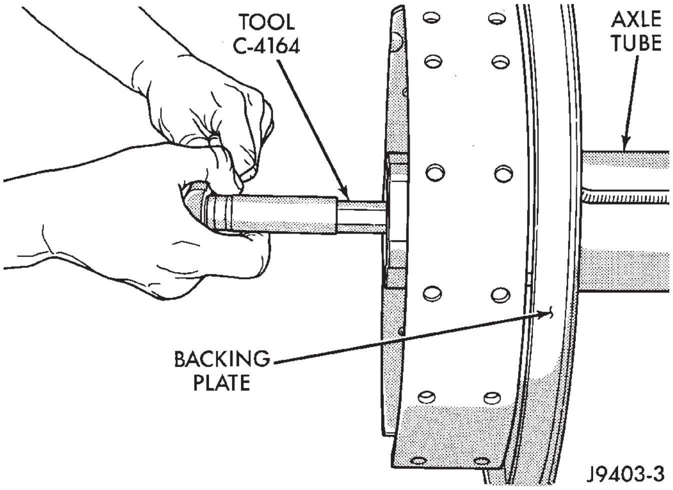

Fig. 18 Threaded Adjuster Tool

(6) Remove the differential case.

NOTE: Each differential bearing cup and threaded adjuster must be kept with their respective bearing.

INSTALLATION

(1) Apply a coating of hypoid gear lubricant to the differential bearings, bearing cups, and threaded adjusters. A dab of grease can be used to keep the adjusters in position. Carefully position the assembled differential case in the housing.

(2) Observe the reference marks and install the differential bearing caps at their original locations (Fig. 19).

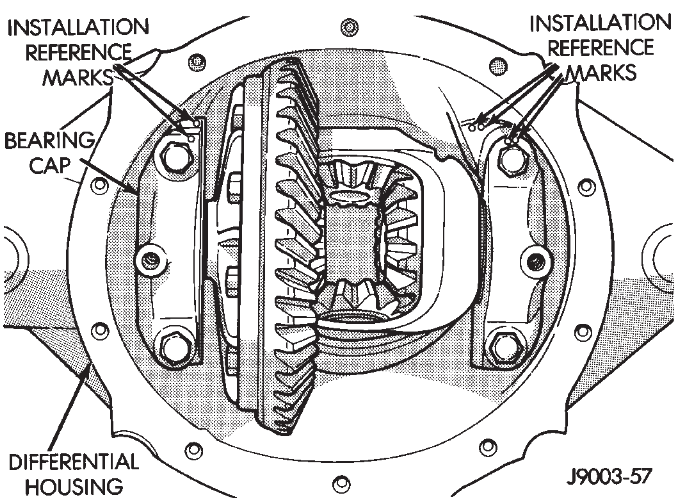

Fig. 19 Bearing Caps & Bolts

(3) Install bearing cap bolts and tighten the upper bolts to 14 N·m (10 ft. lbs.). Tighten the lower bolts finger-tight until the bolt head is seated.

(4) Perform the differential bearing preload and adjustment procedure.

(5) Install axle shafts and differential housing cover.

DIFFERENTIAL SIDE BEARINGS

REMOVAL

(1) Remove differential case from axle housing.

(2) Remove the bearings from the differential case with Puller/Press C-293-PA and Adapters C-293-48 and Plug SP-3289 (Fig. 20).

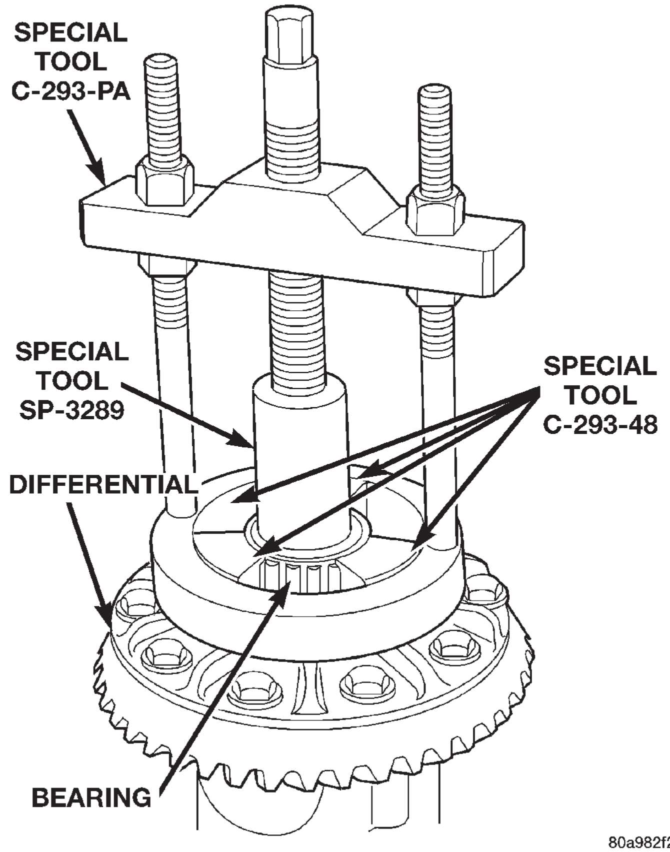

Fig. 20 Differential Bearing Removal

INSTALLATION

(1) Install differential side bearings. Use Installer C-4340 with handle C-4171 (Fig. 21).

(2) Install differential case in axle housing.

RING GEAR

The ring and pinion gears are serviced in a matched set. Do not replace the ring gear without replacing the pinion gear.

REMOVAL

(1) Remove differential from axle housing.

(2) Place differential case in a suitable vise with soft metal jaw protectors (Fig. 22).

(3) Remove bolts holding ring gear to differential case.

(4) Using a soft hammer, drive ring gear from differential case (Fig. 22).

REMOVAL AND INSTALLATION (Continued)

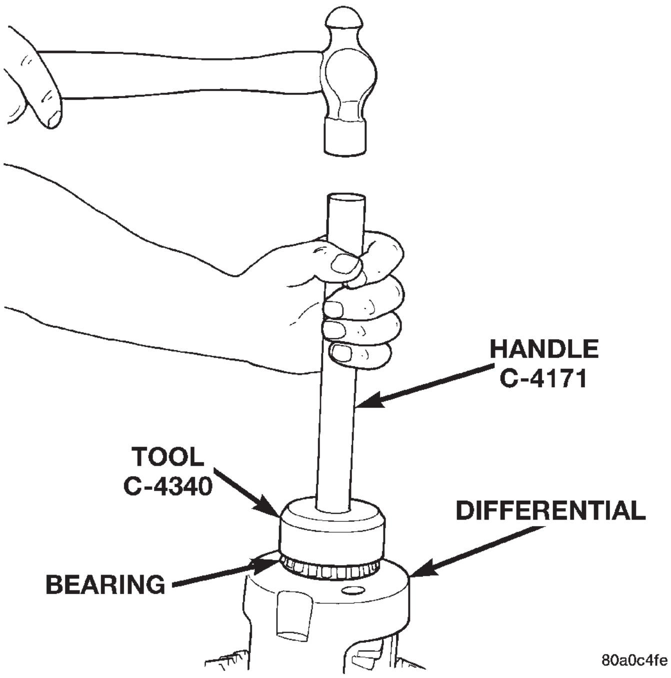

Fig. 21 Install Differential Side Bearings

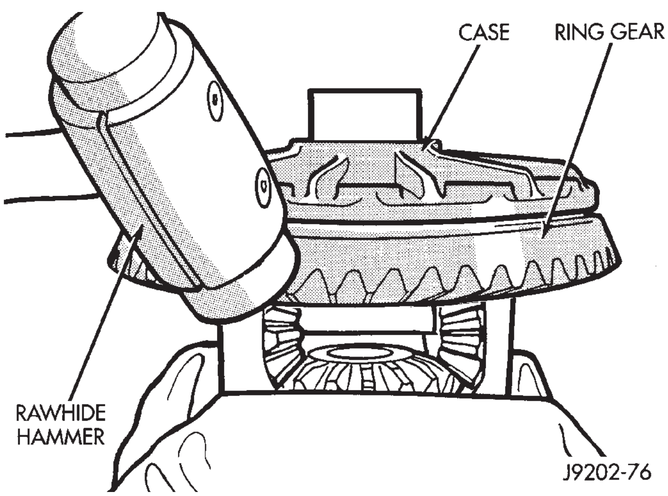

Fig. 22 Ring Gear Removal

INSTALLATION

CAUTION: Do not reuse the bolts that held the ring gear to the differential case. The bolts can fracture causing extensive damage.

(1) Invert the differential case.

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

(3) Invert the differential case in the vise.

(4) Install new ring gear bolts and alternately tighten to 102 N·m (75 ft. lbs.) torque (Fig. 23).

(5) Install differential in axle housing and verify gear mesh and contact pattern.

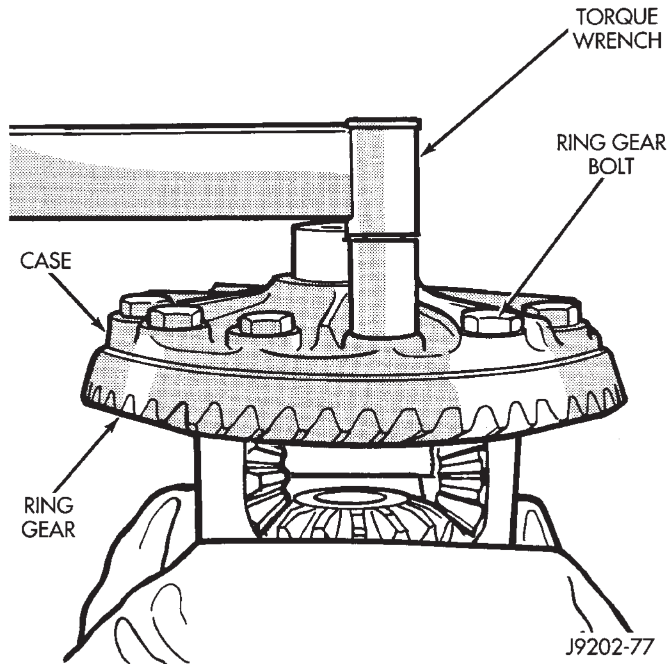

Fig. 23 Ring Gear Bolt Installation

PINION GEAR

The ring and pinion gears are serviced in a matched set. Do not replace the pinion gear without replacing the ring gear.

REMOVAL

(1) Remove differential from the axle housing.

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

(3) Disconnect propeller shaft from pinion yoke. Using suitable wire, tie propeller shaft to underbody.

(4) Using Yoke Holder 6719 to hold yoke and remove the pinion yoke nut and washer.

(5) Using Remover C–452, remove the pinion yoke from pinion shaft (Fig. 24).

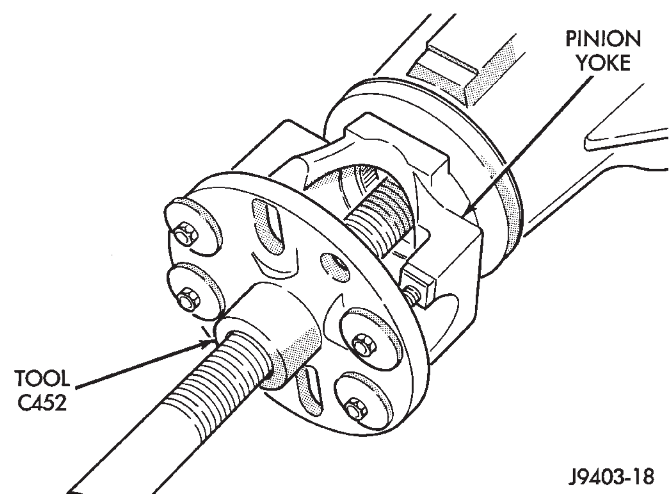

Fig. 24 Pinion Yoke Removal

REMOVAL AND INSTALLATION (Continued)

(6) Partially install pinion nut onto pinion to protect the threads.

(7) Remove the pinion gear from housing (Fig. 25). Catch the pinion with your hand to prevent it from falling and being damaged.

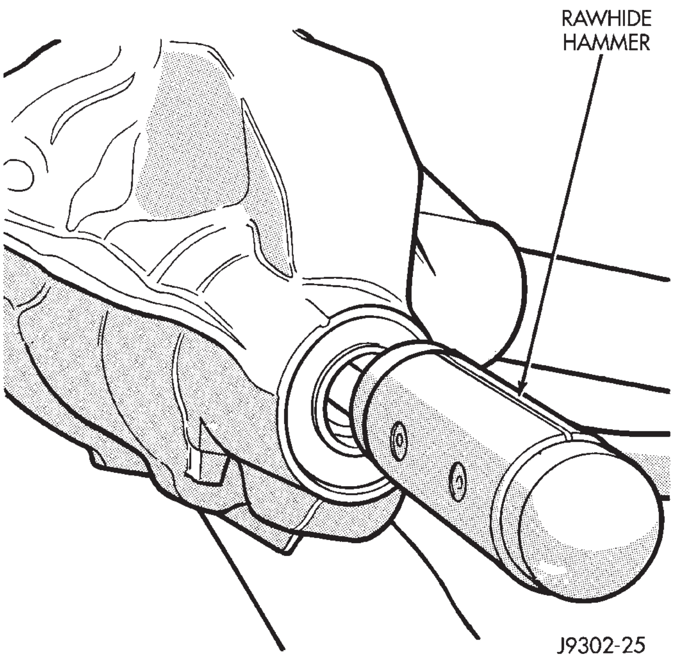

Fig. 25 Remove Pinion Gear

(8) Remove the pinion shaft seal with suitable pry tool or slide-hammer mounted screw.

(9) Remove oil slinger, if equipped, and front pinion bearing.

(10) Remove the front pinion bearing cup with Remover C-4345 and Handle C–4171 (Fig. 26).

(11) Remove the rear bearing cup from housing (Fig. 27). Use Remover C-4307 and Handle C–4171.

(12) Remove the collapsible preload spacer (Fig. 28).

(13) Remove the rear bearing from the pinion (Fig. 29) with Puller/Press C-293-PA and Adapters C-293-47.

Place 4 adapter blocks so they do not damage the bearing cage.

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

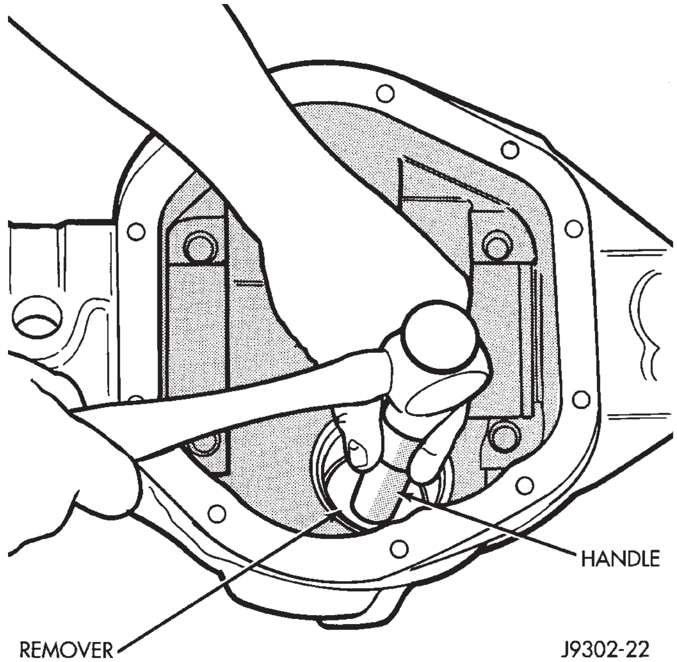

Fig. 26 Front Bearing Cup Removal

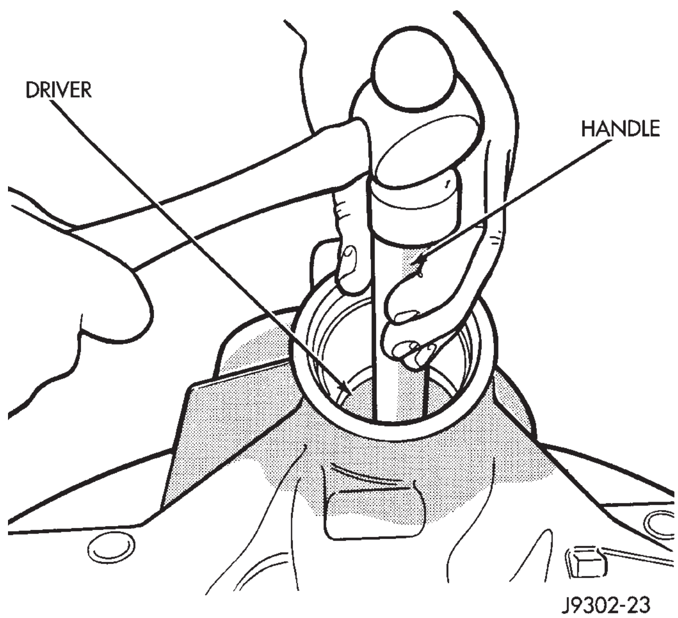

Fig. 27 Rear Bearing Cup Removal

REMOVAL AND INSTALLATION (Continued)

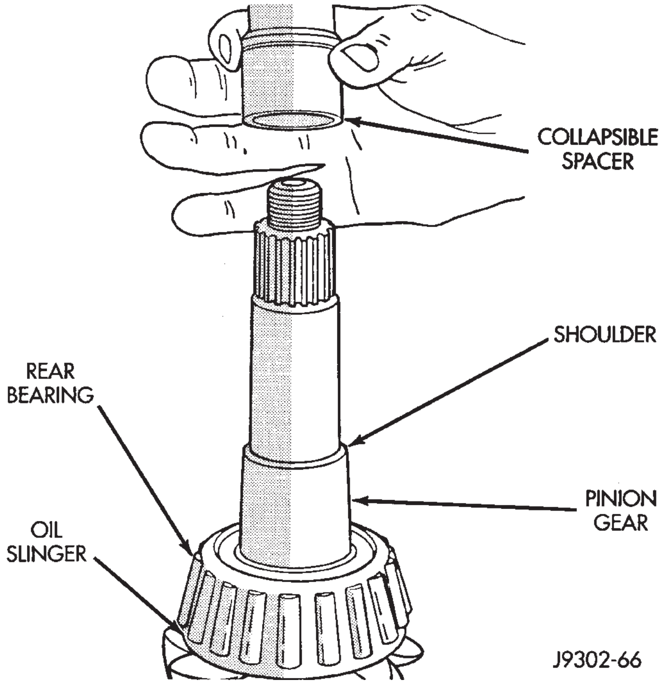

Fig. 28 Collapsible Spacer

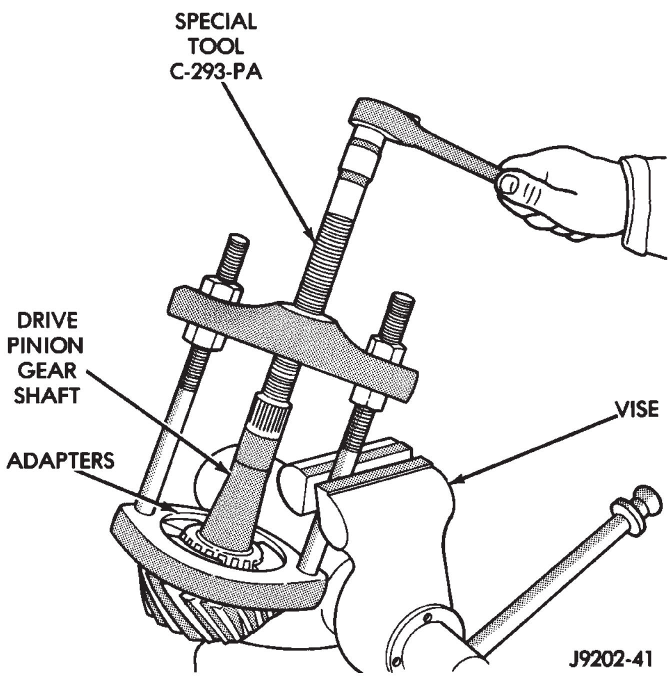

Fig. 29 Rear Bearing Removal

INSTALLATION

(1) Apply Mopar® Door Ease, or equivalent, stick lubricant to outside surface of bearing cup.

(2) Install the pinion rear bearing cup (Fig. 30) with Installer C-4308 and Driver Handle C–4171.

(2) Ensure cup is correctly seated.

(3) Apply Mopar® Door Ease, or equivalent, stick lubricant to outside surface of bearing cup.

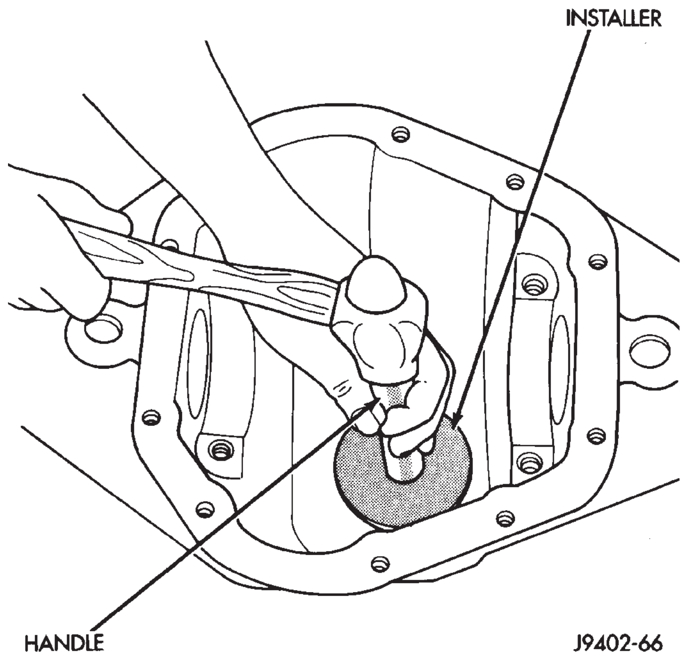

Fig. 30 Pinion Rear Bearing Cup Installation

(4) Install the pinion front bearing cup (Fig. 31) with Installer D–130 and Handle C–4171.

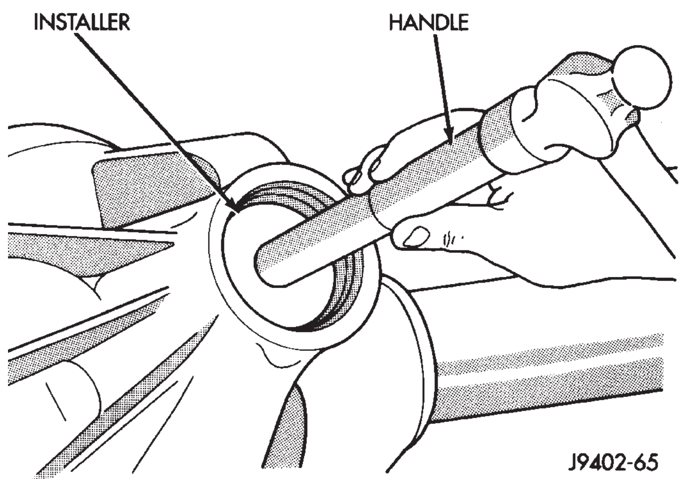

Fig. 31 Pinion Front Bearing Cup Installation

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

(6) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer C-4076–B and Handle C-4735-1 (Fig. 32).

REMOVAL AND INSTALLATION (Continued)

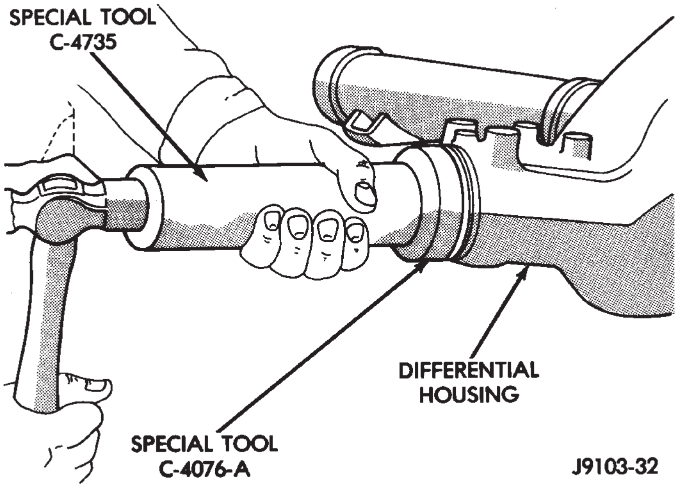

Fig. 32 Pinion Seal Installation

NOTE: Pinion depth shims are placed between the rear pinion bearing cone and pinion gear to achieve proper ring and pinion gear mesh. If the factory installed ring and pinion gears are reused, the pinion depth shim should not require replacement. If required, refer to Pinion Gear Depth to select the proper thickness shim before installing rear pinion bearing.

(7) Place the proper thickness depth shim on the pinion gear.

(8) Install the rear bearing and slinger, if equipped, on the pinion gear (Fig. 33) with Installer 6448.

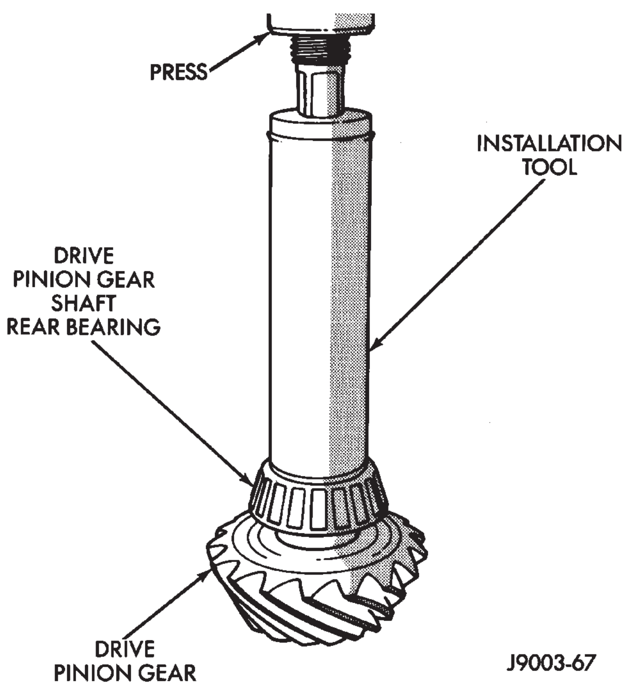

Fig. 33 Shaft Rear Bearing Installation

(9) Install a new collapsible preload spacer on pinion shaft and install pinion gear in housing (Fig. 34).

(10) Install pinion gear in housing.

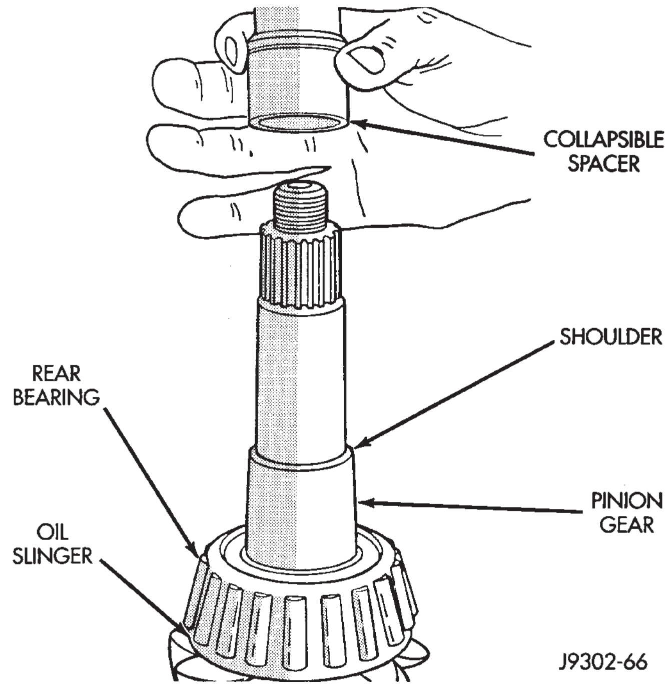

Fig. 34 Collapsible Preload Spacer

(11) Install yoke with Installer C-3718 and Yoke Holder 6719.

(12) Install the yoke washer and a new nut on the pinion gear and tighten the pinion nut until there is zero bearing end-play. It will not be possible at this point to achieve zero bearing end-play if a new collapsible spacer was installed.

(13) Tighten the nut to 285 N·m (210 ft. lbs.).

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing rotating torque and never exceed specified preload torque. If preload torque or rotating torque is exceeded a new collapsible spacer must be installed. The torque sequence will then have to be repeated.

(14) Using Yoke Holder 6719, crush collapsible spacer until bearing end play is taken up.

(15) Slowly tighten the nut in 6.8 N·m (5 ft. lbs.) increments until the desired rotating torque is achieved. Measure the rotating torque frequently to avoid over crushing the collapsible spacer (Fig. 35).

(16) Check bearing rotating torque with an inch pound torque wrench (Fig. 35). The torque necessary to rotate the pinion gear should be:

• Original Bearings — 1 to 3 N·m (10 to 20 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

- New Bearings — 2 to 5 N·m (15 to 35 in. lbs.).

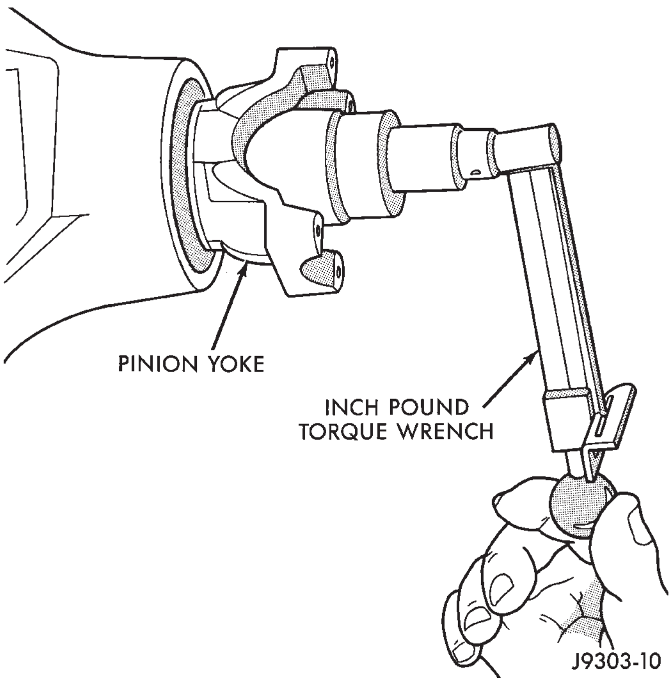

Fig. 35 Check Pinion Gear Rotating Torque

(17) Install propeller shaft.
(18) Install differential in housing.

DISASSEMBLY AND ASSEMBLY

STANDARD DIFFERENTIAL

DISASSEMBLY

(1) Remove pinion gear mate shaft lock screw (Fig. 36).
(2) Remove pinion gear mate shaft.
(3) Rotate the differential side gears and remove the pinion mate gears and thrust washers (Fig. 37).

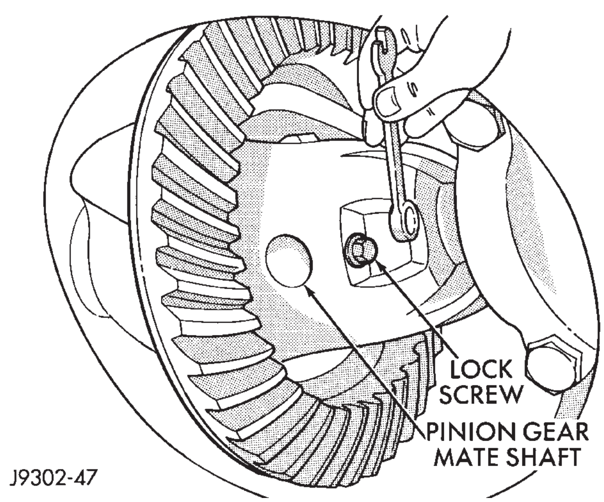

Fig. 36 Pinion Gear Mate Shaft Lock Screw

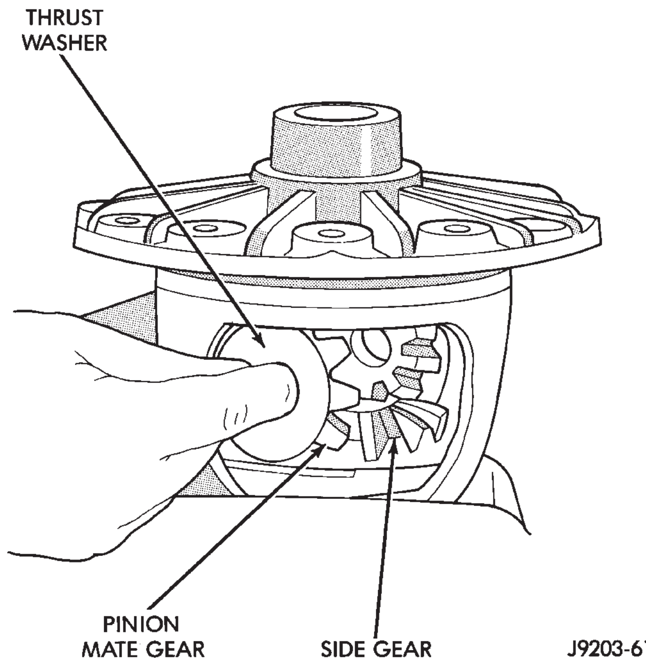

Fig. 37 Pinion Mate Gear Removal

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

ASSEMBLY

(1) Install the differential side gears and thrust washers.
(2) Install the pinion mate gears and thrust washers.
(3) Install the pinion gear mate shaft.
(4) Align the hole in the pinion gear mate shaft with the hole in the differential case and install the pinion gear mate shaft lock screw.
(5) Lubricate all differential components with hypoid gear lubricant.

TRAC-LOK DIFFERENTIAL

The Trac–lok differential components are illustrated in (Fig. 38). Refer to this illustration during repair service.

DISASSEMBLY

(1) Clamp Side Gear Holding Tool 8138 in a vise.
(2) Position the differential case on Side Gear Holding Tool 8138 (Fig. 39).
(3) Remove ring gear, if necessary. Ring gear removal is necessary only if the ring gear is to be replaced. The Trac-lok differential can be serviced with the ring gear installed.
(4) Remove the pinion gear mate shaft lock screw (Fig. 40).

DISASSEMBLY AND ASSEMBLY (Continued)

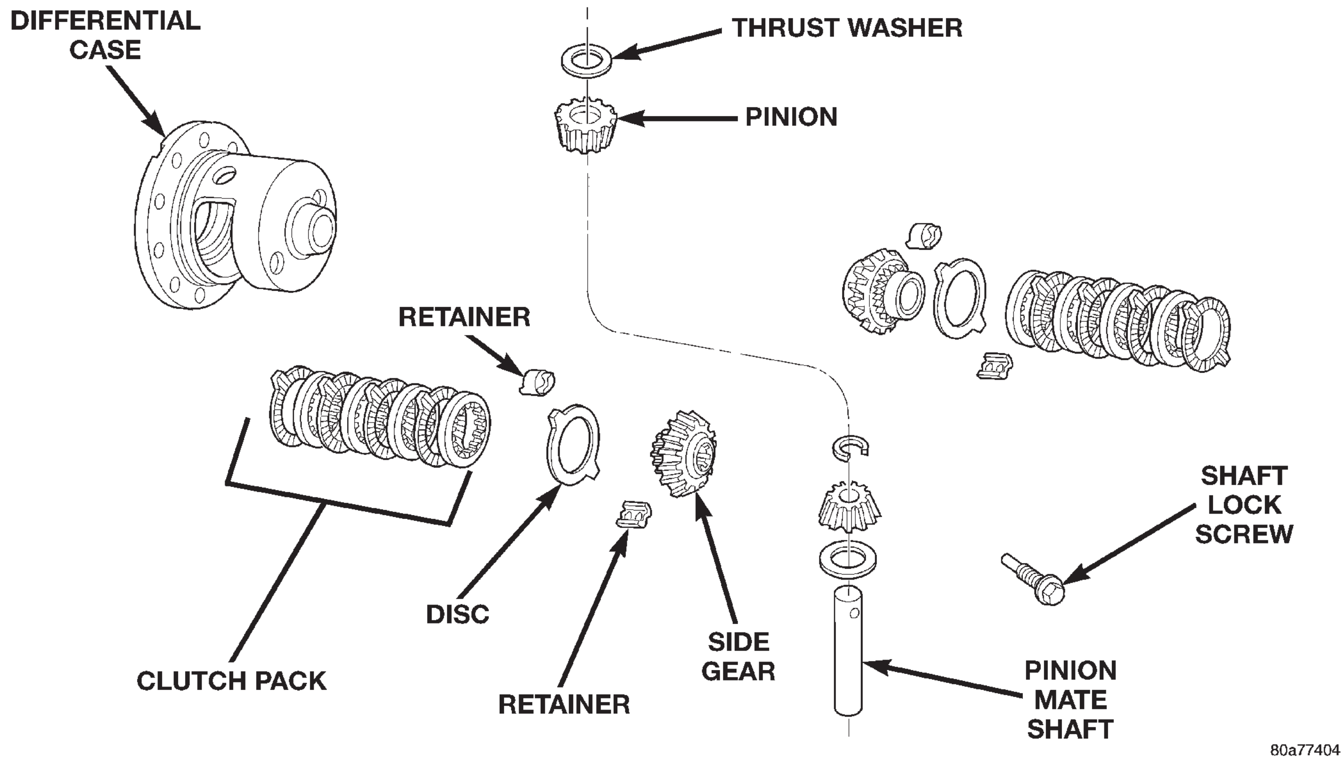

Fig. 38 Trac–lok Differential Components

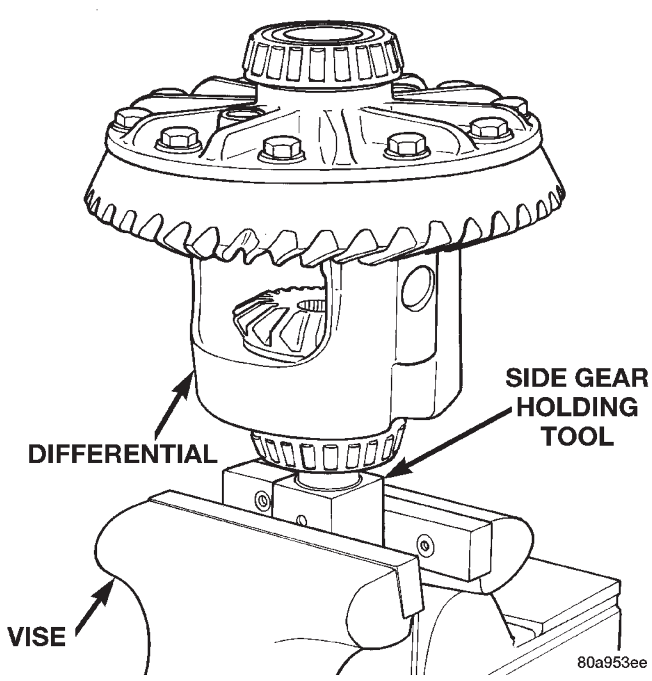

Fig. 39 Differential Case Holding Tool

(5) Remove the pinion gear mate shaft. If necessary, use a drift and hammer (Fig. 41).

(6) Install and lubricate Step Plate 8140–2 (Fig. 42).

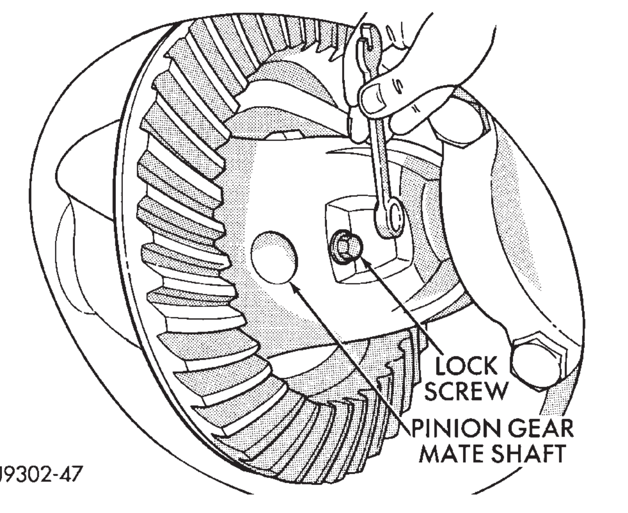

Fig. 40 Mate Shaft Lock Screw

(7) Assemble Threaded Adapter 8140-1 into top side gear. Thread Forcing Screw 6960-4 into adapter until it becomes centered in adapter plate.

(8) Position a small screw driver in slot of Threaded Adapter 8140-1 (Fig. 43) to prevent adapter from turning.

(9) Tighten forcing screw tool 122 N·m (90 ft. lbs.) maximum to compress Belleville springs in clutch packs (Fig. 44).

DISASSEMBLY AND ASSEMBLY (Continued)

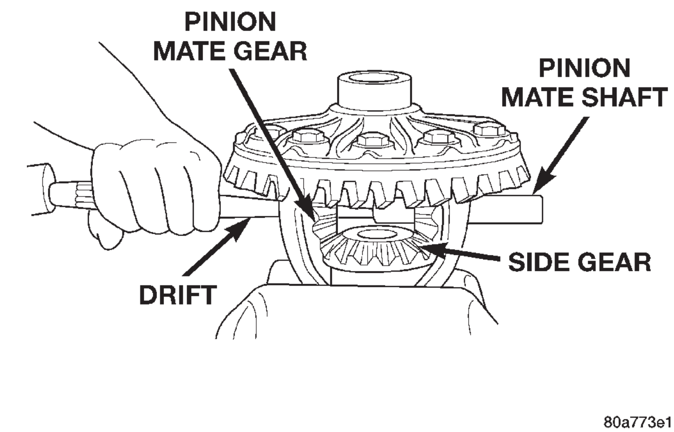

Fig. 41 Mate Shaft Removal

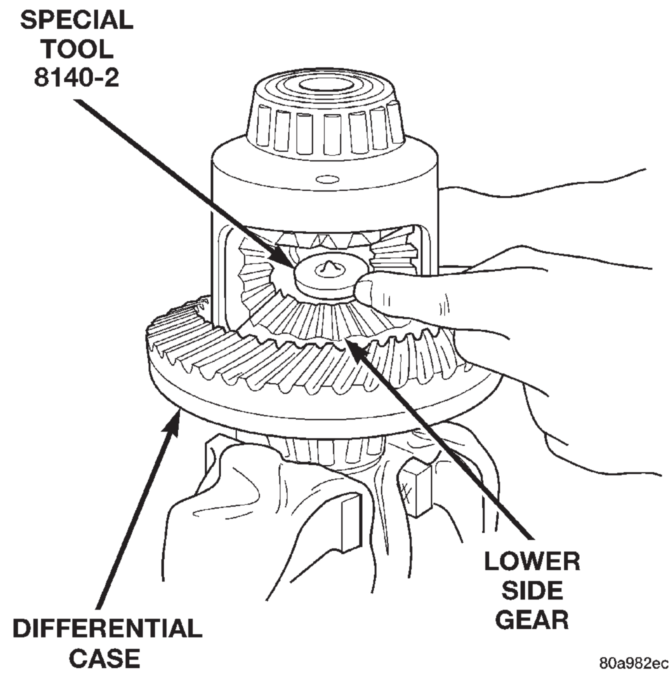

Fig. 42 Step Plate Tool Installation

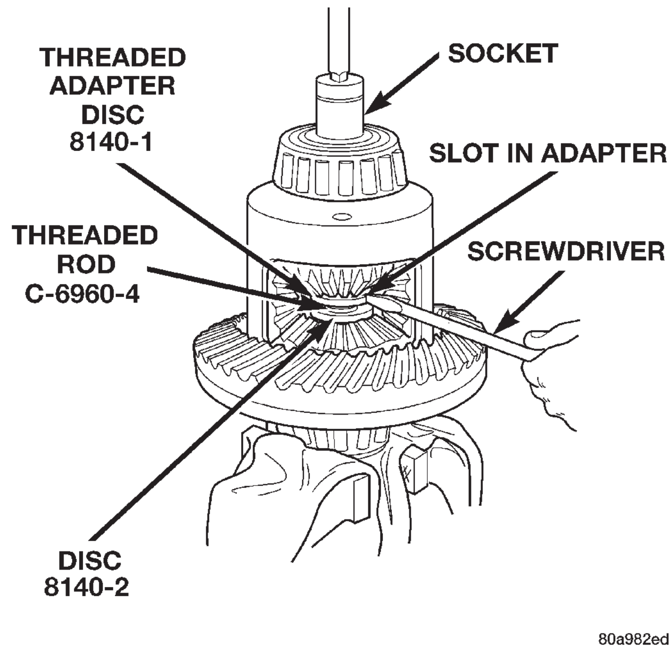

Fig. 43 Threaded Adapter Installation

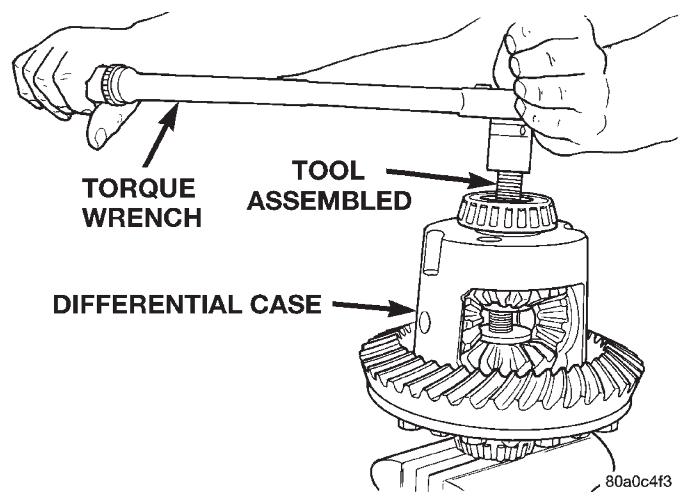

Fig. 44 Tighten Belleville Spring Compressor Tool

(10) Using an appropriate size feeler gauge, remove thrust washers from behind the pinion gears (Fig. 45).

(11) Insert Turning Bar 6960-2 in case (Fig. 46).

(12) Loosen the Forcing Screw 6960-4 in small increments until the clutch pack tension is relieved and the differential case can be turned using Turning Bar 6960-2.

(13) Rotate differential case until the pinion gears can be removed.

(14) Remove pinion gears from differential case.

(15) Remove Forcing Screw 6960-4, Step Plate 8140–2, and Threaded Adapter 8140–1.

(16) Remove top side gear, clutch pack retainer, and clutch pack. Keep plates in correct order during removal (Fig. 47).

(17) Remove differential case from Side Gear Holding Tool 8138. Remove side gear, clutch pack retainer, and clutch pack. Keep plates in correct order during removal.

DISASSEMBLY AND ASSEMBLY (Continued)

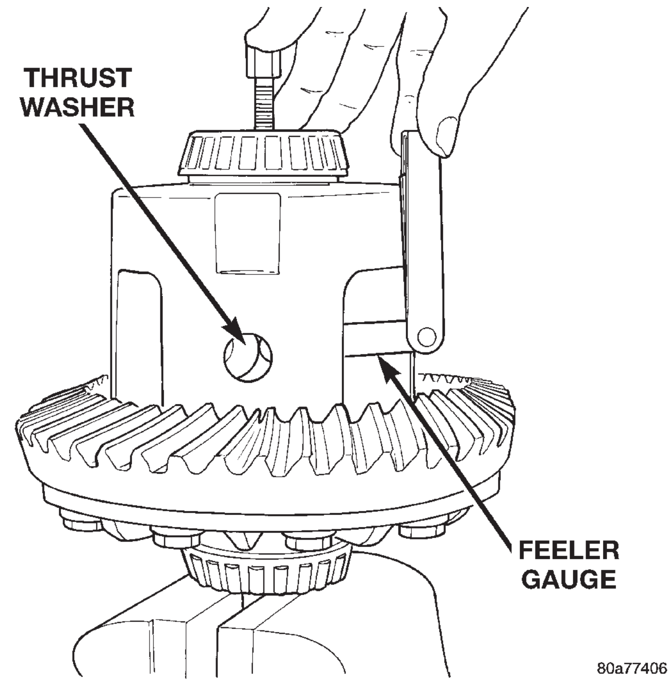

Fig. 45 Remove Pinion Gear Thrust Washer

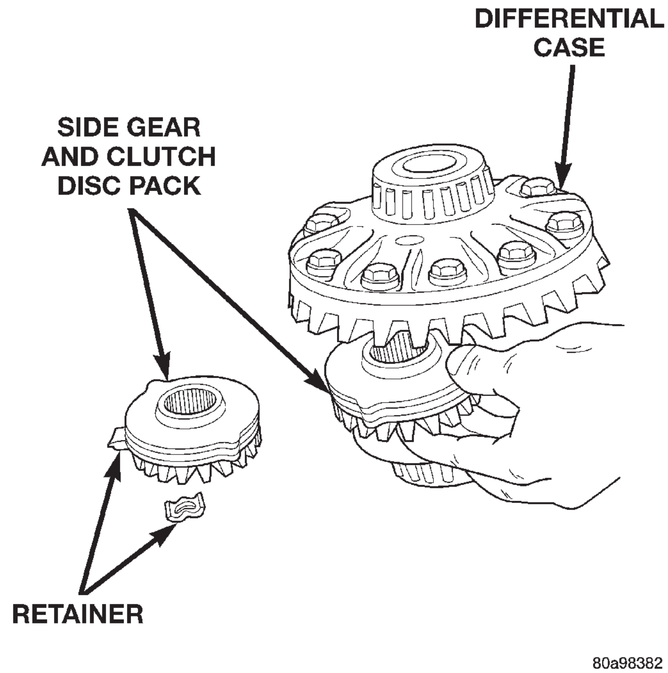

Fig. 47 Side Gear & Clutch Disc Removal

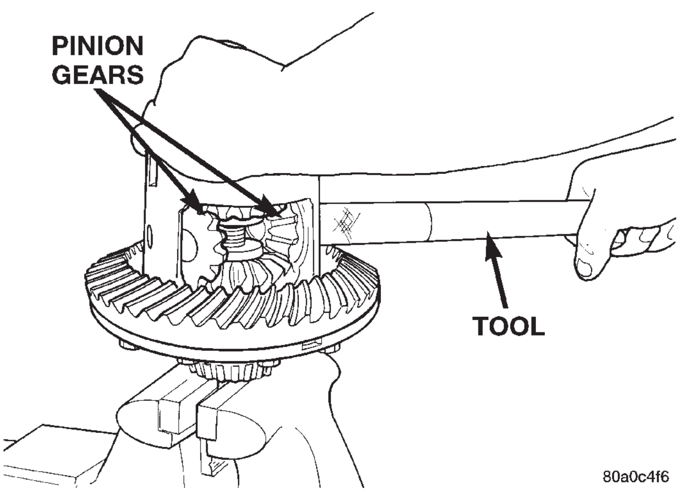

Fig. 46 Pinion Gear Removal

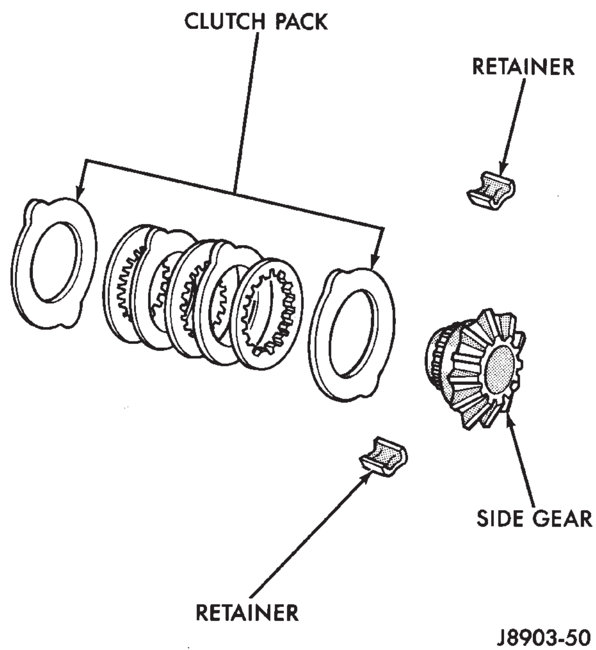

Fig. 48 Clutch Disc Pack

ASSEMBLY

NOTE: The clutch discs are replaceable as complete sets only. If one clutch disc pack is damaged, both packs must be replaced.

Lubricate each component with gear lubricant before assembly.

(1) Assemble the clutch discs into packs and secure disc packs with retaining clips (Fig. 48).

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

(3) Install clutch pack and side gear in the ring gear side of the differential case (Fig. 49). **Be sure clutch pack retaining clips remain in position and are seated in the case pockets.**

(4) Position the differential case on Side Gear Holding Tool 8138.

(5) Install lubricated Step Plate 8140–2 in lower side gear (Fig. 50).

(6) Install the upper side gear and clutch disc pack (Fig. 50).

(7) Hold assembly in position. Insert Threaded Adapter 8140-1 into top side gear.

(8) Insert Forcing Screw 6960-4.

DISASSEMBLY AND ASSEMBLY (Continued)

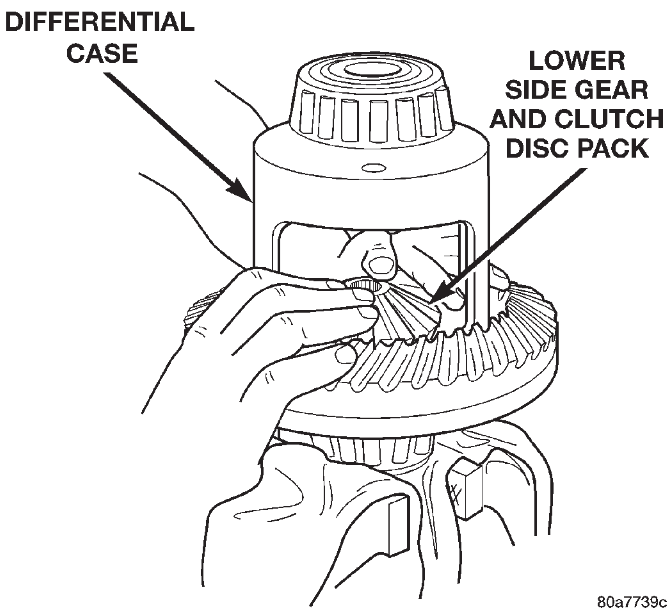

Fig. 49 Clutch Discs & Lower Side Gear Installation

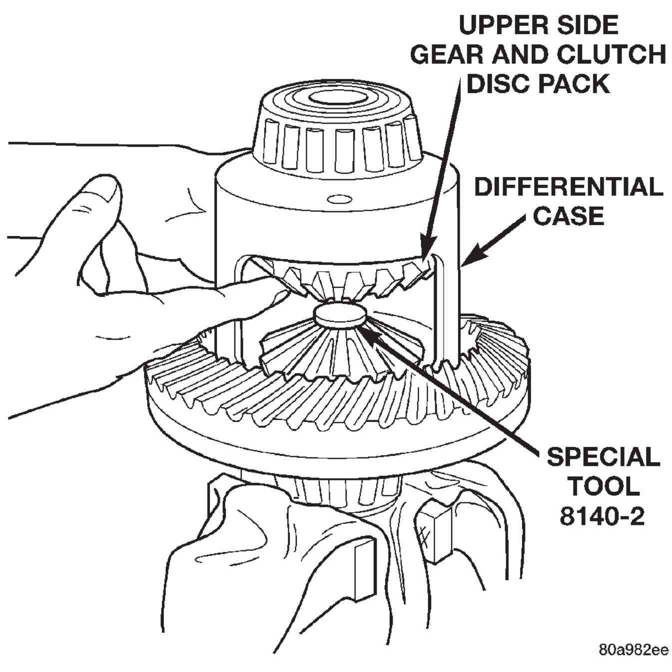

Fig. 50 Upper Side Gear & Clutch Disc Pack Installation

(9) Tighten forcing screw tool to slightly compress clutch discs.

(10) Place pinion gears in position in side gears and verify that the pinion mate shaft holes are aligned.

(11) Rotate case with Turning Bar 6960-2 until the pinion mate shaft holes in pinion gears align with holes in case. It may be necessary to slightly tighten the forcing screw in order to install the pinion gears.

(12) Tighten forcing screw to 122 N·m (90 ft. lbs.) maximum to compress the Belleville springs.

(13) Lubricate and install thrust washers behind pinion gears and align washers with a small screw driver. Insert mate shaft into each pinion gear to verify alignment.

(14) Remove Forcing Screw 6960-4, Step Plate 8140–2, and Threaded Adapter 8140-1.

(15) Install pinion gear mate shaft and align holes in shaft and case.

(16) Install the pinion mate shaft lock screw finger tight to hold shaft during differential installation.

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

CLEANING AND INSPECTION

8 1/4 AXLES

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

Wash bearings with solvent and towel dry, or dry with compressed air. DO NOT spin bearings with compressed air. **Cup and bearing must be replaced as matched sets only.**

Clean axle shaft tubes and oil channels in housing.

Inspect for:

- Smooth appearance with no broken/dented surfaces on the bearing rollers or the roller contact surfaces.
- Bearing cups must not be distorted or cracked.
- Machined surfaces should be smooth and without any raised edges.
- Raised metal on shoulders of cup bores should be removed with a hand stone.
- Wear and damage to pinion gear mate shaft, pinion gears, side gears and thrust washers. Replace as a matched set only.
- Ring and pinion gear for worn and chipped teeth.
- Ring gear for damaged bolt threads. Replaced as a matched set only.
- Pinion yoke for cracks, worn splines, pitted areas, and a rough/corroded seal contact surface. Repair or replace as necessary.
- Pinion depth shims for damage and distortion. Install new shims if necessary.
- The differential case. Replace the case if cracked or damaged.
- The axle shaft C-clip locks for cracks and excessive wear. Replace them if necessary.
- Each threaded adjuster to determine if it rotates freely. If an adjuster binds, repair the damaged threads or replace the adjuster.

Polish each axle shaft sealing surface with No. 600 crocus cloth. This can remove slight surface damage.

CLEANING AND INSPECTION (Continued)

Do not reduce the diameter of the axle shaft seal contact surface. When polishing, the crocus cloth should be moved around the circumference of the shaft (not in-line with the shaft).

TRAC-LOK™

Clean all components in cleaning solvent. Dry components with compressed air. Inspect clutch pack plates for wear, scoring or damage. Replace both clutch packs if any one component in either pack is damaged. Inspect side and pinion gears. Replace any gear that is worn, cracked, chipped or damaged. Inspect differential case and pinion shaft. Replace if worn or damaged.

PRESOAK PLATES AND DISC

Plates and discs with fiber coating (no grooves or lines) must be presoaked in Friction Modifier before assembly. Soak plates and discs for a minimum of 20 minutes.

ADJUSTMENTS

8 1/4 AXLE PINION GEAR DEPTH

GENERAL INFORMATION

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and pinion gear are marked on the face of each gear (Fig. 51). A plus (+) number, minus (–) number or zero (0) is marked on the face of the pinion gear. This number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion marked with a (0). The standard depth provides the best teeth contact pattern. Refer to Backlash and Contact Pattern Analysis Paragraph in this section for additional information.

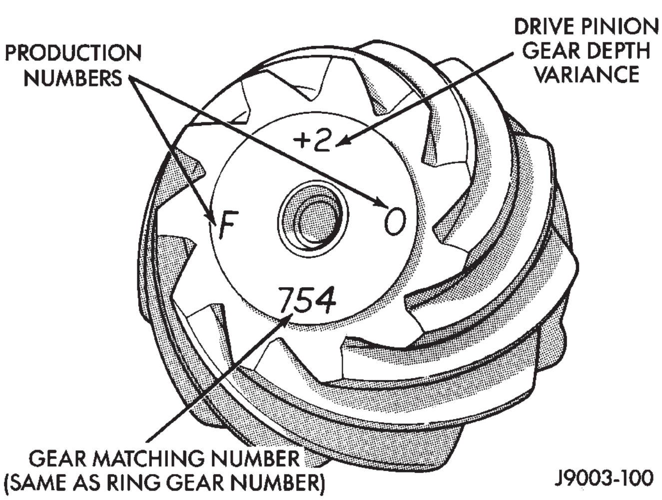

Fig. 51 Pinion Gear ID Numbers

Compensation for pinion depth variance is achieved with select shims. The shims are placed under the rear pinion bearing cone (Fig. 52).

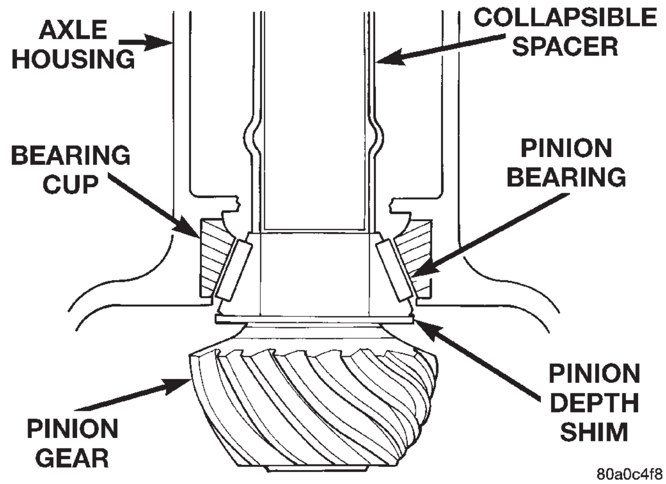

Fig. 52 Shim Locations

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

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

Note the marked number on the face of the drive pinion gear (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shim(s). If the number is positive, subtract that value from the thickness of the depth shim(s). If the number is 0 no change is necessary. Refer to the Pinion Gear Depth Variance Chart.

PINION DEPTH MEASUREMENT AND ADJUSTMENT

(1) Install front pinion bearing cup. Use Installer D-130 and Handle C-4171.

(2) Install rear pinion bearing cup. Use Installer C-4308 and Handle C-4171.

(3) Use Pinion Gear Adjustment Gauge Set C-3715-B (Fig. 53).

(4) Position Spacer SP-6030 over Shaft SP-5385.

(5) Position pinion rear bearing on shaft.

(6) Position tools (with bearing) in the housing.

(7) Install Sleeve SP-5382.

(8) Install pinion front bearing.

(9) Install Spacer SP-6022.

(10) Install Sleeve SP-3194-B, Washer SP-534, and Nut SP-3193.

(11) Tighten the nut to seat the pinion bearings in the housing. Allow the sleeve to turn several times

ADJUSTMENTS (Continued)

PINION GEAR DEPTH VARIANCE

Original Pinion Gear Depth Variance	Replacement Pinion Gear Depth Variance								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

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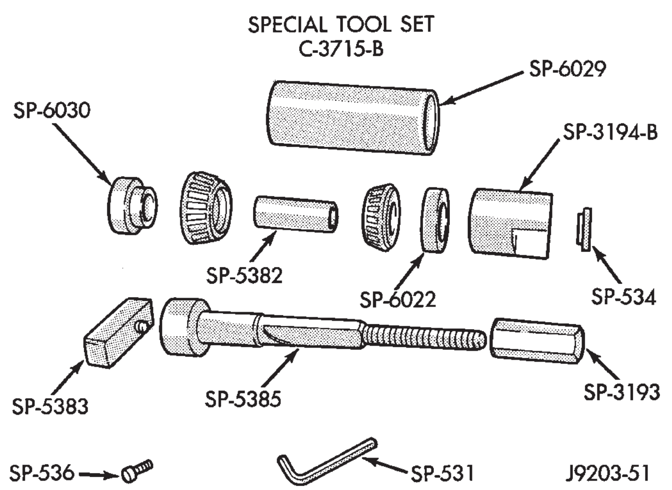


Fig. 53 8 1/4 Axle Pinion Adjustment Tools

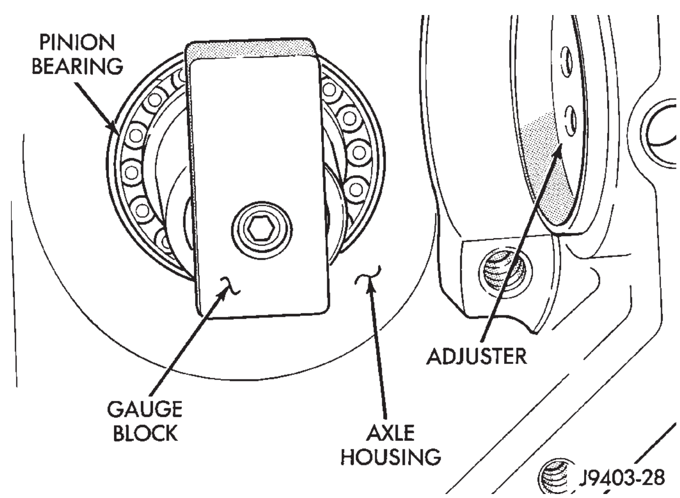


Fig. 54 Gauge Block

during tightening to prevent brinelling bearing cups or bearings.

(12) Loosen the compression nut tool.

(13) Lubricate the pinion gear front and rear bearings with gear lubricant.

(14) Re-tighten the compression nut tool to 1-3 N·m (15-25 in. lbs.) torque.

(15) Rotate the pinion gear several complete revolutions to align the bearing rollers.

(16) Install Gauge Block (Fig. 54).

(17) Install Gauge Block SP-5383 at the end of SP-5385.

(18) Install Cap Screw SP-536 and tighten with Wrench SP-531.

(19) Position Crossbore Arbor SP-6029 in the differential housing (Fig. 55).

(20) Center the arbor tool.

(21) Position the bearing caps on the arbor tool.

(22) Install the attaching bolts.

(23) Tighten the cap bolts to 14 N·m (10 ft. lbs.).

(24) Trial fit depth shim(s) between the crossbore arbor and gauge block (Fig. 56). **The depth shim(s) fit must be snug but not tight (drag friction of a feeler gauge blade).**

(25) Select a shim equal to the shim selected above plus the drive pinion gear depth variance number marked on the face of the pinion gear (Fig. 51) using the opposite sign on the variance number. For exam-

ADJUSTMENTS (Continued)

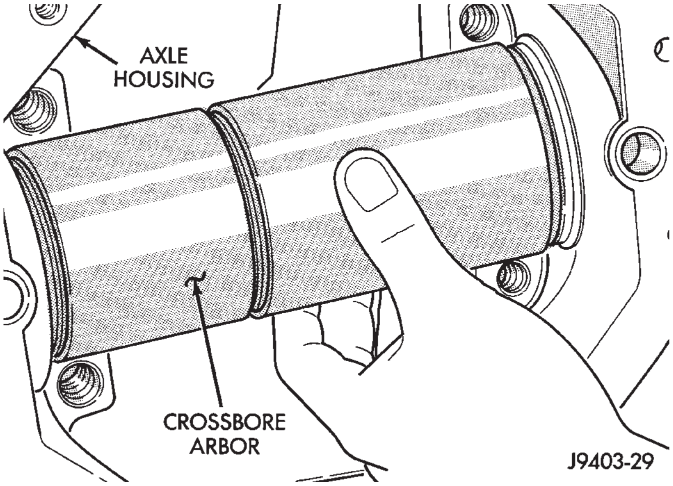


Fig. 55 Crossbore Arbor

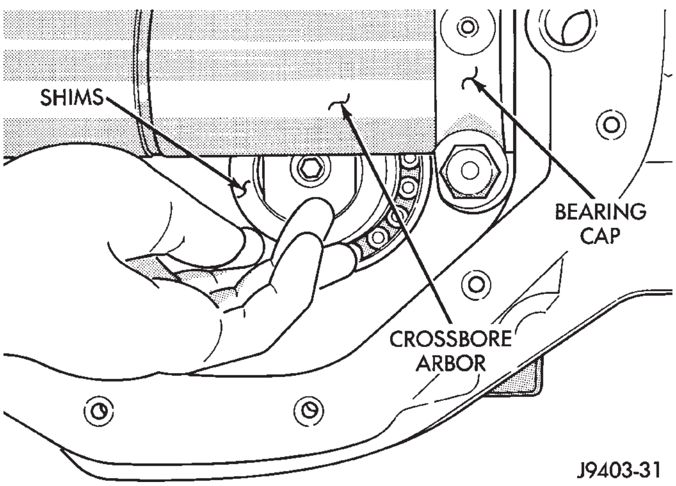


Fig. 56 Depth Shim(s) Selection

ple, if the depth variance is –2, add +0.002 in. to the dial indicator reading.

NOTE: Depth shims are available in 0.001-inch increments from 0.020 inch to 0.038 inch.

(26) Remove the tools from the differential housing.

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

The following must be considered when adjusting bearing preload and gear backlash:

- The maximum ring gear backlash variation is 0.003 inch (0.076 mm).
- Mark the gears so the same teeth are meshed during all backlash measurements.
- Maintain the torque while adjusting the bearing preload and ring gear backlash.
- Excessive adjuster torque will introduce a high bearing load and cause premature bearing failure. Insufficient adjuster torque can result in excessive differential case free-play and ring gear noise.
- Insufficient adjuster torque will not support the ring gear correctly and can cause excessive differential case free-play and ring gear noise.

NOTE: The differential bearing cups will not always immediately follow the threaded adjusters as they are moved during adjustment. To ensure accurate bearing cup responses to the adjustments:

- **Maintain the gear teeth engaged (meshed) as marked.**
- **The bearings must be seated by rapidly rotating the pinion gear a half turn back and forth.**
- **Do this five to ten times each time the threaded adjusters are adjusted.**

(1) Use Wrench C-4164 to adjust each threaded adjuster inward until the differential bearing free-play is eliminated (Fig. 57). Allow some ring gear backlash (approximately 0.01 inch/0.25 mm) between the ring and pinion gear. Seat the bearing cups with the procedure described above.

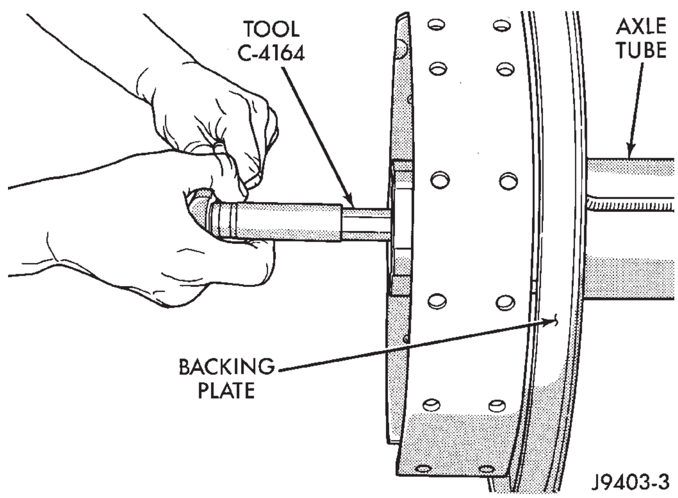


Fig. 57 Threaded Adjuster Tool

(2) Install dial indicator and position the plunger against the drive side of a ring gear tooth (Fig. 58). Measure the backlash at 4 positions (90 degrees apart) around the ring gear. Locate and mark the area of minimum backlash.

(3) Rotate the ring gear to the position of the least backlash. Mark the gear so that all future backlash measurements will be taken with the same gear teeth meshed.

(4) Loosen the right-side, tighten the left-side threaded adjuster. Obtain backlash of 0.003 to 0.004 inch (0.076 to 0.102 mm) with each adjuster tightened to 14 N·m (10 ft. lbs.). Seat the bearing cups with the procedure described above.

(5) Tighten the differential bearing cap bolts 95 N·m (70 ft. lbs.).

ADJUSTMENTS (Continued)

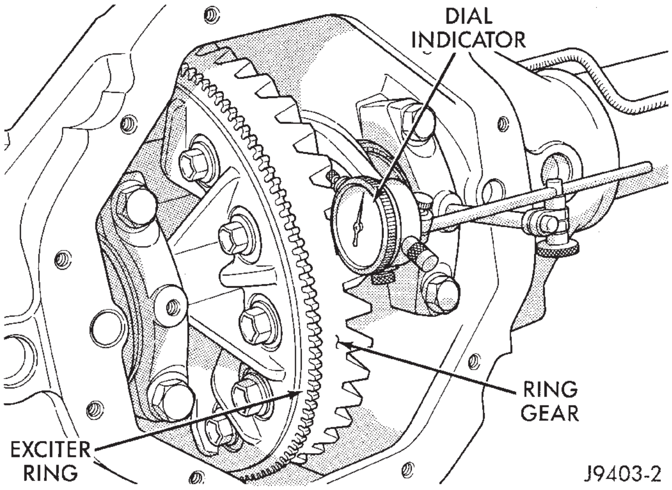


Fig. 58 Ring Gear Backlash Measurement

(6) Tighten the right-side threaded adjuster to 102 N·m (75 ft. lbs.). Seat the bearing cups with the procedure described above. Continue to tighten the right-side adjuster and seat bearing cups until the torque remains constant at 102 N·m (75 ft. lbs.).

(7) Measure the ring gear backlash. The range of backlash is 0.006 to 0.008 inch (0.15 to 0.203 mm).

(8) Continue increasing the torque at the right-side threaded adjuster until the specified backlash is obtained.

NOTE: The left-side threaded adjuster torque should have approximately 102 N·m (75 ft. lbs.). If the torque is considerably less, the complete adjustment procedure must be repeated.

(9) Tighten the left-side threaded adjuster until 102 N·m (75 ft. lbs.) torque is indicated. Seat the bearing rollers with the procedure described above. Do this until the torque remains constant.

(10) Install the threaded adjuster locks and tighten the lock screws to 10 N·m (90 in. lbs.).

After the proper backlash is achieved, perform the Gear Contact Analysis procedure.

GEAR CONTACT PATTERN ANALYSIS

The ring and pinion gear teeth contact patterns will show if the pinion gear depth is correct in the axle housing. It will also show if the ring gear backlash has been adjusted correctly. The backlash can be adjusted within specifications to achieve desired tooth contact patterns.

(1) Apply a thin coat of hydrated ferric oxide, or equivalent, to the drive and coast side of the ring gear teeth.

(2) Wrap, twist, and hold a shop towel around the pinion yoke to increase the turning resistance of the pinion gear. This will provide a more distinct contact pattern.

(3) Using a boxed end wrench on a ring gear bolt, Rotate the differential case one complete revolution in both directions while a load is being applied from shop towel.

The areas on the ring gear teeth with the greatest degree of contact against the pinion gear teeth will squeegee the compound to the areas with the least amount of contact. Note and compare patterns on the ring gear teeth to Gear Tooth Contact Patterns chart (Fig. 59) and adjust pinion depth and gear backlash as necessary.

SIDE GEAR CLEARANCE

When measuring side gear clearance, check each gear independently. If it necessary to replace a side gear, replace both gears as a matched set.

(1) Install the axle shafts and C-clip locks and pinion mate shaft.

(2) Measure each side gear clearance. Insert a matched pair of feeler gauge blades between the gear and differential housing on opposite sides of the hub (Fig. 60).

(3) If side gear clearances is no more than 0.005 inch. Determine if the shaft is contacting the pinion gear mate shaft. **Do not remove the feeler gauges, inspect the axle shaft with the feeler gauge inserted behind the side gear.** If the end of the axle shaft is not contacting the pinion gear mate shaft, the side gear clearance is acceptable.

(4) If clearance is more than 0.005 inch (axle shaft not contacting mate shaft), record the side gear clearance. Remove the thrust washer and measure its thickness with a micrometer. Add the washer thickness to the recorded side gear clearance. The sum of gear clearance and washer thickness will determine required thickness of replacement thrust washer (Fig. 61).

In some cases, the end of the axle shaft will move and contact the mate shaft when the feeler gauge is inserted. The C-clip lock is preventing the side gear from sliding on the axle shaft.

(5) If there is no side gear clearance, remove the C-clip lock from the axle shaft. Use a micrometer to measure the thrust washer thickness. Record the thickness and re-install the thrust washer. Assemble the differential case without the C-clip lock installed and re-measure the side gear clearance.

(6) Compare both clearance measurements. If the difference is less than 0.012 inch (0.305 mm), add clearance recorded when the C-clip lock was installed to thrust washer thickness measured. The sum will determine the required thickness of the replacement thrust washer.

(7) If clearance is 0.012 inch (0.305 mm) or greater, both side gears must be replaced (matched set) and the clearance measurements repeated.

ADJUSTMENTS (Continued)

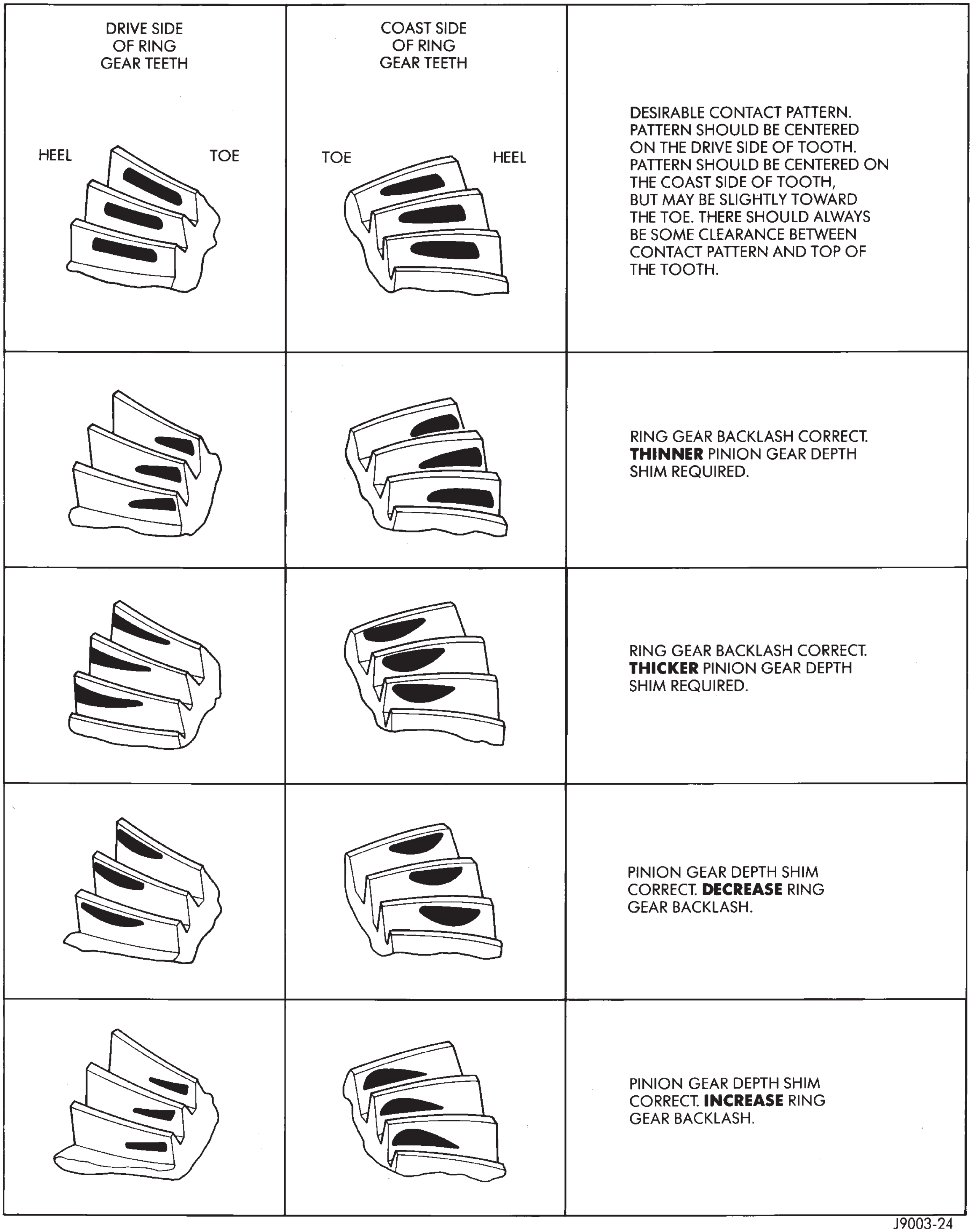


Fig. 59 Gear Tooth Contact Patterns

ADJUSTMENTS (Continued)

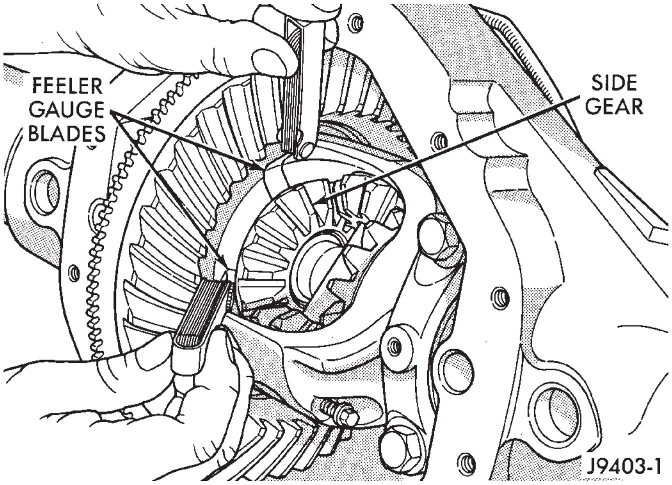


Fig. 60 Side Gear Clearance Measurement

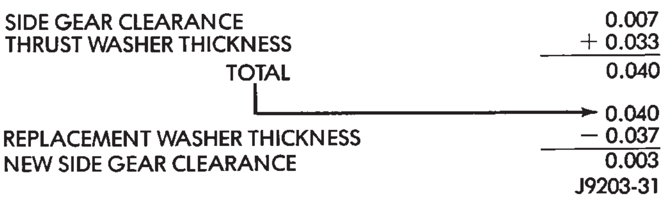


Fig. 61 Side Gear Calculations

(8) If clearance (above) continues to be 0.012 inch (0.305 mm) or greater, the case must be replaced.

SPECIFICATIONS

8 1/4 INCH AXLE

Axle Type . . . . Semi-floating, hypoid
Lubricant . . . . SAE 80W-90
Lube Capacity . . . . 2.08 L (4.4 pts.)
Trac-Lok Additive . . . . 118 ml (4 oz.)
Axle Ratio . . . . 3.07, 3.55, .4.10

Differential

Case Clearance . . . . 0.12 mm (0.005 in.)
Case Flange Runout . . . . 0.076 mm (0.003 in.)

Ring Gear

Diameter . . . . 20.95 cm (8.25 in.)
Backlash . . . . 0.12-0.20 mm (0.005-0.008 in.)
Runout . . . . 0.127 mm (0.005 in.)

Pinion Bearing

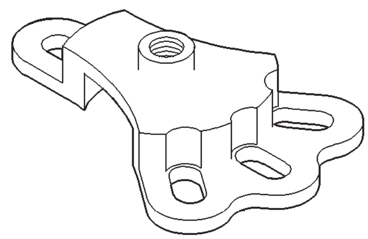
Preload . . . . 1-2 N·m (10-20 in.lbs.)

TORQUE – 8 1/4 INCH AXLE

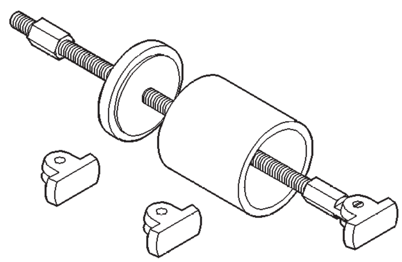
DESCRIPTION	TORQUE
Diff. Cover Bolt	41 N·m (30 ft. lbs.)
Bearing Cap Bolt	136 N·m (100 ft. lbs.)
Pinion Nut–Minimum	285 N·m (210 ft. lbs.)
Ring Gear Bolt	95 N·m (70 ft. lbs.)
Backing Plate Bolt	64 N·m (48 ft. lbs.)
RWAL/ABS Sensor Bolt	24 N·m (18. ft. lbs.)

SPECIAL TOOLS

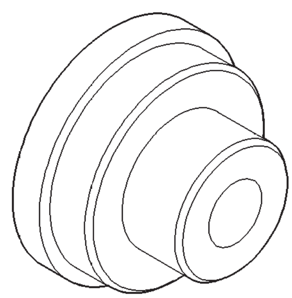
8 1/4 AXLES



Puller, Hub—6790

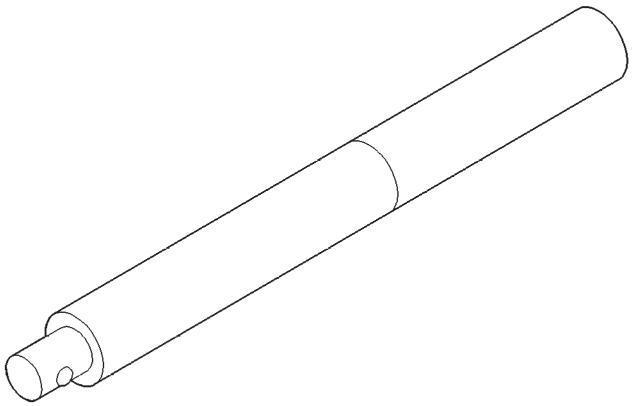


Remover, Bearing—6310

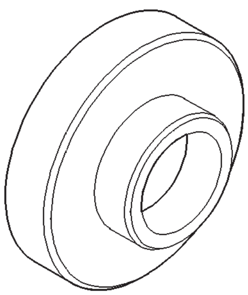


Installer—C-4198

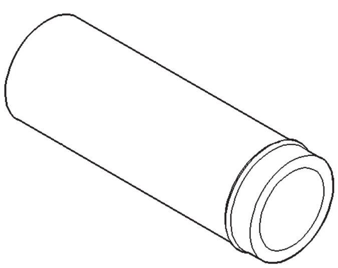
SPECIAL TOOLS (Continued)



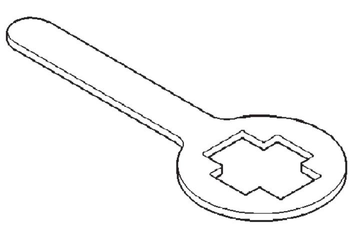
Handle—C-4171



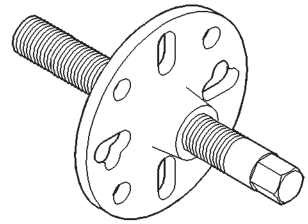
Installer—C-4076-B



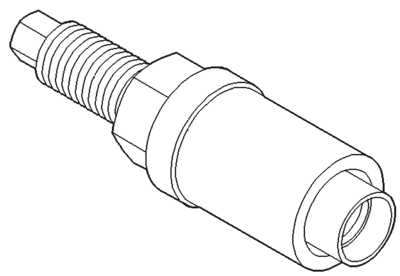
Handle—C-4735-1



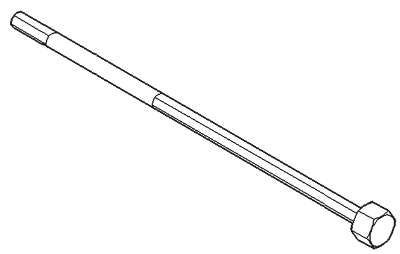
Holder—6719



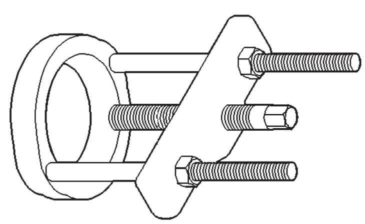
Puller—C-452



Installer—C-3718

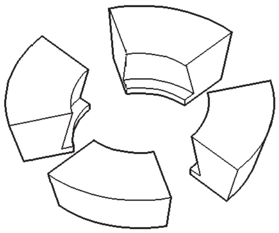


Adjustment Rod—C-4164

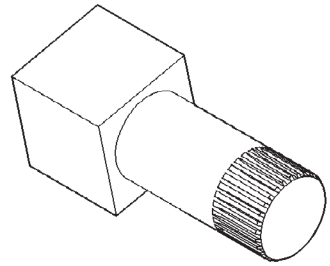


Puller/Press—C-293–PA

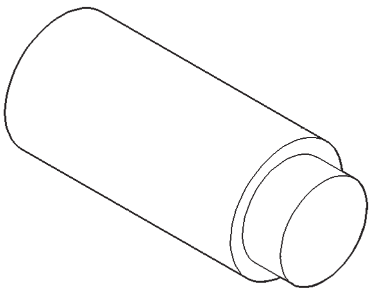
SPECIAL TOOLS (Continued)



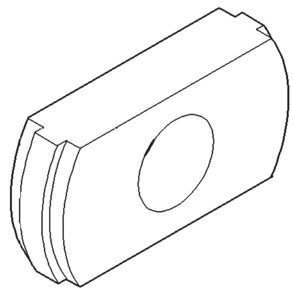
Adapters—C-293-48



Holder—8138



Plug—SP-3289



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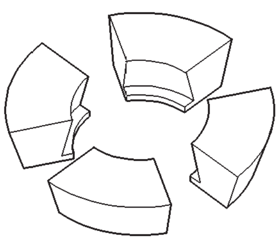
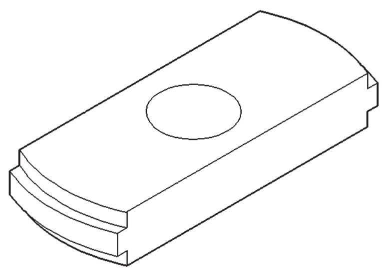
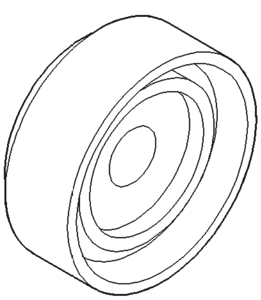


Adapters—C-293-47



Remover—C-4307



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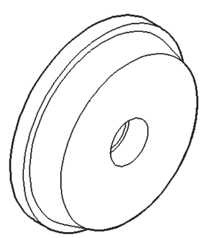
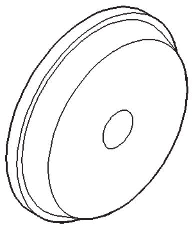
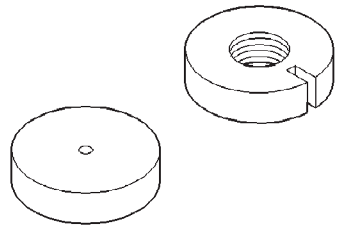


Installer—C-4308

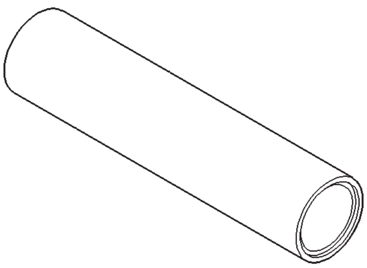
SPECIAL TOOLS (Continued)



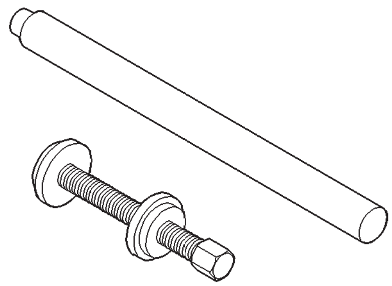
Installer—D-130



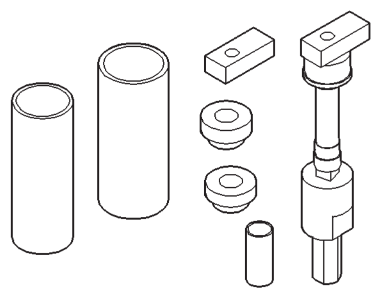
Trac-lok Tools—8140



Installer—6448



Trac-lok Tools—6960



Gauge Set—C-3715-B

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 by a hand lever.

A dual diaphragm vacuum power brake booster is used for all applications. All models have an aluminum master cylinder with plastic reservoir.

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

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

SERVICE WARNINGS & CAUTIONS

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

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

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

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

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 and steering support bracket. The unit is serviced as an assembly, except for the pedal pad.

STOP LAMP SWITCH

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

RED BRAKE WARNING LAMP

A red warning lamp is used for the service brake portion of the hydraulic system. The lamp is located in the instrument cluster. The red warning light alerts the driver if a pressure differential exists between the front and rear hydraulic systems or the parking brakes are applied.

The lamp is turned on momentarily when the ignition switch is turn to the on position. This is a self test to verify the lamp is operational.

POWER BRAKE BOOSTER

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.

DESCRIPTION AND OPERATION (Continued)

Two push rods are used in the booster. The primary push rod connects the booster to the brake pedal. The secondary push rod connects the booster to the master cylinder to stroke the cylinder pistons.

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 force for power assist.

MASTER CYLINDER

The master cylinder has a removable nylon reservoir. The cylinder body is made of aluminum and contains a primary and secondary piston assembly. The cylinder body including the piston assemblies are not serviceable. If diagnosis indicates an internal problem with the cylinder body, it must be replaced

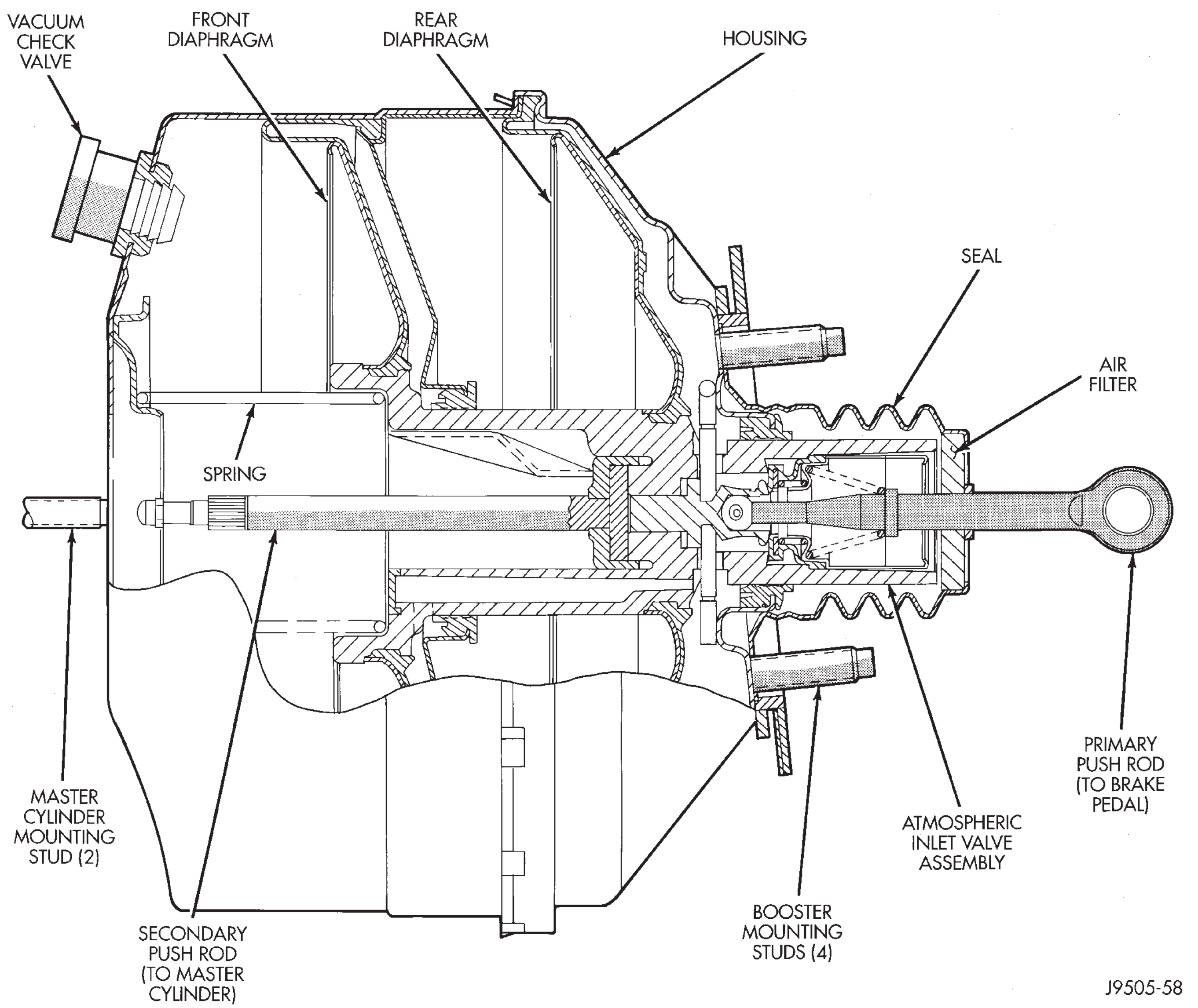


Fig. 1 Power Brake Booster–Typical

DESCRIPTION AND OPERATION (Continued)

as an assembly. The reservoir and grommets are the only replaceable parts on the master cylinder.

COMBINATION VALVE

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

PRESSURE DIFFERENTIAL VALVE

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 to the brake system are made.

PROPORTIONING VALVE

The proportioning valve is used to balance front-rear brake action at high decelerations. The valve allows normal fluid flow during moderate braking. The valve only controls fluid flow during high decelerations brake stops.

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. 2).

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

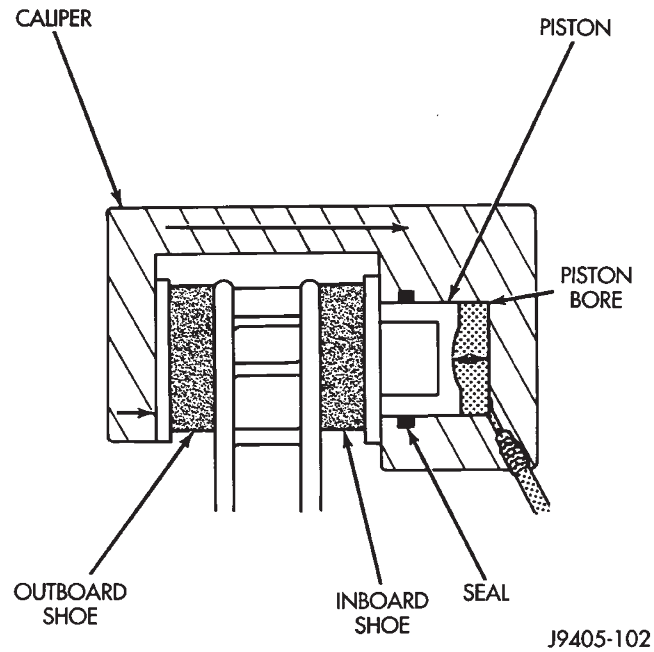


Fig. 2 Brake Caliper Operation

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. 3). When the brakes (and fluid pressure) are released, the seal relaxes and retracts the piston.

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

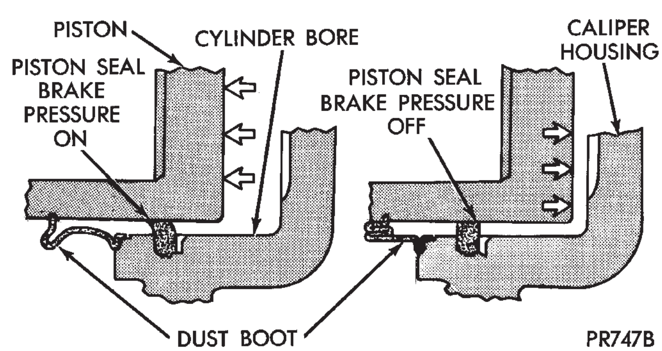


Fig. 3 Lining Wear Compensation By Piston Seal

DESCRIPTION AND OPERATION (Continued)

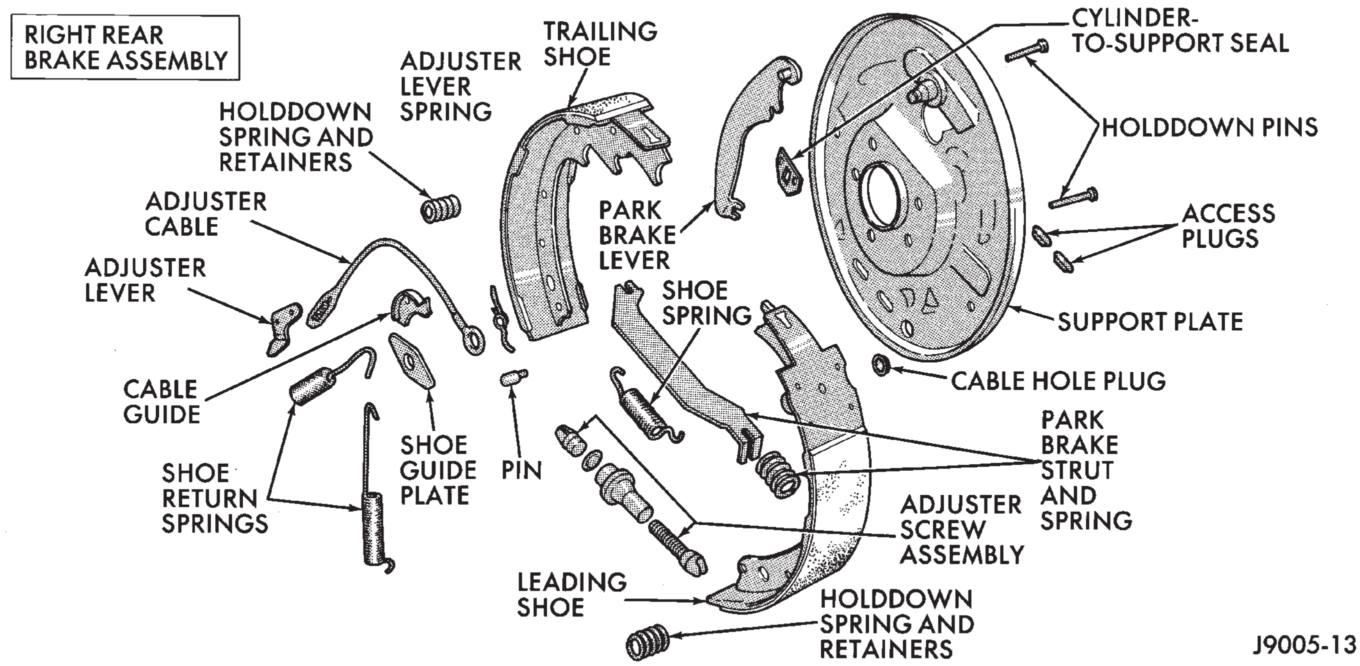


Fig. 4 Brake Components

REAR DRUM BRAKE

The brake systems use a leading shoe (primary) and trailing shoe (secondary) (Fig. 4). 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. 5).

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.

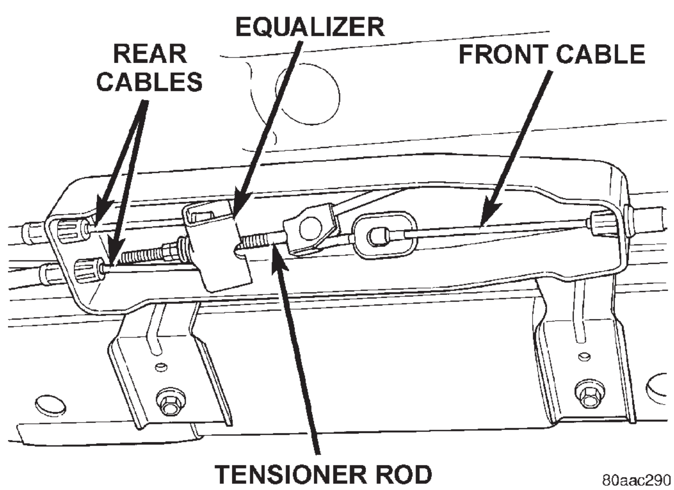


Fig. 5 Parking Brake Components

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 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.

DESCRIPTION AND OPERATION (Continued)

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 brake reservoir fluid level will decrease in proportion to normal lining wear. **Also note that brake fluid tends to darken over time. This is normal and should not be mistaken for contamination.**

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

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

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

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

(6) Check booster vacuum check valve and hose.

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

ROAD TESTING

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

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

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

(4) Attempt to stop the vehicle with the parking brake only and note grab, drag, noise, etc.

PEDAL FALLS AWAY

A brake pedal that falls away under steady foot pressure is generally the result of a system leak. The leak point could be at a brake line, fitting, hose, or caliper/wheel cylinder. If leakage is severe, fluid will be evident at or around the leaking component.

Internal leakage (seal by-pass) in the master cylinder caused by worn or damaged piston cups, may also be the problem cause.

An internal leak in the ABS or RWAL system may also be the problem with no physically evident.

LOW PEDAL

If a low pedal is experienced, pump the pedal several times. If the pedal comes back up worn linings, rotors, drums, or rear brakes out of adjustment are the most likely causes. The proper course of action is to inspect and replace all worn component and make the proper adjustments.

SPONGY PEDAL

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

HARD PEDAL OR HIGH PEDAL EFFORT

A hard pedal or high pedal effort may be due to lining that is water soaked, contaminated, glazed, or badly worn. The power booster or check valve could also be faulty.

PEDAL PULSATION

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

DIAGNOSIS AND TESTING (Continued)

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

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

BRAKE DRAG

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

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

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

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

Common causes of brake drag are:

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

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

BRAKE FADE

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

BRAKE PULL

Front brake pull condition could result from:

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

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

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

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

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

REAR BRAKE GRAB OR PULL

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

BRAKES DO NOT HOLD AFTER DRIVING THROUGH DEEP WATER PUDDLES

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

BRAKE LINING CONTAMINATION

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

WHEEL AND TIRE PROBLEMS

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

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

DIAGNOSIS AND TESTING (Continued)

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

BRAKE NOISES

Some brake noise is common with rear drum brakes and on some disc brakes during the first few stops after a vehicle has been parked overnight or stored. This is primarily due to the formation of trace corrosion (light rust) on metal surfaces. This light corrosion is typically cleared from the metal surfaces after a few brake applications causing the noise to subside.

BRAKE SQUEAK/SQUEAL

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

A very loud squeak or squeal is frequently a sign of severely worn brake lining. If the lining has worn through to the brake shoes in spots, metal-to-metal contact occurs. If the condition is allowed to continue, rotors and drums can become so scored that replacement is necessary.

BRAKE CHATTER

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

THUMP/CLUNK NOISE

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

STOP LAMP SWITCH

Stop lamp switch operation can be tested with an ohmmeter. The ohmmeter is used to check continuity between the pin terminals at different plunger positions (Fig. 6).

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

SWITCH CIRCUIT IDENTIFICATION

- Terminals 1 and 2 are for brake sensor circuit.
- Terminals 5 and 6 are for the stop lamp circuit.
- Terminals 3 and 4 are for the speed control circuit.

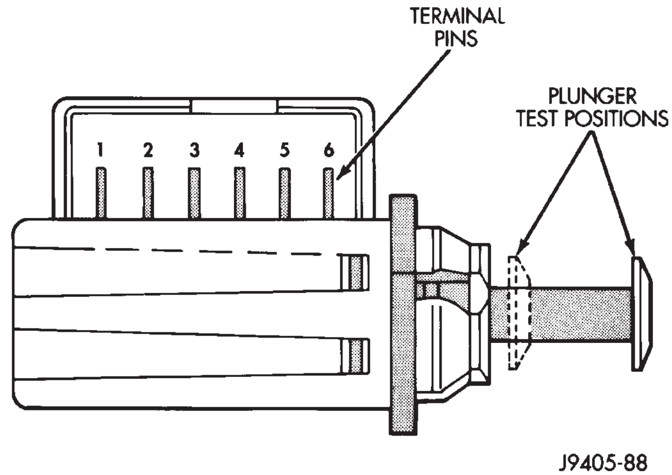


Fig. 6 Stop Lamp Switch Terminal Identification

SWITCH CONTINUITY TEST

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

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

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

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

(2) Check continuity between terminal pins 1 and 2 and pins 3 and 4 as follows:

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

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

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

RED BRAKE WARNING LAMP

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

- Self test at start-up.
- Parking brakes are applied.
- 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. If the lamp on and the brake pedal is low this indicates the pressure differential switch and valve have been actuated due to a leak in the hydraulic system.

On models with ABS brakes, the amber warning lamp only illuminates during the self test and when

DIAGNOSIS AND TESTING (Continued)

an ABS malfunction has occurred. The ABS lamp operates independently of the red warning lamp.

For additional information refer to Group 8W.

MASTER CYLINDER/POWER BOOSTER

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

(2) Stop engine and shift transmission into Neutral.

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

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

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

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

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

POWER BOOSTER VACUUM TEST

(1) Connect vacuum gauge to booster check valve with short length of hose and T-fitting (Fig. 7).

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

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

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

(5) Stop engine and observe vacuum gauge.

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

POWER BOOSTER CHECK VALVE TEST

(1) Disconnect vacuum hose from check valve.

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

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

(4) Apply 15-20 inches vacuum at large end of check valve (Fig. 8).

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

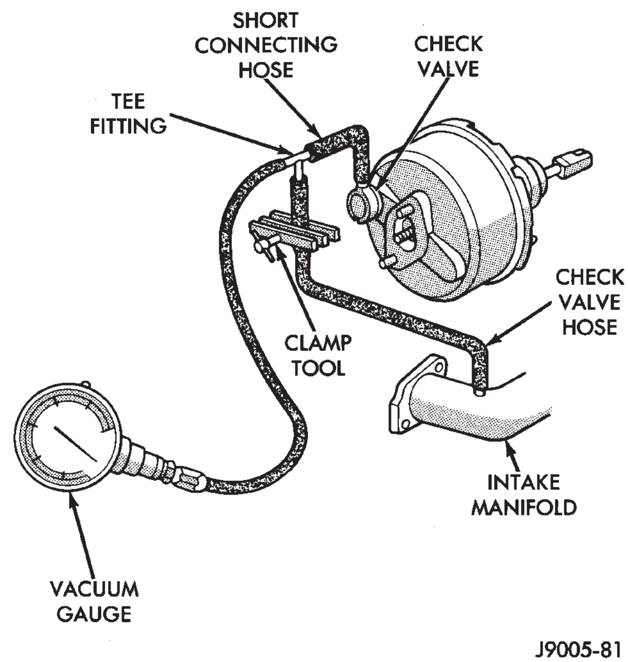


Fig. 7 Typical Booster Vacuum Test Connections

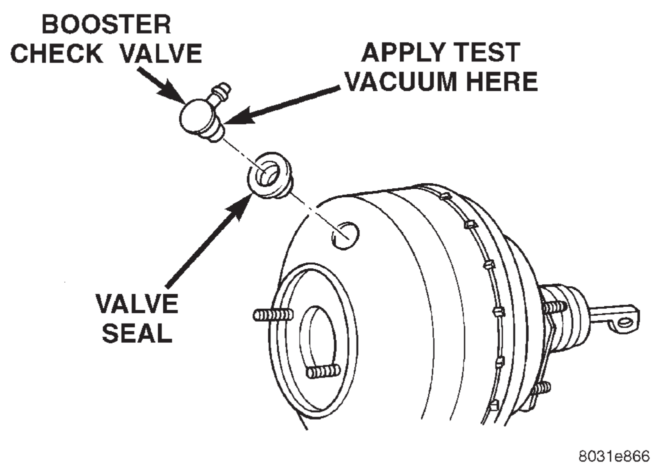


Fig. 8 Vacuum Check Valve And Seal

COMBINATION VALVE

PRESSURE DIFFERENTIAL SWITCH

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

(2) Raise vehicle on hoist.

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

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

(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

DIAGNOSIS AND TESTING (Continued)

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.

REAR PROPORTIONING VALVE

The valve controls fluid flow. If fluid enters the valve and does not exit the valve the combination valve must be replaced.

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

ROTOR THICKNESS VARIATION

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

Measure rotor thickness at 6 to 12 points around the rotor face (Fig. 10).

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.

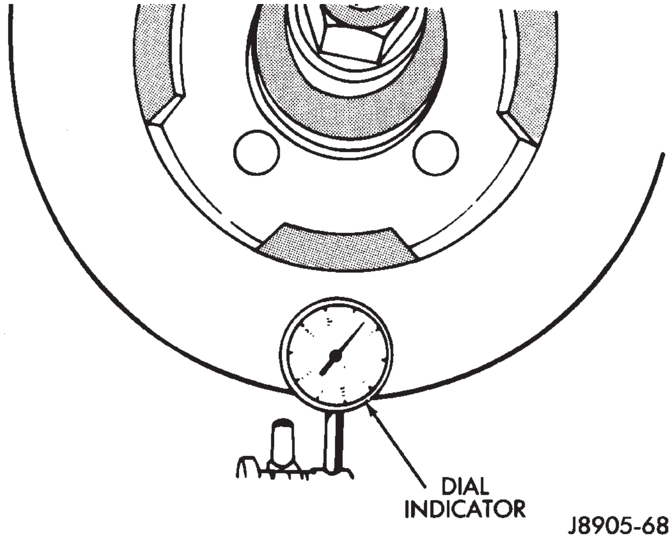


Fig. 9 Checking Rotor Runout And Thickness Variation

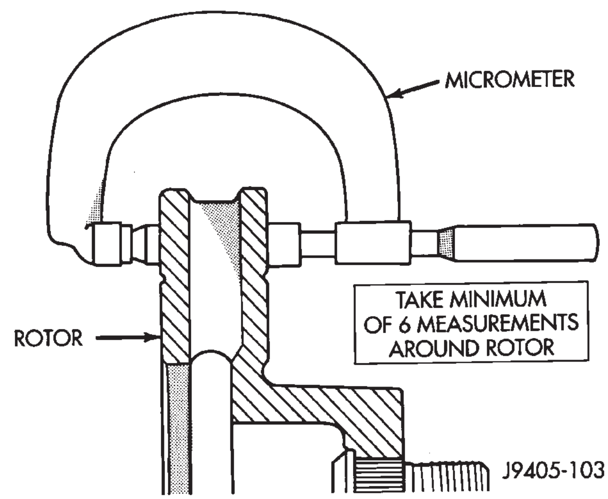


Fig. 10 Measuring Rotor Thickness

BRAKE DRUM

The maximum allowable diameter of the drum braking surface is indicated on the drum outer edge. Generally, a drum can be machined to a maximum of 1.52 mm (0.060 in.) oversize. Always replace the drum if machining would cause drum diameter to exceed the size limit indicated on the drum.

BRAKE DRUM RUNOUT

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

Variations in drum diameter should not exceed 0.076 mm (0.003 in.). Drum runout should not exceed 0.20 mm (0.008 in.) out of round. Machine the drum

DIAGNOSIS AND TESTING (Continued)

if runout or variation exceed these values. Replace the drum if machining causes the drum to exceed the maximum allowable diameter.

BRAKE LINE AND HOSES

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

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

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

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

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

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

BRAKE FLUID CONTAMINATION

Indications of fluid contamination are swollen or deteriorated rubber parts.

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

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

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

SERVICE PROCEDURES

BRAKE FLUID LEVEL

Always clean the master cylinder reservoir and 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. 11) fill to the FULL mark.

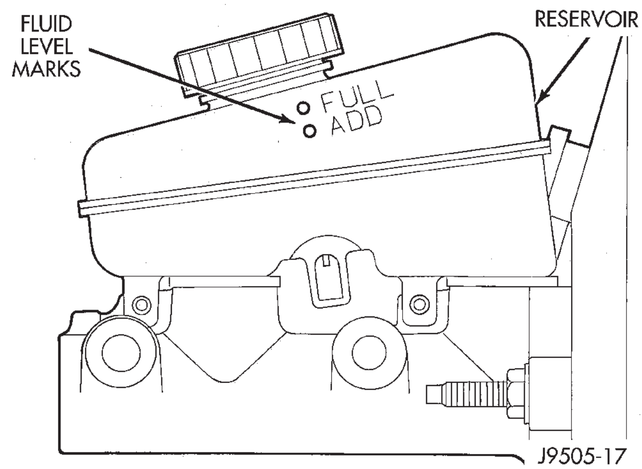


Fig. 11 Master Cylinder Fluid Level

MASTER CYLINDER BLEEDING

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

BLEEDING PROCEDURE

(1) Mount master cylinder in vise.

(2) Attach bleed tubes to cylinder outlet ports. Then position each tube end into reservoir (Fig. 12).

(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.

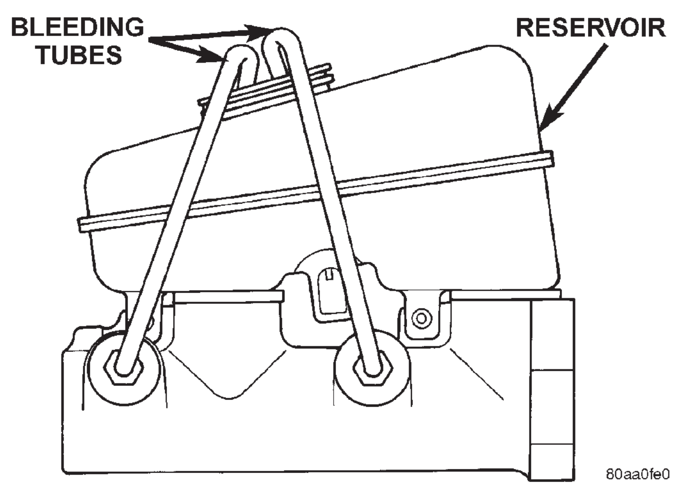


Fig. 12 Master Cylinder Bleeding–Typical

SERVICE PROCEDURES (Continued)

BASE BRAKE BLEEDING

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

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

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

Bleed only one brake component at a time in the following sequence:

- Master Cylinder
- Combination Valve
- Right Rear Wheel
- Left Rear Wheel
- Right Front Wheel
- Left Front Wheel

MANUAL BLEEDING

(1) Remove reservoir filler caps and fill reservoir.

(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. 13). 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.

PRESSURE BLEEDING

Follow the manufacturers instructions carefully when using pressure equipment. Do not exceed the tank manufacturers pressure recommendations. Generally, a tank pressure of 15-20 psi is sufficient for bleeding.

Fill the bleeder tank with recommended fluid and purge air from the tank lines before bleeding.

Do not pressure bleed without a proper master cylinder adapter. The wrong adapter can lead to leakage, or drawing air back into the system. Use adapter provided with the equipment or Adapter 6921.

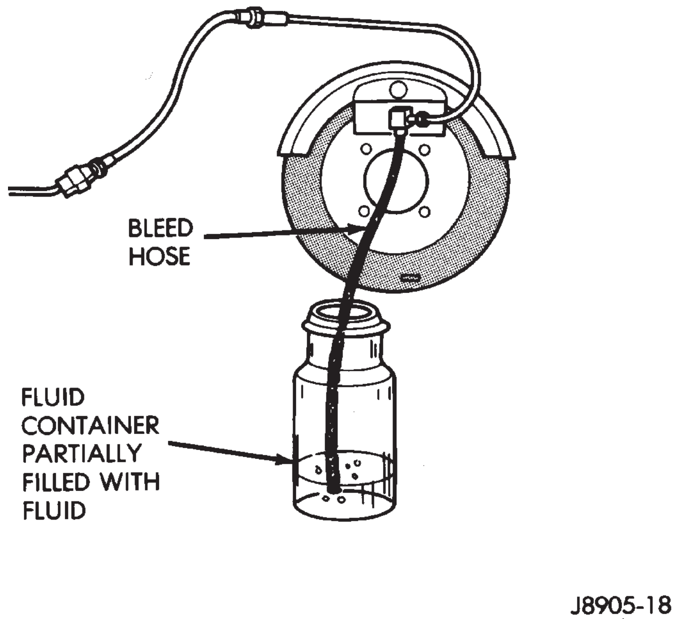


Fig. 13 Bleed Hose Setup

DISC ROTOR MACHINING

The disc brake rotor can be machined if scored or worn. The lathe must machine both sides of the rotor simultaneously with dual cutter heads. Equipment capable of machining only one side at a time may produce a tapered rotor. A hub mounted on-vehicle lathe is recommended. This type of lathe trues the rotor to the vehicles hub/bearing.

CAUTION: Brake rotors that do not meet minimum thickness specifications before or after machining must be replaced.

BRAKE DRUM MACHINING

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

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

The maximum allowable diameter of the drum braking surface is stamped or cast into the drum outer edge.

CAUTION: Replace the drum if machining will cause the drum to exceed the maximum allowable diameter.

SERVICE PROCEDURES (Continued)

BRAKE TUBE FLARING

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

Special bending tools are needed to avoid kinking or twisting of metal brake tubes. Special flaring tools are needed to make a double inverted flar or ISO flare (Fig. 14).

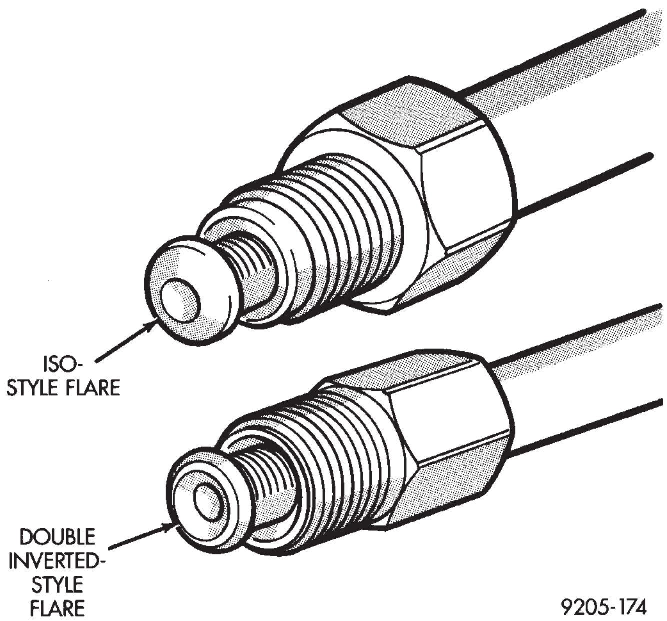


Fig. 14 Inverted Flare And ISO Flare

DOUBLE INVERTED FLARING

(1) Cut off damaged tube with Tubing Cutter.

(2) Ream cut edges of tubing to ensure proper flare.

(3) Install replacement tube nut on the tube.

(4) Insert tube in flaring tool.

(5) Place gauge form over the end of the tube.

(6) Push tubing through flaring tool jaws until tube contacts recessed notch in gauge that matches tube diameter.

(7) Tighten the tool bar on the tube

(8) Insert plug on gauge in the tube. Then swing compression disc over gauge and center tapered flaring screw in recess of compression disc (Fig. 15).

(9) Tighten tool handle until plug gauge is squarely seated on jaws of flaring tool. This will start the inverted flare.

(10) Remove the plug gauge and complete the inverted flare.

ISO FLARING

To make a ISO flare use Snap-On® Flaring Tool TFM-428 or equivalent.

(1) Cut off damaged tube with Tubing Cutter.

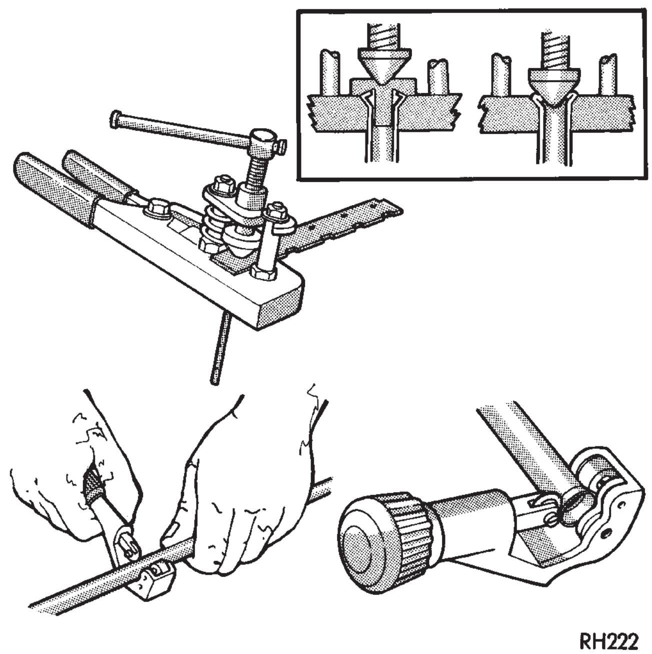


Fig. 15 Inverted Flare Tools

(2) Remove any burrs from the inside of the tube.

(3) Install tube nut on the tube.

(4) Position the tube in the flaring tool flush with the top of the tool bar (Fig. 16). Then tighten the tool bar on the tube.

(5) Install the correct size adaptor on the flaring tool yoke screw.

(6) Lubricate the adaptor.

(7) Align the adaptor and yoke screw over the tube (Fig. 16).

(8) Turn the yoke screw in until the adaptor is squarely seated on the tool bar.

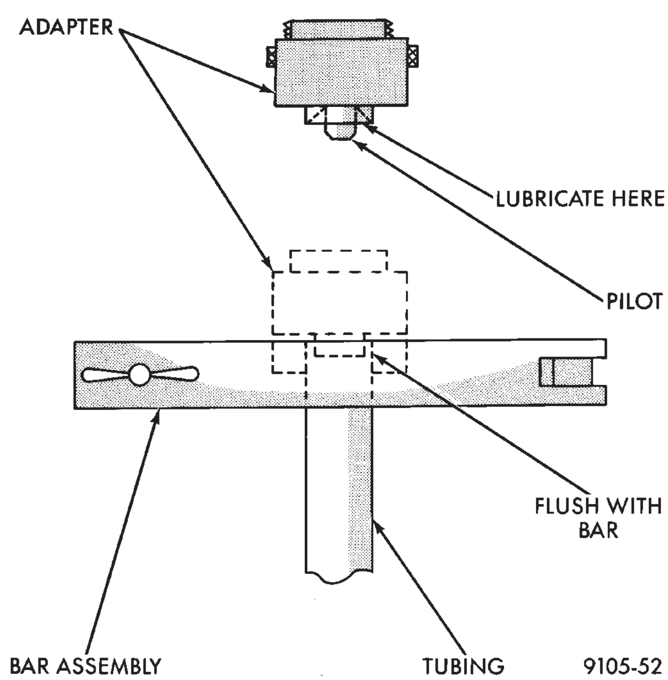


Fig. 16 ISO Flaring

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).

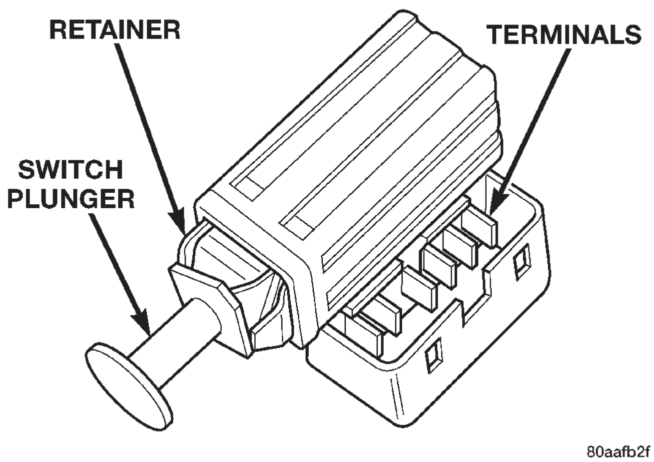


Fig. 17 Stop Lamp Switch

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 ratcheting sound as it self adjusts.

BRAKE PEDAL

REMOVAL

(1) Remove knee blocker under the steering column.

(2) Remove retainer clip securing booster push rod to pedal (Fig. 18).

(3) Remove stop lamp switch.

(4) Remove nuts securing the booster to the pedal support bracket and nuts to the column bracket.

(5) Remove pedal and support bracket as an assembly from the vehicle.

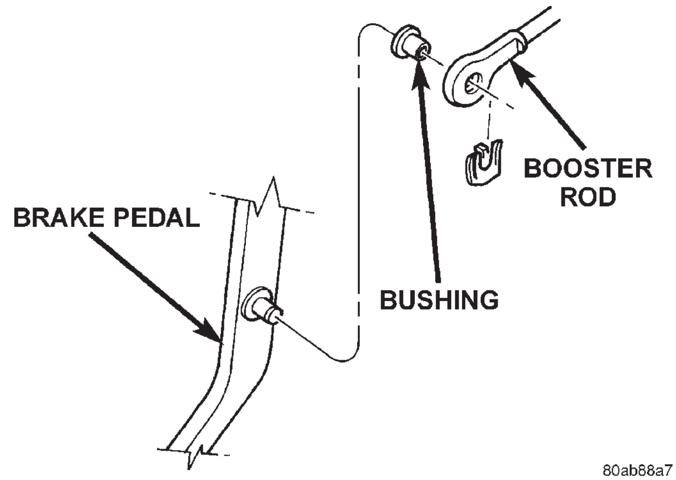


Fig. 18 Booster Push Rod

INSTALLATION

(1) Install pedal and support bracket as an assembly into the vehicle.

(2) Install nuts securing the booster to the pedal support bracket and nuts to the column bracket.

(3) Tighten nuts to 39 N·m (29 ft. lbs.).

(4) Lubricate the brake pedal pin and bushings with Mopar multi-mileage grease.

(5) Install booster push rod on pedal pin and install new retainer clip.

(6) Install knee blocker.

COMBINATION VALVE

NOTE: The combination valve is not repairable. The valve is serviced as an assembly only.

REMOVAL

(1) Remove air cleaner cover and hose for access to valve.

(2) Unsnap connector lock tabs and disconnect differential pressure switch wire at combination valve (Fig. 19). Do not pull switch wire to disconnect.

(3) Disconnect brake lines at combination valve (Fig. 20).

(4) Remove mounting nut and remove valve.

INSTALLATION

(1) Install valve and tighten mounting nut to 17 N·m (155 in. lbs.).

(2) Connect brake lines to replacement valve. Start line fittings by hand to avoid cross threading.

(3) Tighten brake line fittings to 19 N·m (170 in. lbs.).

(4) Connect wire to pressure differential switch.

(5) Bleed base brakes.

REMOVAL AND INSTALLATION (Continued)

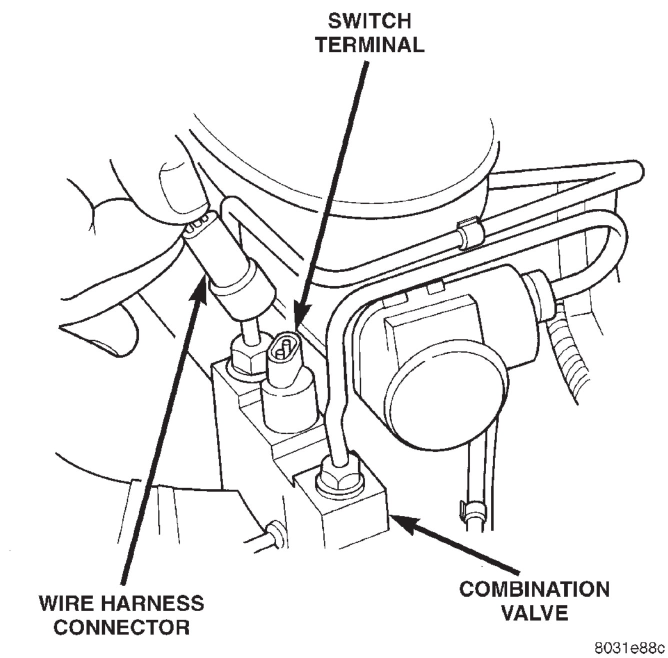


Fig. 19 Differential Pressure Switch

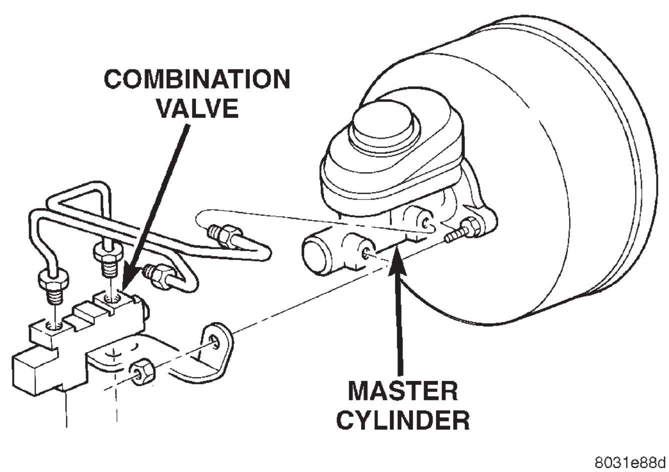


Fig. 20 Combination Valve

MASTER CYLINDER

REMOVAL

(1) On RHD vehicles remove the coolant reserve/ overflow tank. Refer to Group 7 Cooling System.

(2) Remove brake lines at master cylinder and combination valve (Fig. 20).

(3) Disconnect differential pressure switch wire from the combination valve.

(4) Remove mounting nuts from the combination valve bracket and remove the valve (Fig. 20).

(5) Remove mounting nuts from the master cylinder (Fig. 21).

(6) Remove master cylinder.

(7) Remove cylinder cover and drain fluid.

(8) If master cylinder reservoir requires service, refer to reservoir replacement procedure in this section.

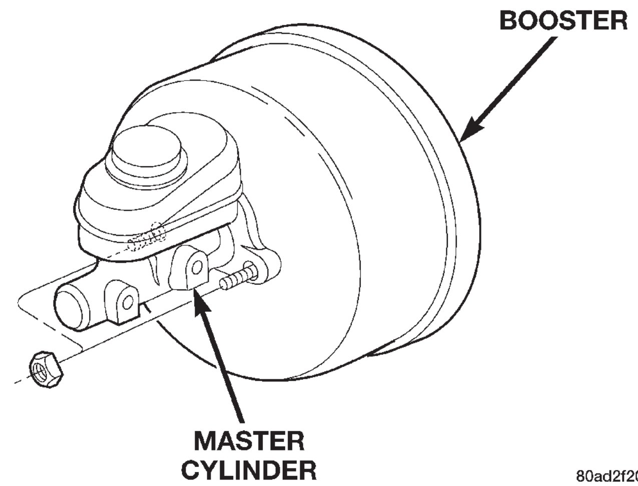


Fig. 21 Master Cylinder

INSTALLATION

NOTE: If master cylinder is replaced, bleed cylinder before installation.

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

(2) Clean cylinder mounting surface of brake booster.

(3) Install master cylinder onto brake booster studs.

(4) Install mounting nuts and tighten to 17.5 N·m (155 in. lbs.).

(5) Install combination valve and install mounting nuts.

(6) Connect brake lines to master cylinder and combination valve and tighten to 19 N·m (170 in. lbs.).

(7) Connect differential pressure switch wire to the combination valve.

(8) On RHD vehicles install the coolant reserve/ overflow tank. Refer to Group 7 Cooling System.

(9) Fill and bleed base brake system.

POWER BRAKE BOOSTER

REMOVAL

(1) On RHD vehicles remove the coolant reserve/ overflow tank. Refer to Group 7 Cooling System.

(2) Disconnect brake lines at master cylinder.

(3) Disconnect wire at combination valve differential pressure switch.

(4) Remove nut mounting combination valve bracket to booster studs and remove valve.

(5) Remove nuts mounting master cylinder to booster studs and remove cylinder.

REMOVAL AND INSTALLATION (Continued)

(6) Disconnect vacuum hose from booster check valve.

(7) Remove knee blocker under the steering column.

(8) Remove retaining clip that secures booster push rod to brake pedal (Fig. 22).

(9) Remove nuts attaching booster to passenger compartment side of dash panel (Fig. 23).

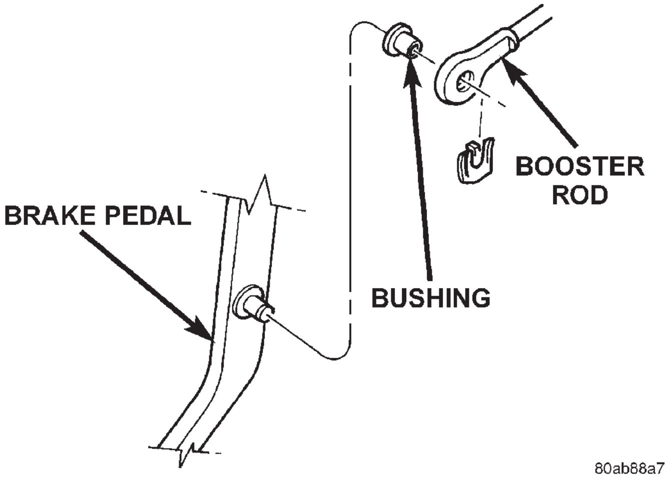


Fig. 22 Booster Push Rod

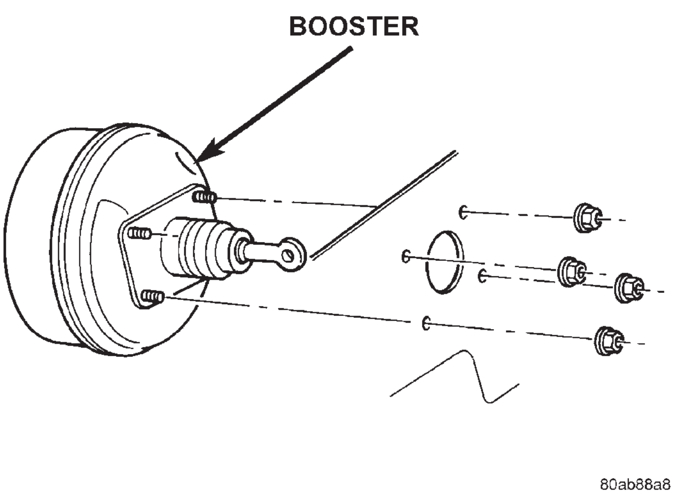


Fig. 23 Booster Mounting

(10) In engine compartment, slide booster studs out of dash panel, tilt booster upward, and remove booster from engine compartment.

(11) Remove dash seal from booster.

INSTALLATION

(1) Install dash seal on booster.

(2) Align and position booster on dash panel.

(3) In passenger compartment, install booster mounting nuts. Tighten nuts just enough to hold booster in place.

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

NOTE: Lubricate the pedal pin and bushing with Mopar multi-mileage grease before installation.

(5) Tighten booster mounting nuts to 39 N·m (29 ft. lbs.).

(6) Install the knee blocker.

(7) If original master cylinder is being installed, check condition of seal at rear of master cylinder. Replace seal if cut, or torn.

(8) Clean cylinder mounting surface of brake booster. Use shop towel wetted with brake cleaner for this purpose. Dirt, grease, or similar materials will prevent proper cylinder seating and could result in vacuum leak.

(9) Align and install master cylinder on booster studs. Install mounting nuts and tighten to 17.5 N·m (155 in. lbs.).

(10) Connect vacuum hose to booster check valve.

(11) Connect and secure brake lines to combination valve and master cylinder. Start all brake line fittings by hand to avoid cross threading.

(12) Install combination valve on booster studs. Tighten bracket mounting nuts to 17.5 N·m (155 in. lbs.).

(13) Connect wire to combination valve switch.

(14) On RHD vehicles install the coolant reserve/overflow tank. Refer to Group 7 Cooling System.

(15) Fill and bleed base brake system.

(16) Verify proper brake operation before moving vehicle.

FRONT DISC BRAKE CALIPER

REMOVAL

(1) Raise and support vehicle.

(2) Remove front wheel and tire assembly.

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

(4) Bottom caliper piston in bore with C-clamp. Position clamp screw on outboard brake shoe and clamp frame on rear of caliper (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.**

(5) Remove brake hose mounting bolt and discard washers (Fig. 25).

(6) Remove caliper mounting bolts (Fig. 26).

(7) Tilt top of caliper outward with pry tool if necessary (Fig. 27) and remove caliper.

(8) Remove caliper from vehicle.

REMOVAL AND INSTALLATION (Continued)

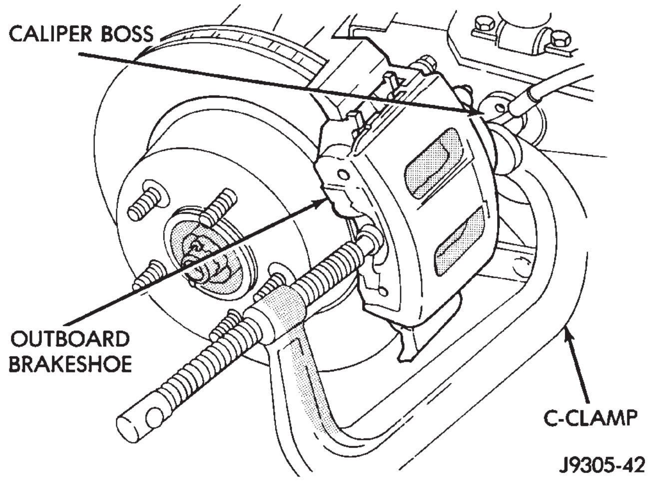


Fig. 24 Bottoming Caliper Piston With C-Clamp

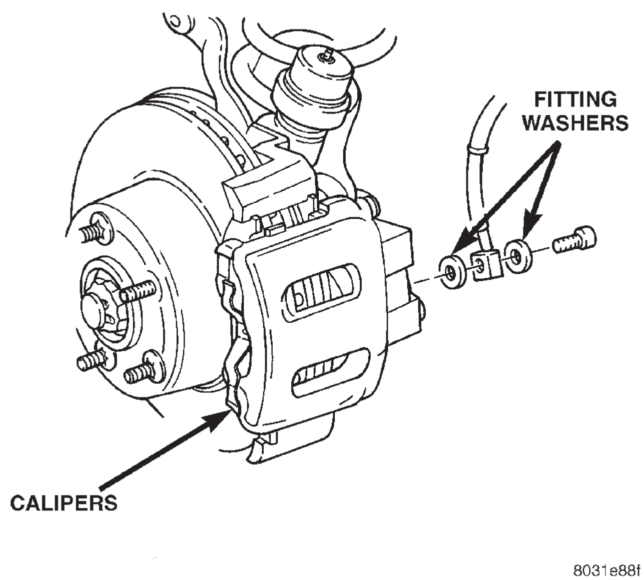


Fig. 25 Brake Hose And Bolt

INSTALLATION

(1) Clean brake shoe mounting ledges with wire brush and apply light coat of Mopar multi-mileage grease to surfaces (Fig. 28).

(2) Install caliper by position 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 top mounting ledge (Fig. 29).

(3) Coat caliper mounting bolts with silicone grease. Then install and tighten bolts to 15 N·m (11 ft. lbs.).

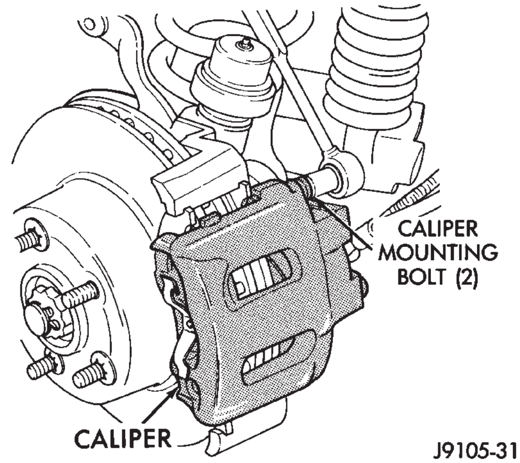


Fig. 26 Caliper Mounting Bolts

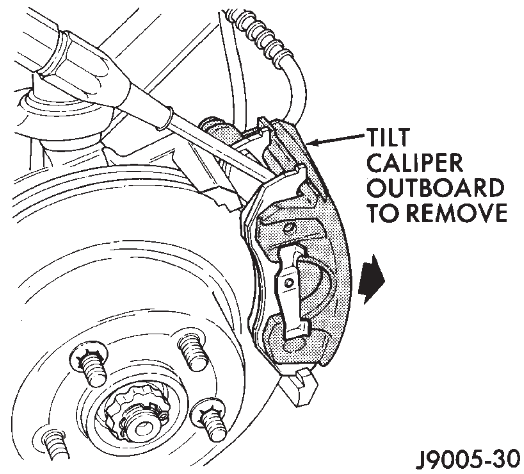


Fig. 27 Caliper Removal

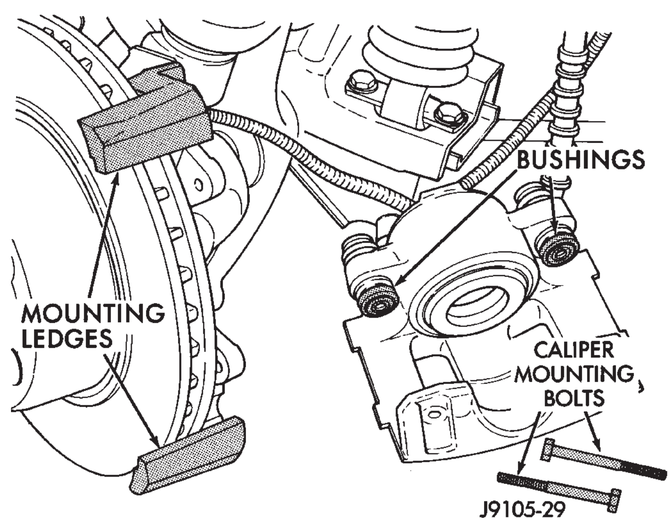


Fig. 28 Caliper Lubrication Points

REMOVAL AND INSTALLATION (Continued)

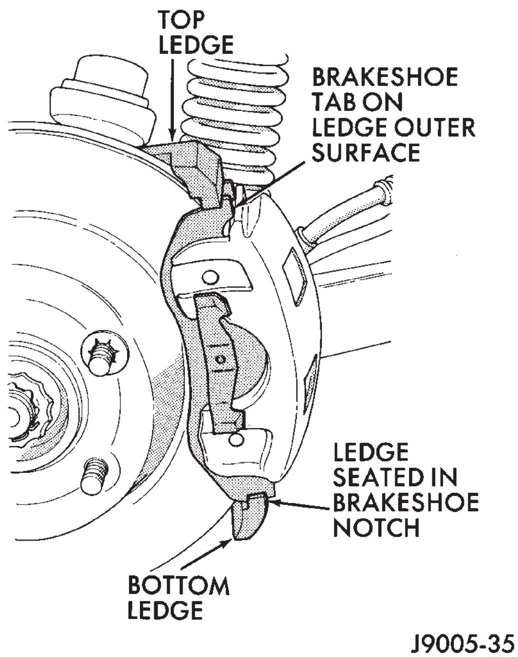


Fig. 29 Caliper Installation

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. Bolts must not have a shank length greater than 67.6 mm (2.66 in.) (Fig. 30).

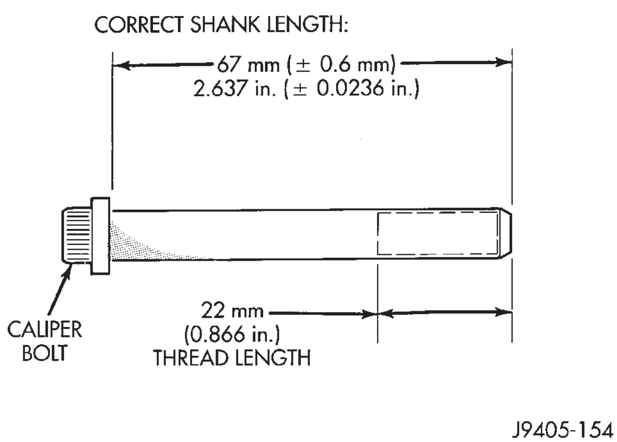


Fig. 30 Mounting Bolt Dimensions

(4) Install brake hose to caliper with **new seal washers** and tighten fitting bolt to 31 N·m (23 ft. lbs.).

CAUTION: Verify brake hose is not twisted or kinked before tightening fitting bolt.

(5) Bleed base brake system.
(6) Install wheel and tire assemblies.
(7) Remove supports and lower vehicle.
(8) Verify firm pedal before moving vehicle.

FRONT DISC BRAKE SHOES

REMOVAL

(1) Raise and support vehicle.
(2) Remove wheel and tire assembly.
(3) Remove caliper.
(4) Pressing one end of outboard 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. 31).

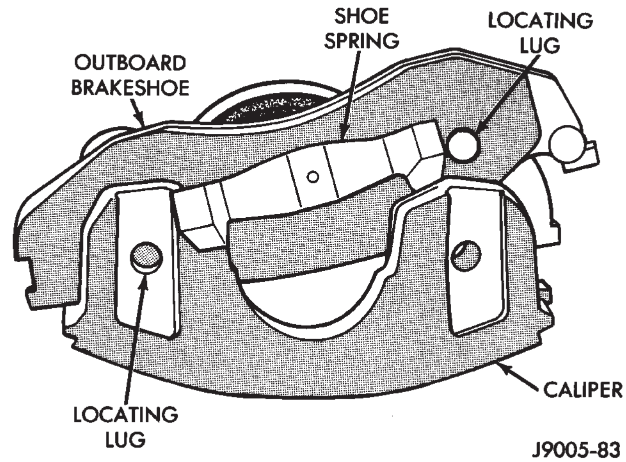


Fig. 31 Outboard Brake Shoe Removal

(5) Grasp ends of inboard shoe and tilt shoe outward to release springs from caliper piston (Fig. 32) and remove shoe from caliper.

NOTE: If original brake shoes will be used, keep them in sets left and right. They are not interchangeable.

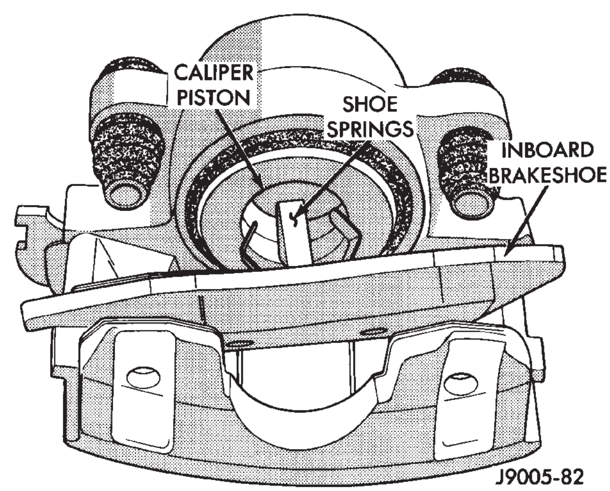


Fig. 32 Inboard Brake Shoe Removal

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

REMOVAL AND INSTALLATION (Continued)

(7) Wipe caliper off with shop rags or towels.

CAUTION: Do not use compressed air, this can unseat dust boot and force dirt into piston bore.

INSTALLATION

(1) Install inboard shoe in caliper and verify shoe retaining is fully seated into the piston.

(2) Starting one end of outboard shoe in caliper and rotating shoe downward into place. Verify shoe locating lugs and shoe spring are seated.

(3) Install caliper.

(4) Install wheel and tire assembly.

(5) Remove support and lower vehicle.

(6) Pump brake pedal until caliper pistons and brake shoes are seated.

(7) 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. 33).

(4) Remove rotor from hub.

(5) If rotor shield requires service, remove front hub and bearing assembly.

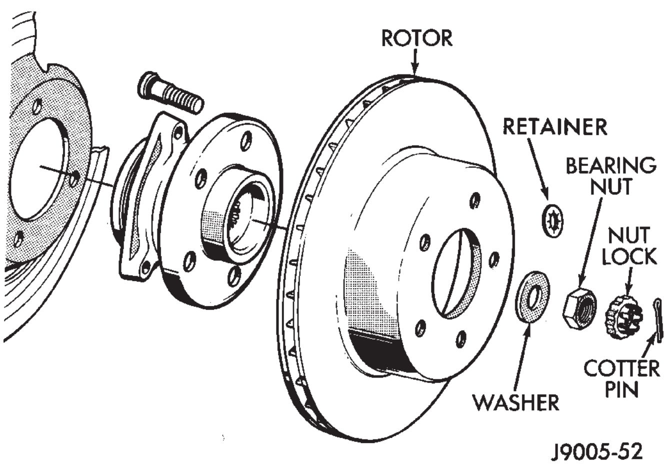


Fig. 33 Rotor & Hub

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 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. If drums prove difficult to remove, retract brake shoes. Remove access plug at the rear of backing plate and back off adjuster screw with brake tool and screwdriver.

(4) Remove U-clip and washer securing adjuster cable to parking brake lever (Fig. 34).

(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.

(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 followed by final rinse with brake cleaner.

(3) Clean and lubricate anchor pin with light coat of Mopar multi-mileage grease.

(4) Apply Mopar multi-mileage grease to brake shoe contact surfaces of support plate (Fig. 35).

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

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

(7) Remove wheel cylinder clamps.

(8) Attach parking brake cable to lever.

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

(10) Install parking brake strut and spring.

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

(12) Install primary and secondary return springs.

(13) Install adjuster cable guide on secondary shoe.

(14) Lubricate and assemble adjuster screw.

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

(16) Adjust shoes to drum.

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

(18) Verify firm brake pedal before moving vehicle.

REMOVAL AND INSTALLATION (Continued)

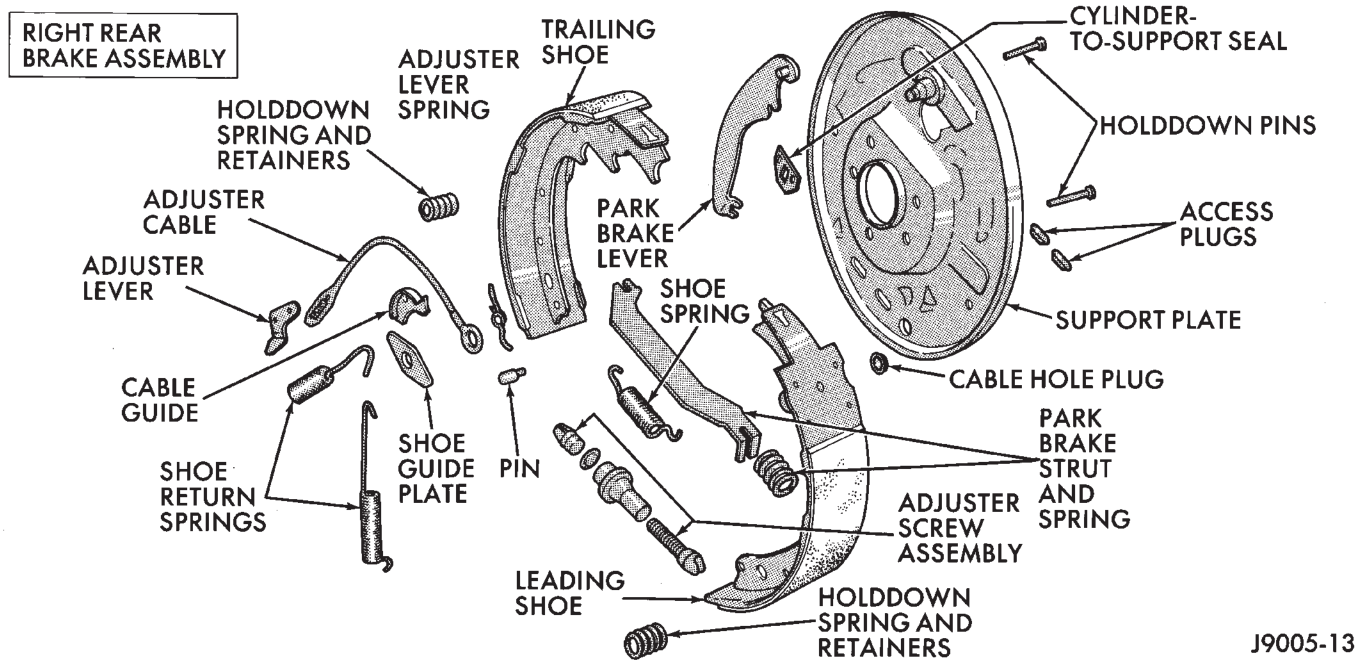


Fig. 34 Drum Brake Components—Typical

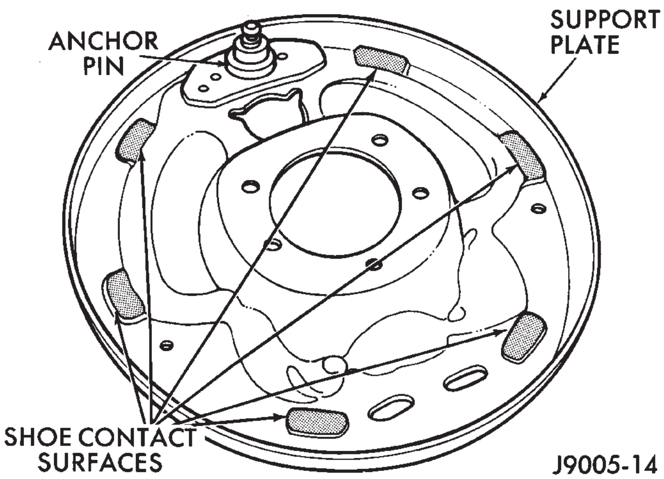


Fig. 35 Shoe Contact Surfaces

WHEEL CYLINDER

REMOVAL

(1) Remove wheel and tire assembly.
(2) Remove brake drum.
(3) Disconnect 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.

INSTALLATION

(1) Apply bead of silicone sealer around cylinder mounting surface of support plate.
(2) Install cylinder mounting bolts and tighten to 20 N·m (15 ft. lbs.).
(3) Connect brake line to cylinder.
(4) Install brake shoe return spring.
(5) Install brake drum.
(6) Install wheel and tire assembly.
(7) Bleed base brake system.

BRAKE SUPPORT PLATE

REMOVAL

(1) Remove wheel and tire assembly and brake drum.
(2) Remove brake shoe assembly.
(3) Remove parking brake cable from parking brake lever.
(4) Compress parking brake cable retainer tabs. Then push retainer and cable through and out of support plate.
(5) Disconnect brake line at wheel cylinder.
(6) Remove wheel cylinder from support plate.
(7) Remove axle shaft, refer to Group 3 for procedures.
(8) Remove bolts attaching support plate to axle and remove support plate.

INSTALLATION

(1) Apply bead of silicone sealer around axle mounting surface of support plate.
(2) Install support plate on axle flange. Tighten attaching bolts to 115 N·m (85 ft. lbs.).
(3) Apply bead of silicone sealer around wheel cylinder mounting surface and install wheel cylinder.
(4) Install brake line in wheel cylinder.
(5) Install parking brake cable in support plate.

REMOVAL AND INSTALLATION (Continued)

(6) Install axle shaft, refer to Group 3 for procedure.

(7) Connect parking brake cable to lever on secondary shoe and install brake shoes on support plate.

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

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

(10) Bleed brake system.

REAR PARKING BRAKE CABLES

REMOVAL

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

(2) Disengage cables from equalizer and compress cable retainers with a worm drive hose clamp.

(3) Remove cables from the cable bracket (Fig. 36).

(4) Remove rear wheel and brake drums.

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

(6) Compress cables retainer with worm drive hose clamp (Fig. 37) and remove cables from backing plates.

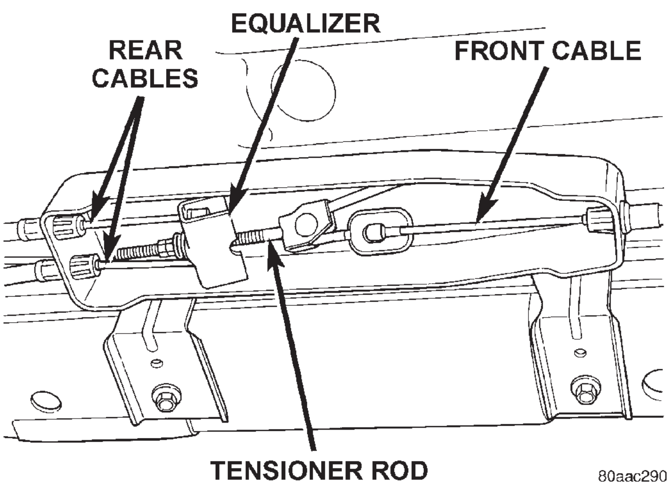


Fig. 36 Parking Brake Cables

INSTALLATION

(1) Install new cables in backing plates. 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 drums and wheels.

(5) Install cables into the cable bracket and insure retainers are seated in the bracket.

(6) Engage the cable ends into the equalizer and install equalizer nut.

(7) Adjust parking brakes.

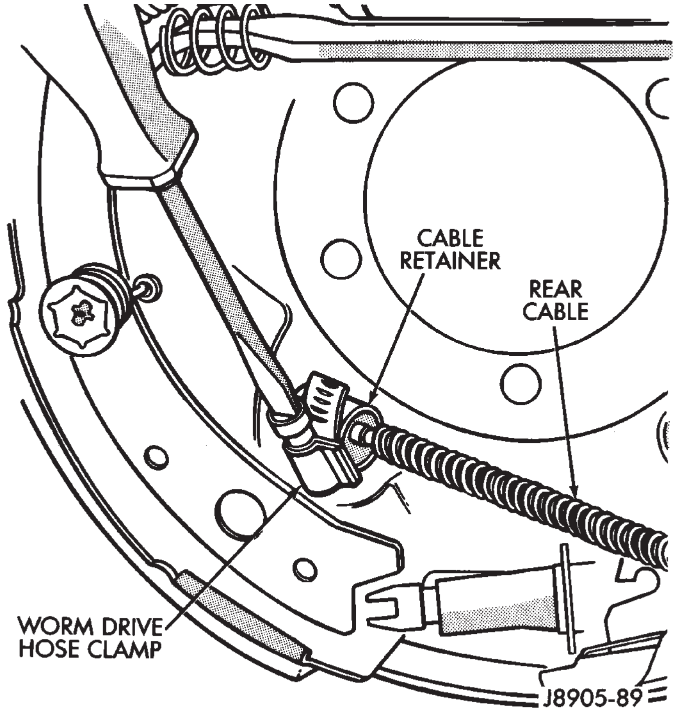


Fig. 37 Cable Retainer

PARKING BRAKE LEVER

The center console must be removed to service the parking brake lever. Refer to Group 23 Interior Components for service procedures.

REMOVAL

(1) Release parking brakes.

(2) Raise vehicle.

(3) Remove adjusting nut from tensioner rod at the equalizer (Fig. 38).

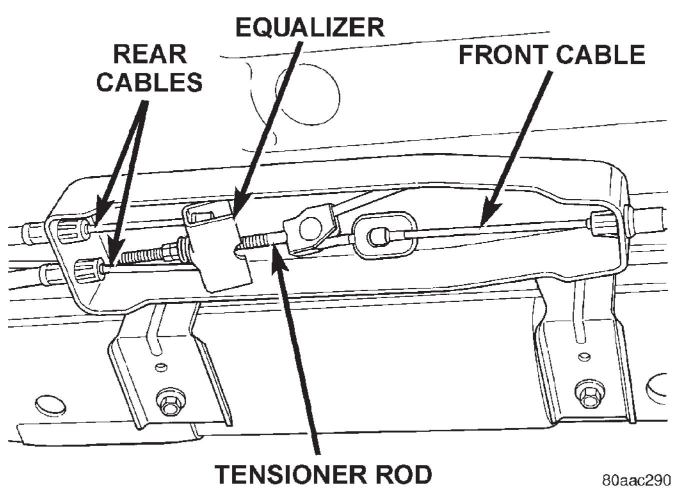


Fig. 38 Parking Brake Equalizer

(4) Lower vehicle.

(5) Disengage front cable from the cable lever.

REMOVAL AND INSTALLATION (Continued)

(6) Compress cable retainer with worm drive hose clamp and remove the cable from the parking brake lever base.

(7) Disconnect parking brake lamp switch wire (Fig. 39).

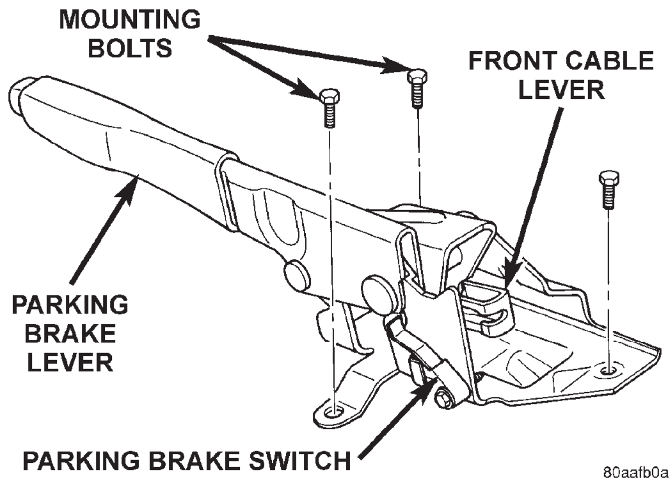


Fig. 39 Parking Brake Lever Assembly

(8) Remove parking brake lever assembly mounting bolts (Fig. 39).

(9) Remove lever assembly.

(10) Remove parking brake lamp switch.

INSTALLATION

(1) Install parking brake lamp switch.

(2) Position lever assembly on floorpan and install lever mounting bolts.

(3) Tighten lever mounting bolts to 10 to 14 N·m (7 to 10 ft. lbs.).

(4) Insert front cable through the parking brake lever base. Insure the cable retainer is seated into the base.

(5) Attach the front cable to the cable lever (Fig. 39).

(6) Connect parking brake lamp switch wire.

(7) Raise vehicle.

(8) Install adjusting nut to the tensioner rod and adjust parking brakes.

(9) Lower vehicle.

(10) Verify correct parking brake operation.

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).

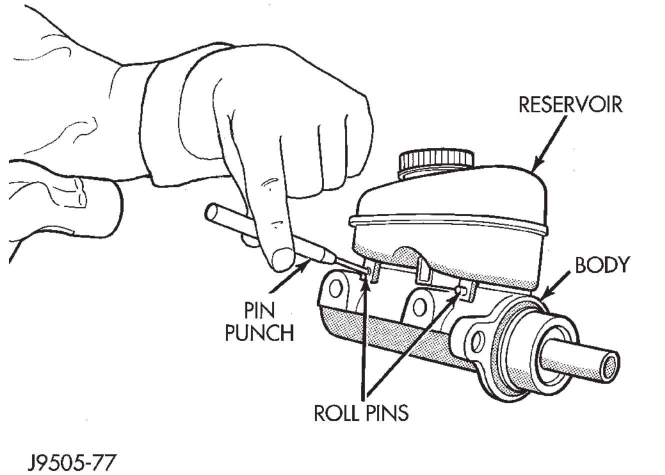


Fig. 40 Reservoir Retaining Pins

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

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

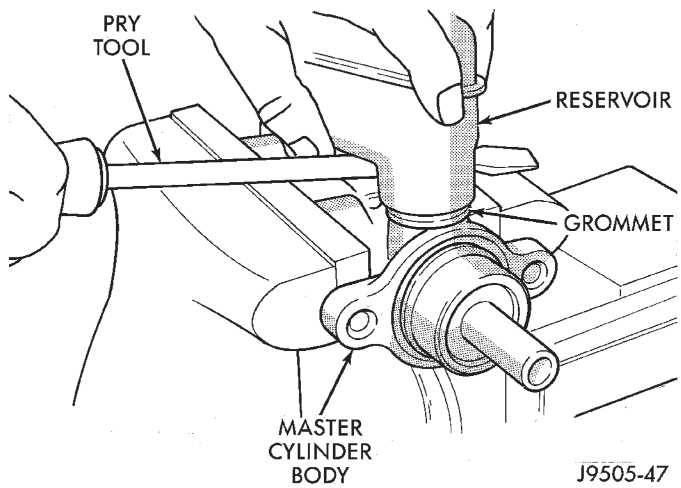


Fig. 41 Loosening Reservoir

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

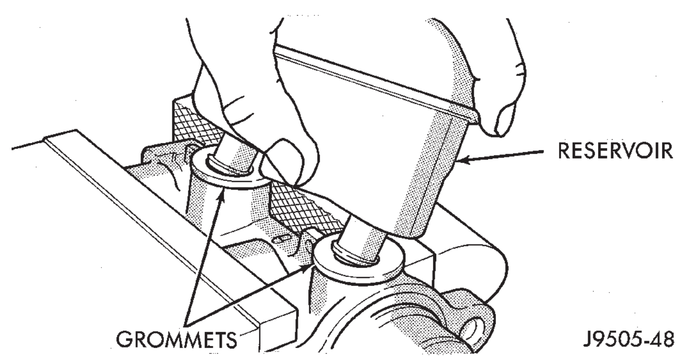


Fig. 42 Reservoir Removal

DISASSEMBLY AND ASSEMBLY (Continued)

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

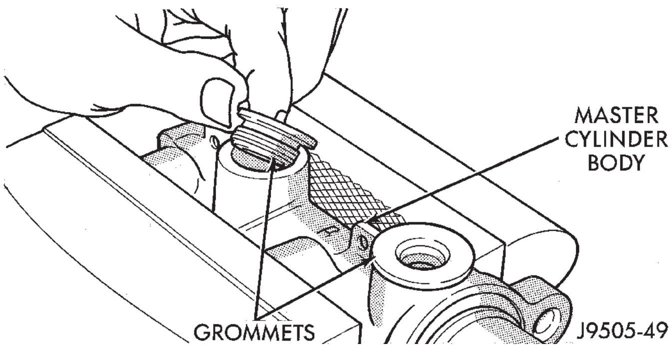


Fig. 43 Grommet Removal

INSTALLATION

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

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

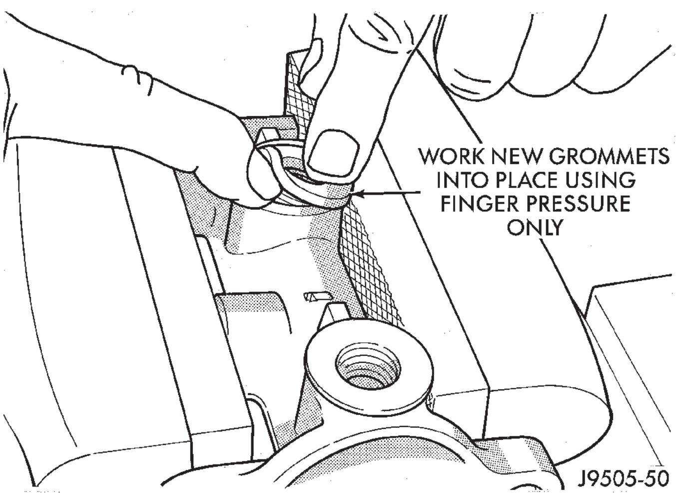


Fig. 44 Grommet Installation

(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) Take a piece of wood and pad it with one-inch thickness of shop towels. Place this piece in the outboard shoe side of the caliper in front of the piston. This will cushion and protect caliper piston during removal (Fig. 45).

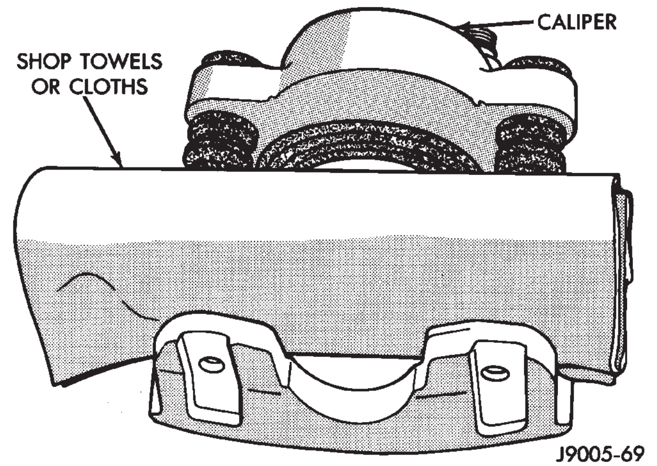


Fig. 45 Padding Caliper Interior

(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.

WARNING: NEVER ATTEMPT TO CATCH THE PISTON AS IT LEAVES THE BORE. THIS MAY RESULT IN PERSONAL INJURY.

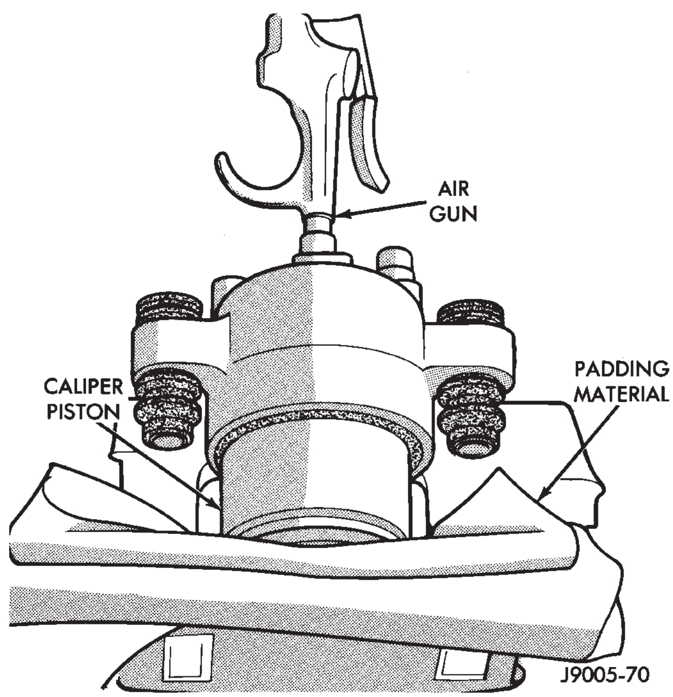


Fig. 46 Caliper Piston Removal

DISASSEMBLY AND ASSEMBLY (Continued)

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

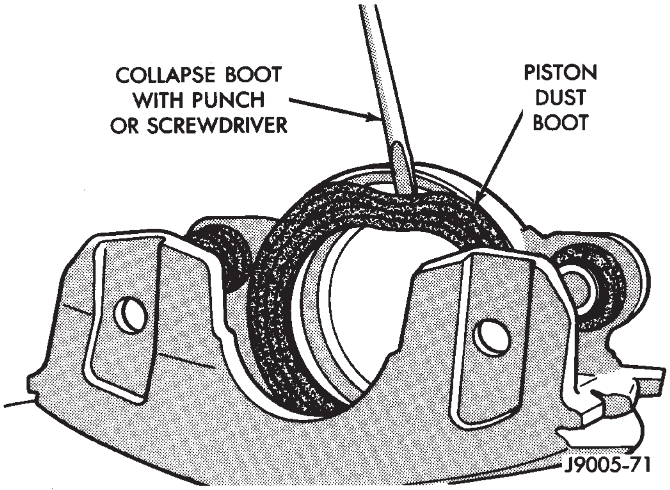


Fig. 47 Caliper Piston Dust Boot Removal

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

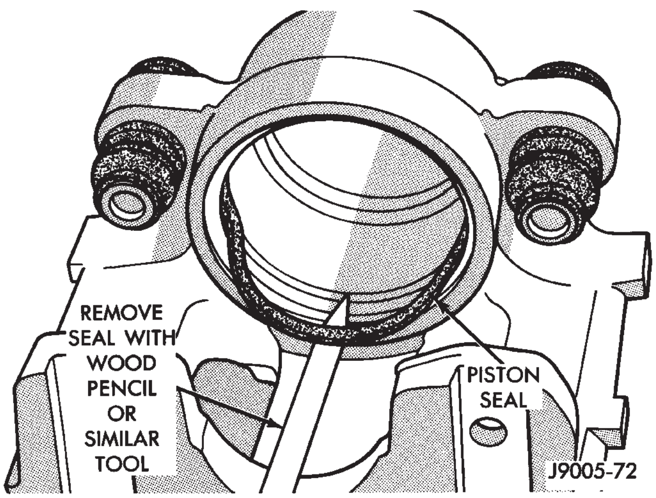


Fig. 48 Piston Seal Removal

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

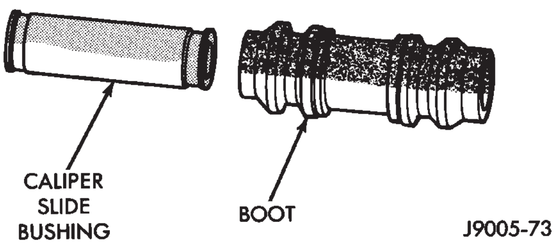


Fig. 49 Mounting Bolt Bushing And Boot

ASSEMBLY

CAUTION: Dirt, oil, and solvents can damage caliper seals. Insure assembly area is clean and dry.

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

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

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

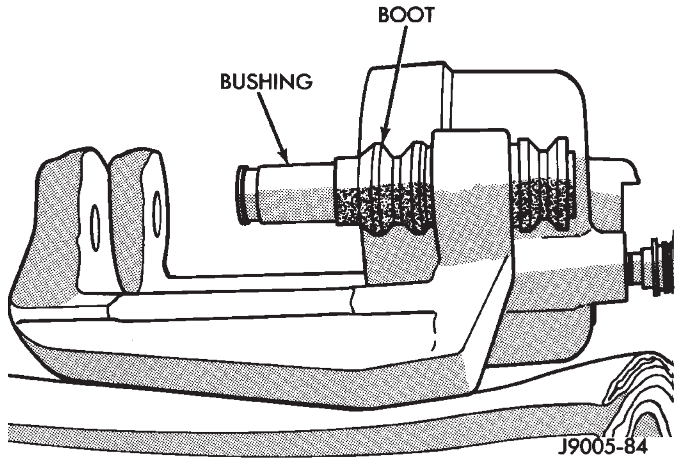


Fig. 50 Bushings And Boots Installation

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

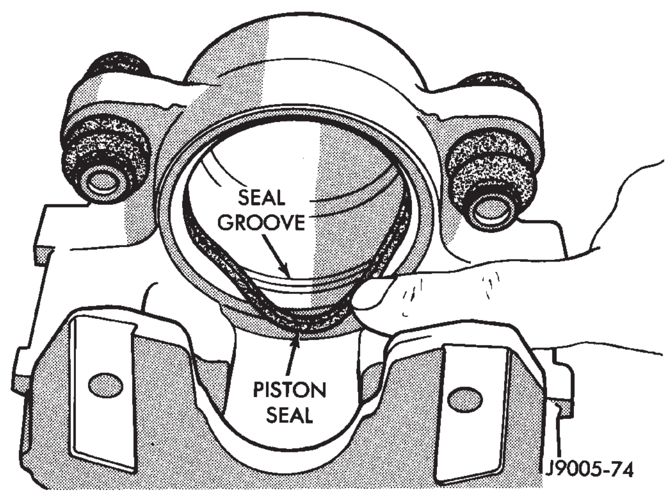


Fig. 51 Piston Seal Installation

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

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

(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) .

DISASSEMBLY AND ASSEMBLY (Continued)

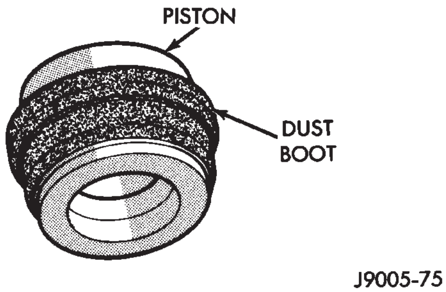


Fig. 52 Dust Boot On Piston

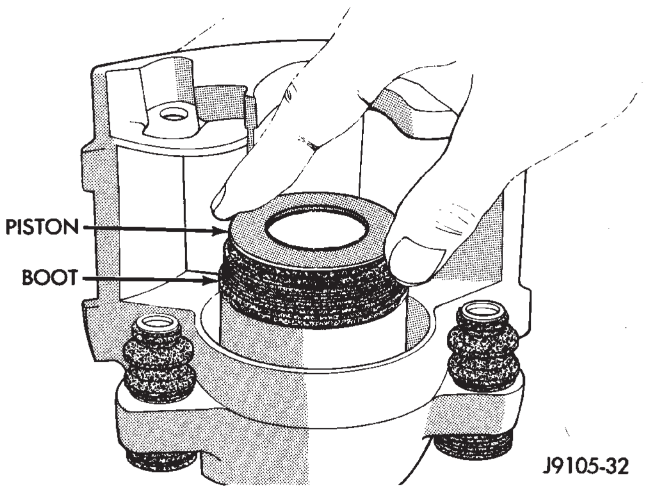


Fig. 53 Caliper Piston Installation

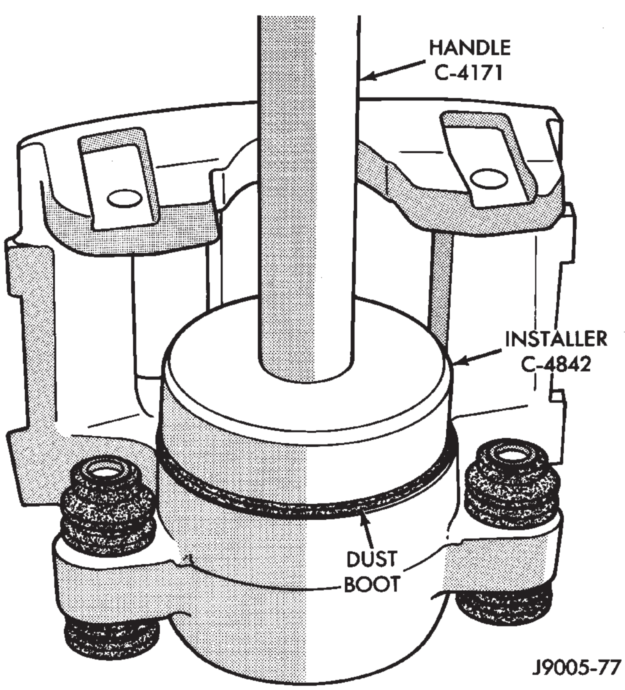


Fig. 54 Piston Dust Boot Installation

(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.

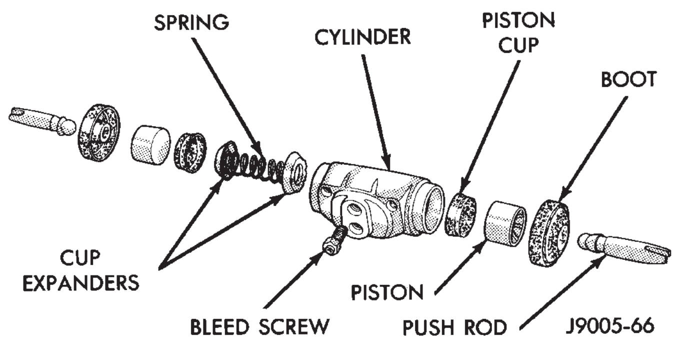


Fig. 55 Wheel Cylinder Components–Typical

ASSEMBLY

(1) Lubricate wheel cylinder bore, pistons, piston cups and spring and expander with clean brake fluid.

(2) Install first piston in cylinder bore. Then install first cup in bore and against piston. **Be sure lip of piston cup is facing inward (toward spring and expander) and flat side is against piston.**

(3) Install spring and expander followed by remaining piston cup and piston.

(4) Install boots on each end of cylinder and insert push rods in boots.

(5) Install cylinder bleed screw.

CLEANING AND INSPECTION

CALIPER

CLEANING

Clean the caliper components with clean brake fluid or brake clean only. Wipe the caliper and piston dry with lint free towels or use low pressure compressed air.

CAUTION: Do not use gasoline, kerosene, thinner, or similar solvents. These products may leave a residue that could damage the piston and seal.

INSPECTION

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

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

CLEANING AND INSPECTION (Continued)

CAUTION: If the caliper piston is replaced, install the same type of piston in the caliper. Never interchange phenolic resin and steel caliper pistons. The pistons, seals, seal grooves, caliper bore and piston tolerances are different.

The bore can be **lightly** polished with a brake hone to remove very minor surface imperfections (Fig. 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).

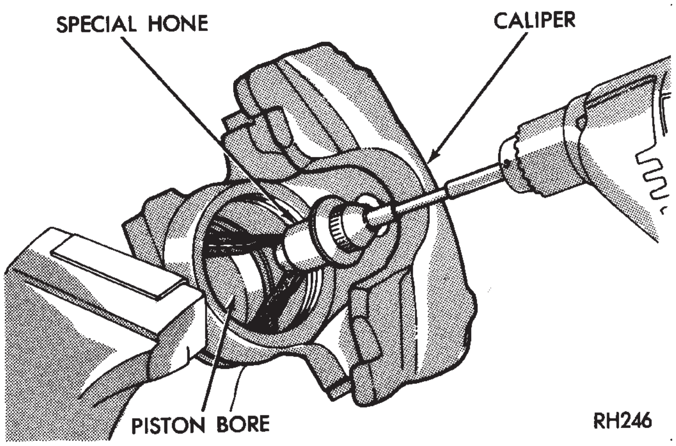


Fig. 56 Polishing Piston Bore

REAR DRUM BRAKE

CLEANING

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

INSPECTION

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

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

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

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

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

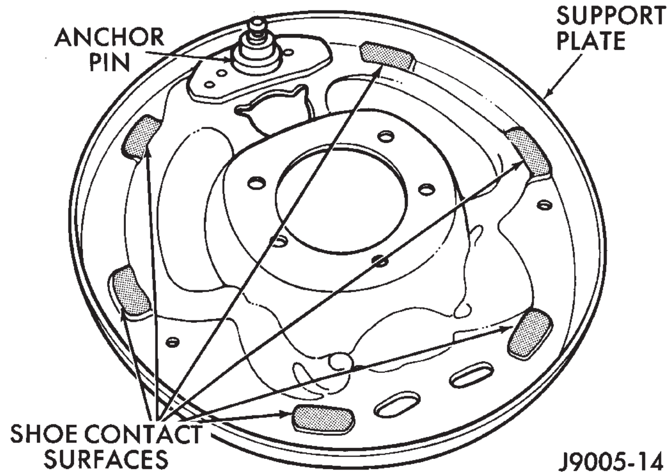


Fig. 57 Shoe Contact Surfaces

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.

ADJUSTMENTS (Continued)

(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 ratcheting sound as it self adjusts.

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. 58).

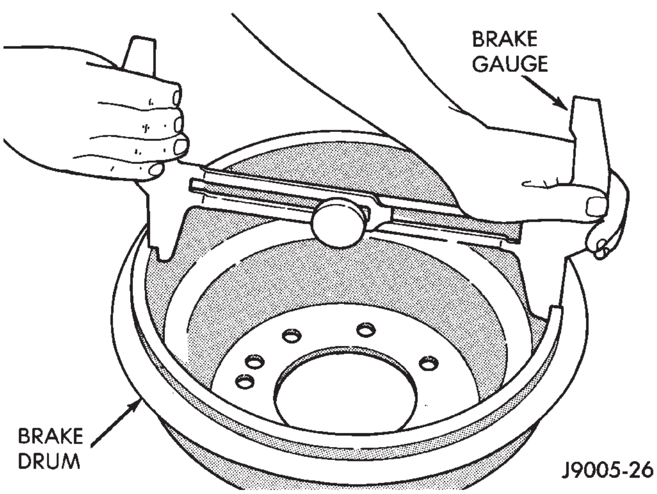


Fig. 58 Adjusting Gauge On Drum

(5) Reverse gauge and install it on brake shoes. Position gauge legs at shoe centers as shown (Fig. 59). If gauge does not fit (too loose/too tight), adjust shoes.

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

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

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

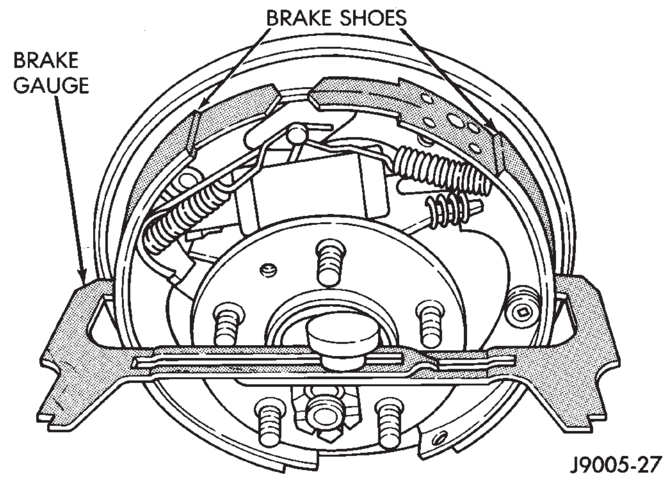


Fig. 59 Adjusting Gauge On Brake Shoes

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

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

ADJUSTMENT WITH ADJUSTING TOOL

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

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

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

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

(5) Insert adjusting tool through support plate access hole and engage tool in teeth of adjusting screw star wheel (Fig. 60).

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

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

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

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

(10) Install support plate access hole plugs.

(11) Adjust parking brake cable and lower vehicle.

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

ADJUSTMENTS (Continued)

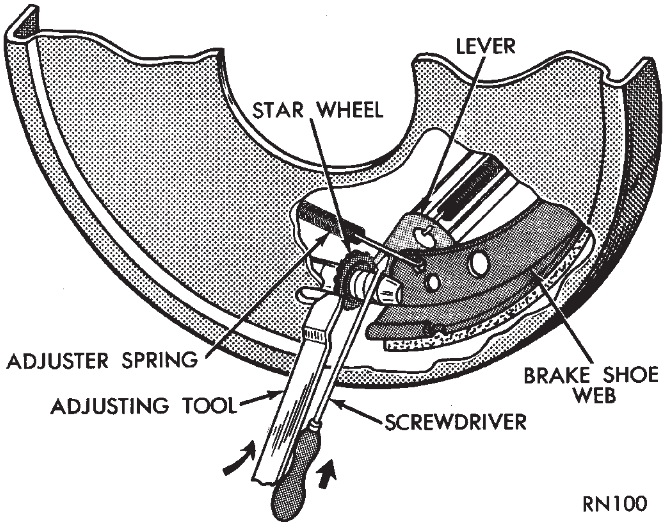


Fig. 60 Brake Adjustment

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

PARKING BRAKE CABLE TENSIONER

NOTE: Parking brake adjustment is only necessary when the tensioner, or a cable has been replaced or disconnected.

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.

CAUTION: 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. 61).

(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.

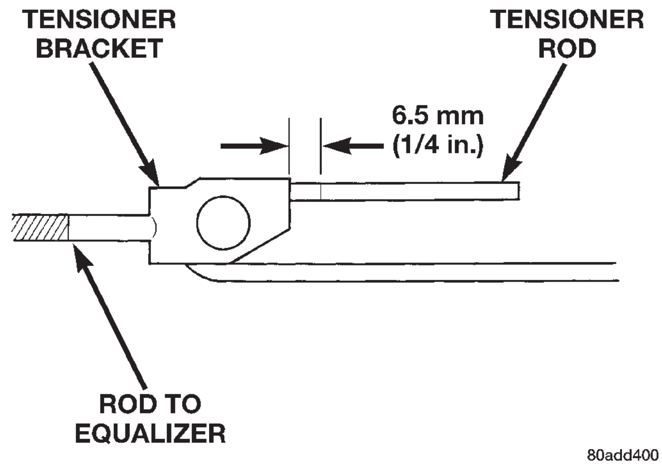


Fig. 61 Tensioner Rod Measurement

SPECIFICATIONS

BRAKE FLUID

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

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

CAUTION: Never use any type of a petroleum-based fluid in the brake hydraulic system. Use of such type fluids will result in seal damage of the vehicle brake hydraulic system causing a failure of the vehicle brake system. Petroleum based fluids would be items such as engine oil, transmission fluid, power steering fluid ect.

SPECIFICATIONS (Continued)

BRAKE COMPONENTS

Disc Brake Caliper

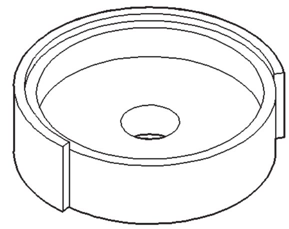
Type	Sliding
Disc Brake Rotor	
Type	Ventilated
Max. Runout	0.12 mm (0.005 in.)
Max. Thickness Variation	0.013 mm (0.0005 in.)
Min. Thickness	22.7 mm (0.8937 in.)
Brake Drum	
Size	9 in. or 10 in.
Brake Booster	
Type	Dual Diaphragm

TORQUE CHART

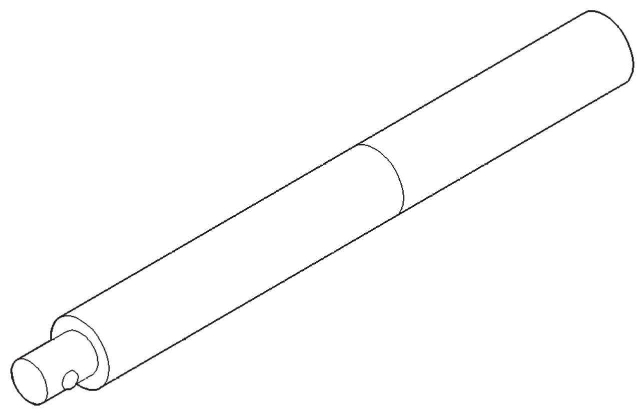
DESCRIPTION	TORQUE
Brake Pedal	
Pivot Bolt/Nut	35 N·m (26 ft. lbs.)
Brake Booster	
Mounting Nuts	39 N·m (29 ft. lbs.)
Master Cylinder	
Mounting Nuts	17.5 N·m (155 in. lbs.)
Brake Lines	19 N·m (170 in. lbs.)
Combination Valve	
Mounting Nuts	17.5 N·m (155 in. lbs.)
Brake Lines	19 N·m (170 in. lbs.)
Caliper	
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 Screws	10-14 N·m (7-10 ft. lbs.)
Lever Bracket Screws	10-14 N·m (7-10 ft. lbs.)
Cable Retainer Nut	1.5 N·m (14 in. lbs.)

SPECIAL TOOLS

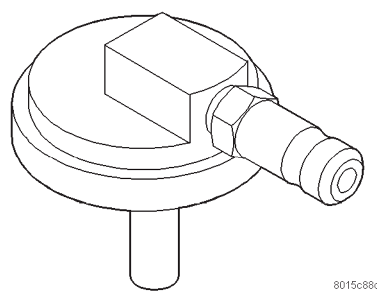
BASE BRAKES



Installer Caliper Dust Boot C-4842



Handle C-4171



Adapter Pressure Bleeder 6921

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
- ABS Warning Light

DESCRIPTION AND OPERATION

ANTILOCK BRAKE SYSTEM

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

The antilock CAB activates the system whenever sensor signals indicate periods of high wheel slip.

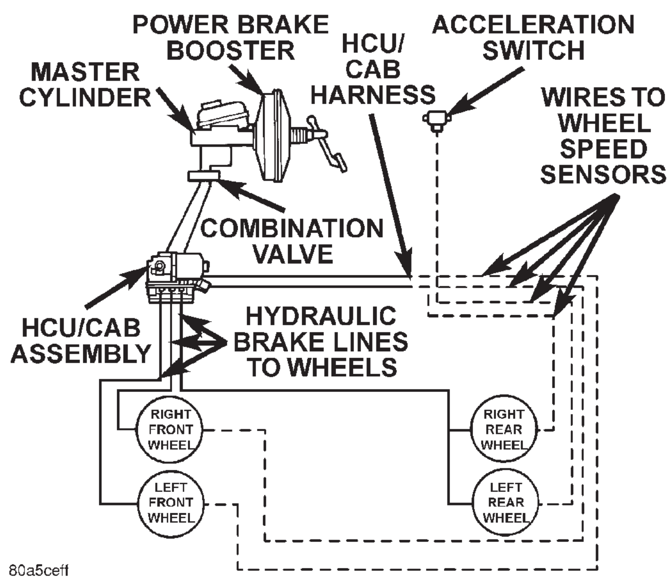


Fig. 1 Antilock Brake System

High wheel slip can be described as the point where wheel rotation begins approaching 20 to 30 percent of actual vehicle speed during braking. Periods of high wheel slip occur when brake stops involve high pedal pressure and rate of vehicle deceleration.

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

The static check occurs after the ignition switch is turned to Run position. The dynamic check occurs when vehicle road speed reaches approximately 30 kph (18 mph). During the dynamic check, the CAB

DESCRIPTION AND OPERATION (Continued)

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.

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 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 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.

The CAB is mounted to the HCU and operates the ABS system (Fig. 2) 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.

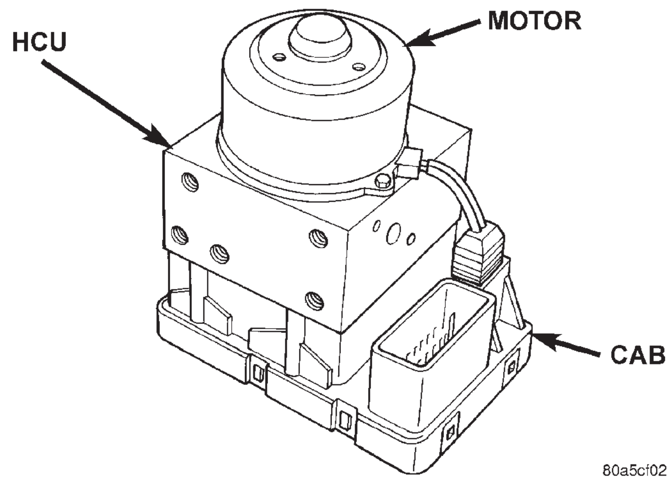


Fig. 2 Controller Antilock Brakes

HYDRAULIC CONTROL UNIT

The HCU consists of a valve body, pump body, accumulators, pump motor, and wire harnesses (Fig. 2).

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.

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.

DESCRIPTION AND OPERATION (Continued)

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

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

Pressure Hold

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

Pressure Increase

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

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 at the outboard end of the axle.

The sensors convert wheel speed into a small AC electrical signal. This signal is transmitted to the CAB. The CAB converts 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 magnet 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. 3). The front/rear sensors have the same electrical values but are not interchangeable. The sensors have a resistance between 900 and 1300 ohms.

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 0.36 to 1.5 mm (0.014 to 0.059 in.). If gap is incorrect, the sensor is either loose, or damaged.

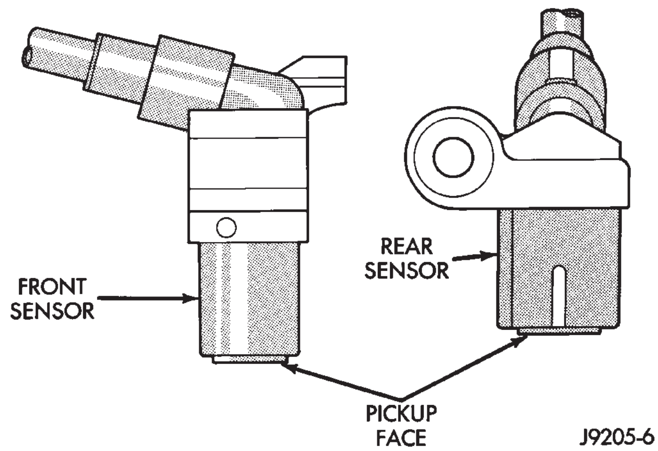


Fig. 3 Wheel Speed Sensors

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 0.92-1.275 mm (0.036-0.05 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.

COMBINATION VALVE

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

PRESSURE DIFFERENTIAL VALVE

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 to the brake system are made.

PROPORTIONING VALVE

The proportioning valve is used to balance front-rear brake action at high decelerations. The valve

DESCRIPTION AND OPERATION (Continued)

allows normal fluid flow during moderate braking. The valve only controls fluid flow during high decelerations brake stops.

ACCELERATION SWITCH

The acceleration switch is located under the rear seat. The switch (Fig. 4), provides an additional vehicle deceleration reference during 4WD 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.

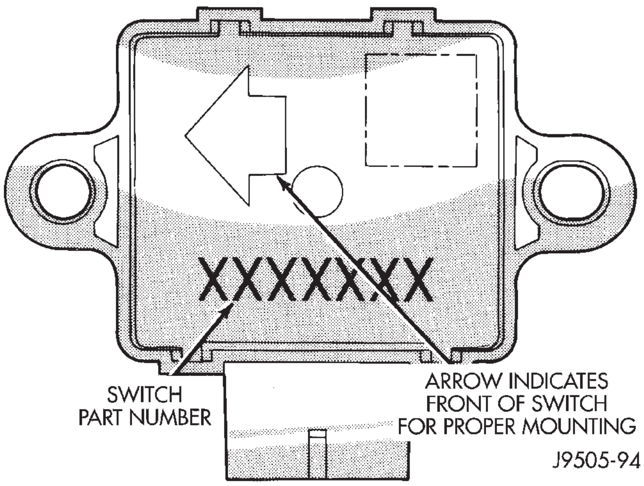


Fig. 4 Acceleration Switch

ABS WARNING LAMP

The amber ABS warning lamp is located in the instrument cluster. The lamp illuminates at start-up to perform a self check. The lamp goes out when the self check program determines the system is operating normal. If an ABS component exhibits a fault the CAB will illuminate the lamp and register a trouble code in the microprocessor.

The lamp is controlled by the CAB. The lamp is illuminated when the CAB sends a ground signal to the ABS relay. The ABS relay then grounds the lamp circuit and illuminates the lamp.

DIAGNOSIS AND TESTING

ANTILOCK BRAKES

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

NOTE: An audible noise may be heard during the self-test. This noise should be considered normal.

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

SERVICE PROCEDURES

BLEEDING ABS BRAKE SYSTEM

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

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

(2) Connect scan tool to the Data Link Connector.

(3) Select ANTILOCK BRAKES, followed by MISCELLANEOUS, then ABS BRAKES. Follow the instructions displayed. When scan tool displays TEST COMPLETE, disconnect scan tool and proceed.

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

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

REMOVAL AND INSTALLATION

HYDRAULIC CONTROL UNIT/CONTROLLER ANTILOCK BRAKES

REMOVAL

(1) Remove negative battery cable from the battery.

(2) Pull up on the CAB harness connector release (Fig. 5) and remove connector.

(3) Remove brake lines from the HCU.

(4) Remove HCU/CAB mounting nuts and bolt (Fig. 6) and remove HCU/CAB.

INSTALLATION

(1) Install HCU/CAB on the mounting studs.

(2) Install mounting nuts and bolt. Tighten to 11.5 N·m (102 in. lbs.).

(3) Install brake lines to the HCU and tighten to 19 N·m (170 in. lbs.).

(4) Install wiring harness connector to the CAB and push down on the release to secure the connector.

(5) Install negative battery cable to the battery.

(6) Bleed ABS brake system.

REMOVAL AND INSTALLATION (Continued)

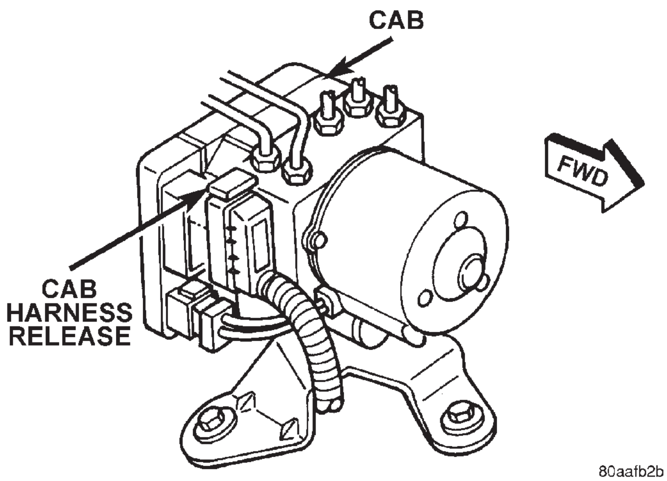


Fig. 5 CAB Harness Connector Release

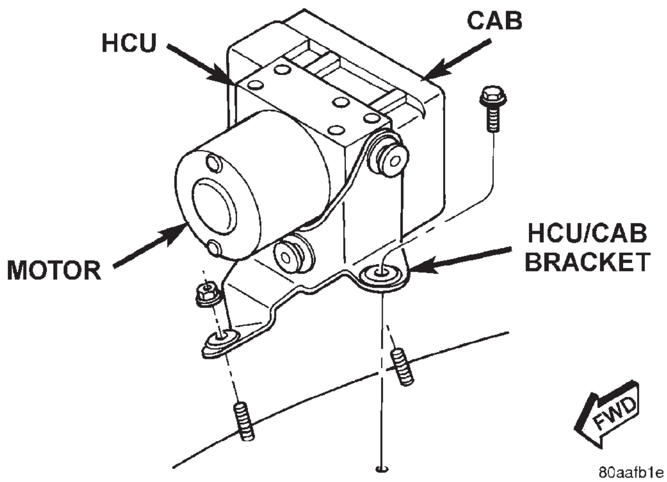


Fig. 6 HCU/CAB Mounting

FRONT WHEEL SPEED SENSOR

REMOVAL

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

(2) Remove sensor wire from mounting brackets.

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

(4) Remove bolt attaching sensor to steering knuckle and remove sensor (Fig. 7).

(5) Remove sensor wire from brackets on body and steering knuckle.

(6) Unseat sensor wire grommet in wheel house panel.

(7) In engine compartment, disconnect sensor wire connector at harness plug. Then remove sensor and wire.

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.

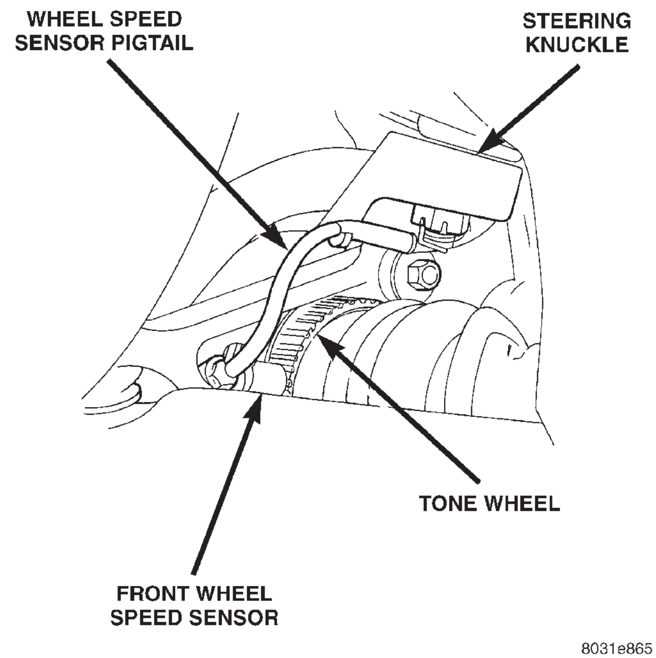


Fig. 7 Front Wheel Speed Sensor

(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 4.7 N·m (42 in. lbs.).

(5) If original sensor has been installed, check sensor air gap. Air gap should be 0.36 to 1.5 mm (0.014 to 0.059 in.). If gap is incorrect, sensor is either loose, or damaged.

(6) Secure sensor wire to steering knuckle and body brackets.

(7) Route sensor wire forward and behind shock absorber. Then attach sensor wire to spring seat bracket with grommets on sensor wire.

(8) Route sensor wire to outer sill bracket. Remove all twists or kinks from wire.

(9) Attach sensor wire to sill bracket with grommet. Be sure wire is free of twists and kinks.

(10) Verify sensor wire routing. Wire should loop forward and above sill bracket. Loose end of wire should be below sill bracket and towards brake hose.

(11) Seat sensor wire grommet in body panel and clip wire to brake line at grommet location.

(12) Connect sensor wire to harness in engine compartment.

REAR WHEEL SPEED SENSOR

REMOVAL

(1) Raise and fold rear seat forward for access to rear sensor connectors (Fig. 8).

REMOVAL AND INSTALLATION (Continued)

(2) Disconnect sensors at rear harness connectors.

(3) Push sensor grommets and sensor wires through floorpan.

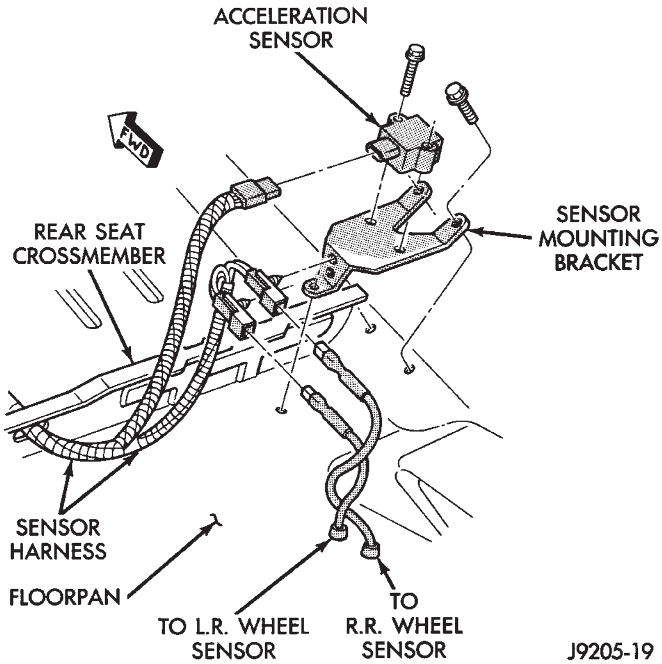


Fig. 8 Acceleration Switch And Rear Sensor Connections

(4) Raise vehicle.

(5) Disconnect sensor wires at rear axle connectors.

(6) Remove wheel and tire assembly.

(7) Remove brake drum.

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

(9) Unseat sensor wire support plate grommet.

(10) Remove bolt attaching sensor to bracket and remove sensor (Fig. 9).

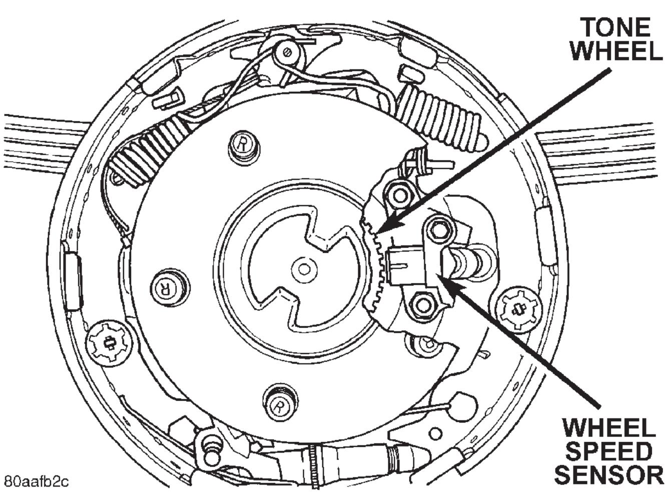


Fig. 9 Rear Wheel Speed Sensor

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 0.92-1.275 mm (0.036-0.05 in.). Use feeler gauge to measure air gap (Fig. 10). Tighten sensor bolt to 13 N·m (115 in. lbs.).

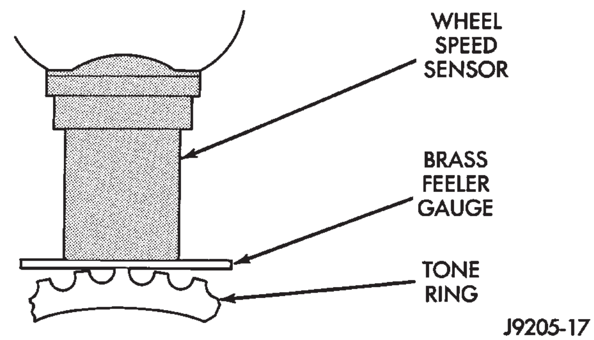


Fig. 10 Setting Air Gap On Original Rear Sensor

(6) If **new** sensor was installed, push cardboard spacer on sensor face against tone ring (Fig. 11). Then tighten sensor bolt to 13 N·m (115 in. lbs.). Correct air gap will be established as tone ring rotates and peels spacer off sensor face.

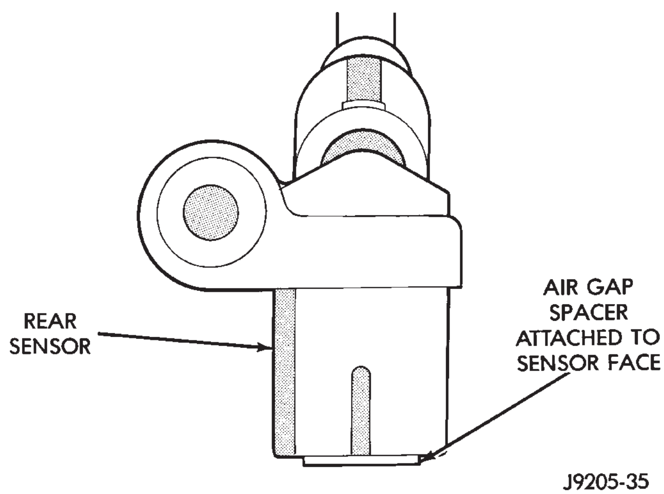


Fig. 11 New Rear Sensor

(7) Route sensor wires to rear seat area.

(8) Feed sensor wires through floorpan access hole and seat sensor grommets in floorpan.

(9) Verify that rear sensor wires are secured to rear brake hose and axle with clips. Verify that wire is clear of rotating components.

REMOVAL AND INSTALLATION (Continued)

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

(11) Lower vehicle.

(12) Connect sensor wire to harness connector. Then reposition carpet and fold rear seat down.

ACCELERATION SWITCH

REMOVAL

(1) Raise and fold rear seat assembly forward for access to sensor.

(2) Disconnect switch harness.

(3) Remove switch mounting screws (Fig. 12)

(4) Remove the acceleration switch.

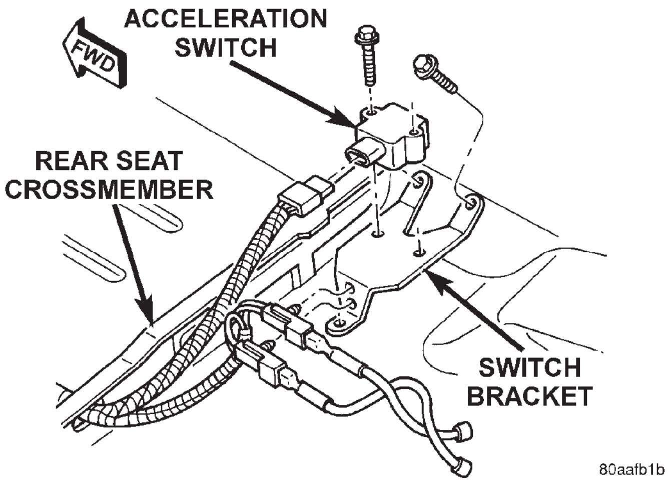


Fig. 12 Acceleration Switch Mounting

INSTALLATION

CAUTION: The mercury switch (inside the acceleration switch), will not function properly if the switch is installed incorrectly. Verify that the switch locating arrow is pointing to the front of the vehicle (Fig. 13).

(1) Position switch in mounting bracket.

(2) Install switch mounting bolts and tighten to 3 N·m (27.5 in. lbs.).

(3) Connect harness to switch. Be sure harness connector is firmly seated.

(4) Move seat back to normal position.

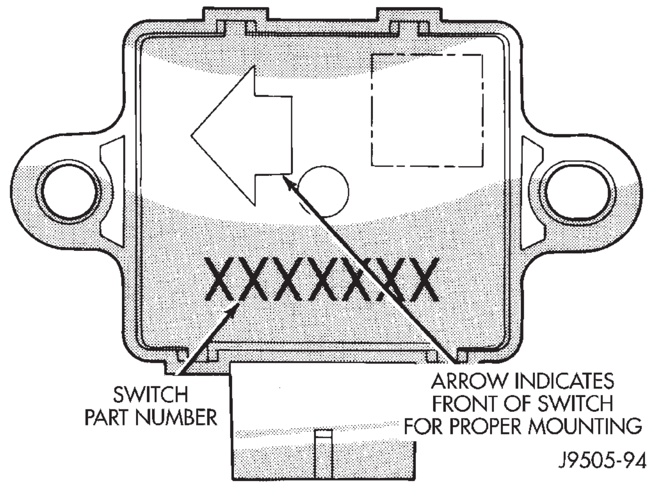


Fig. 13 Acceleration Switch

DISASSEMBLY AND ASSEMBLY

HYDRAULIC CONTROL UNIT/CONTROLLER ANTILOCK BRAKE

DISASSEMBLY

(1) Remove pump motor connector from the CAB.

(2) Remove CAB mounting screws from the HCU (Fig. 14).

(3) Remove CAB from the HCU.

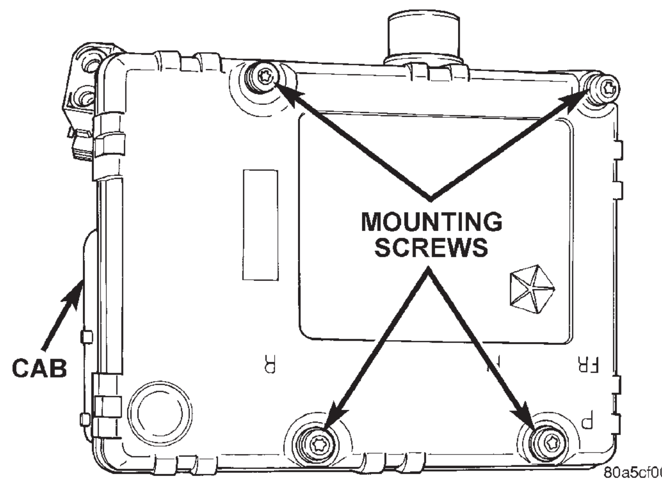


Fig. 14 CAB Mounting Screws

ASSEMBLY

(1) Install the CAB onto the HCU.

(2) Install the CAB mounting screws and tighten to 1.8 N·m (16 in. lbs.).

(3) Install pump motor connector to the CAB.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Acceleration Sensor	
Sensor Bolt	3 N·m (27.5 in. lbs.)
Bracket Bolt	2.7 N·m (24 in. lbs.)
Hydraulic Control Unit/Controller Antilock Brakes	
Mounting Nuts	11.5 N·m (102 in. lbs.)
Brake Lines	19 N·m (170 in. lbs.)
Controller Antilock Brakes	
Mounting Screws	1.8 N·m (16 in. lbs.)
Wheel Speed Sensors	
Front Mounting Bolt	4.7 N·m (42 in. lbs.)
Rear Mounting Bolt	13 N·m (115 in. lbs.)

CLUTCH

CONTENTS

GENERAL INFORMATION

CLUTCH COMPONENTS

The clutch mechanism 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 in the crankshaft flange supports the transmission input shaft. A sleeve type release bearing is used to engage and disengage the clutch cover pressure plate.

The release bearing is operated by a release fork in the clutch housing. The fork pivots on a ball stud mounted in the housing. The release fork is actuated by a hydraulic slave cylinder mounted in the housing. The slave cylinder is operated by a clutch master cylinder mounted on the dash panel. The cylinder push rod is connected to the clutch pedal.

The clutch disc has cushion springs in the disc hub. The clutch disc facing is riveted to the hub. The facing is made from a non-asbestos material. The clutch cover pressure plate is a diaphragm type with a one-piece spring and multiple release fingers. The pressure plate release fingers are preset during manufacture and are not adjustable.

HYDRAULIC LINKAGE COMPONENTS

The hydraulic linkage consists of a clutch master cylinder with integral reservoir, a clutch slave cylinder and an interconnecting fluid line.

The clutch master cylinder push rod is connected to the clutch pedal. The slave cylinder push rod is connected to the clutch release fork. The master cylinder is mounted on the driver side of the dash panel adjacent to the brake master cylinder and booster assembly. This positioning is similar for both left and right hand drive models.

GENERAL INFORMATION (Continued)

SAFETY PRECAUTIONS

WARNING: EXERCISE CARE WHEN SERVICING CLUTCH COMPONENTS. FACTORY INSTALLED CLUTCH DISCS DO NOT CONTAIN ASBESTOS FIBERS. DUST AND DIRT ON CLUTCH PARTS MAY CONTAIN ASBESTOS FIBERS FROM AFTERMARKET COMPONENTS. BREATHING EXCESSIVE CONCENTRATIONS OF THESE FIBERS CAN CAUSE SERIOUS BODILY HARM. WEAR A RESPIRATOR DURING SERVICE AND NEVER CLEAN CLUTCH COMPONENTS WITH COMPRESSED AIR OR WITH A DRY BRUSH. EITHER CLEAN THE COMPONENTS WITH A WATER DAMPENED RAGS OR USE A VACUUM CLEANER SPECIFICALLY DESIGNED FOR REMOVING ASBESTOS FIBERS AND DUST. DO NOT CREATE DUST BY SANDING A CLUTCH DISC. REPLACE THE DISC IF THE FRICTION MATERIAL IS DAMAGED OR CONTAMINATED. DISPOSE OF ALL DUST AND DIRT CONTAINING ASBESTOS FIBERS IN SEALED BAGS OR CONTAINERS. THIS WILL HELP MINIMIZE EXPOSURE TO YOURSELF AND TO OTHERS. FOLLOW ALL RECOMMENDED SAFETY PRACTICES PRESCRIBED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) AND THE ENVIRONMENTAL SAFETY AGENCY (EPA), FOR THE HANDLING AND DISPOSAL OF PRODUCTS CONTAINING ASBESTOS.

CLUTCH HYDRAULIC FLUID

If inspection or diagnosis indicates additional fluid may be needed, it will be necessary to replace the complete hydraulic linkage assembly.

CLUTCH LUBRICATION

Proper clutch component lubrication is important to satisfactory operation. Using the correct lubricant and avoiding over lubrication are also equally important.

During service, apply recommended lubricant sparingly. Do not overlubricate as this could result in clutch disc and pressure plate contamination.

Clutch and transmission components requiring lubrication are:

- pilot bearing.
- release lever pivot ball stud.
- release lever pivot surfaces.
- release bearing bore.
- clutch pedal pivot bore and bushings.
- transmission input shaft splines and pilot hub.
- release bearing slide surface of front bearing retainer.
- master cylinder bushing at the clutch pedal.

Do not apply grease to any part of the clutch cover or disc.

Use Mopar® multi-mileage grease or a silicone grease for the clutch pedal bushings and pivot shaft.

Use Mopar® high temperature bearing grease or equivalent for the pilot bearing, release bearing bore, transmission input shaft and release fork components. Apply recommended amounts only and do not overlubricate.

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.

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. Only use recommended factory parts.

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.

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

DESCRIPTION AND OPERATION (Continued)

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

GENERAL INFORMATION

Problem diagnosis will generally require a road test to determine the type of fault. Component inspection will then determine the problem cause after road testing.

Drive the vehicle at normal speeds during the road test. Shift the transmission through all gear ranges and observe clutch action.

If chatter, grab, slip, or improper release is experienced, remove and inspect the clutch components. However, if the problem is noise or hard shifting, further diagnosis may be needed. The transmission or another driveline component may actually be at fault. Careful observation during the test will help narrow the problem area.

CLUTCH CONTAMINATION

Fluid contamination is a frequent cause of clutch malfunctions. Oil, grease, water, or other fluids on the clutch contact surfaces will cause faulty operation. The usual result is chatter, slip and grab.

During inspection, note if any components are contaminated. Look for evidence of oil, grease, clutch hydraulic fluid, or water/road splash on clutch components.

Oil contamination indicates a leak at either the rear main seal or transmission input shaft. Oil leaks produce a residue of oil on the housing interior and on the clutch cover and flywheel. Heat buildup caused by slippage between the clutch cover, disc, and flywheel can sometimes bake the oil residue onto the components. The glaze-like residue ranges in color from amber to black.

Road splash contamination means dirt/water is entering the clutch housing. This may be due to loose bolts, housing cracks, or through the slave cylinder opening. Driving through deep water puddles can force water/road splash into the housing through such openings.

Clutch fluid leaks are from loose or damaged clutch linkage fluid lines or connections. However, most clutch fluid leaks will usually be noted and corrected before severe contamination occurs.

Grease contamination is usually a product of excessive lubrication during clutch service. Apply only a small amount of grease to the input shaft splines, bearing retainer, pilot bearing, release fork and pivot stud. Excess grease can be thrown off during operation and contaminate the disc.

IMPROPER CLUTCH RELEASE OR ENGAGEMENT

Clutch release or engagement problems are caused by wear, or damage to one or more clutch components. A visual inspection of the release components will usually reveal the problem part.

Release problems can result in hard shifting and noise. Items to look for are: leaks at the clutch cylinders and interconnecting line; loose slave cylinder bolts; worn/loose release fork and pivot stud; damaged release bearing; and a worn clutch disc, or pressure plate.

Normal condensation in vehicles that are stored or out of service for long periods of time can generate enough corrosion to make the disc stick to the flywheel, or pressure plate. If this condition is experienced, correction only requires that the disc be loosened manually through the inspection plate opening.

Engagement problems usually result in slip, chatter/shudder, and noisy operation. The primary causes are clutch disc contamination; clutch disc wear; misalignment, or distortion; flywheel damage; or a combination of the foregoing. A visual inspection is required to determine the part actually causing the problem.

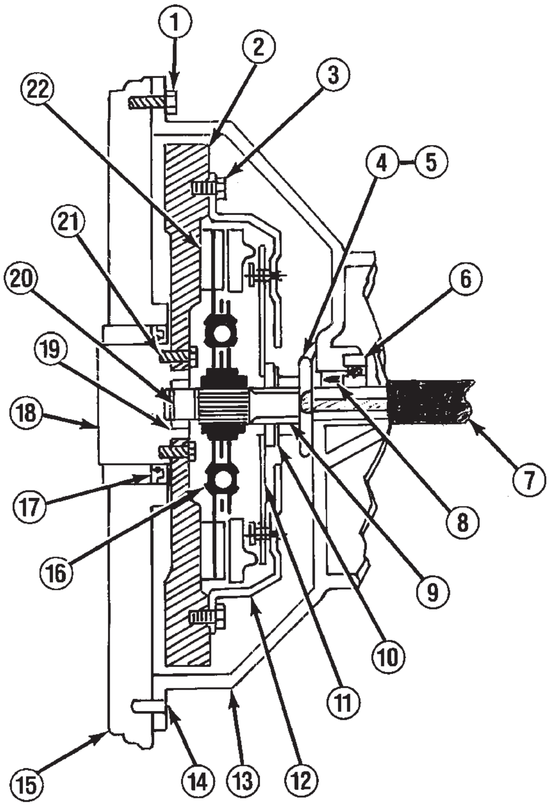
CLUTCH RUNOUT

CLUTCH DISC

Check the clutch disc before installation. Axial (face) runout of a new disc should not exceed 0.5 mm (0.020 in.). Measure runout about 6 mm (1/4 in.) from the outer edge of the disc facing. Obtain another disc if runout is excessive.

DIAGNOSIS AND TESTING (Continued)

Clutch Components



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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DIAGNOSIS AND TESTING (Continued)

CLUTCH COVER

Check condition of the clutch cover before installation. A warped cover or diaphragm spring will cause grab and incomplete release or engagement. Be careful when handling the cover and disc. Impact can distort the cover, diaphragm spring, release fingers and the hub of the clutch disc.

Use an alignment tool when positioning the disc on the flywheel. The tool prevents accidental misalignment which could result in cover distortion and disc damage.

A frequent cause of clutch cover distortion is improper bolt tightening. To avoid warping the cover, the bolts must be tightened in a diagonal pattern and only 2–3 threads at a time to the specified torque.

FLYWHEEL

Flywheel runout should not exceed 0.08 mm (0.003 in.). Measure runout at the outer edge of the flywheel face with a dial indicator. Mount the indicator on a stud installed in place of one of the clutch housing bolts.

Common causes of runout are:

- heat warpage.
- improper machining.
- incorrect bolt tightening.
- improper seating on crankshaft flange shoulder.
- foreign material on crankshaft flange.

Flywheel machining is not recommended. The flywheel clutch surface is machined to a unique contour and machining will negate this feature. However, minor flywheel scoring can be cleaned up by hand with 180 grit emery, or with surface grinding equipment. Remove only enough material to reduce scoring (approximately 0.001 - 0.003 in.). Heavy stock removal is **not recommended.** Replace the flywheel if scoring is severe and deeper than 0.076 mm (0.003 in.). Excessive stock removal can result in flywheel cracking or warpage after installation; it can also weaken the flywheel and interfere with proper clutch release.

Clean the crankshaft flange before mounting the flywheel. Dirt and grease on the flange surface may cock the flywheel causing excessive runout. Use new bolts when remounting a flywheel and secure the bolts with Mopar® Lock And Seal. Tighten flywheel bolts to specified torque only. Overtightening can distort the flywheel hub causing runout.

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. Tighten all the clutch housing bolts to proper torque before installing any struts. Also be sure alignment dowels are in place and seated in the block and housing before bolt tightening. Infrequently, misalignment may also be caused by housing mounting surfaces that are not completely parallel. Misalignment can be corrected with shims.

DIAGNOSTIC CHARTS

The diagnosis charts describe common clutch problems, causes and correction. Fault conditions are listed at the top of each chart. Conditions, causes and corrective action are outlined in the indicated columns.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
Disc facing worn out	1. Normal wear. 2. Driver frequently rides (slips) the clutch. Results in rapid overheating and wear. 3. Insufficient clutch cover diaphragm spring tension.	1. Replace cover and disc. 2. Replace cover and disc. 3. Replace cover and disc.
Clutch disc facing contaminated with oil, grease, or clutch fluid.	1. Leak at rear main engine seal or transmission input shaft seal. 2. Excessive amount of grease applied to the input shaft splines. 3. Road splash, water entering housing. 4. Slave cylinder leaking.	1. Replace appropriate seal. 2. Remove grease and apply the correct amount of grease. 3. Replace clutch disc. Clean clutch cover and reuse if in good condition. 4. Replace hydraulic clutch linkage.
Clutch is running partially disengaged.	1. Release bearing sticking or binding and does not return to the normal running position.	1. Verify failure. Replace the release bearing and transmission front bearing retainer as necessary.
Flywheel below minimum thickness specification.	1. Improper flywheel machining. Flywheel has excessive taper or excessive material removal.	1. Replace flywheel.
Clutch disc, cover and/or diaphragm spring warped or distorted.	1. Rough handling. Impact bent cover, spring, or disc. 2. Improper bolt tightening procedure.	1. Replace disc or cover as necessary. 2. Tighten clutch cover using proper procedure.
Facing on flywheel side of disc torn, gouged, or worn.	1. Flywheel surface scored or nicked. 2. Clutch disc sticking or binding on transmission input shaft.	2. Correct surface condition if possible. Replace flywheel and disc as necessary. 2. Inspect components and correct/replace as necessary.
Clutch disc facing burnt. Flywheel and cover pressure plate surfaces heavily glazed.	1. Frequent operation under high loads or hard acceleration conditions. 2. Driver frequently rides (slips) clutch. Results in rapid wear and overheating of disc and cover.	1. Correct condition of flywheel and pressure plate surface. Replace clutch cover and disc. Alert driver to problem cause. 2. Correct condition of flywheel and pressure plate surface. Replace clutch cover and disc. Alert driver to problem cause.
Clutch disc binds on input shaft splines.	1. Clutch disc hub splines damaged during installation. 2. Input shaft splines rough, damaged, or corroded.	1. Clean, smooth, and lubricate hub splines if possible. Replace disc if necessary. 2. Clean, smooth, and lubricate shaft splines if possible. Replace input shaft if necessary.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
Clutch disc rusted to flywheel and/or pressure plate.	1. Clutch not used for and extended period of time (e.g. long term vehicle storage).	1. Sand rusted surfaces with 180 grit sanding paper. Replace clutch cover and flywheel if necessary.
Pilot bearing seized, loose, or rollers are worn.	1. Bearing cocked during installation.	1. Install and lubricate a new bearing.
	2. Bearing defective.	2. Install and lubricate a new bearing.
	3. Bearing not lubricated.	3. Install and lubricate a new bearing.
	4. Clutch misalignment.	4. Inspect clutch and correct as necessary. Install and lubricate a new bearing.
Clutch will not disengage properly.	1. Low clutch fluid level.	1. Replace hydraulic linkage assembly.
	2. Clutch cover loose.	2. Follow proper bolt tightening procedure.
	3. Clutch disc bent or distorted.	3. Replace clutch disc.
	4. Clutch cover diaphragm spring bent or warped.	4. Replace clutch cover.
	5. Clutch disc installed backwards.	5. Remove and install clutch disc correctly.
	6. Release fork bent or fork pivot loose or damaged.	6. Replace fork or pivot as necessary.
	7. Clutch master or slave cylinder failure.	7. Replace hydraulic linkage assembly.
Clutch pedal squeak.	1. Pivot pin loose.	1. Tighten pivot pin if possible. Replace clutch pedal if necessary.
	2. Master cylinder bushing not lubricated.	2. Lubricate master cylinder bushing.
	3. Pedal bushings worn out or cracked.	3. Replace and lubricate bushings.

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

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. 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.**

Clutch fluid level is checked at the master cylinder reservoir (Fig. 1). An indicator ring is provided on the outside rim of the reservoir.

Be sure to wipe the reservoir and cover clean before removing the cover. This will avoid having dirt or foreign material fall into the reservoir during a fluid level check.

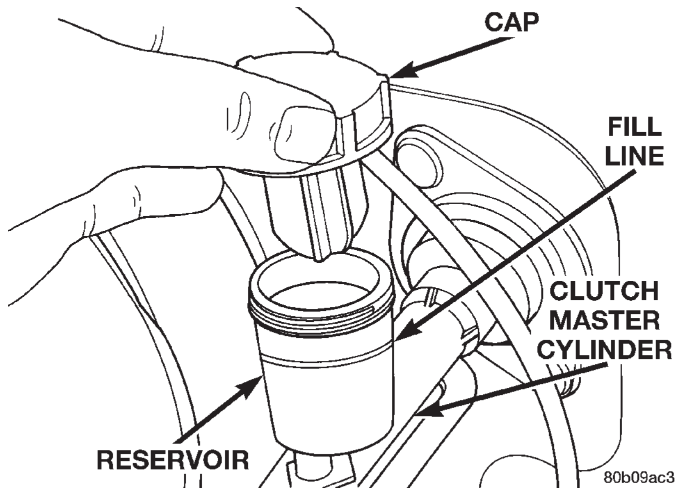


Fig. 1 Clutch Master Cylinder Reservoir And Cap

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 indicator on a stud installed in place of one of the clutch housing 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

SERVICE PROCEDURES (Continued)

- 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 resistent 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 resistent gloves and safety goggles are needed for personal safety. Also use metal tongs, vise grips, or similar tools to position the gear as necessary for installation.

(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. 2).

INSTALLATION

(1) Lightly scuff sand flywheel face with 180 grit emery cloth. Then clean surface with a wax and grease remover.

(2) Lubricate pilot bearing with Mopar high temperature bearing grease.

(3) Check runout and free operation of new clutch disc as follows:

(a) Slide disc onto transmission input shaft splines. Disc should slide freely on splines.

(b) Leave disc on shaft and check face runout with dial indicator. Check runout at disc hub and about 6 mm (1/4 in.) from outer edge of facing.

(c) Face runout should not exceed 0.5 mm (0.020 in.). Obtain another clutch disc if runout exceeds this limit.

(4) Position clutch disc on flywheel. Be sure side of disc marked flywheel side is positioned against flywheel (Fig. 2). If disc is not marked, be sure flat side of disc hub is toward flywheel.

(5) Inspect condition of pressure plate surface of clutch cover (Fig. 2). Replace cover if this surface is worn, heat checked, cracked, or scored.

(6) Insert clutch alignment tool in clutch disc (Fig. 3).

(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. 2). If disc is not marked, place flat side of disc against flywheel.

(8) Position clutch cover over disc and on flywheel (Fig. 3).

(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**

REMOVAL AND INSTALLATION (Continued)

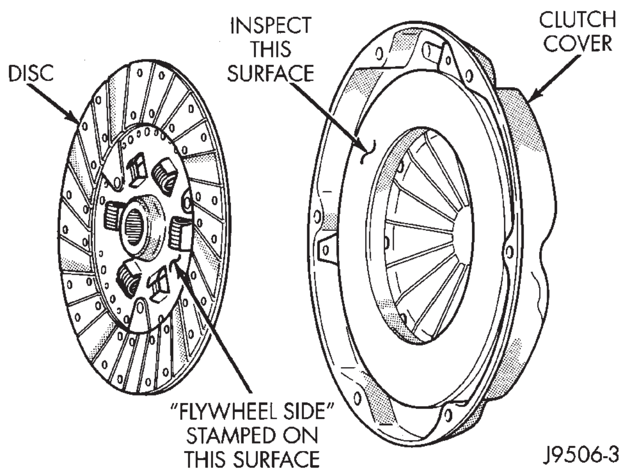


Fig. 2 Clutch Disc And Pressure Plate Inspection

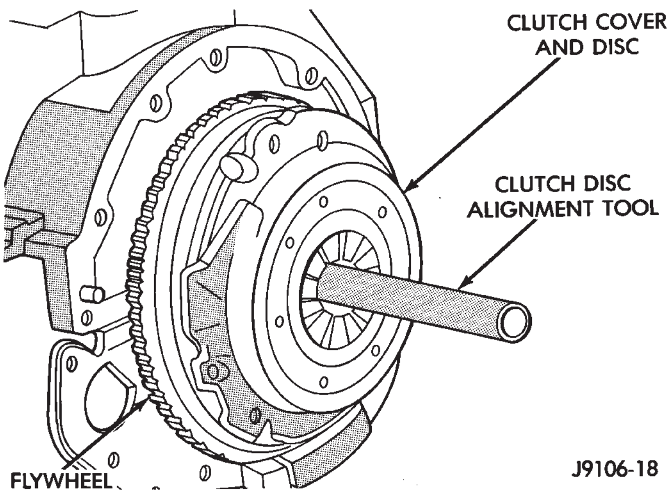


Fig. 3 Typical Method Of Aligning Clutch Disc

(23 ft. lbs.) on 2.5L engines and 52 N·m (38 ft. lbs.) on 4.0 L 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 clutch disc 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. 4).

(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.

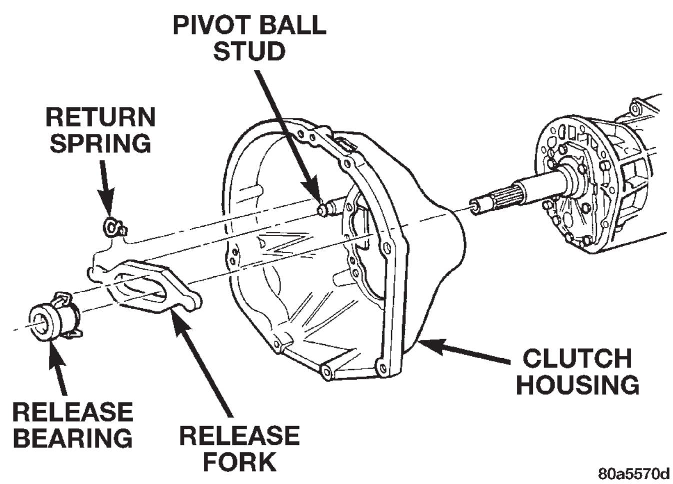


Fig. 4 Release Bearing Attachment

PILOT BEARING

REMOVAL

(1) Remove transmission. Refer to Group 21, Transmission and Transfer Case, for proper procedures.

(2) Remove clutch cover and disc.

(3) Use a suitable blind hole puller to remove pilot bearing.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Clean bearing bore with solvent and wipe dry with shop towel.

(2) Lubricate new pilot bearing with Mopar® high temperature grease.

(3) Position and start new bearing in bearing bore by hand. Note that pilot bearing has seal at one end. Install bearing so seal is facing outward toward transmission.

(4) Seat pilot bearing with clutch alignment tool (Fig. 5). Keep bearing straight during installation. Do not allow bearing to become cocked. Tap bearing into place until flush with edge of bearing bore. Do not recess bearing.

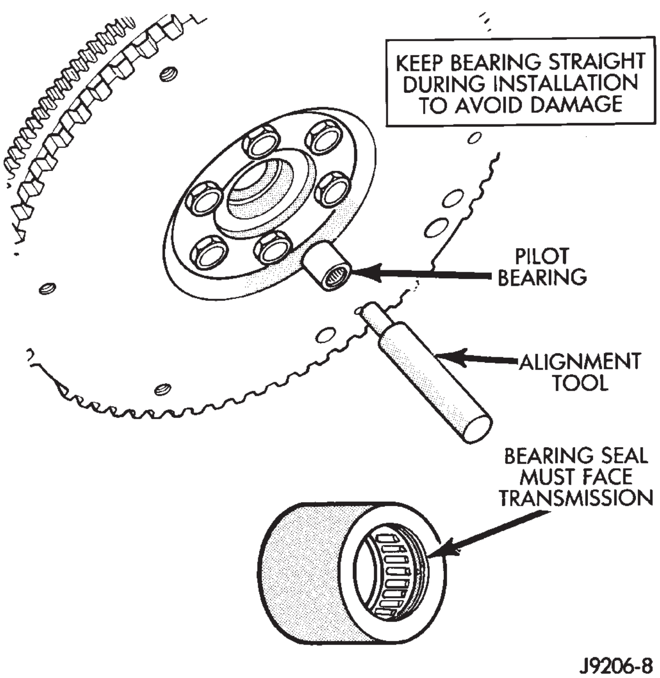


Fig. 5 Typical Method Of Installing Pilot Bearing

(5) Install transmission. Refer to Group 21, Transmission and Transfer Case, for proper procedures.

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. 6). 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.

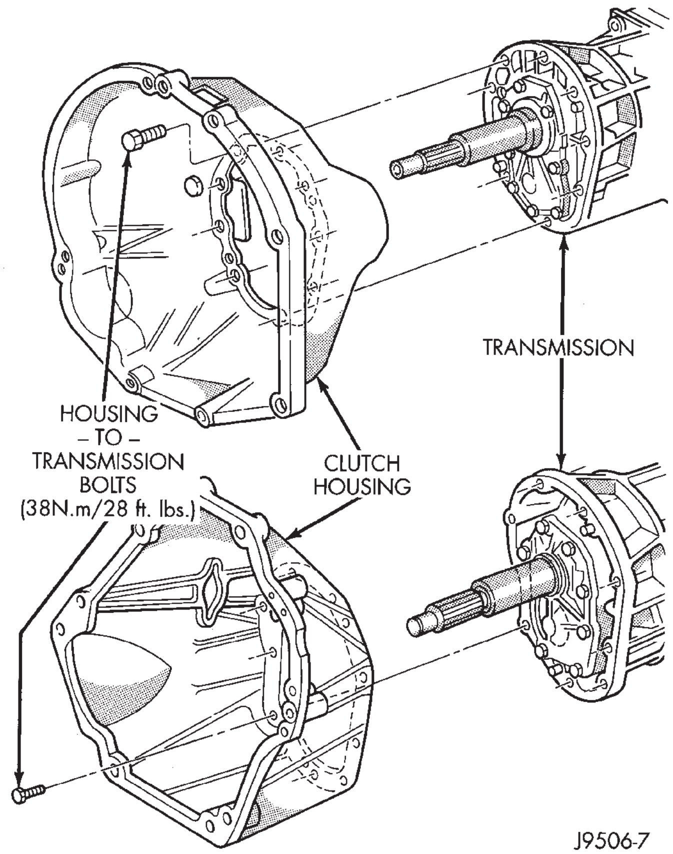


Fig. 6 Clutch Housing Attachment

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. 7).

(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. 7) or (Fig. 8).

(8) Disengage captured bushing on clutch master cylinder actuator from pivot pin on pedal arm.

(9) Slide actuator off pivot pin.

REMOVAL AND INSTALLATION (Continued)

(10) Disconnect clutch interlock safety switch wires.

(11) Remove clutch hydraulic linkage through engine compartment.

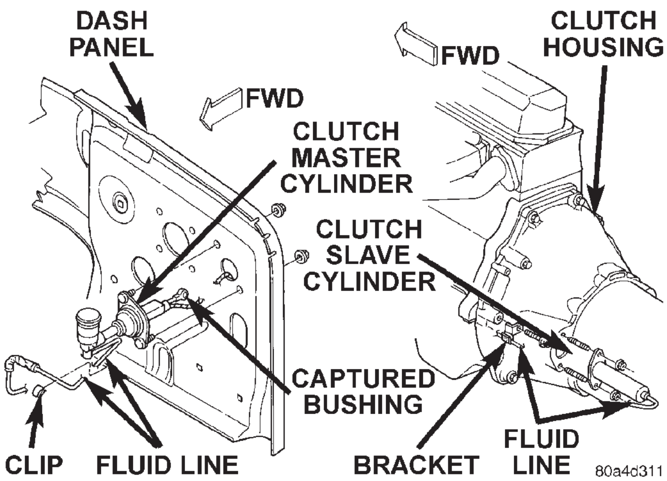


Fig. 7 Slave Cylinder and Left Hand Drive Clutch Master Cylinder

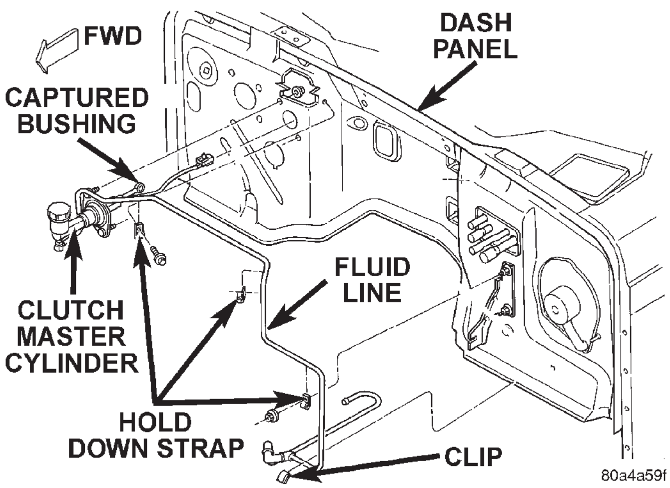


Fig. 8 Right Hand Drive Clutch Master Cylinder

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. 7) or (Fig. 8).

(3) Position clutch master cylinder on dash panel (Fig. 7) or (Fig. 8).

(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 and transmission clips.

(10) Lower vehicle.

(11) Connect clutch interlock safety switch wires.

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)
Bolt/Nut, clutch cyl. mount	23 N·m (200 in. 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
Bolt, starter motor	45 N·m (33 ft. lbs)
Bolts, U-joints	19 N·m (170 in. lbs.)

CLUTCH

CONTENTS

GENERAL INFORMATION

CLUTCH COMPONENTS

The clutch mechanism consists of a single, dry-type clutch disc and a diaphragm style clutch cover. A hydraulic linkage is used to operate the clutch disc and cover. The clutch components are very similar to those used in gas engine models.

A pilot bearing is used to support the transmission input shaft. The bearing is seated in a separate, removable housing bolted to the flywheel hub.

CLUTCH HYDRAULIC SYSTEM

The clutch hydraulic system should not require additional fluid under normal circumstances.

NOTE: The reservoir fluid level will actually increase as normal clutch wear occurs. For this reason, it is important to avoid over filling, or removing fluid from the reservoir.

If inspection indicates additional fluid is needed, add fluid from a sealed container only. Use Mopar® brake fluid, or an equivalent meeting standards SAE J1703 and DOT 3. Do not use any other type of fluid.

REMOVAL AND INSTALLATION

CLUTCH COVER AND DISC

REMOVAL

(1) Remove the transmission and transfer case, if equipped. Refer to Group 21, Transmission and Transfer Case for procedure.

(2) If the original clutch cover will be reinstalled, mark position of cover on flywheel for assembly reference. Use paint or scribe for this purpose.

(3) If the 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 in a star pattern to relieve spring tension equally. This is necessary to avoid warping the cover.

(4) Remove the clutch cover bolts and remove cover and disc (Fig. 1).

REMOVAL AND INSTALLATION (Continued)

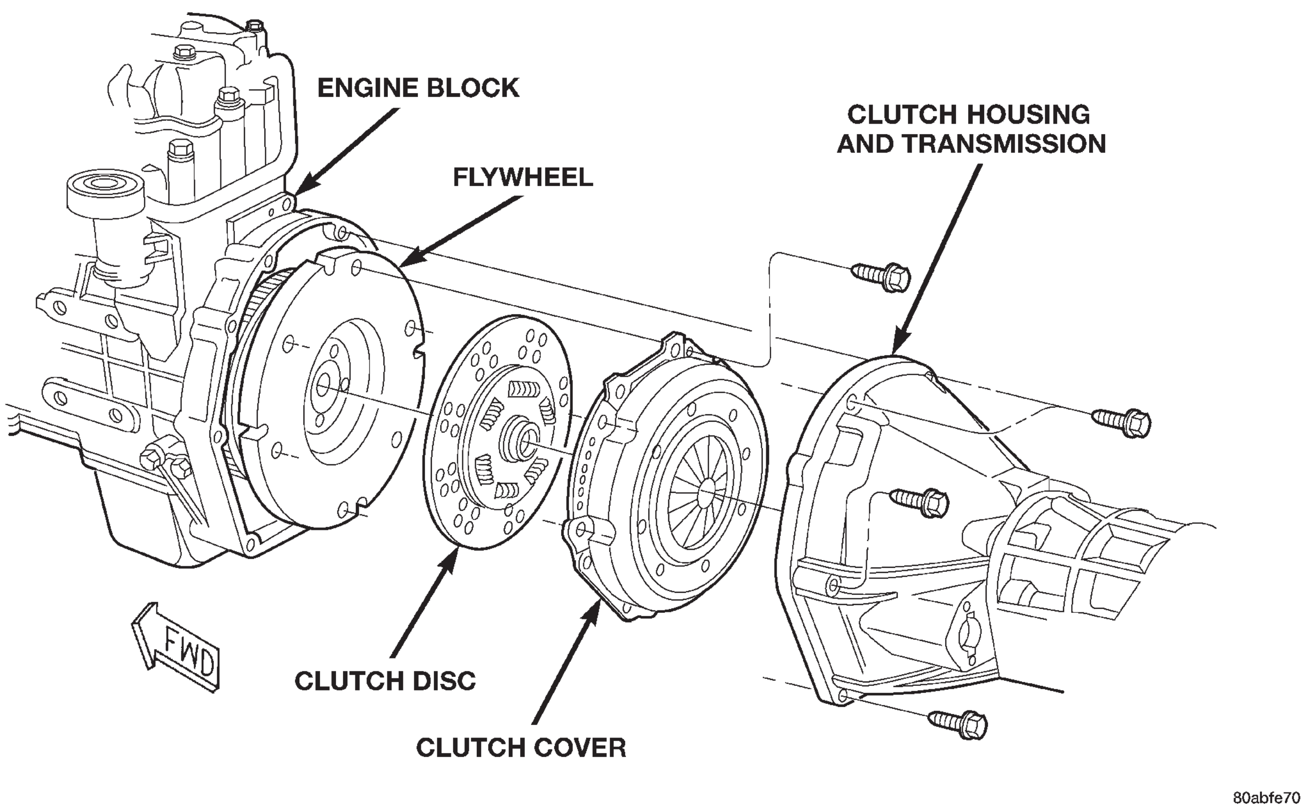


Fig. 1 Clutch Components (VM Diesel)

INSTALLATION

(1) Lightly scuff sand flywheel face with 180 grit emery cloth. Then clean surface with brake cleaner.

(2) Lightly lubricate the pilot bearing with Mopar® high temperature bearing grease.

(3) Check free operation of clutch disc by sliding disc onto transmission output shaft splines. Disc should slide onto splines freely without binding.

(4) Position the clutch disc on flywheel. Be sure side of disc marked “flywheel side” is positioned against flywheel (Fig. 2). If disc is not marked, be sure flat side of disc hub is placed toward the flywheel.

(5) Insert the clutch alignment tool (Fig. 3) in clutch disc and pilot bearing.

(6) Position the clutch cover over disc and on flywheel.

(7) Install the clutch cover bolts finger tight.

(8) Starting with the bolts marked “P” on the cover first, tighten clutch cover bolts in a star pattern to 50 N·m torque.

(9) Apply light coat of Mopar® high temperature bearing grease to pilot bearing and splines of transmission input shaft.

CAUTION: Do not over-lubricate as this will result in grease contamination of the disc.

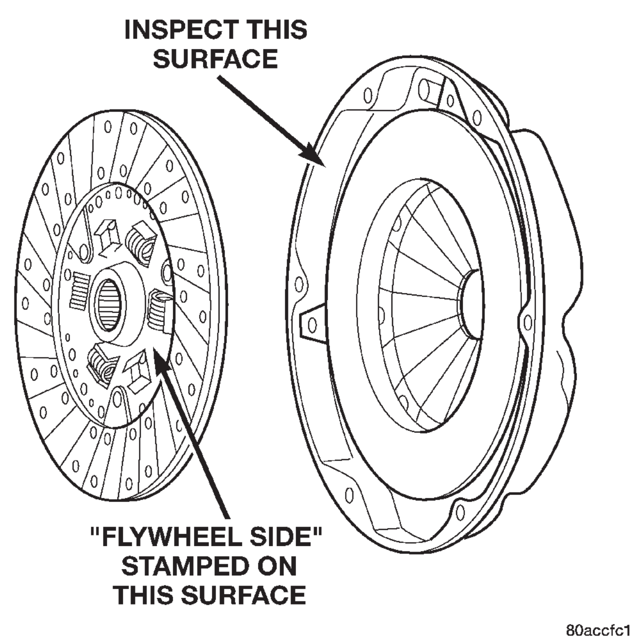


Fig. 2 Clutch Disc Position

(10) Install the transmission and transfer case. Refer to Group 21, Transmission and Transfer Case for procedure.

REMOVAL AND INSTALLATION (Continued)

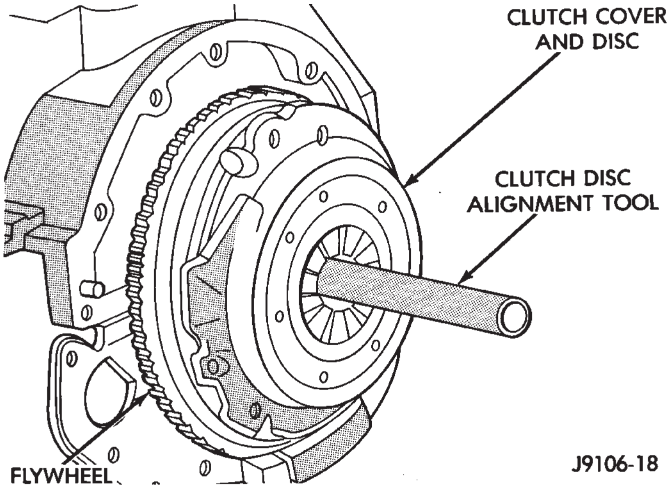


Fig. 3 Clutch Disc Alignment—Typical

PILOT BEARING

REMOVAL

(1) Remove the transmission and transfer case. Refer to Group 21, Transmission and Transfer Casefor procedures.

(2) Remove the clutch cover and disc. Refer to clutch cover and disc removal and installation in this group.

(3) Remove the four bolts that attach the pilot bearing retainer to the flywheel (Fig. 4).

(4) Remove the pilot bearing retainer.

(5) Support the bearing retainer on two wood blocks.

(6) Remove the pilot bearing with a suitable sized socket and extension (Fig. 5). Use mallet to tap bearing out of retainer.

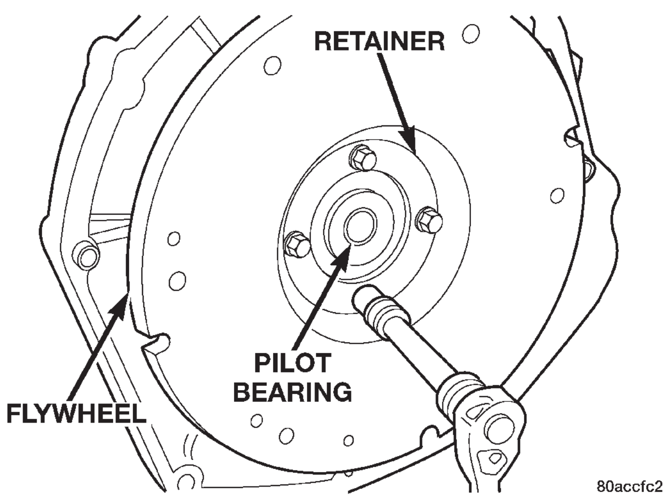


Fig. 4 Pilot Bearing Retainer Bolt Removal/ Installation

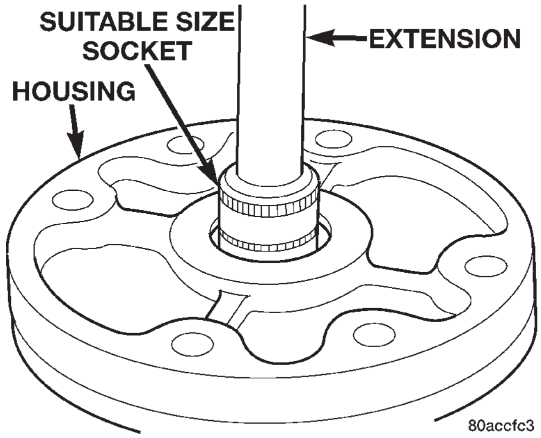


Fig. 5 Pilot Bearing Removal

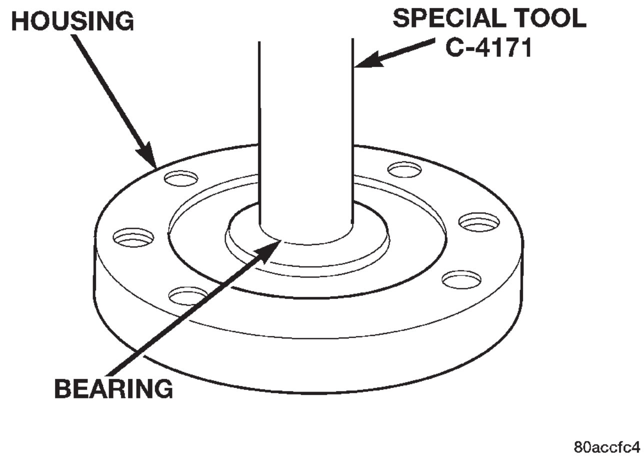


Fig. 6 Pilot Bearing Installation

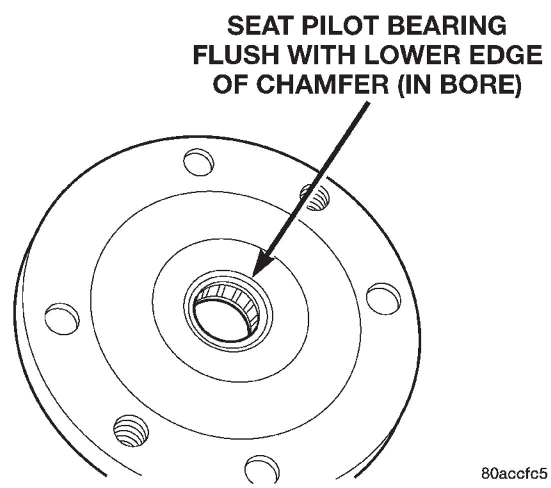


Fig. 7 Pilot Bearing Seated In Retainer

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

CAUTION: The bearing can be installed incorrectly if care is not exercised. Check bearing position before installing it Make sure the bearing seal and the letters on the bearing will both be facing out (toward the clutch) after installation.

(1) Install the new pilot bearing with hammer and tool handle C-4171. (Fig. 6). Seat the bearing flush with lower edge of chamfer in retainer bore (Fig. 7). Reposition the bearing if necessary.

(2) Install the bearing retainer. Torque bolts to 28 N·m (20 ft. lbs.)

(3) Lubricate the pilot bearing with Mopar® high temperature wheel bearing grease.

(4) Lightly scuff sand the flywheel surface with 180 grit emery cloth. Clean the surface with Mopar® brake or carburetor cleaner.

(5) Install the clutch disc and cover. Refer to clutch cover and disc removal and installation in this group.

(6) Install the transmission and transfer case. Refer to Group 21, Transmission and Transfer Case for procedures.

FLYWHEEL

REMOVAL

(1) Remove the transmission and clutch housing. Refer to Group 21, Transmission and Transfer Case for procedure.

(2) Remove the clutch cover and disc as described in this section.

(3) Remove the bolts that attach pilot bearing retainer to flywheel.

(4) Remove the pilot bearing and retainer.

(5) Remove the flywheel bolts.

(6) Grasp the flywheel firmly and work it off the crankshaft flange.

(7) Remove the o-ring from the crankshaft flange, or the mounting shoulder of the flywheel (Fig. 9).

(8) Clean the flywheel in solvent.

INSPECTION

Examine the flywheel mounting surfaces, clutch contact surface, and ring gear. Check condition of flywheel hub and attaching bolts. Replace flywheel if hub exhibits cracks in the area of attaching bolt holes. Replace ring gear if the teeth are damaged. Resurface the flywheel if the clutch contact surface is scored or rough (refer to flywheel finishing and ring gear replacement information in this section.

Check flywheel runout if misalignment is suspected. Runout should not exceed 0.08 mm. Measure flywheel face runout with a dial indicator (Fig. 8). Mount the indicator on a stud installed in the engine block or in one of the flywheel attaching bolt holes. Face runout can be corrected by resurfacing if necessary. Surface grinding equipment is recommended for this purpose. Stock removal should not exceed 0.25 mm.

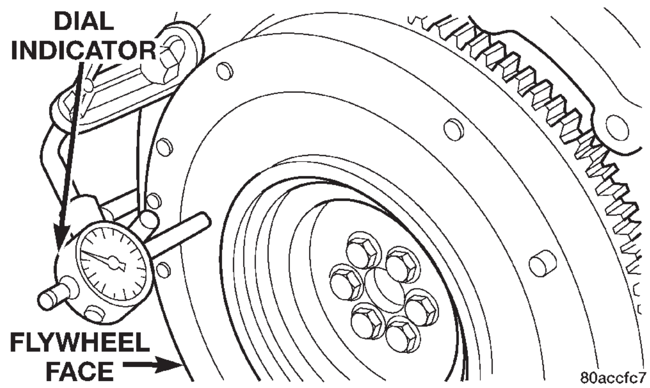


Fig. 8 Checking Flywheel Runout

INSTALLATION

CAUTION: Use NEW flywheel bolts for the following procedure.

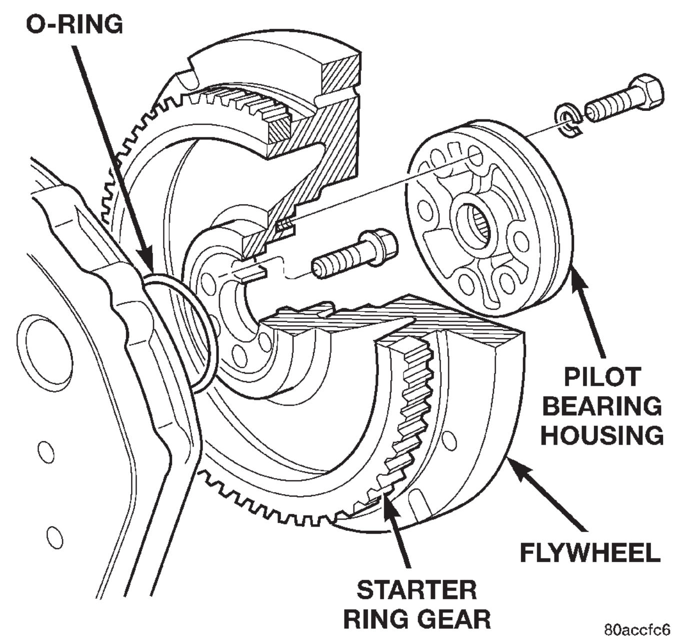


Fig. 9 Flywheel Mounting (VM Diesel)

(1) Clean the crankshaft flange before mounting the flywheel. Dirt or grease on flange surface may cock flywheel causing run-out.

(2) Install new o-ring in the flywheel mounting flange (Fig. 9). Use grease to hold the ring in place.

(3) Install the flywheel on the crankshaft and align the bolt holes.

(4) Install and tighten the new flywheel bolts as follows:

REMOVAL AND INSTALLATION (Continued)

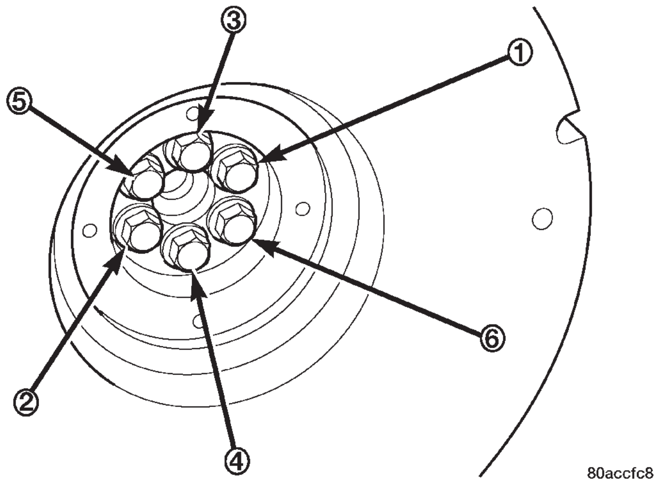


Fig. 10 Cross Tightening Method

(a) Lubricate and install the 6 new flywheel bolts.

(b) Torque the 6 flywheel bolts to 49 N·m (36 ft. lbs.) starting with one bolt and following with the opposite one (cross tightening) until completion, in a clockwise direction (Fig. 10).

(c) Loosen one bolt at a time and tighten to 19.6 N·m (14 ft. lbs.) plus 75° using the cross tightening method until completion.

(5) Install the clutch cover and disc. Refer to clutch cover and disc removal and installation procedure in this section.

(6) Install the transmission and transfer case. Refer to Group 21, Transmission and Transfer Case for removal and installation procedure.

FLYWHEEL RING GEAR

REMOVAL

(1) Remove the transmission and transfer case. Refer to Group 21, Transmission and Transfer Case for removal and installation procedures.

(2) Remove the clutch cover and disc. Refer to clutch cover and disc removal and installation in this group.

(3) Remove the flywheel. Refer to flywheel removal and installation in this group.

(4) Mark position of the old gear for alignment reference. Use a carbide tipped scribe to mark gear location on flywheel.

(5) Wear protective goggles or approved safety glasses.

(6) Remove the old gear by cutting most of the way through it at one point. Use an abrasive cut off wheel for this purpose. Break the ring gear at cut with a hammer and a cold chisel or punch

(7) Ring gear is shrink fit on flywheel. This means the gear must be expanded by heating in order to install it.

NOTE: The method of heating and expanding the new ring 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 350°-375°.

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.

INSTALLATION

(1) Position and install the heated ring gear on the flywheel:

(a) Wear heat resistant gloves to handle the hot ring gear.

(b) Align the ring gear on the flywheel evenly.

(c) Use hammer and brass drift to tap ring gear onto the flywheel.

(d) Seat the ring gear on flywheel

(2) Allow the ring gear to cool down before installation on the engine. Place flywheel on work bench and let it cool in normal shop air.

(3) Install the flywheel and torque bolts. Refer to flywheel removal and installation in this group.

(4) Install the clutch cover and disc. Refer to clutch cover and disc removal and installation in this group.

(5) Install the transmission and transfer case. Refer to Group 21, Transmission and Transfer Case for removal and installation procedures.

CAUTION: Do not use water or compressed air to cool the flywheel. The rapid cooling produced by water or compressed air will distort or crack the new gear.

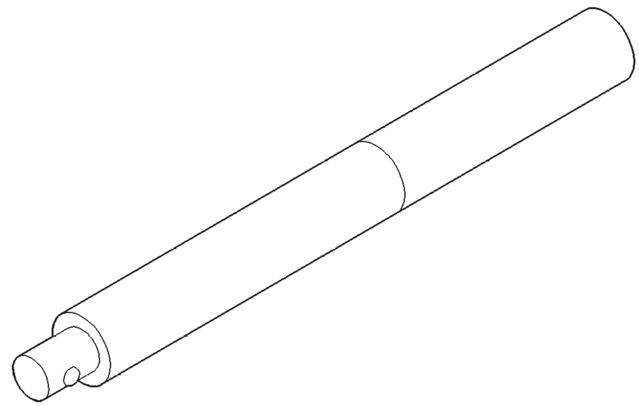
SPECIFICATIONS

SPECIFICATIONS

DESCRIPTION	TORQUE
Clutch Cover to Flywheel	
Bolts	50 N·m (37 ft. lbs.)
Clutch Housing to Transmission	
Bolts	47 N·m (34 ft. lbs.)
Flywheel to Crankshaft	
Bolts	See removal and installation procedure.
Pilot Bearing Retainer to Flywheel/Crankshaft	
Bolts	28 N·m (20 ft. lbs.)
Clutch Housing to Engine	
Top (2) Bolts	37 N·m (27 ft. lbs.)
Middle (2) Bolts	58 N·m (43 ft. lbs.)
Bottom (2) Bolts	75 N·m (55 ft. lbs.)

SPECIAL TOOLS

SPECIAL TOOLS



Universal Handle—C-4171

COOLING SYSTEM

CONTENTS

GENERAL INFORMATION

ACCESSORY DRIVE BELTS

CAUTION: When installing an accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to water pump rotating in wrong direction. Refer to the appropriate Belt Schematic in this group for the correct belt routing. Or, refer to the Belt Routing Label located in the engine compartment.

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. Vehicles equipped with a 2.5L/4.0L engine and heavy duty cooling and/or air conditioning also have an auxiliary electric cooling fan.

COOLING SYSTEM COMPONENTS

The cooling system consists of:

- A radiator
- Cooling fan (mechanical and/or electrical)
- Thermal viscous fan drive
- Fan shroud
- Radiator pressure cap
- Thermostat
- Coolant reserve/overflow system
- Transmission oil cooler (if equipped with an automatic transmission)
- Coolant
- Water pump
- Hoses and hose clamps

COOLING SYSTEM CIRCULATION

Cooling system circulation for 2.5L/4.0L models is shown in (Fig. 1).

WATER PUMP

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.

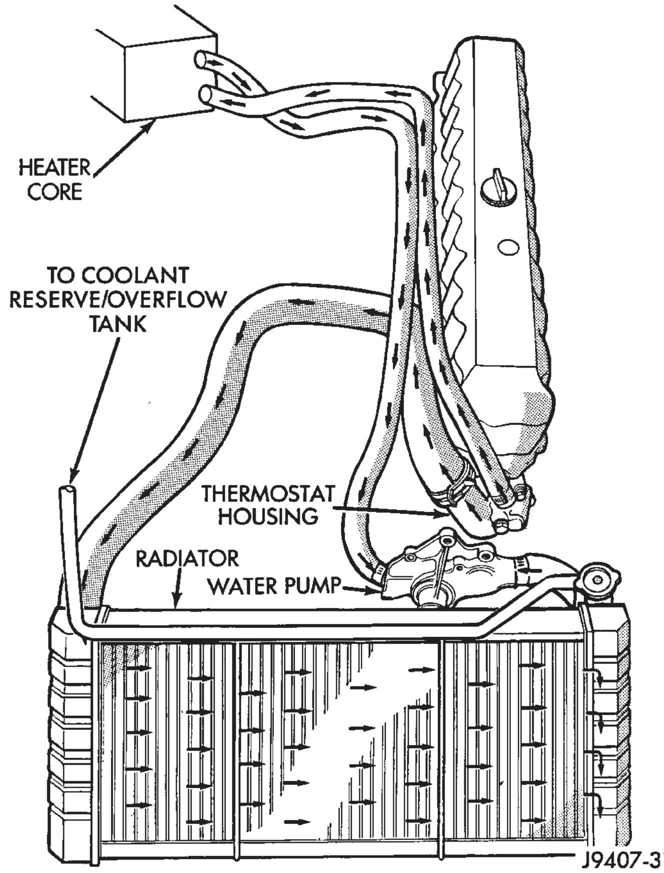


Fig. 1 Coolant Circulation—2.5L/4.0L Engines

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

Radiators for both engines are the cross flow type. Plastic tanks are used on all radiators.

CAUTION: Plastic tanks, while stronger than brass, are subject to damage by impact, such as wrenches.

If the plastic tank has been damaged, the plastic tank and/or o-rings are available for service repair. Tank replacement should be done by a qualified person with proper equipment.

ACCESSORY DRIVE BELT TENSION

Correct accessory drive belt tension is required to ensure optimum performance of belt driven engine

GENERAL INFORMATION (Continued)

accessories. If specified tension is not maintained, belt slippage may cause: engine overheating, lack of power steering assist, loss of air conditioning capacity, reduced generator output rate, greatly reduced belt life and objectionable under hood noise.

DOMESTIC LEFT HAND DRIVE VEHICLES

Belt tension is adjusted at the power steering pump bracket and idler pulley assembly.

DOMESTIC RIGHT HAND DRIVE VEHICLES

If equipped with a 4.0L 6-cylinder engine; the accessory drive belt is adjusted at the generator mounting bracket. When equipped with a 2.5L 4-cylinder engine, the accessory drive belt is adjusted at the power steering pump bracket and idler pulley assembly.

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.

DESCRIPTION AND OPERATION

AUTOMATIC 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.

AIR-TO-OIL COOLER

An auxiliary air-to-oil transmission oil cooler is available with most engine packages.

The auxiliary air-to-oil transmission oil cooler is located in front of the radiator or A/C condenser (if equipped) and behind the grill . It is mounted to the front frame crossmember.

The auxiliary oil coolers on all models operate in conjunction with the internal radiator mounted main oil cooler. The transmission oil is routed through the main cooler first, then the auxiliary cooler, before returning to the transmission.

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 reserve/overflow tank (Fig. 2) (Fig. 3), a tube (hose) connecting the radiator and tank, and an overflow tube on the side of the tank.

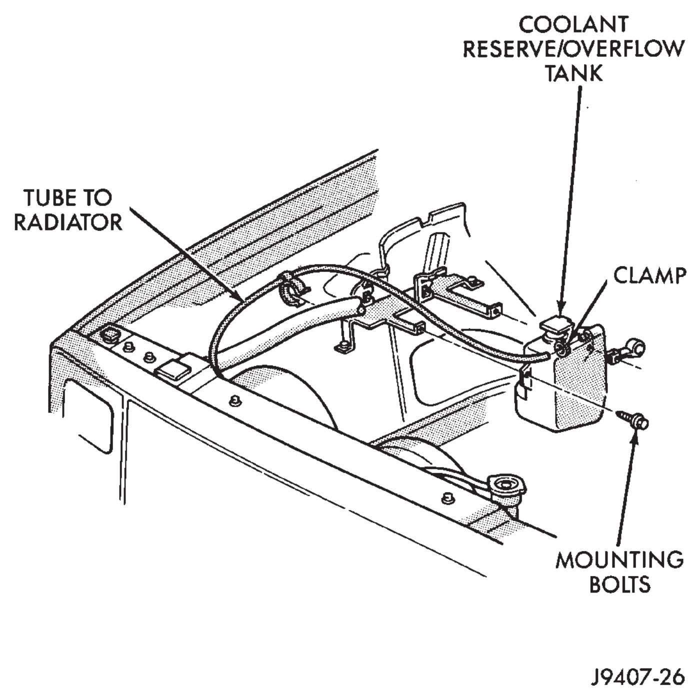


Fig. 2 Reserve/Overflow Tank—Except Right Hand Drive

DESCRIPTION AND OPERATION (Continued)

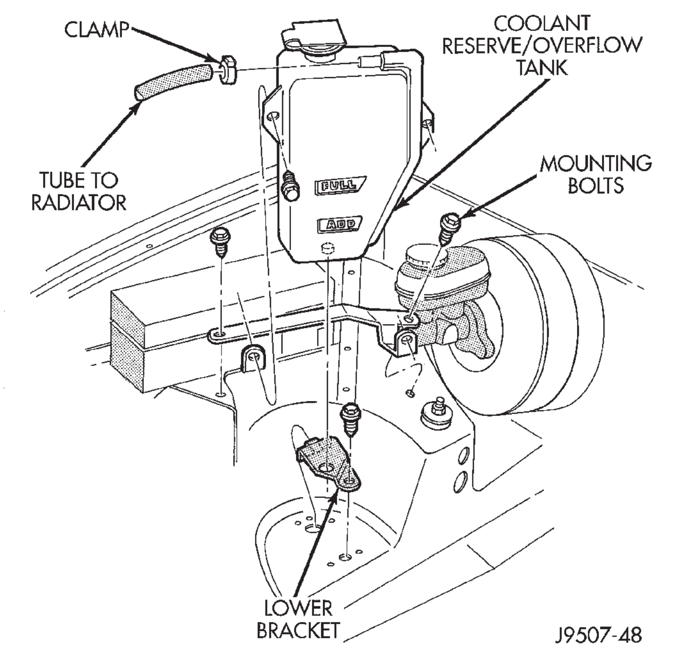


Fig. 3 Reserve/Overflow Tank—With Right Hand Drive

COOLING SYSTEM FANS

All models are equipped with a viscous fan. This thermal viscous fan drive is a torque-and-temperature-sensitive clutch unit. It automatically increases or decreases fan speed to provide proper engine cooling. Vehicles with a 2.5L/4.0L engine with air conditioning, or 4.0L with “max” cooling also have an auxiliary electrical cooling fan.

For individual descriptions or operation, refer to Viscous Fan Drive or Electric Cooling Fan in this group.

ACCESSORY DRIVE BELT TENSION

Both the 2.5L and 4.0L engines use one accessory 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 Poly–V or a conventional V-type belt. Refer to the instructions supplied with the gauge. Make sure to use a gauge designed specifically for serpentine style belts. 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.

For belt tension specifications, refer to Specifications-Accessory Drive Belt in this group.

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.

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

ETHYLENE-GLYCOL MIXTURES

The required ethylene-glycol (antifreeze) and water mixture depends upon the climate and vehicle operating conditions. The recommended mixture of 50/50 ethylene-glycol and water will provide protection against freezing to -37° C (-35° F). The antifreeze concentration **must always** be a minimum of 44 percent, year-round in all climates. **If percentage is lower than 44 percent, engine parts may be eroded by cavitation, and cooling system components may be severely damaged by corrosion.** Maximum protection against freezing is provided with a 68 percent antifreeze concentration, which

DESCRIPTION AND OPERATION (Continued)

prevents freezing down to -67.7° 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 the specific heat of antifreeze is lower than that of water.

100 Percent Ethylene-Glycol—Should Not Be Used in Chrysler Vehicles

Use of 100 percent ethylene-glycol will cause formation of additive deposits in the system, as the corrosion inhibitive additives in ethylene-glycol require the presence of water to dissolve. The deposits act as insulation, causing temperatures to rise to as high as 149° 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).

Propylene-glycol Formulations—Should Not Be Used in Chrysler Vehicles

Propylene-glycol formulations do not meet Chrysler coolant specifications. It's overall effective temperature range is smaller than that of ethylene-glycol. The freeze point of 50/50 propylene-glycol and water is -32° C (-26° F). 5° C higher than ethylene-glycol's freeze point. The boiling point (protection against summer boil-over) of propylene-glycol is 125° C (257° F) at 96.5 kPa (14 psi), compared to 128° C (263° F) for ethylene-glycol. Use of propylene-glycol can result in boil-over or freeze-up in Chrysler vehicles, which are designed for ethylene-glycol. Propylene glycol also has poorer heat transfer characteristics than ethylene glycol. This can increase cylinder head temperatures under certain conditions.

Propylene-glycol/Ethylene-glycol Mixtures—Should Not Be Used in Chrysler Vehicles

Propylene-glycol/ethylene-glycol Mixtures can cause the destabilization of various corrosion inhibitors, causing damage to the various cooling system components. Also, once ethylene-glycol and propylene-glycol based coolants are mixed in the vehicle, conventional methods of determining freeze point will not be accurate. Both the refractive index and specific gravity differ between ethylene glycol and propylene glycol.

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

COOLANT SELECTION-ADDITIVES

Coolant should be maintained at the specified level with a mixture of ethylene glycol-based antifreeze and low mineral content water. Only use an antifreeze containing ALUGARD 340-2 ™.

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

RADIATOR PRESSURE CAP

All radiators are equipped with a pressure cap. This cap releases pressure at some point within a range of 83-110 kPa (12-16 psi). The pressure relief point (in pounds) is engraved on top of the cap (Fig. 4).

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 that opens when system pressure reaches release range of 83-110 kPa (12-16 psi).

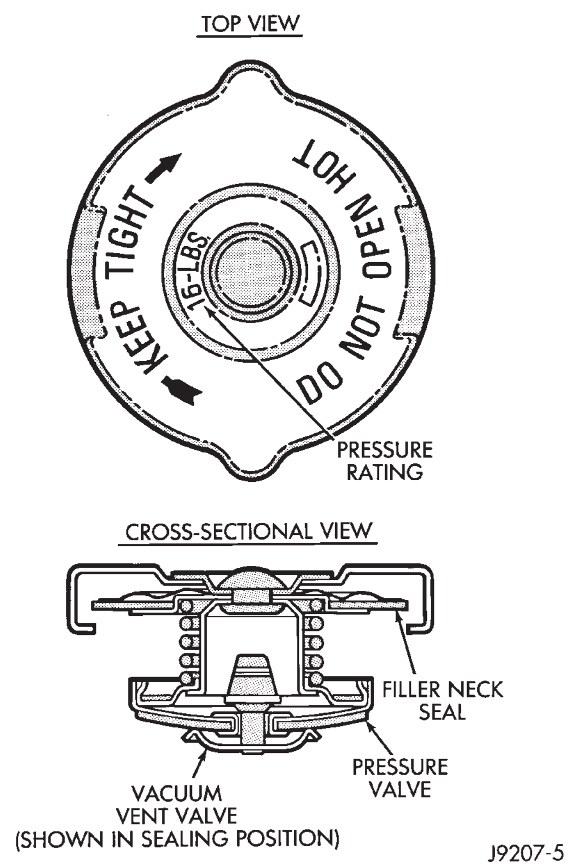


Fig. 4 Radiator Pressure Cap and Filler Neck—Typical

A vent valve in the center of cap allows a small coolant flow through cap when coolant is below boiling temperature. The valve is completely closed when boiling point is reached. As the coolant cools, it contracts and creates a vacuum in the cooling system. This causes the vacuum valve to open and coolant in

DESCRIPTION AND OPERATION (Continued)

the reserve/overflow tank to be drawn through its connecting hose into radiator. If the vacuum valve is stuck shut, the radiator hoses will collapse on cool-down.

A rubber gasket seals radiator filler neck. This is done to maintain vacuum during coolant cool-down and to prevent leakage when system is under pressure.

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.

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. 5).

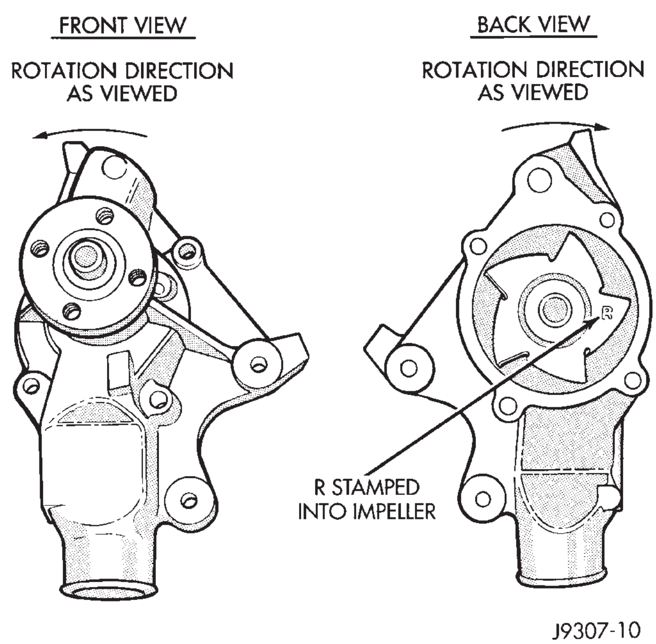


Fig. 5 Reverse Rotating Water Pump—Typical

Engines from previous model years, depending upon application, may have been equipped with a forward (clockwise) rotating water pump. Installation of the wrong water pump will cause engine overheating.

A quick test to determine if the pump is working is to check if the heater warms properly. A defective water pump will not be able to circulate heated coolant through the long heater hose to the heater core.

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. 6). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 7). If replacement is necessary, use only an original equipment clamp with matching number or letter.

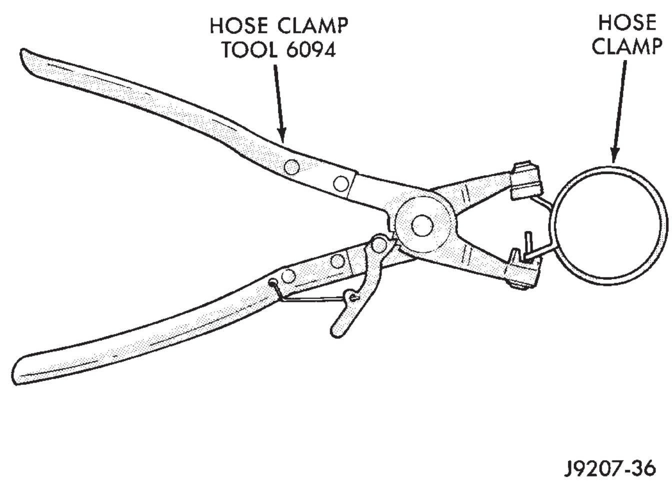


Fig. 6 Hose Clamp Tool—Typical

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.

DESCRIPTION AND OPERATION (Continued)

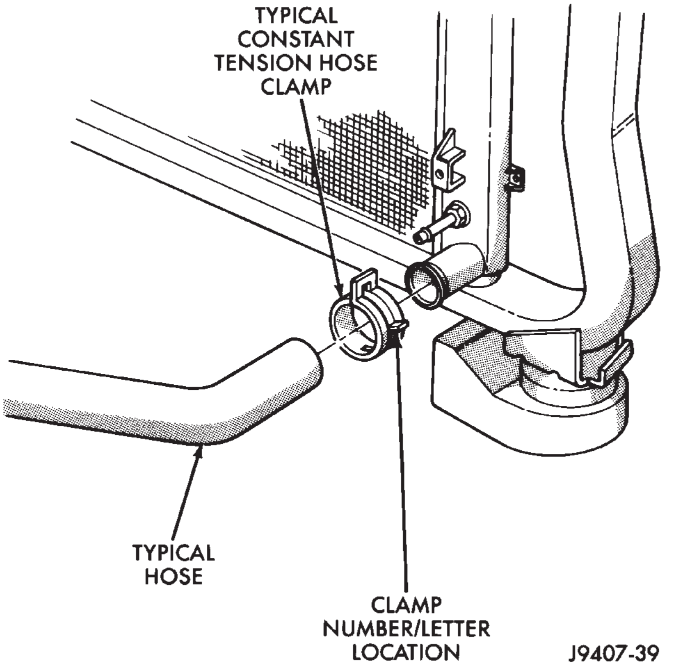


Fig. 7 Clamp Number/Letter Location

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.**

VISCOUS FAN DRIVE

NOTE: Also refer to Cooling System Fans.

The thermal viscous fan drive 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.

2.5L vehicles with A/C are equipped with a viscous fan drive which is designed to "free wheel" during most of the ambient conditions encountered by the vehicle and will only engage during high heat loads as seen in trailer towing or high ambient temperatures.

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. 8). This spring coil reacts to the temperature of the radiator discharge air. It engages the viscous fan drive for higher fan speed if the air temperature from the radiator rises above a certain point. Until additional engine cooling is necessary, the fan will remain at a reduced rpm regardless of engine speed.

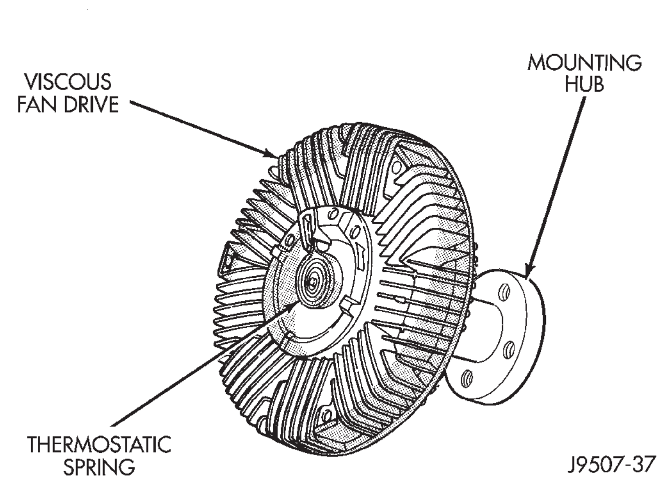


Fig. 8 Typical Viscous Fan Drive

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.

Vehicles equipped with 2.5L engines have what is know as an hybrid cooling fan system. This means that not only do they have a viscous fan but they also have an electric fan as well. The hybrid viscous fan drive has a low speed characteristic. This causes the mechanical fan speeds to be very low 200–400 rpm range when not engaged allowing the engine to have additional performance and horsepower gaines.

CAUTION: Engines equipped with poly–V 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.

DESCRIPTION AND OPERATION (Continued)

NOISE

It is normal for fan noise to be louder (roaring) when:

• The underhood temperature is above the engagement point for the viscous drive coupling. This may occur when ambient (outside air temperature) is very high.

• Engine loads and temperatures are high such as when towing a trailer.

• Cool silicone fluid within the fan drive unit is being redistributed back to its normal disengaged (warm) position. This can occur during the first 15 seconds to one minute after engine start-up on a cold engine.

ELECTRIC COOLING FAN

Vehicles equipped with a 2.5L/4.0L engine and air conditioning and 4.0L vehicles equipped with the "max" cooling package also have an electrical cooling fan. The fan is controlled by the cooling fan relay, which is located in the power distribution center (PDC) (Fig. 9). For the location of relay within the PDC , refer to the label on PDC cover.

The electric fan on the 2.5L equipped vehicles is considered the primary fan (low to moderate ambient conditions) and is energized when the JTEC recieves input from the coolant temperature sensor or the a/c system and supplies ground to the cooling fan relay.

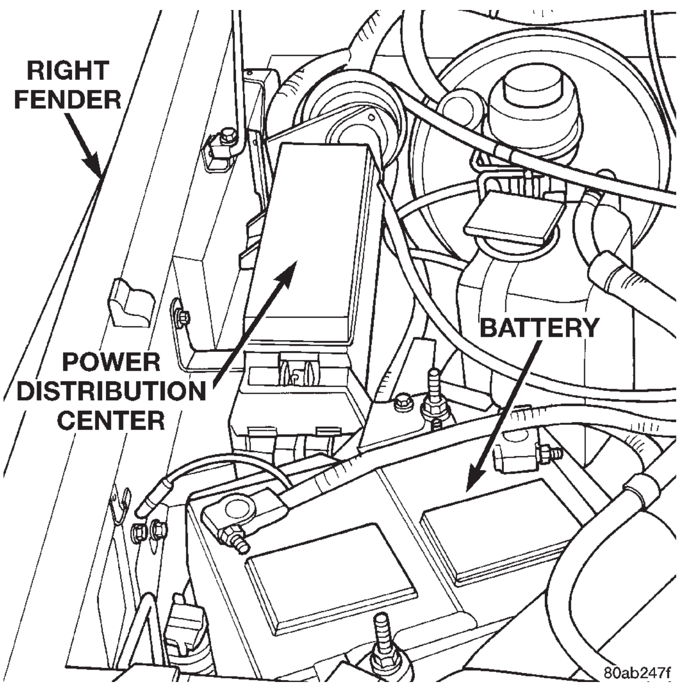


Fig. 9 Power Distribution Center (PDC)

When coolant temperature reaches approximately 103°C (218°F), or when air conditioning is requested, the powertrain control module (PCM) provides a ground path for the fan relay. This ground is provided to the cooling fan relay through pin C2 of PCM connector C3. Battery voltage is then applied to the fan through the relay. When coolant temperature drops below approximately 98°C (209°F), the PCM opens the ground path to the relay. This will prevent the cooling fan from being energized.

The cooling fan motor is protected by a 40 amp maxi-fuse located in the PDC. The fan relay is protected by a 15 amp fuse located in the junction block.

DIAGNOSIS AND TESTING

ON-BOARD DIAGNOSTICS (OBD)

COOLING SYSTEM RELATED DIAGNOSTICS

The Powertrain Control Module (PCM) has been programmed to monitor the certain following cooling system components:

• If the engine has remained cool for too long a period, such as with a stuck open thermostat, a Diagnostic Trouble Code (DTC) can be set.

• If an open or shorted condition has developed in the relay circuit controlling the electric radiator fan, a Diagnostic Trouble Code (DTC) can be set.

If the problem is sensed in a monitored circuit often enough to indicate an actual problem, a DTC is stored. The DTC will be stored in the PCM memory for eventual display to the service technician. (Refer to Group 25, Emission Control Systems for proper procedures).

ACCESSING DIAGNOSTIC TROUBLE CODES

To read DTC's and to obtain cooling system data, refer to Group 25, Emission Control Systems for proper procedures.

DRB SCAN TOOL

For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

ACCESSORY DRIVE BELT DIAGNOSIS

VISUAL DIAGNOSIS

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the belt from rib to rib (Fig. 10), 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. 10). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to the Accessory Drive Belt Diagnosis charts for further belt diagnosis.

DIAGNOSIS AND TESTING (Continued)

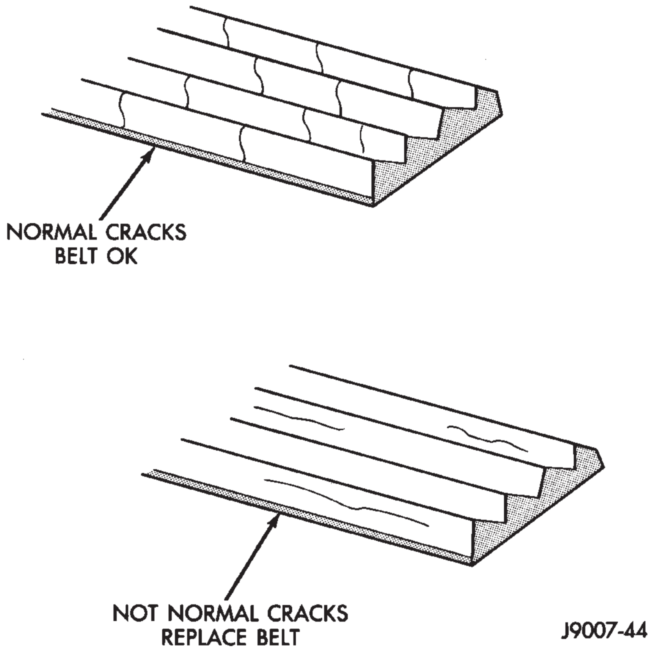


Fig. 10 Belt Wear Patterns

NOISE DIAGNOSIS

Noises generated by the accessory drive belt are most noticeable at idle. Before replacing a belt to resolve a noise condition, inspect all of the accessory drive pulleys for alignment, glazing, or excessive end play.

ACCESSORY DRIVE BELT DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (One or more ribs has separated from belt body)	1. Foreign objects imbedded in pulley grooves. 2. Installation damage	1. Remove foreign objects from pulley grooves. Replace belt. 2. Replace belt
RIB OR BELT WEAR	1. Pulley misaligned 2. Abrasive environment 3. Rusted pulley(s) 4. Sharp or jagged pulley groove tips 5. Belt rubber deteriorated	1. Align pulley(s) 2. Clean pulley(s). Replace belt if necessary 3. Clean rust from pulley(s) 4. Replace pulley. Inspect belt. 5. Replace belt
BELT SLIPS	1. Belt slipping because of insufficient tension 2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, ethylene glycol) 3. Driven component bearing failure (seizure) 4. Belt glazed or hardened from heat and excessive slippage	1. Adjust tension 2. Replace belt and clean pulleys 3. Replace faulty component or bearing 4. Replace belt.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
LONGITUDAL BELT CRACKING	1. Belt has mistracked from pulley groove	1. Replace belt
	2. Pulley groove tip has worn away rubber to tensile member	2. Replace belt
″GROOVE JUMPING″ (Belt does not maintain correct position on pulley)	1. Belt tension either too low or too high	1. Adjust belt tension
	2. Pulley(s) not within design tolerance	2. Replace pulley(s)
	3. Foreign object(s) in grooves	3. Remove foreign objects from grooves
	4. Pulley misalignment	4. Align component
	5. Belt cordline is broken	5. Replace belt
BELT BROKEN (Note: Identify and correct problem before new belt is installed)	1. Excessive tension	1. Replace belt and adjust tension to specification
	2. Tensile member damaged during belt installation	2. Replace belt
	3. Severe misalignment	3. Align pulley(s)
	4. Bracket, pulley, or bearing failure	4. Replace defective component and belt
NOISE (Objectionable squeal, squeak, or rumble is heard or felt while drive belt is in operation)	1. Belt slippage	1. Adjust belt
	2. Bearing noise	2. Locate and repair
	3. Belt misalignment	3. Align belt/pulley(s)
	4. Belt to pulley mismatch	4. Install correct belt
	5. Driven component induced vibration	5. Locate defective driven component and repair
	6. System resonant frequency induced vibration	6. Vary belt tension within specifications.
TENSION SHEETING FABRIC FAILURE (Woven fabric on outside, circumference of belt has cracked or separated from body of belt)	1. Tension sheeting contacting stationary object	1. Correct rubbing condition
	2. Excessive heat causing woven fabric to age	2. Replace belt
	3. Tension sheeting splice has fractured	3. Replace belt
CORD EDGE FAILURE (Tensile member exposed at edges of belt or separated from belt body)	1. Excessive tension	1. Adjust belt tension
	2. Belt contacting stationary object	2. Replace belt
	3. Pulley(s) out of tolerance	3. Replace pulley
	4. Insufficient adhesion between tensile member and rubber matrix	4. Replace belt and adjust tension to specifications

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 or pump rotating in wrong direction due to belt not correctly routed.
- Reconditioned radiator or cooling system refilling (possibly under filled or air trapped in system).

NOTE: If investigation reveals none of the previous items as a cause for an engine overheating complaint, refer to following Cooling System Diagnosis charts.

These charts are to be used as a quick-reference only. Refer to the group text for information.

COOLING SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOW	1. Has a Diagnostic Trouble Code (DTC) been set indicating a stuck open thermostat?	1. Refer to Group 25, Emission Systems for On-Board Diagnostics and DTC information. Replace thermostat if necessary.
	2. Is the temperature sending unit connected?	2. Check the temperature sensor connector. Refer to Group 8E. Repair connector if necessary.
	3. Is the temperature gauge operating OK?	3. Check gauge operation. Refer to Group 8E. Repair as necessary.
	4. Coolant level low in cold ambient temperatures accompanied with poor heater performance.	4. Check coolant level in the coolant reserve/overflow tank and the radiator. Inspect system for leaks. Repair leaks as necessary. Refer to the Coolant section of the manual text for WARNINGS and CAUTIONS associated with removing the radiator cap.
	5. Improper operation of internal heater doors or heater controls.	5. Inspect heater and repair as necessary. Refer to Group 24, Heating and Air Conditioning for procedures.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH OR THE COOLANT WARNING LAMP ILLUMINATES. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM THE COOLING SYSTEM	1. Trailer is being towed, a steep hill is being climbed, vehicle is operated in slow moving traffic, or engine is being idled with very high ambient (outside) temperatures and the air conditioning is on. Higher altitudes could aggravate these conditions.	1. This may be a temporary condition and repair is not necessary. Turn off the air conditioning and attempt to drive the vehicle without any of the previous conditions. Observe the temperature gauge. The gauge should return to the normal range. If the gauge does not return to the normal range, determine the cause for overheating and repair. Refer to Possible Causes (2-20).
	2. Is the temperature gauge reading correctly?	2. Check gauge. Refer to Group 8E. Repair as necessary.
	3. Is the temperature warning illuminating unnecessarily?	3. Check warning lamp operation. Refer to Group 8E. Repair as necessary.
	4. Coolant low in coolant reserve/ overflow tank and radiator?	4. Check for coolant leaks and repair as necessary. Refer to Testing Cooling System for Leaks in this Group.
	5. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following Step 6.	5. Tighten cap
	6. Poor seals at the radiator cap.	6. (a) Check condition of cap and cap seals. Refer to Radiator Cap. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator.
	7. Coolant level low in radiator but not in coolant reserve/overflow tank. This means the radiator is not drawing coolant from the coolant reserve/ overflow tank as the engine cools	7. (a) Check condition of radiator cap and cap seals. Refer to Radiator Cap in this Group. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator. (c) Check condition of the hose from the radiator to the coolant tank. It should fit tight at both ends without any kinks or tears. Replace hose if necessary. (d) Check coolant reserve/overflow tank and tanks hoses for blockage. Repair as necessary.
	8. Incorrect coolant concentration	8. Check coolant. Refer to Coolant section in this Group for correct coolant/water mixture ratio.
	9. Coolant not flowing through system	9. Check for coolant flow at radiator filler neck with some coolant removed, engine warm and thermostat open. Coolant should be observed flowing through radiator. If flow is not observed, determine area of obstruction and repair as necessary.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	10. Radiator or A/C condenser fins are dirty or clogged.	10. Remove insects and debris. Refer to Radiator Cleaning in this Group.
	11. Radiator core is corroded or plugged.	11. Have radiator re-cored or replaced.
	12. Aftermarket A/C installed without proper radiator.	12. Install proper radiator.
	13. Fuel or ignition system problems.	13. Refer to Fuel and Ignition System Groups for diagnosis.
	14. Dragging brakes.	14. Check and correct as necessary. Refer to Group 5, Brakes for correct procedures.
	15. Bug screen or cardboard is being used, reducing airflow.	15. Remove bug screen or cardboard.
	16. Thermostat partially or completely shut.	16. Check thermostat operation and replace as necessary. Refer to Thermostats in this Group.
	17. Viscous fan drive not operating properly.	17. Check fan drive operation and replace as necessary. Refer to Viscous Fan Drive in this Group.
	18. Electric cooling fan not operating properly (vehicles equipped with 2.5L/4.0L and air conditioning	18. Check electric fan operation and repair as necessary. Refer to Electric Cooling Fan in this Group.
	19. Cylinder head gasket leaking.	19. Check for cylinder head gasket leaks. Refer to Cooling System-Testing For Leaks in this Group. For repair, refer to Group 9, Engines.
	20. Heater core leaking.	20. Check heater core for leaks. Refer to Group 24, Heating and Air Conditioning. Repair as necessary.
TEMPERATURE GAUGE READING IS INCONSISTENT (FLUCTUATES, CYCLES OR IS ERRATIC)	1. On vehicles equipped with an electric fan, the gauge may cycle up and down. This is due to the cycling of the electric radiator fan.	1. This is a normal condition. No correction is necessary unless the gauge cycles into the red (overheat) zone. Refer to Electric Cooling Fan Diagnosis and Testing in this group.
	2. During cold weather operation, with the heater blower in the high position, the gauge reading may drop slightly.	2. A normal condition. No correction is necessary.
	3. Temperature gauge or engine mounted gauge sensor defective or shorted. Also, corroded or loose wiring in this circuit.	3. Check operation of gauge and repair if necessary. Refer to Group 8E, Instrument Panel and Gauges.
	4. Gauge reading rises when vehicle is brought to a stop after heavy use (engine still running)	4. A normal condition. No correction is necessary. Gauge should return to normal range after vehicle is driven.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	5. Gauge reading high after re-starting a warmed up (hot) engine.	5. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation.
	6. Coolant level low in radiator (air will build up in the cooling system causing the thermostat to open late).	6. Check and correct coolant leaks. Refer to Cooling System-Testing for leaks in this group.
	7. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing a thermostat to open late.	7. (a) Check for cylinder head gasket leaks. Refer to Cooling System-Testing for Leaks in this group.
		(b) Check for coolant in the engine oil. Inspect for white steam emitting from the exhaust system. Repair as necessary.
	8. Water pump impeller loose on shaft.	8. Check water pump and replace as necessary. Refer to water Pumps in this group.
	9. Loose accessory drive belt. (water pump slipping)	9. Refer to Accessory Drive Belts in this group. Check and correct as necessary.
	10. Air leak on the suction side of the water pump allows air to build up in cooling system causing thermostat to open late.	10. Locate leak and repair as necessary.
PRESSURE CAP IS BLOWING OFF STEAM AND/OR COOLANT TO COOLANT TANK. TEMPERATURE GAUGE READING MAY BE ABOVE NORMAL BUT NOT HIGH. COOLANT LEVEL MAY BE HIGH IN COOLANT RESERVE/OVERFLOW TANK	1. Pressure relief valve in radiator cap is defective.	1. Check condition of radiator cap and cap seals. Refer to Radiator Caps in this group. Replace cap as necessary.
COOLANT LOSS TO THE GROUND WITHOUT PRESSURE CAP BLOWOFF. GAUGE READING HIGH OR HOT	1. Coolant leaks in radiator, cooling system hoses, water pump or engine.	1. Pressure test and repair as necessary. Refer to Cooling System-Testing For Leaks in this group.
DETONATION OR PRE-IGNITION (NOT CAUSED BY IGNITION SYSTEM). GAUGE MAY OR MAY NOT BE READING HIGH	1. engine overheating.	1. Check reason for overheating and repair as necessary.
	2. Freeze point of coolant not correct. Mixture is too rich or too lean.	2. Check coolant concentration. Refer to the Coolant section of this group and adjust ratio as required.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
HOSE OR HOSES COLLAPSE WHILE ENGINE IS RUNNING	1. Vacuum created in cooling system on engine cool-down is not being relieved through coolant reserve/overflow system.	1. (a) Radiator cap relief valve stuck. Refer to Radiator Cap in this group. Replace if necessary (b) Hose between coolant reserve/ overflow tank and radiator is kinked. Repair as necessary. (c) Vent at coolant reserve/overflow tank is plugged. Clean vent and repair as necessary. (d) Reserve/overflow tank is internally blocked or plugged. Check for blockage and repair as necessary.
ELECTRIC RADIATOR FAN RUNS ALL OF THE TIME (2.5L/4.0L MODELS EQUIPPED WITH A/C AND 4.0L MODELS EQUIPPED WITH MAX COOLING)	1. Fan relay, powertrain control module (PCM) or coolant temperature sensor defective.	1. Refer to Electric Cooling Fan Diagnosis and Testing. Also refer to Group 8W, Wiring Diagrams. Repair as necessary.
ELECTRIC RADIATOR FAN WILL NOT RUN AT ALL . GAUGE READING HIGH OR HOT (2.5L/4.0L MODELS EQUIPPED WITH A/C AND 4.0L MODELS EQUIPPED WITH MAX COOLING)	1. Blown Fuse in Power Distribution Center (PDC)	1. Determine reason for blown fuse and repair as necessary.
	2. Fan relay, powertrain control module (PCM) or coolant temperature sensor defective.	2. Refer to Electric Cooling Fan Diagnosis and Testing. Also refer to Group 8W, Wiring Diagrams. Repair as necessary.
	3. Fan Motor Defective	3. Refer to Electric Cooling Fan Diagnosis and Testing. Also refer to Group 8W, Wiring Diagrams. Repair as necessary.
NOISY VISCOUS FAN/DRIVE	1. Fan blades loose.	1. Replace fan blade assembly. Refer to Cooling System Fans in this Group
	2. Fan blades striking a surrounding object.	2. Locate point of fan blade contact and repair as necessary.
	3. Air obstructions at radiator or air conditioning condenser.	3. Remove obstructions and/or clean debris or insects from radiator or A/C condenser.
	4. Thermal viscous fan drive has defective bearing.	4. Replace fan drive. Bearing is not serviceable. Refer to Viscous Fan Drive in this group.
	5. A certain amount of fan noise may be evident on models equipped with a thermal viscous fan drive. Some of this noise is normal.	5. Refer to Viscous Fan Drive in this group for an explanation of normal fan noise.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
INADEQUATE HEATER PERFORMANCE. THERMOSTAT FAILED IN OPEN POSITION	1. Has a Diagnostic trouble Code (DTC) been set?	1. Refer to Group 25, Emissions for correct procedures and replace thermostat if necessary
	2. Coolant level low	2. Refer to Cooling System-Testing For Leaks in this group.
	3. Obstructions in heater hose/fittings	3. Remove heater hoses at both ends and check for obstructions
	4. Heater hose kinked	4. Locate kinked area and repair as necessary
	5. Water pump is not pumping water to/through the heater core. When the engine is fully warmed up, both heater hoses should be hot to the touch. If only one of the hoses is hot, the water pump may not be operating correctly or the heater core may be plugged. Accessory drive belt may be slipping causing poor water pump operation.	5. Refer to Water Pump in this group. If a slipping belt is detected, refer to Accessory Drive Belts in this group. If heater core obstruction is detected, refer to Group 24, Heating and Air Conditioning.
STEAM IS COMING FROM THE FRONT OF VEHICLE NEAR THE GRILL AREA WHEN WEATHER IS WET, ENGINE IS WARMED UP AND RUNNING, AND VEHICLE IS STATIONARY. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. During wet weather, moisture (snow, ice or rain condensation) on the radiator will evaporate when the thermostat opens. This opening allows heated water into the radiator. When the moisture contacts the hot radiator, steam may be emitted. This usually occurs in cold weather with no fan or airflow to blow it away.	1. Occasional steam emitting from this area is normal. No repair is necessary.
COOLANT COLOR	1. Coolant color is not necessarily an indication of adequate corrosion or temperature protection. Do not rely on coolant color for determining condition of coolant.	1. Refer to Coolant in this group for coolant concentration information. Adjust coolant mixture as necessary.
COOLANT LEVEL CHANGES IN COOLANT RESERVE/OVERFLOW TANK. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. Level changes are to be expected as coolant volume fluctuates with engine temperature. If the level in the tank was between the FULL and ADD marks at normal operating temperature, the level should return to within that range after operation at elevated temperatures.	1. A normal condition. No repair is necessary.

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.

COOLING SYSTEM—TESTING 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. 11).

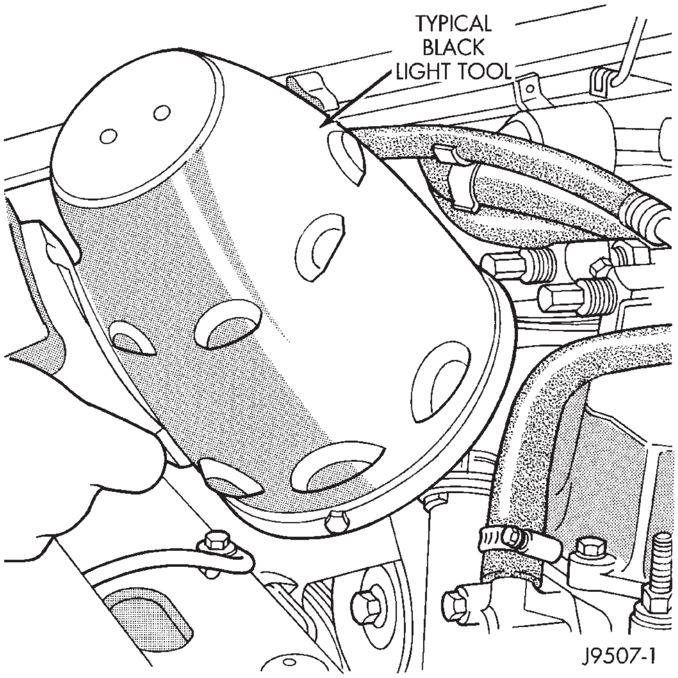


Fig. 11 Leak Detection Using Black Light—Typical

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. 12).

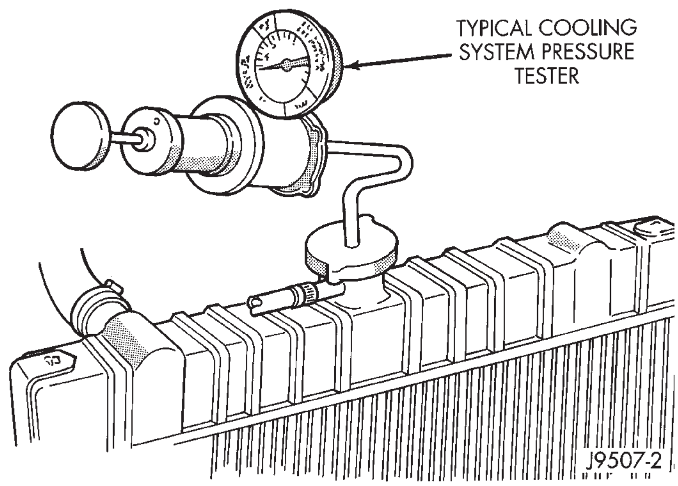


Fig. 12 Pressurizing System—Typical

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.

DIAGNOSIS AND TESTING (Continued)

• Drops Quickly: Shows that a serious leakage is occurring. Examine the system for serious external leakage. If no leaks are visible, inspect for internal leakage. Large radiator leak holes should be repaired by a reputable radiator repair shop.

INTERNAL LEAKAGE INSPECTION

Remove the 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

LEAKS

Viscous fan drive operation is not affected by small oil stains near the drive bearing. If leakage appears excessive, replace the fan drive unit.

TESTING

If the fan assembly free-wheels without drag (the fan blades will revolve more than five turns when spun by hand), replace the fan drive. This spin test must be performed when the engine is cool.

For the following test, the cooling system must be in good condition. It also will ensure against excessively high coolant temperature.

WARNING: BE SURE THAT THERE IS ADEQUATE FAN BLADE CLEARANCE BEFORE DRILLING.

(1) Drill a 3.18-mm (1/8-in) diameter hole in the top center of the fan shroud.

(2) Obtain a dial thermometer with an 8 inch stem (or equivalent). It should have a range of -18°-to-105°C (0°-to-220° F). Insert thermometer through the hole in the shroud. Be sure that there is adequate clearance from the fan blades.

(3) Connect a tachometer and an engine ignition timing light (timing light is to be used as a strobe light).

DIAGNOSIS AND TESTING (Continued)

(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 82° C (165° to 180° 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 79° C (135° to 175° F). A definite **decrease** of fan flow noise (roaring) should be noticed. If not, replace the defective viscous fan drive unit.

ELECTRIC COOLING FAN

ELECTRIC COOLING FAN AND RELAY DIAGNOSIS

NOTE: Refer to Electrical Group 8W for electric cooling fan and relay circuit schematic.

The powertrain control module (PCM) will enter a diagnostic trouble code (DTC) in memory if it detects a problem in the auxiliary cooling fan relay or circuit. Refer to Group 25, Emission Control Systems for correct DTC retrieval procedures.

If the electric cooling fan is inoperative, check the 15A fuse in the junction block and the 40A fuse in the Power Distribution Center (PDC) with a 12 volt test lamp or DVOM. Refer to the inside of the PDC cover for the exact location of the fuse. If fuses are o.k., refer to Group 8W for electric cooling fan and relay circuit schematic.

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. 13) 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.

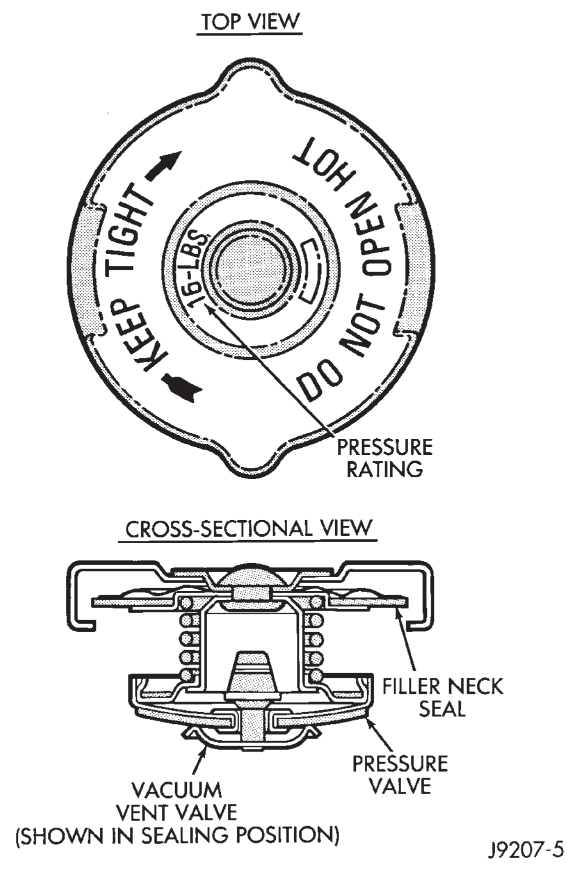


Fig. 13 Radiator Pressure Cap

There is no need to remove the radiator cap **except** for the following purposes:

(1) To check and adjust antifreeze freeze point.

(2) To refill system with new antifreeze.

(3) For conducting service procedures.

(4) When checking for vacuum leaks.

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.

RADIATOR CAP—PRESSURE TESTING

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. 14).

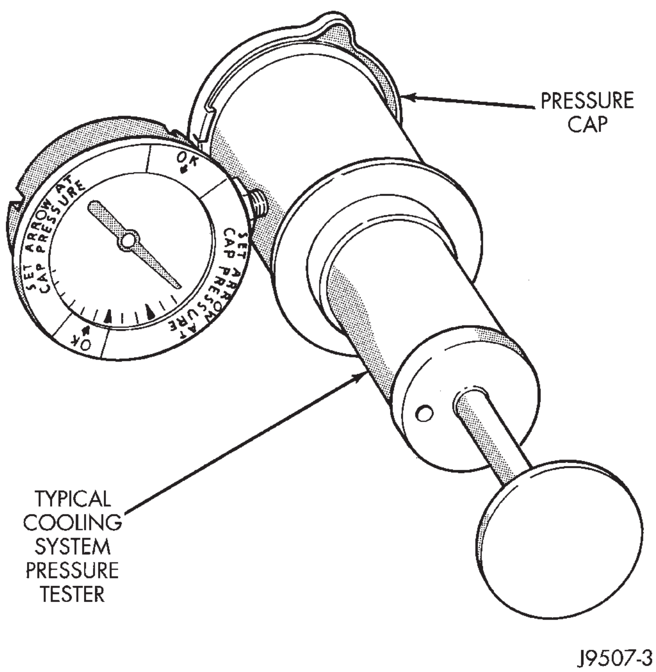


Fig. 14 Pressure Testing Radiator Pressure Cap—Typical

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.

CAP INSPECTION

Visually inspect the pressure valve gasket on the cap. Replace cap if the gasket is swollen, torn or worn. Inspect the area around radiator filler neck for white deposits that indicate a leaking cap.

COOLANT—LOW 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

COOLANT—ROUTINE 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 cold and not running, observe coolant level in reserve/overflow tank. The coolant level should be between ADD and FULL marks.

SERVICE PROCEDURES (Continued)

COOLANT—ADDING ADDITIONAL

Do not remove radiator cap to add coolant to system. When adding coolant to maintain correct level, do so at coolant reserve/overflow tank. Use a 50/50 mixture of ethylene-glycol antifreeze containing Alugard 340-2 ™ and low mineral content water. Remove radiator cap only for testing or when refilling system after service. Removing cap unnecessarily can cause loss of coolant and allow air to enter system, which produces corrosion.

COOLANT—LEVEL CHECK

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

COOLING SYSTEM—DRAINING AND FILLING

DRAINING

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Remove radiator pressure cap.

(2) For access to radiator draincock (Fig. 15), remove radiator grille mounting screws and remove grill. Refer to Group 23, Body for correct procedure.

(3) Attach one end of a 24 inch long X 1/4 inch ID hose to the radiator draincock. Put the other end into a clean container. Open draincock and drain coolant from radiator.

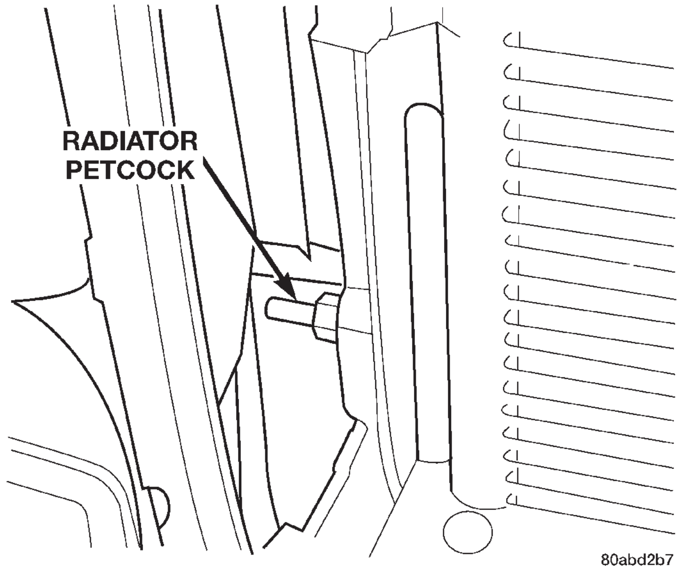


Fig. 15 Radiator Petcock—2.5L/4.0L (LHD/RHD)

(4) Drain coolant from engine by removing the drain plug and coolant temperature sensor on left side of block.

REFILLING

(1) Tighten the radiator petcock and the cylinder block drain plug(s).

(2) Install grille.

(3) Fill system using a 50/50 mixture of water and antifreeze as described in the Coolant section of this group. Fill radiator to top and install radiator cap. Add sufficient coolant to reserve/overflow tank to raise level to FULL mark.

(4) With heater control unit in the HEAT position, operate engine with radiator cap in place.

(5) After engine has reached normal operating temperature, shut engine off and allow it to cool.

(6) Add coolant to reserve/overflow tank as necessary. **Only add coolant when the engine is cold. Coolant level in a warm engine will be higher due to thermal expansion.**

COOLING SYSTEM—REVERSE FLUSHING

CAUTION: The cooling system normally operates at 97-to-124 kPa (14- to-18 psi) pressure. Exceeding this pressure may damage the radiator or hoses.

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.

SERVICE PROCEDURES (Continued)

CHEMICAL CLEANING

If visual inspection indicates the formation of sludge or scaly deposits, use a radiator cleaner (Mopar Radiator Kleen or equivalent) before flushing. This will soften scale and other deposits and aid the flushing operation.

CAUTION: Be sure instructions on the container are followed.

REVERSE FLUSHING RADIATOR

Disconnect the radiator hoses from the radiator fittings. Attach a section of radiator hose to the radiator bottom outlet fitting and insert the flushing gun. Connect a water supply hose and air supply hose to the flushing gun.

CAUTION: The cooling system normally operates at 97-to-124 kPa (14- to-18 psi) pressure. Exceeding this pressure may damage the radiator or hoses.

Allow the radiator to fill with water. When radiator is filled, apply air in short blasts allowing radiator to refill between blasts. Continue this reverse flushing until clean water flows out through rear of radiator cooling tube passages. For more information, refer to operating instructions supplied with flushing equipment. Have radiator cleaned more extensively by a radiator repair shop.

REVERSE FLUSHING ENGINE

Drain the cooling system. Remove the thermostat housing and thermostat. Install the thermostat housing. Disconnect the radiator upper hose from the radiator and attach the flushing gun to the hose. Disconnect the radiator lower hose from the water pump. Attach a lead away hose to the water pump inlet fitting.

CAUTION: Be sure that the heater control valve is closed (heat off). This is done to prevent coolant flow with scale and other deposits from entering the heater core.

Connect the water supply hose and air supply hose to the flushing gun. Allow the engine to fill with water. When the engine is filled, apply air in short blasts, allowing the system to fill between air blasts. Continue until clean water flows through the lead away hose. For more information, refer to operating instructions supplied with flushing equipment.

Remove the lead away hose, flushing gun, water supply hose and air supply hose. Remove the thermostat housing and install thermostat. Install the thermostat housing with a replacement gasket. Refer to Thermostat Replacement. Connect the radiator hoses. Refill the cooling system with the correct antifreeze/water mixture.

REMOVAL AND INSTALLATION

TRANSMISSION OIL COOLERS

WATER-TO-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 Refilling Cooling System and Testing Cooling System For Leaks sections in this group. If the transmission operates properly after repairing the leak, drain the transmission and remove the transmission oil pan. Inspect for sludge and/or rust. Inspect for a dirty or plugged inlet filter. If none of these conditions are found, the transmission and torque convertor may not require reconditioning. Refer to Group 21 for automatic transmission servicing.

AIR-TO-OIL COOLER

REMOVAL

(1) Remove the grill mounting screws and remove the grill. Refer to Group 23, Body for procedures.

(2) Place a drain pan below the transmission oil cooler.

(3) Remove the two hose clamps at oil cooler inlet and outlet tubes.

(4) Remove the two oil cooler mounting bolts (Fig. 16).

(5) Remove the oil cooler from vehicle.

INSTALLATION

(1) Position and secure oil cooler to vehicle. Tighten mounting bolts to 8 N·m (72 in. lbs.) torque.

(2) Secure inlet and outlet tubes with hose clamps. Tighten the two clamps to 2 N·m (15 in. lbs.) torque. Install the grill.

(3) Start engine and check transmission fluid level. Add fluid if necessary.

COOLANT RESERVE TANK

REMOVAL

(1) Remove the tube clamp at the tank and remove tube.

(2) Remove the tank mounting bolts and remove tank (Fig. 17) (Fig. 18).

INSTALLATION

(1) Position tank and tighten to 2 N·m (17 in. lbs.) torque.

(2) Position tube and secure clamp.

REMOVAL AND INSTALLATION (Continued)

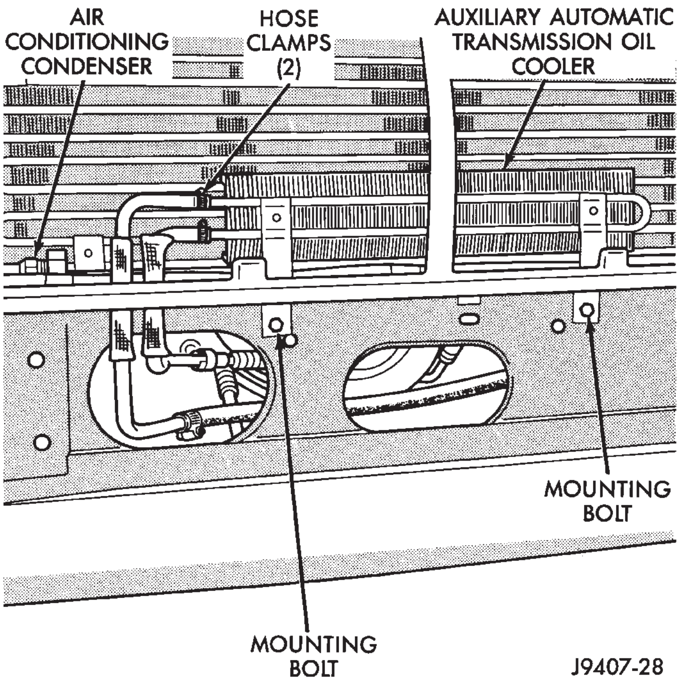


Fig. 16 Auxiliary Air-To-Oil Cooler

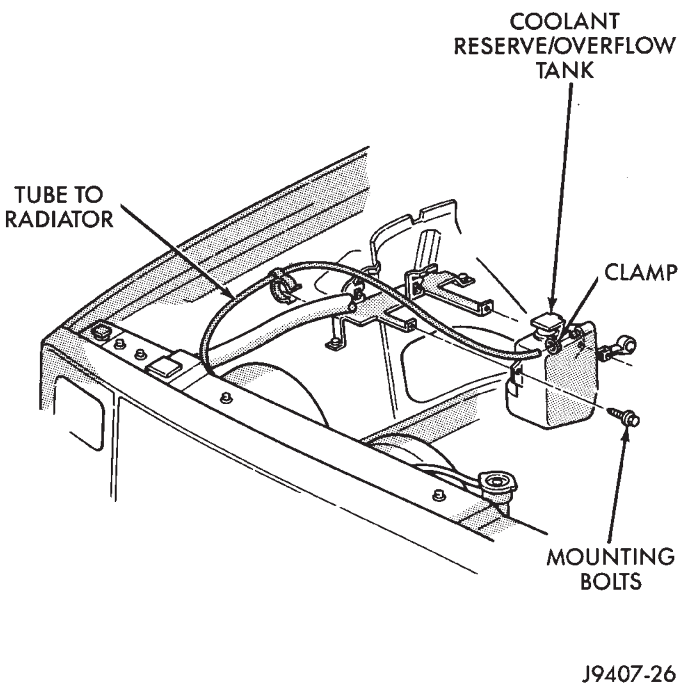


Fig. 17 Reserve/Overflow Tank—Except Right Hand Drive

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.

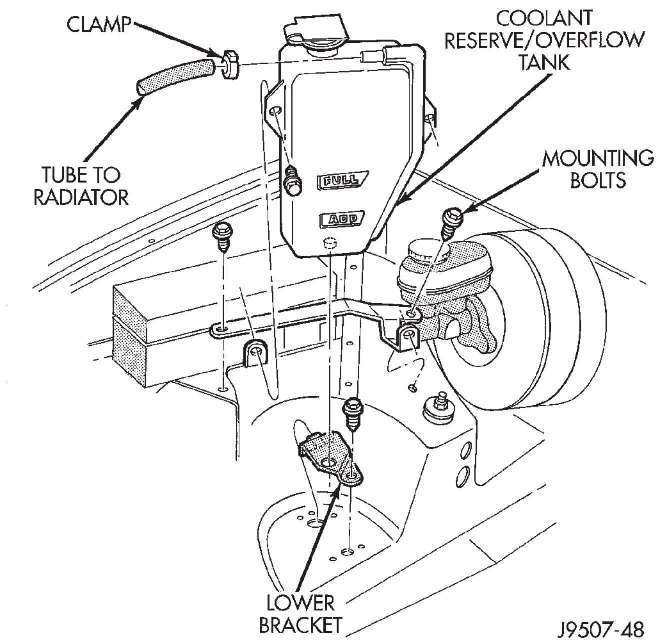


Fig. 18 Reserve/Overflow Tank—With Right Hand Drive

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. 19) 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.

REMOVAL-2.5L ENGINE (LHD/RHD)

(1) Disconnect battery negative cable.
(2) Drain cooling system. Refer to Cooling System-Draining and Filling in this group.
(3) Remove upper radiator hose.
(4) Loosen (but do not remove at this time) the four fan hub-to-water pump pulley mounting nuts (Fig. 20).

REMOVAL AND INSTALLATION (Continued)

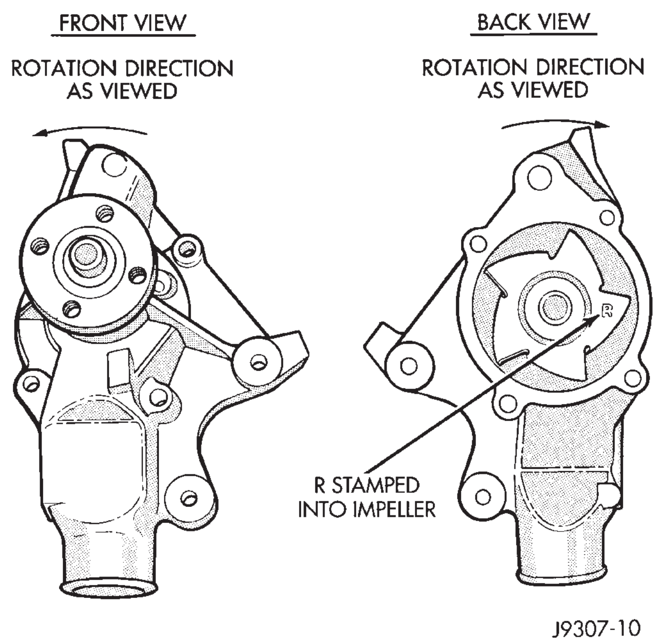


Fig. 19 Reverse Rotating Water Pump—Typical

(5) Remove accessory drive belt. (Refer to Accessory Drive Belt, Removal and Installation in this group).

(6) Disconnect electric cooling fan connector (if equipped).

(7) Unbolt fan shroud.

(8) Remove the four fan hub-to-water pump pulley nuts and remove fan and shroud together.

CAUTION: 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 power steering pump and bracket (Fig. 21), refer to Group 19 Steering for correct procedure.

(10) Remove lower radiator hose from water pump. Remove heater hose from water pump pipe.

(11) Remove the four pump mounting bolts (Fig. 22) and remove pump from vehicle. Discard old gasket. Note that one of the four bolts is longer than the other bolts.

(12) If pump is to be replaced, the heater hose fitting must be removed. Note position of fitting before removal.

INSTALLATION-2.5L ENGINE (LHD/RHD)

(1) If pump is being replaced, install the heater hose pipe 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.

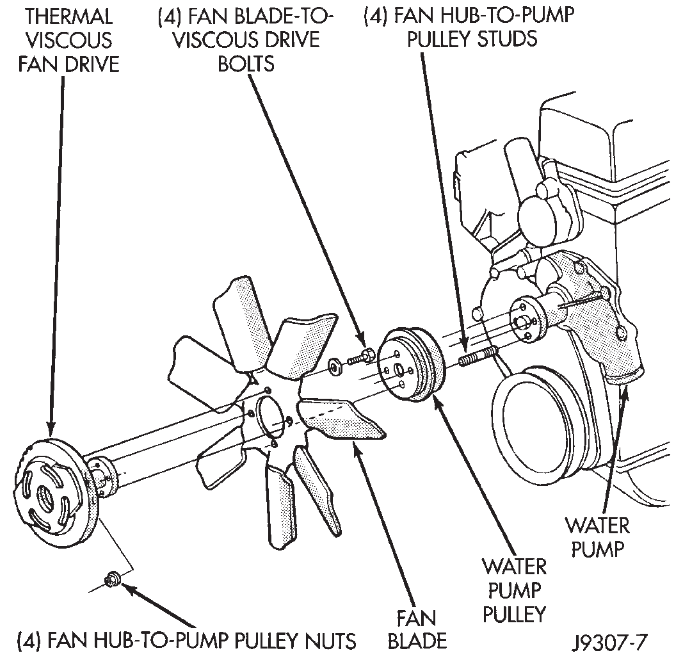


Fig. 20 Fan Mounting Nuts

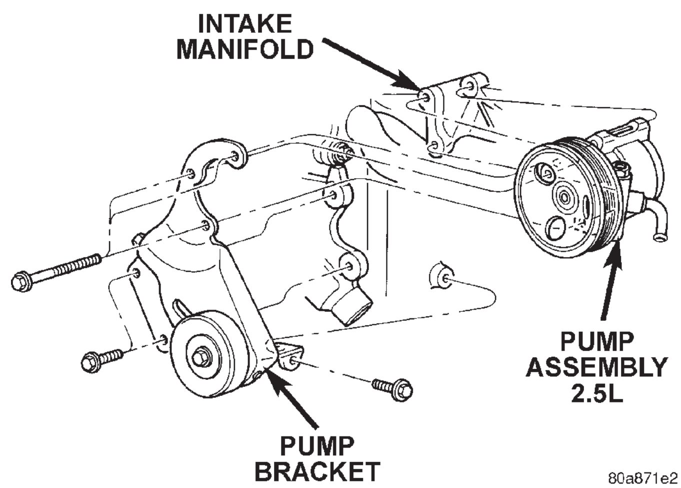


Fig. 21 Power Steering Pump Attachment-2.5L

(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 23 N·m (17 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) Install power steering pump and bracket. Refer to Group 19, Steering.

(6) Position water pump pulley to water pump hub.

REMOVAL AND INSTALLATION (Continued)

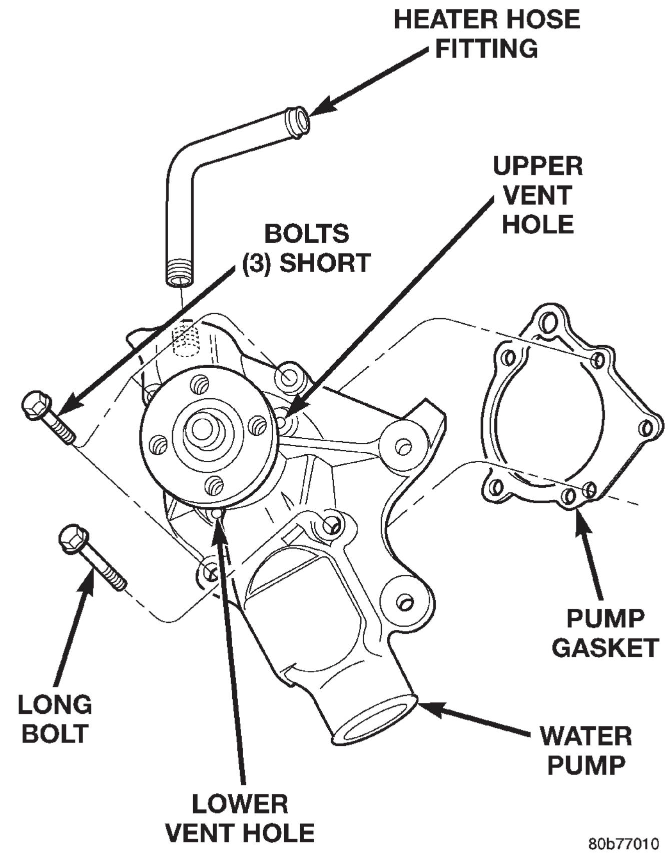


Fig. 22 Water Pump Remove/Install—Typical

(7) Install shroud and fan together and install four nuts to water pump hub studs. Tighten nuts to 27 N·m (20 ft. lbs.) torque.

(8) Install and tighten upper fan shroud nuts to 4 N·m (31 in. lbs.).

(9) Connect electric fan connector (if equipped).

CAUTION: When installing the 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.

(10) Install and tension accessory drive belt, refer to Accessory Drive Belt removal and installation in this group.

(11) Install upper radiator hose.

(12) Fill cooling system with coolant and check for leaks. Refer to Refilling Cooling System in this group.

(13) Connect battery negative cable.

(14) Start and warm the engine. Check for leaks.

REMOVAL-4.0L ENGINE (LHD/RHD)

(1) Disconnect battery negative cable.

(2) Drain the cooling system. (Refer to Cooling System-Draining and Filling in this group.)

(3) Disconnect electric cooling fan connector.

(4) Remove electric cooling fan/shroud assembly (if equipped).

(5) Remove viscous fan shroud bolts (2).

(6) Loosen (but do not remove at this time) the four water pump pulley-to-water pump hub mounting bolts (Fig. 23) and the four viscous fan to idler pulley nuts.

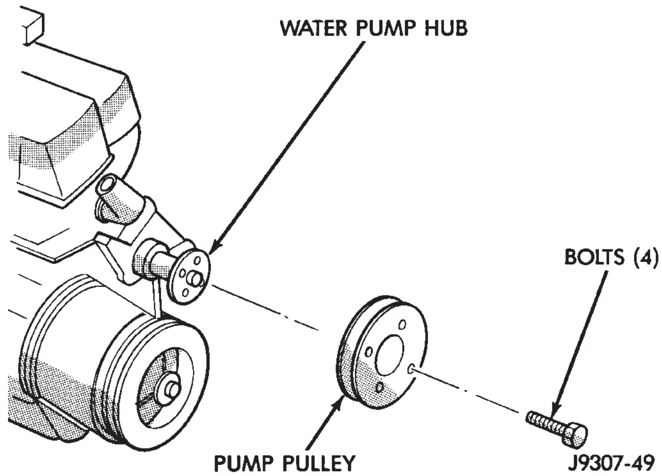


Fig. 23 Water Pump Pulley Bolts

NOTE: The accessory drive belt must be removed prior to removing the fan (if installed at pump) or fan pulley.

(7) Remove accessory drive belt (refer to Accessory Drive Belt, Removal and Installation in this group)

(8) Remove the four viscous fan to idler pulley nuts and remove the fan and shroud together.

CAUTION: 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 water pump pulley bolts and remove the pulley.

(10) Remove power steering pump and bracket (Fig. 24), refer to Group 19 Steering.

(11) Remove lower radiator hose from water pump. Remove heater hose from water pump fitting.

(12) Remove the four pump mounting bolts (Fig. 25) and remove pump from vehicle. Discard old gasket. Note that one of the four bolts is longer than the other bolts.

(13) If pump is to be replaced, the heater hose fitting must be removed. Note position of fitting before removal.

REMOVAL AND INSTALLATION (Continued)

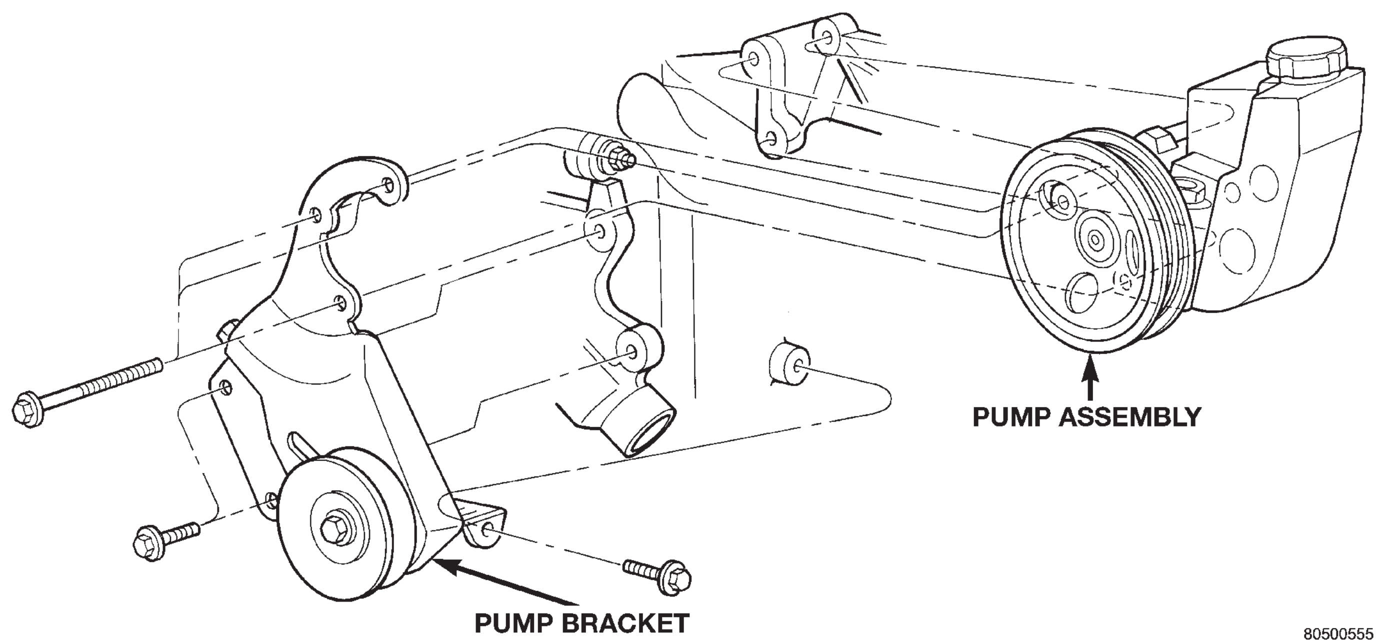


Fig. 24 Power Steering Pump Attachment-4.0L

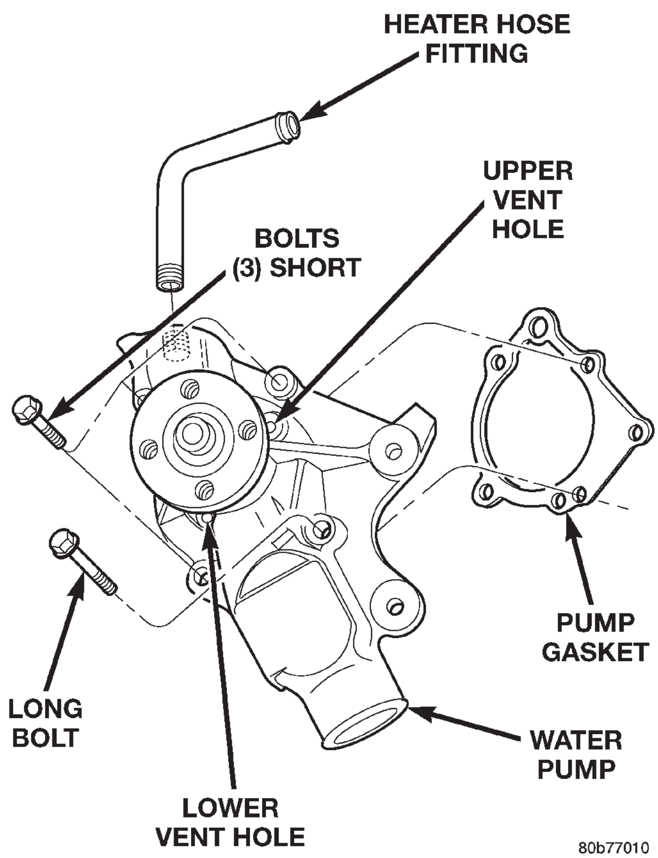


Fig. 25 Water Pump Remove/Install—Typical

INSTALLATION-4.0L ENGINE (LHD/RHD)

(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 23 N·m (17 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 four pump pulley bolts. Tighten bolts (or nuts) to 27 N·m (20 ft. lbs.) torque.

(7) Install power steering pump. Refer to Group 19, Steering for proper procedure and torque values.

(8) Install the viscous fan and shroud together. Install the four fan to idler pulley nuts and tighten to 27 N·m (20 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

CAUTION: When installing the 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.

(9) Install and tighten viscous fan shroud bolts to 4 N·m (31 in. lbs.).

(10) Install and tension the accessory drive belt, refer to Accessory Drive Belt removal and installation in this group.

(11) Install the electric cooling fan/shroud assy.

(12) Install and tighten electric fan shroud bolts to 4 N·m (31 in. lbs.). Connect fan connector.

(13) Fill cooling system with coolant and check for leaks. Refer to Refilling Cooling System in this group.

(14) Connect battery negative cable.

(15) 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. 6). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 7). If replacement is necessary, use only an original equipment clamp with matching number or letter.

(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. 26). Discard old gasket.

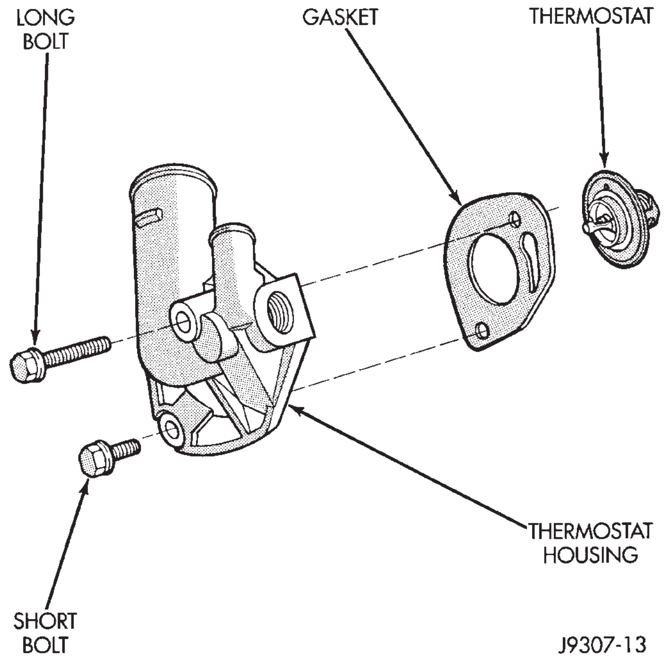


Fig. 26 Thermostat Removal/Installation

(5) Clean the gasket mating surfaces.

INSTALLATION

(1) Install the replacement thermostat so that the pellet, which is encircled by a coil spring, faces the engine. All thermostats are marked on the outer flange to indicate the proper installed position.

(a) Observe the recess groove in the engine cylinder head (Fig. 27).

(b) Position thermostat into this groove with arrow and air bleed hole on outer flange pointing up.

(2) Install replacement gasket and thermostat housing.

CAUTION: Tightening the thermostat housing unevenly or with the thermostat out of its recess may result in a cracked housing.

(3) Tighten the housing bolts to 20 N·m (15 ft. lbs.) torque.

(4) Install hoses to thermostat housing.

(5) Install electrical connector to coolant temperature sensor.

(6) Be sure that the radiator draincock is tightly closed. Fill the cooling system to the correct level with the required coolant mixture. Refer to Refilling Cooling System in this group.

(7) Start and warm the engine. Check for leaks.

REMOVAL AND INSTALLATION (Continued)

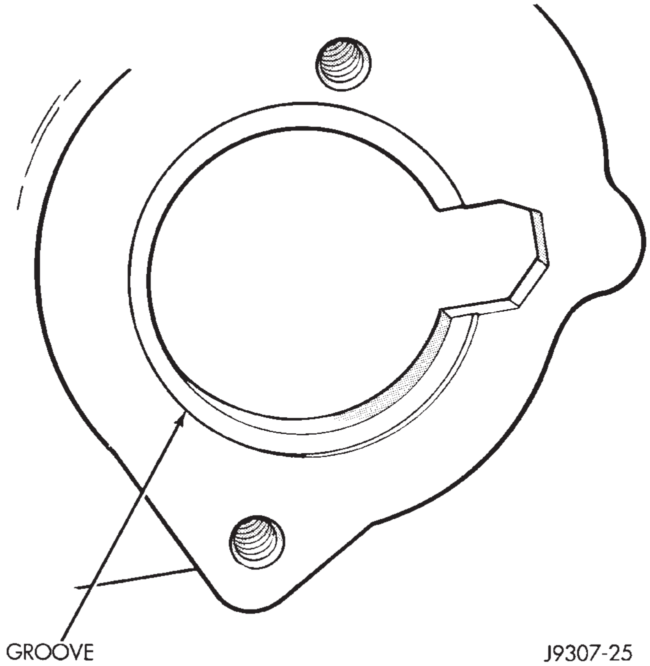


Fig. 27 Thermostat Recess

RADIATOR—2.5L

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (Fig. 6). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 7). If replacement is necessary, use only an original equipment clamp with matching number or letter.

REMOVAL

(1) Disconnect battery negative cable.

(2) Observe the previous **WARNINGS.**

(3) Remove radiator pressure cap.

(4) For access to radiator draincock, remove radiator grill mounting screws and remove grill. Refer to Group 23, Body for procedures.

(5) Attach one end of a 24 inch long X 1/4 inch ID hose to the radiator petcock (Fig. 28). Put the other end into a clean container. Open petcock and drain radiator.

(6) Detach power steering fluid reservoir from fan shroud and lay aside.

(7) Disconnect electric cooling fan electrical connector, if equipped.

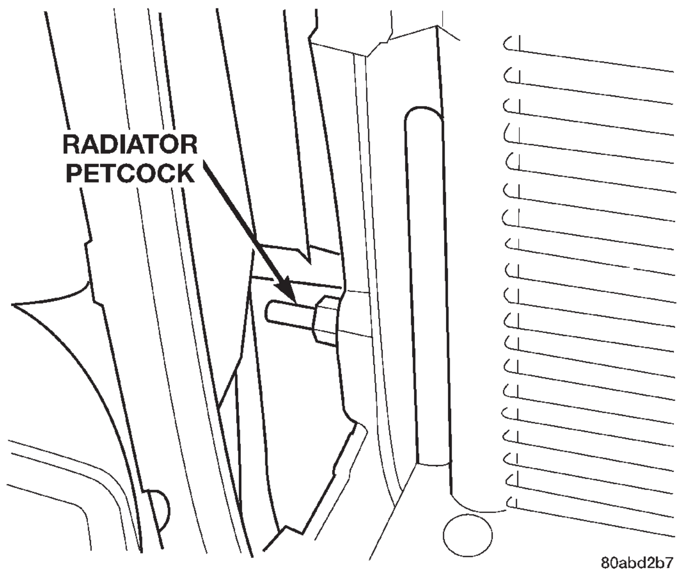


Fig. 28 Radiator Petcock—Typical

(8) Disconnect CRS hose from radiator filler neck and remove from shroud retaining loops.

(9) Remove the four (4) viscous fan/drive assembly nuts from the water pump pulley and remove fan/drive assy.

(10) Remove the four (4) fan shroud to core support mounting screws.

(11) Remove the electric fan (if equipped) and shroud assembly from the vehicle (Fig. 30).

(12) Remove radiator upper crossmember (Fig. 30).

(13) If equipped with air conditioning, separate radiator from condenser by removing condenser-to-radiator mounting brackets (Fig. 29).

(14) Disconnect upper and lower radiator hoses.

(15) If equipped, disconnect and plug automatic transmission fluid cooler lines. Quick Connect Fitting Release Tool 6935 may be needed. If equipped with remote transmission cooler, remove line to cooler from bracket at bottom of radiator.

(16) Lift radiator straight up and out of engine compartment taking care not to damage fins.

(17) If radiator is to be replaced, be sure to remove and transfer any components not included with replacement radiator.

REMOVAL AND INSTALLATION (Continued)

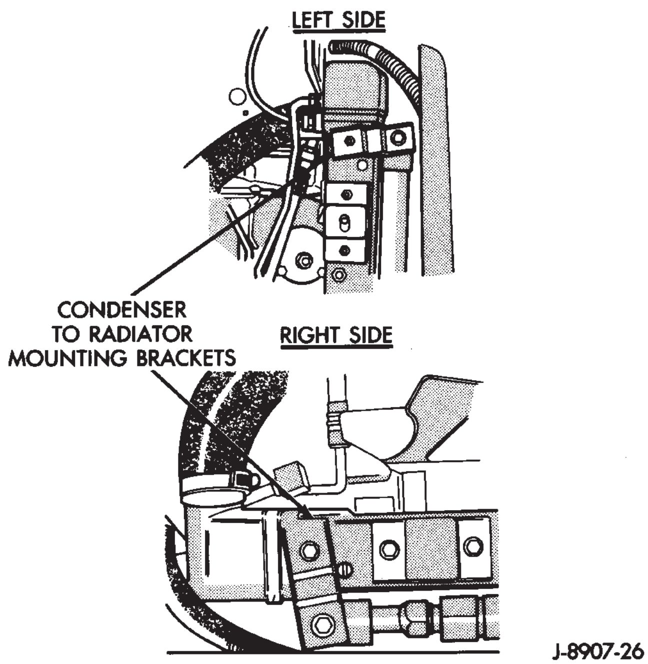


Fig. 29 Condenser-to-Radiator Mounting Brackets

INSTALLATION

The radiator is supplied with two alignment dowels (Fig. 35). They are located on the bottom tank and fit into rubber grommets in the radiator lower crossmember.

(1) Lower radiator into engine compartment. Position alignment dowels into rubber grommets in radiator lower crossmember (Fig. 35).

(2) If equipped with air conditioning, attach condenser to radiator with mounting brackets (Fig. 29).

(3) Install radiator upper crossmember and four mounting bolts.

(4) Install radiator upper crossmember-to-isolator nuts. Tighten nuts to 10 N·m (86 in. lbs.) torque. If isolator-to-radiator nuts had been removed, tighten them to 5 N·m (47 in. lbs.) torque.

(5) Connect radiator upper and lower hoses.

(6) If equipped, connect automatic transmission fluid cooler lines. If equipped with remote cooler, attach cooler line to bracket at bottom of radiator.

(7) Install electric fan (if equipped) and shroud assembly. Insert alignment tabs at bottom of fan

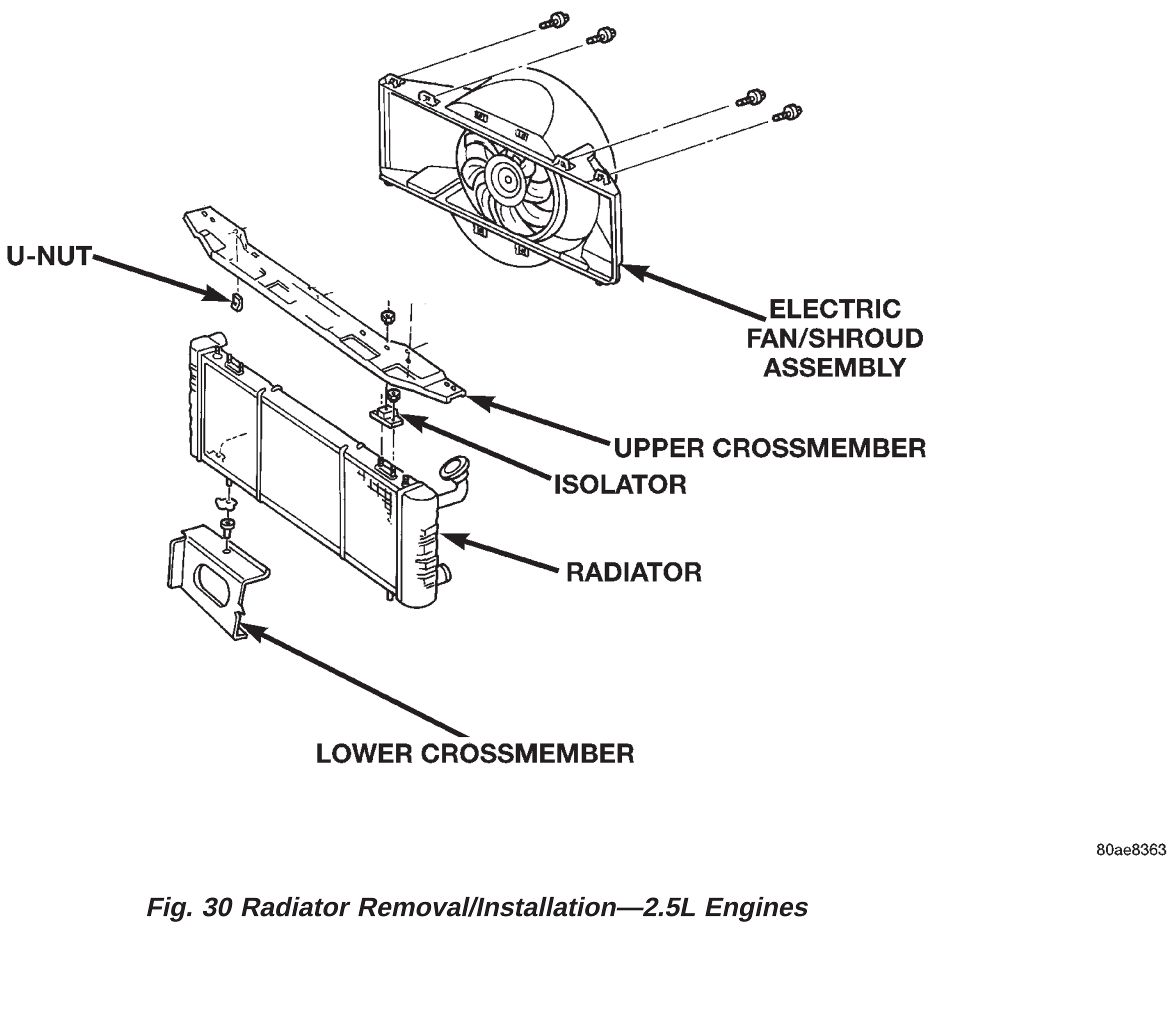


Fig. 30 Radiator Removal/Installation—2.5L Engines

REMOVAL AND INSTALLATION (Continued)

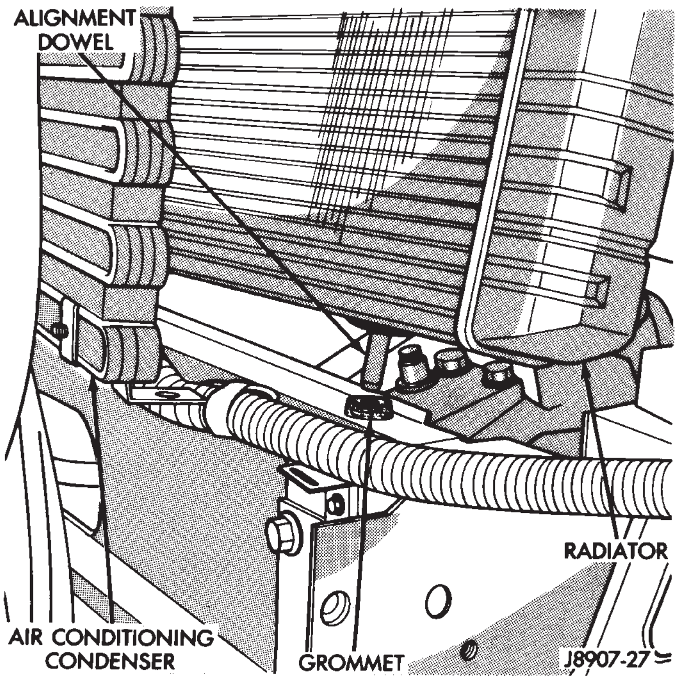


Fig. 31 Radiator Alignment Dowels—Typical

shroud into slots in bracket at bottom of radiator. Tighten mounting bolts to 3 N·m (31 in. lbs.) torque.

(8) Connect electric cooling fan electrical connector.

(9) Install power steering reservoir to fan shroud.

(10) Install grill.

(11) Connect battery negative cable.

(12) Fill cooling system with correct coolant. Refer to the Coolant section of this group.

(13) Install pressure cap.

(14) Check and adjust automatic transmission fluid level (if equipped).

(15) Start engine and visually check for leaks.

RADIATOR—4.0L

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (Fig. 6). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 7). If replacement is necessary, use only an original equipment clamp with matching number or letter.

REMOVAL

(1) Disconnect battery negative cable.

(2) Observe the previous **WARNINGS.**

(3) Remove radiator pressure cap.

(4) For access to radiator draincock, remove radiator grill mounting screws and remove grill. Refer to Group 23, Body for procedures.

(5) Attach one end of a 24 inch long X 1/4 inch ID hose to the radiator petcock (Fig. 32). Put the other end into a clean container. Open petcock and drain radiator.

(6) Disconnect electric cooling fan electrical connector, if equipped.

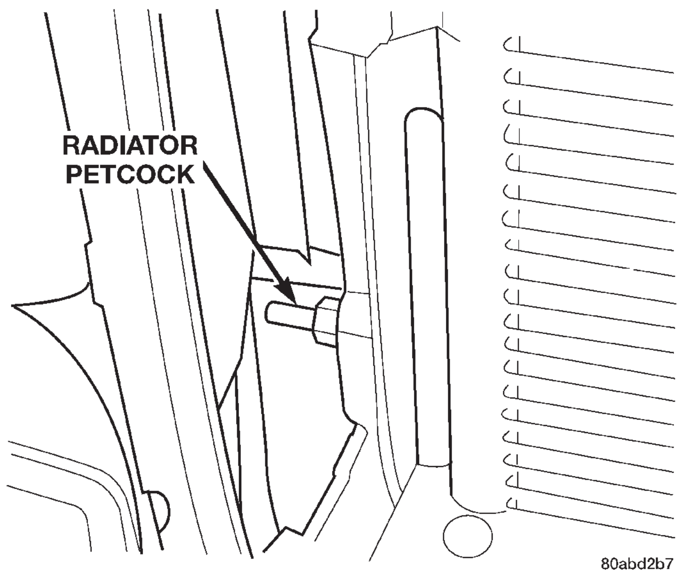


Fig. 32 Radiator Petcock—Typical

(7) If equipped, remove two electric cooling fan mounting bolts. Lift cooling fan straight up until alignment tabs at the bottom are clear of slots in bracket at bottom of radiator (Fig. 33).

(8) Remove the two mechanical (non-electrical) fan shroud mounting bolts. Lift shroud straight up until alignment tabs at the bottom are clear of slots in bracket at bottom of radiator (Fig. 33). Place shroud over mechanical fan.

(9) If equipped, disconnect and plug automatic transmission fluid cooler lines. Quick Connect Fitting Release Tool 6935 may be needed. If equipped with remote transmission cooler, remove line to cooler from bracket at bottom of radiator.

(10) Disconnect radiator upper and lower hoses clamps. Disconnect radiator upper and lower hoses.

REMOVAL AND INSTALLATION (Continued)

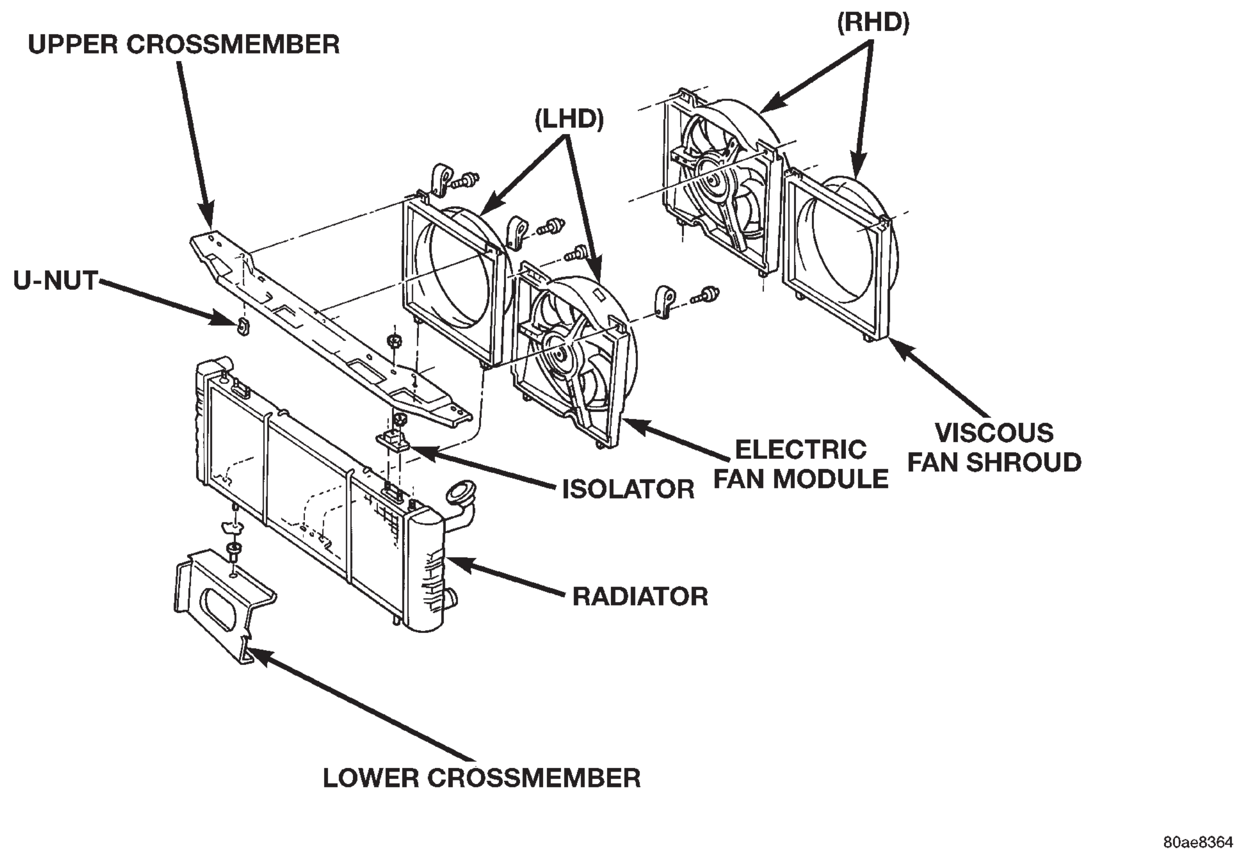


Fig. 33 Radiator Removal/Installation—4.0L Engines

(11) Mark the position of the hood latch striker on the radiator crossmember and remove hood latch striker.

(12) Remove two radiator upper crossmember to isolator nuts (Fig. 33).

(13) Remove four radiator upper crossmember bolts and remove upper crossmember.

(14) If equipped with air conditioning, separate radiator from condenser by removing condenser-to-radiator mounting brackets (Fig. 34).

(15) Lift radiator straight up and out of engine compartment taking care not to damage fins.

INSTALLATION

The radiator is supplied with two alignment dowels (Fig. 35). They are located on the bottom tank and fit into rubber grommets in the radiator lower crossmember.

(1) Lower radiator into engine compartment. Position alignment dowels into rubber grommets in radiator lower crossmember (Fig. 35).

(2) If equipped with air conditioning, attach condenser to radiator with mounting brackets (Fig. 34).

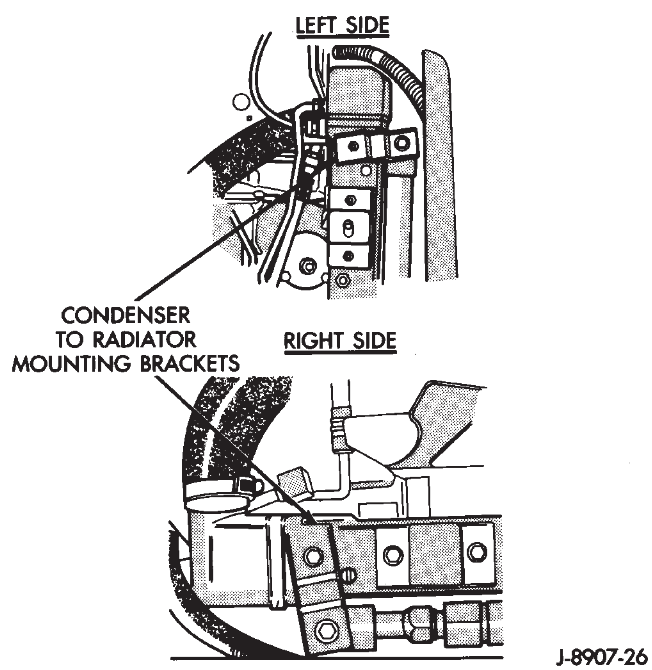


Fig. 34 Condenser to Radiator Mounting Brackets—4.0L Engine

REMOVAL AND INSTALLATION (Continued)

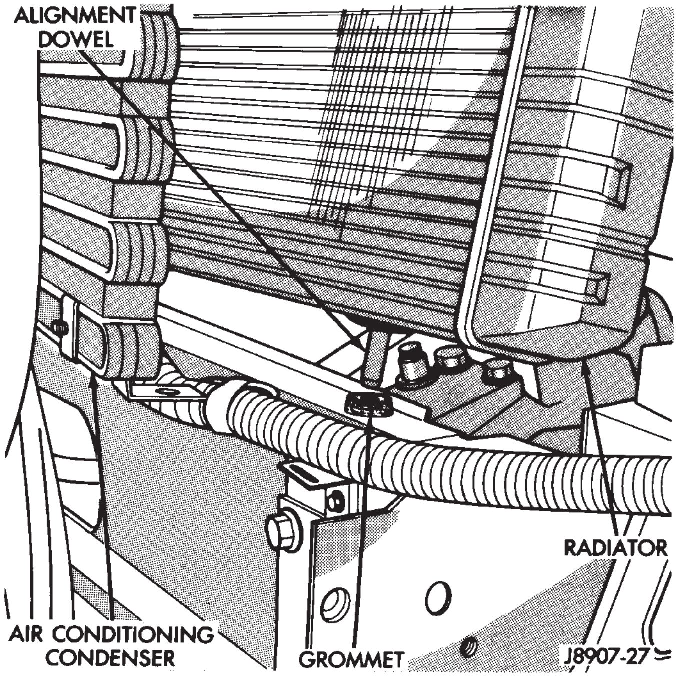


Fig. 35 Radiator Alignment Dowels—Typical

(3) Install radiator upper crossmember and four mounting bolts.

(4) Install radiator upper crossmember-to-isolator nuts. Tighten nuts to 10 N·m (86 in. lbs.) torque. If isolator-to-radiator nuts had been removed, tighten them to 5 N·m (47 in. lbs.) torque.

(5) Install hood latch striker. Note previously marked position.

(6) Connect radiator upper and lower hoses.

(7) If equipped, connect automatic transmission fluid cooler lines. Refer to Group 21, Transmissions for procedures. If equipped with remote cooler, attach cooler line to bracket at bottom of radiator.

(8) Install electric cooling fan (if equipped). Insert alignment tabs at bottom of fan shroud into slots in bracket at bottom of radiator. Tighten mounting bolts to 3 N·m (31 in. lbs.) torque.

(9) Connect electric cooling fan electrical connector.

(10) Install mechanical cooling fan shroud. Insert alignment tabs at bottom of shroud into slots in bracket at bottom of radiator. Tighten mounting bolts to 3 N·m (31 in. lbs.) torque.

(11) Close radiator draincock.

(12) Install grill.

(13) Connect negative battery cable.

(14) Fill cooling system with correct coolant. Refer to the Coolant section of this group.

(15) Install pressure cap.

(16) Check and adjust automatic transmission fluid level (if equipped).

ELECTRIC COOLING FAN—2.5L

The electric fan module is only to be serviced as an assembly.

REMOVAL

(1) Disconnect battery negative cable.

(2) Disconnect CRS hose from radiator filler neck and pull through (remove) the shroud retaining loops.

(3) Detach power steering reservoir from fan shroud and lay aside.

(4) Remove the four viscous fan/drive assembly mounting nuts from the water pump studs and remove viscous fan assembly.

(5) Disconnect cooling fan electrical connector.

(6) Remove the four upper fan shroud to radiator crossmember mounting screws (Fig. 36).

(7) Lift fan and shroud assy. from vehicle.

(8) Detach fan harness from shroud.

(9) Remove four fan module to shroud phillips head screws (Fig. 37) and remove module from shroud.

INSTALLATION

(1) Position fan module in shroud so that the harness exits the motor at the 12 o'clock postion (Fig. 37).

(2) Install and tighten fan module to shroud screws to 3 N·m (31 in. lbs.).

(3) Route fan harness through the shroud and attach to shroud at correct position.

(4) Lower fan and shroud assembly into place, making sure the shroud alignment tabs rest in their corresponding lower radiator slots.

(5) Install upper fan shroud screws and tighten to 3 N·m (31 in. lbs.).

(6) Connect fan electrical connector.

(7) Install power steering reservoir to shoud.

(8) Install viscous fan drive assy. to water pump hub and tighten nuts to 27 N·m (20 ft. lbs.).

(9) Connect battery negative cable.

ELECTRIC COOLING FAN—4.0L

REMOVAL

The auxiliary cooling fan is attached to the radiator upper crossmember behind the radiator.

(1) Remove the two fan mounting bolts from radiator upper crossmember (Fig. 38).

(2) Disconnect the electric fan connector.

(3) Lift fan straight up and out of vehicle.

INSTALLATION

(1) Align lower retaining tabs of fan shroud with slots in bracket at bottom of radiator. Push fan down into position.

REMOVAL AND INSTALLATION (Continued)

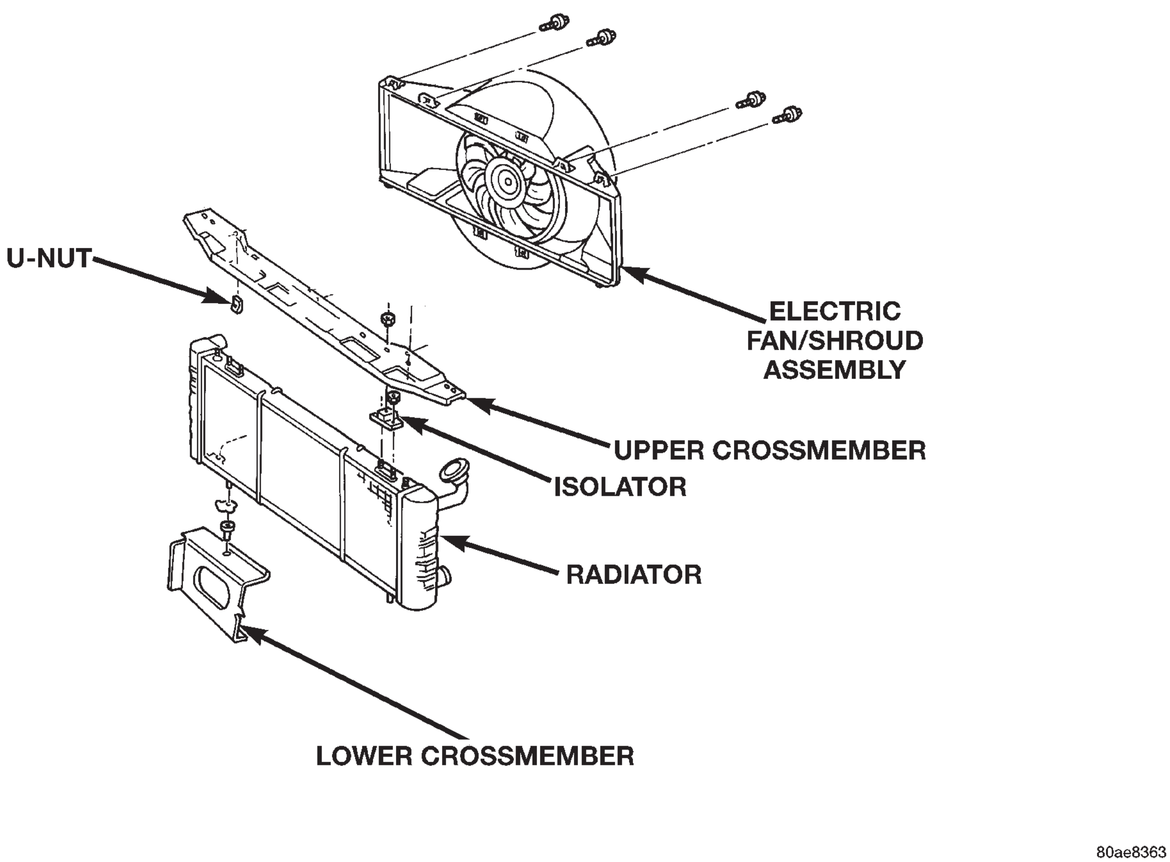


Fig. 36 Fan Shroud Removal/Installation

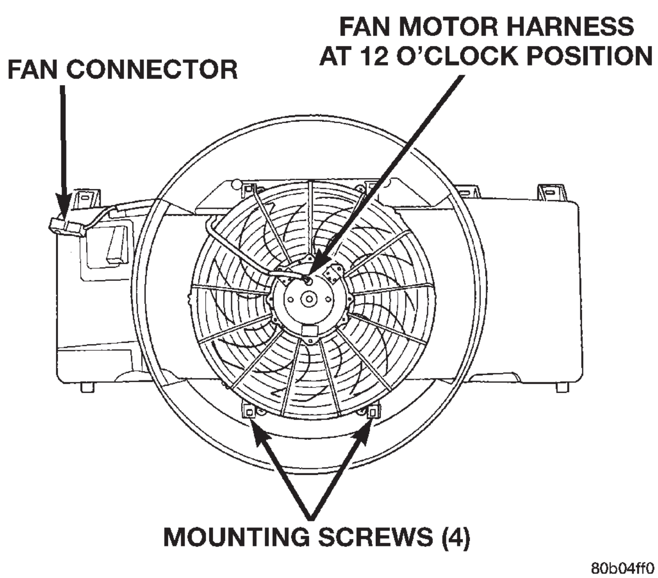


Fig. 37 Fan Module Orientation and Mounting

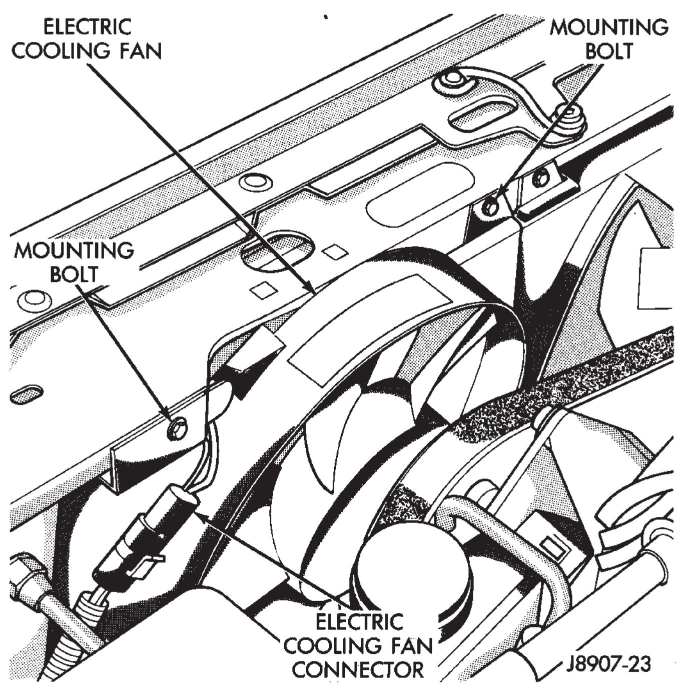


Fig. 38 Auxiliary Cooling Fan—Remove/Install—Typical

REMOVAL AND INSTALLATION (Continued)

(2) Tighten the mounting bolts to 4 N·m (31 in. lbs.) torque.

(3) Connect auxiliary cooling fan electrical connector.

BLOCK HEATER

REMOVAL

Refer to correct illustration (Fig. 39) (Fig. 40) when servicing block heater.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(1) Drain coolant from radiator and engine cylinder block.

(2) Unplug power cord from block heater.

(3) Loosen screw in center of block heater (Fig. 39) (Fig. 40).

(4) Remove block heater from cylinder block.

INSTALLATION

(1) Thoroughly clean the engine core hole and the block heater seat.

(2) Insert block heater assembly into core hole with element loop pointing **Up.**

(3) Seat block heater flush against block face. Tighten mounting screw to 3.6 N·m (32 in. lbs.) torque.

(4) Fill cooling system with coolant. Pressurize system and inspect for leaks.

(5) Plug power cord into block heater. Route cord away from moving parts, linkages and exhaust system components. Secure cord in place with tie-straps.

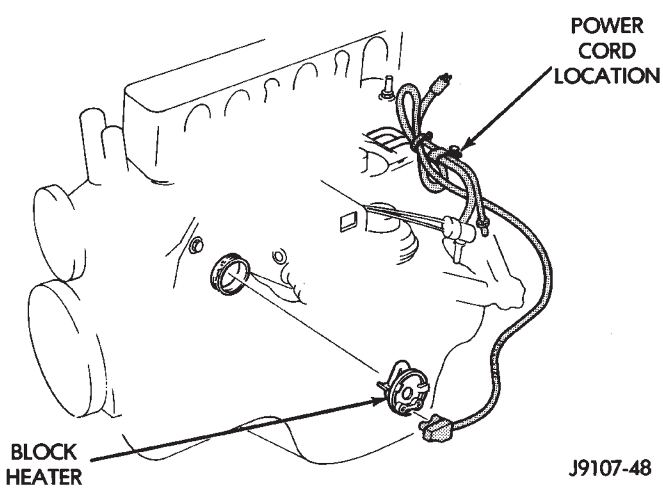


Fig. 39 Heater and Cord— 2.5L 4-Cylinder Engine

ENGINE ACCESSORY DRIVE BELTS

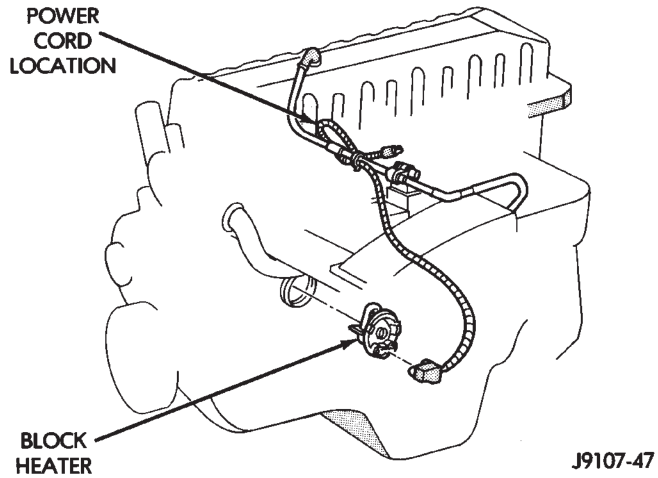


Fig. 40 Heater and Cord—4.0L 6-Cylinder Engine

Correct drive belt tension is required to ensure optimum performance of the belt driven engine accessories. There are different types of adjustment gauges for checking either a serpentine or a V-type belt. Refer to the instructions supplied with the gauge. Use the correct gauge when checking belt tension. Place gauge in the middle of the section of belt being tested (between two pulleys) to check tension. 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. **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. 41) (Fig. 42) (Fig. 43) (Fig. 44) for proper belt routing on vehicles with conventional left hand drive. Refer to (Fig. 45) (Fig. 46) for proper belt routing on vehicles with right hand drive (RHD). Or, refer to the Belt Routing Label located in the vehicle engine compartment.

BELT REPLACEMENT OR ADJUSTMENT—LEFT HAND DRIVE

Belt tension is adjusted at the power steering pump bracket and idler pulley assembly.

(1) Disconnect negative battery cable from battery.

(2) Loosen idler pulley bolt at the power steering bracket (Fig. 47).

(3) Loosen adjusting bolt until belt can be removed from pulleys.

(4) Remove belt.

REMOVAL AND INSTALLATION (Continued)

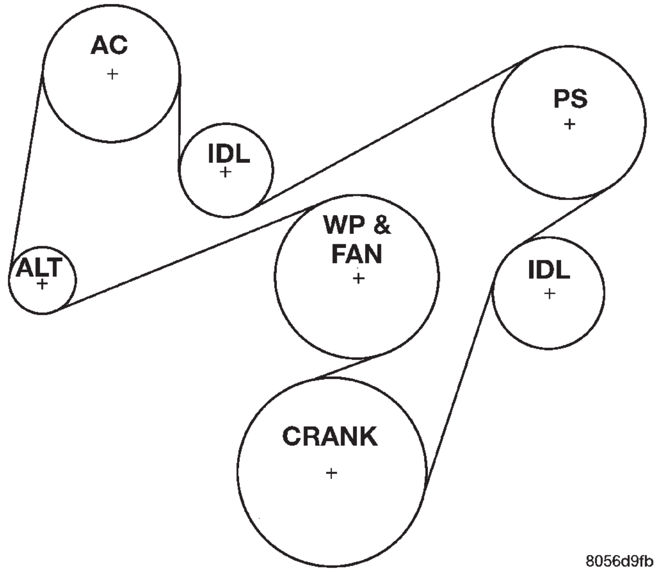


Fig. 41 Models with 2.5L Engine—With A/C

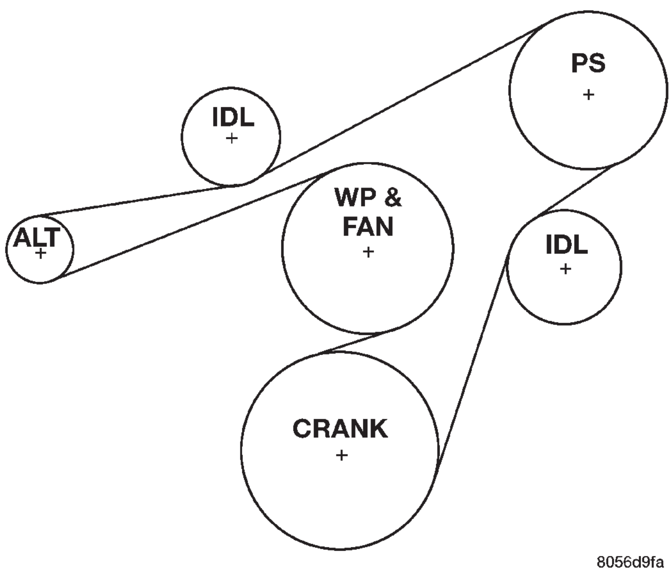


Fig. 42 Models with 2.5L Engine—Without A/C

INSTALLATION

(1) Check condition of all pulleys.

CAUTION: When installing the serpentine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to (Fig. 41) (Fig. 42) (Fig. 43) (Fig. 44) for correct belt routing.

(2) Install new belt.

(3) Using serpentine belt tension gauge, tighten adjusting bolt until belt reaches proper tension. Refer to Belt Tension at the rear of this section for proper belt tension.

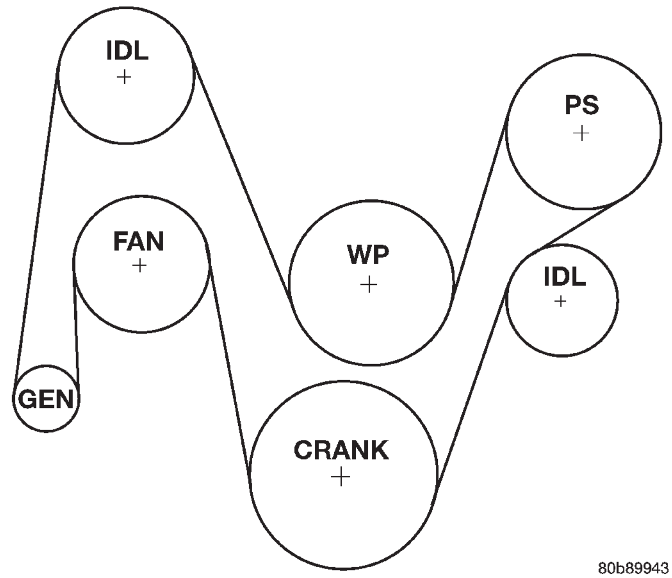


Fig. 43 Models with 4.0L Engine—Without A/C—Except RHD

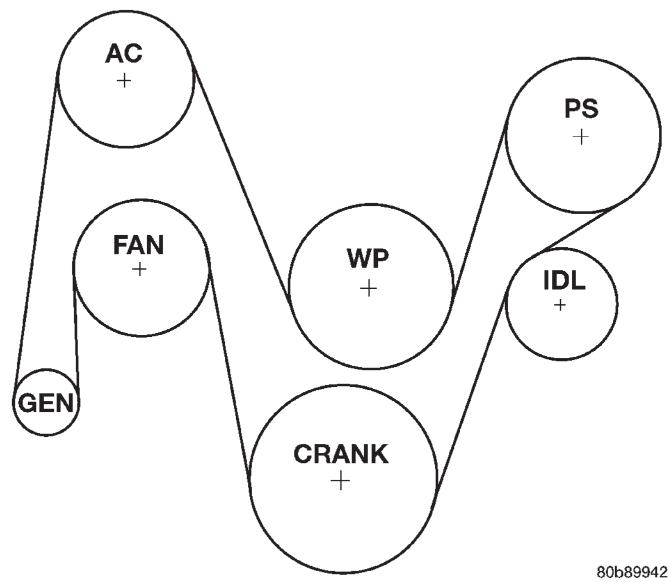


Fig. 44 Models With 4.0L Engine—With A/C—Except RHD

(4) After belt is tensioned correctly, tighten idler pulley bolt to 47 N·m (35 ft. lbs.).

(5) After idler pulley has been tightened into position, recheck belt tension. Adjust if necessary.

BELT REPLACEMENT OR ADJUSTMENT—RIGHT HAND DRIVE (4.0L)

(1) Disconnect negative battery cable from battery.

(2) Loosen lower alternator mounting bolt and nut.

(3) Loosen upper alternator mounting nut.

(4) Loosen adjusting bolt at upper alternator bracket (Fig. 48) until belt can be removed from pulleys.

(5) Remove belt.

REMOVAL AND INSTALLATION (Continued)

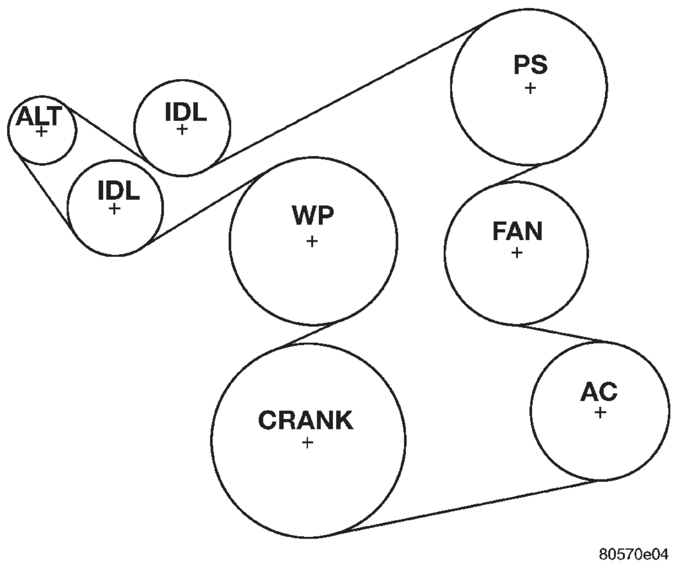


Fig. 45 Models With 4.0L Engine—With A/C—With RHD

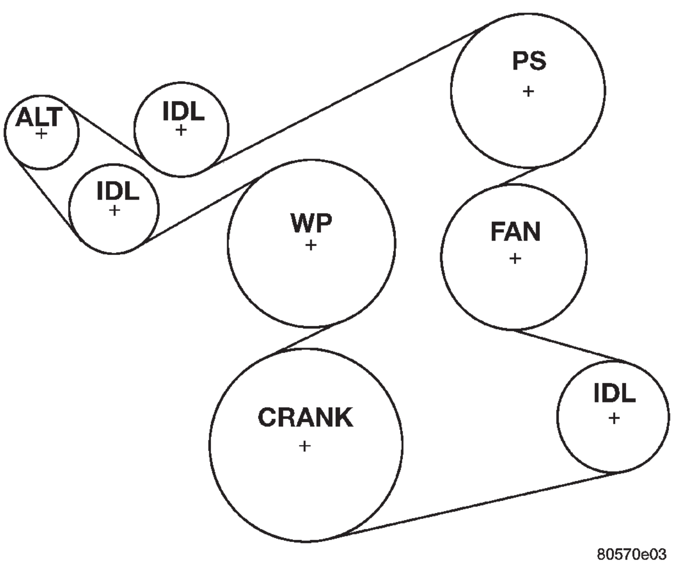


Fig. 46 Models With 4.0L Engine—Without A/C—With RHD

INSTALLATION

(1) Check condition of all pulleys.

CAUTION: When installing the serpentine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to (Fig. 45) (Fig. 46) for correct belt routing.

(2) Install new belt.

(3) Using serpentine belt tension gauge, tighten adjusting bolt until belt reaches proper tension. Refer to Belt Tension at the rear of this section for proper belt tension.

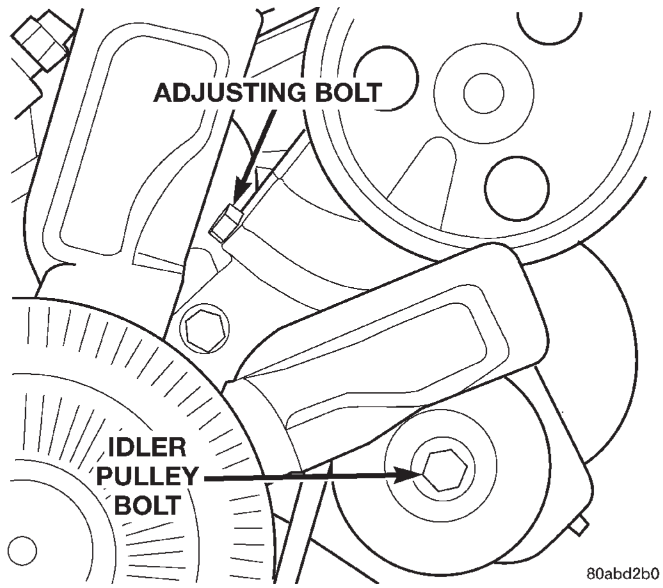


Fig. 47 Power Steering Pump Bracket and Idler Pulley

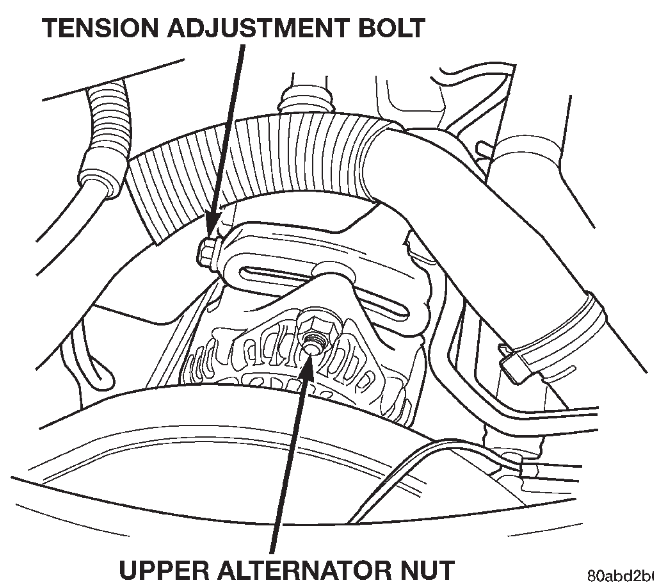


Fig. 48 Generator Belt Tension Adjust Bracket

(4) Tighten alternator upper and lower mounting bolts.

(5) After generator and adjust bracket have been tightened into position, recheck belt tension. Adjust if necessary.

COOLING SYSTEM FANS

REMOVAL

Some engines have the mechanical fan/viscous fan drive assembly mounted directly to the water pump hub (Fig. 49). It may also be mounted to a hub/bear-

REMOVAL AND INSTALLATION (Continued)

ing attached to an aluminum bracket on the right front side of engine (Fig. 50).

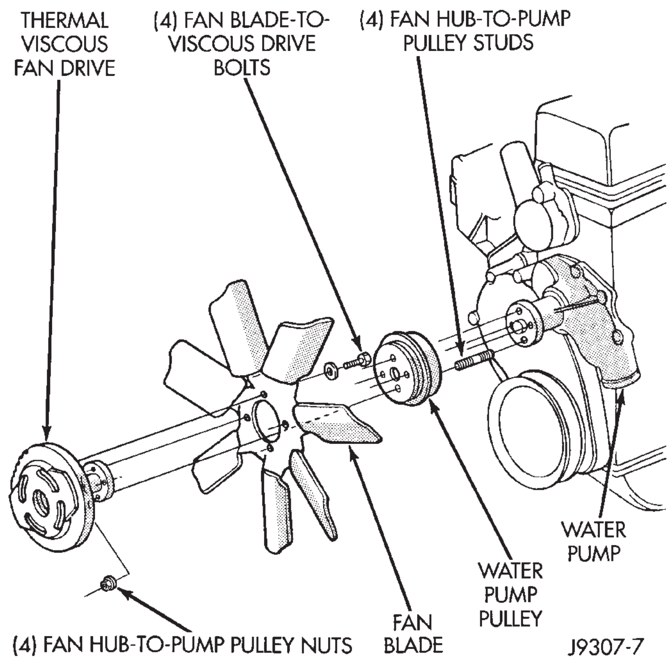


Fig. 49 Water Pump Mounted Cooling Fan

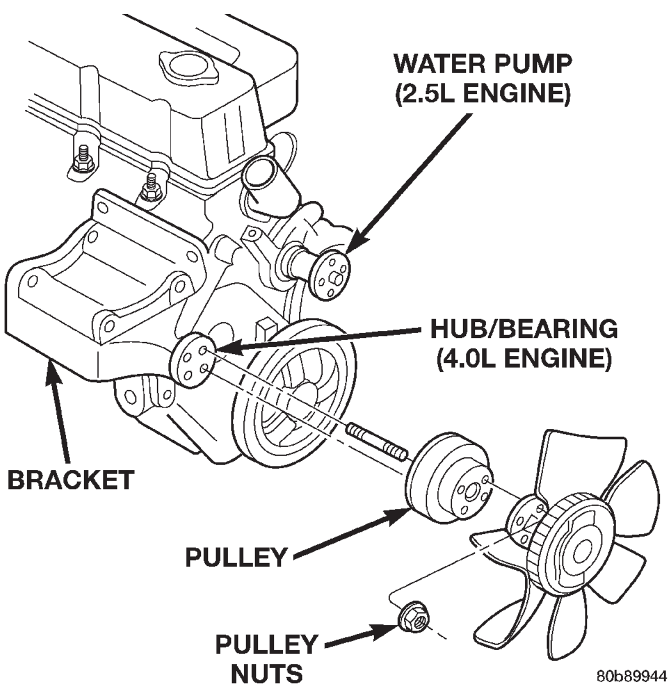


Fig. 50 Bracket Mounted Cooling Fan

(1) Loosen but do not remove at this time, the four fan hub mounting nuts (Fig. 49) (Fig. 50).

(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. 49) (Fig. 50) 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 fluid in viscous fan drive could drain into its bearing assembly and contaminate lubricant.

INSTALLATION

(1) Assemble fan blade to viscous fan drive. Tighten mounting bolts to 27 N·m (20 ft. lbs.) torque.

(2) Position mounting flange of fan blade/viscous fan drive assembly onto hub. Install four nuts and tighten to 24 N·m (18 ft. lbs.) torque. Tighten the first two nuts 180 degrees apart. Then tighten last two nuts.

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to appropriate Engine Accessory Drive Belt Schematic in this group for correct belt routing.

(3) Install accessory drive belts. Tension belts to specifications. Refer to the Specifications section at the end of this group.

VISCOUS FAN DRIVE REMOVAL/INSTALLATION

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.

CLEANING AND INSPECTION

RADIATOR PRESSURE CAP

INSPECTION

Visually inspect the pressure valve gasket on the cap. Replace cap if the gasket is swollen, torn or worn. Inspect the area around radiator filler neck for white deposits that indicate a leaking cap.

RADIATOR CLEANING

The radiator and air conditioning fins should be cleaned when an accumulation of bugs, leaves etc. has occurred. Clean radiator fins are necessary for good heat transfer. With the engine cold, apply cold water and compressed air to the back (engine side) of the radiator to flush the radiator and/or A/C condenser of debris.

COOLING SYSTEM 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 INSPECTION

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 preceding Removal procedure.

(2) Remove fan blade assembly from viscous fan drive unit (four bolts).

(3) Lay fan on a flat surface with leading edge facing down. With tip of blade touching flat surface, replace fan if clearance between opposite blade and surface is greater than 2.0 mm (.090 inch). Rocking motion of opposite blades should not exceed 2.0 mm (.090 inch). Test all blades in this manner.

WARNING: DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN BLADES IF NOT WITHIN SPECIFICATIONS.

(4) Inspect fan assembly for cracks, bends, loose rivets or broken welds. Replace fan if any damage is found.

CAUTION: If fan blade assembly is replaced because of mechanical damage, water pump and viscous fan drive should also be inspected. These components could have been damaged due to excessive vibration.

COOLING SYSTEM HOSES

INSPECTION

Inspect the hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed or swell excessively when the system is pressurized. The use of molded replacement hoses is recommended. When performing a hose inspection, inspect the radiator lower hose for proper position and condition of the spring.

SPECIFICATIONS

BELT TENSION

Belt tension must be adjusted . Refer to the following Belt Tension chart for specifications.

*** 800-900 N (180-200 lbs. force)**
(With ** new serpentine belt)

*** 623-712 N (140-160 lbs. force)**
(With ** used serpentine belt)

** Belt is considered new if it has been used 15 minutes or less.

* Specifications for use with a belt tension gauge. Refer to operating instructions supplied with gauge.

J9307-54

BELT TENSION

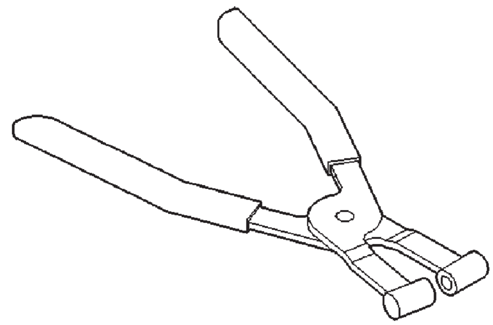
SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS

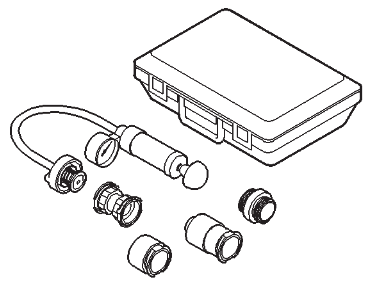
DESCRIPTION	TORQUE
Auto. Trans. Auxiliary Oil Cooler	
Mtg. Screws	2 N·m (18in. lbs.)
Block Heater	
Mounting Screw	4 N·m (20 in. lbs.)
Condenser-to-Radiator	
Screws	6 N·m (55 in. lbs.)
Electric Cooling Fan	
Mtg. Screws	3 N·m (31 in. lbs.)
Fan Blade Assy to Viscous Fan Drive	
Bolts	24 N·m (18 ft. lbs.)
Fan Shroud (2.5L Engine)	
Mounting Bolts	3 N·m (31 in. lbs.)
Fan Shroud (4.0L Engine)	
Screws	3 N·m (31 in. lbs.)
Generator Pivot	
Bolt	38 N·m (28 ft. lbs.)
Generator Rear Adj.	
Bolt	27 N·m (20 ft. lbs.)
Isolator-to-Crossmember	
Nuts	10 N·m (86 in. lbs.)
Isolator-to-Radiator	
Nuts	5 N·m (47 in. lbs.)
Radiator (4.0L Engine)	
Mounting Bolts	8 N·m (6 ft. lbs.)
Radiator (2.5L Engine)	
Mounting Bolts	6 N·m (55 in. lbs.)
Thermostat Housing	
Bolts	20 N·m (15 ft. lbs.)
Viscous Fan Drive Assy. to Water Pump or Hub Bearing	
Nuts	27 N·m (20 ft. lbs.)
Water Pump	
Bolts	23 N·m (17 ft. lbs.)

SPECIAL TOOLS

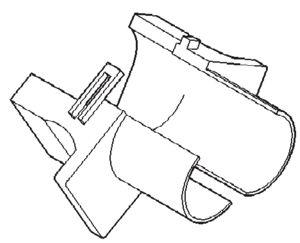
COOLING



Hose Clamp Tool—6094



Cooling System Pressure Tester—7700A



3/8” Quick Connect Release Tool—6935

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. The cooling system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system. A water manifold collects coolant from the cylinder heads. A separate and remotely mounted, pressurized coolant tank using a pressure/vent cap is used.

COOLING SYSTEM COMPONENTS

The cooling system consists of:

- Charge Air Cooler
- Electric Cooling Fan
- A brass-core radiator with plastic side tanks
- A radiator mounted fill vent valve
- A separate pressurized coolant tank
- A threaded-on, pressure/vent cap mounted to the coolant tank
- Cooling fan (mechanical)
- Thermal viscous fan drive
- Fan shroud
- Thermostat
- Coolant
- Low coolant level sensor
- Low coolant warning lamp
- Coolant temperature gauge
- Water pump

GENERAL INFORMATION (Continued)

- Hoses and hose clamps

COOLANT ROUTING

For cooling system flow routing, refer to (Fig. 1).

RADIATOR

The radiator used with the 2.5L diesel is constructed of a horizontal down-flow brass core with plastic side tanks.

CAUTION: Plastic tanks, while stronger than brass, are subject to damage by impact, such as wrenches.

ENGINE ACCESSORY DRIVE BELTS

The accessory drive components are operated by a single, crankshaft driven, serpentine drive belt. An automatic belt tensioner is used to maintain correct belt tension at all times.

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to water pump rotating in wrong direction. Refer to the engine Belt Schematic in Specification section at the end of this group for the correct belt routing.

COOLANT TANK

A pressurized, plastic coolant tank is used with the cooling system. This separate tank should be considered part of the radiator. The tank is located at the right-rear side of the engine compartment and is mounted as the highest point of the cooling system. This will allow any air or vapor exceeding the pres-

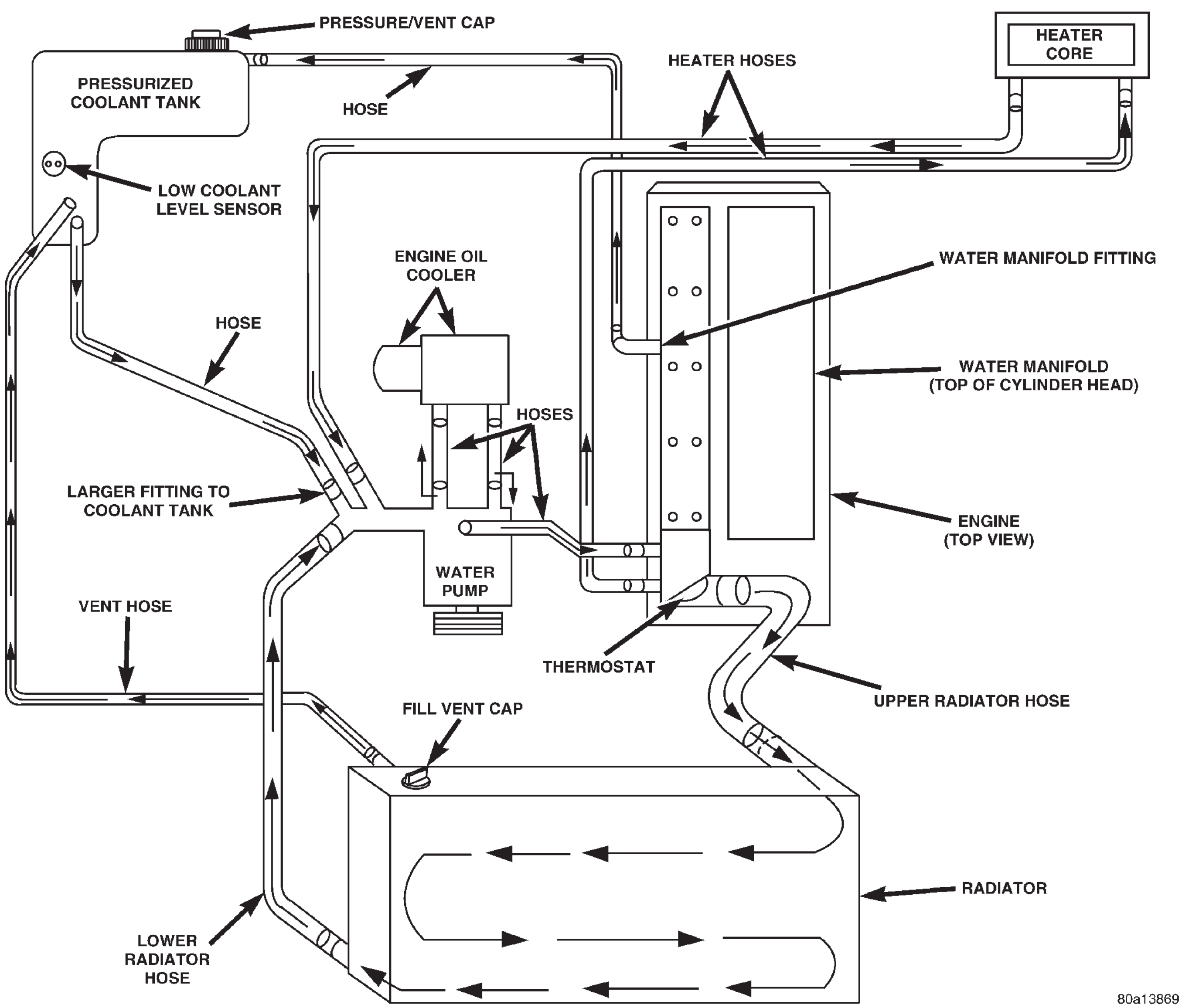


Fig. 1 Coolant Flow—2.5L Diesel Engine—Typical

GENERAL INFORMATION (Continued)

sure/vent cap rating to escape through the cap. Coolant will flow through the tank at all times during engine operation whether the engine is cold or at normal operating temperature. The coolant tank is equipped with a threaded pressure/vent cap. Refer to Pressure/Vent Cap for additional information.

The low coolant level sensor is located on the bottom of the tank.

WATER PUMP

A centrifugal water pump circulates coolant through the water jackets, passages, water manifold, radiator core, pressurized coolant tank, cooling system hoses and heater core. The pump is driven from the engine crankshaft by a drive belt. The water pump is bolted to the water pump adapter (Fig. 2). The water pump adapter is bolted to the engine.

The water pump impeller is pressed onto the rear of a shaft that rotates in bearings pressed into the housing. The bottom of the housing is equipped with a small vent tube (Fig. 2) to allow seepage to escape. A drain hose is attached to this tube. The water pump seals are lubricated by the antifreeze in the coolant mixture. No additional lubrication is necessary.

A rubber o-ring (instead of a gasket) is used as a seal between the water pump and the water pump adapter (Fig. 2).

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.

COOLANT

Coolant flows through the engine water jackets and water manifold 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.

LOW COOLANT LEVEL SENSOR

The low coolant level sensor checks for low coolant level in the coolant tank. A signal will be sent from this sensor to the powertrain control module (PCM). When the PCM determines low coolant level, the instrument panel mounted low coolant level warning lamp will be illuminated. The sensor is located on the front side of the coolant tank (Fig. 3). For information, refer to Group 8E, Instrument Panel and Gauges.

If this lamp is illuminated, it indicates the need for service.

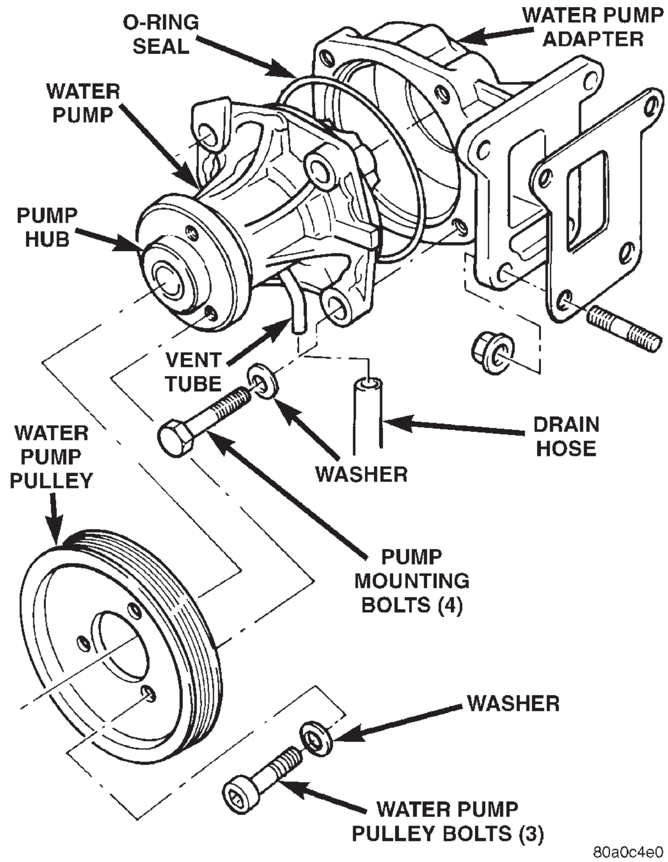


Fig. 2 Water Pump— Typical

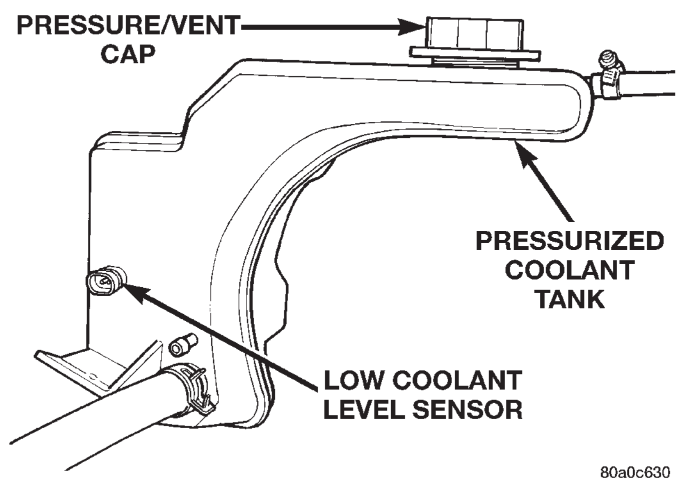


Fig. 3 Low Coolant Level Sensor

DESCRIPTION AND OPERATION

THERMOSTAT

A pellet-type thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. The thermostat starts to open at 80°C (176°F). Above this temperature, coolant is allowed to flow to the radiator. This pro-

DESCRIPTION AND OPERATION (Continued)

vides quick engine warmup and overall temperature control.

The same thermostat is used for winter and summer seasons. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes other problems. These are: longer engine warmup time, unreliable warmup performance, increased exhaust emissions and crankcase condensation. This condensation can result in sludge formation.

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing.

PRESSURE/VENT CAP

The pressure/vent cap is threaded-on to the coolant tank. This cap releases excess pressure at some point within a range of 90-117 kPa (13- 17 psi). The actual pressure relief point (in pounds) is labeled on top of the cap (Fig. 4).

The cooling system will operate at pressures slightly above atmospheric pressure. This results in a higher coolant boiling point allowing increased radiator cooling capacity. The cap (Fig. 4) contains a spring-loaded pressure relief valve. This valve opens when system pressure reaches approximately 103 kPa (15 psi).

When the engine is cooling down, vacuum is formed within the cooling system. To prevent collapse of the radiator and coolant hoses from this vacuum, a vacuum valve is used within the cap. This valve prevents excessive pressure differences from occurring between the closed cooling system and the atmosphere. If the vacuum valve is stuck shut, the radiator and/or cooling system hoses will collapse on cooldown.

NOTE: Do not use any type of tool when tightening the cap. Hand tighten only (approximately 5 N·m or 44 in. lbs.) torque.

COOLANT PERFORMANCE

ETHYLENE-GLYCOL MIXTURES

The required ethylene-glycol (antifreeze) and water mixture depends upon the climate and vehicle operating conditions. The recommended mixture of 50/50 ethylene-glycol and water will provide protection against freezing to -37 deg. C (-35 deg. F). The antifreeze concentration **must always** be a minimum of 44 percent, year-round in all climates. **If percentage is lower than 44 percent, engine parts may be eroded by cavitation, and cooling system components may be severely damaged by corrosion.** Maximum protection against freezing is provided

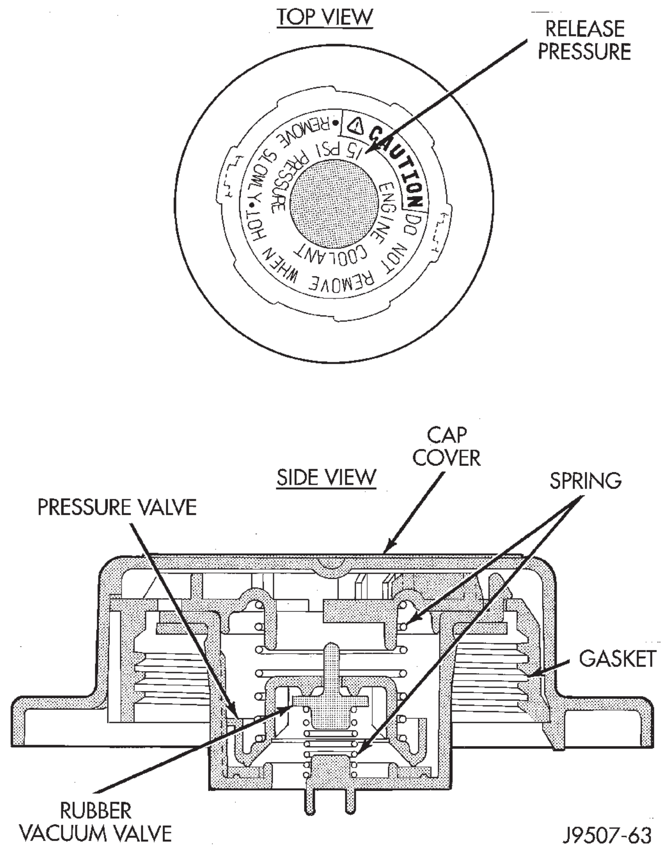


Fig. 4 Coolant Tank Pressure/Vent Cap

with a 68 percent antifreeze concentration, which prevents freezing down to -67.7 deg. C (-90 deg. F). A higher percentage will freeze at a warmer temperature. Also, a higher percentage of antifreeze can cause the engine to overheat because the specific heat of antifreeze is lower than that of water.

100 Percent Ethylene-Glycol—Should Not Be Used in Chrysler Vehicles

Use of 100 percent ethylene-glycol will cause formation of additive deposits in the system, as the corrosion inhibitive additives in ethylene-glycol require the presence of water to dissolve. The deposits act as insulation, causing temperatures to rise to as high as 149 deg. C (300) deg. F). This temperature is hot enough to melt plastic and soften solder. The increased temperature can result in engine detonation. In addition, 100 percent ethylene-glycol freezes at 22 deg. C (-8 deg. F).

Propylene-glycol Formulations—Should Not Be Used in Chrysler Vehicles

Propylene-glycol formulations do not meet Chrysler coolant specifications. It's overall effective temperature range is smaller than that of ethylene-glycol. The freeze point of 50/50 propylene-glycol and water is -32 deg. C (-26 deg. F). 5 deg. C higher

DESCRIPTION AND OPERATION (Continued)

than ethylene-glycol's freeze point. The boiling point (protection against summer boil-over) of propylene-glycol is 125 deg. C (257 deg. F) at 96.5 kPa (14 psi), compared to 128 deg. C (263 deg. F) for ethylene-glycol. Use of propylene-glycol can result in boil-over or freeze-up in Chrysler vehicles, which are designed for ethylene-glycol. Propylene glycol also has poorer heat transfer characteristics than ethylene glycol. This can increase cylinder head temperatures under certain conditions.

Propylene-glycol/Ethylene-glycol Mixtures—Should Not Be Used in Chrysler Vehicles

Propylene-glycol/ethylene-glycol Mixtures can cause the destabilization of various corrosion inhibitors, causing damage to the various cooling system components. Also, once ethylene-glycol and propylene-glycol based coolants are mixed in the vehicle, conventional methods of determining freeze point will not be accurate. Both the refractive index and specific gravity differ between ethylene glycol and propylene glycol.

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

COOLING SYSTEM HOSES

Rubber hoses route coolant to and from the radiator, water manifold and heater core. Models equipped with air conditioning have a heater water control (shut-off) valve. This is located in-line with the heater core inlet and outlet hoses. It controls coolant flow to the heater core when the air conditioning system is in operation.

Radiator lower hoses are spring-reinforced to prevent collapse from water pump suction at moderate and high engine speeds.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP (Fig. 5). ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 6). If replacement is necessary, use only an original equipment clamp with matching number or letter.

Inspect the hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed, or swell excessively when the system is pressurized.

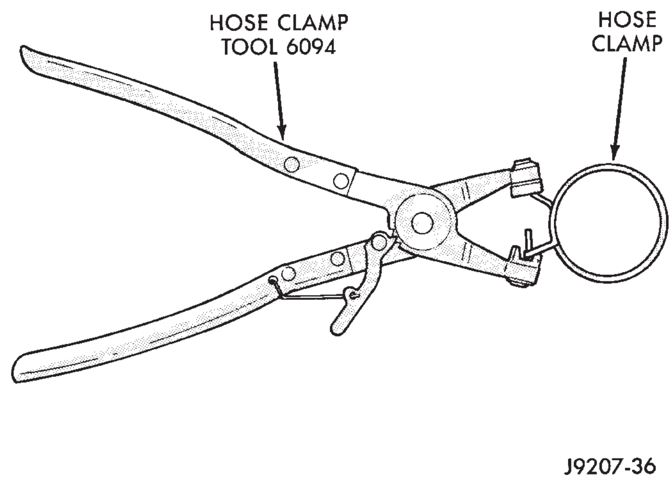


Fig. 5 Hose Clamp Tool

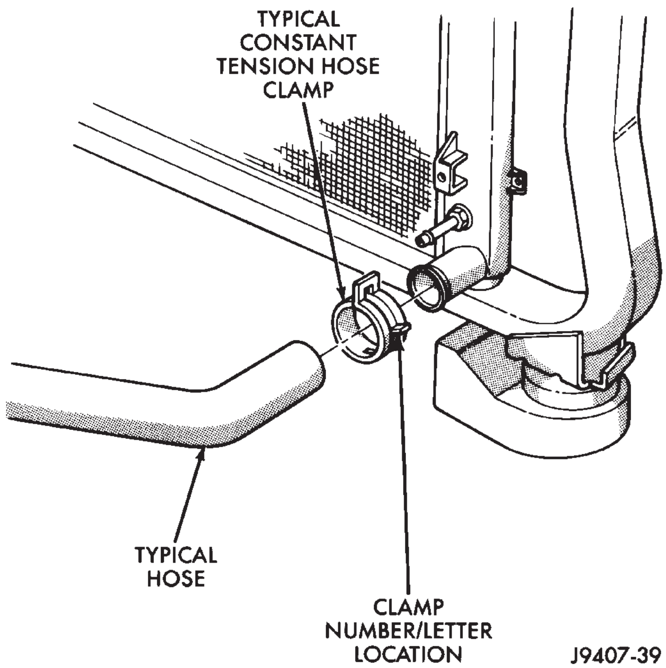


Fig. 6 Clamp Number/Letter Location

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.

DESCRIPTION AND OPERATION (Continued)

VISCOUS FAN DRIVE

The thermal viscous fan drive (Fig. 7) is a silicone-fluid-filled coupling. It connects the fan blade assembly to the fan pulley. The coupling allows the fan to be driven in a normal manner. This is done at low engine speeds while limiting the top speed of the fan to a predetermined maximum level at higher engine speeds. A bimetallic spring coil is located on the front face. This spring coil reacts to the temperature of the radiator discharge air. It engages the viscous fan drive for higher fan speed if the air temperature from the radiator rises above a certain point. Until additional engine cooling is necessary, the fan will remain at a reduced rpm regardless of engine speed.

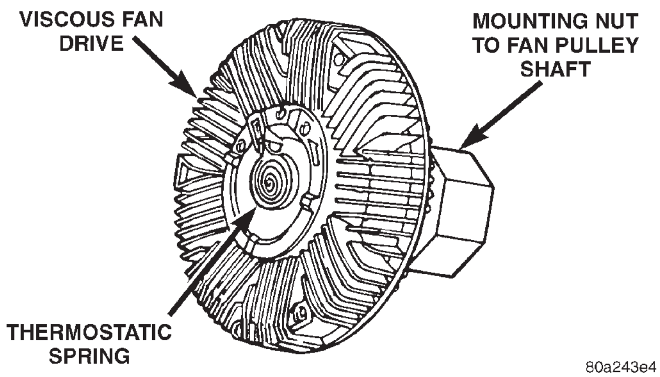


Fig. 7 Viscous Fan Drive

The viscous fan drive will only engage when sufficient heat is present. This is when the air flowing through the radiator core causes a reaction from the bimetallic coil. It then increases fan speed to provide the necessary additional engine cooling.

Once the engine has cooled, the radiator discharge temperature will drop. The bimetallic coil again reacts and the fan speed is reduced to the previous disengaged speed.

CAUTION: Some engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

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.

BELT TENSION

Correct accessory drive belt tension is required to be sure of optimum performance of belt driven engine accessories. If specified tension is not maintained, belt slippage may cause; engine overheating, lack of power steering assist, loss of air conditioning capacity, reduced generator output rate and greatly reduced belt life.

An automatic belt tensioner is used to maintain correct belt tension at all times. Do not attempt to check belt tension with a belt tension gauge on vehicles equipped with an automatic belt tensioner. Refer to Automatic Belt Tensioner in this group.

AUTOMATIC BELT TENSIONER

Drive belt tension is controlled by a spring loaded automatic belt tensioner located below and to the front of the engine oil filter (Fig. 8).

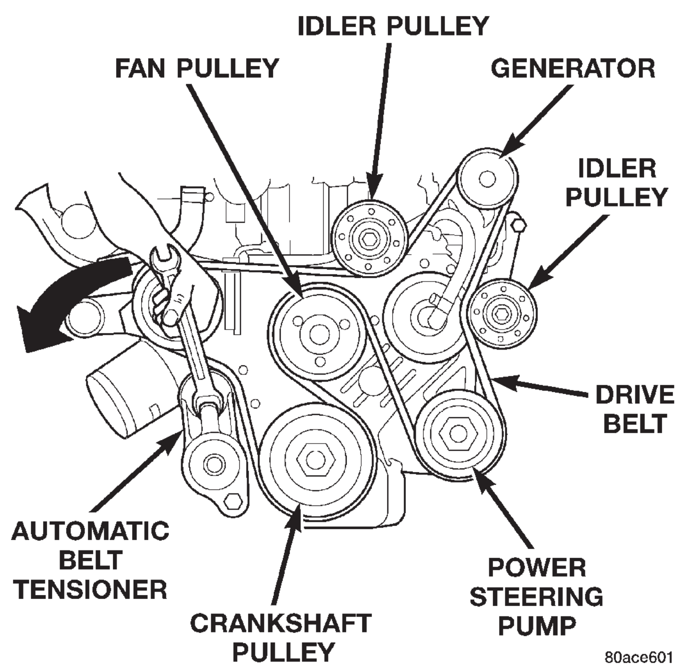


Fig. 8 Automatic Belt Tensioner Assembly

DESCRIPTION AND OPERATION (Continued)

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE THE AUTOMATIC BELT TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY.

DIAGNOSIS AND TESTING

PRELIMINARY CHECKS

ENGINE COOLING SYSTEM OVERHEATING

Establish what driving conditions caused the complaint. Abnormal loads on the cooling system such as the following may be the cause:

(1) PROLONGED IDLE, VERY HIGH AMBIENT TEMPERATURE, SLIGHT TAIL WIND AT IDLE, SLOW TRAFFIC, TRAFFIC JAMS, HIGH SPEED OR STEEP GRADES.

Driving techniques that avoid overheating are:

- Idle with A/C off when temperature gauge is at end of normal range.
- Increasing engine speed for more air flow is recommended.

(2) TRAILER TOWING:

Consult Trailer Towing section of owners manual. Do not exceed limits.

(3) 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
- Brakes (possibly dragging)
- Changed parts (incorrect water pump)
- Reconditioned radiator or cooling system refilling (possibly under filled or air trapped in system).

NOTE: If investigation reveals none of the previous items as a cause for an engine overheating complaint, refer to following Cooling System Diagnosis charts.

These charts are to be used as a quick-reference only. Refer to the group text for information.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS–DIESEL ENGINE

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOW	1. Diesel engines, due to their inherent efficiency are slower to warm up than gasoline powered engines, and will operate at lower temperatures when the vehicle is unloaded.	1. The low gauge reading may be normal. Refer to thermostats in the manual text for information. See Thermostat Diagnosis - Diesel Engine.
	2. Is the temperature gauge connected to the temperature gauge coolant sensor on the engine?	2. Check, the engine temperature sensor connector in the engine compartment. Refer to Group 8E. Repair as necessary.
	3. Is the temperature gauge operating OK?	3. Check gauge operation. Refer to Group 8E. Repair as necessary.
	4. Coolant level low in cold ambient temperatures accompanied with poor heater performance.	4. Check coolant level in the coolant tank. Inspect system for leaks. Repair leaks as necessary. Refer to the Coolant section of the manual text for WARNINGS and precautions before removing the pressure cap.
	5. Improper operation of internal heater doors or heater controls.	5. Inspect heater and repair as necessary. Refer to Group 24, Heating and Air Conditioning for procedures.
TEMPERATURE GAUGE READS HIGH. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM COOLING SYSTEM	1. Trailer is being towed, a steep hill is being climbed, vehicle is operated in slow moving traffic, or engine is being idled with very high ambient (outside) temperatures and the air conditioning is on. Higher altitudes could aggravate these conditions.	1. This may be a temporary condition and repair is not necessary. Turn off the air conditioning and attempt to drive the vehicle without any of the previous conditions. Observe the temperature gauge. The gauge should return to the normal range. If the gauge does not return to normal range, determine the cause for overheating and repair. Refer to POSSIBLE CAUSES (numbers 2 through 16).
	2. Is temperature gauge reading correctly?	2. Check gauge. Refer to Group 8E. Repair as necessary.
	3. Coolant low in coolant tank and radiator?	3. Check for coolant leaks and repair as necessary. Refer to Testing Cooling System For Leaks in this group.
	4. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following step 5.	4. Tighten cap.
	5. Poor seals at pressure/vent cap.	5. (a) Check condition of cap and cap seals. Refer to Pressure/Vent Cap. Replace cap if necessary. (b) Check condition of coolant tank filler neck. Make sure it does not leak pressure.
	6. Freeze point of antifreeze not correct. Mixture may be too rich.	6. Check antifreeze. Refer to Coolant section of this group. Adjust antifreeze-to-water ratio as required.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM COOLING SYSTEM - CONT.	7. Coolant not flowing through system.	7. Check for coolant flow in coolant tank with engine warm and thermostat open. Coolant should be observed flowing through tank. If flow is not observed, determine reason for lack of flow and repair as necessary.
	8. Radiator or A/C condenser fins are dirty or clogged.	8. Clean insects or debris. Refer to Radiator Cleaning in this group.
	9. Radiator core is corroded or plugged.	9. Have radiator re-cored or replaced.
	10. Aftermarket A/C installed without proper A/C condenser.	10. Install proper A/C condenser.
	11. Dragging brakes.	11. Check and correct as necessary. Refer to Group 5, Brakes in the manual text.
	12. Non-factory bug screen is being used reducing airflow.	12. Only a factory approved screen may be used.
	13. Thermostat partially or completely shut. This is more prevalent on high mileage vehicles.	13. Check thermostat operation and replace as necessary. Refer to Thermostats in this group.
	14. Thermal viscous fan drive not operating properly.	14. Check fan drive operation and replace if necessary. Refer to Viscous Fan Drive in this group.
	15. Cylinder head gasket leaking.	15. Check for cylinder head gasket leaks. Refer to Testing Cooling System For Leaks in this group. For repair, refer to Group 9, Engines.
	16. Heater core leaking.	16. Check heater core for leaks. Refer to Group 24, Heating and Air Conditioning. Repair as necessary.
TEMPERATURE GAUGE READING IS INCONSISTENT (FLUCTUATES, CYCLES OR IS ERRATIC)	1. During cold weather operation, with the heater blower in the high position, the gauge reading may drop slightly. Fluctuation is also influenced by loads, outside temperature and extended idle time with diesel engines.	1. A normal condition. No correction is necessary.
	2. Temperature gauge or engine mounted gauge sensor defective or shorted. Also, corroded or loose wiring in this circuit.	2. Check operation of gauge and repair if necessary. Refer to Group 8E, Instrument Panel And Gauges.
	3. Gauge reading rises when vehicle is brought to a stop after heavy use (engine still running).	3. A normal condition. No correction is necessary. Gauge reading should return to normal range after vehicle is driven.
	4. Gauge reading high after re-starting a warmed-up (hot) engine.	4. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation.
	5. Coolant level low in coolant tank (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.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READING IS INCONSISTENT (FLUCTUATES, CYCLES OR IS ERRATIC), CONT'D.	6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing thermostat to open late. 7. Water pump impeller loose on shaft. 8. Loose accessory drive belt (water pump slipping). 9. Air leak on the suction side of water pump allows air to build up in 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. Check water pump and replace as necessary. Refer to Water Pumps in this group. 8. Refer to Engine Accessory Drive Belts in this group. Check and correct as necessary. 9. Locate leak and repair as necessary.
PRESSURE CAP IS BLOWING OFF STEAM AND/OR COOLANT. TEMPERATURE GAUGE READING MAY BE ABOVE NORMAL BUT NOT HIGH. COOLANT LEVEL MAY BE HIGH IN COOLANT TANK	1. Pressure relief valve in pressure/vent cap is defective. 2. Major head gasket leak or cracked cylinder head.	1. Check condition of pressure/vent cap and cap seals. Refer to Pressure/Vent Caps in this group. Replace cap as necessary. 2. Refer to Engine group and repair 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.
HOSE OR HOSES COLLAPSE WHEN ENGINE IS COOLING	1. Vacuum created in cooling system on engine cool-down is not being relieved through pressure/vent cap.	1. Cap relief valve stuck. Refer to Pressure/Vent Cap in this group. Replace if necessary.
NOISY FAN	1. Fan blades loose. 2. Fan blades striking a surrounding object. 3. Air obstructions at radiator or air conditioning condenser. 4. Thermal viscous fan drive has defective bearing. 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.	1. Replace fan blade assembly. Refer to Cooling System Fans in this group. 2. Locate point of fan blade contact and repair as necessary. 3. Remove obstructions and/or clean debris or insects from radiator or A/C condenser. 4. Replace fan drive. Bearing is not serviceable. Refer to Viscous Fan Drive in this group. 5. Refer to Viscous Fan Drive in this group for an explanation of normal fan noise.

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DIAGNOSIS AND TESTING (Continued)

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. The cooling system is 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. MAY BE ACCOMPANIED BY LOW GAUGE READING	1. Diesel engines, due to their inherent efficiency are slower to warm up than gasoline powered engines, and will operate at lower temperatures when the vehicle is unloaded. 2. Coolant level low. 3. Obstructions in heater hose fittings at engine. 4. Heater hose kinked. 5. Water pump is not pumping water to heater core. When the engine is fully warmed up, both heater hoses should be hot to the touch. If only one of the hoses is hot, the water pump may not be operating correctly. The accessory drive belt may also be slipping causing poor water pump operation.	1. The low gauge reading may be normal. Refer to Thermostats in the manual text for information. See Thermostat Diagnosis - Diesel Engine. 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. Located kinked area and repair as necessary. 5. Refer to Water Pumps in this group. Repair as necessary. If a slipping belt is detected, refer to Engine Accessory Drive Belts in this group. Repair as necessary.

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DIAGNOSIS AND TESTING (Continued)

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. 2. Is temperature gauge reading above the normal range? 3. Is cooling fan operating correctly? 4. Has undercoating been applied to any unnecessary component?	1. Locate missing shields and replace or repair as necessary. 2. Refer to the previous Temperature Gauge Reads High in these Diagnosis Charts. Repair as necessary. 3. Refer to Cooling System Fan in this group for diagnosis. Repair as necessary. 4. Clean undercoating as 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 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 HOT and COLD marks at normal engine operating temperature, the level should return to within that range after operation at elevated temperatures.	1. A normal condition. No repair is necessary.

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DIAGNOSIS AND TESTING (Continued)

THERMOSTAT

DIAGNOSIS

Diesel engines, due to their inherent efficiency are slower to warm up than gasoline powered engines, and will operate at lower temperatures when the vehicle is unloaded. Because of this, lower temperature gauge readings for diesel versus gasoline engines may, at times be normal.

TESTING

NOTE: The DRB scan tool cannot be used to monitor engine coolant temperature on the diesel engine.

(1) To determine if the thermostat is defective, it must be removed from the vehicle. Refer to Thermostats for removal and installation procedures.

(2) After the thermostat has been removed, examine the thermostat and inside of thermostat housing for contaminants. If contaminants are found, the thermostat may already be in a “stuck open” position. Flush the cooling system before replacing thermostat. Refer to Cooling System Cleaning/Reverse Flushing in this group for additional information.

(3) Place the thermostat into a container filled with water.

(4) Place the container on a hot plate or other suitable heating device.

(5) Place a commercially available radiator thermometer into the water.

(6) Apply heat to the water while observing the thermostat and thermometer.

(7) When the water temperature reaches 80°C (176°F) the thermostat should start to open (valve will start to move). If the valve starts to move before this temperature is reached, it is opening too early. Replace thermostat. The thermostat should be fully open (valve will stop moving) at approximately 89°C (192°F). If the valve is still moving after the water temperature reaches this temperature, it is opening too late. Replace thermostat.

(8) If the valve refuses to move at any time, replace thermostat.

VISCOUS FAN DRIVE

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.

The cooling system must be in good condition. This is checked prior to performing the following test. It also will ensure against excessively high coolant temperature.

WARNING: BE SURE OF ADEQUATE FAN BLADE CLEARANCE BEFORE DRILLING.

(1) Drill a 3.12-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) 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.

(4) 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.

(5) Start the engine and operate at 2400 rpm. Within ten minutes the air temperature (indicated on the dial thermometer) should be up to 93° C (200° F). Fan drive **engagement** should have started to occur at between 82° to 91° C (180° to 195° F). Engagement is distinguishable by a definite **increase** in fan flow noise (roaring).

(6) When the air temperature reaches 93° C (200° F), remove the plastic sheet. Fan drive **disengagement** should have started to occur at between 57° to 79° C (135° to 175° F). A definite **decrease** of fan flow noise (roaring) should be noticed. If not, replace the defective viscous fan drive unit.

RADIATOR COOLANT FLOW CHECK

There is coolant flow through the coolant tank (bottle) before and after the thermostat opens.

CAUTION: Do not remove the vent valve to insert a temperature gauge thought the opening, coolant will spill out of the system and the engine will not be filled with coolant up to the heads. Major damage could happen if you run the engine in this condition.

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 fac-

DIAGNOSIS AND TESTING (Continued)

tory. 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 parts 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 radiator pressure tester to determine if any external leaks exist (Fig. 9).

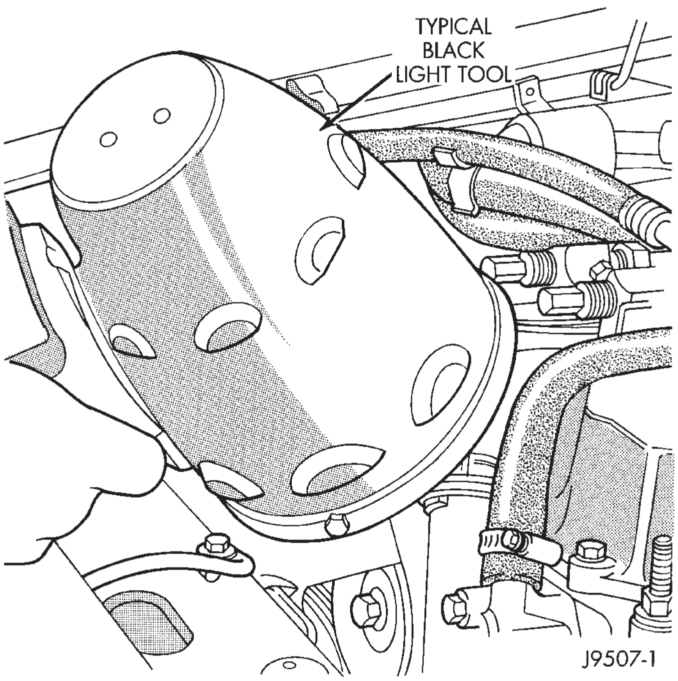

Fig. 9 Leak Detection Using Black Light—Typical

PRESSURE TESTER METHOD

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE SERIOUS INJURY BY SCALDING. NEVER REMOVE THE PRESSURE/VENT CAP OR PRESSURE TESTER WHEN THE COOLING SYSTEM IS HOT OR UNDER PRESSURE!

Allow the engine to cool sufficiently so that the system is not under pressure and carefully remove the pressure/vent cap from the filler neck. Warm the engine with the pressure/vent cap off to normal operating temperature. With the engine turned off attach the cooling system pressure tester and test the system as described below.

Recheck the system cold if the cause of coolant loss is not located during warm engine examination.

A two-piece, threaded adapter set (Fig. 10) must be used to adapt a standard pressure-type tester (Fig. 11) when testing either the coolant tank or pressure cap. Use Kent-Moore® adapter set number J-24460-92 or Snap-On® numbers TA-32 and TA-33. Attach one of the adapters to the coolant pressure tank neck. Adapter must first be threaded to tank. Attach pressure tester to adapter.

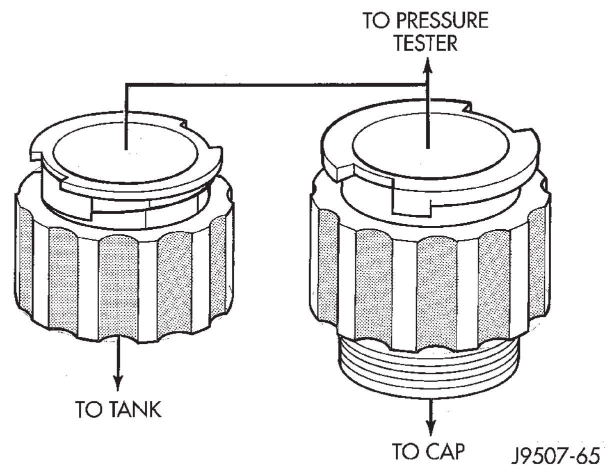

Fig. 10 Typical Pressure Tester Adapters

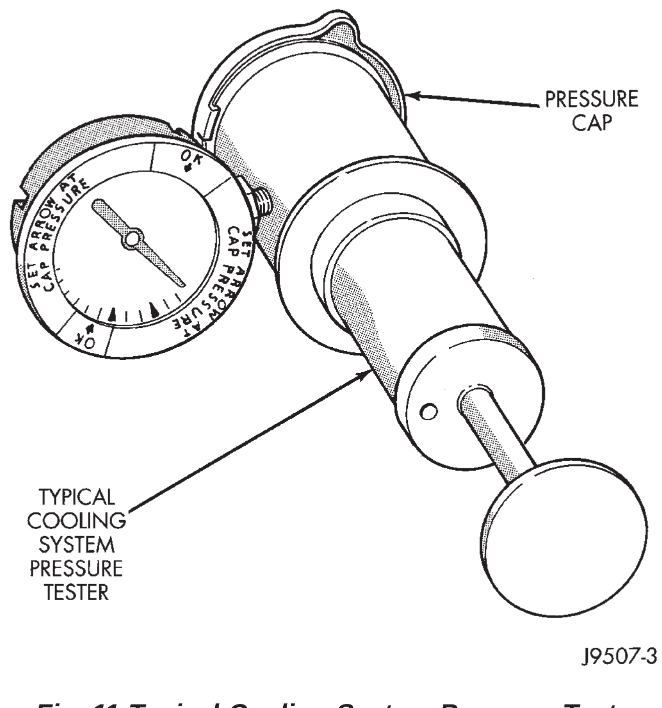

Fig. 11 Typical Cooling System Pressure Tester

Operate the tester pump to apply 103 kPa (15 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 pres-

DIAGNOSIS AND TESTING (Continued)

sure. Inspect for interior leakage or do the Internal Leakage Test. Do this if it is certain that coolant is being lost and no leaks can be detected.

• Drops Slowly: Shows a small leak or seepage is occurring. Examine all connections for seepage or slight leakage with a flashlight. Inspect the radiator, hoses, gasket edges and heater. Seal any small leak holes with a Sealer Lubricant or equivalent. Repair leak holes and reinspect the system with pressure applied.

• Drops Quickly: Shows that a serious leakage is occurring. Examine the system for serious external leakage. If no leaks are visible, inspect for internal leakage. Large radiator leak holes should be repaired by a reputable radiator repair shop.

INTERNAL LEAKAGE INSPECTION

Remove the oil pan drain-plug and drain a small amount of engine oil. Coolant, being heavier will drain first, or operate engine to churn oil, then examine dipstick for water globules. Operate the engine without the pressure/vent cap on the coolant tank until thermostat opens.

Attach a radiator pressure tester to the tank filler neck. If pressure builds up quickly, a leak exists as result of a faulty cylinder head gasket or crack in the engine. Repair as necessary.

WARNING: DO NOT ALLOW PRESSURE TO EXCEED 117 KPA (17 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.

PRESSURE/VENT CAP

PRESSURE TESTING

Remove the cap from the coolant tank. Be sure that sealing surfaces are clean. Moisten rubber gasket with water.

A two-piece, threaded adapter set (Fig. 10) must be used to adapt a standard pressure-type tester (Fig. 11) when testing either the coolant tank or pressure cap. Use Kent-Moore® adapter set number J-24460-92 or Snap-On® numbers TA-32 and TA-33. Attach the adapter to the cap. Adapter must first be threaded to cap. Attach pressure tester to adapter.

Operate the tester pump and observe the gauge pointer at its highest point. The cap release pressure should be 90-to-117 kPa (13-to-17 psi). The cap is satisfactory when the pressure holds steady. It is also good if it holds pressure within the 90-to-117 kPa (13-to-17 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/vent cap to confirm that cap needs replacement.

LOW COOLANT LEVEL- AERATION

CAUTION: Engine damage could occur if the coolant level is allowed to get this low. Always ensure that the coolant level is not below the add coolant mark. The baffles in the pressurized coolant tank (degasser bottle) will not allow you to see the fluid level. Check the coolant level through the pressurized coolant tank. For better visibility of the coolant level use a shop lamp to light the pressurized coolant tank and look through the pressurized coolant tank.

If the coolant level in the radiator drops below the top of radiator core tubes, air will enter the cooling system.

Low coolant level can cause the thermostat pellet to be suspended in air instead of coolant. This will cause the thermostat to open later, which in turn causes higher coolant temperature. Air trapped in the cooling system also reduces the amount of coolant circulating in the heater core resulting in low heat output.

DIAGNOSIS AND TESTING (Continued)

BELT DIAGNOSIS

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the belt from rib to rib (Fig. 12), 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. 12). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to the Serpentine Drive Belt Diagnosis chart for further belt diagnosis.

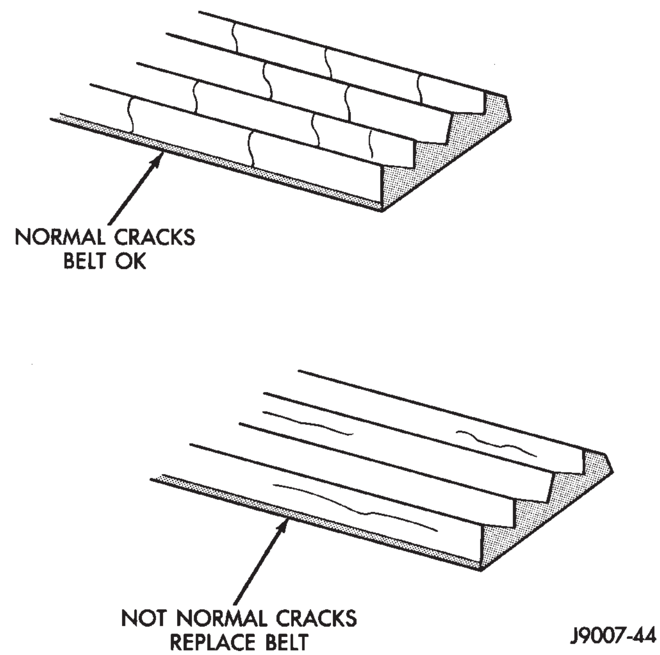

Fig. 12 Serpentine Belt Wear Patterns

DIAGNOSIS AND TESTING (Continued)

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. Incorrect belt. 3. Belt or pulley subjected to substance (belt dressing, oil, ethylene glycol) that has reduced friction. 4. Driven component bearing failure. 5. Belt glazed and hardened from heat and excessive slippage.	1. Replace automatic belt tensioner. 2. Replace belt. 3. Replace belt and clean pulleys. 4. 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. Incorrect belt. 3. Pulley(s) not within design tolerance. 4. Foreign object(s) in grooves. 4. Pulley misalignment. 5. Belt cordline is broken.	1. Replace automatic belt tensioner. 2. Replace belt. 3. Replace pulley(s). 4. Remove foreign objects from grooves. 4. Check and replace. 5. Replace belt.
BELT BROKEN (NOTE: IDENTIFY AND CORRECT PROBLEM BEFORE NEW BELT IS INSTALLED)	1. Excessive tension. 2. Incorrect belt. 3. Tensile member damaged during belt installation. 4. Severe misalignment. 5. Bracket, pulley, or bearing failure.	1. Replace belt and automatic belt tensioner. 2. Replace belt. 3. Replace belt. 4. Check and replace. 5. Replace defective component and belt.
NOISE (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. Replace belt or automatic belt tensioner. 2. Locate and repair. 3. Replace belt. 4. Install correct belt.

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SERPENTINE DRIVE BELT DIAGNOSIS

SERVICE PROCEDURES

COOLANT LEVEL CHECK

The coolant level is checked and adjusted at the pressurized coolant tank (Fig. 13). The tank is located at the right-rear side of the engine compartment and is mounted as the highest point of the cooling system. This will allow any air or vapor exceeding the pressure/vent cap rating to escape through the cap. The coolant tank is equipped with a threaded-on pressure/vent cap. Refer to Pressure/ Vent Cap for additional information.

A coolant reserve/overflow system with a separate tank is not used with the 2.5L diesel engine.

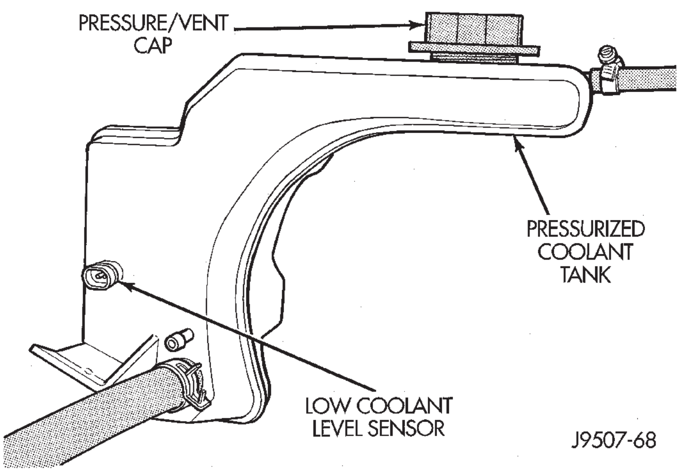

Fig. 13 Coolant Tank and Pressure/Vent Cap

(1) Add coolant into the coolant tank up to the COLD mark. **If possible, only add coolant when the engine is cold. Coolant level in a warm engine will be higher in the tank due to thermal expansion.**

(2) After the engine has been operated through a few heat-up and cool-down cycles, recheck the coolant level in the tank.

DRAINING COOLING SYSTEM

The cooling system is equipped with a pressurized coolant tank using a pressure/vent cap.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN-PLUG, THE COOLANT TANK CAP, THE RADIATOR FILL VENT VALVE, OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

WARNING: IF VEHICLE HAS BEEN RUN RECENTLY, WAIT AT LEAST 15 MINUTES BEFORE REMOVING COOLANT TANK CAP. WITH A RAG, SQUEEZE THE UPPER RADIATOR HOSE TO CHECK IF SYSTEM IS UNDER PRESSURE. PLACE A RAG OVER THE CAP. VERY SLOWLY ROTATE THE CAP COUNTER-CLOCKWISE ALLOWING PRESSURE TO SLOWLY RELEASE. AFTER ALL PRESSURE HAS BEEN RELEASED, REMOVE THE COOLANT TANK CAP COMPLETELY.

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Observe the previous **WARNINGS** and remove the coolant tank pressure/vent cap.

(2) The plastic radiator draincock is located on the bottom of the left radiator tank . It can be accessed from the bottom of vehicle.

(a) Attach one end of a 24 inch long X 1/4 inch ID drain-hose to the nipple below the radiator draincock.

(b) Put the other end of drain-hose into a clean container.

(c) Open the draincock (counterclockwise as viewed from left side of vehicle) and drain coolant from radiator.

(3) If the complete cooling system must be drained, raise the vehicle and remove the cylinder block drain-plug. This hex- headed plug is located on the right/rear side of the engine above the starter motor.

REFILLING COOLING SYSTEM

The cooling system is equipped with a pressurized coolant tank using a pressure/vent cap. Refilling of the system is done through this tank.

NOTE: The radiator draincock is equipped with a rubber o-ring. Do not over tighten draincock.

(1) Tighten the radiator draincock and (if removed), the cylinder block drain-plug.

(2) Remove the plastic radiator fill vent valve (unscrews counter- clockwise) from the radiator. The fill vent valve is located on the top of the right radiator tank.

(3) With the fill vent valve removed, proceed to fill the system using a 50/50 mixture of water and anti-freeze as described in the Coolant section of this group.

(4) Continue to fill the cooling system until coolant is observed escaping from the fill vent opening. When this occurs, install the fill vent valve. **The plastic fill vent valve is equipped with a rubber o-ring. Do not over tighten the fill vent valve.**

(5) Continue to fill the system until the coolant tank is full.

(6) Install and tighten the coolant tank pressure/ vent cap. **Do not use any type of tool when tightening the cap. Hand tighten only.**

SERVICE PROCEDURES (Continued)

(7) With the heater control unit in the HEAT position, operate engine with coolant tank cap tightened.

(8) After engine has reached normal operating temperature, shut engine off and allow it to cool.

(9) Remove coolant tank cap.

(10) Add coolant into the coolant tank up to the COLD mark. **If possible, only add coolant when the engine is cold. Coolant level in a warm engine will be higher in the tank due to thermal expansion.**

(11) After the engine has been operated through a few heat-up and cool-down cycles, recheck the coolant level in the tank.

COOLANT REPLACEMENT

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.

REMOVAL AND INSTALLATION

RADIATOR

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN-PLUG, THE COOLANT TANK CAP, THE RADIATOR FILL VENT VALVE, OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP (Fig. 14). ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 15). If replacement is necessary, use only an original equipment clamp with matching number or letter.

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Observe the previous **WARNINGS.**

(3) Drain cooling system. Refer to Draining Cooling System in this group.

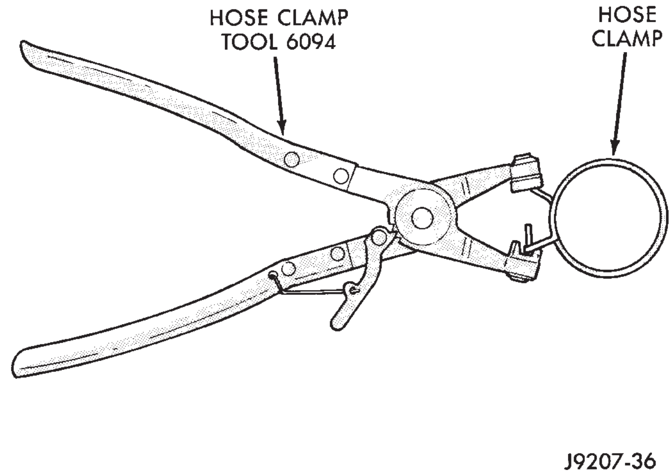

Fig. 14 Hose Clamp Tool

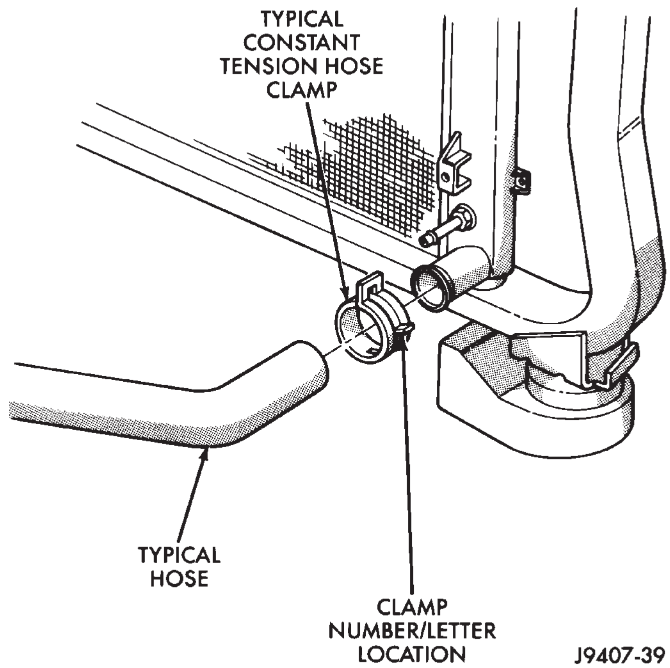

Fig. 15 Clamp Number/Letter Location

(4) Remove the upper fan shroud-to-upper crossmember mounting bolts. One of the bolts is mounted vertically at the bottom of the fan shroud.

(5) Lift the fan shroud up until alignment tabs at the bottom are clear of slots in bracket at bottom of radiator. Slip the fan shroud rearward and position it over the fan blades.

(6) Remove radiator hose clamps and remove radiator hoses.

(7) Mark the position of the hood latch striker on the radiator crossmember and remove hood latch striker.

(8) Remove radiator upper crossmember.

(9) If equipped with air conditioning, separate the radiator from the A/C condenser by removing the condenser-to-radiator mounting brackets.

REMOVAL AND INSTALLATION (Continued)

(10) Lift radiator straight up and out of engine compartment taking care not to damage radiator or A/C condenser fins.

INSTALLATION

The radiator is equipped with two alignment dowels (Fig. 16). They are located on the bottom of the plastic side tanks and fit into rubber grommets located in the front lower crossmember.

(1) Carefully lower the radiator into engine compartment. Position the alignment dowels on the bottom of radiator into the rubber grommets in front lower crossmember (Fig. 16).

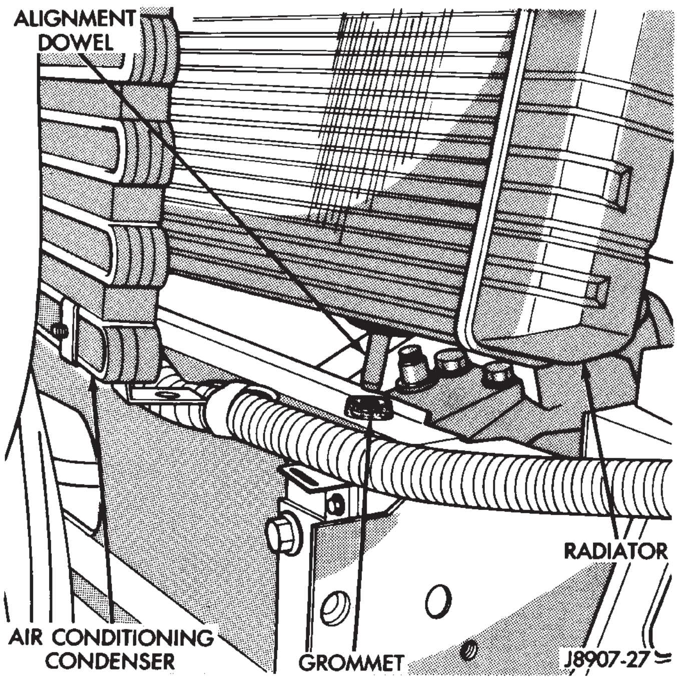

Fig. 16 Radiator Alignment Dowels—Typical

(2) If equipped with air conditioning, attach condenser to radiator with mounting brackets.

(3) Install radiator upper crossmember.

(4) Install hood latch striker.

(5) Connect radiator upper and lower hoses.

(6) Insert alignment tabs at bottom of fan shroud into slots in bracket at bottom of radiator. Install and tighten fan shroud bolts to 3 N·m (31 in. lbs.) torque.

(7) Connect negative battery cable.

(8) Fill cooling system with correct coolant. Refer to Refilling Cooling System in this group.

(9) Start and warm the engine. Check for coolant leaks.

FAN BLADE REMOVAL

FAN BLADE REMOVAL

Accessory drive belt removal is not necessary for fan blade or viscous fan drive removal.

(1) Disconnect negative battery cable from battery.

(2) The thermal viscous fan drive/fan blade assembly is attached (threaded) to the fan pulley shaft (Fig. 17). Remove fan blade/viscous fan drive assembly from fan pulley by turning mounting nut counterclockwise as viewed from front. Threads on viscous fan drive are **RIGHT HAND.** Snap-On® 36 MM Fan Wrenches (number SP346) can be used to turn the mounting nut and to hold the fan pulley from rotating.

(3) Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

(4) Do not unbolt fan blade assembly from viscous fan drive at this time.

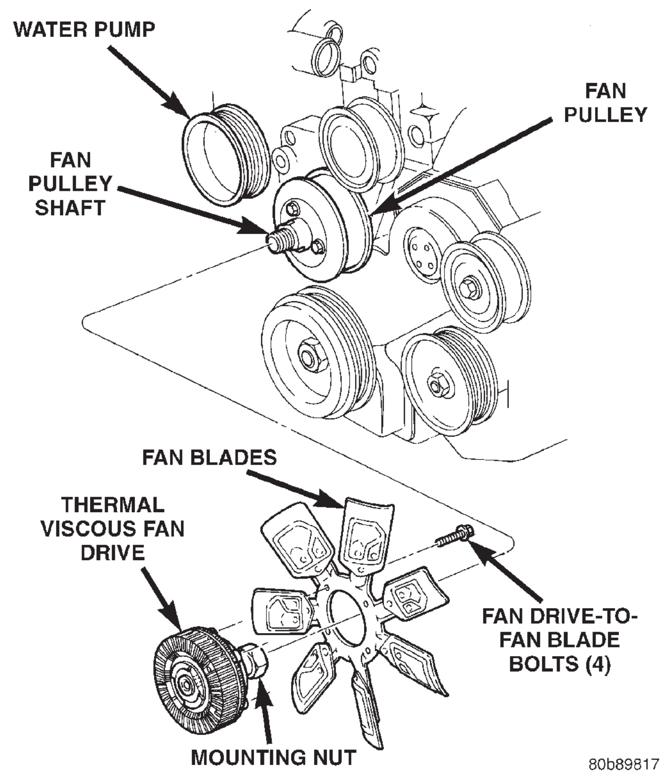

Fig. 17 Thermal Viscous Fan Drive and Blade Assembly

(5) Remove the fan shroud mounting bolts. One of the bolts is mounted vertically at the bottom of shroud.

(6) Remove fan shroud and fan blade/viscous fan drive assembly as a complete unit from vehicle.

(7) After removing fan blade/viscous fan drive assembly, **do not** place viscous fan drive in horizontal position. If stored horizontally, silicone fluid in the viscous fan drive could drain into its bearing assembly and contaminate lubricant.

CAUTION: Do not attempt to remove the fan pulley bolts. The fan pulley is under tension from the drive belt.

REMOVAL AND INSTALLATION (Continued)

(9) Remove four bolts securing fan blade assembly to viscous fan drive (Fig. 17).

FAN BLADE INSTALLATION

(1) Install fan blade assembly to viscous fan drive. Tighten bolts (Fig. 17) to 23 N·m (200 in. lbs.) torque.

(2) Position fan shroud and fan blade/viscous fan drive assembly to vehicle as a complete unit.

(3) Install and tighten fan shroud bolts to 3 N·m (31 in. lbs.) torque.

(4) Install fan blade/viscous fan drive assembly to fan pulley shaft (Fig. 17).

(5) Connect negative battery cable.

VISCOUS FAN DRIVE

The thermal viscous fan drive (Fig. 18) is a silicone-fluid-filled coupling. It connects the fan blade assembly to the fan pulley. The coupling allows the fan to be driven in a normal manner. This is done at low engine speeds while limiting the top speed of the fan to a predetermined maximum level at higher engine speeds. A bimetallic spring coil is located on the front face. This spring coil reacts to the temperature of the radiator discharge air. It engages the viscous fan drive for higher fan speed if the air temperature from the radiator rises above a certain point. Until additional engine cooling is necessary, the fan will remain at a reduced rpm regardless of engine speed.

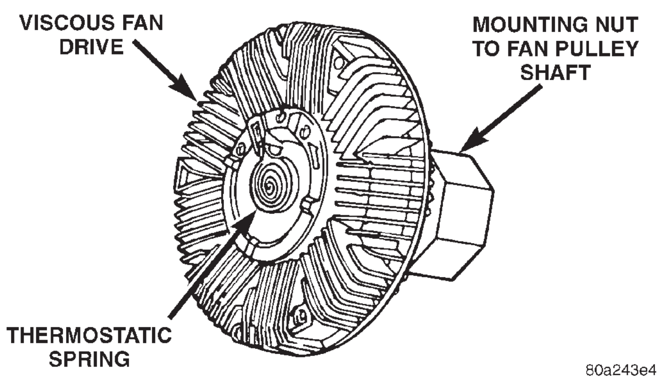

Fig. 18 Viscous Fan Drive

The viscous fan drive will only engage when sufficient heat is present. This is when the air flowing through the radiator core causes a reaction from the bimetallic coil. It then increases fan speed to provide the necessary additional engine cooling.

Once the engine has cooled, the radiator discharge temperature will drop. The bimetallic coil again reacts and the fan speed is reduced to the previous disengaged speed.

CAUTION: Some engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

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.

THERMOSTAT

REMOVAL

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN-PLUG, THE COOLANT TANK CAP, THE RADIATOR FILL VENT VALVE, OR 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. Refer to Draining Cooling System for procedures.

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 (Fig. 14). ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 15). If replacement is necessary, use only an original equipment clamp with matching number or letter.

REMOVAL AND INSTALLATION (Continued)

(2) Remove the upper radiator hose at the thermostat housing.

(3) Remove the four thermostat housing bolts (Fig. 19)

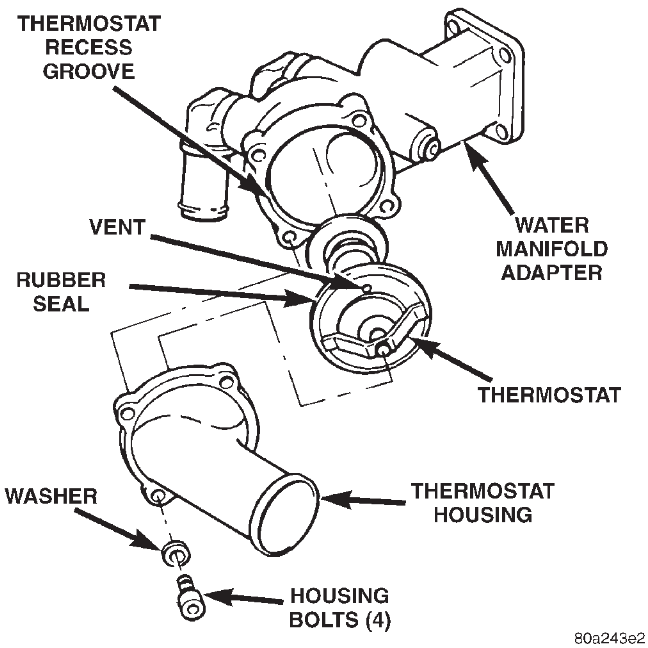

Fig. 19 Thermostat Removal/Installation

(4) Remove the thermostat housing from the water manifold.

(5) Remove the thermostat and rubber seal from the water manifold.

(6) Thoroughly clean the rubber seal mating surfaces.

INSTALLATION

(1) Install a new rubber seal around the outer lip of the thermostat (a notch is provided in the rubber seal). Do not apply any adhesive to this seal.

(2) Install the replacement thermostat and rubber seal as one assembly into the water manifold adapter (the pointed end of the thermostat should be facing towards the front of engine (Fig. 19). Observe the recess groove in the water manifold adapter. Be sure the thermostat vent is in the 12 o'clock position (Fig. 19).

(3) Position the thermostat housing and four bolts to the water manifold.

CAUTION: Tightening the thermostat housing unevenly or with the thermostat out of its recess groove, may result in a cracked housing.

(4) Tighten the four housing bolts to 11 N·m (98 in. lbs.) torque.

(5) Install radiator hose to thermostat housing.

(6) Be sure that the radiator drain is tightly closed. Fill the cooling system to the correct level with the required coolant mixture. Refer to Refilling Cooling System in this group for procedures.

(7) Start and warm the engine. Check thermostat and hose for leaks.

DRIVE BELT

CAUTION: The drive belt on the 2.5L diesel engine is equipped with a spring loaded automatic belt tensioner. After belt installation, do not attempt to check belt tension with a belt tension gauge.

AUTOMATIC BELT TENSIONER

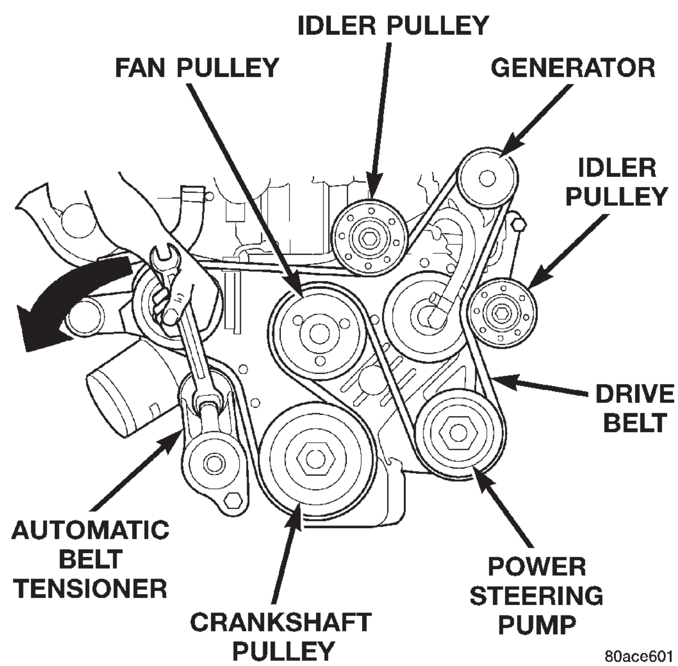

Fig. 20 Automatic Belt Tensioner Assembly

WATER PUMP

REMOVAL

The water pump can be removed without discharging the air conditioning system (if equipped).

The water pump is serviced by replacing the pump and its impeller only. The water pump adapter (Fig. 21) does not have to be removed. The pump impeller is pressed on the rear of the pump shaft and bearing assembly. The pump is serviced only as a complete assembly with the impeller, housing, hub and bearing.

A rubber o-ring seal (instead of a gasket) is used as a seal between the water pump and the water pump adapter.

REMOVAL AND INSTALLATION (Continued)

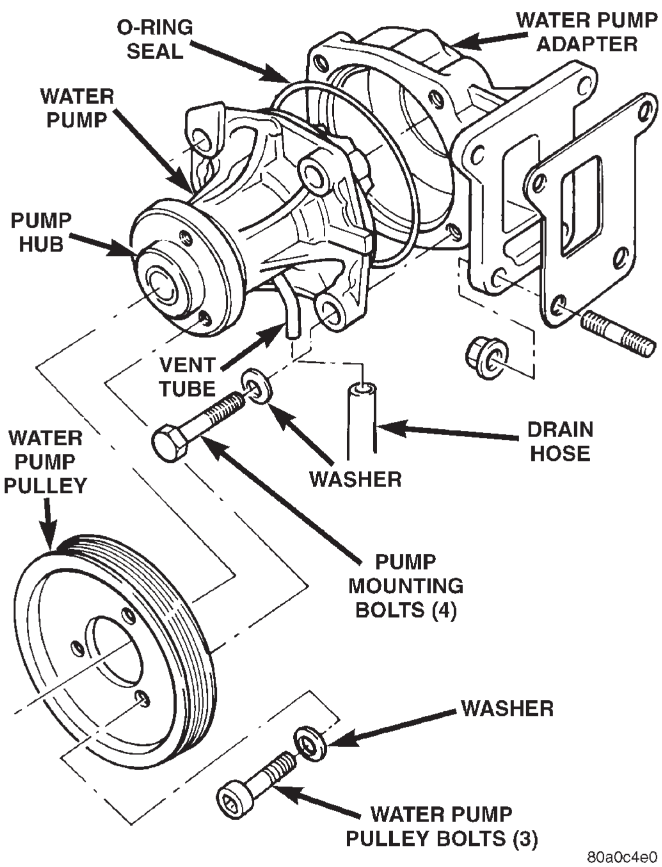

Fig. 21 WATER PUMP REMOVAL/INSTALL—TYPICAL

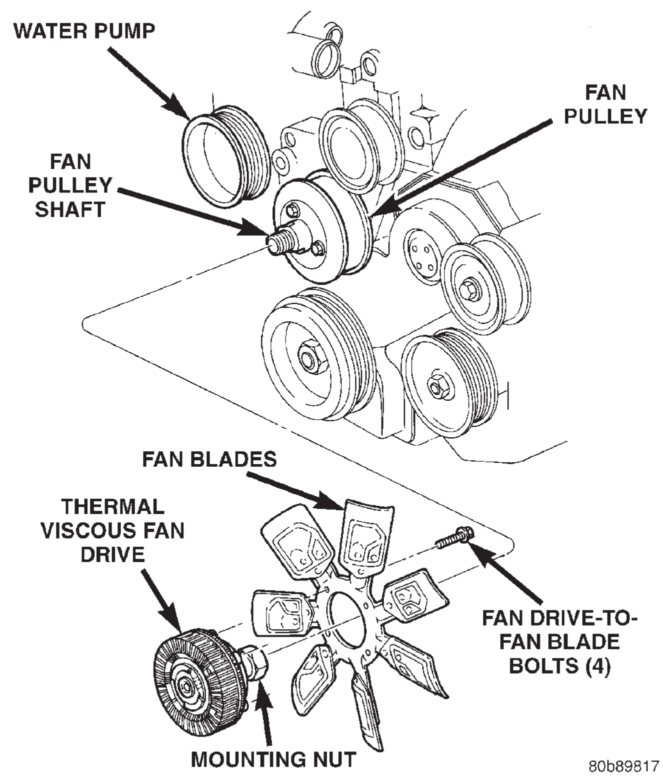

Fig. 22 Thermal Viscous Fan Drive and Blade Assembly

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN-PLUG, THE COOLANT TANK CAP, THE RADIATOR FILL VENT VALVE, OR 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 coolant into a clean container for reuse.

(1) Disconnect the negative battery cable.

(2) Drain the cooling system. Refer to Draining Cooling System in this group.

(3) The thermal viscous fan drive and the fan blade assembly are attached (threaded) to the fan pulley shaft (Fig. 22). Remove the fan/fan drive assembly from the fan pulley by turning the mounting nut counterclockwise (as viewed from front). Threads on the fan drive are **RIGHT HAND.** Snap-On® 36 MM Fan Wrenches (number SP346) can be used to turn the mounting nut and to hold the fan pulley from rotating.

(4) If the water pump is being replaced, do not unbolt the fan blade assembly (Fig. 22) from the thermal viscous fan drive.

(5) Remove the upper fan shroud-to-upper crossmember mounting bolts. One of the bolts is mounted vertically at the bottom of the fan shroud.

(6) Slip the fan shroud rearward. Remove the fan shroud and viscous drive/fan blade together as one assembly from the engine compartment.

(7) Loosen **but do not remove** the 3 water pump pulley bolts (Fig. 21).

(8) Remove the drive belt by relieving the tension on the belt tensioner. For procedures, refer to Belt Removal/Installation in the Engine Accessory Drive Belt section of this group.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP (Fig. 23). ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 24). If replacement is necessary, use only an original equipment clamp with matching number or letter.

(9) A metal coolant tube (used to connect rubber coolant hoses), and its mounting bracket are attached to the front of the water pump (Fig. 25). A rubber

REMOVAL AND INSTALLATION (Continued)

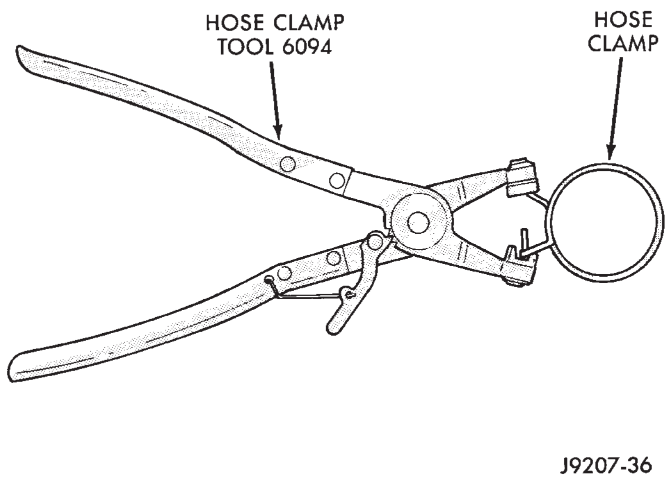

Fig. 23 Hose Clamp Tool

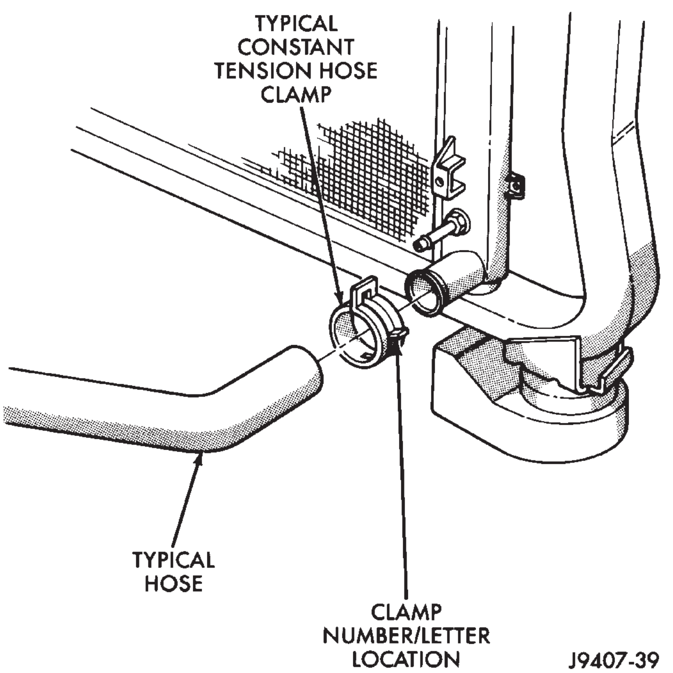

Fig. 24 Clamp Number/Letter Location

hose connects this tube to the engine. Disconnect the hose clamp and rubber hose at the back of the thermostat. Position the hose to the side.

(10) Remove the 3 water pump pulley bolts (Fig. 21).

(11) Remove the water pump pulley from the water pump.

(12) Disconnect the drain hose from the vent tube at the bottom of water pump (Fig. 21).

(13) Remove the 4 water pump mounting bolts (Fig. 21).

(14) Remove water pump from engine.

INSTALLATION

(1) Clean the o-ring mating surfaces. If the original pump is to be reinstalled, remove any deposits or

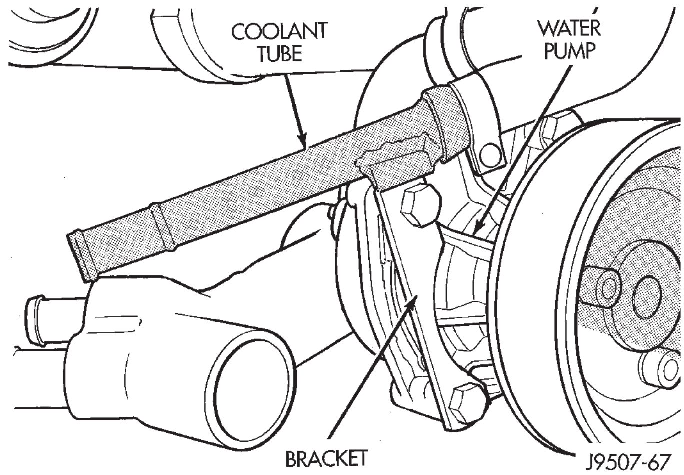

Fig. 25 Coolant Tube at Water Pump

other foreign material. Inspect the water pump, water pump adapter and water pump mating surfaces for erosion or damage from cavitation.

(2) Position a new rubber o-ring seal (Fig. 21) between the pump and pump adapter. Hold the seal with petroleum jelly.

(3) Position the pump on the engine.

(4) Position the metal coolant tube and its mounting bracket on the pump.

(5) Install the four water pump mounting bolts. Torque bolts to 24 N·m (18 ft. lbs.).

(6) Install drain hose to vent tube at bottom of pump.

(7) Position the water pump pulley to the water pump.

(8) Install the water pump pulley bolts finger tight.

(9) Install the rubber coolant hose near the thermostat.

(10) Install the accessory drive belt. For procedures, refer to Belt Removal/Installation in the Engine Accessory Drive Belt section of this group.

(11) Torque the water pump pulley bolts to 24 N·m (18 ft. lbs.).

(12) Position the viscous drive/fan blade and fan shroud to the engine compartment as one assembly.

(13) Install the thermal viscous fan drive and fan blade to fan pulley. Torque to 56 N·m (41 ft. lbs.).

(14) Install the fan shroud mounting bolts. Torque bolts to 3 N·m (31 in. lbs.).

(15) Fill the cooling system with coolant and check for leaks. Refer to Refilling Cooling System in this group.

(16) Connect the negative battery cable.

(17) Start and warm the engine. Check for leaks.

CLEANING AND INSPECTION

WATER PUMP

INSPECTION

Replace the water pump assembly if it has any of the following conditions:

- The body is cracked or damaged
- Water leaks from the shaft seal. This is evident by traces of coolant below the vent tube drain hose
- Loose or rough turning bearing.
- Impeller rubs either the water pump body or water pump adapter.

RADIATOR CLEANING

The radiator and air conditioning fins should be cleaned when an accumulation of bugs, leaves etc. has occurred. Clean radiator fins are necessary for good heat transfer. With the engine cold, apply cold water and compressed air to the back (engine side) of the radiator to flush the radiator and/or A/C condenser of debris.

FAN BLADE

INSPECTION

The fan cannot be repaired. If fan is damaged, it must be replaced. Inspect fan as follows:

(1) Remove fan blade and viscous fan drive as an assembly from the engine.

(2) Remove fan blade assembly from viscous fan drive unit (four bolts) (Fig. 26).

(3) Lay fan on a flat surface with leading edge facing down. With tip of blade touching flat surface, replace fan if clearance between opposite blade and surface is greater than 2.0 mm (.090 inch). Rocking motion of opposite blades should not exceed 2.0 mm (.090 inch). Test all blades in this manner.

WARNING: DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN BLADES IF NOT WITHIN SPECIFICATIONS.

(4) Inspect fan assembly for cracks, bends, loose rivets or broken welds. Replace fan if any damage is found.

CAUTION: If fan blade assembly is replaced because of mechanical damage, the fan pulley bearing and viscous fan drive should also be inspected. These components could have been damaged due to excessive vibration.

CAUTION: Some engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word

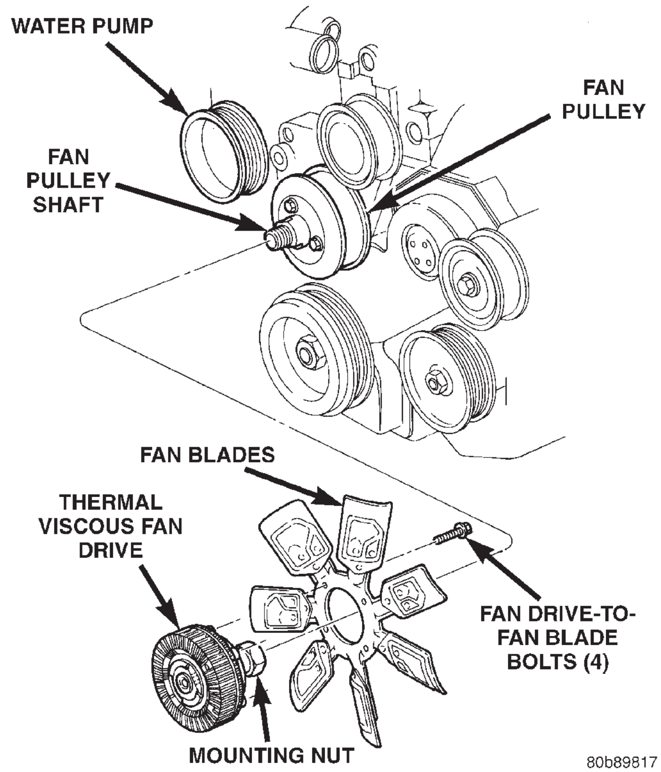

Fig. 26 Thermal Viscous Fan Drive and Blade Assembly

REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

PRESSURE/VENT CAP

INSPECTION

Visually inspect the gasket on the cap. Replace cap if the gasket is swollen, torn or worn. Inspect the area around the coolant tank filler neck for white deposits that indicate a leaking cap.

The cap must be replaced by a similar threaded-on unit with the correct operating pressures if replacement is necessary.

COOLING SYSTEM CLEANING/REVERSE FLUSHING

CAUTION: The cooling system normally operates at 90-to-117 kPa (13- to-17 psi) pressure. Exceeding this pressure may damage the radiator or hoses.

CLEANING

Drain cooling system and refill with water. Run engine with coolant tank pressure/vent cap installed until upper radiator hose is hot. Stop engine and drain water from system. If water is dirty, fill system

CLEANING AND INSPECTION (Continued)

with water, run engine and drain system. Repeat until water drains clean.

REVERSE FLUSHING

Reverse flushing of the cooling system is the forcing of water through the cooling system. This is done using air pressure in the opposite direction of normal coolant flow. It is usually only necessary with very dirty systems with evidence of partial plugging.

REVERSE FLUSHING RADIATOR

Disconnect the radiator hoses from the radiator fittings. Attach a section of radiator hose to the radiator bottom outlet fitting and insert the flushing gun. Connect a water supply hose and air supply hose to the flushing gun.

CAUTION: The cooling system normally operates at 90-to-117 kPa (13- to-17 psi) pressure. Exceeding this pressure may damage the radiator or hoses.

Allow the coolant tank and radiator to fill with water. When radiator is filled, apply air in short blasts allowing radiator to refill between blasts. Continue this reverse flushing until clean water flows out through rear of radiator cooling tube passages. For more information, refer to operating instructions supplied with flushing equipment. Have radiator cleaned more extensively by a radiator repair shop.

REVERSE FLUSHING ENGINE

Drain the cooling system. Remove the thermostat housing and thermostat. Install the thermostat housing. Disconnect the radiator upper hose from the radiator and attach the flushing gun to the hose. Disconnect the radiator lower hose from the water pump. Attach a lead away hose to the water pump inlet fitting.

CAUTION: Be sure that the heater water control valve is closed (heat off). This is done to prevent coolant flow with scale and other deposits from entering the heater core.

Connect the water supply hose and air supply hose to the flushing gun. Allow the engine to fill with water. When the engine is filled, apply air in short blasts, allowing the system to fill between air blasts. Continue until clean water flows through the lead away hose. For more information, refer to operating instructions supplied with flushing equipment.

Remove the lead away hose, flushing gun, water supply hose and air supply hose. Remove the thermostat housing and install thermostat. Install the thermostat housing with a new replacement rubber seal. Refer to Thermostat Installation. Connect the radiator hoses. Refill the cooling system with the correct antifreeze/water mixture.

CHEMICAL CLEANING

In some instances, use a radiator cleaner (Mopar Radiator Kleen or equivalent) before flushing. This will soften scale and other deposits and aid the flushing operation.

CAUTION: Be sure instructions on the container are followed.

SPECIFICATIONS

COOLING SYSTEM CAPACITY

2.5L Diesel Engine: 9.8 Liters (10.4 qts.)

THERMOSTAT

Starts to open at 80°C (176°F).

TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Automatic Belt Tensioner-to-Mounting Bracket	
Bolt (1)	75 N·m
Automatic Belt Tensioner to Block	
Bolts (2)	121 N·m
Coolant Tank	
Cap	5 N·m
Fan Shroud-to-Radiator Mounting	
Bolts	3 N·m
Fan Blade-to-Thermal Viscous Fan Drive	
Bolts	23 N·m
Hose	
Clamps	4 N·m
Radiator-to-A/C Condenser Isolator	
Nuts	6 N·m
Thermal Viscous Fan Drive-to-Fan Hub	
Bolts	56 N·m
Thermostat Housing	
Bolts	11 N·m
Water Pump Mounting	
Bolts	24 N·m
Water Pump Pulley	
Bolts	24 N·m

BATTERY

CONTENTS

DESCRIPTION AND OPERATION

BATTERY

DESCRIPTION

A large capacity, low-maintenance storage battery is standard factory-installed equipment on this model. This battery is designed to provide a safe, efficient and reliable means of storing electrical energy in a chemical form. This means of energy storage allows the battery to produce the electrical energy required to operate the engine starting system, as well as to operate many of the other vehicle accessory systems for limited durations while the engine and/or the charging system are not operating.

The 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.

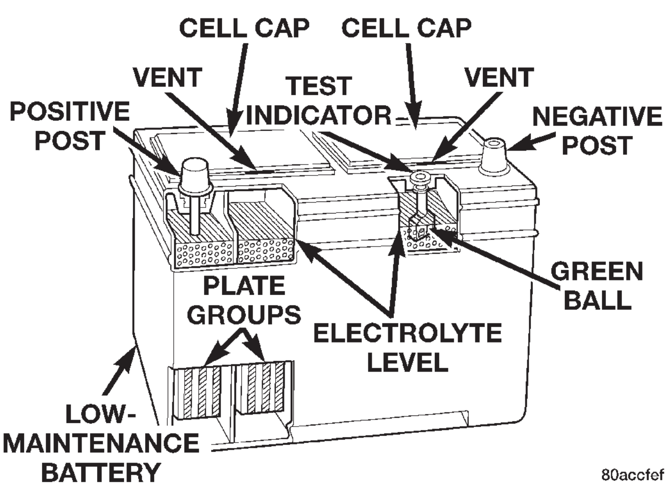

Fig. 1 Low-Maintenance Battery - Typical

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 **Charging System** in the Diagnosis and Testing section of 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. Refer to **Built-In Test Indicator** in the Diagnosis and Testing section of this group for more information.

This group covers only the battery diagnostic and service procedures. For battery maintenance schedules and jump starting procedures, see the owner's manual in the vehicle glove box, or refer to **Maintenance Schedules** and **Jump Starting, Towing and Hoisting** in 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.

Group 8A covers the Battery, Group 8B covers the Starting Systems, and Group 8C covers the Charging System. 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 battery, starting, and charging systems in the vehicle 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 that are used in these systems must perform within specifications. It is important that the battery, starting, and charging systems be thoroughly tested and inspected any time a battery needs to be charged or replaced. The cause of abnormal discharge, overcharging, or early battery failure must be diagnosed and corrected before a battery is replaced or returned to service.

DESCRIPTION AND OPERATION (Continued)

The diagnostic procedures used in each of these groups include the most basic conventional diagnostic methods, to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of an induction-type milliampere ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. Refer to **On-Board Diagnostic Test For Charging System** in the Diagnosis and Testing section of Group 8C - Charging System for more information.

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.

OPERATION

The storage battery is a device used to store electrical energy potential in a chemical form. When an electrical load is applied to the battery terminals, an electrochemical reaction occurs within the battery. This reaction causes the battery to discharge electrical current.

The battery is made up of six individual cells that are connected in series. Each cell contains positively charged plate groups made of lead oxide, and negatively charged plate groups made of sponge lead. These dissimilar metal plates are submerged in a sulfuric acid and water solution called an electrolyte.

As the battery discharges, a gradual chemical change takes place within each cell. The sulfuric acid in the electrolyte combines with the plate materials, causing both plates to slowly change to lead sulfate. At the same time, oxygen from the positive plate material combines with hydrogen from the sulfuric acid, causing the electrolyte to become mainly water.

The chemical changes within the battery are caused by the movement of excess or free electrons between the positive and negative plate groups. This movement of electrons produces a flow of electrical current through the load device attached to the battery terminals.

As the plate materials become more similar chemically, and the electrolyte becomes less acid, the voltage potential of each cell is reduced. However, by charging the battery with a voltage higher than that of the battery, the battery discharging process is reversed.

Charging the battery gradually changes the sulfated lead plates back into sponge lead and lead oxide, and the water back into sulfuric acid. This action restores the difference in the electron charges deposited on the plates, and the voltage potential of the battery cells.

For a battery to remain useful, it must be able to produce high-amperage current over an extended period. A battery must also be able to accept a charge, so that its voltage potential may be restored.

In addition to producing and storing electrical energy, the battery serves as a capacitor, or voltage stabilizer, for the electrical system of the vehicle. It absorbs most abnormal or transient voltages caused by the switching of any of the electrical components in the vehicle.

The battery is vented to release excess hydrogen gas that is created when the battery is being charged or discharged. However, even with these vents, the hydrogen gas can collect in or around the battery. If hydrogen gas is exposed to flame or sparks, it may ignite.

If the electrolyte level is low, the battery may arc internally and explode. If the battery is equipped with removable cell caps, add distilled water whenever the electrolyte level is below the top of the plates. If the battery cell caps cannot be removed, the battery must be replaced if the electrolyte level becomes low.

BATTERY SIZE AND RATINGS

The battery Group Size number, the Cold Cranking Amperage (CCA) rating, and the Reserve Capacity (RC) rating or Ampere-Hours (AH) rating can be found on the original equipment battery label. Be certain that a replacement battery has the correct Group Size number, as well as CCA, and RC or AH ratings that equal or exceed the original equipment specification for the vehicle being serviced.

Refer to **Battery Classifications and Ratings** in the Specifications section of this group for more information. Battery sizes and ratings are discussed in more detail below.

GROUP SIZE

The outside dimensions and terminal placement of the battery conform to standards established by the Battery Council International (BCI). Each battery is assigned a BCI Group Size number to help identify a correctly-sized replacement.

DESCRIPTION AND OPERATION (Continued)

COLD CRANKING AMPERAGE

The Cold Cranking Amperage (CCA) rating specifies how much current (in amperes) the battery can deliver for thirty seconds at -18° C (0° F). Terminal voltage must not fall below 7.2 volts during or after the thirty second discharge period. The CCA required is generally higher as engine displacement increases, depending also upon the starter current draw requirements.

RESERVE CAPACITY

The Reserve Capacity (RC) rating specifies the time (in minutes) it takes for battery terminal voltage to fall below 10.5 volts, at a discharge rate of 25 amperes. RC is determined with the battery fully-charged at 26.7° C (80° F). This rating estimates how long the battery might last after a charging system failure, under minimum electrical load.

AMPERE-HOURS

The Ampere-Hours (AH) rating specifies the current (in amperes) that a battery can deliver steadily for twenty hours, with the voltage in the battery not falling below 10.5 volts. This rating is also sometimes identified as the twenty-hour discharge rating.

MOUNTING

The battery is mounted in a molded plastic tray located in the right front corner of the engine compartment. Two T-bolts are held in formations on each side of the tray by push-on retainers, and extend upward on each side of the battery. A hold down strap fits across the top of the battery case. The ends of the T-bolts pass through the hold down strap on each side of the battery, and a nut secures the hold down strap to the T-bolts. One end of a support strap is located under the forward-most hold down strap nut, and the other end is secured to the upper radiator crossmember by a bolt.

A plastic bubble-wrap style thermoguard slides over the battery case to enclose the sides of the battery. The thermoguard protects the battery from engine compartment temperature extremes.

The battery tray is secured with three nuts to three studs that protrude from the wheelhouse inner panel, forward of the right front wheel.

A hole in the bottom of the battery tray is fitted with a battery temperature sensor. Refer to **Battery Temperature Sensor** in the Description and Operation section of Group 8C - Charging System for more information on this component.

When installing a battery, be certain that the hold down fasteners are tightened to the proper specifications. Improper hold down fastener tightness, whether too loose or too tight, can result in damage to the battery. Refer to **Battery** in the Removal and Installation section of this group for the correct battery hold down fastener tightness specifications.

DIAGNOSIS AND TESTING

BATTERY

DIAGNOSIS

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 Systems, and Group 8C covers the Charging System. 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 an induction-type milliampere ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. Refer to **On-Board Diagnostic Test For Charging System** in the Diagnosis and Testing section of Group 8C - Charging System for more information.

The battery must be completely charged and the top, posts, and terminal clamps should be properly cleaned and inspected before diagnostic procedures are performed. Refer to **Battery** in the Removal and Installation section of this group for the proper battery cleaning and inspection procedures. Refer to **Battery Charging** in the Service Procedures section of this group for the proper charging procedures.

DIAGNOSIS AND TESTING (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.**
- **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 checking the specific gravity of the battery electrolyte (built-in test indicator or hydrometer test), or by checking the battery voltage (open-circuit voltage test).
2. **Cranking Capacity** - This can be determined by performing a battery load test, which measures the ability of the battery to supply high-amperage current.

First, determine the battery state-of-charge. This can be done in one of three ways. If the battery has a built-in test indicator, view the test indicator to 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 battery built-in test indicator has a black or dark color visible.
- The temperature corrected specific gravity of the battery electrolyte is less than 1.235.
- The battery open-circuit voltage is less than 12.4 volts.

A battery that will not accept a charge is faulty, and must be replaced. Further testing is not required. A fully-charged battery must be load tested to determine its cranking capacity. A battery that is fully-charged, but does not pass the load test, is faulty and must be replaced.

NOTE: Completely discharged batteries may take several hours to accept a charge. Refer to Battery Charging - Charging A Completely Discharged Battery in the Service Procedures section of this group for more information.

A battery is fully-charged when:

- All cells are gassing freely during charging.
- A green color is visible in the sight glass of the built-in test indicator.
- Three corrected specific gravity tests, taken at one-hour intervals, indicate no increase in the specific gravity.
- Open-circuit voltage is 12.4 volts or greater.

DIAGNOSIS AND TESTING (Continued)

Battery Diagnosis		
Condition	Possible Causes	Correction
The battery seems weak or dead when attempting to start the engine.	1. The battery has an incorrect size or rating for this vehicle. 2. The battery is physically damaged. 3. The battery terminal connections are loose or corroded. 4. The battery is discharged. 5. The electrical system ignition-off draw is excessive. 6. The battery is faulty. 7. The starting system is faulty. 8. The charging system is faulty.	1. Refer to Battery in the Specifications section of this group. Replace an incorrect battery with the correct battery. 2. Inspect the battery for loose terminal posts or a cracked and leaking case. Replace the battery, if damaged. 3. Refer to Voltage Drop Test in the Diagnosis and Testing section of this group. Clean and tighten the battery terminal connections, if required. 4. Determine the battery state-of-charge. Refer to Built-In Test Indicator, Hydrometer Test, or Open-Circuit Voltage Test in the Diagnosis and Testing section of this group. Charge the battery, if required. 5. Refer to Ignition-Off Draw Test in the Diagnosis and Testing section of this group. Repair the electrical system, if required. 6. Determine the battery cranking capacity. Refer to Load Test in the Diagnosis and Testing section of this group. Replace the battery, if required. 7. Determine if the starting system is performing to specifications. Refer to Starting System in the Diagnosis and Testing section of Group 8B - Starting Systems for more information. Repair the starting system, if required. 8. Determine if the charging system is performing to specifications. Refer to Charging System in the Diagnosis and Testing section of Group 8C - Charging System for more information. Repair the charging system, if required.

DIAGNOSIS AND TESTING (Continued)

Battery Diagnosis		
Condition	Possible Causes	Correction
The battery state-of-charge cannot be maintained.	1. The battery has an incorrect size or rating for this vehicle. 2. The battery terminal connections are loose or corroded. 3. The generator drive belt is slipping. 4. The electrical system ignition-off draw is excessive. 5. The battery is faulty. 6. The starting system is faulty. 7. The charging system is faulty. 8. Electrical loads exceed the output of the charging system. 9. Slow driving or prolonged idling with high-amperage draw systems in use.	1. Refer to Battery in the Specifications section of this group. Replace an incorrect battery with the correct battery. 2. Refer to Voltage Drop Test in the Diagnosis and Testing section of this group. Clean and tighten the battery terminal connections, if required. 3. Refer to Accessory Drive Belt Diagnosis in the Diagnosis and Testing section of Group 7 - Cooling System for more information. Replace or adjust the generator drive belt, if required. 4. Refer to Ignition-Off Draw Test in the Diagnosis and Testing section of this group. Repair the electrical system, if required. 5. Determine the battery cranking capacity. Refer to Load Test in the Diagnosis and Testing section of this group. Replace the battery, if required. 6. Determine if the starting system is performing to specifications. Refer to Starting System in the Diagnosis and Testing section of Group 8B - Starting Systems for more information. Repair the starting system, if required. 7. Determine if the charging system is performing to specifications. Refer to Charging System in the Diagnosis and Testing section of Group 8C - Charging System for more information. Repair the charging system, if required. 8. Inspect the vehicle for aftermarket electrical equipment which might cause excessive electrical loads. 9. Advise the vehicle operator, as required.
The battery will not accept a charge.	1. The battery is faulty.	1. Refer to Battery Charging in the Service Procedures section of this group. Replace the faulty battery, if required.

ABNORMAL BATTERY DISCHARGING

Any of the following conditions can result in abnormal battery discharging:

1. Corroded or loose battery posts and terminal clamps.
2. A loose or worn generator drive belt.
3. Electrical loads that exceed the output of the charging system. This can be due to equipment installed after manufacture, or repeated short trip use.
4. Slow driving speeds (heavy traffic conditions) or prolonged idling, with high-amperage draw systems in use.
5. A faulty circuit or component causing excessive ignition-off draw. Refer to **Ignition-Off Draw Test** in the Diagnosis and Testing section of this group for more information.
6. A faulty or incorrect charging system component. Refer to **Charging System** in the Diagnosis and Testing section of Group 8C - Charging System for more information.
7. A faulty or incorrect battery.

TESTING

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.

DIAGNOSIS AND TESTING (Continued)

Refer to **Load Test** in the Diagnosis and Testing section of this group for more information.

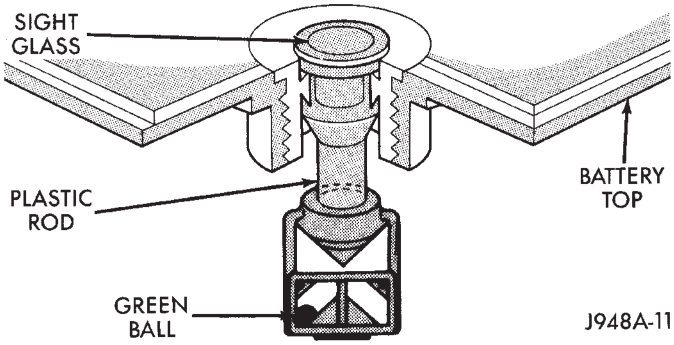

Fig. 2 Built-In Test Indicator

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). The battery condition that each color indicates is described in the following list:

- **Green -** indicates 75% to 100% state-of-charge. The battery is adequately charged for further testing or return to use. If the starter will not crank for a minimum of fifteen seconds with a fully-charged battery, the battery must be load tested. Refer to **Load Test** in the Diagnosis and Testing section of this group for more information.
- **Black or Dark -** indicates 0% to 75% state-of-charge. The battery is inadequately charged and must be charged until a green indication is visible in the sight glass (12.4 volts or more), before the battery is tested further or returned to service. Refer to **Battery Charging** in the Service Procedures section of this group for more information. Also refer to **Abnormal Battery Discharging** in the Diagnosis and Testing section of this group for possible causes of the discharged condition.
- **Clear or Bright -** indicates a low electrolyte level. The electrolyte level in the battery is below the test indicator. A maintenance-free battery with non-removable cell caps must be replaced if the electrolyte level is low. Water must be added to a low-maintenance battery with removable cell caps before it is charged. Refer to **Battery Charging** in the Service Procedures section of this group for more information. A low electrolyte level may be caused by an overcharging condition. Refer to **Charging System** in the Diagnosis and Testing section of Group 8C - Charging System to diagnose an overcharging condition.

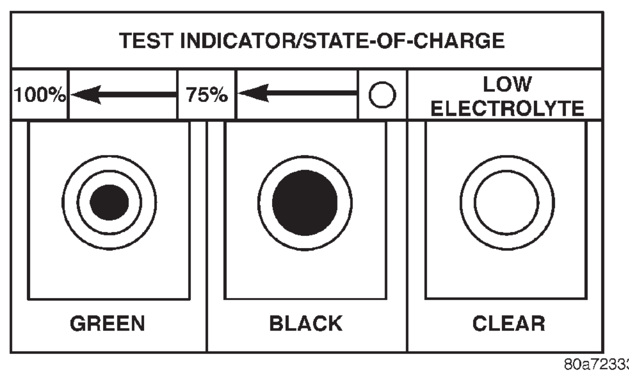

Fig. 3 Built-In Test Indicator Sight Glass

HYDROMETER TEST

The hydrometer test reveals the battery state-of-charge by measuring the specific gravity of the electrolyte. **This test cannot be performed on maintenance-free batteries with non-removable cell caps.** If the battery has non-removable cell caps, refer to **Built-In Test Indicator** or **Open-Circuit Voltage Test** in the Diagnosis and Testing section of this group.

Specific gravity is a comparison of the density of the electrolyte to the density of pure water. Pure water has a specific gravity of 1.000, and sulfuric acid has a specific gravity of 1.835. Sulfuric acid makes up approximately 35% of the electrolyte by weight, or 24% by volume.

DIAGNOSIS AND TESTING (Continued)

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.

See the instructions provided by the manufacturer of the hydrometer for recommendations on the correct use of the hydrometer that you are using. Remove only enough electrolyte from the battery cell so that the float is off the bottom of the hydrometer barrel with pressure on the bulb released.

CAUTION: Exercise care when inserting the tip of the hydrometer into a cell to avoid damaging the plate separators. Damaged plate separators can cause early battery failure.

To read the hydrometer correctly, hold it with the top surface of the electrolyte at eye level (Fig. 4). Hydrometer floats are generally calibrated to indicate the specific gravity correctly only at 26.7° C (80° F). When testing the specific gravity at any other temperature, a correction factor is required.

The correction factor is approximately a specific gravity value of 0.004, which may also be identified

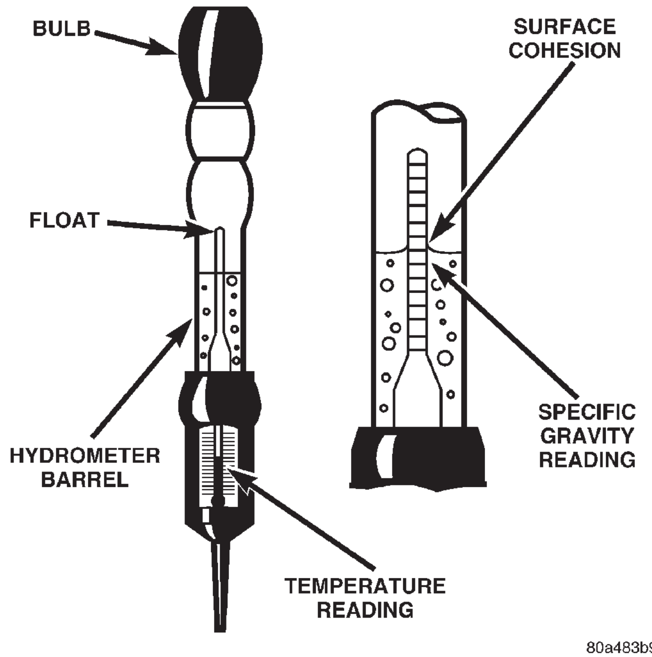

Fig. 4 Hydrometer - Typical

as four points of specific gravity. For each 5.5° C above 26.7° C (10° F above 80° F), add four points. For each 5.5° C below 26.7° C (10° F below 80° F), subtract four points. 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 cell in this example is 1.212.

If the specific gravity of all cells is above 1.235, but the variation between cells is more than fifty points (0.050), the battery should be replaced. If the specific gravity of one or more cells is less than 1.235, charge the battery at a rate of approximately five amperes.

Continue charging the battery until three consecutive specific gravity tests, taken at one-hour intervals, are constant. If the cell specific gravity variation is more than fifty points (0.050) at the end of the charge period, replace the battery.

When the specific gravity of all cells is above 1.235, and the cell variation is less than fifty points (0.050),

DIAGNOSIS AND TESTING (Continued)

the battery may be load tested to determine its cranking capacity. Refer to **Load Test** in the Diagnosis and Testing section of this group for more information.

OPEN-CIRCUIT VOLTAGE TEST

A battery open-circuit voltage (no load) test will show the state-of-charge of a battery. This test can be used in place of the hydrometer test when a hydrometer is not available, or for maintenance-free batteries with non-removable cell caps.

WARNING:

- **IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **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 proceeding with this test, completely charge the battery. Refer to **Battery Charging** in the Service Procedures section of this group for the proper battery charging procedures.

(1) Before measuring the open-circuit voltage, the surface charge must be removed from the battery. Turn on the head lamps for fifteen seconds, then allow up to five minutes for the battery voltage to stabilize.

(2) Disconnect and isolate both battery cables, negative cable first.

(3) Using a voltmeter connected to the battery posts (see the instructions provided by the manufacturer of the voltmeter), measure the open-circuit voltage (Fig. 5).

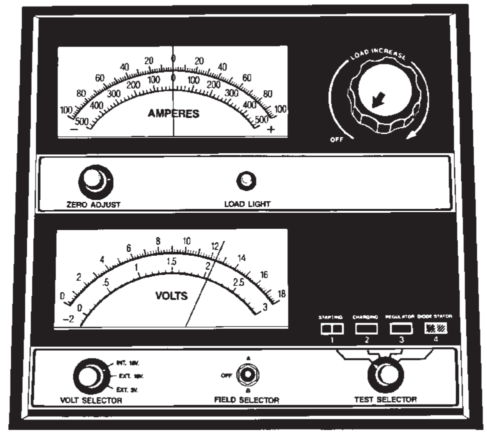

Fig. 5 Testing Open-Circuit Voltage - Typical

See the Open-Circuit Voltage chart. This voltage reading will indicate the battery state-of-charge, but will not reveal its cranking capacity. If a battery has an open-circuit voltage reading of 12.4 volts or greater, it may be load tested to reveal its cranking capacity. Refer to **Load Test** in the Diagnosis and Testing section of this group for more information.

Open Circuit Voltage	
Open Circuit Volts	Charge Percentage
11.7 volts or less	0%
12.0 volts	25%
12.2 volts	50%
12.4 volts	75%
12.6 volts or more	100%

LOAD TEST

A battery load test will verify the battery cranking capacity. The test is based on the Cold Cranking Amperage (CCA) rating of the battery. See the label affixed to the battery case, or refer to **Battery Classifications and Ratings** in the Specifications section of this group for the CCA rating of the factory-installed battery.

DIAGNOSIS AND TESTING (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.**
- **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 proceeding with this test, completely charge the battery. Refer to **Battery Charging** in the Service Procedures section of this group for the proper battery charging procedures.

(1) Disconnect and isolate both battery cables, negative cable first. The battery top and posts should be clean.

(2) Connect a suitable volt-ammeter-load tester (Fig. 6) to the battery posts (Fig. 7). See the instructions provided by the manufacturer of the tester you are using. Check the open-circuit voltage (no load) of the battery. Refer to **Open-Circuit Voltage Test** in the Diagnosis and Testing section of this group for the test procedures. The battery open-circuit voltage must be 12.4 volts or greater.

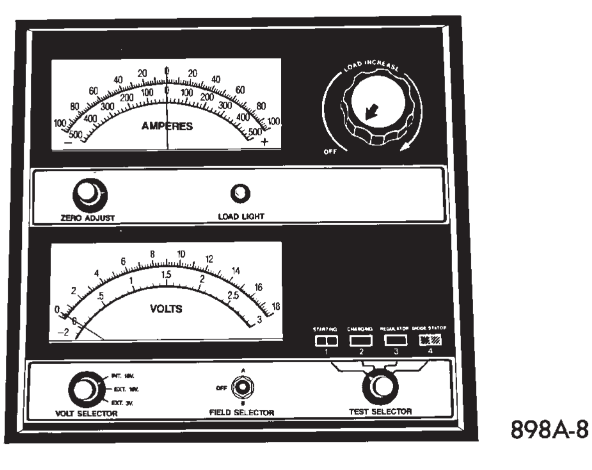

Fig. 6 Volt-Ammeter-Load Tester - Typical

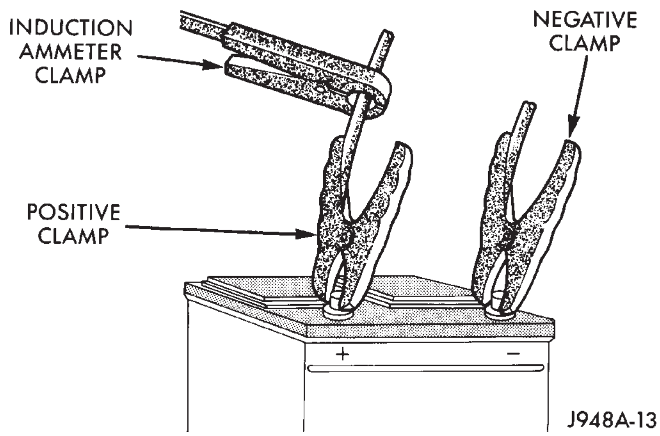

Fig. 7 Volt-Ammeter-Load Tester Connections - Typical

(3) Rotate the load control knob (carbon pile rheostat) to apply a 300 ampere load to the battery for fifteen seconds, then return the control knob to the Off position (Fig. 8). This will remove the surface charge from the battery.

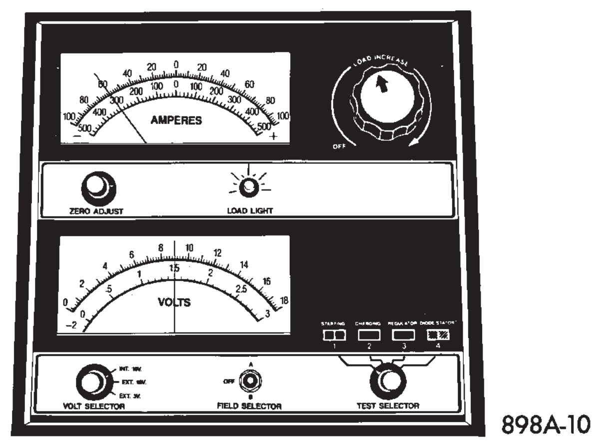

Fig. 8 Remove Surface Charge from Battery - Typical

(4) Allow the battery to stabilize to open-circuit voltage. It may take up to five minutes for the battery voltage to stabilize.

(5) Rotate the load control knob to maintain a load equal to 50% of the CCA rating of the battery (Fig. 9). After fifteen seconds, record the loaded voltage reading, then return the load control knob to the Off position.

(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.

DIAGNOSIS AND TESTING (Continued)

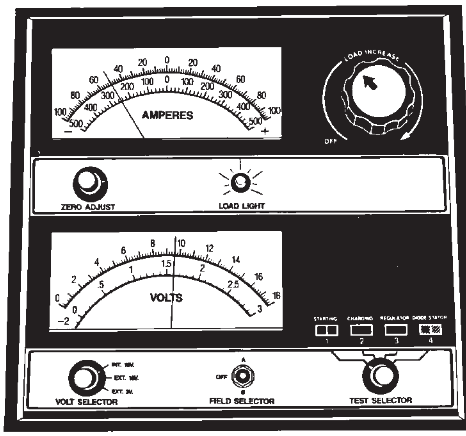

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Fig. 9 Load 50% CCA Rating - Note Voltage - Typical

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.

VOLTAGE DROP TEST

The voltage drop test will determine if there is excessive resistance in the battery terminal connections or the battery cables. When performing these tests, it is important to remember that the voltage drop is giving an indication of the resistance between the two points at which the voltmeter probes are attached.

Example: When testing the resistance of the battery positive cable, touch the voltmeter leads to the battery positive cable clamp and the cable connector at the starter solenoid. If you probe the battery positive terminal post and the cable connector at the starter solenoid, you are reading the combined voltage drop in the battery positive cable clamp-to-terminal post connection and the battery positive cable.

WARNING:

- **IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.**
- **IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.**

The following operation will require a voltmeter accurate to 1/10 (0.10) volt. Before performing the tests, be certain the following procedures are accomplished:

- The battery is fully-charged. Refer to **Battery Charging** in the Service Procedures section of this group for more information.
- Fully engage the parking brake.
- If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position. If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and fully depress the clutch pedal.
- Unplug the Automatic ShutDown (ASD) relay to prevent the engine from starting. The ASD relay is located in the Power Distribution Center (PDC). See the label on the PDC for ASD relay identification and location.

(1) Connect the positive lead of the voltmeter to the battery negative terminal post. Connect the negative lead of the voltmeter to the battery negative cable clamp (Fig. 10). 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. 11). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor contact between the cable clamp and the terminal post.

(3) Connect the voltmeter to measure between the battery positive terminal post and the starter solenoid battery terminal stud (Fig. 12). Rotate and hold

DIAGNOSIS AND TESTING (Continued)

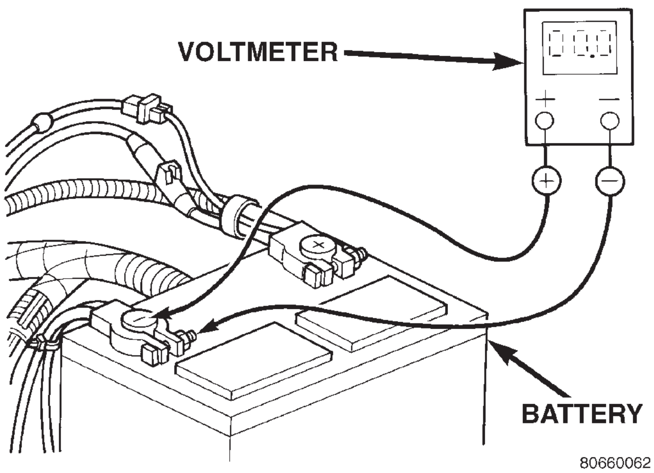

Fig. 10 Test Battery Negative Connection Resistance - Typical

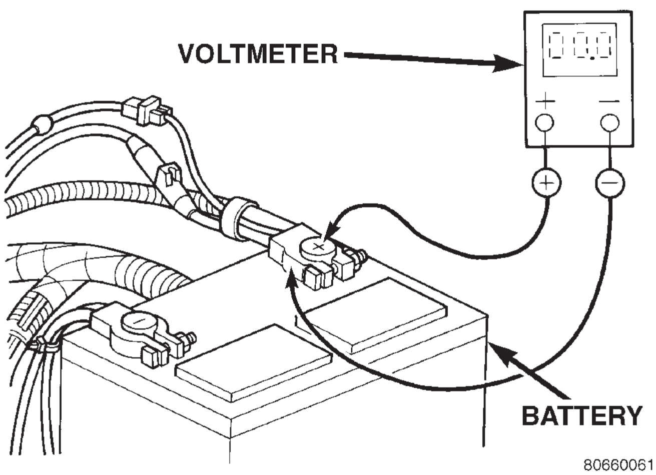

Fig. 11 Test Battery Positive Connection Resistance - Typical

the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery cable connection at the solenoid. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery positive cable.

(4) Connect the voltmeter to measure between the battery negative terminal post and a good clean ground on the engine block (Fig. 13). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery 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.

IGNITION-OFF DRAW TEST

The term Ignition-Off Draw (IOD) identifies a normal condition where power is being drained from the battery with the ignition switch in the Off position. A normal vehicle electrical system will draw from five

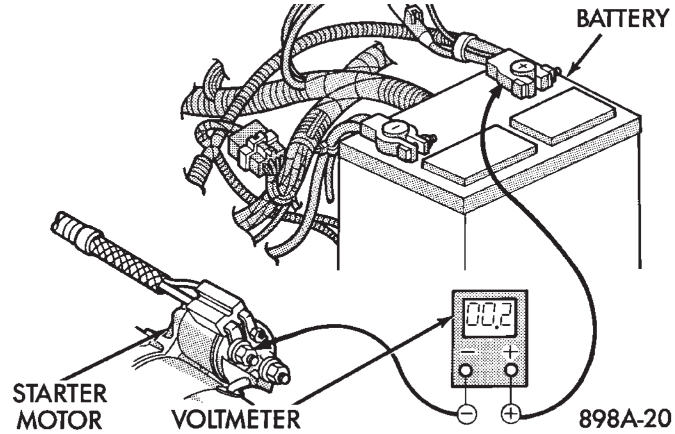

Fig. 12 Test Battery Positive Cable Resistance - Typical

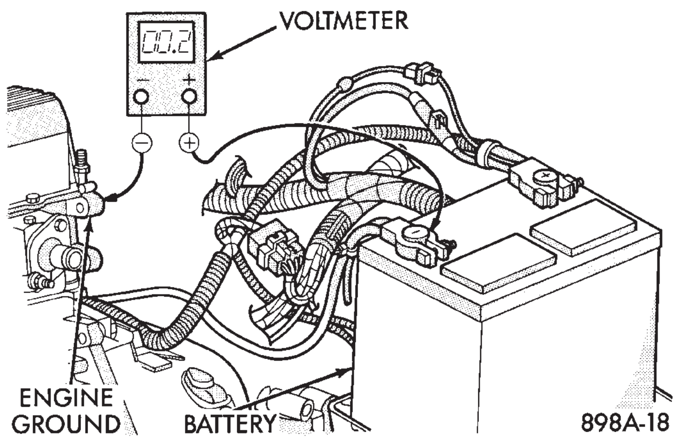

Fig. 13 Test Ground Circuit Resistance - Typical

to twenty-five milliamperes (0.005 to 0.025 ampere) with the ignition switch in the Off position, and all non-ignition controlled circuits in proper working order. The twenty-five milliamperes are needed to enable the memory functions for the Powertrain Control Module (PCM), digital clock, electronically tuned radio, and other modules which may vary with the vehicle equipment.

A vehicle that has not been operated for approximately twenty days, may discharge the battery to an inadequate level. When a vehicle will not be used for twenty days or more (stored), remove the IOD fuse from the Power Distribution Center (PDC). This will reduce battery discharging.

Excessive IOD can be caused by:

- Electrical items left on
- Faulty or improperly adjusted switches
- Faulty or shorted electronic modules and components
- An internally shorted generator
- Intermittent shorts in the wiring.

If the IOD is over twenty-five milliamperes, the problem must be found and corrected before replac-

DIAGNOSIS AND TESTING (Continued)

ing a battery. In most cases, the battery can be charged and returned to service after the excessive IOD condition has been corrected.

(1) Verify that all electrical accessories are off. Turn off all lamps, remove the ignition key, and close all doors. If the vehicle is equipped with an illuminated entry system or an electronically tuned radio, allow the electronic timer function of these systems to automatically shut off (time out). This may take up to three minutes.

(2) Determine that the under-hood lamp is operating properly, then disconnect the lamp wire harness connector or remove the lamp bulb.

(3) Disconnect the battery negative cable.

(4) Set an electronic digital multi-meter to its highest amperage scale. Connect the multi-meter between the disconnected battery negative cable clamp and the battery negative terminal post. Make sure that the doors remain closed so that the illuminated entry system is not activated. The multi-meter amperage reading may remain high for up to three minutes, or may not give any reading at all while set in the highest amperage scale, depending upon the electrical equipment on the vehicle. The multi-meter leads must be securely clamped to the battery negative cable clamp and the battery negative terminal post. If continuity between the battery negative terminal post and the negative cable clamp is lost during any part of the IOD test, the electronic timer function will be activated and all of the tests will have to be repeated.

(5) After about three minutes, the high-amperage IOD reading on the multi-meter should become very low or nonexistent, depending upon the electrical equipment on the vehicle. If the amperage reading remains high, remove and replace each fuse or circuit breaker in the Power Distribution Center (PDC) and then in the junction block (refer to **Power Distribution Center** and **Junction Block** in the Component Index of Group 8W - Wiring Diagrams for fuse and circuit breaker identification) one at a time until the amperage reading becomes very low, or nonexistent. This will isolate each circuit and identify the source of the high-amperage IOD. If the amperage reading remains high after removing and replacing each fuse and circuit breaker, disconnect the wire harness from the generator. If the amperage reading now becomes very low or nonexistent, refer to **Charging System** in the Diagnosis and Testing section of Group 8C - Charging System to diagnose the condition. After the high-amperage IOD has been corrected, switch the multi-meter to progressively lower amperage scales and, if necessary, repeat the fuse and circuit breaker remove-and-replace process to identify and correct all sources of excessive IOD. It is now safe to select the lowest milliampere scale of the multi-meter to check the low-amperage IOD.

CAUTION: Do not open any doors, or turn on any electrical accessories with the lowest milliampere scale selected, or the multi-meter may be damaged.

(6) Observe the multi-meter reading. The low-amperage IOD should not exceed twenty-five milliamperes (0.025 ampere). If the draw exceeds twenty-five milliamperes, isolate each circuit using the fuse and circuit breaker remove-and-replace process. The multi-meter reading will drop to within the acceptable limit when the source of the excessive draw is disconnected. Repair this circuit as required; whether a wiring short, incorrect switch adjustment, or a component failure is at fault.

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 hydrometer tests, taken at one-hour intervals, indicate no increase in the temperature-corrected specific gravity.
- Open-circuit voltage is 12.4 volts or above.

WARNING:

- **IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.**
- **IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.**

SERVICE PROCEDURES (Continued)

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 the battery from being damaged if they are improperly connected. If the battery state-of-charge is too low for the polarity-sensing circuitry to detect, the charger will not operate. This makes it appear that the battery will not accept charging current. See the instructions provided by the manufacturer of the battery charger for details on how to bypass the polarity-sensing circuitry.

After the battery has been charged to 12.4 volts or greater, perform a load test to determine the battery cranking capacity. Refer to **Load Test** in the Diagnosis and Testing section of this group for the procedures. 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. Refer to **Battery** in the Removal and Installation section of this group for the proper cleaning and inspection procedures.

CHARGING A COMPLETELY DISCHARGED BATTERY

The following procedure should be used to recharge a completely discharged battery. Unless this procedure is properly followed, a good battery may be needlessly replaced.

(1) Measure the voltage at the battery posts with a voltmeter, accurate to 1/10 (0.10) volt (Fig. 14). 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 battery chargers.

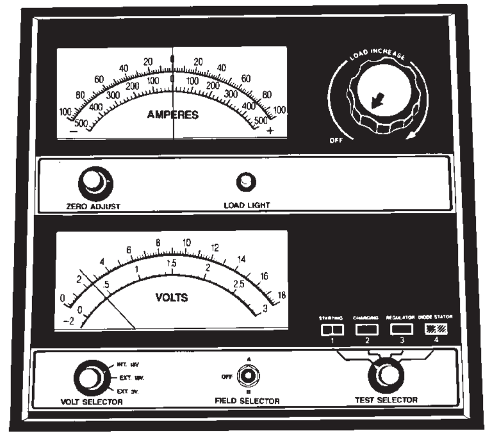

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Fig. 14 Voltmeter Accurate to 1/10 Volt Connected - Typical

(2) Disconnect and isolate the battery negative cable. Connect the battery charger leads. Some battery chargers are equipped with polarity-sensing circuitry. This circuitry protects the charger and/or the battery from being damaged if they are improperly connected. If the battery state-of-charge is too low for the polarity-sensing circuitry to detect, the charger will not operate. This makes it appear that the battery will not accept charging current. See the instructions provided by the manufacturer of the battery charger for details on how to bypass the polarity-sensing circuitry.

(3) Battery chargers vary in the amount of voltage and current they provide. The amount of time required for a battery to accept measurable charger current at various voltages is shown in the Charge Rate chart. If the charge current is still not measurable at the end of the charging time, the battery is faulty and must be replaced. If the charge current is measurable during the charging time, the battery may be good and the charging should be completed in the normal manner.

Charge Rate	
Voltage	Hours
16.0 volts maximum	up to 4 hours
14.0 to 15.9 volts	up to 8 hours
13.9 volts or less	up to 16 hours

CHARGING TIME REQUIRED

The time required to charge a battery will vary, depending upon the following factors:

- **Battery Capacity -** A completely discharged heavy-duty battery requires twice the charging time of a small capacity battery.
- **Temperature -** A longer time will be needed to charge a battery at -18° C (0° F) than at 27° C (80° F). When a fast charger is connected to a cold bat-

SERVICE PROCEDURES (Continued)

tery, the current accepted by the battery will be very low at first. As the battery warms, it will accept a higher charging current rate (amperage).

- **Charger Capacity** - A battery charger that supplies only five amperes will require a longer charging time. A battery charger that supplies twenty amperes or more will require a shorter charging time.
- **State-Of-Charge** - A completely discharged battery requires more charging time than a partially discharged battery. Electrolyte is nearly pure water in a completely discharged battery. At first, the charging current (amperage) will be low. As the battery charges, the specific gravity of the electrolyte will gradually rise.

WARNING: NEVER EXCEED TWENTY AMPERES WHEN CHARGING A COLD (-1° C or 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 12.49	6 hours	3 hours	1.5 hours
12.00 to 12.24	10 hours	5 hours	2.5 hours
10.00 to 11.99	14 hours	7 hours	3.5 hours
*Below 10.00	18 hours	9 hours	4.5 hours
*Refer to Charging A Completely Discharged Battery			

REMOVAL AND INSTALLATION

BATTERY

REMOVAL

(1) Turn the ignition switch to the Off position. Be certain that all electrical accessories are turned off.

(2) Loosen the battery 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. 15).

(3) Inspect the battery 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

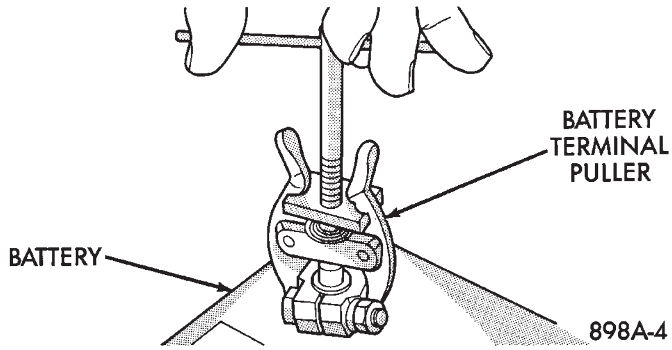


Fig. 15 Remove Battery Cable Terminal Clamp - Typical

cleaning solution (Fig. 16). Replace any battery cable that has damaged or deformed terminal clamps.

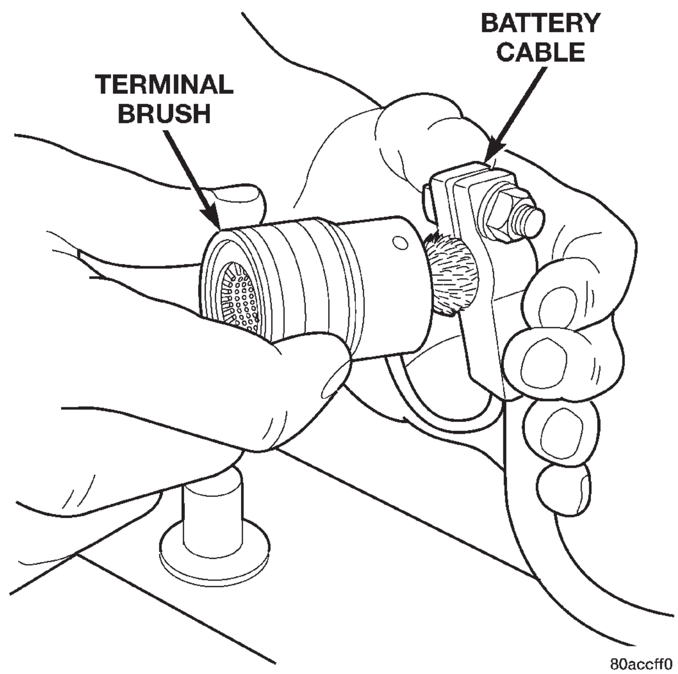


Fig. 16 Clean Battery Cable Terminal Clamp - Typical

WARNING: WEAR A SUITABLE PAIR OF RUBBER GLOVES (NOT THE HOUSEHOLD TYPE) WHEN REMOVING A BATTERY BY HAND. SAFETY GLASSES SHOULD ALSO BE WORN. IF THE BATTERY IS CRACKED OR LEAKING, THE ELECTROLYTE CAN BURN THE SKIN AND EYES.

(4) Remove the battery hold downs and remove the battery from the battery tray (Fig. 17).

(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) Slide the thermoguard off of the battery case. Inspect the battery case for cracks or other damage

REMOVAL AND INSTALLATION (Continued)

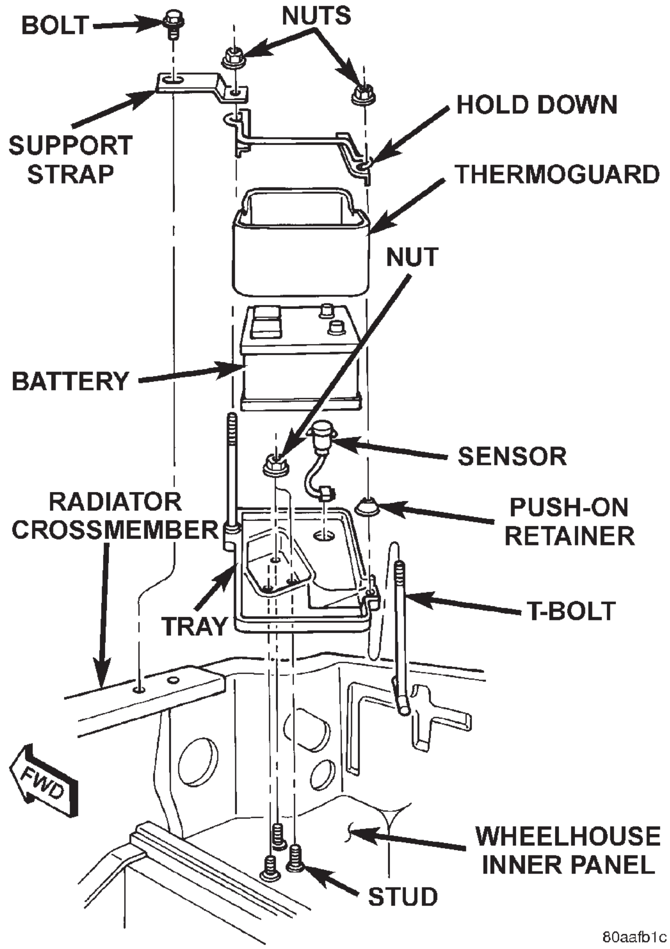


Fig. 17 Battery Hold Downs

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. 18). 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. Refer to **Built-In Test Indicator** in the Diagnosis and Testing section of this group for more information. Also refer to **Battery Charging** in the Service Procedures section of this group for more information.

(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. 19). Rinse the battery with clean water. Ensure that the cleaning solution does not enter the battery cells through the vent holes. If the battery is being replaced, refer to **Battery Ratings and Classifications** in the Specifications section of this group. Confirm that the replacement battery is the correct size and has the correct ratings for the vehicle.

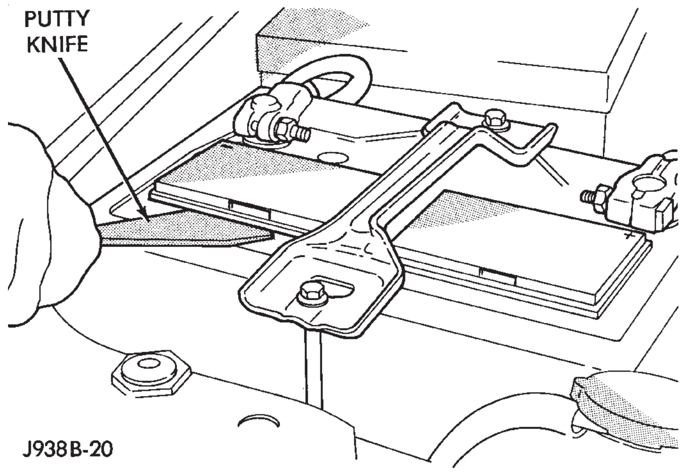


Fig. 18 Removing Cell Caps - Typical

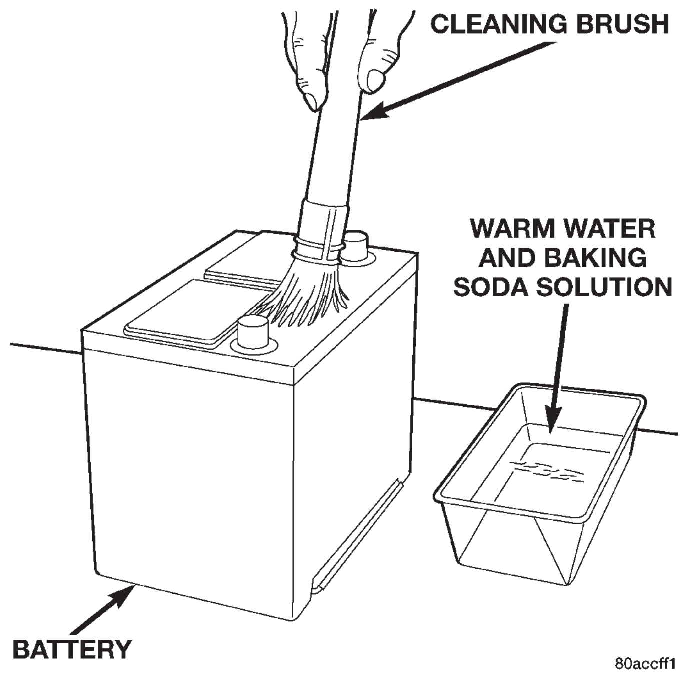


Fig. 19 Clean Battery - Typical

(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. 20).

INSTALLATION

(1) Reinstall the battery thermoguard by sliding it over the battery case.

(2) Position the battery in the tray. Ensure that the positive and negative terminal posts are correctly positioned. The cable terminal clamps must reach the

REMOVAL AND INSTALLATION (Continued)

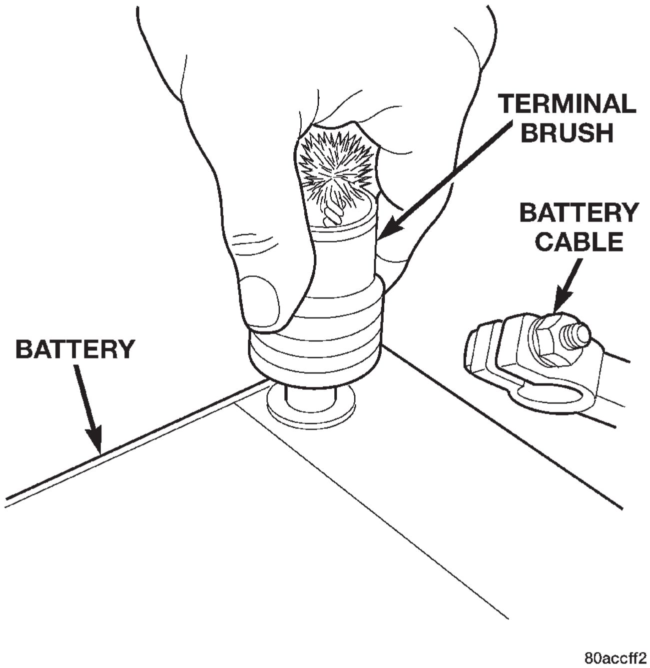


Fig. 20 Clean Battery Terminal Post - Typical

correct battery terminal post without stretching the cables (Fig. 21).

(3) Loosely install the battery hold down hardware. Ensure that the battery base is correctly positioned in the tray, then tighten the hold down nuts to 2.2 N·m (20 in. lbs.). Tighten the hold down support strap bolt to 9 N·m (77 in. lbs.).

CAUTION: Be certain that the battery cables are connected to the correct battery terminals. Reverse polarity may damage electrical components.

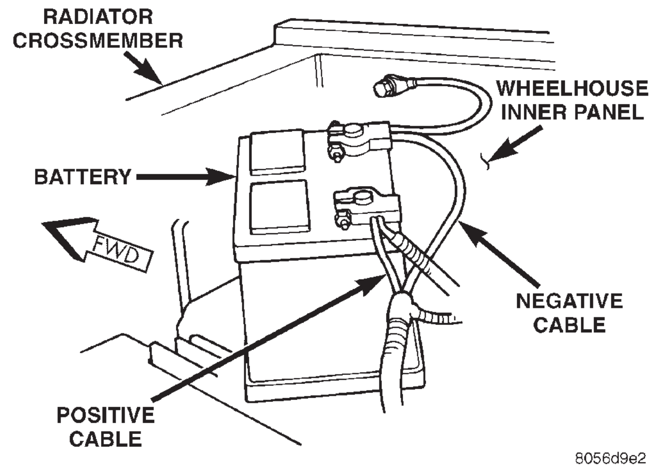


Fig. 21 Battery Cables

(4) Connect and tighten the battery positive cable terminal clamp. Then connect and tighten the battery negative cable terminal clamp. Tighten both battery cable terminal clamp bolts to 8.5 N·m (75 in. lbs.).

(5) Apply a thin coating of petroleum jelly or chassis grease to the exposed surfaces of the battery cable terminal clamps and battery terminal posts.

SPECIFICATIONS

BATTERY

Battery Classifications and Ratings					
Part Number	BCI Group Size Classification	Cold Cranking Amperage	Reserve Capacity	Ampere-Hours	Load Test Amperage
56041105AB	34	500	110 Minutes	60	250

STARTING SYSTEMS

CONTENTS

DESCRIPTION AND OPERATION

STARTING SYSTEM

DESCRIPTION

An electrically operated engine starting system is standard factory-installed equipment on this model. The starting system is designed to provide the vehicle operator with a convenient, efficient and reliable means of cranking and starting the internal combustion engine used to power the vehicle and all of its accessory systems from within the safe and secure confines of the passenger compartment. See the owner's manual in the vehicle glove box for more information and instructions on the recommended use and operation of the factory-installed starting system.

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.

The starting system consists of the following components:

- Battery
- Starter relay
- Starter motor (including an integral starter solenoid)
- Ignition switch
- Clutch pedal position switch (manual transmission)
- Park/neutral position switch (automatic transmission)
- Wire harnesses and connections (including the battery cables).

This group provides complete service information for the starter motor and the starter relay. Complete service information for the other starting system components can be located as follows:

- Refer to **Battery** in the proper section of Group 8A - Battery for complete service information for the battery.
- Refer to **Ignition Switch and Key Lock Cylinder** in the proper section of Group 8D - Ignition System for complete service information for the ignition switch.
- Refer to **Clutch Pedal Position Switch** in the proper section of Group 6 - Clutch for complete service information for the clutch pedal position switch.
- Refer to **Park/Neutral Position Switch** in the proper section of Group 21 - Transmission for complete service information for the park/neutral position switch.
- Refer to the proper section of **Group 8W - Wiring Diagrams** for complete service information and circuit diagrams for the starting system wiring components.

Group 8A covers the Battery, Group 8B covers the Starting Systems, and Group 8C covers the Charging System. 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 battery, starting, and charging systems in the vehicle 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 that are used in these systems must perform within specifications.

DESCRIPTION AND OPERATION (Continued)

The diagnostic procedures used in each of these groups include the most basic conventional diagnostic methods, to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of an induction-type milliampere ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. Refer to **On-Board Diagnostic Test For Charging System** in the Diagnosis and Testing section of Group 8C - Charging System for more information.

OPERATION

The starting system components form two separate circuits. A high-amperage feed circuit that feeds the starter motor between 150 and 350 amperes, and a low-amperage control circuit that operates on less than 20 amperes. The high-amperage feed circuit components include the battery, the battery cables, the contact disc portion of the starter solenoid, and the starter motor. The low-amperage control circuit components include the ignition switch, the clutch pedal position switch (manual transmission), the park/neutral position switch (automatic transmission), the starter relay, the electromagnetic windings of the starter solenoid, and the connecting wire harness components.

If the vehicle is equipped with a manual transmission, it has a clutch pedal position switch installed in series between the ignition switch and the coil battery terminal of the starter relay. This normally open switch prevents the starter relay from being energized when the ignition switch is turned to the momentary Start position, unless the clutch pedal is depressed. This feature prevents starter motor operation while the clutch disc and the flywheel are engaged. The starter relay coil ground terminal is always grounded on vehicles with a manual transmission.

If the vehicle is equipped with an automatic transmission, battery voltage is supplied through the low-amperage control circuit to the coil battery terminal of the starter relay when the ignition switch is turned to the momentary Start position. The park/neutral position switch is installed in series between the starter relay coil ground terminal and ground. This normally open switch prevents the starter relay from being energized and the starter motor from operating unless the automatic transmission gear selector is in the Neutral or Park positions.

When the starter relay coil is energized, the normally open relay contacts close. The relay contacts connect the relay common feed terminal to the relay normally open terminal. The closed relay contacts energize the starter solenoid coil windings.

The energized solenoid pull-in coil pulls in the solenoid plunger. The solenoid plunger pulls the shift lever in the starter motor. This engages the starter overrunning clutch and pinion gear with the starter ring gear on the manual transmission flywheel or on the automatic transmission torque converter drive plate.

As the solenoid plunger reaches the end of its travel, the solenoid contact disc completes the high-amperage starter feed circuit and energizes the solenoid plunger hold-in coil. Current now flows between the solenoid battery terminal and the starter motor, energizing the starter.

Once the engine starts, the overrunning clutch protects the starter motor from damage by allowing the starter pinion gear to spin faster than the pinion shaft. When the driver releases the ignition switch to the On position, the starter relay coil is de-energized. This causes the relay contacts to open. When the relay contacts open, the starter solenoid plunger hold-in coil is de-energized.

When the solenoid plunger hold-in coil is de-energized, the solenoid plunger return spring returns the plunger to its relaxed position. This causes the contact disc to open the starter feed circuit, and the shift lever to disengage the overrunning clutch and pinion gear from the starter ring gear.

Following are general descriptions of the major components in the starting system.

STARTER MOTOR

DESCRIPTION

The starter motors used for both the 2.5L and the 4.0L engines available in this model are not interchangeable. Both starter motors are mounted with two screws, but the 2.5L starter motor is mounted to the right rear corner of the engine block, while the 4.0L starter motor is mounted to the manual transmission clutch housing or automatic transmission torque converter housing on the right side of the engine.

Each of these starter motors incorporates several of the same features to create a reliable, efficient, compact, lightweight and powerful unit. The electric motors of both starters have four brushes contacting the motor commutator. The 2.5L starter motor uses four permanent magnets for the field poles, while the 4.0L starter motor features four electromagnetic field coils wound around four pole shoes. The 2.5L starter motor is rated at 1.2 kilowatts (about 1.6 horsepower) output at 12 volts, while the 4.0L starter

DESCRIPTION AND OPERATION (Continued)

motor is rated at 1.4 kilowatts (about 1.9 horsepower) output at 12 volts.

Both of these starter motors are serviced only as a unit with their starter solenoids, and cannot be repaired. If either component is faulty or damaged, the entire starter motor and starter solenoid unit must be replaced.

OPERATION

These starter motors are equipped with a planetary gear reduction (intermediate transmission) system. The planetary gear reduction system consists of a gear that is integral to the output end of the electric motor armature shaft that is in continual engagement with a larger gear that is splined to the input end of the starter pinion gear shaft. 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 starter pinion gear to the starter ring gear.

The starter motors for both engines are activated by an integral heavy duty starter solenoid switch mounted to the overrunning clutch housing. This electromechanical switch connects and disconnects the feed of battery voltage to the starter motor and actuates a shift fork that engages and disengages the starter pinion gear with the starter ring gear.

Both starter motors use an overrunning clutch and starter pinion gear unit to engage and drive a starter ring gear that is integral to the flywheel (manual transmission) or torque converter drive plate (automatic transmission) mounted on the rear crankshaft flange. Shims are available and can be used to adjust the 2.5L starter motor mounting position to correct for improper starter pinion gear to starter ring gear engagement.

STARTER RELAY

DESCRIPTION

The starter relay is an electromechanical device that switches battery current to the pull-in coil of the starter solenoid when the ignition switch is turned to the Start position. The starter relay is located in the Power Distribution Center (PDC), in the engine compartment. See the fuse and relay layout label affixed to the inside surface of the PDC cover for starter relay identification and location.

The starter relay is a International Standards Organization (ISO) relay. Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions.

The starter relay cannot be repaired or adjusted and, if faulty or damaged, it must be replaced.

OPERATION

The ISO relay consists of an electromagnetic coil, a resistor or diode, and three (two fixed and one movable) electrical contacts. The movable (common feed) relay contact is held against one of the fixed contacts (normally closed) by spring pressure. When the electromagnetic coil is energized, it draws the movable contact away from the normally closed fixed contact, and holds it against the other (normally open) fixed contact.

When the electromagnetic coil is de-energized, spring pressure returns the movable contact to the normally closed position. The resistor or diode is connected in parallel with the electromagnetic coil in the relay, and helps to dissipate voltage spikes that are produced when the coil is de-energized.

DIAGNOSIS AND TESTING

STARTING SYSTEM

DIAGNOSIS

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 Systems, and Group 8C covers the Charging System. 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 an induction-type milliampere ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. Refer to **On-Board Diagnostic Test For Charging System** in the Diagnosis and Testing section of Group 8C - Charging System for more information.

DIAGNOSIS AND TESTING (Continued)

Starting System Diagnosis		
CONDITION	POSSIBLE CAUSE	CORRECTION
STARTER FAILS TO OPERATE.	1. Battery discharged or faulty. 2. Starting circuit wiring faulty. 3. Starter relay faulty. 4. Ignition switch faulty. 5. Clutch pedal position switch faulty. 6. Park/Neutral position switch faulty or misadjusted. 7. Starter solenoid faulty. 8. Starter motor faulty.	1. Refer to Battery in the Diagnosis and Testing section of Group 8A - Battery. Charge or replace the battery, if required. 2. Refer to Starting System in Group 8W - Wiring Diagrams. Test and repair the starter feed and/or control circuits, if required. 3. Refer to Starter Relay in the Diagnosis and Testing section of this group. Replace the starter relay, if required. 4. Refer to Ignition Switch and Key Lock Cylinder in the Diagnosis and Testing section of Group 8D - Ignition System. Replace the ignition switch, if required. 5. Refer to Clutch Pedal Position Switch in the Diagnosis and Testing section of Group 6 - Clutch. 6. Refer to Park/Neutral Position Switch in the Diagnosis and Testing section of Group 21 - Transmission. Replace the park/neutral position switch, if required. 7. Refer to Starter Motor in the Diagnosis and Testing section of this group. Replace the starter motor assembly, if required. 8. If all other starting system components and circuits test OK, replace the starter motor assembly.
STARTER ENGAGES, FAILS TO TURN ENGINE.	1. Battery discharged or faulty. 2. Starting circuit wiring faulty. 3. Starter motor faulty. 4. Engine seized.	1. Refer to Battery in the Diagnosis and Testing section of Group 8A - Battery. Charge or replace the battery, if required. 2. Refer to Starting System in Group 8W - Wiring Diagrams. Test and repair the starter feed and/or control circuits, if required. 3. If all other starting system components and circuits test OK, replace the starter motor assembly. 4. Refer to Engine Diagnosis in the Diagnosis and Testing section of Group 9 - Engine.
STARTER ENGAGES, SPINS OUT BEFORE ENGINE STARTS.	1. Starter ring gear faulty. 2. Starter motor faulty.	1. Refer to Starter Motor in the Removal and Installation section of this group. Remove the starter motor to inspect the starter ring gear. Replace the starter ring gear, if required. 2. If all other starting system components and circuits test OK, replace the starter motor assembly.
STARTER DOES NOT DISENGAGE.	1. Starter motor improperly installed. 2. Starter relay faulty. 3. Ignition switch faulty. 4. Starter motor faulty.	1. Refer to Starter Motor in the Removal and Installation section of this group. Tighten the starter mounting hardware to the correct tightness specifications. 2. Refer to Starter Relay in the Diagnosis and Testing section of this group. Replace the starter relay, if required. 3. Refer to Ignition Switch and Key Lock Cylinder in the Diagnosis and Testing section of Group 8D - Ignition System. Replace the ignition switch, if required. 4. If all other starting system components and circuits test OK, replace the starter motor assembly.

DIAGNOSIS AND TESTING (Continued)

INSPECTION

For complete circuit diagrams, refer to **Starting System** in the Contents of Group 8W - Wiring Diagrams. Before removing any unit from the starting system for repair or diagnosis, perform the following inspections:

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

- **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 **Battery** in the proper section of Group 8A - Battery for complete service information for the battery.
- **Ignition Switch** - Visually inspect the ignition switch for indications of physical damage and loose or corroded wire harness connections. Refer to **Ignition Switch and Key Lock Cylinder** in the proper section of Group 8D - Ignition System for complete service information for the ignition switch.
- **Clutch Pedal Position Switch** - If the vehicle is equipped with a manual transmission, visually inspect the clutch pedal position switch for indications of physical damage and loose or corroded wire harness connections. Refer to **Clutch Pedal Position Switch** in the proper section of Group 6 - Clutch for complete service information for the clutch pedal position switch.
- **Park/Neutral Position Switch** - If the vehicle is equipped with an automatic transmission, visually inspect the park/neutral position switch for indications of physical damage and loose or corroded wire harness connections. Refer to **Park/Neutral Position Switch** in the proper section of Group 21 - Transmission for complete service information for the park/neutral position switch.
- **Starter Relay** - Visually inspect the starter relay for indications of physical damage and loose or corroded wire harness connections.
- **Starter Motor** - Visually inspect the starter motor for indications of physical damage and loose or corroded wire harness connections.
- **Starter Solenoid** - Visually inspect the starter solenoid for indications of physical damage and loose or corroded wire harness connections.
- **Wiring** - Visually inspect the wire harnesses for damage. Repair or replace any faulty wiring, as required. Refer to the proper section of **Group 8W - Wiring Diagrams** for complete service information and circuit diagrams for the starting system wiring components.

TESTING

COLD CRANKING TEST

For complete circuit diagrams, refer to **Starting System** in the Contents of Group 8W - Wiring Diagrams. The battery must be fully-charged and load-tested before proceeding. Refer to **Battery** in the Diagnosis and Testing section of Group 8A - Battery for the procedures.

(1) Connect a suitable volt-ampere tester to the battery terminals (Fig. 1). See the instructions provided by the manufacturer of the volt-ampere tester being used.

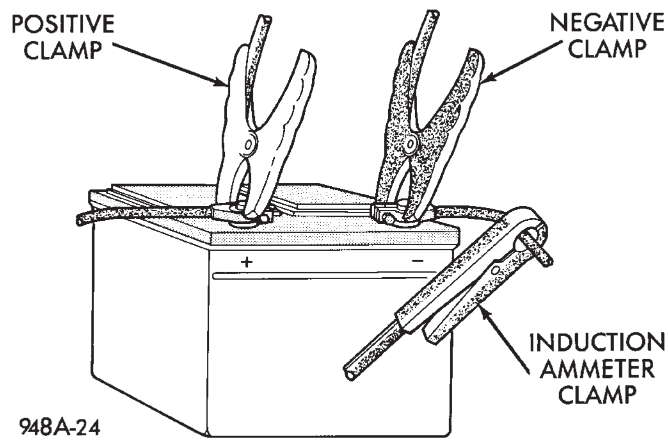


Fig. 1 Volts-Amps Tester Connections - Typical

(2) Fully engage the parking brake.

(3) If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and block the clutch pedal in the fully depressed position. If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position.

(4) Verify that all lamps and accessories are turned off.

(5) To prevent the engine from starting, remove the Automatic ShutDown (ASD) relay. The ASD relay is located in the Power Distribution Center (PDC), in the engine compartment. Refer to the fuse and relay layout label affixed to the underside of the PDC cover for ASD relay identification and location.

(6) Rotate and hold the ignition switch in the Start position. Note the cranking voltage and current (amperage) draw readings shown on the volt-ampere tester.

(a) If the voltage reads below 9.6 volts, refer to **Starter Motor** in the Diagnosis and Testing section of this group. If the starter motor is OK, refer

DIAGNOSIS AND TESTING (Continued)

to **Engine Diagnosis** in the Diagnosis and Testing section of Group 9 - Engine for further testing of the engine. If the starter motor is not OK, replace the faulty starter motor.

(b) If the voltage reads above 9.6 volts and the current (amperage) draw reads below specifications, refer to **Feed Circuit Test** in this section.

(c) If the voltage reads 12.5 volts or greater and the starter motor does not turn, refer to **Control Circuit Testing** in this section.

(d) If the voltage reads 12.5 volts or greater and the starter motor turns very slowly, refer to **Feed Circuit Test** in this section.

NOTE: A cold engine will increase the starter current (amperage) draw reading, and reduce the battery voltage reading.

FEED CIRCUIT TEST

The starter feed circuit test (voltage drop method) will determine if there is excessive resistance in the high-amperage feed circuit. For complete circuit diagrams, refer to **Starting System** in the Contents of Group 8W - Wiring Diagrams.

When performing these tests, it is important to remember that the voltage drop is giving an indication of the resistance between the two points at which the voltmeter probes are attached.

Example: When testing the resistance of the battery positive cable, touch the voltmeter leads to the battery positive cable clamp and the cable connector at the starter solenoid. If you probe the battery positive terminal post and the cable connector at the starter solenoid, you are reading the combined voltage drop in the battery positive cable clamp-to-terminal post connection and the battery positive cable.

The following operation will require a voltmeter accurate to 1/10 (0.10) volt. Before performing the tests, be certain that the following procedures are accomplished:

- Battery is fully-charged and load-tested. Refer to **Battery** in the Diagnosis and Testing section of Group 8A - Battery for the procedures.
- Fully engage the parking brake.
- If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and block the clutch pedal in the fully depressed position. If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position.
- Verify that all lamps and accessories are turned off.
- To prevent the engine from starting, remove the Automatic ShutDown (ASD) relay. The ASD relay is located in the Power Distribution Center (PDC), in the engine compartment. Refer to the fuse and relay layout label affixed to the underside of the PDC cover for ASD relay identification and location.

(1) Connect the positive lead of the voltmeter to the battery negative terminal post. Connect the negative lead of the voltmeter to the battery negative cable 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.

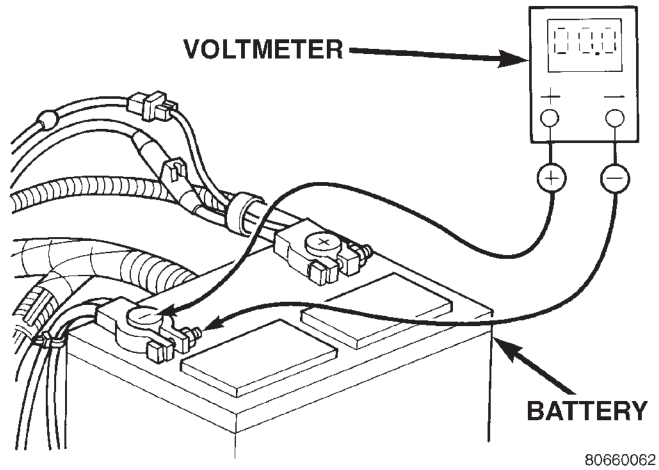


Fig. 2 Test Battery Negative Connection Resistance - Typical

(2) Connect the positive lead of the voltmeter to the battery positive terminal post. Connect the negative lead of the voltmeter to the battery positive cable clamp (Fig. 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.

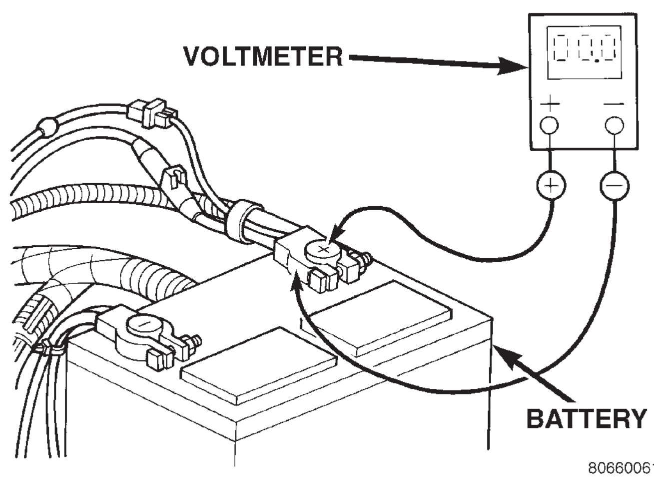


Fig. 3 Test Battery Positive Connection Resistance - Typical

(3) Connect the voltmeter to measure between the battery positive terminal post and the starter solenoid battery terminal stud (Fig. 4). Rotate and hold

DIAGNOSIS AND TESTING (Continued)

the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery cable connection at the solenoid. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery positive cable.

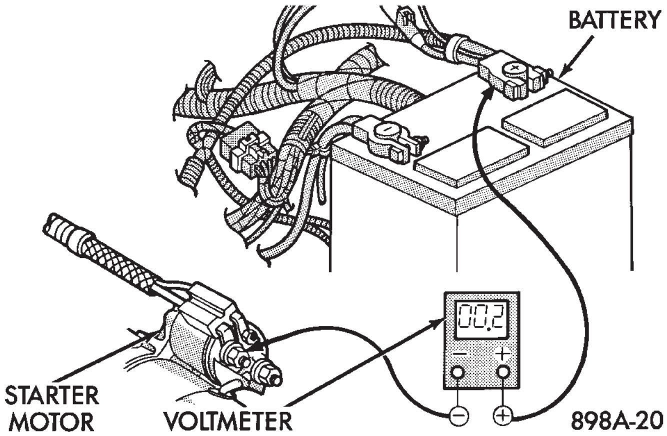


Fig. 4 Test Battery Positive Cable Resistance - Typical

(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.

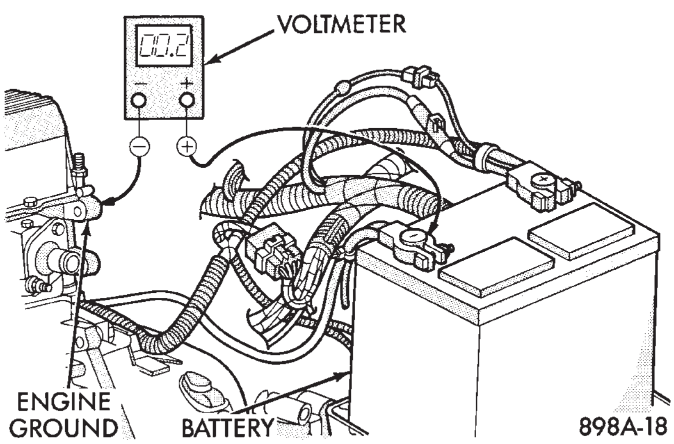


Fig. 5 Test Ground Circuit Resistance - Typical

(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.

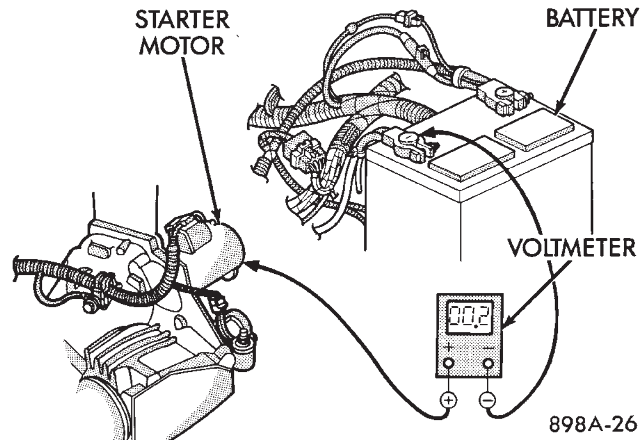


Fig. 6 Test Starter Ground - Typical

If the resistance tests detect no feed circuit problems, refer to **Starter Motor** in the Diagnosis and Testing section of this group.

CONTROL CIRCUIT TESTING

The starter control circuit components should be tested in the order in which they are listed, as follows:

- **Starter Relay** - Refer to **Starter Relay** in the Diagnosis and Testing section of this group for the procedures.
- **Starter Solenoid** - Refer to **Starter Motor** in the Diagnosis and Testing section of this group for the procedures.
- **Ignition Switch** - Refer to **Ignition Switch and Key Lock Cylinder** in the Diagnosis and Testing section of Group 8D - Ignition System for the procedures.
- **Clutch Pedal Position Switch** - If the vehicle is equipped with a manual transmission, refer to **Clutch Pedal Position Switch** in the Diagnosis and Testing section of Group 6 - Clutch for the procedures.
- **Park/Neutral Position Switch** - If the vehicle is equipped with an automatic transmission, refer to **Park/Neutral Position Switch** in the Diagnosis and Testing section of Group 21 - Transmission for the procedures.
- **Wire harnesses and connections** - Refer to **Starting System** in the Contents of Group 8W - Wiring Diagrams for complete circuit diagrams.

DIAGNOSIS AND TESTING (Continued)

STARTER MOTOR NOISE - 2.5L ENGINE

See the Starter Motor Noise Diagnosis chart (Fig. 7). If the complaint is similar to Conditions 1 and 2 in the chart, correction can be made by placing shims between the starter motor and the engine block using the following procedures:

(1) If the complaint is similar to Condition 1, the starter motor must be moved toward the starter ring gear by removing shims from both starter mounting pads on the engine block (Fig. 8). Refer to **Starter Motor** in the Removal and Installation section of this group for the procedures.

NOTE: The shim thickness is 0.381 mm (0.015 in.). These shims may be stacked if additional thickness is required.

(2) If the complaint is similar to Condition 2, the starter motor must be moved away from the starter ring gear. This is done by installing shim(s) across both starter mounting pads on the engine block. More than one shim may be required. Refer to **Starter Motor** in the Removal and Installation section of this group for the procedures.

NOTE: This is a condition that will generally cause broken starter (flywheel/torque converter drive plate) ring gear teeth or broken starter motor housings.

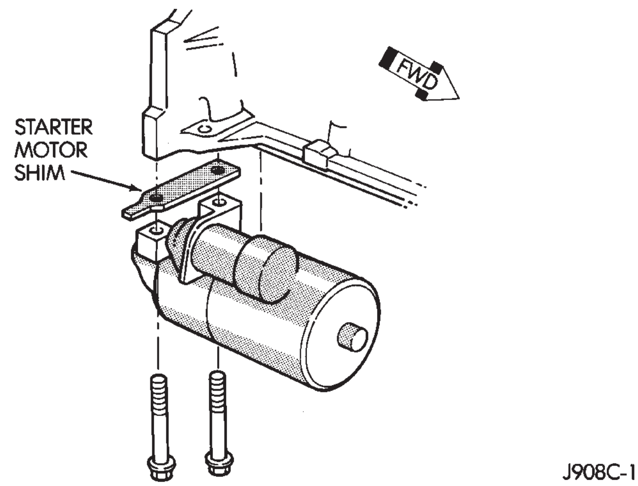


Fig. 8 Starter Motor Shim

STARTER MOTOR

Correct starter motor operation can be confirmed by performing the following free running bench test. This test can only be performed with the starter motor removed from the vehicle. Refer to **Starting System** in the Specifications section of this group for the starter motor specifications.

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.

J958A-5

Fig. 7 Starter Motor Noise Diagnosis

DIAGNOSIS AND TESTING (Continued)

CAUTION: The 2.5L engine uses a permanent magnet starter. Permanent magnet starters are highly sensitive to hammering, shocks, external pressure and reverse polarity. This starter motor must never be clamped in a vise by the starter field frame. The starter should only be clamped by the mounting flange. Do not reverse the battery cable connections to this starter motor when testing. The permanent magnets may be damaged and the starter rendered unserviceable if it is subjected to any of these conditions.

(1) Remove the starter motor from the vehicle. Refer to **Starter Motor** in the Removal and Installation section of this group for the procedures.

(2) Mount the starter motor securely in a soft-jawed bench vise. The vise jaws should be clamped on the mounting flange of the starter motor. Never clamp on the starter motor by the field frame.

(3) Connect a suitable volt-ampere tester and a 12-volt battery to the starter motor in series, and set the ammeter to the 100 ampere scale. See the instructions provided by the manufacturer of the volt-ampere tester being used.

(4) Install a jumper wire from the solenoid terminal to the solenoid battery terminal. The starter motor should operate. If the starter motor fails to operate, replace the faulty starter motor assembly.

(5) Adjust the carbon pile load of the tester to obtain the free running test voltage. Refer to **Starting System** in the Specifications section of this group for the starter motor free running test voltage specifications.

(6) Note the reading on the ammeter and compare this reading to the free running test maximum amperage draw. Refer to **Starting System** in the Specifications section of this group for the starter motor free running test maximum amperage draw specifications.

(7) If the ammeter reading exceeds the maximum amperage draw specification, replace the faulty starter motor assembly.

STARTER SOLENOID

This test can only be performed with the starter motor removed from the vehicle.

(1) Remove the starter motor from the vehicle. Refer to **Starter Motor** in the Removal and Installation section of this group for the procedures.

(2) Disconnect the wire from the solenoid field coil terminal.

(3) Check for continuity between the solenoid terminal and the solenoid field coil terminal with a continuity tester (Fig. 9). There should be continuity. If OK, go to Step 4. If not OK, replace the faulty starter motor assembly.

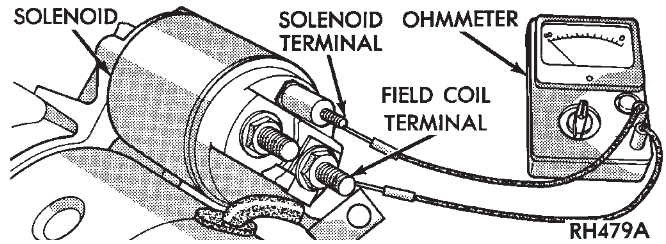


Fig. 9 Continuity Test Between Solenoid Terminal and Field Coil Terminal - Typical

(4) Check for continuity between the solenoid terminal and the solenoid case (Fig. 10). There should be continuity. If not OK, replace the faulty starter motor assembly.

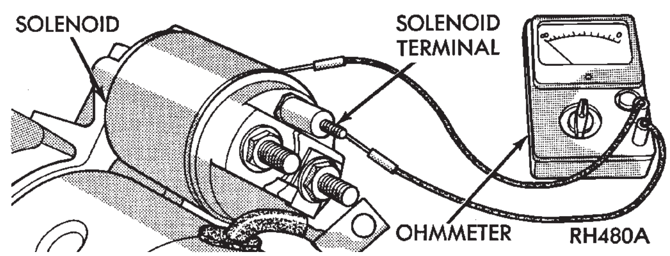


Fig. 10 Continuity Test Between Solenoid Terminal and Solenoid Case - Typical

STARTER RELAY

The starter relay (Fig. 11) is located in the Power Distribution Center (PDC), in the engine compartment. Refer to the fuse and relay layout label affixed to the underside of the PDC cover for starter relay identification and location. For complete circuit diagrams, refer to **Starting System** in the Contents of Group 8W - Wiring Diagrams.

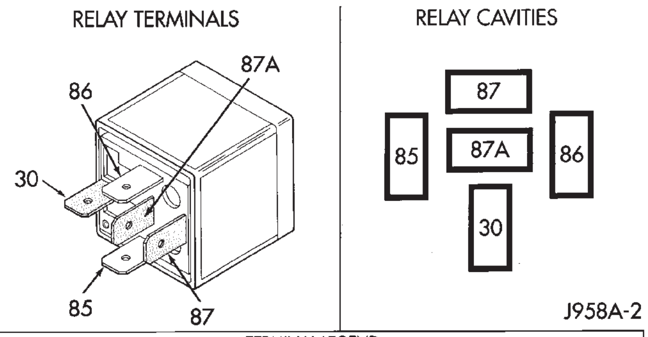
(1) Remove the starter relay from the PDC. Refer to **Starter Relay** in the Removal and Installation section of this group for the procedures.

(2) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

DIAGNOSIS AND TESTING (Continued)

(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, perform the Relay Circuit Test that follows. If not OK, replace the faulty relay.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 11 Starter Relay

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair the open circuit to the fuse in the PDC as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the starter solenoid field coils. There should be continuity between the cavity for relay terminal 87 and the starter solenoid terminal at all times. If OK, go to Step 4. If not OK, repair the open circuit to the starter solenoid as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. It is energized when the ignition switch is held in the Start position. On vehicles with a manual transmission, the clutch pedal must be fully depressed for this test. Check for battery voltage at the cavity for relay terminal 86 with the ignition switch in the Start position, and no voltage when the ignition switch is released to the On position. If OK, go to Step 5. If not OK with an automatic transmission, check for an open or short circuit to the ignition switch and repair, if required. If the circuit to the ignition switch is OK, refer to **Ignition Switch and Key Lock Cylinder** in the Diagnosis and Testing section of Group 8D - Ignition System for testing of the ignition switch. 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, refer to **Clutch Pedal Position Switch** in the Diagnosis and Testing section of Group 6 - Clutch for testing of the switch.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. On vehicles with a manual transmission, it is grounded at all times. 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. Check for continuity to ground at the cavity for relay terminal 85. If not OK with a manual transmission, repair the circuit to ground as required. 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 to the park/neutral position switch is OK, refer to **Park/Neutral Position Switch** in the Diagnosis and Testing section of Group 21 - Transmission for testing of the park/neutral position switch.

REMOVAL AND INSTALLATION

STARTER MOTOR

REMOVAL

2.5L ENGINE

(1) Disconnect and isolate the battery negative cable.

(2) Raise and support the vehicle.

(3) While supporting the starter motor with one hand, use the other hand to remove the two screws that secure the starter motor to the engine block (Fig. 12).

(4) Lower the starter motor from the engine block far enough to access and remove the nut that secures the battery cable eyelet to the solenoid battery terminal (Fig. 13). Always support the starter motor during this process, do not let the starter motor hang from the wire harness.

(5) Remove the battery cable eyelet from the solenoid battery terminal. Always support the starter motor during this process, do not let the starter motor hang from the wire harness.

(6) Disconnect the solenoid terminal wire harness connector from the connector receptacle on the starter solenoid. Always support the starter motor during this process, do not let the starter motor hang from the wire harness.

(7) Remove the starter motor from the engine compartment.

4.0L ENGINE

(1) Disconnect and isolate the battery negative cable.

(2) Raise and support the vehicle.

REMOVAL AND INSTALLATION (Continued)

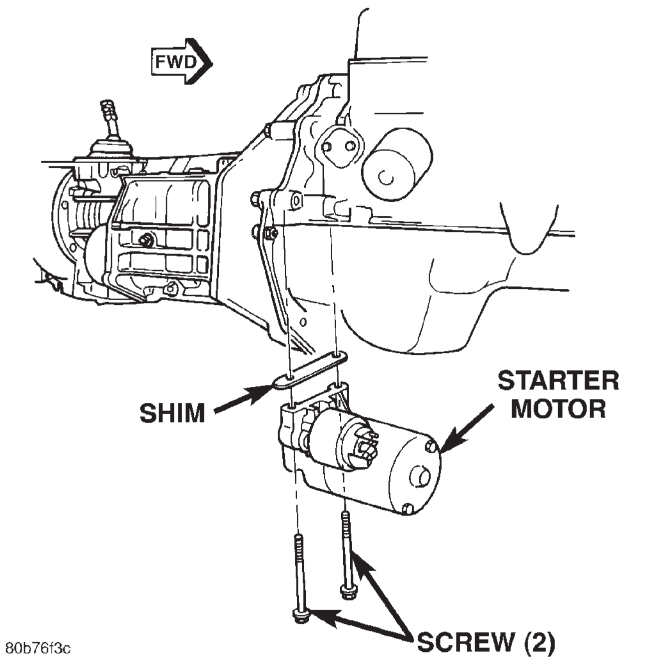


Fig. 12 Starter Motor Remove/Install - 2.5L Engine

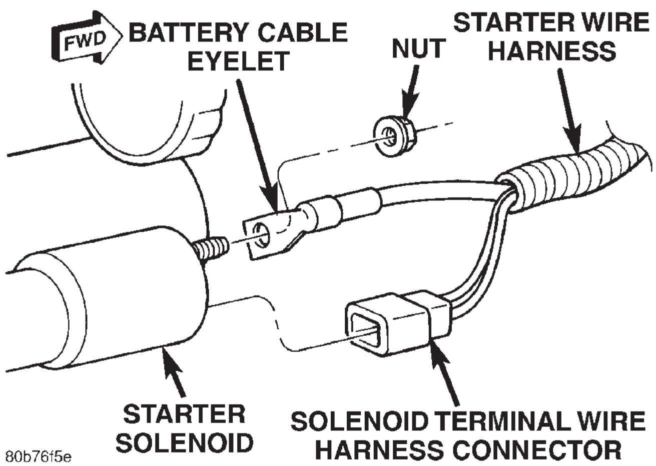


Fig. 13 Starter Wire Harness Remove/Install

(3) Remove the lower (forward facing) mounting screw from the starter motor (Fig. 14).

(4) While supporting the starter motor with one hand, use the other hand to remove the upper (rear facing) mounting screw from the starter motor.

(5) Lower the starter motor from the front of the transmission clutch housing or torque converter housing far enough to access and remove the nut that secures the battery cable eyelet to the solenoid battery terminal (Fig. 13). Always support the starter motor during this process, do not let the starter motor hang from the wire harness.

(6) Remove the battery cable eyelet from the solenoid battery terminal. Always support the starter motor during this process, do not let the starter motor hang from the wire harness.

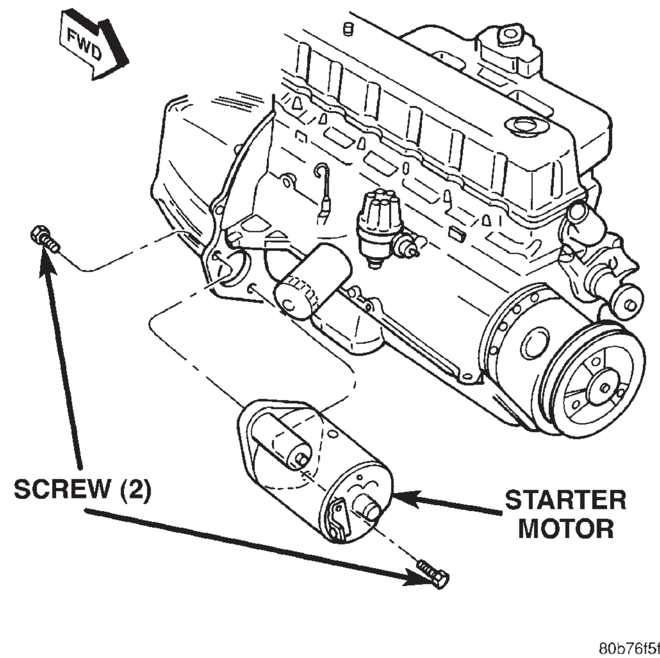


Fig. 14 Starter Motor Remove/Install - 4.0L Engine

(7) Disconnect the solenoid terminal wire harness connector from the connector receptacle on the starter solenoid. Always support the starter motor during this process, do not let the starter motor hang from the wire harness.

(8) Remove the starter motor from the engine compartment.

INSTALLATION

2.5L ENGINE

(1) Position the starter motor in the engine compartment.

(2) Reconnect the solenoid terminal wire harness connector to the connector receptacle on the starter solenoid. Always support the starter motor during this process, do not let the starter motor hang from the wire harness.

(3) Install the battery cable eyelet onto the solenoid battery terminal. Always support the starter motor during this process, do not let the starter motor hang from the wire harness.

(4) Install and tighten the nut that secures the battery cable eyelet to the solenoid battery terminal. Tighten the nut to 10 N·m (90 in. lbs.). Always support the starter motor during this process, do not let the starter motor hang from the wire harness.

(5) Position the starter motor and any starter motor shims that were removed to the engine block and loosely install both of the mounting screws.

REMOVAL AND INSTALLATION (Continued)

NOTE: Shim thickness available is 0.381 mm (0.015 in.). Refer to Starter Motor Noise - 2.5L Engine in the Diagnosis and Testing section of this group for more information.

(6) Tighten both of the starter motor mounting screws. Tighten the screws to 45 N·m (33 ft. lbs.).

(7) Lower the vehicle.

(8) Reconnect the battery negative cable.

4.0L ENGINE

(1) Position the starter motor in the engine compartment.

(2) Reconnect the solenoid terminal wire harness connector to the connector receptacle on the starter solenoid. Always support the starter motor during this process, do not let the starter motor hang from the wire harness.

(3) Install the battery cable eyelet onto the solenoid battery terminal. Always support the starter motor during this process, do not let the starter motor hang from the wire harness.

(4) Install and tighten the nut that secures the battery cable eyelet to the solenoid battery terminal. Tighten the nut to 10 N·m (90 in. lbs.). Always support the starter motor during this process, do not let the starter motor hang from the wire harness.

(5) Position the starter motor to the front of the transmission clutch housing or torque converter housing and loosely install both the upper and lower mounting screws.

(6) Tighten the lower (forward facing) starter motor mounting screw. Tighten the screw to 47 N·m (35 ft. lbs.).

(7) Tighten the upper (rearward facing) starter motor mounting screw. Tighten the screw to 41 N·m (30 ft. lbs.).

(8) Lower the vehicle.

(9) Reconnect the battery negative cable.

STARTER RELAY

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 15).

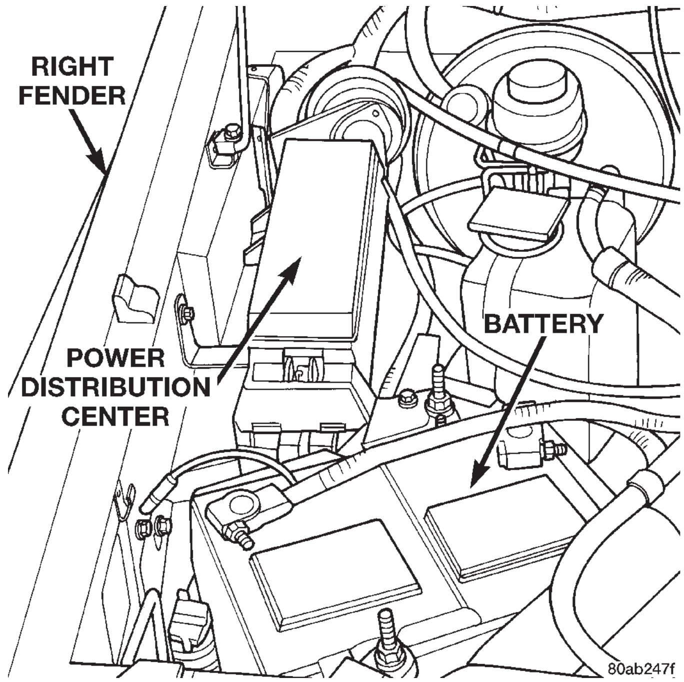


Fig. 15 Power Distribution Center

(3) Refer to the fuse and relay layout label affixed to the underside of the PDC cover for starter relay identification and location.

(4) Remove the starter relay from the PDC.

INSTALLATION

(1) Refer to the fuse and relay layout label affixed to the underside of the PDC cover for the proper starter relay location.

(2) Position the starter relay in the proper receptacle in the PDC.

(3) Align the starter relay terminals with the terminal cavities in the PDC receptacle.

(4) Push down firmly on the starter relay until the terminals are fully seated in the terminal cavities in the PDC receptacle.

(5) Install the cover onto the PDC.

(6) Connect the battery negative cable.

SPECIFICATIONS

STARTING SYSTEM

Starter Motor and Solenoid	
Manufacturer	Mitsubishi
Engine Application	2.5L, 4.0L
Power Rating	2.5L - 1.2 Kilowatt (1.6 Horsepower) 4.0L - 1.4 Kilowatt (1.9 Horsepower)
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	2.5L - 2600 rpm 4.0L - 2500 rpm
Solenoid Closing Maximum Voltage Required	7.8 Volts
*Cranking Amperage Draw Test	2.5L - 130 Amperes 4.0L - 160 Amperes
*Test at operating temperature. Cold engine, tight (new) engine, or heavy oil will increase starter amperage draw.	

STARTING SYSTEMS

CONTENTS

REMOVAL AND INSTALLATION

STARTER — LHD (DIESEL)

Removal

(1) Disconnect the negative battery cable.
(2) Remove the innercooler inlet hose from turbocharger and position it out of the way (Fig. 1).

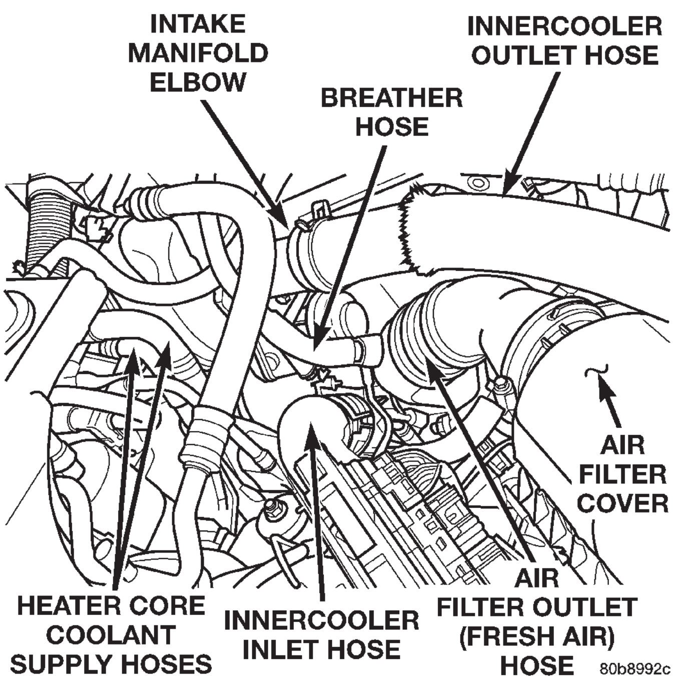


Fig. 1 LHD Engine Compartment — Diesel

(3) Remove the (2) right engine mount upper sill plate nuts.
(4) Raise the vehicle on a hoist.
(5) Remove the turbocharger oil return hose from engine block and plug (Fig. 2).
(6) Remove the right engine mount through bolt nut only (Fig. 2). Do not remove the bolt at this time.

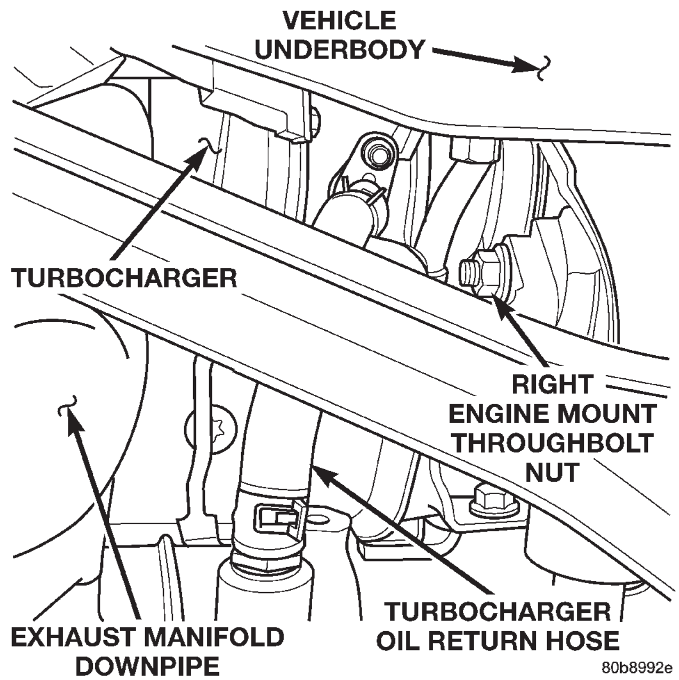


Fig. 2 Turbocharger Oil Return Hose — Position & Orientation

(7) Position a jack stand and raise the weight off the right engine mount.
(8) Remove the (2) right engine mount lower sill plate bolts.
(9) Remove the (4) right engine mount bracket to engine block retaining bolts.
(10) Remove the engine mount throughbolt.
(11) Remove the engine mount and the engine mount bracket from the vehicle.
(12) Remove the starter motor support bracket.
(13) Disconnect the starter motor electrical connectors.

CAUTION: Heatshields are very sharp. Wear gloves to prevent injury.

REMOVAL AND INSTALLATION (Continued)

(14) Remove the starter heatshield.
(15) Remove the (3) starter motor retaining bolts.
(16) Remove the starter motor from the vehicle.

Installation

(1) Position the starter motor and install retaining bolts. Torque bolts to 27 N·m (20 ft. lbs.).
(2) Connect the starter motor electrical. Torque (B+) nut to 27 N·m (20 ft. lbs.).

CAUTION: Heatshields are very sharp. Wear gloves to prevent injury.

(3) Install the starter heatshield.
(4) Install the starter motor support bracket. Torque nuts to 10 N·m (90 in. lbs.).
(5) Install the engine mount and engine mount bracket in the vehicle, making sure sill plate studs are through engine mount.
(6) Install the engine mount throughbolt and nut leaving them loose at this time.
(7) Install the (4) engine mount bracket to engine block bolts. Torque bolts to 61 N·m (45 ft. lbs.).
(8) Tighten, but do not torque (2) right engine mount lower bolts.
(9) Remove the jack stand.
(10) Torque the (2) lower engine mount bolts to 54 N·m (40 ft. lbs.).
(11) Torque throughbolt nut to 65 N·m (48 ft. lbs.).
(12) Install the oil return line on the engine block nipple.
(13) Lower the vehicle from the hoist.
(14) Install the (2) engine mount upper sill plate nuts. Torque nuts to 41 N·m (30 ft. lbs.).
(15) Install the innercooler inlet hose on turbocharger.
(16) Connect the negative battery cable.

STARTER — RHD (DIESEL)

REMOVAL

(1) Disconnect the negative battery cable.
(2) Make sure steering wheel is in the unlocked position.
(3) Raise the vehicle on a hoist.
(4) Rotate the front wheels to access and remove the steering shaft pinch bolt, slide shaft straight off gearbox input shaft and position steering shaft aside.
(5) Remove the turbocharger oil return line from engine block and plug (Fig. 3).

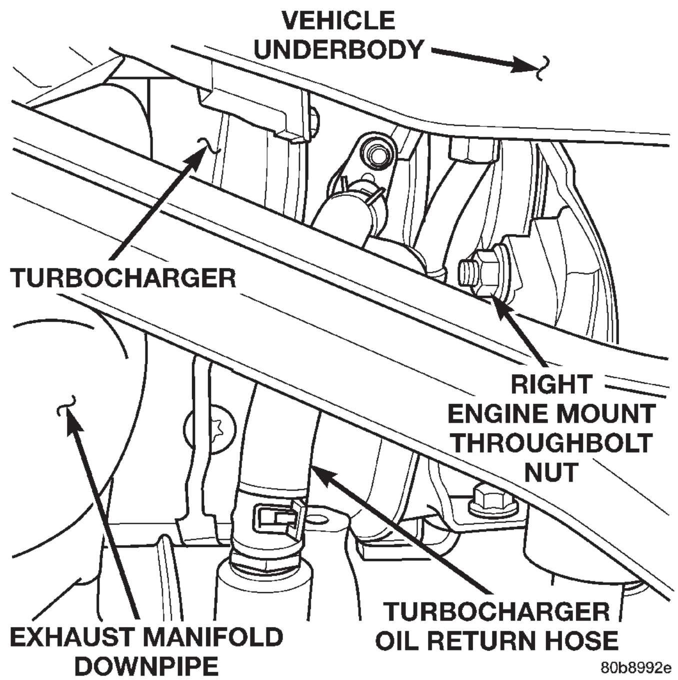


Fig. 3 Turbocharger Oil Return Line

(6) Remove the right engine mount through bolt nut only (Fig. 3). Do not remove the bolt at this time.
(7) Remove the engine mount upper sill plate nuts.
(8) Position a jack stand and raise weight off right engine mount.
(9) Remove the track bar support bracket retaining bolts and remove bracket.
(10) Remove the remaining lower engine mount bolt from the sill plate.
(11) Remove the (4) engine mount bracket bolts.
(12) Remove the engine mount throughbolt.
(13) Remove the engine mount and engine mount bracket from the vehicle.
(14) Remove the starter motor support bracket.

CAUTION: Heatshield is very sharp. Wear gloves to prevent injury.

(15) Remove the starter heat shield.
(16) Disconnect the starter motor electrical connectors.
(17) Remove the (3) stater motor retaining bolts.
(18) Remove the starter motor from the vehicle.

Installation

(1) Position the starter motor. Torque retaining bolts to 27 N·m (20 ft. lbs.).
(2) Reconnect the starter motor electrical. Torque (B+) nut to 27 N·m (20 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

CAUTION: Heatshield is very sharp. Wear gloves to prevent injury.

(3) Install the starter heat shield.

(4) Install the starter motor support bracket. Torque bolt to 47 N·m (35 ft. lbs.). Torque nuts to 10 N·m (90 in. lbs.).

(5) Install the engine mount and engine mount bracket in the vehicle.

(6) Install the engine mount throughbolt and nut leaving them loose at this time.

(7) Install, but do not torque the engine mount and track bar support bracket bolts

(8) Install the (4) engine mount bracket to engine block bolts. Torque bolts to 61 N·m (45 ft. lbs.).

(9) Remove the jack stand.

(10) Install and torque the upper engine mount sill plate nuts to 41 N·m (30 ft. lbs.).

(11) Torque the lower engine mount retaining bolts to 54 N·m (40 ft. lbs.).

(12) Torque the larger track bar support bracket bolts to 125 N·m (92 ft. lbs.).

(13) Torque the engine mount throughbolt nut to 65 N·m (48 ft. lbs.).

(14) Install the oil return line on the engine block nipple.

(15) Install steering shaft pinch bolt. Torque to 49 N·m (36 ft. lbs.).

(16) Lower the vehicle from the hoist.

(17) Connect the negative battery cable.

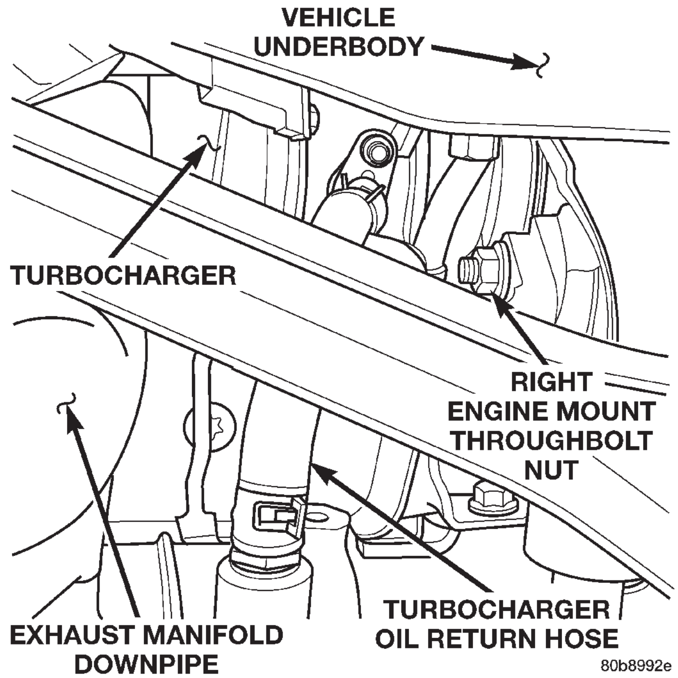


Fig. 4

STARTER RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC).

(3) Refer to the label on the PDC for starter relay identification and location.

(4) Unplug the starter relay from the PDC.

(5) Install the starter relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

SPECIFICATIONS

STARTING SYSTEM

Starter and Solenoid	
Engine Application	2.5L Diesel
Power Rating	2.2 Kilowatt
Voltage	12 Volts
Number of Fields	4
Number of Poles	4
Number of Brushes	4
Drive Type	Planetary Gear Reduction
Free Running Test Voltage	11.5 Volts
Free Running Test Maximum Amperage Draw	160 Amperes
Free Running Test Minimum Speed	5500 rpm
Solenoid Closing Maximum Voltage	7.8 Volts
*Cranking Amperage Draw test	350 Amperes
*Test at operating temperature. Cold engine, tight (new) engine, or heavy oil will increase starter amperage draw.	

TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Engine Mount Throughbolt	65 N·m (48 ft. lbs.)
Engine Mount Upper Sill Plate Nuts	41 N·m (30 ft. lbs.)
Engine Mount to Engine Mounting Bolts	61 N·m (45 ft. lbs.)
Lower Engine Mount Bolts	54 N·m (40 ft. lbs.)
Stater Motor (B+) Terminal	27 N·m (20 ft. lbs.)
Starter Motor Retaining Bolts	27 N·m (20 ft. lbs.)
Starter Motor Support Bracket Nuts	10 N·m (90 in. lbs.)
Steering Shaft Pinch Bolt	49 N·m (36 ft. lbs.)
Track Bar Support Bracket Bolts	125 N·m (92 ft. lbs.)

CHARGING SYSTEM

CONTENTS

DESCRIPTION AND OPERATION

CHARGING SYSTEM

DESCRIPTION

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)

OPERATION

The charging system is turned on and off with the ignition switch. The system is on when the engine is running and the ASD relay is energized. When the ASD relay is on, voltage is supplied to the ASD relay sense circuit at the PCM. This voltage is connected through the PCM and supplied to one of the generator field terminals (Gen. Source +) at the back of the generator.

The amount of DC current produced by the generator is controlled by the EVR (field control) circuitry contained within the PCM. This circuitry is connected in series with the second rotor field terminal and ground.

A battery temperature sensor, located in the battery tray housing, is used to sense battery temperature. This temperature data, along with data from monitored line voltage, is used by the PCM to vary the battery charging rate. This is done by cycling the ground path to control the strength of the rotor magnetic field. The PCM then compensates and regulates generator current output accordingly.

All vehicles are equipped with On-Board Diagnostics (OBD). All OBD-sensed systems, including EVR (field control) circuitry, are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for certain failures it detects. Refer to On-Board Diagnostics in Group 25, Emission Control System for more DTC information.

The Check Gauges Lamp (if equipped) monitors: **charging system voltage,** engine coolant temperature and engine oil pressure. If an extreme condition is indicated, the lamp will be illuminated. This is done as reminder to check the three gauges. The signal to activate the lamp is sent via the CCD bus circuits. The lamp is located on the instrument panel. Refer to Group 8E, Instrument Panel and Gauges for additional information.

GENERATOR

DESCRIPTION

The generator is belt-driven by the engine using a serpentine type drive belt. It is serviced only as a complete assembly. If the generator fails for any reason, the entire assembly must be replaced.

OPERATION

As the energized rotor begins to rotate within the generator, the spinning magnetic field induces a current into the windings of the stator coil. Once the generator begins producing sufficient current, it also provides the current needed to energize the rotor.

DESCRIPTION AND OPERATION (Continued)

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 terminal.

Although the generators appear the same externally, different generators with different output ratings are used on this vehicle. Be certain that the replacement generator has the same output rating and part number as the original unit. Refer to Generator Ratings in the Specifications section at the back of this group for amperage ratings and part numbers.

Noise emitting from the generator may be caused by: worn, loose or defective bearings; a loose or defective drive pulley; incorrect, worn, damaged or misadjusted fan drive belt; loose mounting bolts; a misaligned drive pulley or a defective stator or diode.

BATTERY TEMPERATURE SENSOR

DESCRIPTION

The battery temperature sensor is attached to the battery tray located under the battery.

OPERATION

The battery temperature sensor is used to determine the battery temperature and control battery charging rate. This temperature data, along with data from monitored line voltage, is used by the PCM to vary the battery charging rate. System voltage will be higher at colder temperatures and is gradually reduced at warmer temperatures.

ELECTRONIC VOLTAGE REGULATOR

DESCRIPTION

The Electronic Voltage Regulator (EVR) is not a separate component. It is actually a voltage regulating circuit located within the Powertrain Control Module (PCM). The EVR is not serviced separately. If replacement is necessary, the PCM must be replaced.

OPERATION

The amount of DC current produced by the generator is controlled by EVR circuitry contained within the PCM. This circuitry is connected in series with the generators second rotor field terminal and its ground.

Voltage is regulated by cycling the ground path to control the strength of the rotor magnetic field. The EVR circuitry monitors system line voltage and battery temperature (refer to Battery Temperature Sensor for more information). It then compensates and regulates generator current output accordingly. Also refer to Charging System Operation for additional information.

DIAGNOSIS AND TESTING

CHARGING SYSTEM

The following procedures may be used to diagnose the charging system if:

- the generator lamp (if equipped) is illuminated with the engine running
- the voltmeter (if equipped) does not register properly
- an undercharged or overcharged battery condition occurs.

Remember that an undercharged battery is often caused by:

- accessories being left on with the engine not running
- a faulty or improperly adjusted switch that allows a lamp to stay on. See Ignition-Off Draw Test in Group 8A, Battery for more information.

INSPECTION

To perform a complete test of the charging system, refer to the appropriate Powertrain Diagnostic Procedures service manual and the DRB scan tool. Perform the following inspections before attaching the scan tool.

(1) Inspect the battery condition. Refer to Group 8A, Battery for procedures.

(2) Inspect condition of battery cable terminals, battery posts, connections at engine block, starter solenoid and relay. They should be clean and tight. Repair as required.

(3) Inspect all fuses in both the fuseblock and Power Distribution Center (PDC) for tightness in receptacles. They should be properly installed and tight. Repair or replace as required.

(4) Inspect generator mounting bolts for tightness. Replace or tighten bolts if required. Refer to the Generator Removal/Installation section of this group for torque specifications.

(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 generator electrical connections at generator field, battery output, and ground terminal (if equipped). Also check generator ground wire connection at engine (if equipped). They should all be clean and tight. Repair as required.

DIAGNOSIS AND TESTING (Continued)

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.

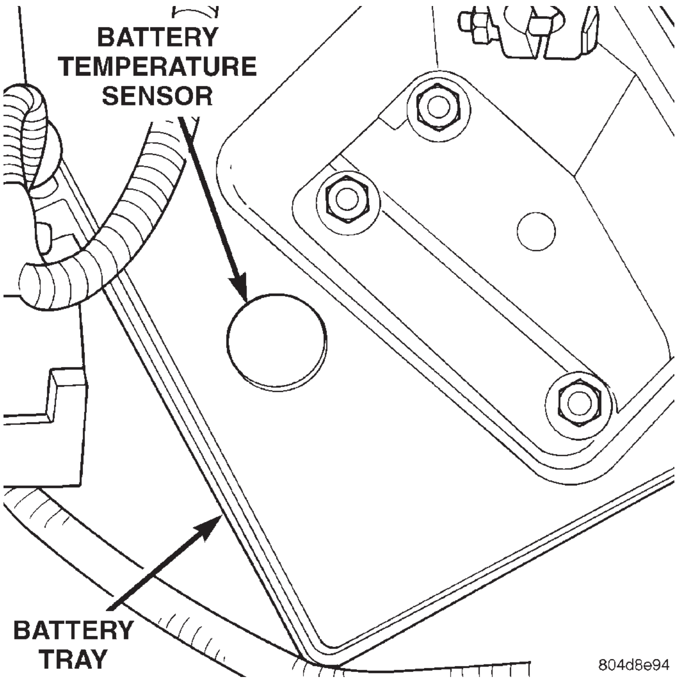


Fig. 1 Battery Temperature Sensor

(2) Disconnect the two-wire pigtail harness from the engine harness.

(3) Attach ohmmeter leads to the wire terminals of the pigtail harness.

(4) At room temperature of 25° C (75–80° F), an ohmmeter reading of 9,000 (9K) to 11,000 (11K) ohms should be observed.

(5) If reading is above or below the specification, replace the sensor.

(6) Refer to the Removal and Installation section for procedures.

ON-BOARD DIAGNOSTIC TEST FOR CHARGING SYSTEM

The Powertrain Control Module (PCM) monitors critical input and output circuits of the charging system, making sure they are operational. A Diagnostic Trouble Code (DTC) is assigned to each input and output circuit monitored by the On-Board Diagnostic (OBD) system. Some circuits are checked continuously and some are checked only under certain conditions.

For DTC information, refer to Diagnostic Trouble Codes in Group 25, Emission Control System. This will include a complete list of DTC's including DTC's for the charging system.

REMOVAL AND INSTALLATION

GENERATOR

REMOVAL

WARNING: DISCONNECT NEGATIVE CABLE FROM BATTERY BEFORE REMOVING BATTERY OUTPUT WIRE (B+ WIRE) FROM GENERATOR. FAILURE TO DO SO CAN RESULT IN INJURY OR DAMAGE TO ELECTRICAL SYSTEM.

(1) Disconnect negative battery cable at battery.

(2) Remove generator drive belt. Refer to Group 7, Cooling System for procedures.

(3) Left Hand Drive (LHD) Vehicles Only: Remove generator pivot and mounting bolts/nut (Fig. 2) or (Fig. 3). Position generator for access to wire connectors.

(4) Right Hand Drive (RHD) Vehicles Only: Remove upper nut (generator adjustment nut) and both belt adjustment bolts (Fig. 4). Remove generator lower nut/bolt. Position generator for access to wire connectors.

(5) If equipped, unsnap plastic cover from B+ terminal.

(6) Remove B+ terminal mounting nut at rear of generator (Fig. 5). Disconnect terminal from generator.

(7) Disconnect field wire connector at rear of generator by pushing on connector tab.

(8) Remove generator from vehicle.

INSTALLATION

(1) Position generator to engine and snap field wire connector into rear of generator.

(2) Install B+ terminal to generator mounting stud. Tighten mounting nut to 8.5 N·m (75 in. lbs.) torque.

(3) If equipped, snap plastic cover to B+ terminal.

(4) LHD Vehicles: Install generator fasteners and tighten as follows:

• Generator upper mounting bolt-55 N·m (41 ft. lbs.) torque.

• Generator lower pivot bolt/nut-55 N·m (41 ft. lbs.) torque.

CAUTION: Never force a belt over a pulley rim using a screwdriver. The synthetic fiber of the belt can be damaged.

REMOVAL AND INSTALLATION (Continued)

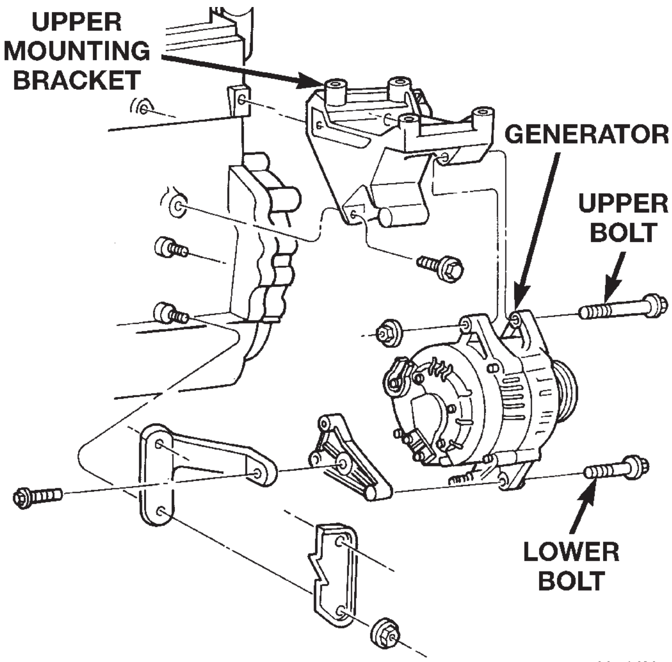


Fig. 2 Remove/Install Generator—2.5L Engine

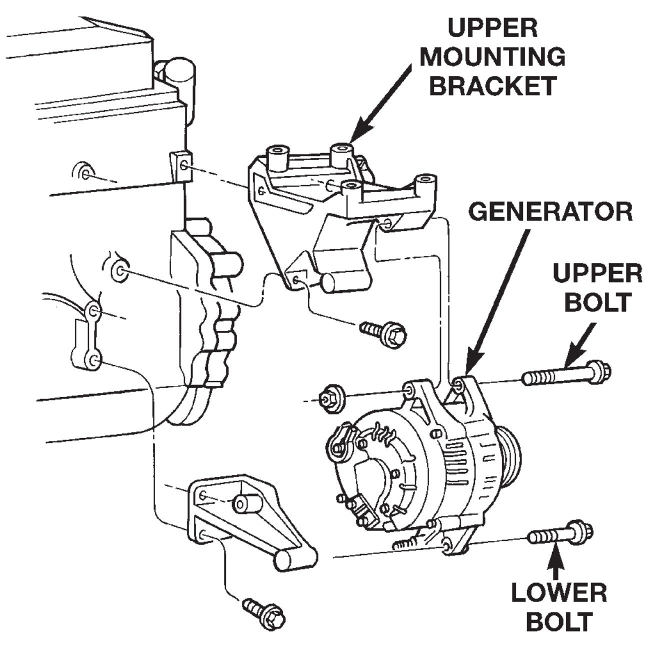


Fig. 3 Remove/Install Generator—4.0L Engine—LHD

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.

(5) LHD Vehicles: Install generator drive belt. Refer to Group 7, Cooling System for procedures.

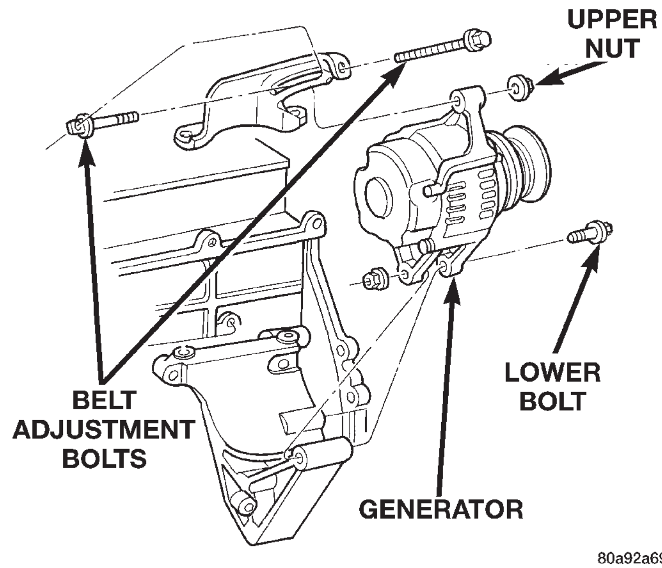


Fig. 4 Remove/Install Generator—4.0L Engine—RHD

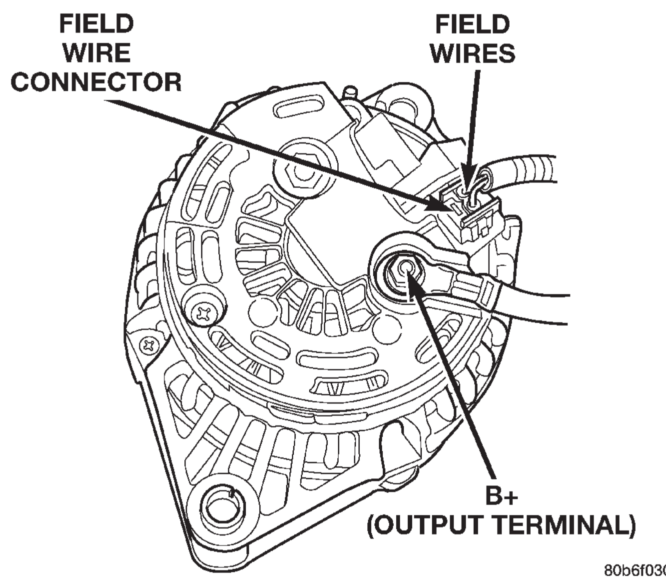


Fig. 5 Generator Connectors—Typical Bosch

(6) RHD Vehicles: Install upper nut (generator adjustment nut) and both belt adjustment bolts. Install generator lower nut/bolt.

(7) RHD Vehicles: On vehicles equipped with RHD, the generator is used to adjust the serpentine belt. Refer to Group 7, Cooling System for belt routing, belt adjustment and bolt tightening procedures.

(8) Install negative battery cable to battery.

BATTERY TEMPERATURE SENSOR

The battery temperature sensor is located under vehicle battery (Fig. 6) and is attached to a mounting hole on battery tray.

REMOVAL AND INSTALLATION (Continued)

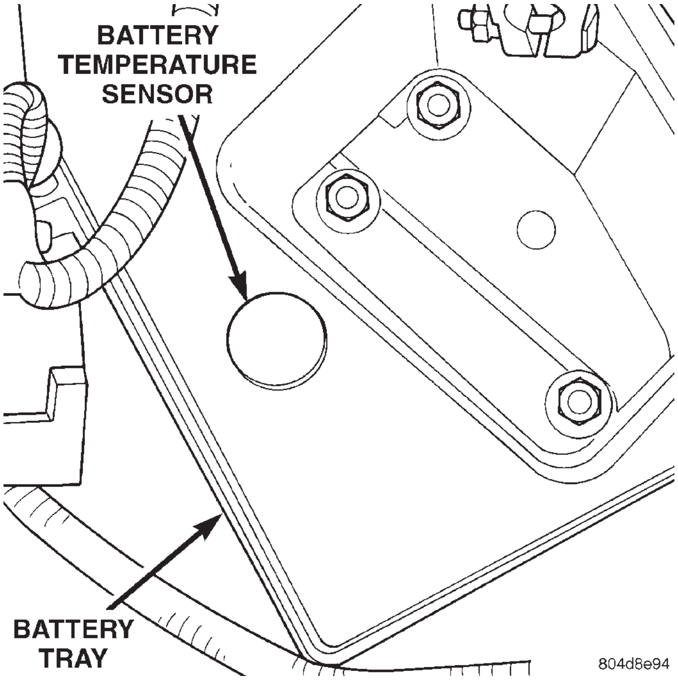


Fig. 6 Battery Temperature Sensor

REMOVAL

(1) Remove battery. Refer to Group 8A, Battery for procedures.

(2) Disconnect sensor pigtail harness from engine wire harness.

(3) Pry sensor straight up from battery tray mounting hole.

INSTALLATION

(1) Feed pigtail harness through hole in top of battery tray and press sensor into top of battery tray.

(2) Connect pigtail harness.

(3) Install battery. Refer to Group 8A, Battery for procedures.

SPECIFICATIONS

GENERATOR RATINGS

TYPE	PART NUMBER	RATED SAE AMPS	ENGINES	MINIMUM TEST AMPS
DENSO	56041822AA	124	2.5L/4.0L	90

TORQUE CHART

Right Hand Drive= RHD, Left Hand Drive= LHD.

Description	Torque
Generator Mounting Bolt—LHD—2.5L/4.0L Engine	55 N·m (41 ft. lbs.)
Generator Pivot Bolt/Nut—LHD—2.5L/4.0L Engine	55 N·m (41 ft. lbs.)
Battery Terminal Nut—LHD or RHD	8.5 N·m (75 in. lbs.)
Ground Terminal Nut—LHD or RHD	8.5 N·m (75 in. lbs.)
Harness Hold-down Nut—LHD or RHD	8.5 N·m (75 in. lbs.)
Field Terminal Nuts—LHD or RHD	2.8 N·m (25 in. lbs.)

CHARGING SYSTEM

CONTENTS

GENERAL INFORMATION

INTRODUCTION

The generator assembly is serviced as a complete assembly. If the generator should be faulty, replace the entire assembly. The only serviceable part is the drive pulley.

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.

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.

REMOVAL

(1) Disconnect the negative battery cable.

(2) Remove the accessory drive belt. Refer to Group 7, Cooling System for procedure.

(3) Remove the nut securing battery output cable to B+ terminal (Fig. 1) at rear of generator.

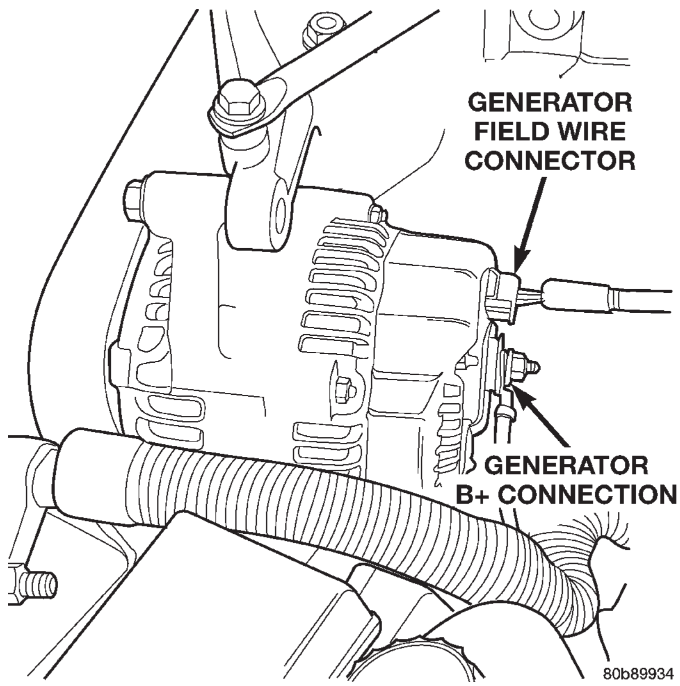


Fig. 1 Generator Terminals

REMOVAL AND INSTALLATION (Continued)

(4) Unplug the field terminal connector (Fig. 1) at rear of generator.

(5) Remove the upper generator mounting bolt (Fig. 2).

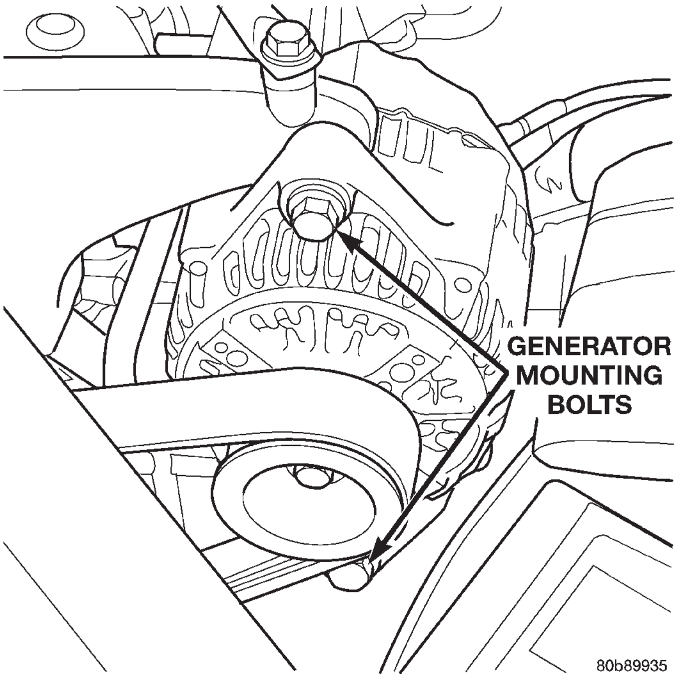


Fig. 2 Generator Mounting

(6) Remove the lower generator mounting bolt (Fig. 2) and remove generator from the vehicle.

INSTALLATION

(1) Install the generator into the generator bracket.

(2) Install the lower generator mounting bolt (Fig. 3).

(3) Install the upper generator mounting bolt (Fig. 3).

(4) Tighten the mounting bolts to proper torque.

- Upper mounting bolt — 27.5 N·m (20 ft. lbs.)
- Lower mounting bolt — 47 N·m (35 ft. lbs.)

(5) Connect the field terminal connector at rear of generator (Fig. 4).

(6) Connect the battery output cable to the B+ terminal at rear of the generator (Fig. 4).

(7) Install the accessory drive belt. Refer to Group 7, Cooling System for procedure.

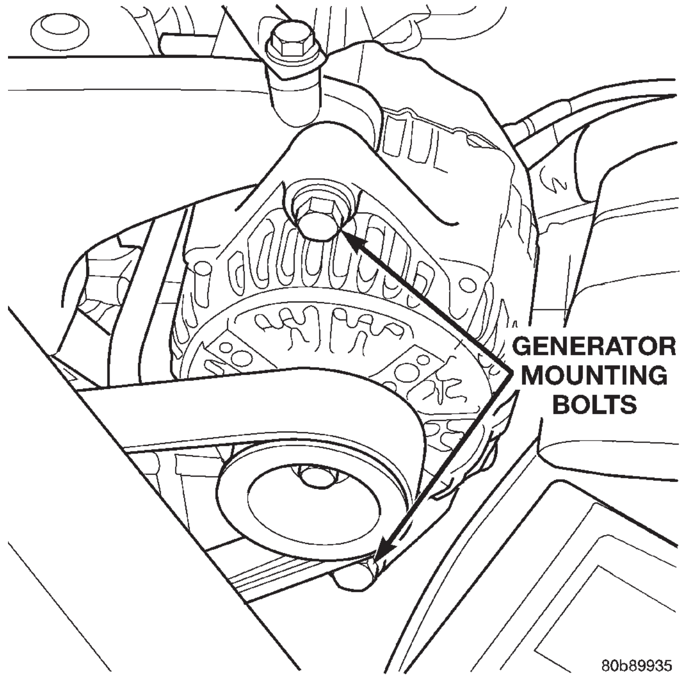


Fig. 3 Generator Mounting

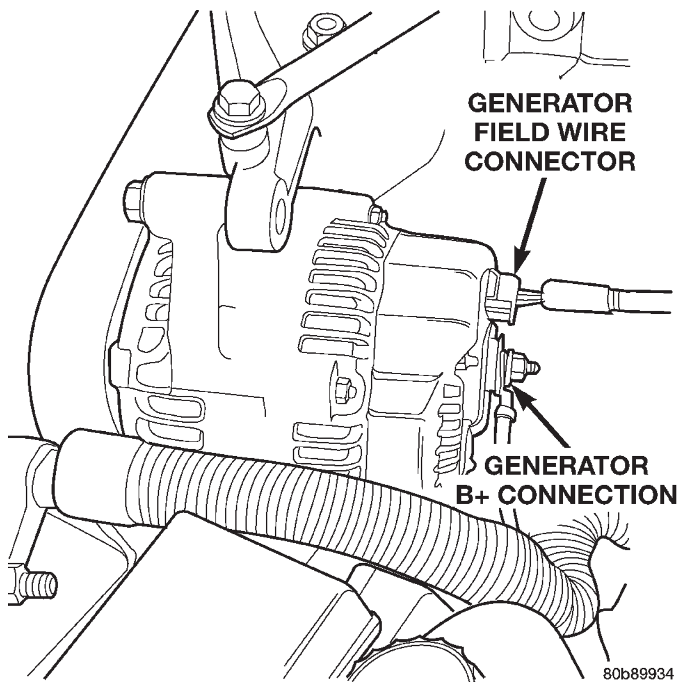


Fig. 4 Generator Terminals

(8) Connect the negative battery cable.

IGNITION SYSTEM

CONTENTS

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.

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).

The ignition system is controlled by the PCM.

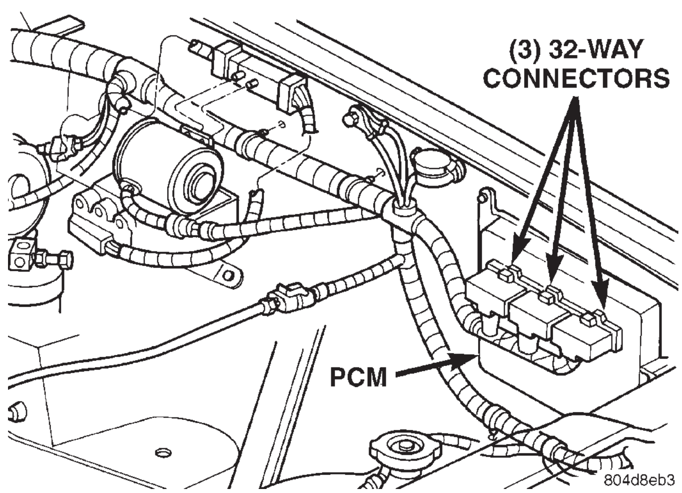


Fig. 1 Powertrain Control Module (PCM) Location

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

DESCRIPTION AND OPERATION (Continued)

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 engines are equipped with a camshaft driven mechanical distributor containing a shaft driven distributor rotor. All distributors are equipped with an internal camshaft position (fuel sync) sensor (Fig. 2). This sensor provides fuel injection synchronization and cylinder identification.

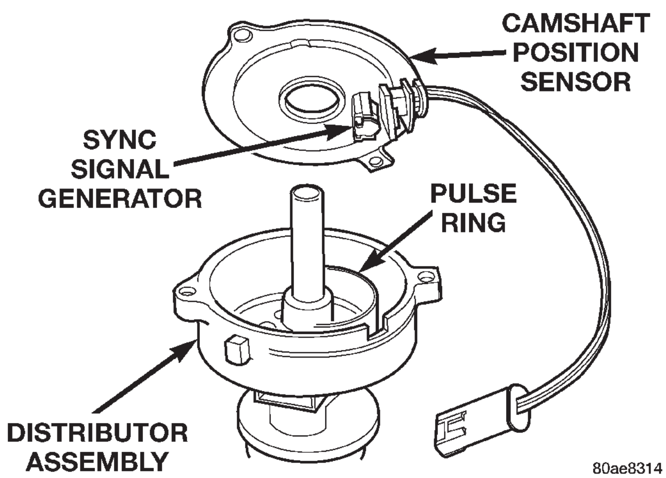


Fig. 2 Distributor and Camshaft Position Sensor-Typical

The distributors on both the 2.5L 4-cylinder and the 4.0L-6 cylinder 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 holddown 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 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 engine block (Fig. 3).

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

DESCRIPTION AND OPERATION (Continued)

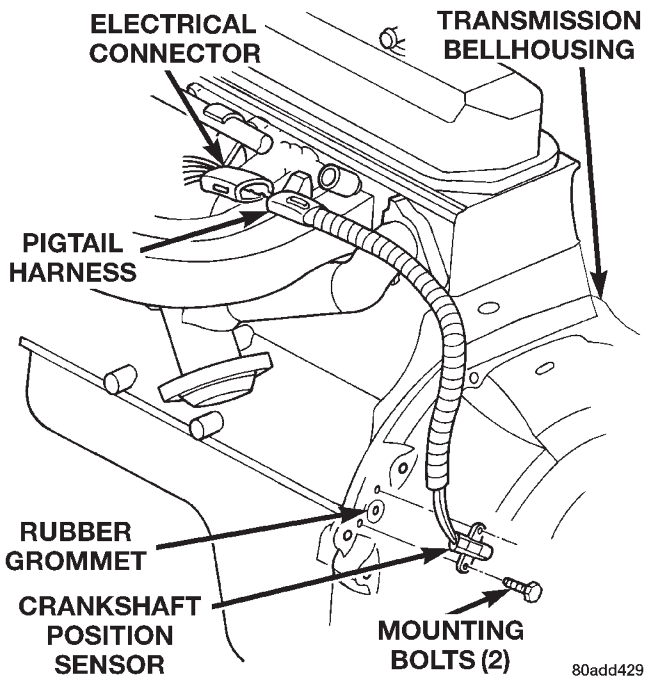


Fig. 3 Crankshaft Position Sensor—Typical

the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

SENSOR OPERATION

The flywheel/drive plate has groups of four notches at its outer edge. On 4.0L 6-cylinder engines there are three sets of notches (Fig. 5). On 2.5L 4-cylinder engines there are two sets of notches (Fig. 4).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM. 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.

CAMSHAFT POSITION SENSOR

The camshaft position sensor is located in the distributor on all engines.

The sensor contains a hall effect device called a sync signal generator to generate a fuel sync signal. This sync signal generator detects a rotating pulse ring (shutter) on the distributor shaft. The pulse ring rotates 180 degrees through the sync signal generator. Its signal is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

When the leading edge of the pulse ring (shutter) enters the sync signal generator, the following occurs: The interruption of magnetic field causes the voltage to switch high resulting in a sync signal of approximately 5 volts.

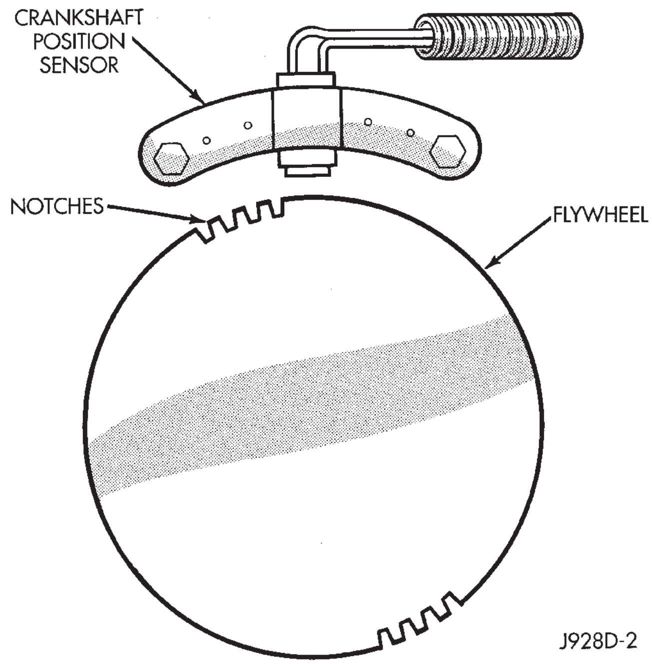


Fig. 4 Sensor Operation—2.5L 4-Cyl. Engine

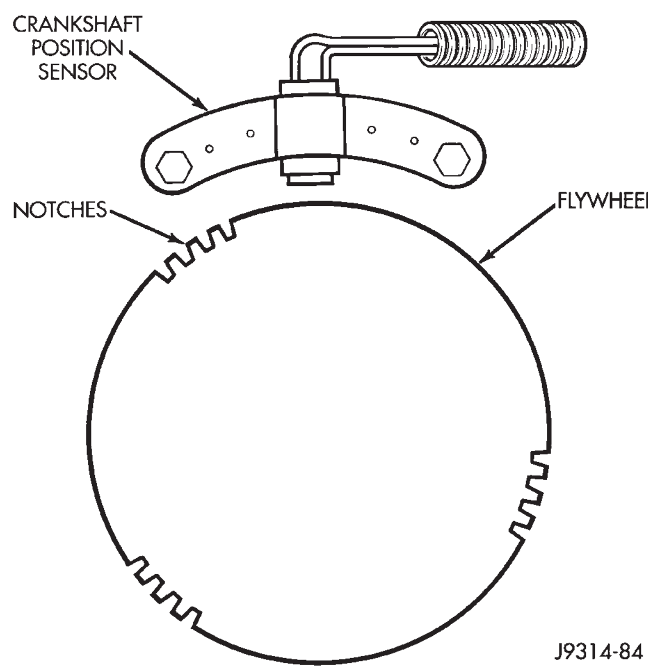


Fig. 5 Sensor Operation—4.0L 6-Cyl. Engine

DESCRIPTION AND OPERATION (Continued)

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.

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

IGNITION 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. 6) or (Fig. 7) 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.

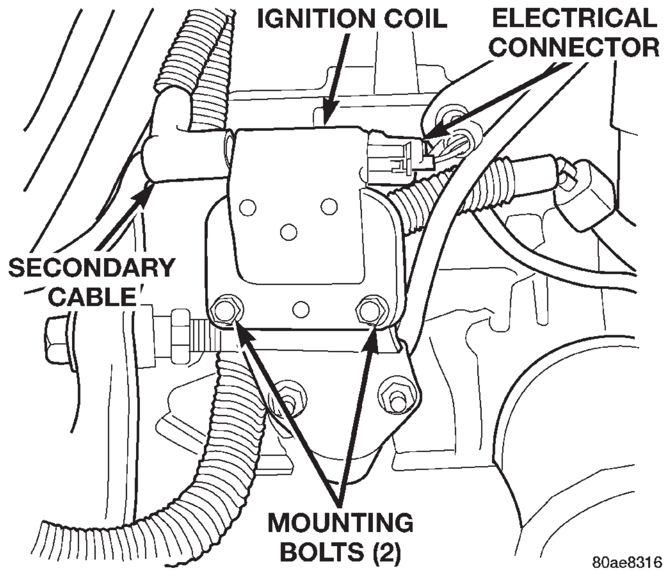


Fig. 6 Ignition Coil—2.5L Engine

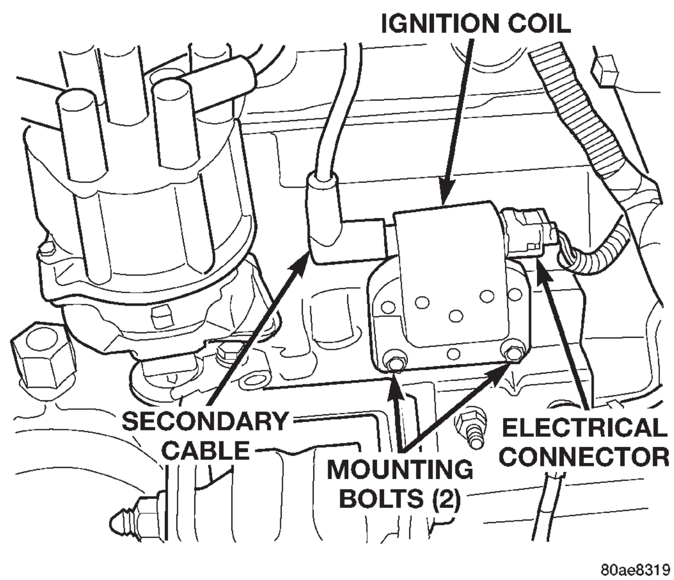


Fig. 7 Ignition Coil—4.0L Engine

Replace any coil that does not meet specifications. Refer to the IGNITION COIL RESISTANCE chart.

IGNITION COIL RESISTANCE

COIL MANUFACTURER	PRIMARY RESISTANCE 21-27°C (70-80°F)	SECONDARY RESISTANCE 21-27°C (70-80°F)
Diamond	0.97 - 1.18 Ohms	11,300 - 15,300 Ohms
Toyodenso	0.95 - 1.20 Ohms	11,300 - 13,300 Ohms

DIAGNOSIS AND TESTING (Continued)

If the ignition coil is being replaced, the secondary spark plug cable must also be checked. Replace cable if it has been burned or damaged.

Arcing at the tower will carbonize the cable boot, which if it is connected to a new ignition coil, will cause the coil to fail.

If the secondary coil cable shows any signs of damage, it should be replaced with a new cable and new terminal. Carbon tracking on the old cable can cause arcing and the failure of a new ignition coil.

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. 8) or (Fig. 9). Also check for white deposits on the inside (caused by condensation entering the cap through cracks). Replace any cap that displays charred or eroded terminals. The machined surface of a terminal end (faces toward rotor) will indicate some evidence of erosion from normal operation. Examine the terminal ends for evidence of mechanical interference with the rotor tip.

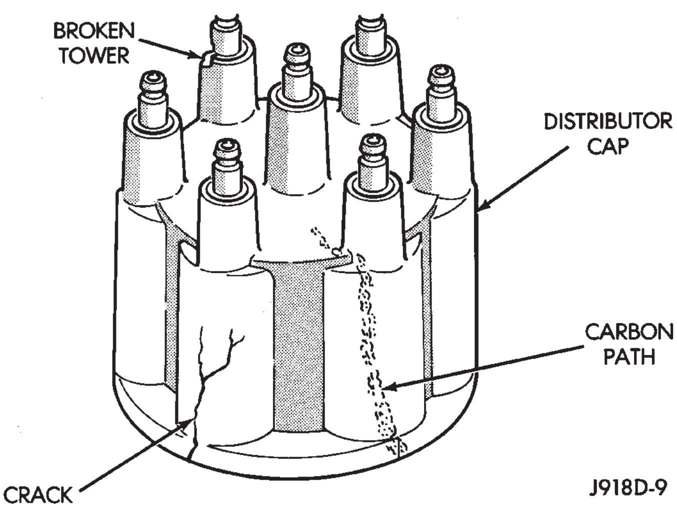


Fig. 8 Cap Inspection—External—Typical

DISTRIBUTOR ROTOR

Visually inspect the rotor (Fig. 10) for cracks, evidence of corrosion or the effects of arcing on the metal tip. Also check for evidence of mechanical interference with the cap. Some charring is normal on the end of the metal tip. The silicone-dielectric-varnish-compound applied to the rotor tip for radio interference noise suppression, will appear charred. This is normal. **Do not remove the charred compound.** Test the spring for insufficient tension. Replace a rotor that displays any of these adverse conditions.

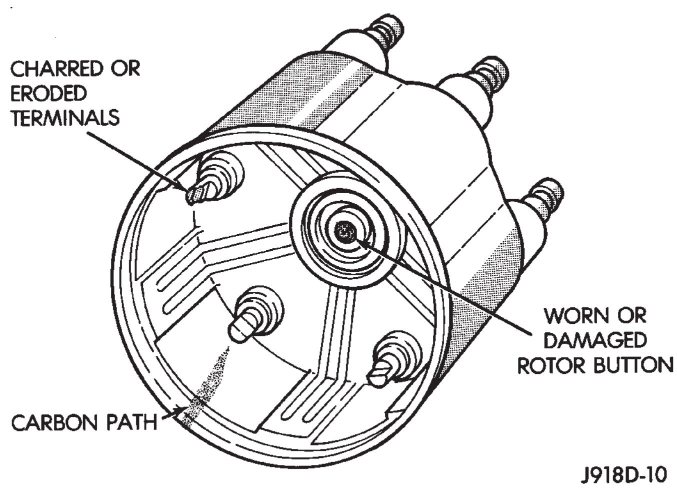


Fig. 9 Cap Inspection—Internal—Typical

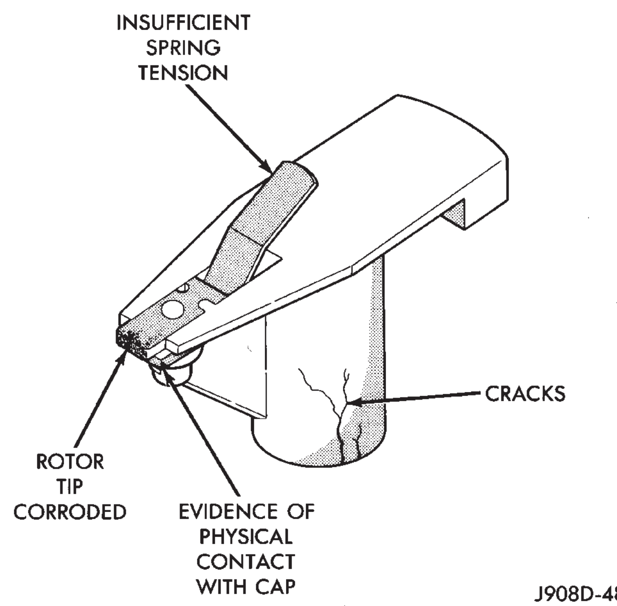


Fig. 10 Rotor Inspection—Typical

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.

DIAGNOSIS AND TESTING (Continued)

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 corresponding electrode in distributor cap. Resistance should be 250 to 1000 Ohms per inch of cable. If not, remove cable from distributor cap tower and connect ohmmeter to the terminal ends of cable. If resistance is not within specifications as found in the SPARK PLUG CABLE RESISTANCE chart, replace the cable. Test all spark plug cables in this manner.

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

To test ignition coil-to-distributor cap cable, do not remove the cable from the cap. Connect ohmmeter to rotor button (center contact) of distributor cap and terminal at ignition coil end of cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, remove the cable from the distributor cap. Connect the ohmmeter to the terminal ends of the cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, replace the cable. Inspect the ignition coil tower for cracks, burns or corrosion.

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. 11). There will not be evidence of electrode burning. Gap growth will not average more than approximately 0.025 mm (.001 in) per 3200 km (2000 miles) of operation. Spark plugs that have normal wear can usually be cleaned, have the electrodes filed, have the gap set and then be installed.

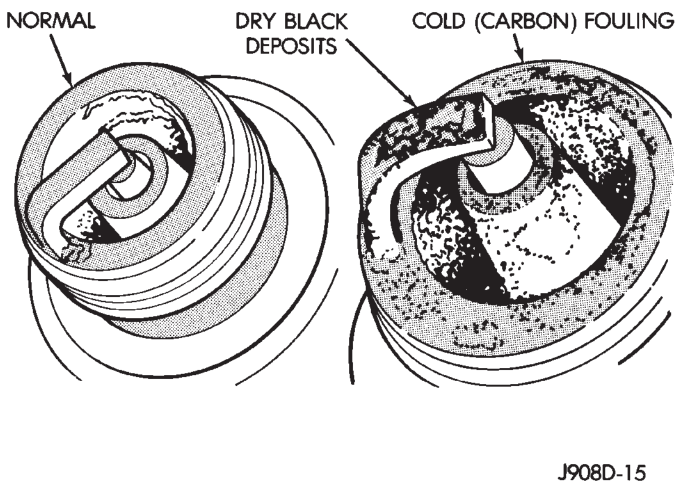


Fig. 11 Normal Operation and Cold (Carbon) Fouling

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 may be affected by MMT deposits.

COLD FOULING/CARBON FOULING

Cold fouling is sometimes referred to as carbon fouling. The deposits that cause cold fouling are basically carbon (Fig. 11). 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).

DIAGNOSIS AND TESTING (Continued)

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. 12), evaluate engine condition for the cause of oil entry into that particular combustion chamber.

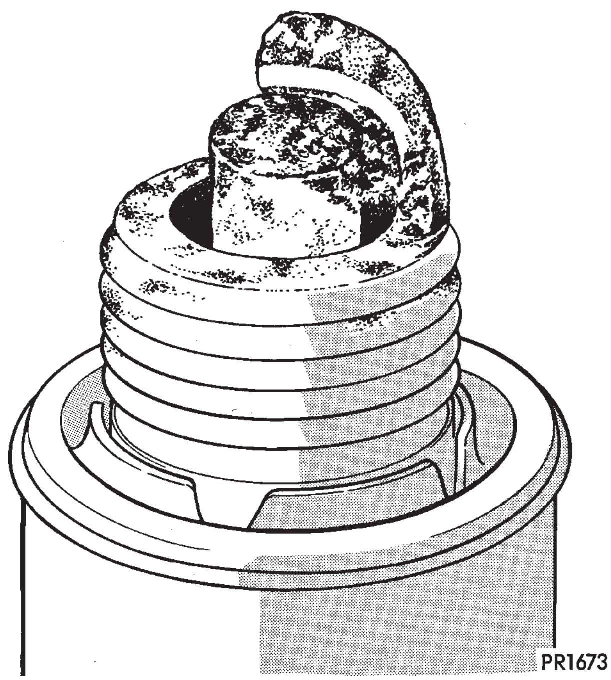


Fig. 12 Oil or Ash Encrusted

ELECTRODE GAP BRIDGING

Electrode gap bridging may be traced to loose deposits in the combustion chamber. These deposits accumulate on the spark plugs during continuous stop-and-go driving. When the engine is suddenly subjected to a high torque load, deposits partially liquefy and bridge the gap between electrodes (Fig. 13). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

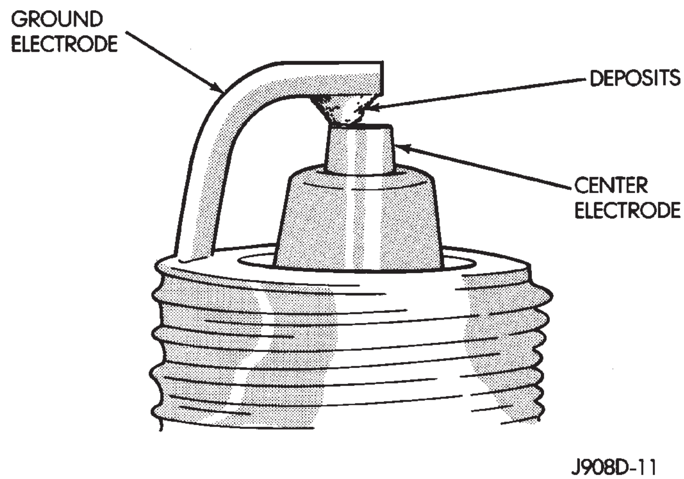


Fig. 13 Electrode Gap Bridging

SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 14). 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.

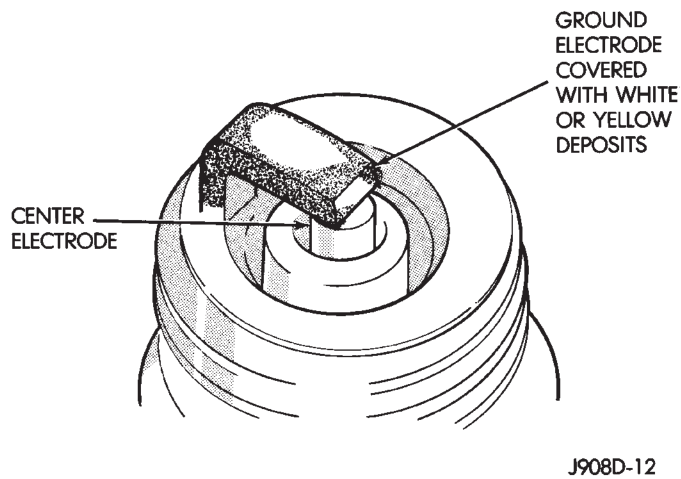


Fig. 14 Scavenger Deposits

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. 15). Spark plugs with this condition must be replaced.

PREIGNITION DAMAGE

Preignition damage is usually caused by excessive combustion chamber temperature. The center electrode dissolves first and the ground electrode dissolves somewhat latter (Fig. 16). Insulators appear relatively deposit free. Determine if the spark plug has the correct heat range rating for the engine.

DIAGNOSIS AND TESTING (Continued)

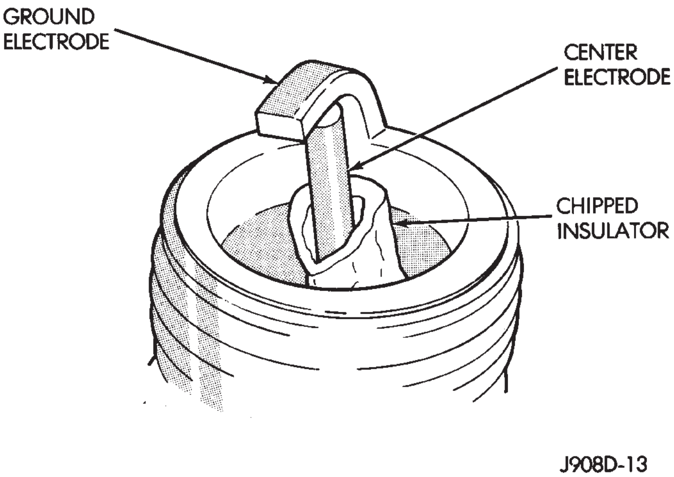


Fig. 15 Chipped Electrode Insulator

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.)

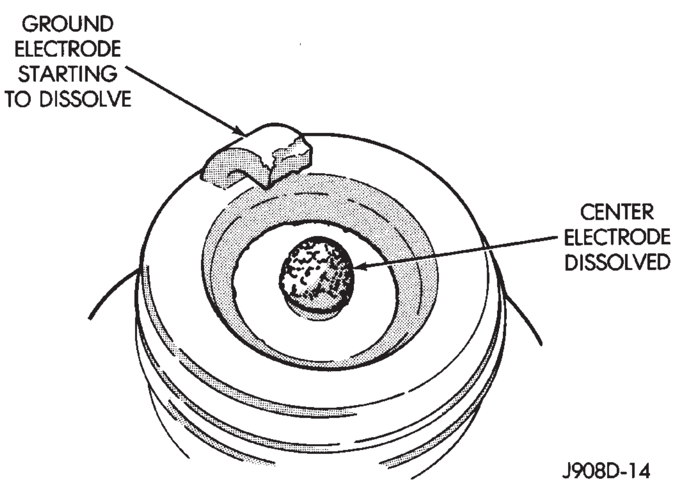


Fig. 16 Preignition Damage

SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 17). The increase in electrode gap will be considerably in excess of 0.001 inch per 2000 miles of operation. This suggests that a plug with a cooler heat range rating should be used. Over advanced ignition timing, detonation and cooling system malfunctions can also cause spark plug overheating.

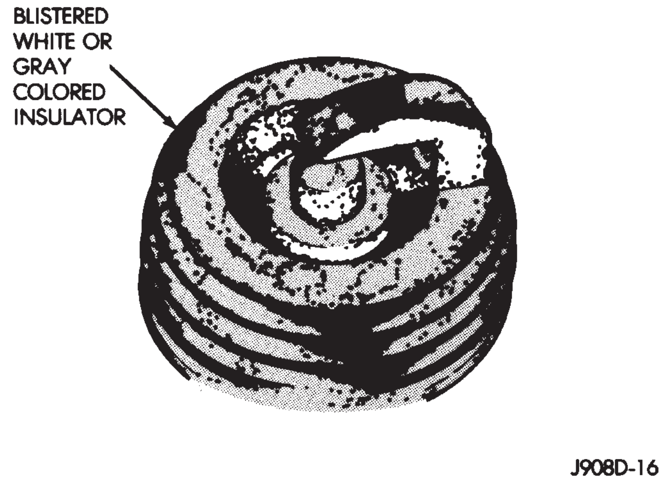


Fig. 17 Spark Plug Overheating

REMOVAL AND INSTALLATION

SPARK PLUG CABLE REMOVAL

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. 18). Grasp the boot (not the cable) and pull it off with a steady, even force.

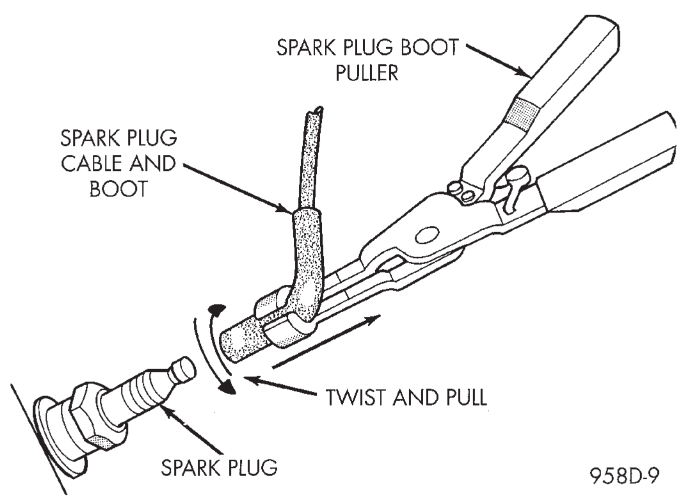


Fig. 18 Cable Removal

SPARK PLUGS

PLUG REMOVAL

(1) Always remove spark plug or ignition coil cables by grasping at the cable boot (Fig. 18). Turn the cable boot 1/2 turn and pull straight back in a steady motion. Never pull directly on the cable. Internal damage to cable will result.

(2) Prior to removing the spark plug, spray compressed air around the spark plug hole and the area

REMOVAL AND INSTALLATION (Continued)

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. 19). **Never attempt to adjust the gap by bending the center electrode.**

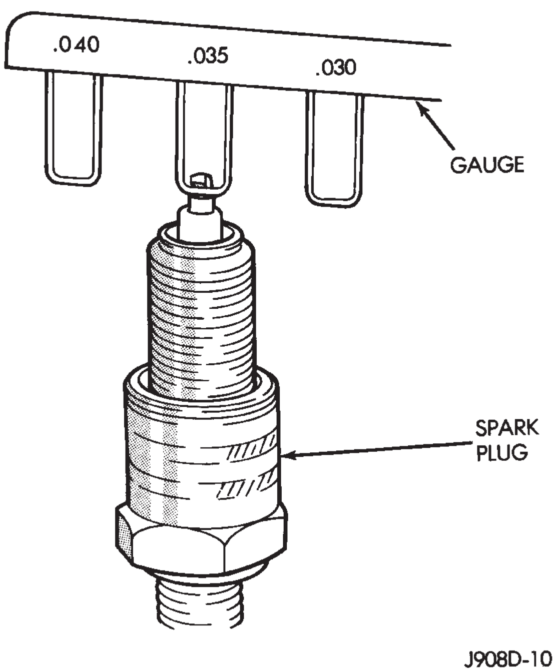


Fig. 19 Setting Spark Plug Gap—Typical

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 side of engine (to rear of distributor) (Fig. 20).

On the 4.0L 6-cylinder engine, the ignition coil is mounted to a bracket on side of engine (to front of distributor) (Fig. 21).

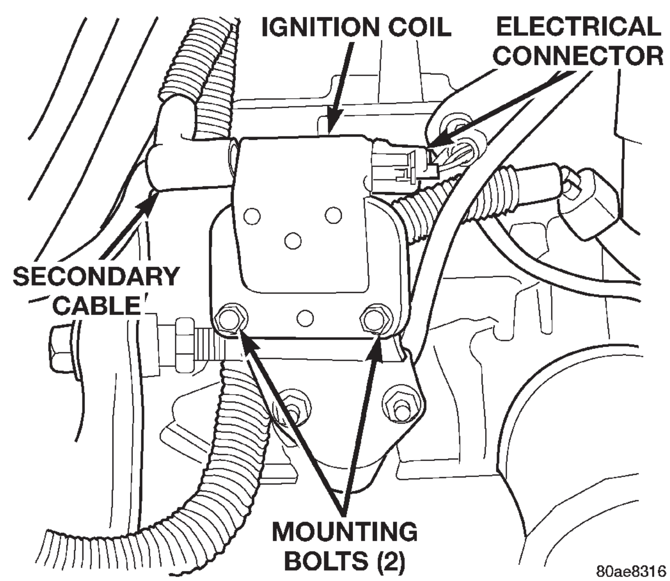


Fig. 20 Ignition Coil—2.5L Engine

(1) Disconnect 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.

REMOVAL AND INSTALLATION (Continued)

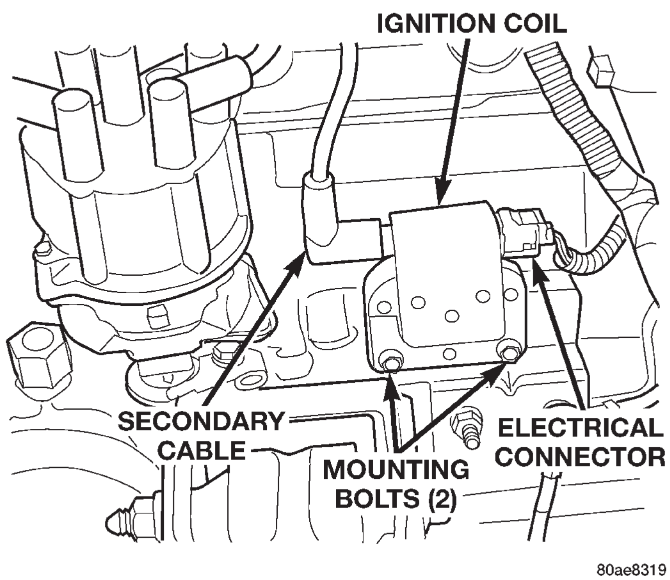


Fig. 21 Ignition Coil—4.0L Engine

INSTALLATION

(1) Install ignition coil to bracket on cylinder block with mounting bolts (and nuts if equipped). If 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.

CRANKSHAFT POSITION SENSOR

The crankshaft position sensor is mounted to the transmission bellhousing at the left/rear side of engine block (Fig. 22) or (Fig. 23).

On 2.5L 4-cylinder 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. All 4.0L 6-cylinder engines have the sensor attached with two bolts.

REMOVAL

Some model/engine combinations may require removal of air cleaner tubes for access to sensor.

(1) Remove air cleaner tube(s) at throttle body (if necessary).

(2) Near rear of intake manifold, disconnect pigtail harness (electrical connector) from main electrical harness.

(3) Depending upon application, remove either sensor mounting bolts or nuts.

(4) Remove sensor.

INSTALLATION

(1) Install sensor flush against opening in transmission housing.

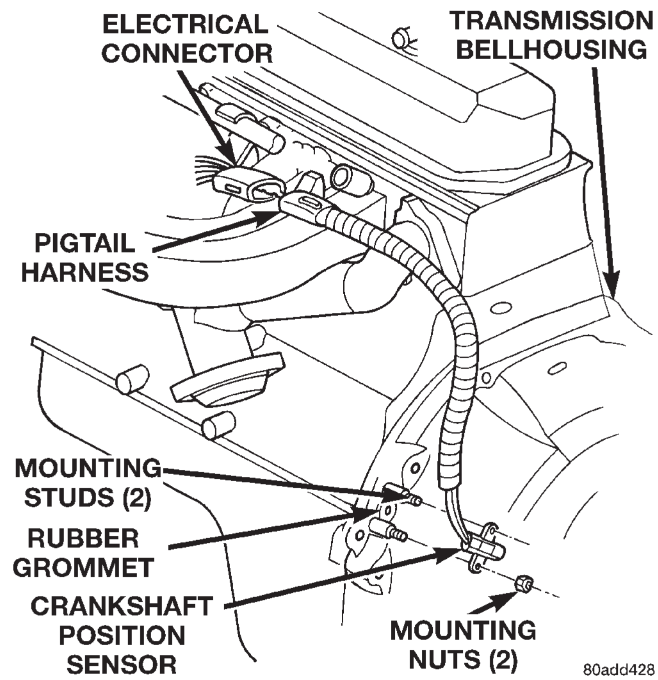


Fig. 22 Crankshaft Position Sensor—2.5L 4-Cyl. Engine With Auto. Trans.

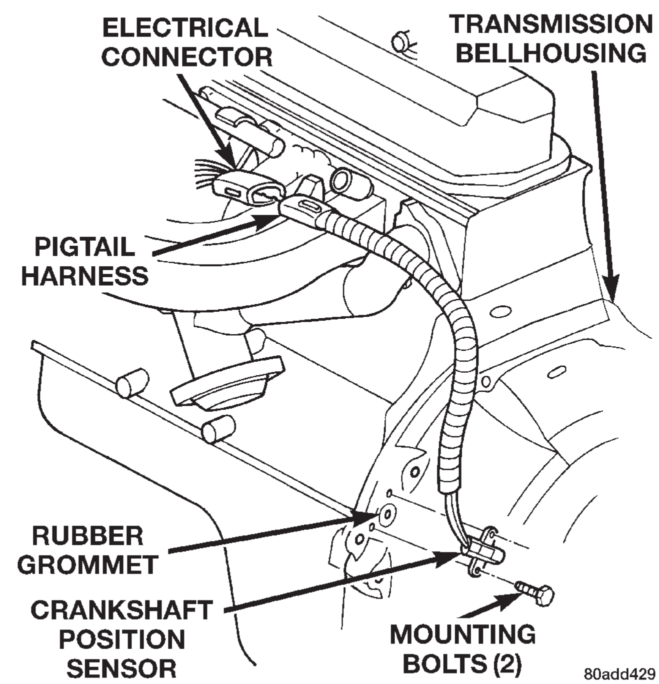


Fig. 23 Crankshaft Position Sensor—Except 2.5L 4-Cyl. Engine With Auto. Trans.

(2) 2.5L engines equipped with automatic transmission: Install and tighten two sensor mounting nuts to 19 N·m (14 ft. lbs.) torque.

(3) 2.5L engines equipped with manual transmission or any 4.0L engines: Install and tighten two sensor mounting bolts to 19 N·m (14 ft. lbs.) torque. **The two sensor mounting bolts are specially**

REMOVAL AND INSTALLATION (Continued)

machined to correctly space unit to flywheel. Do not attempt to install any other bolts.

(4) Connect sensor pigtail harness electrical connector to main wiring harness.

(5) Install air cleaner tube to throttle body (if necessary).

CAMSHAFT POSITION SENSOR

The camshaft position sensor is located in the distributor (Fig. 24).

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.

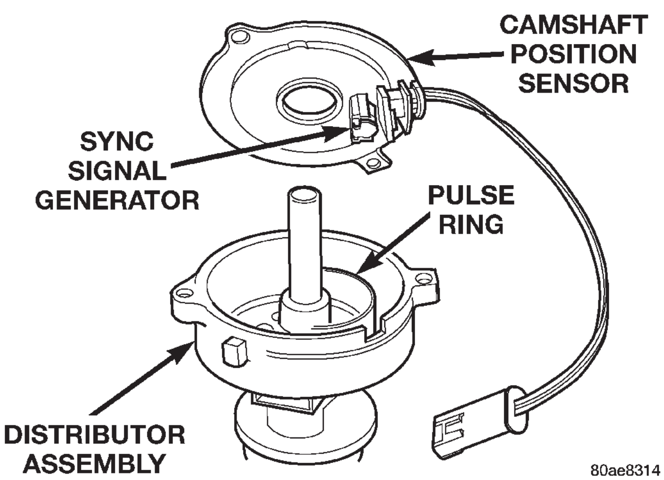


Fig. 24 Camshaft Position Sensor

(4) Remove distributor rotor from distributor shaft.

(5) Lift camshaft position sensor assembly from distributor housing (Fig. 24).

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.

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. 25). 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.

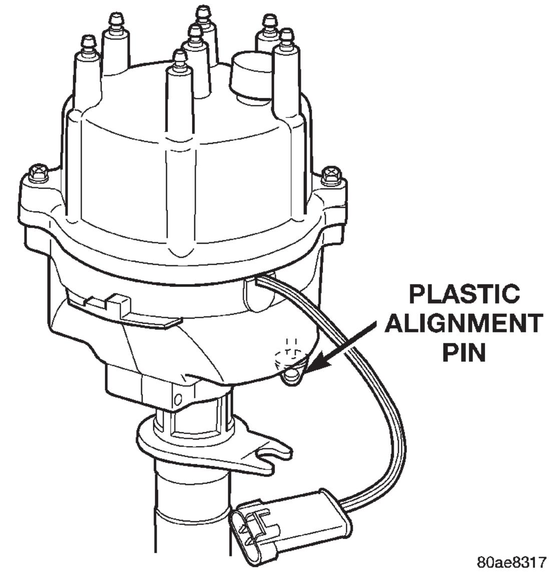


Fig. 25 Plastic Alignment Pin

The camshaft position sensor is located in the distributor on all engines (Fig. 26). For removal/installation procedures, refer to Camshaft Position Sensor. Distributor removal is not necessary for sensor removal.

Refer to (Fig. 26) 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. 26). The centerline of the slot aligns with the distributor holddown 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).

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 negative battery cable at 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 distributor wiring harness from main engine harness.

(5) Remove cylinder number 1 spark plug.

REMOVAL AND INSTALLATION (Continued)

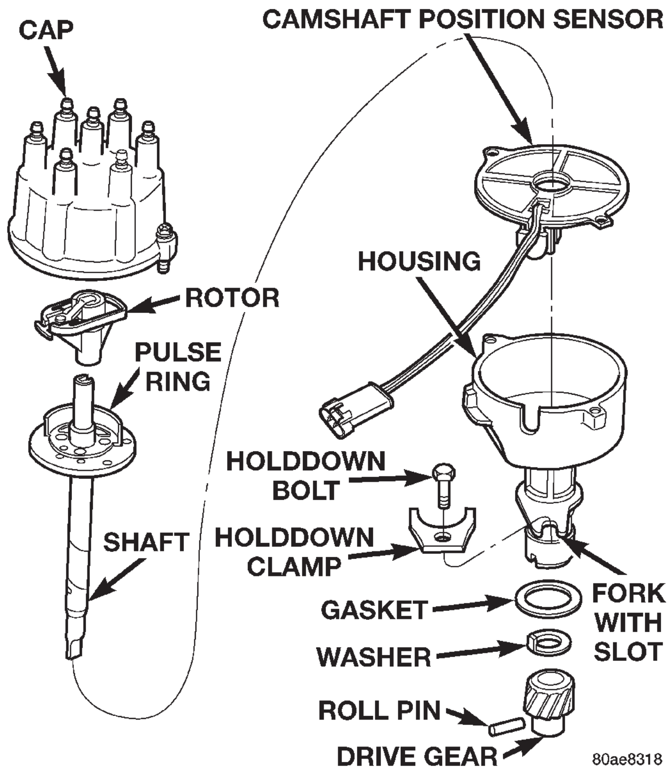


Fig. 26 Distributor—2.5L Or 4.0L Engines—Typical

(6) Hold a finger over open spark plug hole. Rotate engine at vibration dampener bolt until compression (pressure) is felt.

(7) Slowly continue to rotate engine. Do this until timing index mark on vibration damper pulley aligns with top dead center (TDC) mark (0 degree) on timing degree scale (Fig. 27). Always rotate engine in direction of normal rotation. Do not rotate engine backward to align timing marks.

(8) On models equipped with A/C, remove electrical cooling fan and shroud assembly from radiator. Refer to Group 7, Cooling System for procedures.

(9) This will provide room to turn engine crankshaft with a socket and ratchet using vibration damper bolt.

(10) Remove distributor holddown bolt and clamp.

(11) Remove distributor from engine by slowly lifting straight up.

(12) Note that rotor will rotate slightly in a counterclockwise direction while lifting up distributor. The oil pump gear will also rotate slightly in a counterclockwise direction while lifting up distributor. This is due to the helical cut gears on distributor and camshaft.

(13) Note removed position of rotor during distributor removal. During installation, this will be referred to as the Pre-position.

(14) **2.5L 4-Cylinder Engine:** Observe slot in oil pump gear through hole on side of engine. It should

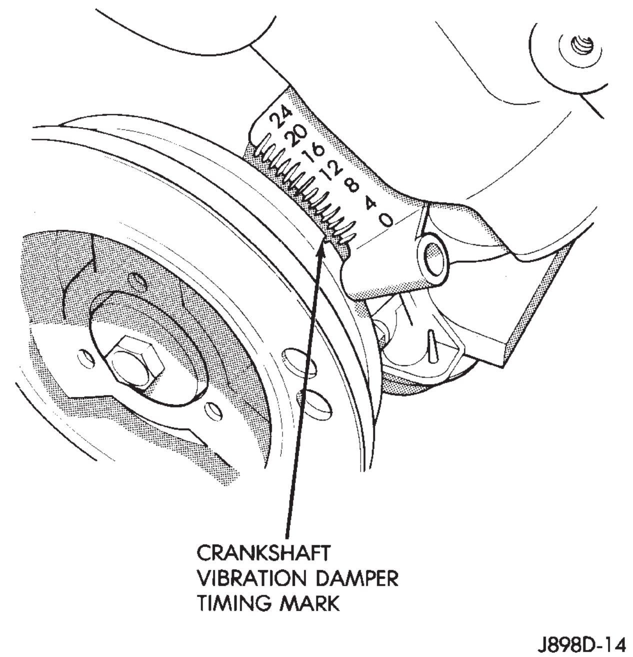


Fig. 27 Align Timing Marks

be slightly before (counterclockwise of) 10 o'clock position (Fig. 28).

(15) **4.0L 6-Cylinder Engine:** Observe slot in oil pump gear through hole on side of engine. It should be slightly before (counterclockwise of) 11 o'clock position (Fig. 29).

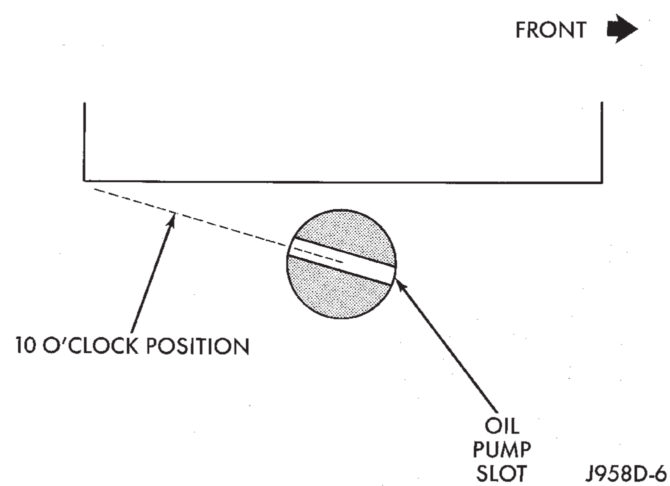


Fig. 28 Slot At 10 O'clock Position—2.5L Engine

(16) Remove and discard the old distributor-to-engine block gasket.

INSTALLATION

(1) If engine crankshaft has been rotated after distributor removal, cylinder number 1 must be returned to its proper firing stroke. Refer to previous REMOVAL Step 5 and Step 6. These steps must be done before installing distributor.

REMOVAL AND INSTALLATION (Continued)

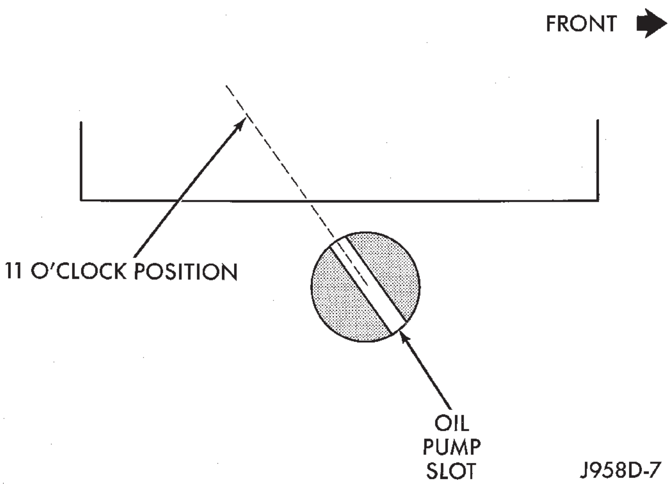


Fig. 29 Slot At 11 O'clock Position—4.0L Engine

(2) Check position of slot on oil pump gear. On the 2.5L engine, it should be just slightly before (counter-clockwise of) 10 o'clock position (Fig. 28). On the 4.0L engine, it should be just slightly before (counterclockwise of) 11 o'clock position (Fig. 29). If not, place a flat blade screwdriver into oil pump gear and rotate it into proper position.

(3) Factory replacement distributors are equipped with a plastic alignment pin already installed (Fig. 25). This pin is used to temporarily hold rotor to cylinder number 1 firing position during distributor installation. If pin is in place, proceed to Step 8. If not, proceed to next step.

(4) If 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 plastic pin.

(5) Remove camshaft position sensor from distributor housing. Lift straight up.

(6) Four different alignment holes are provided on plastic ring (Fig. 30). **Note that 2.5L and 4.0L engines have different alignment holes (Fig. 30).**

(7) Rotate distributor shaft and install pin punch tool through proper alignment hole in plastic ring (Fig. 30) and into mating access hole in distributor housing. This will prevent distributor shaft and rotor from rotating.

(8) Clean distributor mounting hole area of engine block.

(9) Install new distributor-to-engine block gasket (Fig. 26).

(10) Install rotor to distributor shaft.

(11) **2.5L 4-Cylinder Engine:** Pre-position distributor into engine while holding centerline of base slot in 1 o'clock position (Fig. 31). Continue to engage distributor into engine. The rotor and distributor will rotate clockwise during installation. This is due to the helical cut gears on distributor and camshaft.

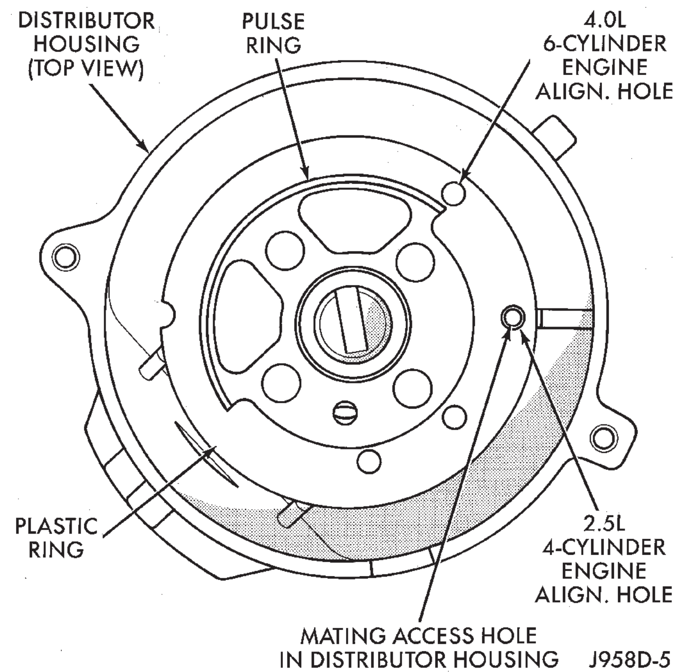


Fig. 30 Pin Alignment Holes

When distributor is fully seated to engine block, the centerline of base slot should be aligned to clamp bolt mounting hole on engine (Fig. 32). The rotor should also be pointed slightly past (clockwise of) 3 o'clock position.

4.0L 6-Cylinder Engine: Pre-position distributor into engine while holding centerline of base slot in 1 o'clock position (Fig. 31). Continue to engage distributor into engine. The rotor and distributor will rotate clockwise during installation. This is due to the helical cut gears on distributor and camshaft. When distributor is fully seated to engine block, the centerline of base slot should be aligned to clamp bolt mounting hole on engine (Fig. 33). The rotor should also be pointed at 5 o'clock position.

It may be necessary to rotate rotor and distributor shaft (very slightly) to engage distributor shaft with slot in oil pump gear. The same may have to be done to engage distributor gear with camshaft gear.

The distributor is correctly installed when:

- rotor is pointed at 3 o'clock position (2.5L engine), or at 5 o'clock position (4.0L engine).
- plastic alignment pin (or pin punch tool) is still installed to distributor.
- number 1 cylinder piston is set at top dead center (TDC) (compression stroke).
- centerline of slot at base of distributor is aligned to centerline of distributor holddown bolt hole on engine. In this position, the holddown bolt should easily pass through slot and into engine.

No adjustments are necessary. Proceed to next step.

REMOVAL AND INSTALLATION (Continued)

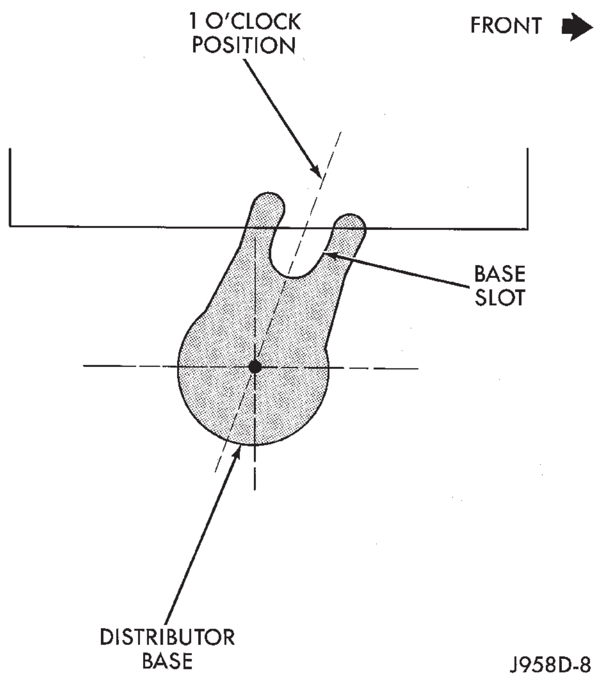


Fig. 31 Distributor Pre-position—All Engines

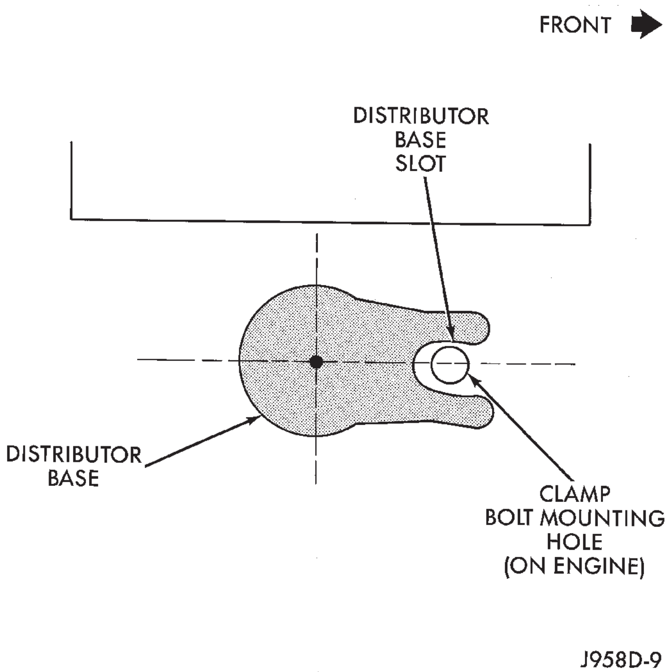


Fig. 32 Distributor Engaged Position—2.5L 4-Cylinder Engine

(12) Install distributor holddown clamp and bolt. Tighten bolt to 23 N·m (17 ft. lbs.) torque.

(13) Remove pin punch tool from distributor. Or, if plastic alignment pin was used, remove it straight down from bottom of distributor. Discard plastic pin.

(14) If removed, install camshaft position sensor to distributor. Align wiring harness grommet to notch in distributor housing.

(15) Install rotor.

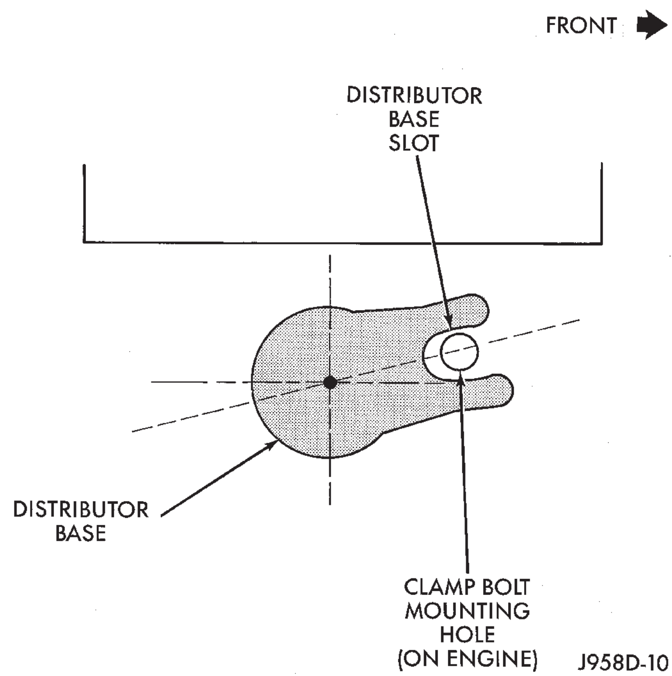


Fig. 33 Distributor Engaged Position—4.0L 6-Cylinder Engine

CAUTION: If the distributor cap is incorrectly positioned on distributor housing, cap or rotor may be damaged when engine is started.

(16) Install distributor cap. Tighten distributor cap holddown screws to 3 N·m (26 in. lbs.) torque.

(17) If removed, install spark plug cables to distributor cap. For proper firing order, refer to Specifications section at the end of this group. See Engine Firing Order.

(18) Connect distributor wiring harness to main engine harness.

(19) Connect battery cable to battery.

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. 34).

(5) Position a small screwdriver or pin punch into tang access hole on bottom of steering column lower cover (Fig. 35).

(6) Push the pin punch up while pulling key cylinder from steering column.

REMOVAL AND INSTALLATION (Continued)

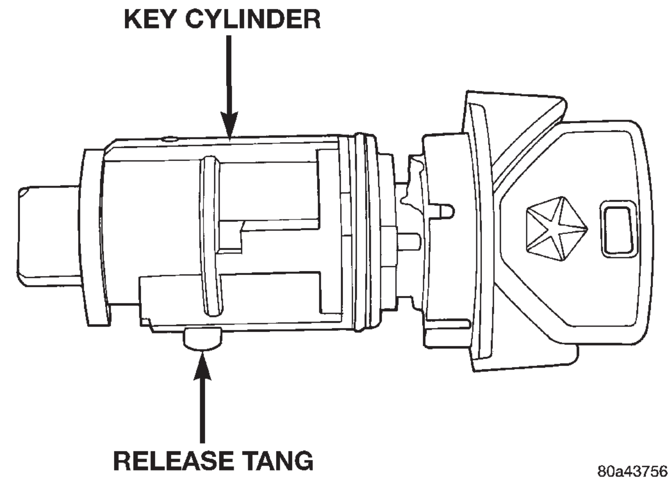


Fig. 34 Key Cylinder Release Tang

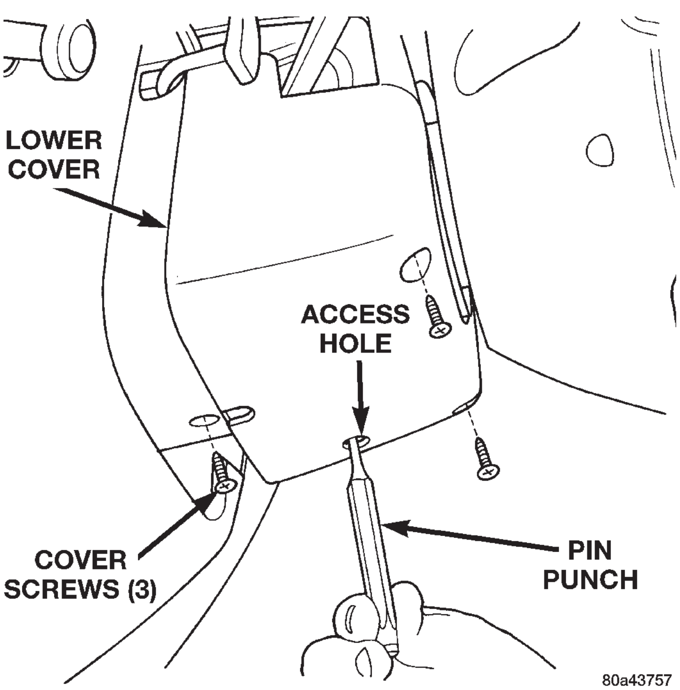


Fig. 35 Key Cylinder and Cover Removal

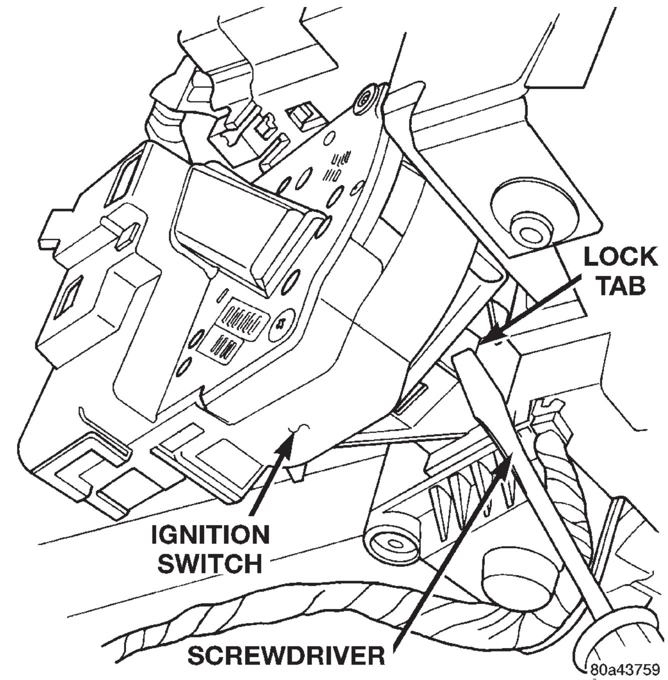


Fig. 36 Ignition Switch Lock Tab

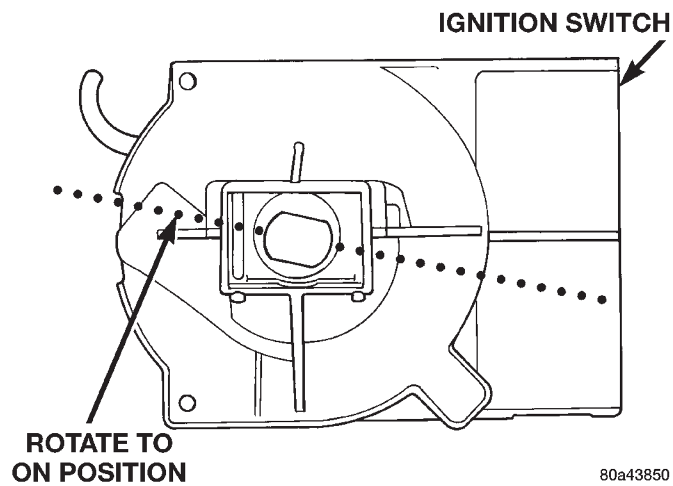


Fig. 37 Switch In ON Position

IGNITION SWITCH REMOVAL

(1) Remove key cylinder. Refer to previous steps.

(2) Remove lower steering column cover screws and remove cover (Fig. 35).

(3) Remove ignition switch mounting screw (Fig. 38). Use tamper proof torx bit (Snap-On® SDMTR10 or equivalent) to remove the screw.

(4) Using a small screwdriver, push on locking tab (Fig. 36) and remove switch from steering column.

(5) Disconnect two electrical connectors at rear of ignition switch (Fig. 38).

IGNITION SWITCH INSTALLATION

(1) Before installing ignition switch, rotate the slot in the switch to the ON position (Fig. 37).

(2) Connect two electrical connectors to rear of ignition switch. Make sure that locking tabs are fully seated into wiring connectors.

(3) Position switch to column and install tamper proof screw. Tighten screw to 3 N·m (26 in. lbs.).

(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

REMOVAL AND INSTALLATION (Continued)

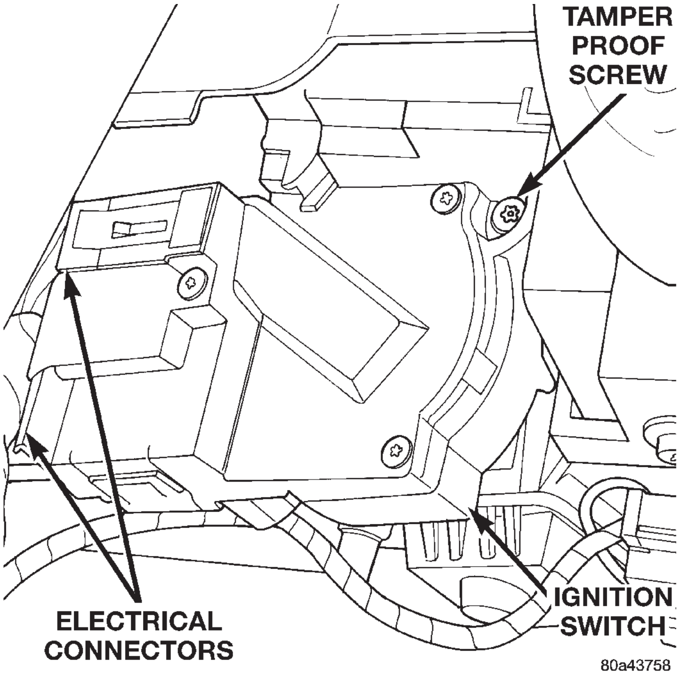


Fig. 38 Ignition Switch Removal/Installation

locked in PARK position after key removal. If key is difficult to rotate or is difficult to remove, the shift 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

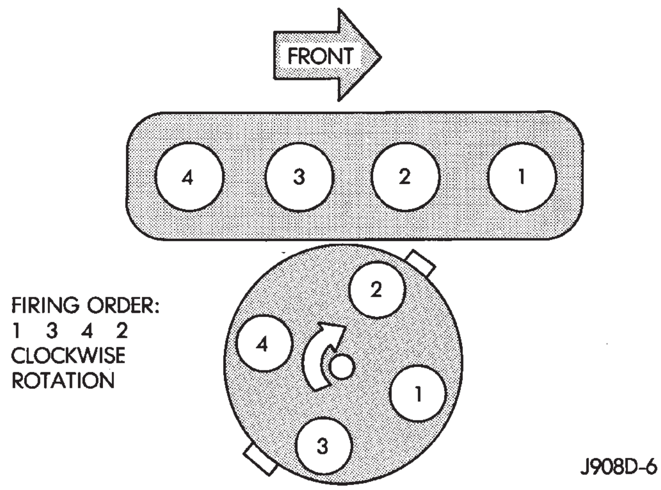
On models equipped with an automatic transmission, a cable connects the ignition switch with the floor shift lever. The shifter will be locked in the PARK position when the ignition key is in the LOCK or ACCESSORY positions. The cable can be adjusted or replaced. Refer to Group 21, Transmissions for 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

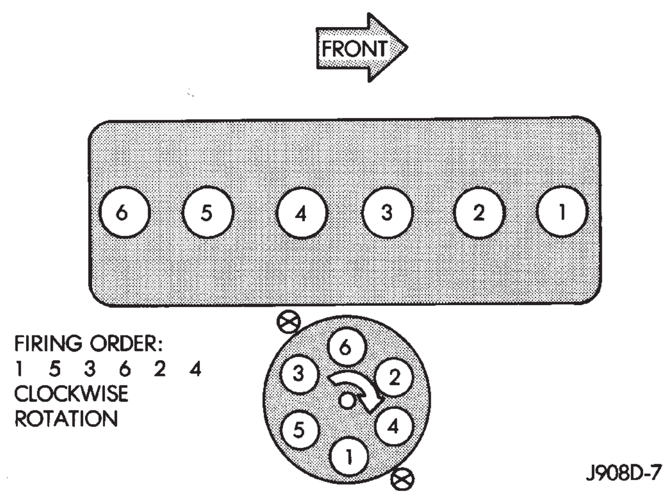
IGNITION TIMING

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



ENGINE FIRING ORDER—4.0L 6-CYLINDER ENGINE



SPARK PLUGS

ENGINE	PLUG TYPE	ELECTRODE GAP
2.5L/4.0L	RC12ECC	0.89 mm (0.035 in.)

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

SPECIFICATIONS (Continued)

IGNITION COIL RESISTANCE

COIL MANUFACTURER	PRIMARY RESISTANCE 21-27°C (70-80°F)	SECONDARY RESISTANCE 21-27°C (70-80°F)
Diamond	0.97 - 1.18 Ohms	11,300 - 15,300 Ohms
Toyodenso	0.95 - 1.20 Ohms	11,300 - 13,300 Ohms

TORQUE CHART

DESCRIPTION	TORQUE
Crankshaft Position Sensor Mounting Bolts	19 N·m (14 ft. lbs.)
Crankshaft Position Sensor Mounting Nuts	19 N·m (14 ft. lbs.)
Distributor Hold Down Bolt	23 N·m (17 ft. 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.)
Powertrain Control Module (PCM) Mounting Screws	1 N·m (9 in. lbs.)
Spark Plugs (all engines)	41 N·m (30 ft. lbs.)

INSTRUMENT PANEL SYSTEMS

CONTENTS

DESCRIPTION AND OPERATION

INSTRUMENT PANEL SYSTEM

DESCRIPTION

The instrument panel serves as the command center of the vehicle, which necessarily makes it 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. The instrument panel is also designed so that all of the various controls can be safely reached and the monitors can be easily viewed by the vehicle operator when driving, while still allowing relative ease of access to each of these items for service. See the owner's manual in the vehicle glove box for more information on the features, use and operation of all of the instrument panel components and systems.

This group is responsible for covering service information for the vehicle instrument panel systems. However, complete service information coverage for all of the systems and components housed in the instrument panel in a single section of the service manual would not be practical. Therefore, the service information for any component will be found in the group designated to cover the vehicle system that the component belongs to, even though the component is mounted on or in the instrument panel. If you cannot locate a listing for the component or system you are servicing in the table of contents for this group, or if you are uncertain as to which vehicle system a component belongs to, it is suggested that you refer to the alphabetical **Component and System Index** found at the back of this service manual.

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

DESCRIPTION

This instrument panel uses a full-width structural plastic foundation as its primary support. When the two primary molded plastic components of this structure are vibration welded together they provide superior instrument panel stiffness and integrity to help reduce buzzes, squeaks, and rattles even on the bumpiest roads.

This type of construction also provides improved energy absorption which, in conjunction with the dual airbag modules and seat belts, helps to improve occupant protection. This foundation structure also serves as the air duct for the heating and air conditioning system panel outlets, which greatly reduces the number of components used over conventional instrument panel construction.

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 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 opening cover and knee blocker provides access to the steering column mounts, the steering column wiring, the headlamp switch, the electronic combination flasher, and much of the instrument panel wiring. Removal of the glove box provides access to the heating and air conditioning electrical and vacuum harnesses, the blower motor relay, the radio antenna coaxial cable, the lower passenger side airbag mounts, and additional instrument panel wiring.

Removal of the instrument panel center bezel allows access to the radio, the heating and air conditioning controls, the accessory switches, the cigar lighter, and the accessory power outlet. Removal of the instrument cluster bezel allows access to the instrument cluster. 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 top cover allows access to the upper passenger side airbag mounts. Instrument panel removal is required for service of most internal components of the heating and air conditioning system housing.

INSTRUMENT CLUSTER

DESCRIPTION

Two basic instrument clusters are offered on this model: low-line, or high-line. Both clusters are electromechanical units that utilize 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. These clusters also incorporate a digital Vacuum Fluorescent Display (VFD) for the odometer/trip odometer display functions. Some variations of each cluster exist due to optional equipment and regulatory requirements.

The low-line cluster includes the following analog gauges:

- Fuel gauge
- Speedometer.

This cluster also includes provisions for the following indicator lamps:

- Airbag indicator lamp
- Anti-lock brake system lamp
- Brake warning lamp
- Coolant temperature warning lamp
- Cruise-on indicator lamp
- Four-wheel drive (Part Time and/or Full Time) indicator lamps
- Headlamp high beam indicator lamp
- Low oil pressure warning lamp
- Low washer fluid warning lamp
- Malfunction indicator (Check Engine) lamp
- Seat belt reminder lamp
- Sentry Key Immobilizer System (SKIS) indicator lamp
- Turn signal indicator lamps
- Upshift indicator lamp (manual transmission)
- Voltage warning lamp.

The high-line cluster replaces some of the indicator lamps found in the low-line cluster with analog gauges. The high-line cluster includes the following analog gauges:

- Coolant temperature gauge
- Fuel gauge
- Oil pressure gauge
- Speedometer
- Tachometer
- Voltmeter.

The high-line cluster also adds a check gauges lamp and a low fuel warning lamp to the remaining indicator lamps found in the low-line cluster.

Both instrument clusters feature circuitry that has a self-diagnostic actuator test capability, which will test each of the CCD bus message-controlled functions of the cluster by lighting the appropriate indicator lamps and positioning the gauge needles at several predetermined locations on the gauge faces in a prescribed sequence. For more information on this function, refer to **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 **Chime Warning System** in the Description and Operation section of Group 8U - Chime/Buzzer Warning Systems for more information on the chime functions of the instrument cluster. Refer to **Rear Window Defogger System** in the Description and Operation section of Group 8N -

DESCRIPTION AND OPERATION (Continued)

Electrically Heated Systems for more information on the timer function of the instrument cluster.

The instrument clusters for this model are serviced only as complete units. If a cluster gauge or the cluster circuit board are faulty, the entire cluster must be replaced. The cluster lens, the cluster hood and mask, the rear cluster housing cover, the odometer reset knob boot and the incandescent lamp bulbs and holders are available for service replacement.

OPERATION

GAUGE

With the ignition switch in the On or Start positions, voltage is supplied to all gauges through the instrument cluster electronic circuit board. With the ignition switch in the Off position, voltage is not supplied to the gauges. The gauges do not accurately indicate any vehicle condition unless the ignition switch is in the On or Start positions.

All of the instrument cluster gauges, except the odometer, are air core magnetic units. Two fixed electromagnetic coils are located within the gauge. These coils are wrapped at right angles to each other around a movable permanent magnet. The movable magnet is suspended within the coils on one end of a shaft. The gauge needle is attached to the other end of the shaft.

One of the coils has a fixed current flowing through it to maintain a constant magnetic field strength. Current flow through the second coil changes, which causes changes in its magnetic field strength. The current flowing through the second coil is changed by the instrument cluster electronic circuitry in response to messages received on the Chrysler Collision Detection (CCD) data bus network.

The gauge needle moves as the movable permanent magnet aligns itself to the changing magnetic fields created around it by the electromagnets. The instrument cluster circuitry is programmed to move all of the gauge needles back to the low end of their respective scales after the ignition switch is turned to the Off position.

INDICATOR LAMP

Indicator lamps are located in the instrument cluster and are served by the cluster circuit board and connectors. Many of the indicator lamps in the instrument cluster are controlled by the instrument cluster circuitry in response to messages received over the Chrysler Collision Detection (CCD) data bus network.

The anti-lock brake system lamp, brake warning lamp, four-wheel drive indicator lamps, headlamp high beam indicator lamp, low washer fluid warning lamp and turn signal indicator lamps are hard wired. The seat belt reminder lamp is controlled by the instrument cluster programming. The instrument cluster circuitry uses CCD data bus messages from the Powertrain Control Module (PCM), Airbag Control Module (ACM), and the Sentry Key Immobilizer Module (SKIM) to control all of the remaining indicator lamps.

Each of the indicator lamps in the instrument cluster uses incandescent bulbs and holders, which are available for service replacement.

CLUSTER ILLUMINATION LAMP

The cluster illumination lamps are hard wired in the instrument cluster. When the park or head lamps are turned on, the cluster illumination lamps light. Illumination brightness is adjusted by rotating the headlamp switch knob (clockwise to dim, counterclockwise to brighten). The instrument cluster illumination lamps receive battery feed from the panel dimmer rheostat in the headlamp switch through a fuse in the fuseblock module.

The instrument cluster electronic circuitry also monitors the cluster illumination lamp dimming level whenever the park or head lamps are turned on. The instrument cluster electronic circuitry responds by adjusting the dimming level of the odometer Vacuum Fluorescent Display (VFD), and sending dimming level messages over the Chrysler Collision Detection (CCD) data bus network. When the park lamps or headlamps are turned off, the VFD is illuminated at full brightness for improved daylight visibility.

Each of the cluster illumination lamps is located on the instrument cluster circuit board. Each cluster illumination lamp has a replaceable bulb and bulb holder.

INSTRUMENT PANEL CIGAR LIGHTER

DESCRIPTION

A cigar lighter is standard equipment on this model. The cigar lighter is installed in the instrument panel accessory switch bezel, which is located near the bottom of the instrument panel center bezel area, below the heater and air conditioner controls. The cigar lighter base is secured by a snap fit within the accessory switch bezel.

The cigar lighter receptacle is serviced only as a part of the accessory switch bezel unit. If the cigar lighter base is faulty or damaged, the accessory switch bezel unit must be replaced. The cigar lighter knob and heating element unit is available for service. This component cannot be repaired and, if faulty or damaged, it must be replaced.

DESCRIPTION AND OPERATION (Continued)

OPERATION

The cigar lighter consists of two major components: a knob and heating element unit, and the cigar lighter base or receptacle shell. The receptacle shell is connected to ground, and an insulated contact in the bottom of the shell is connected to battery current. The cigar lighter receives battery voltage from a fuse in the junction block through the cigar lighter relay only when the ignition switch is in the Accessory or On positions. Refer to **Cigar Lighter Relay** in the Description and Operation section of this group for more information on this component.

The cigar lighter knob and heating element are encased within a spring-loaded housing, which also features a sliding protective heat shield. When the knob and heating element are inserted in the receptacle shell, the heating element resistor coil is grounded through its housing to the receptacle shell. If the cigar lighter knob is pushed inward, the heat shield slides up toward the knob exposing the heating element, and the heating element extends from the housing toward the insulated contact in the bottom of the receptacle shell.

Two small spring-clip retainers are located on either side of the insulated contact inside the bottom of the receptacle shell. These clips engage and hold the heating element against the insulated contact long enough for the resistor coil to heat up. When the heating element is engaged with the contact, battery current can flow through the resistor coil to ground, causing the resistor coil to heat.

When the resistor coil becomes sufficiently heated, excess heat radiates from the heating element causing the spring-clips to expand. Once the spring-clips expand far enough to release the heating element, the spring-loaded housing forces the knob and heating element to pop back outward to their relaxed position. When the cigar lighter knob and element are pulled out of the receptacle shell, the protective heat shield slides downward on the housing so that the heating element is recessed and shielded around its circumference for safety.

CIGAR LIGHTER RELAY

DESCRIPTION

The cigar lighter relay is an electromechanical device that switches fused battery current to the cigar lighter when the ignition switch is turned to the Accessory or On positions. The cigar lighter relay is located in the junction block, on the right cowl side panel below the instrument panel in the passenger compartment.

The cigar lighter relay is a International Standards Organization (ISO) relay. Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions.

The cigar lighter relay cannot be repaired or adjusted and, if faulty or damaged, it must be replaced.

OPERATION

The ISO relay consists of an electromagnetic coil, a resistor or diode, and three (two fixed and one movable) electrical contacts. The movable (common feed) relay contact is held against one of the fixed contacts (normally closed) by spring pressure. When the electromagnetic coil is energized, it draws the movable contact away from the normally closed fixed contact, and holds it against the other (normally open) fixed contact.

When the electromagnetic coil is de-energized, spring pressure returns the movable contact to the normally closed position. The resistor or diode is connected in parallel with the electromagnetic coil in the relay, and helps to dissipate voltage spikes that are produced when the coil is de-energized.

INSTRUMENT PANEL POWER OUTLET

DESCRIPTION

An accessory power outlet is standard equipment on this model. The power outlet is installed in the instrument panel accessory switch bezel, which is located near the bottom of the instrument panel center bezel area, below the heater and air conditioner controls. The power outlet base is secured by a snap fit within the accessory switch bezel. A plastic protective cap snaps into the power outlet base when the power outlet is not being used, and hangs from the power outlet base mount by an integral bail strap while the power outlet is in use.

The power outlet receptacle unit and the accessory power outlet protective cap are serviced only as a part of the accessory switch bezel unit. If the power outlet base is faulty or damaged, the entire accessory switch bezel unit must be replaced.

OPERATION

The power outlet base or receptacle shell is connected to ground, and an insulated contact in the bottom of the shell is connected to battery current. The power outlet receives battery voltage from a fuse in the junction block at all times.

While the power outlet is very similar to a cigar lighter base unit, it does not include the two small spring-clip retainers inside the bottom of the receptacle shell that are used to secure the cigar lighter heating element to the insulated contact.

DIAGNOSIS AND TESTING

INSTRUMENT CLUSTER

If all of the gauges and/or indicator lamps are inoperative, perform the Preliminary Diagnosis. If an individual gauge or Chrysler Collision Detection (CCD) data bus message-controlled indicator lamp is inoperative, go directly to the Actuator Test. If an individual hard wired indicator lamp is inoperative, refer to **Instrument Cluster - Hard Wired Lamp Diagnosis** in the Diagnosis and Testing section of this group for the procedures to diagnosis that lamp. For complete circuit diagrams, refer to **Instrument Cluster** in the Contents of Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

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 fused B(+) 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 fused B(+) fuse in the PDC. If OK, go to Step 4. If not OK, repair the open fused B(+) circuit to the battery as required.

(4) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the instrument cluster wire harness connector A. If OK, refer to **Instrument Cluster - Actuator Test** in the Diagnosis and Testing section of this group. If not OK, repair the open fused B(+) circuit to the fuse in the PDC as required.

(5) Check the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 6. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(6) Turn the ignition switch to the On position and check for battery voltage at the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 7. If not OK, repair the open fused ignition switch output (run/start) circuit to the ignition switch as required.

(7) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Install the instrument cluster. Connect the battery negative cable. Turn the ignition switch to the On position. Set the park brake. The red brake warning lamp should light. If OK, go to Step 8. If not OK, go to Step 9.

(8) Turn the ignition switch to the Off position. Turn on the park lamps and adjust the panel lamps dimmer rheostat in the headlamp switch to the full bright position. The cluster illumination lamps should light. If OK, refer to **Instrument Cluster - Actuator Test** in the Diagnosis and Testing section of this group. If not OK, go to Step 10.

(9) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the instrument cluster. Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) circuit cavity of the instrument cluster wire harness connector A. If OK, refer to **Instrument Cluster - Actuator Test** in the Diagnosis and Testing section of this group. If not OK, repair the open fused ignition switch output (run/start) circuit to the fuse in the junction block as required.

(10) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Check for continuity between the ground circuit cavity of the instrument cluster wire harness connector A and a good ground. There should be continuity. If OK, refer to **Instrument Cluster - Actuator Test** in the Diagnosis and Testing section of this group. If not OK, repair the open ground circuit to ground as required.

ACTUATOR TEST

The instrument cluster actuator test will put the instrument cluster into its self-diagnostic mode. In this mode the instrument cluster can perform a self-diagnostic test that will confirm that the instrument cluster circuitry, the gauges, and the CCD data bus message controlled indicator lamps are capable of operating as designed. During the actuator test the instrument cluster circuitry will position each of the gauge needles at various specified calibration points, and turn all of the CCD data bus message-controlled lamps on and off at specified time intervals (Fig. 1) or (Fig. 2).

Successful completion of the actuator test will confirm that the instrument cluster is operational. However, there may still be a problem with the CCD data bus, the Powertrain Control Module (PCM), the Airbag Control Module (ACM), the Sentry Key Immobi-

DIAGNOSIS AND TESTING (Continued)

lizer Module (SKIM) or the inputs to one of these electronic control modules. Use a DRB scan tool and the proper Diagnostic Procedures manual for testing of these components.

If an individual gauge does not respond properly, or does not respond at all during the actuator test, the instrument cluster should be removed. However, check that the gauge mounting screws on the instrument cluster electronic circuit board for proper tightness before considering instrument cluster replacement. If the gauge mounting screws check OK, replace the faulty cluster.

If an individual indicator lamp does not illuminate during the actuator test, the instrument cluster should be removed. However, check that the incandescent lamp bulb is not faulty and that the bulb holder is properly installed on the instrument cluster electronic circuit board before considering instrument cluster replacement. If the bulb and bulb holder check OK, replace the faulty instrument 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 indicator lamp(s) with the Instrument Cluster Actuator Test chart (Fig. 1) or (Fig. 2).

(6) The instrument cluster will automatically exit the self-diagnostic mode and return to normal operation at the completion of the test, if the ignition switch is turned to the Off position during the test, or if a vehicle speed message indicating that the vehicle is moving is received from the PCM on the CCD data bus during the test.

(7) Go back to Step 1 to repeat the test, if required.

HARD WIRED LAMP DIAGNOSIS

Each of the lamps found in this section depends upon a hard wired circuit input to the instrument cluster for proper operation. The following procedures will help to diagnose conditions that may cause an inoperative hard wired lamp circuit condition.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

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 **Antilock Brakes** in the Diagnosis and Testing section of 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 complete circuit descriptions, refer to **Instrument Cluster** in the Contents of Group 8W - Wiring Diagrams.

(1) Check the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open fused ignition switch output (run/start) circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the instrument cluster. Connect the battery negative cable. Turn the ignition switch to the On position and within five seconds check for continuity between the ABS warning indicator driver circuit cavity of the instrument cluster wire harness connector A and a good ground. There should be continuity for five seconds after ignition On, and then an open circuit. If OK, replace the faulty bulb. If not OK, go to Step 4.

(4) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the Controller Anti-lock Brake (CAB) wire harness connector. Check for continuity between the ABS warning indicator driver circuit cavity of the instrument cluster wire harness connector A and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the shorted ABS warning indicator driver circuit as required.

(5) Check for continuity between the ABS warning indicator driver circuit cavities of the instrument cluster wire harness connector A and the CAB wire harness connector. There should be continuity. If OK, refer to **Antilock Brakes** in the Diagnosis and Testing section of Group 5 - Brakes for diagnosis of the CAB. If not OK, repair the open ABS warning indicator driver 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 park brake released, or comes on

DIAGNOSIS AND TESTING (Continued)

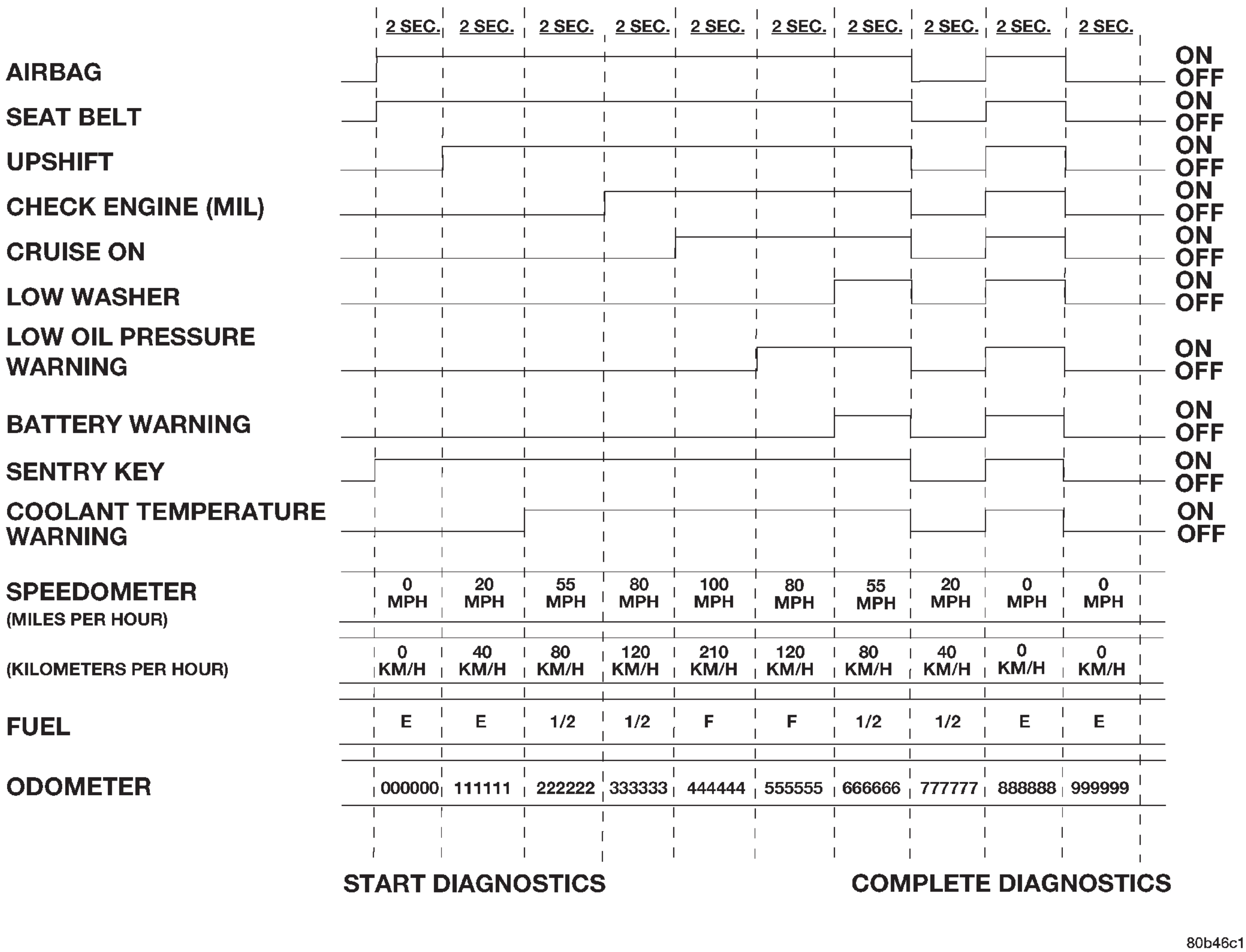


Fig. 1 Low-Line Instrument Cluster Actuator Test

DIAGNOSIS AND TESTING (Continued)

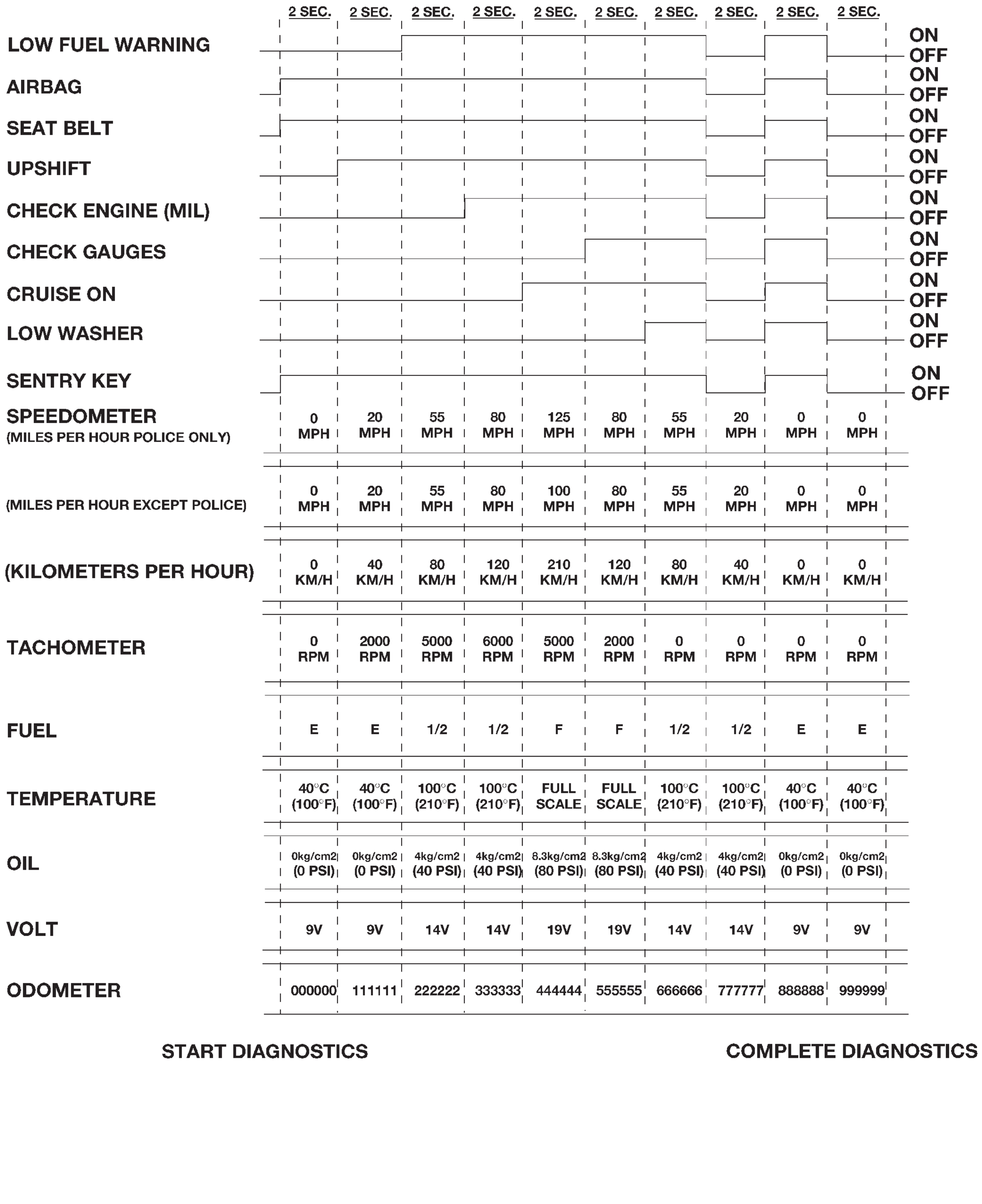


Fig. 2 High-Line Instrument Cluster Actuator Test

DIAGNOSIS AND TESTING (Continued)

while driving, refer **Base Brake System** for vehicles not equipped with the four wheel anti-lock brake system, or refer to **Antilock Brakes** for vehicles equipped with the four wheel anti-lock brake system in the Diagnosis and Testing section of Group 5 - Brakes for further diagnosis. If no brake system problem is found, the following procedure will help locate a short or open circuit, or a faulty switch. For complete circuit diagrams, refer to **Instrument Cluster** in the Contents of Group 8W - Wiring Diagrams.

(1) Check the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open fused ignition switch output (run/start) circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the wire harness connector at the park brake switch. With the park brake released, check for continuity between the park brake switch terminal and a good ground. There should be no continuity. If OK, go to Step 4. If not OK, adjust or replace the faulty park brake switch.

(4) Disconnect the wire harness 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 5. If not OK, replace the faulty brake warning switch.

(5) 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 6. If not OK, replace the faulty brake warning switch.

(6) With both the park brake switch and the brake warning switch wire harness connectors still disconnected, check for continuity between the red brake warning indicator driver circuit cavity of the park brake switch wire harness connector and a good ground. There should be no continuity. If OK, go to Step 7. If not OK, repair the shorted red brake warning indicator driver circuit as required.

(7) With the ignition switch held in the Start position, check for continuity between the red brake warning indicator driver circuit cavity of the park brake switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 8. If not OK, repair the open red brake warning indicator driver circuit to the ignition switch as required.

(8) Turn the ignition switch to the Off position. Remove the instrument cluster. Check for continuity between the red brake warning indicator driver circuit cavity of the instrument cluster wire harness connector A and a good ground. There should be no continuity. If OK, go to Step 9. If not OK, repair the shorted red brake warning indicator driver circuit as required.

(9) Check for continuity between the red brake warning indicator driver circuit cavities of the instrument cluster wire harness connector A and the brake warning switch wire harness connector. There should be continuity. If OK, replace the faulty bulb. If not OK, repair the open red brake warning indicator driver circuit as required.

FOUR-WHEEL DRIVE INDICATOR LAMP - FULL TIME

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 transfer case or transfer case linkage. Refer to **NV242 Diagnosis** in the Diagnosis and Testing section of Group 21 - Transmission for more information. If no transfer case problem is found, the following procedure will help locate a short or open in the indicator lamp circuit. For complete circuit diagrams, refer to **Instrument Cluster** in the Contents of Group 8W - Wiring Diagrams.

(1) Check the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open fused ignition switch output (run/start) circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the transfer case switch wire harness connector. Check for continuity between the ground circuit cavity of the transfer case switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open ground circuit to ground as required.

(4) Connect the battery negative cable. Turn the ignition switch to the On position. Install a jumper wire between the full time four wheel drive indicator lamp driver circuit cavity of the transfer case switch wire harness connector and a good ground. The full time four-wheel drive indicator lamp should light. If OK, replace the faulty transfer case switch. If not OK, go to Step 5.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable.

DIAGNOSIS AND TESTING (Continued)

Remove the instrument cluster. With the transfer case switch wire harness connector still disconnected, check for continuity between the full time four wheel drive indicator lamp driver circuit cavity of the instrument cluster wire harness connector B and a good ground. There should be no continuity. If OK, go to Step 6. If not OK, repair the shorted full time four wheel drive indicator lamp driver circuit as required.

(6) Check for continuity between the full time four wheel drive indicator lamp driver circuit cavities of the instrument cluster wire harness connector B and the transfer case switch wire harness connector. There should be continuity. If OK, replace the faulty bulb. If not OK, repair the open full time four wheel drive indicator lamp driver circuit as required.

FOUR-WHEEL DRIVE INDICATOR LAMP - PART TIME

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 transfer case or transfer case linkage. Refer to **NV231 Diagnosis** or **NV242 Diagnosis** in the Diagnosis and Testing section of Group 21 - Transmission for more information. If no transfer case problem is found, the following procedure will help locate a short or open in the indicator lamp circuit. For complete circuit diagrams, refer to **Instrument Cluster** in the Contents of Group 8W - Wiring Diagrams.

(1) Check the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open fused ignition switch output (run/start) circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the transfer case switch wire harness connector. Check for continuity between the ground circuit cavity of the transfer case switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open ground circuit to ground as required.

(4) Connect the battery negative cable. Turn the ignition switch to the On position. Install a jumper wire between the part time four wheel drive indicator lamp driver circuit cavity of the transfer case switch wire harness connector and a good ground. The part time four-wheel drive indicator lamp should light. If OK, replace the faulty transfer case switch. If not OK, go to Step 5.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the instrument cluster. With the transfer case switch wire harness connector still disconnected, check for continuity between the part time four wheel drive indicator lamp driver circuit cavity of the instrument cluster wire harness connector B and a good ground. There should be no continuity. If OK, go to Step 6. If not OK, repair the shorted part time four wheel drive indicator lamp driver circuit as required.

(6) Check for continuity between the part time four wheel drive indicator lamp driver circuit cavities of the instrument cluster wire harness connector B and the transfer case switch wire harness connector. There should be continuity. If OK, replace the faulty bulb. If not OK, repair the open part time four wheel drive indicator lamp driver circuit 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 **Headlamp Diagnosis** in the Diagnosis and Testing section of Group 8L - Lamps for diagnosis of the headlamp system. If no headlamp system problems are found, the following procedure will help locate an open in the high beam indicator lamp circuit. For complete circuit diagrams, refer to **Instrument Cluster** in the Contents of Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster.

(2) Connect the battery negative cable. Turn the headlamps on and select the high beams with the multi-function switch stalk. Check for battery voltage at the high beam indicator driver circuit cavity of the instrument cluster wire harness connector A. If OK, replace the faulty bulb. If not OK, repair the open high beam indicator driver circuit to the headlamp dimmer (multi-function) switch as required.

LOW WASHER FLUID WARNING LAMP

The diagnosis found here addresses an inoperative low washer fluid warning lamp condition. If the problem being diagnosed is related to lamp accuracy, be certain to confirm that the problem is with the lamp or washer fluid level sensor and not with a damaged or empty washer fluid reservoir. Inspect the reservoir for proper fluid level and signs of damage or distortion that could affect sensor performance before you proceed with lamp diagnosis. Refer to **Washer System** in the Diagnosis and Testing section of Group 8K - Wiper and Washer Systems for more information. For complete circuit diagrams, refer to **Instru-**

DIAGNOSIS AND TESTING (Continued)

ment Cluster in the Contents of Group 8W - Wiring Diagrams.

(1) Check the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open fused ignition switch output (run/start) circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect the wire harness connector from the washer fluid level sensor. Install a jumper wire between the two cavities of the washer fluid level sensor wire harness connector. Turn the ignition switch to the On position. The low washer fluid warning lamp should light. Remove the jumper wire and the lamp should go off. If OK, replace the faulty washer fluid level sensor. If not OK, go to Step 4.

(4) Turn the ignition switch to the Off position. Check for continuity between the ground circuit cavity of the washer fluid level sensor wire harness connector and a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the open ground circuit to ground as required.

(5) Disconnect and isolate the battery negative cable. Remove the instrument cluster. The washer fluid level sensor wire harness connector is still disconnected. Check for continuity between the low washer fluid level sense circuit cavity of the instrument cluster wire harness connector B and a good ground. There should be no continuity. If OK, go to Step 6. If not OK, repair the shorted low washer fluid level sense circuit as required.

(6) Check for continuity between the low washer fluid level sense circuit cavities of the instrument cluster wire harness connector B and the washer fluid level sensor wire harness connector. There should be continuity. If OK, replace the faulty bulb. If not OK, repair the open low washer fluid level sense circuit as required.

TURN SIGNAL INDICATOR LAMP

The diagnosis found here addresses an inoperative turn signal indicator lamp condition. For any other turn signal problem, refer to **Turn Signal and Hazard Warning Systems** in the Diagnosis and Testing section of Group 8J - Turn Signal and Hazard Warning Systems for further 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 complete circuit diagrams, refer to **Instrument Cluster** in the Contents of Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster.

(2) Connect the battery negative cable. Activate the hazard warning system by moving the hazard warning switch button to the On position. Check for battery voltage at the inoperative (right or left) turn signal circuit cavity of the instrument cluster wire harness connector (connector A - left, or connector B - right). There should be a switching (on and off) battery voltage signal. If OK, replace the faulty (right or left) indicator lamp bulb. If not OK, repair the open (right or left) turn signal circuit to the turn signal/hazard warning (multi-function) switch as required.

INSTRUMENT PANEL CIGAR LIGHTER

For complete circuit diagrams, refer to **Horn/Cigar Lighter** in the Contents of Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the cigar lighter knob and element from the cigar lighter receptacle shell. Check for continuity between the inside circumference of the cigar lighter receptacle shell and a good ground. there should be continuity. If OK, go to Step 2. If not OK, go to Step 3.

(2) Turn the ignition switch to the On position. Check for battery voltage at the insulated contact located at the back of the cigar lighter receptacle shell. If OK, replace the faulty cigar lighter knob and element. If not OK, go to Step 3.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the instrument panel accessory switch bezel. Check for continuity between the ground circuit cavity of the cigar lighter wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open ground circuit to ground as required.

(4) Connect the battery negative cable. Turn the ignition switch to the Accessory or On positions. Check for battery voltage at the cigar lighter relay output circuit cavity of the cigar lighter wire harness connector. If OK, replace the faulty cigar lighter receptacle (instrument panel accessory switch bezel unit). If not OK, refer to **Cigar Lighter Relay** in the Diagnosis and Testing section of this group for further diagnosis.

DIAGNOSIS AND TESTING (Continued)

CIGAR LIGHTER RELAY

The cigar lighter relay (Fig. 3) is located in the junction block, on the right cowl side inner panel below the instrument panel in the passenger compartment. For complete circuit diagrams, refer to **Horn/Cigar Lighter** in the Contents of Group 8W - Wiring Diagrams.

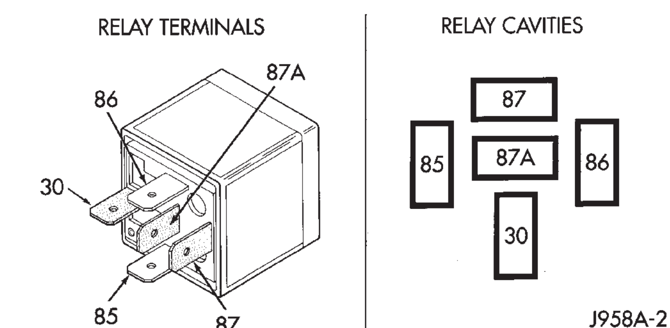
WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the cigar lighter relay from the junction block. Refer to **Cigar Lighter Relay** in the Removal and Installation section of this group for the procedures.

(2) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, perform the Relay Circuit Test that follows. If not OK, replace the faulty relay.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 3 Cigar Lighter Relay

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) of the junction block is connected to battery voltage and should be hot at all times. Check for battery voltage at the fused B(+) circuit cavity of the accessory relay wire harness connector. If OK, go to Step 2. If not OK, repair the fused B(+) circuit to the fuse in the junction block 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 when the relay is energized by the ignition switch. There should be continuity between the junction block cavity for relay terminal 87 and the cigar lighter relay output circuit cavity of the cigar lighter wire harness connector at all times. If OK, go to Step 4. If not OK, repair the open cigar lighter relay output circuit to the cigar lighter wire harness connector as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. It receives battery feed to energize the cigar lighter relay when the ignition switch is in the Accessory or On positions. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (acc/run) circuit cavity for relay terminal 86 in the junction block. If OK, go to Step 5. If not OK, repair the open fused ignition switch output (acc/run) circuit to the ignition switch as required.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. The junction block cavity for this terminal should have continuity to ground at all times. If not OK, repair the open ground circuit to ground as required.

INSTRUMENT PANEL POWER OUTLET

For complete circuit diagrams, refer to **Horn/Cigar Lighter** in the Contents of Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fused B(+) fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fused B(+) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open fused B(+) circuit to the Power Distribution Center (PDC) as required.

DIAGNOSIS AND TESTING (Continued)

(3) Remove the plastic protective cap from the power outlet receptacle. Check for continuity between the inside circumference of the power outlet receptacle and a good ground. There should be continuity. If OK, go to Step 4. If not OK, go to Step 5.

(4) Check for battery voltage at the insulated contact located at the back of the power outlet receptacle. If not OK, go to Step 5.

(5) Disconnect and isolate the battery negative cable. Remove the instrument panel accessory switch bezel. Check for continuity between the ground circuit cavity of the power outlet wire harness connector and a good ground. There should be continuity. If OK, go to Step 6. If not OK, repair the open ground circuit to ground as required.

(6) Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the power outlet wire harness connector. If OK, replace the faulty power outlet receptacle (instrument panel accessory switch bezel unit). If not OK, repair the open fused B(+) circuit to the junction block fuse as required.

REMOVAL AND INSTALLATION

STEERING COLUMN OPENING COVER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) If the vehicle is so equipped, move the tilt steering column to the fully raised position.

(3) Remove the three screws that secure the lower edge of the steering column opening cover to the lower instrument panel reinforcement (Fig. 4).

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the upper edge of the steering column opening cover just below the cluster bezel on each side of the steering column away from the instrument panel far enough to disengage the two snap clip retainers from the receptacles in the instrument panel.

(5) Remove the steering column opening cover from the instrument panel.

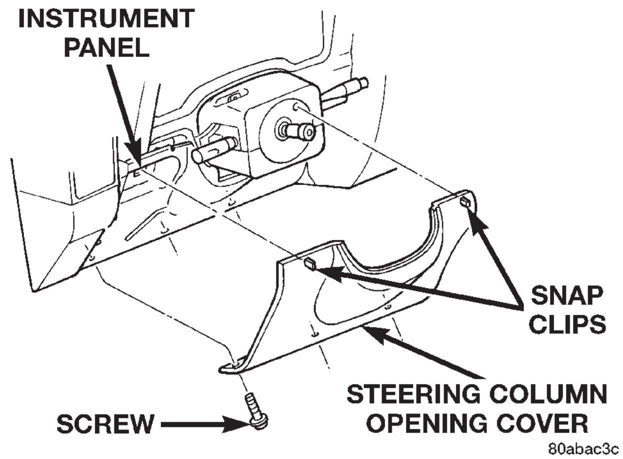


Fig. 4 Steering Column Opening Cover Remove/Install

INSTALLATION

(1) Position the steering column opening cover to the instrument panel.

(2) Align the snap clip retainers on the steering column opening cover with the receptacles in the instrument panel.

(3) Press firmly on the steering column opening cover over the snap clip locations until each of the snap clips is fully engaged in its receptacle.

(4) Install and tighten the three screws that secure the lower edge of the steering column opening cover to the lower instrument panel reinforcement. Tighten the screws to 2.2 N·m (20 in. lbs.).

(5) Reconnect the battery negative cable.

KNEE BLOCKER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

INSTALLATION

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover from the instrument panel. Refer to **Steering Column Opening Cover** in the Removal and Installation section of this group for the procedures.

(3) Remove the two screws that secure the knee blocker to the instrument panel (Fig. 5).

REMOVAL AND INSTALLATION (Continued)

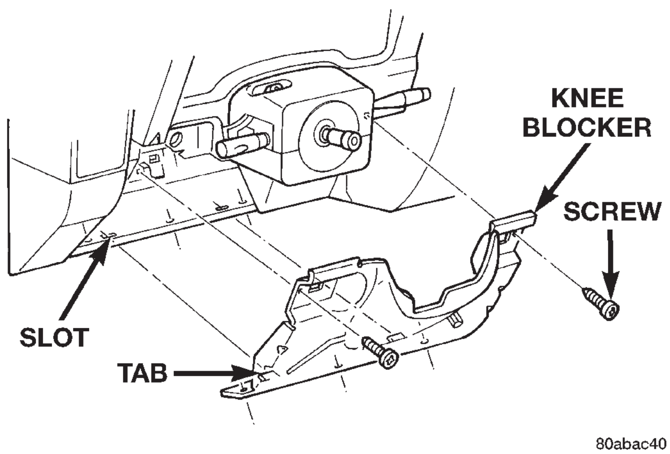


Fig. 5 Knee Blocker Remove/Install

(4) Pull the upper edge of the knee blocker away from the instrument panel far enough to disengage the two lower mounting tabs from the mounting slots in the lower instrument panel reinforcement.

(5) Remove the knee blocker from the instrument panel.

INSTALLATION

(1) Position the knee blocker to the instrument panel.

(2) Install and tighten the four screws that secure the knee blocker to the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.). Be certain that the mounting screws are located in the screw hole on each side of the steering column that is closest to the driver side front door of the vehicle (Fig. 6).

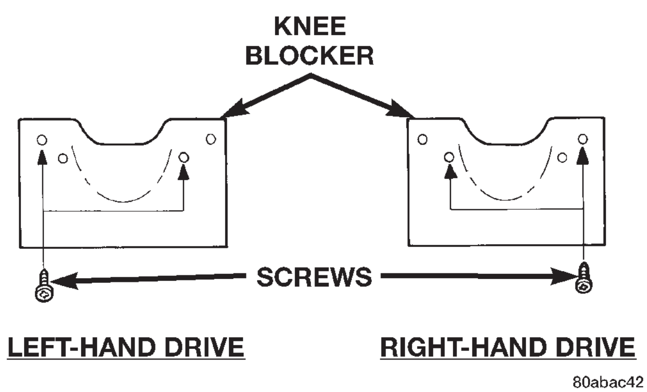


Fig. 6 Knee Blocker Mounting Screw Location

(3) Install the steering column opening cover onto the instrument panel. Refer to **Steering Column Opening Cover** in the Removal and Installation section of this group for the procedures.

(4) Reconnect the battery negative cable.

INSTRUMENT PANEL CENTER BEZEL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry the instrument panel center bezel away from the instrument panel far enough to disengage the six snap clip retainers that secure it from the receptacles in the instrument panel (Fig. 7).

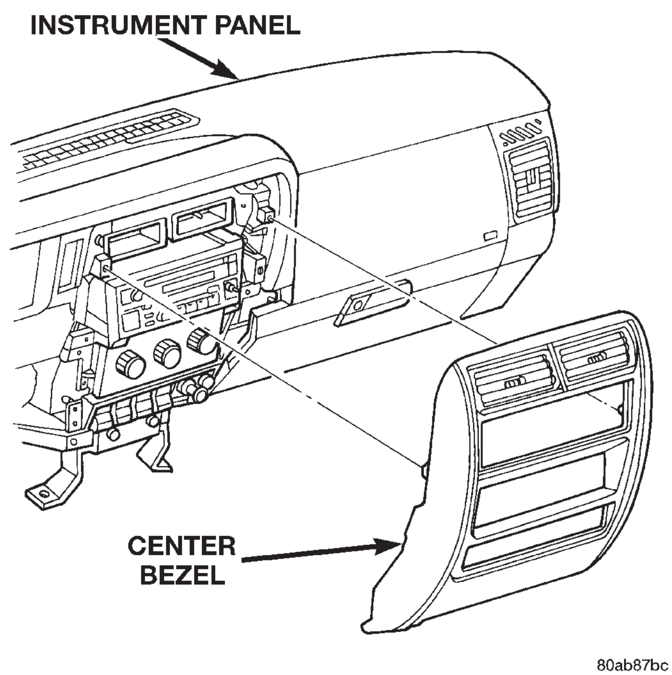


Fig. 7 Instrument Panel Center Bezel Remove/Install

(3) Remove the center bezel from the instrument panel.

INSTALLATION

(1) Position the center bezel to the instrument panel.

(2) Align the snap clips on the center bezel with the receptacles in the instrument panel.

(3) Press firmly on the center bezel over each of the snap clip locations until each of the six snap clips is fully engaged in its receptacle on the instrument panel.

(4) Reconnect the battery negative cable.

REMOVAL AND INSTALLATION (Continued)

INSTRUMENT PANEL ACCESSORY SWITCH BEZEL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the center bezel from the instrument panel. Refer to **Instrument Panel Center Bezel** in the Removal and Installation section of this group for the procedures.

(3) Remove the three screws that secure the accessory switch bezel to the instrument panel (Fig. 8).

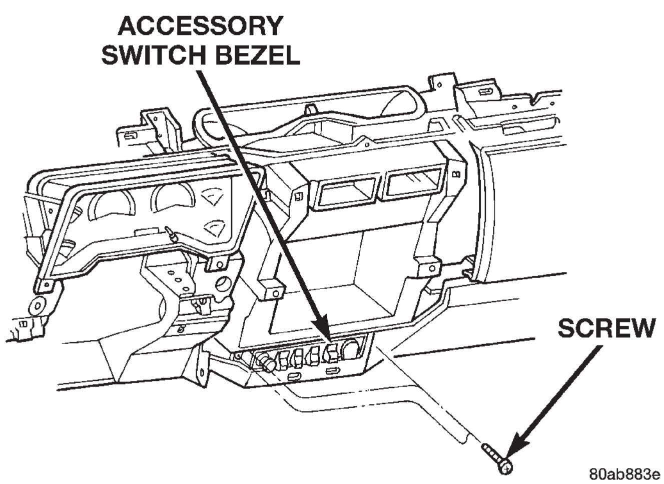


Fig. 8 Instrument Panel Accessory Switch Bezel Remove/Install

(4) Pull the accessory switch bezel away from the instrument panel far enough to access the instrument panel wire harness connectors.

(5) Disconnect the instrument panel wire harness connectors from the connector receptacles, the accessory switches, the cigar lighter and the accessory power outlet on the back of the accessory switch bezel.

(6) Remove the accessory switch bezel from the instrument panel.

INSTALLATION

(1) Position the accessory switch bezel to the instrument panel.

(2) Reconnect the instrument panel wire harness connectors to the connector receptacles, the accessory switches, the cigar lighter and the accessory power outlet on the back of the accessory switch bezel.

(3) Position the accessory switch bezel onto the instrument panel.

(4) Install and tighten the three screws that secure the accessory switch bezel to the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(5) Install the center bezel onto the instrument panel. Refer to **Instrument Panel Center Bezel** in the Removal and Installation section of this group for the procedures.

(6) Reconnect the battery negative cable.

CIGAR LIGHTER RELAY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the fuse access panel by unsnapping it from the right cowl side trim panel.

(3) Remove the stamped nut that secures the right cowl side trim to the junction block stud (Fig. 9).

(4) Remove the screw located above the fuse access opening that secures the right cowl side trim to the right cowl side inner panel.

(5) Remove the screw that secures the right door sill trim and the right cowl side trim to the right door opening sill.

(6) Remove the right cowl side trim panel from the vehicle.

(7) Refer to **Junction Block** in the Contents of Group 8W - Wiring Diagrams for cigar lighter relay identification and location.

(8) Remove the cigar lighter relay from the receptacle in the junction block.

INSTALLATION

(1) Refer to **Junction Block** in the Contents of Group 8W - Wiring Diagrams for the proper cigar lighter relay location.

(2) Position the cigar lighter relay to the receptacle in the junction block.

(3) Align the terminals of the cigar lighter relay with the cavities in the junction block receptacle.

(4) Push on the cigar lighter relay case firmly and evenly until all of the relay terminals are fully seated within the cavities of the junction block receptacle.

REMOVAL AND INSTALLATION (Continued)

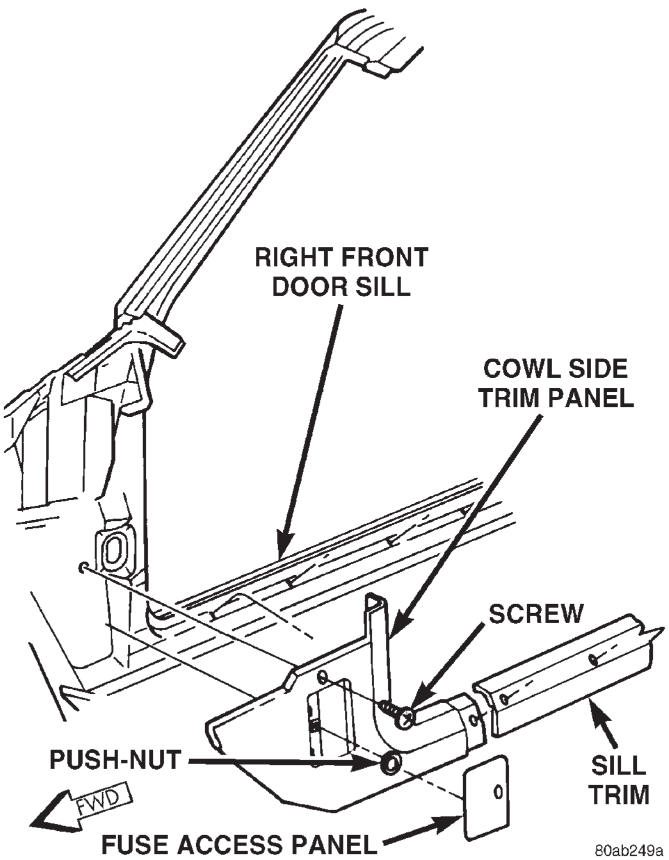


Fig. 9 Right Cowl Side Trim Remove/Install

(5) Position the right cowl side trim to the right door sill trim.

(6) Install and tighten the screw that secures the right cowl side trim to the right door sill trim. Tighten the screw to 2.2 N·m (20 in. lbs.).

(7) Position the right cowl side trim to the right cowl side inner panel.

(8) Install and tighten the screw that secures the right cowl side trim to the right cowl side inner panel. Tighten the screw to 2.2 N·m (20 in. lbs.).

(9) Install the stamped nut that secures the right cowl side trim to the junction block stud.

(10) Install the fuse access panel by snapping it onto the right cowl side trim panel.

(11) Reconnect the battery negative cable.

CLUSTER BEZEL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the knee blocker from the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of this group for the procedures.

(3) Remove the center bezel from the instrument panel. Refer to **Instrument Panel Center Bezel** in the Removal and Installation section of this group for the procedures.

(4) Remove the four screws exposed by the center bezel removal that secure the cluster bezel to the instrument panel.

(5) Remove the headlamp switch knob and shaft from the headlamp switch. Refer to **Headlamp Switch** in the Removal and Installation section of this group for the procedures.

(6) Disengage the two ends of the steering column sight shield from each other at the connector located below the lower steering column shroud (Fig. 10).

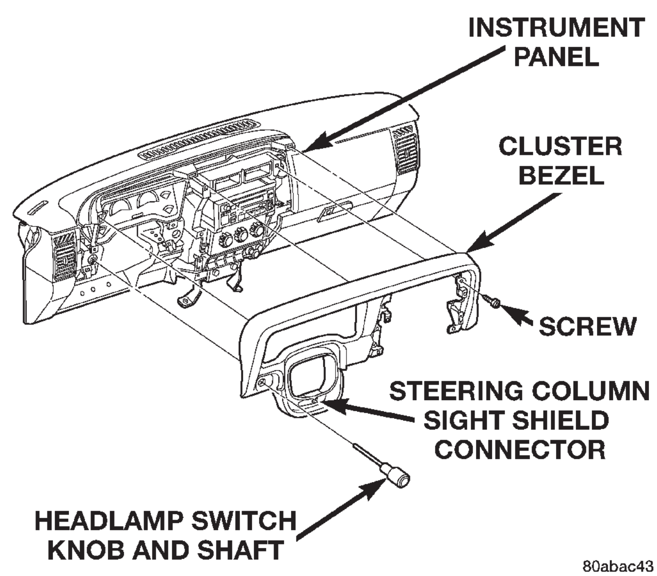


Fig. 10 Cluster Bezel Remove/Install

(7) If the vehicle is so equipped, set the tilt steering column in its lowest position.

(8) Using a trim stick or another suitable wide flat-bladed tool, gently pry around the perimeter of the cluster bezel to disengage the five snap clips from their receptacles in the instrument panel.

(9) Remove the cluster bezel from the instrument panel.

INSTALLATION

(1) Position the cluster bezel to the instrument panel.

(2) Align the snap clips on the cluster bezel with the receptacles in the instrument panel.

REMOVAL AND INSTALLATION (Continued)

(3) Press firmly on the cluster bezel over each of the snap clip locations until each of the snap clips is fully engaged in its receptacle.

(4) Engage the two ends of the steering column sight shield with each other at the connector located below the lower steering column shroud.

(5) Install the headlamp switch knob and shaft onto the headlamp switch. Refer to **Headlamp Switch** in the Removal and Installation section of this group for the procedures.

(6) Install and tighten the four screws that secure the cluster bezel to the instrument panel beneath the instrument panel center bezel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(7) Install the center bezel onto the instrument panel. Refer to **Instrument Panel Center Bezel** in the Removal and Installation section of this group for the procedures.

(8) Install the knee blocker onto the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of this group for the procedures. Be certain that the two ends of the steering column sight shield connector are engaged with each other before installing the knee blocker.

(9) Reconnect the battery negative cable.

HEADLAMP SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: IF THE HEADLAMP SWITCH WAS ON, WAIT FIVE MINUTES TO ALLOW THE CERAMIC DIMMER RESISTOR TO COOL. IF THE CERAMIC DIMMER RESISTOR IS NOT ALLOWED TO COOL, IT CAN BURN YOUR FINGERS.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the knee blocker from the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of this group for the procedures.

(3) Pull the headlamp switch control knob out to the On position stop.

(4) Reach up under the instrument panel through the outboard side of the steering column opening to access and depress the headlamp switch control knob and shaft release button on the inboard side of the switch body.

(5) While holding the release button depressed, pull the headlamp switch control knob and shaft out of the headlamp switch.

(6) Remove the spanner nut that secures the headlamp switch to the instrument panel (Fig. 11).

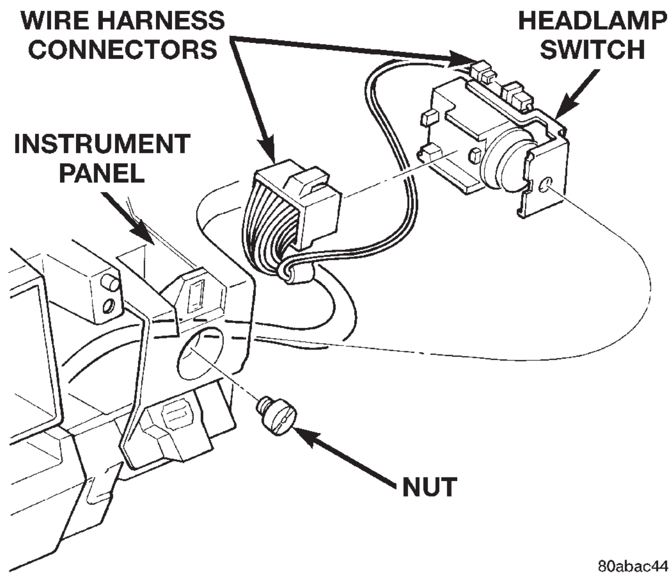


Fig. 11 Headlamp Switch Remove/Install

(7) Pull the headlamp switch into the steering column opening area of the instrument panel far enough to access the instrument panel wire harness connectors.

(8) Disconnect the two instrument panel wire harness connectors from the headlamp switch.

(9) Remove the headlamp switch from the instrument panel.

INSTALLATION

(1) Position the headlamp switch to the instrument panel steering column opening.

(2) Reconnect the two instrument panel wire harness connectors to the headlamp switch.

(3) Position the headlamp switch behind its mounting hole on the instrument panel.

(4) Install and tighten the spanner nut that secures the headlamp switch to the instrument panel. Tighten the nut to 2.7 N·m (24 in. lbs.).

(5) Insert the shaft of the headlamp switch control knob and shaft unit through the opening in the spanner nut and into the headlamp switch.

(6) Push the headlamp switch control knob and shaft unit all the way into the headlamp switch body.

(7) Install the knee blocker onto the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of this group for the procedures.

(8) Reconnect the battery negative cable.

REMOVAL AND INSTALLATION (Continued)

INSTRUMENT CLUSTER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cluster bezel from the instrument panel. Refer to **Cluster Bezel** in the Removal and Installation section of this group for the procedures.

(3) Remove the four screws that secure the instrument cluster to the instrument panel (Fig. 12).

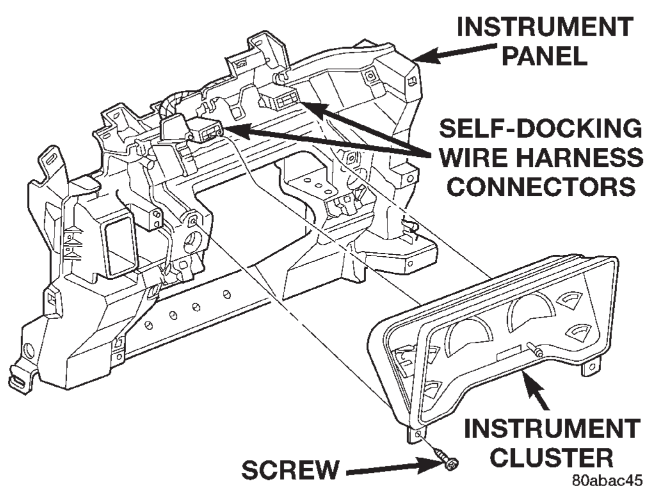


Fig. 12 Instrument Cluster Remove/Install

(4) Pull the instrument cluster rearward far enough to disengage the two self-docking instrument panel wire harness connectors from the connector receptacles on the back of the cluster housing. **Do not pull on the instrument cluster by the lens or mask sections, or the cluster components may become separated.**

(5) Remove the instrument cluster from the instrument panel.

INSTALLATION

(1) Position the instrument cluster to the instrument panel.

(2) Align the instrument cluster with the cluster opening in the instrument panel and push the cluster firmly and evenly into place. The instrument panel has two self-docking wire harness connectors that will be automatically aligned with, and connected to the cluster connector receptacles when the cluster is installed in the instrument panel.

(3) Install and tighten the four screws that secure the instrument cluster to the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(4) Install the cluster bezel onto the instrument panel. Refer to **Cluster Bezel** in the Removal and Installation section of this group for the procedures.

(5) Reconnect the battery negative cable.

INSTRUMENT CLUSTER COMPONENTS

Some of the components for the instrument cluster used in this vehicle are serviced individually. The serviced components include: the incandescent instrument cluster indicator lamp and illumination lamp bulbs (including the integral bulb holders), the odometer reset knob boot, the cluster lens, the cluster hood and mask unit, the instrument cluster housing rear cover, and the instrument cluster housing (including the odometer reset knob, the gauge mask, the gauges and the instrument cluster electronic circuit board). Following are the service procedures for the instrument cluster components.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp or indicator lamp bulb and bulb holder units. However, the illumination lamps and the indicator lamps use different bulb and bulb holder unit sizes. They must never be interchanged. Be certain that any bulb and bulb holder unit removed from the cluster electronic circuit board is reinstalled in the correct position. Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the instrument cluster, the electronic circuit board and/or the gauges.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

REMOVAL AND INSTALLATION (Continued)

(3) Turn the bulb holder counterclockwise about sixty degrees on the cluster electronic circuit board.

(4) Pull the bulb and bulb holder unit straight back to remove it from the bulb mounting hole in the cluster electronic circuit board (Fig. 13).

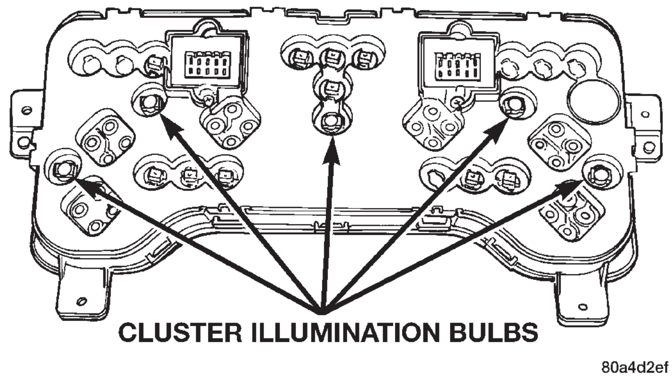


Fig. 13 Cluster Bulb Locations

CLUSTER LENS

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(3) Work around the perimeter of the cluster housing to disengage each of the latches that secure the cluster lens to the cluster housing (Fig. 14).

(4) Gently pull the cluster lens away from the cluster housing.

ODOMETER RESET KNOB BOOT

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(3) Remove the cluster lens from the cluster housing. Refer to **Instrument Cluster Components - Cluster Lens** in the Removal and Installation section of this group for the procedures.

(4) Remove the odometer reset knob boot by pulling it out of the cluster lens.

CLUSTER HOOD AND MASK

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(3) Remove the cluster lens from the cluster housing. Refer to **Instrument Cluster Components - Cluster Lens** in the Removal and Installation section of this group for the procedures.

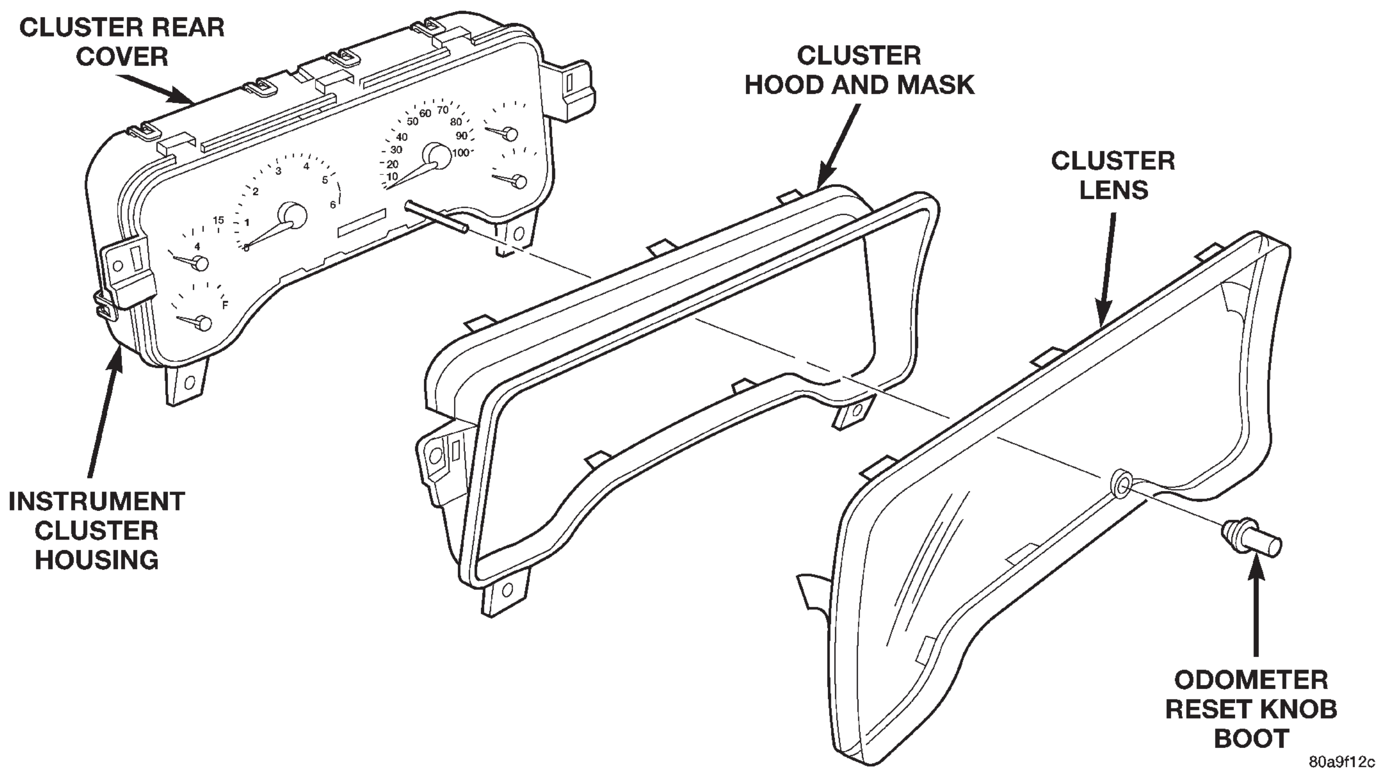


Fig. 14 Instrument Cluster Components

REMOVAL AND INSTALLATION (Continued)

(4) Work around the perimeter of the cluster housing to disengage each of the latches that secure the cluster hood and mask unit to the cluster housing (Fig. 14).

(5) Gently pull the cluster hood and mask unit away from the cluster housing.

CLUSTER HOUSING REAR COVER

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(3) Work around the perimeter of the cluster housing to disengage each of the latches that secure the rear cover to the cluster housing (Fig. 14).

(4) Gently pull the rear cover away from the back of the cluster housing.

CLUSTER HOUSING

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(3) Remove all of the cluster illumination lamp and indicator lamp bulb and bulb holder units from the electronic circuit board. Refer to **Instrument Cluster Components - Cluster Bulbs** in the Removal and Installation section of this group for the procedures.

(4) Remove the cluster hood and mask unit from the cluster housing. Refer to **Instrument Cluster Components - Cluster Hood and Mask** in the Removal and Installation section of this group for the procedures.

(5) Remove the rear cover from the cluster housing. Refer to **Instrument Cluster Components - Cluster Housing Rear Cover** in the Removal and Installation section of this group for the procedures.

INSTALLATION

CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp or indicator lamp bulb and bulb holder units. However, the illumination lamps and the indicator lamps use different bulb and bulb holder unit sizes. They must never be interchanged. Be certain that any bulb and bulb holder unit removed from the cluster electronic circuit board is reinstalled in the correct position.

CAUTION: Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the instrument cluster, the electronic circuit board and/or the gauges.

(1) Insert the bulb and bulb holder unit straight into the correct bulb mounting hole in the cluster electronic circuit board.

(2) With the bulb holder fully seated against the cluster electronic circuit board, turn the bulb holder clockwise about sixty degrees to lock it into place.

(3) Install the instrument cluster onto the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(4) Reconnect the battery negative cable.

CLUSTER LENS

(1) Align the cluster lens with the cluster hood and mask unit.

(2) Press firmly and evenly on the cluster lens to install it onto the cluster housing.

(3) Work around the perimeter of the cluster housing to be certain that each of the latches that secure the cluster lens to the cluster housing is fully engaged.

(4) Install the instrument cluster onto the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(5) Reconnect the battery negative cable.

ODOMETER RESET KNOB BOOT

(1) Position the odometer reset knob to the mounting hole from the back of the cluster lens.

(2) Pull the odometer reset knob into the mounting hole from the face of the cluster lens.

(3) Install the cluster lens onto the cluster housing. Refer to **Instrument Cluster Components - Cluster Lens** in the Removal and Installation section of this group for the procedures.

(4) Install the instrument cluster onto the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(5) Reconnect the battery negative cable.

CLUSTER HOOD AND MASK

(1) Align the hood and mask unit with the cluster housing.

(2) Press firmly and evenly on the hood and mask unit to install it onto the cluster housing.

(3) Work around the perimeter of the cluster housing to be certain that each of the latches that secure the hood and mask unit to the cluster housing is fully engaged.

REMOVAL AND INSTALLATION (Continued)

(4) Install the cluster lens onto the cluster housing. Refer to **Instrument Cluster Components - Cluster Lens** in the Removal and Installation section of this group for the procedures.

(5) Install the instrument cluster onto the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(6) Reconnect the battery negative cable.

CLUSTER HOUSING REAR COVER

(1) Position the rear cover to the back of the cluster housing.

(2) Press firmly and evenly on the rear cover until each of the latches that secure the rear cover to the cluster housing is fully engaged.

(3) Install the instrument cluster onto the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(4) Reconnect the battery negative cable.

CLUSTER HOUSING

(1) Install the rear cover onto the cluster housing. Refer to **Instrument Cluster Components - Cluster Housing Rear Cover** in the Removal and Installation section of this group for the procedures.

(2) Install the cluster hood and mask unit onto the cluster housing. Refer to **Instrument Cluster Components - Cluster Hood and Mask** in the Removal and Installation section of this group for the procedures.

(3) Install all of the cluster illumination lamp and indicator lamp bulb and bulb holder units into the electronic circuit board. Refer to **Instrument Cluster Components - Cluster Bulbs** in the Removal and Installation section of this group for the procedures.

(4) Install the instrument cluster onto the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(5) Reconnect the battery negative cable.

INSTRUMENT PANEL TOP COVER

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REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cluster bezel from the instrument panel. Refer to **Cluster Bezel** in the Removal and Installation section of this group for the procedures.

(3) Using a trim stick or another suitable wide flat-bladed tool, gently pry the rear edge (farthest from the windshield) of the instrument panel top cover up and away from the instrument panel far enough to disengage the seven snap clip retainers from their receptacles in the instrument panel (Fig. 15).

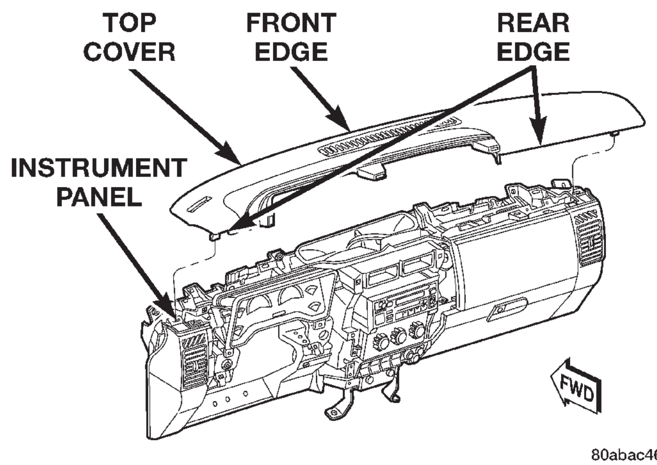

Fig. 15 Instrument Panel Top Cover Remove/Install

(4) Pull the top cover sharply rearwards (away from the windshield) to disengage the four snap clip retainers that secure the forward edge of the top cover from their receptacles in the instrument panel near the base of the windshield.

(5) Remove the top cover from the instrument panel.

INSTALLATION

(1) Position the top cover onto the instrument panel.

(2) Align the four snap clips on the forward edge (nearest the windshield) of the top cover with the snap clip receptacles in the instrument panel.

(3) Press firmly downward on the top cover over each of the four forward snap clip locations until each of the snap clips is fully seated in their receptacles in the instrument panel.

(4) Align the seven snap clips on the rear edge (farthest from the windshield) of the top cover with the snap clip receptacles in the instrument panel.

(5) Press firmly downward on the top cover over each of the seven rearward snap clip locations until each of the snap clips is fully seated in their receptacles in the instrument panel.

REMOVAL AND INSTALLATION (Continued)

(6) Install the cluster bezel onto the instrument panel. Refer to **Cluster Bezel** in the Removal and Installation section of this group for the procedures.

(7) Reconnect the battery negative cable.

GLOVE BOX

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

ROLL DOWN

(1) Disconnect and isolate the battery negative cable.

(2) Open the glove box.

(3) Locate the two rubber stop bumpers on the upper edge of the instrument panel glove box opening (Fig. 16).

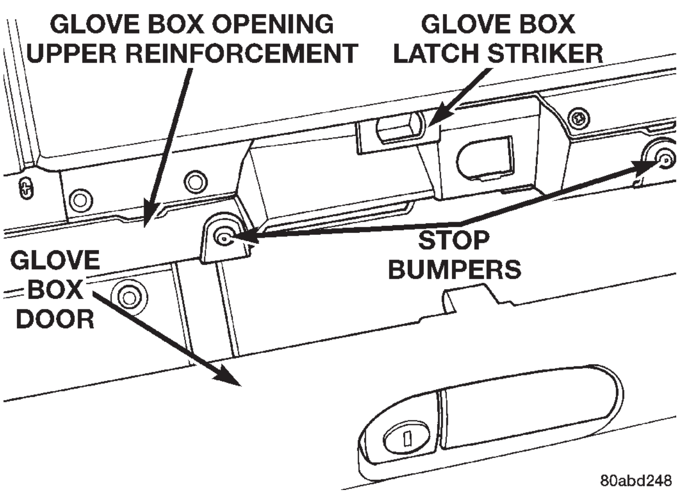

Fig. 16 Glove Box Stop Bumpers Remove/Install

(4) Remove the two glove box stop bumpers by sliding them downward and out of the slots in the instrument panel upper glove box opening reinforcement.

(5) Roll the glove box downward so that the stops molded into the glove box bin pass through the stop bumper slots in the instrument panel upper glove box opening reinforcement.

(6) Reverse the roll down procedure to roll the glove box back up into the instrument panel.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the three screws that secure the glove box hinge to the instrument panel lower glove box opening reinforcement (Fig. 17).

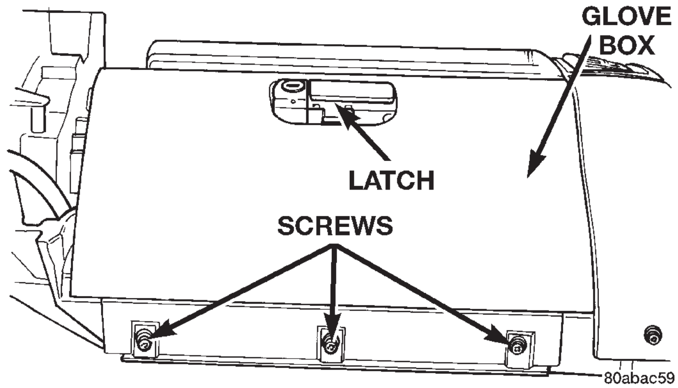

Fig. 17 Glove Box Remove/Install

(3) Release the glove box latch.

(4) Remove the glove box from the instrument panel.

INSTALLATION

(1) Position the glove box to the instrument panel with the bin inserted in the glove box opening far enough so that the stops on each side of the glove box bin are located behind the rubber stop bumpers located on the instrument panel upper glove box opening reinforcement.

(2) Align the screw holes in the glove box hinge with the mounting holes in the instrument panel lower glove box opening reinforcement.

(3) Install and tighten the three screws that secure the glove box hinge to the instrument panel lower glove box opening reinforcement. Tighten the screws to 2.2 N·m (20 in. lbs.).

(4) Reconnect the battery negative cable.

GLOVE BOX COMPONENTS

The glove box hinge, bin, inner door and latch are serviced only as a complete unit. The glove box outer door and lock cylinder are serviced separately.

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REMOVAL AND INSTALLATION (Continued)

REMOVAL

GLOVE BOX HINGE, BIN, INNER DOOR AND LATCH

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. Refer to **Glove Box - Removal** in the Removal and Installation section of this group for the procedures.

(3) Remove the seven screws that secure the inner glove box door to the outer glove box door (Fig. 18).

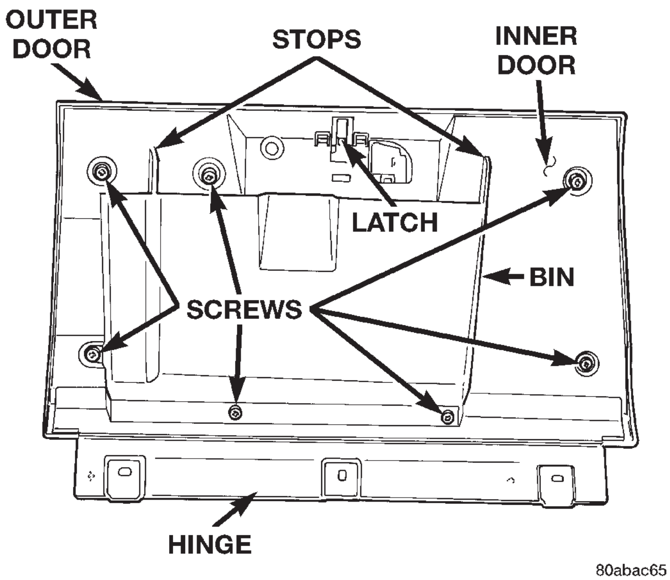

Fig. 18 Glove Box Components Remove/Install

(4) Remove the inner glove box door unit from the outer glove box door.

GLOVE BOX OUTER DOOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. Refer to **Glove Box - Removal** in the Removal and Installation section of this group for the procedures.

(3) Remove the seven screws that secure the inner glove box door to the outer glove box door (Fig. 18).

(4) Remove the outer glove box door from the inner glove box door unit.

GLOVE BOX LOCK CYLINDER

(1) Insert the key into the glove box lock cylinder and turn the lock cylinder to the unlocked position.

(2) Open the glove box.

(3) With the key still in the lock cylinder, insert a small pin punch or a stiff wire into the lock cylinder release hole (Fig. 19) and depress the lock cylinder retaining tumbler.

(4) While holding the retaining tumbler depressed, rotate the key in the lock cylinder clockwise and

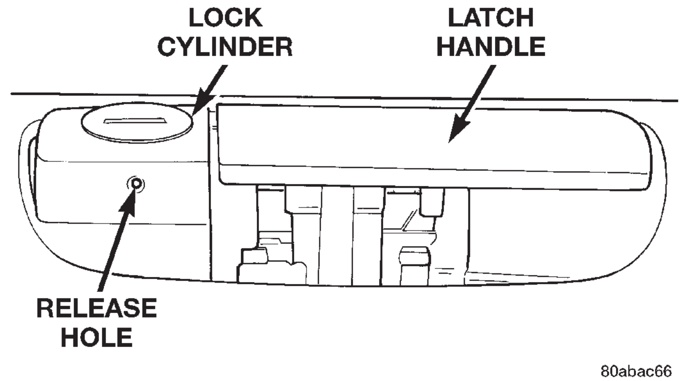

Fig. 19 Glove Box Lock Cylinder Remove/Install

press outward on the back of the lock cylinder from the inside of the glove box door until the lock cylinder comes out of the glove box latch lock cylinder bore.

INSTALLATION

GLOVE BOX HINGE, BIN, INNER DOOR AND LATCH

(1) Position the inner glove box door unit onto the outer glove box door.

(2) Install and tighten the seven screws that secure the inner glove box door to the outer glove box door. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the glove box onto the instrument panel. Refer to **Glove Box - Installation** in the Removal and Installation section of this group for the procedures.

(4) Reconnect the battery negative cable.

GLOVE BOX OUTER DOOR

(1) Position the outer glove box door onto the inner glove box door unit.

(2) Install and tighten the seven screws that secure the inner glove box door to the outer glove box door. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the glove box onto the instrument panel. Refer to **Glove Box - Installation** in the Removal and Installation section of this group for the procedures.

(4) Reconnect the battery negative cable.

GLOVE BOX LOCK CYLINDER

(1) To install the lock cylinder, insert the key into the cylinder and align the lock cylinder tumblers with the ramp in the glove box latch lock cylinder bore. The ramp is located at about the 7 o'clock position.

(2) Push the glove box lock cylinder firmly into the lock cylinder bore while rotating the key and cylinder counterclockwise to the 6 o'clock position, where the lock cylinder retaining tumbler will snap back into place.

GLOVE BOX LATCH STRIKER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Open the glove box.

(3) Remove the passenger side airbag module from the instrument panel. Refer to **Passenger Side Airbag Module** in the Removal and Installation section of Group 8M - Passive Restraint Systems for the procedures.

(4) Remove the two screws that secure the latch striker to the instrument panel glove box opening upper reinforcement (Fig. 20).

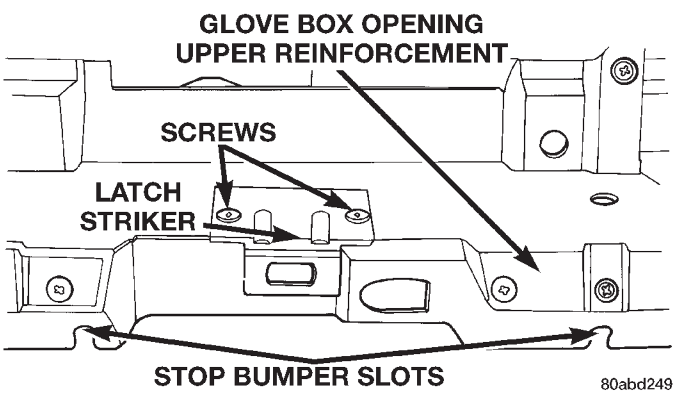

Fig. 20 Glove Box Latch Striker Remove/Install

(5) Remove the latch striker from the instrument panel glove box opening upper reinforcement.

INSTALLATION

(1) Position the latch striker onto the instrument panel glove box opening upper reinforcement.

(2) Install and tighten the two screws that secure the latch striker to the instrument panel glove box opening upper reinforcement. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the passenger side airbag module onto the instrument panel. Refer to **Passenger Side Airbag Module** in the Removal and Installation section of Group 8M - Passive Restraint Systems for the procedures.

(4) Close the glove box.

(5) Reconnect the battery negative cable.

INSTRUMENT PANEL END CAP

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

DRIVER SIDE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the knee blocker from the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of this group for the procedures.

(3) Remove the top cover from the instrument panel. Refer to **Instrument Panel Top Cover** in the Removal and Installation section of this group for the procedures.

(4) Remove the five screws that secure the end cap to the instrument panel (Fig. 21).

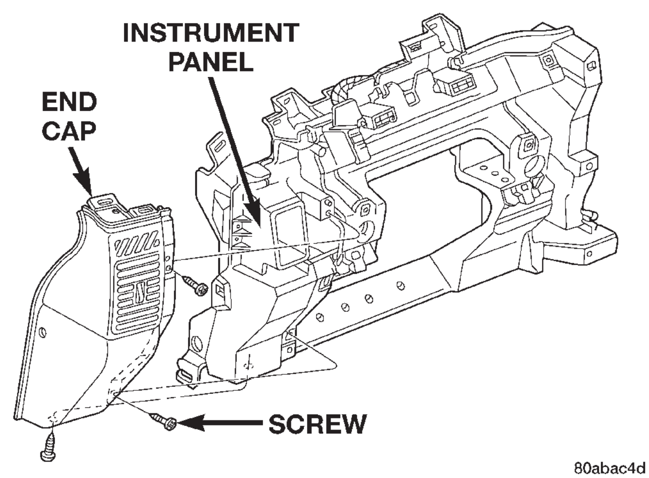

Fig. 21 Instrument Panel End Cap Remove/Install

(5) Remove the end cap from the instrument panel.

PASSENGER SIDE

(1) Disconnect and isolate the battery negative cable.

(2) Roll down the glove box from the instrument panel. Refer to **Glove Box - Roll Down** in the Removal and Installation section of this group for the procedures.

(3) Remove the top cover from the instrument panel. Refer to **Instrument Panel Top Cover** in the

REMOVAL AND INSTALLATION (Continued)

Removal and Installation section of this group for the procedures.

(4) Remove the passenger side airbag module from the instrument panel. Refer to **Passenger Side Airbag Module** in the Removal and Installation section of Group 8M - Passive Restraint Systems for the procedures.

(5) Remove the six screws that secure the end cap to the instrument panel (Fig. 21).

(6) Remove the end cap from the instrument panel.

INSTALLATION

DRIVER SIDE

(1) Position the end cap to the instrument panel.

(2) Install and tighten the five screws that secure the end cap to the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the top cover onto the instrument panel. Refer to **Instrument Panel Top Cover** in the Removal and Installation section of this group for the procedures.

(4) Install the knee blocker onto the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of this group for the procedures.

(5) Reconnect the battery negative cable.

PASSENGER SIDE

(1) Position the end cap to the instrument panel.

(2) Install and tighten the six screws that secure the end cap to the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the passenger side airbag module onto the instrument panel. Refer to **Passenger Side Airbag Module** in the Removal and Installation section of Group 8M - Passive Restraint Systems for the procedures.

(4) Install the top cover onto the instrument panel. Refer to **Instrument Panel Top Cover** in the Removal and Installation section of this group for the procedures.

(5) Roll up the glove box into the instrument panel. Refer to **Glove Box - Roll Down** in the Removal and Installation section of this group for the procedures.

(6) Reconnect the battery negative cable.

INSTRUMENT PANEL CENTER SUPPORT BRACKET

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the center bezel from the instrument panel. Refer to **Instrument Panel Center Bezel** in the Removal and Installation section of this group for the procedures.

(3) Remove the floor console from the floor panel transmission tunnel. Refer to **Floor Console** in the Removal and Installation section of Group 23 - Body for the procedures.

(4) Pull the floor carpet back from the front of the floor panel transmission tunnel far enough to access the instrument panel center support bracket mounting nuts.

(5) Remove the two nuts that secure the center support bracket to the studs on the instrument panel (Fig. 22).

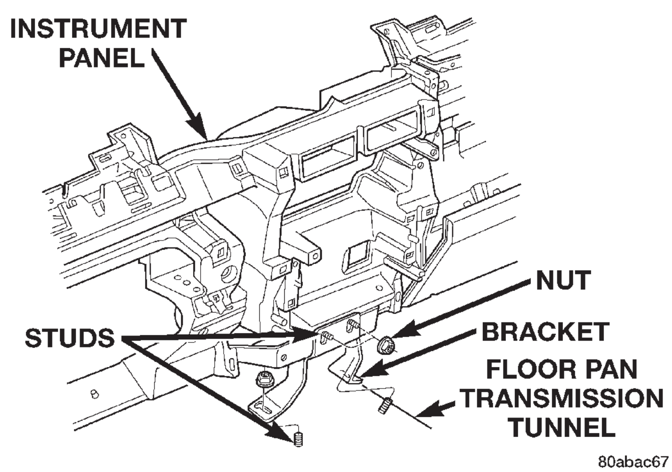

Fig. 22 Instrument Panel Center Support Bracket Remove/Install

(6) Remove the two nuts that secure the instrument panel center support bracket to the studs on the floor panel transmission tunnel.

(7) Remove the center support bracket from the instrument panel.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position the center support bracket to the instrument panel.

(2) Install and tighten the two nuts that secure the instrument panel center support bracket to the studs on the floor panel transmission tunnel. Tighten the nuts to 28 N·m (250 in. lbs.).

(3) Install and tighten the two nuts that secure the center support bracket to the studs on the instrument panel. Tighten the nuts to 28 N·m (250 in. lbs.).

(4) Position the floor carpet back onto the front of the floor panel transmission tunnel.

(5) Install the floor console onto the floor panel transmission tunnel. Refer to **Floor Console** in the Removal and Installation section of Group 23 - Body for the procedures.

(6) Install the center bezel onto the instrument panel. Refer to **Instrument Panel Center Bezel** in the Removal and Installation section of this group for the procedures.

(7) Reconnect the battery negative cable.

INSTRUMENT PANEL ASSEMBLY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

NOTE: Before starting this procedure, be certain to turn the steering wheel until the front wheels are in the straight-ahead position.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the trim from the left and right cowl side inner panels. Refer to **Lower A-Pillar Cowl Trim** in the Removal and Installation section of Group 23 - Body for the procedures.

(3) Remove the knee blocker from the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of this group for the procedures.

(4) Remove the top cover from the instrument panel. Refer to **Instrument Panel Top Cover** in the Removal and Installation section of this group for the procedures.

(5) Remove the center support bracket from the instrument panel. Refer to **Instrument Panel Center Support Bracket** in the Removal and Installation section of this group for the procedures.

(6) Remove the steering column from the vehicle. Refer to **Steering Column** in the Removal and Installation section of Group 19 - Steering for the procedures.

(7) Remove the screws from the centers of the instrument panel-to-body and the instrument panel-to-headlamp and dash wire harness connectors near the left cowl side inner panel and disconnect both connectors.

(8) Remove the screw from the center of the instrument panel-to-floor wire harness connector near the floor panel transmission tunnel under the instrument panel and disconnect the connector.

(9) Disconnect the two wire harness connectors located near the instrument panel-to-floor wire harness connector at the floor panel transmission tunnel under the instrument panel.

(10) Roll down the glove box from the instrument panel. Refer to **Glove Box - Roll Down** in the Removal and Installation section of this group for the procedures.

(11) Reach through the inboard side of the instrument panel glove box opening to disconnect the two halves of the heater-A/C system vacuum harness connector.

(12) Reach under the right end of the instrument panel to access and disconnect the two halves of the radio antenna coaxial cable connector. On Left-Hand Drive models only, also disengage the retainer on the radio half of the coaxial cable from the heater-A/C housing kick cover.

(13) Remove the temperature control cable and blend-air door crank arm from the heater-A/C housing as a unit. Refer to **Temperature Control Cable** in the Removal and Installation section of Group 24 - Heating and Air Conditioning for the procedures.

(14) Loosen the right and left instrument panel cowl side roll down screws about 6 mm (0.25 inch) (Fig. 23).

(15) Remove the four screws and two nuts that secure the top of the instrument panel to the top of the dash panel near the base of the windshield.

(16) With the aid of an assistant, lift the top of the instrument panel assembly off of the two dash panel studs. Then pull the lower instrument panel rearward to clear the cowl side roll down screws.

(17) Remove the instrument panel assembly from the vehicle.

INSTALLATION

(1) With the aid of an assistant, position the instrument panel assembly onto the cowl side roll down screws and the dash panel studs in the vehicle.

REMOVAL AND INSTALLATION (Continued)

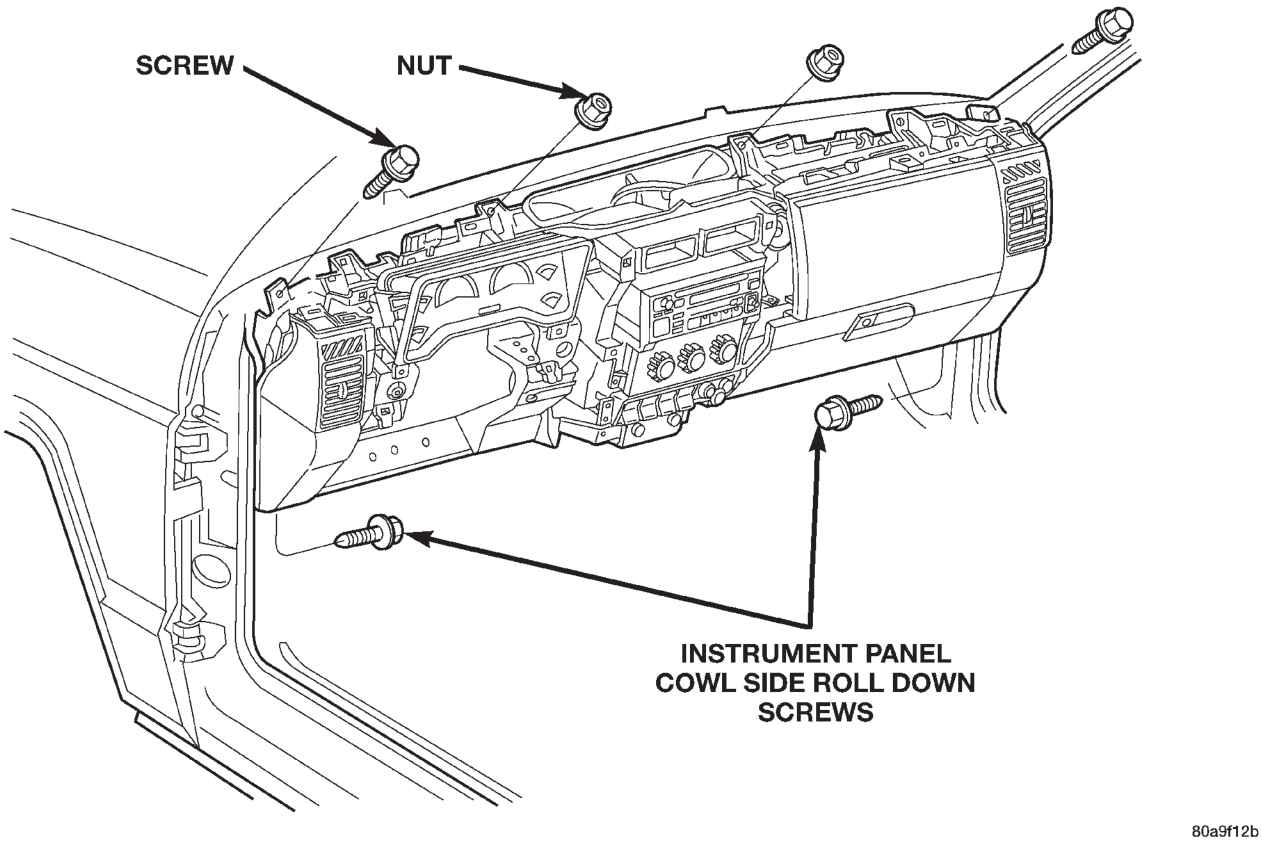

Fig. 23 Instrument Panel Assembly Remove/Install

(2) Install and tighten the four screws and two nuts that secure the top of the instrument panel to the top of the dash panel near the base of the windshield. Tighten the screws and nuts to 7 N·m (60 in. lbs.).

(3) Tighten the right and left instrument panel cowl side roll down screws. Tighten the screws to 28 N·m (250 in. lbs.).

(4) Install the temperature control cable and blend-air door crank arm onto the heater-A/C housing as a unit. Refer to **Temperature Control Cable** in the Removal and Installation section of Group 24 - Heating and Air Conditioning for the procedures.

(5) Reach under the right end of the instrument panel to access and reconnect the two halves of the radio antenna coaxial cable connector. On Left-Hand Drive models only, also engage the retainer on the radio half of the coaxial cable onto the heater-A/C housing kick cover.

(6) Reach through the inboard side of the instrument panel glove box opening to reconnect the two halves of the heater-A/C system vacuum harness connector.

(7) Roll up the glove box into the instrument panel. Refer to **Glove Box - Roll Down** in the Removal and Installation section of this group for the procedures.

(8) Reconnect the two wire harness connectors located near the instrument panel-to-floor wire harness connector at the floor panel transmission tunnel under the instrument panel.

(9) Reconnect the instrument panel-to-floor wire harness connector near the floor panel transmission tunnel under the instrument panel and tighten the connector screw. Tighten the screw to 4 N·m (35 in. lbs.).

(10) Reconnect the instrument panel-to-body and the instrument panel-to-headlamp and dash wire harness connectors near the left cowl side inner panel and tighten the connector screws. Tighten the screws to 4 N·m (35 in. lbs.).

(11) Install the steering column into the vehicle. Refer to **Steering Column** in the Removal and Installation section of Group 19 - Steering for the procedures.

(12) Install the center support bracket onto the instrument panel. Refer to **Instrument Panel Center Support Bracket** in the Removal and Installation section of this group for the procedures.

(13) Install the top cover onto the instrument panel. Refer to **Instrument Panel Top Cover** in the Removal and Installation section of this group for the procedures.

REMOVAL AND INSTALLATION (Continued)

(14) Install the knee blocker onto the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of this group for the procedures.

(15) Install the trim onto the left and right cowl side inner panels. Refer to **Lower A-Pillar Cowl Trim** in the Removal and Installation section of Group 23 - Body for the procedures.

(16) Reconnect the battery negative cable.

INSTRUMENT PANEL SYSTEMS

CONTENTS

REMOVAL AND INSTALLATION

HEADLAMP LEVELING SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry the instrument panel center bezel away from the instrument panel to release the six snap clip retainers (Fig. 1).

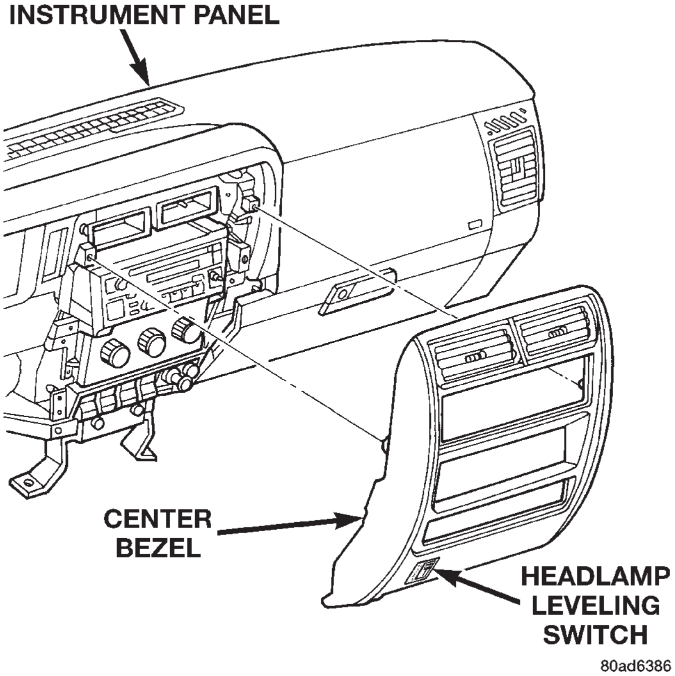

Fig. 1 Center Bezel Remove/Install

(3) Disconnect the wiring harness from the switch.
(4) Remove the center bezel from the vehicle.
(5) Depress switch mounting tabs to remove switch from bezel.

REAR FOG LAMP SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry the instrument panel center bezel away from the instrument panel to release the six snap clip retainers (Fig. 1).
(3) Remove the center bezel from the vehicle.
(4) Remove the three screws that secure the accessory switch bezel to the instrument panel
(5) Pull the accessory switch bezel out from the instrument panel far enough to unplug the wire harness connectors (Fig. 2).

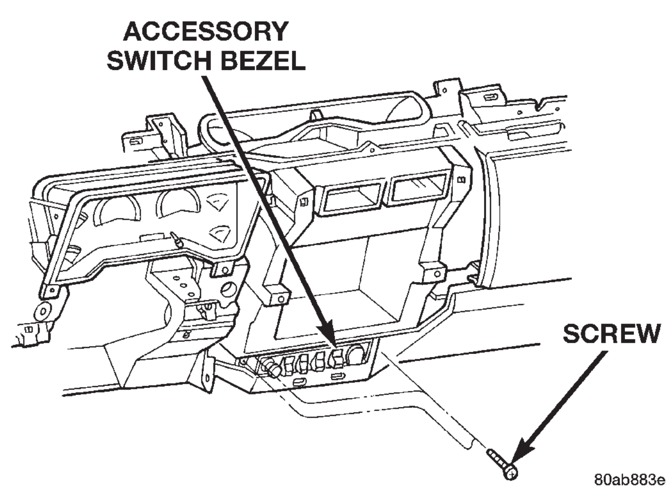

Fig. 2 Accessory Switch Bezel Remove/Install

REMOVAL AND INSTALLATION (Continued)

(6) Remove the accessory switch bezel from the instrument panel.

(7) Carefully pry the snap retainers at the top and bottom of the rear fog lamp switch receptacle on the back of the accessory switch bezel with a small thin-bladed screwdriver and pull the switch out of the receptacle.

(8) Reverse the removal procedures to install. Be certain that both of the switch snap retainers in the receptacle on the back of the accessory switch bezel are fully engaged. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

AUDIO SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

An audio system is standard factory-installed equipment on this model, unless the vehicle is ordered with an available radio delete option. Refer to 8W-47 Audio System in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

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.

AUDIO SYSTEM

Several combinations of radio receivers and speaker systems are offered on this model. The standard equipment audio system includes an AM/FM (RAL sales code) receiver, and speakers in two locations.

Following are general descriptions of the major components in the standard and optional factory-installed audio systems. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of each of the available audio systems.

DESCRIPTION AND OPERATION

RADIO

Available factory-installed radio receivers for this model include an AM/FM (RAL sales code), an AM/FM/cassette (RAS sales code), and an AM/FM/CD/cassette/3-band graphic equalizer (RAZ sales code). All factory-installed radio receivers are stereo Electronically Tuned Radios (ETR), and include an electronic digital clock function.

The radio can only be serviced by an authorized radio repair station. Refer to the latest Warranty Policies and Procedures manual for a current listing of authorized radio repair stations.

For more information on radio features, setting procedures, and control functions refer to the owner's manual in the vehicle glove box.

IGNITION-OFF DRAW FUSE

All vehicles are equipped with an Ignition-Off Draw (IOD) fuse that is removed when the vehicle is shipped from the factory. This fuse feeds various accessories that require battery current when the ignition switch is in the Off position, including the clock 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

DESCRIPTION AND OPERATION (Continued)

ignition switch in the Off position, will correct the scrambled display condition.

The IOD fuse should be checked if the radio is inoperative. The IOD fuse is located in the Power Distribution Center (PDC). Refer to the PDC label for IOD fuse identification and location.

SPEAKER

The standard equipment speaker system includes two 13.3 centimeter (5.25 inch) diameter full-range speakers. Each speaker is mounted to the lower front corner of the front door inner panel behind the door trim panel.

The four speaker option adds two 13.3 centimeter (5.25 inch) diameter full-range speakers to the standard speaker system, for a total of four speakers. Each of the additional speakers is mounted behind a grille installed on the outboard ends of a speaker support structure, which is integral to the headliner and located just forward of the upper liftgate opening reinforcement near the rear of the vehicle cargo area.

The premium speaker option upgrades all of the speakers to Infinity models, and includes a 100 watt Infinity amplifier. Each front door has two separate Infinity speakers: a woofer mounted low in the door, and a tweeter mounted behind the door flag trim panel. Infinity coaxial speakers are mounted in the headliner speaker support structure. The Infinity amplifier is mounted to the floor panel under the left rear seat cushion.

ANTENNA

All models use a fixed-length stainless steel rod-type antenna mast, installed at the right front fender 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 coaxial antenna cable shield (the outer wire mesh of the cable) is grounded to the antenna base and the radio chassis.

The antenna coaxial cable has an additional disconnect, located near the right cowl side inner panel behind the instrument panel. This additional disconnect allows the instrument panel assembly to be removed and installed without removing the radio.

The factory-installed Electronically Tuned Radios (ETRs) automatically compensate for radio antenna trim. Therefore, no antenna trimmer adjustment is required or possible when replacing the receiver or the antenna.

RADIO NOISE SUPPRESSION

DESCRIPTION

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 used on this vehicle to control RFI or EMI noise include the following:

- Radio antenna base ground
- Radio receiver chassis ground wire or strap
- Engine-to-body ground strap
- Resistor-type spark plugs
- Radio suppression-type secondary ignition wiring.

For more information on the spark plugs and secondary ignition components, refer to **Ignition System** in the Description and Operation section of Group 8D - Ignition System.

DIAGNOSIS AND TESTING

AUDIO SYSTEM

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

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. 7. Amplifier faulty (if equipped).	1. Check radio fuses in junction block. Replace fuses, if required. 2. Check for loose or corroded radio connector. Repair, if required. 3. Check for battery voltage at radio connector. Repair wiring, if required. 4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 5. See Radio in the Diagnosis and Testing section of this group. 6. See Speaker in the Diagnosis and Testing section of this group. 7. See Speaker in the Diagnosis and Testing section of this group.
NO DISPLAY.	1. Fuse faulty. 2. Radio connector faulty. 3. Wiring faulty. 4. Ground faulty. 5. Radio faulty.	1. Check radio fuses in junction block. Replace fuses, if required. 2. Check for loose or corroded radio connector. Repair, if required. 3. Check for battery voltage at radio connector. Repair wiring, if required. 4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 5. See Radio in the Diagnosis and Testing section of this group.
CLOCK WILL NOT KEEP SET TIME.	1. Fuse faulty. 2. Radio connector faulty. 3. Wiring faulty. 4. Ground faulty. 5. Radio faulty.	1. Check ignition-off draw fuse. Replace fuse, if required. 2. Check for loose or corroded radio connector. Repair, if required. 3. Check for battery voltage at radio connector. Repair wiring, if required. 4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 5. See Radio in the Diagnosis and Testing section of this group.
POOR RADIO RECEPTION.	1. Antenna faulty. 2. Ground faulty. 3. Radio faulty.	1. See Antenna in the Diagnosis and Testing section of this group. 2. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 3. See Radio in the Diagnosis and Testing section of this group.
NO/POOR TAPE OPERATION.	1. Faulty tape. 2. Foreign objects behind tape door. 3. Dirty cassette tape head. 4. Faulty tape deck.	1. Insert known good tape and test operation. 2. Remove foreign objects and test operation. 3. Clean head with Mopar Cassette Head Cleaner. 4. Exchange or replace radio, if required.

DIAGNOSIS AND TESTING (Continued)

Audio System Diagnosis		
CONDITION	POSSIBLE CAUSE	CORRECTION
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.

RADIO

For circuit descriptions and diagrams, refer to 8W-47 - Audio System in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

CAUTION: The speaker output of the radio is a “floating ground” system. Do not allow any speaker lead to short to ground, as damage to the radio may result.

(1) Check the fuse(s) in the junction block and the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse(s).

(2) Check for battery voltage at the fuse in the PDC. If OK, go to Step 3. If not OK, repair the open circuit to the battery as required.

(3) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 4. If not OK, repair the open circuit to the ignition switch as required.

(4) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the radio, but do not unplug the radio wire harness connectors. Check for continuity between the radio chassis and a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the open radio chassis ground circuit as required.

(5) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (accessory/run) circuit cavity of the left (gray) radio wire harness connector. If OK, go to Step 6. If not OK, repair the open circuit as required.

(6) Turn the ignition switch to the Off position. Check for battery voltage at the fused B(+) circuit cavity of the left (gray) radio wire harness connector. If OK, replace the faulty radio. If not OK, repair the open circuit to the Ignition-Off Draw (IOD) fuse as required.

SPEAKER

For circuit descriptions and diagrams, refer to 8W-47 - Audio System in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

CAUTION: The speaker output of the radio is a “floating ground” system. Do not allow any speaker lead to short to ground, as damage to the radio may result.

(1) Turn the ignition switch to the On position. Turn the radio on. Adjust the balance and fader controls to check the performance of each individual speaker. Note the speaker locations that are not performing correctly. Go to Step 2.

(2) Turn the radio off. Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the radio from the instrument panel. If the vehicle is equipped with the Infinity speaker package, also unplug the wire harness connectors at the amplifier. Check both the speaker feed (+) circuit and return (–) circuit cavities for the inoperative speaker location(s) at the radio wire harness connectors for continuity to ground. In each case, there should be no continuity. If OK, go to Step 3. If not OK, repair the shorted speaker circuit(s) as required.

DIAGNOSIS AND TESTING (Continued)

(3) If the vehicle is equipped with the Infinity speaker package, go to Step 6. If the vehicle is equipped with the standard speaker system, check the resistance between the speaker feed (+) circuit and return (–) circuit cavities of the radio wire harness connectors for the inoperative speaker location(s). The meter should read between 2 and 12 ohms (speaker resistance). If OK, go to Step 4. If not OK, go to Step 5.

(4) Install a known good radio. Connect the battery negative cable. Turn the ignition switch to the On position. Turn on the radio and test the speaker operation. If OK, replace the faulty radio. If not OK, turn the radio off, turn the ignition switch to the Off position, disconnect and isolate the battery negative cable, remove the test radio, and go to Step 5.

(5) Unplug the speaker wire harness connector at the inoperative speaker. Check for continuity between the speaker feed (+) circuit cavities of the radio wire harness connector and the speaker wire harness connector. Repeat the check between the speaker return (–) circuit cavities of the radio wire harness connector and the speaker wire harness connector. In each case, there should be continuity. If OK, replace the faulty speaker. If not OK, repair the open circuit(s) as required.

(6) For each inoperative speaker location, check for continuity between the speaker feed (+) circuit cavities of the radio wire harness connectors and the amplifier wire harness connectors. Repeat the check for each inoperative speaker location between the speaker return (–) circuit cavities of the radio wire harness connectors and the amplifier wire harness connectors. In each case, there should be continuity. If OK, go to Step 7. If not OK, repair the open circuit as required.

(7) Check for continuity between the two ground circuit cavities of the amplifier wire harness connector and a good ground. There should be continuity. If OK, go to Step 8. If not OK, repair the open circuit(s) as required.

(8) Check the amplifier fuse in the junction block. If OK, go to Step 9. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(9) Install the radio. Connect the battery negative cable. Check for battery voltage at the amplifier fuse in the junction block. If OK, go to Step 10. If not OK, repair the open circuit to the PDC as required.

(10) Check for battery voltage at the two fused B(+) circuit cavities of the amplifier wire harness connector. If OK, go to Step 11. If not OK, repair the open circuit to the fuse in the junction block as required.

(11) Turn the ignition switch to the On position. Turn the radio on. Check for battery voltage at the radio 12 volt output circuit cavity of the amplifier wire harness connector. If OK, go to Step 12. If not OK, repair the open circuit to the radio as required.

(12) Turn the radio off. Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. For each inoperative speaker location, check both the amplified feed (+) circuit and the amplified return (–) circuit cavities of the amplifier wire harness connectors for continuity to ground. In each case there should be no continuity. If OK, go to Step 13. If not OK, repair the short circuit as required.

(13) For each inoperative speaker location, check the resistance between the amplified feed (+) circuit and the amplified return (–) circuit cavities of the amplifier wire harness connectors. The meter should read between 2 and 12 ohms (speaker resistance). If OK, replace the faulty amplifier. If not OK, go to Step 14.

(14) Unplug the speaker wire harness connector at the inoperative speaker. Check for continuity between the amplified feed (+) circuit cavities of the speaker wire harness connector and the amplifier wire harness connector. Repeat the check between the amplified return (–) circuit cavities of the speaker wire harness connector and the amplifier wire harness connector. In each case there should be continuity. If OK, replace the faulty speaker. If not OK, repair the open circuit as required.

ANTENNA

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The following four tests are used to diagnose the antenna with an ohmmeter:

- **Test 1 -** Mast to ground test
- **Test 2 -** Tip-of-mast to tip-of-conductor test
- **Test 3 -** Body ground to battery ground test
- **Test 4 -** Body ground to coaxial shield test.

The ohmmeter test lead connections for each test are shown in Antenna Tests (Fig. 1).

DIAGNOSIS AND TESTING (Continued)

NOTE: This model has a two-piece antenna coaxial cable. Tests 2 and 4 must be conducted in two steps to isolate a coaxial cable problem; from the coaxial cable connection under the right end of the instrument panel near the right cowl side inner panel to the antenna base, and then from the coaxial cable connection to the radio chassis connection.

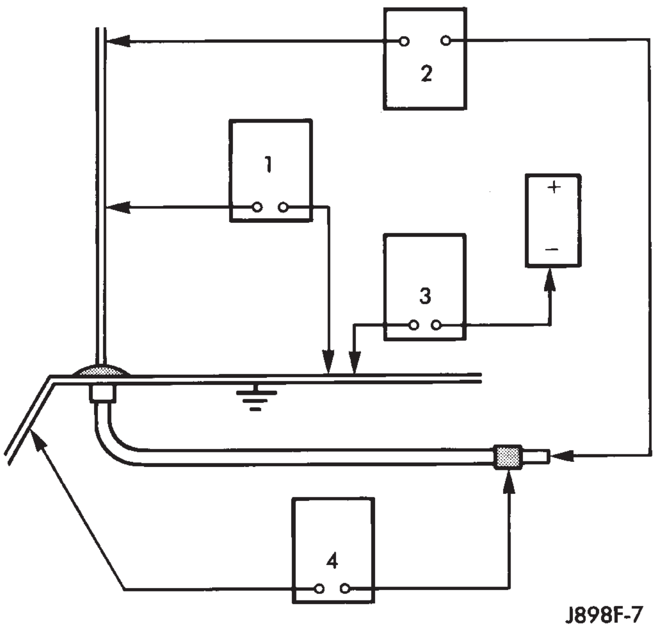

Fig. 1 Antenna Tests

TEST 1

Test 1 determines if the antenna mast is insulated from the base. Proceed as follows:

(1) Unplug the antenna coaxial cable connector from the radio chassis and isolate.

(2) Connect one ohmmeter test lead to the tip of the antenna mast. Connect the other test lead to the antenna base. Check for continuity.

(3) There should be no continuity. If continuity is found, replace the faulty or damaged antenna base and cable assembly.

TEST 2

Test 2 checks the antenna for an open circuit as follows:

(1) Unplug the antenna coaxial cable connector from the radio chassis.

(2) Connect one ohmmeter test lead to the tip of the antenna mast. Connect the other test lead to the center pin of the antenna coaxial cable connector.

(3) Continuity should exist (the ohmmeter should only register a fraction of an ohm). High or infinite resistance indicates damage to the base and cable assembly. Replace the faulty base and cable, if required.

TEST 3

Test 3 checks the condition of the vehicle body ground connection. This test should be performed with the battery positive cable removed from the battery. Disconnect both battery cables, the negative cable first. Reconnect the battery negative cable and perform the test as follows:

(1) Connect one ohmmeter test lead to the vehicle fender. Connect the other test lead to the battery negative post.

(2) The resistance should be less than one ohm.

(3) If the resistance is more than one ohm, check the braided ground strap connected to the engine and the vehicle body for being loose, corroded, or damaged. Repair the ground strap connection, if required.

TEST 4

Test 4 checks the condition of the ground between the antenna base and the vehicle body as follows:

(1) Connect one ohmmeter test lead to the vehicle fender. Connect the other test lead to the outer crimp on the antenna coaxial cable connector.

(2) The resistance should be less then one ohm.

(3) If the resistance is more then one ohm, clean and/or tighten the antenna base to fender mounting hardware.

RADIO FREQUENCY INTERFERENCE

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For complete circuit diagrams, see Group 8W - Wiring Diagrams. Inspect the ground paths and connections at the following locations:

- Blower motor
- Electric fuel pump
- Engine-to-body ground strap
- Generator
- Ignition module
- Radio antenna base ground
- Radio receiver chassis ground wire or strap
- Wiper motor.

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 any ground circuit, clean, tighten, or repair the

DIAGNOSIS AND TESTING (Continued)

ground circuits or connections to ground as required before considering any component replacement.

For service and inspection of secondary ignition components, refer to the Diagnosis and Testing section of Group 8D - Ignition Systems. Inspect the following secondary ignition system components:

- Distributor cap and rotor
- Ignition coil
- Spark plugs
- Spark plug wire routing and condition.

Reroute the spark plug wires or replace the faulty components as required.

If the source of the RFI or EMI noise is identified as two-way mobile radio or telephone equipment, check the equipment installation for the following:

- Power connections should be made directly to the battery, and fused as closely to the battery as possible.
- The antenna should be mounted on the roof or toward the rear of the vehicle. Remember that magnetic antenna mounts on the roof panel can adversely affect the operation of an overhead console compass, if the vehicle is so equipped.
- The antenna cable should be fully shielded coaxial cable, should be as short as is practical, and should be routed away from the factory-installed vehicle wire harnesses whenever possible.
- The antenna and cable must be carefully matched to ensure a low Standing Wave Ratio (SWR).

Fleet vehicles are available with an extra-cost RFI-suppressed Powertrain Control Module (PCM). This unit reduces interference generated by the PCM on 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.

REMOVAL AND INSTALLATION

RADIO

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry the instrument panel center bezel away from the instrument panel to release the six snap clip retainers (Fig. 2).

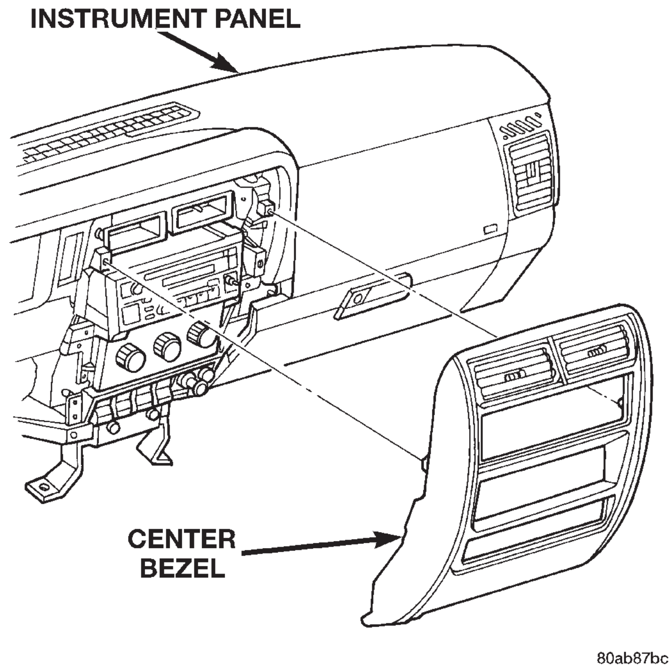


Fig. 2 Center Bezel Remove/Install

(3) Remove the center bezel from the instrument panel.

(4) Remove the two screws that secure the radio to the instrument panel (Fig. 3).

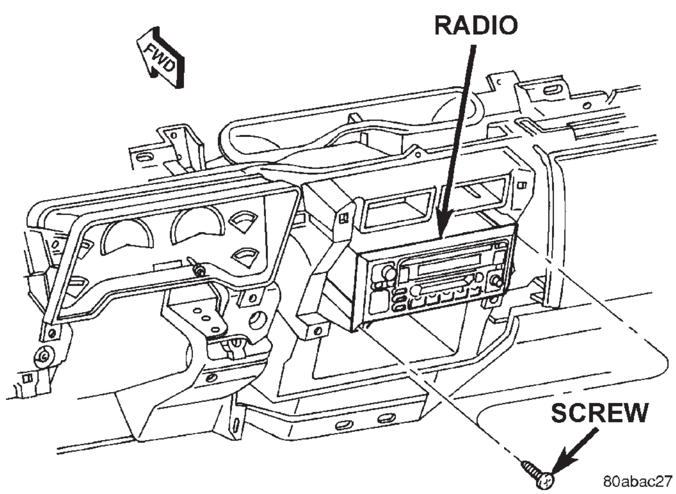


Fig. 3 Radio Remove/Install

(5) Pull the radio out from the instrument panel far enough to access the wire harness connectors and the antenna coaxial cable connector (Fig. 4).

(6) Unplug the wire harness connectors and the antenna coaxial cable connector from the rear of the radio.

(7) Remove the radio from the instrument panel.

REMOVAL AND INSTALLATION (Continued)

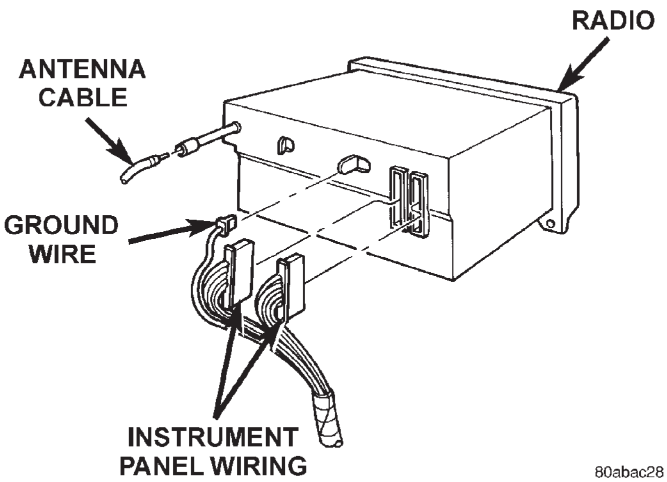


Fig. 4 Radio Connections - Typical

(8) Reverse the removal procedures to install. Tighten the radio mounting screws to 3.9 N·m (35 in. lbs.).

AMPLIFIER

(1) Disconnect and isolate the battery negative cable.

(2) Disengage the rear seat cushion latch by pulling upward on the release strap. Tilt the seat cushion forward.

(3) Lift the carpeting in the left under-seat area as required to access the amplifier.

(4) Unplug the two wire harness connectors from the amplifier (Fig. 5).

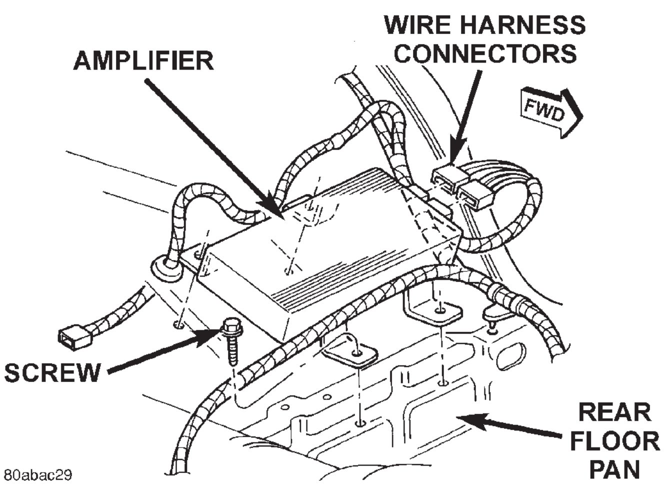


Fig. 5 Amplifier Remove/Install

(5) Remove the three screws that secure the amplifier to the floor panel.

(6) Remove the amplifier from the floor panel.

(7) Reverse the removal procedures to install. Tighten the amplifier mounting screws to 2.8 N·m (25 in. lbs.).

SPEAKER

FRONT DOOR

LOWER

(1) Disconnect and isolate the battery negative cable.

(2) If the vehicle is so equipped, remove the manual window regulator crank handle with a removal tool (Fig. 6).

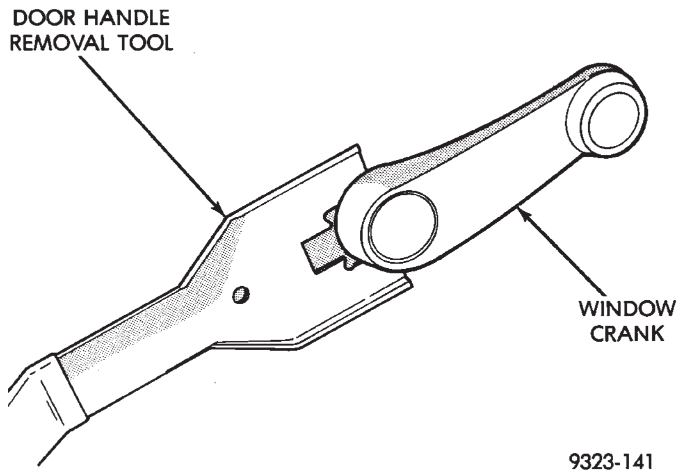


Fig. 6 Window Regulator Crank Handle Remove - Typical

(3) Remove the screws that secure the front door trim panel to the inner door panel (Fig. 7) or (Fig. 8).

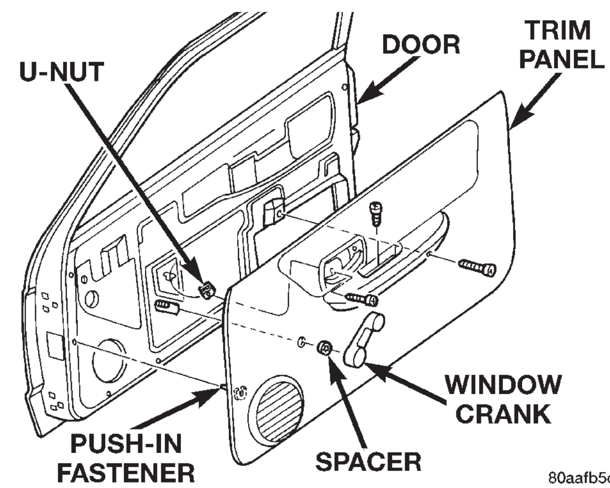


Fig. 7 Front Door Trim Panel Remove/Install - Manual Window

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the front door trim panel away from the door around the perimeter to release the trim panel retainers.

NOTE: To aid in the removal of the trim panel, start at the bottom of the panel.

REMOVAL AND INSTALLATION (Continued)

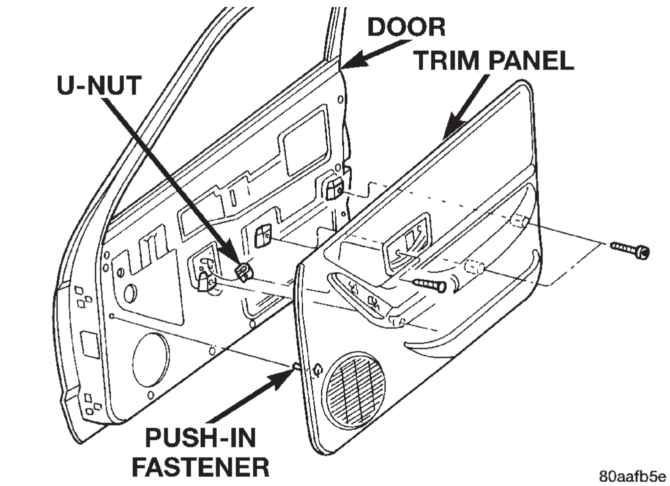


Fig. 8 Front Door Trim Panel Remove/Install - Power Window

(5) Lift the front door trim panel upwards and away from the inner door panel far enough to disengage the top of the panel from the inner belt weatherstrip.

(6) Pull the front door trim panel away from the inner door panel far enough to access the inside door latch release and lock linkage rods near the back of the inside door remote controls.

(7) Unsnap the plastic retainer clips from the inside door remote control ends of the latch release and lock linkage rods, and remove the rod ends from the inside door remote controls.

(8) If the vehicle is so equipped, unplug the wire harness connectors from the door power switch module and, on the driver side only, the power mirror switch.

(9) Set the front door trim panel aside.

(10) Remove the two screws that secure the speaker to the lower front corner of the inner door panel (Fig. 9).

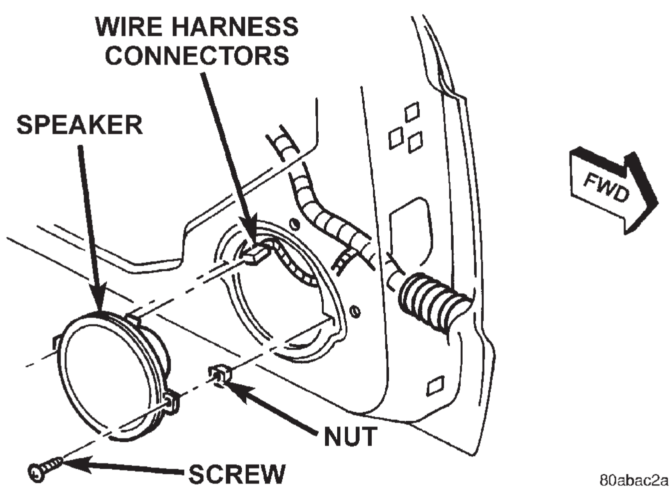


Fig. 9 Front Door Lower Speaker Remove/Install

(11) Pull the speaker away from the inner door panel far enough to access and unplug the speaker wire harness connector.

(12) Remove the speaker from the door.

(13) Reverse the removal procedures to install. Tighten the speaker mounting screws to 1.1 N·m (10 in. lbs.). Tighten the trim panel mounting screws to 2.2 N·m (20 in. lbs.).

UPPER

(1) Remove the front door trim panel from the front door. See Speaker, Front Door, Lower in this group for the procedures.

(2) Remove the one screw that secures the front door flag trim to the inner door panel (Fig. 10).

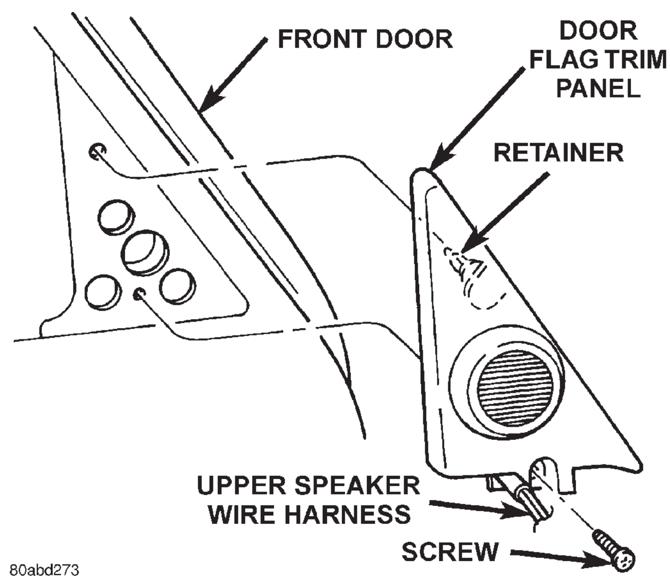


Fig. 10 Front Door Flag Trim Panel Remove/Install

(3) Using a trim stick or another suitable wide flat-bladed tool, gently pry the door flag trim away from the inner door to release the trim panel retainer.

(4) Pull the front door flag trim away from the inner door panel far enough to access and unplug the upper speaker wire harness connector.

(5) Unsnap the speaker from the retainers molded into the back side of the front door flag trim panel.

(6) Reverse the removal procedures to install. Tighten the mounting screw to 2.2 N·m (20 in. lbs.).

REAR HEADLINER

The rear headliner speakers can be serviced without removing the headliner using the procedures that follow. The headliner speaker support structure is integral to the headliner assembly. Refer to Group 23 - Body for the headliner service procedures.

(1) Disconnect and isolate the battery negative cable.

REMOVAL AND INSTALLATION (Continued)

(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry around the perimeter edge of the rear headliner speaker grille to release the five snap retainers that secure the grille to the headliner speaker support structure (Fig. 11).

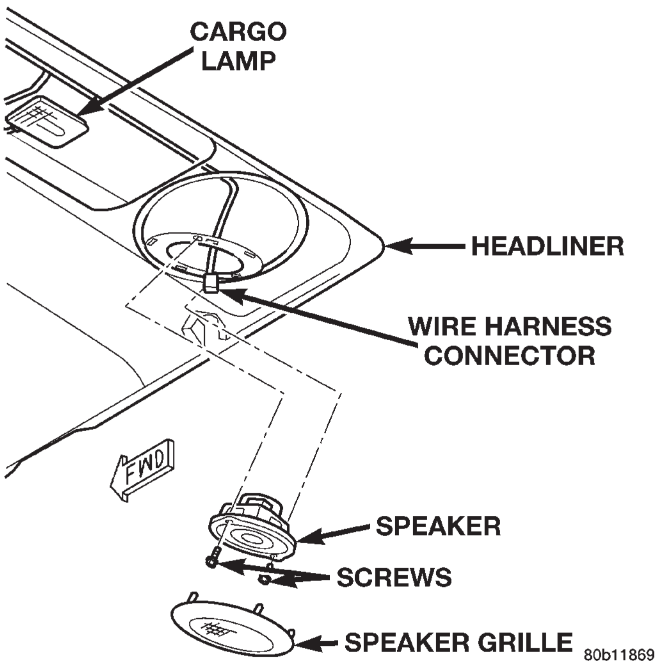


Fig. 11 Rear Headliner Speaker Remove/Install

(3) Remove the speaker grille from the headliner.

(4) Remove the two screws that secure the speaker to the headliner speaker support structure.

(5) Lower the speaker from the headliner far enough to access and unplug the speaker wire harness connector.

(6) Remove the speaker from the headliner.

(7) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

ANTENNA

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the right front fender inner splash shield. Refer to Group 23 - Body for the procedures.

(3) Reach under the right end of the instrument panel to unplug the antenna coaxial cable connector (Fig. 12). Unplug the connector by pulling it apart while twisting the metal connector halves. Do not pull on the cable.

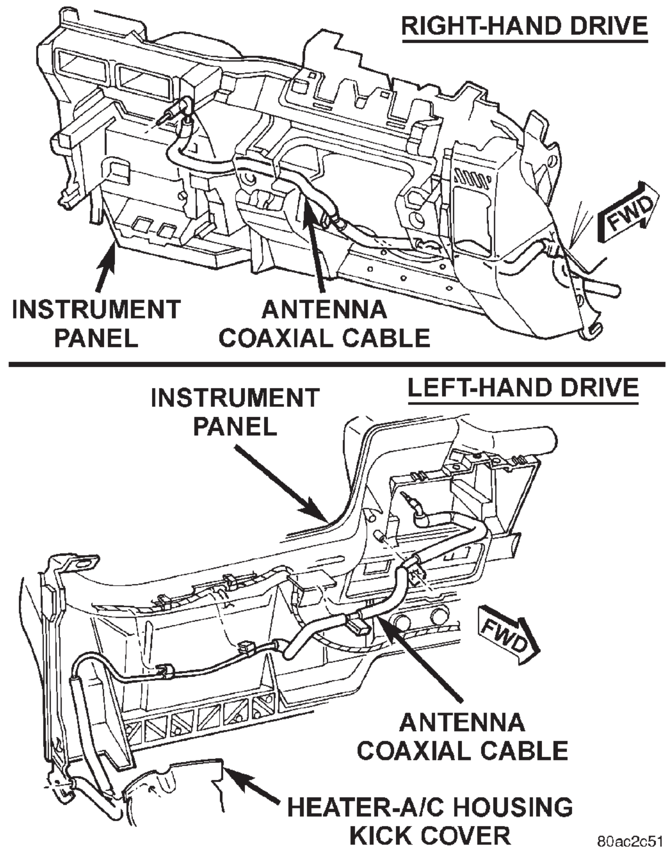


Fig. 12 Antenna Cable Routing

(4) Unscrew the antenna mast from the antenna body (Fig. 13).

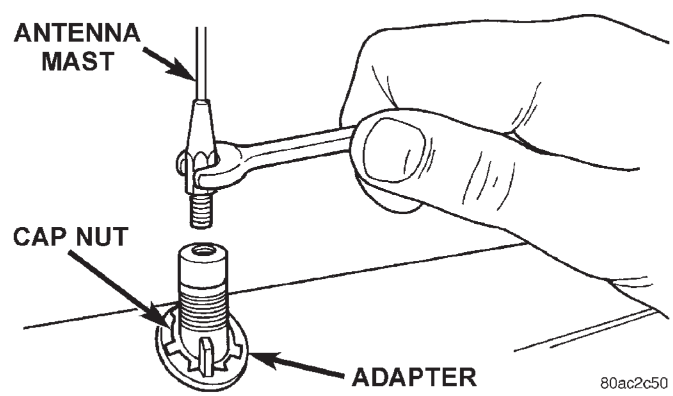


Fig. 13 Antenna Mast Remove/Install - Typical

(5) Remove the antenna cap nut and adapter using an antenna nut wrench (Special Tool C-4816) (Fig. 14).

(6) Lower the antenna body and cable assembly through the top of the fender far enough to access the antenna body by reaching up into the rear of the right front fender wheel housing (Fig. 15).

REMOVAL AND INSTALLATION (Continued)

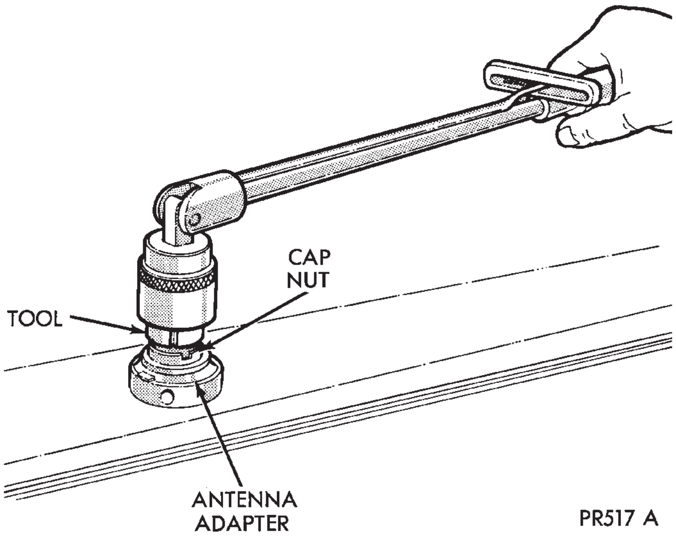


Fig. 14 Antenna Cap Nut and Adapter Remove/ Install - Typical

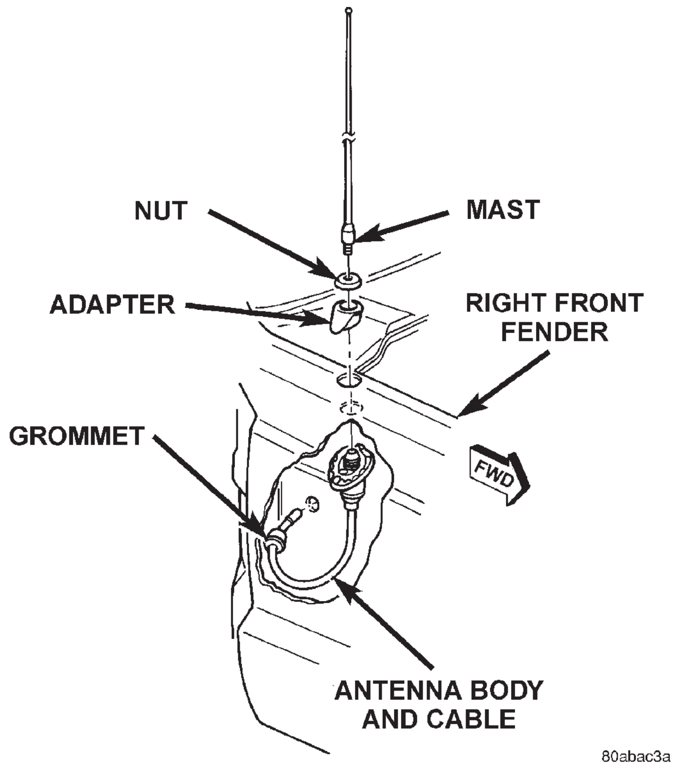


Fig. 15 Antenna Mounting

(7) Disengage the coaxial cable grommet from the hole in the right cowl side outer panel.

(8) Pull the coaxial cable out through the right cowl side outer panel.

(9) Remove the antenna body and cable from the vehicle.

(10) Reverse the removal procedures to install. Tighten the antenna cap nut to 6.2 N·m (55 in. lbs.). Tighten the antenna mast to 3.3 N·m (30 in. lbs.).

RADIO NOISE SUPPRESSION COMPONENTS

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

ENGINE-TO-BODY GROUND STRAP

(1) Remove the screw that secures the engine-to-body ground strap eyelet to the dash panel (Fig. 16).

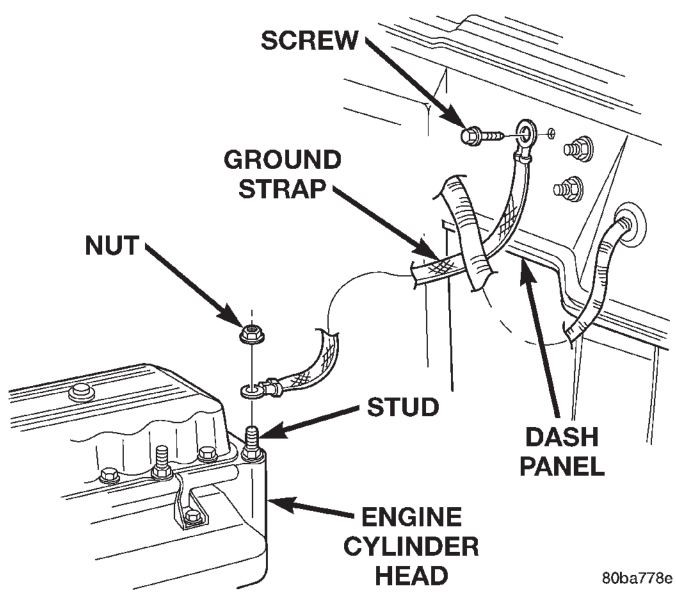


Fig. 16 Engine-To-Body Ground Strap Remove/ Install

(2) Remove the nut that secures the engine-to-body ground strap eyelet to the stud on the left upper rear corner of the engine cylinder head.

(3) Remove the engine-to-body ground strap eyelet from the stud on the left upper rear corner of the engine cylinder head.

(4) Remove the engine-to-body ground strap from the engine compartment.

INSTALLATION

ENGINE-TO-BODY GROUND STRAP

(1) Position the engine-to-body ground strap in the engine compartment.

(2) Position the engine-to-body ground strap eyelet over the stud on the left upper rear corner of the engine cylinder head.

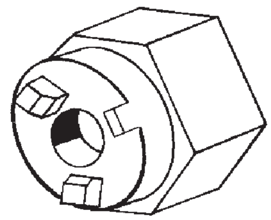
REMOVAL AND INSTALLATION (Continued)

(3) Install and tighten the nut that secures the engine-to-body ground strap eyelet to the stud on the left upper rear corner of the engine cylinder head. Tighten the nut to 27 N·m (20 ft. lbs.).

(4) Install and tighten the screw that secures the engine-to-body ground strap eyelet to the dash panel. Tighten the screw to 27 N·m (20 ft. lbs.).

SPECIAL TOOLS

AUDIO SYSTEMS



Antenna Nut Wrench C-4816

HORN SYSTEMS

CONTENTS

DESCRIPTION AND OPERATION

HORN SYSTEM

DESCRIPTION

A dual-note electric horn system is standard factory-installed equipment on this model. The standard equipment horn system features one low-note horn unit and one high-note horn unit. The horn system uses a non-switched source of battery current so that the system will remain functional, regardless of the ignition switch position. The horn system includes the following components:

- Clockspring
- Horns
- Horn relay
- Horn switch
- Remote Keyless Entry (RKE) receiver (only with the RKE system)

Refer to **Clockspring** in the Description and Operation section of Group 8M - Passive Restraint Systems for more information on this component. Refer to **Remote Keyless Entry System** in the Description and Operation section of Group 8P - Power Lock Systems for more information on this component. Refer to **Horn/Cigar Lighter** in the Contents of Group 8W - Wiring Diagrams for complete circuit diagrams. Following are general descriptions of the remaining major components in the horn system.

OPERATION

The horn system is activated by a horn switch concealed beneath the driver side airbag module trim cover in the center of the steering wheel. Depressing the center of the driver side airbag module trim cover closes the horn switch. Closing the horn switch activates the horn relay. The activated horn relay then switches the battery current needed to energize the horns.

Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the horn system.

REMOTE KEYLESS ENTRY RECEIVER

The Remote Keyless Entry (RKE) receiver can also operate the horn system. An RKE receiver is used on this vehicle when it is equipped with the optional RKE system. The RKE receiver controls and integrates the additional electronic functions and features included on models with this option. A customer programmable feature of the RKE system enables the RKE receiver to momentarily energize the horn relay through a hard wired circuit as an audible verification that the receiver has received a valid lock request from the RKE transmitter.

Refer to **Remote Keyless Entry System** in the Description and Operation section of Group 8P - Power Lock Systems for more information on this feature.

HORN

DESCRIPTION

The dual electromagnetic diaphragm-type horns are standard equipment on this model. The low-note horn is secured with a bracket to the left radiator closure panel brace, behind the front bumper. The high-note horn is secured with a bracket to the right radiator closure panel brace, behind the front bumper. Both horns are grounded through their mounting brackets and receives battery feed through its wire harness connector and circuit from the closed contacts of the horn relay.

The horns cannot be repaired or adjusted and, if faulty or damaged, they must be individually replaced.

DESCRIPTION AND OPERATION (Continued)

OPERATION

Within the two halves of the molded plastic horn housing are a flexible diaphragm, a plunger, an electromagnetic coil and a set of contact points. The diaphragm is secured in suspension around its perimeter by the mating surfaces of the horn housing. The plunger is secured to the center of the diaphragm and extends into the center of the electromagnet. The contact points control the current flow through the electromagnet.

When the horn is energized, electrical current flows through the closed contact points to the electromagnet. The resulting electromagnetic field draws the plunger and diaphragm toward it until that movement mechanically opens the contact points. When the contact points open, the electromagnetic field collapses allowing the plunger and diaphragm to return to their relaxed positions and closing the contact points again. This cycle continues repeating at a very rapid rate producing the vibration and movement of air that creates the sound that is directed through the horn outlet.

HORN RELAY

DESCRIPTION

The horn relay is a electromechanical device that switches battery current to the horn when the horn switch grounds the relay coil. The horn relay is located in the junction block on the right cowl side inner panel below the instrument panel in the passenger compartment. If a problem is encountered with a continuously sounding horn, it can usually be quickly resolved by removing the horn relay from the junction block until further diagnosis is completed. Refer to **Junction Block** in the Contents of Group 8W - Wiring Diagrams for horn relay identification and location.

The horn relay is a International Standards Organization (ISO) relay. Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions.

The horn relay cannot be repaired or adjusted and, if faulty or damaged, it must be replaced.

OPERATION

The ISO relay consists of an electromagnetic coil, a resistor or diode, and three (two fixed and one movable) electrical contacts. The movable (common feed) relay contact is held against one of the fixed contacts (normally closed) by spring pressure. When the electromagnetic coil is energized, it draws the movable contact away from the normally closed fixed contact, and holds it against the other (normally open) fixed contact.

When the electromagnetic coil is de-energized, spring pressure returns the movable contact to the normally closed position. The resistor or diode is connected in parallel with the electromagnetic coil in the relay, and helps to dissipate voltage spikes that are produced when the coil is de-energized.

HORN SWITCH

DESCRIPTION

A center-blow, normally open, resistive membrane-type horn switch is secured with heat stakes to the back side of the driver side airbag module trim cover in the center of the steering wheel (Fig. 1). The switch consists of two plastic membranes, one that is flat and one that is slightly convex. These two membranes are secured to each other around the perimeter. Inside the switch, the centers of the facing surfaces of these membranes each has a grid made with an electrically conductive material applied to it. One of the grids is connected to a circuit that provides it with continuity to ground at all times. The grid of the other membrane is connected to the horn relay control circuit.

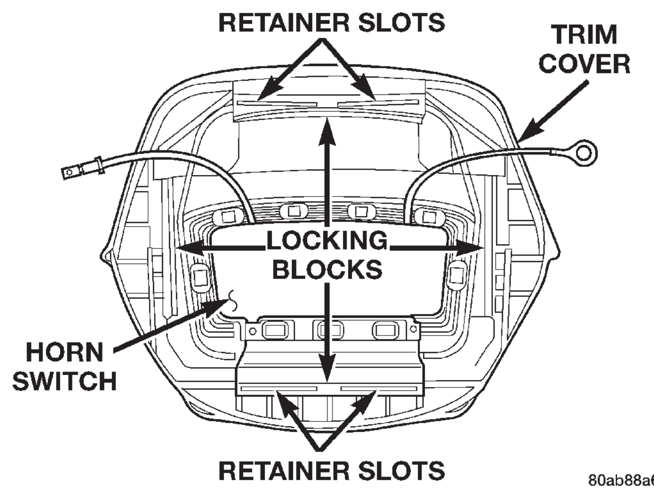


Fig. 1 Driver Side Airbag Module Trim Cover and Horn Switch

The steering wheel and steering column must be properly grounded in order for the horn switch to function properly. The horn switch is only serviced as a part of the driver side airbag module trim cover. If the horn switch is damaged or faulty, or if the driver side airbag is deployed, the driver side airbag module trim cover and horn switch must be replaced as a unit.

OPERATION

When the center area of the driver side airbag trim cover is depressed, the electrically conductive grids on the facing surfaces of the horn switch membranes contact each other, closing the switch circuit. The

DESCRIPTION AND OPERATION (Continued)

completed horn switch circuit provides a ground for the control coil side of the horn relay, which activates the relay. When the horn switch is released, the resistive tension of the convex membrane separates the two electrically conductive grids and opens the switch circuit.

DIAGNOSIS AND TESTING

HORN RELAY

The horn relay (Fig. 2) is located in the junction block on the right cowl side inner panel below the instrument panel in the passenger compartment. If a problem is encountered with a continuously sounding horn, it can usually be quickly resolved by removing the horn relay from the junction block until further diagnosis is completed. Refer to **Junction Block** in the Contents of Group 8W - Wiring Diagrams for horn relay identification and location. For complete circuit diagrams, refer to **Horn/Cigar Lighter** in the Contents of Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the horn relay from the junction block. Refer to **Horn Relay** in the Removal and Installation section of this group for the procedures.

(2) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 3. If not OK, replace the faulty relay.

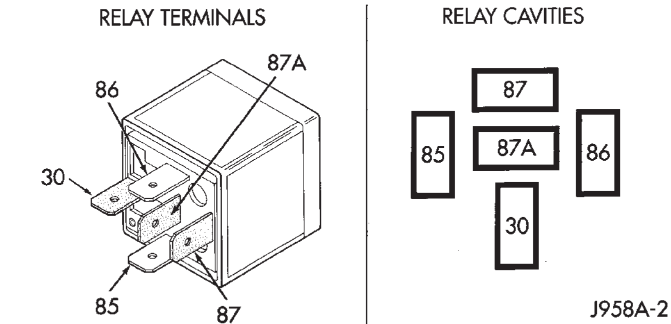
(3) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, perform the Relay Circuit Test that follows. If not OK, replace the faulty relay.

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair the open circuit to the fuse in the junction block 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.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 2 Horn Relay

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the horn(s). There should be continuity between the cavity for relay terminal 87 and the horn relay output circuit cavity of each horn wire harness connector at all times. If OK, go to Step 4. If not OK, repair the open circuit to the horn(s) as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. It is connected to battery voltage and should be hot at all times. Check for battery voltage at the cavity for relay terminal 86. If OK, go to Step 5. If not OK, repair the open circuit to the fuse in the junction block 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. On vehicles equipped with the Remote Keyless Entry (RKE) system, the horn relay coil ground terminal can also be grounded by the RKE receiver in response to certain inputs related to the RKE system. Check for continuity to ground at the cavity for relay terminal 85. There should be continuity with the horn switch depressed, and no continuity with the horn switch released. If not OK, refer to **Horn Switch** in the Diagnosis and Testing section of this group.

HORN SWITCH

For complete circuit diagrams, refer to **Horn/Cigar Lighter** in the Contents of Group 8W - Wiring Diagrams.

DIAGNOSIS AND TESTING (Continued)

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the knee blocker from the instrument panel.

(2) Check for continuity between the metal steering column jacket and a good ground. There should be continuity. If OK, go to Step 3. If not OK, refer to **Steering Column** in the Removal and Installation section of Group 19 - Steering for proper installation of the steering column.

(3) Remove the driver side airbag module from the steering wheel. Disconnect the horn switch wire harness connectors from the driver side airbag module.

(4) Remove the horn relay from the junction block. Check for continuity between the steering column half of the horn switch feed wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the shorted horn relay control circuit to the horn relay in the junction block as required.

(5) Check for continuity between the steering column half of the horn switch feed wire harness connector and the horn relay control circuit cavity for the horn relay in the junction block. There should be continuity. If OK, go to Step 6. If not OK, repair the open horn relay control circuit to the horn relay in the junction block as required.

(6) Check for continuity between the horn switch feed wire and the horn switch ground wire on the driver side airbag module. There should be no continuity. If OK, go to Step 7. If not OK, replace the faulty horn switch.

(7) Depress the center of the driver side airbag module trim cover and check for continuity between the horn switch feed wire and the horn switch ground wire on the driver side airbag module. There should now be continuity. If not OK, replace the faulty horn switch.

HORN

For complete circuit descriptions, refer to **Horn/Cigar Lighter** in the Contents of Group 8W - Wiring Diagrams.

(1) Measure the resistance between the horn(s) mounting bracket(s) and a good ground. There should be no measurable resistance. If OK, go to Step 2. If not OK, clean and tighten the horn mounting hardware as required.

(2) Disconnect the wire harness connector(s) from the horn connector receptacle(s). Check for battery voltage at the horn relay output circuit cavity of the horn(s) wire harness connector(s). There should be zero volts. If OK, go to Step 3. If not OK, repair the shorted horn relay output circuit or replace the faulty horn relay as required.

(3) Depress the horn switch. There should now be battery voltage at the horn relay output circuit cavity of the horn(s) wire harness connector(s). If OK, replace the faulty horn(s). If not OK, repair the open horn relay output circuit to the horn relay as required.

REMOVAL AND INSTALLATION

HORN RELAY

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the fuse access panel by unsnapping it from the right cowl side inner trim panel (Fig. 3).

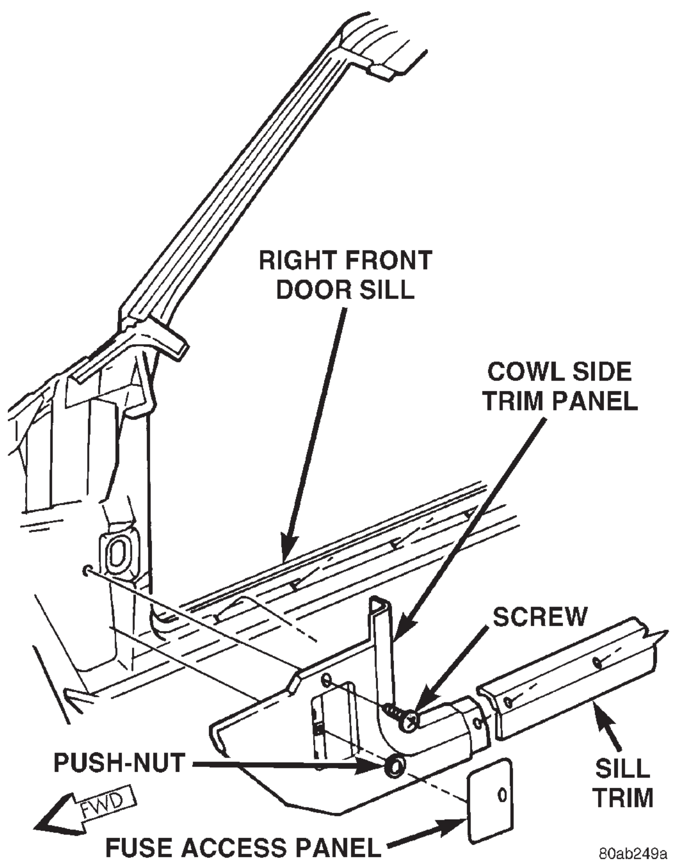


Fig. 3 Right Cowl Side Inner Trim Remove/Install

REMOVAL AND INSTALLATION (Continued)

(3) Remove the push nut that secures the right cowl side inner trim panel to the junction block stud.

(4) Remove the screw located above the fuse access opening that secures the trim panel to the right cowl side inner panel.

(5) Remove the screw that secures the right cowl side inner trim panel and right front door sill trim to the door opening sill.

(6) Remove the trim from the right cowl side inner panel.

(7) Refer to **Junction Block** in the Contents of Group 8W - Wiring Diagrams for horn relay identification and location.

(8) Remove the horn relay from the junction block.

INSTALLATION

(1) Refer to **Junction Block** in the Contents of Group 8W - Wiring Diagrams for proper horn relay location.

(2) Position the horn relay in the proper receptacle in the junction block.

(3) Align the horn relay terminals with the terminal cavities in the junction block receptacle.

(4) Push down firmly on the horn relay until the terminals are fully seated in the terminal cavities in the junction block receptacle.

(5) Position the trim onto the right cowl side inner panel.

(6) Install and tighten the screw that secures the right cowl side inner trim panel and right front door sill trim to the door opening sill. Tighten the screw to 2.2 N·m (20 in. lbs.).

(7) Install and tighten the screw located above the fuse access opening that secures the trim panel to the right cowl side inner panel. Tighten the screw to 2.2 N·m (20 in. lbs.).

(8) Install the push nut that secures the right cowl side inner trim panel onto the junction block stud.

(9) Install the fuse access panel by snapping it onto the right cowl side inner trim panel.

(10) Reconnect the battery negative cable.

HORN

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Raise and support the vehicle.

(3) Remove the front underbody splash shield.

NOTE: Remove the horn and its mounting bracket from the vehicle as a unit. Do not remove the horn from its mounting bracket.

(4) Remove the screw that secures the horn and mounting bracket unit to the radiator closure panel brace (Fig. 4).

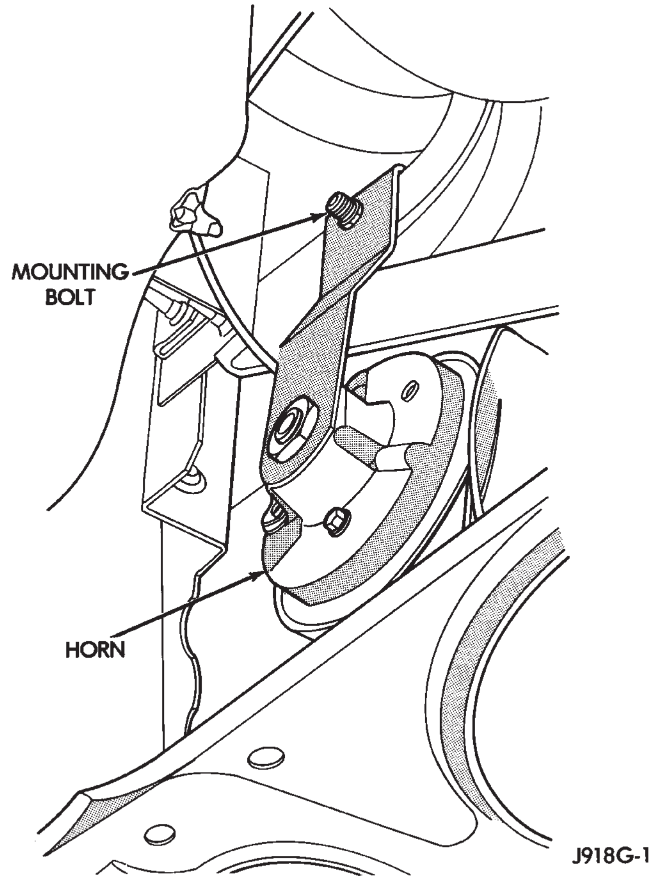


Fig. 4 Horns Remove/Install

(5) Lower the horn and mounting bracket unit far enough to access and disconnect the wire harness connector from the horn connector receptacle.

(6) Remove the horn and mounting bracket unit from behind the front bumper.

INSTALLATION

(1) Position the horn and mounting bracket unit behind the front bumper.

(2) Reconnect the wire harness connector to the horn connector receptacle.

(3) Position the horn and mounting bracket unit to the radiator closure panel brace.

(4) Install and tighten the screw that secures the horn and mounting bracket unit to the radiator closure panel brace. Tighten the screw to 28.5 N·m (21 ft. lbs.).

(5) Install the front underbody splash shield.

(6) Lower the vehicle.

(7) Reconnect the battery negative cable.

SPEED CONTROL SYSTEM

CONTENTS

DESCRIPTION AND OPERATION

SPEED CONTROL SYSTEM

DESCRIPTION

The speed control system is electronically controlled and vacuum operated. Electronic control of the speed control system is integrated into the Powertrain Control Module (PCM). The controls consist of two steering wheel mounted switches. The switches are labeled: ON, OFF, RESUME, ACCEL, SET, COAST, and CANCEL.

The system is designed to operate at speeds above 30 mph (50 km/h).

WARNING: THE USE OF SPEED CONTROL IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT MAINTAINING A CONSTANT SPEED, SUCH AS IN HEAVY TRAFFIC OR ON ROADS THAT ARE WINDING, ICY, SNOW COVERED, OR SLIPPERY.

OPERATION

When speed control is selected by depressing the ON switch, the PCM allows a set speed to be stored in PCM RAM for speed control. To store a set speed, depress the SET switch while the vehicle is moving at a speed between 35 and 85 mph. In order for the speed control to engage, the brakes cannot be applied, nor can the gear selector be indicating the transmission is in Park or Neutral.

The speed control can be disengaged manually by:
- Stepping on the brake pedal
- Depressing the OFF switch
- Depressing the CANCEL switch.
- Depressing the clutch pedal (if equipped)

NOTE: Depressing the OFF switch or turning off the ignition switch will erase the set speed stored in the PCM.

For added safety, the speed control system is programmed to disengaged for any of the following conditions:
- An indication of Park or Neutral
- An rapid increase rpm (indicates that the clutch has been disengaged)
- Excessive engine rpm (indicates that the transmission may be in a low gear)
- The speed signal increases at a rate of 10 mph per second (indicates that the coefficient of friction between the road surface and tires is extremely low)
- The speed signal decreases at a rate of 10 mph per second (indicates that the vehicle may have decelerated at an extremely high rate)

Once the speed control has been disengaged, depressing the RESUME switch (when speed is greater than 30 mph) restores the vehicle to the target speed that was stored in the PCM.

DESCRIPTION AND OPERATION (Continued)

While the speed control is engaged, the driver can increase the vehicle speed by depressing the ACCEL switch. The new target speed is stored in the PCM when the ACCEL is released. The PCM also has a ″tap-up″ feature in which vehicle speed increases at a rate of approximately 2 mph for each momentary switch activation of the ACCEL switch.

A “tap down” feature is used to decelerate without disengaging the speed control system. To decelerate from an existing recorded target speed, momentarily depress the COAST switch. For each switch activation, speed will be lowered approximately 1 mph.

SPEED CONTROL SERVO

DESCRIPTION

The servo unit consists of a solenoid valve body, a vacuum servo and the mounting bracket.

OPERATION

The Powertrain Control Module (PCM) controls the solenoid valve body. The solenoid valve body controls the application and release of vacuum to the diaphragm of the vacuum servo. A cable connects the servo with the throttle linkage. The servo unit cannot be repaired and is serviced only as a complete assembly.

SPEED CONTROL SOLENOID CIRCUITS

OPERATION

When all of the speed control parameters are met, and the SET button is pressed, the PCM actuates the vent solenoid and “duty-cycles” the vacuum solenoid to open the throttle and bring the vehicle up to target speed. When the vehicle is at target speed, it will actuate the vent solenoid with the vacuum solenoid de-activated to maintain the vehicle at target speed. When the vehicle is above target speed, the PCM will “duty-cycle” the vent solenoid with the vacuum solenoid still de-activated to close the throttle to return to target speed.

SPEED CONTROL SWITCHES

DESCRIPTION

Two separate speed control switch modules are mounted on the steering wheel to the left and right side of the driver’s airbag module. The two switch modules are labeled: ON/OFF, SET, RESUME/ACCEL, CANCEL and COAST. Refer to the owner’s manual for more information on speed control switch functions and setting procedures. The individual switches cannot be repaired. If one individual switch fails, the switch module must be replaced.

OPERATION

Within the two switch modules, five **momentary** contact switches, supporting seven different speed control functions are used. The outputs from these switches are filtered into one input. The Powertrain Control Module (PCM) determines which output has been applied through **resistive multiplexing.** The input circuit voltage is measured by the PCM to determine which switch function has been selected.

A speed control indicator lamp, located on the instrument panel cluster is energized by the PCM via the J1850 PCI Bus circuits. This occurs when speed control system power has been turned ON, and the engine is running.

STOP LAMP SWITCH

DESCRIPTION

The switch is mounted on the brake pedal mounting bracket under the instrument panel.

OPERATION

Vehicles equipped with the speed control option use a dual function stop lamp switch. The PCM monitors the state of the dual function stop lamp switch. Refer to the Brake section for more information on stop lamp switch service and adjustment procedures.

SERVO CABLE

DESCRIPTION

The speed control servo cable is connected between the speed control vacuum servo diaphragm and the throttle body control linkage.

OPERATION

This cable causes the throttle control linkage to open or close the throttle valve in response to movement of the vacuum servo diaphragm.

POWERTRAIN CONTROL MODULE

DESCRIPTION

The Powertrain Control Module (PCM) is located in the engine compartment.

OPERATION

The speed control electronic control circuitry is integrated into the PCM. The PCM speed control functions are monitored by the On-Board Diagnostics (OBD). All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for certain failures it detects. See On-Board Diagnostic Test For Speed Control System

DESCRIPTION AND OPERATION (Continued)

in this group for more information. The PCM cannot be repaired and must be replaced if faulty.

VACUUM RESERVOIR

DESCRIPTION

The vacuum reservoir is a plastic storage tank connected to an engine vacuum source by vacuum lines.

OPERATION

The vacuum reservoir is used to supply the vacuum needed to maintain proper speed control operation when engine vacuum drops, such as in climbing a grade while driving. A one-way check valve is used in the vacuum line between the reservoir and the vacuum source. This check valve is used to trap engine vacuum in the reservoir. On certain vehicle applications, this reservoir is shared with the heating/air-conditioning system. The vacuum reservoir cannot be repaired and must be replaced if faulty.

VEHICLE SPEED SENSOR

The Vehicle Speed Sensor (VSS) is a pulse generator mounted to an adapter near the transmission output shaft. The sensor is driven through the adapter by a speedometer pinion gear. The VSS pulse signal to the speedometer/odometer is monitored by the PCM speed control circuitry to determine vehicle speed and to maintain speed control set speed.

DIAGNOSIS AND TESTING

ROAD TEST

Perform a vehicle road test to verify reports of speed control system malfunction. The road test should include attention to the speedometer. Speedometer operation should be smooth and without flutter at all speeds.

Flutter in the speedometer indicates a problem which might cause surging in the speed control system. The cause of any speedometer problems should be corrected before proceeding. Refer to Group 8E, Instrument Panel and Gauges for speedometer diagnosis.

If a road test verifies a system problem and the speedometer operates properly, check for:

- A Diagnostic Trouble Code (DTC). If a DTC exists, conduct tests per the Powertrain Diagnostic Procedures service manual.
- A misadjusted brake (stop) lamp switch. This could also cause an intermittent problem.
- Loose, damaged or corroded electrical connections at the servo. Corrosion should be removed from electrical terminals and a light coating of Mopar MultiPurpose Grease, or equivalent, applied.
- Leaking vacuum reservoir.
- Loose or leaking vacuum hoses or connections.
- Defective one-way vacuum check valve.
- Secure attachment of both ends of the speed control servo cable.
- Smooth operation of throttle linkage and throttle body air valve.
- Failed speed control servo. Do the servo vacuum test.

CAUTION: When test probing for voltage or continuity at electrical connectors, care must be taken not to damage connector, terminals or seals. If these components are damaged, intermittent or complete system failure may occur.

ON-BOARD DIAGNOSTIC TEST FOR SPEED CONTROL SYSTEM

The Powertrain Control Module (PCM) monitors critical input and output circuits of the speed control system, making sure they are operational. A Diagnostic Trouble Code (DTC) is assigned to each input and output circuit monitored by the On-Board Diagnostic (OBD) system. Some circuits are checked continuously and some are checked only under certain conditions.

For DTC information, refer to Diagnostic Trouble Codes in Group 25, Emission Control System. This will include a complete list of DTC's including DTC's for the speed control system.

VEHICLE SPEED SIGNAL

For diagnosis and testing of the Vehicle Speed Signal (VSS), refer to the appropriate Powertrain Diagnostic Procedures service manual. Also refer to the DRB scan tool.

SPEED CONTROL SWITCHES

To perform a complete test of the speed control switch circuits, refer to the appropriate Powertrain Diagnostic Procedures manual.

STOP LAMP SWITCH

For continuity checks and switch adjustment, refer to Group 5, Brakes.

VACUUM SUPPLY TEST

(1) Disconnect vacuum hose at speed control servo and install a vacuum gauge into the disconnected hose.

(2) Start engine and observe gauge at idle. Vacuum gauge should read at least ten inches of mercury.

(3) If vacuum is less than ten inches of mercury, determine source of leak. Check vacuum line to

DIAGNOSIS AND TESTING (Continued)

engine for leaks. Also check actual engine intake manifold vacuum. If manifold vacuum does not meet this requirement, check for poor engine performance and repair as necessary.

(4) If vacuum line to engine is not leaking, check for leak at vacuum reservoir. To locate and gain access to reservoir, refer to Vacuum Reservoir Removal/Installation in this group. Disconnect vacuum line at reservoir and connect a hand-operated vacuum pump to reservoir fitting. Apply vacuum. Reservoir vacuum should not bleed off. If vacuum is being lost, replace reservoir.

(5) Verify operation of one-way check valve and check it for leaks.

(a) Locate one-way check valve. The valve is located in vacuum line between vacuum reservoir and engine vacuum source. Disconnect vacuum hoses (lines) at each end of valve.

(b) Connect a hand-operated vacuum pump to reservoir end of check valve. Apply vacuum. Vacuum should not bleed off. If vacuum is being lost, replace one-way check valve.

(c) Connect a hand-operated vacuum pump to vacuum source end of check valve. Apply vacuum. Vacuum should flow through valve. If vacuum is not flowing, replace one-way check valve. Seal the fitting at opposite end of valve with a finger and apply vacuum. If vacuum will not hold, diaphragm within check valve has ruptured. Replace valve.

SPEED CONTROL SERVO

For complete speed control system diagnosis, including the speed control servo, refer to the appropriate Powertrain Diagnostic Procedures manual.

OVERSHOOT/UNDERSHOOT FOLLOWING SPEED CONTROL SET

If the operator repeatedly presses and releases the set button with their foot off of the accelerator (a “lift foot set” to begin speed control operation), the vehicle may accelerate and exceed the desired set speed by up to 5 MPH (8 km/h) and then decelerate to less than the desired set speed before finally achieving the desired set speed.

The Speed Control has an adaptive strategy that compensates for vehicle-to-vehicle variations in speed control cable lengths. When the speed control is set with the vehicle operators foot off of the accelerator pedal, the speed control thinks there is excessive speed control cable slack and adapts. If the lift foot sets are continually used, the speed control overshoot/undershoot condition will develop.

To “unlearn” the overshoot/undershoot condition, the vehicle operator has to press and release the set button while maintaining the desired set speed with the accelerator pedal (not decelerating or accelerating), and then turn the cruise control switch to the OFF position (or press the CANCEL button if equipped) after waiting 10 seconds. This procedure must be performed approximately 10–15 times to completely unlearn the overshoot/undershoot condition.

REMOVAL AND INSTALLATION

SPEED CONTROL SERVO

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Disconnect vacuum line at servo (Fig. 1).

(3) Disconnect electrical connector at servo.

(4) Disconnect servo cable at throttle body. Refer to Servo Cable Removal/Installation in this group.

(5) Remove 2 mounting nuts holding servo cable sleeve to bracket (Fig. 2).

(6) Pull speed control cable sleeve and servo away from servo mounting bracket to expose cable retaining clip (Fig. 2) and remove clip. Note: The servo mounting bracket displayed in (Fig. 2) is a typical bracket and may/may not be applicable to this model vehicle.

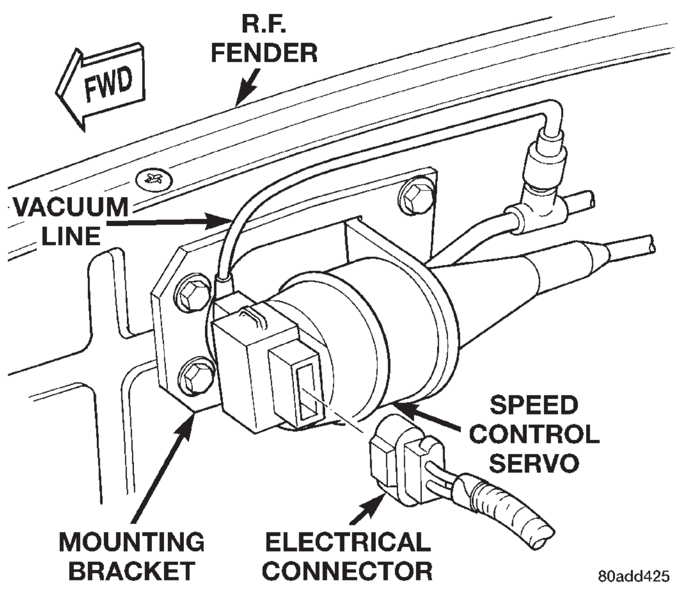


Fig. 1 Speed Control Servo Location

(7) Remove servo from mounting bracket. While removing, note orientation of servo to bracket.

INSTALLATION

(1) Position servo to mounting bracket.

(2) Align hole in cable connector with hole in servo pin. Install cable-to-servo retaining clip.

(3) Insert servo mounting studs through holes in servo mounting bracket.

REMOVAL AND INSTALLATION (Continued)

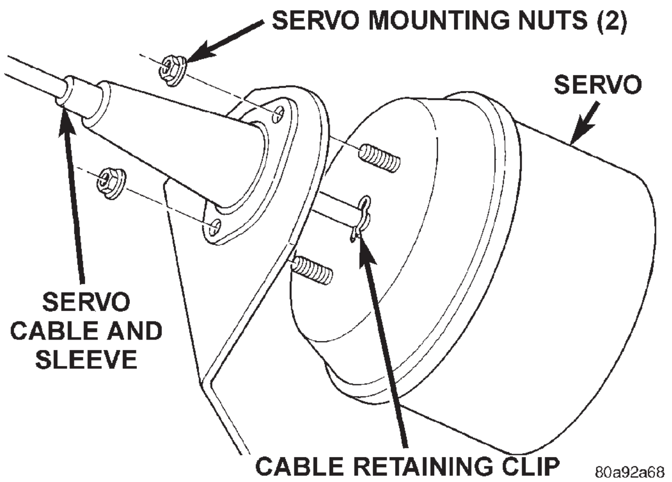


Fig. 2 Servo Cable Clip Remove/Install—Typical

(4) Install servo mounting nuts and tighten to 8.5 N·m (75 in. lbs.).

(5) Connect vacuum line at servo.

(6) Connect electrical connector at servo.

(7) Connect servo cable to throttle body. Refer to Servo Cable Removal/Installation in this group.

(8) Connect negative battery cable to battery.

(9) Before starting engine, operate accelerator pedal to check for any binding.

SPEED CONTROL SWITCH

WARNING: BEFORE ATTEMPTING TO DIAGNOSE, REMOVE OR INSTALL ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL AND STEERING COLUMN COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. WAIT 2 MINUTES FOR SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate negative battery cable from battery.

(2) Remove airbag module. Refer to Group 8M, Passive Restraint Systems for procedures.

(3) From underside of steering wheel, remove speed control switch mounting screw (Fig. 3).

(4) Remove switch from steering wheel and unplug electrical connector.

INSTALLATION

(1) Plug electrical connector into switch.

(2) Position switch to steering wheel.

(3) Install switch mounting screw and tighten to 1.5 N·m (14 in. lbs.) torque.

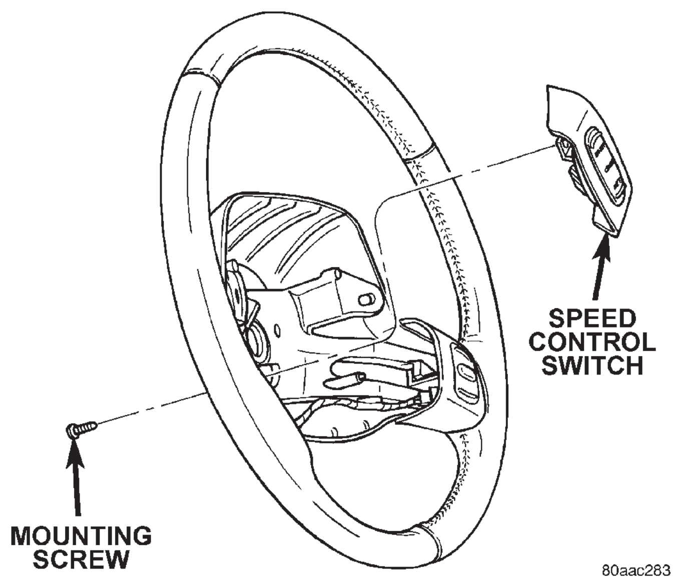


Fig. 3 Speed Control Switch Remove/Install

(4) Install airbag module. Refer to Group 8M, Passive Restraint Systems for procedures.

(5) Connect negative battery cable to battery.

STOP LAMP SWITCH

Refer to Stop Lamp Switch in Group 5, Brakes for removal/installation and adjustment procedures.

SERVO CABLE

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Using finger pressure only, remove cable connector by pushing connector off the throttle body bellcrank pin (Fig. 4). **DO NOT try to pull cable connector off perpendicular to the bellcrank pin. Connector will be broken.**

(3) Two squeeze tabs are located on sides of speed control cable at cable locking plate (Fig. 5). Squeeze the tabs together and push cable out of cable locking plate.

(4) Unclip cable from cable guide at valve cover (Fig. 5).

(5) Disconnect servo cable at servo. Refer to Speed Control Servo—Removal/Installation.

INSTALLATION

(1) Attach end of cable to speed control servo. Refer to Speed Control Servo Removal/Installation.

(2) Install cable into cable locking plate (snaps in).

(3) Install cable connector at throttle body bellcrank pin (snaps on).

(4) Clip cable to cable guide at valve cover.

(5) Connect negative battery cable to battery.

(6) Before starting engine, operate accelerator pedal to check for any binding.

REMOVAL AND INSTALLATION (Continued)

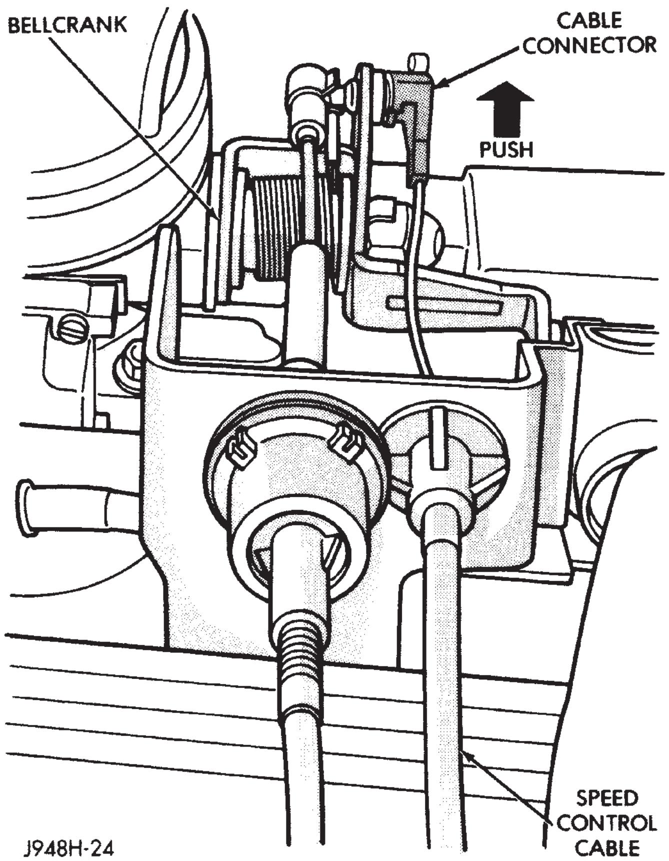


Fig. 4 Servo Cable to Bellcrank—Remove/Install

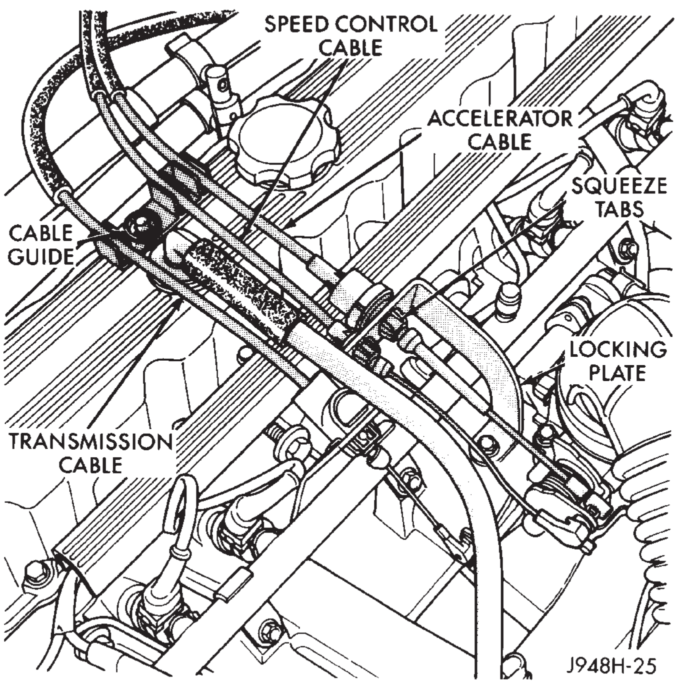


Fig. 5 Squeeze Tabs at Cable Locking Plate

VACUUM RESERVOIR

REMOVAL

The vacuum reservoir is located behind right front bumper end cap on vehicles equipped with LHD (Left Hand Drive) (Fig. 6). It is located behind left front bumper end cap on vehicles equipped with RHD (Right Hand Drive).

(1) Remove front bumper end cap. Refer to Front Bumper End Cap in Group 23, Body for procedures.

(2) Remove vacuum line at reservoir (Fig. 7).

(3) Remove 2 reservoir mounting screws.

(4) Remove reservoir from bumper bar.

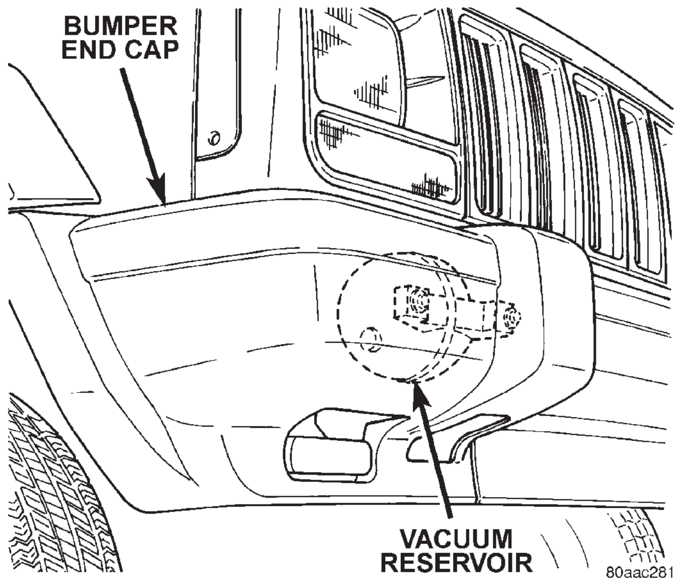


Fig. 6 Vacuum Reservoir Location

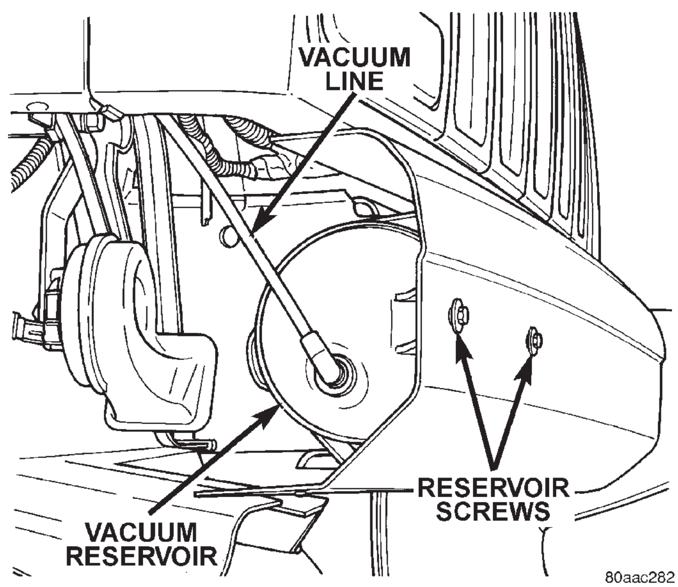


Fig. 7 Vacuum Reservoir Removal/Installation

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position reservoir to bumper bar and install mounting screws. Tighten screws to 8 N·m (72 in. lbs.) torque.

(2) Install vacuum line to reservoir

(3) Install front bumper end cap. Refer to Group 23, Body for procedures.

SPECIFICATIONS

TORQUE CHART

Description	Torque
Servo Mounting Bracket-to-Servo Nuts	8.5 N·m (75 in. lbs.)
Servo Mounting Bracket-to-Body Bolts	2 N·m (20 in. lbs.)
Speed Control Switch Mounting Screws	1.5 N·m (14 in. lbs.)
Vacuum Reservoir Mounting Bolts	8 N·m (72 in. lbs.)

VEHICLE SPEED CONTROL SYSTEM

CONTENTS

GENERAL INFORMATION

INTRODUCTION

This group covers both Left-Hand Drive (LHD) and Right-Hand Drive (RHD) versions of this model. Whenever 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 was/is required.

Features unique to the diesel engine will be covered in this section.

- Models equipped with the 2.5L diesel engine do not use a vacuum reservoir to retain engine vacuum for speed control operation. There are no vaccum-operated speed control servos used in vehicles with the 2.5L diesel engine.
- The range of the speed control system operation is restricted to speeds between 56 km/h (35 MPH) to 145 km/h (90 MPH).
- Inputs to the MSA that allow speed control operation are from the vehicle speed sensor and the Speed Control Switch.
- Two separate speed control switch modules are mounted on the steering wheel to the left and right side of the driver's airbag module. Switch features are:
- Within the two switch modules, five **momentary** contact switches, supporting seven different speed control functions are used. The outputs from these switches are filtered into one input. The MSA determines which output has been applied through **resistive multiplexing.** The input circuit voltage is measured by the MSA to determine which switch function has been selected.
- A speed control indicator lamp, located on the instrument panel cluster is energized by the MSA via the CCD Bus. This occurs when speed control system power has been turned ON, and the engine is running.
- The two switch modules are labeled: ON/OFF, SET, RESUME/ACCEL, CANCEL and COAST. Refer to the owner's manual for more information on speed control switch functions and setting procedures. The individual switches cannot be repaired. If one individual switch fails, the switch module must be replaced.

TURN SIGNAL AND HAZARD WARNING SYSTEMS

CONTENTS

DESCRIPTION AND OPERATION

TURN SIGNAL SYSTEM

DESCRIPTION

A turn signal system is standard factory-installed safety equipment on this model. The turn signal system uses ignition switched battery current, and will operate only when the ignition switch is in the On or Accessory positions. The turn signal system includes the following components:

- Combination flasher
- Front side marker lamps
- Turn signal cancelling cam
- Turn signal indicator lamps
- Turn signal lamps
- Turn signal switch.

Refer to **Lamp** in the proper section of Group 8L - Lamps for more information on the exterior turn signal lamps. Refer to **Instrument Cluster** in the proper section of Group 8E - Instrument Panel Systems for more information on the turn signal indicator lamps. Following are general descriptions of the major components in the turn signal system. For complete circuit diagrams, refer to **Turn Signals** in the Contents of Group 8W - Wiring Diagrams.

OPERATION

With the ignition switch in the On or Accessory position, and the turn signal (multi-function) switch control stalk moved up (right turn) or down (left turn), the turn signal system is activated. When the turn signal system is activated, the circuitry of the turn signal switch and the combination flasher will cause the selected (right or left) turn signal indicator lamp, front park/turn signal lamp, front side marker lamp and rear tail/stop/turn signal lamp to flash on and off. If the exterior lamps are turned off, the front park/turn signal lamp and the front side marker lamp will flash in unison. If the exterior lamps are turned on, the front park/turn signal lamp and the front side marker lamp will flash alternately.

See the owner's manual in the vehicle glove box for more information on the features, use and operation of the turn signal system.

HAZARD WARNING SYSTEM

DESCRIPTION

A hazard warning system is standard factory-installed safety equipment on this model. Unlike the turn signal system, the hazard warning system uses a non-switched source of battery current so that the system will operate regardless of the ignition switch position. The hazard warning system includes the following components:

- Combination flasher
- Front side marker lamps
- Hazard warning switch
- Turn signal indicator lamps
- Turn signal lamps.

Refer to **Lamp** in the proper section of Group 8L - Lamps for more information on the exterior turn signal lamps. Refer to **Instrument Cluster** in the proper section of Group 8E - Instrument Panel Systems for more information on the turn signal indicator lamps. Following are general descriptions of the major components in the hazard warning system. For complete circuit diagrams, refer to **Turn Signals** in the Contents of Group 8W - Wiring Diagrams.

OPERATION

With the hazard warning switch in the On position, the hazard warning system is activated. When the hazard warning system is activated, the circuitry of the hazard warning switch and the combination flasher will cause both the right side and the left side turn signal indicator lamps, front park/turn signal lamps, front side marker lamps and rear tail/stop/turn signal lamps to flash on and off. If the exterior lamps are turned off, the front park/turn signal lamps and the front side marker lamps will flash in unison. If the exterior lamps are turned on, the front park/turn signal lamps and the front side marker lamps will flash alternately.

See the owner's manual in the vehicle glove box for more information on the features, use and operation of the hazard warning system.

TURN SIGNAL SWITCH AND HAZARD WARNING SWITCH

DESCRIPTION

The turn signal and hazard warning switches are integral to the multi-function switch unit, which is secured to the left side of the steering column (Fig. 1). The only visible parts of the multi-function switch are the control stalk that extends from the left side of the steering column, and the hazard warning switch button that protrudes from the top of the steering column. The multi-function switch control stalk has international control symbols on it, which identify its functions. The hazard warning switch button is identified with a double triangle, which is the international control symbol for hazard warning. The remainder of the multi-function switch is concealed beneath the steering column shrouds.

The multi-function switch also contains circuitry for the following functions:

- Headlamp beam selection
- Headlamp optical horn

The information contained in this group addresses only the multi-function switch turn signal and hazard warning functions. For information relative to the other systems that are controlled by and circuits that are integral to the multi-function switch, see the group in this service manual that covers that system. However, the turn signal and hazard warning switches cannot be repaired. If these switches or any other circuit or component of the multi-function switch unit is faulty or damaged, the entire multi-function switch unit must be replaced.

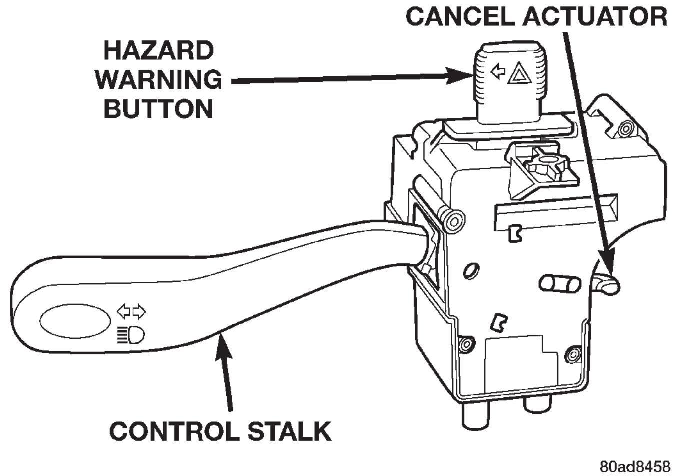


Fig. 1 Multi-Function Switch

OPERATION

TURN SIGNAL SWITCH

The multi-function switch control stalk that extends from the left side of the steering column just below the steering wheel is moved up or down to activate the turn signal switch. When the control stalk is moved in the upward direction, the right turn signal switch circuitry is activated; and, when the control stalk is moved in the downward direction, the left turn signal switch circuitry is activated. The turn signal switch has a detent position in each direction that provides turn signals with automatic cancellation, and an intermediate momentary position in each direction that provides turn signals only until the multi-function switch control stalk is released.

When the turn signal switch is in a detent position, it is turned off by one of two turn signal cancelling cam lobes that are integral to the rotor of the clockspring mechanism. Turning the steering wheel causes the turn signal cancelling cam lobes to contact a cancel actuator in the multi-function switch, and the turn signal switch automatically returns to the off position.

HAZARD WARNING SWITCH

The hazard warning switch is controlled by the hazard warning switch button. Slide the switch button to the left to turn the switch on and activate the hazard warning system, and slide the button to the right again to turn the switch and the hazard warning system off.

DESCRIPTION AND OPERATION (Continued)

TURN SIGNAL CANCELLING CAM

DESCRIPTION

The turn signal cancelling cam is concealed within the steering column below the steering wheel. The turn signal cancelling cam consists of two lobes that are integral to the lower surface of the clockspring rotor. The clockspring mechanism provides turn signal cancellation as well as a constant electrical connection between the horn switch, driver side airbag module and speed control switches on the steering wheel and the instrument panel wire harness on the steering column. The housing of the clockspring is secured to the steering column and remains stationary. The rotor of the clockspring, including the turn signal cancelling cam lobes rotate with the steering wheel.

The turn signal cancelling cam is integral to the clockspring and cannot be repaired. If faulty or damaged, the entire clockspring assembly must be replaced. Refer to **Clockspring** in the Removal and Installation section of Group 8M - Passive Restraint Systems for the clockspring service procedures.

OPERATION

The turn signal cancelling cam has two lobes molded into the lower surface of the clockspring rotor. When the turn signals are activated by moving the multi-function switch control stalk to a detent position, a turn signal cancel actuator is extended from the inside surface of the multi-function switch housing toward the clockspring rotor. When the steering wheel is rotated during the turn, one of the two turn signal cancelling cam lobes will contact the turn signal cancel actuator, releasing the multi-function switch control stalk from its detent and cancelling the turn signal event.

COMBINATION FLASHER

DESCRIPTION

The combination flasher is a smart relay that functions as both the turn signal system and the hazard warning system flasher. The combination flasher contains active electronic Integrated Circuitry (IC) elements. This flasher is designed to handle the current flow requirements of the factory-installed lighting. If supplemental lighting is added to the turn signal lamp circuits, such as when towing a trailer with lights, the combination flasher will automatically try to compensate to keep the flash rate the same.

While the combination flasher has a International Standards Organization (ISO)-type relay terminal configuration or footprint, the internal circuitry is much different. The combination flasher does not use standard ISO-relay inputs or provide ISO-relay type outputs or functions. The combination flasher should never be substituted for an ISO-relay or replaced with an ISO-relay, or else component and vehicle damage may occur.

Because of the active electronic elements within the combination flasher, it cannot be tested with conventional automotive electrical test equipment. If the combination flasher is believed to be faulty, test the turn signal system and hazard warning system circuits as described in this group. Then replace the combination flasher with a known good unit to confirm system operation.

The combination flasher has five blade-type terminals intended for the following inputs and outputs: fused B(+), fused ignition switch output, ground, turn signal circuit, and hazard warning circuit. Constant battery voltage and ground are supplied to the flasher so that it can perform the hazard warning function, and ignition switched battery voltage is supplied for the turn signal function. Refer to **Turn Signals** in the Contents of Group 8W - Wiring Diagrams for complete circuit diagrams.

The combination flasher is located in a wire harness connector which is secured to the diagnostics splice block bracket outboard of the steering column opening underneath the instrument panel. The combination flasher cannot be repaired or adjusted and, if faulty or damaged, it must be replaced.

OPERATION

The IC within the combination flasher (Fig. 2) contains the logic that controls the flasher operation and the flash rate. Pin 6 of the IC receives a sense voltage from the hazard warning circuit of the multi-function switch. When the hazard warning switch is turned on, the ″hazard on sense″ voltage will become low due to the circuit being grounded through the turn signal bulbs. This low voltage sense signals the IC to energize the flash control Positive-Negative-Positive (PNP) transistor at a pre-calibrated flash rate or frequency. Each time the PNP transistor energizes the hazard warning circuit, the pin 6 ″hazard on sense″ voltage will become high and the IC signals the PNP transistor to de-energize the circuit. This cycling will continue until the hazard warning switch is turned off.

Likewise, pin 8 of the IC receives a sense voltage from the turn signal circuits of the multi-function switch. When the left or right turn signal switch is turned on, the ″turn signal on sense″ voltage will become low due to the circuit being grounded through the turn signal bulbs. This low voltage sense signals the IC to energize the flash control PNP transistor at a pre-calibrated flash rate or frequency. Each time the PNP transistor energizes the turn signal circuit, the pin 8 ″turn signal on sense″ voltage

DESCRIPTION AND OPERATION (Continued)

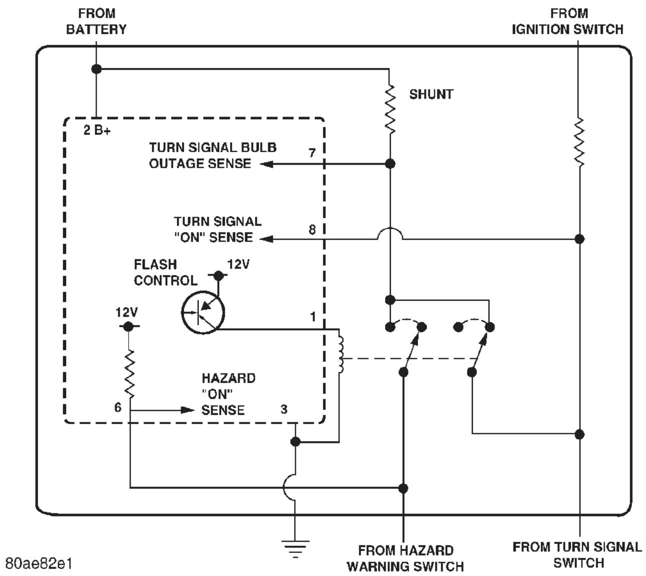


Fig. 2 Combination Flasher - Typical

will become high and the IC signals the PNP transistor to de-energize the circuit. This cycling will continue until the right or left turn signal switch is turned off.

A special design feature of the combination flasher allows it to ″sense″ that a turn signal circuit or bulb is not operating, and provide the driver an indication of the condition by flashing the remaining bulbs in the affected circuit at a higher rate (120 flashes-per-minute or higher). Conventional flashers either continue flashing at their typical rate (heavy-duty type), or discontinue flashing the affected circuit entirely (standard-duty type). During turn signal operation, the combination flasher IC compares normal battery voltage input on pin 2 with the shunt resistor voltage input on pin 7. If the IC ″senses″ that the voltage difference between pin 2 and pin 7 is different than the pre-calibrated value of the IC, it will increase the rate at which it signals the PNP transistor to energize the pin 1 output. Thus, the inoperative half (left or right side) of the turn signal circuit will flash faster.

DIAGNOSIS AND TESTING

TURN SIGNAL AND HAZARD WARNING SYSTEMS

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 **Charging System** in the Diagnosis and Testing section of Group 8C - Charging System for further diagnosis of a possible generator overcharging condition.

If the problem being diagnosed is related to a failure of the turn signals to automatically cancel following completion of a turn, inspect the multi-function switch for a faulty or damaged cancel actuator and inspect the turn signal cancelling cam lobes on the clockspring mechanism for damage or improper installation. For complete circuit diagrams, refer to **Turn Signals** in the Contents of Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Turn the ignition switch to the On position. Actuate the turn signal switch or the hazard warning switch. Observe the turn signal indicator lamp(s) in the instrument cluster. If the flash rate is very high, check for a turn signal bulb that is not lit or is very dimly lit. Repair the circuits to that lamp or replace the faulty bulb, as required. If the turn signal indicator(s) fail to light, go to Step 2.

(2) Turn the ignition switch to the Off position. Check the turn signal fuse in the junction block and/or the hazard warning fuse in the Power Distribution Center (PDC). If OK, go to Step 3. If not OK, repair the shorted circuit or component as required and replace the faulty fuse(s).

(3) Check for battery voltage at the hazard warning fuse in the PDC. If OK, go to Step 4. If not OK, repair the open fused B(+) circuit to the battery as required.

(4) Turn the ignition switch to the On position. Check for battery voltage at the turn signal fuse in the fuseblock module. If OK, go to Step 5. If not OK, repair the open fused ignition switch output (accessory/run) circuit to the ignition switch as required.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the combination flasher from its wire harness connector and replace it with a known good unit. Connect the battery negative cable. Test the operation of the turn signal and hazard warning systems. If OK, discard the faulty combination flasher. If not OK, remove the test flasher and go to Step 6.

(6) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (accessory/run) circuit cavity in the combination flasher wire harness connector. If OK, go to Step 7. If not OK, go to Step 9.

DIAGNOSIS AND TESTING (Continued)

(7) Turn the ignition switch to the Off position. Place the hazard warning switch in the On position. Check for battery voltage again at the fused B+ circuit cavity in the combination flasher wire harness connector. If OK, go to Step 8. If not OK, go to Step 9.

(8) Disconnect and isolate the battery negative cable. Check for continuity between the ground circuit cavity of the combination flasher wire harness connector and a good ground. There should be continuity. If OK, go to Step 9. If not OK, repair the open ground circuit to ground as required.

(9) Disconnect the instrument panel wire harness connector from the multi-function switch connector receptacle. Check for continuity between the turn signal output circuit cavities in the combination flasher wire harness connector and in the instrument panel wire harness connector for the multi-function switch. There should be continuity. If OK, go to Step 10. If not OK, repair the open turn signal output circuit as required.

(10) Check for continuity between the hazard warning output circuit cavities in the combination flasher wire harness connector and in the instrument panel wire harness connector for the multi-function switch. There should be continuity. If OK, refer to **Turn Signal Switch and Hazard Warning Switch** in the Diagnosis and Testing section of this group. If not OK, repair the open hazard warning output circuit as required.

TURN SIGNAL SWITCH AND HAZARD WARNING SWITCH

The turn signal switch and the hazard warning switch are integral to the multi-function switch. Refer to **Turn Signal and Hazard Warning Systems** in the Diagnosis and Testing section of this group before testing the multi-function switch. For complete circuit diagrams, refer to **Turn Signals** in the Contents of Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector from the multi-function switch connector receptacle.

(2) Using an ohmmeter, perform the switch continuity checks at the connector receptacle terminals as shown in the Multi-Function Switch Continuity chart (Fig. 3).

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

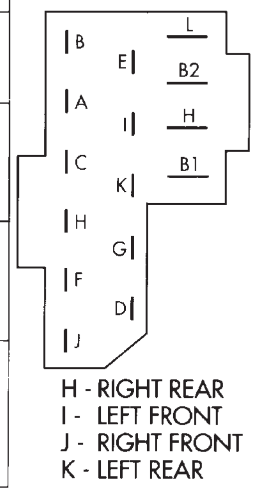


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Fig. 3 Multi-Function Switch Continuity

(3) If the turn signal switch or hazard warning switch fails any of the continuity checks, replace the faulty multi-function switch assembly as required. If the switch circuits are OK, repair the lighting circuits as required.

REMOVAL AND INSTALLATION

COMBINATION FLASHER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the knee blocker from the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

REMOVAL AND INSTALLATION (Continued)

(3) Reach through the outboard side of the steering column opening to access and disengage the combination flasher wire harness connector retainer from the instrument panel diagnostics mounting bracket (Fig. 4).

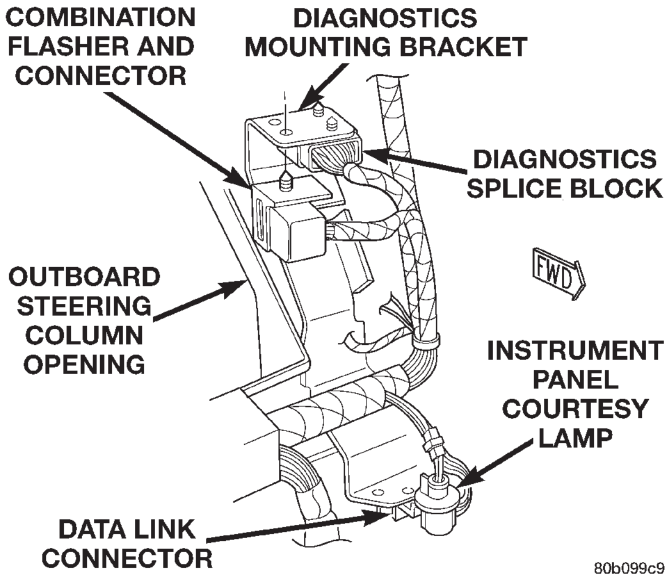


Fig. 4 Combination Flasher Remove/Install

(4) Pull the combination flasher into the instrument panel steering column opening far enough to access the wire harness connector.

(5) Remove the combination flasher from the wire harness connector.

(6) Remove the combination flasher from under the instrument panel.

INSTALLATION

(1) Position the combination flasher under the instrument panel.

(2) Align the combination flasher terminals with the terminal cavities in the wire harness connector.

(3) Push in firmly on the combination flasher until the terminals are fully seated in the terminal cavities in the wire harness connector.

(4) Install the combination flasher wire harness connector retainer into the mounting hole of the instrument panel diagnostics mounting bracket.

(5) Install the knee blocker onto the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(6) Reconnect the battery negative cable.

TURN SIGNAL SWITCH AND HAZARD WARNING SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the knee blocker from the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(3) Remove the three screws that secure the lower steering column shroud to the upper shroud (Fig. 5).

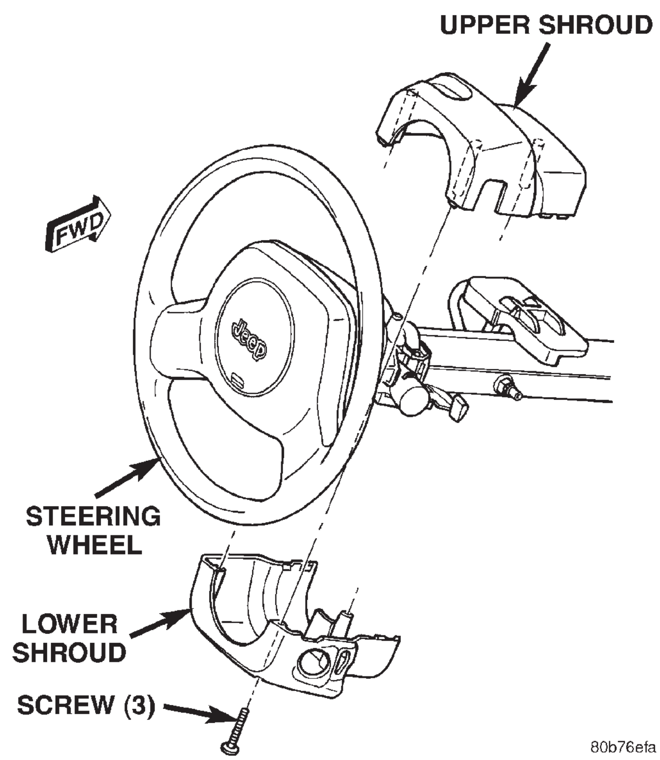


Fig. 5 Steering Column Shrouds Remove/Install

(4) If the vehicle is equipped with a standard non-tilt steering column, loosen the two upper steering column mounting nuts. If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully lowered position.

REMOVAL AND INSTALLATION (Continued)

(5) Remove both the upper and lower shrouds from the steering column.

(6) Remove the two screws that secure the multi-function switch water shield and bracket to the top of the steering column (Fig. 6).

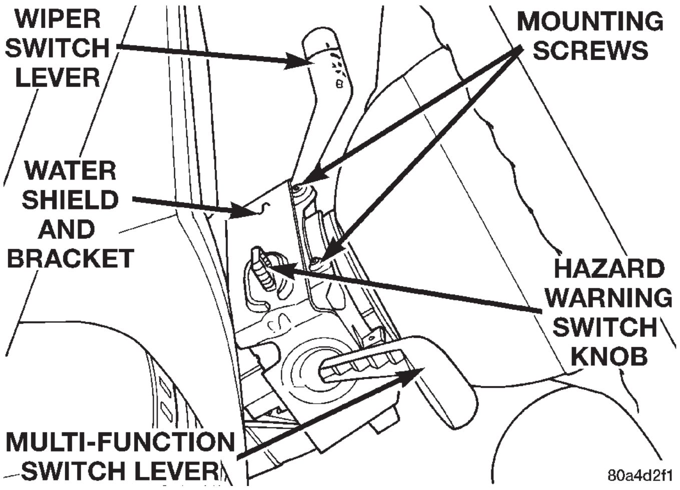


Fig. 6 Water Shield Upper Screws Remove/Install

(7) Remove the one screw located below the multi-function switch control stalk that secures the multi-function switch water shield and bracket to the steering column (Fig. 7).

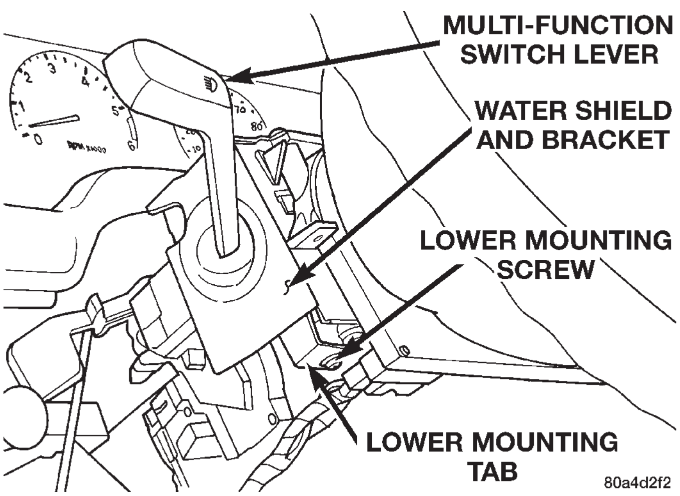


Fig. 7 Water Shield Lower Screw Remove/Install

(8) Gently pull the lower mounting tab of the multi-function switch water shield bracket away from the steering column far enough to clear the screw boss below the multi-function switch control stalk.

(9) Lift the water shield and bracket with the multi-function switch off of the left side of the steering column far enough to access the two multi-function switch wire harness connectors. If the vehicle is equipped with the optional tilt steering column, lifting gently upward on the tilt release lever will provide additional clearance to ease multi-function switch removal.

(10) Disconnect the two instrument panel wire harness connectors from the multi-function switch connector receptacles.

(11) Remove the multi-function switch and water shield from the steering column as a unit.

(12) Gently and carefully remove the water shield from the switch by pulling it over the hazard warning switch button and the multi-function switch control stalk.

INSTALLATION

(1) Gently and carefully install the water shield onto the switch by pulling it over the hazard warning switch button and the multi-function switch control stalk.

(2) Position the multi-function switch and water shield near its mounts on the steering column as a unit.

(3) Reconnect the two instrument panel wire harness connectors to the multi-function switch connector receptacles.

(4) Position the multi-function switch onto its mounts on the left side of the steering column. If the vehicle is equipped with the optional tilt steering column, lifting gently upward on the tilt release lever will provide additional clearance to ease multi-function switch installation.

(5) Position the lower mounting tab of the multi-function switch water shield bracket to the steering column screw boss below the multi-function switch control stalk.

(6) Install and tighten the one screw located below the multi-function switch control stalk that secures the multi-function switch water shield and bracket to the steering column. Tighten the screw to 1.1 N·m (10 in. lbs.).

(7) Install and tighten the two screws that secure the multi-function switch water shield and bracket to the top of the steering column. Tighten the screws to 2.2 N·m (20 in. lbs.).

(8) Position both the upper and lower shrouds onto the steering column.

(9) Install and tighten the three screws that secure the lower steering column shroud to the upper shroud. Tighten the screws to 2 N·m (18 in. lbs.).

(10) If the vehicle is so equipped, tighten the two nuts that secure the non-tilt steering column upper mounting bracket to the dash panel steering column support bracket studs. Tighten the nuts to 22 N·m (200 in. lbs.).

(11) Install the knee blocker onto the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(12) Reconnect the battery negative cable.

WIPER AND WASHER SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Windshield wiper and washer systems are standard factory-installed equipment on this model. A rear wiper and washer system is optional factory-installed equipment. Following is general information about the available wiper and washer systems for this vehicle. 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.

WINDSHIELD WIPER SYSTEM

An intermittent windshield wiper system is standard equipment on this model. The intermittent wiper system lets the driver select from either of two wiper speeds, low or high, or the intermittent wipe delay mode.

The intermittent wipe mode delay times are driver adjustable from about one second to about fifteen seconds. The intermittent wipe mode is provided 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 circuit breaker located in the junction block protects the circuitry of the windshield wiper system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the windshield wiper system.

WINDSHIELD WASHER SYSTEM

An electrically operated windshield washer system is standard equipment. The washer reservoir is located between the inner and outer front fenders, above and forward of the left front wheel housing. The reservoir filler neck is located in the engine compartment on the left inner fender shield.

The washer reservoir 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.

A low washer fluid warning lamp is standard equipment on all models equipped with the optional rear wiper and washer system. The low washer fluid warning lamp in the instrument cluster will warn

GENERAL INFORMATION (Continued)

the driver when the washer fluid level needs to be checked. Refer to Group 8E - Instrument Panel Systems for more information on this feature.

The washers will operate only when the ignition switch is in the Accessory or On positions. If the wipers are not already turned on when the washers are activated, the wipers will be automatically cycled for one or two wipes, then be turned off. A fuse located in the junction block protects the circuitry of the washer system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the windshield washer system.

REAR WIPER AND WASHER SYSTEM

A rear wiper and washer system is an available option on this model. The rear wiper system is a fixed-cycle wiper system. 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.

The rear wiper and washer systems will operate only when the ignition switch is in the Accessory or On positions. A fuse in the junction block protects the circuitry of both the rear wiper and washer systems.

Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the rear wiper and washer system.

DESCRIPTION AND OPERATION

WIPER ARM AND BLADE

All Cherokee models have two 45.72-centimeter (18-inch) windshield wiper blades with non-replaceable rubber elements (squeegees). The optional rear wiper uses a single 33.0-centimeter (13-inch) wiper blade with a non-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, the entire wiper blade assembly must be replaced.

Wiper squeegees exposed to the elements for a long time tend to lose their wiping effectiveness. Periodic cleaning of the squeegees is suggested to remove deposits of salt and road film. The wiper blades, arms, and windshield or rear glass should be cleaned with a sponge or cloth and windshield washer fluid, a mild detergent, or a non-abrasive cleaner. If the squeegees continue to streak or smear, the wiper blades should be replaced.

The blades are mounted to spring-loaded wiper arms. The spring tension of the wiper arms controls the pressure applied to the blades on the glass. The windshield wiper arms are secured by an integral latch to the two wiper pivots on the cowl plenum cover/grille panel at the base of the windshield. The rear wiper arm is secured by a nut directly to the rear wiper motor output shaft on the liftgate below the liftgate glass.

The wiper arms and blades cannot be adjusted or repaired. If faulty or damaged, they must be replaced.

WIPER LINKAGE AND PIVOT

The wiper linkage and pivot module is secured with screws to the cowl top panel beneath the cowl plenum cover/grille panel. The wiper motor is secured with screws to the center of the linkage and pivot module bracket. The wiper pivots are secured to the ends of the module bracket.

The two wiper pivot crank arms and the wiper motor crank arm each have ball studs on their ends. The left pivot ball stud is the longer of the three. A connecting link with a plastic socket-type bushing in the right end, and a plastic sleeve-type bushing in the left end, is fit over the pivot ball studs to join the two pivots.

The wiper drive link has a plastic socket-type bushing on each end. One end of the drive link is snap-fit over the exposed end of the longer left pivot ball stud, while the other end is snap-fit over the ball stud on the wiper motor crank arm.

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 or damaged, the entire unit must be replaced.

WIPER MOTOR

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 secured to the wiper linkage and pivot module bracket with three screws and is protected by a rubber boot. The wiper motor output shaft passes through a hole in the module bracket, where a nut secures the wiper motor crank arm to the motor output shaft. A reinforcement and stud plate with a rubber-isolated mounting bracket extends from the cowl plenum side of the dash panel to the motor mounting bracket to provide additional support.

Wiper speed is controlled by current flow to the proper set of brushes. The wiper motor completes its

DESCRIPTION AND OPERATION (Continued)

wipe cycle when the windshield wiper switch stalk is moved to the Off position, and parks the blades in the lowest portion of the wipe pattern.

The windshield wiper motor cannot be repaired. If faulty or damaged, the entire wiper linkage and pivot module unit must be replaced. The reinforcement bracket and stud plate are available for service.

REAR

The rear wiper motor is secured to a bracket that is fastened to the liftgate inner panel, below the liftgate glass and behind the liftgate trim panel. The motor output shaft passes through the liftgate outer panel where a rubber gasket and plastic bezel unit, and a nut seal and secure the unit to the liftgate outer panel. The rear wiper arm is secured directly to the motor output shaft with a nut.

The rear wiper motor unit provides three operating modes:

- Constant wipe that operates when the rear wiper switch is turned to the On position.
- Constant wipe that operates when the rear washer switch is depressed.
- A park mode that operates the wiper motor until the blade reaches its park position when either the rear wiper switch or the ignition switch is placed in the Off position.

The rear wiper motor cannot be repaired. If faulty or damaged, the entire rear wiper motor assembly must be replaced.

WIPER SWITCH AND WASHER SWITCH

FRONT

The windshield wiper and washer switches are mounted on the right side of the steering column (Fig. 1). The switch stalk is moved up or down to select the wiper switch mode, and pulled towards the steering wheel to activate the washer system. An intermittent wipe system control knob on the end of the switch stalk is rotated to select the desired delay interval. The windshield wiper and washer switch contains circuitry for the following functions:

- Windshield wipers
- Intermittent wiper delay relay control and logic
- Intermittent wipe relay
- Windshield washers.

The windshield wiper and washer switch cannot be repaired. If any function of the switch is faulty, or if the switch is damaged, the entire switch unit must be replaced.

REAR

The single two-function rear wiper and washer switch is installed in the instrument panel accessory switch bezel, which is located near the bottom of the instrument panel center bezel area, below the heater and air conditioner controls. The rear wiper and washer switch controls the rear wiper and washer functions.

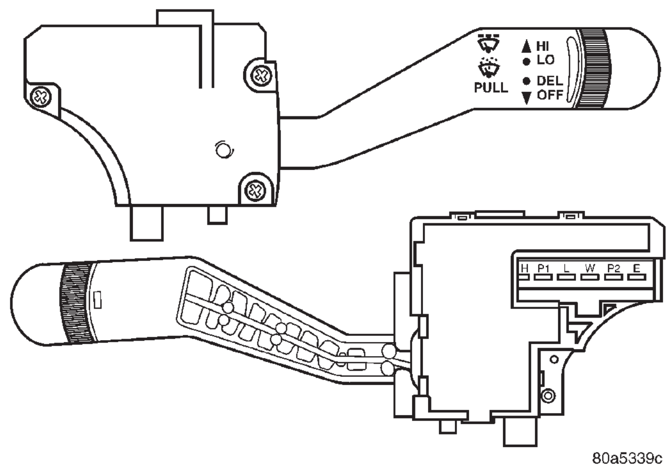


Fig. 1 Windshield Wiper Switch and Washer Switch

The toggle-type switch features a detent in the On position, and a momentary Wash position. The rear wiper and 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.

The rear wiper and washer switch cannot be repaired and, if faulty or damaged, the entire switch unit must be replaced.

WASHER RESERVOIR

A single washer fluid reservoir is used for both the standard front and optional rear washer systems. The washer fluid reservoir is secured between the left front inner and outer fender panels, above and in front of the left front wheel house.

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 washer reservoir has a separate filler neck and grommet seal. The filler neck snaps into the reservoir from the engine compartment side of the left inner fender shield. A snap-fit filler cap with an integral bail strap is fit to the reservoir filler neck. On models so equipped, the reservoir also has a hole provided for a washer fluid level sensor.

The washer reservoir, filler neck, grommet seal, and filler cap are each available for service.

DESCRIPTION AND OPERATION (Continued)

WASHER PUMP

The washer pumps and motors are mounted near the bottom of the washer reservoir. A barbed nipple on the pump housing passes through a rubber grommet seal installed in a hole near the bottom of the reservoir. The washer pump is retained by an interference fit between the barbed pump nipple and the grommet seal, which is a light press fit.

A permanently lubricated and sealed motor is coupled to a rotor-type pump. Washer fluid is gravity-fed from the reservoir to the pump. When the motor is energized, the pump pressurizes the washer fluid and forces it through the plumbing to the nozzles.

On vehicles with the optional rear wiper/washer system, the front washer pump and motor is always mounted in the lower hole of the reservoir. The washer pump and motor unit cannot be repaired. If faulty, the entire washer pump and motor unit must be replaced.

WASHER FLUID LEVEL SENSOR

The washer fluid level sensor is mounted near the front of the washer reservoir, above the two washer pumps. A barbed nipple on the sensor is press-fit into a rubber grommet seal installed in a hole in the front of the reservoir.

When the fluid level in the reservoir falls below the pivoting float on the sensor, the float changes position and closes the internal switch contacts of the sensor. Refer to Group 8E - Instrument Panel Systems for diagnosis of the low washer fluid warning lamp and circuit, including the sensor.

The washer fluid level sensor cannot be repaired. If faulty or damaged, the sensor unit must be replaced.

WASHER NOZZLE AND PLUMBING

FRONT

Pressurized washer fluid is fed through a single hose, attached to a barbed nipple on the front washer pump. The hose is routed to a tee fitting located in the cowl plenum area, beneath the cowl plenum cover/grille panel. Hoses from the tee fitting are routed to the two nozzles, which are riveted into openings in the cowl plenum cover/grille panel below the windshield.

The two fluidic washer nozzles are not adjustable. The nozzles and hose fittings cannot be repaired and, if faulty or damaged, they must be replaced.

REAR

Pressurized washer fluid is fed through a single hose, attached to a barbed nipple on the rear washer pump. The hose is routed from the front of the vehicle to the liftgate with the body wire harness.

Located at the highest point of the supply hose routing, beneath the liftgate opening upper header garnish moulding, the hose connects to a check valve. The check valve prevents washer fluid drain-back or siphoning from occurring. From the check valve, another single hose is routed through a grommet to the liftgate, where it is connected to a nipple that protrudes from the inside of the rear wiper motor output shaft bezel.

The washer fluid passes through the bezel nipple to the outside of the liftgate. There a single hose is connected to a nipple on the outside of the rear wiper motor output shaft bezel. The hose is routed through a plastic trough-like guard snapped to the underside of the rear wiper arm. The hose is then attached to the single rear washer nozzle. The nozzle snaps into place on the rear wiper arm.

The rear washer nozzle cannot be adjusted. The nozzle, bezel, check valve, and hose fittings cannot be repaired and, if faulty or damaged, they must be replaced.

DIAGNOSIS AND TESTING

WIPER SYSTEM

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 ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the circuit breaker in the junction block. If OK, go to Step 2. If not OK, replace the faulty circuit breaker.

(2) Disconnect and isolate the battery negative cable. Unplug the windshield wiper switch wire harness connector. Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/acc) circuit cavity of the wiper switch wire harness connector. If OK, go to Step 3. If not OK, repair the open circuit to the junction block as required.

(3) If 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.

DIAGNOSIS AND TESTING (Continued)

(4) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Check for continuity between the ground circuit cavity of the wiper switch wire harness connector and a good ground. 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. Disconnect and isolate the battery negative cable. Remove the windshield wiper and washer switch and check the switch continuity. See Wiper Switch and Washer Switch in the Diagnosis and Testing section of this group for the procedures. If OK, go to Step 6. If not OK, replace the faulty switch.

(6) Unplug the windshield wiper motor wire harness connector. Check for continuity between the ground circuit cavity in the body half of the wiper motor wire harness 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) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/acc) circuit cavity in the body half of the wiper motor wire harness connector. If OK, go to Step 8. If not OK, repair the open circuit to the junction block as required.

(8) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. With the windshield wiper and washer switch wire harness connector still unplugged, check the cavities for each of the following circuits in the body half of the wiper motor wire harness connector for continuity to ground. In each case, there should be no continuity. If OK, go to Step 9. If not OK, repair the short circuit as required.

- Wiper park switch sense
- Wiper switch low speed output
- Wiper switch high speed output.

(9) Check for continuity between the cavities in the body half of the wiper motor wire harness connector and the cavities in the windshield wiper and washer switch wire harness 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 ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Disconnect and isolate the battery negative cable. Remove the accessory switch bezel and unplug the wire harness connector from the rear wiper and washer switch. Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output circuit cavity of the rear wiper and washer switch wire harness connector. If OK, go to Step 3. If not OK, repair the open circuit to the junction block as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Check for continuity between the ground circuit cavity of the rear wiper and washer switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit to ground as required.

(4) Test the rear wiper and washer switch continuity. See Wiper Switch and Washer Switch in the Diagnosis and Testing section of this group for the procedures. If OK, go to Step 5. If not OK, replace the faulty switch.

(5) Remove the liftgate trim panel and unplug the rear wiper motor wire harness connector. Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run) circuit cavity of the rear wiper motor wire harness connector. If OK, go to Step 6. If not OK, repair the open circuit to the junction block as required.

(6) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Check for continuity between the ground circuit cavity of the rear wiper motor wire harness 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) Check for continuity between the rear wiper motor control circuit cavity of the rear wiper motor wire harness 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.

DIAGNOSIS AND TESTING (Continued)

(8) Check for continuity between the rear wiper motor control circuit cavities of the rear wiper motor wire harness connector and the rear wiper and washer switch wire harness connector. There should be continuity. If OK, replace the faulty rear wiper motor. If not OK, repair the open circuit as required.

WASHER SYSTEM

FRONT

The diagnosis found here addresses an inoperative front 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 ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Turn the ignition switch to the On position. Turn the wiper switch to the Low or High speed position. Check whether the wipers operate. If OK, go to Step 2. If not OK, see the Wiper System diagnosis in this group.

(2) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the front washer pump wire harness connector. Check for continuity between the ground circuit cavity of the front washer pump wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit to ground as required.

(3) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the front washer switch output circuit cavity of the front washer pump wire harness 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. Disconnect and isolate the battery negative cable. Unplug the windshield wiper/washer switch wire harness connector. Check for continuity between the front washer switch output circuit cavity of the front washer pump wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5 If not OK, repair the short circuit as required.

(5) Check for continuity between the front washer switch output circuit cavities of the front washer pump wire harness connector and the wiper/washer switch wire harness 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 rear washer pump. If the washer pump operates, but no washer fluid is emitted from the washer nozzle, be certain to check the fluid level in the reservoir. Check for ice or other foreign material in the reservoir, and for pinched, disconnected, broken, or incorrectly routed washer system plumbing. For circuit descriptions and diagrams, refer to 8W-53 - Wipers in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Turn the ignition switch to the On position. 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 Wiper System diagnosis in this group.

(2) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the rear washer pump wire harness connector. Check for continuity between the ground circuit cavity of the rear washer pump wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit to ground as required.

(3) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the rear washer motor control circuit cavity of the rear washer pump wire harness connector while the rear washer switch is actuated. If OK, replace the faulty pump. If not OK, go to Step 4.

(4) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the rear wiper/washer switch wire harness connector. Check for continuity between the rear washer motor control circuit cavity of the rear washer pump wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the short circuit as required.

DIAGNOSIS AND TESTING (Continued)

(5) Check for continuity between the rear washer motor control circuit cavities of the rear washer pump wire harness connector and the rear wiper/washer switch wire harness connector. There should be continuity. If OK, replace the faulty switch. If not OK, repair the open circuit as required.

WIPER SWITCH AND WASHER SWITCH

FRONT

Perform the diagnosis for the front wiper system and/or washer system as described in this group before testing the front wiper and 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 ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the front wiper and washer switch from the steering column and unplug the wire harness connector from the switch.

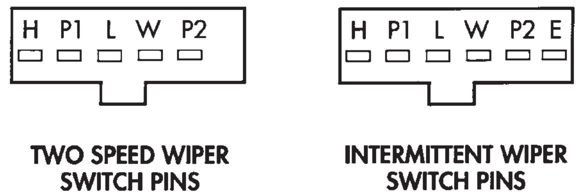
(3) Using an ohmmeter, perform the switch continuity checks at the switch terminals as shown in the Windshield Wiper Switch and Washer Switch Continuity chart (Fig. 2).

(4) If the switch fails any of the continuity checks, replace the faulty switch. If the switch is OK, repair the wiper system and/or washer system wire harness circuits as required.

REAR

Perform the diagnosis for the rear wiper system and/or washer system as described in this group before testing the rear wiper and 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 ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.



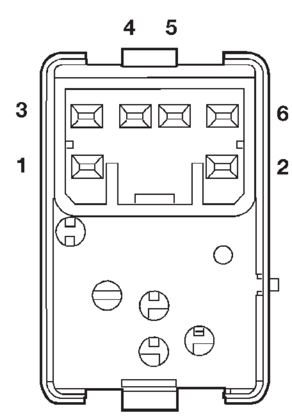
SWITCH POSITION	CONTINUITY BETWEEN
OFF	PIN P2 and PIN L
LOW	PIN P1 and PIN L
HIGH	PIN P1 and PIN H
WASH	PIN P1 and PIN W
INTERMITTENT	CANNOT BE CHECKED

948K-38

Fig. 2 Windshield Wiper Switch and Washer Switch Continuity

(1) Remove the accessory switch bezel from the instrument panel and unplug the rear wiper and washer switch wire harness connector.

(2) Using an ohmmeter, check the rear wiper and washer switch continuity at the switch terminals as shown in the Rear Wiper Switch and Washer Switch Continuity chart (Fig. 3).



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. 3 Rear Wiper Switch and Washer Switch Continuity

(3) If the switch fails any of the continuity checks, replace the faulty switch. If the switch is OK, repair the rear wiper system and/or washer system wire harness circuits as required.

REMOVAL AND INSTALLATION

WIPER BLADE

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.

(1) Lift the wiper arm to raise the wiper blade and element off of the windshield glass.

(2) To remove the wiper blade from the wiper arm, push the release tab under the arm tip and slide the blade away from the tip towards the pivot end of the arm (Fig. 4).

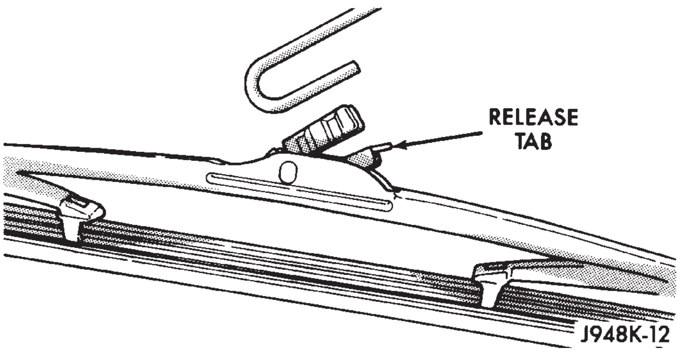


Fig. 4 Wiper Blade Remove/Install - Typical

(3) To install the wiper blade on the wiper arm, slide the blade retainer into the U-shaped formation on the tip of the wiper arm until the release tab snaps into its locked position. Be certain that the notched retainer for the wiper element is oriented towards the end of the wiper blade that is nearest to the wiper pivot.

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.

(1) Lift the rear wiper arm to raise the wiper blade and element off of the rear liftglass.

(2) 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 rear wiper motor output shaft end of the arm (Fig. 4).

(3) To install the wiper blade on the wiper arm, slide the blade retainer into the U-shaped formation on the tip of the wiper arm until the release tab snaps into its locked position. Be certain that the notched retainer for the wiper element is oriented towards the end of the wiper blade that is nearest to the rear wiper motor output shaft.

WIPER ARM

CAUTION: The use of a screwdriver or other prying tool to remove a wiper arm may distort it. This distortion could allow the arm to come off of the pivot shaft, regardless of how carefully it is installed.

FRONT

(1) Lift the wiper arm to permit the latch to be pulled out to its holding position, then release the arm (Fig. 5). The arm will remain off the windshield with the latch in this position.

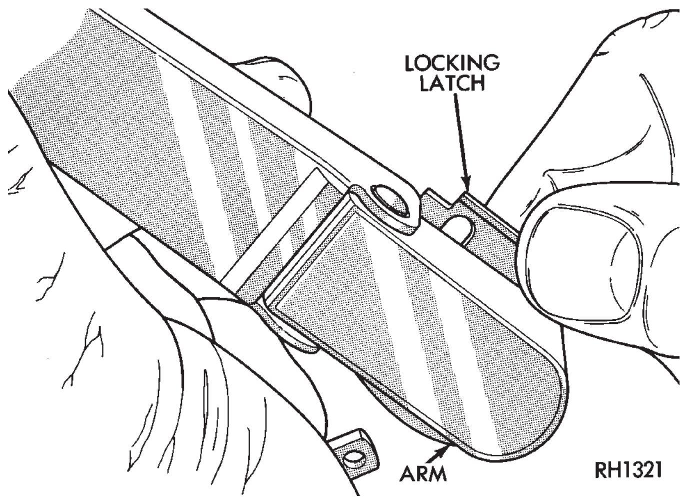


Fig. 5 Wiper Arm Remove/Install

(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 Front Wiper Arm Installation illustration (Fig. 6).

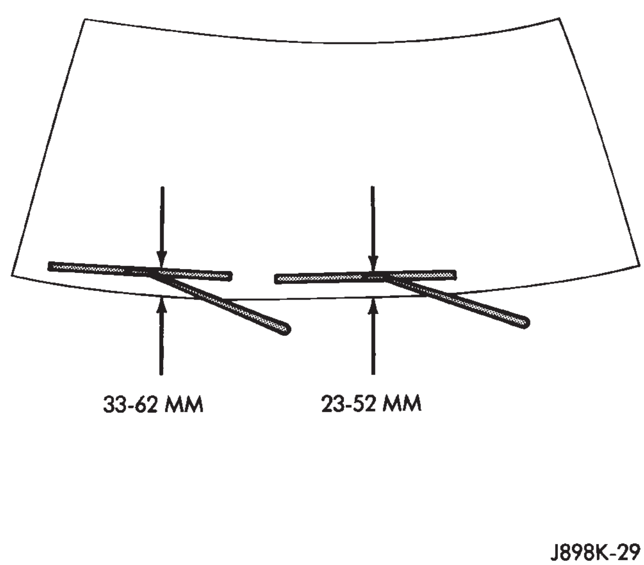


Fig. 6 Front Wiper Arm Installation

REMOVAL AND INSTALLATION (Continued)

(4) Mount the arms on the pivot shafts so that the distance from the lower edge of the wiper arm tip to the upper edge of the lower windshield moulding is:

- 23 to 52 mm (0.90 to 2.04 inch) on the driver side
- 33 to 62 mm (1.29 to 2.44 inch) on the passenger side.

(5) Lift the wiper arm away from the windshield slightly to relieve the spring tension on the latch. Push the latch into the locked position and slowly release the arm until the wiper blade rests on the windshield.

(6) 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.

REAR

(1) Disconnect the washer nozzle hose and clip from the external nipple of the rear wiper motor output shaft bezel.

(2) Lift the wiper arm pivot cover and remove the retaining nut (Fig. 7).

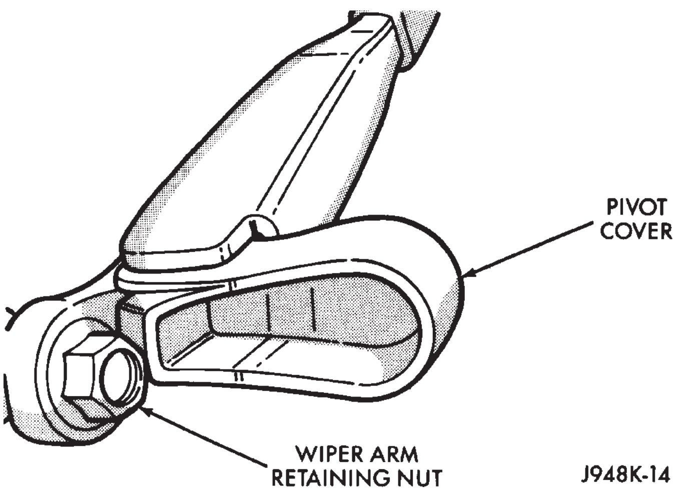


Fig. 7 Rear Wiper Arm Remove/Install

(3) Remove the wiper arm from the motor output shaft using a rocking motion.

(4) 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 the liftgate glass opening, and install the wiper arm retaining nut.

(5) Operate the rear wiper with the liftgate glass wet, then turn the rear wiper switch to the Off position so that the blade moves to the Park position.

(6) The measurement from the tip of the blade should now be from 27 to 35 mm (1.06 to 1.38 inch) above the upper edge of the lower liftgate glass seal (Fig. 8). Check for the correct wiper arm positioning and readjust if required.

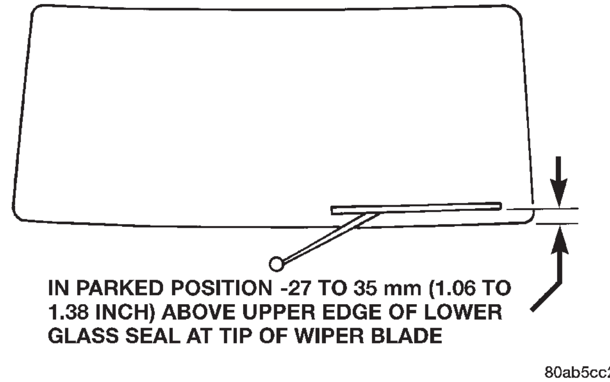


Fig. 8 Rear Wiper Arm Installation

(7) Tighten the wiper arm retaining nut to 18 N·m (160 in. lbs.) and close the pivot cover.

WIPER LINKAGE AND PIVOT

The wiper linkage and pivots can only be removed from or installed in the vehicle as a unit with the wiper motor. See Wiper Motor in this group for the service procedures.

WIPER MOTOR

FRONT

(1) Disconnect and isolate the battery negative cable.

(2) Remove the wiper arms from the wiper pivots. See Wiper Arm in this group for the procedures.

(3) Remove the eight screws that secure the cowl plenum cover/grille panel and screen to the cowl top panel (Fig. 9).

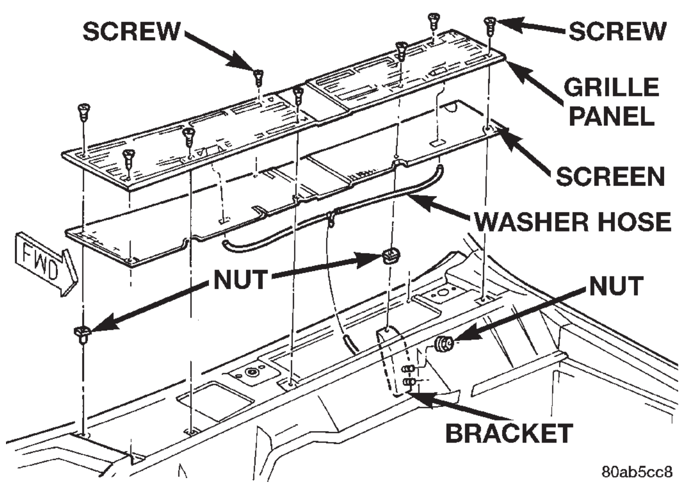


Fig. 9 Cowl Plenum Cover/Grille Panel Remove/ Install

(4) Carefully lift the cowl plenum cover/grille panel and screen from the vehicle far enough to access the windshield washer plumbing. Use care so as not to

REMOVAL AND INSTALLATION (Continued)

damage the paint around the pivot openings of the panel.

(5) Disconnect the windshield washer supply hose and the passenger side washer nozzle hose from the washer nozzle supply hose tee fitting.

(6) Remove the cowl plenum cover/grille panel and screen from the vehicle.

(7) Reach into the cowl plenum and unplug the wiper motor wire harness connector.

(8) Open and support the hood

(9) Remove the two nuts that secure the studs of the wiper module mounting bracket and reinforcement to the dash panel (Fig. 10).

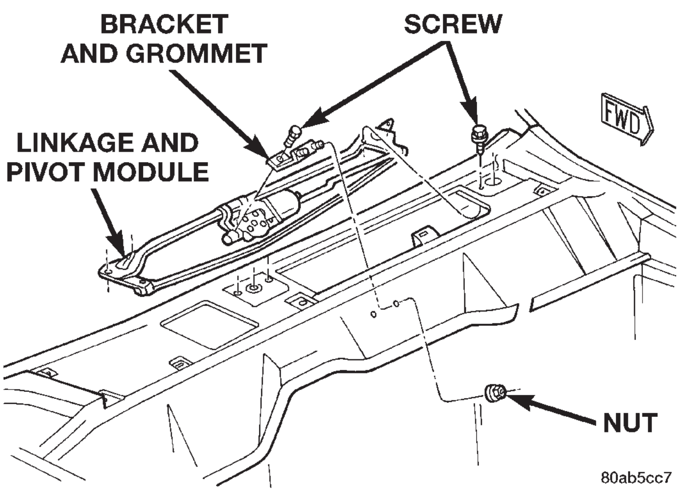


Fig. 10 Wiper Linkage Module Remove/Install

(10) Remove the four screws near the wiper pivots that secure the wiper module to the cowl plenum panel.

(11) Remove the wiper module from the cowl plenum as a unit.

(12) Reverse the removal procedures to install. Tighten the mounting hardware as follows:

• Wiper module mounting screws - 6 N·m (50 in. lbs.)

• Wiper module mounting bracket and reinforcement nuts - 6 N·m (50 in. lbs.).

REAR

(1) Disconnect and isolate the battery negative cable.

(2) From the outside of the liftgate glass, remove the rear wiper arm from the rear wiper motor output shaft. See Wiper Arm in this group for the procedures.

(3) From the outside of the liftgate, remove the rear wiper motor output shaft nut (Fig. 11).

(4) Pull the rear wiper motor output shaft bezel and rubber gasket away from the liftgate far enough to access the washer supply hose.

(5) Disconnect the washer supply hose from the internal nipple on the bezel.

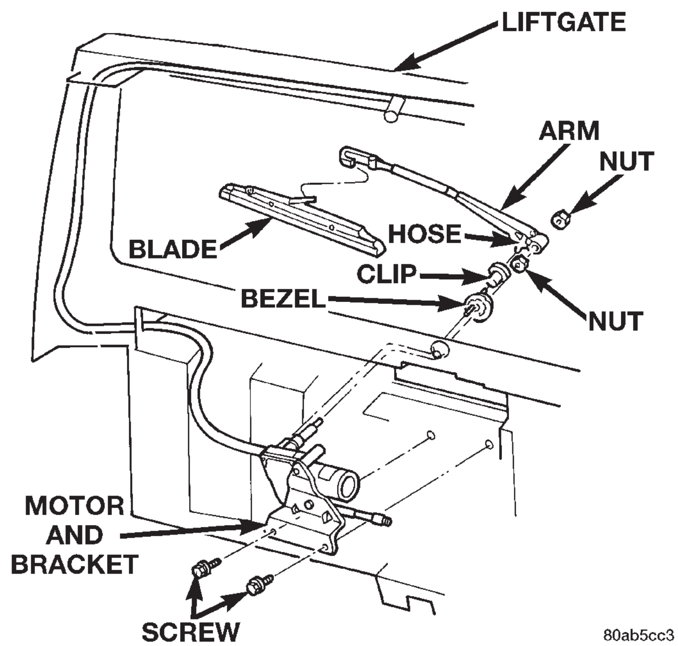


Fig. 11 Rear Wiper Motor Remove/Install

(6) Remove the bezel and rubber gasket from the motor output shaft.

(7) Remove the liftgate trim panel from the liftgate. Refer to Group 23 - Body for the procedures.

(8) Unplug the rear wiper motor wire harness connector.

(9) Remove the two screws that secure the rear wiper motor mounting bracket to the liftgate inner panel.

(10) Remove the rear wiper motor and mounting bracket from the liftgate as a unit.

(11) Reverse the removal procedures to install. Tighten the mounting hardware as follows:

• Rear wiper motor mounting bracket screws - 5 N·m (45 in. lbs.)

• Rear wiper motor output shaft retaining nut - 3 N·m (27 in. lbs.).

WIPER SWITCH AND WASHER SWITCH

FRONT

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL AND INSTALLATION (Continued)

(1) Disconnect and isolate the battery negative cable.

(2) Remove the knee blocker from the instrument panel. See Knee Blocker in Group 8E - Instrument Panel Systems for the procedures.

(3) If the vehicle is so equipped, move the tilt steering 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. 12).

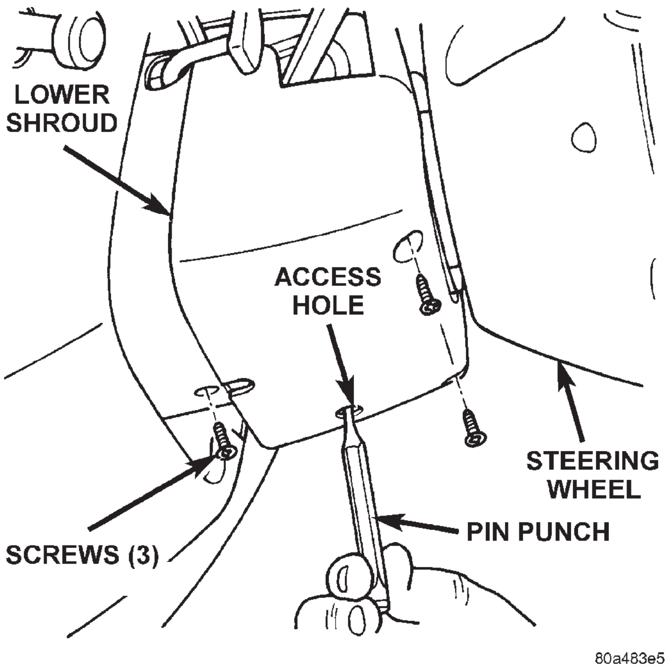


Fig. 12 Steering Column Shrouds Remove/Install

(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 so equipped, move the tilt steering column to the fully lowered position.

(9) If the vehicle is so equipped, loosen the two nuts that secure the non-tilt steering column upper mounting bracket to the dash panel steering column support bracket studs. Lower the column far enough to remove the upper steering column shroud.

(10) Remove both the upper and lower shrouds from the steering column.

(11) Remove the two screws that secure the multi-function switch water shield and bracket to the top of the steering column (Fig. 13).

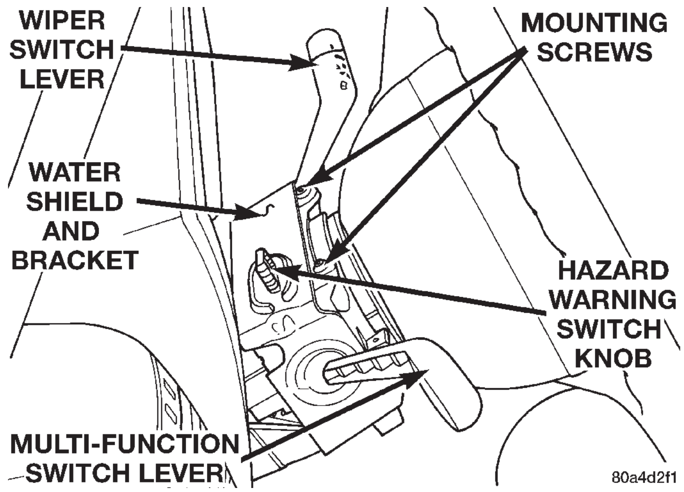


Fig. 13 Water Shield Upper Screws Remove/Install

(12) Remove the one screw located below the multi-function switch lever that secures the multi-function switch water shield and bracket to the steering column (Fig. 14).

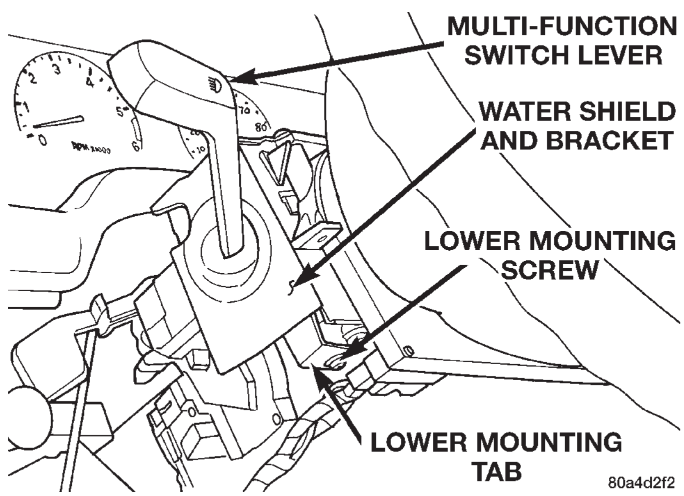


Fig. 14 Water Shield Lower Screw Remove/Install

(13) Gently pull the lower mounting tab of the multi-function switch water shield bracket away from the steering column far enough to clear the screw boss below the multi-function switch lever.

(14) 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. If the vehicle is equipped with the optional tilt steering column, lifting gently upward on the tilt release lever will provide additional clearance to ease multi-function switch removal.

(15) Gently pull the windshield wiper and washer switch up and away from the right side of the steering column far enough to access the wire harness connector.

(16) Unplug the wire harness connector from the windshield wiper and washer switch.

REMOVAL AND INSTALLATION (Continued)

(17) Remove the windshield wiper and washer switch from the steering column.

(18) Reverse the removal procedures to install. Tighten the upper switch mounting screws to 2.2 N·m (20 in. lbs.). Tighten the lower switch water shield and bracket screw to 1.1 N·m (10 in. lbs.). Tighten the non-tilt steering column mounting nuts to 22 N·m (200 in. lbs.) and the steering column shroud mounting screws to 2 N·m (18 in. lbs.).

REAR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the center bezel from the instrument panel. See Instrument Panel Center Bezel in Group 8E - Instrument Panel Systems for the procedures.

(3) Remove the three screws that secure the accessory switch bezel to the instrument panel (Fig. 15).

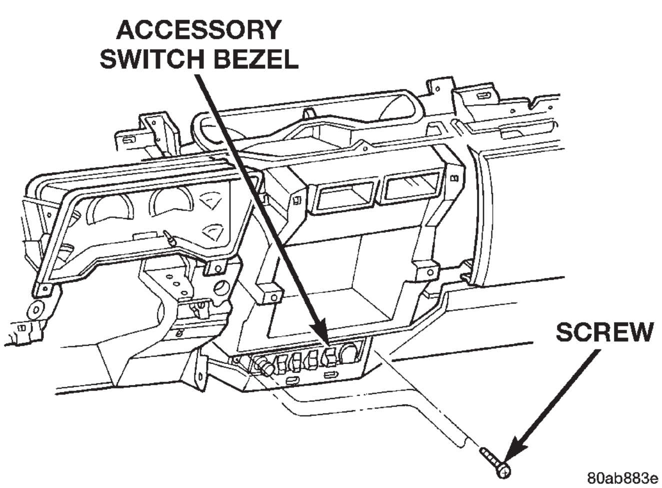


Fig. 15 Accessory Switch Bezel Remove/Install

(4) Pull the accessory switch bezel out from the instrument panel far enough to access the wire harness connectors.

(5) Unplug the wire harness connectors from the rear of the accessory switches, the cigar lighter and the power outlet.

(6) Remove the accessory switch bezel from the instrument panel.

(7) With a small thin-bladed screwdriver, gently pry the snap clips at the top and bottom of the rear wiper and washer switch receptacle on the back of the accessory switch bezel and pull the switch out of the bezel.

(8) Reverse the removal procedures to install. Be certain that both of the switch snap clip retainers in the receptacle on the back of the accessory switch bezel are fully engaged. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

WASHER SYSTEM

WASHER RESERVOIR

(1) Disconnect and isolate the battery negative cable.

(2) The washer reservoir filler neck is held in the reservoir by an interference fit. Remove the filler neck from the reservoir using a combination of pulling, rocking and twisting actions (Fig. 16).

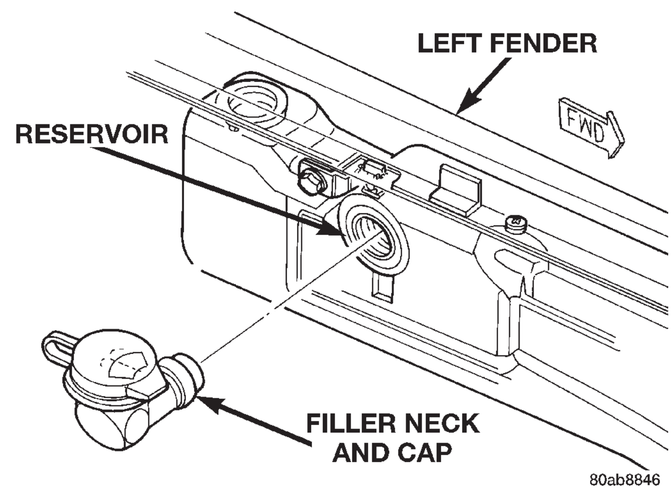


Fig. 16 Washer Reservoir Filler Neck Remove/Install

(3) Remove the engine air filter housing. Refer to Group 14 - Fuel System for the procedures.

(4) Remove the two screws that secure the washer reservoir to the inner fender shield (Fig. 17).

(5) Raise and support the vehicle.

(6) Remove the left front inner wheelhouse splash shield. Refer to Group 23 - Body for the procedures.

(7) Remove the washer supply hose(s) from the washer pump(s) and drain the washer fluid from the reservoir into a clean container for reuse.

(8) Unplug the wire harness connectors from the washer pump(s) and the washer fluid level sensor.

(9) Slide the reservoir slightly towards the rear of the vehicle to release the two hooks from the inner fender ledge slots.

(10) Lower the front of the washer reservoir and slide the unit forward to remove it from the vehicle.

(11) Reverse the removal procedures to install. Tighten the reservoir mounting screws to 3 N·m (26 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

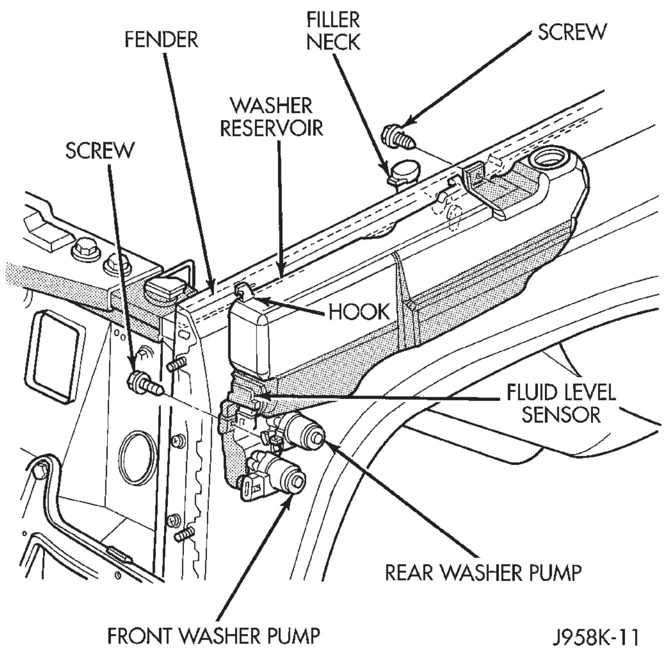


Fig. 17 Washer Reservoir Remove/Install

WASHER PUMP

(1) Disconnect and isolate the battery negative cable.

(2) Raise and support the vehicle.

(3) Remove the left front inner wheelhouse splash shield. Refer to Group 23 - Body for the procedures.

(4) Remove the washer supply hose(s) from the barbed outlet nipple of the washer pump(s) and drain the washer fluid from the reservoir into a clean container for reuse.

(5) Unplug the wire harness connectors from the washer pump(s).

(6) Using a trim stick or another suitable wide flat-bladed tool, gently pry the barbed inlet nipple of the washer pump out of the rubber grommet seal in the reservoir. Care must be taken not to damage the reservoir.

(7) Remove the rubber grommet seal from the reservoir and discard.

(8) Reverse the removal procedures to install. Always use a new rubber grommet seal on the reservoir.

WASHER FLUID LEVEL SENSOR

(1) Remove the washer reservoir from the vehicle. See Washer Reservoir in this group for the procedures.

NOTE: The pivoting float of the washer fluid sensor must be in a horizontal position within the reservoir in order to be removed. With the reservoir empty and in an upright position, the pivoting float will orient itself to the horizontal position when the sensor connector is pointed straight downwards.

(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry the washer fluid level sensor out of the rubber grommet seal. Care must be taken not to damage the reservoir.

(3) Remove the rubber grommet seal from the reservoir and discard.

(4) Reverse the removal procedures to install. Always use a new rubber grommet seal on the reservoir.

WASHER NOZZLE

FRONT

(1) Remove the wiper arms from the wiper pivots. See Wiper Arm in this group for the procedures.

(2) Remove the eight screws that secure the cowl plenum cover/grille panel and screen to the cowl top panel (Fig. 18).

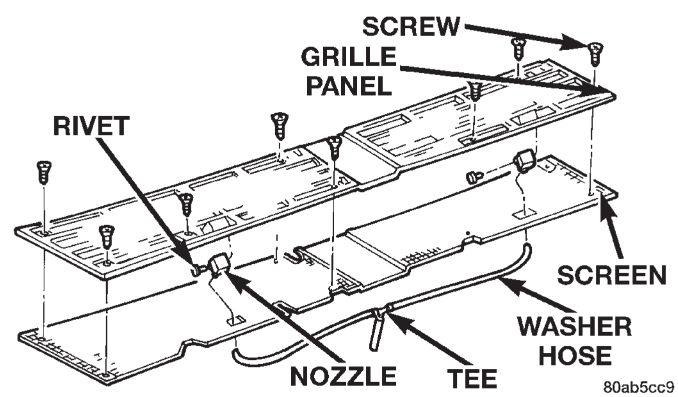


Fig. 18 Front Washer Nozzles Remove/Install

(3) Carefully lift the cowl plenum cover/grille panel and screen from the vehicle far enough to access the windshield washer plumbing. Use care so as not to damage the paint around the pivot openings of the panel.

(4) Disconnect the windshield washer supply hose and the passenger side washer nozzle hose from the washer nozzle supply hose tee fitting.

(5) Remove the cowl plenum cover/grille panel and screen from the vehicle.

(6) From the underside of the cowl plenum cover/grille panel, disconnect the washer hose from the nozzle fitting.

(7) From the underside of the cowl plenum cover/grille panel, remove the rivet that secures the nozzle to the opening in the cowl plenum cover/grille panel.

(8) Remove the washer nozzle from the cowl plenum cover/grille panel.

(9) Reverse the removal procedures to install.

REAR

(1) Unsnap the rear washer nozzle from the rear wiper arm (Fig. 19).

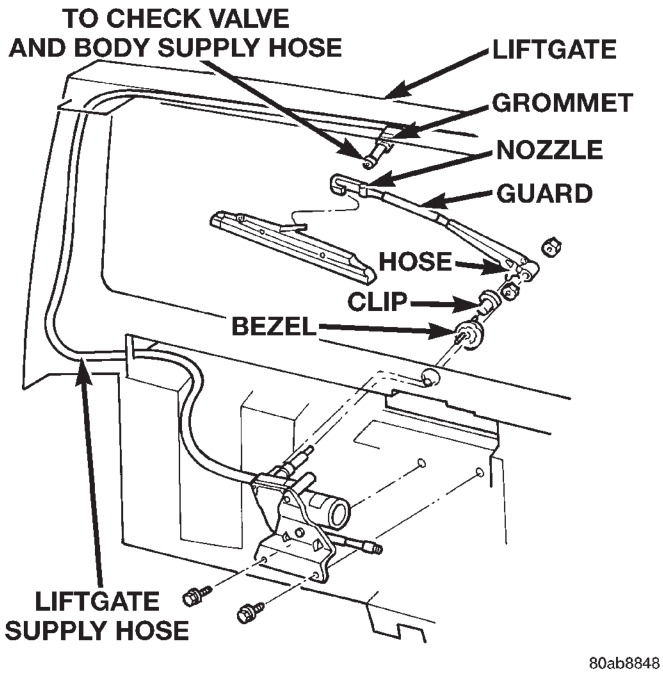


Fig. 19 Rear Washer Nozzle Remove/Install

(2) Disconnect the washer supply hose from the barbed rear washer nozzle nipple.

(3) Reverse the removal procedures to install.

CHECK VALVE

(1) Remove the four screws that secure the liftgate opening upper garnish moulding to the upper liftgate opening reinforcement.

(2) Using a trim stick or another suitable wide-bladed flat tool, gently pry the liftgate opening upper garnish moulding away from the upper liftgate opening reinforcement to release the snap clip retainers.

(3) Remove the garnish moulding from the upper liftgate opening.

(4) Disconnect the liftgate half of the washer supply hose from the barbed nipple of the rear washer system check valve.

(5) Disconnect the body half of the washer supply hose from the other barbed nipple of the rear washer system check valve.

(6) Remove the check valve from the vehicle.

(7) When reinstalling the check valve, be certain the valve is properly oriented within the system flow (Fig. 20).

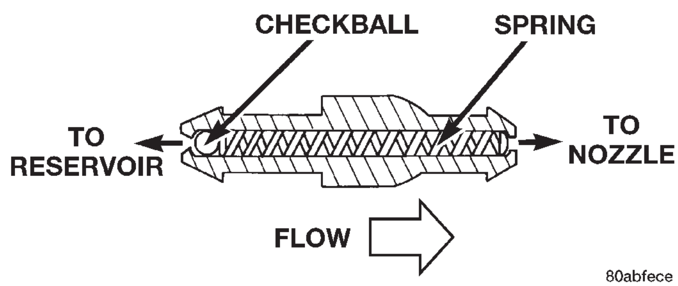


Fig. 20 Rear Washer System Check Valve

(8) Reverse the remaining removal procedures to complete the installation.

LAMPS

CONTENTS

LAMP DIAGNOSIS

INDEX

GENERAL INFORMATION

GENERAL INFORMATION

Each vehicle is equipped with various lamp assemblies. A good ground is necessary for proper lighting operation. Grounding is provided by the lamp socket when it comes in contact with the metal body, or through a separate ground wire.

When changing lamp bulbs check the socket for corrosion. If corrosion is present, clean it with a wire brush and coat the inside of the socket lightly with Mopar Multi-Purpose Grease or equivalent.

SAFETY PRECAUTIONS

WARNING: EYE PROTECTION SHOULD BE USED WHEN SERVICING GLASS COMPONENTS. PERSONAL INJURY CAN RESULT.

CAUTION: Do not touch the glass of halogen bulbs with fingers or other possibly oily surface, reduced bulb life will result.

Do not use bulbs with higher candle power than indicated in the Bulb Application table at the end of this group. Damage to lamp and/or Daytime Running Lamp Module can result.

Do not use fuses, circuit breakers or relays having greater amperage value than indicated on the fuse panel or in the Owners Manual.

When it is necessary to remove components to service another, it should not be necessary to apply excessive force or bend a component to remove it. Before damaging a trim component, verify hidden fasteners or captured edges are not holding the component in place.

DIAGNOSIS AND TESTING

DIAGNOSTIC PROCEDURES

When a vehicle experiences problems with the headlamp system, verify the condition of the battery connections, fuses, charging system, headlamp bulbs, wire connectors, relay, high beam switch, dimmer switch, and headlamp switch. Refer to Group 8W, Wiring Diagrams for component locations and circuit information.

SYSTEM DIAGNOSIS

HEADLAMP

Always begin any diagnosis by testing all of the fuses and circuit breakers in the system. Refer to Group 8W, Wiring Diagrams.

Conventional and halogen headlamps are interchangeable. It is recommended that they not be intermixed on a given vehicle.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
HEADLAMPS ARE DIM WITH ENGINE IDLING OR IGNITION TURNED OFF	1. Loose or corroded battery cables.	1. Clean and secure battery cable clamps and posts.
	2. Loose or worn generator drive belt.	2. Adjust or replace generator drive belt.
	3. Charging system output too low.	3. Test and repair charging system, refer to Group 8A,
	4. Battery has insufficient charge.	4. Test battery state-of-charge, refer to Group 8A.
	5. Battery is sulfated or shorted.	5. Load test battery, refer to Group 8A.
	6. Poor lighting circuit Z1-ground.	6. Test for voltage drop across Z1-ground locations, refer to Group 8W.
	7. Both headlamp bulbs defective.	7. Replace both headlamp bulbs.
HEADLAMP BULBS BURN OUT FREQUENTLY	1. Charging system output too high.	1. Test and repair charging system, refer to Group 8A.
	2. Loose or corroded terminals or splices in circuit.	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.	1. Test and repair charging system, refer to Group 8A.
	2. Poor lighting circuit Z1-ground.	2. Test for voltage drop across Z1-ground locations, refer to Group 8W.
	3. High resistance in headlamp circuit.	3. Test amperage draw of headlamp circuit.
	4. Both headlamp bulbs defective.	4. Replace both headlamp bulbs.
HEADLAMPS FLASH RANDOMLY	1. Poor lighting circuit Z1-ground.	1. Test for voltage drop across Z1-ground locations, refer to Group 8W.
	2. High resistance in headlamp circuit.	2. Test amperage draw of headlamp circuit. Should not exceed 30 amps.
	3. Faulty headlamp switch.	3. Replace headlamp switch.
	4. Loose or corroded terminals or splices in circuit.	4. Inspect and repair all connectors and splices, refer to Group 8W.
HEADLAMPS DO NOT ILLUMINATE	1. No voltage to headlamps.	1. Repair open headlamp circuit, refer to Group 8W.
	2. No Z1-ground at headlamps.	2. Repair circuit ground, refer to Group 8W.
	3. Faulty headlamp switch.	3. Replace headlamp switch.
	4. Faulty headlamp dimmer (multi-function) switch.	4. Replace multi-function switch.
	5. Broken connector terminal or wire splice in headlamp circuit.	5. Repair connector terminal or wire splice.
*Canada vehicles must have lamps ON.		

DIAGNOSIS AND TESTING (Continued)

FOG LAMP

CONDITION	POSSIBLE CAUSES	CORRECTION
FOG LAMPS ARE DIM WITH ENGINE IDLING OR IGNITION TURNED OFF.	1. Loose or corroded battery cables.	1. Clean and secure battery cable clamps and posts.
	2. Loose or worn generator drive belt.	2. Adjust or replace generator drive belt.
	3. Charging system output too low.	3. Test and repair charging system. Refer to Group 8A,
	4. Battery has insufficient charge.	4. Test battery state-of -charge. Refer to Group 8A.
	5. Battery is sulfated or shorted.	5. Load test battery. Refer to Group 8A.
	6. Poor lighting circuit Z1-ground.	6. Test for voltage drop across Z1-ground locations. Refer to Group 8W.
FOG LAMP BULBS BURN OUT FREQUENTLY	1. Charging system output too high.	1. Test and repair charging system. Refer to Group 8A.
	2. Loose or corroded terminals or splices in circuit.	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.	1. Test and repair charging system. Refer to Group 8A.
	2. Poor lighting circuit Z1-ground.	2. Test for voltage drop across Z1-ground locations. Refer to Group 8W.
	3. High resistance in fog lamp circuit.	3. Test amperage draw of fog lamp circuit.
FOG LAMPS FLASH RANDOMLY	1. Poor lighting circuit Z1-ground.	1. Test for voltage drop across Z1-ground locations. Refer to Group 8W.
	2. High resistance in fog lamp circuit.	2. Test amperage draw of fog lamp circuit.
	3. Faulty fog lamp switch.	3. Replace fog lamp switch.
	4. Loose or corroded terminals or splices in circuit.	4. Inspect and repair all connectors and splices. Refer to Group 8W.
FOG LAMPS DO NOT ILLUMINATE	1. Blown fuse for fog lamp.	1. Replace fuse. Refer to Group 8W.
	2. No Z1-ground at fog lamps.	2. Repair circuit ground. Refer to Group 8W.
	3. Faulty fog lamp switch.	3. Replace fog lamp switch.
	4. Broken connector terminal or wire splice in fog lamp circuit.	4. Repair connector terminal or wire splice.
	5. Defective or burned out bulb.	5. Replace bulb.

DIAGNOSIS AND TESTING (Continued)

HEADLAMP DELAY MODULE

DELAY FUNCTION INOPERATIVE

(1) Ensure headlamps operate before proceeding.

(2) Remove, inspect and test the HDLP delay 10 amp fuse in junction box. Replace if defective.

(3) With the key off and the connector disconnected, measure the resistance from the delay module connector, terminal 4 to vehicle body ground. The ohmmeter should indicate zero ohms. If not, repair the open circuit in the wire harness to vehicle body ground.

(4) With the key on measure the voltage between the delay module connector, terminal 8 and vehicle body ground. The voltmeter should indicate battery voltage. If not, repair the open circuit in the wire harness from ignition switch to HDLP delay module.

(5) Turn headlamps on and measure voltage at delay module connector, terminal 6. The voltmeter should indicate battery voltage. If not repair open circuit between L2 and HDLP delay module.

(6) Measure the voltage between the delay module connector, terminal 2 and vehicle body ground. The voltmeter should indicate battery voltage. If not, repair the open circuit in the wire harness to the HDLP fuse in the PDC.

(7) If steps 1 through 6 prove out good, replace headlamp delay 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.

SERVICE PROCEDURES

LAMP 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.

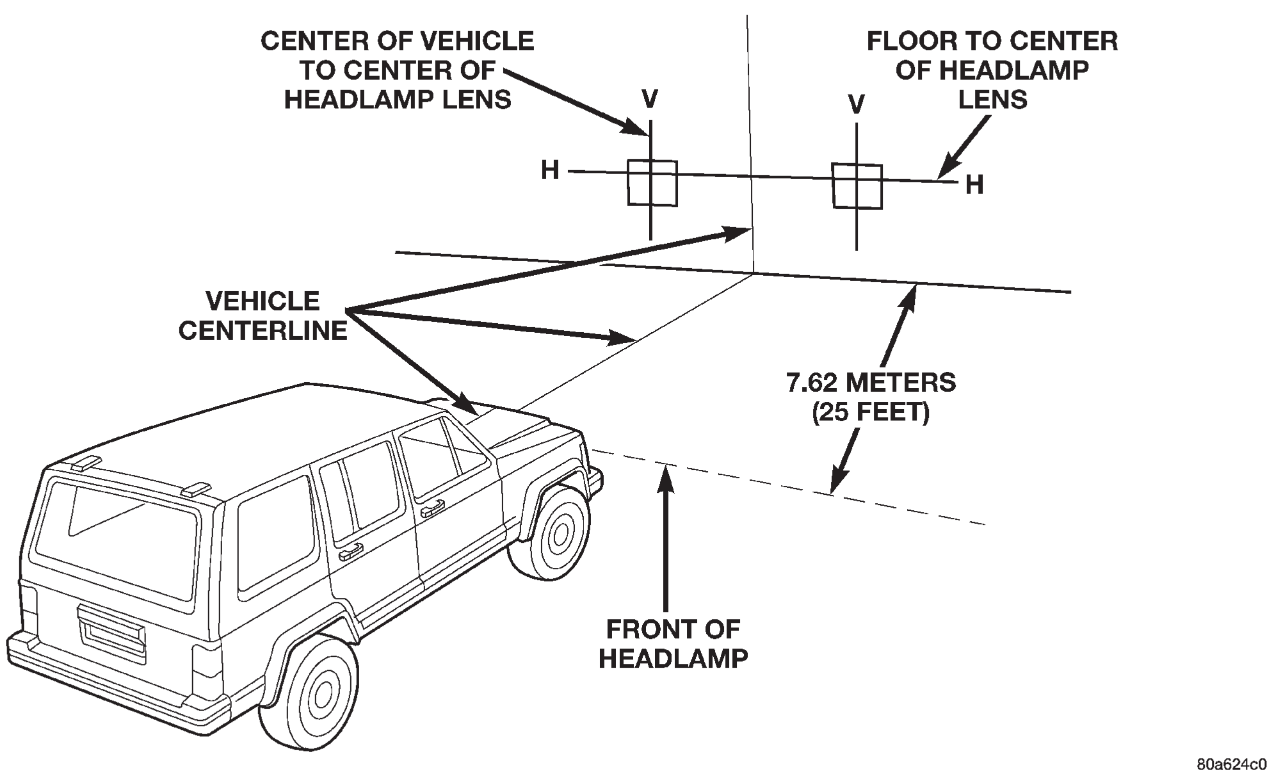


Fig. 1 Headlamp Alignment Screen—Typical

SERVICE PROCEDURES (Continued)

(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.

VEHICLE PREPARATION FOR HEADLAMP ALIGNMENT

(1) Verify headlamp dimmer switch and high beam indicator operation.
(2) Correct defective components that could hinder proper headlamp alignment.
(3) Verify proper tire inflation.
(4) Clean headlamp lenses.
(5) Verify that luggage area is not heavily loaded.
(6) Fuel tank should be FULL. Add 2.94 kg (6.5 lbs.) of weight over the fuel tank for each estimated gallon of missing fuel.

HEADLAMP ADJUSTMENT

Headlamps can be aligned using the screen method. The Headlamp Alignment Tool C-4466-A or equivalent can also be used. Refer to instructions provided with the tool for proper procedures.

A properly aimed low beam will project the top edge of the beam intensity pattern on the screen from 25 mm (1 in.) above to 75 mm (3 in.) below headlamp centerline. The side-to-side left edge of the beam intensity pattern should be from 50 mm (2 in.) left to 50 mm (2 in.) right of headlamp centerline (Fig. 2).

(1) Remove screws and both headlamp bezels.
(2) Clean front of the headlamps.
(3) Place headlamps on LOW beam.
(4) Cover front of the headlamp that is not being adjusted.
(5) Turn vertical adjustment screw (Fig. 3) until the headlamp beam pattern on screen/wall is similar to the pattern depicted in the alignment screen figure.

NOTE: When using a headlamp aiming screen, adjust the headlamps so that:

- The left edge of the beam intensity pattern is positioned within 50 mm (2 in.) left to 50 mm (2 in.) right of the vertical centerline (Fig. 2).
- The top edge of the beam intensity pattern is positioned within 25 mm (1 in.) above or 75 mm (3 in.) below the headlamp horizontal centerline (Fig. 2).

(6) Cover front of the headlamp and adjust the other headlamp beam as instructed below.
(7) Rotate the adjustment screws until the beam intensity pattern on the aiming screen/wall is aligned within the headlamp the alignment screen target (Fig. 2).
(8) Cover front of headlamp that has been adjusted and adjust the other headlamp beam as instructed above.
(9) Install headlamp bezels. Tighten the screws securely.

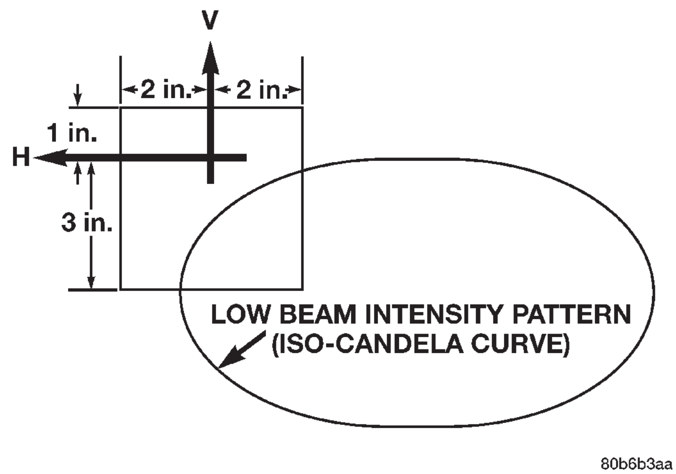


Fig. 2 Headlamp Alignment Screen Target

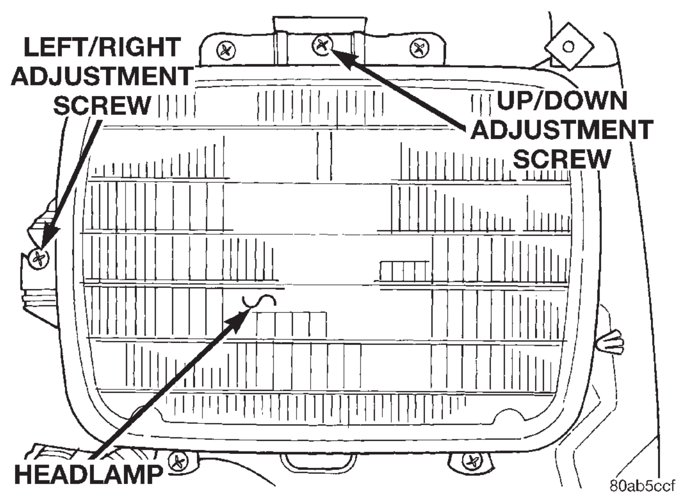


Fig. 3 Headlamp Beam Adjustment Screws

FOG LAMP ADJUSTMENT

Prepare an alignment screen. A properly aligned fog lamp will project a pattern on the alignment screen 100 mm (4 in.) below the fog lamp centerline and straight ahead (Fig. 4).

Rotate the adjustment screw to adjust beam height (Fig. 5).

SERVICE PROCEDURES (Continued)

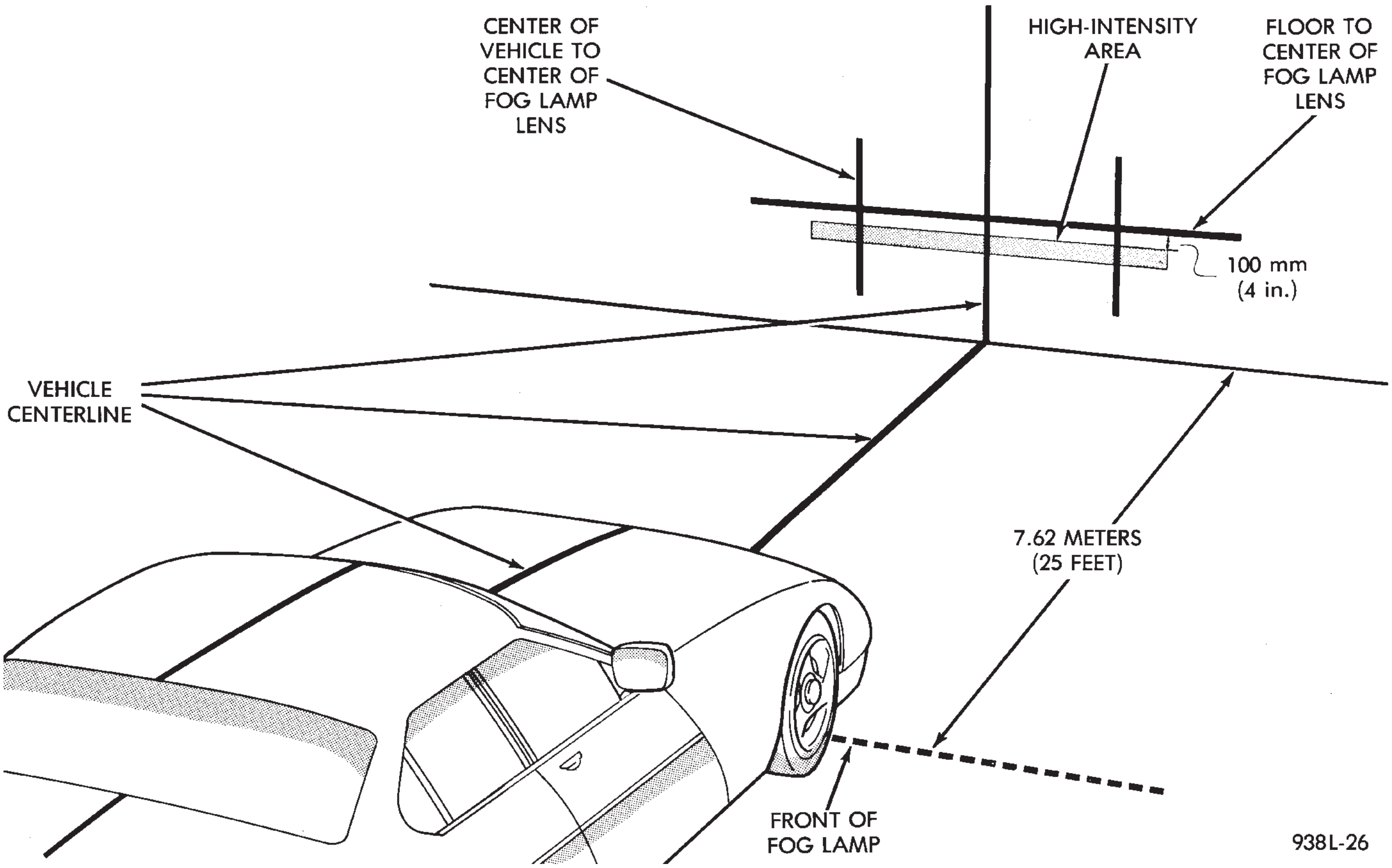


Fig. 4 Fog Lamp Alignment —Typical

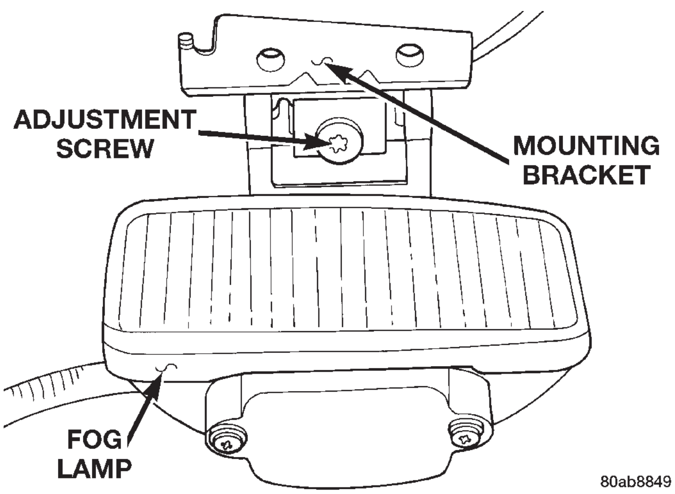
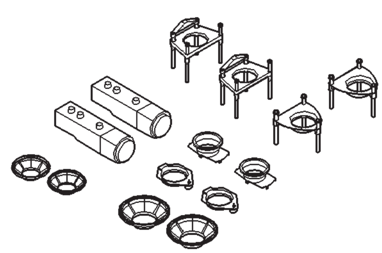


Fig. 5 Fog Lamp Adjustment

SPECIAL TOOLS

HEADLAMP ALIGNMENT



Headlamp Aiming Kit C-4466–A

LAMP BULB SERVICE

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REMOVAL AND INSTALLATION

HEADLAMP BULB

REMOVAL

(1) Remove the screws attaching the bezel to the grille opening panel (Fig. 1).

(2) Remove screws attaching the retaining ring to the headlamp canister.

(3) Disconnect the headlamp bulb wire harness connector.

(4) Separate the sealed beam from the vehicle.

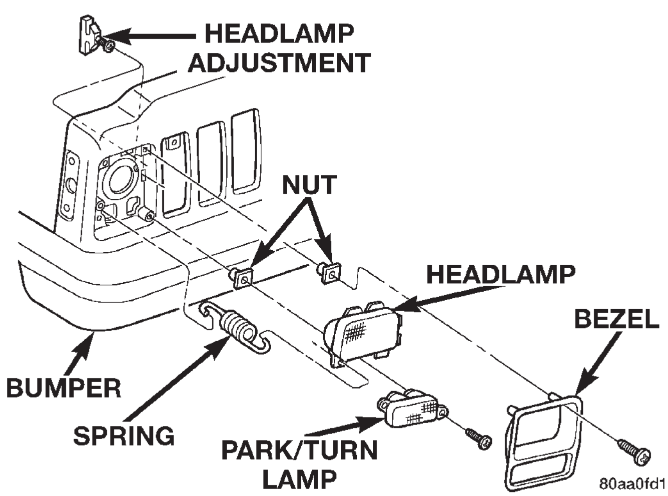

Fig. 1 Headlamp Bezel

INSTALLATION

(1) Connect wire harness connector.

(2) Position bulb in canister.

(3) Position retaining ring on sealed beam and install screws.

(4) Install headlamp bezel.

FOG LAMP BULB

REMOVAL

(1) Remove the screws attaching the access cover to the bottom of the fog lamp (Fig. 2).

(2) Remove spring clip securing bulb to fog lamp.

(3) Disconnect wire connectors at bulb.

(4) Remove bulb element from fog lamp.

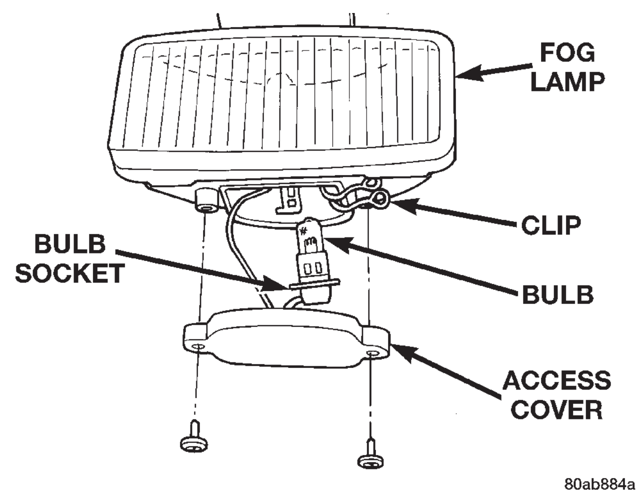

Fig. 2 Fog Lamp Components

INSTALLATION

CAUTION: Do not touch the bulb glass with fingers or other oily surfaces. Reduced bulb life will result.

(1) Position bulb element in fog lamp.

(2) Connect wire connectors at bulb.

(3) Install spring clip securing bulb to fog lamp.

(4) Install screws attaching the access cover to the bottom of the fog lamp.

FRONT PARK/TURN SIGNAL LAMP BULB

REMOVAL

(1) Remove headlamp bezel.

REMOVAL AND INSTALLATION (Continued)

(2) Remove screws attaching park/turn signal lamp housing to grille opening panel.

(3) Rotate bulb socket one-third turn counter-clockwise and remove it from lamp housing (Fig. 3).

(4) Pull bulb from socket.

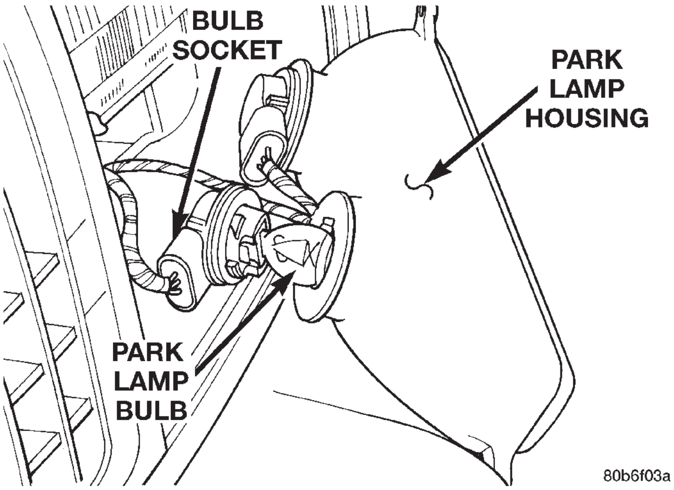

Fig. 3 Park/Turn Signal Lamp Bulb

INSTALLATION

(1) Install bulb in socket.

(2) Install socket in lamp housing.

(3) Install park/turn signal lamp housing.

(4) Install headlamp bezel.

SIDE MARKER LAMP BULB

REMOVAL

(1) Remove screws attaching side marker lamp housing.

(2) Rotate bulb socket counter-clockwise and pull from back side of lamp housing (Fig. 4).

(3) Pull bulb from socket.

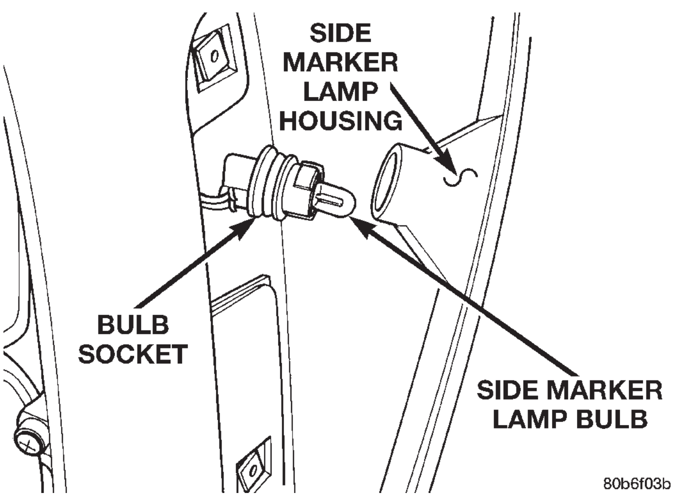

Fig. 4 Side Marker Lamp

INSTALLATION

(1) Install bulb in socket.

(2) Install bulb and socket in back of side marker lamp housing.

(3) Install side marker lamp housing.

BACK-UP/REAR TURN SIGNAL/TAIL LAMP BULB

REMOVAL

(1) Remove tail lamp housing.

(2) Rotate bulb socket one-third turn counter-clockwise and remove bulb socket from lamp housing (Fig. 5).

(3) Pull bulb from socket.

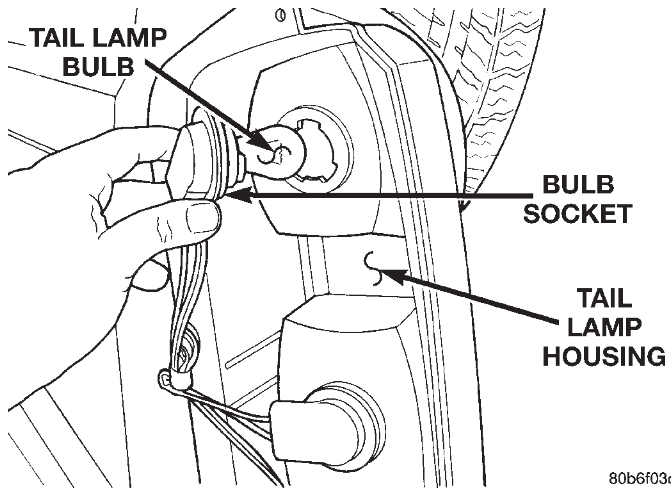

Fig. 5 Bulb Socket Removal

INSTALLATION

(1) Install bulb in socket.

(2) Install bulb and socket in lamp housing.

(3) Install lamp housing.

LICENSE PLATE LAMP BULB

REMOVAL

(1) Remove screws attaching license plate lamp housing to liftgate.

(2) Rotate bulb socket counter-clockwise and remove bulb socket from lamp housing.

(3) Pull bulb from socket.

INSTALLATION

(1) Install bulb in lamp socket.

(2) Install bulb socket in lamp housing.

(3) Install screws attaching license plate lamp to liftgate.

REMOVAL AND INSTALLATION (Continued)

CENTER HIGH MOUNTED STOP LAMP (CHMSL) BULB

REMOVAL

(1) Remove the screws attaching the lamp housing to the liftgate.

(2) Rotate bulb socket 1/4 turn counter-clockwise and pull from housing (Fig. 6).

(3) Pull bulb from socket.

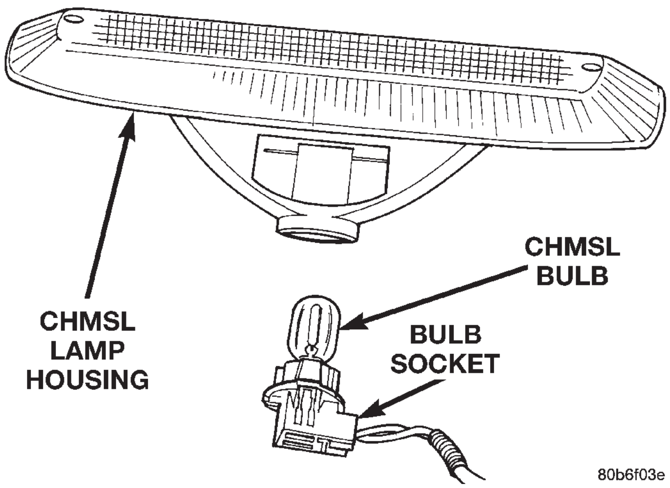

Fig. 6 CHMSL Bulb

INSTALLATION

(1) Push bulb into socket.

(2) Position socket in lamp and rotate 1/4 turn clockwise.

(3) Install screws attaching lamp housing to the liftgate.

UNDERHOOD LAMP BULB

REMOVAL

(1) Insert a small flat blade in the access slot between the lamp base and lamp lens.

(2) Pry the lamp lens upward and remove the lamp lens (Fig. 7).

(3) Depress the bulb terminal inward (Fig. 8) to release the bulb.

INSTALLATION

(1) Engage the replacement bulb wire loop to the terminal closest to the lamp base wire connector.

(2) Depress the opposite terminal inward and engage the remaining bulb wire loop.

(3) Position the lamp lens on the lamp base and press into place.

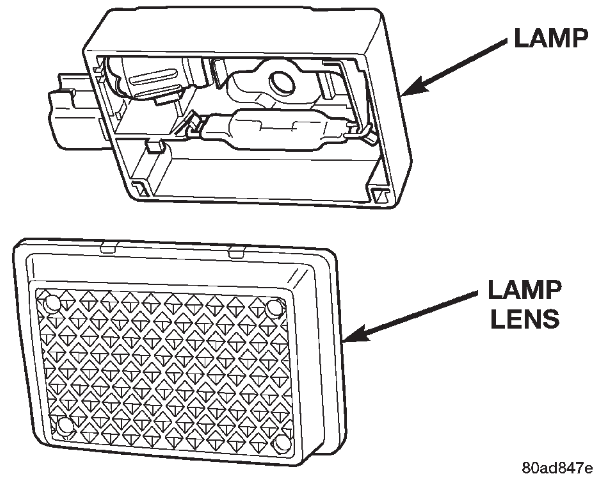

Fig. 7 Underhood Lamp Lens

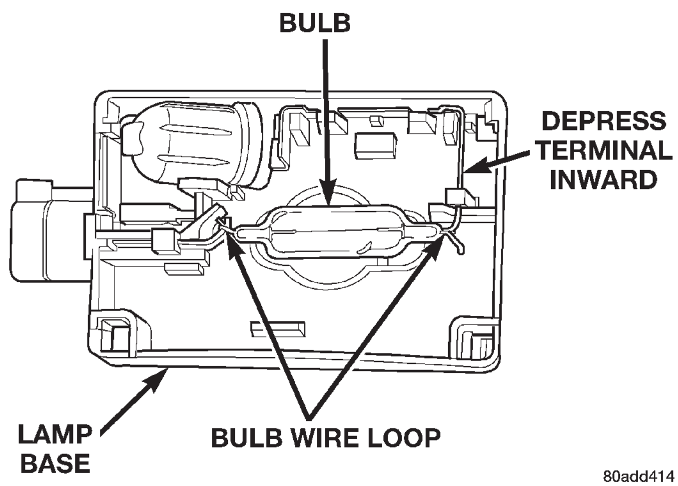

Fig. 8 Underhood Lamp Bulb

CARGO LAMP BULB

REMOVAL

(1) Insert a small flat blade into the access slots (Fig. 9).

(2) Carefully pry the lens from the lamp.

(3) Grasp bulb and pull from lamp.

INSTALLATION

(1) Position bulb in lamp and snap into place.

(2) Position the lens at the lamp housing and force it upward into the housing until the mounting tabs are seated on the lamp mounting pins.

MAP READING LAMP BULB

REMOVAL

(1) Insert a flat blade screwdriver in slot at front of lens (Fig. 10).

(2) Rotate the screwdriver until lens snaps out of the housing.

REMOVAL AND INSTALLATION (Continued)

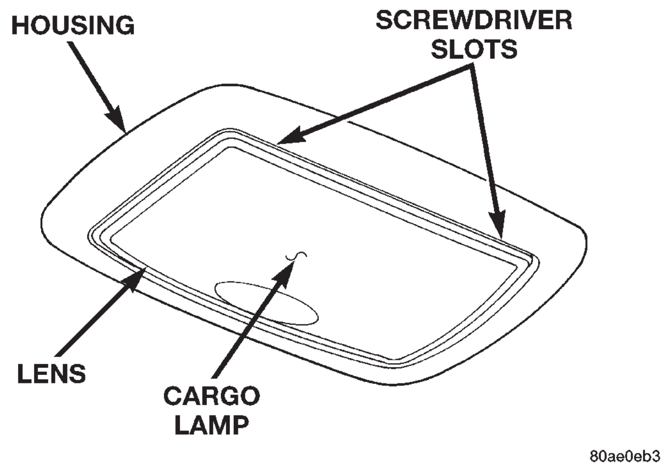

Fig. 9 Cargo Lamp Lens

(3) Remove lens from housing.
(4) Remove bulb from terminals.

INSTALLATION

(1) Insert bulb into reading lamp terminals.
(2) Replace lens by holding lens level and pushing rearward into housing.
(3) Push lens up to snap into housing.

VISOR VANITY LAMP BULB

REMOVAL

(1) Using a small flat blade, carefully pry each corner of lens outward from lamp.

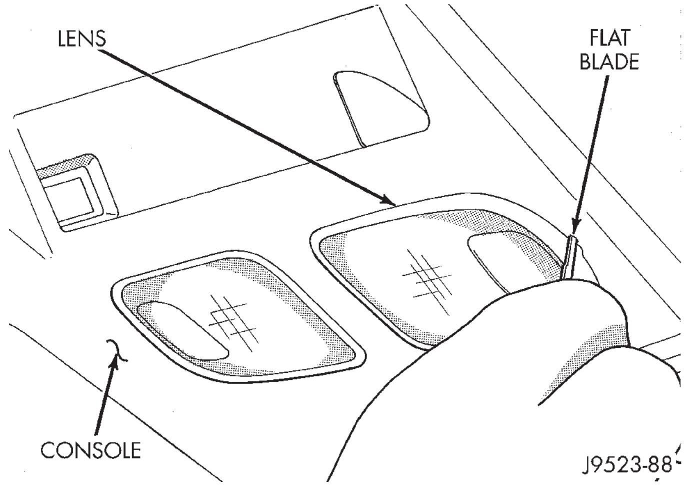

Fig. 10 Reading Lamp Bulb

(2) Separate lens from lamp.
(3) Grasp bulb and pull outward.

INSTALLATION

(1) Position bulb in socket and push into place.
(2) Position lens on lamp and snap into place.

LAMP SERVICE

INDEX

REMOVAL AND INSTALLATION

HEADLAMP

REMOVAL

(1) Remove the screws attaching the bezel to the grille opening panel

(2) Remove the screws attaching the retaining ring to the headlamp bucket.

(3) Disconnect the headlamp bulb wire harness connector (Fig. 1).

(4) Separate the bulb from the vehicle.

(5) Remove the spring attaching the headlamp bucket to the grille opening panel (Fig. 2).

(6) Slide the headlamp bucket downward to disengage it from the headlamp adjusting screws.

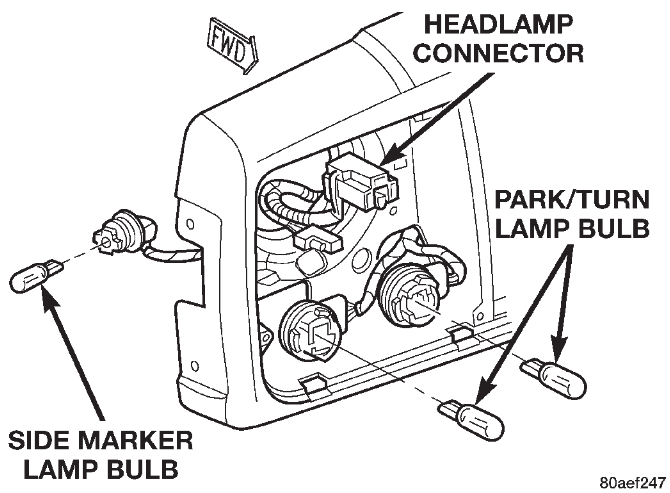

Fig. 1 Headlamp Connector

INSTALLATION

(1) Position the headlamp bucket in the grille opening panel and slide the headlamp bucket upward to engage it with the headlamp adjusting screws.

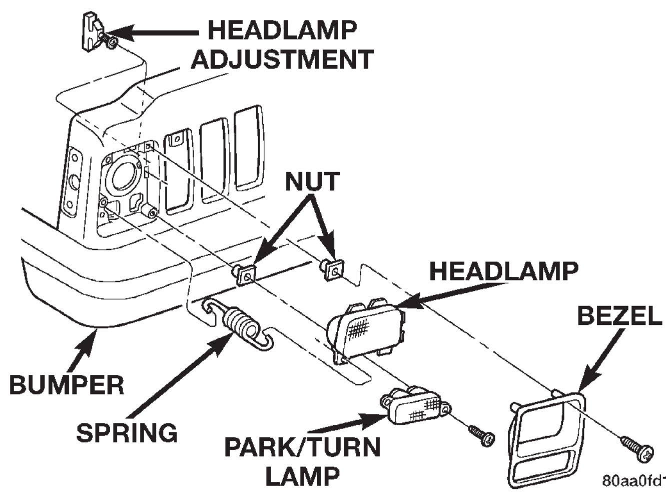

Fig. 2 Headlamp

(2) Install the spring attaching the headlamp bucket to the grille opening panel.

(3) Connect the wire harness connector.

(4) Position the bulb in the bucket.

(5) Position retaining ring on the headlamp bulb and install screws.

(6) Install the headlamp bezel.

FOG LAMP

REMOVAL

(1) Disconnect the fog lamp wire harness connector.

(2) Remove the screws attaching the fog lamp to the support (Fig. 3).

(3) Separate the fog lamp from the vehicle.

INSTALLATION

(1) Position the fog lamp in the support bracket and install the screws.

(2) Connect the fog lamp wire harness connector.

REMOVAL AND INSTALLATION (Continued)

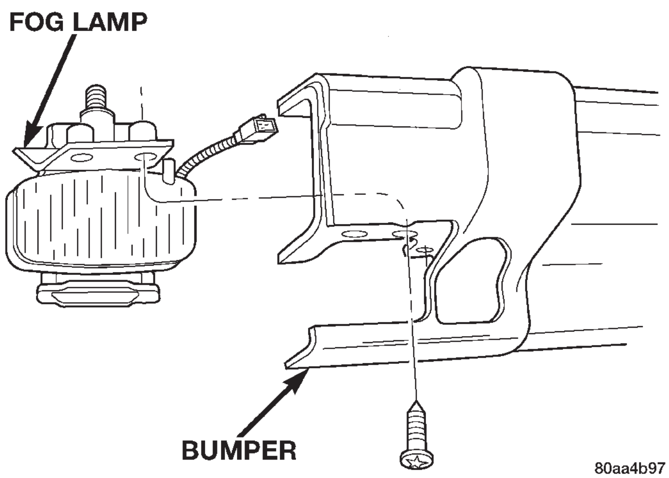

Fig. 3 Fog Lamp

FRONT PARK/TURN SIGNAL LAMP

REMOVAL

(1) Remove the headlamp bezel.

(2) Remove the screws attaching the park/turn signal lamp housing to the grille opening panel (Fig. 4).

(3) Remove the bulb sockets and separate from the vehicle.

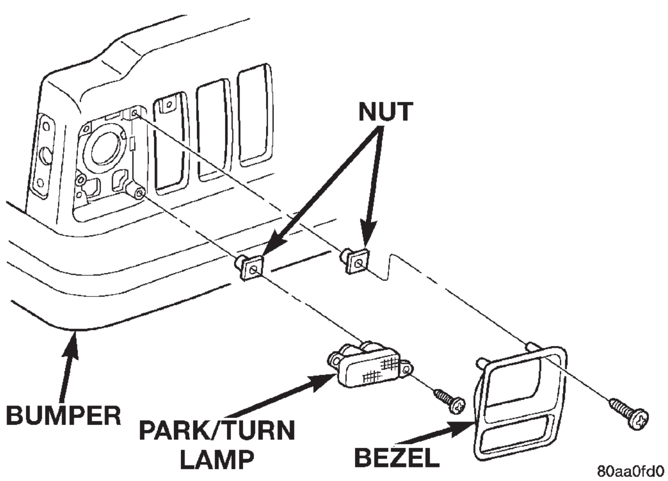

Fig. 4 Park/Turn Signal Lamp

INSTALLATION

(1) Install bulbs and sockets in the lamp housing.

(2) Position the park/turn signal lamp housing on the grille opening panel and install the screws.

(3) Install the headlamp bezel.

SIDE MARKER LAMP

REMOVAL

(1) Remove screws attaching side marker lamp lens to grille opening panel (Fig. 5).

(2) Remove bulb and socket from back side of lamp.

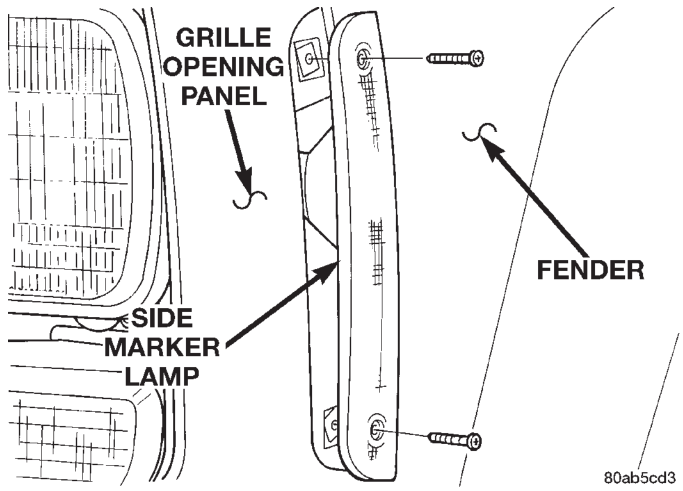

Fig. 5 Side Marker Lamp

INSTALLATION

(1) Install bulb and socket in back of side marker lamp.

(2) Install side marker lamp in grille opening panel.

BACK-UP/REAR TURN SIGNAL/TAIL LAMP

REMOVAL

(1) Open the liftgate.

(2) Remove the bolts attaching the tail lamp housing to the quarter panel (Fig. 6).

(3) Grasp the lamp and pull to disengage it from the grommet at the base of the lamp.

(4) Rotate the bulb sockets one-third turn and remove the bulb sockets from the lamp housing.

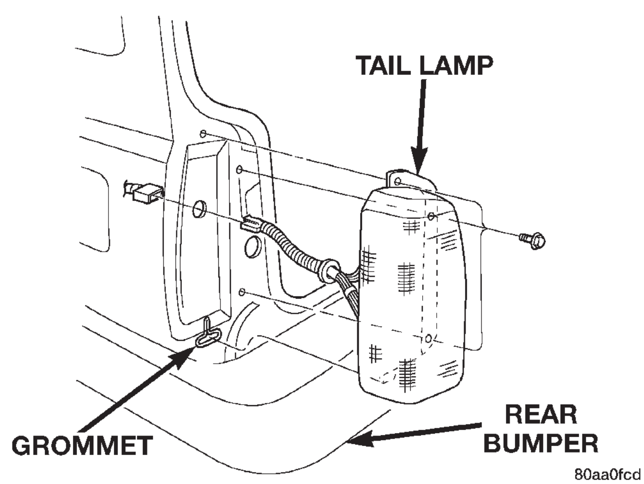

Fig. 6 Tail Lamp

INSTALLATION

(1) Install the bulb and sockets in the lamp housing.

(2) Position the lamp housing in the quarter panel and push to engage the grommet.

REMOVAL AND INSTALLATION (Continued)

(3) Install the lamp housing screws. Tighten the screws securely.

(4) Install the bolts attaching the tail lamp housing to the quarter panel.

(5) Close the liftgate.

CENTER HIGH MOUNTED STOP LAMP (CHMSL)

REMOVAL

(1) Remove the screws attaching the CHMSL to the liftgate (Fig. 7).

(2) Disconnect the wire harness connector.

(3) Separate the CHMSL from the vehicle.

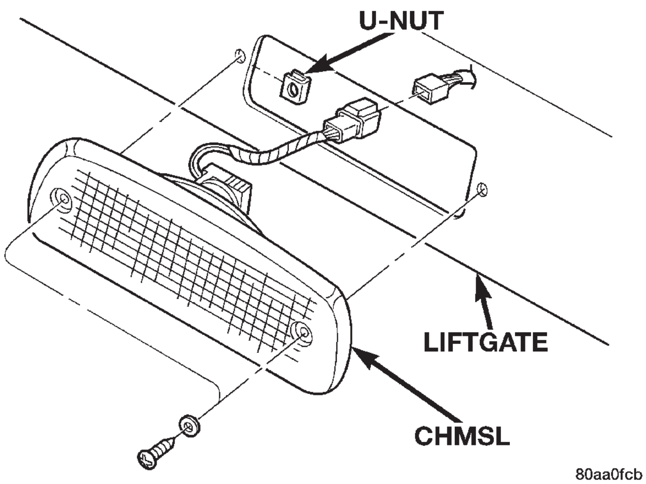

Fig. 7 Center High Mounted Stop lamp

INSTALLATION

(1) Connect the wire harness connector.

(2) Position the CHMSL on the liftgate.

(3) Install the screws attaching the CHMSL to the liftgate.

LICENSE PLATE LAMP

REMOVAL

(1) Remove screws attaching the license plate lamp to the liftgate.

(2) Remove the bulb from the lamp socket.

INSTALLATION

(1) Install bulb in the lamp socket.

(2) Position the license plate lamp on the liftgate and install screws.

UNDERHOOD LAMP

The underhood lamp is installed on the hood inner panel. The lamp illuminates when the hood is opened. A switch that is integral with the lamp base controls the operation. The switch provides automatic ON/OFF functions each time the hood is opened and closed.

REMOVAL

(1) Disconnect the wire harness connector from the lamp.

(2) Remove lamp lens.

(3) Remove bulb.

(4) Remove screw attaching underhood lamp to the inner hood panel.

(5) Separate underhood lamp from vehicle.

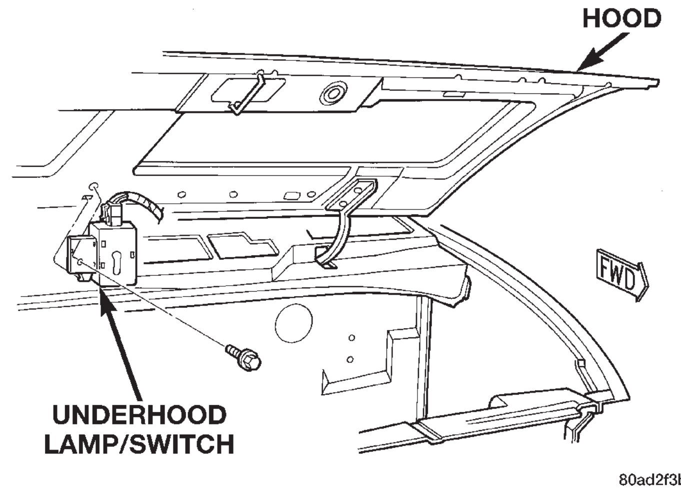

Fig. 8 Underhood Lamp

INSTALLATION

(1) Position underhood lamp on hood inner panel. Ensure anti-rotation tab is positioned in slot on hood inner panel.

(2) Install the attaching screw through the lamp and into the hood panel (Fig. 8). Tighten the screw securely.

(3) Fold lamp housing over and firmly press onto base to snap into place.

(4) Connect the wire harness connector to the lamp.

CARGO LAMP

REMOVAL

(1) Insert a small flat blade into the access slots (Fig. 9).

(2) Carefully pry the lens from the lamp.

(3) Disengage the lens mounting tabs from the lamp mounting pins (Fig. 10).

(4) Remove the fasteners attaching the lamp to the roof.

(5) Remove the lamp housing from the headliner cavity.

(6) Disconnect the wire harness connector.

REMOVAL AND INSTALLATION (Continued)

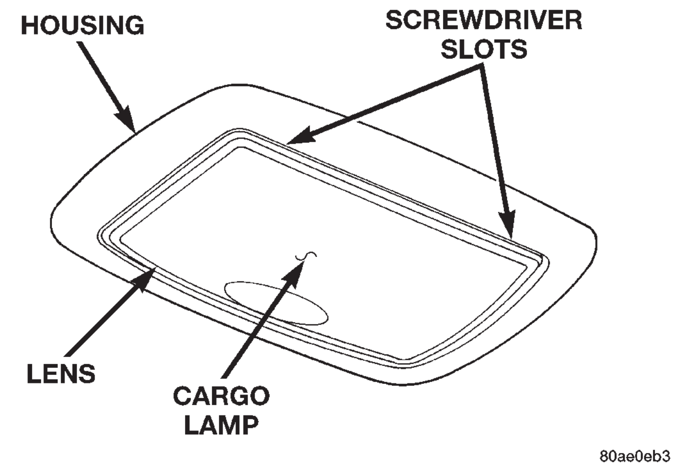

Fig. 9 Cargo Lamp

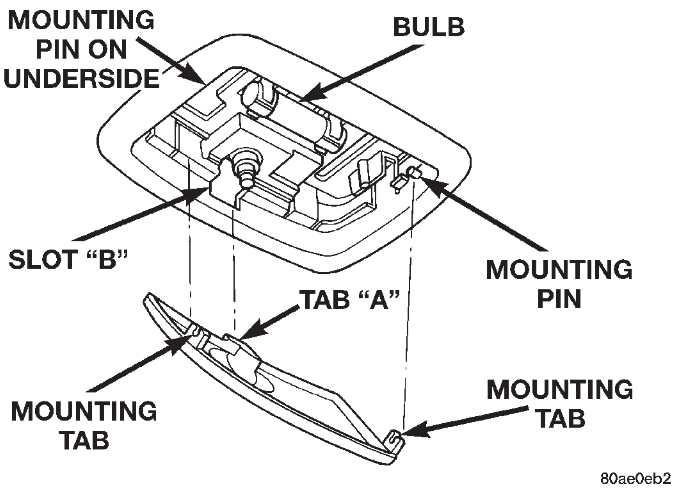

Fig. 10 Cargo Lamp Lens

INSTALLATION

(1) Position the dome lamp housing at the headliner cavity.

(2) Connect the wire harness connector.

(3) Install the fasteners attaching the lamp to the roof.

(4) Position the lens at the lamp housing and force it upward into the housing until the mounting tabs are seated on the lamp mounting pins.

MAP/READING LAMP

The map/reading lamp can be serviced by removing the overhead console. Refer to Group 8C, Overhead Console for removal/installation procedures.

VISOR VANITY LAMP

REMOVAL

(1) Fold down sunvisor.

(2) Starting at the base of the lamp assembly and working right-to-left, use a small flat blade, carefully pry lamp from visor.

(3) Disconnect visor lamp wire connector and remove from vehicle.

INSTALLATION

(1) Position visor lamp at visor and connect visor lamp wire connector.

(2) Position visor lamp in visor and press into place.

LAMP SYSTEMS

INDEX

GENERAL INFORMATION

SENTINEL HEADLAMP DELAY MODULE

The Headlamp Module delays the de-activation of the headlamps for 45 ± 15 seconds after the ignition switch is turned OFF. The driver engages the module by turning the ignition switch OFF, then turning the headlamps OFF.

DAYTIME RUNNING LAMP MODULE

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 and the vehicle is put into motion. 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 approximately 30 percent of normal intensity.

REMOVAL AND INSTALLATION

SENTINEL HEADLAMP DELAY MODULE

REMOVAL

(1) Remove the knee blocker.

(2) Remove the screw that attaches the module to the inside of the instrument panel (Fig. 1).

(3) Disconnect the wire harness connector and remove the module from the instrument panel.

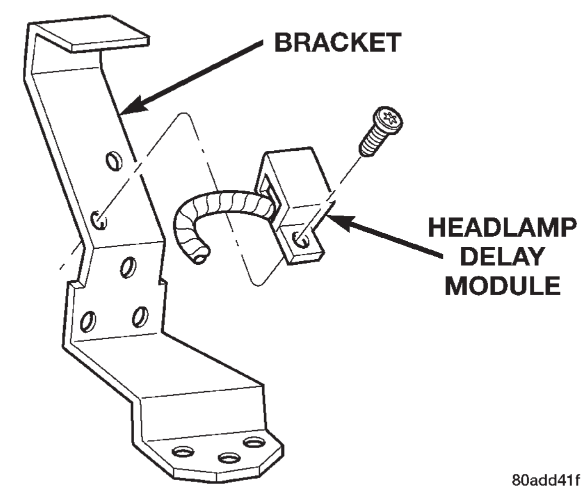

Fig. 1 Headlamp Delay Module

INSTALLATION

(1) Position the module inside the I/P and connect the wire harness connector to the module.

(2) Install the screw that attaches the module to the inside of the instrument panel.

(3) Install the knee blocker.

REMOVAL AND INSTALLATION (Continued)

DAYTIME RUNNING LAMP MODULE

REMOVAL

The Daytime Running Lights (DRL) module is located on the right fender inner panel adjacent to the dash panel (Fig. 2).

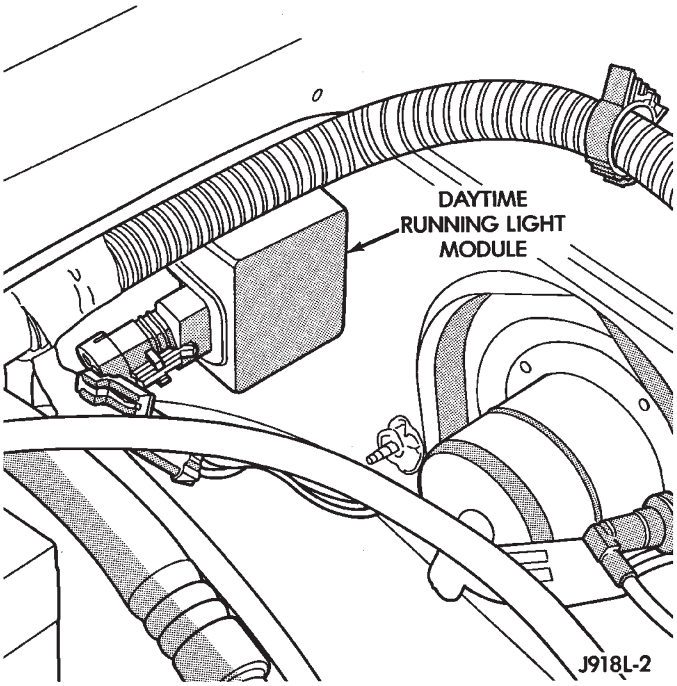

Fig. 2 Daytime Running Lamp Module

(1) Disconnect the wire harness connector from the module.

(2) Remove the screws that attach the module to the fender inner panel.

(3) Remove the module from the fender inner panel.

INSTALLATION

(1) Position the module on the right fender inner panel.

(2) Install the attaching screws. Tighten the screws securely.

(3) Connect the wire harness connector to the module.

BULB APPLICATION

INDEX

SPECIFICATIONS

EXTERIOR LAMPS

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.

The following Bulb Application Table lists the lamp title on the left side of the column and trade number or part number on the right.

LAMP	BULB
Back-up	3157
Center High Mounted Stoplamp	921
Fog lamp	H3
Front Side Marker	168
Headlamp/Sealed Beam	H6054
License Plate	168
Park/Turn Signal	3157
Tail/Stop	3157
Rear Turn Signal	3157

INTERIOR LAMPS

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.

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.

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.

LAMP	BULB
Cargo	561
Dome	561
Dome/Reading	906
Overhead Console	912
Under Hood	105
Vanity Mirror	74
Underpanel Courtesy	168

INDICATOR LAMPS

LAMP	BULB
A/C Control	74
Airbag	74
Anti-lock Brake	74
Brake Warning	74
Check Engine	74
Check Gauges	74
Cigar Lighter	53
Coolant Temp High	194
Cruise	74
Fasten Seat Belts	74
Four Wheel Drive	74
Generator	194
Heater Control	74
High Beam	74
Illumination	103
Low Fuel	74
Low Oil Pressure	194
Low Washer Fluid	74
Radio	ASC
Security	74
Transfer Case	658
Transmission Floor Shift	658
Turn Signal	74
Upshift	74

LAMPS

CONTENTS

REMOVAL AND INSTALLATION

HEADLIGHTS

REMOVAL

1. Remove the 2 screws holding the bezel in place and remove bezel (Fig. 1).
2. Remove the 4 screws holding the headlight and replace the bulb from the front of the housing (Fig. 2).

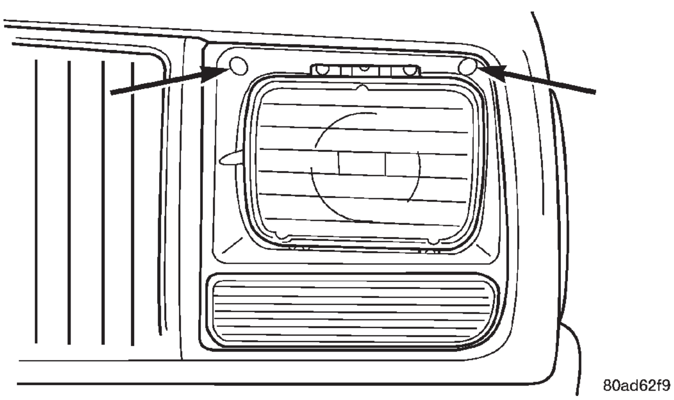

Fig. 1 Headlight Bezel

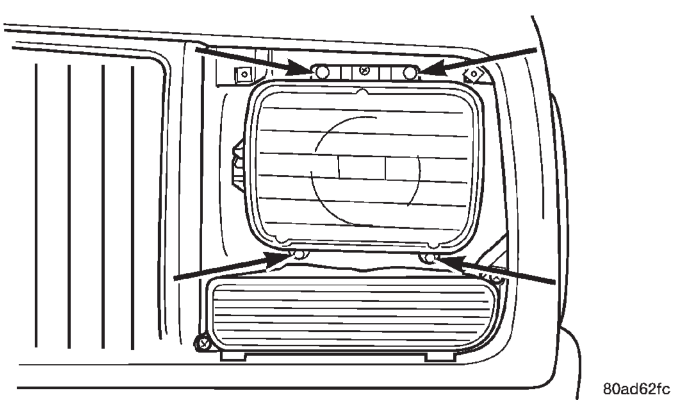

Fig. 2 Headlight Housing

INSTALLATION

1. Reverse the removal procedures to install.

SIDE REPEATER LIGHT

REMOVAL

1. Grip the side repeater lamp assembly with your hand and pull from the body to remove.
2. Rotate and pull the socket from the housing (Fig. 3).
3. Pull the bulb from the socket.

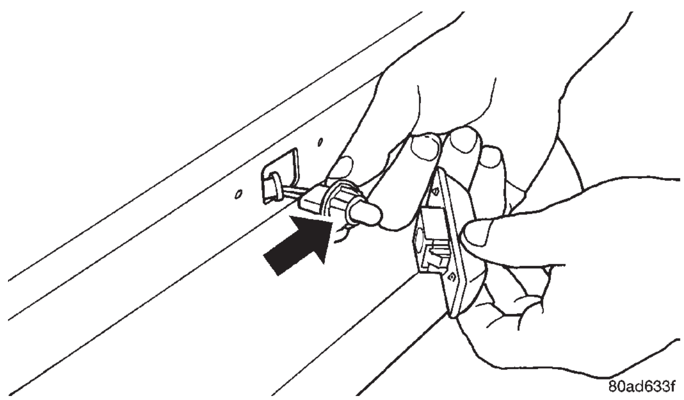

Fig. 3 Side Repeater Light

INSTALLATION

1. Align the side repeater lamp bulb to the socket (Fig. 3).
2. Push the bulb into the socket.
3. Push and rotate the socket into the housing.
4. Press the lamp assembly into the body mounting hole.
5. Verify lamp operation.

FRONT POSITION LIGHT

REMOVAL

1. Remove the 2 screws holding the headlight bezel in place and remove the bezel (Fig. 1).

REMOVAL AND INSTALLATION (Continued)

2. Remove the 4 screws holding the headlight housing (Fig. 2).

3. Pull the front position light socket from the rubber grommet and replace the bulb (Fig. 4).

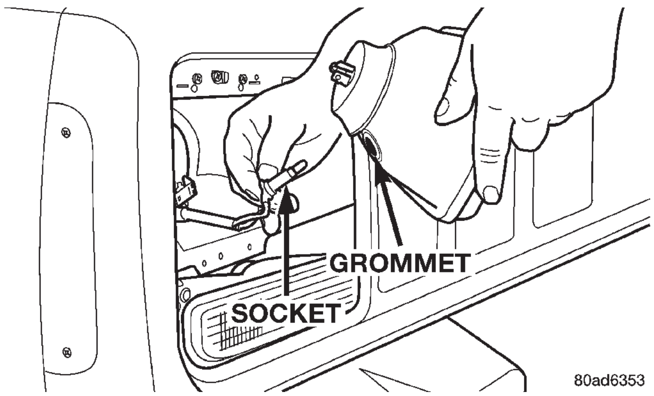

Fig. 4 Front Position Light

INSTALLATION

1. Reverse the removal procedure for installation.

FRONT TURN SIGNAL

REMOVAL

1. Remove the 2 screws holding the bezel in place and remove the bezel (Fig. 5).

2. Remove the screws holding the turn signal housing in place (Fig. 6).

3. Remove the turn signal housing.

4. Twist the socket from the back of the turn signal housing and then pull from the housing (Fig. 7).

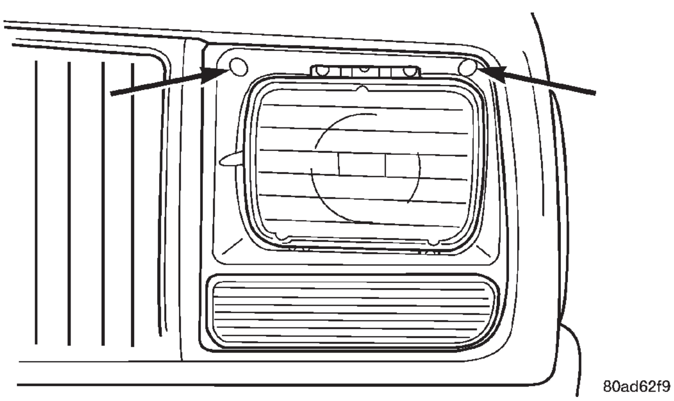

Fig. 5 Headlight Bezel

INSTALLATION

1. Reverse the removal procedure to install.

FRONT FOG LAMP

REMOVAL

1. Remove the 2 screws from the bottom cover of the lamp body.

2. Disconnect the 2 wires from the lamp element.

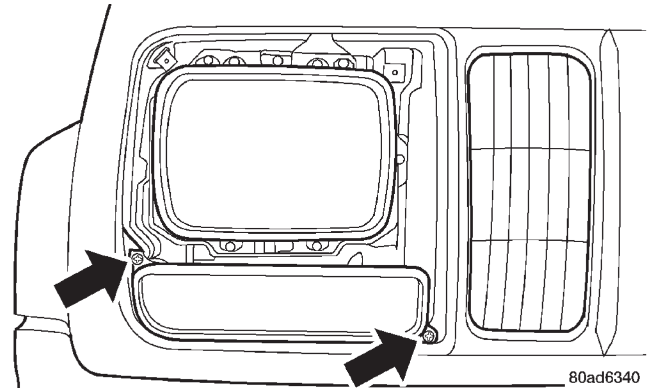

Fig. 6 Front Turn Signal Lamp

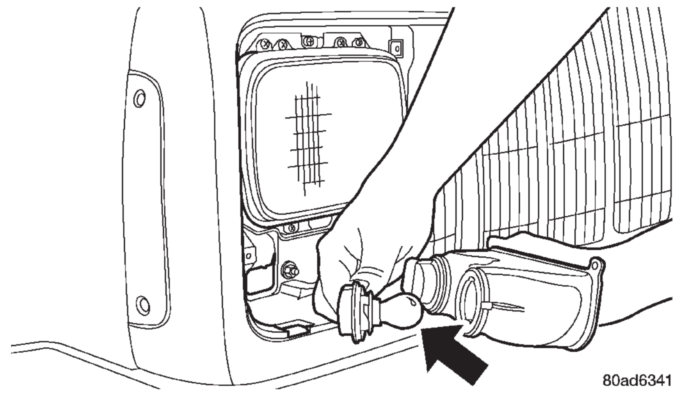

Fig. 7 Front Turn Signal Bulb

3. Remove the lamp element from the housing.

INSTALLATION

1. Install the new lamp element in the housing and reinstall the lower housing.

BACKUP, REAR TURN SIGNAL, TAILLIGHT AND REAR FOG LIGHT

REMOVAL

1. There are 3 mounting bolts attaching the taillight assembly. When removing, unfasten the 3 bolts located on the top and side. Lift up and out to remove the assembly.

2. Turn the socket assembly 1/3 turn and pull the socket from the housing to replace the bulb (Fig. 8).

INSTALLATION

1. Reverse the removal procedure to install.

CENTER HIGH MOUNTED STOPLIGHT

REMOVAL

1. Remove the 2 screws (Fig. 9).

2. Remove the Center High Mount Stoplight Assembly.

REMOVAL AND INSTALLATION (Continued)

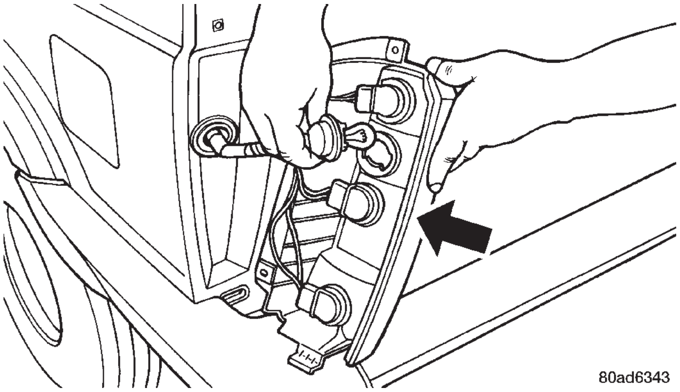

Fig. 8 Rear Lamp Replacement

3. Twist and pull the socket from the back of the housing.

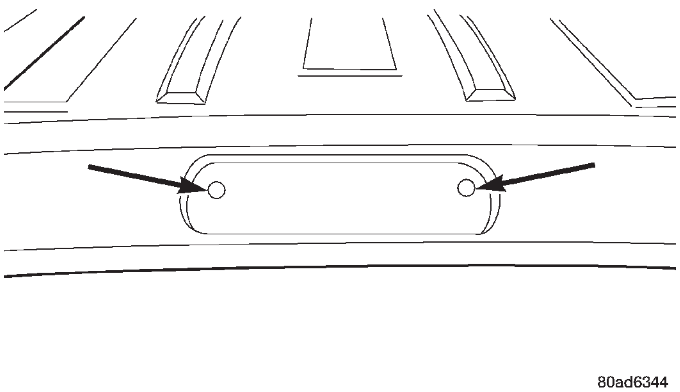

Fig. 9 Center High Mounted Stoplight

INSTALLATION

1. Reverse the removal procedure for installation.

SPECIFICATIONS

REPLACEMENT BULBS

Exterior Lamps	Bulb Type
Headlamp	H4
Front Position	T4W
Front Turn Signal	P27/7W
Side Turn Signal	W3W
License Lamp	W5W
Rear Position and Stop	P27/7W
Rear Turn Signal	P27/7W
Reversing	P27/7W
Rear Fog	P27/7W
Underhood Lamp	W5W
Underhood Retractable Lamp	105
Front Fog	H3
CHMSL	W16W

Interior Lamps	Bulb Type
Ashtray Lamp	1891
Cigarette Lighter Lamp	53
Auto. Trans. Floor Shift Lamp	658
Cargo Lamp	561
Climate Control Lamp (2)	74
Dome Lamp	561
Dome/Reading Lamp	(1) 561 and (2) 906
Glove Box Lamp	194
Lighted Vanity Mirror (2)	74
Map Reading Light in Overhead Console (4)	912
Rocker Switch	37
Transfer Case Lamp	658
Underpanel Courtesy lamps (2)	168

NOTE: Numbers refer to commercial bulb types that can be purchased from your local Jeep dealer.

PASSIVE RESTRAINT SYSTEMS

CONTENTS

DESCRIPTION AND OPERATION

AIRBAG SYSTEM

DESCRIPTION

A dual front airbag system is standard factory-installed safety equipment on this model. The primary passenger restraints in this vehicle are the standard equipment factory-installed seat belts, which require active use by the vehicle occupants. The airbag system is a supplemental passive restraint that was designed and is intended to enhance the protection for the front seat occupants of the vehicle **only** when used in conjunction with the seat belts. See the owner's manual in the vehicle glove box for more information on the features, use and operation of all of the factory-installed passenger restraints, including the airbag system.

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.

The dual front airbag system consists of the following components:
- Airbag Control Module (ACM)
- Airbag indicator lamp
- Clockspring
- Driver and passenger side airbag modules (including the airbag inflators)
- Driver and passenger side knee blockers
- Wire harness and connections.

This group provides complete service information for the ACM, both airbag modules, and the clockspring. Complete service information for the other airbag system components can be located as follows:
- Refer to **Instrument Cluster** in the proper section of Group 8E - Instrument Panel Systems for complete service information for the airbag indicator lamp.
- Refer to **Knee Blocker** in the Removal and Installation section of Group 8E - Instrument Panel Systems for complete service information on the driver side knee blocker.
- Refer to **Glove Box** in the Removal and Installation section of Group 8E - Instrument Panel Systems for complete service information on the passenger side knee blocker.
- Refer to **Airbag System** in the Contents of Group 8W - Wiring Diagrams for complete service information and circuit diagrams for the airbag system wiring components.

See the proper Diagnostic Procedures manual to test or diagnose a problem with any component of the airbag system.

OPERATION

The airbag system electrical circuits are continuously monitored and controlled by a microprocessor and software contained within the Airbag Control

DESCRIPTION AND OPERATION (Continued)

Module (ACM). The ACM also contains an impact sensor and a safing sensor, which are monitored by the ACM to determine when an impact occurs that is severe enough to require airbag system protection. When a frontal impact is severe enough, the ACM signals the inflator units of both airbag modules to deploy the airbags.

An airbag indicator lamp in the instrument cluster lights for about seven seconds as a bulb test, each time the ignition switch is turned to the On or Start positions. Following the bulb test, the airbag indicator lamp is turned on or off by the ACM to indicate the status of the airbag system. If the airbag indicator lamp comes on at any time other than during the bulb test, it indicates that there is a problem in the airbag system circuits. Such a problem may cause the airbags not to deploy when required, or to deploy when not required.

The driver side airbag module includes an inflatable airbag and an inflator unit behind a trim cover in the hub area of the steering wheel. The passenger side airbag module includes a second inflatable airbag and an inflator unit behind an airbag door in the instrument panel above the glove box.

During a frontal vehicle impact, the knee blockers work in concert with properly adjusted seat belts to restrain the driver and front seat passenger in the proper position for an airbag deployment. The knee blockers also work to absorb and distribute the crash energy from the driver and front seat passenger to the structure of the instrument panel. The driver side knee blocker is a stamped metal reinforcement located behind the instrument panel steering column opening cover. The passenger side knee blocker is integral to the glove box door.

Following are general descriptions of the major components in the airbag system.

WARNING:

- **THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTROMECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**
- **THE DRIVER SIDE 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. THE PASSENGER AIRBAG MODULE CONTAINS ARGON GAS PRESSURIZED TO OVER 2500 PSI. DO NOT ATTEMPT TO DISMANTLE AN AIRBAG MODULE OR TAMPER WITH ITS INFLATOR. DO NOT PUNCTURE, INCINERATE, OR BRING INTO CONTACT WITH ELECTRICITY. DO NOT STORE AT TEMPERATURES EXCEEDING 93° C (200° F).**
- **REPLACE AIRBAG SYSTEM COMPONENTS ONLY WITH PARTS SPECIFIED IN THE CHRYSLER MOPAR PARTS CATALOG. SUBSTITUTE PARTS MAY APPEAR INTERCHANGEABLE, BUT INTERNAL DIFFERENCES MAY RESULT IN INFERIOR OCCUPANT PROTECTION.**
- **THE FASTENERS, SCREWS, AND BOLTS ORIGINALLY USED FOR THE AIRBAG SYSTEM COMPONENTS HAVE SPECIAL COATINGS AND ARE SPECIFICALLY DESIGNED FOR THE AIRBAG SYSTEM. THEY MUST NEVER BE REPLACED WITH ANY SUBSTITUTES. ANY TIME A NEW FASTENER IS NEEDED, REPLACE IT WITH THE CORRECT FASTENERS PROVIDED IN THE SERVICE PACKAGE OR SPECIFIED IN THE CHRYSLER MOPAR PARTS CATALOG.**
- **WHEN A STEERING COLUMN HAS AN AIRBAG MODULE ATTACHED, NEVER PLACE THE COLUMN ON THE FLOOR OR ANY OTHER SURFACE WITH THE STEERING WHEEL OR AIRBAG MODULE FACE DOWN.**

DRIVER SIDE AIRBAG MODULE

DESCRIPTION

The driver side airbag module protective trim cover is the most visible part of the driver side airbag system. The driver side airbag module is mounted directly to the steering wheel. Located under the airbag module trim cover are the horn switch, the folded airbag cushion, and the airbag cushion supporting components. The resistive membrane-type horn switch is secured with heat stakes to the inside surface of the airbag module trim cover, between the trim cover and the folded airbag cushion.

The driver side airbag module cannot be repaired, and must be replaced if deployed or in any way damaged. The driver side airbag module trim cover and the horn switch are available as a unit for service replacement.

OPERATION

The driver side airbag module includes a stamped metal housing to which the cushion and an inflator

DESCRIPTION AND OPERATION (Continued)

unit are attached and sealed. The conventional pyrotechnic-type inflator assembly is mounted to studs on the back of the airbag module housing. 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. Following an airbag deployment, the airbag cushion quickly deflates by venting this gas towards the instrument panel through the porous fabric material used on the steering wheel side of the airbag cushion.

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. The inside of the trim cover has locking blocks molded into it that engage a lip on the airbag module metal housing. Two stamped metal retainers then fit over the inflator mounting studs on the back of the airbag module housing and are engaged in slots on the inside of the cover, securely locking the trim cover into place. The trim cover will split at predetermined breakout lines, then fold back out of the way along with the horn switch upon airbag deployment.

PASSENGER SIDE AIRBAG MODULE

DESCRIPTION

The passenger side airbag door on the instrument panel above the glove box is the most visible part of the passenger side airbag system. Located under the airbag door are the passenger side airbag cushion and the airbag cushion supporting components.

The passenger side airbag module includes an extruded aluminum housing within which the cushion and inflator are mounted and sealed. Two stamped metal brackets, one on each end of the housing, enclose the cushion and inflator and also serve as the mounting brackets for the module. The two mounting brackets at the top front of the airbag module are secured with screws to the top of the instrument panel structural support beneath the instrument panel top cover. The two mounting brackets at the bottom front of the airbag module are secured with screws to the instrument panel structural support over the glove box.

Following a passenger side airbag deployment, the passenger side airbag module and the passenger side airbag door must be replaced. The passenger side airbag module cannot be repaired, and must be replaced if deployed or in any way damaged. The passenger side airbag door is available as a separate service item.

OPERATION

The hybrid-type inflator assembly includes a small canister of highly compressed argon gas. 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. Following an airbag deployment, the airbag cushion quickly deflates by venting this gas through the porous fabric material used on each end panel of the airbag cushion.

The molded plastic passenger side airbag door is secured to extruded tabs at the top and bottom rear of the airbag module housing by keyed openings in the upper and lower mounting flange returns of the airbag door. The upper and lower airbag door mounting flanges are then secured to the instrument panel structural support and the upper glove box opening reinforcement with screws. The airbag door has predetermined breakout lines concealed beneath its decorative cover. Upon airbag deployment, the airbag door will split at the breakout lines and the door will fold back over the top of the instrument panel, out of the way.

AIRBAG CONTROL MODULE

DESCRIPTION

The Airbag Control Module (ACM) is secured with screws to a mount that is welded onto the floor panel underneath the left front seat in the passenger compartment of the vehicle. A stamped metal protective cover shields the ACM and its wire harness connector from the feet of rear seat passengers or other objects that might become lodged under the driver side front seat. The ACM contains an electronic microprocessor, an electronic impact sensor, an electromechanical safing sensor, and an energy storage capacitor.

The ACM cannot be repaired or adjusted and, if damaged or faulty, it must be replaced.

OPERATION

The microprocessor in the ACM contains the airbag system logic. The airbag system logic includes On-Board Diagnostics (OBD), and the ability to communicate with the instrument cluster circuitry over the Chrysler Collision Detection (CCD) data bus to control the airbag indicator lamp. The microprocessor continuously monitors all of the airbag system electrical circuits to determine the system readiness. If the ACM detects a monitored system fault, it sends messages to the instrument cluster over the CCD data bus to turn on the airbag indicator lamp. Refer to **Instrument Cluster** in the proper section of Group 8E - Instrument Panel Systems for more information on the airbag indicator lamp.

One electronic impact sensor is used in this airbag system. The impact sensor is an accelerometer that senses the rate of vehicle deceleration, which provides verification of the direction and severity of an impact. The impact sensor is calibrated for the spe-

DESCRIPTION AND OPERATION (Continued)

cific vehicle, and is only serviced as a unit with the ACM. A pre-programmed decision algorithm in the ACM microprocessor determines when the deceleration rate as signaled by the impact sensor indicates an impact that is severe enough to require airbag system protection. When the programmed conditions are met, the ACM sends an electrical signal to deploy the airbags.

In addition to the electronic impact sensor, there is an electromechanical sensor within the ACM called a safing sensor. The safing sensor is a normally open series switch located in the airbag deployment circuit of the ACM. This sensor detects impact energy of a lesser magnitude than the electronic impact sensor, and must be closed in order for the airbags to deploy.

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.

CLOCKSPRING

DESCRIPTION

The clockspring assembly is secured with two integral plastic latches onto the steering column lock housing near the top of the steering column behind the steering wheel. The clockspring is used to maintain a continuous electrical circuit between the fixed clockspring wire harness on the steering column and several electrical components that rotate with the steering wheel. The rotating components include the driver side airbag module, the horn switch and, if the vehicle is so equipped, the vehicle speed control switches.

The clockspring cannot be repaired. If the clockspring is faulty, damaged, or if the driver side airbag has been deployed, the clockspring must be replaced.

OPERATION

The clockspring assembly consists of a plastic case which contains a flat, ribbon-like, electrically conductive tape that winds and unwinds like a clockspring with the steering wheel rotation. The electrically conductive tape consists of several fine gauge copper wire leads sandwiched between two narrow strips of plastic film.

Like the clockspring in a timepiece, the clockspring tape has travel limits and can be damaged by being wound too tightly. To prevent this from occurring, the clockspring is centered when it is installed on the steering column. Centering the clockspring indexes the clockspring tape to other steering components so that it can operate within its designed travel limits. However, if the clockspring is removed for service or if the steering column is disconnected from the steering gear allowing the clockspring tape to change position relative to the other steering components, it must be re-centered following completion of the service or it may be damaged. Refer to **Clockspring Centering** in the Adjustments section of this group for the proper centering procedures.

Service replacement clocksprings are shipped pre-centered and with a locking pin installed. This locking pin should not be removed until the clockspring has been installed on the steering column. If the locking pin is removed before the clockspring is installed on a steering column, the clockspring centering procedure must be performed.

DIAGNOSIS AND TESTING

AIRBAG SYSTEM

A DRB scan tool is required for diagnosis of the airbag system. See the proper Diagnostic Procedures manual for more information.

(1) Connect the DRB scan tool to the 16-way data link wire harness connector. The connector is located on the driver side lower edge of the instrument panel, outboard of the steering column (Fig. 1).

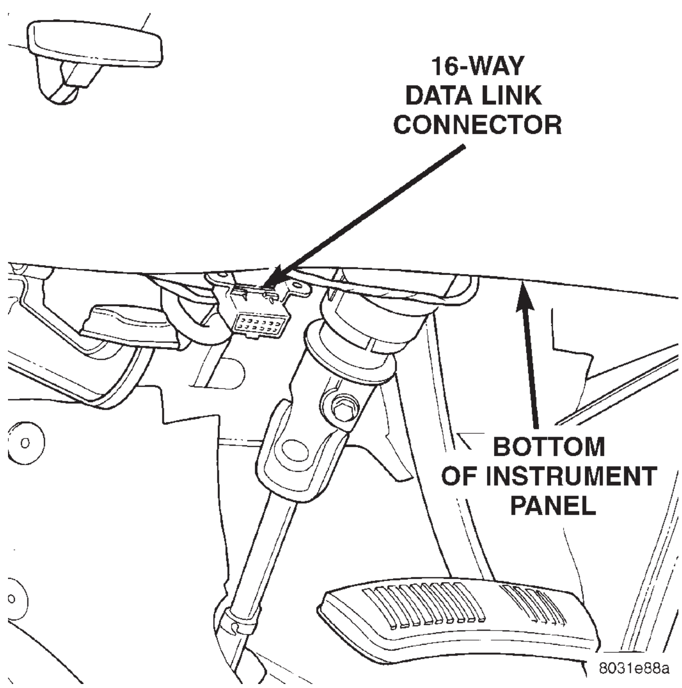

Fig. 1 16-Way Data Link Connector - Typical

(2) Turn the ignition switch to the On position. Exit the vehicle with the DRB. Be certain that the DRB contains the latest version of the proper DRB software.

DIAGNOSIS AND TESTING (Continued)

(3) Using the DRB, read and record the active Diagnostic Trouble Code (DTC) data.

(4) Read and record any stored DTC data.

(5) See the proper Diagnostic Procedures manual if any DTC is found in Step 3 or Step 4.

(6) After completing the necessary repairs, try to erase the stored DTC data. If any problems remain, the stored DTC data will not erase. See the proper Diagnostic Procedures manual for the procedures to diagnose any stored DTC that will not erase.

(7) With the ignition switch still in the On position, check to be certain that nobody is in the vehicle.

(8) From outside of the vehicle (away from the airbags in case of an accidental deployment) turn the ignition switch to the Off position for about ten seconds, and then back to the On position. Observe the airbag indicator lamp in the instrument cluster. It should light for six to eight seconds, and then go out. This indicates that the airbag system is functioning normally.

NOTE: If the airbag indicator lamp fails to light, or lights and stays on, there is an airbag system malfunction. See the proper Diagnostic Procedures manual to diagnose the problem.

SERVICE PROCEDURES

AIRBAG SYSTEM

NON-DEPLOYED

At no time should any source of electricity be permitted near the inflator on the back of an airbag module. When carrying a non-deployed airbag module, the trim cover or airbag side of the module should be pointed away from the body to minimize injury in the event of an accidental deployment. If the module is placed on a bench or any other surface, the trim cover or airbag side of the module should be face up to minimize movement in the event of an accidental deployment.

In addition, the airbag system should be disarmed whenever any steering wheel, steering column, or instrument panel components require diagnosis or service. Failure to observe this warning could result in accidental airbag deployment and possible personal injury. Refer to **Group 8E - Instrument Panel Systems** for additional service procedures on the instrument panel components. Refer to **Group 19 - Steering** for additional service procedures on the steering wheel and steering column components.

DISPOSAL OF NON-DEPLOYED AIRBAG MODULES

All damaged or faulty and non-deployed driver side or passenger side airbag modules which are replaced on vehicles are to be returned. If an airbag module assembly is faulty or damaged and non-deployed, refer to the parts return list in the current Chrysler Corporation Warranty Policies and Procedures manual for the proper handling and disposal procedures.

DEPLOYED

Any vehicle which is to be returned to use after an airbag deployment, must have both airbag modules, the passenger side airbag module door and the clockspring replaced. These components will be damaged or weakened as a result of an airbag deployment, which may or may not be obvious during a visual inspection, and are not intended for reuse.

Other vehicle components should be closely inspected, but are to be replaced only as required by the extent of the visible damage incurred.

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.

CLEANUP PROCEDURE

Following an airbag system deployment, the vehicle interior will contain a powdery residue. This residue consists primarily of harmless particulate by-products of the small pyrotechnic charge used to initiate the airbag deployment propellant. However, this residue will also contain traces of sodium hydroxide powder, a chemical by-product of the propellant material that is used to generate the nitrogen gas that inflates the airbag. Since sodium hydroxide powder can irritate the skin, eyes, nose, or throat, be sure to wear safety glasses, rubber gloves, and a long-sleeved shirt during cleanup (Fig. 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 the cleanup by removing the airbag modules from the vehicle. Refer to **Driver Side Airbag Module** and **Passenger Side Airbag Module** in the Removal and Installation section of this group for the procedures.

Use a vacuum cleaner to remove any residual powder from the vehicle interior. Clean from outside the

SERVICE PROCEDURES (Continued)

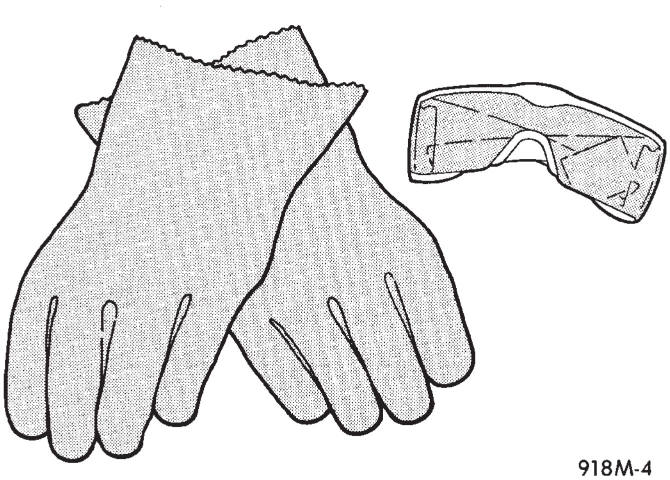

Fig. 2 Wear Safety Glasses and Rubber Gloves - Typical

vehicle and work your way inside, so that you avoid kneeling or sitting on a non-cleaned area.

Be sure to vacuum the heater and air conditioning outlets as well (Fig. 3). Run the heater and air conditioner 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.

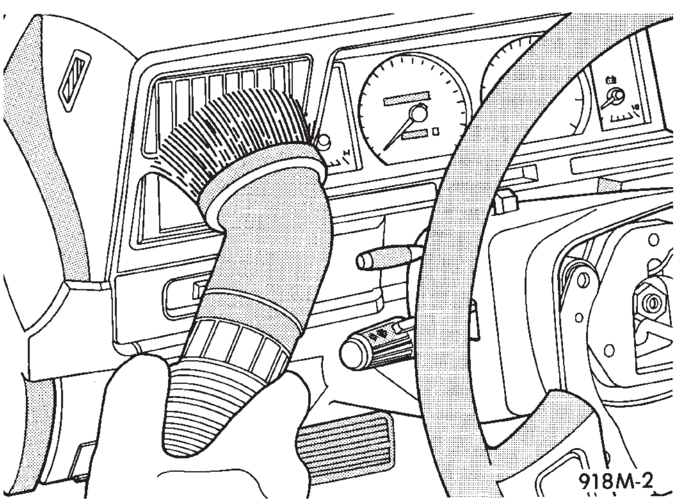

Fig. 3 Vacuum Heater and A/C Outlets - Typical

Place the deployed airbag modules in your vehicular scrap pile.

REMOVAL AND INSTALLATION

DRIVER SIDE AIRBAG MODULE

The following procedure is for replacement of a faulty or damaged driver side airbag module. If the driver side airbag has been deployed, the clockspring must also be replaced. Refer to **Clockspring** in the Removal and Installation section of this group for the additional service procedures for the clockspring.

WARNING:

- **THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTROMECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**
- **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.**

REMOVAL

(1) Disconnect and isolate the battery negative cable. If either of the airbags has not been deployed, wait two minutes for the system capacitor to discharge before further service.

(2) From the underside of the steering wheel, remove the two screws that secure the driver side airbag module to the steering wheel (Fig. 4).

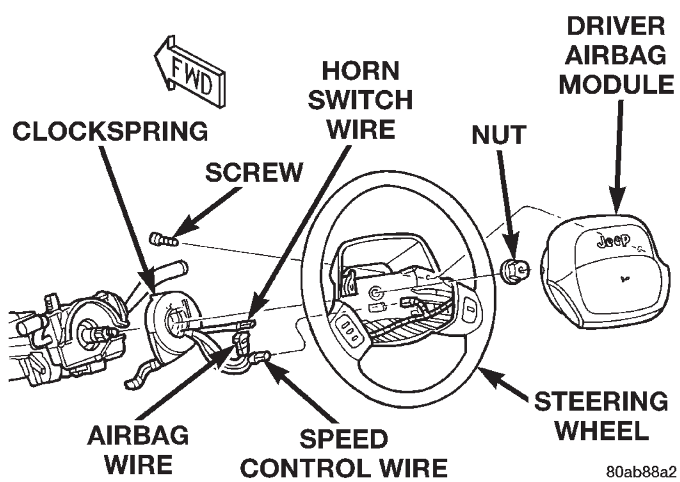

Fig. 4 Driver Side Airbag Module Remove/Install

(3) Pull the airbag module away from the steering wheel far enough to access the two wire harness connectors on the back of the airbag module.

REMOVAL AND INSTALLATION (Continued)

(4) Disconnect the clockspring horn switch wire harness connector from the horn switch feed wire connector, which is located on the back of the airbag module.

(5) The clockspring airbag wire harness connector is a tight snap-fit into the airbag module connector receptacle, which is located on the airbag inflator on the back of the airbag module. Firmly grasp and pull or gently pry on the clockspring airbag wire harness connector to disconnect it from the airbag module. **Do not pull on the clockspring wire harness to disengage the connector from the airbag module connector receptacle.**

(6) Remove the driver side airbag module from the steering wheel.

(7) If the driver side airbag has been deployed, the clockspring must be replaced. Refer to **Clockspring** in the Removal and Installation section of this group for the clockspring service procedures.

INSTALLATION

WARNING:

- **USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE DRIVER SIDE AIRBAG MODULE, OR BECOMING ENTRAPPED BETWEEN THE AIRBAG CUSHION AND THE DRIVER SIDE AIRBAG TRIM COVER. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.**
- **THE DRIVER SIDE AIRBAG MODULE TRIM COVER MUST NEVER BE PAINTED. REPLACEMENT TRIM COVERS ARE SERVICED IN THE ORIGINAL COLORS. PAINT MAY CHANGE THE WAY IN WHICH THE MATERIAL OF THE TRIM COVER RESPONDS TO AN AIRBAG DEPLOYMENT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.**

(1) When installing the driver side airbag module, reconnect the clockspring airbag wire harness connector to the airbag module connector receptacle by pressing straight in on the connector. You can be certain that the connector is fully engaged by listening carefully for a distinct audible click as the connector snaps into place.

(2) Reconnect the clockspring horn switch wire harness connector to the horn switch feed wire connector, which is located on the back of the airbag module.

(3) Carefully position the driver side airbag module in the steering wheel. Be certain that the clockspring wire harnesses in the steering wheel hub area are not pinched between the airbag module and the steering wheel.

(4) From the underside of the steering wheel, install and tighten the two driver side airbag module mounting screws. Tighten the screws to 10.2 N·m (90 in. lbs.).

(5) Do not reconnect the battery negative cable at this time. Refer to **Airbag System** in the Diagnosis and Testing section of this group for the proper procedures.

DRIVER SIDE AIRBAG MODULE TRIM COVER

The horn switch is integral to the driver side airbag module trim cover. If either component is faulty or damaged, the entire driver side airbag module trim cover and horn switch unit must be replaced.

WARNING:

- **THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTROMECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**
- **THE HORN SWITCH IS INTEGRAL TO THE AIRBAG MODULE TRIM COVER. SERVICE OF THIS COMPONENT SHOULD BE PERFORMED ONLY BY CHRYSLER-TRAINED AND AUTHORIZED DEALER SERVICE TECHNICIANS. FAILURE TO TAKE THE PROPER PRECAUTIONS OR TO FOLLOW THE PROPER PROCEDURES COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER AIRBAG DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.**

REMOVAL

(1) Disconnect and isolate the battery negative cable. If either of the airbags has not been deployed, wait two minutes for the system capacitor to discharge before further service.

(2) Remove the driver side airbag module from the steering wheel. Refer to **Driver Side Airbag Module** in the Removal and Installation section of this group for the procedures.

(3) Remove the plastic horn switch feed wire retainer from the stud on the back of the driver side airbag housing (Fig. 5).

(4) Remove the four nuts that secure the upper and lower trim cover retainers to the studs on the back of the driver side airbag housing (Fig. 6).

REMOVAL AND INSTALLATION (Continued)

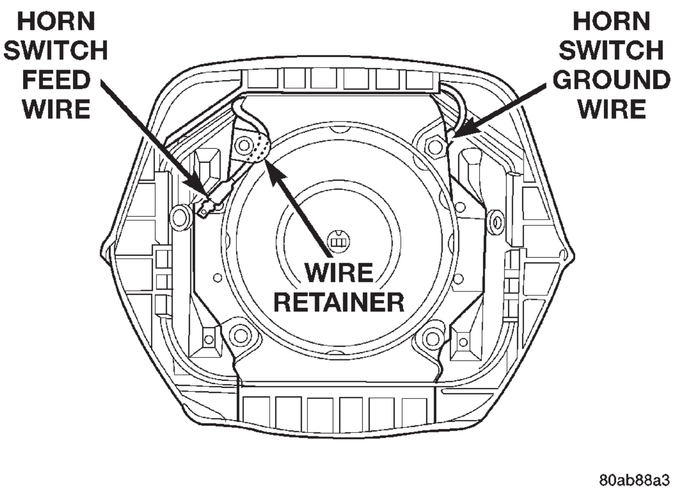

Fig. 5 Horn Switch Feed Wire Remove/Install

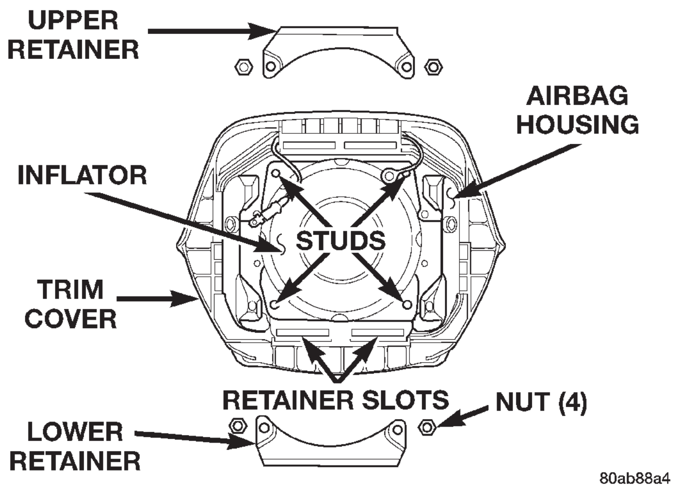

Fig. 6 Driver Side Airbag Trim Cover Retainers Remove/Install

(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) Disengage the four trim cover locking blocks from the lip around the outside edge of the driver side airbag housing and remove the housing from the cover (Fig. 7).

INSTALLATION

WARNING:

• USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE DRIVER SIDE AIRBAG MODULE, OR BECOMING ENTRAPPED BETWEEN THE AIRBAG CUSHION AND THE DRIVER SIDE AIRBAG TRIM COVER. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

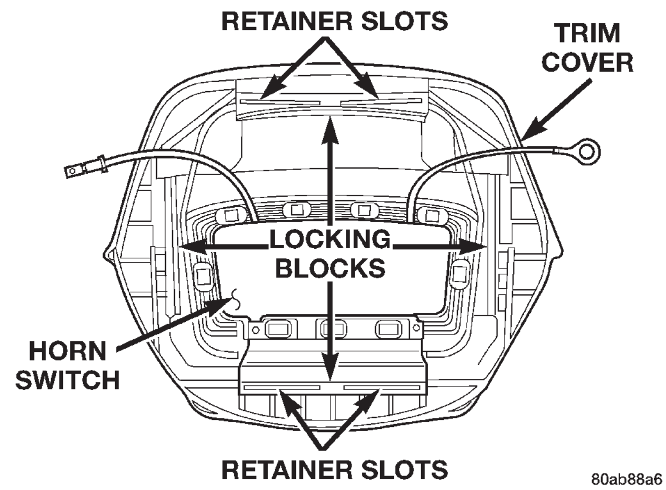

Fig. 7 Driver Side Airbag Trim Cover Remove/Install

• THE DRIVER SIDE AIRBAG MODULE TRIM COVER MUST NEVER BE PAINTED. REPLACEMENT TRIM COVERS ARE SERVICED IN THE ORIGINAL COLORS. PAINT MAY CHANGE THE WAY IN WHICH THE MATERIAL OF THE TRIM COVER RESPONDS TO AN AIRBAG DEPLOYMENT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

(1) Carefully position the driver side airbag module in the trim cover. Be certain that the horn switch feed and ground wires are not pinched between the airbag housing and the trim cover locking blocks.

(2) Engage the upper and lower trim cover locking blocks with the lip of the driver side airbag housing, then engage the locking blocks on each side of the trim cover with the lip of the housing. Be certain that each of the locking blocks is fully engaged on the lip of the airbag housing (Fig. 8).

(3) Install the horn switch ground wire eyelet over the upper airbag housing stud.

(4) Install the upper and lower airbag trim cover retainers over the airbag housing studs. Be certain that the tabs on each retainer are engaged in the retainer slots of the upper and lower trim cover locking blocks (Fig. 7).

(5) Install and tighten the trim cover retainer mounting nuts on the airbag housing studs. Tighten the nuts to 10 N·m (90 in. lbs.).

(6) Install the driver side airbag module onto the steering wheel. Refer to **Driver Side Airbag Module** in the Removal and Installation section of this group for the procedures.

PASSENGER SIDE AIRBAG MODULE

The following procedure is for replacement of a faulty or damaged passenger side airbag module. If the passenger side airbag module has been deployed,

REMOVAL AND INSTALLATION (Continued)

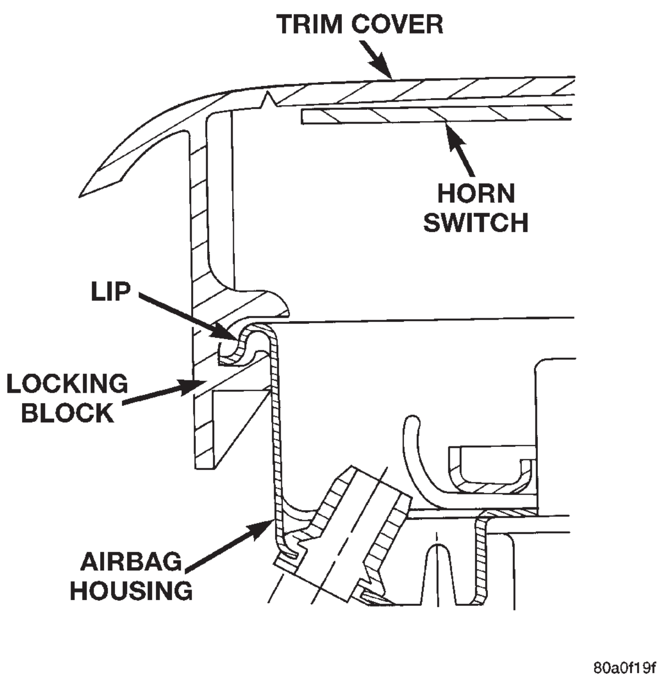

Fig. 8 Driver Side Airbag Trim Cover Locking Blocks Engaged

the passenger side airbag door must also be replaced. Refer to **Passenger Side Airbag Door** in the Removal and Installation section of this group for the additional service procedures for the passenger side airbag door.

WARNING:

- **THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTROMECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**
- **WHEN REMOVING A DEPLOYED AIRBAG MODULE, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG MODULE AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.**

REMOVAL

(1) Disconnect and isolate the battery negative cable. If either of the airbags has not been deployed, wait two minutes for the system capacitor to discharge before further service.

(2) Remove the top cover from the instrument panel. Refer to **Instrument Panel Top Cover** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(3) Disconnect the passenger side airbag module wire harness connector from the instrument panel wire harness. This connector is located on the top of the instrument panel structural support between the airbag module and the windshield (Fig. 9).

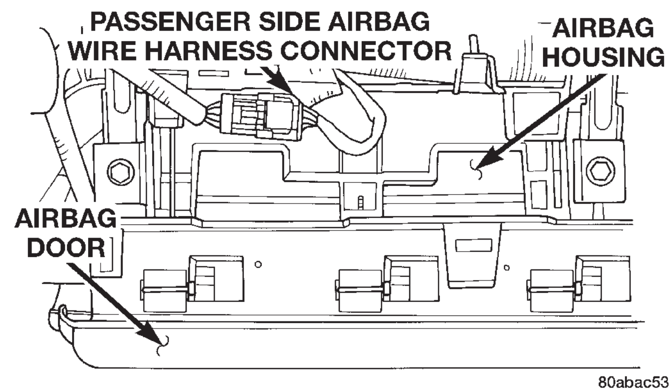

Fig. 9 Passenger Side Airbag Module Connector

(4) Disengage the passenger side airbag module wire harness connector retainer from the mounting hole on the top of the instrument panel structural support.

(5) Remove the four screws that secure the upper flange of the passenger side airbag door to the instrument panel structural support (Fig. 10).

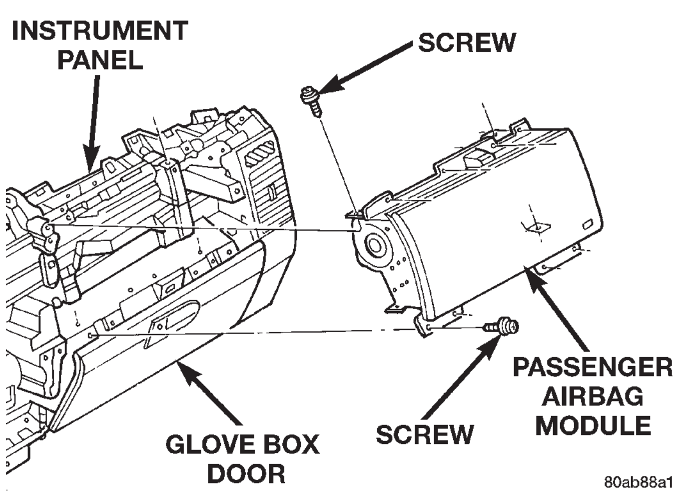

Fig. 10 Passenger Side Airbag Module Remove/ Install

REMOVAL AND INSTALLATION (Continued)

(6) Remove the two screws that secure the passenger side airbag module upper mounting brackets to the top of the instrument panel structural support.

(7) Roll down the glove box from the instrument panel. Refer to **Glove Box - Roll Down** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(8) Remove the four screws that secure the lower flange of the passenger side airbag door to the instrument panel upper glove box opening reinforcement.

(9) Reach through and above the instrument panel glove box opening to access and remove the two screws that secure the passenger side airbag module lower mounting brackets to the instrument panel structural support.

(10) Remove the passenger side airbag module and airbag door from the instrument panel as a unit.

(11) Remove the passenger side airbag door from the airbag module. Refer to **Passenger Side Airbag Door** in the Removal and Installation section of this group for the procedures.

INSTALLATION

WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE PASSENGER SIDE AIRBAG MODULE, OR BECOMING ENTRAPPED BETWEEN THE AIRBAG CUSHION AND THE PASSENGER SIDE AIRBAG DOOR. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

(1) Install the passenger side airbag door onto the airbag module. Refer to **Passenger Side Airbag Door** in the Removal and Installation section of this group for the procedures.

(2) Carefully position the passenger side airbag module and airbag door in the instrument panel as a unit.

(3) Reach through and above the instrument panel glove box opening to install and tighten the two screws that secure the passenger side airbag module lower mounting brackets to the instrument panel structural support. Tighten the screws to 11.8 N·m (105 in. lbs.).

(4) Install and tighten the four screws that secure the lower flange of the passenger side airbag door to the instrument panel upper glove box opening reinforcement. Tighten the screws to 2.2 N·m (20 in. lbs.).

(5) Install the glove box into the instrument panel. Refer to **Glove Box - Roll Down** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(6) Install and tighten the two screws that secure the passenger side airbag module upper mounting brackets to the top of the instrument panel structural support. Tighten the screws to 11.8 N·m (105 in. lbs.).

(7) Install and tighten the four screws that secure the upper flange of the passenger side airbag door to the instrument panel structural support. Tighten the screws to 2.2 N·m (20 in. lbs.).

(8) Engage the passenger side airbag module wire harness connector retainer in the mounting hole on the top of the instrument panel structural support.

(9) Reconnect the passenger side airbag module wire harness connector to the instrument panel wire harness. Be certain that the connector is fully engaged and latched.

(10) Install the top cover onto the instrument panel. Refer to **Instrument Panel Top Cover** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(11) Do not reconnect the battery negative cable at this time. Refer to **Airbag System** in the Diagnosis and Testing section of this group for the proper procedures.

PASSENGER SIDE AIRBAG DOOR

WARNING:

- **THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTROMECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**
- **WHEN REMOVING A DEPLOYED AIRBAG MODULE, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG MODULE AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.**

REMOVAL

(1) Disconnect and isolate the battery negative cable. If either of the airbags has not been deployed, wait two minutes for the system capacitor to discharge before further service.

REMOVAL AND INSTALLATION (Continued)

(2) Remove the passenger side airbag module from the instrument panel. Refer to **Passenger Side Airbag Module** in the Removal and Installation section of this group for the procedures.

(3) Place the passenger side airbag module on a suitable work surface. Slide the passenger side airbag door sideways on the airbag module until the keyed holes in the returns of the upper and lower airbag door mounting flanges clear the three tabs on the top and the bottom of the airbag module housing (Fig. 11).

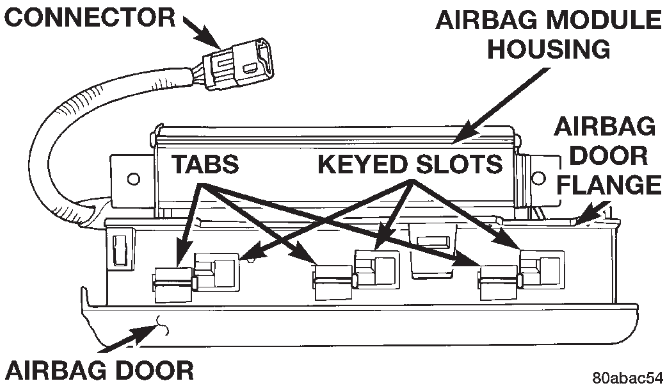

Fig. 11 Passenger Side Airbag Door Remove/Install

(4) Disengage the keyed holes in the returns of the upper and lower airbag door mounting flange returns from the three tabs on the top and the bottom of the passenger side airbag module housing.

(5) Remove the passenger side airbag door from the airbag module.

INSTALLATION

WARNING:

• USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE PASSENGER SIDE AIRBAG MODULE, OR BECOMING ENTRAPPED BETWEEN THE AIRBAG CUSHION AND THE PASSENGER SIDE AIRBAG DOOR. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

• THE PASSENGER SIDE AIRBAG DOOR MUST NEVER BE PAINTED. REPLACEMENT AIRBAG DOORS ARE SERVICED IN THE ORIGINAL COLORS. PAINT MAY CHANGE THE WAY IN WHICH THE MATERIAL OF THE AIRBAG DOOR RESPONDS TO AN AIRBAG DEPLOYMENT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

(1) Position the passenger side airbag door over the airbag module.

(2) Engage the keyed holes in the returns of the upper and lower airbag door mounting flanges with the three tabs on the top and the bottom of the passenger side airbag module housing.

(3) Slide the passenger side airbag door sideways until the keyed holes in the returns of the upper and lower airbag door mounting flanges are locked onto the three tabs on the top and the bottom of the airbag module housing.

(4) Install the passenger side airbag module onto the instrument panel. Refer to **Passenger Side Airbag Module** in the Removal and Installation section of this group for the procedures.

AIRBAG CONTROL MODULE

WARNING:

• THE AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE AIRBAG. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

• NEVER STRIKE OR KICK THE AIRBAG CONTROL MODULE, AS IT CAN DAMAGE THE IMPACT SENSOR OR AFFECT ITS CALIBRATION. IF AN AIRBAG CONTROL MODULE IS ACCIDENTALLY DROPPED DURING SERVICE, THE MODULE MUST BE SCRAPPED AND REPLACED WITH A NEW UNIT. ALWAYS REINSTALL THE AIRBAG CONTROL MODULE PROTECTIVE COVER. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER AIRBAG DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.

REMOVAL

(1) Disconnect and isolate the battery negative cable. If either of the airbags has not been deployed, wait two minutes for the system capacitor to discharge before further service.

(2) Remove the left front bucket seat assembly from the passenger compartment of the vehicle. Refer to **Seats** in the Removal and Installation section of Group 23 - Body for the procedures.

(3) Remove the three screws that secure the Airbag Control Module (ACM) protective cover to the floor panel and the ACM mounting bracket (Fig. 12).

(4) Lift the ACM protective cover away from the ACM far enough to access and disengage the instru-

REMOVAL AND INSTALLATION (Continued)

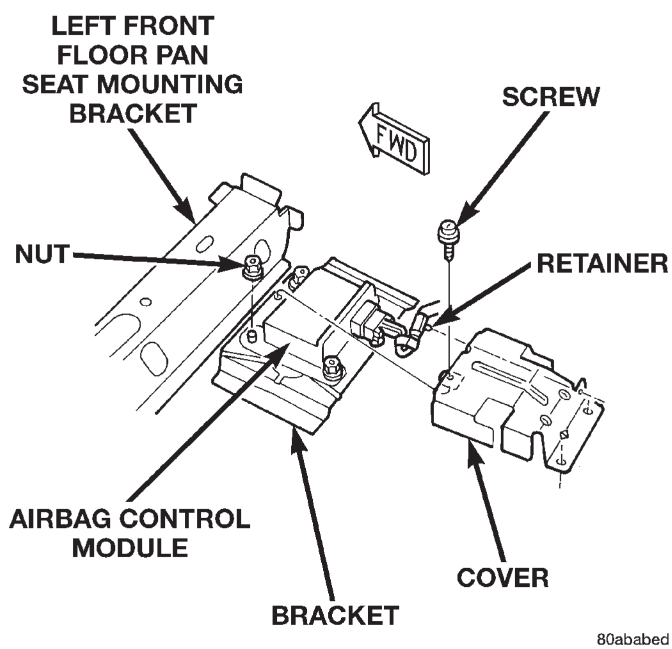

Fig. 12 Airbag Control Module Remove/Install

ment panel floor wire harness retainer from the slotted mounting hole near the rear of the cover.

(5) Reach under the front of the driver side front seat to access and disconnect the instrument panel floor wire harness connector from the Airbag Control Module (ACM). To disconnect the instrument panel floor wire harness connector from the ACM:

(a) Squeeze the two connector latch tabs between the thumb and forefinger.

(b) Pull the connector straight away from the ACM connector receptacle.

(6) Remove the three nuts that secure the ACM mounting bracket to the mount that is welded onto the floor panel.

(7) Remove the ACM from the mount on the floor panel.

INSTALLATION

(1) Carefully position the ACM to the mount that is welded onto the floor panel. When the ACM is correctly positioned the arrow on the ACM label will be pointed forward in the vehicle.

(2) Install and tighten the three nuts that secure the ACM to the mount. Tighten the nuts to 7.3 N·m (65 in. lbs.).

(3) Reconnect the instrument panel floor wire harness connector to the ACM connector receptacle. Be certain that the connector latches are fully engaged.

(4) Position the protective cover over the ACM.

(5) Engage the instrument panel floor wire harness retainer in the slotted mounting hole near the rear of the ACM protective cover.

(6) Install and tighten the three screws that secure the ACM protective cover to the floor panel and the ACM mounting bracket. Tighten the screws to 4 N·m (35 in. lbs.).

(7) Install the left front bucket seat assembly into the passenger compartment of the vehicle. Refer to **Seats** in the Removal and Installation section of Group 23 - Body for the procedures.

(8) Do not reconnect the battery negative cable at this time. Refer to **Airbag System** in the Diagnosis and Testing section of this group for the proper procedures.

CLOCKSPRING

The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver side airbag has been deployed.

WARNING: THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTROMECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

NOTE: Before starting this procedure, be certain to turn the steering wheel until the front wheels are in the straight-ahead position.

(1) Place the front wheels in the straight-ahead position.

(2) Remove the driver side airbag module from the steering wheel. Refer to **Driver Side Airbag Module** in the Removal and Installation section of this group for the procedures.

(3) If the vehicle is so equipped, disconnect the upper clockspring wire harness connector from the steering wheel wire harness for the vehicle speed control switches located within the hub cavity of the steering wheel.

(4) Remove the nut that secures the steering wheel armature to the steering column upper shaft, which is located within the hub cavity of the steering wheel.

(5) Pull the steering wheel off of the steering column upper shaft spline using a steering wheel puller (Special Tool C-3428-B).

REMOVAL AND INSTALLATION (Continued)

(6) Remove the steering column opening cover from the instrument panel. Refer to **Steering Column Opening Cover** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(7) If the vehicle is so equipped, move the tilt steering column to the fully raised position.

(8) Remove the three screws that secure the lower steering column shroud to the upper shroud (Fig. 13).

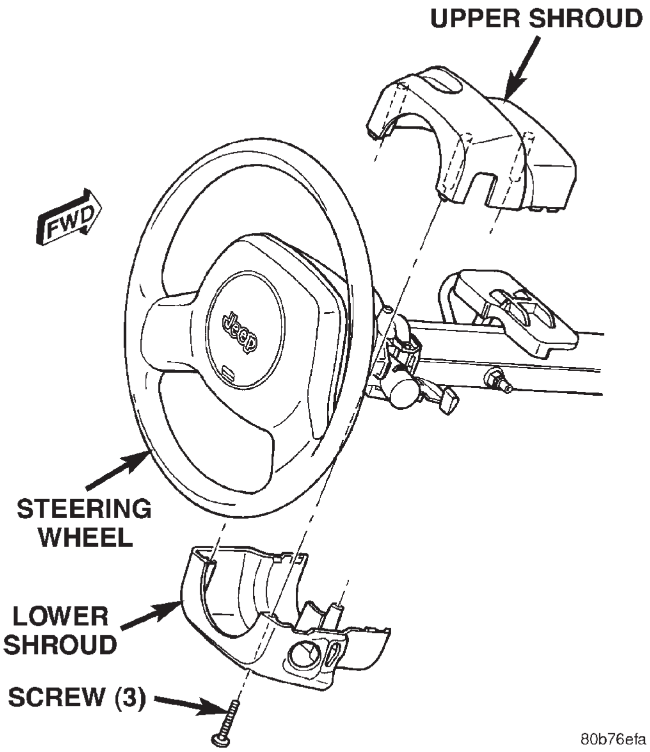

Fig. 13 Steering Column Shrouds Remove/Install

(9) If the vehicle is equipped with a standard non-tilt steering column, loosen the two upper steering column mounting nuts. If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully lowered position.

(10) Remove both the upper and lower shrouds from the steering column.

(11) Disconnect the two instrument panel wire harness connectors from the lower clockspring connector receptacles (Fig. 14).

(12) The multi-function switch water shield bracket on the top of the steering column has a small access window which allows access to the upper clockspring latch with a small screwdriver (Fig. 15). Gently pry both plastic latches of the clockspring assembly to release them from the steering column upper housing.

NOTE: If the clockspring plastic latches are broken, be certain to remove the broken pieces from the steering column upper housing.

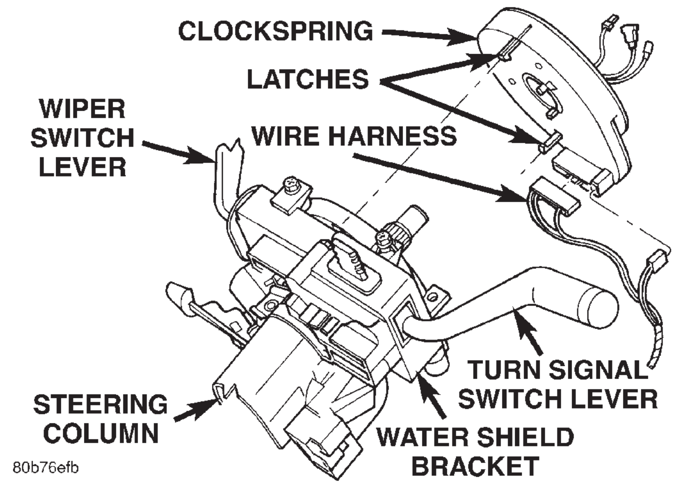

Fig. 14 Clockspring Remove/Install

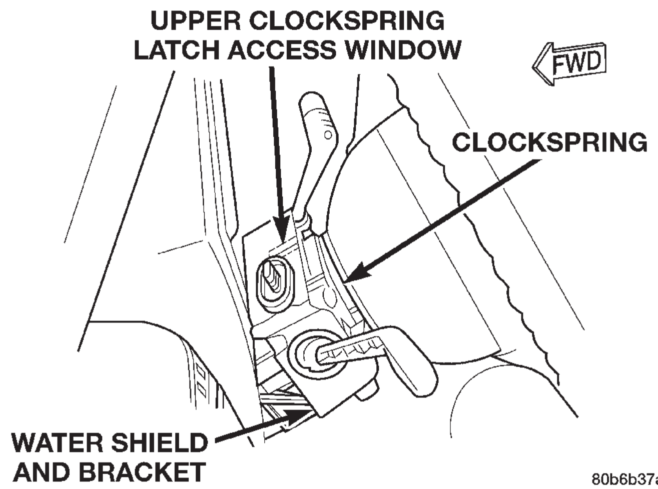

Fig. 15 Upper Clockspring Latch Access Window

(13) Remove the clockspring from the steering column. The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver side airbag has been deployed.

(14) If the removed clockspring is to be reused, lock the clockspring rotor to the clockspring case to maintain clockspring centering until it is reinstalled on the steering column. This can be done by inserting a stiff wire through the small index hole located at about the 11 o'clock position in the centered clockspring rotor and case. Refer to **Clockspring Centering** in the Adjustments section of this group for an illustration of the clockspring index hole. Bend the wire over after it has been inserted through the index hole to prevent it from falling out.

INSTALLATION

If the clockspring is not properly centered in relation to the steering wheel, steering shaft and steering gear, it may be damaged. Refer to **Clockspring Centering** in the Adjustments section of this group before installing or reinstalling a clockspring.

REMOVAL AND INSTALLATION (Continued)

Service replacement clocksprings are shipped pre-centered and with a locking pin installed. This locking pin should not be removed until the clockspring has been installed on the steering column. If the locking pin is removed before the clockspring is installed on a steering column, the clockspring centering procedure must be performed.

NOTE: Before starting this procedure, be certain that the front wheels are still in the straight-ahead position.

(1) If the removed clockspring is being reused, remove the wire from the index hole that is locking the clockspring rotor to the clockspring case to maintain clockspring centering.

(2) Be certain that the turn signal switch stalk is in the neutral position, then carefully slide the centered clockspring down over the steering column upper shaft until the clockspring latches engage the steering column upper housing.

(3) If a new clockspring has been installed, remove the locking pin that is securing the clockspring rotor to the clockspring case and maintaining clockspring centering.

(4) Reconnect the two instrument panel wire harness connectors to the lower clockspring connector receptacles. Be certain that the connector latches are fully engaged.

(5) Position the steering column shrouds on the steering column.

(6) Install and tighten the three screws that secure the lower steering column shroud to the upper shroud. Tighten the screws to 2 N·m (18 in. lbs.).

(7) Install the steering column opening cover onto the instrument panel. Refer to **Steering Column Opening Cover** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(8) Install the steering wheel onto the steering column upper shaft. Be certain to index the flats on the hub of the steering wheel with the formations on the inside of the clockspring rotor. Pull the upper clockspring wire harnesses through the lower hole in the steering wheel armature.

(9) Install and tighten the steering wheel mounting nut. Tighten the nut to 61 N·m (45 ft. lbs.). Be certain not to pinch the wire harnesses between the steering wheel and the nut.

(10) If the vehicle is so equipped, reconnect the upper clockspring wire harness connector to the steering wheel wire harness for the vehicle speed control switches.

(11) Install the driver side airbag module onto the steering wheel. Refer to **Driver Side Airbag Module** in the Removal and Installation section of this group for the procedures.

ADJUSTMENTS

CLOCKSPRING CENTERING

The clockspring is designed to wind and unwind when the steering wheel is rotated, but is only designed to rotate the same number of turns (about five complete rotations) as the steering wheel can be turned from stop to stop. Centering the clockspring indexes the clockspring tape to other steering components so that it can operate within its designed travel limits. The rotor of a centered clockspring can be rotated two and one-half turns in either direction from the centered position, without damaging the clockspring tape.

However, if the clockspring is removed for service or if the steering column is disconnected from the steering gear, the clockspring tape can change position relative to the other steering components. The clockspring must then be re-centered following completion of the service or the clockspring tape may be damaged.

Service replacement clocksprings are shipped pre-centered and with a locking pin installed. This locking pin should not be removed until the clockspring has been installed on the steering column. If the locking pin is removed before the clockspring is installed on a steering column, the clockspring centering procedure must be performed.

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NOTE: Before starting this procedure, be certain to turn the steering wheel until the front wheels are in the straight-ahead position.

(1) Place the front wheels in the straight-ahead position.

(2) Remove the clockspring from the steering column. Refer to **Clockspring** in the Removal and Installation section of this group for the procedures.

(3) Hold the clockspring case in one hand so that it is oriented as it would be when it is installed on the steering column (Fig. 16).

ADJUSTMENTS (Continued)

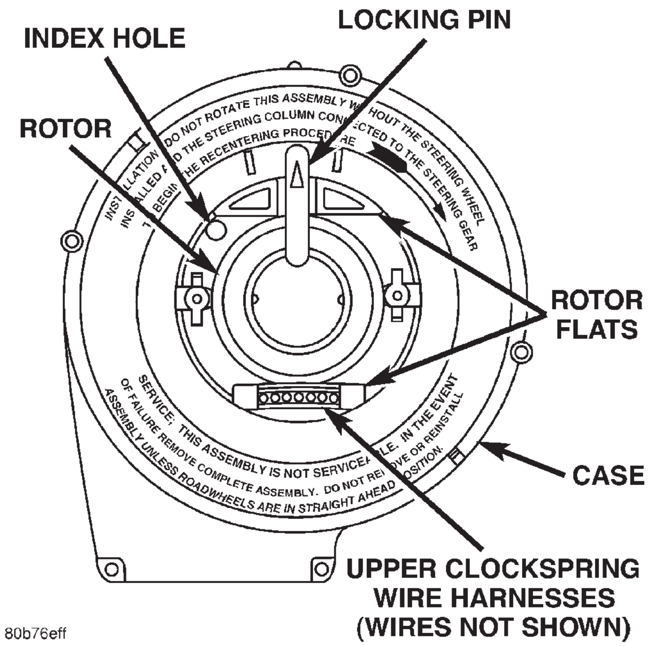


Fig. 16 Clockspring

(4) Use your other hand to rotate the clockspring rotor clockwise to the end of its travel. **Do not apply excessive torque.**

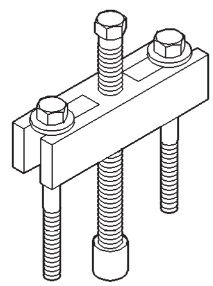
(5) From the end of the clockwise travel, rotate the rotor about two and one-half turns counterclockwise, until the rotor flats are horizontal. If the upper clockspring wire harnesses are not oriented towards the bottom of the clockspring, rotate the rotor another one-half turn in the counterclockwise direction.

(6) The clockspring is now centered. Lock the clockspring rotor to the clockspring case to maintain clockspring centering until it is reinstalled on the steering column. This can be done by inserting a stiff wire through the small index hole located at about the 11 o'clock position in the centered clockspring rotor and case. Bend the wire over after it has been inserted through the index hole to prevent it from falling out.

(7) The front wheels should still be in the straight-ahead position. Install the clockspring onto the steering column. Refer to **Clockspring** in the Removal and Installation section of this group for the procedures.

SPECIAL TOOLS

PASSIVE RESTRAINT SYSTEMS



Puller C-3428-B

ELECTRICALLY HEATED SYSTEMS

CONTENTS

REAR WINDOW DEFOGGER SYSTEM

INDEX

GENERAL INFORMATION

INTRODUCTION

An electrically heated rear window defogger and electrically heated outside rear view mirrors are available factory-installed options on this model. Refer to 8W-48 - Rear Window Defogger and 8W-62 - Power Mirrors 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.

REAR WINDOW DEFOGGER SYSTEM

The rear window defogger system will only operate when the ignition switch is in the On position. When the defogger switch is in the On position, an electric heater grid on the rear window glass is energized. Vehicles with the heated mirror options also have heater grids located behind the outside rear view mirror glass. Each of these grids produce heat to help clear the rear window glass and outside rear view mirrors of ice, snow, or fog.

The defogger system is controlled by a switch installed in the instrument panel accessory switch bezel, which is located near the bottom of the instrument panel center bezel area, below the heater and air conditioner controls. 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

GENERAL INFORMATION (Continued)

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. Following are general descriptions of the major components in the defogger system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the defogger system.

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 switch is placed in the On position, electrical current is directed to the rear window grid lines through the bus bars. The grid lines heat the rear window to clear the surface of fog or snow. Protection for the heated grid circuit is provided by a fuse in the Power Distribution Center (PDC).

The grid lines and bus bars are highly resistant to abrasion. However, it is possible for an open circuit to occur in an individual grid line, resulting in no current flow through the line.

The grid lines can be damaged or scraped off with sharp instruments. Care should be taken when cleaning the glass or removing foreign materials, decals, or stickers from the glass. Normal glass cleaning solvents or hot water used with rags or toweling is recommended.

A repair kit is available to repair the grid lines and bus bars, or to reinstall the heated glass pigtail wires.

OUTSIDE MIRROR HEATING GRID

Vehicles equipped with the optional heated mirror package have an electric heating grid located behind the mirror glass of each outside rear view mirror. The heated mirrors are controlled by the rear window defogger switch. Electrical current is directed to the heating grid inside the mirror only when the rear window defogger switch is in the On position.

If the outside mirror heating grids and the rear window heating grid are all inoperative, diagnosis of the rear window defogger system should be performed as described in this group. If the outside mirror heating grids are inoperative, but the rear window heating grid is operating as designed, refer to Power Mirror in the Diagnosis and Testing section of Group 8T - Power Mirror Systems for diagnosis of the mirror heating grids.

The heating grid behind each outside mirror glass cannot be repaired and, if faulty or damaged, the entire power mirror unit must be replaced. Refer to Power Mirror in the Removal and Installation section of Group 8T - Power Mirror Systems for the service procedures.

DEFOGGER SWITCH

The rear window defogger switch is installed in the instrument panel accessory switch bezel, which is located near the bottom of the instrument panel center bezel area, below the heater and air conditioner controls. The momentary-type switch provides a hard-wired ground signal to the instrument cluster each time it is depressed. The instrument cluster rear window defogger timer and logic circuitry responds by energizing or de-energizing the rear window defogger relay.

Energizing the rear window defogger relay provides electrical current to the rear window defogger grid and, if the vehicle is so equipped, the outside rear view mirror heating grids. An amber indicator lamp in the defogger switch, which lights to indicate when the defogger system is turned On, is also powered by the defogger relay output.

The defogger switch illumination lamp and indicator lamp bulbs are serviceable. The defogger switch cannot be repaired and, if faulty or damaged, it must be replaced.

INSTRUMENT CLUSTER

The instrument cluster is an electromechanical unit that contains integrated circuitry and internal programming to perform a variety of functions. The instrument cluster circuitry monitors hard-wired switch inputs, as well as message inputs received from other vehicle electronic control modules on the Chrysler Collision Detection (CCD) data bus network.

The instrument cluster uses these many inputs along with its internal programming and integral timer and logic circuitry to perform the functions of the rear window defogger timer on this model. The instrument cluster circuitry also has a self-diagnostic capability. Refer to Instrument Cluster in Group 8E - Instrument Panel Systems for more information on this feature.

However, there are no diagnostics available for the rear window defogger timer and logic circuitry. Therefore, the diagnosis for this system consists of confirming the presence of a rear window defogger switch input signal at the instrument cluster connector, and the resulting rear window defogger relay

DESCRIPTION AND OPERATION (Continued)

control output signal at the defogger relay. For diagnosis of the CCD data bus and the data bus message inputs, a DRB scan tool and the proper Diagnostic Procedures manual are recommended.

Refer to Instrument Cluster in 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 or damaged, the instrument cluster assembly must be replaced.

DEFOGGER RELAY

The rear window defogger relay is a International Standards Organization (ISO)-type relay. The rear window defogger relay is a electromechanical device that switches fused battery current to the rear glass and outside mirror heating grids, and the indicator lamp of the defogger switch, when the instrument cluster rear window defogger timer and logic circuitry grounds the relay coil. See Defogger Relay in the Diagnosis and Testing section of this group for more information.

The rear window defogger relay is located in the junction block, on the right cowl side inner panel below the instrument panel in the passenger compartment. The rear window defogger relay cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING

DEFOGGER SYSTEM

For circuit descriptions and diagrams, refer to 8W-48 - Rear Window Defogger or 8W-62 Power Mirrors in Group 8W - Wiring Diagrams. The operation of the electrically heated rear window defogger system can be confirmed in one of the following manners:

1. Turn the ignition switch to the On position. While monitoring the instrument panel voltmeter, set the 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 rear window defogger operation can be checked by feeling the rear window or outside rear view mirror glass. A distinct difference in temperature between the grid lines and the adjacent clear glass or the mirror glass can be detected within three to four minutes of operation.

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.

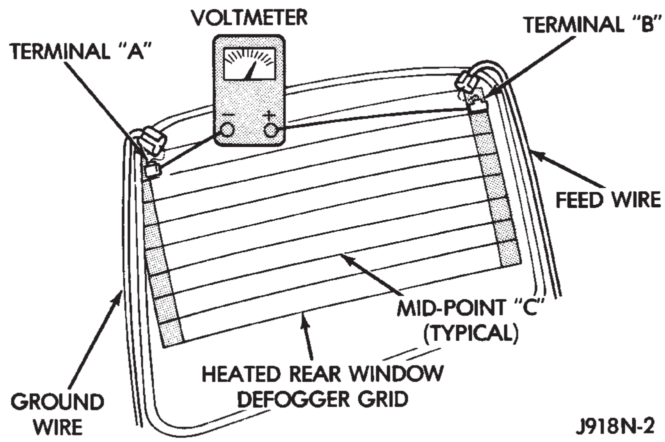


Fig. 1 Rear Window Glass Grid Test

The above checks will confirm system operation. Illumination of the defogger switch indicator lamp means that there is electrical current available at the output of the defogger relay, but does not confirm that the electrical current is reaching the rear glass heating grid lines.

If the defogger system does not operate, the problem should be isolated in the following manner:

(1) Confirm that the ignition switch is in the 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 (PDC) and in the junction block. The fuses must be tight in their receptacles and all electrical connections must be secure.

When the above steps have been completed and the rear glass or outside rear view mirror heating grid is still inoperative, one or more of the following is faulty:

- Defogger switch
- Defogger relay
- 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)
- Outside rear view mirror heating grid.

If setting the defogger switch to the On position produces a severe voltmeter deflection, check for a short circuit between the defogger relay output and the rear glass or outside rear view mirror heating grids.

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:

DIAGNOSIS AND TESTING (Continued)

(1) Turn the ignition switch to the On position. Set the 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 midpoint 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 midpoint C and the left side bus bar. A reading of ten to fourteen volts indicates a break between midpoint 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

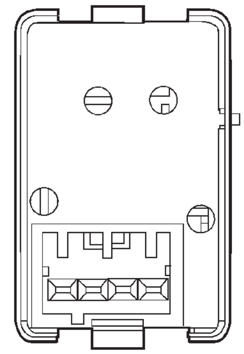
For circuit descriptions and diagrams, refer to 8W-48 - Rear Window Defogger in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the accessory switch bezel from the instrument panel and unplug the defogger switch wire harness connector.

(2) Check for continuity between the ground circuit cavity of the defogger 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 terminal and the rear window defogger switch sense circuit terminal on the back of the defogger 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 the 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

80a5035f

Fig. 2 Defogger Switch Continuity

DEFOGGER RELAY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

RELAY TEST

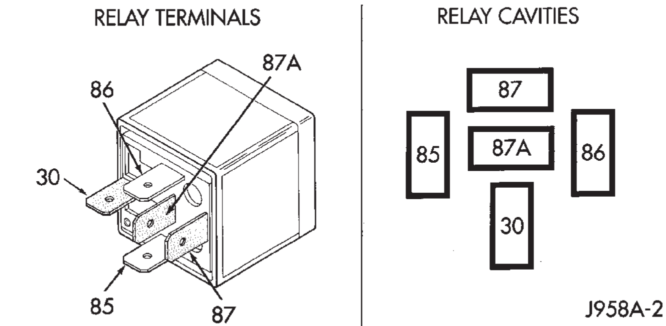
The defogger relay (Fig. 3) is located in the junction block, on the right cowl side inner panel below the instrument panel in the passenger compartment. Remove the defogger relay from the junction block to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and 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.

DIAGNOSIS AND TESTING (Continued)



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 3 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 and outside rear view mirror heating grids and the defogger switch indicator lamp. There should be continuity between the cavity for relay terminal 87 and the rear window defogger relay output circuit cavities of the rear glass heating grid connector, both outside rear view mirror heating grid connectors, and the defogger switch connector at all times. If OK, go to Step 4. If not OK, repair the open circuit(s) as required.

(4) The coil ground terminal (85) is connected to the electromagnet in the relay. This terminal is provided with ground by the instrument cluster rear window defogger timer and logic circuitry to energize the defogger relay. There should be continuity to ground at the cavity for relay terminal 85 when the defogger switch is turned On. However, with the defogger relay removed, the defogger switch indicator lamp will not light to show that the defogger system is turned On. Be certain that you depress the defogger switch at least twice to confirm that the system is turned on during this test. If OK, go to Step 5. If not OK, repair the open circuit to the instrument cluster as required.

(5) The coil battery terminal (86) is connected to the electromagnet in the relay. It is connected to fused ignition switch output voltage and should be hot when the ignition switch is in the On position. Check for battery voltage at the cavity for relay terminal 86 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 junction block 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 ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the defogger relay from the junction block and unplug the defogger switch wire harness connector.

(2) Remove the instrument cluster from the instrument panel. Refer to Instrument Cluster in Group 8E - Instrument Panel Systems for the procedures.

(3) Check for continuity between the rear window defogger switch sense circuit cavity of the right instrument cluster wire harness connector (connector B) and a good ground. There should be no continuity. If OK, go to Step 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 instrument cluster wire harness connector (connector B) and the defogger switch wire harness connector. There should be continuity. If OK, go to Step 5. If not OK, repair the open circuit as required.

(5) Check for continuity between the rear window defogger relay control circuit cavity of the right instrument cluster wire harness connector (connector B) and a good ground. There should be no continuity. If OK, go to Step 6. If not OK, repair the short circuit as required.

(6) Check for continuity between the rear window defogger relay control circuit cavities of the right instrument cluster wire harness connector (connector B) and the defogger relay receptacle (the cavity for ISO relay terminal 85) in the junction block. There should be continuity. If OK, replace the faulty instrument cluster. If not OK, repair the open circuit as required.

SERVICE PROCEDURES

REAR GLASS HEATING GRID REPAIR

Repair of the rear glass heating grid lines, bus bars, terminals or pigtail wires can be accomplished using a Mopar Rear Window Defogger Repair Kit (Part Number 4267922) or equivalent.

WARNING: MATERIALS CONTAINED IN THE REPAIR KIT MAY CAUSE SKIN OR EYE IRRITATION. THE KIT CONTAINS EPOXY RESIN AND AMINE TYPE HARDENER, WHICH ARE HARMFUL IF SWALLOWED. AVOID CONTACT WITH THE SKIN AND EYES. FOR SKIN CONTACT, WASH THE AFFECTED AREAS WITH SOAP AND WATER. FOR CONTACT WITH THE EYES, FLUSH WITH PLENTY OF WATER. DO NOT TAKE INTERNALLY. IF TAKEN INTERNALLY, INDUCE VOMITING AND CALL A PHYSICIAN IMMEDIATELY. USE WITH ADEQUATE VENTILATION. DO NOT USE NEAR FIRE OR FLAME. CONTAINS FLAMMABLE SOLVENTS. KEEP OUT OF THE REACH OF CHILDREN.

(1) Mask the repair area so that the conductive epoxy can be applied neatly. Extend the epoxy application onto the grid line or the bus bar on each side of the break (Fig. 4).

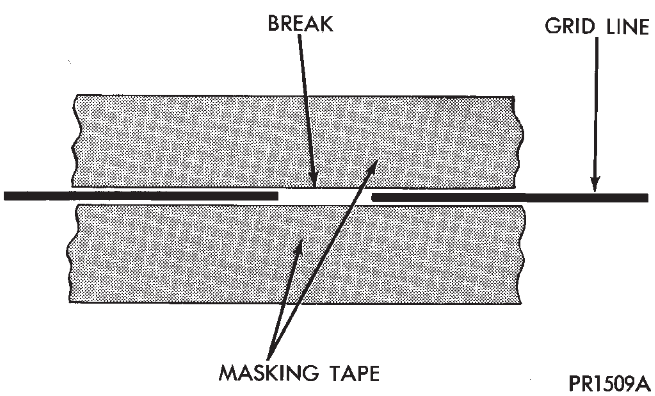


Fig. 4 Grid Line Repair - Typical

(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 millimeters (0.75 inch).

(6) For a terminal or pigtail wire replacement, mask the adjacent areas so the epoxy can be extended onto the adjacent grid line as well as the bus bar. Apply a thin layer of epoxy to the area where the terminal or pigtail wire was fastened and onto the adjacent grid line.

(7) Apply a thin layer of conductive epoxy to the terminal or bare wire end of the pigtail and place it in the proper location on the bus bar. To prevent the terminal or pigtail wire from moving while the epoxy is curing, it must be wedged or clamped.

(8) Carefully remove the masking tape or template.

CAUTION: Do not allow the glass surface to exceed 204° C (400° F) or the glass may fracture.

(9) Allow the epoxy to cure 24 hours at room temperature, or use a heat gun with a 260° to 371° C (500° to 700° F) range for fifteen minutes. Hold the heat gun approximately 25.4 centimeters (10 inches) from the repair.

(10) After the conductive epoxy is properly cured, remove the wedge or clamp from the terminal or pigtail wire. Do not attach the wire harness connectors until the curing process is complete.

(11) Check the operation of the rear window defogger glass heating grid.

REMOVAL AND INSTALLATION

DEFOGGER SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the center bezel from the instrument panel. See Instrument Panel Center Bezel in Group 8E - Instrument Panel Systems for the procedures.

(3) Remove the three screws that secure the accessory switch bezel to the instrument panel (Fig. 5).

(4) Pull the accessory switch bezel out from the instrument panel far enough to access the wire harness connectors.

(5) Unplug the wire harness connectors from the rear of the accessory switches and the cigar lighter/ power outlet.

(6) Remove the accessory switch bezel from the instrument panel.

REMOVAL AND INSTALLATION (Continued)

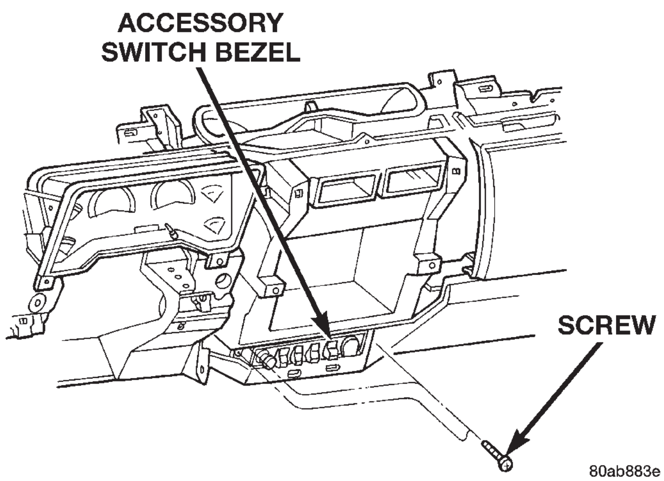


Fig. 5 Accessory Switch Bezel Remove/Install

(7) With a small thin-bladed screwdriver, gently pry the snap clips at the top and bottom of the rear window defogger switch receptacle on the back of the accessory switch bezel and pull the switch out of the bezel.

(8) Reverse the removal procedures to install. Be certain that both of the switch snap retainers in the receptacle on the back of the accessory switch bezel are fully engaged. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

DEFOGGER RELAY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the fuse access panel by unsnapping it from the right cowl side trim panel.

(3) Remove the stamped nut that secures the right cowl side trim to the junction block stud (Fig. 6).

(4) Remove the screw located above the fuse access opening that secures the right cowl side trim to the right cowl side inner panel.

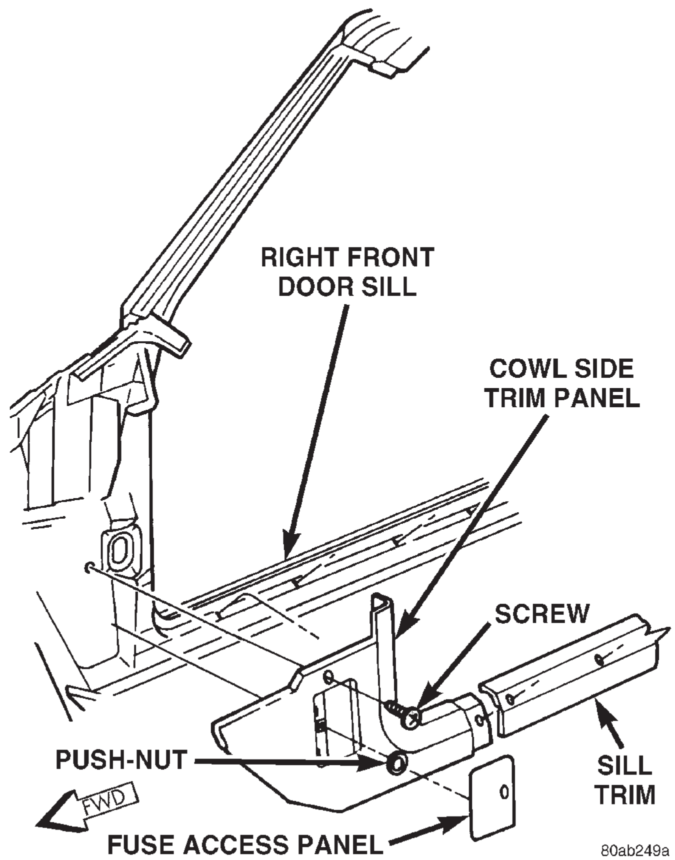


Fig. 6 Right Cowl Side Trim Remove/Install

(5) Remove the screw that secures the right door sill trim and the right cowl side trim to the right door opening sill.

(6) Remove the right cowl side trim panel from the vehicle.

(7) Unplug the rear window defogger relay from the junction block.

(8) Install the defogger relay by aligning the relay terminals with the cavities in the junction block and pushing the relay firmly into place.

(9) Connect the battery negative cable.

(10) Test the relay operation.

(11) Reinstall the right cowl side trim and the fuse access panel. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

HEATED SEAT SYSTEM

INDEX

GENERAL INFORMATION

INTRODUCTION

Individually controlled electrically heated front seats are available factory-installed optional equipment on this model. The seat heaters will only operate when the ignition switch is in the ON position, and the surface temperature at the front seat heating element sensors is below the designed temperature set points of the system. The heated seat system will not operate in ambient temperatures greater than about 32° C (90° F).

There are separate momentary, tactile, two-directional rocker switches located in the center console with center NEUTRAL, HI and LO positions for each front seat. Depressing the rocker switch to its momentary HI or LO position signals the Seat Heat Interface Module (SHIM) to power the selected heated seat and maintain the requested temperature setting (HI or LO). Each switch has a HI and LO Light-Emitting Diode (LED) which, via the SHIM, illuminates to give a visual indication that the system is in the HI or LO mode. The LO heat set point is about 32° C (90° F), and the HI heat set point is about 38° C (100° F). The system shall be deactivated whenever the same set position is depressed a second time and shall change states directly when switching from HI to LO or vice versa. The system shall be deactivated whenever the ignition switch is placed in the off position. When the ignition switch is placed back in the run position, the heated seat system shall remain deactivated until a momentary switch is depressed. When a seat heater is turned on, a sensor located near the seat cushion electric heater element provides the SHIM with input indicating the surface temperature of the seat cushion. If the surface temperature input is below the temperature set point of the SHIM for the selected temperature setting, an N-FET Transistor within the SHIM energizes the heating elements in the seat cushion and back. When the sensor input indicates the correct temperature set point has been achieved, the SHIM de-energizes the N-FET. The SHIM will continue to cycle the N-FET as needed to maintain the temperature set point.

The SHIM will automatically turn off the heating elements if it detects a short in the heating element or a sensor out of range. These conditions will also cause the SHIM to notify the occupant of the failure via flashing the heated seat switch LED's as discussed later.

Switched battery power to the SHIM is supplied by the heated seat relay mounted to the seat cushion frame with the SHIM under the right front seat. The battery feed is protected by a circuit breaker located in the junction block.

Following are general descriptions of the major components in the heated seat system. Refer to 8W-63 - Power Seat With Heated Seats in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

DESCRIPTION AND OPERATION

HEATED SEAT SWITCH

The heated seat switch assembly is located on the center console where the ashtray is normally located (Fig. 1). The two momentary, two-directional rocker switches, one switch for each front seat, provide a resistor-multiplexed signal to the Seat Heat Interface Module (SHIM). Each switch has center NEUTRAL, and momentary LO and HI positions so that both the driver and the front seat passenger can select a preferred seat heating mode.

Each switch has two telltales (LED's) which indicate the mode of the heater of the respective seat.

DESCRIPTION AND OPERATION (Continued)

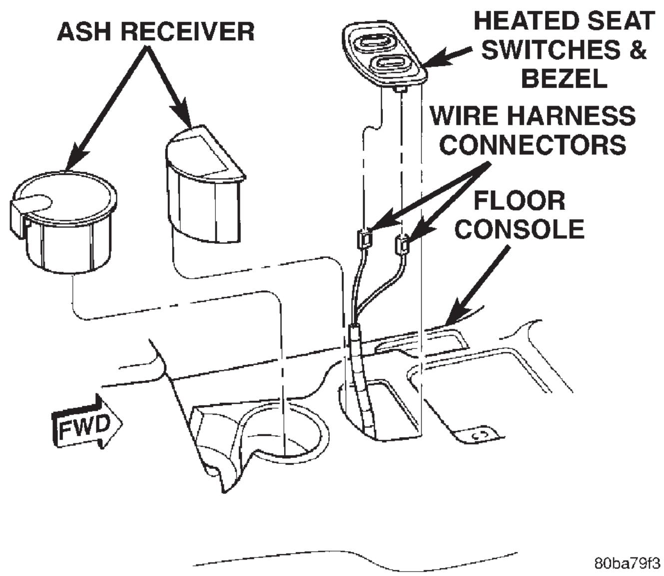


Fig. 1 Heated Seat Switch Location

The switches also have LED's which provide back-lighting when the ignition switch is in the ON position. The LED's cannot be repaired. If the LED is faulty, the individual switch must be replaced.

SEAT HEAT INTERFACE MODULE

The Seat Heat Interface Module (SHIM) is an electronic microprocessor controlled device designed to operate the electric seat heater elements. The SHIM is located under the right front seat cushion. Inputs to the module include the console mounted resistor multiplexed switch signals, seat cushion temperature sensors, a relay-switched battery feed, and a ground. The SHIM outputs are the feed for the seat heating elements and sensors, and the switch telltale circuits. The SHIM cannot be repaired and, if faulty or damaged, it must be replaced.

HEATED SEAT RELAY

The heated seat relay is located under the right front seat cushion near the SHIM. Ignition and battery power is fed to the relay, which then provides a switched battery feed to the SHIM. The heated seat relay cannot be repaired and, if faulty or damaged, it must be replaced.

HEATED SEAT ELEMENT and SENSOR

Two heated seat heating elements are used in each front seat, one for the seat cushion and the other for the seat back. The two elements for each seat are connected in series with the SHIM.

The temperature sensor is a Negative Temperature Coefficient (NTC) thermistor. One temperature sensor is used for each seat, and it is integral to the seat cushion heating element.

The heating elements are sewn into the seat cushion cover and seat back cover assemblies, which are serviced individually. The heating elements and temperature sensor cannot be repaired and, if faulty or damaged, the affected seat cover assembly must be replaced. Refer to Group 23 - Body for the seat cushion cover and seat back cover Removal and Installation.

DIAGNOSIS AND TESTING

HEATED SEAT SYSTEM

For circuit descriptions and diagrams, refer to 8W - 63 - Power Seat With Heated Seats in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The heated seat system is capable of performing some self-diagnostics. The following table depicts the various failure modes which will be reported to the occupant via flashing the momentary switch telltales. The switch telltales will flash on the driver's switch if the failure exists in the driver's seat portion of the system, similarly with the passenger's switch. The telltale will illuminate for approximately a ½ second on, ½ second off pulse for a duration of one minute. This process will repeat every time the system is initiated via the switches until the problem has been corrected.

SEAT HEAT INTERFACE MODULE DIAGNOSTIC ROUTINES

FAILURE MODE	SWITCH "HI" TELLTALE	SWITCH "LO" TELLTALE
Shorted Heating Element	Flashing	Flashing
NTC Value Out of Range	Off	Flashing

DIAGNOSIS AND TESTING (Continued)

Before testing the individual components in the heated seat system, check the following:

- If the heated seat switch backlighting does not illuminate with the ignition switch in the ON position, check the fuse in the junction block. If the fuse is OK, see Heated Seat Switch Backlighting in the Diagnosis and Testing section of this group. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.
- If the heated seat switch telltales do not illuminate with the ignition switch in the ON position, but the heating elements do heat, see Heated Seat Switch Telltales in the Diagnosis and Testing section of this group.
- If the heated seat switch backlighting illuminates with the ignition switch in the ON position, but the heating elements do not heat and the telltales do not illuminate, check the circuit breaker in the junction block. If the circuit breaker is OK, see Heated Seat Switch Multiplexed Resistances in the Diagnosis and Testing section of this group. If not OK, replace the faulty circuit breaker.
- If the heated seat switch backlighting illuminates and the telltales illuminate, but the heating elements do not heat; see Heated Seat Element in the Diagnosis and Testing section of this group.

HEATED SEAT SWITCH

For circuit descriptions and diagrams, refer to 8W - 63 - Power Seat With Heated Seats in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

BACKLIGHTING

(1) Disconnect and isolate the battery negative cable

(2) Remove the heated seat switch assembly from the center console. Remove the connector from the suspect switch. Check for continuity between the ground circuit cavity of the 6-way heated seat 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) Connect the battery negative cable. Turn the ignition switch to the ON position. Check for battery voltage at the fused ignition switch output circuit cavity of the 6-way heated seat switch wire harness connector. If OK, turn the ignition switch to the OFF position, disconnect and isolate the battery negative cable, and replace the heated seat switch. If not OK, repair the open circuit as required.

TELLTALES

(1) Replace the heated seat switch with a known good unit and test the operation of the switch telltales. If OK, discard the faulty heated seat switch. If not OK, see Seat Heat Interface Module in the Diagnosis and Testing section of this group.

MULTIPLEXED RESISTANCES

(1) Disconnect and isolate the battery negative cable.

(2) Remove the heated seat switch assembly from the center console. Remove the connector from the suspect switch.

(3) With the suspect heated seat switch in the NEUTRAL position, using an ohmmeter, measure the resistance between the fused ignition switch output circuit terminal and the heated seat switch output circuit terminal in the 6-way connector receptacle on the back of the switch. The resistance reading should be about 2.2. Kohms. If OK, go to Step 4. If not OK, replace the faulty switch.

(4) Hold the suspect heated seat switch in the LO position. Using an ohmmeter, check the resistance between the fused ignition switch output circuit terminal and the heated seat switch output circuit terminal in the 6-way connector receptacle on the back of the switch. The resistance reading should be about 414 Ohms. If OK, go to Step 5. If not OK, replace the faulty switch.

(5) Hold the suspect heated seat switch in the HI position. Using an ohmmeter, check the resistance between the fused ignition switch output circuit terminal and the heated seat switch output circuit terminal in the 6-way connector receptacle on the back of the switch. The resistance reading should be about 32.5 Ohms. If OK, see Heated Seat Relay in the Diagnosis and Testing section of this group. If not OK, replace the faulty switch.

HEATED SEAT ELEMENT and SENSOR

The wire harness connectors for the seat cushion and seat back heating elements are located under the seat, near the rear edge of the seat cushion frame. For circuit descriptions and diagrams, refer to 8W - 63 - Power Seat With Heated Seats in Group 8W - Wiring Diagrams.

SEAT CUSHION

(1) Disconnect and isolate the battery negative cable. Unplug the 4-way heated seat cushion wire harness connector.

DIAGNOSIS AND TESTING (Continued)

(2) Check for continuity between the two heated seat element circuit cavities of the seat cushion cover half of the heated seat cushion wire harness connector. There should be continuity. If OK, go to Step 3. If not OK, replace the faulty seat cushion cover.

(3) Check for continuity between one of the heated seat element circuit cavities of the seat cushion cover half of the heated seat cushion wire harness connector and the seat cushion frame. There should be no continuity. If OK, see Seat Back in the Diagnosis and Testing section of this group. If not OK, replace the faulty seat cushion cover.

SEAT BACK

(1) Disconnect and isolate the battery negative cable. Unplug the 2-way heated seat back wire harness connector.

(2) Check for continuity between the heated seat element circuit cavity and the ground circuit cavity of the seat back cover half of the heated seat back wire harness connector. There should be continuity. If OK, go to Step 3. If not OK, replace the faulty seat back cover.

(3) Check for continuity between the heated seat element circuit cavity of the seat back cover half of the heated seat back wire harness connector and the seat back frame. There should be no continuity. If OK, see Heated Seat Sensor in the Diagnosis and Testing section of this group. If not OK, replace the faulty seat back cover.

HEATED SEAT SENSOR

The wire harness connector for the seat cushion heating element and sensor are located under the seat, near the rear edge of the seat cushion frame. For circuit descriptions and diagrams, refer to 8W - 63 - Power Seat With Heated Seats in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable. Unplug the 4-way heated seat cushion wire harness connector.

(2) Using an ohmmeter, check the resistance between the heated seat sensor input circuit cavity and the heated seat sensor feed circuit cavity of the seat cushion cover half of the heated seat cushion wire harness connector. The sensor resistance should be between 1 Kohm and 200 Kohms. If OK, see Heated Seat Relay in the Diagnosis and Testing section of this group. If not OK, replace the faulty seat cushion cover.

HEATED SEAT RELAY

For circuit descriptions and diagrams, refer to 8W - 63 - Power Seat With Heated Seats in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable. Unplug the 8-way heated seat relay connector.

(2) Check for continuity between the ground circuit cavity of the 8-way heated seat relay 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) Connect the battery negative cable. Check for battery voltage at the battery feed circuit cavity (pin 8) of the 8-way heated seat relay wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Turn the ignition switch to the ON position. Check for battery voltage at the fused ignition switch output circuit cavity of the 8-way heated seat relay wire harness connector. If OK, turn the ignition switch to the OFF position, disconnect and isolate the battery negative cable, and go to Step 5. If not OK, repair the open circuit as required.

(5) Unplug the 14-way seat heat interface module (SHIM) connector. Check for continuity between the two switched battery feed cavities of the 14-way SHIM wire harness connector and the switched battery feed cavity of the 8-way heated seat relay wire harness connector. If OK, reconnect the heated seat relay wire harness connector, and go to Step 6. If not OK, repair the open circuit as required.

(6) Connect the battery negative cable. Turn the ignition switch to the ON position. Check for battery voltage at the switched battery feed cavities of the 14-way SHIM wire harness connector. If OK, turn the ignition switch to the OFF position, disconnect and isolate the battery negative cable, and see Seat Heat Interface Module in the diagnosis and testing section of this group. If not OK, replace the heated seat relay.

SEAT HEAT INTERFACE MODULE

Before testing the seat heat interface module, test the heated seat switch, the heated seat elements, and the heated seat sensor as described in the Diagnosis and Testing section of this group. If testing of the heated seat switch, elements, and sensor reveals no problems, proceed as follows. For circuit descriptions and diagrams, refer to 8W - 63 - Power Seat With Heated Seats in Group 8W - Wiring Diagrams.

(1) Replace the seat heat interface module with a known good unit and test the operation of the heated seats. If OK, discard the faulty seat heat interface module. If not OK, go to Step 2.

(2) Test each of the circuits from the heated seat switch, heated seat relay, heated seat elements, and heated seat sensor to the seat heat interface module. Repair any short or open circuits as required.

REMOVAL AND INSTALLATION

HEATED SEAT SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry around the perimeter edges of the heated switch assembly bezel to release the assembly from the console. Remove the assembly from the console.

(3) Pull the switch assembly out from the console far enough to access and unplug the wire harness connectors.

(4) Remove the heated seat switch assembly from the console.

(5) Remove the heated seat switch(es) from the heated seat switch assembly.

(6) Reverse the removal procedures to install.

SEAT HEAT INTERFACE MODULE

(1) Move the right power seat adjuster to its full up and full rear stop positions.

(2) Disconnect and isolate the battery negative cable.

(3) Unhook the seat cushion cover retainer from the seat cushion frame and pull back the seat cushion cover.

(4) Pull back the seat cushion to allow access to the Seat Heat Interface Module (SHIM).

(5) Pull the SHIM upward to release the two mounting fasteners from either the module or the mounting bracket. Unplug the wire harness connector from the module.

WARNING: THERE ARE MANY SHARP METAL EDGES ON THE SEAT CUSHION FRAME AND SEAT ADJUSTER RAILS UNDER THE SEAT. WHEN PERFORMING THIS SERVICE, A LONG-SLEEVED SHIRT AND GLOVES SHOULD BE WORN IN ORDER TO AVOID UNNECESSARY CUTS AND ABRASIONS TO EXPOSED SKIN.

(6) Reverse the removal procedures to install. Be certain that the SHIM terminals are aligned with the cavities in the wire harness connector before pushing the module firmly into place.

HEATED SEAT RELAY

(1) Move the right power seat adjuster to its full up and full rear stop positions.

(2) Disconnect and isolate the battery negative cable.

(3) Unhook the seat cushion cover retainer from the seat cushion frame and pull back the seat cushion cover.

(4) Pull back the seat cushion to allow access to the Heated Seat Relay.

(5) Cut the Christmas tree fastener to remove the Heated Seat Relay fastener from the mounting bracket. Unplug the wire harness connector from the relay.

(6) Reverse the removal procedures to install. A new Christmas tree fastener must be used to mount the relay. Be certain that the relay terminals are aligned with the cavities in the wire harness connector before pushing the relay firmly into place.

POWER DISTRIBUTION SYSTEMS

CONTENTS

DESCRIPTION AND OPERATION

POWER DISTRIBUTION SYSTEM

DESCRIPTION

This group covers the various standard and optional power distribution components used on this model. Refer to Group 8W - Wiring Diagrams for complete circuit diagrams of the various power distribution components.

The power distribution system for this vehicle is designed to provide safe, reliable, and centralized distribution of the electrical current required to operate all of the many standard and optional factory-installed electrical and electronic powertrain, chassis, safety, comfort and convenience systems. At the same time, these systems were designed to provide convenient to access centralized locations for conducting diagnosis of faulty circuits, and for sourcing the additional current requirements of many aftermarket vehicle accessory and convenience items.

These power distribution systems also incorporate various types of circuit control and protection features, including:

- Fuses
- Maxi fuse-type fusible links
- Relays.

The power distribution system for this vehicle consists of the following components:

- Power Distribution Center (PDC)
- Junction Block (JB).

Following are general descriptions of the major components in the power distribution system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of all of the power distribution system components.

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.

POWER DISTRIBUTION CENTER

DESCRIPTION

All of the electrical current distributed throughout this vehicle is directed through the standard equipment Power Distribution Center (PDC) (Fig. 1). The molded plastic PDC housing is located on the right side of the engine compartment, just behind the battery. The PDC housing has a molded plastic cover that includes two integral pivot hooks on the inboard side, and an integral latch on the outboard side. The PDC cover is easily removed for service access and has a convenient fuse and relay layout map integral to the inside surface of the cover to ensure proper component identification.

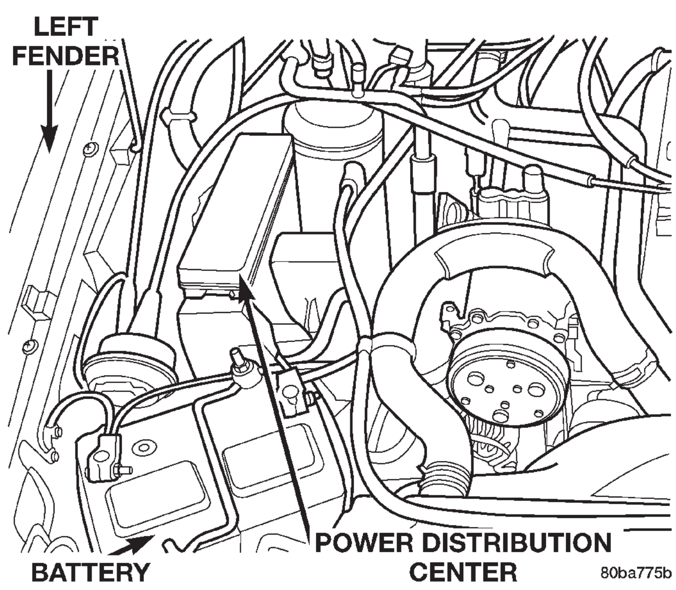


Fig. 1 Power Distribution Center

DESCRIPTION AND OPERATION (Continued)

The PDC housing is secured to a stamped sheet metal bracket in the engine compartment by mounting slots and tabs that are integral to the PDC housing. The PDC mounting bracket is secured with two screws to the right front inner fender shield above the right front wheel house. A separate cover that is secured by integral tabs and a latch to the front of the PDC housing is unlatched and removed to access the battery/generator cable connection stud. The PDC is integral to the headlamp and dash wire harness, which exits from the rearward end of the PDC housing.

The PDC houses up to fourteen blade-type maxi fuses, which replace all in-line fusible links. The PDC also houses up to twelve blade-type mini fuses, and up to eight International Standards Organization (ISO) relays (four standard-type and four micro-type). Internal connection of all of the PDC circuits is accomplished by an intricate combination of hard wiring and bus bars. Refer to **Power Distribution** in the Contents of Group 8W - Wiring Diagrams for complete circuit diagrams.

The maxi fuses, mini fuses and relays are available for service replacement. The PDC unit cannot be repaired and is only serviced as a unit with the headlamp and dash wire harness. If any of the internal circuits or if the PDC housing are faulty or damaged, the PDC and the headlamp and dash wire harness unit must be replaced.

JUNCTION BLOCK

DESCRIPTION

An electrical Junction Block (JB) is concealed behind the right cowl side inner trim panel in the passenger compartment of the vehicle. The molded plastic JB housing has integral mounting brackets that are secured with three nuts to studs on the right cowl side inner panel below the instrument panel. The right cowl side inner trim panel is secured to a stud on the junction block with a push nut, and a snap-fit fuse access panel that can be removed for service of the junction block fuses conceals the push nut (Fig. 2). A finger recess is molded into the front of the fuse access panel for easy removal, and a fuse puller and spare fuse holders are located on the back of the fuse access panel.

The JB combines the functions previously provided by a separate fuseblock module and relay center, serves to simplify and centralize numerous electrical components, as well as to distribute electrical current to many of the accessory systems in the vehicle. It also eliminates the need for numerous splice connections and serves in place of a bulkhead connector between many of the engine compartment, instrument panel, and body wire harnesses.

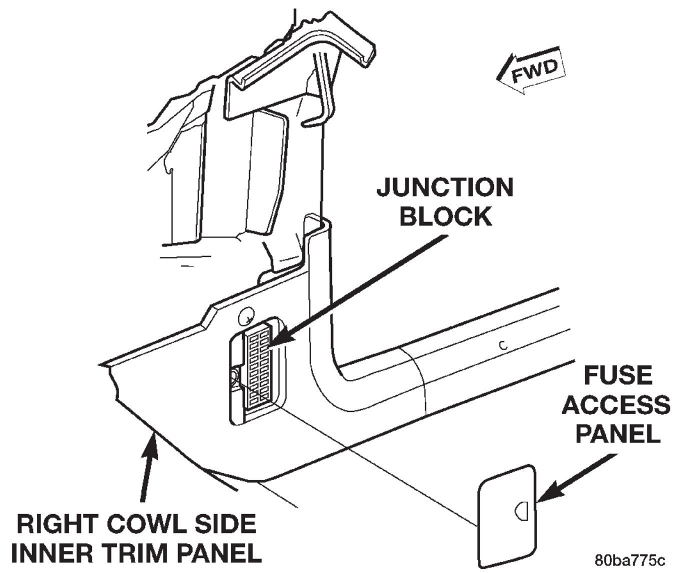


Fig. 2 Junction Block

All of the circuits entering and leaving the JB do so through up to ten wire harness connectors, which are connected to the JB through integral connector receptacles molded into the JB housing. The JB houses up to twenty-seven blade-type fuses (three standard-type and twenty-four mini-type), up to three blade-type automatic resetting circuit breakers, and four International Standards Organization (ISO) relays (three standard-type and one micro-type). Internal connection of all of the JB circuits is accomplished by an intricate combination of hard wiring and bus bars. Refer to **Junction Block** in the Contents of Group 8W - Wiring Diagrams for complete circuit diagrams.

The fuses, circuit breakers, and relays are available for service replacement. The JB unit cannot be repaired and is only serviced as a unit. If any internal circuit or if the JB housing is faulty or damaged, the entire JB unit must be replaced.

REMOVAL AND INSTALLATION

POWER DISTRIBUTION CENTER

The Power Distribution Center (PDC) is serviced as a unit with the headlamp and dash wire harness. If any internal circuit of the PDC or if the PDC housing is faulty or damaged, the entire PDC and the headlamp and dash wire harness unit must be replaced.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect each of the headlamp and dash wire harness connectors. Refer to **Connector Locations**

REMOVAL AND INSTALLATION (Continued)

in the Contents of Group 8W - Wiring Diagrams for more information on the locations of the affected connectors.

(3) Remove all of the fasteners that secure each of the headlamp and dash wire harness ground eyelets to the vehicle body and chassis components. Refer to **Connector Locations** in the Contents of Group 8W - Wiring Diagrams for more information on the ground eyelet locations.

(4) Disengage each of the retainers that secure the headlamp and dash wire harness to the vehicle body and chassis components. Refer to **Connector Locations** in the Contents of Group 8W - Wiring Diagrams for more information on the retainer locations.

(5) Unlatch and remove the terminal stud cover from the front end of the PDC (Fig. 3).

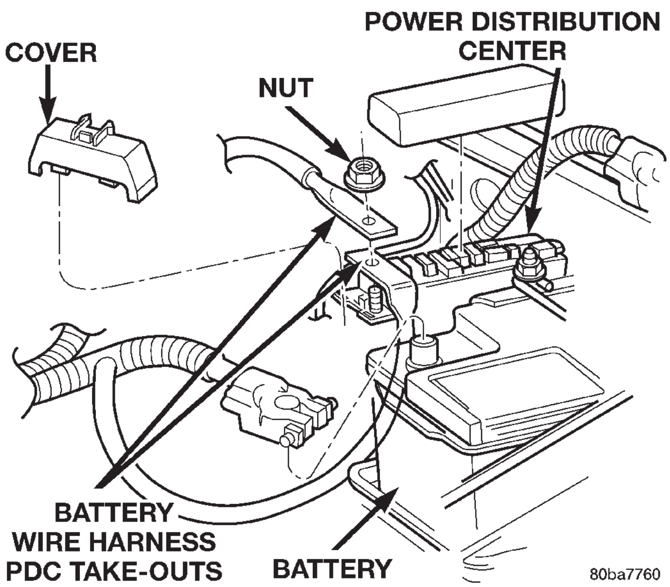


Fig. 3 Power Distribution Center Connections

(6) Remove the nut that secures the eyelets of the battery wire harness PDC take outs to the stud on the PDC.

(7) Remove the battery wire harness PDC take out eyelets from the PDC stud.

(8) Disengage the latches on the PDC mounting bracket from the tabs on the PDC housing, and pull the PDC housing upward to disengage the mounting slots from the stanchions of the mounting bracket (Fig. 4).

(9) Remove the PDC and the headlamp and dash wire harness from the engine compartment as a unit.

(10) Remove the two screws that secure the PDC mounting bracket to the right front inner fender (Fig. 5).

(11) Remove the PDC mounting bracket from the right front inner fender.

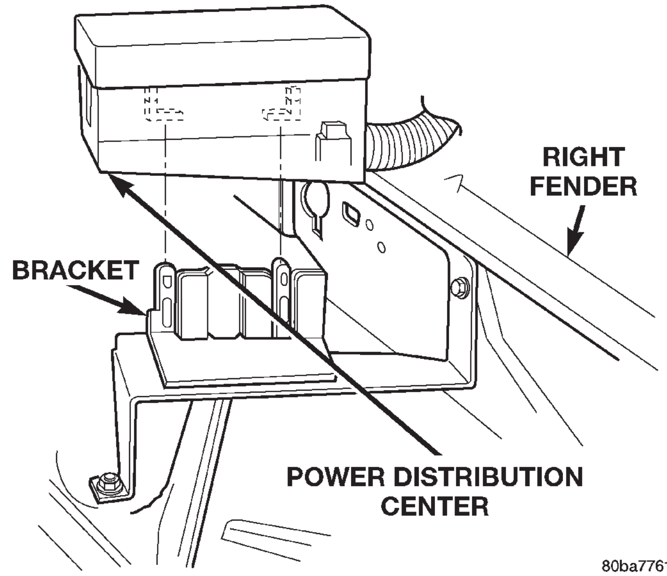


Fig. 4 Power Distribution Center Remove/Install

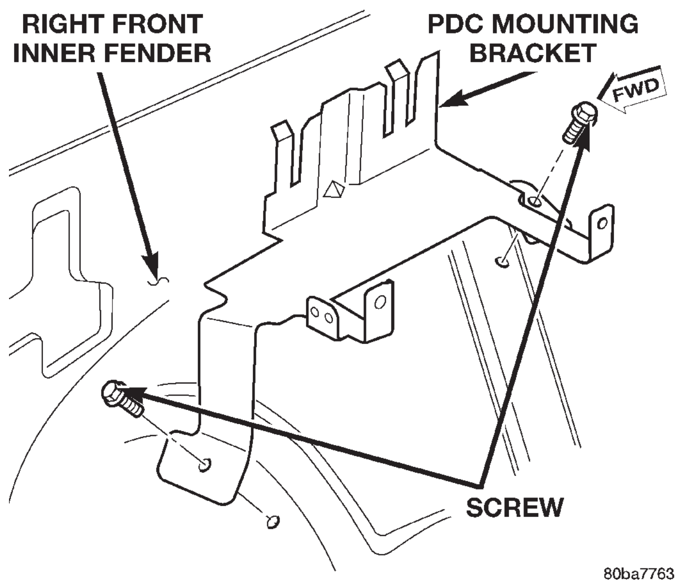


Fig. 5 PDC Mounting Bracket Remove/Install

INSTALLATION

NOTE: If the PDC is being replaced with a new unit, be certain to transfer each of the fuses and relays from the old PDC to the proper cavities of the new PDC. Refer to Power Distribution in the Contents of Group 8W - Wiring Diagrams for the proper PDC cavity assignments.

(1) Position the PDC mounting bracket onto the right front inner fender.

(2) Install and tighten the two screws that secure the PDC mounting bracket to the right front inner fender. Tighten the screws to 8.1 N·m (72 in. lbs.).

(3) Position the PDC and the headlamp and dash wire harness unit in the engine compartment.

REMOVAL AND INSTALLATION (Continued)

(4) Engage the mounting slots on the PDC housing with the stanchions of the PDC mounting bracket and push the unit downward until the mounting bracket latches engage the mounting tabs on the PDC housing.

(5) Install the eyelets of the battery wire harness PDC take outs onto the PDC stud.

(6) Install and tighten the nut that secures the eyelet of the battery wire harness PDC take outs onto the PDC stud. Tighten the nut to 7.9 N·m (70 in. lbs.).

(7) Engage the tabs on the lower edge of the terminal stud cover in the slots on the front of the PDC housing, then engage the latch on the top of the cover with the latch tabs on the PDC housing.

(8) Engage each of the retainers that secure the headlamp and dash wire harness to the vehicle body and chassis components. Refer to **Connector Locations** in the Contents of Group 8W - Wiring Diagrams for more information on the retainer locations.

(9) Install all of the fasteners that secure each of the headlamp and dash wire harness ground eyelets to the vehicle body and chassis components. Refer to **Connector Locations** in the Contents of Group 8W - Wiring Diagrams for more information on the ground eyelet locations.

(10) Reconnect each of the headlamp and dash wire harness connectors. Refer to **Connector Locations** in the Contents of Group 8W - Wiring Diagrams for more information on the locations of the affected connectors.

(11) Reconnect the battery negative cable.

JUNCTION BLOCK

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the fuse access panel by unsnapping it from the right cowl side inner trim panel (Fig. 6).

(3) Remove the push nut that secures the right cowl side inner trim panel to the junction block stud.

(4) Remove the screw located above the fuse access opening that secures the trim panel to the right cowl side inner panel.

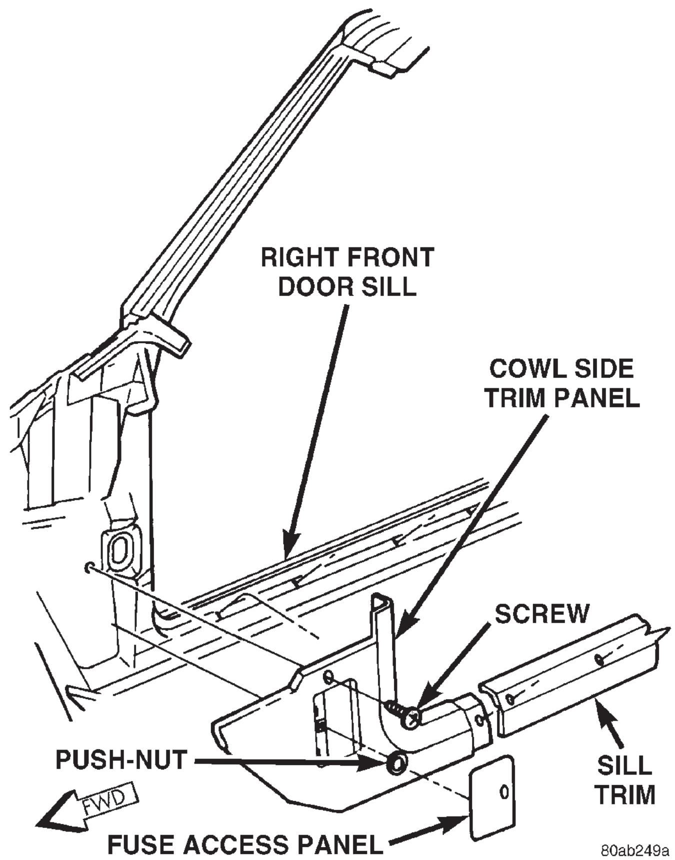


Fig. 6 Right Cowl Side Inner Trim Remove/Install

(5) Remove the screw that secures the right cowl side inner trim panel and right front door sill trim to the door opening sill.

(6) Remove the trim from the right cowl side inner panel.

(7) Remove the screw that secures the lower instrument panel wire harness connector to the junction block.

(8) Disconnect all of the wire harness connectors from the connector receptacles on the junction block.

(9) Remove the three nuts that secure the junction block to the studs on the right cowl side inner panel (Fig. 7).

(10) Remove the junction block from the right cowl side inner panel.

INSTALLATION

NOTE: If the Junction Block (JB) is being replaced with a new unit, be certain to transfer each of the fuses, circuit breakers and relays from the old JB to the proper cavities of the new JB. Refer to Junction Block in the Contents of Group 8W - Wiring Diagrams for the proper JB cavity assignments.

(1) Position the junction block onto the right cowl side inner panel.

REMOVAL AND INSTALLATION (Continued)

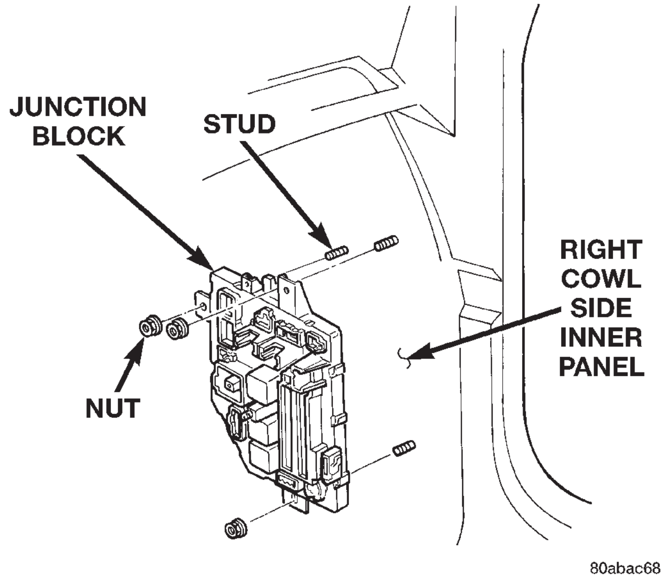


Fig. 7 Junction Block Remove/Install

(2) Install and tighten the three nuts that secure the junction block to the studs on the right cowl side inner panel. Tighten the nuts to 2.7 N·m (24 in. lbs.).

(3) Reconnect all of the wire harness connectors to the connector receptacles on the junction block.

(4) Install and tighten the screw that secures the lower instrument panel wire harness connector to the junction block. Tighten the screw to 3.5 N·m (31 in. lbs.).

(5) Position the trim onto the right cowl side inner panel.

(6) Install and tighten the screw that secures the right cowl side inner trim panel and right front door sill trim to the door opening sill. Tighten the screw to 2.2 N·m (20 in. lbs.).

(7) Install and tighten the screw located above the fuse access opening that secures the trim panel to the right cowl side inner panel. Tighten the screw to 2.2 N·m (20 in. lbs.).

(8) Install the push nut that secures the right cowl side inner trim panel onto the junction block stud.

(9) Install the fuse access panel by snapping it onto the right cowl side inner trim panel.

(10) Reconnect the battery negative cable.

POWER LOCK SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Power locks are optional factory-installed equipment on this model. The power window system and the power mirror system are included on vehicles equipped with the power lock option. The Remote Keyless Entry (RKE) system is an additional option available on vehicles equipped with the power lock option. Refer to 8W-61 - Power Door Locks 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.

POWER LOCK SYSTEM

The power lock system allows all of the doors and the liftgate to be locked or unlocked electrically by operating the switch on either front door trim panel. This system operates with battery power supplied through a fuse in the junction block, independent of the ignition switch.

The power lock system includes a lock inhibit feature, which prevents the doors from being locked by the power lock system if the driver door is open with the key in the ignition switch or with the headlamp switch in the On position. However, the lock inhibit feature will not prevent manual locking of the vehicle using the manual lock buttons or the key cylinders.

The power lock system includes the front door power lock switches integral to the driver and passenger door modules, and the power lock motors mounted in each door and the liftgate. The power lock control circuitry and the power lock and unlock relays are integral to the Passenger Door Module (PDM).

Following are general descriptions of the major components in the power lock system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the power lock system.

GENERAL INFORMATION (Continued)

REMOTE KEYLESS ENTRY SYSTEM

The Remote Keyless Entry (RKE) system is a radio frequency system that allows the use of a remote battery-powered radio transmitter to control the power lock system. On vehicles with the RKE option, the power locks can be operated by depressing the Lock or Unlock buttons of the RKE transmitter. The RKE system includes an illuminated entry feature, which turns on the courtesy lamps for a timed interval (about thirty seconds), when the power locks are unlocked using the RKE transmitter.

The RKE system for this vehicle also features a customer programmable horn chirp feature. This feature allows the customer the option of enabling or disabling the horn chirp request that the RKE receiver issues as an audible indication that a valid Lock signal has been received from the RKE transmitter. See Remote Keyless Entry Receiver Programming in this group for more information on this feature.

The RKE system can retain the vehicle access codes of up to four transmitters. The transmitter codes are retained in memory, even if the battery is disconnected. If a transmitter is faulty or lost, new transmitter vehicle access codes can be programmed into the system using a DRB scan tool and the proper Diagnostic Procedures manual.

The RKE system consists of the remote key fob transmitter and a radio receiver with program logic. The RKE receiver is installed in an RKE housing on the headliner of the vehicle, or in the housing of the optional overhead console, depending upon how the vehicle is equipped.

Following are general descriptions of the major components in the RKE system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the RKE system.

DESCRIPTION AND OPERATION

POWER LOCK SWITCH

The power locks are controlled by a two-way switch that is integral to the Driver Door Module (DDM) and the Passenger Door Module (PDM) mounted in the trim panel of its respective front door. Each switch is illuminated by a light-emitting diode when the ignition switch is turned to the On position. The power lock switches provide a hard-wired lock or unlock signal to the power lock system control circuitry, which is located in the PDM.

The power lock switches and their lamps cannot be repaired. If the switches are damaged or faulty, the entire PDM or DDM unit must be replaced.

DOOR MODULE

A Driver Door Module (DDM) and a Passenger Door Module (PDM) are used on all models equipped with power locks and power windows. Each door module houses both the front door power lock and power window switches. In addition to the switches for its own door, the DDM houses individual switches for each passenger door power window, a power window lockout switch and the power mirror switch. The PDM contains the control circuitry and the power lock and unlock relays for the entire power lock system.

In its role as the power lock control module, the PDM receives inputs from the battery, the ignition switch, the DDM, the driver door ajar switch, the key-in ignition switch, and the headlamp switch. It also receives a hard-wired input from the remote Keyless Entry (RKE) receiver, if the vehicle is so equipped. In response to these inputs, the PDM sends the proper outputs to control the power lock motors through its integral power lock and unlock relays.

The DDM and the PDM are mounted to their respective front door trim panels. The DDM and PDM are serviced individually and cannot be repaired. If the DDM or PDM, or any of the switches and circuitry that they contain are faulty or damaged, the complete DDM or PDM unit must be replaced.

POWER LOCK MOTOR

In the power lock and Remote Keyless Entry (RKE) systems, the locks are actuated by a reversible electric motor mounted within each door and the liftgate. The power lock motor direction is controlled by the battery and ground feeds from the power lock and unlock relays integral to the Passenger Door Module (PDM).

The power lock motors cannot be repaired and, if faulty or damaged, the entire motor must be replaced.

REMOTE KEYLESS ENTRY TRANSMITTER

The Remote Keyless Entry (RKE) system transmitter is equipped with two buttons, labeled Lock and Unlock. It is also equipped with a key ring and is designed to serve as a key fob. The operating range of the transmitter radio signal is up to 7 meters (23 feet) from the RKE receiver.

Each transmitter has a different vehicle access code, which must be programmed into the memory of the RKE receiver in the vehicle in order to operate the RKE system. See Remote Keyless Entry Transmitter Programming in this group for more information.

DESCRIPTION AND OPERATION (Continued)

The transmitter operates on two Panasonic CR2016 (or equivalent) batteries. Typical battery life is from one to two years. The transmitter cannot be repaired and, if faulty or damaged, it must be replaced.

REMOTE KEYLESS ENTRY RECEIVER

On models with the Remote Keyless Entry (RKE) option, an RKE receiver is mounted in an RKE housing, or in the overhead console housing on the vehicle headliner. The RKE receiver is a radio frequency unit that also contains the RKE system program logic. The RKE receiver also performs as a smart relay for the illuminated entry feature.

The RKE receiver has a memory function to retain the vehicle access codes of at least one, but no more than four RKE transmitters. The receiver is designed to retain the transmitter codes in memory, even if the battery is disconnected.

The RKE receiver receives inputs from the battery, the driver door ajar switch, and the Chrysler Collision Detection (CCD) data bus. It also receives the radio signal input from the RKE transmitter. In response to those inputs, it is programmed to control outputs to the power lock motors, the courtesy lamp circuits, and the vehicle horn.

The RKE system for this vehicle also features a customer programmable horn chirp feature. This feature allows the customer the option of enabling or disabling the horn chirp request that the RKE receiver issues as an audible indication that a valid Lock signal has been received from the RKE transmitter. See Remote Keyless Entry Receiver Programming in this group for more information on this feature.

The RKE receiver cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING

POWER LOCK SYSTEM AND REMOTE KEYLESS ENTRY SYSTEM

On models without the Remote Keyless Entry (RKE) option, proceed directly to the Door Module diagnosis. As a preliminary diagnosis for models with the RKE system, note the power lock system and illuminated entry system operation while you actuate both the Lock and Unlock functions with the power lock switches and the RKE transmitter. Then, proceed as follows:

- If the entire power lock system fails to function with either the power lock switches or the RKE transmitter, unplug the wire harness connector from the RKE receiver and test the power lock system operation again using the power lock switches. If the power lock system now operates, see the Remote Keyless Entry Receiver diagnosis in this group. If the power lock system still fails to operate, see the Door Module diagnosis in this group.
- If the power lock system functions with both power lock switches, but not with the RKE transmitter, see the Remote Keyless Entry Transmitter diagnosis in this group.
- If one power lock motor fails to operate with both of the power lock switches and/or the RKE transmitter, see the Power Lock Motor diagnosis in this group.
- If the RKE and power lock systems are functioning, but the illuminated entry system fails to operate, see the Remote Keyless Entry Receiver diagnosis in this group.

DOOR MODULE

If the power lock system is inoperative with either front door power lock switch, test the Passenger Door Module (PDM). If the power lock system is inoperative with only the driver side front door power lock switch, test the Driver Door Module (DDM). For circuit descriptions and diagrams, refer to 8W-61 - Power Door Locks in Group 8W - Wiring Diagrams.

DRIVER DOOR MODULE

The only function of the Driver Door Module (DDM) in the power lock system is to provide a Lock or Unlock signal to the power lock system control circuitry contained within the Passenger Door Module (PDM). The DDM signals the PDM by providing a hard-wired ground path through the DDM ground circuit and the driver side power lock switch contacts to the lock request or unlock request terminals of the PDM. The DDM power lock switch function can be tested as follows:

(1) Disconnect and isolate the battery negative cable. Remove the driver side front door trim panel and unplug the 12-way DDM wire harness connector (C-2) from the DDM. Check for continuity between the ground circuit cavity of the 12-way DDM wire harness 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.

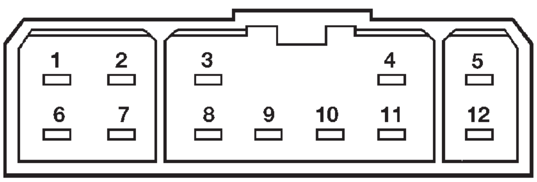
(2) If the problem being diagnosed is inoperative power lock switch illumination, proceed as follows. If the problem is not power lock switch illumination, go to Step 4. Connect the battery negative cable. Turn the ignition switch to the Accessory or On positions. Check for battery voltage at both sides of the power window circuit breaker in the junction block. If OK, go to Step 3. If not OK, replace the faulty circuit breaker.

(3) With the ignition switch still in the On or Accessory position, check for battery voltage at the fused ignition switch output circuit cavity of the

DIAGNOSIS AND TESTING (Continued)

12-way DDM wire harness connector. If OK, replace the faulty DDM. If not OK, repair the open circuit to the junction block as required.

(4) Test the power lock switch continuity through the DDM 12-way wire harness connector receptacle. See the DDM Power Lock Switch Continuity chart (Fig. 1) to determine if the continuity is correct in both the Lock and Unlock switch positions. If OK, repair the lock request circuit and/or the unlock request circuit between the DDM and the PDM as required. If not OK, replace the faulty DDM.



CONNECTOR 2 (C2)

CONNECTOR 2 (C2)

SWITCH POSITION	CONTINUITY BETWEEN
LOCK	7 & 8
UNLOCK	11 & 8

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Fig. 1 DDM Power Lock Switch Continuity

PASSENGER DOOR MODULE

The Passenger Door Module (PDM) contains the passenger side front door power lock switch and the power lock system control circuitry. In its role as a power lock switch, it provides the power lock system control circuitry with a ground path through the PDM ground circuit and the driver side power lock switch contacts to indicate a lock request or unlock request.

In its role as the power lock control module, the PDM receives inputs from the battery, the ignition switch, the DDM, the driver door ajar switch, the key-in ignition switch, and the headlamp switch. It also receives a hard-wired input from the RKE receiver, if the vehicle is so equipped. In response to these inputs, the PDM sends the proper outputs to control the power lock motors through its integral power lock and unlock relays. The PDM power lock system functions can be tested as outlined below. If the power lock system operates, but the RKE system lock and/or unlock functions are inoperative, see the diagnosis for the Remote Keyless Entry Transmitter in this group.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Disconnect and isolate the battery negative cable. Remove the passenger side front door trim panel and unplug the 8-way PDM wire harness connector (C-1) from the PDM. Check for continuity between the ground circuit cavity of the 8-way PDM wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit to ground as required.

(3) If the problem being diagnosed is inoperative power lock switch illumination, proceed as follows. If the problem is not power lock switch illumination, go to Step 5. Connect the battery negative cable. Turn the ignition switch to the Accessory or On positions. Check for battery voltage at both sides of the power window circuit breaker in the junction block. If OK, go to Step 4. If not OK, replace the faulty circuit breaker.

(4) With the ignition switch still in the Accessory or On positions, check for battery voltage at the fused ignition switch output circuit cavity of the 8-way PDM wire harness connector. If OK, replace the faulty PDM. If not OK, repair the open circuit to the junction block as required.

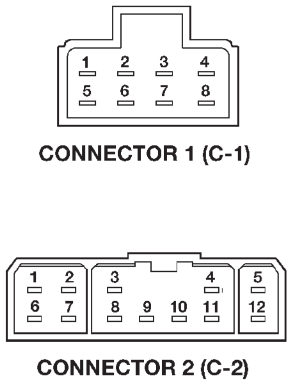
(5) If the problem being diagnosed is an inoperative door lock inhibit feature or a power lock system that responds to an Unlock command, but not a Lock command, proceed as follows. Otherwise, go to Step 7. With the driver side front door closed, check for continuity between the door ajar/key-in circuit cavity of the 8-way PDM wire harness connector and a good ground. There should be no continuity. If OK, go to Step 6. If not OK, repair the shorted door ajar and/or key-in ignition circuits as required. Refer to Group 8U - Chime/Buzzer Warning Systems for more information.

(6) Open the driver side front door with the key in the ignition switch or with the headlamp switch in the On position. Check for continuity between the door ajar/key-in circuit cavity of the 8-way PDM wire harness connector and a good ground. There should be continuity. If OK, go to Step 8. If not OK, repair the open door ajar and/or key-in ignition circuits as required. Refer to Group 8U - Chime/Buzzer Warning Systems for more information.

(7) Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the 8-way PDM wire harness connector. If OK, go to Step 8. If not OK, repair the open circuit to the fuse in the junction block as required.

(8) Test the PDM power lock switch continuity through the two PDM wire harness connector receptacles. See the PDM Power Lock Switch Continuity chart (Fig. 2) to determine if the continuity is correct in both the Lock and Unlock switch positions. If OK, see the diagnosis for Power Lock Motors in this group. If not OK, replace the faulty PDM.

DIAGNOSIS AND TESTING (Continued)



LEFT-HAND DRIVE (LHD)	
SWITCH POSITION	CONTINUITY BETWEEN
LOCK	C1 PIN 3 & C1 PIN 6
	C1 PIN 3 & C2 PIN 1
	C1 PIN 3 & C2 PIN 5
UNLOCK	C1 PIN 6 & C1 PIN 7
	C1 PIN 7 & C2 PIN 1
	C1 PIN 7 & C2 PIN 5

RIGHT-HAND DRIVE (RHD)	
SWITCH POSITION	CONTINUITY BETWEEN
LOCK	C1 PIN 7 & C1 PIN 6
	C1 PIN 7 & C2 PIN 1
	C1 PIN 7 & C2 PIN 5
UNLOCK	C1 PIN 6 & C1 PIN 3
	C1 PIN 3 & C2 PIN 1
	C1 PIN 3 & C2 PIN 5

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Fig. 2 PDM Power Lock Switch Continuity

POWER LOCK MOTOR

Before you proceed with this diagnosis, confirm proper power door lock switch operation. See Door Module in this group for the diagnostic procedures. Remember, the Passenger Door Module (PDM) circuitry controls the output to each of the power lock motors. For circuit descriptions and diagrams, refer to 8W-61 - Power Door Locks in Group 8W - Wiring Diagrams.

(1) Check each power lock motor for correct operation while moving the power lock switch to both the Lock and Unlock positions. If all of the power lock motors are inoperative, go to Step 2. If one power lock motor is inoperative, go to Step 3.

(2) If all of the power lock motors are inoperative, the problem may be caused by one shorted motor. Unplugging a shorted power lock motor from the power lock circuit will allow the good power lock motor to operate. Unplug each power lock motor wire harness connector, one at a time, and recheck both the lock and unlock functions by operating the power lock switch. If all of the power lock motors are still inoperative after the above test, check for a short or open circuit between the power lock motors and the PDM. If unplugging one power lock motor causes the other motors to become functional, go to Step 3 to test the unplugged motor.

(3) Once it is determined which power lock motor is inoperative, that motor can be tested as follows. Unplug the wire harness connector at the inoperative power lock motor. Apply 12 volts to the motor terminals to check its operation in one direction. Reverse the polarity to check the operation in the other direction. If OK, repair the short or open circuits between the power lock motor and the PDM as required. If not OK, replace the faulty power lock motor.

REMOTE KEYLESS ENTRY TRANSMITTER

(1) Replace the Remote Keyless Entry (RKE) transmitter batteries. See Remote Keyless Entry Transmitter Battery Replacement in this group for the procedures. Test each of the transmitter functions. If OK, discard the faulty batteries. If not OK, go to Step 2.

(2) Perform the Remote Keyless Entry Transmitter Programming procedure with the suspect transmitter and another known good transmitter. Use a DRB scan tool, as described in the proper Diagnostic Procedures manual.

(3) Test the RKE system operation with both transmitters. If both transmitters fail to operate the power lock system, see the diagnosis for the Remote Keyless Entry Receiver in this group. If the known good transmitter operates the power locks and the suspect transmitter does not, replace the faulty transmitter.

NOTE: Be certain to perform the Remote Keyless Entry Transmitter Programming procedure again following this test. This procedure will erase the access code of the test transmitter from the RKE receiver.

REMOTE KEYLESS ENTRY RECEIVER

If the problem being diagnosed is an inoperative Remote Keyless Entry (RKE) horn chirp feature, be certain that the horn chirp feature has not been disabled. See Remote Keyless Entry Receiver Programming in this group for the procedures. Also be certain that the vehicle horn system is operational. Refer to Group 8G - Horn Systems for more information.

If the problem being diagnosed is an inoperative RKE illuminated entry system, be certain that the

DIAGNOSIS AND TESTING (Continued)

interior courtesy lamp system is operational. Refer to Group 8L - Lamps for more information.

Before you proceed with diagnosis of the RKE receiver, see the diagnosis for Remote Keyless Entry Transmitter in this group. For circuit descriptions and diagrams, refer to 8W-61 - Power Door Locks in Group 8W - Wiring Diagrams.

(1) Check the fuses in the Power Distribution Center (PDC) and the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Disconnect and isolate the battery negative cable. Remove the Remote Keyless Entry (RKE) receiver from the headliner. Unplug the wire harness connector from the RKE receiver.

(3) Check the wire harness connector and the receptacle in the RKE receiver for loose, corroded, or damaged terminals and pins. If OK, go to Step 4. If not OK, repair as required.

(4) Check for continuity between each of the two ground circuit cavities of the RKE receiver wire harness connector and a good ground. In each case, there should be continuity. If OK, go to Step 5. If not OK, repair the circuit to ground as required.

(5) Connect the battery negative cable. Check for battery voltage at each of the two fused B(+) circuit cavities of the RKE receiver wire harness connector. If OK, go to Step 6. If not OK, repair the open circuit to the PDC or the junction block as required.

(6) If the problem being diagnosed involves only the RKE horn chirp feature, go to Step 10. If the problem being diagnosed involves only the RKE illuminated entry feature, go to Step 9. If the problem being diagnosed involves only the RKE power lock feature, go to Step 7.

(7) Disconnect and isolate the battery negative cable. Unplug the 8-way Passenger Door Module (PDM) wire harness connector. Check for continuity between the lock request circuit cavity of the RKE receiver wire harness connector and a good ground. Repeat the test between the unlock request circuit cavity of the RKE receiver wire harness connector and a good ground. In each case, there should be no continuity. If OK, go to Step 8. If not OK, repair the shorted circuit as required.

(8) Check for continuity between the lock request circuit cavities of the RKE receiver wire harness connector and the 8-way PDM wire harness connector. Repeat the test between the unlock request circuit cavities of the RKE receiver wire harness connector and the 8-way PDM wire harness connector. In each case, there should be continuity. If OK, replace the faulty RKE receiver. If not OK, repair the open circuit as required.

(9) Check for continuity between the door ajar circuit cavity of the RKE receiver wire harness connector and a good ground with the driver door closed. There should be no continuity until the driver door is opened. If OK, replace the faulty RKE receiver. If not OK, repair the circuit or replace the faulty driver door ajar switch as required.

(10) Unplug the horn relay from the junction block. Check for continuity between the horn relay output circuit cavity of the RKE receiver wire harness connector and a good ground. There should be no continuity. If OK, go to Step 11. If not OK, repair the short circuit to the horn relay as required.

(11) Check for continuity between the horn relay output circuit cavity of the RKE receiver wire harness connector and the junction block cavity for the horn relay coil ground terminal (85). There should be continuity. If OK, replace the faulty RKE receiver. If not OK, repair the open circuit to the junction block as required.

SERVICE PROCEDURES

REMOTE KEYLESS ENTRY TRANSMITTER BATTERY REPLACEMENT

The Remote Keyless Entry (RKE) transmitter case snaps open and shut for battery access. To replace the RKE transmitter batteries:

(1) Using a trim stick or another suitable wide flat-bladed tool, gently pry at the center seam of the transmitter case halves near the key ring until the two halves unsnap.

(2) Lift the back half of the transmitter case off of the transmitter.

(3) Remove the two batteries from the transmitter.

(4) Replace the two batteries with new Panasonic CR2016, or their equivalent. Be certain that the batteries are installed with their polarity correctly oriented.

(5) Align the two transmitter case halves with each other, and squeeze them firmly together until they snap back into place.

REMOTE KEYLESS ENTRY TRANSMITTER PROGRAMMING

To program the Remote Keyless Entry (RKE) transmitter access codes into the RKE receiver requires the use of a DRB scan tool. Refer to the proper Diagnostic Procedures manual for more information.

REMOTE KEYLESS ENTRY RECEIVER PROGRAMMING

The optional Remote Keyless Entry (RKE) system for this vehicle has a customer programmable horn chirp feature. The horn chirp is requested by the RKE receiver through a hard-wired circuit to the

SERVICE PROCEDURES (Continued)

horn relay, whenever a valid Lock message is received from a programmed RKE radio transmitter.

The purpose of the horn chirp is to provide the vehicle operator with an audible verification that the Lock request has been received by the RKE receiver. However, for any number of reasons, some customers may prefer that this feature be disabled. This RKE system allows them that option.

To program the Remote Keyless Entry (RKE) receiver so that the horn chirp feature is disabled, proceed as follows:

(1) While within the reception range of the RKE receiver, press and hold the Lock button of a programmed RKE transmitter depressed for five to ten seconds.

(2) While holding the RKE transmitter Lock button depressed, press and release the RKE transmitter Unlock button.

(3) The RKE horn chirp feature is now disabled.

Repeating the preceding steps will again enable the RKE horn chirp feature.

REMOVAL AND INSTALLATION

DOOR MODULE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the screws that secure the front door trim panel to the inner door panel (Fig. 3).

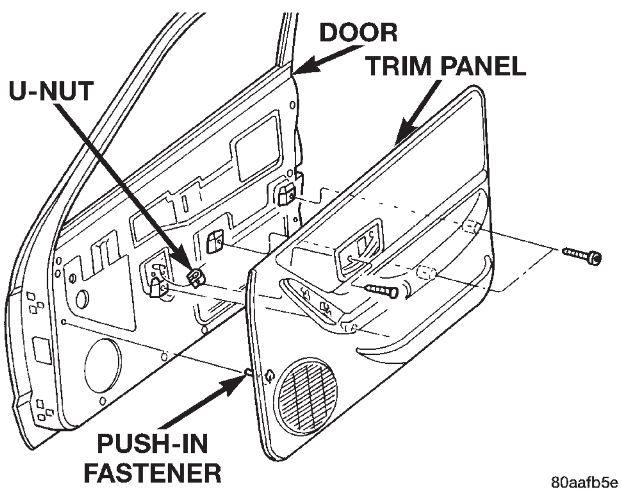

Fig. 3 Front Door Trim Panel Remove/Install

(3) Using a trim stick or another suitable wide flat-bladed tool, gently pry the front door trim panel away from the door around the perimeter to release the trim panel retainers.

NOTE: To aid in the removal of the trim panel, start at the bottom of the panel.

(4) Lift the front door trim panel upwards and away from the inner door panel far enough to disengage the top of the panel from the inner belt weatherstrip.

(5) Pull the front door trim panel away from the inner door panel far enough to access the inside door latch release and lock linkage rods near the back of the inside door remote controls.

(6) Unsnap the plastic retainer clips from the inside door remote control ends of the latch release and lock linkage rods, and remove the rod ends from the inside door remote controls.

(7) Unplug the wire harness connectors from the door module.

(8) Remove the trim panel from the front door.

(9) Remove the three screws that secure the door module to the front door trim panel (Fig. 4).

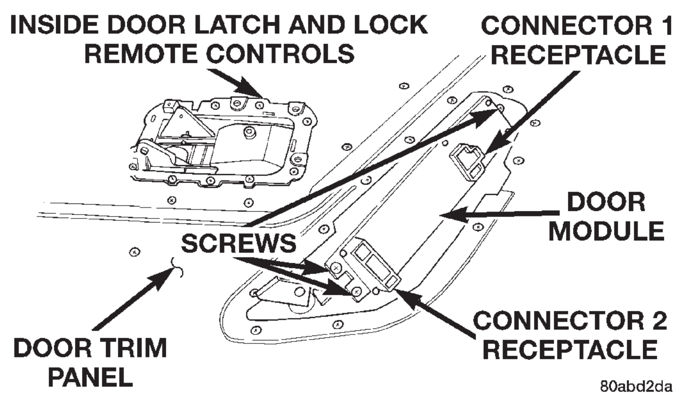

Fig. 4 Door Module Remove/Install

(10) Remove the door module from the front door trim panel.

(11) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

POWER LOCK MOTOR

FRONT DOOR

The front door power lock motor is integral to the front door latch unit. If the front door power lock motor is faulty or damaged, the entire latch unit must be replaced. Refer to Group 23 - Body for the front door latch service procedures.

REAR DOOR

The rear door power lock motor is integral to the rear door latch unit. If the rear door power lock motor is faulty or damaged, the entire latch unit must be replaced. Refer to Group 23 - Body for the rear door latch service procedures.

LIFTGATE

(1) Disconnect and isolate the battery negative cable.

(2) Open the liftgate.

REMOVAL AND INSTALLATION (Continued)

(3) Remove the liftgate trim panel from the liftgate. Refer to Group 23 - Body for the procedures.

(4) Reach through the liftgate inner panel access hole and disconnect the link from the clip on the power lock motor (Fig. 5).

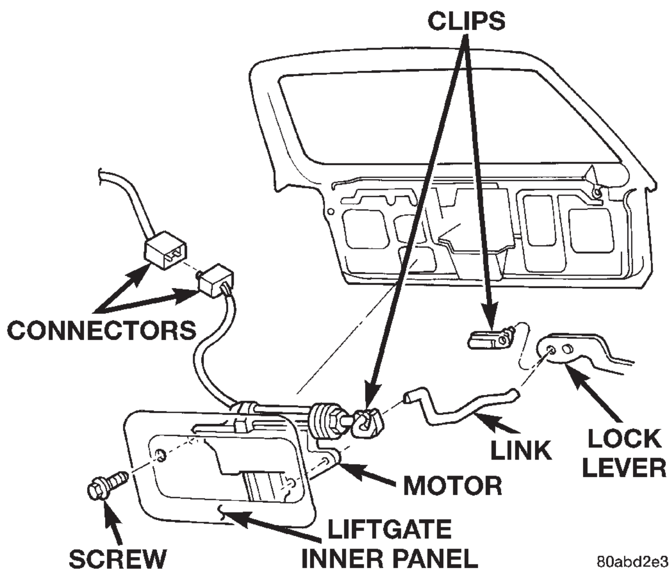

Fig. 5 Liftgate Power Lock Motor Remove/Install

(5) Remove the two screws that secure the power lock motor to the liftgate inner panel.

(6) Pull the power lock motor out through the liftgate inner panel access hole far enough to access the wire harness connector.

(7) Unplug the wire harness connector from the power lock motor.

(8) Remove the power lock motor from the liftgate.

(9) Reverse the removal procedures to install. Tighten the power lock motor mounting screws to 3 N·m (28 in. lbs.).

REMOTE KEYLESS ENTRY RECEIVER

CAUTION: A discharge of static electricity may damage this unit. At no time should any source of static electricity be permitted near this unit. Technicians handling or servicing the unit should wear cotton clothing, not synthetic fabric clothing; and, should ground themselves before and during all handling and service procedures. Electrically conductive wrist or heel straps are recommended, or static dissipating shoes are also acceptable. Work and storage areas should be free of static generative materials such as: dry air, glass, nylon, wool, fur, silk, rayon, acrylic, polystyrene foam, polyester, saran, polyethylene, polypropylene, PVC, and teflon.

MINI-DOME MOUNTED TYPE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the two screws that secure the Remote Keyless Entry (RKE) mini-dome housing to the roof panel reinforcement (Fig. 6).

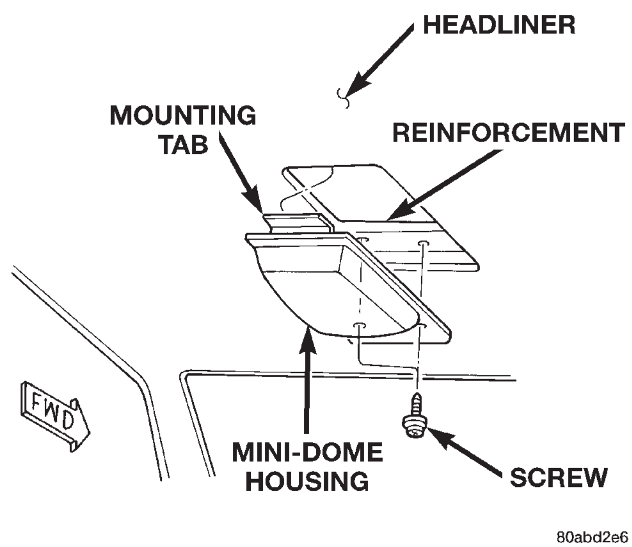

Fig. 6 Mini-Dome Housing Remove/Install

(3) Lower the front of the mini-dome housing and slide the unit forward to disengage the rear mounting tab from the headliner.

(4) Lower the mini-dome housing far enough to access the RKE receiver wire harness connector.

(5) Unplug the wire harness connector from the RKE receiver.

(6) Remove the RKE mini-dome unit from the headliner.

(7) Reverse the removal procedures to install. Tighten the mounting screws to 2.8 N·m (24 in. lbs.).

OVERHEAD CONSOLE MOUNTED TYPE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the overhead console from the headliner. Refer to Overhead Console in Group 8V - Overhead Console Systems for the procedures.

(3) Remove the six screws that secure the rear overhead console housing to the overhead console bezel (Fig. 7).

(4) Gently flex the sides of the overhead console bezel far enough to clear the tabs on the rear console housing and remove the housing from the bezel.

(5) Remove the two screws that secure the RKE receiver circuit board to the rear overhead console housing.

(6) Remove the RKE circuit board from the rear overhead console housing.

REMOVAL AND INSTALLATION (Continued)

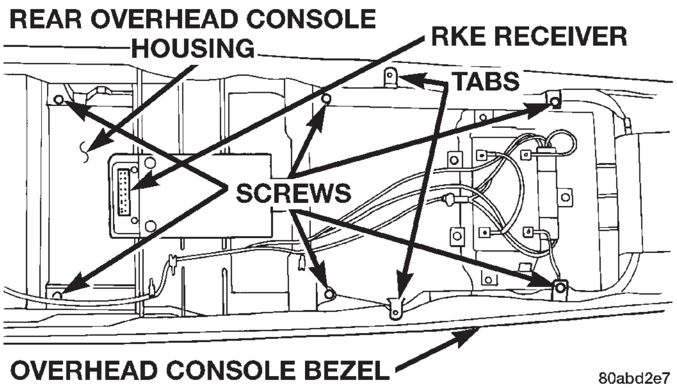

Fig. 7 RKE Receiver Remove/Install

(7) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

VEHICLE THEFT/SECURITY SYSTEMS

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GENERAL INFORMATION

INTRODUCTION

The Sentry Key Immobilizer System (SKIS) is available factory-installed optional equipment for this model. Following are some general descriptions of the features and components of the SKIS. Refer to the vehicle owner's manual for more information on the use and operation of the SKIS. Refer to 8W-30 - Fuel/ Ignition System in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

SENTRY KEY IMMOBILIZER SYSTEM

The Sentry Key Immobilizer System (SKIS) is designed to provide passive protection against unauthorized vehicle use by preventing the engine from operating while the system is armed. The primary components of this system are the Sentry Key Immobilizer Module (SKIM), the Sentry Key transponder, the SKIS indicator lamp, and the Powertrain Control Module (PCM).

The SKIM is installed on the steering column near the ignition lock cylinder. The transponder is located under the molded rubber cap on the head of the ignition key. The SKIS indicator lamp is located in the instrument cluster.

The SKIS includes two valid Sentry Key transponders from the factory. If the customer wishes, additional non-coded blank Sentry Keys are available. These blank keys can be cut to match a valid ignition key, but the engine will not start unless the key transponder is also programmed to the vehicle. The SKIS will recognize no more than eight valid Sentry Key transponders at any one time.

The SKIS performs a self-test each time the ignition switch is turned to the On position, and will store Diagnostic Trouble Codes (DTCs) if a system malfunction is detected. The SKIS can be diagnosed, and any stored DTC can be retrieved using a DRB scan tool as described in the proper Diagnostic Procedures manual.

DESCRIPTION AND OPERATION

SENTRY KEY IMMOBILIZER MODULE

The Sentry Key Immobilizer Module (SKIM) contains a Radio Frequency (RF) transceiver and a central processing unit, which includes the Sentry Key Immobilizer System (SKIS) program logic. The SKIS programming enables the SKIM to program and retain in memory the codes of at least two, but no more than eight electronically coded Sentry Key transponders. The SKIS programming also enables the SKIM to communicate over the Chrysler Collision Detection (CCD) data bus network with the Powertrain Control Module (PCM), the instrument cluster and/or the DRB scan tool.

The SKIM transmits and receives RF signals through a tuned antenna enclosed within a molded plastic ring formation that is integral to the SKIM housing. When the SKIM is properly installed on the steering column, the antenna ring is oriented around the circumference of the ignition lock cylinder housing. This antenna ring must be located within eight millimeters (0.31 inches) of the Sentry Key in order to ensure proper RF communication between the SKIM and the Sentry Key transponder.

For added system security, each SKIM is programmed with a unique “Secret Key” code and a security code. The SKIM keeps the “Secret Key” code in memory and sends the code over the CCD data bus to the PCM, which also keeps this code in its memory. The SKIM also sends the “Secret Key” code to each of the programmed Sentry Key transponders. The security code is used by the assembly plant to access the SKIS for initialization, or by the dealer

DESCRIPTION AND OPERATION (Continued)

technician to access the system for service. The SKIM also stores in its memory the Vehicle Identification Number (VIN), which it learns through a CCD data bus message from the PCM during initialization.

The SKIM and the PCM both use software that includes a rolling code algorithm strategy, which helps to reduce the possibility of unauthorized SKIS disarming. The rolling code algorithm ensures security by preventing an override of the SKIS through the unauthorized substitution of the SKIM or the PCM. However, the use of this strategy also means that replacement of either the SKIM or the PCM units will require a system initialization procedure to restore system operation.

When the ignition switch is turned to the On or Start positions, the SKIM transmits an RF signal to excite the Sentry Key transponder. The SKIM then listens for a return RF signal from the transponder of the Sentry Key that is inserted in the ignition lock cylinder. If the SKIM receives an RF signal with valid “Secret Key” and transponder identification codes, the SKIM sends a “valid key” message to the PCM over the CCD data bus. If the SKIM receives an invalid RF signal or no response, it sends “invalid key” messages to the PCM. The PCM will enable or disable engine operation based upon the status of the SKIM messages.

The SKIM also sends messages to the instrument cluster over the CCD data bus network to control the SKIS indicator lamp. The SKIM sends messages to the instrument cluster to turn the lamp on for about three seconds when the ignition switch is turned to the On position as a bulb test. After completion of the bulb test, the SKIM sends bus messages to keep the lamp off for a duration of about one second. Then the SKIM sends messages to turn the lamp on or off based upon the results of the SKIS self-tests. If the SKIS indicator lamp comes on and stays on after the bulb test, it indicates that the SKIM has detected a system malfunction and/or that the SKIS has become inoperative.

If the SKIM detects an invalid key when the ignition switch is turned to the On position, it sends messages to the instrument cluster to flash the SKIS indicator lamp. The SKIM can also send messages to the instrument cluster to flash the lamp and to generate a single audible chime tone. These functions serve as an indication to the customer that the SKIS has been placed in its “Customer Learn” programming mode. See Sentry Key Immobilizer System Transponder Programming in this group for more information on the “Customer Learn” programming mode.

For diagnosis or initialization of the SKIM and the PCM, a DRB scan tool and the proper Diagnostic Procedures manual are required. The SKIM cannot be repaired and, if faulty or damaged, the unit must be replaced.

SENTRY KEY IMMOBILIZER TRANSPONDER

The Sentry Key Immobilizer System (SKIS) uses a transponder that is integral to each of the two ignition keys that are supplied with the vehicle when it is shipped from the factory. The transponder chip is insulated within a nylon mount inserted in the head of the key, and invisible beneath a molded rubber cap (Fig. 1).

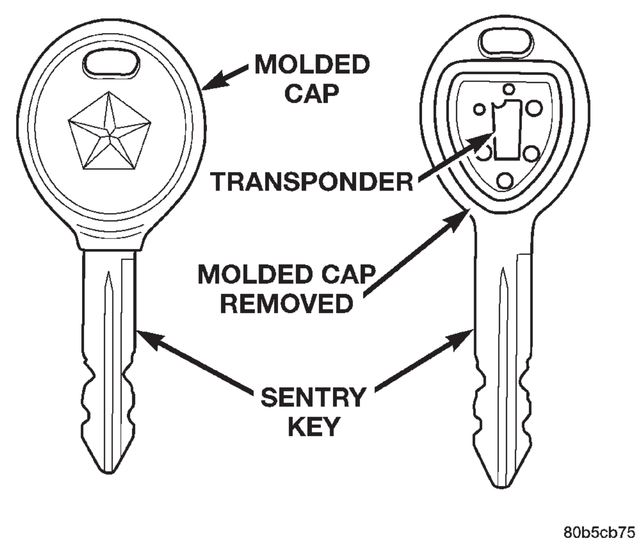

Fig. 1 Sentry Key Immobilizer Transponder

Each Sentry Key transponder has a unique transponder identification code programmed into it by the manufacturer. The Sentry Key Immobilizer Module (SKIM) has a unique “Secret Key” code programmed into it by the manufacturer. When a Sentry Key transponder is programmed into the memory of the SKIM, the SKIM learns the transponder identification code from the transponder, and the transponder learns the “Secret Key” code from the SKIM. Each of these codes is stored within the transponder and in the nonvolatile memory of the SKIM. Therefore, blank keys for the SKIS must be programmed by and into the SKIM, in addition to being cut to match the mechanical coding of the ignition lock cylinder. See Sentry Key Immobilizer System Transponder Programming in this group for more information.

The Sentry Key transponder is within the range of the SKIM transceiver antenna ring when it is inserted in the ignition lock cylinder. When the ignition switch is turned to the Start or On positions, the SKIM transceiver issues a Radio Frequency (RF) signal that excites the transponder chip. The transponder chip responds by issuing an RF signal containing its transponder identification code and the “Secret

DESCRIPTION AND OPERATION (Continued)

Key" code. The SKIM transceiver compares the transponder codes with the codes stored in its memory to determine whether a valid key is in the ignition lock cylinder.

The Sentry Key transponder cannot be repaired and, if faulty or damaged, it must be replaced.

SENTRY KEY IMMOBILIZER SYSTEM INDICATOR LAMP

The Sentry Key Immobilizer System (SKIS) indicator lamp gives an indication when the SKIS is faulty or when the vehicle has been immobilized due to the use of an invalid ignition key. The lamp is controlled by the instrument cluster circuitry based upon messages received from the Sentry Key Immobilizer Module (SKIM) on the Chrysler Collision Detection (CCD) data bus.

The SKIM sends messages to the instrument cluster to turn the lamp on for about three seconds when the ignition switch is turned to the On position as a bulb test. After completion of the bulb test, the SKIM sends bus messages to keep the lamp off for a duration of about one second. Then the SKIM sends messages to the instrument cluster circuitry to turn the lamp on or off based upon the results of the SKIS self-tests. If the SKIS indicator lamp comes on and stays on after the bulb test, it indicates that the SKIM has detected a system malfunction and/or that the SKIS has become inoperative.

If the SKIM detects an invalid key when the ignition switch is turned to the On position, it sends messages to the instrument cluster to flash the SKIS indicator lamp. The SKIM can also send messages to the instrument cluster to flash the lamp and to generate a single audible chime tone. These functions serve as an indication to the customer that the SKIS has been placed in its "Customer Learn" programming mode. See Sentry Key Immobilizer System Transponder Programming in this group for more information on the "Customer Learn" programming mode.

The SKIS indicator lamp uses a replaceable incandescent bulb and bulb holder on the instrument cluster electronic circuit board. Refer to Group 8E - Instrument Panel Systems for diagnosis and service of a faulty SKIS indicator lamp. If the SKIS indicator lamp comes on and stays on after the bulb test function, diagnosis of the SKIS should be performed with a DRB scan tool and the proper Diagnostic Procedures manual.

DIAGNOSIS AND TESTING

SENTRY KEY IMMOBILIZER SYSTEM

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

NOTE: The following tests may not prove conclusive in the diagnosis of this system. The most reliable, efficient, and accurate means to diagnose the Sentry Key Immobilizer System involves the use of a DRB scan tool. Refer to the proper Diagnostic Procedures manual for the procedures.

The Sentry Key Immobilizer System (SKIS) and the Chrysler Collision Detection (CCD) data bus network should be diagnosed using a DRB scan tool. The DRB will allow confirmation that the CCD data bus is functional, that the Sentry Key Immobilizer Module (SKIM) is placing the proper messages on the CCD data bus, and that the Powertrain Control Module (PCM) and the instrument cluster are receiving the CCD data bus messages. Refer to the proper Diagnostic Procedures manual for the procedures. Refer to 8W-39 - Vehicle Theft Security System in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

(1) Check the fuses 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) Disconnect and isolate the battery negative cable. Unplug the wire harness connector at the SKIM. Check for continuity between the ground circuit cavity of the SKIM wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit to ground as required.

(3) Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the SKIM wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit to the fuse in the fuseblock module as required.

DIAGNOSIS AND TESTING (Continued)

(4) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) circuit cavity of the SKIM wire harness connector. If OK, use a DRB scan tool and the proper Diagnostic Procedures manual to complete the diagnosis of the SKIS. If not OK, repair the open circuit to the fuse in the fuseblock module as required.

SERVICE PROCEDURES

SENTRY KEY IMMOBILIZER SYSTEM TRANSPONDER PROGRAMMING

Two programmed Sentry Key transponders are included with the Sentry Key Immobilizer System (SKIS) when it is shipped from the factory. The Sentry Key Immobilizer Module (SKIM) can be programmed to recognize up to six additional transponders, for a total of eight Sentry Keys. The following "Customer Learn" programming procedure for the programming of additional transponders requires access to at least two of the valid Sentry Keys. If two valid Sentry Keys are not available, Sentry Key programming will require the use of a DRB scan tool and the proper Diagnostic Procedures manual.

CUSTOMER LEARN

(1) Obtain the additional Sentry Key transponder blank(s) that are to be programmed for the vehicle. Cut the additional Sentry Key transponder blanks to match the ignition lock cylinder mechanical key codes.

(2) Insert one of the two valid Sentry Key transponders into the ignition switch and turn the ignition switch to the On position.

(3) After the ignition switch has been in the On position for about three seconds, but no more than fifteen seconds later, cycle the ignition switch back to the Off position. Replace the first valid Sentry Key in the ignition lock cylinder with the second valid Sentry Key and turn the ignition switch back to the On position.

(4) About ten seconds after the completion of Step 3, the SKIS indicator lamp will start to flash and a single audible chime tone will sound to indicate that the system has entered the "Customer Learn" programming mode.

(5) Within about fifty seconds of entering the "Customer Learn" programming mode, turn the ignition switch to the Off position, replace the valid Sentry Key with a blank Sentry Key transponder, and turn the ignition switch back to the On position.

(6) About ten seconds after the completion of Step 5, a single audible chime tone will sound and the SKIS indicator lamp will stop flashing and stay on solid for about three seconds to indicate that the blank Sentry Key transponder has been successfully programmed. The SKIS will immediately return to normal system operation following exit from the "Customer Learn" programming mode.

(7) Go back to Step 2 and repeat this process for each additional Sentry Key transponder blank to be programmed.

If any of the above steps is not completed in the proper sequence, or within the allotted time, the SKIS will automatically exit the "Customer Learn" programming mode. The SKIS will also automatically exit the "Customer Learn" programming mode if it sees a non-blank Sentry Key transponder when it should see a blank, if it has already programmed eight valid Sentry Keys, or if the ignition switch is turned to the Off position for more than about fifty seconds.

REMOVAL AND INSTALLATION

SENTRY KEY IMMOBILIZER MODULE

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the knee blocker from the instrument panel. See Knee Blocker in Group 8E - Instrument Panel Systems for the procedures.

(3) Insert the key in the ignition lock cylinder and turn the ignition switch to the On position.

(4) 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. 2).

(5) While holding the retaining tumbler depressed, pull the ignition lock cylinder and key out of the ignition lock housing.

(6) Remove the three screws that secure the lower steering column shroud to the upper shroud.

(7) If the vehicle is so equipped, move the tilt steering column to the fully lowered position.

(8) If the vehicle is so equipped, loosen the two nuts that secure the non-tilt steering column upper mounting bracket to the dash panel steering column

REMOVAL AND INSTALLATION (Continued)

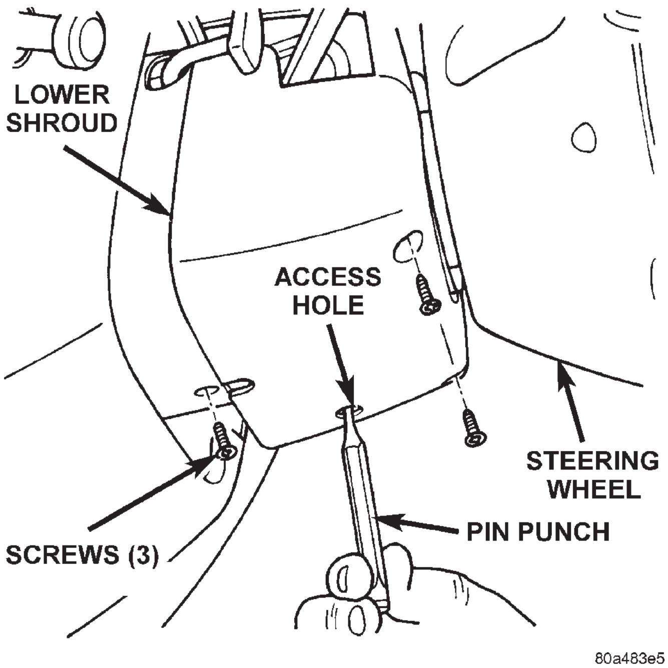

Fig. 2 Steering Column Shrouds Remove/Install

support bracket studs. Lower the column far enough to remove the upper steering column shroud.

(9) Remove both the upper and lower shrouds from the steering column.

(10) Disengage the steering column wire harness retainer from the tab on the top of the Sentry Key Immobilizer Module (SKIM) mounting bracket (Fig. 3).

(11) Unplug the wire harness connector from the SKIM receptacle.

(12) The SKIM mounting bracket features a clip formation that secures the SKIM to the inboard lower flange of the steering column jacket. Pull downward on the connector end of the SKIM mounting bracket to release this clip from the steering column jacket.

(13) Rotate the SKIM and its mounting bracket downwards and then to the side away from the steering column to slide the SKIM antenna ring from around the ignition switch lock cylinder housing.

(14) Remove the SKIM from the vehicle.

(15) Reverse the removal procedures to install. Tighten the non-tilt steering column mounting nuts to 22 N·m (200 in. lbs.) and the steering column shroud mounting screws to 2 N·m (18 in. lbs.).

(16) If the SKIM is replaced with a new unit, a DRB scan tool and the proper Diagnostic Procedures manual MUST be used to initialize the new SKIM and to program at least two Sentry Key transponders.

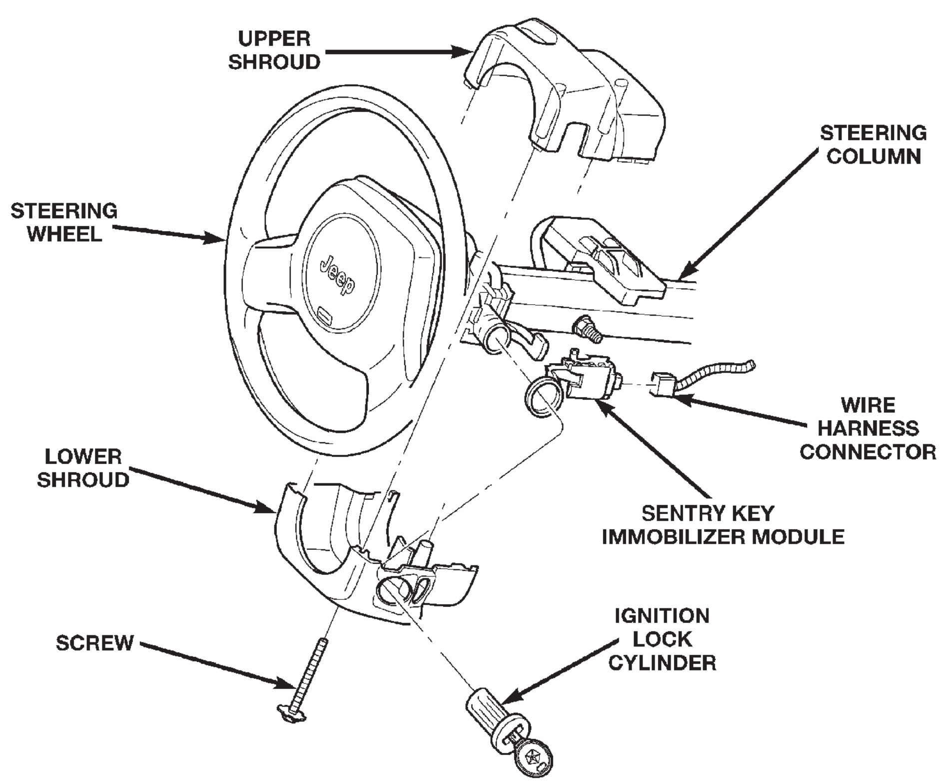

Fig. 3 Sentry Key Immobilizer Module Remove/Install

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The Sentry Key Immobilizer System (SKIS) is available factory-installed optional equipment for this model. Following are some general descriptions of the features and components of the SKIS. Refer to the vehicle owner's manual for more information on the use and operation of the SKIS. Refer to 8W-30 - Fuel/ Ignition System in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

SENTRY KEY IMMOBILIZER SYSTEM

The Sentry Key Immobilizer System (SKIS) is designed to provide passive protection against unauthorized vehicle use by preventing the engine from operating. The primary components of this system are the Sentry Key Immobilizer Module (SKIM), the Sentry Key transponder, the SKIS indicator lamp, and the Powertrain Control Module (PCM).

The SKIM is installed on the steering column near the ignition lock cylinder. The transponder is located under the molded rubber cap on the head of the ignition key. The SKIS indicator lamp is located in the instrument cluster.

The SKIS includes two valid Sentry Key transponders from the factory. If the customer wishes, additional non-coded blank Sentry Keys are available. These blank keys can be cut to match a valid ignition key, but the engine will not start unless the key transponder is also programmed to the vehicle. The SKIS will recognize no more than eight valid Sentry Key transponders at any one time.

The SKIS performs a self-test each time the ignition switch is turned to the On position, and will store Diagnostic Trouble Codes (DTCs) if a system malfunction is detected. The SKIS can be diagnosed, and any stored DTC can be retrieved using a DRB scan tool as described in the proper Diagnostic Procedures manual.

DESCRIPTION AND OPERATION

SENTRY KEY IMMOBILIZER MODULE

The Sentry Key Immobilizer Module (SKIM) contains a Radio Frequency (RF) transceiver and a central processing unit, which includes the Sentry Key Immobilizer System (SKIS) program logic. The SKIS programming enables the SKIM to program and retain in memory the codes of at least two, but no more than eight electronically coded Sentry Key transponders. The SKIS programming also enables the SKIM to communicate over the Chrysler Collision Detection (CCD) data bus network with the Powertrain Control Module (PCM), the instrument cluster and/or the DRB scan tool.

The SKIM transmits and receives RF signals through a tuned antenna enclosed within a molded plastic ring formation that is integral to the SKIM housing. When the SKIM is properly installed on the steering column, the antenna ring is oriented around the circumference of the ignition lock cylinder housing. This antenna ring must be located within eight millimeters (0.31 inches) of the Sentry Key in order to ensure proper RF communication between the SKIM and the Sentry Key transponder.

For added system security, each SKIM is programmed with a unique “Secret Key” code and a security code. The SKIM keeps the “Secret Key” code in memory and sends the code over the CCD data bus to the PCM, which also keeps this code in its memory. The SKIM also sends the “Secret Key” code to each of the programmed Sentry Key transponders. The security code is used by the assembly plant to access the SKIS for initialization, or by the dealer technician to access the system for service. The

DESCRIPTION AND OPERATION (Continued)

SKIM also stores in its memory the Vehicle Identification Number (VIN), which it learns through a CCD data bus message from the PCM during initialization.

The SKIM and the PCM both use software that includes a rolling code algorithm strategy, which helps to reduce the possibility of unauthorized SKIS disarming. The rolling code algorithm ensures security by preventing an override of the SKIS through the unauthorized substitution of the SKIM or the PCM. However, the use of this strategy also means that replacement of either the SKIM or the PCM units will require a system initialization procedure to restore system operation.

When the ignition switch is turned to the On or Start positions, the SKIM transmits an RF signal to excite the Sentry Key transponder. The SKIM then listens for a return RF signal from the transponder of the Sentry Key that is inserted in the ignition lock cylinder. If the SKIM receives an RF signal with valid “Secret Key” and transponder identification codes, the SKIM sends a “valid key” message to the PCM over the CCD data bus. If the SKIM receives an invalid RF signal or no response, it sends “invalid key” messages to the PCM. The PCM will enable or disable engine operation based upon the status of the SKIM messages.

The SKIM also sends messages to the instrument cluster over the CCD data bus network to control the SKIS indicator lamp. The SKIM sends messages to the instrument cluster to turn the lamp on for about three seconds when the ignition switch is turned to the On position as a bulb test. After completion of the bulb test, the SKIM sends bus messages to keep the lamp off for a duration of about one second. Then the SKIM sends messages to turn the lamp on (steady or flashing) or off based upon the results of the SKIS self-tests. If the SKIS indicator lamp comes on and stays on after the bulb test, it indicates that the SKIM has detected a system malfunction and/or that the SKIS has become inoperative.

If the SKIM detects an invalid key when the ignition switch is turned to the On position, it sends messages to the instrument cluster to flash the SKIS indicator lamp.

For diagnosis or initialization of the SKIM and the PCM, a DRB scan tool and the proper Diagnostic Procedures manual are required. The SKIM cannot be repaired and, if faulty or damaged, the unit must be replaced.

SENTRY KEY IMMOBILIZER TRANSPONDER

The Sentry Key Immobilizer System (SKIS) uses a transponder that is integral to each of the two ignition keys that are supplied with the vehicle when it is shipped from the factory. The transponder chip is insulated within a nylon mount inserted in the head of the key, and invisible beneath a molded rubber cap (Fig. 1).

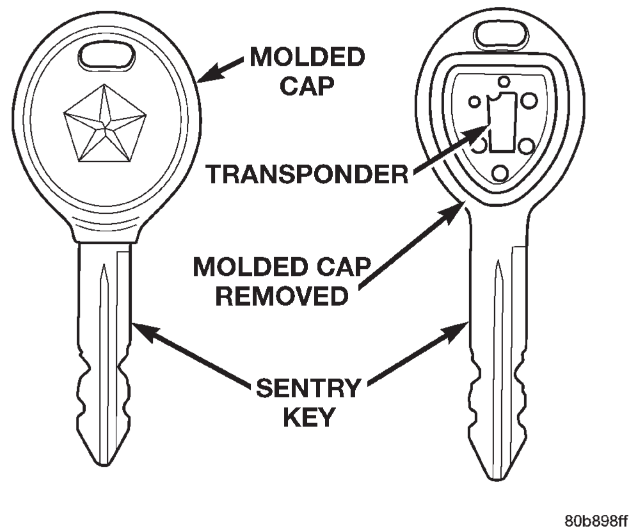


Fig. 1 Sentry Key Immobilizer Transponder

Each Sentry Key transponder has a unique transponder identification code programmed into it by the manufacturer. The Sentry Key Immobilizer Module (SKIM) has a unique “Secret Key” code programmed into it by the manufacturer. When a Sentry Key transponder is programmed into the memory of the SKIM, the SKIM learns the transponder identification code from the transponder, and the transponder learns the “Secret Key” code from the SKIM. Each of these codes is stored within the transponder and in the nonvolatile memory of the SKIM. Therefore, blank keys for the SKIS must be programmed by and into the SKIM, in addition to being cut to match the mechanical coding of the ignition lock cylinder. See Sentry Key Immobilizer System Transponder Programming in this group for more information.

The Sentry Key transponder is within the range of the SKIM transceiver antenna ring when it is inserted in the ignition lock cylinder. When the ignition switch is turned to the Start or On positions, the SKIM transceiver issues a Radio Frequency (RF) signal that excites the transponder chip. The transponder chip responds by issuing an RF signal containing its transponder identification code and the “Secret Key” code. The SKIM transceiver compares the transponder codes with the codes stored in its memory to determine whether a valid key is in the ignition lock cylinder.

The Sentry Key transponder cannot be repaired and, if faulty or damaged, it must be replaced.

DESCRIPTION AND OPERATION (Continued)

SENTRY KEY IMMOBILIZER SYSTEM INDICATOR LAMP

The Sentry Key Immobilizer System (SKIS) indicator lamp gives an indication when the SKIS is faulty or when the vehicle has been immobilized due to the use of an invalid ignition key. The lamp is controlled by the instrument cluster circuitry based upon messages received from the Sentry Key Immobilizer Module (SKIM) on the Chrysler Collision Detection (CCD) data bus.

The SKIM sends messages to the instrument cluster to turn the lamp on for about three seconds when the ignition switch is turned to the On position as a bulb test. After completion of the bulb test, the SKIM sends bus messages to keep the lamp off for a duration of about one second. Then the SKIM sends messages to the instrument cluster circuitry to turn the lamp on or off based upon the results of the SKIS self-tests. If the SKIS indicator lamp comes on and stays on after the bulb test, it indicates that the SKIM has detected a system malfunction and/or that the SKIS has become inoperative. If the SKIM detects an invalid key when the ignition switch is turned to the On position, it sends messages to the instrument cluster to flash the SKIS indicator lamp.

The SKIM can also send messages to the instrument cluster to flash the lamp and to generate a single audible chime tone. These functions serve as an indication to the customer that the SKIS has been placed in its “Customer Learn” programming mode. See Sentry Key Immobilizer System Transponder Programming in this group for more information on the “Customer Learn” programming mode.

The SKIS indicator lamp uses a replaceable incandescent bulb and bulb holder on the instrument cluster electronic circuit board. Refer to Group 8E - Instrument Panel Systems for diagnosis and service of a faulty SKIS indicator lamp. If the SKIS indicator lamp comes on and stays on after the bulb test function, diagnosis of the SKIS should be performed with a DRB scan tool and the proper Diagnostic Procedures manual.

DIAGNOSIS AND TESTING

SENTRY KEY IMMOBILIZER SYSTEM

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

NOTE: The following tests may not prove conclusive in the diagnosis of this system. The most reliable, efficient, and accurate means to diagnose the Sentry Key Immobilizer System involves the use of a DRB scan tool. Refer to the proper Diagnostic Procedures manual for the procedures.

The Sentry Key Immobilizer System (SKIS) and the Chrysler Collision Detection (CCD) data bus network should be diagnosed using a DRB scan tool. The DRB will allow confirmation that the CCD data bus is functional, that the Sentry Key Immobilizer Module (SKIM) is placing the proper messages on the CCD data bus, and that the Powertrain Control Module (PCM) and the instrument cluster are receiving the CCD data bus messages. Refer to the proper Diagnostic Procedures manual for the procedures. Refer to 8W-30 - Fuel/Ignition System in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

(1) Check the fuses 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) Disconnect and isolate the battery negative cable. Unplug the wire harness connector at the SKIM. Check for continuity between the ground circuit cavity of the SKIM wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit to ground as required.

(3) Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the SKIM wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit to the fuse in the fuseblock module as required.

(4) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) circuit cavity of the SKIM wire harness connector. If OK, use a DRB scan tool and the proper Diagnostic Procedures manual to complete the diagnosis of the SKIS. If not OK, repair the open circuit to the fuse in the fuseblock module as required.

SERVICE PROCEDURES

SENTRY KEY IMMOBILIZER SYSTEM TRANSPONDER PROGRAMMING

Two programmed Sentry Key transponders are included with the Sentry Key Immobilizer System (SKIS) when it is shipped from the factory. The Sentry Key Immobilizer Module (SKIM) can be programmed to recognize up to six additional transponders, for a total of eight Sentry Keys. Sentry Key programming will require the use of a DRB scan tool and the proper Diagnostic Procedures manual.

REMOVAL AND INSTALLATION

SENTRY KEY IMMOBILIZER MODULE

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect the negative battery cable.

(2) Remove the knee blocker from the instrument panel. See Knee Blocker in Group 8E - Instrument Panel Systems for the procedures.

(3) Insert the key in the ignition lock cylinder and turn the ignition switch to the On position.

(4) 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. 2).

(5) While holding the retaining tumbler depressed, pull the ignition lock cylinder and key out of the ignition lock housing.

(6) Remove the three screws that secure the lower steering column shroud to the upper shroud.

(7) If the vehicle is so equipped, move the tilt steering column to the fully lowered position.

(8) If the vehicle is so equipped, loosen the two nuts that secure the non-tilt steering column upper mounting bracket to the dash panel steering column support bracket studs. Lower the column far enough to remove the upper steering column shroud.

(9) Remove both the upper and lower shrouds from the steering column.

(10) Disengage the steering column wire harness retainer from the tab on the top of the Sentry Key Immobilizer Module (SKIM) mounting bracket (Fig. 3).

(11) Unplug the wire harness connector from the SKIM receptacle.

(12) The SKIM mounting bracket features a clip formation that secures the SKIM to the inboard lower flange of the steering column jacket. Pull downward on the connector end of the SKIM mounting bracket to release this clip from the steering column jacket.

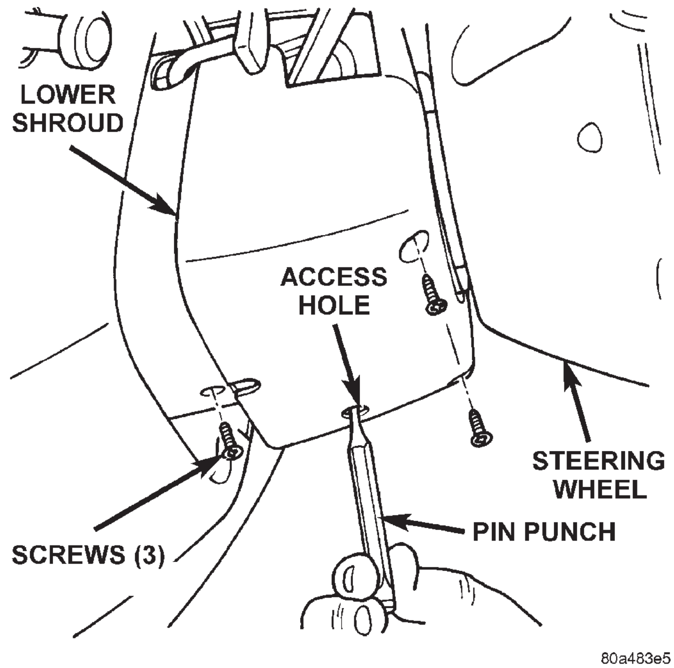


Fig. 2 Steering Column Shrouds Remove/Install

(13) Rotate the SKIM and its mounting bracket downwards and then to the side away from the steering column to slide the SKIM antenna ring from around the ignition switch lock cylinder housing.

(14) Remove the SKIM from the vehicle.

(15) Reverse the removal procedures to install. Tighten the non-tilt steering column mounting nuts to 22 N·m (200 in. lbs.) and the steering column shroud mounting screws to 2 N·m (18 in. lbs.).

(16) If the SKIM is replaced with a new unit, a DRB scan tool and the proper Diagnostic Procedures manual MUST be used to initialize the new SKIM and to program at least two Sentry Key transponders.

REMOVAL AND INSTALLATION (Continued)

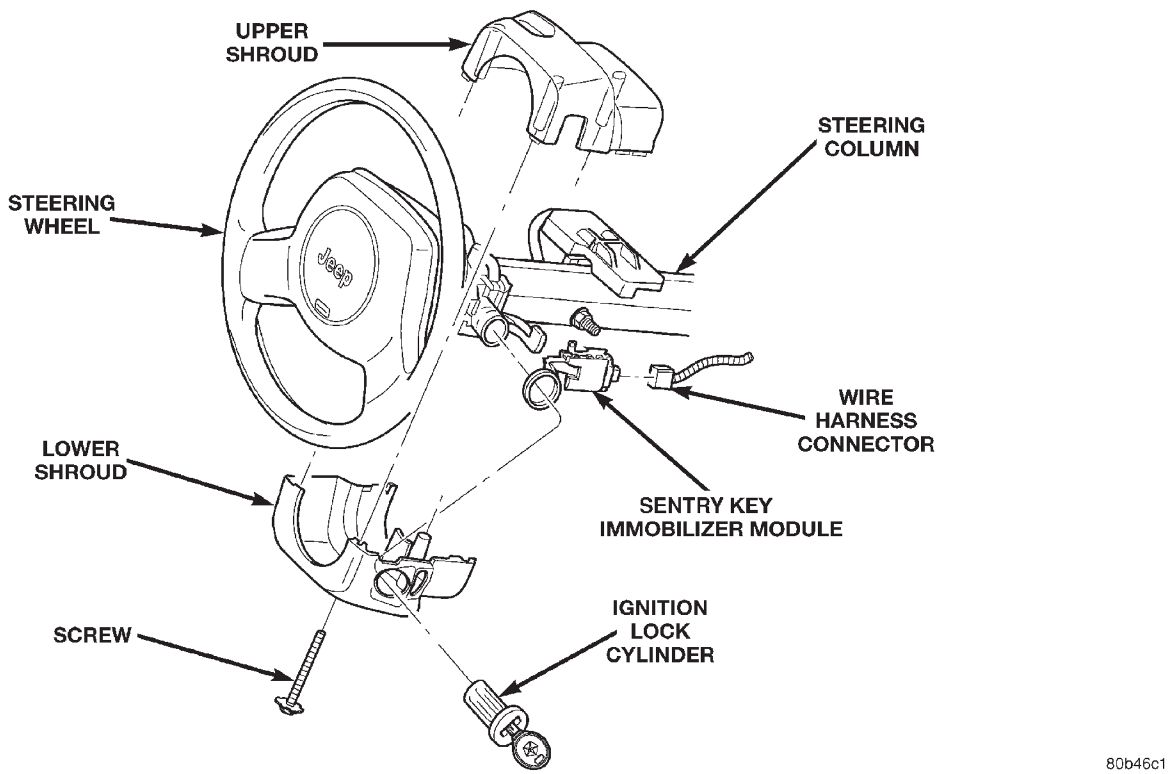


Fig. 3 Sentry Key Immobilizer Module Remove/Install

POWER SEAT SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Six-way power seats are an available factory-installed option for Left-Hand Drive (LHD) versions of this model. Refer to 8W-63 - Power Seat 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.

POWER SEAT SYSTEM

The power seat system option allows the front seating positions to be electrically adjusted for optimum control and comfort using the power seat switches located on the outboard seat cushion side shield. The power seat system allows the seating position to be adjusted forward, rearward, front up, front down, rear up, or rear down. The power seat system receives battery current through a fuse in the Power Distribution Center and a circuit breaker in the junction block, regardless of the ignition switch position.

The power seat system includes the power seat adjuster and motors unit, the power seat switch, and the circuit breaker. Following are general descriptions of the major components in the power seat system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the power seat system.

DESCRIPTION AND OPERATION

POWER SEAT SWITCH

The power seat can be adjusted in six different ways using the power seat switch. The switch is located on the lower outboard side of the seat cushion on the seat cushion side shield. Refer to the owner's manual for more information on the power seat switch functions and the seat adjusting procedures.

The individual switches in the power seat switch unit cannot be repaired. If one switch is damaged or faulty, the entire power seat switch unit must be replaced.

POWER SEAT ADJUSTER AND MOTORS

There are three reversible motors that operate the power seat adjuster. The motors are connected to worm-drive gearboxes that move the seat adjuster through a combination of screw-type drive units.

The front and rear of a seat are operated by different motors. They can be raised or lowered independently of each other. When the center seat switch is pushed to the Up or Down position, both the front and rear motors operate in unison, moving the entire seat up or down. The forward-rearward motor is operated by pushing the center seat switch to the Forward or Rearward position.

When a switch is actuated, a battery feed and a ground path are applied through the switch contacts to the motor(s). The motor(s) and drives operate to move the seat in the selected direction until the

DESCRIPTION AND OPERATION (Continued)

switch is released, or until the travel limit of the power seat adjuster is reached. When the switch is moved in the opposite direction, the battery feed and ground path to the motor(s) are reversed through the switch contacts. This causes the motor to run in the opposite direction.

Each motor contains a self-resetting circuit breaker to protect it from overload. Consecutive or frequent resetting of the circuit breakers must not be allowed to continue, or the motors may be damaged. Make the necessary repairs.

The power seat adjuster and motors cannot be repaired, and are serviced only as a complete unit. If any component in this unit is faulty or damaged, the entire power seat adjuster and motors assembly must be replaced.

CIRCUIT BREAKER

An automatic resetting circuit breaker in the junction block is used to protect the power seat system circuit. The circuit breaker can protect the system from a short circuit, or from an overload condition caused by an obstructed or stuck seat adjuster.

The circuit breaker cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING

POWER SEAT SYSTEM

Before any testing of the power seat system is attempted, the battery should be fully-charged and all wire harness connections and pins cleaned and tightened to ensure proper continuity and grounds. For circuit descriptions and diagrams, refer to 8W-63 - Power Seat in Group 8W - Wiring Diagrams.

With the dome lamp on, apply the power seat switch in the direction of the failure. If the dome lamp dims, the seat may be jamming. Check under and behind the seat for binding or obstructions. If the dome lamp does not dim, proceed with testing of the individual components and circuits.

CIRCUIT BREAKER

For circuit descriptions and diagrams, refer to 8W-63 - Power Seat in Group 8W - Wiring Diagrams.

(1) Locate the correct circuit breaker in the junction block. Pull out the circuit breaker slightly, but be certain that the circuit breaker terminals still contact the terminals in the junction block cavities.

(2) Connect the negative lead of a 12-volt DC voltmeter to a good ground.

(3) With the voltmeter positive lead, check both terminals of the circuit breaker for battery voltage.

If only one terminal has battery voltage, the circuit breaker is faulty and must be replaced. If neither terminal has battery voltage, repair the open circuit from the Power Distribution Center (PDC) as required.

POWER SEAT ADJUSTER AND MOTORS

For circuit descriptions and diagrams, refer to 8W-63 - Power Seat in Group 8W - Wiring Diagrams.

Operate the power seat switch to move all three seat motors in each direction. The seat should move in each of the selected directions. If the power seat adjuster fails to operate in only one direction, move the adjuster a short distance in the opposite direction and test again to be certain that the adjuster is not at its travel limit. If the power seat adjuster still fails to operate in only one direction, see Power Seat Switch in the Diagnosis and Testing section of this group. If the power seat adjuster fails to operate in more than one direction, proceed as follows:

(1) Test the circuit breaker in the junction block as described in this group. If OK, go to Step 2. If not OK, replace the faulty circuit breaker.

(2) Remove the power seat switch from the seat. Check for battery voltage at the fused B(+) circuit cavity of the power seat switch wire harness connector. If OK, go to Step 3. If not OK, repair the open circuit to the junction block as required.

(3) Check for continuity between the ground circuit cavity of the power seat switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit to ground as required.

(4) Test the power seat switch as described in this group. If the switch tests OK, check the wire harness for the inoperative power seat motor(s) between the power seat switch and the motor for shorts or opens. If the circuits check OK, replace the faulty power seat adjuster and motors assembly. If the circuits are not OK, repair the wire harness as required.

POWER SEAT SWITCH

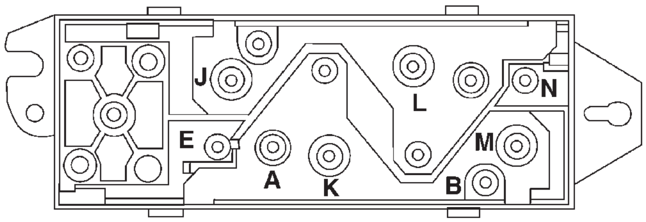
For circuit descriptions and diagrams, refer to 8W-63 - Power Seat in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the power seat switch from the power seat.

(3) Use an ohmmeter to test the continuity of the power seat switches in each position. See the Power Seat Switch Continuity chart (Fig. 1). If OK, see the diagnosis for the Power Seat Adjuster and Motors in this group. If not OK, replace the faulty power seat switch module.

DIAGNOSIS AND TESTING (Continued)



POWER SEAT SWITCH	
LEFT SEAT SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN
Off	B-E, B-J, B-K, B-L, B-M, B-N
Vertical Up	A-J, A-M, B-E, B-N
Vertical Down	A-E, A-N, B-J, B-M
Horizontal Forward	A-L, B-K
Horizontal Rearward	A-K, B-L
Front Tilt Up	A-M, B-N
Front Tilt Down	A-N, B-M
Rear Tilt Up	A-J, B-E
Rear Tilt Down	A-E, B-J

RIGHT SEAT SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN
Off	A-E, A-J, A-K, A-L, A-M, A-N
Vertical Up	A-J, A-N, B-E, B-M
Vertical Down	A-E, A-M, B-J, B-N
Horizontal Forward	A-L, B-K
Horizontal Rearward	A-K, B-L
Front Tilt Up	A-N, B-M
Front Tilt Down	A-M, B-N
Rear Tilt Up	A-J, B-E
Rear Tilt Down	A-E, B-J

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Fig. 1 Power Seat Switch Continuity

REMOVAL AND INSTALLATION

POWER SEAT SWITCH

(1) Disconnect and isolate the battery negative cable.

(2) Remove the three screws that secure the seat cushion side shield to the outboard seat cushion frame.

(3) Pull the seat cushion side shield away from the seat cushion frame far enough to access the power seat switch wire harness connector.

(4) Unplug the wire harness connector from the power seat switch.

(5) Remove the seat cushion side shield from the seat.

(6) Remove the two screws that secure the power seat switch to the inside of the seat cushion side shield (Fig. 2).

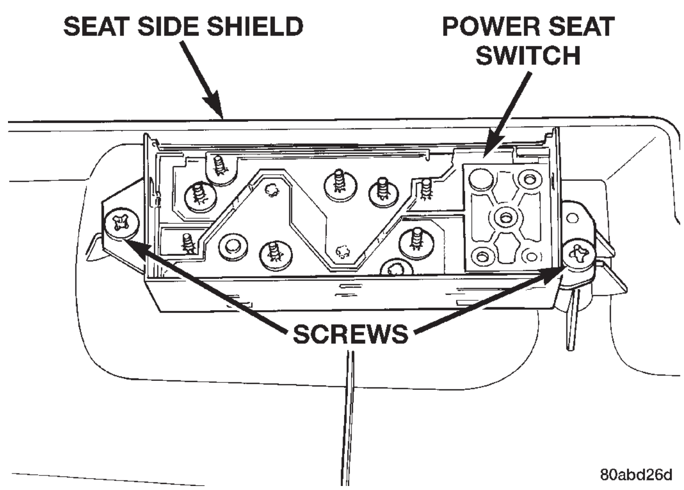


Fig. 2 Power Seat Switch Remove/Install

REMOVAL AND INSTALLATION (Continued)

(7) Remove the power seat switch from the seat cushion side shield.

(8) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

POWER SEAT ADJUSTER AND MOTORS

(1) Move the seat to its fully raised and fully forward position, if possible.

(2) Disconnect and isolate the battery negative cable.

(3) Unplug the seat belt switch wire harness connector from the driver side seat belt buckle half on the inboard side of the seat (Fig. 3).

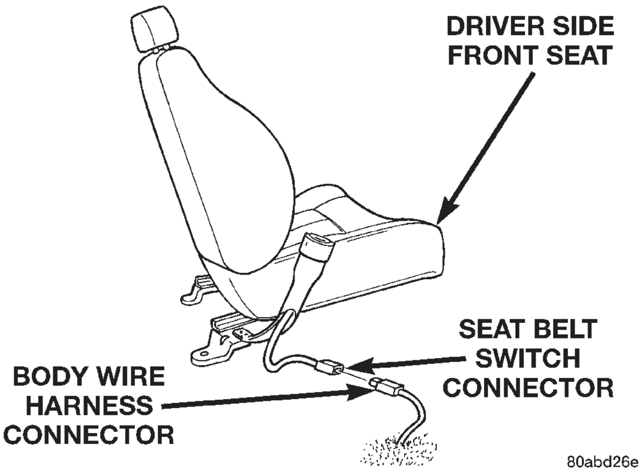


Fig. 3 Driver Seat Belt Switch Connector

(4) Remove the two screws that secure the front of the seat adjuster frame to the floor panel seat mounting reinforcement (Fig. 4).

(5) Remove the screw that secures the outboard rear of the seat adjuster frame to the floor panel.

(6) Remove the nut that secures the inboard rear of the seat adjuster frame to the stud on the floor panel.

(7) Unplug the power seat wire harness connector from the body wire harness connector.

(8) Remove the driver side power seat and adjuster assembly from the vehicle.

(9) Unplug the power seat wire harness connectors at each of the three power seat motors.

(10) Remove the four nuts that secure the seat adjuster and motors assembly to the seat cushion frame (Fig. 5).

(11) Remove the adjuster and motors assembly from the seat cushion frame.

(12) Reverse the removal procedures to install. Tighten the seat mounting hardware as follows:

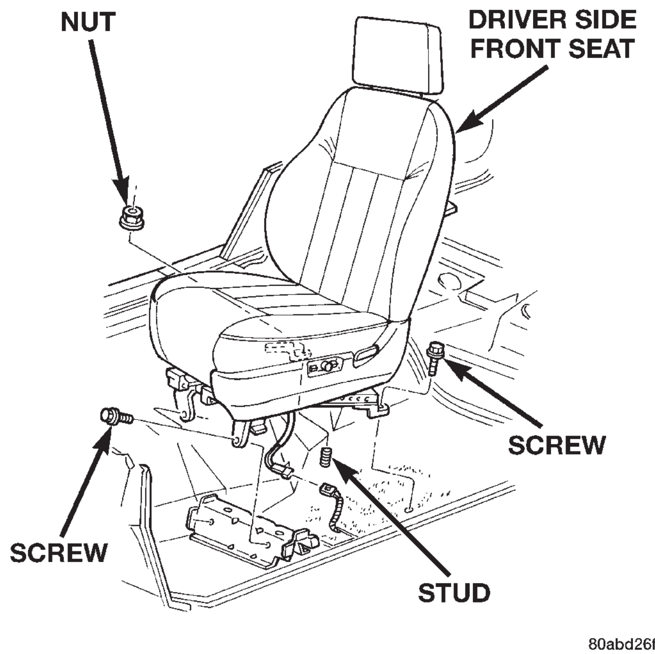


Fig. 4 Power Seat Remove/Install

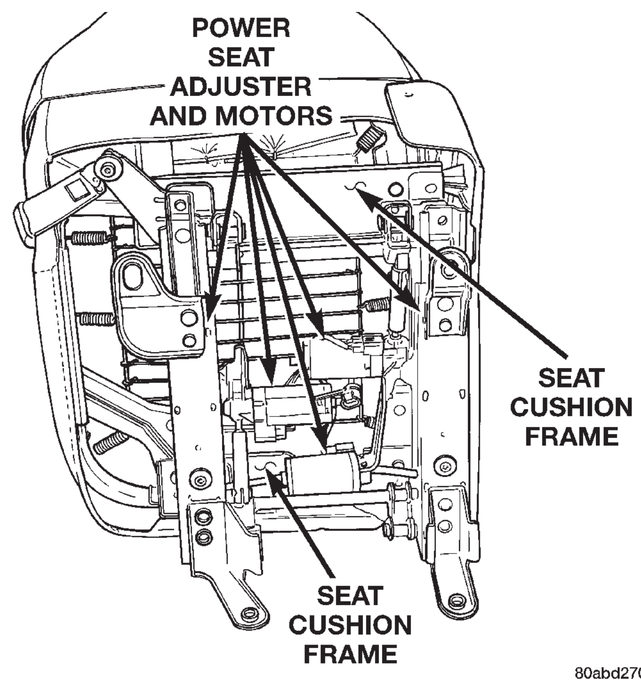


Fig. 5 Power Seat Adjuster and Motors Remove/Install

- Seat adjuster to seat cushion frame nuts - 25 N·m (18 ft. lbs.)
- Seat adjuster to floor panel screws - 27 N·m (20 ft. lbs.)
- Seat adjuster to floor panel nut - 40 N·m (30 ft. lbs.).

POWER WINDOW SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Power windows are available as factory-installed optional equipment on this model. The power lock system and power mirror system are included on vehicles equipped with the power window option. Refer to 8W-60 - Power Windows in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

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.

POWER WINDOW SYSTEM

The power window system allows all of the door windows to be raised and lowered electrically by actuating a switch on the trim panel of each respective door. Additionally, a set of master switches on the driver side front door trim panel allows the driver to raise or lower each of the passenger door windows. A power window lockout switch on the driver side front door trim panel can prevent the passenger door windows from being operated, except from the master switches. The power window system receives battery current through a circuit breaker in the junction block, only when the ignition switch is in the On or Accessory positions.

The power window system includes the power window switches on each door trim panel, the circuit breaker in the junction block, and the power window motors inside each door. This group covers diagnosis and service of only the electrical components in the power window system. For service of mechanical components, such as the regulator, lift plate, window tracks, or glass refer to Group 23 - Body.

Following are general descriptions of the major components in the power window system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the power window system.

DESCRIPTION AND OPERATION

POWER WINDOW SWITCH

The individual power windows are controlled by a two-way momentary switch mounted on the trim panel of the passenger side front door trim panel and, on four-door models, on each of the rear door trim panels. Two-way momentary master switches on the driver side front door trim panel control all of the power windows in the vehicle. The driver side front door trim panel also has a two-position power window lockout switch.

The front door power window switches and the power window lockout switch are integral to the Driver Door Module (DDM) or Passenger Door Module (PDM), respectively. The rear door power window switches are stand-alone units.

Each power window switch controls its power window motor by switching battery current and ground

DESCRIPTION AND OPERATION (Continued)

between the terminals of the power window motor. The passenger side front door and, on four-door models, both rear door power window switches receive their battery feed through the power window lockout switch or through the master switches in the DDM. Also, each of the individual power window switches receives its ground through the DDM. When the lockout switch is placed in the Lock position, the individual power window switches become inoperative because they have no battery current available to them. However, the master switches are unaffected by the lockout switch position.

Each power window switch, except the lockout switch, is illuminated by a Light-Emitting Diode (LED) when the ignition switch is turned to the On position. However, when the power window lockout switch is placed in the Lock position, the LED for the locked-out passenger side front and, on four-door models, the rear passenger door power window switches is turned off.

The front door power window switches and their lamps cannot be repaired and, if faulty or damaged, the entire door module must be replaced. The rear door power window switches and their lamps cannot be repaired but, if faulty or damaged, only the affected switch unit must be replaced.

DOOR MODULE

A Driver Door Module (DDM) and a Passenger Door Module (PDM) are used on all models equipped with power locks and power windows. Each door module houses both the front door power lock and power window switches. In addition to the switches for its own door, the DDM houses individual switches for each passenger door power window, a power window lockout switch, the power mirror switch, and circuitry to support the one-touch down feature of the driver side front door power window. The PDM also houses the control circuitry and the power lock and unlock relays for the power lock system.

The DDM and the PDM are mounted to their respective front door trim panels. The DDM and PDM are serviced individually and cannot be repaired. If the DDM or PDM, or any of the switches and circuitry that they contain are faulty or damaged, the complete DDM or PDM unit must be replaced.

POWER WINDOW MOTOR

A permanent magnet reversible motor moves the window regulator through an integral gearbox mechanism. A positive and negative battery connection to the two motor terminals will cause the motor to rotate in one direction. Reversing the current through these same two connections will cause the motor to rotate in the opposite direction.

In addition, each power window motor is equipped with an integral self-resetting circuit breaker to protect the motor from overloads. The power window motor and gearbox assembly cannot be repaired and, if faulty or damaged, the entire power window regulator assembly must be replaced.

CIRCUIT BREAKER

An automatic resetting circuit breaker in the junction block is used to protect the power window system circuit. The circuit breaker can protect the system from a short circuit, or from an overload condition caused by an obstructed or stuck window glass or regulator.

The circuit breaker cannot be repaired and, if faulty, it must be replaced.

DIAGNOSIS AND TESTING

POWER WINDOW SYSTEM

For circuit descriptions and diagrams, refer to 8W-60 - Power Windows in Group 8W - Wiring Diagrams.

ALL WINDOWS INOPERATIVE

(1) Check the circuit breaker in the junction block, as described in this group. If OK, go to Step 2. If not OK, replace the faulty circuit breaker.

(2) Disconnect and isolate the battery negative cable. Remove the driver side front door trim panel and unplug the Driver Door Module (DDM) wire harness connectors from the DDM. Check for continuity between the ground circuit cavity of the 8-way DDM wire harness connector and a good ground. If OK, go to Step 3. If not OK, repair the circuit to ground as required.

(3) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the master switch power feed (run/acc) circuit cavity of the 12-way DDM wire harness connector. If OK, see the diagnosis for the Door Module in this group. If not OK, repair the open circuit to the circuit breaker in the junction block as required.

ONE WINDOW INOPERATIVE

The window glass must be free to slide up and down for the power window motor to function properly. If the glass is not free to move up and down, the motor will overload and trip the integral circuit breaker. To determine if the glass is free, disconnect the regulator plate from the glass. Then slide the window up and down by hand.

There is an alternate method to check if the glass is free. Position the glass between the up and down stops. Then, shake the glass in the door. Check that

DIAGNOSIS AND TESTING (Continued)

the glass can be moved slightly from side to side, front to rear, and up and down. Then check that the glass is not bound tight in the tracks. If the glass is free, proceed with the diagnosis that follows. If the glass is not free, refer to Group 23 - Body for the door window glass and hardware service and adjustment procedures.

(1) Check the power window switch continuity as described in the diagnosis for the Door Module (front doors) or Power Window Switch (rear doors) in this group. If OK and the driver side front window is inoperative, see the Power Window Motor diagnosis in this group. If OK and the inoperative window is other than the driver side front, go to Step 2. If not OK, replace the faulty door module or switch.

(2) Refer to the circuit diagrams in 8W-60 - Power Windows in Group 8W - Wiring Diagrams. Check the continuity in each circuit between the inoperative Passenger Door Module (PDM) or power window switch wire harness connector cavities and the corresponding Driver Door Module (DDM) wire harness connector cavities. If OK, see the diagnosis for the Power Window Motor in this group. If not OK, repair the open circuit(s) as required.

NOTE: All individual power window switches receive their battery and ground feeds through the Driver Door Module (DDM) and wire harness connectors.

CIRCUIT BREAKER

For circuit descriptions and diagrams, refer to 8W-60 - Power Windows in Group 8W - Wiring Diagrams.

(1) Locate the circuit breaker in the junction block. Pull out the circuit breaker slightly, but be certain that the circuit breaker terminals still contact the terminals in the junction block cavities.

(2) Connect the negative lead of a 12-volt DC voltmeter to a good ground.

(3) With the voltmeter positive lead, check both terminals of the circuit breaker for battery voltage.

If only one terminal has battery voltage, the circuit breaker is faulty and must be replaced. If neither terminal has battery voltage, repair the open circuit from the Power Distribution Center (PDC) as required. If the circuit breaker checks OK, but no power windows operate, see Power Window System in the Diagnosis and Testing section of this group.

DOOR MODULE

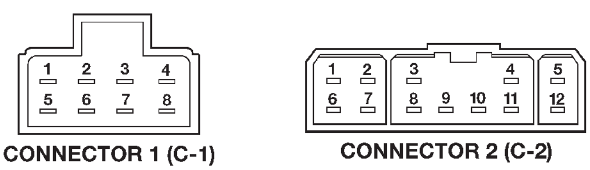
The Driver Door Module (DDM) contains the master switches and the lockout switch in the power window system. The DDM also contains an integrated circuit to support the one-touch down feature of the driver side front door power window. Remember that the passenger side front door power window switch and, on four-door models, the rear door power window switches get their battery current through the power window lockout switch in the Driver Door Module (DDM). In addition, each individual power window switch gets its ground through the master switch in the DDM.

The one-touch down feature circuitry within the DDM will not operate the power window motor if the door glass, window regulator, or gearbox mechanism are stuck, obstructed, or binding. If the driver side front door power window operates as designed, but the one-touch down feature is inoperative, replace the faulty DDM.

If the problem being diagnosed is an inoperative power window switch illumination lamp, but the power window switch operates as designed, replace the faulty door module. For circuit descriptions and diagrams, refer to 8W-60 - Power Windows in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable. Remove the front door trim panel and unplug the door module wire harness connectors from the door module.

(2) Check the door module power window switch and/or power window lockout switch continuity in each position, as shown in the proper chart (Fig. 1) or (Fig. 2). If OK, see the Power Window Motor diagnosis in this group. If not OK, replace the faulty door module.



POWER WINDOWS
CONNECTOR 2 (C2)

SWITCH POSITION	CONTINUITY BETWEEN
OFF (NORMAL)	1&8,2&8,3&8,4&8,5&8,6&8,10&8,12&8
RIGHT REAR DOWN	1&9,2&8
RIGHT REAR UP	2&9,1&8
RIGHT FRONT UP	3&9,6&8
LEFT REAR UP	4&9,10&8
LEFT FRONT UP	5&9,12&8
RIGHT FRONT DOWN	6&9,3&8
LEFT REAR DOWN	10&9,4&8
LEFT FRONT DOWN	12&9,5&8

WINDOW LOCKOUT
CONNECTOR 1 (C1), CONNECTOR 2 (C2)

SWITCH POSITION	CONTINUITY BETWEEN
LOCKOUT OFF (UP)	C1 PIN 8 & C2 PIN 9
LOCKOUT ON (DOWN)	NO CONTINUITY BETWEEN C1 PIN 8 & C2 PIN 9

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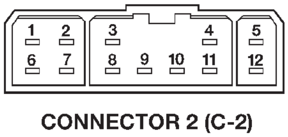
Fig. 1 DDM Power Window Switch Continuity

DIAGNOSIS AND TESTING (Continued)



POWER WINDOWS	
OFF (NORMAL)	C2 PIN 2 & C2 PIN 3
	C2 PIN 4 & C2 PIN 9
UP	C2 PIN 2 & C2 PIN 3
	C2 PIN 9 & C2 PIN 10
DOWN	C2 PIN 2 & C2 PIN 10
	C2 PIN 4 & C2 PIN 9

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Fig. 2 PDM Power Window Switch Continuity

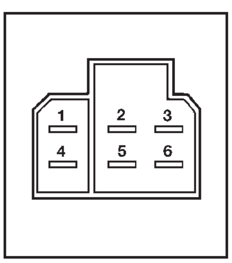
POWER WINDOW SWITCH

The diagnosis found here applies only to the rear door power window switches. For diagnosis of the front door power window switches, see Door Module in this group. If the problem being diagnosed is an inoperative power window switch illumination lamp, but the power window switch operates as designed, replace the faulty switch. For circuit descriptions and diagrams, refer to 8W-60 - Power Windows in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the power window switch from the rear door trim panel.

(3) Check the power window switch continuity in each position as shown in the Rear Door Power Window Switch Continuity chart (Fig. 3). If OK, see the Power Window Motor diagnosis in this group. If not OK, replace the faulty switch.



SWITCH POSITION	CONTINUITY BETWEEN
OFF (NORMAL)	1&4
	2&5
UP	1&6
	2&5
DOWN	1&4
	5&6

80abd2ed

Fig. 3 Rear Door Power Window Switch Continuity

POWER WINDOW MOTOR

For circuit descriptions and diagrams, refer to 8W-60 - Power Windows in Group 8W - Wiring Diagrams. Before you proceed with this diagnosis, confirm proper switch operation. See the Door Module and/or Power Window Switch diagnosis in this group.

(1) Disconnect and isolate the battery negative cable. Remove the trim panel from the door with the inoperative power window.

(2) Unplug the power window motor wire harness connector. Apply 12 volts across the motor terminals to check its operation in one direction. Reverse the connections across the motor terminals to check the operation in the other direction. Remember, if the window is in the full up or full down position, the motor will not operate in that direction by design. If OK, repair the circuits from the power window motor to the door module or the power window switch as required. If not OK, replace the faulty motor.

(3) If the motor operates in both directions, check the operation of the window glass and lift mechanism through its complete up and down travel. There should be no binding or sticking of the window glass or lift mechanism through the entire travel range. If not OK, refer to Group 23 - Body to check the window glass, tracks, and regulator for sticking, binding, or improper adjustment.

REMOVAL AND INSTALLATION

DOOR MODULE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the screws that secure the front door trim panel to the inner door panel (Fig. 4).

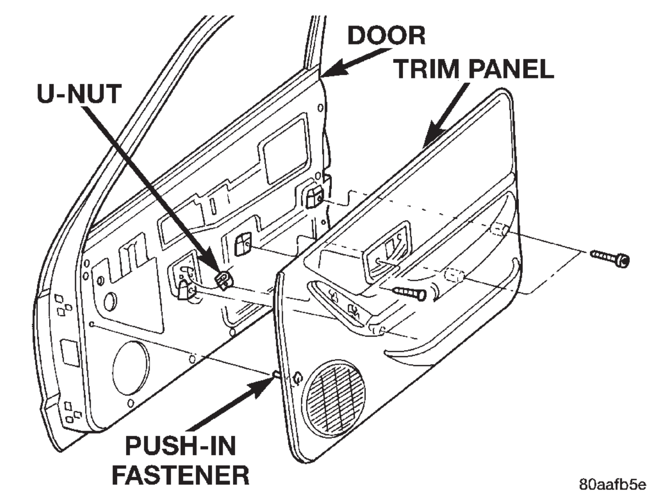


Fig. 4 Front Door Trim Panel Remove/Install

(3) Using a trim stick or another suitable wide flat-bladed tool, gently pry the front door trim panel

REMOVAL AND INSTALLATION (Continued)

away from the door around the perimeter to release the trim panel retainers.

NOTE: To aid in the removal of the trim panel, start at the bottom of the panel.

(4) Lift the front door trim panel upwards and away from the inner door panel far enough to disengage the top of the panel from the inner belt weatherstrip.

(5) Pull the front door trim panel away from the inner door panel far enough to access the inside door latch release and lock linkage rods near the back of the inside door remote controls.

(6) Unsnap the plastic retainer clips from the inside door remote control ends of the latch release and lock linkage rods, and remove the rod ends from the inside door remote controls.

(7) Unplug the wire harness connectors from the door module.

(8) Remove the trim panel from the front door.

(9) Remove the three screws that secure the door module to the front door trim panel (Fig. 5).

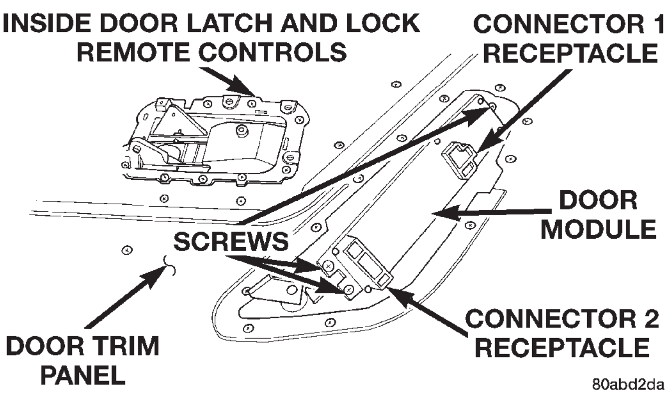


Fig. 5 Door Module Remove/Install

(10) Remove the door module from the front door trim panel.

(11) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

POWER WINDOW SWITCH

(1) Disconnect and isolate the battery negative cable.

(2) Remove the screws that secure the door trim panel to the inner door panel (Fig. 6).

(3) Using a trim stick or another suitable wide flat-bladed tool, gently pry the rear door trim panel away from the door around the perimeter to release the trim panel retainers.

NOTE: To aid in the removal of the trim panel, start at the bottom of the panel.

(4) Lift the rear door trim panel upwards and away from the inner door panel far enough to disengage the top of the panel from the inner belt weatherstrip.

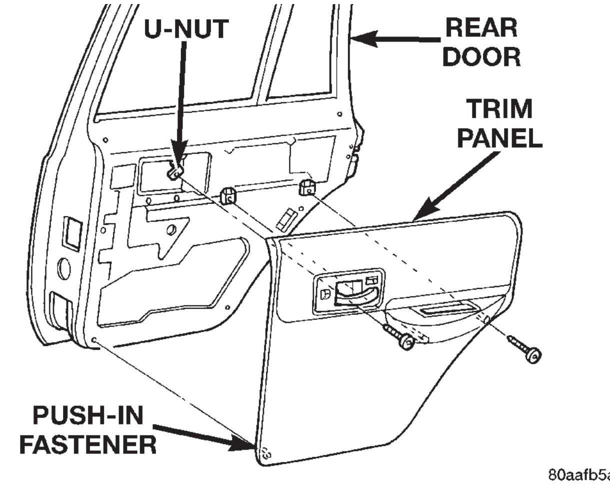


Fig. 6 Rear Door Trim Panel Remove/Install

(5) Pull the rear door trim panel away from the inner door panel far enough to access the inside door latch release and lock linkage rods near the back of the inside door remote controls.

(6) Unsnap the plastic retainer clips from the inside door remote control ends of the latch release and lock linkage rods, and remove the rod ends from the inside door remote controls.

(7) Unplug the wire harness connector from the rear door power window switch.

(8) Remove the trim panel from the rear door.

(9) With a small thin-bladed screwdriver, gently pry the snap clips at the sides of the power window switch receptacle on the back of the rear door trim panel and pull the switch out of the receptacle (Fig. 7).

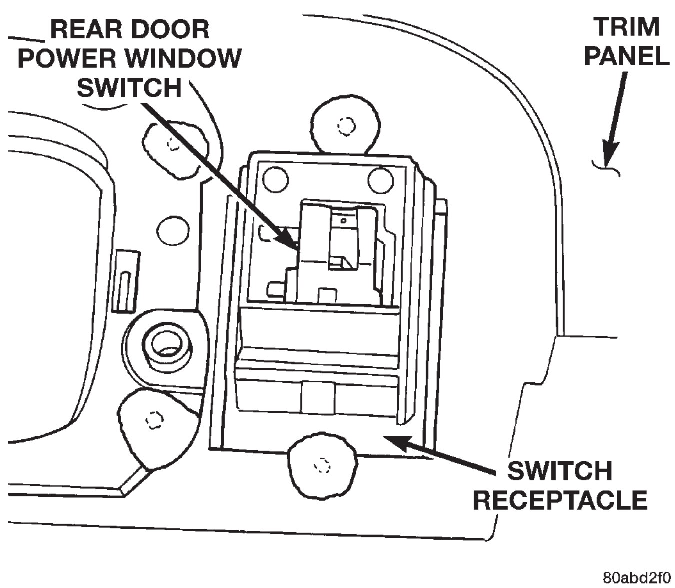


Fig. 7 Rear Door Power Window Switch Remove/Install

REMOVAL AND INSTALLATION (Continued)

(10) Reverse the removal procedures to install. Be certain that both of the switch snap retainers in the receptacle on the back of the trim panel are fully engaged.

POWER WINDOW MOTOR

FRONT DOOR

The front door power window motor and mechanism is integral to the front door power window regulator unit. If the front door power window motor or mechanism is faulty or damaged, the entire power window regulator unit must be replaced. Refer to Group 23 - Body for the front door window regulator service procedures.

REAR DOOR

The rear door power window motor and mechanism is integral to the rear door power window regulator unit. If the rear door power window motor or mechanism is faulty or damaged, the entire power window regulator unit must be replaced. Refer to Group 23 - Body for the rear door window regulator service procedures.

POWER MIRROR SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Power operated or power operated and heated outside rear view mirrors are available factory-installed options on this model. Refer to 8W-62 - Power Mirrors in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

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.

POWER MIRROR SYSTEM

The power operated or power operated and heated outside rear view mirrors allow the driver to adjust both outside mirrors electrically from the driver seat position by operating a switch on the driver side front door trim panel. The power mirrors receive battery current through a fuse in the junction block, and will only operate when the ignition switch is in the On or Accessory positions.

The heated mirror option includes an electric heating grid behind the mirror glass in each outside mirror, which can clear the mirror glass of ice, snow, or fog. The heating grid receives fused battery current through the rear window defogger relay only when the rear window defogger system is turned on. Refer to Group 8N - Electrically Heated Systems for more information on the rear window defogger system.

Following are general descriptions of the major components in the power mirror system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the power mirror system.

DESCRIPTION AND OPERATION

POWER MIRROR

Each power mirror head contains two electric motors, two drive mechanisms, and the mirror glass. One motor and drive controls mirror up-and-down movement, and the other controls right-and-left movement.

The power mirrors in vehicles equipped with the available heated mirror option also include an electric heating grid located behind the mirror glass. This heating grid is energized by the rear window defogger relay whenever the rear window defogger system is turned on. Refer to Group 8N - Electrically Heated Systems for more information on the operation of the rear window defogger system.

The power mirror assembly cannot be repaired. Only the mirror glass is serviced separately. If any other component of the power mirror unit is faulty or damaged, the entire assembly must be replaced.

POWER MIRROR SWITCH

Both the right and left power outside mirrors are controlled by a single multi-function switch unit located on the driver side front door trim panel. Two versions of this switch are offered. Models without power windows or power locks have a stand-alone switch mounted in the driver side front door trim panel. Models equipped with power windows and power locks have a power mirror switch that is integral to the Driver Door Module (DDM).

Both versions of the switch are operated in the same manner. A three position rocker-type mirror

DESCRIPTION AND OPERATION (Continued)

selector switch is moved right (right mirror control), left (left mirror control), or center to turn the power mirrors off. Then one of four directional control buttons is depressed to control movement of the selected mirror up, down, right, or left. The directional control buttons of the DDM-mounted switch are illuminated when the ignition switch is in the On or Accessory positions. The stand-alone switch is not illuminated.

The stand-alone power mirror switch cannot be repaired and, if faulty or damaged, it must be replaced as a complete unit. If the DDM power mirror switch is faulty or damaged, the entire DDM unit must be replaced.

DOOR MODULE

A Driver Door Module (DDM) and a Passenger Door Module (PDM) are used on all models equipped with power locks and power windows. Each door module houses both the front door power lock and power window switches. In addition to the switches for its own door, the DDM houses individual switches for each passenger door power window, a power window lockout switch, the power mirror switch, and circuitry to support the one-touch down feature of the driver side front door power window. The PDM also houses the control circuitry and the power lock and unlock relays for the power lock system.

The DDM and the PDM are mounted to their respective front door trim panels. The DDM and PDM are serviced individually and cannot be repaired. If the DDM or PDM, or any of the switches and circuitry that they contain are faulty or damaged, the complete DDM or PDM unit must be replaced.

DIAGNOSIS AND TESTING

POWER MIRROR SYSTEM

For circuit descriptions and diagrams, refer to 8W-62 - Power Mirrors in Group 8W - Wiring Diagrams.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) If the problem being diagnosed is inoperative illumination of the power mirror switch directional buttons for the Driver Door Module (DDM)-type switch, proceed as follows. If not, go to Step 5. Check the power window circuit breaker in the junction block. If OK, go to Step 4. If not OK, replace the faulty circuit breaker.

(4) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the driver side front door trim panel and unplug the DDM wire harness connectors. Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output circuit cavity of the 12-way DDM wire harness connector. If OK, replace the faulty DDM. If not OK, repair the open circuit to the power window circuit breaker in the junction block as required.

(5) If the problem being diagnosed is an inoperative power mirror electric heating grid, proceed as follows. If not, go to Step 8. Disconnect and isolate the battery negative cable. Remove the front door trim panel on the side of the vehicle with the inoperative mirror heating grid. Unplug the wire harness connector at the mirror. Check for continuity between the ground circuit cavity in the body half of the power mirror wire harness connector and a good ground. If OK, go to Step 6. If not OK, repair the open circuit to ground as required.

(6) Connect the battery negative cable. Turn the ignition switch to the On position. Turn on the rear window defogger system. Check for battery voltage at the rear window defogger relay output circuit cavity in the body half of the power mirror wire harness connector. If OK, go to Step 7. If not OK, repair the open circuit to the rear window defogger relay as required.

(7) Check for continuity between the ground circuit and the rear window defogger relay output circuit cavities in the mirror half of the power mirror wire harness connector. There should be continuity. If not OK, replace the faulty power mirror. If OK, check the resistance through the electric heating grid circuit. Correct resistance through the electric heating grid should be from 10 to 16 ohms when measured at an ambient temperature of 21° C (70° F). If not OK, replace the faulty power mirror.

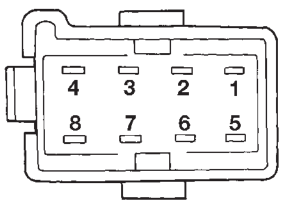
(8) Disconnect and isolate the battery negative cable. Remove the stand-alone power mirror switch from the driver side front door trim panel or, with a DDM-mounted switch, remove the driver side front door trim panel. Unplug the wire harness connector from the stand-alone switch or the 8-way wire harness connector from the DDM. Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output circuit cavity of the stand-alone switch wire harness connector or the 8-way DDM wire harness connector. If OK, go to Step 9. If not OK, repair the open circuit to the junction block as required.

(9) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable.

DIAGNOSIS AND TESTING (Continued)

Check for continuity between the ground circuit cavity of the stand-alone switch wire harness connector or the 8-way DDM wire harness connector and a good ground. There should be continuity. If OK, go to Step 10. If not OK, repair the circuit to ground as required.

(10) Check the stand-alone power mirror switch or DDM-mounted power mirror switch continuity as shown in (Fig. 1) or (Fig. 2). If OK, go to Step 11. If not OK, replace the faulty stand-alone power mirror switch or the faulty DDM.



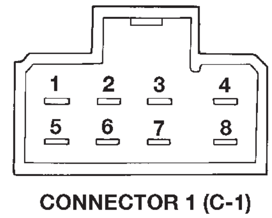
SELECT RIGHT MIRROR	
SWITCH POSITION	CONTINUITY BETWEEN
OFF	1 & 3, 1 & 4, 1 & 5, 1 & 6
UP	2 & 4, 1 & 3, 1 & 5, 1 & 6
DOWN	2 & 5, 1 & 3, 1 & 4, 1 & 6
RIGHT	2 & 6, 1 & 3, 1 & 4, 1 & 5
LEFT	2 & 3, 1 & 4, 1 & 5, 1 & 6

SELECT LEFT MIRROR	
SWITCH POSITION	CONTINUITY BETWEEN
OFF	1 & 5, 1 & 6, 1 & 7, 1 & 8
UP	2 & 8, 1 & 5, 1 & 6, 1 & 7
DOWN	2 & 5, 1 & 6, 1 & 7, 1 & 8
RIGHT	2 & 6, 1 & 5, 1 & 7, 1 & 8
LEFT	2 & 7, 1 & 5, 1 & 6, 1 & 8

80abfeca

Fig. 1 Stand-Alone Power Mirror Switch Continuity

(11) Connect the battery negative cable. Use two jumper wires, one connected to a 12-volt battery feed, and the other connected to a good body ground. See the Power Mirror Test chart for the correct jumper wire connections at the mirror half of the power mirror wire harness connector (Fig. 3). If the mirror reactions are OK, repair the wire harness between the mirror and the stand-alone power mirror switch or the DDM as required. If the mirror reactions are not OK, replace the faulty power outside mirror assembly.



SELECT RIGHT MIRROR	
SWITCH POSITION	CONTINUITY BETWEEN
UP	7 & 3, 2 & 5
DOWN	2 & 3, 7 & 5
RIGHT	4 & 3, 2 & 5
LEFT	2 & 3, 4 & 5

SELECT LEFT MIRROR	
SWITCH POSITION	CONTINUITY BETWEEN
UP	1 & 3, 2 & 5
DOWN	2 & 3, 1 & 5
RIGHT	6 & 3, 2 & 5
LEFT	2 & 3, 6 & 5

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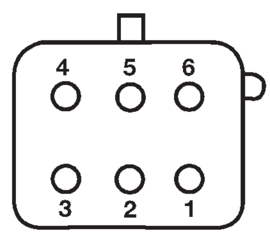
Fig. 2 Driver Door Module Power Mirror Switch Continuity



POWER MIRROR TEST		
12 VOLTS	GROUND	MIRROR REACTION
PIN 1	PIN 4	UP
PIN 4	PIN 1	DOWN
PIN 2	PIN 3	LEFT
PIN 3	PIN 2	RIGHT
PIN 5	PIN 6	HEATER

80ac2c55

Fig. 3 Power Mirror Test

REMOVAL AND INSTALLATION

POWER MIRROR SWITCH

This procedure covers removal of the stand-alone type power mirror switch. Vehicles with power windows and power locks have a power mirror switch which is integral to the Driver Door Module (DDM). See Door Module in this group for the DDM-type power mirror switch service procedures.

(1) Disconnect and isolate the battery negative cable.

(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry around the perimeter edge of the switch to release the snap clips that secure the switch to the trim panel (Fig. 4).

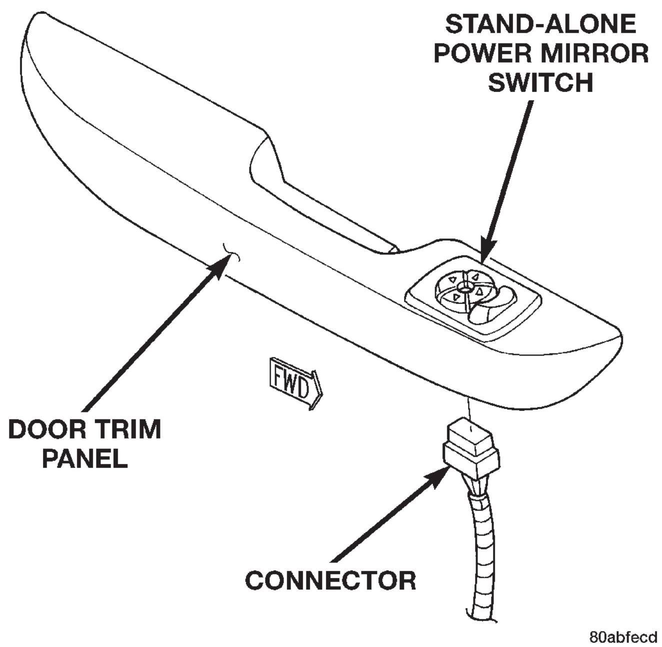


Fig. 4 Stand-Alone Power Mirror Switch Remove/ Install

(3) Pull the power mirror switch away from the trim panel far enough to access the wire harness connector.

(4) Unplug the power mirror switch from the wire harness connector.

(5) Reverse the removal procedures to install.

DOOR MODULE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the screws that secure the front door trim panel to the inner door panel (Fig. 5).

(3) Using a trim stick or another suitable wide flat-bladed tool, gently pry the front door trim panel away from the door around the perimeter to release the trim panel retainers.

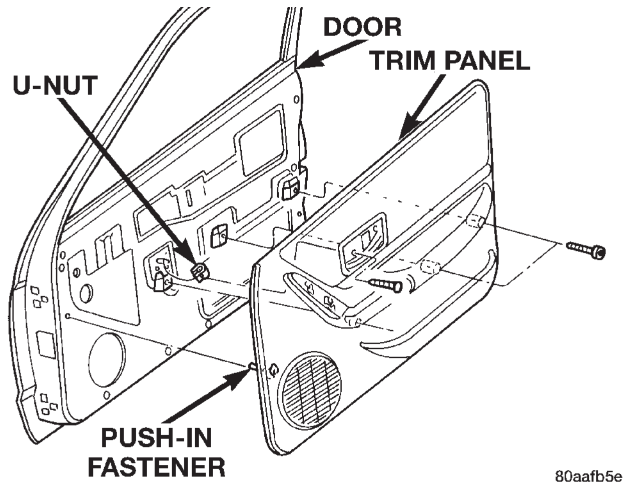


Fig. 5 Front Door Trim Panel Remove/Install

NOTE: To aid in the removal of the trim panel, start at the bottom of the panel.

(4) Lift the front door trim panel upwards and away from the inner door panel far enough to disengage the top of the panel from the inner belt weatherstrip.

(5) Pull the front door trim panel away from the inner door panel far enough to access the inside door latch release and lock linkage rods near the back of the inside door remote controls.

(6) Unsnap the plastic retainer clips from the inside door remote control ends of the latch release and lock linkage rods, and remove the rod ends from the inside door remote controls.

(7) Unplug the wire harness connectors from the door module.

(8) Remove the trim panel from the front door.

(9) Remove the three screws that secure the door module to the front door trim panel (Fig. 6).

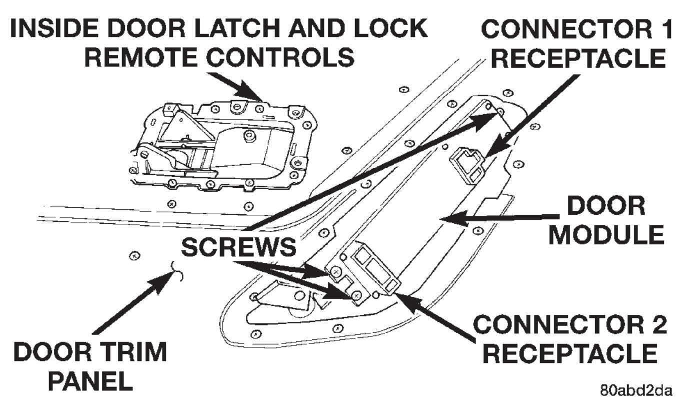


Fig. 6 Door Module Remove/Install

(10) Remove the door module from the front door trim panel.

(11) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

POWER MIRROR

(1) Disconnect and isolate the battery negative cable.

(2) If the vehicle is so equipped, remove the manual window regulator crank handle with a removal tool (Fig. 7).

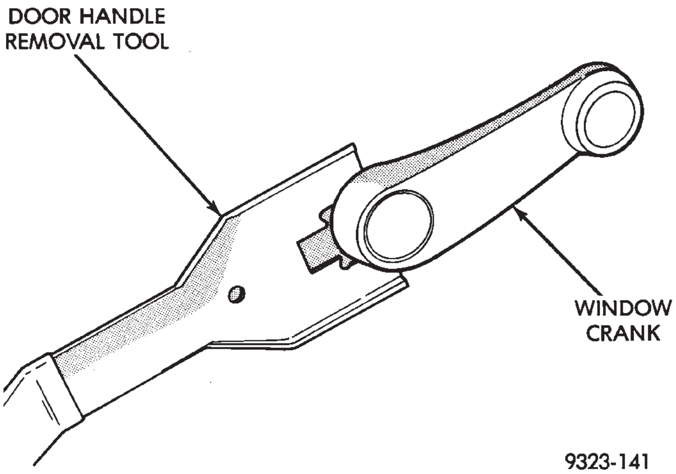


Fig. 7 Window Regulator Crank Handle Remove - Typical

(3) Remove the screws that secure the front door trim panel to the inner door panel (Fig. 8) or (Fig. 9).

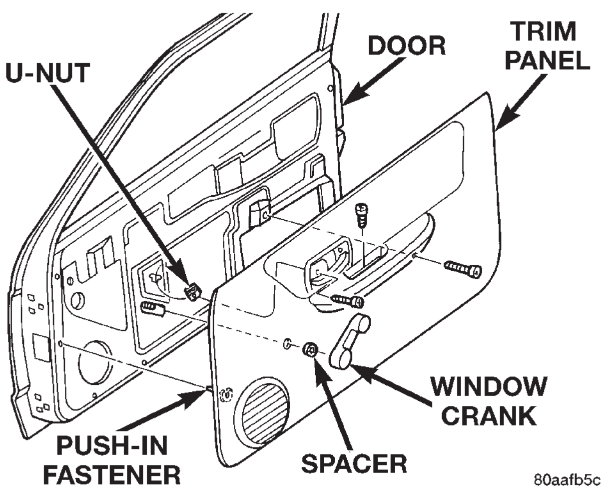


Fig. 8 Front Door Trim Panel Remove/Install - Manual Window

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the front door trim panel away from the door around the perimeter to release the trim panel retainers.

NOTE: To aid in the removal of the trim panel, start at the bottom of the panel.

(5) Lift the front door trim panel upwards and away from the inner door panel far enough to disengage the top of the panel from the inner belt weatherstrip.

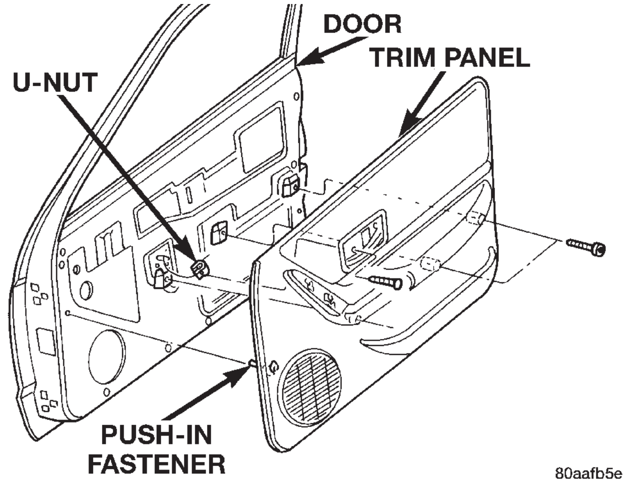


Fig. 9 Front Door Trim Panel Remove/Install - Power Window

(6) Pull the front door trim panel away from the inner door far enough to access the inside door latch release and lock linkage rods near the back of the inside door remote controls.

(7) Unsnap the plastic retainer clips from the inside door remote control ends of the latch release and lock linkage rods, and remove the rod ends from the inside door remote controls.

(8) Unplug the wire harness connectors from the door power switch module or, on the driver side only, the stand-alone power mirror switch.

(9) Set the front door trim panel aside.

(10) Remove the one screw that secures the front door flag trim to the inner door panel (Fig. 10).

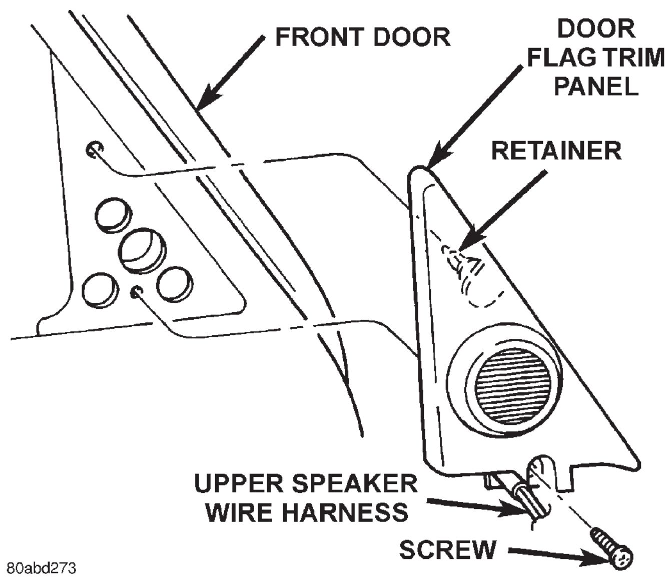


Fig. 10 Front Door Flag Trim Panel Remove/Install

REMOVAL AND INSTALLATION (Continued)

(11) Using a trim stick or another suitable wide flat-bladed tool, gently pry the door flag trim away from the inner door to release the trim panel retainer.

(12) Unplug the power mirror wire harness connector.

(13) Remove the three screws that secure the power mirror to the inner door panel (Fig. 11).

(14) Unseat the power mirror wire harness grommet by pushing it out through the hole in the door flag from the inside.

(15) Pull the mirror and seal from the outside of the door while feeding the wire harness, grommet, and connector out through the hole from the inside of the door.

(16) Reverse the removal procedures to install. Tighten the mirror mounting screws to 4.3 N·m (38 in. lbs.). Tighten the door trim mounting screws to 2.2 N·m (20 in. lbs.).

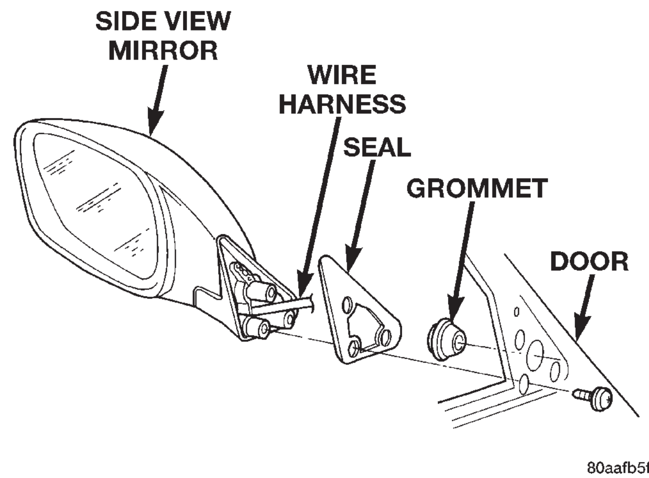


Fig. 11 Power Mirror Remove/Install

CHIME/BUZZER WARNING SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

This group covers the chime warning system, which is standard factory-installed equipment on this model. 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.

CHIME WARNING SYSTEM

The chime warning system provides an audible warning to the driver under the following conditions:

- Driver side seat belt is not fastened (chimes will sound after the ignition switch is turned to the On position for the duration of the seat belt reminder lamp illumination or until the driver side seat belt is buckled, whichever occurs first)
- Engine coolant temperature is high
- Head or park lamps are turned on with the ignition switch Off and the driver side front door open
- Key is in the ignition switch with the ignition switch Off and the driver side front door open
- Low fuel warning lamp illumination - less than about one-eighth tank of fuel remaining
- Overhead console trip computer is reset.
- The optional Sentry Key Immobilizer System (SKIS) is in the “customer programming” mode.

Following are general descriptions of the major components in the chime warning system. Refer to the owner’s manual in the vehicle glove box for more information on the features, use and operation of the chime warning system.

DESCRIPTION AND OPERATION

INSTRUMENT CLUSTER

The instrument cluster is an electromechanical unit that contains integrated circuitry and internal programming to perform a variety of functions. The instrument cluster circuitry monitors hard-wired switch inputs, as well as message inputs received from other vehicle electronic modules on the Chrysler Collision Detection (CCD) data bus network.

The instrument cluster uses these many inputs along with its internal programming and an integral chime tone generator to perform the functions of the chime warning module on this model. The instrument cluster circuitry also has a self-diagnostic capability. Refer to Group 8E - Instrument Panel Systems for more information on this feature.

Hard-wired chime warning system inputs to the instrument cluster include the following:

- Driver door jamb switch
- Driver seat belt switch
- Headlamp switch
- Key-in ignition switch.

The only instrument cluster diagnosis found in this group consists of confirming the viability of the hard-wired chime request inputs to the instrument cluster circuitry. For diagnosis of the CCD data bus and the data bus message inputs, a DRB scan tool and the

DESCRIPTION AND OPERATION (Continued)

proper Diagnostic Procedures manual are recommended.

Refer to Group 8E - Instrument Panel Systems for the instrument cluster service procedures. The instrument cluster chime warning circuitry and chime tone generator cannot be repaired and, if faulty or damaged, the instrument cluster assembly must be replaced.

DRIVER DOOR JAMB SWITCH

The driver door jamb switch is mounted to the driver side front 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 opens the ground path when the driver door is closed.

The driver door jamb switch cannot be repaired and, if faulty or damaged, it must be replaced. Refer to 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 driver seat belt switch cannot be repaired and, if faulty or damaged, the entire driver seat belt buckle-half unit must be replaced. Refer to Group 23 - Body 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 jamb switch is closed (driver door is open). The key-in ignition switch opens the ground path when the key is removed from the ignition lock cylinder.

The key-in ignition switch cannot be repaired and, if faulty or damaged, the entire ignition switch must be replaced. Refer to 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 jamb 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 or damaged, 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 ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Rotate the headlamp switch knob counterclockwise to ensure that the dome lamps are not switched off. Open the driver door and note whether the interior lamps light. They should light. If OK, see the diagnosis for the Key-In Ignition Switch or the Headlamp Switch in this group. If not OK, go to Step 2.

(2) Disconnect and isolate the battery negative cable. Unplug the driver door jamb switch from its wire harness connector. Check for continuity between the ground circuit cavity of the driver door jamb switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the circuit to ground as required.

(3) Check for continuity between the door jamb switch ground circuit terminal and the left front door jamb switch sense terminal of the door jamb 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 ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

DIAGNOSIS AND TESTING (Continued)

(1) Disconnect and isolate the battery negative cable. Unplug the driver seat belt switch wire harness 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 driver seat belt switch wire harness 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 body half of the driver seat belt switch wire harness 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.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the steering column shrouds. Refer to Group 8D - Ignition Systems for the procedures. Unplug the key-in ignition switch wire harness connector from the ignition switch.

(2) Check for continuity between the key-in switch sense circuit and the left front door jamb switch sense circuit terminals of the key-in ignition switch. There should be continuity with the key in the ignition lock cylinder, and no continuity with the key removed from the ignition lock cylinder. If OK, go to Step 3. If not OK, replace the faulty ignition switch assembly.

(3) Check for continuity between the left front door jamb switch sense circuit cavity of the key-in ignition switch wire harness connector and a good ground. There should be continuity with the driver door open, and no continuity with the driver door closed. If OK, see the diagnosis for Instrument Cluster in this group. If not OK, repair the circuit to the driver door jamb switch as required.

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 ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the headlamp switch from the instrument panel. Refer to Group 8E - Instrument Panel Systems for the procedures. Unplug the headlamp switch wire harness connectors. Check for continuity between the left front door jamb switch sense circuit cavity of the headlamp switch wire harness connector and a good ground. There should be continuity with the driver door 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 no continuity with the switch in the Off position, and continuity with the switch in the park or head lamps On position. If OK, see the diagnosis for the Instrument Cluster 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 ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster from the

DIAGNOSIS AND TESTING (Continued)

instrument panel. Refer to Group 8E - Instrument Panel Systems for the procedures.

(2) Unplug the headlamp switch and the key-in ignition switch wire harness connectors. Check for continuity between the key-in switch sense circuit cavity of the right instrument cluster wire harness connector (connector B) and a good ground. There should be no continuity. If OK, go to Step 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 instrument cluster wire harness connector (connector B) and the headlamp switch wire harness connector. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Unplug the driver seat belt switch wire harness connector. Check for continuity between the seat belt switch sense circuit cavity of the right instrument cluster wire harness connector (connector B) and a good ground. There should be no continuity. If OK, go to Step 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 instrument cluster wire harness connector (connector B) and the driver seat belt switch wire harness connector. There should be continuity. If OK, test the instrument cluster as described in Group 8E - Instrument Panel Systems. 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 proper group as follows:

- Driver door jamb switch - refer to Group 8L - Lamps
- Driver seat belt switch - refer to Group 23 - Body
- Headlamp switch - refer to Group 8E - Instrument Panel Systems
- Key-in ignition switch - refer to Group 8D - Ignition Systems.

OVERHEAD CONSOLE SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

An overhead console featuring a mini trip computer, an electronic compass, and an outside ambient temperature thermometer is an available factory-installed option on this model. Refer to 8W-49 - Overhead Console in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

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.

OVERHEAD CONSOLE

The overhead console for this model includes a mini trip computer, an electronic compass, and an outside ambient temperature thermometer. The overhead console also houses two front-mounted and two rear-mounted reading and courtesy lamps, a garage door opener storage bin, and a sunglasses storage bin.

On models equipped with the Remote Keyless Entry (RKE) option, the RKE receiver is also located within the overhead console housing. Refer to Group 8P - Power Lock Systems for more information on this feature.

Following are general descriptions of the major components used in the overhead console. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the various overhead console components.

DESCRIPTION AND OPERATION

TRIP COMPUTER

A mini trip computer is available on this model to provide several electronic functions and features. The trip computer contains a central processing unit and interfaces with other modules in the vehicle on the Chrysler Collision Detection (CCD) data bus network.

The CCD data bus network allows the sharing of sensor information. This helps to reduce wire harness complexity, reduce internal controller hardware, and reduce component sensor current loads. At the same time, this system provides increased reliability, enhanced diagnostics, and allows the addition of many new feature capabilities.

DESCRIPTION AND OPERATION (Continued)

Some of the functions and features that the trip computer supports and/or controls, include the following display options:

- Compass and temperature
- Trip odometer (ODO)
- Average fuel economy (AVG ECO)
- Instant fuel economy (ECO)
- Distance to empty (DTE)
- Elapsed time (ET)
- Blank display.

Momentarily depressing and releasing the Step button when the ignition switch is in the On position will cause the overhead console display to step sequentially through the listed display options. Momentarily depressing and releasing the U.S./Metric button toggles the display between U.S. and Metric measurements.

The push button (Step and U.S./Metric) switch module in the overhead console is hard wired to the trip computer. The compass flux-gate unit is integral to the trip computer, compass, and thermometer display module unit. Data input for all other trip computer functions is received through CCD data bus messages. The trip computer uses its internal programming and all of these inputs to calculate and display the requested data. If the data displayed is incorrect, see Trip Computer, Compass, and Thermometer Display Module - Self-Diagnostic Test in the Diagnosis and Testing section of this group. If these tests prove inconclusive, the use of a DRB scan tool and the proper Diagnostic Procedures manual are recommended for further testing of the trip computer and the CCD data bus.

The trip computer, compass, and thermometer display module cannot be repaired, and is only available for service as a unit. If faulty or damaged, the complete module must be replaced. The push button (Step and U.S./Metric) switch module is serviced separately.

COMPASS

The compass will display the direction in which the vehicle is pointed using the eight major compass headings (Examples: north is N, northeast is NE). It does not display the headings in actual degrees.

The self-calibrating compass unit requires no adjusting in normal use. The only calibration that may prove necessary is to drive the vehicle in three complete circles, on level ground, in not less than 48 seconds. This will reorient the compass unit to its vehicle.

The compass unit also will compensate for magnetism the body of the vehicle may acquire during normal use. However, avoid placing anything magnetic directly on the roof of the vehicle. Magnetic mounts for an antenna, a repair order hat, or a funeral procession flag can exceed the compensating ability of the compass unit if placed on the roof panel. Magnetic bit drivers used on the fasteners that hold the assembly to the roof header can also affect compass operation. If the vehicle roof should become magnetized, demagnetizing and calibration may be required to restore proper compass operation. See Compass Calibration or Compass Demagnetizing in the Service Procedures section of this group for these procedures.

The compass, trip computer, and thermometer display module cannot be repaired, and is only available for service as a unit. If faulty or damaged, the complete module must be replaced. The push button (Step and U.S./Metric) switch module is serviced separately.

THERMOMETER

The thermometer displays the outside ambient temperature. The temperature display can be changed from Fahrenheit to Celsius using the U.S./Metric button, located just rearward of the display module. The displayed temperature is not an instant reading of conditions, but an average temperature. It may take the thermometer display several minutes to respond to a major temperature change, such as driving out of a heated garage into winter temperatures.

When the ignition switch is turned to the Off position, the last displayed temperature reading stays in the thermometer unit memory. When the ignition switch is turned to the On position again, the thermometer will display the memory temperature if the engine coolant temperature is above about 52° C (125° F). If the engine coolant temperature is below about 52° C (125° F), the thermometer will display the actual temperature sensed by the ambient temperature sensor. The thermometer temperature display update interval varies with the vehicle speed.

The thermometer function is supported by an ambient temperature sensor. The sensor is mounted outside the passenger compartment near the front and center of the vehicle and is hard-wired to the module. The ambient temperature sensor is available as a separate service item.

The thermometer, compass, and trip computer display module cannot be repaired, and are only available for service as a unit. If faulty or damaged, the complete module must be replaced. The push button (Step and U.S./Metric) switch module and ambient temperature sensor are serviced separately.

READING AND COURTESY LAMP

All reading and courtesy lamps located in the overhead console are activated by the door ajar switches. When the doors are closed, the lamps can be individually activated by depressing the corresponding lens.

DESCRIPTION AND OPERATION (Continued)

When a door is open, depressing the lamp lens switches will not turn the lamps off. Refer to Group 8L - Lamps, for diagnosis of the reading and courtesy lamps.

The reading and courtesy lamp lens, and bulbs are available for service replacement. The reading and courtesy lamp holders and switches are only available as part of the overhead console wire harness. If any reading lamp switch is faulty or damaged, the wire harness and all four switches must be replaced.

GARAGE DOOR OPENER STORAGE BIN

A compartment in the overhead console is designed to hold most garage door opener remote control transmitters. The transmitter is mounted within the compartment with an adhesive-backed hook and loop fastener patch.

With the transmitter mounted in the storage bin, adapter pegs located on the front of the storage bin door are selected and mounted on a post near the center of the storage bin door. The peg(s) selected and/or the post must be long enough to depress the button of the transmitter, when the garage door opener storage bin door is depressed. The pegs may be stacked, if necessary. Refer to the owner's manual in the vehicle glove box for more information.

A transmitter mounting kit including the adhesive-backed hook and loop fastener material and a selection of pegs is available for service. The garage door opener storage bin door assembly is also available for service replacement.

SUNGLASSES STORAGE BIN

A sunglasses storage bin is included in the overhead console. The interior of the bin is lined with a foam rubber padding material to protect the sunglasses from being scratched. This bin features a push/push-type latching mechanism, and a viscous dampening system for a fluid opening action.

The sunglasses storage bin door, latch, viscous damper, hinge spring and housing are available for service only as a complete module. If any part of this unit is faulty or damaged, the entire module must be replaced.

DIAGNOSIS AND TESTING

TRIP COMPUTER, COMPASS, AND THERMOMETER DISPLAY MODULE

If the problem with the trip computer, compass, and thermometer display module is an inaccurate or scrambled display, use the Self-Diagnostic Test procedures. If the problem is incorrect display lighting levels, use a DRB scan tool and the proper Diagnostic Procedures manual to test for the correct dimming message inputs being received from the instrument cluster over the Chrysler Collision Detection (CCD) data bus. If the problem is a no-display condition, use the following procedures. For circuit descriptions and diagrams, refer to 8W-49 - Overhead Console in Group 8W - Wiring Diagrams.

(1) Check the fuses in the junction block and the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse(s).

(2) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the overhead console from the headliner. Check for continuity between the ground circuit cavities of the overhead console wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit to ground as required.

(4) Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the overhead console wire harness connector. If OK, go to Step 5. If not OK, repair the open circuit to the junction block as required.

(5) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output circuit cavity of the overhead console wire harness connector. If OK, proceed to the Self-Diagnostic Test in this group for further diagnosis of the module and the CCD data bus. If not OK, repair the open circuit to the junction block as required.

SELF-DIAGNOSTIC TEST

A self-diagnostic test is used to determine that the trip computer, compass, thermometer, and all of the display module segments are operating properly electrically. Initiate the self-diagnostic test as follows:

(1) With the ignition switch in the Off position, simultaneously press and hold the Step button and the U.S./Metric button.

(2) Turn the ignition switch to the On position.

(3) Continue to hold both buttons until the display module performs a display segment test. In this test, all of the vacuum fluorescent display segments are lighted. This test will:

a. Verify that all display segments are functional

b. Check the internal circuitry of the module

c. Check that all of the CCD data bus messages needed are being received.

(4) Respond to the respective test results as follows. If all tests are passed, the module will automatically return to normal operation.

DIAGNOSIS AND TESTING (Continued)

d. In the display segment test, if any segment should fail to light the unit is faulty and must be replaced.

e. If the internal circuitry test is failed, the module will display “FAIL”. If “FAIL” is displayed, the unit is faulty and must be replaced.

f. If the CCD data bus message test is failed, the module will display “CCD”. If “CCD” is displayed, the use of a DRB scan tool and the proper Diagnostic Procedures manual are required for further diagnosis.

(5) Momentarily depress and release either button one time to exit the self-diagnostic test mode and return the trip computer, compass, and thermometer display module to normal operation.

NOTE: If the compass functions, but accuracy is suspect, it may be necessary to perform a variation adjustment. This procedure allows the compass unit to accommodate variations in the earth’s magnetic field strength, based on geographic location. See the Compass Variation Adjustment procedures, in this group.

NOTE: If the compass reading has blanked out, and only “CAL” appears in the display module, demagnetizing may be necessary to remove excessive residual magnetic fields from the vehicle. See the Compass Demagnetizing procedure, in this group.

THERMOMETER

The thermometer function is supported by a ambient temperature sensor, a wiring circuit, and a portion of the overhead console trip computer, compass, and thermometer display module display. The sensor is mounted outside the passenger compartment near the front and center of the vehicle.

If any portion of the ambient temperature sensor circuit fails, the thermometer display will self-diagnose the circuit. An “SC” (short circuit) will appear in the display in place of the temperature, when the sensor is exposed to temperatures above 55° C (131° F), or if the sensor circuit is shorted. An “OC” (open circuit) will appear in the display in place of the temperature, when the sensor is exposed to temperatures below -40° C (-40° F), or if the sensor circuit is open.

The ambient temperature sensor circuit can also be diagnosed using the following Sensor Test, and Sensor Circuit Test. If the temperature sensor and circuit are confirmed to be OK, but the temperature display is inoperative or incorrect, see the Trip Computer, Compass, and Thermometer Display Module diagnosis in this group. For circuit descriptions and diagrams, refer to 8W-49 - Overhead Console in Group 8W - Wiring Diagrams.

SENSOR TEST

(1) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the temperature sensor wire harness connector.

(2) Measure the resistance of the temperature sensor. At -40° C (-40° F), the sensor resistance is 336 kilohms. At 55° C (131° F), the sensor resistance is 2.986 kilohms. The sensor resistance should read between these two values. If OK, go to the Sensor Circuit Test. If not OK, replace the faulty sensor.

SENSOR CIRCUIT TEST

(1) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the ambient temperature sensor wire harness connector and the overhead console wire harness connector.

(2) Connect a jumper wire between the two terminals in the body half of the sensor wire harness connector.

(3) Check for continuity between the sensor return circuit and the ambient temperature sensor signal circuit cavities of the overhead console wire harness connector. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Remove the jumper wire from the ambient temperature sensor wire harness connector. Check for continuity between the sensor return circuit cavity of the overhead console wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the short circuit as required.

(5) Check for continuity between the ambient temperature sensor signal circuit cavity of the overhead console wire harness connector and a good ground. There should be no continuity. If OK, see the Trip Computer, Compass, and Thermometer Display Module diagnosis in this group. If not OK, repair the short circuit as required.

SERVICE PROCEDURES

COMPASS VARIATION ADJUSTMENT

Variance is the difference between magnetic north and geographic north. In some geographic locations, the difference between magnetic and geographic north is great enough to cause the compass to give false readings. If this problem occurs, the compass variance must be set.

To set the compass variance:

(1) Using the Variance Settings map, find your geographic location and note the zone number (Fig. 1).

SERVICE PROCEDURES (Continued)

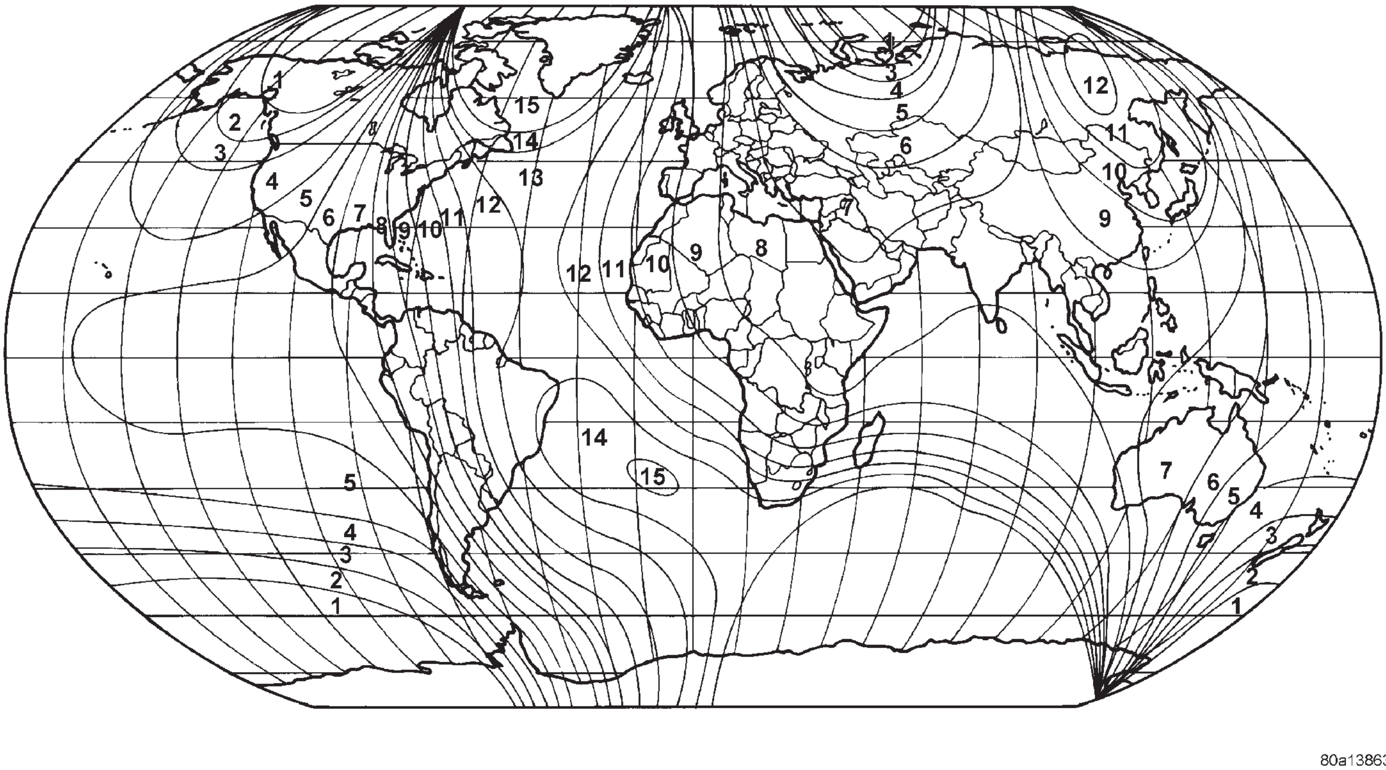


Fig. 1 Variance Settings

(2) Turn the ignition switch to the On position. If the compass/temperature data is not currently being displayed, momentarily depress and release the Step button to step through the display options until you have reached the compass/temperature display.

(3) Depress both the U.S./Metric, and the Step buttons. Hold the buttons down until “VAR” appears in the display. This takes about five seconds.

(4) Release both of the buttons. The current variance zone number setting will appear in the display.

(5) Press and release the U.S./Metric button to step through the zone numbers, until the zone number for your geographic location appears in the display.

(6) Press the Step button to enter this zone number into the compass unit memory.

(7) Confirm that the correct directions are now indicated by the compass.

COMPASS CALIBRATION

CAUTION: Do not place any external magnets, such as magnetic roof mount antennas, in the vicinity of the compass. Do not use magnetic tools when servicing the overhead console.

The electronic compass unit features a self-calibrating design, which simplifies the calibration procedure. This feature automatically updates the compass calibration while the vehicle is being driven. This allows the compass unit to compensate for small changes in the residual magnetism that the vehicle may acquire during normal use. Do not attempt to calibrate the compass near large metal objects such as other vehicles, large buildings, or bridges.

NOTE: Whenever the compass is calibrated manually, the variation number must also be reset. See Compass Variation Adjustment in the Service Procedures section of this group.

Calibrate the compass manually as follows:

(1) Start the engine. If the compass/temperature data is not currently being displayed, momentarily depress and release the Step button to step through the display options until you have reached the compass/temperature display.

(2) Depress both the U.S./Metric and the Step buttons. Hold the buttons down until “CAL” appears in the display. This takes about ten seconds, and appears about five seconds after “VAR” is displayed.

(3) Release both of the buttons.

(4) Drive the vehicle on a level surface, away from large metal objects, through three or more complete circles in not less than 48 seconds. The “CAL” message will disappear from the display to indicate that the compass is now calibrated.

SERVICE PROCEDURES (Continued)

NOTE: If the “CAL” message remains in the display, either there is excessive magnetism near the compass, or the unit is faulty. Repeat the demagnetizing and calibration procedures at least one more time.

NOTE: If the wrong direction is still indicated in the compass display, the area selected for calibration may be too close to a strong magnetic field. Repeat the calibration procedure in another location.

COMPASS DEMAGNETIZING

A degaussing tool (Special Tool 6029) is used to demagnetize, or degauss, the overhead console forward mounting screw(s) and the roof panel. Equivalent units must be rated as continuous duty for 110/115 volts and 60 Hz. They must also have a field strength of over 350 gauss at 7 millimeters (0.25 inch) beyond the tip of the probe.

To demagnetize the roof panel and the overhead console forward mounting screw(s), proceed as follows:

(1) Be certain that the ignition switch is in the Off position, before you begin the demagnetizing procedure.

(2) Plug in the degaussing tool, while keeping the tool at least 61 centimeters (2 feet) away from the compass unit.

(3) Slowly approach the head of the overhead console forward mounting screw with the degaussing tool plugged in.

(4) Contact the head of each screw with the plastic coated tip of the degaussing tool for about two seconds.

(5) With the degaussing tool still energized, slowly back it away from the screw. When the tip of the tool is at least 61 centimeters (2 feet) from the screw head, unplug the tool.

(6) Place a piece of paper approximately 22 by 28 centimeters (8.5 by 11 inches), oriented on the vehicle lengthwise from front to rear, on the center line of the roof at the windshield header (Fig. 2). The purpose of the paper is to protect the roof panel from scratches, and to define the area to be demagnetized.

(7) Plug in the degaussing tool, while keeping the tool at least 61 centimeters (2 feet) away from the compass unit.

(8) Slowly approach the center line of the roof panel at the windshield header, with the degaussing tool plugged in.

(9) Contact the roof panel with the plastic coated tip of the degaussing tool. Be sure that the template is in place to avoid scratching the roof panel. Using a slow, back-and-forth sweeping motion, and allowing 13 millimeters (0.50 inch) between passes, move the tool at least 11 centimeters (4 inches) to each side of the roof center line, and 28 centimeters (11 inches) back from the windshield header.

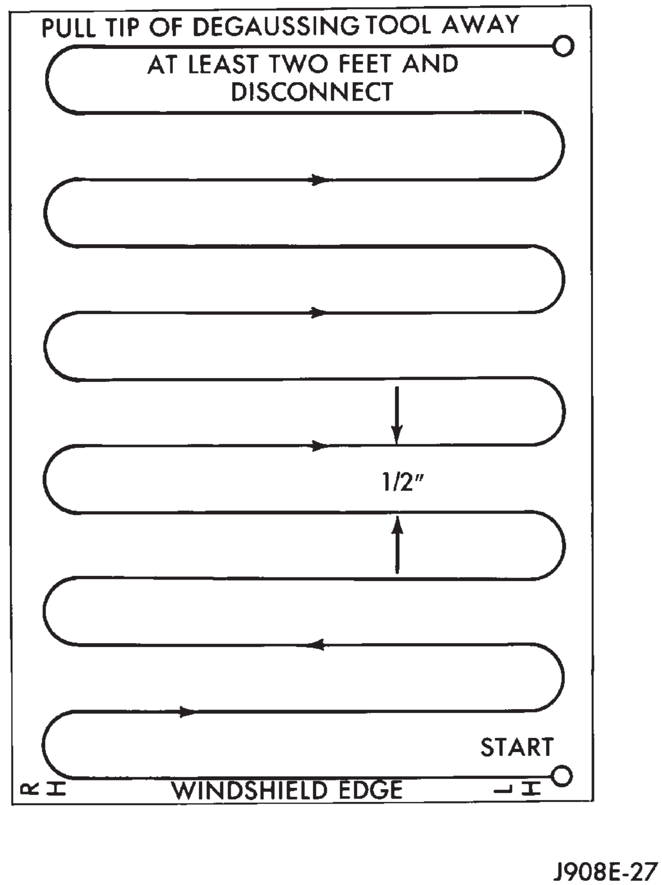


Fig. 2 Roof Demagnetizing Pattern

(10) With the degaussing tool still energized, slowly back it away from the roof panel. When the tip of the tool is at least 61 centimeters (2 feet) from the roof panel, unplug the tool.

(11) Calibrate the compass and adjust the compass variance as described in the Service Procedures section of this group.

REMOVAL AND INSTALLATION

OVERHEAD CONSOLE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the two screws located forward of the display module that secure the overhead console to the upper windshield opening reinforcement (Fig. 3).

(3) To release the overhead console from the rear mounting bracket, use your fingertips to gently pull the sides of the overhead console housing outward near the rear mounting bracket.

(4) Move the overhead console forward to disengage the rear mounting tab from the headliner.

REMOVAL AND INSTALLATION (Continued)

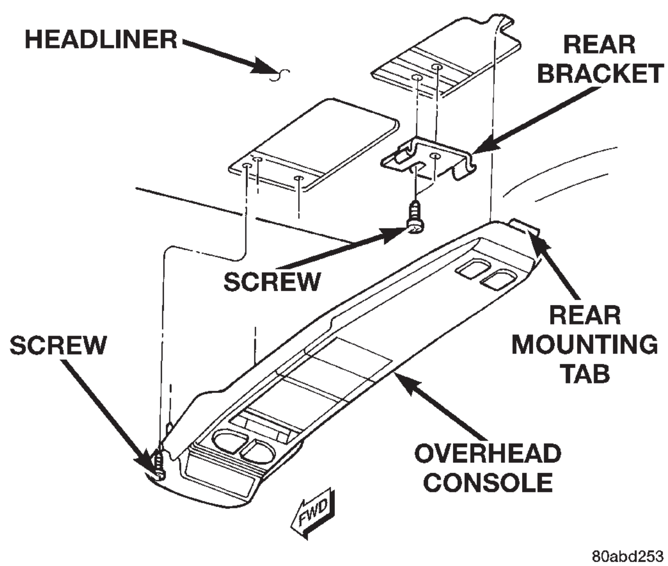


Fig. 3 Overhead Console Remove/Install

(5) Lower the overhead console far enough to access the two wire harness connectors.

(6) Unplug one wire harness connector near the push button module towards the front of the overhead console.

(7) Unplug one wire harness connector from the Remote Keyless Entry (RKE) receiver near the center of the overhead console, if the vehicle is so equipped.

(8) Remove the overhead console from the headliner.

(9) Reverse the removal procedures to install. Tighten the overhead console mounting screws to 2.7 N·m (24 in. lbs.).

TRIP COMPUTER, COMPASS, AND THERMOMETER DISPLAY MODULE

(1) Remove the overhead console from the vehicle. See Overhead Console in this group for the procedures.

(2) Remove the two screws that secure the forward end of the trip computer, compass, and thermometer display module to the overhead console housing (Fig. 4).

(3) Gently flex the sides of the overhead console housing as required to release the trip computer, compass, and thermometer display module mounting pins.

(4) Pull the trip computer, compass, and thermometer display module away from the overhead console housing far enough to access the two wire harness connectors.

(5) Unplug the overhead console and push button module wire harness connectors from the trip computer, compass, and thermometer display module.

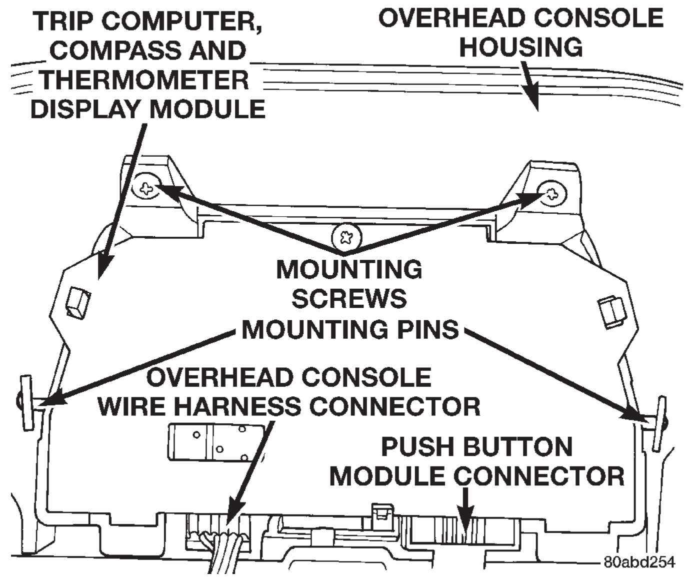


Fig. 4 Trip Computer, Compass, and Thermometer Display Module Remove/Install

(6) Remove the trip computer, compass, and thermometer display module from the overhead console housing.

(7) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

PUSH BUTTON MODULE

(1) Remove the overhead console from the vehicle. See Overhead Console in this group for the procedures.

(2) Unplug the push button module wire harness connector from the trip computer, compass, and thermometer display module.

(3) Remove the four screws that secure the push button module to the overhead console housing (Fig. 5).

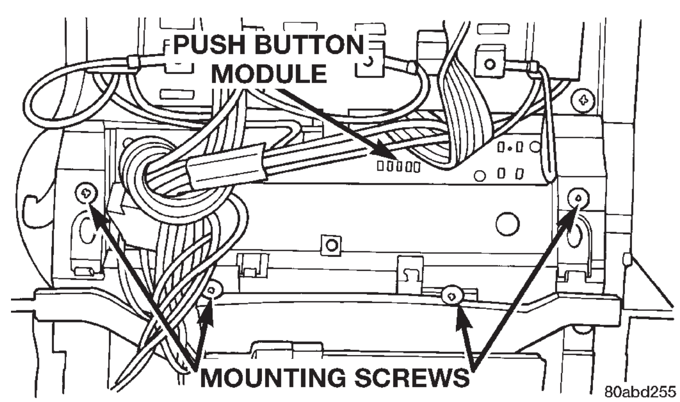


Fig. 5 Push Button Module Remove/Install

(4) Remove the push button module from the overhead console.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

READING AND COURTESY LAMP BULB

(1) Disconnect and isolate the battery negative cable.

(2) Insert a long, narrow, flat-bladed tool in the notch on the edge of the reading and courtesy lamp lens.

(3) Gently pry the lens downward from the overhead console housing and pivot the lens down. It may be necessary to move the tool along the edge of the lens to free the lens from the console housing.

(4) Unsnap the bulb from the bulb holders by pulling the bulb gently downwards.

(5) Install a new bulb by aligning its base with the bulb holders and pushing the bulb firmly into place.

(6) Pivot the lens back up into position and press upward firmly until it snaps into place.

(7) Connect the battery negative cable.

(8) Test the lamp by depressing the lens to check for proper lamp switching and lighting.

GARAGE DOOR OPENER STORAGE BIN DOOR

(1) Open the garage door opener storage bin door.

(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry between the door pivot pin and the pivot hole on one side of the overhead console housing until the pivot pin clears the pivot hole.

(3) Use a gentle twisting action to remove the garage door opener storage bin door from the overhead console housing.

(4) To install, insert the pivot pin on one side of the door into the pivot hole in the overhead console housing. Gently depress the pivot pin on the other side of the door until it clears the side of the garage door opener storage bin opening of the overhead console housing, and push the door into the opening. Guide the door into the opening so that the second pivot pin snaps into its pivot hole.

SUNGLASSES STORAGE BIN

The sunglasses storage bin door and bin, housing, damper, spring and latch are serviced only as a unit. Remove the sunglasses storage bin module from the overhead console as follows:

(1) Remove the overhead console from the vehicle. See Overhead Console in this group for the procedures.

(2) Disengage the overhead console courtesy lamp wire harness from the retainers molded into the sunglasses storage bin housing.

(3) Remove the six screws that secure the sunglasses storage bin module to the overhead console housing (Fig. 6).

(4) Remove the sunglasses storage bin module from the overhead console.

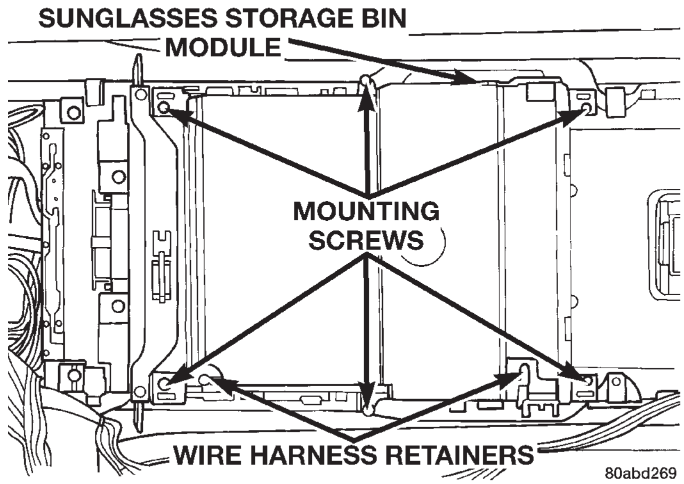


Fig. 6 Sunglasses Storage Bin Module Remove/Install

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

AMBIENT TEMPERATURE SENSOR

(1) Disconnect and isolate the battery negative cable.

(2) Locate the ambient temperature sensor, below the grille and behind the front bumper on the radiator support crossmember (Fig. 7).

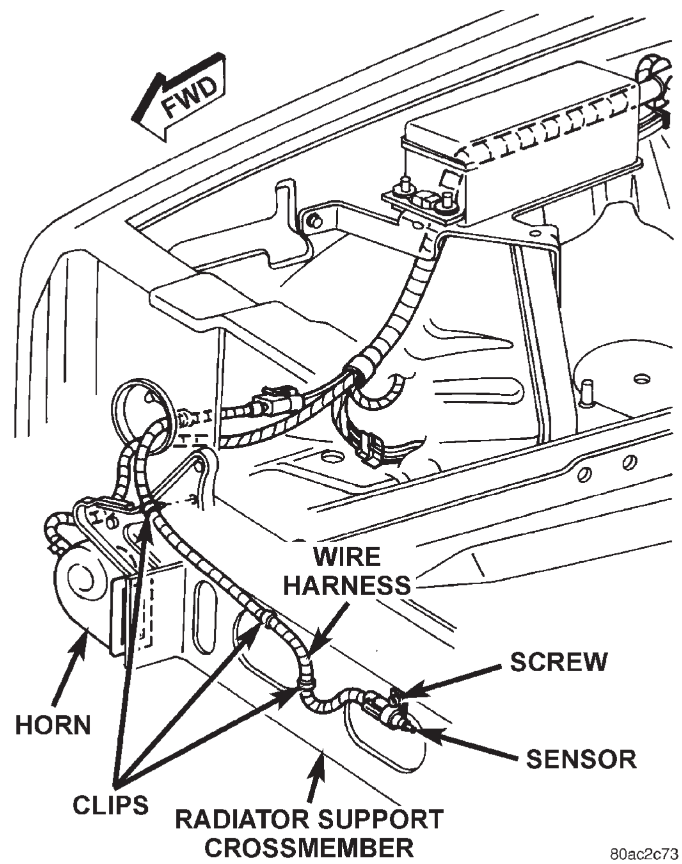


Fig. 7 Ambient Temperature Sensor Remove/Install

REMOVAL AND INSTALLATION (Continued)

(3) Unplug the ambient temperature sensor wire harness connector.

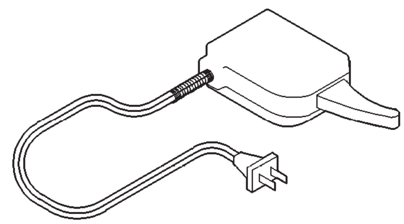
(4) Remove the screw that secures the ambient temperature sensor to the radiator support cross-member.

(5) Remove the ambient temperature sensor from the vehicle.

(6) Reverse the removal procedures to install. Tighten the ambient temperature sensor mounting screw to 3.4 N·m (30 in. lbs.).

SPECIAL TOOLS

OVERHEAD CONSOLE



Degaussing Tool 6029

WIRING DIAGRAMS

CONTENTS

8W-01 GENERAL INFORMATION

INDEX

DESCRIPTION AND OPERATION

INTRODUCTION

Chrysler wiring diagrams are designed to provide information regarding the vehicles wiring content. In order to effectively use Chrysler wiring diagrams to diagnose and repair a Chrysler vehicle, it is important to understand all of their features and characteristics.

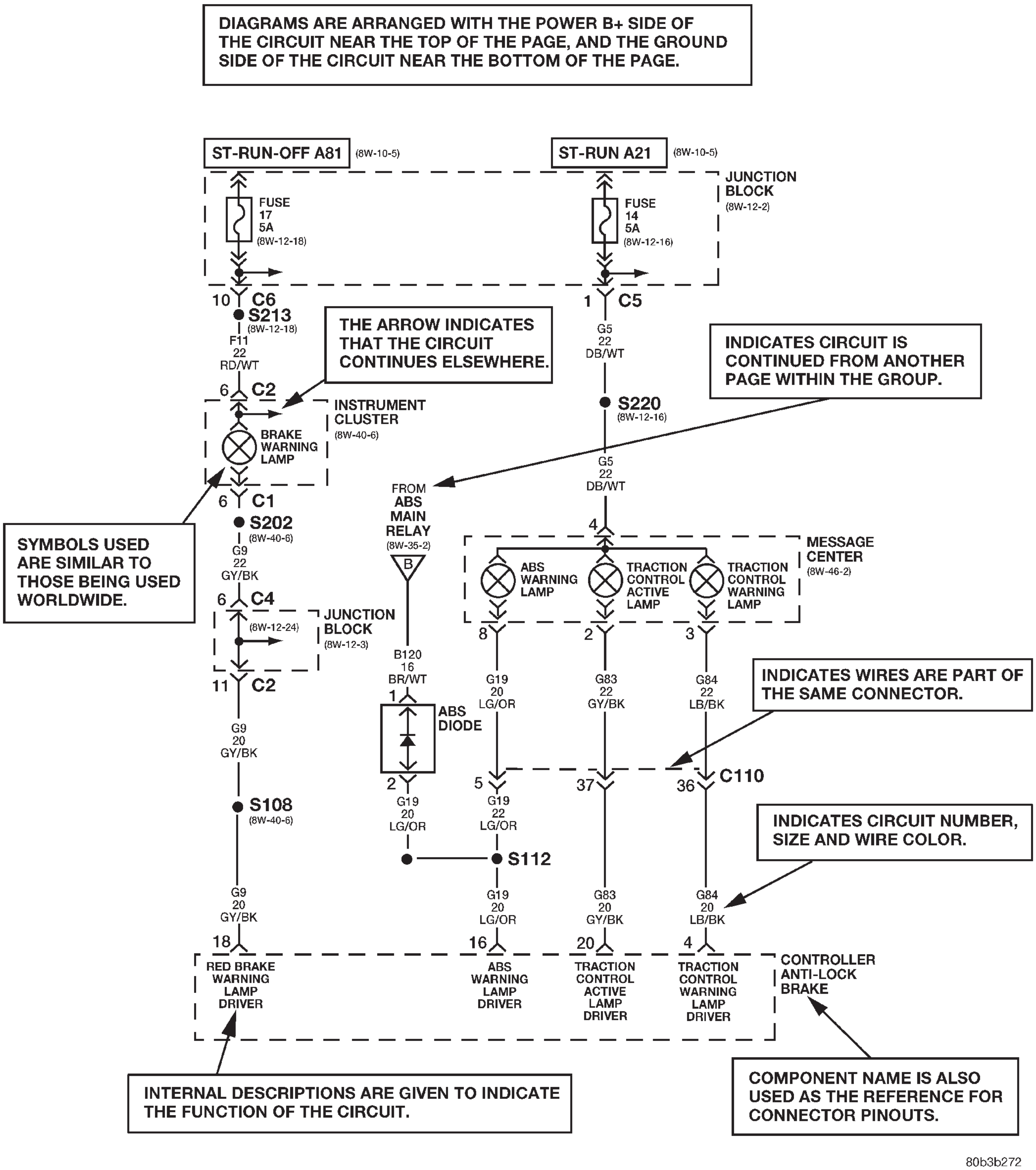
Diagrams are arranged such that the power (B+) side of the circuit is placed near the top of the page, and the ground (B-) side of the circuit is placed near the bottom of the page.

All switches, components, and modules are shown in the at rest position with the doors closed and the key removed from the ignition.

Components are shown two ways. A solid line around a component indicates that the component is complete. A dashed line around a component indicates that the component being shown is not complete. Incomplete components have a reference number to indicate the page where the component is shown complete.

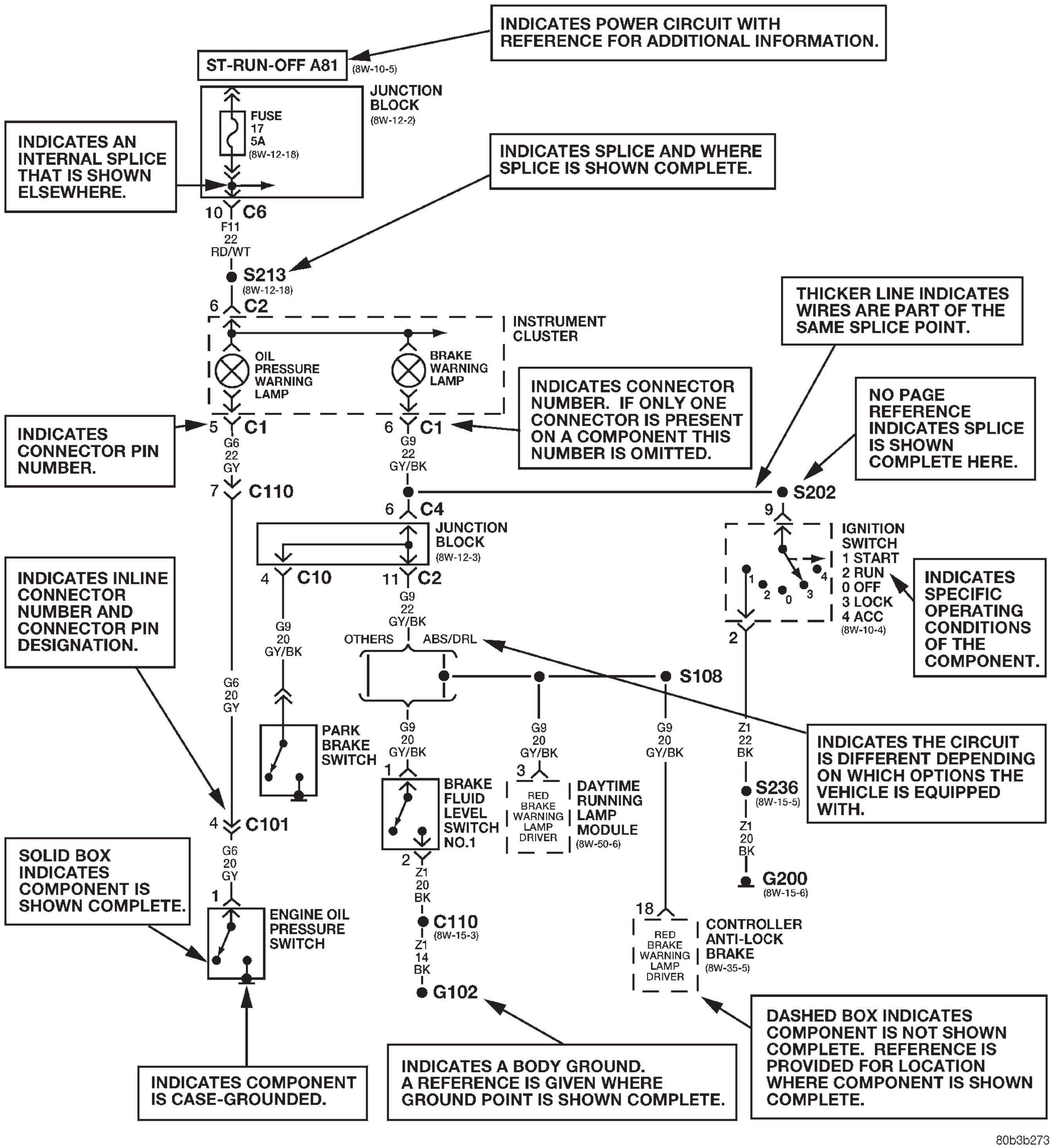
It is important to realize that no attempt is made on the diagrams to represent components and wiring as they appear on the vehicle. For example, a short piece of wire is treated the same as a long one. In addition, switches and other components are shown as simply as possible, with regard to function only.

DESCRIPTION AND OPERATION (Continued)



The System shown here is an EXAMPLE ONLY. It does not represent the actual circuit shown in the WIRING DIAGRAM SECTION.

DESCRIPTION AND OPERATION (Continued)



The System shown here is an EXAMPLE ONLY. It does not represent the actual circuit shown in the WIRING DIAGRAM SECTION.

DESCRIPTION AND OPERATION (Continued)

CIRCUIT INFORMATION

Each wire shown in the diagrams contains a code which identifies the main circuit, part of the main circuit, gage of wire, and color (Fig. 1).

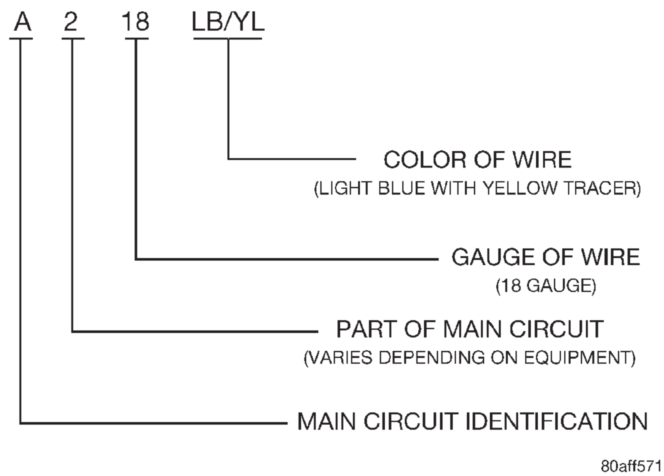


Fig. 1 Wire Code Identification

WIRE COLOR CODE CHART

COLOR CODE	COLOR	STANDARD TRACER COLOR
BL	BLUE	WT
BK	BLACK	WT
BR	BROWN	WT
DB	DARK BLUE	WT
DG	DARK GREEN	WT
GY	GRAY	BK
LB	LIGHT BLUE	BK
LG	LIGHT GREEN	BK
OR	ORANGE	BK
PK	PINK	BK or WT
RD	RED	WT
TN	TAN	WT
VT	VIOLET	WT
WT	WHITE	BK
YL	YELLOW	BK
*	WITH TRACER	

CIRCUIT FUNCTIONS

All circuits in the diagrams use an alpha/numeric code to identify the wire and its function. To identify which circuit code applies to a system, refer to the Circuit Identification Code Chart. This chart shows the main circuits only and does not show the secondary codes that may apply to some models.

CIRCUIT IDENTIFICATION CODE CHART

CIRCUIT	FUNCTION
A	BATTERY FEED
B	BRAKE CONTROLS
C	CLIMATE CONTROLS
D	DIAGNOSTIC CIRCUITS
E	DIMMING ILLUMINATION CIRCUITS
F	FUSED CIRCUITS
G	MONITORING CIRCUITS (GAUGES)
H	OPEN
I	NOT USED
J	OPEN
K	POWERTRAIN CONTROL MODULE
L	EXTERIOR LIGHTING
M	INTERIOR LIGHTING
N	NOT USED
O	NOT USED
P	POWER OPTION (BATTERY FEED)
Q	POWER OPTIONS (IGNITION FEED)
R	PASSIVE RESTRAINT
S	SUSPENSION/STEERING
T	TRANSMISSION/TRANSAXLE/ TRANSFER CASE
U	OPEN
V	SPEED CONTROL, WIPER/WASHER
W	OPEN
X	AUDIO SYSTEMS
Y	OPEN
Z	GROUNDS

DESCRIPTION AND OPERATION (Continued)

SECTION IDENTIFICATION

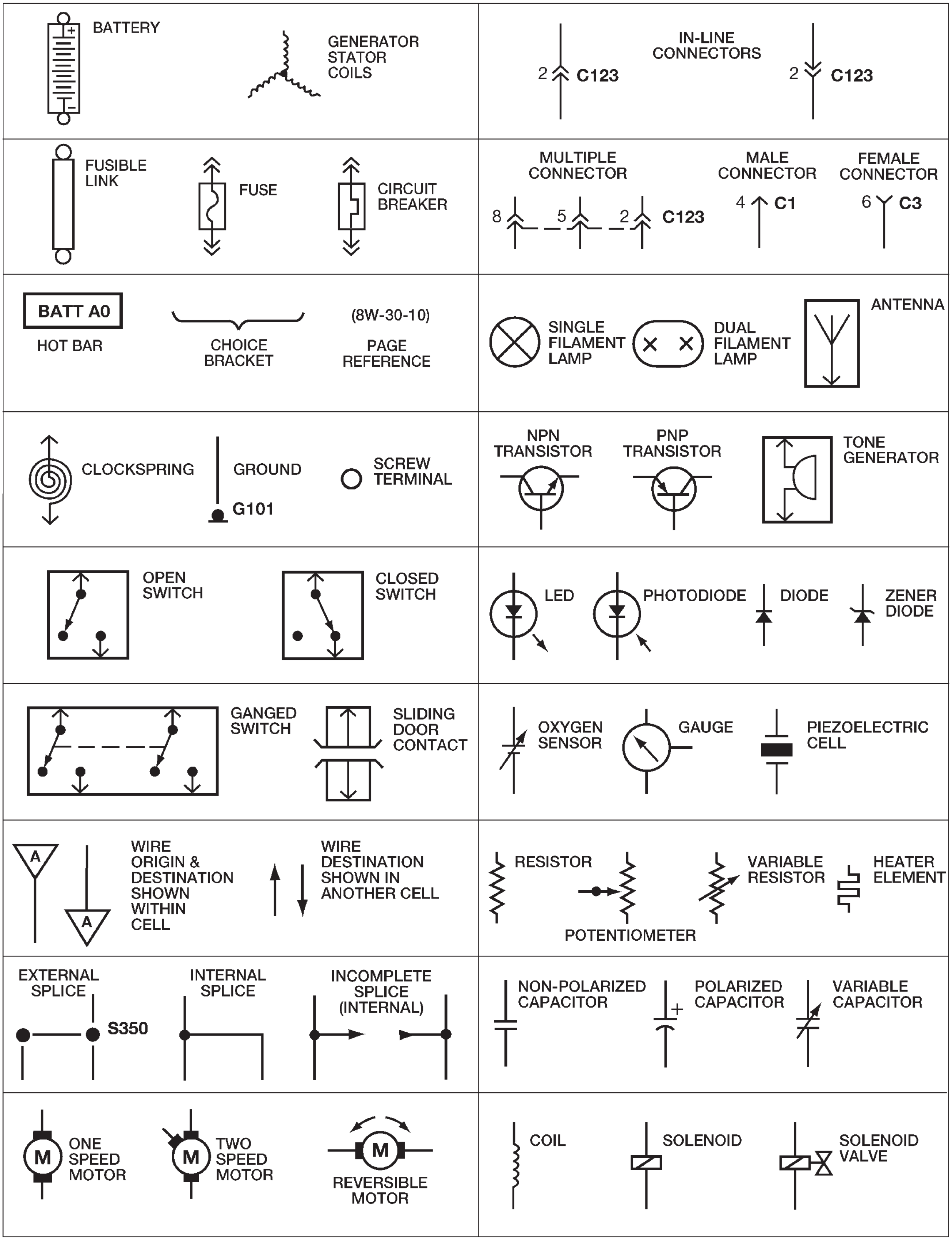
The wiring diagrams are grouped into individual sections. If a component is most likely found in a particular group, it will be shown complete (all wires, connectors, and pins) within that group. For example, the Auto Shutdown Relay is most likely to be found in Group 30, so it is shown there complete. It can, however, be shown partially in another group if it contains some associated wiring.

GROUP	TOPIC
8W-01 thru 8W-09	General Information and Diagram Overview
8W-10 thru 8W-19	Main Sources of Power and Vehicle Grounding
8W-20 thru 8W-29	Starting and Charging
8W-30 thru 8W-39	Powertrain/Drivetrain Systems
8W-40 thru 8W-49	Body Electrical items and A/C
8W-50 thru 8W-59	Exterior Lighting, Wipers, and Trailer Tow
8W-60 thru 8W-69	Power Accessories
8W-70	Splice Information
8W-80	Connector Pin Outs
8W-90	Connector Locations (including grounds)
8W-95	Splice Locations

SYMBOLS

International symbols are used throughout the wiring diagrams. These symbols are consistent with those being used around the world

DESCRIPTION AND OPERATION (Continued)



Wiring Diagram Symbols

DESCRIPTION AND OPERATION (Continued)

TERMINOLOGY

This a list of terms with there definitions used in the wiring diagrams.

Built-Up-Export	Vehicles Built For Sale In Markets Other Than North America
Except-Built-Up-Export	Vehicles Built For Sale In North America
LHD	Left Hand Drive Vehicles
RHD	Right Hand Drive Vehicles
ATX	Automatic Transmission-Front Wheel Drive
MTX	Manual Transmission-Front Wheel Drive
AT	Automatic Transmission-Rear Wheel Drive
MT	Manual Transmission-Rear Wheel Drive
SOHC	Single Over Head Cam Engine
DOHC	Dual Over Head Cam Engine

CONNECTOR INFORMATION

CAUTION: Not all connectors are serviced. Some connectors are serviced only with a harness. A typical example might be the Supplemental Restraint System connectors. Always check parts availability before attempting a repair.

IDENTIFICATION

In-line connectors are identified by a number, as follows:

- In-line connectors located on the **engine compartment harness** are **C100** series numbers.
- Connectors located on the **instrument panel harness** are **C200** series numbers.
- Connectors located on the **body harness** are **C300** series numbers.
- **Jumper harness connectors** are **C400** series numbers.
- **Grounds and ground connectors** are identified with a **"G"** and follow the same series numbering as the in-line connector.

Component connectors are identified by the component name instead of a number (Fig. 2). Multiple connectors on a component use a C1, C2, etc. identifier (Fig. 3).

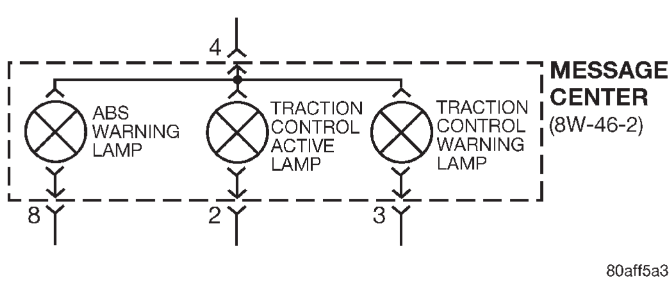


Fig. 2 Component Identification

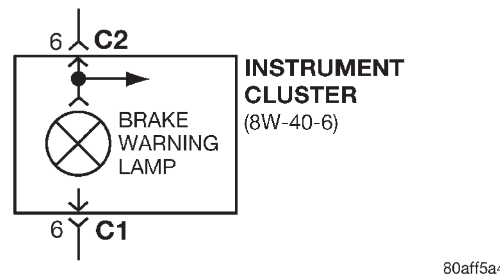


Fig. 3 Connector Identification

LOCATIONS

Section 8W-90 contains connector/ground location illustrations. The illustrations contain the connector name (or number)/ground number and component identification. Connector/ground location charts in Section 8W-90 reference the illustration number for components and connectors.

Section 8W-80 shows each connector and the circuits involved with that connector. The connectors are identified using the name/number on the Diagram pages.

SPLICE LOCATIONS

Splice Location charts in Section 8W-70 show the entire splice, and provide references to other sections the splice serves.

Section 8W-95 contains illustrations that show the general location of the splices in each harness. The illustrations show the splice by number, and provide a written location.

NOTES, CAUTIONS, and WARNINGS

Throughout this group additional important information is presented in three ways; Notes, Cautions, and Warnings.

NOTES are used to help describe how switches or components operate to complete a particular circuit. They are also used to indicate different conditions that may appear on the vehicle. For example, an up-to and after condition.

CAUTIONS are used to indicate information that could prevent making an error that may damage the vehicle.

WARNINGS provide information to prevent personal injury and vehicle damage. Below is a list of general warnings that should be followed any time a vehicle is being serviced.

WARNING: ALWAYS WEAR SAFETY GLASSES FOR EYE PROTECTION.

WARNING: USE SAFETY STANDS ANYTIME A PROCEDURE REQUIRES BEING UNDER A VEHICLE.

DESCRIPTION AND OPERATION (Continued)

WARNING: BE SURE THAT THE IGNITION SWITCH ALWAYS IS IN THE OFF POSITION, UNLESS THE PROCEDURE REQUIRES IT TO BE ON.

WARNING: SET THE PARKING BRAKE WHEN WORKING ON ANY VEHICLE. AN AUTOMATIC TRANSMISSION SHOULD BE IN PARK. A MANUAL TRANSMISSION SHOULD BE IN NEUTRAL.

WARNING: OPERATE THE ENGINE ONLY IN A WELL-VENTILATED AREA.

WARNING: KEEP AWAY FROM MOVING PARTS WHEN THE ENGINE IS RUNNING, ESPECIALLY THE FAN AND BELTS.

WARNING: TO PREVENT SERIOUS BURNS, AVOID CONTACT WITH HOT PARTS SUCH AS THE RADIATOR, EXHAUST MANIFOLD(S), TAIL PIPE, CATALYTIC CONVERTER, AND MUFFLER.

WARNING: DO NOT ALLOW FLAME OR SPARKS NEAR THE BATTERY. GASES ARE ALWAYS PRESENT IN AND AROUND THE BATTERY.

WARNING: ALWAYS REMOVE RINGS, WATCHES, LOOSE HANGING JEWELRY, AND LOOSE CLOTHING.

TAKE OUTS

The abbreviation T/O is used in the component location section to indicate a point in which the wiring harness branches out to a component.

ELECTROSTATIC DISCHARGE (ESD) SENSITIVE DEVICES

All ESD sensitive components are solid state and a symbol (Fig. 4) is used to indicate this. When handling any component with this symbol comply with the following procedures to reduce the possibility of electrostatic charge build up on the body and inadvertent discharge into the component. If it is not known whether the part is ESD sensitive, assume that it is.

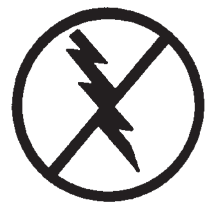
(1) Always touch a known good ground before handling the part. This should be repeated while handling the part and more frequently after sliding across a seat, sitting down from a standing position, or walking a distance.

(2) Avoid touching electrical terminals of the part, unless instructed to do so by a written procedure.

(3) When using a voltmeter, be sure to connect the ground lead first.

(4) Do not remove the part from its protective packing until it is time to install the part.

(5) Before removing the part from its package, ground the package to a known good ground on the vehicle.



948W-193

Fig. 4 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 rating.

• Ohmmeter - Used to check the resistance between two points of a circuit. Low or no resistance in a circuit means good continuity.

CAUTION: - Most of the electrical components used in today's vehicle are Solid State. When checking resistance in these circuits use a meter with a 10-megohm or greater impedance rating. In addition, make sure the power is disconnected from the circuit. Circuits that are powered up by the vehicle electrical system can cause damage to the equipment and provide false readings.

DIAGNOSIS AND TESTING (Continued)

• Probing Tools - These tools are used for probing terminals in connectors (Fig. 5). Select the proper size tool from Special Tool Package 6807, and insert it into the terminal being tested. Use the other end of the tool to insert the meter probe.

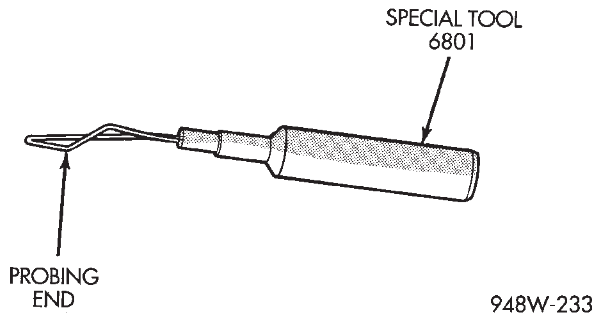


Fig. 5 Probing Tool

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
- Some or all of the wiring strands broken inside of the insulation covering.
- Wiring broken inside of the insulation

TROUBLESHOOTING TESTS

Before beginning any tests on a vehicles electrical system use the Wiring Diagrams and study the circuit. Also refer to the Troubleshooting Wiring Problems in this section.

TESTING FOR VOLTAGE POTENTIAL

(1) Connect the ground lead of a voltmeter to a known good ground (Fig. 6).

(2) Connect the other lead of the voltmeter to the selected test point. The vehicle ignition may need to be turned ON to check voltage. Refer to the appropriate test procedure.

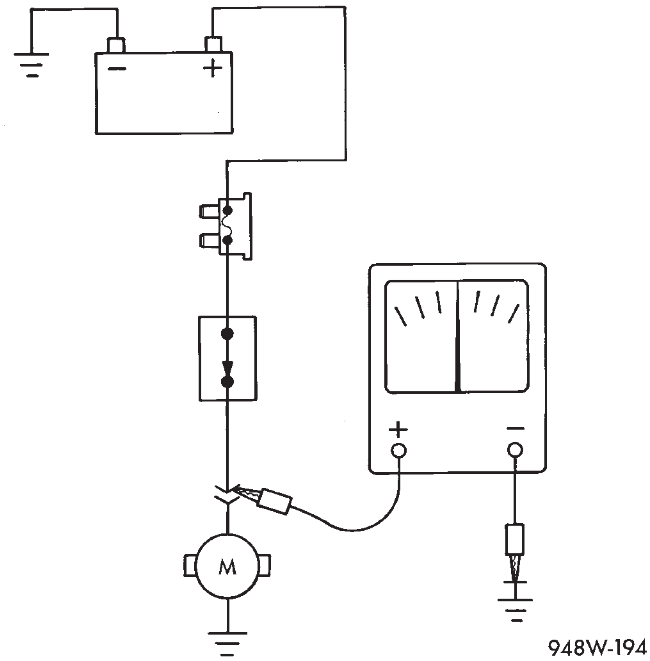


Fig. 6 Testing for Voltage Potential

TESTING FOR CONTINUITY

(1) Remove the fuse for the circuit being checked or, disconnect the battery.

(2) Connect one lead of the ohmmeter to one side of the circuit being tested (Fig. 7).

(3) Connect the other lead to the other end of the circuit being tested. Low or no resistance means good continuity.

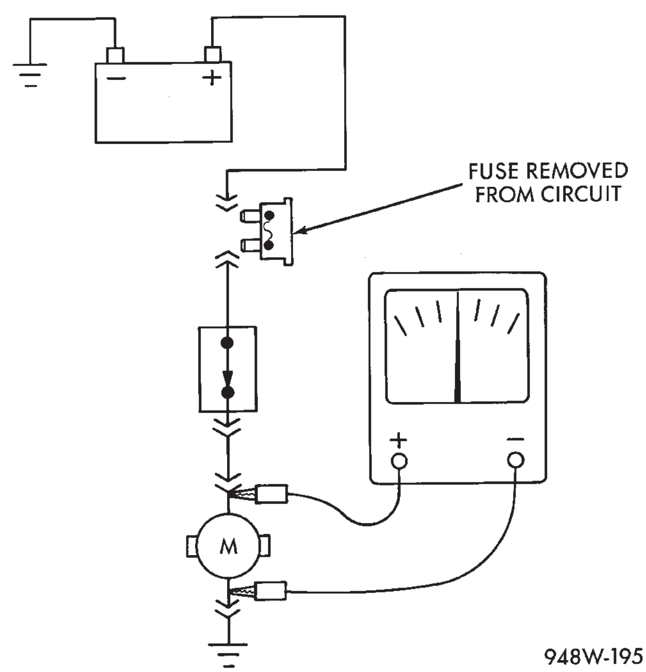


Fig. 7 Testing for Continuity

DIAGNOSIS AND TESTING (Continued)

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 suspected fused circuits.
(2) Replace the blown fuse.
(3) Supply power to the fuse by turning ON the ignition switch or re-connecting the battery.
(4) Start connecting the items in the fuse circuit one at a time. When the fuse blows the circuit with the short to ground has been isolated.

TESTING FOR A VOLTAGE DROP

(1) Connect the positive lead of the voltmeter to the side of the circuit closest to the battery (Fig. 8).
(2) Connect the other lead of the voltmeter to the other side of the switch or component.
(3) Operate the item.
(4) The voltmeter will show the difference in voltage between the two points.

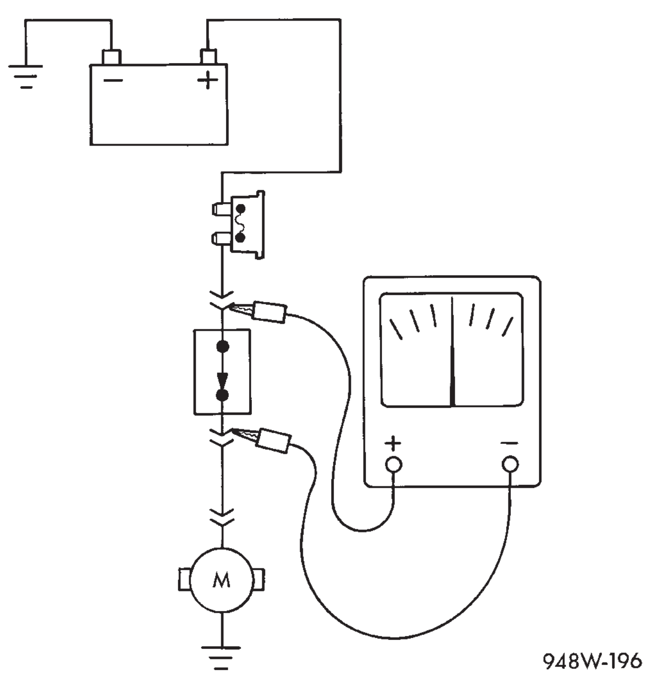


Fig. 8 Testing for Voltage Drop

TROUBLESHOOTING WIRING PROBLEMS

When troubleshooting wiring problems there are six steps which can aid in the procedure. The steps are listed and explained below. Always check for non-factory items added to the vehicle before doing any diagnosis. If the vehicle is equipped with these items, disconnect them to verify these add-on items are not the cause of the problem.
(1) Verify the problem.
(2) Verify any related symptoms. Do this by performing operational checks on components that are in the same circuit. Refer to the wiring diagrams.
(3) Analyze the symptoms. Use the wiring diagrams to determine what the circuit is doing, where the problem most likely is occurring and where the diagnosis will continue.
(4) Isolate the problem area.
(5) Repair the problem.
(6) Verify proper operation. For this step check for proper operation of all items on the repaired circuit. Refer to the wiring diagrams.

SERVICE PROCEDURES

WIRING REPAIR

When replacing or repairing a wire, it is important that the correct gage be used as shown in the wiring diagrams. The wires must also be held securely in place to prevent damage to the insulation.
(1) Disconnect battery negative cable
(2) Remove 1 inch of insulation from each end of the wire.
(3) Place a piece of heat shrink tubing over one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.
(4) Spread the strands of the wire apart on each part of the exposed wire (example 1). (Fig. 9)
(5) Push the two ends of wire together until the strands of wire are close to the insulation (example 2) (Fig. 9)
(6) Twist the wires together (example 3) (Fig. 9)
(7) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**
(8) Center the heat shrink tubing over the joint, and heat using a heat gun. Heat the joint until the tubing is tightly sealed and sealant comes out of both ends of the tubing.
(9) Secure the wire to the existing ones to prevent chafing or damage to the insulation
(10) Connect battery and test all affected systems.

TERMINAL/CONNECTOR REPAIR-MOLEX CONNECTORS

(1) Disconnect battery.

SERVICE PROCEDURES (Continued)

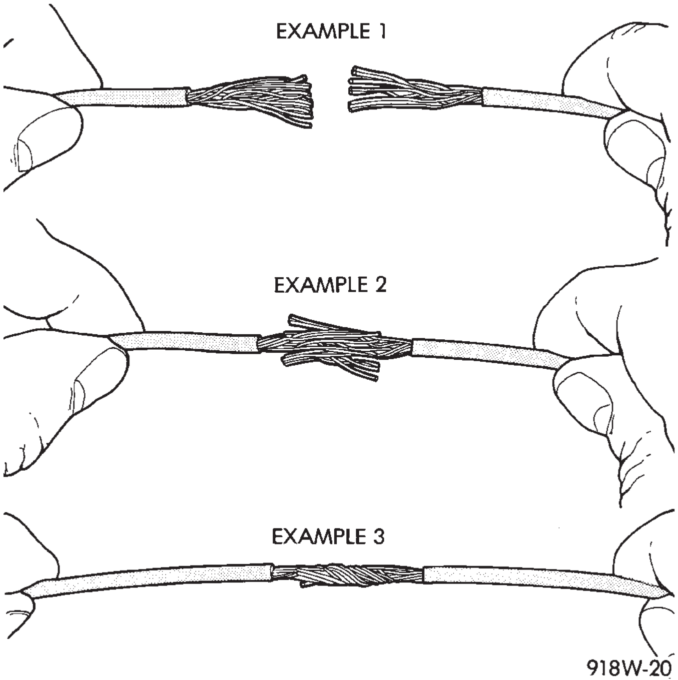


Fig. 9 Wire Repair

(2) Disconnect the connector from its mating half/component.

(3) Insert the terminal releasing special tool 6742 into the terminal end of the connector (Fig. 10).

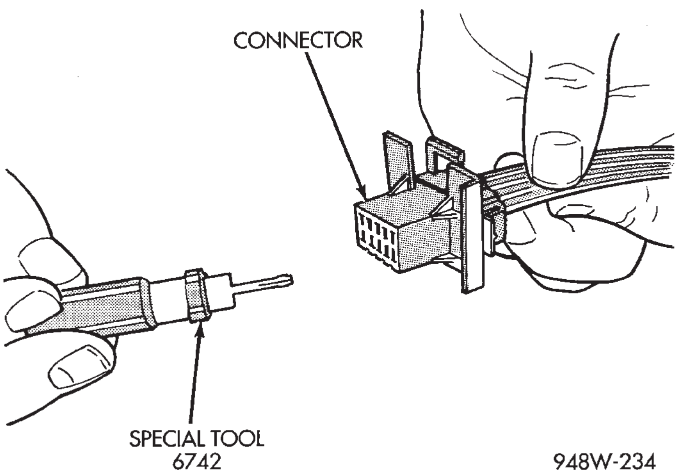


Fig. 10 Molex Connector Repair

(4) Using special tool 6742 release the locking fingers on the terminal (Fig. 11).

(5) Pull on the wire to remove it from the connector.

(6) Repair or replace the connector or terminal, as necessary.

TERMINAL/CONNECTOR REPAIR—THOMAS AND BETTS CONNECTORS

(1) Disconnect battery.

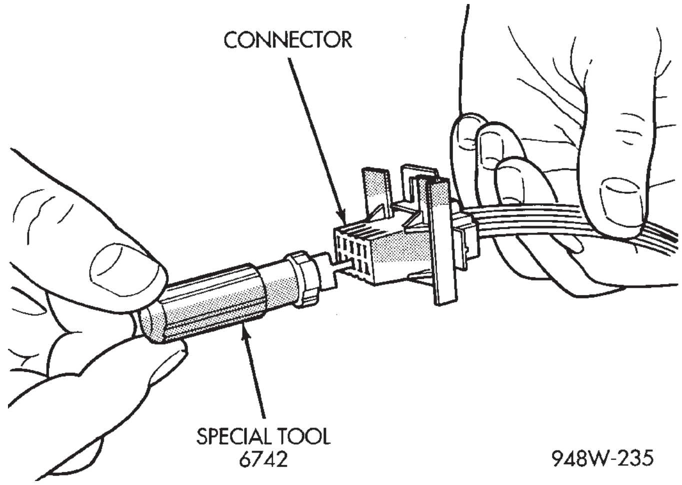


Fig. 11 Using Special Tool 6742

(2) Disconnect the connector from its mating half/component.

(3) Push in the two lock tabs on the side of the connector (Fig. 12).

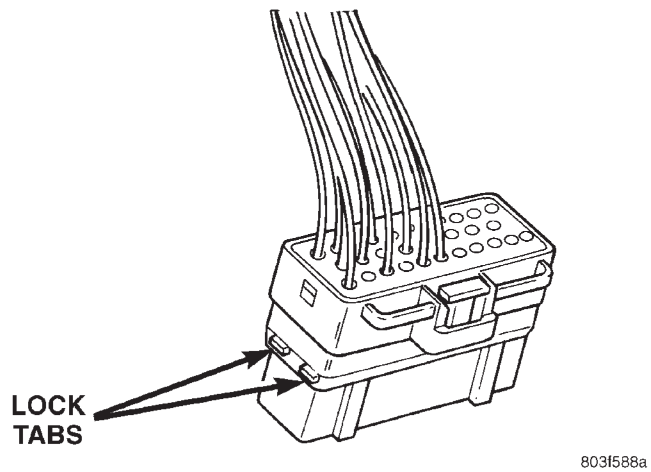


Fig. 12 Thomas and Betts Connector Lock Release Tabs

(4) Insert the probe end of special tool 6934 into the back of the connector cavity (Fig. 13).

(5) Grasp the wire and tool 6934 and slowly remove the wire and terminal from the connector.

(6) Repair or replace the terminal.

(7) Install the wire and terminal in the connector. Fully seat the terminal in the connector.

(8) Push in the single lock tab on the side of the connector (Fig. 14).

CONNECTOR REPLACEMENT

(1) Disconnect battery.

(2) Disconnect the connector that is to be repaired from its mating half/component

(3) Remove the connector locking wedge, if required (Fig. 15)

SERVICE PROCEDURES (Continued)

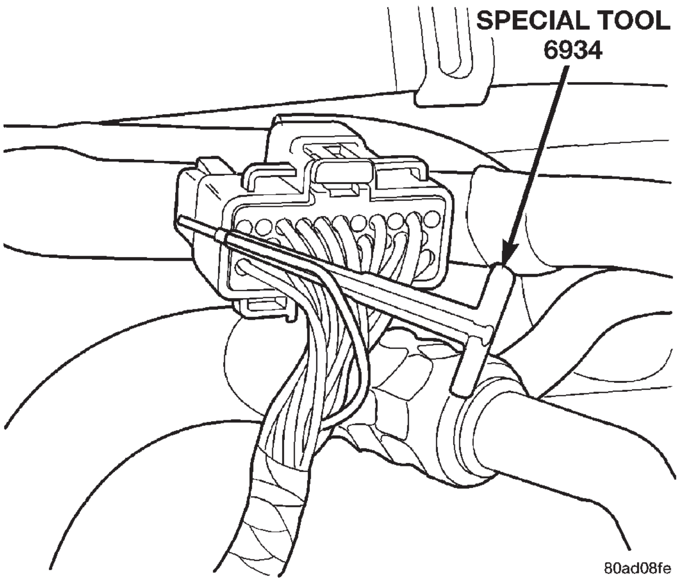


Fig. 13 Removing Wire Terminal

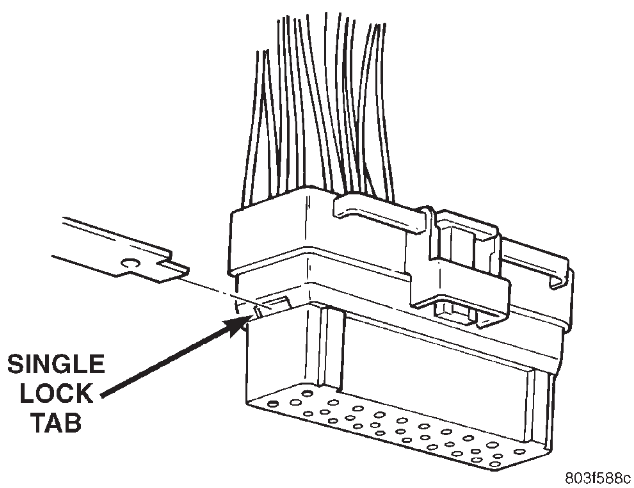


Fig. 14 Single Lock Tab

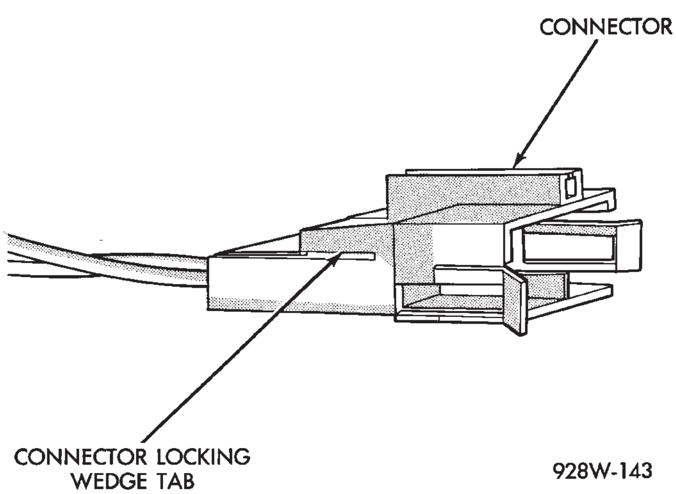


Fig. 15 Connector Locking Wedge

(4) Position the connector locking finger away from the terminal using the proper pick from special tool kit 6680. Pull on the wire to remove the terminal from the connector (Fig. 16) (Fig. 17).

(5) Reset the terminal locking tang, if it has one.

(6) Insert the removed wire in the same cavity on the repair connector.

(7) Repeat steps four through six for each wire in the connector, being sure that all wires are inserted into the proper cavities. For additional connector pin-out identification, refer to the wiring diagrams.

(8) Insert the connector locking wedge into the repaired connector, if required.

(9) Connect connector to its mating half/component.

(10) Connect battery and test all affected systems.

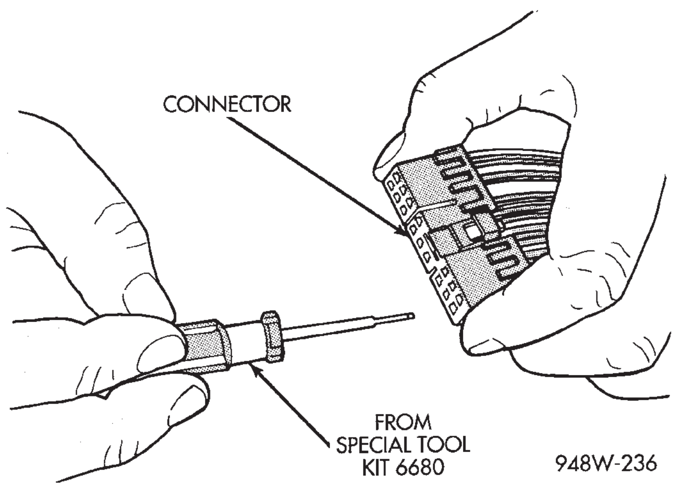


Fig. 16 Terminal Removal

CONNECTOR AND TERMINAL REPLACEMENT

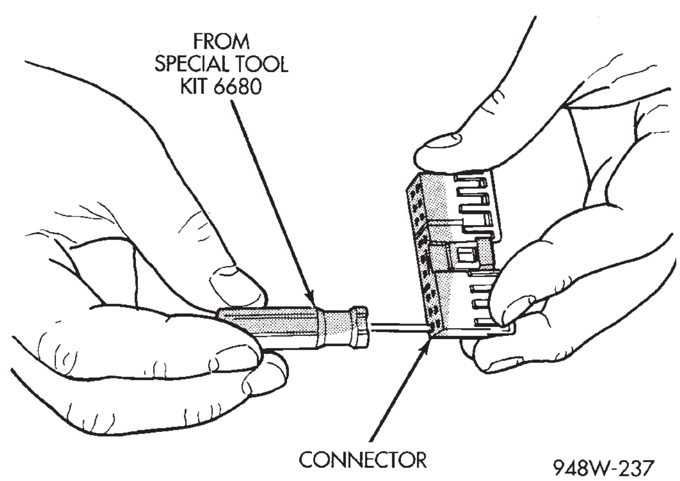


Fig. 17 Terminal Removal Using Special Tool

(1) Disconnect battery.

(2) Disconnect the connector (that is to be repaired) from its mating half/component.

SERVICE PROCEDURES (Continued)

(3) Cut off the existing wire connector directly behind the insulator. Remove six inches of tape from the harness.

(4) Stagger cut all wires on the harness side at 1/2 inch intervals (Fig. 18).

(5) Remove 1 inch of insulation from each wire on the harness side.

(6) Stagger cut the matching wires on the repair connector assembly in the opposite order as was done on the harness side of the repair. Allow extra length for soldered connections. Check that the overall length is the same as the original (Fig. 18).

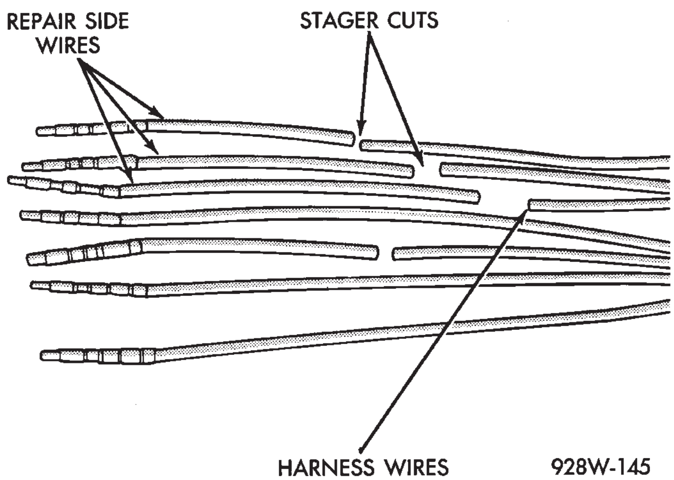


Fig. 18 Stagger Cutting Wires

(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.

(12) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(13) Center the heat shrink tubing over the joint and heat using a heat gun. Heat the joint until the tubing is tightly sealed and sealant comes out of both ends of the tubing

(14) Repeat steps 8 through 13 for each wire.

(15) Re-tape the wire harness starting 1-1/2 inches behind the connector and 2 inches past the repair.

(16) Re-connect the repaired connector.

(17) Connect the battery, and test all affected systems.

TERMINAL REPLACEMENT

(1) Disconnect battery.

(2) Disconnect the connector being repaired from its mating half. Remove connector locking wedge, if required (Fig. 19).

(3) Remove connector locking wedge, if required (Fig. 19).

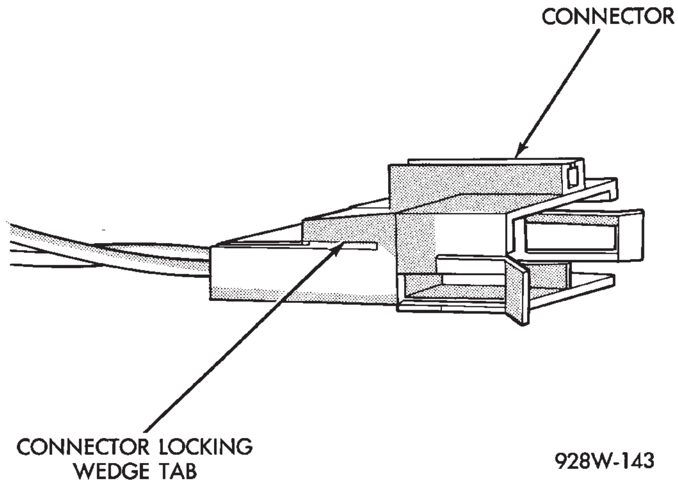


Fig. 19 Connector Locking Wedge Tab (Typical)

(4) Position the connector locking finger away from the terminal using the proper pick from special tool kit 6680. Pull on the wire to remove the terminal from the connector (Fig. 20) (Fig. 21).

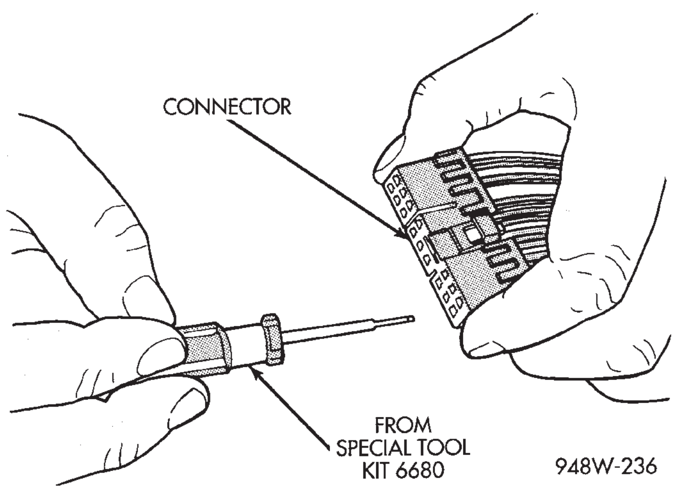


Fig. 20 Terminal Removal

(5) Cut the wire 6 inches from the back of the connector.

(6) Remove 1 inch of insulation from the wire on the harness side.

(7) Select a wire from the terminal repair assembly that best matches the color wire being repaired.

(8) Cut the repair wire to the proper length and remove 1 inch of insulation.

(9) Place a piece of heat shrink tubing over one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.

(10) Spread the strands of the wire apart on each part of the exposed wires.

(11) Push the two ends of wire together until the strands of wire are close to the insulation.

SERVICE PROCEDURES (Continued)

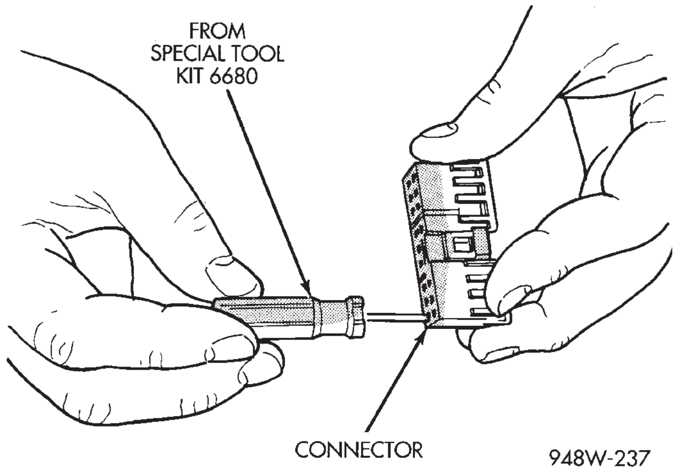


Fig. 21 Terminal Removal Using Special Tool

(12) Twist the wires together.

(13) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(14) Center the heat shrink tubing over the joint and heat using a heat gun. Heat the joint until the tubing is tightly sealed and sealant comes out of both ends of the tubing.

(15) Insert the repaired wire into the connector.

(16) Install the connector locking wedge, if required, and reconnect the connector to its mating half/component.

(17) Re-tape the wire harness starting 1-1/2 inches behind the connector and 2 inches past the repair.

(18) Connect battery, and test all affected systems.

DIODE REPLACEMENT

(1) Disconnect the battery.

(2) Locate the diode in the harness, and remove the protective covering.

(3) Remove the diode from the harness, pay attention to the current flow direction (Fig. 22).

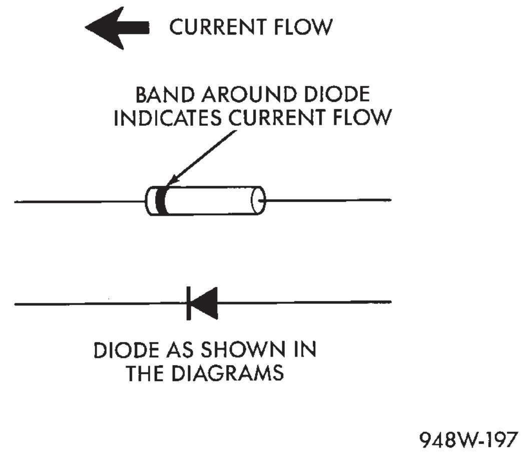


Fig. 22 Diode Identification

(4) Remove the insulation from the wires in the harness. Only remove enough insulation to solder in the new diode.

(5) Install the new diode in the harness, making sure current flow is correct. If necessary refer to the appropriate wiring diagram for current flow.

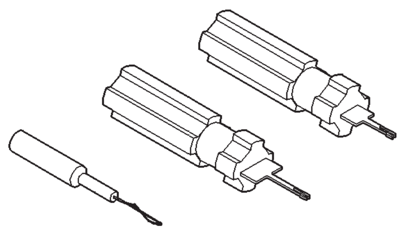
(6) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(7) Tape the diode to the harness using electrical tape making, sure the diode is completely sealed from the elements.

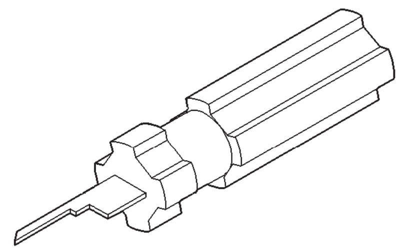
(8) Re-connect the battery, and test affected systems.

SPECIAL TOOLS

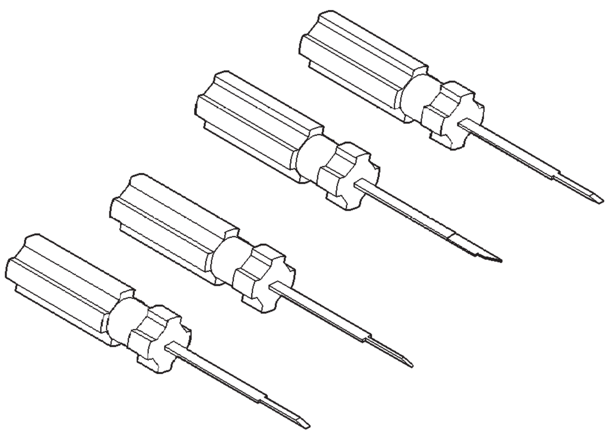
WIRING/TERMINAL



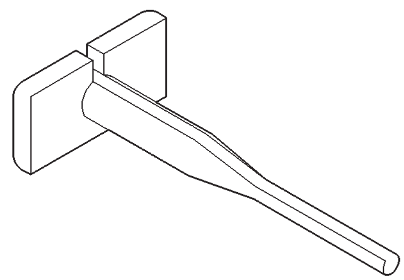
Probing Tool Package 6807



Terminal Removing Tool 6932



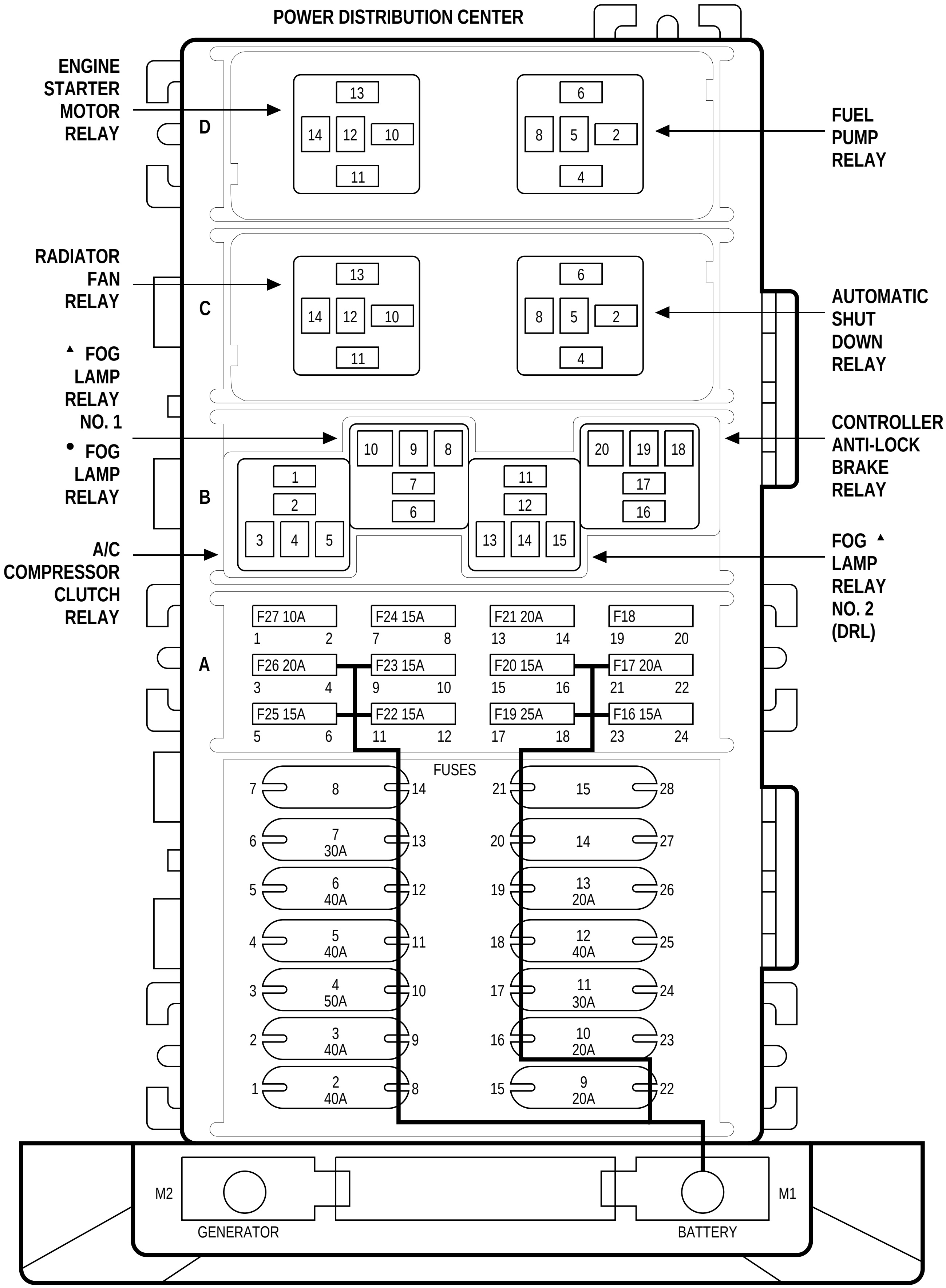
Terminal Pick 6680



Terminal Removing Tool 6934

8W-02 COMPONENT INDEX

8W-10 POWER DISTRIBUTION



J998W-7

▲ EXCEPT BUILT-UP-EXPORT

● BUILT-UP-EXPORT

XJI01002

FUSES

FUSE NO.	AMPS	FUSED CIRCUIT	FEED CIRCUIT
1	-	-	-
2	40A	A1 12RD	A0 6RD
3	40A	A2 12PK/BK	A0 6RD
4	50A	A7 10RD/BK	A0 6RD
5	40A	F141 12LG/RD	A0 6RD
6	40A	A111 12RD/LG	A0 6RD
7	30A	A3 14RD/WT A3 14RD/WT ▲	A0 6RD
8	-	-	-
9	20A	A17 16RD/BK A17 16RD/BK	A0 6RD
10	20A	A41 16YL	A0 6RD
11	30A	A4 12BK/PK	A0 6RD
12 ●	40A	A10 12RD/DG	A0 6RD
13 ●	20A	A20 12RD/DB	A0 6RD
14	-	-	-
15	-	-	-
16	15A	M1 20PK	A0 6RD
17	20A	F34 18TN/BK	A0 6RD
18	-	-	-
19	25A	A16 16RD/LG	A0 6RD
20	15A	L9 20BK/PK	A0 6RD
21	20A	A142 18DG/OR	A999 16RD
22	15A	A61 14DG/BK	A0 6RD
23	15A	F32 20PK/DB	A0 6RD
24	15A	F142 20DG/WT	A999 16RD
25	15A	F61 20WT/OR	A0 6RD
26	20A	F75 16VT	A0 6RD
27	10A	F1 20DB/GY	A17 16RD/BK

● ABS
▲ DRL

A/C COMPRESSOR CLUTCH RELAY

CAVITY	CIRCUIT	FUNCTION
B1	A17 16RD/BK	FUSED B(+)
B2	C3 16DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
B3	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
B4	-	-
B5	F20 18WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)

AUTOMATIC SHUT DOWN RELAY

CAVITY	CIRCUIT	FUNCTION
C2	A16 16RD/LG	FUSED B(+)
C4	F12 18DB/WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
C5	-	-
C6	K51 18DB/YL	AUTOMATIC SHUT DOWN RELAY CONTROL
C8	A999 16RD A999 16RD	AUTOMATIC SHUT DOWN RELAY OUTPUT

CONTROLLER ANTI-LOCK BRAKE RELAY

CAVITY	CIRCUIT	FUNCTION
B16	G19 20LG/OR	ABS WARNING INDICATOR DRIVER
B17	-	-
B18	G83 18GY/BK	ABS RELAY CONTROL
B19	Z1 20BK	GROUND
B20	F15 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)

ENGINE STARTER MOTOR RELAY

CAVITY	CIRCUIT	FUNCTION
D10	A41 16YL	FUSED B(+)
D11	T41 20BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE
	T41 20BK/WT ●	PARK/NEUTRAL POSITION SWITCH SENSE
D11	Z1 20BK ■	GROUND
D12	-	-
D13	F45 20YL/RD ●	FUSED B(+) ENGINE STARTER MOTOR RELAY
D13	T141 20YL ▲	IGNITION SWITCH OUTPUT (START)
D14	T40 16BR	STARTER RELAY OUTPUT

▲ 2.5L, 4.0L M/T, RHD 4.0L A/T
● LHD 4.0L A/T
■ 4.0L M/T

FOG LAMP RELAY NO. 1

CAVITY	CIRCUIT	FUNCTION
B6	F61 20WT/OR	FUSED B(+)
B7	L92 20PK ▲▲	FOG LAMP RELAY OUTPUT
B7	L139 20VT	FOG LAMP RELAY OUTPUT
B8	Z1 20BK ▲▲	GROUND
	Z1 20BK ▲▲	GROUND
B8	L35 20BR/WT	FOG LAMP RELAY CONTROL
B9	-	-
B10	L77 20BR/YL	FUSED LEFT INBOARD TAIL LAMP
	L77 20BR/YL	FUSED LEFT INBOARD TAIL LAMP

FOG LAMP RELAY NO. 2 (DRL)

CAVITY	CIRCUIT	FUNCTION
B11	L92 20PK	FOG LAMP RELAY OUTPUT
B12	-	-
B13	Z1 20BK	GROUND
B14	L139 20VT	FOG LAMP RELAY OUTPUT
B15	G34 16RD/GY	HIGH BEAM INDICATOR DRIVER
	G34 16RD/GY	HIGH BEAM INDICATOR DRIVER

FUEL PUMP RELAY

CAVITY	CIRCUIT	FUNCTION
D2	A61 14DG/BK	FUSED B(+)
	A61 16DG/BK	FUSED B(+)
D4	F12 18DB/WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
D6	K31 18BR	FUEL PUMP RELAY CONTROL
D8	A141 14DG/WT	FUEL PUMP RELAY OUTPUT

RADIATOR FAN RELAY

CAVITY	CIRCUIT	FUNCTION
C10	F141 12LG/RD	FUSED B(+)
C11	F20 18WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
C12	-	-
C13	C27 18DB/PK	RADIATOR FAN RELAY CONTROL
C14	C25 12LB	RADIATOR FAN RELAY OUTPUT

▲▲ DRL

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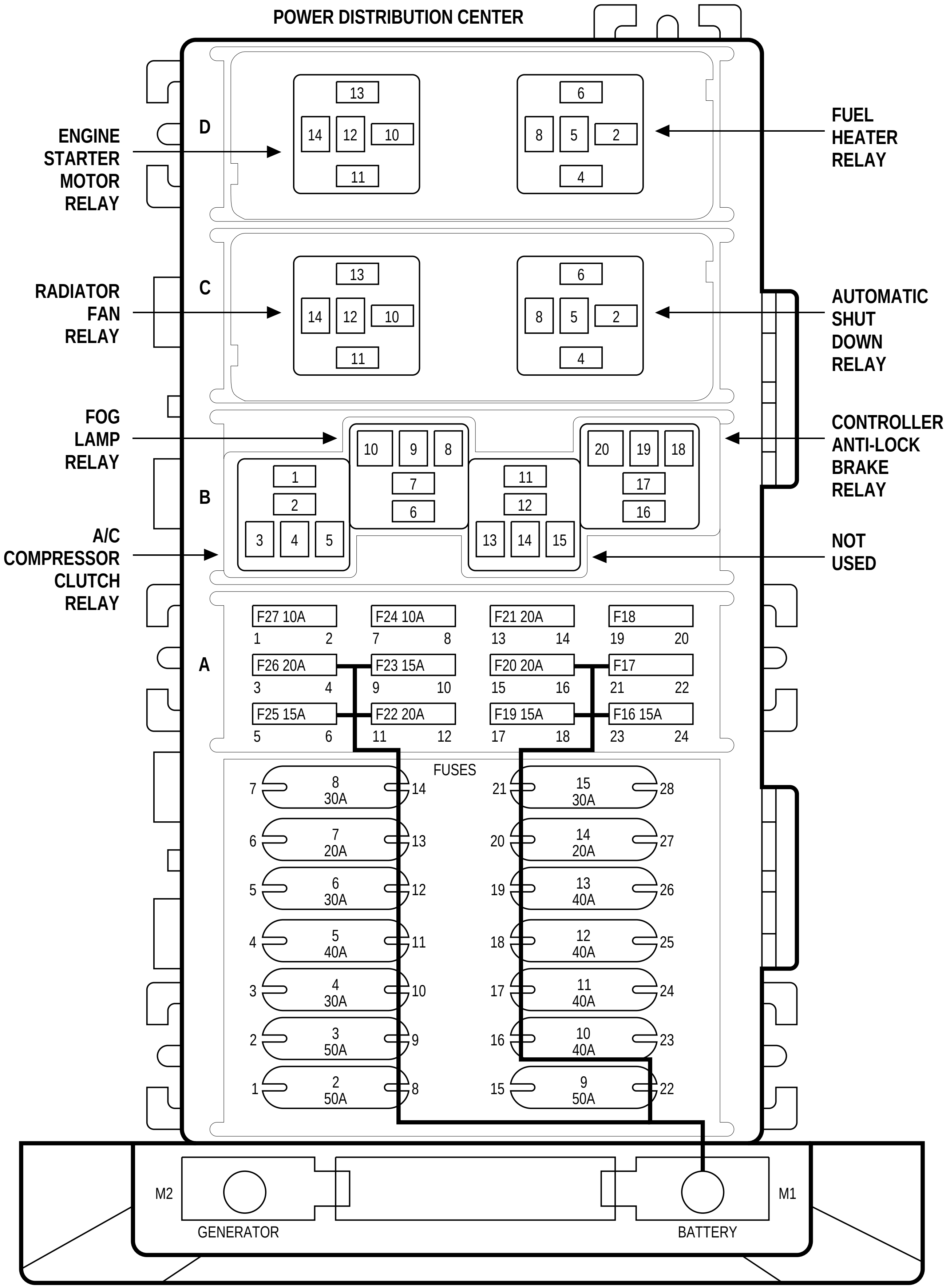
POWER DISTRIBUTION CENTER
ENGINE STARTER MOTOR RELAY
FUEL HEATER RELAY
RADIATOR FAN RELAY
AUTOMATIC SHUT DOWN RELAY
FOG LAMP RELAY
CONTROLLER ANTI-LOCK BRAKE RELAY
A/C COMPRESSOR CLUTCH RELAY
NOT USED
D
C
B
A
F27 10A
F24 10A
F21 20A
F18
F26 20A
F23 15A
F20 20A
F17
F25 15A
F22 20A
F19 15A
F16 15A
FUSES
8 30A
7 20A
6 30A
5 40A
4 30A
3 50A
2 50A
15 30A
14 20A
13 40A
12 40A
11 40A
10 40A
9 50A
M2
GENERATOR
M1
BATTERY

FUSES

FUSE NO.	AMPS	FUSED CIRCUIT	FEED CIRCUIT
1	-	-	-
2	50A	A54 12RD/GY	A0 6RD
3	50A	A54 12RD/GY	A0 6RD
4	30A	A16 12RD/LG	A0 6RD
5	40A	A1 12RD	A0 6RD
6	30A	A61 14LG/RD	A0 6RD
7	20A	A41 16YL	A0 6RD
8	30A	A3 14RD/WT	A0 6RD
9	50A	A7 10RD/BK	A0 6RD
10	40A	A2 12PK/BK	A0 6RD
11	40A	A111 12RD/LG	A0 6RD
12 •	40A	A10 12RD/DG	A0 6RD
13	40A	F141 12LG/RD	A0 6RD
14 •	20A	A20 12RD/DB	A0 6RD
15	30A	A4 12BK/PK	A0 6RD
16	15A	M1 20PK M1 20PK	A0 6RD
17	-	-	-
18	-	-	-
19	15A	F32 20PK/DB	A0 6RD
20	20A	A17 18RD/BK A17 16RD/BK	A0 6RD
21	20A	F142 16DG/OR	A142 16DG/OR
22	20A	F75 16VT	A0 6RD
23	15A	L9 20BK/PK	A0 6RD
24	10A	F16 16RD/LG	A16 12RD/LG
25	15A	F61 20WT/OR	A0 6RD
26	20A	F34 18TN/BK	A0 6RD
27	10A	F1 20DB/GY	A17 18RD/BK

• ABS

A/C COMPRESSOR CLUTCH RELAY

CAVITY	CIRCUIT	FUNCTION
B1	A17 16RD/BK	FUSED B(+)
B2	C3 16DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
B3	C13 20DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
B4	-	-
B5	F20 18WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)

AUTOMATIC SHUT DOWN RELAY

CAVITY	CIRCUIT	FUNCTION
C2	A16 12RD/LG	FUSED B(+)
C4	A16 12RD/LG	FUSED B(+)
C5	-	-
C6	K51 20DB/YL	AUTOMATIC SHUT DOWN RELAY CONTROL
C8	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT

CONTROLLER ANTI-LOCK BRAKE RELAY

CAVITY	CIRCUIT	FUNCTION
B16	G19 20LG/OR	ABS WARNING INDICATOR DRIVER
B17	-	-
B18	F15 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
	F15 18DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
B19	Z1 20BK/YL	GROUND
B20	G83 18GY/BK	ABS RELAY CONTROL

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ENGINE STARTER MOTOR RELAY

CAVITY	CIRCUIT	FUNCTION
D10	A41 16YL	FUSED B(+)
D11	T141 20YL	IGNITION SWITCH OUTPUT (START)
D12	-	-
D13	Z1 20BK	GROUND
D14	T40 16BR	STARTER RELAY OUTPUT

FOG LAMP RELAY

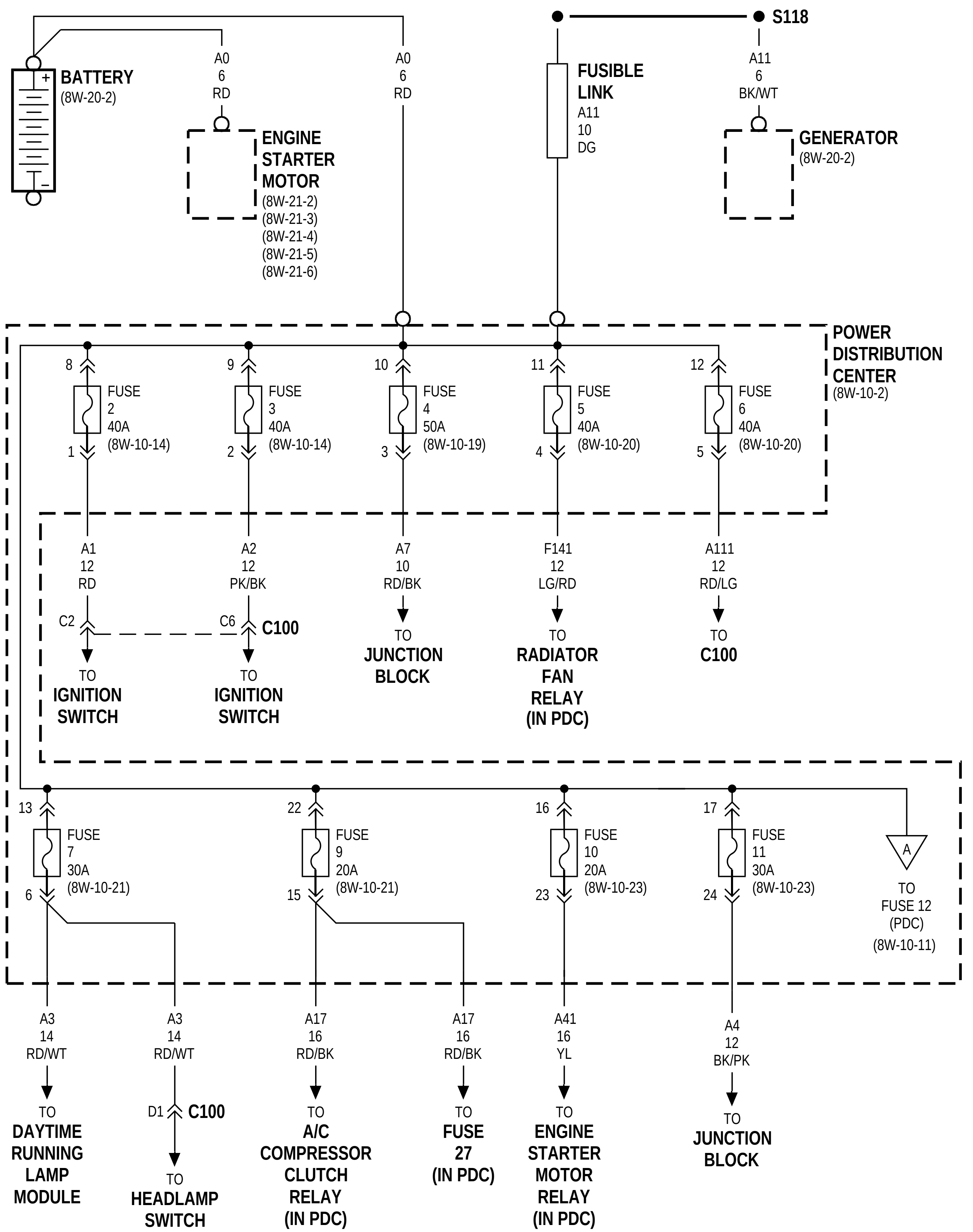
CAVITY	CIRCUIT	FUNCTION
B6	F61 20WT/OR	FUSED B(+)
B7	L139 20VT	FOG LAMP RELAY OUTPUT
B8	L77 18BR/YL	FUSED LEFT INBOARD TAIL LAMP
	L77 20BR/YL	FUSED LEFT INBOARD TAIL LAMP
B9	-	-
B10	Z1 20BK/YL	GROUND
	Z1 20BK/YL	GROUND

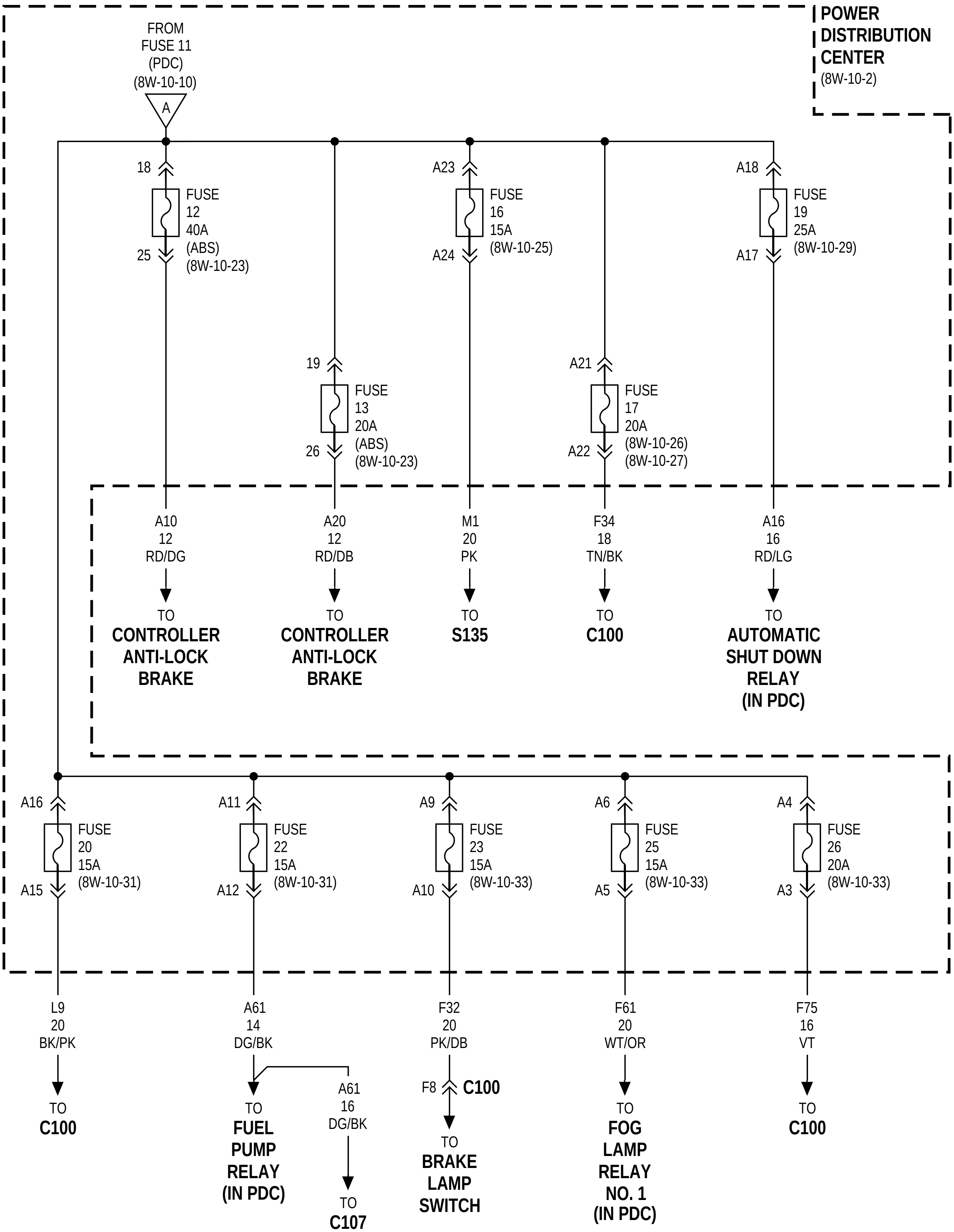
FUEL HEATER RELAY

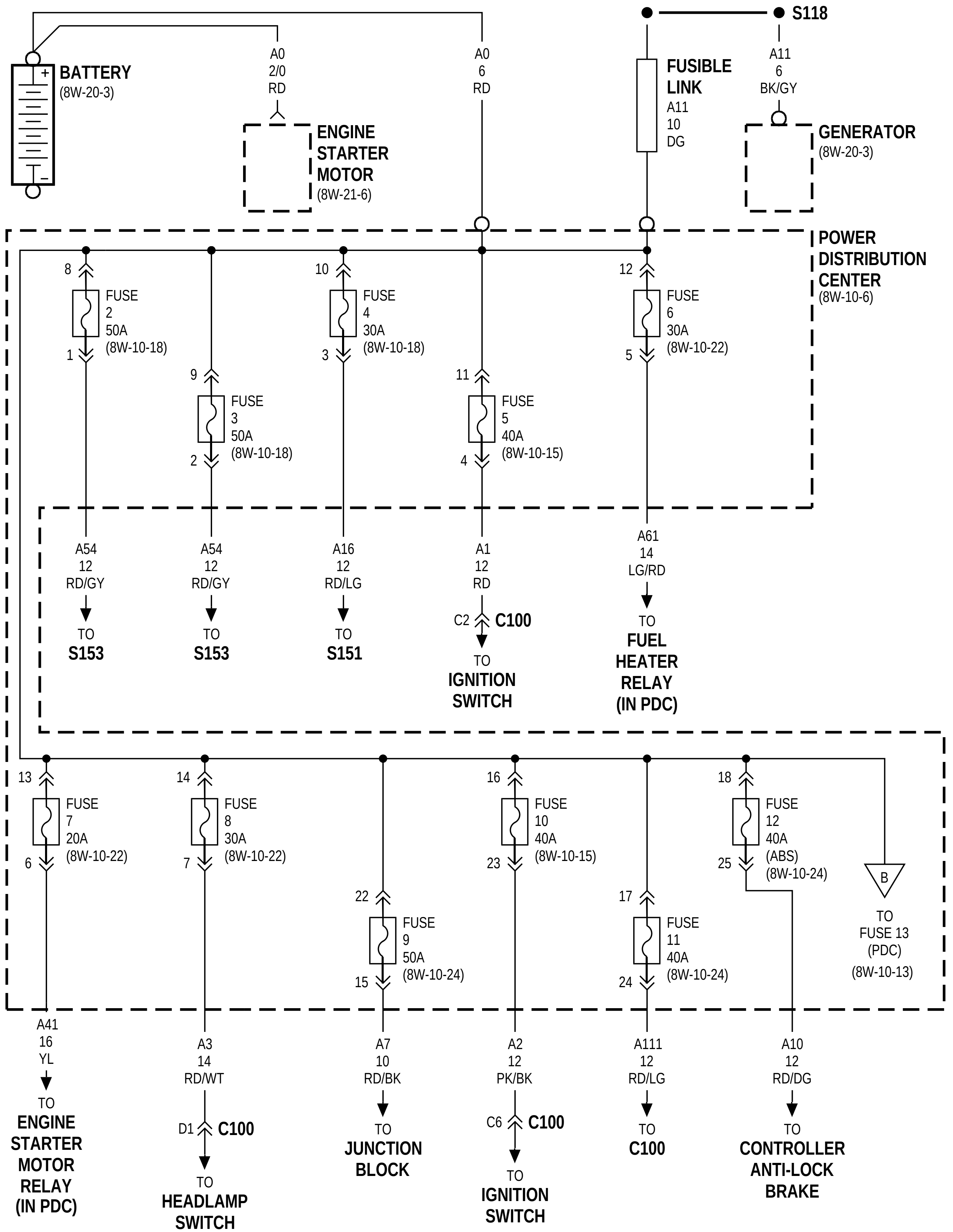
CAVITY	CIRCUIT	FUNCTION
D2	A61 14LG/RD	FUSED B(+)
D4	F12 18DB/WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
D5	-	-
D6	Z1 18BK	GROUND
D8	A93 14RD/BK	FUEL HEATER RELAY OUTPUT

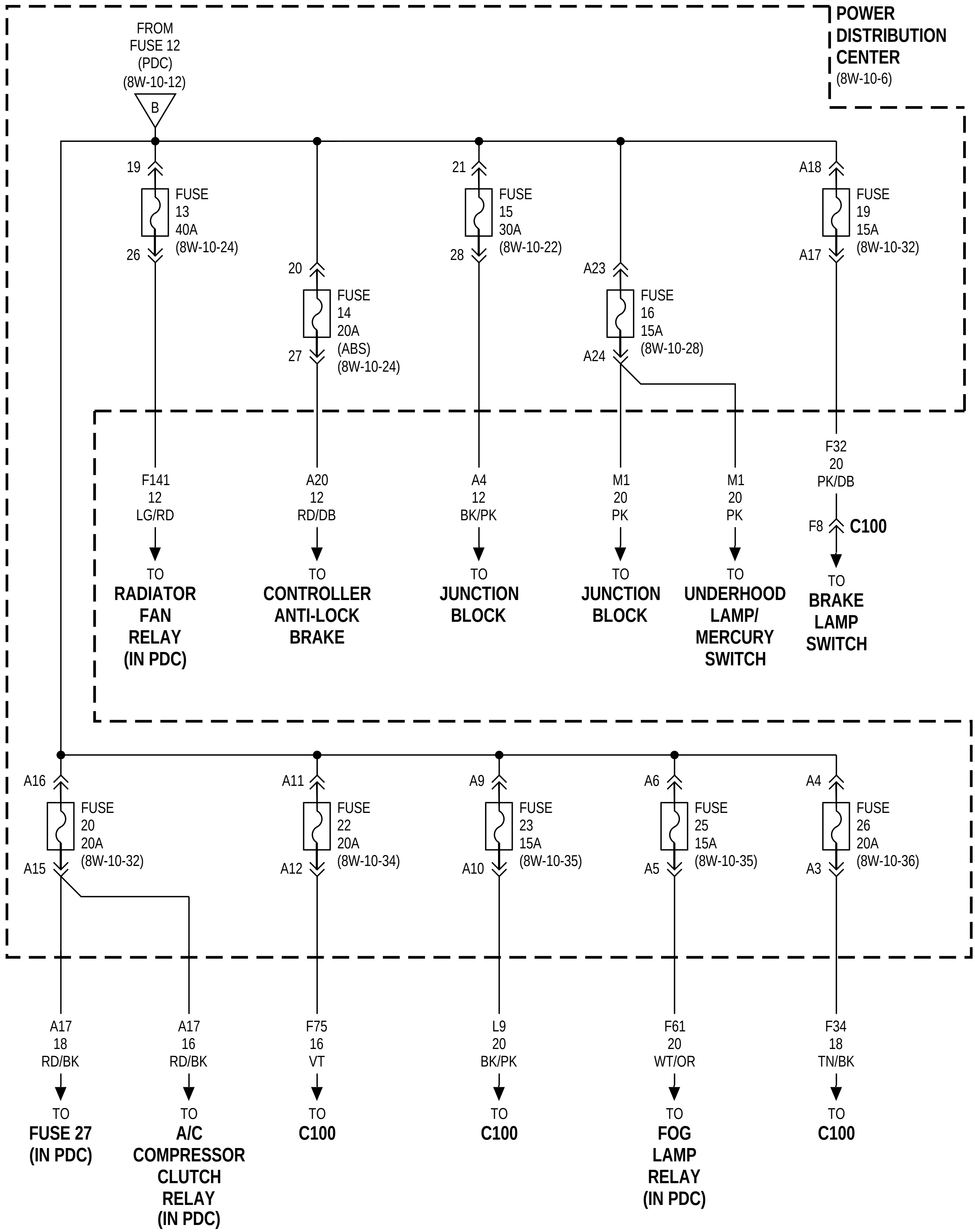
RADIATOR FAN RELAY

CAVITY	CIRCUIT	FUNCTION
C10	F141 12LG/RD	FUSED B(+)
C11	F20 18WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
C12	-	-
C13	C27 20DB/PK	RADIATOR FAN RELAY CONTROL
C14	C25 12LB	RADIATOR FAN RELAY OUTPUT

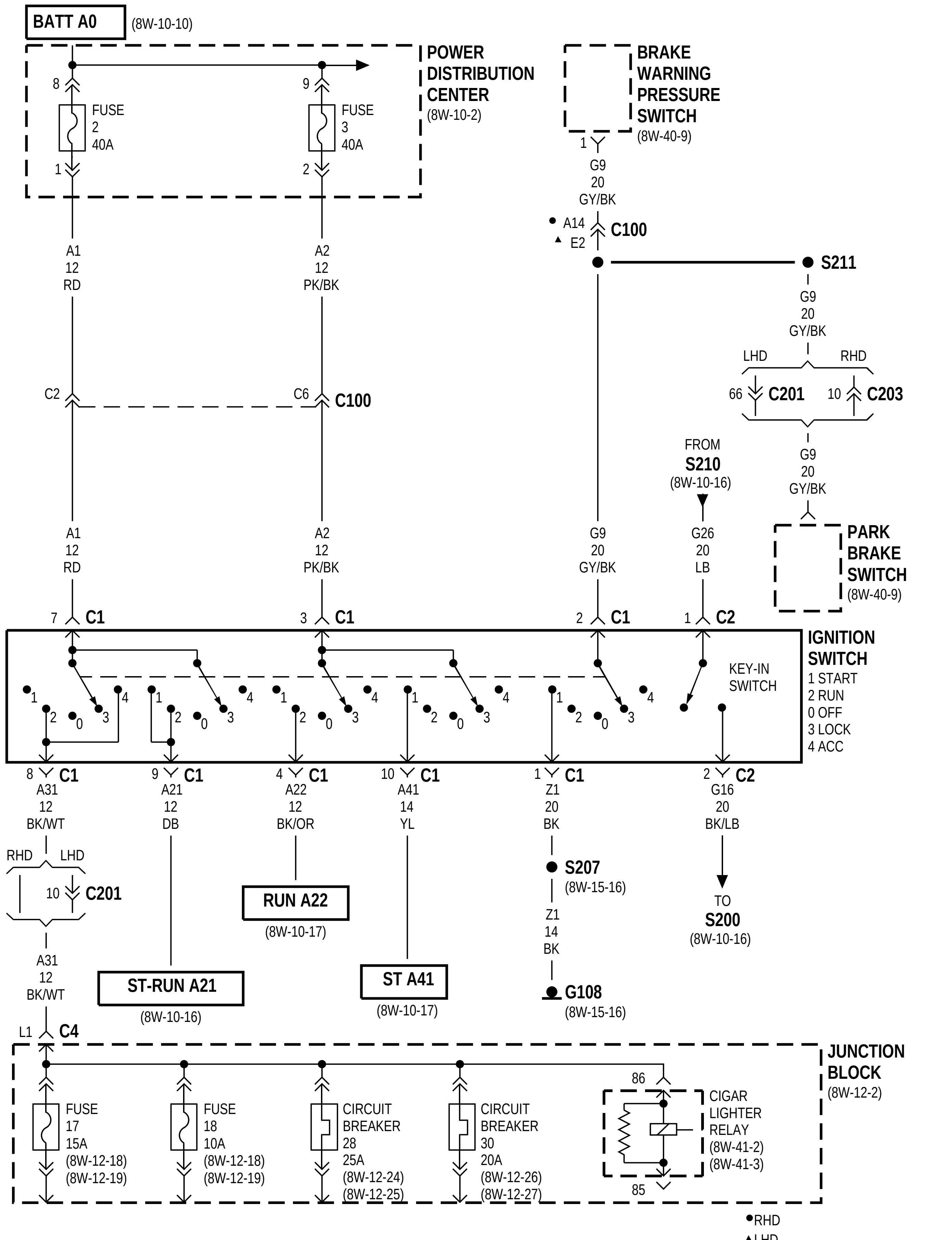

S118
BATTERY
(8W-20-2)
A0
6
RD
A0
6
RD
FUSIBLE
LINK
A11
10
DG
A11
6
BK/WT
ENGINE
STARTER
MOTOR
(8W-21-2)
(8W-21-3)
(8W-21-4)
(8W-21-5)
(8W-21-6)
GENERATOR
(8W-20-2)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
8
FUSE
2
40A
(8W-10-14)
1
9
FUSE
3
40A
(8W-10-14)
2
10
FUSE
4
50A
(8W-10-19)
3
11
FUSE
5
40A
(8W-10-20)
4
12
FUSE
6
40A
(8W-10-20)
5
A1
12
RD
A2
12
PK/BK
A7
10
RD/BK
F141
12
LG/RD
A111
12
RD/LG
C2
C6
C100
TO
IGNITION
SWITCH
TO
IGNITION
SWITCH
TO
JUNCTION
BLOCK
TO
RADIATOR
FAN
RELAY
(IN PDC)
TO
C100
13
FUSE
7
30A
(8W-10-21)
6
22
FUSE
9
20A
(8W-10-21)
15
16
FUSE
10
20A
(8W-10-23)
23
17
FUSE
11
30A
(8W-10-23)
24
A
TO
FUSE 12
(PDC)
(8W-10-11)
A3
14
RD/WT
A3
14
RD/WT
A17
16
RD/BK
A17
16
RD/BK
A41
16
YL
A4
12
BK/PK
TO
DAYTIME
RUNNING
LAMP
MODULE
D1
C100
TO
HEADLAMP
SWITCH
TO
A/C
COMPRESSOR
CLUTCH
RELAY
(IN PDC)
TO
FUSE
27
(IN PDC)
TO
ENGINE
STARTER
MOTOR
RELAY
(IN PDC)
TO
JUNCTION
BLOCK

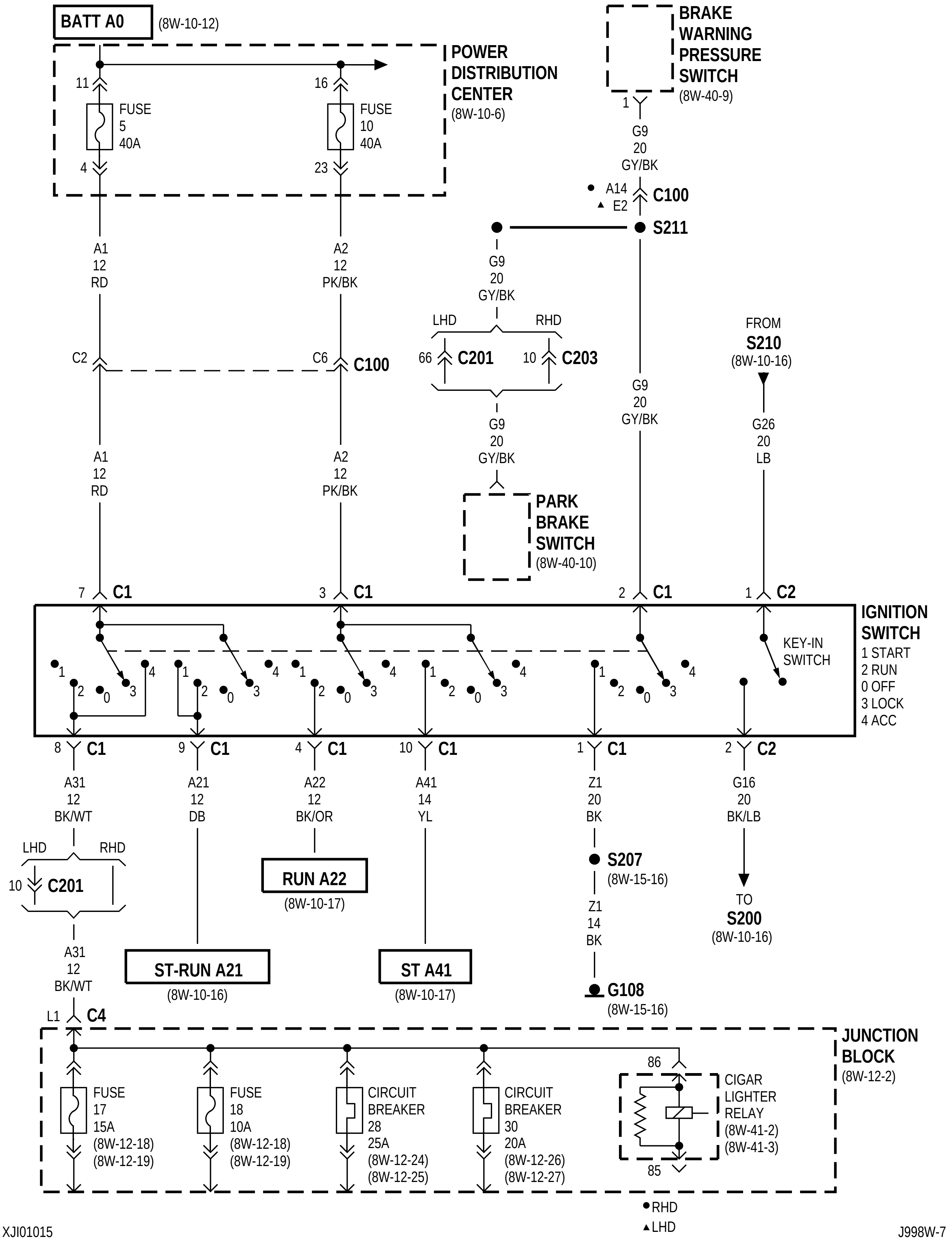

POWER DISTRIBUTION CENTER
(8W-10-2)
FROM FUSE 11 (PDC) (8W-10-10)
A
18
FUSE 12 40A (ABS) (8W-10-23)
25
19
FUSE 13 20A (ABS) (8W-10-23)
26
A23
FUSE 16 15A (8W-10-25)
A24
A21
FUSE 17 20A (8W-10-26) (8W-10-27)
A22
A18
FUSE 19 25A (8W-10-29)
A17
A10 12 RD/DG
TO CONTROLLER ANTI-LOCK BRAKE
A20 12 RD/DB
TO CONTROLLER ANTI-LOCK BRAKE
M1 20 PK
TO S135
F34 18 TN/BK
TO C100
A16 16 RD/LG
TO AUTOMATIC SHUT DOWN RELAY (IN PDC)
A16
FUSE 20 15A (8W-10-31)
A15
A11
FUSE 22 15A (8W-10-31)
A12
A9
FUSE 23 15A (8W-10-33)
A10
A6
FUSE 25 15A (8W-10-33)
A5
A4
FUSE 26 20A (8W-10-33)
A3
L9 20 BK/PK
TO C100
A61 14 DG/BK
TO FUEL PUMP RELAY (IN PDC)
A61 16 DG/BK
TO C107
F32 20 PK/DB
F8 C100
TO BRAKE LAMP SWITCH
F61 20 WT/OR
TO FOG LAMP RELAY NO. 1 (IN PDC)
F75 16 VT
TO C100


S118
BATTERY
(8W-20-3)
A0
2/0
RD
A0
6
RD
ENGINE
STARTER
MOTOR
(8W-21-6)
FUSIBLE
LINK
A11
10
DG
A11
6
BK/GY
GENERATOR
(8W-20-3)
POWER
DISTRIBUTION
CENTER
(8W-10-6)
FUSE
2
50A
(8W-10-18)
FUSE
3
50A
(8W-10-18)
FUSE
4
30A
(8W-10-18)
FUSE
5
40A
(8W-10-15)
FUSE
6
30A
(8W-10-22)
A54
12
RD/GY
TO
S153
A54
12
RD/GY
TO
S153
A16
12
RD/LG
TO
S151
A1
12
RD
C2
C100
TO
IGNITION
SWITCH
A61
14
LG/RD
TO
FUEL
HEATER
RELAY
(IN PDC)
FUSE
7
20A
(8W-10-22)
FUSE
8
30A
(8W-10-22)
FUSE
9
50A
(8W-10-24)
FUSE
10
40A
(8W-10-15)
FUSE
11
40A
(8W-10-24)
FUSE
12
40A
(ABS)
(8W-10-24)
B
TO
FUSE 13
(PDC)
(8W-10-13)
A41
16
YL
TO
ENGINE
STARTER
MOTOR
RELAY
(IN PDC)
A3
14
RD/WT
D1
C100
TO
HEADLAMP
SWITCH
A7
10
RD/BK
TO
JUNCTION
BLOCK
A2
12
PK/BK
C6
C100
TO
IGNITION
SWITCH
A111
12
RD/LG
TO
C100
A10
12
RD/DG
TO
CONTROLLER
ANTI-LOCK
BRAKE

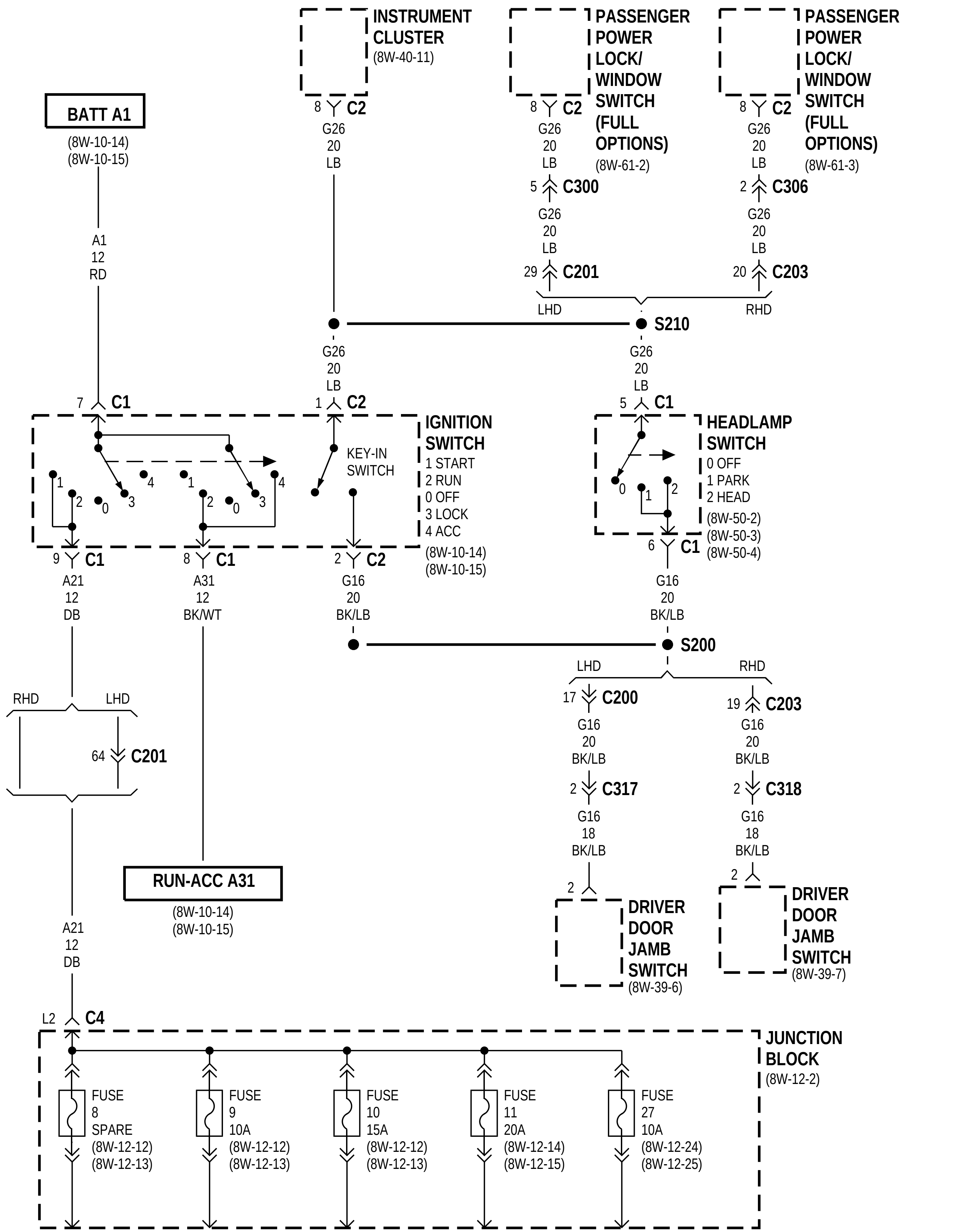


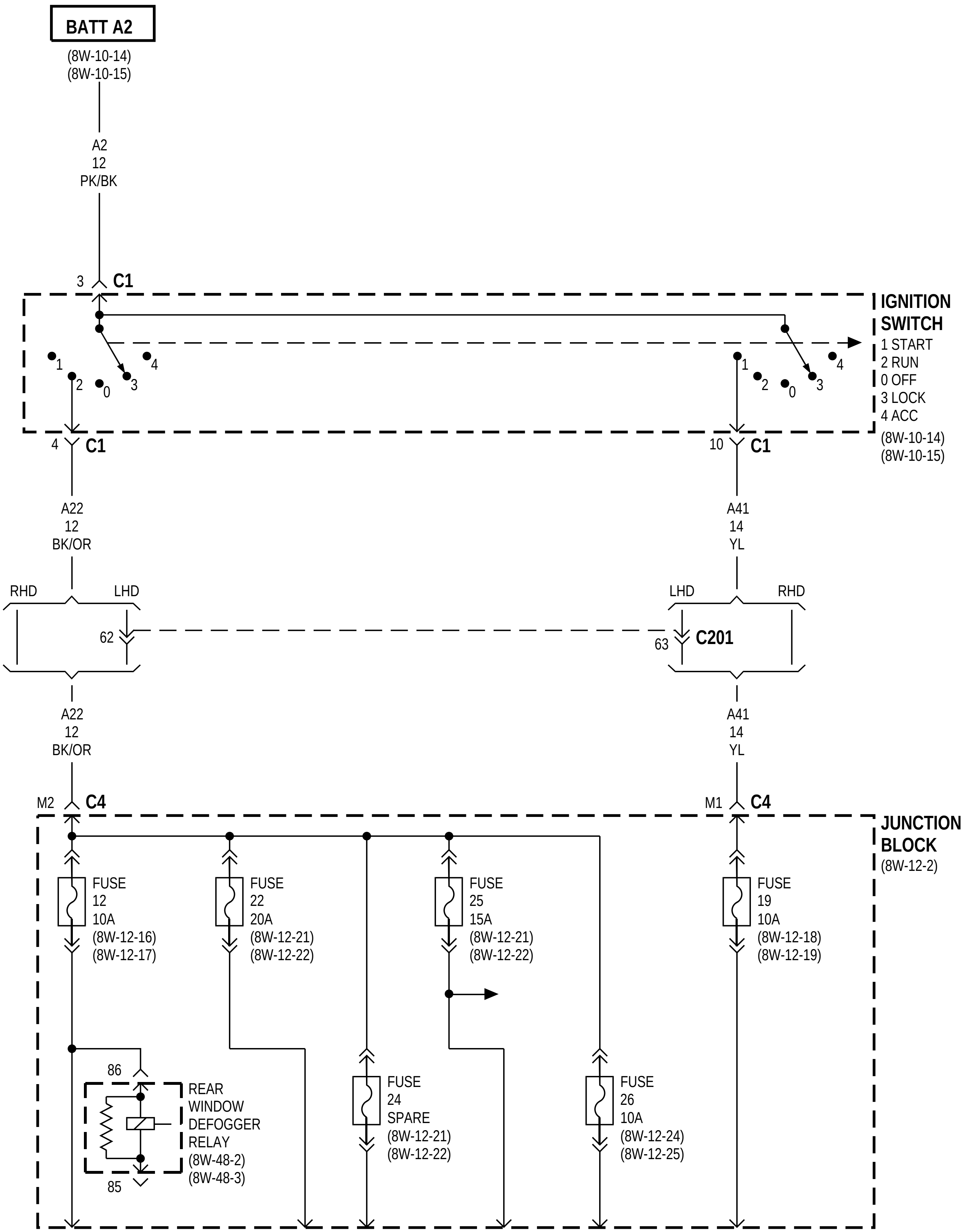
POWER DISTRIBUTION CENTER
(8W-10-6)
FROM FUSE 12 (PDC) (8W-10-12)
B
19
FUSE 13 40A (8W-10-24)
26
20
FUSE 14 20A (ABS) (8W-10-24)
27
21
FUSE 15 30A (8W-10-22)
28
A23
FUSE 16 15A (8W-10-28)
A24
A18
FUSE 19 15A (8W-10-32)
A17
F141 12 LG/RD
TO RADIATOR FAN RELAY (IN PDC)
A20 12 RD/DB
TO CONTROLLER ANTI-LOCK BRAKE
A4 12 BK/PK
TO JUNCTION BLOCK
M1 20 PK
TO JUNCTION BLOCK
M1 20 PK
TO UNDERHOOD LAMP/ MERCURY SWITCH
F32 20 PK/DB
F8 C100
TO BRAKE LAMP SWITCH
A16
FUSE 20 20A (8W-10-32)
A15
A11
FUSE 22 20A (8W-10-34)
A12
A9
FUSE 23 15A (8W-10-35)
A10
A6
FUSE 25 15A (8W-10-35)
A5
A4
FUSE 26 20A (8W-10-36)
A3
A17 18 RD/BK
TO FUSE 27 (IN PDC)
A17 16 RD/BK
TO A/C COMPRESSOR CLUTCH RELAY (IN PDC)
F75 16 VT
TO C100
L9 20 BK/PK
TO C100
F61 20 WT/OR
TO FOG LAMP RELAY (IN PDC)
F34 18 TN/BK
TO C100

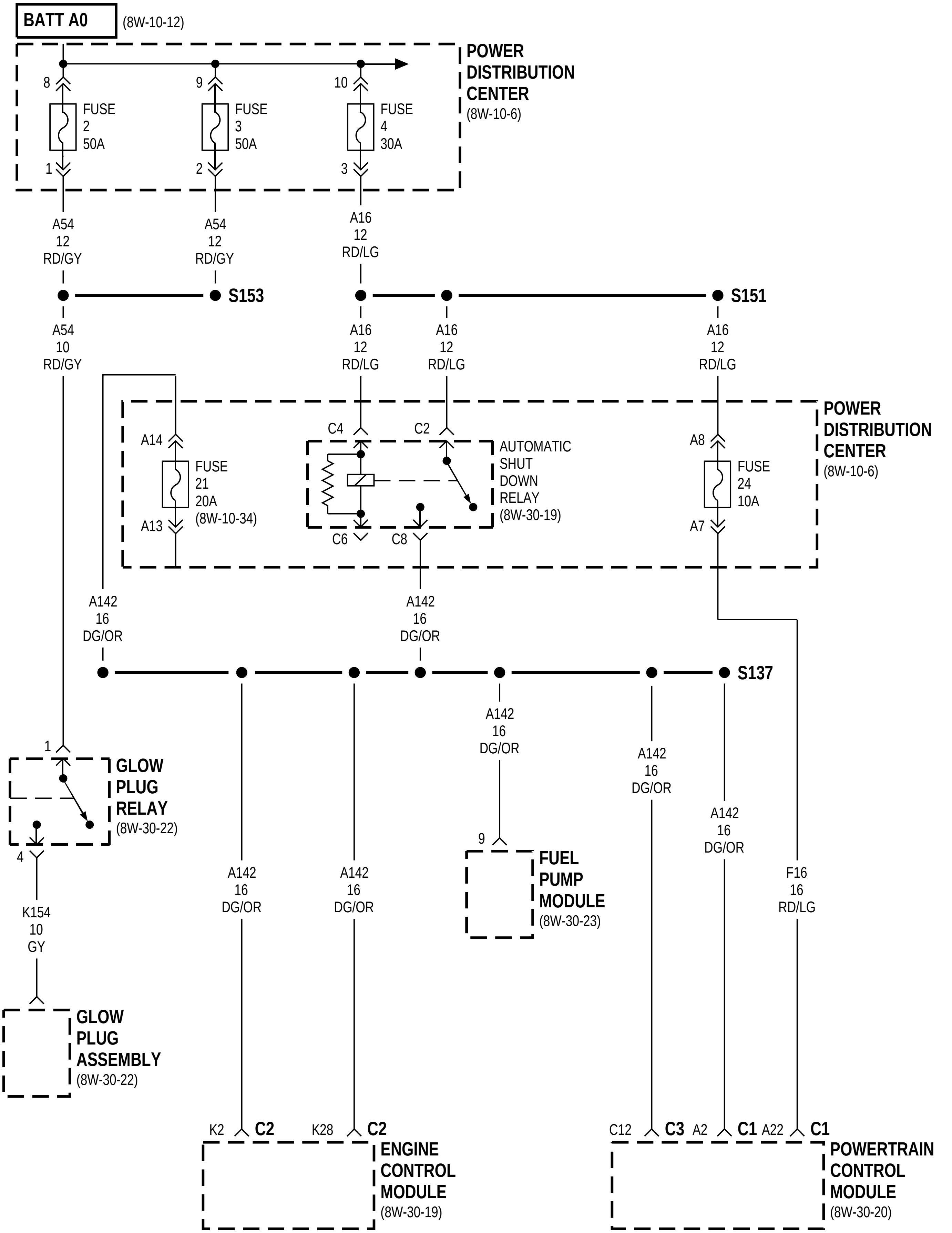

BATT A0
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
8
FUSE 2 40A
1
9
FUSE 3 40A
2
A1 12 RD
A2 12 PK/BK
C2
C6
C100
A1 12 RD
A2 12 PK/BK
BRAKE WARNING PRESSURE SWITCH
(8W-40-9)
1
G9 20 GY/BK
A14
E2
C100
S211
G9 20 GY/BK
LHD
RHD
66
C201
10
C203
G9 20 GY/BK
PARK BRAKE SWITCH
(8W-40-9)
FROM
S210
(8W-10-16)
G26 20 LB
G9 20 GY/BK
7 C1
3 C1
2 C1
1 C2
IGNITION SWITCH
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
KEY-IN SWITCH
8 C1
A31 12 BK/WT
9 C1
A21 12 DB
4 C1
A22 12 BK/OR
10 C1
A41 14 YL
1 C1
Z1 20 BK
2 C2
G16 20 BK/LB
RHD
LHD
10
C201
A31 12 BK/WT
RUN A22
(8W-10-17)
ST-RUN A21
(8W-10-16)
ST A41
(8W-10-17)
S207
(8W-15-16)
Z1 14 BK
G108
(8W-15-16)
TO
S200
(8W-10-16)
L1
C4
JUNCTION BLOCK
(8W-12-2)
FUSE 17 15A
(8W-12-18)
(8W-12-19)
FUSE 18 10A
(8W-12-18)
(8W-12-19)
CIRCUIT BREAKER 28 25A
(8W-12-24)
(8W-12-25)
CIRCUIT BREAKER 30 20A
(8W-12-26)
(8W-12-27)
86
85
CIGAR LIGHTER RELAY
(8W-41-2)
(8W-41-3)
●RHD
▲LHD

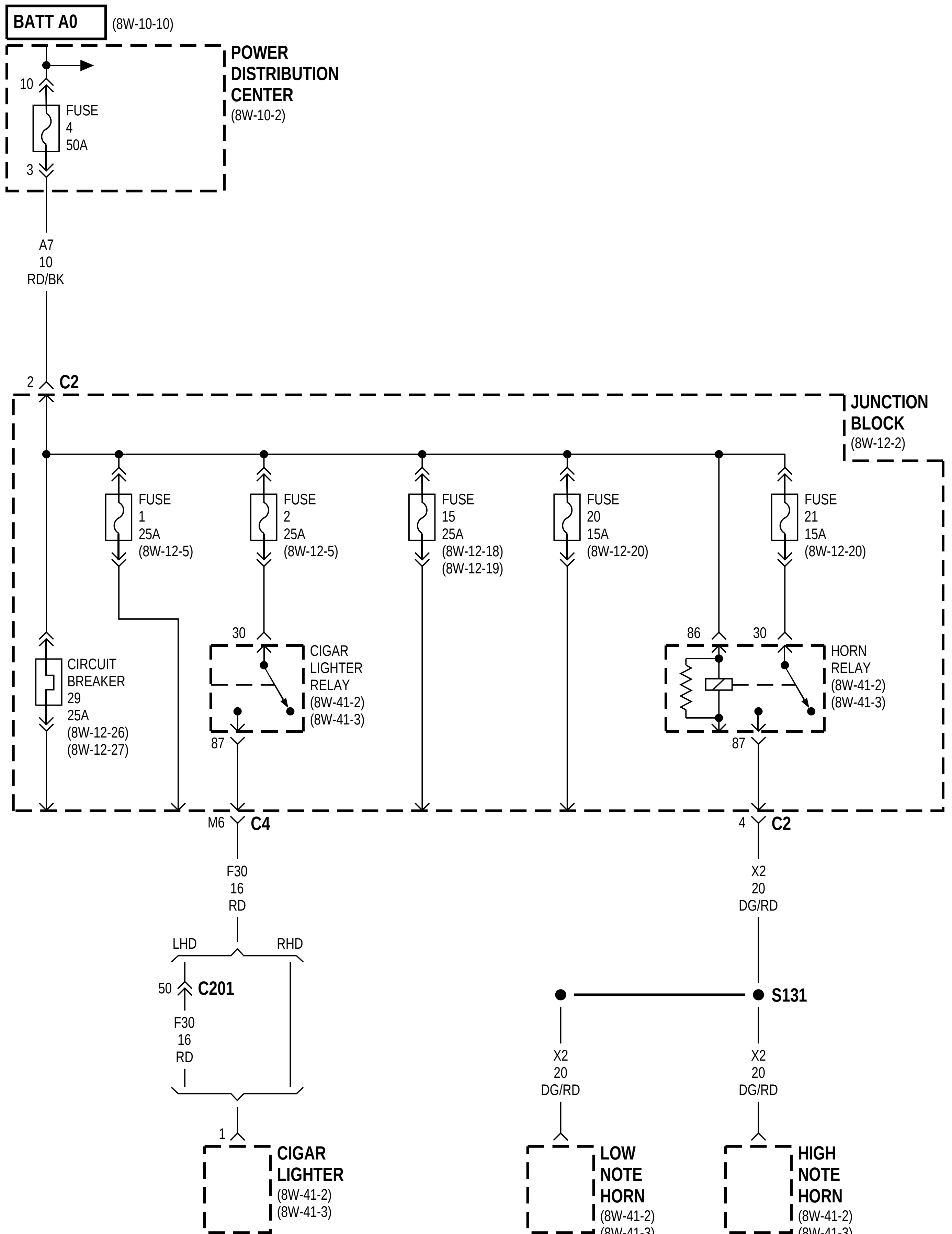


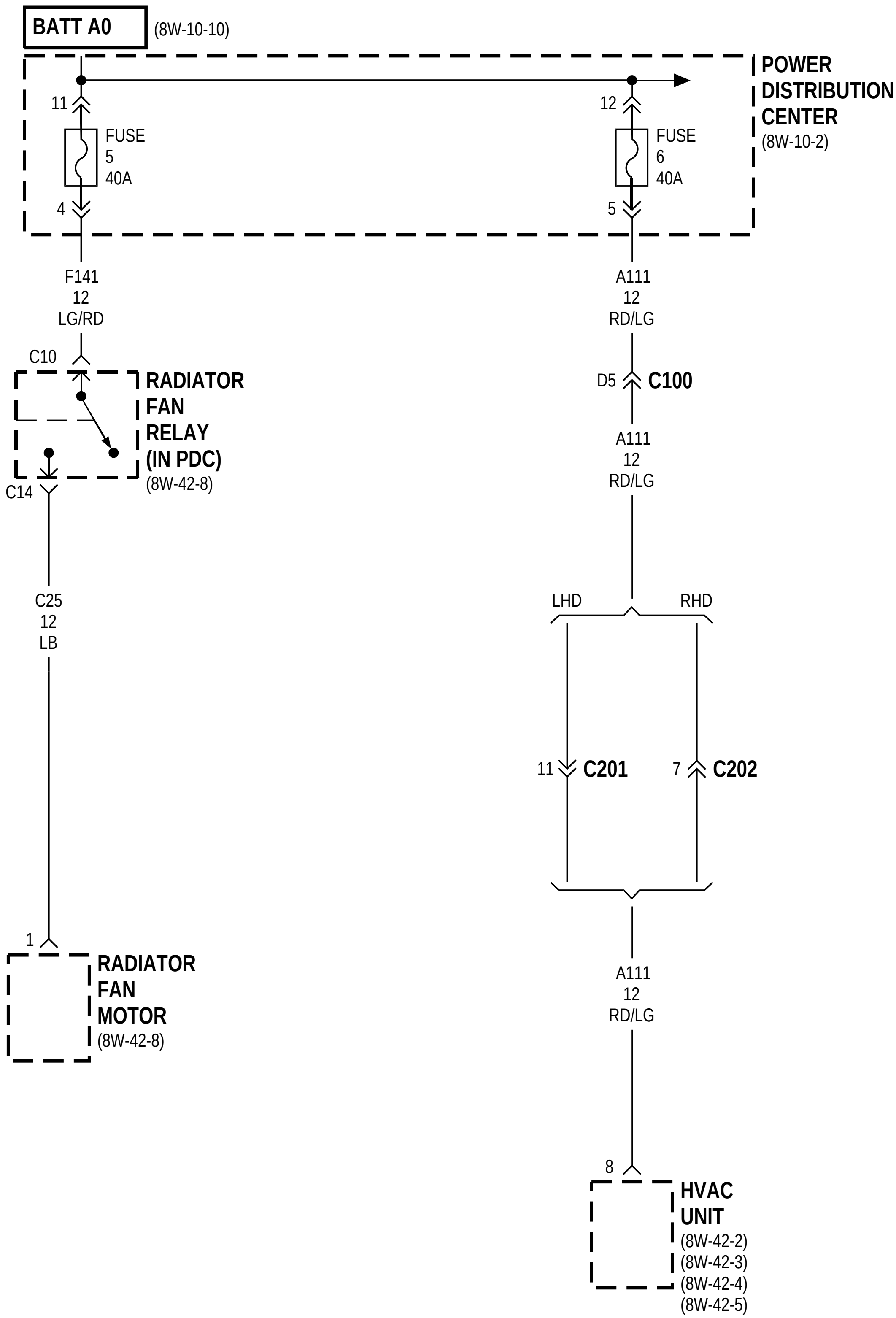
BATT A0
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-6)
11
16
FUSE 5 40A
FUSE 10 40A
4
23
A1 12 RD
A2 12 PK/BK
C2
C6
C100
BRAKE WARNING PRESSURE SWITCH
(8W-40-9)
1
G9 20 GY/BK
A14
E2
C100
S211
G9 20 GY/BK
LHD
RHD
66
C201
10
C203
G9 20 GY/BK
PARK BRAKE SWITCH
(8W-40-10)
FROM S210
(8W-10-16)
G26 20 LB
7 C1
3 C1
2 C1
1 C2
IGNITION SWITCH
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
KEY-IN SWITCH
8 C1
9 C1
4 C1
10 C1
1 C1
2 C2
A31 12 BK/WT
A21 12 DB
A22 12 BK/OR
A41 14 YL
Z1 20 BK
G16 20 BK/LB
LHD
RHD
10
C201
RUN A22
(8W-10-17)
S207
(8W-15-16)
TO S200
(8W-10-16)
A31 12 BK/WT
ST-RUN A21
(8W-10-16)
ST A41
(8W-10-17)
Z1 14 BK
G108
(8W-15-16)
L1
C4
JUNCTION BLOCK
(8W-12-2)
FUSE 17 15A (8W-12-18) (8W-12-19)
FUSE 18 10A (8W-12-18) (8W-12-19)
CIRCUIT BREAKER 28 25A (8W-12-24) (8W-12-25)
CIRCUIT BREAKER 30 20A (8W-12-26) (8W-12-27)
86
85
CIGAR LIGHTER RELAY
(8W-41-2)
(8W-41-3)
• RHD
▲ LHD

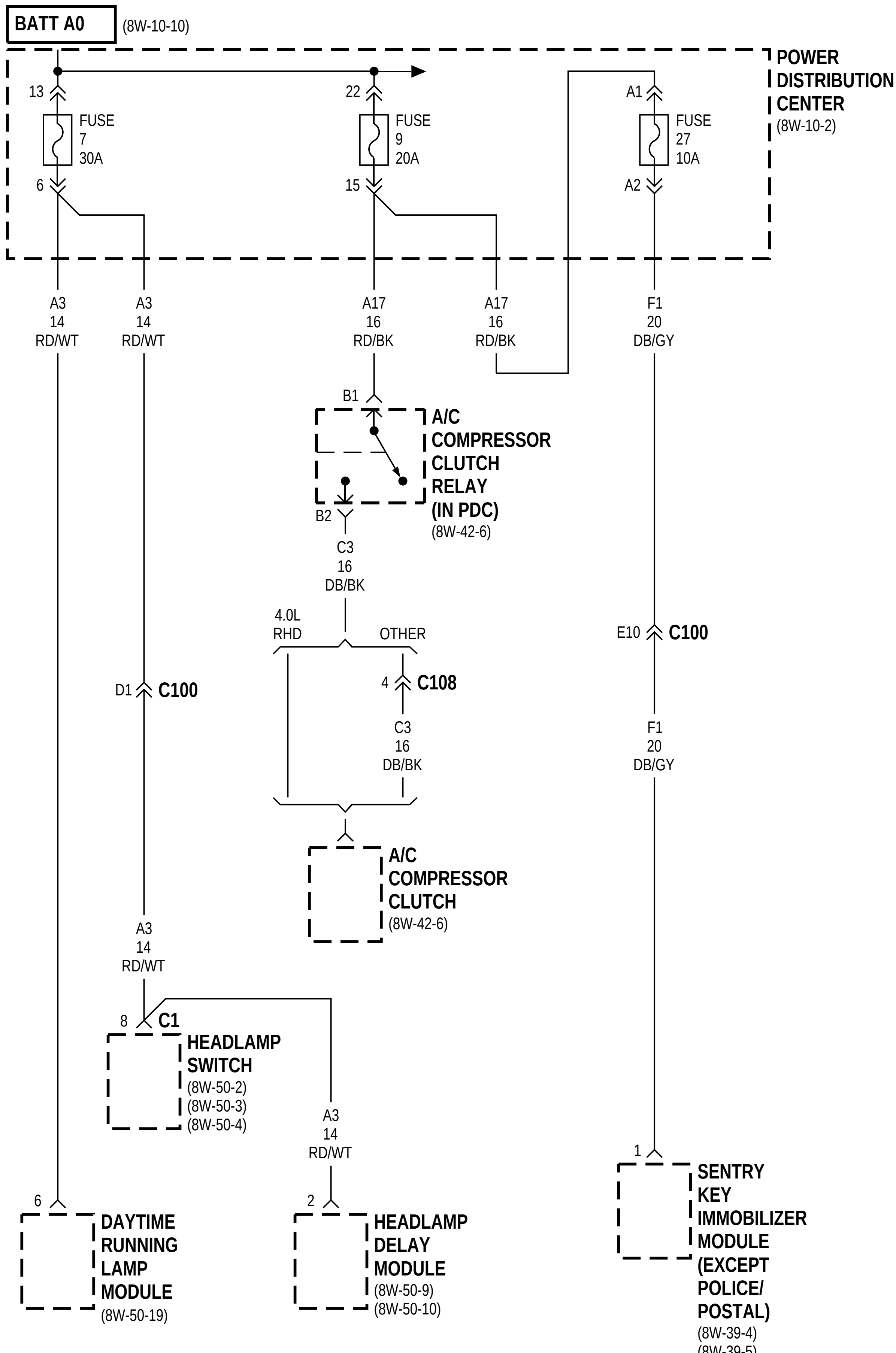

INSTRUMENT CLUSTER
(8W-40-11)
PASSENGER POWER LOCK/ WINDOW SWITCH (FULL OPTIONS)
(8W-61-2)
PASSENGER POWER LOCK/ WINDOW SWITCH (FULL OPTIONS)
(8W-61-3)
BATT A1
(8W-10-14)
(8W-10-15)
8 C2
G26 20 LB
C300
C306
C201
C203
LHD
RHD
S210
A1 12 RD
7 C1
1 C2
5 C1
IGNITION SWITCH
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
(8W-10-14)
(8W-10-15)
KEY-IN SWITCH
HEADLAMP SWITCH
0 OFF
1 PARK
2 HEAD
(8W-50-2)
(8W-50-3)
(8W-50-4)
9 C1
8 C1
2 C2
6 C1
A21 12 DB
A31 12 BK/WT
G16 20 BK/LB
S200
17 C200
19 C203
64 C201
2 C317
2 C318
G16 18 BK/LB
RUN-ACC A31
(8W-10-14)
(8W-10-15)
DRIVER DOOR JAMB SWITCH
(8W-39-6)
DRIVER DOOR JAMB SWITCH
(8W-39-7)
L2 C4
JUNCTION BLOCK
(8W-12-2)
FUSE 8 SPARE (8W-12-12) (8W-12-13)
FUSE 9 10A (8W-12-12) (8W-12-13)
FUSE 10 15A (8W-12-12) (8W-12-13)
FUSE 11 20A (8W-12-14) (8W-12-15)
FUSE 27 10A (8W-12-24) (8W-12-25)

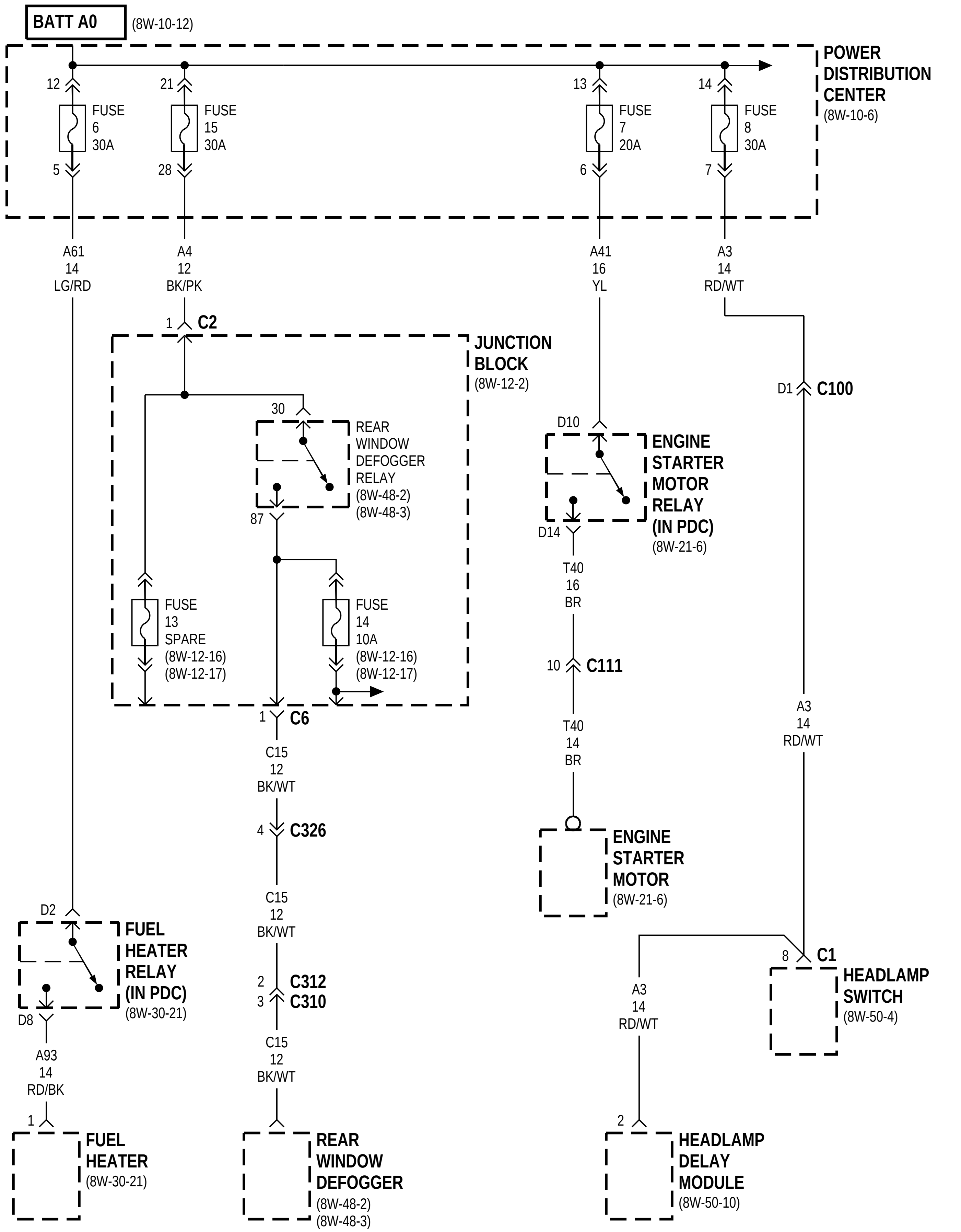

BATT A2
(8W-10-14)
(8W-10-15)
A2
12
PK/BK
3
C1
IGNITION
SWITCH
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
(8W-10-14)
(8W-10-15)
1
2
0
3
4
4
C1
10
C1
A22
12
BK/OR
A41
14
YL
RHD
LHD
LHD
RHD
62
63
C201
A22
12
BK/OR
A41
14
YL
M2
C4
M1
C4
JUNCTION
BLOCK
(8W-12-2)
FUSE
12
10A
(8W-12-16)
(8W-12-17)
FUSE
22
20A
(8W-12-21)
(8W-12-22)
FUSE
25
15A
(8W-12-21)
(8W-12-22)
FUSE
19
10A
(8W-12-18)
(8W-12-19)
86
REAR
WINDOW
DEFOGGER
RELAY
(8W-48-2)
(8W-48-3)
85
FUSE
24
SPARE
(8W-12-21)
(8W-12-22)
FUSE
26
10A
(8W-12-24)
(8W-12-25)

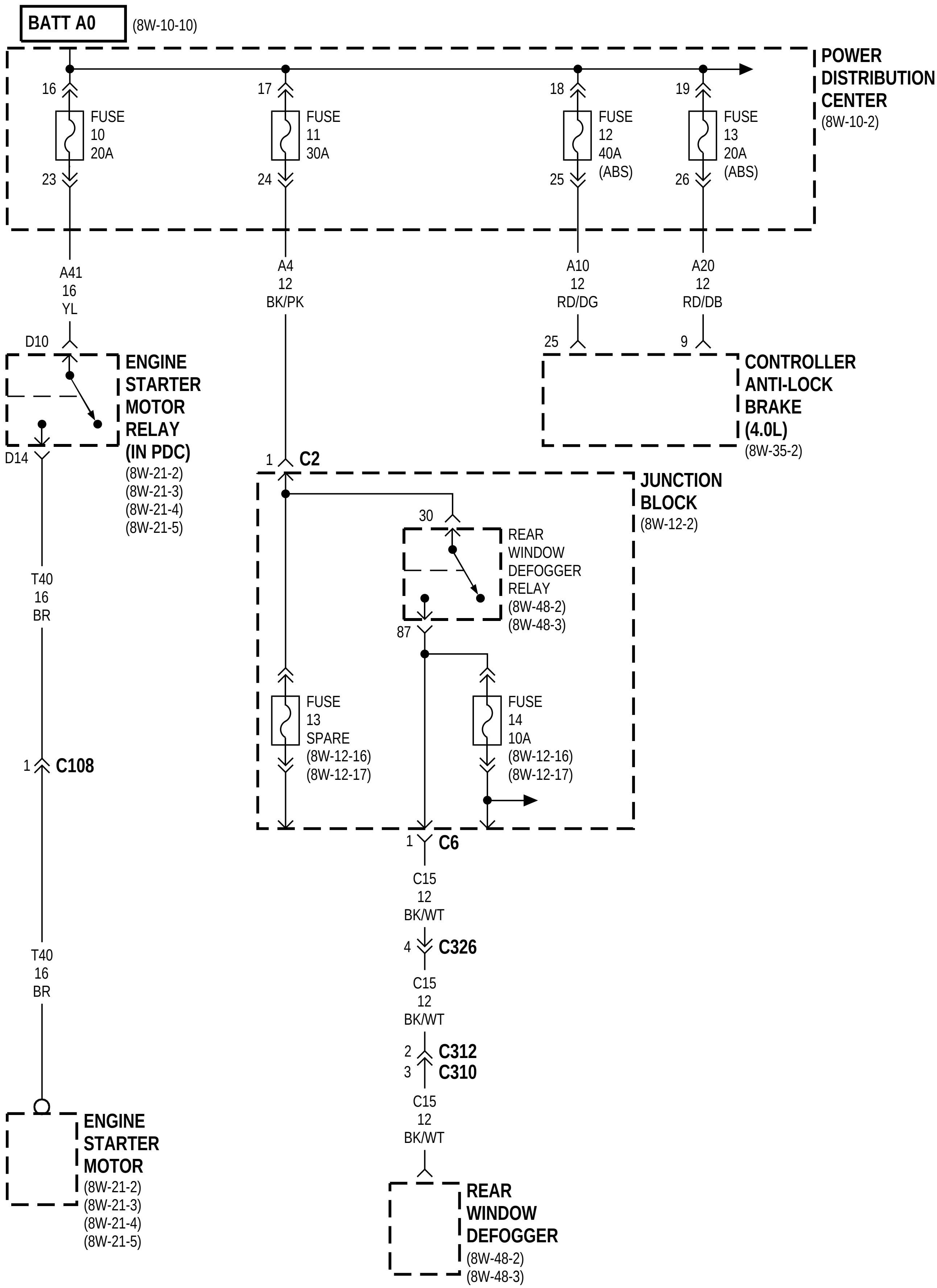

BATT A0
(8W-10-12)
POWER
DISTRIBUTION
CENTER
(8W-10-6)
8
9
10
FUSE
2
50A
FUSE
3
50A
FUSE
4
30A
1
2
3
A54
12
RD/GY
A54
12
RD/GY
A16
12
RD/LG
S153
S151
A54
10
RD/GY
A16
12
RD/LG
A16
12
RD/LG
A16
12
RD/LG
POWER
DISTRIBUTION
CENTER
(8W-10-6)
A14
FUSE
21
20A
(8W-10-34)
A13
C4
C2
AUTOMATIC
SHUT
DOWN
RELAY
(8W-30-19)
C6
C8
A8
FUSE
24
10A
A7
A142
16
DG/OR
A142
16
DG/OR
S137
A142
16
DG/OR
A142
16
DG/OR
A142
16
DG/OR
1
GLOW
PLUG
RELAY
(8W-30-22)
4
A142
16
DG/OR
A142
16
DG/OR
9
FUEL
PUMP
MODULE
(8W-30-23)
F16
16
RD/LG
K154
10
GY
GLOW
PLUG
ASSEMBLY
(8W-30-22)
K2
C2
K28
C2
ENGINE
CONTROL
MODULE
(8W-30-19)
C12
C3
A2
C1
A22
C1
POWERTRAIN
CONTROL
MODULE
(8W-30-20)

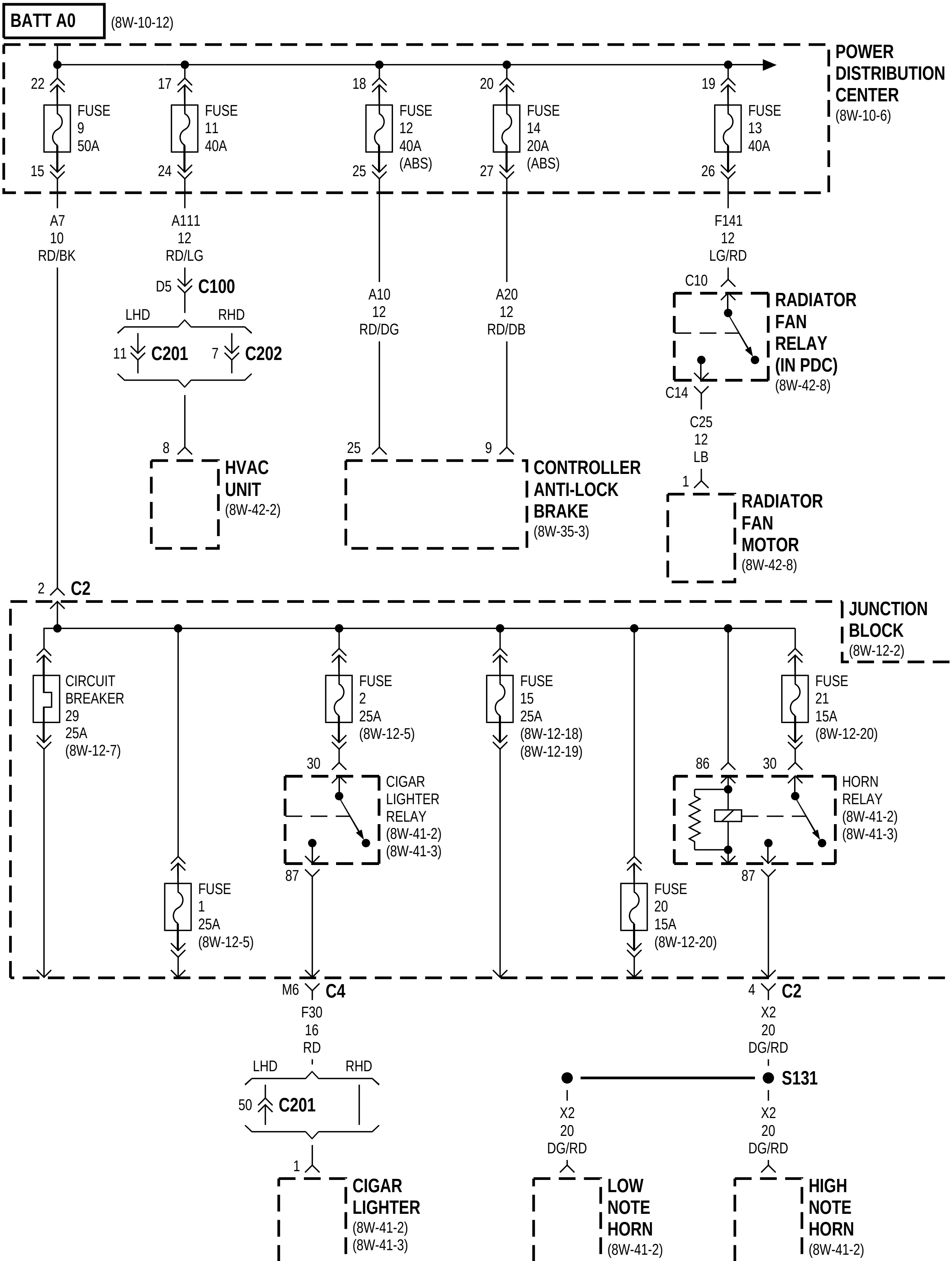

BATT A0
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
10
FUSE 4 50A
3
A7 10 RD/BK
2 C2
JUNCTION BLOCK
(8W-12-2)
FUSE 1 25A (8W-12-5)
FUSE 2 25A (8W-12-5)
FUSE 15 25A (8W-12-18) (8W-12-19)
FUSE 20 15A (8W-12-20)
FUSE 21 15A (8W-12-20)
CIRCUIT BREAKER 29 25A (8W-12-26) (8W-12-27)
30
CIGAR LIGHTER RELAY (8W-41-2) (8W-41-3)
87
86
30
HORN RELAY (8W-41-2) (8W-41-3)
87
M6 C4
4 C2
F30 16 RD
X2 20 DG/RD
LHD
RHD
50 C201
F30 16 RD
S131
X2 20 DG/RD
X2 20 DG/RD
1
CIGAR LIGHTER (8W-41-2) (8W-41-3)
LOW NOTE HORN (8W-41-2) (8W-41-3)
HIGH NOTE HORN (8W-41-2) (8W-41-3)

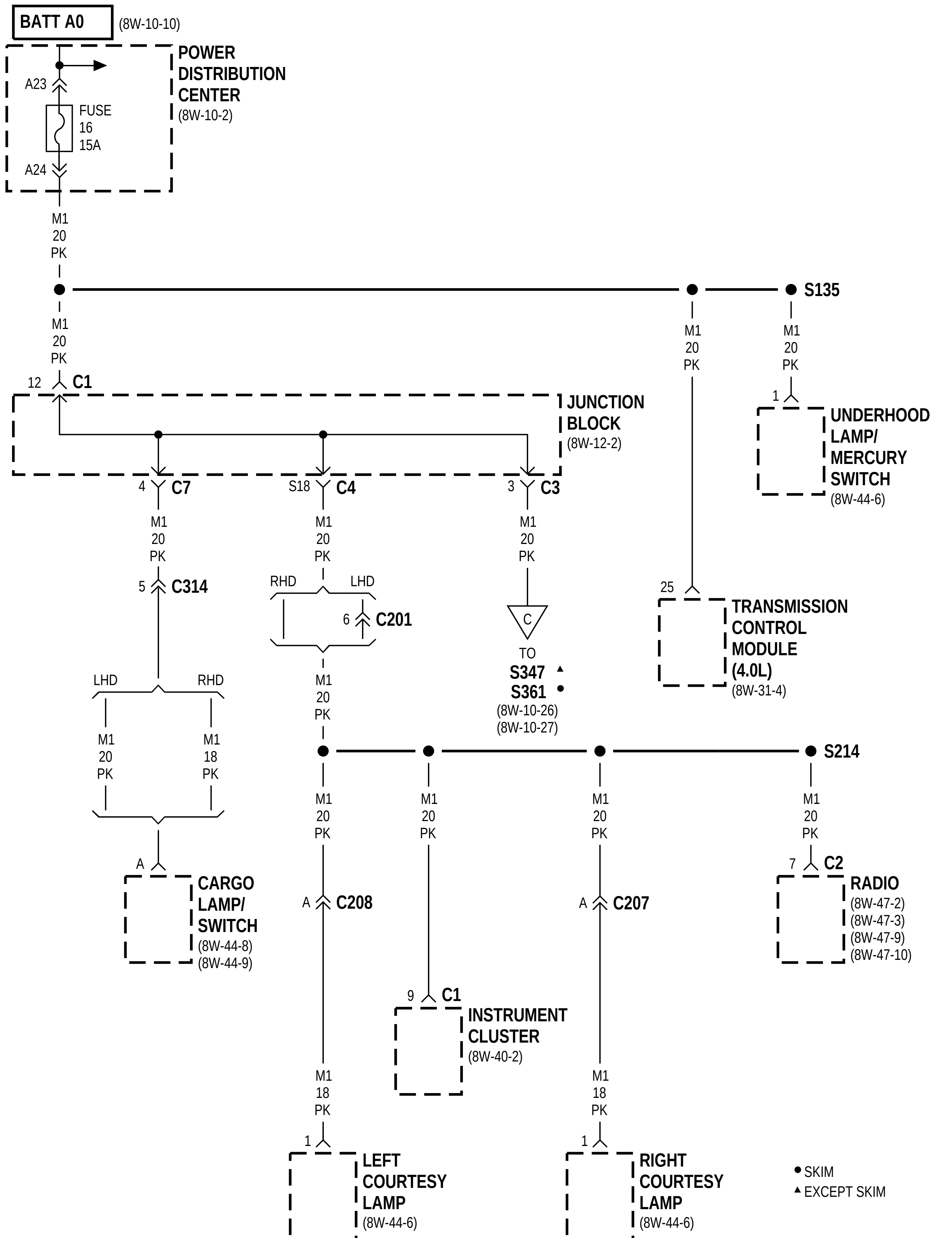

BATT A0
(8W-10-10)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
11
FUSE
5
40A
4
12
FUSE
6
40A
5
F141
12
LG/RD
A111
12
RD/LG
C10
RADIATOR
FAN
RELAY
(IN PDC)
(8W-42-8)
C14
D5
C100
A111
12
RD/LG
C25
12
LB
LHD
RHD
11
C201
7
C202
1
RADIATOR
FAN
MOTOR
(8W-42-8)
A111
12
RD/LG
8
HVAC
UNIT
(8W-42-2)
(8W-42-3)
(8W-42-4)
(8W-42-5)

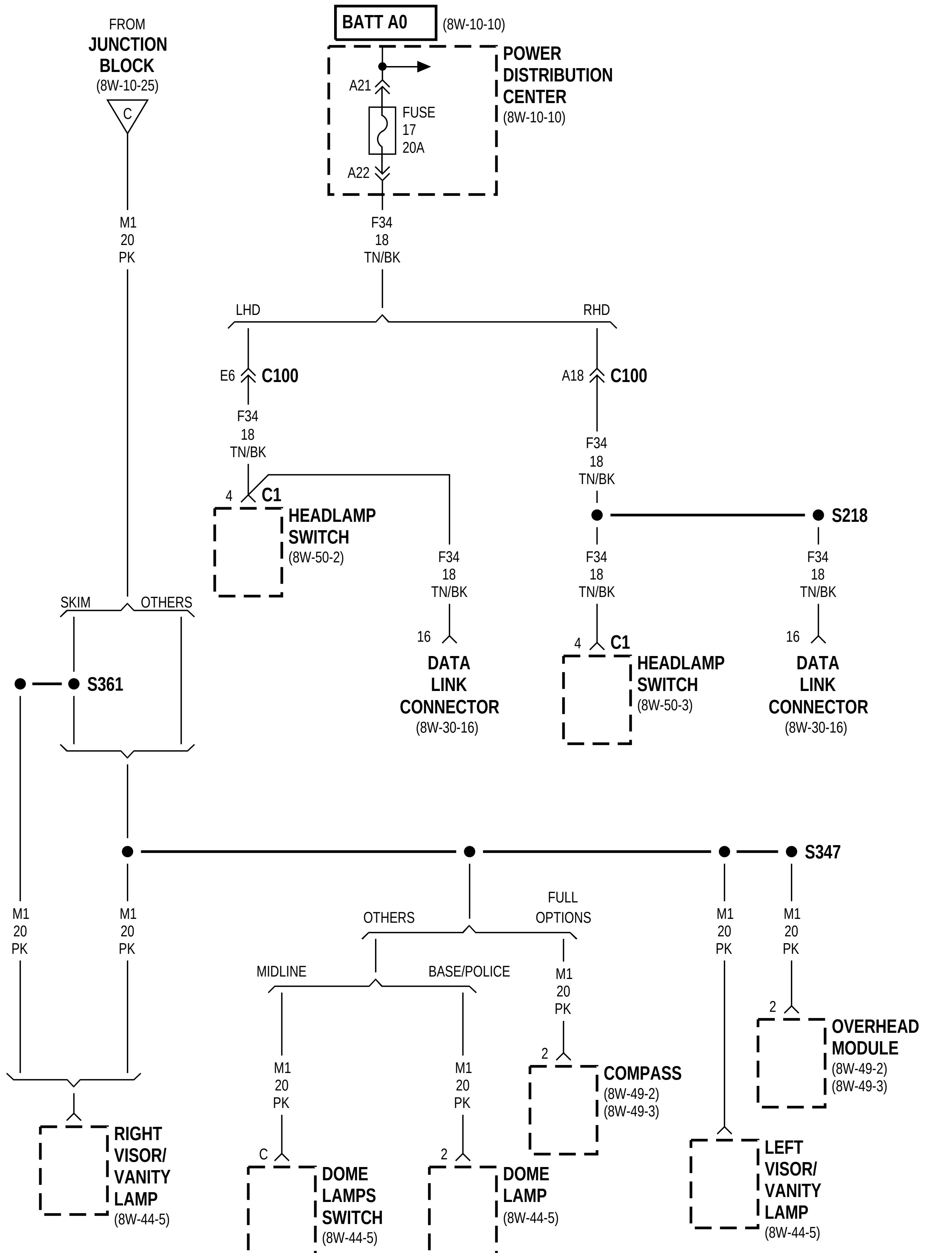

BATT A0
(8W-10-10)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
13
FUSE
7
30A
6
22
FUSE
9
20A
15
A1
FUSE
27
10A
A2
A3
14
RD/WT
A3
14
RD/WT
A17
16
RD/BK
A17
16
RD/BK
F1
20
DB/GY
B1
A/C
COMPRESSOR
CLUTCH
RELAY
(IN PDC)
(8W-42-6)
B2
C3
16
DB/BK
4.0L
RHD
OTHER
4
C108
C3
16
DB/BK
E10
C100
F1
20
DB/GY
D1
C100
A/C
COMPRESSOR
CLUTCH
(8W-42-6)
A3
14
RD/WT
8
C1
HEADLAMP
SWITCH
(8W-50-2)
(8W-50-3)
(8W-50-4)
A3
14
RD/WT
1
SENTRY
KEY
IMMOBILIZER
MODULE
(EXCEPT
POLICE/
POSTAL)
(8W-39-4)
(8W-39-5)
6
DAYTIME
RUNNING
LAMP
MODULE
(8W-50-19)
2
HEADLAMP
DELAY
MODULE
(8W-50-9)
(8W-50-10)

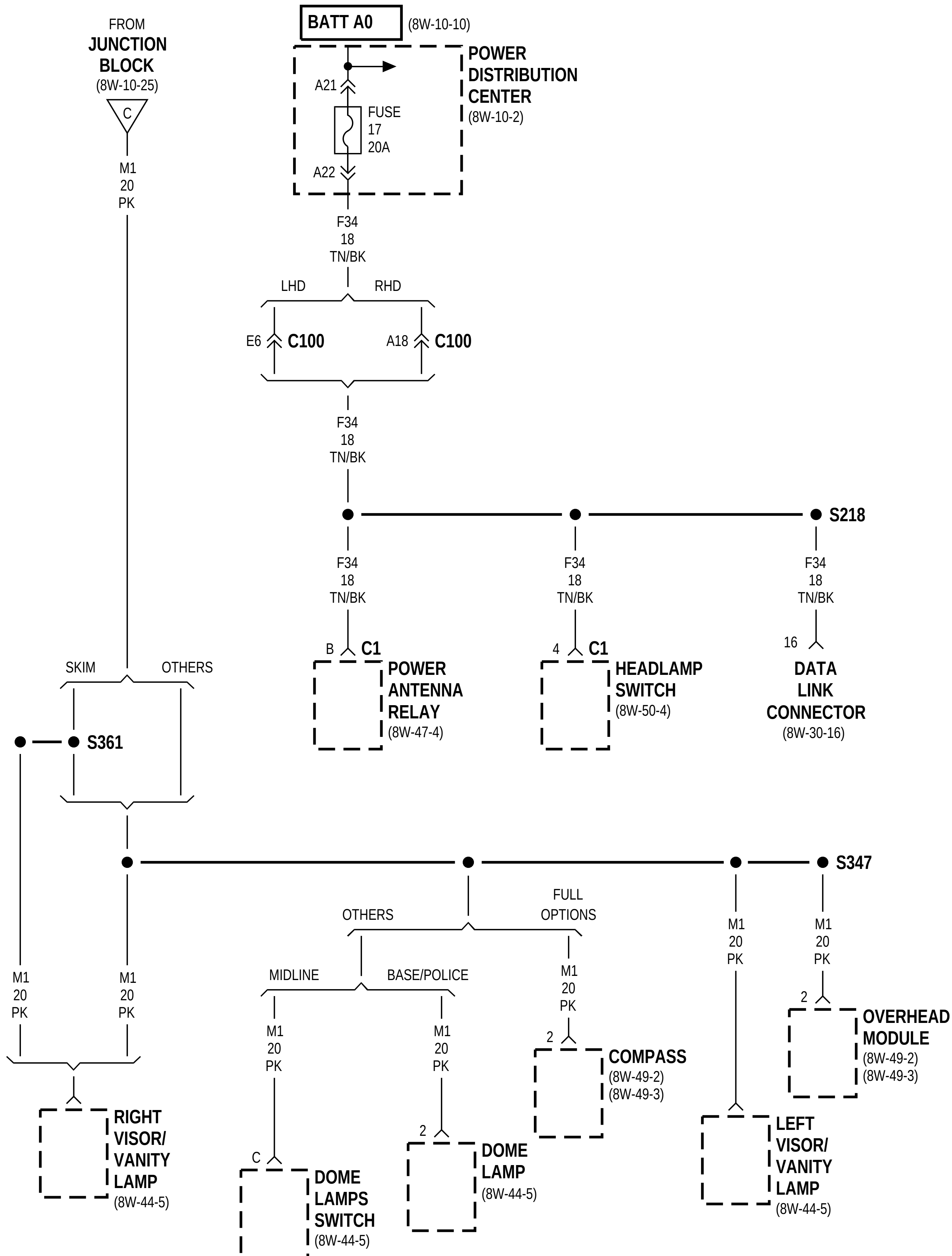

BATT A0
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-6)
FUSE 6 30A
FUSE 15 30A
FUSE 7 20A
FUSE 8 30A
12
5
21
28
13
6
14
7
A61 14 LG/RD
A4 12 BK/PK
A41 16 YL
A3 14 RD/WT
1 C2
JUNCTION BLOCK
(8W-12-2)
30
REAR WINDOW DEFOGGER RELAY
(8W-48-2)
(8W-48-3)
87
FUSE 13 SPARE
(8W-12-16)
(8W-12-17)
FUSE 14 10A
(8W-12-16)
(8W-12-17)
1 C6
C15 12 BK/WT
4 C326
C15 12 BK/WT
2 C312
3 C310
C15 12 BK/WT
D1 C100
D10
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-6)
D14
T40 16 BR
10 C111
T40 14 BR
ENGINE STARTER MOTOR
(8W-21-6)
A3 14 RD/WT
D2
FUEL HEATER RELAY (IN PDC)
(8W-30-21)
D8
A93 14 RD/BK
1
FUEL HEATER
(8W-30-21)
REAR WINDOW DEFOGGER
(8W-48-2)
(8W-48-3)
8 C1
HEADLAMP SWITCH
(8W-50-4)
A3 14 RD/WT
2
HEADLAMP DELAY MODULE
(8W-50-10)

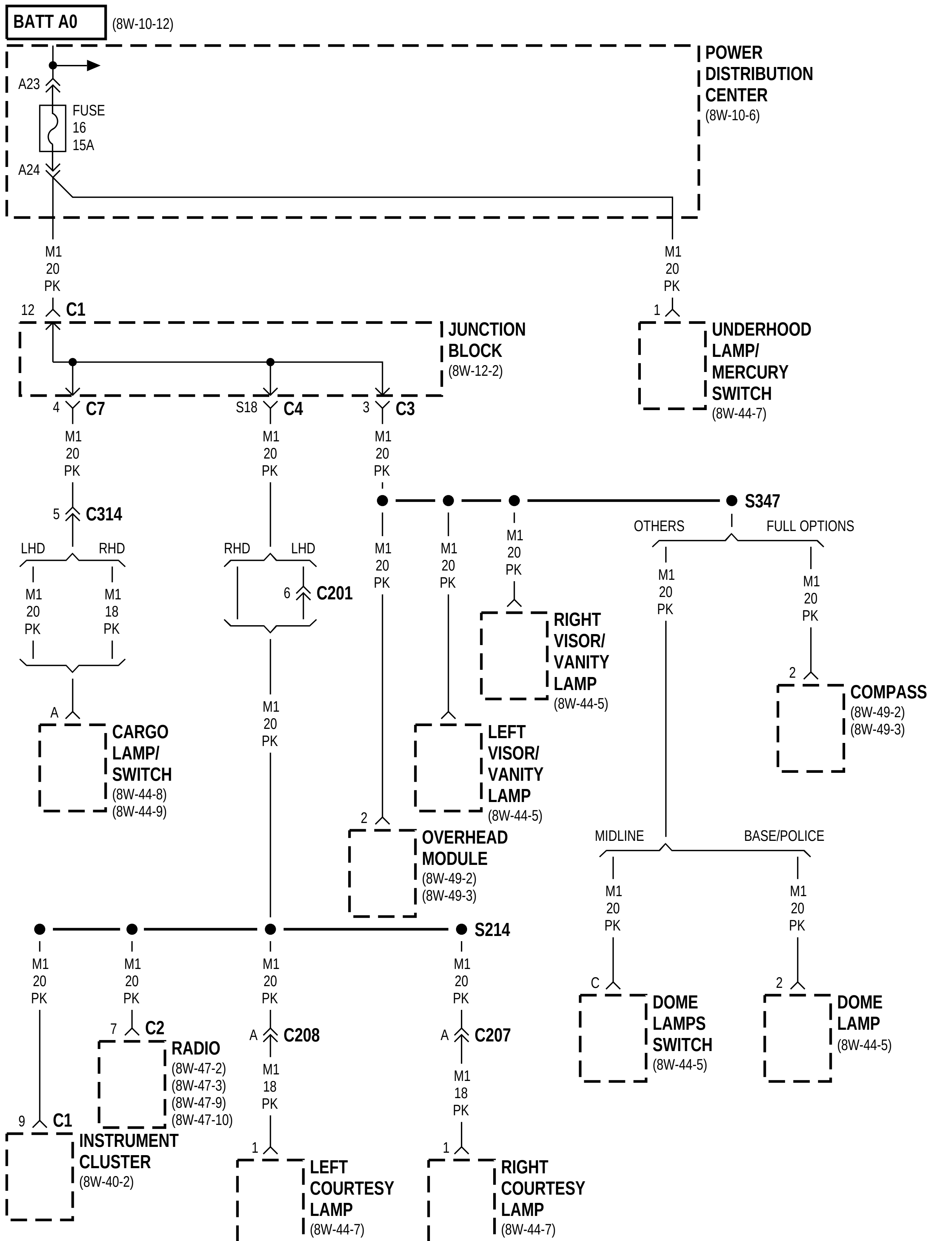

BATT A0
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
16
FUSE 10 20A
23
17
FUSE 11 30A
24
18
FUSE 12 40A (ABS)
25
19
FUSE 13 20A (ABS)
26
A41 16 YL
A4 12 BK/PK
A10 12 RD/DG
A20 12 RD/DB
D10
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-2)
(8W-21-3)
(8W-21-4)
(8W-21-5)
D14
25
9
CONTROLLER ANTI-LOCK BRAKE (4.0L)
(8W-35-2)
1 C2
JUNCTION BLOCK
(8W-12-2)
30
REAR WINDOW DEFOGGER RELAY
(8W-48-2)
(8W-48-3)
87
FUSE 13 SPARE
(8W-12-16)
(8W-12-17)
FUSE 14 10A
(8W-12-16)
(8W-12-17)
T40 16 BR
1 C108
T40 16 BR
1 C6
C15 12 BK/WT
4 C326
C15 12 BK/WT
2 C312
3 C310
C15 12 BK/WT
ENGINE STARTER MOTOR
(8W-21-2)
(8W-21-3)
(8W-21-4)
(8W-21-5)
REAR WINDOW DEFOGGER
(8W-48-2)
(8W-48-3)

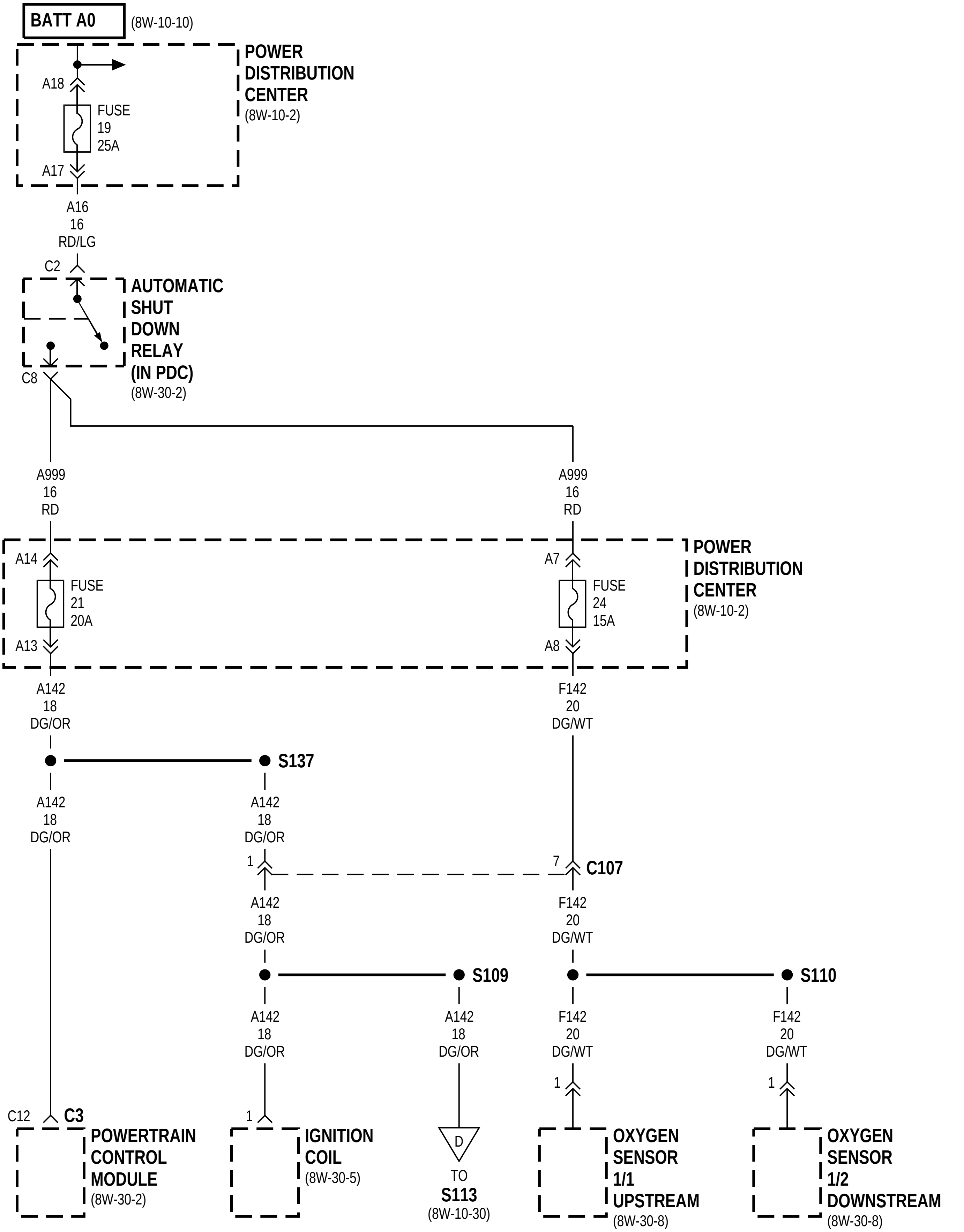

BATT A0
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-6)
22
17
18
20
19
FUSE 9 50A
FUSE 11 40A
FUSE 12 40A (ABS)
FUSE 14 20A (ABS)
FUSE 13 40A
15
24
25
27
26
A7 10 RD/BK
A111 12 RD/LG
F141 12 LG/RD
D5 C100
LHD
RHD
11 C201
7 C202
A10 12 RD/DG
A20 12 RD/DB
C10
RADIATOR FAN RELAY (IN PDC)
(8W-42-8)
C14
C25 12 LB
8
HVAC UNIT
(8W-42-2)
25
9
CONTROLLER ANTI-LOCK BRAKE
(8W-35-3)
1
RADIATOR FAN MOTOR
(8W-42-8)
2 C2
JUNCTION BLOCK
(8W-12-2)
CIRCUIT BREAKER 29 25A (8W-12-7)
FUSE 2 25A (8W-12-5)
FUSE 15 25A (8W-12-18) (8W-12-19)
FUSE 21 15A (8W-12-20)
30
CIGAR LIGHTER RELAY (8W-41-2) (8W-41-3)
86
30
HORN RELAY (8W-41-2) (8W-41-3)
87
FUSE 1 25A (8W-12-5)
FUSE 20 15A (8W-12-20)
87
M6 C4
4 C2
F30 16 RD
X2 20 DG/RD
LHD
RHD
S131
50 C201
X2 20 DG/RD
X2 20 DG/RD
1
CIGAR LIGHTER
(8W-41-2) (8W-41-3)
LOW NOTE HORN
(8W-41-2) (8W-41-3)
HIGH NOTE HORN
(8W-41-2) (8W-41-3)

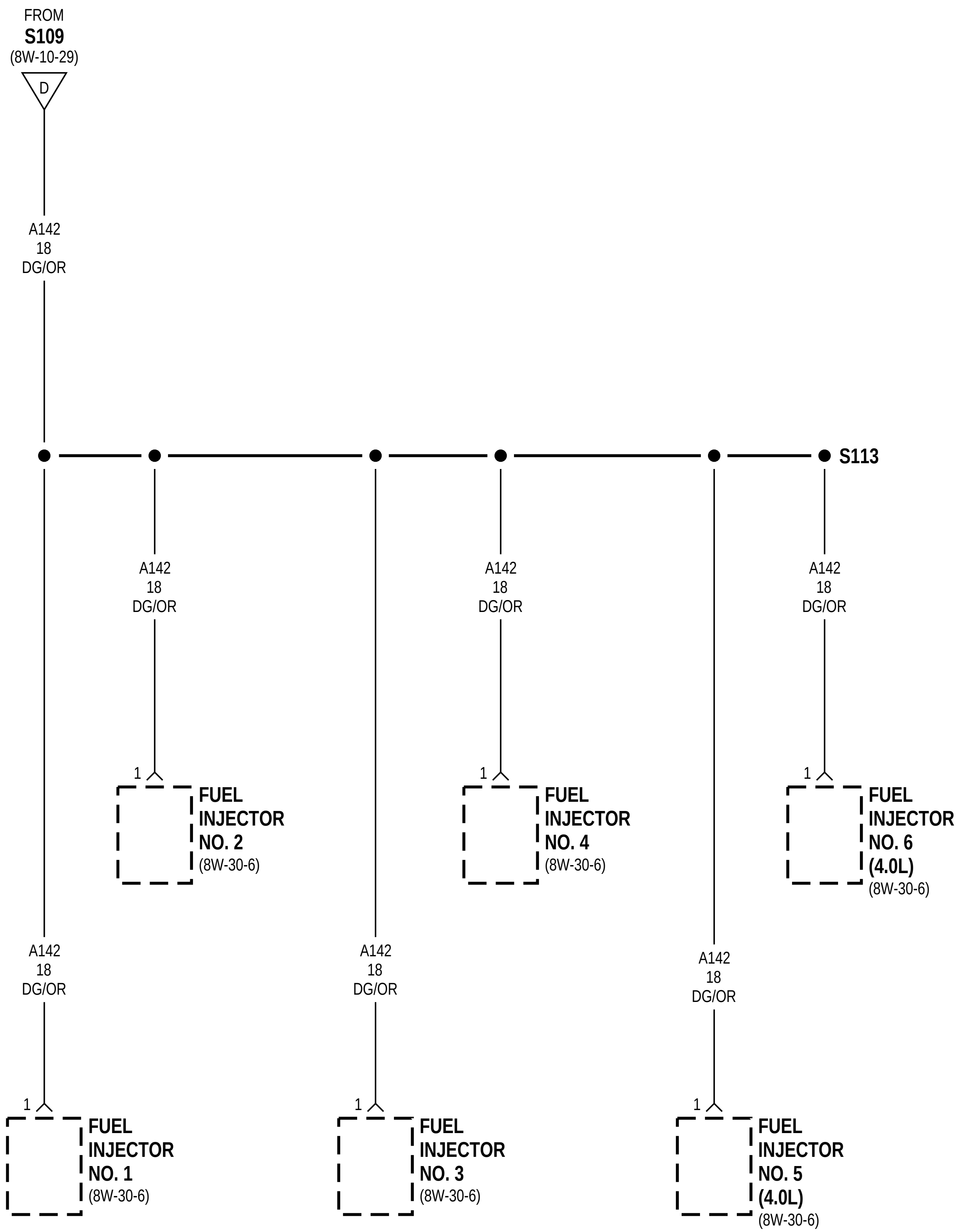

BATT A0
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
A23
FUSE 16 15A
A24
M1 20 PK
S135
12 C1
JUNCTION BLOCK
(8W-12-2)
4 C7
S18 C4
3 C3
1
UNDERHOOD LAMP/ MERCURY SWITCH
(8W-44-6)
5 C314
RHD
LHD
6 C201
C
TO
S347 ▲
S361 ●
(8W-10-26)
(8W-10-27)
25
TRANSMISSION CONTROL MODULE (4.0L)
(8W-31-4)
M1 18 PK
S214
A
CARGO LAMP/ SWITCH
(8W-44-8)
(8W-44-9)
A C208
A C207
7 C2
RADIO
(8W-47-2)
(8W-47-3)
(8W-47-9)
(8W-47-10)
9 C1
INSTRUMENT CLUSTER
(8W-40-2)
LEFT COURTESY LAMP
(8W-44-6)
RIGHT COURTESY LAMP
(8W-44-6)
● SKIM
▲ EXCEPT SKIM

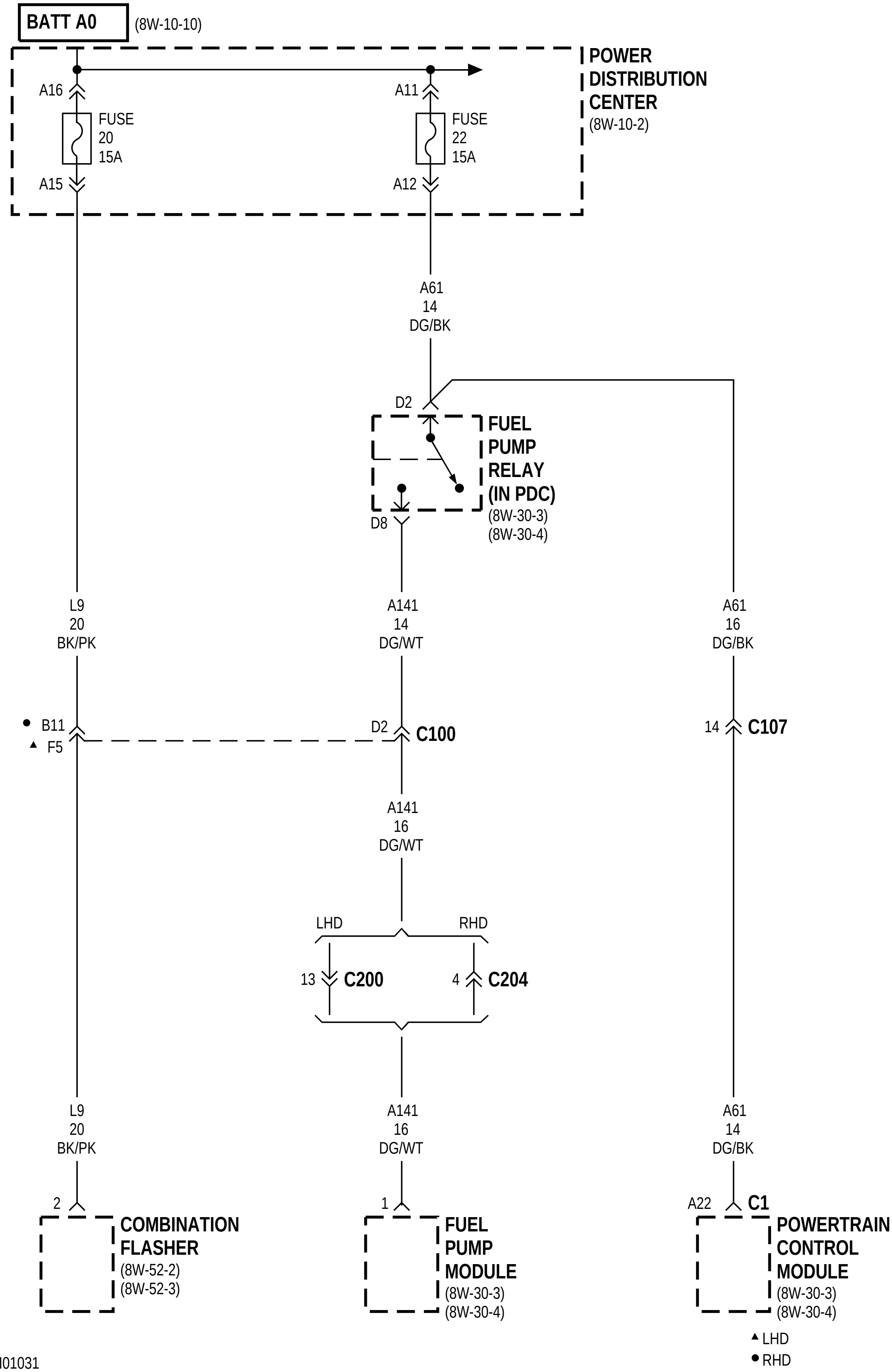

BATT A0
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-10)
A21
FUSE
17
20A
A22
F34
18
TN/BK
FROM
JUNCTION BLOCK
(8W-10-25)
C
M1
20
PK
LHD
RHD
E6
C100
A18
C100
4
C1
HEADLAMP SWITCH
(8W-50-2)
16
DATA LINK CONNECTOR
(8W-30-16)
4
C1
HEADLAMP SWITCH
(8W-50-3)
S218
16
DATA LINK CONNECTOR
(8W-30-16)
SKIM
OTHERS
S361
S347
OTHERS
FULL OPTIONS
MIDLINE
BASE/POLICE
RIGHT VISOR/ VANITY LAMP
(8W-44-5)
C
DOME LAMPS SWITCH
(8W-44-5)
2
DOME LAMP
(8W-44-5)
2
COMPASS
(8W-49-2)
(8W-49-3)
LEFT VISOR/ VANITY LAMP
(8W-44-5)
2
OVERHEAD MODULE
(8W-49-2)
(8W-49-3)

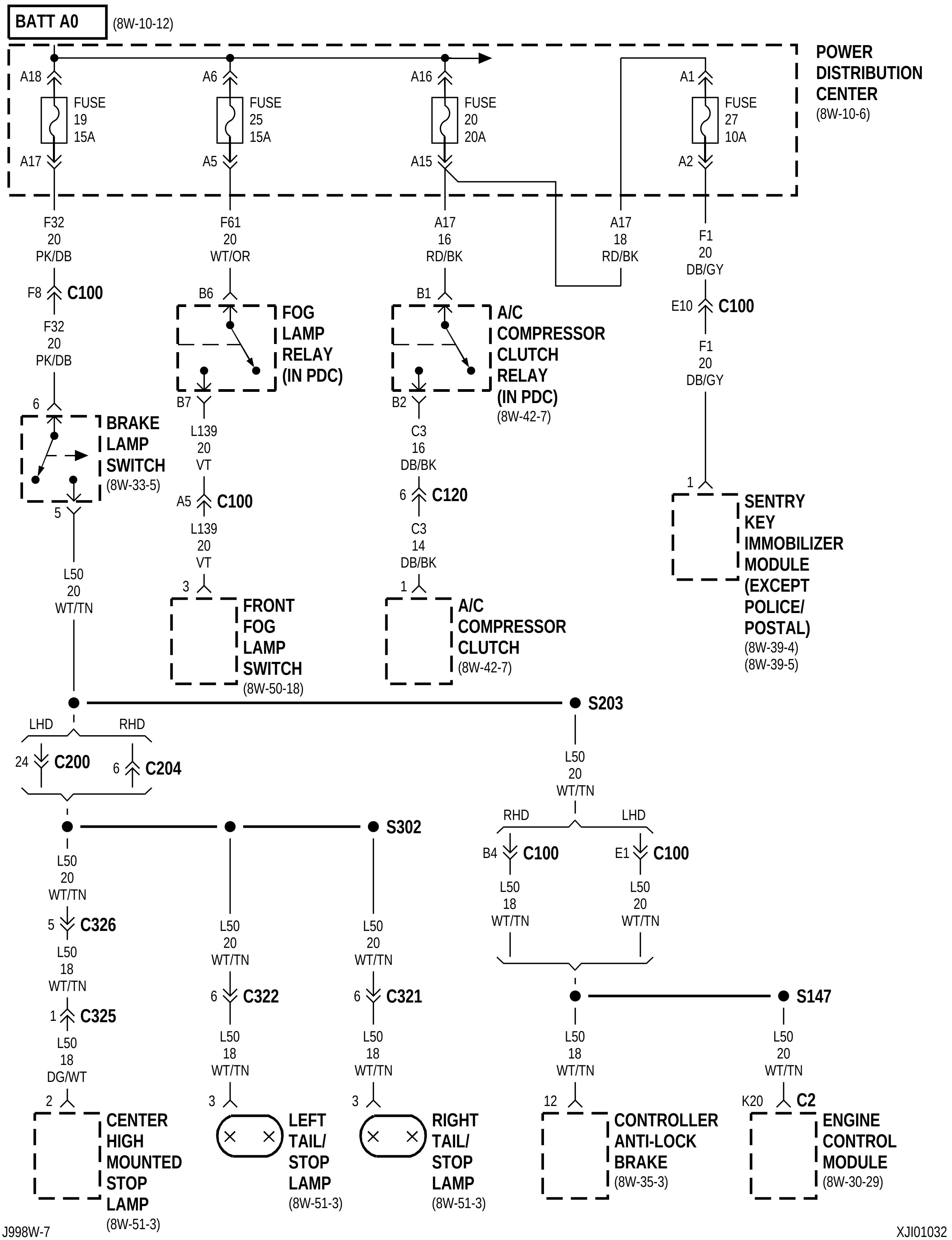

BATT A0
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
A21
FUSE 17 20A
A22
FROM JUNCTION BLOCK
(8W-10-25)
C
M1 20 PK
F34 18 TN/BK
LHD
RHD
E6
C100
A18
C100
S218
B
C1
POWER ANTENNA RELAY
(8W-47-4)
4
C1
HEADLAMP SWITCH
(8W-50-4)
16
DATA LINK CONNECTOR
(8W-30-16)
SKIM
OTHERS
S361
S347
OTHERS
FULL OPTIONS
MIDLINE
BASE/POLICE
RIGHT VISOR/ VANITY LAMP
(8W-44-5)
C
DOME LAMPS SWITCH
(8W-44-5)
2
DOME LAMP
(8W-44-5)
2
COMPASS
(8W-49-2)
(8W-49-3)
LEFT VISOR/ VANITY LAMP
(8W-44-5)
2
OVERHEAD MODULE
(8W-49-2)
(8W-49-3)


BATT A0
(8W-10-12)
A23
FUSE
16
15A
A24
POWER
DISTRIBUTION
CENTER
(8W-10-6)
M1
20
PK
12
C1
JUNCTION
BLOCK
(8W-12-2)
1
UNDERHOOD
LAMP/
MERCURY
SWITCH
(8W-44-7)
4
C7
S18
C4
3
C3
5
C314
LHD
RHD
M1
18
PK
6
C201
S347
OTHERS
FULL OPTIONS
RIGHT
VISOR/
VANITY
LAMP
(8W-44-5)
2
COMPASS
(8W-49-2)
(8W-49-3)
A
CARGO
LAMP/
SWITCH
(8W-44-8)
(8W-44-9)
LEFT
VISOR/
VANITY
LAMP
(8W-44-5)
OVERHEAD
MODULE
(8W-49-2)
(8W-49-3)
MIDLINE
BASE/POLICE
S214
C
DOME
LAMPS
SWITCH
(8W-44-5)
DOME
LAMP
(8W-44-5)
7
C2
RADIO
(8W-47-2)
(8W-47-3)
(8W-47-9)
(8W-47-10)
C208
C207
9
INSTRUMENT
CLUSTER
(8W-40-2)
LEFT
COURTESY
LAMP
(8W-44-7)
RIGHT
COURTESY
LAMP
(8W-44-7)


BATT A0
(8W-10-10)
A18
FUSE
19
25A
A17
POWER
DISTRIBUTION
CENTER
(8W-10-2)
A16
16
RD/LG
C2
AUTOMATIC
SHUT
DOWN
RELAY
(IN PDC)
(8W-30-2)
C8
A999
16
RD
A999
16
RD
A14
FUSE
21
20A
A13
A7
FUSE
24
15A
A8
POWER
DISTRIBUTION
CENTER
(8W-10-2)
A142
18
DG/OR
F142
20
DG/WT
S137
A142
18
DG/OR
A142
18
DG/OR
1
7
C107
A142
18
DG/OR
F142
20
DG/WT
S109
S110
A142
18
DG/OR
A142
18
DG/OR
F142
20
DG/WT
F142
20
DG/WT
1
1
C12
C3
POWERTRAIN
CONTROL
MODULE
(8W-30-2)
1
IGNITION
COIL
(8W-30-5)
D
TO
S113
(8W-10-30)
OXYGEN
SENSOR
1/1
UPSTREAM
(8W-30-8)
OXYGEN
SENSOR
1/2
DOWNSTREAM
(8W-30-8)


FROM
S109
(8W-10-29)
D
A142
18
DG/OR
S113
A142
18
DG/OR
1
FUEL
INJECTOR
NO. 2
(8W-30-6)
A142
18
DG/OR
1
FUEL
INJECTOR
NO. 4
(8W-30-6)
A142
18
DG/OR
1
FUEL
INJECTOR
NO. 6
(4.0L)
(8W-30-6)
A142
18
DG/OR
1
FUEL
INJECTOR
NO. 1
(8W-30-6)
A142
18
DG/OR
1
FUEL
INJECTOR
NO. 3
(8W-30-6)
A142
18
DG/OR
1
FUEL
INJECTOR
NO. 5
(4.0L)
(8W-30-6)


BATT A0
(8W-10-10)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
A16
FUSE
20
15A
A15
A11
FUSE
22
15A
A12
A61
14
DG/BK
D2
FUEL
PUMP
RELAY
(IN PDC)
(8W-30-3)
(8W-30-4)
D8
L9
20
BK/PK
A141
14
DG/WT
A61
16
DG/BK
B11
F5
D2
C100
14
C107
A141
16
DG/WT
LHD
RHD
13
C200
4
C204
L9
20
BK/PK
A141
16
DG/WT
A61
14
DG/BK
2
COMBINATION
FLASHER
(8W-52-2)
(8W-52-3)
1
FUEL
PUMP
MODULE
(8W-30-3)
(8W-30-4)
A22
C1
POWERTRAIN
CONTROL
MODULE
(8W-30-3)
(8W-30-4)
▲ LHD
● RHD



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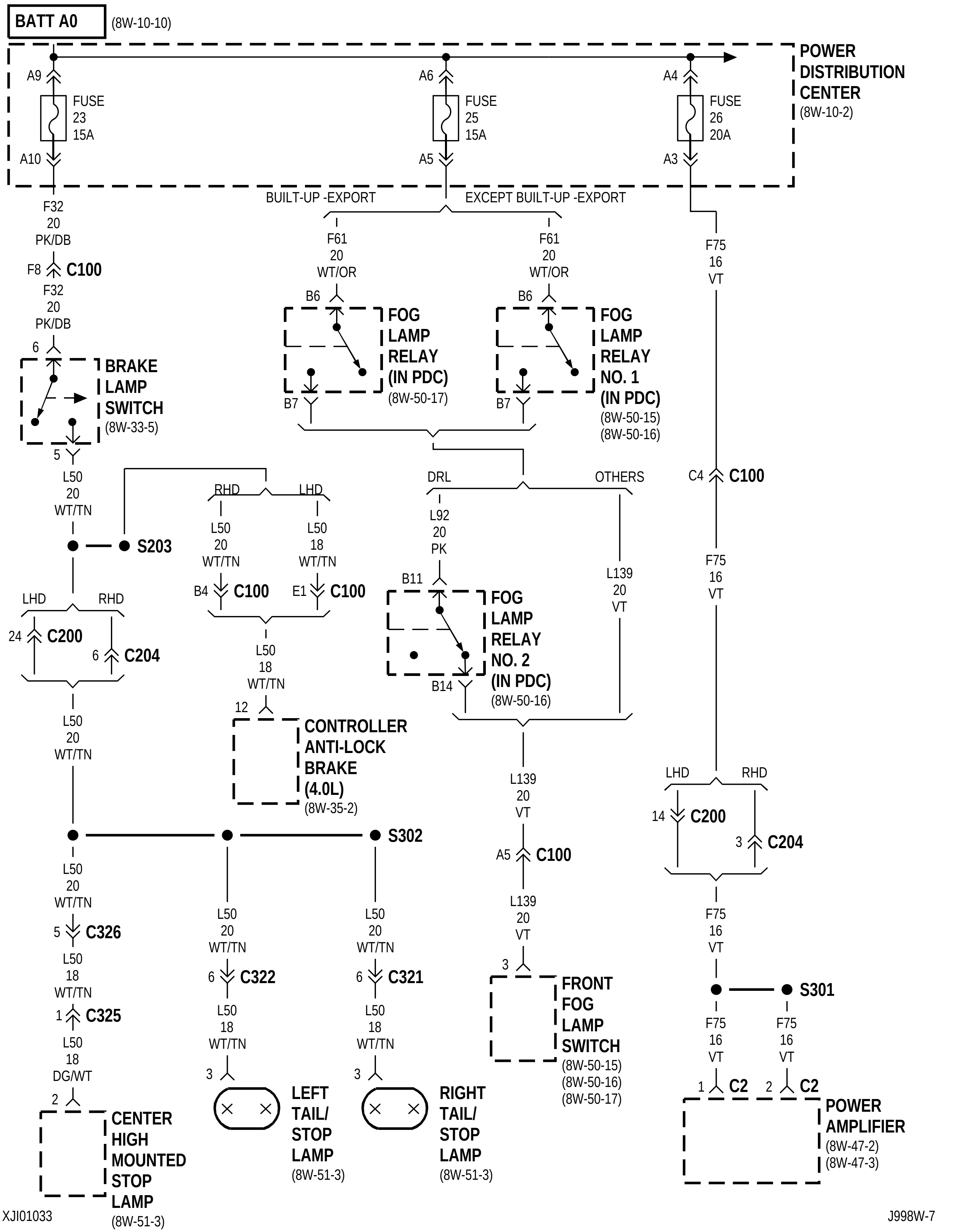
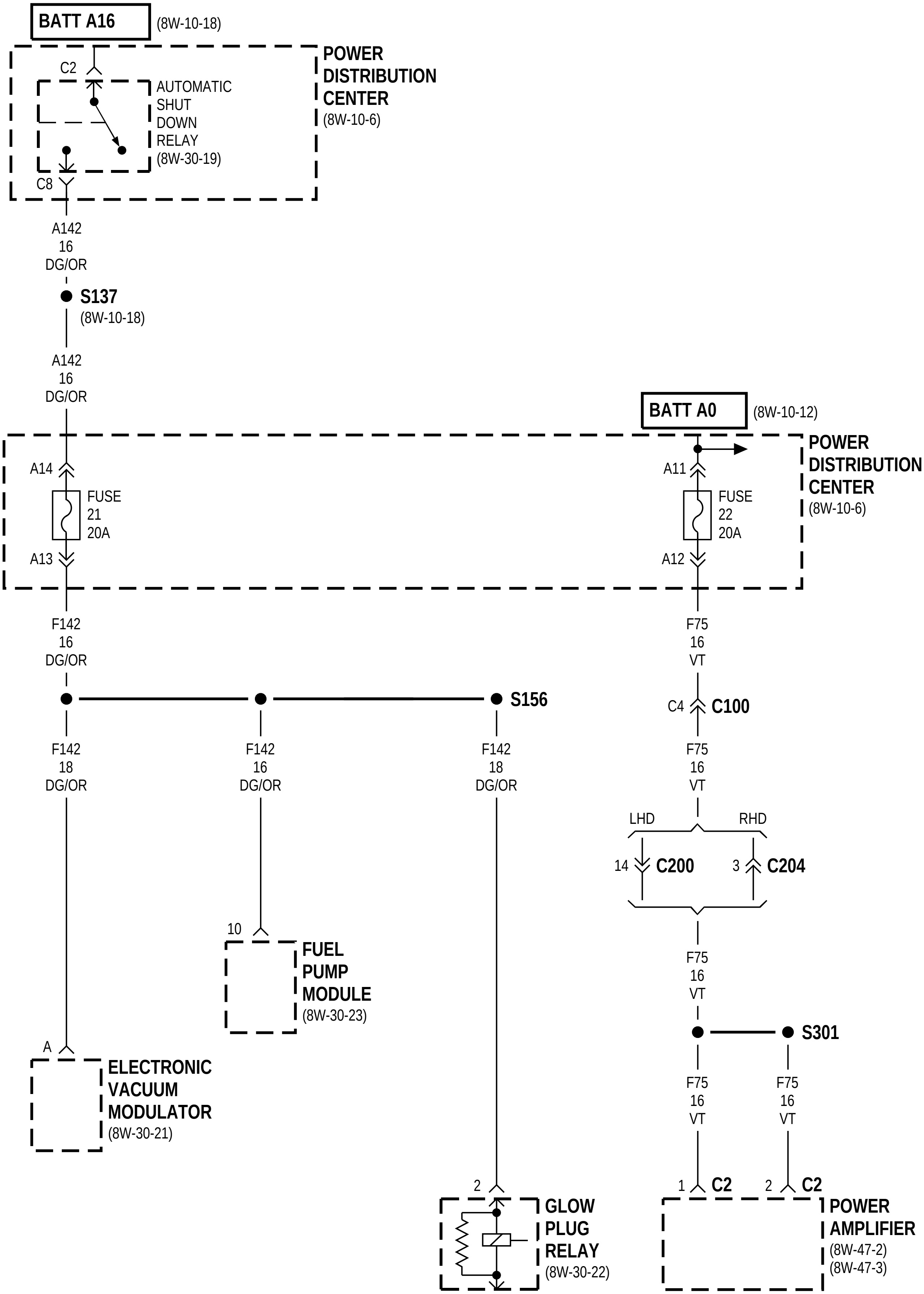
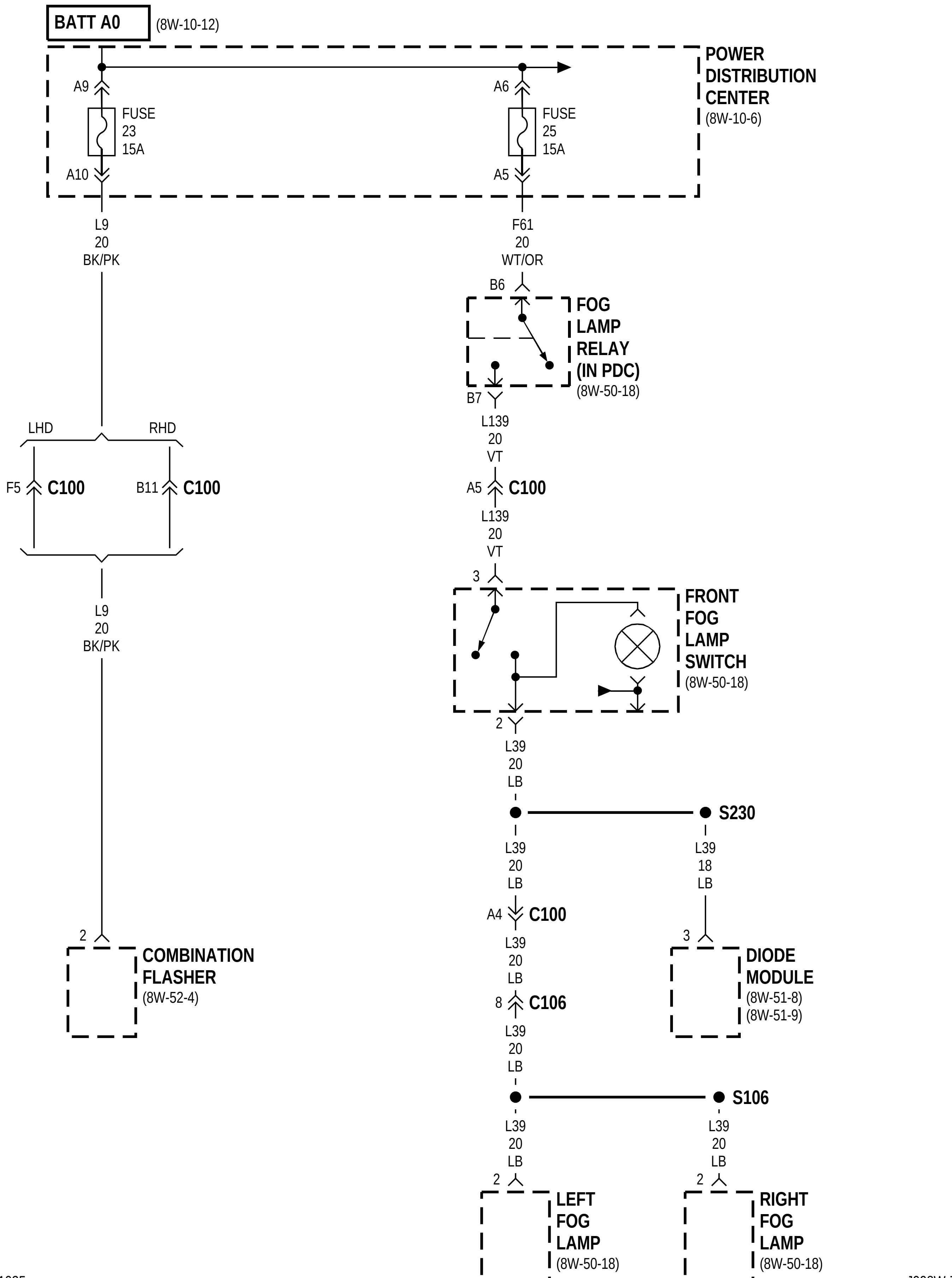
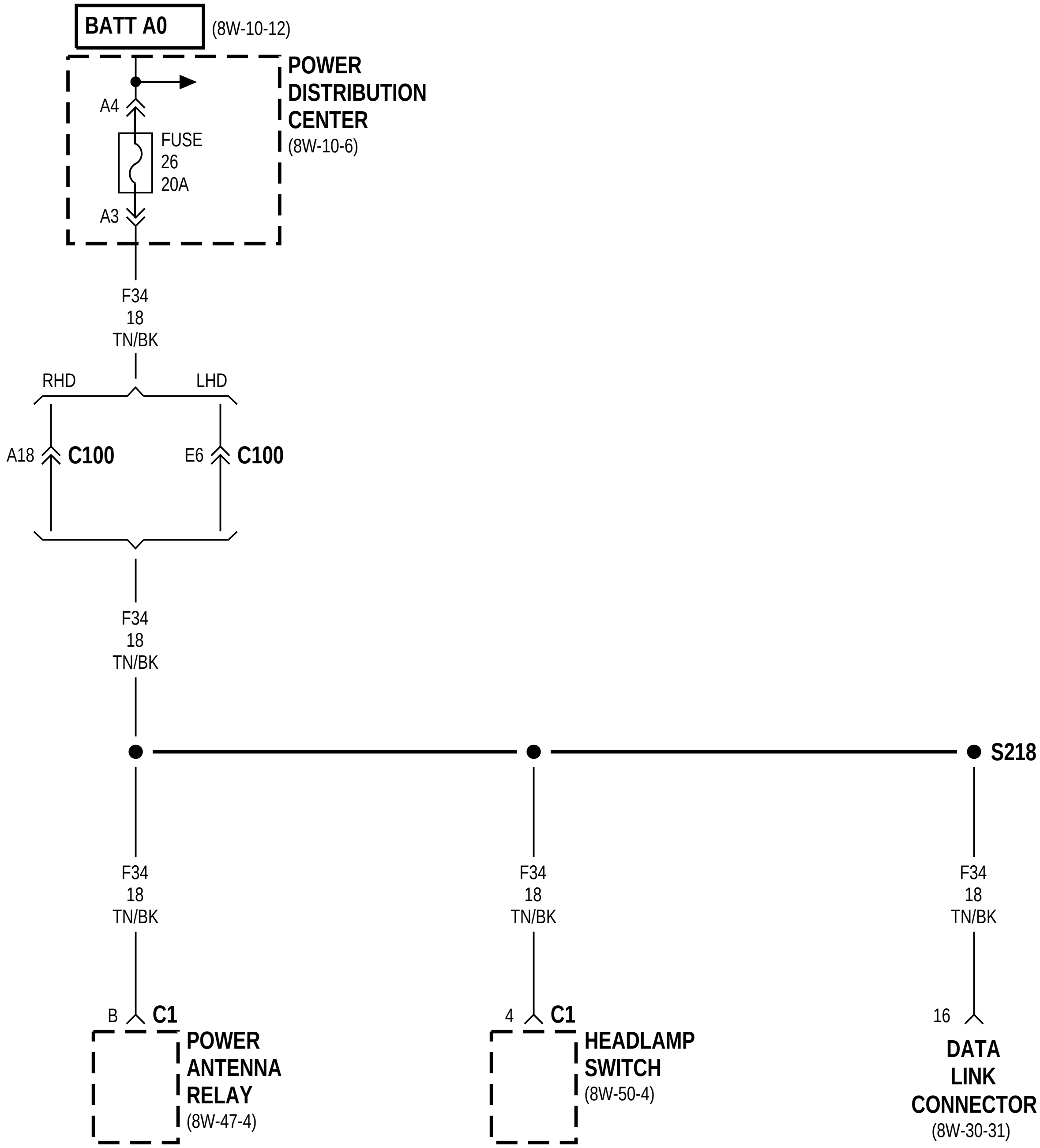
XJI01032


BATT A0
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
A9
FUSE 23 15A
A10
A6
FUSE 25 15A
A5
A4
FUSE 26 20A
A3
F32 20 PK/DB
F8 C100
F32 20 PK/DB
6
BRAKE LAMP SWITCH
(8W-33-5)
5
L50 20 WT/TN
S203
LHD
RHD
24 C200
6 C204
L50 20 WT/TN
S302
L50 20 WT/TN
5 C326
L50 18 WT/TN
1 C325
L50 18 DG/WT
2
CENTER HIGH MOUNTED STOP LAMP
(8W-51-3)
RHD
LHD
L50 20 WT/TN
L50 18 WT/TN
B4 C100
E1 C100
L50 18 WT/TN
12
CONTROLLER ANTI-LOCK BRAKE (4.0L)
(8W-35-2)
L50 20 WT/TN
6 C322
L50 18 WT/TN
3
LEFT TAIL/ STOP LAMP
(8W-51-3)
L50 20 WT/TN
6 C321
L50 18 WT/TN
3
RIGHT TAIL/ STOP LAMP
(8W-51-3)
BUILT-UP -EXPORT
EXCEPT BUILT-UP -EXPORT
F61 20 WT/OR
B6
FOG LAMP RELAY (IN PDC)
(8W-50-17)
B7
F61 20 WT/OR
B6
FOG LAMP RELAY NO. 1 (IN PDC)
(8W-50-15)
(8W-50-16)
B7
DRL
OTHERS
L92 20 PK
B11
FOG LAMP RELAY NO. 2 (IN PDC)
(8W-50-16)
B14
L139 20 VT
L139 20 VT
A5 C100
L139 20 VT
3
FRONT FOG LAMP SWITCH
(8W-50-15)
(8W-50-16)
(8W-50-17)
F75 16 VT
C4 C100
F75 16 VT
LHD
RHD
14 C200
3 C204
F75 16 VT
S301
F75 16 VT
F75 16 VT
1 C2
2 C2
POWER AMPLIFIER
(8W-47-2)
(8W-47-3)

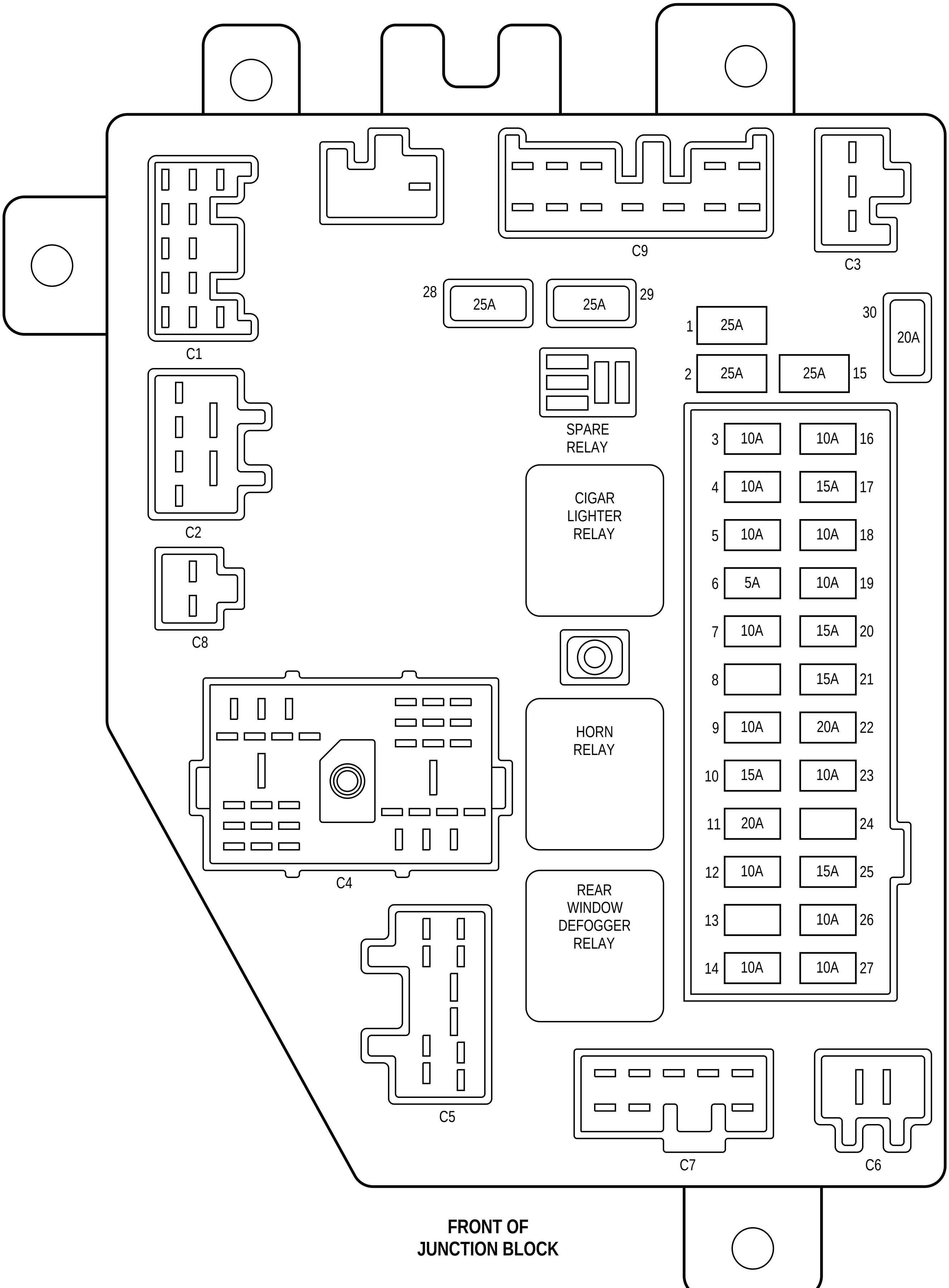

BATT A16
(8W-10-18)
C2
AUTOMATIC
SHUT
DOWN
RELAY
(8W-30-19)
POWER
DISTRIBUTION
CENTER
(8W-10-6)
C8
A142
16
DG/OR
S137
(8W-10-18)
A142
16
DG/OR
BATT A0
(8W-10-12)
A14
FUSE
21
20A
A13
A11
FUSE
22
20A
A12
POWER
DISTRIBUTION
CENTER
(8W-10-6)
F142
16
DG/OR
F75
16
VT
S156
C4
C100
F142
18
DG/OR
F142
16
DG/OR
F142
18
DG/OR
F75
16
VT
LHD
RHD
14
C200
3
C204
10
FUEL
PUMP
MODULE
(8W-30-23)
F75
16
VT
S301
A
ELECTRONIC
VACUUM
MODULATOR
(8W-30-21)
F75
16
VT
F75
16
VT
2
GLOW
PLUG
RELAY
(8W-30-22)
1
C2
2
C2
POWER
AMPLIFIER
(8W-47-2)
(8W-47-3)


BATT A0
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-6)
A9
A6
FUSE 23 15A
FUSE 25 15A
A10
A5
L9 20 BK/PK
F61 20 WT/OR
B6
FOG LAMP RELAY (IN PDC)
(8W-50-18)
B7
L139 20 VT
LHD
RHD
F5
C100
B11
C100
A5
C100
L139 20 VT
3
FRONT FOG LAMP SWITCH
(8W-50-18)
2
L9 20 BK/PK
L39 20 LB
S230
L39 20 LB
L39 18 LB
A4
C100
L39 20 LB
8
C106
L39 20 LB
2
COMBINATION FLASHER
(8W-52-4)
3
DIODE MODULE
(8W-51-8)
(8W-51-9)
S106
L39 20 LB
L39 20 LB
2
LEFT FOG LAMP
(8W-50-18)
2
RIGHT FOG LAMP
(8W-50-18)


BATT A0
(8W-10-12)
POWER
DISTRIBUTION
CENTER
(8W-10-6)
A4
FUSE
26
20A
A3
F34
18
TN/BK
RHD
LHD
A18
C100
E6
C100
F34
18
TN/BK
S218
F34
18
TN/BK
F34
18
TN/BK
F34
18
TN/BK
B
C1
POWER
ANTENNA
RELAY
(8W-47-4)
4
C1
HEADLAMP
SWITCH
(8W-50-4)
16
DATA
LINK
CONNECTOR
(8W-30-31)

8W-12 JUNCTION BLOCK

Component **Page**



FRONT OF
JUNCTION BLOCK

FUSES

FUSE NO.	AMPS	FUSED CIRCUIT	FEED CIRCUIT
1	25A	F38 16RD/LB	A7 10RD/BK
2	25A	INTERNAL	A7 10RD/BK
3	10A	L33 20RD	L3 16RD/OR
4	10A	L43 20VT	L4 16VT/WT
5	10A	L44 20VT/RD	L4 16VT/WT
6	5A	E2 20OR	E1 20TN
7	10A	INTERNAL	L7 18BK/YL
8	-	-	A21 12DB
9	10A	F87 20WT/BK	A21 12DB
10	15A	F20 18WT	A21 12DB
11	20A	F12 18DB/WT	A21 12DB
12	10A	L5 20BK INTERNAL	A22 12BK/OR
13	-	-	A4 12BK/PK
14	10A	INTERNAL	INTERNAL
15	25A	F35 16RD	A7 10RD/BK
16	10A	L34 20RD/OR	L3 16RD/OR
17	15A	X12 16RD/WT	A31 12BK/WT
18	10A	F83 18YL/DG	A31 12BK/WT
19	10A	F45 20YL/RD	A41 14YL
20	15A	A6 20RD/OR	A7 10RD/BK
21	15A	INTERNAL	A7 10RD/BK
22	20A	V23 18BR/PK	A22 12BK/OR
23	10A	INTERNAL	L7 18BK/YL
24	-	-	A22 12BK/OR
25	15A	F15 20DB/WT	A22 12BK/OR
26	10A	F14 18LG/YL	A22 12BK/OR
27	10A	F23 18DB/YL	A21 12DB

CIRCUIT BREAKERS

CB NO.	AMPS	FUSED CIRCUIT	FEED CIRCUIT
28	25A	INTERNAL	A31 12BK/WT
29	25A	F37 14RD/LB	A7 10RD/BK
30	20A	V6 16DB	A31 12BK/WT

CIGAR LIGHTER RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B (+)
85	Z1 14BK	GROUND
86	A31 12BK/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
87	F30 16RD	CIGAR LIGHTER RELAY OUTPUT
87A	-	-

HORN RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B (+)
85	X3 20BK/RD	HORN RELAY CONTROL
86	A7 10RD/BK	FUSED B (+)
87	X2 20DG/RD	HORN RELAY OUTPUT
87A	-	-

REAR WINDOW DEFOGGER RELAY

CAVITY	CIRCUIT	FUNCTION
30	A4 12BK/PK	FUSED B (+)
85	C81 20LB/WT	REAR WINDOW DEFOGGER RELAY CONTROL
86	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN)
87	C15 12BK/WT	REAR WINDOW DEFOGGER RELAY OUTPUT
87A	-	-

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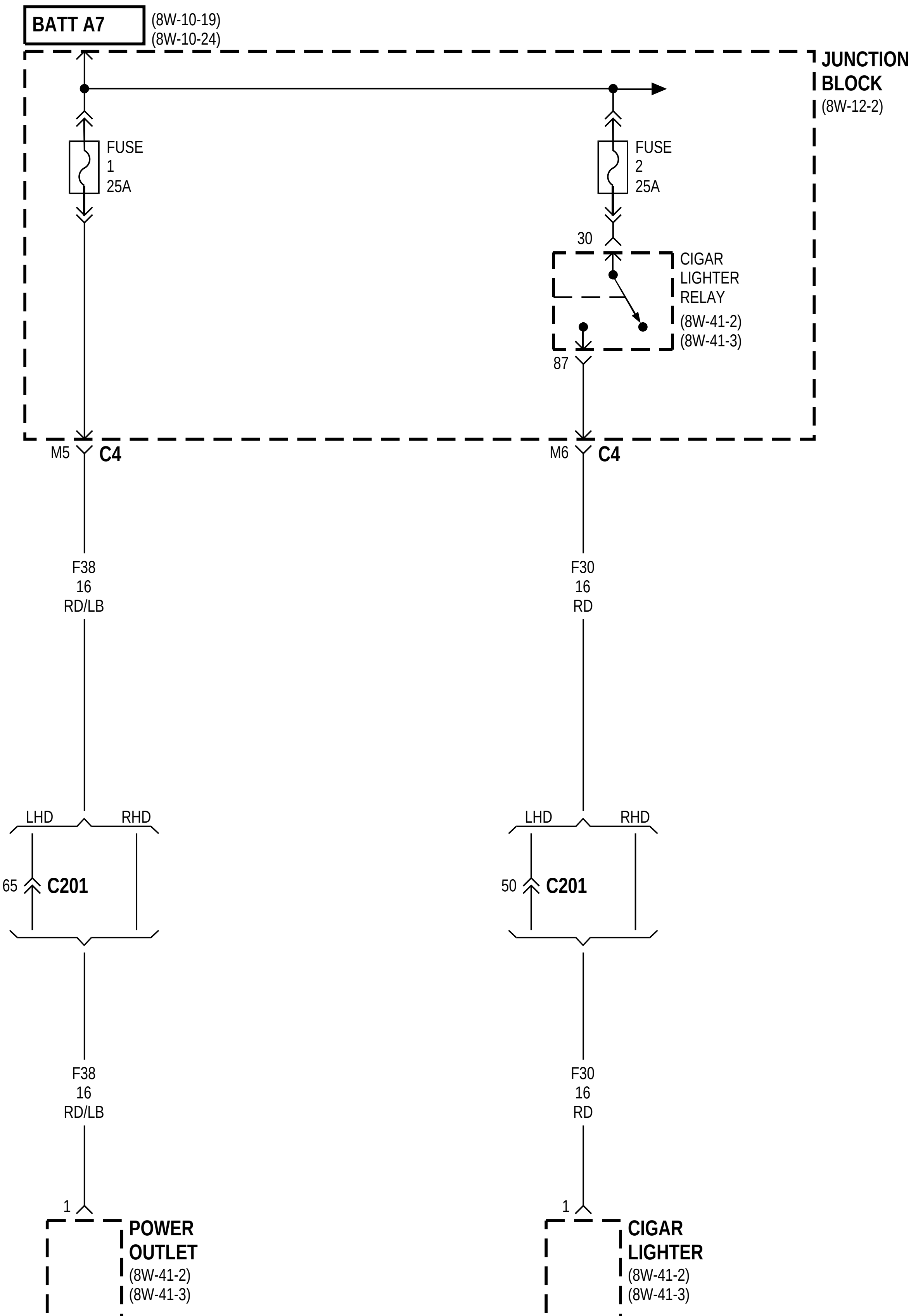
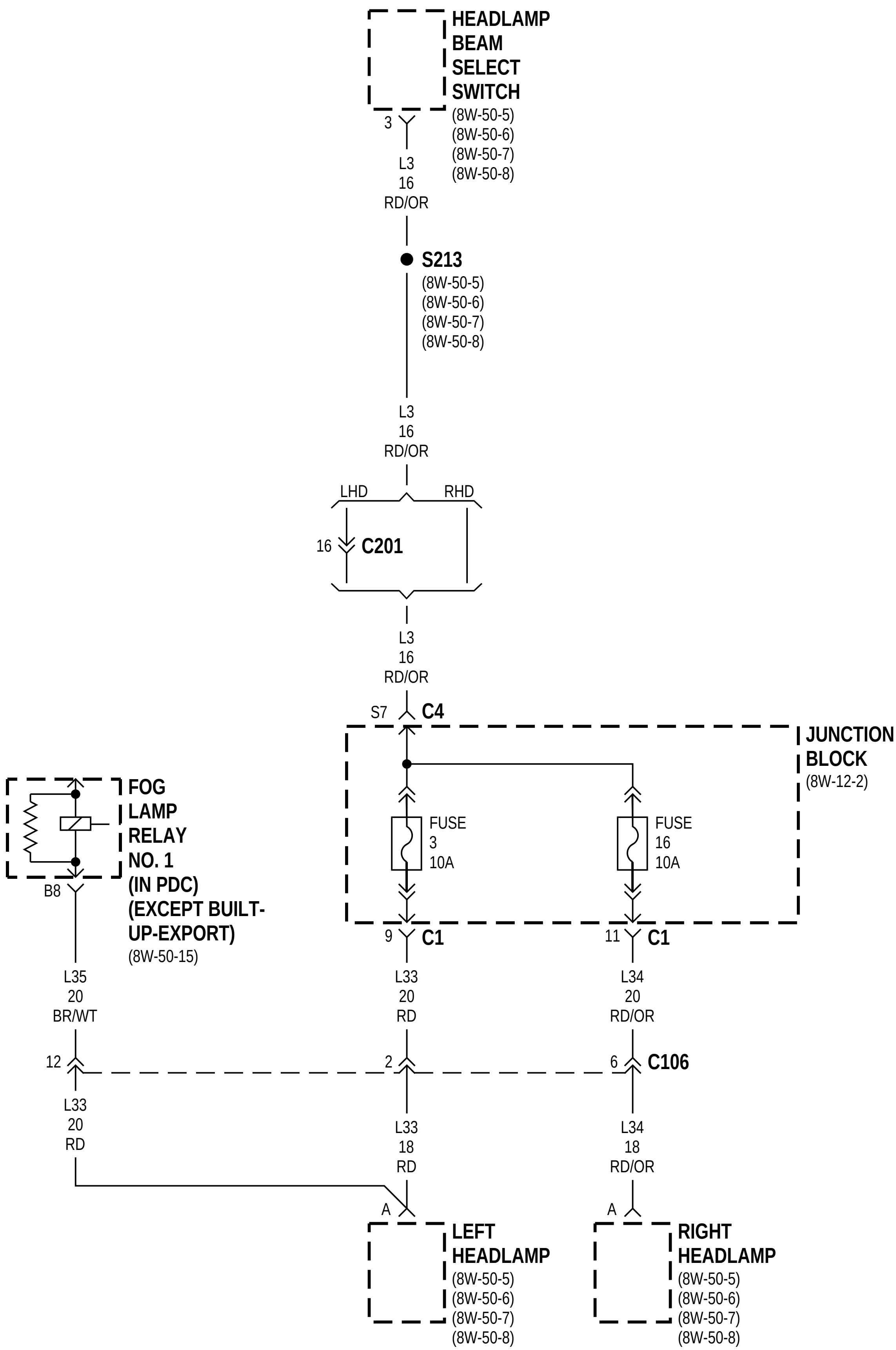
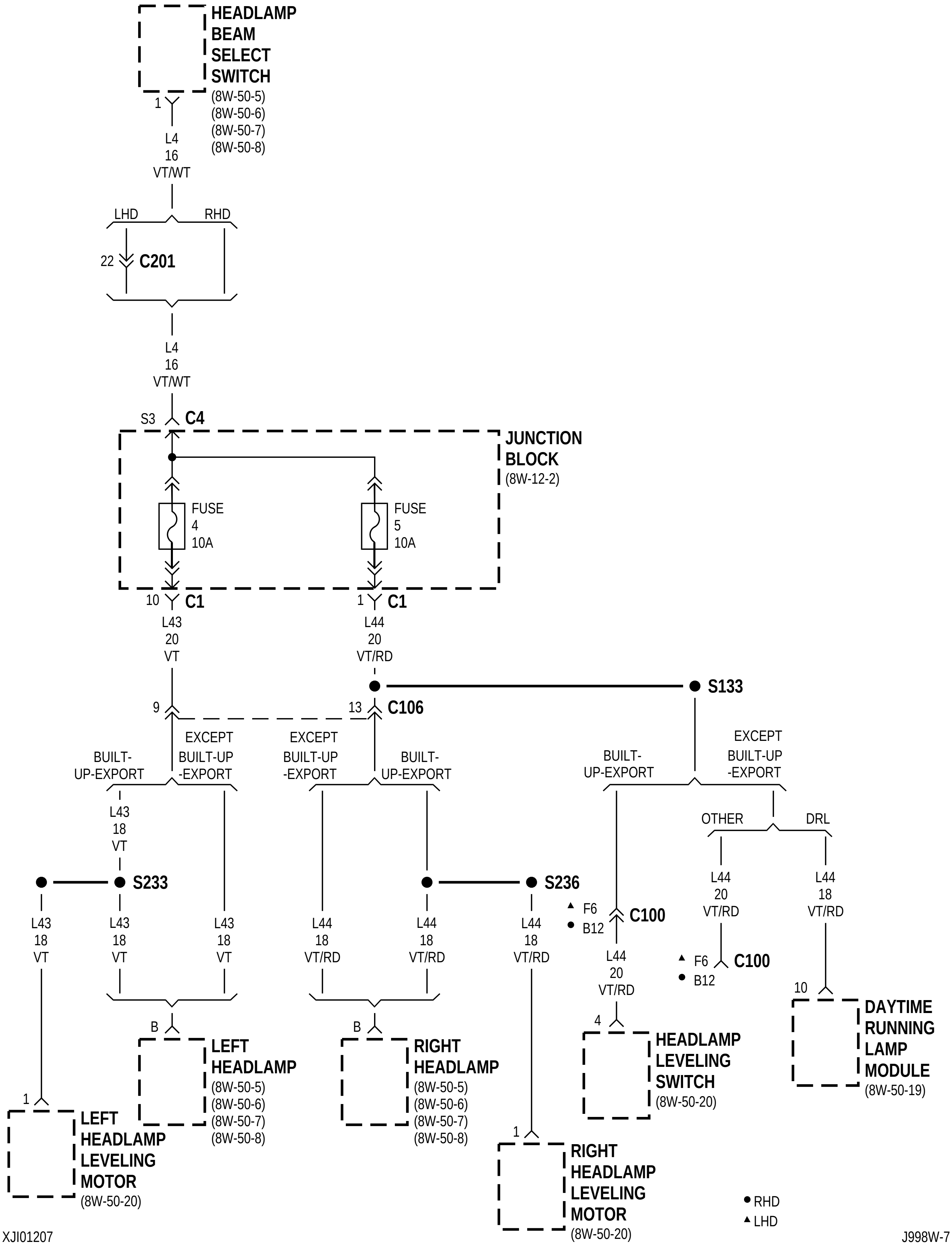
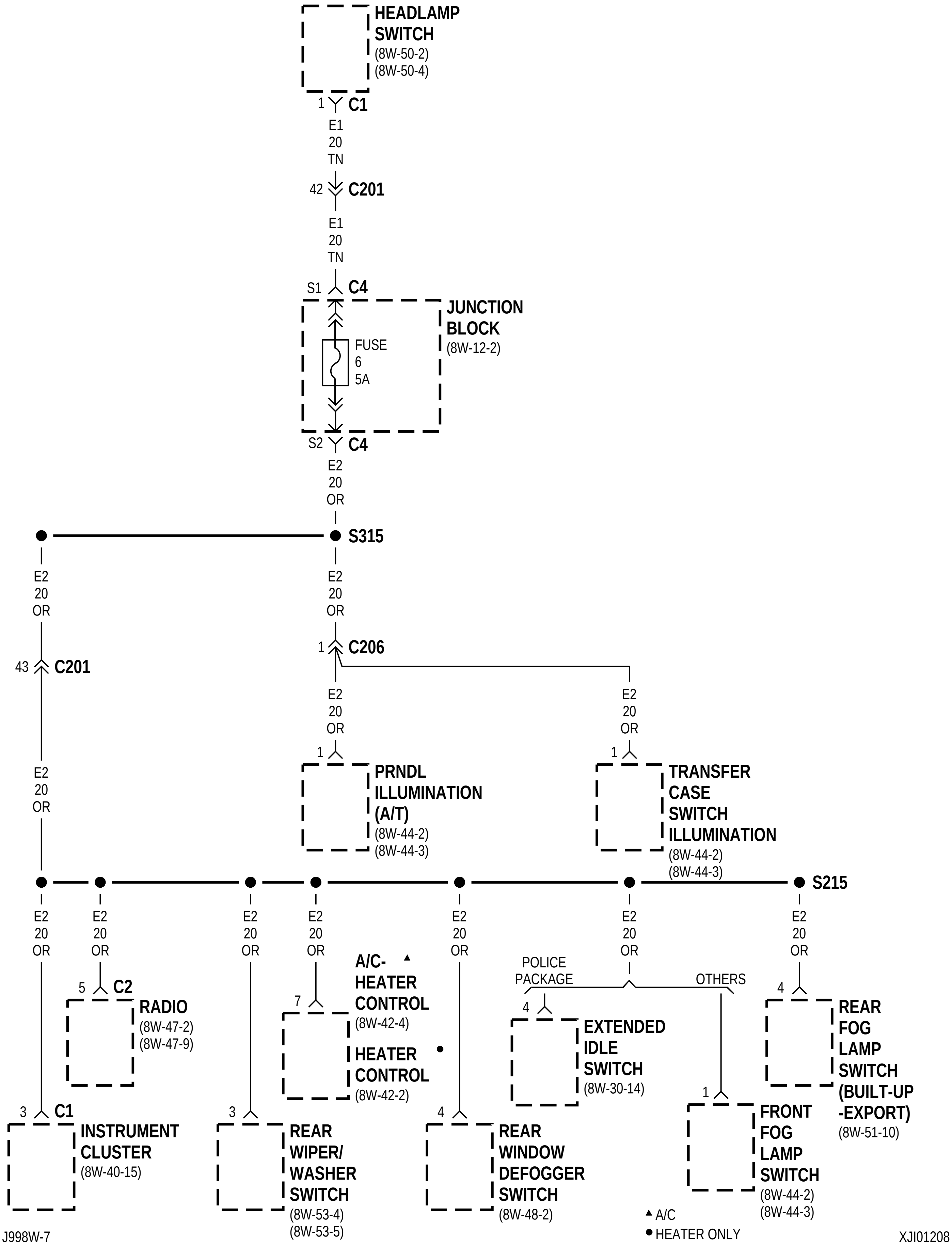

BATT A7
(8W-10-19)
(8W-10-24)
JUNCTION BLOCK
(8W-12-2)
FUSE 1 25A
FUSE 2 25A
30
CIGAR LIGHTER RELAY
(8W-41-2)
(8W-41-3)
87
M5 C4
M6 C4
F38 16 RD/LB
F30 16 RD
LHD RHD
65 C201
LHD RHD
50 C201
F38 16 RD/LB
F30 16 RD
1
POWER OUTLET
(8W-41-2)
(8W-41-3)
1
CIGAR LIGHTER
(8W-41-2)
(8W-41-3)

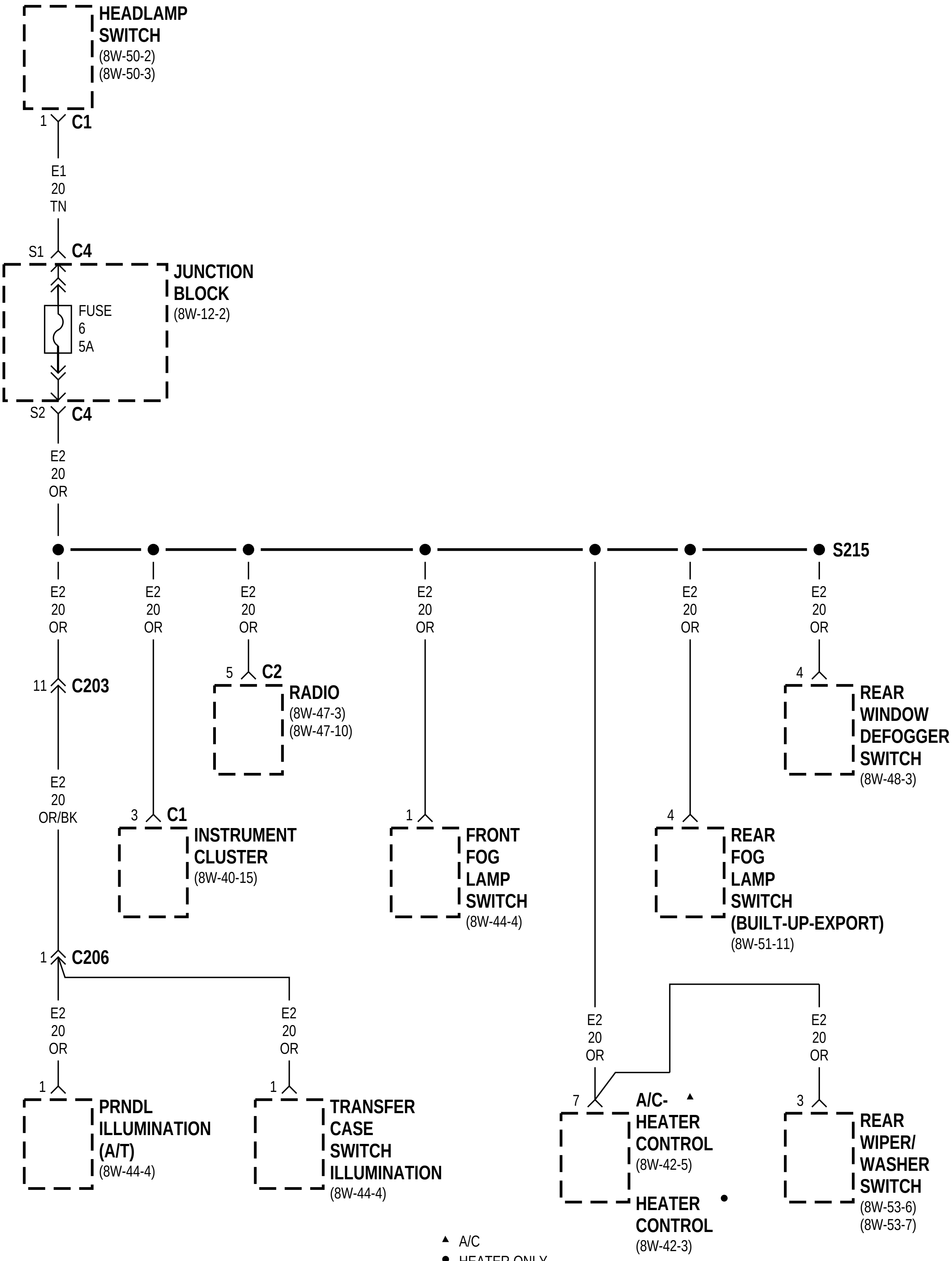

HEADLAMP
BEAM
SELECT
SWITCH
(8W-50-5)
(8W-50-6)
(8W-50-7)
(8W-50-8)
3
L3
16
RD/OR
S213
(8W-50-5)
(8W-50-6)
(8W-50-7)
(8W-50-8)
L3
16
RD/OR
LHD
RHD
16
C201
L3
16
RD/OR
S7
C4
JUNCTION
BLOCK
(8W-12-2)
FUSE
3
10A
FUSE
16
10A
FOG
LAMP
RELAY
NO. 1
(IN PDC)
(EXCEPT BUILT-
UP-EXPORT)
(8W-50-15)
B8
9
C1
11
C1
L35
20
BR/WT
L33
20
RD
L34
20
RD/OR
12
2
6
C106
L33
20
RD
L33
18
RD
L34
18
RD/OR
A
A
LEFT
HEADLAMP
(8W-50-5)
(8W-50-6)
(8W-50-7)
(8W-50-8)
RIGHT
HEADLAMP
(8W-50-5)
(8W-50-6)
(8W-50-7)
(8W-50-8)


HEADLAMP BEAM SELECT SWITCH
(8W-50-5)
(8W-50-6)
(8W-50-7)
(8W-50-8)
1
L4
16
VT/WT
LHD
RHD
22
C201
L4
16
VT/WT
S3
C4
JUNCTION BLOCK
(8W-12-2)
FUSE
4
10A
FUSE
5
10A
10
C1
1
C1
L43
20
VT
L44
20
VT/RD
S133
9
13
C106
BUILT-UP-EXPORT
EXCEPT BUILT-UP-EXPORT
EXCEPT BUILT-UP-EXPORT
BUILT-UP-EXPORT
BUILT-UP-EXPORT
EXCEPT BUILT-UP-EXPORT
OTHER
DRL
L43
18
VT
S233
S236
L44
20
VT/RD
L44
18
VT/RD
L43
18
VT
L43
18
VT
L43
18
VT
L44
18
VT/RD
L44
18
VT/RD
L44
18
VT/RD
F6
B12
C100
F6
B12
C100
L44
20
VT/RD
10
B
B
4
DAYTIME RUNNING LAMP MODULE
(8W-50-19)
LEFT HEADLAMP
(8W-50-5)
(8W-50-6)
(8W-50-7)
(8W-50-8)
RIGHT HEADLAMP
(8W-50-5)
(8W-50-6)
(8W-50-7)
(8W-50-8)
HEADLAMP LEVELING SWITCH
(8W-50-20)
1
LEFT HEADLAMP LEVELING MOTOR
(8W-50-20)
1
RIGHT HEADLAMP LEVELING MOTOR
(8W-50-20)
RHD
LHD

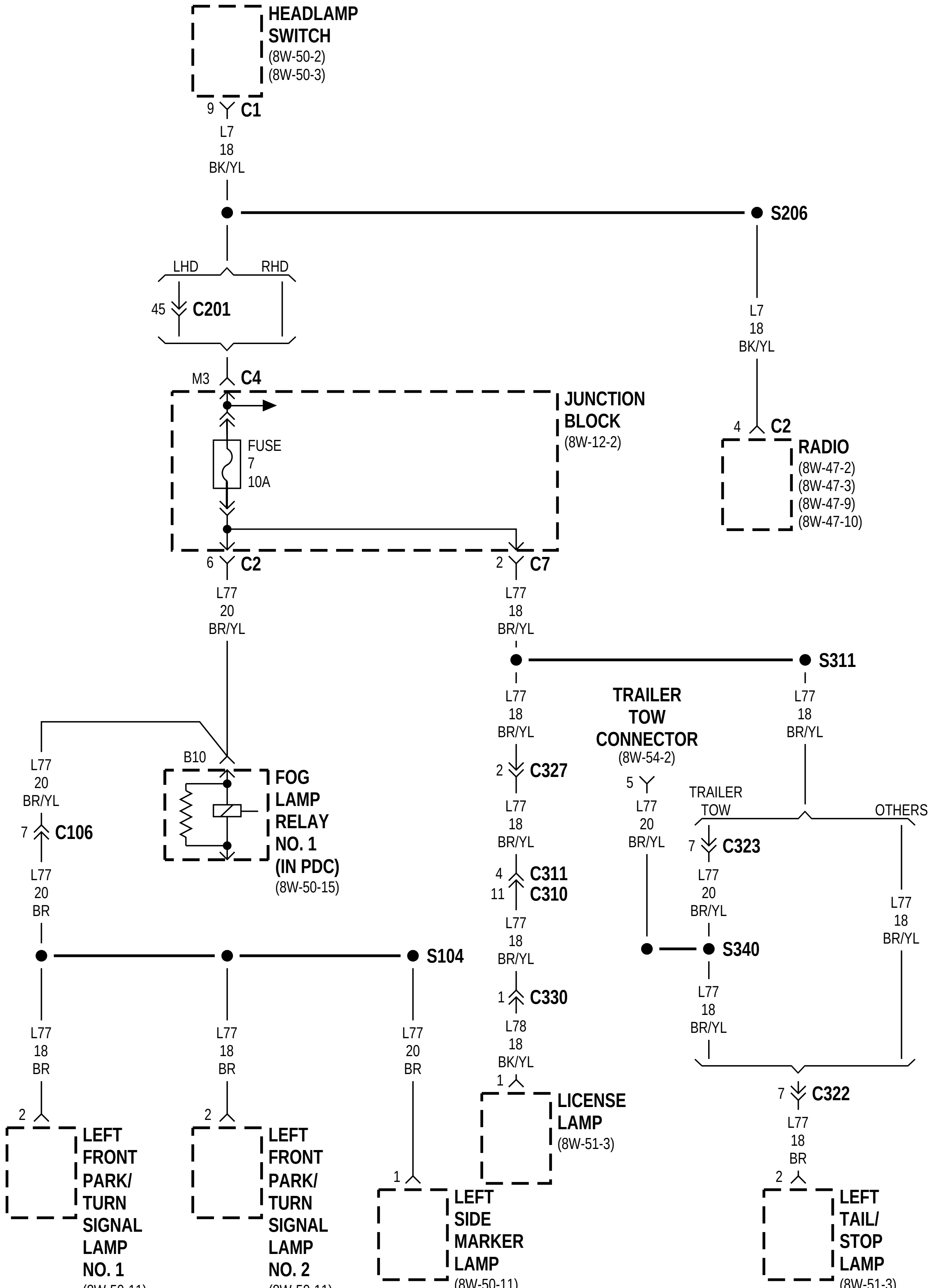
LHD



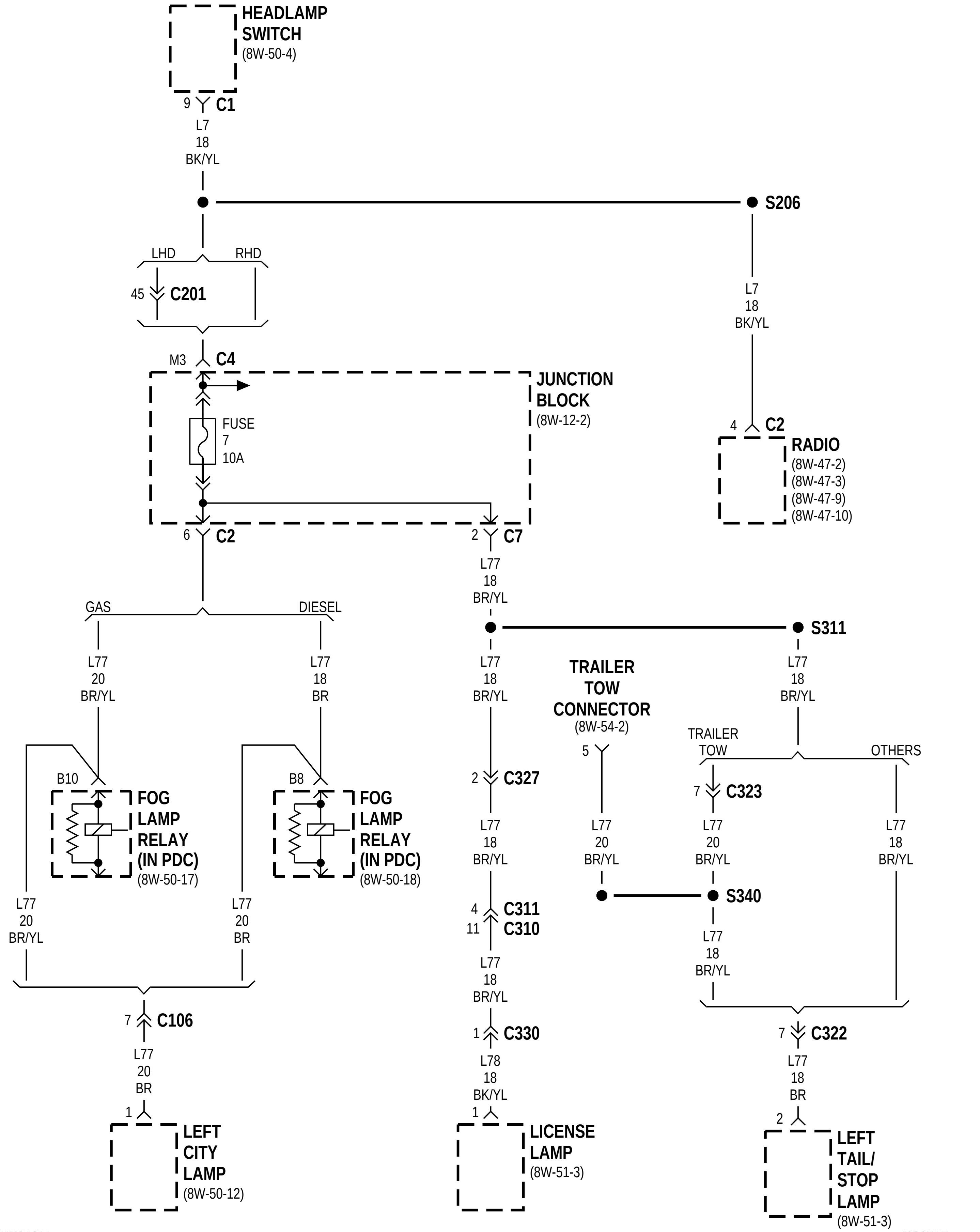
J998W-7 XJI01208

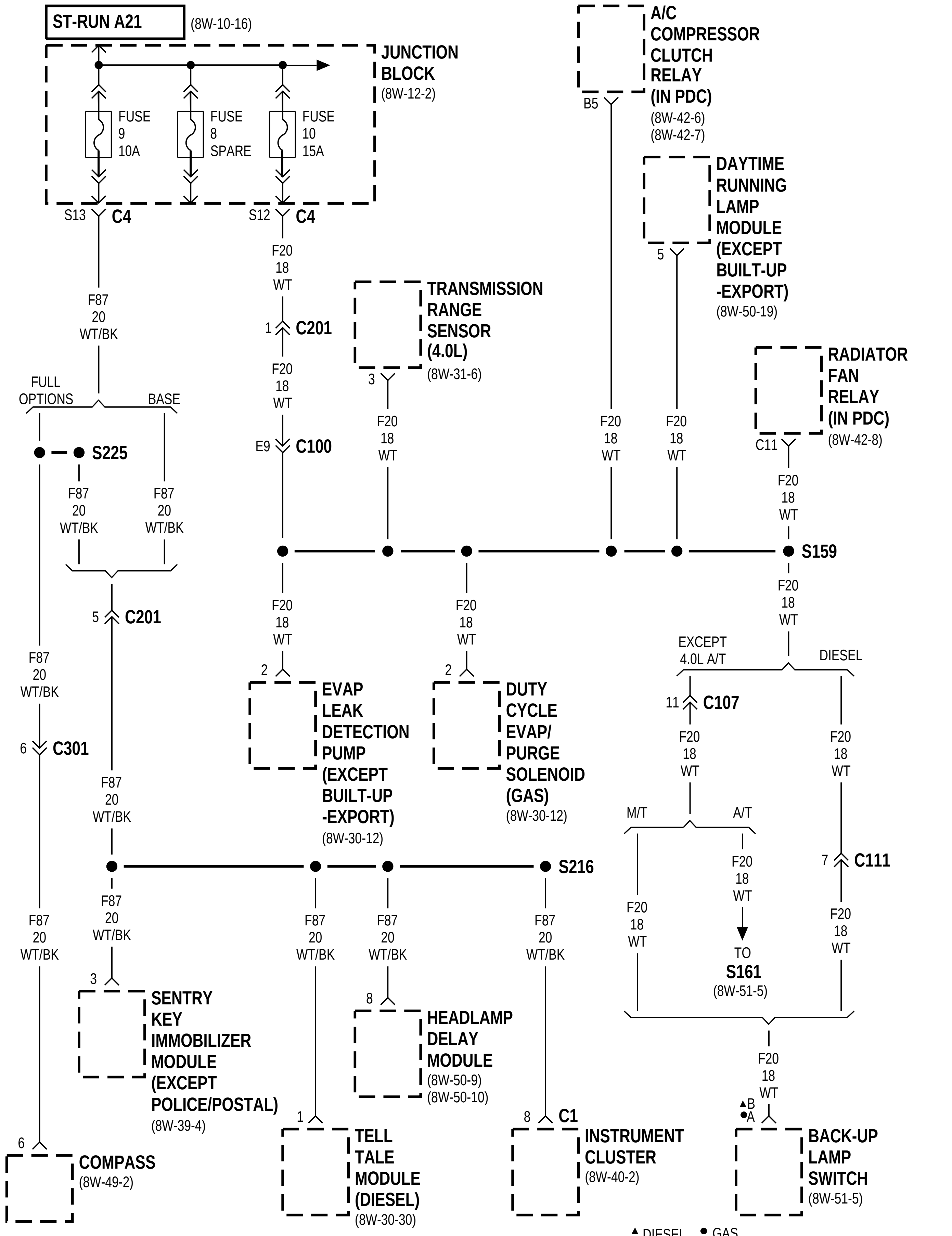

HEADLAMP SWITCH
(8W-50-2)
(8W-50-3)
1 C1
E1
20
TN
S1 C4
JUNCTION BLOCK
(8W-12-2)
FUSE
6
5A
S2 C4
E2
20
OR
S215
11 C203
E2
20
OR/BK
5 C2
RADIO
(8W-47-3)
(8W-47-10)
4
REAR WINDOW DEFOGGER SWITCH
(8W-48-3)
3 C1
INSTRUMENT CLUSTER
(8W-40-15)
1
FRONT FOG LAMP SWITCH
(8W-44-4)
4
REAR FOG LAMP SWITCH (BUILT-UP-EXPORT)
(8W-51-11)
1 C206
1
PRNDL ILLUMINATION (A/T)
(8W-44-4)
1
TRANSFER CASE SWITCH ILLUMINATION
(8W-44-4)
7
A/C-HEATER CONTROL ▲
(8W-42-5)
HEATER CONTROL ●
(8W-42-3)
3
REAR WIPER/ WASHER SWITCH
(8W-53-6)
(8W-53-7)
▲ A/C
● HEATER ONLY

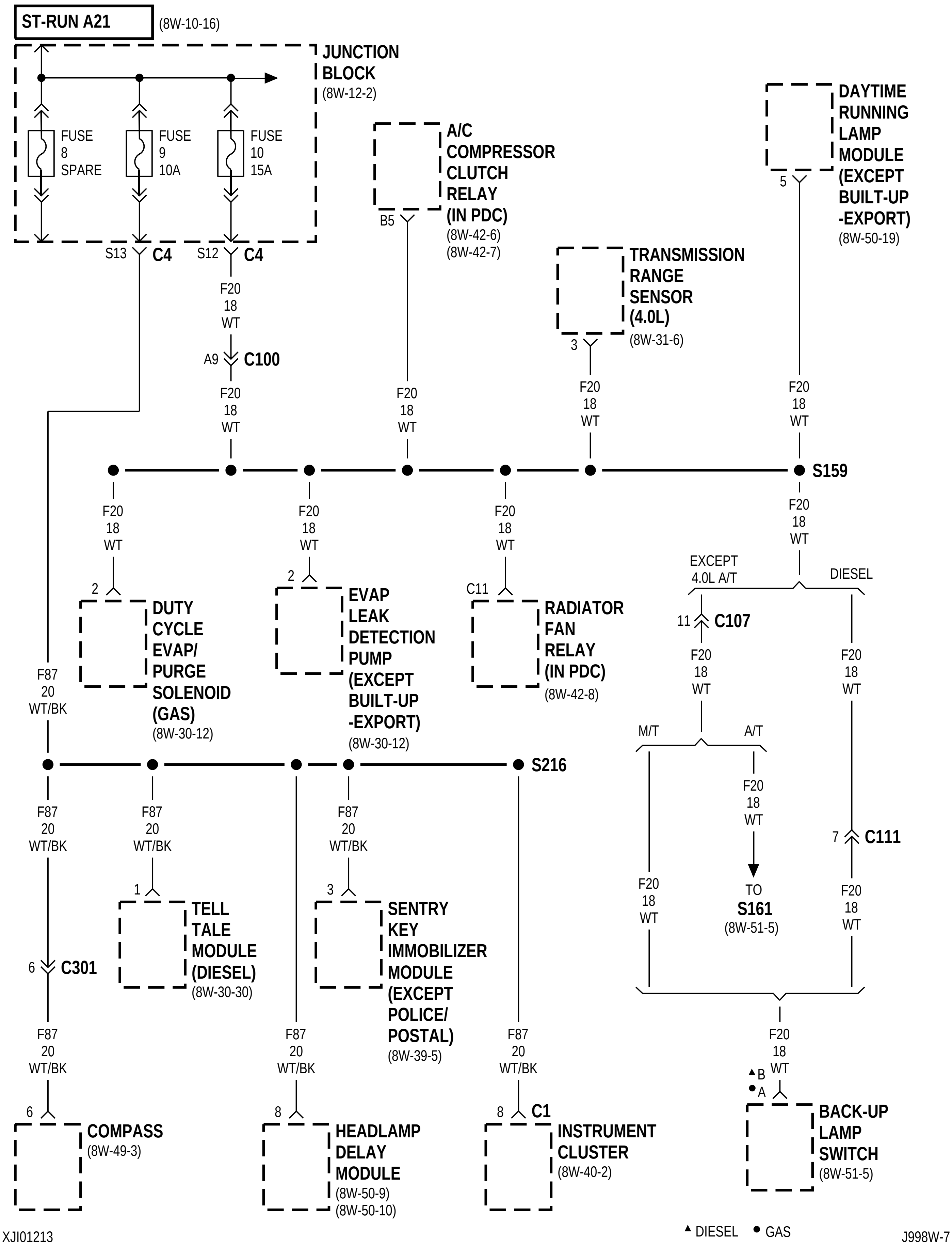
EXCEPT BUILT-UP-EXPORT

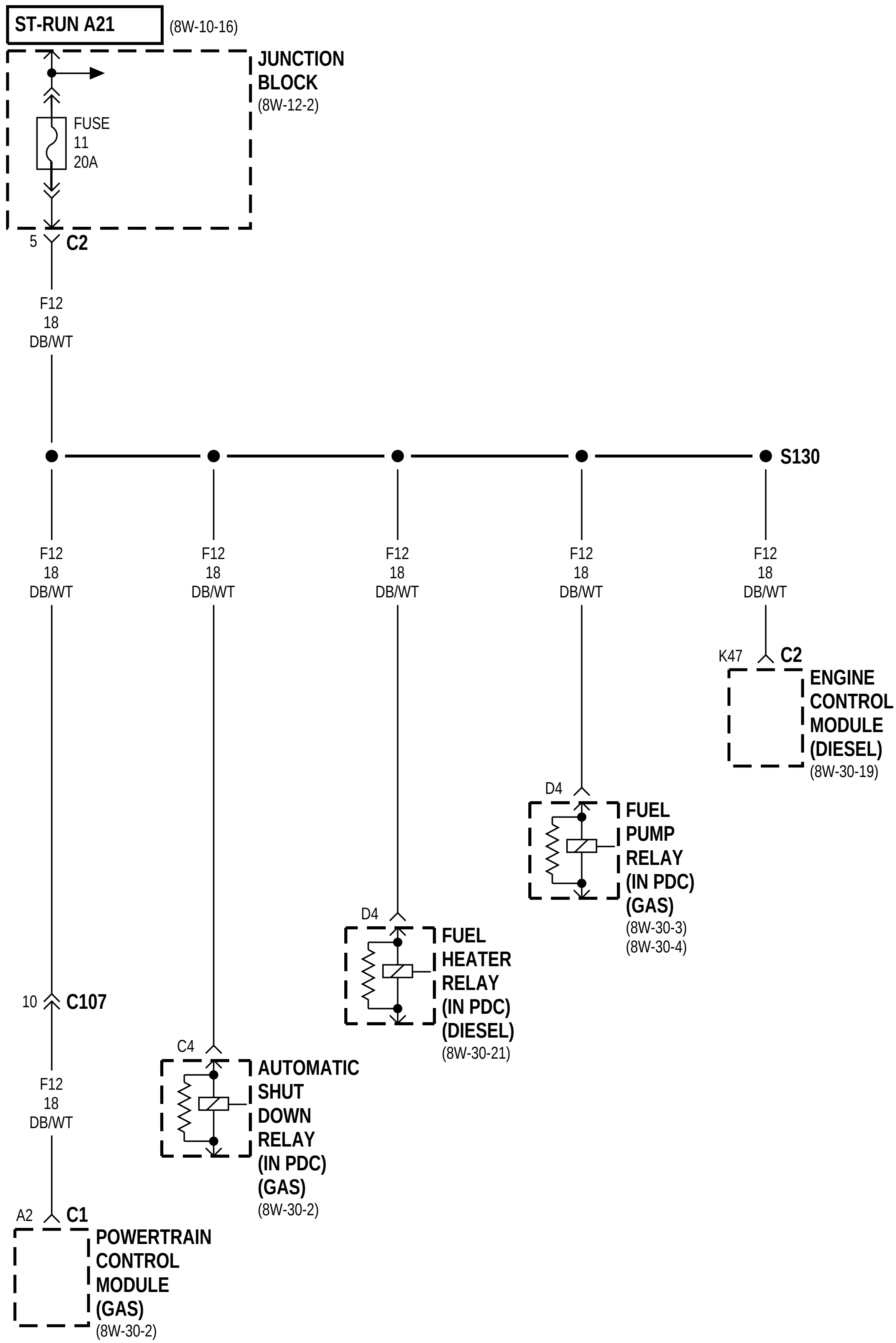


BUILT-UP-EXPORT

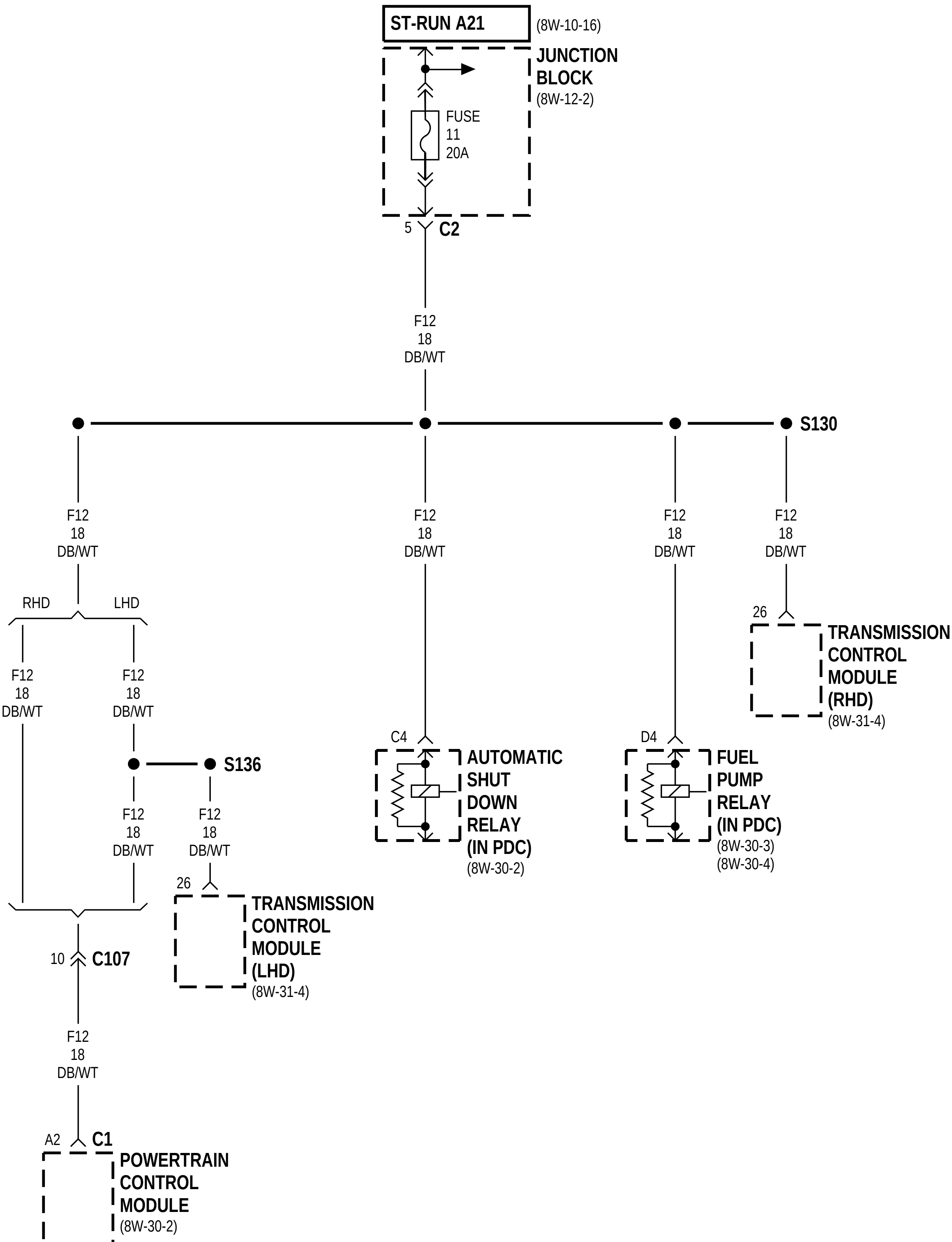



ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE 9 10A
FUSE 8 SPARE
FUSE 10 15A
S13 C4
S12 C4
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
(8W-42-6)
(8W-42-7)
B5
DAYTIME RUNNING LAMP MODULE (EXCEPT BUILT-UP -EXPORT)
(8W-50-19)
5
TRANSMISSION RANGE SENSOR (4.0L)
(8W-31-6)
3
RADIATOR FAN RELAY (IN PDC)
(8W-42-8)
C11
F87 20 WT/BK
F20 18 WT
1 C201
E9 C100
FULL OPTIONS
BASE
S225
S159
5 C201
6 C301
EXCEPT 4.0L A/T
DIESEL
11 C107
M/T
A/T
7 C111
TO S161
(8W-51-5)
2
EVAP LEAK DETECTION PUMP (EXCEPT BUILT-UP -EXPORT)
(8W-30-12)
DUTY CYCLE EVAP/ PURGE SOLENOID (GAS)
(8W-30-12)
S216
3
SENTRY KEY IMMOBILIZER MODULE (EXCEPT POLICE/POSTAL)
(8W-39-4)
8
HEADLAMP DELAY MODULE
(8W-50-9)
(8W-50-10)
6
COMPASS
(8W-49-2)
1
TELL TALE MODULE (DIESEL)
(8W-30-30)
8 C1
INSTRUMENT CLUSTER
(8W-40-2)
▲B ●A
BACK-UP LAMP SWITCH
(8W-51-5)
▲ DIESEL ● GAS


ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE 8 SPARE
FUSE 9 10A
FUSE 10 15A
S13 C4
S12 C4
F20 18 WT
A9 C100
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
(8W-42-6)
(8W-42-7)
B5
TRANSMISSION RANGE SENSOR (4.0L)
(8W-31-6)
3
DAYTIME RUNNING LAMP MODULE (EXCEPT BUILT-UP -EXPORT)
(8W-50-19)
5
S159
2
DUTY CYCLE EVAP/ PURGE SOLENOID (GAS)
(8W-30-12)
EVAP LEAK DETECTION PUMP (EXCEPT BUILT-UP -EXPORT)
(8W-30-12)
C11
RADIATOR FAN RELAY (IN PDC)
(8W-42-8)
EXCEPT 4.0L A/T
DIESEL
11 C107
M/T
A/T
F87 20 WT/BK
S216
1
TELL TALE MODULE (DIESEL)
(8W-30-30)
SENTRY KEY IMMOBILIZER MODULE (EXCEPT POLICE/ POSTAL)
(8W-39-5)
TO S161
(8W-51-5)
7 C111
6 C301
6
COMPASS
(8W-49-3)
8
HEADLAMP DELAY MODULE
(8W-50-9)
(8W-50-10)
8 C1
INSTRUMENT CLUSTER
(8W-40-2)
▲B
●A
BACK-UP LAMP SWITCH
(8W-51-5)
▲ DIESEL ● GAS
XJI01213

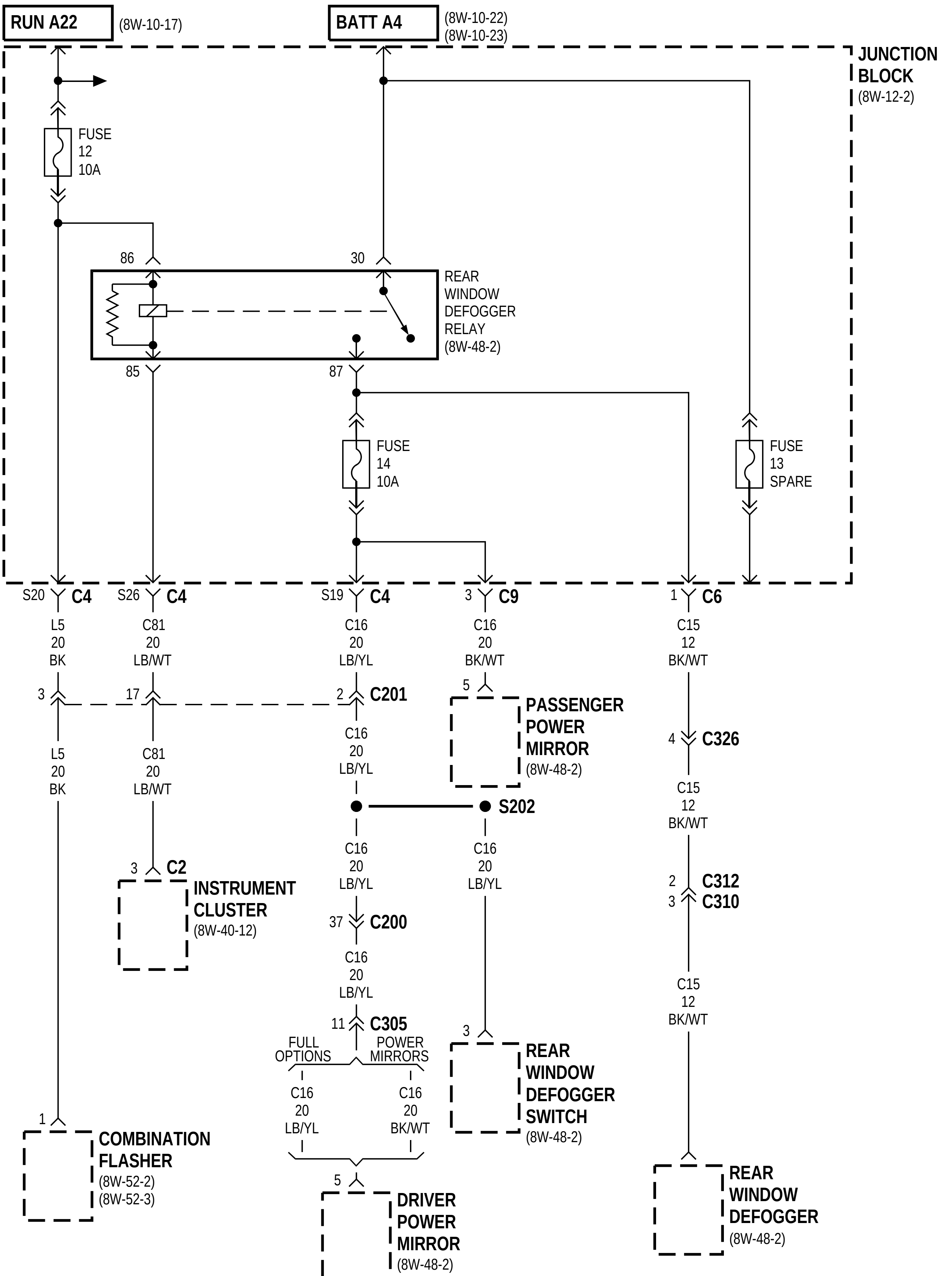

ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE 11 20A
5 C2
F12 18 DB/WT
S130
F12 18 DB/WT
K47 C2
ENGINE CONTROL MODULE (DIESEL)
(8W-30-19)
D4
FUEL PUMP RELAY (IN PDC) (GAS)
(8W-30-3)
(8W-30-4)
D4
FUEL HEATER RELAY (IN PDC) (DIESEL)
(8W-30-21)
10 C107
C4
AUTOMATIC SHUT DOWN RELAY (IN PDC) (GAS)
(8W-30-2)
A2 C1
POWERTRAIN CONTROL MODULE (GAS)
(8W-30-2)

4.0L

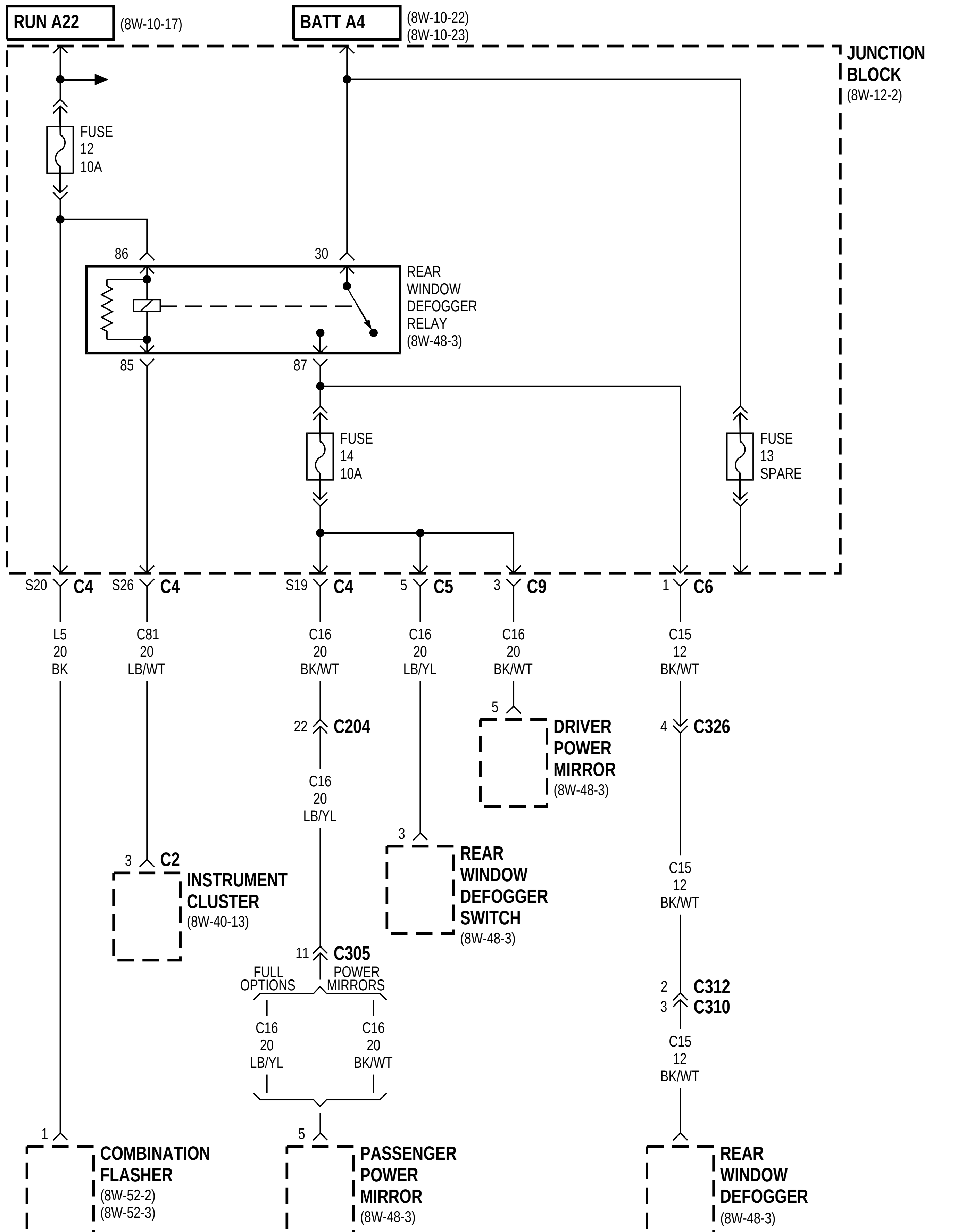


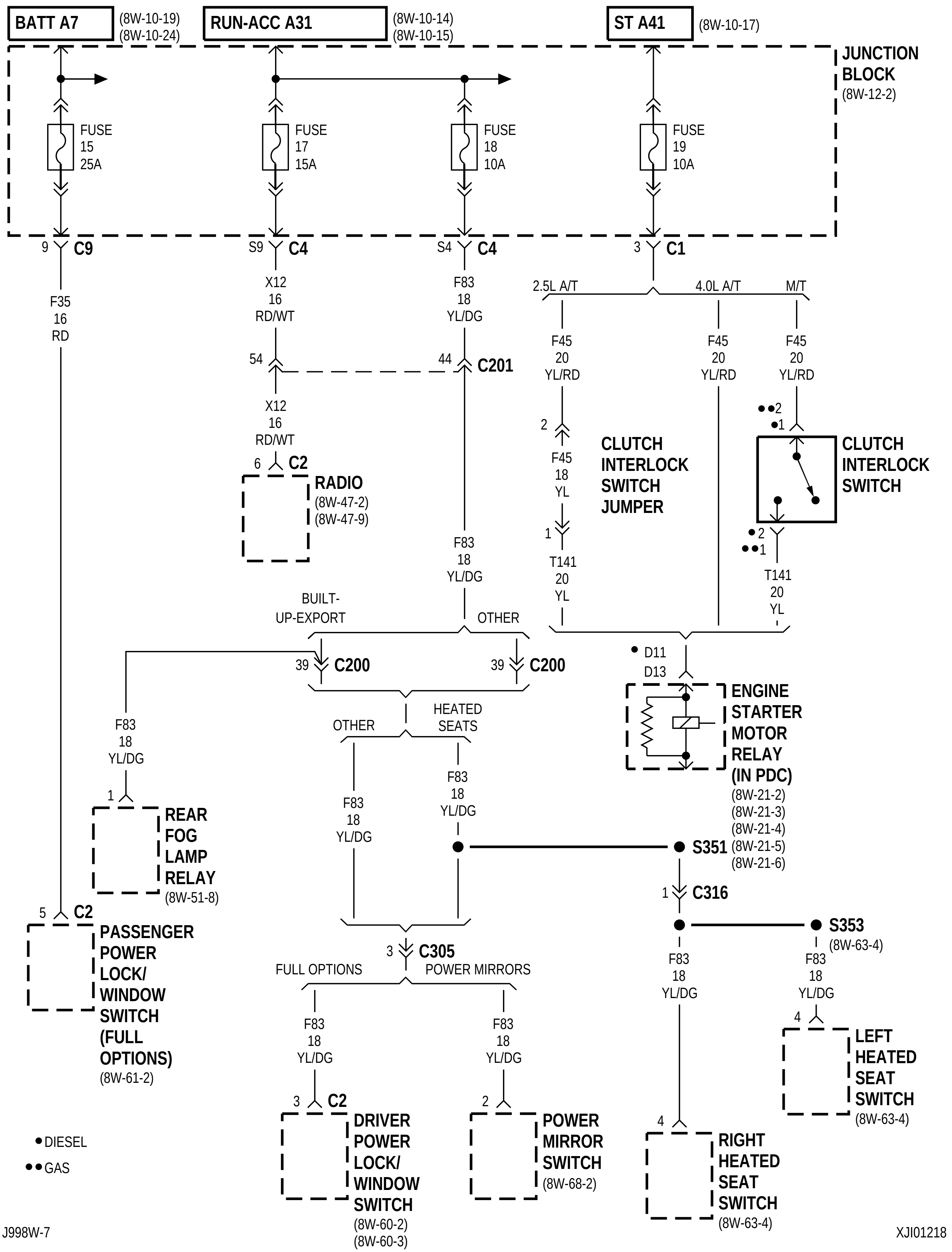
ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE
11
20A
5
C2
F12
18
DB/WT
S130
RHD
LHD
S136
C4
AUTOMATIC SHUT DOWN RELAY (IN PDC)
(8W-30-2)
D4
FUEL PUMP RELAY (IN PDC)
(8W-30-3)
(8W-30-4)
26
TRANSMISSION CONTROL MODULE (RHD)
(8W-31-4)
26
TRANSMISSION CONTROL MODULE (LHD)
(8W-31-4)
10
C107
A2
C1
POWERTRAIN CONTROL MODULE
(8W-30-2)

LHD

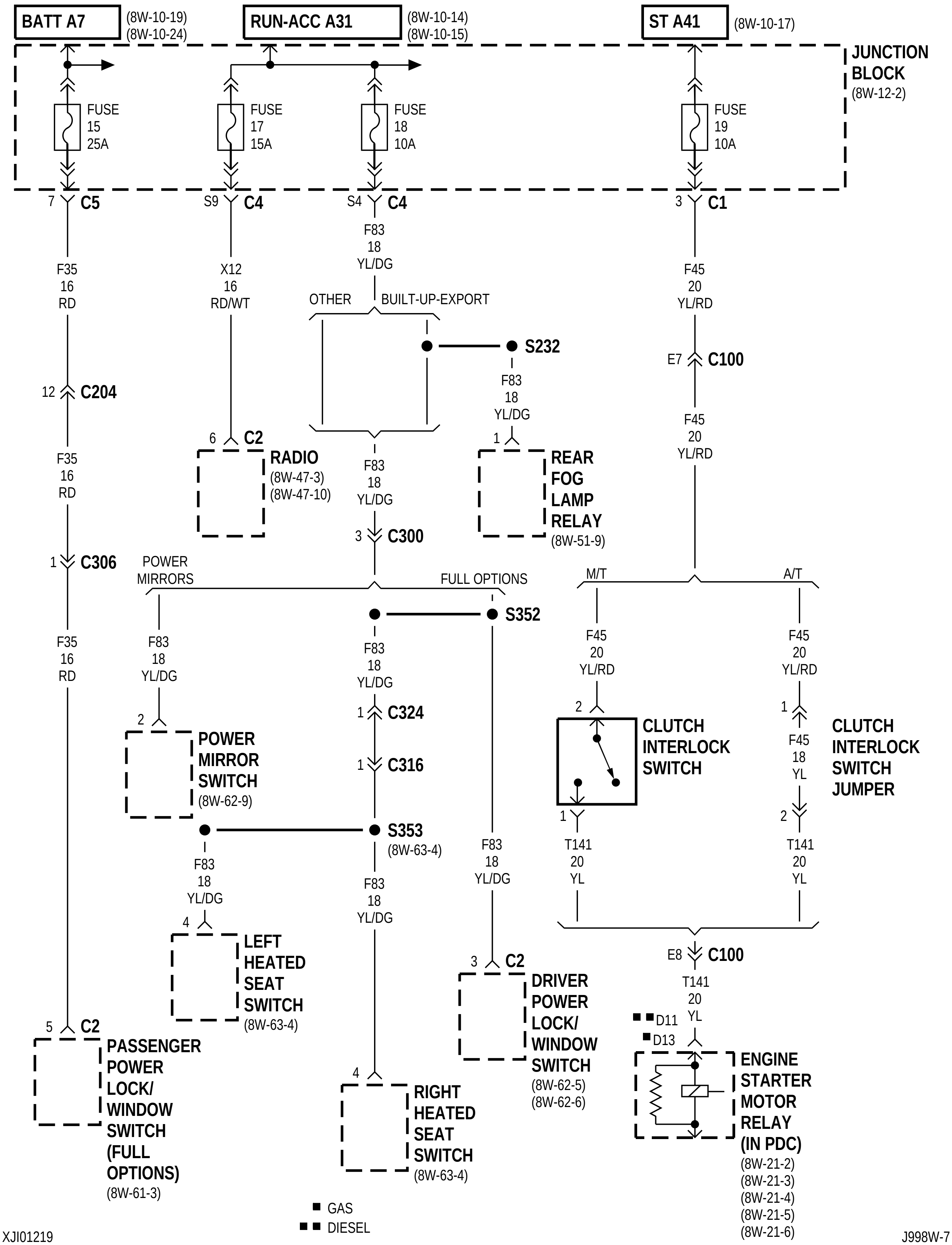

RUN A22
(8W-10-17)
BATT A4
(8W-10-22)
(8W-10-23)
JUNCTION BLOCK
(8W-12-2)
FUSE
12
10A
86
30
REAR WINDOW DEFOGGER RELAY
(8W-48-2)
85
87
FUSE
14
10A
FUSE
13
SPARE
S20 C4
S26 C4
S19 C4
3 C9
1 C6
L5
20
BK
C81
20
LB/WT
C16
20
LB/YL
C16
20
BK/WT
C15
12
BK/WT
3
17
2 C201
5
PASSENGER POWER MIRROR
(8W-48-2)
4 C326
S202
3 C2
INSTRUMENT CLUSTER
(8W-40-12)
2 C312
3 C310
37 C200
11 C305
FULL OPTIONS
POWER MIRRORS
3
REAR WINDOW DEFOGGER SWITCH
(8W-48-2)
1
COMBINATION FLASHER
(8W-52-2)
(8W-52-3)
5
DRIVER POWER MIRROR
(8W-48-2)
REAR WINDOW DEFOGGER
(8W-48-2)

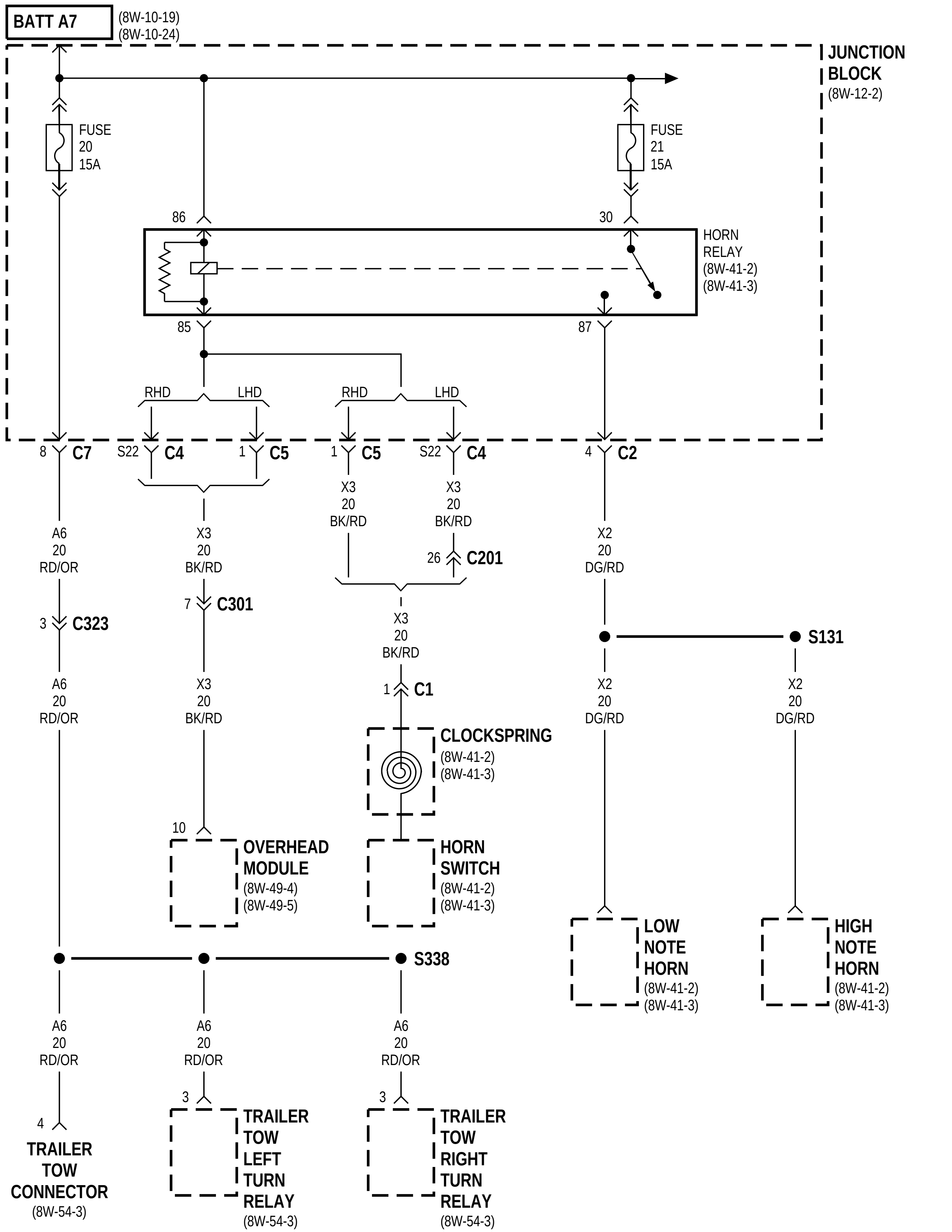
RHD

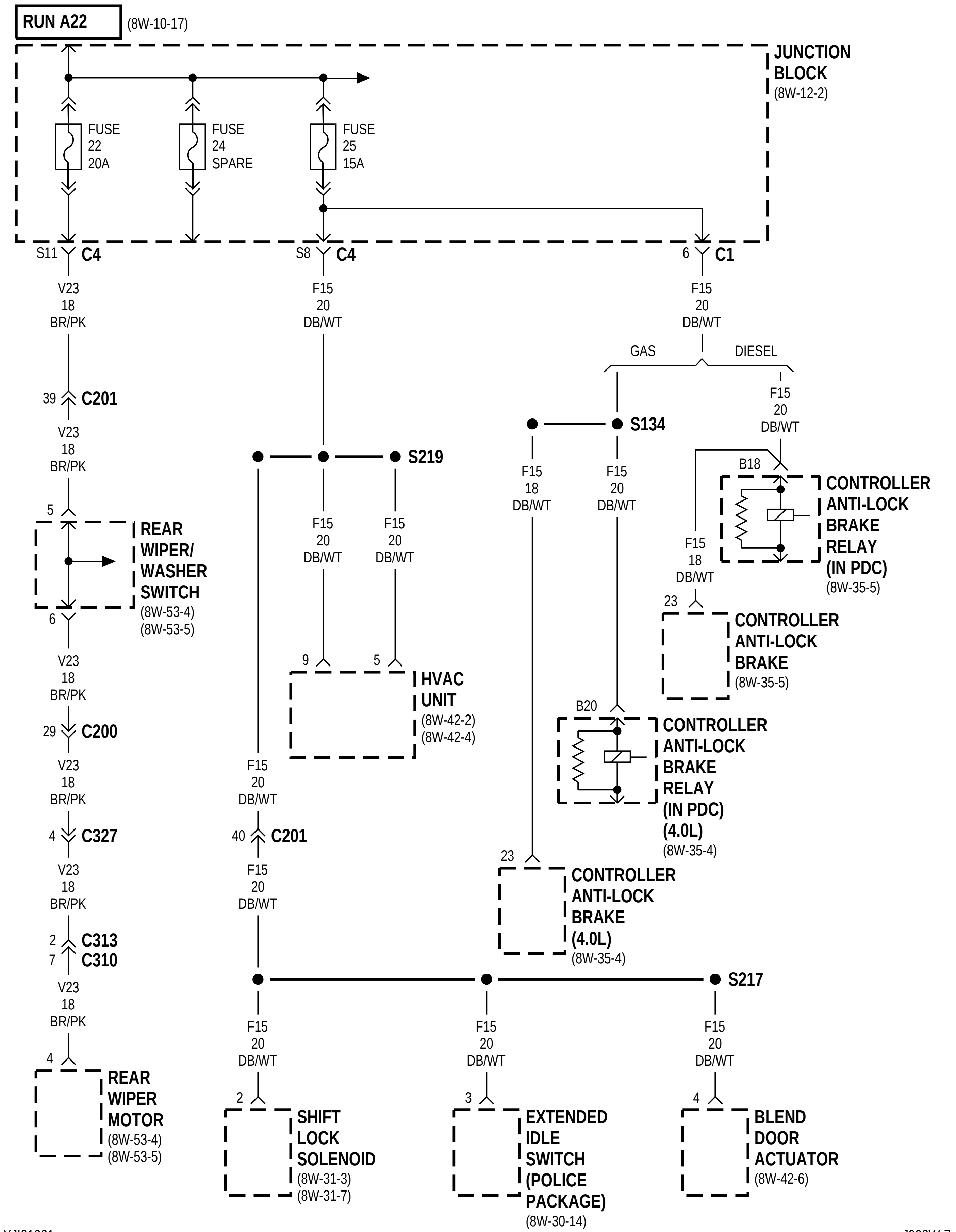

RUN A22
(8W-10-17)
BATT A4
(8W-10-22)
(8W-10-23)
JUNCTION BLOCK
(8W-12-2)
FUSE 12 10A
86
30
REAR WINDOW DEFOGGER RELAY
(8W-48-3)
85
87
FUSE 14 10A
FUSE 13 SPARE
S20 C4
S26 C4
S19 C4
5 C5
3 C9
1 C6
L5 20 BK
C81 20 LB/WT
C16 20 BK/WT
C16 20 LB/YL
C16 20 BK/WT
C15 12 BK/WT
5
DRIVER POWER MIRROR
(8W-48-3)
22 C204
4 C326
C16 20 LB/YL
3
REAR WINDOW DEFOGGER SWITCH
(8W-48-3)
3 C2
INSTRUMENT CLUSTER
(8W-40-13)
C15 12 BK/WT
11 C305
FULL OPTIONS
POWER MIRRORS
2 C312
3 C310
C16 20 LB/YL
C16 20 BK/WT
C15 12 BK/WT
1
COMBINATION FLASHER
(8W-52-2)
(8W-52-3)
5
PASSENGER POWER MIRROR
(8W-48-3)
REAR WINDOW DEFOGGER
(8W-48-3)

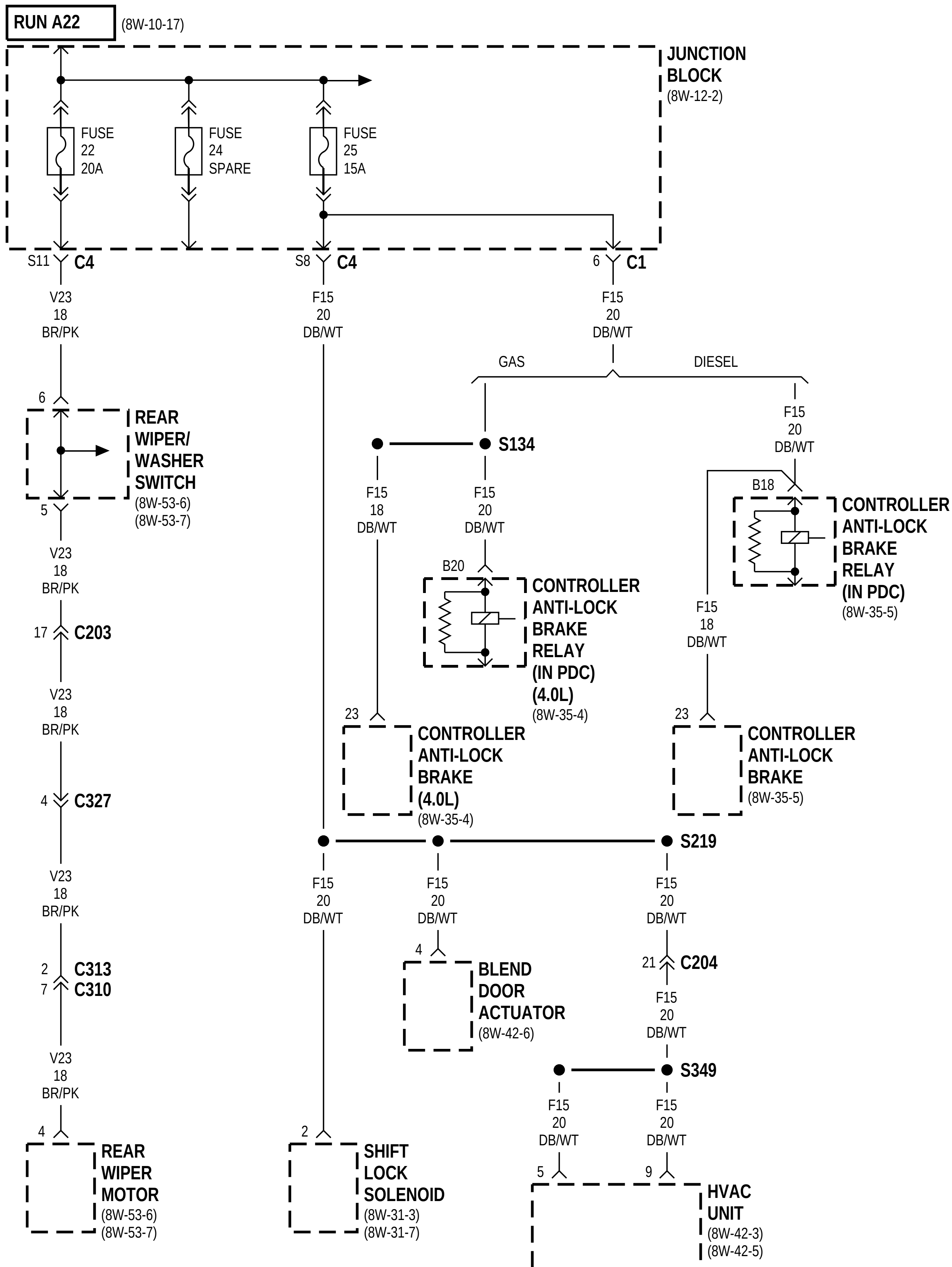

BATT A7
(8W-10-19)
(8W-10-24)
RUN-ACC A31
(8W-10-14)
(8W-10-15)
ST A41
(8W-10-17)
JUNCTION
BLOCK
(8W-12-2)
FUSE
15
25A
FUSE
17
15A
FUSE
18
10A
FUSE
19
10A
9
C9
S9
C4
S4
C4
3
C1
2.5L A/T
4.0L A/T
M/T
F35
16
RD
X12
16
RD/WT
F83
18
YL/DG
F45
20
YL/RD
F45
20
YL/RD
F45
20
YL/RD
54
44
C201
X12
16
RD/WT
2
F45
18
YL
CLUTCH
INTERLOCK
SWITCH
JUMPER
••2
•1
CLUTCH
INTERLOCK
SWITCH
6
C2
RADIO
(8W-47-2)
(8W-47-9)
1
T141
20
YL
•2
••1
T141
20
YL
F83
18
YL/DG
BUILT-
UP-EXPORT
OTHER
39
C200
39
C200
• D11
D13
ENGINE
STARTER
MOTOR
RELAY
(IN PDC)
(8W-21-2)
(8W-21-3)
(8W-21-4)
(8W-21-5)
(8W-21-6)
F83
18
YL/DG
OTHER
HEATED
SEATS
F83
18
YL/DG
F83
18
YL/DG
1
REAR
FOG
LAMP
RELAY
(8W-51-8)
S351
1
C316
5
C2
PASSENGER
POWER
LOCK/
WINDOW
SWITCH
(FULL
OPTIONS)
(8W-61-2)
3
C305
FULL OPTIONS
POWER MIRRORS
S353
(8W-63-4)
F83
18
YL/DG
F83
18
YL/DG
F83
18
YL/DG
F83
18
YL/DG
4
LEFT
HEATED
SEAT
SWITCH
(8W-63-4)
3
C2
DRIVER
POWER
LOCK/
WINDOW
SWITCH
(8W-60-2)
(8W-60-3)
2
POWER
MIRROR
SWITCH
(8W-68-2)
4
RIGHT
HEATED
SEAT
SWITCH
(8W-63-4)
•DIESEL
••GAS

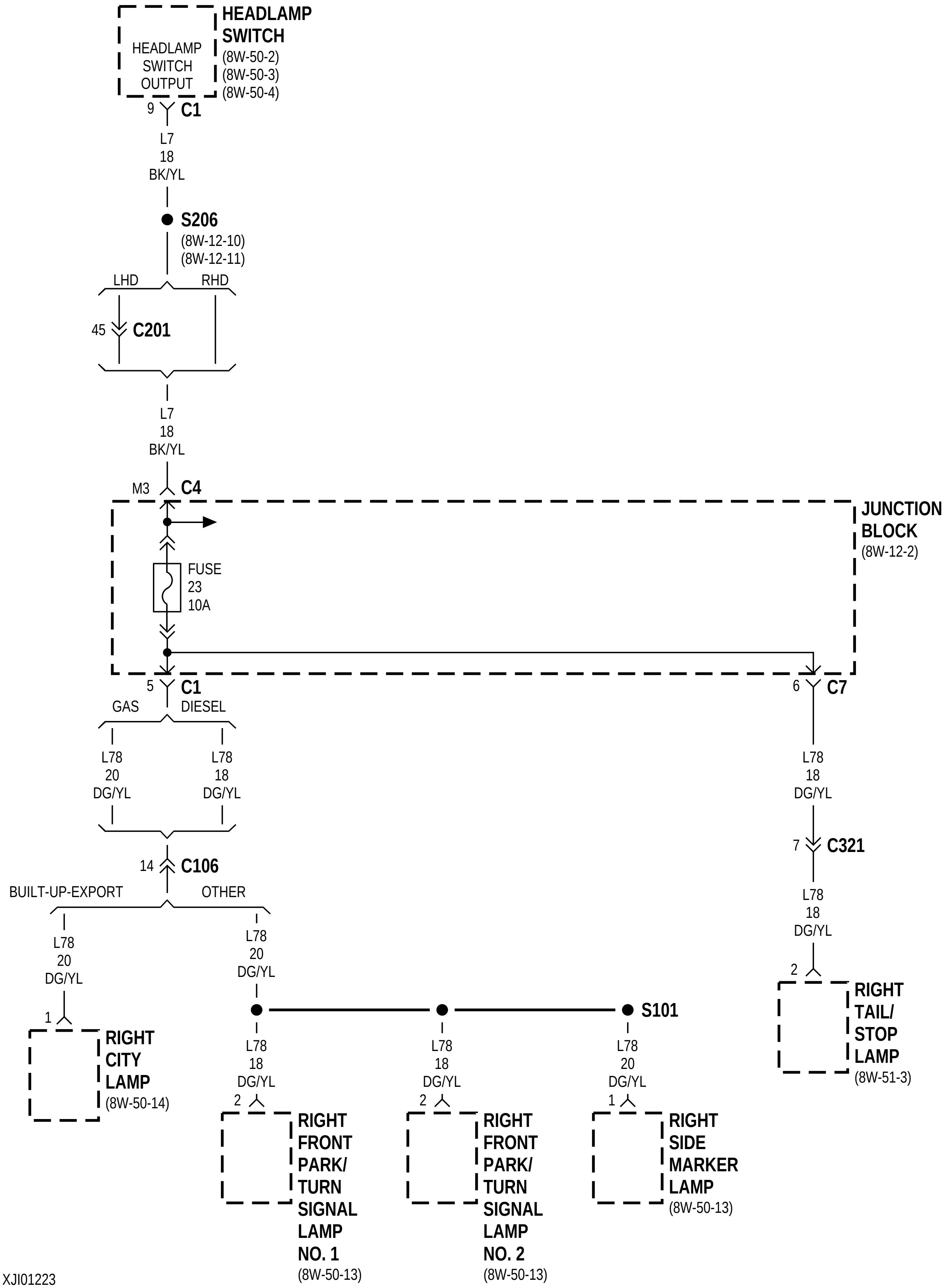
RHD


BATT A7
(8W-10-19)
(8W-10-24)
RUN-ACC A31
(8W-10-14)
(8W-10-15)
ST A41
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE 15 25A
FUSE 17 15A
FUSE 18 10A
FUSE 19 10A
7 C5
S9 C4
S4 C4
3 C1
F35 16 RD
X12 16 RD/WT
F83 18 YL/DG
F45 20 YL/RD
OTHER
BUILT-UP-EXPORT
S232
E7 C100
12 C204
6 C2
RADIO
(8W-47-3)
(8W-47-10)
1
REAR FOG LAMP RELAY
(8W-51-9)
3 C300
1 C306
POWER MIRRORS
FULL OPTIONS
M/T
A/T
S352
2
POWER MIRROR SWITCH
(8W-62-9)
1 C324
1 C316
S353
(8W-63-4)
2
CLUTCH INTERLOCK SWITCH
1
F45 18 YL
2
CLUTCH INTERLOCK SWITCH JUMPER
T141 20 YL
4
LEFT HEATED SEAT SWITCH
(8W-63-4)
3 C2
DRIVER POWER LOCK/ WINDOW SWITCH
(8W-62-5)
(8W-62-6)
E8 C100
5 C2
PASSENGER POWER LOCK/ WINDOW SWITCH (FULL OPTIONS)
(8W-61-3)
■■ D11
■ D13
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-2)
(8W-21-3)
(8W-21-4)
(8W-21-5)
(8W-21-6)
4
RIGHT HEATED SEAT SWITCH
(8W-63-4)
■ GAS
■■ DIESEL

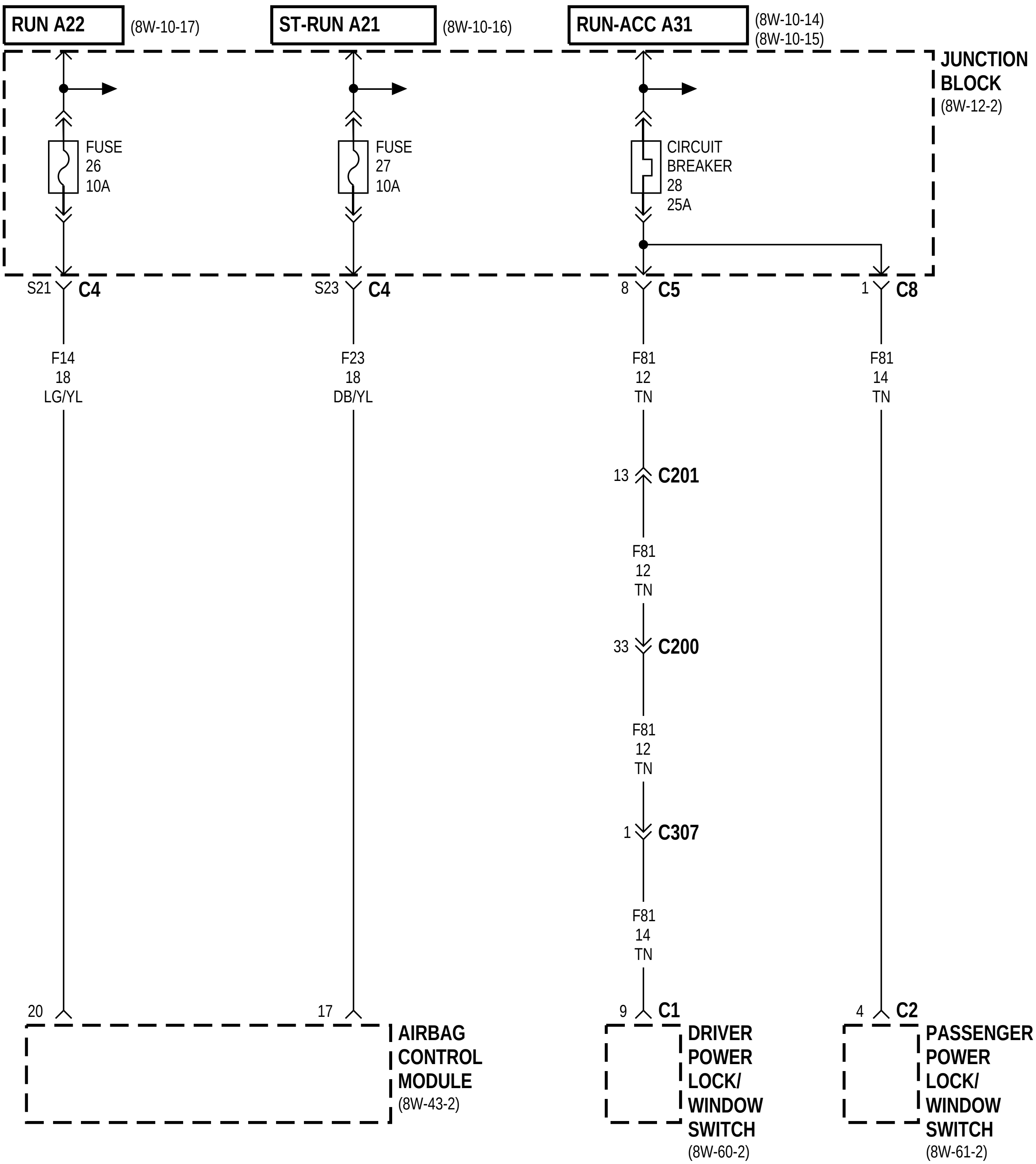

BATT A7
(8W-10-19)
(8W-10-24)
JUNCTION BLOCK
(8W-12-2)
FUSE 20 15A
FUSE 21 15A
86
30
85
87
HORN RELAY
(8W-41-2)
(8W-41-3)
RHD
LHD
RHD
LHD
8 C7
S22 C4
1 C5
1 C5
S22 C4
4 C2
A6 20 RD/OR
X3 20 BK/RD
X3 20 BK/RD
X3 20 BK/RD
X2 20 DG/RD
26 C201
3 C323
7 C301
X3 20 BK/RD
S131
A6 20 RD/OR
X3 20 BK/RD
1 C1
X2 20 DG/RD
X2 20 DG/RD
CLOCKSPRING
(8W-41-2)
(8W-41-3)
10
OVERHEAD MODULE
(8W-49-4)
(8W-49-5)
HORN SWITCH
(8W-41-2)
(8W-41-3)
LOW NOTE HORN
(8W-41-2)
(8W-41-3)
HIGH NOTE HORN
(8W-41-2)
(8W-41-3)
S338
A6 20 RD/OR
A6 20 RD/OR
A6 20 RD/OR
4
TRAILER TOW CONNECTOR
(8W-54-3)
3
TRAILER TOW LEFT TURN RELAY
(8W-54-3)
3
TRAILER TOW RIGHT TURN RELAY
(8W-54-3)


RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE 22 20A
FUSE 24 SPARE
FUSE 25 15A
S11 C4
S8 C4
6 C1
V23 18 BR/PK
F15 20 DB/WT
GAS
DIESEL
39 C201
S134
S219
F15 18 DB/WT
B18
CONTROLLER ANTI-LOCK BRAKE RELAY (IN PDC)
(8W-35-5)
5
REAR WIPER/ WASHER SWITCH
(8W-53-4)
(8W-53-5)
6
23
CONTROLLER ANTI-LOCK BRAKE
(8W-35-5)
9
5
HVAC UNIT
(8W-42-2)
(8W-42-4)
B20
CONTROLLER ANTI-LOCK BRAKE RELAY (IN PDC) (4.0L)
(8W-35-4)
29 C200
4 C327
40 C201
23
CONTROLLER ANTI-LOCK BRAKE (4.0L)
(8W-35-4)
2 C313
7 C310
S217
4
REAR WIPER MOTOR
(8W-53-4)
(8W-53-5)
2
SHIFT LOCK SOLENOID
(8W-31-3)
(8W-31-7)
3
EXTENDED IDLE SWITCH (POLICE PACKAGE)
(8W-30-14)
4
BLEND DOOR ACTUATOR
(8W-42-6)


RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE 22 20A
FUSE 24 SPARE
FUSE 25 15A
S11 C4
S8 C4
6 C1
V23 18 BR/PK
F15 20 DB/WT
GAS
DIESEL
6
REAR WIPER/ WASHER SWITCH
(8W-53-6)
(8W-53-7)
5
S134
F15 18 DB/WT
F15 20 DB/WT
B20
CONTROLLER ANTI-LOCK BRAKE RELAY (IN PDC) (4.0L)
(8W-35-4)
B18
CONTROLLER ANTI-LOCK BRAKE RELAY (IN PDC)
(8W-35-5)
17 C203
4 C327
2 C313
7 C310
23
CONTROLLER ANTI-LOCK BRAKE (4.0L)
(8W-35-4)
CONTROLLER ANTI-LOCK BRAKE
(8W-35-5)
S219
4
BLEND DOOR ACTUATOR
(8W-42-6)
21 C204
S349
2
REAR WIPER MOTOR
(8W-53-6)
(8W-53-7)
SHIFT LOCK SOLENOID
(8W-31-3)
(8W-31-7)
5
9
HVAC UNIT
(8W-42-3)
(8W-42-5)

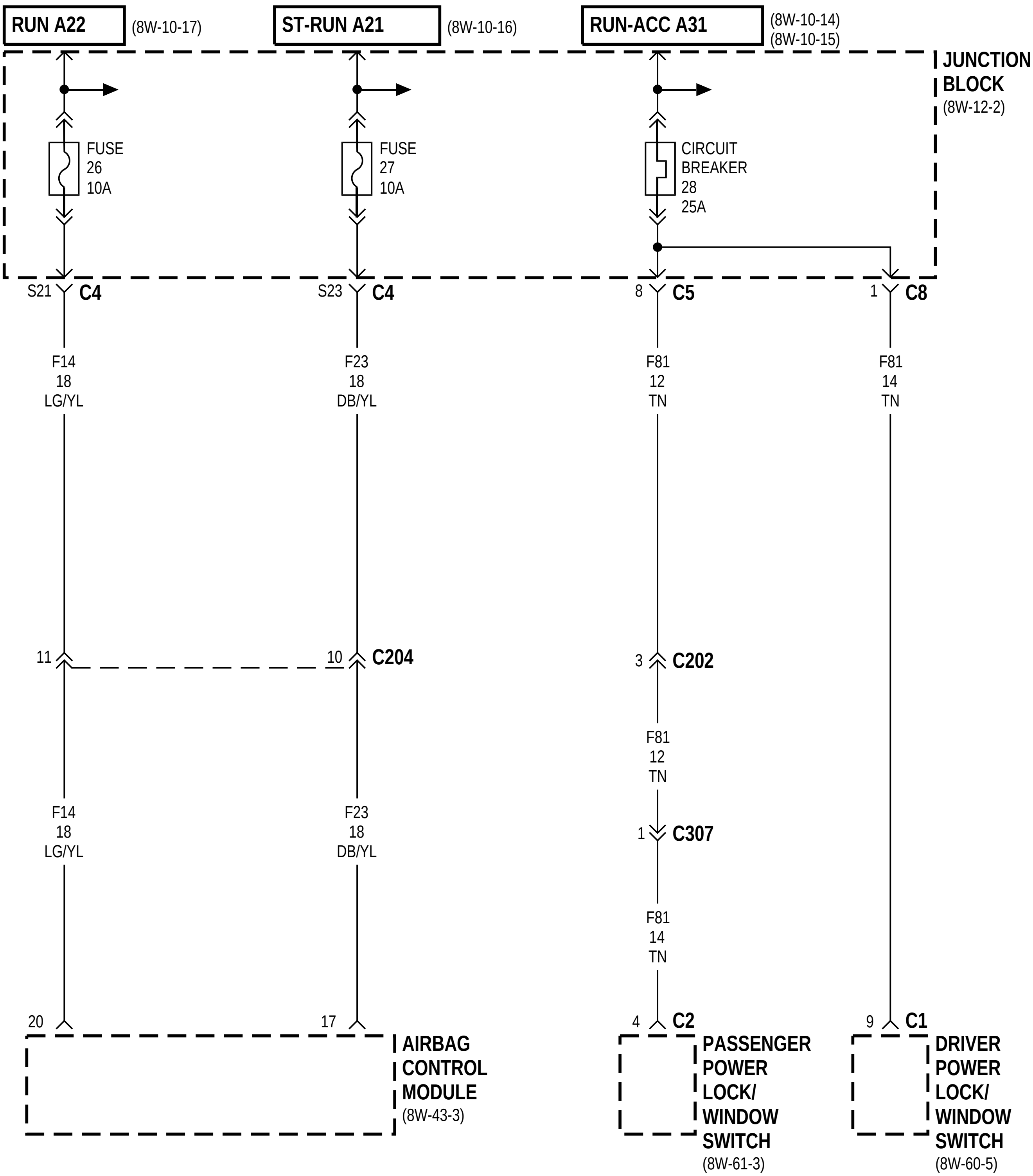

HEADLAMP SWITCH
(8W-50-2)
(8W-50-3)
(8W-50-4)
HEADLAMP SWITCH OUTPUT
9 C1
L7 18 BK/YL
S206
(8W-12-10)
(8W-12-11)
LHD
RHD
45 C201
L7 18 BK/YL
M3 C4
JUNCTION BLOCK
(8W-12-2)
FUSE 23 10A
5 C1
6 C7
GAS
DIESEL
L78 20 DG/YL
L78 18 DG/YL
L78 18 DG/YL
7 C321
L78 18 DG/YL
14 C106
BUILT-UP-EXPORT
OTHER
L78 20 DG/YL
L78 20 DG/YL
2
RIGHT TAIL/ STOP LAMP
(8W-51-3)
1
RIGHT CITY LAMP
(8W-50-14)
S101
L78 18 DG/YL
L78 18 DG/YL
L78 20 DG/YL
2
2
1
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 1
(8W-50-13)
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 2
(8W-50-13)
RIGHT SIDE MARKER LAMP
(8W-50-13)

LHD

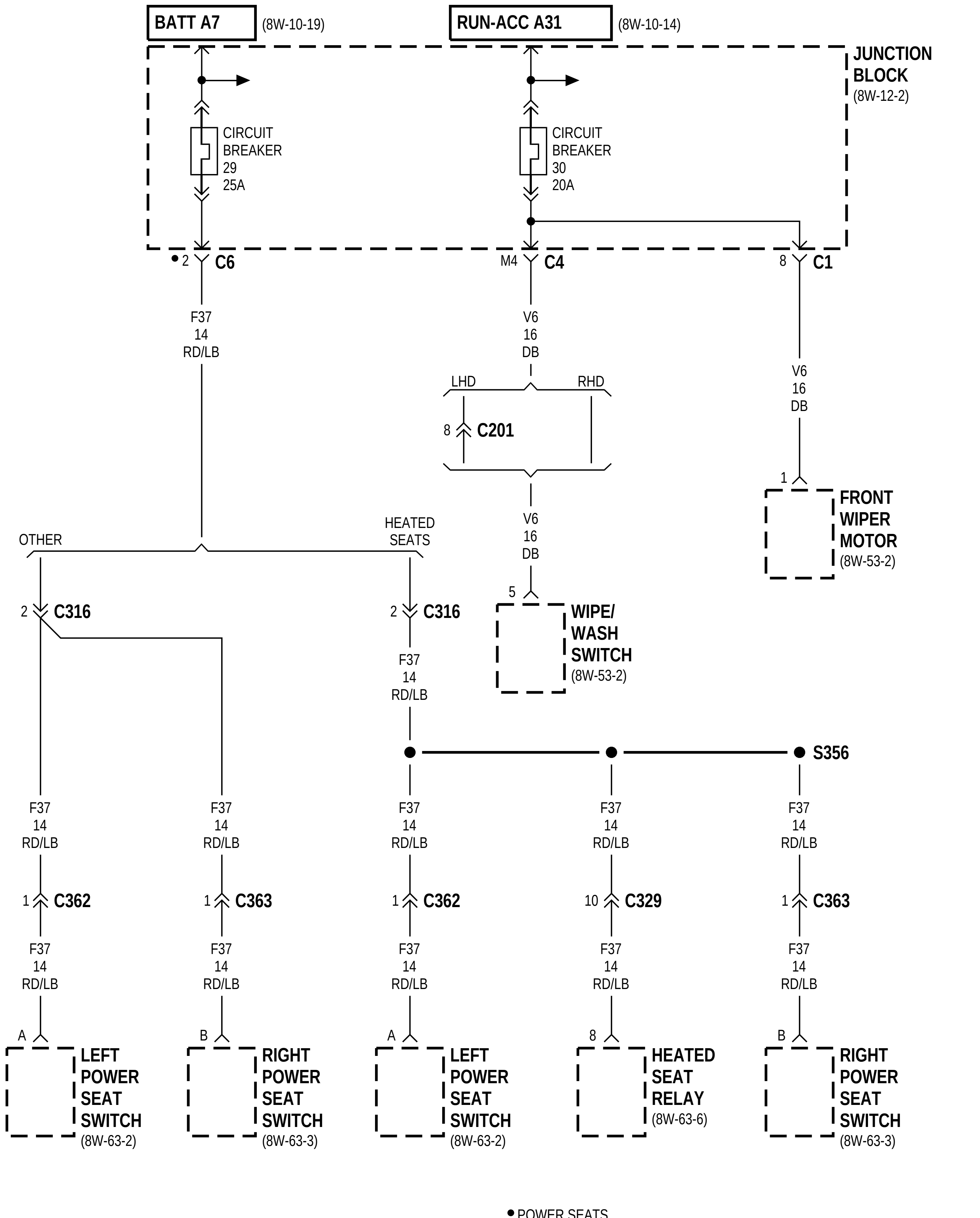


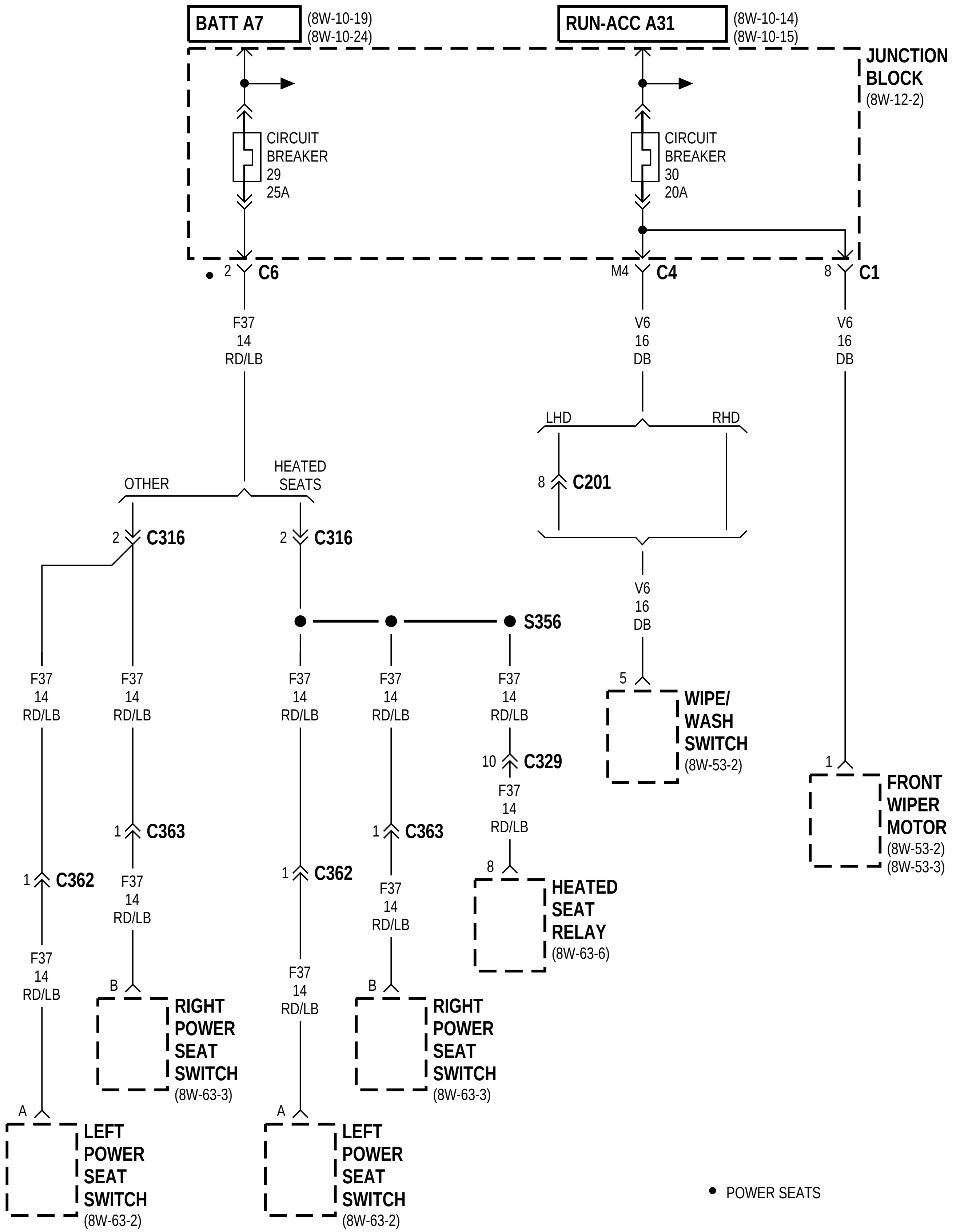
RUN A22
(8W-10-17)
ST-RUN A21
(8W-10-16)
RUN-ACC A31
(8W-10-14)
(8W-10-15)
JUNCTION
BLOCK
(8W-12-2)
FUSE
26
10A
FUSE
27
10A
CIRCUIT
BREAKER
28
25A
S21
C4
S23
C4
8
C5
1
C8
F14
18
LG/YL
F23
18
DB/YL
F81
12
TN
F81
14
TN
13
C201
F81
12
TN
33
C200
F81
12
TN
1
C307
F81
14
TN
20
17
9
C1
4
C2
AIRBAG
CONTROL
MODULE
(8W-43-2)
DRIVER
POWER
LOCK/
WINDOW
SWITCH
(8W-60-2)
PASSENGER
POWER
LOCK/
WINDOW
SWITCH
(8W-61-2)

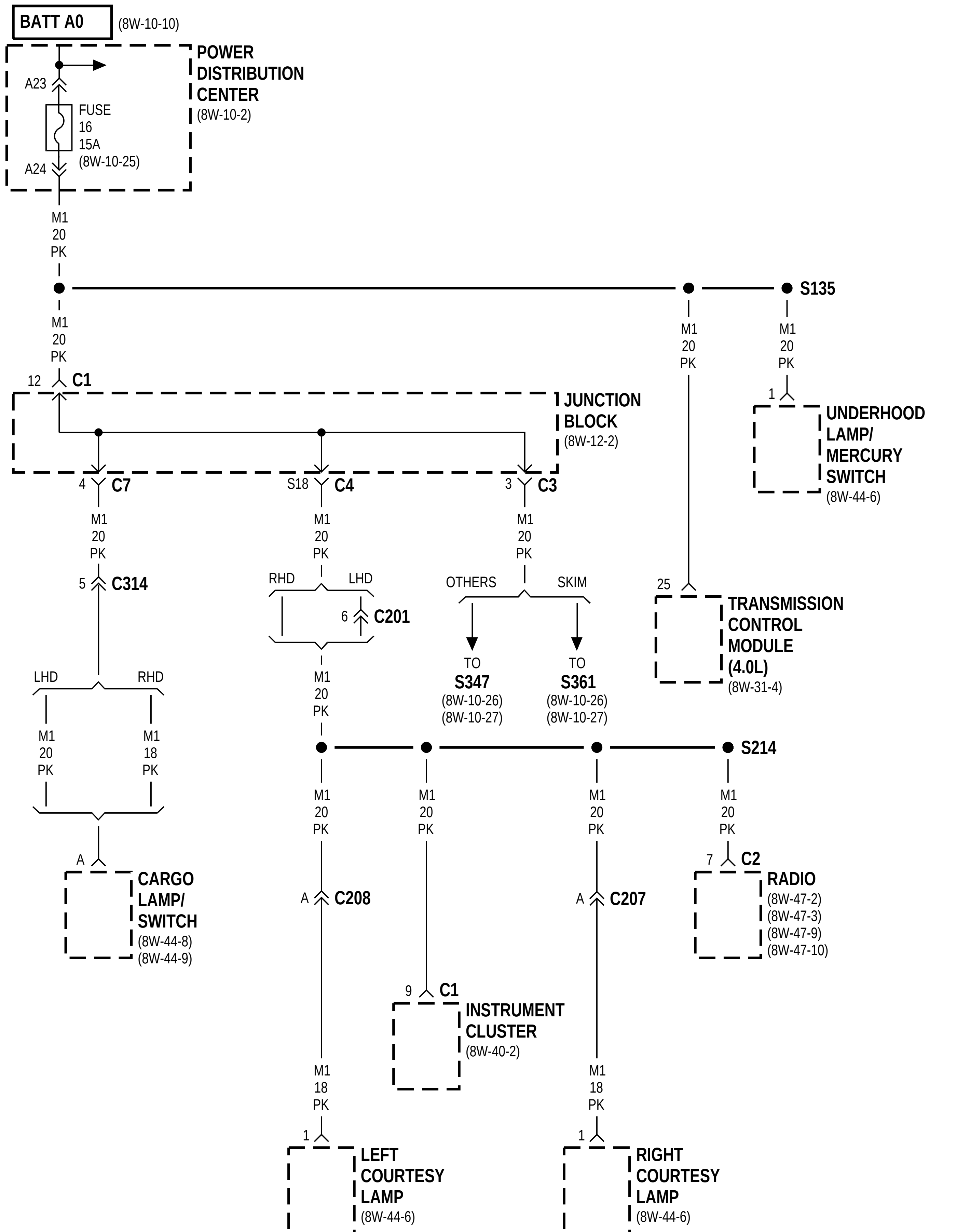
8W-12 JUNCTION BLOCK RHD



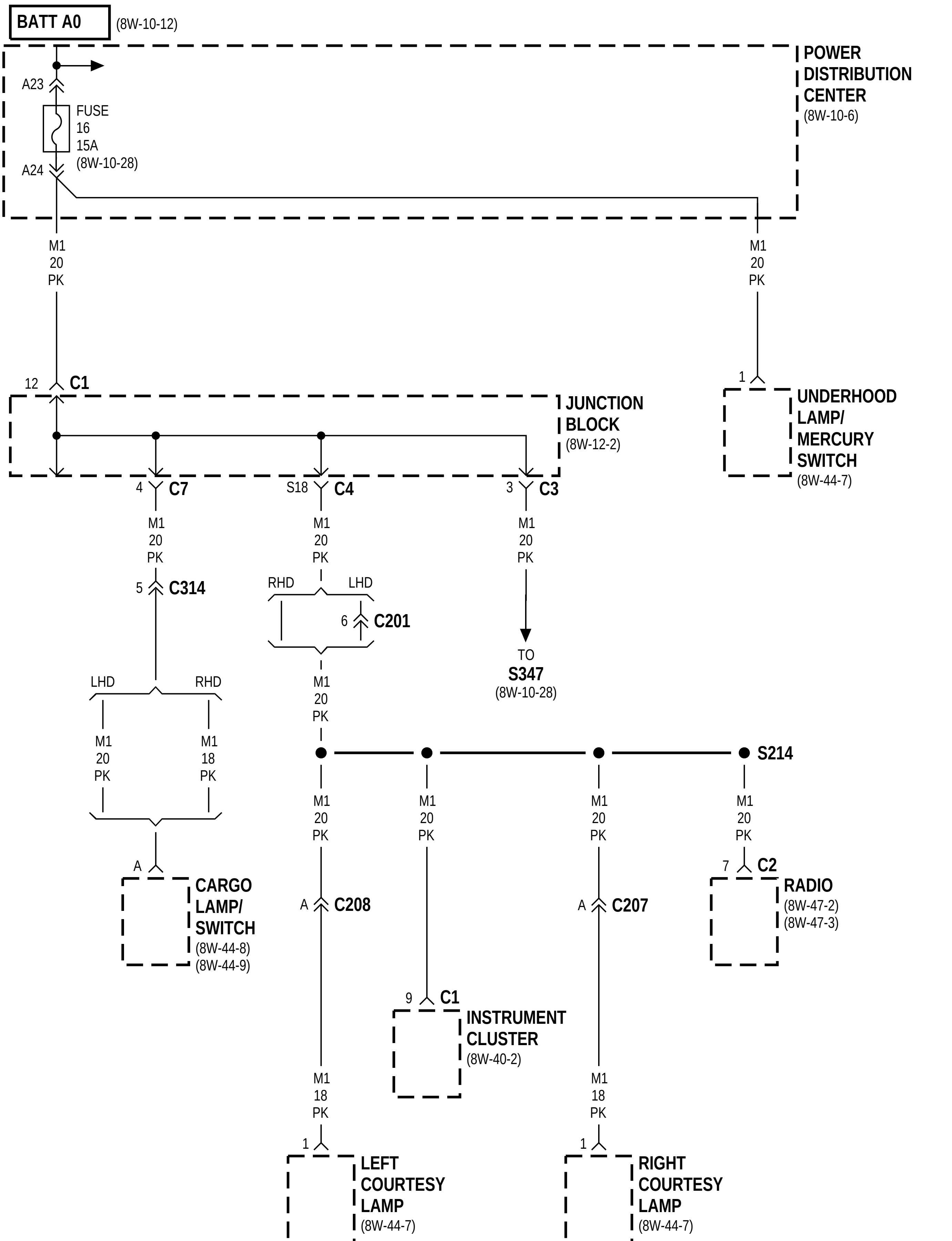
EXCEPT BUILT-UP-EXPORT



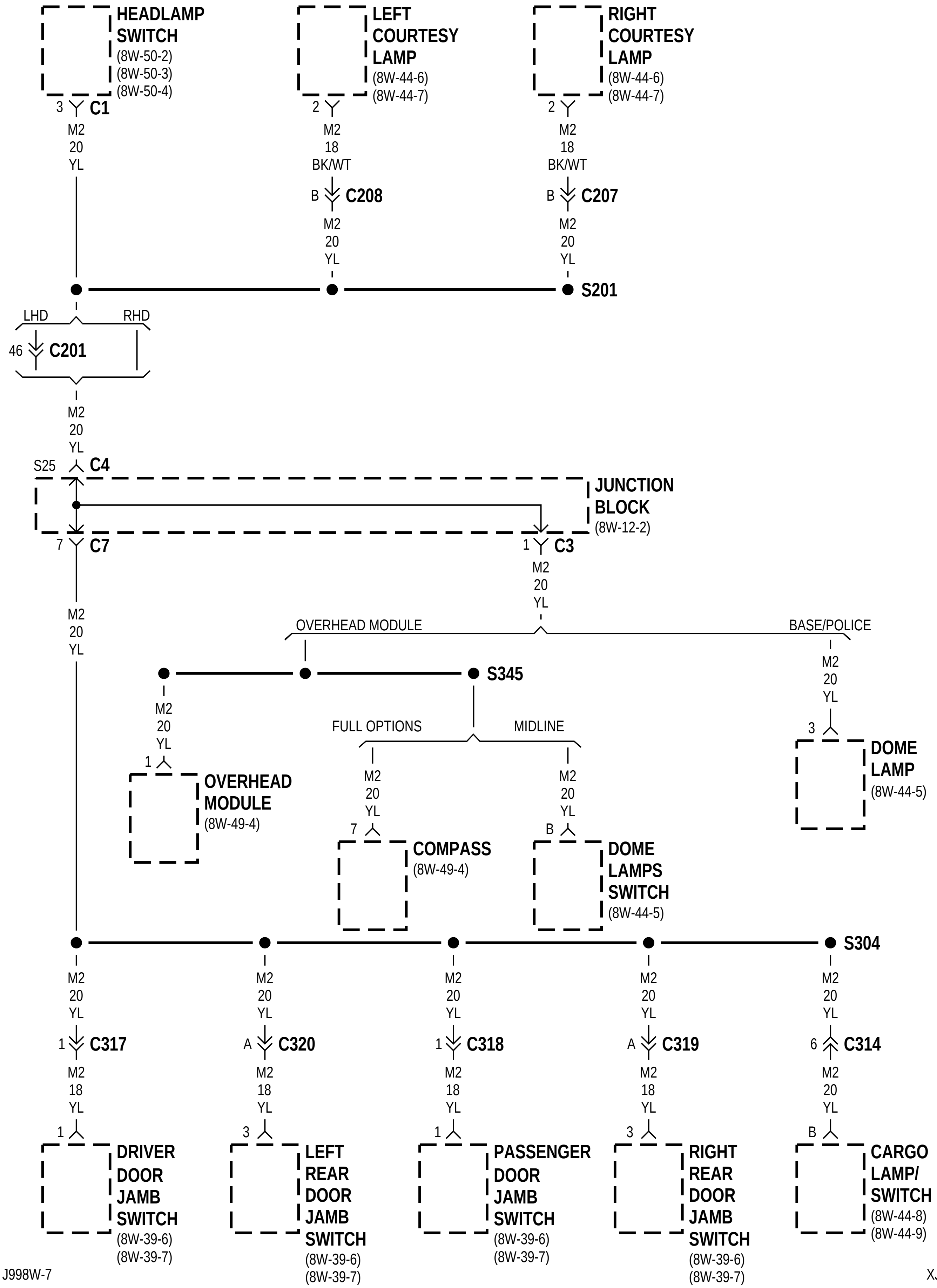

BATT A7
(8W-10-19)
(8W-10-24)
RUN-ACC A31
(8W-10-14)
(8W-10-15)
JUNCTION
BLOCK
(8W-12-2)
CIRCUIT
BREAKER
29
25A
CIRCUIT
BREAKER
30
20A
2
C6
M4
C4
8
C1
F37
14
RD/LB
V6
16
DB
V6
16
DB
LHD
RHD
8
C201
OTHER
HEATED
SEATS
2
C316
2
C316
S356
V6
16
DB
5
WIPE/
WASH
SWITCH
(8W-53-2)
10
C329
1
FRONT
WIPER
MOTOR
(8W-53-2)
(8W-53-3)
1
C363
1
C363
1
C362
1
C362
8
HEATED
SEAT
RELAY
(8W-63-6)
B
RIGHT
POWER
SEAT
SWITCH
(8W-63-3)
A
LEFT
POWER
SEAT
SWITCH
(8W-63-2)
• POWER SEATS

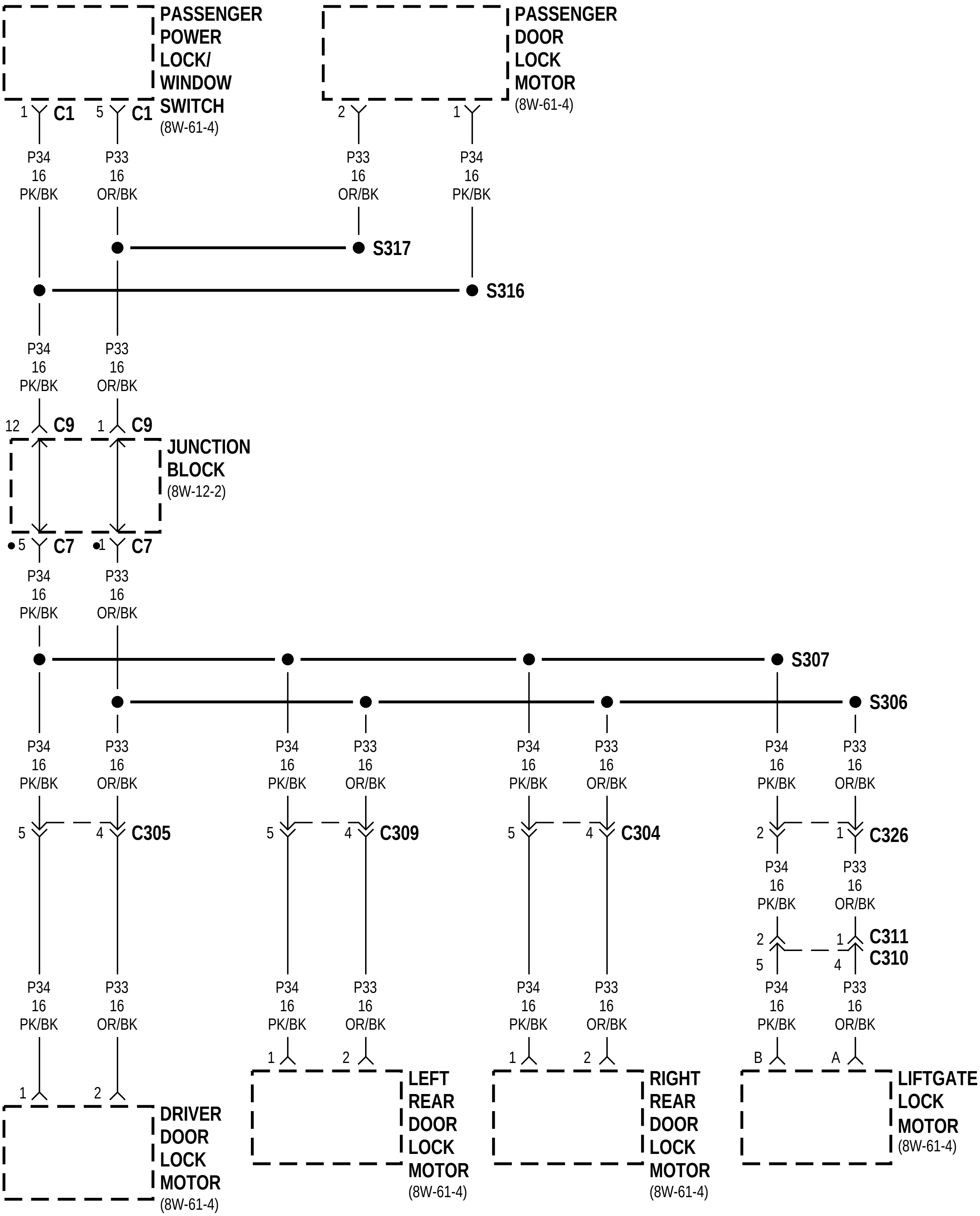

BATT A0
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
A23
FUSE 16 15A (8W-10-25)
A24
M1 20 PK
S135
M1 20 PK
12 C1
JUNCTION BLOCK
(8W-12-2)
4 C7
S18 C4
3 C3
1
UNDERHOOD LAMP/ MERCURY SWITCH
(8W-44-6)
M1 20 PK
5 C314
RHD
LHD
6 C201
OTHERS
SKIM
TO S347 (8W-10-26) (8W-10-27)
TO S361 (8W-10-26) (8W-10-27)
25
TRANSMISSION CONTROL MODULE (4.0L)
(8W-31-4)
LHD
RHD
M1 20 PK
M1 18 PK
S214
A
CARGO LAMP/ SWITCH
(8W-44-8) (8W-44-9)
A C208
A C207
7 C2
RADIO
(8W-47-2) (8W-47-3) (8W-47-9) (8W-47-10)
9 C1
INSTRUMENT CLUSTER
(8W-40-2)
M1 18 PK
1
LEFT COURTESY LAMP
(8W-44-6)
1
RIGHT COURTESY LAMP
(8W-44-6)

DIESEL

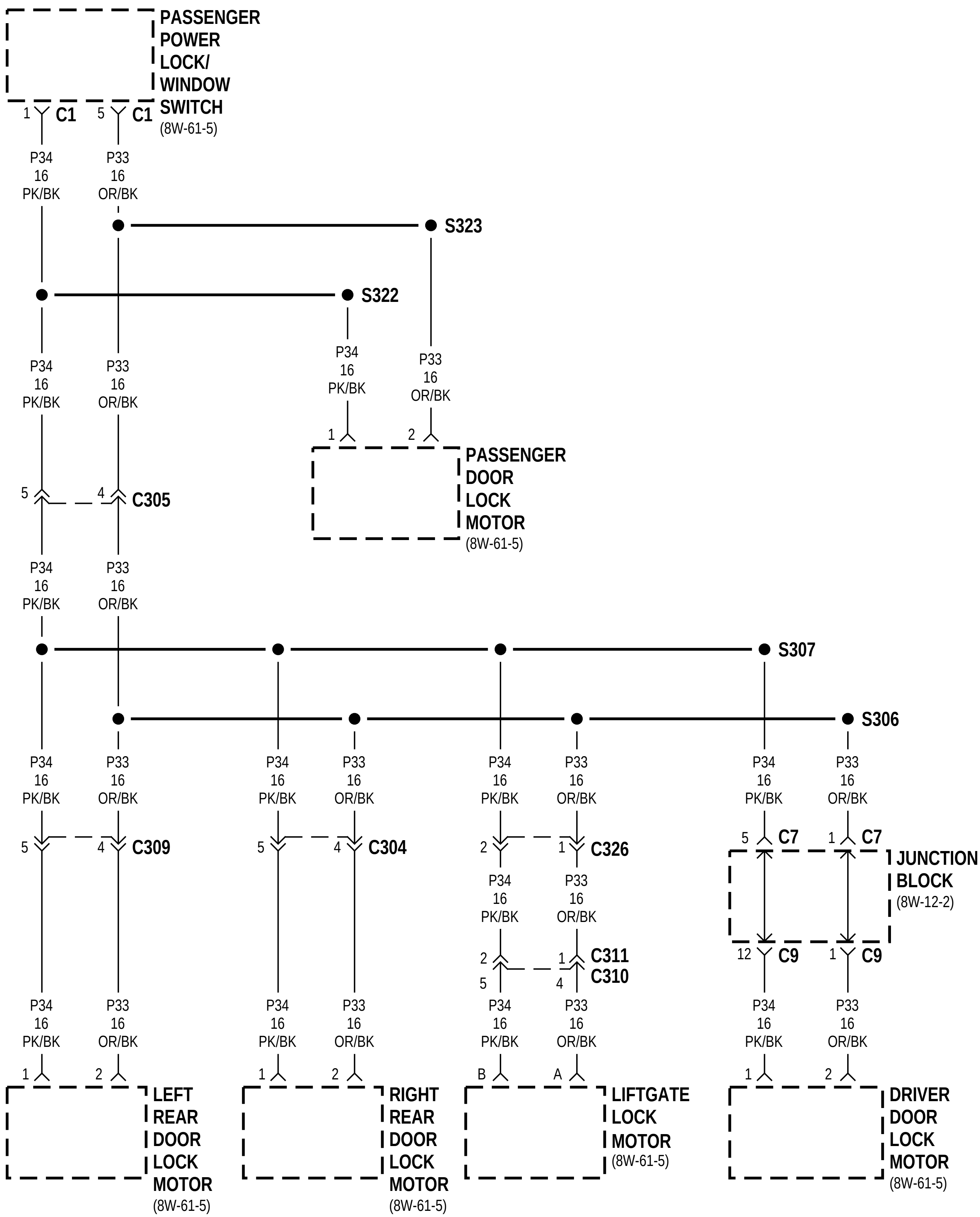


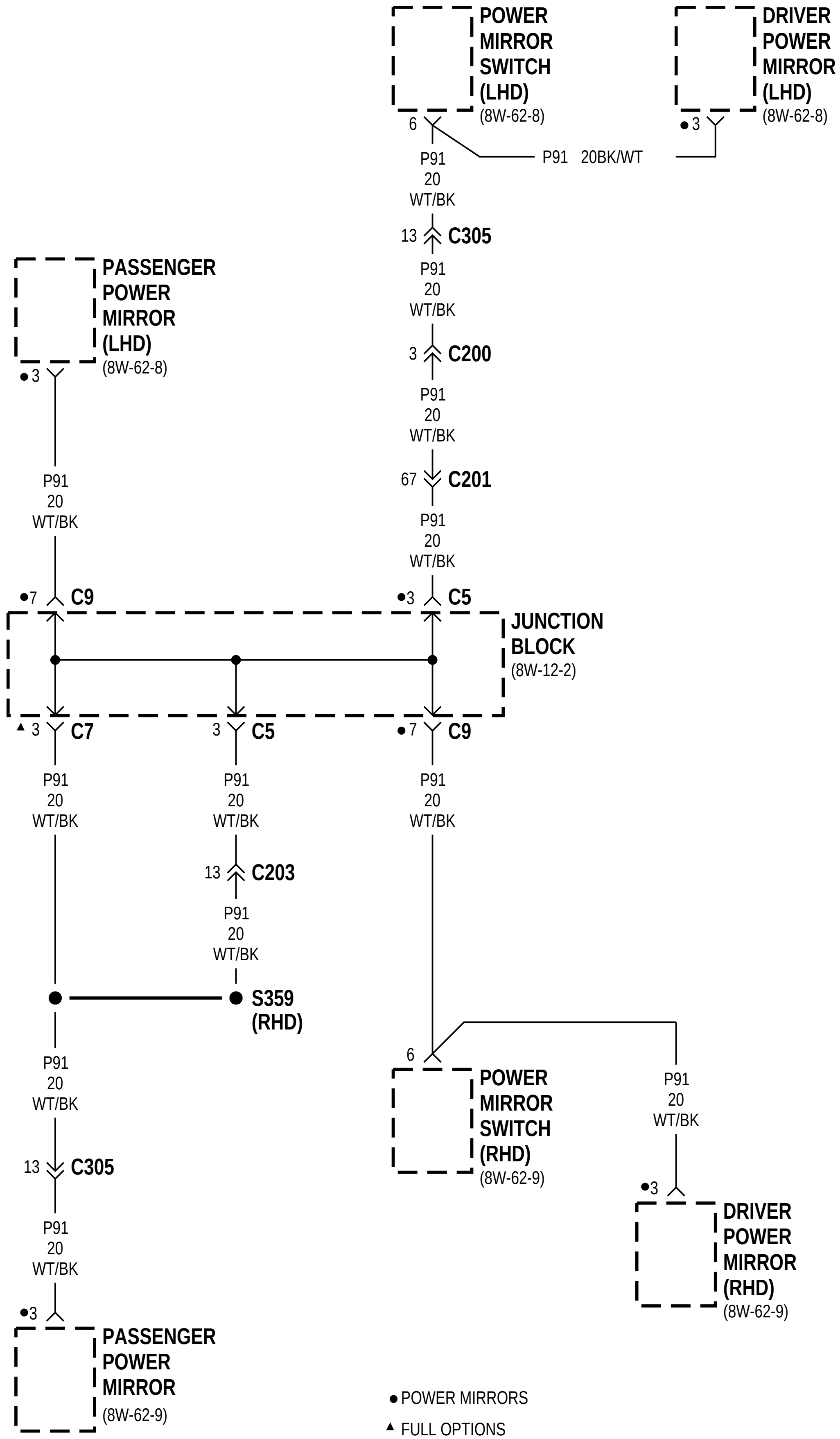
BATT A0
(8W-10-12)
A23
FUSE
16
15A
(8W-10-28)
A24
POWER
DISTRIBUTION
CENTER
(8W-10-6)
M1
20
PK
M1
20
PK
12
C1
JUNCTION
BLOCK
(8W-12-2)
1
UNDERHOOD
LAMP/
MERCURY
SWITCH
(8W-44-7)
4
C7
S18
C4
3
C3
M1
20
PK
5
C314
RHD
LHD
6
C201
TO
S347
(8W-10-28)
LHD
RHD
M1
20
PK
M1
18
PK
S214
7
C2
RADIO
(8W-47-2)
(8W-47-3)
A
CARGO
LAMP/
SWITCH
(8W-44-8)
(8W-44-9)
A
C208
A
C207
9
C1
INSTRUMENT
CLUSTER
(8W-40-2)
M1
18
PK
1
LEFT
COURTESY
LAMP
(8W-44-7)
1
RIGHT
COURTESY
LAMP
(8W-44-7)


HEADLAMP SWITCH
(8W-50-2)
(8W-50-3)
(8W-50-4)
3 C1
M2 20 YL
LEFT COURTESY LAMP
(8W-44-6)
(8W-44-7)
2
M2 18 BK/WT
B C208
M2 20 YL
RIGHT COURTESY LAMP
(8W-44-6)
(8W-44-7)
2
M2 18 BK/WT
B C207
M2 20 YL
S201
LHD
RHD
46 C201
M2 20 YL
S25 C4
JUNCTION BLOCK
(8W-12-2)
7 C7
1 C3
M2 20 YL
OVERHEAD MODULE
BASE/POLICE
S345
M2 20 YL
1
OVERHEAD MODULE
(8W-49-4)
FULL OPTIONS
MIDLINE
M2 20 YL
7
COMPASS
(8W-49-4)
M2 20 YL
B
DOME LAMPS SWITCH
(8W-44-5)
M2 20 YL
3
DOME LAMP
(8W-44-5)
S304
M2 20 YL
1 C317
M2 18 YL
1
DRIVER DOOR JAMB SWITCH
(8W-39-6)
(8W-39-7)
M2 20 YL
A C320
M2 18 YL
3
LEFT REAR DOOR JAMB SWITCH
(8W-39-6)
(8W-39-7)
M2 20 YL
1 C318
M2 18 YL
1
PASSENGER DOOR JAMB SWITCH
(8W-39-6)
(8W-39-7)
M2 20 YL
A C319
M2 18 YL
3
RIGHT REAR DOOR JAMB SWITCH
(8W-39-6)
(8W-39-7)
M2 20 YL
6 C314
M2 20 YL
B
CARGO LAMP/ SWITCH
(8W-44-8)
(8W-44-9)

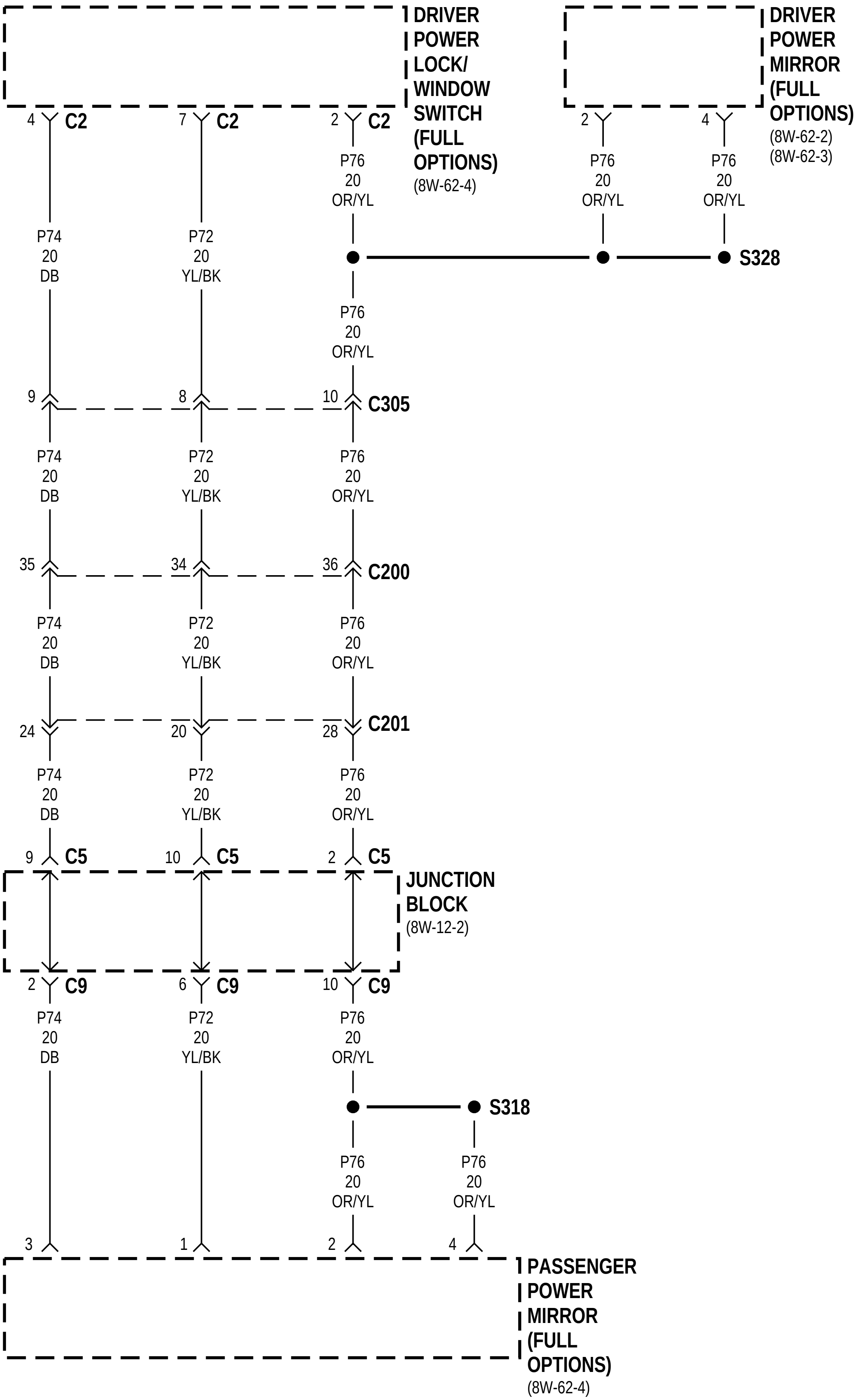


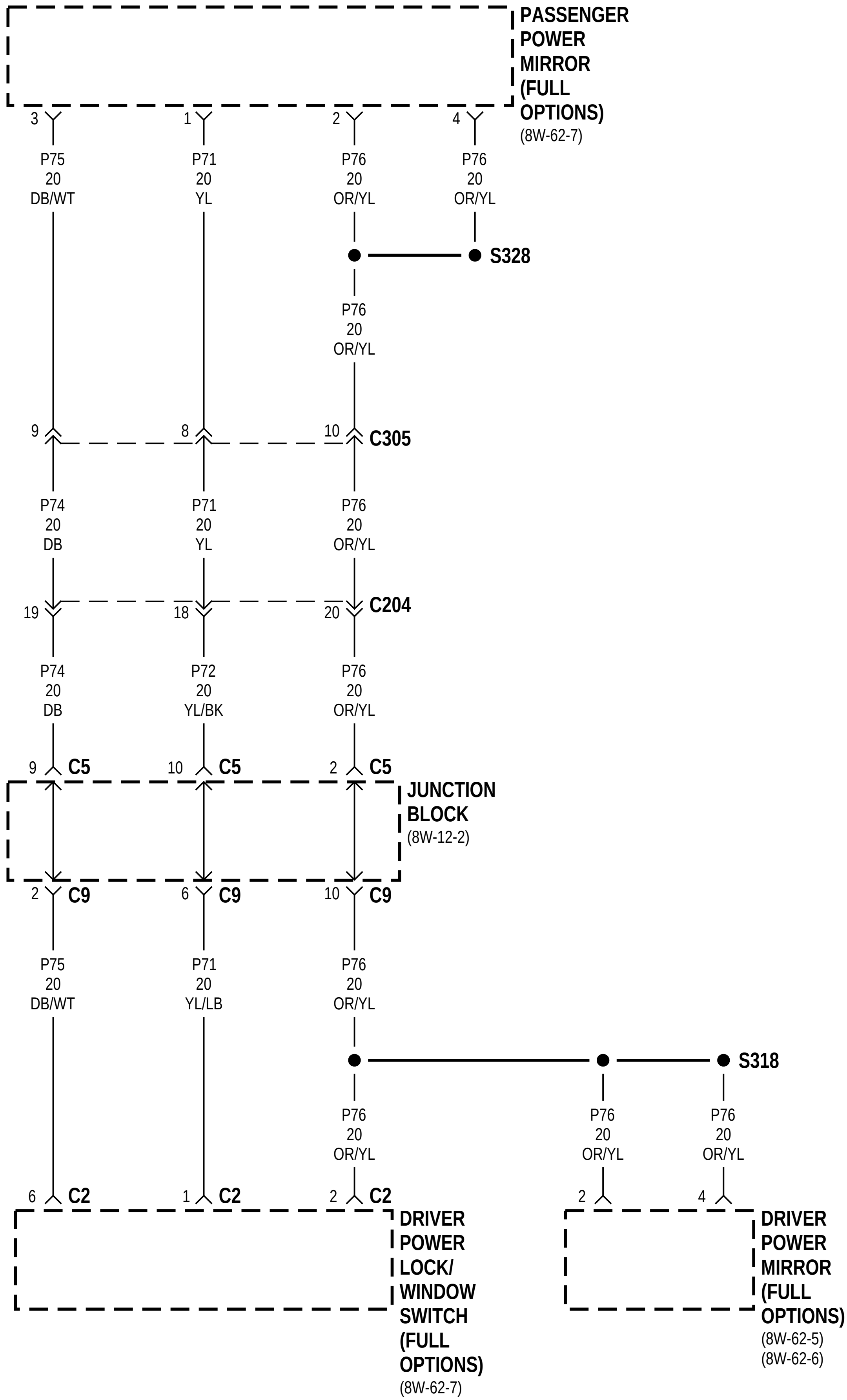
● FULL OPTIONS


PASSENGER POWER LOCK/ WINDOW SWITCH
(8W-61-5)
C1
P34 16 PK/BK
P33 16 OR/BK
S323
S322
PASSENGER DOOR LOCK MOTOR
(8W-61-5)
C305
S307
S306
C309
C304
C326
C311
C310
C7
JUNCTION BLOCK
(8W-12-2)
C9
LEFT REAR DOOR LOCK MOTOR
(8W-61-5)
RIGHT REAR DOOR LOCK MOTOR
(8W-61-5)
LIFTGATE LOCK MOTOR
(8W-61-5)
DRIVER DOOR LOCK MOTOR
(8W-61-5)

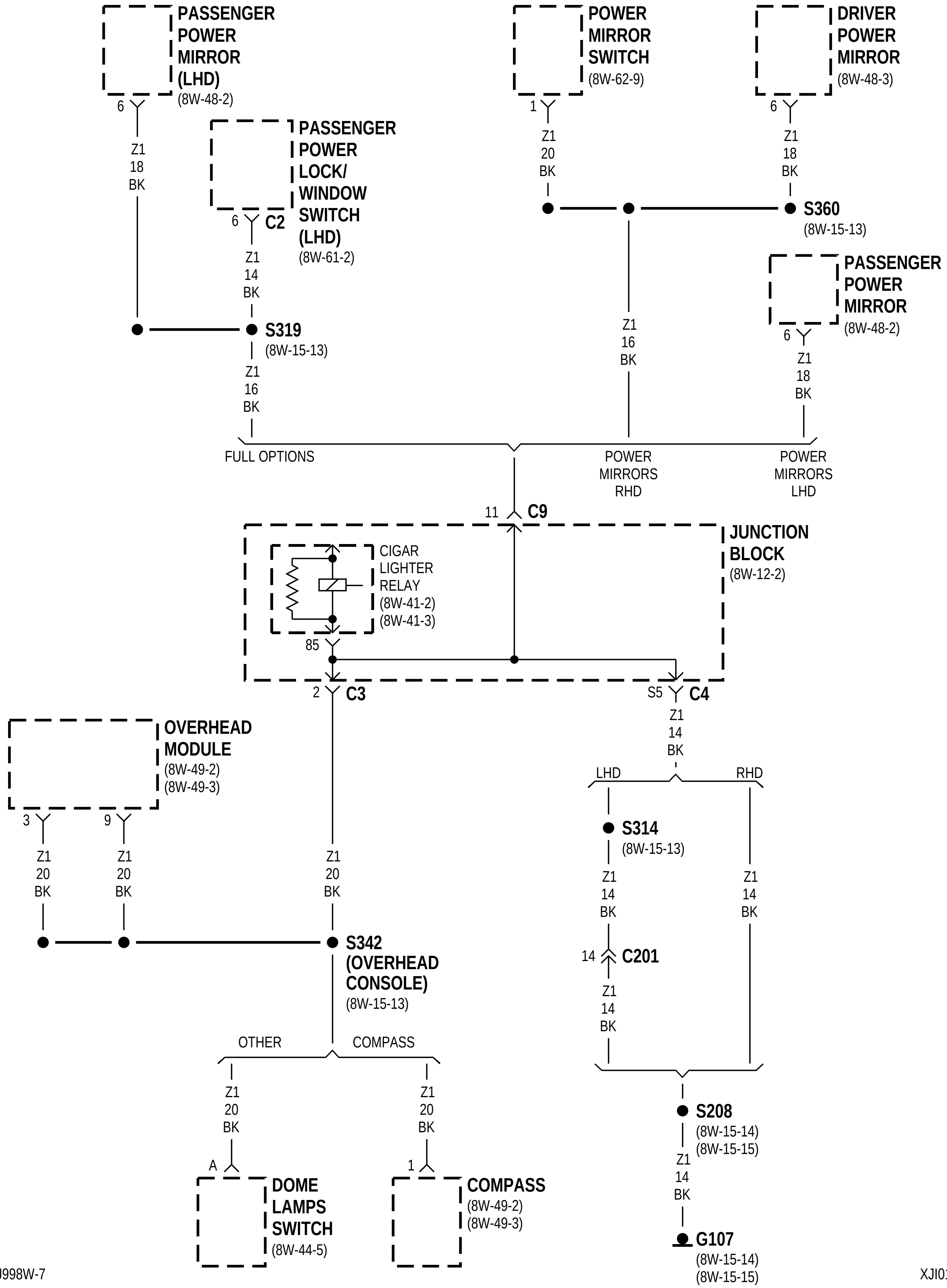

POWER MIRROR SWITCH (LHD)
(8W-62-8)
DRIVER POWER MIRROR (LHD)
(8W-62-8)
6
3
P91 20 WT/BK
P91 20BK/WT
13 C305
P91 20 WT/BK
3 C200
P91 20 WT/BK
67 C201
P91 20 WT/BK
PASSENGER POWER MIRROR (LHD)
(8W-62-8)
3
P91 20 WT/BK
7 C9
3 C5
JUNCTION BLOCK
(8W-12-2)
3 C7
3 C5
7 C9
P91 20 WT/BK
P91 20 WT/BK
P91 20 WT/BK
13 C203
P91 20 WT/BK
S359 (RHD)
P91 20 WT/BK
6
POWER MIRROR SWITCH (RHD)
(8W-62-9)
P91 20 WT/BK
13 C305
P91 20 WT/BK
3
DRIVER POWER MIRROR (RHD)
(8W-62-9)
3
PASSENGER POWER MIRROR
(8W-62-9)
● POWER MIRRORS
▲ FULL OPTIONS

LHD


DRIVER POWER LOCK/ WINDOW SWITCH (FULL OPTIONS)
(8W-62-4)
DRIVER POWER MIRROR (FULL OPTIONS)
(8W-62-2)
(8W-62-3)
4 C2
7 C2
2 C2
2
4
P76 20 OR/YL
P74 20 DB
P72 20 YL/BK
S328
9
8
10 C305
35
34
36 C200
24
20
28 C201
9 C5
10 C5
2 C5
JUNCTION BLOCK
(8W-12-2)
2 C9
6 C9
10 C9
S318
3
1
2
4
PASSENGER POWER MIRROR (FULL OPTIONS)
(8W-62-4)


PASSENGER POWER MIRROR (FULL OPTIONS)
(8W-62-7)
3
1
2
4
P75 20 DB/WT
P71 20 YL
P76 20 OR/YL
P76 20 OR/YL
S328
P76 20 OR/YL
9
8
10
C305
P74 20 DB
P71 20 YL
P76 20 OR/YL
19
18
20
C204
P74 20 DB
P72 20 YL/BK
P76 20 OR/YL
9 C5
10 C5
2 C5
JUNCTION BLOCK
(8W-12-2)
2 C9
6 C9
10 C9
P75 20 DB/WT
P71 20 YL/LB
P76 20 OR/YL
S318
P76 20 OR/YL
P76 20 OR/YL
P76 20 OR/YL
6 C2
1 C2
2 C2
2
4
DRIVER POWER LOCK/ WINDOW SWITCH (FULL OPTIONS)
(8W-62-7)
DRIVER POWER MIRROR (FULL OPTIONS)
(8W-62-5)
(8W-62-6)

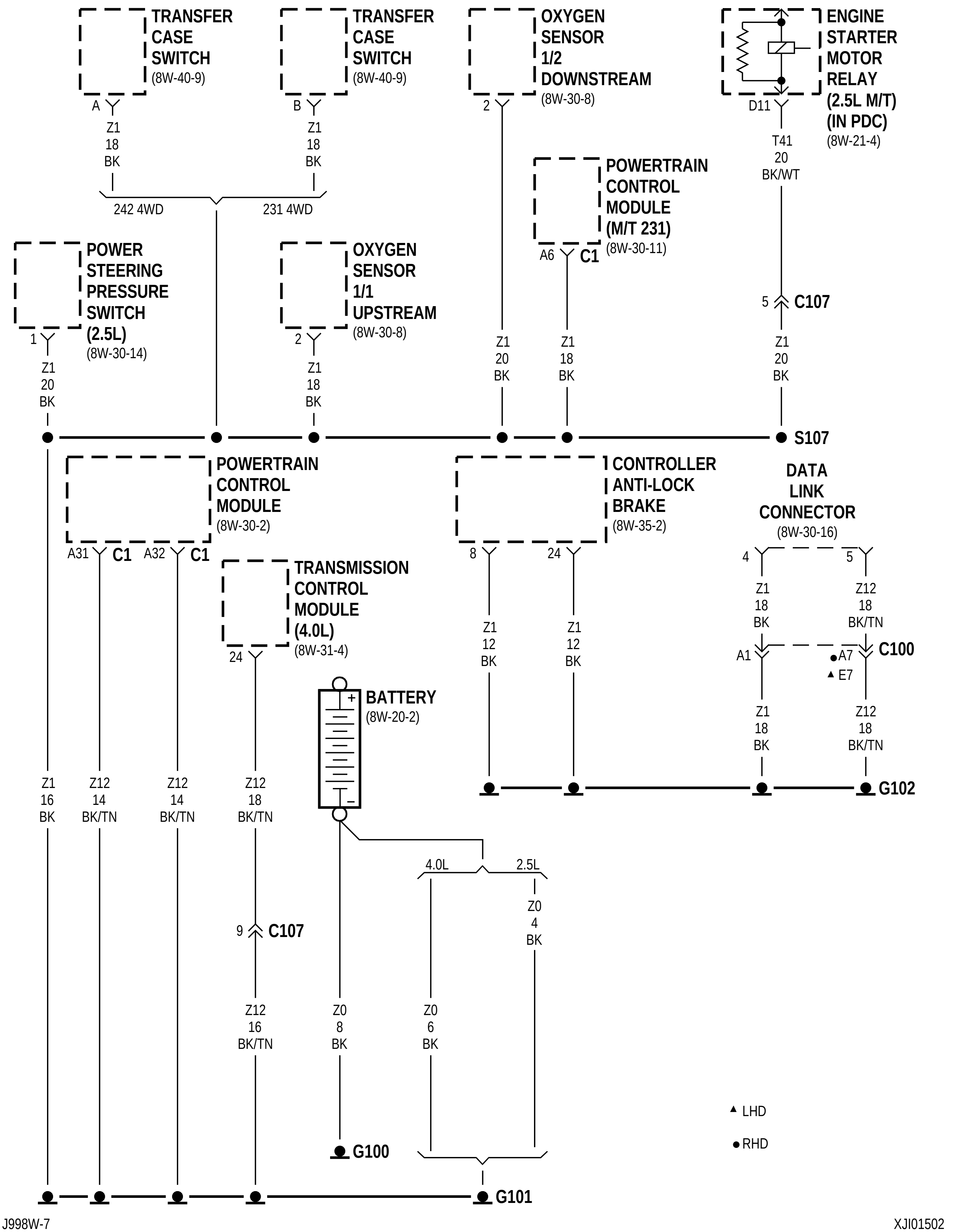
XJI01235

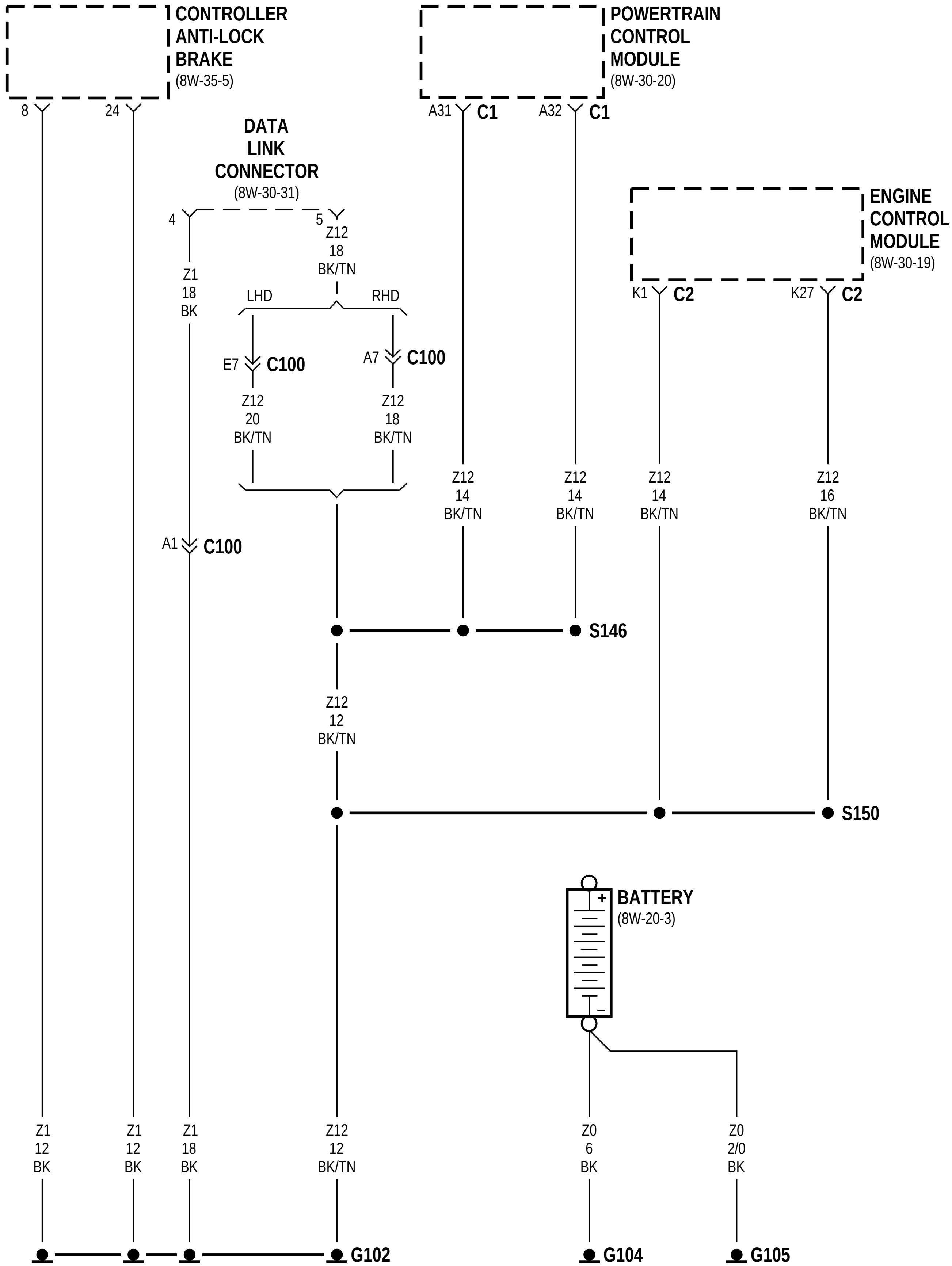


J998W-7 XJI01236

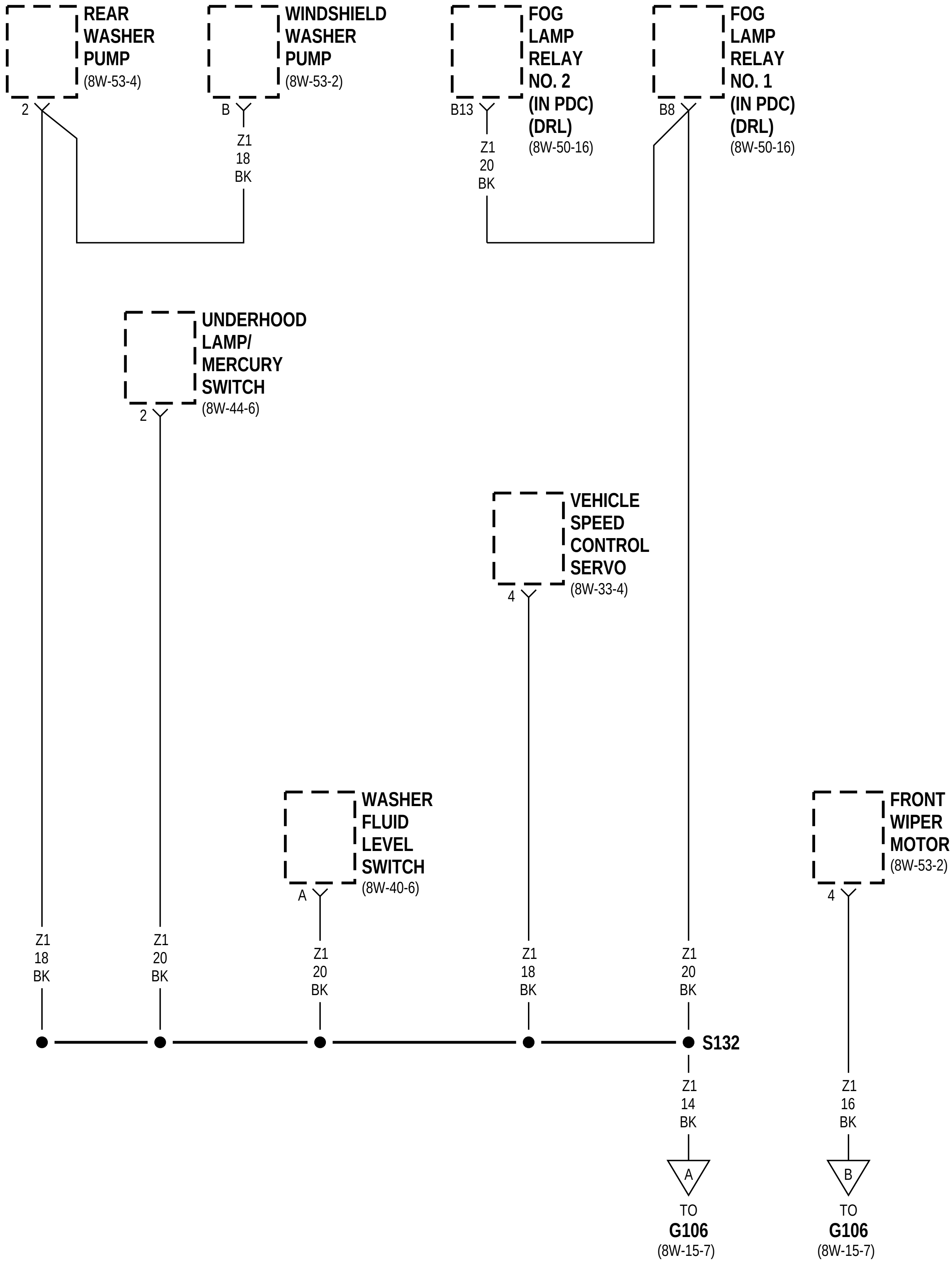
8W-15 GROUND DISTRIBUTION

GAS

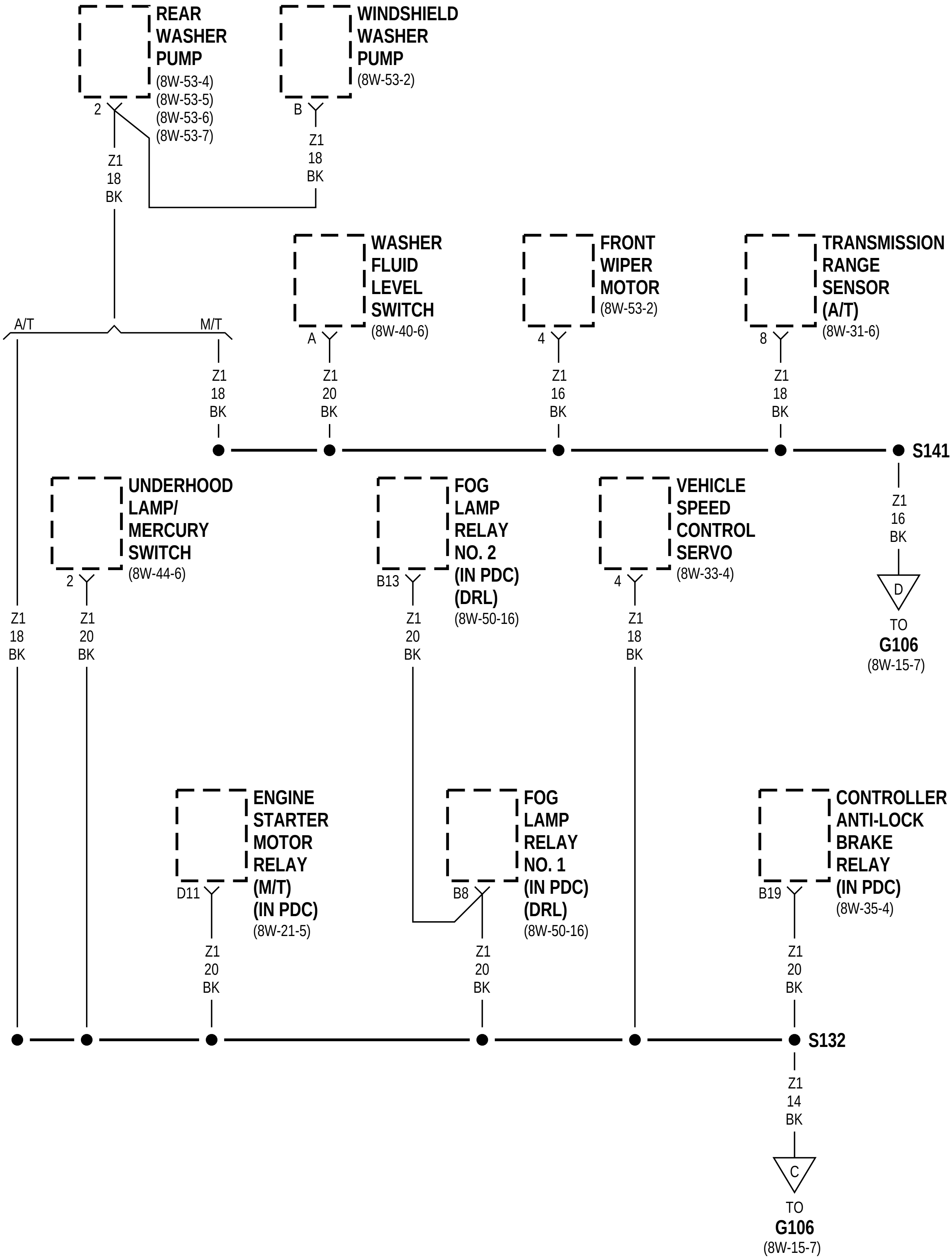

TRANSFER CASE SWITCH (8W-40-9)
A
Z1 18 BK
TRANSFER CASE SWITCH (8W-40-9)
B
Z1 18 BK
242 4WD
231 4WD
OXYGEN SENSOR 1/2 DOWNSTREAM (8W-30-8)
2
Z1 20 BK
ENGINE STARTER MOTOR RELAY (2.5L M/T) (IN PDC) (8W-21-4)
D11
T41 20 BK/WT
POWERTRAIN CONTROL MODULE (M/T 231) (8W-30-11)
A6 C1
Z1 18 BK
5 C107
Z1 20 BK
POWER STEERING PRESSURE SWITCH (2.5L) (8W-30-14)
1
Z1 20 BK
OXYGEN SENSOR 1/1 UPSTREAM (8W-30-8)
2
Z1 18 BK
S107
POWERTRAIN CONTROL MODULE (8W-30-2)
A31 C1
A32 C1
CONTROLLER ANTI-LOCK BRAKE (8W-35-2)
8
24
Z1 12 BK
Z1 12 BK
DATA LINK CONNECTOR (8W-30-16)
4
5
Z1 18 BK
Z12 18 BK/TN
A1
A7
E7
C100
Z1 18 BK
Z12 18 BK/TN
G102
TRANSMISSION CONTROL MODULE (4.0L) (8W-31-4)
24
BATTERY (8W-20-2)
Z1 16 BK
Z12 14 BK/TN
Z12 14 BK/TN
Z12 18 BK/TN
4.0L
2.5L
Z0 4 BK
9 C107
Z12 16 BK/TN
Z0 8 BK
Z0 6 BK
G100
G101
LHD
RHD
J998W-7
XJI01502


CONTROLLER
ANTI-LOCK
BRAKE
(8W-35-5)
8
24
POWERTRAIN
CONTROL
MODULE
(8W-30-20)
A31 C1
A32 C1
DATA
LINK
CONNECTOR
(8W-30-31)
4
5
Z12
18
BK/TN
Z1
18
BK
LHD
RHD
E7 C100
A7 C100
Z12
20
BK/TN
Z12
18
BK/TN
ENGINE
CONTROL
MODULE
(8W-30-19)
K1 C2
K27 C2
Z12
14
BK/TN
Z12
14
BK/TN
Z12
14
BK/TN
Z12
16
BK/TN
A1 C100
S146
Z12
12
BK/TN
S150
BATTERY
(8W-20-3)
+
–
Z1
12
BK
Z1
12
BK
Z1
18
BK
Z12
12
BK/TN
Z0
6
BK
Z0
2/0
BK
G102
G104
G105

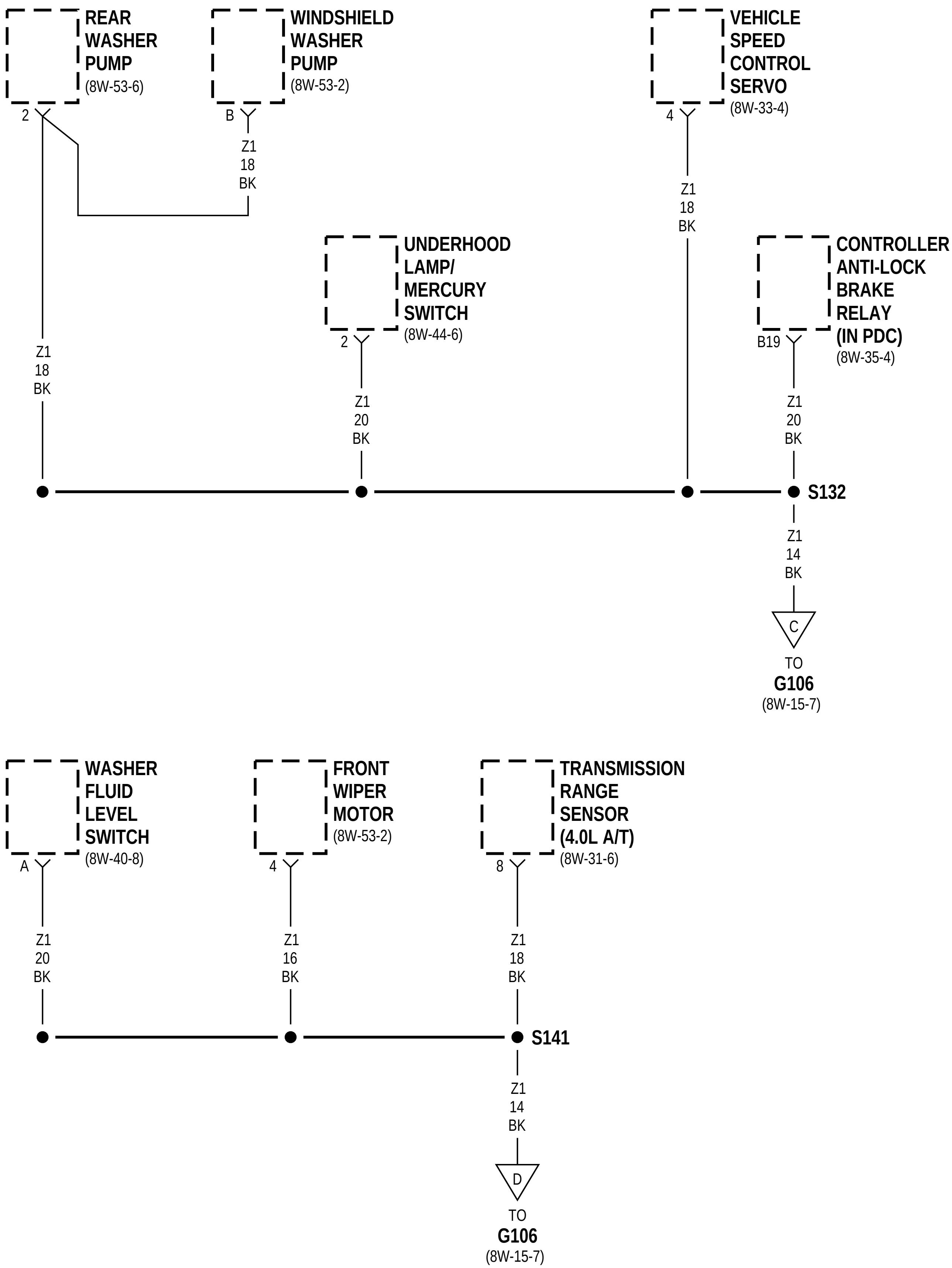
LHD 2.5L GAS


REAR WASHER PUMP
(8W-53-4)
WINDSHIELD WASHER PUMP
(8W-53-2)
FOG LAMP RELAY NO. 2 (IN PDC) (DRL)
(8W-50-16)
FOG LAMP RELAY NO. 1 (IN PDC) (DRL)
(8W-50-16)
2
B
B13
B8
Z1 18 BK
Z1 20 BK
UNDERHOOD LAMP/ MERCURY SWITCH
(8W-44-6)
2
VEHICLE SPEED CONTROL SERVO
(8W-33-4)
4
WASHER FLUID LEVEL SWITCH
(8W-40-6)
A
FRONT WIPER MOTOR
(8W-53-2)
4
Z1 18 BK
Z1 20 BK
Z1 20 BK
Z1 18 BK
Z1 20 BK
S132
Z1 14 BK
Z1 16 BK
A
B
TO G106
(8W-15-7)
TO G106
(8W-15-7)

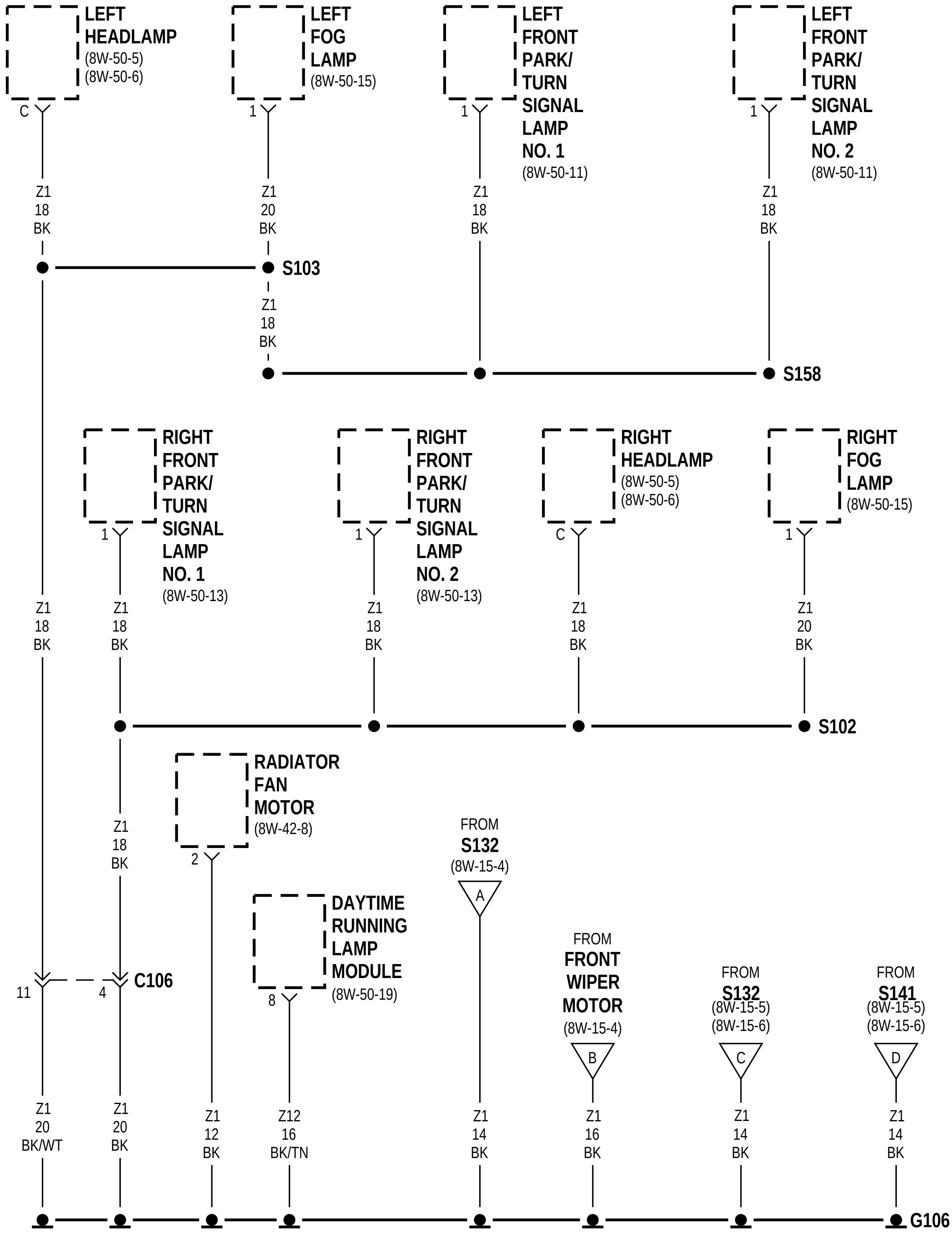
LHD 4.0L EXCEPT BUILT-UP-EXPORT



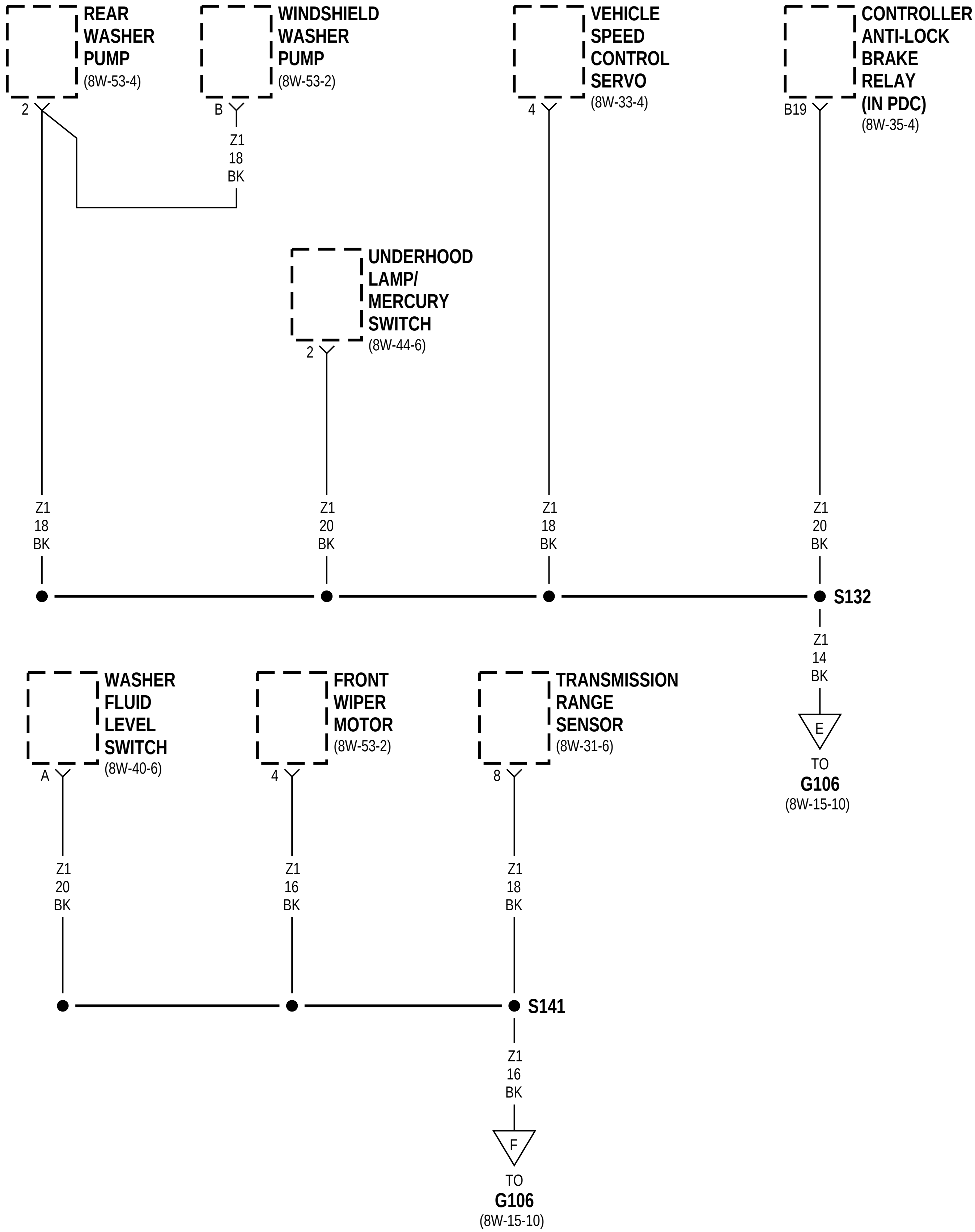
RHD GAS


REAR
WASHER
PUMP
(8W-53-6)
2
WINDSHIELD
WASHER
PUMP
(8W-53-2)
B
Z1
18
BK
VEHICLE
SPEED
CONTROL
SERVO
(8W-33-4)
4
Z1
18
BK
UNDERHOOD
LAMP/
MERCURY
SWITCH
(8W-44-6)
2
CONTROLLER
ANTI-LOCK
BRAKE
RELAY
(IN PDC)
(8W-35-4)
B19
Z1
18
BK
Z1
20
BK
Z1
20
BK
S132
Z1
14
BK
C
TO
G106
(8W-15-7)
WASHER
FLUID
LEVEL
SWITCH
(8W-40-8)
A
FRONT
WIPER
MOTOR
(8W-53-2)
4
TRANSMISSION
RANGE
SENSOR
(4.0L A/T)
(8W-31-6)
8
Z1
20
BK
Z1
16
BK
Z1
18
BK
S141
Z1
14
BK
D
TO
G106
(8W-15-7)

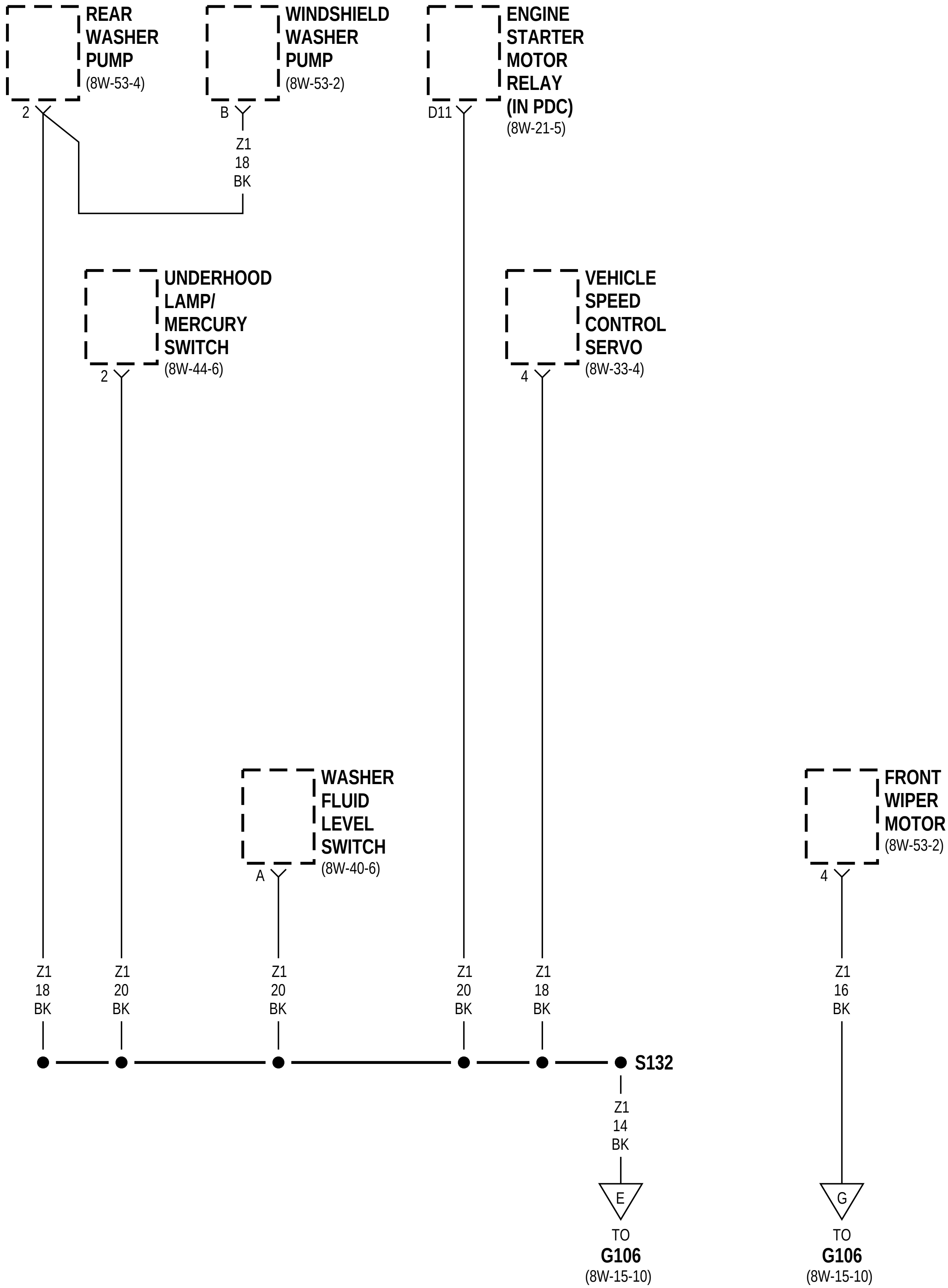
EXCEPT BUILT-UP-EXPORT



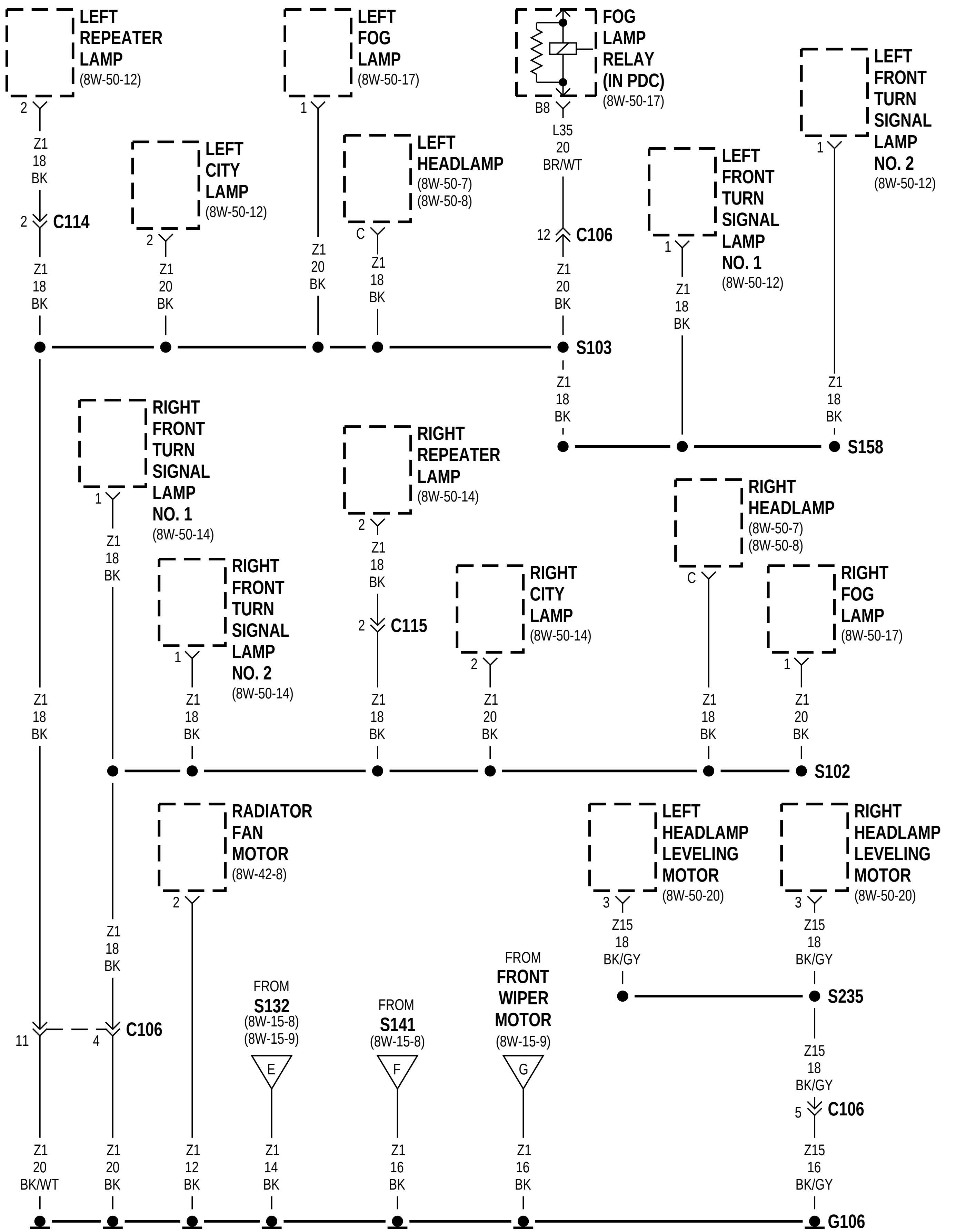
BUILT-UP-EXPORT LHD 4.0L A/T



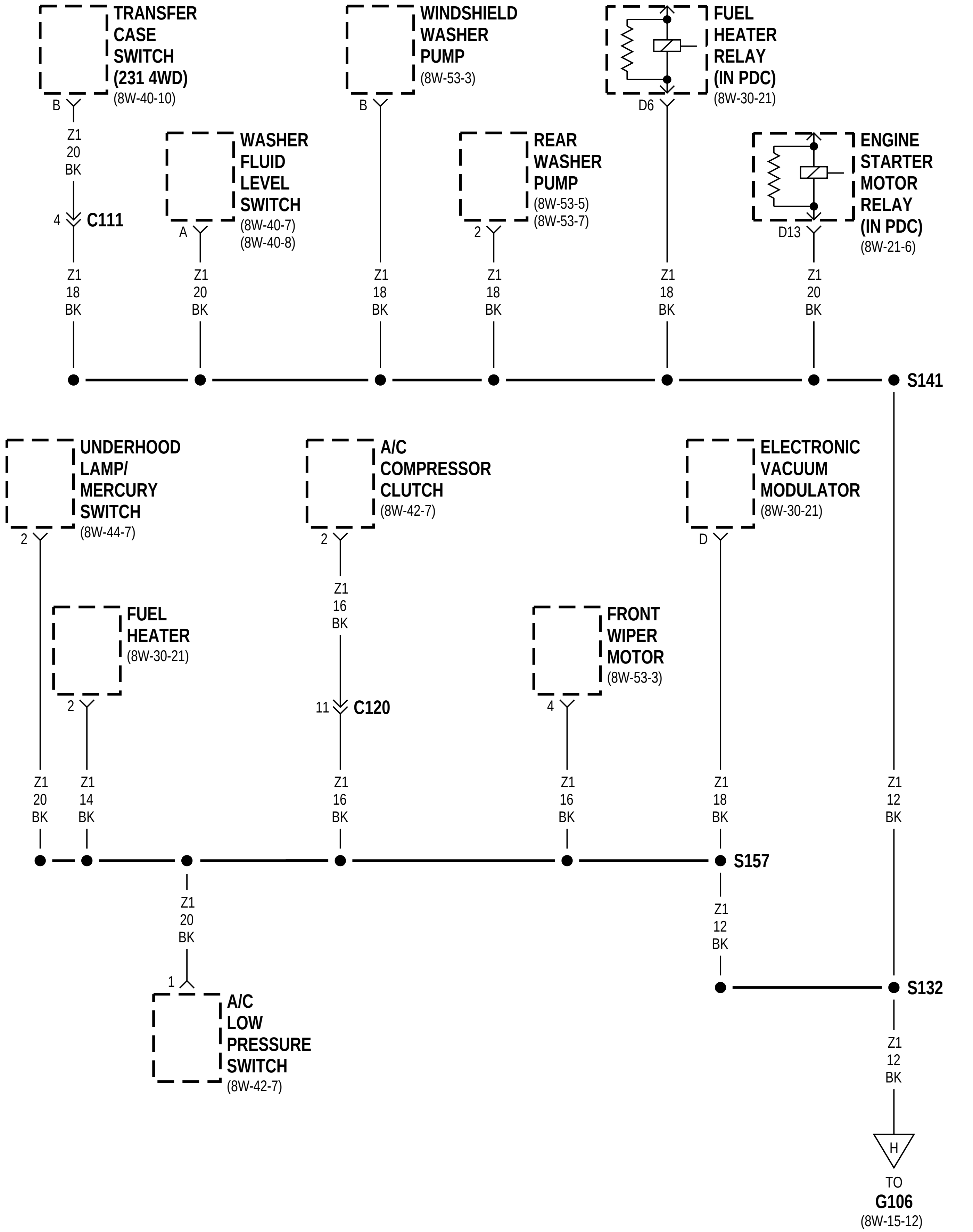
BUILT-UP-EXPORT LHD 4.0L M/T



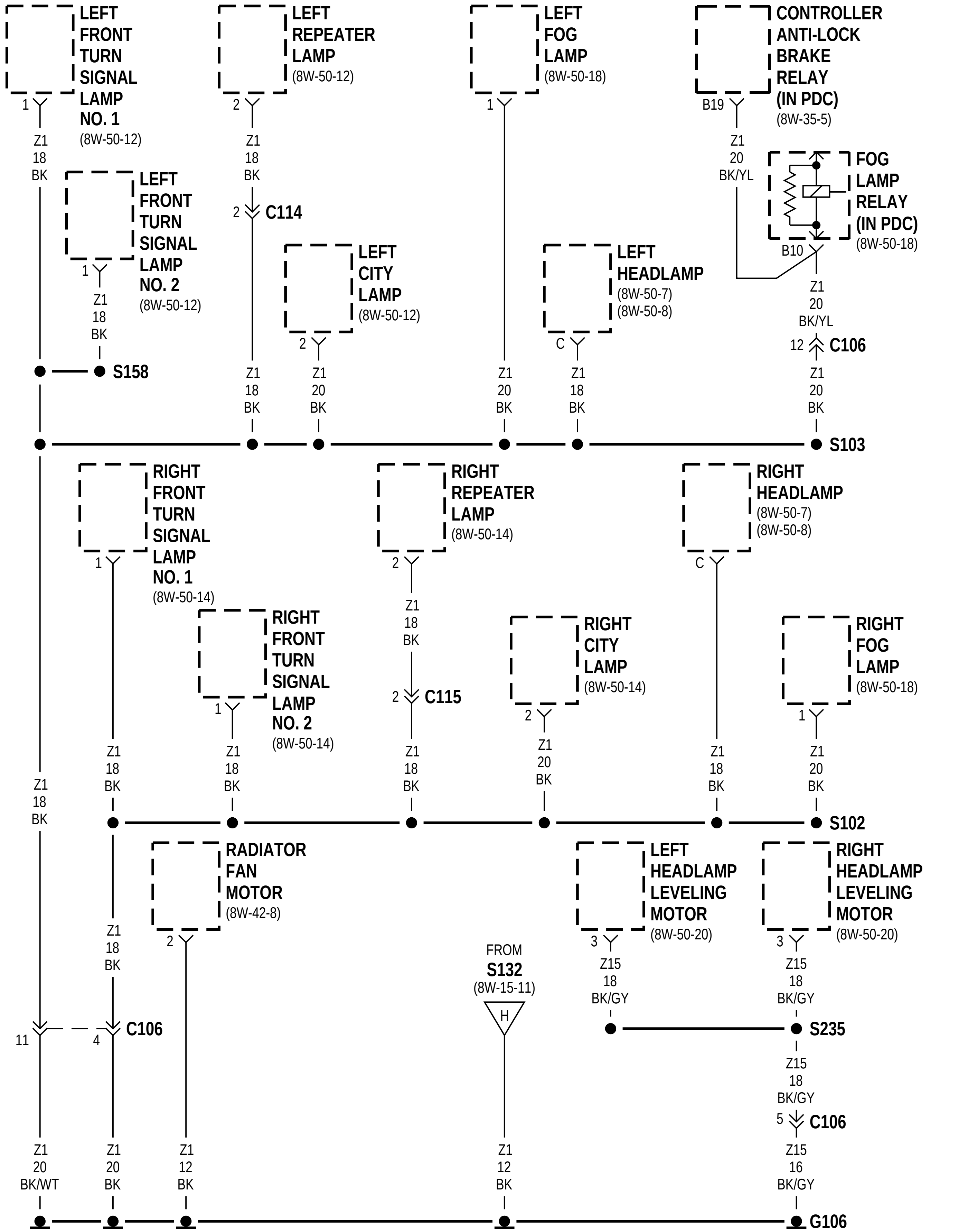
BUILT-UP-EXPORT GAS

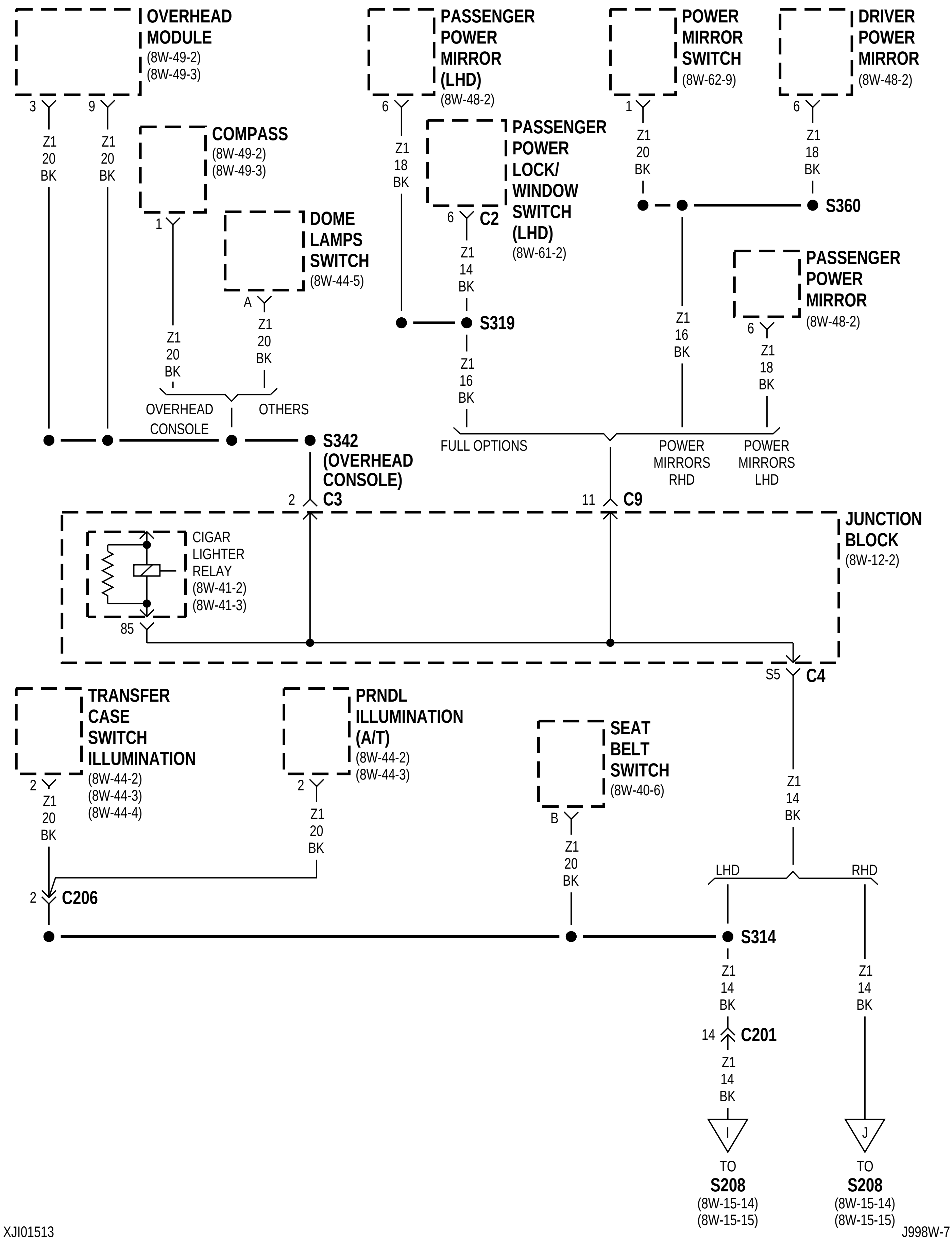


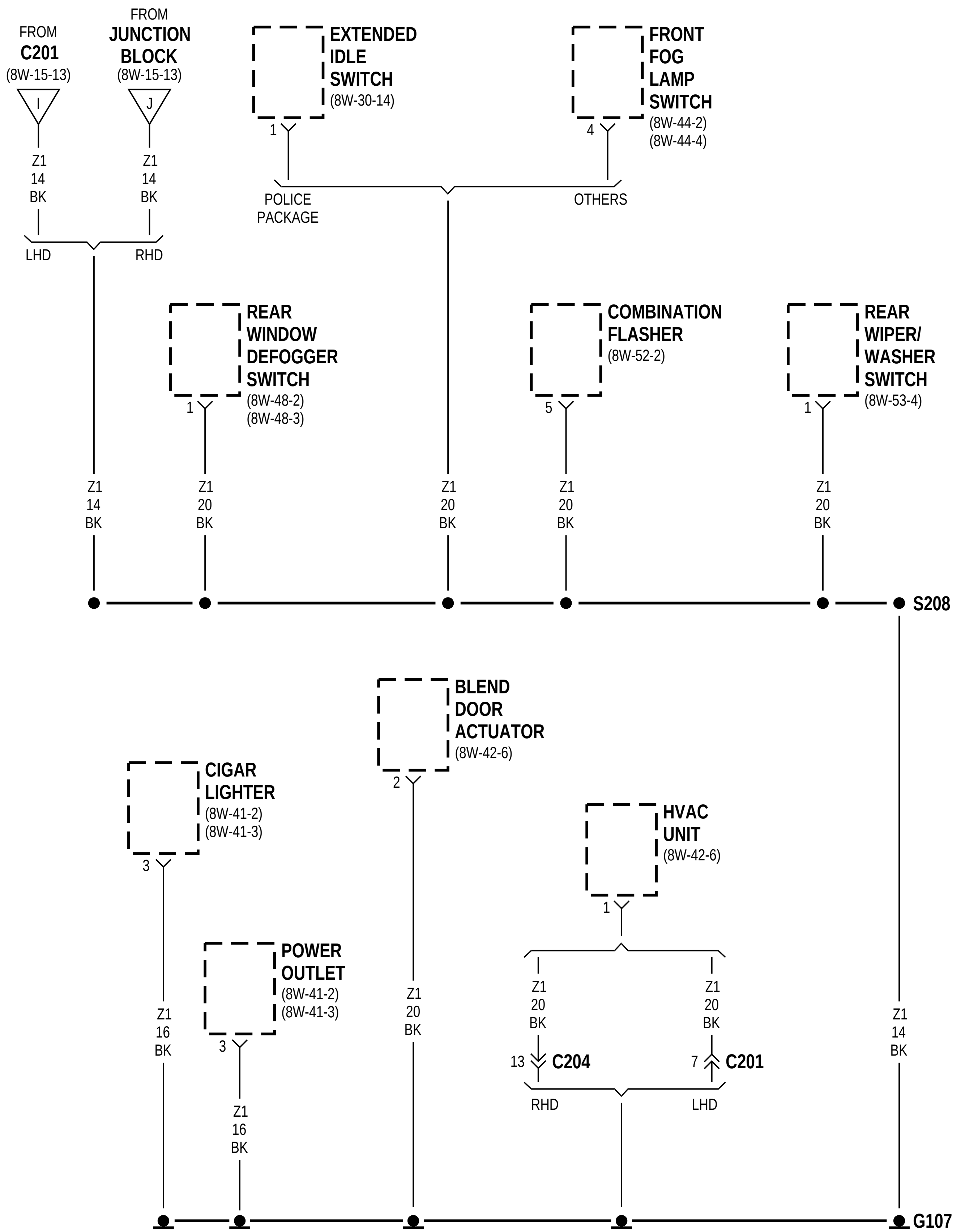
DIESEL


TRANSFER CASE SWITCH (231 4WD)
(8W-40-10)
B
Z1 20 BK
4
C111
Z1 18 BK
WASHER FLUID LEVEL SWITCH
(8W-40-7)
(8W-40-8)
A
Z1 20 BK
WINDSHIELD WASHER PUMP
(8W-53-3)
B
Z1 18 BK
REAR WASHER PUMP
(8W-53-5)
(8W-53-7)
2
Z1 18 BK
FUEL HEATER RELAY (IN PDC)
(8W-30-21)
D6
Z1 18 BK
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-6)
D13
Z1 20 BK
S141
UNDERHOOD LAMP/ MERCURY SWITCH
(8W-44-7)
2
Z1 20 BK
FUEL HEATER
(8W-30-21)
2
Z1 14 BK
A/C COMPRESSOR CLUTCH
(8W-42-7)
2
Z1 16 BK
11
C120
Z1 16 BK
FRONT WIPER MOTOR
(8W-53-3)
4
Z1 16 BK
ELECTRONIC VACUUM MODULATOR
(8W-30-21)
D
Z1 18 BK
S157
Z1 12 BK
Z1 20 BK
1
A/C LOW PRESSURE SWITCH
(8W-42-7)
Z1 12 BK
S132
Z1 12 BK
H
TO
G106
(8W-15-12)

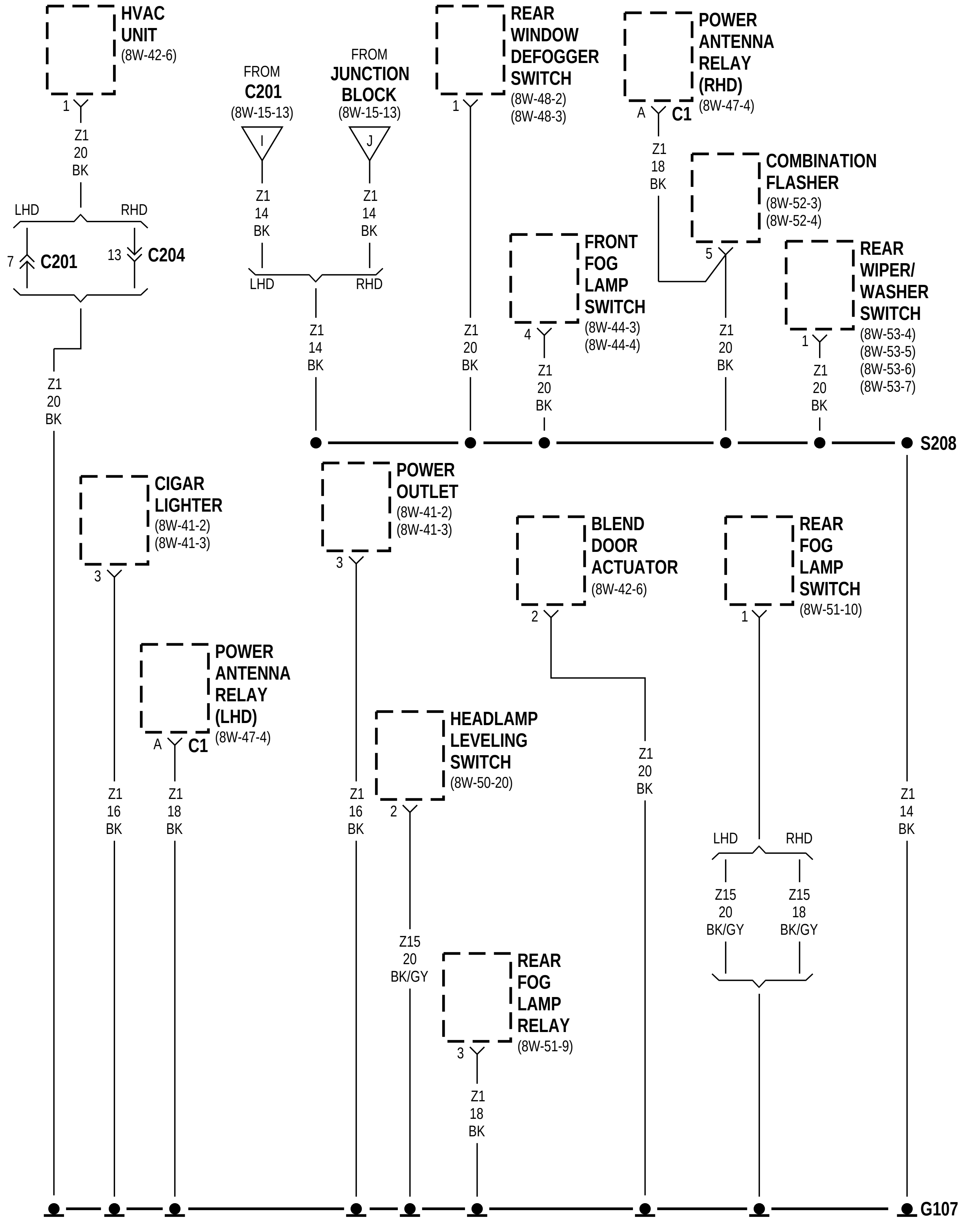
DIESEL

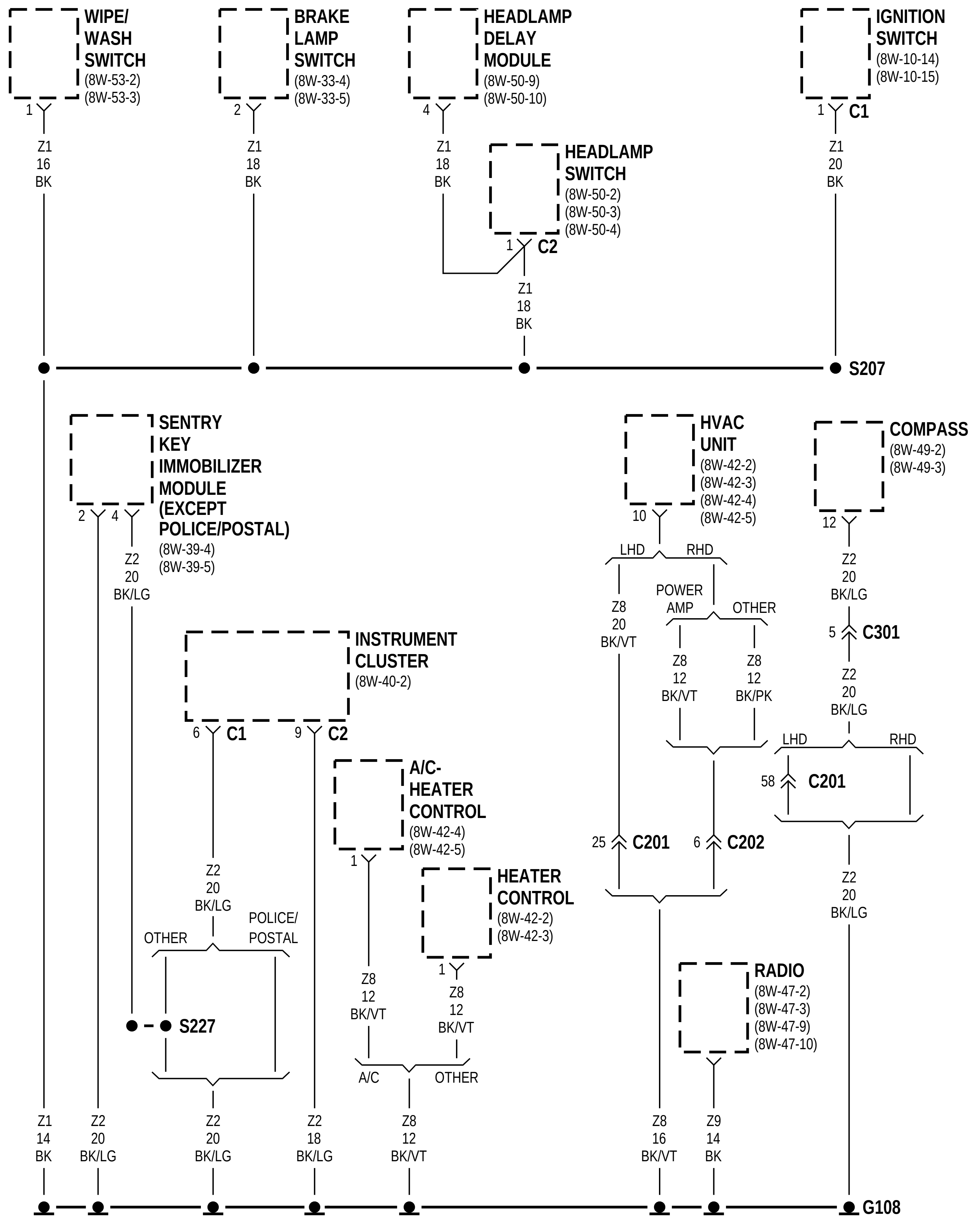

LEFT FRONT TURN SIGNAL LAMP NO. 1 (8W-50-12)
LEFT REPEATER LAMP (8W-50-12)
LEFT FOG LAMP (8W-50-18)
CONTROLLER ANTI-LOCK BRAKE RELAY (IN PDC) (8W-35-5)
B19
Z1 20 BK/YL
FOG LAMP RELAY (IN PDC) (8W-50-18)
B10
LEFT FRONT TURN SIGNAL LAMP NO. 2 (8W-50-12)
C114
LEFT CITY LAMP (8W-50-12)
LEFT HEADLAMP (8W-50-7) (8W-50-8)
C106
S158
S103
RIGHT FRONT TURN SIGNAL LAMP NO. 1 (8W-50-14)
RIGHT REPEATER LAMP (8W-50-14)
RIGHT HEADLAMP (8W-50-7) (8W-50-8)
RIGHT FRONT TURN SIGNAL LAMP NO. 2 (8W-50-14)
C115
RIGHT CITY LAMP (8W-50-14)
RIGHT FOG LAMP (8W-50-18)
S102
RADIATOR FAN MOTOR (8W-42-8)
LEFT HEADLAMP LEVELING MOTOR (8W-50-20)
RIGHT HEADLAMP LEVELING MOTOR (8W-50-20)
FROM S132 (8W-15-11)
H
Z15 18 BK/GY
S235
Z15 16 BK/GY
Z1 20 BK/WT
Z1 12 BK
G106


OVERHEAD MODULE
(8W-49-2)
(8W-49-3)
3
9
Z1
20
BK
COMPASS
(8W-49-2)
(8W-49-3)
1
DOME LAMPS SWITCH
(8W-44-5)
A
OVERHEAD CONSOLE
OTHERS
S342 (OVERHEAD CONSOLE)
2
C3
PASSENGER POWER MIRROR (LHD)
(8W-48-2)
6
Z1
18
BK
PASSENGER POWER LOCK/ WINDOW SWITCH (LHD)
(8W-61-2)
6
C2
Z1
14
BK
S319
Z1
16
BK
FULL OPTIONS
11
C9
POWER MIRROR SWITCH
(8W-62-9)
1
DRIVER POWER MIRROR
(8W-48-2)
S360
PASSENGER POWER MIRROR
(8W-48-2)
POWER MIRRORS RHD
POWER MIRRORS LHD
JUNCTION BLOCK
(8W-12-2)
CIGAR LIGHTER RELAY
(8W-41-2)
(8W-41-3)
85
S5
C4
TRANSFER CASE SWITCH ILLUMINATION
(8W-44-2)
(8W-44-3)
(8W-44-4)
2
PRNDL ILLUMINATION (A/T)
(8W-44-2)
(8W-44-3)
C206
SEAT BELT SWITCH
(8W-40-6)
B
LHD
RHD
S314
14
C201
I
J
TO
S208
(8W-15-14)
(8W-15-15)
XJI01513
J998W-7


FROM
C201
(8W-15-13)
I
FROM
JUNCTION
BLOCK
(8W-15-13)
J
Z1
14
BK
LHD
RHD
EXTENDED
IDLE
SWITCH
(8W-30-14)
1
FRONT
FOG
LAMP
SWITCH
(8W-44-2)
(8W-44-4)
4
POLICE
PACKAGE
OTHERS
REAR
WINDOW
DEFOGGER
SWITCH
(8W-48-2)
(8W-48-3)
COMBINATION
FLASHER
(8W-52-2)
5
REAR
WIPER/
WASHER
SWITCH
(8W-53-4)
Z1
20
BK
S208
BLEND
DOOR
ACTUATOR
(8W-42-6)
2
CIGAR
LIGHTER
(8W-41-2)
(8W-41-3)
3
POWER
OUTLET
(8W-41-2)
(8W-41-3)
HVAC
UNIT
(8W-42-6)
Z1
16
BK
13
C204
7
C201
G107

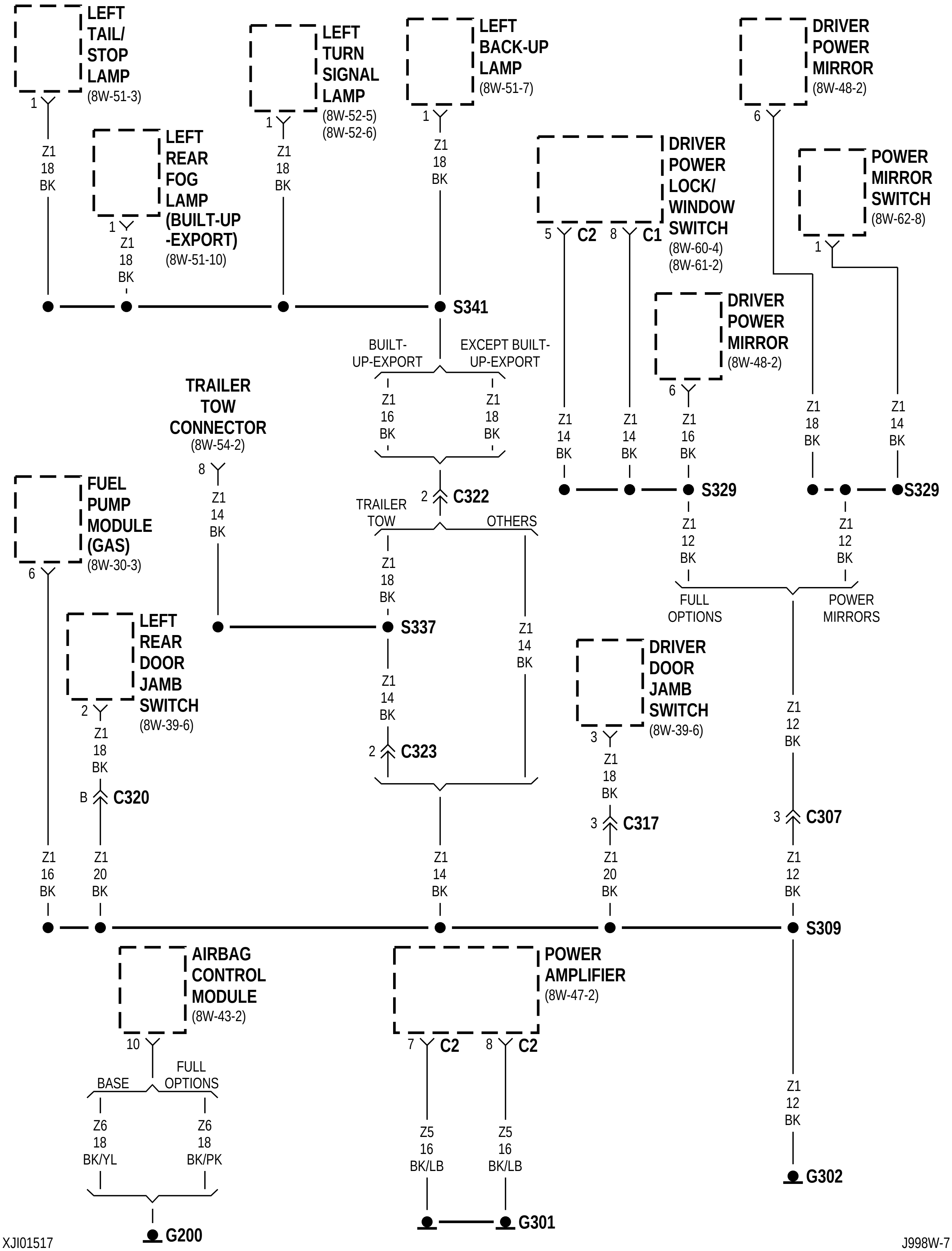
BUILT-UP-EXPORT



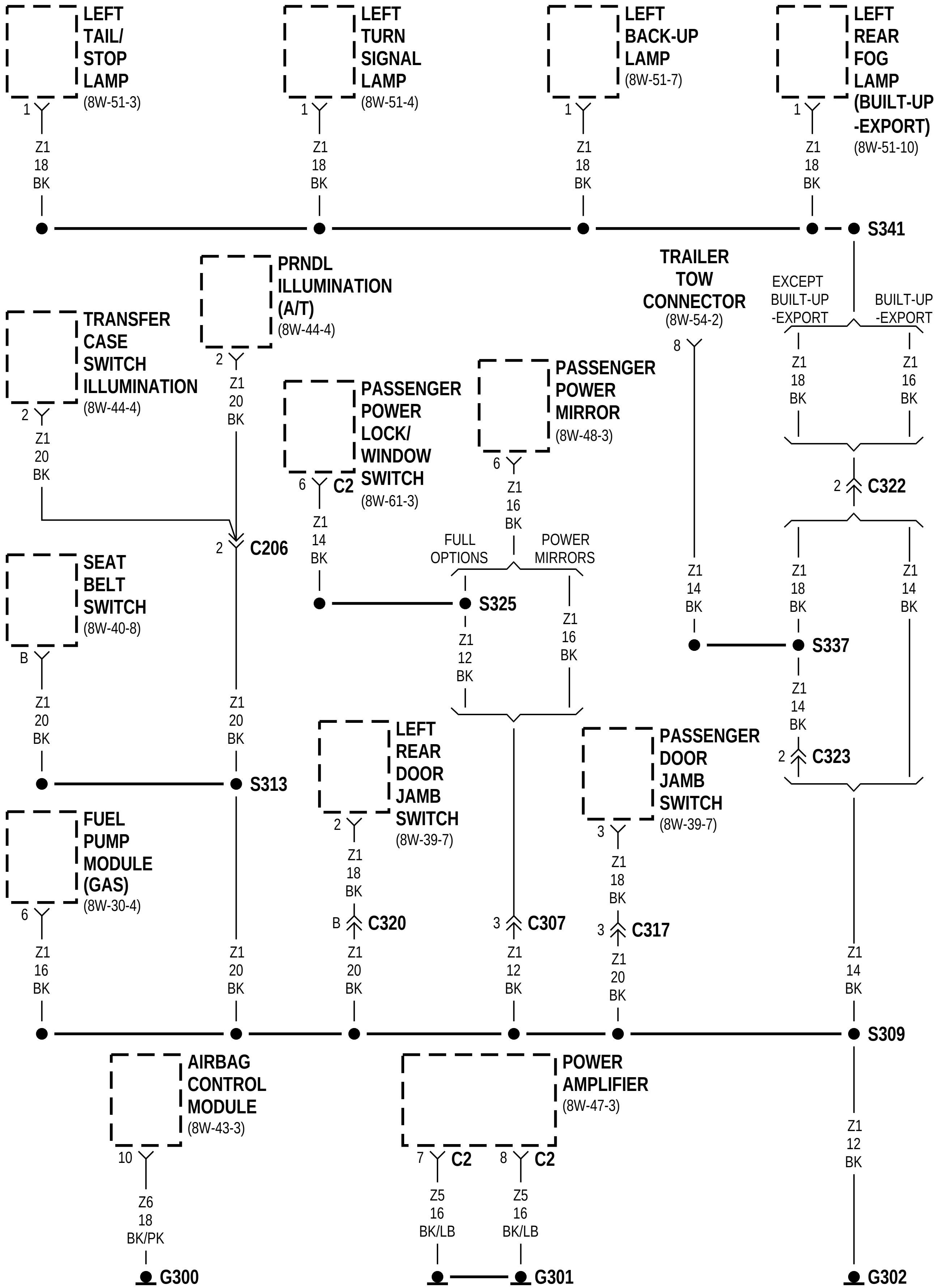


J998W-7 XJI01516

LHD

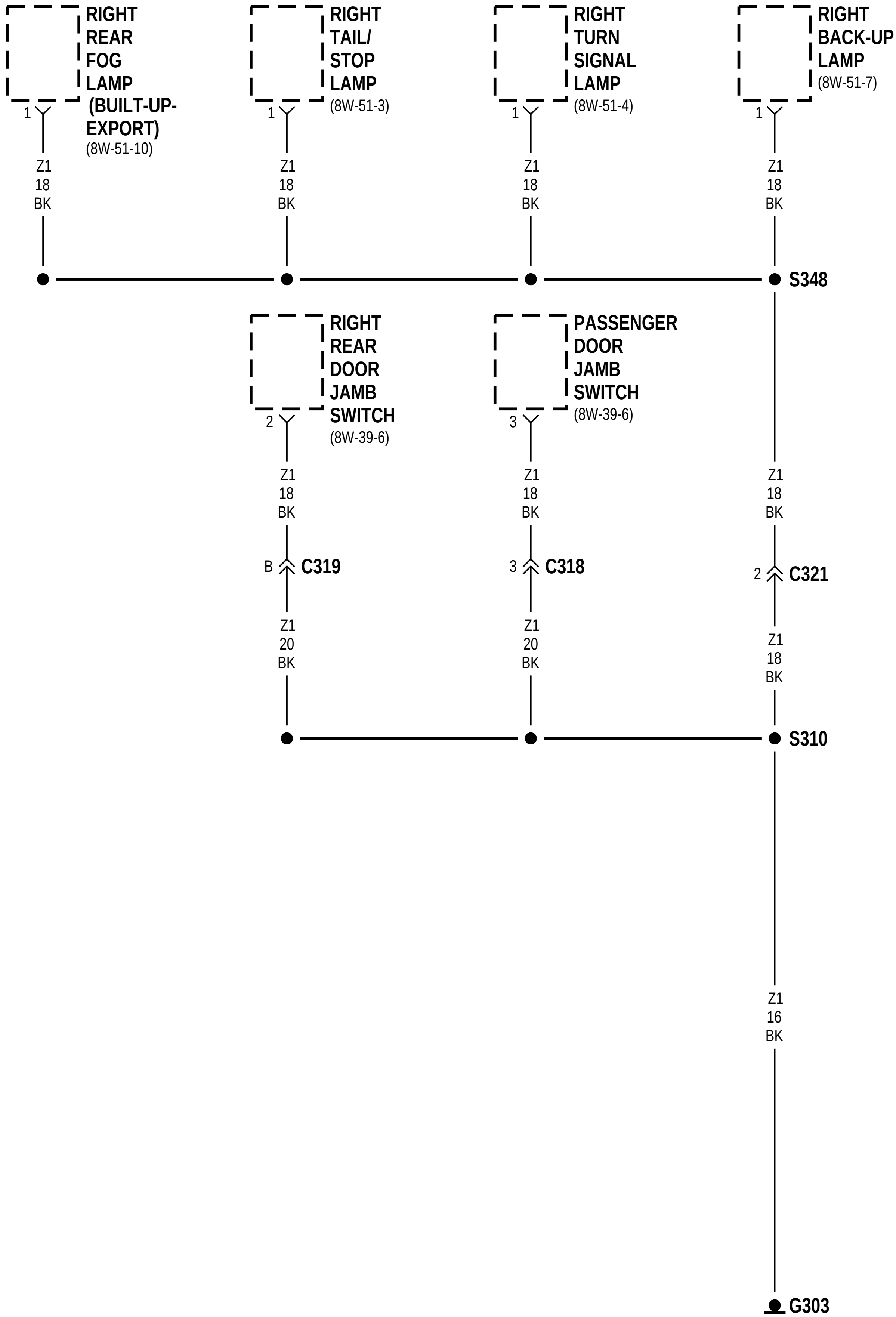

LEFT TAIL/ STOP LAMP (8W-51-3)
1
Z1 18 BK
LEFT REAR FOG LAMP (BUILT-UP -EXPORT) (8W-51-10)
1
Z1 18 BK
LEFT TURN SIGNAL LAMP (8W-52-5) (8W-52-6)
1
Z1 18 BK
LEFT BACK-UP LAMP (8W-51-7)
1
Z1 18 BK
S341
BUILT- UP-EXPORT
EXCEPT BUILT- UP-EXPORT
Z1 16 BK
Z1 18 BK
2 C322
TRAILER TOW
OTHERS
Z1 18 BK
S337
Z1 14 BK
2 C323
Z1 14 BK
TRAILER TOW CONNECTOR (8W-54-2)
8
Z1 14 BK
FUEL PUMP MODULE (GAS) (8W-30-3)
6
Z1 16 BK
LEFT REAR DOOR JAMB SWITCH (8W-39-6)
2
Z1 18 BK
B C320
Z1 20 BK
Z1 14 BK
DRIVER POWER MIRROR (8W-48-2)
6
POWER MIRROR SWITCH (8W-62-8)
1
DRIVER POWER LOCK/ WINDOW SWITCH (8W-60-4) (8W-61-2)
5 C2
8 C1
Z1 14 BK
Z1 14 BK
DRIVER POWER MIRROR (8W-48-2)
6
Z1 16 BK
S329
Z1 18 BK
Z1 14 BK
S329
Z1 12 BK
Z1 12 BK
FULL OPTIONS
POWER MIRRORS
Z1 12 BK
3 C307
Z1 12 BK
DRIVER DOOR JAMB SWITCH (8W-39-6)
3
Z1 18 BK
3 C317
Z1 20 BK
S309
AIRBAG CONTROL MODULE (8W-43-2)
10
BASE
FULL OPTIONS
Z6 18 BK/YL
Z6 18 BK/PK
G200
POWER AMPLIFIER (8W-47-2)
7 C2
8 C2
Z5 16 BK/LB
Z5 16 BK/LB
G301
Z1 12 BK
G302
XJI01517
J998W-7

RHD

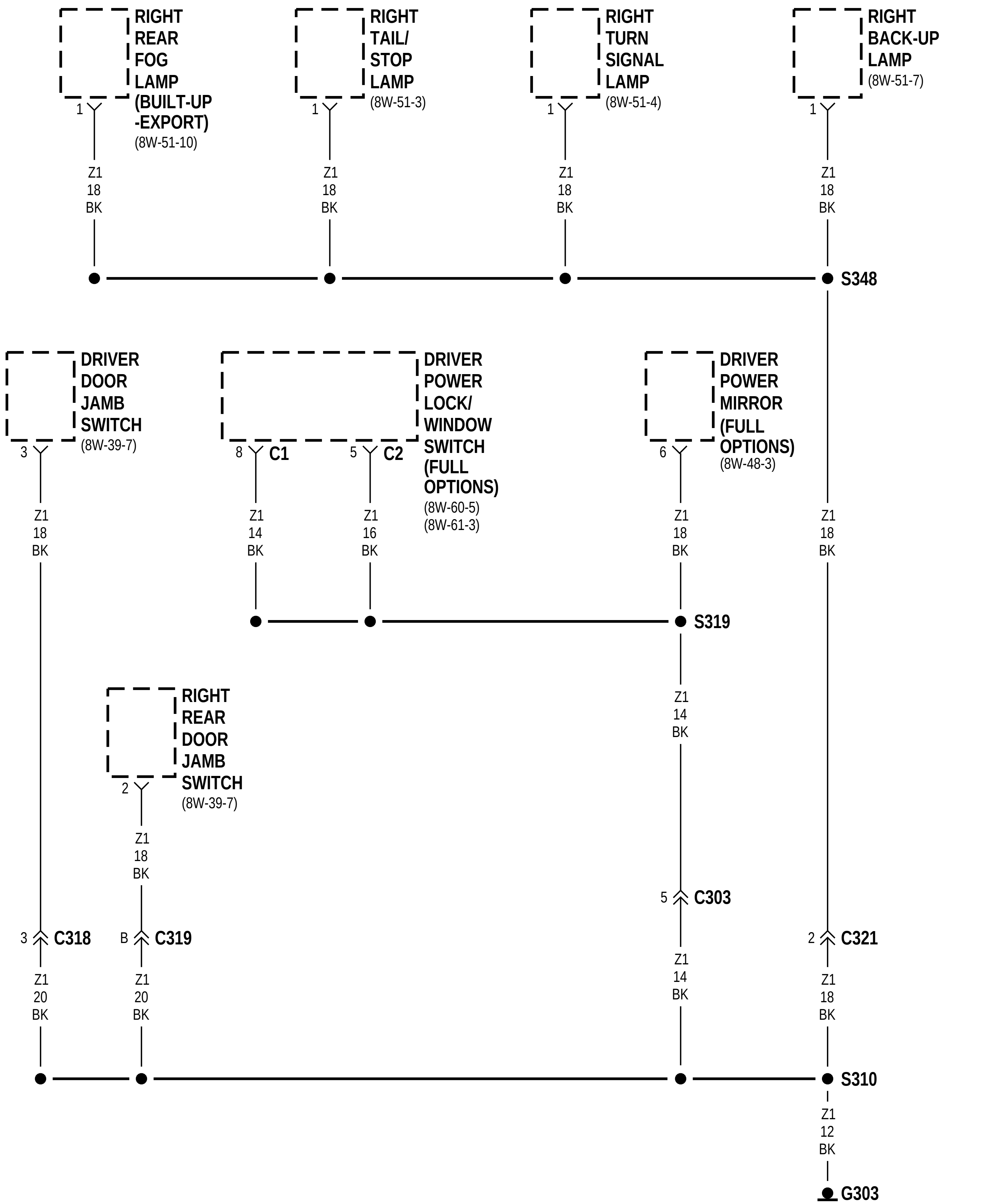


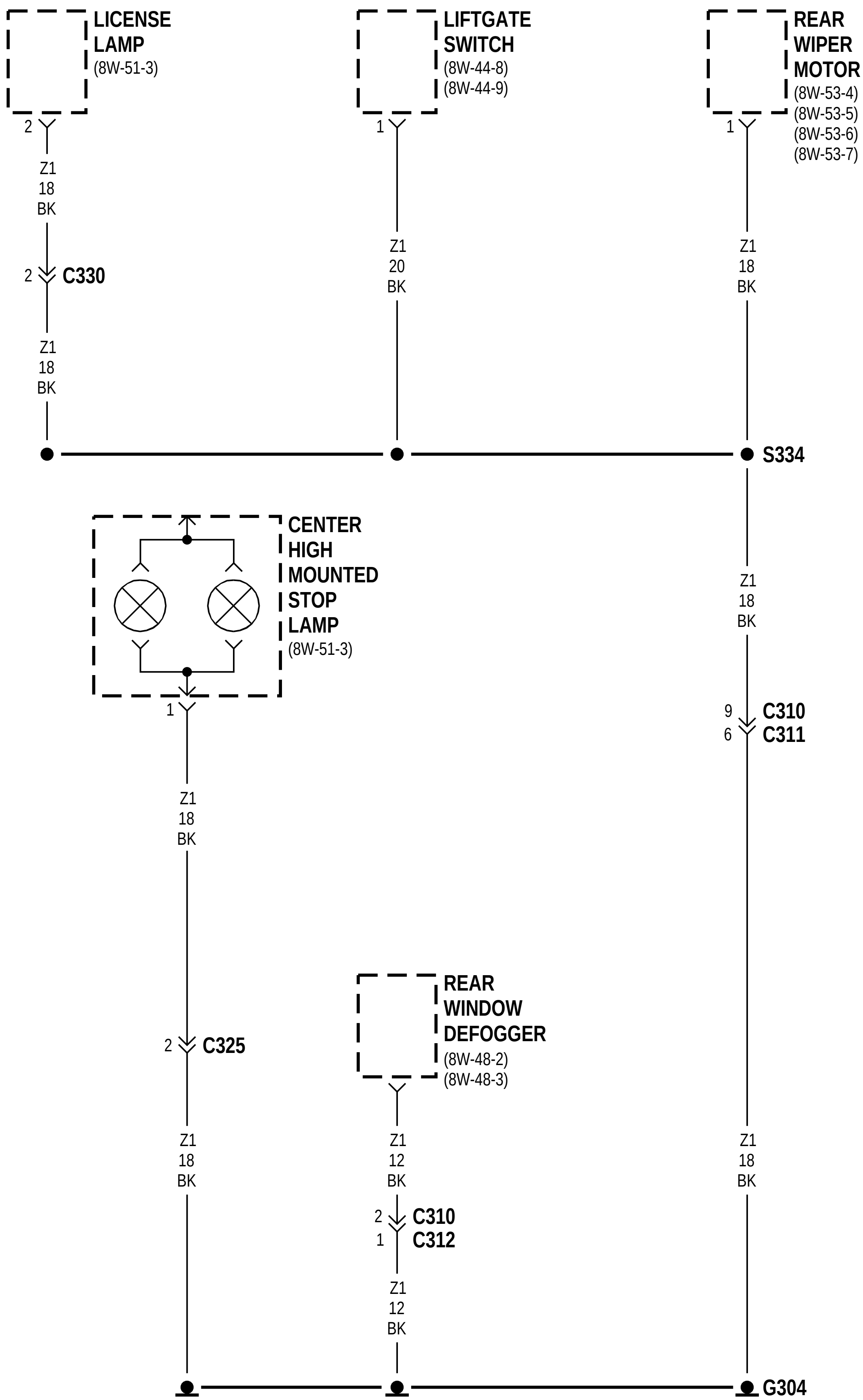
J998W-7 XJI01518

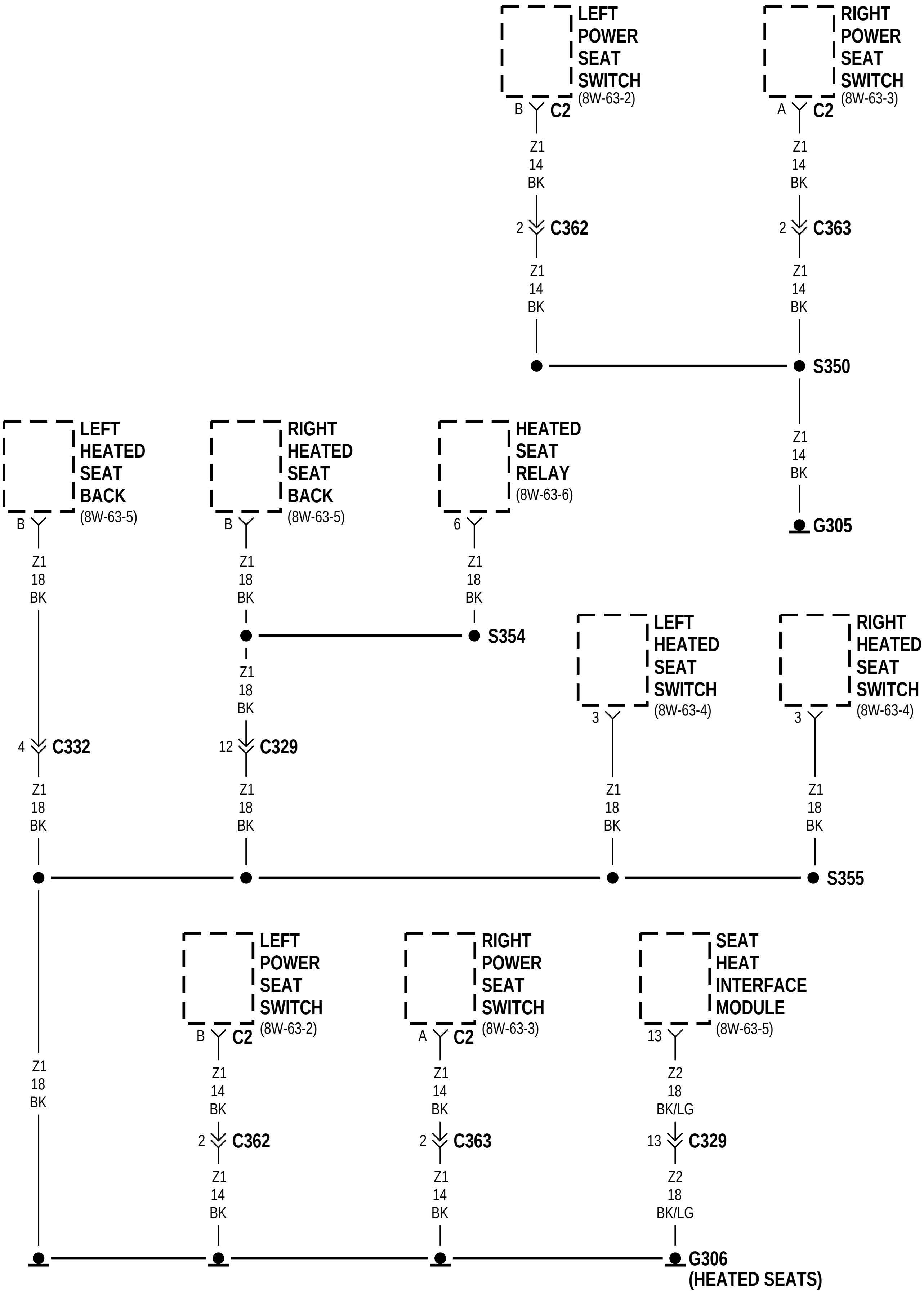
LHD


RIGHT REAR FOG LAMP (BUILT-UP-EXPORT)
(8W-51-10)
RIGHT TAIL/ STOP LAMP
(8W-51-3)
RIGHT TURN SIGNAL LAMP
(8W-51-4)
RIGHT BACK-UP LAMP
(8W-51-7)
1
Z1
18
BK
S348
RIGHT REAR DOOR JAMB SWITCH
(8W-39-6)
PASSENGER DOOR JAMB SWITCH
(8W-39-6)
2
3
B
C319
C318
C321
Z1
20
BK
S310
Z1
16
BK
G303

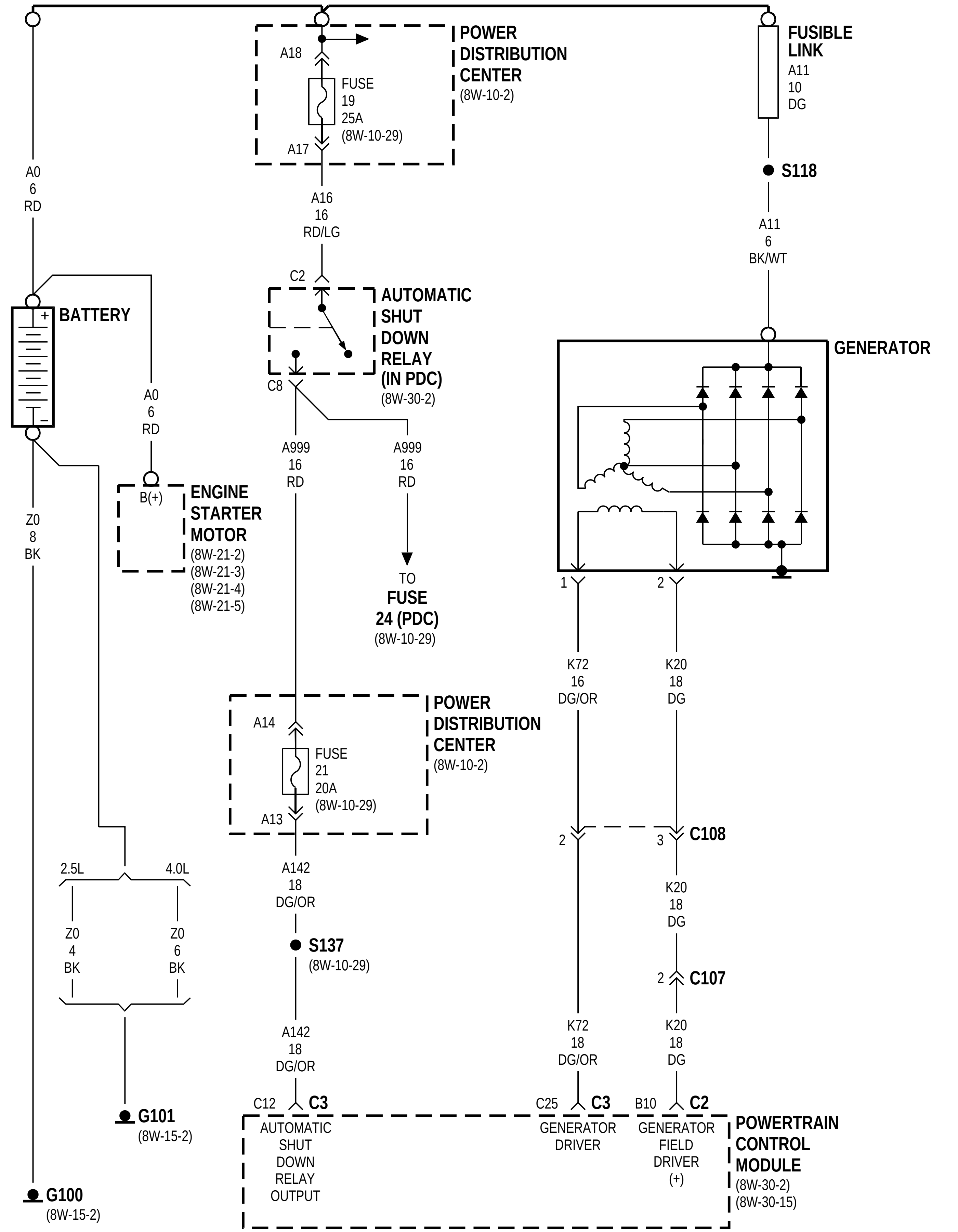
RHD

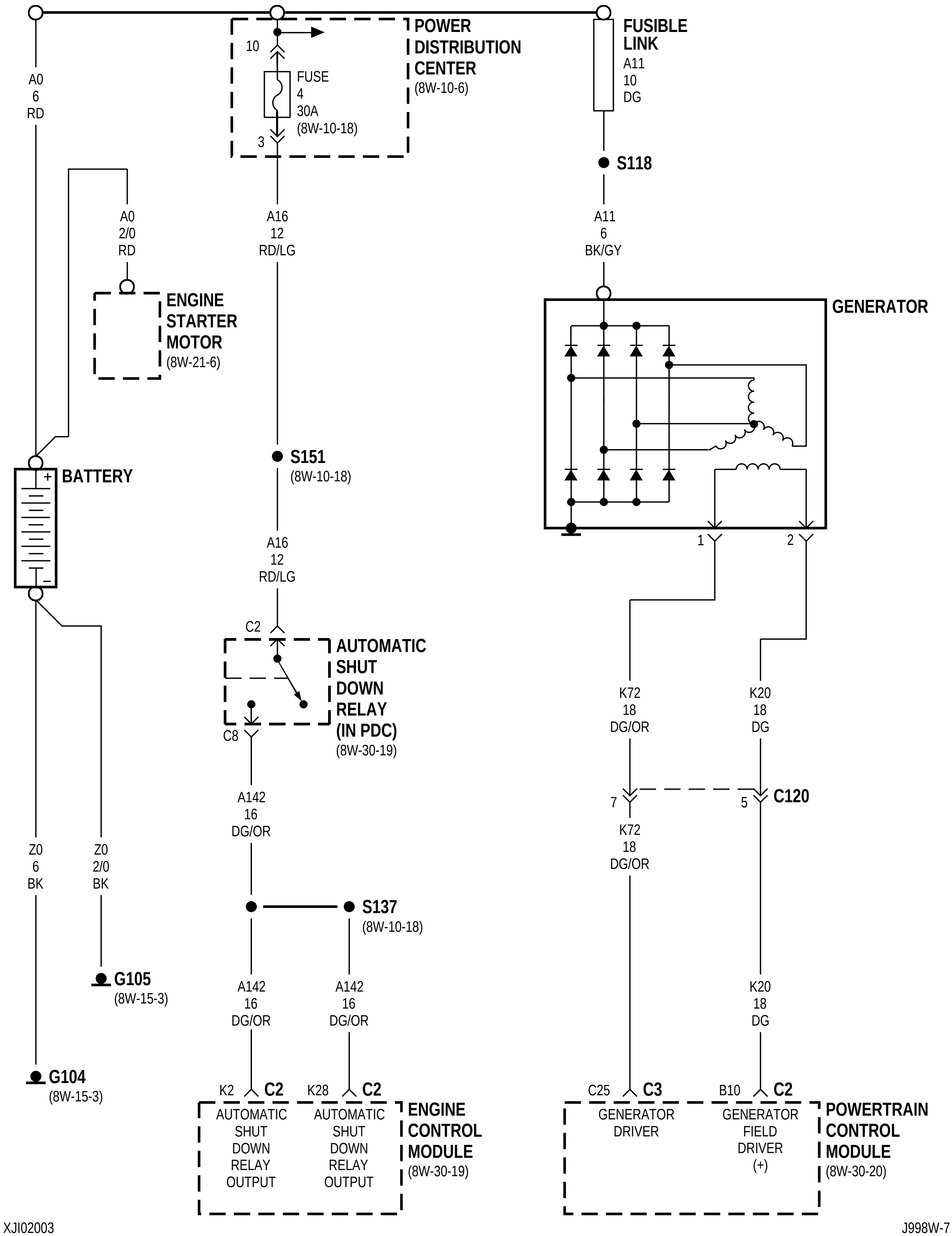

RIGHT REAR FOG LAMP (BUILT-UP -EXPORT)
(8W-51-10)
RIGHT TAIL/ STOP LAMP
(8W-51-3)
RIGHT TURN SIGNAL LAMP
(8W-51-4)
RIGHT BACK-UP LAMP
(8W-51-7)
1
Z1 18 BK
S348
DRIVER DOOR JAMB SWITCH
(8W-39-7)
3
8 C1
5 C2
DRIVER POWER LOCK/ WINDOW SWITCH (FULL OPTIONS)
(8W-60-5)
(8W-61-3)
DRIVER POWER MIRROR (FULL OPTIONS)
(8W-48-3)
6
Z1 14 BK
Z1 16 BK
S319
RIGHT REAR DOOR JAMB SWITCH
(8W-39-7)
2
5 C303
3 C318
B C319
2 C321
Z1 20 BK
S310
Z1 12 BK
G303


LICENSE
LAMP
(8W-51-3)
2
Z1
18
BK
2
C330
Z1
18
BK
LIFTGATE
SWITCH
(8W-44-8)
(8W-44-9)
1
Z1
20
BK
REAR
WIPER
MOTOR
(8W-53-4)
(8W-53-5)
(8W-53-6)
(8W-53-7)
1
Z1
18
BK
S334
CENTER
HIGH
MOUNTED
STOP
LAMP
(8W-51-3)
1
Z1
18
BK
2
C325
Z1
18
BK
Z1
18
BK
9
C310
6
C311
REAR
WINDOW
DEFOGGER
(8W-48-2)
(8W-48-3)
Z1
12
BK
2
C310
1
C312
Z1
12
BK
Z1
18
BK
G304

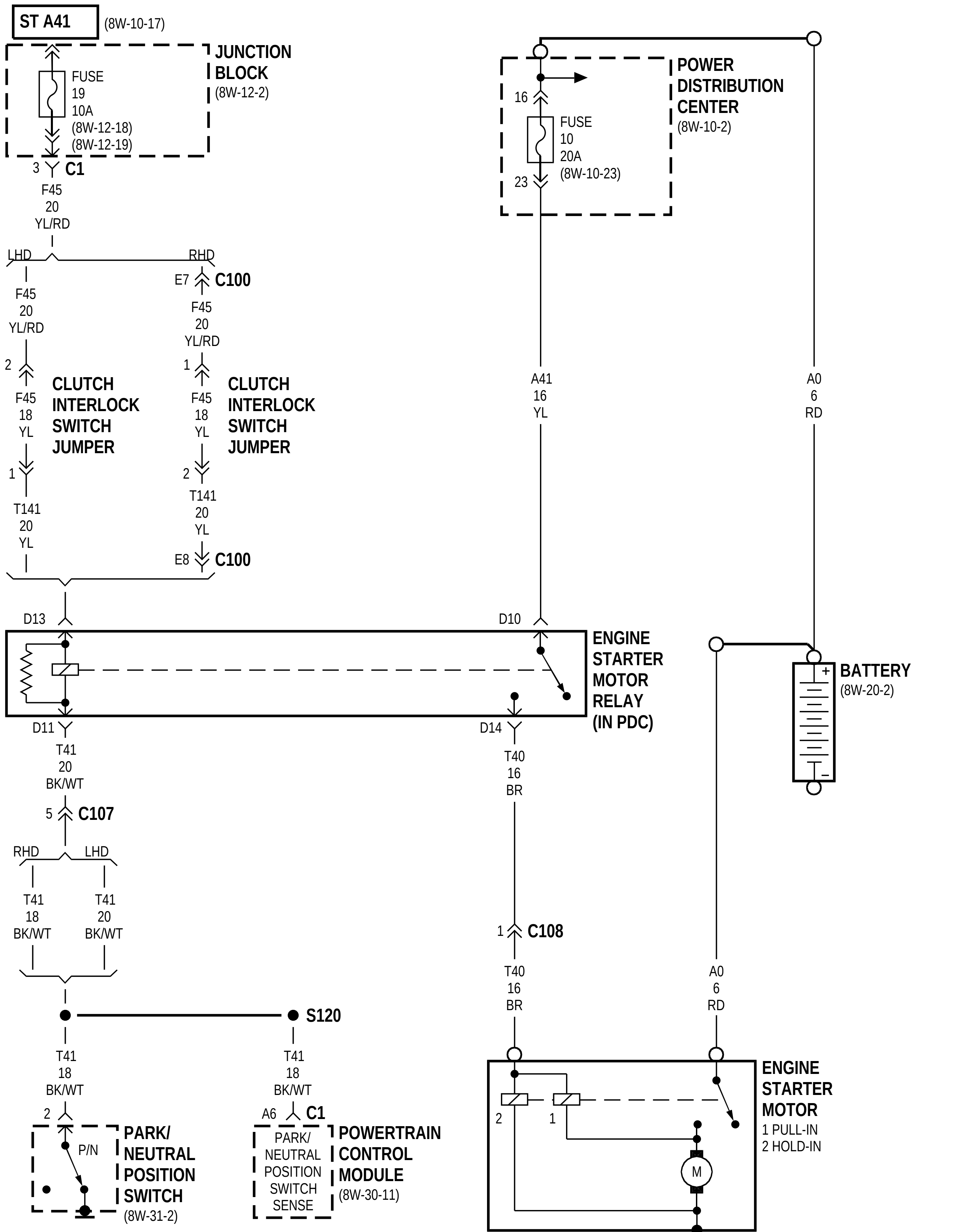

LEFT POWER SEAT SWITCH
(8W-63-2)
B
C2
Z1
14
BK
2
C362
Z1
14
BK
RIGHT POWER SEAT SWITCH
(8W-63-3)
A
C2
Z1
14
BK
2
C363
Z1
14
BK
S350
Z1
14
BK
G305
LEFT HEATED SEAT BACK
(8W-63-5)
B
Z1
18
BK
4
C332
Z1
18
BK
RIGHT HEATED SEAT BACK
(8W-63-5)
B
Z1
18
BK
Z1
18
BK
12
C329
Z1
18
BK
HEATED SEAT RELAY
(8W-63-6)
6
Z1
18
BK
S354
LEFT HEATED SEAT SWITCH
(8W-63-4)
3
Z1
18
BK
RIGHT HEATED SEAT SWITCH
(8W-63-4)
3
Z1
18
BK
S355
Z1
18
BK
LEFT POWER SEAT SWITCH
(8W-63-2)
B
C2
Z1
14
BK
2
C362
Z1
14
BK
RIGHT POWER SEAT SWITCH
(8W-63-3)
A
C2
Z1
14
BK
2
C363
Z1
14
BK
SEAT HEAT INTERFACE MODULE
(8W-63-5)
13
Z2
18
BK/LG
13
C329
Z2
18
BK/LG
G306
(HEATED SEATS)

8W-20 CHARGING SYSTEM

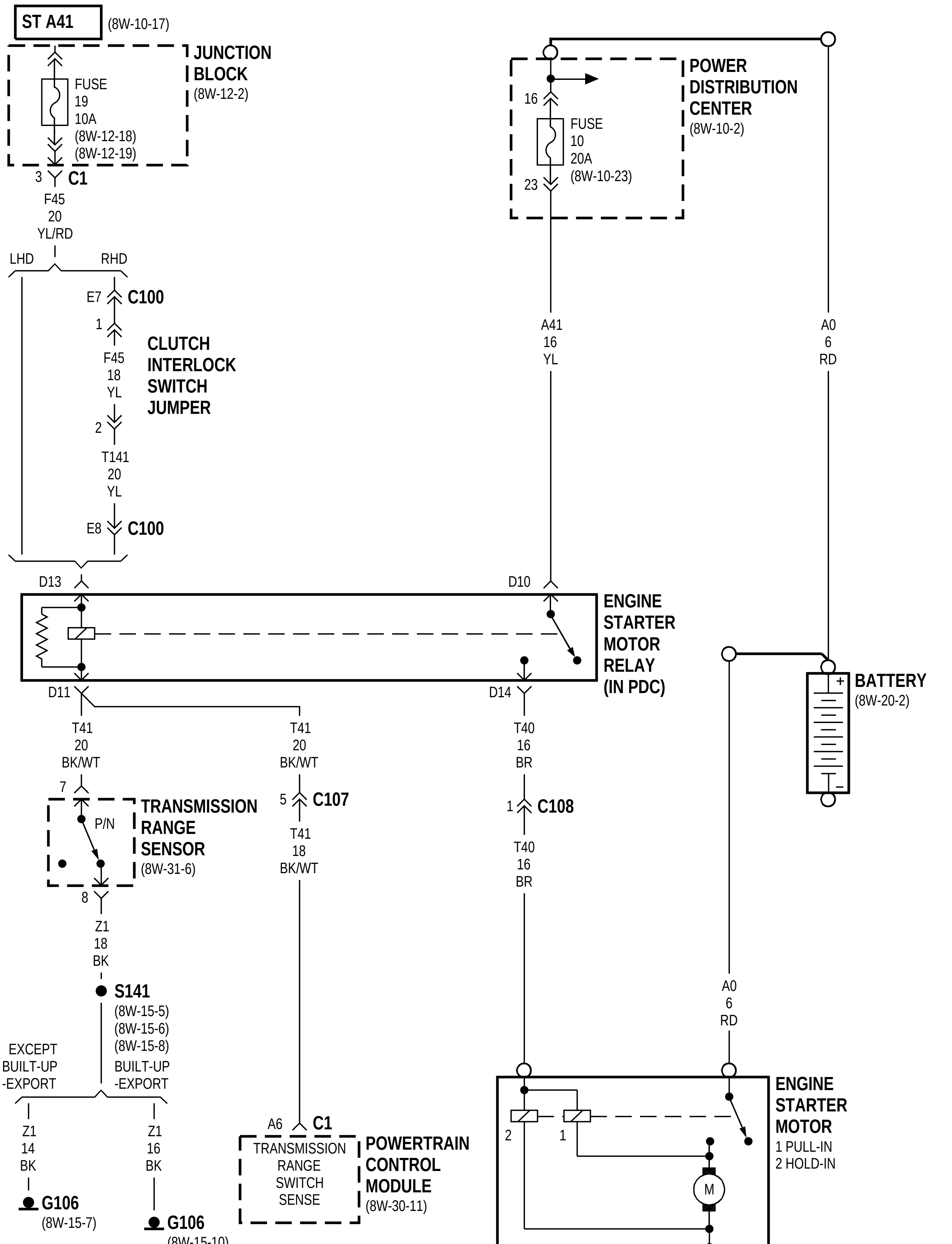

POWER DISTRIBUTION CENTER
(8W-10-2)
A18
FUSE
19
25A
(8W-10-29)
A17
FUSIBLE LINK
A11
10
DG
S118
A0
6
RD
A16
16
RD/LG
A11
6
BK/WT
C2
AUTOMATIC SHUT DOWN RELAY (IN PDC)
(8W-30-2)
BATTERY
+
–
GENERATOR
C8
A0
6
RD
A999
16
RD
A999
16
RD
B(+)
ENGINE STARTER MOTOR
(8W-21-2)
(8W-21-3)
(8W-21-4)
(8W-21-5)
Z0
8
BK
TO
FUSE
24 (PDC)
(8W-10-29)
1
2
K72
16
DG/OR
K20
18
DG
POWER DISTRIBUTION CENTER
(8W-10-2)
A14
FUSE
21
20A
(8W-10-29)
A13
2
3
C108
2.5L
4.0L
A142
18
DG/OR
K20
18
DG
Z0
4
BK
Z0
6
BK
S137
(8W-10-29)
2
C107
A142
18
DG/OR
K72
18
DG/OR
K20
18
DG
C12
C3
C25
C3
B10
C2
G101
(8W-15-2)
AUTOMATIC SHUT DOWN RELAY OUTPUT
GENERATOR DRIVER
GENERATOR FIELD DRIVER (+)
POWERTRAIN CONTROL MODULE
(8W-30-2)
(8W-30-15)
G100
(8W-15-2)


POWER DISTRIBUTION CENTER
(8W-10-6)
10
FUSE
4
30A
(8W-10-18)
3
FUSIBLE LINK
A11
10
DG
A0
6
RD
S118
A0
2/0
RD
A16
12
RD/LG
A11
6
BK/GY
ENGINE STARTER MOTOR
(8W-21-6)
GENERATOR
S151
(8W-10-18)
BATTERY
+
−
1
2
A16
12
RD/LG
C2
AUTOMATIC SHUT DOWN RELAY (IN PDC)
(8W-30-19)
C8
K72
18
DG/OR
K20
18
DG
A142
16
DG/OR
7
5
C120
K72
18
DG/OR
Z0
6
BK
Z0
2/0
BK
S137
(8W-10-18)
G105
(8W-15-3)
A142
16
DG/OR
A142
16
DG/OR
K20
18
DG
G104
(8W-15-3)
K2
C2
K28
C2
C25
C3
B10
C2
AUTOMATIC SHUT DOWN RELAY OUTPUT
AUTOMATIC SHUT DOWN RELAY OUTPUT
ENGINE CONTROL MODULE
(8W-30-19)
GENERATOR DRIVER
GENERATOR FIELD DRIVER (+)
POWERTRAIN CONTROL MODULE
(8W-30-20)
XJI02003
J998W-7

8W-21 STARTING SYSTEM

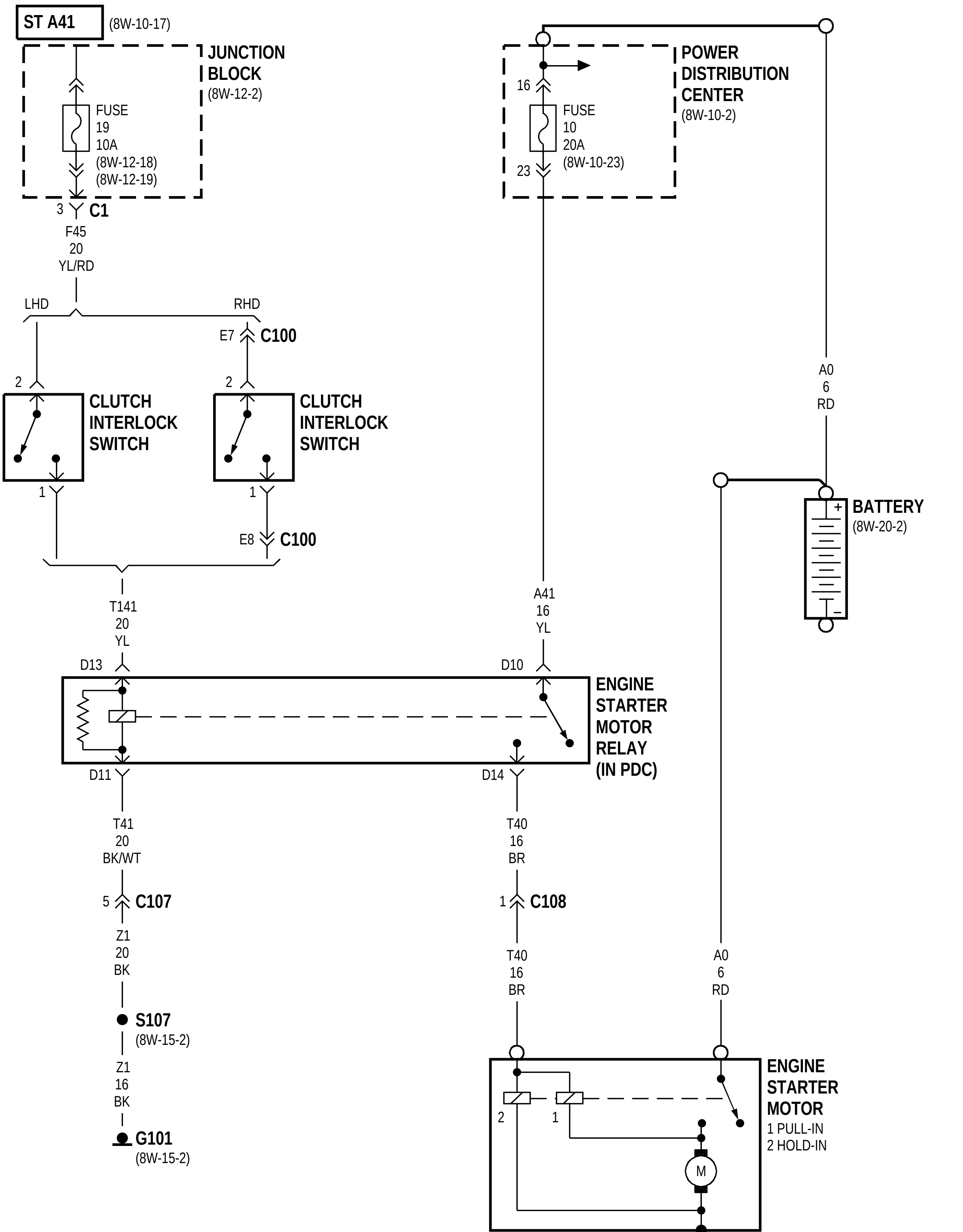

ST A41
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE
19
10A
(8W-12-18)
(8W-12-19)
3 C1
F45
20
YL/RD
LHD
RHD
E7 C100
F45
20
YL/RD
2
1
F45
18
YL
CLUTCH INTERLOCK SWITCH JUMPER
T141
20
YL
E8 C100
POWER DISTRIBUTION CENTER
(8W-10-2)
16
FUSE
10
20A
(8W-10-23)
23
A41
16
YL
A0
6
RD
D13
D10
D11
D14
ENGINE STARTER MOTOR RELAY (IN PDC)
BATTERY
(8W-20-2)
+
–
T41
20
BK/WT
5 C107
RHD
LHD
T41
18
BK/WT
T40
16
BR
1 C108
S120
A6 C1
P/N
PARK/ NEUTRAL POSITION SWITCH
(8W-31-2)
PARK/ NEUTRAL POSITION SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-11)
M
ENGINE STARTER MOTOR
1 PULL-IN
2 HOLD-IN

4.0L A/T

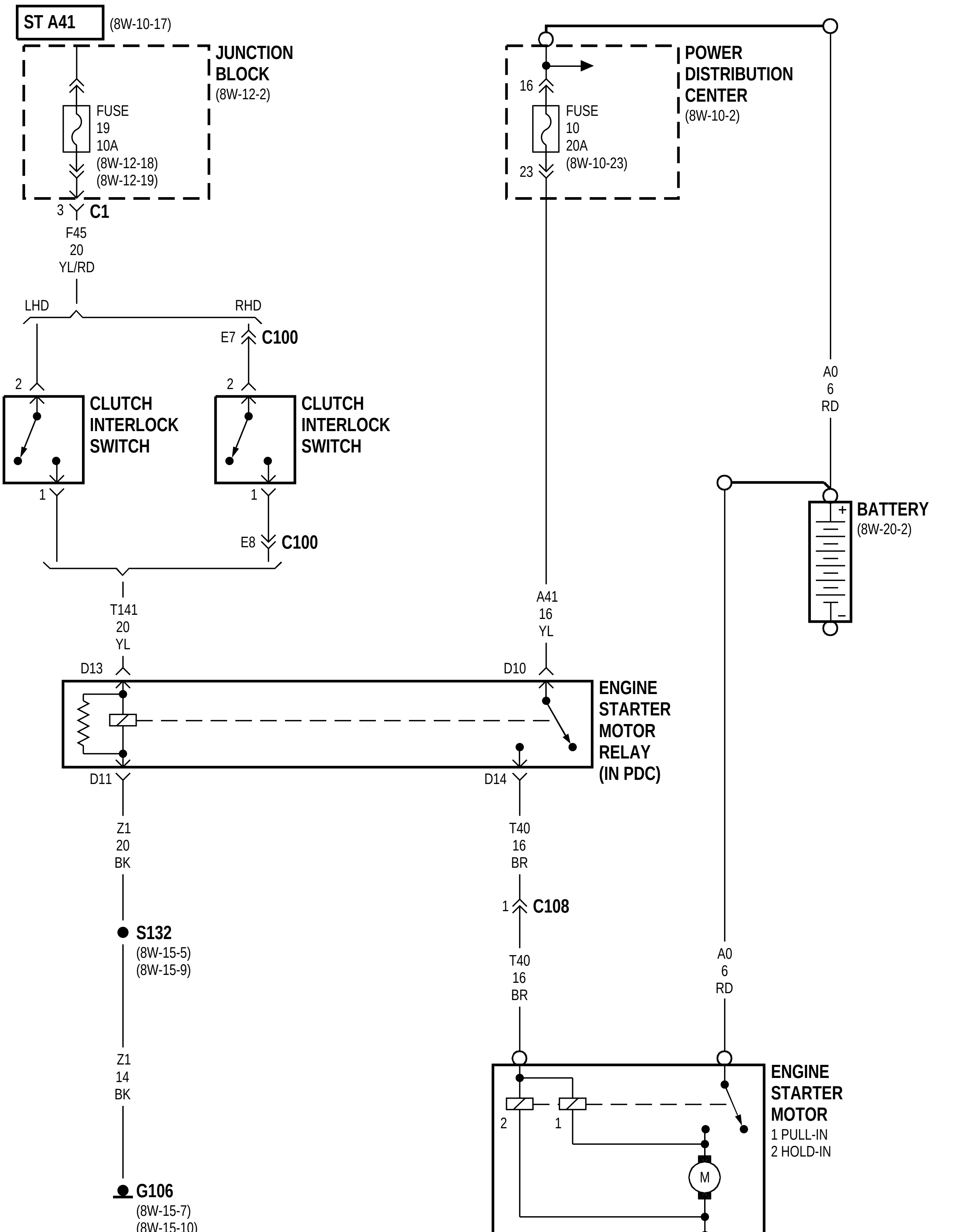


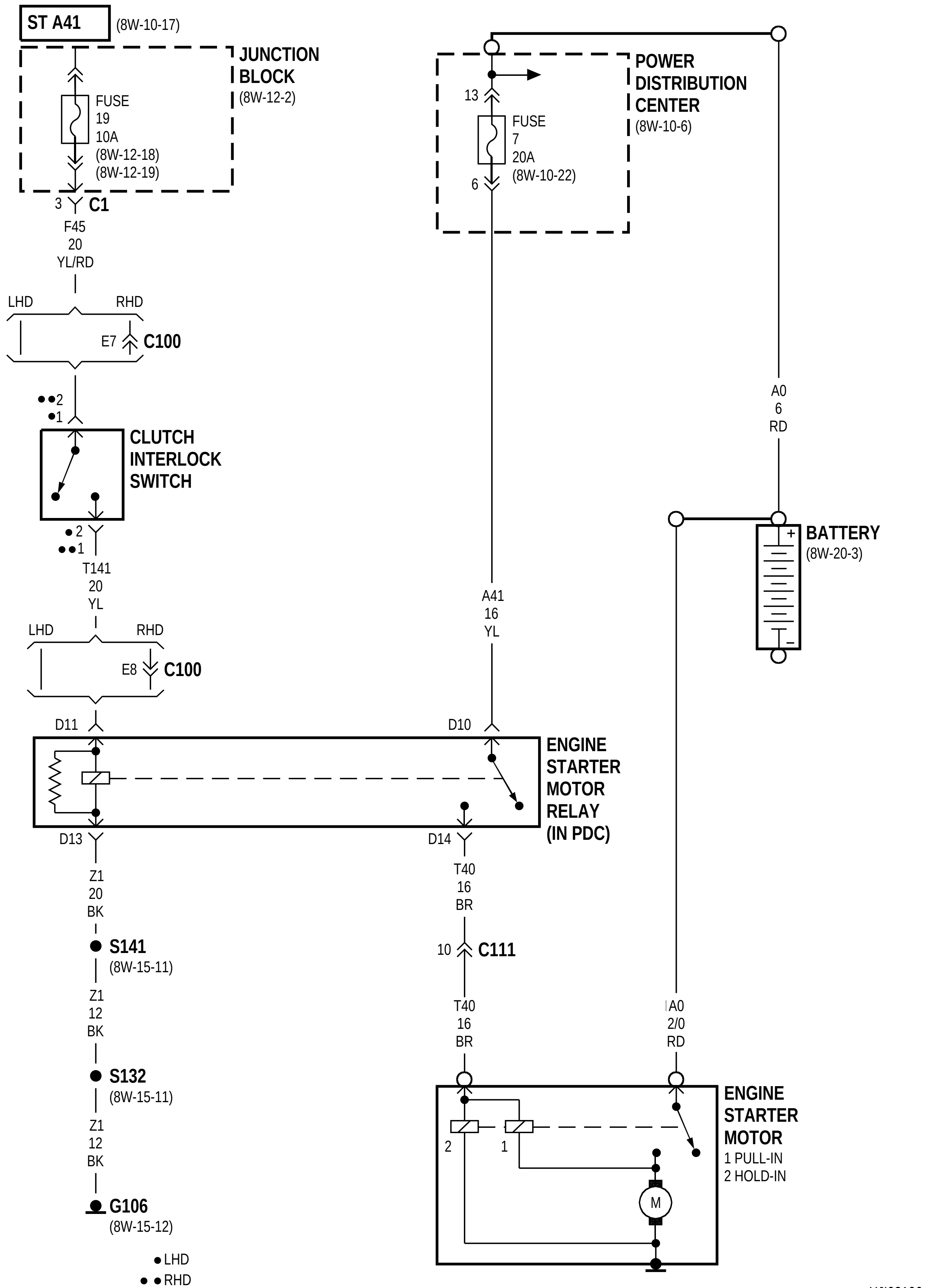
ST A41
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE 19 10A
(8W-12-18)
(8W-12-19)
3 C1
F45 20 YL/RD
LHD
RHD
E7 C100
1
F45 18 YL
2
T141 20 YL
E8 C100
CLUTCH INTERLOCK SWITCH JUMPER
POWER DISTRIBUTION CENTER
(8W-10-2)
16
FUSE 10 20A
(8W-10-23)
23
A41 16 YL
A0 6 RD
D13
D10
ENGINE STARTER MOTOR RELAY (IN PDC)
D11
D14
T41 20 BK/WT
T41 20 BK/WT
T40 16 BR
BATTERY
(8W-20-2)
7
P/N
TRANSMISSION RANGE SENSOR
(8W-31-6)
8
5 C107
T41 18 BK/WT
1 C108
T40 16 BR
Z1 18 BK
S141
(8W-15-5)
(8W-15-6)
(8W-15-8)
EXCEPT BUILT-UP -EXPORT
BUILT-UP -EXPORT
Z1 14 BK
Z1 16 BK
G106
(8W-15-7)
G106
(8W-15-10)
A6 C1
TRANSMISSION RANGE SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-11)
A0 6 RD
2
1
M
ENGINE STARTER MOTOR
1 PULL-IN
2 HOLD-IN

2.5L GAS M/T

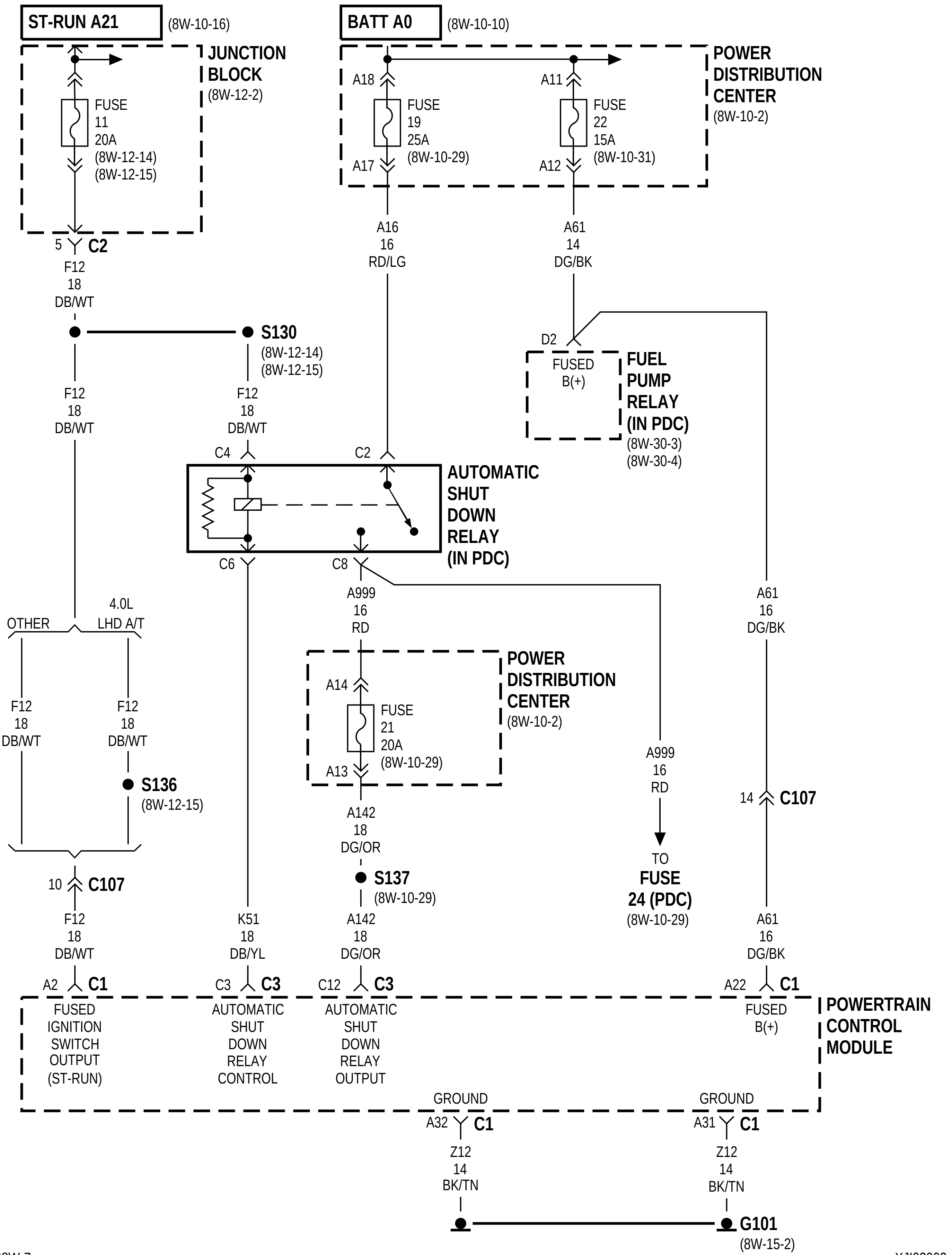

ST A41
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE
19
10A
(8W-12-18)
(8W-12-19)
3
C1
F45
20
YL/RD
LHD
RHD
E7
C100
2
CLUTCH INTERLOCK SWITCH
2
CLUTCH INTERLOCK SWITCH
1
1
E8
C100
T141
20
YL
POWER DISTRIBUTION CENTER
(8W-10-2)
16
FUSE
10
20A
(8W-10-23)
23
A0
6
RD
BATTERY
(8W-20-2)
A41
16
YL
D13
D10
ENGINE STARTER MOTOR RELAY (IN PDC)
D11
D14
T41
20
BK/WT
5
C107
Z1
20
BK
S107
(8W-15-2)
Z1
16
BK
G101
(8W-15-2)
T40
16
BR
1
C108
T40
16
BR
A0
6
RD
ENGINE STARTER MOTOR
1 PULL-IN
2 HOLD-IN
2
1
M

4.0L M/T

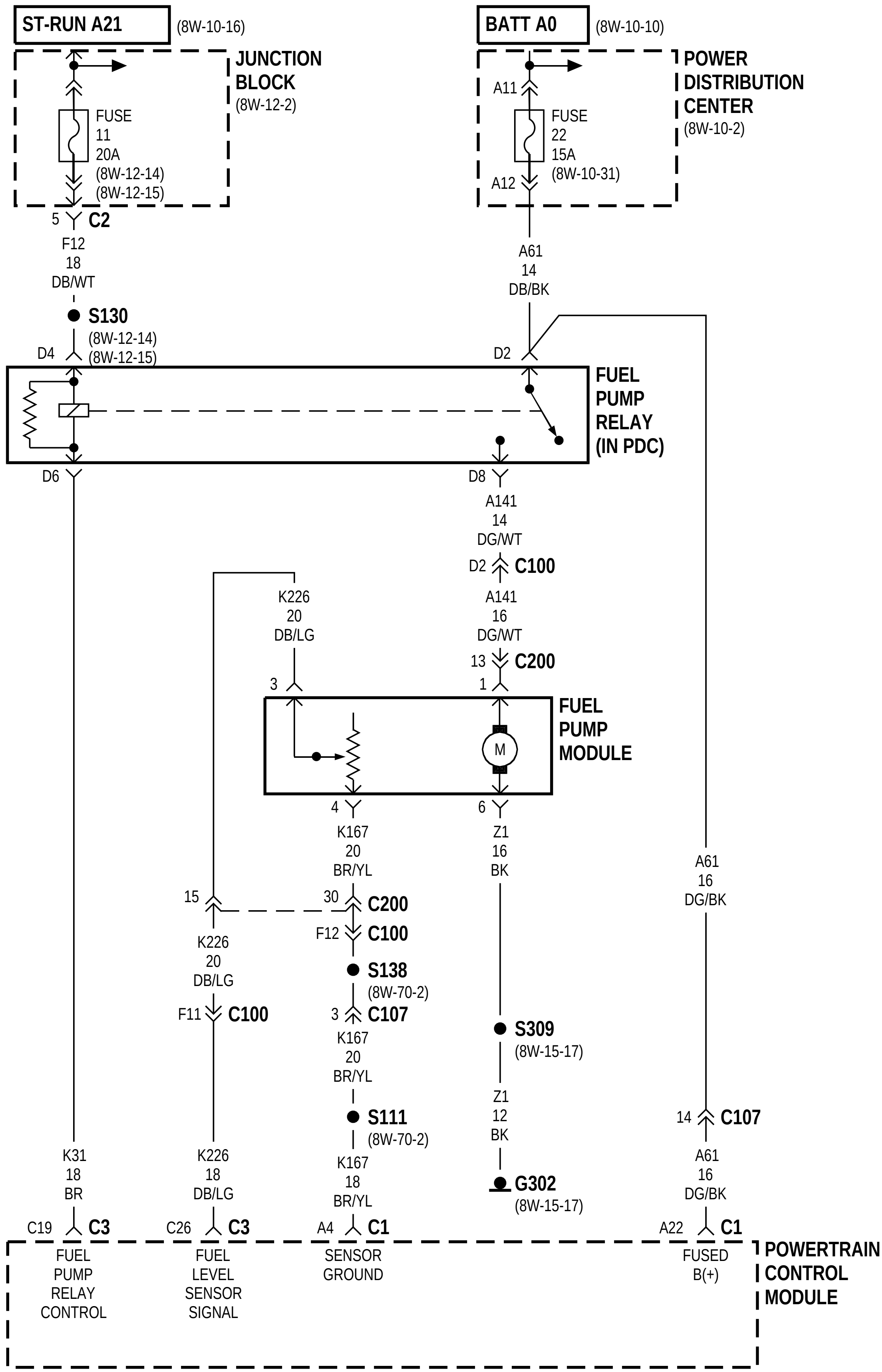

ST A41
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE
19
10A
(8W-12-18)
(8W-12-19)
3
C1
F45
20
YL/RD
LHD
RHD
E7
C100
2
CLUTCH INTERLOCK SWITCH
2
CLUTCH INTERLOCK SWITCH
1
1
E8
C100
T141
20
YL
D13
D11
Z1
20
BK
S132
(8W-15-5)
(8W-15-9)
Z1
14
BK
G106
(8W-15-7)
(8W-15-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
16
FUSE
10
20A
(8W-10-23)
23
A41
16
YL
D10
ENGINE STARTER MOTOR RELAY (IN PDC)
D14
T40
16
BR
1
C108
T40
16
BR
A0
6
RD
BATTERY
(8W-20-2)
A0
6
RD
ENGINE STARTER MOTOR
1 PULL-IN
2 HOLD-IN
2
1
M


ST A41
(8W-10-17)
JUNCTION
BLOCK
(8W-12-2)
FUSE
19
10A
(8W-12-18)
(8W-12-19)
3
C1
F45
20
YL/RD
LHD
RHD
E7
C100
2
1
CLUTCH
INTERLOCK
SWITCH
2
1
T141
20
YL
LHD
RHD
E8
C100
D11
D10
ENGINE
STARTER
MOTOR
RELAY
(IN PDC)
D13
D14
Z1
20
BK
S141
(8W-15-11)
Z1
12
BK
S132
(8W-15-11)
Z1
12
BK
G106
(8W-15-12)
LHD
RHD
POWER
DISTRIBUTION
CENTER
(8W-10-6)
13
FUSE
7
20A
(8W-10-22)
6
A41
16
YL
T40
16
BR
10
C111
T40
16
BR
A0
6
RD
BATTERY
(8W-20-3)
A0
2/0
RD
ENGINE
STARTER
MOTOR
1 PULL-IN
2 HOLD-IN
2
1
M

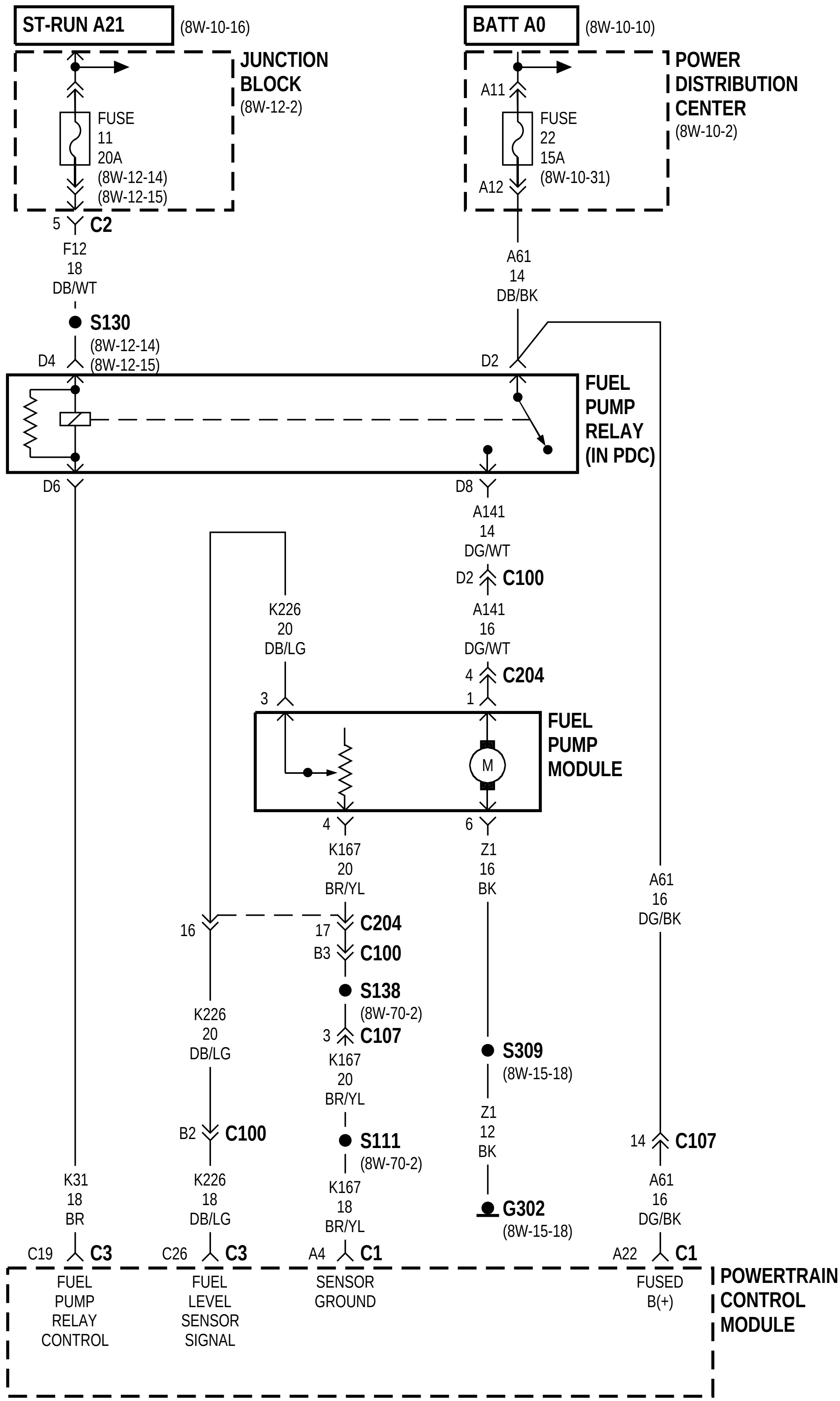
8W-30 FUEL/IGNITION SYSTEM


ST-RUN A21
(8W-10-16)
BATT A0
(8W-10-10)
JUNCTION BLOCK
(8W-12-2)
FUSE 11 20A
(8W-12-14)
(8W-12-15)
POWER DISTRIBUTION CENTER
(8W-10-2)
A18
FUSE 19 25A
(8W-10-29)
A17
A11
FUSE 22 15A
(8W-10-31)
A12
5 C2
F12 18 DB/WT
A16 16 RD/LG
A61 14 DG/BK
S130
(8W-12-14)
(8W-12-15)
D2
FUSED B(+)
FUEL PUMP RELAY (IN PDC)
(8W-30-3)
(8W-30-4)
F12 18 DB/WT
F12 18 DB/WT
C4
C2
AUTOMATIC SHUT DOWN RELAY (IN PDC)
C6
C8
A999 16 RD
A61 16 DG/BK
4.0L LHD A/T
OTHER
POWER DISTRIBUTION CENTER
(8W-10-2)
A14
FUSE 21 20A
(8W-10-29)
A13
F12 18 DB/WT
F12 18 DB/WT
S136
(8W-12-15)
A999 16 RD
14 C107
A142 18 DG/OR
S137
(8W-10-29)
TO FUSE 24 (PDC)
(8W-10-29)
10 C107
F12 18 DB/WT
K51 18 DB/YL
A142 18 DG/OR
A61 16 DG/BK
A2 C1
C3 C3
C12 C3
A22 C1
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
AUTOMATIC SHUT DOWN RELAY CONTROL
AUTOMATIC SHUT DOWN RELAY OUTPUT
FUSED B(+)
POWERTRAIN CONTROL MODULE
GROUND
GROUND
A32 C1
A31 C1
Z12 14 BK/TN
Z12 14 BK/TN
G101
(8W-15-2)

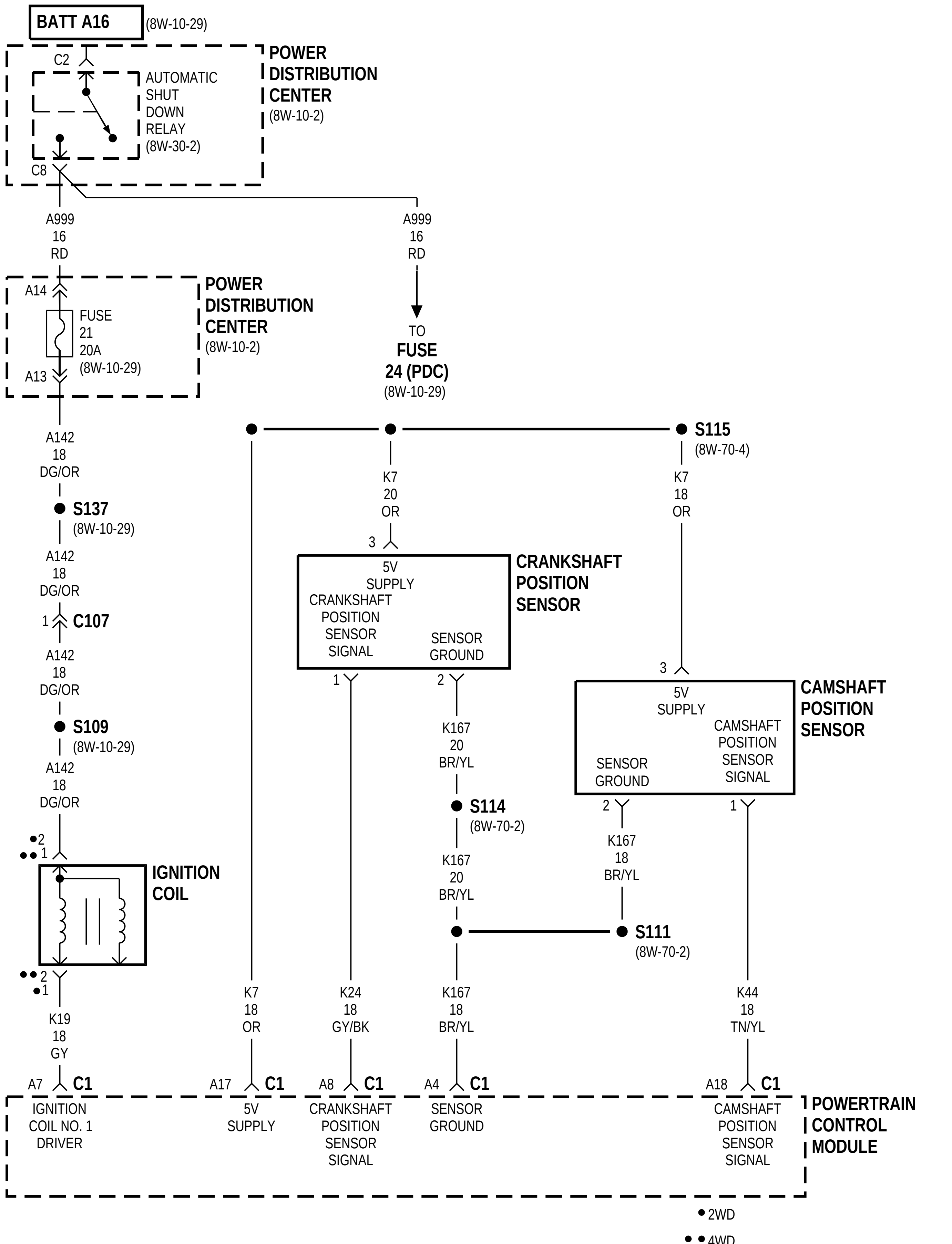
LHD GAS


ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE 11 20A (8W-12-14) (8W-12-15)
5 C2
F12 18 DB/WT
S130
(8W-12-14) (8W-12-15)
D4
BATT A0
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
A11
FUSE 22 15A (8W-10-31)
A12
A61 14 DB/BK
D2
FUEL PUMP RELAY (IN PDC)
D6
D8
A141 14 DG/WT
D2 C100
A141 16 DG/WT
13 C200
K226 20 DB/LG
3
1
FUEL PUMP MODULE
M
4
6
K167 20 BR/YL
Z1 16 BK
A61 16 DG/BK
15
30 C200
F12 C100
K226 20 DB/LG
S138
(8W-70-2)
F11 C100
3 C107
K167 20 BR/YL
S309
(8W-15-17)
S111
(8W-70-2)
Z1 12 BK
14 C107
K31 18 BR
K226 18 DB/LG
K167 18 BR/YL
G302
(8W-15-17)
A61 16 DG/BK
C19 C3
C26 C3
A4 C1
A22 C1
FUEL PUMP RELAY CONTROL
FUEL LEVEL SENSOR SIGNAL
SENSOR GROUND
FUSED B(+)
POWERTRAIN CONTROL MODULE

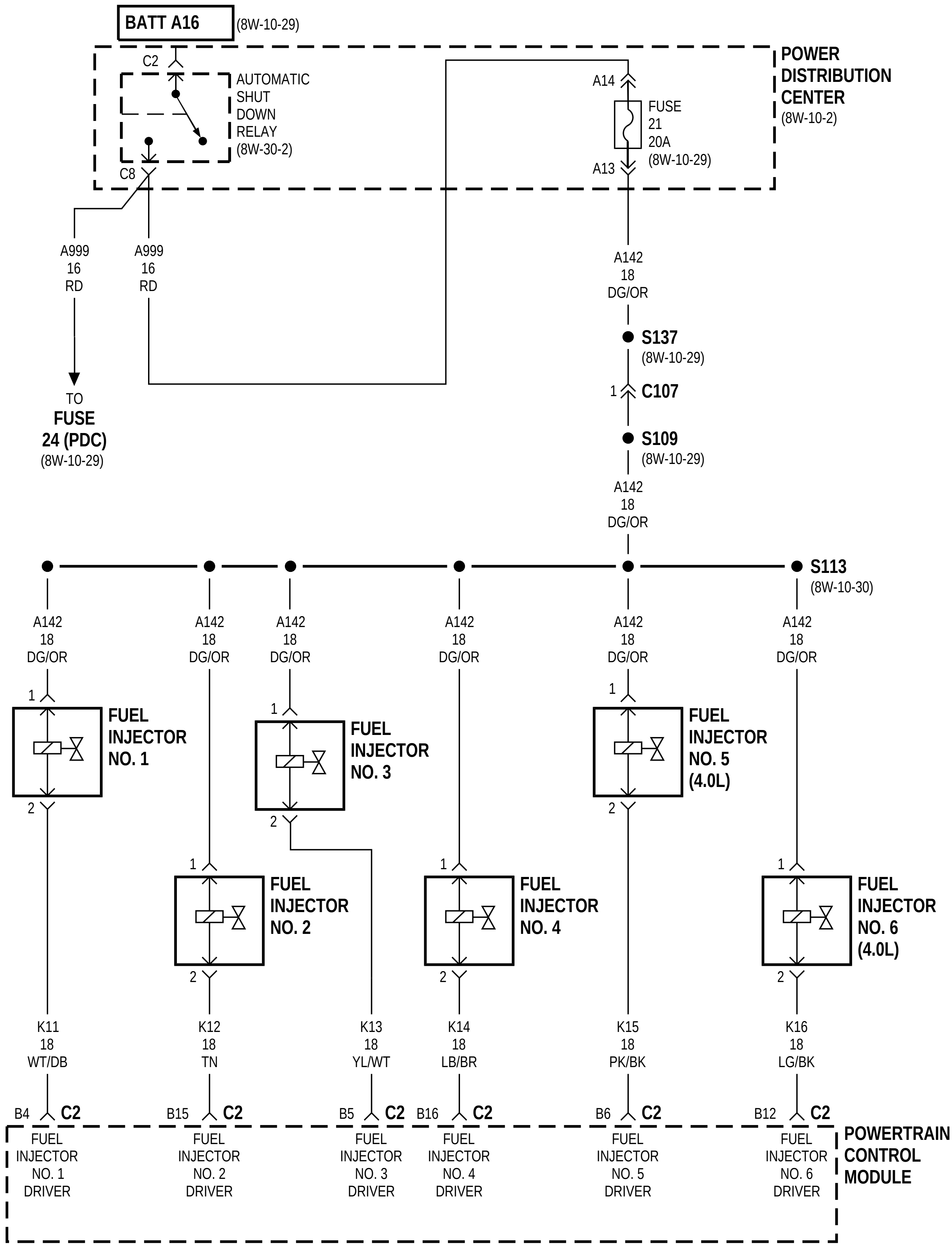
RHD GAS

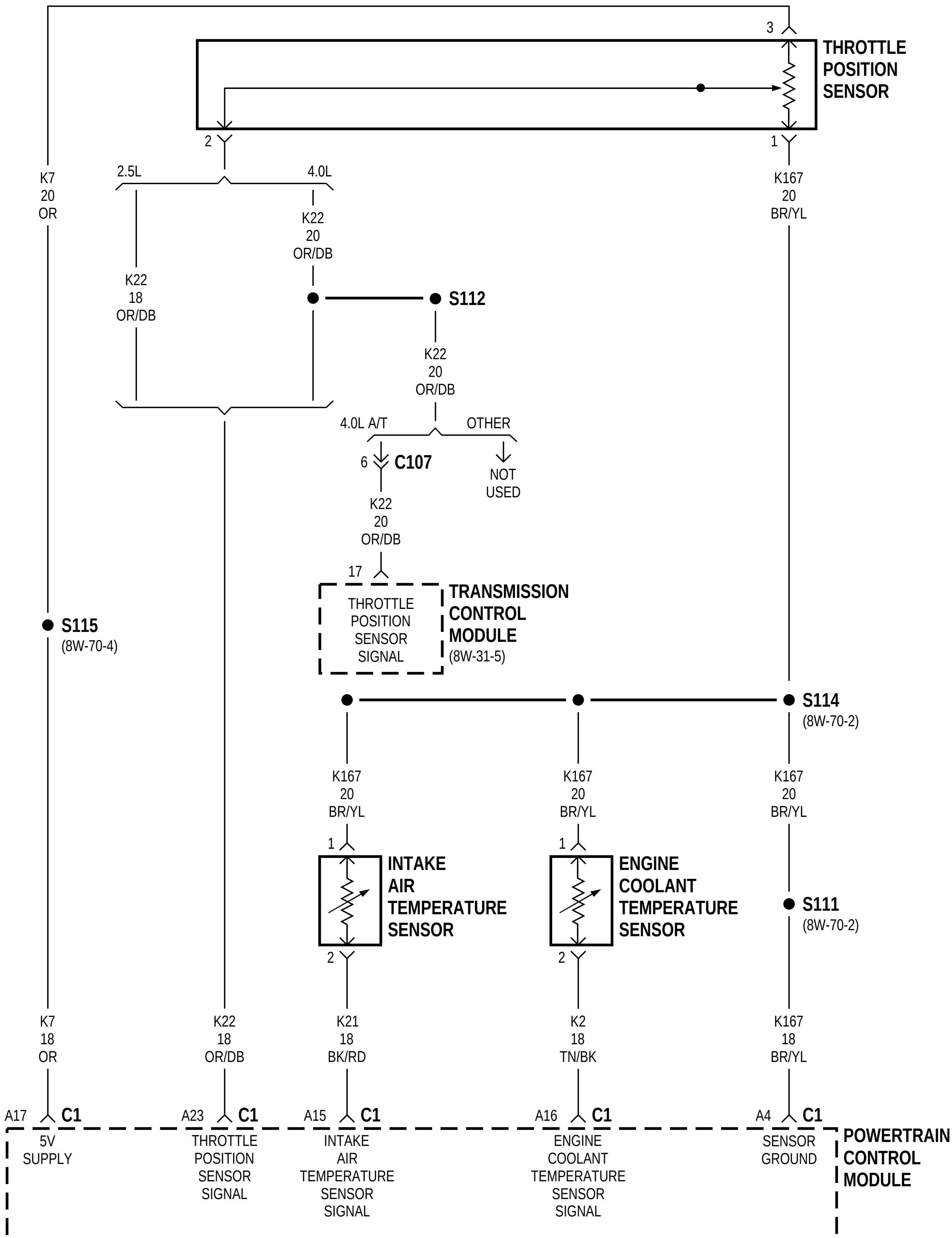


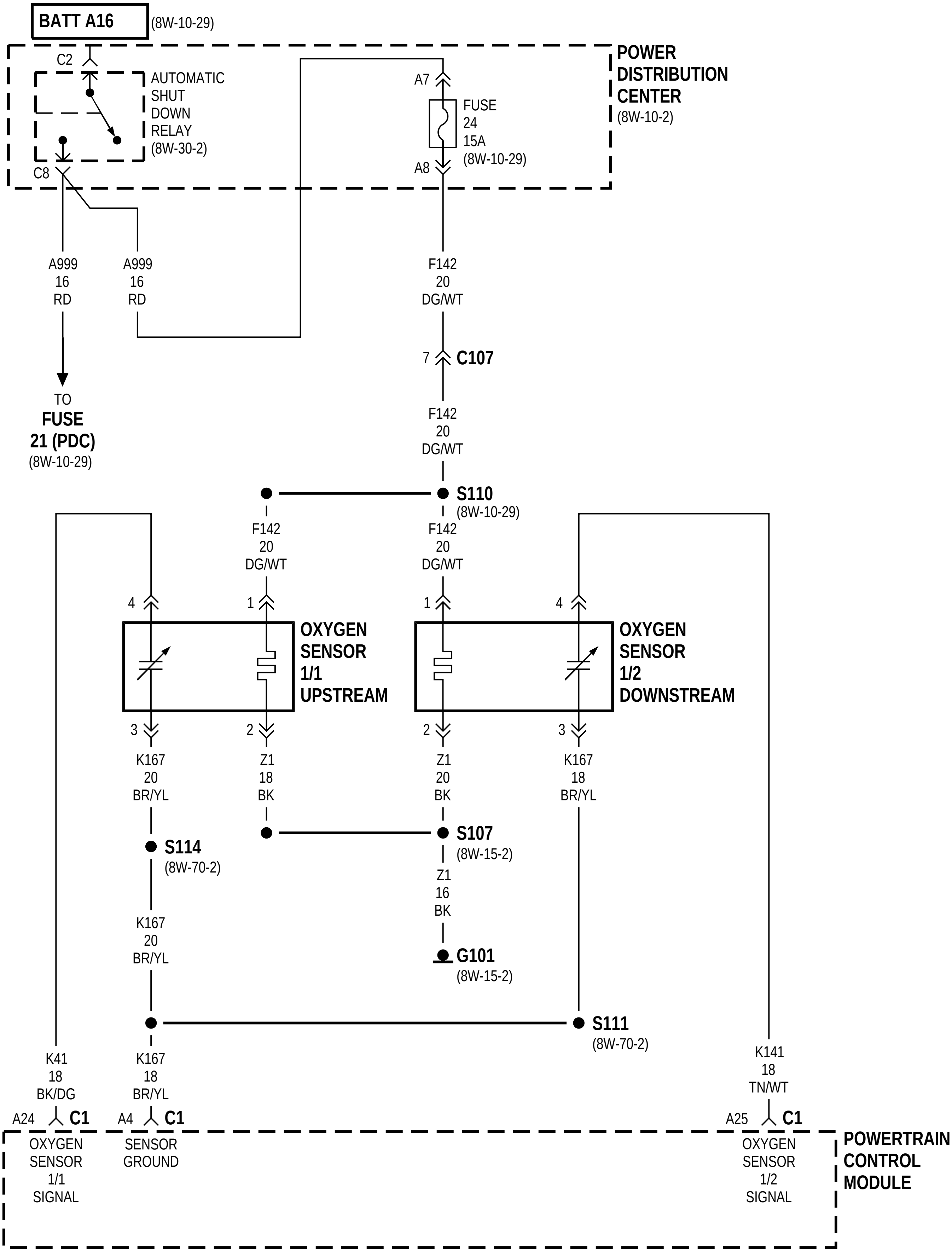
ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE 11 20A
(8W-12-14)
(8W-12-15)
5 C2
F12 18 DB/WT
S130
(8W-12-14)
(8W-12-15)
D4
BATT A0
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
A11
FUSE 22 15A
(8W-10-31)
A12
A61 14 DB/BK
D2
FUEL PUMP RELAY (IN PDC)
D6
D8
A141 14 DG/WT
D2 C100
A141 16 DG/WT
4 C204
1
K226 20 DB/LG
3
FUEL PUMP MODULE
M
4
6
K167 20 BR/YL
Z1 16 BK
A61 16 DG/BK
16
17 C204
B3 C100
S138
(8W-70-2)
3 C107
K226 20 DB/LG
K167 20 BR/YL
S309
(8W-15-18)
Z1 12 BK
B2 C100
S111
(8W-70-2)
14 C107
K31 18 BR
K226 18 DB/LG
K167 18 BR/YL
G302
(8W-15-18)
A61 16 DG/BK
C19 C3
C26 C3
A4 C1
A22 C1
FUEL PUMP RELAY CONTROL
FUEL LEVEL SENSOR SIGNAL
SENSOR GROUND
FUSED B(+)
POWERTRAIN CONTROL MODULE

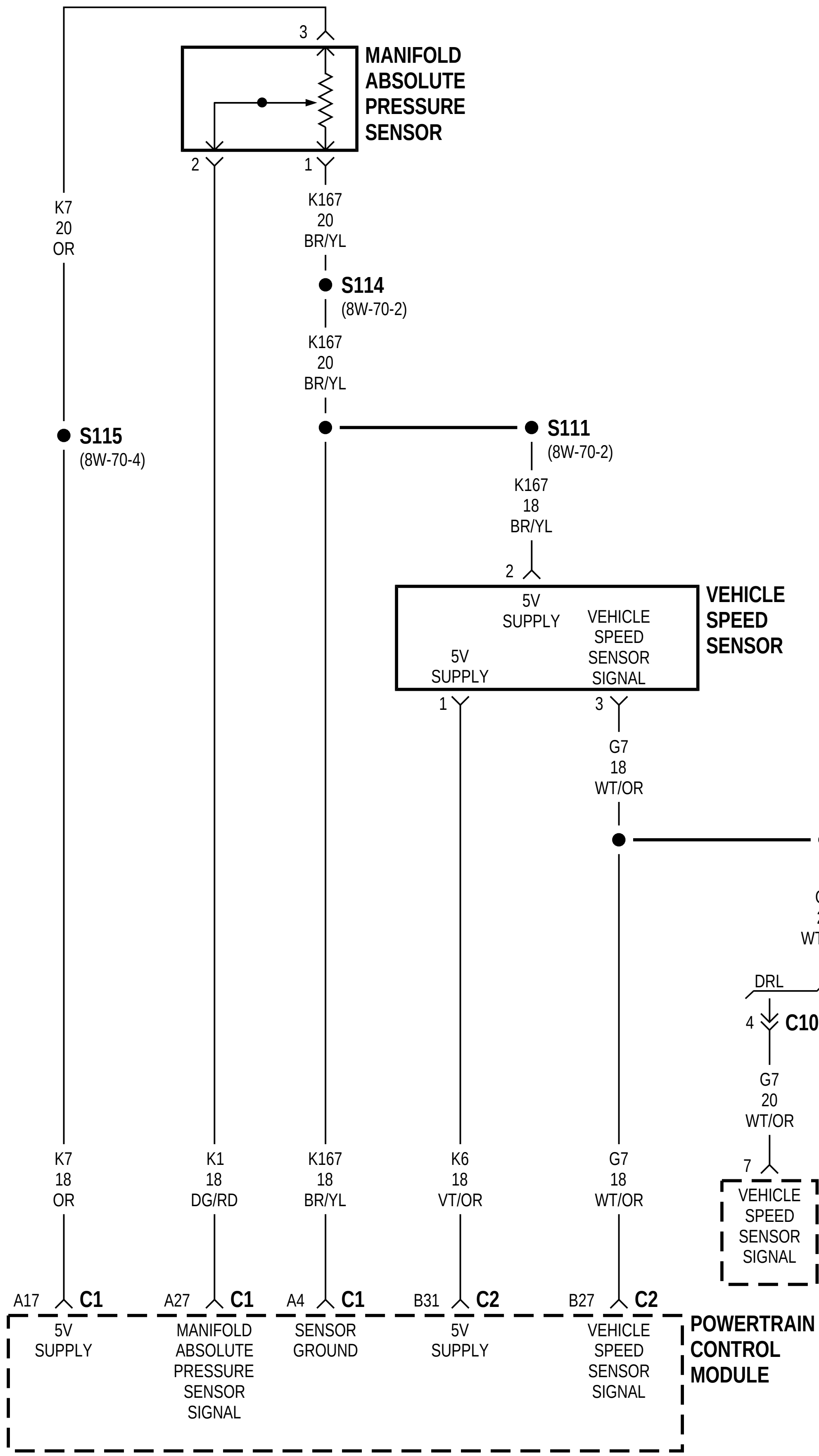


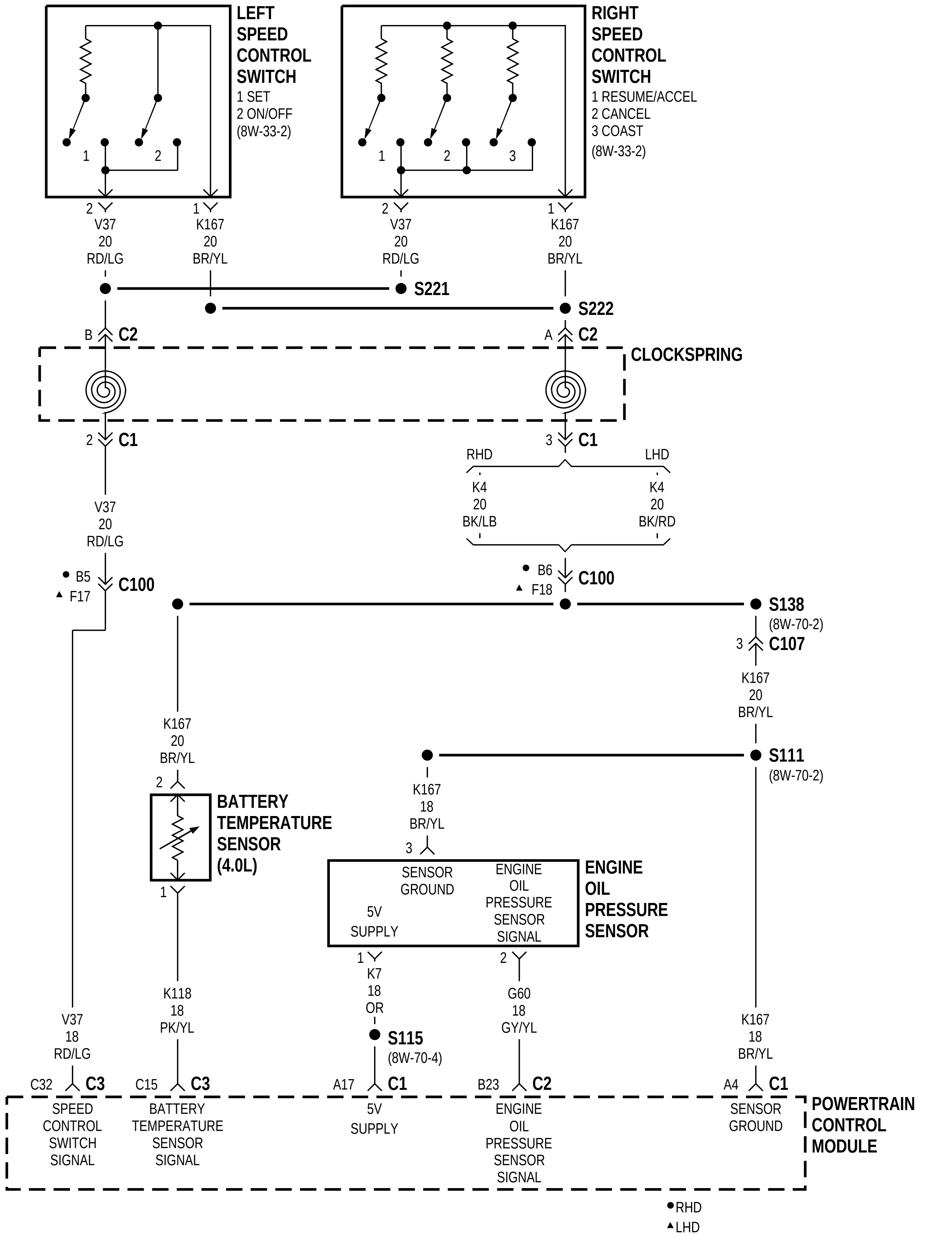
BATT A16
(8W-10-29)
C2
AUTOMATIC SHUT DOWN RELAY (8W-30-2)
POWER DISTRIBUTION CENTER (8W-10-2)
C8
A999 16 RD
A999 16 RD
TO FUSE 24 (PDC) (8W-10-29)
A14
FUSE 21 20A (8W-10-29)
A13
POWER DISTRIBUTION CENTER (8W-10-2)
A142 18 DG/OR
S137 (8W-10-29)
A142 18 DG/OR
1 C107
A142 18 DG/OR
S109 (8W-10-29)
A142 18 DG/OR
S115 (8W-70-4)
K7 20 OR
K7 18 OR
3
5V SUPPLY
CRANKSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
CRANKSHAFT POSITION SENSOR
1
2
K167 20 BR/YL
S114 (8W-70-2)
K167 20 BR/YL
3
5V SUPPLY
CAMSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
CAMSHAFT POSITION SENSOR
2
1
K167 18 BR/YL
S111 (8W-70-2)
2
1
IGNITION COIL
2
1
K19 18 GY
K7 18 OR
K24 18 GY/BK
K167 18 BR/YL
K44 18 TN/YL
A7 C1
A17 C1
A8 C1
A4 C1
A18 C1
IGNITION COIL NO. 1 DRIVER
5V SUPPLY
CRANKSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
CAMSHAFT POSITION SENSOR SIGNAL
POWERTRAIN CONTROL MODULE
• 2WD
• • 4WD

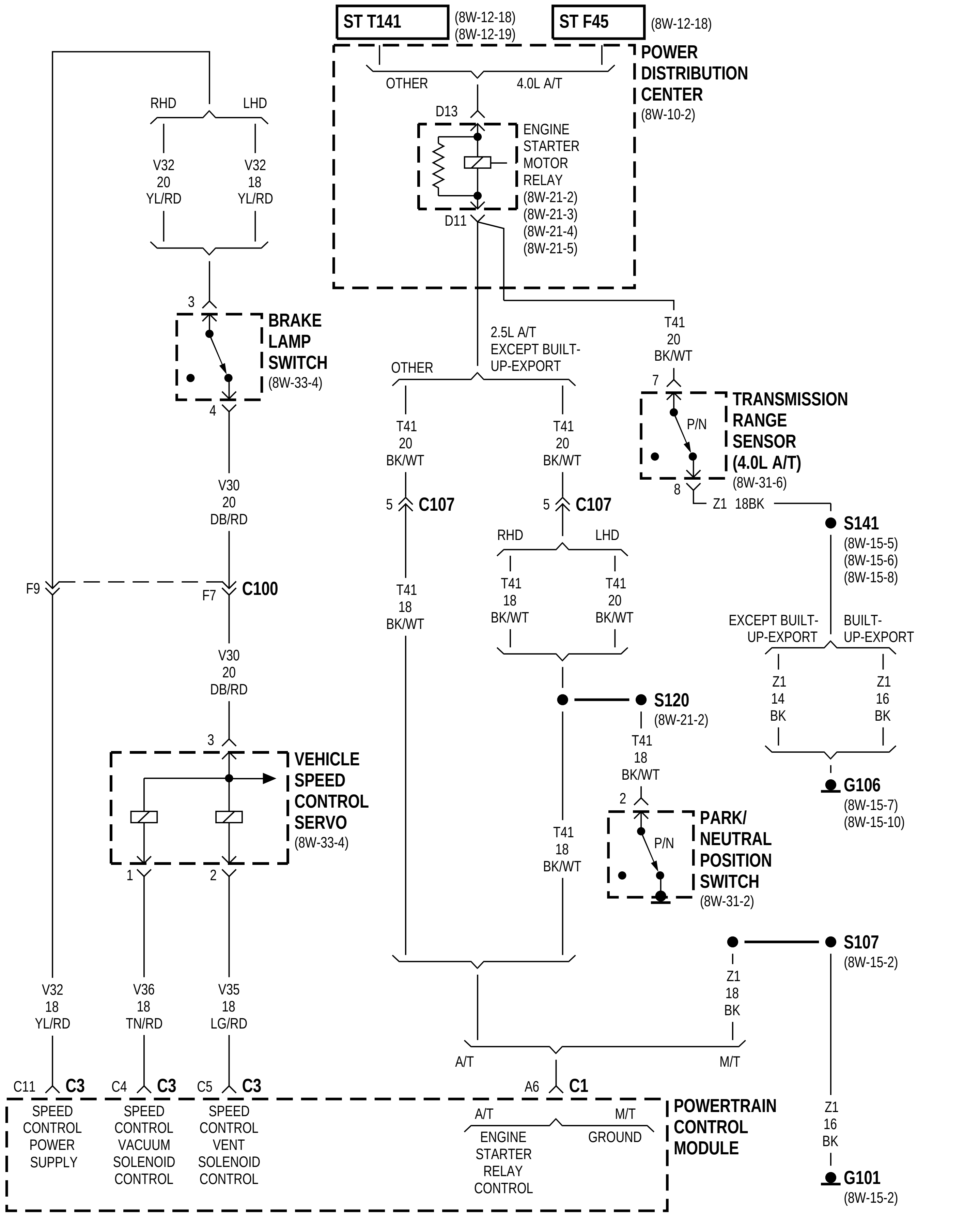

BATT A16
(8W-10-29)
C2
AUTOMATIC SHUT DOWN RELAY (8W-30-2)
C8
A14
FUSE 21 20A (8W-10-29)
A13
POWER DISTRIBUTION CENTER (8W-10-2)
A999 16 RD
A999 16 RD
TO FUSE 24 (PDC) (8W-10-29)
A142 18 DG/OR
S137 (8W-10-29)
1 C107
S109 (8W-10-29)
A142 18 DG/OR
S113 (8W-10-30)
A142 18 DG/OR
A142 18 DG/OR
A142 18 DG/OR
A142 18 DG/OR
A142 18 DG/OR
A142 18 DG/OR
1
2
FUEL INJECTOR NO. 1
FUEL INJECTOR NO. 2
FUEL INJECTOR NO. 3
FUEL INJECTOR NO. 4
FUEL INJECTOR NO. 5 (4.0L)
FUEL INJECTOR NO. 6 (4.0L)
K11 18 WT/DB
K12 18 TN
K13 18 YL/WT
K14 18 LB/BR
K15 18 PK/BK
K16 18 LG/BK
B4 C2
B15 C2
B5 C2
B16 C2
B6 C2
B12 C2
FUEL INJECTOR NO. 1 DRIVER
FUEL INJECTOR NO. 2 DRIVER
FUEL INJECTOR NO. 3 DRIVER
FUEL INJECTOR NO. 4 DRIVER
FUEL INJECTOR NO. 5 DRIVER
FUEL INJECTOR NO. 6 DRIVER
POWERTRAIN CONTROL MODULE


THROTTLE POSITION SENSOR
3
2
1
K7 20 OR
2.5L
4.0L
K22 18 OR/DB
K22 20 OR/DB
K167 20 BR/YL
S112
K22 20 OR/DB
4.0L A/T
OTHER
6
C107
NOT USED
K22 20 OR/DB
17
THROTTLE POSITION SENSOR SIGNAL
TRANSMISSION CONTROL MODULE
(8W-31-5)
S115
(8W-70-4)
S114
(8W-70-2)
K167 20 BR/YL
K167 20 BR/YL
K167 20 BR/YL
1
INTAKE AIR TEMPERATURE SENSOR
2
1
ENGINE COOLANT TEMPERATURE SENSOR
2
S111
(8W-70-2)
K7 18 OR
K22 18 OR/DB
K21 18 BK/RD
K2 18 TN/BK
K167 18 BR/YL
A17 C1
A23 C1
A15 C1
A16 C1
A4 C1
5V SUPPLY
THROTTLE POSITION SENSOR SIGNAL
INTAKE AIR TEMPERATURE SENSOR SIGNAL
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
SENSOR GROUND
POWERTRAIN CONTROL MODULE

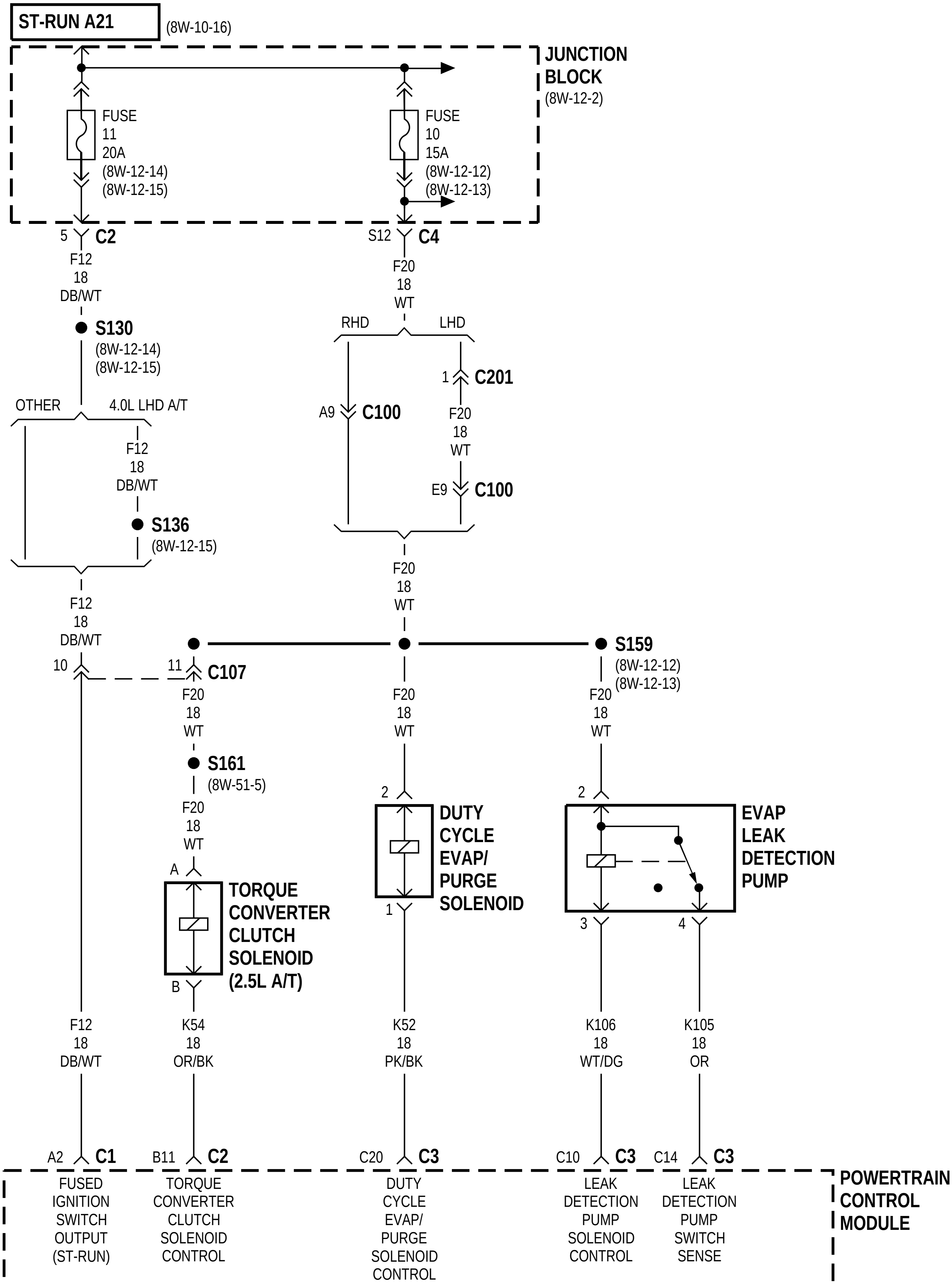

BATT A16
(8W-10-29)
C2
AUTOMATIC
SHUT
DOWN
RELAY
(8W-30-2)
C8
A7
FUSE
24
15A
(8W-10-29)
A8
POWER
DISTRIBUTION
CENTER
(8W-10-2)
A999
16
RD
A999
16
RD
F142
20
DG/WT
TO
FUSE
21 (PDC)
(8W-10-29)
7
C107
F142
20
DG/WT
S110
(8W-10-29)
F142
20
DG/WT
F142
20
DG/WT
4
1
1
4
OXYGEN
SENSOR
1/1
UPSTREAM
OXYGEN
SENSOR
1/2
DOWNSTREAM
3
2
2
3
K167
20
BR/YL
Z1
18
BK
Z1
20
BK
K167
18
BR/YL
S107
(8W-15-2)
S114
(8W-70-2)
Z1
16
BK
K167
20
BR/YL
G101
(8W-15-2)
S111
(8W-70-2)
K41
18
BK/DG
K167
18
BR/YL
K141
18
TN/WT
A24
C1
A4
C1
A25
C1
OXYGEN
SENSOR
1/1
SIGNAL
SENSOR
GROUND
OXYGEN
SENSOR
1/2
SIGNAL
POWERTRAIN
CONTROL
MODULE

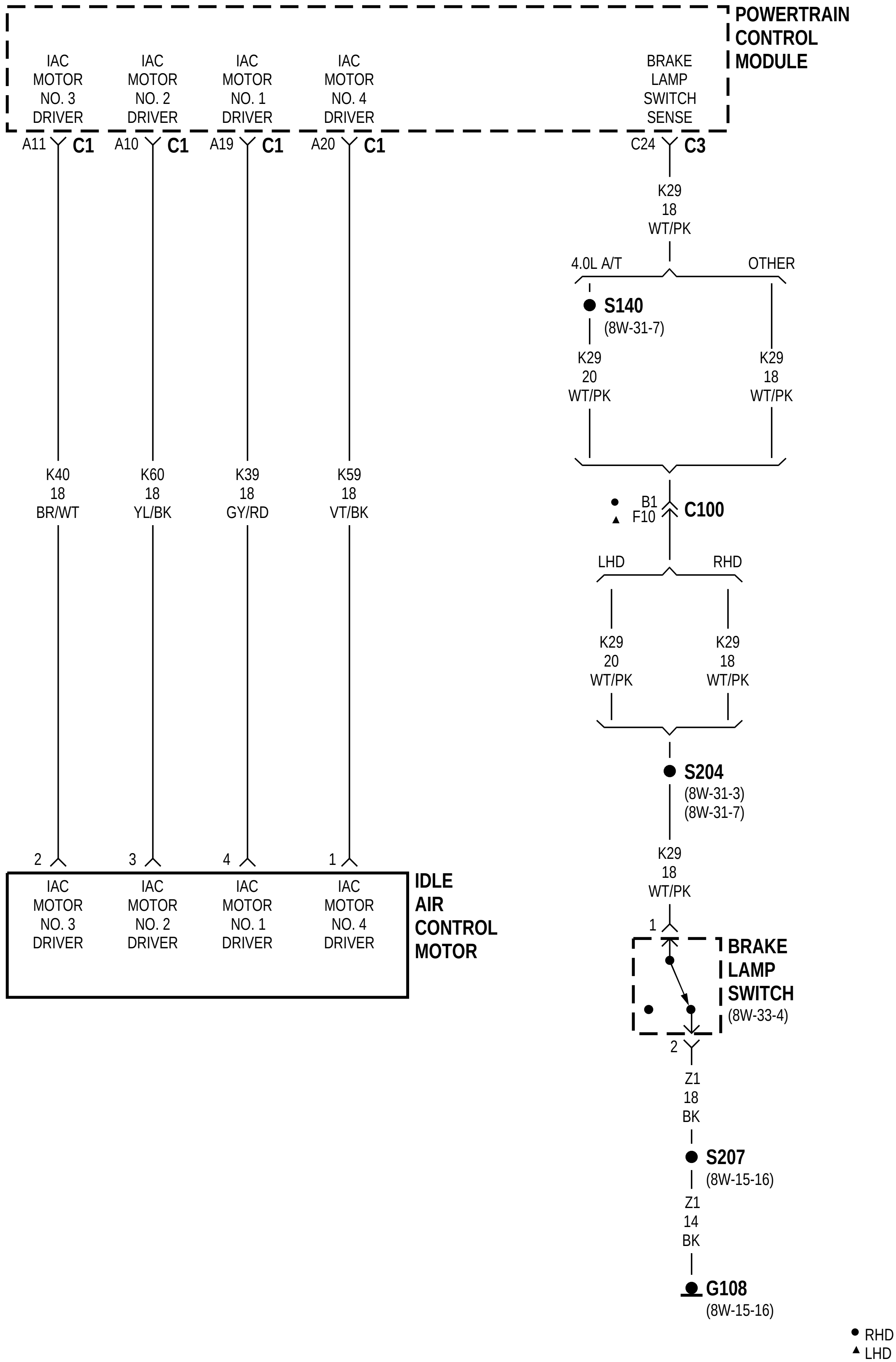

3
MANIFOLD ABSOLUTE PRESSURE SENSOR
2
1
K167
20
BR/YL
S114
(8W-70-2)
K167
20
BR/YL
K7
20
OR
S115
(8W-70-4)
S111
(8W-70-2)
K167
18
BR/YL
2
5V SUPPLY
VEHICLE SPEED SENSOR SIGNAL
5V SUPPLY
VEHICLE SPEED SENSOR
1
3
G7
18
WT/OR
S108
G7
20
WT/OR
DRL
OTHER
4
C107
NOT USED
G7
20
WT/OR
7
VEHICLE SPEED SENSOR SIGNAL
DAYTIME RUNNING LAMP MODULE
(8W-50-19)
K7
18
OR
K1
18
DG/RD
K167
18
BR/YL
K6
18
VT/OR
G7
18
WT/OR
A17 C1
A27 C1
A4 C1
B31 C2
B27 C2
5V SUPPLY
MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
SENSOR GROUND
5V SUPPLY
VEHICLE SPEED SENSOR SIGNAL
POWERTRAIN CONTROL MODULE

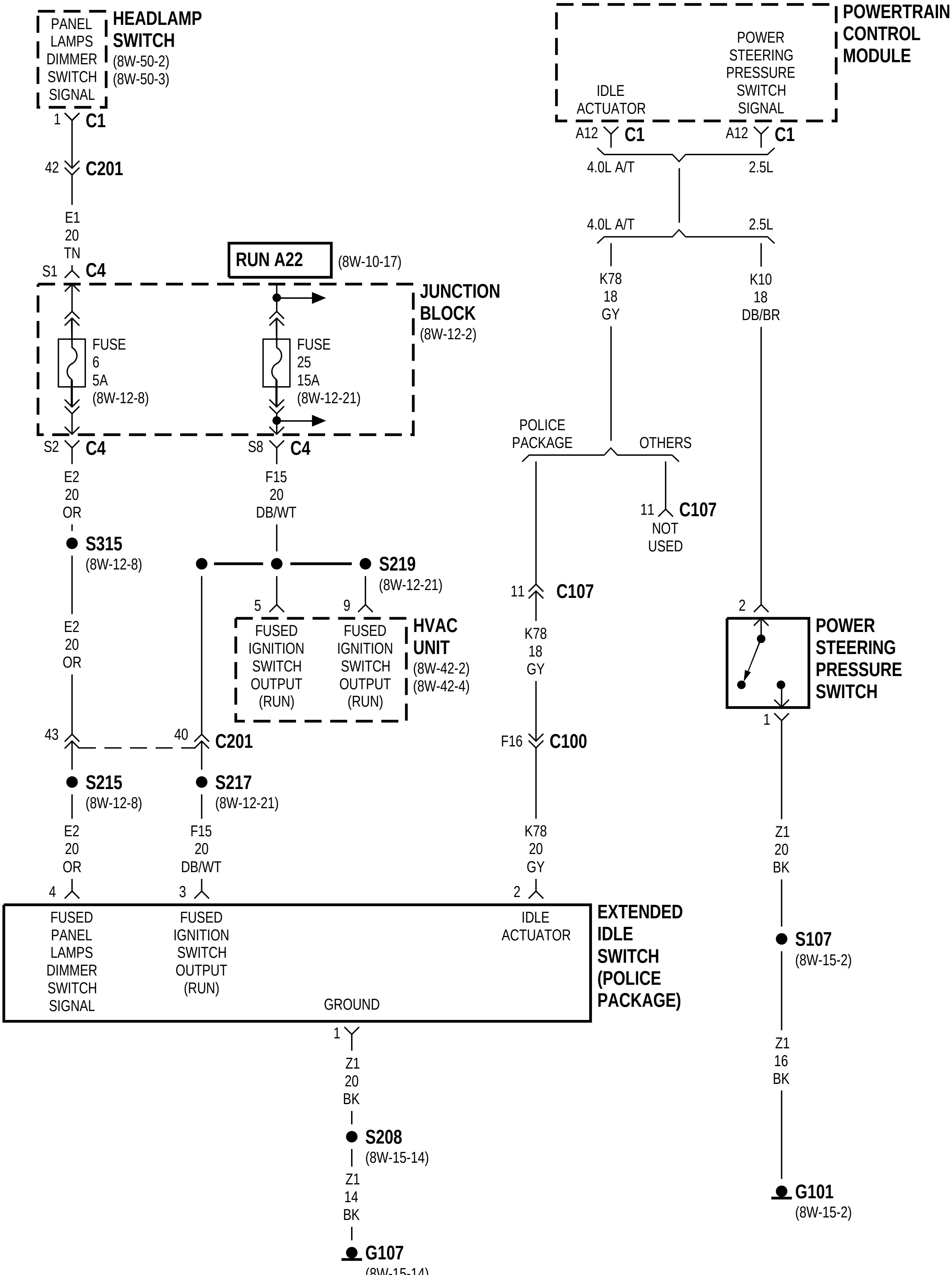

LEFT SPEED CONTROL SWITCH
1 SET
2 ON/OFF
(8W-33-2)
RIGHT SPEED CONTROL SWITCH
1 RESUME/ACCEL
2 CANCEL
3 COAST
(8W-33-2)
V37 20 RD/LG
K167 20 BR/YL
S221
S222
C2
CLOCKSPRING
C1
RHD
LHD
K4 20 BK/LB
K4 20 BK/RD
B5 F17 C100
B6 F18 C100
S138 (8W-70-2)
C107
S111 (8W-70-2)
K167 18 BR/YL
BATTERY TEMPERATURE SENSOR (4.0L)
SENSOR GROUND
ENGINE OIL PRESSURE SENSOR SIGNAL
5V SUPPLY
ENGINE OIL PRESSURE SENSOR
K7 18 OR
S115 (8W-70-4)
G60 18 GY/YL
K118 18 PK/YL
V37 18 RD/LG
C32 C3
C15 C3
A17 C1
B23 C2
A4 C1
SPEED CONTROL SWITCH SIGNAL
BATTERY TEMPERATURE SENSOR SIGNAL
5V SUPPLY
ENGINE OIL PRESSURE SENSOR SIGNAL
SENSOR GROUND
POWERTRAIN CONTROL MODULE
●RHD
▲LHD

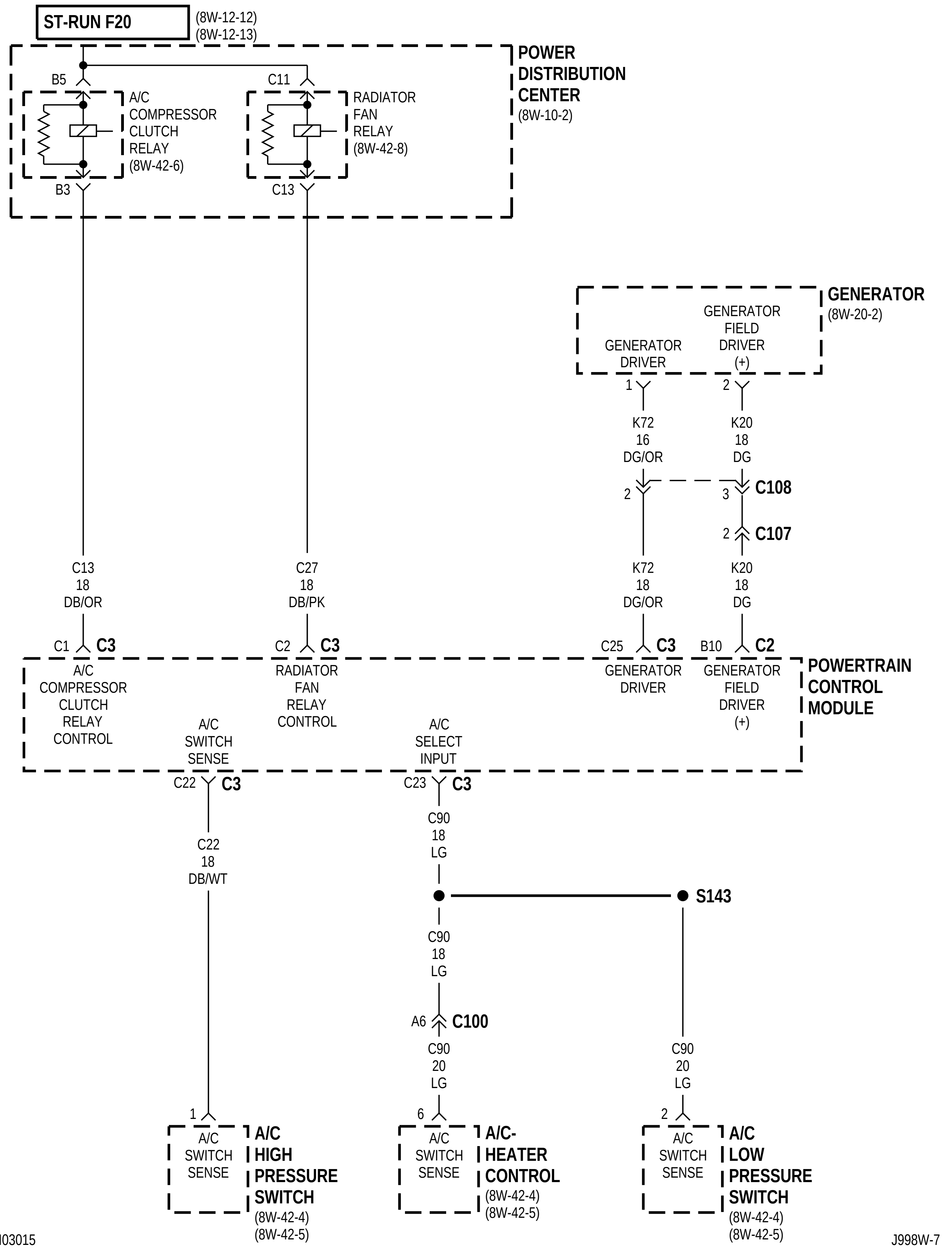


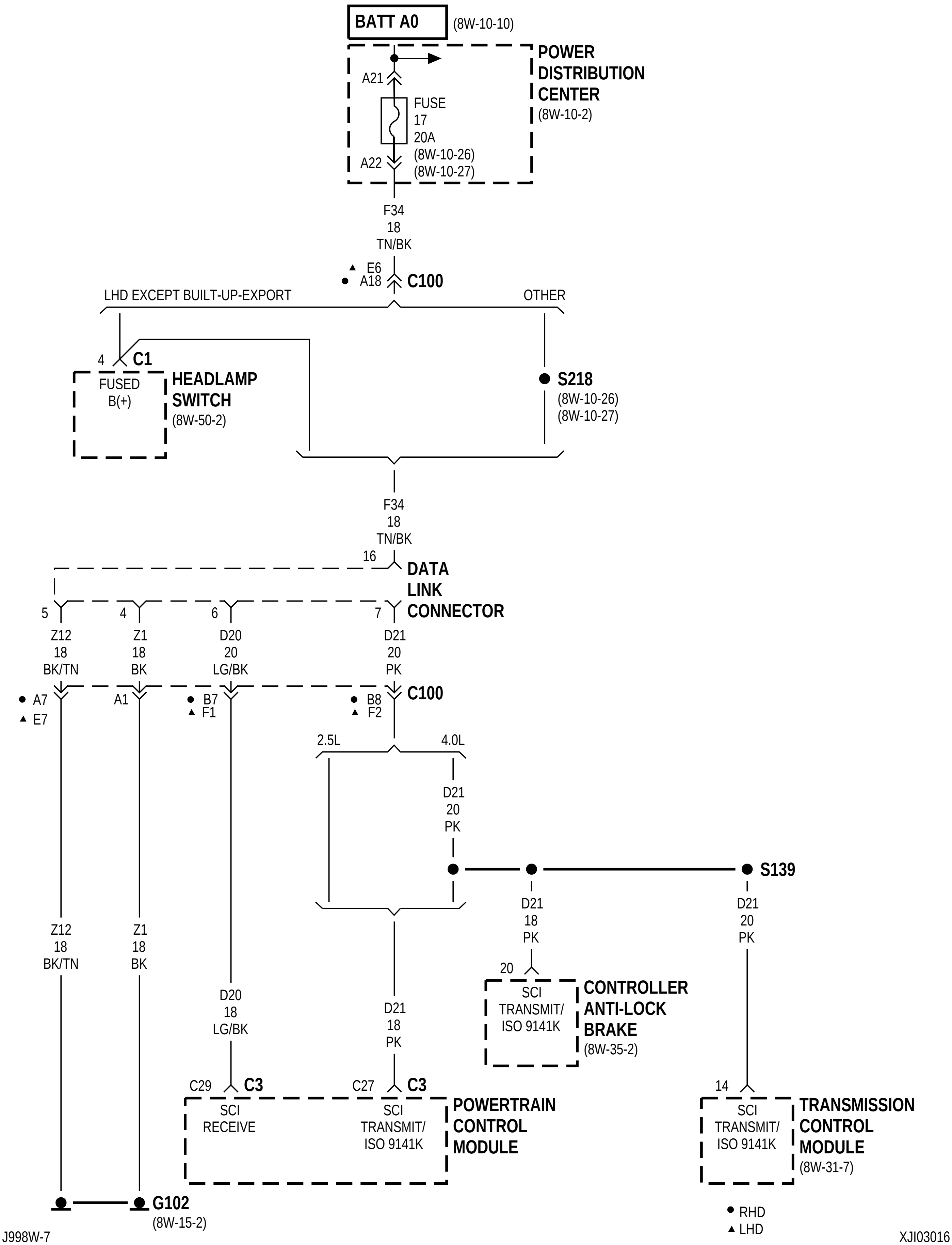
ST T141
(8W-12-18)
(8W-12-19)
ST F45
(8W-12-18)
POWER DISTRIBUTION CENTER
(8W-10-2)
OTHER
4.0L A/T
D13
ENGINE STARTER MOTOR RELAY
(8W-21-2)
(8W-21-3)
(8W-21-4)
(8W-21-5)
D11
RHD
LHD
V32 20 YL/RD
V32 18 YL/RD
3
BRAKE LAMP SWITCH
(8W-33-4)
4
V30 20 DB/RD
2.5L A/T EXCEPT BUILT-UP-EXPORT
OTHER
T41 20 BK/WT
T41 20 BK/WT
T41 20 BK/WT
7
TRANSMISSION RANGE SENSOR (4.0L A/T)
P/N
(8W-31-6)
8
Z1 18BK
S141
(8W-15-5)
(8W-15-6)
(8W-15-8)
5 C107
5 C107
RHD
LHD
T41 18 BK/WT
T41 18 BK/WT
T41 20 BK/WT
F9
F7
C100
V30 20 DB/RD
EXCEPT BUILT-UP-EXPORT
BUILT-UP-EXPORT
Z1 14 BK
Z1 16 BK
S120
(8W-21-2)
T41 18 BK/WT
G106
(8W-15-7)
(8W-15-10)
3
VEHICLE SPEED CONTROL SERVO
(8W-33-4)
2
PARK/ NEUTRAL POSITION SWITCH
P/N
(8W-31-2)
T41 18 BK/WT
1
2
S107
(8W-15-2)
Z1 18 BK
V32 18 YL/RD
V36 18 TN/RD
V35 18 LG/RD
A/T
M/T
C11 C3
C4 C3
C5 C3
A6 C1
SPEED CONTROL POWER SUPPLY
SPEED CONTROL VACUUM SOLENOID CONTROL
SPEED CONTROL VENT SOLENOID CONTROL
A/T
M/T
ENGINE STARTER RELAY CONTROL
GROUND
POWERTRAIN CONTROL MODULE
Z1 16 BK
G101
(8W-15-2)


ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE
11
20A
(8W-12-14)
(8W-12-15)
FUSE
10
15A
(8W-12-12)
(8W-12-13)
5
C2
S12
C4
F12
18
DB/WT
F20
18
WT
RHD
LHD
S130
(8W-12-14)
(8W-12-15)
1
C201
A9
C100
OTHER
4.0L LHD A/T
F20
18
WT
E9
C100
F12
18
DB/WT
S136
(8W-12-15)
F20
18
WT
F12
18
DB/WT
S159
(8W-12-12)
(8W-12-13)
10
11
C107
F20
18
WT
S161
(8W-51-5)
2
DUTY CYCLE EVAP/ PURGE SOLENOID
1
2
EVAP LEAK DETECTION PUMP
3
4
A
TORQUE CONVERTER CLUTCH SOLENOID (2.5L A/T)
B
F12
18
DB/WT
K54
18
OR/BK
K52
18
PK/BK
K106
18
WT/DG
K105
18
OR
A2
C1
B11
C2
C20
C3
C10
C3
C14
C3
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
TORQUE CONVERTER CLUTCH SOLENOID CONTROL
DUTY CYCLE EVAP/ PURGE SOLENOID CONTROL
LEAK DETECTION PUMP SOLENOID CONTROL
LEAK DETECTION PUMP SWITCH SENSE
POWERTRAIN CONTROL MODULE


POWERTRAIN CONTROL MODULE
IAC MOTOR NO. 3 DRIVER
IAC MOTOR NO. 2 DRIVER
IAC MOTOR NO. 1 DRIVER
IAC MOTOR NO. 4 DRIVER
BRAKE LAMP SWITCH SENSE
A11 C1
A10 C1
A19 C1
A20 C1
C24 C3
K29 18 WT/PK
4.0L A/T
OTHER
S140
(8W-31-7)
K29 20 WT/PK
K29 18 WT/PK
K40 18 BR/WT
K60 18 YL/BK
K39 18 GY/RD
K59 18 VT/BK
B1
F10
C100
LHD
RHD
K29 20 WT/PK
K29 18 WT/PK
S204
(8W-31-3)
(8W-31-7)
K29 18 WT/PK
2
3
4
1
IAC MOTOR NO. 3 DRIVER
IAC MOTOR NO. 2 DRIVER
IAC MOTOR NO. 1 DRIVER
IAC MOTOR NO. 4 DRIVER
IDLE AIR CONTROL MOTOR
1
BRAKE LAMP SWITCH
(8W-33-4)
2
Z1 18 BK
S207
(8W-15-16)
Z1 14 BK
G108
(8W-15-16)
● RHD
▲ LHD

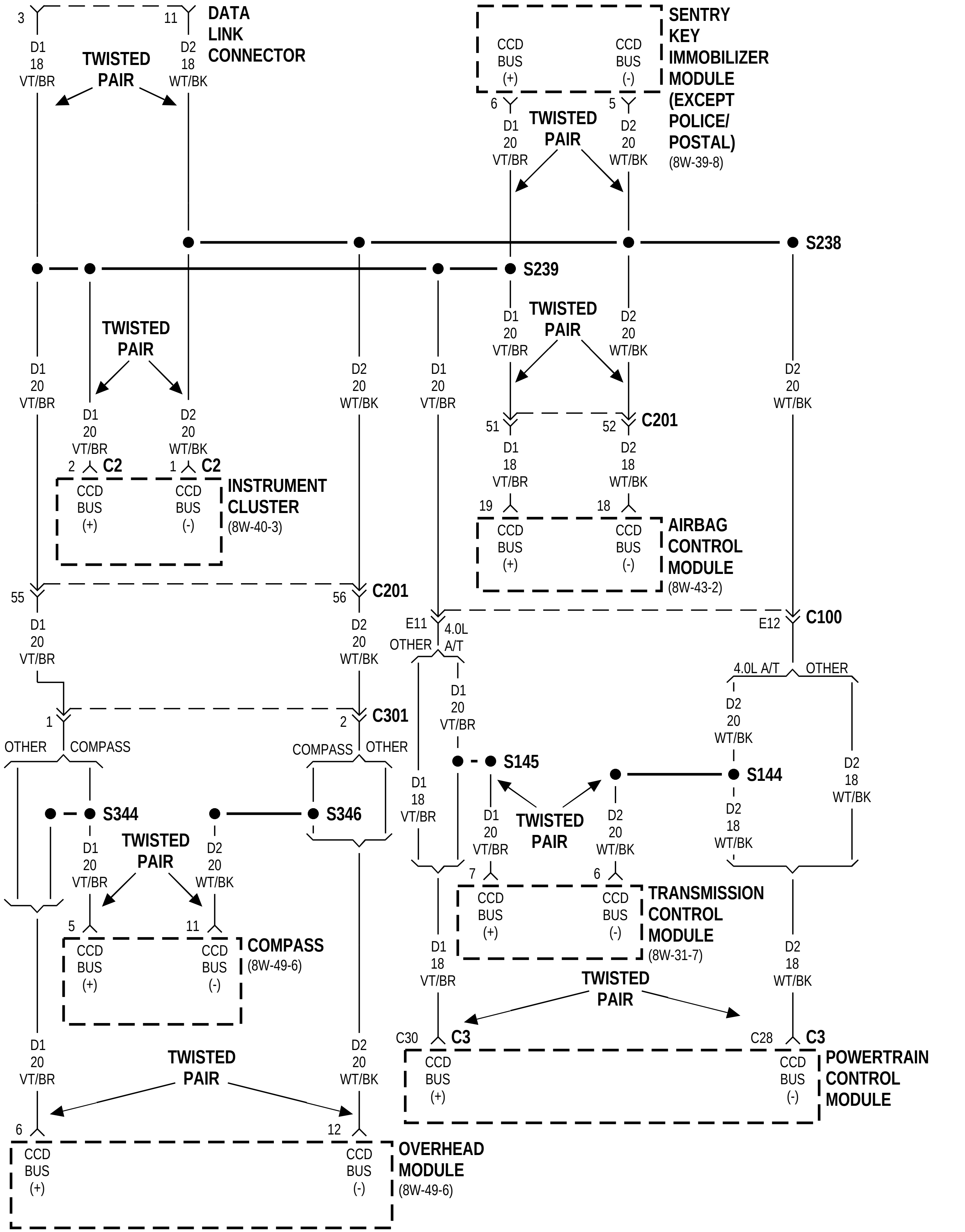

HEADLAMP SWITCH
(8W-50-2)
(8W-50-3)
PANEL LAMPS DIMMER SWITCH SIGNAL
1 C1
42 C201
E1 20 TN
S1 C4
RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE 6 5A (8W-12-8)
FUSE 25 15A (8W-12-21)
S2 C4
S8 C4
E2 20 OR
F15 20 DB/WT
S315
(8W-12-8)
S219
(8W-12-21)
5
9
FUSED IGNITION SWITCH OUTPUT (RUN)
FUSED IGNITION SWITCH OUTPUT (RUN)
HVAC UNIT
(8W-42-2)
(8W-42-4)
E2 20 OR
43
40 C201
S215
(8W-12-8)
S217
(8W-12-21)
E2 20 OR
F15 20 DB/WT
4
3
POWERTRAIN CONTROL MODULE
IDLE ACTUATOR
POWER STEERING PRESSURE SWITCH SIGNAL
A12 C1
A12 C1
4.0L A/T
2.5L
4.0L A/T
2.5L
K78 18 GY
K10 18 DB/BR
POLICE PACKAGE
OTHERS
11 C107
NOT USED
11 C107
K78 18 GY
F16 C100
K78 20 GY
2
2
POWER STEERING PRESSURE SWITCH
1
Z1 20 BK
FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
FUSED IGNITION SWITCH OUTPUT (RUN)
IDLE ACTUATOR
GROUND
EXTENDED IDLE SWITCH (POLICE PACKAGE)
1
Z1 20 BK
S208
(8W-15-14)
Z1 14 BK
G107
(8W-15-14)
S107
(8W-15-2)
Z1 16 BK
G101
(8W-15-2)


ST-RUN F20
(8W-12-12)
(8W-12-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
B5
C11
A/C COMPRESSOR CLUTCH RELAY
(8W-42-6)
RADIATOR FAN RELAY
(8W-42-8)
B3
C13
GENERATOR
(8W-20-2)
GENERATOR DRIVER
GENERATOR FIELD DRIVER (+)
1
2
K72
16
DG/OR
K20
18
DG
2
3
C108
2
C107
C13
18
DB/OR
C27
18
DB/PK
K72
18
DG/OR
K20
18
DG
C1
C3
C2
C3
C25
C3
B10
C2
POWERTRAIN CONTROL MODULE
A/C COMPRESSOR CLUTCH RELAY CONTROL
RADIATOR FAN RELAY CONTROL
GENERATOR DRIVER
GENERATOR FIELD DRIVER (+)
A/C SWITCH SENSE
A/C SELECT INPUT
C22
C3
C23
C3
C22
18
DB/WT
C90
18
LG
S143
C90
18
LG
A6
C100
C90
20
LG
C90
20
LG
1
6
2
A/C SWITCH SENSE
A/C HIGH PRESSURE SWITCH
(8W-42-4)
(8W-42-5)
A/C SWITCH SENSE
A/C-HEATER CONTROL
(8W-42-4)
(8W-42-5)
A/C SWITCH SENSE
A/C LOW PRESSURE SWITCH
(8W-42-4)
(8W-42-5)



BATT A0
(8W-10-10)
A21
FUSE
17
20A
(8W-10-26)
(8W-10-27)
A22
POWER
DISTRIBUTION
CENTER
(8W-10-2)
F34
18
TN/BK
E6
A18
C100
LHD EXCEPT BUILT-UP-EXPORT
OTHER
4
C1
FUSED
B(+)
HEADLAMP
SWITCH
(8W-50-2)
S218
(8W-10-26)
(8W-10-27)
F34
18
TN/BK
16
DATA
LINK
CONNECTOR
5
4
6
7
Z12
18
BK/TN
Z1
18
BK
D20
20
LG/BK
D21
20
PK
C100
A7
E7
A1
B7
F1
B8
F2
2.5L
4.0L
D21
20
PK
S139
D21
18
PK
D21
20
PK
Z12
18
BK/TN
Z1
18
BK
D20
18
LG/BK
D21
18
PK
20
SCI
TRANSMIT/
ISO 9141K
CONTROLLER
ANTI-LOCK
BRAKE
(8W-35-2)
C29
C3
C27
C3
SCI
RECEIVE
SCI
TRANSMIT/
ISO 9141K
POWERTRAIN
CONTROL
MODULE
14
SCI
TRANSMIT/
ISO 9141K
TRANSMISSION
CONTROL
MODULE
(8W-31-7)
G102
(8W-15-2)
RHD
LHD

LHD



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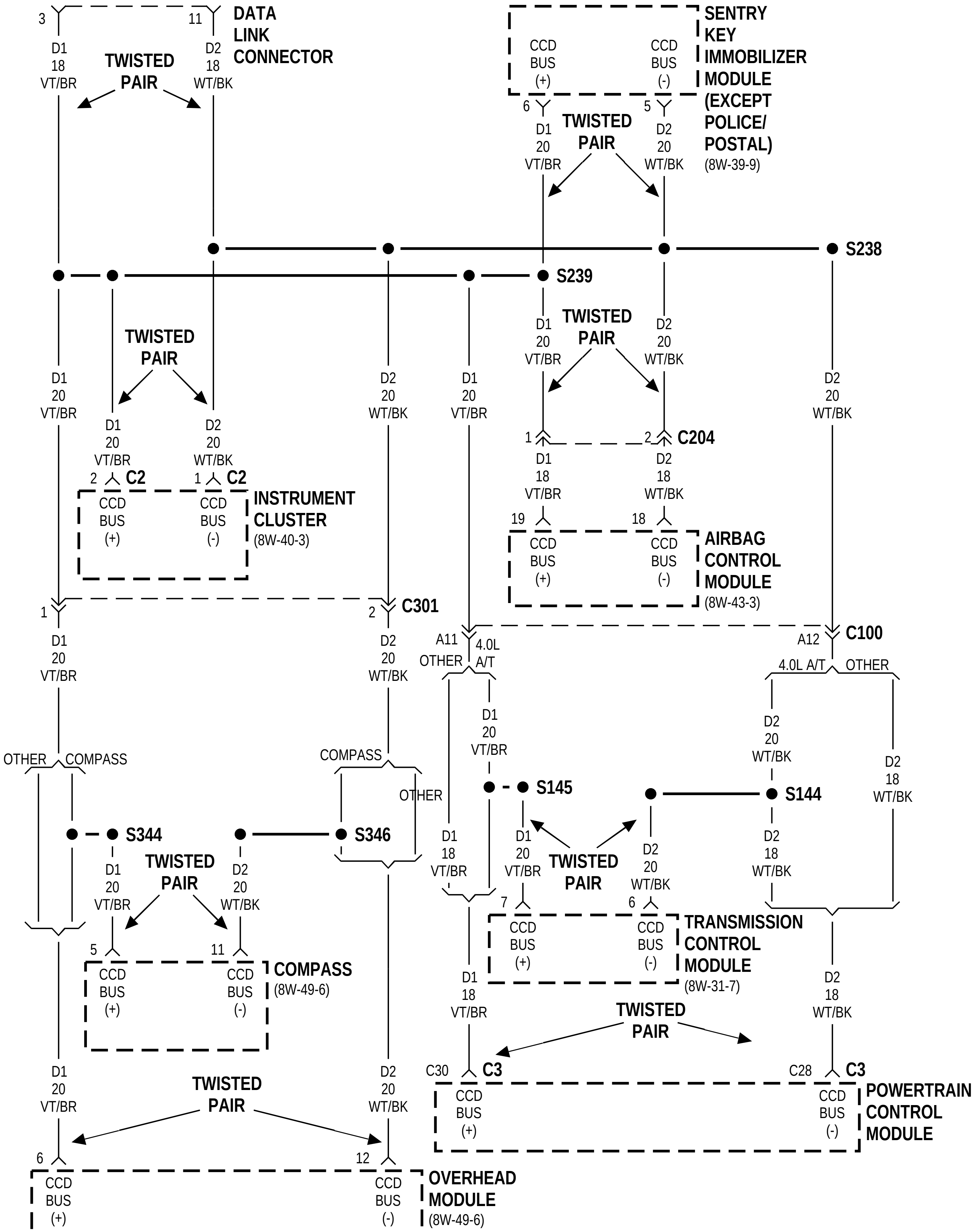
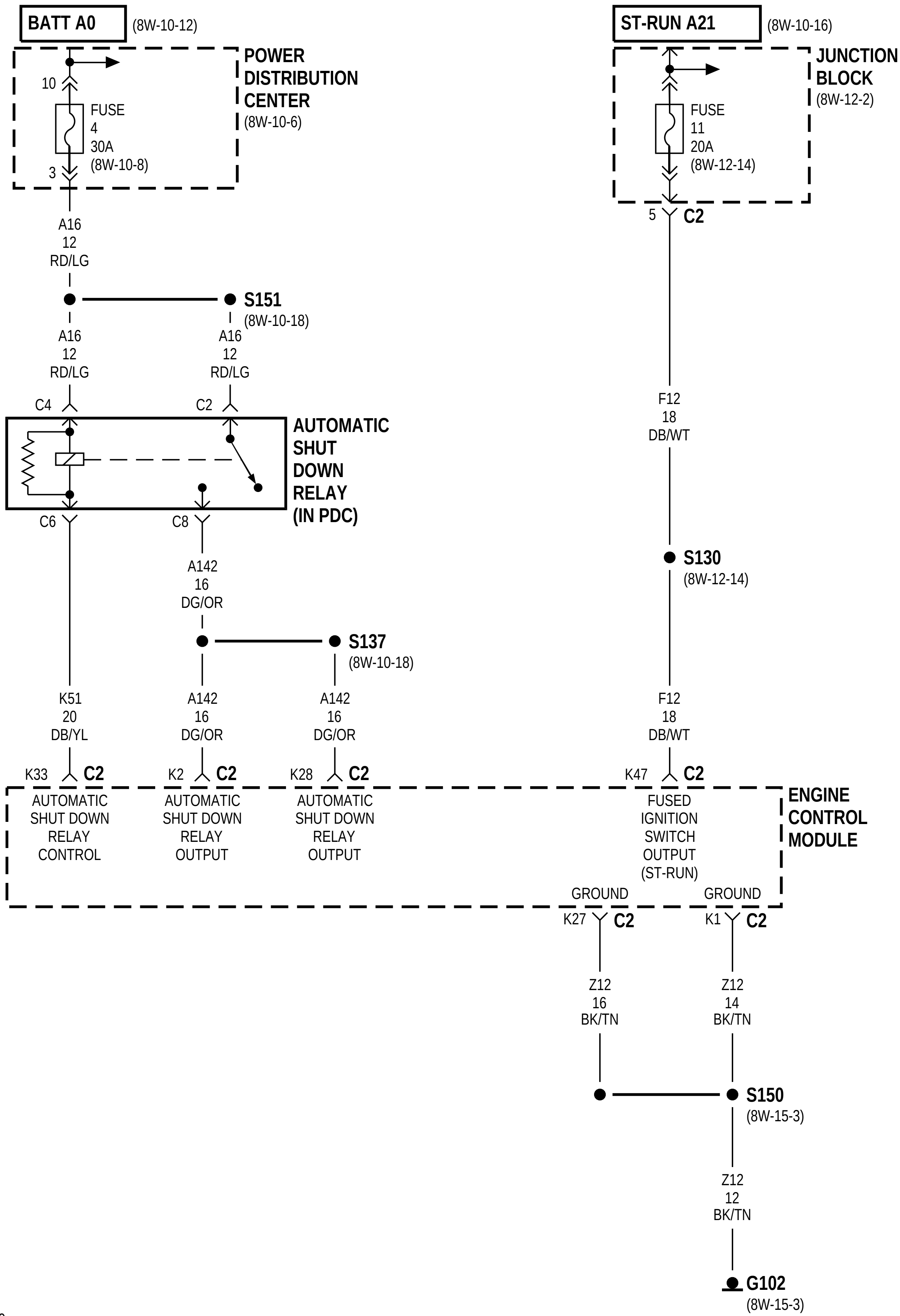
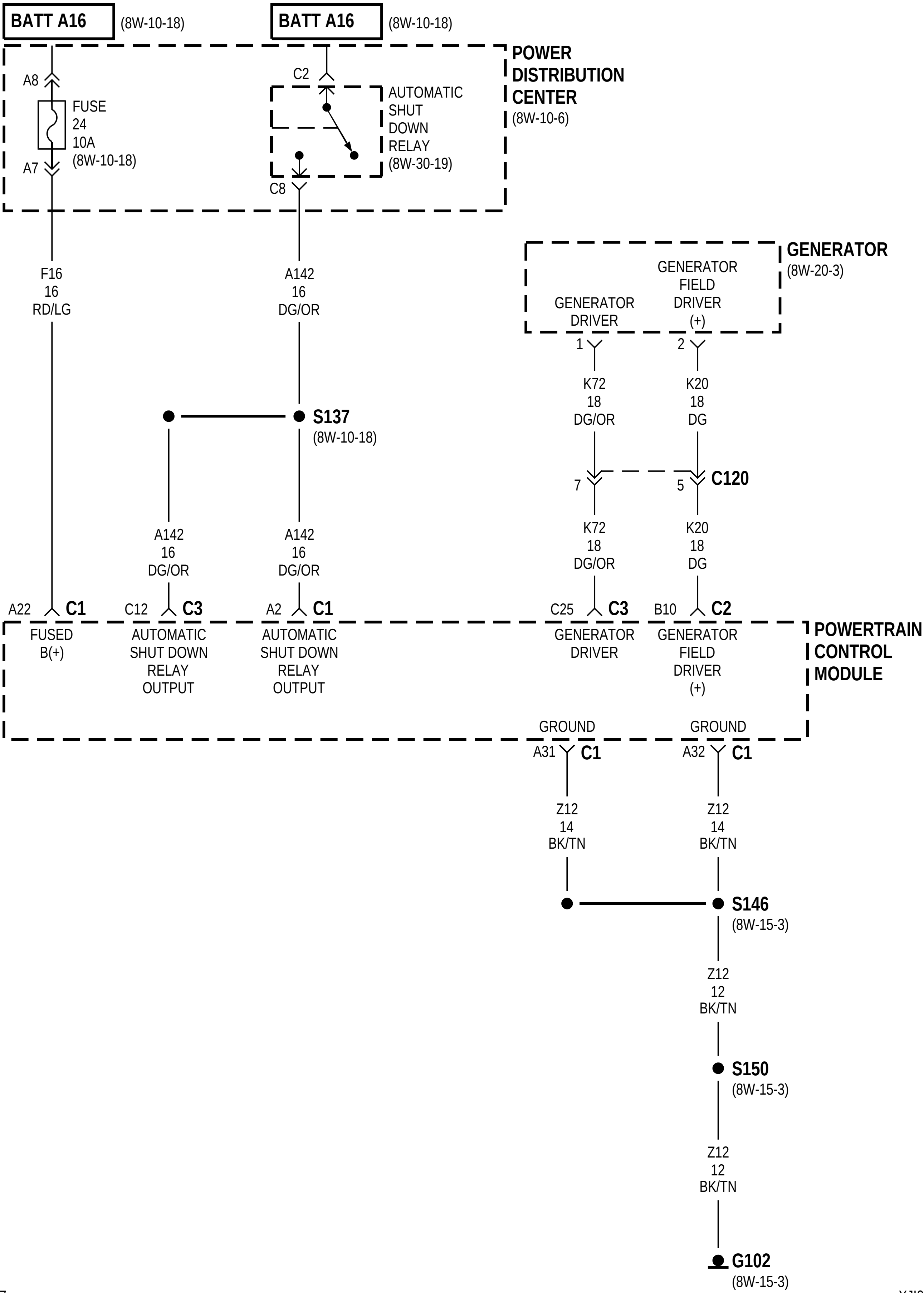
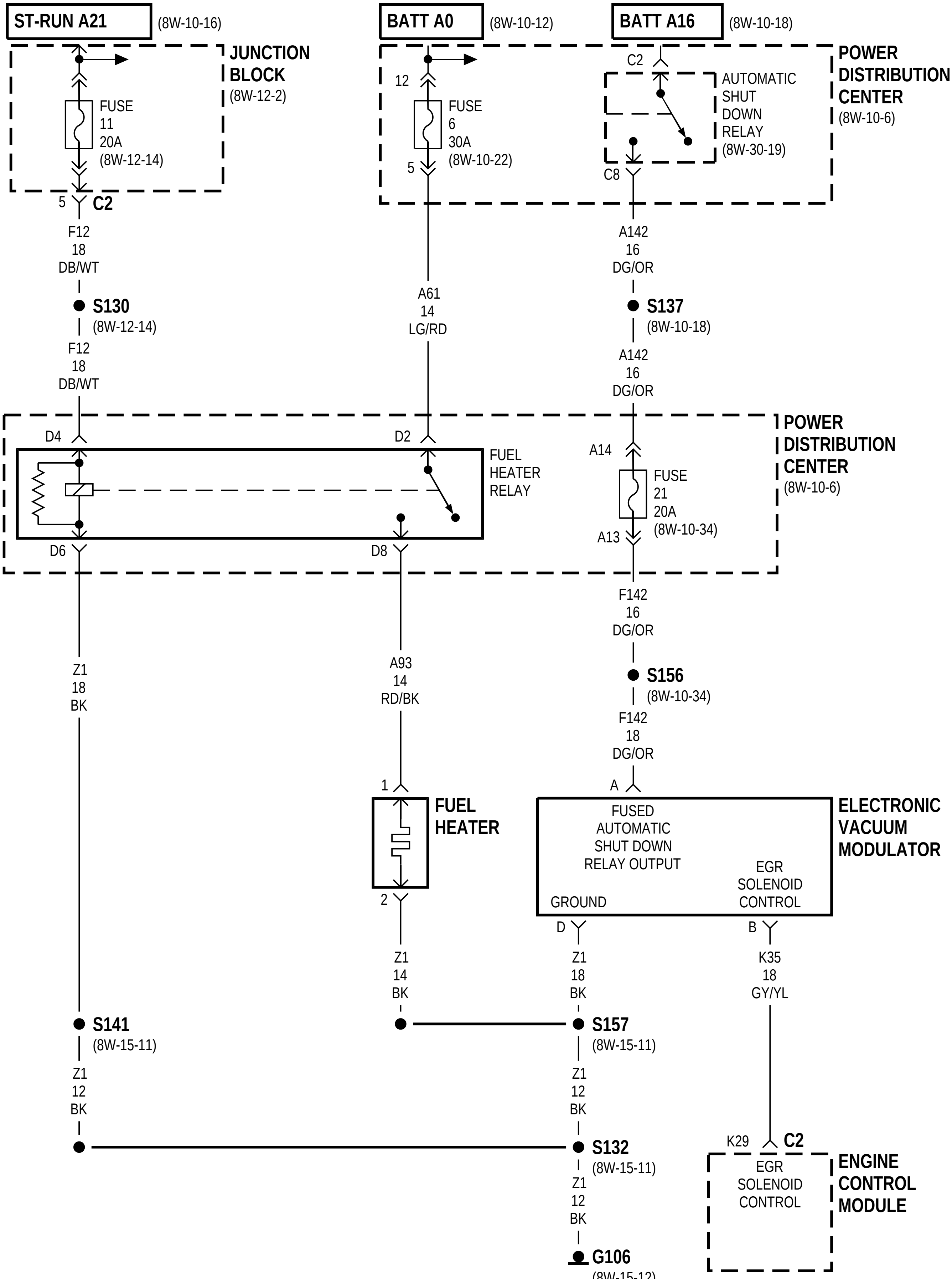
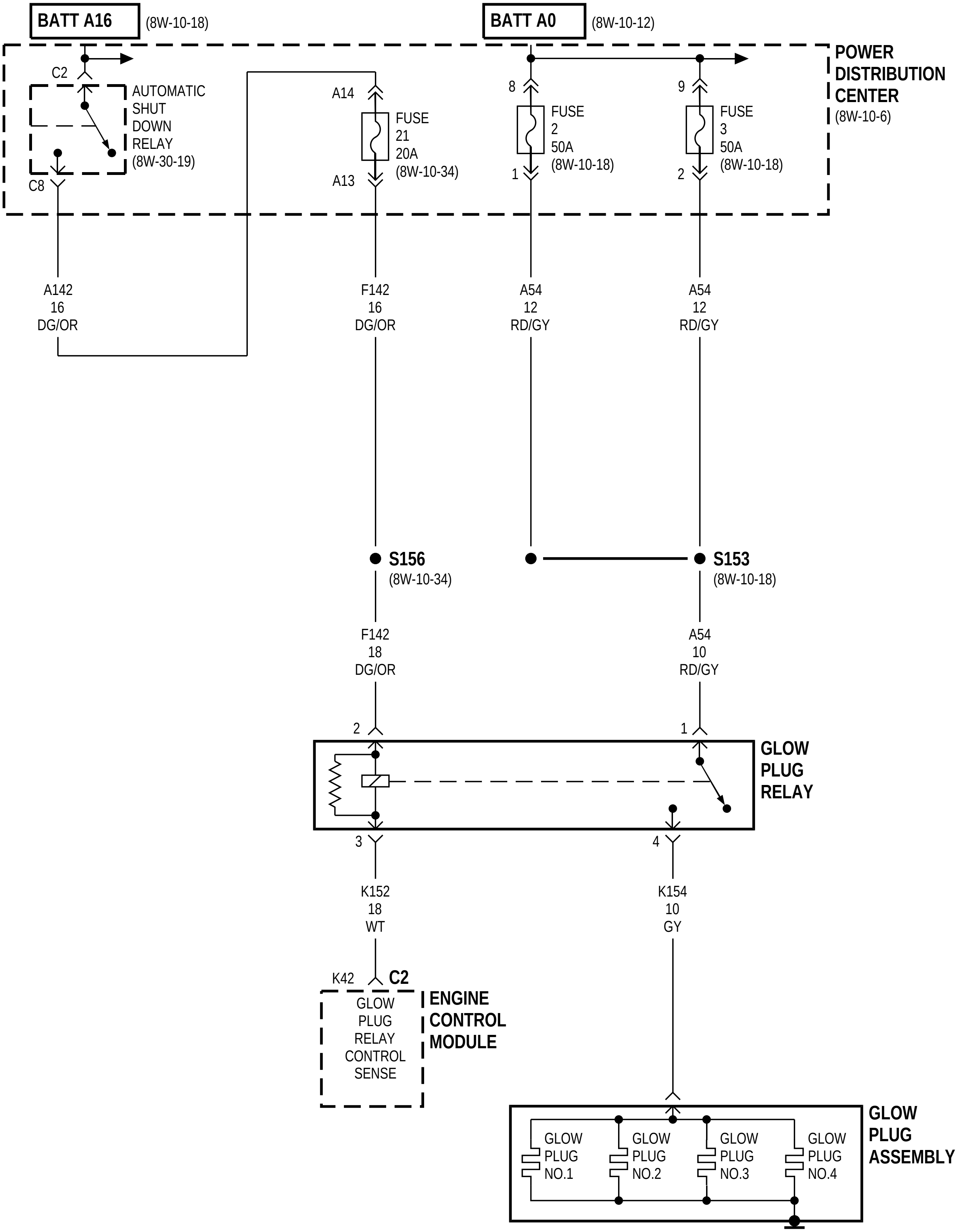

DATA LINK CONNECTOR
3
11
D1 18 VT/BR
D2 18 WT/BK
TWISTED PAIR
SENTRY KEY IMMOBILIZER MODULE (EXCEPT POLICE/ POSTAL)
(8W-39-9)
CCD BUS (+)
CCD BUS (-)
6
5
D1 20 VT/BR
D2 20 WT/BK
S238
S239
D1 20 VT/BR
D2 20 WT/BK
D2 20 WT/BK
D1 20 VT/BR
D2 20 WT/BK
C204
D1 18 VT/BR
D2 18 WT/BK
19
18
AIRBAG CONTROL MODULE
(8W-43-3)
C2
INSTRUMENT CLUSTER
(8W-40-3)
C301
C100
A11
A12
4.0L A/T
OTHER
COMPASS
S145
S144
S344
S346
COMPASS
(8W-49-6)
TRANSMISSION CONTROL MODULE
(8W-31-7)
D1 18 VT/BR
D2 18 WT/BK
C30
C28
C3
POWERTRAIN CONTROL MODULE
OVERHEAD MODULE
(8W-49-6)
12

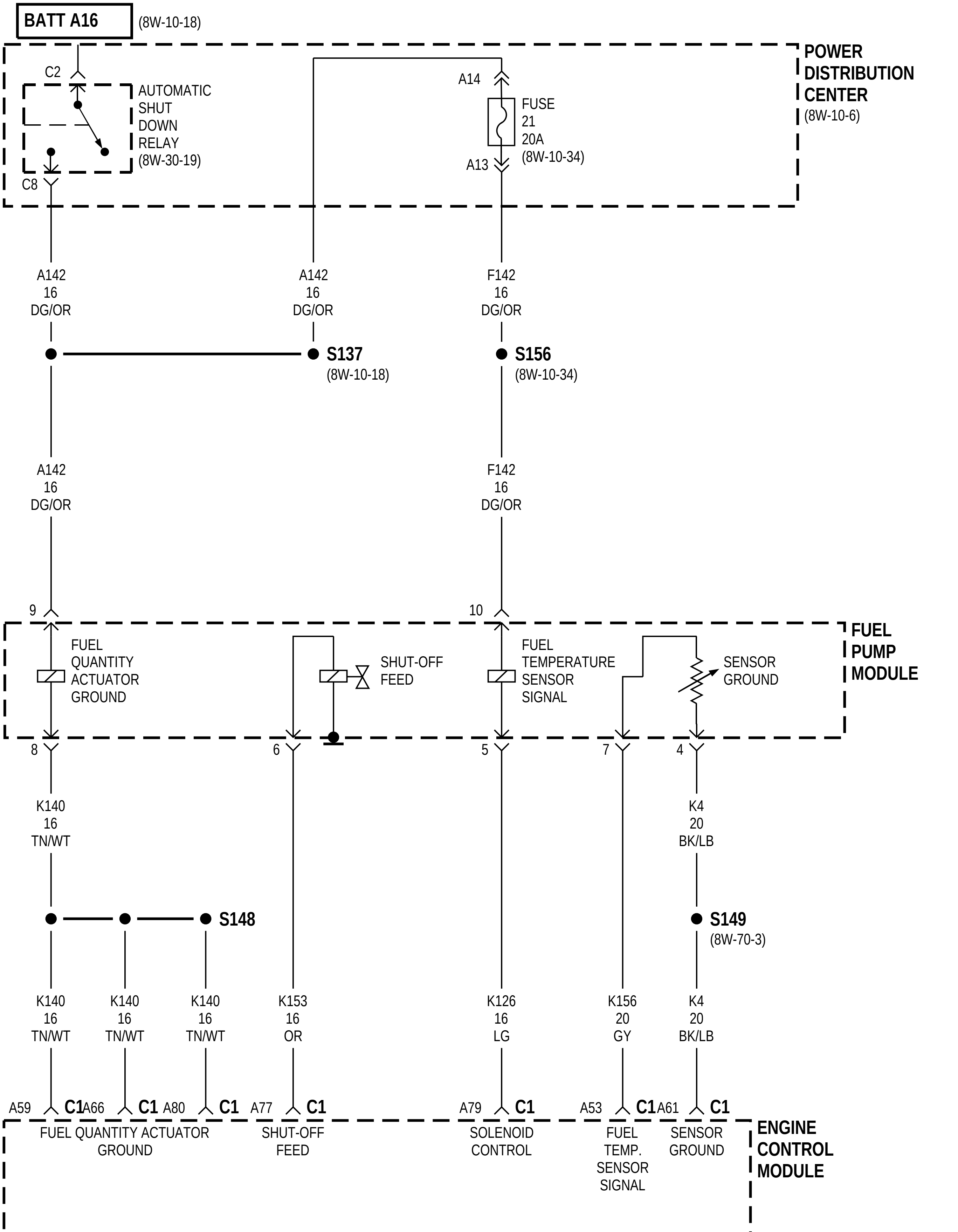

BATT A0
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-6)
10
FUSE 4 30A (8W-10-8)
3
A16 12 RD/LG
S151
(8W-10-18)
A16 12 RD/LG
A16 12 RD/LG
C4
C2
AUTOMATIC SHUT DOWN RELAY (IN PDC)
C6
C8
A142 16 DG/OR
S137
(8W-10-18)
K51 20 DB/YL
A142 16 DG/OR
A142 16 DG/OR
ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE 11 20A (8W-12-14)
5 C2
F12 18 DB/WT
S130
(8W-12-14)
F12 18 DB/WT
K33 C2
K2 C2
K28 C2
K47 C2
AUTOMATIC SHUT DOWN RELAY CONTROL
AUTOMATIC SHUT DOWN RELAY OUTPUT
AUTOMATIC SHUT DOWN RELAY OUTPUT
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
ENGINE CONTROL MODULE
GROUND
GROUND
K27 C2
K1 C2
Z12 16 BK/TN
Z12 14 BK/TN
S150
(8W-15-3)
Z12 12 BK/TN
G102
(8W-15-3)

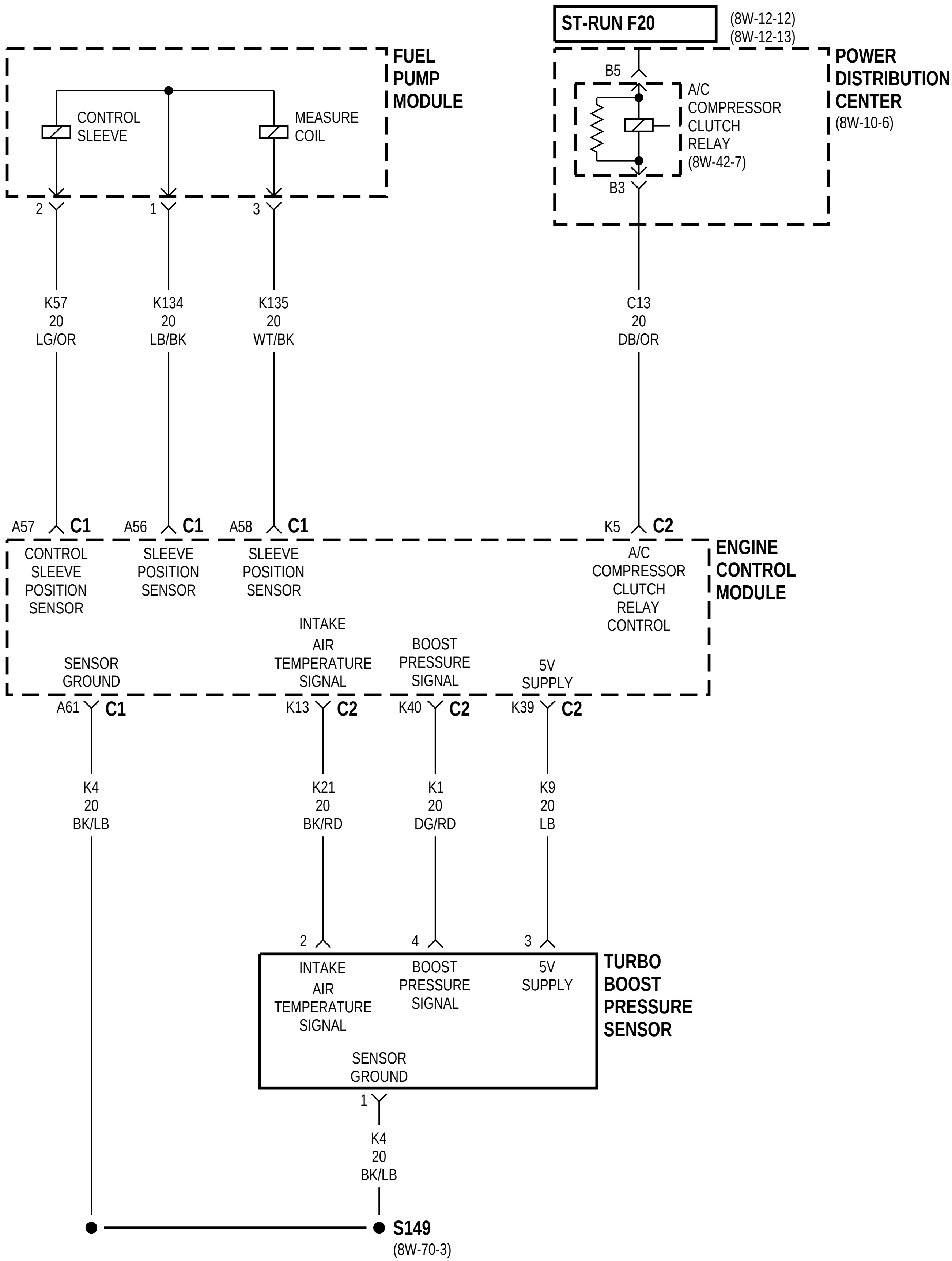

BATT A16
(8W-10-18)
BATT A16
(8W-10-18)
POWER
DISTRIBUTION
CENTER
(8W-10-6)
A8
FUSE
24
10A
(8W-10-18)
A7
C2
AUTOMATIC
SHUT
DOWN
RELAY
(8W-30-19)
C8
F16
16
RD/LG
A142
16
DG/OR
GENERATOR
(8W-20-3)
GENERATOR
DRIVER
GENERATOR
FIELD
DRIVER
(+)
1
2
K72
18
DG/OR
K20
18
DG
S137
(8W-10-18)
7
5
C120
K72
18
DG/OR
K20
18
DG
A142
16
DG/OR
A142
16
DG/OR
A22 C1
C12 C3
A2 C1
C25 C3
B10 C2
FUSED
B(+)
AUTOMATIC
SHUT DOWN
RELAY
OUTPUT
AUTOMATIC
SHUT DOWN
RELAY
OUTPUT
GENERATOR
DRIVER
GENERATOR
FIELD
DRIVER
(+)
POWERTRAIN
CONTROL
MODULE
GROUND
GROUND
A31 C1
A32 C1
Z12
14
BK/TN
Z12
14
BK/TN
S146
(8W-15-3)
Z12
12
BK/TN
S150
(8W-15-3)
Z12
12
BK/TN
G102
(8W-15-3)

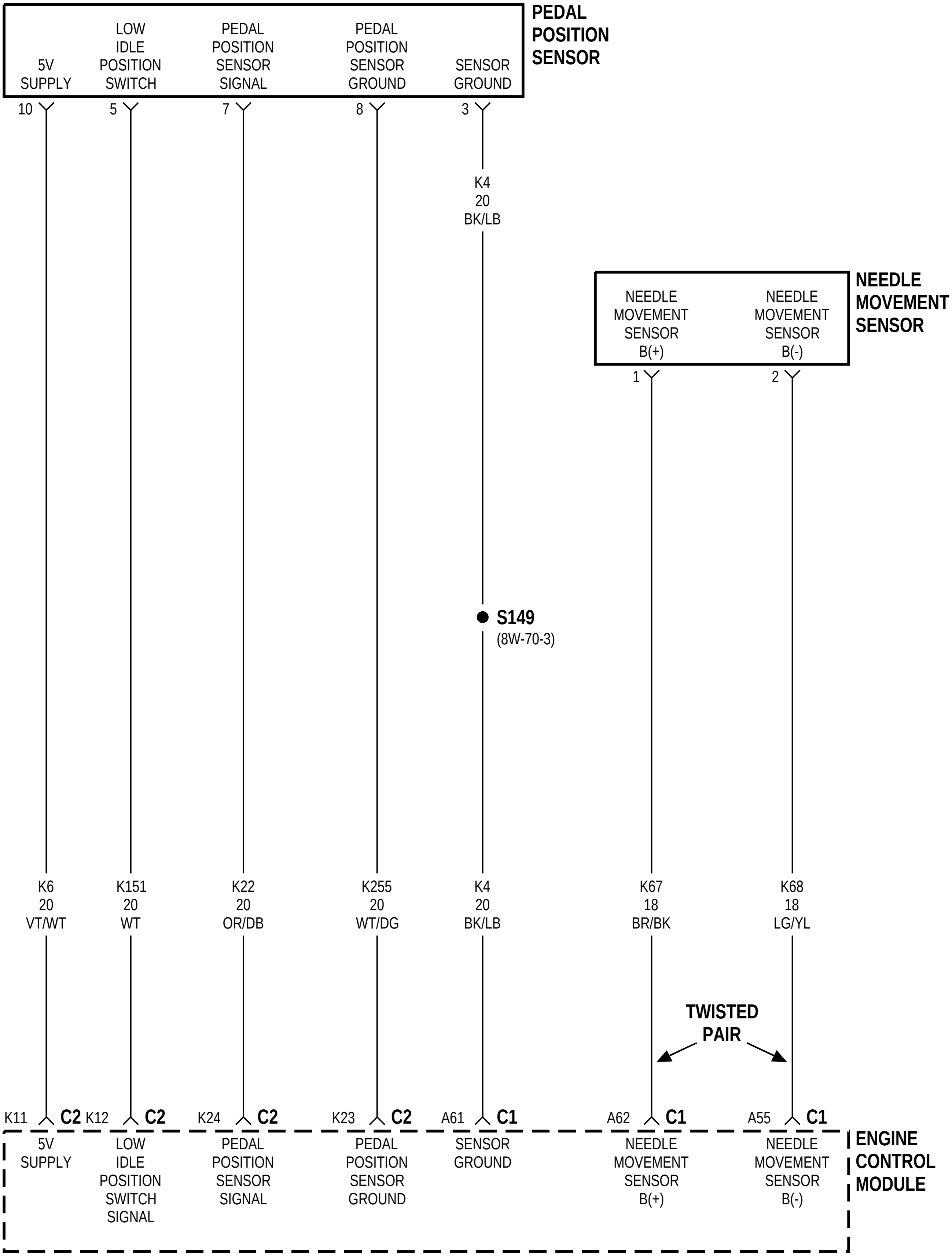

ST-RUN A21
(8W-10-16)
BATT A0
(8W-10-12)
BATT A16
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
FUSE
11
20A
(8W-12-14)
5
C2
F12
18
DB/WT
S130
(8W-12-14)
12
FUSE
6
30A
(8W-10-22)
5
A61
14
LG/RD
C2
AUTOMATIC SHUT DOWN RELAY
(8W-30-19)
C8
POWER DISTRIBUTION CENTER
(8W-10-6)
A142
16
DG/OR
S137
(8W-10-18)
D4
D2
FUEL HEATER RELAY
D6
D8
A14
FUSE
21
20A
(8W-10-34)
A13
POWER DISTRIBUTION CENTER
(8W-10-6)
F142
16
DG/OR
S156
(8W-10-34)
F142
18
DG/OR
Z1
18
BK
A93
14
RD/BK
1
FUEL HEATER
2
A
FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
EGR SOLENOID CONTROL
GROUND
ELECTRONIC VACUUM MODULATOR
D
B
Z1
14
BK
Z1
18
BK
K35
18
GY/YL
S141
(8W-15-11)
S157
(8W-15-11)
Z1
12
BK
S132
(8W-15-11)
K29
C2
EGR SOLENOID CONTROL
ENGINE CONTROL MODULE
G106
(8W-15-12)

DIESEL


BATT A16
(8W-10-18)
BATT A0
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-6)
C2
AUTOMATIC SHUT DOWN RELAY
(8W-30-19)
C8
A14
FUSE 21 20A
(8W-10-34)
A13
8
FUSE 2 50A
(8W-10-18)
1
9
FUSE 3 50A
(8W-10-18)
2
A142 16 DG/OR
F142 16 DG/OR
A54 12 RD/GY
A54 12 RD/GY
S156
(8W-10-34)
S153
(8W-10-18)
F142 18 DG/OR
A54 10 RD/GY
2
1
GLOW PLUG RELAY
3
4
K152 18 WT
K154 10 GY
K42
C2
GLOW PLUG RELAY CONTROL SENSE
ENGINE CONTROL MODULE
GLOW PLUG NO.1
GLOW PLUG NO.2
GLOW PLUG NO.3
GLOW PLUG NO.4
GLOW PLUG ASSEMBLY


BATT A16
(8W-10-18)
C2
AUTOMATIC
SHUT
DOWN
RELAY
(8W-30-19)
C8
A14
FUSE
21
20A
(8W-10-34)
A13
POWER
DISTRIBUTION
CENTER
(8W-10-6)
A142
16
DG/OR
A142
16
DG/OR
F142
16
DG/OR
S137
(8W-10-18)
S156
(8W-10-34)
A142
16
DG/OR
F142
16
DG/OR
9
10
FUEL
QUANTITY
ACTUATOR
GROUND
SHUT-OFF
FEED
FUEL
TEMPERATURE
SENSOR
SIGNAL
SENSOR
GROUND
FUEL
PUMP
MODULE
8
6
5
7
4
K140
16
TN/WT
K4
20
BK/LB
S148
S149
(8W-70-3)
K140
16
TN/WT
K140
16
TN/WT
K140
16
TN/WT
K153
16
OR
K126
16
LG
K156
20
GY
K4
20
BK/LB
A59 C1
A66 C1
A80 C1
A77 C1
A79 C1
A53 C1
A61 C1
FUEL QUANTITY ACTUATOR
GROUND
SHUT-OFF
FEED
SOLENOID
CONTROL
FUEL
TEMP.
SENSOR
SIGNAL
SENSOR
GROUND
ENGINE
CONTROL
MODULE


ST-RUN F20
(8W-12-12)
(8W-12-13)
FUEL PUMP MODULE
CONTROL SLEEVE
MEASURE COIL
POWER DISTRIBUTION CENTER
(8W-10-6)
B5
A/C COMPRESSOR CLUTCH RELAY
(8W-42-7)
B3
2
1
3
K57 20 LG/OR
K134 20 LB/BK
K135 20 WT/BK
C13 20 DB/OR
A57 C1
A56 C1
A58 C1
K5 C2
CONTROL SLEEVE POSITION SENSOR
SLEEVE POSITION SENSOR
SLEEVE POSITION SENSOR
A/C COMPRESSOR CLUTCH RELAY CONTROL
ENGINE CONTROL MODULE
SENSOR GROUND
INTAKE AIR TEMPERATURE SIGNAL
BOOST PRESSURE SIGNAL
5V SUPPLY
A61 C1
K13 C2
K40 C2
K39 C2
K4 20 BK/LB
K21 20 BK/RD
K1 20 DG/RD
K9 20 LB
2
4
3
INTAKE AIR TEMPERATURE SIGNAL
BOOST PRESSURE SIGNAL
5V SUPPLY
TURBO BOOST PRESSURE SENSOR
SENSOR GROUND
1
K4 20 BK/LB
S149
(8W-70-3)



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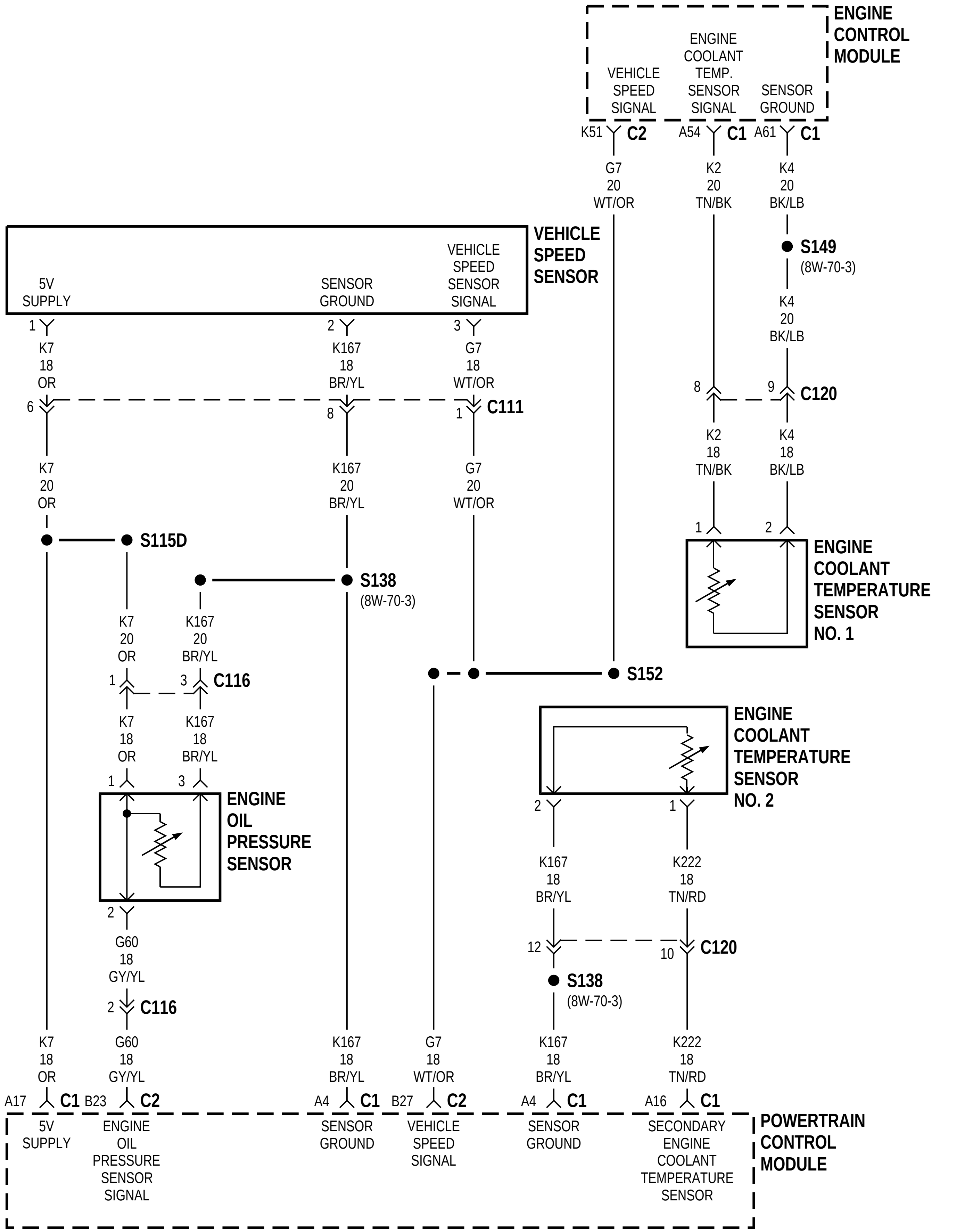
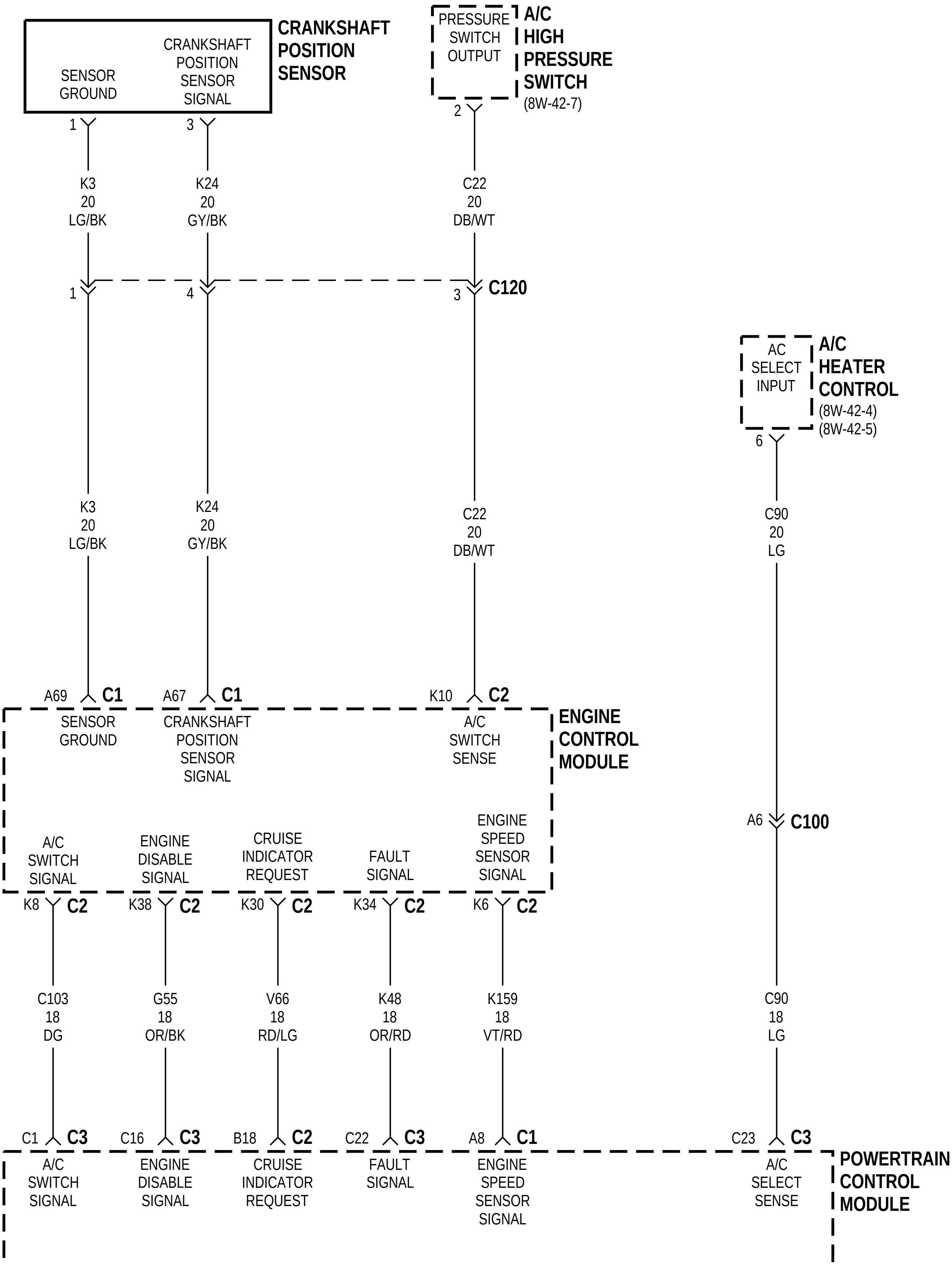
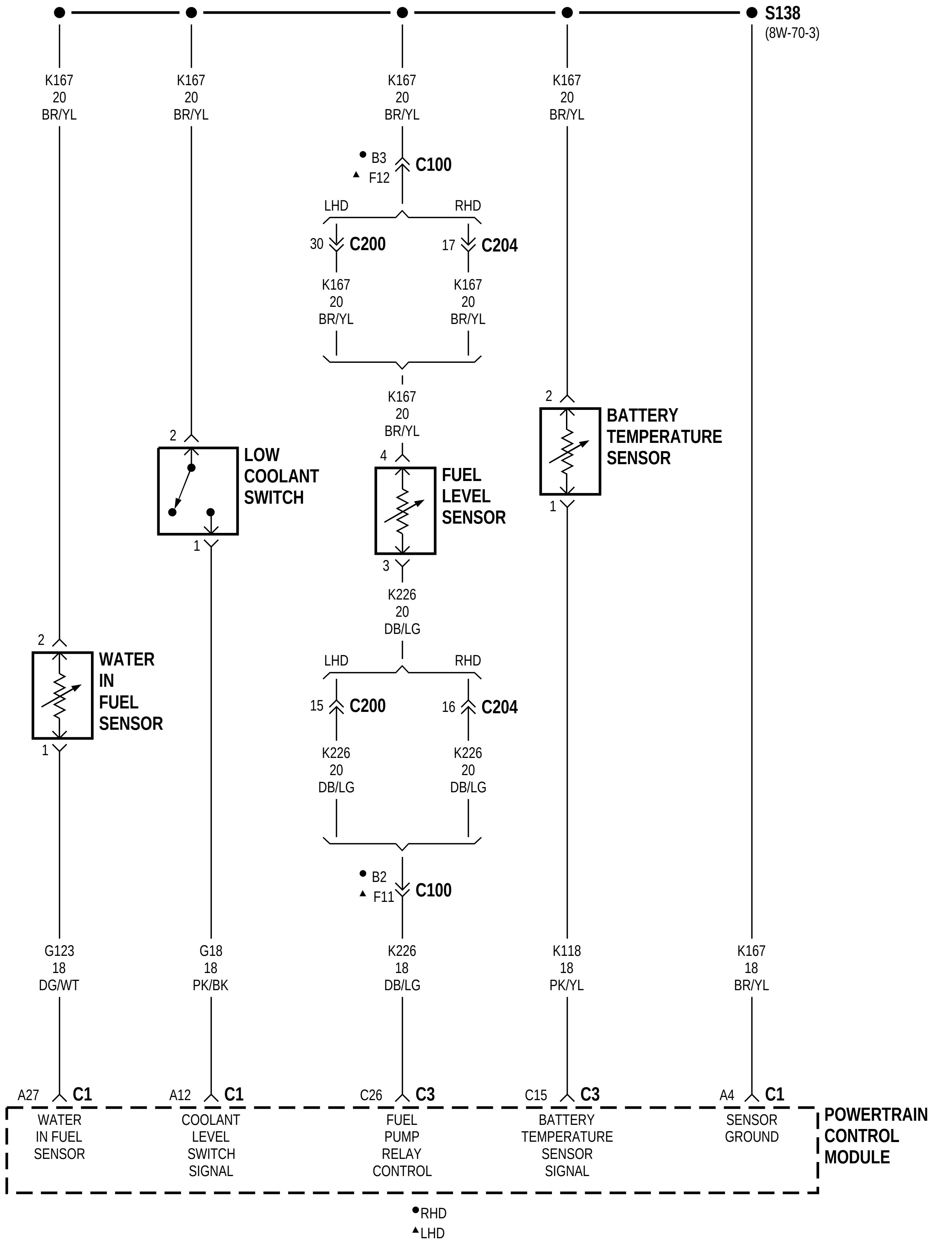
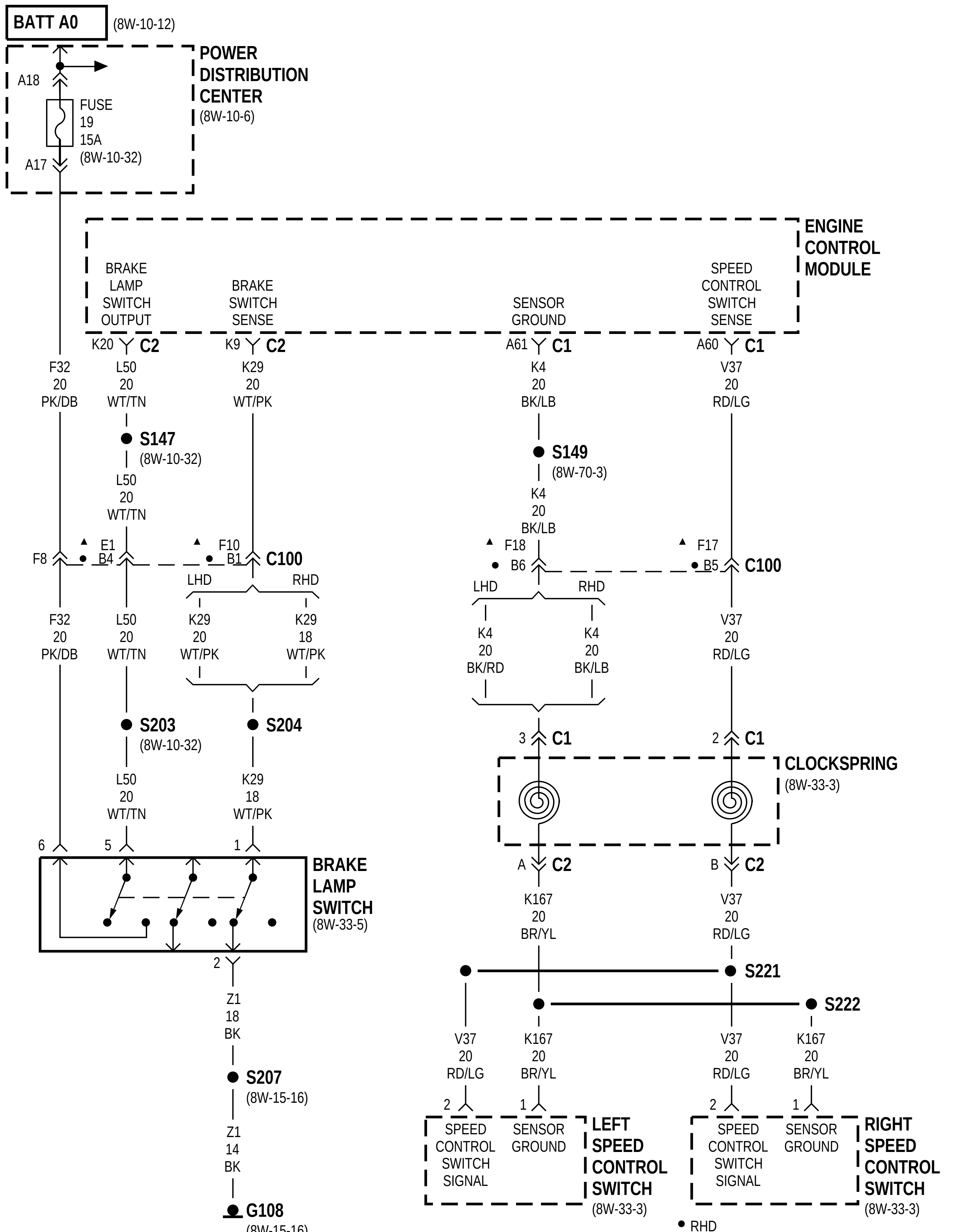
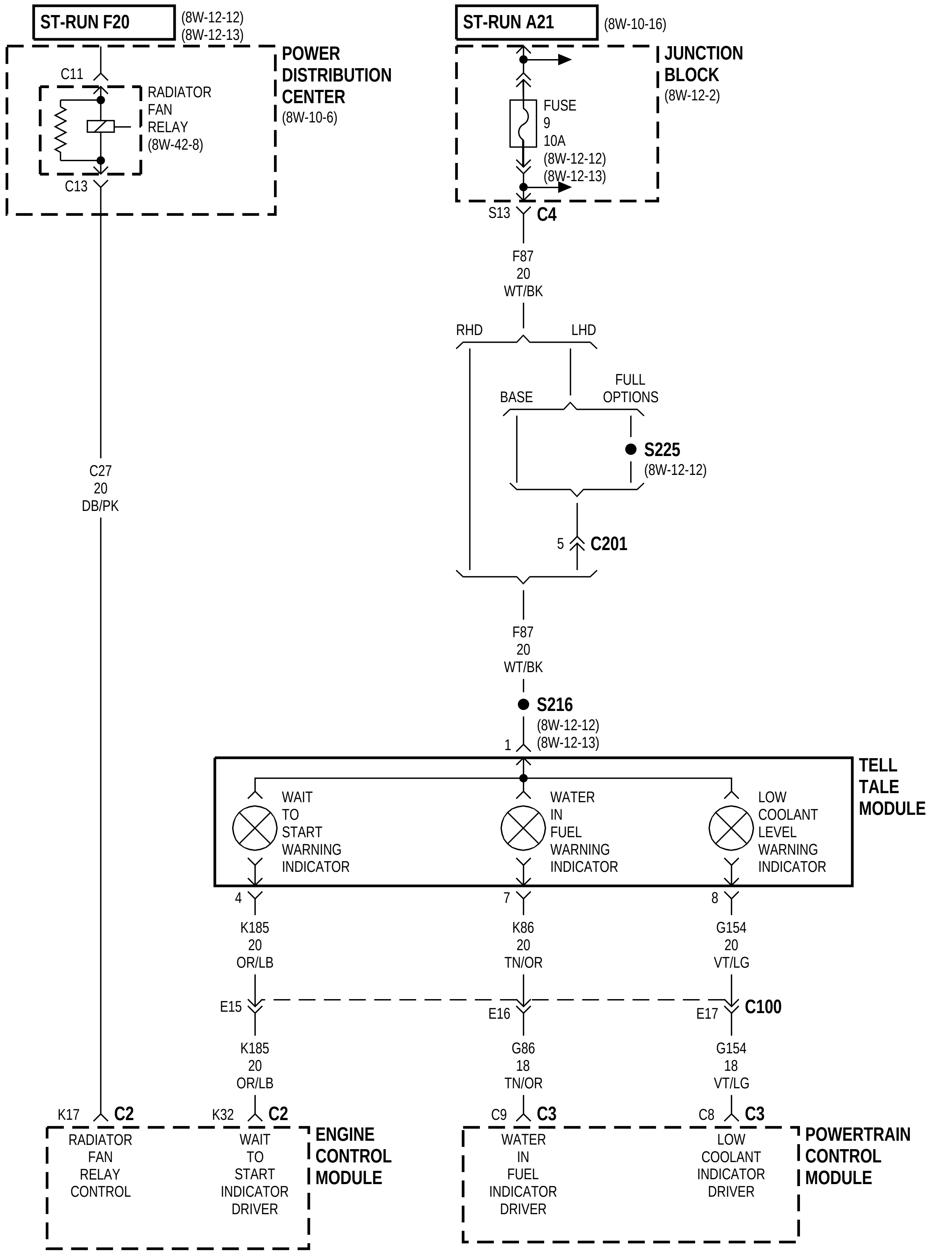

ENGINE CONTROL MODULE
VEHICLE SPEED SIGNAL
ENGINE COOLANT TEMP. SENSOR SIGNAL
SENSOR GROUND
K51 C2
A54 C1
A61 C1
G7 20 WT/OR
K2 20 TN/BK
K4 20 BK/LB
S149 (8W-70-3)
K4 20 BK/LB
VEHICLE SPEED SENSOR
5V SUPPLY
SENSOR GROUND
VEHICLE SPEED SENSOR SIGNAL
K7 18 OR
K167 18 BR/YL
G7 18 WT/OR
C111
C120
K2 18 TN/BK
K4 18 BK/LB
K7 20 OR
K167 20 BR/YL
G7 20 WT/OR
S115D
S138 (8W-70-3)
ENGINE COOLANT TEMPERATURE SENSOR NO. 1
K7 20 OR
K167 20 BR/YL
C116
S152
K7 18 OR
K167 18 BR/YL
ENGINE COOLANT TEMPERATURE SENSOR NO. 2
ENGINE OIL PRESSURE SENSOR
K167 18 BR/YL
K222 18 TN/RD
G60 18 GY/YL
C120
S138 (8W-70-3)
C116
K7 18 OR
G60 18 GY/YL
K167 18 BR/YL
G7 18 WT/OR
K167 18 BR/YL
K222 18 TN/RD
A17 C1
B23 C2
A4 C1
B27 C2
A4 C1
A16 C1
5V SUPPLY
ENGINE OIL PRESSURE SENSOR SIGNAL
SENSOR GROUND
VEHICLE SPEED SIGNAL
SENSOR GROUND
SECONDARY ENGINE COOLANT TEMPERATURE SENSOR
POWERTRAIN CONTROL MODULE

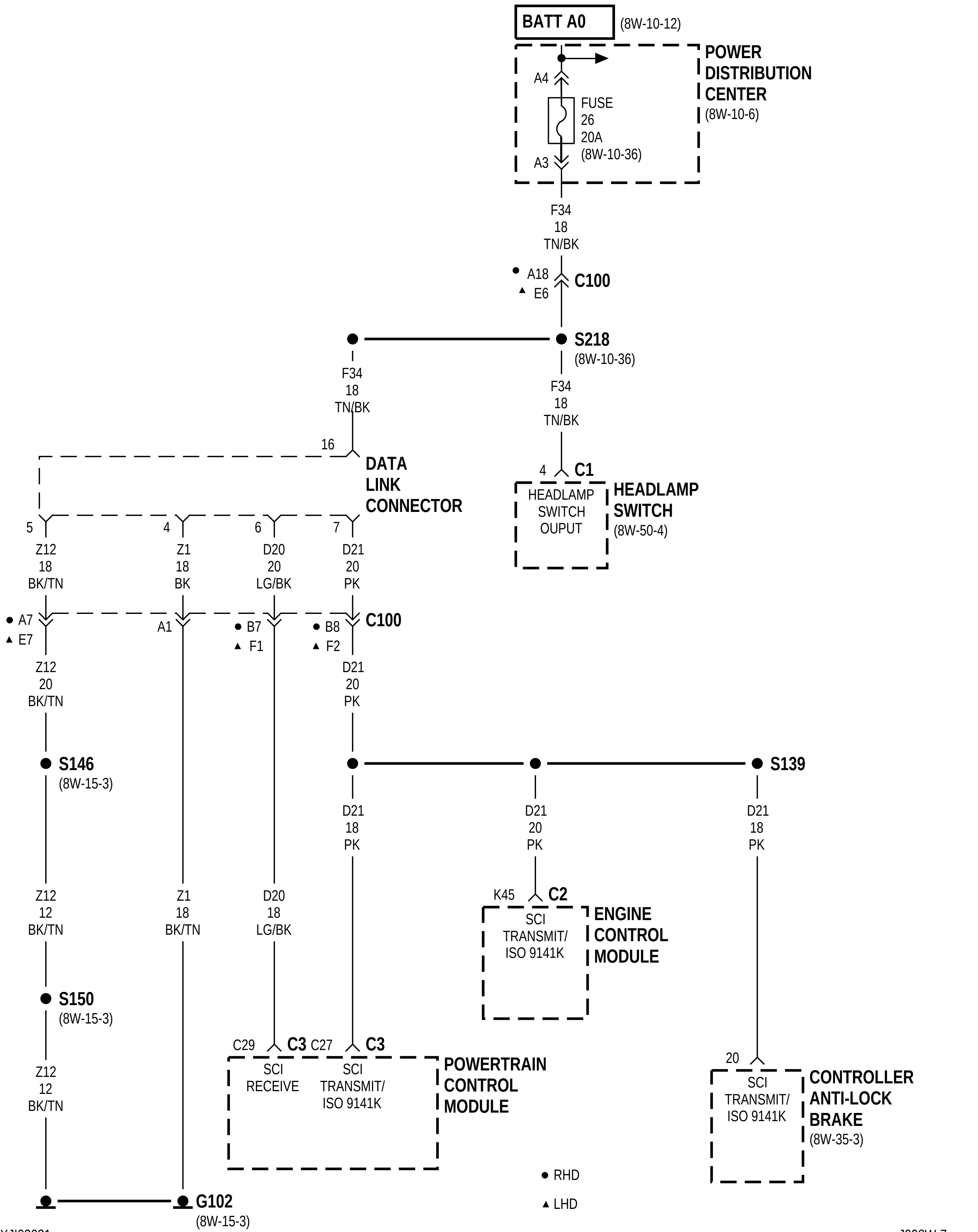

CRANKSHAFT POSITION SENSOR
SENSOR GROUND
CRANKSHAFT POSITION SENSOR SIGNAL
1
3
A/C HIGH PRESSURE SWITCH
(8W-42-7)
PRESSURE SWITCH OUTPUT
2
K3 20 LG/BK
K24 20 GY/BK
C22 20 DB/WT
1
4
3
C120
A/C HEATER CONTROL
(8W-42-4)
(8W-42-5)
AC SELECT INPUT
6
K3 20 LG/BK
K24 20 GY/BK
C22 20 DB/WT
C90 20 LG
A69 C1
A67 C1
K10 C2
ENGINE CONTROL MODULE
SENSOR GROUND
CRANKSHAFT POSITION SENSOR SIGNAL
A/C SWITCH SENSE
A6 C100
A/C SWITCH SIGNAL
ENGINE DISABLE SIGNAL
CRUISE INDICATOR REQUEST
FAULT SIGNAL
ENGINE SPEED SENSOR SIGNAL
K8 C2
K38 C2
K30 C2
K34 C2
K6 C2
C103 18 DG
G55 18 OR/BK
V66 18 RD/LG
K48 18 OR/RD
K159 18 VT/RD
C90 18 LG
C1 C3
C16 C3
B18 C2
C22 C3
A8 C1
C23 C3
POWERTRAIN CONTROL MODULE
A/C SWITCH SIGNAL
ENGINE DISABLE SIGNAL
CRUISE INDICATOR REQUEST
FAULT SIGNAL
ENGINE SPEED SENSOR SIGNAL
A/C SELECT SENSE


S138
(8W-70-3)
K167
20
BR/YL
B3
F12
C100
LHD
RHD
30
C200
17
C204
4
3
2
1
LOW
COOLANT
SWITCH
FUEL
LEVEL
SENSOR
BATTERY
TEMPERATURE
SENSOR
WATER
IN
FUEL
SENSOR
K226
20
DB/LG
15
16
B2
F11
G123
18
DG/WT
G18
18
PK/BK
K226
18
DB/LG
K118
18
PK/YL
K167
18
BR/YL
A27
C1
A12
C26
C3
C15
A4
WATER
IN FUEL
SENSOR
COOLANT
LEVEL
SWITCH
SIGNAL
FUEL
PUMP
RELAY
CONTROL
BATTERY
TEMPERATURE
SENSOR
SIGNAL
SENSOR
GROUND
POWERTRAIN
CONTROL
MODULE
RHD
LHD

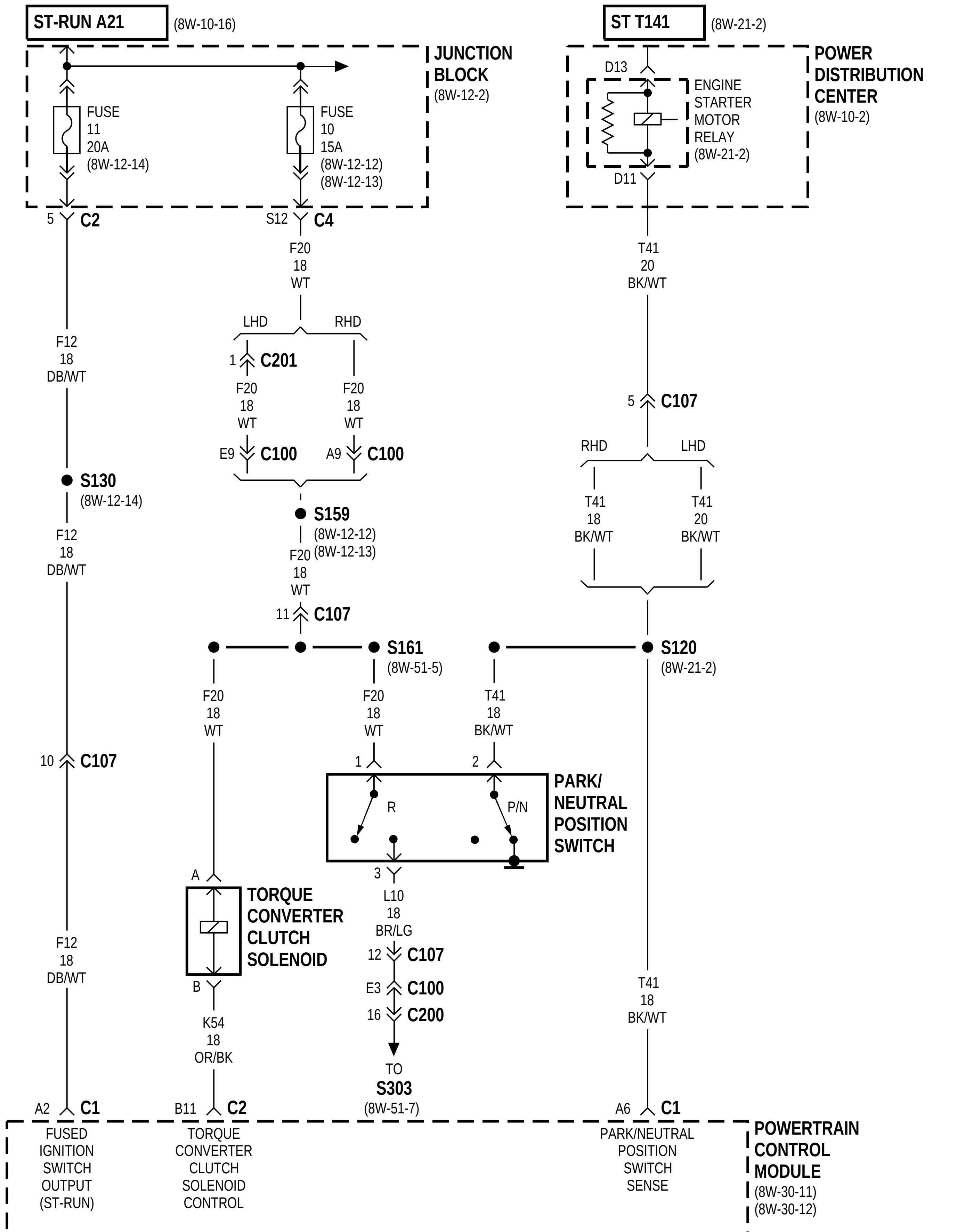

BATT A0
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-6)
A18
FUSE 19 15A
(8W-10-32)
A17
ENGINE CONTROL MODULE
BRAKE LAMP SWITCH OUTPUT
BRAKE SWITCH SENSE
SENSOR GROUND
SPEED CONTROL SWITCH SENSE
K20 C2
K9 C2
A61 C1
A60 C1
F32 20 PK/DB
L50 20 WT/TN
K29 20 WT/PK
K4 20 BK/LB
V37 20 RD/LG
S147
(8W-10-32)
L50 20 WT/TN
S149
(8W-70-3)
K4 20 BK/LB
F8
E1
B4
F10
B1
C100
F18
B6
F17
B5
C100
LHD
RHD
LHD
RHD
F32 20 PK/DB
L50 20 WT/TN
K29 20 WT/PK
K29 18 WT/PK
K4 20 BK/RD
K4 20 BK/LB
V37 20 RD/LG
S203
(8W-10-32)
S204
3 C1
2 C1
CLOCKSPRING
(8W-33-3)
L50 20 WT/TN
K29 18 WT/PK
6
5
1
BRAKE LAMP SWITCH
(8W-33-5)
A C2
B C2
K167 20 BR/YL
V37 20 RD/LG
2
S221
S222
Z1 18 BK
S207
(8W-15-16)
Z1 14 BK
G108
(8W-15-16)
V37 20 RD/LG
K167 20 BR/YL
V37 20 RD/LG
K167 20 BR/YL
2
1
2
1
SPEED CONTROL SWITCH SIGNAL
SENSOR GROUND
LEFT SPEED CONTROL SWITCH
(8W-33-3)
SPEED CONTROL SWITCH SIGNAL
SENSOR GROUND
RIGHT SPEED CONTROL SWITCH
(8W-33-3)
● RHD
▲ LHD

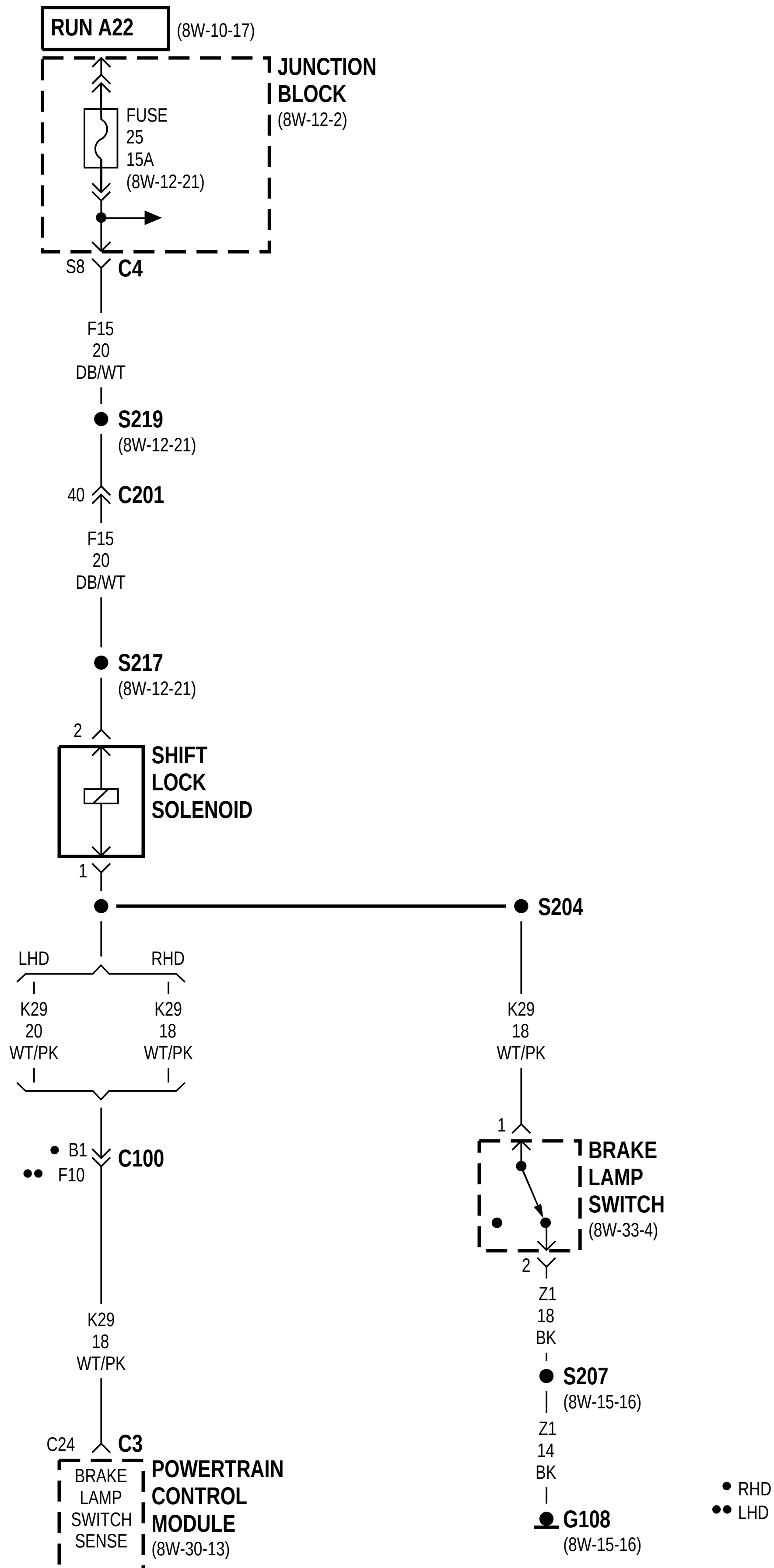


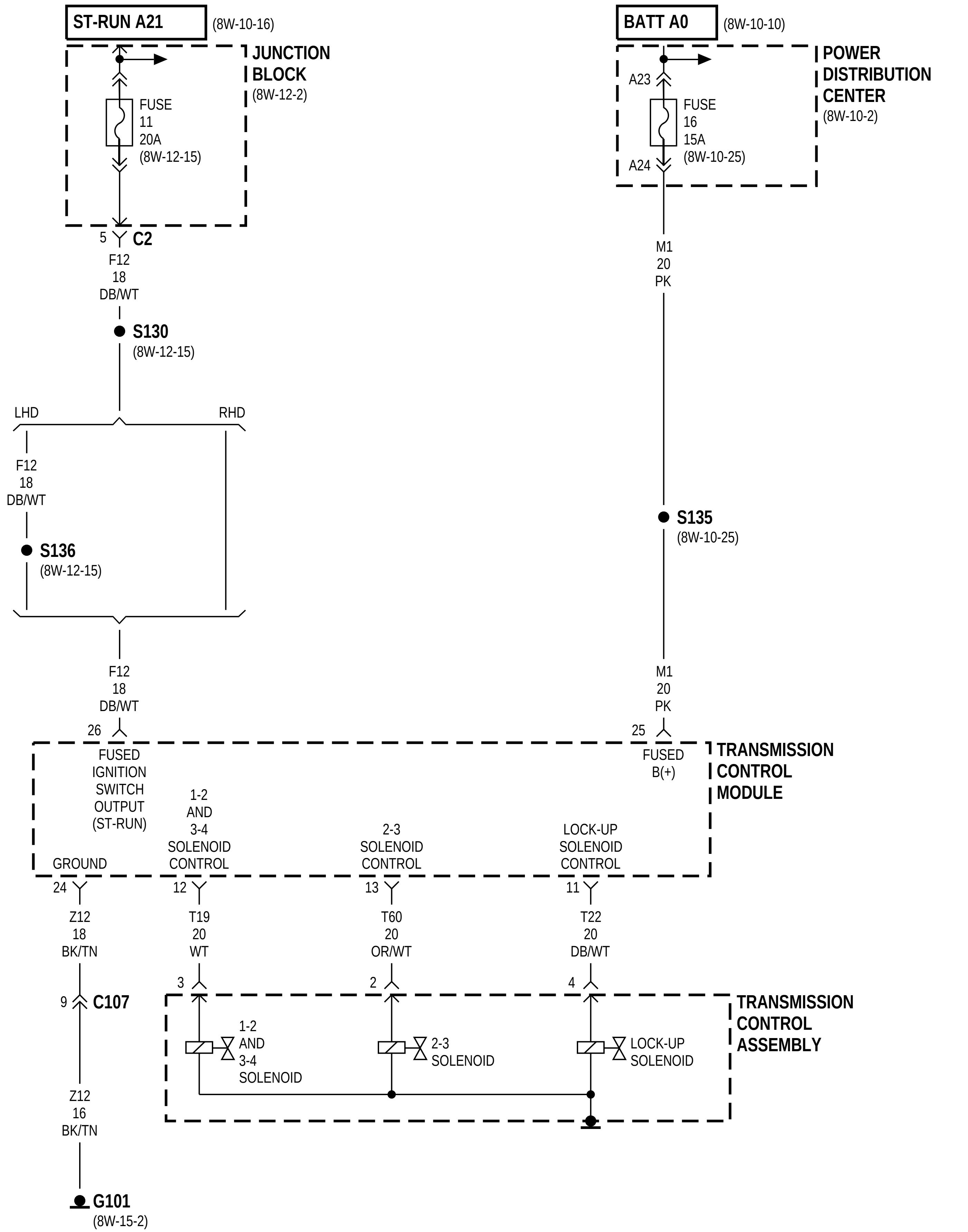
ST-RUN F20
(8W-12-12)
(8W-12-13)
POWER DISTRIBUTION CENTER
(8W-10-6)
C11
RADIATOR FAN RELAY
(8W-42-8)
C13
C27
20
DB/PK
ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE
9
10A
(8W-12-12)
(8W-12-13)
S13
C4
F87
20
WT/BK
RHD
LHD
BASE
FULL OPTIONS
S225
(8W-12-12)
5
C201
F87
20
WT/BK
S216
(8W-12-12)
(8W-12-13)
1
TELL TALE MODULE
WAIT TO START WARNING INDICATOR
WATER IN FUEL WARNING INDICATOR
LOW COOLANT LEVEL WARNING INDICATOR
4
7
8
K185
20
OR/LB
K86
20
TN/OR
G154
20
VT/LG
E15
E16
E17
C100
K185
20
OR/LB
G86
18
TN/OR
G154
18
VT/LG
K17
C2
K32
C2
C9
C3
C8
C3
RADIATOR FAN RELAY CONTROL
WAIT TO START INDICATOR DRIVER
ENGINE CONTROL MODULE
WATER IN FUEL INDICATOR DRIVER
LOW COOLANT INDICATOR DRIVER
POWERTRAIN CONTROL MODULE


BATT A0
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-6)
A4
FUSE
26
20A
(8W-10-36)
A3
F34
18
TN/BK
A18
E6
C100
S218
(8W-10-36)
F34
18
TN/BK
F34
18
TN/BK
16
DATA LINK CONNECTOR
4
C1
HEADLAMP SWITCH OUPUT
HEADLAMP SWITCH
(8W-50-4)
5
4
6
7
Z12
18
BK/TN
Z1
18
BK
D20
20
LG/BK
D21
20
PK
A7
E7
A1
B7
F1
B8
F2
C100
Z12
20
BK/TN
D21
20
PK
S146
(8W-15-3)
S139
D21
18
PK
D21
20
PK
D21
18
PK
Z12
12
BK/TN
Z1
18
BK/TN
D20
18
LG/BK
K45
C2
SCI TRANSMIT/ ISO 9141K
ENGINE CONTROL MODULE
S150
(8W-15-3)
C29
C3
C27
C3
SCI RECEIVE
SCI TRANSMIT/ ISO 9141K
POWERTRAIN CONTROL MODULE
20
SCI TRANSMIT/ ISO 9141K
CONTROLLER ANTI-LOCK BRAKE
(8W-35-3)
Z12
12
BK/TN
RHD
LHD
G102
(8W-15-3)

8W-31 TRANSMISSION CONTROL SYSTEM


ST-RUN A21
(8W-10-16)
ST T141
(8W-21-2)
JUNCTION BLOCK
(8W-12-2)
FUSE
11
20A
(8W-12-14)
FUSE
10
15A
(8W-12-12)
(8W-12-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
D13
ENGINE STARTER MOTOR RELAY
(8W-21-2)
D11
5 C2
S12 C4
F20
18
WT
T41
20
BK/WT
LHD
RHD
1 C201
F20
18
WT
F20
18
WT
E9 C100
A9 C100
F12
18
DB/WT
S130
(8W-12-14)
F12
18
DB/WT
S159
(8W-12-12)
(8W-12-13)
F20
18
WT
11 C107
5 C107
RHD
LHD
T41
18
BK/WT
T41
20
BK/WT
S161
(8W-51-5)
S120
(8W-21-2)
F20
18
WT
F20
18
WT
T41
18
BK/WT
10 C107
1
2
R
P/N
PARK/ NEUTRAL POSITION SWITCH
3
L10
18
BR/LG
12 C107
E3 C100
16 C200
TO
S303
(8W-51-7)
A
TORQUE CONVERTER CLUTCH SOLENOID
B
K54
18
OR/BK
F12
18
DB/WT
T41
18
BK/WT
A2 C1
B11 C2
A6 C1
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
TORQUE CONVERTER CLUTCH SOLENOID CONTROL
PARK/NEUTRAL POSITION SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-11)
(8W-30-12)

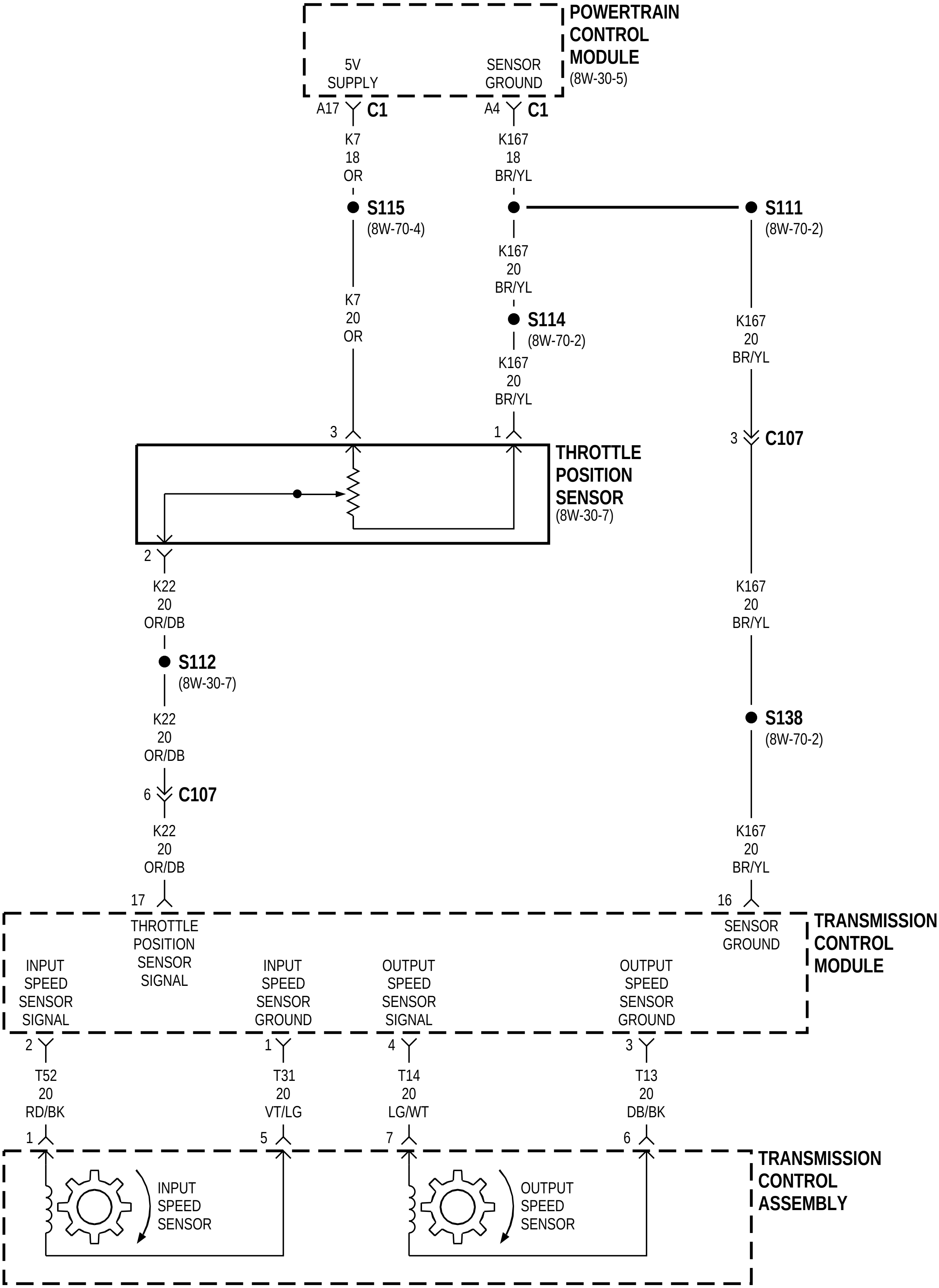

RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE
25
15A
(8W-12-21)
S8
C4
F15
20
DB/WT
S219
(8W-12-21)
40
C201
F15
20
DB/WT
S217
(8W-12-21)
2
SHIFT LOCK SOLENOID
1
S204
LHD
RHD
K29
20
WT/PK
K29
18
WT/PK
K29
18
WT/PK
1
BRAKE LAMP SWITCH
(8W-33-4)
2
• B1
•• F10
C100
Z1
18
BK
S207
(8W-15-16)
K29
18
WT/PK
Z1
14
BK
C24
C3
BRAKE LAMP SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-13)
G108
(8W-15-16)
• RHD
•• LHD



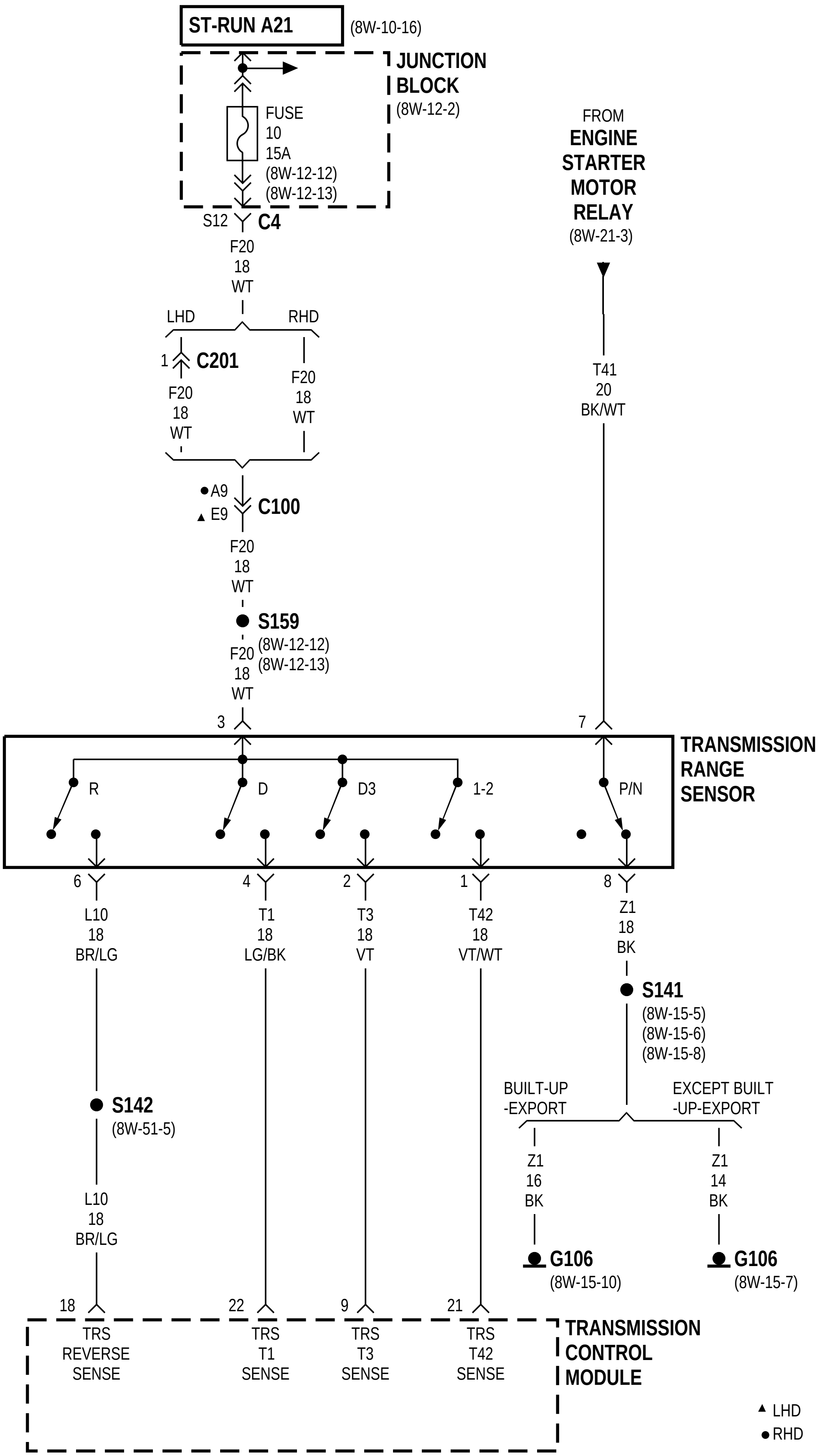
J998W-7

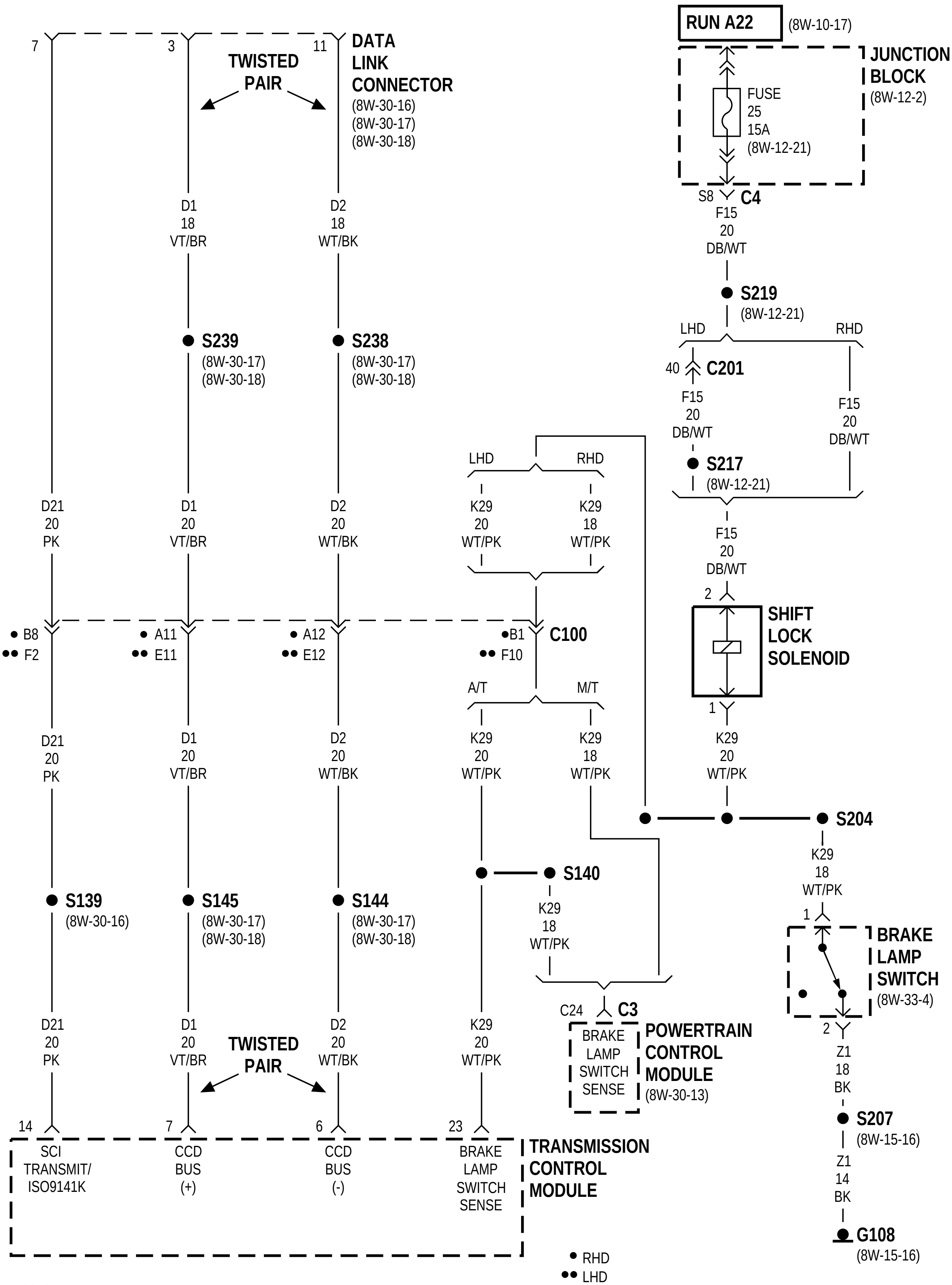
XJI03104

4.0L


POWERTRAIN CONTROL MODULE
(8W-30-5)
5V SUPPLY
SENSOR GROUND
A17 C1
A4 C1
K7 18 OR
K167 18 BR/YL
S115
(8W-70-4)
S111
(8W-70-2)
K167 20 BR/YL
S114
(8W-70-2)
K7 20 OR
K167 20 BR/YL
K167 20 BR/YL
3
1
3 C107
THROTTLE POSITION SENSOR
(8W-30-7)
2
K22 20 OR/DB
K167 20 BR/YL
S112
(8W-30-7)
S138
(8W-70-2)
K22 20 OR/DB
6 C107
K22 20 OR/DB
K167 20 BR/YL
17
16
THROTTLE POSITION SENSOR SIGNAL
SENSOR GROUND
TRANSMISSION CONTROL MODULE
INPUT SPEED SENSOR SIGNAL
INPUT SPEED SENSOR GROUND
OUTPUT SPEED SENSOR SIGNAL
OUTPUT SPEED SENSOR GROUND
2
1
4
3
T52 20 RD/BK
T31 20 VT/LG
T14 20 LG/WT
T13 20 DB/BK
1
5
7
6
INPUT SPEED SENSOR
OUTPUT SPEED SENSOR
TRANSMISSION CONTROL ASSEMBLY

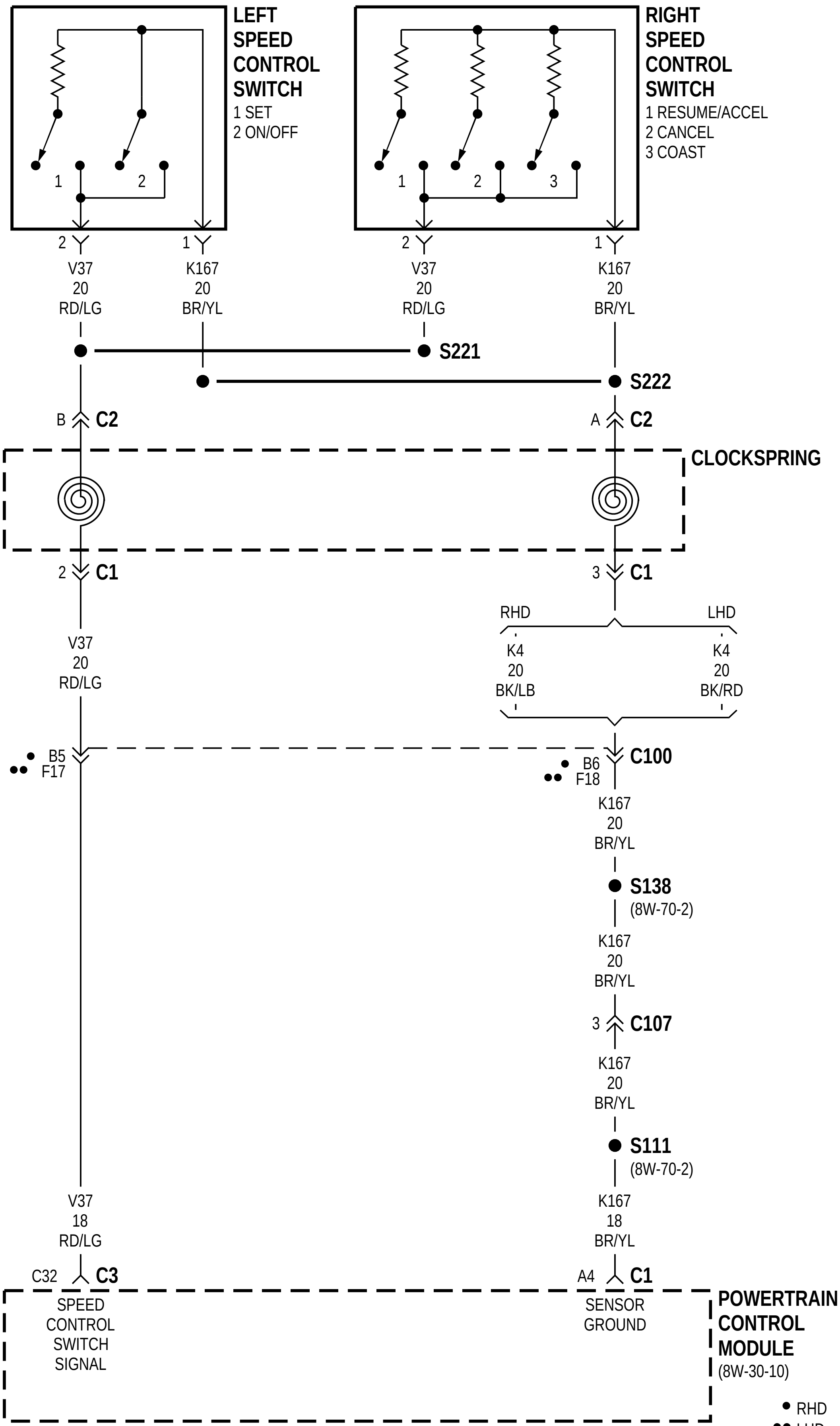
4.0L

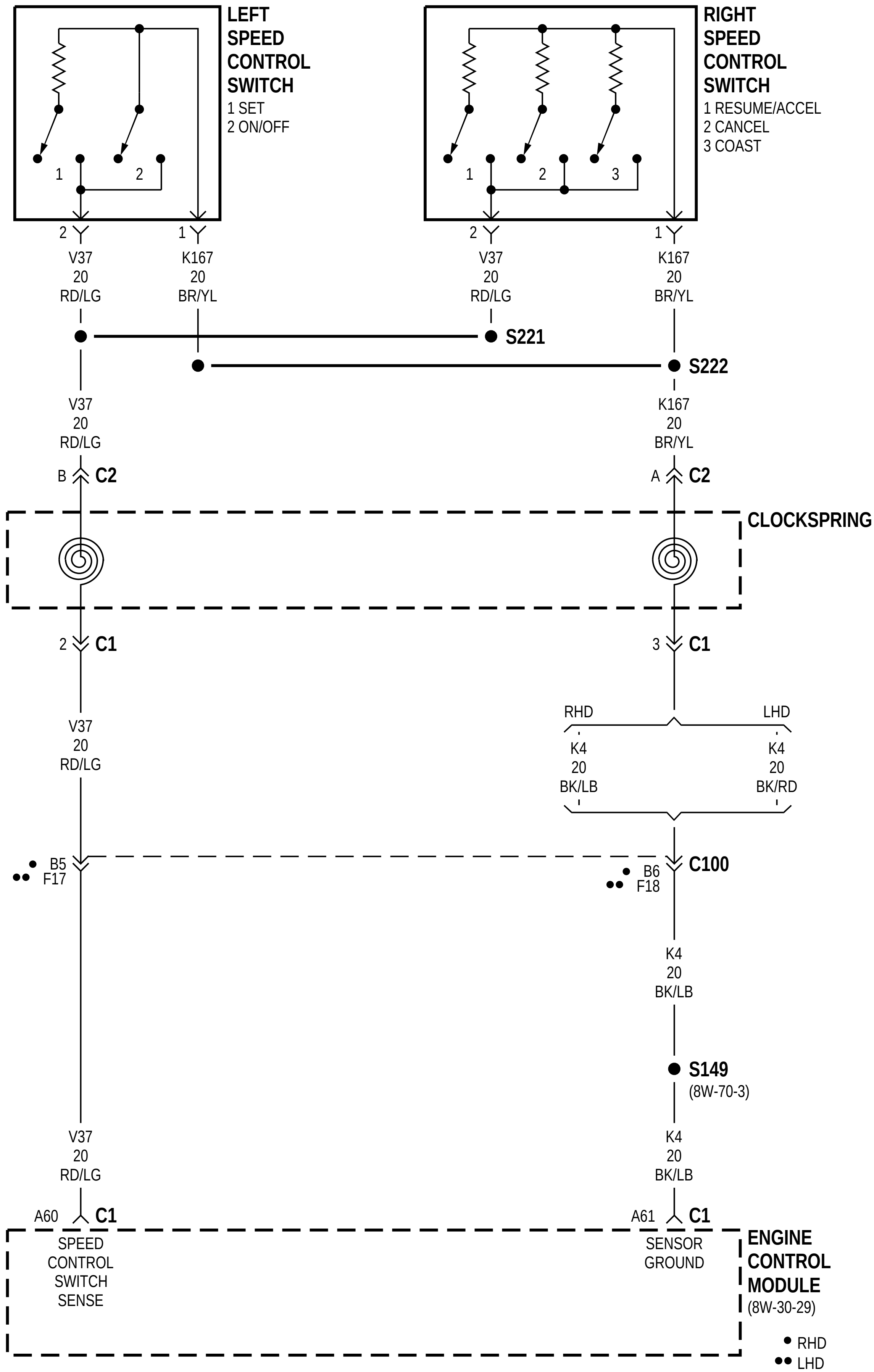

ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE
10
15A
(8W-12-12)
(8W-12-13)
S12
C4
F20
18
WT
LHD
RHD
1
C201
F20
18
WT
F20
18
WT
A9
E9
C100
F20
18
WT
S159
(8W-12-12)
(8W-12-13)
F20
18
WT
FROM
ENGINE STARTER MOTOR RELAY
(8W-21-3)
T41
20
BK/WT
3
7
TRANSMISSION RANGE SENSOR
R
D
D3
1-2
P/N
6
4
2
1
8
L10
18
BR/LG
T1
18
LG/BK
T3
18
VT
T42
18
VT/WT
Z1
18
BK
S141
(8W-15-5)
(8W-15-6)
(8W-15-8)
S142
(8W-51-5)
L10
18
BR/LG
BUILT-UP -EXPORT
EXCEPT BUILT -UP-EXPORT
Z1
16
BK
Z1
14
BK
G106
(8W-15-10)
G106
(8W-15-7)
18
22
9
21
TRS REVERSE SENSE
TRS T1 SENSE
TRS T3 SENSE
TRS T42 SENSE
TRANSMISSION CONTROL MODULE
▲ LHD
● RHD

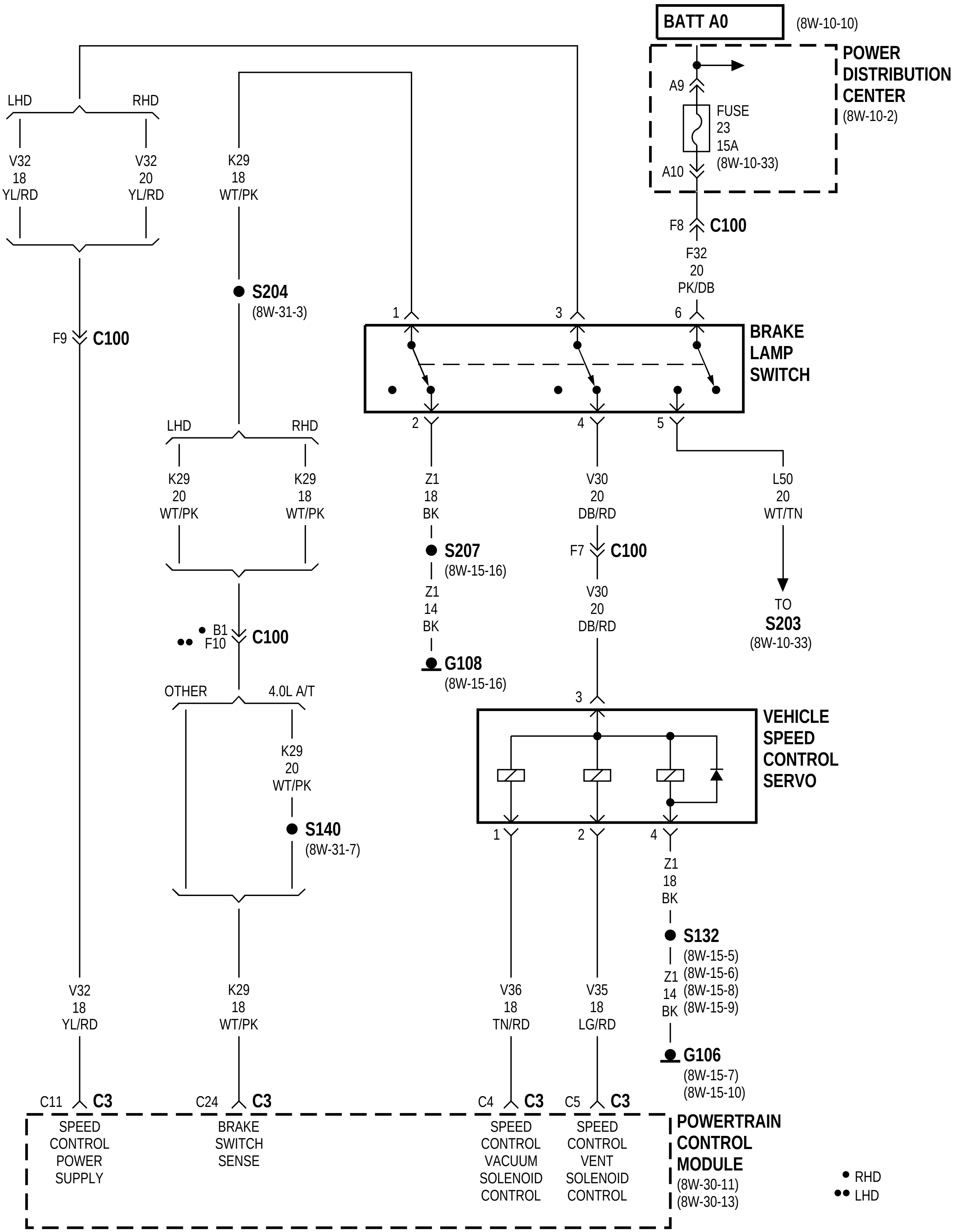

RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE
25
15A
(8W-12-21)
S8
C4
F15
20
DB/WT
S219
(8W-12-21)
LHD
RHD
40
C201
F15
20
DB/WT
S217
(8W-12-21)
F15
20
DB/WT
2
SHIFT LOCK SOLENOID
1
K29
20
WT/PK
S204
K29
18
WT/PK
1
BRAKE LAMP SWITCH
(8W-33-4)
2
Z1
18
BK
S207
(8W-15-16)
Z1
14
BK
G108
(8W-15-16)
7
3
11
DATA LINK CONNECTOR
(8W-30-16)
(8W-30-17)
(8W-30-18)
TWISTED PAIR
D1
18
VT/BR
D2
18
WT/BK
S239
(8W-30-17)
(8W-30-18)
S238
(8W-30-17)
(8W-30-18)
D21
20
PK
D1
20
VT/BR
D2
20
WT/BK
LHD
RHD
K29
20
WT/PK
K29
18
WT/PK
B8
F2
A11
E11
A12
E12
B1
F10
C100
A/T
M/T
S139
(8W-30-16)
S145
(8W-30-17)
(8W-30-18)
S144
(8W-30-17)
(8W-30-18)
S140
C24
C3
BRAKE LAMP SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-13)
14
7
6
23
SCI TRANSMIT/ ISO9141K
CCD BUS (+)
CCD BUS (-)
BRAKE LAMP SWITCH SENSE
TRANSMISSION CONTROL MODULE
• RHD
•• LHD

8W-33 VEHICLE SPEED CONTROL

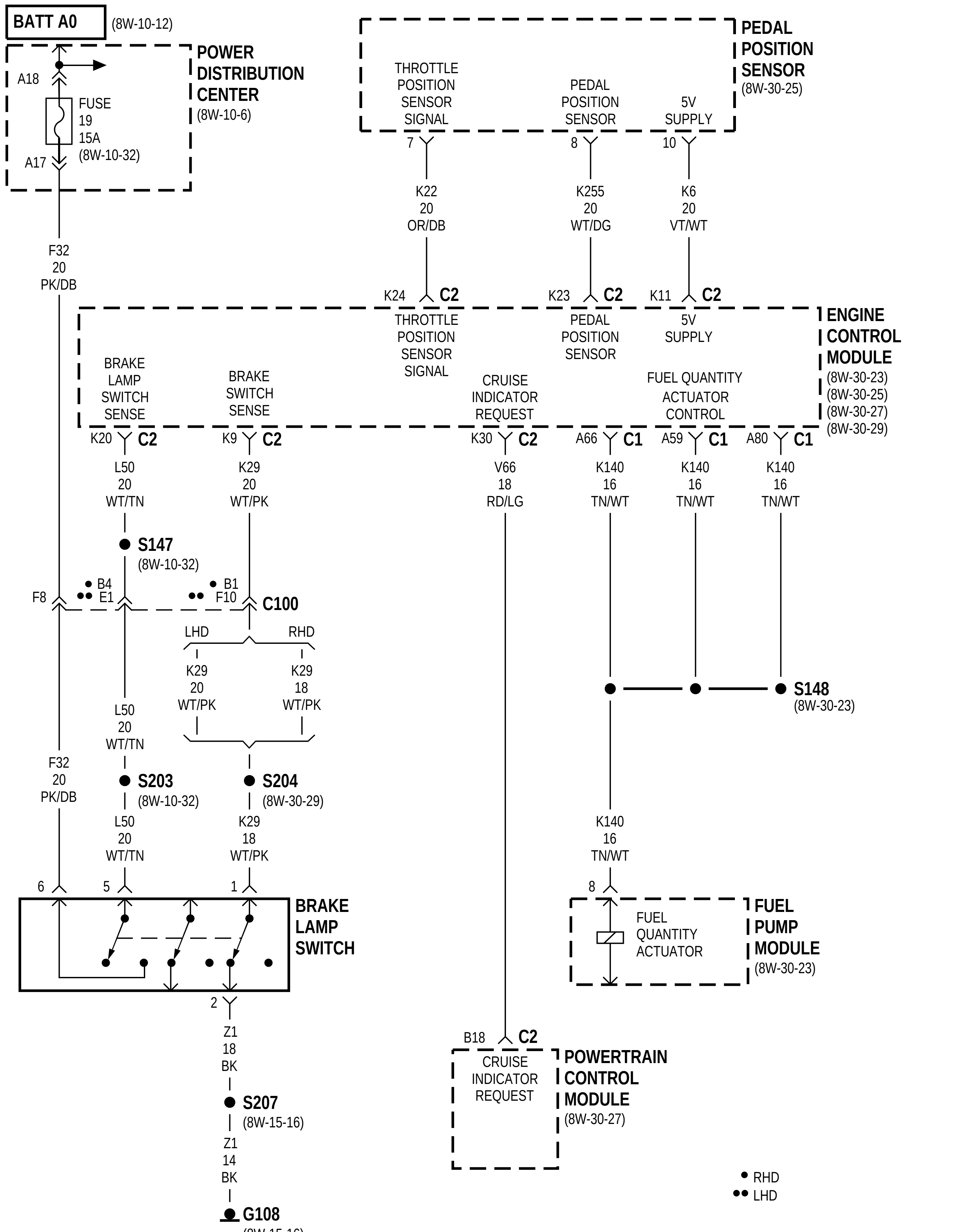
GAS


LEFT
SPEED
CONTROL
SWITCH
1 SET
2 ON/OFF
RIGHT
SPEED
CONTROL
SWITCH
1 RESUME/ACCEL
2 CANCEL
3 COAST
V37
20
RD/LG
K167
20
BR/YL
S221
S222
B C2
A C2
CLOCKSPRING
2 C1
3 C1
RHD
LHD
K4
20
BK/LB
K4
20
BK/RD
B5
F17
B6
F18
C100
S138
(8W-70-2)
3 C107
S111
(8W-70-2)
V37
18
RD/LG
K167
18
BR/YL
C32 C3
A4 C1
SPEED
CONTROL
SWITCH
SIGNAL
SENSOR
GROUND
POWERTRAIN
CONTROL
MODULE
(8W-30-10)
• RHD
•• LHD

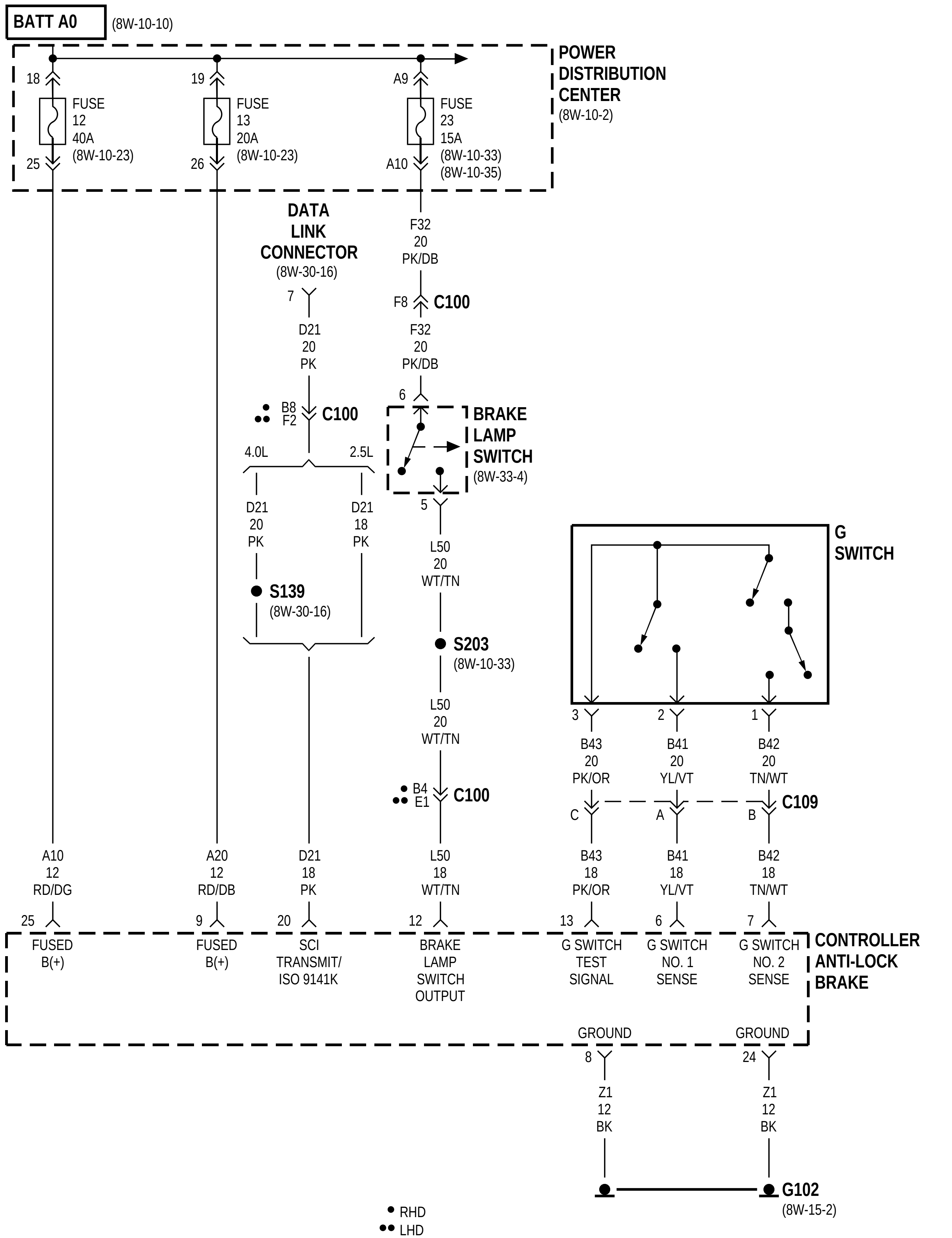

LEFT SPEED CONTROL SWITCH
1 SET
2 ON/OFF
RIGHT SPEED CONTROL SWITCH
1 RESUME/ACCEL
2 CANCEL
3 COAST
1
2
3
V37 20 RD/LG
K167 20 BR/YL
S221
S222
B
A
C2
CLOCKSPRING
C1
RHD
LHD
K4 20 BK/LB
K4 20 BK/RD
B5 F17
B6 F18
C100
S149 (8W-70-3)
A60
A61
SPEED CONTROL SWITCH SENSE
SENSOR GROUND
ENGINE CONTROL MODULE (8W-30-29)
• RHD
•• LHD

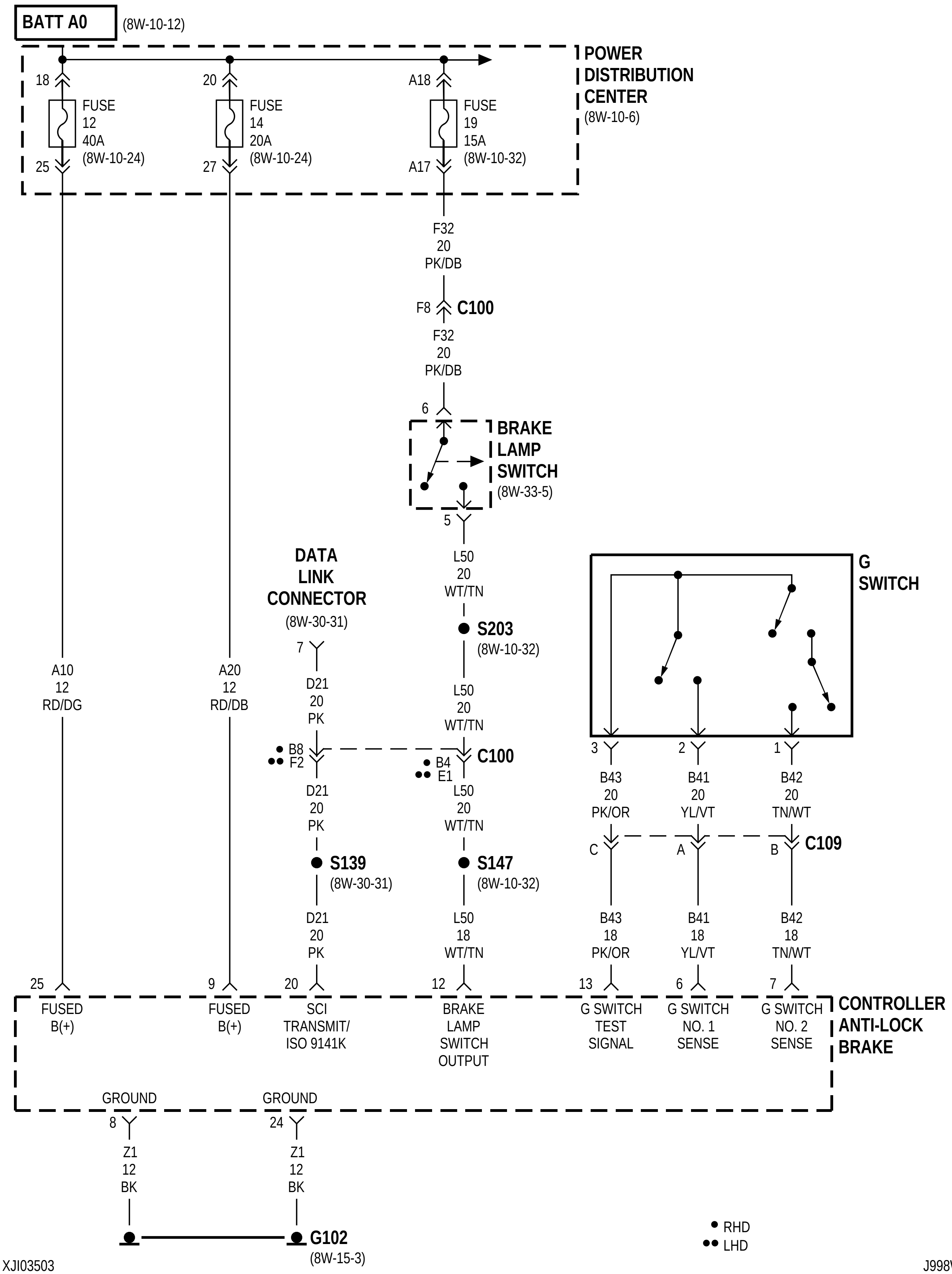

BATT A0
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
A9
FUSE 23 15A (8W-10-33)
A10
F8 C100
F32 20 PK/DB
LHD
RHD
V32 18 YL/RD
V32 20 YL/RD
K29 18 WT/PK
S204 (8W-31-3)
F9 C100
1
3
6
BRAKE LAMP SWITCH
2
4
5
LHD
RHD
K29 20 WT/PK
K29 18 WT/PK
Z1 18 BK
V30 20 DB/RD
L50 20 WT/TN
S207 (8W-15-16)
F7 C100
Z1 14 BK
V30 20 DB/RD
TO S203 (8W-10-33)
B1
F10
C100
G108 (8W-15-16)
OTHER
4.0L A/T
K29 20 WT/PK
3
VEHICLE SPEED CONTROL SERVO
S140 (8W-31-7)
1
2
4
Z1 18 BK
S132 (8W-15-5) (8W-15-6) (8W-15-8) (8W-15-9)
Z1 14 BK
V32 18 YL/RD
K29 18 WT/PK
V36 18 TN/RD
V35 18 LG/RD
G106 (8W-15-7) (8W-15-10)
C11 C3
C24 C3
C4 C3
C5 C3
SPEED CONTROL POWER SUPPLY
BRAKE SWITCH SENSE
SPEED CONTROL VACUUM SOLENOID CONTROL
SPEED CONTROL VENT SOLENOID CONTROL
POWERTRAIN CONTROL MODULE
(8W-30-11)
(8W-30-13)
• RHD
•• LHD

DIESEL

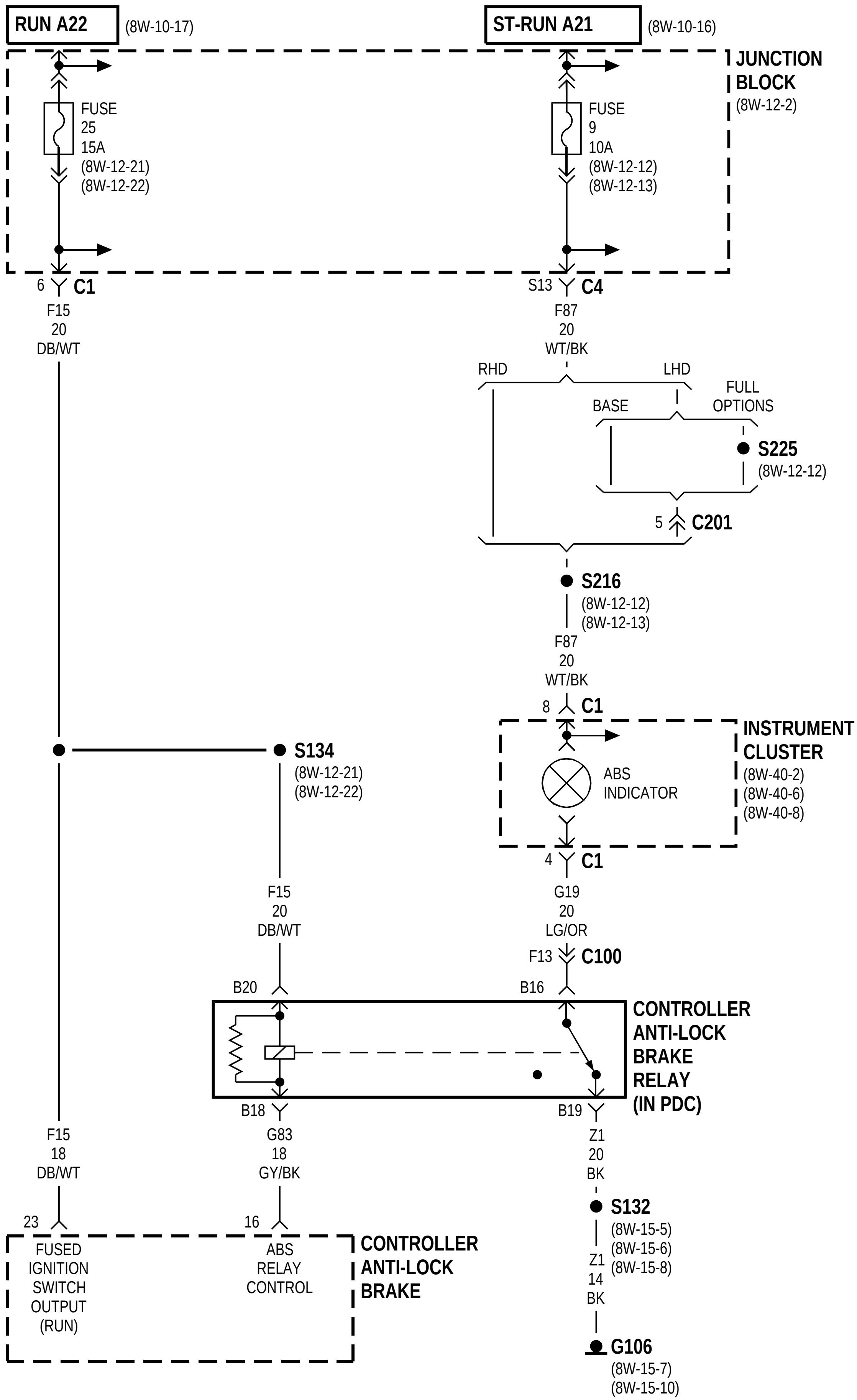

BATT A0
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-6)
A18
FUSE
19
15A
(8W-10-32)
A17
F32
20
PK/DB
PEDAL POSITION SENSOR
(8W-30-25)
THROTTLE POSITION SENSOR SIGNAL
PEDAL POSITION SENSOR
5V SUPPLY
7
8
10
K22
20
OR/DB
K255
20
WT/DG
K6
20
VT/WT
K24 C2
K23 C2
K11 C2
ENGINE CONTROL MODULE
(8W-30-23)
(8W-30-25)
(8W-30-27)
(8W-30-29)
THROTTLE POSITION SENSOR SIGNAL
PEDAL POSITION SENSOR
5V SUPPLY
BRAKE LAMP SWITCH SENSE
BRAKE SWITCH SENSE
CRUISE INDICATOR REQUEST
FUEL QUANTITY ACTUATOR CONTROL
K20 C2
K9 C2
K30 C2
A66 C1
A59 C1
A80 C1
L50
20
WT/TN
K29
20
WT/PK
V66
18
RD/LG
K140
16
TN/WT
S147
(8W-10-32)
F8
B4
E1
B1
F10
C100
LHD
RHD
K29
20
WT/PK
K29
18
WT/PK
S148
(8W-30-23)
L50
20
WT/TN
F32
20
PK/DB
S203
(8W-10-32)
S204
(8W-30-29)
L50
20
WT/TN
K29
18
WT/PK
K140
16
TN/WT
6
5
1
8
BRAKE LAMP SWITCH
FUEL PUMP MODULE
(8W-30-23)
FUEL QUANTITY ACTUATOR
2
Z1
18
BK
S207
(8W-15-16)
Z1
14
BK
G108
(8W-15-16)
B18 C2
POWERTRAIN CONTROL MODULE
(8W-30-27)
CRUISE INDICATOR REQUEST
• RHD
•• LHD

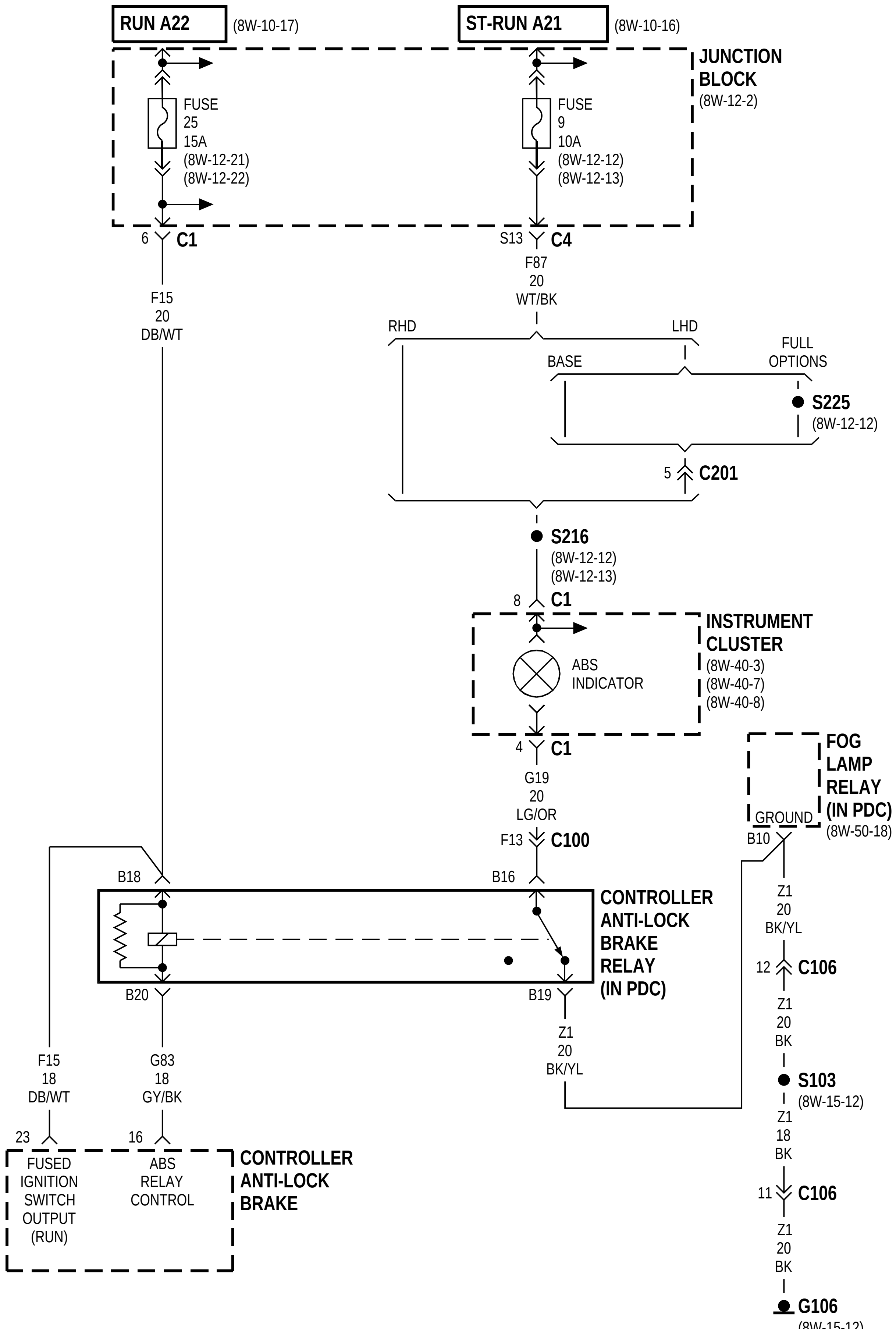
8W-35 ANTI-LOCK BRAKES

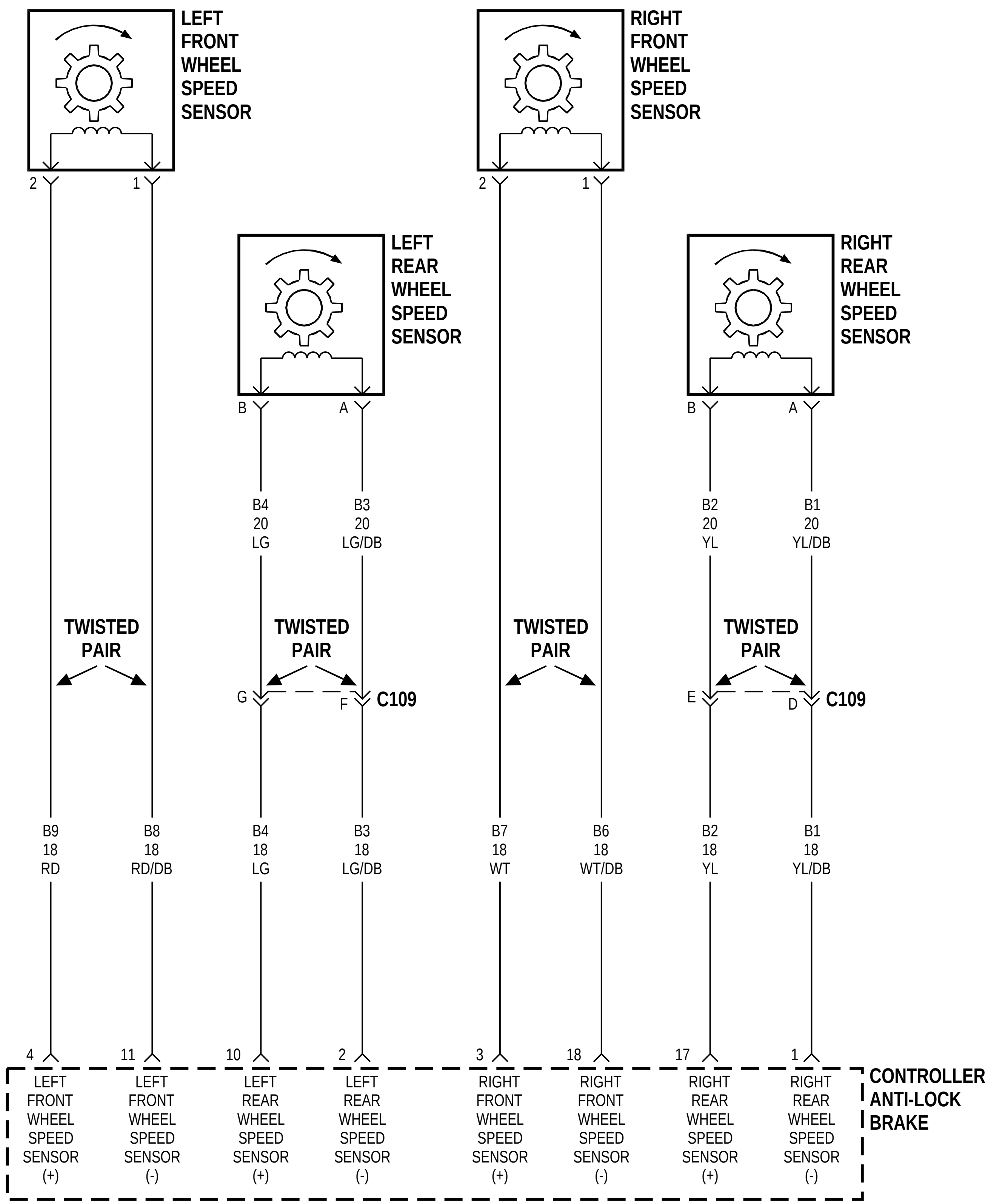

BATT A0
(8W-10-10)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
18
FUSE
12
40A
(8W-10-23)
25
19
FUSE
13
20A
(8W-10-23)
26
A9
FUSE
23
15A
(8W-10-33)
(8W-10-35)
A10
DATA
LINK
CONNECTOR
(8W-30-16)
7
D21
20
PK
B8
F2
C100
4.0L
2.5L
D21
20
PK
D21
18
PK
S139
(8W-30-16)
F32
20
PK/DB
F8
C100
F32
20
PK/DB
6
BRAKE
LAMP
SWITCH
(8W-33-4)
5
L50
20
WT/TN
S203
(8W-10-33)
L50
20
WT/TN
B4
E1
C100
G
SWITCH
3
2
1
B43
20
PK/OR
B41
20
YL/VT
B42
20
TN/WT
C
A
B
C109
A10
12
RD/DG
A20
12
RD/DB
D21
18
PK
L50
18
WT/TN
B43
18
PK/OR
B41
18
YL/VT
B42
18
TN/WT
25
9
20
12
13
6
7
FUSED
B(+)
FUSED
B(+)
SCI
TRANSMIT/
ISO 9141K
BRAKE
LAMP
SWITCH
OUTPUT
G SWITCH
TEST
SIGNAL
G SWITCH
NO. 1
SENSE
G SWITCH
NO. 2
SENSE
CONTROLLER
ANTI-LOCK
BRAKE
GROUND
GROUND
8
24
Z1
12
BK
Z1
12
BK
G102
(8W-15-2)
RHD
LHD



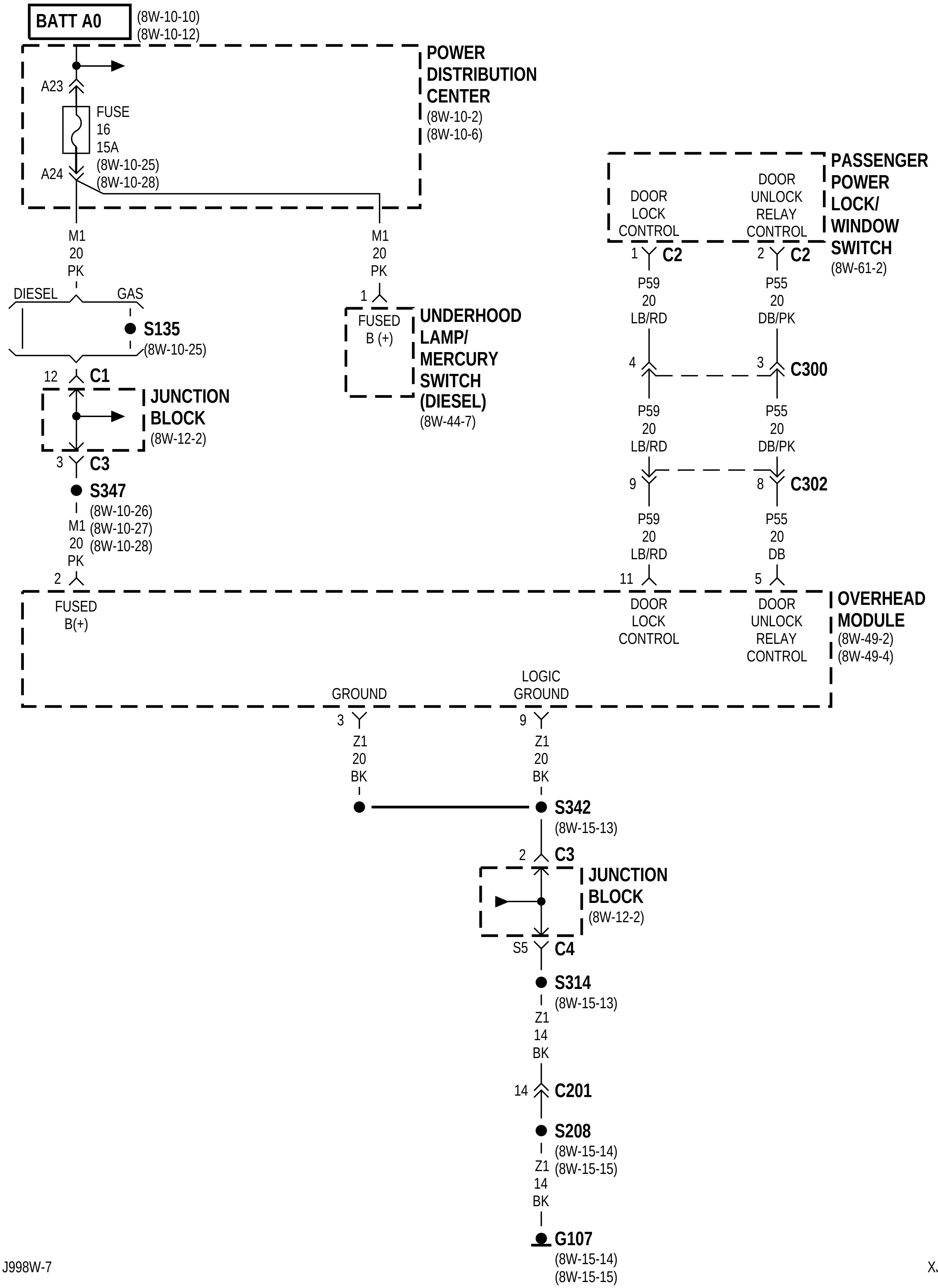
BATT A0
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-6)
18
FUSE 12 40A (8W-10-24)
25
20
FUSE 14 20A (8W-10-24)
27
A18
FUSE 19 15A (8W-10-32)
A17
F32 20 PK/DB
F8
C100
F32 20 PK/DB
6
BRAKE LAMP SWITCH
(8W-33-5)
5
L50 20 WT/TN
S203
(8W-10-32)
L50 20 WT/TN
DATA LINK CONNECTOR
(8W-30-31)
7
D21 20 PK
B8
F2
B4
E1
C100
D21 20 PK
L50 20 WT/TN
S139
(8W-30-31)
S147
(8W-10-32)
D21 20 PK
L50 18 WT/TN
A10 12 RD/DG
A20 12 RD/DB
G SWITCH
3
2
1
B43 20 PK/OR
B41 20 YL/VT
B42 20 TN/WT
C
A
B
C109
B43 18 PK/OR
B41 18 YL/VT
B42 18 TN/WT
25
9
20
12
13
6
7
FUSED B(+)
FUSED B(+)
SCI TRANSMIT/ ISO 9141K
BRAKE LAMP SWITCH OUTPUT
G SWITCH TEST SIGNAL
G SWITCH NO. 1 SENSE
G SWITCH NO. 2 SENSE
CONTROLLER ANTI-LOCK BRAKE
GROUND
GROUND
8
24
Z1 12 BK
Z1 12 BK
G102
(8W-15-3)
● RHD
●● LHD

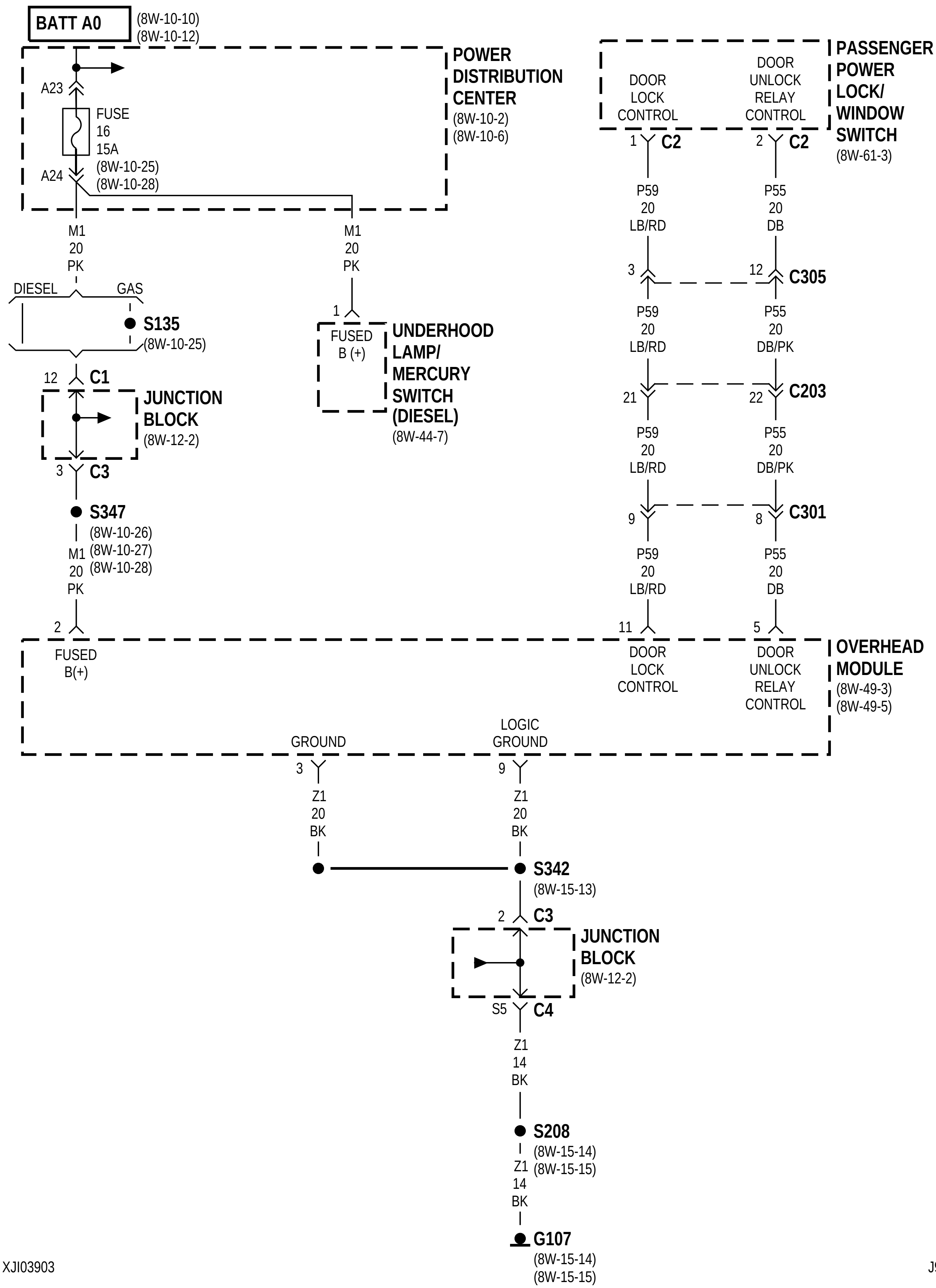

RUN A22
(8W-10-17)
ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE
25
15A
(8W-12-21)
(8W-12-22)
FUSE
9
10A
(8W-12-12)
(8W-12-13)
6 C1
F15
20
DB/WT
S13 C4
F87
20
WT/BK
RHD
LHD
BASE
FULL OPTIONS
S225
(8W-12-12)
5 C201
S216
(8W-12-12)
(8W-12-13)
F87
20
WT/BK
8 C1
INSTRUMENT CLUSTER
(8W-40-2)
(8W-40-6)
(8W-40-8)
ABS INDICATOR
4 C1
G19
20
LG/OR
F13 C100
S134
(8W-12-21)
(8W-12-22)
F15
20
DB/WT
B20
B16
CONTROLLER ANTI-LOCK BRAKE RELAY (IN PDC)
B18
B19
F15
18
DB/WT
G83
18
GY/BK
Z1
20
BK
S132
(8W-15-5)
(8W-15-6)
(8W-15-8)
Z1
14
BK
G106
(8W-15-7)
(8W-15-10)
23
16
FUSED IGNITION SWITCH OUTPUT (RUN)
ABS RELAY CONTROL
CONTROLLER ANTI-LOCK BRAKE


RUN A22
(8W-10-17)
ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE
25
15A
(8W-12-21)
(8W-12-22)
FUSE
9
10A
(8W-12-12)
(8W-12-13)
6
C1
S13
C4
F87
20
WT/BK
F15
20
DB/WT
RHD
LHD
BASE
FULL OPTIONS
S225
(8W-12-12)
5
C201
S216
(8W-12-12)
(8W-12-13)
8
C1
INSTRUMENT CLUSTER
(8W-40-3)
(8W-40-7)
(8W-40-8)
ABS INDICATOR
4
C1
G19
20
LG/OR
F13
C100
FOG LAMP RELAY (IN PDC)
(8W-50-18)
GROUND
B10
B18
B16
CONTROLLER ANTI-LOCK BRAKE RELAY (IN PDC)
Z1
20
BK/YL
12
C106
Z1
20
BK
B20
B19
Z1
20
BK/YL
S103
(8W-15-12)
Z1
18
BK
F15
18
DB/WT
G83
18
GY/BK
23
16
FUSED IGNITION SWITCH OUTPUT (RUN)
ABS RELAY CONTROL
CONTROLLER ANTI-LOCK BRAKE
11
C106
Z1
20
BK
G106
(8W-15-12)


LEFT FRONT WHEEL SPEED SENSOR
RIGHT FRONT WHEEL SPEED SENSOR
LEFT REAR WHEEL SPEED SENSOR
RIGHT REAR WHEEL SPEED SENSOR
2
1
2
1
B
A
B
A
B4 20 LG
B3 20 LG/DB
B2 20 YL
B1 20 YL/DB
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
G
F
C109
E
D
C109
B9 18 RD
B8 18 RD/DB
B4 18 LG
B3 18 LG/DB
B7 18 WT
B6 18 WT/DB
B2 18 YL
B1 18 YL/DB
4
11
10
2
3
18
17
1
LEFT FRONT WHEEL SPEED SENSOR (+)
LEFT FRONT WHEEL SPEED SENSOR (-)
LEFT REAR WHEEL SPEED SENSOR (+)
LEFT REAR WHEEL SPEED SENSOR (-)
RIGHT FRONT WHEEL SPEED SENSOR (+)
RIGHT FRONT WHEEL SPEED SENSOR (-)
RIGHT REAR WHEEL SPEED SENSOR (+)
RIGHT REAR WHEEL SPEED SENSOR (-)
CONTROLLER ANTI-LOCK BRAKE

8W-39 VEHICLE THEFT SECURITY SYSTEM


BATT A0
(8W-10-10)
(8W-10-12)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
(8W-10-6)
A23
FUSE
16
15A
(8W-10-25)
(8W-10-28)
A24
M1
20
PK
M1
20
PK
DIESEL
GAS
S135
(8W-10-25)
1
FUSED
B (+)
UNDERHOOD
LAMP/
MERCURY
SWITCH
(DIESEL)
(8W-44-7)
12
C1
JUNCTION
BLOCK
(8W-12-2)
3
C3
S347
(8W-10-26)
(8W-10-27)
(8W-10-28)
M1
20
PK
2
FUSED
B(+)
DOOR
LOCK
CONTROL
DOOR
UNLOCK
RELAY
CONTROL
PASSENGER
POWER
LOCK/
WINDOW
SWITCH
(8W-61-2)
1
C2
2
C2
P59
20
LB/RD
P55
20
DB/PK
4
3
C300
P59
20
LB/RD
P55
20
DB/PK
9
8
C302
P59
20
LB/RD
P55
20
DB
11
5
DOOR
LOCK
CONTROL
DOOR
UNLOCK
RELAY
CONTROL
OVERHEAD
MODULE
(8W-49-2)
(8W-49-4)
GROUND
LOGIC
GROUND
3
9
Z1
20
BK
Z1
20
BK
S342
(8W-15-13)
2
C3
JUNCTION
BLOCK
(8W-12-2)
S5
C4
S314
(8W-15-13)
Z1
14
BK
14
C201
S208
(8W-15-14)
(8W-15-15)
Z1
14
BK
G107
(8W-15-14)
(8W-15-15)



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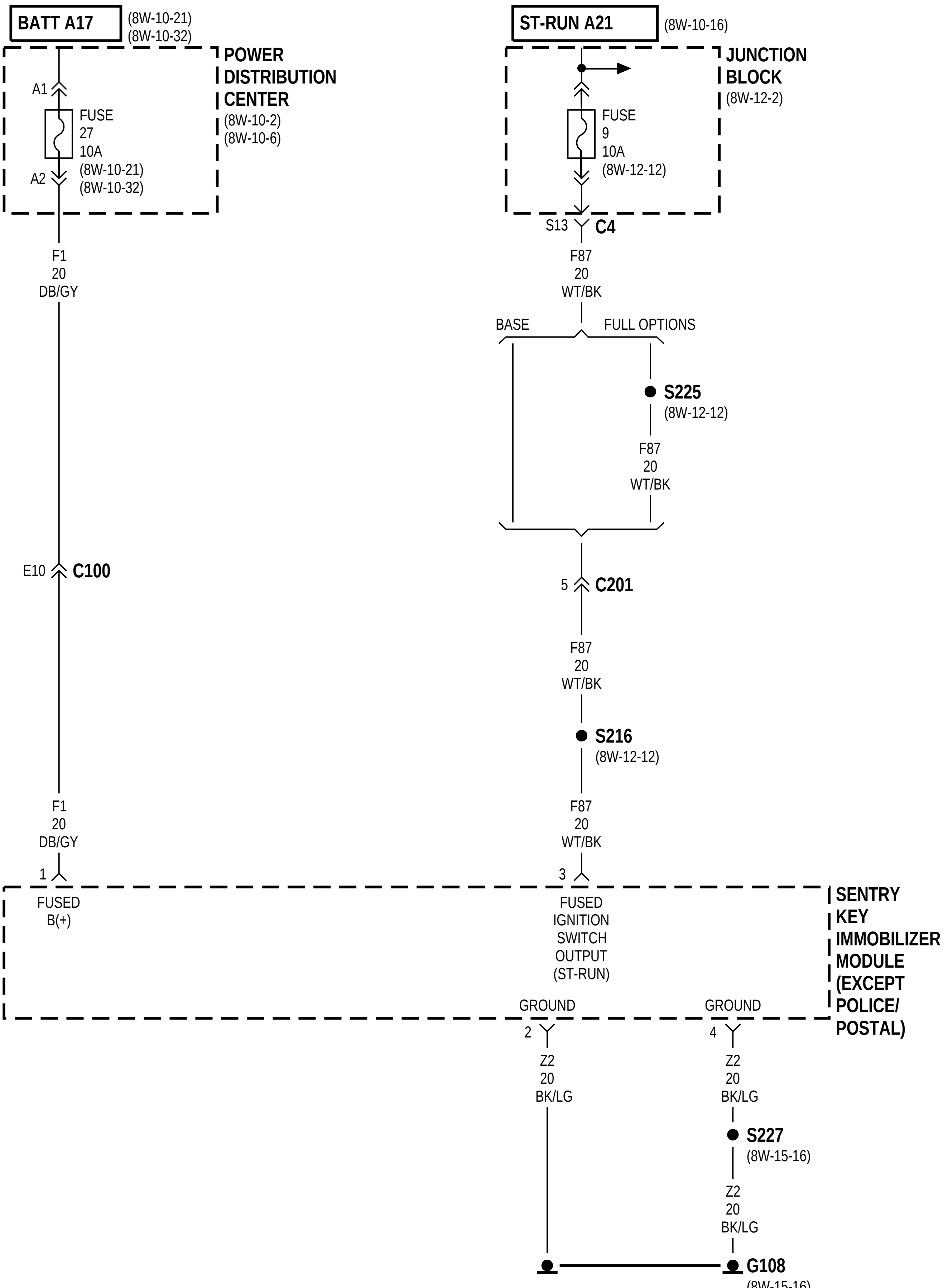
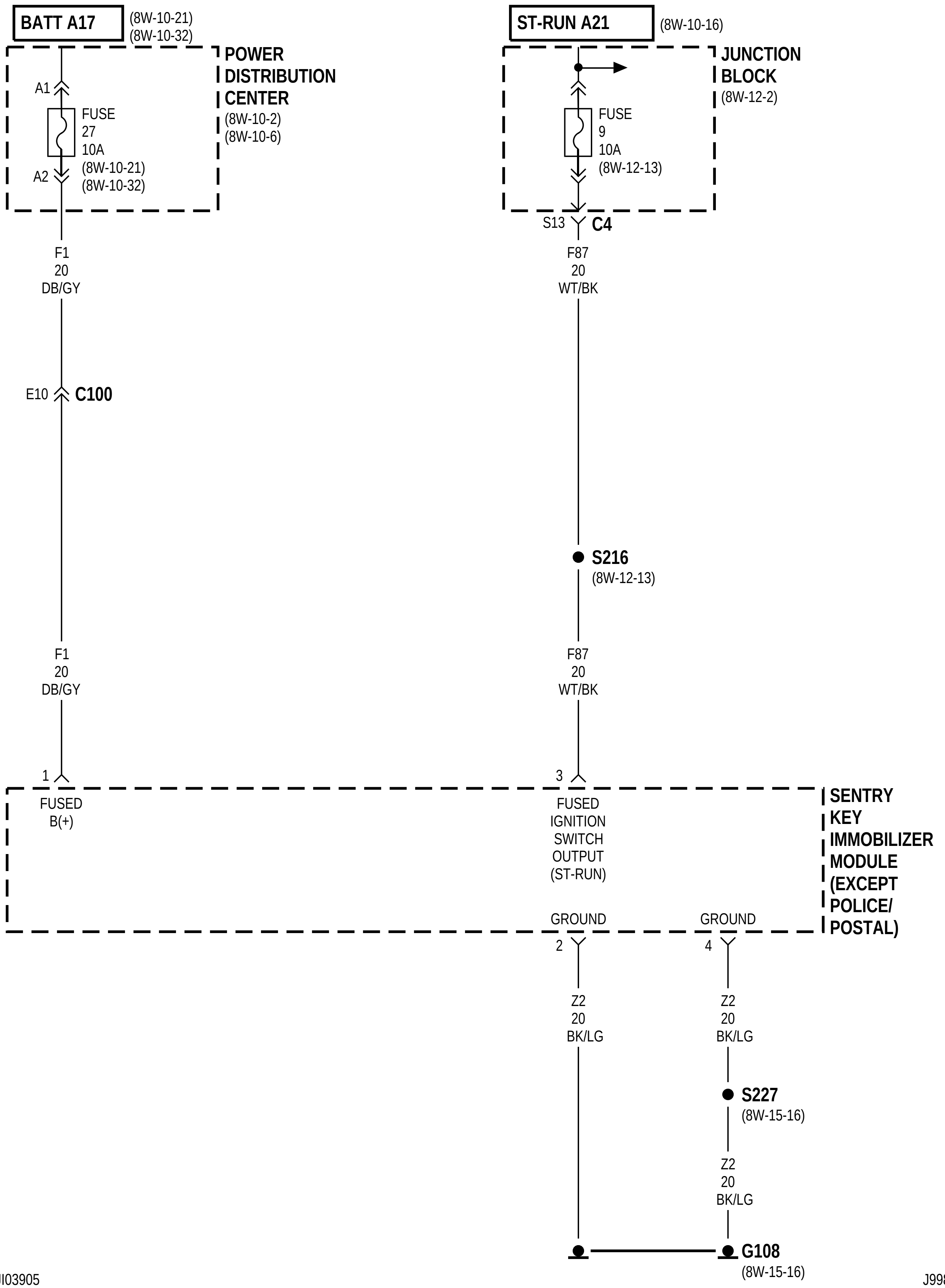
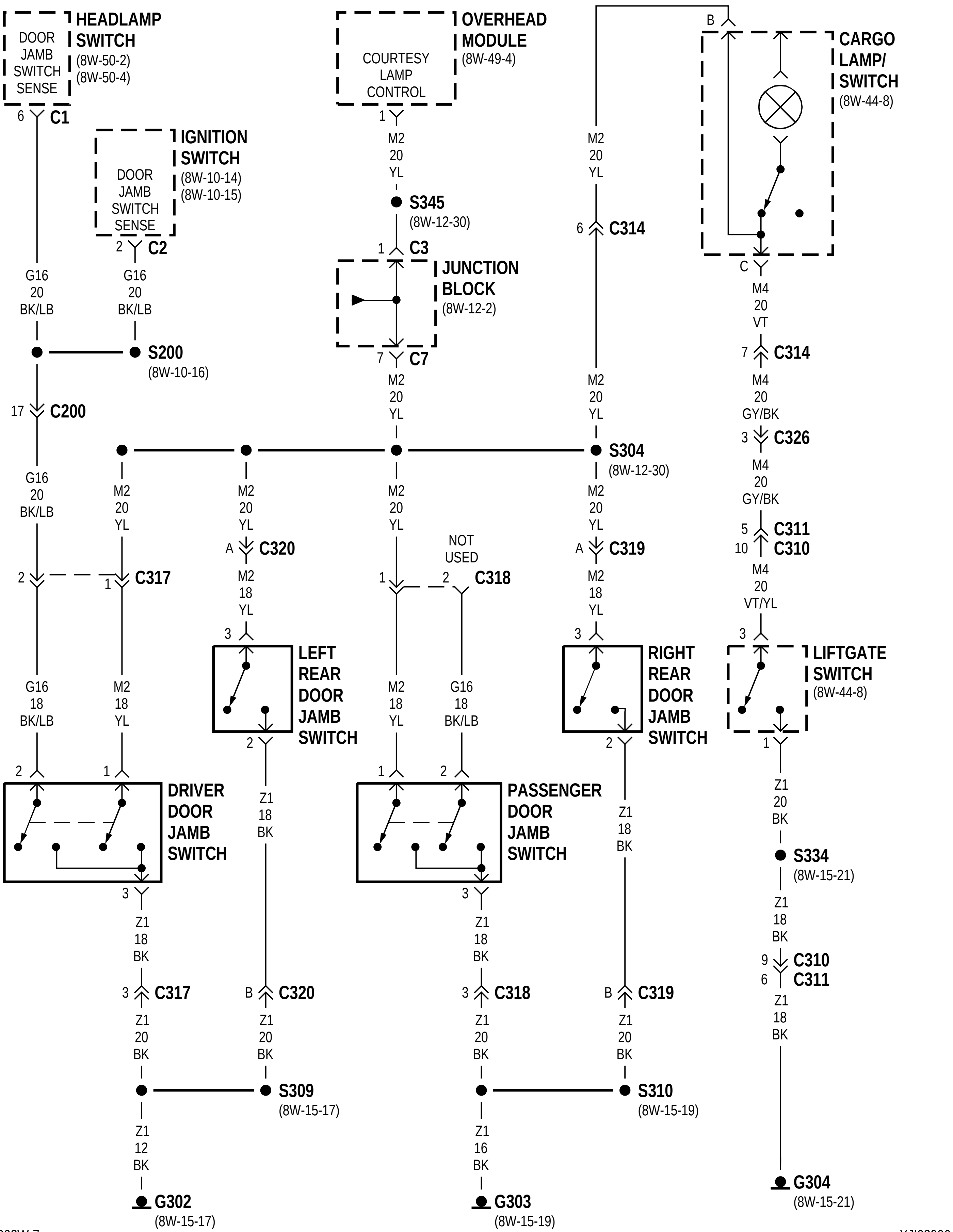

BATT A17
(8W-10-21)
(8W-10-32)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
(8W-10-6)
A1
FUSE
27
10A
(8W-10-21)
(8W-10-32)
A2
F1
20
DB/GY
E10
C100
F1
20
DB/GY
1
ST-RUN A21
(8W-10-16)
JUNCTION
BLOCK
(8W-12-2)
FUSE
9
10A
(8W-12-12)
S13
C4
F87
20
WT/BK
BASE
FULL OPTIONS
S225
(8W-12-12)
F87
20
WT/BK
5
C201
F87
20
WT/BK
S216
(8W-12-12)
F87
20
WT/BK
3
FUSED
B(+)
FUSED
IGNITION
SWITCH
OUTPUT
(ST-RUN)
GROUND
GROUND
SENTRY
KEY
IMMOBILIZER
MODULE
(EXCEPT
POLICE/
POSTAL)
2
4
Z2
20
BK/LG
Z2
20
BK/LG
S227
(8W-15-16)
Z2
20
BK/LG
G108
(8W-15-16)

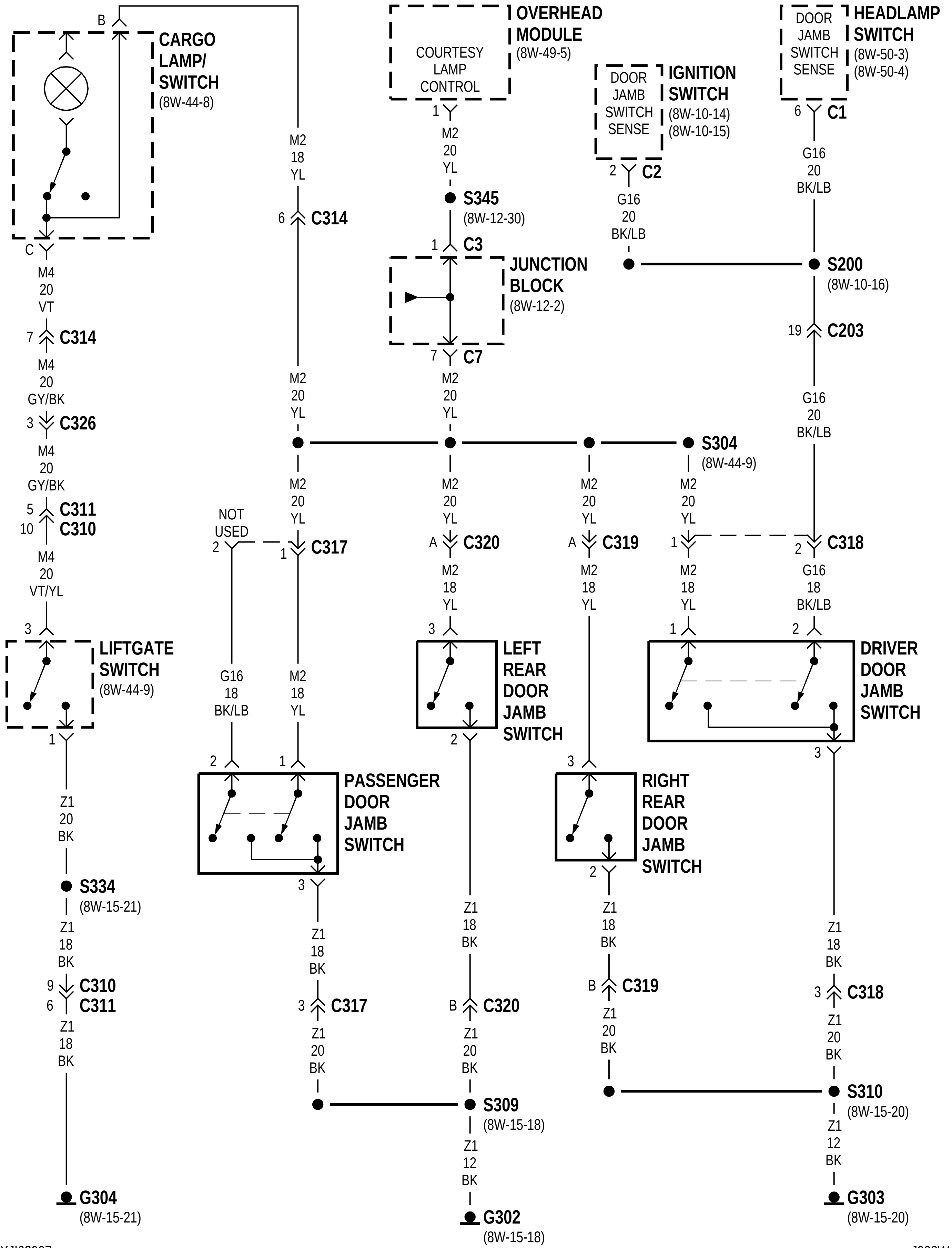
RHD

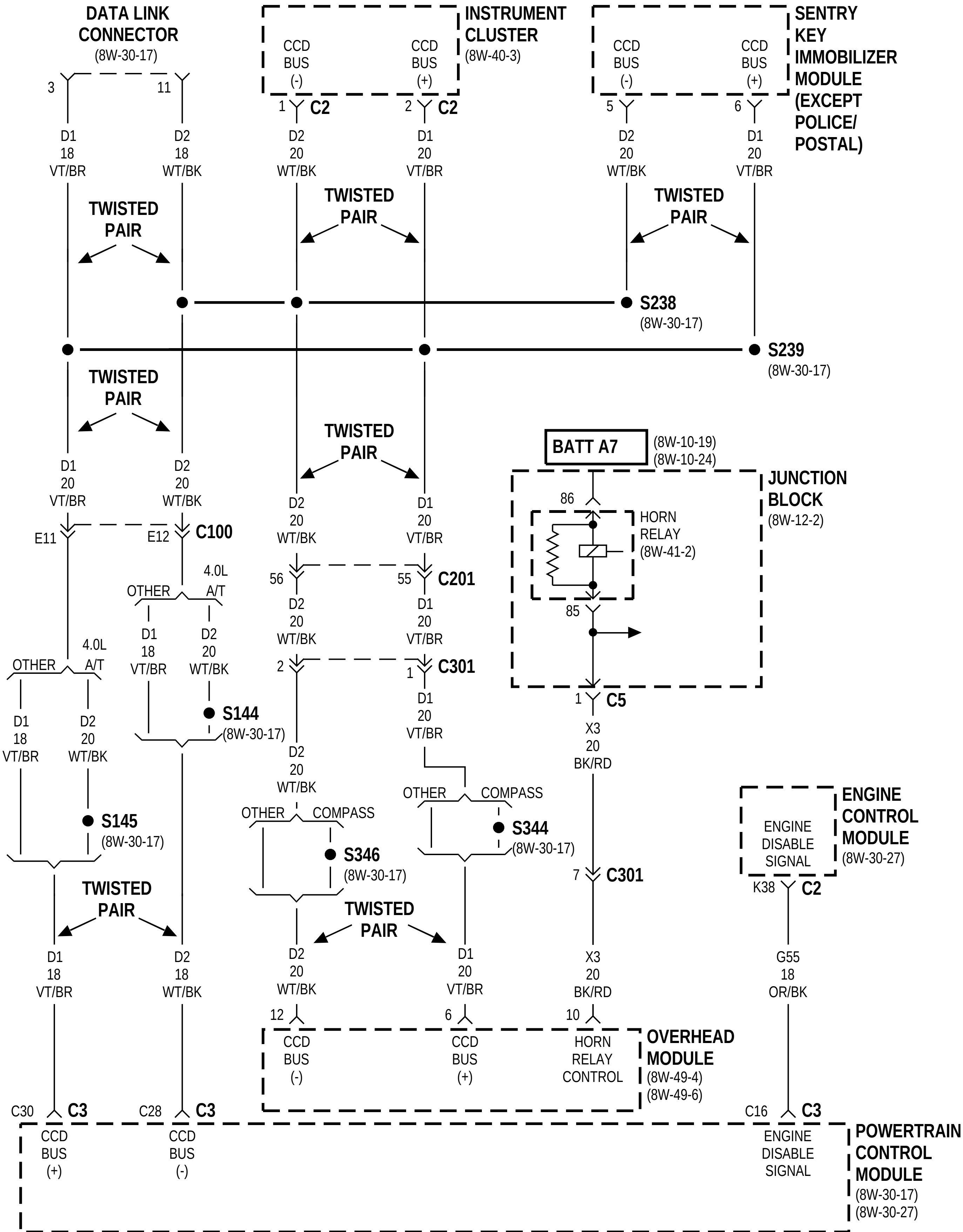

BATT A17
(8W-10-21)
(8W-10-32)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
(8W-10-6)
A1
FUSE
27
10A
(8W-10-21)
(8W-10-32)
A2
F1
20
DB/GY
E10
C100
F1
20
DB/GY
1
FUSED
B(+)
ST-RUN A21
(8W-10-16)
JUNCTION
BLOCK
(8W-12-2)
FUSE
9
10A
(8W-12-13)
S13
C4
F87
20
WT/BK
S216
(8W-12-13)
F87
20
WT/BK
3
FUSED
IGNITION
SWITCH
OUTPUT
(ST-RUN)
GROUND
GROUND
SENTRY
KEY
IMMOBILIZER
MODULE
(EXCEPT
POLICE/
POSTAL)
2
4
Z2
20
BK/LG
Z2
20
BK/LG
S227
(8W-15-16)
Z2
20
BK/LG
G108
(8W-15-16)

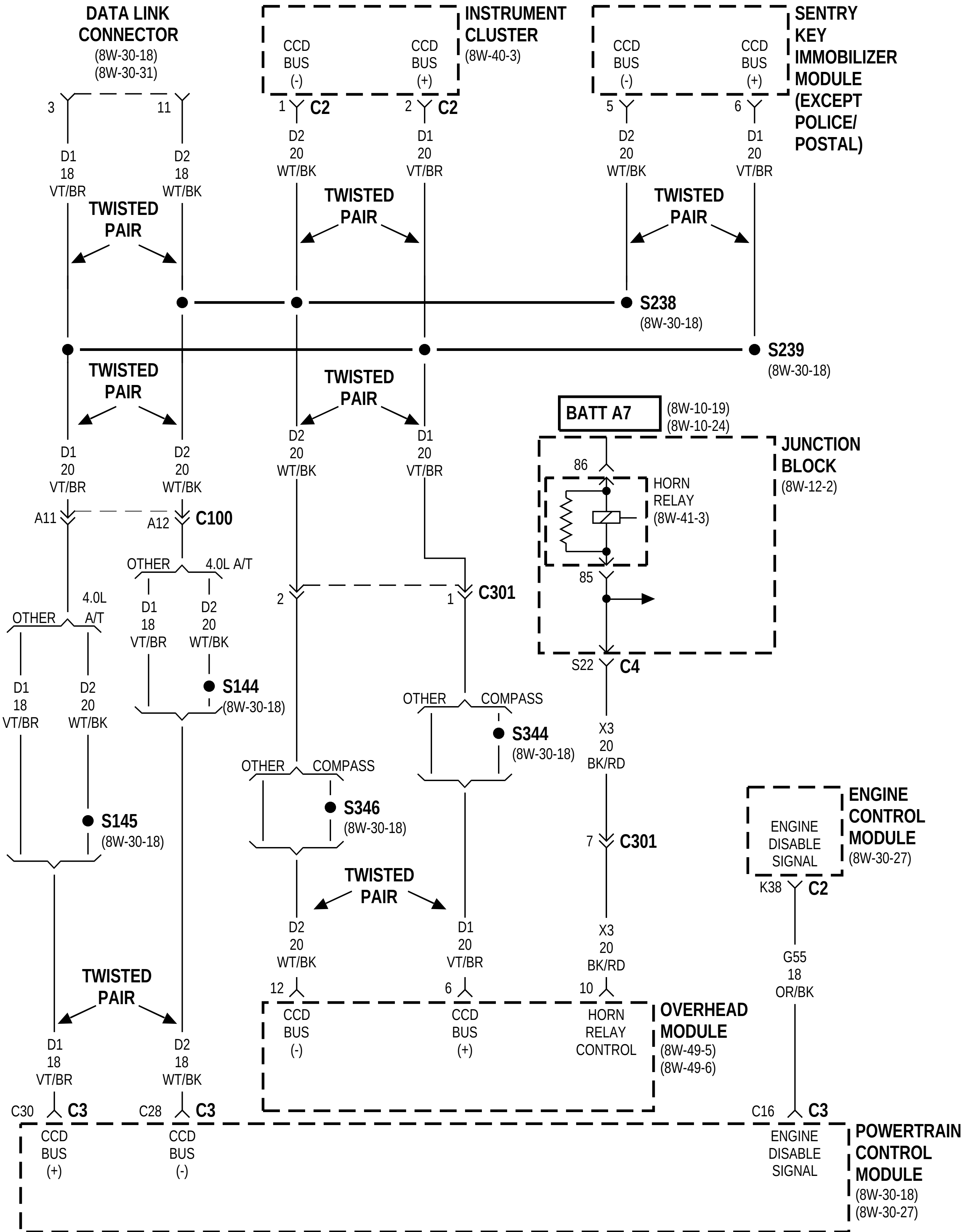
LHD


HEADLAMP SWITCH
DOOR JAMB SWITCH SENSE
(8W-50-2)
(8W-50-4)
6 C1
IGNITION SWITCH
DOOR JAMB SWITCH SENSE
(8W-10-14)
(8W-10-15)
2 C2
G16 20 BK/LB
S200
(8W-10-16)
17 C200
OVERHEAD MODULE
COURTESY LAMP CONTROL
(8W-49-4)
1
M2 20 YL
S345
(8W-12-30)
1 C3
JUNCTION BLOCK
(8W-12-2)
7 C7
B
CARGO LAMP/ SWITCH
(8W-44-8)
6 C314
C
M4 20 VT
7 C314
M4 20 GY/BK
3 C326
S304
(8W-12-30)
5 C311
10 C310
M4 20 VT/YL
A C320
M2 18 YL
A C319
2 1 C317
1 2 C318
NOT USED
LEFT REAR DOOR JAMB SWITCH
RIGHT REAR DOOR JAMB SWITCH
LIFTGATE SWITCH
(8W-44-8)
G16 18 BK/LB
M2 18 YL
DRIVER DOOR JAMB SWITCH
PASSENGER DOOR JAMB SWITCH
Z1 18 BK
Z1 20 BK
S334
(8W-15-21)
9 C310
6 C311
3 C317
B C320
3 C318
B C319
Z1 20 BK
S309
(8W-15-17)
S310
(8W-15-19)
Z1 12 BK
Z1 16 BK
G302
(8W-15-17)
G303
(8W-15-19)
G304
(8W-15-21)

RHD


CARGO LAMP/ SWITCH
(8W-44-8)
B
C
M4 20 VT
C314
M4 20 GY/BK
C326
C311
C310
M4 20 VT/YL
LIFTGATE SWITCH
(8W-44-9)
Z1 20 BK
S334
(8W-15-21)
Z1 18 BK
Z1 18 BK
G304
(8W-15-21)
M2 18 YL
C314
OVERHEAD MODULE
(8W-49-5)
COURTESY LAMP CONTROL
M2 20 YL
S345
(8W-12-30)
C3
JUNCTION BLOCK
(8W-12-2)
C7
M2 20 YL
S304
(8W-44-9)
NOT USED
C317
C320
C319
C318
G16 18 BK/LB
M2 18 YL
PASSENGER DOOR JAMB SWITCH
LEFT REAR DOOR JAMB SWITCH
RIGHT REAR DOOR JAMB SWITCH
DRIVER DOOR JAMB SWITCH
Z1 18 BK
Z1 20 BK
S309
(8W-15-18)
Z1 12 BK
G302
(8W-15-18)
IGNITION SWITCH
(8W-10-14)
(8W-10-15)
DOOR JAMB SWITCH SENSE
C2
G16 20 BK/LB
HEADLAMP SWITCH
(8W-50-3)
(8W-50-4)
C1
S200
(8W-10-16)
C203
S310
(8W-15-20)
G303
(8W-15-20)

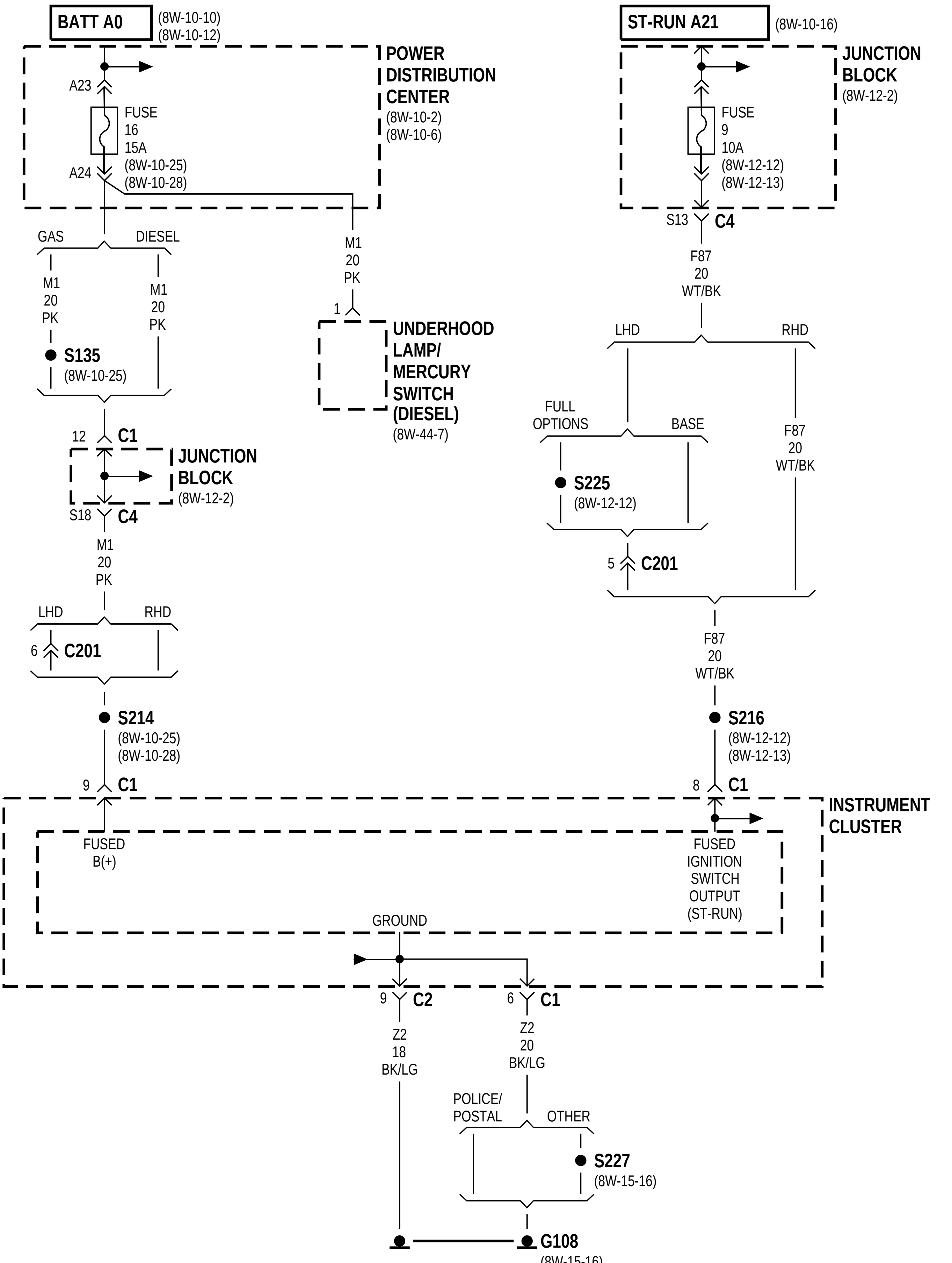

DATA LINK CONNECTOR
(8W-30-17)
INSTRUMENT CLUSTER
(8W-40-3)
CCD BUS (-)
CCD BUS (+)
C2
SENTRY KEY IMMOBILIZER MODULE (EXCEPT POLICE/ POSTAL)
D1 18 VT/BR
D2 18 WT/BK
D2 20 WT/BK
D1 20 VT/BR
TWISTED PAIR
S238
(8W-30-17)
S239
(8W-30-17)
C100
E11
E12
4.0L A/T
OTHER
C201
C301
S144
S145
S344
S346
COMPASS
BATT A7
(8W-10-19)
(8W-10-24)
JUNCTION BLOCK
(8W-12-2)
HORN RELAY
(8W-41-2)
86
85
C5
X3 20 BK/RD
ENGINE CONTROL MODULE
(8W-30-27)
ENGINE DISABLE SIGNAL
K38
G55 18 OR/BK
OVERHEAD MODULE
(8W-49-4)
(8W-49-6)
HORN RELAY CONTROL
C30
C28
C16
C3
POWERTRAIN CONTROL MODULE
(8W-30-17)
(8W-30-27)


DATA LINK CONNECTOR (8W-30-18) (8W-30-31)
INSTRUMENT CLUSTER (8W-40-3)
CCD BUS (-)
CCD BUS (+)
SENTRY KEY IMMOBILIZER MODULE (EXCEPT POLICE/ POSTAL)
C2
D1 18 VT/BR
D2 18 WT/BK
D2 20 WT/BK
D1 20 VT/BR
TWISTED PAIR
S238 (8W-30-18)
S239 (8W-30-18)
BATT A7 (8W-10-19) (8W-10-24)
JUNCTION BLOCK (8W-12-2)
HORN RELAY (8W-41-3)
86
85
C100
A11
A12
OTHER
4.0L A/T
C301
COMPASS
S144 (8W-30-18)
S145 (8W-30-18)
S344 (8W-30-18)
S346 (8W-30-18)
S22 C4
X3 20 BK/RD
ENGINE CONTROL MODULE (8W-30-27)
ENGINE DISABLE SIGNAL
K38 C2
G55 18 OR/BK
OVERHEAD MODULE (8W-49-5) (8W-49-6)
HORN RELAY CONTROL
C30 C3
C28 C3
C16 C3
POWERTRAIN CONTROL MODULE (8W-30-18) (8W-30-27)
CCD BUS (+)
CCD BUS (-)

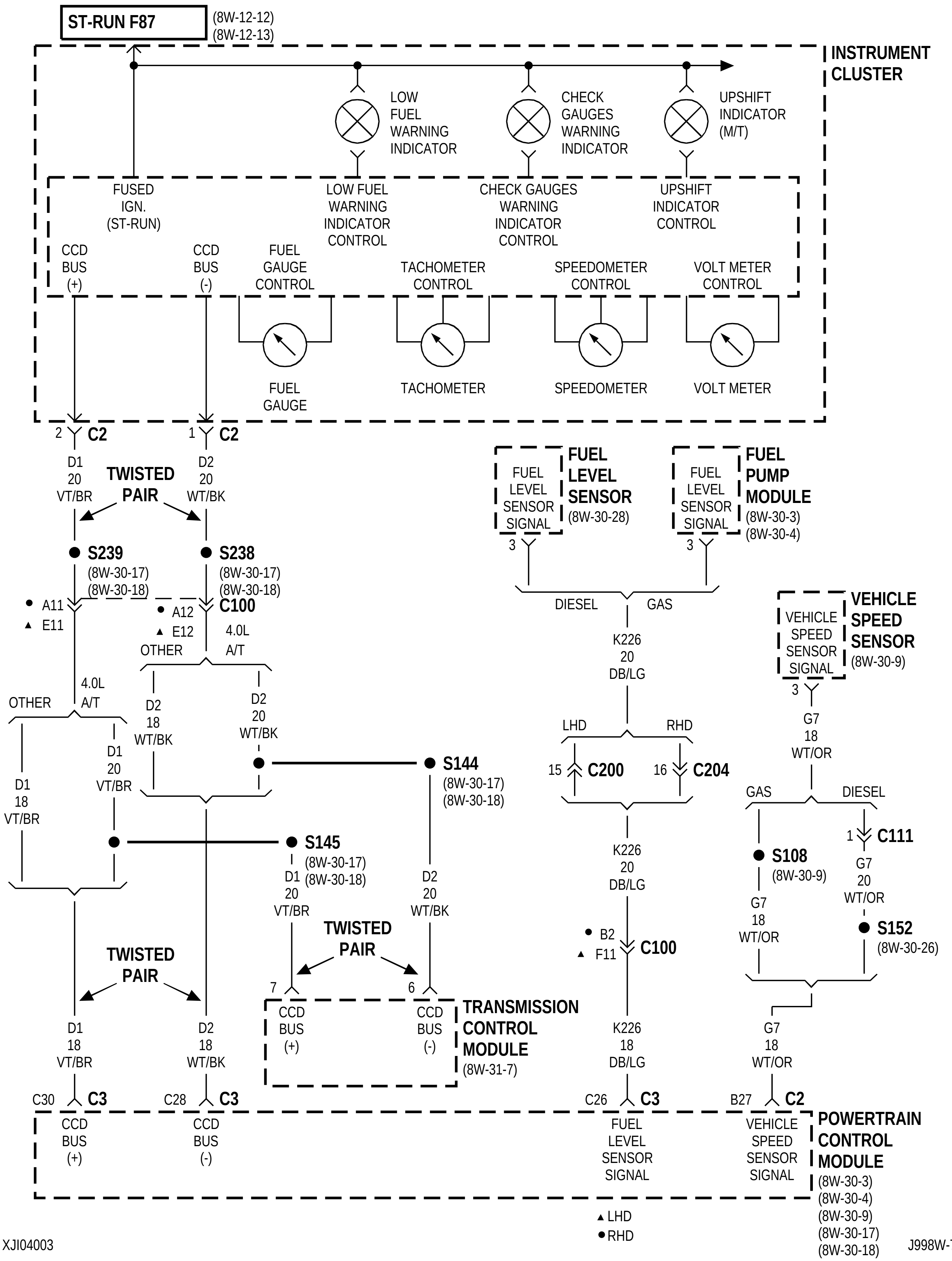
8W-40 INSTRUMENT CLUSTER

Component **Page**

Component **Page**



BATT A0
(8W-10-10)
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-2)
(8W-10-6)
A23
FUSE
16
15A
(8W-10-25)
(8W-10-28)
A24
GAS
DIESEL
M1
20
PK
S135
(8W-10-25)
12
C1
JUNCTION BLOCK
(8W-12-2)
S18
C4
LHD
RHD
6
C201
S214
(8W-10-25)
(8W-10-28)
9
C1
1
UNDERHOOD LAMP/ MERCURY SWITCH (DIESEL)
(8W-44-7)
ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE
9
10A
(8W-12-12)
(8W-12-13)
S13
C4
F87
20
WT/BK
FULL OPTIONS
BASE
S225
(8W-12-12)
5
C201
S216
(8W-12-12)
(8W-12-13)
8
INSTRUMENT CLUSTER
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
GROUND
C2
Z2
18
BK/LG
Z2
20
BK/LG
POLICE/ POSTAL
OTHER
S227
(8W-15-16)
G108
(8W-15-16)



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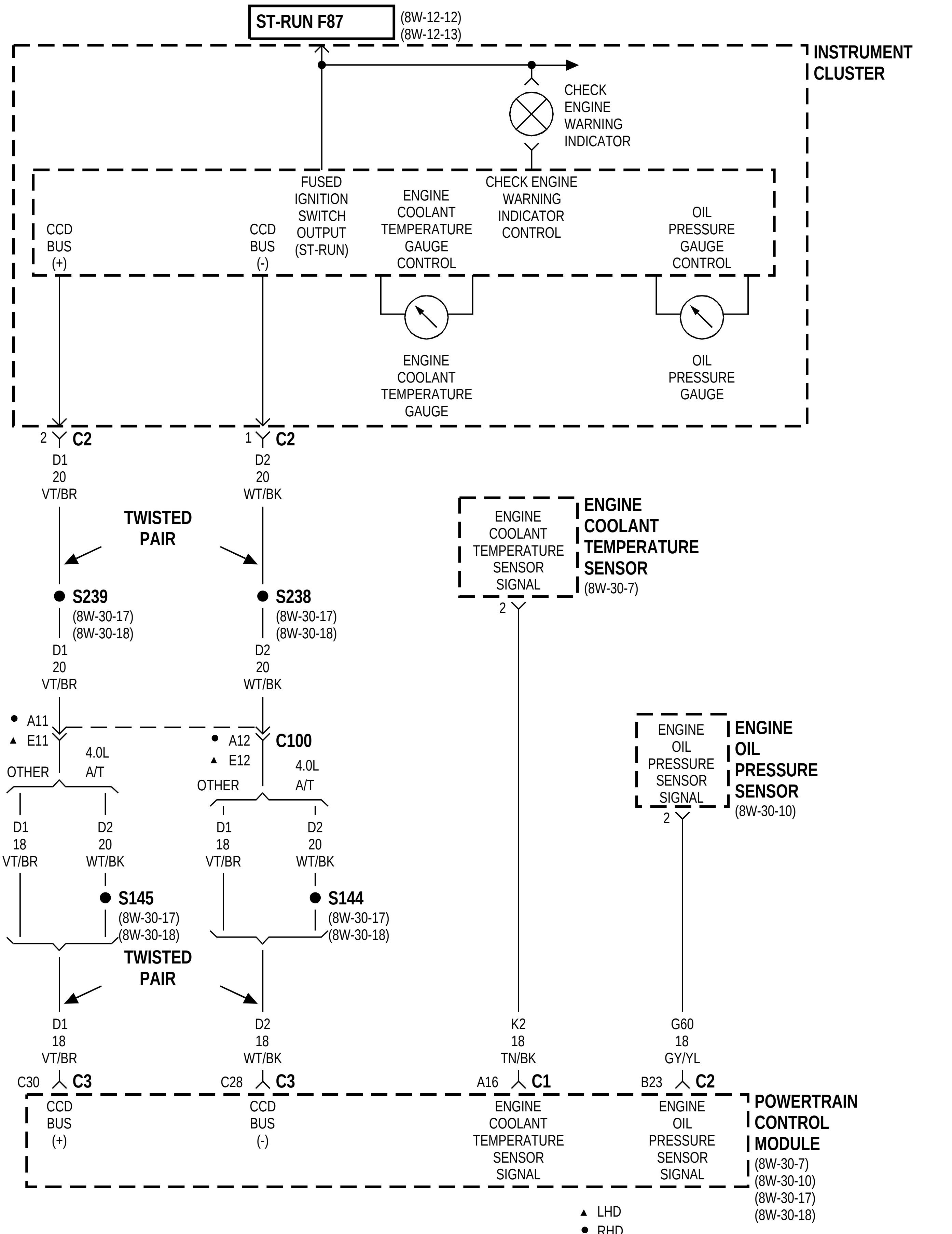
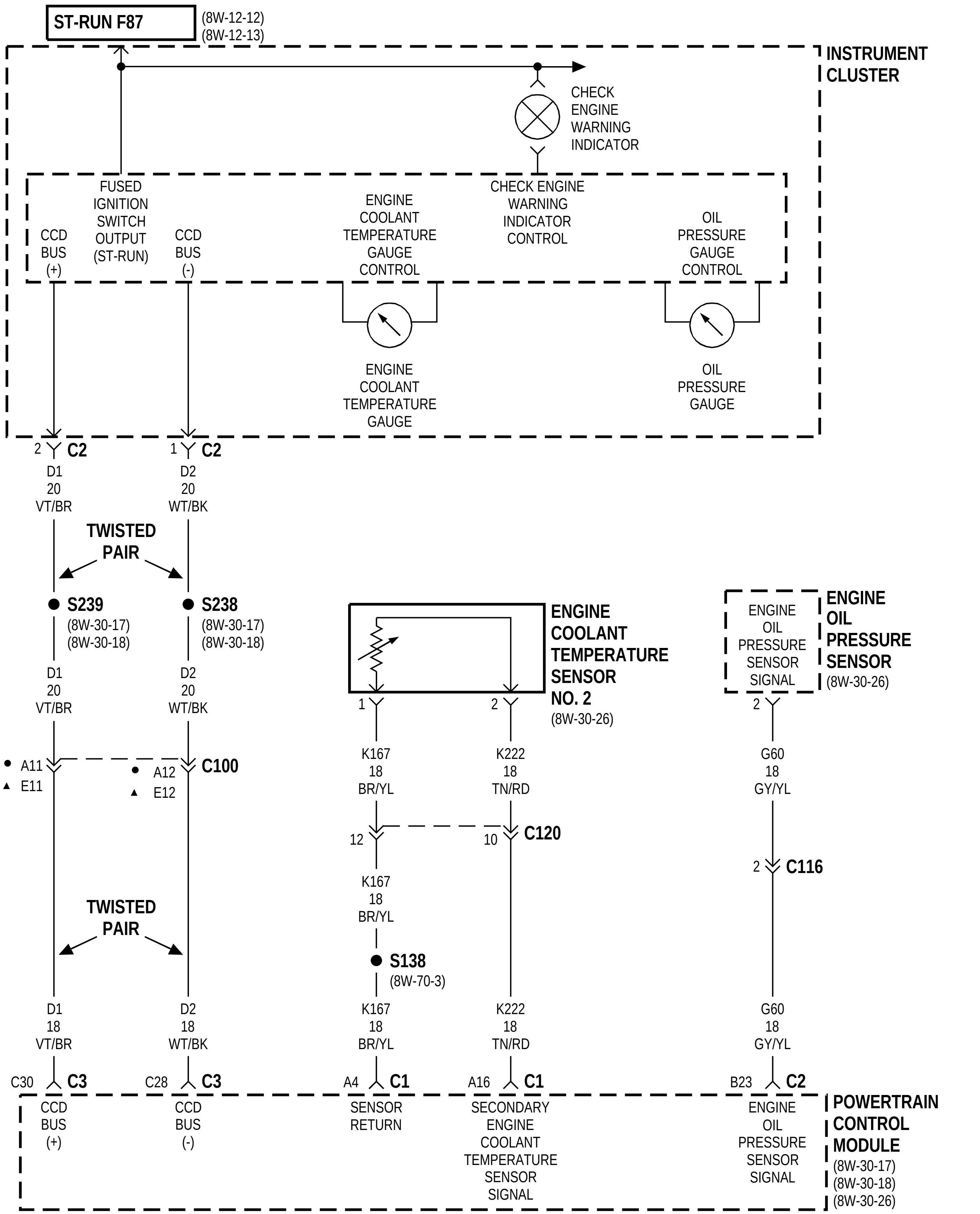
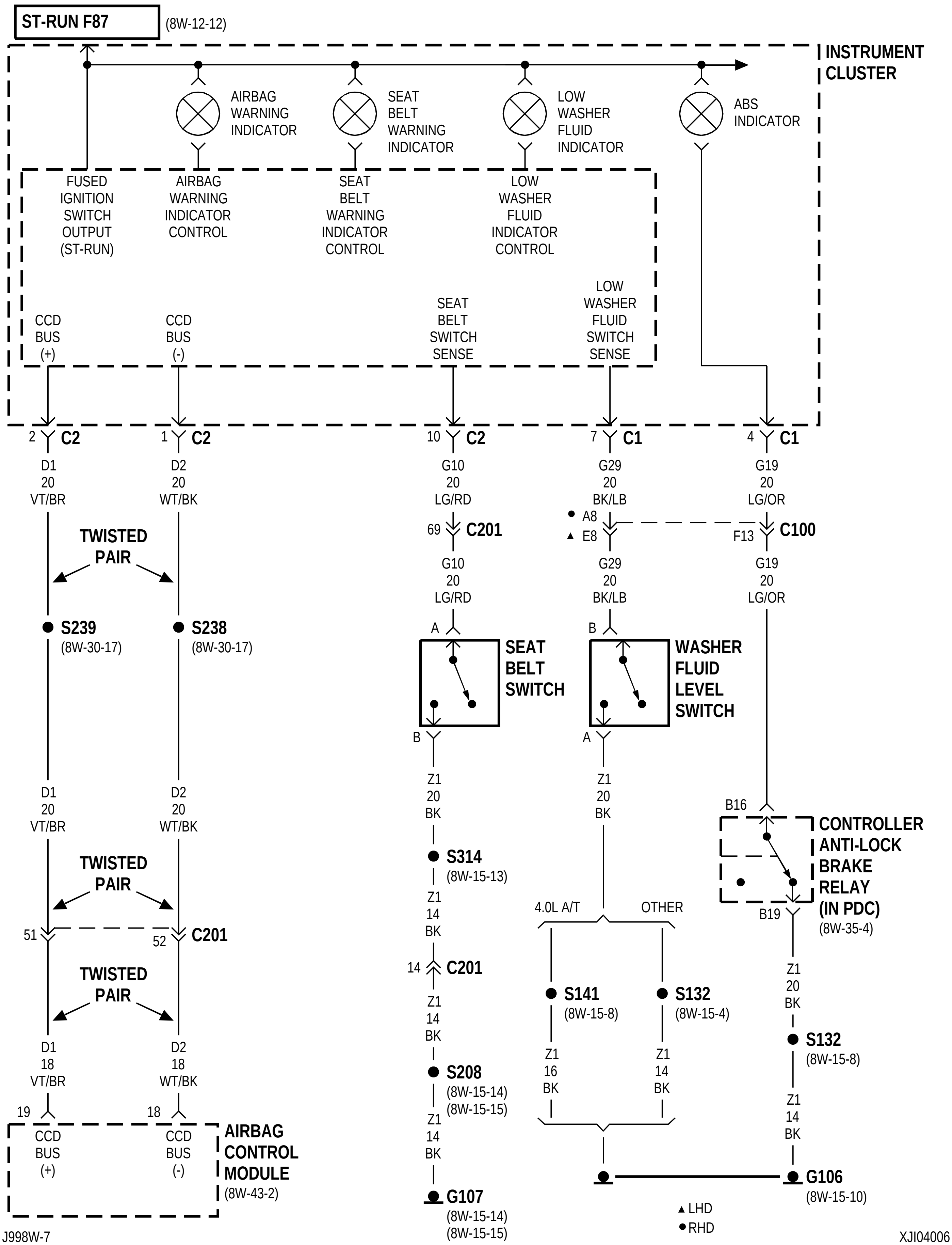
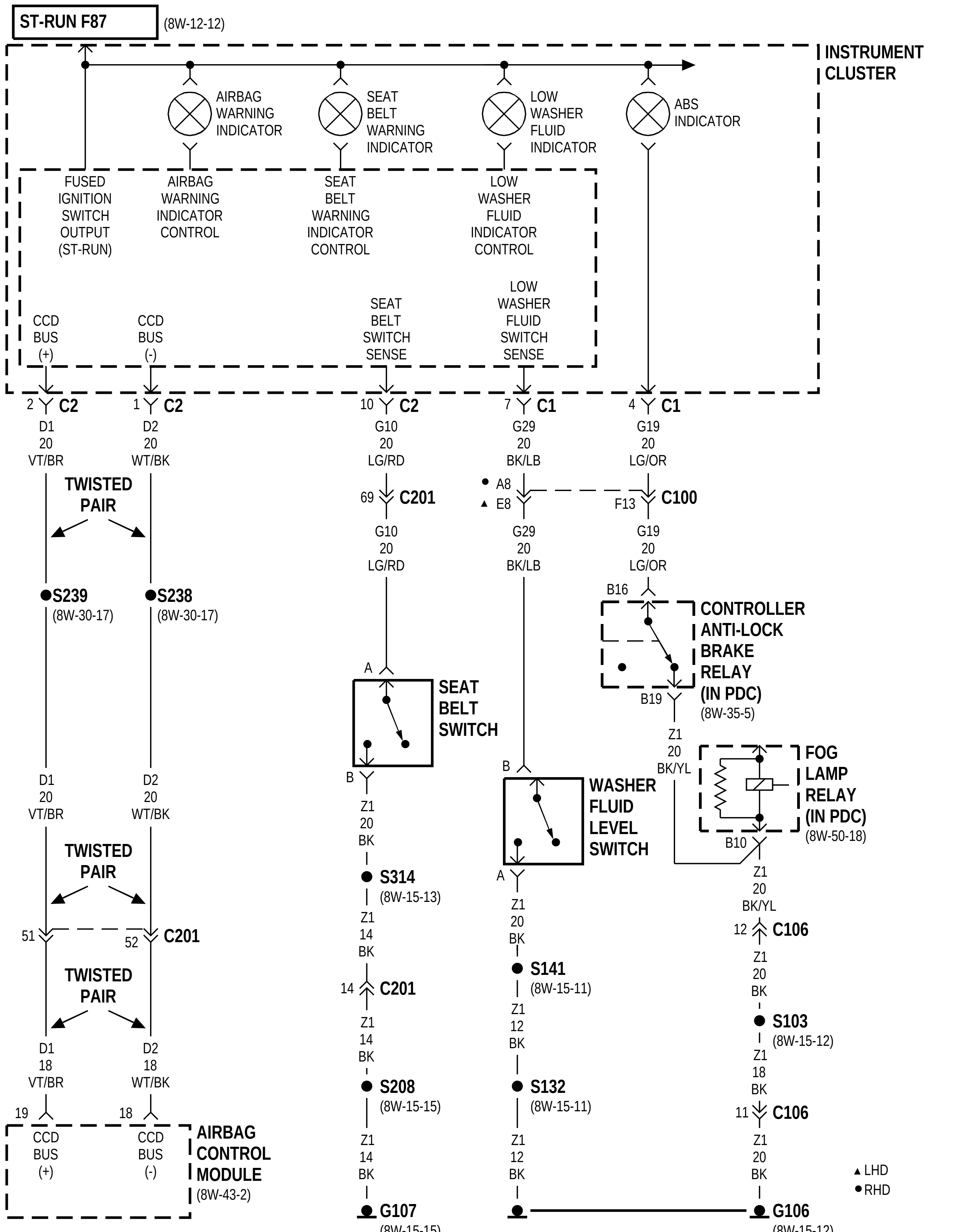
GAS

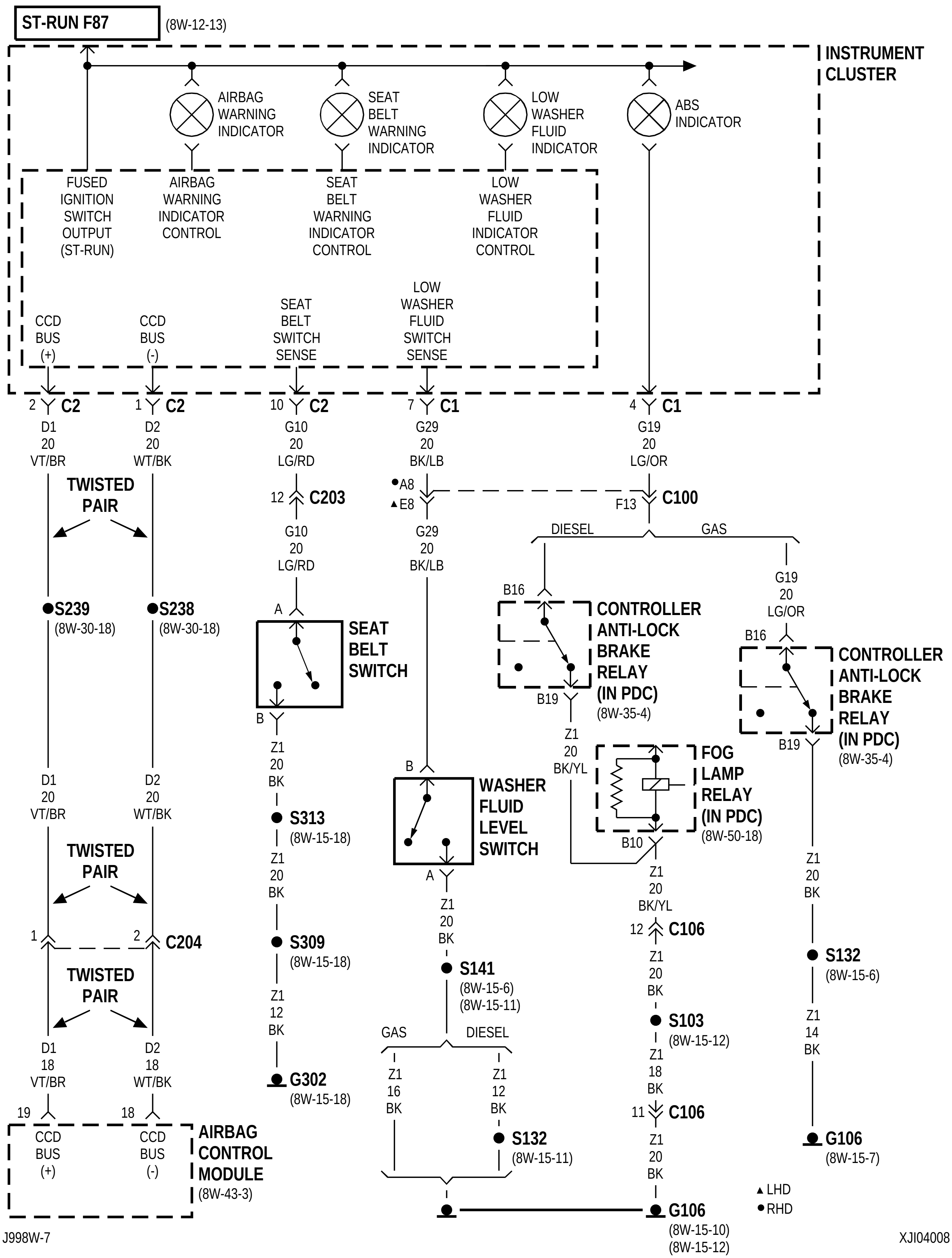

ST-RUN F87
(8W-12-12)
(8W-12-13)
INSTRUMENT CLUSTER
CHECK ENGINE WARNING INDICATOR
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
CCD BUS (+)
CCD BUS (-)
ENGINE COOLANT TEMPERATURE GAUGE CONTROL
CHECK ENGINE WARNING INDICATOR CONTROL
OIL PRESSURE GAUGE CONTROL
ENGINE COOLANT TEMPERATURE GAUGE
OIL PRESSURE GAUGE
2 C2
1 C2
D1 20 VT/BR
D2 20 WT/BK
TWISTED PAIR
S239 (8W-30-17) (8W-30-18)
S238 (8W-30-17) (8W-30-18)
D1 20 VT/BR
D2 20 WT/BK
A11
E11
A12
E12
C100
4.0L A/T
OTHER
D1 18 VT/BR
D2 20 WT/BK
S145 (8W-30-17) (8W-30-18)
S144 (8W-30-17) (8W-30-18)
TWISTED PAIR
D1 18 VT/BR
D2 18 WT/BK
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
ENGINE COOLANT TEMPERATURE SENSOR
(8W-30-7)
2
ENGINE OIL PRESSURE SENSOR SIGNAL
ENGINE OIL PRESSURE SENSOR
(8W-30-10)
2
K2 18 TN/BK
G60 18 GY/YL
C30 C3
C28 C3
A16 C1
B23 C2
CCD BUS (+)
CCD BUS (-)
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
ENGINE OIL PRESSURE SENSOR SIGNAL
POWERTRAIN CONTROL MODULE
(8W-30-7)
(8W-30-10)
(8W-30-17)
(8W-30-18)
▲ LHD
● RHD

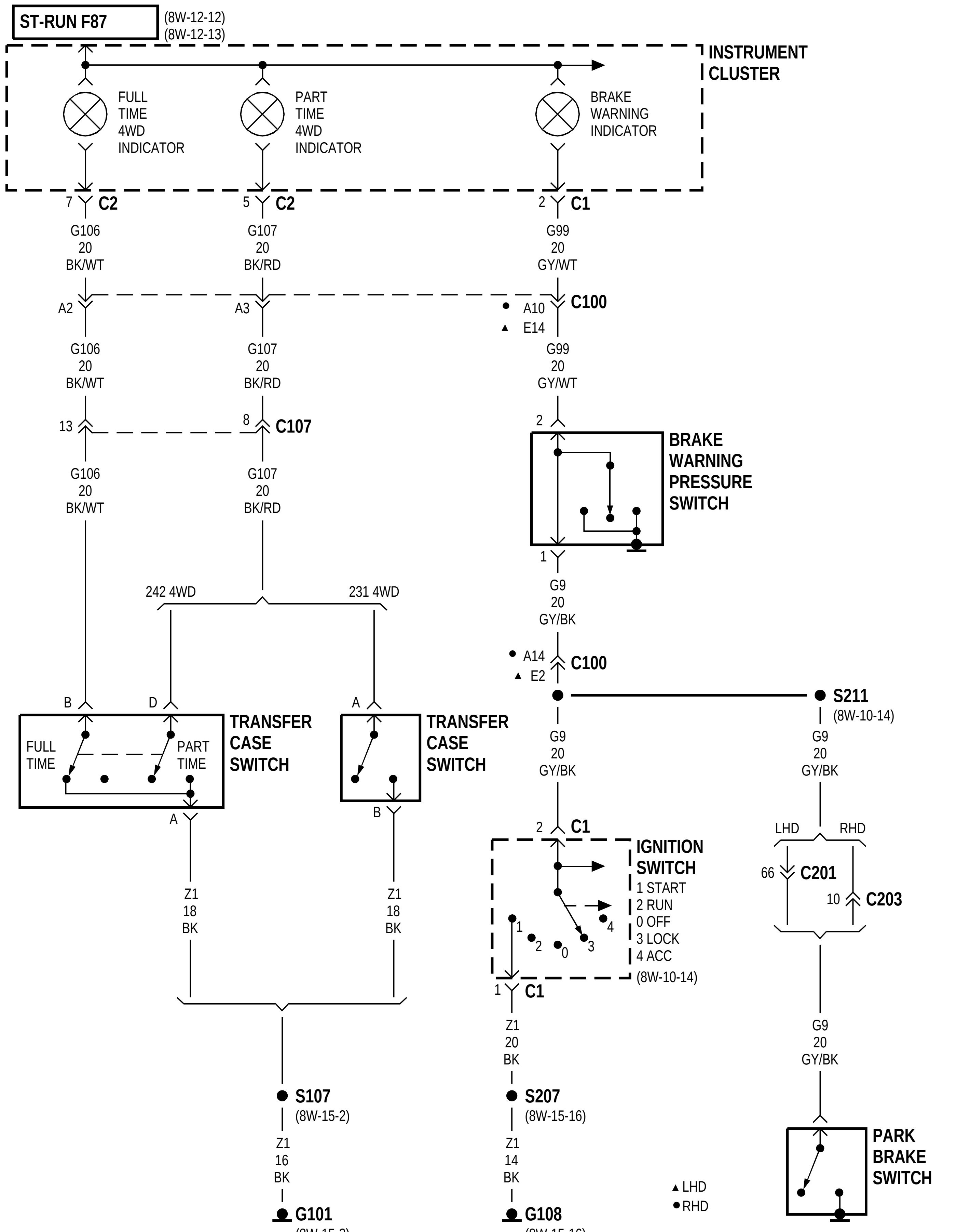

ST-RUN F87
(8W-12-12)
(8W-12-13)
INSTRUMENT CLUSTER
CHECK ENGINE WARNING INDICATOR
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
CCD BUS (+)
CCD BUS (-)
ENGINE COOLANT TEMPERATURE GAUGE CONTROL
CHECK ENGINE WARNING INDICATOR CONTROL
OIL PRESSURE GAUGE CONTROL
ENGINE COOLANT TEMPERATURE GAUGE
OIL PRESSURE GAUGE
2 C2
1 C2
D1 20 VT/BR
D2 20 WT/BK
TWISTED PAIR
S239
(8W-30-17)
(8W-30-18)
S238
(8W-30-17)
(8W-30-18)
D1 20 VT/BR
D2 20 WT/BK
A11
E11
A12
E12
C100
TWISTED PAIR
D1 18 VT/BR
D2 18 WT/BK
ENGINE COOLANT TEMPERATURE SENSOR NO. 2
(8W-30-26)
1
2
K167 18 BR/YL
K222 18 TN/RD
12
10
C120
K167 18 BR/YL
S138
(8W-70-3)
K167 18 BR/YL
K222 18 TN/RD
ENGINE OIL PRESSURE SENSOR SIGNAL
ENGINE OIL PRESSURE SENSOR
(8W-30-26)
2
G60 18 GY/YL
2 C116
G60 18 GY/YL
C30 C3
C28 C3
A4 C1
A16 C1
B23 C2
CCD BUS (+)
CCD BUS (-)
SENSOR RETURN
SECONDARY ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
ENGINE OIL PRESSURE SENSOR SIGNAL
POWERTRAIN CONTROL MODULE
(8W-30-17)
(8W-30-18)
(8W-30-26)
▲ LHD
● RHD

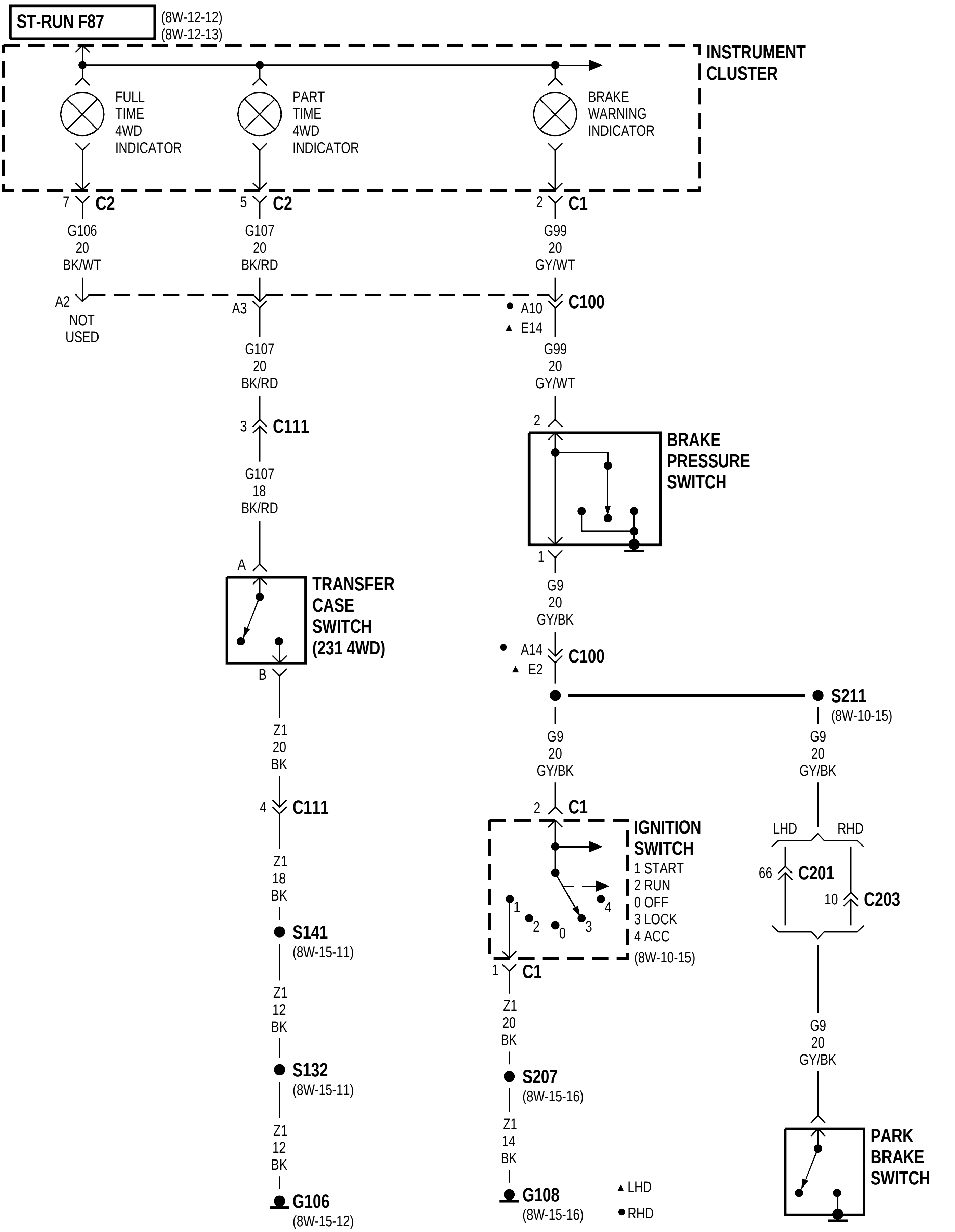

ST-RUN F87
(8W-12-12)
INSTRUMENT CLUSTER
AIRBAG WARNING INDICATOR
SEAT BELT WARNING INDICATOR
LOW WASHER FLUID INDICATOR
ABS INDICATOR
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
AIRBAG WARNING INDICATOR CONTROL
SEAT BELT WARNING INDICATOR CONTROL
LOW WASHER FLUID INDICATOR CONTROL
CCD BUS (+)
CCD BUS (-)
SEAT BELT SWITCH SENSE
LOW WASHER FLUID SWITCH SENSE
2 C2
1 C2
10 C2
7 C1
4 C1
D1 20 VT/BR
D2 20 WT/BK
G10 20 LG/RD
G29 20 BK/LB
G19 20 LG/OR
TWISTED PAIR
A8
E8
F13
69 C201
C100
S239 (8W-30-17)
S238 (8W-30-17)
A
B
SEAT BELT SWITCH
WASHER FLUID LEVEL SWITCH
D1 20 VT/BR
D2 20 WT/BK
Z1 20 BK
S314 (8W-15-13)
Z1 14 BK
14 C201
B16
CONTROLLER ANTI-LOCK BRAKE RELAY (IN PDC) (8W-35-4)
B19
4.0L A/T
OTHER
51
52
C201
S141 (8W-15-8)
S132 (8W-15-4)
Z1 20 BK
S132 (8W-15-8)
D1 18 VT/BR
D2 18 WT/BK
S208 (8W-15-14) (8W-15-15)
Z1 16 BK
Z1 14 BK
19
18
CCD BUS (+)
CCD BUS (-)
AIRBAG CONTROL MODULE (8W-43-2)
G107 (8W-15-14) (8W-15-15)
G106 (8W-15-10)
▲ LHD
● RHD

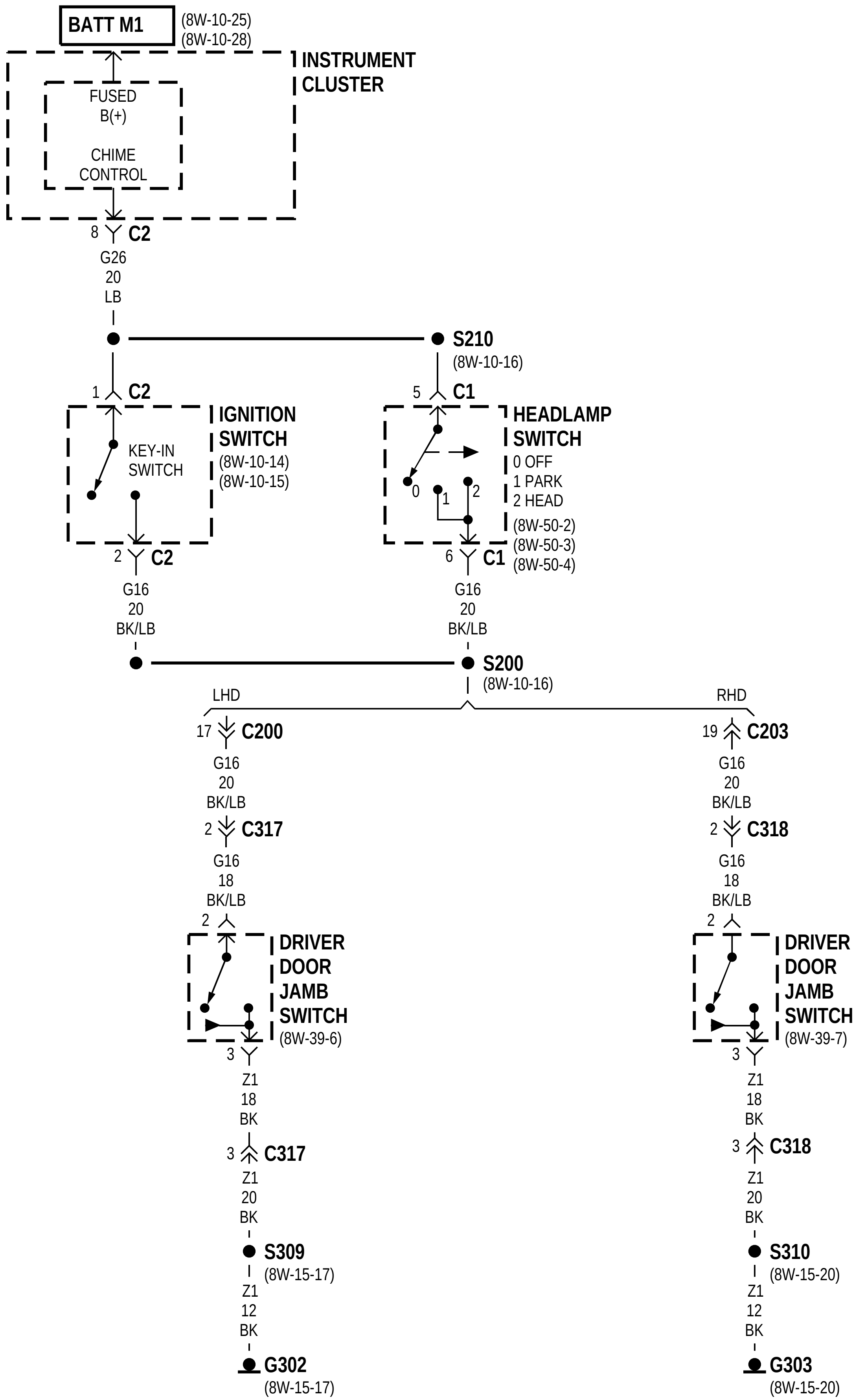


ST-RUN F87
(8W-12-12)
INSTRUMENT CLUSTER
AIRBAG WARNING INDICATOR
SEAT BELT WARNING INDICATOR
LOW WASHER FLUID INDICATOR
ABS INDICATOR
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
AIRBAG WARNING INDICATOR CONTROL
SEAT BELT WARNING INDICATOR CONTROL
LOW WASHER FLUID INDICATOR CONTROL
CCD BUS (+)
CCD BUS (-)
SEAT BELT SWITCH SENSE
LOW WASHER FLUID SWITCH SENSE
2 C2
1 C2
10 C2
7 C1
4 C1
D1 20 VT/BR
D2 20 WT/BK
G10 20 LG/RD
G29 20 BK/LB
G19 20 LG/OR
TWISTED PAIR
69 C201
A8
E8
F13 C100
B16
CONTROLLER ANTI-LOCK BRAKE RELAY (IN PDC)
(8W-35-5)
B19
S239 (8W-30-17)
S238 (8W-30-17)
A
SEAT BELT SWITCH
B
Z1 20 BK/YL
FOG LAMP RELAY (IN PDC)
(8W-50-18)
WASHER FLUID LEVEL SWITCH
B10
Z1 20 BK
S314 (8W-15-13)
Z1 14 BK
51
52 C201
14 C201
Z1 20 BK/YL
12 C106
S141 (8W-15-11)
Z1 12 BK
S103 (8W-15-12)
Z1 18 BK
D1 18 VT/BR
D2 18 WT/BK
S208 (8W-15-15)
S132 (8W-15-11)
11 C106
19
18
AIRBAG CONTROL MODULE
(8W-43-2)
G107 (8W-15-15)
G106 (8W-15-12)
▲ LHD
● RHD

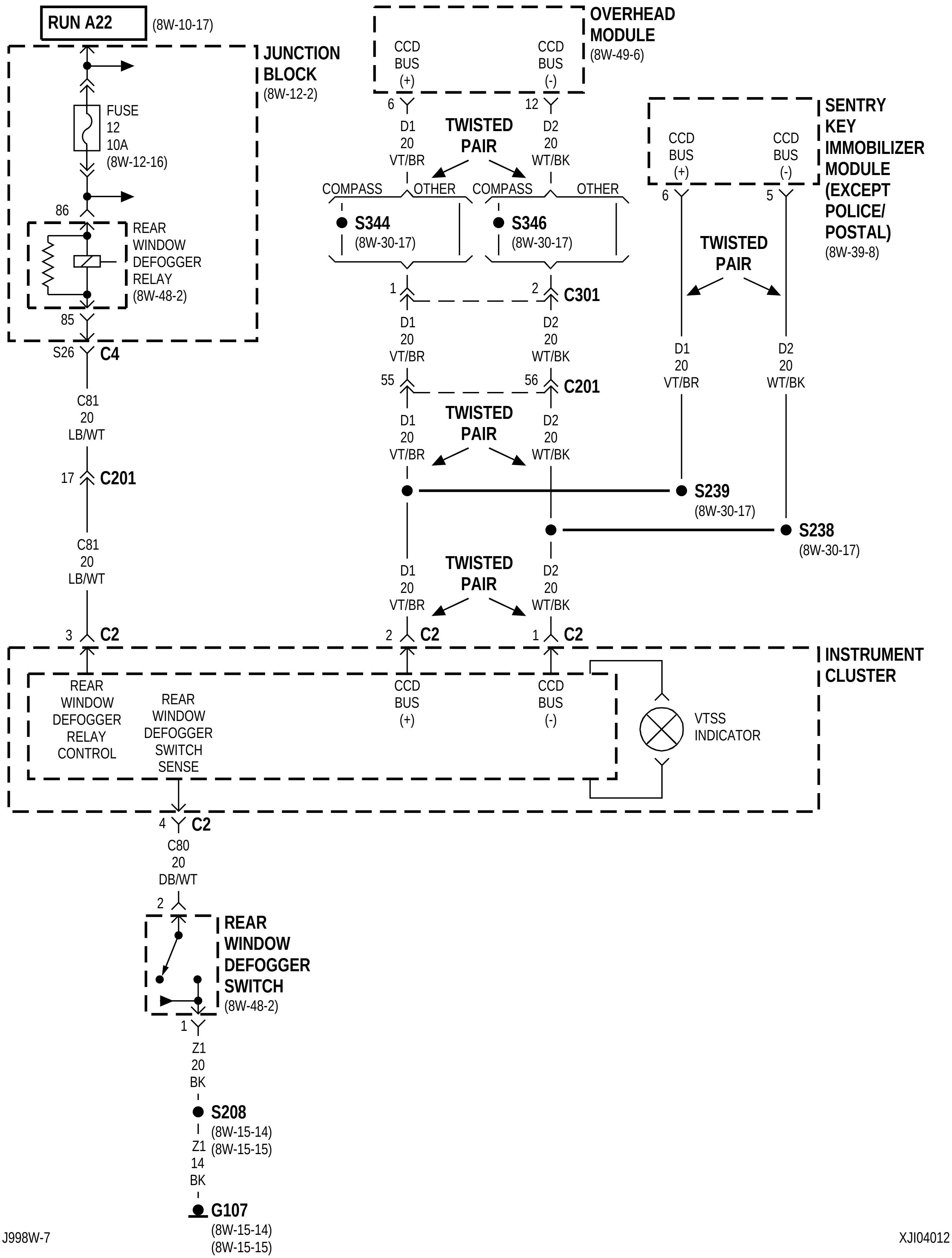

ST-RUN F87
(8W-12-13)
INSTRUMENT CLUSTER
AIRBAG WARNING INDICATOR
SEAT BELT WARNING INDICATOR
LOW WASHER FLUID INDICATOR
ABS INDICATOR
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
AIRBAG WARNING INDICATOR CONTROL
SEAT BELT WARNING INDICATOR CONTROL
LOW WASHER FLUID INDICATOR CONTROL
CCD BUS (+)
CCD BUS (-)
SEAT BELT SWITCH SENSE
LOW WASHER FLUID SWITCH SENSE
2 C2
1 C2
10 C2
7 C1
4 C1
D1 20 VT/BR
D2 20 WT/BK
G10 20 LG/RD
G29 20 BK/LB
G19 20 LG/OR
TWISTED PAIR
12 C203
A8
E8
F13 C100
DIESEL
GAS
S239 (8W-30-18)
S238 (8W-30-18)
A
SEAT BELT SWITCH
B
B16
CONTROLLER ANTI-LOCK BRAKE RELAY (IN PDC) (8W-35-4)
B19
Z1 20 BK
S313 (8W-15-18)
Z1 20 BK/YL
FOG LAMP RELAY (IN PDC) (8W-50-18)
B10
WASHER FLUID LEVEL SWITCH
S309 (8W-15-18)
Z1 12 BK
G302 (8W-15-18)
1
2
C204
D1 18 VT/BR
D2 18 WT/BK
19
18
AIRBAG CONTROL MODULE (8W-43-3)
12 C106
S141 (8W-15-6) (8W-15-11)
Z1 16 BK
S132 (8W-15-11)
S103 (8W-15-12)
Z1 18 BK
11 C106
S132 (8W-15-6)
Z1 14 BK
G106 (8W-15-7)
G106 (8W-15-10) (8W-15-12)
LHD
RHD


ST-RUN F87
(8W-12-12)
(8W-12-13)
INSTRUMENT CLUSTER
FULL TIME 4WD INDICATOR
PART TIME 4WD INDICATOR
BRAKE WARNING INDICATOR
7 C2
5 C2
2 C1
G106 20 BK/WT
G107 20 BK/RD
G99 20 GY/WT
A2
A3
A10
E14
C100
13
8 C107
2
BRAKE WARNING PRESSURE SWITCH
1
G9 20 GY/BK
A14
E2
C100
S211
(8W-10-14)
242 4WD
231 4WD
B
D
A
TRANSFER CASE SWITCH
FULL TIME
PART TIME
A
B
Z1 18 BK
2 C1
IGNITION SWITCH
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
(8W-10-14)
1 C1
LHD
RHD
66 C201
10 C203
Z1 20 BK
S107
(8W-15-2)
S207
(8W-15-16)
Z1 16 BK
Z1 14 BK
G101
(8W-15-2)
G108
(8W-15-16)
PARK BRAKE SWITCH
▲ LHD
● RHD


ST-RUN F87
(8W-12-12)
(8W-12-13)
INSTRUMENT CLUSTER
FULL TIME 4WD INDICATOR
PART TIME 4WD INDICATOR
BRAKE WARNING INDICATOR
7 C2
5 C2
2 C1
G106 20 BK/WT
G107 20 BK/RD
G99 20 GY/WT
A2 NOT USED
A3
A10
E14
C100
G107 20 BK/RD
G99 20 GY/WT
3 C111
G107 18 BK/RD
2
BRAKE PRESSURE SWITCH
1
A
TRANSFER CASE SWITCH (231 4WD)
B
G9 20 GY/BK
A14
E2
C100
S211
(8W-10-15)
Z1 20 BK
G9 20 GY/BK
G9 20 GY/BK
4 C111
2 C1
IGNITION SWITCH
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
(8W-10-15)
LHD
RHD
66 C201
10 C203
Z1 18 BK
S141
(8W-15-11)
1 C1
Z1 12 BK
Z1 20 BK
G9 20 GY/BK
S132
(8W-15-11)
S207
(8W-15-16)
Z1 12 BK
Z1 14 BK
PARK BRAKE SWITCH
G106
(8W-15-12)
G108
(8W-15-16)
▲ LHD
● RHD


BATT M1
(8W-10-25)
(8W-10-28)
INSTRUMENT
CLUSTER
FUSED
B(+)
CHIME
CONTROL
8 C2
G26
20
LB
S210
(8W-10-16)
1 C2
IGNITION
SWITCH
(8W-10-14)
(8W-10-15)
KEY-IN
SWITCH
2 C2
G16
20
BK/LB
5 C1
HEADLAMP
SWITCH
0 OFF
1 PARK
2 HEAD
(8W-50-2)
(8W-50-3)
(8W-50-4)
6 C1
G16
20
BK/LB
S200
(8W-10-16)
LHD
RHD
17 C200
G16
20
BK/LB
2 C317
G16
18
BK/LB
DRIVER
DOOR
JAMB
SWITCH
(8W-39-6)
3
Z1
18
BK
3 C317
Z1
20
BK
S309
(8W-15-17)
Z1
12
BK
G302
(8W-15-17)
19 C203
G16
20
BK/LB
2 C318
G16
18
BK/LB
DRIVER
DOOR
JAMB
SWITCH
(8W-39-7)
Z1
18
BK
3 C318
Z1
20
BK
S310
(8W-15-20)
Z1
12
BK
G303
(8W-15-20)

LHD



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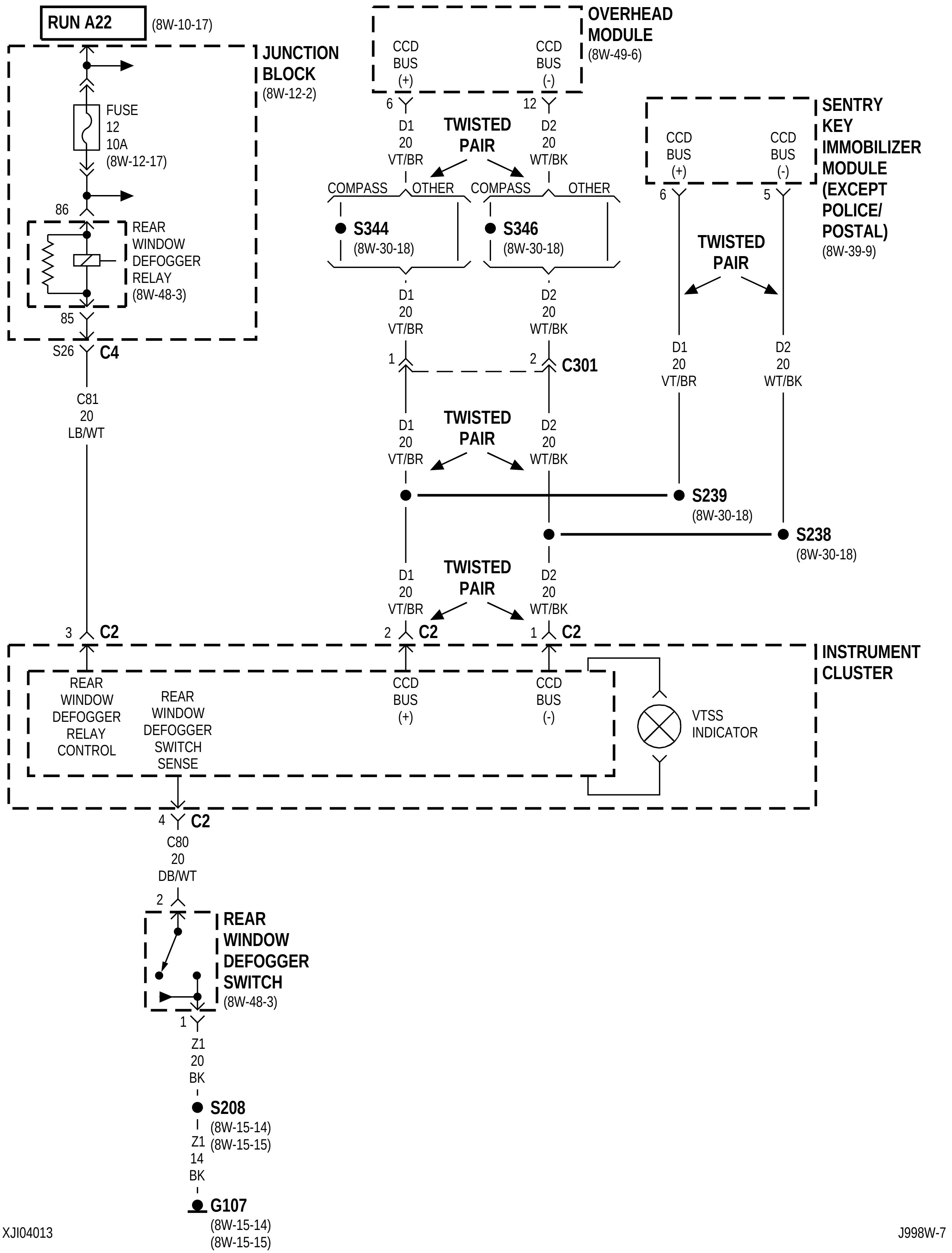
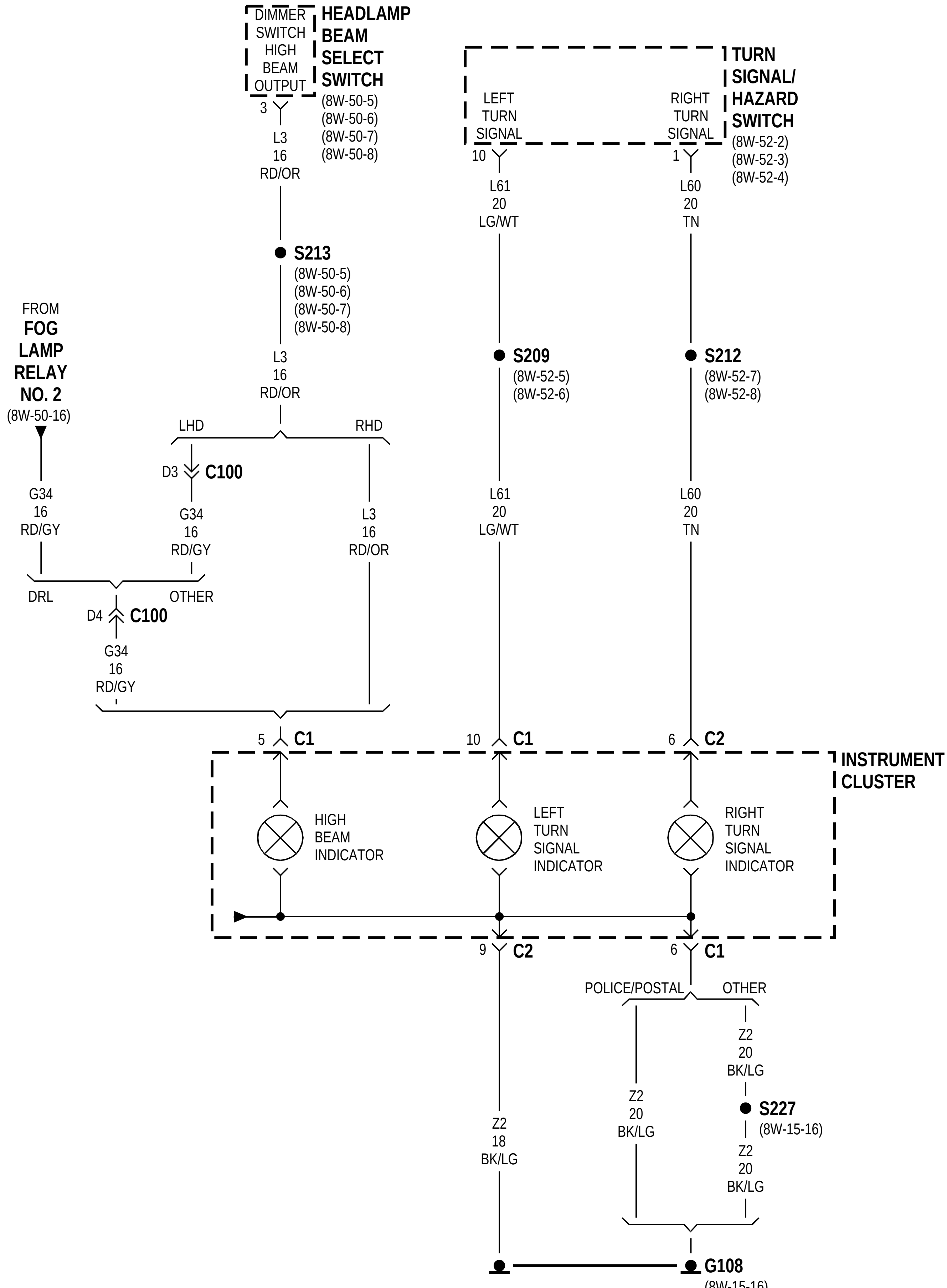
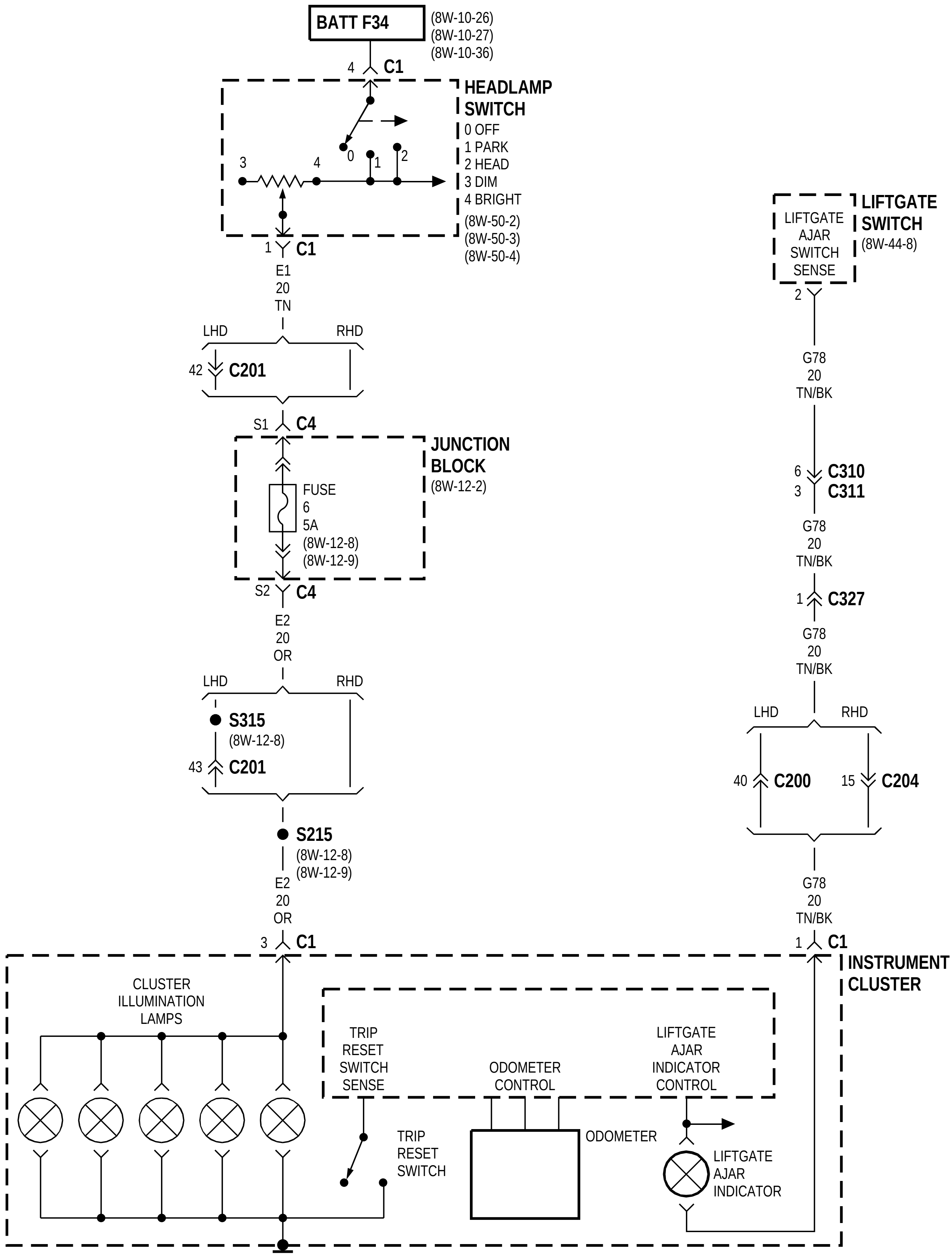
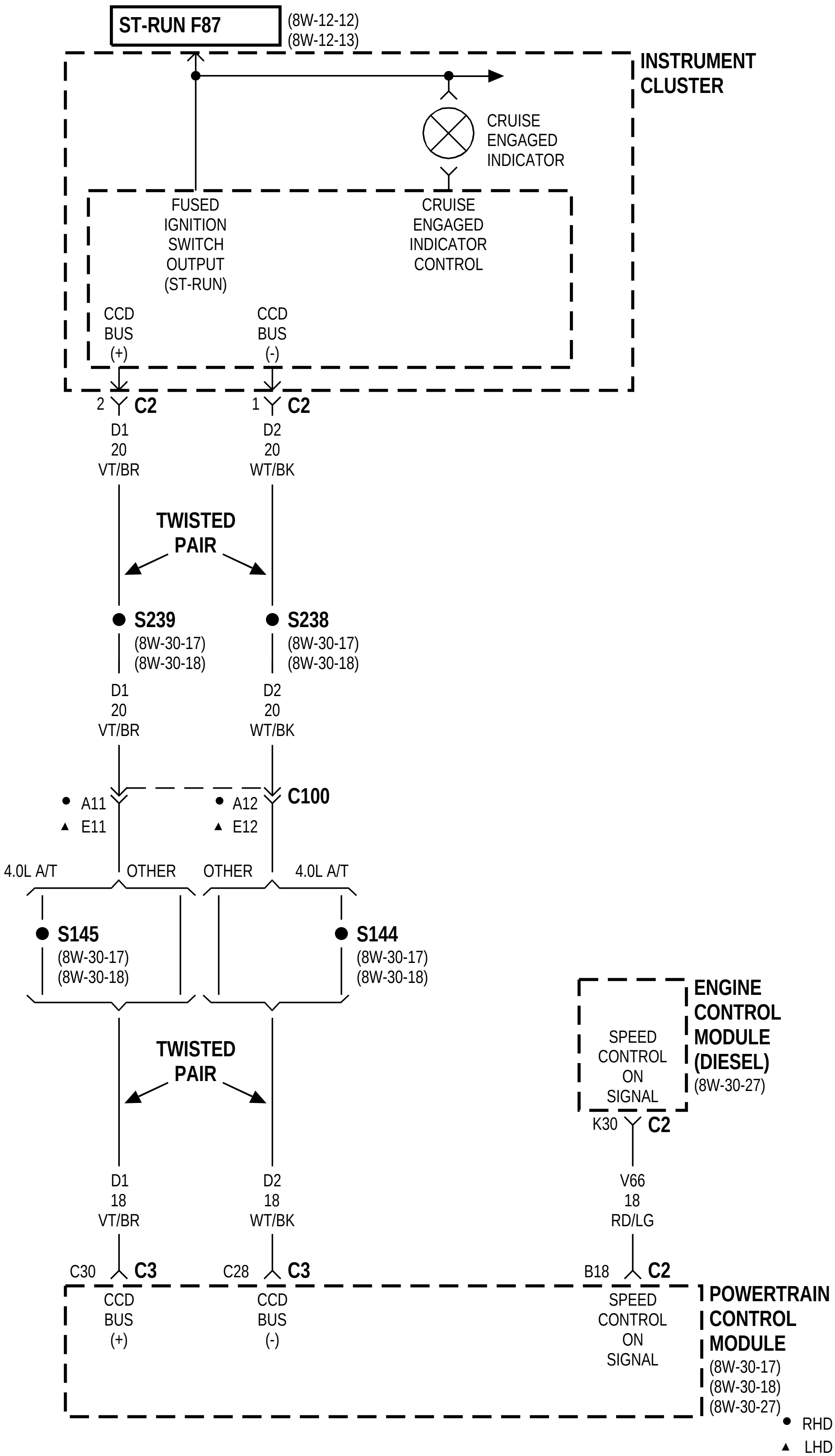
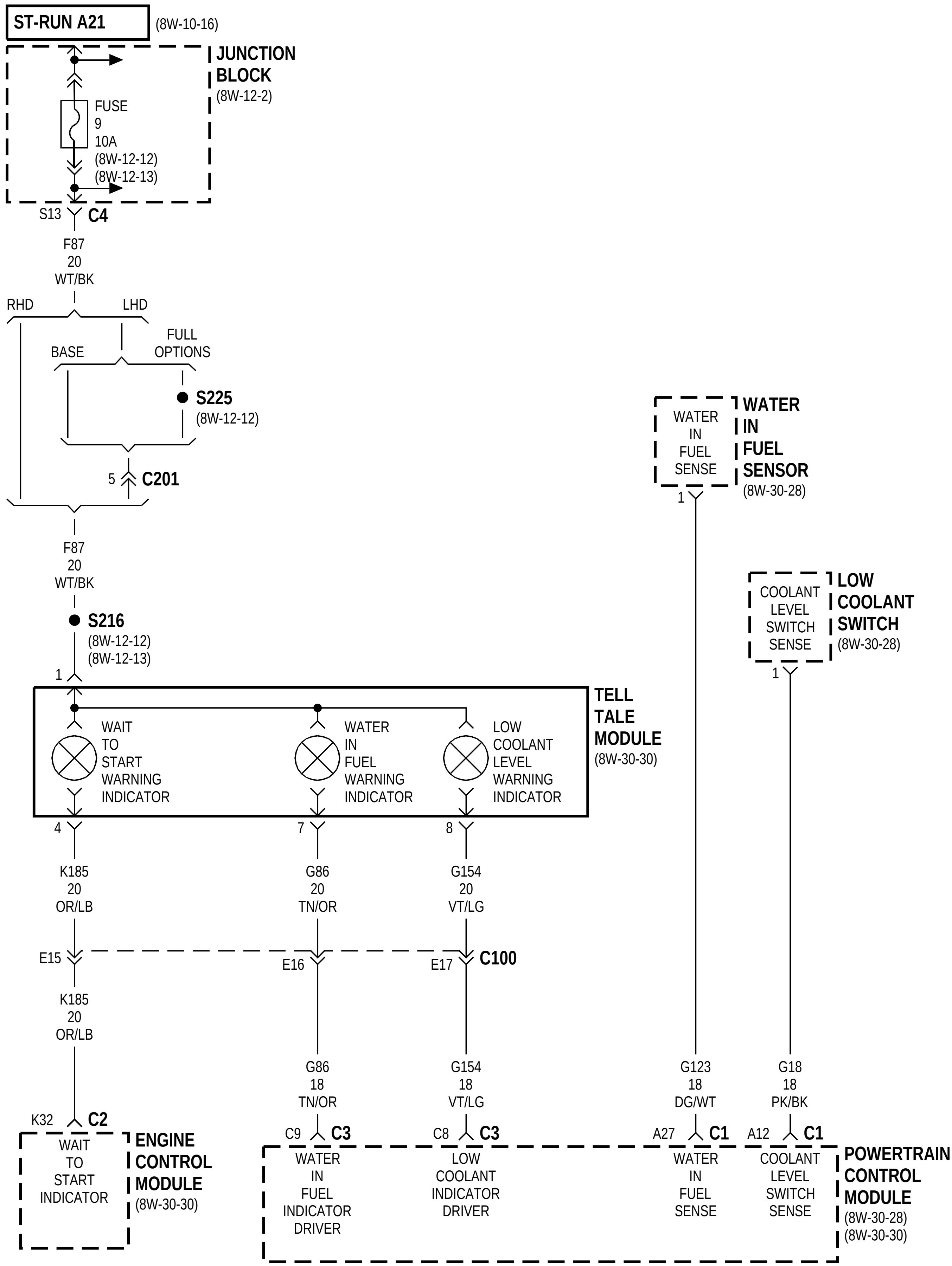

RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE
12
10A
(8W-12-17)
86
REAR WINDOW DEFOGGER RELAY
(8W-48-3)
85
S26
C4
C81
20
LB/WT
OVERHEAD MODULE
(8W-49-6)
CCD BUS (+)
CCD BUS (-)
6
12
D1
20
VT/BR
D2
20
WT/BK
TWISTED PAIR
COMPASS
OTHER
S344
(8W-30-18)
S346
(8W-30-18)
1
2
C301
SENTRY KEY IMMOBILIZER MODULE (EXCEPT POLICE/ POSTAL)
(8W-39-9)
5
S239
(8W-30-18)
S238
(8W-30-18)
3
C2
INSTRUMENT CLUSTER
REAR WINDOW DEFOGGER RELAY CONTROL
REAR WINDOW DEFOGGER SWITCH SENSE
VTSS INDICATOR
4
C80
20
DB/WT
REAR WINDOW DEFOGGER SWITCH
(8W-48-3)
Z1
20
BK
S208
(8W-15-14)
(8W-15-15)
Z1
14
BK
G107
(8W-15-14)
(8W-15-15)


DIMMER SWITCH HIGH BEAM OUTPUT
HEADLAMP BEAM SELECT SWITCH
(8W-50-5)
(8W-50-6)
(8W-50-7)
(8W-50-8)
3
L3 16 RD/OR
S213
(8W-50-5)
(8W-50-6)
(8W-50-7)
(8W-50-8)
L3 16 RD/OR
LHD
RHD
D3
C100
G34 16 RD/GY
L3 16 RD/OR
FROM FOG LAMP RELAY NO. 2
(8W-50-16)
G34 16 RD/GY
DRL
OTHER
D4
C100
G34 16 RD/GY
TURN SIGNAL/ HAZARD SWITCH
(8W-52-2)
(8W-52-3)
(8W-52-4)
LEFT TURN SIGNAL
RIGHT TURN SIGNAL
10
1
L61 20 LG/WT
L60 20 TN
S209
(8W-52-5)
(8W-52-6)
S212
(8W-52-7)
(8W-52-8)
L61 20 LG/WT
L60 20 TN
5
C1
10
C1
6
C2
INSTRUMENT CLUSTER
HIGH BEAM INDICATOR
LEFT TURN SIGNAL INDICATOR
RIGHT TURN SIGNAL INDICATOR
9
C2
6
C1
POLICE/POSTAL
OTHER
Z2 20 BK/LG
S227
(8W-15-16)
Z2 20 BK/LG
Z2 20 BK/LG
Z2 18 BK/LG
G108
(8W-15-16)

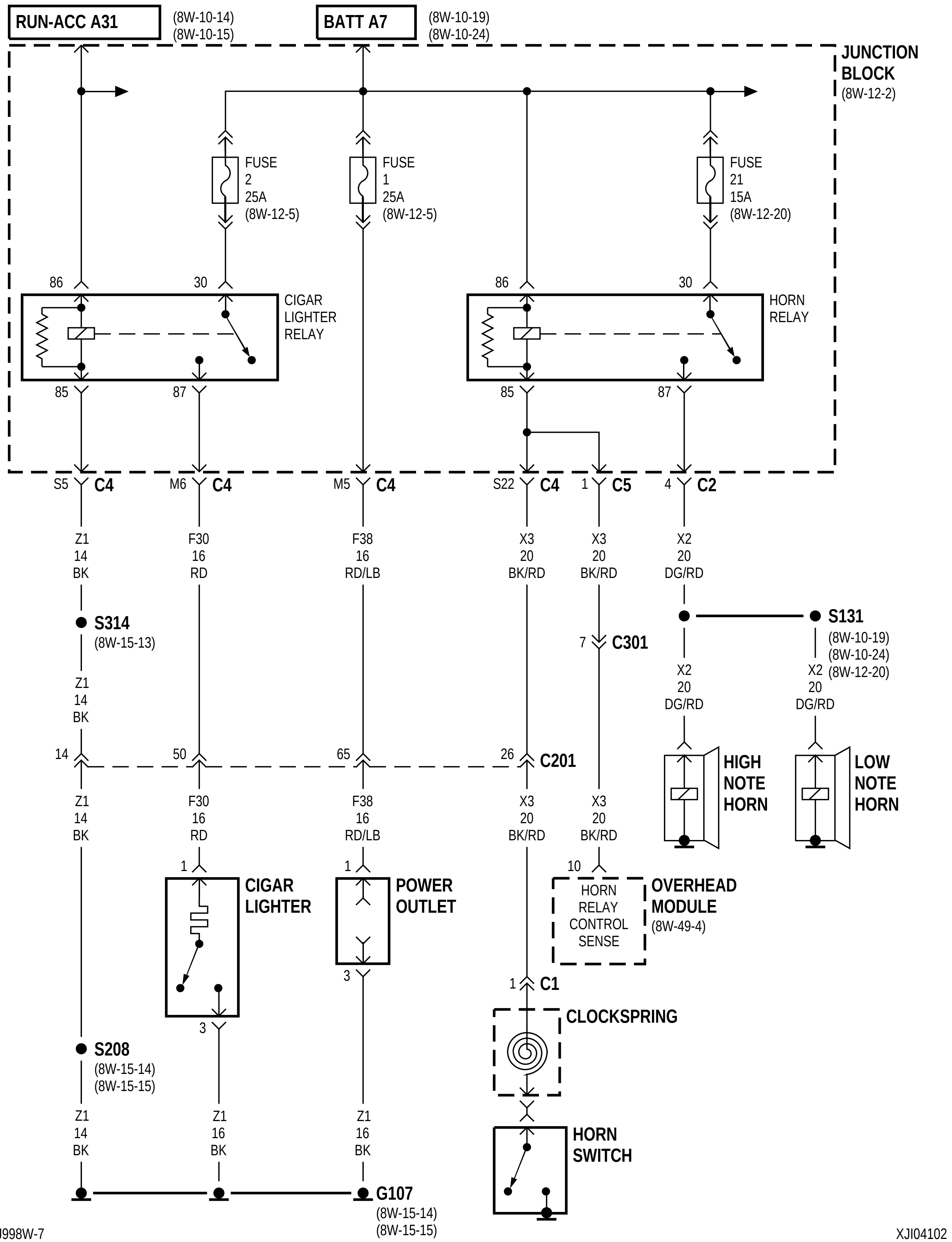


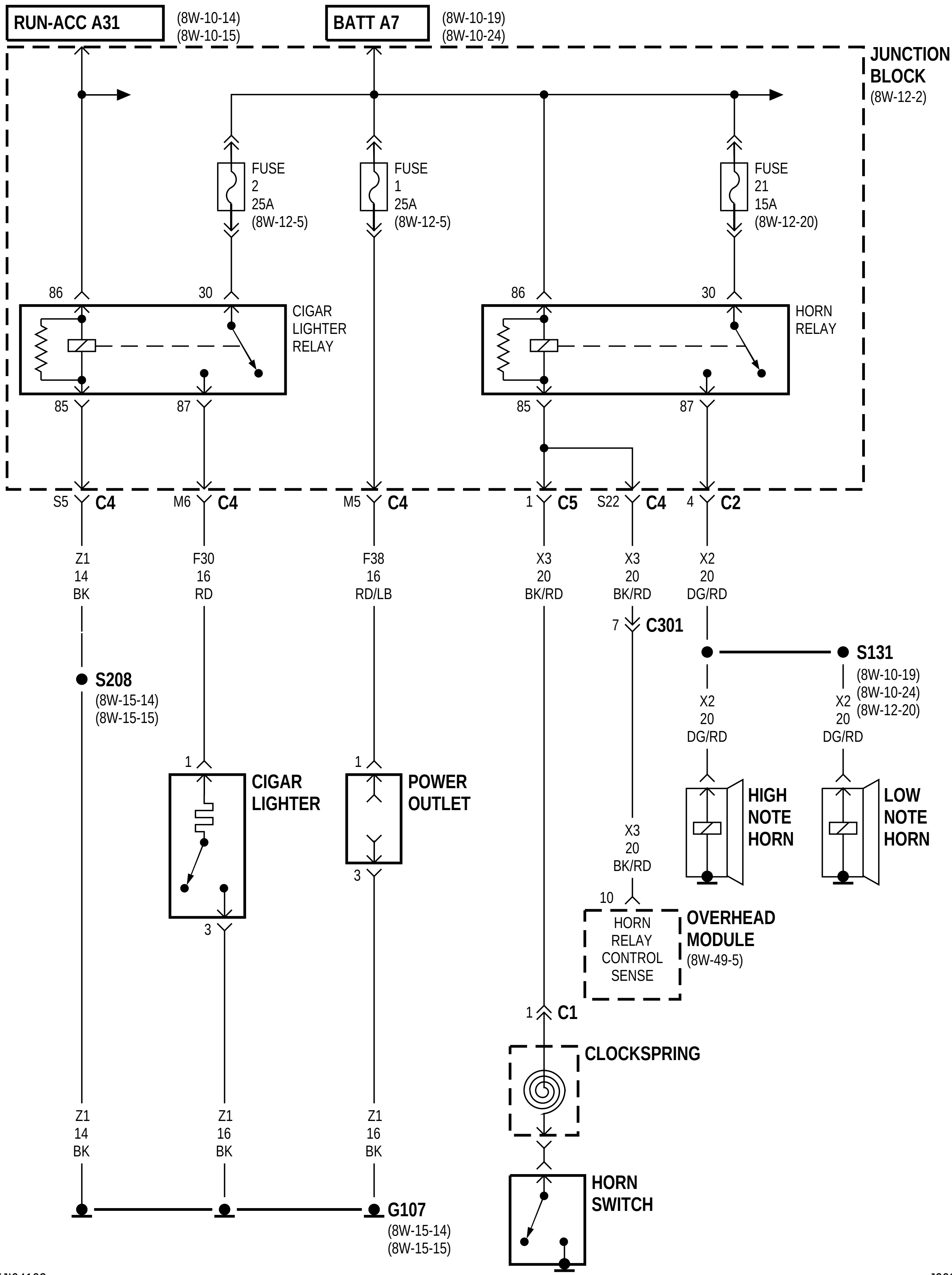
BATT F34
(8W-10-26)
(8W-10-27)
(8W-10-36)
4 C1
HEADLAMP SWITCH
0 OFF
1 PARK
2 HEAD
3 DIM
4 BRIGHT
(8W-50-2)
(8W-50-3)
(8W-50-4)
3 4 0 1 2
1 C1
E1 20 TN
LHD RHD
42 C201
S1 C4
JUNCTION BLOCK
(8W-12-2)
FUSE 6 5A
(8W-12-8)
(8W-12-9)
S2 C4
E2 20 OR
LHD RHD
S315
(8W-12-8)
43 C201
S215
(8W-12-8)
(8W-12-9)
E2 20 OR
3 C1
LIFTGATE SWITCH
LIFTGATE AJAR SWITCH SENSE
(8W-44-8)
2
G78 20 TN/BK
6 C310
3 C311
G78 20 TN/BK
1 C327
G78 20 TN/BK
LHD RHD
40 C200
15 C204
G78 20 TN/BK
1 C1
INSTRUMENT CLUSTER
CLUSTER ILLUMINATION LAMPS
TRIP RESET SWITCH SENSE
ODOMETER CONTROL
LIFTGATE AJAR INDICATOR CONTROL
TRIP RESET SWITCH
ODOMETER
LIFTGATE AJAR INDICATOR


ST-RUN F87
(8W-12-12)
(8W-12-13)
INSTRUMENT CLUSTER
CRUISE ENGAGED INDICATOR
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
CRUISE ENGAGED INDICATOR CONTROL
CCD BUS (+)
CCD BUS (-)
2 C2
1 C2
D1 20 VT/BR
D2 20 WT/BK
TWISTED PAIR
S239 (8W-30-17) (8W-30-18)
S238 (8W-30-17) (8W-30-18)
D1 20 VT/BR
D2 20 WT/BK
A11 E11
A12 E12
C100
4.0L A/T
OTHER
OTHER
4.0L A/T
S145 (8W-30-17) (8W-30-18)
S144 (8W-30-17) (8W-30-18)
TWISTED PAIR
ENGINE CONTROL MODULE (DIESEL) (8W-30-27)
SPEED CONTROL ON SIGNAL
K30 C2
V66 18 RD/LG
D1 18 VT/BR
D2 18 WT/BK
C30 C3
C28 C3
B18 C2
CCD BUS (+)
CCD BUS (-)
SPEED CONTROL ON SIGNAL
POWERTRAIN CONTROL MODULE (8W-30-17) (8W-30-18) (8W-30-27)
RHD
LHD


ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE
9
10A
(8W-12-12)
(8W-12-13)
S13
C4
F87
20
WT/BK
RHD
LHD
BASE
FULL OPTIONS
S225
(8W-12-12)
5
C201
F87
20
WT/BK
S216
(8W-12-12)
(8W-12-13)
1
TELL TALE MODULE
(8W-30-30)
WAIT TO START WARNING INDICATOR
WATER IN FUEL WARNING INDICATOR
LOW COOLANT LEVEL WARNING INDICATOR
4
7
8
K185
20
OR/LB
G86
20
TN/OR
G154
20
VT/LG
E15
E16
E17
C100
K185
20
OR/LB
G86
18
TN/OR
G154
18
VT/LG
WATER IN FUEL SENSE
WATER IN FUEL SENSOR
(8W-30-28)
1
COOLANT LEVEL SWITCH SENSE
LOW COOLANT SWITCH
(8W-30-28)
1
G123
18
DG/WT
G18
18
PK/BK
K32
C2
WAIT TO START INDICATOR
ENGINE CONTROL MODULE
(8W-30-30)
C9
C3
C8
C3
A27
C1
A12
C1
WATER IN FUEL INDICATOR DRIVER
LOW COOLANT INDICATOR DRIVER
WATER IN FUEL SENSE
COOLANT LEVEL SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-28)
(8W-30-30)

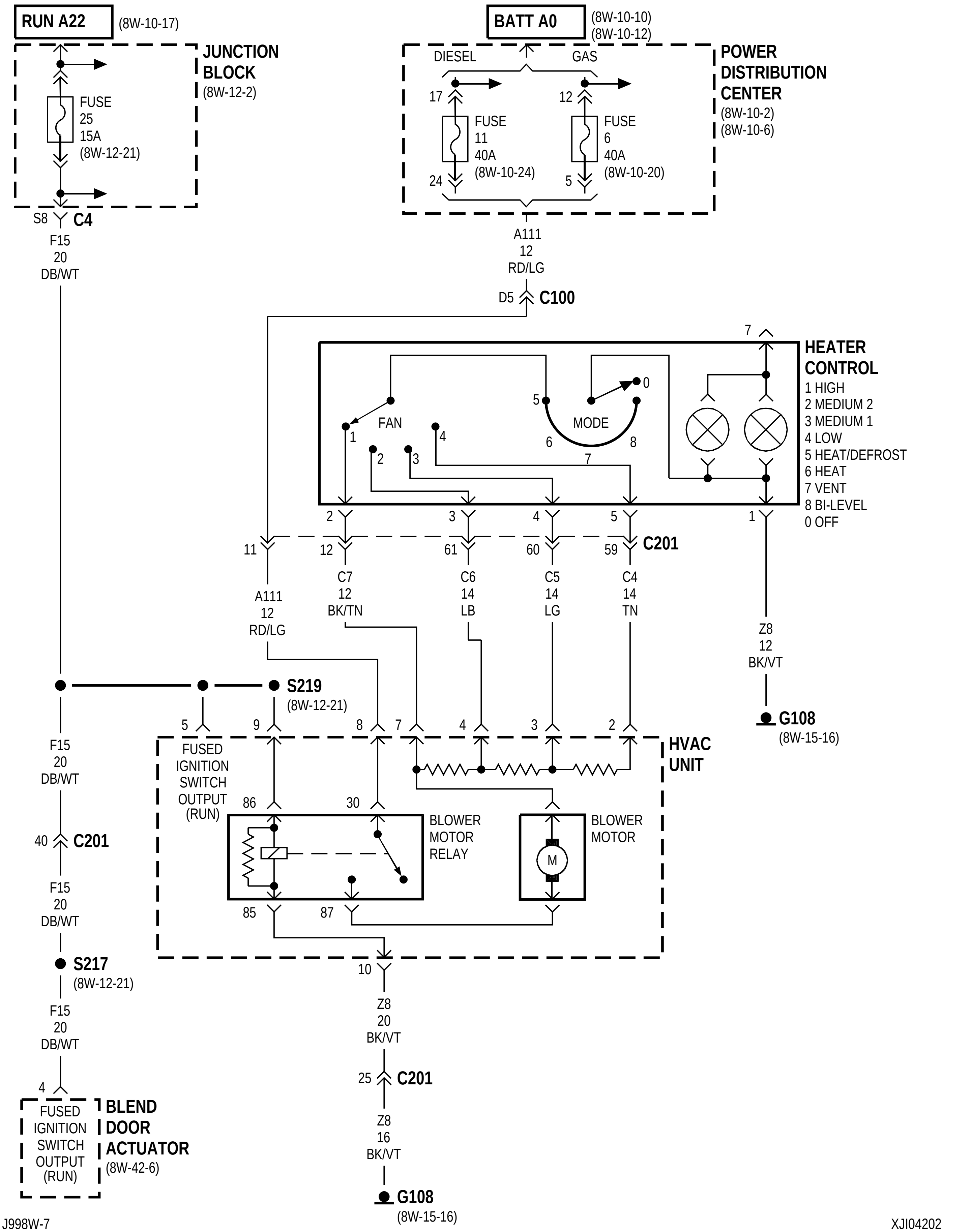
8W-41 HORN/CIGAR LIGHTER/POWER OUTLET


RUN-ACC A31
(8W-10-14)
(8W-10-15)
BATT A7
(8W-10-19)
(8W-10-24)
JUNCTION BLOCK
(8W-12-2)
FUSE 2 25A (8W-12-5)
FUSE 1 25A (8W-12-5)
FUSE 21 15A (8W-12-20)
86
30
CIGAR LIGHTER RELAY
85
87
HORN RELAY
S5 C4
M6 C4
M5 C4
S22 C4
1 C5
4 C2
Z1 14 BK
F30 16 RD
F38 16 RD/LB
X3 20 BK/RD
X2 20 DG/RD
S314
(8W-15-13)
7 C301
S131
(8W-10-19)
(8W-10-24)
(8W-12-20)
14
50
65
26 C201
HIGH NOTE HORN
LOW NOTE HORN
1
CIGAR LIGHTER
POWER OUTLET
3
10
HORN RELAY CONTROL SENSE
OVERHEAD MODULE
(8W-49-4)
1 C1
CLOCKSPRING
HORN SWITCH
S208
(8W-15-14)
(8W-15-15)
Z1 16 BK
G107
(8W-15-14)
(8W-15-15)

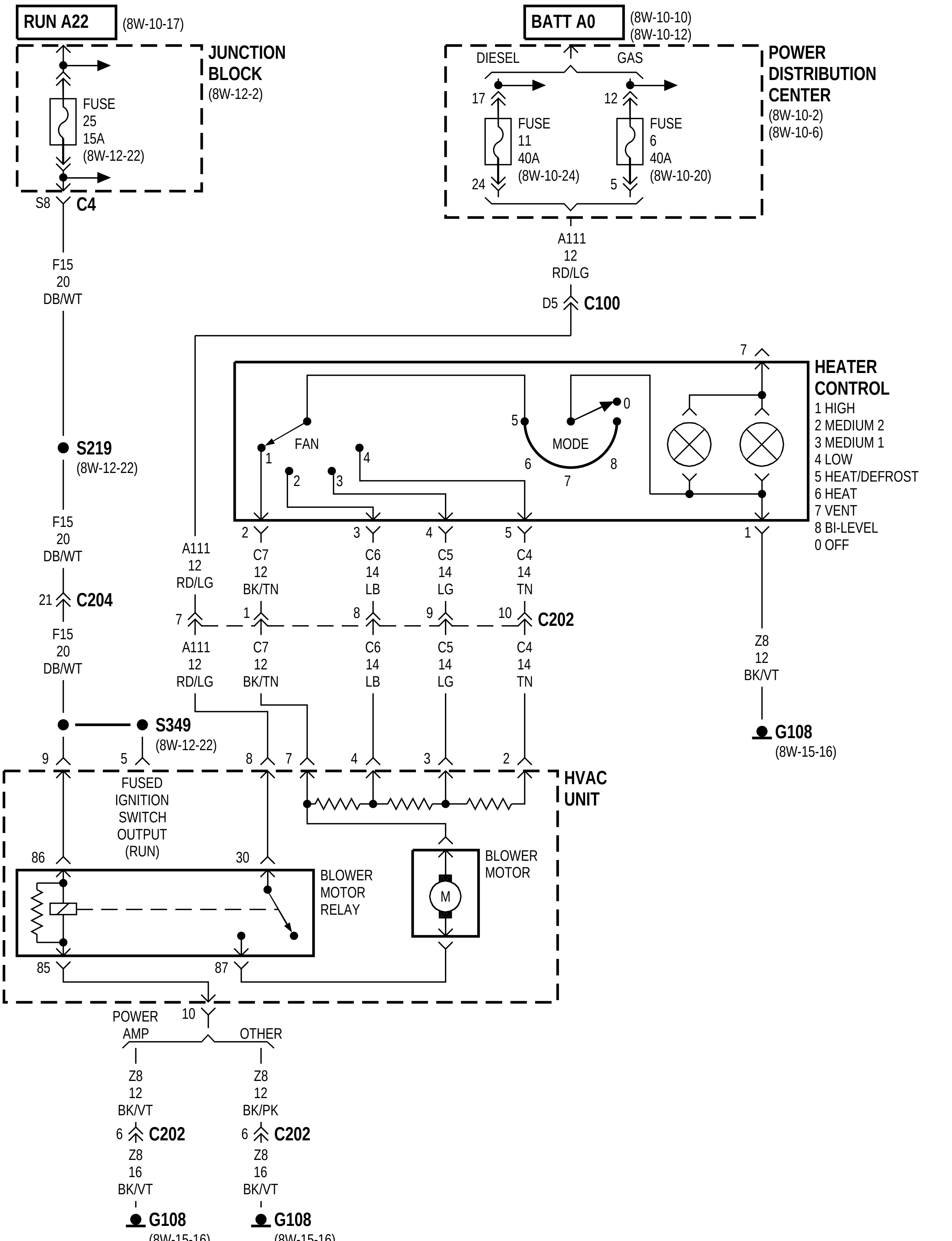

RUN-ACC A31
(8W-10-14)
(8W-10-15)
BATT A7
(8W-10-19)
(8W-10-24)
JUNCTION BLOCK
(8W-12-2)
FUSE 2 25A (8W-12-5)
FUSE 1 25A (8W-12-5)
FUSE 21 15A (8W-12-20)
86
30
CIGAR LIGHTER RELAY
85
87
HORN RELAY
S5 C4
M6 C4
M5 C4
1 C5
S22 C4
4 C2
Z1 14 BK
F30 16 RD
F38 16 RD/LB
X3 20 BK/RD
X2 20 DG/RD
7 C301
S131
(8W-10-19)
(8W-10-24)
(8W-12-20)
S208
(8W-15-14)
(8W-15-15)
CIGAR LIGHTER
POWER OUTLET
1
3
HIGH NOTE HORN
LOW NOTE HORN
10
HORN RELAY CONTROL SENSE
OVERHEAD MODULE
(8W-49-5)
1 C1
CLOCKSPRING
Z1 16 BK
HORN SWITCH
G107
(8W-15-14)
(8W-15-15)

8W-42 AIR CONDITIONING-HEATER

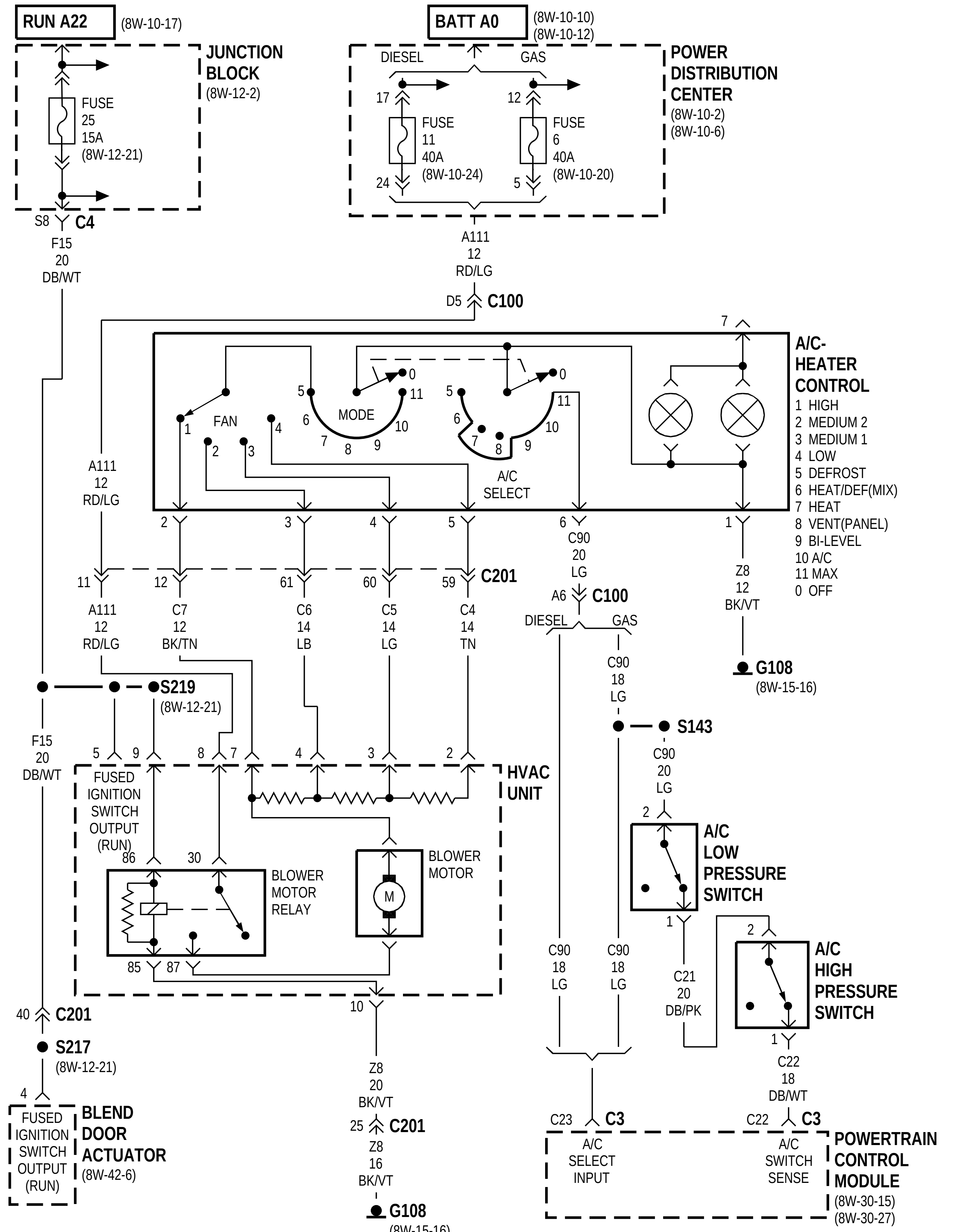
LHD HEATER ONLY

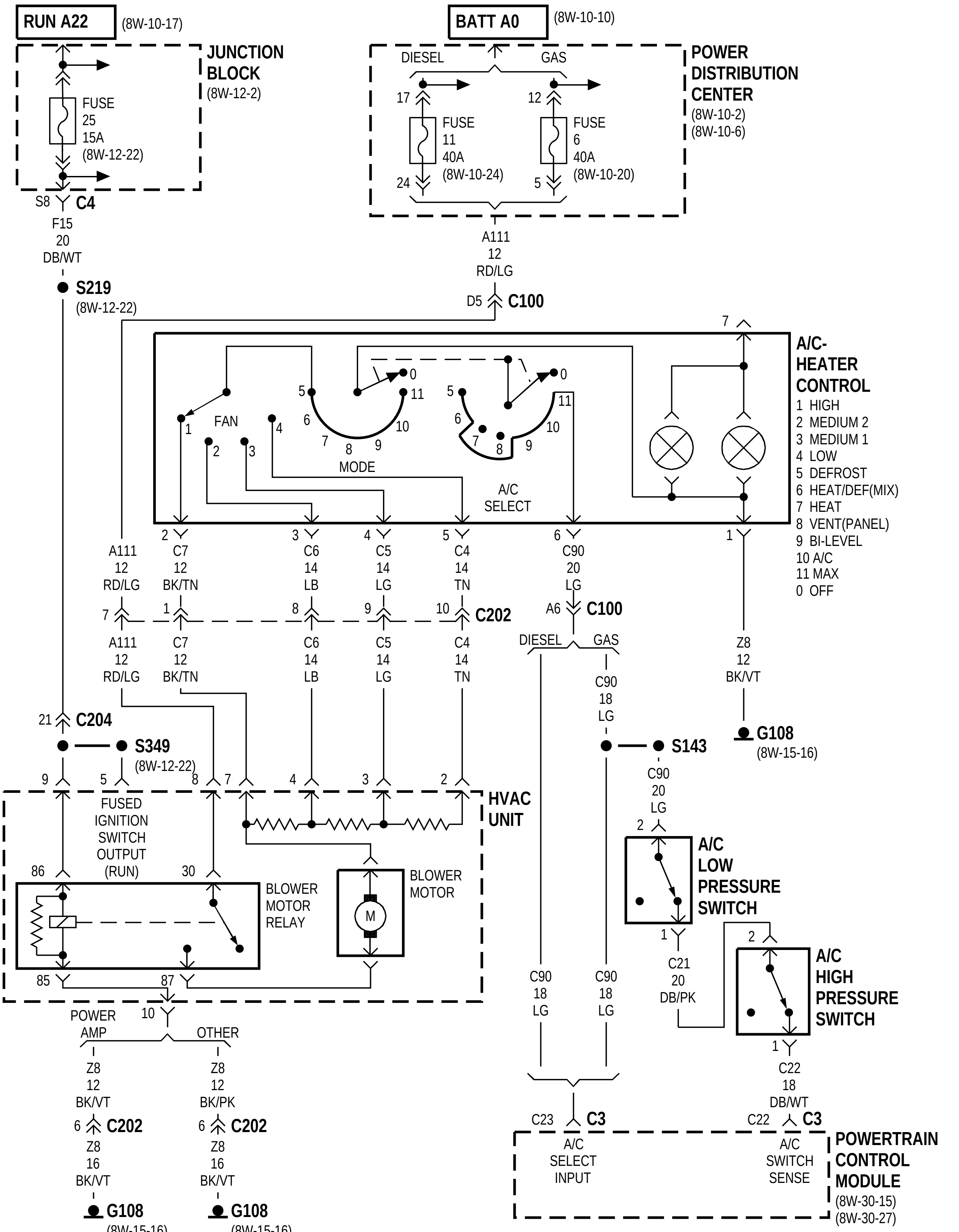


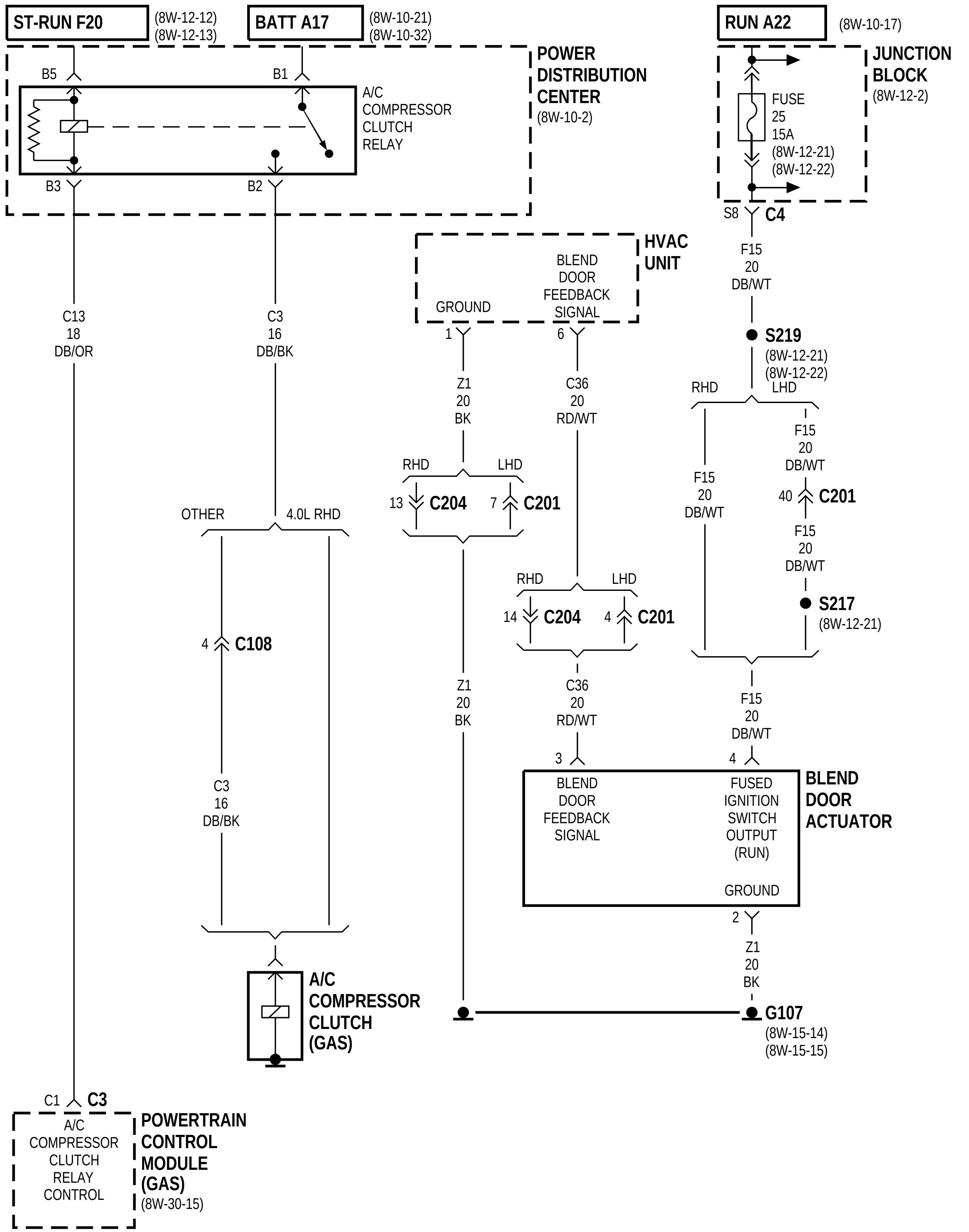
RHD HEATER ONLY



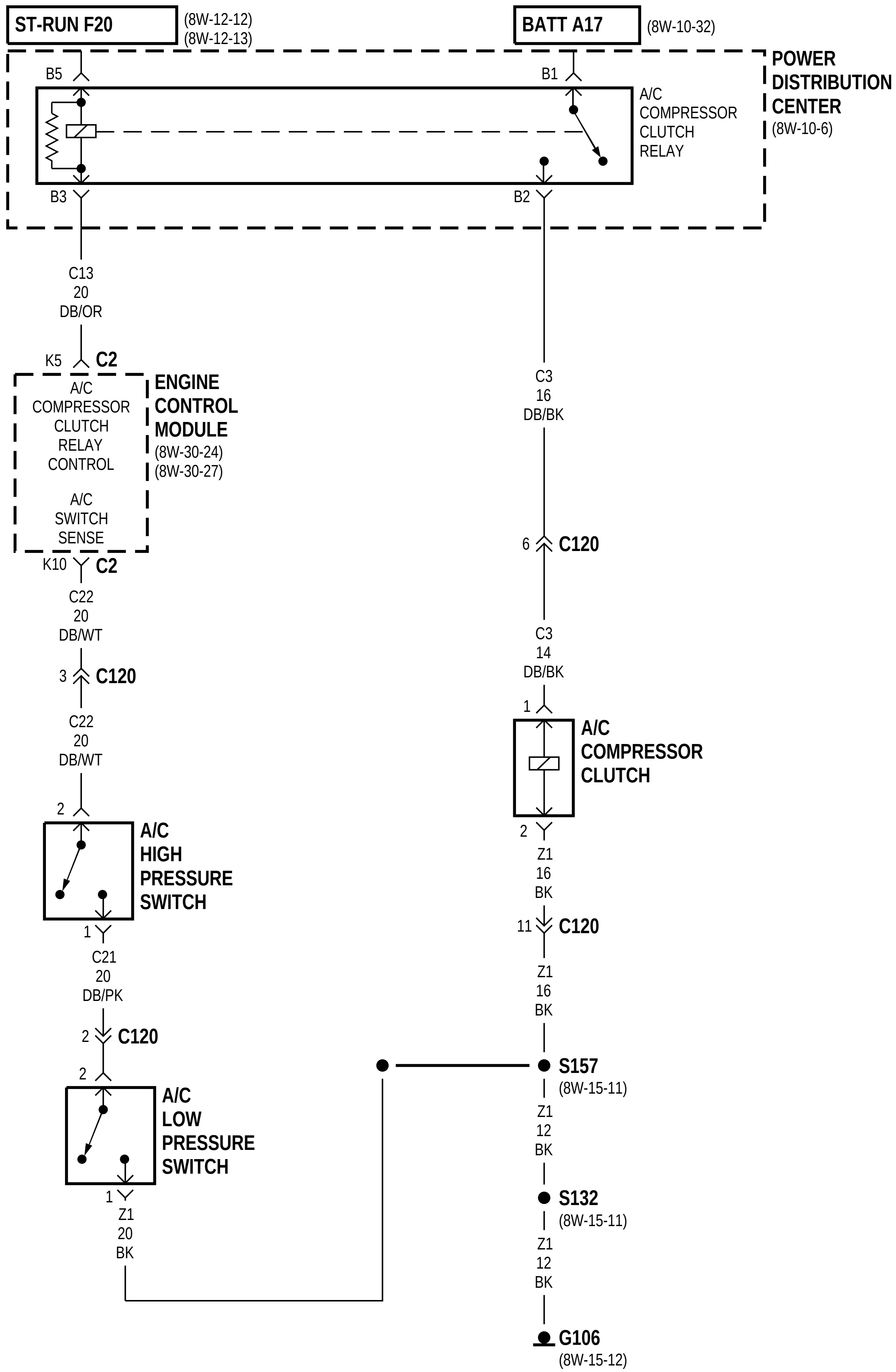
LHD

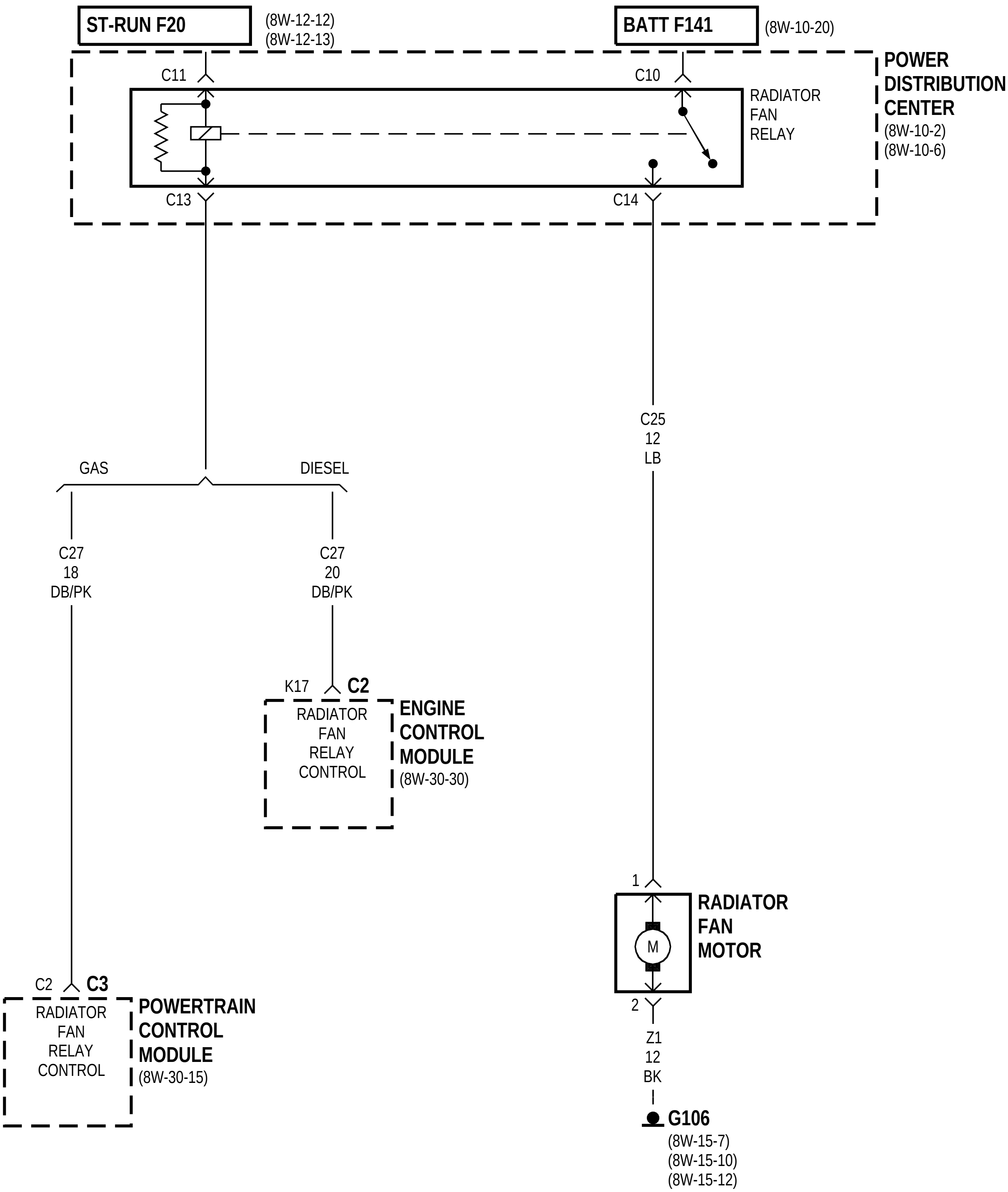

RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE 25 15A (8W-12-21)
S8 C4
F15 20 DB/WT
BATT A0
(8W-10-10)
(8W-10-12)
DIESEL
GAS
POWER DISTRIBUTION CENTER
(8W-10-2)
(8W-10-6)
FUSE 11 40A (8W-10-24)
FUSE 6 40A (8W-10-20)
A111 12 RD/LG
D5 C100
A/C-HEATER CONTROL
FAN
MODE
A/C SELECT
1 HIGH
2 MEDIUM 2
3 MEDIUM 1
4 LOW
5 DEFROST
6 HEAT/DEF(MIX)
7 HEAT
8 VENT(PANEL)
9 BI-LEVEL
10 A/C
11 MAX
0 OFF
C90 20 LG
C201
A6 C100
Z8 12 BK/VT
G108
(8W-15-16)
C7 12 BK/TN
C6 14 LB
C5 14 LG
C4 14 TN
C90 18 LG
S219
(8W-12-21)
S143
F15 20 DB/WT
FUSED IGNITION SWITCH OUTPUT (RUN)
HVAC UNIT
BLOWER MOTOR RELAY
BLOWER MOTOR
M
A/C LOW PRESSURE SWITCH
A/C HIGH PRESSURE SWITCH
C21 20 DB/PK
C22 18 DB/WT
40 C201
S217
(8W-12-21)
BLEND DOOR ACTUATOR
(8W-42-6)
Z8 20 BK/VT
25 C201
Z8 16 BK/VT
G108
(8W-15-16)
C23 C3
C22 C3
A/C SELECT INPUT
A/C SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-15)
(8W-30-27)


RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE 25 15A (8W-12-22)
S8 C4
F15 20 DB/WT
S219 (8W-12-22)
BATT A0
(8W-10-10)
DIESEL
GAS
POWER DISTRIBUTION CENTER
(8W-10-2)
(8W-10-6)
FUSE 11 40A (8W-10-24)
FUSE 6 40A (8W-10-20)
A111 12 RD/LG
D5 C100
A/C-HEATER CONTROL
1 HIGH
2 MEDIUM 2
3 MEDIUM 1
4 LOW
5 DEFROST
6 HEAT/DEF(MIX)
7 HEAT
8 VENT(PANEL)
9 BI-LEVEL
10 A/C
11 MAX
0 OFF
FAN
MODE
A/C SELECT
A111 12 RD/LG
C7 12 BK/TN
C6 14 LB
C5 14 LG
C4 14 TN
C90 20 LG
A6 C100
C202
Z8 12 BK/VT
G108 (8W-15-16)
C204
S349 (8W-12-22)
S143
C90 18 LG
C90 20 LG
HVAC UNIT
FUSED IGNITION SWITCH OUTPUT (RUN)
BLOWER MOTOR RELAY
BLOWER MOTOR
POWER AMP
OTHER
Z8 12 BK/PK
Z8 16 BK/VT
A/C LOW PRESSURE SWITCH
C21 20 DB/PK
A/C HIGH PRESSURE SWITCH
C22 18 DB/WT
C23 C3
C22 C3
POWERTRAIN CONTROL MODULE
(8W-30-15)
(8W-30-27)
A/C SELECT INPUT
A/C SWITCH SENSE



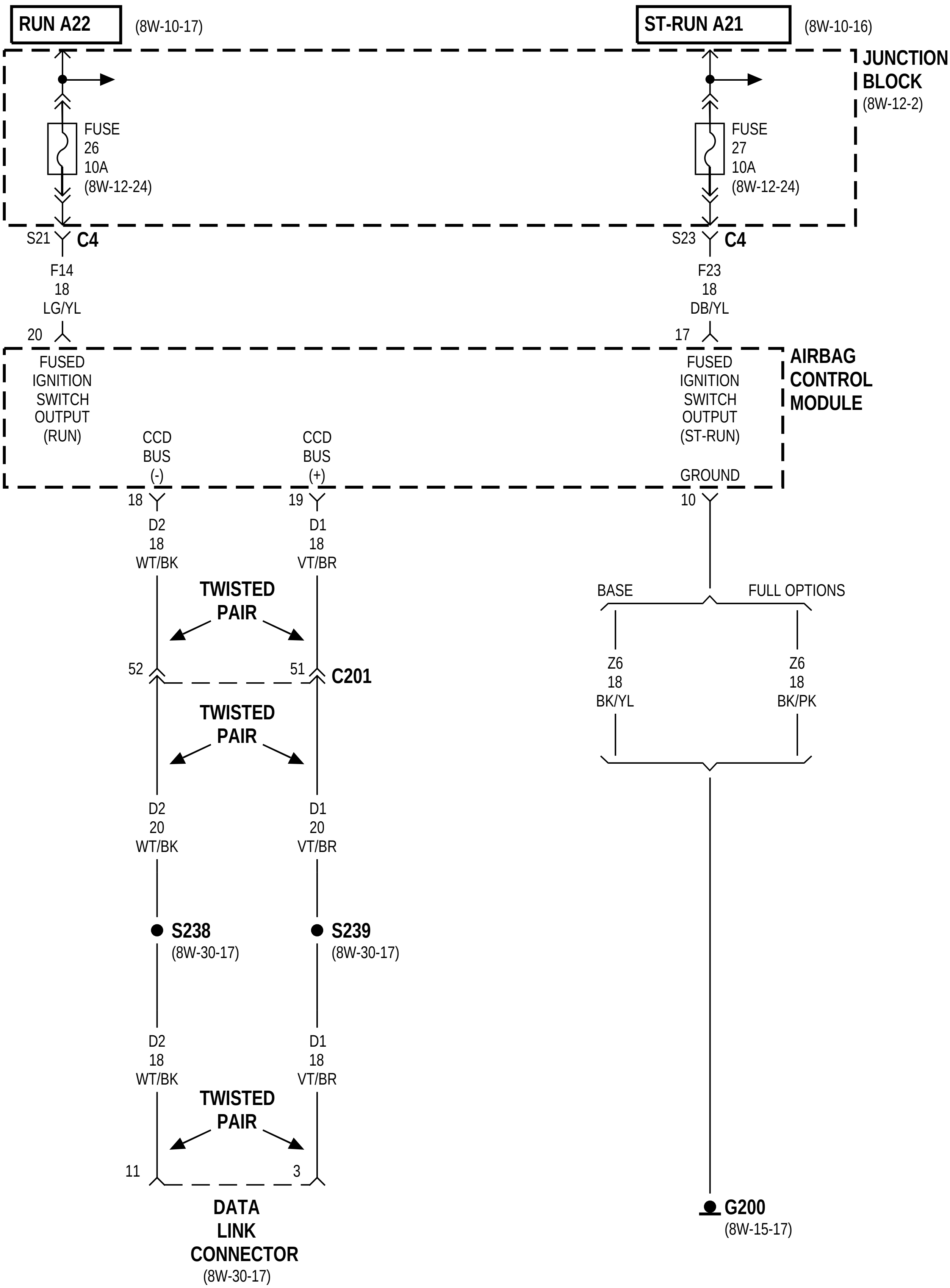
ST-RUN F20
(8W-12-12)
(8W-12-13)
BATT A17
(8W-10-21)
(8W-10-32)
RUN A22
(8W-10-17)
POWER DISTRIBUTION CENTER
(8W-10-2)
B5
B1
A/C COMPRESSOR CLUTCH RELAY
B3
B2
JUNCTION BLOCK
(8W-12-2)
FUSE 25 15A
(8W-12-21)
(8W-12-22)
S8
C4
F15 20 DB/WT
HVAC UNIT
BLEND DOOR FEEDBACK SIGNAL
GROUND
1
6
C13 18 DB/OR
C3 16 DB/BK
S219
(8W-12-21)
(8W-12-22)
RHD
LHD
Z1 20 BK
C36 20 RD/WT
F15 20 DB/WT
RHD
LHD
13
C204
7
C201
OTHER
4.0L RHD
40
C201
F15 20 DB/WT
RHD
LHD
14
C204
4
C201
S217
(8W-12-21)
4
C108
Z1 20 BK
C36 20 RD/WT
F15 20 DB/WT
3
4
BLEND DOOR FEEDBACK SIGNAL
FUSED IGNITION SWITCH OUTPUT (RUN)
GROUND
BLEND DOOR ACTUATOR
C3 16 DB/BK
2
Z1 20 BK
A/C COMPRESSOR CLUTCH (GAS)
G107
(8W-15-14)
(8W-15-15)
C1
C3
A/C COMPRESSOR CLUTCH RELAY CONTROL
POWERTRAIN CONTROL MODULE (GAS)
(8W-30-15)

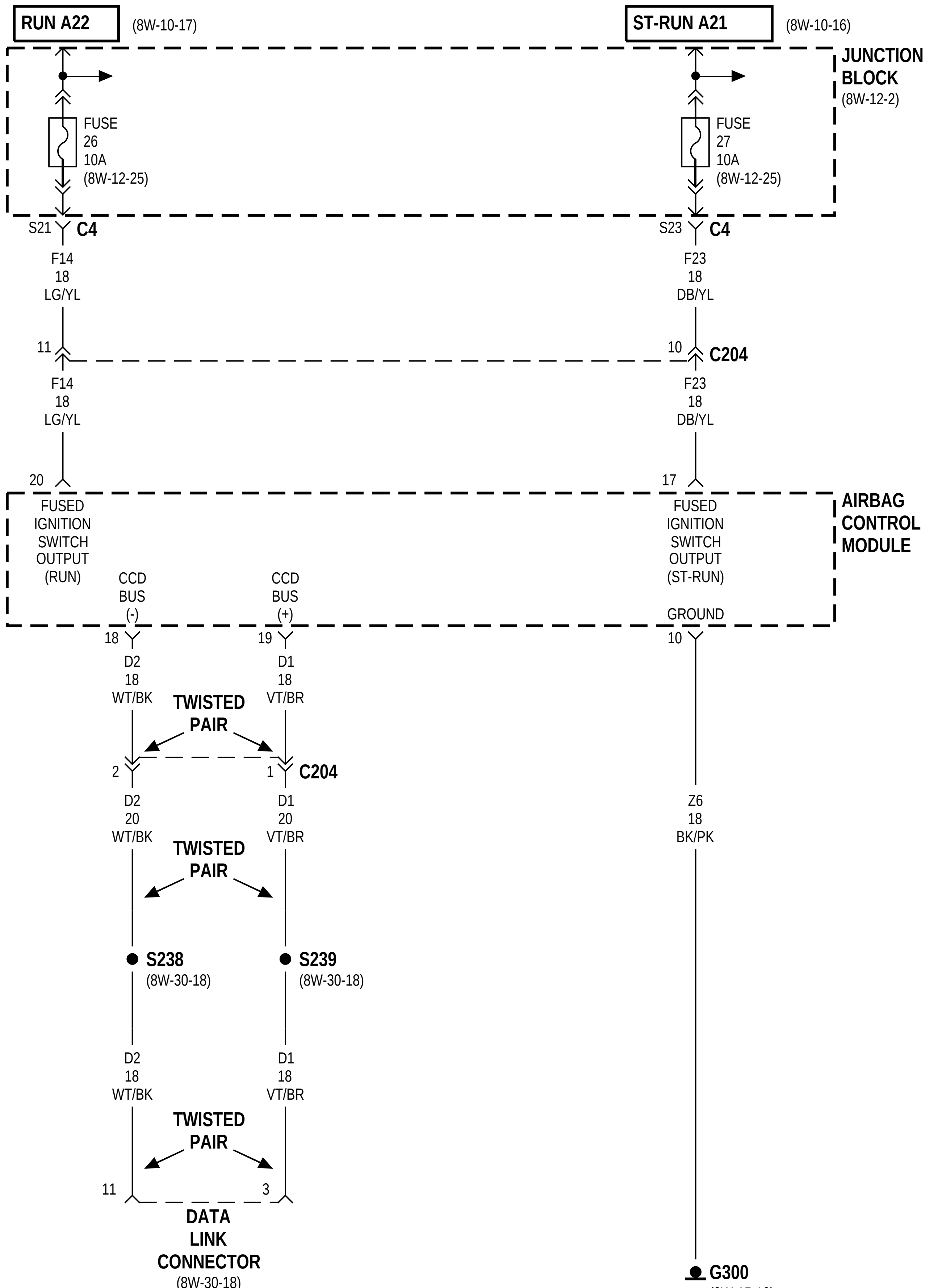

ST-RUN F20
(8W-12-12)
(8W-12-13)
BATT A17
(8W-10-32)
B5
B1
POWER
DISTRIBUTION
CENTER
(8W-10-6)
A/C
COMPRESSOR
CLUTCH
RELAY
B3
B2
C13
20
DB/OR
K5
C2
A/C
COMPRESSOR
CLUTCH
RELAY
CONTROL
A/C
SWITCH
SENSE
ENGINE
CONTROL
MODULE
(8W-30-24)
(8W-30-27)
K10
C2
C22
20
DB/WT
3
C120
C22
20
DB/WT
2
A/C
HIGH
PRESSURE
SWITCH
1
C21
20
DB/PK
2
C120
2
A/C
LOW
PRESSURE
SWITCH
1
Z1
20
BK
C3
16
DB/BK
6
C120
C3
14
DB/BK
1
A/C
COMPRESSOR
CLUTCH
2
Z1
16
BK
11
C120
Z1
16
BK
S157
(8W-15-11)
Z1
12
BK
S132
(8W-15-11)
Z1
12
BK
G106
(8W-15-12)

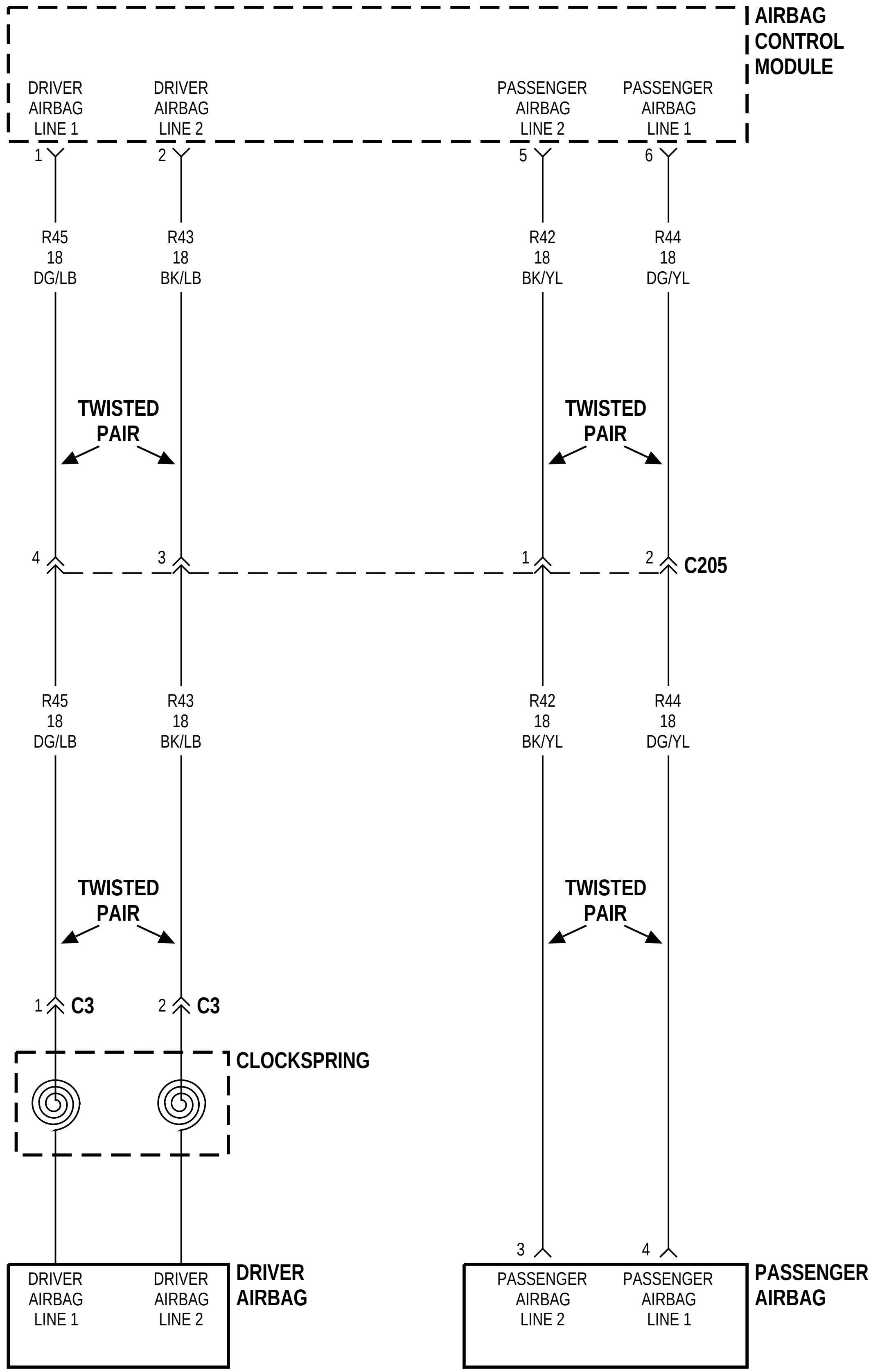

ST-RUN F20
(8W-12-12)
(8W-12-13)
BATT F141
(8W-10-20)
C11
C10
RADIATOR
FAN
RELAY
POWER
DISTRIBUTION
CENTER
(8W-10-2)
(8W-10-6)
C13
C14
C25
12
LB
GAS
DIESEL
C27
18
DB/PK
C27
20
DB/PK
K17
C2
RADIATOR
FAN
RELAY
CONTROL
ENGINE
CONTROL
MODULE
(8W-30-30)
1
RADIATOR
FAN
MOTOR
M
2
Z1
12
BK
G106
(8W-15-7)
(8W-15-10)
(8W-15-12)
C2
C3
RADIATOR
FAN
RELAY
CONTROL
POWERTRAIN
CONTROL
MODULE
(8W-30-15)

8W-43 AIRBAG SYSTEM

LHD

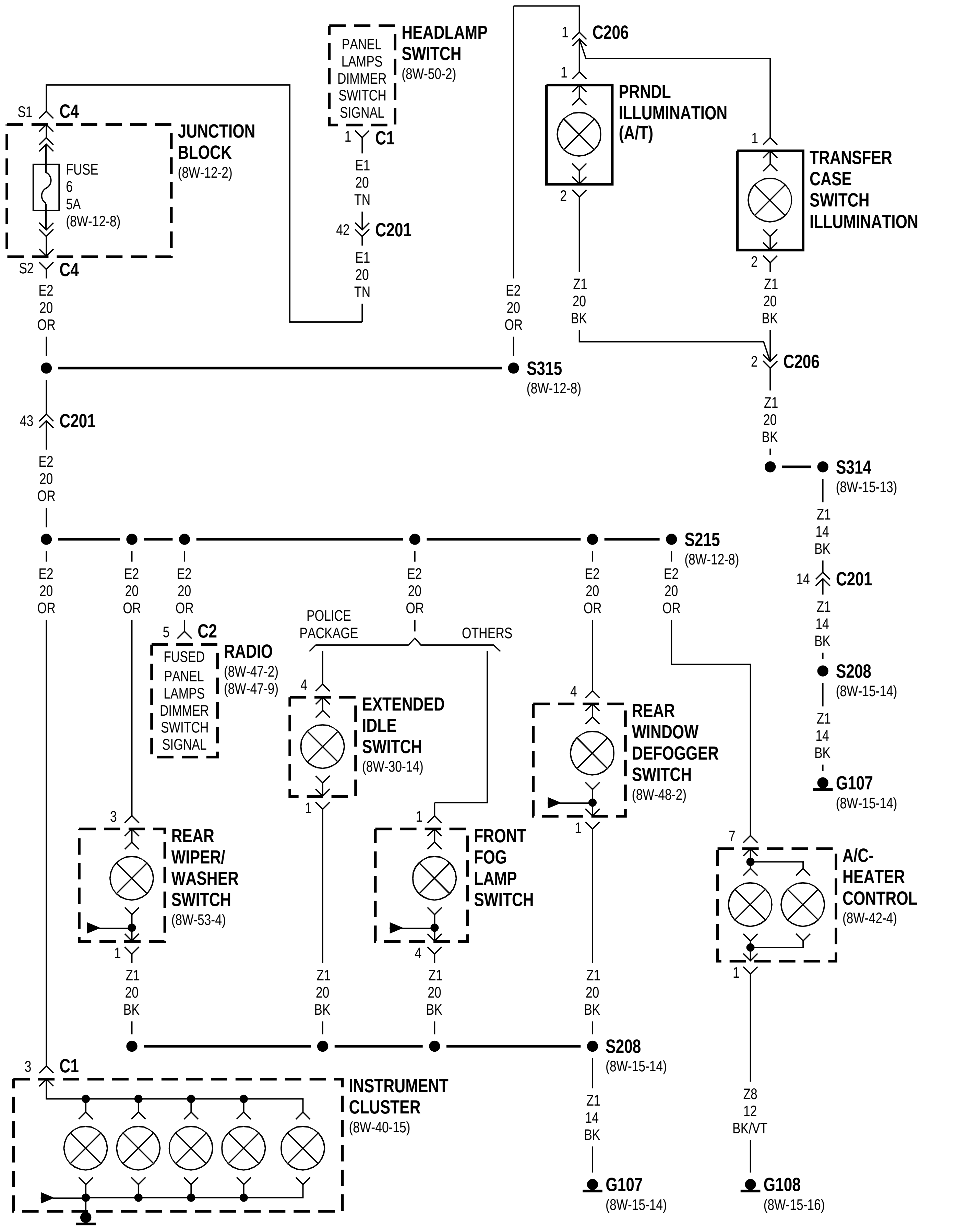

RUN A22
(8W-10-17)
ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE
26
10A
(8W-12-24)
FUSE
27
10A
(8W-12-24)
S21
C4
S23
C4
F14
18
LG/YL
F23
18
DB/YL
20
17
AIRBAG CONTROL MODULE
FUSED IGNITION SWITCH OUTPUT (RUN)
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
CCD BUS (-)
CCD BUS (+)
GROUND
18
19
10
D2
18
WT/BK
D1
18
VT/BR
TWISTED PAIR
BASE
FULL OPTIONS
52
51
C201
Z6
18
BK/YL
Z6
18
BK/PK
TWISTED PAIR
D2
20
WT/BK
D1
20
VT/BR
S238
(8W-30-17)
S239
(8W-30-17)
D2
18
WT/BK
D1
18
VT/BR
TWISTED PAIR
11
3
DATA LINK CONNECTOR
(8W-30-17)
G200
(8W-15-17)

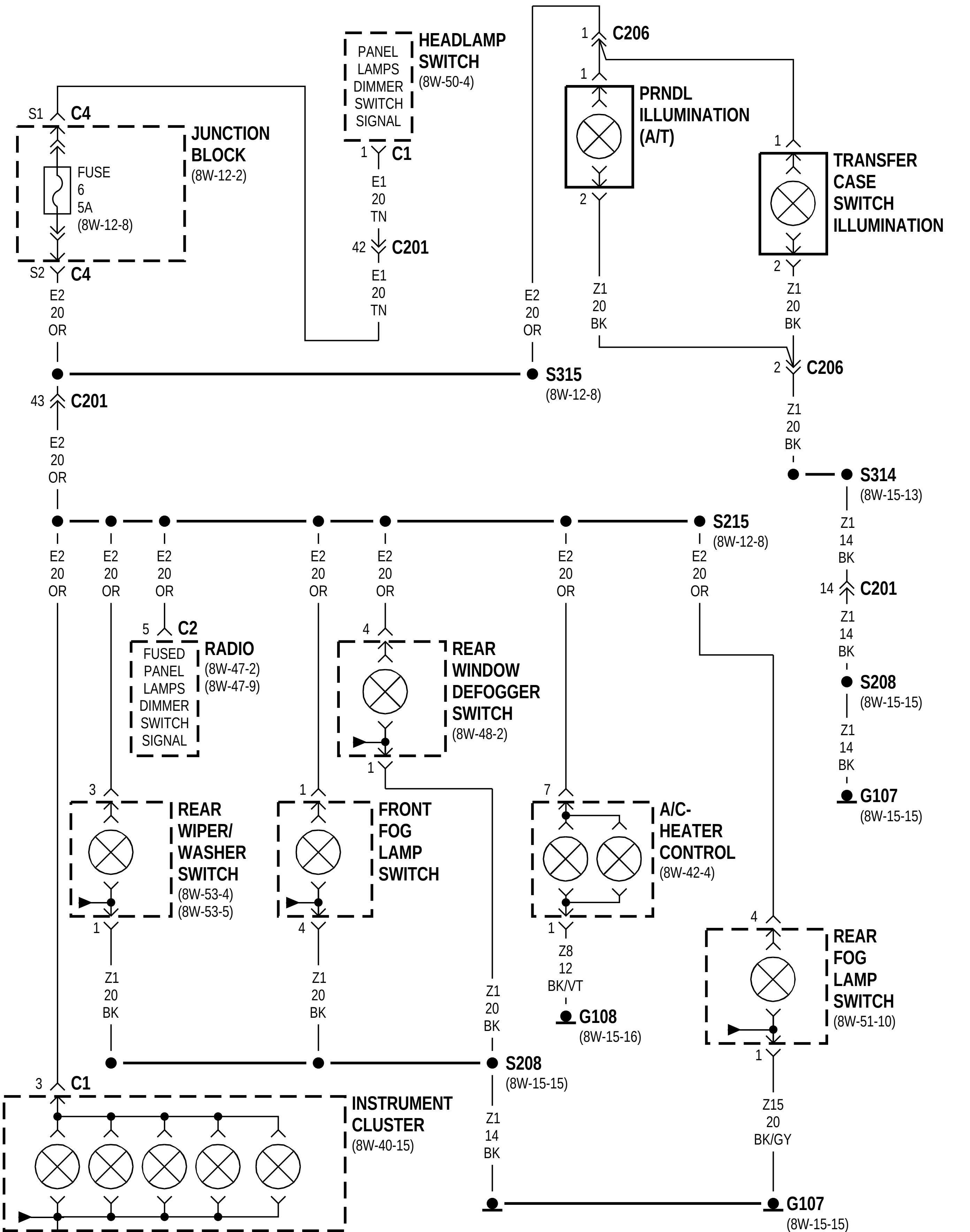

RUN A22
(8W-10-17)
ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE 26 10A
(8W-12-25)
FUSE 27 10A
(8W-12-25)
S21 C4
S23 C4
F14 18 LG/YL
F23 18 DB/YL
11
10 C204
F14 18 LG/YL
F23 18 DB/YL
20
17
AIRBAG CONTROL MODULE
FUSED IGNITION SWITCH OUTPUT (RUN)
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
CCD BUS (-)
CCD BUS (+)
GROUND
18
19
10
D2 18 WT/BK
D1 18 VT/BR
TWISTED PAIR
2
1 C204
D2 20 WT/BK
D1 20 VT/BR
Z6 18 BK/PK
TWISTED PAIR
S238
(8W-30-18)
S239
(8W-30-18)
D2 18 WT/BK
D1 18 VT/BR
TWISTED PAIR
11
3
DATA LINK CONNECTOR
(8W-30-18)
G300
(8W-15-18)


AIRBAG
CONTROL
MODULE
DRIVER
AIRBAG
LINE 1
DRIVER
AIRBAG
LINE 2
PASSENGER
AIRBAG
LINE 2
PASSENGER
AIRBAG
LINE 1
1
2
5
6
R45
18
DG/LB
R43
18
BK/LB
R42
18
BK/YL
R44
18
DG/YL
TWISTED
PAIR
TWISTED
PAIR
4
3
1
2
C205
R45
18
DG/LB
R43
18
BK/LB
R42
18
BK/YL
R44
18
DG/YL
TWISTED
PAIR
TWISTED
PAIR
1 C3
2 C3
CLOCKSPRING
3
4
DRIVER
AIRBAG
LINE 1
DRIVER
AIRBAG
LINE 2
DRIVER
AIRBAG
PASSENGER
AIRBAG
LINE 2
PASSENGER
AIRBAG
LINE 1
PASSENGER
AIRBAG

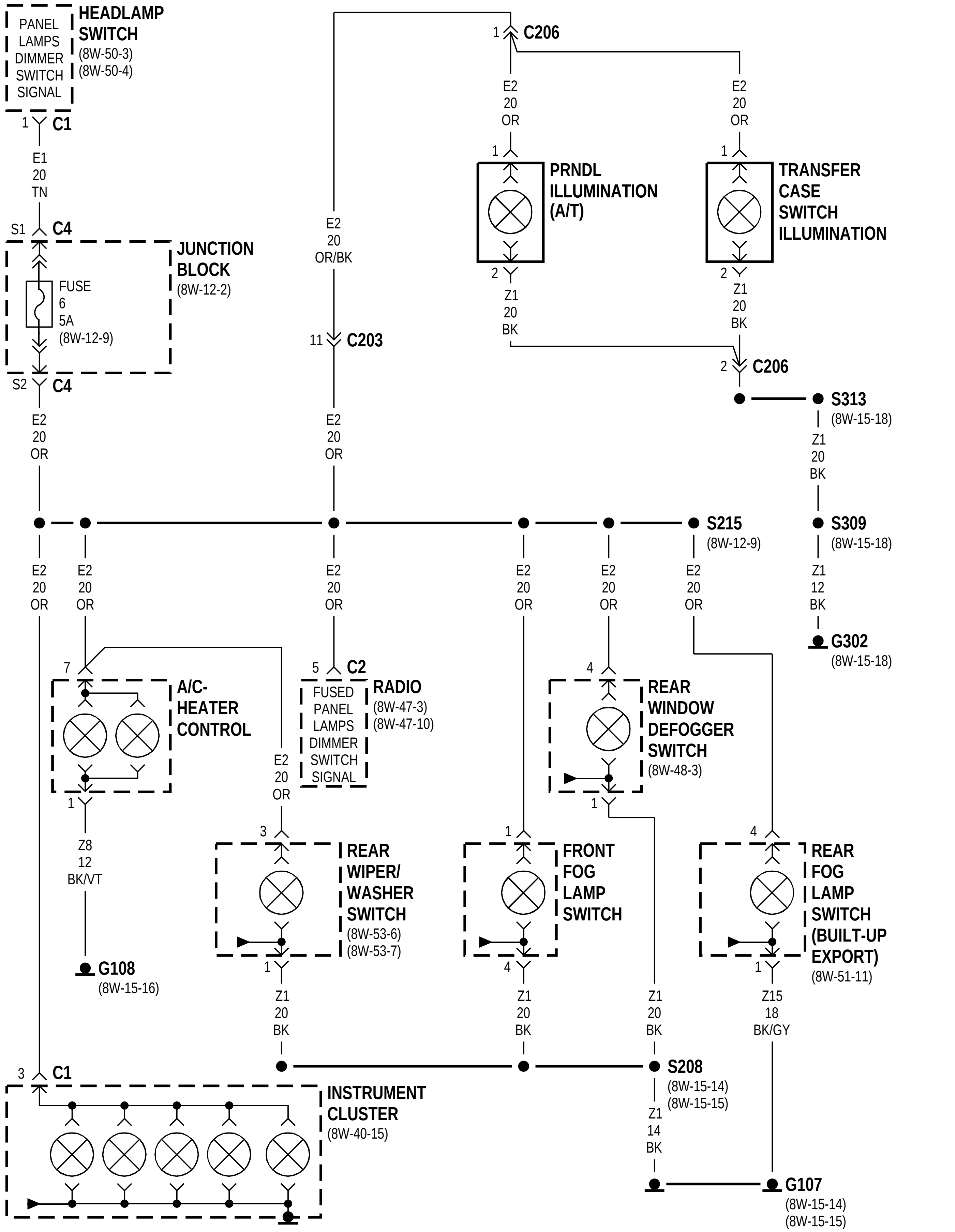
8W-44 INTERIOR LIGHTING

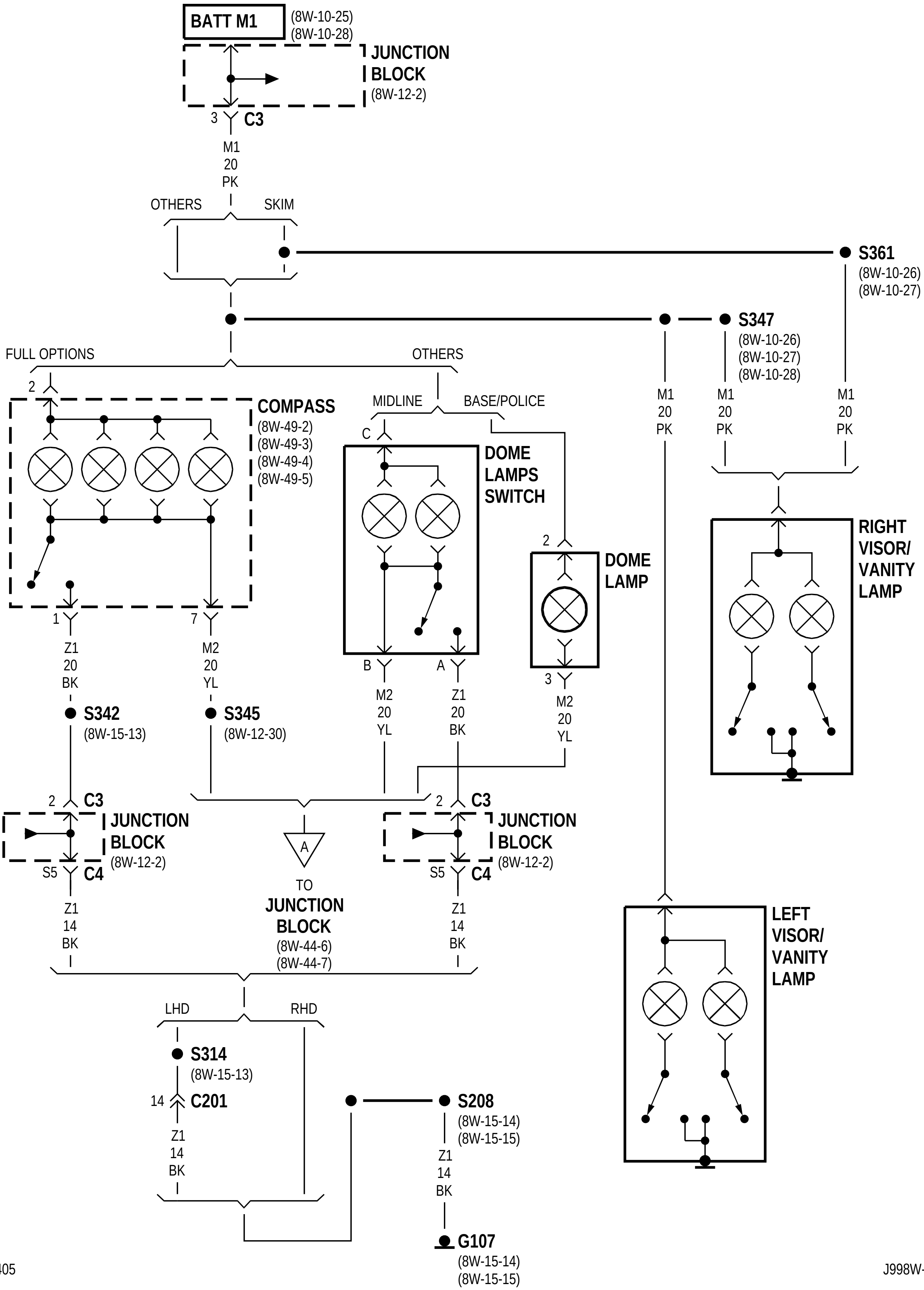
LHD EXCEPT BUILT-UP-EXPORT



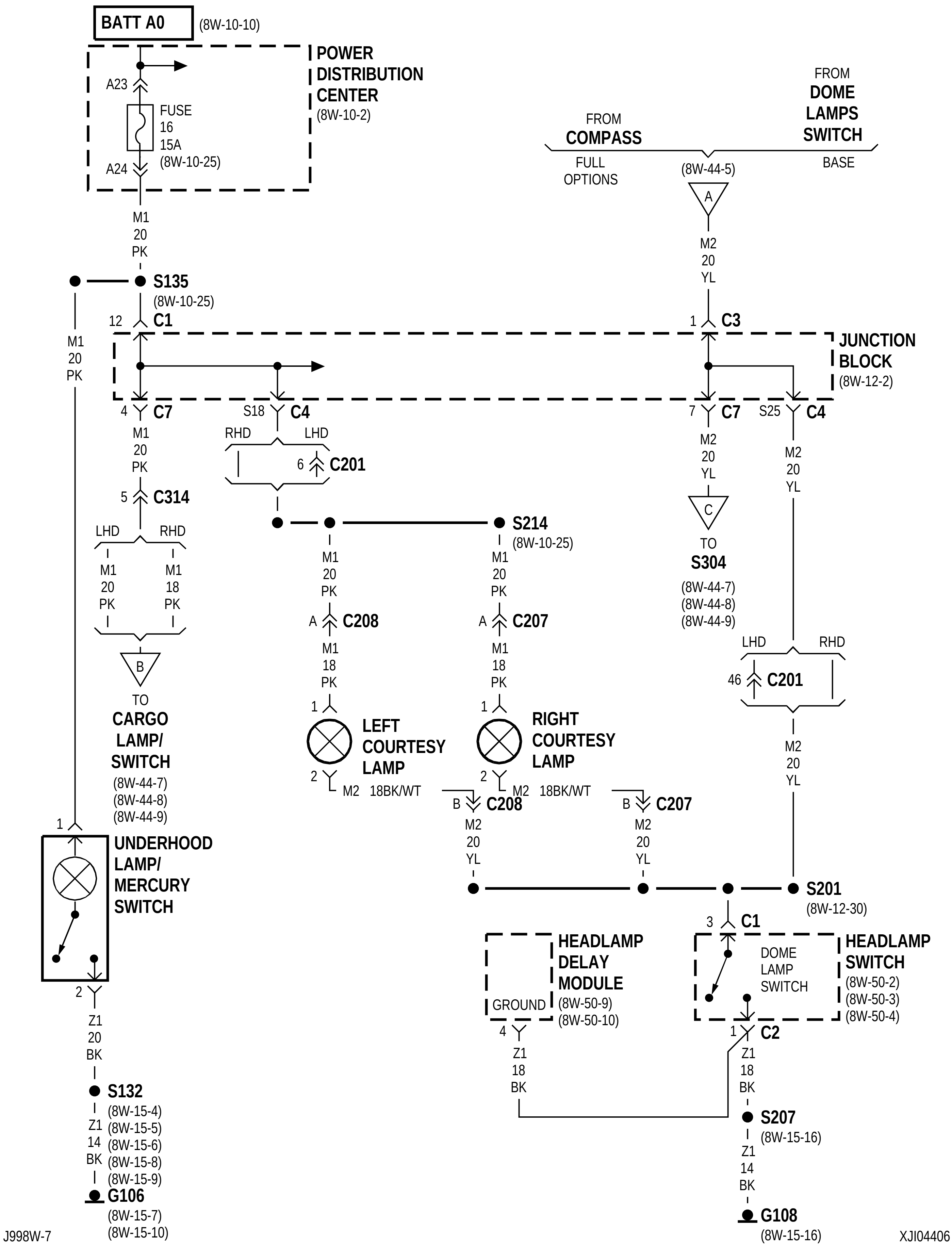


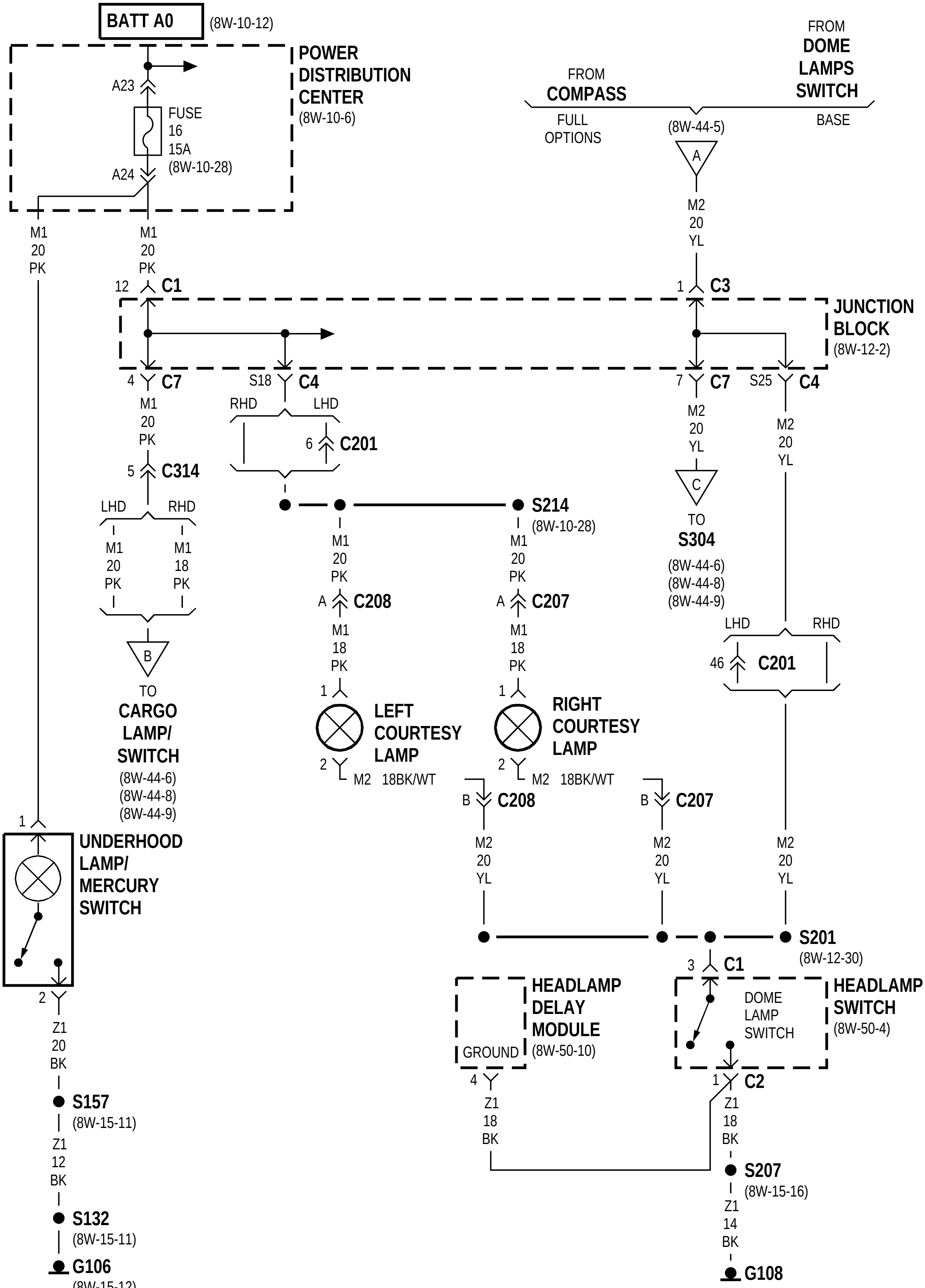
XJI04403 J998W-7

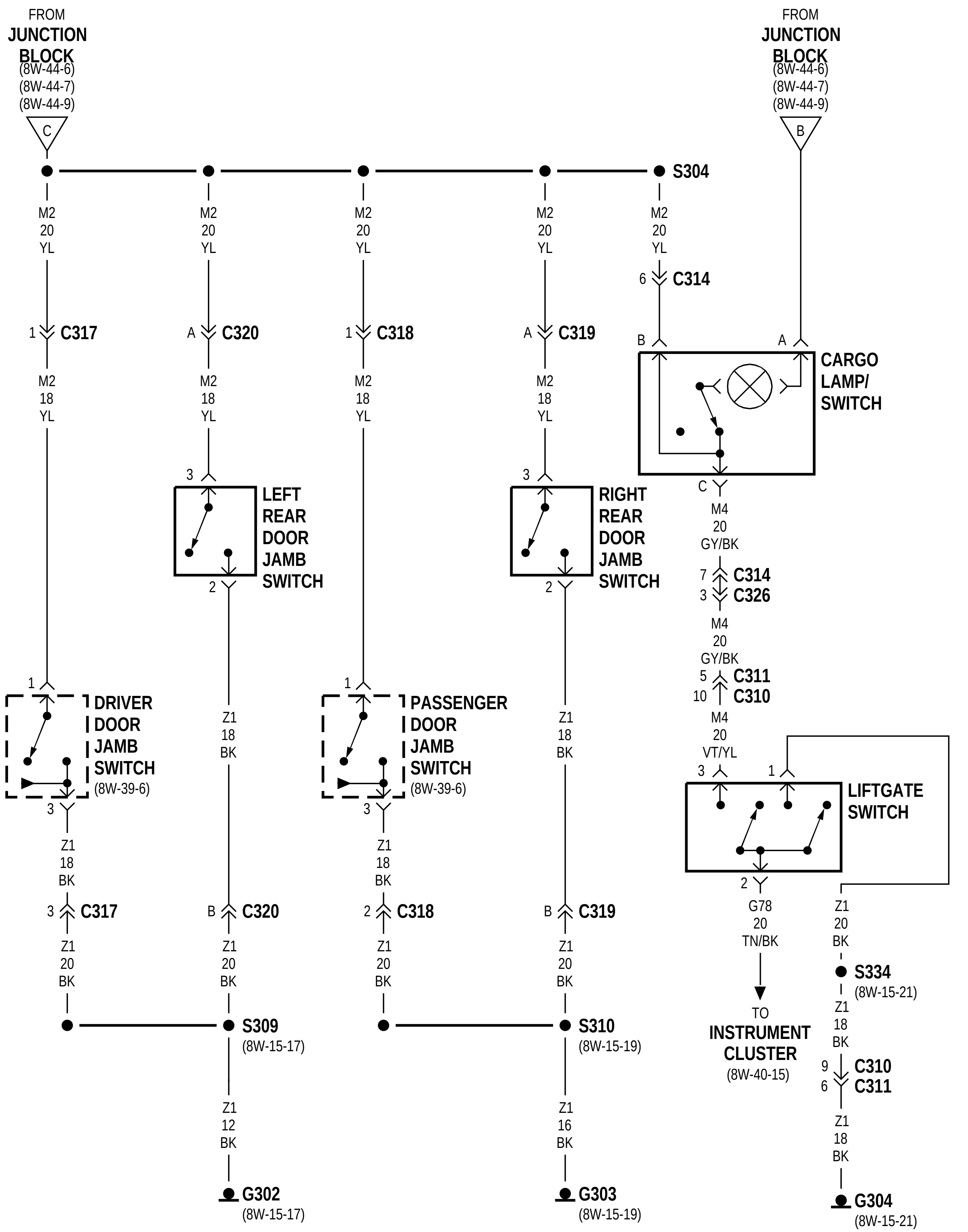

PANEL LAMPS DIMMER SWITCH SIGNAL
HEADLAMP SWITCH
(8W-50-3)
(8W-50-4)
1 C1
E1 20 TN
S1 C4
JUNCTION BLOCK
(8W-12-2)
FUSE 6 5A (8W-12-9)
S2 C4
E2 20 OR
1 C206
E2 20 OR
E2 20 OR/BK
PRNDL ILLUMINATION (A/T)
TRANSFER CASE SWITCH ILLUMINATION
Z1 20 BK
11 C203
2 C206
S313
(8W-15-18)
Z1 20 BK
S215
(8W-12-9)
S309
(8W-15-18)
Z1 12 BK
G302
(8W-15-18)
7
A/C-HEATER CONTROL
5 C2
RADIO
(8W-47-3)
(8W-47-10)
FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
REAR WINDOW DEFOGGER SWITCH
(8W-48-3)
Z8 12 BK/VT
G108
(8W-15-16)
REAR WIPER/ WASHER SWITCH
(8W-53-6)
(8W-53-7)
FRONT FOG LAMP SWITCH
REAR FOG LAMP SWITCH (BUILT-UP EXPORT)
(8W-51-11)
Z15 18 BK/GY
S208
(8W-15-14)
(8W-15-15)
Z1 14 BK
3 C1
INSTRUMENT CLUSTER
(8W-40-15)
G107
(8W-15-14)
(8W-15-15)

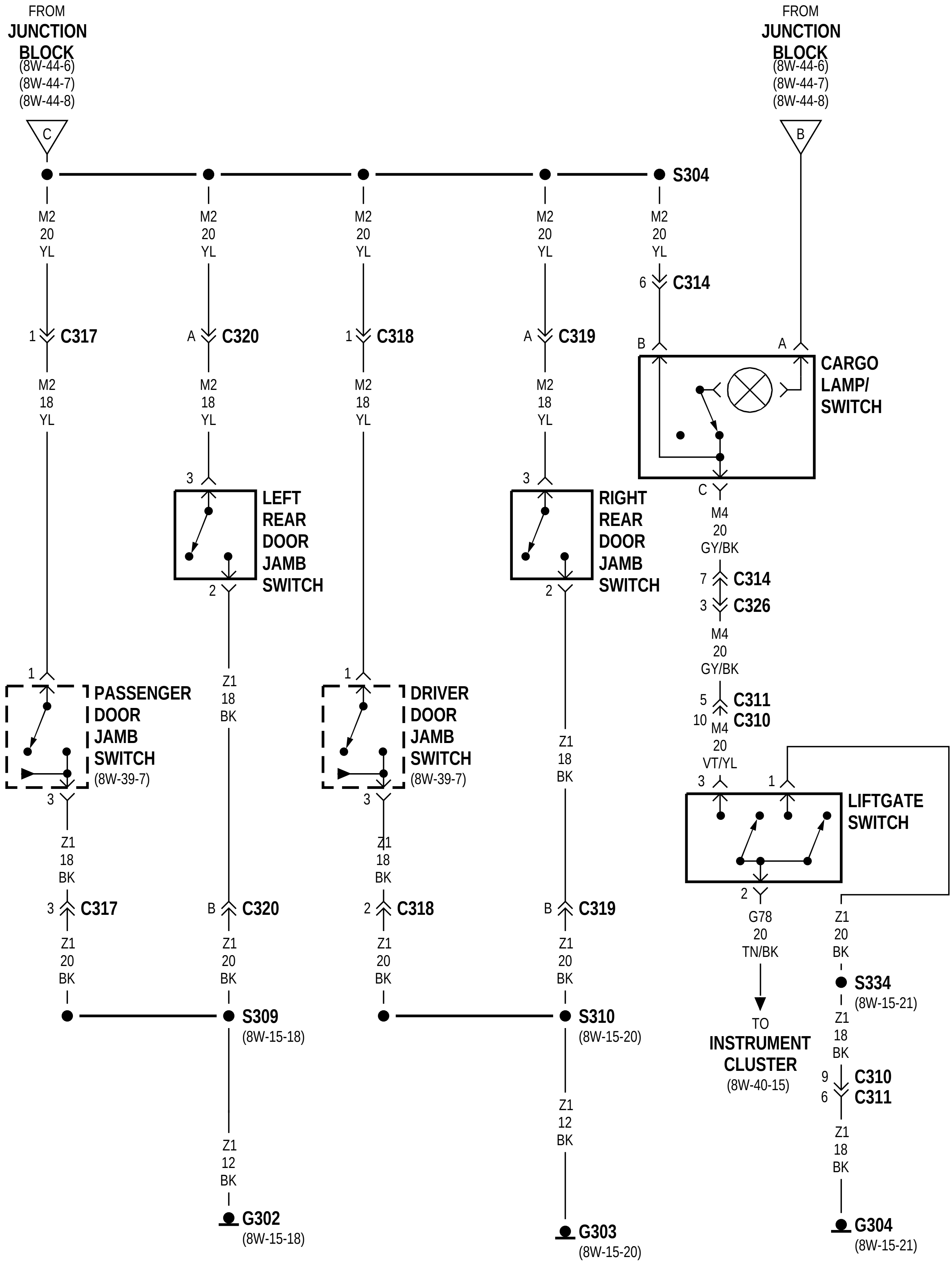


BATT M1
(8W-10-25)
(8W-10-28)
JUNCTION BLOCK
(8W-12-2)
3 C3
M1 20 PK
OTHERS
SKIM
S361
(8W-10-26)
(8W-10-27)
S347
(8W-10-26)
(8W-10-27)
(8W-10-28)
FULL OPTIONS
OTHERS
2
COMPASS
(8W-49-2)
(8W-49-3)
(8W-49-4)
(8W-49-5)
MIDLINE
BASE/POLICE
C
DOME LAMPS SWITCH
M1 20 PK
M1 20 PK
M1 20 PK
RIGHT VISOR/ VANITY LAMP
2
DOME LAMP
3
1
7
Z1 20 BK
M2 20 YL
B
A
M2 20 YL
Z1 20 BK
M2 20 YL
S342
(8W-15-13)
S345
(8W-12-30)
2 C3
JUNCTION BLOCK
(8W-12-2)
S5 C4
A
TO JUNCTION BLOCK
(8W-44-6)
(8W-44-7)
2 C3
JUNCTION BLOCK
(8W-12-2)
S5 C4
Z1 14 BK
Z1 14 BK
LEFT VISOR/ VANITY LAMP
LHD
RHD
S314
(8W-15-13)
14 C201
Z1 14 BK
S208
(8W-15-14)
(8W-15-15)
Z1 14 BK
G107
(8W-15-14)
(8W-15-15)


BATT A0 (8W-10-10)
POWER DISTRIBUTION CENTER (8W-10-2)
A23
FUSE 16 15A (8W-10-25)
A24
M1 20 PK
S135 (8W-10-25)
12 C1
M1 20 PK
JUNCTION BLOCK (8W-12-2)
FROM COMPASS
FULL OPTIONS
FROM DOME LAMPS SWITCH
BASE
(8W-44-5)
A
M2 20 YL
1 C3
4 C7
S18 C4
7 C7
S25 C4
RHD LHD
6 C201
M1 20 PK
5 C314
LHD RHD
M1 20 PK
M1 18 PK
B
TO CARGO LAMP/ SWITCH (8W-44-7) (8W-44-8) (8W-44-9)
S214 (8W-10-25)
M1 20 PK
A C208
M1 18 PK
A C207
1
LEFT COURTESY LAMP
RIGHT COURTESY LAMP
2
M2 18BK/WT
B C208
B C207
M2 20 YL
C
TO S304 (8W-44-7) (8W-44-8) (8W-44-9)
LHD RHD
46 C201
S201 (8W-12-30)
1
UNDERHOOD LAMP/ MERCURY SWITCH
2
Z1 20 BK
S132 (8W-15-4) (8W-15-5) (8W-15-6) (8W-15-8) (8W-15-9)
Z1 14 BK
G106 (8W-15-7) (8W-15-10)
3 C1
HEADLAMP DELAY MODULE (8W-50-9) (8W-50-10)
GROUND
4
Z1 18 BK
DOME LAMP SWITCH
HEADLAMP SWITCH (8W-50-2) (8W-50-3) (8W-50-4)
1 C2
S207 (8W-15-16)
G108 (8W-15-16)
J998W-7
XJI04406

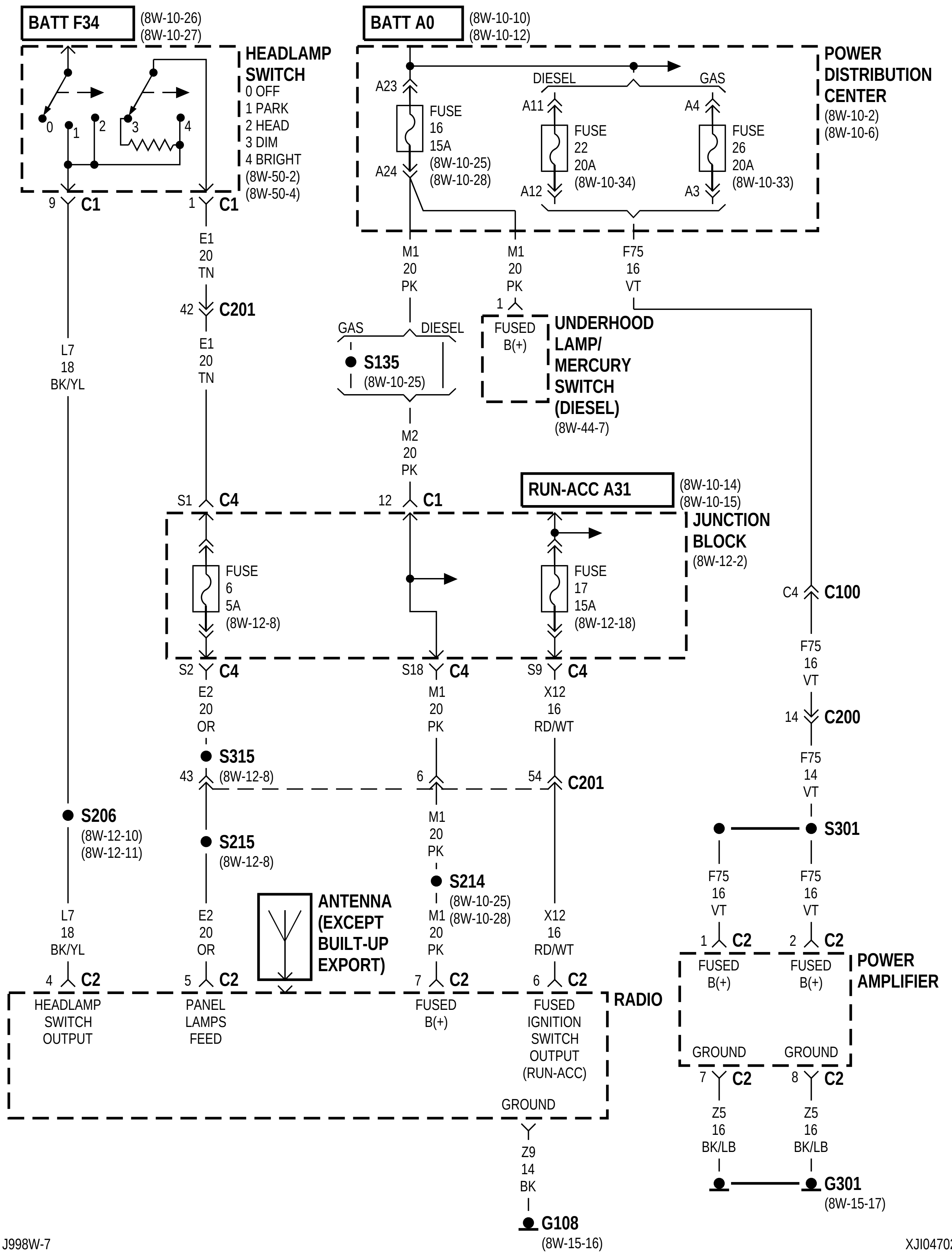

BATT A0
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-6)
A23
FUSE 16 15A (8W-10-28)
A24
M1 20 PK
FROM COMPASS
FULL OPTIONS
(8W-44-5)
FROM DOME LAMPS SWITCH
BASE
A
M2 20 YL
12 C1
1 C3
JUNCTION BLOCK
(8W-12-2)
4 C7
S18 C4
7 C7
S25 C4
RHD LHD
6 C201
C314
LHD RHD
M1 18 PK
B
TO CARGO LAMP/ SWITCH
(8W-44-6)
(8W-44-8)
(8W-44-9)
S214
(8W-10-28)
A C208
A C207
LEFT COURTESY LAMP
RIGHT COURTESY LAMP
M2 18BK/WT
B C208
B C207
C
TO S304
46 C201
UNDERHOOD LAMP/ MERCURY SWITCH
Z1 20 BK
S157
(8W-15-11)
Z1 12 BK
S132
G106
(8W-15-12)
S201
(8W-12-30)
3 C1
HEADLAMP DELAY MODULE
GROUND
(8W-50-10)
DOME LAMP SWITCH
HEADLAMP SWITCH
(8W-50-4)
1 C2
Z1 18 BK
S207
(8W-15-16)
Z1 14 BK
G108


FROM
JUNCTION BLOCK
(8W-44-6)
(8W-44-7)
(8W-44-9)
C
B
S304
M2 20 YL
C314
C317
C320
C318
C319
M2 18 YL
CARGO LAMP/ SWITCH
LEFT REAR DOOR JAMB SWITCH
RIGHT REAR DOOR JAMB SWITCH
M4 20 GY/BK
C314
C326
C311
C310
M4 20 VT/YL
DRIVER DOOR JAMB SWITCH
(8W-39-6)
PASSENGER DOOR JAMB SWITCH
(8W-39-6)
Z1 18 BK
LIFTGATE SWITCH
G78 20 TN/BK
Z1 20 BK
S334
(8W-15-21)
TO INSTRUMENT CLUSTER
(8W-40-15)
S309
(8W-15-17)
S310
(8W-15-19)
C310
C311
Z1 12 BK
Z1 16 BK
G302
(8W-15-17)
G303
(8W-15-19)
G304
(8W-15-21)

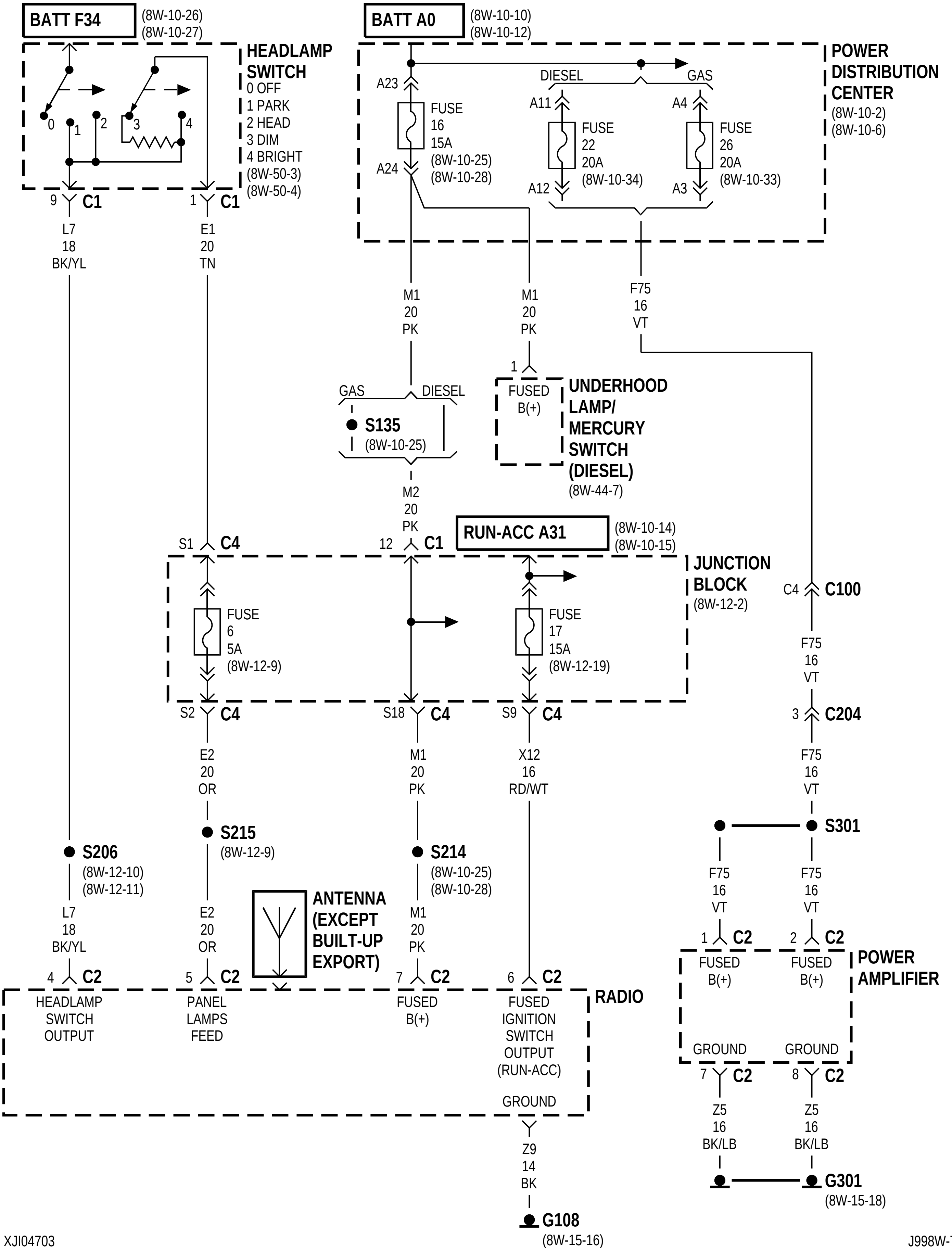

FROM
JUNCTION BLOCK
(8W-44-6)
(8W-44-7)
(8W-44-8)
C
FROM
JUNCTION BLOCK
(8W-44-6)
(8W-44-7)
(8W-44-8)
B
S304
M2 20 YL
6 C314
1 C317
A C320
1 C318
A C319
M2 18 YL
B
A
CARGO LAMP/ SWITCH
C
M4 20 GY/BK
7 C314
3 C326
M4 20 GY/BK
5 C311
10 C310
M4 20 VT/YL
3
LEFT REAR DOOR JAMB SWITCH
2
RIGHT REAR DOOR JAMB SWITCH
Z1 18 BK
1
PASSENGER DOOR JAMB SWITCH
(8W-39-7)
DRIVER DOOR JAMB SWITCH
(8W-39-7)
3
1
LIFTGATE SWITCH
Z1 18 BK
3 C317
B C320
2 C318
B C319
Z1 20 BK
G78 20 TN/BK
TO
INSTRUMENT CLUSTER
(8W-40-15)
S334
(8W-15-21)
S309
(8W-15-18)
S310
(8W-15-20)
9 C310
6 C311
Z1 12 BK
G302
(8W-15-18)
G303
(8W-15-20)
G304
(8W-15-21)

8W-47 AUDIO SYSTEM

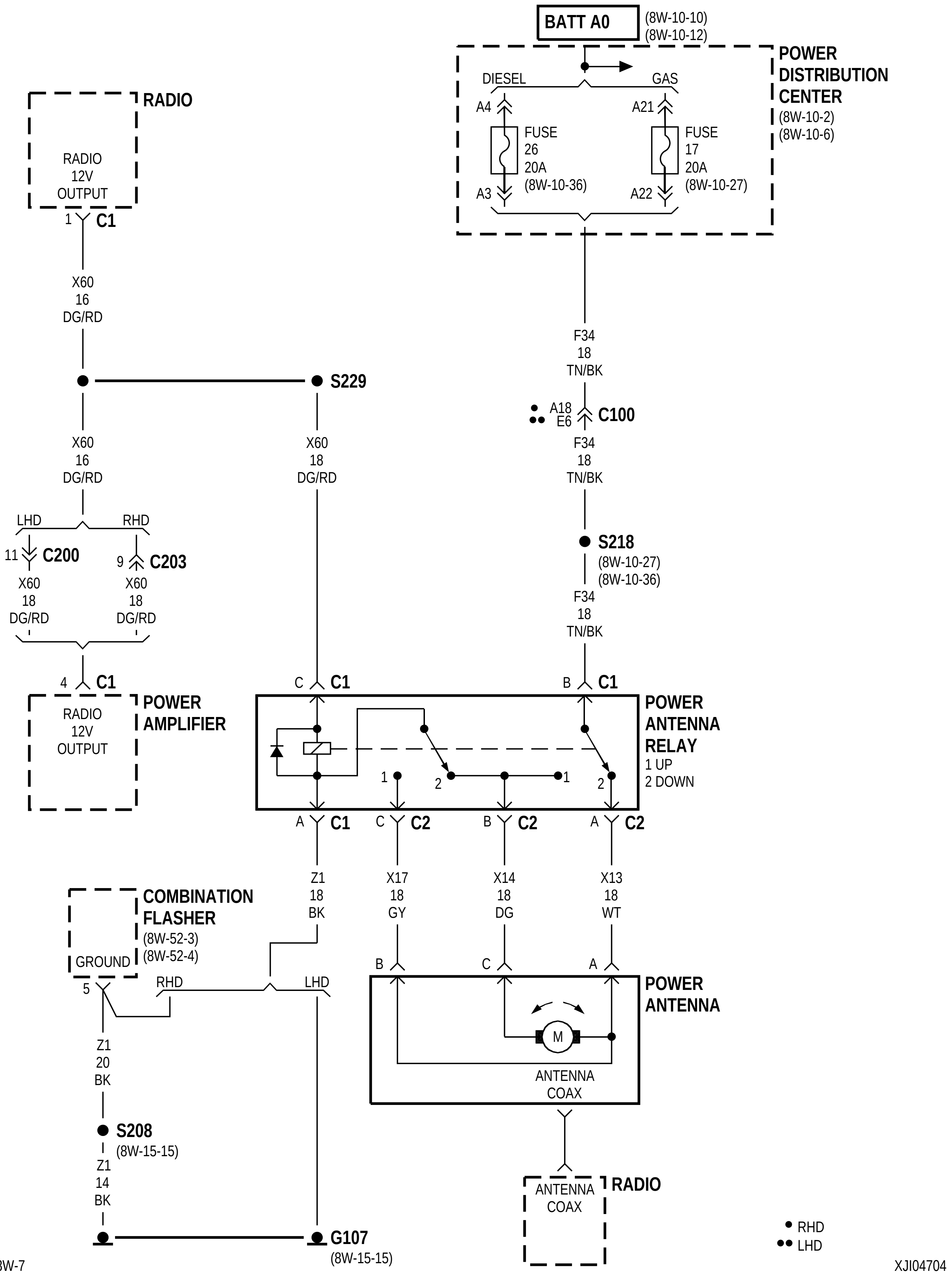
LHD 6 SPEAKER SYSTEM



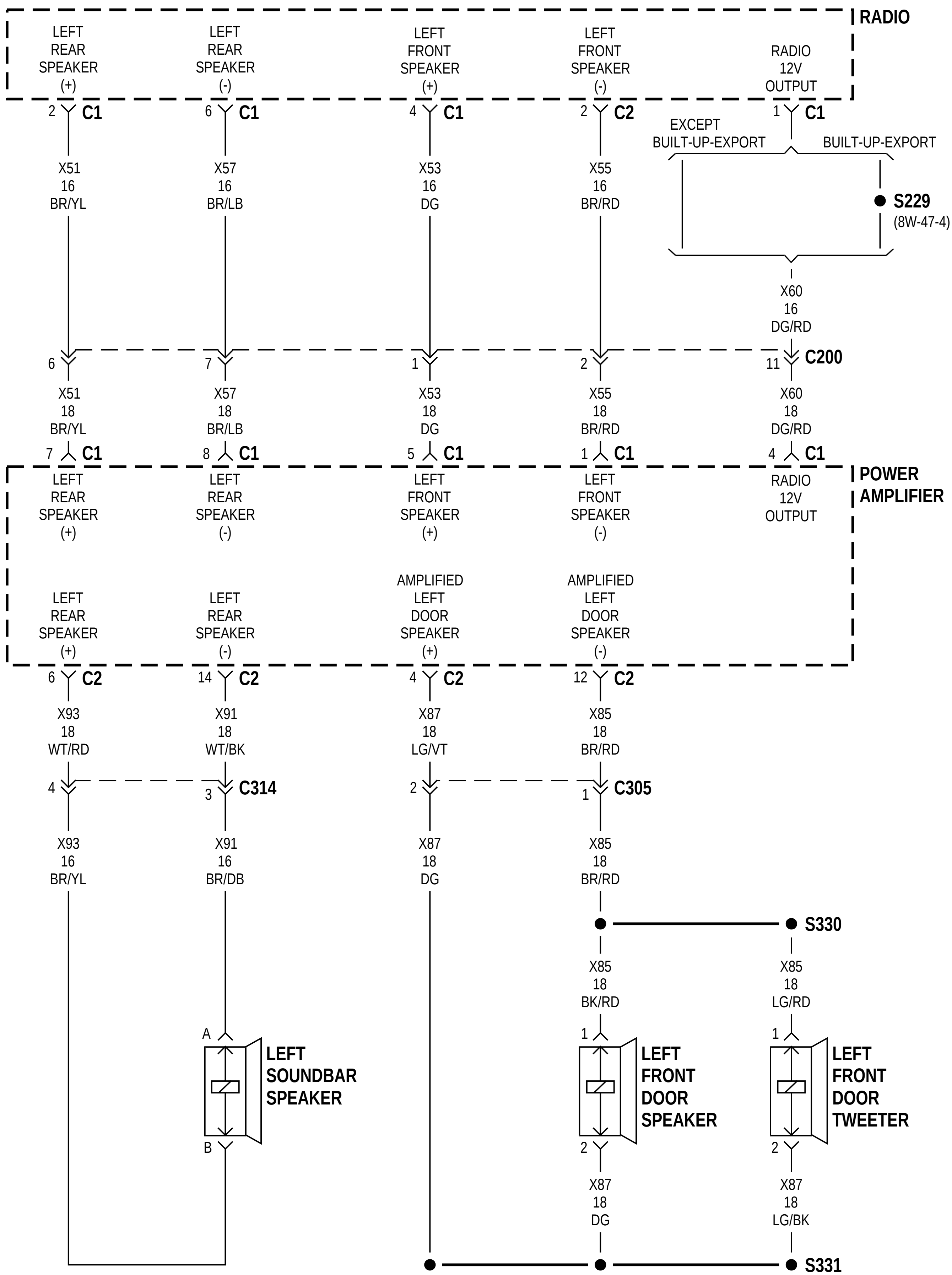
RHD 6 SPEAKER SYSTEM



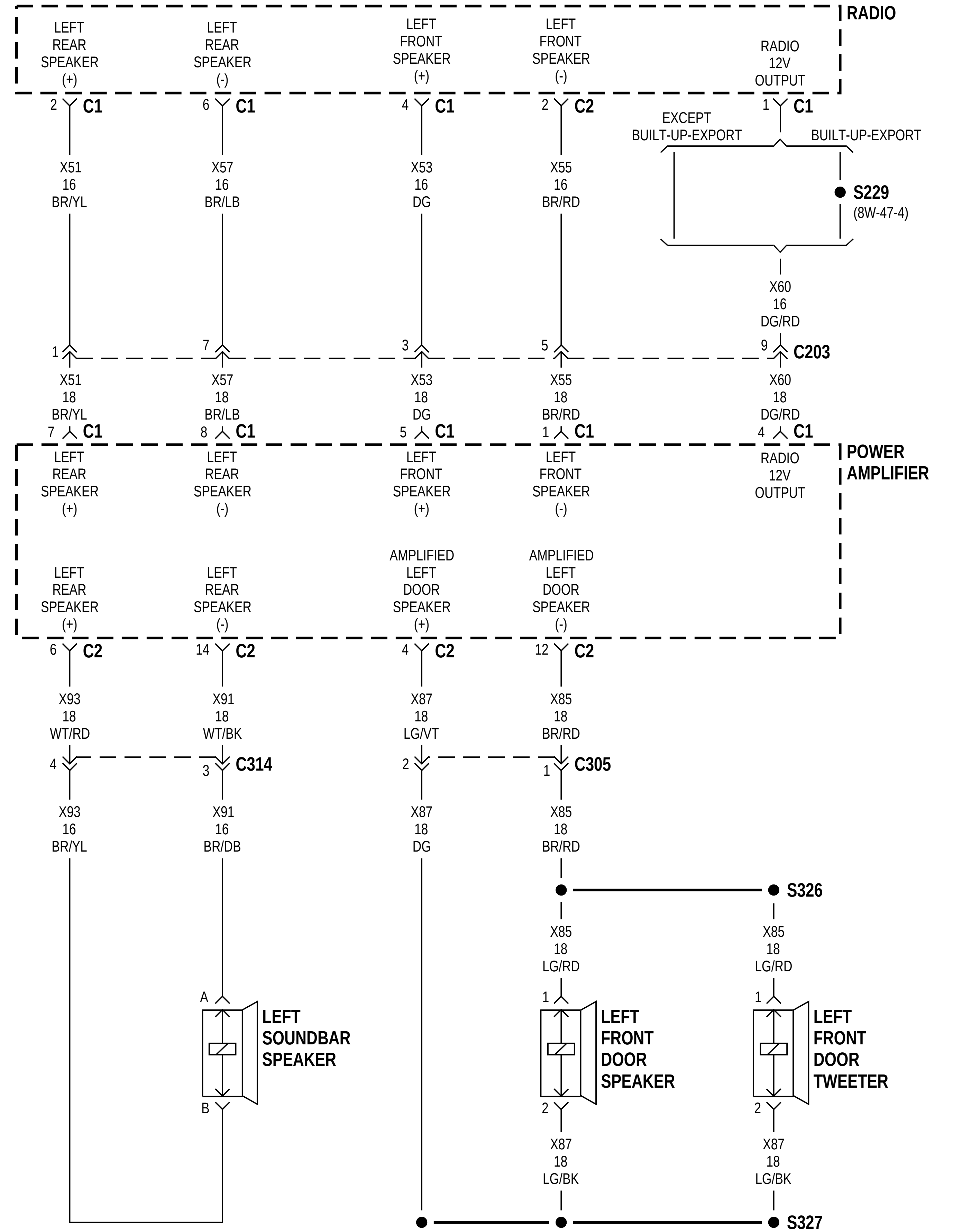
BUILT-UP-EXPORT



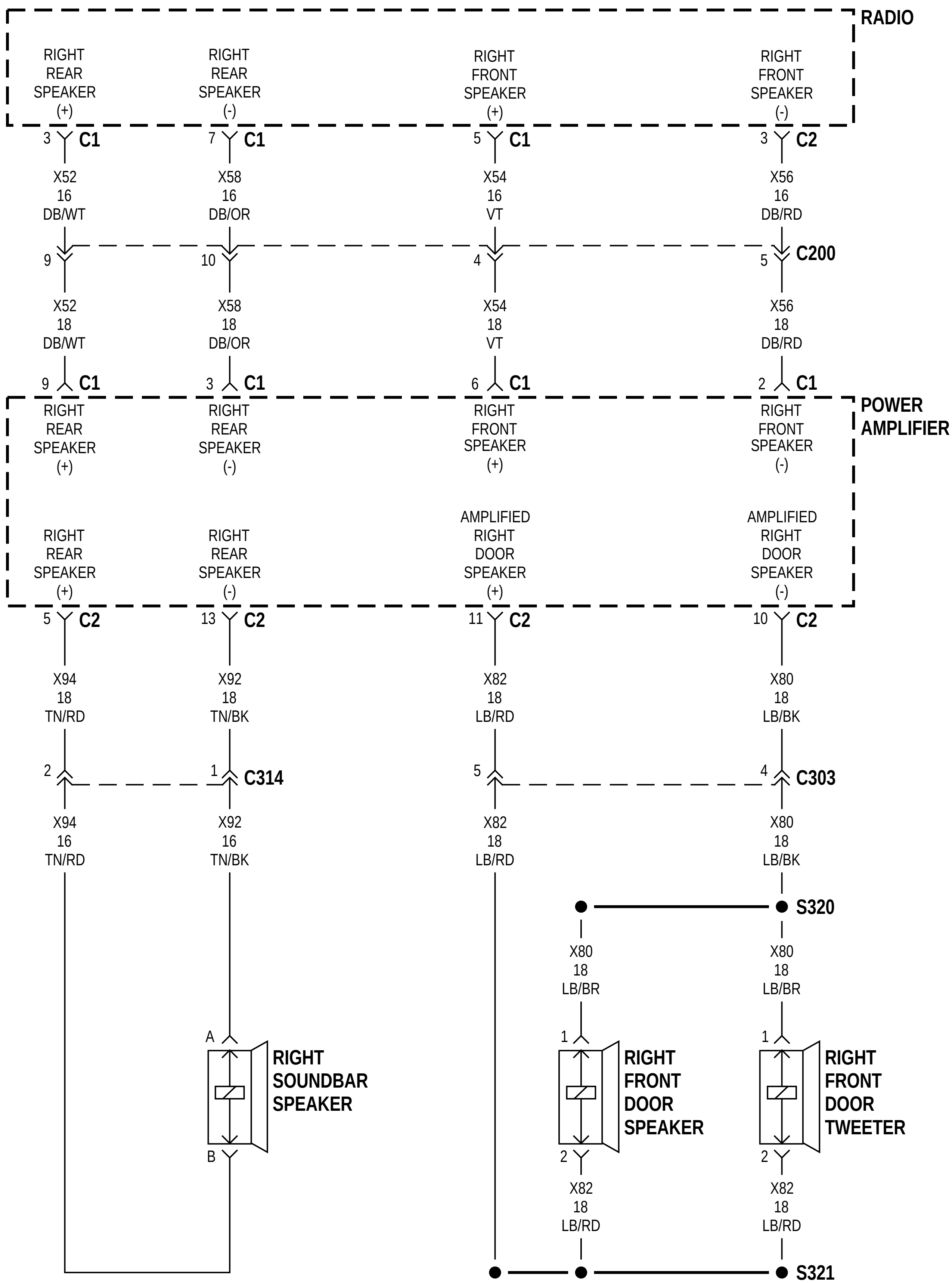
LHD 6 SPEAKER SYSTEM



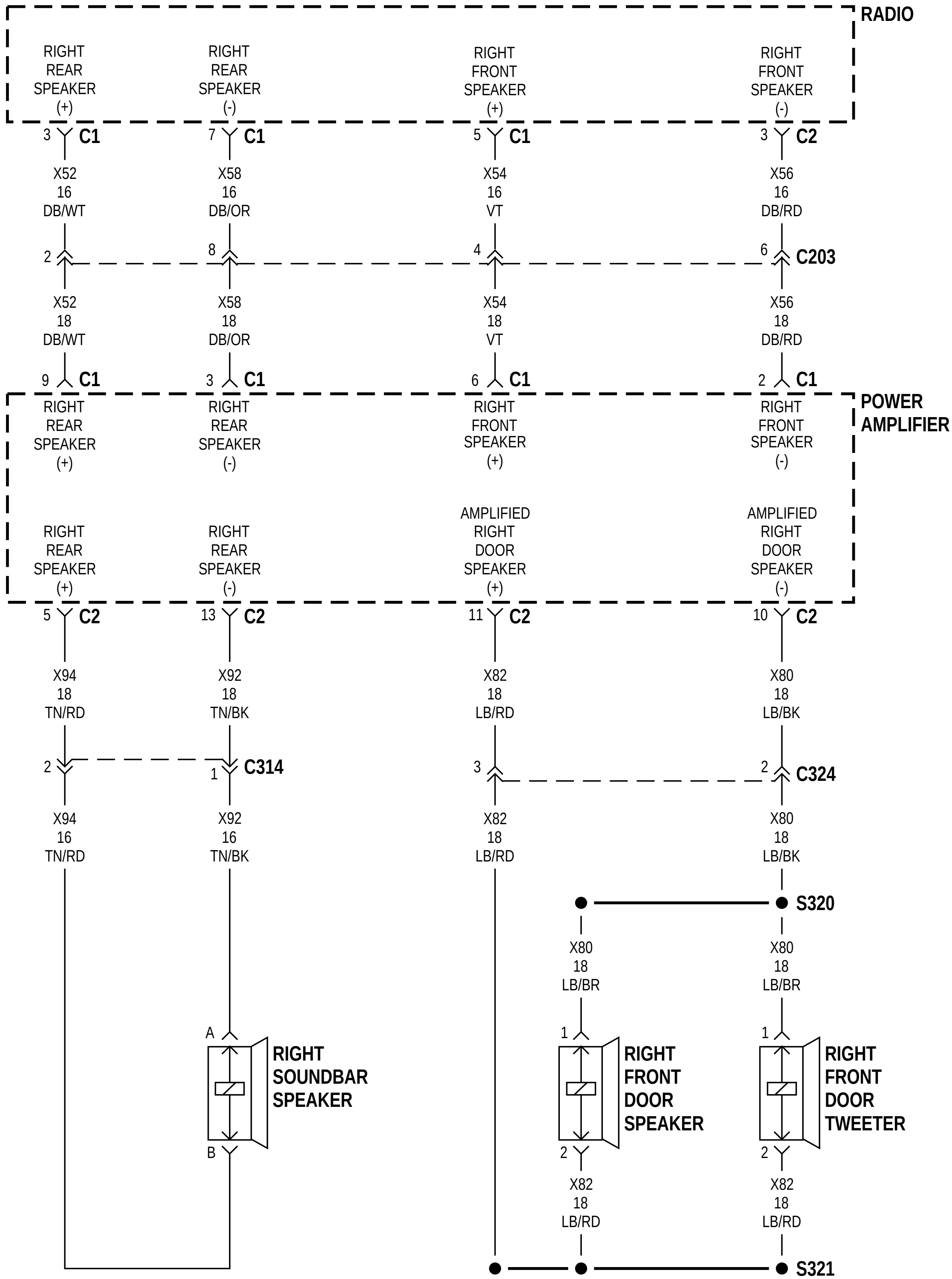
RHD 6 SPEAKER SYSTEM



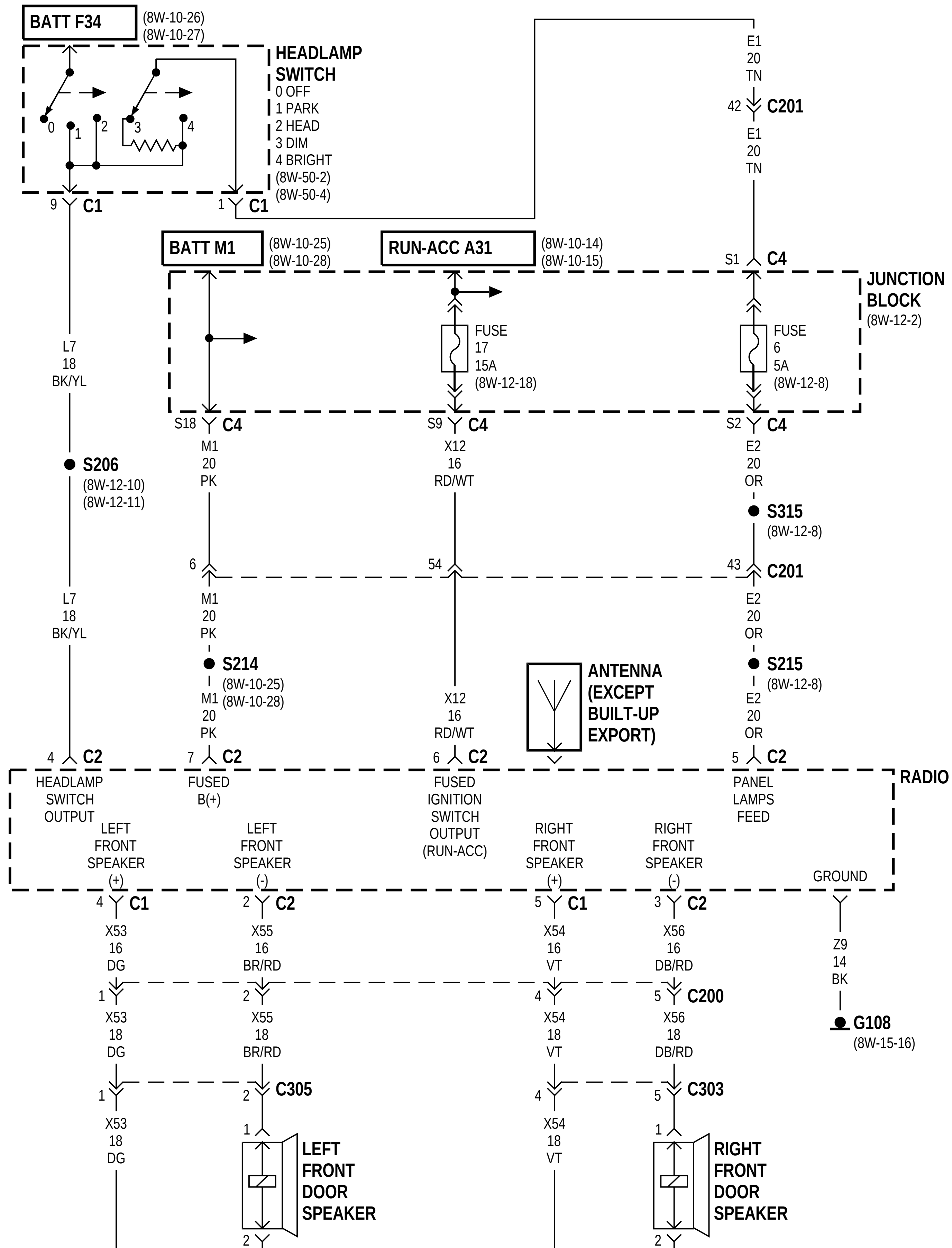
LHD 6 SPEAKER SYSTEM



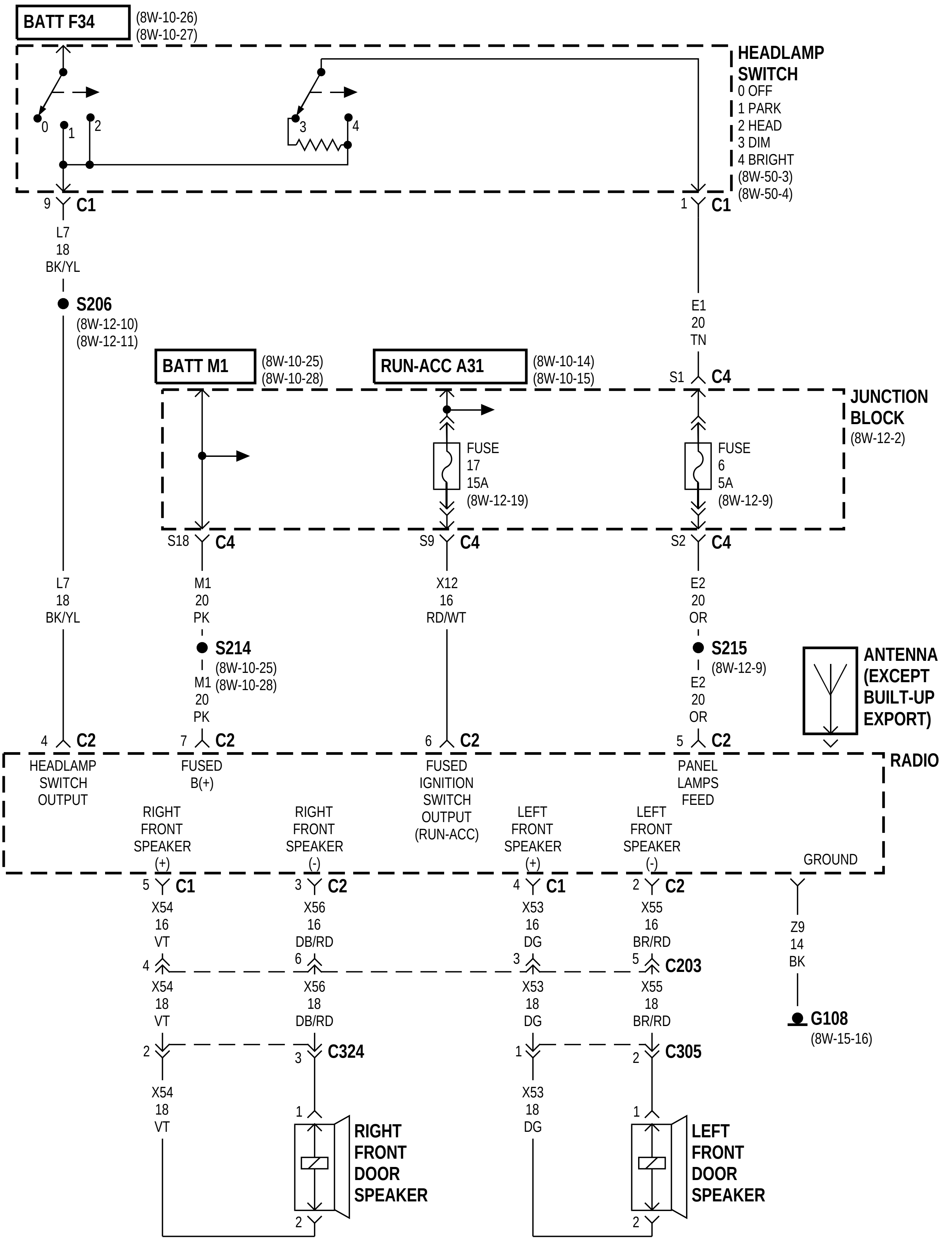
RHD 6 SPEAKER SYSTEM

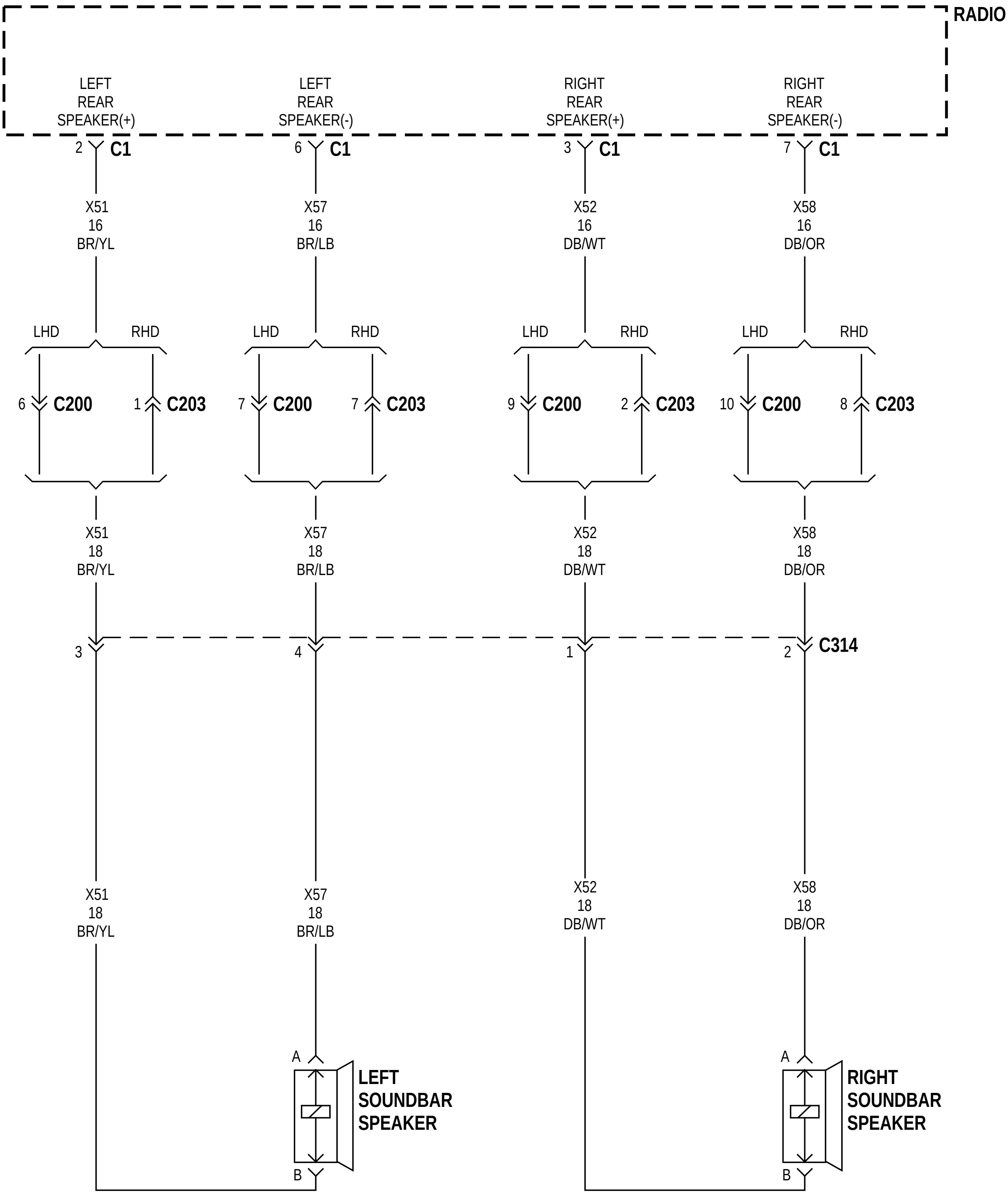


LHD 4 SPEAKER SYSTEM



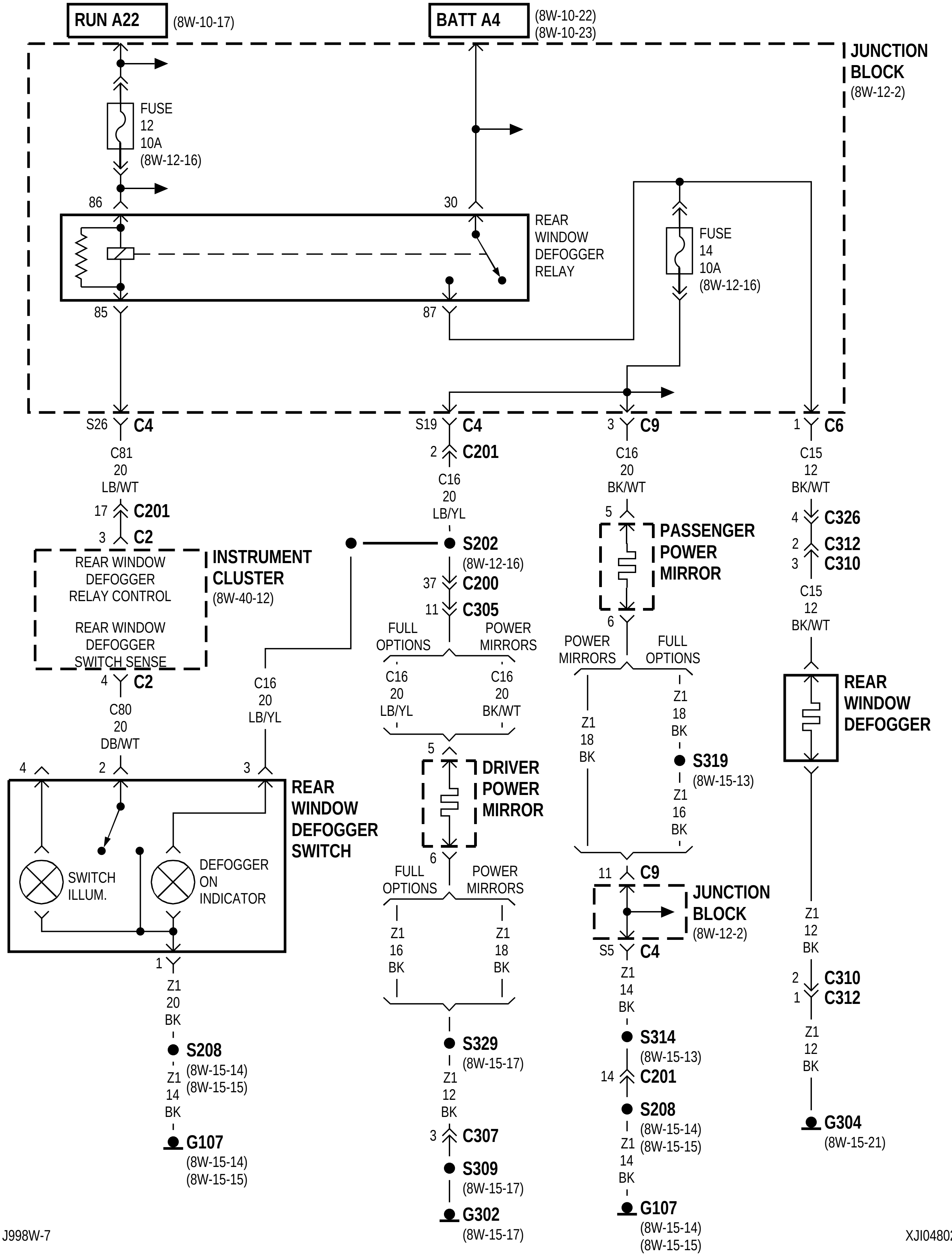
RHD 4 SPEAKER SYSTEM

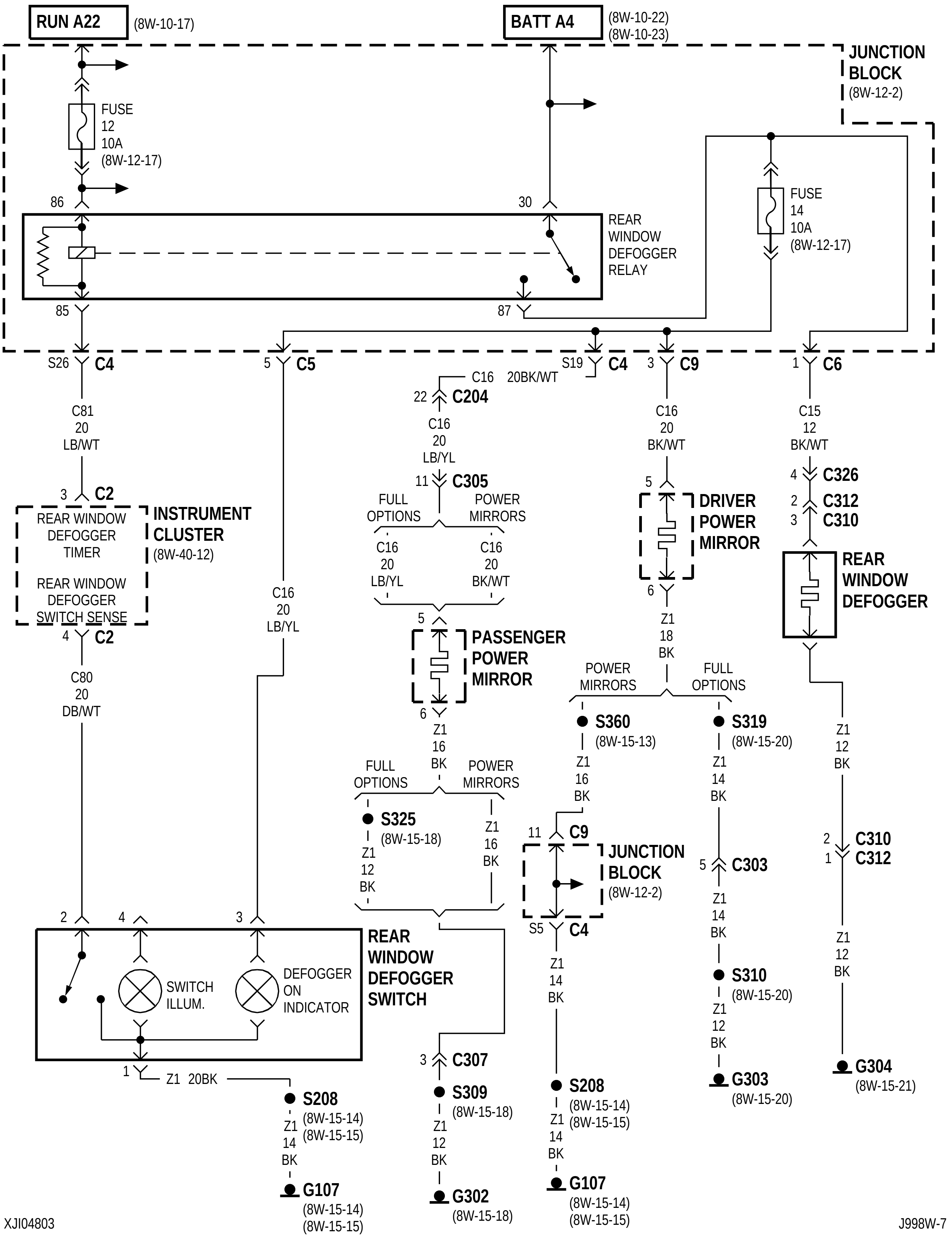



RADIO
LEFT REAR SPEAKER(+)
LEFT REAR SPEAKER(-)
RIGHT REAR SPEAKER(+)
RIGHT REAR SPEAKER(-)
2 C1
6 C1
3 C1
7 C1
X51 16 BR/YL
X57 16 BR/LB
X52 16 DB/WT
X58 16 DB/OR
LHD
RHD
6 C200
1 C203
7 C200
7 C203
9 C200
2 C203
10 C200
8 C203
X51 18 BR/YL
X57 18 BR/LB
X52 18 DB/WT
X58 18 DB/OR
3
4
1
2 C314
X51 18 BR/YL
X57 18 BR/LB
X52 18 DB/WT
X58 18 DB/OR
A
B
LEFT SOUNDBAR SPEAKER
A
B
RIGHT SOUNDBAR SPEAKER

8W-48 REAR WINDOW DEFOGGER

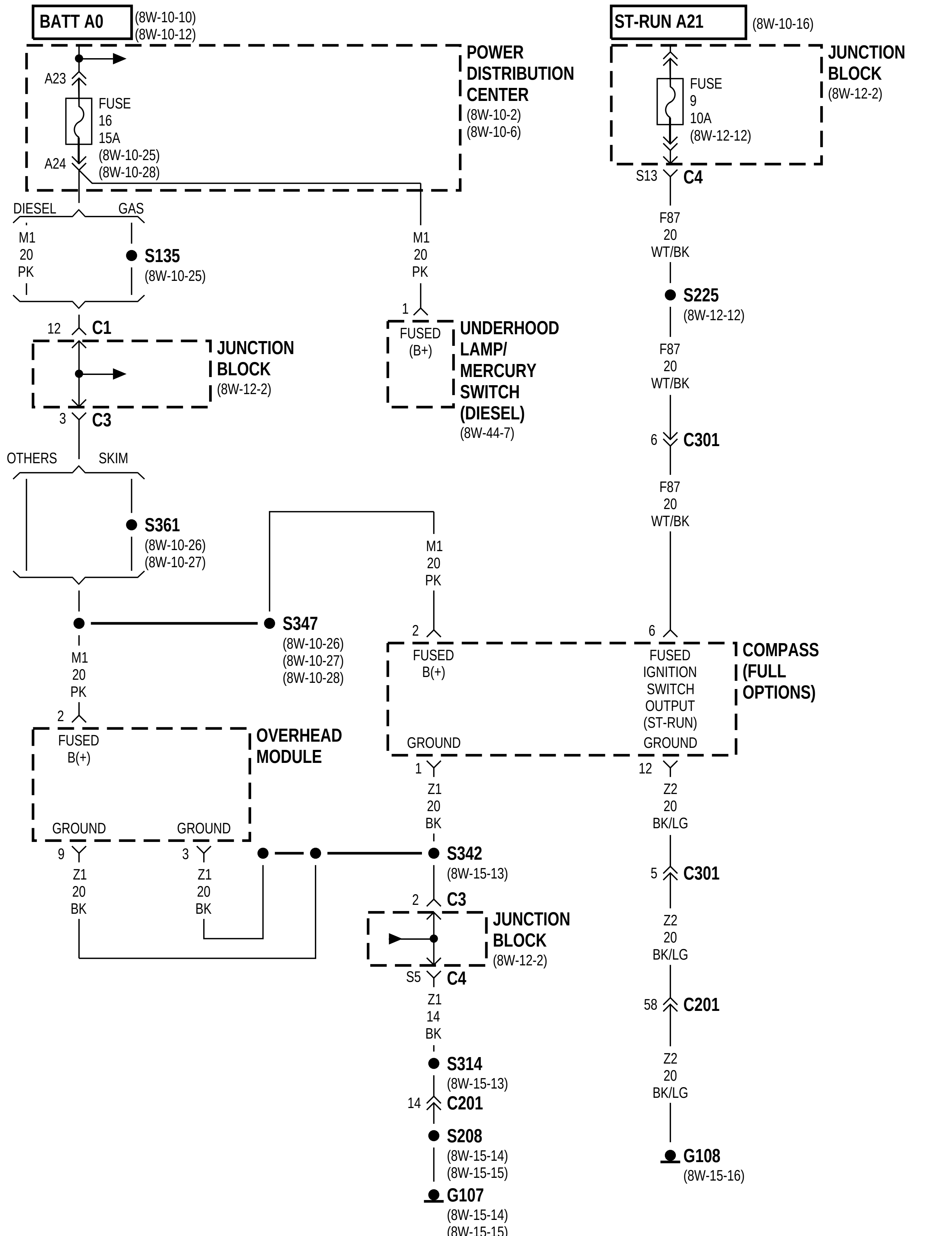
LHD

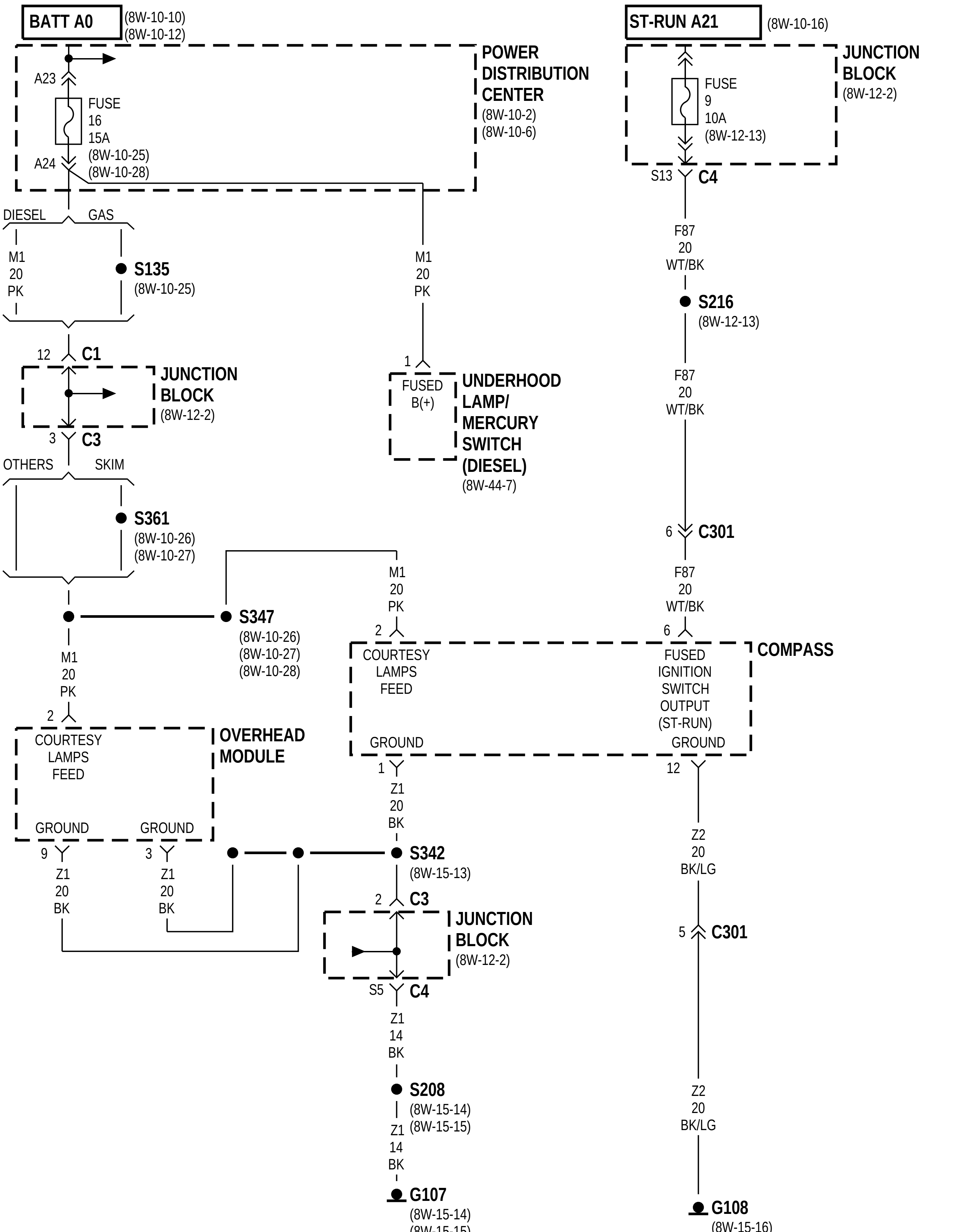

RUN A22
(8W-10-17)
BATT A4
(8W-10-22)
(8W-10-23)
JUNCTION BLOCK
(8W-12-2)
FUSE 12 10A (8W-12-16)
86
30
REAR WINDOW DEFOGGER RELAY
FUSE 14 10A (8W-12-16)
85
87
S26 C4
S19 C4
3 C9
1 C6
C81 20 LB/WT
2 C201
C16 20 BK/WT
C15 12 BK/WT
17 C201
C16 20 LB/YL
5
PASSENGER POWER MIRROR
4 C326
3 C2
S202
(8W-12-16)
2 C312
3 C310
INSTRUMENT CLUSTER
(8W-40-12)
REAR WINDOW DEFOGGER RELAY CONTROL
REAR WINDOW DEFOGGER SWITCH SENSE
37 C200
11 C305
C15 12 BK/WT
6
FULL OPTIONS
POWER MIRRORS
POWER MIRRORS
FULL OPTIONS
4 C2
C16 20 LB/YL
C16 20 LB/YL
C16 20 BK/WT
Z1 18 BK
REAR WINDOW DEFOGGER
C80 20 DB/WT
Z1 18 BK
5
S319
(8W-15-13)
4
2
3
DRIVER POWER MIRROR
Z1 16 BK
REAR WINDOW DEFOGGER SWITCH
6
11 C9
SWITCH ILLUM.
DEFOGGER ON INDICATOR
FULL OPTIONS
POWER MIRRORS
JUNCTION BLOCK
(8W-12-2)
Z1 12 BK
S5 C4
1
Z1 16 BK
Z1 18 BK
Z1 14 BK
2 C310
1 C312
Z1 20 BK
S208
(8W-15-14)
(8W-15-15)
Z1 14 BK
S329
(8W-15-17)
S314
(8W-15-13)
Z1 12 BK
Z1 12 BK
14 C201
G107
(8W-15-14)
(8W-15-15)
3 C307
S208
(8W-15-14)
(8W-15-15)
Z1 14 BK
G304
(8W-15-21)
S309
(8W-15-17)
G302
(8W-15-17)
G107
(8W-15-14)
(8W-15-15)


RUN A22
(8W-10-17)
BATT A4
(8W-10-22)
(8W-10-23)
JUNCTION BLOCK
(8W-12-2)
FUSE
12
10A
(8W-12-17)
FUSE
14
10A
(8W-12-17)
86
30
85
87
REAR WINDOW DEFOGGER RELAY
S26 C4
5 C5
S19 C4
3 C9
1 C6
C16 20BK/WT
22 C204
C81
20
LB/WT
C16
20
LB/YL
C16
20
BK/WT
C15
12
BK/WT
11 C305
FULL OPTIONS
POWER MIRRORS
4 C326
2 C312
3 C310
3 C2
INSTRUMENT CLUSTER
(8W-40-12)
REAR WINDOW DEFOGGER TIMER
REAR WINDOW DEFOGGER SWITCH SENSE
4 C2
C80
20
DB/WT
DRIVER POWER MIRROR
REAR WINDOW DEFOGGER
PASSENGER POWER MIRROR
Z1
18
BK
Z1
16
BK
S360
(8W-15-13)
S319
(8W-15-20)
S325
(8W-15-18)
Z1
12
BK
Z1
14
BK
11 C9
JUNCTION BLOCK
(8W-12-2)
S5 C4
5 C303
2 C310
1 C312
REAR WINDOW DEFOGGER SWITCH
SWITCH ILLUM.
DEFOGGER ON INDICATOR
1 Z1 20BK
S208
(8W-15-14)
(8W-15-15)
G107
(8W-15-14)
(8W-15-15)
3 C307
S309
(8W-15-18)
G302
(8W-15-18)
S310
(8W-15-20)
G303
(8W-15-20)
G304
(8W-15-21)

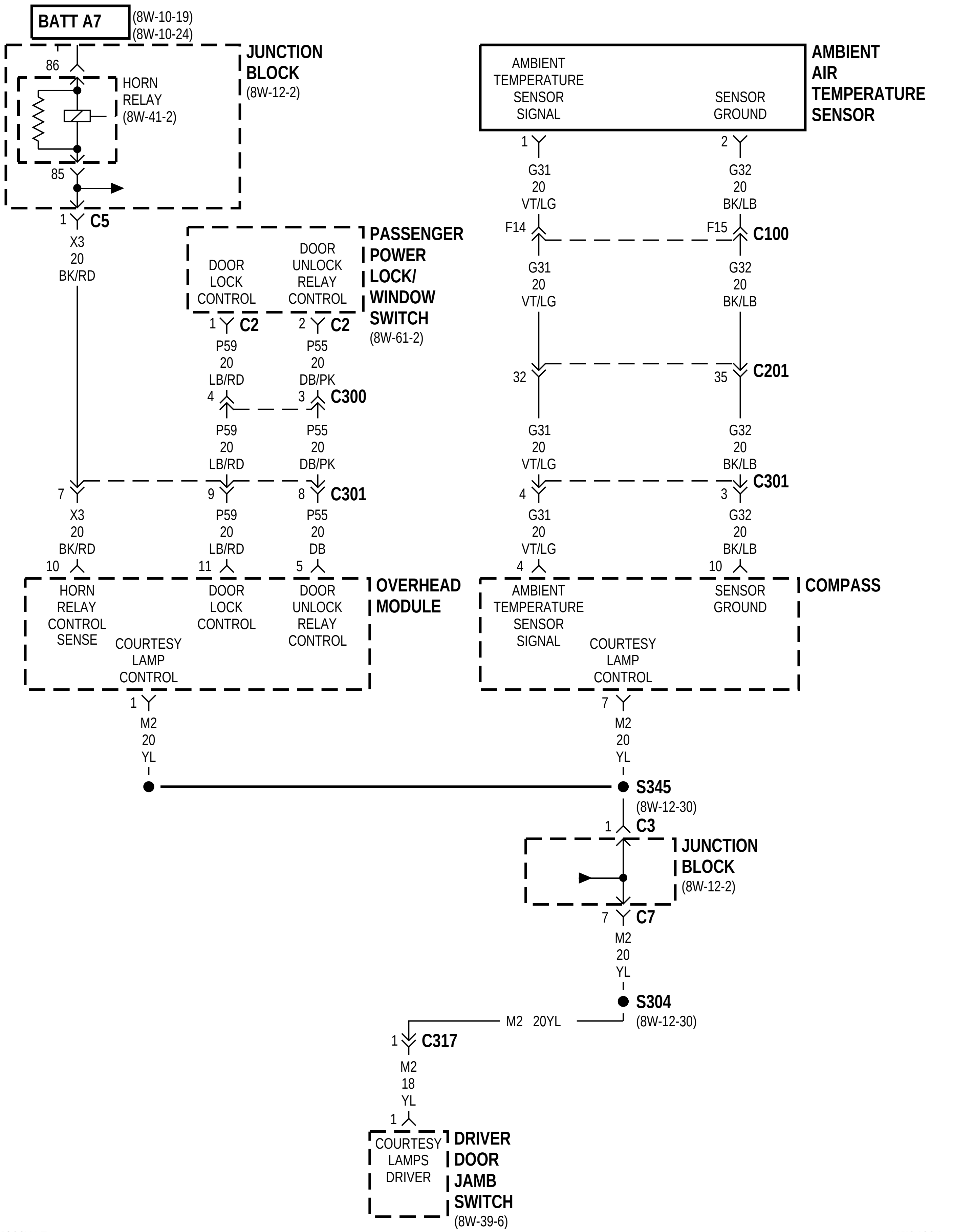
8W-49 OVERHEAD CONSOLE

LHD

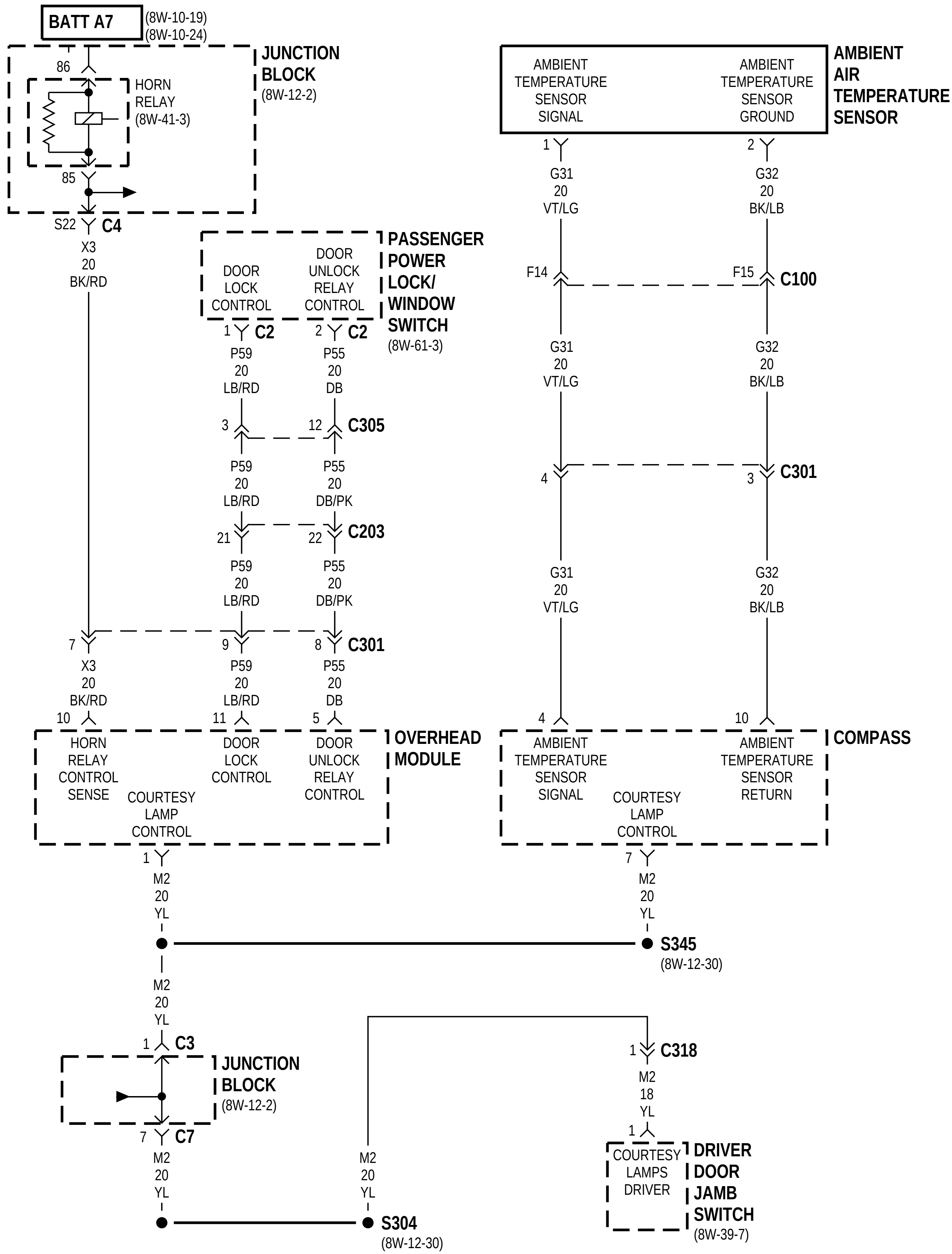

BATT A0
(8W-10-10)
(8W-10-12)
A23
FUSE
16
15A
(8W-10-25)
(8W-10-28)
A24
POWER
DISTRIBUTION
CENTER
(8W-10-2)
(8W-10-6)
DIESEL
GAS
M1
20
PK
S135
(8W-10-25)
12
C1
JUNCTION
BLOCK
(8W-12-2)
3
C3
OTHERS
SKIM
S361
(8W-10-26)
(8W-10-27)
S347
(8W-10-26)
(8W-10-27)
(8W-10-28)
M1
20
PK
2
FUSED
B(+)
OVERHEAD
MODULE
GROUND
GROUND
9
3
Z1
20
BK
1
FUSED
(B+)
UNDERHOOD
LAMP/
MERCURY
SWITCH
(DIESEL)
(8W-44-7)
ST-RUN A21
(8W-10-16)
JUNCTION
BLOCK
(8W-12-2)
FUSE
9
10A
(8W-12-12)
S13
C4
F87
20
WT/BK
S225
(8W-12-12)
6
C301
6
FUSED
IGNITION
SWITCH
OUTPUT
(ST-RUN)
GROUND
COMPASS
(FULL
OPTIONS)
12
Z2
20
BK/LG
5
C301
58
C201
G108
(8W-15-16)
S342
(8W-15-13)
2
C3
JUNCTION
BLOCK
(8W-12-2)
S5
C4
Z1
14
BK
S314
(8W-15-13)
14
C201
S208
(8W-15-14)
(8W-15-15)
G107
(8W-15-14)
(8W-15-15)

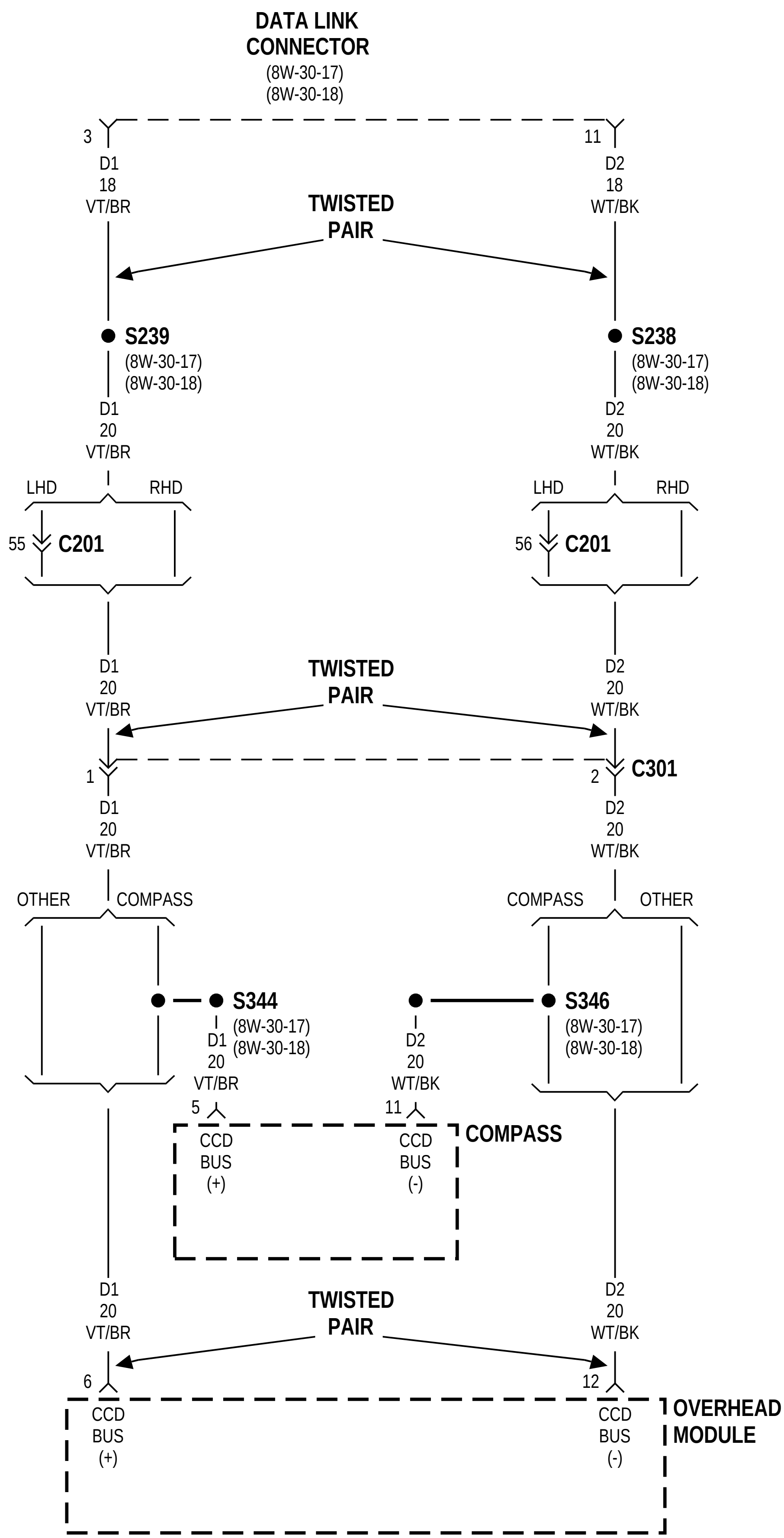

BATT A0
(8W-10-10)
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-2)
(8W-10-6)
A23
FUSE 16 15A
(8W-10-25)
(8W-10-28)
A24
DIESEL
GAS
M1 20 PK
S135
(8W-10-25)
M1 20 PK
12 C1
JUNCTION BLOCK
(8W-12-2)
3 C3
1
FUSED B(+)
UNDERHOOD LAMP/ MERCURY SWITCH (DIESEL)
(8W-44-7)
OTHERS
SKIM
S361
(8W-10-26)
(8W-10-27)
S347
(8W-10-26)
(8W-10-27)
(8W-10-28)
M1 20 PK
2
COURTESY LAMPS FEED
OVERHEAD MODULE
GROUND
GROUND
9
3
Z1 20 BK
Z1 20 BK
ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE 9 10A
(8W-12-13)
S13 C4
F87 20 WT/BK
S216
(8W-12-13)
F87 20 WT/BK
6 C301
F87 20 WT/BK
M1 20 PK
2
6
COURTESY LAMPS FEED
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
COMPASS
GROUND
GROUND
1
12
Z1 20 BK
S342
(8W-15-13)
2 C3
JUNCTION BLOCK
(8W-12-2)
S5 C4
Z1 14 BK
S208
(8W-15-14)
(8W-15-15)
Z1 14 BK
G107
(8W-15-14)
(8W-15-15)
Z2 20 BK/LG
5 C301
Z2 20 BK/LG
G108
(8W-15-16)

LHD


BATT A7
(8W-10-19)
(8W-10-24)
JUNCTION BLOCK
(8W-12-2)
86
HORN RELAY
(8W-41-2)
85
1 C5
X3
20
BK/RD
PASSENGER POWER LOCK/ WINDOW SWITCH
(8W-61-2)
DOOR LOCK CONTROL
DOOR UNLOCK RELAY CONTROL
1 C2
2 C2
P59
20
LB/RD
P55
20
DB/PK
4
3 C300
P59
20
LB/RD
P55
20
DB/PK
7
9
8 C301
X3
20
BK/RD
P59
20
LB/RD
P55
20
DB
10
11
5
OVERHEAD MODULE
HORN RELAY CONTROL SENSE
COURTESY LAMP CONTROL
DOOR LOCK CONTROL
DOOR UNLOCK RELAY CONTROL
1
M2
20
YL
AMBIENT AIR TEMPERATURE SENSOR
AMBIENT TEMPERATURE SENSOR SIGNAL
SENSOR GROUND
1
2
G31
20
VT/LG
G32
20
BK/LB
F14
F15 C100
G31
20
VT/LG
G32
20
BK/LB
32
35 C201
G31
20
VT/LG
G32
20
BK/LB
4
3 C301
G31
20
VT/LG
G32
20
BK/LB
4
10
COMPASS
AMBIENT TEMPERATURE SENSOR SIGNAL
SENSOR GROUND
COURTESY LAMP CONTROL
7
M2
20
YL
S345
(8W-12-30)
1 C3
JUNCTION BLOCK
(8W-12-2)
7 C7
M2
20
YL
S304
(8W-12-30)
M2 20YL
1 C317
M2
18
YL
1
COURTESY LAMPS DRIVER
DRIVER DOOR JAMB SWITCH
(8W-39-6)

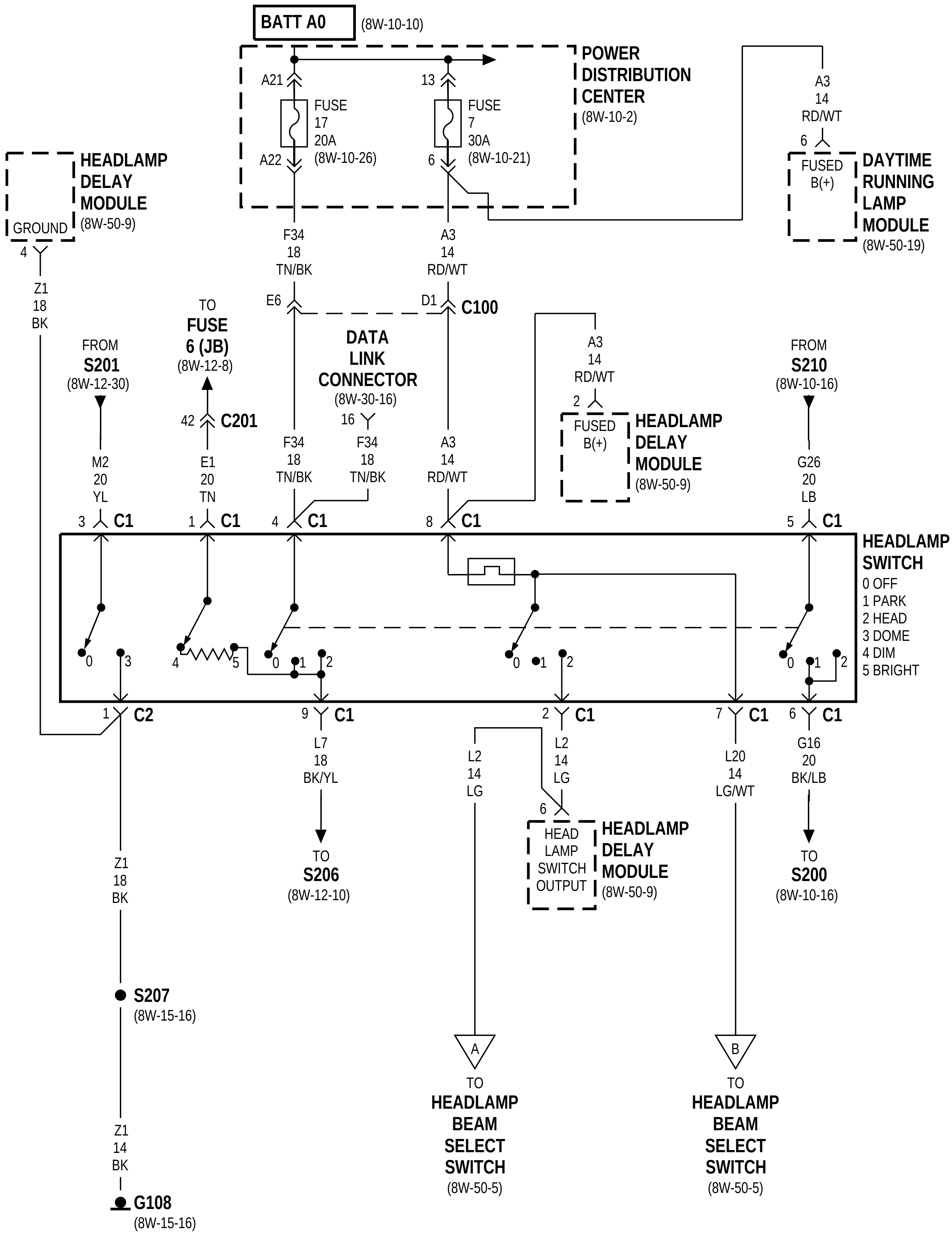
RHD


BATT A7
(8W-10-19)
(8W-10-24)
86
HORN RELAY (8W-41-3)
85
JUNCTION BLOCK (8W-12-2)
S22 C4
X3 20 BK/RD
PASSENGER POWER LOCK/ WINDOW SWITCH (8W-61-3)
DOOR LOCK CONTROL
DOOR UNLOCK RELAY CONTROL
1 C2
2 C2
P59 20 LB/RD
P55 20 DB
3
12 C305
P59 20 LB/RD
P55 20 DB/PK
21
22 C203
P59 20 LB/RD
P55 20 DB/PK
7
9
8 C301
X3 20 BK/RD
P59 20 LB/RD
P55 20 DB
10
11
5
OVERHEAD MODULE
HORN RELAY CONTROL SENSE
COURTESY LAMP CONTROL
DOOR LOCK CONTROL
DOOR UNLOCK RELAY CONTROL
1
M2 20 YL
S345 (8W-12-30)
M2 20 YL
1 C3
JUNCTION BLOCK (8W-12-2)
7 C7
M2 20 YL
M2 20 YL
S304 (8W-12-30)
AMBIENT AIR TEMPERATURE SENSOR
AMBIENT TEMPERATURE SENSOR SIGNAL
AMBIENT TEMPERATURE SENSOR GROUND
1
2
G31 20 VT/LG
G32 20 BK/LB
F14
F15 C100
G31 20 VT/LG
G32 20 BK/LB
4
3 C301
G31 20 VT/LG
G32 20 BK/LB
4
10
COMPASS
AMBIENT TEMPERATURE SENSOR SIGNAL
COURTESY LAMP CONTROL
AMBIENT TEMPERATURE SENSOR RETURN
7
M2 20 YL
1 C318
M2 18 YL
1
DRIVER DOOR JAMB SWITCH (8W-39-7)
COURTESY LAMPS DRIVER

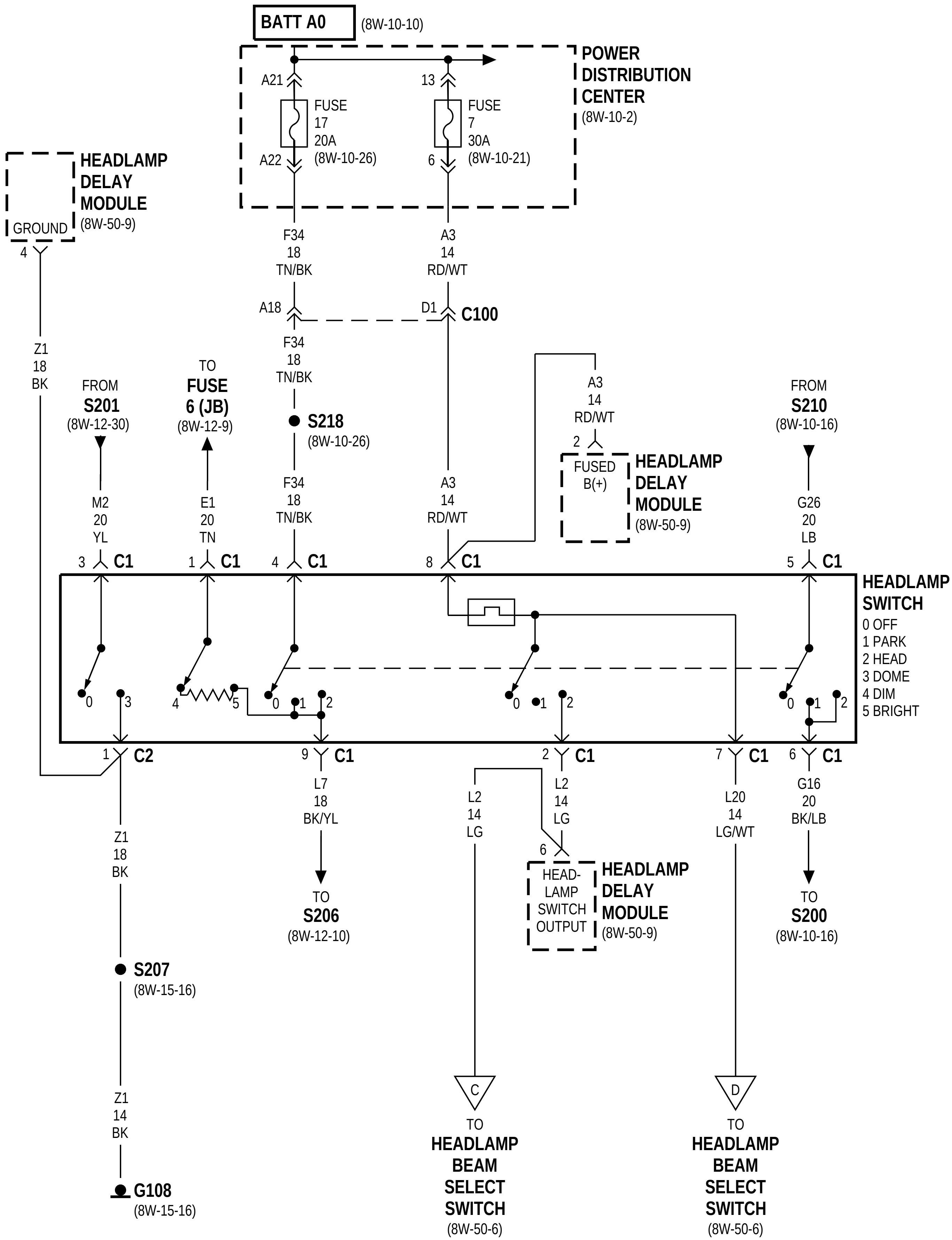

DATA LINK
CONNECTOR
(8W-30-17)
(8W-30-18)
3
11
D1
18
VT/BR
D2
18
WT/BK
TWISTED
PAIR
S239
(8W-30-17)
(8W-30-18)
S238
(8W-30-17)
(8W-30-18)
D1
20
VT/BR
D2
20
WT/BK
LHD
RHD
55
C201
LHD
RHD
56
C201
D1
20
VT/BR
TWISTED
PAIR
D2
20
WT/BK
1
2
C301
D1
20
VT/BR
D2
20
WT/BK
OTHER
COMPASS
COMPASS
OTHER
S344
(8W-30-17)
(8W-30-18)
D1
20
VT/BR
D2
20
WT/BK
S346
(8W-30-17)
(8W-30-18)
5
11
CCD
BUS
(+)
CCD
BUS
(-)
COMPASS
D1
20
VT/BR
TWISTED
PAIR
D2
20
WT/BK
6
12
CCD
BUS
(+)
CCD
BUS
(-)
OVERHEAD
MODULE

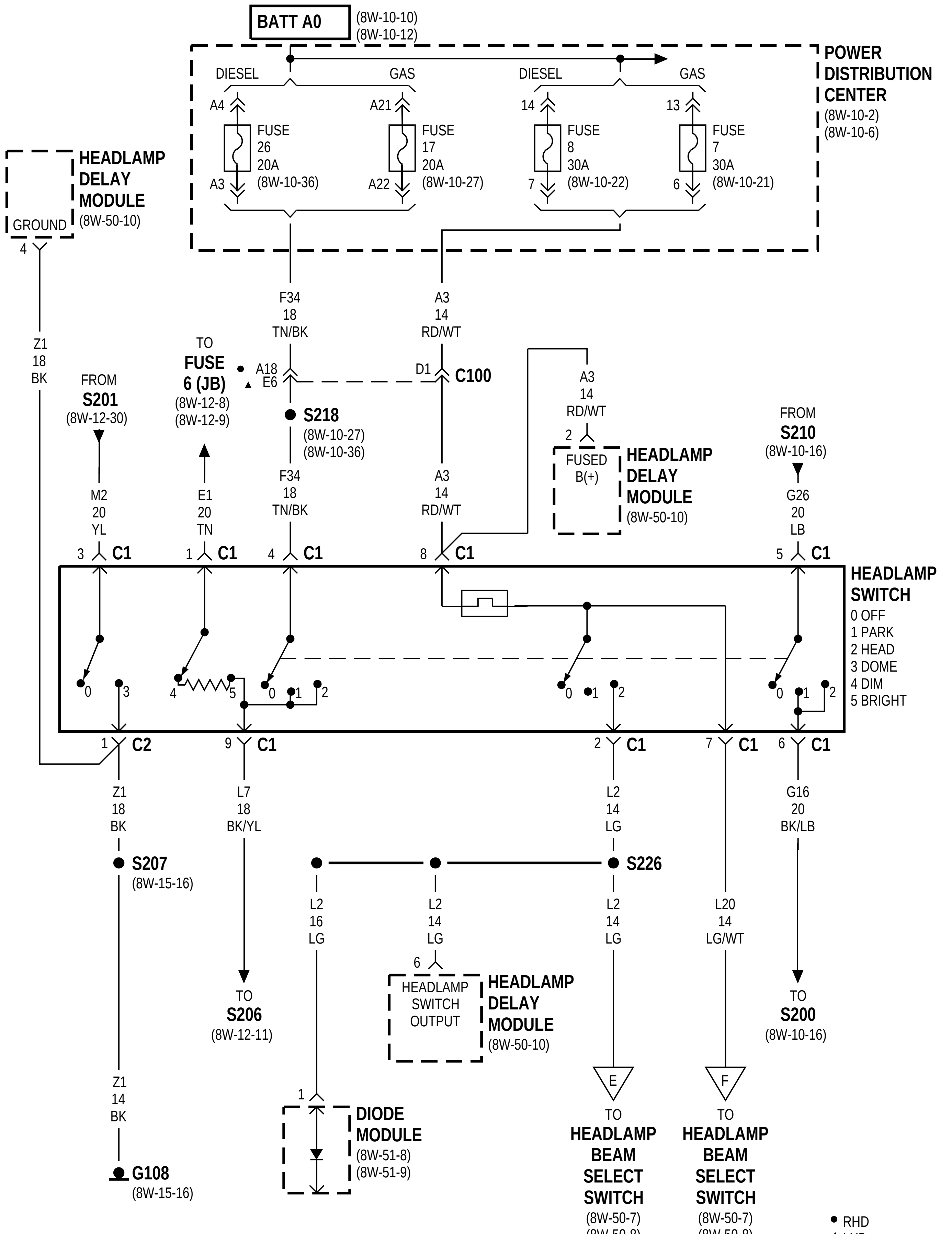
8W-50 FRONT LIGHTING

LHD EXCEPT BUILT-UP-EXPORT

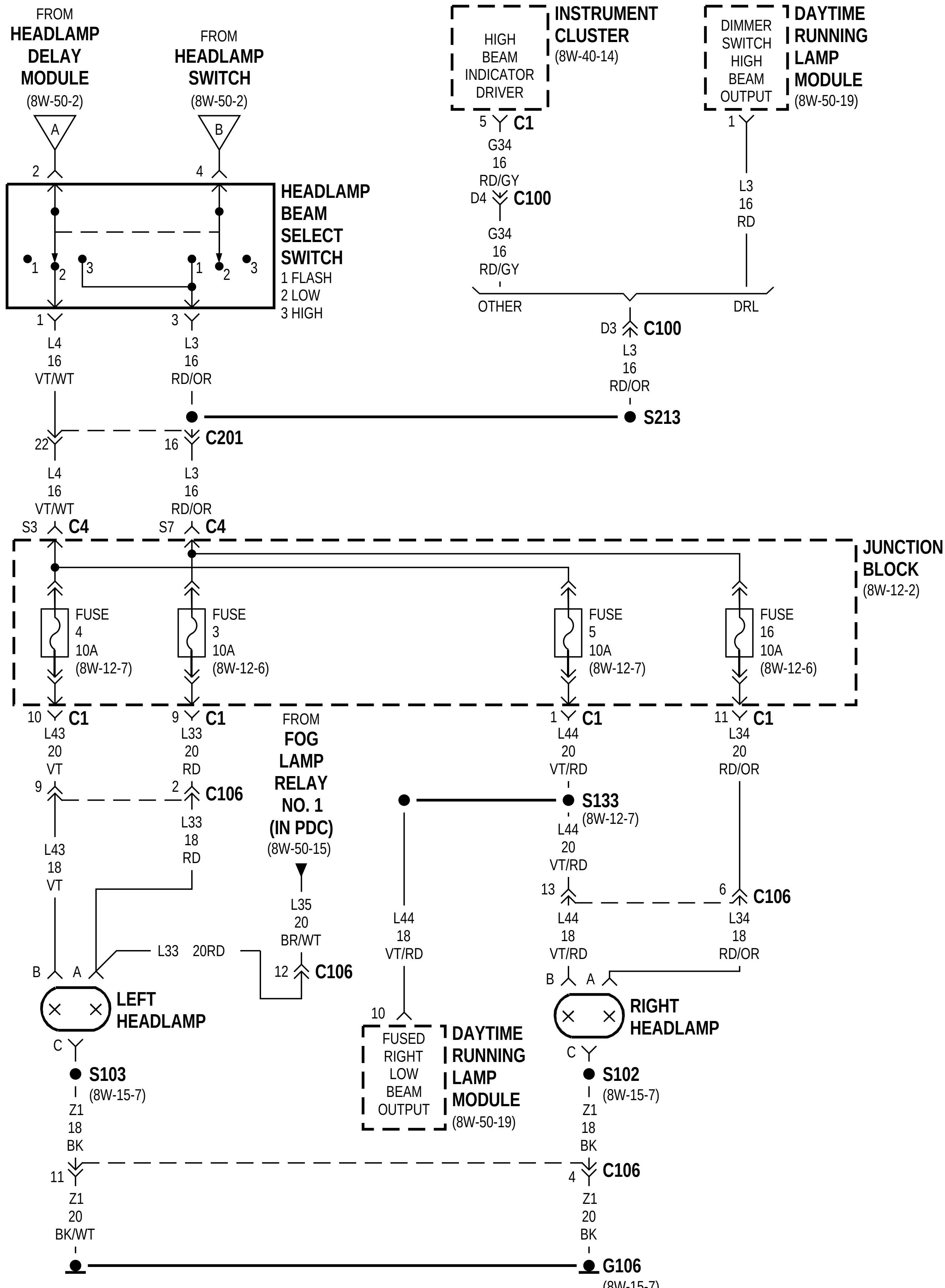


RHD EXCEPT BUILT-UP-EXPORT

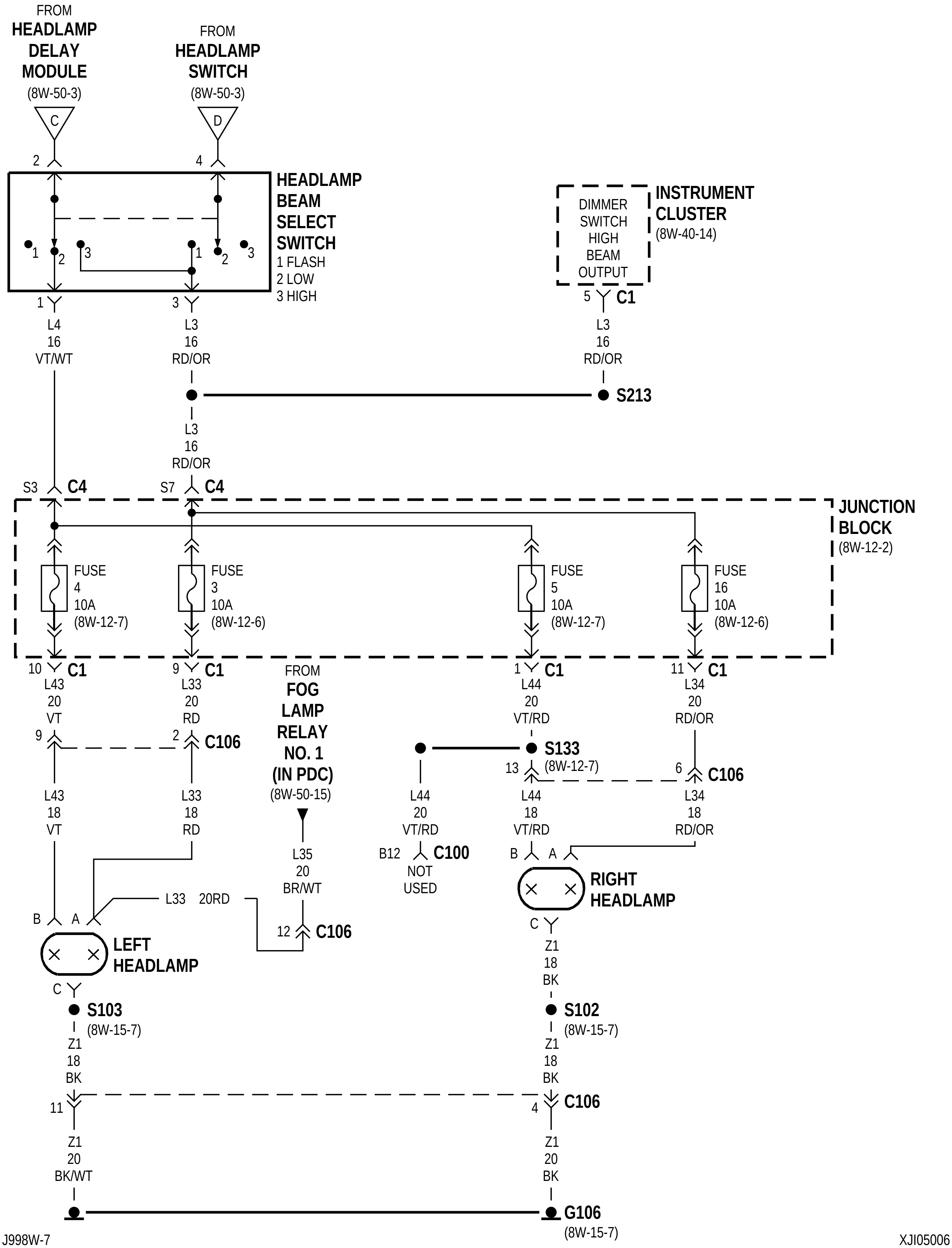


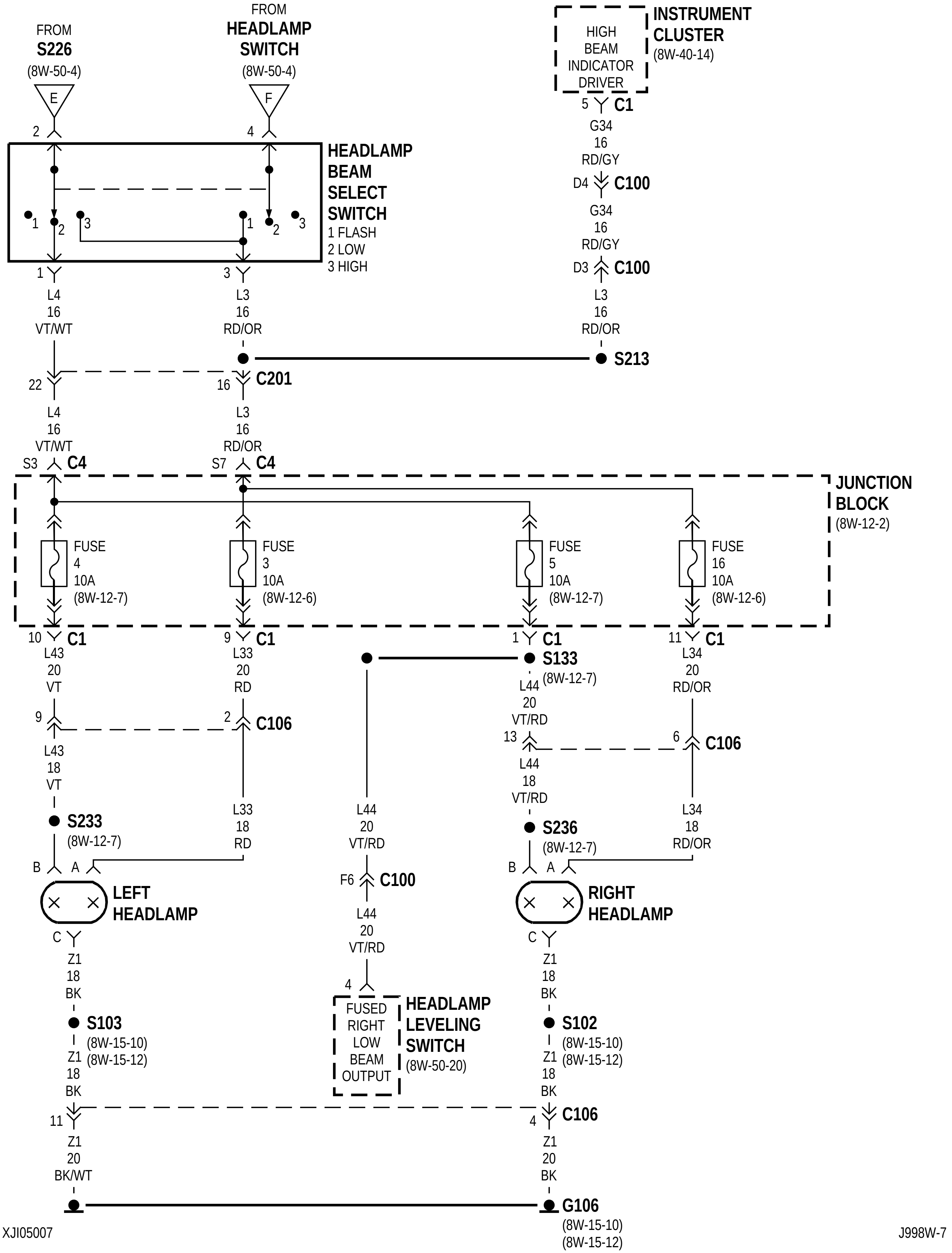

BATT A0
(8W-10-10)
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-2)
(8W-10-6)
DIESEL
GAS
DIESEL
GAS
A4
A21
14
13
FUSE 26 20A (8W-10-36)
FUSE 17 20A (8W-10-27)
FUSE 8 30A (8W-10-22)
FUSE 7 30A (8W-10-21)
A3
A22
7
6
HEADLAMP DELAY MODULE
GROUND
(8W-50-10)
4
Z1 18 BK
F34 18 TN/BK
A3 14 RD/WT
FROM S201 (8W-12-30)
TO FUSE 6 (JB) (8W-12-8) (8W-12-9)
A18
E6
D1
C100
S218 (8W-10-27) (8W-10-36)
A3 14 RD/WT
2
FUSED B(+)
HEADLAMP DELAY MODULE (8W-50-10)
FROM S210 (8W-10-16)
M2 20 YL
E1 20 TN
F34 18 TN/BK
A3 14 RD/WT
G26 20 LB
3 C1
1 C1
4 C1
8 C1
5 C1
HEADLAMP SWITCH
0 OFF
1 PARK
2 HEAD
3 DOME
4 DIM
5 BRIGHT
1 C2
9 C1
2 C1
7 C1
6 C1
Z1 18 BK
L7 18 BK/YL
L2 14 LG
G16 20 BK/LB
S207 (8W-15-16)
S226
L2 16 LG
L2 14 LG
L2 14 LG
L20 14 LG/WT
6
HEADLAMP SWITCH OUTPUT
HEADLAMP DELAY MODULE (8W-50-10)
TO S206 (8W-12-11)
TO S200 (8W-10-16)
Z1 14 BK
G108 (8W-15-16)
1
DIODE MODULE (8W-51-8) (8W-51-9)
E
F
TO HEADLAMP BEAM SELECT SWITCH (8W-50-7) (8W-50-8)
TO HEADLAMP BEAM SELECT SWITCH (8W-50-7) (8W-50-8)
● RHD
▲ LHD

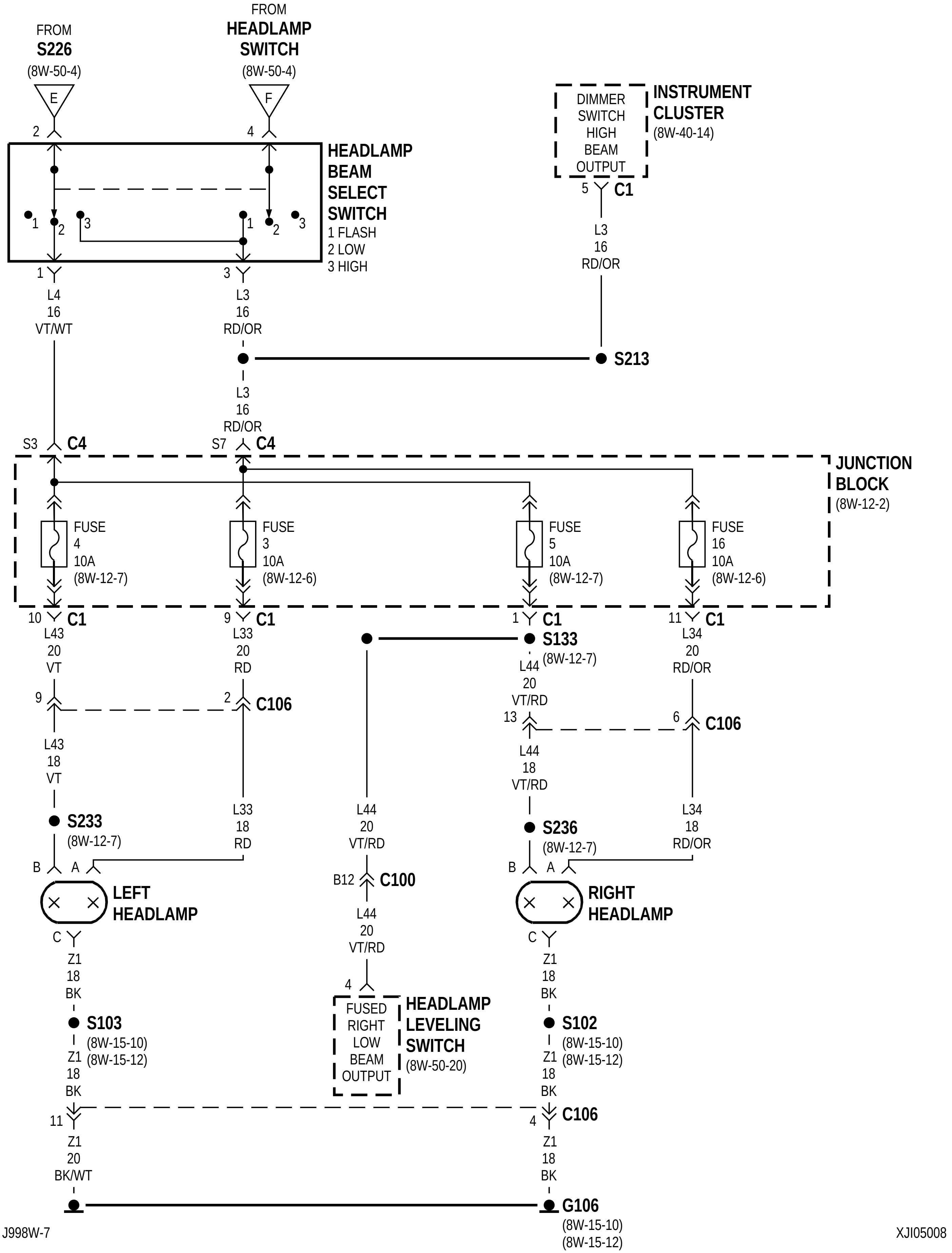
LHD EXCEPT BUILT-UP-EXPORT

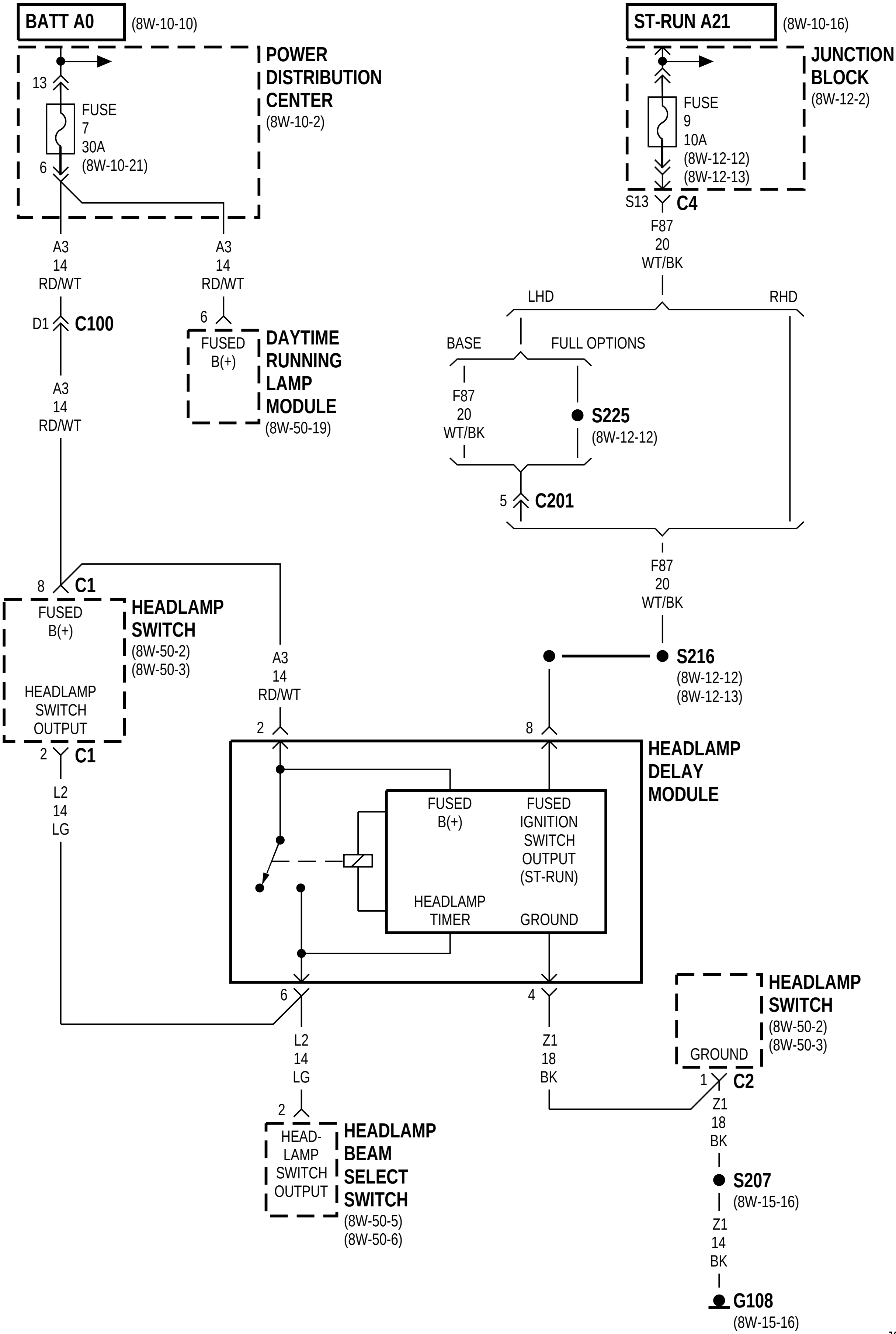


RHD EXCEPT BUILT-UP-EXPORT

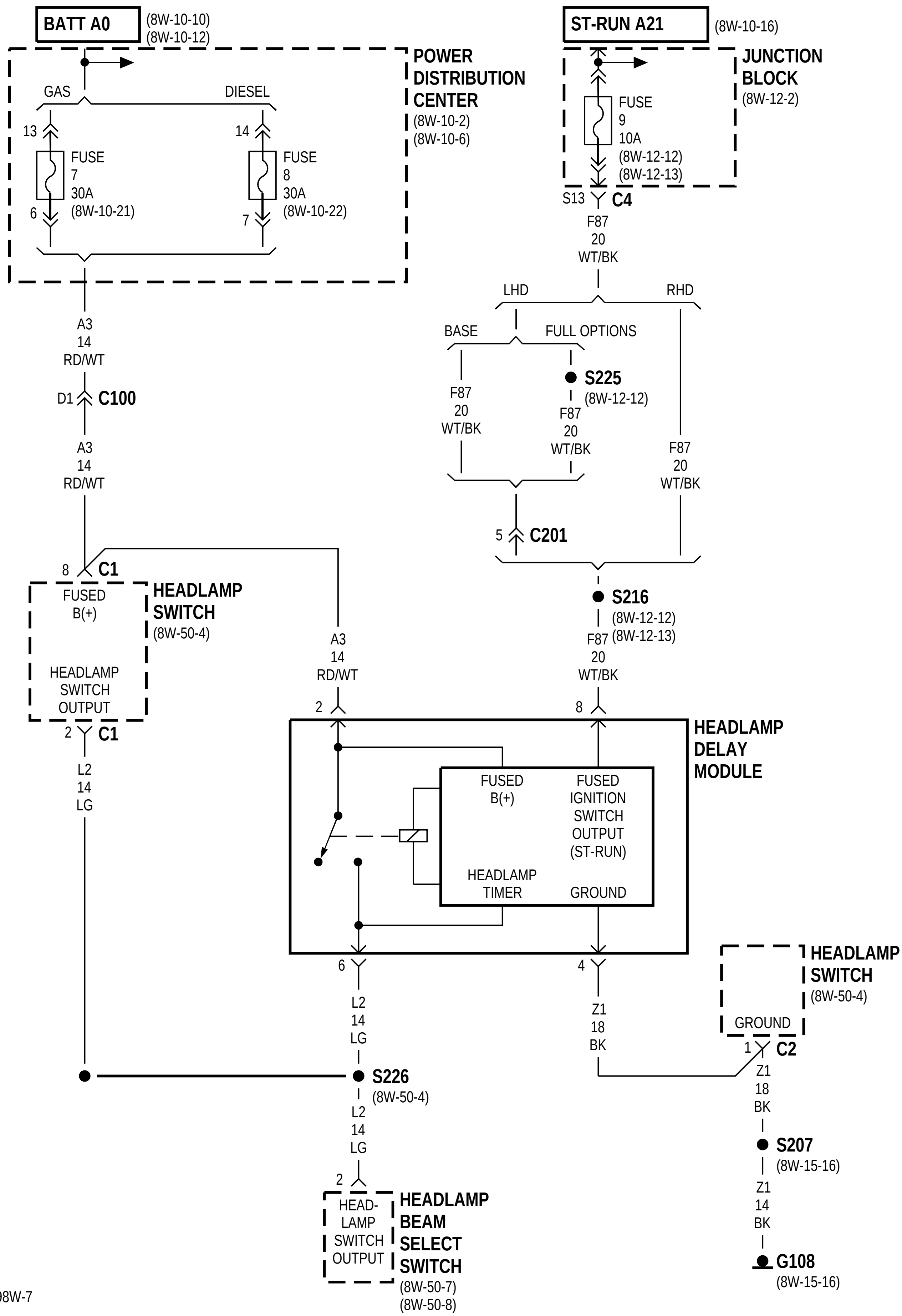



FROM
S226
(8W-50-4)
E
FROM
HEADLAMP SWITCH
(8W-50-4)
F
HIGH BEAM INDICATOR DRIVER
INSTRUMENT CLUSTER
(8W-40-14)
5 C1
G34 16 RD/GY
D4 C100
G34 16 RD/GY
D3 C100
L3 16 RD/OR
S213
HEADLAMP BEAM SELECT SWITCH
1 FLASH
2 LOW
3 HIGH
L4 16 VT/WT
L3 16 RD/OR
22
16 C201
L4 16 VT/WT
L3 16 RD/OR
S3 C4
S7 C4
JUNCTION BLOCK
(8W-12-2)
FUSE 4 10A (8W-12-7)
FUSE 3 10A (8W-12-6)
FUSE 5 10A (8W-12-7)
FUSE 16 10A (8W-12-6)
10 C1
9 C1
1 C1
11 C1
L43 20 VT
L33 20 RD
S133 (8W-12-7)
L44 20 VT/RD
L34 20 RD/OR
9
2 C106
13
6 C106
L43 18 VT
L44 18 VT/RD
S233 (8W-12-7)
L33 18 RD
L44 20 VT/RD
S236 (8W-12-7)
L34 18 RD/OR
B A
LEFT HEADLAMP
F6 C100
B A
RIGHT HEADLAMP
C
Z1 18 BK
L44 20 VT/RD
C
Z1 18 BK
4
FUSED RIGHT LOW BEAM OUTPUT
HEADLAMP LEVELING SWITCH
(8W-50-20)
S103 (8W-15-10) (8W-15-12)
S102 (8W-15-10) (8W-15-12)
Z1 18 BK
Z1 18 BK
11
4 C106
Z1 20 BK/WT
Z1 20 BK
G106
(8W-15-10)
(8W-15-12)


FROM
S226
(8W-50-4)
E
FROM
HEADLAMP SWITCH
(8W-50-4)
F
HEADLAMP BEAM SELECT SWITCH
1 FLASH
2 LOW
3 HIGH
DIMMER SWITCH HIGH BEAM OUTPUT
INSTRUMENT CLUSTER
(8W-40-14)
C1
L3 16 RD/OR
L4 16 VT/WT
S213
S3 C4
S7 C4
JUNCTION BLOCK
(8W-12-2)
FUSE 4 10A (8W-12-7)
FUSE 3 10A (8W-12-6)
FUSE 5 10A (8W-12-7)
FUSE 16 10A (8W-12-6)
C1
L43 20 VT
L33 20 RD
S133
(8W-12-7)
L44 20 VT/RD
L34 20 RD/OR
C106
L43 18 VT
L33 18 RD
L44 18 VT/RD
L34 18 RD/OR
S233
(8W-12-7)
S236
(8W-12-7)
L44 20 VT/RD
B12 C100
LEFT HEADLAMP
RIGHT HEADLAMP
Z1 18 BK
S103
(8W-15-10)
(8W-15-12)
S102
(8W-15-10)
(8W-15-12)
FUSED RIGHT LOW BEAM OUTPUT
HEADLAMP LEVELING SWITCH
(8W-50-20)
C106
Z1 20 BK/WT
Z1 18 BK
G106
(8W-15-10)
(8W-15-12)

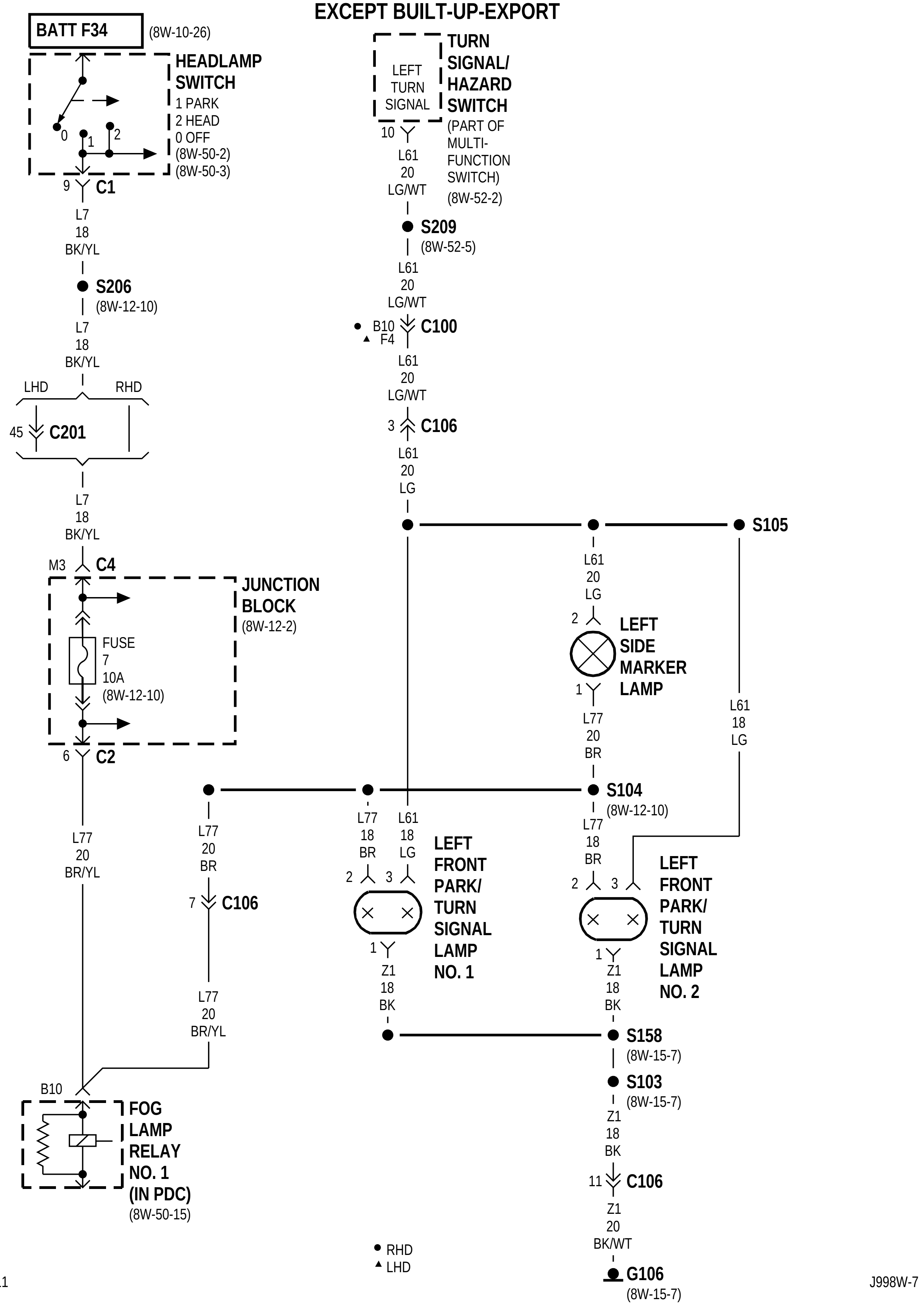

BATT A0
(8W-10-10)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
13
FUSE
7
30A
(8W-10-21)
6
A3
14
RD/WT
A3
14
RD/WT
D1
C100
6
FUSED
B(+)
DAYTIME
RUNNING
LAMP
MODULE
(8W-50-19)
A3
14
RD/WT
8
C1
FUSED
B(+)
HEADLAMP
SWITCH
(8W-50-2)
(8W-50-3)
HEADLAMP
SWITCH
OUTPUT
2
C1
L2
14
LG
A3
14
RD/WT
ST-RUN A21
(8W-10-16)
JUNCTION
BLOCK
(8W-12-2)
FUSE
9
10A
(8W-12-12)
(8W-12-13)
S13
C4
F87
20
WT/BK
LHD
RHD
BASE
FULL OPTIONS
F87
20
WT/BK
S225
(8W-12-12)
5
C201
F87
20
WT/BK
S216
(8W-12-12)
(8W-12-13)
2
8
HEADLAMP
DELAY
MODULE
FUSED
B(+)
FUSED
IGNITION
SWITCH
OUTPUT
(ST-RUN)
HEADLAMP
TIMER
GROUND
6
4
L2
14
LG
Z1
18
BK
HEADLAMP
SWITCH
(8W-50-2)
(8W-50-3)
GROUND
1
C2
Z1
18
BK
S207
(8W-15-16)
Z1
14
BK
G108
(8W-15-16)
2
HEAD-
LAMP
SWITCH
OUTPUT
HEADLAMP
BEAM
SELECT
SWITCH
(8W-50-5)
(8W-50-6)

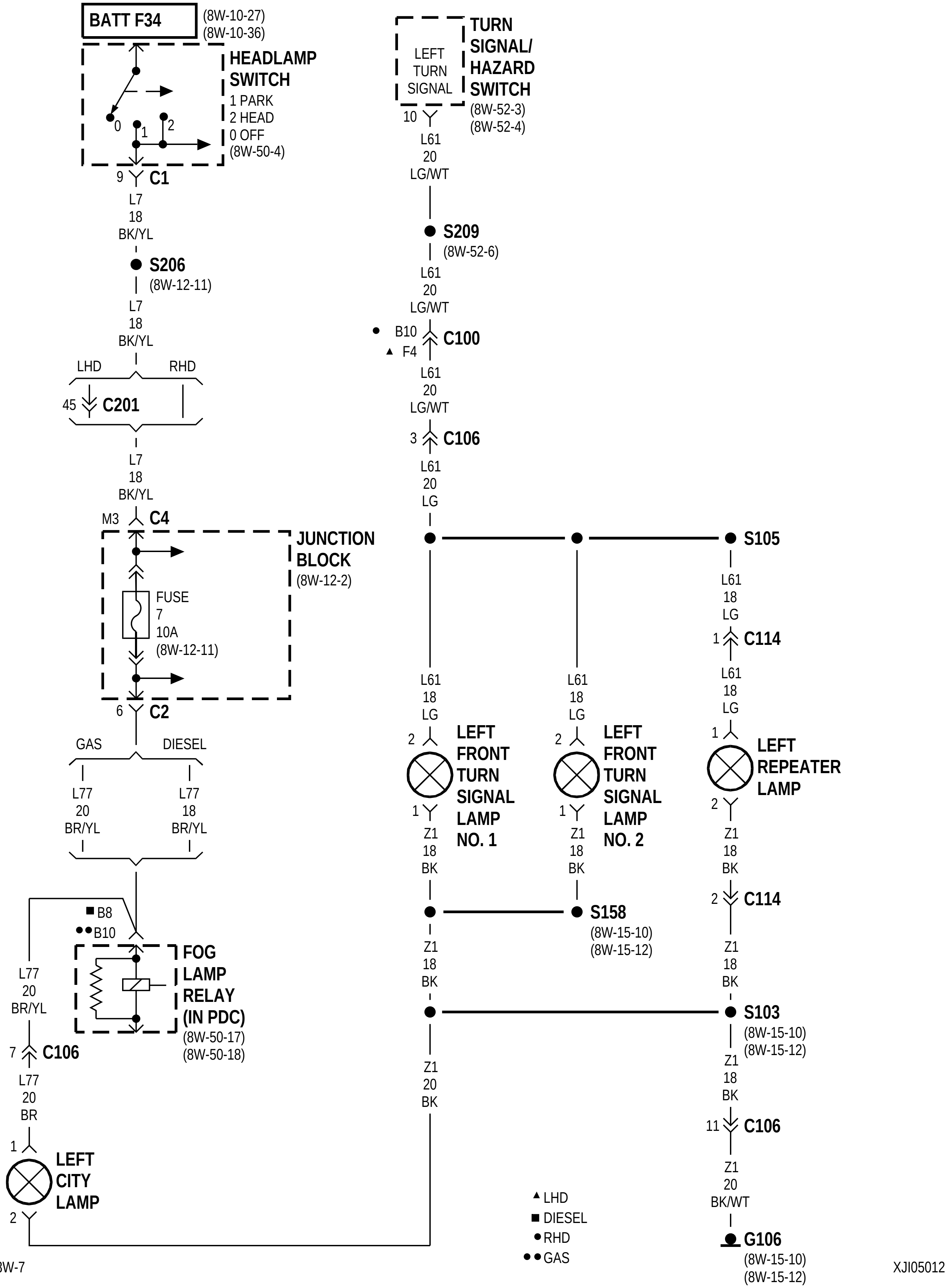
BUILT-UP-EXPORT

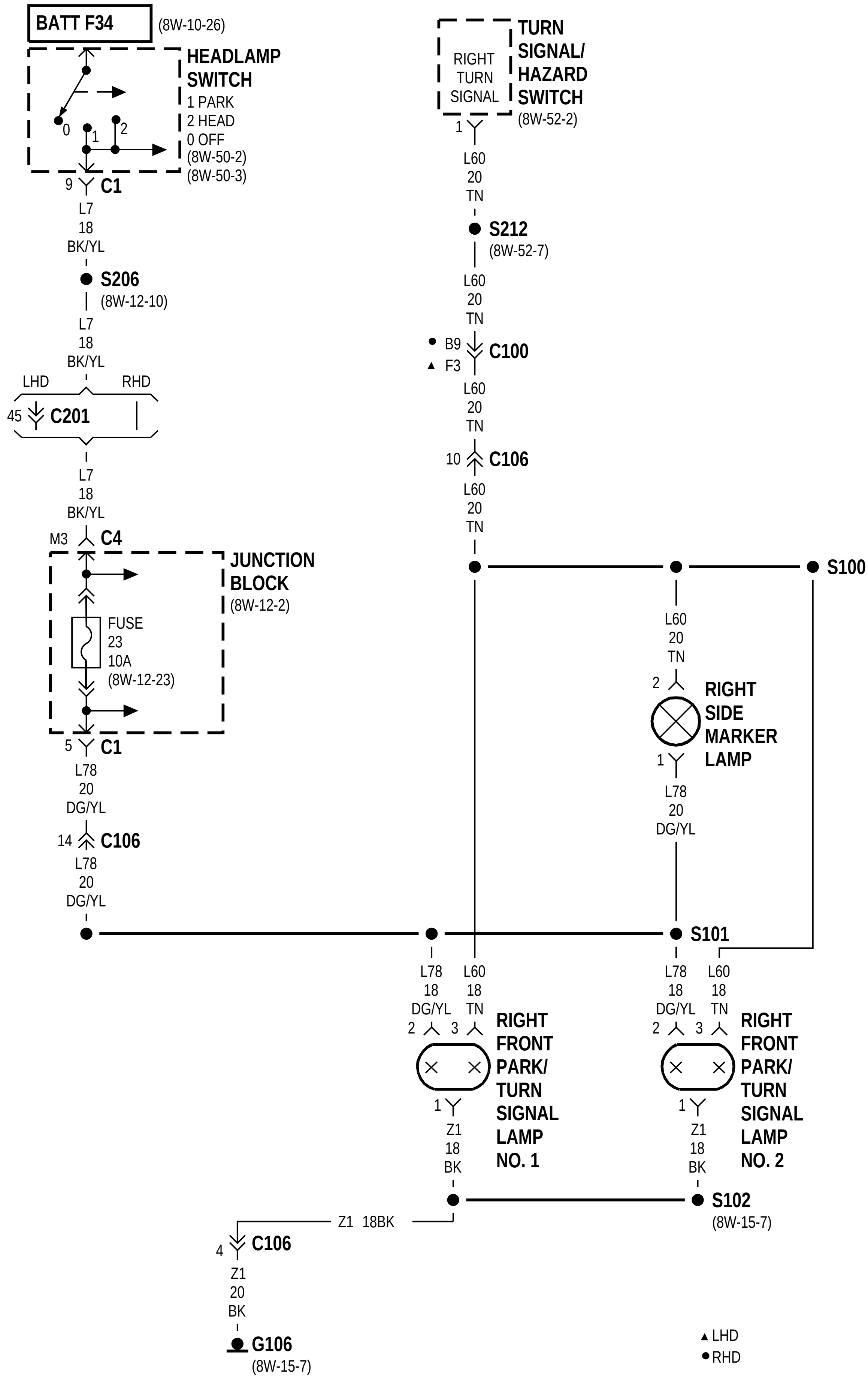


J998W-7

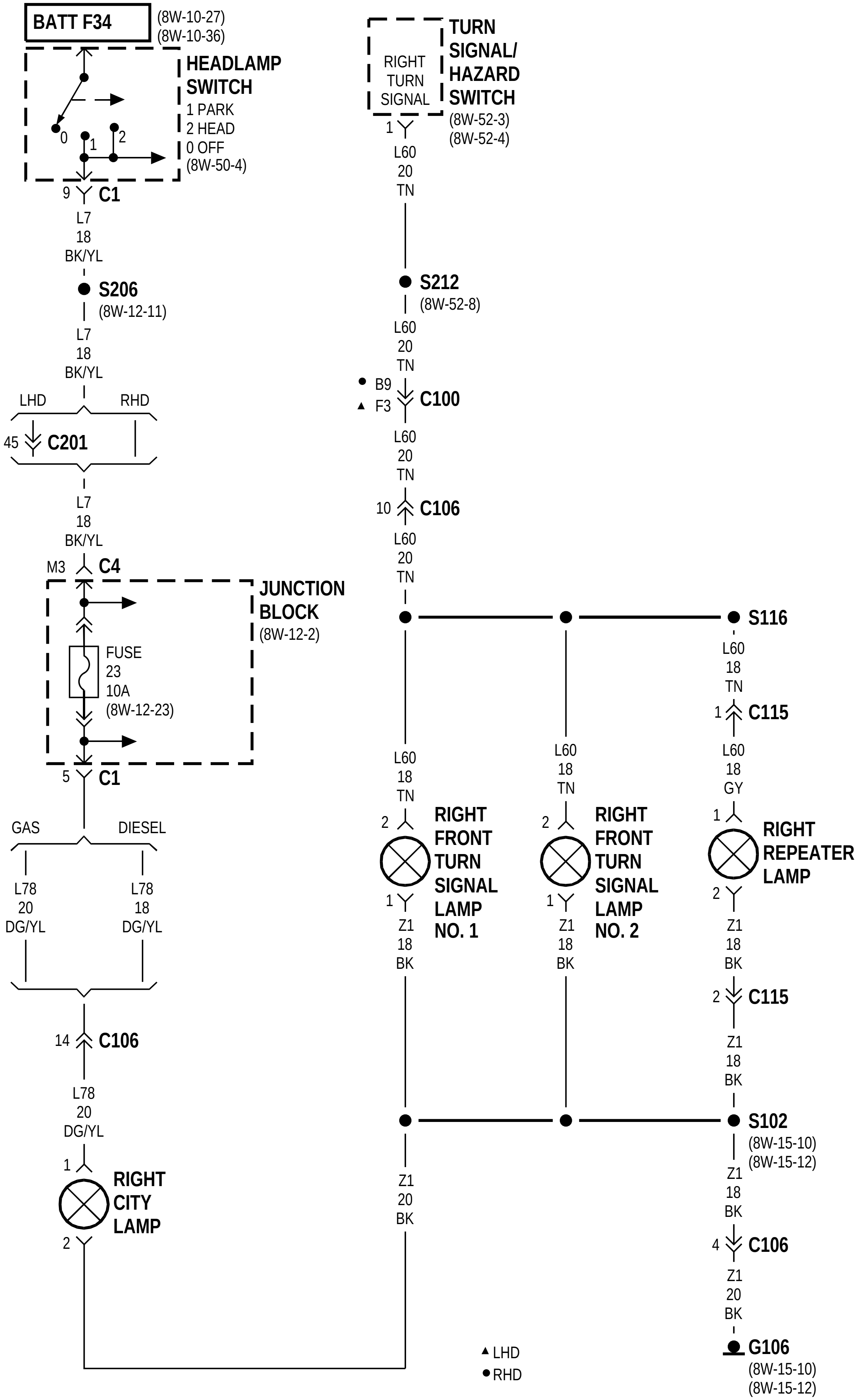
XJI05010

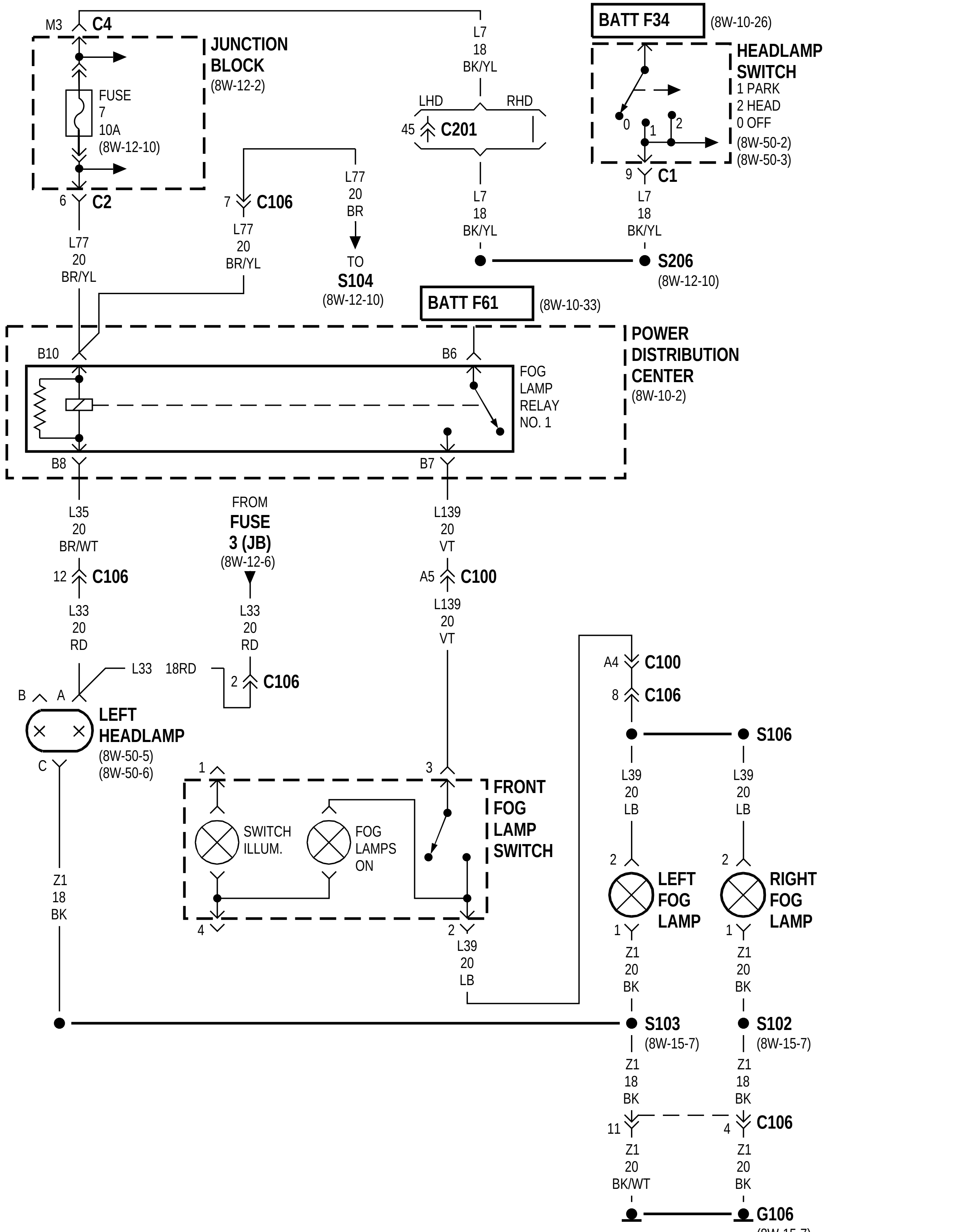

BATT F34
(8W-10-26)
HEADLAMP SWITCH
1 PARK
2 HEAD
0 OFF
(8W-50-2)
(8W-50-3)
C1
L7 18 BK/YL
S206
(8W-12-10)
LHD
RHD
C201
C4
JUNCTION BLOCK
(8W-12-2)
FUSE 7 10A
(8W-12-10)
C2
L77 20 BR/YL
B10
FOG LAMP RELAY NO. 1 (IN PDC)
(8W-50-15)
LEFT TURN SIGNAL
TURN SIGNAL/ HAZARD SWITCH
(PART OF MULTI-FUNCTION SWITCH)
(8W-52-2)
L61 20 LG/WT
S209
(8W-52-5)
C100
C106
L61 20 LG
S105
L61 18 LG
LEFT SIDE MARKER LAMP
L77 20 BR
S104
(8W-12-10)
L77 18 BR
LEFT FRONT PARK/ TURN SIGNAL LAMP NO. 1
LEFT FRONT PARK/ TURN SIGNAL LAMP NO. 2
Z1 18 BK
S158
(8W-15-7)
S103
(8W-15-7)
Z1 20 BK/WT
G106
(8W-15-7)
● RHD
▲ LHD


BATT F34
(8W-10-27)
(8W-10-36)
HEADLAMP SWITCH
1 PARK
2 HEAD
0 OFF
(8W-50-4)
9 C1
L7 18 BK/YL
S206
(8W-12-11)
L7 18 BK/YL
LHD
RHD
45 C201
L7 18 BK/YL
M3 C4
JUNCTION BLOCK
(8W-12-2)
FUSE 7 10A (8W-12-11)
6 C2
GAS
DIESEL
L77 20 BR/YL
L77 18 BR/YL
B8
B10
FOG LAMP RELAY (IN PDC)
(8W-50-17)
(8W-50-18)
L77 20 BR/YL
7 C106
L77 20 BR
LEFT CITY LAMP
LEFT TURN SIGNAL
TURN SIGNAL/ HAZARD SWITCH
(8W-52-3)
(8W-52-4)
10
L61 20 LG/WT
S209
(8W-52-6)
L61 20 LG/WT
B10
F4
C100
L61 20 LG/WT
3 C106
L61 20 LG
S105
L61 18 LG
1 C114
L61 18 LG
LEFT FRONT TURN SIGNAL LAMP NO. 1
LEFT FRONT TURN SIGNAL LAMP NO. 2
LEFT REPEATER LAMP
Z1 18 BK
2 C114
S158
(8W-15-10)
(8W-15-12)
S103
(8W-15-10)
(8W-15-12)
Z1 20 BK
11 C106
Z1 20 BK/WT
G106
(8W-15-10)
(8W-15-12)
LHD
DIESEL
RHD
GAS

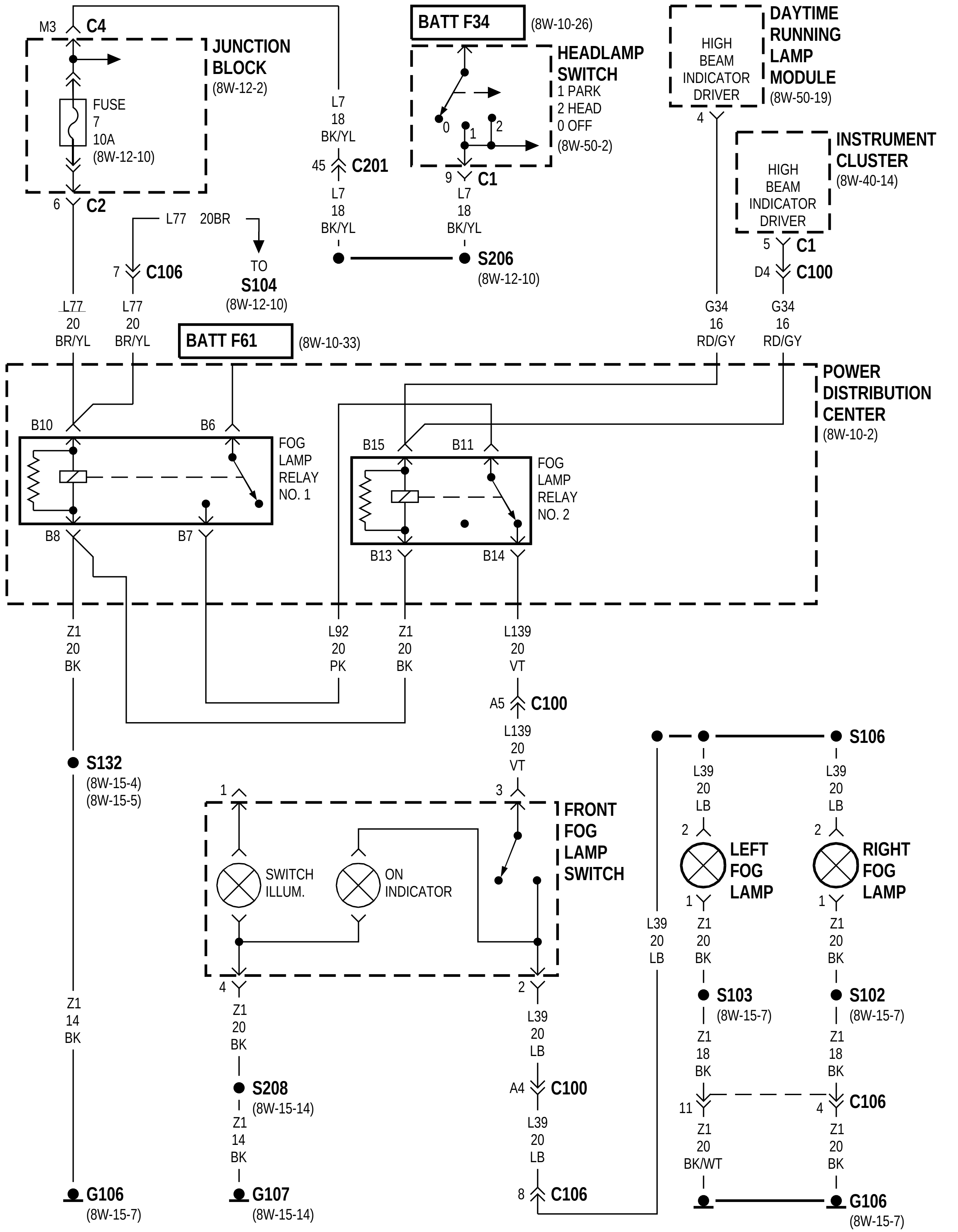

BATT F34
(8W-10-26)
HEADLAMP SWITCH
1 PARK
2 HEAD
0 OFF
(8W-50-2)
(8W-50-3)
0
1
2
9
C1
L7
18
BK/YL
S206
(8W-12-10)
L7
18
BK/YL
LHD
RHD
45
C201
L7
18
BK/YL
M3
C4
JUNCTION BLOCK
(8W-12-2)
FUSE
23
10A
(8W-12-23)
5
C1
L78
20
DG/YL
14
C106
L78
20
DG/YL
RIGHT TURN SIGNAL
TURN SIGNAL/ HAZARD SWITCH
(8W-52-2)
1
L60
20
TN
S212
(8W-52-7)
L60
20
TN
B9
F3
C100
L60
20
TN
10
C106
L60
20
TN
S100
L60
20
TN
2
RIGHT SIDE MARKER LAMP
1
L78
20
DG/YL
S101
L78
18
DG/YL
L60
18
TN
2
3
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 1
1
Z1
18
BK
L78
18
DG/YL
L60
18
TN
2
3
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 2
1
Z1
18
BK
S102
(8W-15-7)
Z1 18BK
4
C106
Z1
20
BK
G106
(8W-15-7)
▲ LHD
● RHD

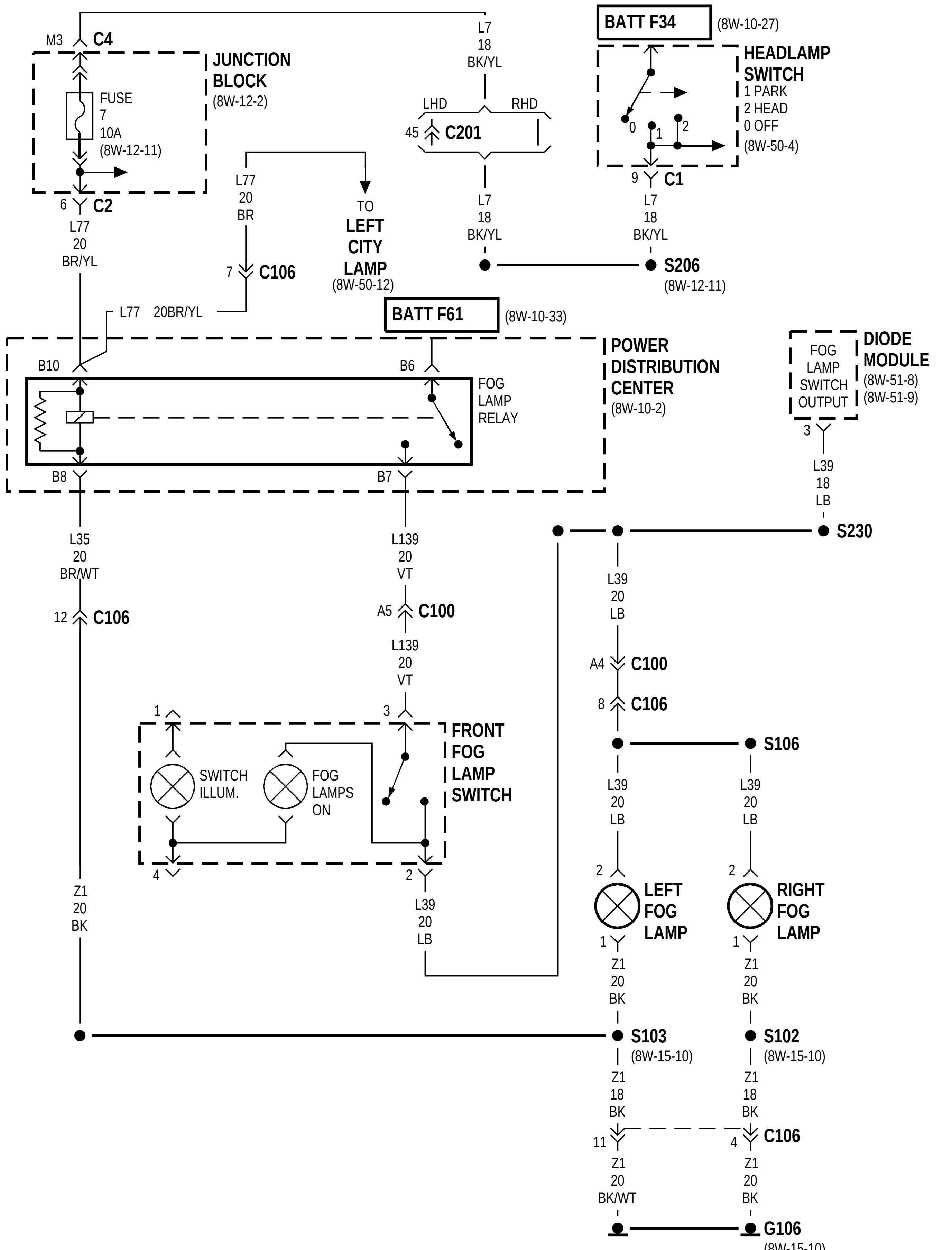
BUILT-UP-EXPORT

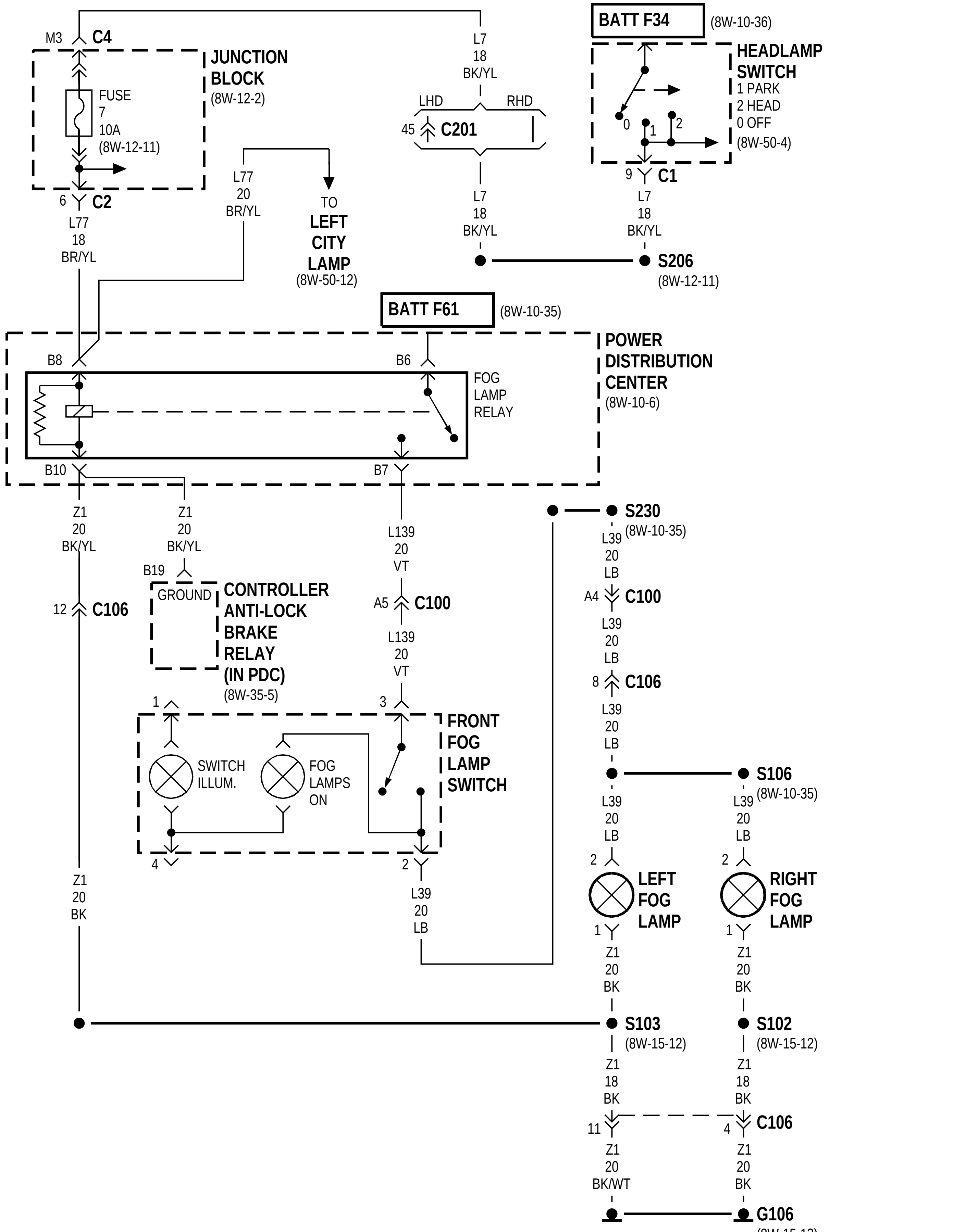



M3
C4
JUNCTION
BLOCK
(8W-12-2)
FUSE
7
10A
(8W-12-10)
6
C2
L7
18
BK/YL
LHD
RHD
45
C201
BATT F34
(8W-10-26)
HEADLAMP
SWITCH
1 PARK
2 HEAD
0 OFF
(8W-50-2)
(8W-50-3)
9
C1
L77
20
BR/YL
7
C106
L77
20
BR
TO
S104
(8W-12-10)
S206
(8W-12-10)
BATT F61
(8W-10-33)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
B10
B6
FOG
LAMP
RELAY
NO. 1
B8
B7
L35
20
BR/WT
FROM
FUSE
3 (JB)
(8W-12-6)
L139
20
VT
12
C106
A5
C100
L33
20
RD
L33 18RD
2
C106
B
A
LEFT
HEADLAMP
(8W-50-5)
(8W-50-6)
C
A4
C100
8
C106
S106
L39
20
LB
1
3
FRONT
FOG
LAMP
SWITCH
SWITCH
ILLUM.
FOG
LAMPS
ON
Z1
18
BK
4
2
LEFT
FOG
LAMP
RIGHT
FOG
LAMP
Z1
20
BK
S103
(8W-15-7)
S102
(8W-15-7)
11
C106
Z1
20
BK/WT
G106
(8W-15-7)

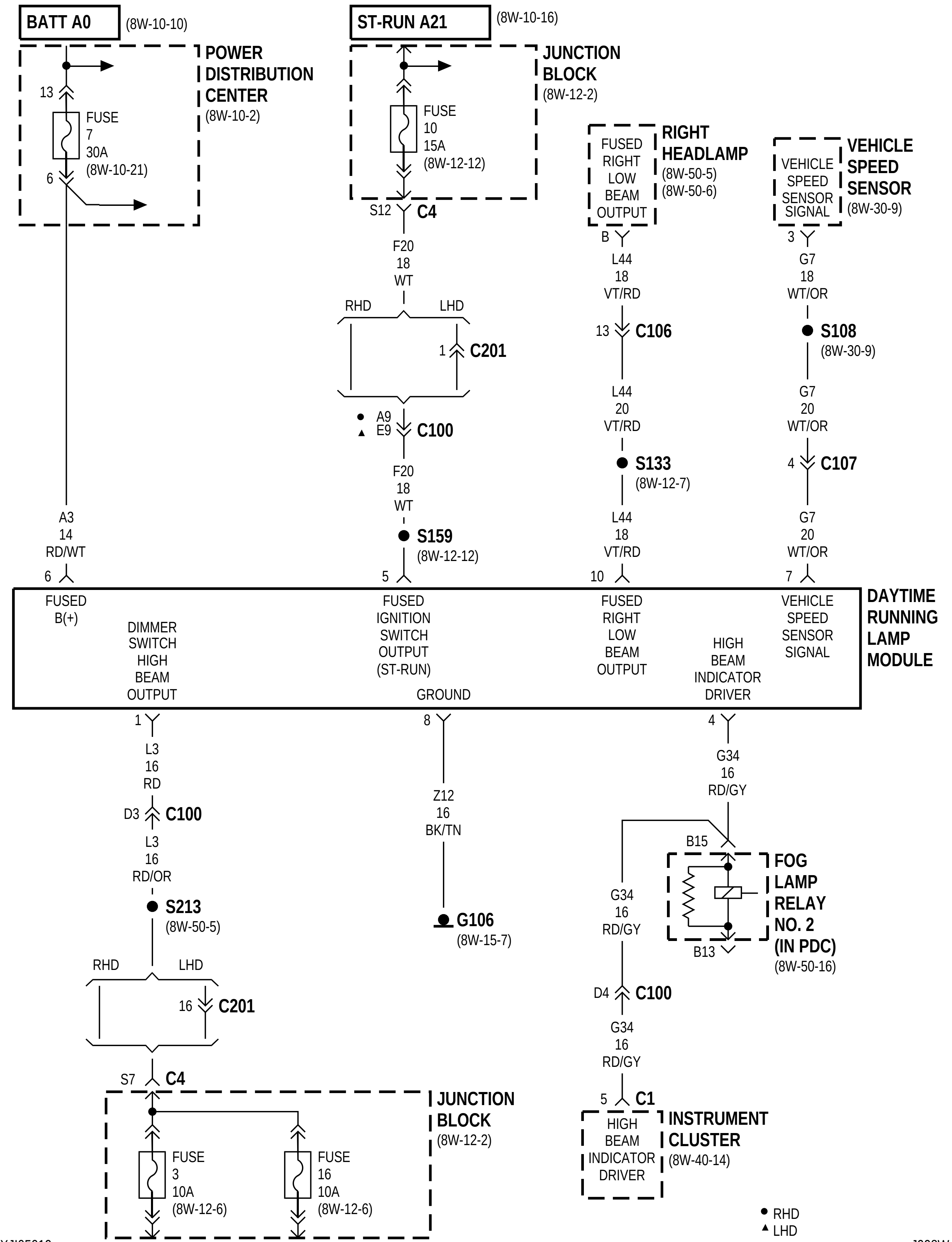
DRL


M3
C4
JUNCTION BLOCK
(8W-12-2)
FUSE
7
10A
(8W-12-10)
6
C2
L7
18
BK/YL
45
C201
BATT F34
(8W-10-26)
HEADLAMP SWITCH
1 PARK
2 HEAD
0 OFF
(8W-50-2)
0
1
2
9
C1
S206
(8W-12-10)
DAYTIME RUNNING LAMP MODULE
(8W-50-19)
HIGH BEAM INDICATOR DRIVER
4
INSTRUMENT CLUSTER
(8W-40-14)
5
D4
C100
L77 20BR
TO
S104
(8W-12-10)
7
C106
L77
20
BR/YL
BATT F61
(8W-10-33)
G34
16
RD/GY
POWER DISTRIBUTION CENTER
(8W-10-2)
B10
B6
FOG LAMP RELAY NO. 1
B8
B7
B15
B11
FOG LAMP RELAY NO. 2
B13
B14
Z1
20
BK
L92
20
PK
L139
20
VT
A5
S132
(8W-15-4)
(8W-15-5)
Z1
14
BK
G106
(8W-15-7)
1
3
FRONT FOG LAMP SWITCH
SWITCH ILLUM.
ON INDICATOR
4
2
S208
(8W-15-14)
G107
(8W-15-14)
L39
20
LB
A4
8
S106
LEFT FOG LAMP
RIGHT FOG LAMP
S103
(8W-15-7)
S102
(8W-15-7)
Z1
18
BK
11
Z1
20
BK/WT
G106
(8W-15-7)

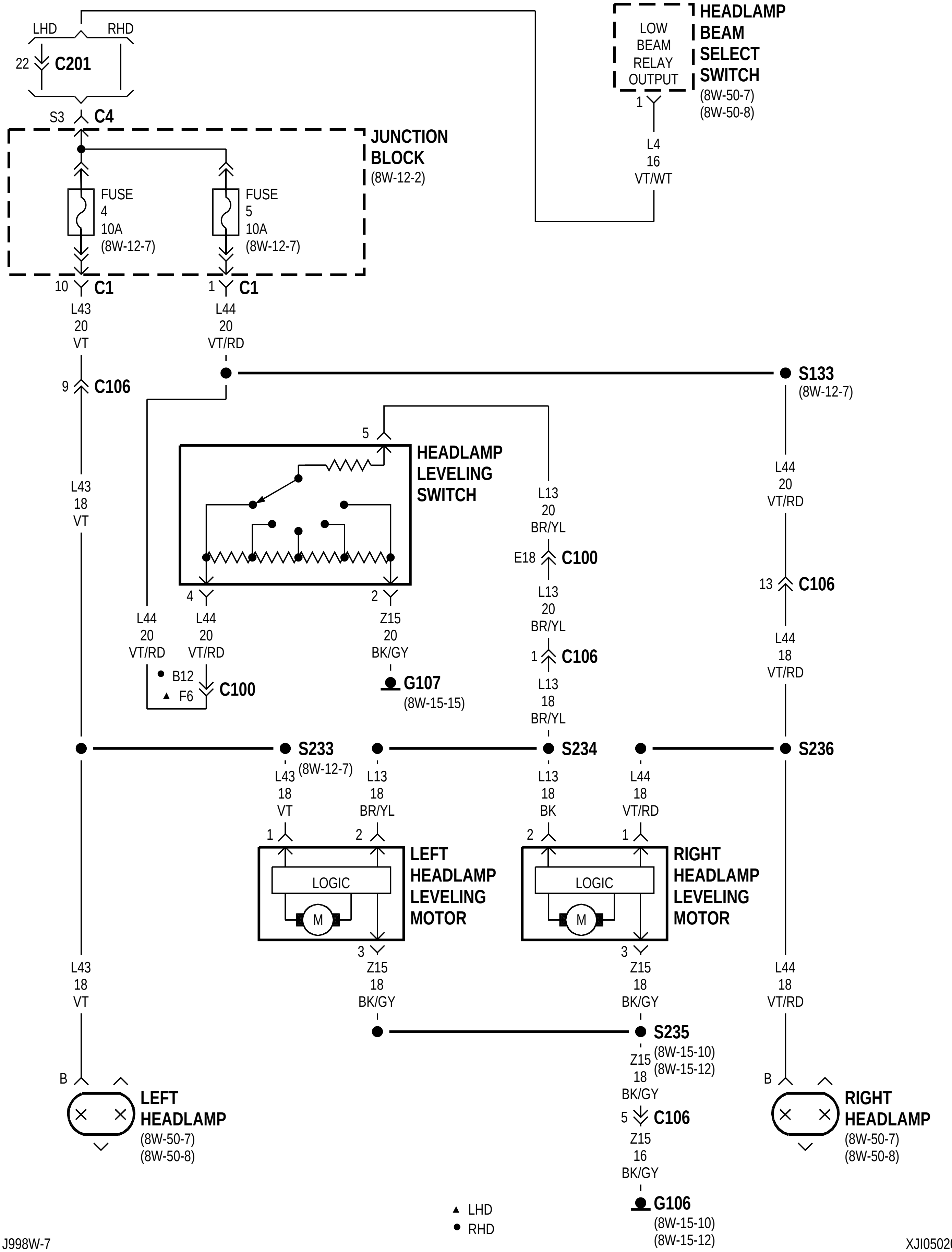

M3
C4
JUNCTION BLOCK
(8W-12-2)
FUSE
7
10A
(8W-12-11)
6
C2
L77
20
BR/YL
L7
18
BK/YL
LHD
RHD
45
C201
L77
20
BR
TO LEFT CITY LAMP
(8W-50-12)
7
C106
L77 20BR/YL
BATT F34
(8W-10-27)
HEADLAMP SWITCH
1 PARK
2 HEAD
0 OFF
(8W-50-4)
0
1
2
9
C1
L7
18
BK/YL
S206
(8W-12-11)
BATT F61
(8W-10-33)
POWER DISTRIBUTION CENTER
(8W-10-2)
B10
B6
FOG LAMP RELAY
B8
B7
DIODE MODULE
(8W-51-8)
(8W-51-9)
FOG LAMP SWITCH OUTPUT
3
L39
18
LB
S230
L35
20
BR/WT
12
C106
L139
20
VT
A5
C100
L139
20
VT
L39
20
LB
A4
C100
8
C106
S106
1
3
FRONT FOG LAMP SWITCH
SWITCH ILLUM.
FOG LAMPS ON
4
2
L39
20
LB
L39
20
LB
L39
20
LB
2
LEFT FOG LAMP
2
RIGHT FOG LAMP
1
1
Z1
20
BK
Z1
20
BK
Z1
20
BK
S103
(8W-15-10)
S102
(8W-15-10)
Z1
18
BK
Z1
18
BK
11
4
C106
Z1
20
BK/WT
Z1
20
BK
G106
(8W-15-10)


M3 C4
L7
18
BK/YL
BATT F34
(8W-10-36)
JUNCTION BLOCK
(8W-12-2)
FUSE
7
10A
(8W-12-11)
LHD
RHD
45 C201
HEADLAMP SWITCH
1 PARK
2 HEAD
0 OFF
(8W-50-4)
0 1 2
9 C1
6 C2
L77
20
BR/YL
TO LEFT CITY LAMP
(8W-50-12)
L77
18
BR/YL
L7
18
BK/YL
L7
18
BK/YL
S206
(8W-12-11)
BATT F61
(8W-10-35)
POWER DISTRIBUTION CENTER
(8W-10-6)
B8
B6
FOG LAMP RELAY
B10
B7
S230
(8W-10-35)
Z1
20
BK/YL
Z1
20
BK/YL
L139
20
VT
L39
20
LB
B19
GROUND
CONTROLLER ANTI-LOCK BRAKE RELAY (IN PDC)
(8W-35-5)
12 C106
A5 C100
L139
20
VT
A4 C100
L39
20
LB
8 C106
L39
20
LB
1
3
FRONT FOG LAMP SWITCH
SWITCH ILLUM.
FOG LAMPS ON
S106
(8W-10-35)
L39
20
LB
L39
20
LB
4
2
2
2
L39
20
LB
LEFT FOG LAMP
RIGHT FOG LAMP
Z1
20
BK
1
1
Z1
20
BK
Z1
20
BK
S103
(8W-15-12)
S102
(8W-15-12)
Z1
18
BK
Z1
18
BK
11
4 C106
Z1
20
BK/WT
Z1
20
BK
G106
(8W-15-12)

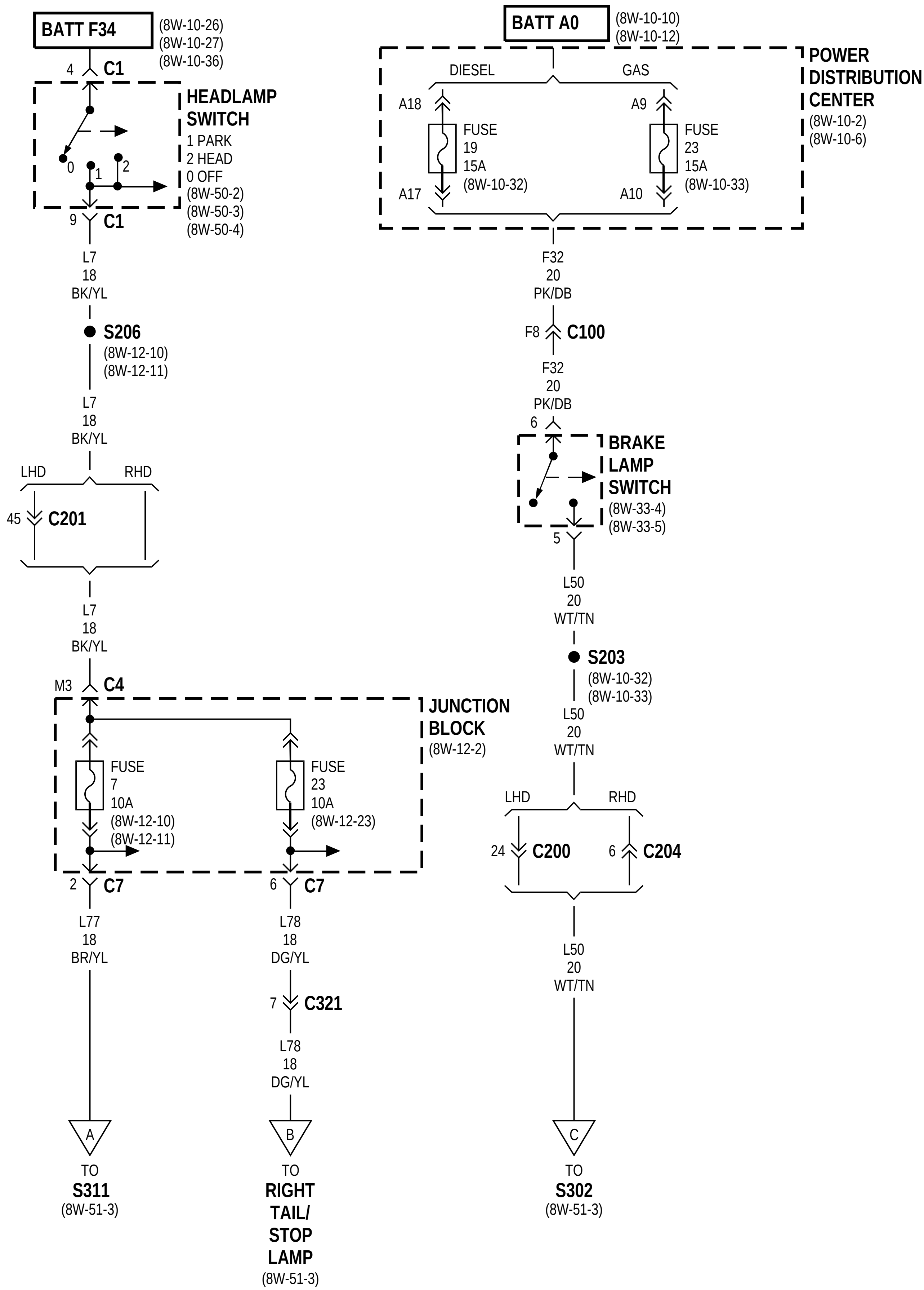
DRL

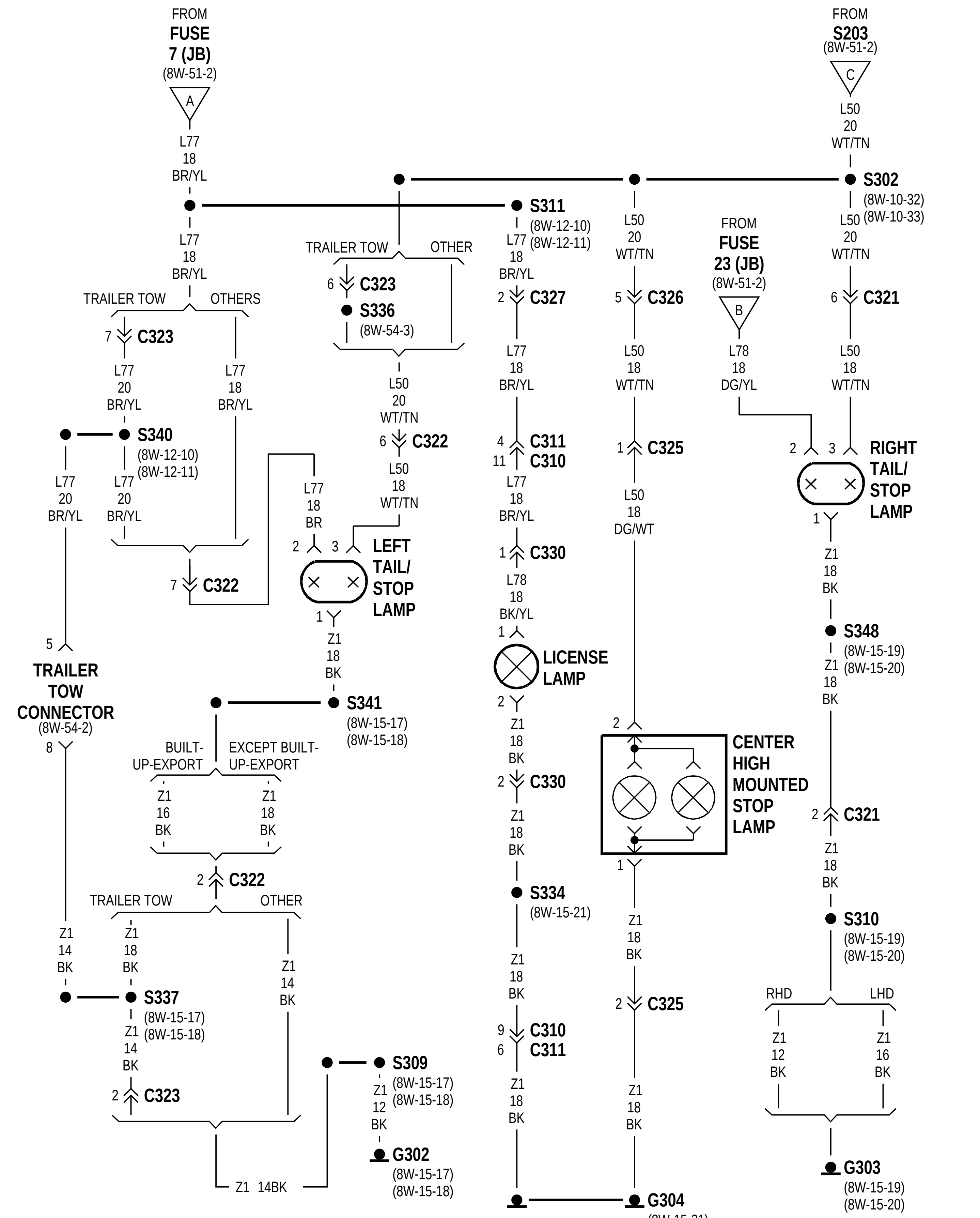

BATT A0
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
13
FUSE 7 30A (8W-10-21)
6
ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE 10 15A (8W-12-12)
S12
C4
F20 18 WT
RHD
LHD
1
C201
A9
E9
C100
F20 18 WT
S159
(8W-12-12)
FUSED RIGHT LOW BEAM OUTPUT
RIGHT HEADLAMP
(8W-50-5)
(8W-50-6)
B
L44 18 VT/RD
13
C106
L44 20 VT/RD
S133
(8W-12-7)
L44 18 VT/RD
VEHICLE SPEED SENSOR SIGNAL
VEHICLE SPEED SENSOR
(8W-30-9)
3
G7 18 WT/OR
S108
(8W-30-9)
G7 20 WT/OR
4
C107
G7 20 WT/OR
A3 14 RD/WT
6
5
10
7
FUSED B(+)
DIMMER SWITCH HIGH BEAM OUTPUT
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
GROUND
FUSED RIGHT LOW BEAM OUTPUT
HIGH BEAM INDICATOR DRIVER
VEHICLE SPEED SENSOR SIGNAL
DAYTIME RUNNING LAMP MODULE
1
8
4
L3 16 RD
D3
C100
L3 16 RD/OR
S213
(8W-50-5)
RHD
LHD
16
C201
S7
C4
JUNCTION BLOCK
(8W-12-2)
FUSE 3 10A (8W-12-6)
FUSE 16 10A (8W-12-6)
Z12 16 BK/TN
G106
(8W-15-7)
G34 16 RD/GY
B15
FOG LAMP RELAY NO. 2 (IN PDC)
(8W-50-16)
B13
G34 16 RD/GY
D4
C100
G34 16 RD/GY
5
C1
HIGH BEAM INDICATOR DRIVER
INSTRUMENT CLUSTER
(8W-40-14)
● RHD
▲ LHD

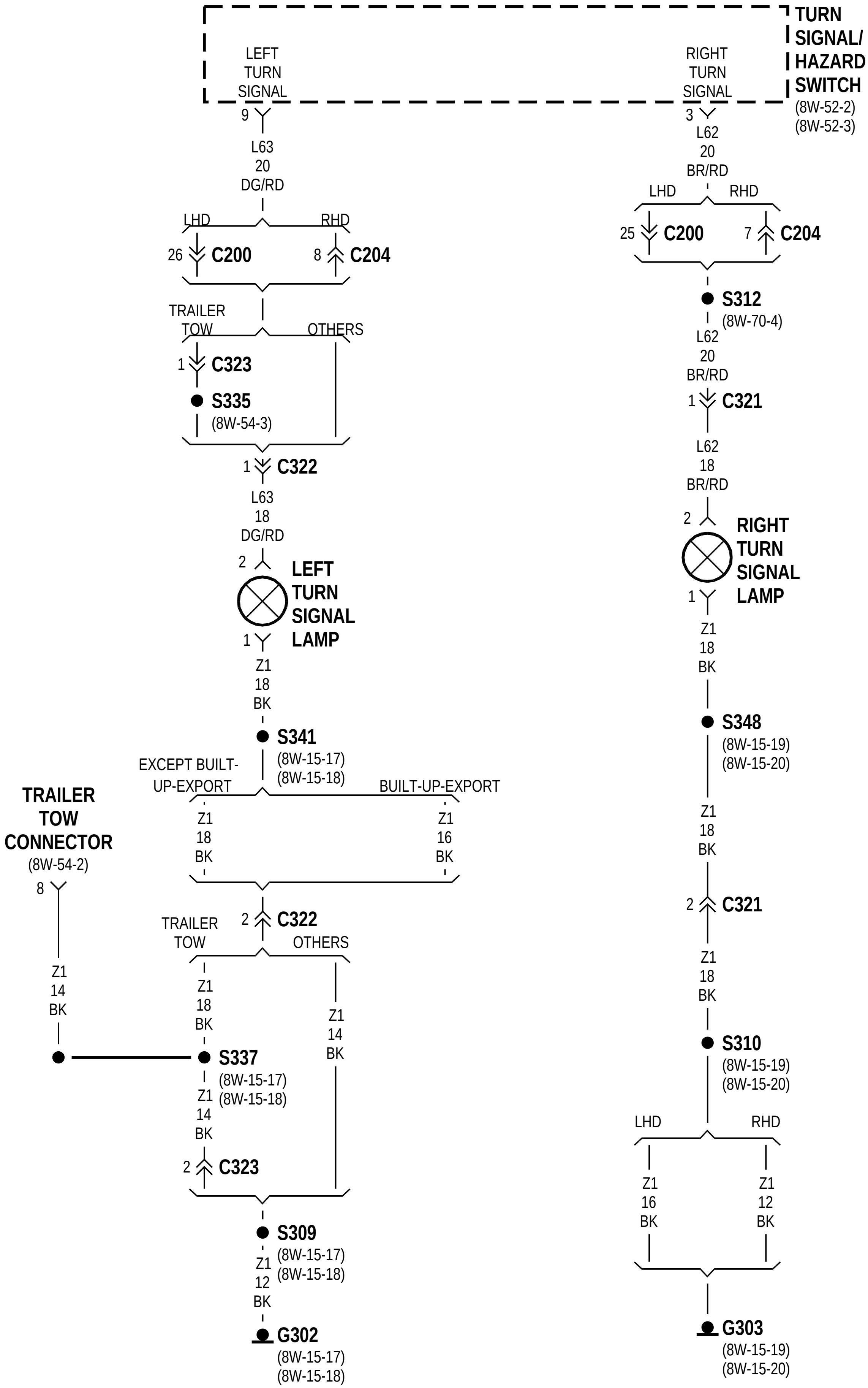
BUILT-UP-EXPORT



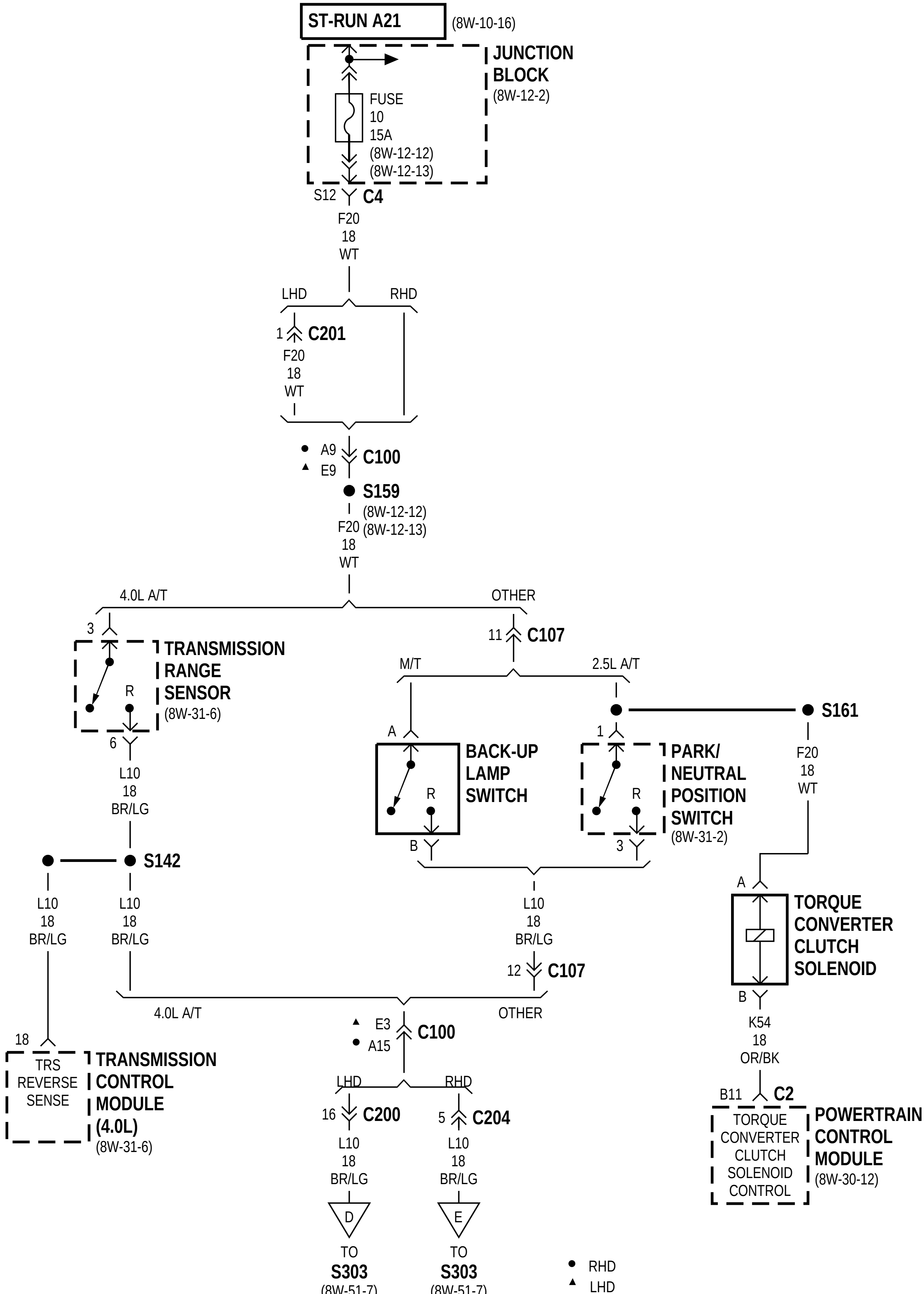
8W-51 REAR LIGHTING


BATT F34
(8W-10-26)
(8W-10-27)
(8W-10-36)
4 C1
HEADLAMP SWITCH
1 PARK
2 HEAD
0 OFF
(8W-50-2)
(8W-50-3)
(8W-50-4)
0 1 2
9 C1
L7 18 BK/YL
S206
(8W-12-10)
(8W-12-11)
L7 18 BK/YL
LHD RHD
45 C201
L7 18 BK/YL
M3 C4
JUNCTION BLOCK
(8W-12-2)
FUSE 7 10A (8W-12-10) (8W-12-11)
FUSE 23 10A (8W-12-23)
2 C7
6 C7
L77 18 BR/YL
L78 18 DG/YL
7 C321
L78 18 DG/YL
A
TO S311 (8W-51-3)
B
TO RIGHT TAIL/ STOP LAMP (8W-51-3)
BATT A0
(8W-10-10)
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-2)
(8W-10-6)
DIESEL GAS
A18 A9
FUSE 19 15A (8W-10-32)
FUSE 23 15A (8W-10-33)
A17 A10
F32 20 PK/DB
F8 C100
F32 20 PK/DB
6
BRAKE LAMP SWITCH
(8W-33-4)
(8W-33-5)
5
L50 20 WT/TN
S203
(8W-10-32)
(8W-10-33)
L50 20 WT/TN
LHD RHD
24 C200
6 C204
L50 20 WT/TN
C
TO S302 (8W-51-3)

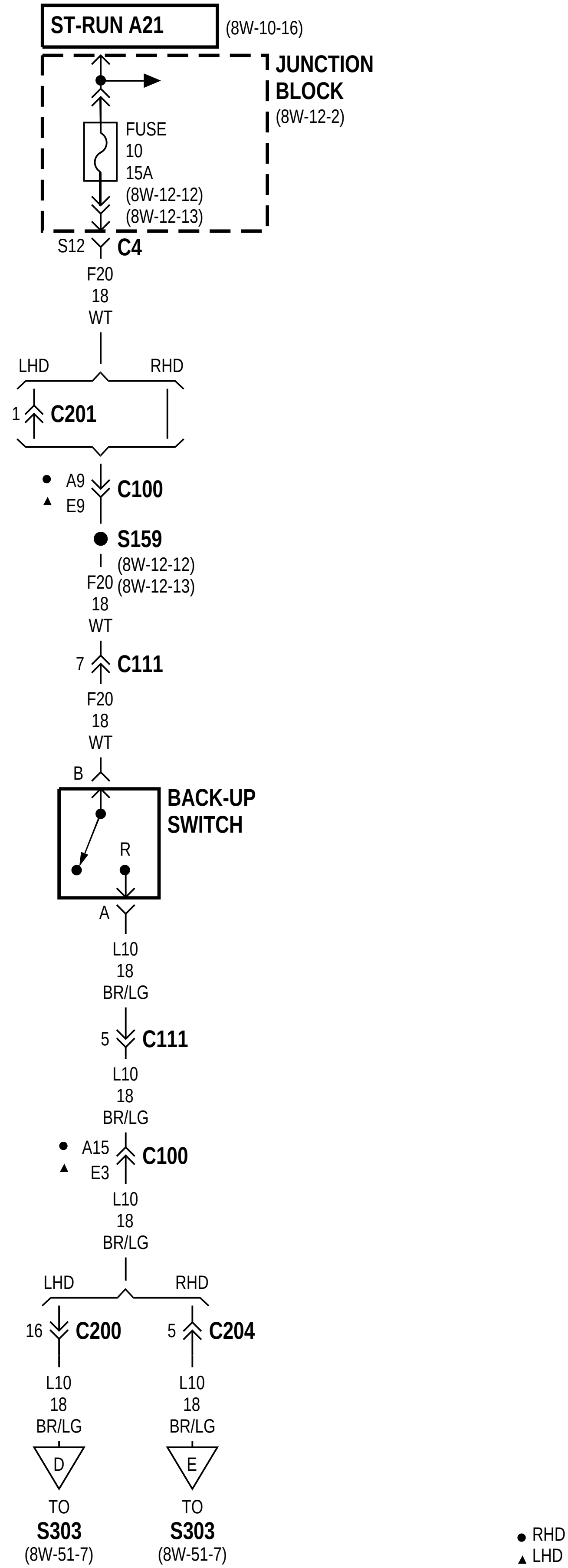

FROM
FUSE
7 (JB)
(8W-51-2)
A
L77
18
BR/YL
FROM
S203
(8W-51-2)
C
L50
20
WT/TN
S302
(8W-10-32)
(8W-10-33)
S311
(8W-12-10)
(8W-12-11)
TRAILER TOW
OTHER
TRAILER TOW
OTHERS
C323
S336
(8W-54-3)
C327
C326
FROM
FUSE
23 (JB)
(8W-51-2)
B
C321
L78
18
DG/YL
S340
(8W-12-10)
(8W-12-11)
C322
C311
C310
C325
RIGHT
TAIL/
STOP
LAMP
LEFT
TAIL/
STOP
LAMP
L50
18
DG/WT
C330
L77
18
BR
L78
18
BK/YL
LICENSE
LAMP
TRAILER
TOW
CONNECTOR
(8W-54-2)
S341
(8W-15-17)
(8W-15-18)
S348
(8W-15-19)
(8W-15-20)
BUILT-
UP-EXPORT
EXCEPT BUILT-
UP-EXPORT
CENTER
HIGH
MOUNTED
STOP
LAMP
Z1
18
BK
S334
(8W-15-21)
S310
(8W-15-19)
(8W-15-20)
RHD
LHD
S337
(8W-15-17)
(8W-15-18)
S309
(8W-15-17)
(8W-15-18)
G302
(8W-15-17)
(8W-15-18)
G303
(8W-15-19)
(8W-15-20)
G304
(8W-15-21)
Z1 14BK

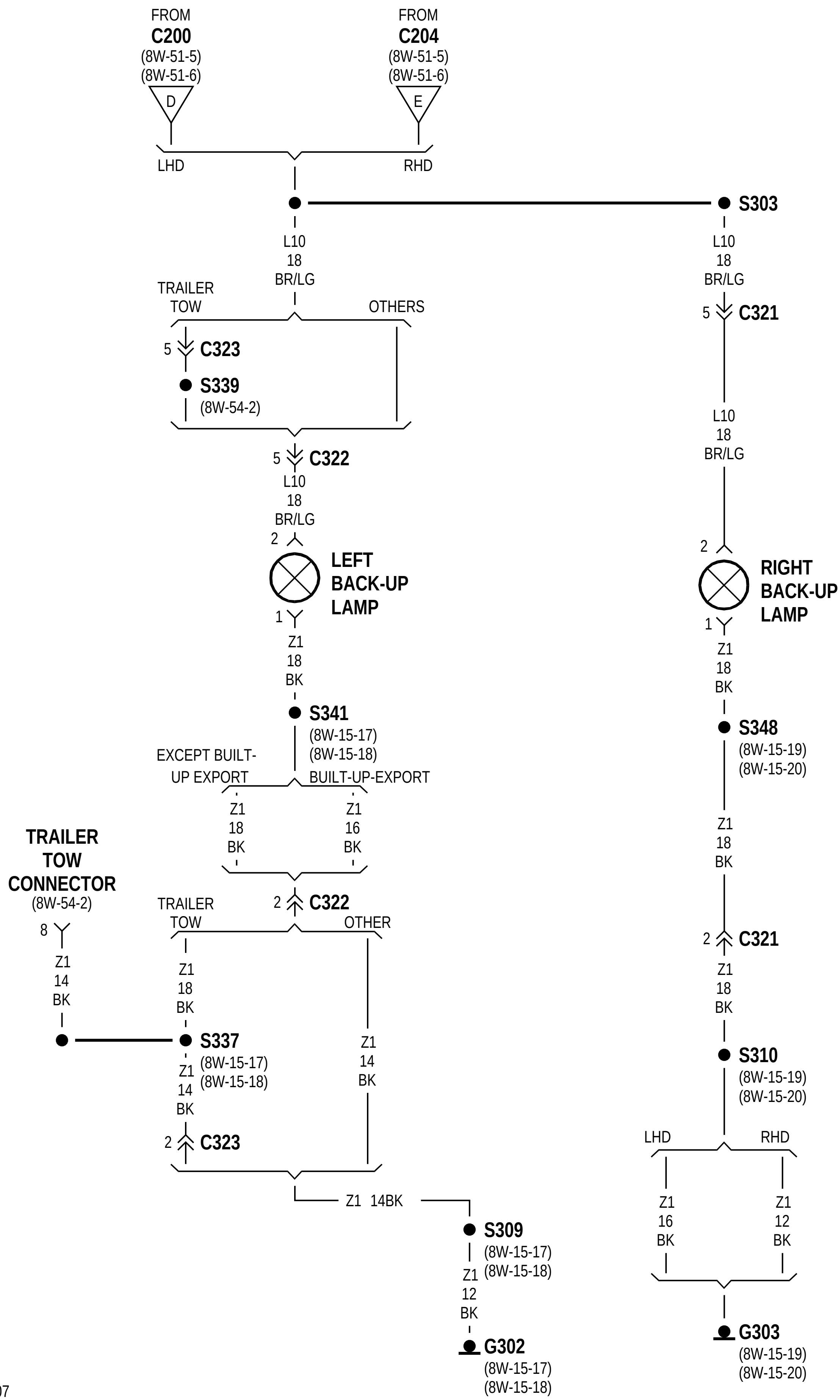

TURN SIGNAL/ HAZARD SWITCH
(8W-52-2)
(8W-52-3)
LEFT TURN SIGNAL
RIGHT TURN SIGNAL
9
L63
20
DG/RD
3
L62
20
BR/RD
LHD
RHD
26
C200
8
C204
25
C200
7
C204
S312
(8W-70-4)
TRAILER TOW
OTHERS
1
C323
S335
(8W-54-3)
L62
20
BR/RD
1
C321
1
C322
L62
18
BR/RD
L63
18
DG/RD
2
RIGHT TURN SIGNAL LAMP
2
LEFT TURN SIGNAL LAMP
1
Z1
18
BK
S348
(8W-15-19)
(8W-15-20)
S341
(8W-15-17)
(8W-15-18)
EXCEPT BUILT-UP-EXPORT
BUILT-UP-EXPORT
TRAILER TOW CONNECTOR
(8W-54-2)
8
Z1
16
BK
2
C322
2
C321
Z1
14
BK
S337
(8W-15-17)
(8W-15-18)
S310
(8W-15-19)
(8W-15-20)
2
C323
Z1
12
BK
S309
(8W-15-17)
(8W-15-18)
G302
(8W-15-17)
(8W-15-18)
G303
(8W-15-19)
(8W-15-20)

GAS

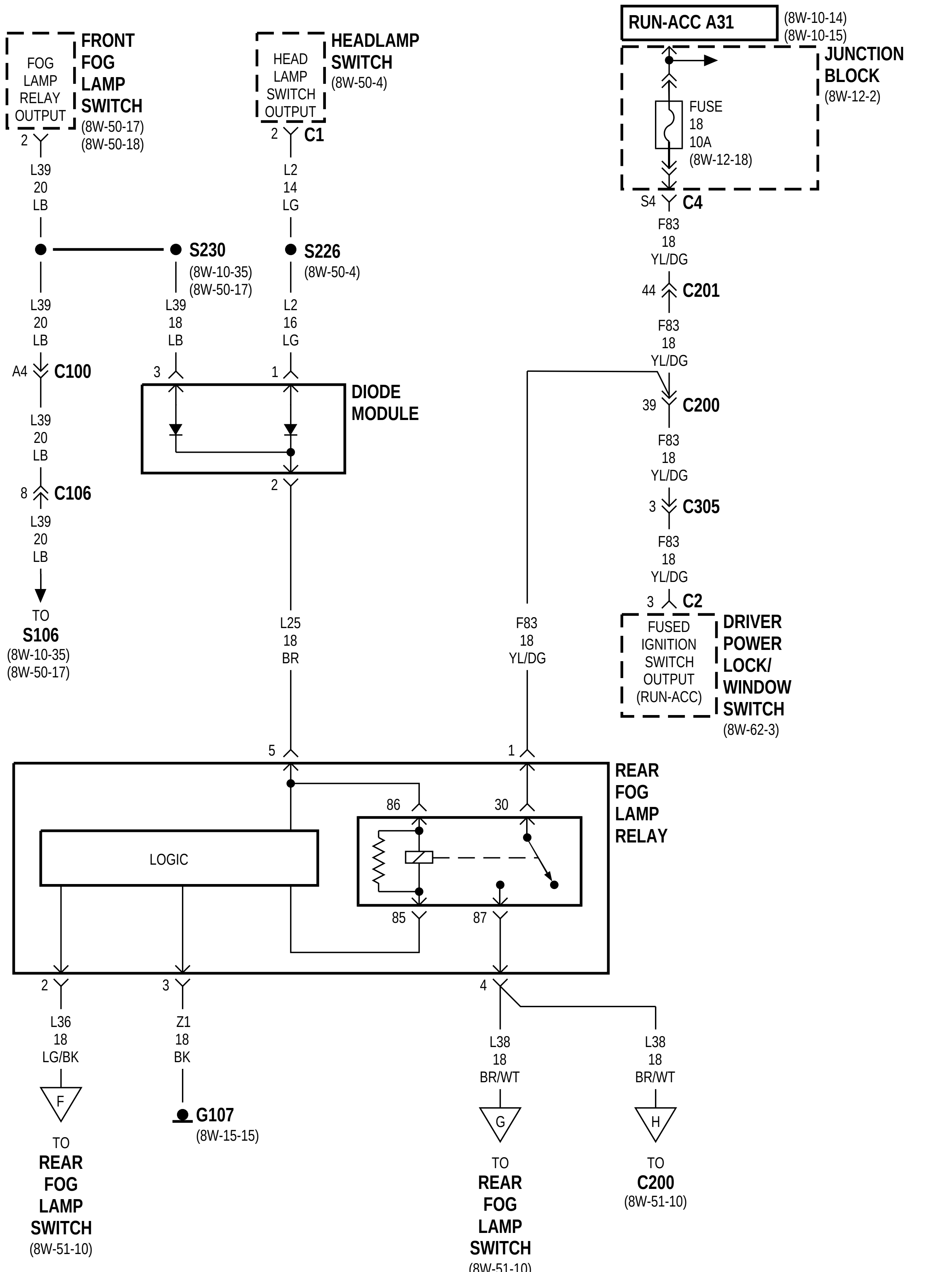

ST-RUN A21
(8W-10-16)
JUNCTION BLOCK
(8W-12-2)
FUSE
10
15A
(8W-12-12)
(8W-12-13)
S12
C4
F20
18
WT
LHD
RHD
1
C201
F20
18
WT
A9
E9
C100
S159
(8W-12-12)
(8W-12-13)
F20
18
WT
4.0L A/T
OTHER
3
TRANSMISSION RANGE SENSOR
R
(8W-31-6)
6
11
C107
M/T
2.5L A/T
S161
A
BACK-UP LAMP SWITCH
R
1
PARK/ NEUTRAL POSITION SWITCH
R
(8W-31-2)
F20
18
WT
B
3
L10
18
BR/LG
S142
L10
18
BR/LG
L10
18
BR/LG
L10
18
BR/LG
12
C107
A
TORQUE CONVERTER CLUTCH SOLENOID
B
4.0L A/T
OTHER
E3
A15
C100
18
TRS REVERSE SENSE
TRANSMISSION CONTROL MODULE (4.0L)
(8W-31-6)
K54
18
OR/BK
LHD
RHD
16
C200
5
C204
B11
C2
TORQUE CONVERTER CLUTCH SOLENOID CONTROL
POWERTRAIN CONTROL MODULE
(8W-30-12)
L10
18
BR/LG
L10
18
BR/LG
D
E
TO
S303
(8W-51-7)
TO
S303
(8W-51-7)
RHD
LHD

DIESEL

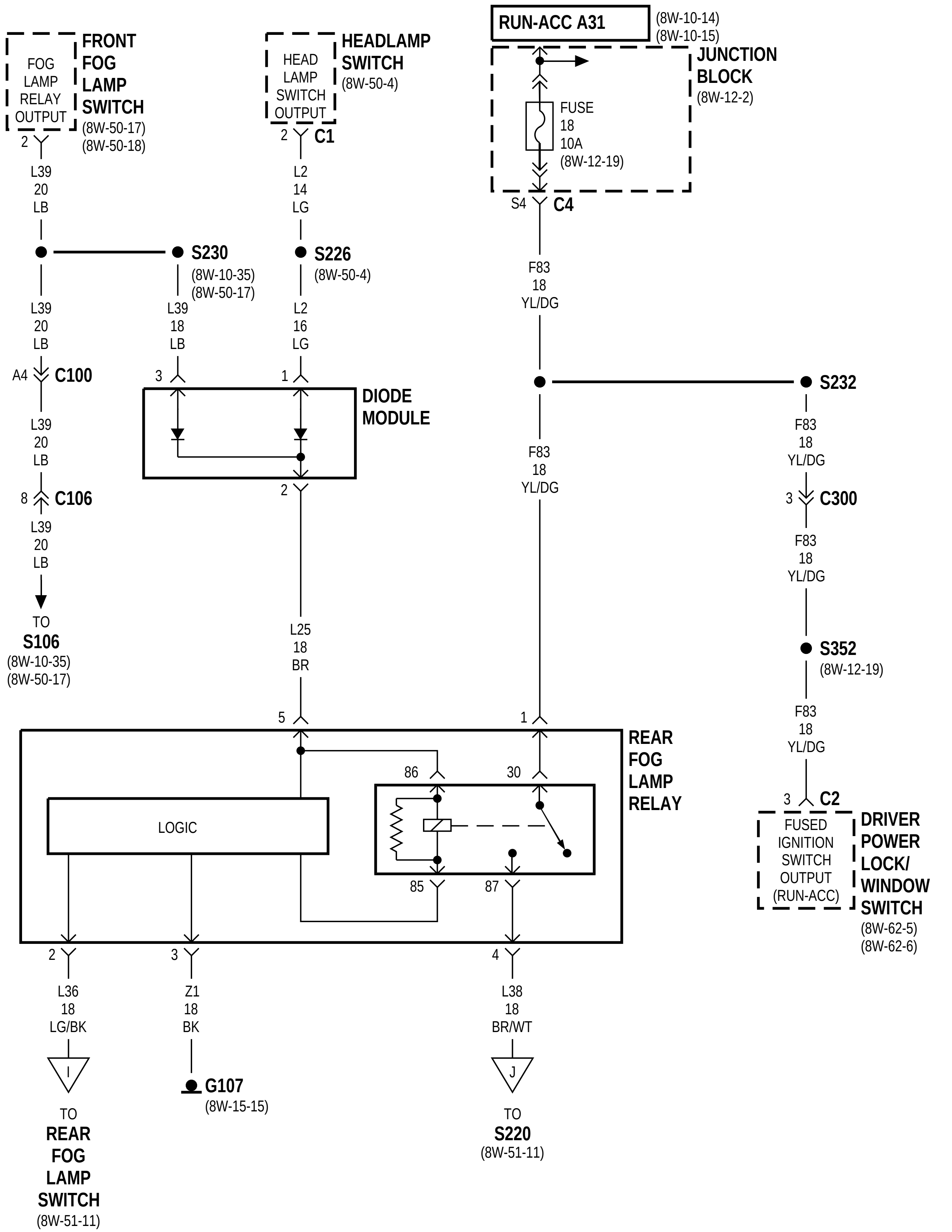

ST-RUN A21
(8W-10-16)
JUNCTION
BLOCK
(8W-12-2)
FUSE
10
15A
(8W-12-12)
(8W-12-13)
S12
C4
F20
18
WT
LHD
RHD
1
C201
A9
E9
C100
S159
(8W-12-12)
(8W-12-13)
F20
18
WT
7
C111
F20
18
WT
B
BACK-UP
SWITCH
R
A
L10
18
BR/LG
5
C111
L10
18
BR/LG
A15
E3
C100
L10
18
BR/LG
LHD
RHD
16
C200
5
C204
L10
18
BR/LG
L10
18
BR/LG
D
E
TO
S303
(8W-51-7)
TO
S303
(8W-51-7)
● RHD
▲ LHD


FROM
C200
(8W-51-5)
(8W-51-6)
D
FROM
C204
(8W-51-5)
(8W-51-6)
E
LHD
RHD
S303
L10
18
BR/LG
TRAILER
TOW
OTHERS
5
C323
S339
(8W-54-2)
5
C322
L10
18
BR/LG
2
LEFT
BACK-UP
LAMP
1
Z1
18
BK
S341
(8W-15-17)
(8W-15-18)
EXCEPT BUILT-
UP EXPORT
BUILT-UP-EXPORT
Z1
18
BK
Z1
16
BK
TRAILER
TOW
CONNECTOR
(8W-54-2)
8
Z1
14
BK
2
C322
TRAILER
TOW
OTHER
Z1
18
BK
S337
(8W-15-17)
(8W-15-18)
Z1
14
BK
Z1
14
BK
2
C323
Z1 14BK
S309
(8W-15-17)
(8W-15-18)
Z1
12
BK
G302
(8W-15-17)
(8W-15-18)
L10
18
BR/LG
5
C321
L10
18
BR/LG
2
RIGHT
BACK-UP
LAMP
1
Z1
18
BK
S348
(8W-15-19)
(8W-15-20)
Z1
18
BK
2
C321
Z1
18
BK
S310
(8W-15-19)
(8W-15-20)
LHD
RHD
Z1
16
BK
Z1
12
BK
G303
(8W-15-19)
(8W-15-20)

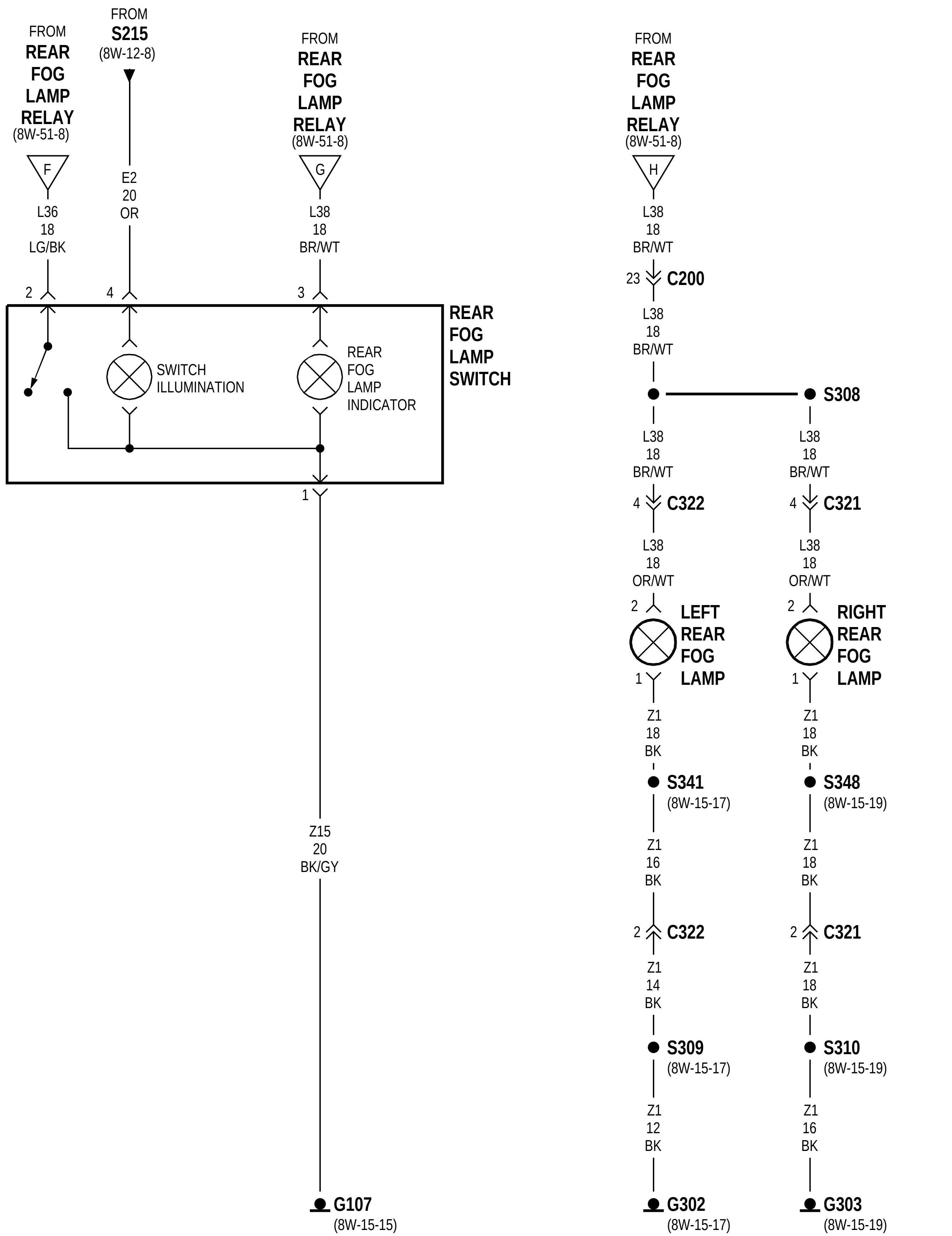
BUILT-UP-EXPORT LHD



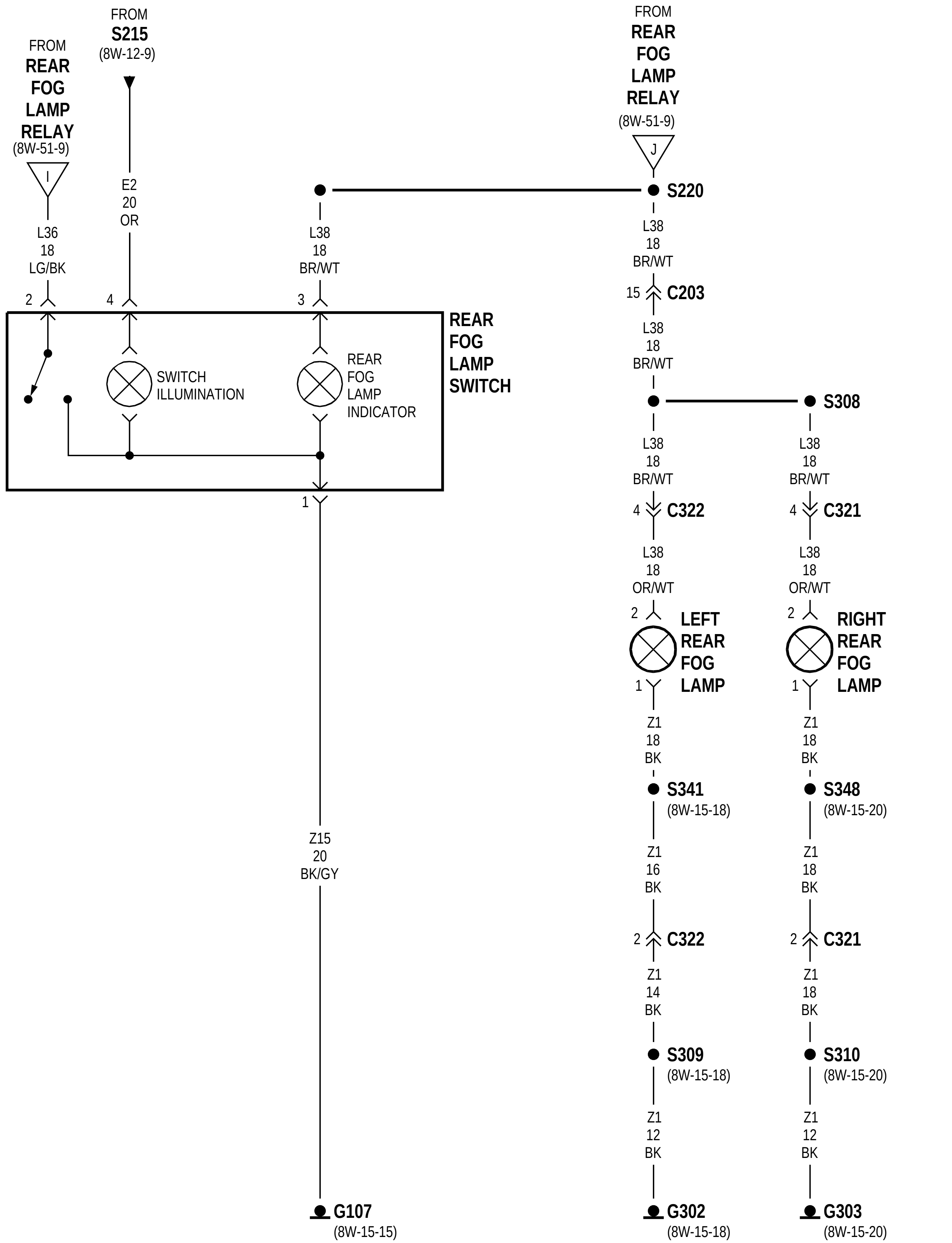
BUILT-UP-EXPORT RHD



XJI05109 J998W-7

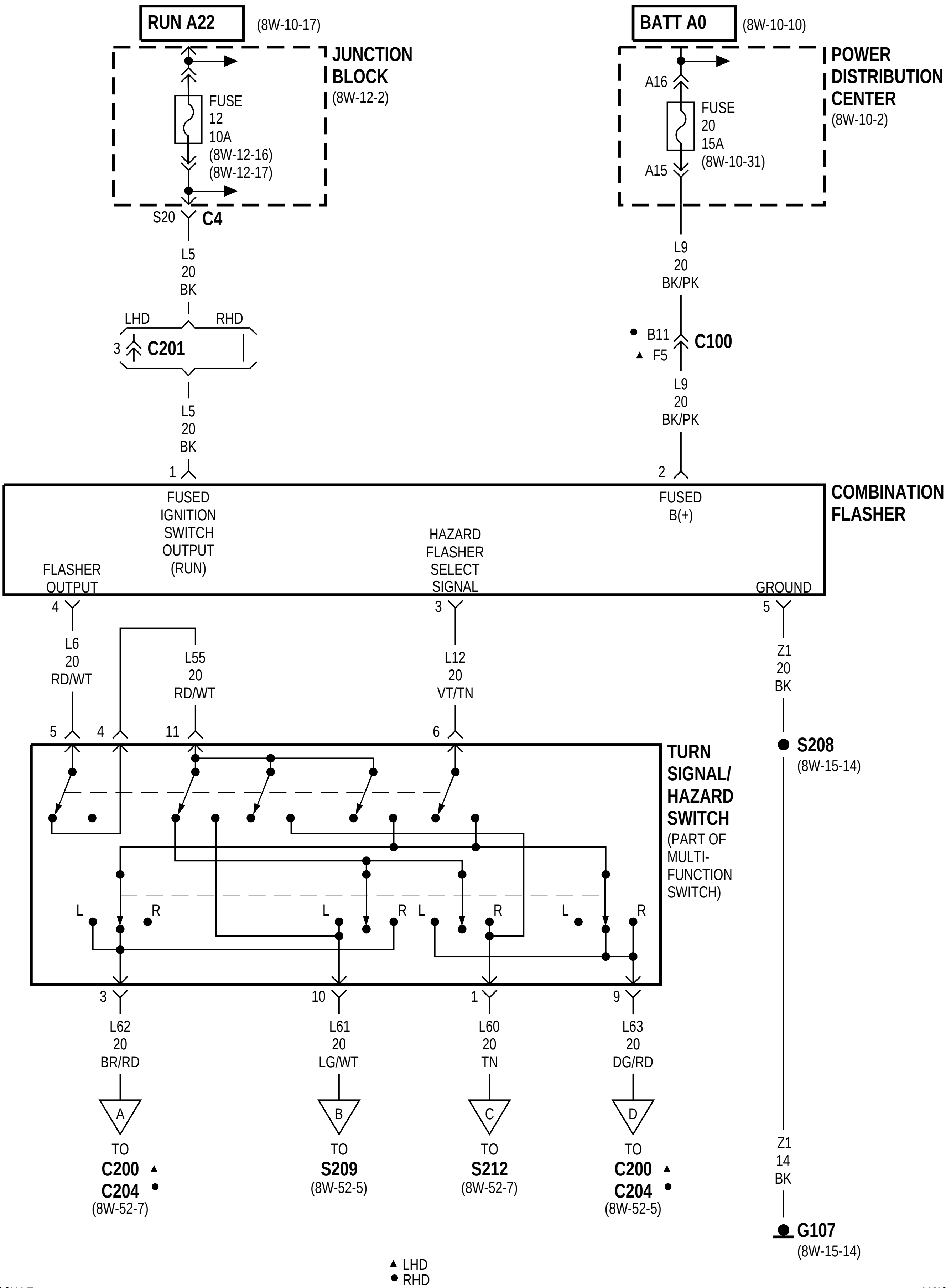


FROM REAR FOG LAMP RELAY (8W-51-8)
F
L36 18 LG/BK
FROM S215 (8W-12-8)
E2 20 OR
FROM REAR FOG LAMP RELAY (8W-51-8)
G
L38 18 BR/WT
2
4
3
SWITCH ILLUMINATION
REAR FOG LAMP INDICATOR
REAR FOG LAMP SWITCH
1
Z15 20 BK/GY
G107 (8W-15-15)
FROM REAR FOG LAMP RELAY (8W-51-8)
H
L38 18 BR/WT
23 C200
L38 18 BR/WT
S308
L38 18 BR/WT
4 C322
4 C321
L38 18 OR/WT
2
LEFT REAR FOG LAMP
RIGHT REAR FOG LAMP
1
Z1 18 BK
S341 (8W-15-17)
S348 (8W-15-19)
Z1 16 BK
Z1 18 BK
2 C322
2 C321
Z1 14 BK
Z1 18 BK
S309 (8W-15-17)
S310 (8W-15-19)
Z1 12 BK
Z1 16 BK
G302 (8W-15-17)
G303 (8W-15-19)

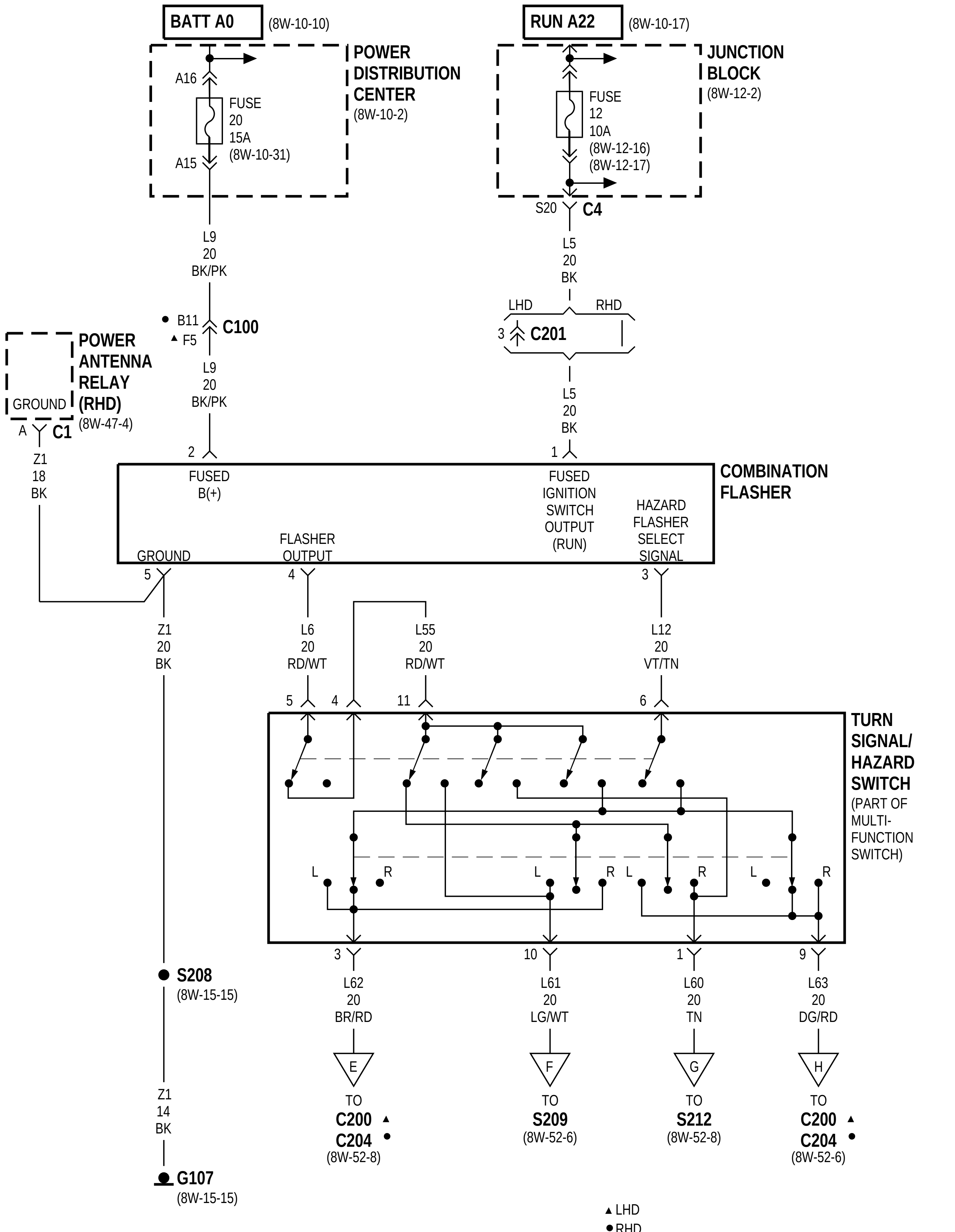

FROM
REAR FOG LAMP RELAY
(8W-51-9)
I
FROM
S215
(8W-12-9)
E2
20
OR
L36
18
LG/BK
L38
18
BR/WT
FROM
REAR FOG LAMP RELAY
(8W-51-9)
J
S220
L38
18
BR/WT
15
C203
L38
18
BR/WT
2
4
3
REAR FOG LAMP SWITCH
SWITCH ILLUMINATION
REAR FOG LAMP INDICATOR
1
S308
L38
18
BR/WT
L38
18
BR/WT
4
C322
4
C321
L38
18
OR/WT
L38
18
OR/WT
2
LEFT REAR FOG LAMP
2
RIGHT REAR FOG LAMP
1
1
Z1
18
BK
Z1
18
BK
S341
(8W-15-18)
S348
(8W-15-20)
Z15
20
BK/GY
Z1
16
BK
Z1
18
BK
2
C322
2
C321
Z1
14
BK
Z1
18
BK
S309
(8W-15-18)
S310
(8W-15-20)
Z1
12
BK
Z1
12
BK
G107
(8W-15-15)
G302
(8W-15-18)
G303
(8W-15-20)

8W-52 TURN SIGNALS

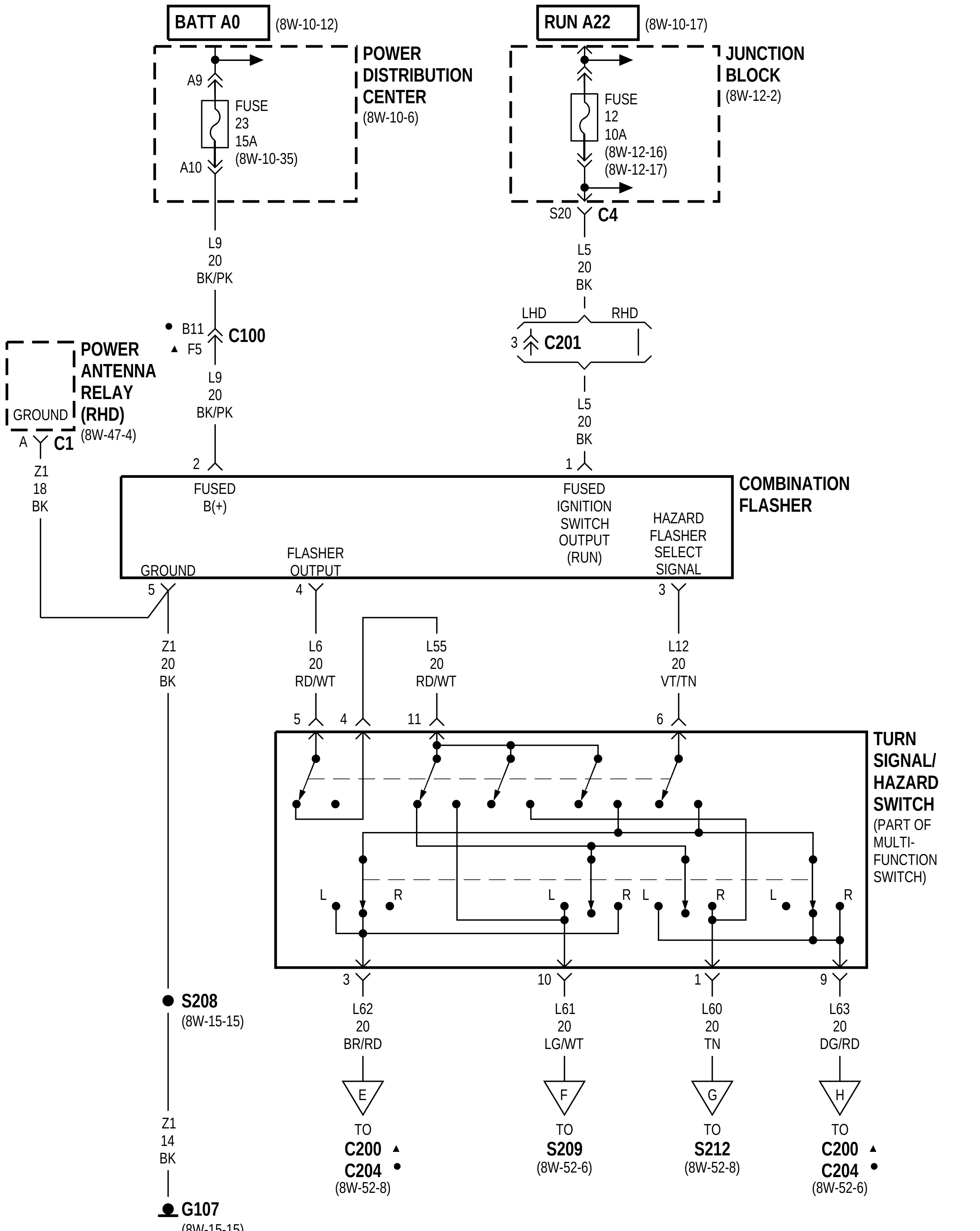
EXCEPT BUILT-UP-EXPORT



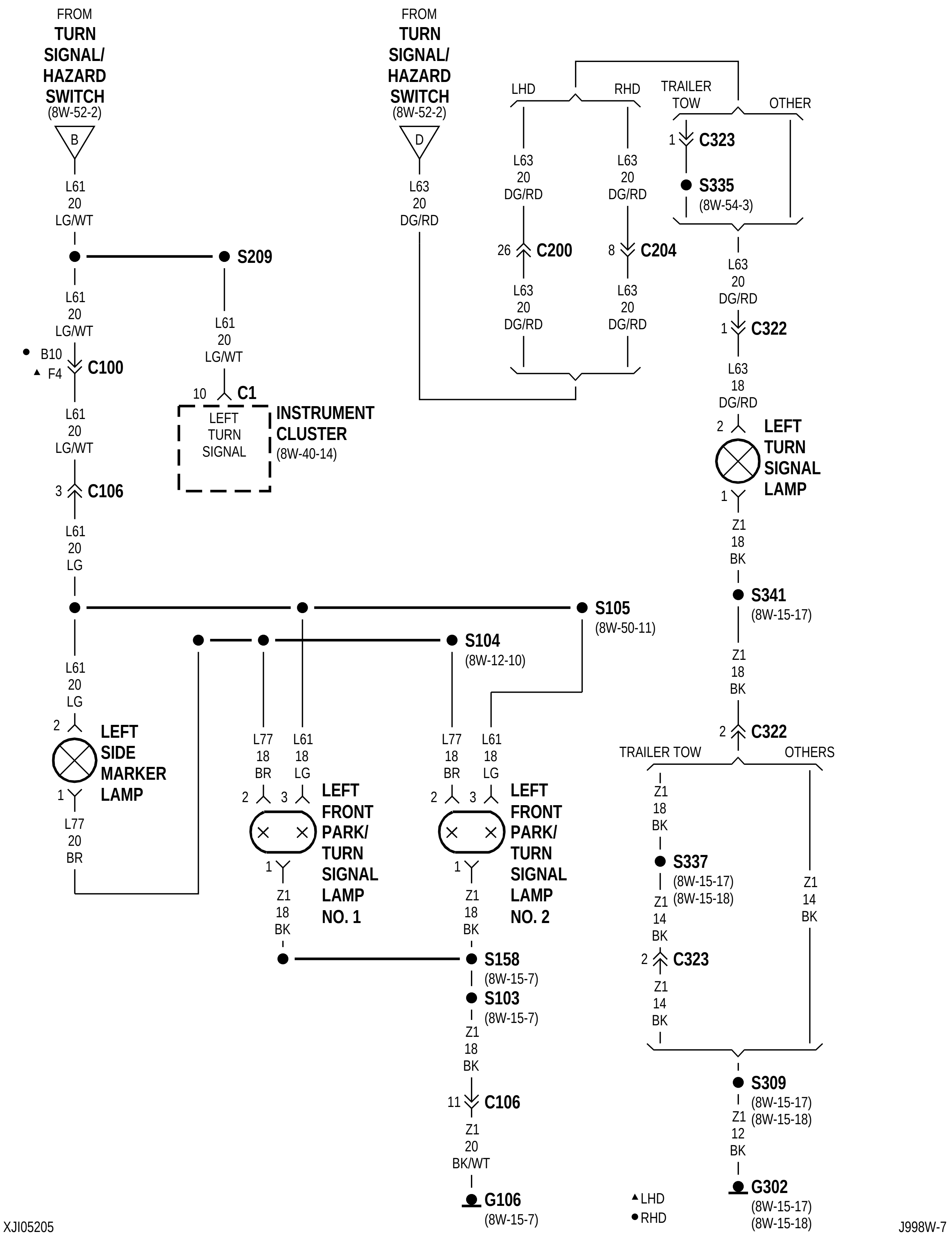
BUILT-UP-EXPORT GAS

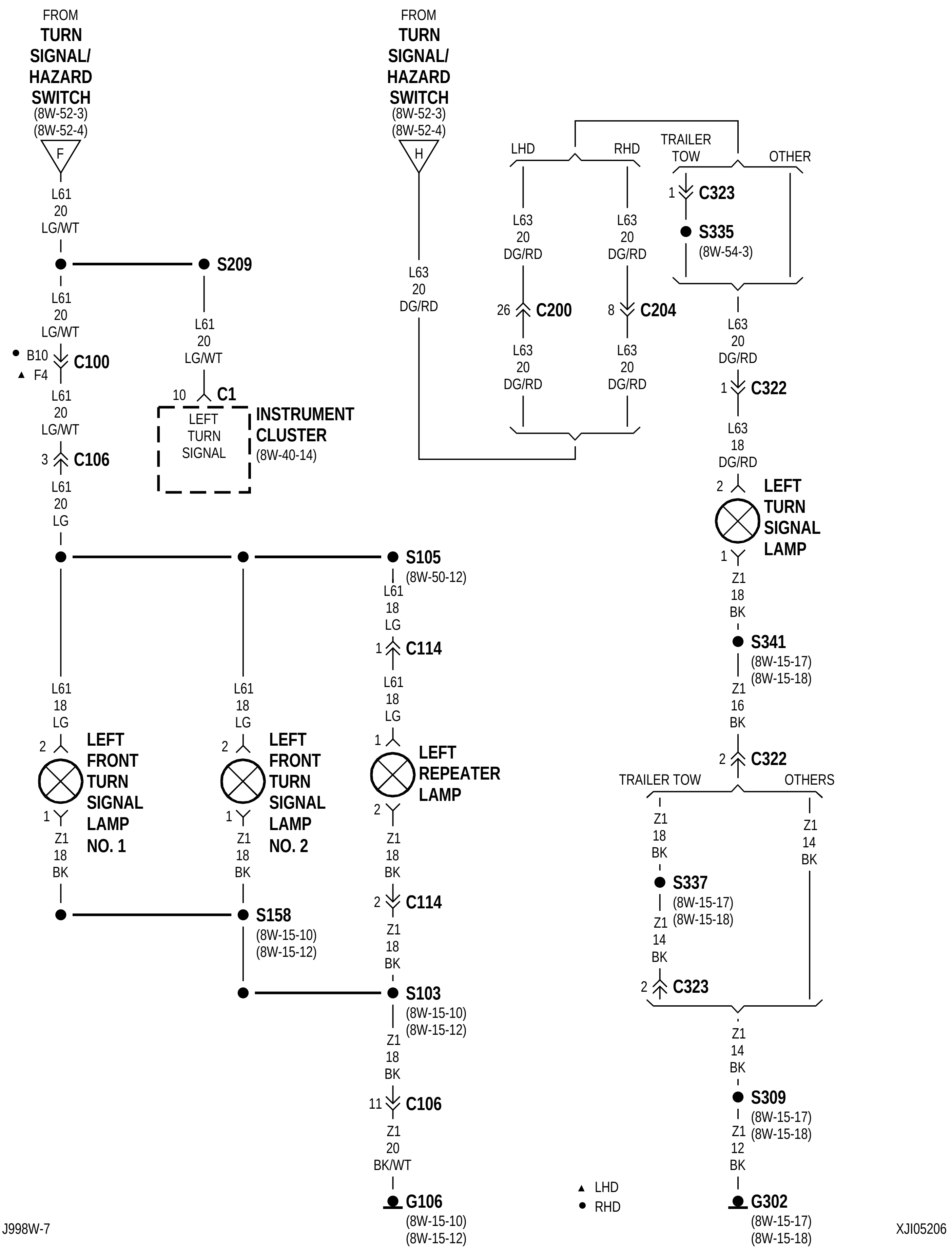


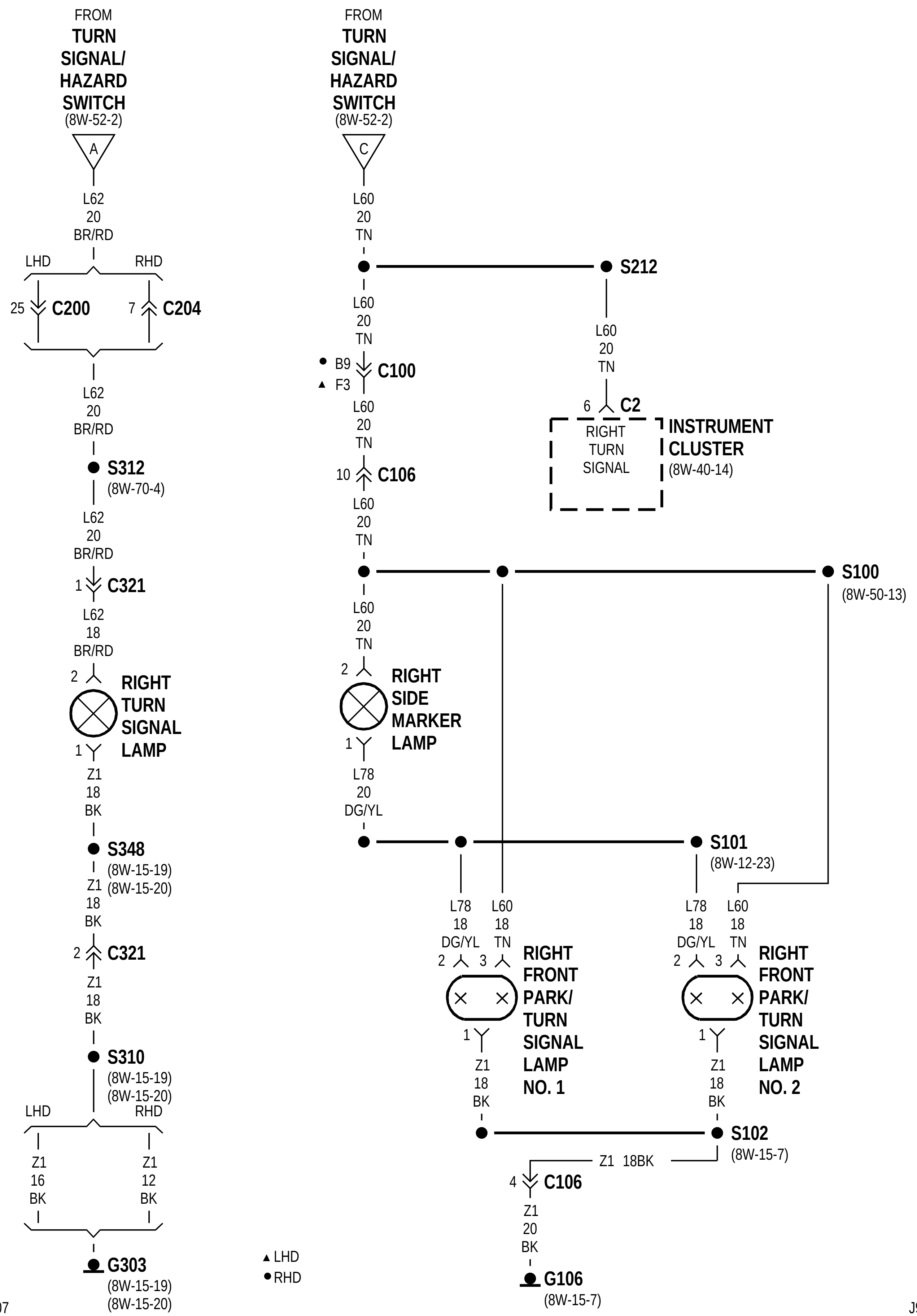
DIESEL


BATT A0
(8W-10-12)
POWER DISTRIBUTION CENTER
(8W-10-6)
A9
FUSE
23
15A
(8W-10-35)
A10
RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE
12
10A
(8W-12-16)
(8W-12-17)
S20
C4
L9
20
BK/PK
B11
F5
C100
L5
20
BK
LHD
RHD
3
C201
POWER ANTENNA RELAY (RHD)
GROUND
(8W-47-4)
A
C1
Z1
18
BK
2
1
COMBINATION FLASHER
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (RUN)
HAZARD FLASHER SELECT SIGNAL
GROUND
FLASHER OUTPUT
5
4
3
Z1
20
BK
L6
20
RD/WT
L55
20
RD/WT
L12
20
VT/TN
5
4
11
6
TURN SIGNAL/ HAZARD SWITCH
(PART OF MULTI-FUNCTION SWITCH)
L
R
L
R
L
R
L
R
3
10
1
9
L62
20
BR/RD
L61
20
LG/WT
L60
20
TN
L63
20
DG/RD
E
F
G
H
TO
C200
C204
(8W-52-8)
TO
S209
(8W-52-6)
TO
S212
(8W-52-8)
TO
C200
C204
(8W-52-6)
S208
(8W-15-15)
Z1
14
BK
G107
(8W-15-15)
▲ LHD
● RHD

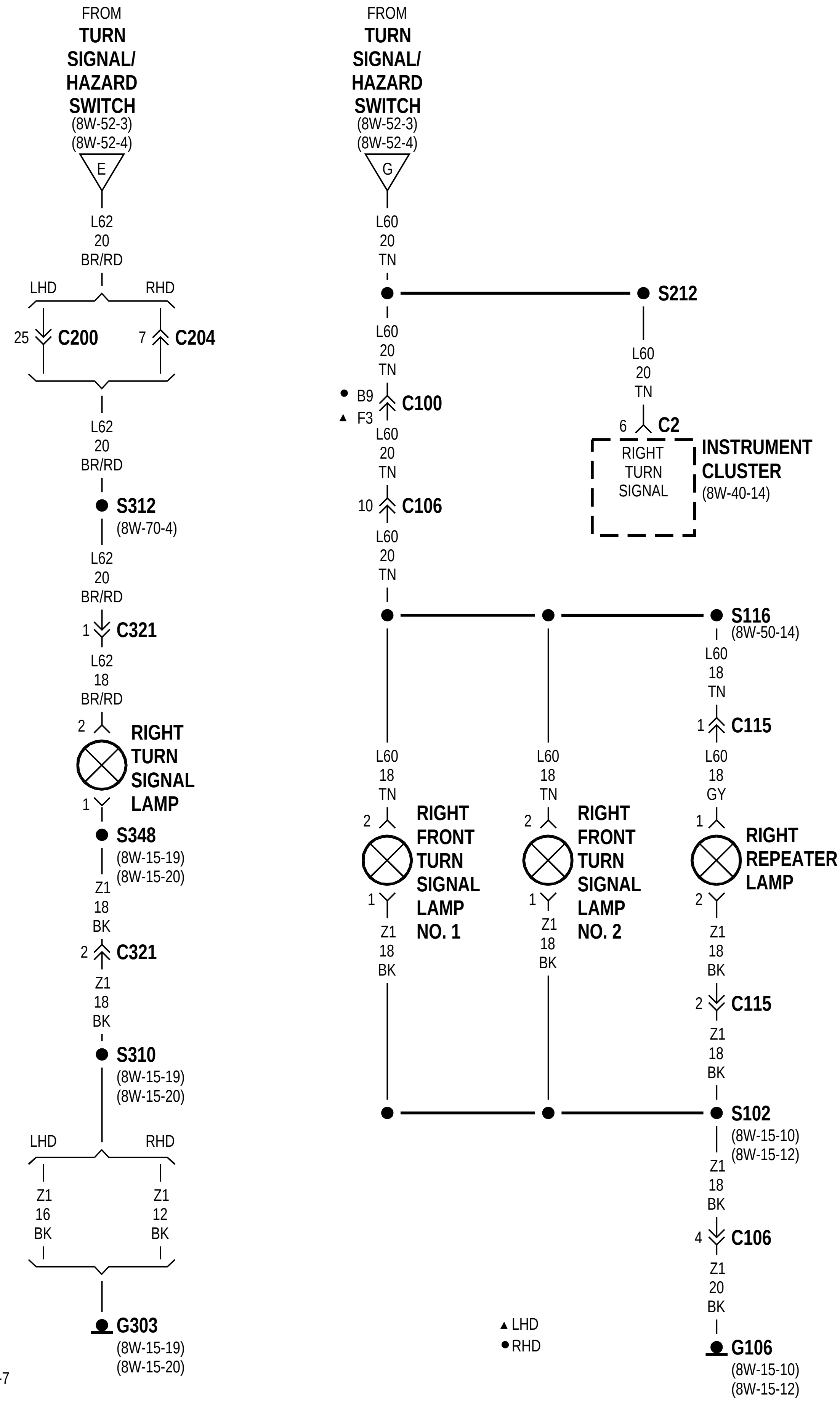
EXCEPT BUILT-UP-EXPORT



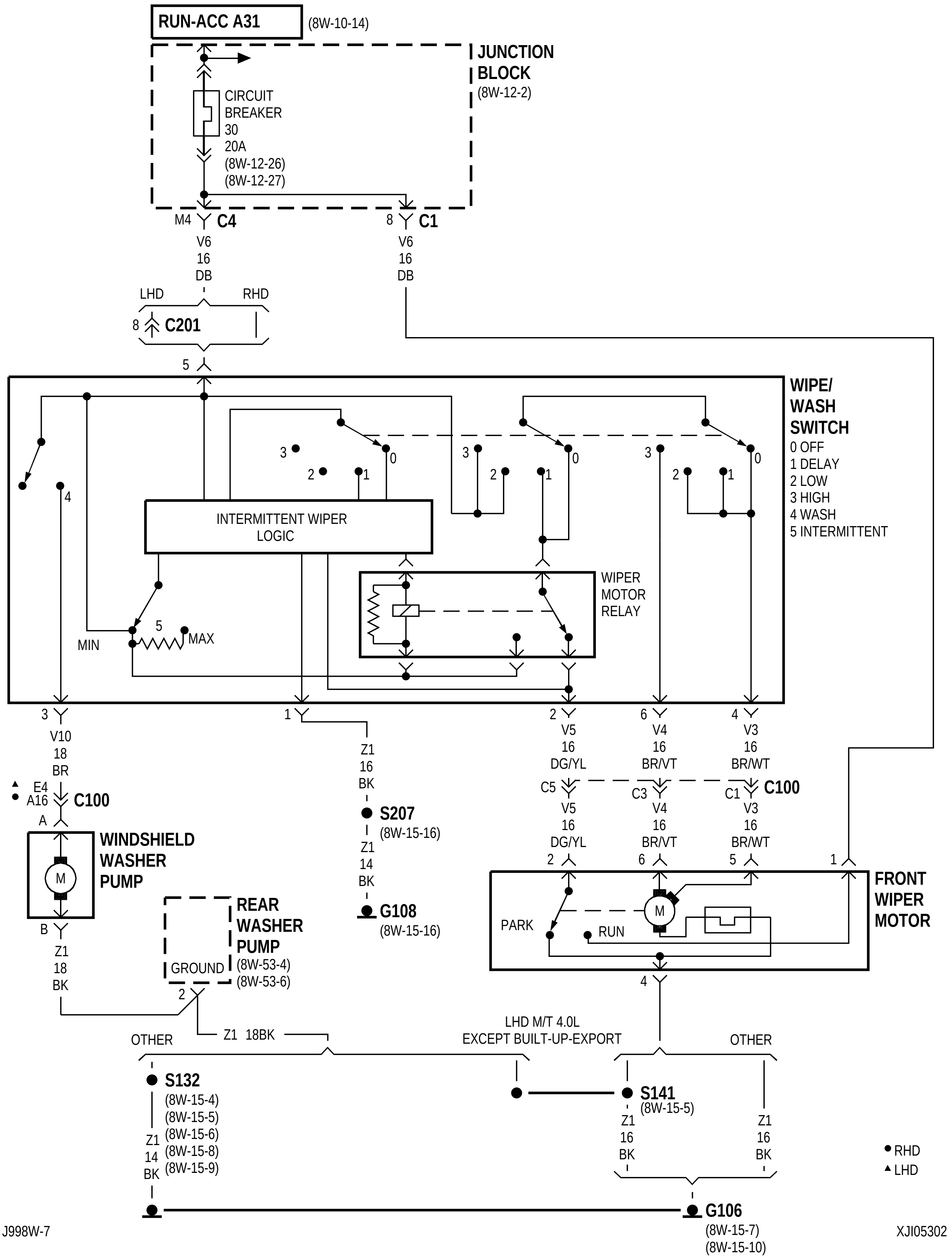

FROM
TURN SIGNAL/ HAZARD SWITCH
(8W-52-3)
(8W-52-4)
F
L61 20 LG/WT
S209
L61 20 LG/WT
B10
F4
C100
L61 20 LG/WT
10 C1
LEFT TURN SIGNAL
INSTRUMENT CLUSTER
(8W-40-14)
L61 20 LG/WT
3 C106
L61 20 LG
S105
(8W-50-12)
L61 18 LG
1 C114
L61 18 LG
L61 18 LG
L61 18 LG
2
LEFT FRONT TURN SIGNAL LAMP NO. 1
1
Z1 18 BK
2
LEFT FRONT TURN SIGNAL LAMP NO. 2
1
Z1 18 BK
S158
(8W-15-10)
(8W-15-12)
1
LEFT REPEATER LAMP
2
Z1 18 BK
2 C114
Z1 18 BK
S103
(8W-15-10)
(8W-15-12)
Z1 18 BK
11 C106
Z1 20 BK/WT
G106
(8W-15-10)
(8W-15-12)
FROM
TURN SIGNAL/ HAZARD SWITCH
(8W-52-3)
(8W-52-4)
H
L63 20 DG/RD
LHD
RHD
TRAILER TOW
OTHER
L63 20 DG/RD
L63 20 DG/RD
26 C200
8 C204
L63 20 DG/RD
L63 20 DG/RD
1 C323
S335
(8W-54-3)
L63 20 DG/RD
1 C322
L63 18 DG/RD
2
LEFT TURN SIGNAL LAMP
1
Z1 18 BK
S341
(8W-15-17)
(8W-15-18)
Z1 16 BK
2 C322
TRAILER TOW
OTHERS
Z1 18 BK
Z1 14 BK
S337
(8W-15-17)
(8W-15-18)
Z1 14 BK
2 C323
Z1 14 BK
S309
(8W-15-17)
(8W-15-18)
Z1 12 BK
G302
(8W-15-17)
(8W-15-18)
▲ LHD
● RHD

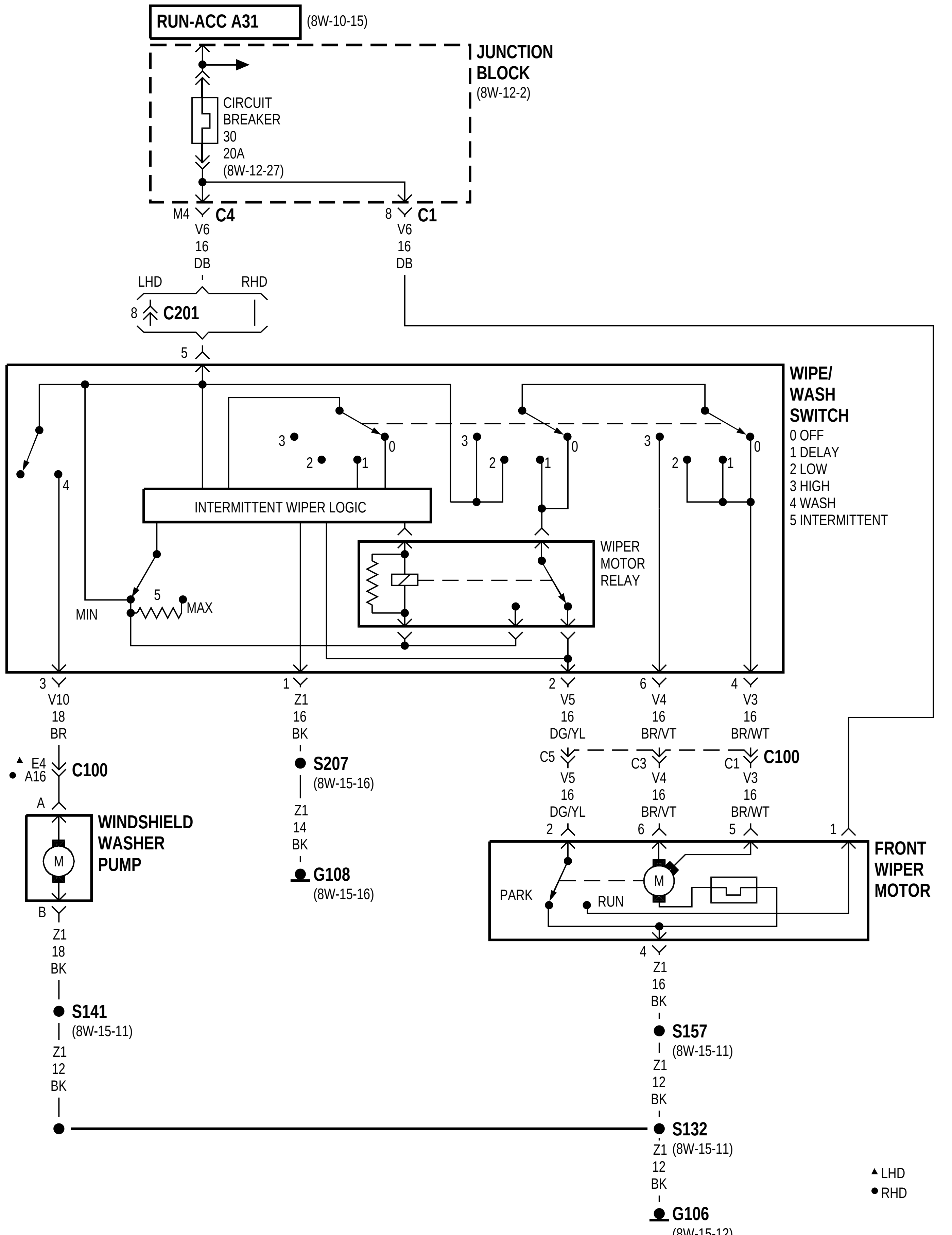

FROM
TURN SIGNAL/ HAZARD SWITCH
(8W-52-2)
A
L62 20 BR/RD
LHD
RHD
25 C200
7 C204
L62 20 BR/RD
S312
(8W-70-4)
L62 20 BR/RD
1 C321
L62 18 BR/RD
2
RIGHT TURN SIGNAL LAMP
1
Z1 18 BK
S348
(8W-15-19)
(8W-15-20)
Z1 18 BK
2 C321
Z1 18 BK
S310
(8W-15-19)
(8W-15-20)
LHD
RHD
Z1 16 BK
Z1 12 BK
G303
(8W-15-19)
(8W-15-20)
FROM
TURN SIGNAL/ HAZARD SWITCH
(8W-52-2)
C
L60 20 TN
S212
L60 20 TN
B9
F3
C100
L60 20 TN
10 C106
L60 20 TN
L60 20 TN
6 C2
RIGHT TURN SIGNAL
INSTRUMENT CLUSTER
(8W-40-14)
S100
(8W-50-13)
L60 20 TN
2
RIGHT SIDE MARKER LAMP
1
L78 20 DG/YL
S101
(8W-12-23)
L78 18 DG/YL
L60 18 TN
2 3
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 1
1
Z1 18 BK
L78 18 DG/YL
L60 18 TN
2 3
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 2
1
Z1 18 BK
S102
(8W-15-7)
Z1 18BK
4 C106
Z1 20 BK
G106
(8W-15-7)
▲ LHD
● RHD

BUILT-UP-EXPORT

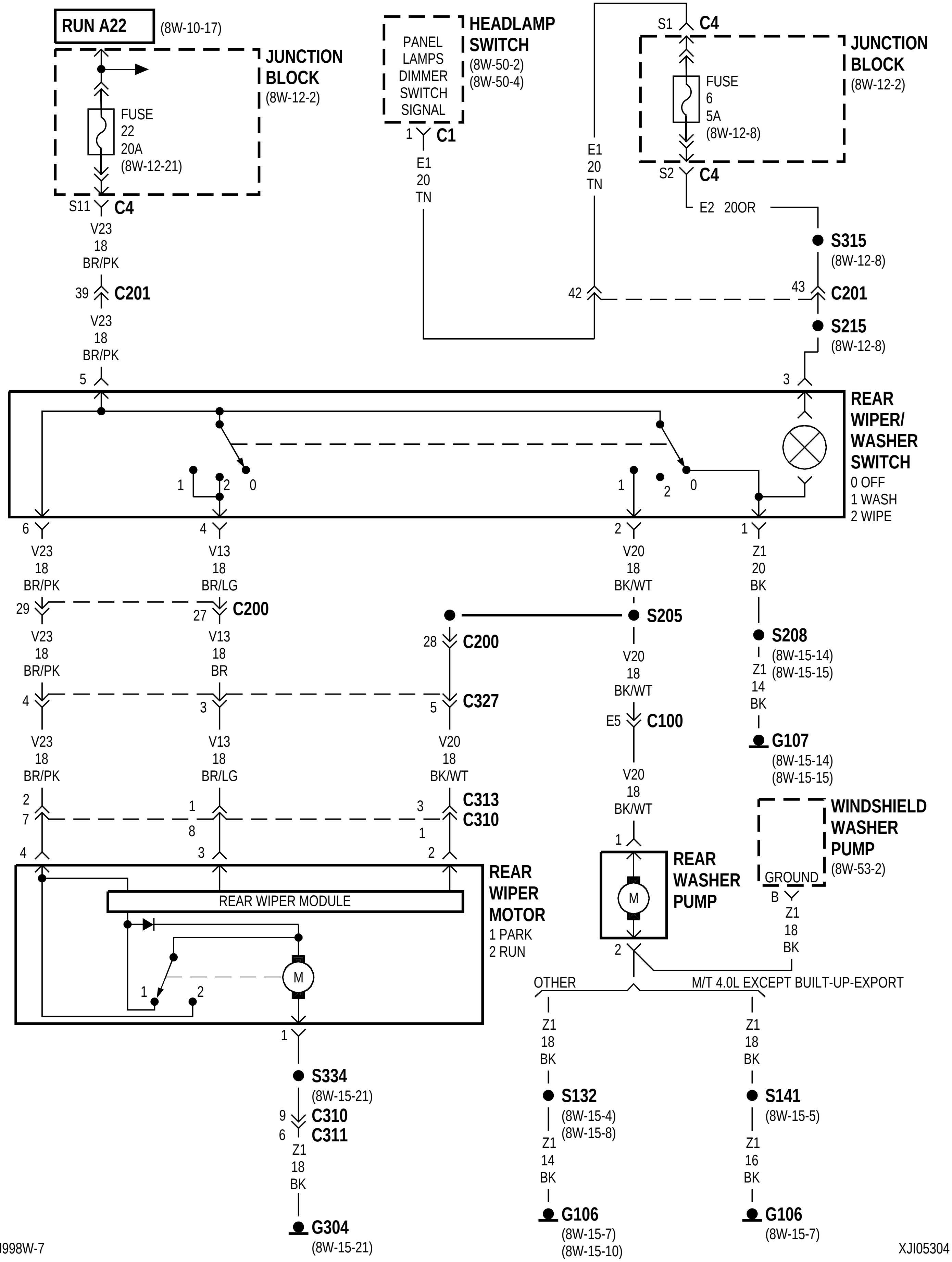


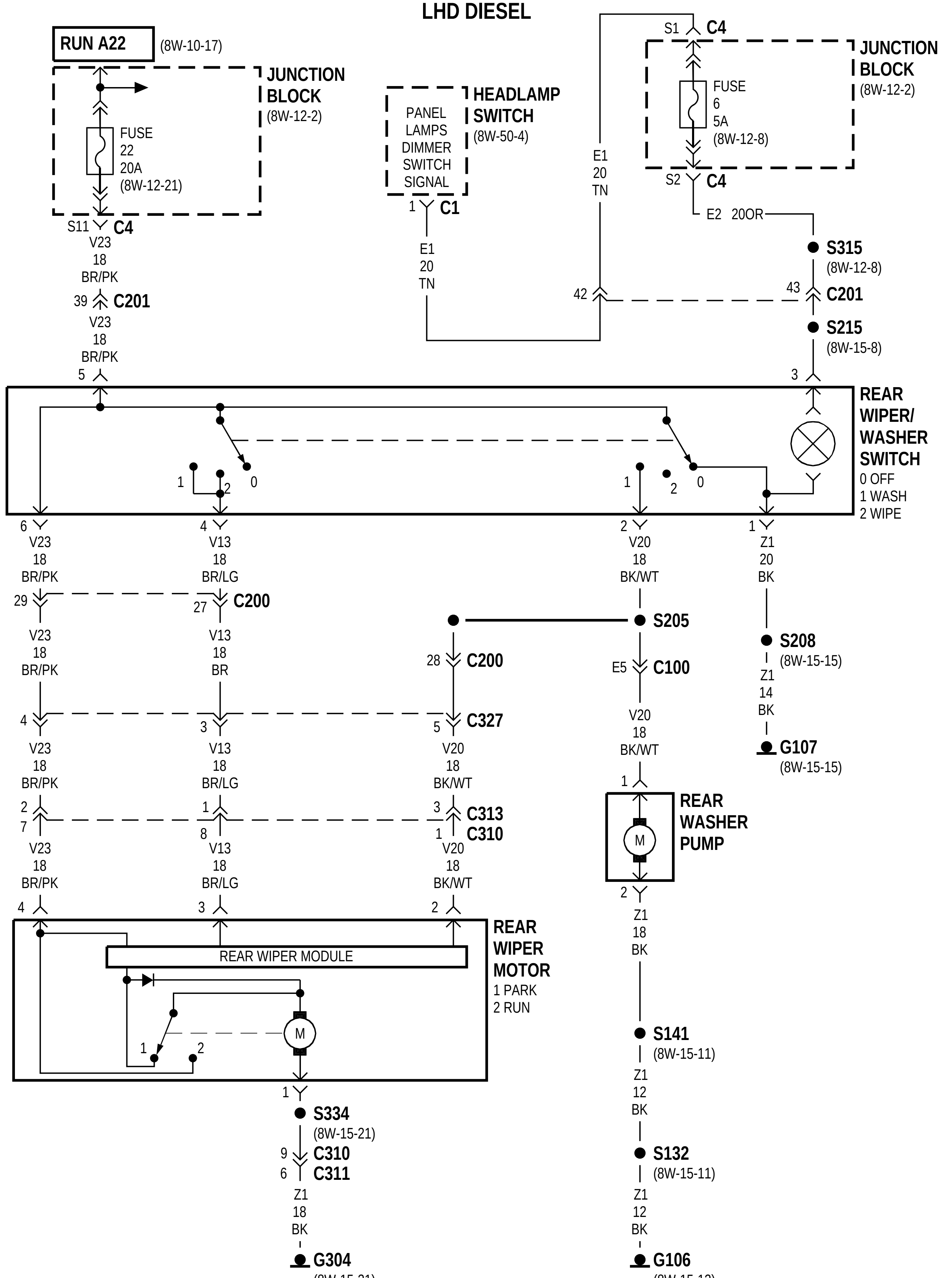
8W-53 WIPERS

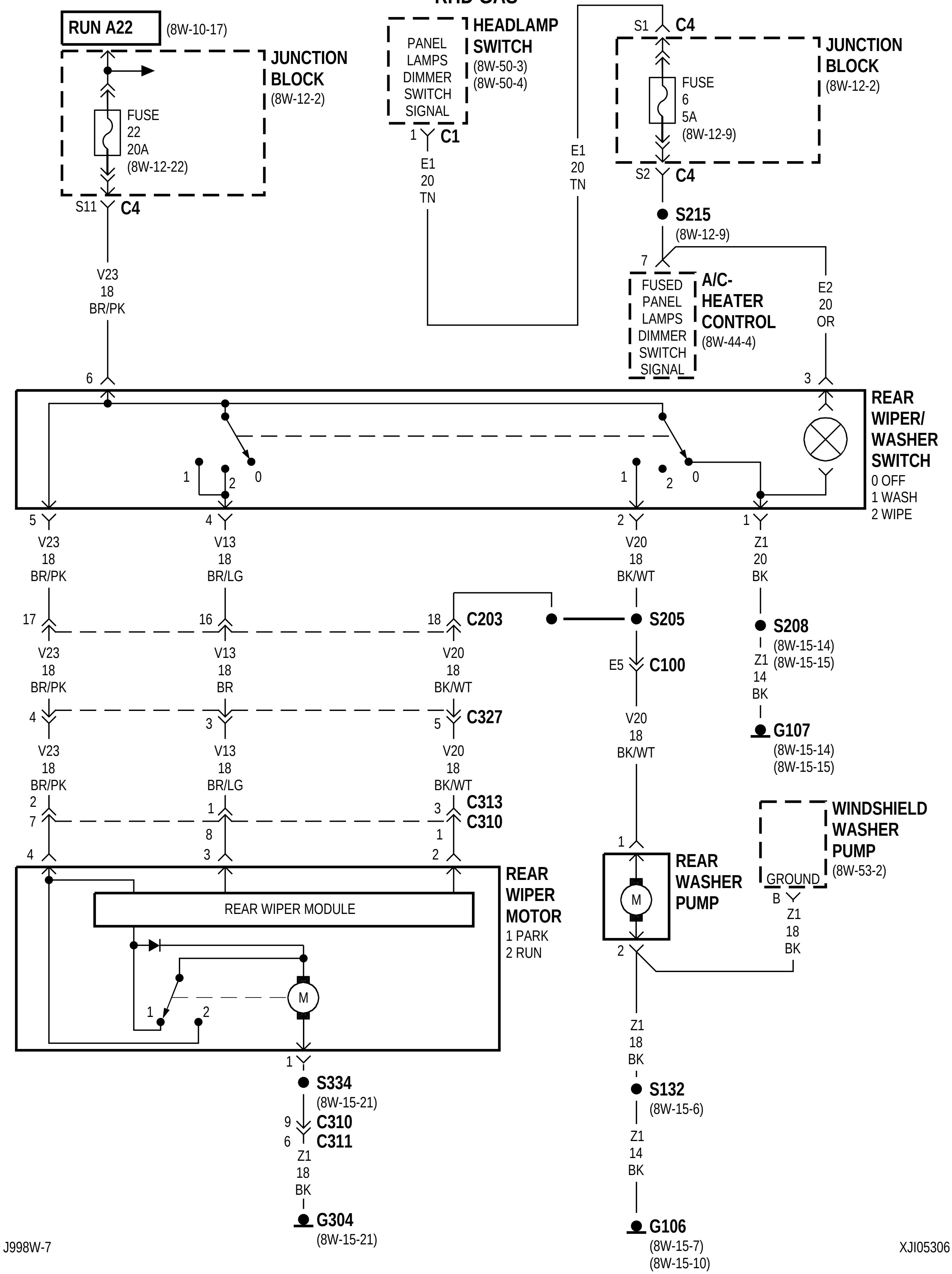

RUN-ACC A31
(8W-10-14)
JUNCTION BLOCK
(8W-12-2)
CIRCUIT BREAKER 30 20A
(8W-12-26)
(8W-12-27)
M4 C4
8 C1
V6 16 DB
V6 16 DB
LHD
RHD
8 C201
5
WIPE/ WASH SWITCH
0 OFF
1 DELAY
2 LOW
3 HIGH
4 WASH
5 INTERMITTENT
INTERMITTENT WIPER LOGIC
WIPER MOTOR RELAY
MIN
5
MAX
3
1
2
6
4
V10 18 BR
E4
A16
C100
A
WINDSHIELD WASHER PUMP
M
B
Z1 18 BK
Z1 16 BK
S207
(8W-15-16)
Z1 14 BK
G108
(8W-15-16)
V5 16 DG/YL
V4 16 BR/VT
V3 16 BR/WT
C5
C3
C1
C100
FRONT WIPER MOTOR
PARK
RUN
REAR WASHER PUMP
GROUND
(8W-53-4)
(8W-53-6)
2
Z1 18BK
OTHER
LHD M/T 4.0L EXCEPT BUILT-UP-EXPORT
OTHER
S132
(8W-15-4)
(8W-15-5)
(8W-15-6)
(8W-15-8)
(8W-15-9)
Z1 14 BK
S141
(8W-15-5)
Z1 16 BK
Z1 16 BK
● RHD
▲ LHD
G106
(8W-15-7)
(8W-15-10)

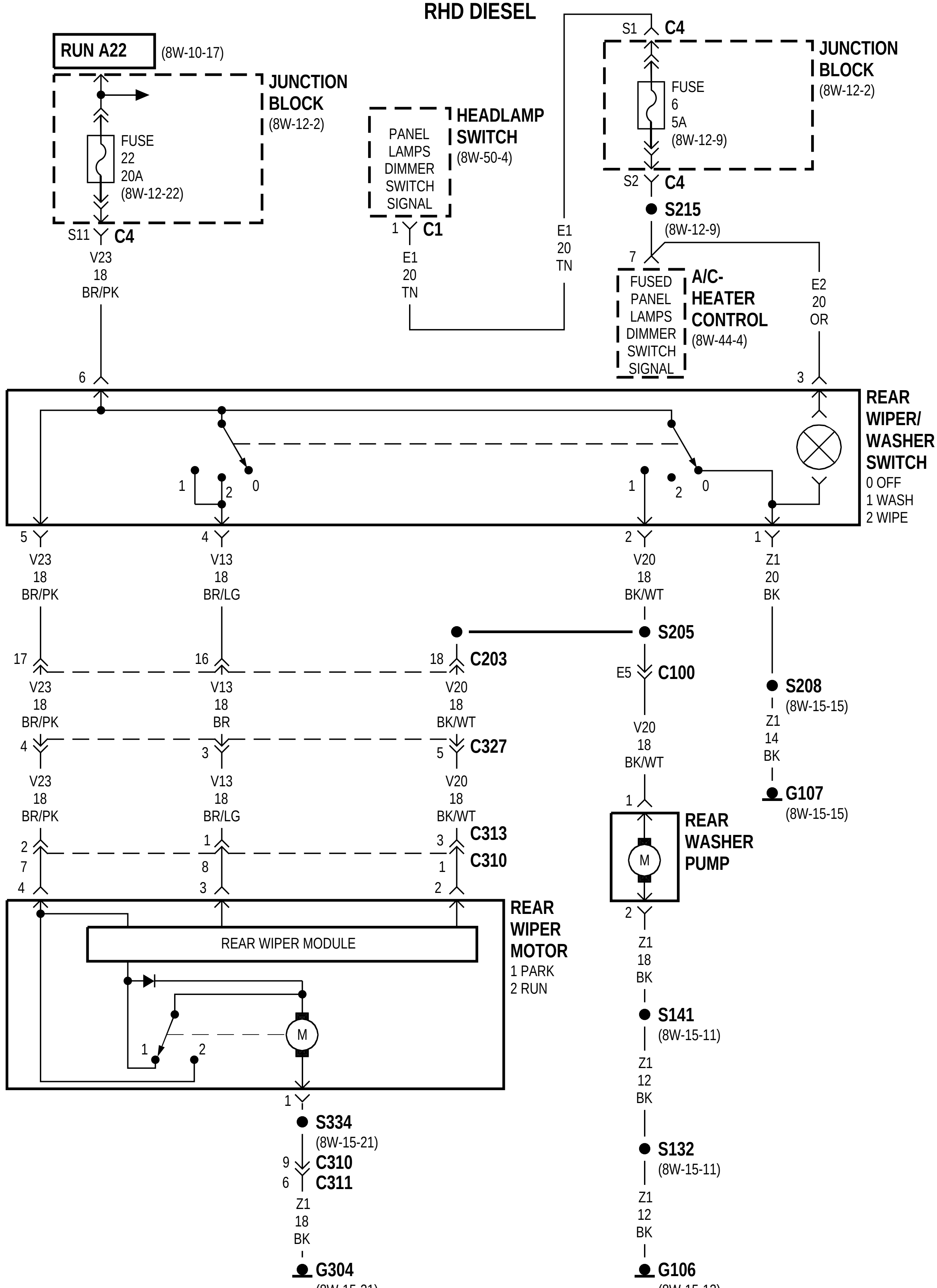

RUN-ACC A31
(8W-10-15)
JUNCTION BLOCK
(8W-12-2)
CIRCUIT BREAKER
30
20A
(8W-12-27)
M4
C4
V6
16
DB
8
C1
V6
16
DB
LHD
RHD
8
C201
5
WIPE/ WASH SWITCH
0 OFF
1 DELAY
2 LOW
3 HIGH
4 WASH
5 INTERMITTENT
INTERMITTENT WIPER LOGIC
WIPER MOTOR RELAY
MIN
5
MAX
3
V10
18
BR
E4
A16
C100
A
WINDSHIELD WASHER PUMP
M
B
Z1
18
BK
S141
(8W-15-11)
Z1
12
BK
1
Z1
16
BK
S207
(8W-15-16)
Z1
14
BK
G108
(8W-15-16)
2
V5
16
DG/YL
6
V4
16
BR/VT
4
V3
16
BR/WT
C5
C3
C1
C100
V5
16
DG/YL
V4
16
BR/VT
V3
16
BR/WT
FRONT WIPER MOTOR
PARK
RUN
M
4
Z1
16
BK
S157
(8W-15-11)
Z1
12
BK
S132
Z1
(8W-15-11)
12
BK
G106
(8W-15-12)
LHD
RHD

LHD GAS

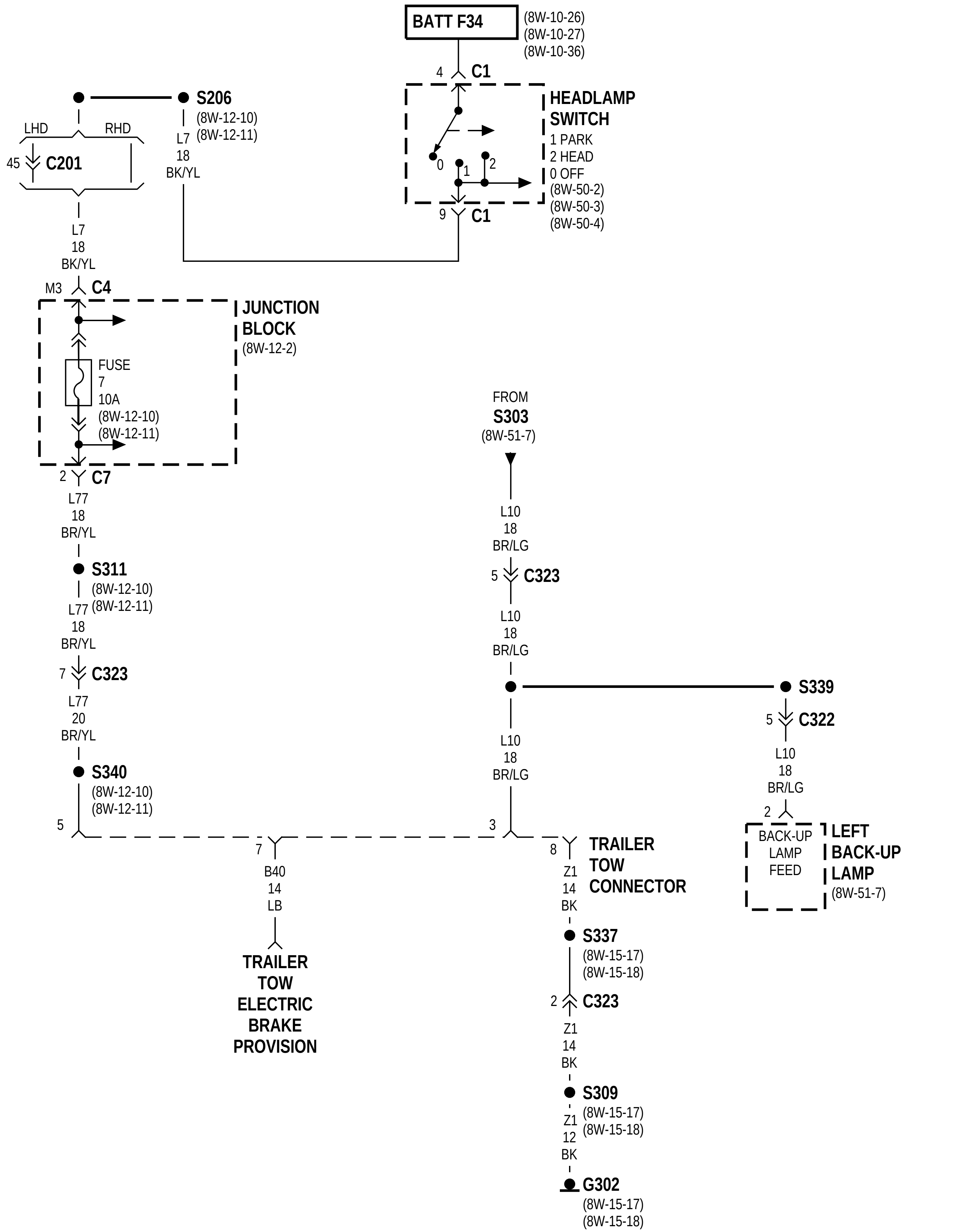

RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE 22 20A (8W-12-21)
S11 C4
V23 18 BR/PK
39 C201
V23 18 BR/PK
5
PANEL LAMPS DIMMER SWITCH SIGNAL
HEADLAMP SWITCH
(8W-50-2)
(8W-50-4)
1 C1
E1 20 TN
E1 20 TN
S1 C4
JUNCTION BLOCK
(8W-12-2)
FUSE 6 5A (8W-12-8)
S2 C4
E2 20OR
S315
(8W-12-8)
42
43 C201
S215
(8W-12-8)
3
REAR WIPER/ WASHER SWITCH
0 OFF
1 WASH
2 WIPE
1 2 0
1 2 0
6 4 2 1
V23 18 BR/PK
V13 18 BR/LG
V20 18 BK/WT
Z1 20 BK
29 27 C200
V23 18 BR/PK
V13 18 BR
S205
28 C200
V20 18 BK/WT
S208
(8W-15-14)
(8W-15-15)
Z1 14 BK
E5 C100
G107
(8W-15-14)
(8W-15-15)
4 3 5 C327
V23 18 BR/PK
V13 18 BR/LG
V20 18 BK/WT
V20 18 BK/WT
2 1 3 C313
7 8 1 C310
4 3 2
WINDSHIELD WASHER PUMP
(8W-53-2)
GROUND
B
Z1 18 BK
REAR WIPER MODULE
REAR WIPER MOTOR
1 PARK
2 RUN
M
1 2
1
REAR WASHER PUMP
M
2
OTHER
M/T 4.0L EXCEPT BUILT-UP-EXPORT
1
S334
(8W-15-21)
9 C310
6 C311
Z1 18 BK
G304
(8W-15-21)
Z1 18 BK
S132
(8W-15-4)
(8W-15-8)
Z1 14 BK
G106
(8W-15-7)
(8W-15-10)
Z1 18 BK
S141
(8W-15-5)
Z1 16 BK
G106
(8W-15-7)

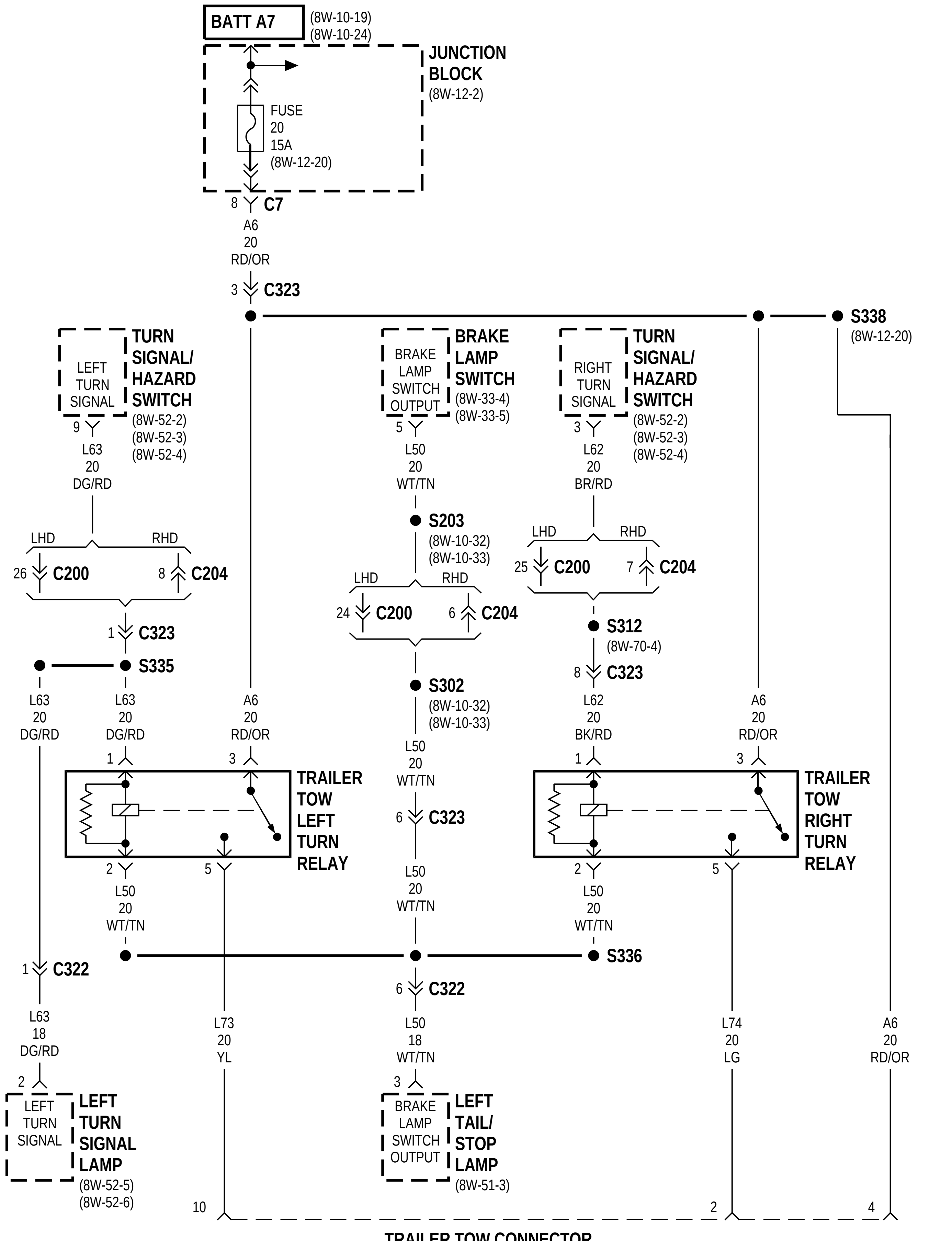

RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE 22 20A (8W-12-21)
S11 C4
V23 18 BR/PK
39 C201
V23 18 BR/PK
5
PANEL LAMPS DIMMER SWITCH SIGNAL
HEADLAMP SWITCH
(8W-50-4)
1 C1
E1 20 TN
E1 20 TN
42
S1 C4
JUNCTION BLOCK
(8W-12-2)
FUSE 6 5A (8W-12-8)
S2 C4
E2 20OR
S315
(8W-12-8)
43 C201
S215
(8W-15-8)
3
REAR WIPER/ WASHER SWITCH
0 OFF
1 WASH
2 WIPE
6 V23 18 BR/PK
4 V13 18 BR/LG
2 V20 18 BK/WT
1 Z1 20 BK
29
27 C200
V23 18 BR/PK
V13 18 BR
S205
28 C200
E5 C100
S208
(8W-15-15)
Z1 14 BK
G107
(8W-15-15)
4
3
5 C327
V23 18 BR/PK
V13 18 BR/LG
V20 18 BK/WT
V20 18 BK/WT
2 7
1 8
3 C313
1 C310
V23 18 BR/PK
V13 18 BR/LG
V20 18 BK/WT
REAR WASHER PUMP
M
2
Z1 18 BK
REAR WIPER MOTOR
1 PARK
2 RUN
REAR WIPER MODULE
M
1 2
S334
(8W-15-21)
9 C310
6 C311
Z1 18 BK
G304
(8W-15-21)
S141
(8W-15-11)
Z1 12 BK
S132
(8W-15-11)
Z1 12 BK
G106
(8W-15-12)


RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE 22 20A (8W-12-22)
S11 C4
V23 18 BR/PK
PANEL LAMPS DIMMER SWITCH SIGNAL
HEADLAMP SWITCH
(8W-50-3)
(8W-50-4)
1 C1
E1 20 TN
S1 C4
JUNCTION BLOCK
(8W-12-2)
FUSE 6 5A (8W-12-9)
S2 C4
S215
(8W-12-9)
FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
A/C-HEATER CONTROL
(8W-44-4)
E2 20 OR
REAR WIPER/ WASHER SWITCH
0 OFF
1 WASH
2 WIPE
V23 18 BR/PK
V13 18 BR/LG
V20 18 BK/WT
Z1 20 BK
C203
S205
S208
(8W-15-14)
(8W-15-15)
E5 C100
Z1 14 BK
G107
(8W-15-14)
(8W-15-15)
V13 18 BR
C327
C313
C310
REAR WIPER MODULE
REAR WIPER MOTOR
1 PARK
2 RUN
REAR WASHER PUMP
WINDSHIELD WASHER PUMP
(8W-53-2)
GROUND
Z1 18 BK
S334
(8W-15-21)
C310
C311
G304
(8W-15-21)
S132
(8W-15-6)
G106
(8W-15-7)
(8W-15-10)

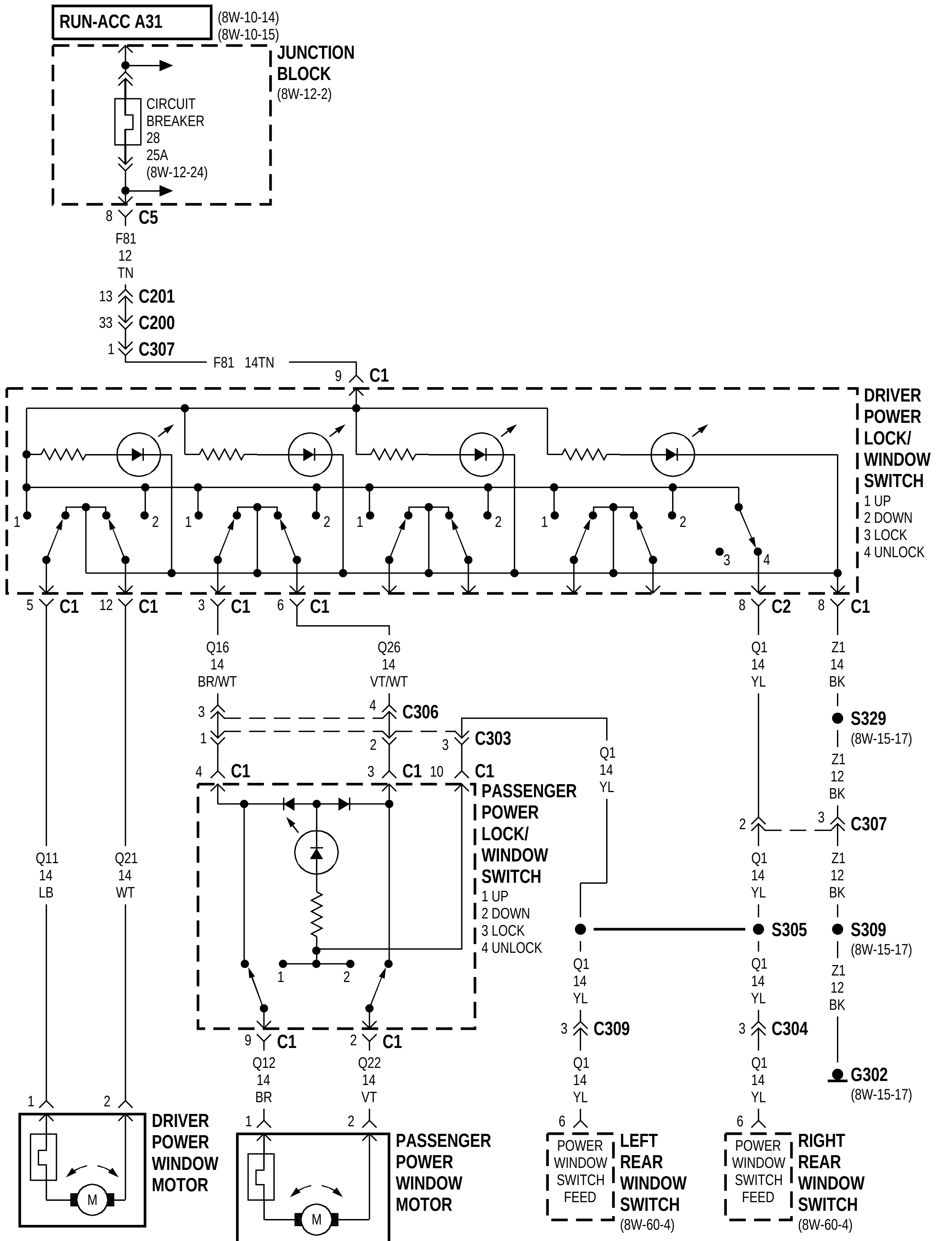

RUN A22
(8W-10-17)
JUNCTION BLOCK
(8W-12-2)
FUSE
22
20A
(8W-12-22)
S11 C4
V23
18
BR/PK
PANEL LAMPS DIMMER SWITCH SIGNAL
HEADLAMP SWITCH
(8W-50-4)
1 C1
E1
20
TN
S1 C4
JUNCTION BLOCK
(8W-12-2)
FUSE
6
5A
(8W-12-9)
S2 C4
S215
(8W-12-9)
FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
A/C-HEATER CONTROL
(8W-44-4)
E2
20
OR
REAR WIPER/ WASHER SWITCH
0 OFF
1 WASH
2 WIPE
V13
18
BR/LG
V20
18
BK/WT
Z1
20
BK
S205
C203
C100
S208
(8W-15-15)
Z1
14
BK
G107
(8W-15-15)
V13
18
BR
C327
C313
C310
REAR WASHER PUMP
REAR WIPER MODULE
REAR WIPER MOTOR
1 PARK
2 RUN
Z1
18
BK
S141
(8W-15-11)
Z1
12
BK
S132
(8W-15-11)
G106
(8W-15-12)
S334
(8W-15-21)
C310
C311
G304
(8W-15-21)

8W-54 TRAILER TOW

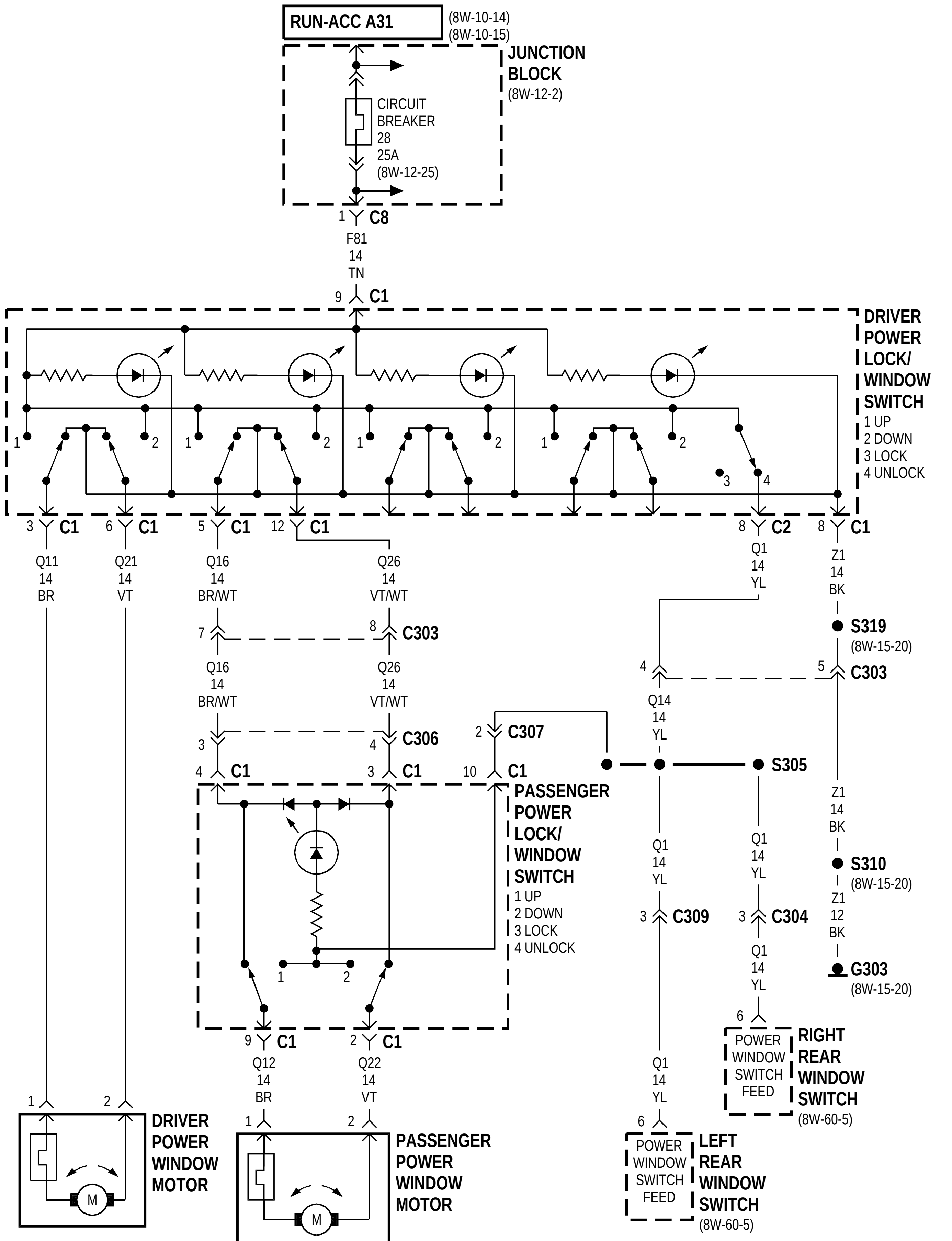

BATT F34
(8W-10-26)
(8W-10-27)
(8W-10-36)
4 C1
HEADLAMP SWITCH
1 PARK
2 HEAD
0 OFF
(8W-50-2)
(8W-50-3)
(8W-50-4)
9 C1
S206
(8W-12-10)
(8W-12-11)
L7 18 BK/YL
LHD
RHD
45 C201
L7 18 BK/YL
M3 C4
JUNCTION BLOCK
(8W-12-2)
FUSE 7 10A
(8W-12-10)
(8W-12-11)
2 C7
L77 18 BR/YL
S311
(8W-12-10)
(8W-12-11)
L77 18 BR/YL
7 C323
L77 20 BR/YL
S340
(8W-12-10)
(8W-12-11)
FROM S303
(8W-51-7)
L10 18 BR/LG
5 C323
L10 18 BR/LG
S339
5 C322
L10 18 BR/LG
2
BACK-UP LAMP FEED
LEFT BACK-UP LAMP
(8W-51-7)
L10 18 BR/LG
5
3
7
8
TRAILER TOW CONNECTOR
B40 14 LB
TRAILER TOW ELECTRIC BRAKE PROVISION
Z1 14 BK
S337
(8W-15-17)
(8W-15-18)
2 C323
Z1 14 BK
S309
(8W-15-17)
(8W-15-18)
Z1 12 BK
G302
(8W-15-17)
(8W-15-18)

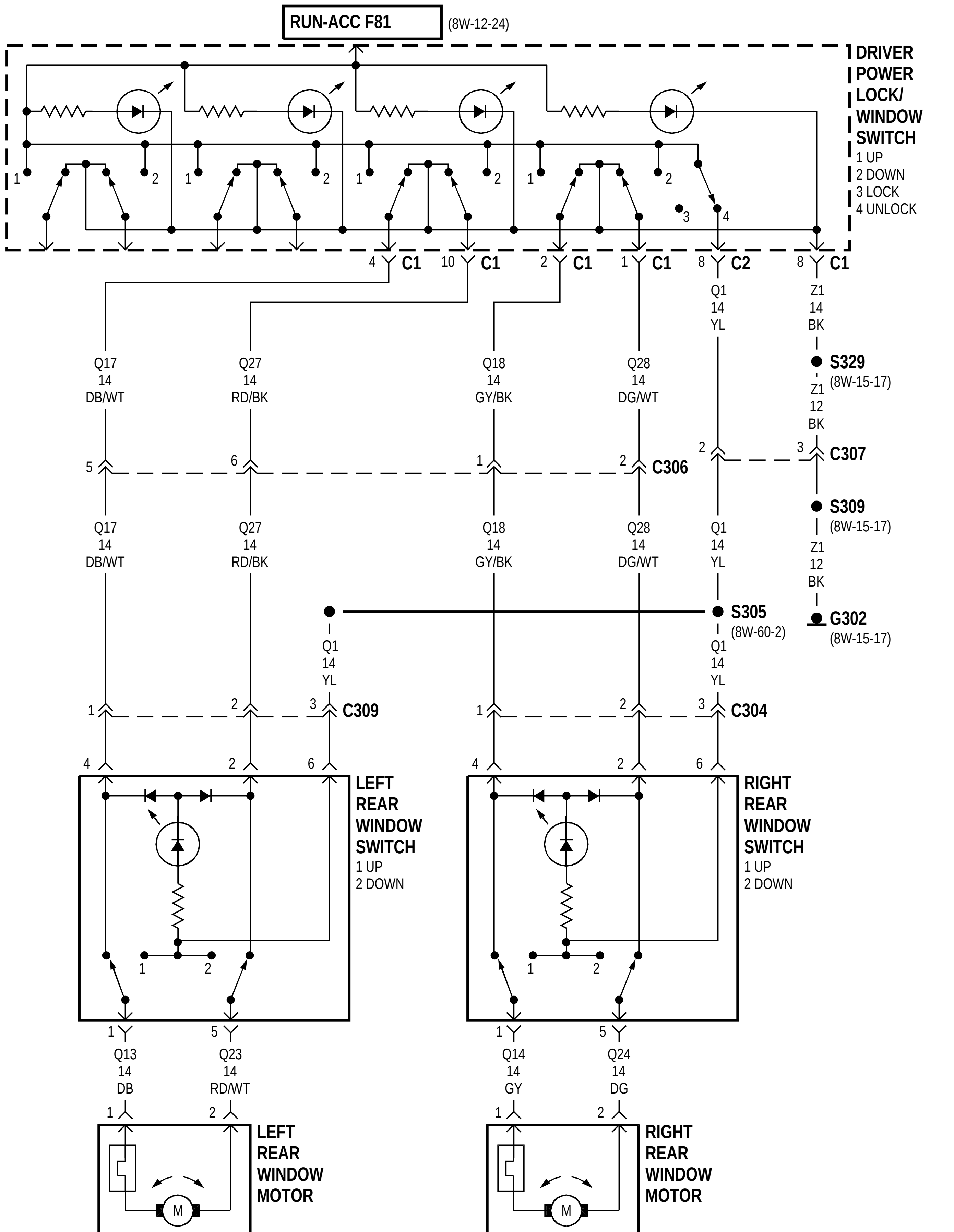

BATT A7
(8W-10-19)
(8W-10-24)
JUNCTION BLOCK
(8W-12-2)
FUSE
20
15A
(8W-12-20)
8 C7
A6
20
RD/OR
3 C323
S338
(8W-12-20)
LEFT TURN SIGNAL
TURN SIGNAL/ HAZARD SWITCH
(8W-52-2)
(8W-52-3)
(8W-52-4)
9
L63
20
DG/RD
BRAKE LAMP SWITCH OUTPUT
BRAKE LAMP SWITCH
(8W-33-4)
(8W-33-5)
5
L50
20
WT/TN
RIGHT TURN SIGNAL
TURN SIGNAL/ HAZARD SWITCH
(8W-52-2)
(8W-52-3)
(8W-52-4)
3
L62
20
BR/RD
S203
(8W-10-32)
(8W-10-33)
LHD
RHD
26 C200
8 C204
24 C200
6 C204
25 C200
7 C204
1 C323
S312
(8W-70-4)
8 C323
S335
S302
(8W-10-32)
(8W-10-33)
L63
20
DG/RD
L63
20
DG/RD
A6
20
RD/OR
L62
20
BK/RD
A6
20
RD/OR
L50
20
WT/TN
1
3
TRAILER TOW LEFT TURN RELAY
6 C323
TRAILER TOW RIGHT TURN RELAY
2
5
L50
20
WT/TN
L50
20
WT/TN
L50
20
WT/TN
S336
1 C322
6 C322
L63
18
DG/RD
L73
20
YL
L50
18
WT/TN
L74
20
LG
A6
20
RD/OR
2
LEFT TURN SIGNAL
LEFT TURN SIGNAL LAMP
(8W-52-5)
(8W-52-6)
3
BRAKE LAMP SWITCH OUTPUT
LEFT TAIL/ STOP LAMP
(8W-51-3)
10
2
4
TRAILER TOW CONNECTOR

8W-60 POWER WINDOWS

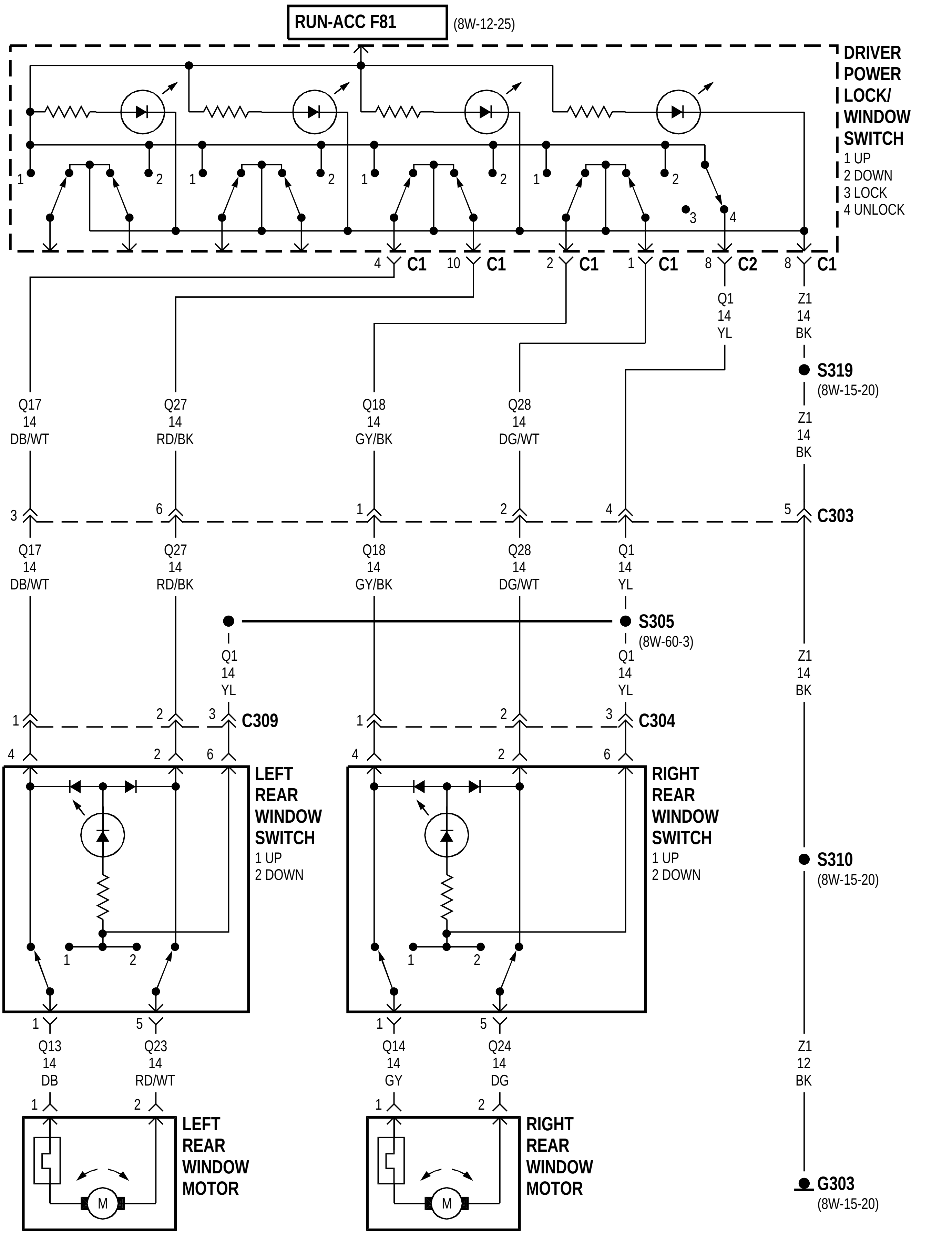

RUN-ACC A31
(8W-10-14)
(8W-10-15)
JUNCTION BLOCK
(8W-12-2)
CIRCUIT BREAKER
28
25A
(8W-12-24)
8 C5
F81
12
TN
13 C201
33 C200
1 C307
F81 14TN
9 C1
DRIVER POWER LOCK/ WINDOW SWITCH
1 UP
2 DOWN
3 LOCK
4 UNLOCK
5 C1
12 C1
3 C1
6 C1
8 C2
8 C1
Q16
14
BR/WT
Q26
14
VT/WT
Q1
14
YL
Z1
14
BK
S329
(8W-15-17)
Z1
12
BK
3 C306
4
1
2
3 C303
Q1
14
YL
4 C1
3 C1
10 C1
PASSENGER POWER LOCK/ WINDOW SWITCH
1 UP
2 DOWN
3 LOCK
4 UNLOCK
2
3 C307
Q11
14
LB
Q21
14
WT
Q1
14
YL
Z1
12
BK
S305
S309
(8W-15-17)
Q1
14
YL
Q1
14
YL
Z1
12
BK
3 C309
3 C304
9 C1
2 C1
Q12
14
BR
Q22
14
VT
Q1
14
YL
Q1
14
YL
G302
(8W-15-17)
1
2
DRIVER POWER WINDOW MOTOR
M
1
2
PASSENGER POWER WINDOW MOTOR
M
6
POWER WINDOW SWITCH FEED
LEFT REAR WINDOW SWITCH
(8W-60-4)
6
POWER WINDOW SWITCH FEED
RIGHT REAR WINDOW SWITCH
(8W-60-4)

RHD


RUN-ACC A31
(8W-10-14)
(8W-10-15)
JUNCTION BLOCK
(8W-12-2)
CIRCUIT BREAKER
28
25A
(8W-12-25)
C8
F81
14
TN
C1
DRIVER POWER LOCK/ WINDOW SWITCH
1 UP
2 DOWN
3 LOCK
4 UNLOCK
Q11
14
BR
Q21
14
VT
Q16
14
BR/WT
Q26
14
VT/WT
C2
Q1
14
YL
Z1
14
BK
C303
S319
(8W-15-20)
Q14
14
YL
C306
C307
S305
PASSENGER POWER LOCK/ WINDOW SWITCH
1 UP
2 DOWN
3 LOCK
4 UNLOCK
Z1
14
BK
S310
(8W-15-20)
Z1
12
BK
G303
(8W-15-20)
C309
C304
Q12
14
BR
Q22
14
VT
POWER WINDOW SWITCH FEED
RIGHT REAR WINDOW SWITCH
(8W-60-5)
DRIVER POWER WINDOW MOTOR
PASSENGER POWER WINDOW MOTOR
LEFT REAR WINDOW SWITCH
(8W-60-5)
M


RUN-ACC F81
(8W-12-24)
DRIVER POWER LOCK/ WINDOW SWITCH
1 UP
2 DOWN
3 LOCK
4 UNLOCK
C1
C2
Q17 14 DB/WT
Q27 14 RD/BK
Q18 14 GY/BK
Q28 14 DG/WT
Q1 14 YL
Z1 14 BK
S329
(8W-15-17)
Z1 12 BK
C306
C307
S309
(8W-15-17)
S305
(8W-60-2)
G302
(8W-15-17)
C309
C304
LEFT REAR WINDOW SWITCH
1 UP
2 DOWN
RIGHT REAR WINDOW SWITCH
1 UP
2 DOWN
Q13 14 DB
Q23 14 RD/WT
Q14 14 GY
Q24 14 DG
LEFT REAR WINDOW MOTOR
RIGHT REAR WINDOW MOTOR
M

RHD



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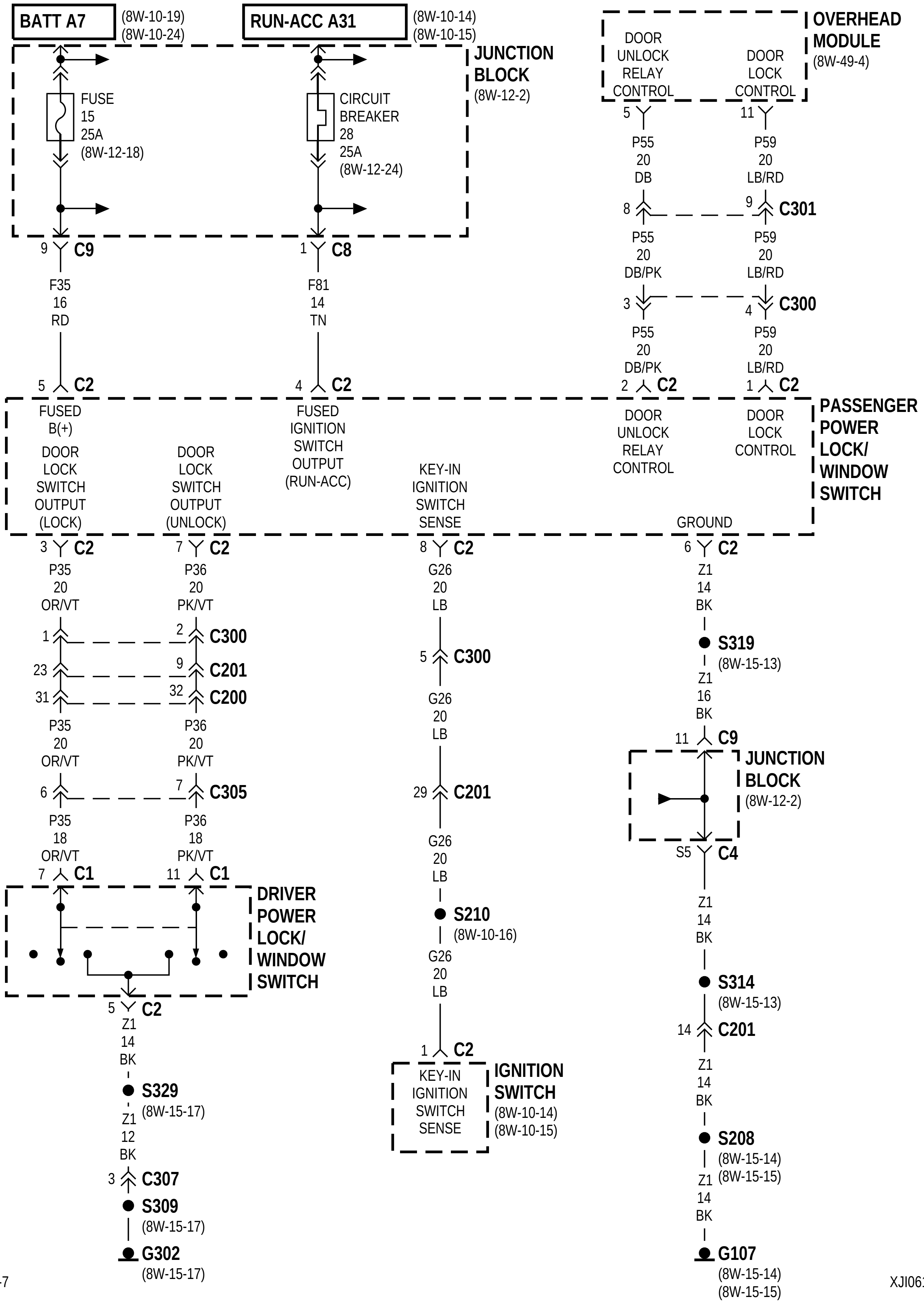
J998W-7

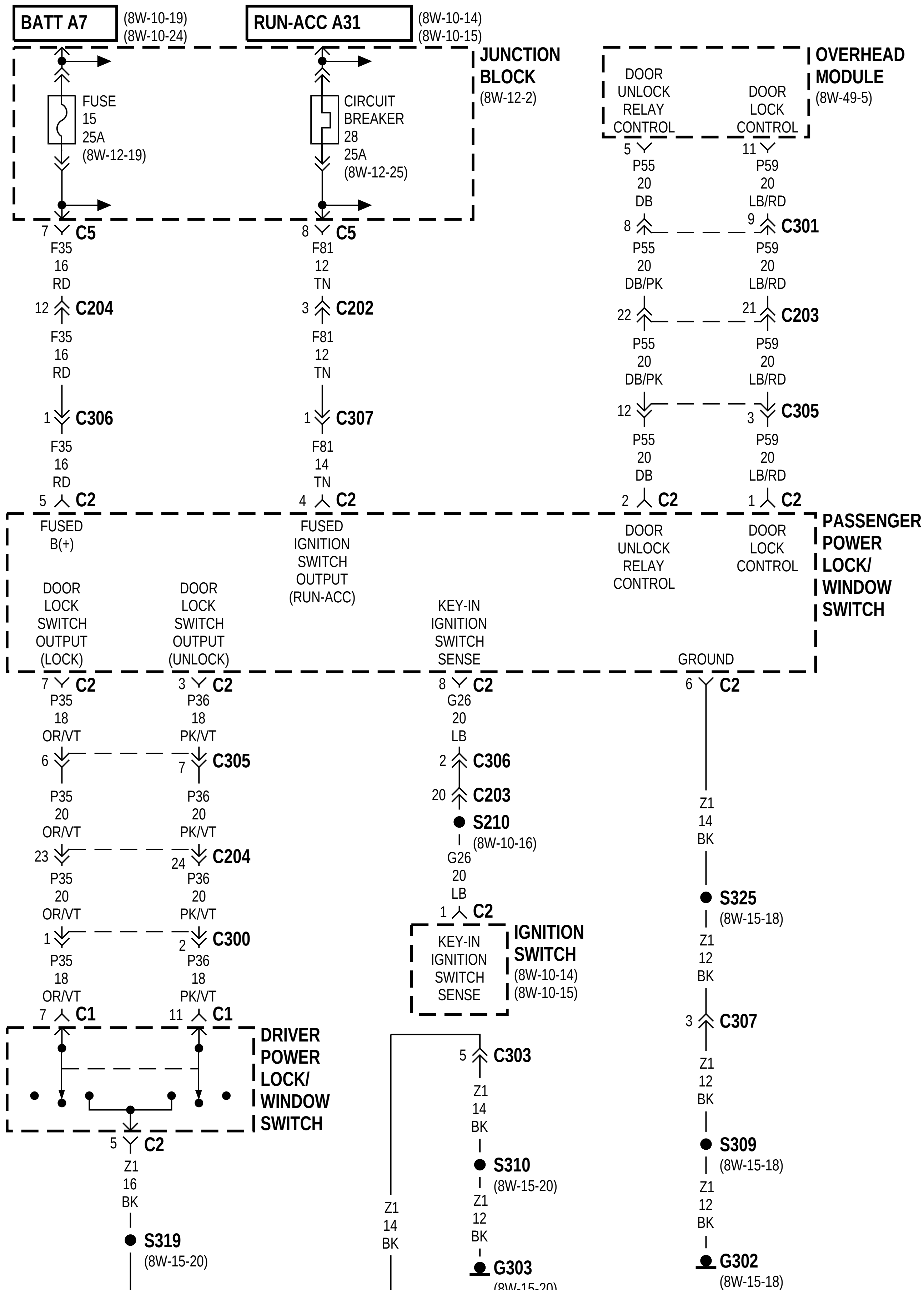
8W-61 POWER DOOR LOCKS

Component **Page**

LHD



BATT A7
(8W-10-19)
(8W-10-24)
RUN-ACC A31
(8W-10-14)
(8W-10-15)
JUNCTION BLOCK
(8W-12-2)
FUSE
15
25A
(8W-12-18)
CIRCUIT BREAKER
28
25A
(8W-12-24)
OVERHEAD MODULE
(8W-49-4)
DOOR UNLOCK RELAY CONTROL
DOOR LOCK CONTROL
5
11
P55
20
DB
P59
20
LB/RD
8
9
C301
P55
20
DB/PK
P59
20
LB/RD
3
4
C300
P55
20
DB/PK
P59
20
LB/RD
2 C2
1 C2
9 C9
1 C8
F35
16
RD
F81
14
TN
5 C2
4 C2
PASSENGER POWER LOCK/ WINDOW SWITCH
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
DOOR UNLOCK RELAY CONTROL
DOOR LOCK CONTROL
DOOR LOCK SWITCH OUTPUT (LOCK)
DOOR LOCK SWITCH OUTPUT (UNLOCK)
KEY-IN IGNITION SWITCH SENSE
GROUND
3 C2
7 C2
8 C2
6 C2
P35
20
OR/VT
P36
20
PK/VT
G26
20
LB
Z1
14
BK
1
2
C300
23
9
C201
31
32
C200
5 C300
S319
(8W-15-13)
Z1
16
BK
P35
20
OR/VT
P36
20
PK/VT
G26
20
LB
11 C9
JUNCTION BLOCK
(8W-12-2)
6
7
C305
29 C201
P35
18
OR/VT
P36
18
PK/VT
G26
20
LB
S5 C4
7 C1
11 C1
DRIVER POWER LOCK/ WINDOW SWITCH
S210
(8W-10-16)
Z1
14
BK
G26
20
LB
S314
(8W-15-13)
5 C2
Z1
14
BK
14 C201
1 C2
S329
(8W-15-17)
Z1
12
BK
IGNITION SWITCH
(8W-10-14)
(8W-10-15)
KEY-IN IGNITION SWITCH SENSE
Z1
14
BK
S208
(8W-15-14)
(8W-15-15)
Z1
14
BK
3 C307
S309
(8W-15-17)
G302
(8W-15-17)
G107
(8W-15-14)
(8W-15-15)



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J998W-7

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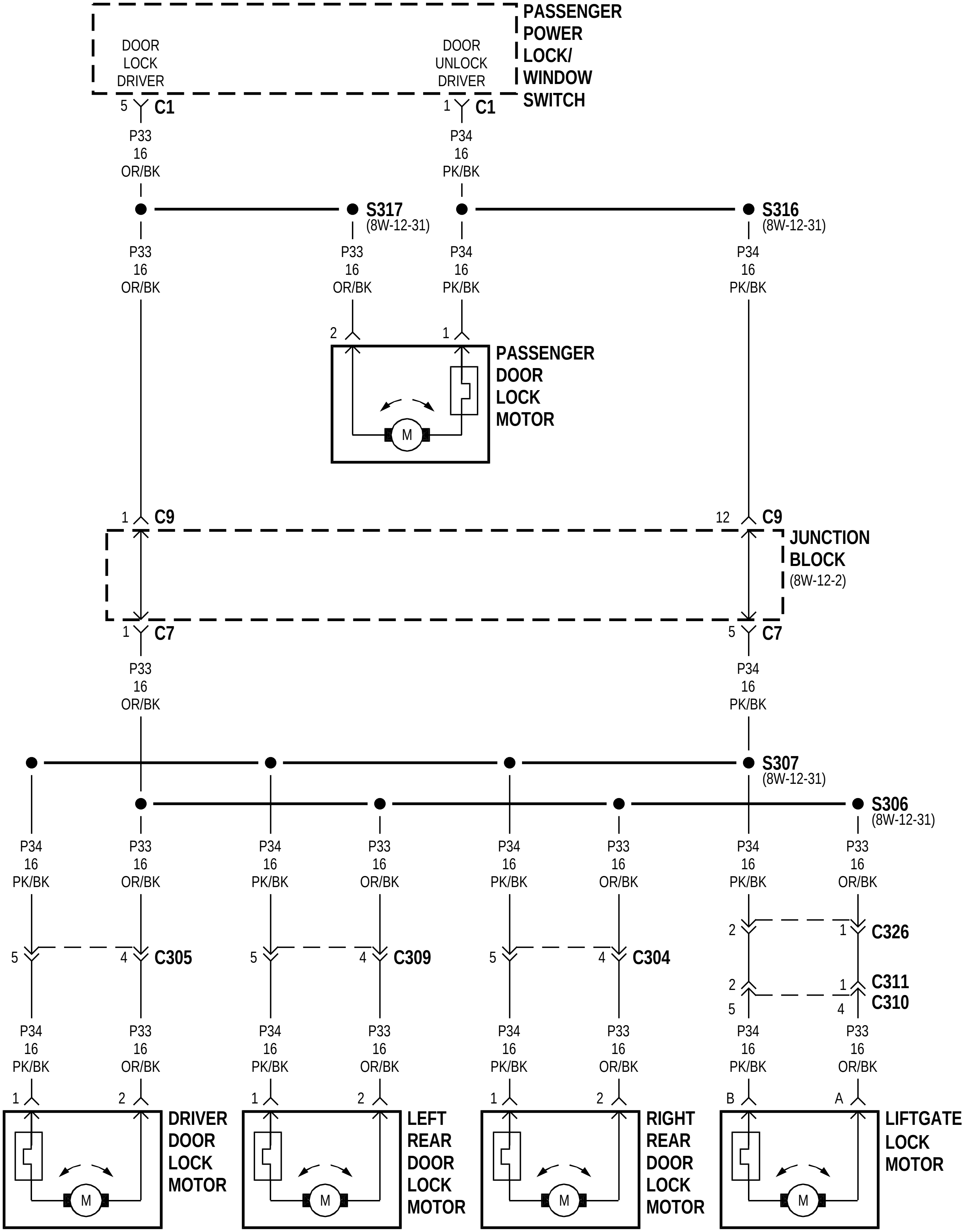
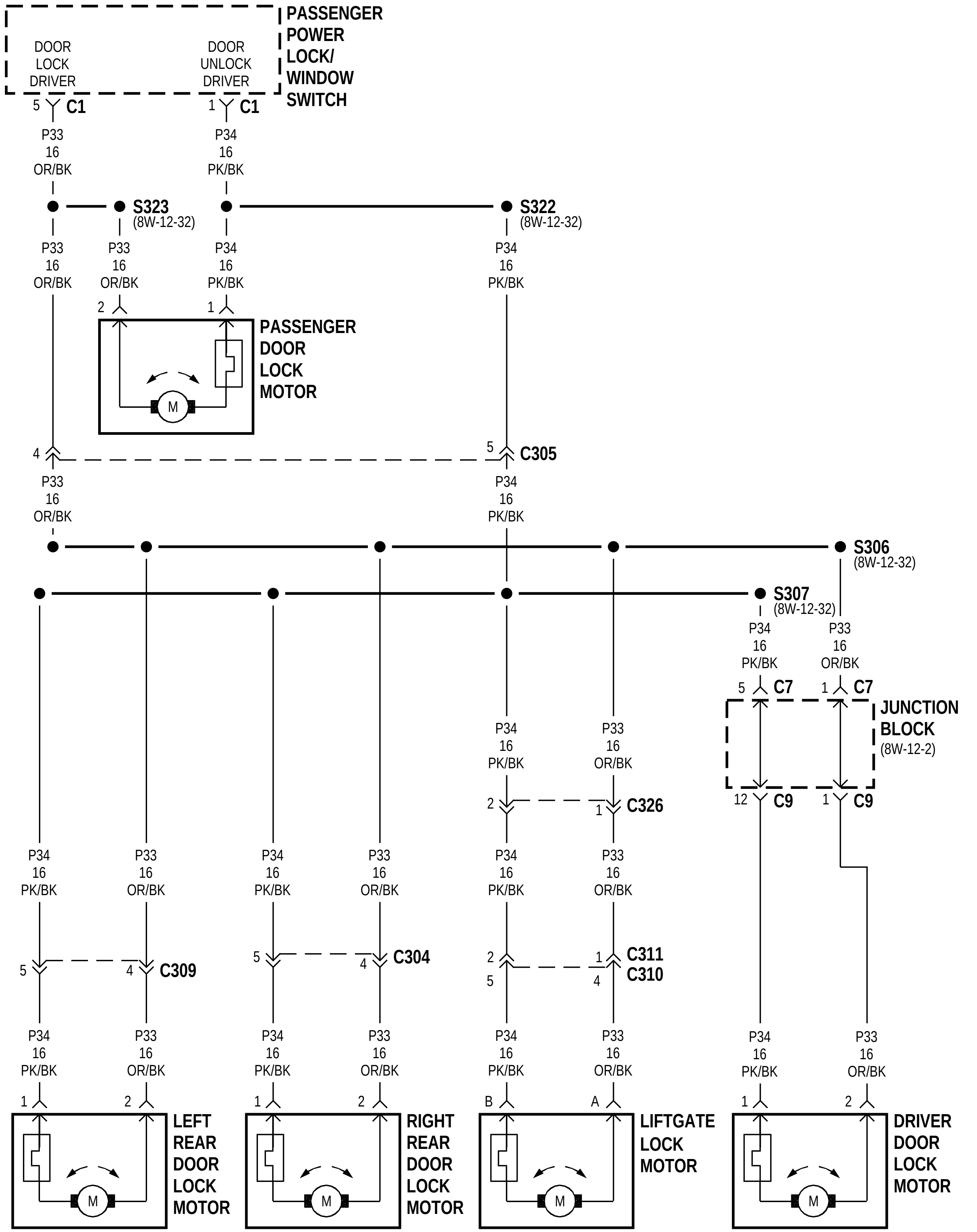
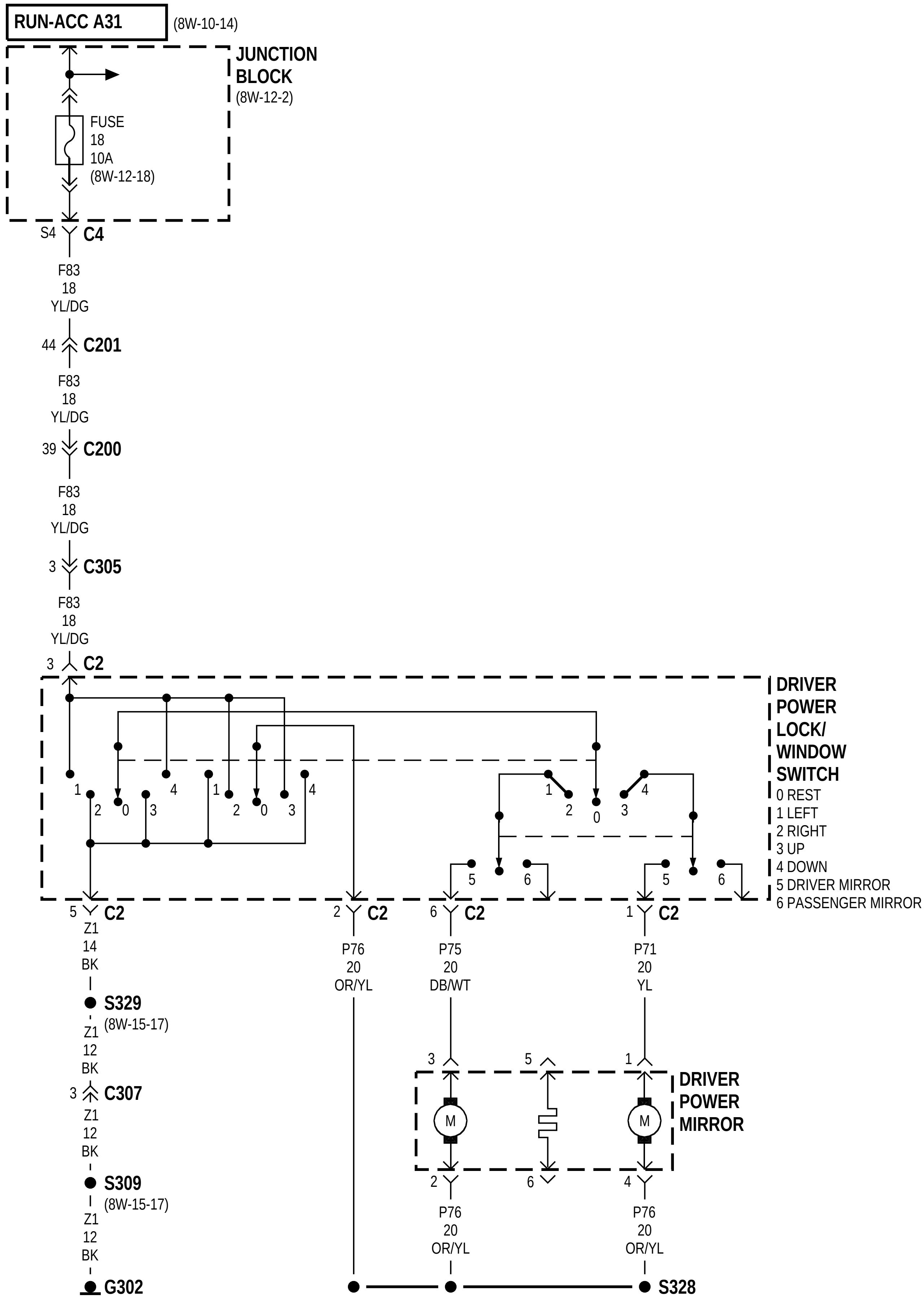

PASSENGER
POWER
LOCK/
WINDOW
SWITCH
DOOR
LOCK
DRIVER
DOOR
UNLOCK
DRIVER
5 C1
1 C1
P33
16
OR/BK
P34
16
PK/BK
S317
(8W-12-31)
S316
(8W-12-31)
PASSENGER
DOOR
LOCK
MOTOR
M
1 C9
12 C9
JUNCTION
BLOCK
(8W-12-2)
1 C7
5 C7
S307
(8W-12-31)
S306
(8W-12-31)
C305
C309
C304
C326
C311
C310
DRIVER
DOOR
LOCK
MOTOR
LEFT
REAR
DOOR
LOCK
MOTOR
RIGHT
REAR
DOOR
LOCK
MOTOR
LIFTGATE
LOCK
MOTOR

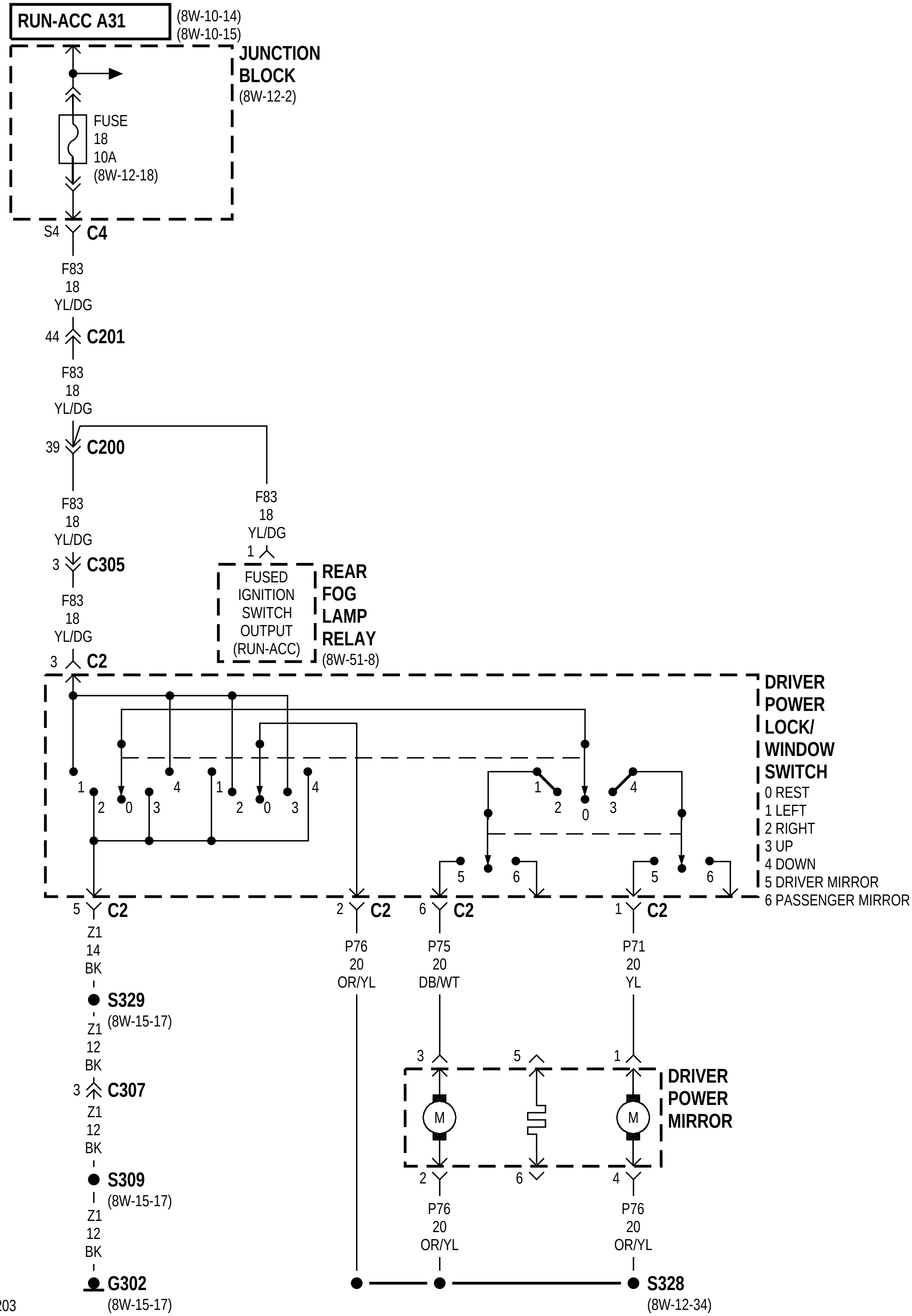

PASSENGER POWER LOCK/ WINDOW SWITCH
DOOR LOCK DRIVER
DOOR UNLOCK DRIVER
C1
P33 16 OR/BK
P34 16 PK/BK
S323 (8W-12-32)
S322 (8W-12-32)
PASSENGER DOOR LOCK MOTOR
M
C305
S306 (8W-12-32)
S307 (8W-12-32)
C7
JUNCTION BLOCK (8W-12-2)
C9
C326
C309
C304
C311
C310
LEFT REAR DOOR LOCK MOTOR
RIGHT REAR DOOR LOCK MOTOR
LIFTGATE LOCK MOTOR
DRIVER DOOR LOCK MOTOR

8W-62 POWER MIRRORS

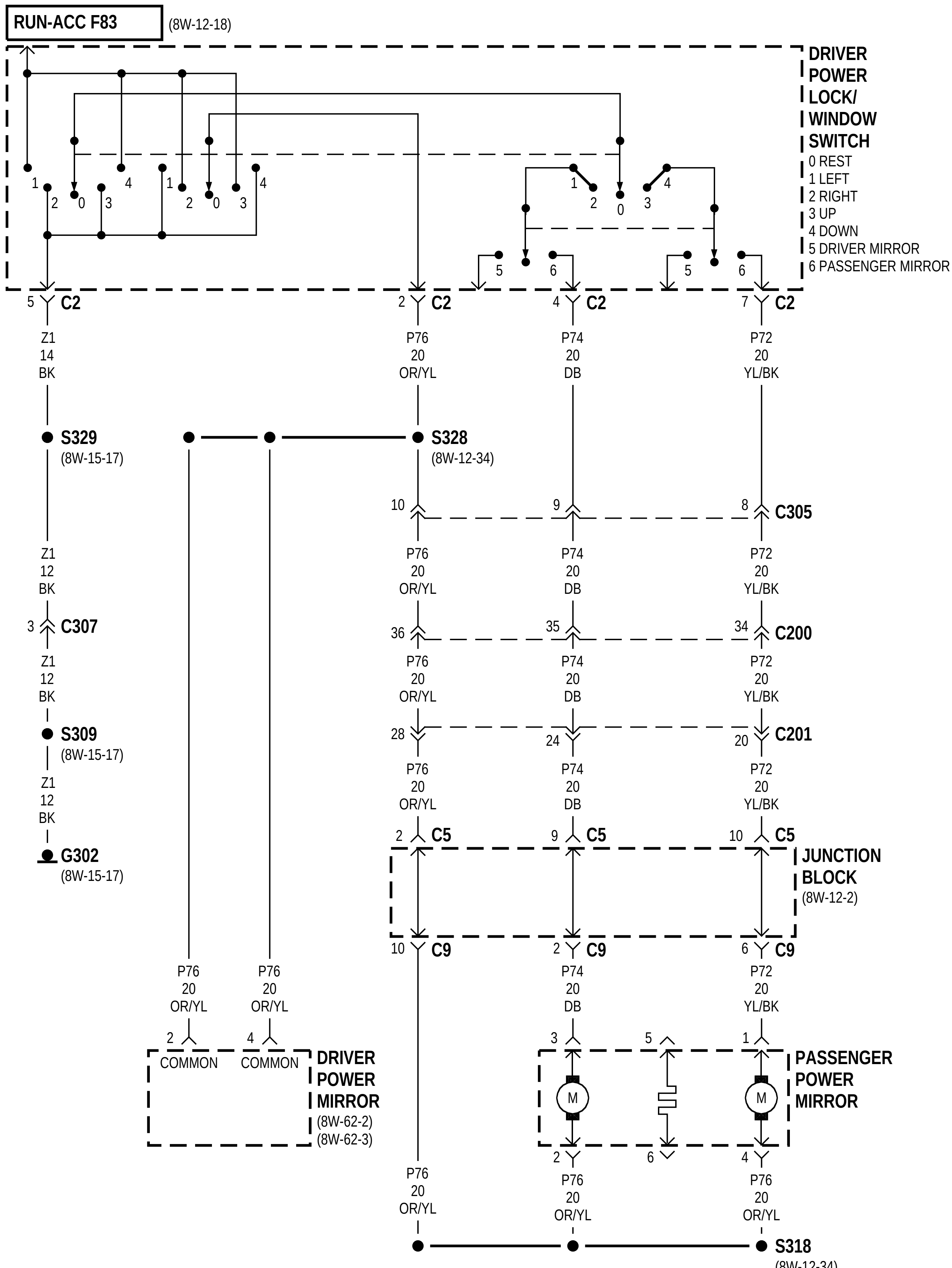
LHD EXCEPT BUILT-UP-EXPORT FULL OPTIONS



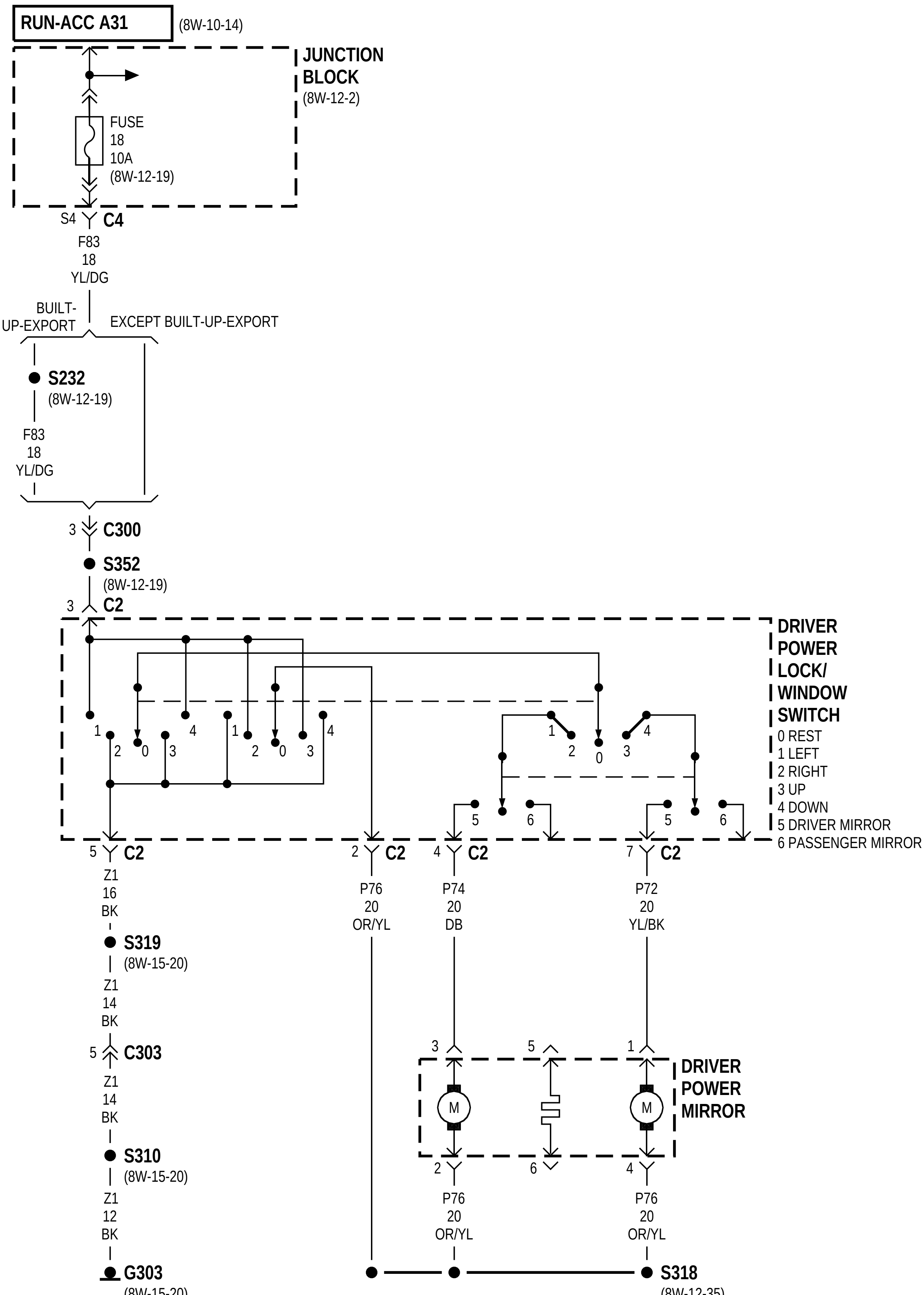
BUILT-UP-EXPORT LHD FULL OPTIONS



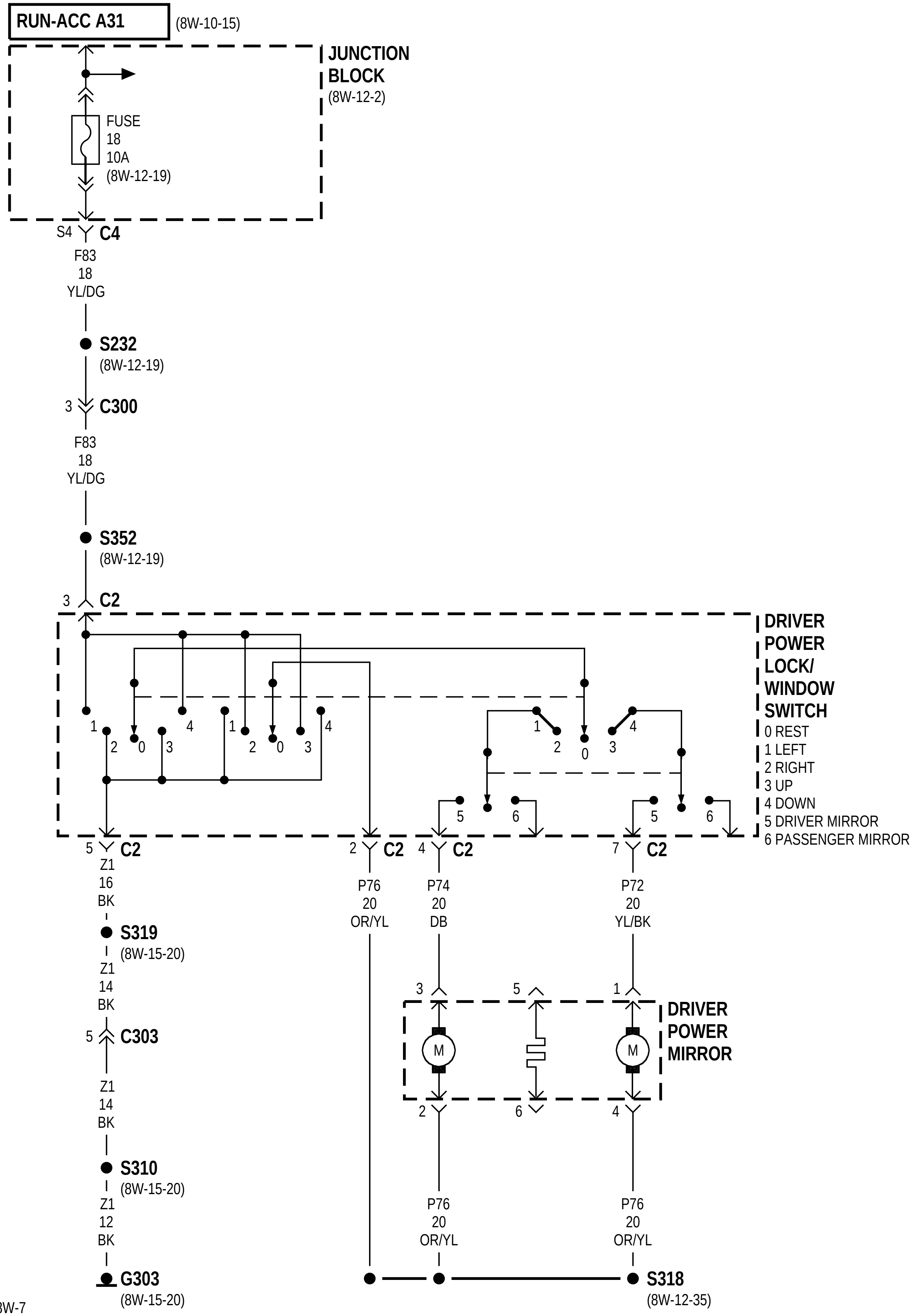
LHD FULL OPTIONS



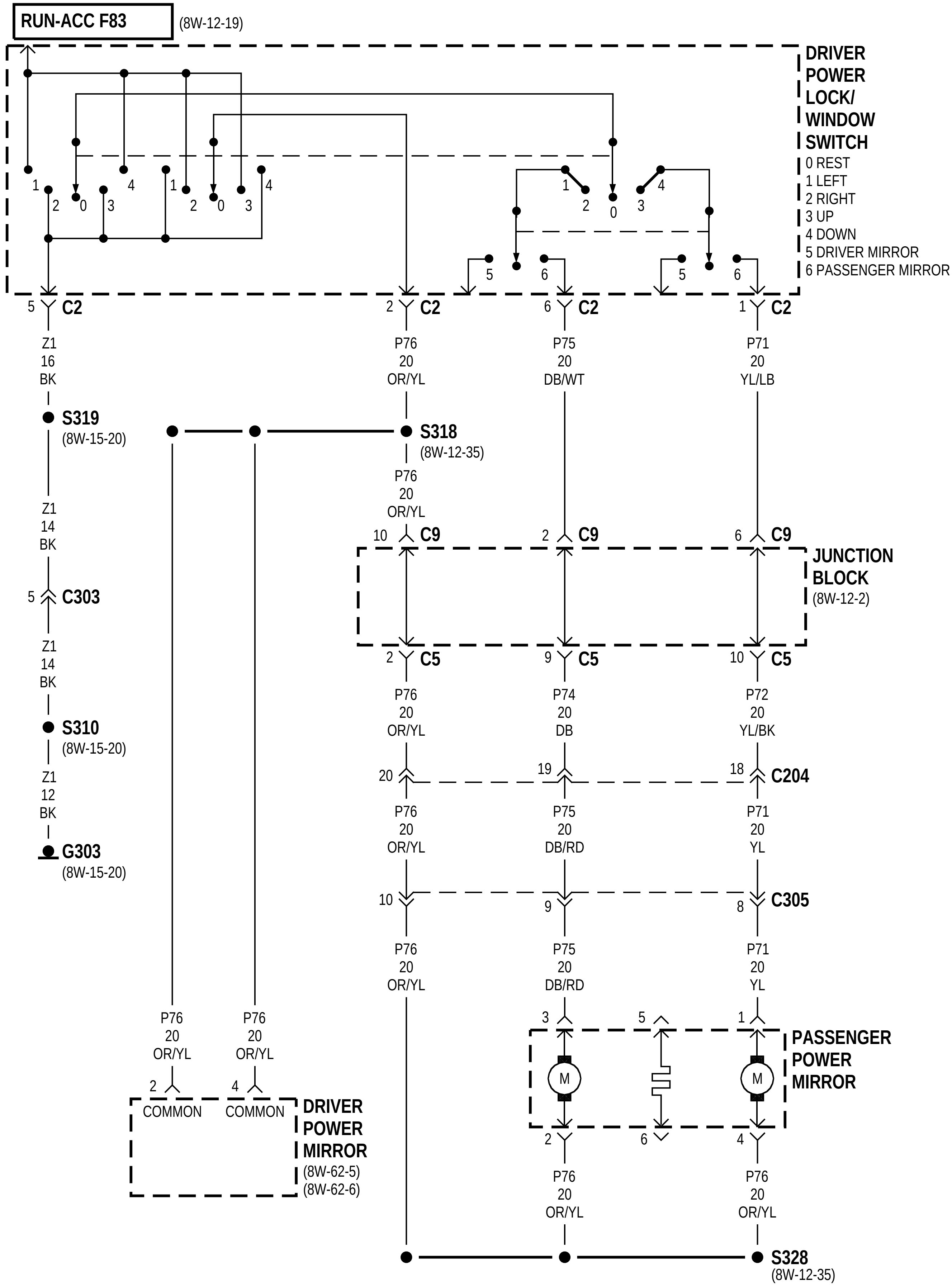
RHD GAS FULL OPTIONS



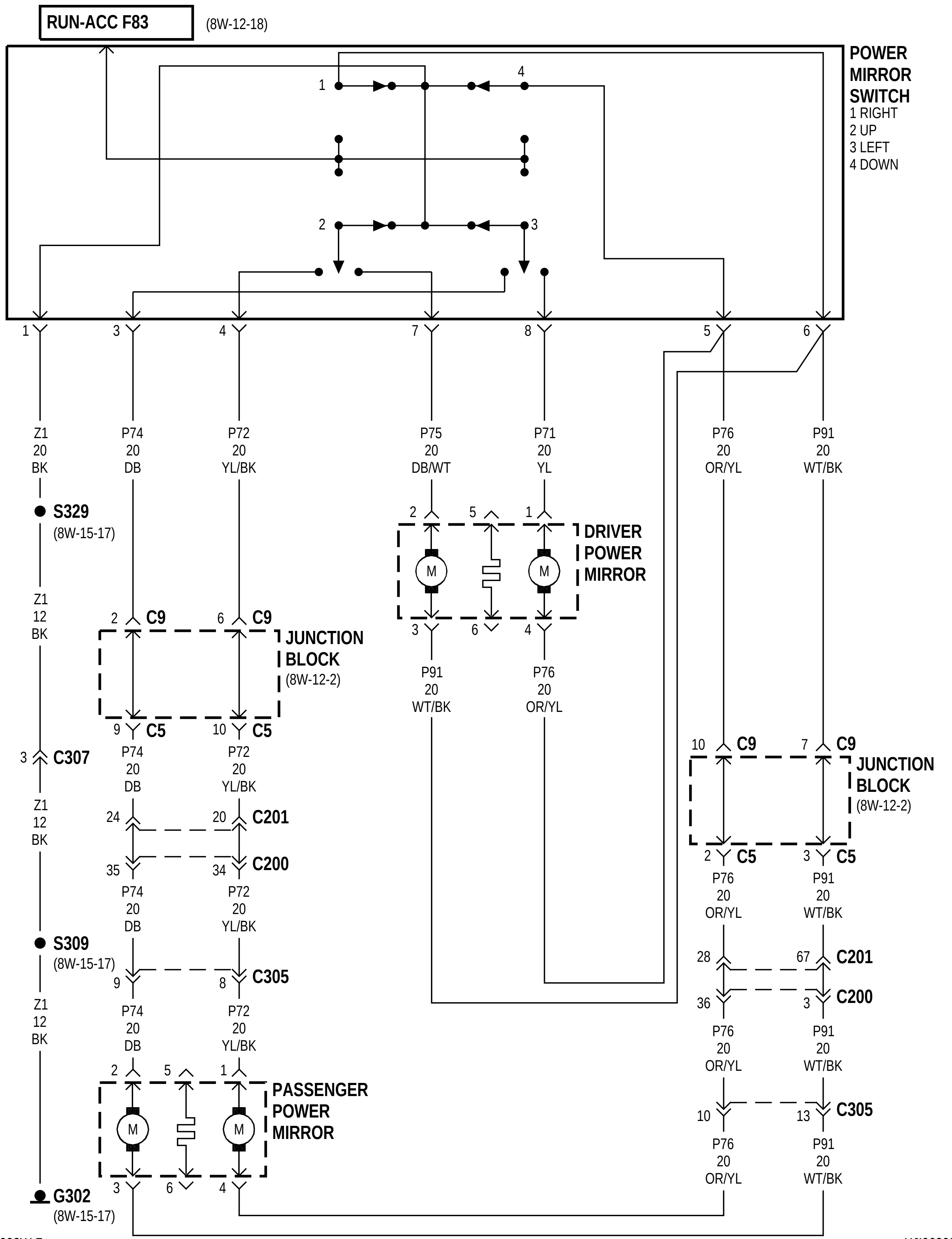
RHD DIESEL FULL OPTIONS



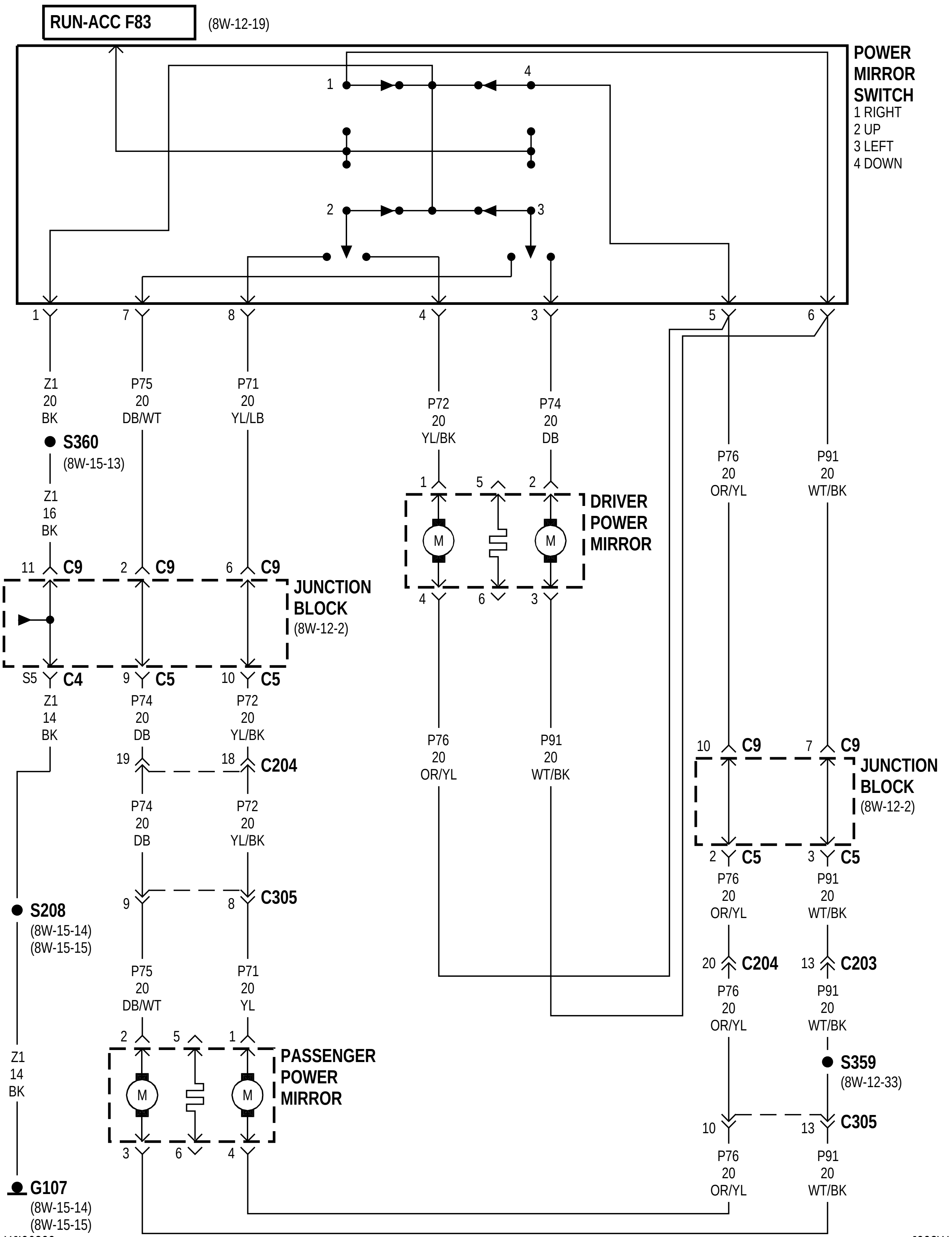
8W-62 POWER MIRRORS
RHD FULL OPTIONS



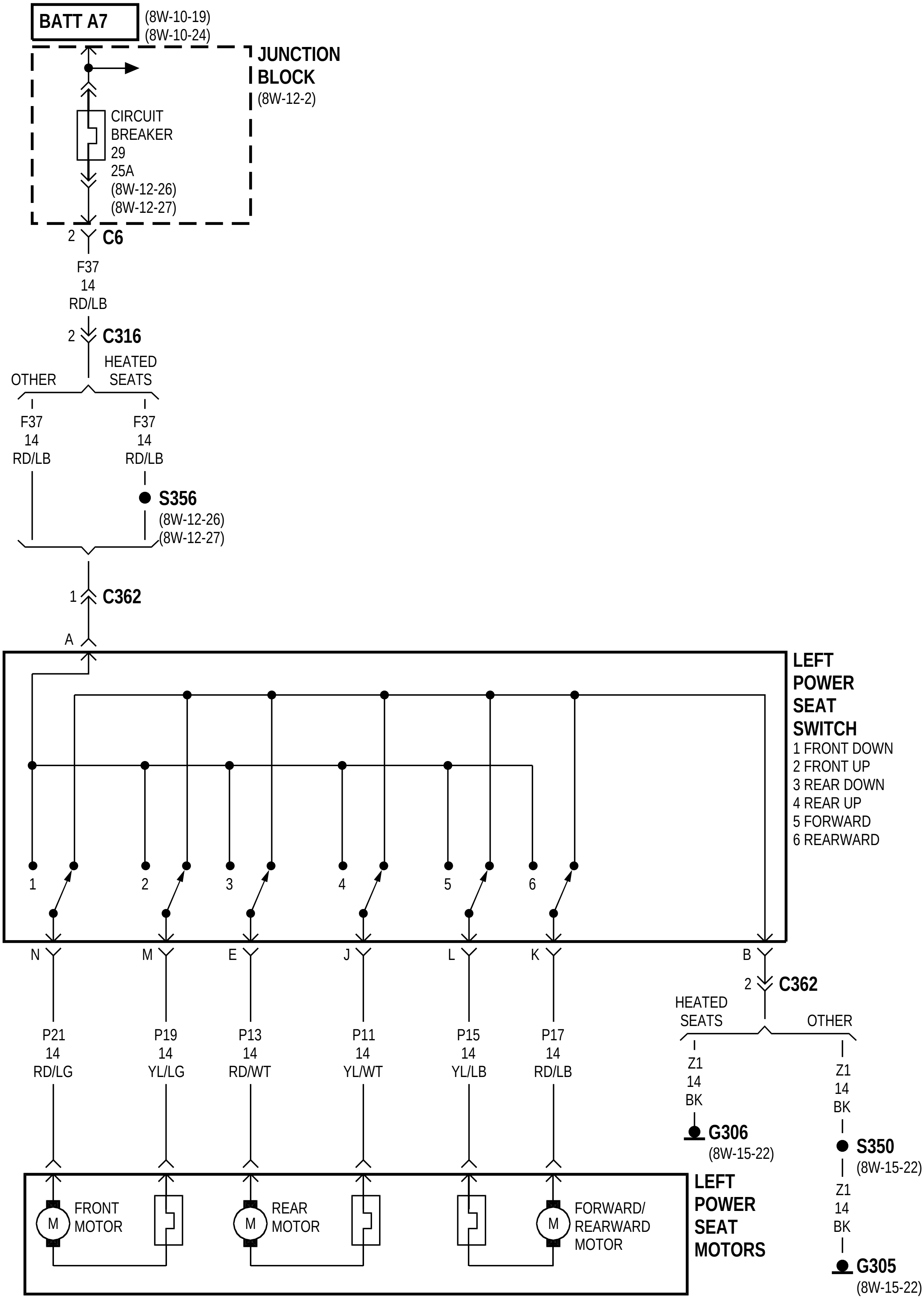
LHD EXCEPT FULL OPTIONS

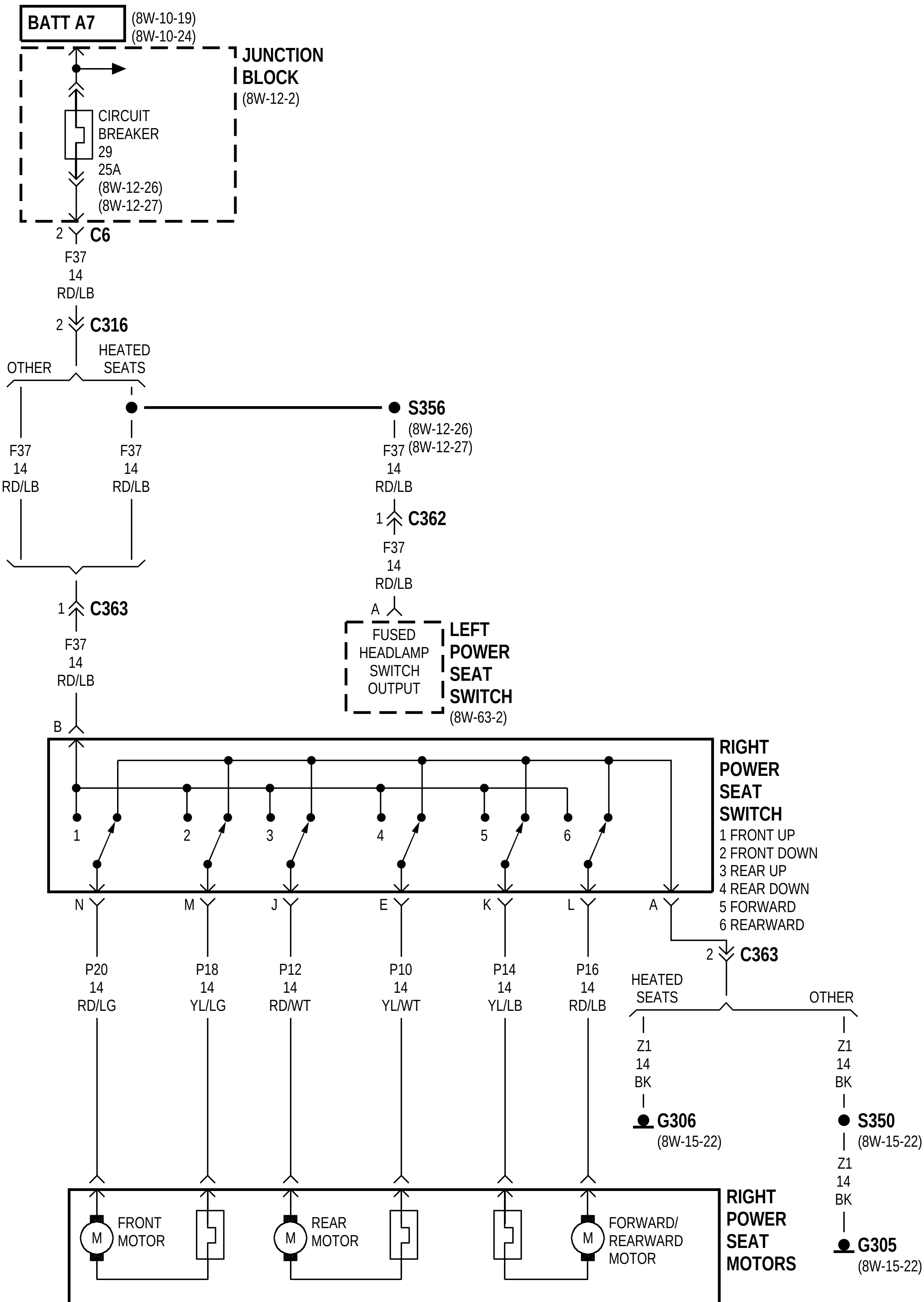


RHD EXCEPT FULL OPTIONS



8W-63 POWER SEAT


BATT A7
(8W-10-19)
(8W-10-24)
JUNCTION BLOCK
(8W-12-2)
CIRCUIT BREAKER 29 25A
(8W-12-26)
(8W-12-27)
2 C6
F37 14 RD/LB
2 C316
OTHER
HEATED SEATS
F37 14 RD/LB
F37 14 RD/LB
S356
(8W-12-26)
(8W-12-27)
1 C362
A
LEFT POWER SEAT SWITCH
1 FRONT DOWN
2 FRONT UP
3 REAR DOWN
4 REAR UP
5 FORWARD
6 REARWARD
1 2 3 4 5 6
N M E J L K B
2 C362
HEATED SEATS
OTHER
P21 14 RD/LG
P19 14 YL/LG
P13 14 RD/WT
P11 14 YL/WT
P15 14 YL/LB
P17 14 RD/LB
Z1 14 BK
G306
(8W-15-22)
Z1 14 BK
S350
(8W-15-22)
Z1 14 BK
G305
(8W-15-22)
M
FRONT MOTOR
REAR MOTOR
FORWARD/ REARWARD MOTOR
LEFT POWER SEAT MOTORS



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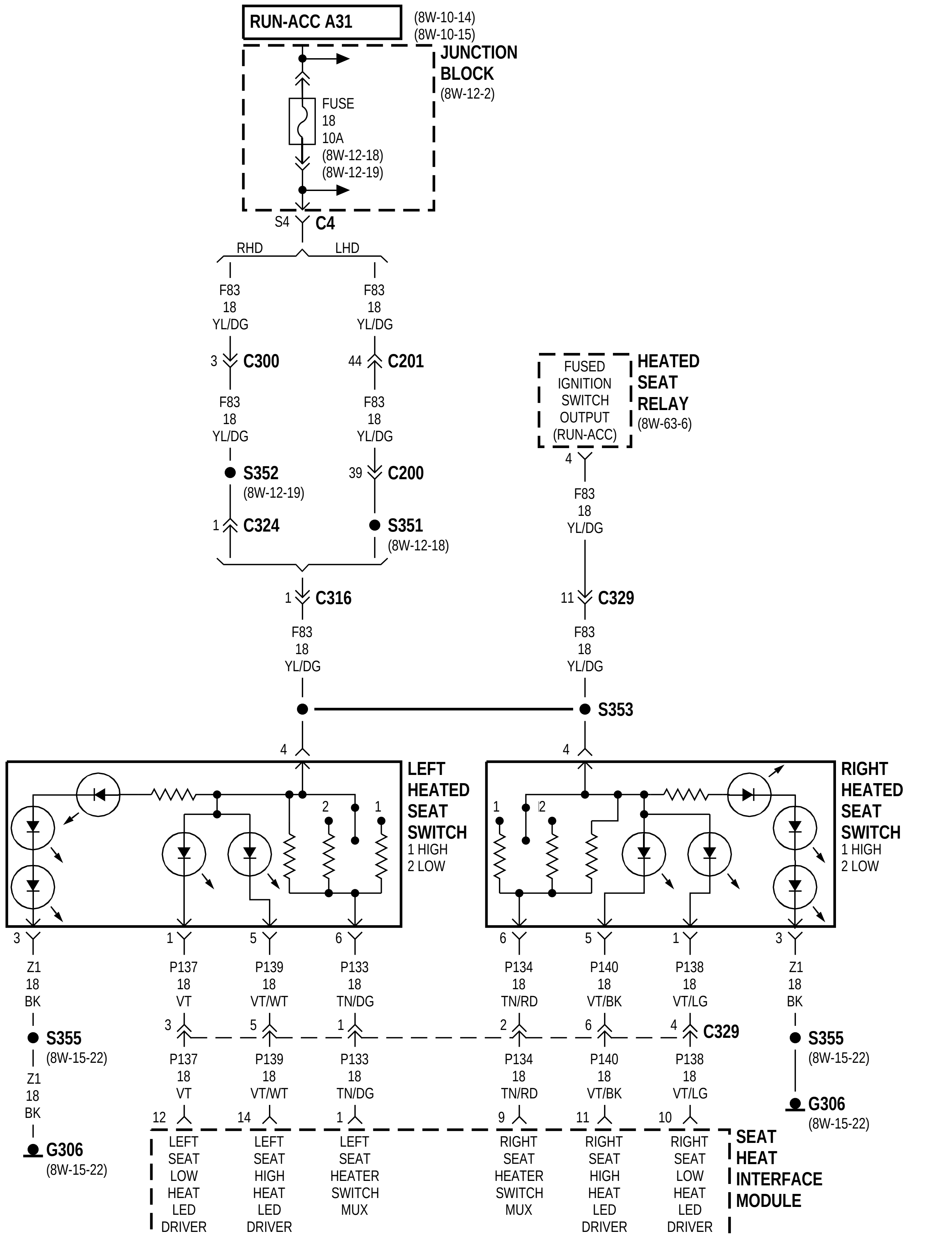

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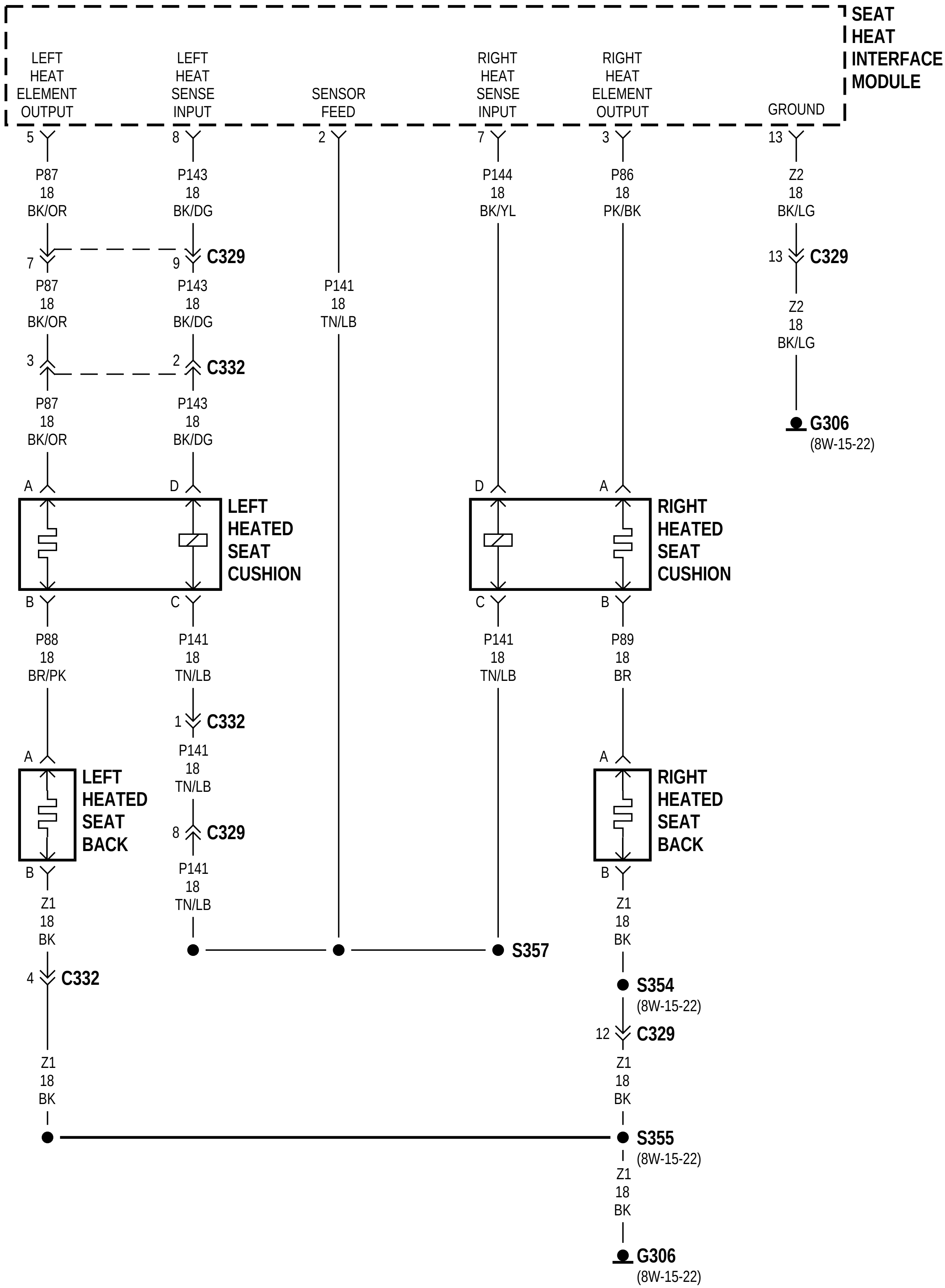
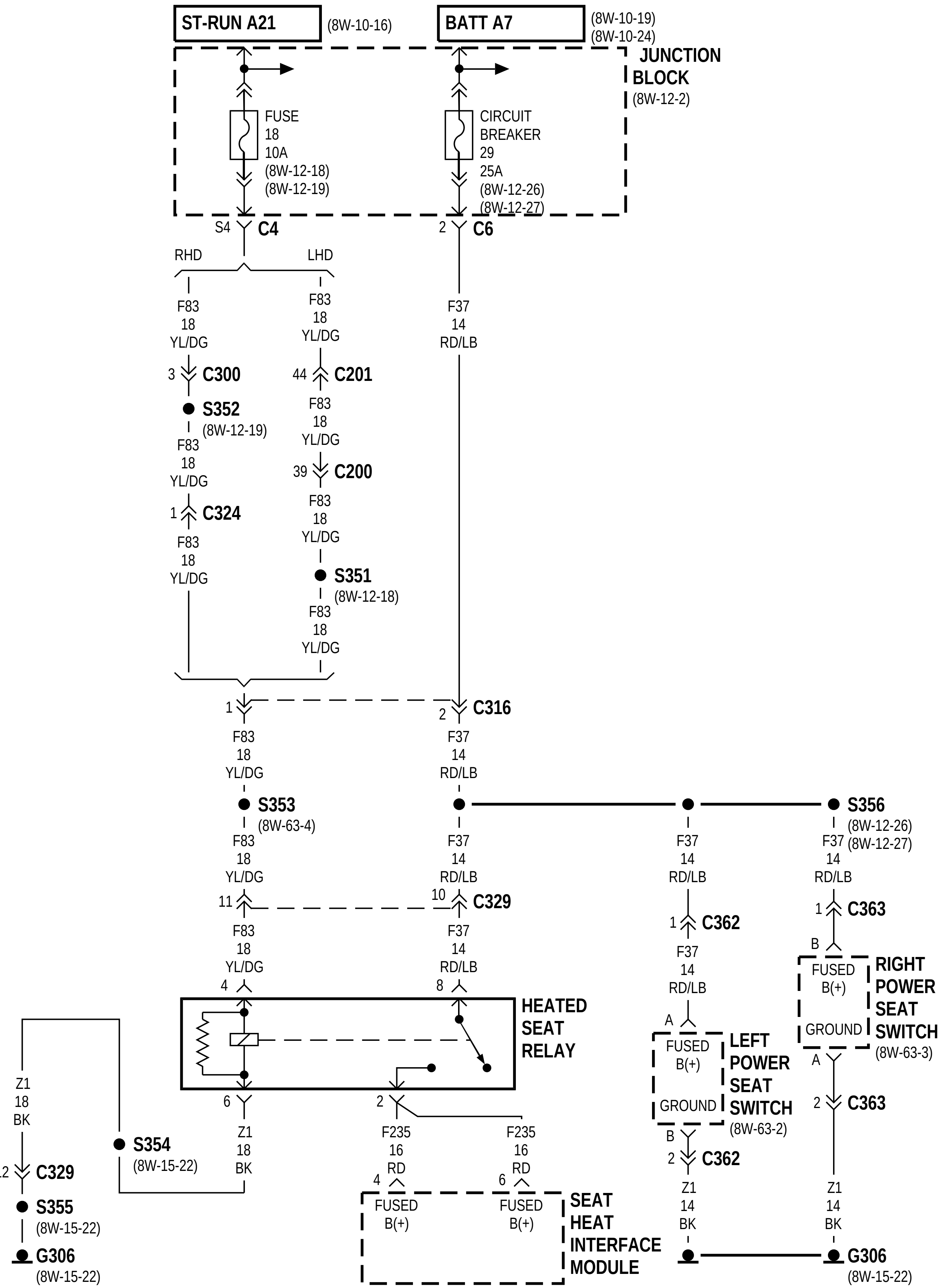
HEATED SEATS



HEATED SEATS



8W-70 SPLICE INFORMATION

Component	Page
S100	8W-50-13
S101	8W-12-23
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S103	8W-15-7, 10, 12
S104	8W-12-10
S105	8W-50-11, 12
S106	8W-10-35
S107	8W-15-2
S108	8W-30-9
S109	8W-10-29
S110	8W-10-29
S111	8W-70-2
S112	8W-30-7
S113	8W-10-30
S114	8W-70-2
S115	8W-70-4
S116	8W-50-14
S118	8W-20-2, 3
S120	8W-21-2
S130	8W-12-14, 15
S131	8W-12-20
S132	8W-15-4, 5, 6, 8, 9, 11
S133	8W-12-7
S134	8W-12-21, 22
S135	8W-10-25
S136	8W-12-15
S137	8W-10-18, 29
S138	8W-70-2, 3
S139	8W-30-16, 31
S140	8W-31-7
S141	8W-15-5, 6, 8, 11
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S143	8W-30-15
S144	8W-30-17, 18
S145	8W-30-17, 18
S146	8W-15-3
S147	8W-10-32
S148	8W-30-23
S149	8W-70-3
S150	8W-15-3
S151	8W-10-18
S152	8W-30-26
S153	8W-10-18
S156	8W-10-34
S157	8W-15-11
S158	8W-15-7, 10, 12
S159	8W-12-12, 13
S161	8W-51-5
S200	8W-10-16
S201	8W-12-30
S202	8W-12-16
S203	8W-10-32, 33
S204	8W-30-29
S205	8W-53-4, 5, 6, 7
S206	8W-12-10, 11
S207	8W-15-16
S208	8W-15-14, 15
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S210	8W-10-16
S211	8W-10-14, 15
S212	8W-52-7, 8
S213	8W-50-5, 6, 7, 8
S214	8W-10-25, 28
S215	8W-12-8, 9
S216	8W-12-12, 13
S217	8W-12-21
S218	8W-10-26, 27, 36
S219	8W-12-21, 22
S220	8W-51-11
S221	8W-33-2, 3
S222	8W-33-2, 3
S225	8W-12-12
S226	8W-50-4
S227	8W-15-16
S229	8W-47-4
S230	8W-10-35
S232	8W-12-19
S233	8W-12-7
S234	8W-50-20
S235	8W-15-10, 12
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S238	8W-30-17, 18
S239	8W-30-17, 18
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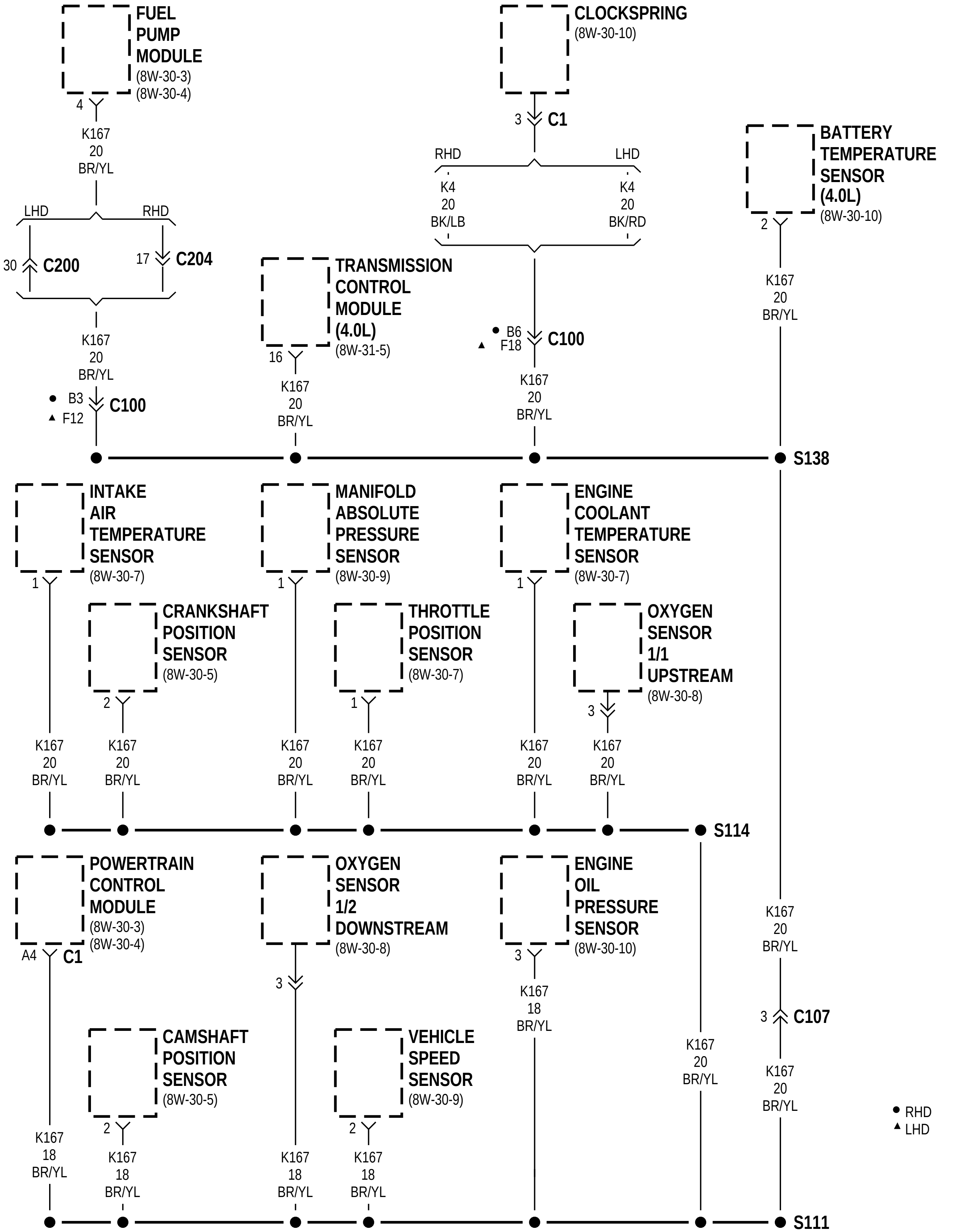
S302	8W-10-32, 33
S304	8W-12-30
S305	8W-60-2, 3
S306	8W-12-31, 32
S307	8W-12-31, 32
S308	8W-51-10, 11
S309	8W-15-17, 18
S310	8W-15-19, 20
S311	8W-12-10, 11
S312	8W-70-4
S313	8W-15-18
S314	8W-15-13
S315	8W-12-8
S316	8W-12-31
S317	8W-12-31
S318	8W-12-34, 35
S319	8W-15-13, 20
S320	8W-47-7, 8
S321	8W-47-7, 8
S322	8W-12-32
S323	8W-12-32
S325	8W-15-18
S326	8W-47-6
S327	8W-47-6
S328	8W-12-34, 35
S329	8W-15-17
S330	8W-47-5
S331	8W-47-5
S334	8W-15-21
S335	8W-54-3
S336	8W-54-3
S337	8W-15-17, 18
S338	8W-12-20
S339	8W-54-2
S340	8W-12-10, 11
S341	8W-15-17, 18
S342	8W-15-13
S344	8W-30-17, 18
S345	8W-12-30
S346	8W-30-17, 18
S347	8W-10-26, 27, 28
S348	8W-15-19, 20
S349	8W-12-22
S350	8W-15-22
S351	8W-12-18
S352	8W-12-19
S353	8W-63-4
S354	8W-15-22
S355	8W-15-22
S356	8W-12-26, 27
S357	8W-63-5
S359	8W-12-33
S360	8W-15-13
S361	8W-10-26, 27

GAS



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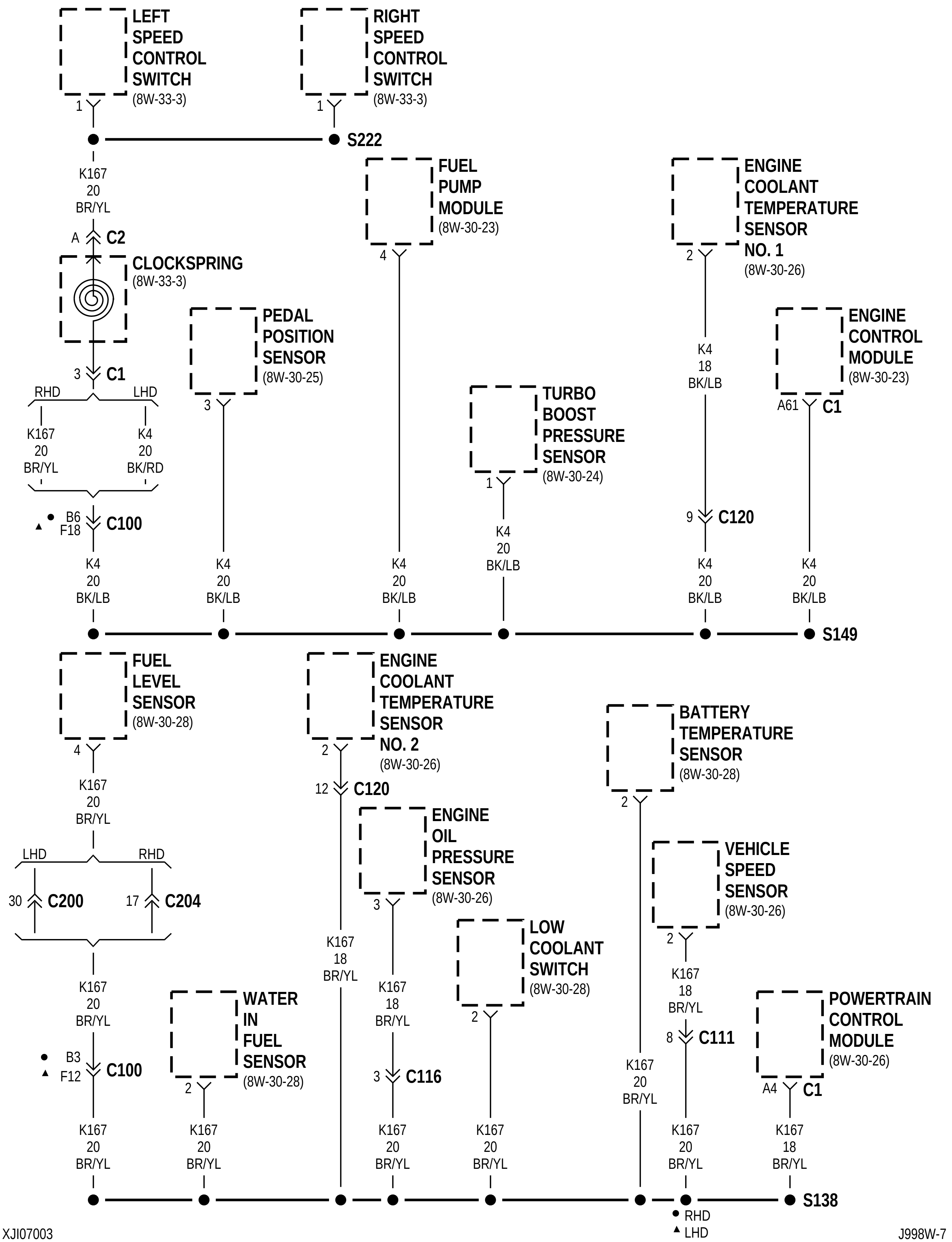
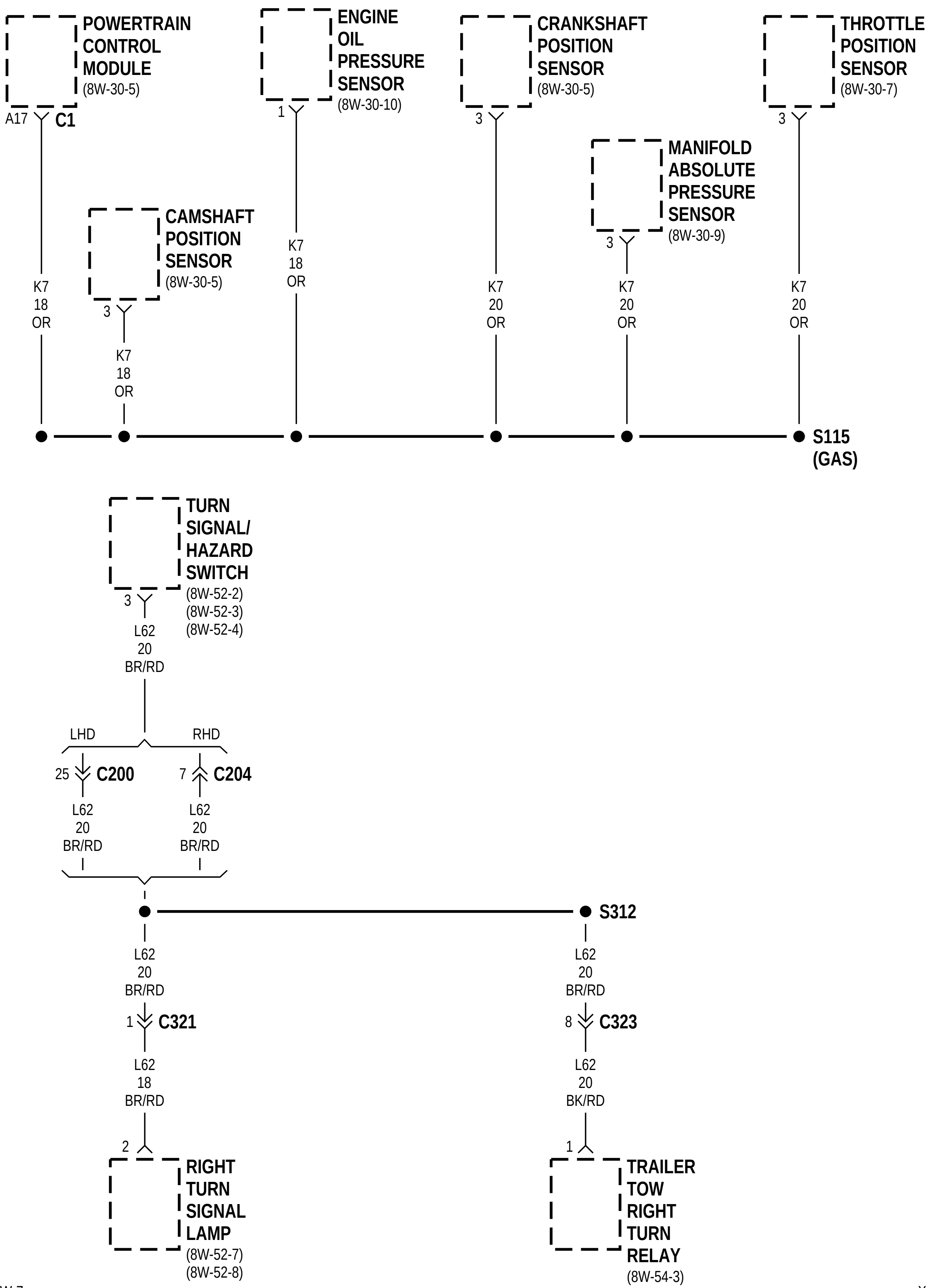
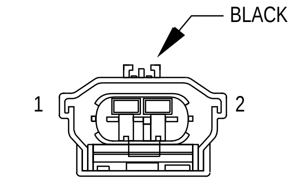
DIESEL


LEFT SPEED CONTROL SWITCH
(8W-33-3)
RIGHT SPEED CONTROL SWITCH
(8W-33-3)
S222
K167 20 BR/YL
C2
CLOCKSPRING
(8W-33-3)
C1
RHD
LHD
K167 20 BR/YL
K4 20 BK/RD
B6
F18
C100
FUEL PUMP MODULE
(8W-30-23)
ENGINE COOLANT TEMPERATURE SENSOR NO. 1
(8W-30-26)
PEDAL POSITION SENSOR
(8W-30-25)
ENGINE CONTROL MODULE
(8W-30-23)
TURBO BOOST PRESSURE SENSOR
(8W-30-24)
K4 18 BK/LB
A61
C120
K4 20 BK/LB
S149
FUEL LEVEL SENSOR
(8W-30-28)
ENGINE COOLANT TEMPERATURE SENSOR NO. 2
(8W-30-26)
BATTERY TEMPERATURE SENSOR
(8W-30-28)
K167 20 BR/YL
C200
C204
ENGINE OIL PRESSURE SENSOR
(8W-30-26)
VEHICLE SPEED SENSOR
(8W-30-26)
LOW COOLANT SWITCH
(8W-30-28)
K167 18 BR/YL
WATER IN FUEL SENSOR
(8W-30-28)
POWERTRAIN CONTROL MODULE
(8W-30-26)
B3
F12
C111
C116
A4
S138
RHD
LHD

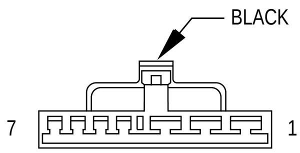

POWERTRAIN
CONTROL
MODULE
(8W-30-5)
A17
C1
ENGINE
OIL
PRESSURE
SENSOR
(8W-30-10)
1
CRANKSHAFT
POSITION
SENSOR
(8W-30-5)
3
THROTTLE
POSITION
SENSOR
(8W-30-7)
3
MANIFOLD
ABSOLUTE
PRESSURE
SENSOR
(8W-30-9)
3
CAMSHAFT
POSITION
SENSOR
(8W-30-5)
3
K7
18
OR
K7
20
OR
S115
(GAS)
TURN
SIGNAL/
HAZARD
SWITCH
(8W-52-2)
(8W-52-3)
(8W-52-4)
3
L62
20
BR/RD
LHD
RHD
25
C200
7
C204
S312
1
C321
8
C323
L62
18
BR/RD
L62
20
BK/RD
2
RIGHT
TURN
SIGNAL
LAMP
(8W-52-7)
(8W-52-8)
1
TRAILER
TOW
RIGHT
TURN
RELAY
(8W-54-3)

8W-80 CONNECTOR PIN-OUTS



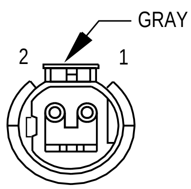
A/C COMPRESSOR CLUTCH (DIESEL)

CAV	CIRCUIT	FUNCTION
1	C3 14DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
2	Z1 16BK	GROUND



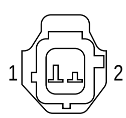
A/C-HEATER CONTROL OR HEATER CONTROL

CAV	CIRCUIT	FUNCTION
1	Z8 12BK/VT	GROUND
2	C7 12BK/TN	HIGH SPEED BLOWER MOTOR
3	C6 14LB	M2 BLOWER MOTOR DRIVER
4	C5 14LG	M1 BLOWER MOTOR DRIVER
5	C4 14TN	LOW SPEED BLOWER MOTOR DRIVER
6	C90 20LG ▲	A/C SWITCH SENSE
7	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
	E2 20OR ●	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL



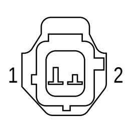
A/C HIGH PRESSURE SWITCH (DIESEL)

CAV	CIRCUIT	FUNCTION
1	C21 20DB/PK	A/C SWITCH SENSE
2	C22 20DB/WT	PRESSURE SWITCH OUTPUT



A/C HIGH PRESSURE SWITCH (GAS)

CAV	CIRCUIT	FUNCTION
1	C22 18DB/WT	A/C SWITCH SENSE
2	C21 20DB/PK	A/C SWITCH SENSE



A/C LOW PRESSURE SWITCH (DIESEL)

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	C21 20DB/PK	A/C SWITCH SENSE

▲ A/C ONLY
● RHD

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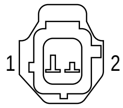
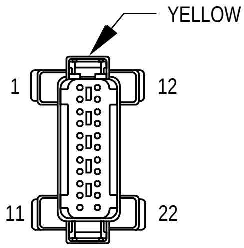


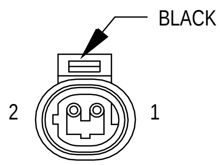
A/C LOW PRESSURE SWITCH (GAS)

CAV	CIRCUIT	FUNCTION
1	C21 20DB/PK	A/C SWITCH SENSE
2	C90 20LG	A/C SWITCH SENSE



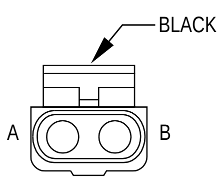
AIRBAG CONTROL MODULE

CAV	CIRCUIT	FUNCTION
1	R45 18DG/LB	DRIVER AIRBAG LINE 1
2	R43 18BK/LB	DRIVER AIRBAG LINE 2
3	-	-
4	-	-
5	R42 18BK/YL	PASSENGER AIRBAG LINE 2
6	R44 18DG/YL	PASSENGER AIRBAG LINE 1
7	-	-
8	-	-
9	-	-
10	Z6 18BK/PK ●	GROUND
10	Z6 18BK/YL ●●	GROUND
11	-	-
12	-	-
13	-	-
14	-	-
15	-	-
16	-	-
17	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
18	D2 18WT/BK	CCD BUS(-)
19	D1 18VT/BR	CCD BUS(+)
20	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN)



AMBIENT AIR TEMPERATURE SENSOR

CAV	CIRCUIT	FUNCTION
1	G31 20VT/LG	AMBIENT TEMPERATURE SENSOR SIGNAL
2	G32 20BK/LB	SENSOR GROUND



BACK-UP LAMP SWITCH (DIESEL)

CAV	CIRCUIT	FUNCTION
A	L10 18BR/LG	BACK UP LAMP FEED
B	F20 18WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)

● FULL OPTIONS
●● BASE

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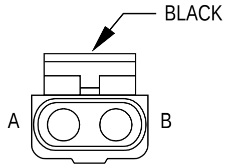
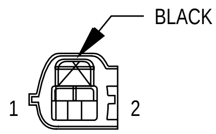


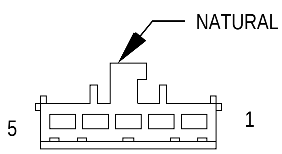
BACK-UP LAMP SWITCH (GAS)

CAV	CIRCUIT	FUNCTION
A	F20 18WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
B	L10 18BR/LG	BACK-UP LAMP FEED



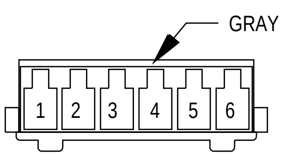
BATTERY TEMPERATURE SENSOR (4.0L, GAS DIESEL)

CAV	CIRCUIT	FUNCTION
1	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
2	K167 20BR/YL	SENSOR GROUND



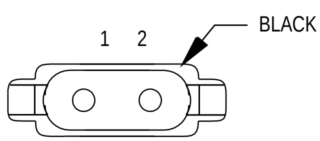
BLEND DOOR ACTUATOR

CAV	CIRCUIT	FUNCTION
1	-	-
2	Z1 20BK	GROUND
3	C36 20RD/WT ●	BLEND DOOR FEEDBACK SIGNAL
3	C36 18RD/WT ▲	BLEND DOOR FEEDBACK SIGNAL
4	F15 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
5	-	-



BRAKE LAMP SWITCH

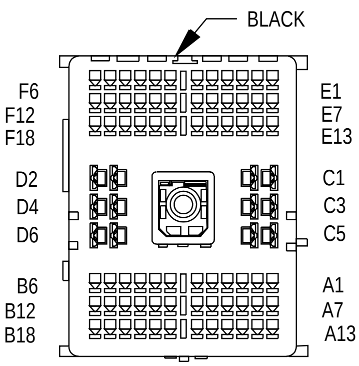
CAV	CIRCUIT	FUNCTION
1	K29 18WT/PK	BRAKE LAMP SWITCH SENSE
2	Z1 18BK	GROUND
3	V32 20YL/RD ▲	SPEED CONTROL POWER SUPPLY
3	V32 18YL/RD ●	SPEED CONTROL POWER SUPPLY
4	V30 20DB/RD	SPEED CONTROL BRAKE SWITCH OUTPUT
5	L50 20WT/TN	BRAKE LAMP SWITCH OUTPUT
6	F32 20PK/DB	FUSED B(+)



BRAKE WARNING PRESSURE SWITCH

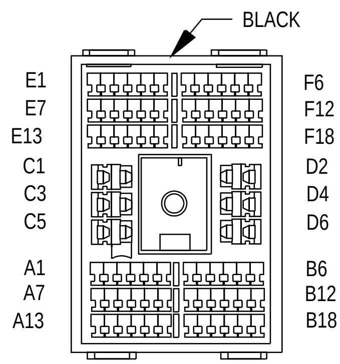
CAV	CIRCUIT	FUNCTION
1	G9 20GY/BK	RED BRAKE WARNING INDICATOR DRIVER
2	G99 20GY/WT	RED BRAKE WARNING INDICATOR DRIVER

● LHD
▲ RHD



C100 (LHD)

CAV	CIRCUIT
A1	Z1 18BK
A2	G106 20BK/WT ●
A3	G107 20BK/RD
A4	L39 20LB ▲▲
A5	L139 20VT ▲▲
A6	C90 20LG
A6	C90 18LG ■■
A7	-
A8	-
A9	-
A10	-
A11	-
A12	-
A13	-
A14	-
A15	-
A16	-
A17	-
A18	-
B1	-
B2	-
B3	-
B4	-
B5	-
B6	-
B7	-
B8	-
B9	-
B10	-
B11	-
B12	-
B13	-
B14	-
B15	-
B16	-
B17	-
B18	-
C1	V3 16BR/WT
C2	A1 12RD
C3	V4 16BR/VT
C4	F75 16VT ▲
C5	V5 16DG/YL
C6	A2 12PK/BK
D1	A3 14RD/WT
D2	A141 14DG/WT ●●
D3	L3 16RD ■
D3	G34 16RD/GY
D4	G34 16RD/GY
D5	A111 12RD/LG
D6	-



C100 (LHD)

CAV	CIRCUIT
A1	Z1 18BK
A2	G106 20BK/WT ●
A3	G107 20BK/RD
A4	L39 20LB ▲▲
A5	L139 20VT ▲▲
A6	C90 20LG
A6	C90 18LG ■■
A7	-
A8	-
A9	-
A10	-
A11	-
A12	-
A13	-
A14	-
A15	-
A16	-
A17	-
A18	-
B1	-
B2	-
B3	-
B4	-
B5	-
B6	-
B7	-
B8	-
B9	-
B10	-
B11	-
B12	-
B13	-
B14	-
B15	-
B16	-
B17	-
B18	-
C1	V3 16BR/WT
C2	A1 12RD
C3	V4 16BR/VT
C4	F75 16VT ▲
C5	V5 16DG/YL
C6	A2 12PK/BK
D1	A3 14RD/WT
D2	A141 16DG/WT ●●
D3	L3 16RD/OR
D4	G34 16RD/GY
D5	A111 12RD/LG
D6	-

(CONTINUED ON NEXT PAGE)

- ● 4.0L A/T
- ●● FUEL PUMP (GAS)
- ▲ POWER AMPLIFIER
- ▲▲ FOG LAMPS
- ■ DRL
- ■■ DIESEL 2.5L

(CONTINUED)

CAV	CIRCUIT
E1	L50 20WT/TN ●●●
E1	L50 18WT/TN ●
E2	G9 20GY/BK
E3	L10 18BR/LG
E4	V10 18BR
E5	V20 18BK/WT
E6	F34 18TN/BK
E7	Z12 20BK/TN ●●●
E7	Z12 18BK/TN
E8	G29 20BK/LB
E9	F20 18WT
E10	F1 20DB/GY ■■■
E11	D1 20VT/BR ●●
E11	D1 18VT/BR ●●●
E12	D2 20WT/BK ●●
E12	D2 18WT/BK ●●●
E13	-
E14	G99 20GY/WT
E15	K185 20OR/LB
E16	G86 18TN/OR
E17	G154 18VT/LG
E18	L13 20BR/YL ■■
F1	D20 18LG/BK
F2	D21 20PK
F2	D21 18PK ■
F3	L60 20TN
F4	L61 20LG/WT
F5	L9 20BK/PK
F6	L44 20VT/RD ■■
F7	V30 20DB/RD
F8	F32 20PK/DB
F9	V32 18YL/RD
F10	K29 18WT/PK ▲
F10	K29 20WT/PK ●●
F11	K226 18DB/LG
F12	K167 20BR/YL
F13	G19 20LG/OR ●
F14	G31 20VT/LG
F15	G32 20BK/LB
F16	K78 20GY
F17	V37 20RD/LG ●●●
F17	V37 18RD/LG ▲▲▲
F18	K4 20BK/LB ●●●
F18	K167 20BR/YL ▲▲▲

CAV	CIRCUIT
E1	L50 20WT/TN ●●●
E1	L50 18WT/TN ●
E2	G9 20GY/BK
E3	L10 18BR/LG
E4	V10 18BR
E5	V20 18BK/WT
E6	F34 18TN/BK
E7	Z12 20BK/TN ●●●
E7	Z12 18BK/TN
E8	G29 20BK/LB
E9	F20 18WT
E10	F1 20DB/GY ■■■
E11	D1 20VT/BR
E12	D2 20WT/BK
E13	-
E14	G99 20GY/WT
E15	K185 20OR/LB
E16	G86 20TN/OR
E17	G154 20VT/LG
E18	L13 20BR/YL ■■
F1	D20 20LG/BK
F2	D21 20PK
F3	L60 20TN
F4	L61 20LG/WT
F5	L9 20BK/PK
F6	L44 20VT/RD ■■
F7	V30 20DB/RD
F8	F32 20PK/DB
F9	V32 18YL/RD
F10	K29 20WT/PK
F11	K226 20DB/LG
F12	K167 20BR/YL
F13	G19 20LG/OR ●
F14	G31 20VT/LG
F15	G32 20BK/LB
F16	K78 18GY
F17	V37 20RD/LG
F18	K4 20BK/RD

● ABS
●● 4.0L A/T
●●● DIESEL
▲ EXCEPT 4.0L A/T
▲▲ SPEED CONTROL (GAS)
▲▲▲ GAS
■ 2.5L GAS
■ ■ HEADLAMP LEVELING
■ ■ ■ SENTRY KEY IMMOBILIZER MODULE

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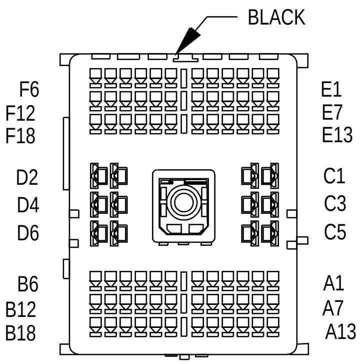
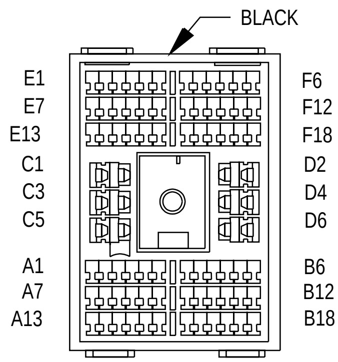


C100
(RHD)

CAV	CIRCUIT
A1	Z1 18BK
A2	G106 20BK/WT ●●
A3	G107 20BK/RD
A4	L39 20LB ●●●
A5	L139 20VT ●●●
A6	C90 18LG
A7	Z12 18BK/TN
A8	G29 20BK/LB
A9	F20 18WT
A10	G99 20GY/WT
A11	D1 18VT/BR ▼▼
A11	D1 20VT/BR ●●
A12	D2 18WT/BK ▼▼
A12	D2 20WT/BK ●●
A13	-
A14	G9 20GY/BK
A15	L10 18BR/LG
A16	V10 18BR
A17	V20 18BK/WT
A18	F34 18TN/BK
B1	K29 20WT/PK ●●
B1	K29 18WT/PK ▼▼
B2	K226 18DB/LG
B3	K167 20BR/YL
B4	L50 18WT/TN ▲
B5	V37 18RD/LG
B6	K167 20BR/YL ■
B6	K4 20BK/LB ■■
B7	D20 18LG/BK
B8	D21 18PK ▲▲
B8	D21 20PK
B9	L60 20TN
B10	L61 20LG/WT
B11	L9 20BK/PK
B12	L44 20VT/RD ▼
B13	-
B14	-
B15	-
B16	-
B17	-
B18	-
C1	V3 16BR/WT
C2	A1 12RD
C3	V4 16BR/VT
C4	F75 16VT ▲▲▲
C5	V5 16DG/YL
C6	A2 12PK/BK
D1	A3 14RD/WT
D2	A141 14DG/WT
D3	-
D4	-
D5	A111 12RD/LG
D6	-



C100
(RHD)

CAV	CIRCUIT
A1	Z1 18BK
A2	G106 20BK/WT ●●
A3	G107 20BK/RD
A4	L39 20LB ●●●
A5	L139 20VT ●●●
A6	C90 20LG
A7	Z12 18BK/TN
A8	G29 20BK/LB
A9	F20 18WT
A10	G99 20GY/WT
A11	D1 20VT/BR
A12	D2 20WT/BK
A13	-
A14	G9 20GY/BK
A15	L10 18BR/LG
A16	V10 18BR
A17	V20 18BK/WT
A18	F34 18TN/BK
B1	K29 18WT/PK
B2	K226 20DB/LG
B3	K167 20BR/YL
B4	L50 20WT/TN ▲
B5	V37 20RD/LG
B6	K4 20BK/LB ■
B6	K167 20BR/YL ■■
B7	D20 20LG/BK
B8	D21 20PK
B9	L60 20TN
B10	L61 20LG/WT
B11	L9 20BK/PK
B12	L44 20VT/RD ▼
B13	-
B14	-
B15	-
B16	-
B17	-
B18	-
C1	V3 16BR/WT
C2	A1 12RD
C3	V4 16BR/VT
C4	F75 16VT ▲▲▲
C5	V5 16DG/YL
C6	A2 12PK/BK
D1	A3 14RD/WT
D2	A141 16DG/WT
D3	-
D4	-
D5	A111 12RD/LG
D6	-

(CONTINUED ON NEXT PAGE)

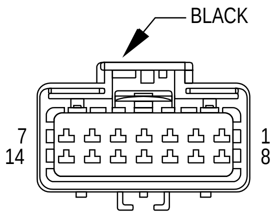
■ GAS
■■ DIESEL
▲ ABS
▲▲ 2.5L
▲▲▲ POWER AMP
● DRL
●● 4.0L A/T
●●● FOG LAMPS
▼ HEADLAMP LEVELING
▼▼ EXCEPT 4.0L A/T

(CONTINUED)

CAV	CIRCUIT
E1	-
E2	-
E3	-
E4	-
E5	-
E6	-
E7	F45 20YL/RD
E8	T141 20YL
E9	-
E10	F1 20DB/GY ●●
E11	-
E12	-
E13	-
E14	-
E15	K185 20OR/LB ■
E16	G86 18TN/OR ■
E17	G154 18VT/LG ■
E18	L13 20BR/YL ▲
F1	D20 18LG/BK
F2	-
F3	-
F4	-
F5	-
F6	-
F7	V30 20DB/RD
F8	F32 20PK/DB
F9	V32 18YL/RD
F10	-
F11	-
F12	-
F13	G19 20LG/OR ●
F14	G31 20VT/LG
F15	G32 20BK/LB
F16	-
F17	-
F18	-

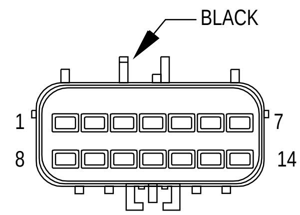
CAV	CIRCUIT
E1	-
E2	-
E3	-
E4	-
E5	-
E6	-
E7	F45 20YL/RD
E8	T141 20YL
E9	-
E10	F1 20DB/GY ●●
E11	-
E12	-
E13	-
E14	-
E15	K185 20OR/LB ■
E16	G86 20TN/OR ■
E17	G154 20VT/LG ■
E18	L13 20BR/YL ▲
F1	-
F2	-
F3	-
F4	-
F5	-
F6	-
F7	V30 20DB/RD
F8	F32 20PK/DB
F9	V32 20YL/RD
F10	-
F11	-
F12	-
F13	G19 20LG/OR
F14	G31 20VT/LG
F15	G32 20BK/LB
F16	-
F17	-
F18	-

● ABS
●● SENTRY KEY IMMOBILIZER MODULE
■ TELL TALE MODULE
▲ HEADLAMP LEVELING



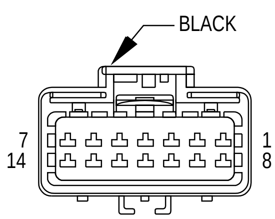
C106
(DIESEL)

CAV	CIRCUIT
1	L13 18BR/YL ▲
2	L33 20RD
3	L61 20LG
4	Z1 20BK
5	Z15 16BK/GY ▲
6	L34 20RD/OR
7	L77 20BR
8	L39 20LB ●
9	L43 20VT
10	L60 20TN
11	Z1 20BK/WT
12	L33 20BK
12	Z1 20BK/YL ●
13	L44 20VT/RD
14	L78 18DG/YL



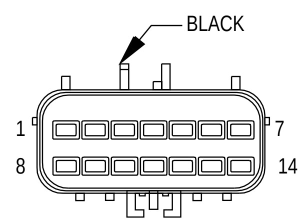
C106
(DIESEL)

CAV	CIRCUIT
1	L13 18BR/YL ▲
2	L33 18RD
3	L61 20LG
4	Z1 18BK
5	Z15 18BK/GY ▲
6	L34 18RD/OR
7	L77 20BR
8	L39 20LB ●
9	L43 18VT
10	L60 20TN
11	Z1 18BK
12	L33 20BK
12	Z1 20BK ●
13	L44 18VT/RD
14	L78 20DG/YL



C106
(GAS)

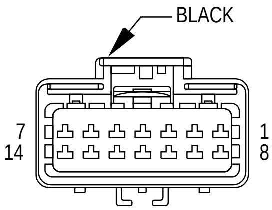
CAV	CIRCUIT
1	L13 20BR/YL ▲
2	L33 20RD
3	L61 20LG/WT
4	Z1 20BK
5	Z15 16BK/GY ▲
6	L34 20RD/OR
7	L77 20BR/YL
8	L39 20LB ▼
9	L43 20VT
10	L60 20TN
11	Z1 20BK/WT
12	L35 20BR/WT
13	L44 20VT/RD
14	L78 20DG/YL



C106
(GAS)

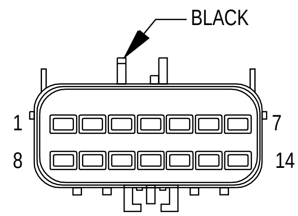
CAV	CIRCUIT
1	L13 18BR/YL ▲
2	L33 18RD
3	L61 20LG
4	Z1 18BK
5	Z15 18BK/GY ▲
6	L34 18RD/OR
7	L77 20BR
8	L39 20LB ▼
9	L43 18VT
10	L60 20TN
11	Z1 18BK
12	L33 20RD ■
12	Z1 20BK ●
13	L44 18VT/RD
14	L78 20DG/YL

▼ FOG LAMPS
■ FOG LAMPS EXCEPT BUILT-UP-EXPORT
● FOG LAMPS BUILT-UP-EXPORT
▲ HEADLAMP LEVELING



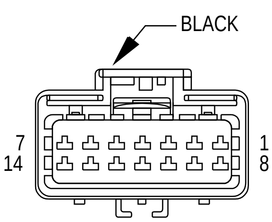
C107
(LHD 2.5L GAS)

CAV	CIRCUIT
1	A142 18DG/OR
2	K20 18DG
3	K167 20BR/YL
4	G7 20WT/OR ■■
5	T41 20BK/WT
6	-
7	F142 20DG/WT
8	G107 20BK/RD
9	-
10	F12 18DB/WT
11	F20 18WT ●●
12	L10 18BR/LG ●●
13	-
14	A61 16DG/BK



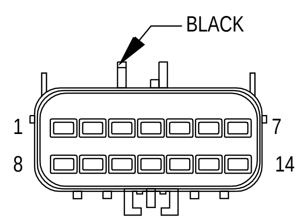
C107
(LHD 2.5L GAS)

CAV	CIRCUIT
1	A142 18DG/OR
2	K20 18DG
3	K167 20BR/YL
4	G7 20WT/OR ■■
5	Z1 20 BK ●●
5	T41 20BK/WT
6	-
7	F142 20DG/WT
8	G107 20BK/RD
9	-
10	F12 18DB/WT
11	F20 18WT ●●
12	L10 18BR/LG ●●
13	-
14	A61 16DG/BK



C107
(LHD 4.0L GAS)

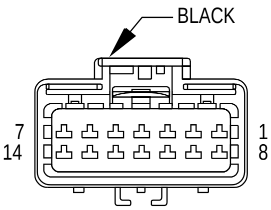
CAV	CIRCUIT
1	A142 18DG/OR
2	K20 18DG
3	K167 20BR/YL
4	G7 20WT/OR ■■
5	T41 20BK/WT ●
6	K22 20OR/DB ▲
7	F142 20DG/WT
8	G107 20BK/RD ◄►
9	Z12 18BK/TN ▲
10	F12 18DB/WT
11	K78 18GY ▲▲
11	F20 18WT ●●
12	L10 18BR/LG
13	G106 20BK/WT ◄►
14	A61 16DG/BK



C107
(LHD 4.0L GAS)

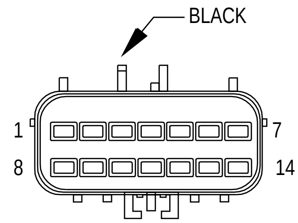
CAV	CIRCUIT
1	A142 18DG/OR
2	K20 18DG
3	K167 20BR/YL
4	G7 20WT/OR ■■
5	T41 18BK/WT ●
6	K22 20OR/DB
7	F142 20DG/WT
8	G107 20BK/RD ◄►
9	Z12 16BK/TN
10	F12 18DB/WT
11	K78 18GY ▲▲
11	F20 18WT ●●
12	L10 18BR/LG
13	G106 20BK/WT ◄►
14	A61 16DG/BK

▲ 4.0L A/T
◄► 4WD
● A/T
●● M/T
▲▲ EXTENDED IDLE
■ EXCEPT 4.0L M/T 2WD
■■ DRL



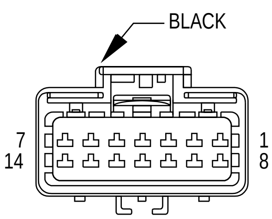
C107
(RHD 2.5L GAS)

CAV	CIRCUIT
1	A142 18DG/OR
2	K20 18DG
3	K167 20BR/YL
4	G7 20WT/OR
5	T41 20BK/WT
6	-
7	F142 20DG/WT
8	G107 20BK/RD
9	-
10	F12 18DB/WT
11	F20 18WT ●●
12	L10 18BR/LG
13	-
14	A61 16DG/BK



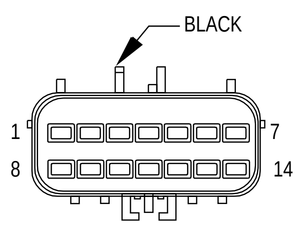
C107
(RHD 2.5L GAS)

CAV	CIRCUIT
1	A142 18DG/OR
2	K20 18DG
3	K167 20BR/YL
4	G7 20WT/OR ■■
5	Z1 20 BK ●●
5	T41 18BK/WT ●
6	-
7	F142 20DG/WT
8	G107 20BK/RD
9	-
10	F12 18DB/WT
11	F20 18WT ●●
12	L10 18BR/LG
13	-
14	A61 16DG/BK



C107
(RHD 4.0L GAS)

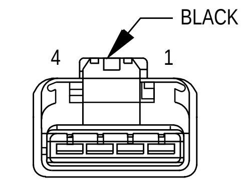
CAV	CIRCUIT
1	A142 18DG/OR
2	K20 18DG
3	K167 20BR/YL
4	G7 20WT/OR
5	T41 18BK/WT ●
6	K22 20OR/DB ■
7	F142 20DG/WT
8	G107 20BK/RD ■■
9	Z12 18BK/TN ■
10	F12 18DB/WT
11	K78 18GY ●
11	F20 18WT ●●
12	L10 18BR/LG ●●
13	G106 20BK/WT ■■
14	A61 16DG/BK



C107
(RHD 4.0L GAS)

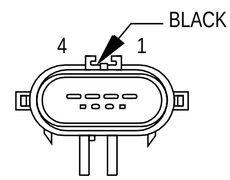
CAV	CIRCUIT
1	A142 18DG/OR
2	K20 18DG
3	K167 20BR/YL
4	G7 20WT/OR
5	T41 20BK/WT ●
6	K22 20OR/DB
7	F142 20DG/WT
8	G107 20BK/RD ■■
9	Z12 16BK/TN ■
10	F12 18DB/WT
11	K78 18GY ●
11	F20 18WT ●●
12	L10 18BR/LG ●●
13	G106 20BK/WT ■■
14	A61 16DG/BK

● A/T
●● M/T
■■ 4WD
■ 4.0L GAS (EXCEPT M/T 2WD)



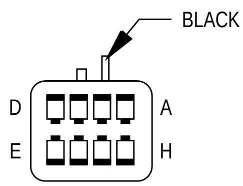
C108

CAV	CIRCUIT
1	T40 16BR
2	K72 18DG/OR
3	K20 18DG
4	C3 16DB/BK



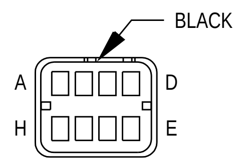
C108

CAV	CIRCUIT
1	T40 16BR
2	K72 16DG/OR
3	K20 18DG
4	C3 16DB/BK



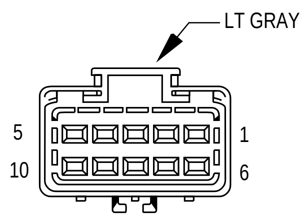
C109

CAV	CIRCUIT
A	B41 18YL/VT
B	B42 18TN/WT
C	B43 18PK/OR
D	B1 18YL/DB
E	B2 18YL
F	B3 18LG/DB
G	B4 18LG



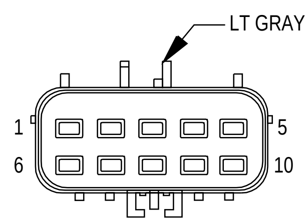
C109

CAV	CIRCUIT
A	B41 20YL/VT
B	B42 20TN/WT
C	B43 20PK/OR
D	B1 18YL/DB
E	B2 18YL
F	B3 18LG/DB
G	B4 18LG



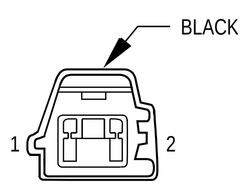
C111
(DIESEL)

CAV	CIRCUIT
1	G7 20WT/OR
2	-
3	G107 20BK/RD
4	Z1 18BK
5	L10 18BR/LG
6	K7 20OR
7	F20 18WT
8	K167 20BR/YL
9	-
10	T40 16BR



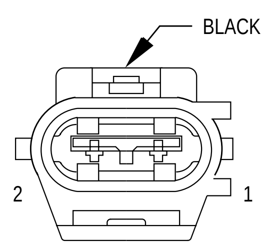
C111
(DIESEL)

CAV	CIRCUIT
1	G7 18WT/OR
2	-
3	G107 20BK/RD
4	Z1 20BK
5	L10 18BR/LG
6	K7 18OR
7	F20 18WT
8	K167 18BR/YL
9	-
10	T40 14BR



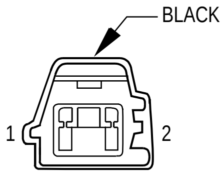
C114
(BUILT-UP-EXPORT)

CAV	CIRCUIT
1	L61 18LG
2	Z1 18BK



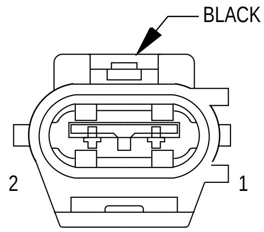
C114
(BUILT-UP-EXPORT)

CAV	CIRCUIT
1	L61 18LG
2	Z1 18BK



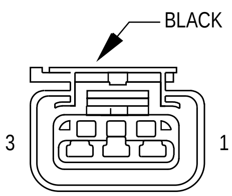
C115
(BUILT-UP-EXPORT)

CAV	CIRCUIT
1	L60 18TN
2	Z1 18BK



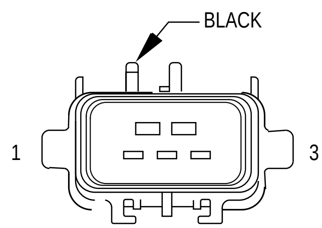
C115
(BUILT-UP-EXPORT)

CAV	CIRCUIT
1	L60 18GY
2	Z1 18BK



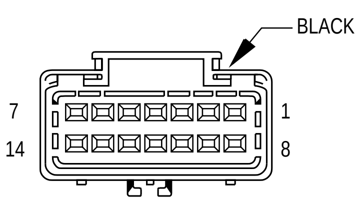
C116
(DIESEL)

CAV	CIRCUIT
1	K7 20OR
2	G60 18GY/YL
3	K167 20BR/YL



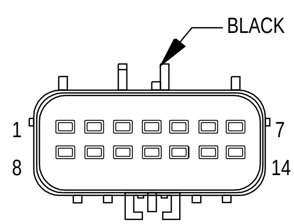
C116
(DIESEL)

CAV	CIRCUIT
1	K7 18OR
2	G60 18GY/YL
3	K167 18BR/YL



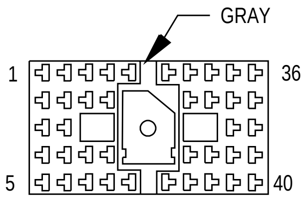
C120
(DIESEL)

CAV	CIRCUIT
1	K3 20LG/BK
2	C21 20DB/PK
3	C22 20DB/WT
4	K24 20GY/BK
5	K20 18DG
6	C3 16DB/BK
7	K72 18DG/OR
8	K2 20TN/BK
9	K4 20BK/LB
10	K222 18TN/RD
11	Z1 16BK
12	K167 18BR/YL
13	-
14	-



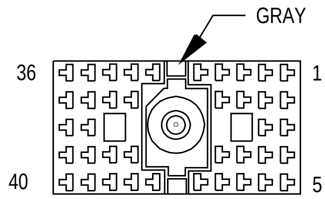
C120
(DIESEL)

CAV	CIRCUIT
1	K3 20LG/BK
2	C21 20DB/PK
3	C22 20DB/WT
4	K24 20GY/BK
5	K20 18DG
6	C3 14DB/BK
7	K72 18DG/OR
8	K2 18TN/BK
9	K4 18BK/LB
10	K222 18TN/RD
11	Z1 16BK
12	K167 18BR/YL
13	-
14	-



C200 (LHD)

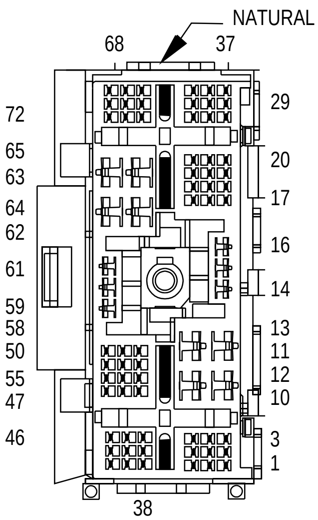
CAV	CIRCUIT
1	X53 18DG
2	X55 18BR/RD
3	P91 20WT/BK
4	X54 18VT
5	X56 18DB/RD
6	X51 18BR/YL
7	X57 18BR/LB
8	-
9	X52 18DB/WT
10	X58 18DB/OR
11	X60 18DG/RD ●
12	-
13	A141 16DG/WT
14	F75 14VT ●
15	K226 20DB/LG
16	L10 18BR/LG
17	G16 20BK/LB
18	-
19	-
20	-
21	-
22	-
23	L38 18BR/WT
24	L50 20WT/TN
25	L62 20BR/RD
26	L63 20DG/RD
27	V13 18BR
28	V20 18BK/WT
29	V23 18BR/PK
30	K167 20BR/YL
31	P35 20OR/VT ●●
32	P36 20PK/VT ●●
33	F81 12TN ●●
34	P72 20YL/BK
35	P74 20DB
36	P76 20OR/YL
37	C16 20LB/YL
38	-
39	F83 18YL/DG
40	G78 20TN/BK



C200 (LHD)

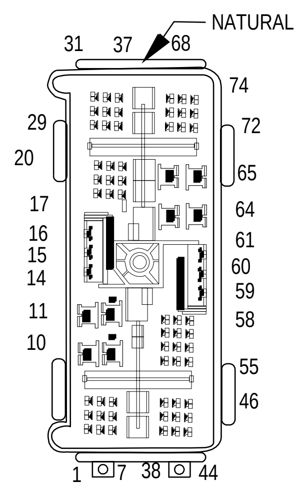
CAV	CIRCUIT
1	X53 16DG
2	X55 16BR/RD
3	P91 20WT/BK
4	X54 16VT
5	X56 16DB/RD
6	X51 16BR/YL
7	X57 16BR/LB
8	-
9	X52 16DB/WT
10	X58 16DB/OR
11	X60 16DG/RD ●
12	-
13	A141 16DG/WT
14	F75 16VT ●
15	K226 20DB/LG
16	L10 18BR/LG
17	G16 20BK/LB
18	-
19	-
20	-
21	-
22	-
23	L38 18BR/WT ▲
24	L50 20WT/TN
25	L62 20BR/RD
26	L63 20DG/RD
27	V13 18BR/LG
28	V20 18BK/WT
29	V23 18BR/PK
30	K167 20BR/YL
31	P35 20OR/VT ●●
32	P36 20PK/VT ●●
33	F81 12TN ●●
34	P72 20YL/BK
35	P74 20DB
36	P76 20OR/YL
37	C16 20LB/YL
38	-
39	F83 18YL/DG
	F83 18YL/DG ▲
40	G78 20TN/BK

● FULL OPTIONS (WITH POWER AMPLIFIER)
●● FULL OPTIONS
▲ BUILT-UP-EXPORT



C201
(LHD)

CAV	CIRCUIT
1	F20 18WT
2	C16 20LB/YL
3	L5 20BK
4	C36 20RD/WT
5	F87 20WT/BK
6	M1 20PK
7	Z1 20BK
8	V6 16DB
9	P36 20PK/VT
10	A31 12BK/WT
11	A111 12RD/LG
12	C7 12BK/TN
13	F81 12TN
14	Z1 14BK
15	-
16	L3 16RD/OR
17	C81 20LB/WT
18	-
19	-
20	P72 20YL/BK
21	-
22	L4 16VT/WT
23	P35 20OR/VT
24	P74 20DB
25	Z8 20BK/VT
26	X3 20BK/RD
27	-
28	P76 20OR/YL
29	G26 20LB
30	-
31	-
32	G31 20VT/LG
33	-
34	-
35	G32 20BK/LB
36	-
37	-
38	-
39	V23 18BR/PK
40	F15 20DB/WT
41	-
42	E1 20TN
43	E2 20OR



C201
(LHD)

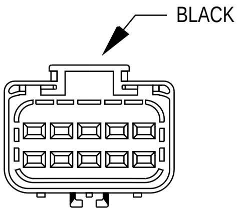
CAV	CIRCUIT
1	F20 18WT
2	C16 20LB/YL
3	L5 20BK
4	C36 20RD/WT
5	F87 20WT/BK
6	M1 20PK
7	Z1 20BK
8	V6 16DB
9	P36 20PK/VT
10	A31 12BK/WT
11	A111 12RD/LG
12	C7 12BK/TN
13	F81 12TN
14	Z1 14BK
15	-
16	L3 16RD/OR
17	C81 20LB/WT
18	-
19	-
20	P72 20YL/BK
21	-
22	L4 16VT/WT
23	P35 20OR/VT
24	P74 20DB
25	Z8 16BK/VT
26	X3 20BK/RD
27	-
28	P76 20OR/YL
29	G26 20LB
30	-
31	-
32	G31 20VT/LG
33	-
34	-
35	G32 20BK/LB
36	-
37	-
38	-
39	V23 18BR/PK
40	F15 20DB/WT
41	-
42	E1 20TN
43	E2 20OR

(CONTINUED)

(CONTINUED)

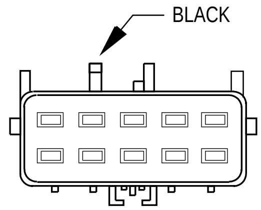
CAV	CIRCUIT
44	F83 18YL/DG
45	L7 18BK/YL
46	M2 20YL
47	-
48	-
49	-
50	F30 16RD
51	D1 18VT/BR
52	D2 18WT/BK
53	-
54	X12 16RD/WT
55	D1 20VT/BR
56	D2 20WT/BK
57	-
58	Z2 20BK/LG
59	C4 14TN
60	C5 14LG
61	C6 14LB
62	A22 12BK/OR
63	A41 14YL
64	A21 12DB
65	F38 16RD/LB
66	G9 20GY/BK
67	P91 20WT/BK
68	-
69	G10 20LG/RD
70	-
71	-
72	-
73	-
74	-

CAV	CIRCUIT
44	F83 18YL/DG
45	L7 18BK/YL
46	M2 20YL
47	-
48	-
49	-
50	F30 16RD
51	D1 20VT/BR
52	D2 20WT/BK
53	-
54	X12 16RD/WT
55	D1 20VT/BR
56	D2 20WT/BK
57	-
58	Z2 20BK/LG
59	C4 14TN
60	C5 14LG
61	C6 14LB
62	A22 12BK/OR
63	A41 14YL
64	A21 12DB
65	F38 16RD/LB
66	G9 20GY/BK
67	P91 20WT/BK
68	-
69	G10 20LG/RD
70	-
71	-
72	-
73	-
74	-



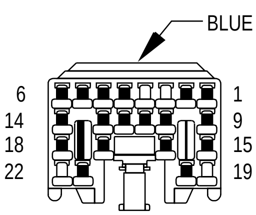
C202
(RHD)

CAV	CIRCUIT
1	C7 12BK/TN
2	-
3	F81 12TN ●
4	-
5	-
6	Z8 12BK/VT ●
6	Z8 12BK/PK ●●
7	A111 12RD/LG
8	C6 14LB
9	C5 14LG
10	C4 14TN



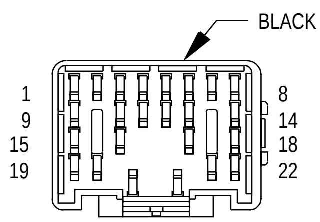
C202
(RHD)

CAV	CIRCUIT
1	C7 12BK/TN
2	-
3	F81 12TN ●
4	-
5	-
6	Z8 16BK/VT
7	A111 12RD/LG
8	C6 14LB
9	C5 14LG
10	C4 14TN



C203
(RHD)

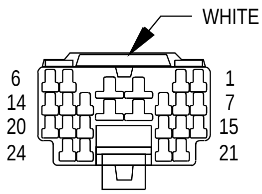
CAV	CIRCUIT
1	X51 16BR/YL
2	X52 16DB/WT
3	X53 16DG
4	X54 16VT
5	X55 16BR/RD
6	X56 16DB/RD
7	X57 16BR/LB
8	X58 16DB/OR
9	X60 16DG/RD ■
10	G9 20GY/BK
11	E2 20OR
12	G10 20LG/RD
13	P91 20WT/BK
14	-
15	L38 18BR/WT ■
16	V13 18BR/LG
17	V23 18BR/PK
18	V20 18BK/WT
19	G16 20BK/LB
20	G26 20LB ●
21	P59 20LB/RD ●
22	P55 20DB/PK ●



C203
(RHD)

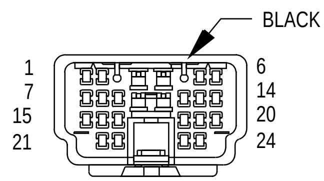
CAV	CIRCUIT
1	X51 18BR/YL
2	X52 18DB/WT
3	X53 18DG
4	X54 18VT
5	X55 18BR/RD
6	X56 18DB/RD
7	X57 18BR/LB
8	X58 18DB/OR
9	X60 18DG/RD ■
10	G9 20GY/BK
11	E2 20OR/BK
12	G10 20LG/RD
13	P91 20WT/BK
14	-
15	L38 18BR/WT
16	V13 18BR
17	V23 18BR/PK
18	V20 18BK/WT
19	G16 20BK/LB
20	G26 20LB ●
21	P59 20LB/RD ●
22	P55 20DB/PK ●

■ BUILT UP EXPORT
●● BASE AND FULL OPTIONS W/O POWER AMPLIFIER
● FULL OPTIONS



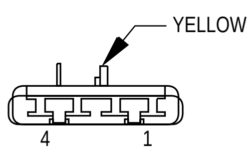
C204
(RHD)

CAV	CIRCUIT
1	D1 20VT/BR
2	D2 20WT/BK
3	F75 16VT •
4	A141 16DG/WT
5	L10 18BR/LG
6	L50 20WT/TN
7	L62 20BR/RD
8	L63 20DG/RD
9	-
10	F23 18DB/YL
11	F14 18LG/YL
12	F35 16RD
13	Z1 20BK
14	C6 20RD/WT
15	G78 20TN/BK
16	K226 20DB/LG
17	K167 20BR/YL
18	P72 20YL/BK
19	P74 20DB
20	P76 20OR/YL
21	F15 20DB/WT
22	C16 20BK/WT
23	P35 20OR/VT
24	P36 20PK/VT



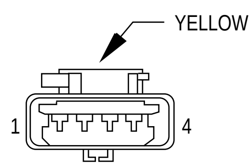
C204
(RHD)

CAV	CIRCUIT
1	D1 18VT/BR
2	D2 18WT/BK
3	F75 16VT •
4	A141 16DG/WT
5	L10 18BR/LG
6	L50 20WT/TN
7	L62 20BR/RD
8	L63 20DG/RD
9	-
10	F23 18DB/YL
11	F14 18LG/YL
12	F35 16RD •
13	Z1 20BK
14	C36 20RD/WT
15	G78 20TN/BK
16	K226 20DB/LG
17	K167 20BR/YL
18	P71 20YL
19	P74 20DB
20	P76 20OR/YL
21	F15 20DB/WT
22	C16 20LB/YL
23	P35 20OR/VT •
24	P36 20PK/VT •



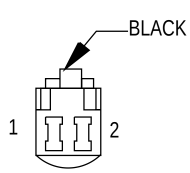
C205

CAV	CIRCUIT
1	R42 18BK/YL
2	R44 18DG/YL
3	R43 18BK/LB
4	R45 18DG/LB



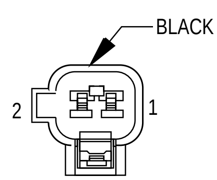
C205

CAV	CIRCUIT
1	R42 18BK/YL
2	R44 18DG/YL
3	R43 18BK/LB
4	R45 18DG/LB



C206
(A/T)

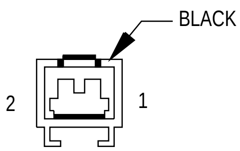
CAV	CIRCUIT
1	E2 20OR ■
1	E2 20OR/BK ▲
2	Z1 20BK



C206
(A/T)

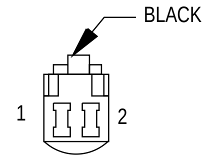
CAV	CIRCUIT
1	E2 20OR
	E2 20OR
2	Z1 20BK
	Z1 20BK

• FULL OPTIONS
▲ RHD
■ LHD



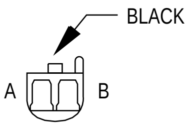
C206
(M/T)

CAV	CIRCUIT
1	E2 20OR
2	Z1 20BK



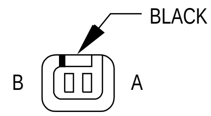
C206
(M/T)

CAV	CIRCUIT
1	E2 20OR
2	Z1 20BK



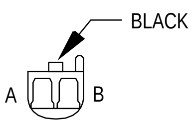
C207

CAV	CIRCUIT
A	M1 20PK
B	M2 20YL



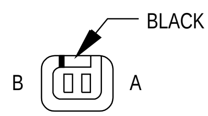
C207

CAV	CIRCUIT
A	M1 18PK
B	M2 18BK/WT



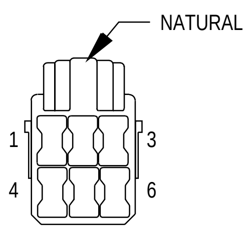
C208

CAV	CIRCUIT
A	M1 20PK
B	M2 20YL



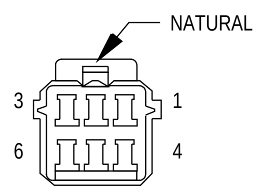
C208

CAV	CIRCUIT
A	M1 18PK
B	M2 18BK/WT



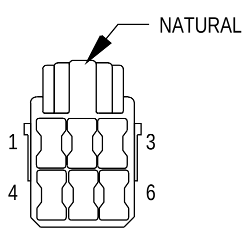
C300
(LHD)

CAV	CIRCUIT
1	P35 20OR/VT
2	P36 20PK/VT
3	P55 20DB/PK
4	P59 20LB/RD
5	G26 20LB
6	-



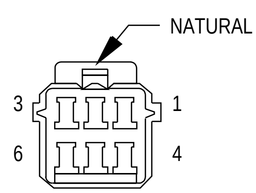
C300
(LHD)

CAV	CIRCUIT
1	P35 20OR/VT
2	P36 20PK/VT
3	P55 20DB/PK
4	P59 20LB/RD
5	G26 20LB
6	-



C300
(RHD)

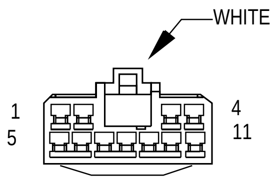
CAV	CIRCUIT
1	P35 18OR/VT
2	P36 18PK/VT
3	F83 18YL/DG ●
4	-
5	-
6	-



C300
(RHD)

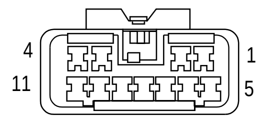
CAV	CIRCUIT
1	P35 20OR/VT
2	P36 20PK/VT
3	F83 18YL/DG ●
4	-
5	-
6	-

● FULL OPTIONS AND POWER MIRRORS



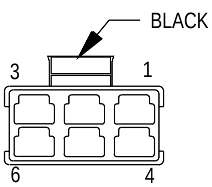
C301

CAV	CIRCUIT
1	D1 20VT/BR
2	D2 20WT/BK
3	G32 20BK/LB
4	G31 20VT/LG
5	Z2 20BK/LG
6	F87 20WT/BK
7	X3 20BK/RD
8	P55 20DB
9	P59 20LB/RD
10	-
11	-



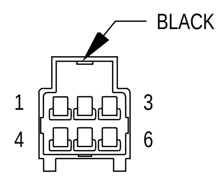
C301

CAV	CIRCUIT
1	D1 20VT/BR
2	D2 20WT/BK
3	G32 20BK/LB
4	G31 20VT/LG
5	Z2 20BK/LG
6	F87 20WT/BK
7	X3 20BK/RD
8	P55 20DB/PK
9	P59 20LB/RD
10	-
11	-



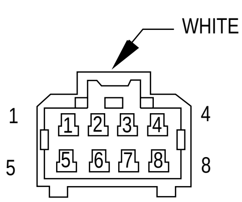
C303
(LHD)

CAV	CIRCUIT
1	Q16 14BR/WT
1	V23 18BR/PK
2	Q26 14VT/WT
3	Q1 14YL
4	X80 18LB/BK ▲▲
4	X54 18VT ▲
5	X82 18LB/RD ▲▲
5	X56 18DB/RD ▲
6	-



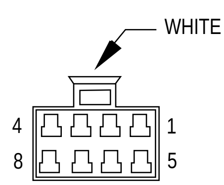
C303
(LHD)

CAV	CIRCUIT
1	Q16 14BR/WT
1	V23 18BR/PK ●●
2	Q26 14VT/WT
3	Q1 14YL
4	X80 18LB/BK ▲▲
4	X54 18VT ▲
5	X82 18LB/RD ▲▲
5	X56 18DB/RD ▲
6	-



C303
(RHD)
(FULL OPTIONS)

CAV	CIRCUIT
1	Q18 14GY/BK
2	Q28 14DG/WT
3	Q17 14DB/WT
4	Q1 14YL
5	Z1 14BK
6	Q27 14RD/BK
7	Q16 14BR/WT
8	Q26 14VT/WT

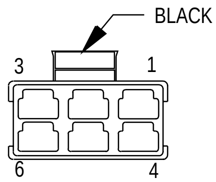


C303
(RHD)
(FULL OPTIONS)

CAV	CIRCUIT
1	Q18 14GY/BK
2	Q28 14DG/WT
3	Q17 14DB/WT
4	Q1 14YL
5	Z1 14BK
6	Q27 14RD/BK
7	Q16 14BR/WT
8	Q26 14VT/WT

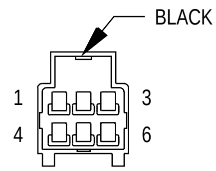
●● BASE W/O POWER AMPLIFIER
▲ 4 SPEAKER SYSTEM
▲▲ 6 SPEAKER SYSTEM

J998W-7 XJI08022



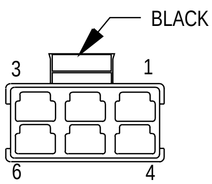
C304
(LHD)

CAV	CIRCUIT
1	Q18 14GY/BK
2	Q28 14DG/WT
3	Q1 14YL
4	P33 16OR/BK
5	P34 16PK/BK
6	-



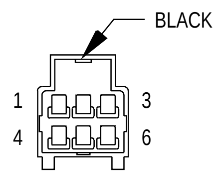
C304
(LHD)

CAV	CIRCUIT
1	Q18 14GY/BK
2	Q28 14DG/WT
3	Q1 14YL
4	P33 16OR/BK
5	P34 16PK/BK
6	-



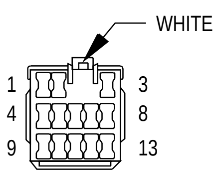
C304
(RHD)

CAV	CIRCUIT
1	Q18 14GY/BK
2	Q28 14DG/WT
3	Q1 14YL
4	P33 16OR/BK
5	P34 16PK/BK
6	-



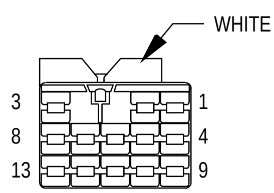
C304
(RHD)

CAV	CIRCUIT
1	Q18 14GY/BK
2	Q28 14DG/WT
3	Q1 14YL
4	P33 16OR/BK
5	P34 16PK/BK
6	-



C305
(LHD)

CAV	CIRCUIT
1	X85 18BR/RD ■■
1	X53 18DG ■
2	X87 18DG ■■
2	X55 18BR/RD ■
3	F83 18YL/DG ●
4	P33 16OR/BK
5	P34 16PK/BK
6	P35 20OR/VT
7	P36 20PK/VT
8	P72 20YL/BK
9	P74 20DB
10	P76 20OR/YL
11	C16 20LB/YL ●●
11	C16 20BK/WT ▲▲
12	-
13	P91 20WT/BK ●

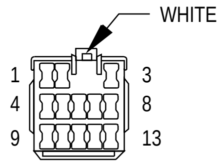


C305
(LHD)

CAV	CIRCUIT
1	X85 18BR/RD ■■
1	X53 18DG ■
2	X87 18LG/VT ■■
2	X55 18BR/RD ■
3	F83 18YL/DG ●
4	P33 16OR/BK ▲
5	P34 16PK/BK ▲
6	P35 18OR/VT ▲
7	P36 18PK/VT ▲
8	P72 20YL/BK
9	P74 20DB
10	P76 20OR/YL
11	C16 20LB/YL
12	-
13	P91 20WT/BK ●

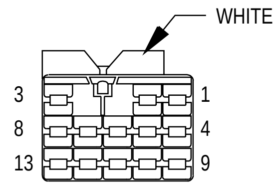
● FULL OPTIONS AND POWER MIRRORS
▲ POWER LOCK/WINDOWS
■ 4 SPEAKERS
■■ 6 SPEAKERS

▲▲ POWER MIRRORS
●● FULL OPTIONS



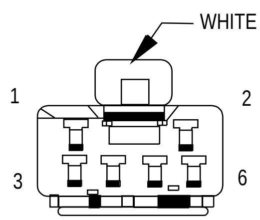
C305
(RHD)

CAV	CIRCUIT
1	X85 18BR/RD ■■
1	X54 18VT ■
2	X87 18DG ■■
2	X56 18DB/RD ■
3	P59 20LB/RD
4	P33 16OR/BK ▲
5	P34 16PK/BK ▲
6	P35 20OR/VT ▲
7	P36 20PK/VT ▲
8	P71 20YL
9	P75 20DB/RD ●
9	P75 20DB/WT
10	P76 20OR/YL
11	C16 20LB/YL ●●
11	C16 20BK/WT ▲▲
12	P55 20DB
13	P91 20WT/BK ●●



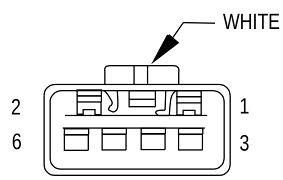
C305
(RHD)

CAV	CIRCUIT
1	X85 18BR/RD ■■
1	X54 18VT ■
2	X87 18LG/VT ■■
2	X56 18DB/RD ■
3	P59 20LB/RD
4	P33 16OR/BK
5	P34 16PK/BK
6	P35 18OR/VT
7	P36 18PK/VT
8	P71 20YL
9	P75 20DB/RD ●
9	P75 20DB/WT
10	P76 20OR/YL
11	C16 20LB/YL
12	P55 20DB/PK
13	P91 20WT/BK ●●



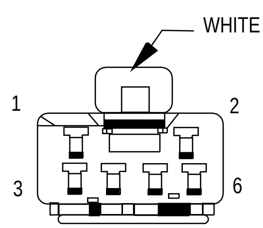
C306
(LHD)
(FULL OPTIONS)

CAV	CIRCUIT
1	Q18 14GY/BK
2	Q28 14DG/WT
3	Q16 14BR/WT
4	Q26 14VT/WT
5	Q17 14DB/WT
6	Q27 14RD/BK



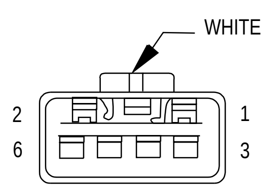
C306
(LHD)
(FULL OPTIONS)

CAV	CIRCUIT
1	Q18 14GY/BK
2	Q28 14DG/WT
3	Q16 14BR/WT
4	Q26 14VT/WT
5	Q17 14DB/WT
6	Q27 14RD/BK



C306
(RHD)
(FULL OPTIONS)

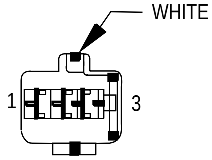
CAV	CIRCUIT
1	F35 16RD
2	G26 20LB
3	Q16 14BR/WT
4	Q26 14VT/WT
5	-
6	-



C306
(RHD)
(FULL OPTIONS)

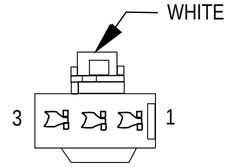
CAV	CIRCUIT
1	F35 16RD
2	G26 20LB
3	Q16 14BR/WT
4	Q26 14VT/WT
5	-
6	-

▲▲ POWER MIRRORS
●● FULL OPTIONS
● FULL OPTIONS AND POWER MIRRORS
▲ POWER LOCK/WINDOW SWITCHES
■ 4 SPEAKERS
■■ 6 SPEAKERS



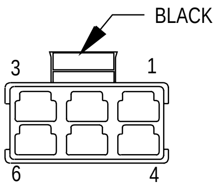
C307

CAV	CIRCUIT
1	F81 14TN
2	Q1 14YL
3	Z1 12BK ●
3	Z1 16BK ▲



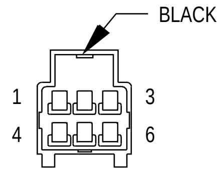
C307

CAV	CIRCUIT
1	F81 12TN
2	Q1 14YL
3	Z1 12BK



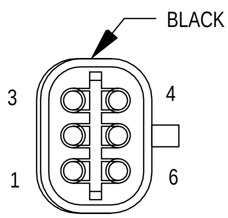
C309
(FULL OPTIONS)

CAV	CIRCUIT
1	Q17 14DB/WT
2	Q27 14RD/BK
3	Q1 14YL
4	P33 16OR/BK
5	P34 16PK/BK
6	-



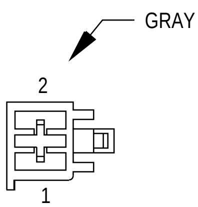
C309
(FULL OPTIONS)

CAV	CIRCUIT
1	Q17 14DB/WT
2	Q27 14RD/BK
3	Q1 14YL
4	P33 16OR/BK
5	P34 16PK/BK
6	-



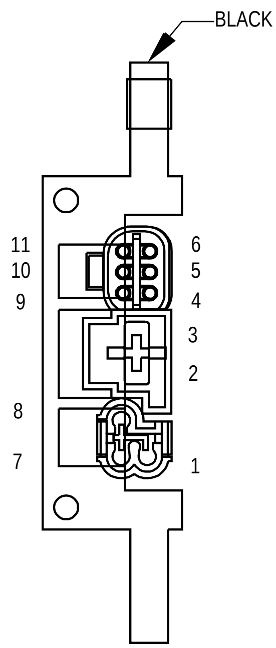
C311

CAV	CIRCUIT
1	P33 16OR/BK
2	P34 16PK/BK
3	G78 20TN/BK
4	L77 18BR/YL
5	M4 20GY/BK
6	Z1 18BK



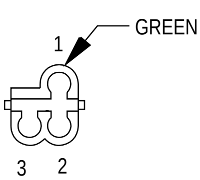
C312

CAV	CIRCUIT
1	Z1 12 BK
2	C15 12BK/WT



C310

CAV	CIRCUIT
1	V20 18BK/WT
2	Z1 12 BK
3	C15 12BK/WT
4	P33 16OR/BK
5	P34 16PK/BK
6	G78 20TN/BK
7	V23 18BR/PK
8	V13 18BR/LG
9	Z1 18BK
10	M4 20VT/YL
11	L77 18BR/YL

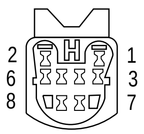


C313

CAV	CIRCUIT
1	V13 18BR/LG
2	V23 18BR/PK
3	V20 18BK/WT

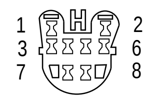
▲ POWER MIRRORS
● FULL OPTIONS

XJI08025 J998W-7



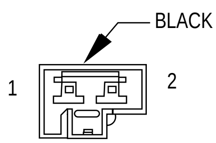
C314

CAV	CIRCUIT
1	X92 18TN/BK ▲
1	X52 18DB/WT ▲▲
2	X94 18TN/RD ▲
2	X58 18DB/OR ▲▲
3	X91 16BR/DB ▲
3	X51 18BR/YL ▲▲
4	X93 16BR/YL ▲
4	X57 18BR/LB ▲▲
5	M1 20PK
6	M2 20YL
7	M4 20GY/BK
8	-



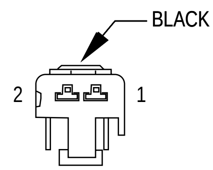
C314

CAV	CIRCUIT
1	X92 16TN/BK ▲
1	X52 18DB/WT ▲▲
2	X94 16TN/RD ▲
2	X58 18DB/OR ▲▲
3	X91 18WT/BK ▲
3	X51 18BR/YL ▲▲
4	X93 18WT/RD ▲
4	X57 18BR/LB ▲▲
5	M1 18PK ●
5	M1 20PK ●●
6	M2 20YL
7	M4 20GY/BK
8	-



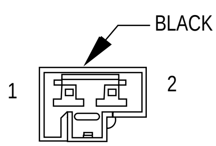
C316 (HEATED SEATS)

CAV	CIRCUIT
1	F83 18YL/DG
2	F37 14RD/LB



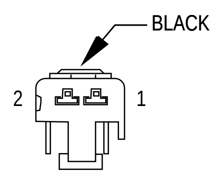
C316 (HEATED SEATS)

CAV	CIRCUIT
1	F83 18YL/DG
2	F37 14RD/LB



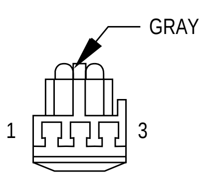
C316 (WITHOUT HEATED SEATS)

CAV	CIRCUIT
1	-
2	F37 14RD/LB
	F37 14RD/LB



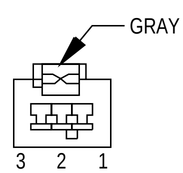
C316 (WITHOUT HEATED SEATS)

CAV	CIRCUIT
1	-
2	F37 14RD/LB



C317

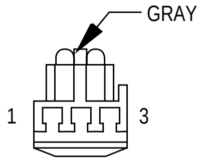
CAV	CIRCUIT
1	M2 18YL
2	G16 18BK/LB
3	Z1 18BK



C317

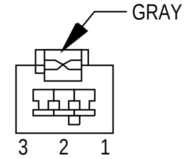
CAV	CIRCUIT
1	M2 20YL
2	G16 20BK/LB ●●
3	Z1 20BK

▲ 6 SPEAKER
▲▲ 4 SPEAKER
●● LHD
● RHD



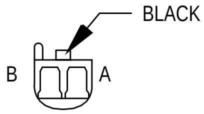
C318

CAV	CIRCUIT
1	M2 18YL
2	G16 18BK/LB ■
3	Z1 18BK



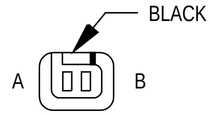
C318

CAV	CIRCUIT
1	M2 20YL
2	G16 20BK/LB
3	Z1 20BK



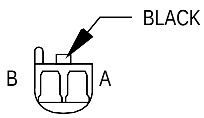
C319

CAV	CIRCUIT
A	M2 18YL
B	Z1 18BK



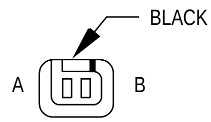
C319

CAV	CIRCUIT
A	M2 20YL
B	Z1 20BK



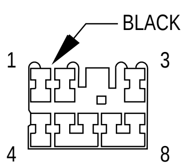
C320

CAV	CIRCUIT
A	M2 18YL
B	Z1 18BK



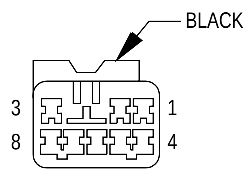
C320

CAV	CIRCUIT
A	M2 20YL
B	Z1 20BK



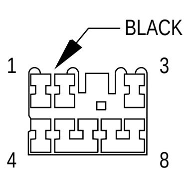
C321

CAV	CIRCUIT
1	L62 18BR/RD
2	Z1 18BK
3	-
4	L38 18OR/WT
5	L10 18BR/LG
6	L50 18WT/TN
7	L78 18DG/YL
8	-



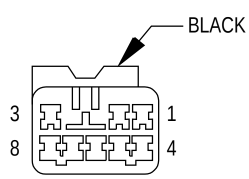
C321

CAV	CIRCUIT
1	L62 20BR/RD
2	Z1 18BK
3	-
4	L38 18BR/WT
5	L10 18BR/LG
6	L50 20WT/TN
7	L78 18DG/YL
8	-



C322
(W/O TRAILER TOW)

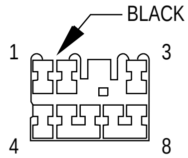
CAV	CIRCUIT
1	L63 18DG/RD
2	Z1 16BK ▲▲
2	Z1 18BK ●
3	-
4	L38 18OR/WT
5	L10 18BR/LG
6	L50 18WT/TN
7	L77 18BR
8	-



C322
(W/O TRAILER TOW)

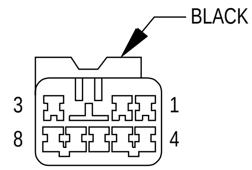
CAV	CIRCUIT
1	L63 20DG/RD
2	Z1 14BK
3	A6 20RD/OR
4	L38 18BR/WT
5	L10 18BR/LG
6	L50 20WT/TN
7	L77 18BR/YL
8	L62 20BR/RD

▲▲ BUILT-UP-EXPORT
● EXCEPT BUILT-UP-EXPORT
■ RHD



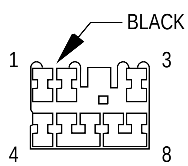
C322
(TRAILER TOW)

CAV	CIRCUIT
1	L63 18DG/RD
2	Z1 16BK ▲
2	Z1 18BK ●
3	-
4	L38 18OR/WT
5	L10 18BR/LG
6	L50 18WT/TN
7	L77 18BR
8	-



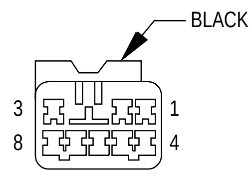
C322
(TRAILER TOW)

CAV	CIRCUIT
1	L63 20DG/RD
2	Z1 18BK
3	-
4	L38 18BR/WT
5	L10 18BR/LG
6	L50 20WT/TN
7	L77 18BR/YL
8	-



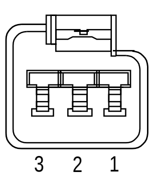
C323
(TRAILER TOW)

CAV	CIRCUIT
1	L63 20DG/RD
2	Z1 14BK
3	A6 20RD/OR
4	L38 20OR/WT
5	L10 18BR/LG
6	L50 20WT/TN
7	L77 20BR/YL
8	L62 20BK/RD



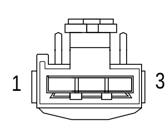
C323
(TRAILER TOW)

CAV	CIRCUIT
1	L63 20DG/RD
2	Z1 14BK
3	A6 20RD/OR
4	L38 18BR/WT
5	L10 18BR/LG
6	L50 20WT/TN
7	L77 18BR/YL
8	L62 20BR/RD



C324
(RHD)

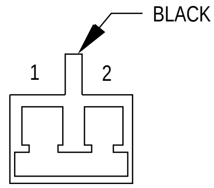
CAV	CIRCUIT
1	F83 18YL/DG
2	X54 18VT ●●
2	X80 18LB/BK
3	X56 18DB/RD ●●
3	X82 18LB/RD



C324
(RHD)

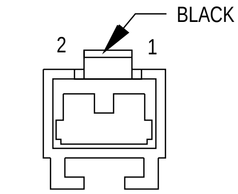
CAV	CIRCUIT
1	F83 18YL/DG
2	X54 18VT ●●
2	X80 18LB/BK
3	X56 18DB/RD ●●
3	X82 18LB/RD

▲ BUILT-UP-EXPORT
● EXCEPT BUILT-UP-EXPORT
●● FULL OPTIONS W/O POWER AMPLIFIER



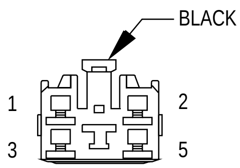
C325

CAV	CIRCUIT
1	L50 18WT/TN
2	Z1 18BK



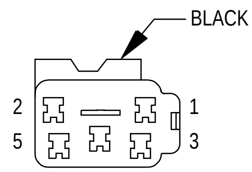
C325

CAV	CIRCUIT
1	L50 18DG/WT
2	Z1 18BK



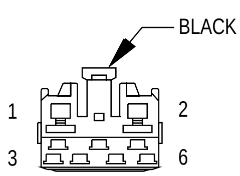
C326

CAV	CIRCUIT
1	P33 16OR/BK
2	P34 16PK/BK
3	M4 20GY/BK
4	C15 12BK/WT
5	L50 18WT/TN



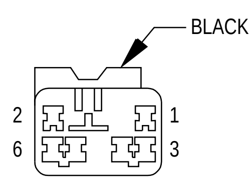
C326

CAV	CIRCUIT
1	P33 16OR/BK ●
2	P34 16PK/BK ●
3	M4 20GY/BK
4	C15 12BK/WT
5	L50 20WT/TN



C327

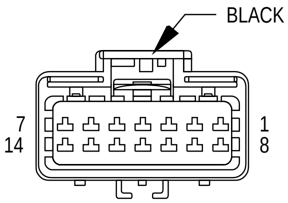
CAV	CIRCUIT
1	G78 20TN/BK
2	L77 18BR/YL
3	V13 18BR/LG
4	V23 18BR/PK
5	V20 18BK/WT
6	-



C327

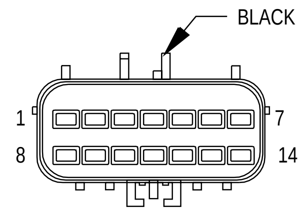
CAV	CIRCUIT
1	G78 20TN/BK
2	L77 18BR/YL
3	V13 18BR
4	V23 18BR/PK
5	V20 18BK/WT
6	-

● FULL OPTIONS



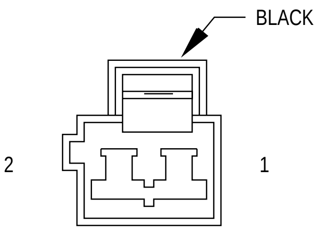
C329

CAV	CIRCUIT
1	P133 18TN/DG
2	P134 18TN/RD
3	P137 18VT
4	P138 18VT/LG
5	P139 18VT/WT
6	P140 18VT/BK
7	P87 18BK/OR
8	P141 18TN/LB
9	P143 18BK/DG
10	F37 14RD/LB
11	F83 18YL/DG
12	Z1 18BK
13	Z2 18BK/LG
14	-



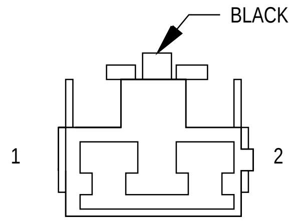
C329

CAV	CIRCUIT
1	P133 18TN/DG
2	P134 18TN/RD
3	P137 18VT
4	P138 18VT/LG
5	P139 18VT/WT
6	P140 18VT/BK
7	P87 18BK/OR
8	P141 18TN/LB
9	P143 18BK/DG
10	F37 14RD/LB
11	F83 18YL/DG
12	Z1 18BK
13	Z2 18BK/LG
14	-



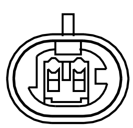
C330

CAV	CIRCUIT
1	L77 18BR/YL
2	Z1 18BK



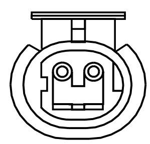
C330

CAV	CIRCUIT
1	L78 18BK/YL
2	Z1 18BK



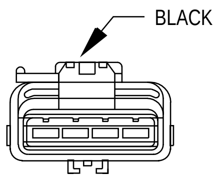
C331

CAV	CIRCUIT
1	G31 20VT/LG
2	G32 20BK/LG



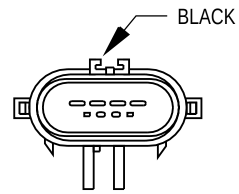
C331

CAV	CIRCUIT
1	G31 20VT/LG
2	G32 20BK/LG



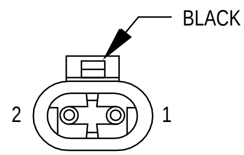
C332

CAV	CIRCUIT
1	P141 18TN/LB
2	P143 18BK/DG
3	P87 18BK/OR
4	Z1 18BK



C332

CAV	CIRCUIT
1	P141 18TN/LB
2	P143 18BK/DG
3	P87 18BK/OR
4	Z1 18BK

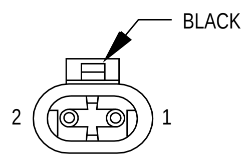


C362

CAV	CIRCUIT
1	F37 14RD/LB
2	Z1 14BK

C362

CAV	CIRCUIT
1	F37 14RD/LB
2	Z1 14BK

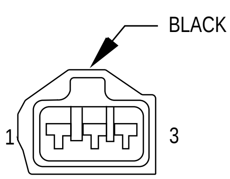


C363

CAV	CIRCUIT
1	F37 14RD/LB
2	Z1 14BK

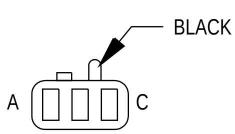
C363

CAV	CIRCUIT
1	F37 14RD/LB
2	Z1 14BK



CAMSHAFT POSITION SENSOR (GAS)

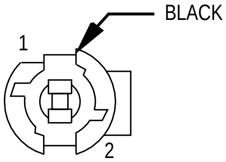
CAV	CIRCUIT	FUNCTION
1	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
2	K167 18BR/YL	SENSOR GROUND
3	K7 18OR	5 VOLT SUPPLY



CARGO LAMP/SWITCH

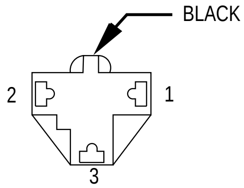
CAV	CIRCUIT	FUNCTION
A	M1 18PK ●	FUSED B(+)
A	M1 20PK ●●	FUSED B(+)
B	M2 20YL	COURTESY LAMPS DRIVER
C	M4 20GY/BK	GATE GROUND

● RHD
●● LHD



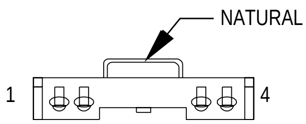
CENTER HIGH MOUNTED STOP LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L50 18DG/WT	BRAKE LAMP SWITCH OUTPUT



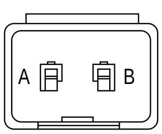
CIGAR LIGHTER

CAV	CIRCUIT	FUNCTION
1	F30 16RD	CIGAR LIGHTER RELAY OUTPUT
2	-	-
3	Z1 16BK	GROUND



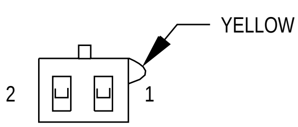
CLOCKSPRING - C1

CAV	CIRCUIT	FUNCTION
1	X3 20BK/RD	HORN RELAY CONTROL
2	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL
3	K4 20BK/RD ▲	SENSOR GROUND
3	K4 20BK/LB ●	SENSOR GROUND
4	-	-



CLOCKSPRING - C2

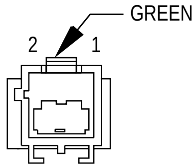
CAV	CIRCUIT	FUNCTION
A	K167 20BR/YL	SENSOR GROUND
B	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL



CLOCKSPRING - C3

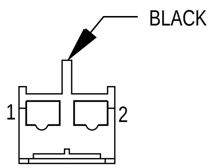
CAV	CIRCUIT	FUNCTION
1	R45 18DG/LB	DRIVER AIRBAG LINE 1
2	R43 18BK/LB	DRIVER AIRBAG LINE 2

▲ LHD
● RHD



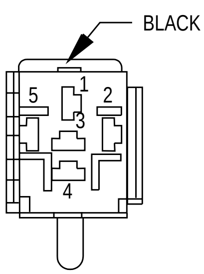
CLUTCH INTERLOCK SWITCH

CAV	CIRCUIT		FUNCTION
1	F45 20YL/RD	▲	FUSED B(+) ENGINE STARTER MOTOR RELAY
1	T141 20YL	▲▲	IGNITION SWITCH OUTPUT (START)
2	T141 20YL	▲	IGNITION SWITCH OUTPUT (START)
2	F45 20YL/RD	▲▲	FUSED B(+) ENGINE STARTER MOTOR RELAY



CLUTCH INTERLOCK SWITCH JUMPER

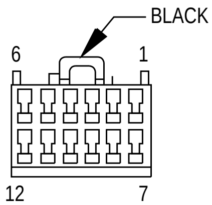
CAV	CIRCUIT	FUNCTION
1	F45 18YL	FUSED B(+) ENGINE STARTER MOTOR RELAY
2	F45 18YL	FUSED B(+) ENGINE STARTER MOTOR RELAY



COMBINATION FLASHER

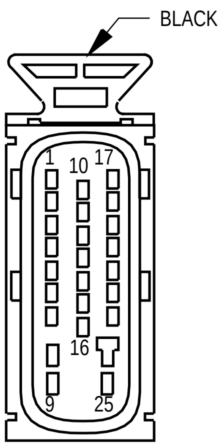
CAV	CIRCUIT		FUNCTION
1	L5 20BK		FUSED IGNITION SWITCH OUTPUT (RUN)
2	L9 20BK/PK		FUSED FLASHER FEED
3	L12 20VT/TN		HAZARD FLASHER SELECT SIGNAL
4	L6 20RD/WT		FLASHER OUTPUT
5	Z1 18BK	●	GROUND
	Z1 20BK		GROUND

● RHD BUILT-UP-EXPORT
▲ LHD DIESEL
▲▲ EXCEPT LHD DIESEL



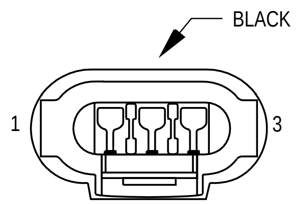
COMPASS

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	M1 20PK	FUSED B(+)
3	-	-
4	G31 20VT/LG	AMBIENT TEMPERATURE SENSOR SIGNAL
5	D1 20VT/BR	CCD BUS (+)
6	F87 20WT/BK	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
7	M2 20YL	COURTESY LAMP DRIVER
8	-	-
9	-	-
10	G32 20BK/LB	AMBIENT TEMPERATURE SENSOR GROUND
11	D2 20WT/BK	CCD BUS (-)
12	Z2 20BK/LG	GROUND



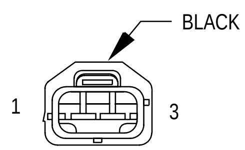
CONTROLLER ANTI-LOCK BRAKE

CAV	CIRCUIT	FUNCTION
1	B1 18YL/DB	RIGHT REAR WHEEL SPEED SENSOR (-)
2	B3 18LG/DB	LEFT REAR WHEEL SPEED SENSOR (-)
3	B7 18WT	RIGHT FRONT WHEEL SPEED SENSOR (+)
4	B9 18RD	LEFT FRONT WHEEL SPEED SENSOR (+)
5	-	-
6	B41 18YL/VT	G SWITCH NO. 1 SENSE
7	B42 18TN/WT	G SWITCH NO. 2 SENSE
8	Z1 12BK	GROUND
9	A20 12RD/DB	FUSED B(+)
10	B4 18LG	LEFT REAR WHEEL SPEED SENSOR (+)
11	B8 18RD/DB	LEFT FRONT WHEEL SPEED SENSOR (-)
12	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
13	B43 18PK/OR	G SWITCH TEST SIGNAL
14	-	-
15	-	-
16	G83 18GY/BK	ABS RELAY CONTROL
17	B2 18YL	RIGHT
18	B6 18WT/DB	RIGHT
19	-	-
20	D21 18PK	SCI TRANSMIT/ ISO 9141K
21	-	-
22	-	-
23	F15 18DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
24	Z1 12BK	GROUND
25	A10 12RD/DG	FUSED B(+)



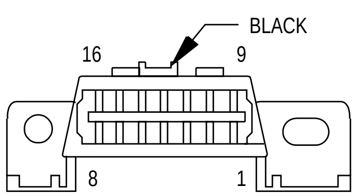
CRANKSHAFT
POSITION SENSOR
(DIESEL)

CAV	CIRCUIT	FUNCTION
1	K3 20LG/BK	SENSOR GROUND
2	-	-
3	K24 20GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL



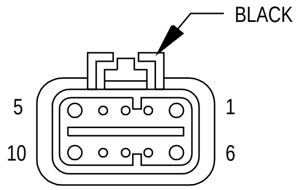
CRANKSHAFT
POSITION SENSOR
(GAS)

CAV	CIRCUIT	FUNCTION
1	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
2	K167 20BR/YL	SENSOR GROUND
3	K7 20OR	5 VOLT SUPPLY



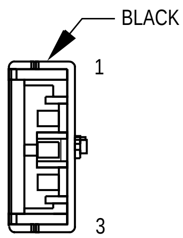
DATA LINK
CONNECTOR

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	D1 18VT/BR	CCD BUS (+)
4	Z1 18BK	GROUND
5	Z12 18BK/TN	GROUND
6	D20 20LG/BK	SCI RECEIVE
7	D21 20PK	SCI TRANSMIT/ ISO 9141K
8	-	-
9	-	-
10	-	-
11	D2 18WT/BK	CCD BUS (-)
12	-	-
13	-	-
14	-	-
15	-	-
16	F34 18TN/BK	FUSED B(+)



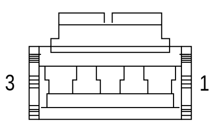
DAYTIME RUNNING LAMP MODULE (EXCEPT BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L3 16RD	DIMMER SWITCH HIGH BEAM OUTPUT
2	-	-
3	-	-
4	G34 16RD/GY	HIGH BEAM INDICATOR DRIVER
5	F20 18WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
6	A3 14RD/WT	FUSED B(+)
7	G7 20WT/OR	VEHICLE SPEED SENSOR SIGNAL
8	Z12 16BK/TN	GROUND
9	-	-
10	L44 18VT/RD	FUSED RIGHT LOW BEAM OUTPUT



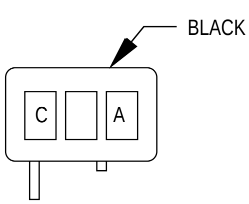
DIODE MODULE (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L2 16LG	HEADLAMP RELAY OUTPUT
2	L25 18BR	REAR FOG LAMP FEED
3	L39 18LB	FOG LAMP SWITCH OUTPUT



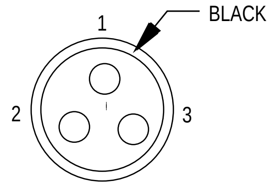
DOME LAMP (BASE/POLICE)

CAV	CIRCUIT	FUNCTION
1	-	-
2	M1 20PK	FUSED B(+)
3	M2 20YL	COURTESY LAMPS SWITCH OUTPUT



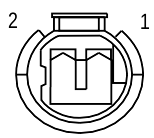
DOME LAMPS SWITCH (MIDLINE)

CAV	CIRCUIT	FUNCTION
A	Z1 20BK	GROUND
B	M2 20YL	COURTESY LAMPS SWITCH OUTPUT
C	M1 20PK	FUSED B(+)



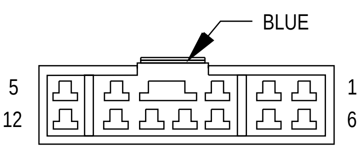
DRIVER DOOR JAMB SWITCH

CAV	CIRCUIT	FUNCTION
1	M2 18YL	COURTESY LAMPS DRIVER
2	G16 18BK/LB	DRIVER DOOR AJAR SWITCH SENSE
3	Z1 18BK	GROUND



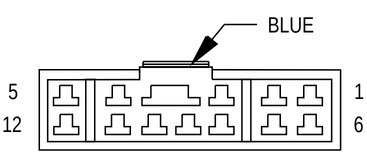
DRIVER DOOR LOCK MOTOR

CAV	CIRCUIT	FUNCTION
1	P34 16PK/BK	DOOR UNLOCK DRIVER
2	P33 16OR/BK	DOOR LOCK DRIVER



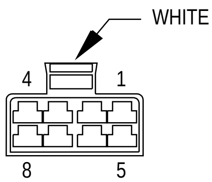
DRIVER POWER LOCK/WINDOW SWITCH-C1 (LHD) (FULL OPTIONS)

CAV	CIRCUIT	FUNCTION
1	Q28 14DG/WT	MASTER WINDOW SWITCH RIGHT REAR DOWN
2	Q18 14GY/BK	RIGHT REAR WINDOW DRIVER UP
3	Q16 14BR/WT	MASTER WINDOW SWITCH RIGHT FRONT UP
4	Q17 14DB/WT	LEFT REAR WINDOW DRIVER UP
5	Q11 14LB	LEFT WINDOW DRIVER UP
6	Q26 14VT/WT	MASTER WINDOW SWITCH RIGHT FRONT DOOR
7	P35 18OR/VT	DOOR LOCK SWITCH OUTPUT (LOCK)
8	Z1 14BK	GROUND
9	F81 14TN	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
10	Q27 14RD/BK	LEFT REAR WINDOW DRIVER (DOWN)
11	P36 18PK/VT	DOOR LOCK SWITCH OUPUT (UNLOOK
12	Q21 14WT	LEFT FRONT WINDOW DRIVER (DOWN)



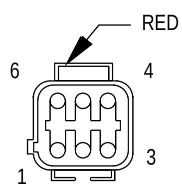
DRIVER POWER LOCK/WINDOW SWITCH-C1 (RHD) (FULL OPTIONS)

CAV	CIRCUIT	FUNCTION
1	Q28 14DG/WT	MASTER WINDOW SWITCH RIGHT REAR DOWN
2	Q18 14GY/BK	RIGHT REAR WINDOW DRIVER UP
3	Q11 14BR	LEFT WINDOW DRIVER UP
4	Q17 14DB/WT	LEFT REAR DRIVER DOWN
5	Q16 14BR/WT	MASTER WINDOW SWITCH RIGHT FRONT UP
6	Q21 14VT	LEFT FRONT WINDOW DRIVER UP
7	P35 18OR/VT	DOOR LOCK SWITCH OUTPUT (LOCK)
8	Z1 14BK	GROUND
9	F81 14TN	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
10	Q27 14RD/BK	LEFT REAR WINDOW DRIVER (DOWN)
11	P36 18PK/VT	DOOR LOCK SWITCH OUTPUT (UNLOCK)
12	Q26 14VT/WT	MASTER WINDOW SWITCH RIGHT FRONT DOOR



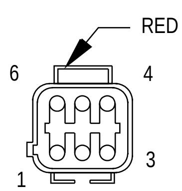
DRIVER POWER LOCK/WINDOW SWITCH-C2 (FULL OPTIONS)

CAV	CIRCUIT	FUNCTION
1	P71 20YL ■	LEFT POWER MIRROR LEFT MOVEMENT
1	P71 20YL/LB ●●	LEFT POWER MIRROR LEFT MOVEMENT
2	P76 20OR/YL	COMMON
3	F83 18YL/DG	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
4	P74 20DB	RIGHT POWER MIRROR LEFT MOVEMENT
5	Z1 14BK ■	GROUND
5	Z1 16BK ●●	GROUND
6	P75 20DB/WT	LEFT POWER MIRROR UP MOVEMENT
7	P72 20YL/BK	RIGHT POWER MIRROR UP MOVEMENT
8	Q1 14YL	POWER WINDOW SWITCH FEED



DRIVER POWER MIRROR (LHD)

CAV	CIRCUIT	FUNCTION
1	P71 20YL	LEFT MIRROR UP DRIVER
2	P75 20DB/WT ●	LEFT POWER MIRROR UP MOVEMENT
2	P76 20OR/YL ▲	COMMON
3	P91 20WT/BK ●	LEFT/RIGHT POWER MIRROR HORIZONTAL SUPPLY
3	P75 20DB/WT ▲	LEFT MIRROR LEFT DRIVER
4	P76 20OR/YL	COMMON
5	C16 20BK/WT ●	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
5	C16 20LB/YL ▲	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
6	Z1 18BK ●	GROUND
6	Z1 16BK ▲	GROUND

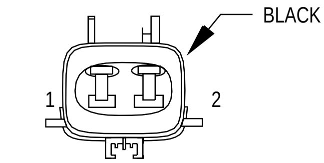


DRIVER POWER MIRROR (RHD)

CAV	CIRCUIT	FUNCTION
1	P72 20YL/BK	RIGHT POWER MIRROR UP MOVEMENT
2	P74 20DB ●	RIGHT POWER MIRROR LEFT MOVEMENT
2	P76 20OR/YL ▲	COMMON
3	P91 20WT/BK ●	LEFT/RIGHT POWER MIRROR HORIZONTAL SUPPLY
3	P74 20DB ▲	RIGHT POWER MIRROR LEFT MOVEMENT
4	P76 20OR/YL	COMMON
5	C16 20BK/WT	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
6	Z1 18BK	GROUND

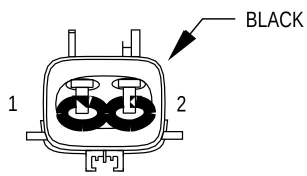
● POWER MIRRORS
▲ FULL OPTIONS
■ LHD
●● RHD

J998W-7 XJI08038



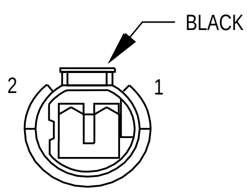
DRIVER POWER WINDOW MOTOR (LHD)

CAV	CIRCUIT	FUNCTION
1	Q11 14LB	LEFT WINDOW DRIVER (UP)
2	Q21 14WT	LEFT FRONT WINDOW DRIVER DOWN



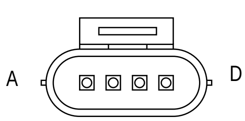
DRIVER POWER WINDOW MOTOR (RHD)

CAV	CIRCUIT	FUNCTION
1	Q11 14BR	LEFT WINDOW DRIVER (UP)
2	Q21 14VT	LEFT FRONT WINDOW DRIVER DOWN



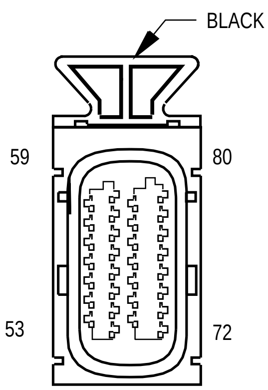
DUTY CYCLE EVAP/PURGE SOLENOID (GAS)

CAV	CIRCUIT	FUNCTION
1	K52 18PK/BK	DUTY CYCLE EVAP PURGE/SOLENOID CONTROL
2	F20 18WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)



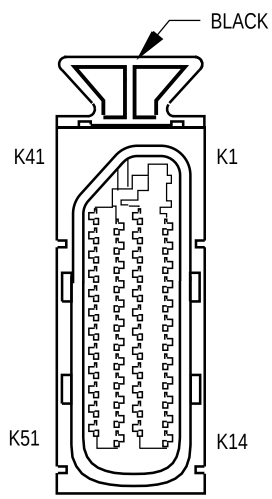
ELECTRONIC VACUUM MODULATOR (DIESEL)

CAV	CIRCUIT	FUNCTION
A	F142 18DG/OR	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
B	K35 18GY/YL	EGR SOLENOID CONTROL
C	-	-
D	Z1 18BK	GROUND



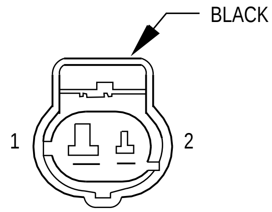
ENGINE CONTROL MODULE - C1 (DIESEL)

CAV	CIRCUIT	FUNCTION
A50	-	-
A51	-	-
A52	-	-
A53	K156 20GY	FUEL TEMPERATURE SENSOR SIGNAL
A54	K2 20TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
A55	K68 18LG/YL	NEEDLE MOVEMENT SENSOR (-)
A56	K134 20LB/BK	SLEEVE POSITION SENSOR (-)
A57	K57 20LG/OR	CONTROL SLEEVE POSITION SENSOR
A58	K135 20WT/BK	SLEEVE POSITION SENSOR(+)
A59	K140 16TN/WT	FUEL QUANTITY ACTUATOR GROUND
A60	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL
A61	K4 20BK/LB	SENSOR GROUND
A62	K67 18BR/BK	NEEDLE MOVEMENT SENSOR (+)
A63	-	
A64	-	
A65	-	
A66	K140 16TN/WT	FUEL QUANTITY ACTUATOR GROUND
A67	K24 20GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
A68	-	
A69	K3 20LG/BK	SENSOR GROUND
A70	-	
A71	-	
A72	-	
A73	-	
A74	-	
A75	-	
A76	-	
A77	K153 16OR	SHUT-OFF FEED
A78	-	
A79	K126 16LG	SOLENOID CONTROL
A80	K140 16TN/WT	FUEL QUANTITY ACTUATOR GROUND



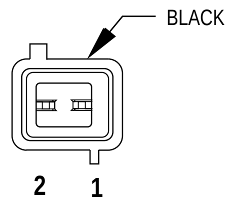
ENGINE CONTROL MODULE - C2 (DIESEL)

CAV	CIRCUIT	FUNCTION
K1	Z12 14BK/TN	GROUND
K2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
K3	-	-
K4	-	-
K5	C13 20DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
K6	K159 18VT/RD	ENGINE SPEED SENSOR SIGNAL
K7		
K8	C103 18DG	A/C SWITCH SIGNAL
K9	K29 20WT/PK	BRAKE SWITCH SENSE
K10	C22 20DB/WT	A/C SWITCH SENSE
K11	K6 20VT/WT	5 VOLT SUPPLY
K12	K151 20WT	LOW IDLE POSITION SWITCH
K13	K21 20BK/RD	INTAKE AIR TEMPERATURE SIGNAL
K14	-	-
K15	-	-
K16	-	-
K17	C27 20DB/PK	RADIATOR FAN RELAY CONTROL
K18	G8 18LB/BK	FUEL MONITOR OUTPUT SIGNAL
K19	-	-
K20	L50 20WT/TN	BRAKE LAMP SWITCH OUTPUT
K21	-	-
K22	-	-
K23	K255 20WT/DG	PEDAL POSITION SENSOR
K24	K22 20OR/DB	THROTTLE POSITION SENSOR SIGNAL
K25	-	-
K26	-	-
K27	Z12 16BK/TN	GROUND
K28	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
K29	K35 18GY/YL	EGR SOLENOID CONTROL
K30	V66 18RD/LG	WIPER PARK SWITCH SENSE
K31	-	-
K32	K185 20OR/LB	WAIT TO START INDICATOR
K33	K51 20DB/YL	AUTOMATIC SHUT DOWN RELAY CONTROL
K34	K48 18OR/RD	FAULT SIGNAL
K35	-	-
K36	-	-
K37	-	-
K38	G55 18OR/BK	ENGINE DISABLE SIGNAL
K39	K9 20LB	5V SUPPLY
K40	K1 20DG/RD	BOOST PRESSURE SIGNAL
K41	-	-
K42	K152 18WT	GLOW PLUG RELAY CONTROL SENSE
K43	-	-
K44	-	-
K45	D21 20PK	SCI TRANSMIT/ ISO 9141K
K46	-	-
K47	F12 18DB/WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
K48	-	-
K49	-	-
K50	-	-
K51	G7 20WT/OR	VEHICLE SPEED SENSOR SIGNAL



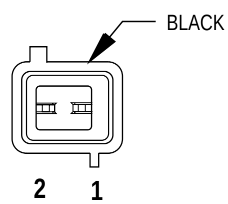
ENGINE COOLANT TEMPERATURE SENSOR (GAS)

CAV	CIRCUIT	FUNCTION
1	K167 20BR/YL	SENSOR GROUND
2	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL



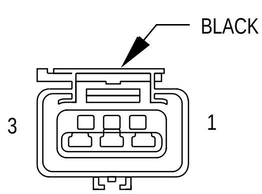
ENGINE COOLANT TEMPERATURE SENSOR NO. 1 (DIESEL)

CAV	CIRCUIT	FUNCTION
1	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
2	K4 18BK/LB	SENSOR GROUND



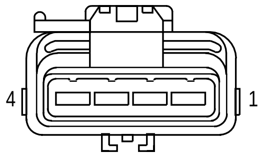
ENGINE COOLANT TEMPERATURE SENSOR NO. 2 (DIESEL)

CAV	CIRCUIT	FUNCTION
1	K222 18TN/RD	SECONDARY ENGINE COOLANT TEMPERATURE SENSOR
2	K167 18BR/YL	SENSOR RETURN



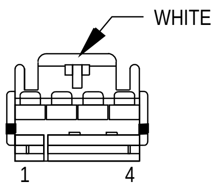
ENGINE OIL PRESSURE SENSOR

CAV	CIRCUIT	FUNCTION
1	K7 18OR	5 VOLT SUPPLY
2	G60 18GY/YL	ENGINE OIL PRESSURE SENSOR SIGNAL
3	K167 18BR/YL	SENSOR GROUND



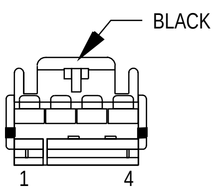
EVAP LEAK DETECTION PUMP (EXCEPT BUILT-UP -EXPORT)

CAV	CIRCUIT	FUNCTION
1	-	-
2	F20 18WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
3	K106 18WT/DG	LEAK DETECTION PUMP SOLENOID CONTROL
4	K105 18OR	LEAK DETECTION PUMP SWITCH SENSE



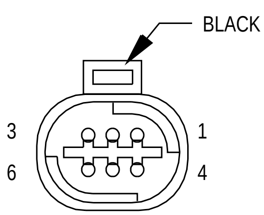
EXTENDED IDLE SWITCH (POLICE PACKAGE)

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	K78 20GY	IDLE ACTUATOR
3	F15 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
4	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL



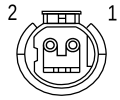
FRONT FOG LAMP SWITCH

CAV	CIRCUIT	FUNCTION
1	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
2	L39 20LB	FOG LAMP SWITCH OUTPUT
3	L139 20VT	FOG LAMP RELAY OUTPUT
4	Z1 20BK	GROUND



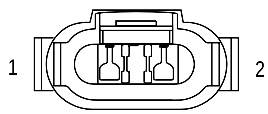
FRONT WIPER MOTOR

CAV	CIRCUIT	FUNCTION
1	V6 16DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	V5 16DG/YL	WIPER PARK SWITCH SENSE
3	-	-
4	Z1 16BK	GROUND
5	V3 16BR/WT	LOW SPEED WIPER SWITCH OUTPUT
6	V4 16BR/VT	WIPER HIGH SPEED OUTPUT



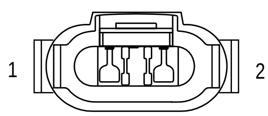
FUEL HEATER
(DIESEL)

CAV	CIRCUIT	FUNCTION
1	A93 14RD/BK	FUEL HEATER RELAY OUTPUT
2	Z1 14BK	GROUND



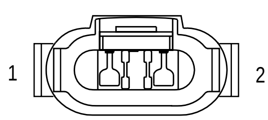
CAV	CIRCUIT	FUNCTION
1	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER

FUEL INJECTOR NO. 1
(2.5L GAS)



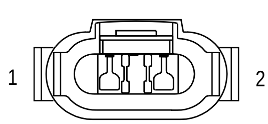
CAV	CIRCUIT	FUNCTION
1	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K12 18TN	FUEL INJECTOR NO. 2 DRIVER

FUEL INJECTOR NO. 2
(2.5L GAS)



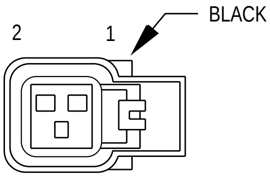
CAV	CIRCUIT	FUNCTION
1	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER

FUEL INJECTOR NO. 3
(2.5L GAS)



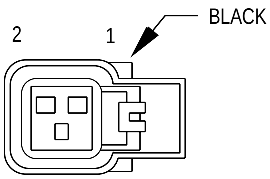
CAV	CIRCUIT	FUNCTION
1	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER

FUEL INJECTOR NO. 4
(2.5L GAS)



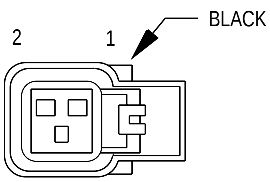
CAV	CIRCUIT	FUNCTION
1	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER

FUEL INJECTOR NO. 1 (4.0L GAS)



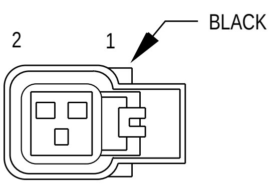
CAV	CIRCUIT	FUNCTION
1	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K12 18TN	FUEL INJECTOR NO. 2 DRIVER

FUEL INJECTOR NO. 2 (4.0L GAS)



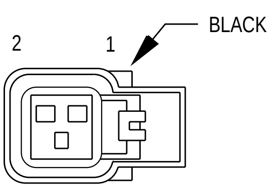
CAV	CIRCUIT	FUNCTION
1	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER

FUEL INJECTOR NO. 3 (4.0L GAS)



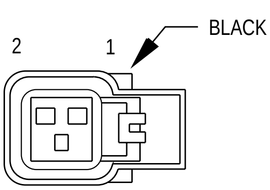
CAV	CIRCUIT	FUNCTION
1	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER

FUEL INJECTOR NO. 4 (4.0L GAS)



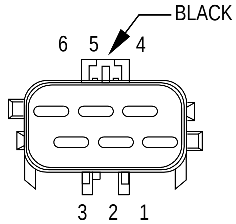
CAV	CIRCUIT	FUNCTION
1	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K15 18PK/BK	FUEL INJECTOR NO. 5 DRIVER

FUEL INJECTOR NO. 5 (4.0L GAS)



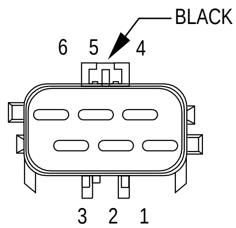
CAV	CIRCUIT	FUNCTION
1	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K16 18LG/BK	FUEL INJECTOR NO. 6 DRIVER

FUEL INJECTOR NO. 6 (4.0L GAS)



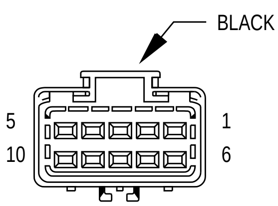
FUEL LEVEL SENSOR (DIESEL)

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	K226 20DB/LG	FUEL LEVEL SENSOR SIGNAL
4	K167 20BR/YL	SENSOR RETURN
5	-	-
6	-	-



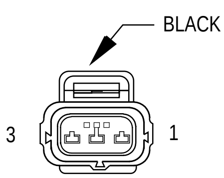
FUEL PUMP MODULE (GAS)

CAV	CIRCUIT	FUNCTION
1	A141 16DG/WT	FUEL PUMP RELAY OUTPUT
2	-	-
3	K226 20DB/LG	FUEL LEVEL SENSOR SIGNAL
4	K167 20BR/YL	SENSOR GROUND
5	-	-
6	Z1 16BK	GROUND



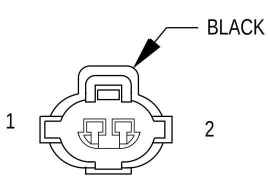
FUEL PUMP MODULE (DIESEL)

CAV	CIRCUIT	FUNCTION
1	K134 20LB/BK	SLEEVE POSITION SENSOR (-)
2	K57 20LG/OR	CONTROL SLEEVE POSITION SENSOR
3	K135 20WT/BK	SLEEVE POSITION SENSOR (-)
4	K4 20BK/LB	SENSOR GROUND
5	K126 16LG	SOLENOID CONTROL
6	K153 16OR	SHUTOFF FEED
7	K156 20GY	FUEL TEMPERATURE SENSOR SIGNAL
8	K140 16TN/WT	FUEL QUANITY ACTUATOR GROUND
9	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
10	F142 16DG/OR	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT



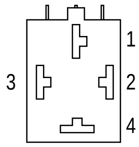
G SWITCH

CAV	CIRCUIT	FUNCTION
1	B42 20TN/WT	G SWITCH NO. 2 SENSE
2	B41 20YL/VT	G SWITCH NO.1 SENSE
3	B43 20PK/OR	G SWITCH TEST SIGNAL



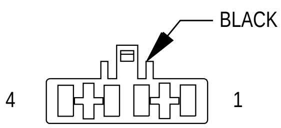
GENERATOR

CAV	CIRCUIT	FUNCTION
1	K72 18DG/OR	GENERATOR DRIVER
1	K72 16DG/OR •	GENERATOR DRIVER
2	K20 18DG	GENERATOR FIELD DRIVER (+)



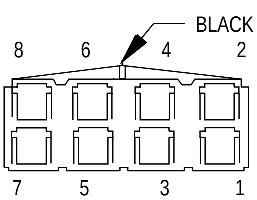
GLOW PLUG RELAY (DIESEL)

CAV	CIRCUIT	FUNCTION
1	A54 10RD/GY	FUSED B (+)
2	F142 18DG/OR	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
3	K152 18WT	-
4	K154 10GY	GLOW PLUG RELAY OUTPUT



HEADLAMP BEAM SELECT SWITCH

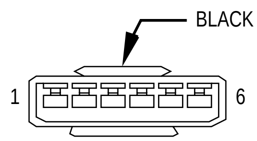
CAV	CIRCUIT	FUNCTION
1	L4 16VT/WT	LOW BEAM RELAY OUTPUT
2	L2 14LG	HEADLAMP SWITCH OUTPUT
3	L3 16RD/OR	HIGH BEAM INDICATOR DRIVER
4	L20 14LG/WT	FUSED B (+) OPTICAL HORN FEED



HEADLAMP DELAY MODULE

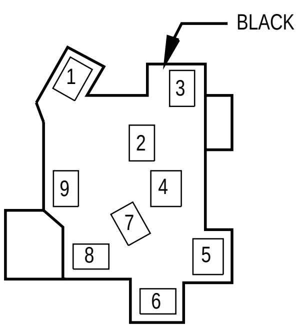
CAV	CIRCUIT	FUNCTION
1	-	-
2	A3 14RD/WT	FUSED B(+)
3	-	-
4	Z1 18BK	GROUND
5	-	-
6	L2 14LG	HEADLAMP SWITCH OUTPUT
	L2 14LG •	HEADLAMP SWITCH OUTPUT
7	-	-
8	F87 20WT/BK	FUSED IGNITION SWITCH OUTPUT (ST-RUN)

• EXCEPT BUILT-UP-EXPORT



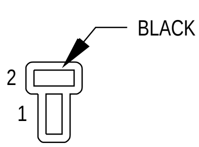
HEADLAMP LEVELING SWITCH (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	-	-
2	Z15 20BK/GY	GROUND
3	-	-
4	L44 20VT/RD	FUSED RIGHT LOW BEAM OUTPUT
5	L13 20BR/YL	HEADLAMP ADJUST SIGNAL
6	-	-



HEADLAMP SWITCH - C1

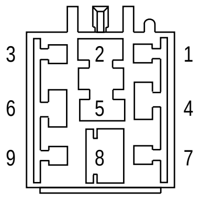
CAV	CIRCUIT	FUNCTION
1	E1 20TN	PANEL LAMPS DIMMER SWITCH SIGNAL
2	L2 14LG	HEADLAMP SWITCH OUTPUT
3	M2 20YL	COURTESY LAMPS DRIVER
4	F34 18TN/BK	FUSED B(+)
	F34 18TN/BK ●	FUSED B(+)
5	G26 20LB	DOOR LOCK INHIBIT SENSE
6	G16 20BK/LB	DRIVER DOOR AJAR SWITCH SENSE
7	L20 14LG/WT	FUSED B (+)
8	A3 14RD/WT	FUSED B (+)
	A3 14RD/WT	FUSED B (+)
9	L7 18BK/YL	HEADLAMP SWITCH OUTPUT



HEADLAMP SWITCH - C2

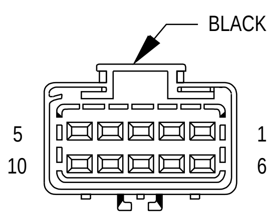
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
	Z1 18BK	GROUND
2	-	-

● LHD EXCEPT BUILT-UP-EXPORT



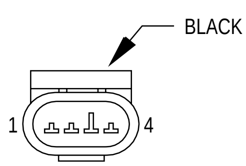
HEATED SEAT RELAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	F235 16RD	B(+) TO HEATED SEAT MODULE
2	F235 16RD	B(+) TO HEATED SEAT MODULE
3	-	-
4	F83 18YL/DG	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
5	-	-
6	Z1 18BK	GROUND
7	-	-
8	F37 14RD/LB	FUSED B(+)



HVAC UNIT

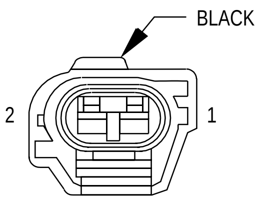
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	C4 14TN	LOW MOTOR BLOWER DRIVER
3	C5 14LG	M1 MOTOR BLOWER DRIVER
4	C6 14LB	M2 MOTOR BLOWER DRIVER
5	F15 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
6	C36 20RD/WT	BLEND DOOR FEEDBACK SIGNAL
7	C7 12BK/TN	HIGH MOTOR BLOWER DRIVER
8	A111 12RD/LG	FUSED B (+)
9	F15 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
10	Z8 12BK/VT ●	GROUND
10	Z8 12BK/PK ■	GROUND
10	Z8 20BK/VT ▲	GROUND



IDLE AIR CONTROL MOTOR

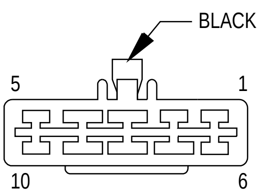
CAV	CIRCUIT	FUNCTION
1	K59 18VT/BK	IDLE AIR CONTROL NO. 4 DRIVER
2	K40 18BR/WT	IDLE AIR CONTROL NO. 3 DRIVER
3	K60 18YL/BK	IDLE AIR CONTROL NO. 2 DRIVER
4	K39 18GY/RD	IDLE AIR CONTROL NO. 1 DRIVER

▲ LHD
■ RHD W/O POWER AMPLIFER
● RHD WITH POWER AMPLIFER



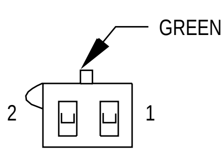
IGNITION COIL

CAV	CIRCUIT	FUNCTION
1	K19 18GY •	IGNITION COIL NO. 1 DRIVER
1	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	A142 18DG/OR •	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K19 18GY	IGNITION COIL NO. 1 DRIVER



IGNITION SWITCH - C1

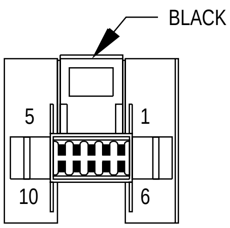
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	G9 20GY/BK	RED BRAKE INDICATOR WARNING DRIVER
3	A2 12PK/BK	FUSED B(+)
4	A22 12BK/OR	FUSED IGNITION SWITCH OUTPUT (RUN)
5	-	-
6	-	-
7	A1 12RD	FUSED B(+)
8	A31 12BK/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
9	A21 12DB	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
10	A41 14YL	FUSED IGNITION SWITCH OUTPUT (START)



IGNITION SWITCH - C2

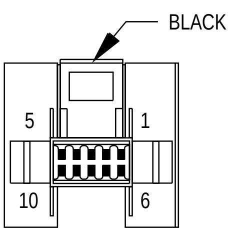
CAV	CIRCUIT	FUNCTION
1	G26 20LB	KEY-IN IGNITION SWITCH SENSE
2	G16 20BK/LB	DRIVER DOOR AJAR SWITCH SENSE

• 2WD



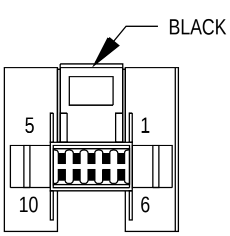
INSTRUMENT CLUSTER - C1 (LHD)

CAV	CIRCUIT	FUNCTION
1	G78 20TN/BK	LIFTGATE AJAR SWITCH SENSE
2	G99 20GY/WT	RED BRAKE WARNING INDICATOR DRIVER
3	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
4	G19 20LG/OR	ABS INDICATOR DRIVER
5	G34 16RD/GY	HIGH BEAM INDICATOR DRIVER
6	Z2 20BK/LG	GROUND
7	G29 20BK/LB	LOW WASHER FLUID SENSE
8	F87 20WT/BK	FUSED IGNITION SWITCH OUTPUT (START-RUN)
9	M1 20PK	FUSED B(+)
10	L61 20LG/WT	LEFT TURN SIGNAL



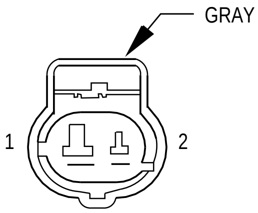
INSTRUMENT CLUSTER - C1 (RHD)

CAV	CIRCUIT	FUNCTION
1	G78 20TN/BK	LIFTGATE AJAR SWITCH SENSE
2	G99 20GY/WT	RED BRAKE WARNING INDICATOR DRIVER
3	E2 20OR	FUSED PANEL LAMPS SWITCH SIGNAL
4	G19 20LG/OR	ABS INDICATOR DRIVER
5	L3 16RD/OR	HIGH BEAM INDICATOR DRIVER
6	Z2 20BK/LG	GROUND
7	G29 20BK/LB	LOW WASHER FLUID SENSE
8	F87 20WT/BK	FUSED IGNITION SWITCH OUTPUT (START-RUN)
9	M1 20PK	FUSED B(+)
10	L61 20LG/WT	LEFT TURN SIGNAL



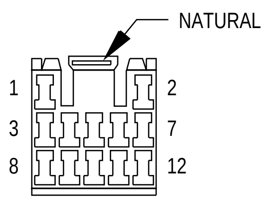
INSTRUMENT CLUSTER - C2

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/WT	REAR WINDOW DEFOGGER SWITCH SENSE
5	G107 20BK/RD	4WD SWITCH SENSE
6	L60 20TN	RIGHT TURN SIGNAL
7	G106 20BK/WT	PART TIME 4WD INDICATOR LAMP
8	G26 20LB	DOOR LOCK INHIBIT SENSE
9	Z2 18BK/LG	GROUND
10	G10 20LG/RD	SEAT BELT SWITCH SENSE



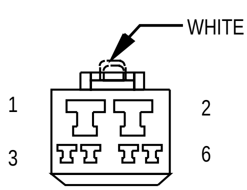
INTAKE AIR TEMPERATURE SENSOR

CAV	CIRCUIT	FUNCTION
1	K167 20BR/YL	SENSOR GROUND
2	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL



JUNCTION BLOCK - C1

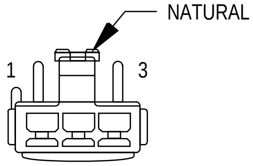
CAV	CIRCUIT	FUNCTION
1	L44 20VT/RD	FUSED RIGHT LOW BEAM OUTPUT
2	-	-
3	F45 20YL/RD	FUSED B(+) ENGINE STARTER MOTOR RELAY
4	-	-
5	L78 18DG/YL ●	FUSED HEADLAMP SWITCH OUTPUT
5	L78 20DG/YL ▲	FUSED HEADLAMP SWITCH OUTPUT
6	F15 20DB/WT ●●	FUSED IGNITION SWITCH OUTPUT (RUN)
7	-	-
8	V6 16DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
9	L33 20RD	FUSED LEFT HIGH BEAM OUTPUT
10	L43 20VT	FUSED LEFT LOW BEAM OUTPUT
11	L34 20RD/OR	FUSED RIGHT HIGH BEAM OUTPUT
12	M1 20PK	FUSED B(+)



JUNCTION BLOCK - C2

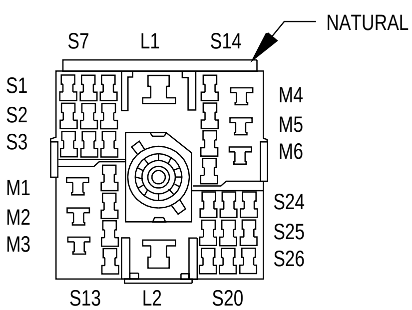
CAV	CIRCUIT	FUNCTION
1	A4 12BK/PK	FUSED B(+)
2	A7 10RD/BK	FUSED B(+)
3	-	-
4	X2 20DG/RD	HORN RELAY OUTPUT
5	F12 18DB/WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
6	L77 20BR/YL ▲	FUSED LEFT INBOARD TAIL LAMP
6	L77 18BR/YL ●	FUSED LEFT INBOARD TAIL LAMP

▲ GAS
● DIESEL
●● 4.0L AND DIESEL



JUNCTION BLOCK - C3

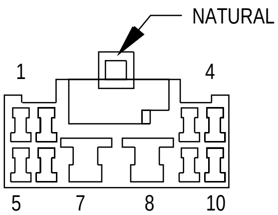
CAV	CIRCUIT	FUNCTION
1	M2 20YL	COURTESY LAMPS DRIVER
2	Z1 20BK ●	GROUND
3	M1 20PK	FUSED B(+)



JUNCTION BLOCK - C4

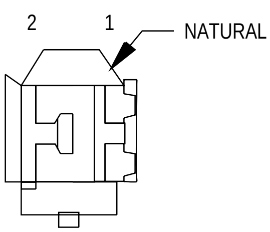
CAV	CIRCUIT	FUNCTION
L1	A31 12BK/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
L2	A21 12DB	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
M1	A41 14YL	FUSED IGNITION SWITCH OUTPUT (ST)
M2	A22 12BK/OR	FUSED IGNITION SWITCH OUTPUT (RUN)
M3	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
M4	V6 16DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
M5	F38 16RD/LB	FUSED B(+)
M6	F30 16RD	CIGAR LIGHTER RELAY OUTPUT
S1	E1 20TN	PANEL LAMPS DIMMER SWITCH SIGNAL
S2	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
S3	L4 16VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
S4	F83 18YL/DG	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
S5	Z1 14BK	GROUND
S6	-	-
S7	L3 16RD/OR	HIGH BEAM INDICATOR DRIVER
S8	F15 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
S9	X12 16RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
S10	-	-
S11	V23 18BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
S12	F20 18WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
S13	F87 20WT/BK	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
S14	-	-
S15	-	-
S16	-	-
S17	-	-
S18	M1 20PK	FUSED B(+)
S19	C16 20LB/YL ●●	FUSED REAR WINDOW DEFFOGGER RELAY OUTPUT
S19	C16 20BK/WT ●●●	FUSED REAR WINDOW DEFFOGGER RELAY OUTPUT
S20	L5 20BK	FUSED IGNITION SWITCH OUTPUT (RUN)
S21	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
S22	X3 20BK/RD	HORN RELAY CONTROL
S23	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
S24	-	
S25	M2 20YL	COURTESY LAMPS DRIVER
S26	C81 20LB/WT	REAR WINDOW DEFOGGER RELAY CONTROL

● OVERHEAD CONSOLE
●● LHD
●●● RHD



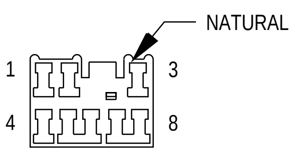
JUNCTION BLOCK - C5

CAV	CIRCUIT	FUNCTION
1	X3 20BK/RD	HORN RELAY CONTROL
2	P76 20OR/YL	COMMON
3	P91 20WT/BK	LEFT/RIGHT POWER MIRROR HORIZONTAL SUPPLY
4	-	-
5	C16 20LB/YL ▲▲	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
6	-	-
7	F35 16RD ▲▲	FUSED B(+)
8	F81 12TN	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
9	P74 20DB	RIGHT POWER MIRROR LEFT MOVEMENT
10	P72 20YL/BK	RIGHT POWER MIRROR UP MOVEMENT



JUNCTION BLOCK - C6

CAV	CIRCUIT	FUNCTION
1	C15 12BK/WT	REAR WINDOW DEFOGGER RELAY OUTPUT
2	F37 14RD/LB ■	FUSED B(+)



JUNCTION BLOCK - C7

CAV	CIRCUIT	FUNCTION
1	P33 16OR/BK ●	DOOR LOCK DRIVER
2	L77 18BR/YL	FUSED LEFT INBOARD TAIL LAMP
3	P91 20WT/BK ●●	LEFT/RIGHT POWER MIRROR HORIZONTAL SUPPLY
4	M1 20PK	FUSED B(+)
5	P34 16PK/BK ●	DOOR UNLOCK DRIVER
6	L78 18DG/YL	FUSED HEADLAMP SWITCH OUTPUT
7	M2 20YL	COURTESY LAMPS DRIVER
8	A6 20RD/OR	FUSED B(+)

● FULL OPTIONS
●● RHD FULL OPTIONS
▲ BASE
▲▲ RHD
■ POWER SEATS

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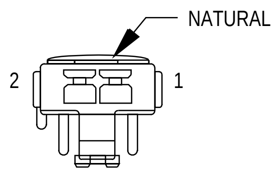
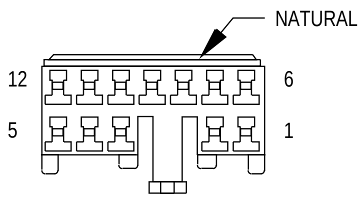


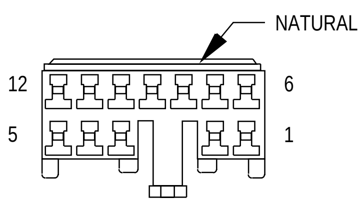
JUNCTION BLOCK - C8

CAV	CIRCUIT	FUNCTION
1	F81 14TN	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	-	-



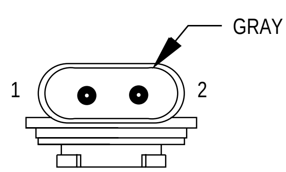
JUNCTION BLOCK - C9 (LHD)

CAV	CIRCUIT		FUNCTION
1	P33 16OR/BK		DOOR LOCK DRIVER
2	P74 20DB		RIGHT POWER MIRROR LEFT MOVEMENT
3	C16 20BK/WT		FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
4	-		-
5	-		-
6	P72 20YL/BK	●	RIGHT POWER MIRROR UP MOVEMENT
7	P91 20WT/BK	●	LEFT/RIGHT POWER MIRROR HORIZONTAL SUPPLY
8	-		-
9	F35 16RD		FUSED B(+)
10	P76 20OR/YL		COMMON
11	Z1 18BK	●	GROUND
11	Z1 16BK	▲	GROUND
12	P34 16PK/BK		DOOR UNLOCK DRIVER



JUNCTION BLOCK - C9 (RHD)

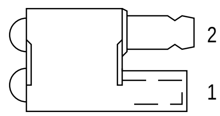
CAV	CIRCUIT		FUNCTION
1	P33 16OR/BK		DOOR LOCK DRIVER
2	P75 20DB/WT		LEFT POWER MIRROR UP MOVEMENT
3	C16 20BK/WT		FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
4	-		-
5	-		-
6	P71 20YL/LB		LEFT POWER MIRROR LEFT MOVEMENT
7	P91 20WT/BK	●	LEFT/RIGHT POWER MIRROR HORIZONTAL SUPPLY
8	-		-
9	-		-
10	P76 20OR/YL		COMMON
11	Z1 16BK	●	GROUND
12	P34 16PK/BK		DOOR UNLOCK DRIVER



LEFT BACK-UP LAMP

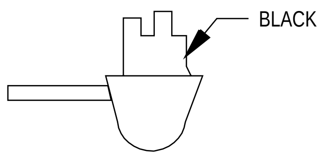
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L10 18BR/LG	BACK-UP LAMP FEED

● POWER MIRROR
▲ FULL OPTIONS



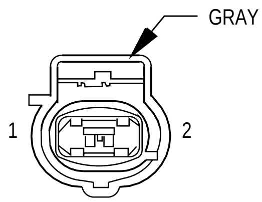
LEFT CITY LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L77 20BR	FUSED LEFT INBOARD TAIL LAMP
2	Z1 20BK	GROUND



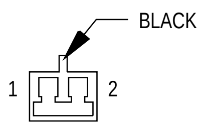
LEFT COURTESY LAMP

CAV	CIRCUIT	FUNCTION
1	M1 18PK	FUSED B(+)
2	M2 18BK/WT	COURTESY LAMPS DRIVER



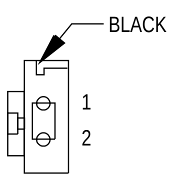
LEFT FOG LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	L39 20LB	FOG LAMP SWITCH OUTPUT



LEFT FRONT DOOR SPEAKER

CAV	CIRCUIT	FUNCTION
1	X85 18BK/RD ●	AMPLIFIED LEFT FRONT DOOR SPEAKER (-)
1	X55 18BR/RD ●●	LEFT FRONT SPEAKER (-)
1	X85 18LG/RD ▲	AMPLIFIED LEFT FRONT DOOR SPEAKER (-)
2	X87 18DG ●	AMPLIFIED LEFT DOOR SPEAKER (+)
2	X53 18DG ●●	LEFT FRONT SPEAKER (+)
2	X87 18LG/BK ▲	AMPLIFIED LEFT DOOR SPEAKER (+)



LEFT FRONT DOOR TWEETER

CAV	CIRCUIT	FUNCTION
1	X85 18LG/RD	AMPLIFIED LEFT FRONT DOOR SPEAKER (-)
2	X87 18LG/BK	AMPLIFIED LEFT DOOR SPEAKER (+)

● 6 SPEAKER LHD
▲ 6 SPEAKER RHD
●● 4 SPEAKER

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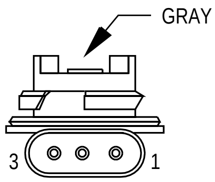
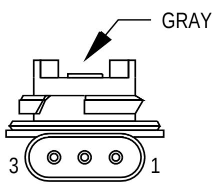


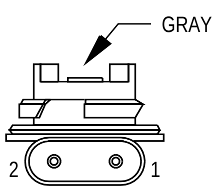
LEFT FRONT PARK/TURN SIGNAL LAMP NO.1 (EXCEPT BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L77 18BR	FUSED LEFT INBOARD TAIL LAMP
3	L61 18LG	LEFT TURN SIGNAL



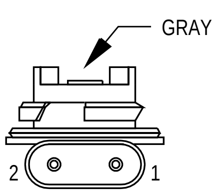
LEFT FRONT PARK/TURN SIGNAL LAMP NO.2 (EXCEPT BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L77 18BR	FUSED LEFT INBOARD TAIL LAMP
3	L61 18LG	LEFT TURN SIGNAL



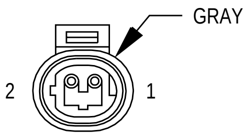
LEFT FRONT TURN SIGNAL LAMP NO.1 (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L61 18LG	LEFT TURN SIGNAL



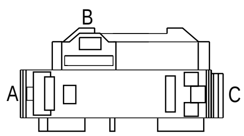
LEFT FRONT TURN SIGNAL LAMP NO.2 (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L61 18LG	LEFT TURN SIGNAL



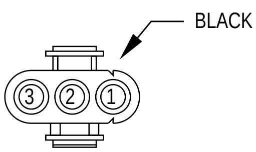
LEFT FRONT WHEEL SPEED SENSOR

CAV	CIRCUIT	FUNCTION
1	B8 18RD/DB	LEFT FRONT WHEEL SPEED SENSOR (-)
2	B9 18RD	LEFT FRONT WHEEL SPEED SENSOR (+)



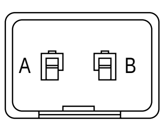
LEFT HEADLAMP

CAV	CIRCUIT	FUNCTION
A	L33 18RD	FUSED LEFT HIGH BEAM OUTPUT
	L33 20RD •	FUSED LEFT HIGH BEAM OUTPUT
B	L43 18VT	FUSED LEFT LOW BEAM OUTPUT
C	Z1 18BK	GROUND



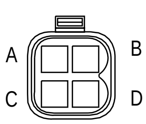
LEFT HEADLAMP LEVELING MOTOR (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L43 18VT	FUSED LEFT LOW BEAM OUTPUT
2	L13 18BR/YL	HEADLAMP ADJUST SIGNAL
3	Z15 18BK/GY	GROUND



LEFT HEATED SEAT BACK

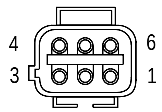
CAV	CIRCUIT	FUNCTION
A	P88 18BR/BK	HEATED SEAT DRIVER
B	Z1 18BK	GROUND



LEFT HEATED SEAT CUSHION

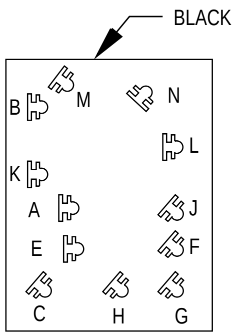
CAV	CIRCUIT	FUNCTION
A	P87 18BK/OR	HEATED SEAT DRIVER
B	P88 18BR/BK	HEATED SEAT DRIVER
C	P141 18TN/LB	LEFT SEAT TEMPERATURE SENSOR INPUT
D	P143 18BK/DG	LEFT SEAT TEMPERATURE SENSOR INPUT

• FOG LAMP



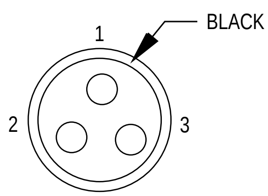
LEFT HEATED SEAT SWITCH

CAV	CIRCUIT	FUNCTION
1	P137 18VT	LEFT SEAT LOW HEAT LED DRIVER
2	-	-
3	Z1 18BK	GROUND
4	F83 18YL/DG	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
5	P139 18VT/WT	LEFT SEAT HIGH HEAT LED DRIVER
6	P133 18TN/DG	LEFT SEAT HEATER SWITCH MUX



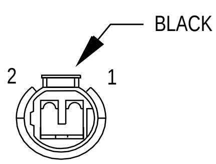
LEFT POWER SEAT SWITCH

CAV	CIRCUIT	FUNCTION
A	F37 14RD	FUSED B(+)
B	Z1 14BK	GROUND
C	-	-
E	P13 14RD/WT	RIGHT POWER SEAT HORIZONTAL FORWARD
F	-	-
G	-	-
H	-	-
J	P11 14YL/WT	LEFT POWER SEAT REAR UP
K	P17 14RD/LB	LEFT POWER SEAT HORIZONTAL FORWARD
L	P15 14YL/LB	LEFT POWER SEAT HORIZONTAL FORWARD
M	P19 14YL/LG	SEAT FRONT UP SWITCH SENSE
N	P21 14RD/LG	LEFT POWER SEAT FRONT DOWN



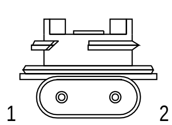
LEFT REAR DOOR JAMB SWITCH

CAV	CIRCUIT	FUNCTION
1	-	-
2	Z1 18BK	GROUND
3	M2 18YL	COURTESY LAMPS DRIVER



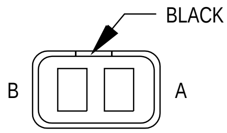
LEFT REAR DOOR LOCK MOTOR

CAV	CIRCUIT	FUNCTION
1	P34 16PK/BK	DOOR UNLOCK DRIVER
2	P33 16OR/BK	DOOR LOCK DRIVER



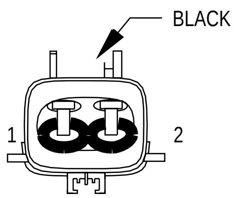
LEFT REAR FOG LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L38 18OR/WT	REAR FOG LAMP FEED



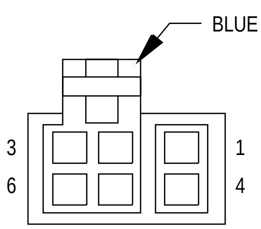
LEFT REAR WHEEL SPEED SENSOR

CAV	CIRCUIT	FUNCTION
A	B3 20LG/DB	LEFT REAR WHEEL SPEED SENSOR (-)
B	B4 20LG	LEFT REAR WHEEL SPEED SENSOR (+)



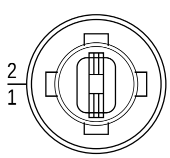
LEFT REAR WINDOW MOTOR

CAV	CIRCUIT	FUNCTION
1	Q13 14DB	POWER WINDOW LEFT REAR B(+) UP
2	Q23 14RD/WT	LEFT REAR WINDOW DRIVER DOWN



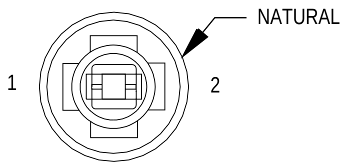
LEFT REAR WINDOW SWITCH

CAV	CIRCUIT	
1	Q13 14DB	POWER WINDOW LEFT REAR B(+) UP
2	Q27 14RD/BK	LEFT REAR WINDOW DRIVER (DOWN)
3	-	
4	Q17 14DB/WT	LEFT REAR WINDOW DRIVER (UP)
5	Q23 14RD/WT	LEFT REAR WINDOW DRIVER DOWN
6	Q1 14YL	POWER WINDOW SWITCH FEED



LEFT REPEATER LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L61 18LG	LEFT TURN SIGNAL
2	Z1 18BK	GROUND

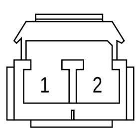


LEFT SIDE MARKER LAMP (EXCEPT BUILT -UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L77 20BR	FUSED LEFT INBOARD TAIL LAMP
2	L61 20LG	LEFT TURN SIGNAL

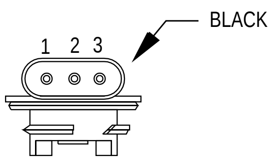
LEFT SOUNDBAR SPEAKER

CAV	CIRCUIT		FUNCTION
A	X57 18BR/LB	●	LEFT REAR SPEAKER (-)
A	X91 16BR/DB	▲	AMPLIFIED LEFT REAR SPEAKER (-)
B	X51 18BR/YL	●	LEFT REAR SPEAKER (+)
B	X93 16BR/YL	▲	AMPLIFIED LEFT REAR SPEAKER (+)



LEFT SPEED CONTROL SWITCH

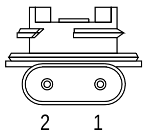
CAV	CIRCUIT	FUNCTION
1	K167 20BR/YL	SENSOR GROUND
2	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL



LEFT TAIL/ STOP LAMP

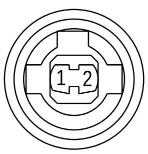
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L77 18BR	FUSED LEFT INBOARD TAIL LAMP
3	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT

● 4 SPEAKER SYSTEM
▲ 6 SPEAKER SYSTEM



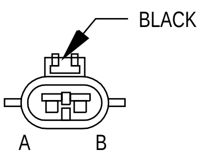
LEFT TURN SIGNAL LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L63 18DG/RD	LEFT TURN SIGNAL



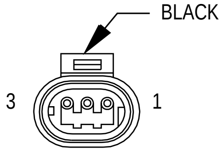
LICENSE LAMP

CAV	CIRCUIT	FUNCTION
1	L78 18BK/YL	FUSED B(+)
2	Z1 18BK	GROUND



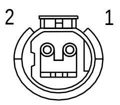
LIFTGATE LOCK MOTOR

CAV	CIRCUIT	FUNCTION
A	P33 16OR/BK	DOOR LOCK DRIVER
B	P34 16PK/BK	DOOR UNLOCK DRIVER



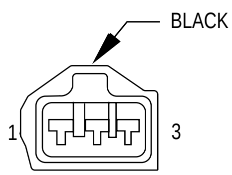
LIFTGATE SWITCH

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	G78 20TN/BK	LIFTGATE AJAR SWITCH SENSE
3	M4 20VT/YL	LIFTGATE COURTESY LAMPS DRIVER



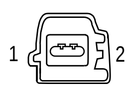
LOW COOLANT SWITCH (DIESEL)

CAV	CIRCUIT	FUNCTION
1	G18 18PK/BK	COOLANT LEVEL SWITCH SENSE
2	K167 20BR/YL	SENSOR GROUND



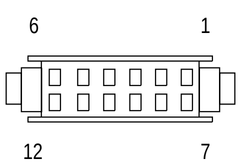
MANIFOLD ABSOLUTE PRESSURE SENSOR

CAV	CIRCUIT	FUNCTION
1	K167 20BR/YL	SENSOR GROUND
2	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
3	K7 20OR	5V SUPPLY



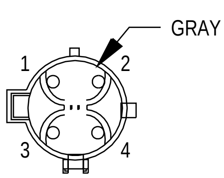
NEEDLE MOVEMENT SENSOR (DIESEL)

CAV	CIRCUIT	FUNCTION
1	K67 18BR/BK	NEEDLE MOVEMENT SENSOR B(+)
2	K68 18LG/YL	NEEDLE MOVEMENT SENSOR B(-)



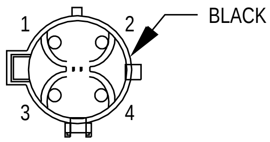
OVERHEAD MODULE

CAV	CIRCUIT	FUNCTION
1	M2 20YL	COURTESY LAMPS DRIVER
2	M1 20PK	FUSED B(+)
3	Z1 20BK	GROUND
4	-	-
5	P55 20DB	DOOR UNLOCK RELAY CONTROL
6	D1 20VT/BR	CCD BUS(+)
7	-	-
8	-	-
9	Z1 20BK	GROUND
10	X3 20BK/RD	HORN RELAY CONTROL
11	P59 20LB/RD	DOOR LOCK CONTROL
12	D2 20WT/BK	CCD BUS(-)



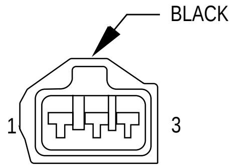
OXYGEN SENSOR 1/1 UPSTREAM

CAV	CIRCUIT	FUNCTION
1	F142 20DG/WT	FUSED AUTOMATIC SHUTDOWN RELAY OUTPUT
2	Z1 18BK	GROUND
3	K167 20BR/YL	SENSOR GROUND
4	K41 18BK/DG	OXYGEN SENSOR 1/1 SIGNAL



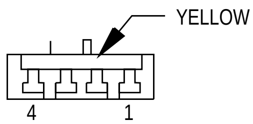
OXYGEN SENSOR 1/2 DOWNSTREAM

CAV	CIRCUIT	FUNCTION
1	F142 20DG/WT	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	Z1 20BK	GROUND
3	K167 18BR/YL	SENSOR GROUND
4	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL



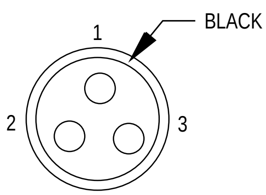
PARK/NEUTRAL POSITION SWITCH (2.5L GAS A/T)

CAV	CIRCUIT	FUNCTION
1	F20 18WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
2	T41 18BK/WT	PARK NETURAL POSITION SWITCH SENSE
3	L10 18BR/LG	TRS REVERSE SENSE



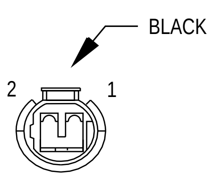
PASSENGER AIRBAG

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	R42 18BK/YL	PASSENGER AIRBAG LINE 2
4	R44 18DG/YL	PASSENGER AIRBAG LINE 1



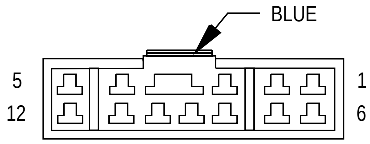
PASSENGER DOOR JAMB SWITCH

CAV	CIRCUIT	FUNCTION
1	M2 18YL	COURTESY LAMPS DRIVER
2	G16 18BK/LB	LEFT DOOR AJAR SWITCH SENSE
3	Z1 18BK	GROUND



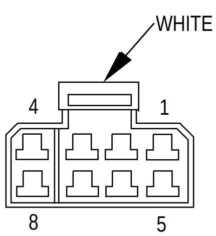
PASSENGER DOOR LOCK MOTOR

CAV	CIRCUIT	FUNCTION
1	P34 16PK/BK	DOOR UNLOCK DRIVER
2	P33 16OR/BK	DOOR LOCK DRIVER



PASSENGER POWER LOCK/WINDOW SWITCH - C1 (FULL OPTIONS)

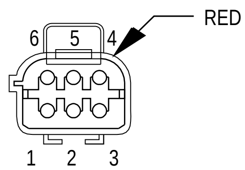
CAV	CIRCUIT	FUNCTION
1	P34 16PK/BK	DOOR UNLOCK DRIVER
2	Q22 14VT	RIGHT FRONT WINDOW DRIVER (DOWN)
3	Q26 14VT/WT	MASTER SWITCH RIGHT FRONT WINDOW MOTOR (DOWN)
4	Q16 14BR/WT	MASTER WINDOW SWITCH RIGHT FRONT DOWN
5	P33 16OR/BK	DOOR LOCK DRIVER
6	-	-
7	-	-
8	-	-
9	Q12 14BR	RIGHT FRONT WINDOW DRIVER (UP)
10	Q1 14YL	POWER WINDOW SWITCH FEED
11	-	-
12	-	-



PASSENGER POWER LOCK/WINDOW SWITCH - C2 (FULL OPTIONS)

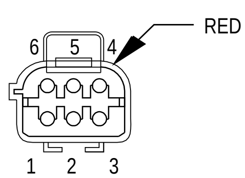
CAV	CIRCUIT	FUNCTION
1	P59 20LB/RD	DOOR LOCK CONTROL
2	P55 20DB/PK ■	DOOR UNLOCK RELAY CONTROL
2	P55 20DB ●●	DOOR UNLOCK RELAY CONTROL
3	P35 20OR/VT ■	LOCK REQUEST
3	P36 18PK/VT ●●	DOOR UNLOCK SWITCH SENSE
4	F81 14TN	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
5	F35 16RD	FUSED B(+)
6	Z1 14BK	GROUND
7	P36 20PK/VT ■	DOOR UNLOCK SWITCH SENSE
7	P35 18OR/VT ●●	LOCK REQUEST
8	G26 20LB	DOOR LOCK INHIBIT SENSE

■ LHD
●● RHD



PASSENGER POWER MIRROR (LHD)

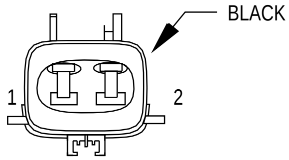
CAV	CIRCUIT		FUNCTION
1	P72 20YL/BK		RIGHT POWER MIRROR UP MOVEMENT
2	P74 20DB	●	RIGHT POWER MIRROR LEFT MOVEMENT
2	P76 20OR/YL	▲	COMMON
3	P91 20WT/BK	●	LEFT/RIGHT POWER MIRROR HORIZONTAL SUPPLY
3	P74 20DB	▲	RIGHT POWER MIRROR LEFT MOVEMENT
4	P76 20OR/YL		COMMON
5	C16 20BK/WT		FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
6	Z1 18BK		GROUND



PASSENGER POWER MIRROR (RHD)

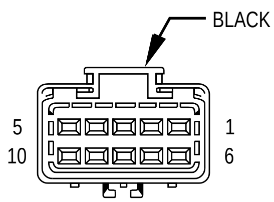
CAV	CIRCUIT		FUNCTION
1	P71 20YL		LEFT POWER MIRROR LEFT MOVEMENT
2	P75 20DB/WT	●	LEFT POWER MIRROR UP MOVEMENT
2	P76 20OR/YL	▲	COMMON
3	P91 20WT/BK	●	LEFT/RIGHT POWER MIRROR HORIZONTAL SUPPLY
3	P75 20DB/RD	▲	LEFT POWER MIRROR UP MOVEMENT
4	P76 20OR/YL		COMMON
5	C16 20BK/WT	●	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
5	C16 20LB/YL	▲	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
6	Z1 16BK		GROUND

● POWER MIRRORS
▲ FULL OPTIONS



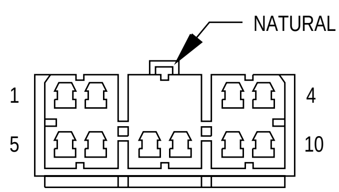
PASSENGER POWER WINDOW MOTOR

CAV	CIRCUIT	FUNCTION
1	Q12 14BR	RIGHT FRONT WINDOW DRIVER (UP)
2	Q22 14VT	RIGHT FRONT DRIVER (DOWN)



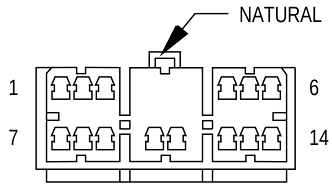
PEDAL POSITION SENSOR (DIESEL)

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	K4 20BK/LB	SENSOR GROUND
4	-	-
5	K151 20WT	LOW IDLE POSITION SENSE
6	-	-
7	K22 20OR/DB	THROTTLE POSITION SENSE SIGNAL
8	K255 20WT/DG	PEDAL POSITION SENSOR
9	-	-
10	K6 20VT/WT	5V OUTPUT



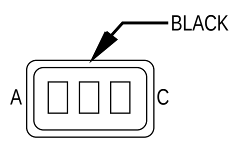
POWER AMPLIFIER - C1

CAV	CIRCUIT	FUNCTION
1	X55 18BR/RD	LEFT FRONT SPEAKER (-)
2	X56 18DB/RD	RIGHT FRONT SPEAKER (-)
3	X58 18DB/OR	RIGHT REAR SPEAKER (-)
4	X60 18DG/RD	RADIO 12V OUTPUT
5	X53 18DG	LEFT FRONT SPEAKER (+)
6	X54 18VT	RIGHT FRONT SPEAKER (+)
7	X51 18BR/YL	LEFT REAR SPEAKER (+)
8	X57 18BR/LB	LEFT SOUND SPEAKER (-)
9	X52 18DB/WT	RIGHT SOUND SPEAKER (+)
10	-	



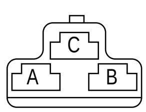
POWER AMPLIFIER - C2

CAV	CIRCUIT	FUNCTION
1	F75 16VT	FUSED B(+)
2	F75 16VT	FUSED B(+)
3	-	-
4	X87 18LG/VT	AMPLIFIED LEFT DOOR SPEAKER (+)
5	X94 18TN/RD	RIGHT REAR SPEAKER (+)
6	X93 18WT/RD	LEFT REAR SPEAKER (-)
7	Z5 16BK/LB	GROUND
8	Z5 16BK/LB	GROUND
9	-	-
10	X80 18LB/BK	AMPLIFIED RIGHT DOOR SPEAKER (-)
11	X82 18LB/RD	AMPLIFIED RIGHT DOOR SPEAKER (+)
12	X85 18BR/RD	AMPLIFIED LEFT DOOR SPEAKER (-)
13	X92 18TN/BK	AMPLIFIED RIGHT SOUND BAR SPEAKER (-)
14	X91 18WT/BK	AMPLIFIED LEFT SOUND BAR SPEAKER (-)



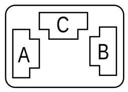
POWER ANTENNA (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
A	X13 18WT	RADIO CHOKE OUTPUT
B	X17 18GY	POWER ANTENNA UP (-)
C	X14 18DG	POWER ANTENNA B(+) DOWN



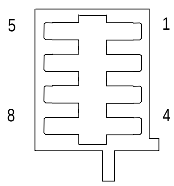
POWER ANTENNA RELAY - C1 (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
A	Z1 18BK	GROUND
B	F34 18TN/BK	FUSED B(+)
C	X60 18DG/RD	RADIO 12V OUTPUT



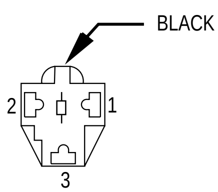
POWER ANTENNA RELAY - C2 (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
A	X13 18WT	RADIO CHOKE OUTPUT
B	X14 18DG	POWER ANTENNA B(+) DOWN
C	X17 18GY	POWER ANTENNA UP (-)



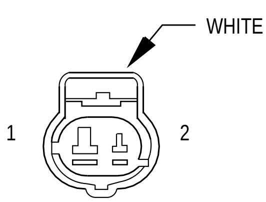
POWER MIRROR SWITCH

CAV	CIRCUIT	FUNCTION
1	Z1 20BK ●	GROUND
1	Z1 14BK ▲	GROUND
2	F83 18YL/DG	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
3	P74 20DB	RIGHT POWER MIRROR LEFT MOVEMENT
4	P72 20YL/BK	RIGHT POWER MIRROR UP MOVEMENT
5	P76 20OR/YL	COMMON
	P76 20OR/YL	COMMON
6	P91 20WT/BK	LEFT/RIGHT POWER MIRROR HORIZONTAL SUPPLY
	P91 20WT/BK	LEFT/RIGHT POWER MIRROR HORIZONTAL SUPPLY
7	P75 20 DB/WT	LEFT MIRROR LEFT DRIVER
8	P71 20YL/LB ●	LEFT MIRROR UP DRIVER
8	P71 20YL ▲	LEFT MIRROR UP DRIVER



POWER OUTLET

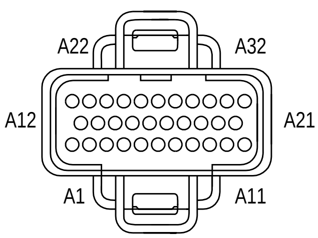
CAV	CIRCUIT	FUNCTION
1	F38 16RD/LB	FUSED B(+)
2	-	-
3	Z1 16BK	GROUND



POWER STEERING PRESSURE SWITCH (2.5L GAS)

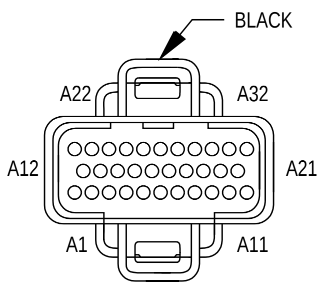
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	K10 18DB/BR	POWER STEERING PRESSURE SWITCH (PSPS) SIGNAL

● RHD
▲ LHD



POWERTRAIN CONTROL MODULE - C1 (DIESEL)

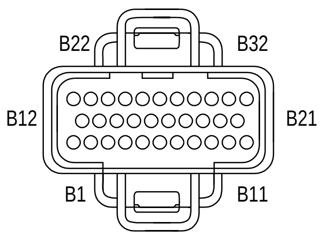
CAV	CIRCUIT	FUNCTION
A1	-	-
A2	A142 16DG/DR	AUTOMATIC SHUT DOWN RELAY OUTPUT
A3	-	-
A4	K167 18BR/YL	SENSOR RETURN
A5	-	-
A6	-	-
A6	-	-
A6	-	-
A7	-	-
A8	K159 18VT/RD	ENGINE SPEED SENSOR SIGNAL
A9	-	-
A10	-	-
A11	-	-
A12	G18 18PK/BK	COOLANT LEVEL SWITCH SENSE
A13	-	-
A14	-	-
A15	-	-
A16	K222 18TN/RD	SECONDARY ENGINE COOLANT TEMP SENSOR
A17	K7 18OR	5 VOLT SUPPLY
A18	G8 18LB/BK	FUEL MONITOR OUTPUT SIGNAL
A19	-	-
A20	-	-
A21	-	-
A22	F16 16RD/LG	FUSED B(+)
A23	-	-
A24	-	-
A25	-	-
A26	-	-
A27	G123 18DG/WT	WATER IN FUEL SENSE
A28	-	-
A29	-	-
A30	-	-
A31	Z12 14BK/TN	GROUND
A32	Z12 14BK/TN	GROUND



POWERTRAIN CONTROL MODULE - C1 (GAS)

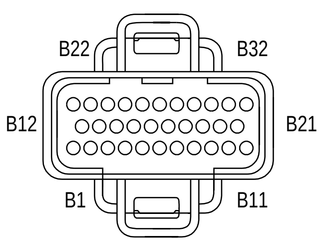
CAV	CIRCUIT	FUNCTION
A1	-	-
A2	F12 18DB/WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
A3	-	-
A4	K167 18BR/YL	SENSOR GROUND
A5	-	-
A6	T41 18BK/WT ●	PARK/NEUTRAL POSITION SWITCH SENSE
A6	Z1 18BK ▲▲	GROUND
A6	T41 18BK/WT ●●	TRANSMISSION RANGE SWITCH SENSE
A7	K19 18GY	IGNITION COIL NO. 1 DRIVER
A8	K24 18GY/BK	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 PRESURE SENSE
A12	K78 18GY ●●	IDLE ACTUATOR
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	A61 16DG/BK	FUSED B(+)
A23	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
A24	K41 18BK/DG	OXYGEN SENSOR 1/1 SIGNAL
A25	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL
A26	-	-
A27	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
A28	-	-
A29	-	-
A30	-	-
A31	Z12 14BK/TN	GROUND
A32	Z12 14BK/TN	GROUND

▲▲ M/T
▲ 2.5L
● 2.5L A/T
●● 4.0L A/T



POWERTRAIN CONTROL MODULE - C2 (DIESEL)

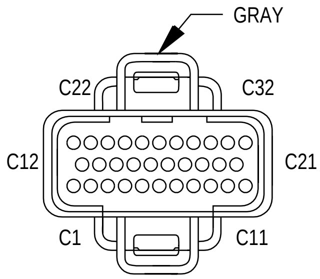
CAV	CIRCUIT	FUNCTION
B1	-	-
B2	-	-
B3	-	-
B4	-	-
B5	-	-
B6	-	-
B7	-	-
B8	-	-
B9	-	-
B10	K20 18DG	GENERATOR FIELD DRIVER (+)
B11	-	-
B12	-	-
B13	-	-
B14	-	-
B15	-	-
B16	-	-
B17	-	-
B18	V66 18RD/LG	WIPER PARK SWITCH SENSE
B19	-	-
B20	-	-
B21	-	-
B22	-	-
B23	G60 18GY/YL	ENGINE OIL PRESSURE SENSOR SIGNAL
B24	-	-
B25	-	-
B26	-	-
B27	G7 18WT/OR	VEHICLE SPEED SENSOR SIGNAL
B28	-	-
B29	-	-
B30	-	-
B31	-	-
B32	-	-



POWERTRAIN CONTROL MODULE - C2 (GAS)

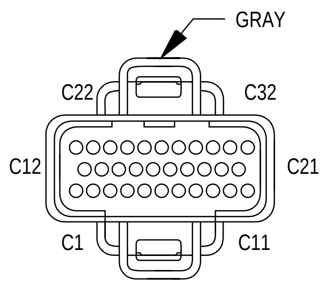
CAV	CIRCUIT	FUNCTION
B1	-	-
B2	-	-
B3	-	-
B4	K11 18WT/DB	FUEL INJECTOR NO.1 DRIVER
B5	K13 18YL/WT	FUEL INJECTOR NO.3 DRIVER
B6	K15 18PK/BK •	FUEL INJECTOR NO.5 DRIVER
B7	-	-
B8	-	-
B9	-	-
B10	K20 18DG	GENERATOR FIELD DRIVER (+)
B11	K54 18OR/BK ••	TORQUE CONVERTER CLUTCH SOLENOID CONTROL
B12	K16 18LG/BK •	FUEL INJECTOR NO.6 DRIVER
B13	-	-
B14	-	-
B15	K12 18TN	FUEL INJECTOR NO. 2 DRIVER
B16	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER
B17	-	-
B18	-	-
B19	-	-
B20	-	-
B21	-	-
B22	-	-
B23	G60 18GY/YL	ENGINE OIL PRESSURE SENSOR SIGNAL
B24	-	-
B25	-	-
B26	-	-
B27	G7 18WT/OR	VEHICLE SPEED SENSOR SIGNAL
B28	-	-
B29	-	-
B30	-	-
B31	K6 18VT/OR	5V SUPPLY
B32	-	-

• 4.0L
•• 2.5L A/T



POWERTRAIN CONTROL MODULE - C3 (DIESEL)

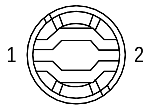
CAV	CIRCUIT	FUNCTION
C1	C103 18DG	A/C SWITCH SIGNAL
C2		
C3		
C4		
C5		
C6		
C7		
C8	G154 18VT/LG	LOW COOLANT INDICATOR DRIVER
C9	G86 18TN/OR	WATER-IN-FUEL INDICATOR DRIVER
C10		
C11		
C12	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
C13		
C14		
C15	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
C16	G55 18OR/BK	ENGINE DISABLE SIGNAL
C17		
C18		
C19		
C20		
C21		
C22	K48 18OR/RD	FAULT SIGNAL
C23	C90 18LG	A/C SWITCH SENSE
C24		
C25	K72 18DG/OR	GENERATOR DRIVER
C26	K226 18DB/LG	FUEL PUMP RELAY CONTROL
C27	D21 18PK	SCI TRANSMIT/ ISO 9141K
C28	D2 18WT/BK	CCD BUS(-)
C29	D20 18LG/BK	SCI RECIEVE
C30	D1 18VT/BR	CCD BUS(+)
C31		
C32		



POWERTRAIN CONTROL MODULE - C3 (GAS)

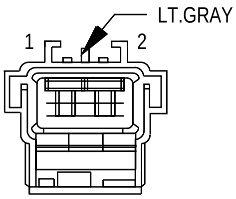
CAV	CIRCUIT		FUNCTION
C1	C13 18DB/OR		A/C COMPRESSOR CLUTCH RELAY CONTROL
C2	C27 18DB/PK		RADIATOR FAN RELAY CONTROL
C3	K51 18DB/YL		AUTOMATIC SHUT DOWN RELAY CONTROL
C4	V36 18TN/RD		SPEED CONTROL VACUUM SOLENOID CONTROL
C5	V35 18LG/RD		SPEED CONTROL VENT SOLENOID CONTROL
C6	-		-
C7	-		-
C8	-		-
C9	-		-
C10	K106 18WT/DG	●	LEAK DETECTION PUMP SOLENOID CONTROL
C11	V32 18YL/RD		SPEED CONTROL POWER SUPPLY
C12	A142 18DG/OR		AUTOMATIC SHUT DOWN RELAY OUTPUT
C13	-		-
C14	K105 18OR	●	LEAK DETECTION PUMP SWITCH SENSE
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		A/C SELECT INPUT
C24	K29 18WT/PK		BRAKE LAMP SWITCH SENSE
C25	K72 18DG/OR		GENERATOR DRIVER
C26	K226 18DB/LG		FUEL LEVEL SENSOR SIGNAL
C27	D21 18PK		SCI TRANSMIT/ ISO 9141K
C28	D2 18WT/BK		CCD BUS (-)
C29	D20 18LG/BK		SCI RECEIVE
C30	D1 18VT/BR		CCD BUS (+)
C31	-		-
C32	V37 18RD/LG		SPEED CONTROL SWITCH SIGNAL

● 4.0L EXCEPT BUILT-UP-EXPORT



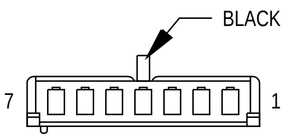
PRNDL ILLUMINATION (A/T)

CAV	CIRCUIT	FUNCTION
1	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
2	Z1 20BK	GROUND



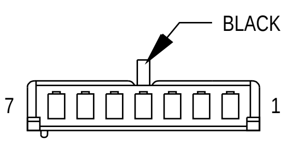
RADIATOR FAN MOTOR

CAV	CIRCUIT	FUNCTION
1	C25 12LB	RADIATOR FAN RELAY OUTPUT
2	Z1 12BK	GROUND



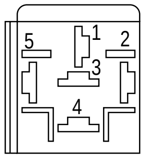
RADIO - C1

CAV	CIRCUIT	FUNCTION
1	X60 16DG/RD	RADIO 12V OUTPUT
2	X51 16BR/YL	LEFT REAR SPEAKER (+)
3	X52 16DB/WT	RIGHT REAR SPEAKER (+)
4	X53 16DG	LEFT FRONT SPEAKER (+)
5	X54 16VT	RIGHT FRONT SPEAKER (+)
6	X57 16BR/LB	LEFT REAR SPEAKER (-)
7	X58 16DB/OR	RIGHT REAR SPEAKER (-)



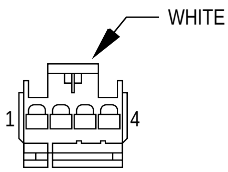
RADIO - C2

CAV	CIRCUIT	FUNCTION
1	-	-
2	X55 16BR/RD	LEFT FRONT SPEAKER (-)
3	X56 16DB/RD	RIGHT FRONT SPEAKER (-)
4	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
5	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
6	X12 16RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
7	M1 20PK	FUSED B(+)



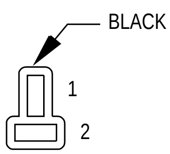
REAR FOG LAMP RELAY (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	F83 18YL/DG	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	L36 18LG/BK	REAR FOG LAMP
3	Z1 18BK	GROUND
4	L38 18BR/WT	REAR FOG LAMP SWITCH OUTPUT
	L38 18BR/WT ●	REAR FOG LAMP SWITCH OUTPUT
5	L25 18BR	FUSED B(+)



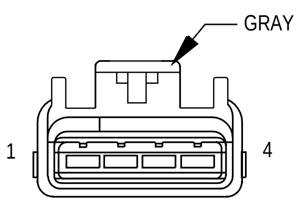
REAR FOG LAMP SWITCH (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	Z15 18BK/GY ▲	GROUND
1	Z15 20BK/GY ●	GROUND
2	L36 18LG/BK	REAR FOG LAMP
3	L38 18BR/WT	REAR FOG LAMP FEED
4	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL



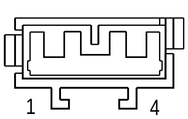
REAR WASHER PUMP

CAV	CIRCUIT	FUNCTION
1	V20 18BK/WT	REAR WASHER MOTOR CONTROL
2	Z1 18BK	GROUND
	Z1 18BK ■	GROUND



REAR WINDOW DEFOGGER SWITCH

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	C80 20DB/WT	REAR WINDOW DEFOGGER RELAY CONTROL
3	C16 20LB/YL	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
4	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL



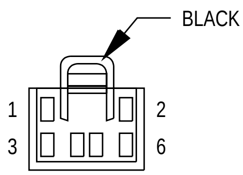
REAR WIPER MOTOR

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	V20 18BK/WT	REAR WASHER MOTOR CONTROL
3	V13 18BR/LG	REAR REAR WIPER MOTOR CONTROL
4	V23 18BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)

■ GAS

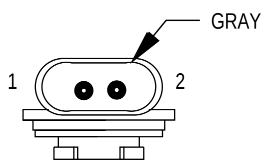
● LHD

▲ RHD



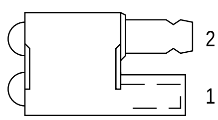
REAR WIPER/
WASHER SWITCH

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	V20 18BK/WT	REAR WASHER MOTOR CONTROLLER
3	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
4	V13 18BR/LG	REAR WIPER MOTOR CONTROL
5	V23 18BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
6	V23 18BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)



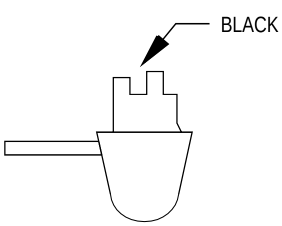
RIGHT BACK-UP
LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L10 18BR/LG	BACK-UP LAMP FEED



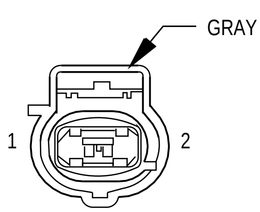
RIGHT CITY
LAMP
(BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L78 20DG/YL	FUSED HEADLAMP SWITCH OUTPUT
2	Z1 20BK	GROUND



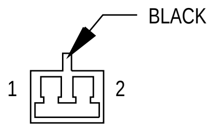
RIGHT COURTESY
LAMP

CAV	CIRCUIT	FUNCTION
1	M1 18PK	FUSED B(+)
2	M2 18BK/WT	COURTESY LAMPS DRIVER



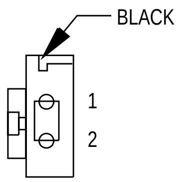
RIGHT
FOG LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	L39 20LB	FOG LAMP SWITCH OUTPUT



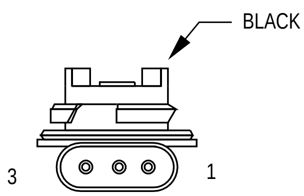
RIGHT FRONT DOOR SPEAKER

CAV	CIRCUIT	FUNCTION
1	X80 18LB/BR •	RIGHT FRONT DOOR SPEAKER (-)
1	X56 18DB/RD ••	RIGHT FRONT DOOR SPEAKER (-)
2	X82 18LB/RD •	RIGHT FRONT DOOR SPEAKER (+)
2	X54 18VT ••	RIGHT FRONT DOOR SPEAKER (+)



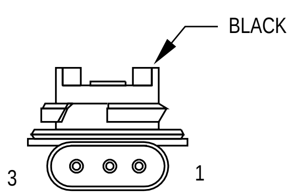
RIGHT FRONT DOOR TWEETER

CAV	CIRCUIT	FUNCTION
1	X80 18LB/BR	RIGHT DOOR TWEETER (-)
2	X82 18LB/RD	RIGHT DOOR TWEETER (+)



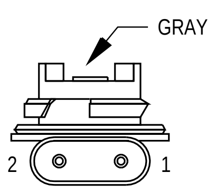
RIGHT FRONT PARK/TURN SIGNAL LAMP NO.1 (EXCEPT BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L78 18DG/YL	FUSED HEADLAMP SWITCH OUTPUT
3	L60 18TN	RIGHT TURN SIGNAL



RIGHT FRONT PARK/TURN SIGNAL LAMP NO.2 (EXCEPT BUILT-UP-EXPORT)

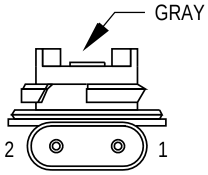
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L78 18DG/YL	FUSED HEADLAMP SWITCH OUTPUT
3	L60 18TN	RIGHT TURN SIGNAL



RIGHT FRONT TURN SIGNAL LAMP NO.1 (BUILT-UP-EXPORT)

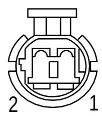
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L60 18TN	RIGHT TURN SIGNAL

• 6 SPEAKER
•• 4 SPEAKER



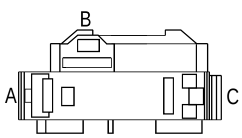
RIGHT FRONT
TURN SIGNAL
LAMP NO.2
(BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L60 18TN	RIGHT TURN SIGNAL



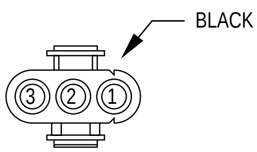
RIGHT FRONT
WHEEL SPEED
SENSOR

CAV	CIRCUIT	FUNCTION
1	B6 18WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
2	B7 18WT	RIGHT FRONT WHEEL SPEED SENSOR (+)



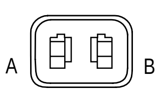
RIGHT
HEADLAMP

CAV	CIRCUIT	FUNCTION
A	L34 18RD/OR	FUSED RIGHT HIGH BEAM OUTPUT
B	L44 18VT/RD	FUSED RIGHT LOW BEAM OUTPUT
C	Z1 18BK	GROUND



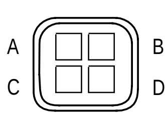
RIGHT HEADLAMP
LEVELING MOTOR
(BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L44 18VT/RD	FUSED RIGHT LOW BEAM OUTPUT
2	L13 18BK	HEADLAMP ADJUST SIGNAL
3	Z15 18BK/GY	GROUND



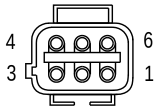
RIGHT HEATED
SEAT BACK

CAV	CIRCUIT	FUNCTION
A	P89 18BR	HEATED SEAT BACK TO CUSHION
B	Z1 18BK	GROUND



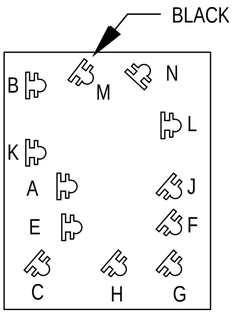
RIGHT HEATED
SEAT CUSHION

CAV	CIRCUIT	FUNCTION
A	P86 18PK/BK	RIGHT HEAT ELEMENT OUTPUT
B	P89 18BR	HEATED SEAT BACK TO CUSHION
C	P141 18TN/LB	SENSOR FEED
D	P144 18BK/YL	RIGHT SENSE INPUT



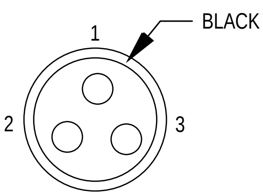
RIGHT HEATED SEAT SWITCH

CAV	CIRCUIT	FUNCTION
1	P138 18VT/LG	RIGHT SEAT LOW HEAT LED DRIVER
2	-	-
3	Z1 18BK	GROUND
4	F83 18YL/DG	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
5	P140 18VT/BK	RIGHT SEAT HIGH HEAT LED DRIVER
6	P134 18TN/RD	RIGHT SEAT HEATER SWITCH MUX



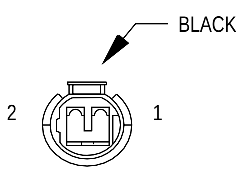
RIGHT POWER SEAT SWITCH

CAV	CIRCUIT	FUNCTION
A	Z1 14BK	GROUND
B	F37 14RD	FUSED B(+)
C	-	-
E	P10 14YL/WT	RIGHT POWER SEAT REAR UP
F	-	-
G	-	-
H	-	-
J	P12 14RD/WT	RIGHT POWER SEAT REAR DOWN
K	P14 14YL/LB	RIGHT POWER SEAT HORIZONTAL FORWARD
L	P16 14RD/LB	RIGHT POWER SEAT HORIZONTAL REARWARD
M	P18 14YL/LG	RIGHT POWER SEAT FRONT UP
N	P20 14RD/LG	RIGHT POWER SEAT FRONT DOWN



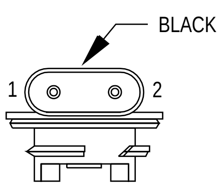
RIGHT REAR DOOR JAMB SWITCH

CAV	CIRCUIT	FUNCTION
1	-	-
2	Z1 18BK	GROUND
3	M2 18YL	COURTESY LAMPS DRIVER



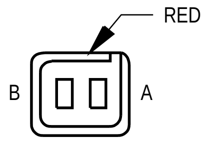
RIGHT REAR DOOR LOCK MOTOR

CAV	CIRCUIT	FUNCTION
1	P34 16PK/BK	DOOR UNLOCK DRIVER
2	P33 16OR/BK	DOOR LOCK DRIVER



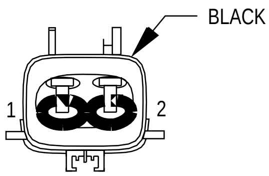
RIGHT REAR FOG LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L38 18OR/WT	REAR FOG LAMP FEED



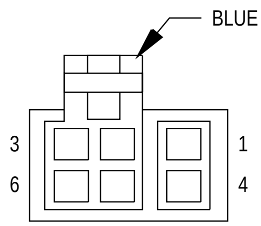
RIGHT REAR WHEEL SPEED SENSOR

CAV	CIRCUIT	FUNCTION
A	B1 20YL/DB	REAR WHEEL SENSOR (-)
B	B2 20YL	REAR WHEEL SENSOR (+)



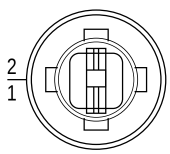
RIGHT REAR WINDOW MOTOR

CAV	CIRCUIT	FUNCTION
1	Q14 14GY	POWER WINDOW RIGHT REAR B(+) UP
2	Q24 14DG	POWER WINDOW RIGHT REAR B(+) DOWN



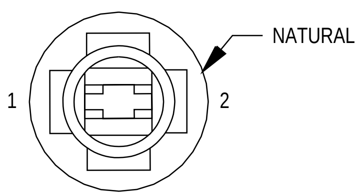
RIGHT REAR WINDOW SWITCH

CAV	CIRCUIT	FUNCTION
1	Q14 14GY	POWER WINDOW RIGHT REAR B(+) UP
2	Q28 14DG/WT	MASTER WINDOW SWITCH RIGHT REAR DOWN
3	-	-
4	Q18 14GY/BK	RIGHT REAR WINDOW DRIVER UP
5	Q24 14DG	RIGHT REAR WINDOW DRIVER DOWN
6	Q1 14YL	POWER WINDOW SWITCH FEED



RIGHT REPEATER LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L60 18GY	RIGHT TURN SIGNAL
2	Z1 18BK	GROUND



RIGHT SIDE MARKER LAMP (EXCEPT BUILT -UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L78 20DG/YL	FUSED HEADLAMP SWITCH OUTPUT
2	L60 20TN	RIGHT TURN SIGNAL

RIGHT SOUNDBAR SPEAKER

CAV	CIRCUIT	FUNCTION
A	X58 18DB/OR	RIGHT REAR AMPLIFIED SPEAKER (-)
A	X92 16TN/BK	AMPLIFIED RIGHT REAR SPEAKER (-)
B	X52 18DB/WT	RIGHT REAR AMPLIFIED SPEAKER (+)
B	X94 16TN/RD	AMPLIFIED RIGHT REAR SPEAKER (+)

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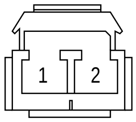
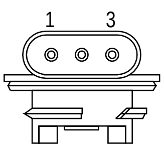


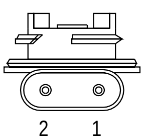
RIGHT SPEED CONTROL SWITCH

CAV	CIRCUIT	FUNCTION
1	K167 20BR/YL	SENSOR GROUND
2	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL



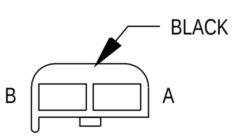
RIGHT TAIL/ STOP LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L78 18DG/YL	FUSED HEADLAMP SWITCH OUTPUT
3	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT



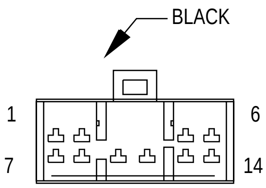
RIGHT TURN SIGNAL LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L62 18BR/RD	RIGHT TURN SIGNAL



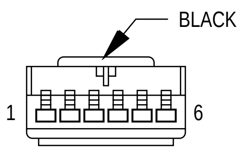
SEAT BELT SWITCH

CAV	CIRCUIT	FUNCTION
A	G10 20LG/RD	SEAT BELT SWITCH SENSE
B	Z1 20BK	GROUND



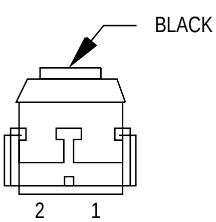
SEAT HEAT INTERFACE MODULE

CAV	CIRCUIT	FUNCTION
1	P133 18TN/DG	LEFT SEAT HEATER SWITCH MUX
2	P141 18TN/LB	SENSOR FEED
3	P86 18PK/BK	RIGHT HEAT ELEMENT OUTPUT
4	F235 16RD	B(+) TO HEATED SEAT MODULE FROM RELAY
5	P87 18BK/OR	LEFT HEAT ELEMENT OUTPUT
6	F235 16RD	B(+) TO HEATED SEAT MODULE FROM RELAY
7	P144 18BK/YL	RIGHT HEAT SENSE INPUT
8	P143 18BK/DG	LEFT HEAT SENSE INPUT
9	P134 18TN/RD	RIGHT SEAT HEATER SWITCH MUX
10	P138 18VT/LG	RIGHT SEAT LOW HEAT LED DRIVER
11	P140 18VT/BK	RIGHT SEAT HIGH HEAT LED DRIVER
12	P137 18VT	LEFT SEAT LOW HEAT LED DRIVER
13	Z2 18BK/LG	GROUND
14	P139 18VT/WT	LEFT SEAT HIGH HEAT LED DRIVER



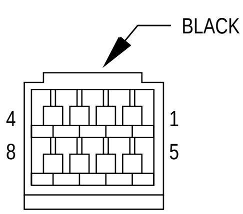
SENTRY KEY IMMOBILIZER MODULE (EXCEPT POLICE/POSTAL)

CAV	CIRCUIT	FUNCTION
1	F1 20DB/GY	FUSED B(+)
2	Z2 20BK/LG	GROUND
3	F87 20WT/BK	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
4	Z2 20BK/LG	GROUND
5	D2 20WT/BK	CCD BUS (-)
6	D1 20VT/BR	CCD BUS (+)



SHIFT LOCK SOLENOID

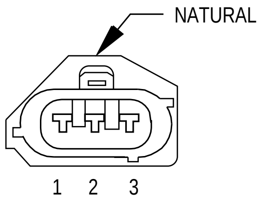
CAV	CIRCUIT	FUNCTION
1	K29 20WT/PK •	BRAKE SWITCH SENSE
1	K29 18WT/PK ••	BRAKE SWITCH SENSE
2	F15 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)



TELL TALE MODULE (DIESEL)

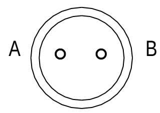
CAV	CIRCUIT	FUNCTION
1	F87 20WT/BK	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
2	-	-
3	-	-
4	K185 20OR/LB	WAIT TO START INDICATOR
5	-	-
6	-	-
7	G86 20TN/OR	WATER IN FUEL INDICATOR DRIVER
8	G154 20VT/LG	LOW COOLANT INDICATOR DRIVER

• LHD
•• RHD



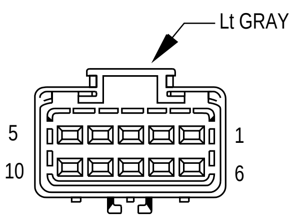
THROTTLE POSITION SENSOR

CAV	CIRCUIT	FUNCTION
1	K167 20BR/YL	SENSOR GROUND
2	K22 18OR/DB ▲	THROTTLE POSITION SENSOR SIGNAL
2	K22 20OR/DB ▲▲	THROTTLE POSITION SENSOR SIGNAL
3	K7 20OR	5 VOLT SUPPLY



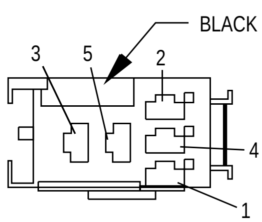
TORQUE CONVERTER CLUTCH SOLENOID (2.5L GAS A/T)

CAV	CIRCUIT	FUNCTION
A	F20 18WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
B	K54 18OR/BK	TORQUE CONVERTER CLUTCH SOLENOID CONTROL



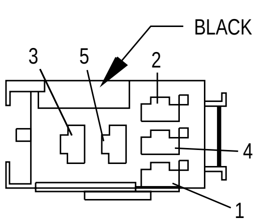
TRAILER TOW CONNECTOR

CAV	CIRCUIT	FUNCTION
1	-	-
2	L74 20LG	BRAKE LAMP SWITCH OUTPUT
3	L10 18BR/LG	BACK-UP LAMP FEED
4	A6 20RD/OR	FUSED B(+)
5	L77 20BR/YL	FUSED LEFT INBOARD TAIL LAMP
6	-	-
7	B40 14LB	TRAILER TOW BRAKE B(+)
8	Z1 14BK	GROUND
9	-	-
10	L73 20YL	BRAKE LAMP SWITCH OUTPUT



TRAILER TOW LEFT TURN RELAY

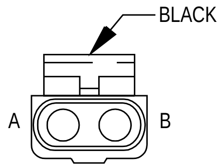
CAV	CIRCUIT	FUNCTION
1	L63 20DG/RD	LEFT TURN SIGNAL
2	L50 20WT/TN	BRAKE LAMP SWITCH OUTPUT
3	A6 20RD/OR	FUSED B(+)
4	-	-
5	L73 20YL	BRAKE LAMP SWITCH OUTPUT



TRAILER TOW RIGHT TURN RELAY

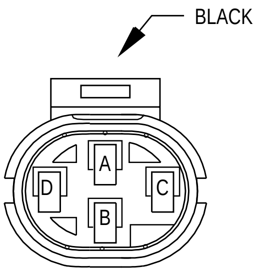
CAV	CIRCUIT	FUNCTION
1	L62 20BK/RD	RIGHT TURN SIGNAL
2	L50 20WT/TN	BRAKE LAMP SWITCH OUTPUT
3	A6 20RD/OR	FUSED B(+)
4	-	-
5	L74 20LG	BRAKE LAMP SWITCH OUTPUT

▲ 2.5L
▲▲ 4.0L



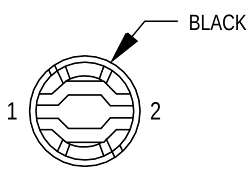
TRANSFER CASE SWITCH (231 4WD)

CAV	CIRCUIT	FUNCTION
A	G107 20BK/RD	4WD SWITCH SENSE (PART-TIME)
B	Z1 18BK ••	GROUND
B	Z1 20BK •	GROUND



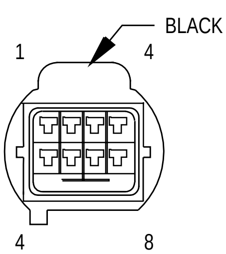
TRANSFER CASE SWITCH (242 4WD)

CAV	CIRCUIT	FUNCTION
A	Z1 18BK	GROUND
B	G106 20BK/WT	4WD SWITCH SENSE (FULL-TIME)
C	-	-
D	G107 20BK/RD	4WD SWITCH SENSE (PART-TIME)



TRANSFER SWITCH ILLUMINATION

CAV	CIRCUIT	FUNCTION
1	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
2	Z1 20BK	GROUND



TRANSMISSION CONTROL ASSEMBLY

CAV	CIRCUIT	FUNCTION
1	T52 20RD/BK	INPUT SPEED SENSOR SIGNAL
2	T60 20OR/WT	TRANSMISSION SOLENOID A
3	T19 20WT	TRANSMISSION SOLENOID B
4	T22 20DB/WT	TRANSMISSION SOLENOID C (LOCK-UP)
5	T31 20VT/LG	INPUT SPEED SENSOR GROUND
6	T13 20DB/BK	OUTPUT SPEED SENSOR GROUND
7	T14 20LG/WT	OUTPUT SPEED SENSOR SIGNAL
8	-	-

• DIESEL
•• GAS

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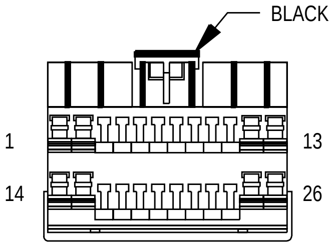
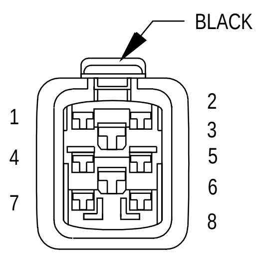


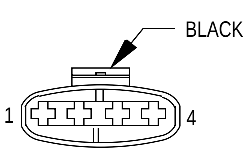
TRANSMISSION CONTROL MODULE (4.0L)

CAV	CIRCUIT	FUNCTION
1	T31 20VT/LG	INPUT SPEED SENSOR GROUND
2	T52 20RD/BK	INPUT SPEED SENSOR SIGNAL
3	T13 20DB/BK	OUTPUT SPEED SENSOR GROUND
4	T14 20LG/WT	OUTPUT SPEED SIGNAL
5	-	-
6	D2 20WT/BK	CCD BUS (-)
7	D1 20VT/BR	CCD BUS (+)
8	-	-
9	T3 18VT	TRS T3 SENSE
10	-	-
11	T22 20DB/WT	SOLENOID CONTROL
12	T19 20WT	SOLENOID A CONTROL
13	T60 20OR/WT	SOLENOID B CONTROL
14	D21 20PK	SCI TRANSMIT/ISO 9141K
15	-	-
16	K167 20BR/YL	SENSOR GROUND
17	K22 20OR/DB	THROTTLE POSITION SENSOR SIGNAL
18	L10 18BR/LG	TRS REVERSE SENSE
19	-	-
20	-	-
21	T42 18VT/WT	TRS T42 SENSE
22	T1 18LG/BK	TRS T1 SENSE
23	K29 20WT/PK	BRAKE SWITCH SENSE
24	Z12 18BK/TN	GROUND
25	M1 20PK	FUSED B(+)
26	F12 18DB/WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)



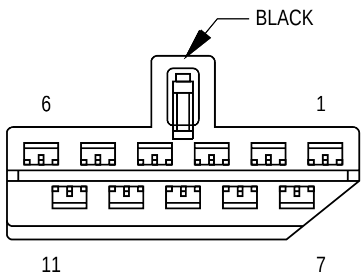
TRANSMISSION RANGE SENSOR (4.0L A/T)

CAV	CIRCUIT	FUNCTION
1	T42 18VT/WT	TRS T42 SENSE
2	T3 18VT	TRS T3 SENSE
3	F20 18WT	FUSED IGNITION SWITCH OUTPUT (START-RUN)
4	T1 18LG/BK	TRS T1 SENSE
5	-	-
6	L10 18BR/LG	TRS REVERSE SENSE
7	T41 20BK/WT	TRS T41 SENSE
8	Z1 18BK	GROUND



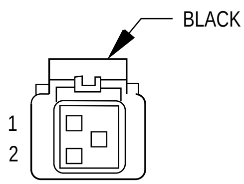
TURBO BOOST PRESSURE SENSOR (DIESEL)

CAV	CIRCUIT	FUNCTION
1	K4 20BK/LB	SENSOR GROUND
2	K21 20BK/RD	INTAKE AIR TEMPERATURE SIGNAL
3	K9 20LB	5V SUPPLY
4	K1 20DG/RD	BOOST PRESSURE SIGNAL



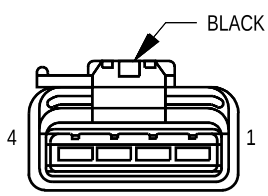
TURN SIGNAL/ HAZARD SWITCH

CAV	CIRCUIT	FUNCTION
1	L60 20TN	RIGHT TURN SIGNAL
2	-	-
3	L62 20BR/RD	RIGHT TURN SIGNAL
4	L55 20RD/WT	COMBINATION FLASHER INPUT
5	L6 20RD/WT	FLASHER OUTPUT
6	L12 20VT/TN	HAZARD FLASHER SELECT SIGNAL
7	-	-
8	-	-
9	L63 20DG/RD	LEFT TURN SIGNAL
10	L61 20LG/WT	LEFT TURN SIGNAL
11	L55 20RD/WT	COMBINATION FLASHER INPUT



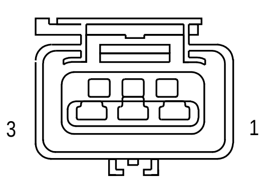
UNDERHOOD LAMP/ MERCURY SWITCH

CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
2	Z1 20BK	GROUND



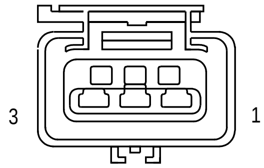
VEHICLE SPEED CONTROL SERVO

CAV	CIRCUIT	FUNCTION
1	V36 18TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
2	V35 18LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
3	V30 20DB/RD	SPEED CONTROL POWER SUPPLY
4	Z1 18BK	GROUND



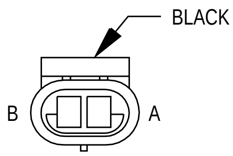
VEHICLE SPEED SENSOR (DIESEL)

CAV	CIRCUIT	FUNCTION
1	K7 18OR	5V SUPPLY
2	K167 18BR/YL	SENSOR RETURN
3	G7 18WT/OR	VEHICLE SPEED SIGNAL



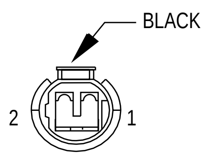
VEHICLE SPEED SENSOR (GAS)

CAV	CIRCUIT	FUNCTION
1	K6 18VT/OR	5V SUPPLY
2	K167 18BR/YL	SENSOR GROUND
3	G7 18WT/OR	VEHICLE SPEED SENSOR SIGNAL



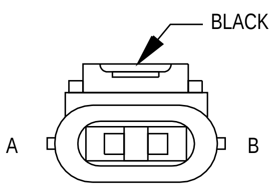
WASHER FLUID LEVEL SWITCH

CAV	CIRCUIT	FUNCTION
A	Z1 20BK	GROUND
B	G29 20BK/LB	WASHER FLUID SWITCH SENSE



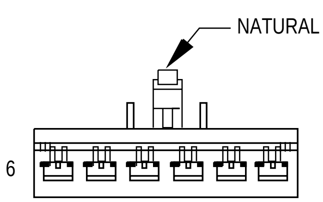
WATER IN FUEL SENSOR (DIESEL)

CAV	CIRCUIT	FUNCTION
1	G123 18DG/WT	WATER IN FUEL SENSOR
2	K167 20BR/YL	SENSOR GROUND



WINDSHIELD WASHER PUMP

CAV	CIRCUIT	FUNCTION
A	V10 18BR	WASHER PUMP CONTROL SWITCH OUTPUT
B	Z1 18BK	GROUND



WIPE/WASH SWITCH

CAV	CIRCUIT	FUNCTION
1	Z1 16BK	GROUND
2	V5 16DG/YL	WIPER PARK SWITCH SENSE
3	V10 18BR	WASHER PUMP CONTROL
4	V3 16BR/WT	LOW SPEED WIPER SWITCH OUTPUT
5	V6 16DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
6	V4 16BR/VT	WIPER SPEED SWITCH OUTPUT

8W-90 CONNECTOR LOCATIONS

DESCRIPTION AND OPERATION

INTRODUCTION

This section provides illustrations identifying component and connector locations in the vehicle. A connector index is provided. Use the wiring diagrams in each section for connector number identification. Refer to the index for the proper figure number.

CONNECTOR/GROUND LOCATIONS

For items that are not shown in this section N/S is placed in the Fig. column.

Connector Name/Number	Color	Location	Fig.
A/C Compressor Clutch (Diesel)	BK	Top of Compressor	13, 14, 15, 37
A/C-Heater Control or Heater Control	BK	At Control Unit	19, 20
A/C High Pressure Switch (Diesel)	GY	At Drier Bottle	6, 37
A/C High Pressure Switch (Gas)		At Drier Bottle	3, 6, 9
A/C Low Pressure Switch (Diesel)		At Switch	33, 34
A/C Low Pressure Switch (Gas)		At Switch	N/S
Airbag Control Module	YL	Under Left Seat	21, 22
Ambient Air Temperature Sensor	BK	Lower Radiator Support	4, 5, 10 ,11, 34
Back-Up Lamp Switch (Diesel)	BK	On Transmission	31, 39
Back-Up Lamp Switch (Gas)	BK	On Transmission	N/S
Battery Temperature Sensor (4.0L, Gas, Diesel)	BK	At Battery (4.0L, 2.5L Diesel)	16
Blend Door Actuator	NAT	T/O at A/C-Heater Control T/O	N/S
Brake Lamp Switch	GY	Near Brake Pedal	12

Connector Name/Number	Color	Location	Fig.
Brake Warning Pressure Switch	BK	At Master Cylinder	2, 5, 8, 11, 32, 35
C100	BK	Near Junction Block	17, 18, 23
C106	BK	Front End Lighting	32, 33
C107 (2.5L)	BK	Rear of Engine Compartment	13, 14
C107 (4.0L)	BK	Rear of Engine Compartment	11, 15
C108	BK	Near Battery	N/S
C109	BK	ABS Connector	N/S
C111 (Diesel)	LT GY	Near Battery	N/S
C114 (Built-Up-Export)	BK	Left Rear Lamp to Front End Lighting Jumper	N/S
C115 (Built-Up-Export)	BK	Right Repeater lamp to Front Lighting Jumper	N/S
C116 (Diesel)	BK	Right Rear of Engine	N/S
C120 (Diesel)	BK	Near Engine	N/S
C200 (LHD)	GY	Left Kick Panel	17, 23
C201 (LHD)	NAT	At Center Console	17, 23
C202 (RHD)	BK	Lower Instrument Panel	18
C203 (RHD)	BL/BK	Lower Instrument Panel	18
C204 (RHD)	WT/ BK	Lower Instrument Panel	18

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
C205	YL	At Center Console	17, 18, 23
C206	BK	At Center Console	17, 21, 22
C207	BK	Near Right Courtesy Lamp	N/S
C208	BK	Near Left Courtesy Lamp	N/S
C300	NAT	At Right Kick Panel	18, 21
C301	WT	At Right Kick Panel	21
C303	BK (LHD) WT (RHD)	Right Kick Panel	N/S
C304	BK	Right Rear Door	N/S
C305	WT	Left Kick Panel	N/S
C306	WT	Left Kick Panel	N/S
C307	WT	Left Kick Panel	N/S
C309	BK	Left Rear Door	N/S
C310	BK	Top of Liftgate	30
C311	BK	Top of Liftgate	30
C312	GY	Top of Liftgate	30
C313	GN	Top of Liftgate	30
C314		At Soundbar	N/S
C316	BK	At Power Seat	N/S
C317	GY	Near Left Front Door Sill	25
C318	GY	Near Right Front Door Sill	N/S
C319	BK	Base of Right B-Pillar	N/S
C320	BK	Base of Left B-Pillar	25
C321	BK	Near Right Tail Lamp	N/S
C322	BK	Near left Tail Lamp	N/S
C323 (Trailer Tow)	BK	Left Side at Trailer Tow Harness	N/S
C324 (RHD)		Right Kick Panel	N/S

Connector Name/Number	Color	Location	Fig.
C325	BK	T/O Near Liftgate Grommet	N/S
C326	BK	In Liftgate Harness	N/S
C327	BK	In Liftgate Harness	N/S
C329	BK	At Passengers Seat	N/S
C330	BK	Near License Lamp	N/S
C331		Lower Radiator Support Pigtail to Ambient Air Temperature Sensor	N/S
C332	BK	At Drivers Seat	N/S
C362	BK	Near Left Power Seat Switch	N/S
C363	BK	Near Right Power Seat Switch	N/S
Camshaft Position Sensor (GAS)	BK	Near Distributor	13, 14, 15
Cargo Lamp/Switch	BK	At Lamp	N/S
Center High Mounted Stop Lamp	BK	Liftgate	N/S
Cigar Lighter	BK	Instrument Panel	19, 20
Clockspring - C1	NAT	Steering Column	24
Clockspring - C2		Steering Column	N/S
Clockspring - C3	YL	Steering Column	N/S
Clutch Interlock Switch	GN	Lower Steering Column	12
Clutch Interlock Switch Jumper	BK	Lower Steering Column	18
Combination Flasher	BK	Near Headlamp Delay Module	17, 18
Compass	BK	Overhead Console	29

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Controller Anti-Lock Brake	BK	At Controller Anti-Lock Brake	8, 9, 32, 33
Crankshaft Position Sensor (Diesel)	BK	Rear of Engine	N/S
Crankshaft Position Sensor (Gas)	BK	Near Fuel Rail	16
Data Link Connector	BK	Lower Instrument Panel	17, 18
Daytime Running Lamp Module (Except Built-Up-Export)	BK	Near Blower Motor	6
Diode Module (Built-Up-Export)	BK	Instrument Panel	N/S
Dome Lamp (Base/Police)		At Lamp	N/S
Dome Lamps Switch (Midline)	BK	At Switch	N/S
Driver Door Jamb Switch	BK	At Switch	N/S
Driver Door Lock Motor		In Driver Door	28
Driver Power Lock/Window Switch-C1	BL	In Driver Door	28
Driver Power Door Lock/ Window Switch-C2	WT	In Driver Door	28
Driver Power Mirror	RD	At Mirror	28
Driver Power Window Motor	BK	In Driver Door	28
Duty Cycle EVAP/Purge Solenoid (GAS)	BK	Rear of Engine Compartment	3, 4, 9, 10
Electronic Vacuum Modulator (Diesel)		At Modulator	N/S
Engine Control Module - C1 (Diesel)	BK	Rear of Engine Compartment	N/S

Connector Name/Number	Color	Location	Fig.
Engine Control Module - C2 (Diesel)	BK	Rear of Engine Compartment	N/S
Engine Coolant Temperature Sensor (GAS)	BK	Front of Engine (GAS)	13, 14, 15
Engine Coolant Temperature Sensor NO.1 (Diesel)	BK	Near Crankshaft Position Sensor T/O	N/S
Engine Coolant Temperature Sensor NO.2 (Diesel)	BK	Near Generator T/O	36, 37
Engine Oil Pressure Sensor	BK	Right Rear of Engine	13, 15, 38
Engine Starter Motor	BK	At Starter	13, 14, 15, 38
EVAP Leak Detection Pump (Except Built-Up-Export)		Rear of Engine Compartment	N/S
Extended Idle Switch (Police Package)	WT	Instrument Panel Harness Near T/O to Power Outlet	N/S
Front Fog Lamp Switch	BK	Instrument Panel	19, 20
Front Wiper Motor	BK	At Wiper Motor	6, 7
Fuel Heater (Diesel)		Left Rear Engine Compartment	32, 33
Fuel Injector No. 1	BK	At Injector	13, 14, 15
Fuel Injector No. 2	BK	At Injector	13, 14, 15
Fuel Injector No. 3	BK	At Injector	13, 14, 15
Fuel Injector No. 4	BK	At Injector	13, 14, 15
Fuel Injector No. 5	BK	At Injector	15
Fuel Injector No. 6	BK	At Injector	15
Fuel Level Sensor (Diesel)	BK	At Sensor	N/S

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Fuel Pump Module (Diesel)	BK	Left Side of Engine	36, 37
Fuel Pump Module (GAS)	BK	At Fuel Pump Module	N/S
G100		Near Battery	16
G101		Near Starter	13, 14, 15, 16
G102		Near Engine Connector C107	34, 35
G103 (4.0L)		Near Ignition Coil	16
G104		Body Ground (VM Diesel) From Negative Battery Cable	N/S
G105		Engine Ground (VM Diesel) From Negative Battery Cable	N/S
G106		Near Powertrain Control Module	2, 3, 8, 9, 32, 33
G107		Near Glove Box Lamp Switch	17, 18
G108		Near Headlamp Switch	17, 18
G200		Near Air Bag Control Module	21, 22
G300		Near Air Bag Control Module	N/S
G301		Near Power Amplifier	25
G302		Near Left Tail Lamp	27
G303		Between Right Tail Lamp and Power Amplifier	N/S
G304		Near Rear Window Defogger Grid	N/S
G305		In Power Seat Harness	N/S
G306 (Heated Seats)		In Power Seat Harness	N/S
G Switch	BK	Under Rear Seat	26

Connector Name/Number	Color	Location	Fig.
Generator	BK	At Generator	13, 14, 16, 36, 37
Glow Plug Relay (Diesel)		Left Rear Engine Compartment	32, 33
Headlamp Beam Select Switch	BK	On Steering Column	24
HeadLamp Delay Module	BK	Near Headlamp Switch	17, 18
Headlamp Leveling Switch (Built-Up-Export)	BK	At Switch	N/S
Headlamp Switch - C1	BK	At Headlamp Switch	17, 18, 19, 20
Headlamp Switch - C2	BK	At Headlamp Switch	17, 18, 19, 20
Heated Seat Relay		At Passengers Seat	N/S
HVAC Unit	BK	On HVAC Tub	21
Idle Air Control Motor	BK	At Throttle Body	13, 14,16
Ignition Coil	BK	Front of Engine	13, 14, 16
Ignition Switch-C1	BK	Steering Column	24
Ignition Switch-C2	GN	Steering Column	24
Instrument Cluster - C1	BK	At Instrument Cluster	17, 18
Instrument Cluster - C2	BK	At Instrument Cluster	17, 18
Intake Air Temperature Sensor	GY	At Intake Manifold	13, 15,16
Junction Block - C1	NAT	At Junction Block	12, 29
Junction Block - C2	WT	At Junction Block	12, 29
Junction Block - C3	NAT	At Junction Block	29
Junction Block - C4	NAT	At Junction Block	18, 22, 29
Junction Block - C5	NAT	At Junction Block	29

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Junction Block - C6	NAT	At Junction Block	29
Junction Block - C7	NAT	At Junction Block	29
Junction Block - C8	NAT	At Junction Block	29
Junction Block - C9	NAT	At Junction Block	29
Left Back-Up Lamp	GY	At Back-Up Lamp	N/S
Left City Lamp (Built-Up-Export)		At Lamp	N/S
Left Courtesy Lamp	BK	At Courtesy Lamp	N/S
Left Fog Lamp	GY	At Fog Lamp	1
Left Front Door Speaker	BK	At Speaker	28
Left Front Door Tweeter	BK	Left Front Door	28
Left Front Park/Turn Signal Lamp NO.1 (Except Built-Up-Export)	GY	At Lamp	1
Left Front Park/Turn Signal Lamp NO.2 (Except Built-Up-Export)	GY	At Lamp	1
Left Front Turn Signal Lamp NO.1 (Built-Up-Export)	GY	At Lamp	N/S
Left Front Turn Signal Lamp NO.2 (Built-Up-Export)	GY	At Lamp	N/S
Left Front Wheel Speed Sensor	GY	Left Engine Compartment	8, 9, 32, 33
Left Headlamp		At Headlamp	1
Left Headlamp Leveling Motor (Built-Up-Export)	BK	At Headlamp	32, 33
Left Heated Seat Back		At Seat	N/S

Connector Name/Number	Color	Location	Fig.
Left Heated Seat Cushion		At Seat	N/S
Left Heated Seat Switch		At Seat	N/S
Left Power Seat Switch	BK	At Switch	N/S
Left Rear Door Jamb Switch	BK	At Switch	N/S
Left Rear Door Lock Motor	BK	In Left Rear Door	28
Left Rear Fog Lamp (Built-Up-Export)		At Lamp	N/S
Left Rear Wheel Speed Sensor	BK	Under Rear Seat	26
Left Rear Window Motor	BK	In Left Rear Door	28
Left Rear Window Switch	BL	In Left Rear Door	28
Left Repeater Lamp (Built-Up-Export)		At Lamp	N/S
Left Side Marker Lamp (Except Built-Up-Export)	NAT	At Lamp	1
Left Soundbar Speaker	BK	At Soundbar	N/S
Left Speed Control Switch		On Steering Wheel	N/S
Left Tail/Stop Lamp	BK	At Lamp	N/S
Left Turn Signal Lamp		At Rear Lamp	N/S
License Lamp	WT	At Lamp	30
Liftgate Lock Motor	BK	Liftgate	30
Liftgate Switch	BK	Liftgate	30
Left Vanity Lamp	BK	At Lamp	29
Low Coolant Switch (Diesel)		Right Rear Engine Compartment	33, 34

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Manifold Absolute Pressure Sensor	BK	At Throttle Body	13, 14, 15
Needle Movement sensor (Diesel)		Left Front of Engine	36
Overhead Module		At Overhead Console	29
Oxygen Sensor 1/1 Upstream	GY	Left Side of Engine at Exhaust	13, 14, 15
Oxygen Sensor 1/2 Downstream	BK	T/O Near Vehicle Speed Sensor	31
Park Brake Switch	BK	At Park Brake Lever	21, 22
Park/Neutral Position Switch (2.5L Gas A/T)	BK	On Transmission	N/S
Passenger Airbag	YL	Behind Instrument Panel	17, 18, 19, 20
Passenger Door Jamb Switch	BK	At Switch	N/S
Passenger Door Lock Motor	BK	In Front Passenger Door	28
Passenger Power Lock/Window Switch - C1	BL	In Front Passenger Door	28
Passenger Power Lock/Window Switch - C2	WT	In Front Passenger Door	28
Passenger Power Mirror	RD	At Mirror	28
Passenger Power Window Motor	BK	In Passenger Door	28
Pedal Position Sensor (Diesel)	BK	At Acclerator Pedal	N/S
Power Amplifier - C1	NAT	Under Rear Seat Left Side	N/S
Power Amplifier - C2	NAT	Under Rear Seat Left Side	N/S

Connector Name/Number	Color	Location	Fig.
Power Antenna (Built-Up-Export)	BK	Rear of Engine Compartment	N/S
Power Antenna Relay - C1 (Built-Up-Export)		Rear of Engine Compartment	N/S
Power Antenna Relay - C2 (Built-Up-Export)		Rear of Engine Compartment	N/S
Power Mirror Switch		In Drivers Door	N/S
Power Outlet	BK	Instrument Panel	19, 20
Power Steering Pressure Switch (2.5L)	WT	Front of Engine	13, 14
Powertrain Control Module - C1 (Diesel)		Right Fender Side Shield	N/S
Powertrain Control Module - C1 (GAS)	BK	Left Fender Side Shield	2, 6, 7
Powertrain Control Module - C2 (Diesel)		Right Fender Side Shield	N/S
Powertrain Control Module - C2 (GAS)		Left Fender Side Shield	2, 6, 7
Powertrain Control Module - C3 (Diesel)	GY	Right Fender Side Shield	N/S
Powertrain Control Module C3 (GAS)	GY	Left Fender Side Shield	2, 6, 7
PRNDL Illumination	BK	Steering Co;umn	N/S
Radiator Fan Motor	LT GY	At Radiator	8, 9
Radio - C1	BK	Behind Radio	19, 20
Radio - C2	BK	Behind Radio	19, 20
Rear Fog Lamp Relay (Built-Up-Export)		Instrument Panel	18

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Rear Fog Lamp Switch (Built-Up-Export)	WT	Instrument Panel	N/S
Rear Washer Pump	BK	At Washer Reservoir	6, 7, 32, 33
Rear Window Defogger Switch	GY	Instrument Panel	19, 20
Rear Wiper Motor		Liftgate	30
Rear Wiper/ Washer Switch	BK	Instrument Panel	19, 20
Right Back-Up Lamp	GY	At Lamp	N/S
Right City Lamp (Built-Up-Export)		At Lamp	N/S
Right Courtesy Lamp	BK	At Lamp	N/S
Right Fog Lamp	GY	At Lamp	1
Right Front Door Speaker	BK	At Speaker	28
Right Front Door Tweeter	BK	At Right Front Door	28
Right Front Park/Turn Signal Lamp NO.1 (Except Built-Up-Export)	BK	At Lamp	1
Right Front Park/Turn Signal lamp NO.2 (Except Built-Up-Export)	BK	At Lamp	1
Right Front Turn Signal Lamp NO.1 (Built-Up-Export)	GY	At Lamp	N/S
Right Front Turn Signal Lamp NO.2 (Built-Up-Export)	GY	At Lamp	N/S
Right Front Wheel Speed Sensor		Right Engine Compartment	10, 11, 34, 35
Right Headlamp		At Headlamp	1

Connector Name/Number	Color	Location	Fig.
Right Headlamp Leveling Motor (Built-Up-Export)	BK	At Headlamp	N/S
Right Heated Seat Back		At Seat	N/S
Right Heated Seat Cushion		At Seat	N/S
Right Heated Seat Switch		At Seat	N/S
Right Power Seat Switch	BK	At Power Seat	N/S
Right Rear Door Jamb Switch	BK	At Switch	N/S
Right Rear Door Lock Motor	BK	In Right Rear Door	28
Right Rear Fog Lamp (Built-Up-Export)	BK	At Lamp	N/S
Right Rear Wheel Speed Sensor	RD	Under Rear Seat	26
Right Rear Window Motor	BK	In Right Rear Door	28
Right Rear Window Switch	BL	In Right Rear Door	28
Right Repeater Lamp (Built-Up-Export)		At Lamp	N/S
Right Side Marker Lamp (Except Built-Up-Export)	NAT	At Lamp	1
Right Sound Bar Speaker		At Soundbar	N/S
Right Speed Control Switch		On Steering Wheel	N/S
Right Tail/Stop Lamp		At Lamp	27
Right Turn Signal Lamp		At Rear Lamp	N/S
Rear Window Defogger Grid	BK	Liftgate	30
Right Vanity Lamp	BK	At Lamp	28

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Seat Belt Switch	BK	Near Center Console	21, 22
Seat Heat Interface Module	BK	At Passengers Seat	N/S
Sentry Key Immobilizer Module (Except Police/Postal)	BK	Instrument Panel	N/S
Shift Lock Solenoid	BK	Lower Steering Column	24
Tell Tale Module (Diesel)	BK	Near Instrument Panel Connections	N/S
Throttle Position Sensor	NAT	On Throttle Body	13, 14, 15, 16, 36
Torque Converter Clutch Solenoid (2.5L Gas A/T)		Engine Harness Near T/O for Park Neutral Switch	N/S
Trailer Tow Connector	LT GY	Trailer Tow Wiring Harness	N/S
Trailer Tow Left Turn Relay	BK	Trailer Tow Wiring Harness	N/S
Trailer Tow Right Turn Relay	BK	Trailer Tow Wiring Harness	N/S
Transfer Case Switch (231)	BK	On Transfer Case	31, 39
Transfer Case Switch (242)	BK	On Transfer Case (4.0L A/T Only)	31
Transfer Switch Illumination	BK	Near Center Console	N/S

Connector Name/Number	Color	Location	Fig.
Transmission Control Assembly	BK	On Transmission	N/S
Transmission Control Module (4.0L)	BK	Under Center Instrument Panel	12
Transmission Range Sensor (4.0L A/T)	BK	On Transmission	N/S
Turbo Boost Pressure Sensor (Diesel)	BK	Left Side of Engine	N/S
Turn Signal/ Hazard Switch	BK	Steering Column	24
Underhood Lamp/Mercury Switch	BK	At Lamp	4, 5, 10, 11, 34, 35
Vehicle Speed Control Servo	BK	At Speed Control Servo	4,7
Vehicle Speed Sensor		On Transmission (2WD) On Transfer Case (4WD)	31, 39
Washer Fluid Level Switch	BK	At Washer Reservoir	6, 7, 32, 33
Water In Fuel Sensor (Diesel)	BK	At Fuel Heater	N/S
Windshield Washer Pump	BK	At Washer Reservoir	6, 7, 32, 33
Wiper/Wash Switch	NAT	Steering Column	24

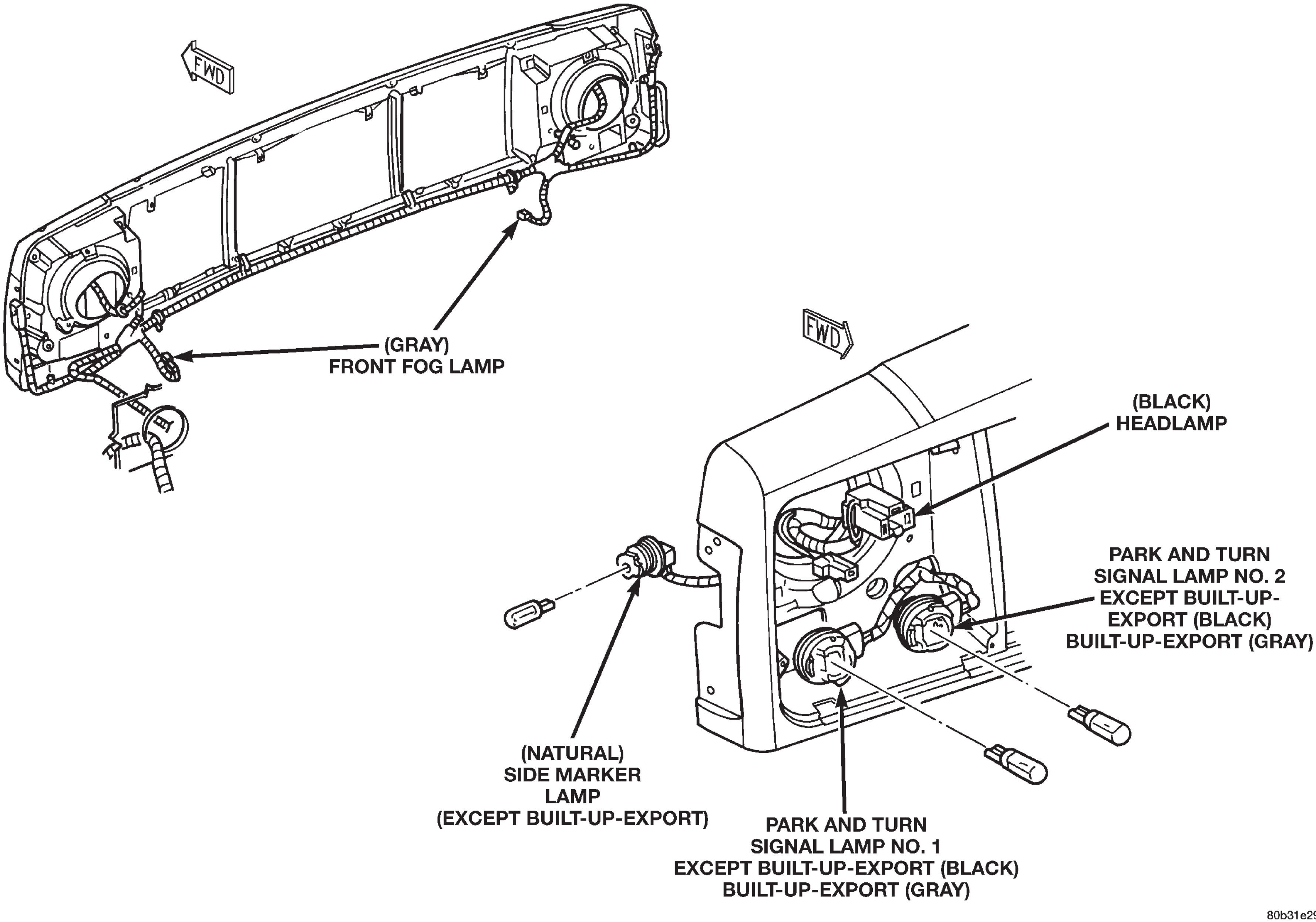


Fig. 1 Front End Lighting (Right Side Shown, Left Side Similar)

DESCRIPTION AND OPERATION (Continued)

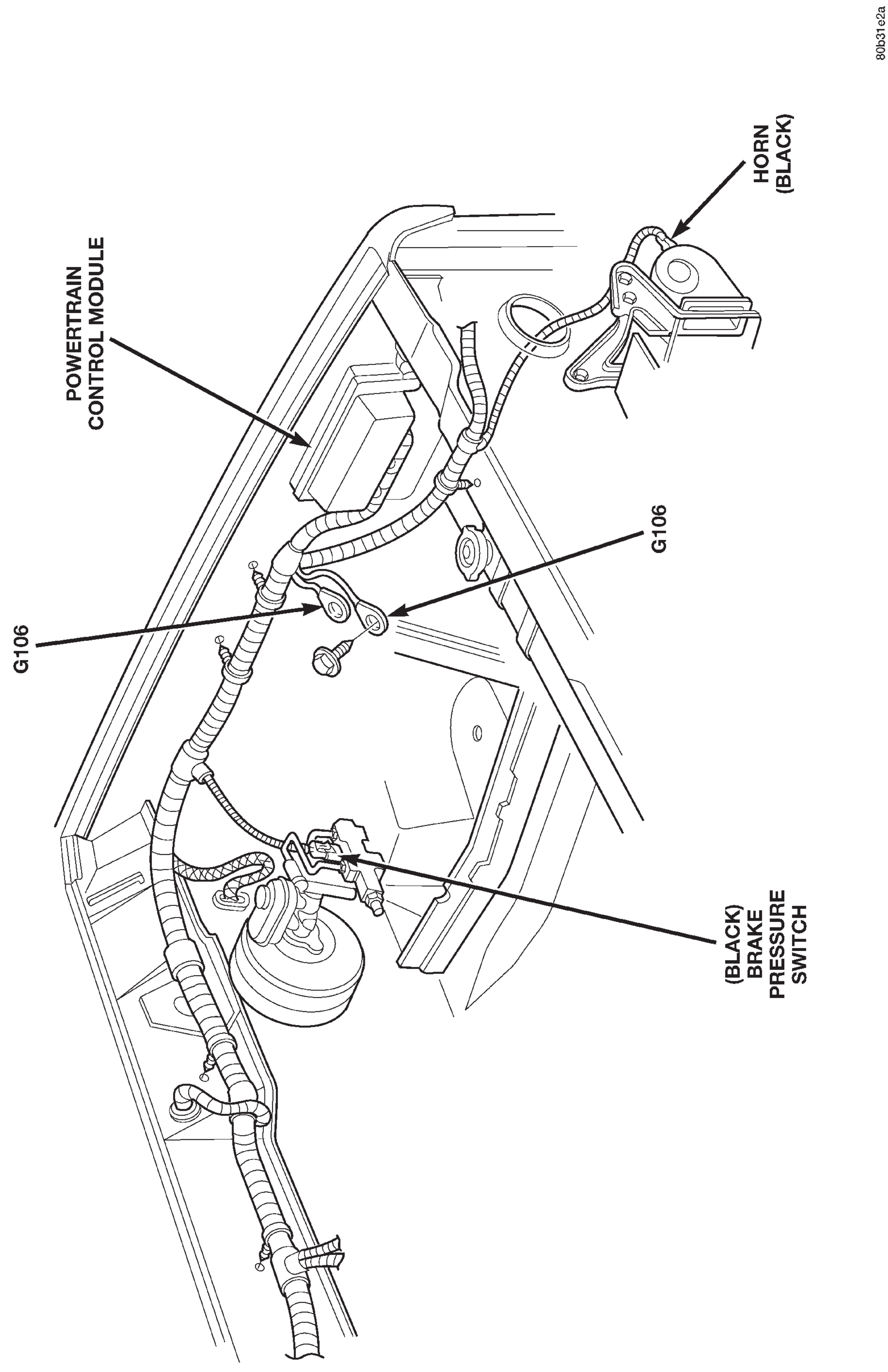


Fig. 2 Left Engine Compartment 2.5L Engine LHD

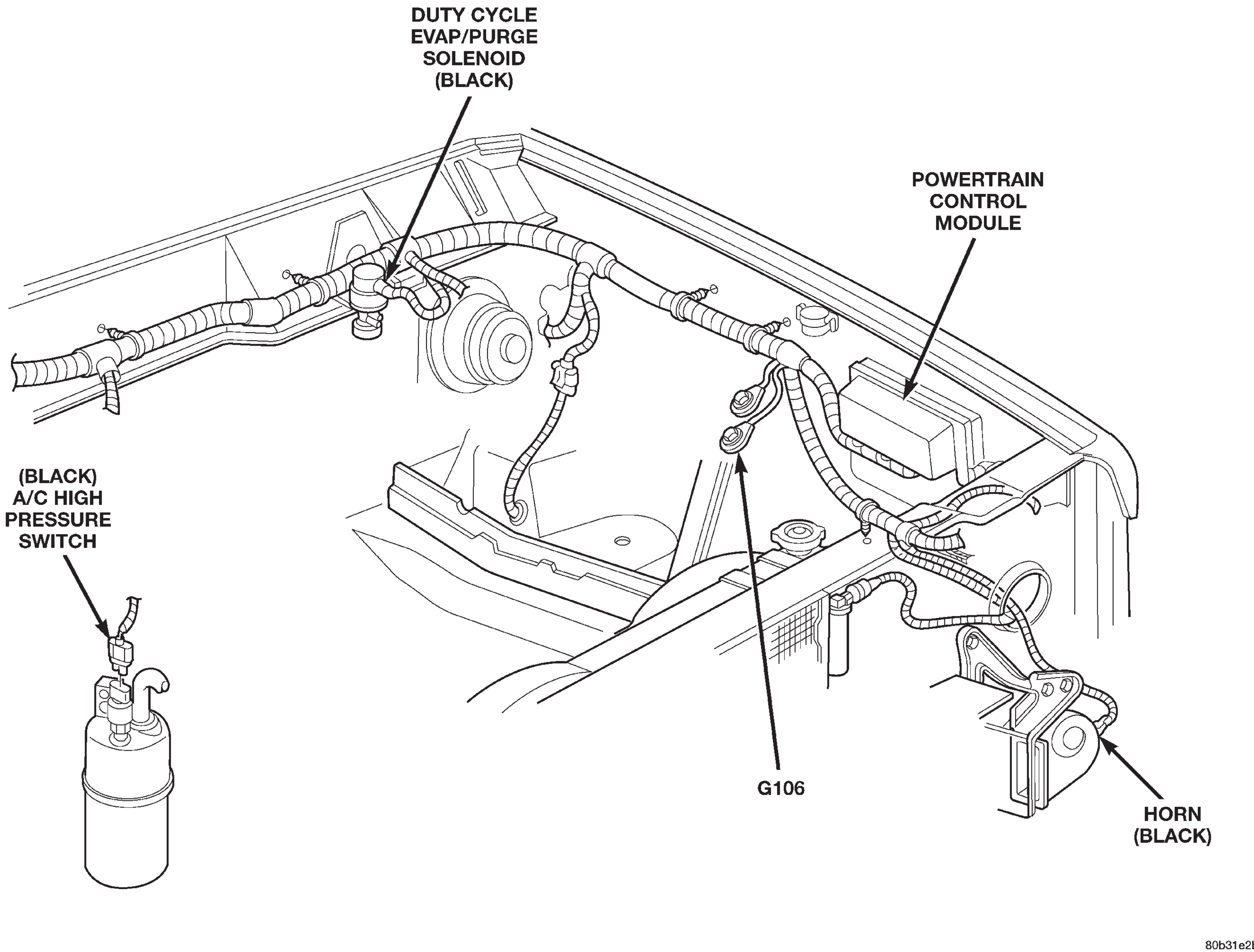


Fig. 3 Left Engine Compartment 2.5L Engine RHD

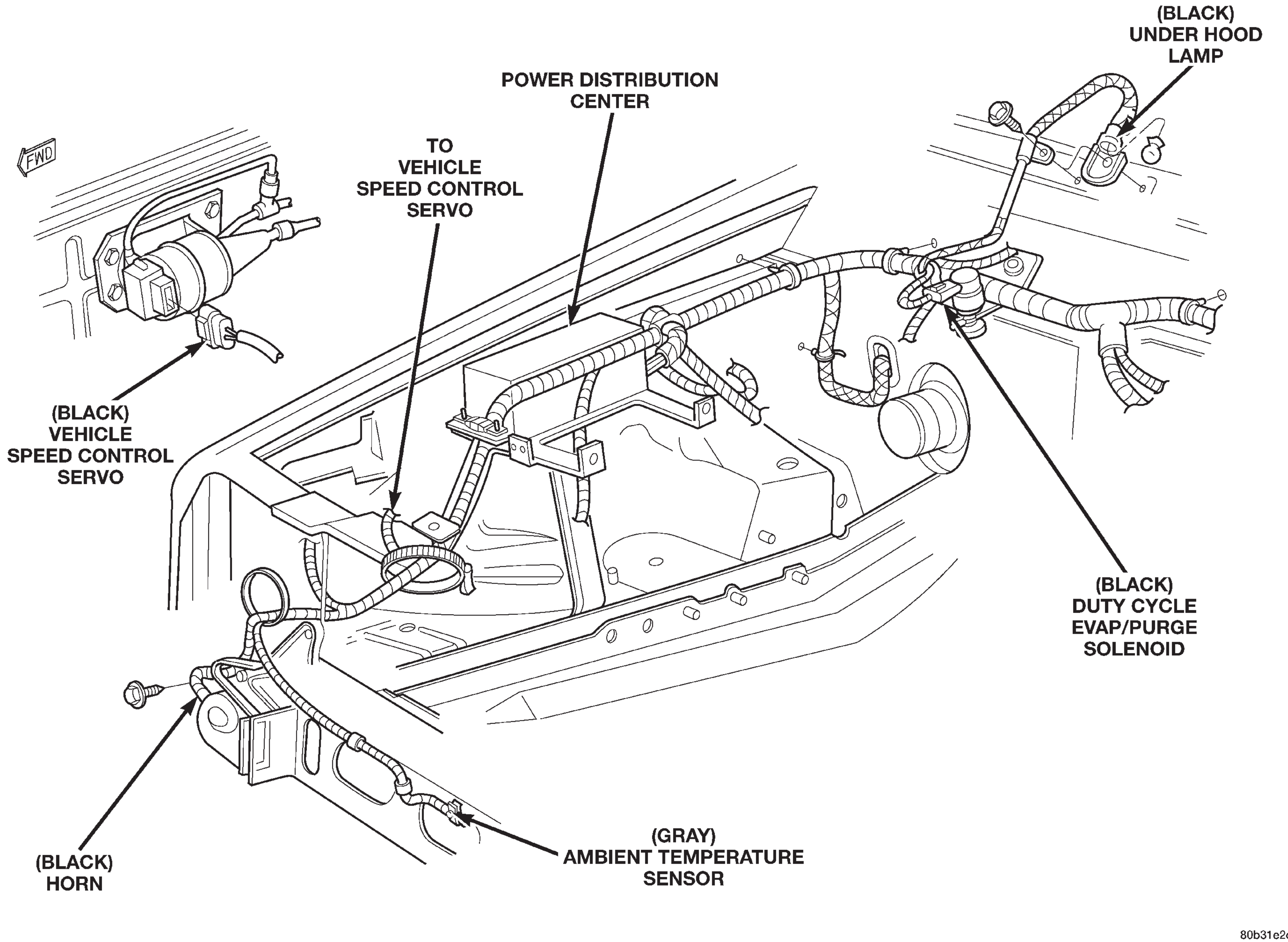


Fig. 4 Right Engine Compartment 2.5L Engine LHD

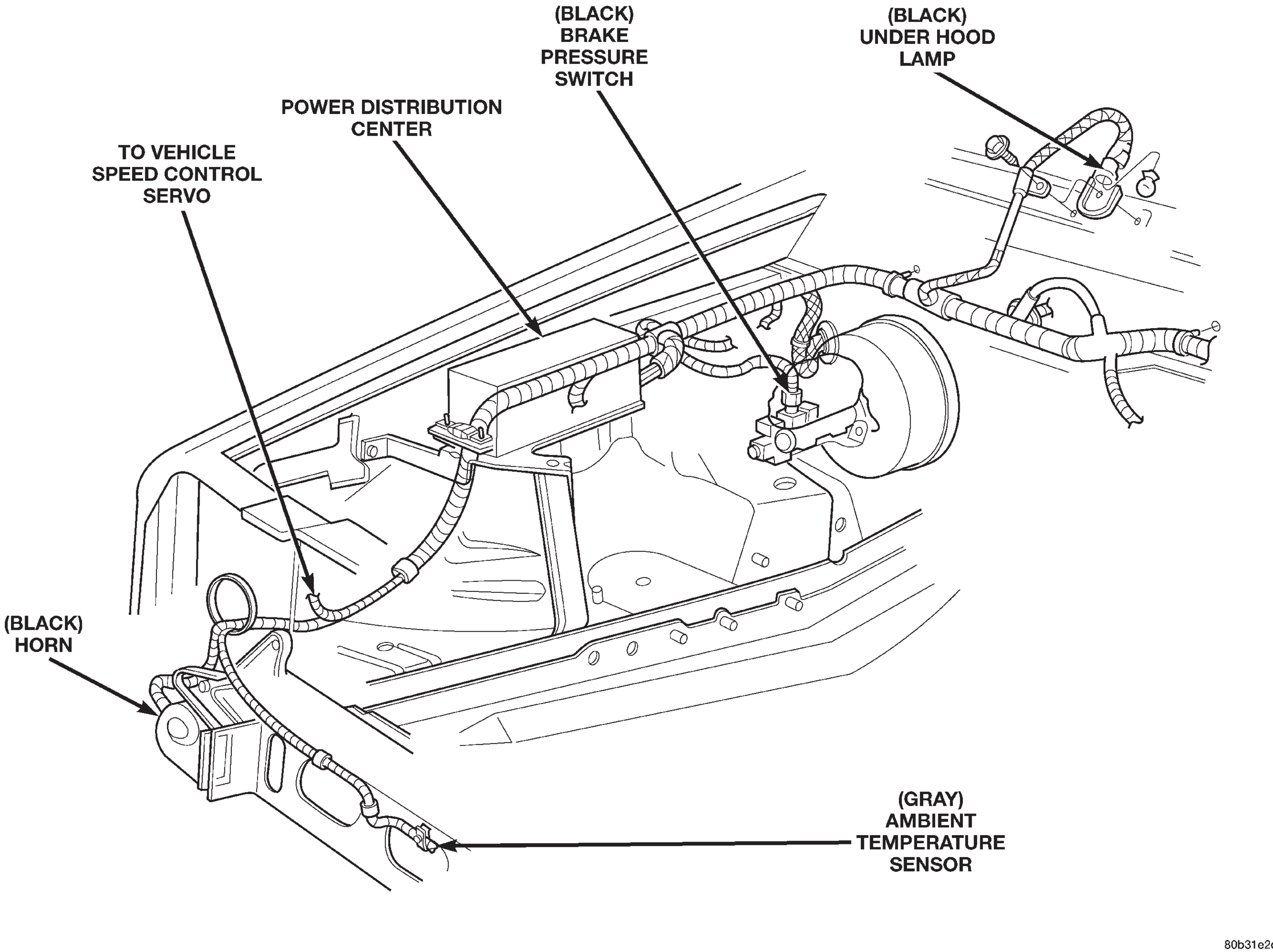


Fig. 5 Right Engine Compartment 2.5L Engine RHD

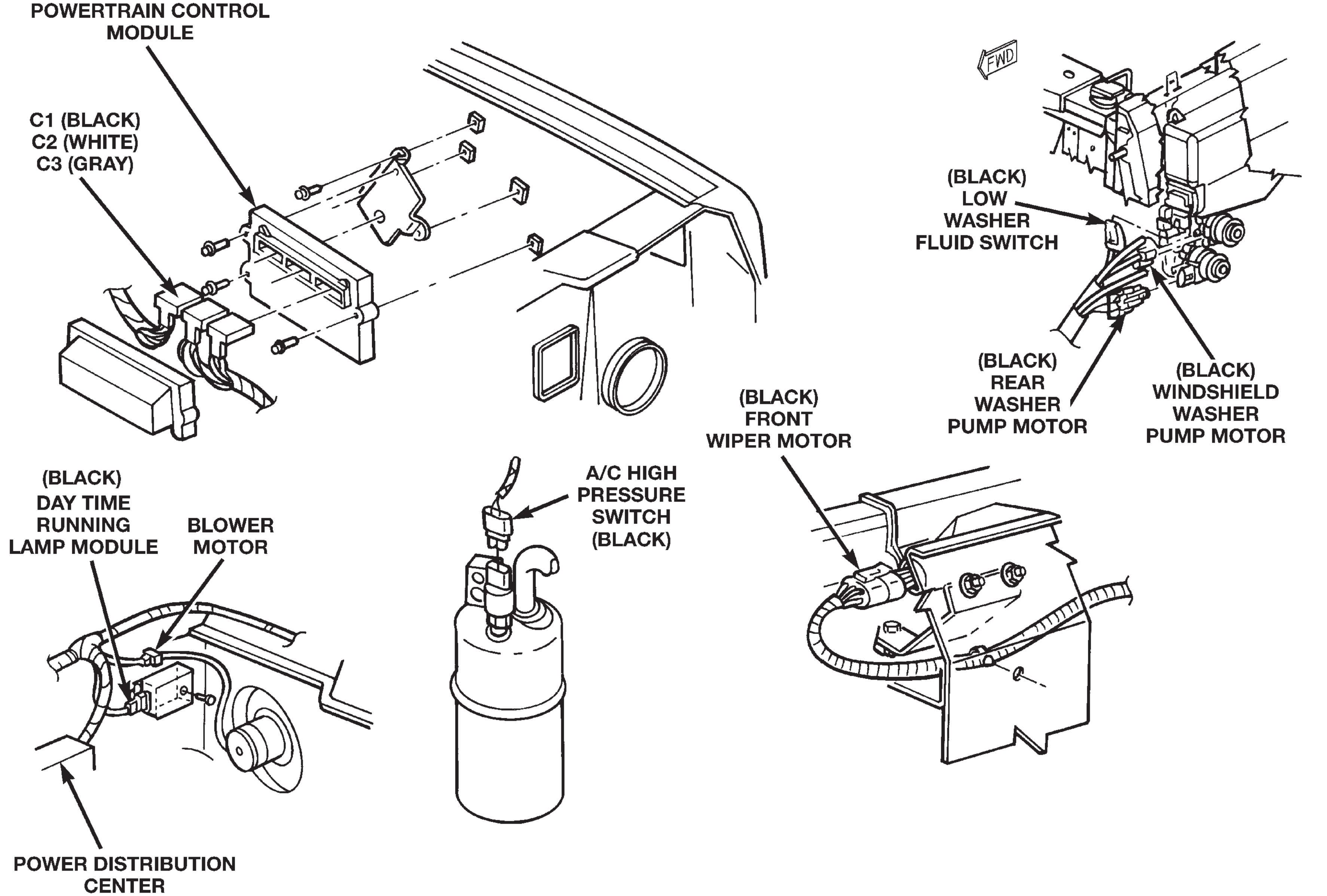


Fig. 6 Engine Compartment Components LHD

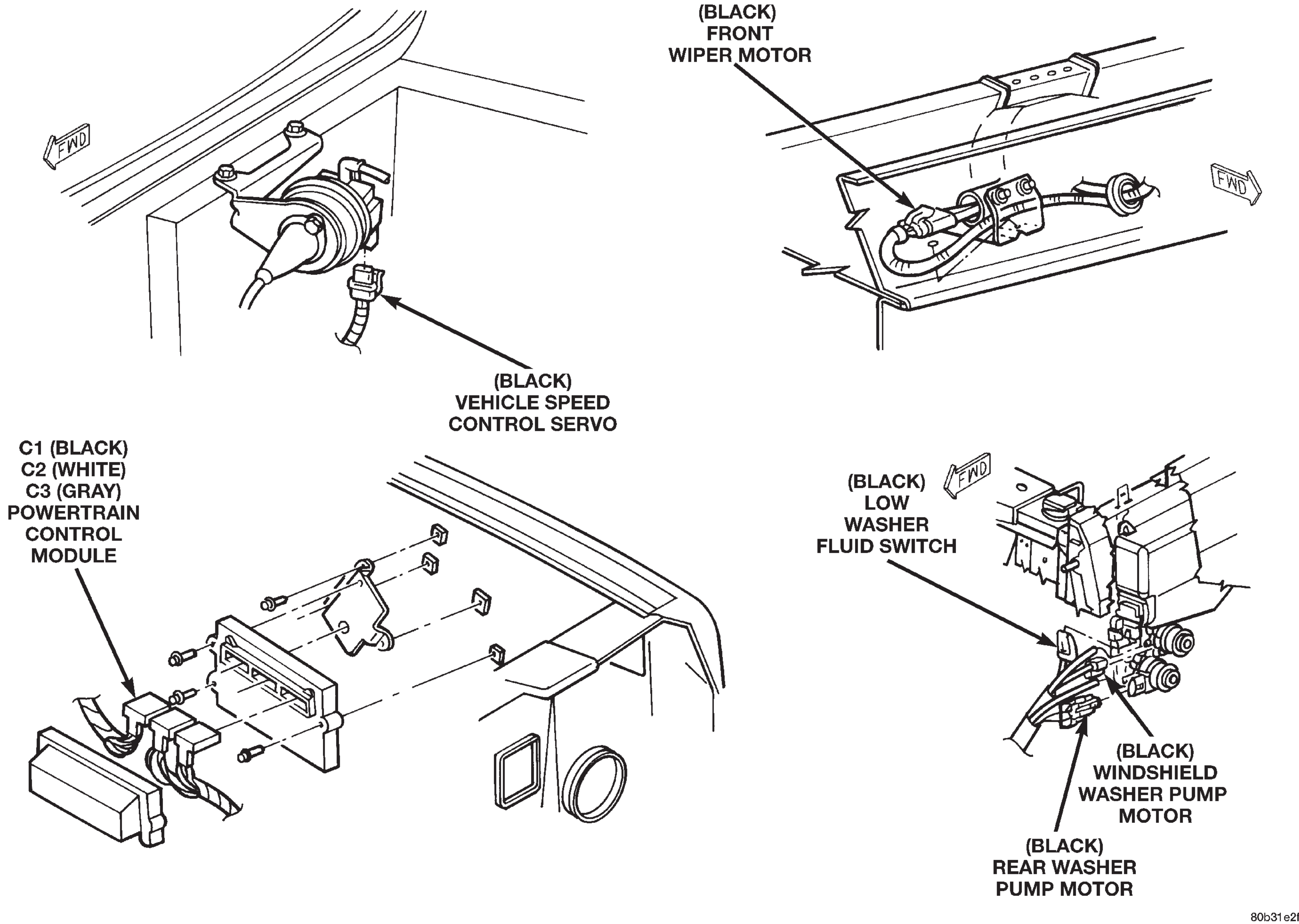


Fig. 7 Engine Compartment Components RHD

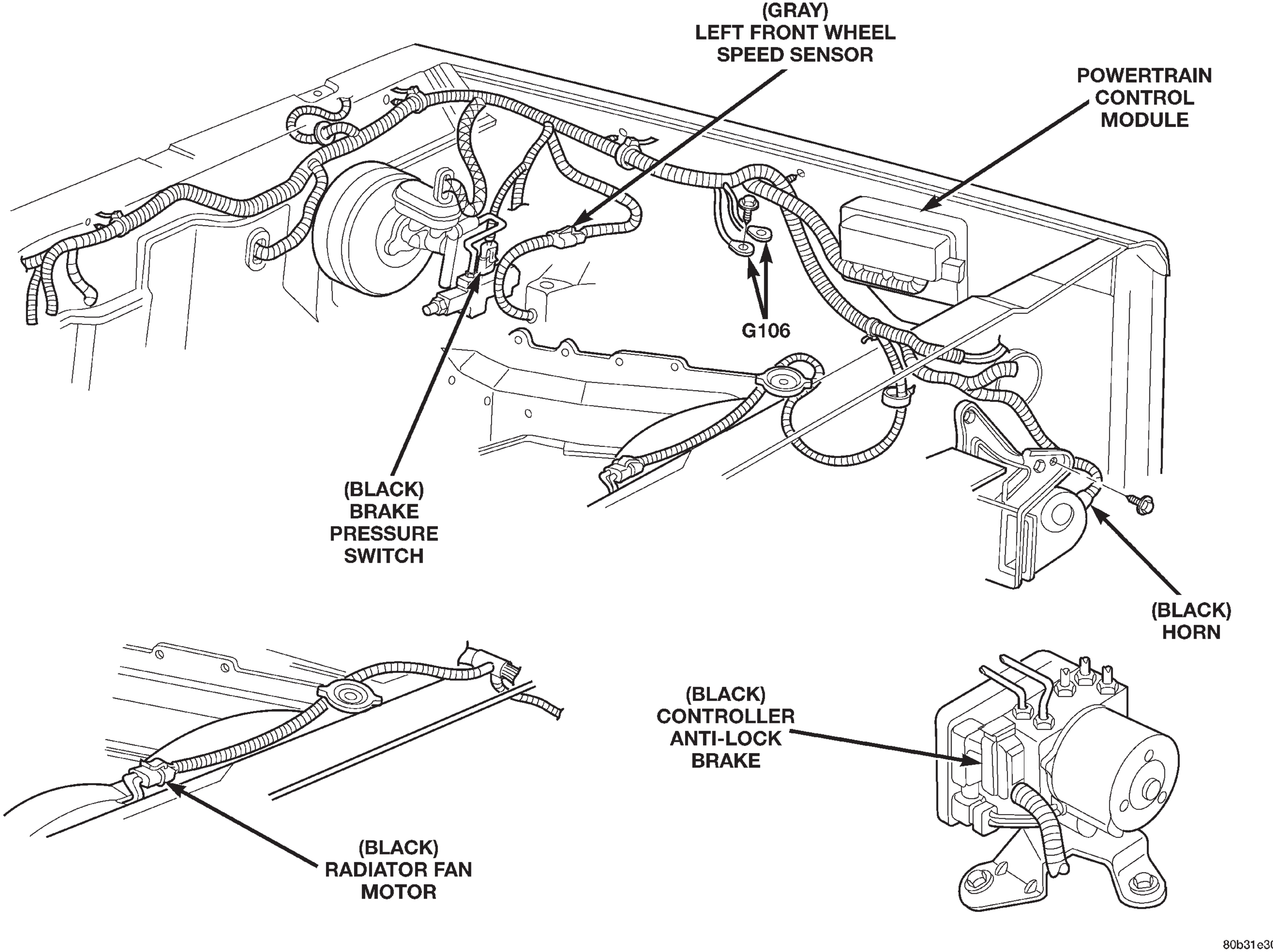


Fig. 8 Left Engine Compartment 4.0L Engine LHD

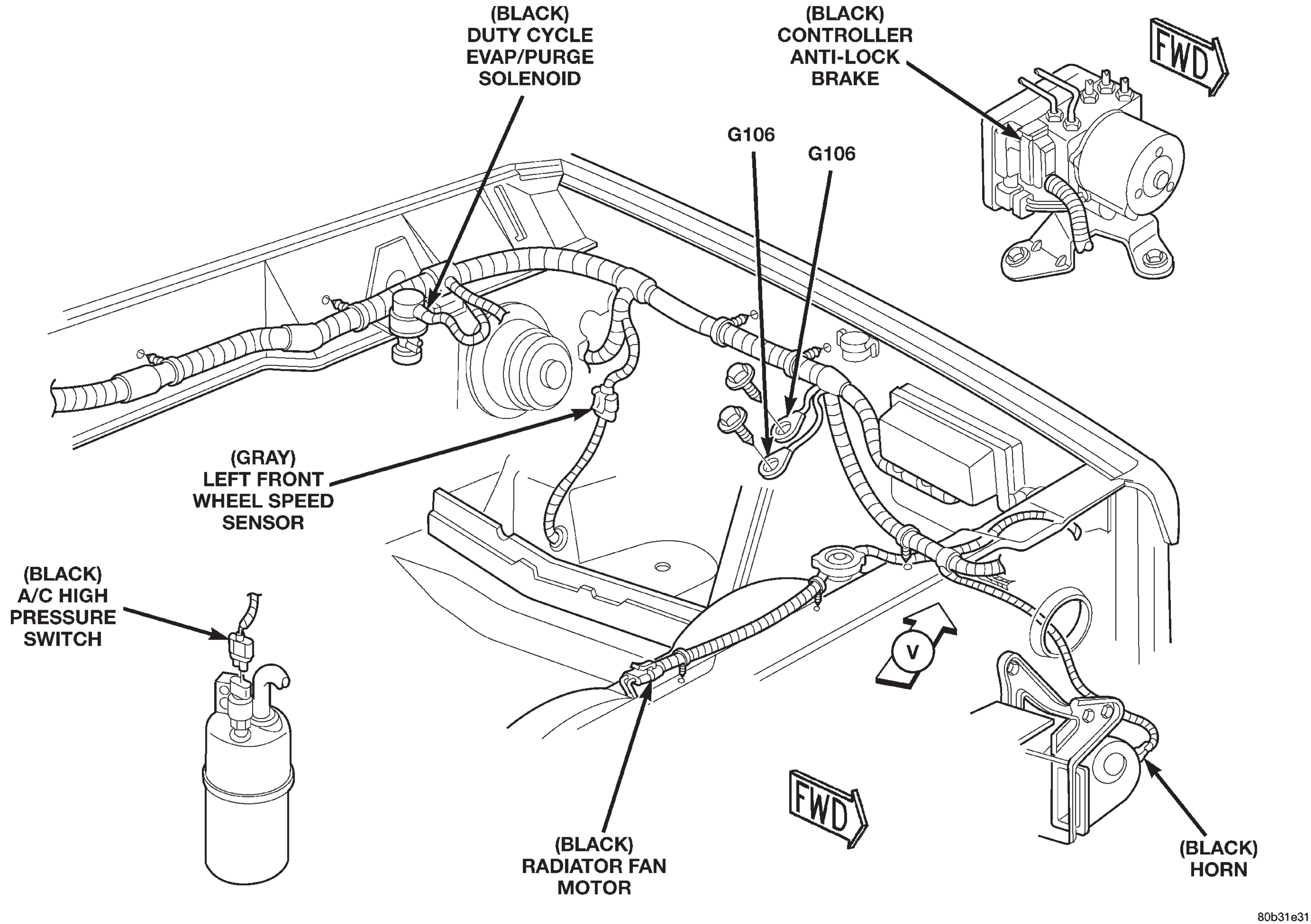


Fig. 9 Left Engine Compartment 4.0L Engine RHD

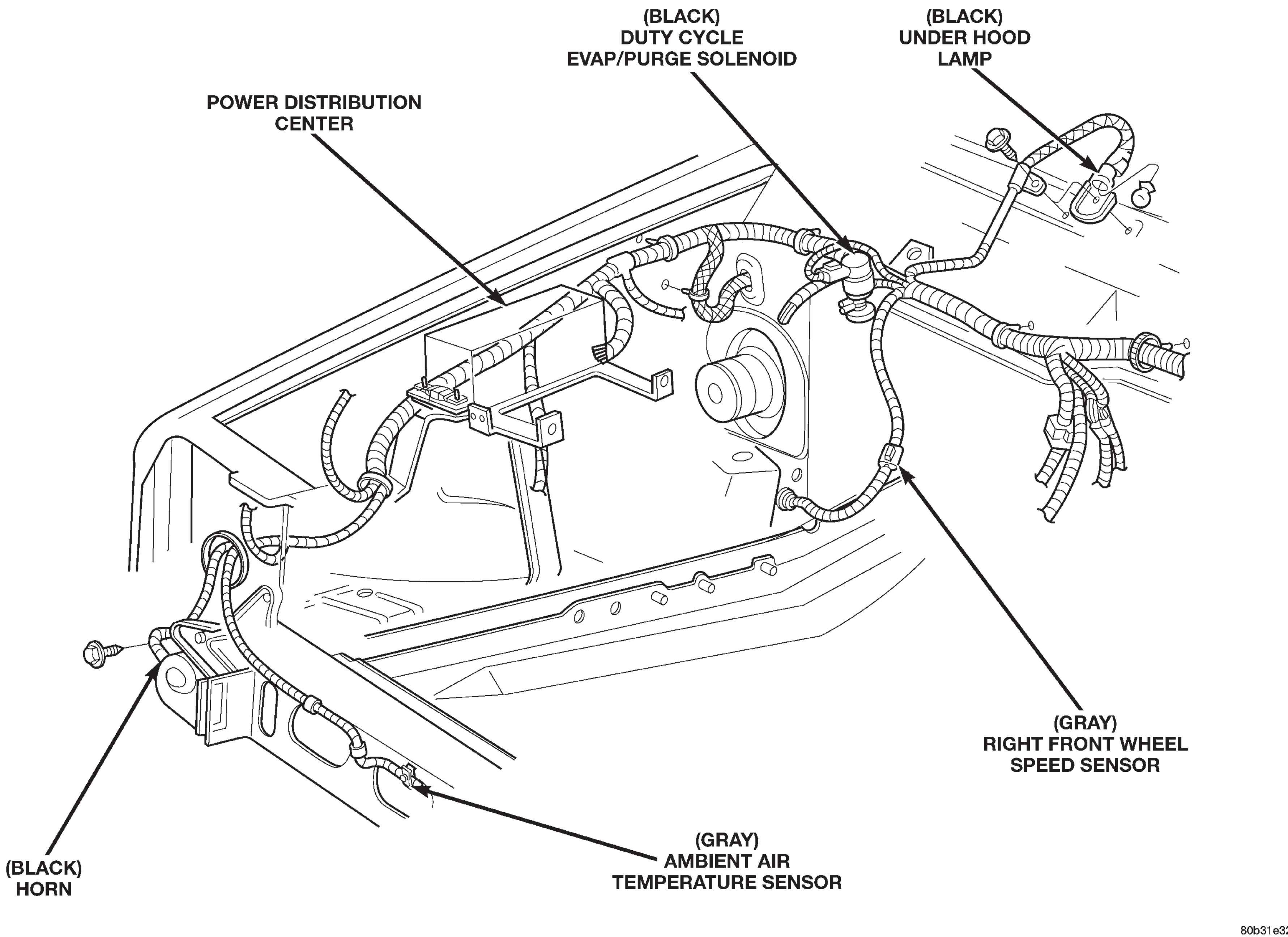


Fig. 10 Right Engine Compartment 4.0L Engine LHD

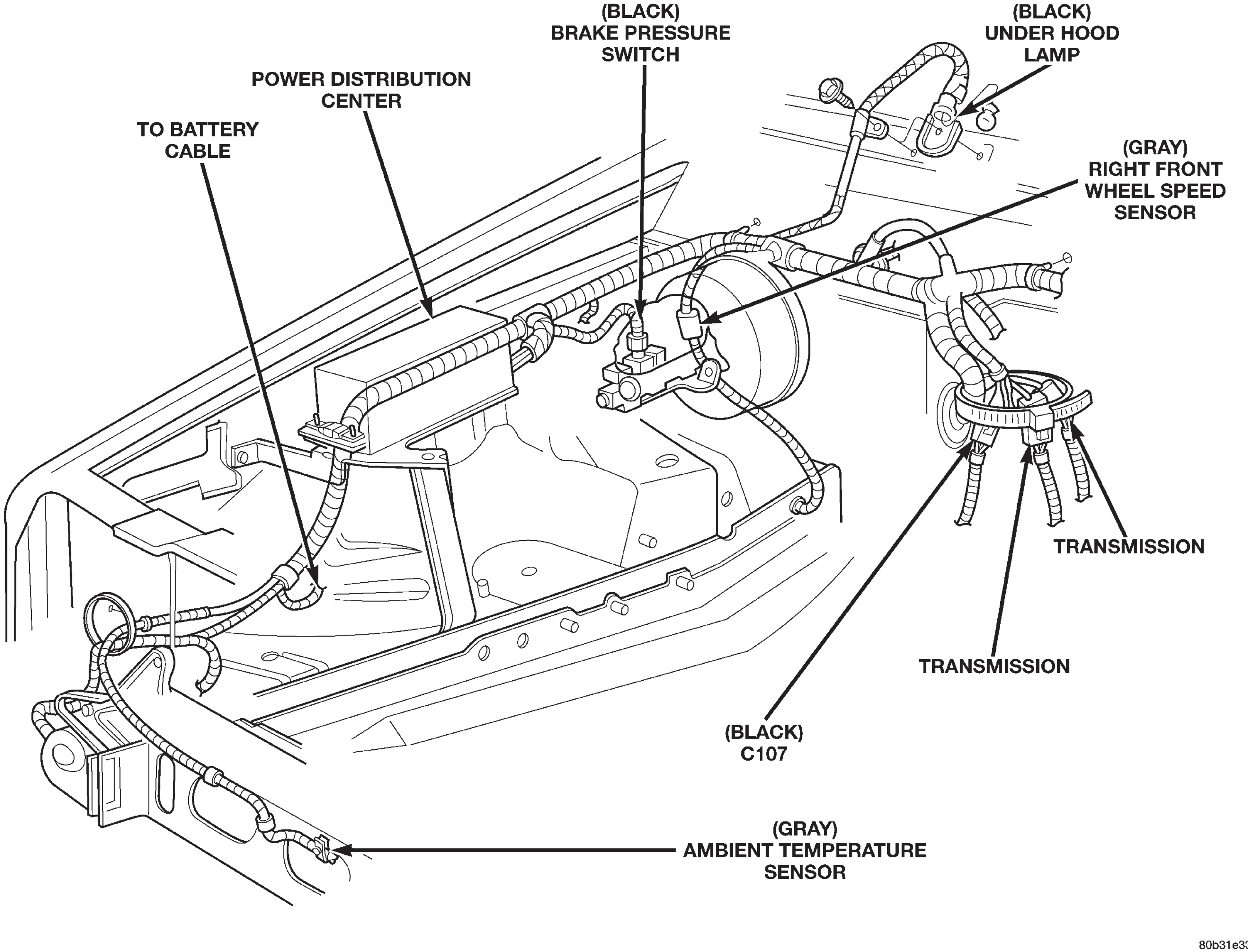


Fig. 11 Right Engine Compartment 4.0L Engine RHD

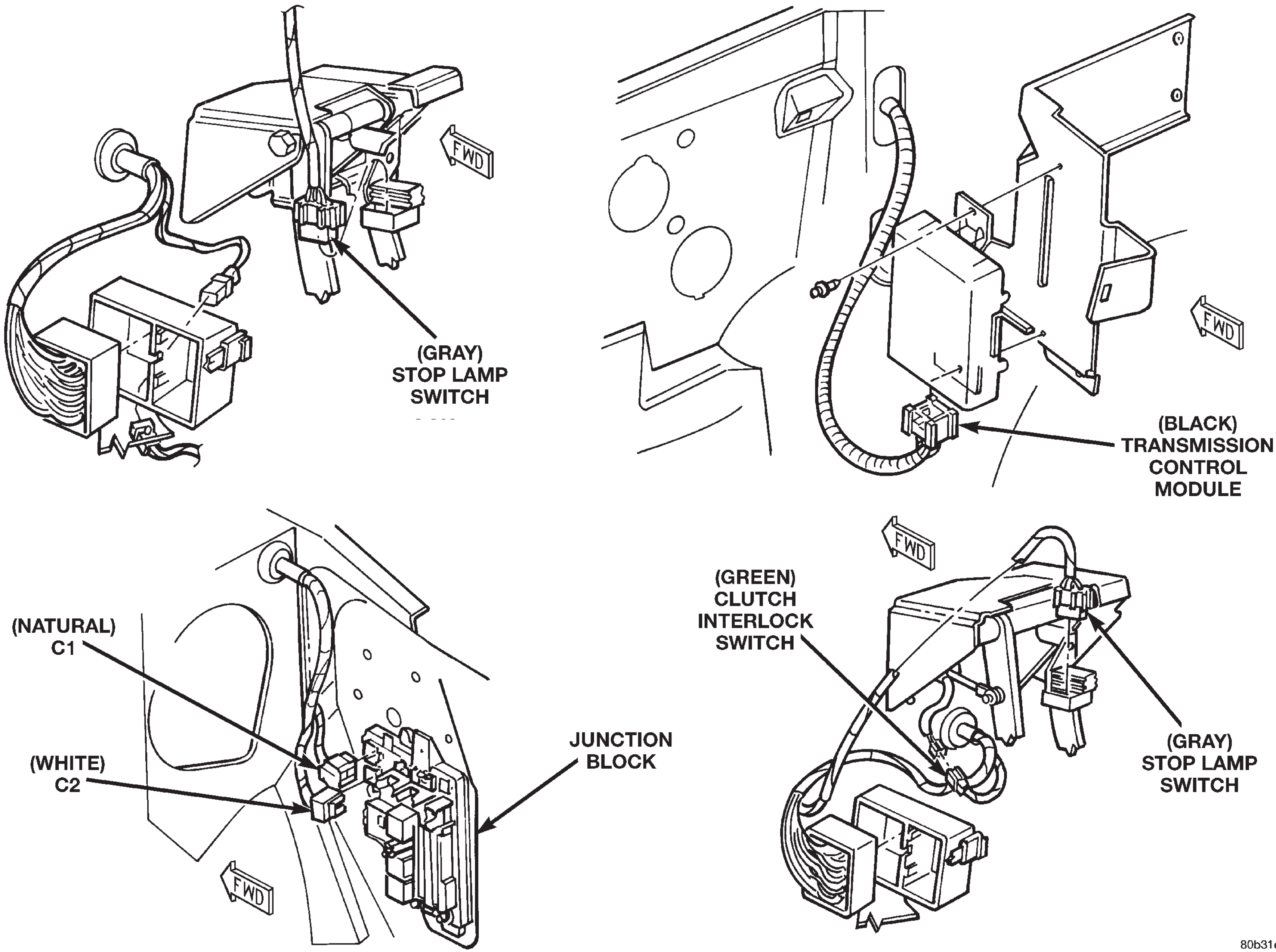


Fig. 12 Under Dash Components

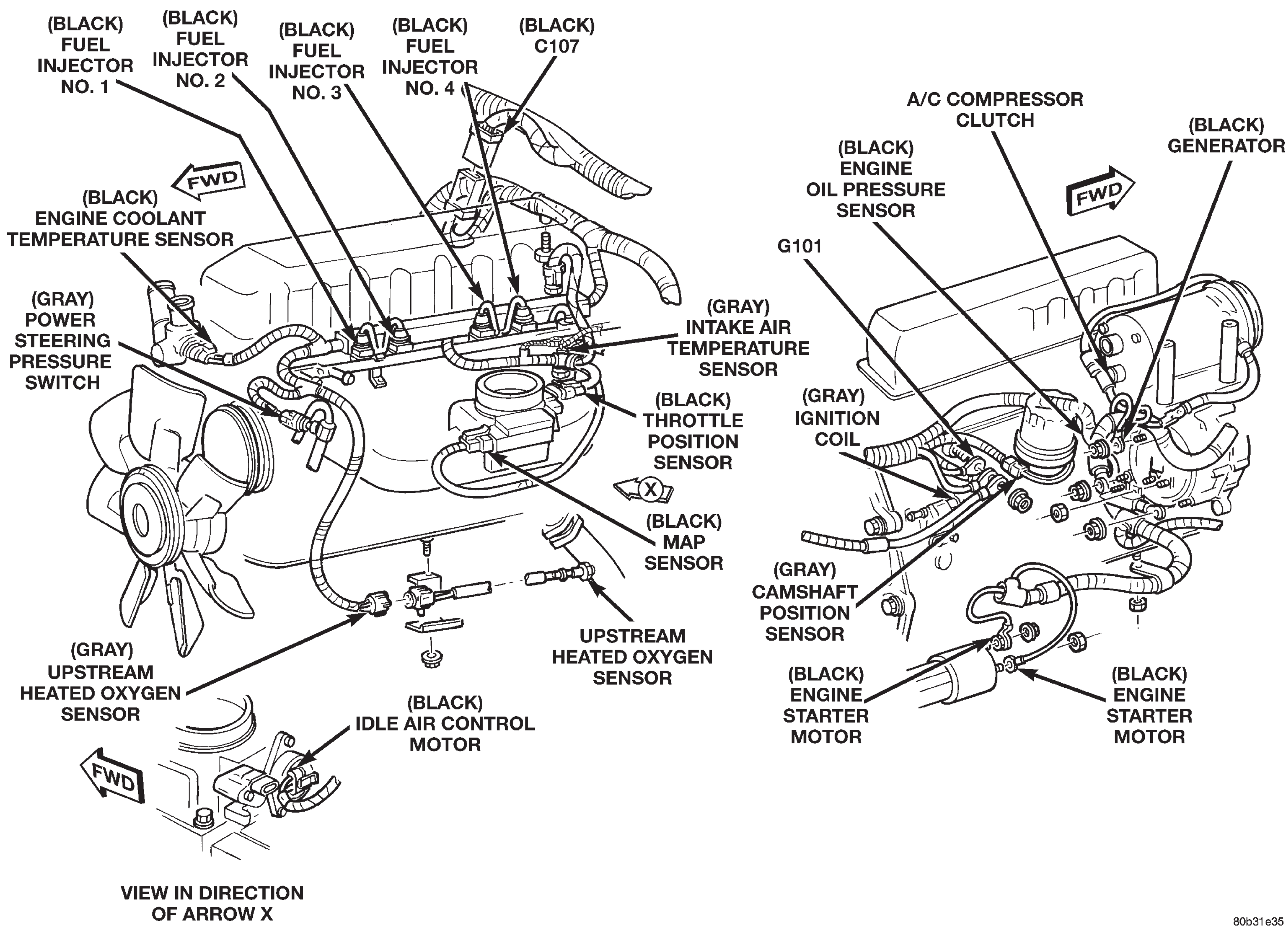


Fig. 13 Engine Connectors 2.5L Engine LHD

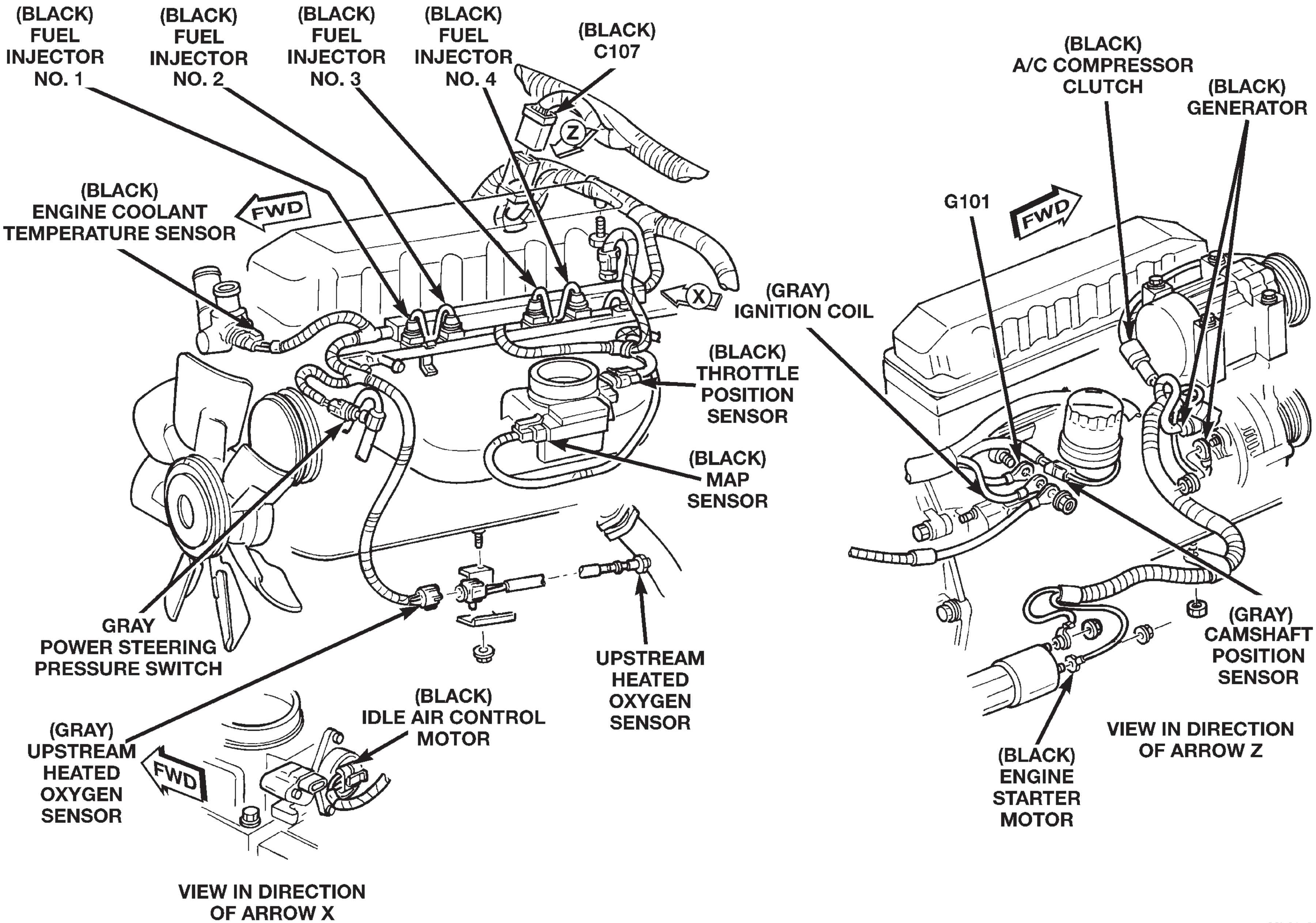


Fig. 14 Engine Connectors 2.5L Engine RHD

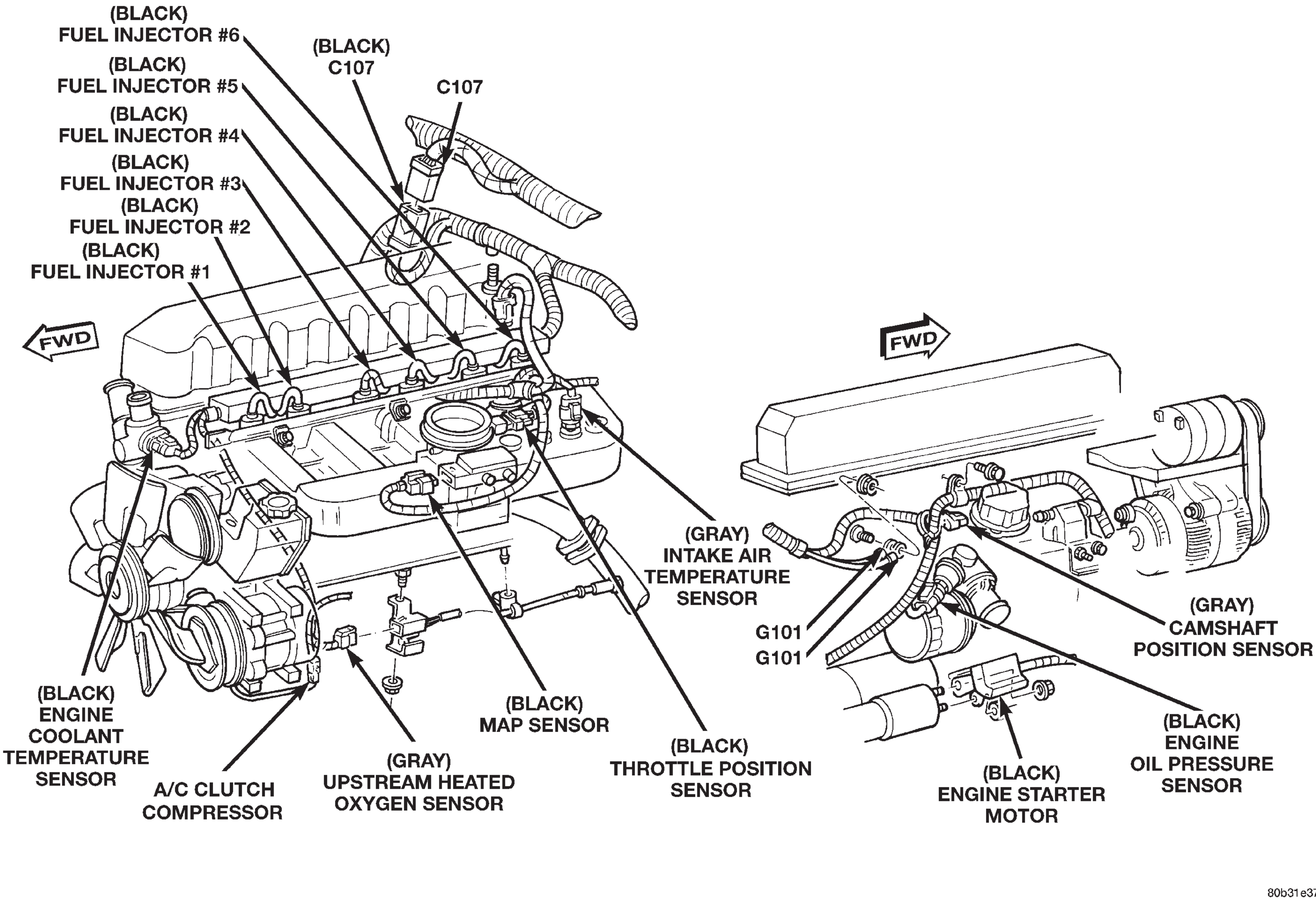


Fig. 15 Engine Connectors 4.0L Engine

DESCRIPTION AND OPERATION (Continued)

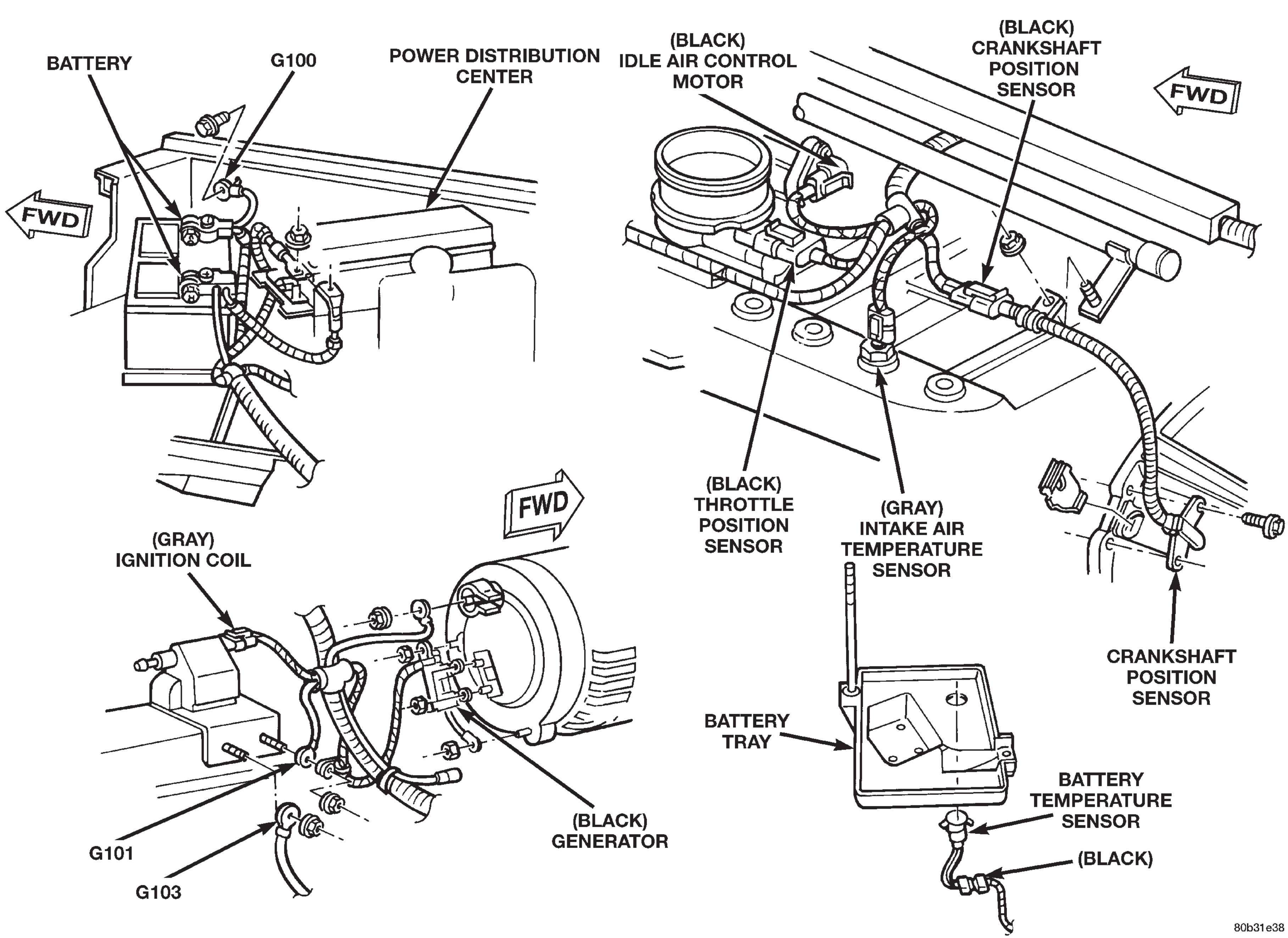


Fig. 16 Engine and Battery 4.0L Engine

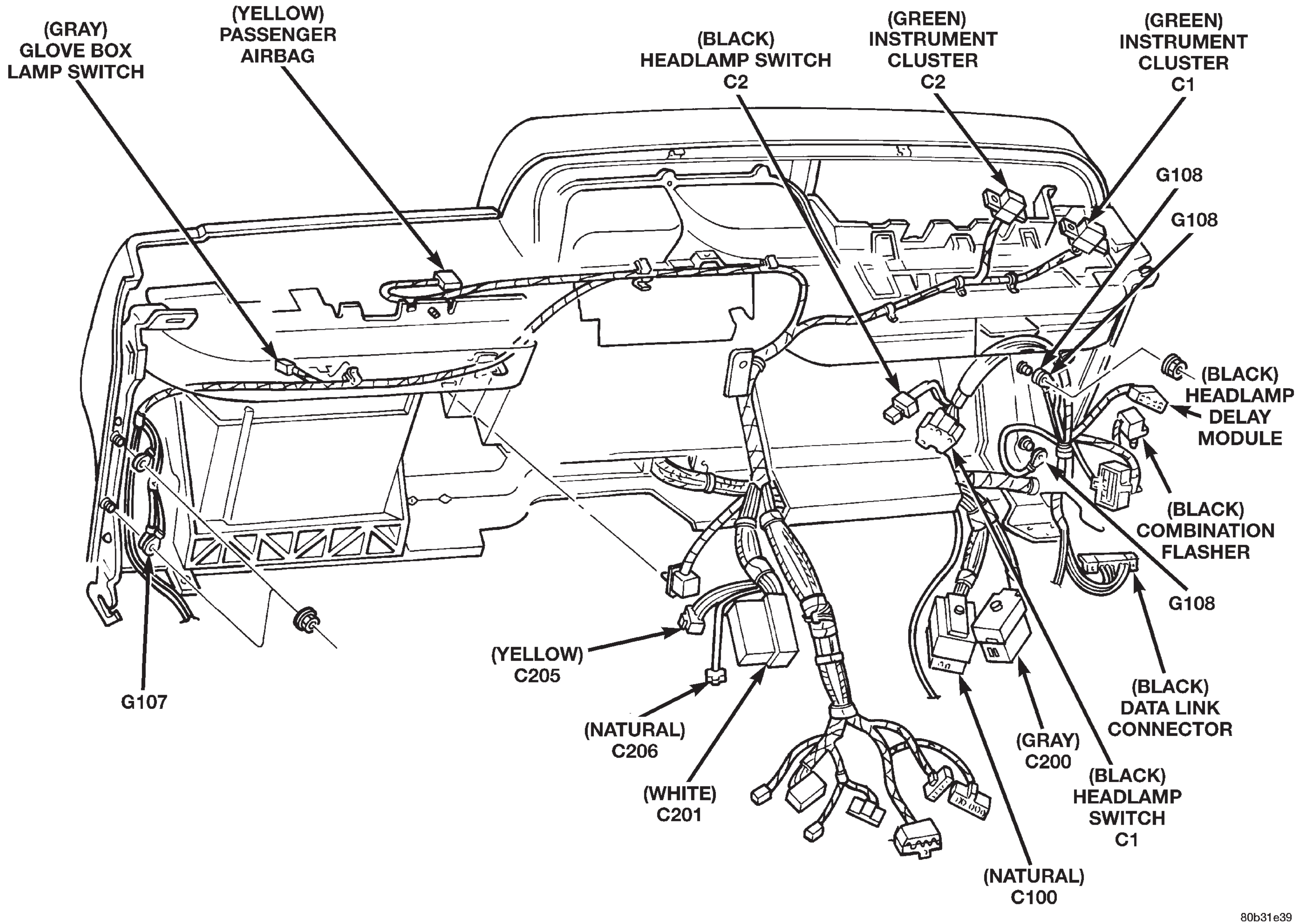


Fig. 17 Instrument Panel Connectors LHD

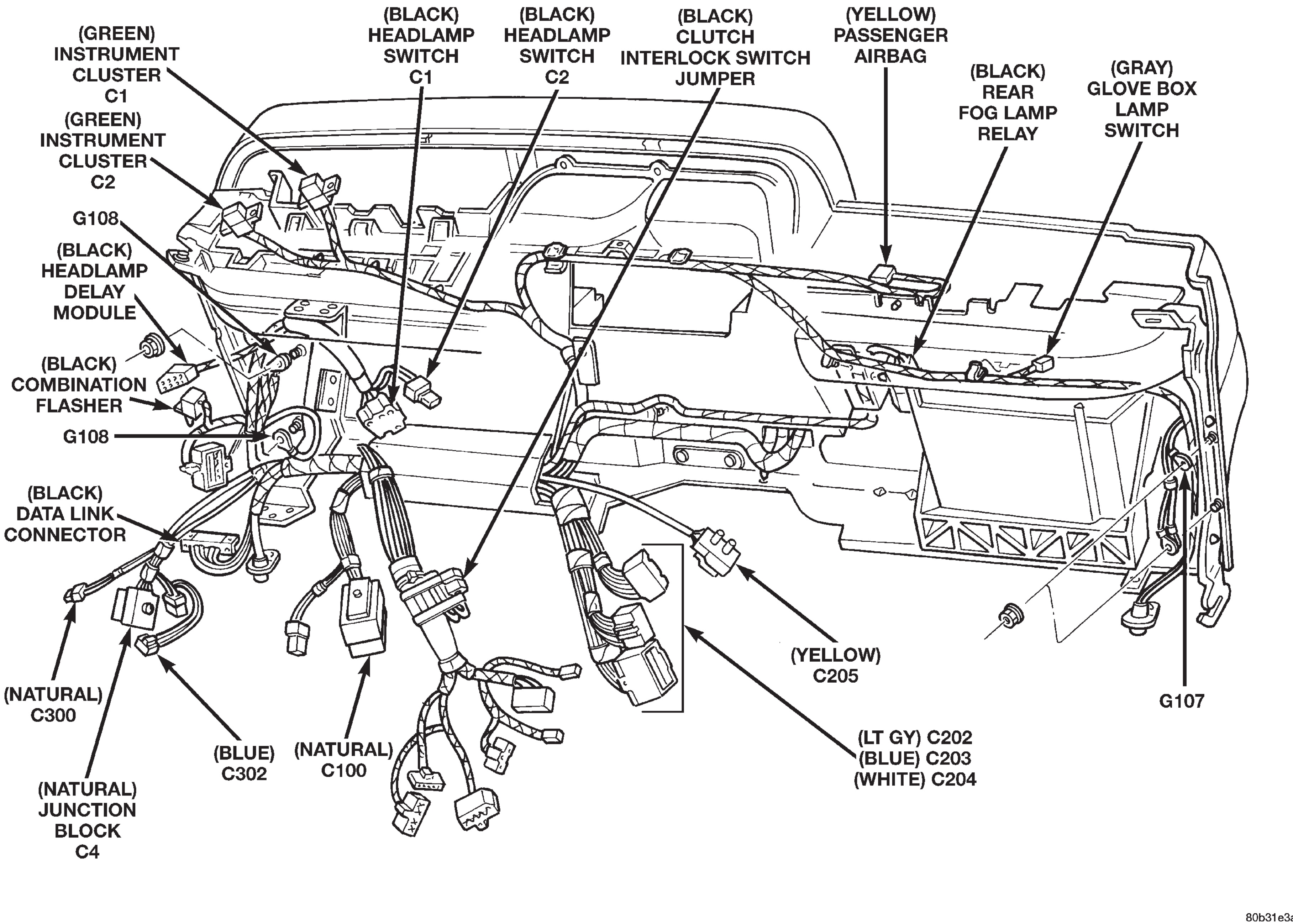


Fig. 18 Instrument Panel Connectors RHD

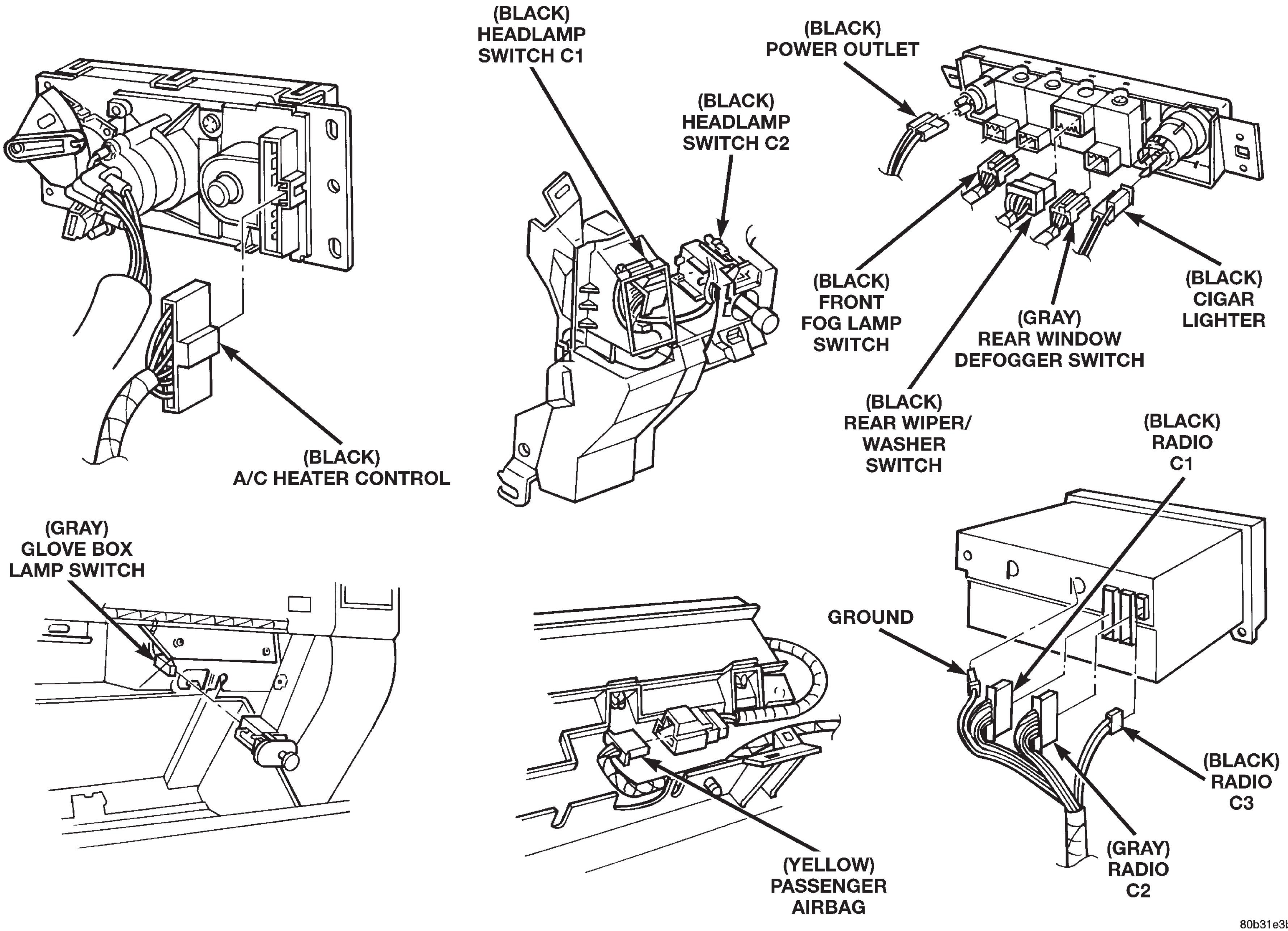


Fig. 19 Instrument Panel Components LHD

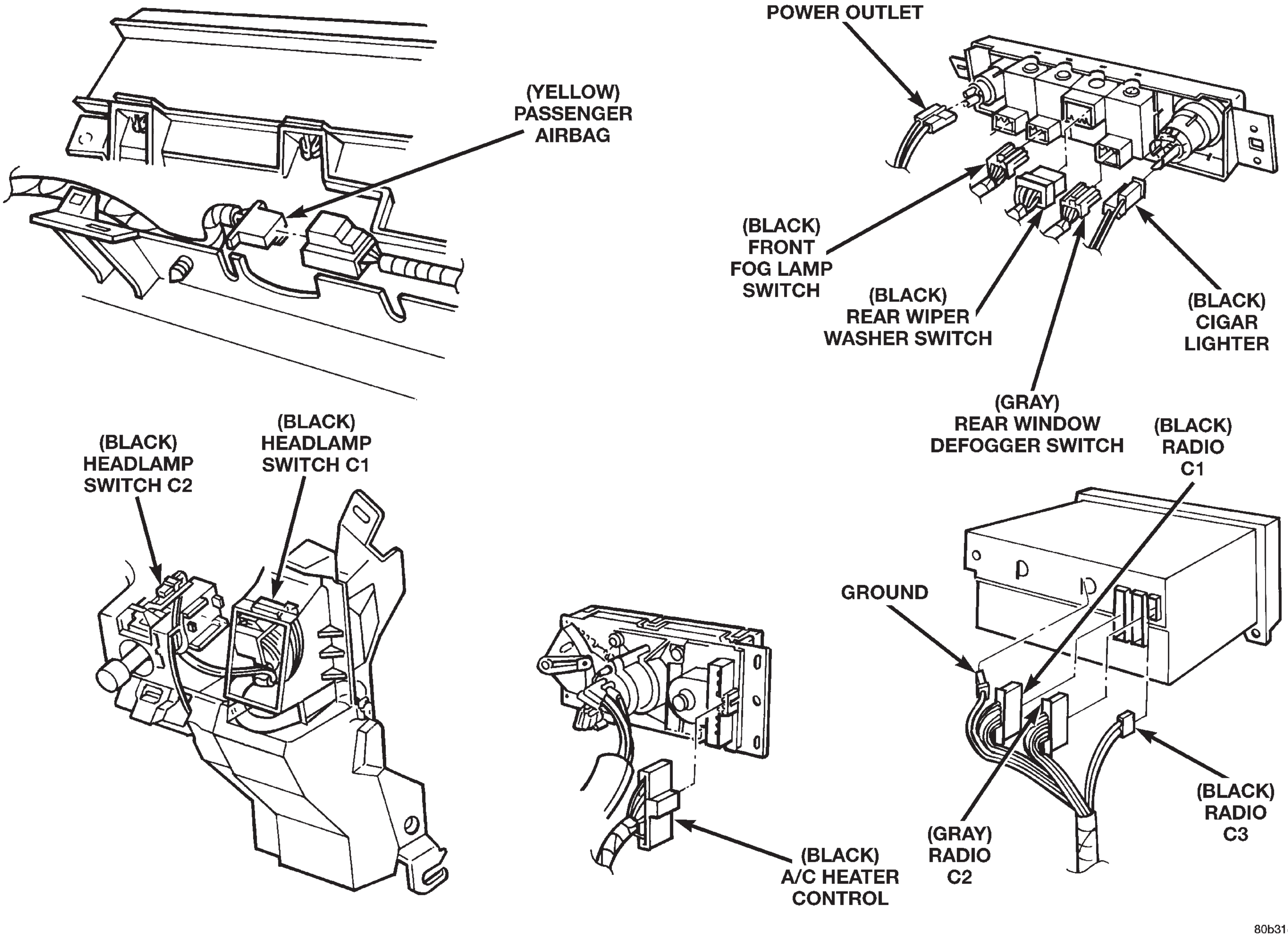


Fig. 20 Instrument Panel Components RHD

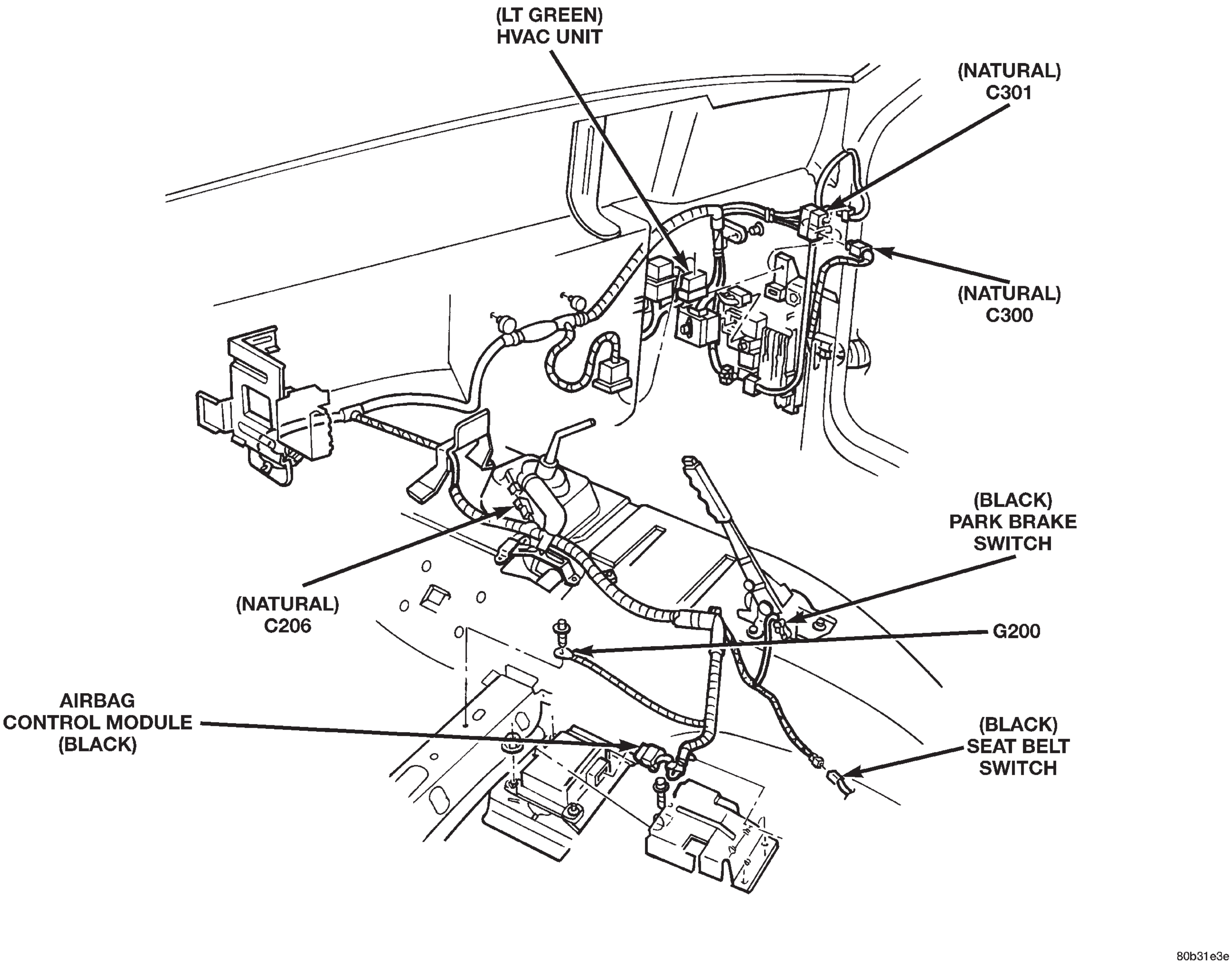


Fig. 21 Center Console LHD

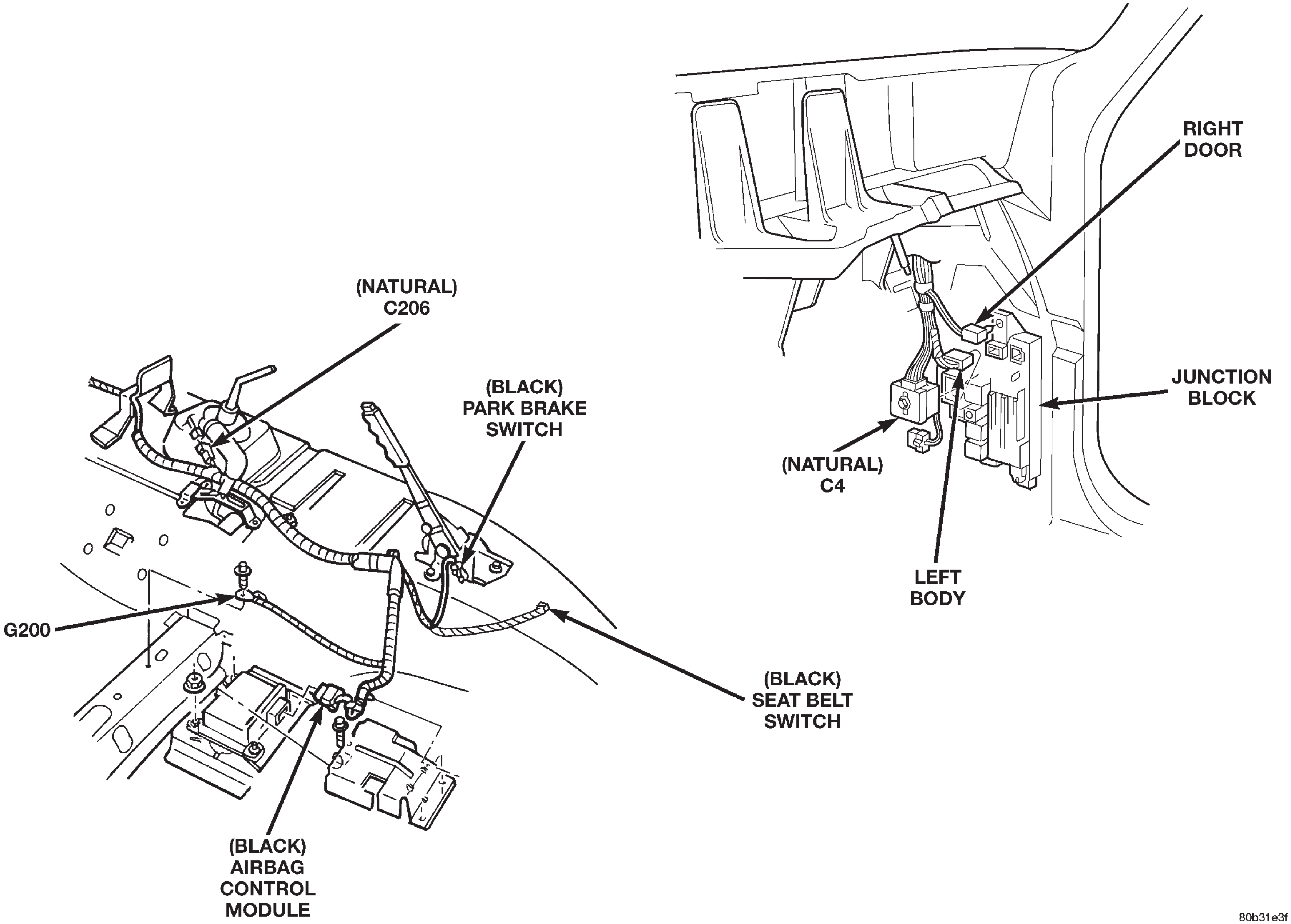


Fig. 22 Center Console RHD

DESCRIPTION AND OPERATION (Continued)

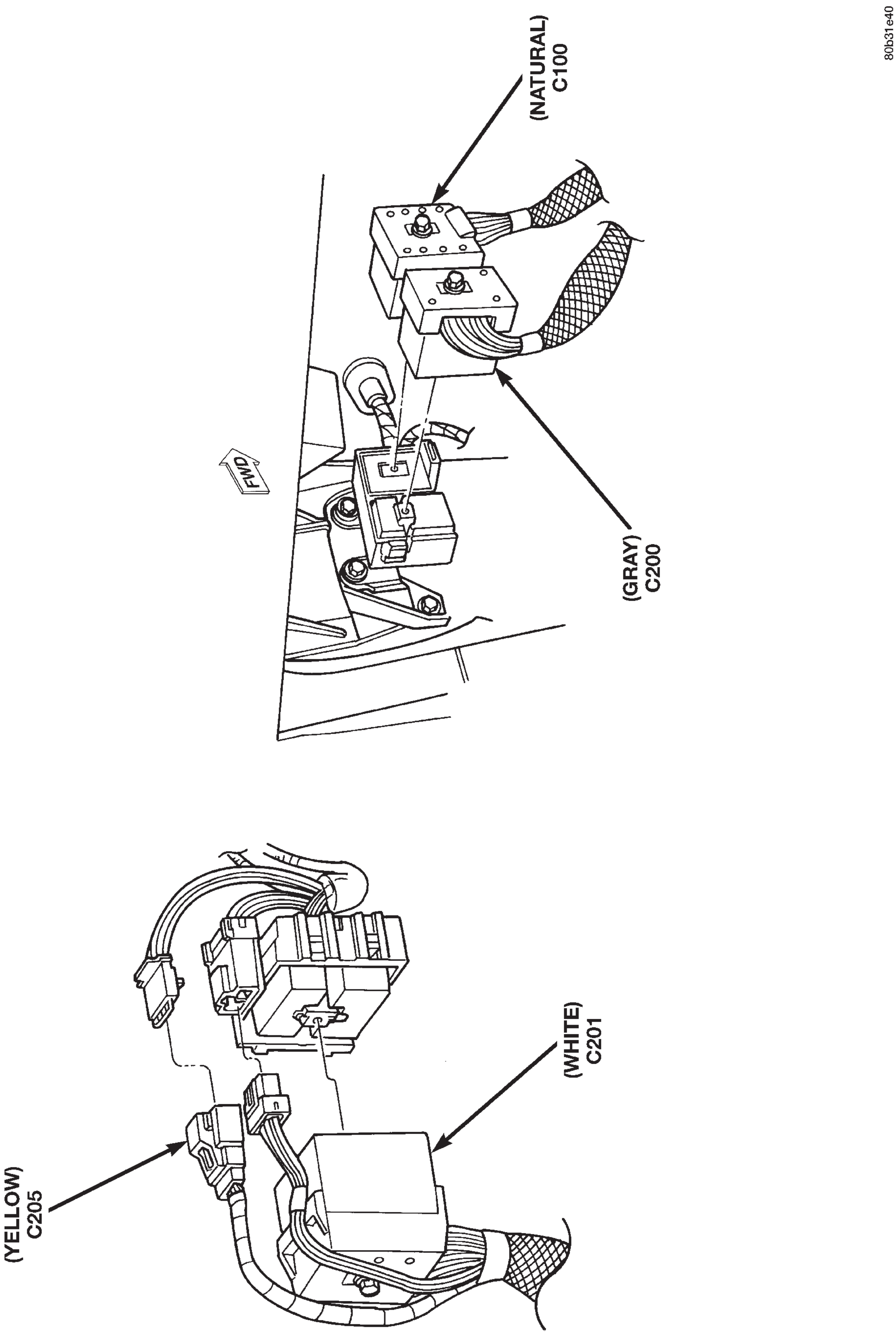


Fig. 23 Instrument Panel to Body Connectors LHD

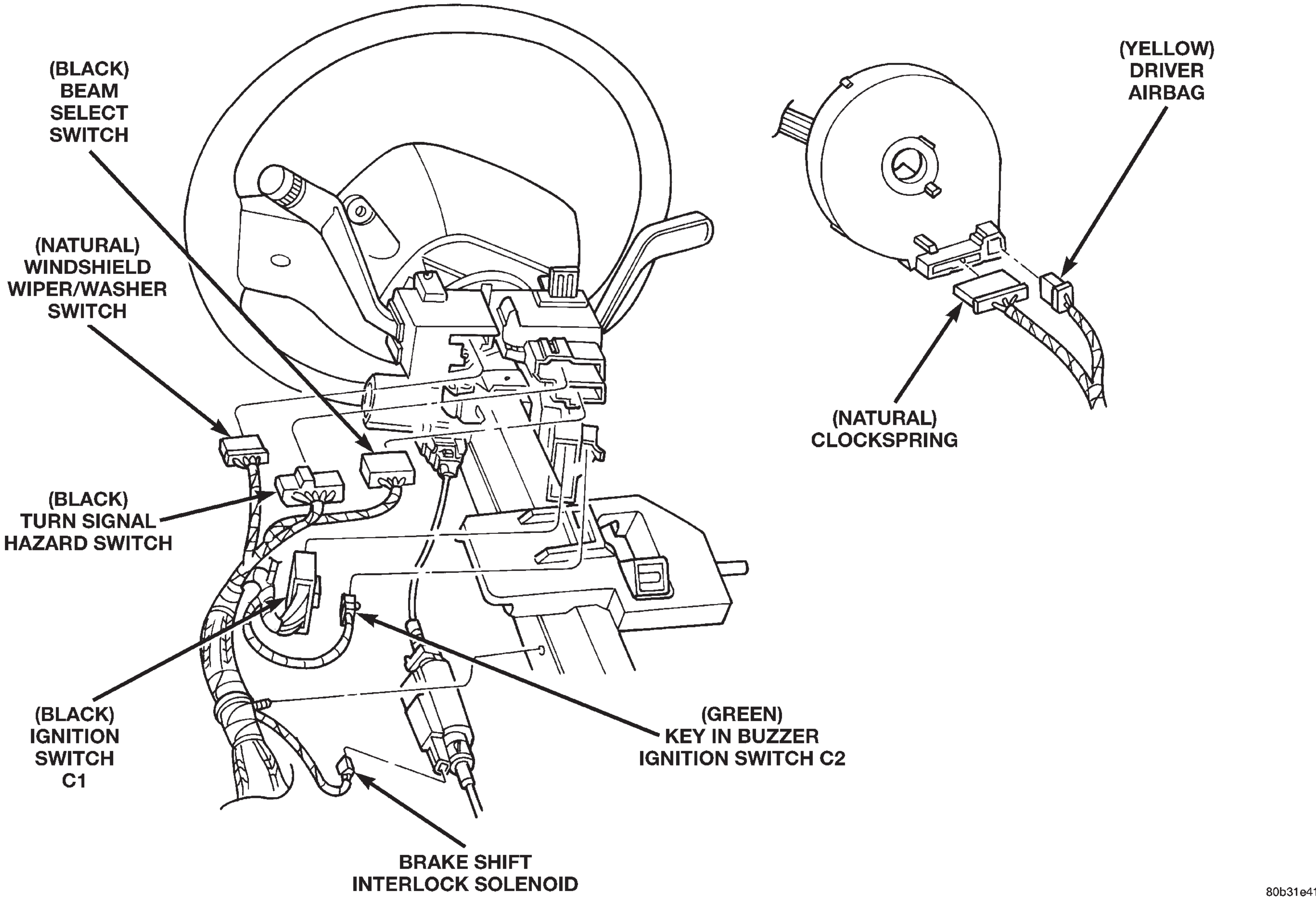


Fig. 24 Steering Column

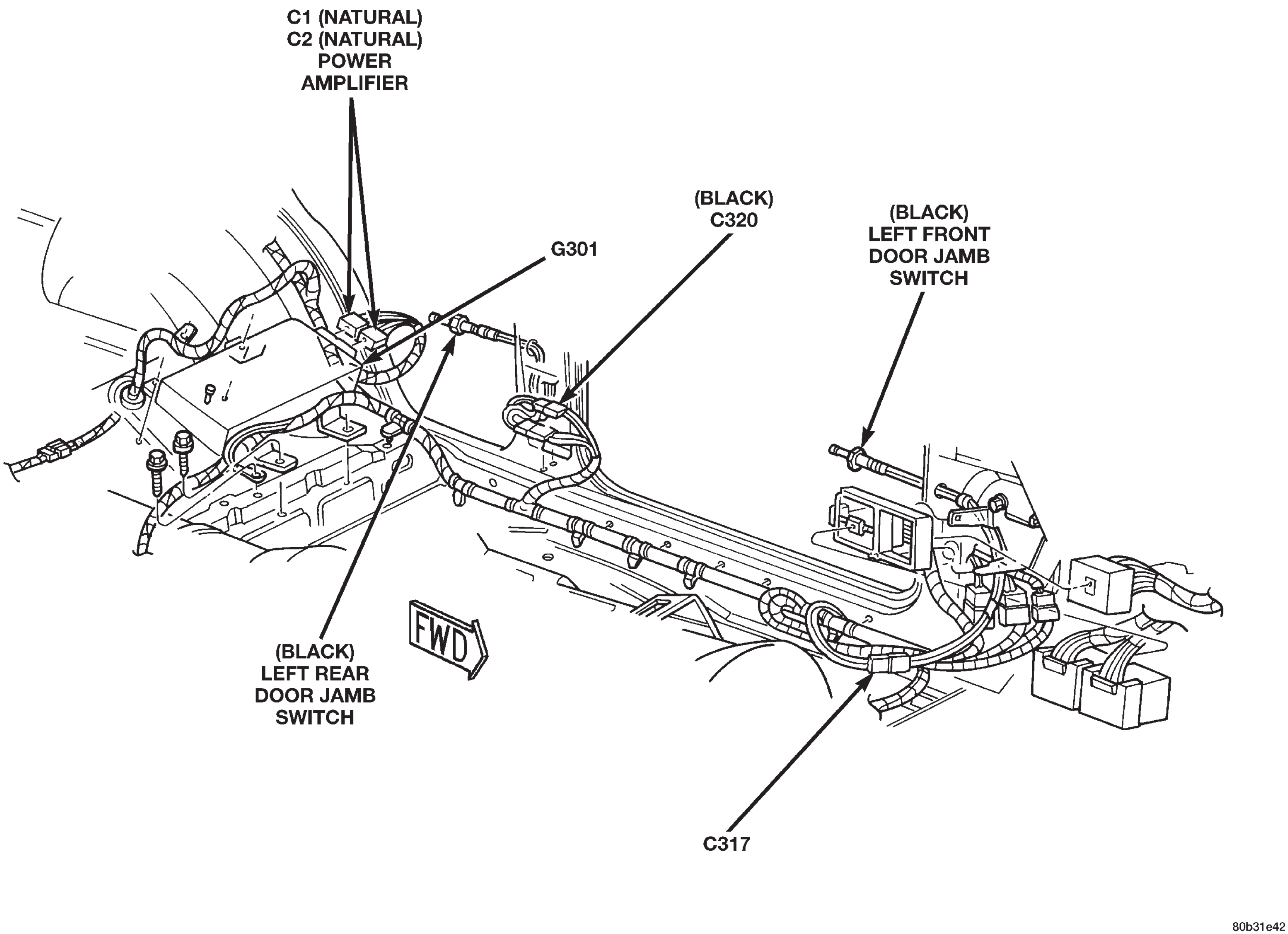


Fig. 25 Left Side Body

DESCRIPTION AND OPERATION (Continued)

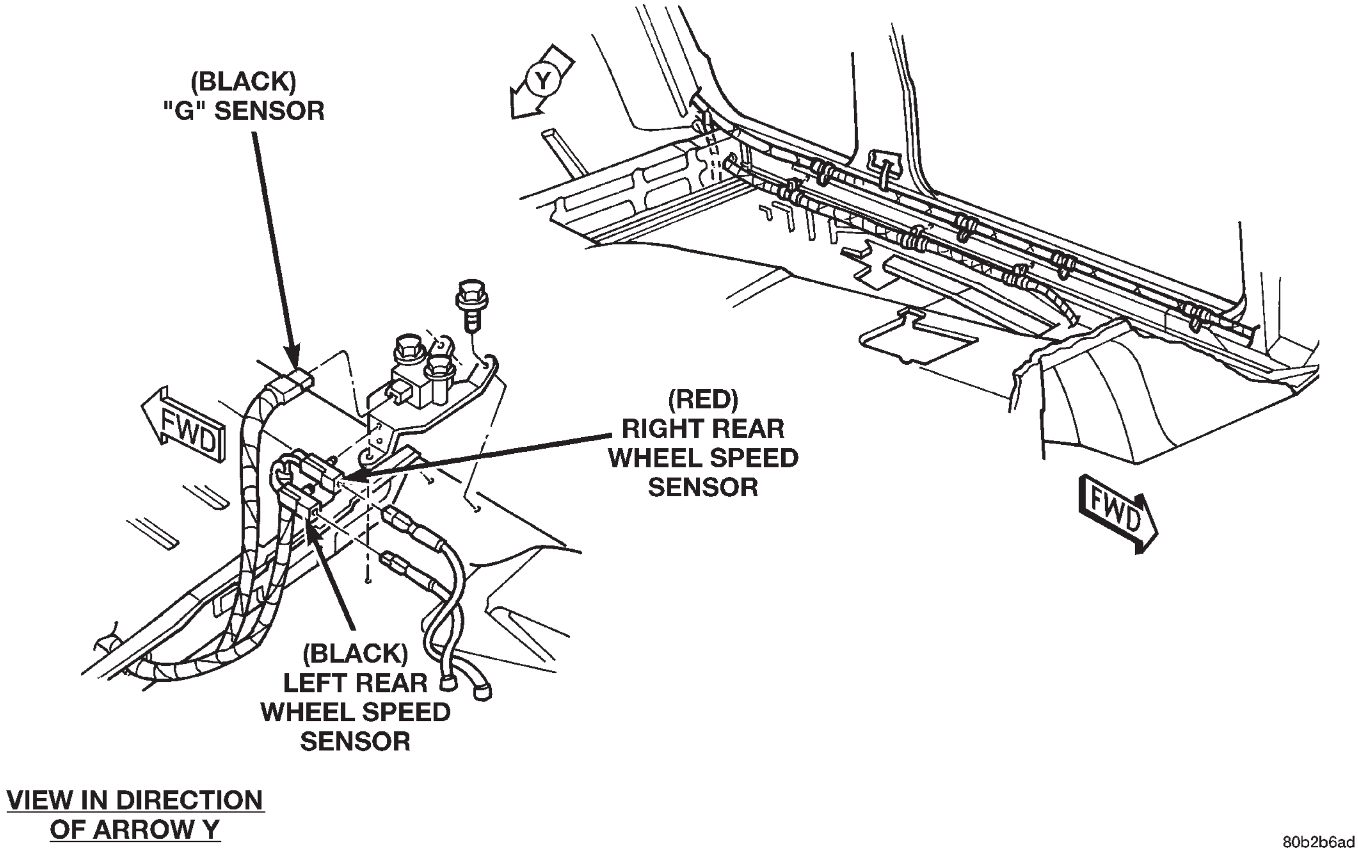


Fig. 26 ABS G-Sensor

DESCRIPTION AND OPERATION (Continued)

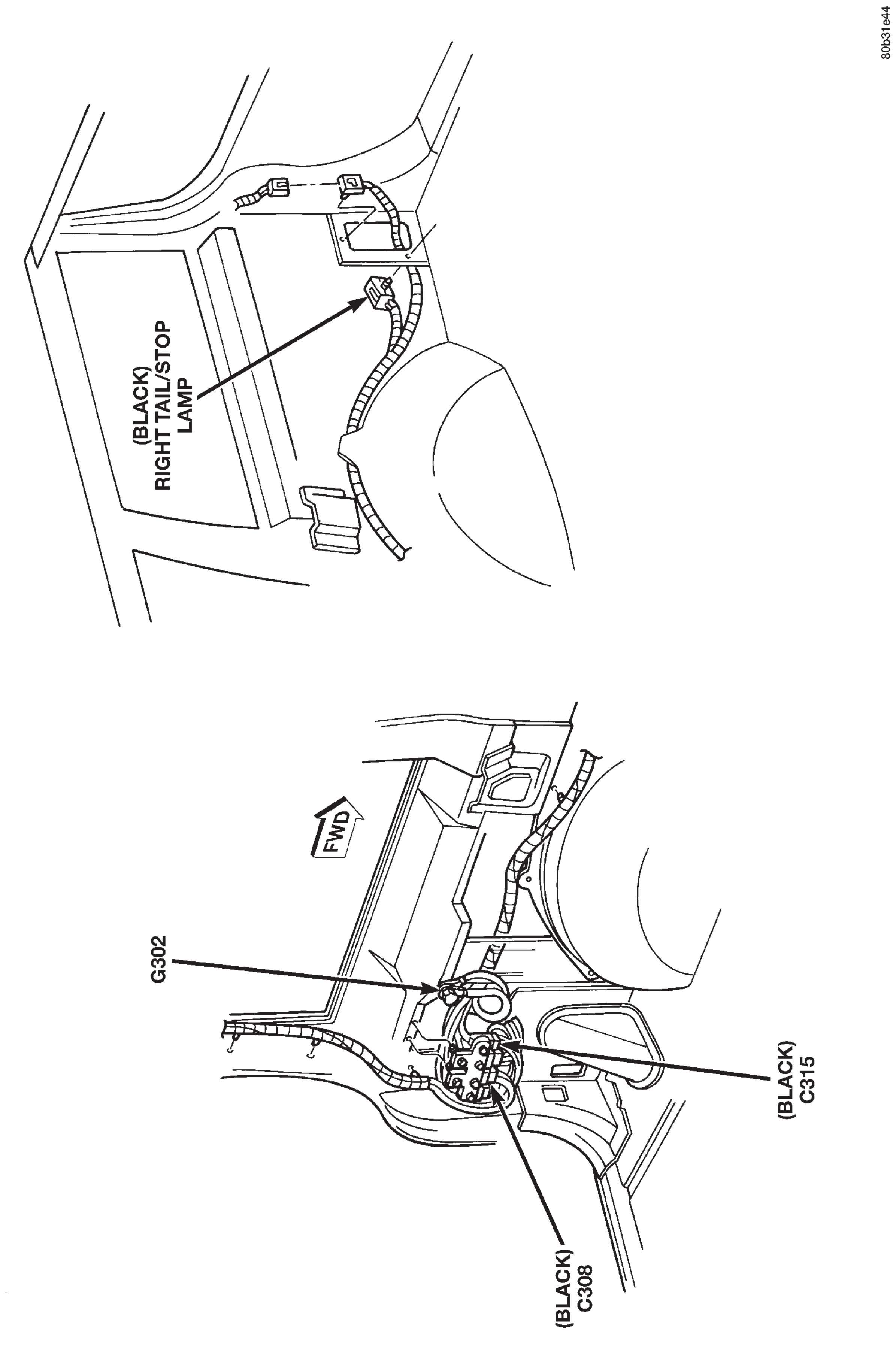


Fig. 27 Rear Lamps

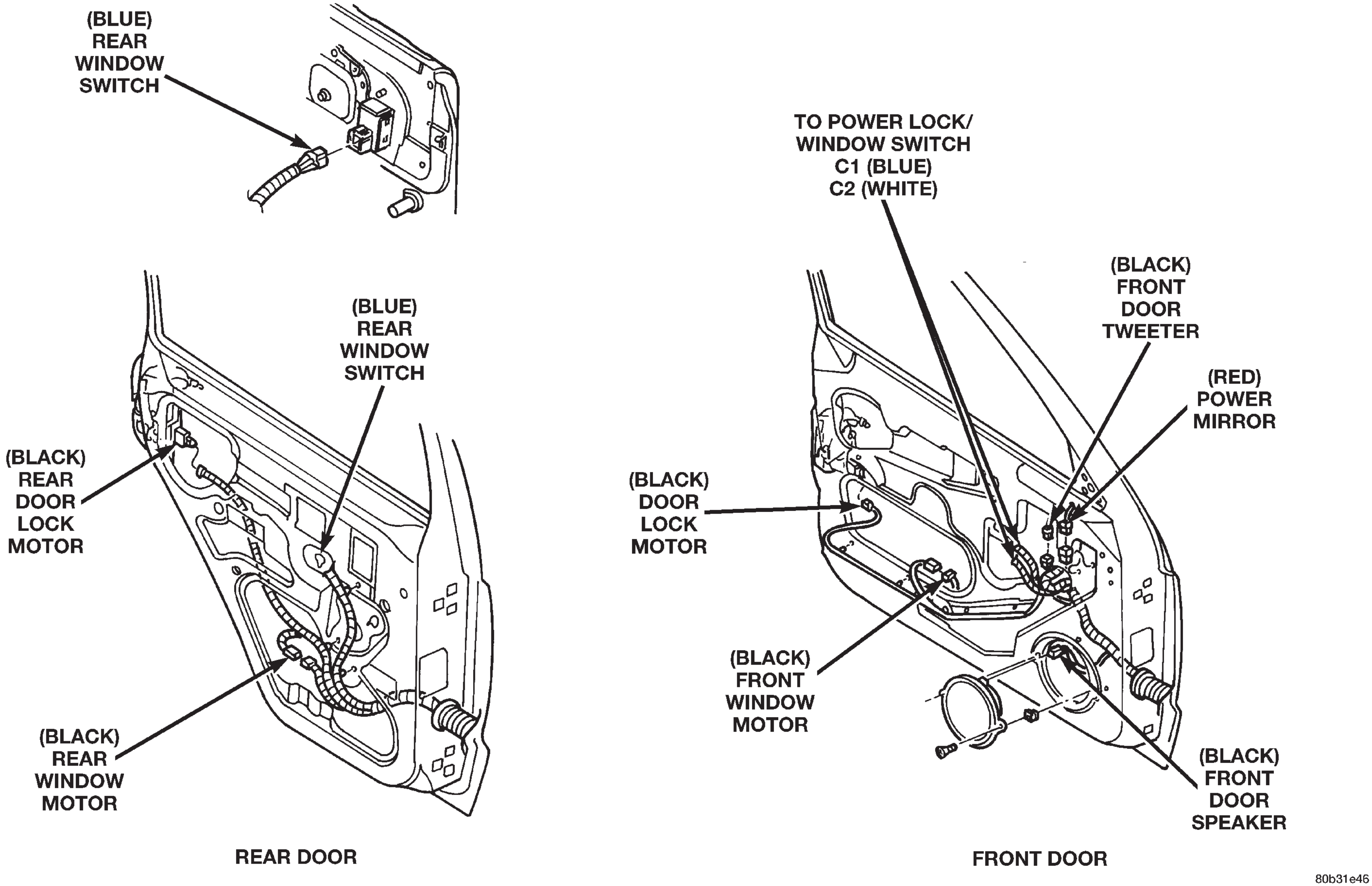


Fig. 28 Front and Rear Doors (Left Side Shown, Right Side Similar)

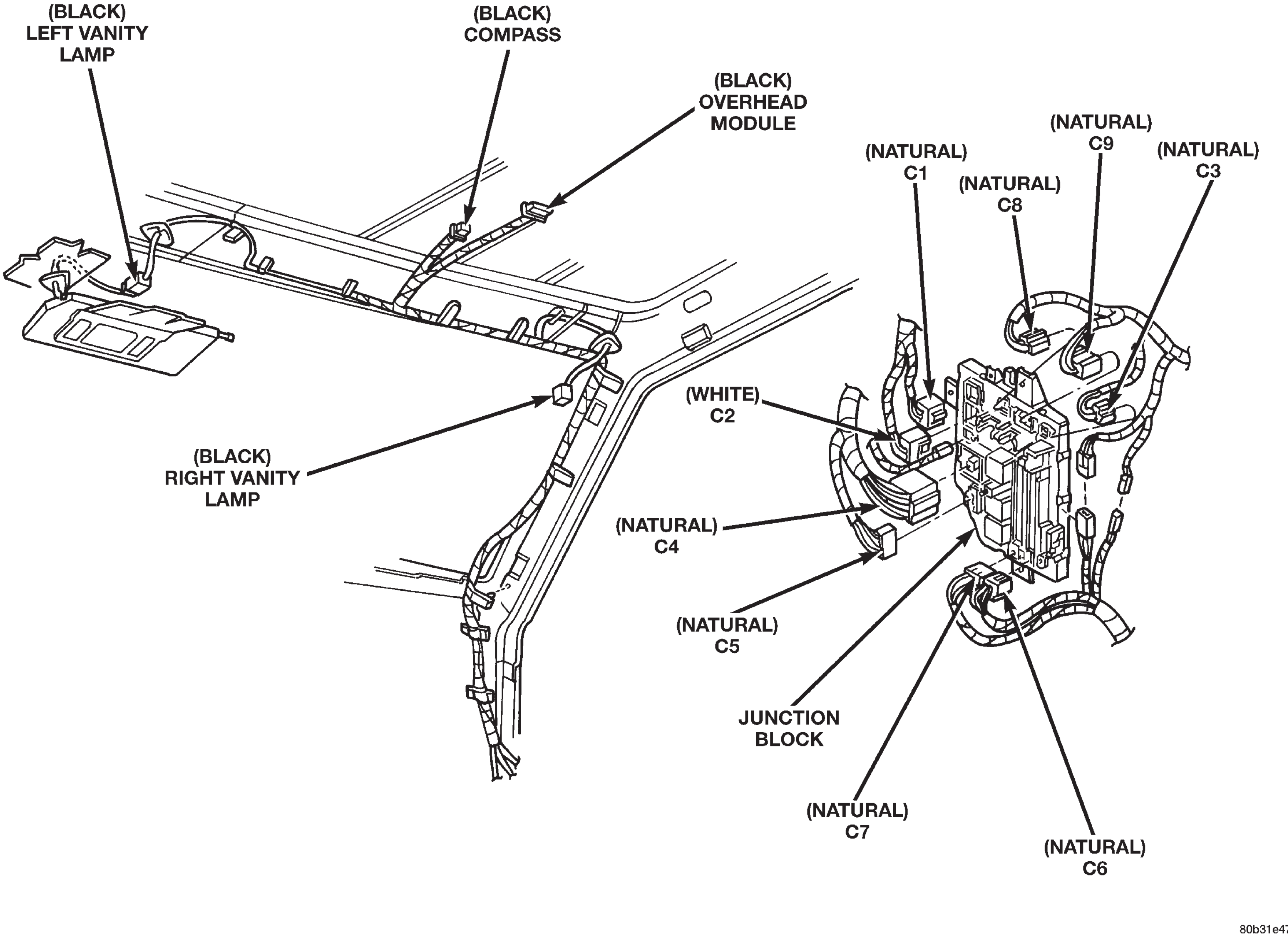


Fig. 29 Overhead and Junction Block

DESCRIPTION AND OPERATION (Continued)

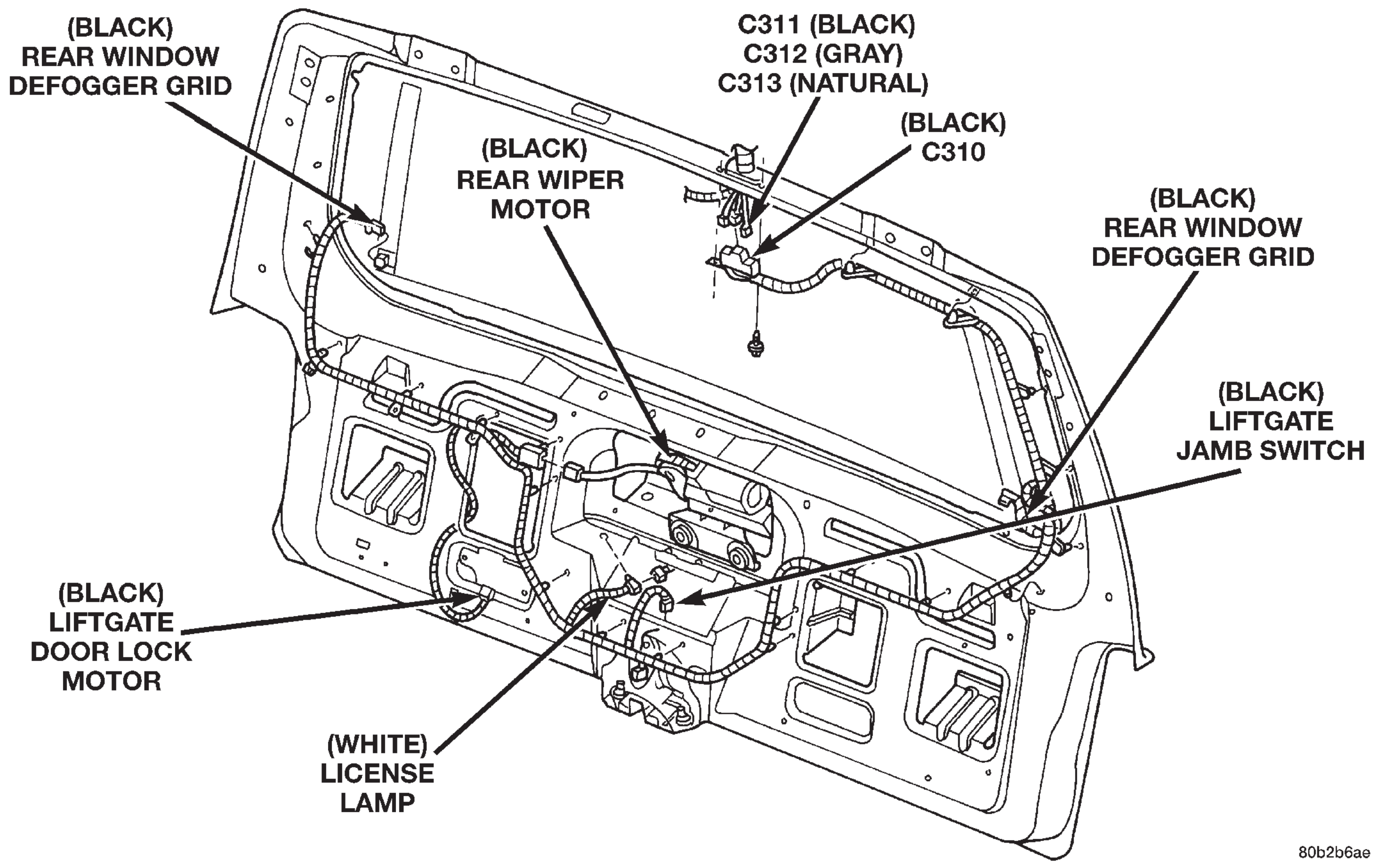


Fig. 30 Liftgate

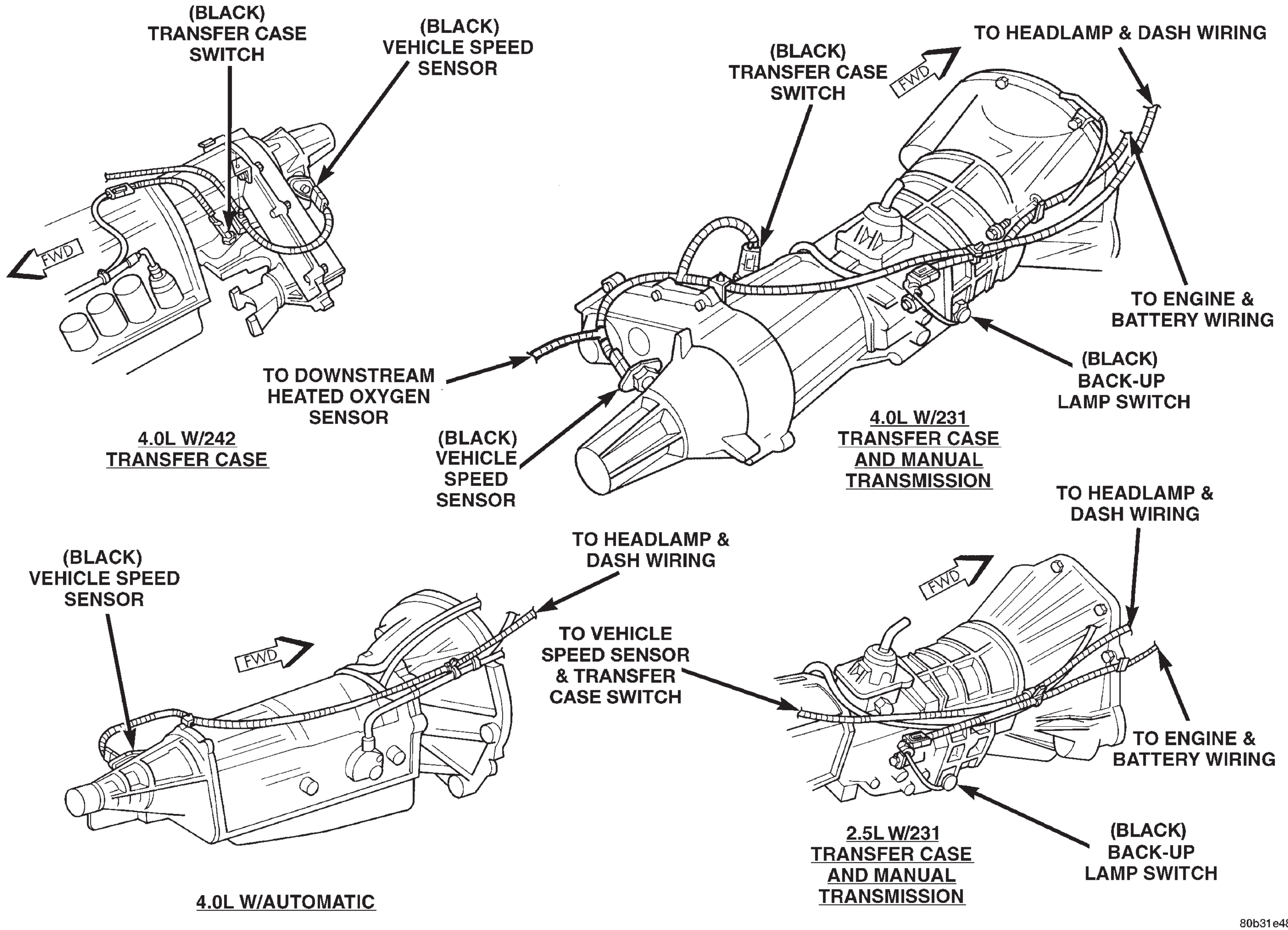


Fig. 31 Transmission Wiring Connectors

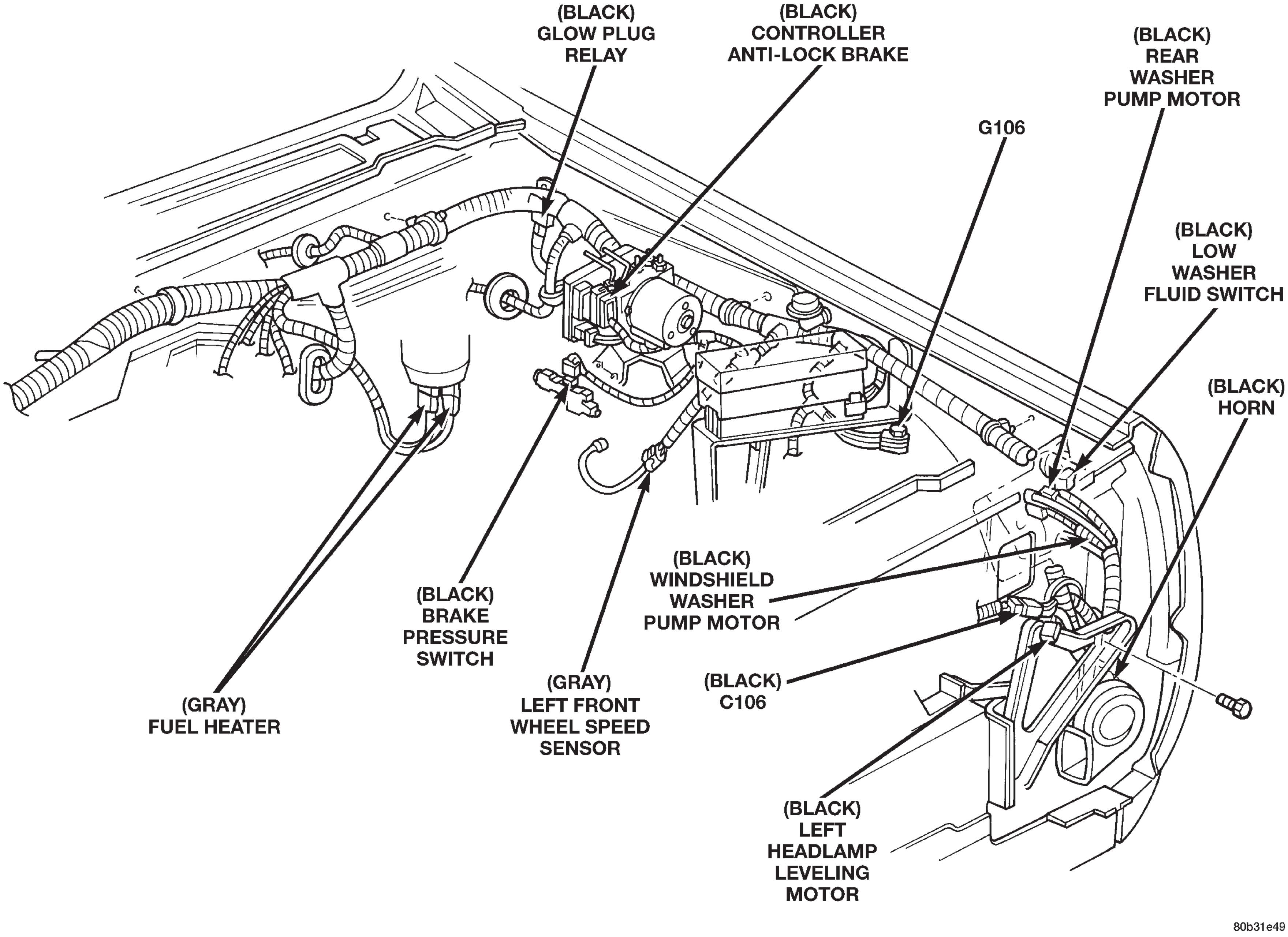


Fig. 32 Left Engine Compartment Diesel Engine LHD

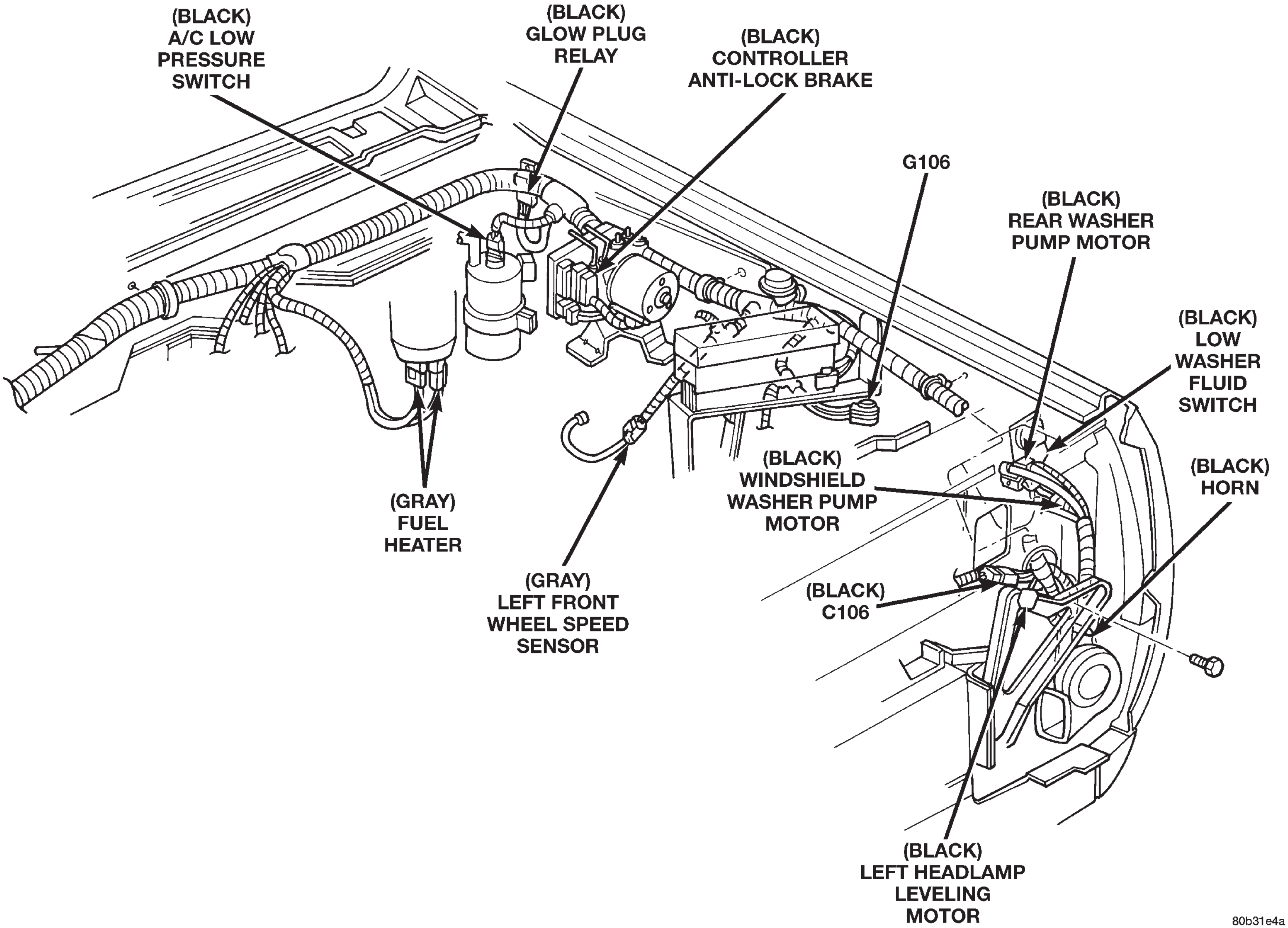


Fig. 33 Left Engine Compartment Diesel Engine RHD

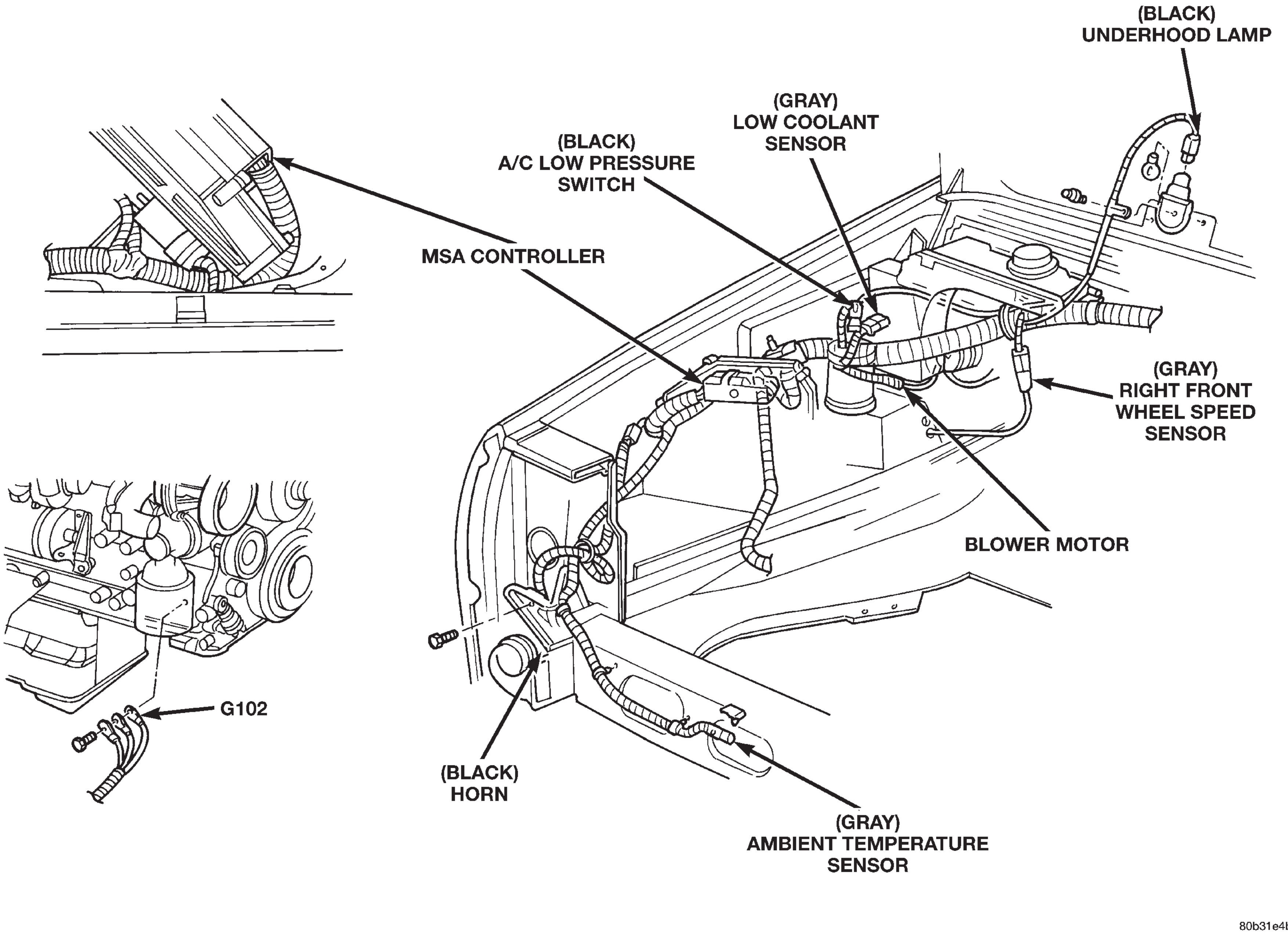


Fig. 34 Right Engine Compartment Diesel Engine LHD

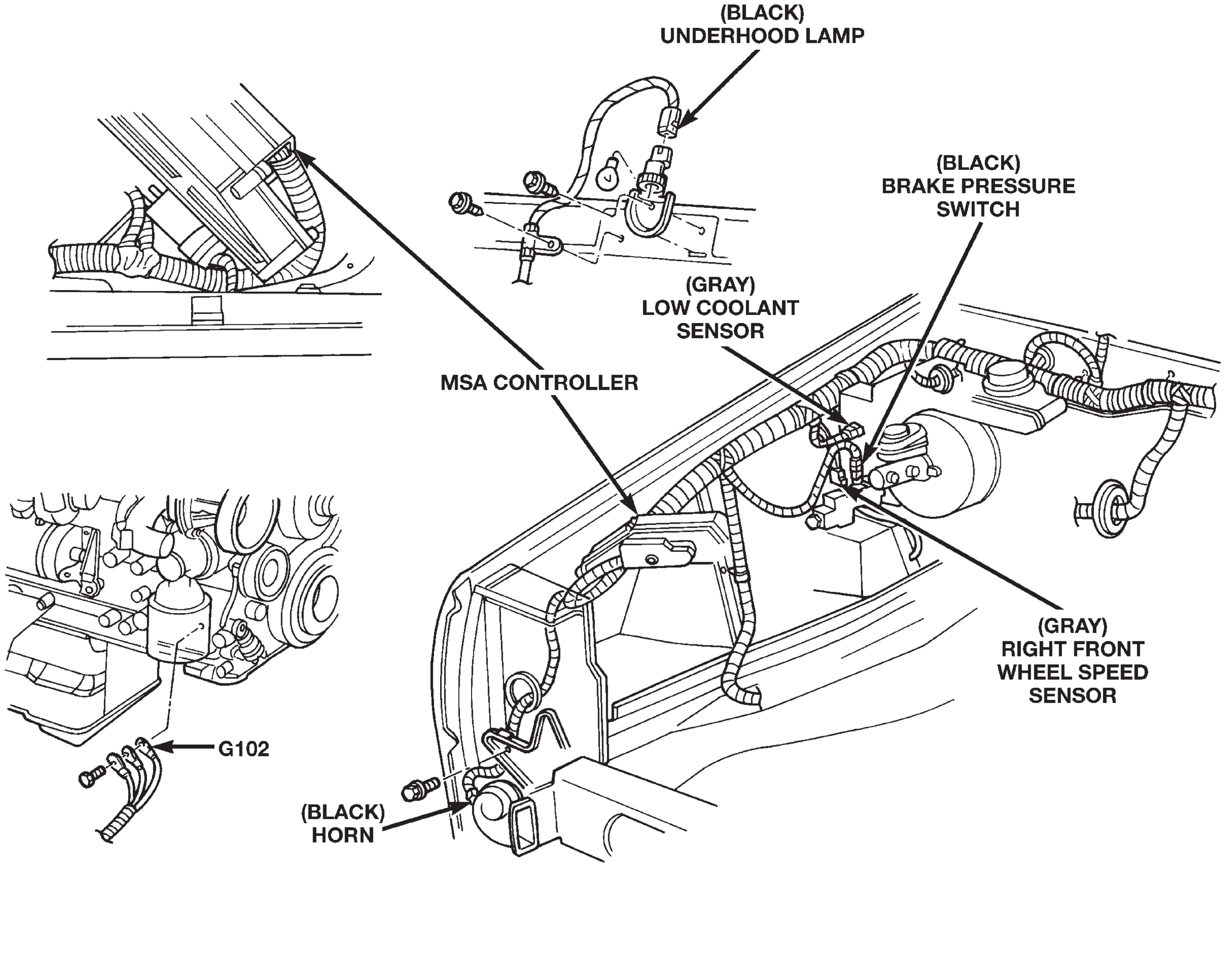


Fig. 35 Right Engine Compartment Diesel Engine RHD

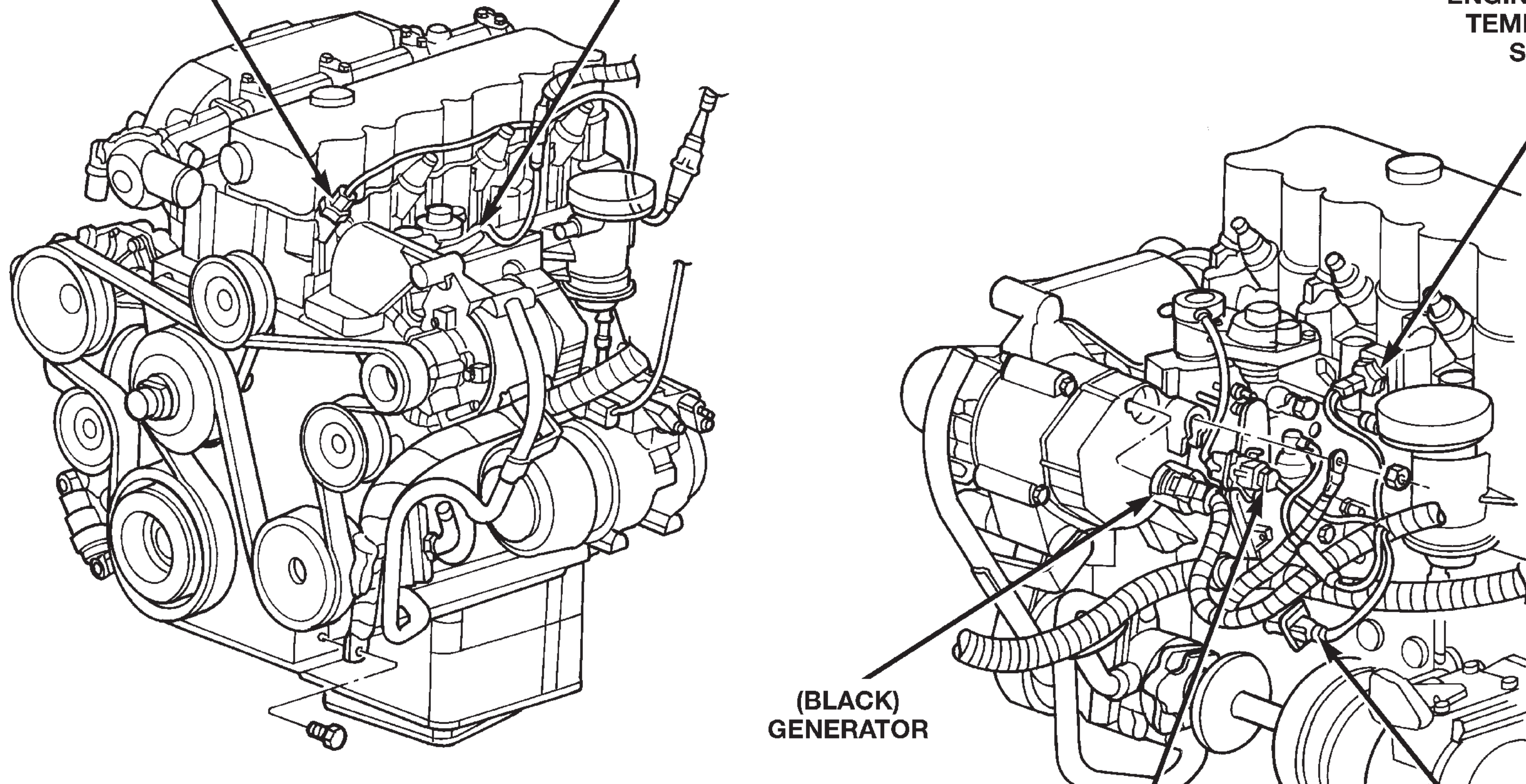


Fig. 36 Engine Connectors Diesel Engine

DESCRIPTION AND OPERATION (Continued)

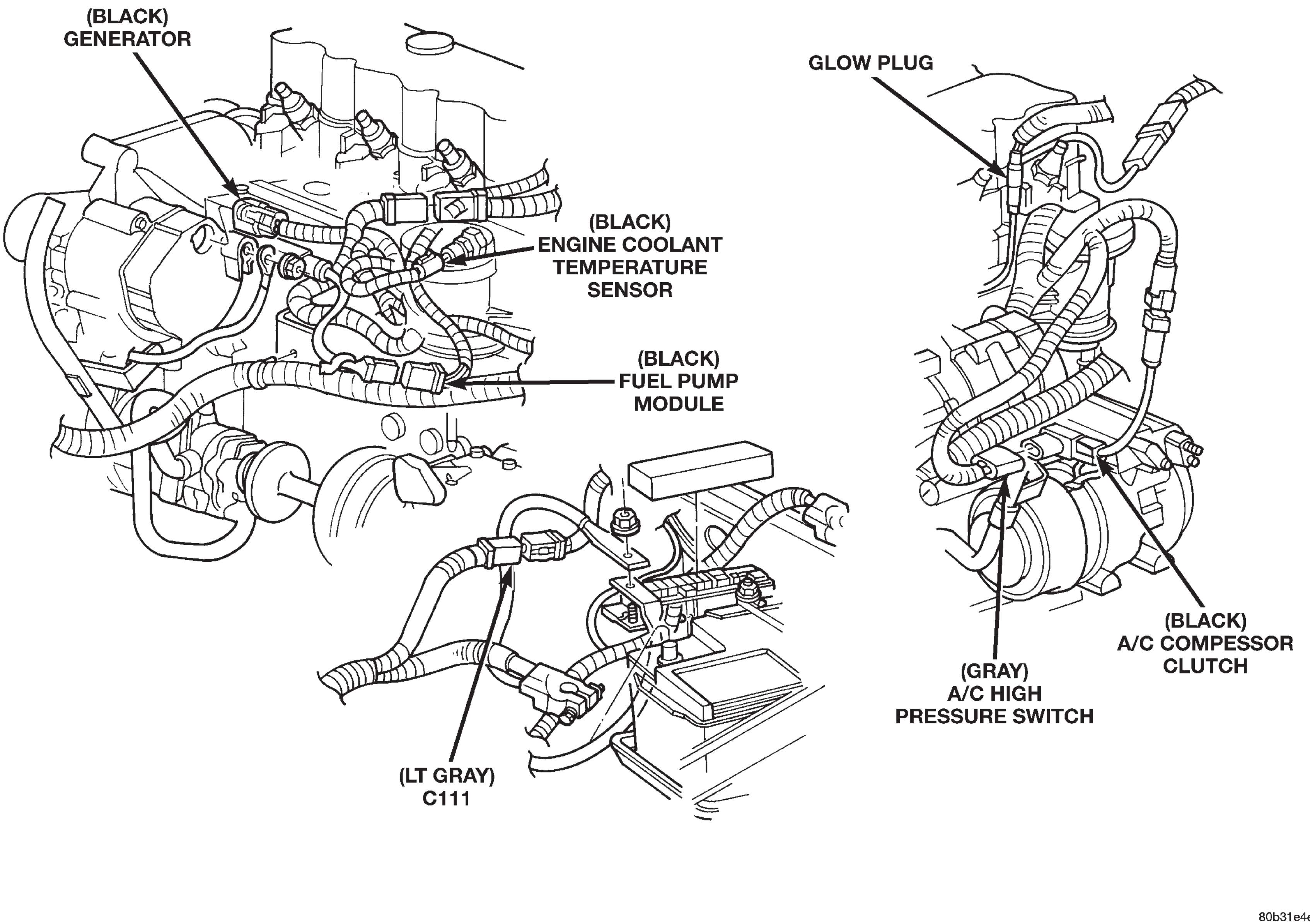


Fig. 37 Engine and Battery Diesel Engine

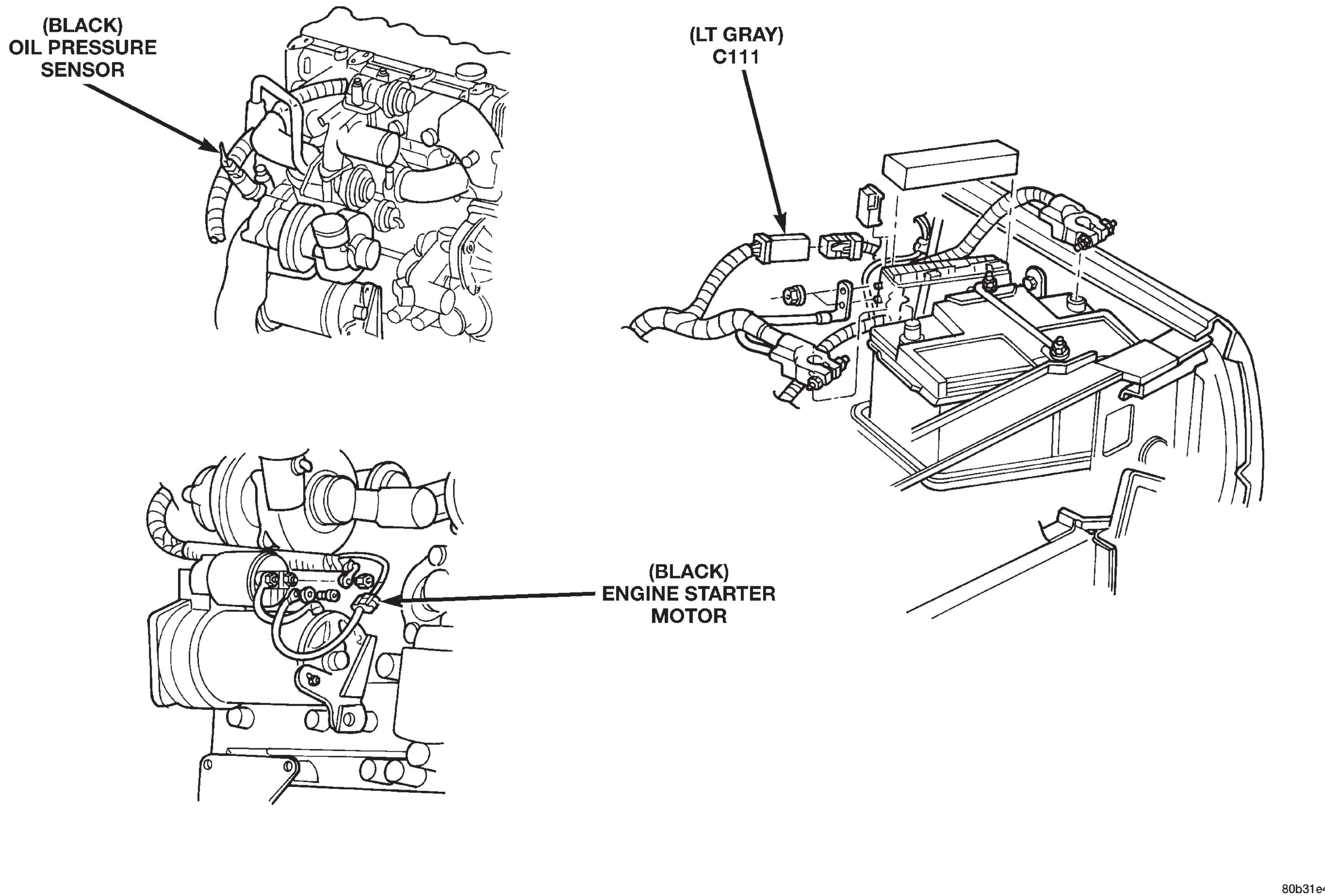


Fig. 38 Starter and Battery Diesel Engine

DESCRIPTION AND OPERATION (Continued)

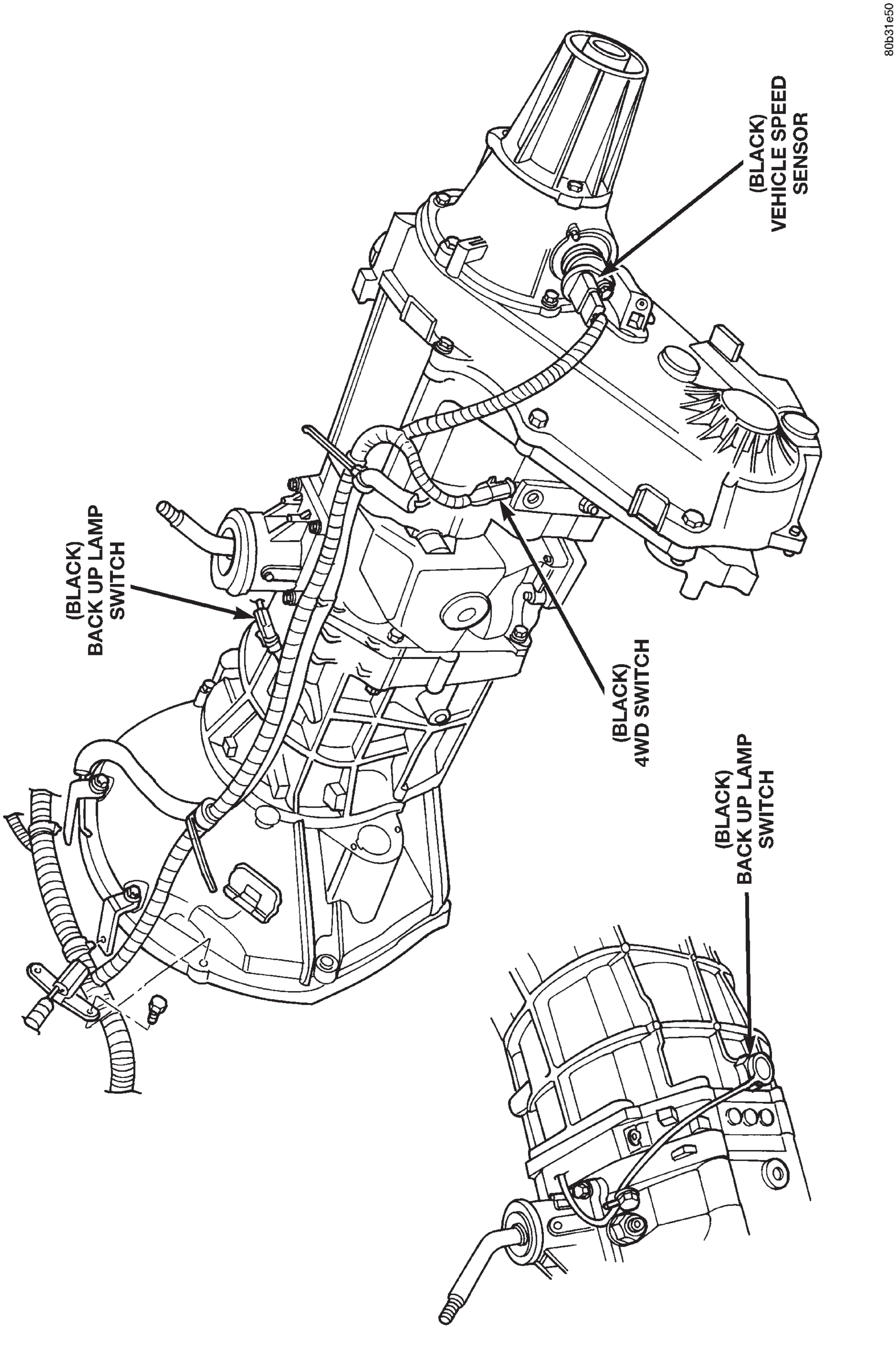


Fig. 39 Transmission Connectors Diesel Engine

8W-95 SPLICE LOCATIONS

DESCRIPTION AND OPERATION

INTRODUCTION

This section provides illustrations identifying the general location of the splices in this vehicle. A splice index is provided. Use the wiring diagrams in each section for splice number identification. Refer to the index for proper splice number.

SPLICE LOCATIONS

For splices that are not shown in the figures in this section a N/S is placed in the Fig. column.

Splice Number	Location	Fig.
S100	Near Right Headlamp	9
S101 (Except Built-Up-Export)	Near Right Headlamp	9
S102	Between Headlamps	9
S103	Near Left Headlamp	9
S104 (Except Built-Up-Export)	Near Left Headlamp	9
S105	Near Left Headlamp	9
S106 (W/Fog Lamps)	Near Left Headlamp	9
S107	Rear of Engine	10, 11, 12
S108	Rear of Engine	10, 11, 12
S109	Near Fuel Injector Harness	10, 11, 12
S110	Near Fuel Injector Harness	10, 11, 12
S111	Near Fuel Injector Harness	10, 11, 12
S112	Near Fuel Injector Harness	10
S113	Near Fuel Injector Harness	10, 11, 12
S114	Near Fuel Injector Harness	10, 11, 12
S115	Near MAP Sensor	11, 12, 19, 20
S116 (Built-Up-Export)	Near Back-Up Switch	11, 12
S118	Near Generator	10
S120 (2.5L)	Rear of Engine	11, 12
S130	Near Power Distribution Center	3, 4, 7, 8, 17, 18

Splice Number	Location	Fig.
S131	Near Purge Solenoid	3, 4, 7, 8, 18, 19, 20
S132	Near Purge Solenoid	2, 3, 4, 7, 8, 17, 18
S133	Left Rear of Engine Compartment	1, 2, 3, 5, 6, 7, 17, 18, 20
S134	Left Rear of Engine Compartment	2, 3
S135	Rear of Engine Compartment	2, 3, 4, 7, 8
S136	Rear of Engine Compartment	2, 3, 7
S137	Rear of Engine Compartment	1, 2, 5, 6, 7, 18
S138	Rear of Engine Compartment	1, 2, 5, 6, 7, 17, 18
S139	Left Rear of Engine Compartment	1, 2, 17, 18
S140	Left Rear of Engine Compartment	1, 2
S141	Left Rear of Engine Compartment	1,2, 6, 17
S142	Left Rear of Engine Compartment	1, 4
S143	Left Rear of Engine Compartment	1, 4, 5, 8
S144	Left Rear of Engine Compartment	1, 2
S145	Left Rear of Engine Compartment	1, 2
S146 (4.0L)	Near Cooling Fan Relay #2	N/S
S146 (Diesel)	Near MSA Controller	19,20

DESCRIPTION AND OPERATION (Continued)

Splice Number	Location	Fig.
S147 (Diesel)	Left Rear of Engine Compartment	17,18
S148 (Diesel)	Left Rear of Engine Compartment	17,18
S149 (Diesel)	Left rear of Engine Compartment	17,18
S150 (Diesel)	Left Rear of Engine Compartment	17,18
S151 (Diesel)	Near Power Distribution Center	17, 18
S152 (Diesel)	Left Fender Side Shield	17, 18
S153	In T/O to PDC	17, 18
S156 (Diesel)	Rear of Engine Compartment	17
S157 (Diesel)	Left Rear of Engine Compartment	17, 18
S158	Near T/O for Left Headlamp	9
S159	Near T/O for PDC	3, 4, 7, 8, 17, 18
S161	Near Vehicle Speed Sensor T/O	N/S
S200	Near Headlamp Switch	13, 14
S201	Near Data Link Connector	13, 14
S202	Lower Left Instrument Panel	13
S203	Near Brake Switch	13, 14
S204 (LHD)	Near Brake Switch	13
S204 (RHD)	Lower Steering Column	14
S205	Lower Instrument Panel	13, 14
S206	In Lower Instrument Panel Trough	13, 14
S207	In Lower Instrument Panel Trough	13, 14
S208	In Lower Instrument Panel Trough	13, 14
S209	In Lower Instrument Panel Trough	13, 14
S210	In Lower Instrument Panel Trough	13, 14
S211	In Lower Instrument Panel Trough	13, 14
S212 (LHD)	Near Brake Shift Interlock	13

Splice Number	Location	Fig.
S212 (RHD)	In Lower Instrument Panel Trough	14
S213	Near Brake Shift Interlock	13, 14
S214	Between Glove Box Lamp and Trough	13, 14
S215	Near Center Console	13, 14
S216	Near Instrument Cluster	13, 14
S217	In Lower Instrument Panel Trough	13
S218	Lower Instrument Panel	14
S219	Lower Instrument Panel	14
S220	Near T/O for Rear Fog Lamp Relay	N/S
S221	Near Clock Spring	N/S
S222	Near Clock Spring	N/S
S225	Near Junction Block	N/S
S226 (Built-Up-Export)	Near Headlamp Switch	N/S
S227 (Built-Up-Export)	Near Headlamp Switch	N/S
S229 (Built-Up-Export)	Lower Instrument Panel	13, 14
S230 (Built-Up-Export)	Near Center Console	13, 14
S232	Lower Instrument Panel	14
S233 (Built-up-Export)	Near Left headlamp (W/Headlamp Leveling)	9
S234 (Built-Up-Export)	Near Left Headlamp (W/Headlamp Leveling)	9
S235 (Built-Up-Export)	Between Headlamps (W/Headlamp Leveling)	9
S236 (Built-Up-Export)	Near right Headlamp (w/Headlamp Leveling)	9
S237 (Built-Up-Export)	Near Diode Module	13
S238	In T/O for Combination Flasher	N/S
S239	In T/O for Combination Flasher	N/S
S301	Near Power Amplifier	16
S302	Near Power Amplifier	16
S303	Near Power Amplifier	16
S304	Near Right Front Door Jamb Switch	N/S

DESCRIPTION AND OPERATION (Continued)

Splice Number	Location	Fig.
S305	Between Right Tail Lamp and Power Seat	N/S
S306	Between Right Tail Lamp and Power Seat	N/S
S307	Between Right Tail Lamp and Power Seat	N/S
S308	Between Left Tail Lamp and Left Rear Door	N/S
S309	Between Left Tail Lamp and Left Rear Door	N/S
S310	Near Right Rear Door Jamb Switch	N/S
S311	Near Left Tail Lamp	N/S
S312	Near Power Seat	N/S
S313	Near Console Illumination	N/S
S314	Instrument Panel to Body Harness	15
S315	Instrument Panel to Body Harness	15
S316 (LHD)	Near Right Power Window Motor	N/S
S317 (LHD)	Near Right Power Window Motor	N/S
S318	Right Front Door Near Tweeter	N/S
S319	Right Front Door Near Tweeter	N/S
S320	Right Front Door	N/S
S321	Right Front Door	N/S
S322 (RHD)	Near Left Power Window Motor	N/S
S323 (RHD)	Near Left Power Window Motor	N/S
S325 (RHD)	Near Left Door Tweeter	N/S
S326 (RHD)	Near Left Front Door Speaker	N/S
S327 (RHD)	Near Left Front Door Speaker	N/S
S328	Near Left Door Tweeter	N/S
S329 (LHD)	Near Left Door Tweeter	N/S
S330 (LHD)	Near Left Front Door Speaker	N/S
S331 (LHD)	Near Left Front Door Speaker	N/S

Splice Number	Location	Fig.
S334	Liftgate	N/S
S335	Trailer Tow Harness	N/S
S336	Trailer Tow Harness	N/S
S337	Trailer Tow Harness	N/S
S338	Trailer Tow Harness	N/S
S339	Trailer Tow Harness	N/S
S340	Trailer Tow Harness	N/S
S341	Left Rear Lighting Harness	N/S
S342	Overhead Console	N/S
S344	Overhead Console	N/S
S345	Overhead Console	N/S
S346	Overhead Console	N/S
S347	Dome and Vanity Harness	N/S
S348	Right Rear Lighting Harness	N/S
S349	In T/O for HVAC Unit	N/S
S350	In the Power Seat Harness	N/S
S351	Near T/O for Left Door Connectors	N/S
S352	Left Kick Panel	N/S
S353	Near Right Heated Seat Switch	N/S
S354	In the Right Heated Seat Harness	N/S
S355	In Left and Right Heated Seat Switch Harness	N/S
S356	Near the Left and Right Heated Seat Harness Ground	N/S
S357	Near the Heated Seat Relay	N/S
S359	Near T/O for HVAC Unit	N/S
S360	Near Power Mirror Switch	N/S
S361	Near Junction Block in the Dome Harness	N/S

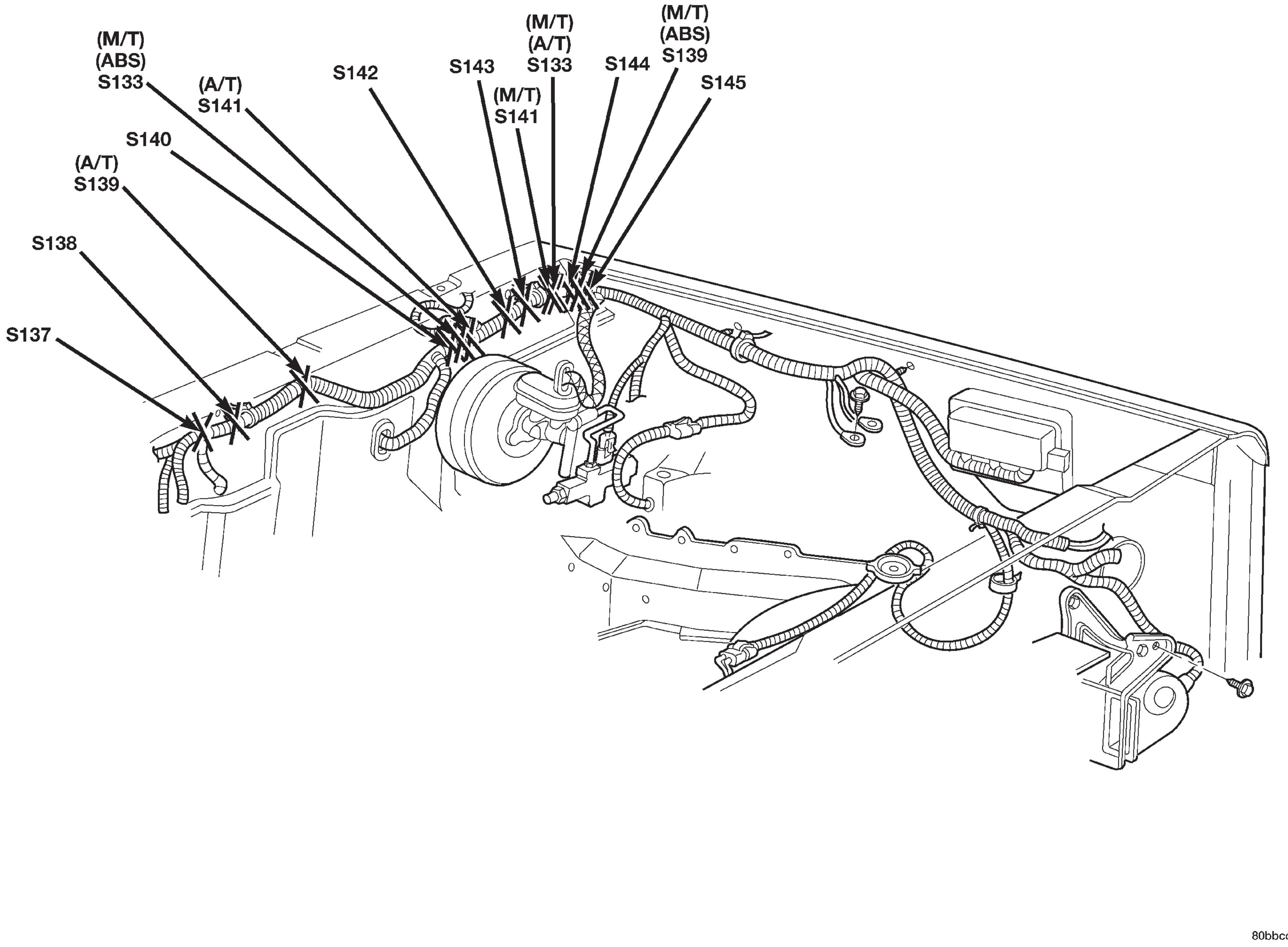


Fig. 1 Left Engine Compartment Splices 4.0L Engine LHD

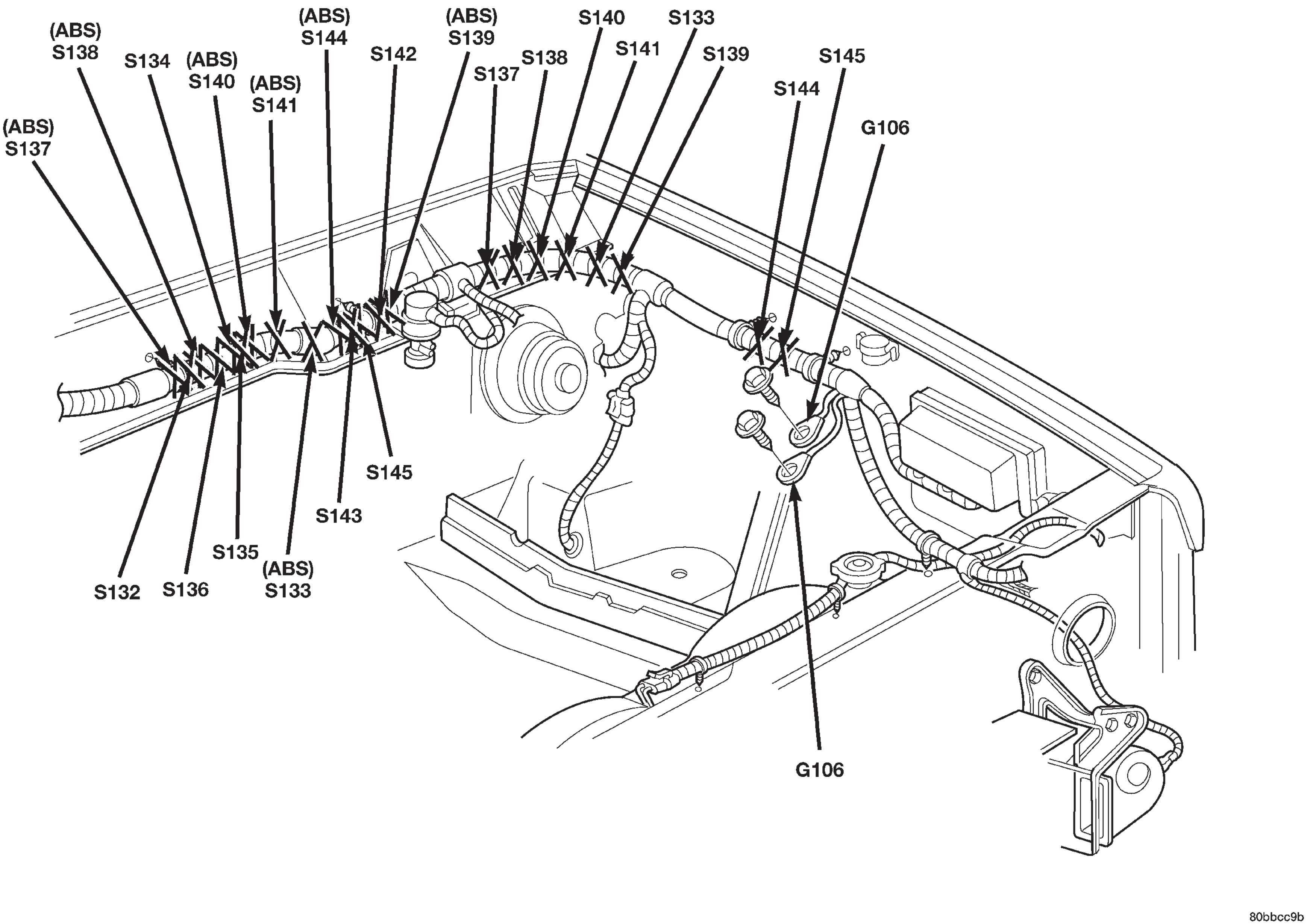


Fig. 2 Left Engine Compartment Splices 4.0L Engine RHD

DESCRIPTION AND OPERATION (Continued)

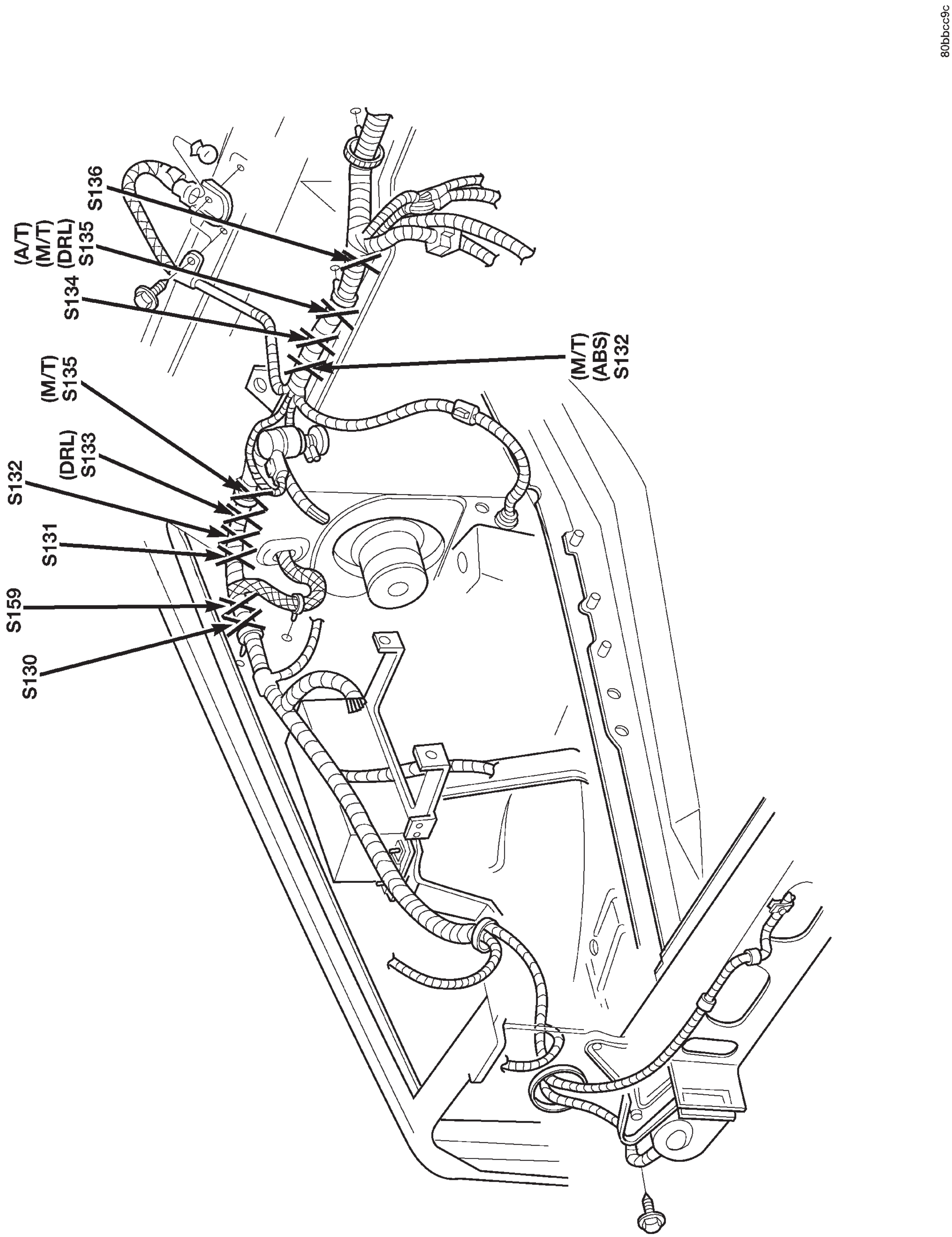


Fig. 3 Right Engine Compartment Splices 4.0L Engine LHD

DESCRIPTION AND OPERATION (Continued)

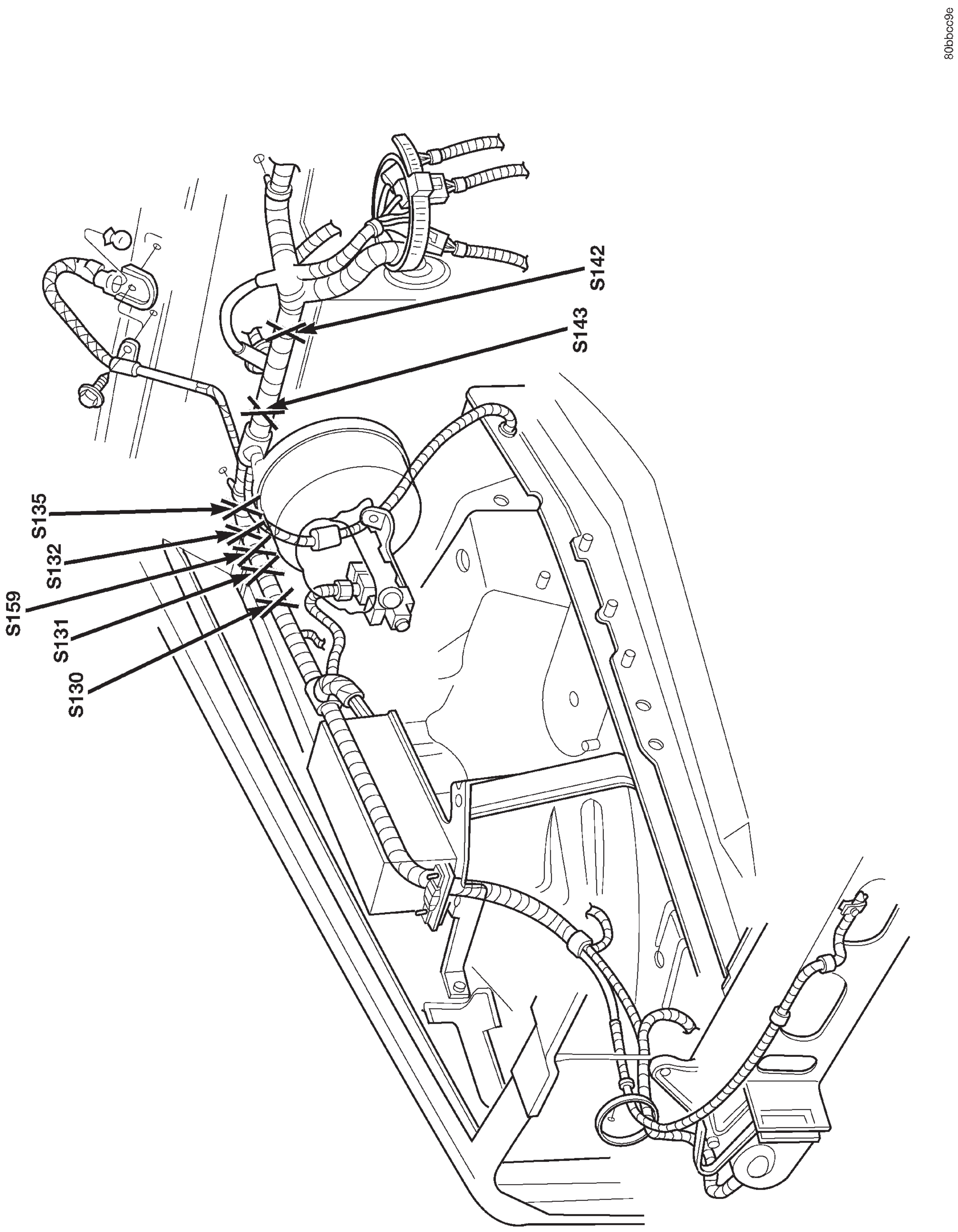


Fig. 4 Right Engine Compartment Splices 4.0L Engine RHD

DESCRIPTION AND OPERATION (Continued)

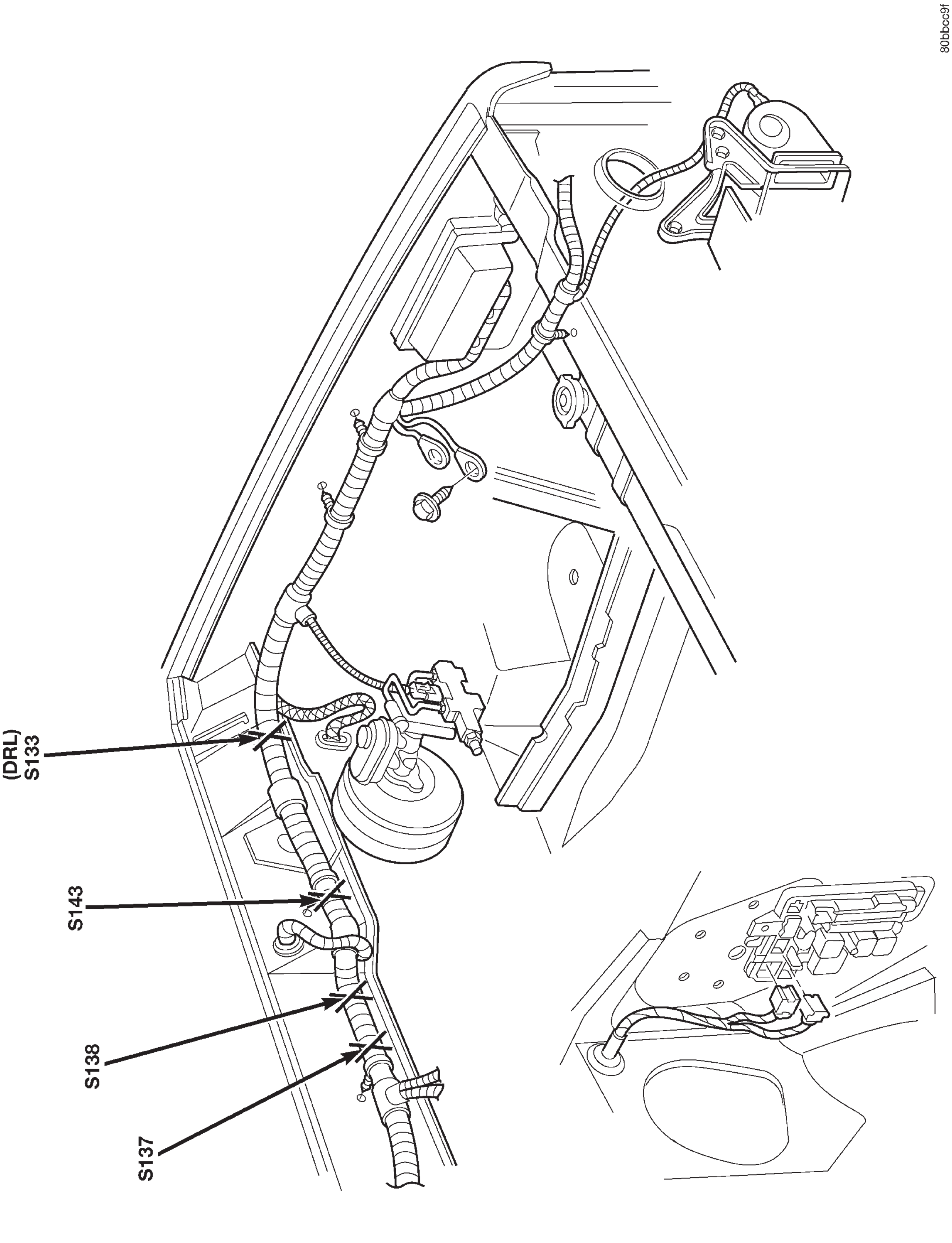


Fig. 5 Left Engine Compartment Splices 2.5L Engine LHD

DESCRIPTION AND OPERATION (Continued)

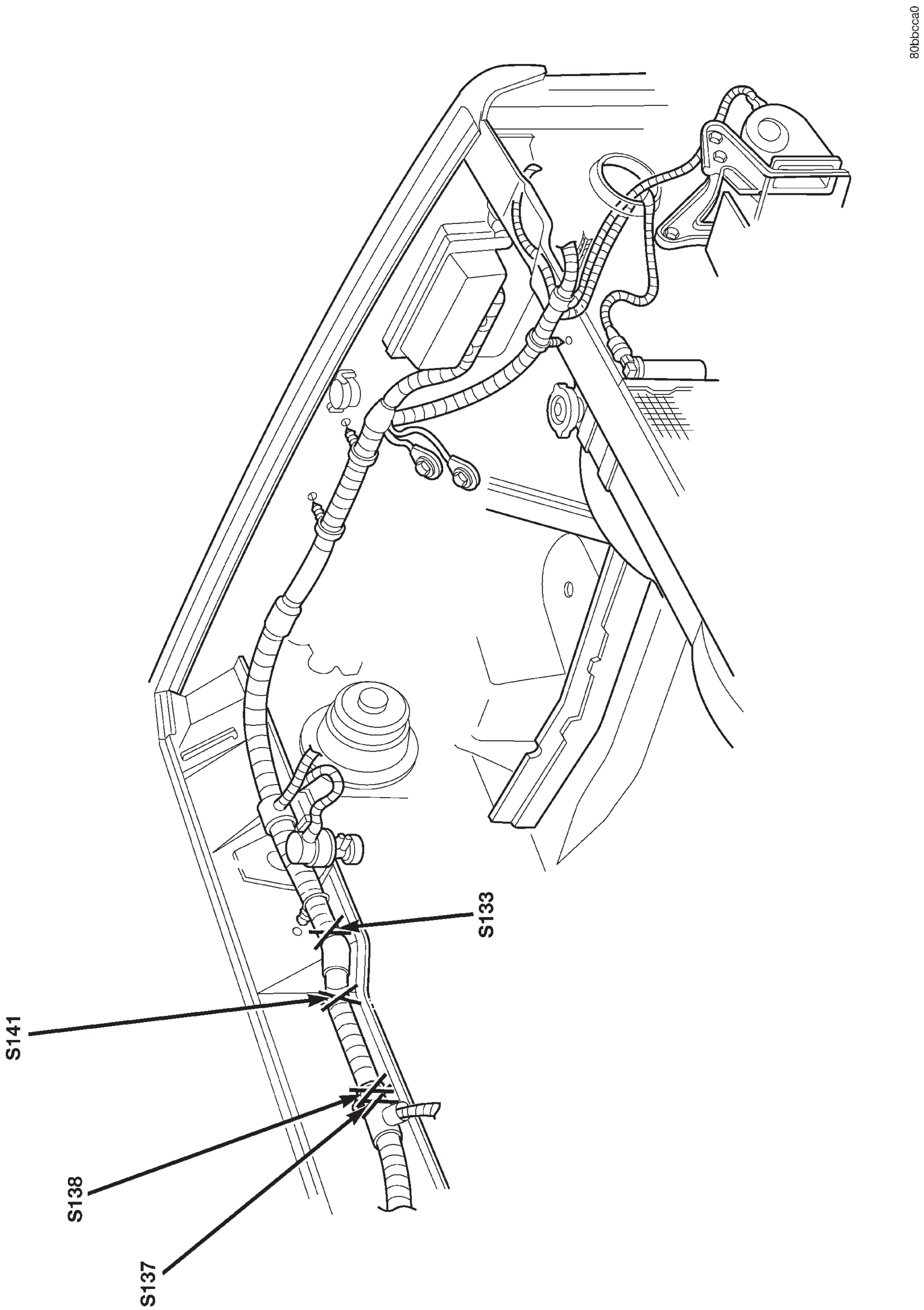


Fig. 6 Left Engine Compartment Splices 2.5L Engine RHD

DESCRIPTION AND OPERATION (Continued)

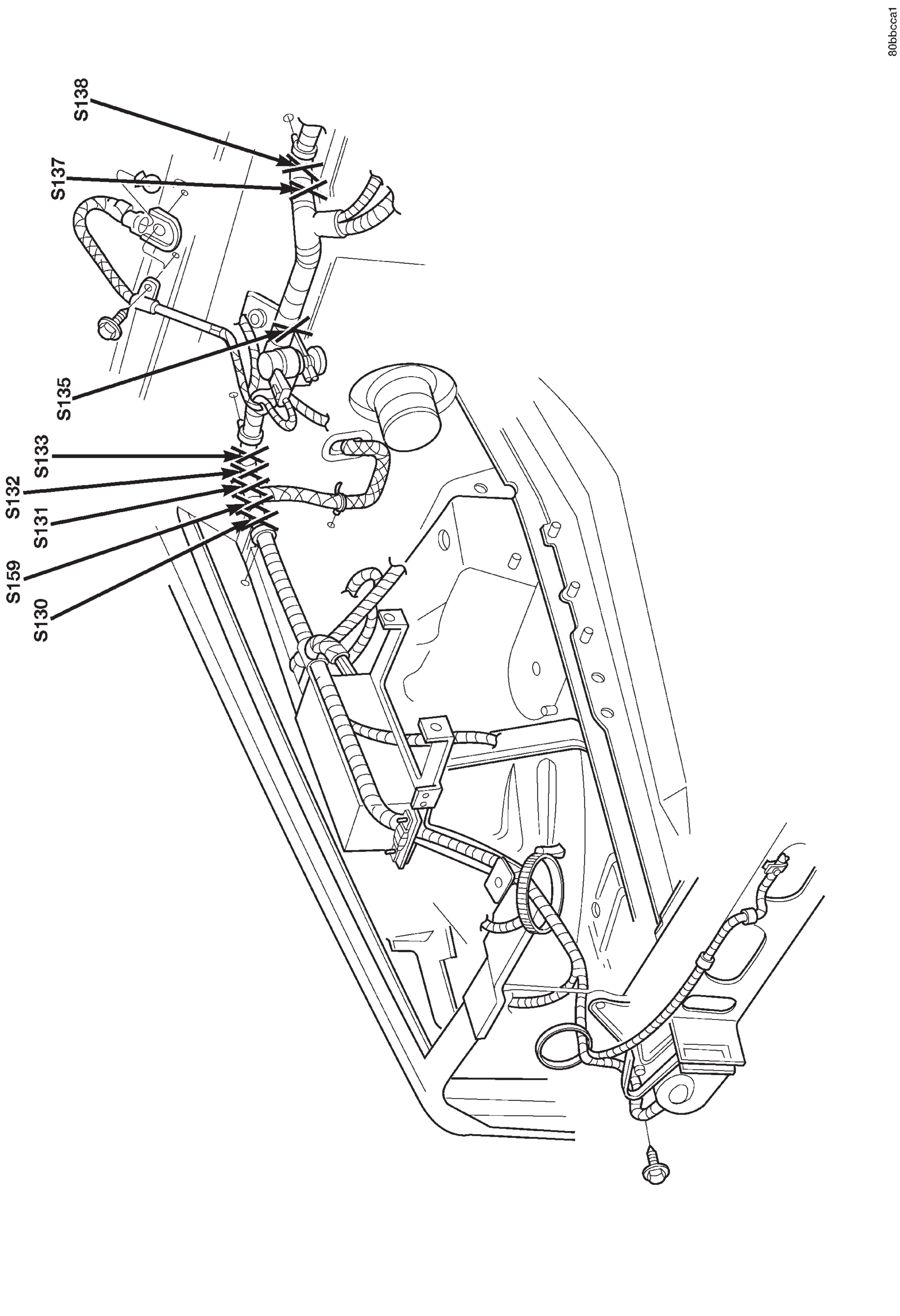


Fig. 7 Right Engine Compartment Splices 2.5L Engine LHD

DESCRIPTION AND OPERATION (Continued)

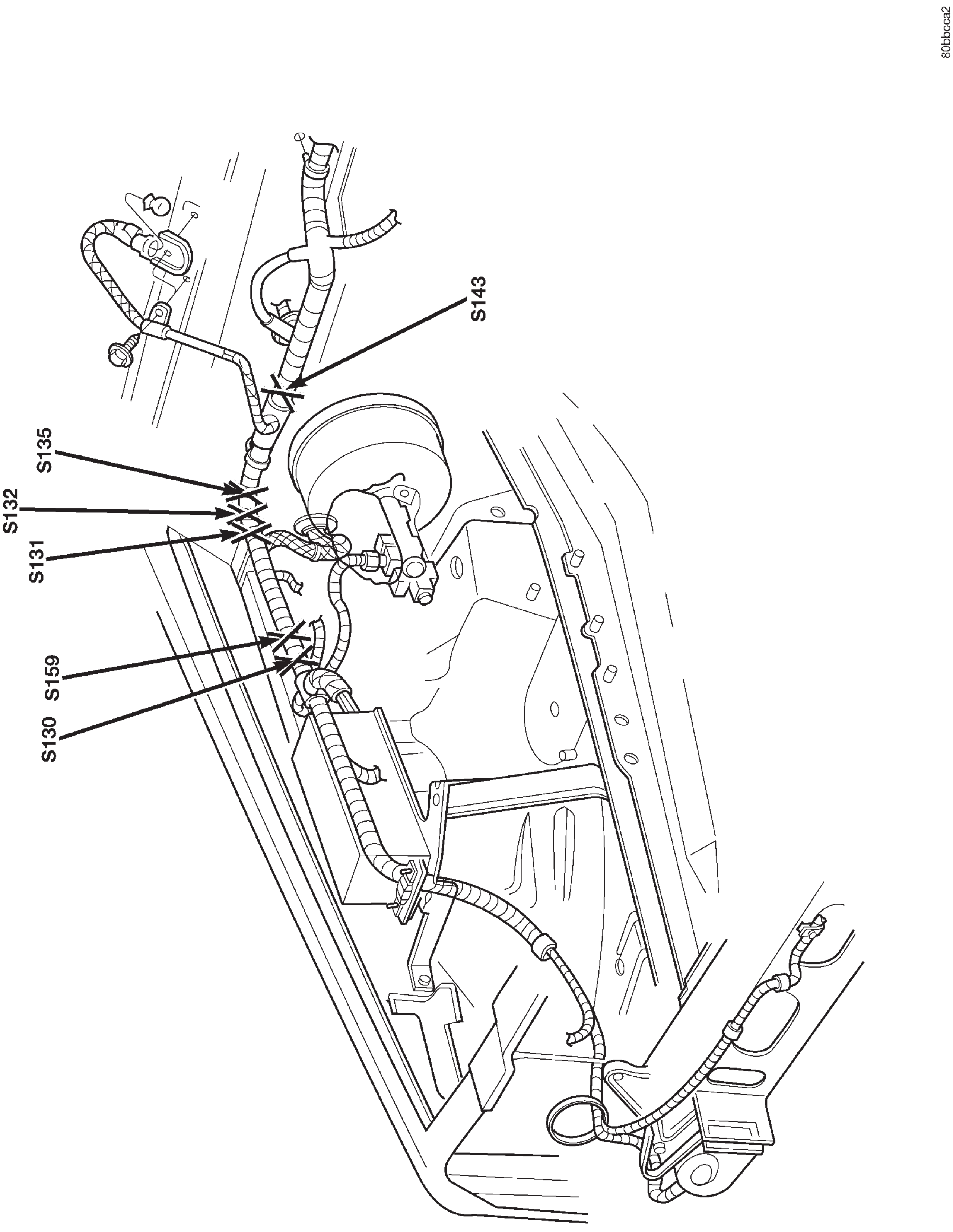


Fig. 8 Right Engine Compartment Splices 2.5L Engine RHD

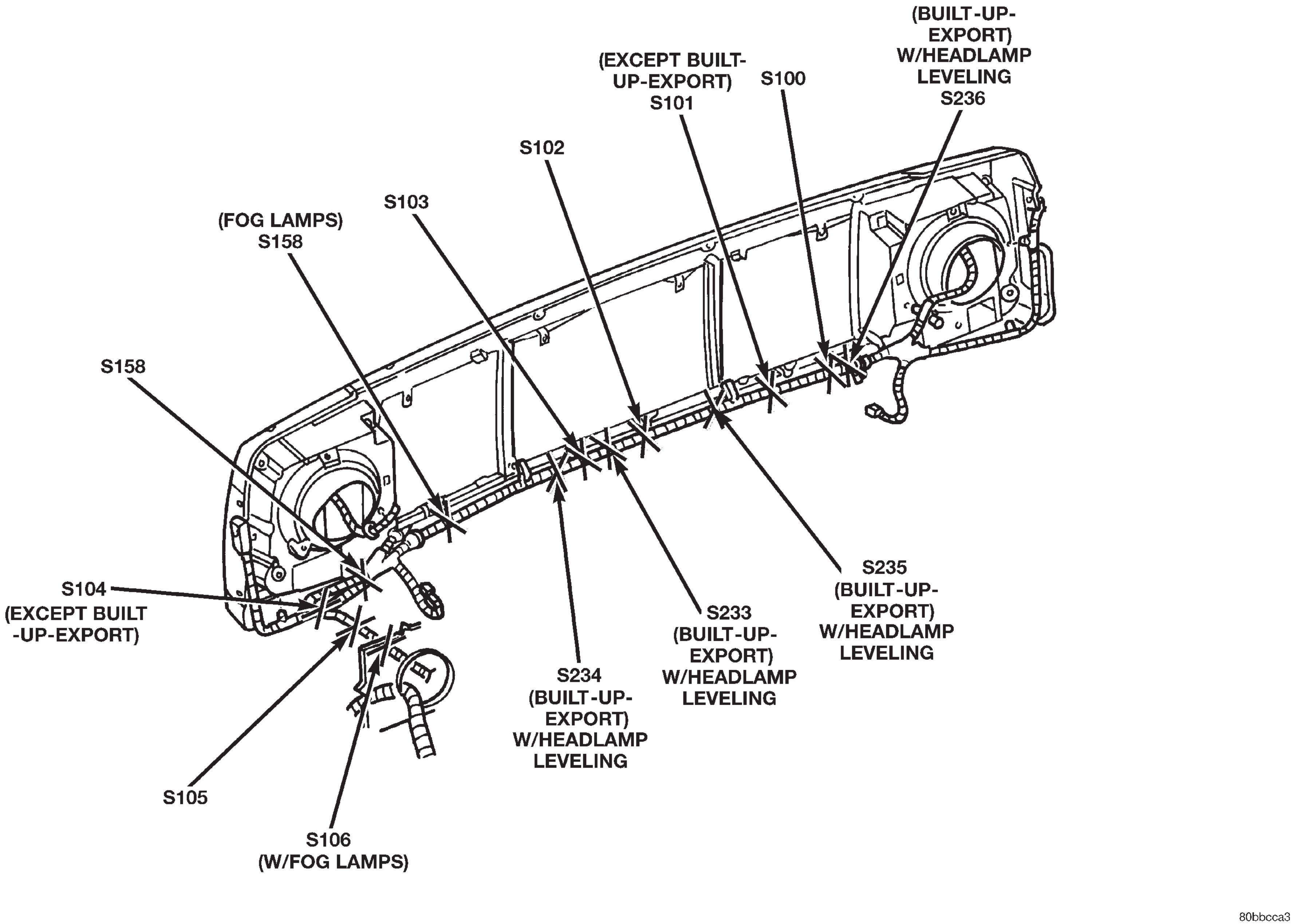


Fig. 9 Front End Lighting Splices

DESCRIPTION AND OPERATION (Continued)

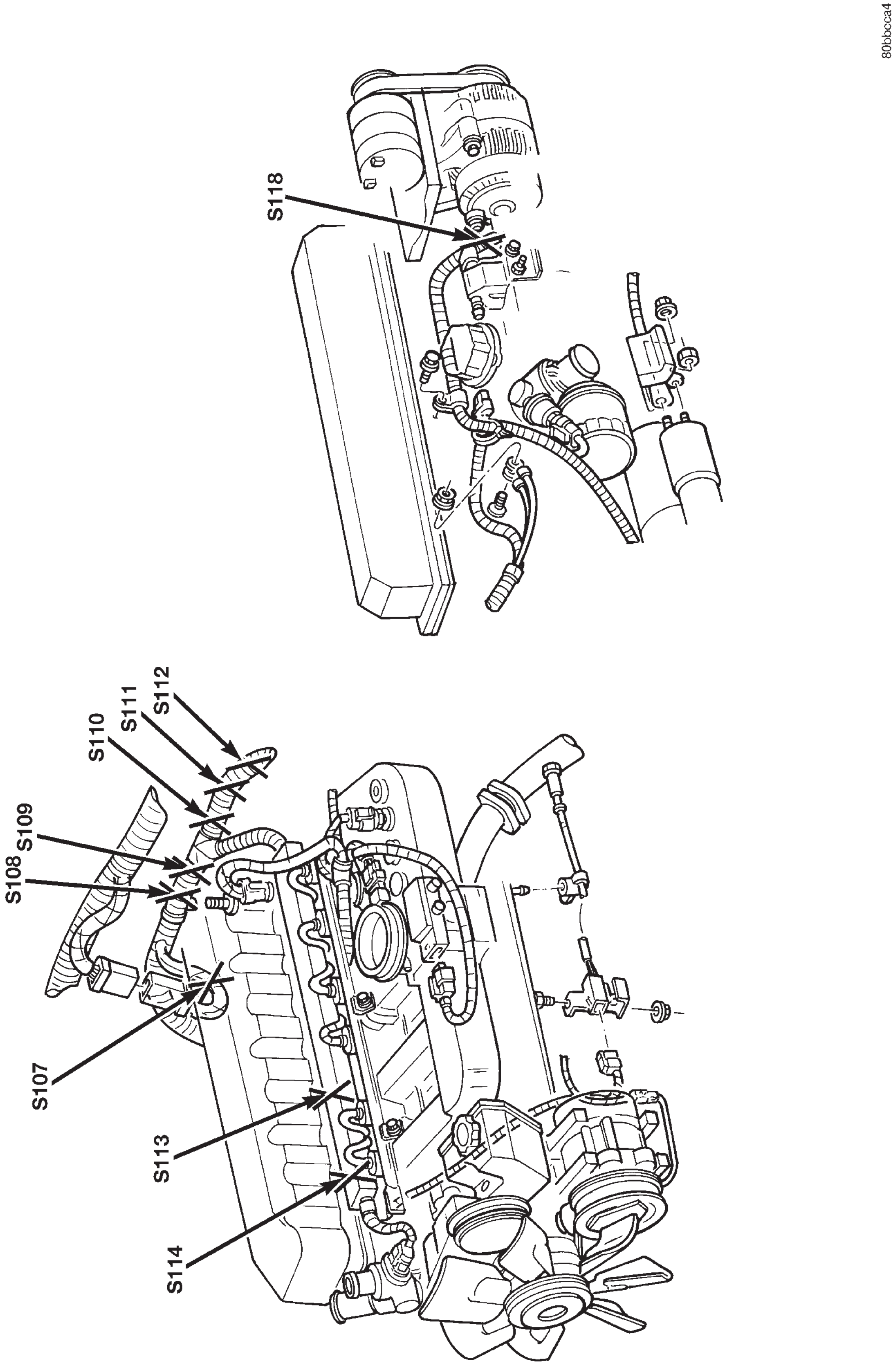


Fig. 10 Engine Wiring Splices 4.0L Engine

DESCRIPTION AND OPERATION (Continued)

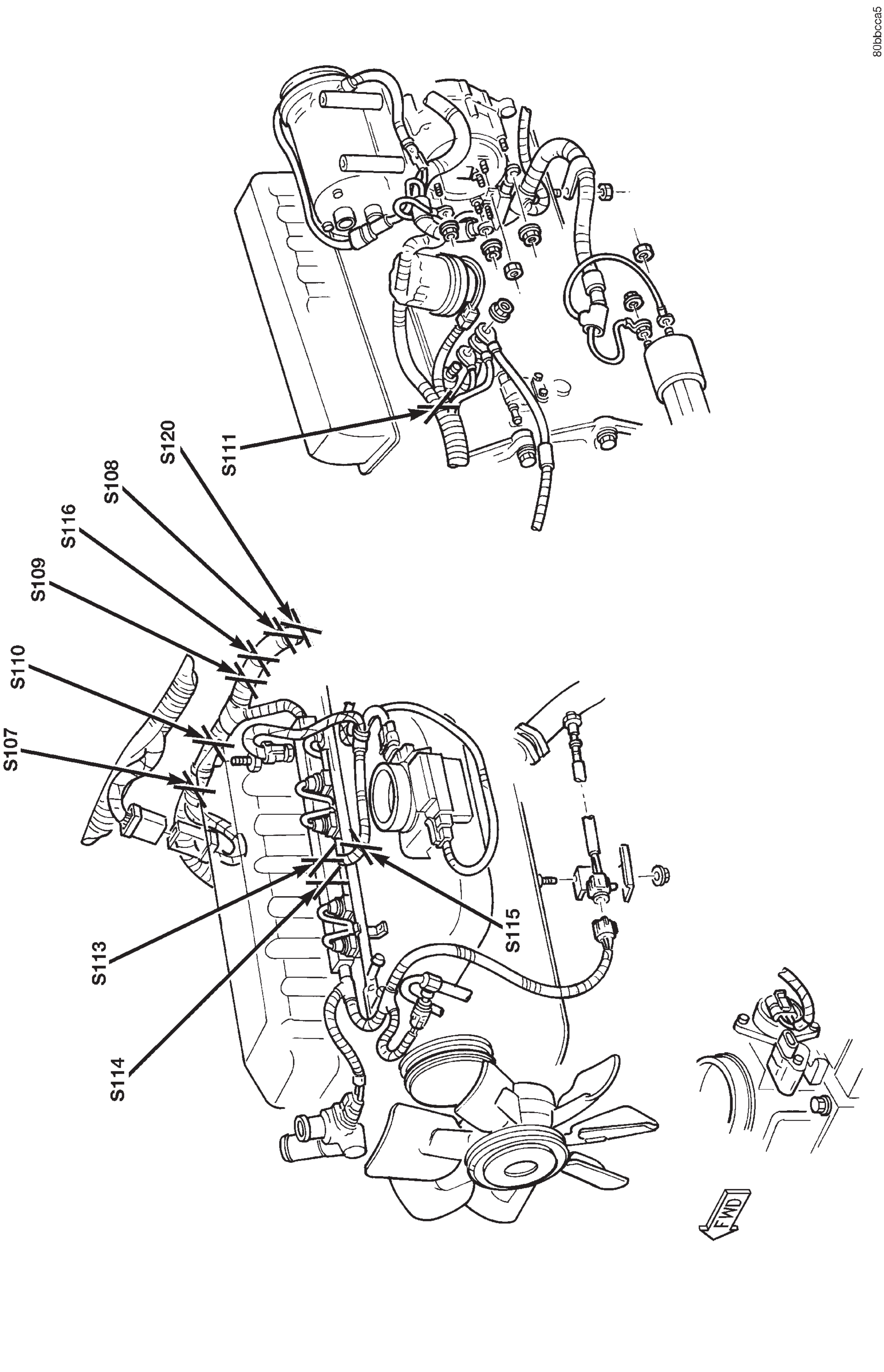


Fig. 11 Engine Wiring Splices 2.5L Engine LHD

DESCRIPTION AND OPERATION (Continued)

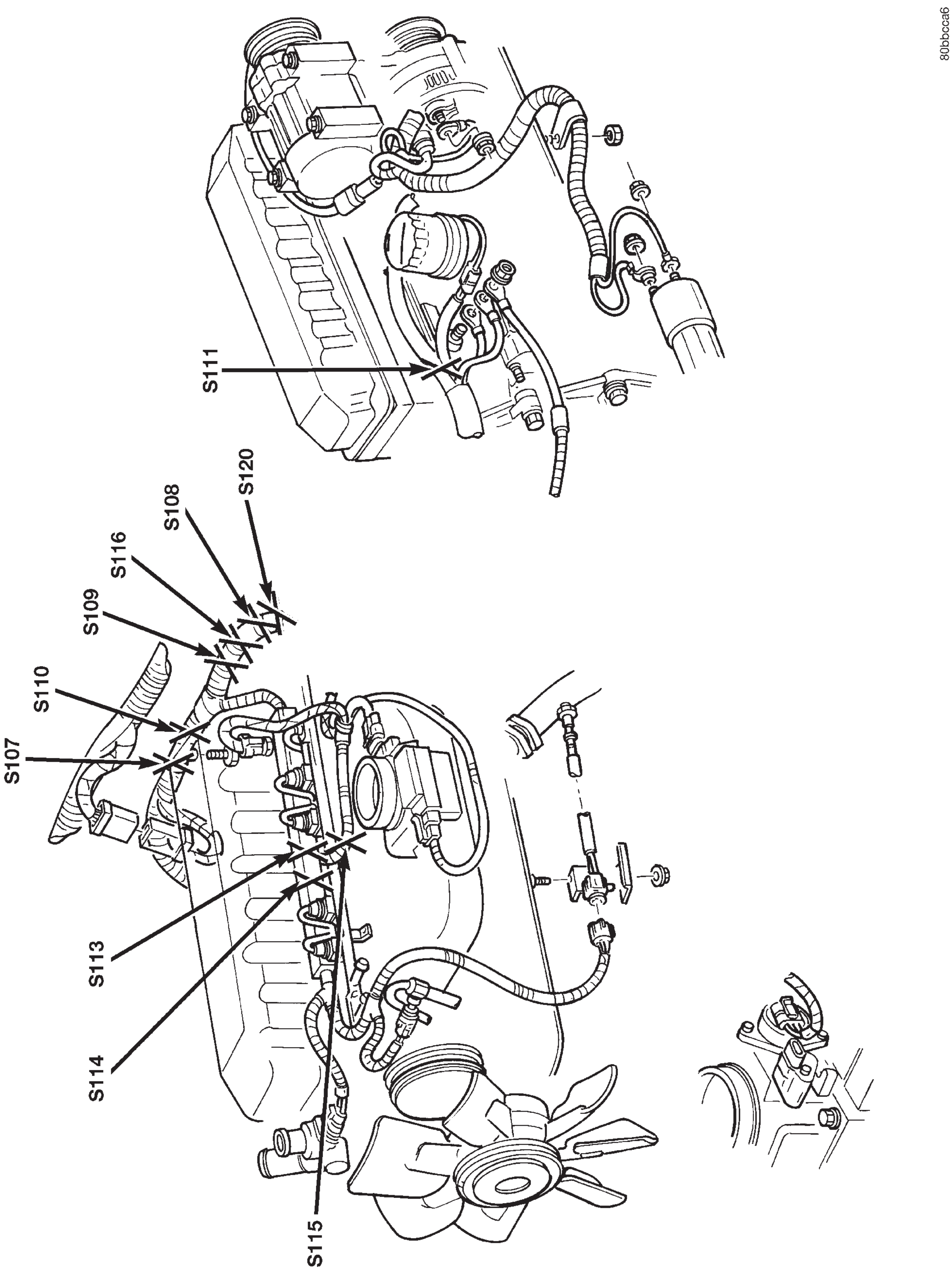


Fig. 12 Engine Wiring Splices 2.5L Engine RHD

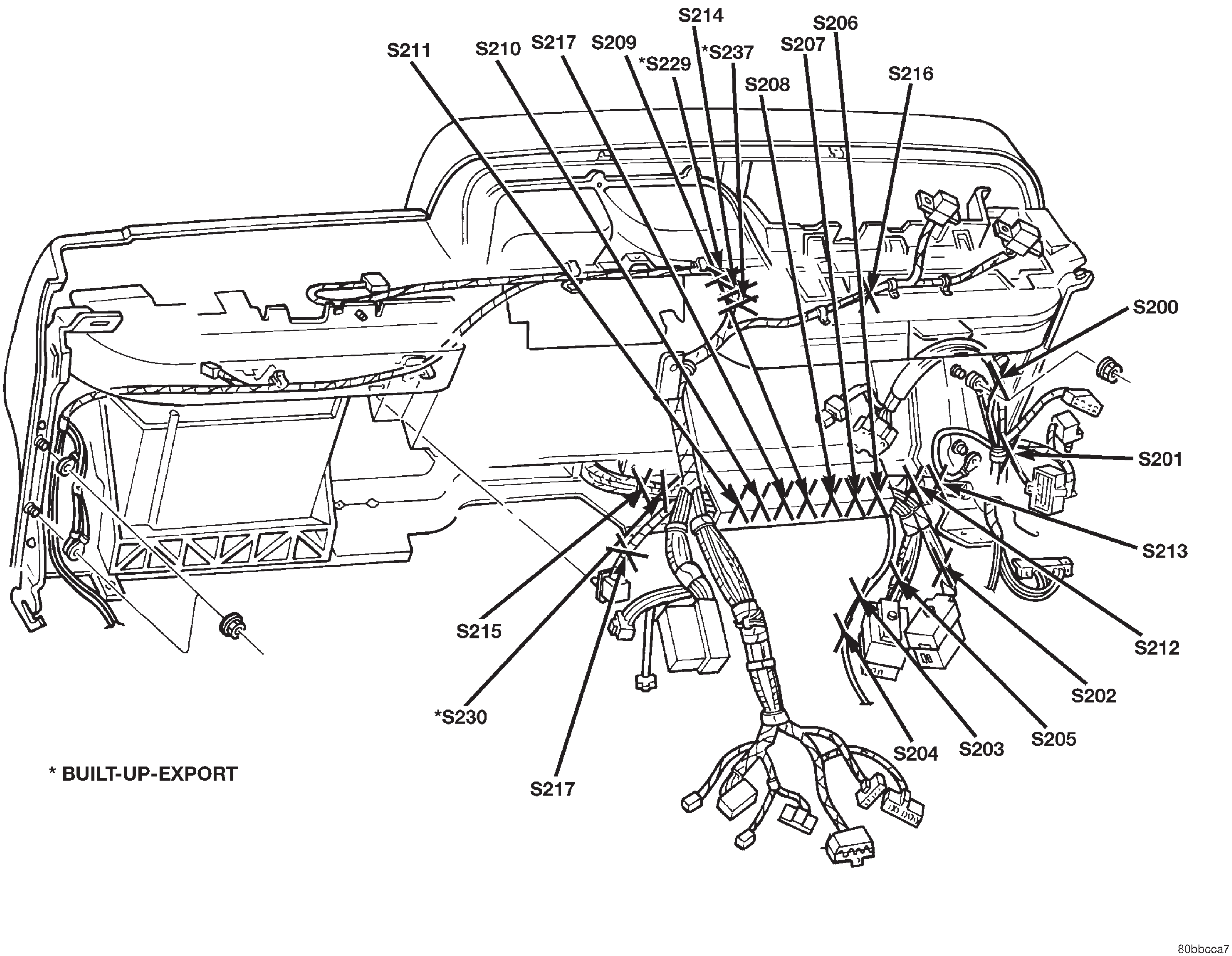
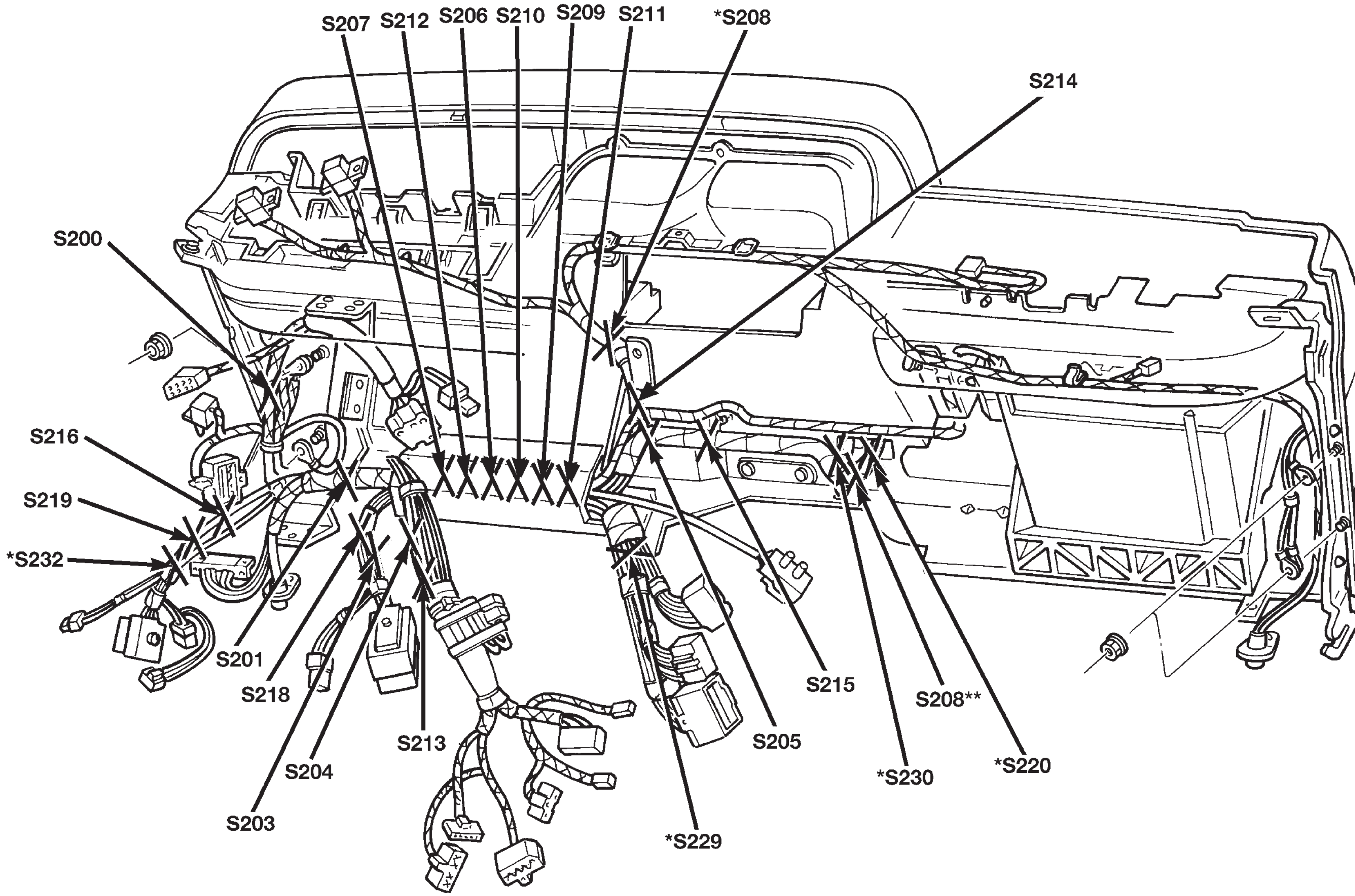


Fig. 13 Instrument Panel Wiring Splices LHD

DESCRIPTION AND OPERATION (Continued)



* BUILT-UP-EXPORT
** EXCEPT BUILT-UP EXPORT

80bbcca8

Fig. 14 Instrument Panel Wiring Splices RHD

DESCRIPTION AND OPERATION (Continued)

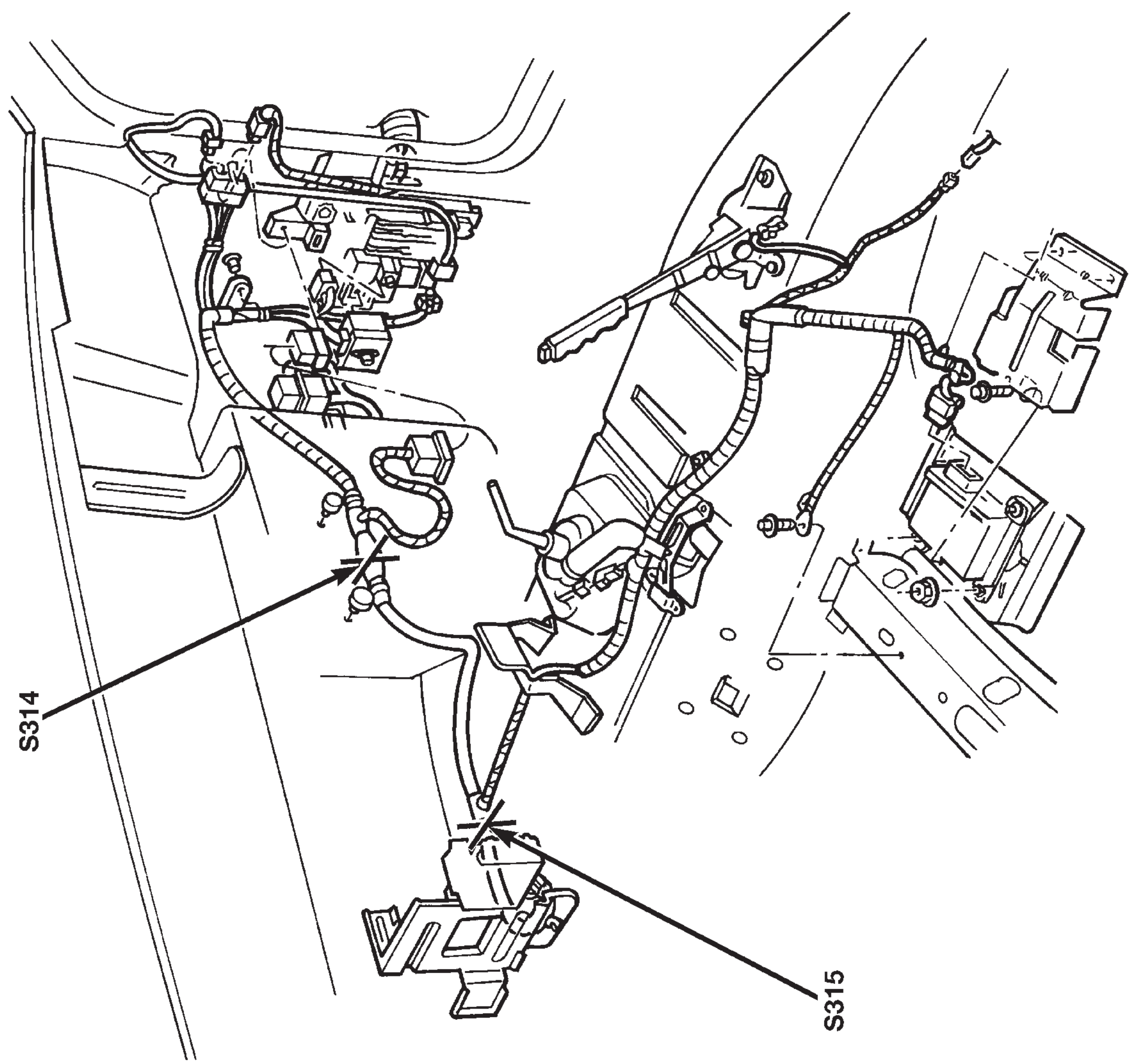


Fig. 15 Instrument Panel to Body Harness Splices

DESCRIPTION AND OPERATION (Continued)

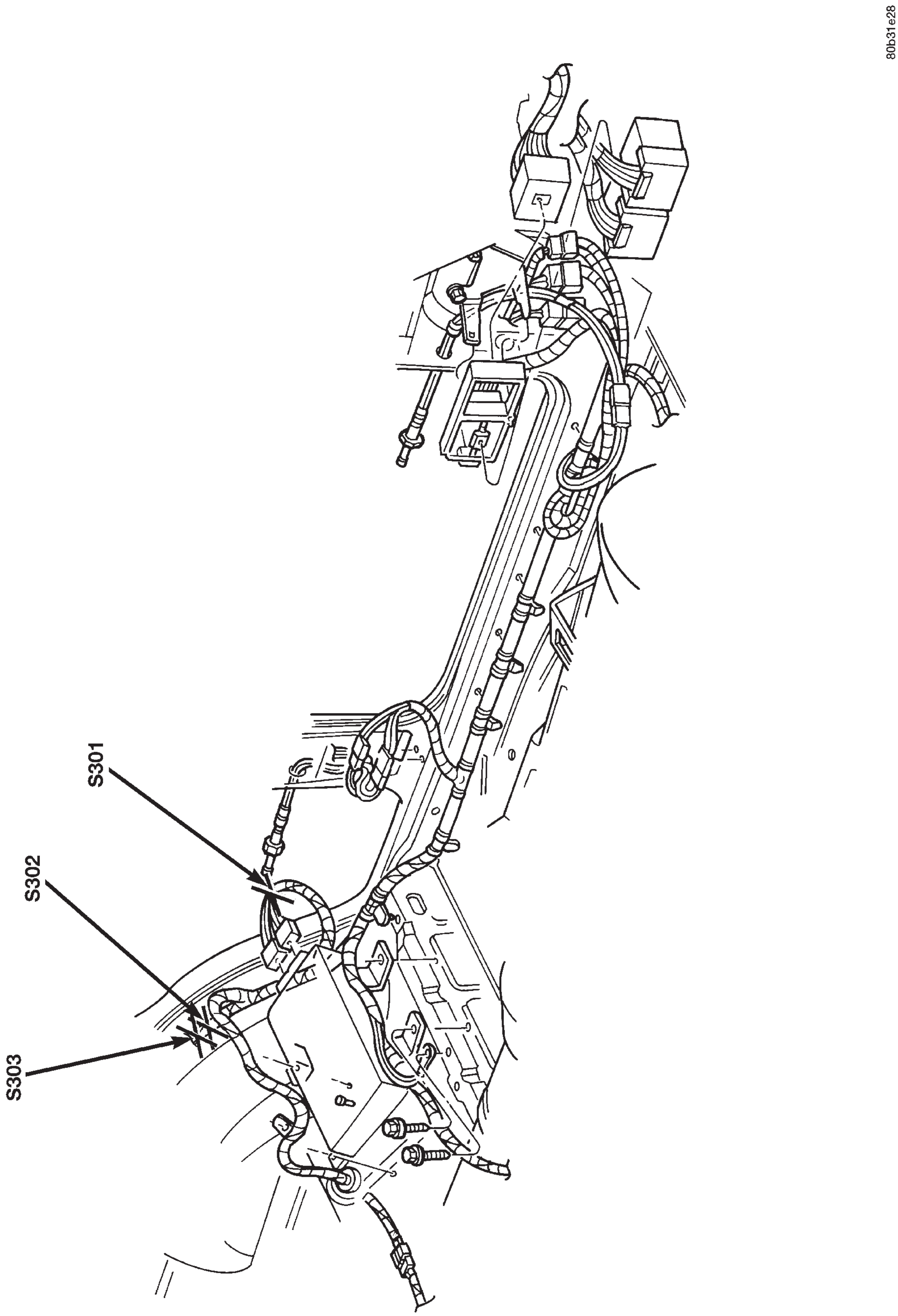


Fig. 16 Left Side Body Harness Splices

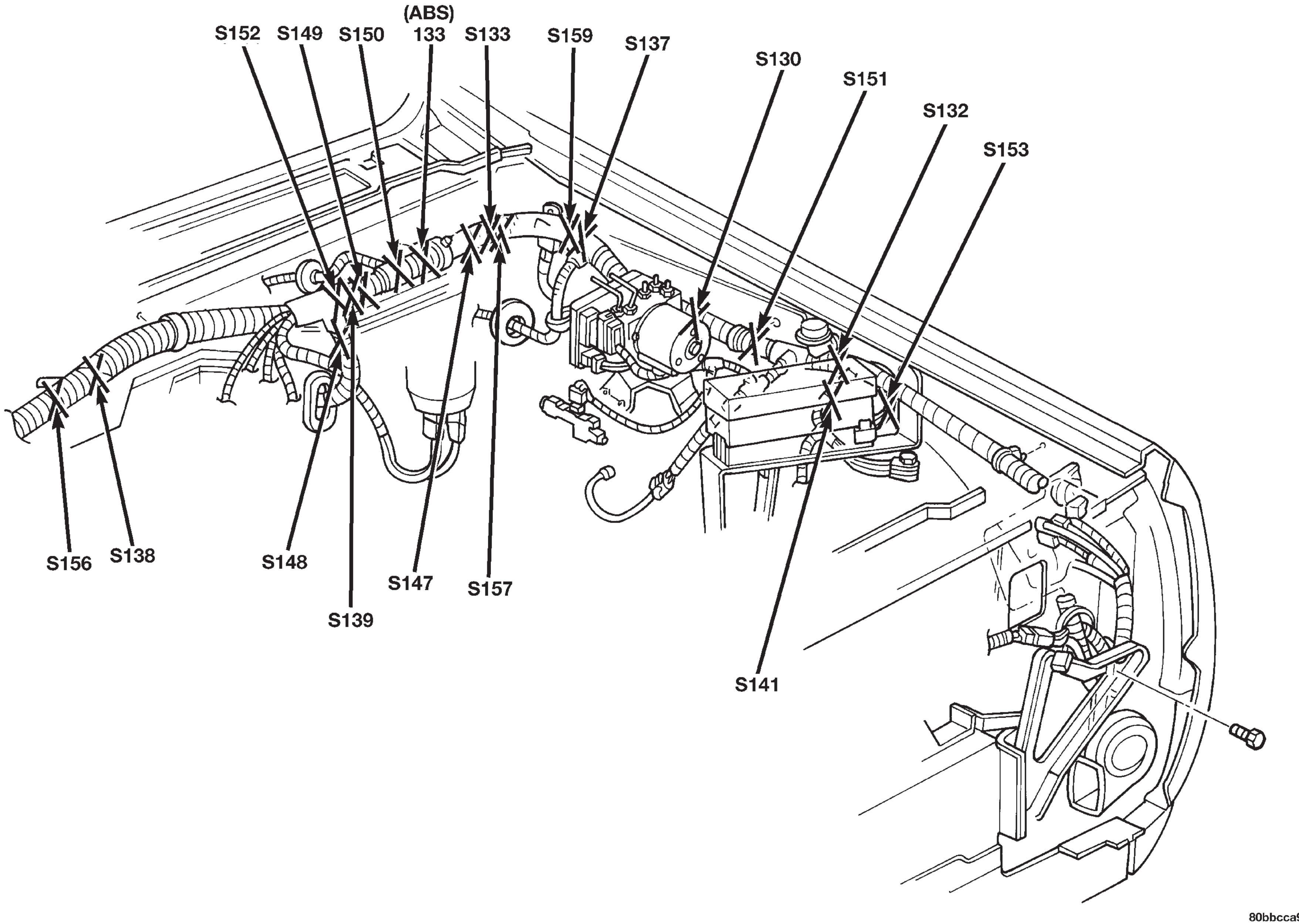


Fig. 17 Left Engine Compartment Splices Diesel LHD

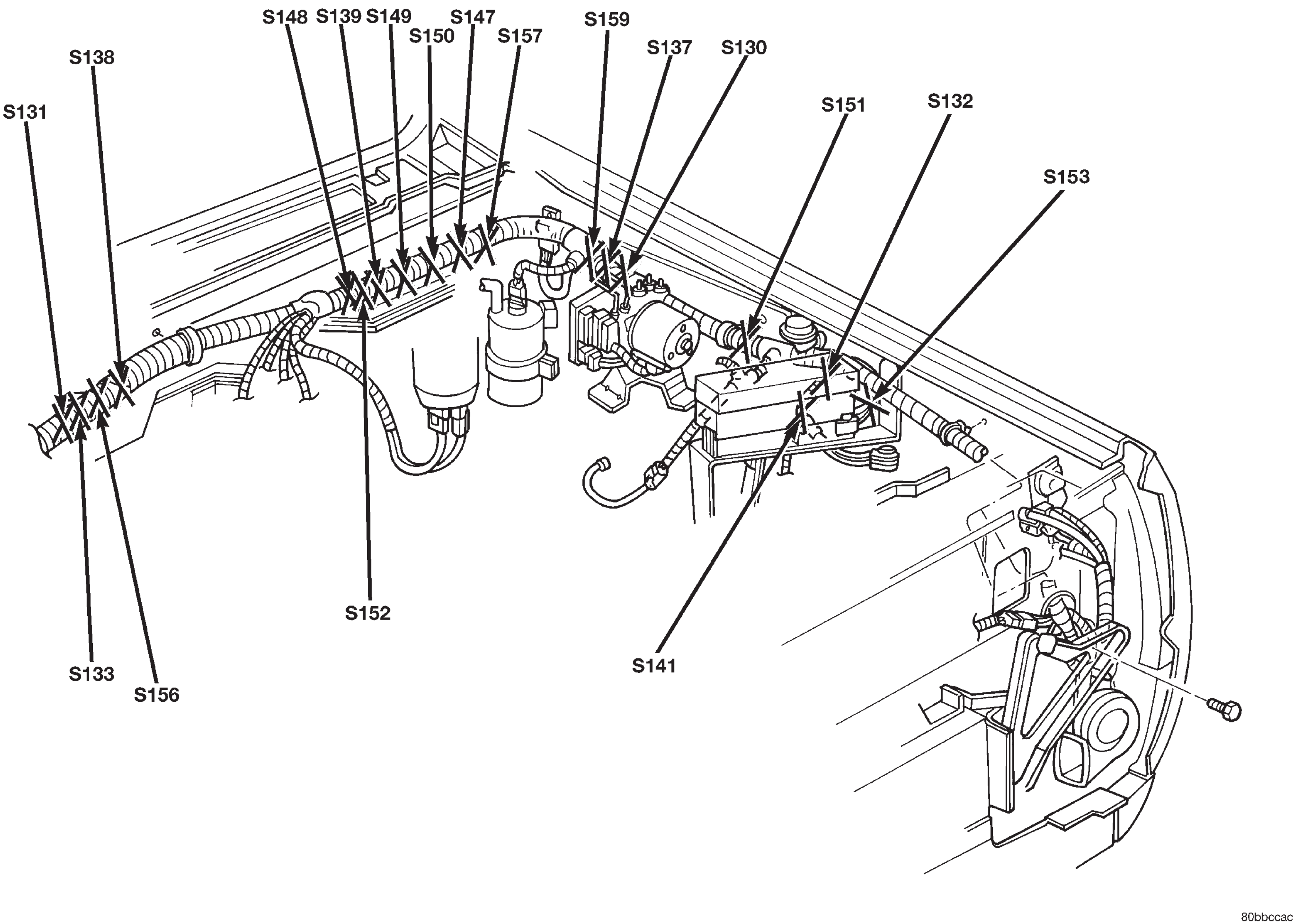


Fig. 18 Left Engine Compartment Splices Diesel RHD

DESCRIPTION AND OPERATION (Continued)

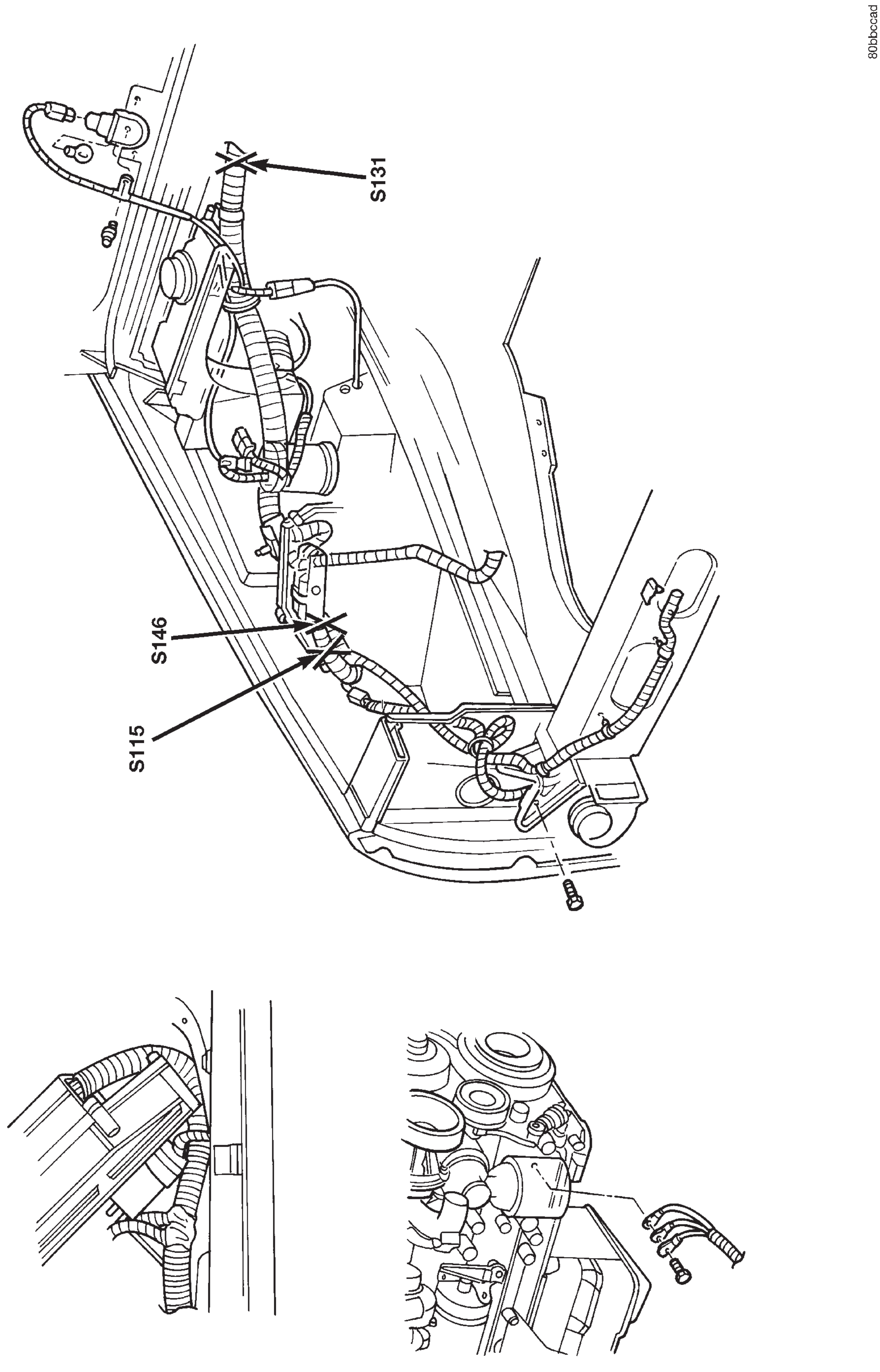


Fig. 19 Right Engine Compartment Splices Diesel LHD

DESCRIPTION AND OPERATION (Continued)

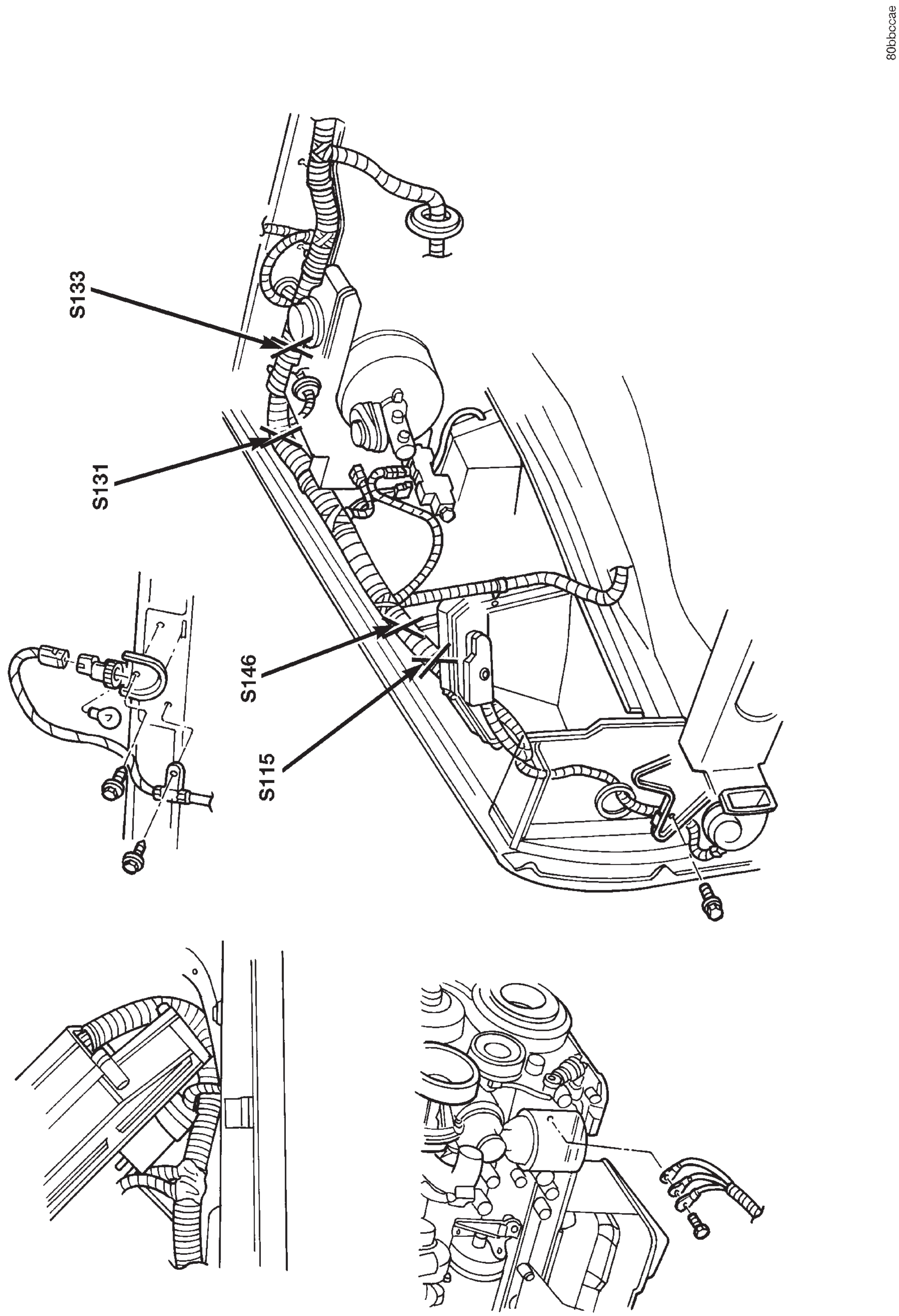


Fig. 20 Right Engine Compartment Splices Diesel RHD

ENGINE

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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

It is important that the vehicle is operating to its optimum performance level to maintain fuel economy and the lowest emission levels. If vehicle is not operating to these standards, refer to Engine Diagnosis outlined in this section. The following procedures can assist in achieving the proper engine diagnosis.

(1) Test cranking amperage draw. Refer to Electrical Group 8B, Cold Cranking Test.

(2) Check intake manifold bolt torque; Refer to Group 11, Exhaust System and Intake Manifold.

(3) Perform cylinder compression test. Refer to Cylinder Compression Pressure Test in the Engine Diagnosis area of this section.

(4) Clean or replace spark plugs as necessary and adjust gap as specified in Electrical Group 8D. Tighten to specifications.

(5) Test resistance of spark plug cables. Refer to Electrical Group 8D, Spark Plug Cables.

(6) Inspect the primary wires. Test coil output voltage and primary resistance. Replace parts as necessary. Refer to Electrical Group 8D, for specifications.

(7) Test fuel pump for pressure. Refer to Group 14, Fuel System Specifications.

(8) The air filter elements should be replaced as specified in Lubrication and Maintenance, Group 0.

(9) Inspect crankcase ventilation system as out lined in Group 0, Lubrication and Maintenance. For emission controls see Group 25, Emission Controls for service procedures.

(10) Road test vehicle as a final test.

HONING CYLINDER BORES

Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.

(1) Used carefully, the Cylinder Bore Sizing Hone C-823 equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round as well as removing light scuffing, scoring or scratches. Usually a few strokes will clean up a bore and maintain the required limits.

CAUTION: DO NOT use rigid type hones to remove cylinder wall glaze.

(2) Deglazing of the cylinder walls may be done if the cylinder bore is straight and round. Use a cylinder surfacing hone, Honing Tool C-3501, equipped with 280 grit stones (C-3501-3810). 20-60 strokes, depending on the bore condition, will be sufficient to provide a satisfactory surface. Using honing oil C-3501-3880 or a light honing oil available from major oil distributors.

CAUTION: DO NOT use engine or transmission oil, mineral spirits or kerosene.

(3) Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 50° to 60° for proper seating of rings (Fig. 1).

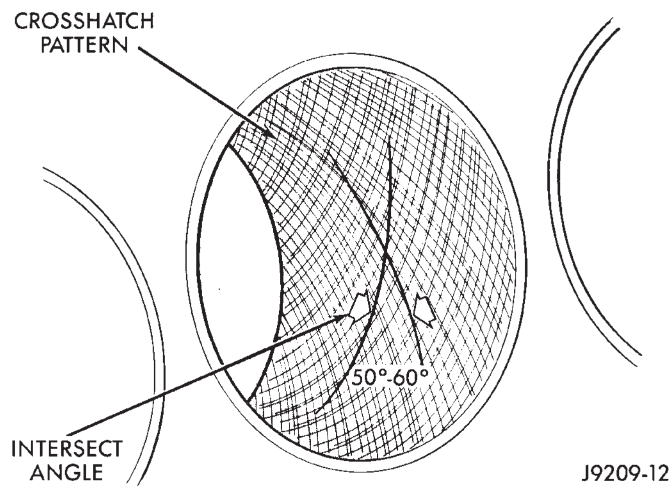


Fig. 1 Cylinder Bore Crosshatch Pattern

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

GENERAL INFORMATION (Continued)

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 required torque. (Refer to the torque specifications at the rear of the engine's section). **DO NOT rotate the crankshaft or the Plastigage may be smeared, giving inaccurate results.**

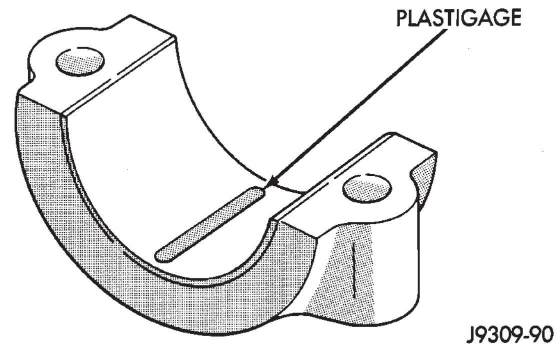


Fig. 2 Placement of Plastigage in Bearing Shell

(2) Remove the bearing cap and compare the width of the flattened Plastigage with the scale provided on the package (Fig. 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).

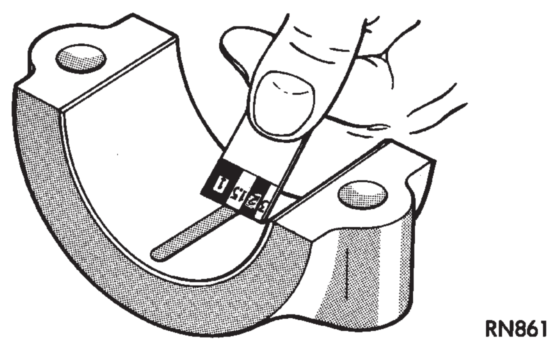


Fig. 3 Clearance Measurement

(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

GENERAL INFORMATION (Continued)

Plastigage in place be assembled. Tighten the rod cap nuts to required torque. (Refer to the torque specifications at the rear of the engine's section). **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.

(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 SERVICE

WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL FUEL, THINNER, OR SOLVENTS, HEALTH PROBLEMS CAN RESULT. DO NOT POLLUTE, DISPOSE OF USED ENGINE OIL PROPERLY.

ENGINE OIL SPECIFICATION

CAUTION: Do not use non-detergent or straight mineral oil when adding or changing crankcase lubricant. Engine failure can result.

GENERAL INFORMATION (Continued)

API SERVICE GRADE CERTIFIED

Use an engine oil that is API Service Grade Certified. MOPAR provides engine oils that conform to the latest recommended service grades.

Standard engine oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans (Fig. 4).

Fig. 4 Engine Oil Container Standard Notations

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. SAE 10W–30 specifies a multiple 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. 5).

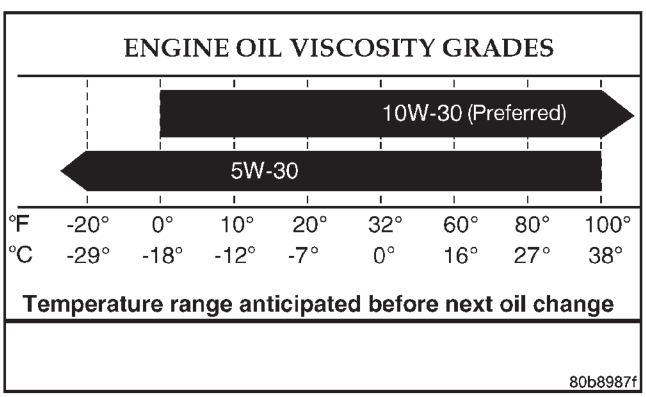


Fig. 5 Temperature/Engine Oil Viscosity

ENERGY CONSERVING OIL

An Energy Conserving type oil is recommended for gasoline engines. The designation of ENERGY CONSERVING is located on the label of an engine oil container.

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, oil foaming and oil pressure loss can result.

The engine oil level indicator (Dipstick) is located at the right rear of both 2.5L engines and 4.0L engines. Inspect engine oil level approximately every 800 kilometers (500 miles). Unless the engine has exhibited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level on a cold engine is not accurate.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil dipstick (Fig. 6) (Fig. 7).

(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. 6) (Fig. 7).

(6) Add oil only if level is below the ADD mark on dipstick.

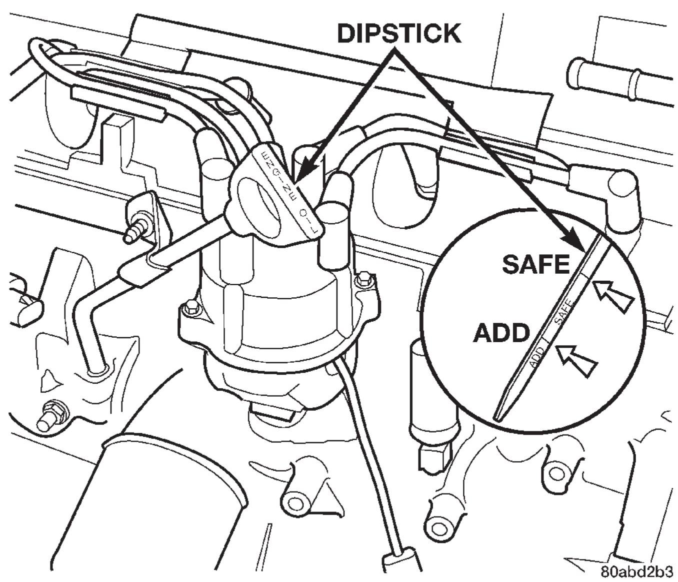


Fig. 6 Engine Oil Dipstick—2.5L Engine

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.

GENERAL INFORMATION (Continued)

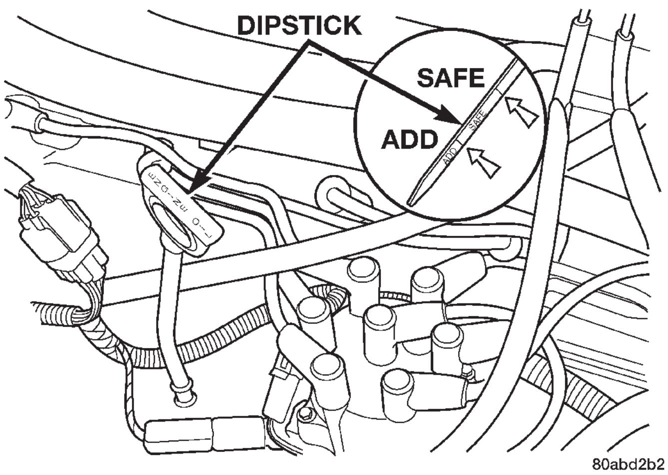


Fig. 7 Engine Oil Dipstick—4.0L Engine

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.

(6) Install drain plug in crankcase.

(7) 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 Corporation recommends a Mopar or equivalent oil filter be used.

OIL FILTER REMOVAL

(1) Position a drain pan under the oil filter.

(2) Using a suitable oil filter wrench loosen filter.

(3) Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss or filter adapter housing (Fig. 8) (Fig. 9).

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(5) Make sure old gasket comes off with oil filter. With a wiping cloth, clean the gasket sealing surface (Fig. 10) of oil and grime.

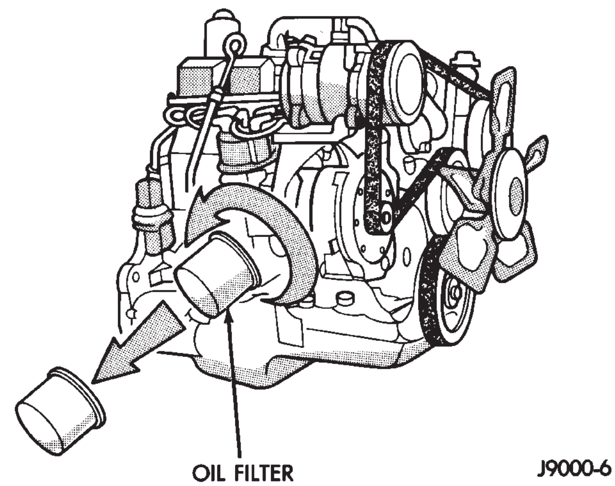


Fig. 8 Oil Filter—2.5L Engine

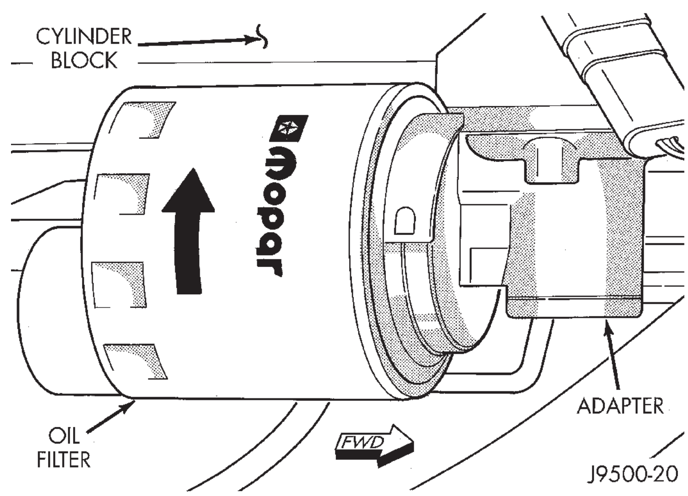


Fig. 9 Oil Filter—4.0L Engine

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.

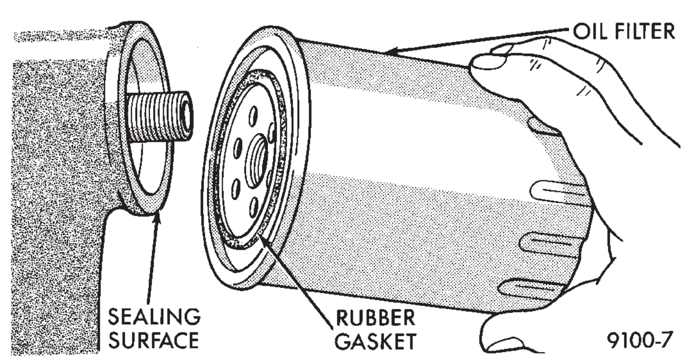


Fig. 10 Oil Filter Sealing Surface—Typical

GENERAL INFORMATION (Continued)

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 maintenance.

These malfunctions may be classified as either performance (e.g., engine idles rough and stalls) or mechanical (e.g., a strange noise).

Refer to the Service Diagnosis—Performance chart and the Service Diagnosis—Mechanical chart for possible causes and corrections of malfunctions. Refer to Group 14, Fuel System for the fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that can not be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following diagnosis:

- Cylinder Compression Pressure Test.
- Cylinder Combustion Pressure Leakage Test.
- Engine Cylinder Head Gasket Failure Diagnosis.
- Intake Manifold Leakage Diagnosis.

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

(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) Disable the fuel system. (Refer to Group 14, Fuel System for the correct procedure)
(5) Disconnect the ignition coil.
(6) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.
(7) Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.

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.

DIAGNOSIS AND TESTING (Continued)

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders; follow the procedures outlined in Cylinder Compression Pressure Test. An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50-70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

Remove the radiator cap.

Start the engine and allow it to warm up until the engine thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

If bubbles are not visible, install a radiator pressure tester and pressurize the coolant system.

If a cylinder is leaking combustion pressure into the water jacket, the tester pointer will pulsate with every combustion stroke of the cylinder.

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating).
- Leaks between adjacent cylinders or into water jacket.
- Any causes for combustion/compression pressure loss.

(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.

All gauge pressure indications should be equal, with no more than 25% leakage.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

Refer to the Cylinder Combustion Pressure Leakage Test Diagnosis chart.

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary
AIR ESCAPES THROUGH RADIATOR	Head gasket leaking or cracked cylinder head or block	Remove cylinder head and inspect. Replace defective part
MORE THAN 50% LEAKAGE FROM ADJACENT CYLINDERS	Head gasket leaking or crack in cylinder head or block between adjacent cylinders	Remove cylinder head and inspect. Replace gasket, head, or block as necessary
MORE THAN 25% LEAKAGE AND AIR ESCAPES THROUGH OIL FILLER CAP OPENING ONLY	Stuck or broken piston rings; cracked piston; worn rings and/or cylinder wall	Inspect for broken rings or piston. Measure ring gap and cylinder diameter, taper and out-of-round. Replace defective part as necessary

ENGINE OIL LEAK INSPECTION

Begin with a thorough visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.

(2) Add an oil soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.

(3) Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair 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 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) Disconnect connector and remove oil pressure sending unit.

(2) Install Oil Pressure Line and Gauge Tool C-3292 or equivalent. Start engine and record pressure. Refer to Oil Pressure in Engine Specifications for the correct pressures.

DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS—PERFORMANCE

ENGINE PERFORMANCE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK	1. Weak or dead battery	1. Charge/Replace Battery. Refer to Group 8A, Battery, for correct procedures. Check charging system. Refer to Group 8C, Charging Systems, for correct procedures.
	2. Corroded or loose battery connections	2. Clean/tighten suspect battery/ starter connections
	3. Faulty starter or related circuit(s)	3. Check starting system. Refer to Group 8B, Starting Systems, for correct diagnostics/procedures
	4. Siezed accessory drive component	4. Remove accessory drive belt and attempt to start engine. If engine starts, repair/replace siezed component.
	5. Engine internal mechanical failure or hydro-static lock	5. Refer to Group 9, Engine, for correct diagnostics/procedures
ENGINE CRANKS BUT WILL NOT START	1. No spark	1. Check for spark. Refer to Group 8D, Ignition System, for correct procedures.
	2. No fuel	2. Perform fuel pressure test, and if necessary, inspect fuel injector(s) and driver circuits. Refer to Group 14, Fuel System, for correct procedures.
	3. Low or no engine compression	3. Perform cylinder compression pressure test. Refer to Group 9, Engine, for correct procedures.
ENGINE LOSS OF POWER	1. Worn or burned distributor rotor	1. Install new distributor rotor
	2. Worn distributor shaft	2. Remove and repair distributor (Refer to group 8D, Ignition System
	3. Worn or incorrect gapped spark plugs	3. Clean plugs and set gap. (Refer to group 8D, Ignition System)
	4. Dirt or water in fuel system	4. Clean system and replace fuel filter
	5. Faulty fuel pump	5. Install new fuel pump
	6. Incorrect valve timing	6. Correct valve timing
	7. Blown cylinder head gasket	7. Install new cylinder head gasket
	8. Low compression	8. Test cylinder compression
	9. Burned, warped, or pitted valves	9. Install/Reface valves as necessary
	10. Plugged or restricted exhaust system	10. Install new parts as necessary
	11. Faulty ignition cables	11. Replace any cracked or shorted cables
	12. Faulty ignition coil	12. Test and replace, as necessary (Refer to Group 8D, ignition system)

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE STALLS OR ROUGH IDLE	1. Carbon build-up on throttle plate	1. Remove throttle body and de-carbon. (Refer to Group 14 for correct procedures)
	2. Engine idle speed too low	2. Check Idle Air Control circuit. (Refer to Group 14, Fuel System)
	3. Worn or incorrectly gapped spark plugs	3. Replace or clean and re-gap spark plugs (Refer to group 8D, Ignition System)
	4. Worn or burned distributor rotor	4. Install new distributor rotor
	5. Spark plug cables defective or crossed	5. Check for correct firing order or replace spark plug cables. (Refer to Group 8D, Ignition System for correct procedures.)
	6. Faulty coil	6. Test and replace, if necessary (Refer to group 8D, Ignition System)
	7. Intake manifold vacuum leak	7. Inspect intake manifold gasket and vacuum hoses. Replace if necessary (Refer to Group 11, Exhaust System & Intake Manifold)
	8. EGR valve leaking or stuck open	8. Test and replace, if necessary (Refer to group 25, Emission Control Systems)
ENGINE MISSES ON ACCELERATION	1. Worn or incorrectly gapped spark plugs	1. Replace spark plugs or clean and set gap. (Refer to group 8D, Ignition System)
	2. Spark plug cables defective or crossed	2. Check Idle Air Control circuit. (Refer to Group 14, Fuel System)
	3. Dirt in fuel system	3. Clean fuel system
	4. Burned, warped or pitted valves	4. Install new valves
	5. Faulty coil	5. Test and replace as necessary (refer to group 8D, Ignition System)

DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS—MECHANICAL

ENGINE MECHANICAL DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES/LIFTERS	1. High or low oil level in crankcase	1. Check for correct oil level. Adjust oil level by draining or adding as needed
	2. Thin or diluted oil	2. Change oil (Refer to Engine Oil Service in this group)
	3. Low oil pressure	3. Check engine oil level. If ok, Perform oil pressure test. Refer to this group for engine oil pressure test/specifications
	4. Dirt in tappets/lash adjusters	4. Clean/replace hydraulic tappets/ lash adjusters
	5. Bent push rod(s)	5. Install new push rods
	6. Worn rocker arms	6. Inspect oil supply to rocker arms and replace worn arms as needed
	7. Worn tappets/lash adjusters	7. Install new hydraulic tappets/lash adjusters
	8. Worn valve guides	8. Inspect all valve guides and replace as necessary
	9. Excessive runout of valve seats or valve faces	9. Grind valves and seats
CONNECTING ROD NOISE	1. Insufficient oil supply	1. Check engine oil level. (Refer to group 0, Lubrication and Maintenance)
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. Refer to this group for engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. Refer to this group for correct procedure/engine oil specifications
	4. Excessive connecting rod bearing clearance	4. Measure bearings for correct clearance with plasti-gage. Repair as necessary
	5. Connecting rod journal out of round	5. Replace crankshaft or grind journals
	6. Misaligned connecting rods	6. Replace bent connecting rods
MAIN BEARING NOISE	1. Insufficient oil supply	1. Check engine oil level. (Refer to group 0, Lubrication and Maintenance)
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. Refer to this group for engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. Refer to this group for correct procedure/engine oil specifications

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	4. Excessive main bearing clearance	4. Measure bearings for correct clearance. Repair as necessary
	5. Excessive end play	5. Check crankshaft thrust bearing for excessive wear on flanges
	6. Crankshaft main journal out of round or worn	6. Grind journals or replace crankshaft
	7. Loose flywheel or torque converter	7. Inspect crankshaft, flexplate/ flywheel and bolts for damage. Tighten to correct torque
LOW OIL PRESSURE	1. Low oil level	1. Check oil level and fill if necessary
	2. Faulty oil pressure sending unit	2. Install new sending unit
	3. Clogged oil filter	3. Install new oil filter
	4. Worn oil pump	4. Replace worn gears or oil pump assy
	5. Thin or diluted oil	5. Change oil to correct viscosity. Refer to this group for correct procedure/engine oil specifications
	6. Excessive bearing clearance	6. Measure bearings for correct clearance
	7. Oil pump relief valve stuck	7. Remove valve to inspect, clean and reinstall
	8. Oil pump suction tube loose, broken, bent or clogged	8. Inspect suction tube and clean or replace if necessary
	9. Oil pump cover warped or cracked	9. Install new oil pump
OIL LEAKS	1. Misaligned or deteriorated gaskets	1. Replace gasket
	2. Loose fastener, broken or porous metal part	2. Tighten, repair or replace the part
	3. Front or rear crankshaft oil seal leaking	3. Replace seal
	4. Leaking oil gallery plug or cup plug	4. Remove and reseal threaded plug. Replace cup style plug
EXCESSIVE OIL CONSUMPTION OR SPARK PLUGS OIL FOULED	1. PCV System malfunction	1. Refer to group 25, Emission Control System for correct operation
	2. Defective valve stem seal(s)	2. Repair or replace seal(s)
	3. Worn or broken piston rings	3. Hone cylinder bores. Install new rings
	4. Scuffed pistons/cylinder walls	4. Hone cylinder bores and replace pistons as required
	5. Carbon in oil control ring groove	5. Remove rings and de-carbon piston
	6. Worn valve guides	6. Inspect/replace valve guides as necessary
	7. Piston rings fitted too tightly in grooves	7. Remove rings and check ring end gap and side clearance. Replace if necessary

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.

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).

The crankshaft rotation is clockwise, when viewed from the front of the engine. The crankshaft rotates within five main bearings and the camshaft rotates within four bearings.

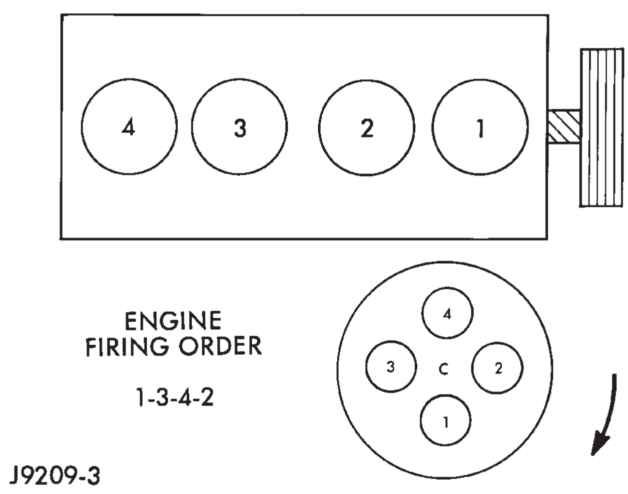


Fig. 1 Engine Firing Order

DESCRIPTION AND OPERATION (Continued)

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).

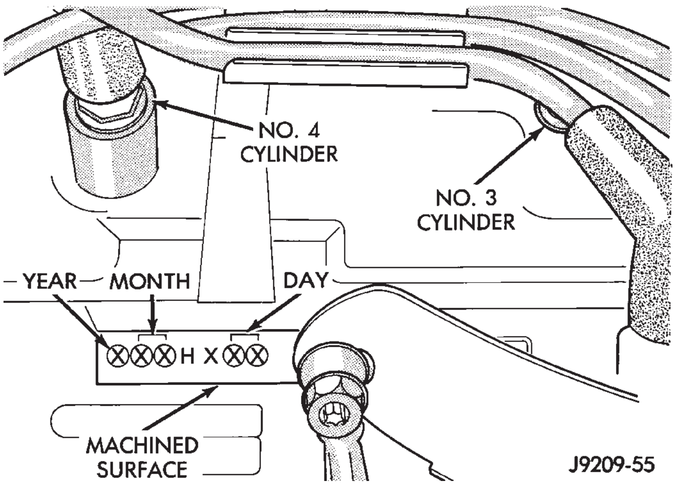


Fig. 2 Build Date Code Location

The digits of the code identify:

- 1st Digit—The year (8 = 1998).
- 2nd & 3rd Digits—The month (01 - 12).
- 4th & 5th Digits—The engine type/fuel system/ compression ratio (HX = A 2.5 liter (150 CID) 9.1:1 compression ratio engine with a multi-point fuel injection system).
- 6th & 7th Digits—The day of engine build (01 - 31).

FOR EXAMPLE: Code * 801HX23 * identifies a 2.5 liter (150 CID) engine with a multi-point fuel injection system, 9.1:1 compression ratio and built on January 23, 1998.

LUBRICATION SYSTEM

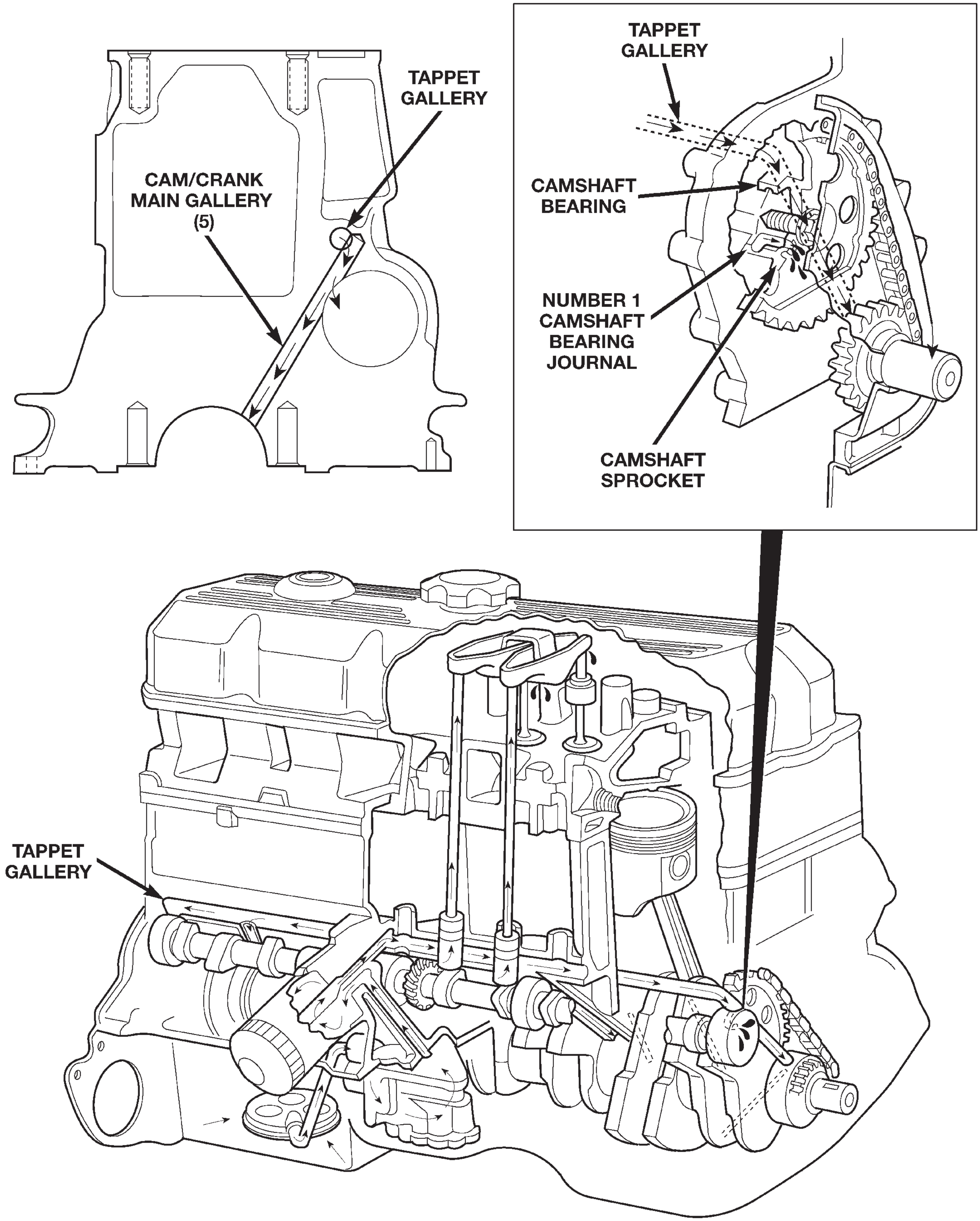
A gear—type positive displacement pump is mounted at the underside of the block opposite the No. 4 main bearing. The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and pump body, then forced through the outlet 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—2.5L Engine

DESCRIPTION AND OPERATION (Continued)

OIL PUMP PRESSURE

The MINIMUM oil pump pressure is 89.6 kPa (13 psi) at 600 rpm. The NORMAL oil pump pressure is 255-517 kPa (37-75 psi) at 1600 rpm or more.

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 GAUGE 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. 4).

(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 (Fig. 3). 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.

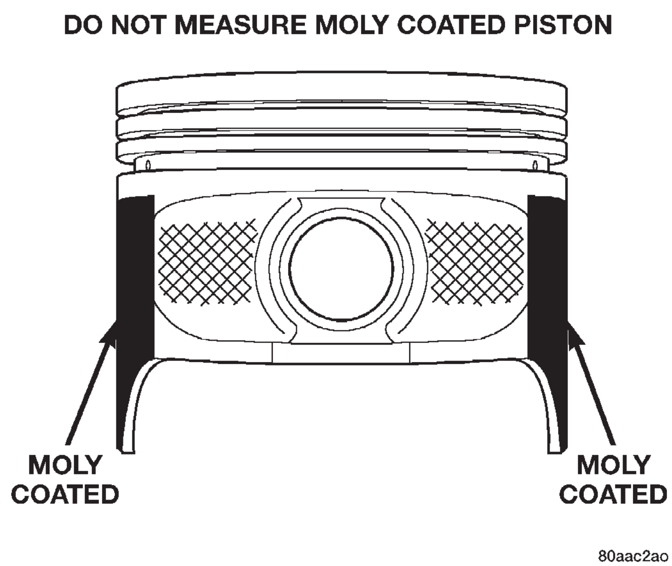


Fig. 3 Moly Coated Piston

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. 5) (Fig. 6). Rotate the ring in the groove. It must move freely around circumference of the groove.

SERVICE PROCEDURES (Continued)

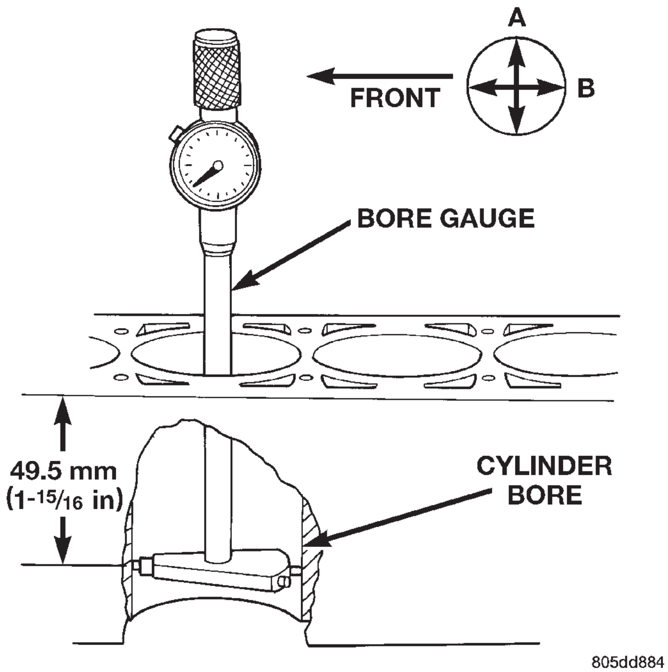


Fig. 4 Bore Gauge

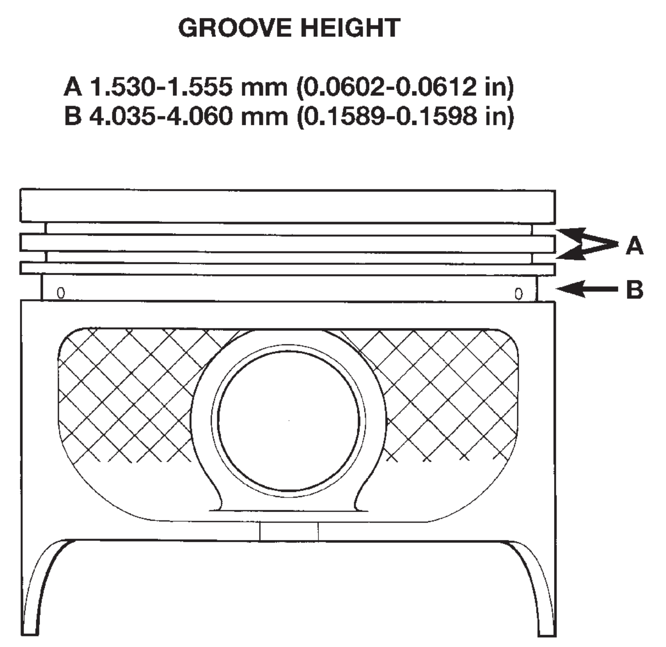


Fig. 5 Piston Dimensions

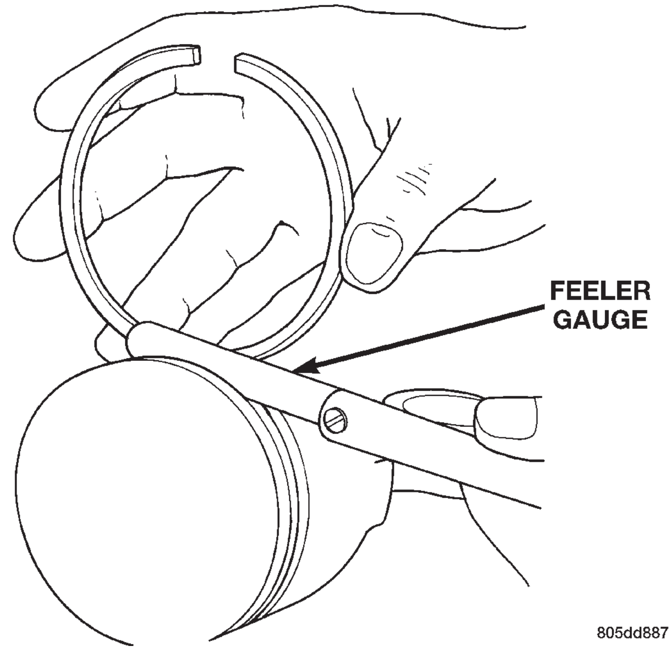


Fig. 6 Ring Side Clearance Measurement

Ring Side Clearance Measurement

Top Compression Ring . . . . 0.042 to 0.084 mm (0.0017 to 0.0033 in.)

Second Compression Ring . . . . . . 0.042 to 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. 7).

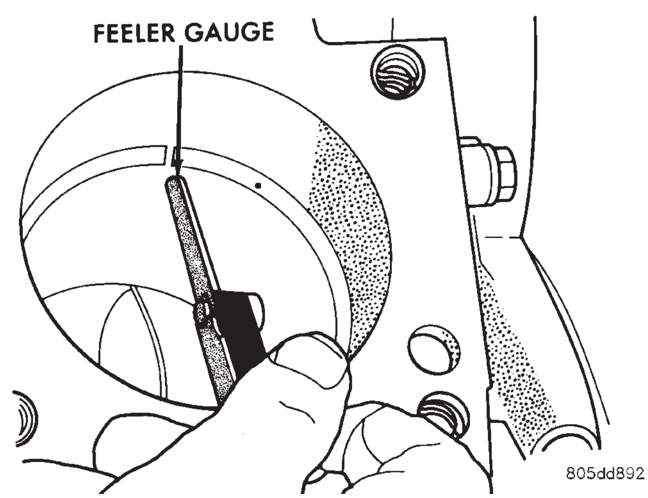


Fig. 7 Gap Measurement

SERVICE PROCEDURES (Continued)

Ring Gap Measurement

Top Compression Ring . . . . 0.229 to 0.610 mm (0.0090 to 0.0240 inch)

Second Compression 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)

(5) The oil control rings are symmetrical, and can be installed with either side 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 and can be installed with either side up (Fig. 8).

(7) The second compression ring has a slight chamfer on the bottom of the inside edge and a dot on the top for correct installation (Fig. 9).

(8) Using a ring installer, install the second compression ring with the dot facing up (Fig. 9) (Fig. 11).

(9) Using a ring installer, install the top compression ring (either side up).

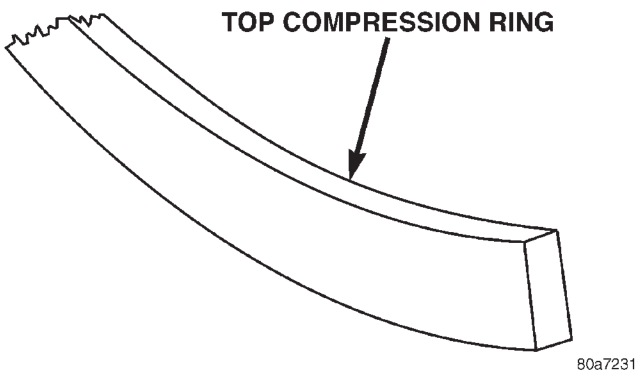


Fig. 8 Top Compression ring identification

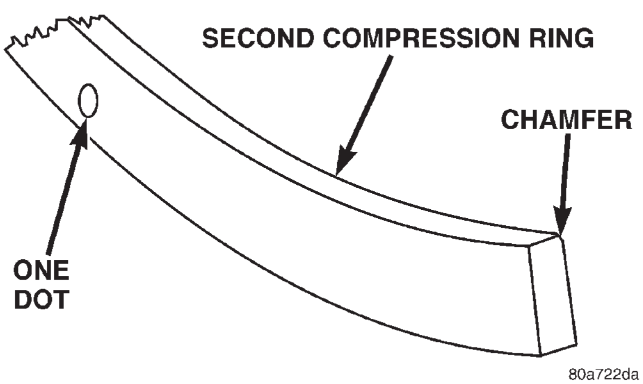


Fig. 9 Second Compression Ring Identification

Ring Gap Orientation

- Position the gaps on the piston as shown (Fig. 12).
- Oil spacer - Gap on center line of piston skirt.

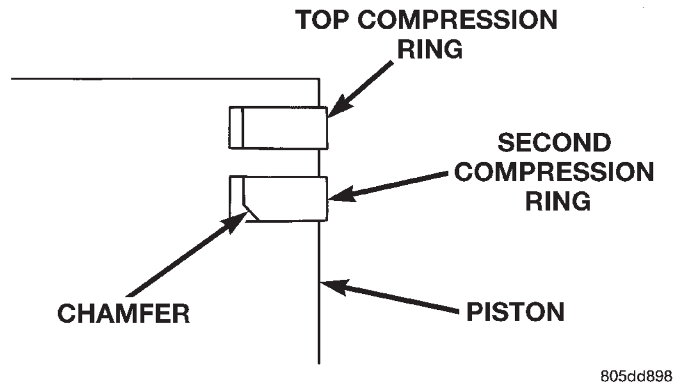


Fig. 10 Compression Ring Chamfer Location

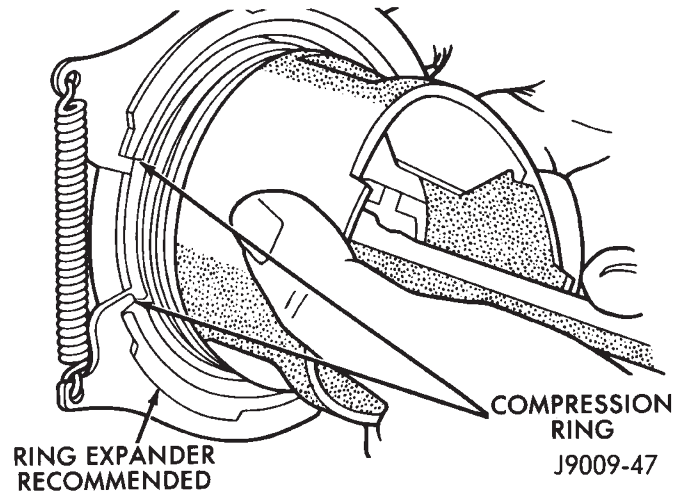


Fig. 11 Compression Ring Installation

- Oil rails - gap 180° apart on centerline of piston pin bore.
- No. 2 Compression ring - Gap 180° from top oil rail gap.
- No. 1 Compression ring - Gap 180° from No. 2 compression ring gap.

FITTING CONNECTING ROD BEARINGS

INSPECTION

BEARINGS

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 13) (Fig. 14). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 15). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

CONNECTING RODS

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to

SERVICE PROCEDURES (Continued)

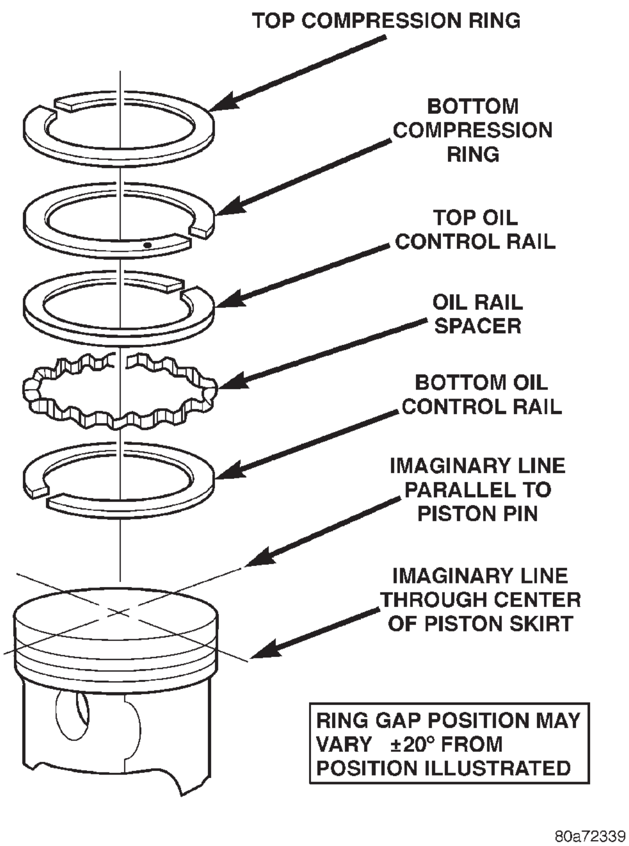


Fig. 12 Ring Gap Orientation

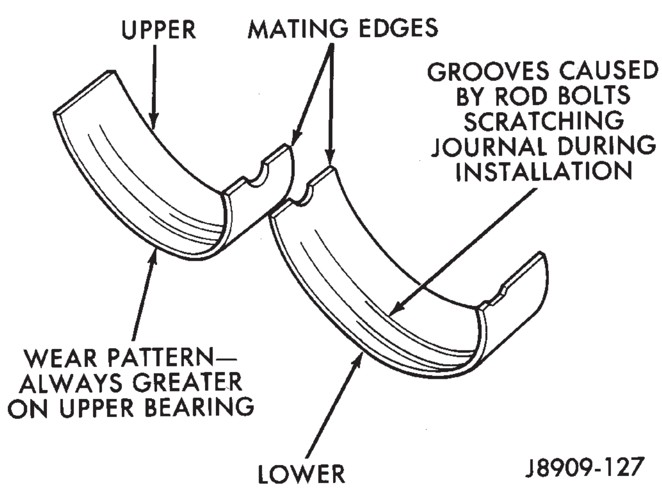


Fig. 13 Connecting Rod Bearing Inspection

any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

BEARING-TO-JOURNAL CLEARANCE

(1) Wipe the oil from the connecting rod journal.

(2) Use short rubber hose sections over rod bolts during installation.

(3) Lubricate the upper bearing insert and install in connecting rod.

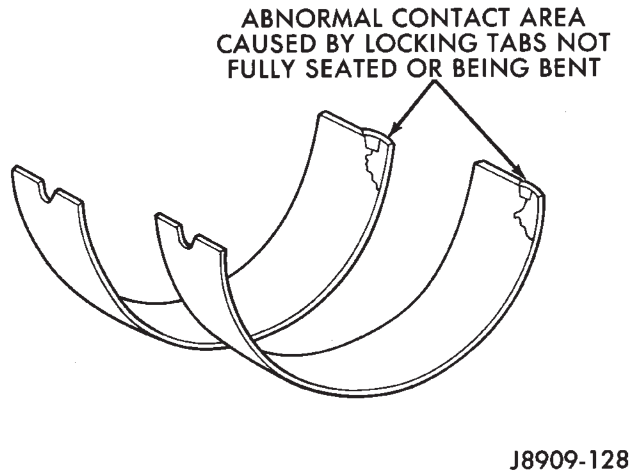


Fig. 14 Locking Tab Inspection

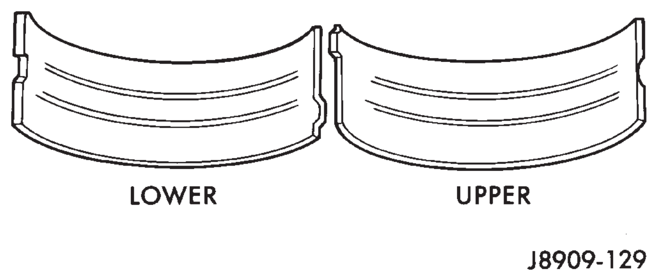


Fig. 15 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

(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. 16). 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.

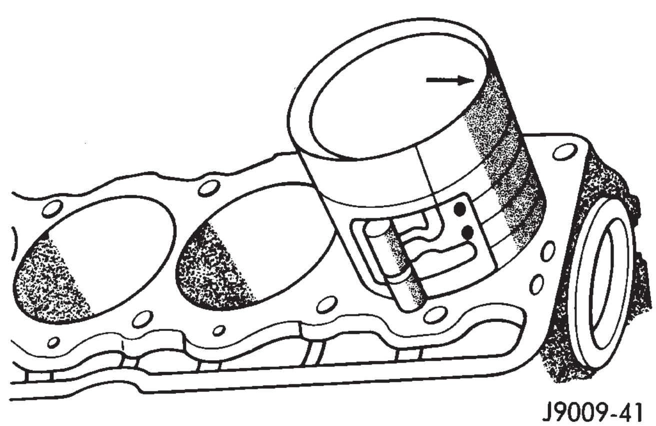


Fig. 16 Rod and Piston Assembly Installation

(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.

SERVICE PROCEDURES (Continued)

(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. 17). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**

(8) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

(9) If bearing-to-journal clearance exceeds the specification, install a pair of 0.0254 mm (0.001 inch) undersize bearing inserts. All the odd size inserts must be on the bottom. The sizes of the service replacement bearing inserts are stamped on the backs of the inserts. Measure the clearance as described in the previous steps.

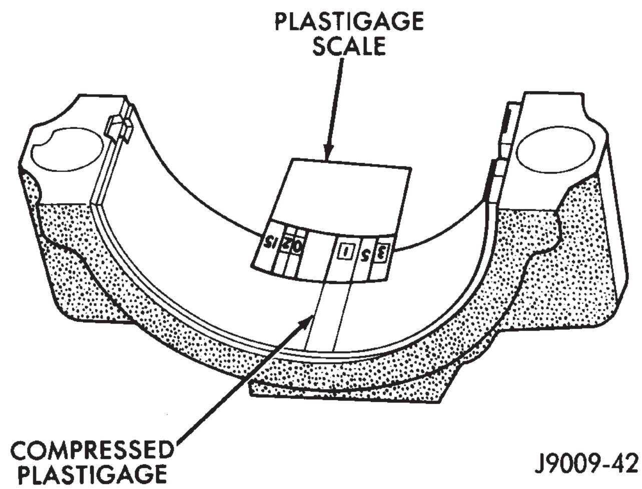


Fig. 17 Measuring Bearing Clearance with Plastigage

(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).

CONNECTING ROD BEARING FITTING CHART

CRANKSHAFT JOURNAL		CORRESPONDING CONNECTING ROD BEARING INSERT	
Color Code	**Diameter**	**Upper Insert Size**	**Lower Insert Size**
Yellow	53.2257-53.2079 mm (2.0955-2.0948 in.)	Yellow - Standard	Yellow - Standard
Orange	53.2079 - 53.1901 mm (2.0948 - 2.0941 in.) 0.0178 mm (0.0014 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.)

SERVICE PROCEDURES (Continued)

(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 (Fig. 18). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

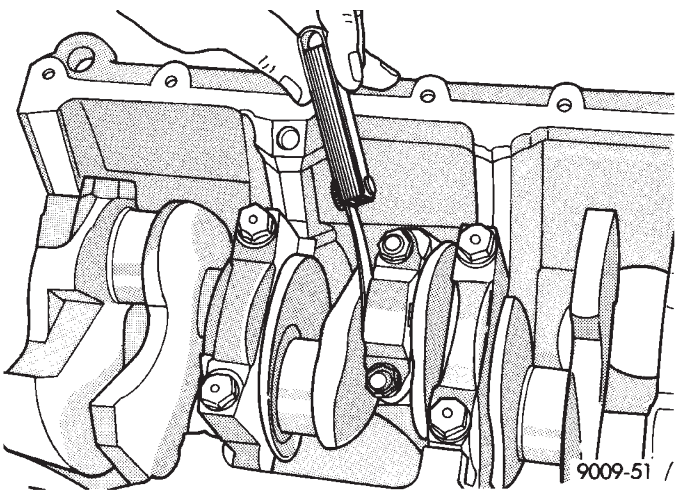


Fig. 18 Checking Connecting Rod Side Clearace—Typical

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. 19).

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.

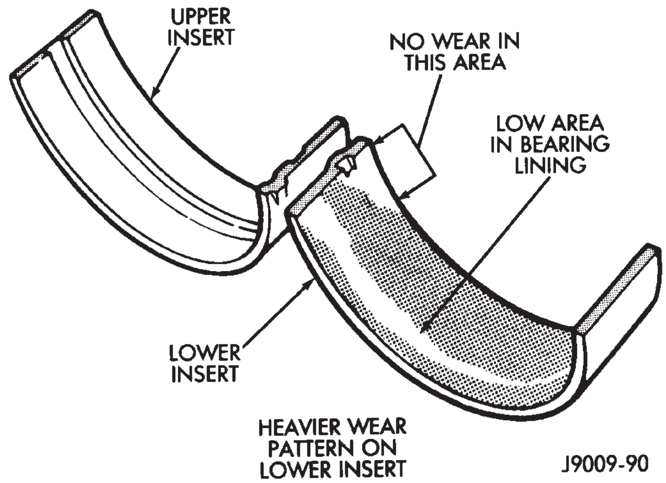


Fig. 19 Main Bearing Wear Patterns

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. 20).**

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.025 mm (0.001 in.) Undersize	0.051 mm (0.002 in.) Undersize

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Fig. 20 Bearing Insert Pairs

SERVICE PROCEDURES (Continued)

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. 21). Refer to Engine Specifications for the proper clearance.

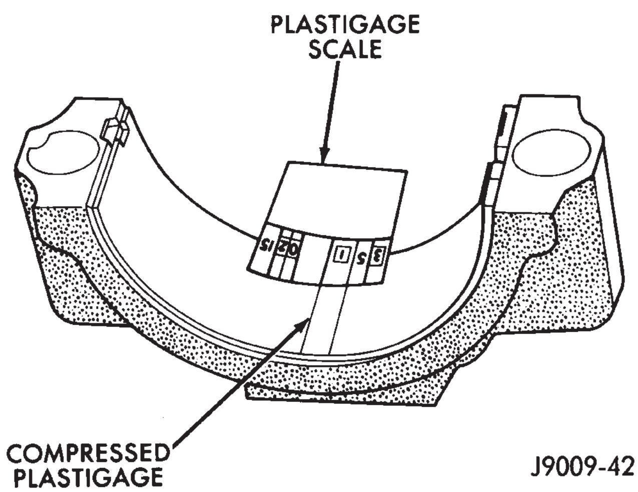


Fig. 21 Measuring Bearing Clearance with Plastigage

Plastigage should indicate the same clearance across the entire width of the insert. If clearance varies, it may indicate a tapered journal or foreign material trapped behind the insert.

If the specified clearance is indicated and there are no abnormal wear patterns, replacement of the bearing inserts is not necessary. Remove the Plastigage from the crankshaft journal and bearing insert. Proceed to Crankshaft Main Bearing—Installation.

If the clearance exceeds specification, install a pair of 0.025 mm (0.001 inch) undersize bearing inserts and measure the clearance as described in the previous steps.

The clearance indicated with the 0.025 mm (0.001 inch) undersize insert pair installed will determine if this insert size or some other combination will provide the specified clearance. **FOR EXAMPLE:** If the clearance was 0.0762 mm (0.003 inch) originally, a pair of 0.0254 mm (0.001 inch) undersize inserts would reduce the clearance by 0.0254 mm (0.001 inch). The clearance would then be 0.0508 mm (0.002 inch) and within the specification. A 0.051 mm (0.002 inch) undersize bearing insert and a 0.0254 mm (0.001 inch) undersize insert would reduce the original clearance an additional 0.0127 mm (0.0005 inch). The clearance would then be 0.0381 mm (0.0015 inch).

CAUTION: Never use a pair of inserts that differ more than one bearing size as a pair.

FOR EXAMPLE: DO NOT use a standard size upper insert and a 0.051 mm (0.002 inch) undersize lower insert.

If the clearance exceeds specification using a pair of 0.051 mm (0.002 inch) undersize bearing inserts, measure crankshaft journal diameter with a micrometer. If the journal diameter is correct, the crankshaft bore in the cylinder block may be misaligned, which requires cylinder block replacement or machining to true bore.

If journals 1 through 5 diameters are less than 63.4517 mm (2.4981 inches), replace crankshaft or grind crankshaft down to accept the appropriate undersize bearing inserts.

Once the proper clearances have been obtained, proceed to Crankshaft Main Bearing—Installation.

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Remove the crankshaft from the cylinder block (refer to Cylinder Block - Disassemble).

Clean the oil off the main bearing journal.

Determine the maximum diameter of the journal with a micrometer. Measure at two locations 90° apart at each end of the journal.

The maximum allowable taper and out of round is 0.013 mm (0.0005 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

Once the proper clearances have been obtained, proceed to Crankshaft Main Bearing—Installation.

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 - Standard	Blue- Undersize 0.025 mm (0.001 in.)
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 - Standard	Blue - Undersize 0.025 mm (0.001 in.)
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 through bolt nut (Fig. 22). DO NOT remove the through bolt.
(5) Remove the retaining bolts and nuts from the support cushions (Fig. 22).
(6) Remove the through bolt.
(7) Remove the support cushions.

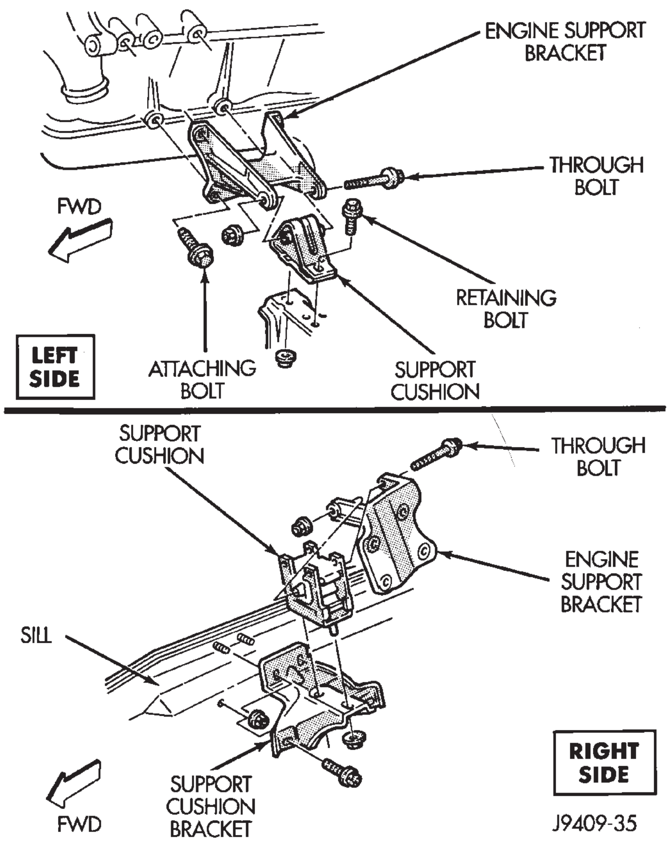


Fig. 22 Front Mounts

INSTALLATION

(1) If the engine support bracket was removed, position the LEFT bracket (Fig. 22) and the RIGHT bracket (Fig. 23) onto the cylinder block. Install the bolts and stud nuts.
(a) RIGHT SIDE (Fig. 23) —Tighten the bolts to 61 N·m (45 ft. lbs.) torque. Tighten the stud nuts to 46 N·m (34 ft. lbs.) torque.
(b) LEFT SIDE (Fig. 22) —Tighten the bolts to 61 N·m (45 ft. lbs.) torque.

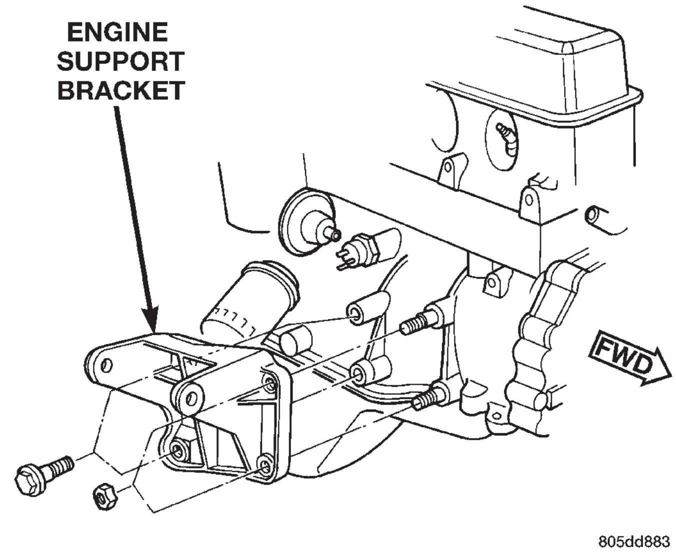


Fig. 23 Engine Support Bracket—Right Side

(2) If the support cushion brackets were removed, position the brackets onto the lower front sill (Fig. 22) (Fig. 24). Install the bolts and stud nuts. Tighten the bolts to 54 N·m (40 ft. lbs.) torque and the stud nuts to 41 N·m (30 ft. lbs.) torque.

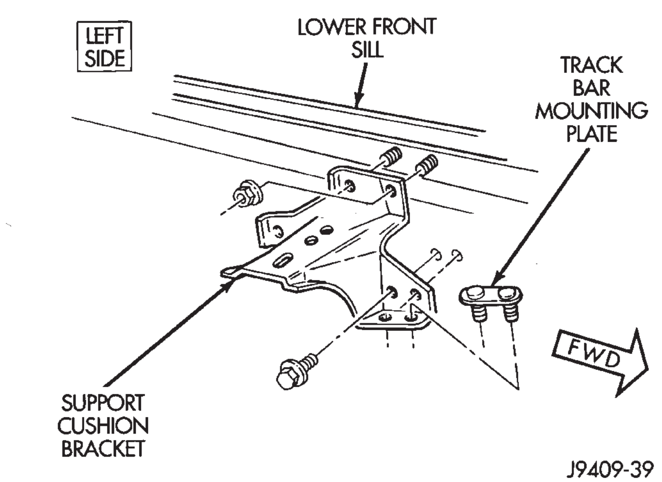


Fig. 24 Support Cushion Bracket—Left Side

(3) Place the support cushions onto the support cushion brackets (Fig. 22). Tighten the right support cushion nuts to 65 N·m (48 ft. lbs.) torque. Tighten the left support cushion bolt and nut to 41 N·m (30 ft. lbs.) torque.
(4) Install the through bolt and the retaining nut (Fig. 22). Tighten the through bolt nut to 65 N·m (48 ft. lbs.) torque.
(5) Remove the engine support.
(6) Lower the vehicle.
(7) Connect negative cable to battery.

REMOVAL AND INSTALLATION (Continued)

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

(1) Disconnect negative cable from battery.

(2) Raise the vehicle and support the transmission.

(3) Remove the nuts holding the support cushion to the crossmember (Fig. 25) (Fig. 26). Remove the crossmember.

MANUAL TRANSMISSION:

a. Remove the support cushion nuts and remove the cushion.

b. If necessary, remove the bolts holding the transmission support bracket to the transmission (Fig. 25). Remove the bracket.

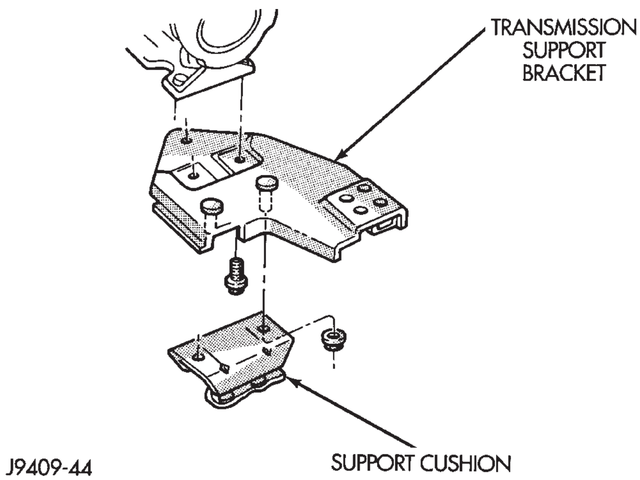


Fig. 25 Rear Mount (Manual Transmission)

AUTOMATIC TRANSMISSION:

a. Remove the support cushion bolts and remove the cushion and the transmission support bracket.

b. If necessary on 2WD vehicles, remove the bolts holding the transmission support adaptor bracket to the transmission (Fig. 26). Remove the adaptor bracket.

INSTALLATION

MANUAL TRANSMISSION:

a. If removed, position the transmission support bracket to the transmission and install the bolts. Tighten the bolts to 43 N·m (32 ft. lbs.) torque.

b. Position the support cushion onto the transmission support bracket. Install and tighten the nuts to 46 N·m (34 ft. lbs.) torque.

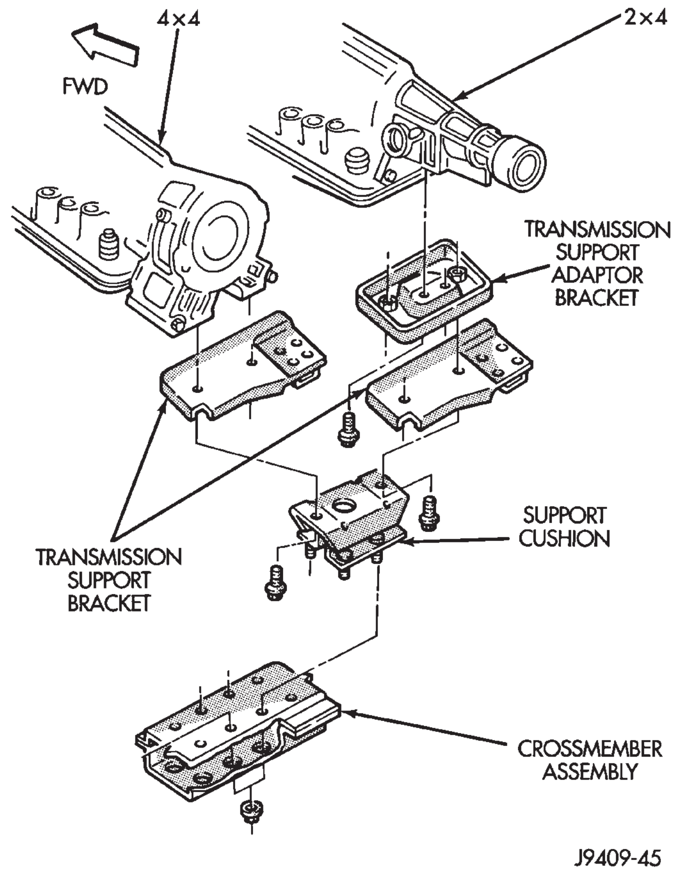


Fig. 26 Rear Mount (Automatic Transmission)

AUTOMATIC TRANSMISSION:

a. If removed, position the transmission support adaptor bracket (2WD vehicles) to the transmission and install the bolts. Tighten the bolts to 75 N·m (55 ft. lbs.) torque.

b. Position the transmission support bracket and support cushion to the transmission and install the bolts. Tighten the bolts to 75 N·m (55 ft. lbs.) torque.

(1) Position the crossmember onto the support cushion studs and install the nuts. Tighten the nuts to 22 N·m (192 in. lbs.) torque.

(2) Install the crossmember to sill bolts and tighten to 41 N·m (30 ft. lbs.) torque.

(3) Remove the transmission support.

(4) Lower the vehicle.

(5) Connect negative cable to battery.

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect the battery cables. Remove the battery.

(2) Mark the hinge locations on the hood panel for alignment reference during installation. Remove the engine compartment lamp. Remove the hood.

REMOVAL AND INSTALLATION (Continued)

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) Loosen the radiator drain cock and radiator cap to drain the coolant. DO NOT waste usable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(4) Remove the air cleaner assembly.

(5) Remove the lower radiator hose.

(6) Remove the upper radiator hose and coolant recovery hose (Fig. 27).

(7) Remove the fan shroud (Fig. 27).

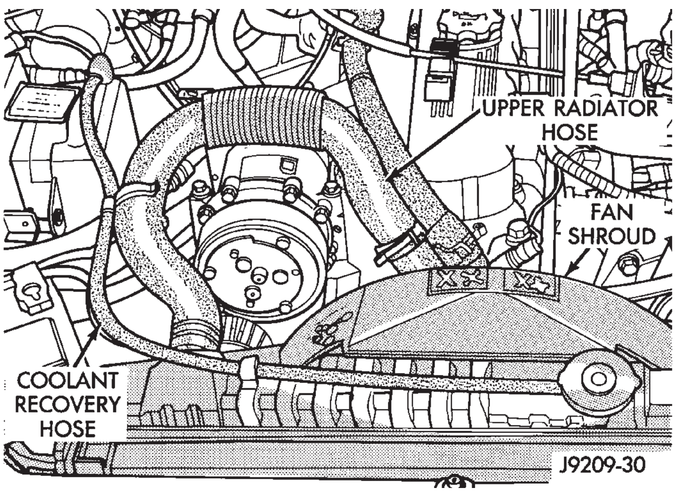


Fig. 27 Upper Radiator Hose, Coolant Recovery Hose & Fan Shroud

(8) Remove the radiator/condenser (if equipped with air conditioning).

(9) Remove fan assembly and install a 5/16 x 1/2-inch SAE capscrew through fan pulley into water pump flange. This will maintain the pulley and water pump in alignment when crankshaft is rotated.

(10) Disconnect the heater hoses.

(11) Disconnect the throttle cable, speed control cable (if equipped) and transmission cable (if equipped).

(12) Disconnect the body ground at the firewall.

(13) Disconnect the wires from the starter motor solenoid.

(14) Disconnect all fuel injection harness connections.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE TURNED OFF). BEFORE DISCONNECTING FUEL LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

(15) Perform fuel pressure release procedure. (refer to Group 14, Fuel System for the proper procedure).

(16) Remove latch clip and disconnect the quick-connect fuel line at the fuel rail.

(17) Recover refrigerant (if equipped with A/C). (Refer to group 24, Heating and Air Conditioning for proper procedures.)

(18) Disconnect suction/discharge hose from A/C compressor and cap off ports to prevent intrusion of foreign material or refrigerant oil loss.

(19) Remove the power brake vacuum check valve from the booster, if equipped.

(20) If equipped with power steering:

(a) Disconnect the power steering hoses from the fittings at the steering gear.

(b) Drain the pump reservoir.

(c) Cap the fittings on the hoses and steering gear to prevent foreign material from entering the system.

(21) Identify, tag and disconnect all necessary wire connectors and vacuum hoses.

(22) Raise the vehicle.

(23) Remove the oil filter.

(24) Remove the starter motor.

(25) Disconnect the exhaust pipe from the exhaust manifold.

(26) Remove the flywheel housing access cover.

(27) Remove the upper flywheel and converter housing bolts and loosen the bottom bolts.

(28) Remove the engine support cushion-to-engine compartment bracket bolts.

(29) Remove the engine shock damper bracket from the sill.

(30) Lower the vehicle.

(31) Attach a lifting device to the engine.

(32) Raise the engine slightly off the front supports.

(33) Place a support stand under the converter or flywheel housing.

(34) Lift the engine out of the engine compartment and install on an engine stand.

(35) 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. (M/T models)

(4) Align the flywheel housing with the engine.

(5) Install and tighten the flywheel housing lower bolts.

(6) Install the engine support cushions (if removed).

REMOVAL AND INSTALLATION (Continued)

(7) Lower the engine and engine support cushions onto the engine compartment brackets.

(8) Remove the engine lifting device.

(9) Raise the vehicle.

(10) Install the converter-housing access cover.

(11) Install the exhaust pipe support.

(12) Install the starter motor and connect the cable. Tighten the bolts to 45 N·m (33 ft. lbs.) torque.

(13) Tighten the engine support cushion through-bolt nuts.

(14) Connect the exhaust pipe to the manifold.

(15) Install the oil filter.

(16) Lower the vehicle.

(17) Connect the coolant hoses and tighten the clamps.

(18) If equipped with power steering:

(a) Remove the protective caps.

(b) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.

(c) Fill the pump reservoir with fluid.

(19) Remove the pulley-to-water pump flange alignment capscrew and install the fan assembly.

(20) Install the fan shroud and radiator and condenser (if equipped with air conditioning).

(21) Connect the radiator hoses.

(22) Connect the oxygen sensor wire connector.

(23) Connect the throttle cable and install the rod. Connect the transmission and speed control cables (if equipped).

(24) Connect the fuel supply line to the injector rail. push until a "click" is heard. Re-install latch clip.

(25) Connect all the vacuum hoses and wire connectors.

(26) Connect suction/discharge hose to compressor. (if equipped)

(27) Fill the power steering reservoir.

(28) Connect the battery cables.

(29) Install the air cleaner.

(30) Install the hood.

(31) Add engine oil and coolant.

(32) Start the engine and inspect for leaks.

(33) Stop the engine and check the fluid levels. Add fluid, as required.

(34) Recharge air conditioning (Refer to group 24, Heating and Air Conditioning for proper procedures).

INTAKE MANIFOLD—2.5L ENGINE

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove the air inlet hose from the throttle body and air cleaner.

(3) Loosen the accessory drive belt tension and remove the belt from the power steering pump (refer to Group 07, Cooling Systems for proper procedures).

(4) Remove the power steering pump and brackets from the water pump and intake manifold. Secure power steering pump and bracket out of the way.

(5) Perform fuel system pressure release procedure (refer to Group 14, Fuel System for correct procedure).

(6) Disconnect fuel supply tube from the fuel rail. Some fuel lines require a special tool for removal/installation (refer to Group 14, Fuel System - Quick Connect Fittings).

(7) Disconnect the accelerator cable, the cruise control cable (if equipped), and the transmission line pressure cable (if equipped) from the throttle body and remove them from the cable 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.

(8) Disconnect the electrical connectors. Pull the harnesses away from the manifold and secure them so they do not interfere with the manifold removal and installation process.

- The throttle position sensor.
- The idle air control motor.
- The coolant temperature sensor at the thermostat.
- The manifold air temperature sensor at the intake manifold.
- The fuel injectors.
- The oxygen sensor.

(9) Disconnect the crankcase ventilation (CCV) vacuum hose and manifold absolute pressure (MAP) sensor vacuum hose connector at the intake manifold.

(10) Disconnect vacuum hose from vacuum port on the intake manifold.

(11) Disconnect CCV hose at the cylinder head cover (Fig. 28).

(12) Remove the molded vacuum harness.

(13) Disconnect the vacuum brake booster hose at the intake manifold.

(14) Remove bolts 2 through 5 securing the intake manifold to the cylinder head (Fig. 29). Slightly loosen bolt No.1 and nuts 6 and 7.

(15) 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)

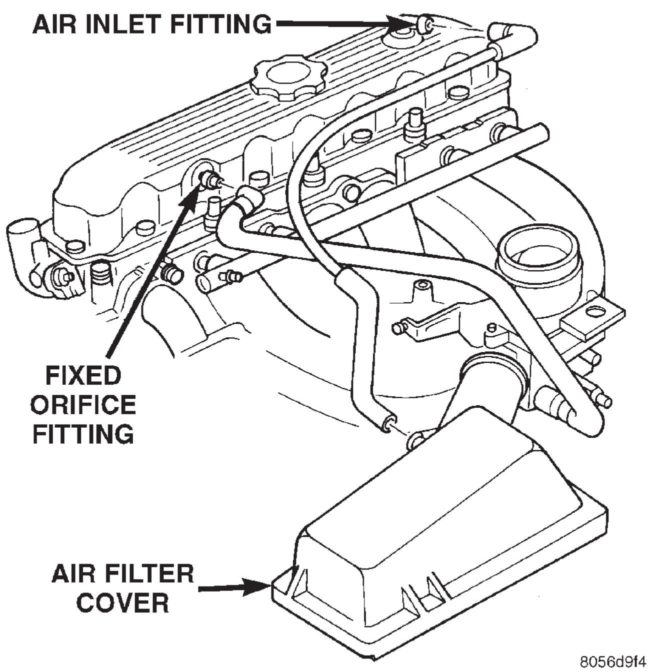


Fig. 28 Crankcase Ventilation (CCV) Hose—2.5L Engine

(3) Position the manifold in place and finger tighten the mounting bolts.

(4) Tighten the fasteners in sequence and to the specified torque (Fig. 29).

- 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 fuel supply tube to the fuel rail inlet. Push tube until a “click” is heard. **Before connecting the fuel line to the fuel rail replace the O-rings at the quick-connect fuel line coupling.**

(6) Pull out on the fuel supply tube to ensure that it is locked in place.

(7) Connect the molded vacuum hoses to the vacuum port on the intake manifold and the cylinder head cover.

(8) Connect the electrical connectors.

- The throttle position sensor.
- The idle air control motor.
- The coolant temperature sensor at the thermostat housing.
- The fuel injectors.
- The air manifold temperature sensor.
- The oxygen sensor.

(9) Connect the CCV vacuum hose and MAP sensor vacuum hose connectors to the throttle body.

(10) Install the power steering pump and bracket assembly to the water pump and intake manifold. Hand start the three (3) tensioner bracket to p/s pump to intake manifold bolts and the two (2) tensioner bracket to water pump bolts.

(11) Tighten the power steering pump bolts to 28 N·m (21 ft. lbs.) Tighten the tensioner bracket to water pump bolts to 28 N·m (21 ft. lbs.).

(12) Connect the accelerator cable, cruise control cable (if equipped), and the transmission line pressure cable (if equipped) to the hold-down bracket and the throttle lever.

(13) Install and tension the accessory drive belt. Refer to Group 7, Cooling System for the proper procedure.

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.

(14) Connect the air inlet hose to the throttle body and the air cleaner.

(15) Connect the battery negative cable.

(16) Start the engine and check for leaks.

EXHAUST MANIFOLD—2.5L ENGINE

REMOVAL

(1) Disconnect the battery negative cable.

(2) Raise the vehicle.

(3) Disconnect the exhaust pipe from the engine exhaust manifold.

(4) Lower the vehicle.

(5) Remove intake manifold (refer to procedure in this section).

(6) Remove fasteners 2 through 5 and remove the intake manifold (Fig. 29).

(7) Remove fasteners 1, 6 and 7 and remove the engine exhaust manifold (Fig. 29).

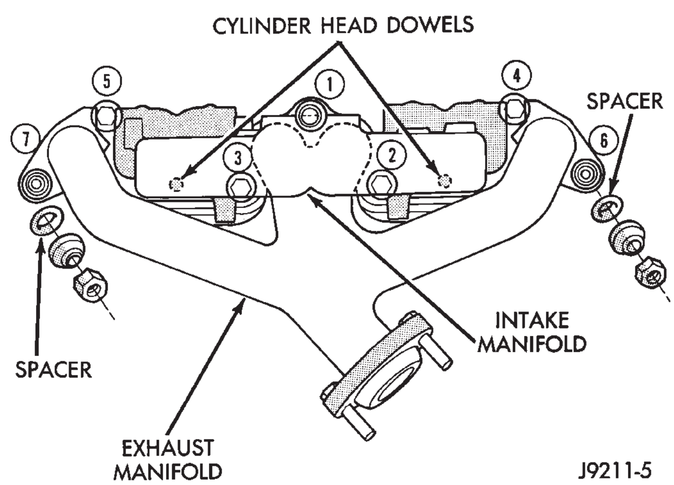


Fig. 29 Intake/Exhaust Manifold Removal/ Installation—2.5L Engine

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. 29).**

(4) Tighten bolt No.1 to 41 N·m (30 ft. lbs.) torque (Fig. 29).

(5) Install the intake manifold on the cylinder head dowels (Fig. 29).

(6) Install bolts 2 through 5 (Fig. 29). 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. 29).

(8) Tighten nuts 6 and 7 to 31 N·m (23 ft. lbs.) torque (Fig. 29).

(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.

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. 30).

(3) Disconnect the fresh air inlet hose from the engine cylinder head cover (Fig. 30).

(4) Remove the engine cylinder head cover mounting bolts.

(5) Remove the 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.

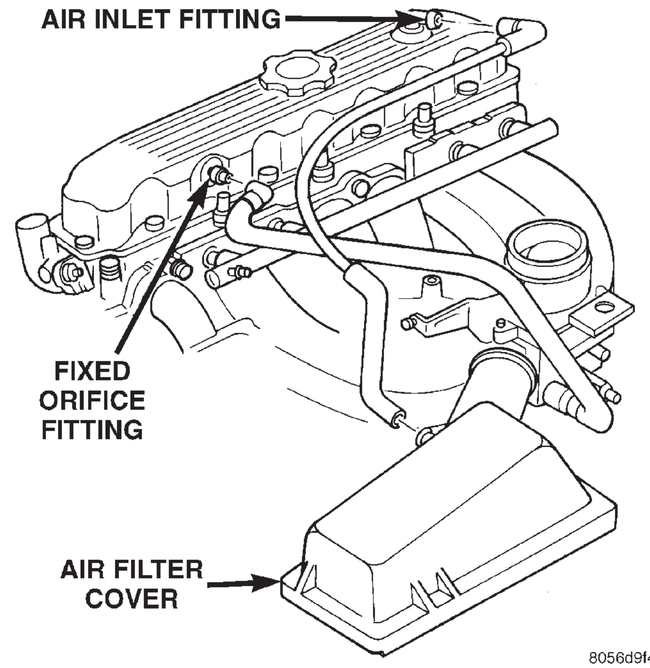


Fig. 30 Engine Cylinder Head Cover

(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 13 N·m (115 in. lbs.) torque.

(4) Connect the CCV hoses (Fig. 30).

(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. (Refer to procedure in this section)

(2) Check for rocker arm bridges which are causing misalignment of the rocker arm to valve tip area.

(3) Remove the capscrews at each bridge and pivot assembly (Fig. 31). Alternately loosen the capscrews one turn at a time to avoid damaging the bridges.

(4) Remove the bridges, pivots and corresponding pairs of rocker arms (Fig. 31). 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.

REMOVAL AND INSTALLATION (Continued)

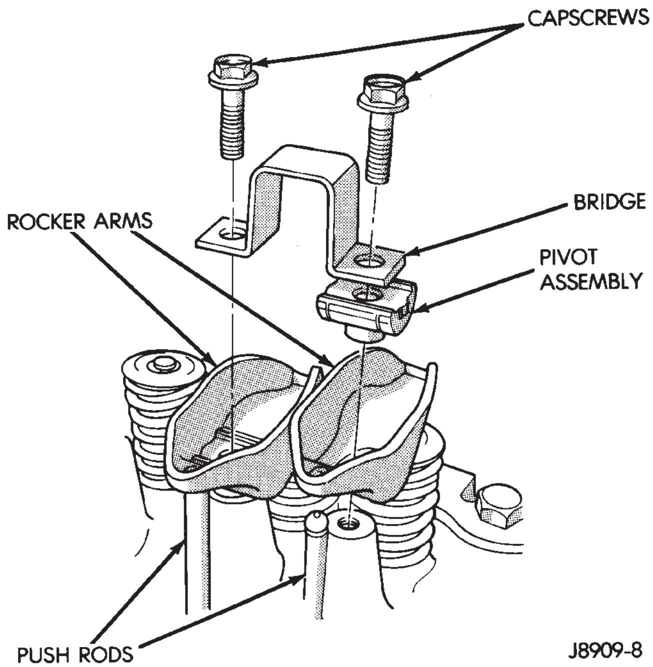


Fig. 31 Rocker Arm Assembly

(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. Refer to procedure in this section.

(2) Remove cap screws, 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. 32).

(9) Remove valve spring and retainer (Fig. 32).

(10) Remove valve stem oil seals (Fig. 32). Note the valve seals are different for intake and exhaust valves. The top of each seal is marked either INT (intake/black in color) or EXH (exhaust/brown in color). DO NOT mix the seals.

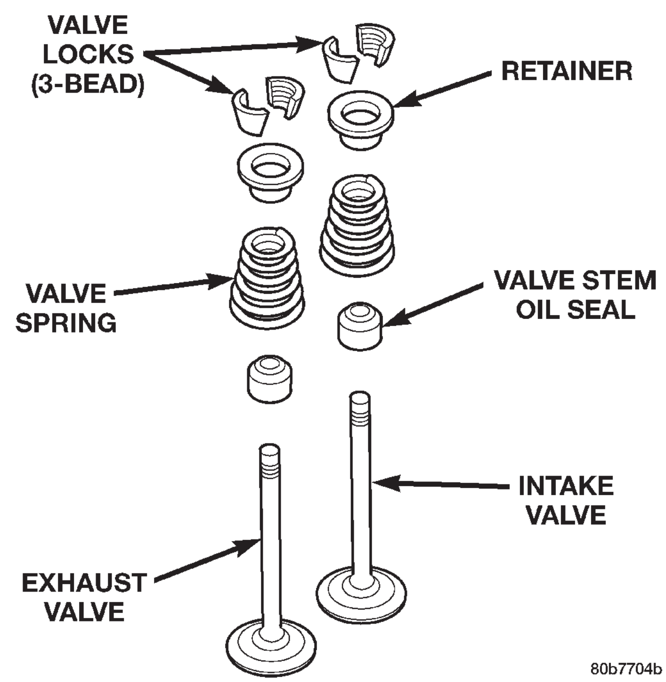


Fig. 32 Valve and Valve Components

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)

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) Release air pressure and 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 cap screws alternately, one at a time, to avoid damaging the bridge. Tighten the cap screws to 28 N·m (21 ft. lbs.) torque.

(9) Install the engine cylinder head cover.

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. (Refer to procedure in this section)

(5) Remove the capscrews, bridge and pivot assemblies and rocker arms (Fig. 33).

(6) Remove the push rods (Fig. 33). **Retain the push rods, bridges, pivots and rocker arms in the same order as removed.**

(7) Loosen the accessory drive belt at the power steering pump bracket, if equipped or at the idler pulley bracket (refer to Group 7, Cooling System for the proper procedure).

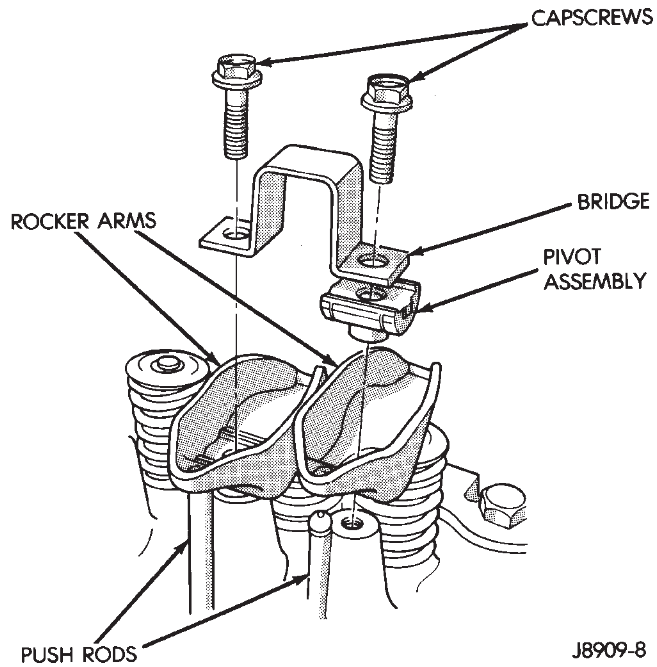


Fig. 33 Rocker Arm Assembly

(8) If equipped with air conditioning, perform the following:

(a) Remove the bolts from the A/C compressor mounting bracket and set the compressor aside.

(b) Remove the air conditioner compressor bracket bolts from the engine cylinder head.

(c) Loosen the through bolt at the bottom of the bracket.

(9) If equipped, disconnect the power steering pump bracket. Set the pump and bracket aside. DO NOT disconnect the hoses.

(10) Perform fuel pressure release procedure (Refer to Group 14, fuel systems for proper procedures).

(11) Remove the latch clip and disconnect the fuel supply 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) Number and disconnect the ignition wires and remove the spark plugs.

(14) Disconnect the coolant temperature sending unit connector.

(15) Remove the engine cylinder head bolts.

(16) Remove the engine cylinder head and gasket (Fig. 34).

(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.

REMOVAL AND INSTALLATION (Continued)

(18) Stuff clean lint free shop towels into the cylinder bores.

NOTE: If valves, springs, or seals are to be inspected/replaced at this time, refer to Valves and Valve Springs later in this section for proper procedures.

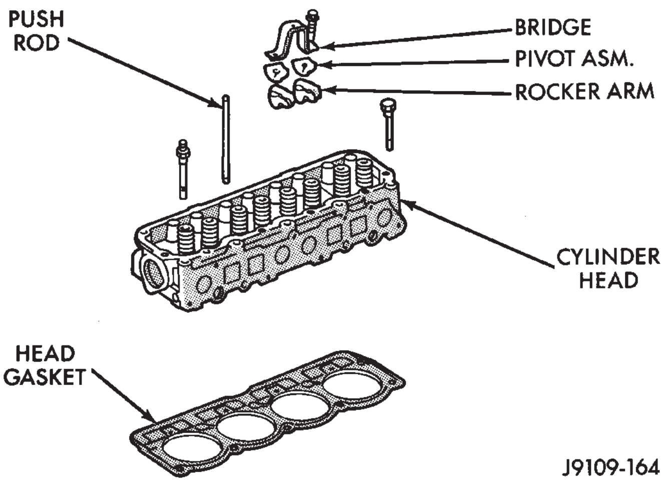


Fig. 34 Engine Cylinder Head Assembly

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. 35). 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.

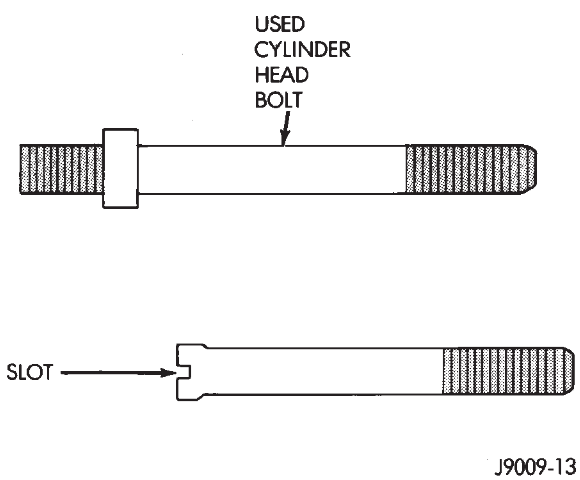


Fig. 35 Fabricate Alignment Dowels

(2) Install one dowel in bolt hole No.10 and the other dowel in bolt hole No.8 (Fig. 36).

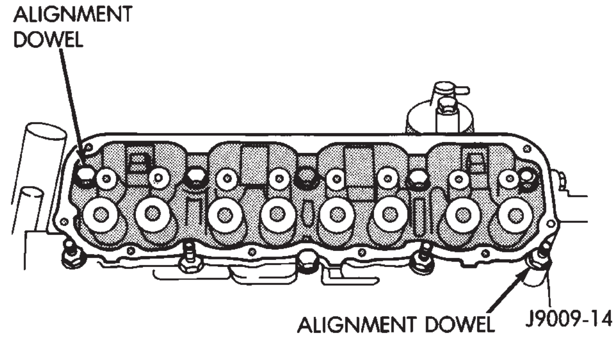


Fig. 36 Alignment Dowel Locations

(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. 37):

(a) Tighten all bolts in sequence (1 through 10) to 30 N·m (22 ft. lbs.) torque.

(b) Tighten all bolts in sequence (1 through 10) to 61 N·m (45 ft. lbs.) torque.

(c) Check all bolts to verify they are set to 61 N·m (45 ft. lbs.) torque.

(d) Tighten bolts (in sequence):

- Bolts 1 through 6 to 149 N·m (110 ft. lbs.) torque.
- Bolt 7 to 136 N·m (100 ft. lbs.) torque.
- Bolts 8 through 10 to 149 N·m (110 ft. lbs.) torque.

(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.

REMOVAL AND INSTALLATION (Continued)

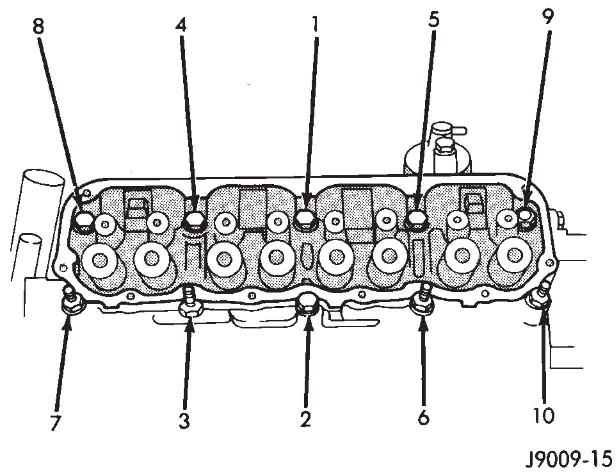


Fig. 37 Engine cylinder head Bolt Tightening Sequence

(11) Connect the coolant temperature sending unit connector.

(12) Install the spark plugs and tighten to 37 N·m (27 ft. lbs.) torque. Connect the ignition wires.

(13) Install the intake and exhaust manifolds (refer to Group 11, Exhaust System and Intake Manifold for the proper procedures).

(14) Install the fuel supply line. Push until a “click” is heard. Reinstall latch clip.

(15) If equipped, attach the power steering pump and bracket.

(16) Install the push rods, rocker arms, pivots and bridges in the order they were removed.

(17) Install the engine cylinder head cover.

(18) 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.

(19) Attach the air conditioning compressor to the bracket. Tighten the bolts to 27 N·m (20 ft. lbs.) torque.

CAUTION: The accessory drive belt must be routed correctly. Incorrect routing can cause the water pump to turn in the opposite direction causing the engine to overheat.

(20) Install the accessory drive belt and correctly tension the belt (refer to Group 7, Cooling System for the proper procedure).

(21) Install the air cleaner and ducting.

(22) 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).

(23) Install the coolant temperature sending unit connector.

(24) Connect negative cable to battery.

(25) Connect the upper radiator hose and heater hose at the 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 thermostat opens. Add coolant, if required.

CYLINDER HEAD

DISASSEMBLY

(1) Use Valve Spring Compressor Tool MD-998772A and compress each valve spring.

(2) Remove the valve locks, retainers, springs and valve stem oil seals. Discard the oil seals.

(3) 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.

(4) Remove the valves, and place them in a rack in the same order as removed.

ASSEMBLY

(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.

HYDRAULIC TAPPETS

REMOVAL

Retain all the components in the same order as removed.

(1) Remove the engine cylinder head cover (refer to procedure earlier in this section).

(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.

REMOVAL AND INSTALLATION (Continued)

(4) Remove the tappets through the push rod openings in the cylinder head with a Hydraulic Valve Tappet Removal/Installation Tool (Fig. 38).

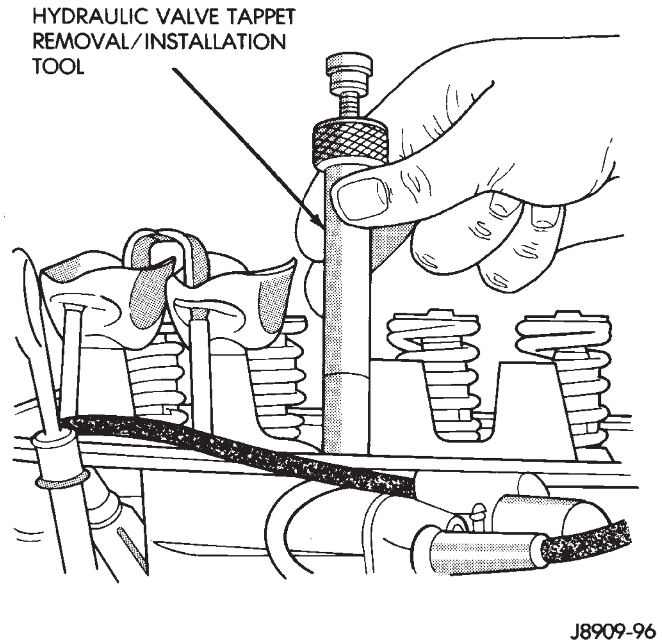


Fig. 38 Hydraulic Valve Tappet Removal/Installation Tool

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) 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. 39).

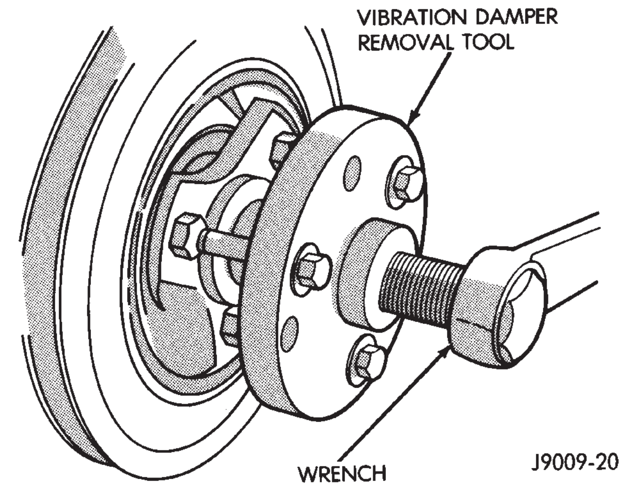


Fig. 39 Vibration Damper Removal Tool 7697

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 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. 40). Tighten the nut against the tool until it contacts the cover.

REMOVAL AND INSTALLATION (Continued)

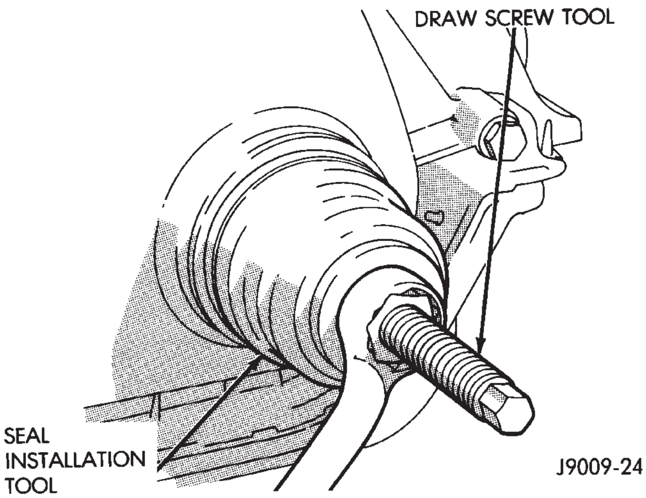


Fig. 40 Timing Case Cover Oil Seal Installation

(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 battery negative cable.

(2) Remove accessory drive belt (Refer to Group 07, Cooling System for proper procedure).

(3) Remove the accessory drive brackets that are attached to the timing case cover.

(4) Remove the fan and hub assembly and remove the fan shroud.

(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 vibration damper (Fig. 41).

(7) Remove the oil pan-to-timing case cover bolts and timing case cover-to-cylinder block bolts.

(8) Remove the timing case cover and gasket from the engine.

(9) Pry the crankshaft oil seal from the front of the timing case cover (Fig. 41).

INSTALLATION

(1) Clean the timing case cover, oil pan and cylinder block gasket surfaces.

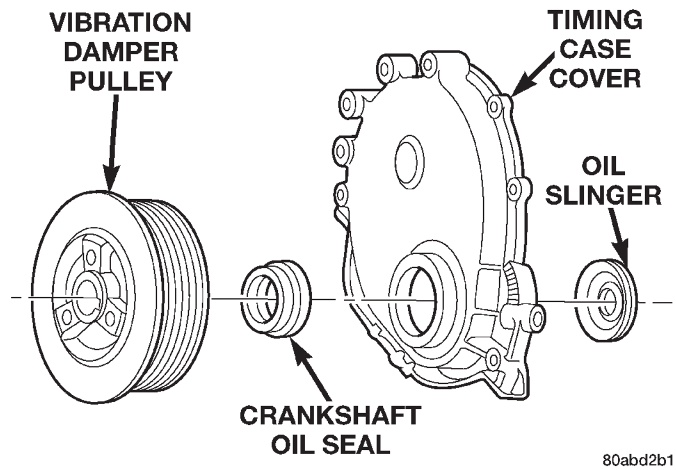


Fig. 41 Timing Case Cover Components

(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.

(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. 42).

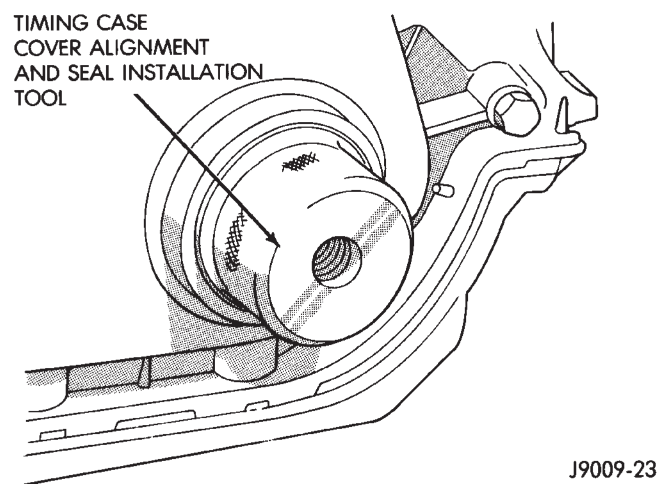


Fig. 42 Timing Case Cover Alignment and Seal Installation Tool 6139

(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 bolts to 9.5 N·m (84 in. lbs.) torque.

(8) Remove the cover alignment tool.

REMOVAL AND INSTALLATION (Continued)

(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 accessory 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. 43).

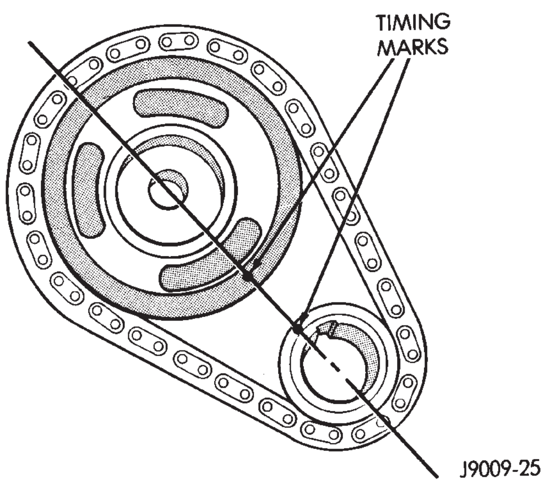


Fig. 43 Crankshaft—Camshaft Alignment

(7) Remove the oil slinger from the crankshaft.

(8) Remove the camshaft retaining bolt and remove the sprockets and chain as an assembly (Fig. 44).

(9) To replace the timing chain tensioner, the oil pan must be removed.

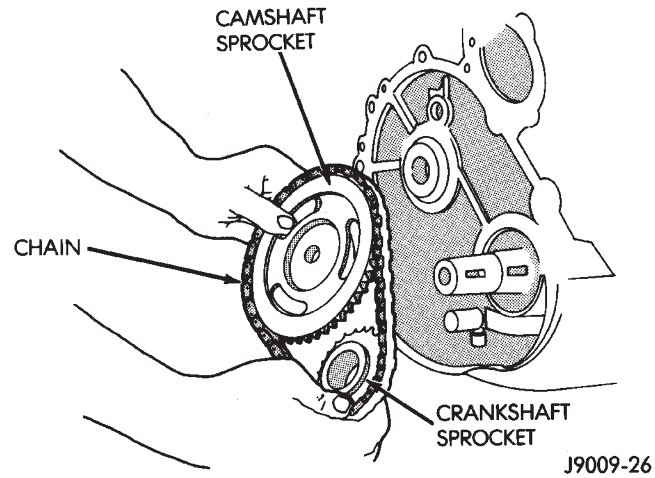


Fig. 44 Camshaft and Crankshaft Sprockets and Chain

INSTALLATION

(1) Turn the tensioner lever to the unlocked (down) position (Fig. 45).

(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. 45).

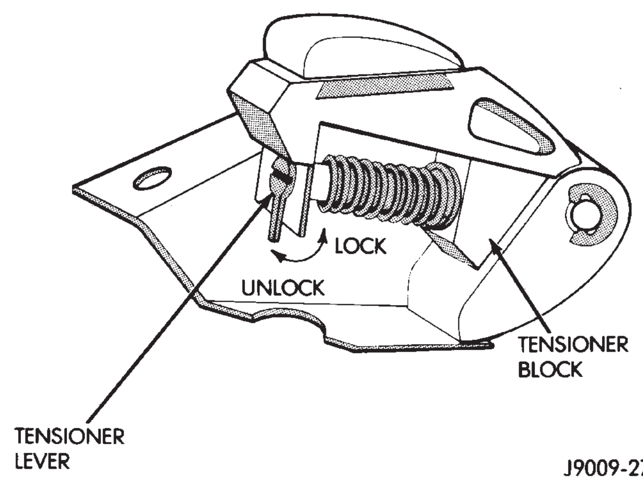


Fig. 45 Loading Timing Chain Tensioner

(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. 43).

(4) Install the camshaft sprocket retaining bolt and washer. Tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(5) To verify correct installation of the timing chain, turn the crankshaft to position the camshaft sprocket timing mark as shown in (Fig. 46). Count the number of chain pins between the timing marks of both sprockets. There must be 20 pins.

REMOVAL AND INSTALLATION (Continued)

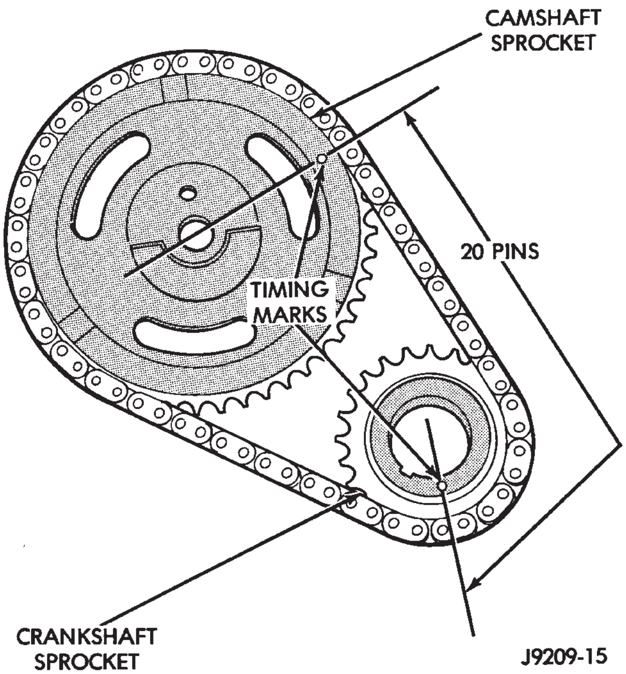


Fig. 46 Verify Sprocket—Chain Installation

(6) Turn the chain tensioner lever to the unlocked (down) position (Fig. 45).

(7) Install the oil slinger.

(8) Replace the oil seal in the timing case cover.

(9) Install the timing case cover and gasket.

(10) With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(11) Install the fan and shroud.

(12) Connect negative cable to battery.

CAMSHAFT

REMOVAL

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. RELEASE THE PRESSURE BEFORE REMOVING THE DRAIN COCK, CAP AND DRAIN PLUGS.

(1) Disconnect negative cable from battery.

(2) Drain the cooling system. DO NOT waste reusable coolant. If the solution is clean, drain it into a clean container for reuse.

(3) Remove the radiator or radiator 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. 47).

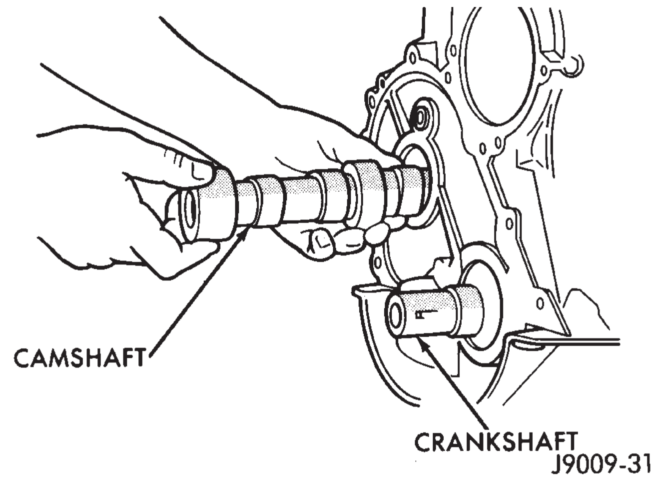


Fig. 47 Camshaft

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. 47).

(8) Turn the tensioner lever to the unlocked (down) position (Fig. 48).

(9) 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. 48).

(10) Install the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned.

(11) Install the camshaft sprocket retaining bolt and washer. Tighten the bolt to 108 N·m (80 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(12) Release the timing chain tensioner by moving the lever to the unlock position (Fig. 48).

(13) Install the timing case cover with a replacement oil seal (Fig. 49). Refer to Timing Case Cover Installation.

(14) Install the vibration damper.

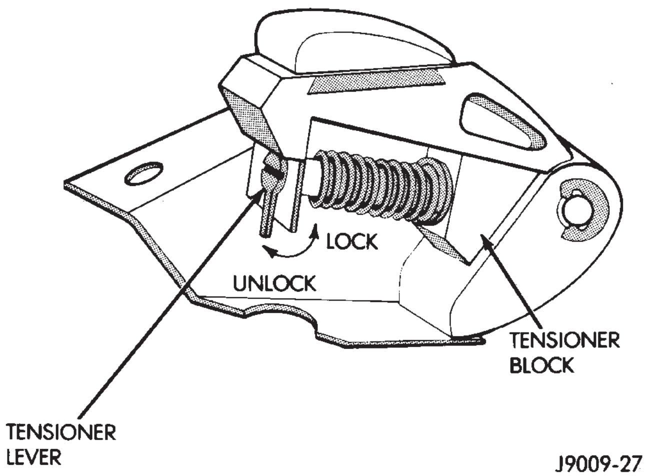


Fig. 48 Loading Timing Chain Tensioner

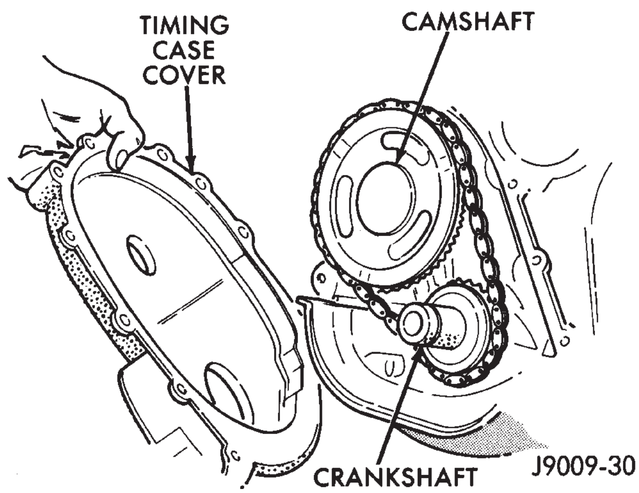


Fig. 49 Timing Case Cover

(15) Install the hydraulic valve tappets.

(16) Install the push rods.

(17) Install the rocker arms, bridges and pivots.

(18) Install the engine cylinder head cover.

(19) Position the oil pump gear. Refer to Distributor in the Component Removal/Installation section of Group 8D, Ignition Systems.

(20) Install the distributor and ignition wires. Refer to Distributor in the Component Removal/Installation section of Group 8D, Ignition Systems.

(21) Install the radiator or radiator and condenser, if equipped with A/C.

(22) Fill the cooling system.

(23) 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. 50).

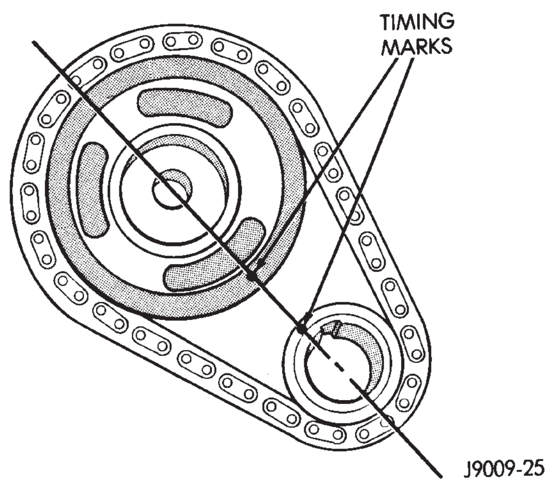


Fig. 50 Timing Chain Alignment

(11) Remove camshaft sprocket retaining bolt.

(12) Remove the crankshaft oil slinger.

REMOVAL AND INSTALLATION (Continued)

(13) Remove the sprockets and chain as an assembly (Fig. 51).

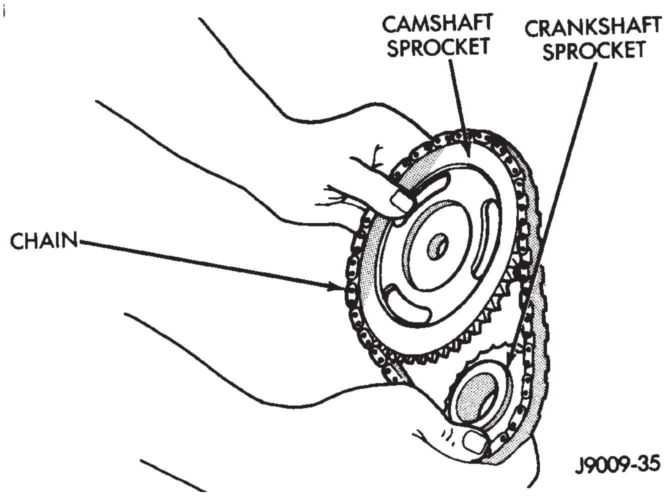


Fig. 51 Camshaft and Crankshaft Sprocket and Chain

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. 50).

(5) To verify correct installation of the timing chain, turn the crankshaft to position the camshaft sprocket timing mark as shown in (Fig. 52). Count the number of chain pins between the timing marks of both sprockets. There must be 20 pins.

(6) Install the crankshaft oil slinger.

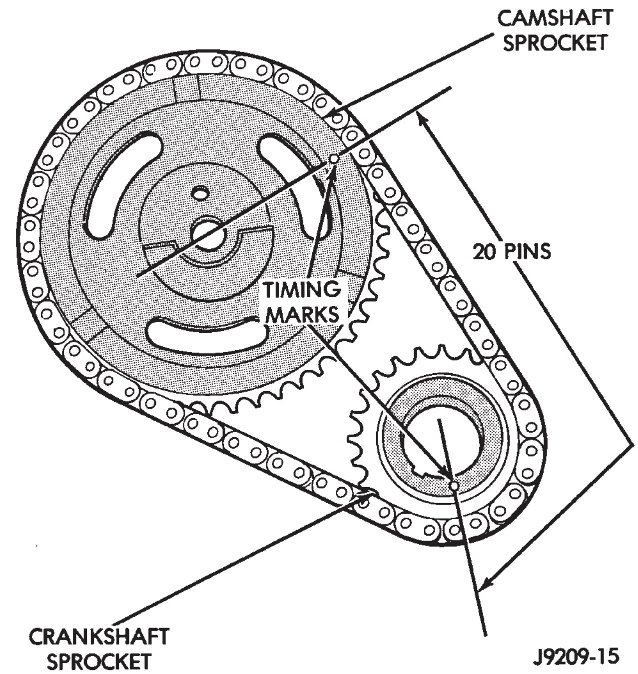


Fig. 52 Verify Crankshaft—Camshaft Installation

(7) Tighten the camshaft sprocket bolt to 108 N·m (80 ft. lbs.) torque.

(8) Check the valve timing.

(9) Coat both sides of the replacement timing case cover gasket with gasket sealer. Apply a 3 mm (1/8 inch) bead of Mopar Silicone Rubber Adhesive Sealant, or equivalent to the joint formed at the timing case cover and cylinder block.

(10) Position the timing case cover on the oil pan gasket and the cylinder block.

(11) Place Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening of the cover (Fig. 53).

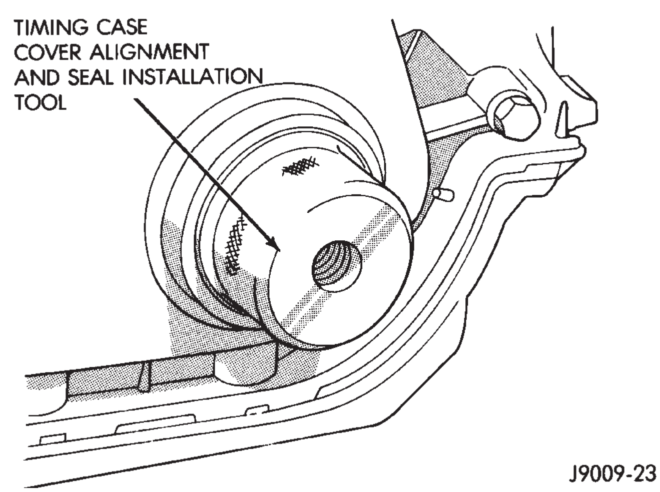


Fig. 53 Timing Case Cover Alignment and Seal Installation Tool 6139

REMOVAL AND INSTALLATION (Continued)

(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.

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. 54).

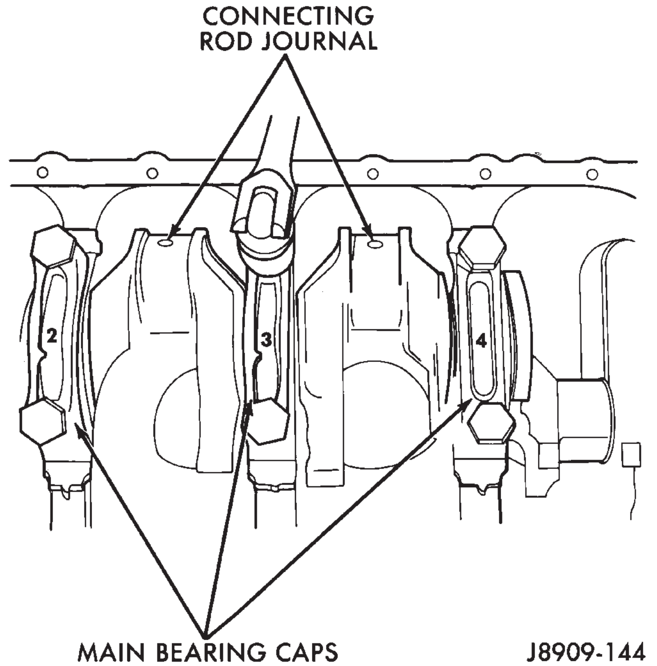


Fig. 54 Removing Main Bearing Caps and Lower Inserts

(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. 55). 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. 55). 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.

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 Mopar® Gasket Maker, or equivalent on the rear bearing cap (Fig. 56). The bead should be 3

REMOVAL AND INSTALLATION (Continued)

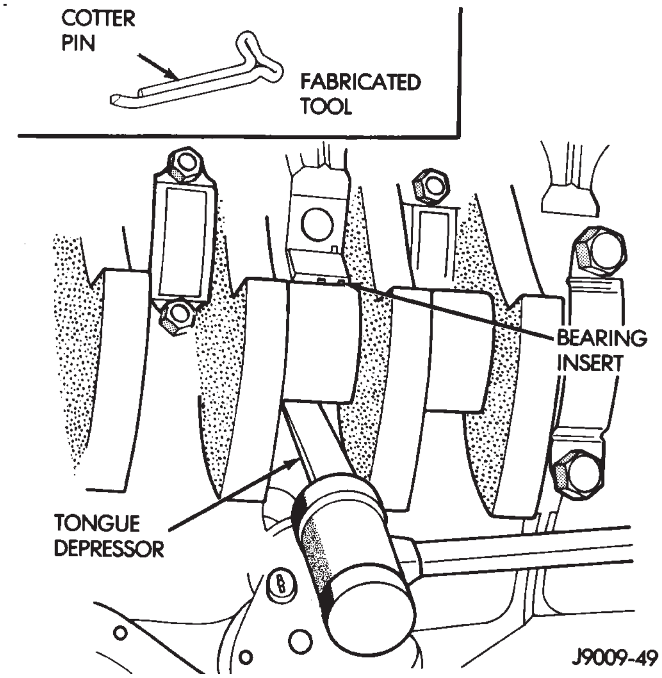


Fig. 55 Removing Upper Inserts

mm (0.125 in) thick. DO NOT apply Mopar® Gasket Maker, 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.

(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. 57). 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.

(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) Install new rearmain seal. Refer to Rear Main Seal in this section.

(16) Lower the vehicle.

(17) Install the spark plugs. Tighten the plugs to 37 N·m (27 ft. lbs.) torque.

(18) Fill the oil pan with engine oil to the safe mark on the dipstick level.

(19) Connect negative cable to battery.

REMOVAL AND INSTALLATION (Continued)

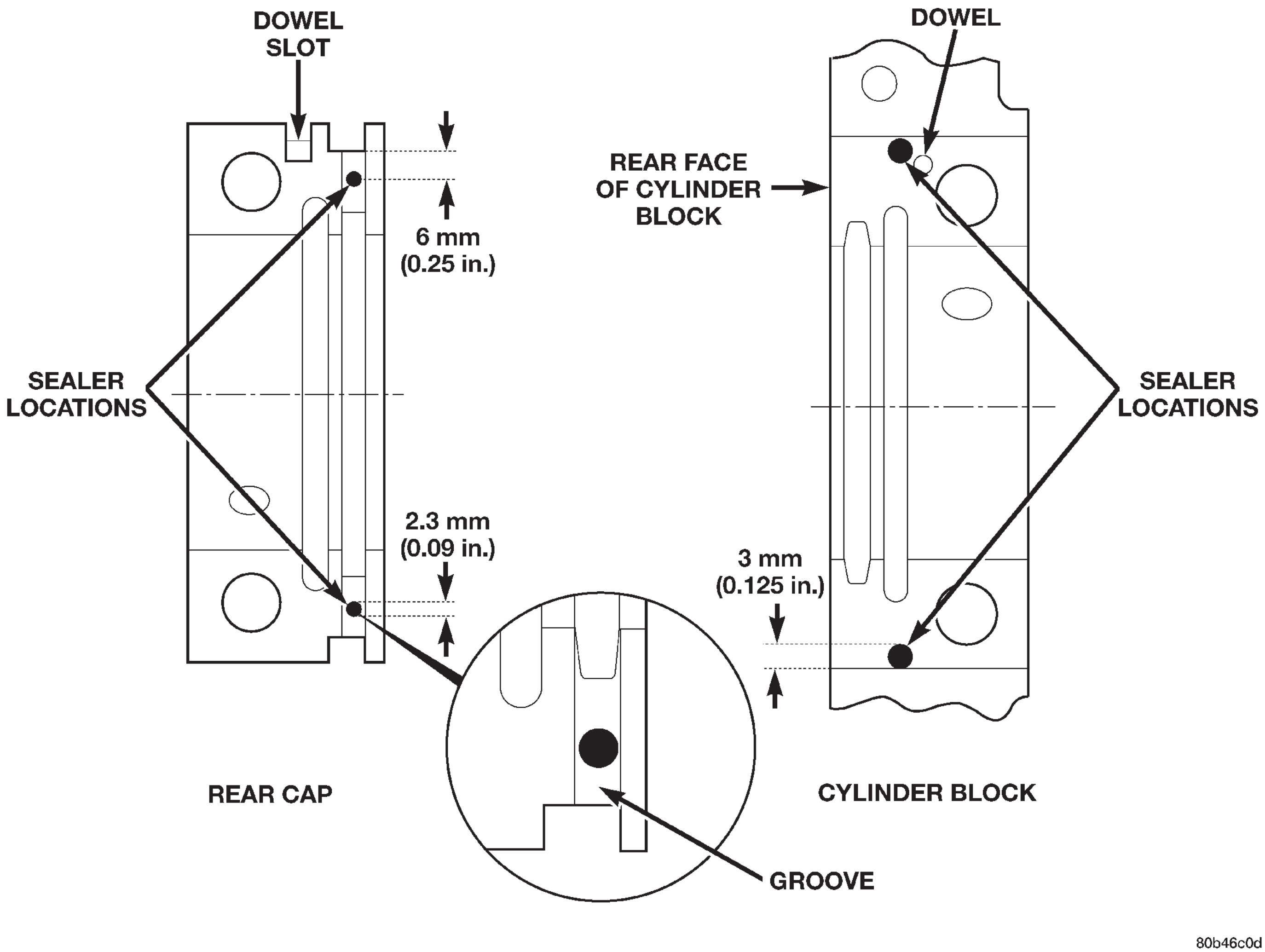


Fig. 56 Location of Mopar® Gasket Maker

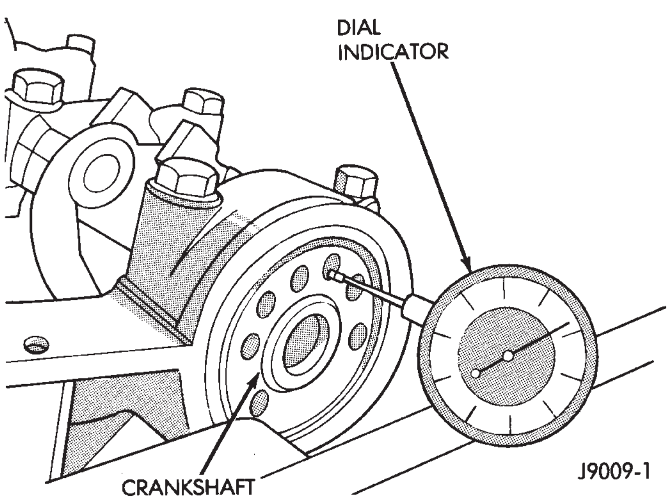


Fig. 57 Crankshaft End Play Measurement

OIL PAN

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise the vehicle.

(3) Remove the oil pan drain plug and drain the engine oil.

(4) Disconnect the exhaust pipe at the engine exhaust manifold.

(5) Disconnect the exhaust hanger at the catalytic converter and lower the pipe.

(6) Remove the engine starter motor.

(7) Remove the flywheel/torque converter housing access cover.

(8) Position a jack stand directly under the engine vibration damper.

(9) Place a piece of wood (2 x 2) between the jack stand and the engine vibration damper.

(10) Remove the engine mount through bolts.

(11) Using the jack stand, raise the engine until adequate clearance is obtained to remove the oil pan.

REMOVAL AND INSTALLATION (Continued)

(12) If equipped, disconnect the transmission cooler lines and oxygen sensor harness from oil pan mounting studs.

(13) Remove the oil pan bolts and studs. 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 into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 58).

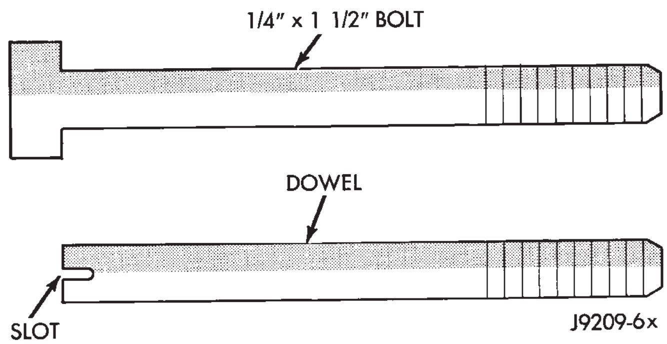


Fig. 58 Fabrication of Alignment Dowels

(3) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 59).

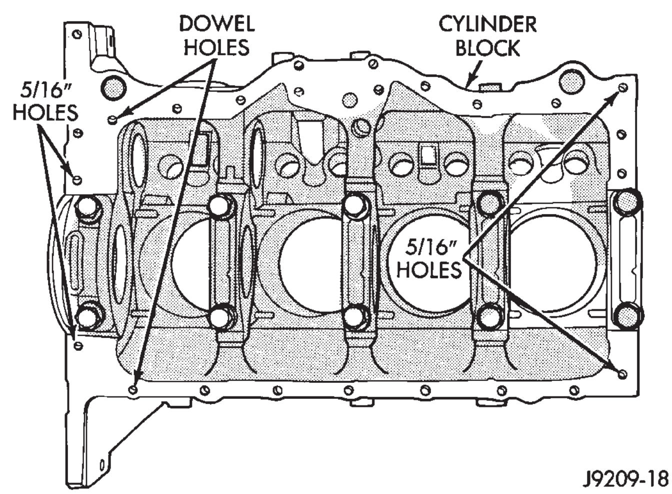


Fig. 59 Position of Dowels in Cylinder Block

(4) Apply Mopar® Silicone Adhesive Sealant onto the cylinder block in four location as shown (Fig. 60).

(5) Slide the one-piece gasket over the dowels and onto the block and timing case cover.

(6) Position the oil pan over the dowels and onto the gasket.

(7) 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. 61). Tighten these bolts to 15 N·m (132 in. lbs.) torque.

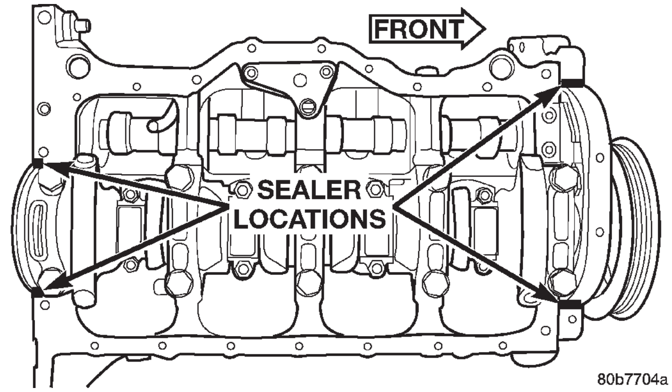


Fig. 60 Location of Mopar® Silicone Adhesive Sealant on Cylinder Block

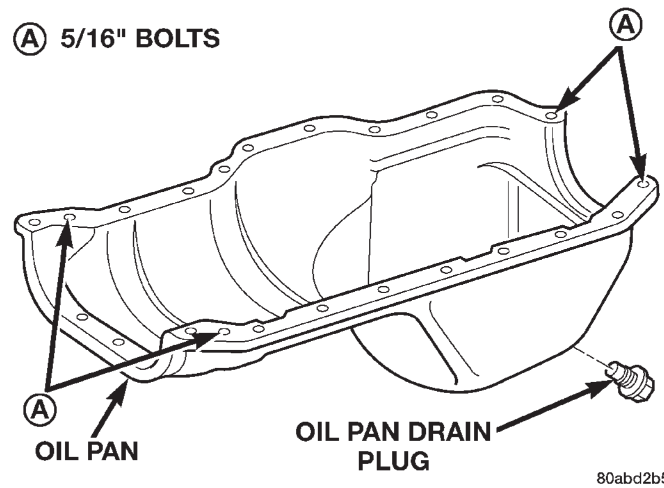


Fig. 61 Position of 5/16 inch Oil Pan Bolts

(8) Remove the dowels. Install the remaining 1/4 inch oil pan bolts. Tighten these bolts to 9.5 N·m (84 in. lbs.) torque.

(9) Lower the engine until it is properly located on the engine mounts.

(10) Install the through bolts and tighten the nuts.

(11) Lower the jack stand and remove the piece of wood.

(12) Install the flywheel and torque converter housing access cover.

(13) Install the engine starter motor.

(14) Connect the exhaust pipe to the hanger and to the engine exhaust manifold.

(15) Install the oil pan drain plug (Fig. 61). Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(16) Lower the vehicle.

(17) Connect negative cable to battery.

(18) Fill the oil pan with engine oil to the specified level.

REMOVAL AND INSTALLATION (Continued)

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.

(19) 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. 62).

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.

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.

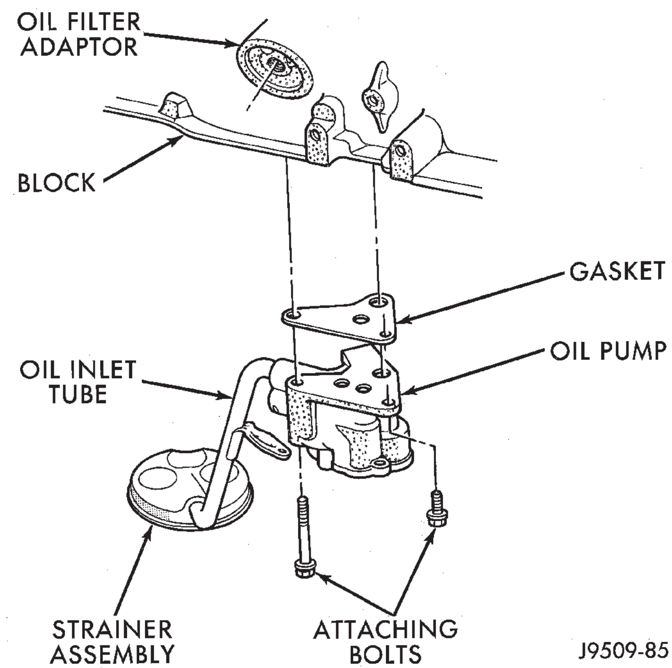


Fig. 62 Oil Pump Assembly

(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. 63).

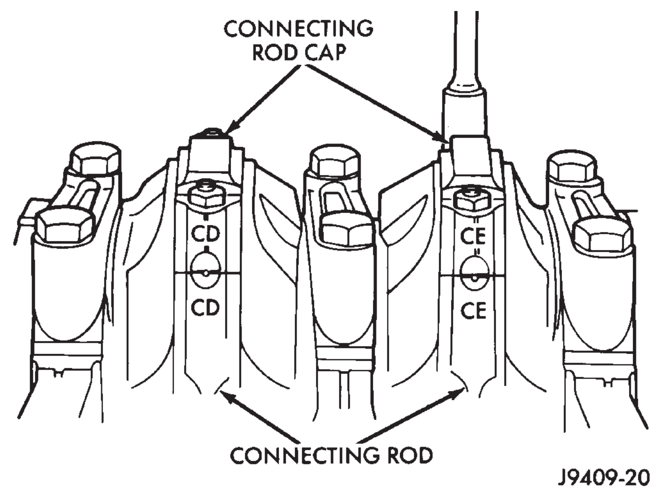


Fig. 63 Stamped Connecting Rods and Caps

(10) Lower the vehicle until it is about 2 feet from the floor.

CAUTION: Ensure that the connecting rod bolts DO NOT scratch the crankshaft journals or cylinder walls. Short pieces of rubber hose, slipped over the rod bolts will provide protection during removal.

REMOVAL AND INSTALLATION (Continued)

(11) Have an assistant push the piston and connecting rod assemblies up and through the top of the cylinder bores (Fig. 64).

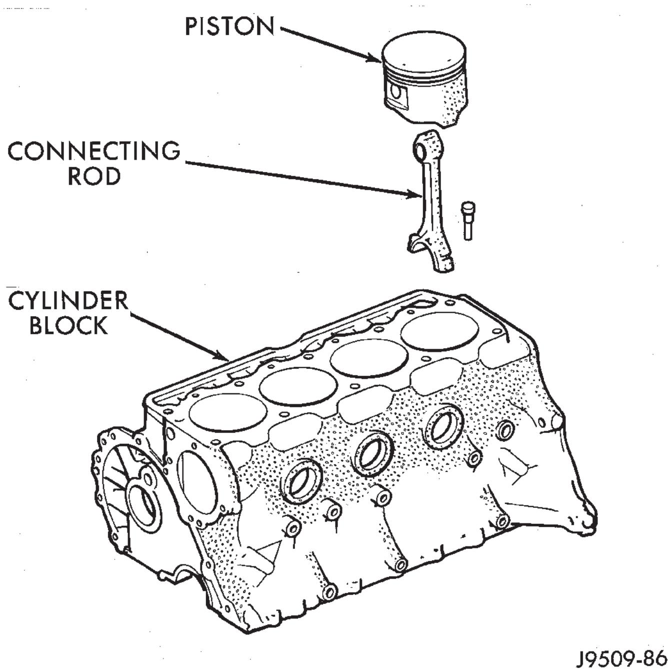


Fig. 64 Removal of Connecting Rod and Piston Assembly

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.

(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. 65).

(5) Ensure the arrow on the piston top points to the front of the engine (Fig. 65).

(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.

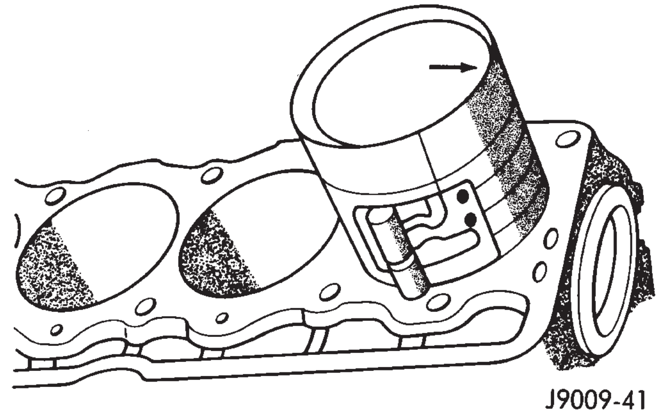


Fig. 65 Rod and Piston Assembly Installation

(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, making sure not to scratch or nick the crankshaft (Fig. 66).

REMOVAL AND INSTALLATION (Continued)

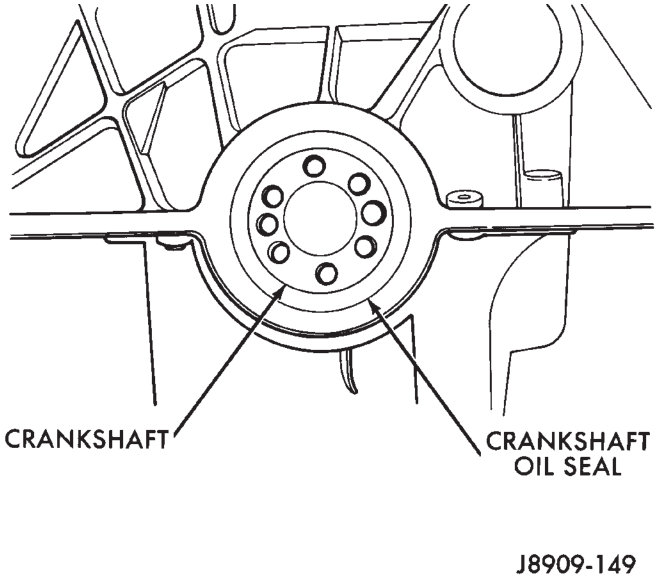


Fig. 66 Replacement of Rear Crankshaft Oil Seal

INSTALLATION

(1) Wipe the seal surface area of the crankshaft until it is clean.

(2) Coat the outer lip of the replacement rear main bearing seal with engine oil.

(3) 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.

(4) Install the flywheel or converter drive plate. New bolts MUST be used when installing the flywheel or converter plate. Tighten the new bolts to 68 N·m (50 ft. lbs.) torque. Turn the bolts an additional 60°.

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. 67). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

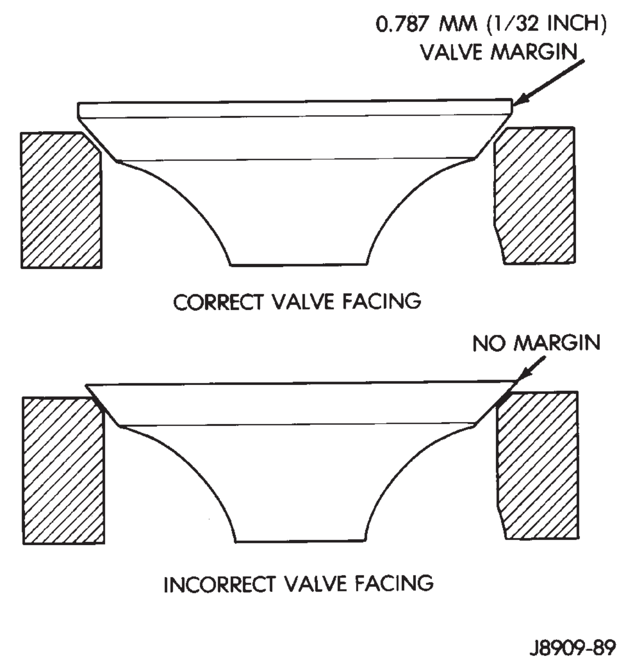


Fig. 67 Valve Facing Margin

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. 68).

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. Ser-

DISASSEMBLY AND ASSEMBLY (Continued)

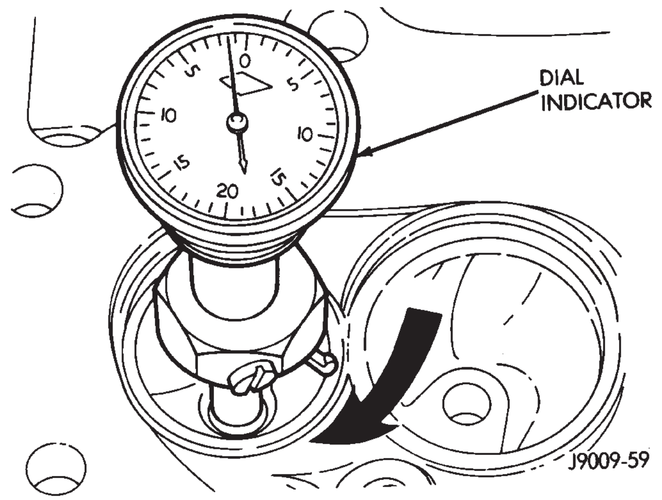


Fig. 68 Measurement of Valve Seat Runout

vice 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.

(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. 69).

(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.

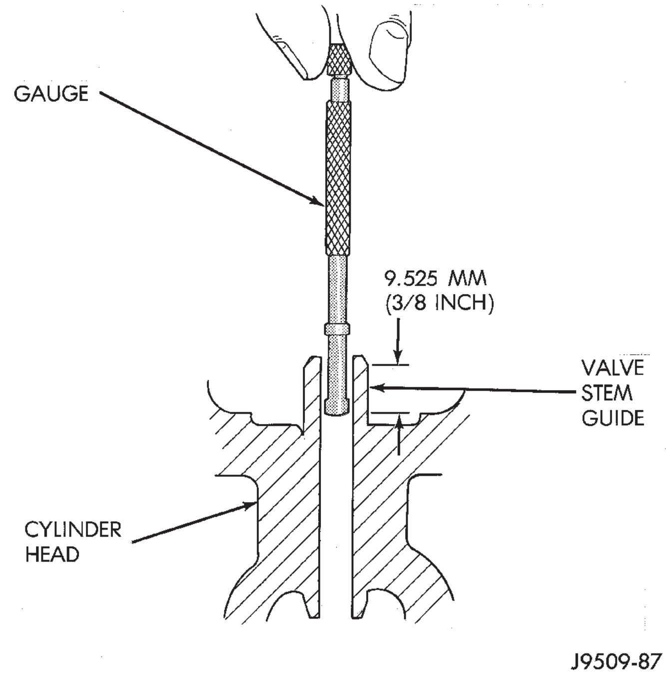


Fig. 69 Measurement of Valve Guide Bore Diameter

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. 70).

(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.

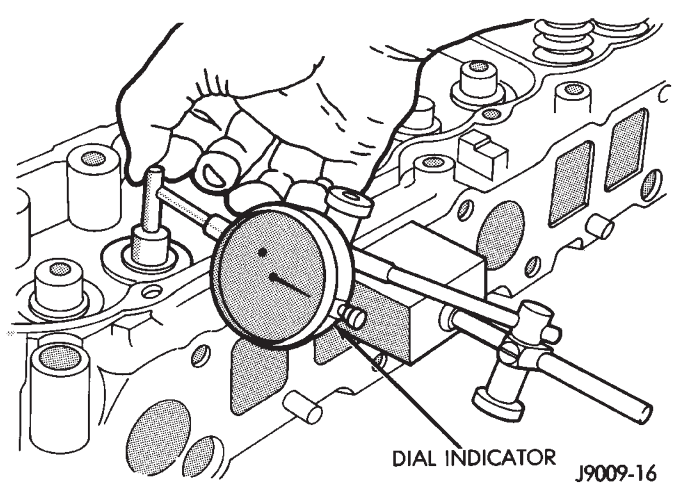


Fig. 70 Measurement of Lateral Movement Of Valve Stem

DISASSEMBLY AND ASSEMBLY (Continued)

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. 71).

Replace valve springs that are not within specifications.

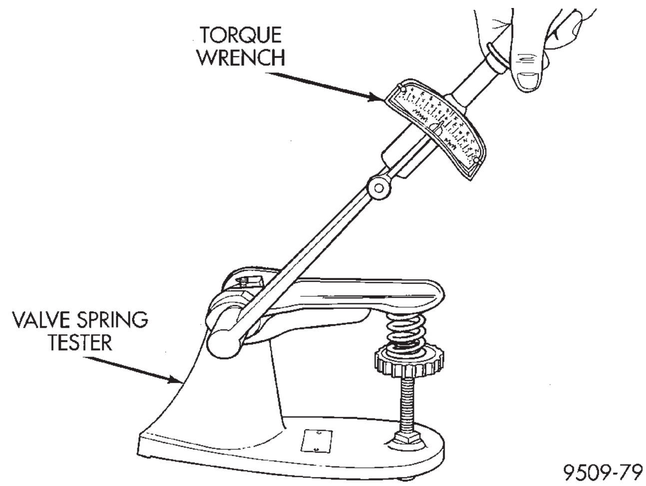


Fig. 71 Valve Spring Tester

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.

(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.

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.

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.

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. 72).

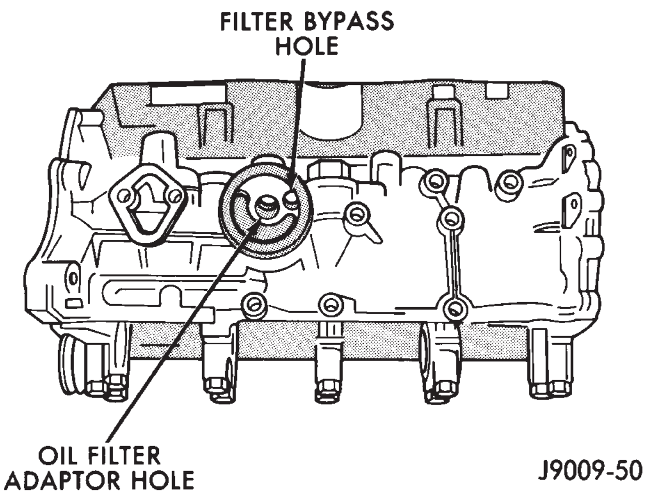


Fig. 72 Oil Filter Adaptor Hole

• The front and rear oil galley holes (Fig. 73) (Fig. 74).

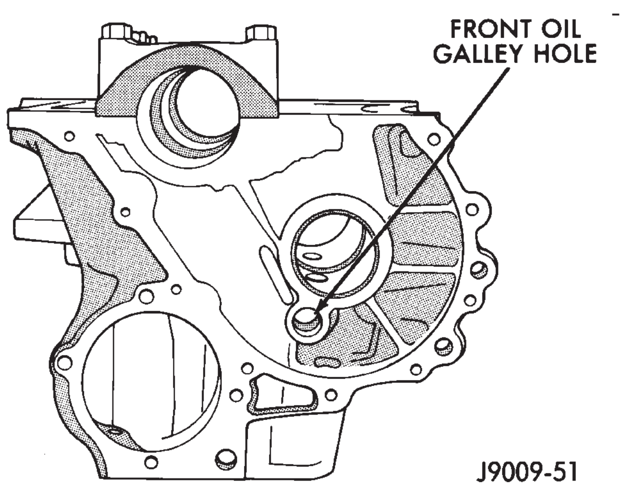


Fig. 73 Front Oil Galley Hole

• The feed holes for the crankshaft main bearings.

Once the block has been completely cleaned, apply Loctite PST pipe sealant with Teflon 592 to the threads of the front and rear oil galley plugs. Tighten the plugs to 41 N·m (30 ft. lbs.) torque.

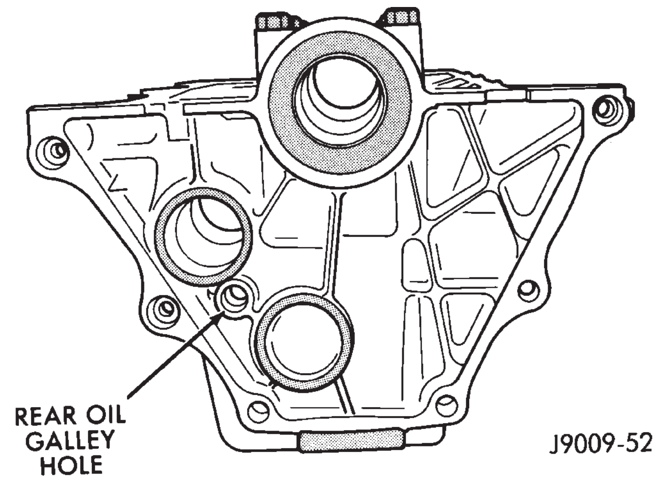


Fig. 74 Rear Oil Galley Hole

INSPECTION—CYLINDER BORE

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter (Fig. 75). 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.

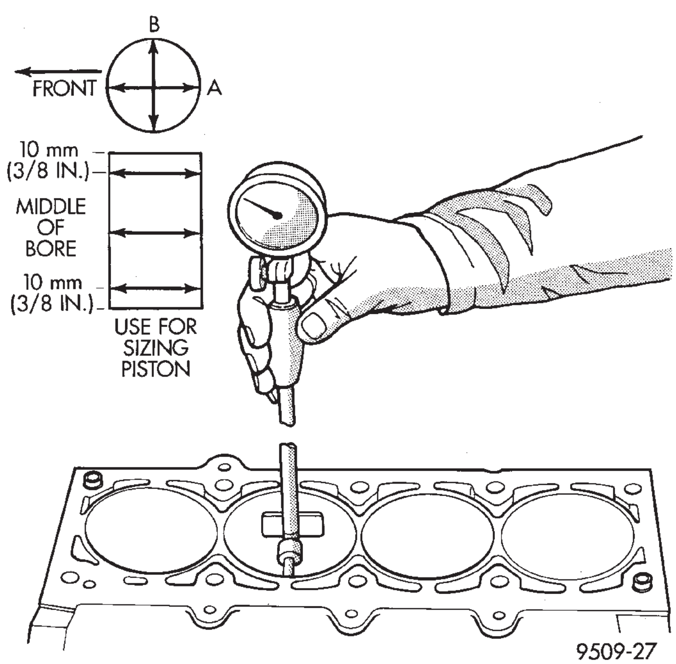


Fig. 75 Cylinder Bore Measurement

(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.

CLEANING AND INSPECTION (Continued)

(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

Engine Description

Engine Type . . . . In-line 4 Cylinder
Bore and Stroke . . . 98.4 x 81.0mm (3.88 x 3.19 in.)
Displacement . . . . 2.5L (150 cu. in.)
Compression Ratio 9.1:1
Firing Order 1–3–4–2
Lubrication . . . . Pressure Feed–Full Flow Filtration
Cooling System . . Liquid Cooled–Forced Circulation
Cylinder Block . . . . Cast Iron
Crankshaft . . . . Cast Nodular Iron
Cylinder Head . . . . Cast Iron
Camshaft . . . . Cast Iron
Pistons . . . . Aluminum Alloy
Cylinder Combustion Cavity . . . . . . Double Quench
Connecting Rods . . . . Cast Malleable Iron

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.)

SPECIFICATIONS (Continued)

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.)
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 . . . . 316 to 351 N @ 41.656 mm (71 to 79 lbf. @ 1.64 in.)
Spring Tension—Valve Open . . . . 898.6 to 969.7 N 30.89 mm (202 to 218 lbf @ 1.216 in.)
Inside Diameter . . . . 21.0 mm to 21.51 mm (0.827 to 0.847 in.)
Installed Height . . . . 41.656 mm (1.640 in.)

Pistons

Weight (Less Pin) . . . . 417 to 429 grams (14.7 to 15.1 oz.)
Piston Pin Bore (Centerline to Piston Top) . . . . . 40.61 to 40.72 mm (1.599 to 1.603 in.)
Piston-to-Bore Clearance . . . . . 0.018 to 0.038 mm (0.0008 to 0.0015 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 Ring #1 . . . . 88.39 to 88.65 mm (3.48 to 3.49 in.)

SPECIFICATIONS (Continued)

Piston Ring Groove Diameter—Compression Ring #2 . . . . 87.63 to 87.88 mm (3.45 to 3.4599 in.)
Piston Ring Groove Diameter—Oil Control Ring . . . . 89.66 to 89.92 mm (3.53 to 3.54 in.)
Piston Pin Bore Diameter . . 23.650 to 23.658 mm (0.9312 to 0.9315 in.)
Piston Pin Diameter . . . . . . 23.637 to 23.640 mm (0.9306 to 0.9307 in.)
Piston-to-Pin Clearance . . . . 0.0102 to 0.0208 mm (0.0005 to 0.0009 in.)
Piston-to-Pin Connecting Rod (Press Fit) . . 8.9 kN (2000 lbf.)

Piston Rings

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.)

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)

2.5L 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.)

Block Heater
Nut . . . . 1.8 N·m (16 in. lbs.)

DESCRIPTION **TORQUE**

Camshaft Sprocket
Bolt . . . . 108 N·m (80 ft. lbs.)

Clutch Cover to Flywheel
Bolts . . . . 31 N·m (23 ft. lbs.)

Connecting Rod Cap
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.)

Dipstick Tube Bracket to Cylinder Block
Bolt . . . . 19 N·m (168 in. lbs.)

Distributor Hold-Down Clamp
Bolt . . . . 23 N·m (204 in. lbs.)

Engine Mounts—Front
Insulator Bracket Bolts . . . . . . 81 N·m (60 ft. lbs.)
Insulator Bracket Nuts . . . . . . 47 N·m (35 ft. lbs.)
Insulator Thru-Bolt . . . . 81 N·m (60 ft. lbs.)

Engine Mounts—Rear
Support Cushion/Crossmember Nuts . . . . 22 N·m (192 in. lbs.)
Support Cushion/Bracket Nuts . . . . 46 N·m (34 ft. lbs.)
Transmission Support Bracket Bolts . . . . . 43 N·m (32 ft. lbs.)
Transmission Support Bracket/Cushion Bolt . . . . 75 N·m (55 ft. lbs.)
Transmission Support Adaptor Bracket Bolts . . . . 75 N·m (55 ft. lbs.)

Exhaust Manifold/Pipe
Nuts . . . . 27 N·m (20 ft. lbs.)

Flywheel/Converter Housing
Bolts . . . . 38 N·m (28 ft. lbs.)

Flywheel to Crankshaft
Bolts . . . . 143 N·m (105 ft. lbs.)

Front Cover to Block
Bolts 1/4–20 . . . . 7 N·m (60 in. lbs.)
Bolts 5/16–18 . . . . 22 N·m (192 in. 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 Cap
Bolts . . . . 108 N·m (80 ft. lbs.)

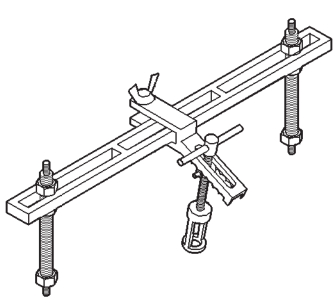
Oil Filter
Adaptor Bolt . . . . 102 N·m (75 ft. lbs.)
Connector . . . . 68 N·m (50 ft. lbs.)
Filter . . . . 18 N·m (13 ft. lbs.)

SPECIFICATIONS (Continued)

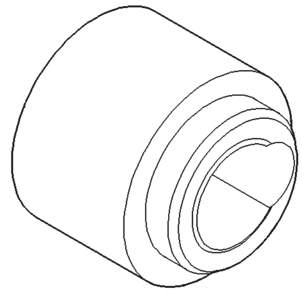
DESCRIPTION	TORQUE
Oil Galley	
Plug	41 N·m (30 ft. lbs.)
Oil Pan	
1/4–20 Bolts	9.5 N·m (84 in. lbs.)
5/16–18 Bolts	15 N·m (132 in. lbs.)
Drain Plug	34 N·m (25 ft. lbs.)
Oil Pressure Sending Unit	
Sending Unit	15 N·m (130 in. lbs.)
Oil Pump	
Short Attaching Bolts	23 N·m (204 in. lbs.)
Long Attaching Bolts	23 N·m (204 in. 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 (21 ft. lbs.)
Spark Plugs	
Plugs	37 N·m (27 ft. lbs.)
Starter Motor	
Mounting Bolts	45 N·m (33 ft. lbs.)
Tensioner Bracket ot Cylinder Block	
Bolts	19 N·m (168 in. lbs.)
Thermostat Housing	
Bolts	18 N·m (156 in. lbs.)
Throttle Body	
Bolts	10 N·m (90 in. lbs.)
Vibration Damper	
Bolt	108 N·m (80 ft. lbs.)
Water Pump to Block	
Bolts	31 N·m (23 ft. lbs.)

SPECIAL TOOLS

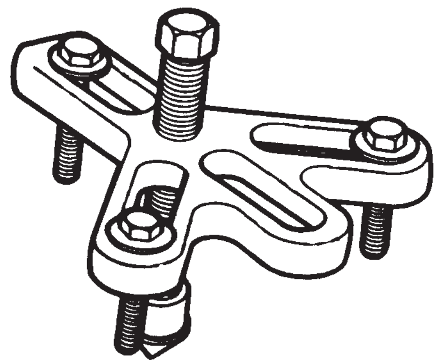
2.5L ENGINE



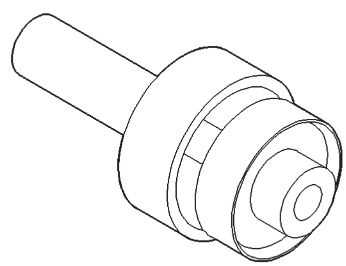
Valve Spring Compressor Tool MD-998772A



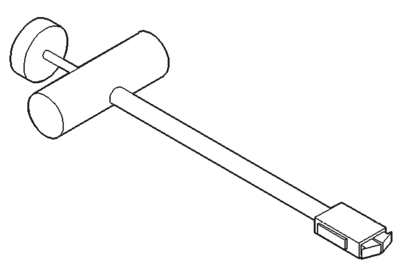
Timing Case Cover Alignment and Seal installation Tool 6139



Vibration Damper Removal Tool 7697



Rear Main Seal Installer Tool 6271A



Hydraulic Valve Tappet Removal/Installation Tool C-4129–A

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.

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).

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).

The digits of the code identify:

- 1st Digit—The year (8 = 1998).
- 2nd & 3rd Digits—The month (01 - 12).

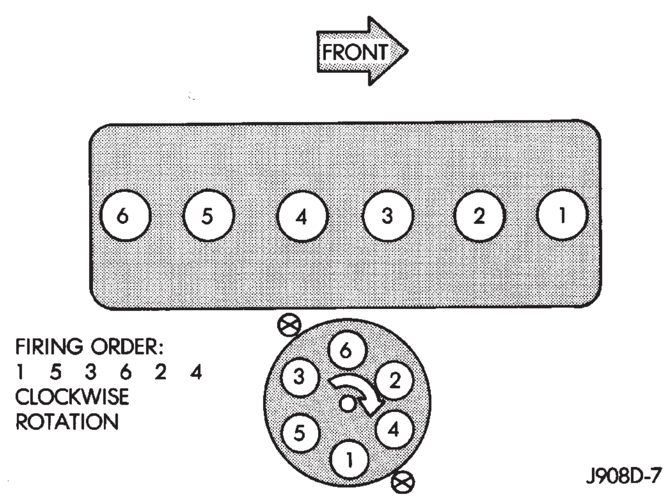


Fig. 1 Engine Firing Order

- 4th & 5th Digits—The engine type/fuel system/compression ratio (MX = A 4.0 Liter (242 CID) 8.7:1 compression ratio engine with a multi-point fuel injection system).
- 6th & 7th Digits—The day of engine build (01 - 31).

DESCRIPTION AND OPERATION (Continued)

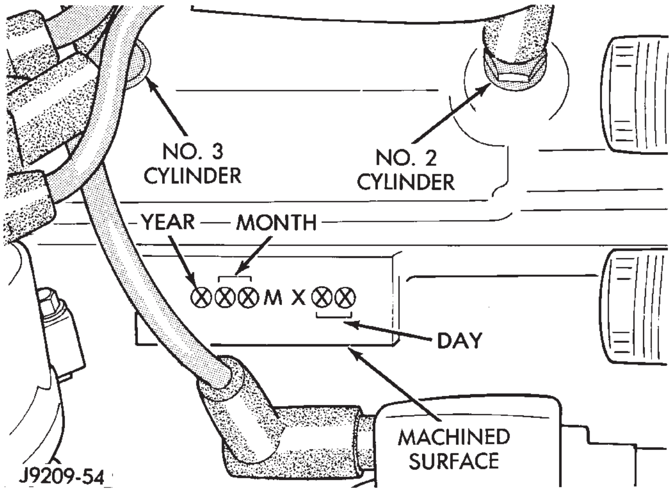


Fig. 2 Build Date Code Location

(1) **FOR EXAMPLE:** Code * 801MX12 * identifies a 4.0 Liter (242 CID) engine with a multi-point fuel injection system, 8.7:1 compression ratio and built on January 12, 1998.

LUBRICATION SYSTEM

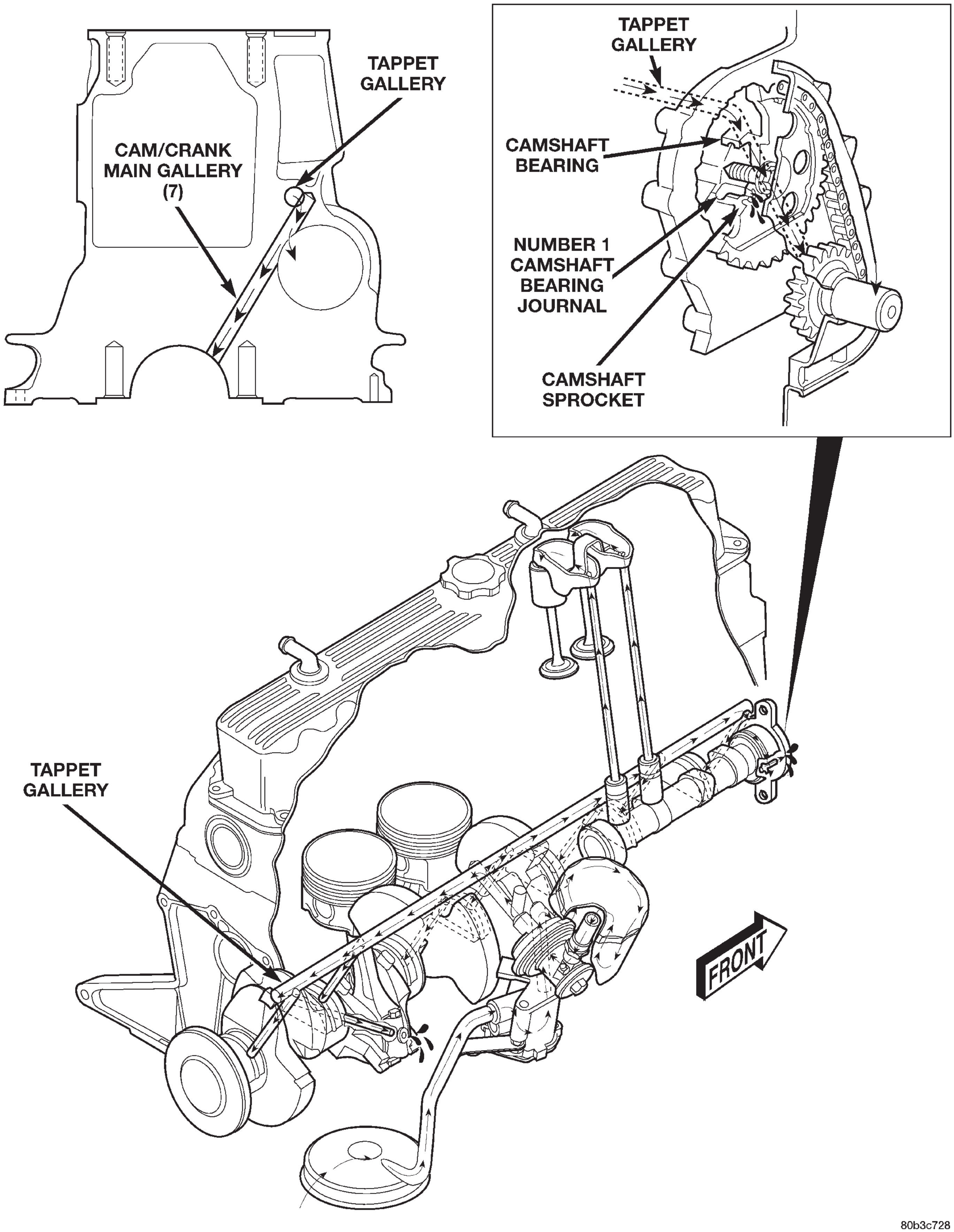
A gear—type positive displacement pump is mounted at the underside of the block opposite the No. 4 main bearing. The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and pump body, then forced through the outlet 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—4.0L Engine

DESCRIPTION AND OPERATION (Continued)

OIL PUMP PRESSURE

The MINIMUM oil pump pressure is 89.6 kPa (13 psi) at 600 rpm. The NORMAL oil pump pressure is 517 kPa (75 psi) at 1600 rpm or more.

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.

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. 4).

(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 (Fig. 3). 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.

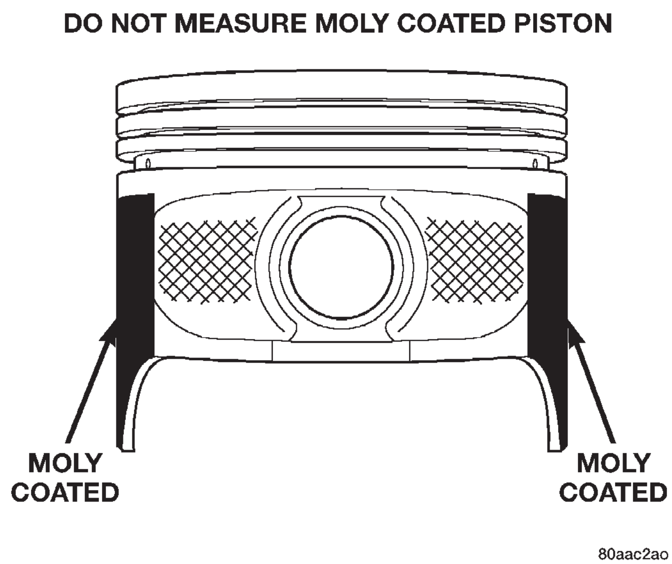


Fig. 3 Moly Coated Piston

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.

SERVICE PROCEDURES (Continued)

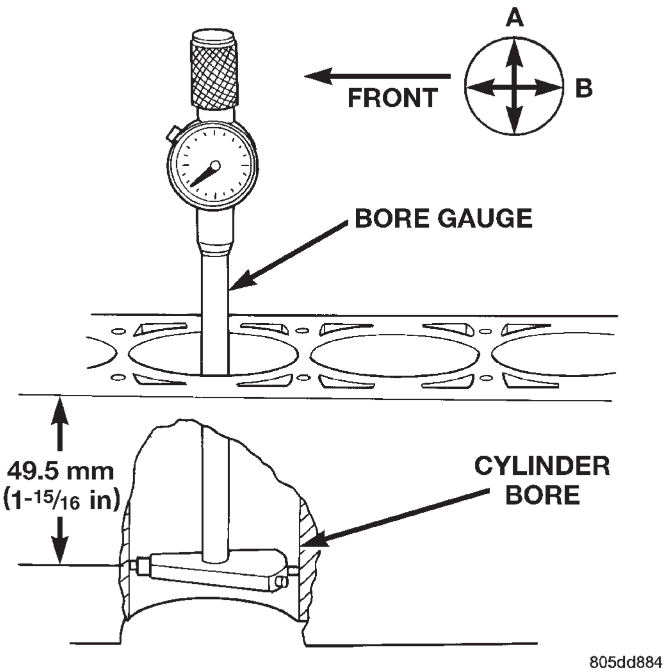


Fig. 4 Bore Gauge

(3) Measure the ring side clearance with a feeler gauge fitted snugly between the ring land and ring (Fig. 5) (Fig. 6). Rotate the ring in the groove. It must move freely around circumference of the groove.

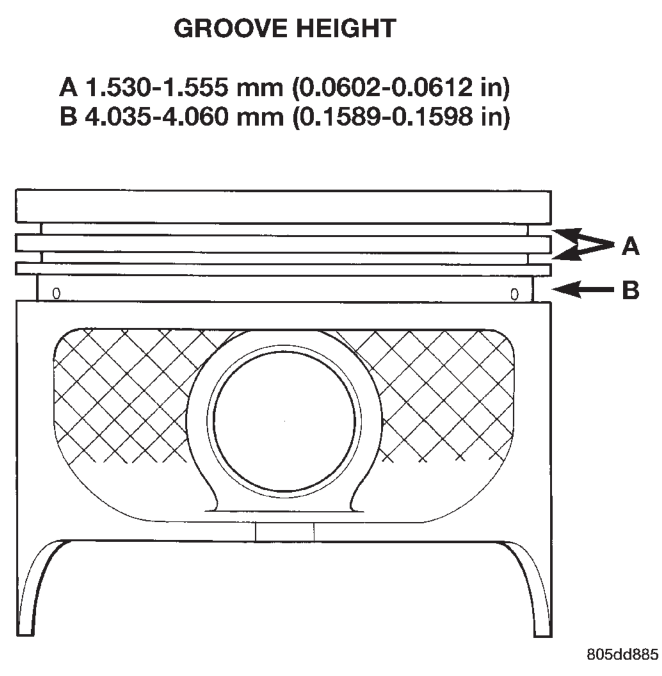


Fig. 5 Piston Dimensions

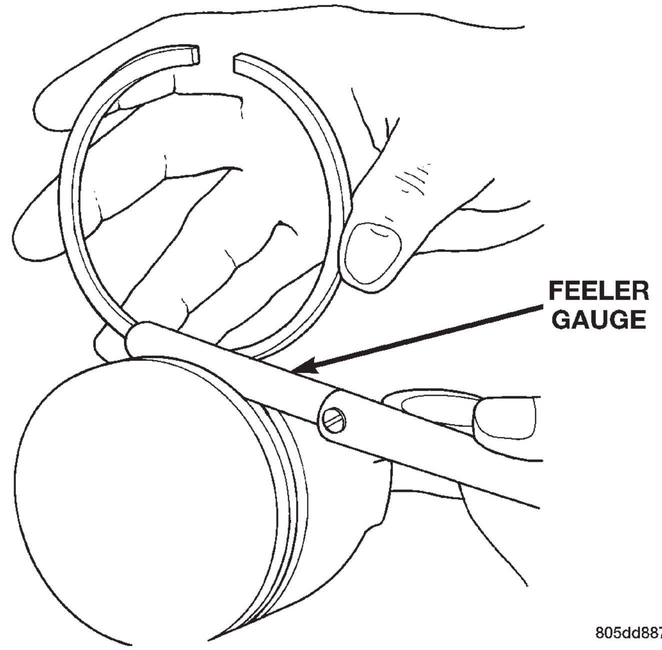


Fig. 6 Ring Side Clearance Measurement

Ring Side Clearance Measurement

Top Compression Ring . . . . 0.042 to 0.084 mm
(0.0017 to 0.0033 in.)
Second Compression Ring . . . . . . 0.042 to 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. 7).

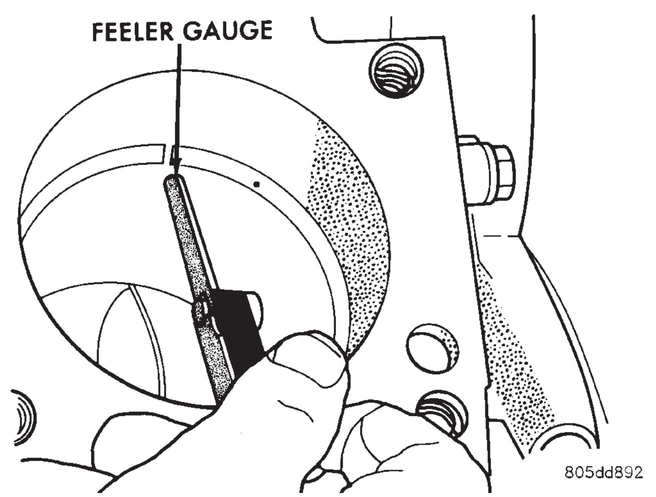


Fig. 7 Gap Measurement

SERVICE PROCEDURES (Continued)

Ring Gap Measurement

Top Compression Ring . . . . 0.229 to 0.610 mm (0.0090 to 0.0240 inch)

Second Compression 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)

(5) The oil control rings are symmetrical, and can be installed with either side 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 and can be installed with either side up (Fig. 8).

(7) The second compression ring has a slight chamfer on the bottom of the inside edge and a dot on the top for correct installation (Fig. 9).

(8) Using a ring installer, install the second compression ring with the dot facing up (Fig. 9) (Fig. 11).

(9) Using a ring installer, install the top compression ring (either side up).

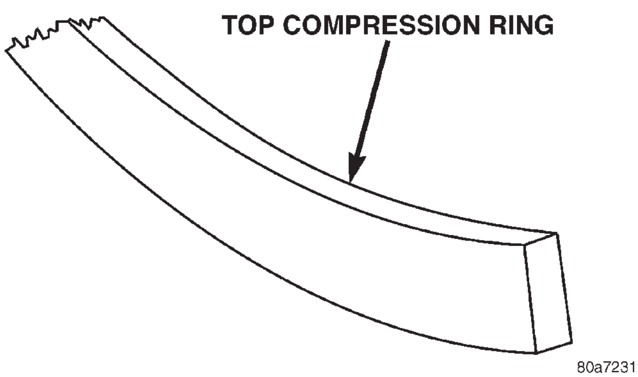


Fig. 8 Top Compression ring identification

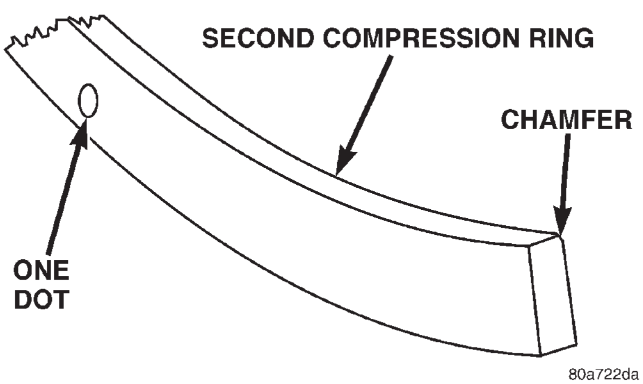


Fig. 9 Second Compression Ring Identification

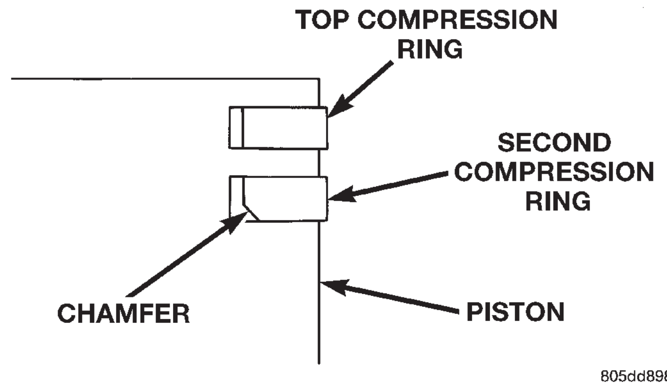


Fig. 10 Compression Ring Chamfer Location

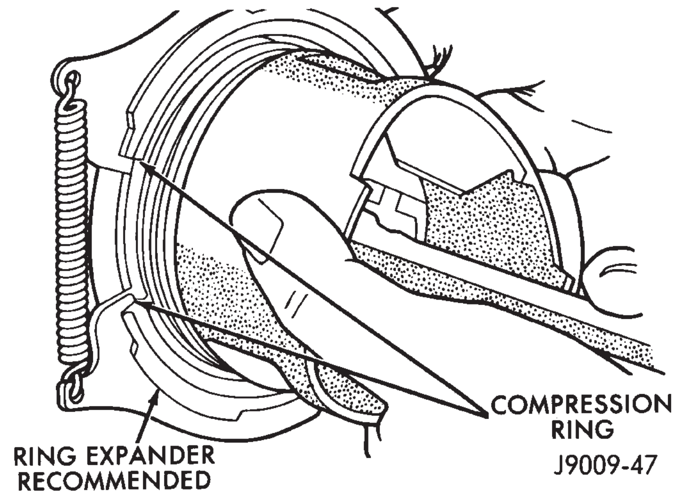


Fig. 11 Compression Ring Installation

Ring Gap Orientation

- Position the gaps on the piston as shown (Fig. 12).
- Oil spacer - Gap on center line of piston skirt.
- Oil rails - gap 180° apart on centerline of piston pin bore.
- No. 2 Compression ring - Gap 180° from top oil rail gap.
- No. 1 Compression ring - Gap 180° from No. 2 compression ring gap.

FITTING CONNECTING ROD BEARINGS

INSPECTION

BEARINGS

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 13) (Fig. 14). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 15). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

SERVICE PROCEDURES (Continued)

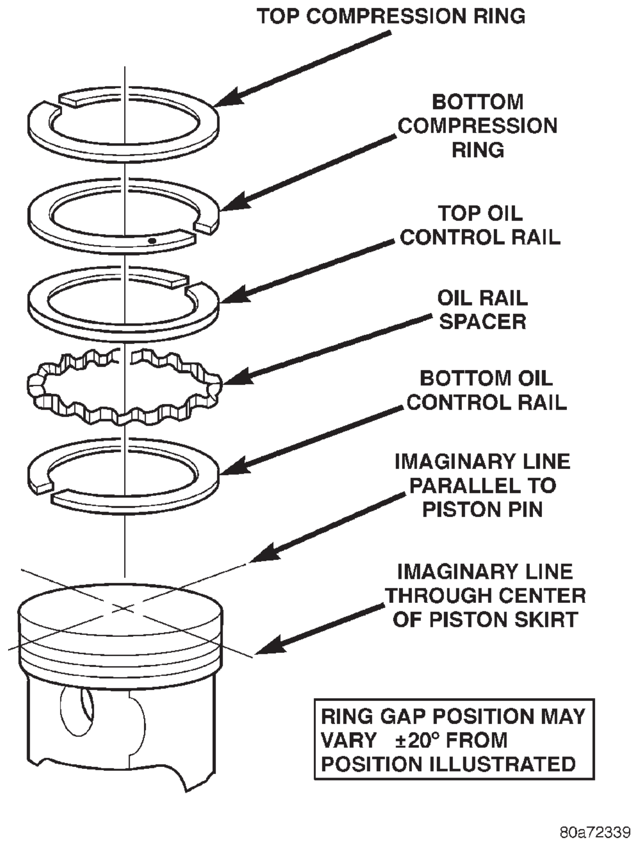


Fig. 12 Ring Gap Orientation

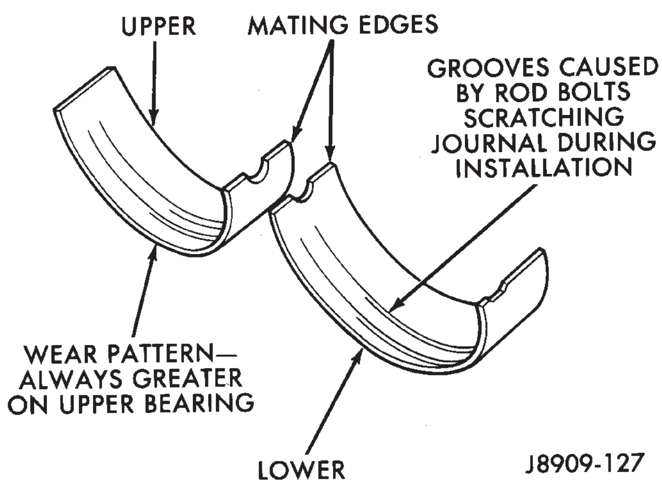


Fig. 13 Connecting Rod Bearing Inspection

CONNECTING RODS

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

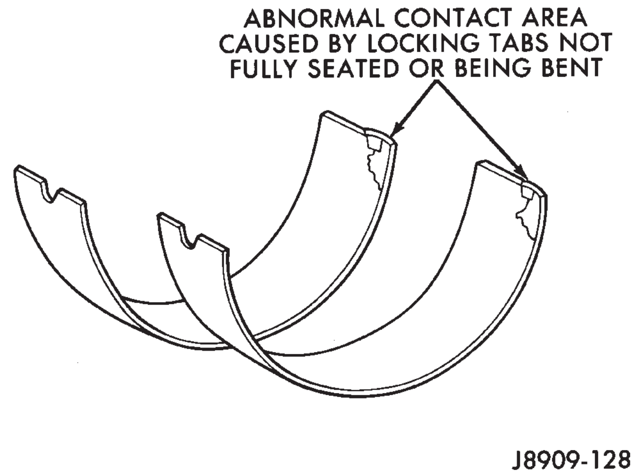


Fig. 14 Locking Tab Inspection

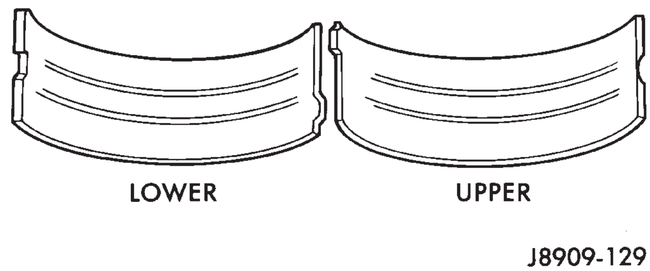


Fig. 15 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

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. 16). 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 compressed Plastigage (Fig. 17). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the**

SERVICE PROCEDURES (Continued)

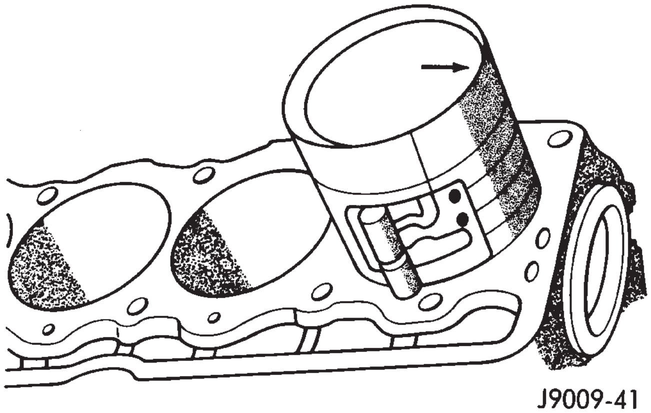


Fig. 16 Rod and Piston Assembly Installation

clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.

(8) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

(9) If bearing-to-journal clearance exceeds the specification, install a pair of 0.0254 mm (0.001 inch) undersize bearing inserts. All the odd size inserts must be on the bottom. The sizes of the service replacement bearing inserts are stamped on the backs of the inserts. Measure the clearance as described in the previous steps.

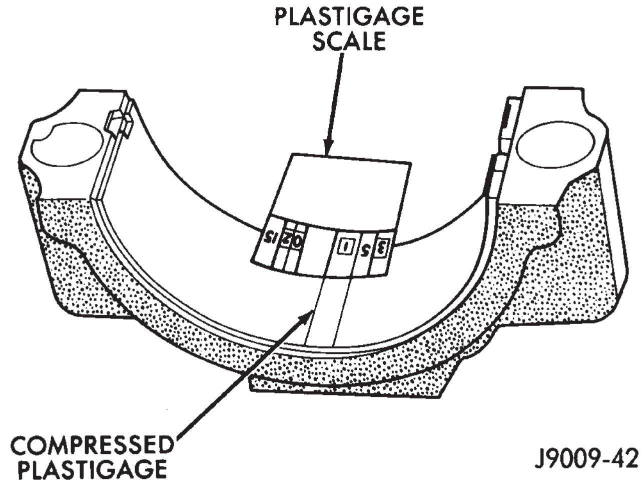


Fig. 17 Measuring Bearing Clearance with Plastigage

(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).

CONNECTING ROD BEARING FITTING CHART

CRANKSHAFT JOURNAL		CORRESPONDING 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.)

SERVICE PROCEDURES (Continued)

(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 (Fig. 18). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

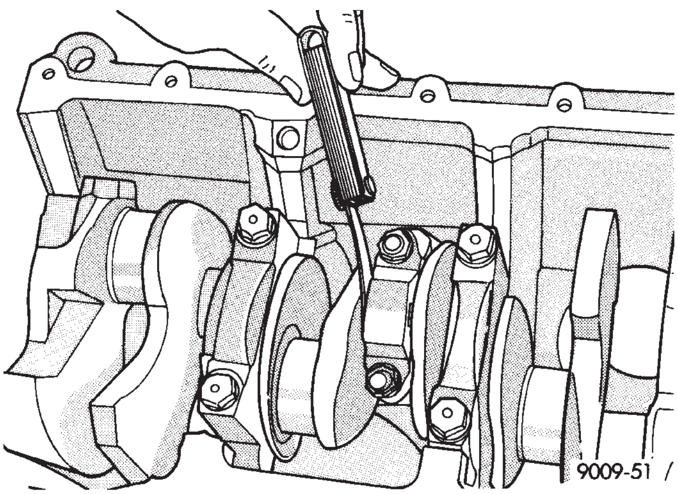


Fig. 18 Checking Connecting Rod Side Clearance—Typical

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. 19).

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.

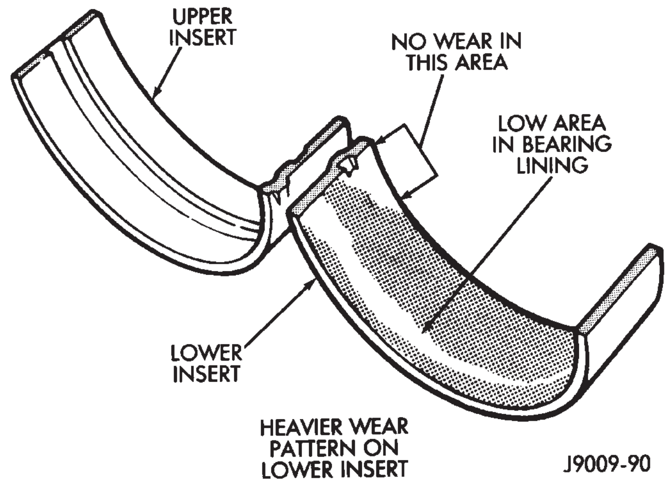


Fig. 19 Main Bearing Wear Patterns

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 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 (Fig. 20) on the adjacent cheek or counterweight towards the rear of the crankshaft (flange end). 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. 21).**

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.

SERVICE PROCEDURES (Continued)

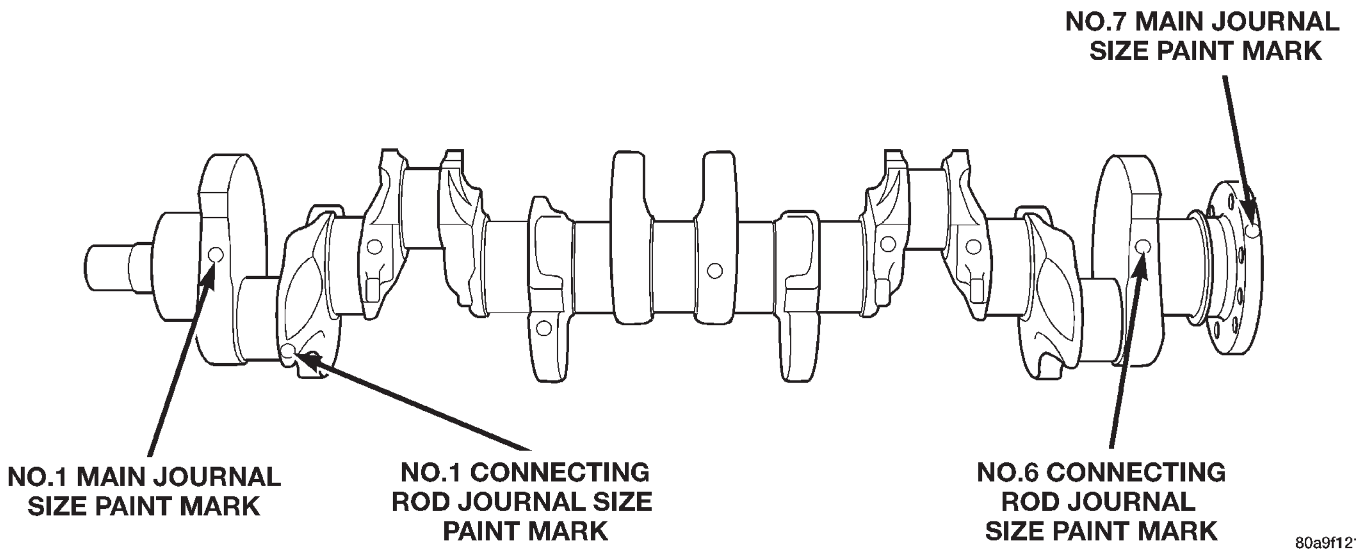


Fig. 20 Crankshaft Journal Size Paint I.D. Location

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.025 mm (0.001 in.) Undersize	0.051 mm (0.002 in.) Undersize

J9109-179

Fig. 21 Bearing Insert Pairs

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. 22). 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.

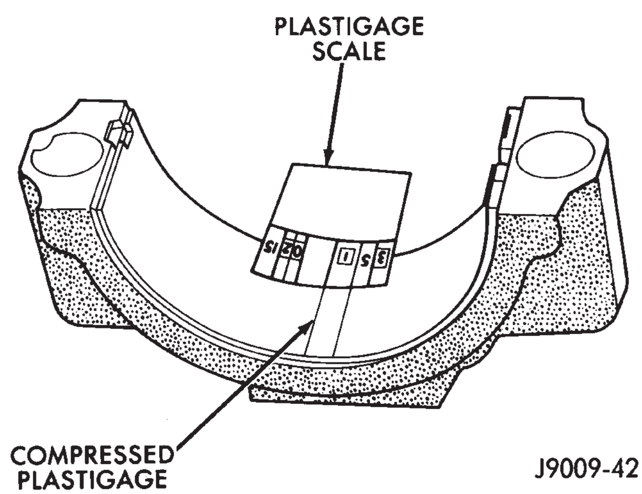


Fig. 22 Measuring Bearing Clearance with Plastigage

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 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

SERVICE PROCEDURES (Continued)

inch) and within the specification. A 0.051 mm (0.002 inch) undersize bearing insert and a 0.0254 mm (0.001 inch) undersize insert would reduce the original clearance an additional 0.0127 mm (0.0005 inch). The clearance would then be 0.0381 mm (0.0015 inch).

CAUTION: Never use a pair of inserts that differ more than one bearing size as a pair.

FOR EXAMPLE: DO NOT use a standard size upper insert and a 0.051 mm (0.002 inch) undersize lower insert.

If the clearance exceeds specification using a pair of 0.051 mm (0.002 inch) undersize bearing inserts, measure crankshaft journal diameter with a micrometer. If the journal diameter is correct, the crankshaft bore in the cylinder block may be misaligned, which requires cylinder block replacement or machining to true bore.

Replace the crankshaft or grind to accept the appropriate undersize bearing inserts if:

- Journal diameters 1 through 6 are less than 63.4517 mm (2.4981 inches)
- Journal 7 diameter is less than 63.4365 mm (2.4975 inches).

Once the proper clearances have been obtained, proceed to Crankshaft Main Bearing—Installation.

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Remove the crankshaft from the cylinder block (refer to Cylinder Block - Disassemble).

Clean the oil off the main bearing journal.

Determine the maximum diameter of the journal with a micrometer. Measure at two locations 90° apart at each end of the journal.

The maximum allowable taper and out of round is 0.013 mm (0.0005 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

Install the crankshaft into the cylinder block (refer to Cylinder Block - Assemble and Crankshaft Main Bearings - Installation).

SERVICE PROCEDURES (Continued)

MAIN BEARING FITTING CHART

Crankshaft Journals #1-6		Corresponding Crankshaft Bearing Insert	
Color Code	**Diameter**	**Upper Insert Size**	**Lower Insert Size**
Yellow	63.5025 -63.4898 mm (2.5001 - 2.4996 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4898 - 63.4771 mm (2.4996 - 2.4991 in.) 0.0127 mm (0.0015 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
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 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 (2.4996 - 2.4991 in.) 0.0127 mm (0.0005 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
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. 23). DO NOT remove the through bolt.
(5) Remove the retaining bolts and nuts from the support cushions (Fig. 23).
(6) Remove the through bolt.
(7) Remove the support cushions.

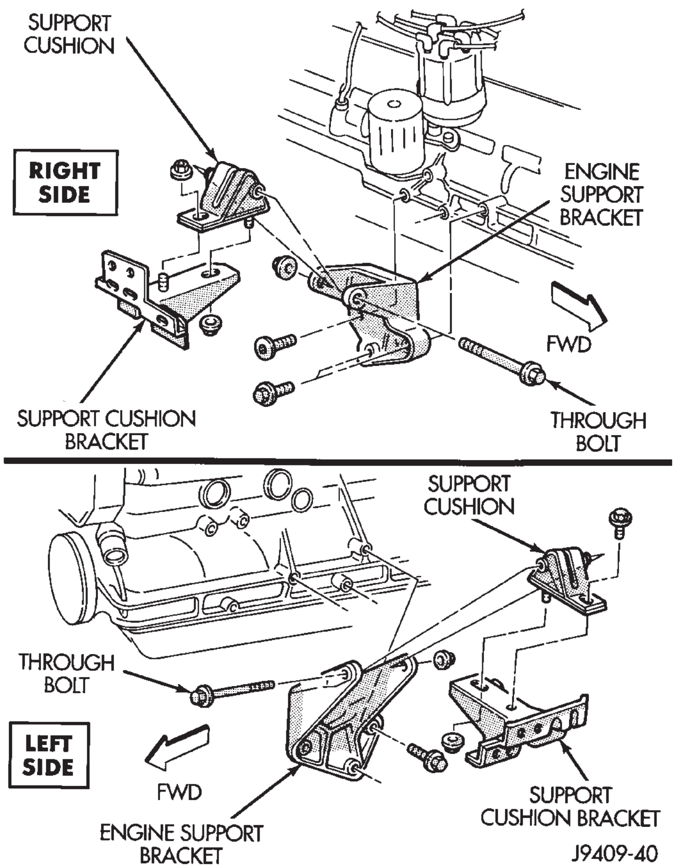


Fig. 23 Front Mounts

INSTALLATION

(1) If the engine support bracket was removed, position the bracket onto the block and install the attaching bolts (Fig. 23). Tighten the engine support bracket bolts to 61 N·m (45 ft. lbs.) torque.
(2) If the support cushion bracket was removed, position the bracket onto the lower front sill (Fig. 24). Install support cushion bracket bolts and nuts. Tighten the bolts to 54 N·m (40 ft. lbs.) torque. Tighten the nuts to 41 N·m (30 ft. lbs.) torque.

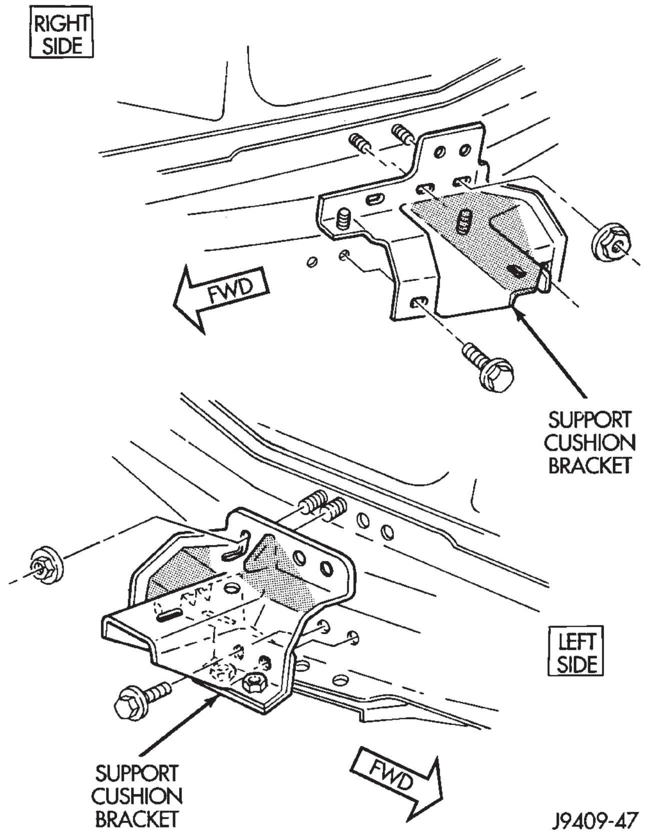


Fig. 24 Support Cushion Bracket

(3) Place the support cushion into position on the support cushion bracket (Fig. 23). Install and tighten the bolts and nuts to 41 N·m (30 ft. lbs.) torque.
(4) Install the through bolt and the retaining nut (Fig. 23). Tighten the through bolt nut to 65 N·m (48 ft. lbs.) torque.
(5) Remove the engine support.
(6) Lower the vehicle.
(7) Connect negative cable to battery.

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

(1) Disconnect negative cable from battery.
(2) Raise the vehicle and support the transmission.
(3) Remove the nuts holding the support cushion to the crossmember (Fig. 25) (Fig. 26). Remove the crossmember.

MANUAL TRANSMISSION

(Fig. 25)

REMOVAL AND INSTALLATION (Continued)

a. Remove the support cushion nuts and remove the cushion.

b. Remove the transmission support bracket bolts and remove the bracket from the transmission.

AUTOMATIC TRANSMISSION

(Fig. 26)

a. Remove the support cushion bolts and remove the cushion and the support bracket from the transmission (4WD) or from the adaptor bracket (2WD).

b. On 2WD vehicles, remove the bolts holding the transmission support adaptor bracket to the transmission (Fig. 26). Remove the adaptor bracket.

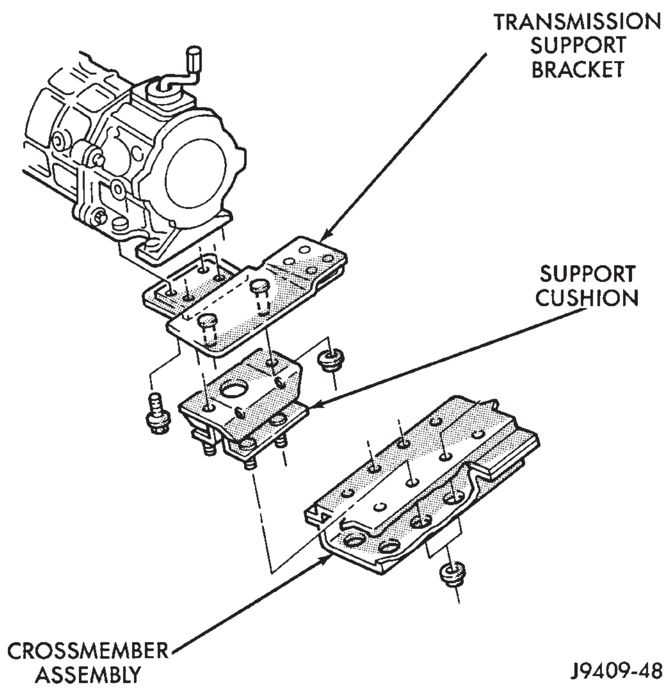


Fig. 25 Rear Mount (Manual Transmission)

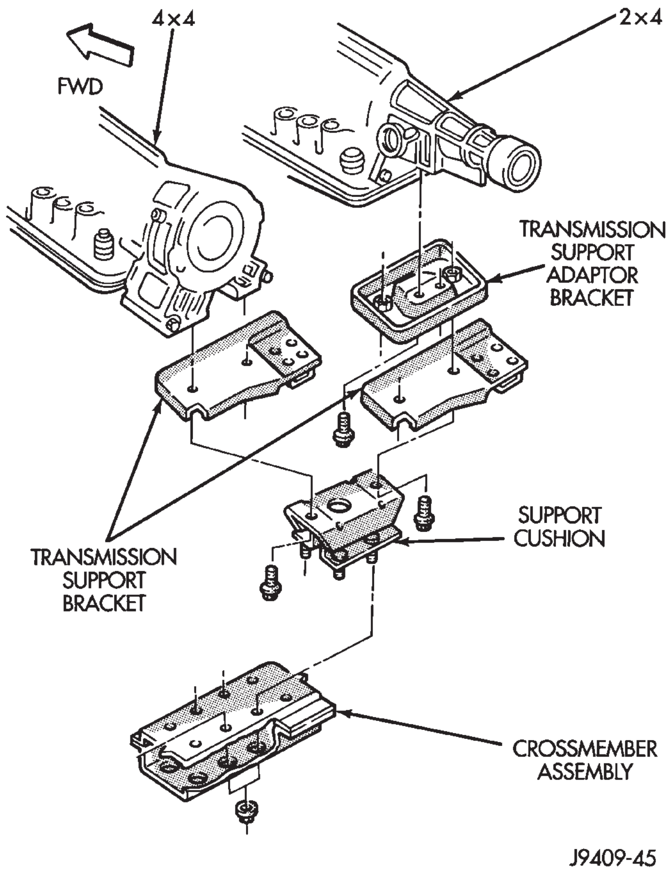


Fig. 26 Rear Mount (Automatic Transmission)

INSTALLATION

MANUAL TRANSMISSION:

a. Install the transmission support bracket to the transmission. Install the bolts and tighten to 46 N·m (34 ft. lbs.) torque.

b. Install the support cushion to the support bracket. Install the nuts and tighten to 75 N·m (55 ft. lbs.) torque.

AUTOMATIC TRANSMISSION:

a. On 2WD vehicles, position the transmission support adaptor bracket to the transmission. Install the bolts and tighten to 75 N·m (55 ft. lbs.) torque.

b. Position the transmission support bracket and support cushion to the adaptor bracket (2WD) or the transmission (4WD). Install the bolts and tighten to 75 N·m (55 ft. lbs.) torque.

(1) Position the crossmember onto the support cushion studs. Install the stud nuts and tighten to 22 N·m (192 in. lbs) torque.

(2) Install crossmember-to-sill bolts and tighten to 41 N·m (30 ft. lbs.) torque.

(3) Remove the transmission support.

(4) Lower the vehicle.

(5) Connect negative cable to battery.

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect the battery cables. Remove the battery.

(2) Mark the hinge locations on the hood panel for alignment reference during installation. Remove the engine compartment lamp. Remove the hood.

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. USE CARE TO PREVENT SCALDING BY HOT COOLANT. CAREFULLY RELEASE THE PRESSURE BEFORE REMOVING THE RADIATOR DRAIN COCK AND CAP.

(3) Remove the air cleaner assembly.

(4) Loosen the radiator drain cock and radiator cap to drain the coolant. DO NOT waste usable coolant.

REMOVAL AND INSTALLATION (Continued)

If the solution is clean, drain the coolant into a clean container for reuse.

(5) Remove the lower radiator hose.

(6) Remove the upper radiator hose and coolant recovery hose (Fig. 27).

(7) Remove upper radiator support retaining bolts and remove radiator support.

(8) Remove the fan shroud (Fig. 27) and electric cooling fan.

(9) Disconnect the transmission fluid cooler tubing (automatic transmission).

(10) Disconnect radiator fan switch wire connector.

(11) **Vehicles with Air Conditioning:**

(a) Discharge A/C system (refer to group 24, Heating and Air Conditioning for proper procedures)

(b) Disconnect the suction/discharge hose and cap off compressor ports to prevent foreign material and refrigerant oil loss.

(12) Remove the radiator or radiator and condenser (if equipped with A/C).

(13) Remove the fan assembly from the idler pulley.

(14) Disconnect the heater hoses at the engine thermostat housing and water pump (Fig. 27) (Fig. 28).

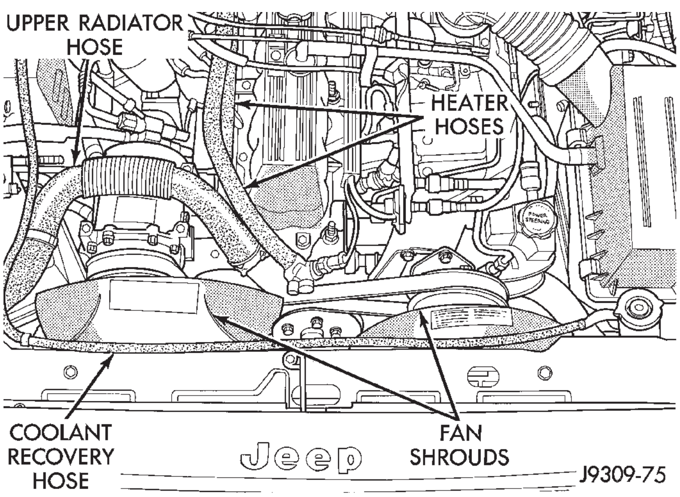


Fig. 27 Upper Radiator Hose, Coolant Recovery Hose, Fan Shroud & Heater hoses

(15) Disconnect the throttle cable.

(16) Disconnect the speed control cable (if equipped).

(17) Disconnect the line pressure cable (if equipped with automatic transmission).

(18) Disconnect the fuel injector harness at the injectors.

(19) Disconnect the distributor electrical connection and the oil pressure switch connector.

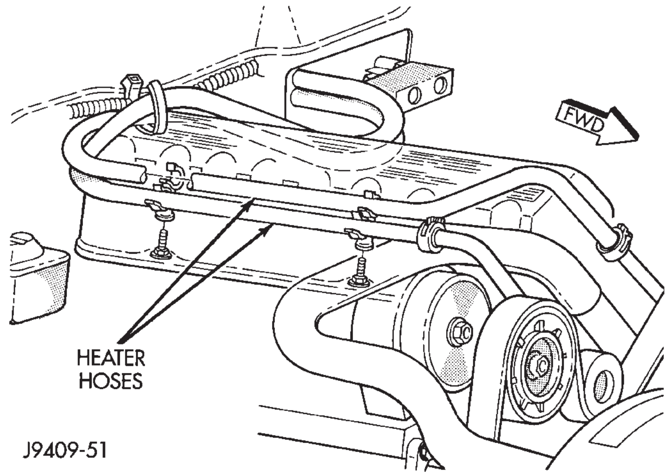


Fig. 28 Heater Hoses (RH Drive Vehicle)

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE TURNED OFF). BEFORE DISCONNECTING FUEL LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

(20) Perform the Fuel System Pressure Release procedure (refer to Group 14, Fuel System).

(21) Remove the latch clip and disconnect fuel supply line.

(22) Remove the power brake vacuum check valve from the booster, if equipped.

(23) 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.

(24) Identify, tag and disconnect all necessary wire connectors and vacuum hoses.

(25) Raise and support the vehicle.

(26) Disconnect the wires from the starter motor solenoid.

(27) Remove the starter motor.

(28) Disconnect the exhaust pipe from the manifold.

(29) Disconnect the engine speed sensor wire connection.

(30) Remove the exhaust pipe support.

(31) Remove the flywheel and converter housing access cover.

(32) **Vehicles with Automatic Transmission:**

(a) Mark the converter and drive plate location.

(b) Remove the converter-to-drive plate bolts.

(33) Remove the upper flywheel and converter housing bolts and loosen the bottom bolts.

(34) Remove the engine mount cushion-to-engine compartment bracket bolts.

REMOVAL AND INSTALLATION (Continued)

(35) Lower the vehicle.

(36) Attach a lifting device to the engine.

(37) Raise the engine off the front supports.

(38) Place a support or floor jack under the converter (or flywheel) housing.

(39) Remove the remaining converter (or flywheel) housing bolts.

(40) Lift the engine out of the engine compartment.

INSTALLATION

CAUTION: When installing the engine into a vehicle equipped with an automatic transmission, be careful not to damage the trigger wheel on the flywheel.

(1) Attach a lifting device to the engine and lower the engine into the engine compartment. For easier installation, it may be necessary to remove the engine mount cushions from the engine mount bracket as an aide in alignment of the engine to the transmission.

(2) **Vehicles with Manual Transmission:**

(a) Insert the transmission shaft into the clutch spline.

(b) Align the flywheel housing with the engine.

(c) Install and tighten the flywheel housing lower bolts finger tight.

(3) **Vehicles with Automatic Transmission:**

(a) Align the transmission torque converter housing with the engine.

(b) Loosely install the converter housing lower bolts and install the next higher bolt and nut on each side.

(c) Tighten all 4 bolts finger tight.

(4) Install the engine mount cushions (if removed).

(5) Lower the engine and engine mount cushions onto the engine compartment brackets. Install the bolts and finger tighten the nuts.

(6) Remove the engine lifting device.

(7) Raise and support the vehicle.

(8) Install the remaining flywheel and converter housing bolts. Tighten all bolts to 38 N·m (28 ft. lbs.) torque.

(9) **Vehicles with Automatic Transmission:**

(a) Install the converter-to-drive plate bolts.

(b) Ensure the installation reference marks are aligned.

(10) Install the flywheel and converter housing access cover.

(11) Install the exhaust pipe support and tighten the screw.

(12) Tighten the engine mount-to-bracket bolts.

(13) Connect the engine speed sensor wire connections and tighten the screws.

(14) Connect the exhaust pipe to the manifold.

(15) Install the starter motor and connect the cable.

(16) Connect the wires to the starter motor solenoid.

(17) Lower the vehicle.

(18) Connect all the vacuum hoses and wire connectors identified during engine removal.

(19) **Vehicles with Power Steering:**

(a) Remove the protective caps.

(b) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.

(c) Fill the pump reservoir with fluid.

(20) Install the power brake vacuum check valve to the booster, if equipped.

(21) Connect the fuel supply hose the fuel rail. Push until a “click” is heard. Install latch clip.

(22) Connect the fuel injector harness to the injectors.

(23) Connect the distributor electrical connector and oil pressure switch connector.

(24) Connect the line pressure cable (if equipped with automatic transmission).

(25) Connect the speed control cable, if equipped.

(26) Connect the throttle cable.

(27) Connect the heater hoses at the engine thermostat housing and water pump.

(28) Install the fan assembly to the idler pulley.

(29) Connect the suction/discharge hose to the compressor.

(30) Connect automatic transmission fluid cooler lines, if equipped.

(31) Install the fan shroud, electric cooling fan and radiator and condenser (if equipped with A/C).

(32) Connect the electric fan connector.

(33) Install upper radiator support.

(34) Connect the upper radiator hose.

(35) Connect the lower radiator hose.

(36) Align the hood to the scribe marks. Install the hood.

(37) Install the air cleaner assembly.

(38) Install the battery and connect the battery cable.

(39) Add the proper amount of engine oil and coolant.

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.

(40) Start the engine, inspect for leaks and correct the fluid levels, as necessary.

(41) Charge the air conditioning system (refer to Group 24, Heating and Air Conditioning for proper procedures).

REMOVAL AND INSTALLATION (Continued)

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 the crankcase ventilation (CCV) vacuum hose and manifold absolute pressure (MAP) sensor vacuum hose connector at the intake manifold.

(6) Disconnect vacuum hose from vacuum port on the intake manifold.

(7) Disconnect CCV hose at the cylinder head cover (Fig. 29).

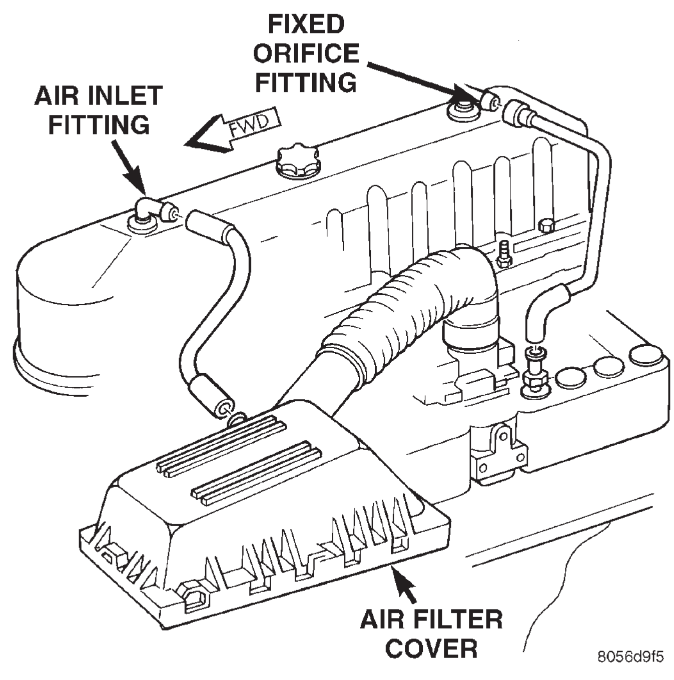


Fig. 29 Crankcase Ventilation (CCV) Hose —4.0L Engine

(8) Perform fuel system pressure release procedure (refer to Group 14, Fuel System for correct procedure).

(9) Remove fuel supply line latch clip at injector rail.

(10) Disconnect fuel supply tube from the fuel rail. Some fuel lines require a special tool for removal/installation (refer to Group 14, Fuel System - Quick Connect Fittings).

(11) Disconnect all electrical connectors on the intake manifold.

- The throttle position sensor.
- The idle air control motor.
- The coolant temperature sensor at the thermostat.
- The manifold air temperature sensor at the intake manifold.
- The fuel injectors.
- The oxygen sensor.

(12) Loosen the accessory drive belt tension and remove the belt from the power steering pump (refer to Group 07, Cooling Systems for proper procedures).

(13) Remove the power steering pump and bracket from the intake manifold and water pump and set aside.

(14) Raise the vehicle.

(15) Disconnect the exhaust pipe from the engine exhaust manifold. Discard the seal.

(16) Lower the vehicle.

(17) 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 reinstalled.

(1) If the manifold is being replaced, ensure all the sensors, fittings, etc. are transferred to the replacement manifold.

(2) Install a new exhaust/intake manifold gasket over the alignment dowels on the cylinder head.

(3) Position the engine exhaust manifold to the cylinder head. Install fastener No.3 and finger tighten at this time (Fig. 30).

(4) Install intake manifold on the cylinder head dowels.

(5) Install washers and fasteners Nos.1, 2, 4, 5, 8, 9, 10 and 11 (Fig. 30).

(6) Install washers and fasteners Nos.6 and 7 (Fig. 30).

(7) Tighten the fasteners in sequence and to the specified torque (Fig. 30).

- 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.

(8) Install the power steering pump and bracket to the intake manifold and water pump. Tighten the belt to specification (Refer to Group 7, Cooling System for the proper procedures).

(9) Connect fuel supply tube to the fuel rail inlet. Push tube until a “click” is heard. **Before connect-**

REMOVAL AND INSTALLATION (Continued)

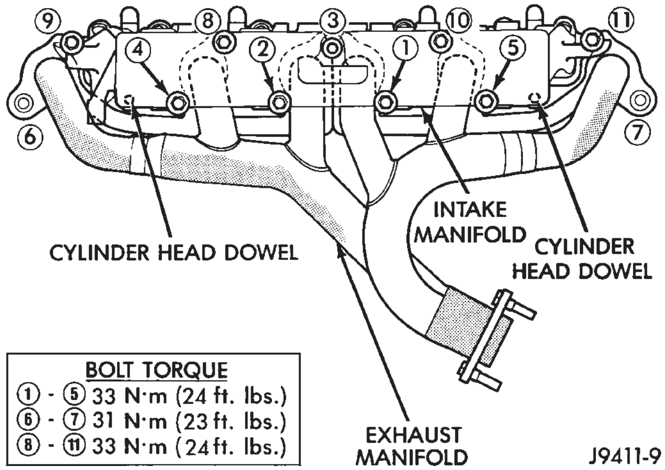


Fig. 30 Intake/Engine Exhaust Manifold Installation (4.0L Engine)

ing the fuel line to the fuel rail replace the O-rings at the quick-connect fuel line coupling.

(10) Pull out on the fuel supply tube to ensure that it is locked in place.

(11) Replace latch clip.

(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—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.

CYLINDER HEAD COVER

The cylinder head cover is isolated from the cylinder head via grommets and a reusable molded rubber gasket. The grommet and limiter are retained in the cylinder head cover.

There are two cylinder head bolts that have a pin to locate the cylinder head cover gasket, they are located at position 8 and 9 (Fig. 32).

REMOVAL

(1) Disconnect negative cable from battery.

(2) Disconnect the Crankcase Ventilation (CCV) vacuum hose from engine cylinder head cover.

(3) Disconnect the fresh air inlet hose from the engine cylinder head cover.

(4) Disconnect the accelerator, transmission, and speed (if equipped) control cables from the throttle body (Fig. 31).

(5) Remove the three bolts that fasten the control cable bracket to the intake manifold.

(6) Remove control cables from cylinder head cover clip.

(7) Position control cables and bracket away from cylinder head cover secure with tie straps.

(8) Remove the engine cylinder head cover mounting bolts.

(9) Remove the engine cylinder head cover and gasket.

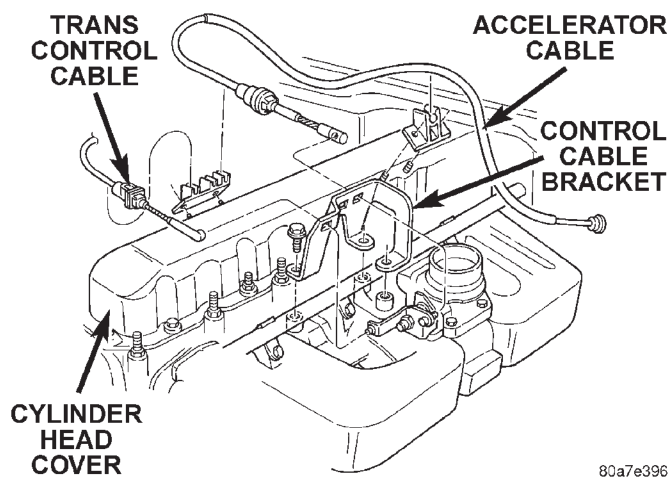


Fig. 31 Engine Cylinder Head Cover

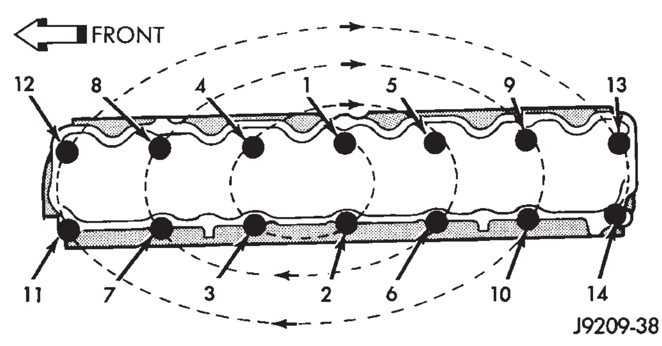


Fig. 32 Cylinder Head Cover Gasket Locator Pins at #8 & #9

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) If a replacement cover is installed, transfer the CCV valve grommet and oil filler cap from the original cover to the replacement cover.

(2) Install cylinder head cover and gasket. Tighten the mounting bolts to 10 N·m (85 in. lbs.) torque.

(3) Connect the CCV hoses.

(4) Install control cables and bracket on intake manifold and tighten bolts to 8.7 N·m (77 in. lbs.) torque.

(5) Connect control cables to throttle body linkage.

(6) Snap control cables into cylinder head cover clip.

(7) 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) Check for rocker arm bridges which are causing misalignment of the rocker arm to valve tip area.

(3) Remove the capscrews at each bridge and pivot assembly (Fig. 33). Alternately loosen the capscrews one turn at a time to avoid damaging the bridges.

(4) Remove the bridges, pivots and corresponding pairs of rocker arms (Fig. 33). 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.

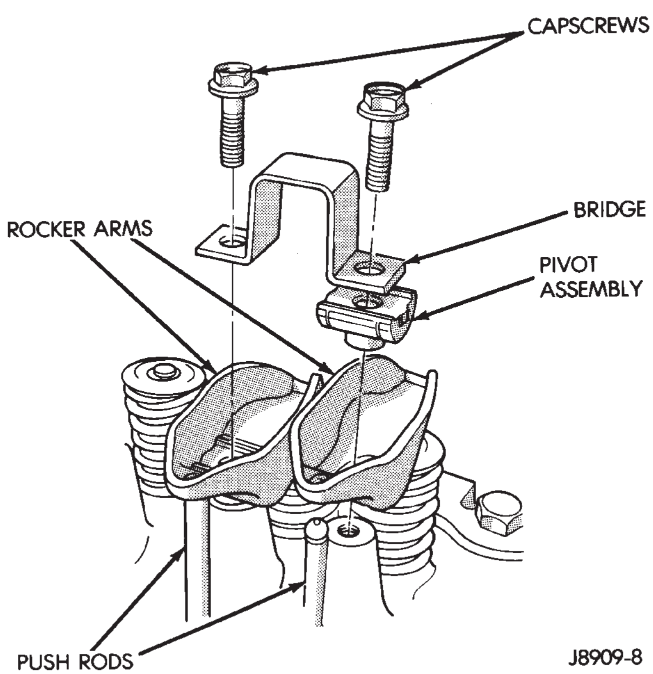


Fig. 33 Rocker Arm Assembly

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.

VALVE SPRINGS AND OIL SEALS

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 cap screws, 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. 34).

(8) Remove valve spring and retainer (Fig. 34).

(9) Remove valve stem oil seals (Fig. 34). Note the valve seals are different for intake and exhaust valves. The top of each seal is marked either INT (intake/black in color) or EXH (exhaust/brown in color). DO NOT mix the seals.

REMOVAL AND INSTALLATION (Continued)

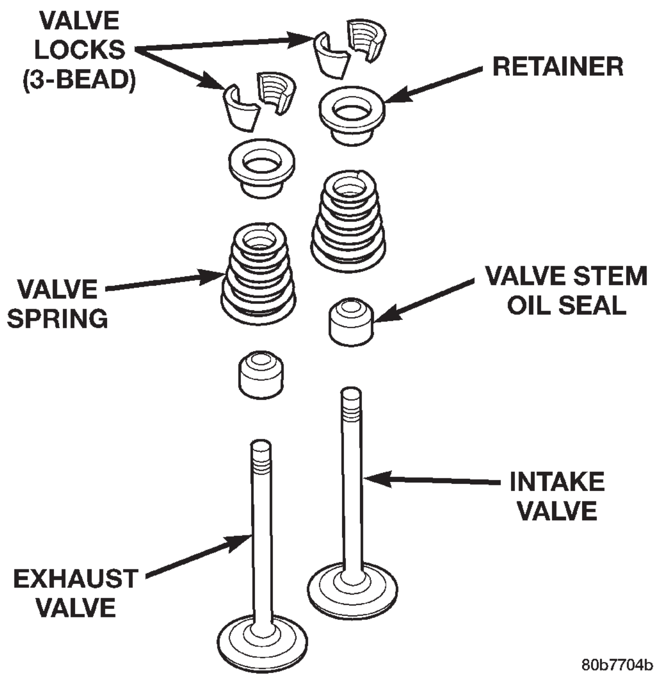


Fig. 34 Valve and Valve Components

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) Release air pressure and 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 cap screws alternately, one at a time, to avoid damaging the bridge. Tighten the cap screws to 28 N·m (21 ft. lbs.) torque.

(9) Install the engine cylinder head cover.

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 and gasket.

(5) Remove the capscrews, bridge and pivot assemblies and rocker arms.

(6) Remove the push rod. **Retain the push rods, bridges, pivots and rocker arms in the same order as removed.**

(7) Loosen the serpentine drive belt at the power steering pump, if equipped or at the idler pulley (refer to Group 7, Cooling System for the proper procedure).

(8) If equipped with air conditioning, perform the following:

(a) Remove the bolts from the A/C compressor mounting bracket and set the compressor aside.

(b) Remove the air conditioner compressor bracket bolts from the engine cylinder head.

(c) Loosen the through bolt at the bottom of the bracket.

(9) If equipped, disconnect the power steering pump bracket. Set the pump and bracket aside. DO NOT disconnect the hoses.

(10) 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) Remove the ignition coil and bracket assembly.

(15) Remove the engine cylinder head bolts. Bolt No.14 cannot be removed until the head is moved forward (Fig. 35). Pull bolt No.14 out as far as it will go

REMOVAL AND INSTALLATION (Continued)

and then suspend the bolt in this position (tape around the bolt).

(16) Remove the engine cylinder head and gasket (Fig. 35).

(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.

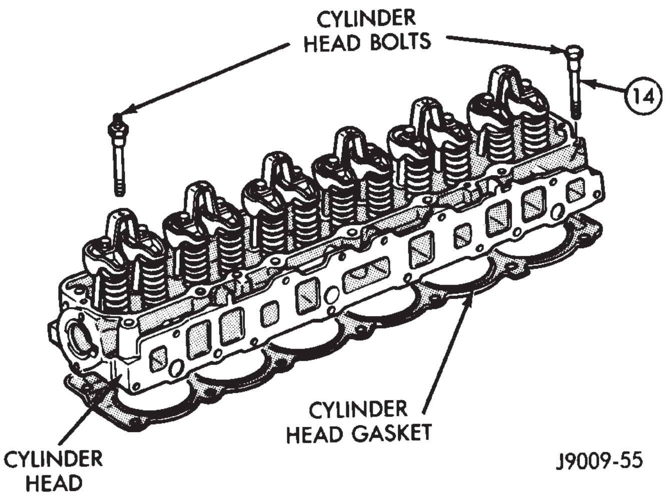


Fig. 35 Engine Cylinder Head Assembly

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) onto the cylinder block.

CAUTION: Engine cylinder head bolts should be reused only once. Replace the head bolts if they were used before or if they have a paint dab on the top of the bolt.

(3) With bolt No.14 held in place (tape around bolt), install the engine cylinder head. Remove the tape from bolt No.14.

(4) Coat the threads of stud bolt No.11 with Loctite 592 sealant, or equivalent.

(5) Tighten the engine cylinder head bolts in sequence according to the following procedure (Fig. 36).

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.

(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.

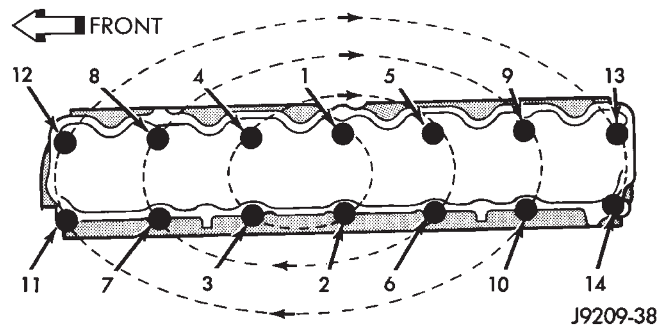


Fig. 36 Engine Cylinder Head Bolt Tightening Sequence

(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).

REMOVAL AND INSTALLATION (Continued)

(13) Install the engine cylinder head cover and gasket.

(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) Connect the fuel line.

(22) Connect negative cable to battery.

(23) Connect the upper radiator hose and heater hose at the engine thermostat housing.

(24) 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.

(25) 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.

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 (Refer to cylinder head r&i in this section).

(2) Remove the push rods.

(3) Remove the tappets through the push rod openings in the cylinder block with a Hydraulic Valve Tappet Removal/Installation Tool (Fig. 37).

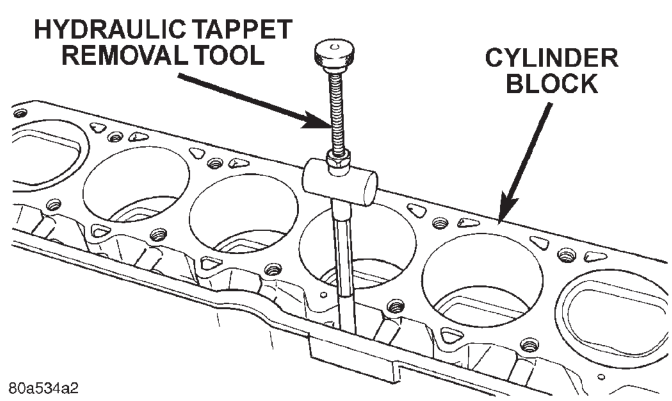


Fig. 37 Hydraulic Valve Tappet Removal—Installation Tool

REMOVAL AND INSTALLATION (Continued)

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 cylinder head assy (Refer to cylinder head r&i in this section).

(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. 38).

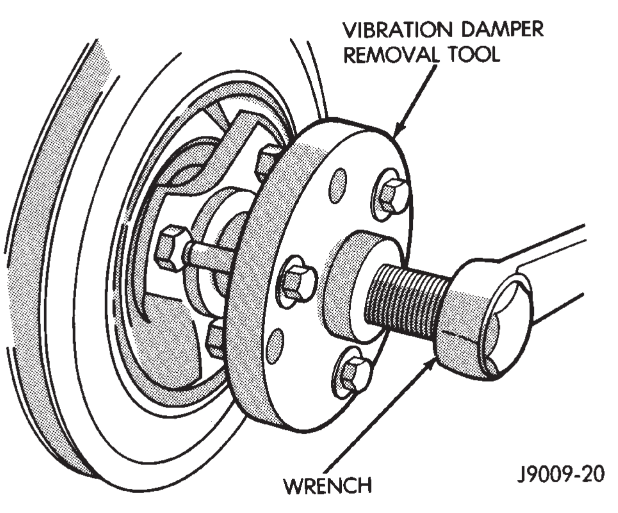


Fig. 38 Vibration Damper Removal Tool 7697

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 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

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.

(8) Pry the crankshaft oil seal from the front of the timing case cover (Fig. 39).

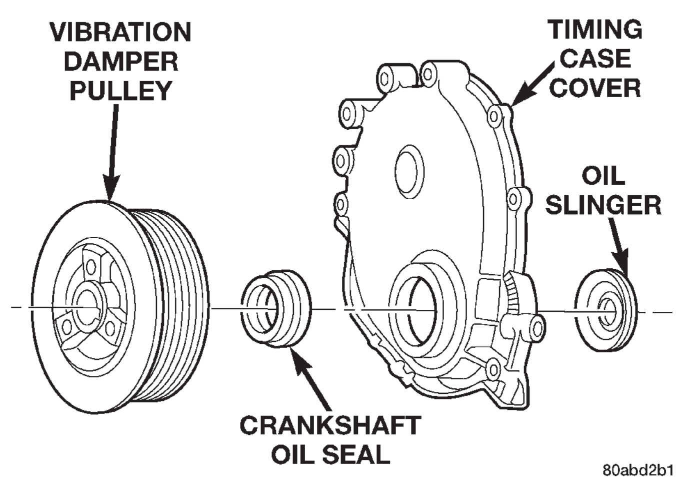


Fig. 39 Timing Case Cover Components

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

REMOVAL AND INSTALLATION (Continued)

the inside of the cover. Support the cover at the seal area while installing the seal. Force it into position with Seal Installation Tool 6139.

(2) Position the gasket on the cylinder block.

(3) Position the timing case cover on the oil pan gasket and the cylinder block.

(4) Insert Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening in the cover (Fig. 40).

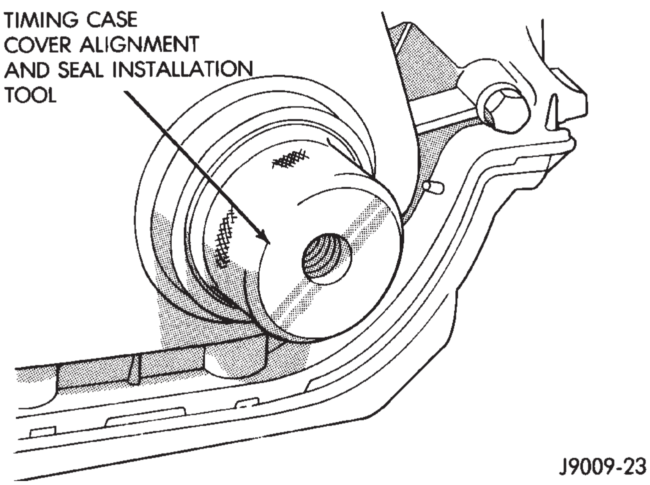


Fig. 40 Timing Case Cover Alignment and Seal Installation Tool 6139

(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.

(7) Remove the cover alignment tool.

(8) Apply a light film of engine oil on the vibration damper hub contact surface of the seal.

(9) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(10) Install the A/C compressor (if equipped) and generator bracket assembly.

(11) Install the engine fan and hub assembly and shroud.

(12) Install the serpentine drive belt and tighten to obtain the specified tension.

(13) Connect negative cable to battery.

TIMING CHAIN AND SPROCKETS

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. 41).

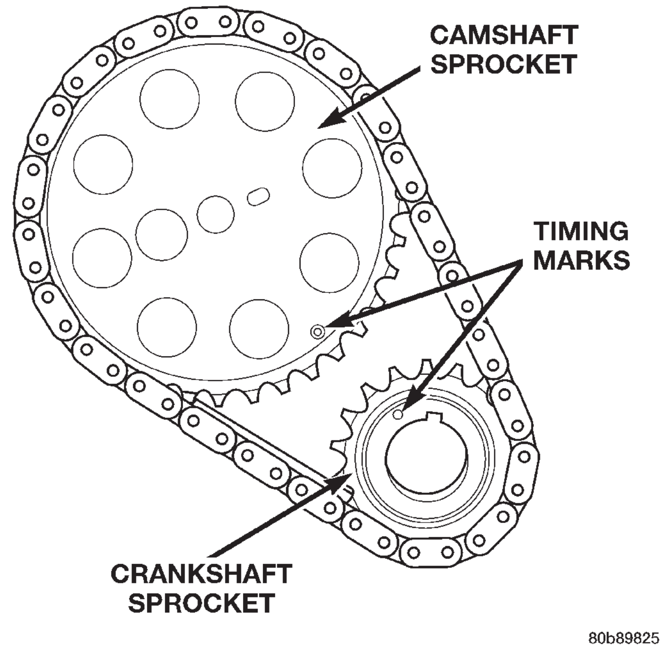


Fig. 41 Crankshaft—Camshaft Alignment

(7) Remove the oil slinger from the crankshaft.

(8) Remove the camshaft sprocket bolt and washer (Fig. 42).

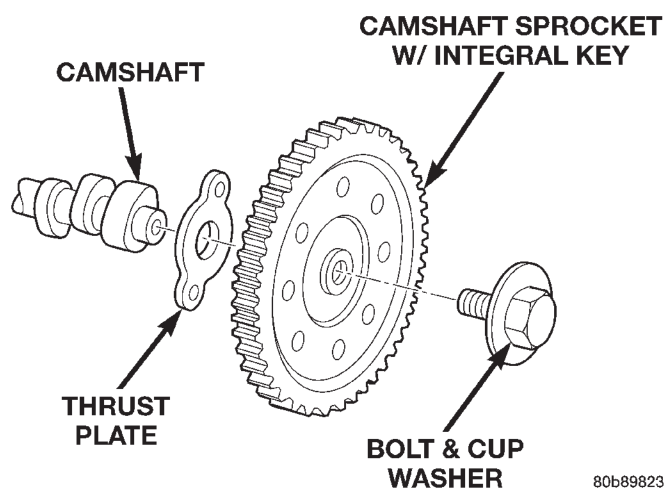


Fig. 42 Camshaft Sprocket and Thrust Plate

(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

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REMOVAL AND INSTALLATION (Continued)

timing. If the timing chain deflects more than 12.7 mm (1/2 inch) replace it.

INSTALLATION

Assemble the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned (Fig. 41).

(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 bolt and washer (Fig. 42). Tighten the bolt to 68 N·m (50 ft. lbs.) torque.

(3) To verify correct installation of the timing chain, rotate the crankshaft 2 revolutions. The camshaft and crankshaft sprocket timing mark should align (Fig. 41).

(4) Install the crankshaft oil slinger.

(5) Replace the oil seal in the timing case cover.

(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.

(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 distributor cap and mark the position of the rotor.

(5) Remove the distributor and ignition wires.

(6) Remove the engine cylinder head cover.

(7) Remove the rocker arms, bridges and pivots.

(8) Remove the push rods.

(9) Remove the engine cylinder head and gasket.

(10) Remove the hydraulic valve tappets from the engine cylinder block.

(11) Remove the vibration damper.

(12) Remove the timing case cover.

(13) Remove the timing chain and sprockets.

(14) Remove the front bumper and/or grille, as required.

(15) Remove the two thrust plate retaining screws, thrust plate and camshaft (Fig. 43).

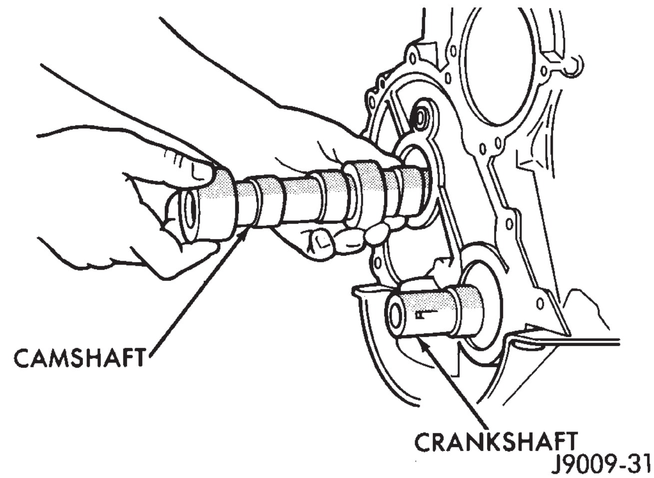

Fig. 43 Camshaft

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 thrust washer, 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. 43).

(8) Position the thrust plate and install the retaining screws. Tighten screws to 24 N·m (18 ft. lbs.).

(9) Install the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned.

(10) Install the camshaft sprocket bolt/cup washer. Tighten the bolt to 68 N·m (50 ft. lbs.).

(11) Install the timing case cover with a replacement oil seal (Fig. 44). Refer to Timing Case Cover Installation.

(12) Install the vibration damper (Fig. 44).

(13) Install the hydraulic valve tappets.

(14) Install the cylinder head gasket with the numbers facing up.

(15) Install the cylinder head and head bolts (Refer to cylinder head R&I in this section for torque values and tightening sequence).

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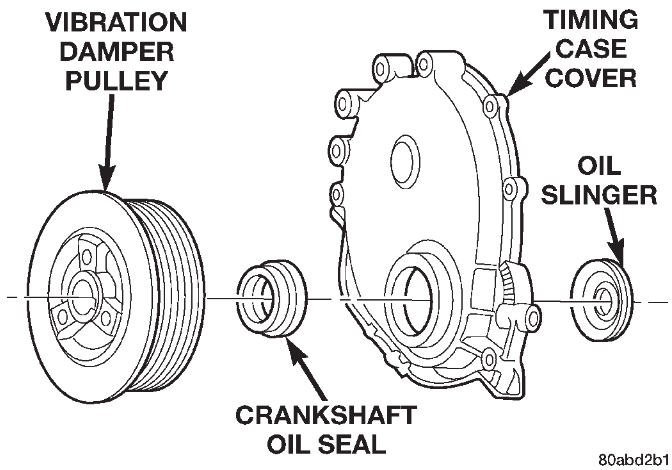


Fig. 44 Timing Case Cover Components

(16) Install the push rods.

(17) 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 (Refer to Rocker Arms and Push Rods in this section).

(18) Install the engine cylinder head cover.

(19) Position the oil pump gear. Refer to Distributor in the Component Removal/Installation section of Group 8D, Ignition Systems.

(20) Install the distributor and ignition wires. Refer to Distributor in the Component Removal/Installation section of Group 8D, Ignition Systems.

(21) 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 1609 km (1,000 miles). The oil supplement need not be drained until the next scheduled oil change.

(22) 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.

(23) 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).

(24) Check the ignition timing and adjust as necessary.

(25) Install the grille and bumper, if removed.

(26) Connect negative cable to battery.

CAMSHAFT BEARINGS

REMOVAL

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. Camshaft end play is maintained by the thrust plate.

(1) Remove the camshaft. Refer to Camshaft in this section for procedure.

NOTE: It is not advisable to attempt to replace camshaft bearings unless special removal and installation tools are available.

(2) Using Special tool, remove the camshaft bearings.

INSTALLATION

(1) Inspect the camshaft bearing journals for uneven wear pattern or finish.

(2) Inspect the camshaft lobes and distributor gear for wear.

(3) Inspect the camshaft thrust plate for wear. If the plate shows excessive wear inspect the camshaft oil pressure relief holes in the rear cam jounral. The relief holes must be clean and free of debris.

CAUTION: Make sure outside diameter of number 1 bearing is clean. Make sure that the bearing is properly installed in the engine block, align the oil hole in the bearing with the oil gallery in the bearing bore. Failure to do so will cause inadequate oil supply for the sprockets and timing chain.

(4) Using special tool, install new camshaft bearings.

(5) Lubricate the camshaft with Mopar® engine oil supplement, or equivalent.

(6) Carefully install the camshaft to prevent damage to the camshaft bearings.

(7) Position the thrust plate and install the two retaining screws. Tighten screws to 24 N·m (18 ft. lbs.).

(8) Install the camshaft sprocket, crankshaft sprocket and timing chain with the timing marks aligned. Install the sprocket bolt.

(9) Tighten the camshaft sprocket bolt and washer to 68 N·m (50 ft. lbs.).

(10) To verify correct installation of the timing chain, turn the crankshaft two full revolutions then position the camshaft sprocket timing mark as shown

REMOVAL AND INSTALLATION (Continued)

in (Fig. 45). Count the number of chain pins between the timing marks of both sprockets. There must be 21 pins.

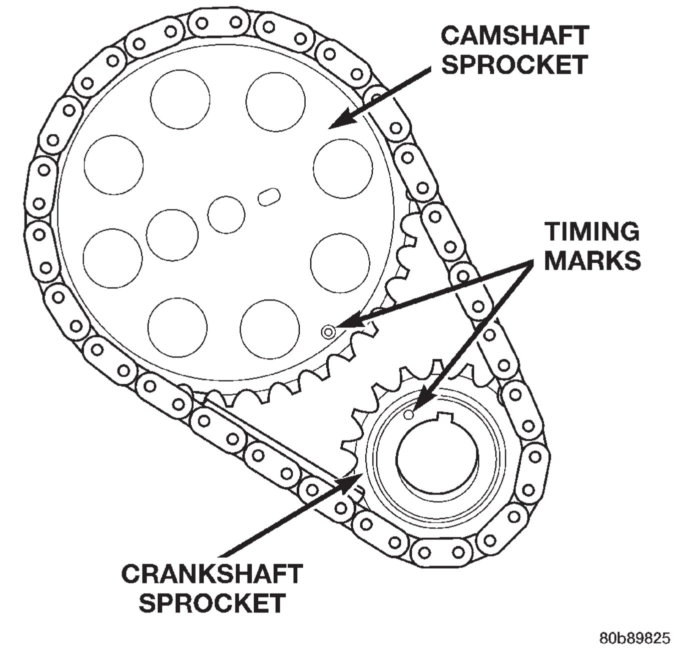


Fig. 45 Verify Crankshaft—Camshaft Installation—Typical

(11) Install the timing chain cover refer to the procedure in this section.

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).
(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.

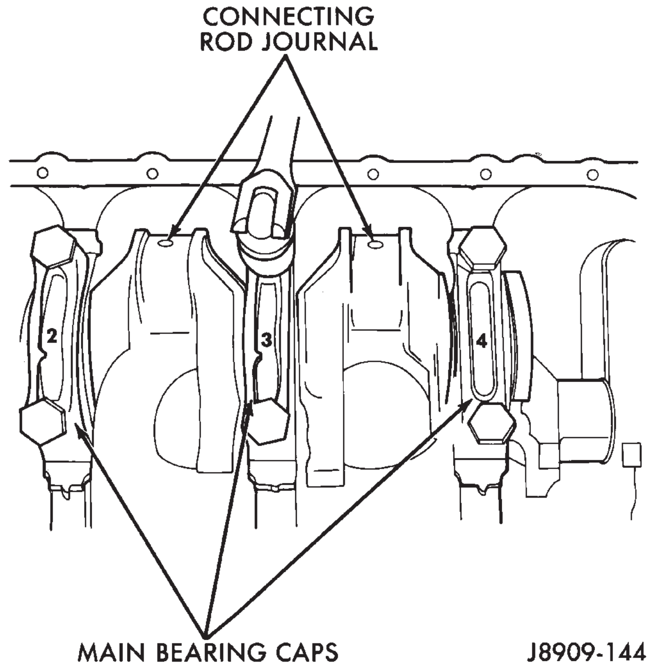


Fig. 46 Removing Main Bearing Caps and Lower Inserts

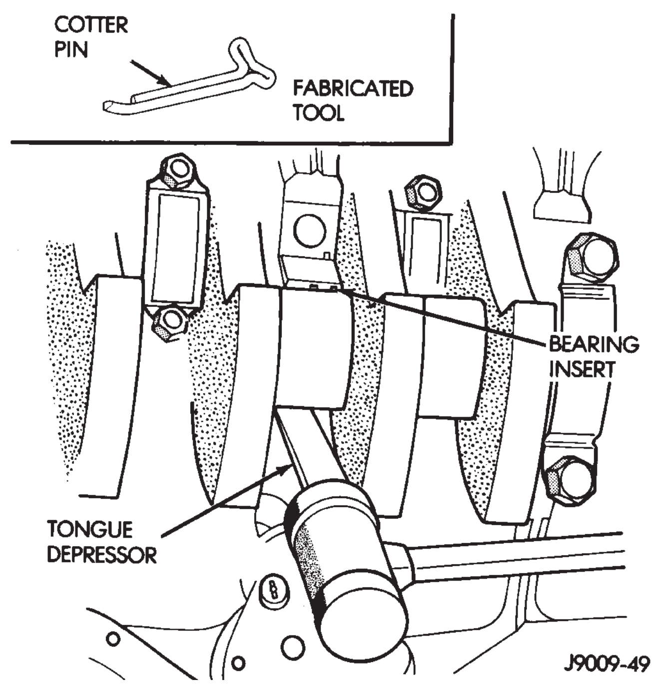


Fig. 47 Removing Upper Inserts

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.

REMOVAL AND INSTALLATION (Continued)

(4) Install the main bearing cap(s) and lower insert(s).

(5) Tighten the bolts of caps 1, 2, 4, 5, 6, and 7 to 54 N·m (40 ft. lbs.) torque. Now tighten these bolts to 95 N·m (70 ft. lbs.) torque. Finally, tighten these bolts to 108 N·m (80 ft. lbs.) torque.

(6) Push the crankshaft forward and backward. Load the crankshaft front or rear and tighten cap bolt No.3 to 54 N·m (40 ft. lbs.) torque. Then tighten to 95 N·m (70 ft. lbs.) torque and finally tighten to 108 N·m (80 ft. lbs.) torque.

(7) Rotate the crankshaft after tightening each main bearing cap to ensure the crankshaft rotates freely.

(8) Check crankshaft end play. Crankshaft end play is controlled by the thrust bearing which is flange and installed at the No.2 main bearing position.

(a) Attach a magnetic base dial indicator to the cylinder block at either the front or rear of the engine.

(b) Position the dial indicator rod so that it is parallel to the center line of the crankshaft.

(c) Pry the crankshaft forward, position the dial indicator to zero.

(d) Pry the crankshaft forward and backward. Note the dial indicator readings. End play is the difference between the high and low measurements (Fig. 48). 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.

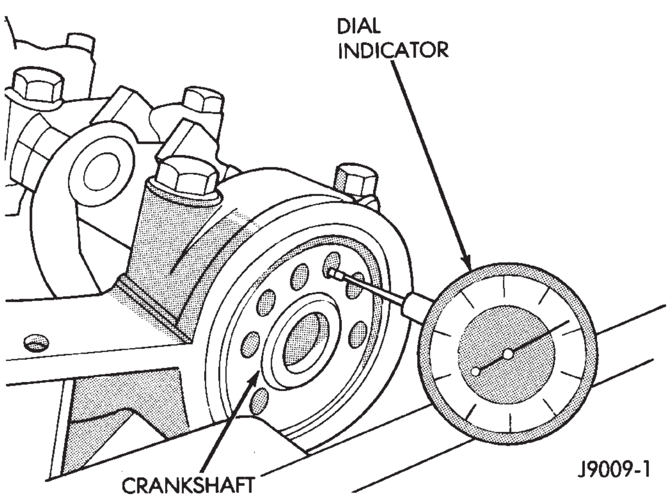


Fig. 48 Crankshaft End Play Measurement

(9) If the crankshaft was removed, install the crankshaft into the cylinder block (refer to Cylinder Block - Assemble).

(10) Install the oil pan.

(11) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(12) Lower the vehicle.

(13) Install the spark plugs. Tighten the plugs to 37 N·m (27 ft. lbs.) torque.

(14) Fill the oil pan with engine oil to the full mark on the dipstick level.

(15) 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 transmission oil cooling lines (if equipped) and oxygen sensor wiring supports that are attached to the oil pan studs.

(14) Remove the oil pan bolts and studs. 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. 49).

(3) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 50).

(4) Apply Mopar® Silicone Rubber Adhesive Sealant on cylinder block to rear main bearing cap cor-

REMOVAL AND INSTALLATION (Continued)

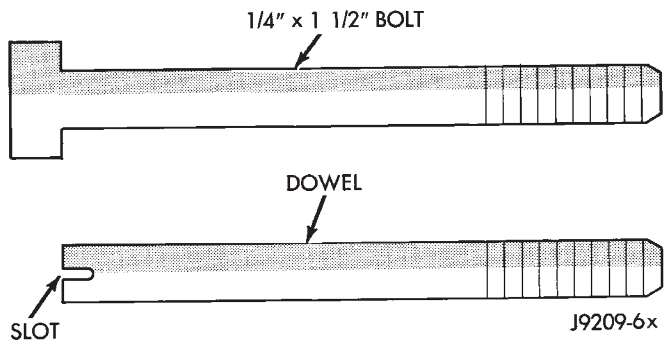


Fig. 49 Fabrication of Alignment Dowels

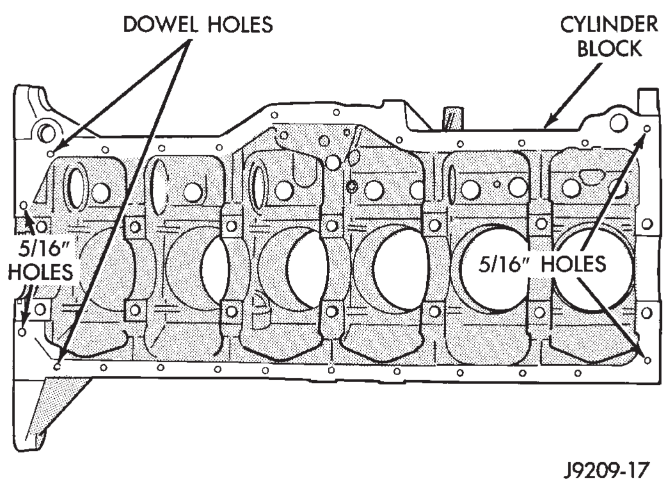


Fig. 50 Position of Dowels in Cylinder Block

ners and cylinder block to front cover joints (four places) (Fig. 51).

(5) Slide the one-piece gasket over the dowels and onto the block and timing case cover.

(6) 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.

(7) 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.

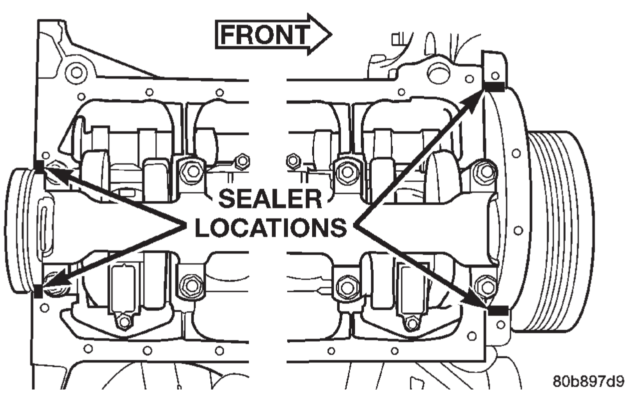


Fig. 51 Oil Pan Sealer Location

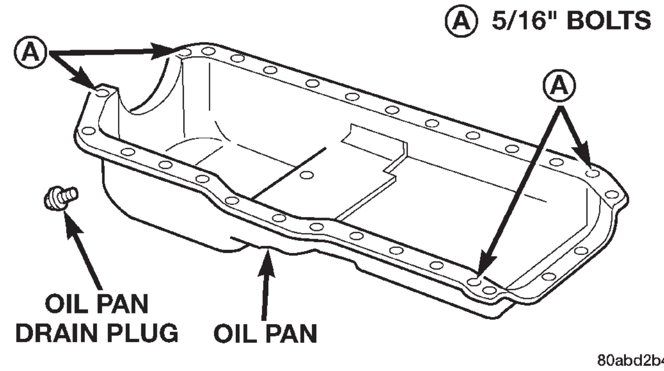


Fig. 52 Position of 5/16 inch Oil Pan Bolts

(8) Remove the dowels. Install the remaining 1/4 inch oil pan bolts. Tighten these bolts to 9.5 N·m (84 in. lbs.) torque.

(9) Lower the engine until it is properly located on the engine mounts.

(10) Install the through bolts and tighten the nuts.

(11) Lower the jack stand and remove the piece of wood.

(12) Install the engine flywheel and transmission torque converter housing access cover.

(13) Install the engine starter motor.

(14) Connect the exhaust pipe to the hanger and to the engine exhaust manifold.

(15) Install transmission oil cooling lines (if equipped) and oxygen sensor wiring supports that attach to the oil pan studs.

(16) Install the oil pan drain plug (Fig. 52). Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(17) Lower the vehicle.

(18) Connect negative cable to battery.

(19) 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.

(20) Start the engine and inspect for leaks.

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.

REMOVAL AND INSTALLATION (Continued)

(6) Raise the vehicle.
(7) Drain the engine oil.
(8) Remove the oil pan and gasket.
(9) Remove main bearing cap brace (Fig. 53).

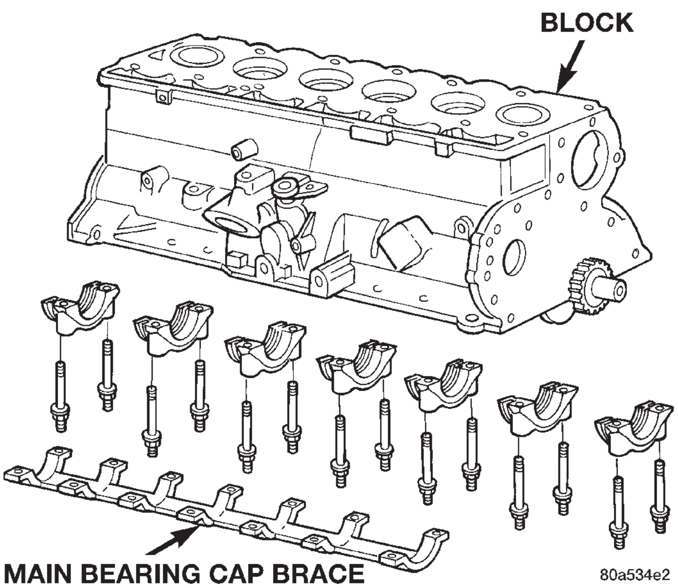


Fig. 53 Main Bearings Caps and Brace

(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. 54).

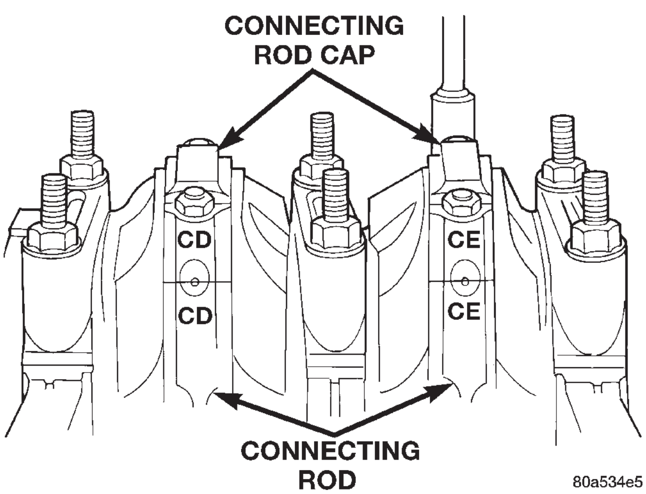


Fig. 54 Stamped Connecting Rods and Caps

(11) Lower the vehicle until it is about 2 feet from the floor.

CAUTION: Ensure that the connecting rod bolts DO NOT scratch the crankshaft journals or cylinder walls. Short pieces of rubber hose, slipped over the rod bolts will provide protection during removal.

(12) Have an assistant push the piston and connecting rod assemblies up and through the top of the cylinder bores (Fig. 55).

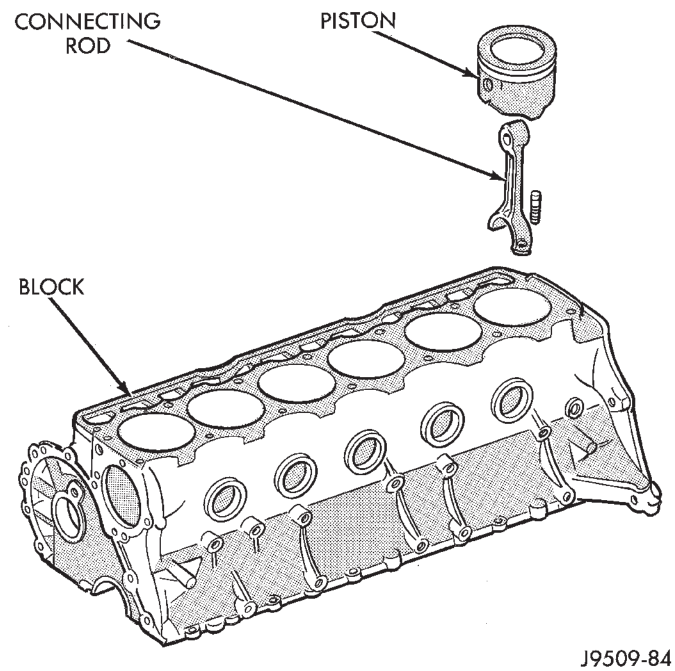


Fig. 55 Removal of Connecting Rod and Piston Assembly

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.
(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).
(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.

REMOVAL AND INSTALLATION (Continued)

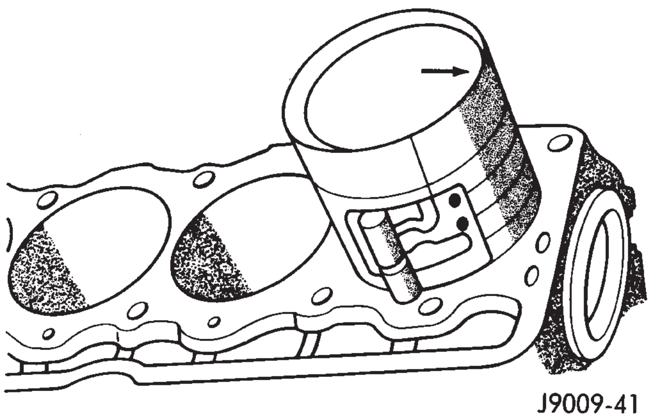


Fig. 56 Rod and Piston Assembly Installation

(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 (Fig. 53). Tighten nuts to 47 N·m (35 ft. lbs.).

(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.

CRANKSHAFT OIL SEALS—REAR

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 transmission inspection cover.

(2) Remove oil pan. Refer to procedure in this section.

(3) Remove main bearing cap brace.

(4) Remove rear main bearing cap (No.7).

(5) Push upper seal out of the groove. Ensure that the crankshaft and seal groove are not damaged.

(6) Remove 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 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. 57).

(6) Coat the outer curved surface of the lower seal with soap and the lip of the seal with engine oil (Fig. 57).

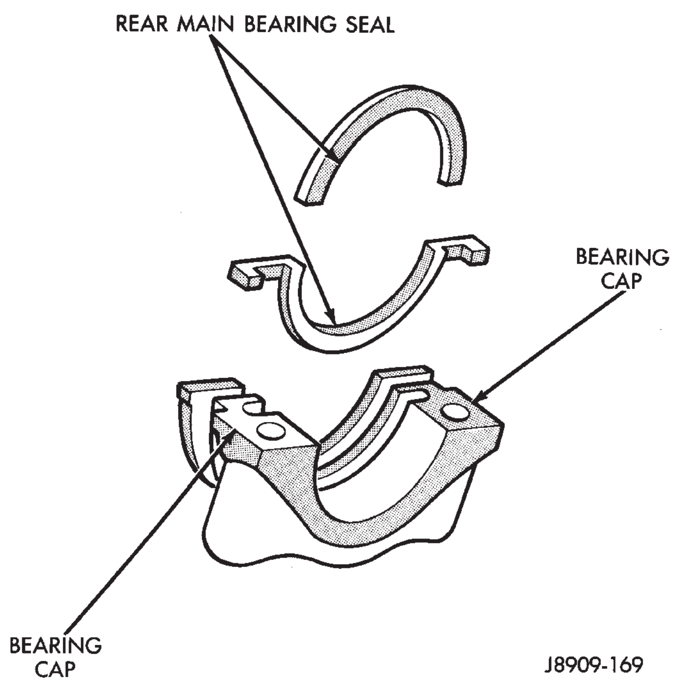


Fig. 57 Rear Main Bearing Oil Seal

(7) Apply Mopar® Gasket Maker sealer on both sides of cylinder block as shown in (Fig. 58). The dab of sealer should be 3 mm (0.125 in.) in diameter.

(8) 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.

(9) Apply Mopar® Gasket Maker on the rear bearing cap (Fig. 58). The bead should be 2.3 mm (0.09

REMOVAL AND INSTALLATION (Continued)

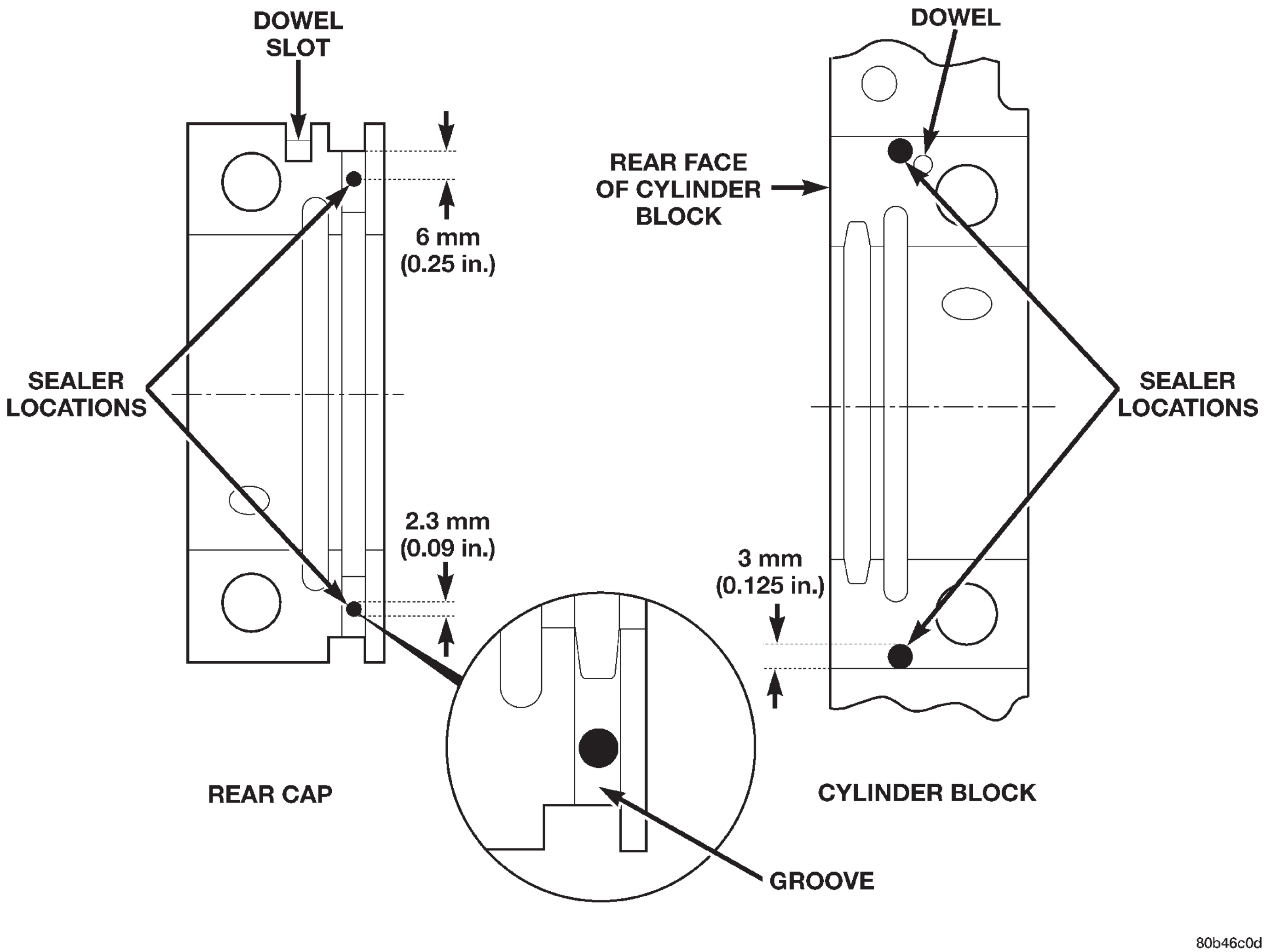


Fig. 58 Location of Sealer

in.) in diameter. DO NOT apply sealer to the lip of the seal.

(10) Install the rear main bearing cap. DO NOT strike the cap more than twice for proper engagement.

(11) Tighten all main bearing bolts to 108 N·m (80 ft. lbs.) torque.

(12) Install the main bearing cap brace. Tighten nuts to 47 N·m (35 ft. lbs.).

(13) Install the oil pan gasket and oil pan. Tighten 1/4 – 20 screws to 14 N·m (120 in. lbs.). Tighten 5/16 – 18 screws to 18 N·m (156 in. lbs.).

(14) Install transmission inspection cover.

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. 59).

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)

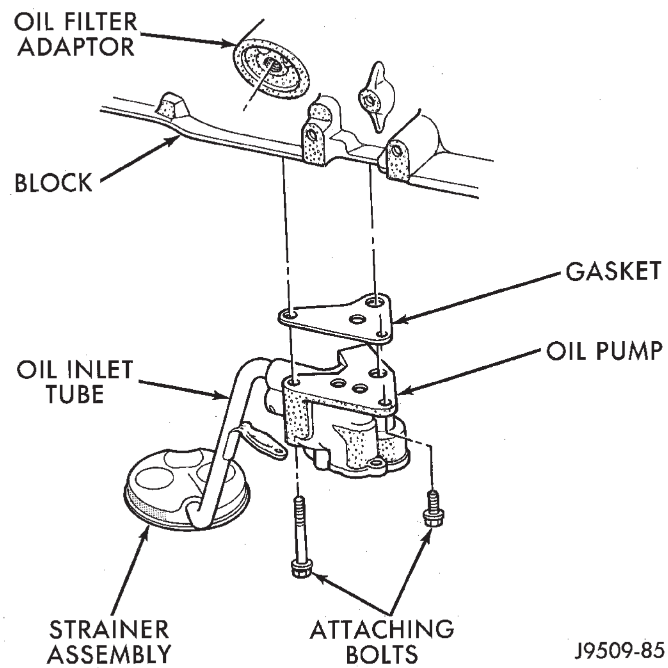


Fig. 59 Oil Pump Assembly

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.

TIMING CASE COVER OIL SEAL

This procedure is done with the timing case cover installed.

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. 60). 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.

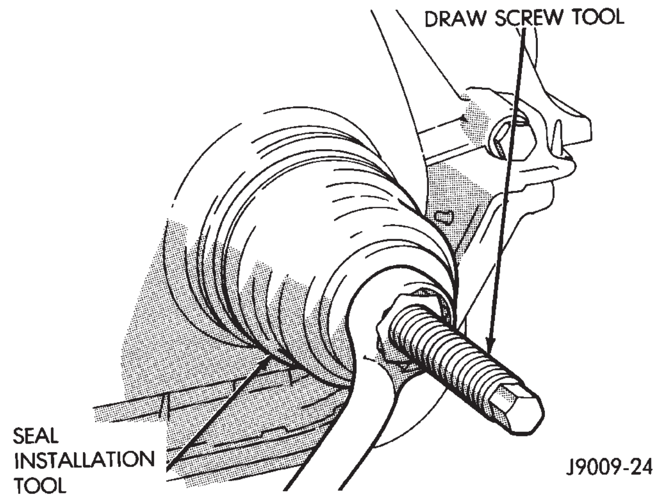


Fig. 60 Timing Case Cover Oil Seal Installation

(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.

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. 61). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

DISASSEMBLY AND ASSEMBLY (Continued)

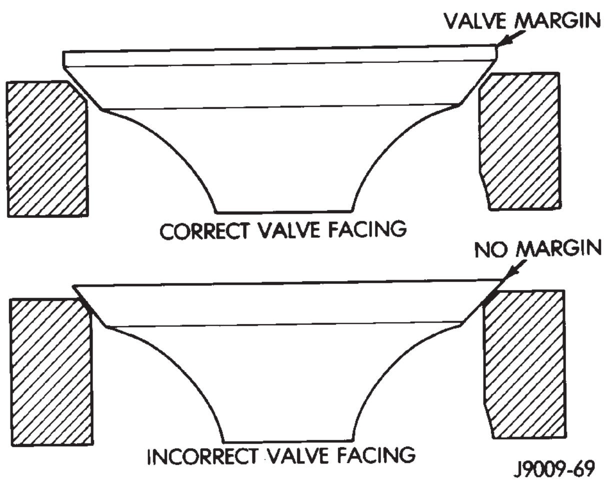


Fig. 61 Valve Facing Margin

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. 62).

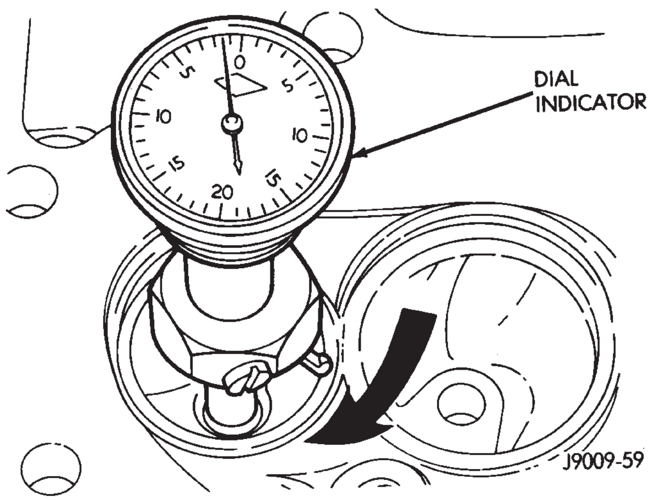


Fig. 62 Measurement of Valve Seat Runout

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.

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. 63).

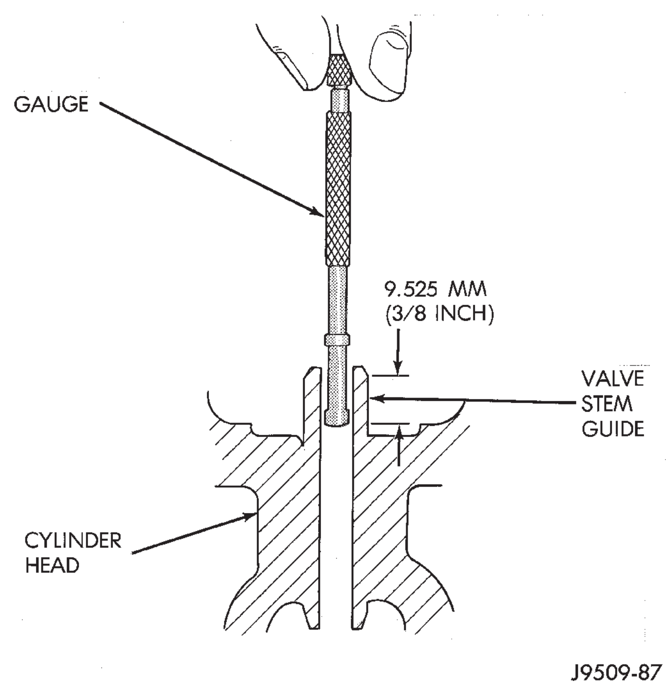


Fig. 63 Measurement of Valve Guide Bore Diameter

(4) Remove and measure telescoping gauge with a micrometer.

(5) Repeat the measurement with contacts lengthwise to engine cylinder head.

DISASSEMBLY AND ASSEMBLY (Continued)

(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. 64).

(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.

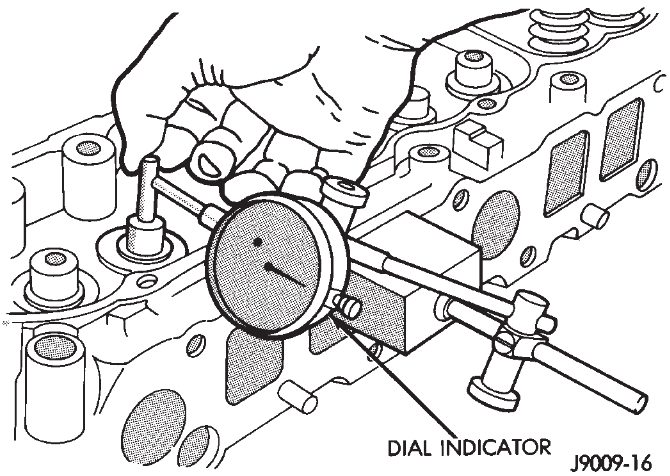


Fig. 64 Measurement of Lateral Movement of Valve Stem

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. 65).

Replace valve springs that are not within specifications.

CYLINDER BLOCK

DISASSEMBLY

Refer to the applicable sections for detailed instructions.

(1) Drain the engine oil. Remove and discard the oil filter.

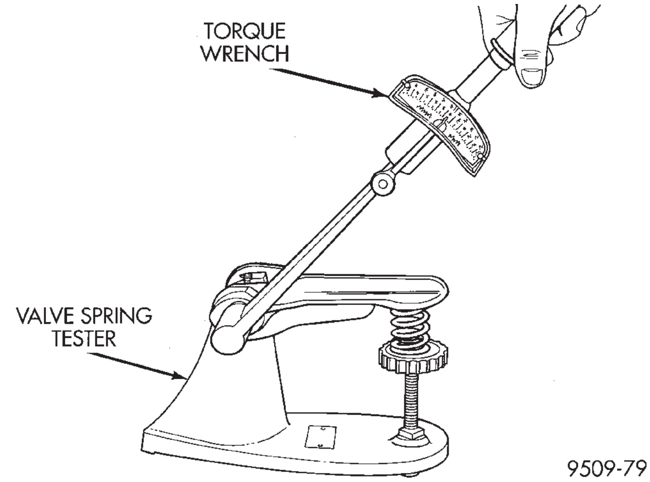


Fig. 65 Valve Spring Tester

(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 (23 ft. lbs.) torque.

(12) Lubricate the oil filter seal with clean engine oil. Tighten oil filter to 18 N·m (156 in. lbs.) torque.

(13) Install the engine into the vehicle.

DISASSEMBLY AND ASSEMBLY (Continued)

(14) Fill the engine with clean lubrication oil (refer to Group 0, Lubrication and Maintenance).

(15) Fill the cooling system.

CLEANING AND INSPECTION

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.

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 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.

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 66).

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.

CLEANING AND INSPECTION (Continued)

(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.

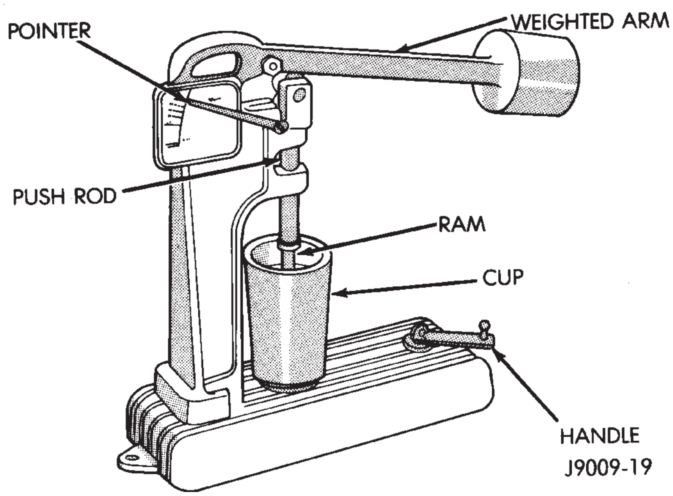


Fig. 66 Leak-Down Tester

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 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 34 N·m (25 ft. lbs.) torque.

INSPECTION—CYLINDER BORE

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter (Fig. 67). 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.

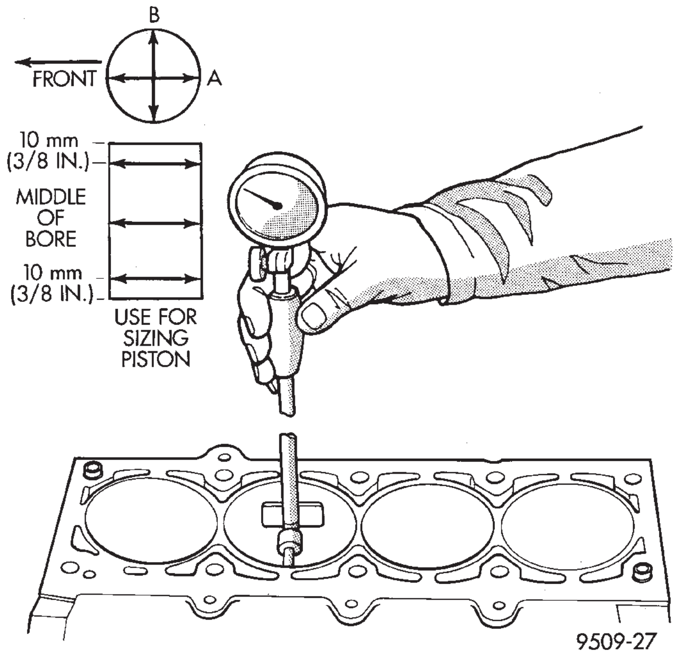


Fig. 67 Cylinder Bore Measurement

(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.

Refer to Standard Service Procedures in the beginning of this Group for the proper honing of cylinder bores.

SPECIFICATIONS

4.0L ENGINE SPECIFICATIONS

Engine Description
Engine Type . . . . In-line 6 Cylinder
Bore and Stroke . 98.4 x 86.69 mm (3.88 x 3.413 in.)
Displacement . . . . 4.0L (242 cu. in.)
Compression Ratio 8.8:1
Firing Order 1–5–3–6–2–4
Lubrication . . . . Pressure Feed–Full Flow Filtration
Cooling System . . Liquid Cooled–Forced Circulation
Cylinder Block . . . . Cast Iron
Crankshaft . . . . Cast Nodular Iron
Cylinder Head . . . . Cast Iron
Camshaft . . . . Cast Iron
Pistons . . . . Aluminum Alloy
Combustion Chamber . . . . Dual-Quench
Connecting Rods . . . . Cast Malleable Iron

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 . . . . 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 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.)
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.)

SPECIFICATIONS (Continued)

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 8.8:1
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) . . . . . 7.95 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 . . . . 1.02 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 . . . . 316 to 351 N @ 41.656 mm (71 to 79 lbf. @ 1.64 in.)
Spring Tension—Valve Open . . . . 898.6 to 969.7 N 30.89 mm (202 to 218 lbf @ 1.216 in.)
Inside Diameter . . . . 21.0 mm to 21.51 mm (0.827 to 0.847 in.)

Pistons

Weight (Less Pin) . . . . 417 to 429 grams (14.7 to 15.1 oz.)
Piston Pin Bore (Centerline to Piston Top) . . . . . 40.61 to 40.72 mm (1.599 to 1.603 in.)
Piston-to-Bore Clearance . . . . . 0.018 to 0.038 mm (0.0008 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 Rings . . . . 0.06 to 0.21 mm (0.0024 to 0.0083 in.)
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—No.1 Compression Ring . . . . 88.39 to 88.65 mm (3.48 to 3.49 in.)
Piston Ring Groove Diameter—No.2 Compression Ring . . . . 87.63 to 87.88 mm (3.45 to 3.46 in.)
Piston Ring Groove Diameter—Oil Control Ring . . . . 89.66 to 89.92 mm (3.53 to 3.54 in.)
Piston Pin Bore Diameter . . 23.650 to 23.658 mm (0.9312 to 0.9315 in.)
Piston Pin Diameter . . . . . . 23.637 to 23.640 mm (0.9306 to 0.9307 in.)
Piston-to-Pin Clearance . . . . 0.0102 to 0.0208 mm (0.0005 to 0.0009 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.)

SPECIFICATIONS (Continued)

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)

4.0L TORQUE SPECIFICATIONS

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 . . . . 2 N·m (16 in. lbs.)
Camshaft Sprocket
Bolt . . . . 68 N·m (50 ft. lbs.)
Camshaft Thrust Plate to Cylinder Block
Screws . . . . 24 N·m (18 ft. lbs.)
Clutch Cover to Flywheel
Bolts . . . . 54 N·m (40 ft. lbs.)
Coil Bracket to Block
Bolts . . . . 22 N·m (192 in. lbs.)
Connecting Rod
Nuts . . . . 45 N·m (33 ft. lbs.)
Cylinder Block
Drain Plugs . . . . 34 N·m (25 ft. lbs.)
Cylinder Head
Bolts . . . . 135 N·m (100 ft. lbs.)
Cylinder Head Cover
Bolts . . . . 10 N·m (85 in. lbs.)
Distributor Clamp
Bolt . . . . 23 N·m (204 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.)

DESCRIPTION **TORQUE**

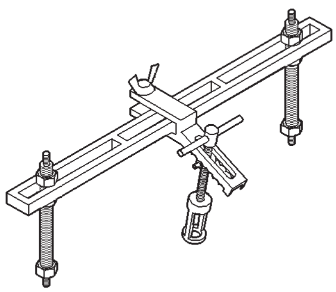
Support Cushion/Crossmember Nuts . . . . 22 N·m (192 in. lbs.)
Support Cushion/Bracket Nuts (Manual) . 75 N·m (55 ft. lbs.)
Transmission Support Bracket Bolt (Manual) . . . . 46 N·m (34 ft. lbs.)
Transmission Support Bracket/ Cushion Bolt (4WD Auto) . . . . 75 N·m (55 ft. lbs.)
Transmission Support Adaptor Bracket Bolts (2WD Auto) . . . . 75 N·m (55 ft. lbs.)
Exhaust Manifold/Pipe
Nuts . . . . 27 N·m (20 ft. lbs.)
Flywheel to Converter Housing
Bolts . . . . 38 N·m (28 ft. lbs.)
Flywheel to Crankshaft
Bolts . . . . 143 N·m (105 ft. lbs.)
Front Cover-to-Block
Bolts 1/4–20 . . . . 7 N·m (60 in. lbs.)
Bolts 5/16–18 . . . . 22 N·m (192 in. lbs.)
Fuel Rail
Bolts/Stud . . . . 12 N·m (108 in. lbs.)
Generator
Fixed Bolt . . . . 24 N·m (18 ft. lbs.)
Thru Bolt/Nut . . . . 38 N·m (28 ft. lbs.)
Main Bearing Cap
Bolts . . . . 108 N·m (80 ft. lbs.)
Main Bearing Brace
Nuts . . . . 47 N·m (35 ft. lbs.)
Oil Filter
Filter . . . . 18 N·m (156 in. lbs.)
Connector (to adaptor) . . . . . . 47 N·m (35 ft. lbs.)
Connector (to block) . . . . 68 N·m (50 ft. lbs.)
Adaptor Bolts . . . . 102 N·m (50 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 (204 in. lbs.)
Long Attaching Bolts . . . . . . 23 N·m (204 in. 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 . . . . 30 N·m (21ft. lbs.)
Spark Plugs
Plugs . . . . 37 N·m (27 ft. lbs.)
Starter Motor
Mounting Bolts . . . . 45 N·m (33 ft. lbs.)
Thermostat Housing
Bolts . . . . 18 N·m (156 in. lbs.)

SPECIFICATIONS (Continued)

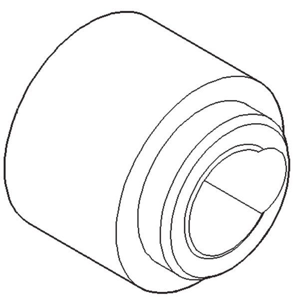
DESCRIPTION	TORQUE
Throttle Body	
Bolts	10 N·m (90 in.lbs.)
Vibration Damper	
Bolts	108 N·m (80 ft. lbs.)
Water Pump/Block	
Bolts	23 N·m (17 ft. lbs.)

SPECIAL TOOLS

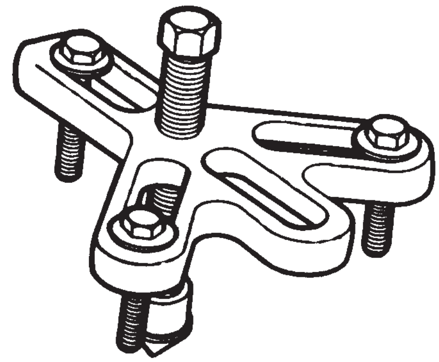
4.0L ENGINE



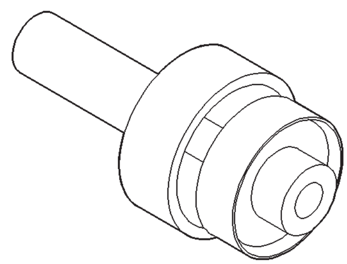
Valve Spring Compressor Tool MD-998772A



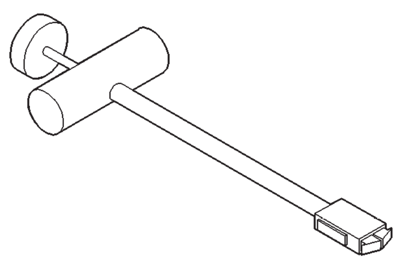
Timing Case Cover Alignment and Seal installation Tool 6139



Vibration Damper Removal Tool 7697



Rear Main Seal Installer Tool 6271A



Hydraulic Valve Tappet Removal/Installation Tool C-4129–A

ENGINE

CONTENTS

GENERAL INFORMATION

ENGINE IDENTIFICATION

The engine model code and serial number are stamped on the left side of the engine block, just below the oil dipstick tube (Fig. 1).

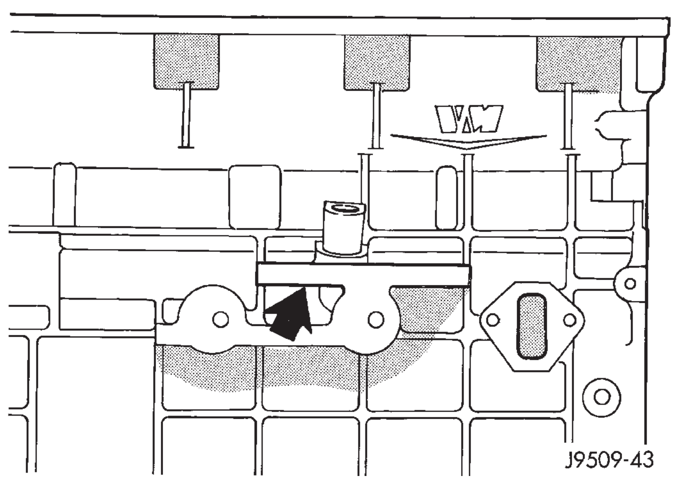


Fig. 1 Engine Code Location

GENERAL INFORMATION (Continued)

Displacement	2.5L (2499 cc)
Bore	92.00
Stroke	94.00
Compression Ratio	20.95:1
Vacuum at idle	600 mm/Hg (23.6 In/Hg)
Belt Tension	53 DaN - New 30 DaN - Used
Thermostat Opening	80°C ± 2°C
Generator Rating	Bosch 50/120 Amp
Cooling System Capacity	9.5 Liter
P/S Capacity	0.75 Liter
Engine Oil Capacity	6.8 Liter w/filter change
Timing System	Pushrod operated overhead valves, with gear-driven camshaft in crankcase.
Air Intake	Dry filter.
Fuel Feed	Vane pump incorporated in injection pump.
Fuel System	Indirect fuel injection (precombustion chamber).
Combustion Cycle	4 stroke.
Cooling System	Water cooling.
Injection Pump	Rotary pump with built-in mechanical regulator.
Lubrication	Pressure lubrication by rotary pump, full-flow filtration.
Engine Rotation	Clockwise viewed from front cover.

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Engine Description

HYDRAULIC TAPPETS

Before disassembling any part of the engine to correct tappet noise, check the oil pressure. If vehicle has no oil pressure gauge, install a reliable gauge at the pressure sending unit. The pressure should be between 4 bars (50 psi) at 3000 RPM.

Check the oil level after the engine reaches normal operating temperature. Allow 5 minutes to stabilize oil level, check dipstick. The oil level in the pan should never be above the FULL mark or below the ADD OIL mark on dipstick. Either of these 2 conditions could be responsible for noisy tappets:

OIL LEVEL HIGH

If oil level is above the FULL mark, it is possible for the connecting rods to dip into the oil. With the engine running, this condition could create foam in the oil pan. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

OIL LEVEL LOW

Low oil level may allow oil pump to take in air. When air is fed to the tappets, they lose length which allows valves to seat noisily. Any leaks on intake side of oil pump through which air can be drawn will create the same tappet action. Check the lubrication system from the intake strainer to the pump cover, including the relief valve retainer cap. When tappet noise is due to aeration, it may be intermittent or constant, and usually more than 1 tappet will be noisy. When oil level and leaks have been corrected, operate the engine at fast idle. Run engine for a sufficient time to allow all of the air inside the tappets to be bled out.

DIAGNOSIS AND TESTING

SERVICE DIAGNOSIS—DIESEL—PERFORMANCE

SERVICE DIAGNOSIS—DIESEL—MECHANICAL

TAPPET NOISE

(1) To determine source of tappet noise, operate engine at idle with cylinder head covers removed.

(2) Feel each valve spring or rocker arm to detect noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

NOTE: Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on the valve spring. If noise is not appreciably reduced, it can be assumed the noise is in the tappet. Inspect the rocker arm push rod sockets and push rod ends for wear.

(3) Valve tappet noise ranges from light noise to a heavy click. A light noise is usually caused by excessive leak down around the unit plunger or by the plunger partially sticking in the tappet body cylinder. The tappet should be replaced. A heavy click is caused by a tappet check valve not seating or by foreign particles becoming wedged between the plunger and the tappet body. This will cause the plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between the valve stem and rocker arm as valve closes. In either case, tappet assembly should be removed for inspection and cleaning.

The valve train generates a noise very much like a light tappet noise during normal operation. Care must be taken to ensure that tappets are making the noise. In general, if more than one tappet seems to be noisy, its probably not the tappets.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK OR CRANKS SLOWLY	1. Starting motor operating, but not cranking the engine.	1. Remove the starter motor. Check for broken flywheel teeth or a broken starting motor spring.
	2. Crankshaft rotation restricted.	2. Rotate the engine to check for rotational resistance.
	3. Starting circuit connections loose or corroded.	3. Clean and tighten connections.
	4. Neutral safety switch or starter relay inoperative.	4. Check starter relay supply voltage and proper operation of neutral safety switch (if equipped). Replace defective parts.
	5. Battery charge low.	5. Check battery voltage. Replace battery if a charge cannot be held.
	6. No voltage to starter solenoid.	6. Check voltage to solenoid. If necessary, replace the solenoid.
	7. Solenoid or starter motor inoperative.	7. Replace starter motor.
ENGINE CRANKS, BUT WILL NOT START NO SMOKE	1. No fuel in supply tank.	1. Fill fuel supply.
	2. Electrical fuel shutdown solenoid not operating.	2. Check for loose wires and verify that the fuel shutdown solenoid and fuel shutdown solenoid relay is functioning.
	3. Air intake or exhaust plugged.	3. Remove the obstruction.
	4. Fuel filter plugged.	4. Drain fuel/water separator and replace fuel filter.
	5. Excessive fuel inlet restriction.	5. Check fuel inlet restriction. Correct cause.
	6. Injection pump not getting fuel or fuel is aerated.	6. Check fuel flow/bleed fuel system.
	7. One or more injectors worn or not operating properly.	7. Check/replace bad or improperly operating injectors.
	8. Worn or inoperative injection pump.	8. Visually check delivery with externally connected injector to one of the pump outlets. Repair or replace the pump if fuel is not being delivered.
	9. Camshaft out of time.	9. Check/correct gear train timing alignment.
ENGINE HARD TO START, OR WILL NOT START SMOKE FROM EXHAUST	1. Incorrect starting procedure.	1. The fuel shutoff solenoid control must be in the run position. Ensure proper procedure is being used.
	2. Cranking speed too slow.	2. (A) Verify that the transmission is not engaged. (B) Check the battery, starting motor and look for loose or corroded wiring connections.
	3. Cylinder heads heater plugs relay defective.	3. Verify system is working. Repair/replace inoperative parts.
	4. One or more cylinder head heater plugs defective.	4. Verify system is working. Repair/replace inoperative parts.
	5. Insufficient intake air.	5. Inspect or replace filter and check for obstruction to the air supply tube.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE HARD TO START, OR WILL NOT START SMOKE FROM EXHAUST (CONT.)	6. Air in fuel system or the fuel supply is inadequate. 7. Contaminated fuel. 8. Fuel screen plugged. 9. One or more injectors worn or not operating properly. 10. Worn or inoperative injection pump. 11. Injection pump out of time. 12. Engine compression low.	6. Check the flow through the filter and bleed the system. Locate and eliminate the air source. 7. Verify by operating the engine with clean fuel from a temporary tank. Check for presence of gasoline. Drain and flush fuel supply tank. Replace fuel/water separator filter. 8. Check fuel screen. 9. Check/replace improperly operating injectors. 10. Visually check fuel delivery with an externally connected injector to one of the pump outlets. Repair or replace the pump if fuel is not being delivered. 11. Check/Time the pump (refer to Group 14, Fuel System). 12. Check compression to identify the problem.
ENGINE STARTS, BUT WILL NOT KEEP RUNNING	1. Cylinder heads heater plugs relay defective. 2. One or more cylinder head heater plugs defective. 3. Intake air or exhaust system restricted. 4. Air in the fuel system or the fuel supply is inadequate. 5. Fuel waxing due to extremely cold weather. 6. Contaminated fuel.	1. Verify system is working. Repair/ replace inoperative parts. 2. Verify system is working. Repair/ replace inoperative parts. 3. Visually check for exhaust restriction and inspect the air intake. Repair/replace restricting parts. 4. Check flow through the filter and bleed the system. Locate and eliminate the air source. 5. Verify by inspecting the fuel filter. Clean the system and use climatized fuel. Replace fuel/water separator filter. Check fuel heater for proper operation. 6. Verify by operating the engine with clean fuel from a temporary supply tank. Check for presence of gasoline. Replace fuel/water separator filter.
SURGING (SPEED CHANGE)	1. If the condition occurs at idle, the idle speed is set too low for the accessories. 2. High pressure fuel leak. 3. One or more injectors worn or not operating properly. 4. Improperly operating injection pump.	1. Adjust the idle speed. 2. Inspect/correct leaks in the high pressure lines. Fittings and delivery valve sealing washers. 3. Check/replace the inoperative injectors. 4. Replace the injector pump.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
ROUGH IDLE (IRREGULARLY FIRING OR ENGINE SHAKING)	1. If engine is cold, glow plug relay on glow plug(s) defective. 2. Engine mounts damaged or lose. 3. High pressure fuel leaks. 4. Air in the fuel system. 5. Sticking needle valve in an injector.	1. Refer to troubleshooting for cylinder head heater plugs (see Group 14, Fuel System). 2. Repair or replace mounts. 3. Correct leaks in the high pressure lines, fittings or delivery valves. 4. Bleed the fuel system and eliminate the source of the air. 5. Check and replace the injector with the sticking needle valve.
ENGINE RUNS ROUGH	1. Fuel injection lines leaking. 2. Air in the fuel or the fuel supply is inadequate. 3. Contaminated fuel. 4. Incorrect valve operation. 5. Injection pump timing incorrect. 6. Improperly operating injectors. 7. Defective injection pump (delivery valve). 8. Camshaft out of time. 9. Damaged camshaft or tappets. 10. Automatic timing advance not operating.	1. Correct leaks in the high pressure lines, fittings, injectors sealing washers or delivery valves. 2. Check the flow through the filter and bleed the system. Locate and eliminate the air source. 3. Verify by operating the engine with clean fuel from a temporary supply tank. Check for presence of gasoline. Replace fuel/water separator filter. 4. Check for a bent push rod and adjust valves. Replace push rod, if necessary. 5. Check/time pump (refer to Group 14, Fuel System). 6. Replace inoperative injectors. 7. Repair or replace injection pump. 8. Check/correct gear train timing alignment. 9. Inspect camshaft valve lift. Replace camshaft and tappets. 10. Check injection pump. Check fuel injector sensor at number 1 cylinder injector.
ENGINE RPM WILL NOT REACH RATED SPEED	1. Engine overload. 2. Improperly operating tachometer. 3. Inadequate fuel supply. 4. Air/fuel controls leak.	1. Verify high idle speed without load. Investigate operation to be sure correct gear is being used. 2. Verify engine speed with hand tachometer, correct as required. 3. Check the fuel flow through the system to locate the reason for inadequate fuel supply, correct as required. 4. Check and repair leak. Check AFC tubing for obstruction.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE RPM WILL NOT REACH RATED SPEED (CONT.)	6. Improperly operating injection pump.	6. Repair or replace injection pump.
LOW POWER	1. Fuel control lever not moving to full throttle.	1. Check/correct for stop-to-stop travel.
	2. High oil level.	2. Check/correct oil level.
	3. Engine overloaded.	3. Check for added loading from accessories or driven units, brakes dragging and other changes in vehicle loading. Repair/replace as needed.
	4. Slow throttle response caused by leaking or obstructed air control tube or improperly operating control in the pump.	4. Check for leaks and obstructions. Tighten the fittings. Repair or replace the pump if the controls are not functioning.
	5. Inadequate intake air flow.	5. Inspect/replace air cleaner element. Look for other restrictions.
	6. Inadequate fuel supply. Air in the fuel.	6. Check the flow through the filter to locate the source of the restriction. Check fuel pressure and inlet restriction.
	7. Excessive exhaust restriction.	7. Check/correct the restriction in the exhaust system.
	8. High fuel temperature.	8. Verify that fuel heater is off when engine is warm. Check for restricted fuel drain tubes. Repair/replace as needed.
	9. Poor quality fuel or fuel contaminated with gasoline.	9. Verify by operating from a temporary tank with good fuel. Check for presence of gasoline. Replace fuel/water separator filter.
	10. Air leak between the turbocharger and the intake manifold.	10. Check/correct leaks in hoses, gaskets, charge air cooler and around mounting capscrews or through holes in the manifold cover.
	11. Exhaust leak at the manifold or turbocharger.	11. Check/correct leaks in the manifold or turbocharger gaskets. If manifold is cracked, replace manifold.
	12. Improperly operating turbocharger.	12. Inspect/replace turbocharger.
	13. Wastegate operation.	13. Check wastegate operation.
	14. Valve not operating.	14. Check for bent push rod, replace if necessary.
	15. Worn or improperly operating injectors.	15. Check/replace injectors.
	16. Incorrect injection pump timing.	16. Verify injection pump timing (see Group 14, Fuel System).
	17. Improperly operating injection pump.	17. Repair or replace injection pump.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
EXCESSIVE EXHAUST SMOKE	1. Engine running too cold (white smoke).	1. Refer to troubleshooting for coolant temperature below normal (refer to Group 7, Cooling System). Inspect cylinder head heater plugs for proper operation.
	2. Improper starting procedure (white smoke).	2. Use proper starting procedures.
	3. Fuel supply inadequate.	3. Check fuel supply pressure and inlet restriction.
	4. Injection pump timing.	4. Check and time pump (refer to Group 14, Fuel System).
	5. Inadequate intake air.	5. Inspect/change air filter. Look for other restriction. Check charge air cooler for obstructions.
	6. Air leak between turbocharger and intake manifold.	6. Check/correct leaks in the air crossover tube, hoses, gaskets, mounting capscrews or through holes in the manifold cover.
	7. Exhaust leak at the manifold or turbocharger.	7. Check/correct leaks in the manifold or turbocharger gaskets. If cracked replace manifold.
	8. Improperly operating turbocharger.	8. Inspect/replace turbocharger.
	9. Improperly operating injectors.	9. Check and replace inoperative injectors.
	10. Improperly operating or overfueled injector pump.	10. Repair or replace injection pump.
	11. Piston rings not sealing (blue smoke).	11. Perform blow-by check. Correct as required.
ENGINE WILL NOT SHUT-OFF	1. Fuel shutoff solenoid inoperative.	1. Check/replace fuel shutoff solenoid.
	2. Engine running on fumes drawn into the air intake.	2. Check the air intake ducts for the source of fumes. **WARNING: In case of engine runaway due to flammable fumes from gasoline spills or turbocharger oil leaks being sucked into the engine, shut off engine ignition switch first then use a CO2 fire extinguisher and direct the spray under the front bumper to remove oxygen supply. The engine air intake is on the passenger side behind the bumper. The fire extinguisher must be directed at this location for emergency shutdown conditions.**
	3. Fuel injection pump malfunction.	3. Repair or replace fuel injection pump.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
COOLANT TEMPERATURE ABOVE NORMAL	1. Low coolant level.	1. Check coolant level. Add coolant, if necessary. Locate and correct the source of the coolant loss, (refer to Group 7, Cooling).
	2. Incorrect/improperly operating pressure cap.	2. Replace cap with the correct rating for the system.
	3. Loose drive belt on water pump/fan.	3. Check/replace belt or belt tensioner.
	4. Inadequate air flow to the radiator.	4. Check/repair radiator core, fan shroud and viscous fan drive as required.
	5. Radiator fins plugged.	5. Blow debris from fins.
	6. Collapsed radiator hose.	6. Replace the hose. Check coolant tank cap operation, (refer to Group 7, Cooling Tanks).
	7. Improperly operating temperature sensor/gauge.	7. Verify that the gauge and temperature sensor are accurate. Replace gauge/sensor, if bad.
	8. Improperly operating, incorrect or no thermostat.	8. Check and replace the thermostat.
	9. Air in the cooling system.	9. (A) make sure the fill rate is not being exceeded and the correct vented thermostat is installed. (B) Check for loose hose clamps. Tighten if loose. (C) If aeration continued, check for a compression leak through the head gasket.
	10. Inoperative water pump.	10. Check and replace the water pump.
	11. Incorrect injection pump timing.	11. Verify pump timing marks are aligned. Check/time the injector pump(refer to Group 14, Fuel System).
	12. Overfueled injection pump.	12. Repair or replace the injection pump.
	13. Plugged cooling passages in radiator, head, head gasket or block.	13. Flush the system and fill with clean coolant.
	14. Engine overloaded.	14. Verify that the engine load rating is not being exceeded.
COOLANT TEMPERATURE BELOW NORMAL	1. Too much air flow across the radiator.	1. Check/repair viscous fan drive as required.
	2. Incorrect thermostat or contamination in thermostat.	2. Check and replace thermostat.
	3. Temperature sensor or gauge inoperative.	3. Verify that the gauge and sensor are accurate. If not, replace gauge/sensor.
	4. Coolant not flowing by temperature sensor.	4. Check and clean coolant passages.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
LUBRICATING OIL PRESSURE LOW	1. Low oil level.	1. (A) Check and fill with clean engine oil. (B) Check for a severe external oil leak that could reduce the pressure.
	2. Oil viscosity thin, diluted or wrong specification.	2. Verify the correct oil is being used. Check for oil dilution. Refer to Contaminated Lube Oil (Engine Diagnosis Mechanical).
	3. Improperly operating pressure switch/gauge.	3. Verify the pressure switch is functioning correctly. If not, replace switch/gauge.
	4. Relief valve stuck open.	4. Check/replace valve.
	5. Plugged oil filter.	5. Change oil filter. Oil filter change interval may need to be revised.
	6. If cooler was replaced, shipping plugs left in cooler.	6. Check/remove shipping plugs.
	7. Worn oil pump.	7. Check and replace oil pump.
	8. Suction tube loose or seal leaking.	8. Check and replace seal.
	9. Loose main bearing cap.	9. Check and install new bearing and tighten cap to proper torque.
	10. Worn bearings or wrong bearings installed.	10. Inspect and replace connecting rod or main bearings. Check and replace piston cooling nozzles.
	11. Oil jet under piston bad fit into main carrier.	11. Check oil jet position.
LUBRICATING OIL PRESSURE TOO HIGH	1. Pressure switch/gauge not operating properly.	1. Verify the pressure switch is functioning correctly. If not, replace switch/gauge.
	2. Engine running to cold.	2. Refer to Coolant Temperature Below Normal (Engine Diagnosis Performance).
	3. Oil viscosity too thick.	3. Make sure the correct oil being used, (Refer to Group 0, Lubrication and Maintenance).
	4. Oil pressure relief valve stuck closed or binding.	4. Check and replace valve.
LUBRICATING OIL LOSS	1. External leaks.	1. Visually inspect for oil leaks. Repair as required.
	2. Crankcase being overfilled.	2. Verify that the correct dipstick is being used.
	3. Incorrect oil specification or viscosity.	3. (A) Make sure the correct oil is being used. (B) Look for reduced viscosity from dilution with fuel. (C) Review/reduce the oil change intervals.
	4. Oil cooler leak.	4. Check and replace the oil cooler.
	5. High blow-by forcing oil out the breather.	5. Check the breather tube area for signs of oil loss. Perform the required repairs.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
LUBRICATING OIL LOSS (CONT.)	6. Turbocharger leaking oil to the air intake. 7. Piston rings not sealing (oil being consumed by the engine).	6. Inspect the air ducts for evidence of oil transfer. Repair as required. 7. Perform blow-by check. Repair as required.
COMPRESSION KNOCKS	1. Air in the fuel system. 2. Poor quality fuel or water/gasoline contaminated fuel. 3. Engine overloaded. 4. Incorrect injection pump timing. 5. Improperly operating injectors.	1. Bleed the fuel system (refer to Group 14, Fuel System). 2. Verify by operating from a temporary tank with good fuel. Clean and flush the fuel supply tanks. Replace fuel/ water separator. 3. Verify the engine load rating is not being exceeded. 4. Check and time injection pump (refer to Group 14, Fuel System). 5. Check and replace inoperative injectors.
EXCESSIVE VIBRATION	1. Loose or broken engine mounts. 2. Damaged fan or improperly operating accessories. 3. Improperly operating vibration damper. 4. Improperly operating viscous fan drive. 5. Worn or damaged generator bearing. 6. Flywheel housing misaligned. 7. Loose or broken power component. 8. Worn or unbalanced driveline components.	1. Replace engine mounts. 2. Check and replace the vibrating components. 3. Inspect/replace the vibration damper. 4. Inspect/replace the fan drive. 5. Check/replace the generator. 6. Check/correct flywheel alignment. 7. Inspect the crankshaft and rods for damage that causes an unbalance. Repair/replace as required. 8. Check/repair driveline components.
EXCESSIVE ENGINE NOISES	1. Drive belt squeal, insufficient tension or abnormally high loading. 2. Intake air or exhaust leaks. 3. Turbocharger noise. 4. Gear train noise. 5. Power function knock.	1. Check the automatic tensioner and inspect the drive belt. Make sure water pump, tensioner pulley, fan hub and generator turn freely. 2. Refer to Excessive Exhaust smoke (Engine Diagnosis Performance). 3. Check turbocharger impeller and turbine wheel for housing contact. Repair/replace as required. 4. Visually inspect and measure gear backlash. Replace gears as required. 5. Check/replace rod and main bearings.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
GENERATOR NOT CHARGING OR INSUFFICIENT CHARGING	1. Loose or corroded battery.	1. Clean/tighten battery connection.
	2. Generator belt slipping.	2. Check/replace automatic belt tensioner. Check/replace and adjust belt.
	3. Generator pulley loose on shaft.	3. Tighten pulley.
	4. Improperly operating generator.	4. Check/replace generator.

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SERVICE PROCEDURES

VALVE SERVICE

This procedure is done with the engine cylinder head removed from the block.

DISASSEMBLY

(1) Remove the engine cylinder head from the cylinder block. Refer to cylinder head removal and installation in this section.

(2) Use Valve Spring Compressor Tool and compress each valve spring.

(3) Remove the valve locks, retainers, and springs.

(4) Use an Arkansas smooth stone or a jewelers file to remove any burrs on the top of the valve stem, especially around the groove for the locks.

(5) Remove the valves, and place them in a rack in the same order as removed.

VALVE CLEANING

(1) Clean all carbon deposits from the combustion chambers, valve ports, valve stems, valve stem guides and head.

(2) Clean all grime and gasket material from the engine cylinder head machined gasket surface.

INSPECTION

(1) Inspect for cracks in the combustion chambers and valve ports.

(2) Inspect for cracks on the exhaust seat.

(3) Inspect for cracks in the gasket surface at each coolant passage.

(4) Inspect valves for burned, cracked or warped heads.

(5) Inspect for scuffed or bent valve stems.

(6) Replace valves displaying any damage.

(7) Check valve spring height (Fig. 2).

VALVE REFACING

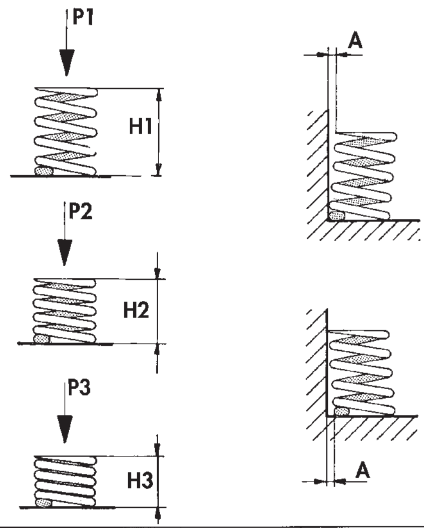
(1) Use a valve refacing machine to reface the intake and exhaust valves to the specified angle.

(2) After refacing, a margin of at least 4.52-4.49 mm (.178-.177 inch) must remain (Fig. 3). If the margin is less than 4.49 mm (.177 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.



LOAD Kg		HEIGHT mm		STATE
P1	0.00	H1	44.65	FREE LENGTH
P2	33-35	H2	38.60	VALVE CLOSED
P3	90-95	H3	28.20	VALVE OPEN

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Fig. 2 Valve Spring Chart

VALVE STAND DOWN

Valve stand down is to maintain the adequate compression ratio.

(1) Invert cylinder head.

(2) Fit each valve to its respective valve guide.

(3) Using a straight edge and feeler gauge (Fig. 4), check valve head stand down: Inlet valve head stand down .80 to 1.2 mm (.031 to .047 in.) and exhaust valve stand down .79 to 1.19 mm (.031 to .047 in).

(4) If valve head stand down is not in accordance with above, discard original valves, check stand down with new valves and recut valve seat inserts to obtain correct stand down.

VALVE GUIDES

(1) Valve Guides height requirement.

(2) Measurement A (Fig. 5): 13.50 - 14.00 mm.

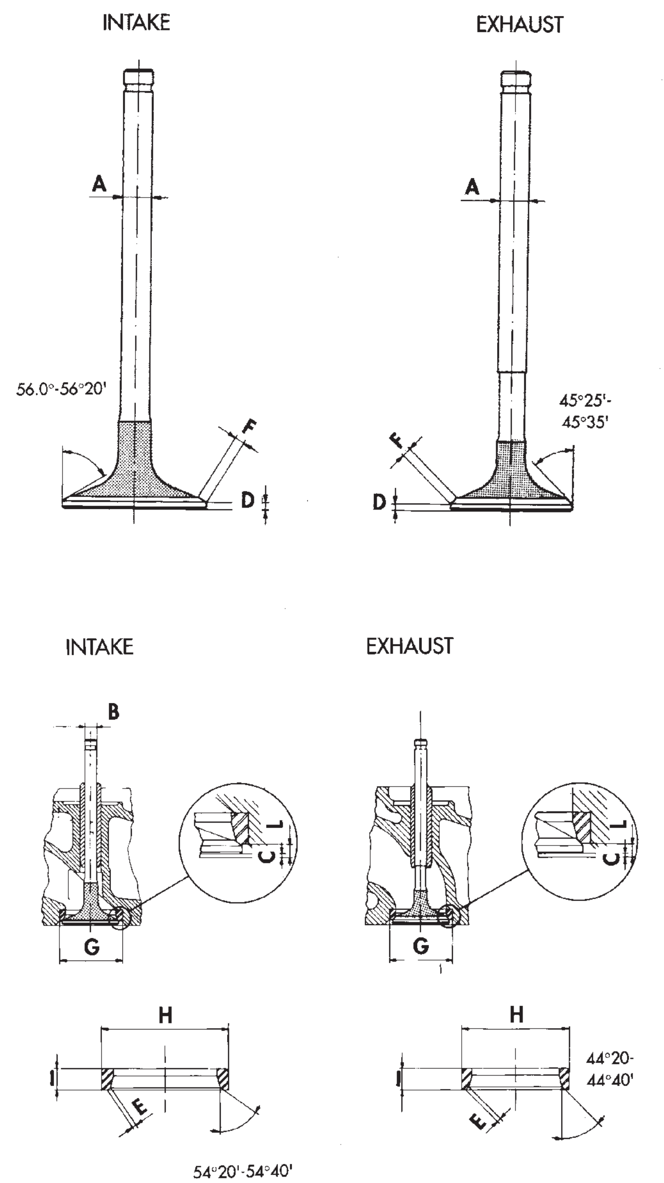
VALVE STEM-TO-GUIDE CLEARANCE MEASUREMENT

(1) Measure and record internal diameter of valve guides. Valve guide internal diameter is 8.0 to 8.015 mm (.3149 to .3155 ins.).

(2) Measure valve stems and record diameters. Intake valve stem diameter 7.94 to 7.96 mm (.3125 to .3133 in). Exhaust valve stem diameter 7.92 to 7.94 mm (.3118 to .31215 in).

(3) Subtract diameter of valve stem from internal diameter of its respective valve guide to obtain valve stem clearance in valve guide. Clearance of inlet valve stem in valve guide is .040 to .075 mm (.0015 to .0029 in). Clearance of exhaust valve stem in valve guide is .060 to .095 mm (.0023 to .0037 in).

SERVICE PROCEDURES (Continued)



MEASUREMENT	INTAKE	EXHAUST
A	7.940-7.960	7.922-7.940
B	8.00-8.015	8.000-8.015
C	0.880-1.140	0.990-1.250
D	2.2±0.08	$2.09^{+0.07}_{-0.09}$
E	1.80-2.20	1.65-2.05
F	2.73-3.44	2.45-3.02
G	41.962-41.985	35.964-35.987
H	42.070-42.086	36.050-36.066
I	7.14-7.19	7.00-7.05
L	3.11-3.26	3.10-3.25

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Fig. 3 Valve Specification

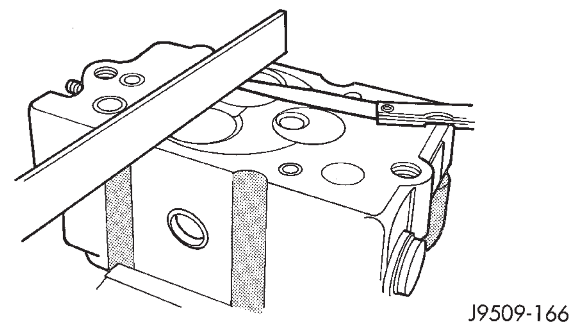

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Fig. 4 Checking Valve Stand Down

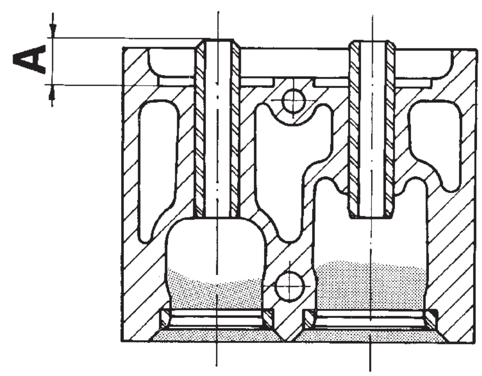

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Fig. 5 Valve Guide Height

(4) If valve stem clearance in valve guide exceeds tolerances, new valve guides must be installed.

REMOVAL AND INSTALLATION

ENGINE MOUNTS — LHD DIESEL

The engine mounts support the engine at each side. These supports are made of resilient rubber.

REMOVAL—RIGHT SIDE

(1) Disconnect the negative battery cable.

(2) Remove the innercooler inlet hose from the turbocharger and position it out of the way (Fig. 6).

(3) Remove the right engine mount upper sill plate nuts.

(4) Raise the vehicle on a hoist.

(5) Remove the oil filter and adaptor from the engine.

(6) Remove the engine mount throughbolt nut only. Do not remove the bolt at this time.

(7) Position a jack stand and raise the weight off the right engine mount.

(8) Remove the (2) engine mount lower sill plate bolts.

(9) Remove the (4) engine mount bracket bolts from the engine block.

REMOVAL AND INSTALLATION (Continued)

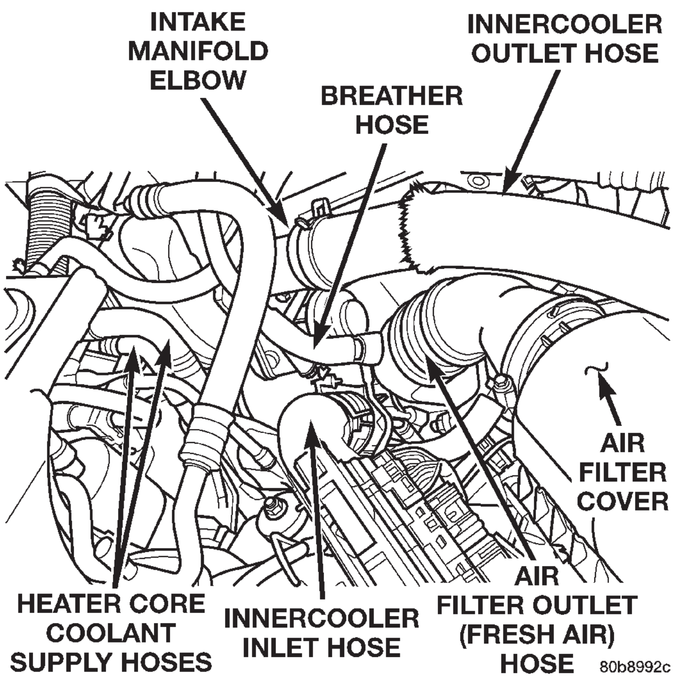

Fig. 6 Engine Compartment View — Diesel

(10) Remove the engine mount throughbolt.

(11) Remove the right engine mount from the vehicle.

INSTALLATION—RIGHT SIDE

(1) Position the engine mount and bracket and install the engine mount throughbolt and nut, leaving them loose at this time.

(2) Install, but do not torque the engine mount lower sill plate bolts.

(3) Install the (4) engine mount bracket to engine block retaining bolts and torque to 61 N·m (45 ft. lbs.).

(4) Torque the engine mount lower sill plate bolts to 41 N·m (30 ft. lbs.).

(5) Remove the jack stand.

(6) Torque the engine mount throughbolt nut to 65 N·m (48 ft. lbs.).

(7) Install the oil filter and adaptor on the engine. Torque the adaptor retaining bolt to 50 N·m (37 ft. lbs.).

(8) Lower the vehicle from the hoist.

(9) Install the engine mount upper sill plate nuts. Torque to 41 N·m (30 ft. lbs.).

(10) Install the innercooler inlet hose on the turbocharger (Fig. 7).

(11) Connect the negative battery cable.

REMOVAL—LEFT SIDE

(1) Disconnect the negative battery cable.

(2) Remove the refrigerant line support bracket from the rear of the rocker cover.

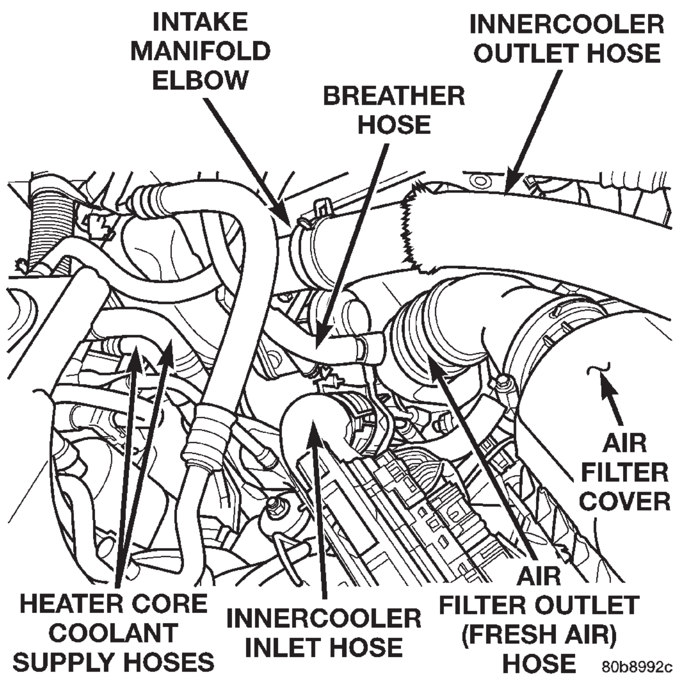

Fig. 7 Engine Compartment View — Diesel

(3) Disconnect the A/C compressor electrical connector.

(4) Remove the (2) engine mount upper sill plate nuts (Fig. 8).

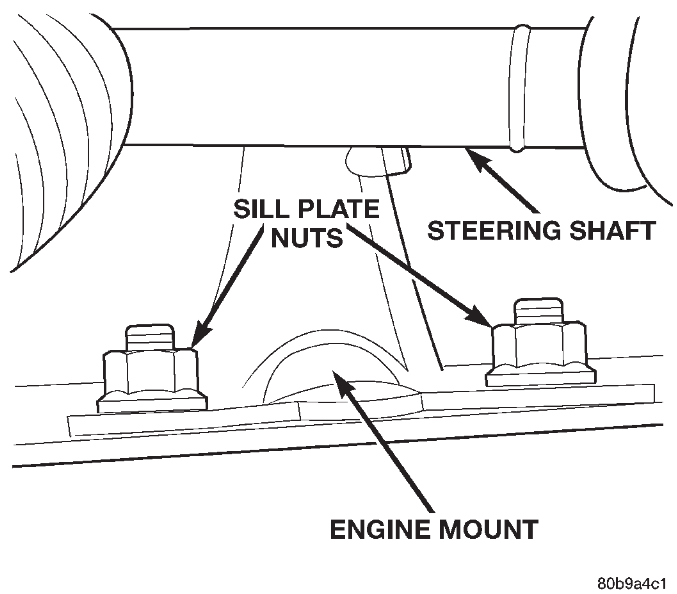

Fig. 8 Left Engine Mount Sill Plate Nuts

(5) Make sure the steering shaft is in the unlocked position. Raise the vehicle on a hoist.

(6) Remove the steering shaft pinchbolt. Remove the shaft from the gearbox by sliding it straight off the gearbox input shaft.

REMOVAL AND INSTALLATION (Continued)

CAUTION: Do not rotate the steering shaft while removed from the gearbox input shaft. Damage to the steering column clockspring will occur.

(7) Remove the left engine mount throughbolt nut only (Fig. 9). Do not remove the bolt at this time.

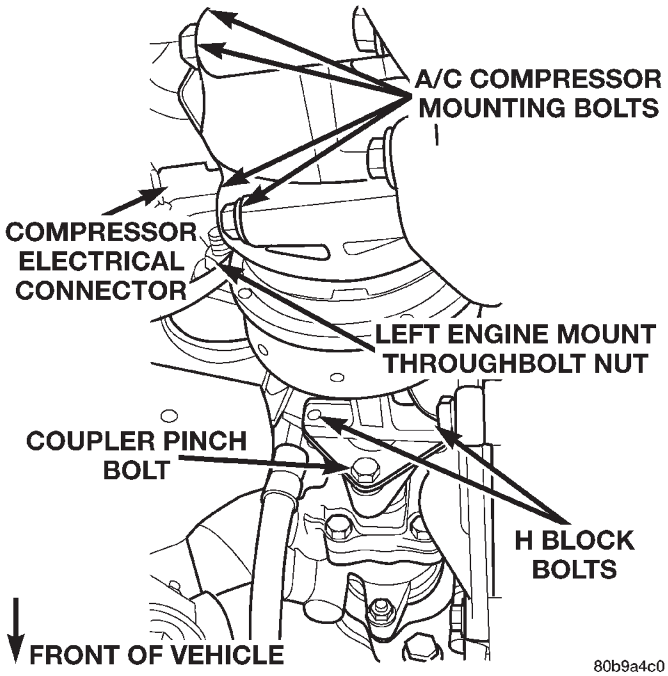

Fig. 9 A/C Compressor Position & Orientation

(8) Loosen the (4) H-Block retaining bolts, Do not remove the bolts at this time.

NOTE: Mark the position of the H-Block in relation to the power steering pump and the A/C Compressor so it may be installed in its original position.

(9) Remove the (2) H-Block retaining bolts from the power steering pump side of the block (Fig. 9).

(10) Support the A/C Compressor with mechanics wire before proceeding to the next step.

(11) Remove the (4) A/C Compressor retaining bolts (Fig. 9).

(12) Remove the remaining (2) bolts from the H-Block and remove the H-Block from the compressor.

(13) Position a jack stand and raise the weight off the left engine mount.

(14) Remove the (4) engine mount bracket bolts from the engine block.

(15) Remove the (4) trackbar support bracket bolts and remove the bracket (Fig. 10).

(16) Remove the remaining engine mount lower sill plate bolt (Fig. 10).

(17) Remove the engine mount throughbolt.

(18) Remove the left engine mount from the vehicle.

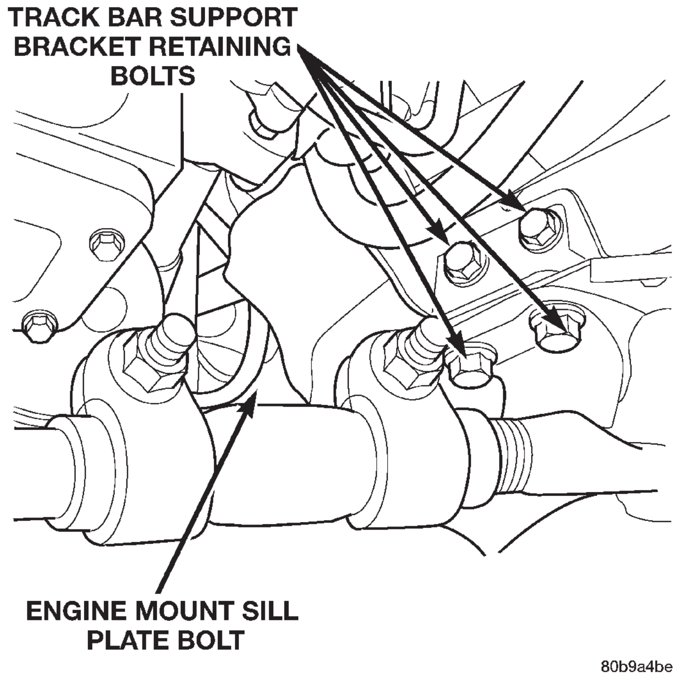

Fig. 10 Left Engine Mount Retaining Bolts

INSTALLATION—LEFT SIDE

(1) Position the engine mount and bracket and install the engine mount through bolt and nut, leaving them loose at this time.

(2) Install, but do not torque the engine mount lower sill plate bolt and the trackbar support bracket bolts (Fig. 11).

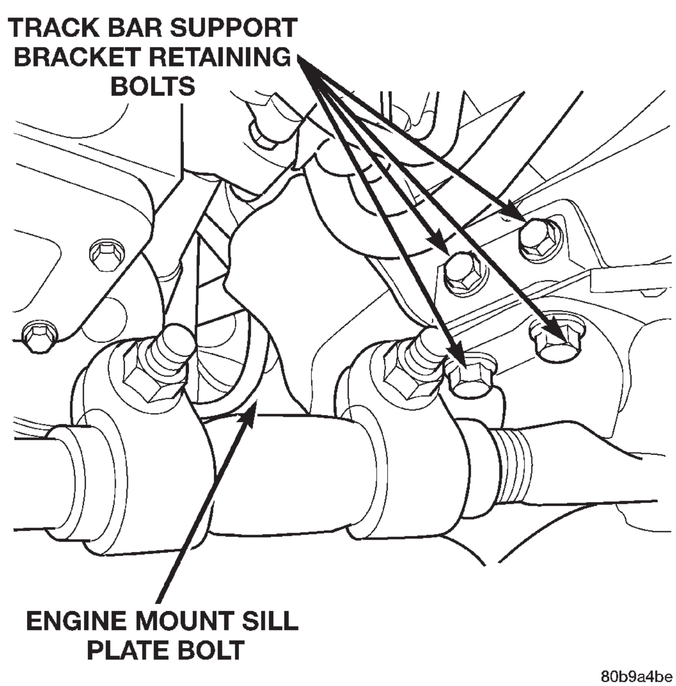

Fig. 11 Left Engine Mount Retaining Bolts

(3) Install the (4) engine mount bracket bolts. Torque to 61 N·m (45 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

(4) Torque the lower engine mount sill plate bolts to 41 N·m (30 ft. lbs.) (Fig. 11).

(5) Torque the larger trackbar support bracket bolts to 125 N·m (92 ft. lbs.) (Fig. 11).

(6) Remove the jack stand.

(7) Position the H-Block and the A/C Compressor in there original positions and install the retaining bolts (Fig. 12).

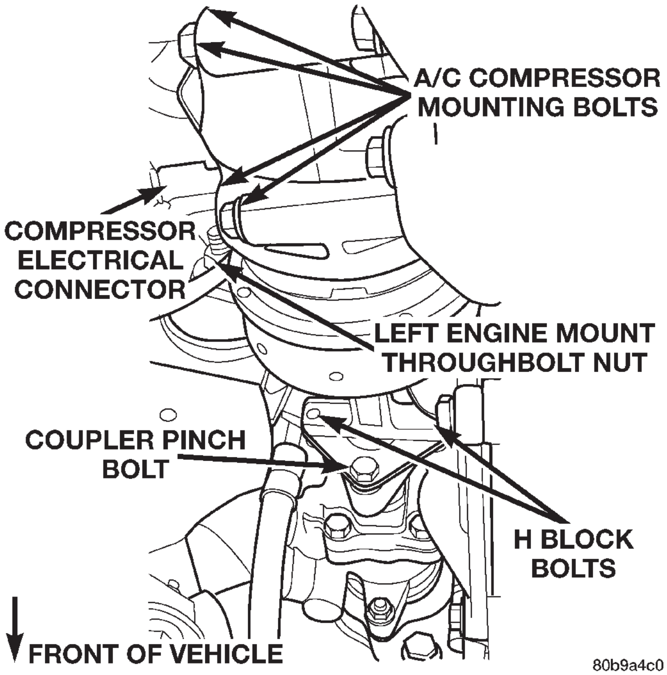

Fig. 12 A/C Compressor Position & Orientation

(8) Torque the A/C Compressor mounting bolts to 41 N·m (30 ft. lbs.) (Fig. 12).

(9) Torque all the H-Block retaining bolts to 18 N·m (159 in. lbs.).

(10) Torque the engine mount throughbolt nut to 65 N·m (48 ft. lbs.) (Fig. 12).

(11) Install the steering shaft. Torque the pinch-bolt to 49 N·m (36 ft. lbs.).

(12) Lower the vehicle from the hoist.

(13) Install the engine mount upper sill plate nuts. Torque to 41 N·m (30 ft. lbs.) (Fig. 13).

(14) Install the refrigerant line support bracket on the rear of the rocker cover.

(15) Connect the A/C compressor electrical connector.

(16) Connect the negative battery cable.

ENGINE MOUNTS — RHD DIESEL

The engine mounts support the engine at each side. These supports are made of resilient rubber.

REMOVAL—RIGHT SIDE

(1) Disconnect the negative battery cable.

(2) Make sure the steering wheel is in the unlocked position. Raise the vehicle on a hoist.

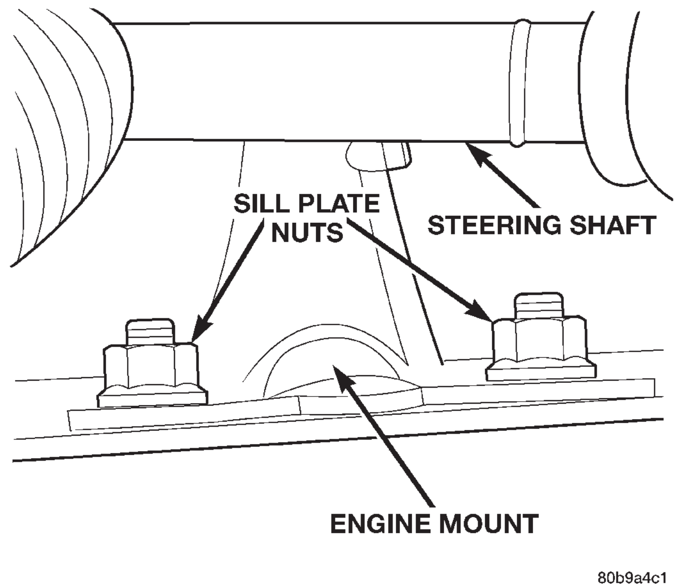

Fig. 13 Left Engine Mount Sill Plate Nuts

(3) Remove the steering shaft pinchbolt and slide the steering shaft straight off the gearbox input shaft.

CAUTION: Do not rotate the steering shaft while removed from the gearbox input shaft. Damage to the steering column clockspring will occur.

(4) Remove the oil filter adaptor retaining bolt and remove oil filter and adaptor from the vehicle.

(5) Remove the engine mount upper sill plate nuts (Fig. 14).

(6) Remove the engine mount throughbolt nut only. Leave the bolt installed at this time.

(7) Position a jack stand and raise the weight off the right engine mount.

(8) Remove the (4) trackbar support bracket retaining bolts and remove the bracket.

(9) Remove the (4) engine mount bracket bolts from the engine block.

(10) Remove the remaining engine mount lower sill plate bolt.

(11) Remove the engine mount through bolt.

(12) Remove the right engine mount from the vehicle.

INSTALLATION—RIGHT SIDE

(1) Position the engine mount and bracket in position and install the engine mount through bolt and nut, leaving them loose at this time.

(2) Install, but do not torque the engine mount lower sill plate bolts and the trackbar support bracket bolts.

REMOVAL AND INSTALLATION (Continued)

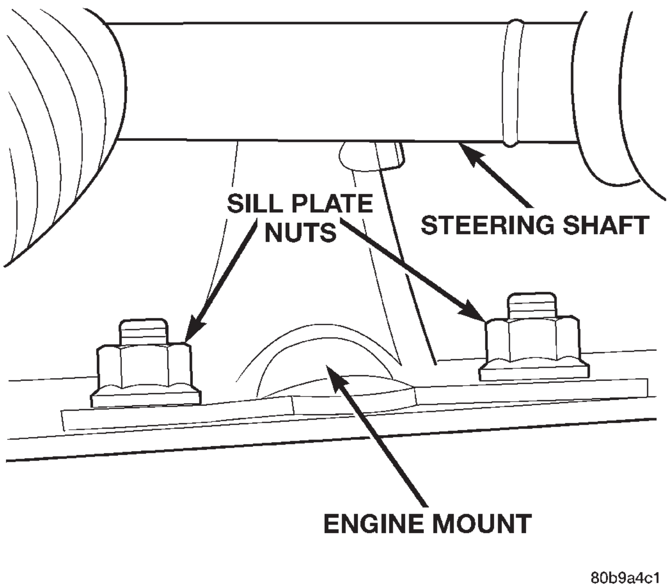

Fig. 14 Right Engine Mount Sill Plate Nuts

(3) Install the (4) engine mount bracket to engine block retaining bolts. Torque bolts to 61 N·m (45 ft. lbs.).

(4) Torque the engine mount lower sill plate bolts to 41 N·m (30 ft. lbs.).

(5) Torque the larger trackbar support bracket bolts to 125 N·m (92 ft. lbs.).

(6) Install the oil filter and adaptor on the engine. Torque oil filter adaptor retaining bolt to 50 N·m (75 ft. lbs.).

(7) Remove the jack stand.

(8) Install the engine mount upper sill plate nuts. Torque to 41 N·m (30 ft. lbs.).

(9) Torque the engine mount throughbolt nut to 65 N·m (48 ft. lbs.).

(10) Install the steering shaft and torque the pinchbolt to 49 N·m (36 ft. lbs.).

(11) Lower the vehicle from the hoist.

(12) Connect the negative battery cable.

REMOVAL—LEFT SIDE

(1) Disconnect the negative battery cable.

(2) Remove the refrigerant line support bracket bolt from the upper radiator support crossmember..

(3) Remove the A/C filter-drier assembly support bracket nuts from the left fenderwell.

(4) Disconnect A/C compressor electrical connector (Fig. 15).

(5) Raise the vehicle on a hoist.

(6) Remove the engine mount throughbolt nut only (Fig. 15). Leave the bolt installed at this time.

(7) Loosen the (4) H-Block retaining bolts. Do not remove the bolts at this time.

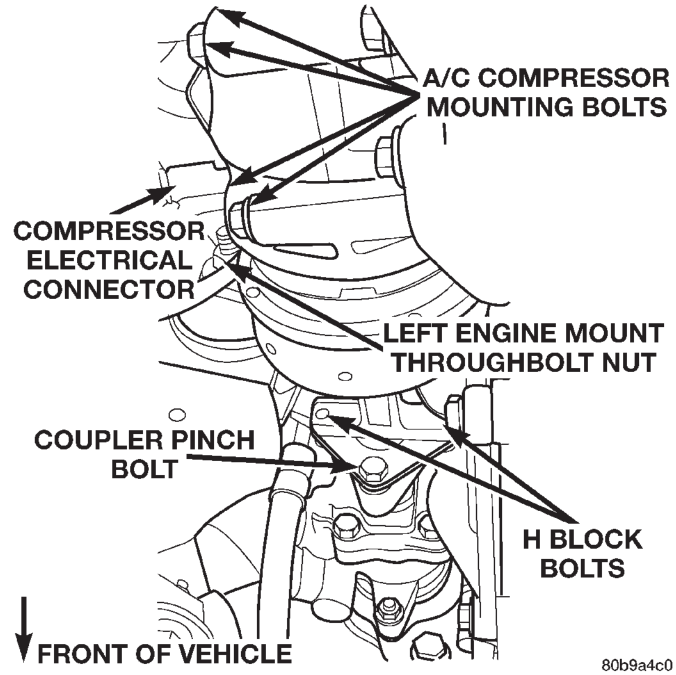

Fig. 15 A/C Compressor Position & Orientation

NOTE: Mark the position of the H-Block in relation to the power steering pump and A/C Compressor so it may be installed in its original position.

(8) Remove the (2) H-Block retaining bolts from the power steering pump side of the block (Fig. 15).

(9) Support the A/C Compressor with mechanics wire before proceeding to the next step.

(10) Remove the (4) A/C Compressor mounting bolts (Fig. 15).

(11) Remove the remaining (2) bolts from H-Block and remove the H-Block from the compressor.

(12) Position a jack stand and raise the weight off the left engine mount.

(13) Remove the (2) engine mount upper sill plate nuts.

(14) Remove the (4) engine mount bracket bolts from the engine block.

(15) Remove the (2) engine mount lower sill plate bolts.

(16) Remove the engine mount troughbolt.

(17) Remove the left engine mount from the vehicle.

INSTALLATION—LEFT SIDE

(1) Position the engine mount and bracket in position and install the engine mount through bolt and nut, leaving them loose at this time.

(2) Install, but do not torque engine mount lower sill plate bolts.

(3) Install the (4) engine mount bracket to engine block retaining bolts. Torque to 61 N·m (45 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

(4) Torque the (2) lower engine mount sill plate bolts to 41 N·m (30 ft. lbs.).

(5) Install the (2) engine mount upper sill plate nuts. Torque to 41 N·m (30 ft. lbs.).

(6) Remove the jack stand.

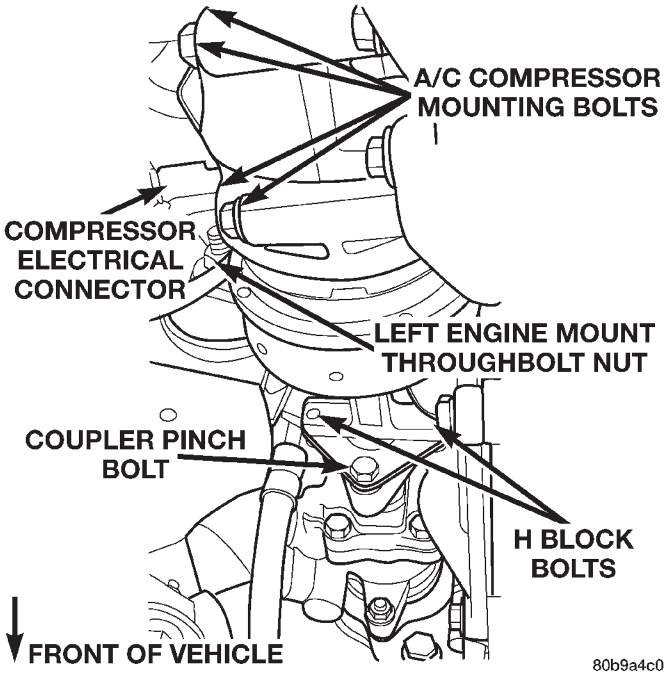

Fig. 16 A/C Compressor Position & Orientation

(7) Position the H-Block and the A/C Compressor in there original positions and install the retaining bolts (Fig. 16).

(8) Torque the A/C Compressor mounting bolts to 41 N·m (30 ft. lbs.) (Fig. 16).

(9) Torque all the H-Block bolts to 18 N·m (159 in. lbs.) (Fig. 16).

(10) Torque the engine mount throughbolt nut to 65 N·m (48 ft. lbs.) (Fig. 16).

(11) Lower the vehicle from the hoist.

(12) Install the refrigerant line support bracket.

(13) Install the A/C filter-drier support bracket.

(14) Connect the negative battery cable.

2.5L DIESEL ENGINE

REMOVAL

(1) Disconnect both of the battery cables and remove the battery.

(2) Mark the hinge locations on the hood for alignment reference during installation.

CAUTION: Wrap the appropriate size drillbit with masking tape 1/4 inch from tip. This will prevent damaging the hood outer panel when drilling out the rivets retaining the hood latch cable control assembly.

(3) Drill out the rivets retaining the hood latch cable control assembly.

(4) Remove the hood latch assemblies from the hood.

(5) Disconnect and remove the engine compartment lamp.

(6) With assistance from another person, remove the hood.

(7) Cover both of the fenders and the grill opening panel to prevent paint damage.

(8) Remove the battery tray.

(9) Disconnect the radiator cooling fan electrical.

(10) Remove the manual cooling fan and let set inside of the fan shroud.

(11) If equipped, recover the refrigerant. Refer to Group 24, Heating and Air Conditioning for the procedure.

(12) Disconnect the suction and discharge lines and remove the lines from the vehicle.

(13) Disconnect the breather hose and remove the air filter outlet hose from the vehicle (Fig. 17).

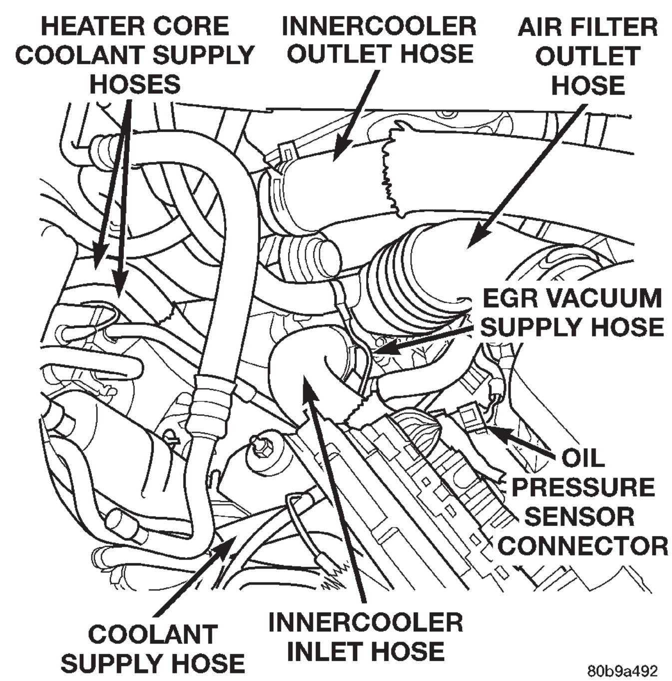

Fig. 17 LHD Engine Compartment — Diesel

(14) Disconnect the oil pressure sensor electrical connector (Fig. 17).

(15) Disconnect the EGR vacuum supply hose from the engine (Fig. 17).

(16) Remove the coolant reservoir cap.

(17) Drain the cooling system. Refer to Group 7, Cooling System for the procedure.

(18) Remove the upper and lower radiator hoses from the engine.

(19) Remove the innercooler inlet and outlet hoses from the engine (Fig. 17).

REMOVAL AND INSTALLATION (Continued)

(20) Remove the coolant reservoir supply hose from the engine (Fig. 17).

(21) On L.H.D. vehicles, disconnect the heater core coolant supply and the brake vacuum supply hoses from the engine.

(22) On R.H.D. vehicles, disconnect the heater core coolant supply and the brake vacuum supply hoses from the right side of the engine compartment. Remove the line assembly retaining bolt and bracket from the rear of the rocker cover and position the assembly out of the way.

(23) Working inside of the vehicle, remove the center console. Refer to Group 23, Body for the procedure.

(24) Remove the shifter boot seal.

(25) Disconnect the shifter from the transmission

(26) Raise the vehicle on a hoist.

(27) Remove the lower fan shroud retaining bolts and remove the lower fan shroud panel.

(28) Remove the engine ground wire (Fig. 18).

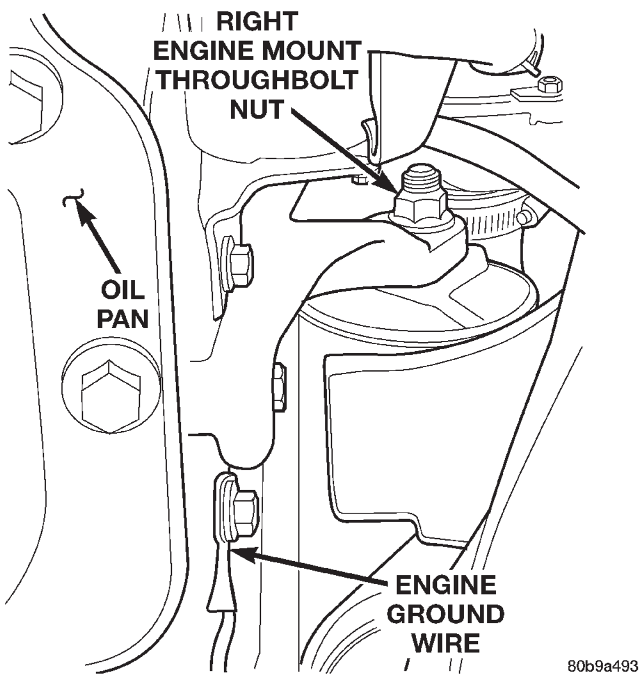

Fig. 18 Engine Ground Wire Location

(29) Remove the right and left engine mount throughbolt nuts only. Do not remove the bolts at this time (Fig. 18).

(30) Drain the transmission fluid. Refer to Group 21, Transmission and Transfer Case for the procedure.

(31) Mark the position of the front and rear driveshafts in relation to there companion flanges.

(32) Remove the front driveshaft. Refer to Group 3, Differential and Driveline for the procedure.

(33) Remove the rear driveshaft. Refer to Group 3, Differential and Driveline for the procedure.

(34) Disconnect the exhaust system at the (3) bolt flange (Fig. 19).

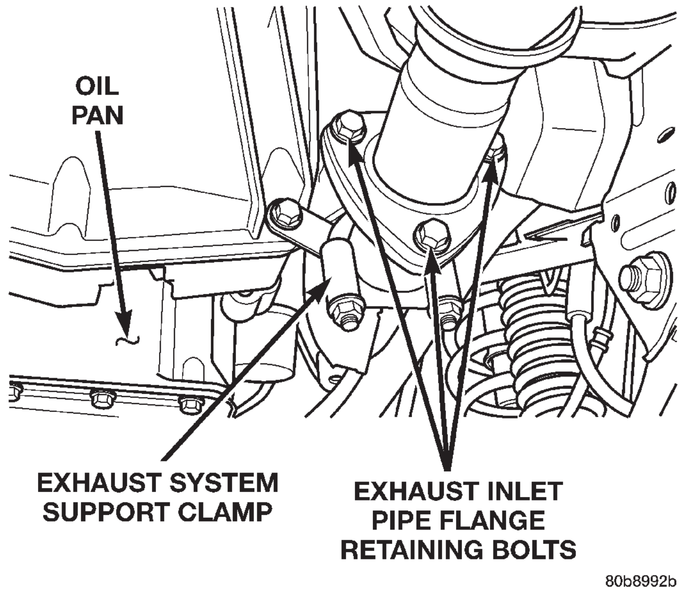

Fig. 19 Exhaust System Inlet Pipe Connection

(35) Remove the exhaust system support clamp (Fig. 19).

(36) Remove the clutch slave cylinder from the clutch housing (Fig. 20).

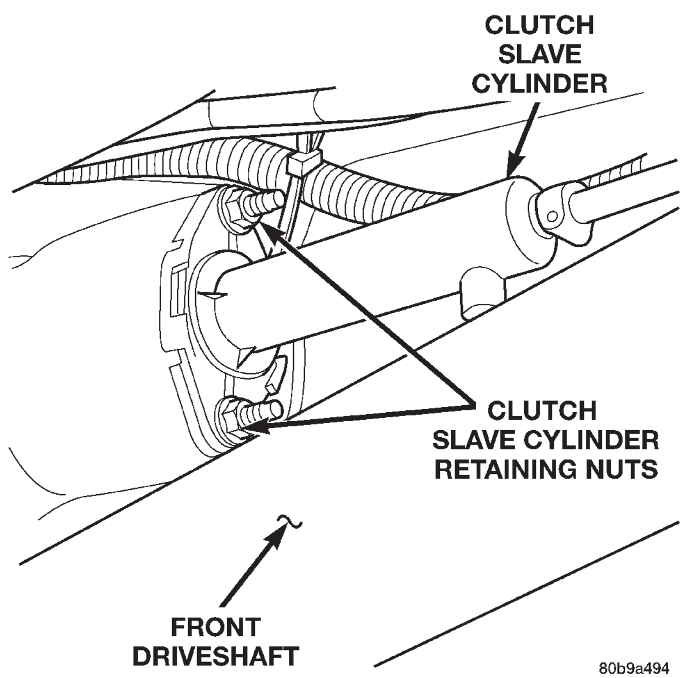

Fig. 20 Clutch Slave Cylinder

(37) Remove the (3) nuts retaining the transfer case shift linkage and position the linkage aside (Fig. 21).

REMOVAL AND INSTALLATION (Continued)

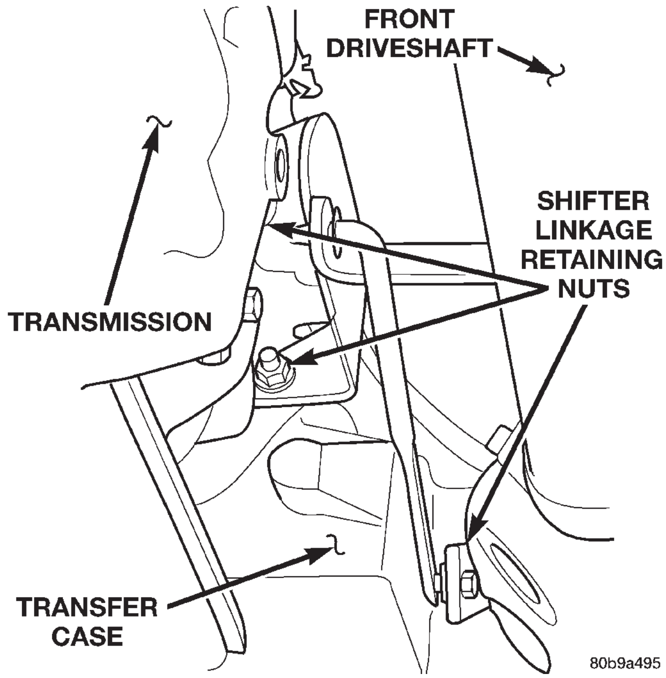

Fig. 21 Transfer Case Shift Linkage — 4x4

(38) Disconnect the electrical connectors and the vent hose and from the transfer case and transmission.

(39) Support the rear of the transmission with a jack.

(40) Remove the transmission support crossmember.

(41) Lower the transmission to gain access to the transmission to engine retaining bolts.

(42) Remove all the bolts securing the transmission to the engine assembly. Remove the transmission and the transfer case assembly from the vehicle.

(43) Lower the vehicle from the hoist.

(44) Remove the fan shroud and both cooling fans as an assembly.

(45) Remove the oil filter and adaptor from the vehicle as an assembly.

(46) Remove the power steering fluid pressure line from the steering gear.

(47) Disconnect the electrical connectors from the bottom of the fuel / water separator.

(48) Drain the fuel / water separator. Refer to Group 9, Fuel System for the procedure.

(49) Remove the fuel lines from the fuel / water separator and cap.

(50) Remove the fuel / water separator and mounting bracket assembly from the bulkhead.

(51) Remove all the remaining wiring from the engine assembly and position it out of the way.

(52) Attach a lifting device to the engine lifting brackets and slightly raise the weight off the engine mounts.

(53) Remove the right and left engine mount throughbolts.

(54) Carefully lift the engine out of the engine compartment.

INSTALLATION

(1) Carefully place the engine assembly into the engine compartment..

(2) Install the engine mount throughbolts and nuts in there original position. Leaving them loose at this time.

(3) Install the fuel / water separator and mounting bracket on the bulkhead.

(4) Install the fuel lines on the fuel / water separator.

(5) Connect the electrical connectors to the bottom of the fuel/water separator.

(6) Install the power steering fluid pressure line on the steering gear.

(7) Install the oil filter and adaptor on the engine. Torque adaptor retaining bolt to 50 N·m (37 ft. lbs.). Fill the oil filter prior to installation.

(8) Install the fan shroud and both cooling fans as an assembly in the vehicle.

(9) Raise the vehicle on a hoist.

(10) Install the transmission and transfer case assembly in the vehicle.

(11) Install the bolts securing the transmission to the engine assembly. Torque to 74.6 N·m (55 ft. lbs.).

(12) Position, connect and secure all electrical connectors and vent hoses on the transfer case and transmission in there original positions.

(13) Install the transmission support crossmember. Torque bolts to 50 N·m (37 ft. lbs.).

(14) Install the (3) nuts retaining the transfer case shift linkage (Fig. 22).

(15) Install the clutch slave cylinder on the clutch housing, making sure the cylinder pushrod is properly aligned with the clutch fork (Fig. 23).

(16) Connect the exhaust system at the (3) bolt flange (Fig. 24).

(17) Install the exhaust system support clamp (Fig. 24).

(18) Install the rear driveshaft in its original position.

(19) Install the front driveshaft in its original position.

(20) Install the lower fan shroud panel and retaining bolt.

(21) Install the engine ground wire (Fig. 25).

(22) Lower the vehicle from the hoist.

(23) Working inside the vehicle, install the shifter on the transmission

(24) Install the shifter boot seal.

REMOVAL AND INSTALLATION (Continued)

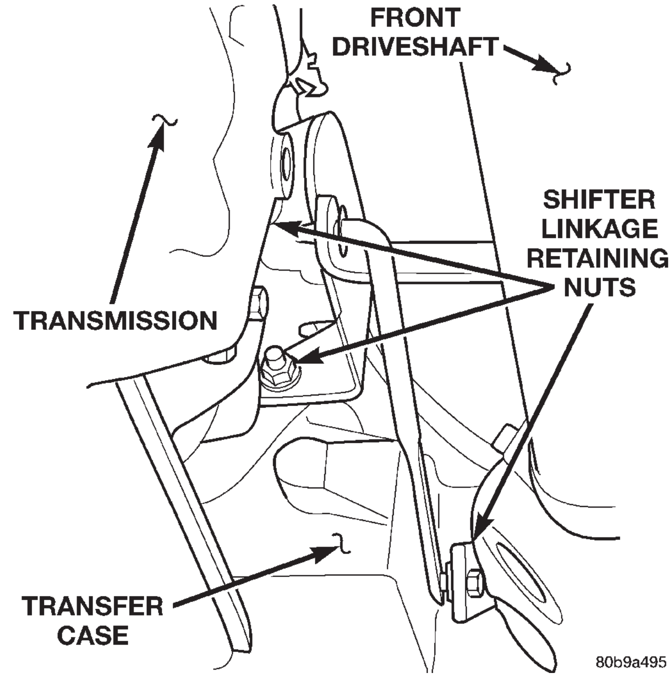

Fig. 22 Transfer Case Shift Linkage — 4x4

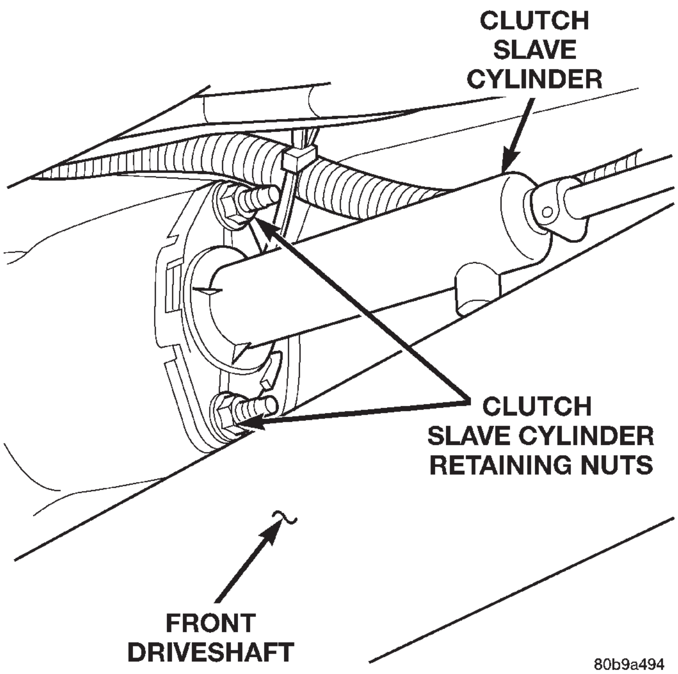

Fig. 23 Clutch Slave Cylinder

(25) Install the center console. Refer to Group 23, Body for the procedure.

(26) Position, connect and secure all engine wiring in its original position

(27) On L.H.D. vehicles, connect the heater core coolant supply and brake vacuum supply hoses on the engine.

(28) On R.H.D. vehicles, position the steel line assembly and connect the heater core coolant supply and the brake vacuum supply hoses on the engine.

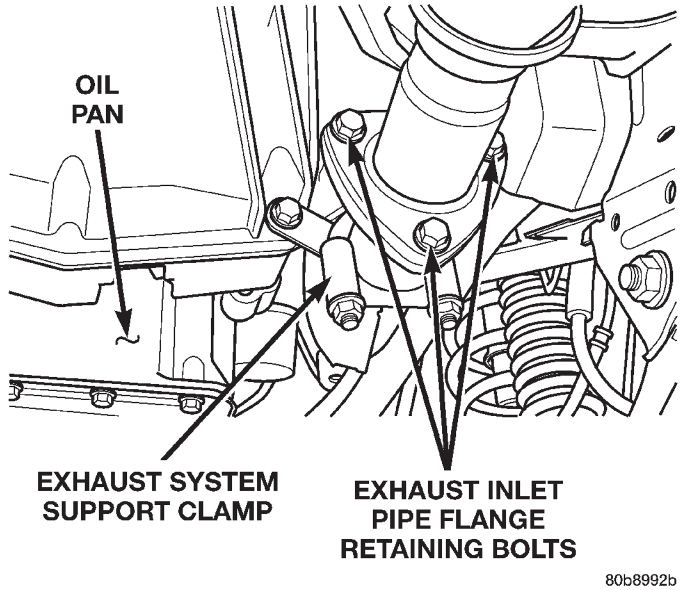

Fig. 24 Exhaust System Inlet Pipe Connection

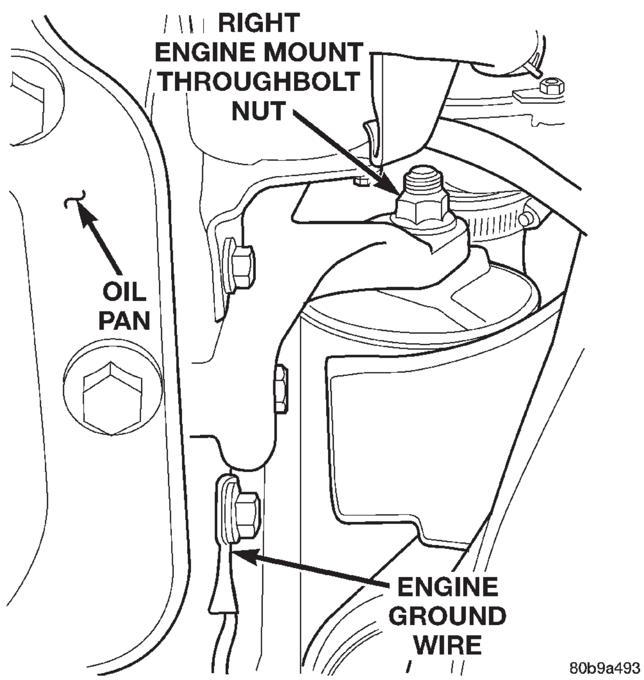

Fig. 25 Engine Ground Wire Location

(29) Install the coolant reservoir supply hose on the engine (Fig. 26).

(30) Install the innercooler inlet and outlet hoses on the engine (Fig. 26).

(31) Install the upper and lower radiator hoses on the engine.

(32) Fill the cooling system. Refer to Group 7, Cooling System, for the procedure.

(33) Connect the oil pressure sensor electrical connector (Fig. 26).

REMOVAL AND INSTALLATION (Continued)

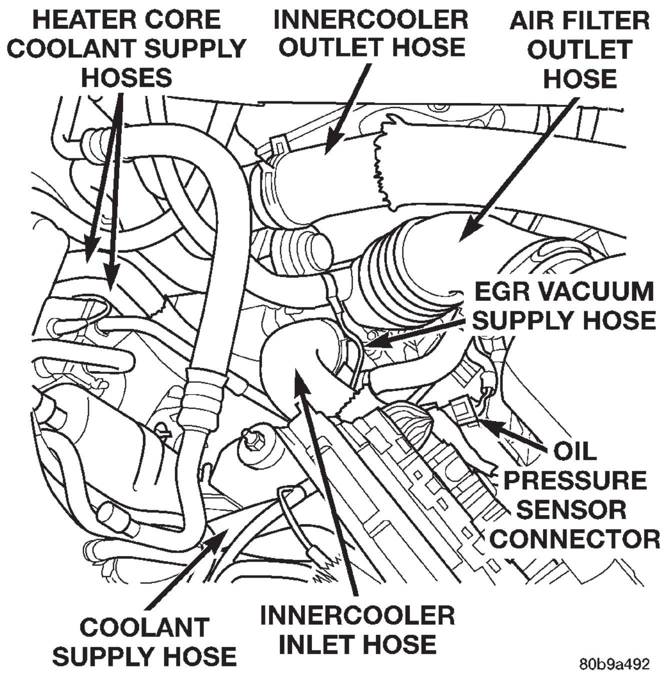

Fig. 26 LHD Engine Compartment — Diesel

(34) Connect the EGR vacuum supply hose on the engine (Fig. 26).

(35) Install the air filter outlet hose and connect the breather hose on the engine (Fig. 26).

(36) Install the refrigerant suction and discharge lines. Torque the retaining bolts on the A/C compressor to 22 N·m (200 in. lbs.). Make sure the O-Rings are well lubricated and free of tears.

(37) Charge the refrigerant system. Refer to Group 24, Heating and Air Conditioning for the procedure.

(38) Install the manual cooling fan.

(39) Connect the electric cooling fan electrical connector.

(40) Install the battery tray.

(41) With assistance from another person, install the hood.

NOTE: Use the previously marked hinge locations for alignment reference.

(42) Install the hood retaining bolts.

(43) Install the rivets on the hood latch cable control assembly.

(44) Install the hood latch assemblies on the hood.

(45) Install and connect the engine compartment lamp.

(46) Install the battery and connect both of the battery cables.

(47) Fill the power steering fluid. Refer to Group 19, Steering — Power Steering Pump-Initial operation for the procedure.

(48) Fill the transmission fluid. Refer to Group 21, Transmission and Transfer Case for the procedure.

(49) Check the engine oil level before engine start up.

CYLINDER HEAD COVER

REMOVAL

(1) Disconnect the negative battery cable.

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) On right hand drive vehicles, drain the cooling system. Refer to Group 7, Cooling System for the procedure.

(3) Recover the air conditioning system, if equipped. Refer to Group 24, Heating and Air Conditioning for the procedure.

(4) Remove the A/C lines at the compressor and cap all openings. Refer to Group 24, Heating and Air Conditioning for the procedure. Remove the A/C line support bracket attached to cylinder head cover, and move the A/C, vacuum lines away from the cylinder head.

(5) Remove the generator support brace.

(6) Remove the Crankcase breather hose from the rear of the valve cover

(7) Remove the cylinder head cover bolts.

(8) Remove the cylinder head cover.

INSTALLATION

(1) Install the cylinder head cover. Torque the bolts to 15 N·m (133 in. lbs.).

(2) Connect the crankcase breather hose.

(3) Install the generator support brace. Torque bolts to 7 N·m (62 in. lbs.).

(4) Install the A/C lines on the compressor and install the support bracket on the cylinder head cover. Torque bolt to 7 N·m (62 in. lbs.).

(5) Connect the negative battery cable.

(6) If equipped with A/C, evacuate and charge the air conditioning system. Refer to Group 24, Heater and Air Conditioning.

(7) On right hand drive vehicles, 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.

(8) Operate the engine with the radiator cap off. Inspect for leaks and continue operating the engine until the thermostat opens. Add coolant, if required.

REMOVAL AND INSTALLATION (Continued)

HYDRAULIC TAPPETS

REMOVAL

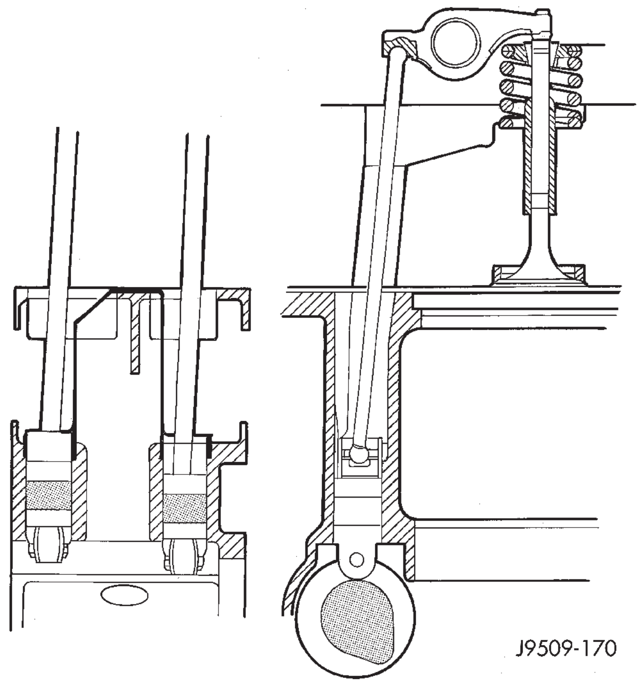

Fig. 27 Tappet And Rocker Arm Assembly

(1) Disconnect the negative battery cable.

(2) Discharge the air conditioning system, if equipped. Refer to Group 24, Heating and Air Conditioning for procedure.

(3) If equipped with air conditioning, remove the A/C lines at the compressor and cap.

(4) Remove the A/C line bracket attached to the cylinder head cover and move the lines away from the cylinder head.

(5) Remove cylinder head cover. Refer to cylinder head cover removal and installation procedure in this section.

(6) Remove the rocker assemblies and push rods. Refer to rocker arms and push rod removal and installation procedure in this section. Identify push rods to ensure installation in original location.

(7) Remove cylinder head, intake manifold, and exhaust manifold. Refer to cylinder head removal and installation in this section.

(8) Remove the tappet retainers (Fig. 28).

(9) Slide Hydraulic Tappet Remover/Installer Tool through opening in block and seat tool firmly in the head of tappet.

(10) Pull the tappet out of the bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

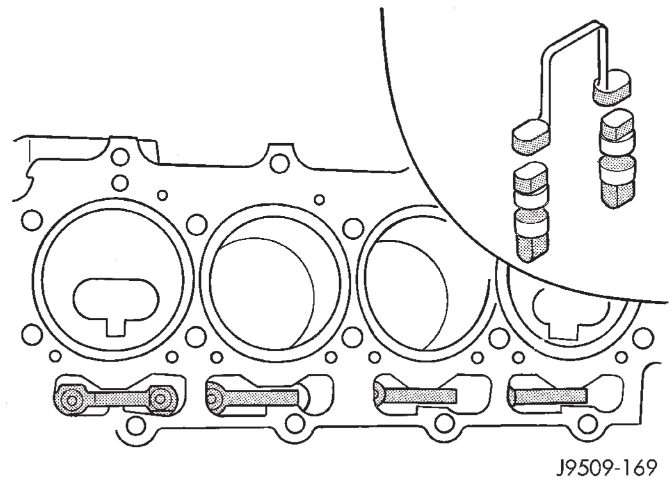

Fig. 28 Tappet And Retainer

CAUTION: The plunger and tappet bodies are not interchangeable. The plunger and valve must always be fitted to the original body. It is advisable to work on one tappet at a time to avoid mixing of parts. Mixed parts are not compatible. DO NOT disassemble a tappet on a dirty work bench.

INSTALLATION

(1) Lubricate the tappets.

(2) Install the tappets and retainers in their original positions. Ensure that the oil feed hole in the side of the tappet body faces up (away from the crankshaft).

(3) Install the cylinder head, intake manifold, and exhaust manifold. Refer to cylinder head removal and installation in this section.

(4) Install the push rods.

(5) Install the rocker arms. Refer to rocker arms and push rod removal and installation in this section.

(6) Install the cylinder head cover. Refer to cylinder head cover removal and installation in this section.

(7) Connect the negative battery cable.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

(8) Start and operate engine. Warm up to normal operating temperature.

REMOVAL AND INSTALLATION (Continued)

ROCKER ARMS AND PUSH RODS

REMOVAL

(1) Disconnect the negative battery cable.

(2) Discharge the air conditioning system, if equipped. Refer to Group 24, Heating and Air Conditioning for procedure.

(3) If equipped with air conditioning, remove the service valves and cap the compressor ports. Refer to Group 24, Heating and Air Conditioning.

(4) Remove the generator bracket.

(5) Remove the cylinder head cover. Refer to cylinder head cover removal and installation in this section.

(6) Remove the rocker arm retaining nut (Fig. 29).

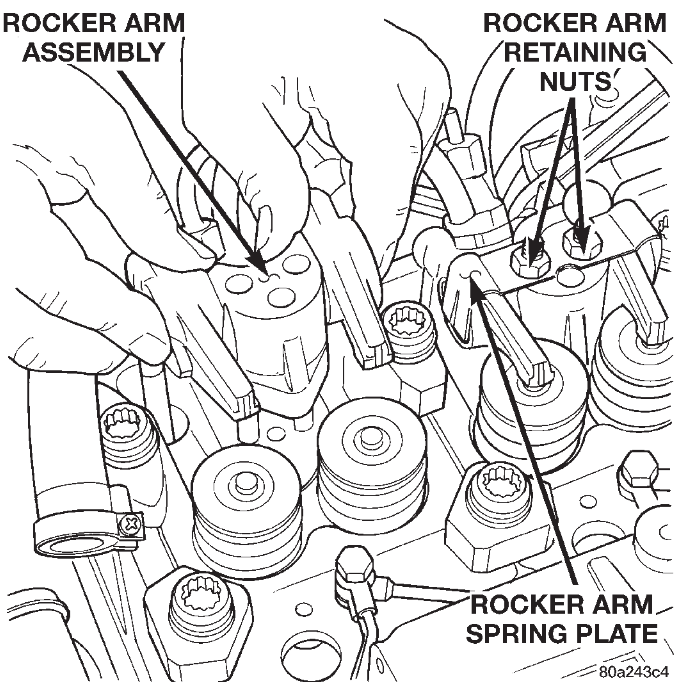

Fig. 29 Rocker Arm Retaining Nut

(7) Remove the rocker assembly. Place them on a bench in the same order as removed.

(8) Remove the push rods and place them on a bench in the same order as removed.

INSTALLATION

(1) Rotate the crankshaft until the mark lines up with the TDC mark on the timing cover.

(2) Install the push rods in the same order as removed.

(3) Install the rocker arm assemblies in the same order as removed. Torque nuts to 29.4 N·m (264 in. lbs.).

(4) Install the cylinder head cover. Refer to cylinder head cover removal and installation in this group.

(5) Install the generator bracket. Torque bolts to 7 N·m (4 ft. lbs.).

(6) If equipped, evacuate and charge the air conditioning system. Refer to Group 24, Heater and Air Conditioning.

(7) Connect the negative battery cable.

VALVE SPRINGS

This procedure can be done with the engine cylinder head installed on the block.

REMOVAL

(1) Disconnect the negative battery cable.

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.

(2) Remove the cylinder head cover. Refer to cylinder head cover removal and installation in this section.

(3) Remove the rocker arms assemblies and push rods. Refer to rocker arm and push rod removal and installation in this section. Retain the push rods, and rocker arms assemblies in the same order and position as removed.

(4) Inspect the springs and retainer for cracks and possible signs of weakening.

(5) Install an air hose adaptor in the fuel injector hole.

(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.

(7) Tap the retainer or tip with a rawhide hammer to loosen the lock from the retainer. Use Valve Spring Compressor Tool to compress the spring and remove the locks.

(8) Remove the valve spring and retainer.

(9) Inspect the valve stems, especially the grooves. An Arkansas smooth stone should be used to remove nicks and high spots.

INSTALLATION

(1) Install the valve spring and retainer.

(2) Compress the valve spring with Valve Spring Compressor Tool 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.

(3) Disconnect the air hose. Remove the adaptor from the fuel injector hole and install the fuel injector.

(4) Repeat the procedures for each remaining valve spring to be removed.

(5) Install the push rods. Ensure the bottom end of each rod is centered in the plunger cap seat of the hydraulic valve tappet.

REMOVAL AND INSTALLATION (Continued)

(6) Install the rocker arm assemblies, in their original locations. Torque nuts to 29.4 N·m (264 in. lbs.).

(7) Install the cylinder head cover. Refer to cylinder head cover removal and installation in this section.

(8) Connect the negative battery cable.

ENGINE CYLINDER HEAD

REMOVAL

(1) Disconnect the negative battery cable.

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 cooling system. Refer to Group 7, Cooling System for procedure.

(3) Discharge the air conditioning system, if equipped. Refer to Group 24, Heating and Air Conditioning for procedure.

(4) If equipped with air conditioning, remove the A/C lines at the compressor and cap. Refer to Group 24, Heating and Air Conditioning. Remove A/C line bracket attached to cylinder head cover, and move A/C lines away from cylinder head.

(5) Remove the air cleaner hose from turbocharger and breather hose.

(6) Remove the air cleaner assembly and breather hose.

(7) Remove the generator support bracket.

(8) Remove the upper radiator hose and coolant recovery hose.

(9) Remove the water manifold and recovery hose.

(10) Disconnect the heater hoses and coolant recover bottle hose.

(11) Disconnect the EGR tube from EGR valve.

(12) Remove the EGR valve

(13) Remove the exhaust heat shield from exhaust manifold.

(14) Remove the exhaust heat shield from down pipe.

(15) Remove the exhaust down pipe from turbocharger (Fig. 30).

(16) Disconnect the oil feed line from turbocharger.

(17) Disconnect the oil drain line from turbocharger.

(18) Remove the Exhaust manifold. Refer to Group 11, Exhaust System and Turbocharger.

(19) Remove the Intake manifold. Refer to intake manifold removal and installation procedure in this section.

(20) Remove the oil feed line for rocker arm assemblies (Fig. 31).

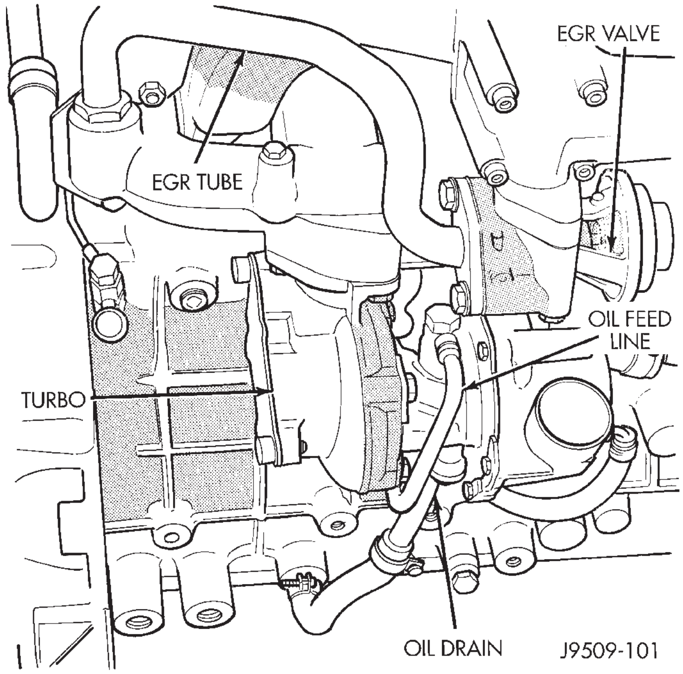

Fig. 30 Turbocharger

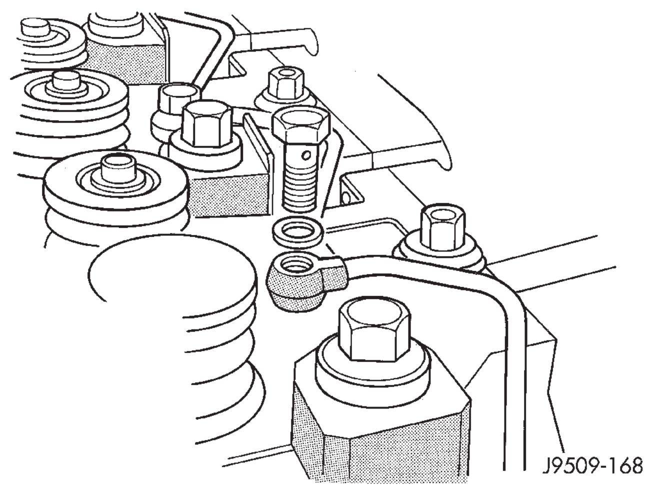

Fig. 31 Rocker Arm Oil Feed Lines

(21) Remove the Crankcase breather hose from rear of the valve cover

(22) Remove the injector sensor wire and the glow plug hot lead.

(23) Remove the fuel lines and fuel filter. Refer to Group 14, Fuel Systems for procedure.

(24) Remove the injector fuel lines from injectors to pump.

(25) Remove the fuel injectors with tool VM.1012 (Fig. 32). Refer to Group 14, Fuel System for procedure.

(26) Remove the engine cylinder head cover.

(27) Remove the rocker retaining nuts (Fig. 34).

(28) Remove the rocker arm assemblies. Place them on a bench in the same order as removed.

REMOVAL AND INSTALLATION (Continued)

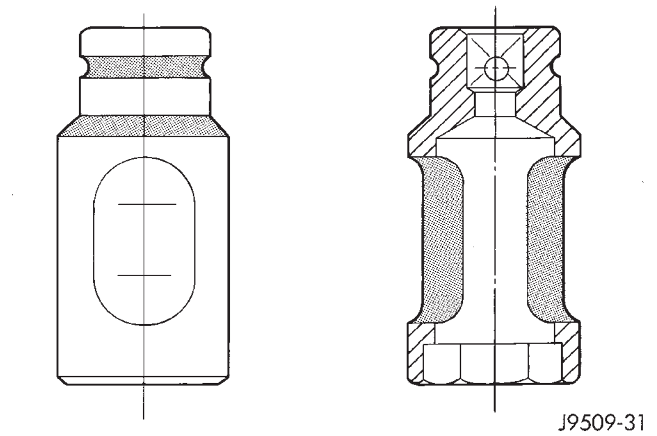

Fig. 32 Fuel Injector Tool VM.1012

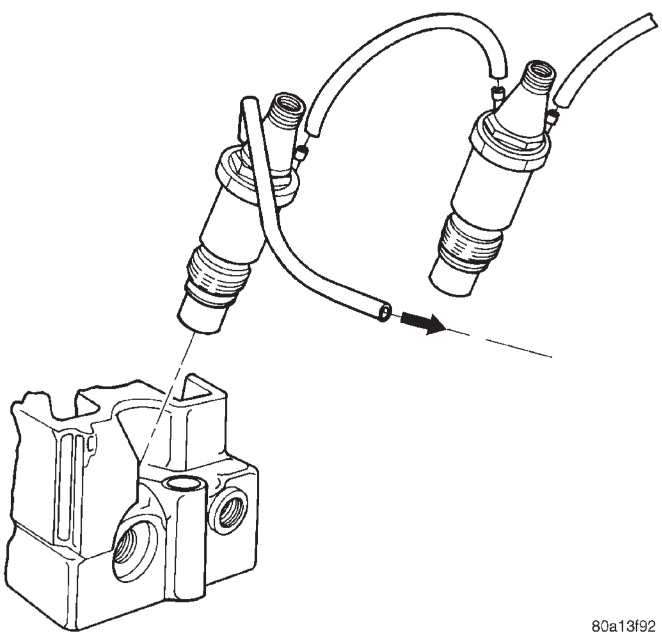

Fig. 33 Fuel Injector

(29) Remove the push rods and place them on a bench in the same order as removed.

(30) Mark the cylinder head positions.

(31) Remove the engine cylinder head bolts with special tool VM.1018 and VM.1019.

(32) Remove the engine cylinder head and gasket.

(33) Stuff clean lint free shop towels into the cylinder bores.

CYLINDER HEAD GASKETS

A steel cylinder head gasket is used for all four cylinder heads.

Cylinder head gaskets are available in three thicknesses. Identification holes in the right front corner of the gasket indicate the thickness of the gasket (Fig. 35).

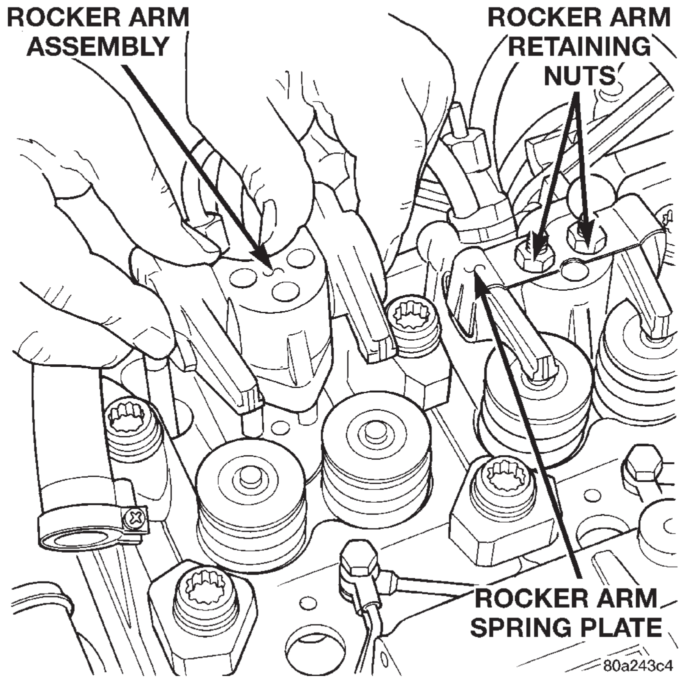

Fig. 34 Rocker Arm Retaining Nuts

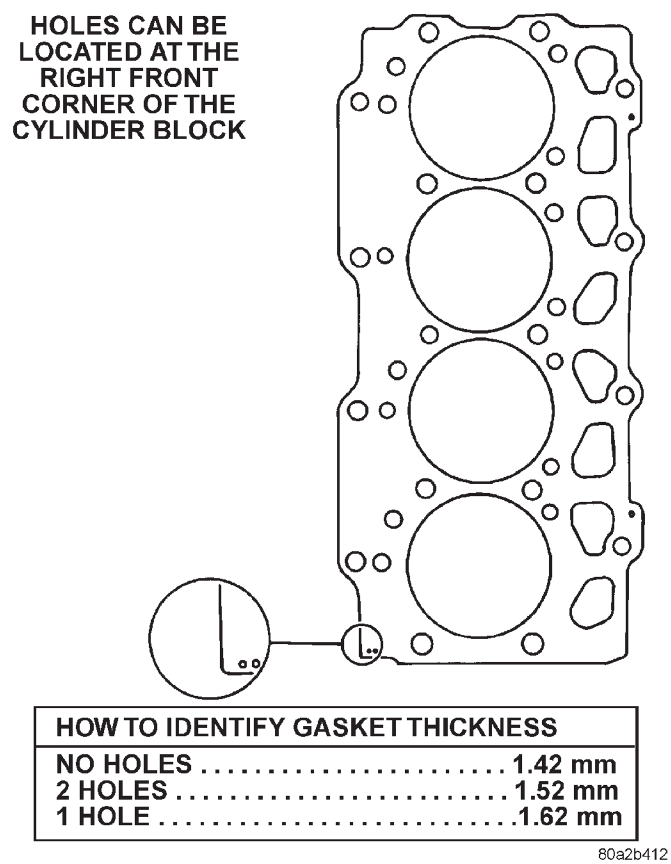

Fig. 35 Steel Type Cylinder Head Gasket—identification

CAUTION: Piston protrusion must be measured, to determine cylinder head gasket thickness, if one or more cylinder wall liners have been replaced.

REMOVAL AND INSTALLATION (Continued)

NOTE: If cylinder wall liners have not been removed; the same thickness head gasket removed, may be used.

MEASURING PISTON PROTRUSION

(1) Use special tool VM.1010 with dial indicator special tool VM.1013 (Fig. 36).

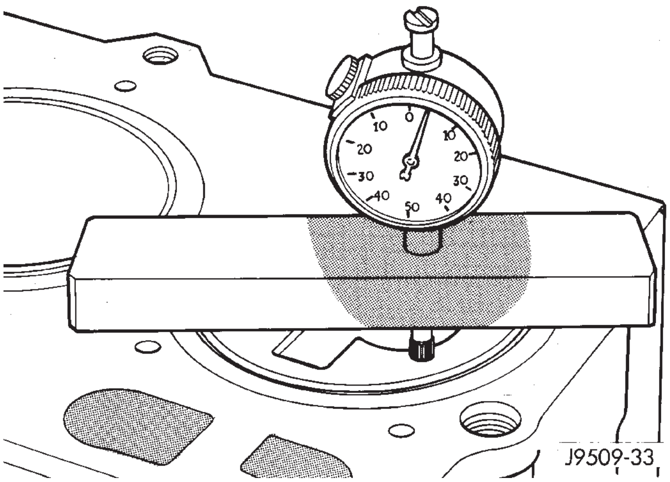

Fig. 36 Measuring Piston Protrusion

(2) Bring the piston of cylinder no. 1 exactly to top dead center.

(3) Zero the dial indicator on the cylinder block mating surface.

(4) Setup the dial indicator on the piston crown (above the center of the piston pin) 5mm (1/8 in.) from the edge of the piston and note the measurement (Fig. 37).

(5) Repeat the procedure with the rest of the cylinders.

(6) Establish the thickness of the steel gasket for all four cylinder heads on the basis of the greatest piston protrusion (Fig. 35).

Measured dimension (mm)	0.53 - 0.62
Cyl. head gasket thickness (mm)	1.42
Piston clearance (mm)	0.80 - 0.89
Measured dimension (mm)	0.63 - 0.72
Cyl. head gasket thickness (mm)	1.52
Piston clearance (mm)	0.80 - 0.89
Measured dimension (mm)	0.73 - 0.82
Cyl. head gasket thickness (mm)	1.62
Piston clearance (mm)	0.80 - 0.89

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Fig. 37 Piston Protrusion Chart

CAUTION: Gaskets are to be installed DRY. DO NOT use a gasket sealing compound on the gasket.

INSTALLATION

(1) Remove the shop towels from the cylinder bores. Coat the bores with clean engine oil.

(2) Install cylinder head alignment studs VM.1009.

(3) After determining the correct head gasket thickness, clean the block and head mating surfaces, place the engine cylinder head gasket over the alignment studs.

(4) Place the engine cylinder head over the alignment studs.

CAUTION: New cylinder head bolts should be used.

(5) Tighten the engine cylinder head bolts in sequence according to the following procedure (Fig. 38):

a. The threads and underside heads of the bolts should be lubricated. Use the cylinder head alignment studs tool number VM-1009. Position the heads on the block and secure with the ten large center bolts and spacers (clamps), finger tight only.

b. Ensure that the various clamps are installed correctly and the head gasket remains in it's proper position, completely covered. Then, lubricate and install the eight small bolts, also finger tight.

(6) Install the intake and exhaust manifolds with a new gasket, partially tightening the nuts to a maximum of 5 N·m (44 in. lbs.). This will align the heads. Refer to Group 11, Exhaust System and Turbocharger for the proper procedure. Install lift eye and brake vacuum tube at this time.

(7) Then, tighten the 12mm bolts with special tool VM.1019 in the following manner:

(8) **1st Phase:** Tightening Head Bolts (Fig. 38). Central bolts (A-L): Tighten all bolts, starting with bolt H then G-F-E-D-C-B-A-L-I, to 30 N·m. Tighten all bolts an additional 70°, starting with bolt A and continuing in alphabetical order. Finally, tighten all bolts an additional 70°, starting again with bolt A and continuing in alphabetical order.

(9) Tighten the 14mm bolts in the following manner:

(10) Side bolts (M1-M2): Tighten M1 bolts to 30 N·m, then rotate them 85° (±5). Tighten M2 bolts to 30 N·m, then rotate them 85° (±5).

NOTE: If vehicle is equipped with A/C do not install A/C lines to compressor and charge A/C till Phase 2 is complete.

(11) **2nd Phase:** After 20 minutes of engine operation at operating temperature, allow engine to cool down completely. Then retorque the head bolts as follows:

(12) Central bolts A-L: Completely back off bolts one-by-one and then retighten to 30 N·m plus 130° (±5°). Then proceed in the same way, bolt by bolt, following alphabetical order, as indicated.

REMOVAL AND INSTALLATION (Continued)

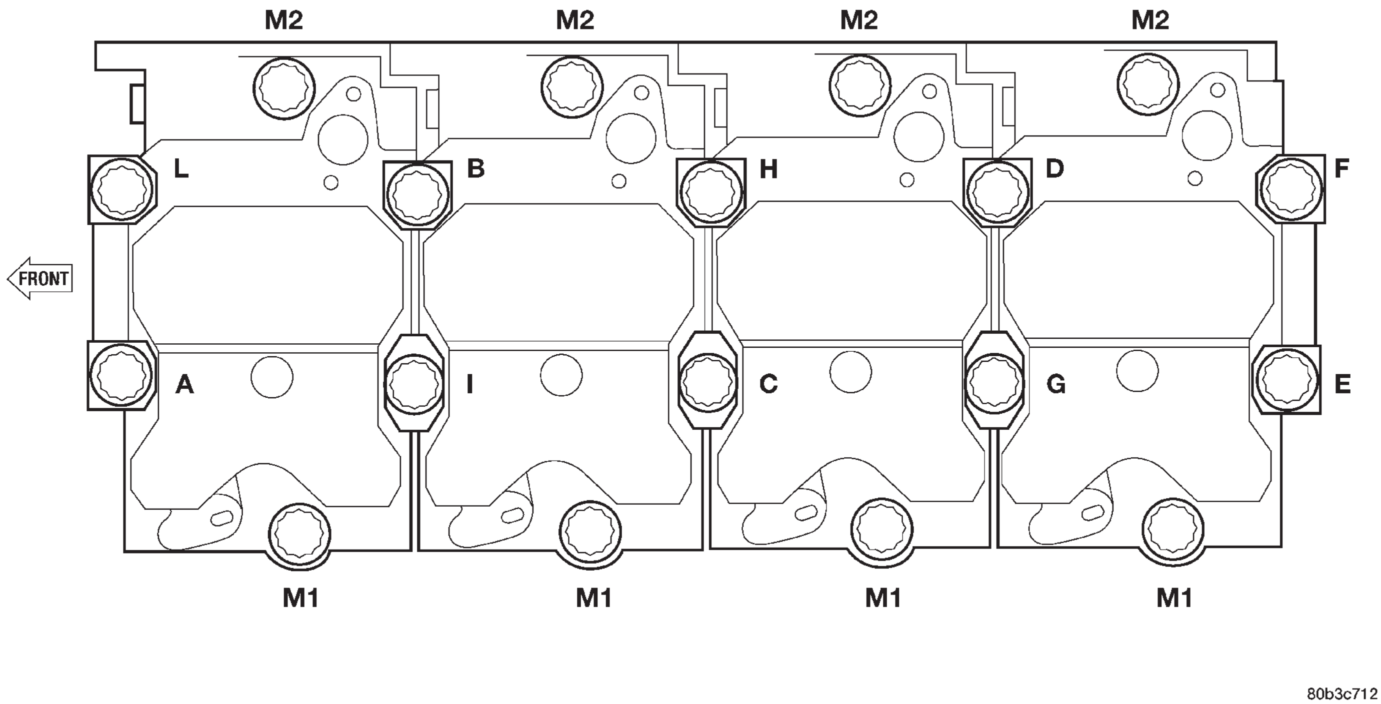

Fig. 38 Engine Cylinder Head Bolt Tightening Sequence

(13) Side bolts M1-M2: **Without slackening**, torque bolts M1 then bolts M2 to 90 N·m (66 ft. lbs.).

(14) Torque intake nuts to 32 N·m (24 ft. lbs.) and exhaust manifolds nuts to 32 N·m (24 ft. lbs.) after completing the cylinder head torquing procedure.

NOTE: 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.

(15) Install the oil feed lines for the rocker arm assemblies and oil pressure switch. Torque oil feed lines to 13 N·m (115 in. lbs.).

(16) Install the push rods and rocker arm assemblies, tighten nuts to 29 N·m (22 ft. lbs.).

(17) Install the cylinder head cover. Torque bolts to 15 N·m (133 in. lbs.).

(18) Connect the crankcase breather hose.

(19) Connect the injector sensor wire and the glow plug hot lead.

(20) Install the turbocharger oil feed line. Torque banjo bolts to 27 N·m (20 ft. lbs).

(21) Install the turbocharger oil drain line. Torque bolts to 11 N·m (97 in. lbs.).

(22) Install the water manifold. Torque bolts to 12 N·m (106 in. lbs.).

(23) Install the generator support bracket.

(24) Raise the vehicle on hoist.

(25) Install the exhaust down pipe to turbocharger, tighten bolts to 22 N·m (16 ft. lbs.).

(26) Install the exhaust down pipe heat shield.

(27) Install the exhaust heat shield, Tighten bolts to 11 N·m (8 ft. lbs.).

(28) Install the EGR valve to intake manifold, tighten bolts to 26 N·m (19 ft. lbs.).

(29) Install the EGR tube to EGR valve, tighten bolts to 26 N·m (19 ft. lbs.).

(30) Install the lower Charge air cooler hose to turbocharger.

(31) Install the air cleaner assembly and hose.

(32) Install the oil breather hose to air cleaner hose.

(33) Install the upper charge cooler hose to turbocharger.

(34) Connect the recover bottle hose to water manifold.

(35) Install the fuel injectors using special tool VM.1012. Refer to Group 14, Fuel System for procedures.

(36) Install the fuel injector lines from the pump to injectors. Torque nuts to 23 N·m (17 ft. lbs.).

(37) Connect the A/C lines to compressor and install bracket on cylinder head cover, if equipped with air conditioning.

REMOVAL AND INSTALLATION (Continued)

(38) Install the fuel filter, Tighten bolts to 28 N·m (250 in. lbs.)

(39) Connect the fuel supply and return lines

(40) Connect the upper radiator hose.

(41) Connect the negative cable battery.

(42) If equipped with A/C, evacuate and charge the air conditioning system. Refer to Group 24, Heater and Air Conditioning.

(43) 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.

(44) Operate the engine with the radiator cap off. Inspect for leaks and continue operating the engine until the thermostat opens. Add coolant, if required.

CAUTION: After rebuild or cylinder head gasket replacement, the cylinder head must be retorqued within the first 20,000km. If individual fiber type head gaskets were used.

NOTE: The one piece steel type head gasket does not require, the above mentioned, retorque procedure.

CYLINDER HEAD RE-TORQUE

Within the first 20,000 km (12,000 miles) after rebuild, retorque the cylinder head bolts as follows: (Fig. 38) Central bolts A-L: Without slackening the bolts, following alphabetical order tighten the bolts through an angle of 15°. Side bolts M1-M2: Without slackening, tighten M1 then M2 bolts through an angle of 15°.

VIBRATION DAMPER

REMOVAL

(1) Disconnect the negative battery cable.

(2) Remove the fan and set fan inside fan shroud then remove fan shroud and fan as an assembly.

(3) Remove the accessary drive belt. Refer to Group 7, Cooling System for procedure.

(4) Remove the vibration damper nut.

(5) Install special tool VM.1000-A to remove vibration damper.

INSTALLATION

(1) Install the vibration damper and align with key way.

(2) Install the vibration damper nut. Torque nut to 196 N·m (147 ft. lbs.).

(3) Install the accessary drive belt. Refer to Group 7, Cooling System for procedure.

(4) Connect the negateive battery cable.

TIMING GEAR COVER OIL SEAL

REMOVAL

(1) Disconnect the negative battery cable.

(2) Remove the vibration damper. Refer to vibration damper removal and installation in this section.

CAUTION: Use care when removing the old seal. Be sure not to damage the timing gear cover.

(3) Pry out the old seal.

INSTALLATION

Remove the oil seal ring. The seating diameter must be 68.000 - 68.030 mm.

(1) Install the new seal using special tool VM.1015A.

(2) Install the vibration damper. Refer to vibration damper removal and installation in this section.

(3) Connect the negative battery cable.

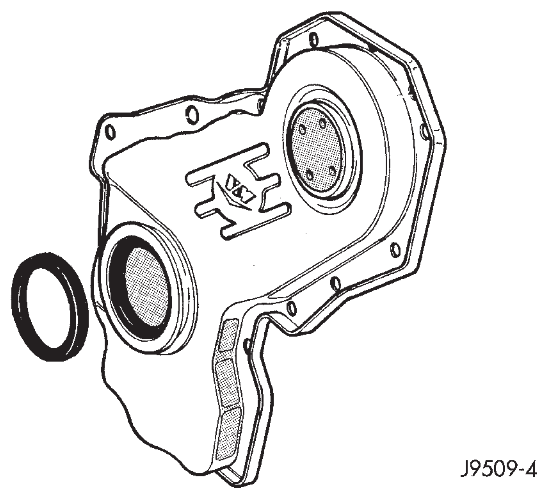

Fig. 39 Timing Gear Cover Oil Seal

TIMING GEAR COVER

REMOVAL

(1) Disconnect the negative battery cable.

(2) Remove the fan and set fan inside fan shroud then remove fan shroud and fan as an assembly.

(3) Remove the accessary drive belt. Refer to Group 7, Cooling System for procedure.

(4) Remove the vibration damper nut.

(5) Install special tool VM.1000-A to remove the vibration damper.

(6) Remove the fan pulley.

NOTE: The idler pulley bolt has left hand thread.

REMOVAL AND INSTALLATION (Continued)

(7) Remove the idler pulley and bracket.
(8) Remove the automatic belt tensioner.
(9) Remove the Power steering pump pulley.
(10) Remove the timing gear cover.

INSTALLATION

(1) Be sure the mating surfaces of the gear case cover and the cylinder block are clean and free from burrs.

(2) Apply a continuous 3 mm bead of Silicone Sealer (Fig. 40) to timing cover, install within 10 minutes, tighten 6mm bolts to 10.3 N·m (91 in. lbs) and tighten 8mm bolts to 26.2 N·m (19 ft. lbs.).

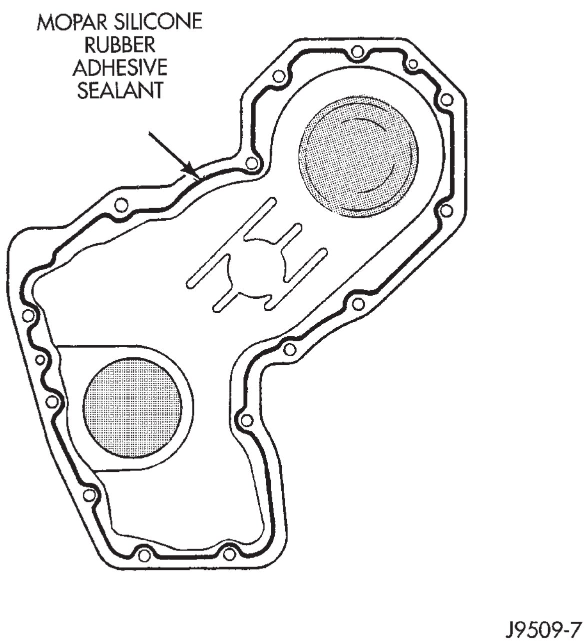

Fig. 40 Front Cover Sealer Location

(3) Install Power steering pump pulley. Torque nut to 130 N·m (96 ft. lbs.).

(4) Install the automatic belt tensioner.

(5) Install the idler pulley bracket. Torque bolts to 40 N·m (29 ft. lbs.).

NOTE: The idler pulley has left hand thread.

(6) Install the idler pulley. Torque nut to 48 N·m (35 ft. lbs.).

(7) Install the fan pulley. Torque bolts to 56 N·m (41 ft. lbs.).

(8) Install the vibration damper. torque nut to 196 N·m (147 ft. lbs.).

(9) Install the accessary drive belt. Refer to Group 7, Cooling System for procedure).

(10) Install the fan and fan shroud.

(11) Connect the negative battery cable.

CAMSHAFT

REMOVAL

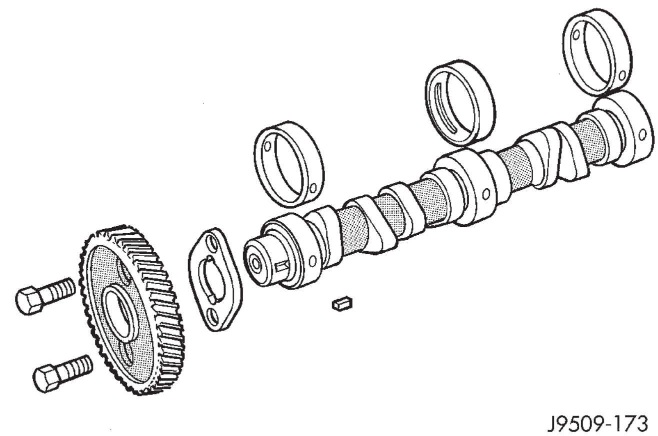

Fig. 41 Camshaft Assembly

(1) Disconnect the negative battery cable.

(2) Remove the cylinder head cover. Refer to cylinder head cover removal and installation in this section.

(3) Remove the cylinder heads. Refer to cylinder head removal and installation in this section.

(4) Remove the rocker arm assemblies, push rods, and hydraulic tappets. Refer to the respective groups in this section.

(5) Remove the fan and set fan inside fan shroud then remove fan shroud and fan as an assembly.

(6) Remove the accessary drive belt. Refer to Group 7, Cooling System for procedure.

(7) Remove the radiator. Refer to Group 7, Cooling System for procedure.

(8) Remove the A/C condenser. Refer to Group 24, Heating and Air Conditioning for procedure.

(9) Remove the vibration damper. Refer to vibration damper removal and installation in this section.

(10) Remove the power steering pump pulley.

(11) Remove timing gear cover. Refer to timing gear cover removal and installation in this section.

(12) Rotate the engine to align the timing marks as shown (Fig. 42).

(13) Unscrew the flange bolts and remove camshaft (Fig. 43).

THRUST PLATE INSPECTION

Check the thickness (Fig. 44) of the plate at points a-b-c-d. If the measurement is not between 3.950 - 4.050 it must be changed.

INSTALLATION

(1) Coat the camshaft journals with clean engine oil and carefully install the camshaft complete with

REMOVAL AND INSTALLATION (Continued)

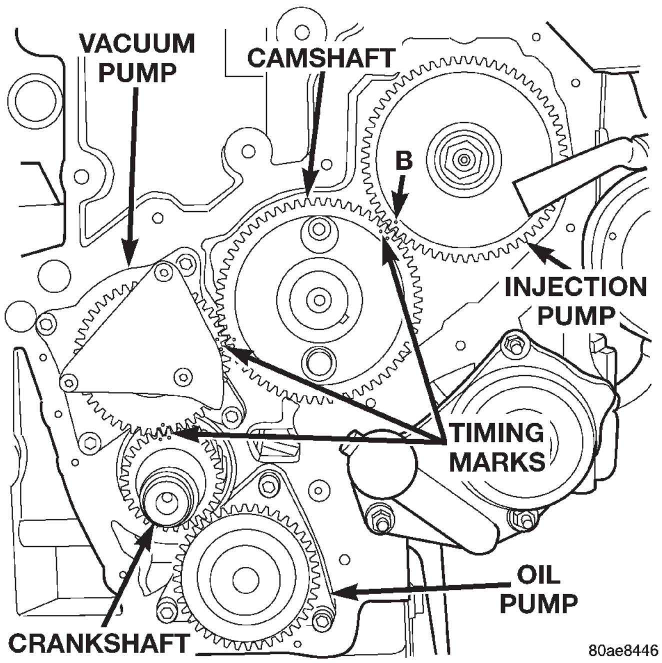

Fig. 42 Timing Marks

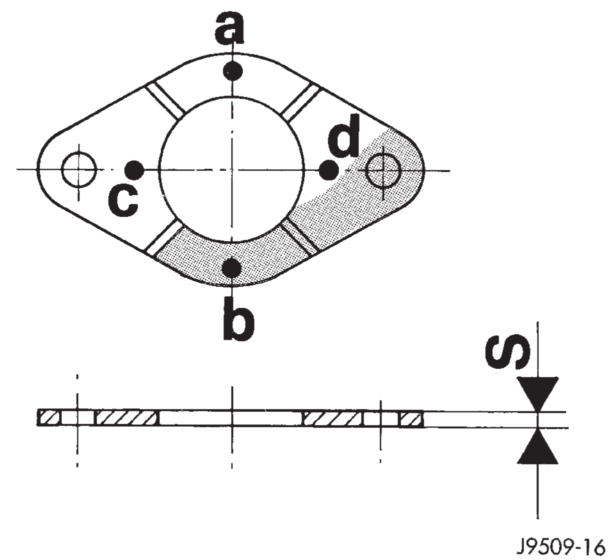

Fig. 44 Camshaft Thrust Plate

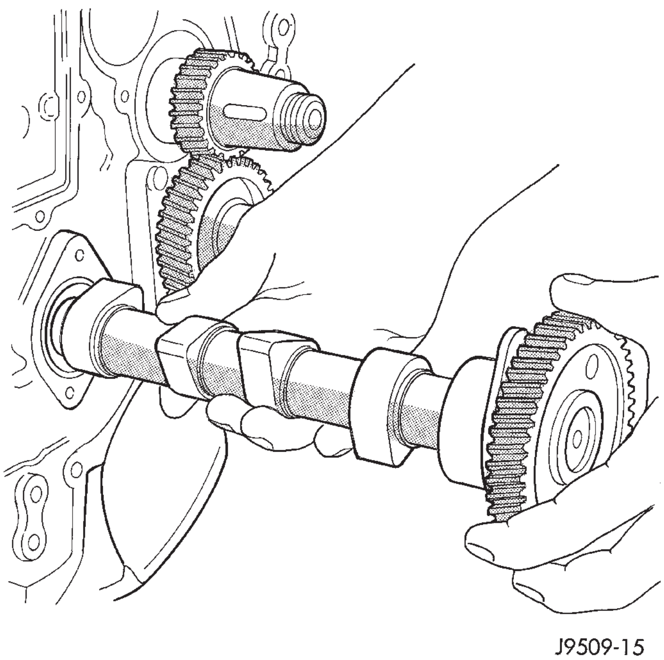

Fig. 43 Camshaft Removal

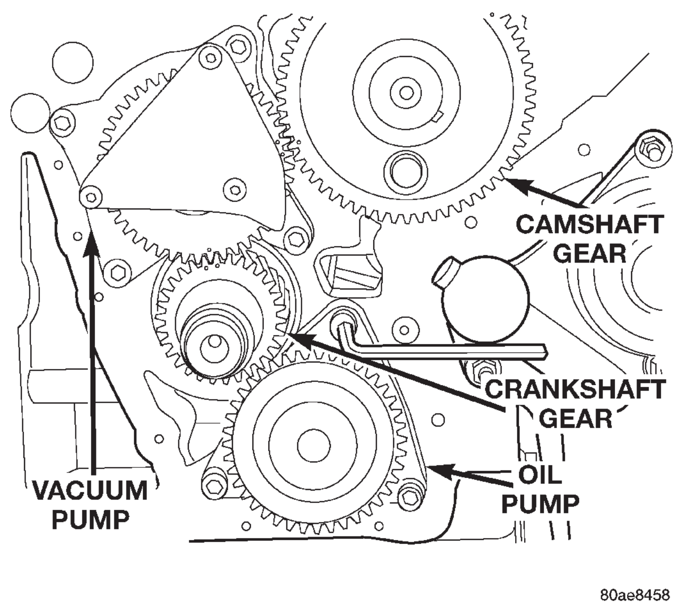

Fig. 45 Timing Marks

thrust plate and gear. Tighten retaining bolts to 24 N·m (18 ft. lbs.) torque. Be sure to align the timing marks as shown (Fig. 45).

(2) Install the hydraulic tappets and retainers. Refer to hydraulic tappet removal and installation in this section.

(3) Install the cylinder heads. Refer to cylinder head removal and installation in this section.

(4) Install the push rods and rocker arm assemblies. Refer to the respective sections.

(5) Install the cylinder head cover. Refer to cylinder head cover removal and installation in this section.

(6) Install the timing gear cover. Refer to timing gear cover removal and installation in this section.

(7) Install the vibration damper. Refer to the vibration damper removal and installation in this section.

(8) Install the A/C condenser. Refer to Group 24, Heating and Air Conditioning for procedure.

REMOVAL AND INSTALLATION (Continued)

(9) Install the radiator. Refer to Group 7, Cooling System for procedure.

(10) Install the fan and fan shroud,. Torque fan to 56 N·m (41 ft. lbs.).

(11) If equipped, evacuate and charge the air conditioning system. Refer to Group 24, Heater and Air Conditioning for procedure.

(12) Connect the negative battery cable.

(13) 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.

(14) Operate the engine with the radiator cap off. Inspect for leaks and continue operating the engine until the thermostat opens. Add coolant, if required.

CAMSHAFT BEARINGS

This procedure requires that the engine is removed from the vehicle.

REMOVAL

(1) With the engine completely disassembled, remove camshaft rear plate and o-ring.

(2) Install the proper size adapters and horseshoe washers (part of Camshaft Bearing Remover/Installer Tool C-3132–A) at back of each bearing shell. Drive out the bearing shells.

INSTALLATION

(1) Install the new camshaft bearings with Camshaft Bearing Remover/Installer Tool C3131–A by sliding the new camshaft bearing shell over proper adapter.

(2) Position the rear bearing in the tool. Install horseshoe lock and by reversing removal procedure, carefully drive bearing shell into place.

(3) Install the remaining bearings in the same manner. The Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearing. If the camshaft bearing shell oil holes are not in exact alignment, remove and install them correctly. Install a new rear plate o-ring at the rear of camshaft. **Be sure this seal does not leak.**

OIL PAN

REMOVAL

(1) Disconnect the negative battery cable.

(2) Raise the vehicle on hoist.

(3) Drain the oil.

(4) Remove the oil pan lower cover (Fig. 46).

(5) Remove the bolts from oil pan. Remove the 6 bolts that are on the inside of the oil pan.

(6) Remove the oil pan.

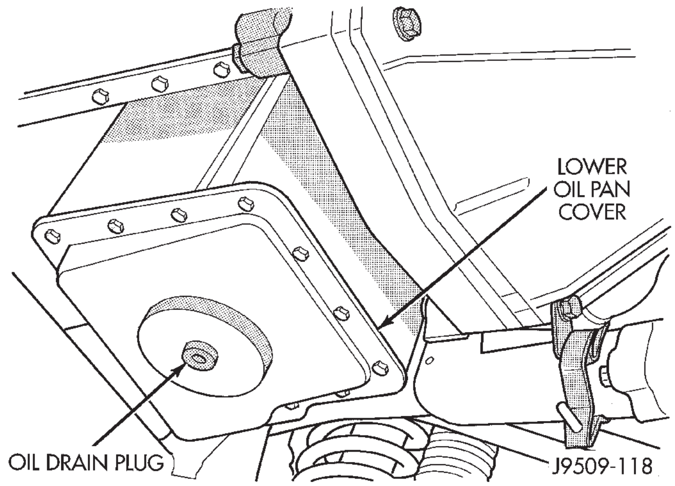

Fig. 46 Oil Pan

INSTALLATION

(1) Remove all gasket material from cylinder block. Be careful not gouge or scratch aluminum pan sealing surface.

(2) Apply a continuous 3 mm bead of Silicone Sealer to oil pan, install within 10 minutes. Install the oil pan.

(3) Install the inside oil pan bolts. Torque bolts to 11 N·m (8 ft. lbs.).

(4) Torque the smaller oil pan bolts to 11 N·m (8 ft. lbs.). Torque the larger oil pan bolts to 25 N·m (18 ft. lbs.).

(5) Install the oil drain plug. Torque to 79 N·m (58 ft. lbs).

(6) Lower the vehicle from hoist.

(7) Fill engine with proper amount of oil.

(8) Connect the negative battery cable.

OIL PUMP

REMOVAL

(1) Disconnect the negative battery cable.

(2) Remove the timing gear cover. Refer to timing gear cover removal and installation in this section).

(3) Remove the oil pump (Fig. 47).

INSTALLATION

(1) Install new O-ring and lubricate with clean engine oil.

(2) Install the oil pump. Torque screws to 24.5-29.9 N·m (22.7-28.3 ft. lbs.). Check for normal backlash between pump and crankshaft gears.

(3) Install the timing gear cover. Refer to timing gear cover removal and installation in this section.

REMOVAL AND INSTALLATION (Continued)

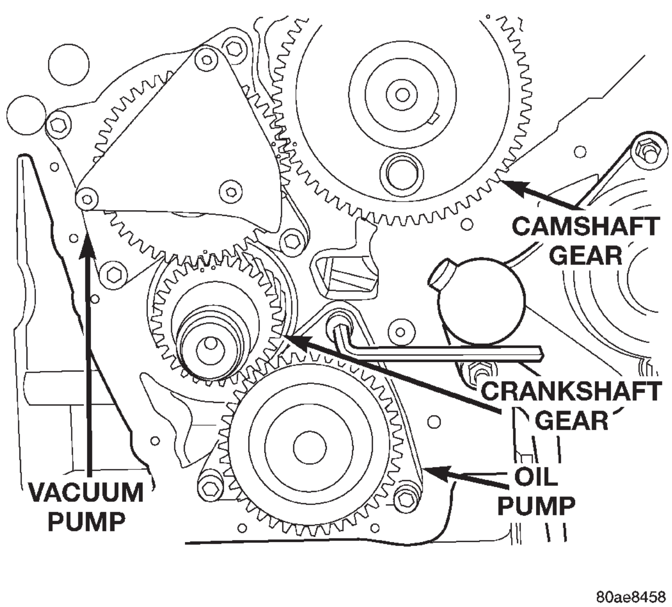

Fig. 47 Oil Pump Removal

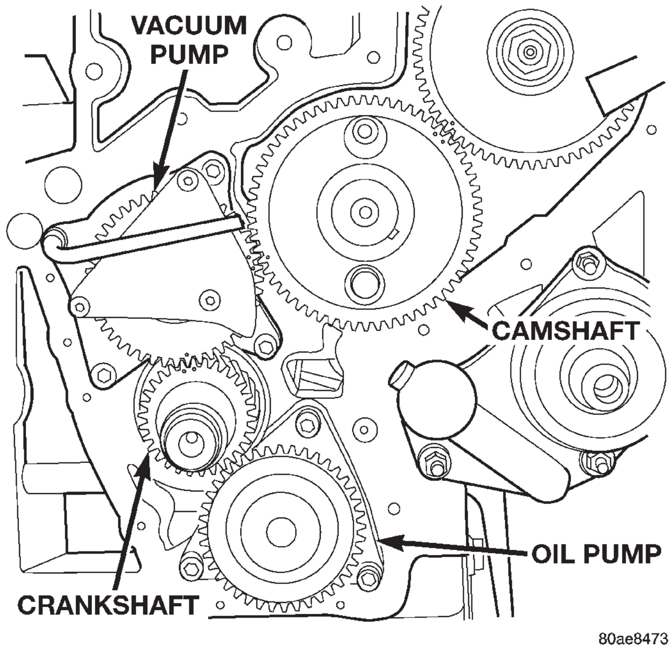

Fig. 49 Vacuum Pump

INTERNAL VACUUM PUMP

REMOVAL

(1) Disconnect the negative battery cable.

(2) Remove the timing gear cover. Refer to timing gear cover removal in this section.

(3) Align all the timing marks before removing the vacuum pump (Fig. 48).

(4) Remove the vacuum pump retaining bolts..

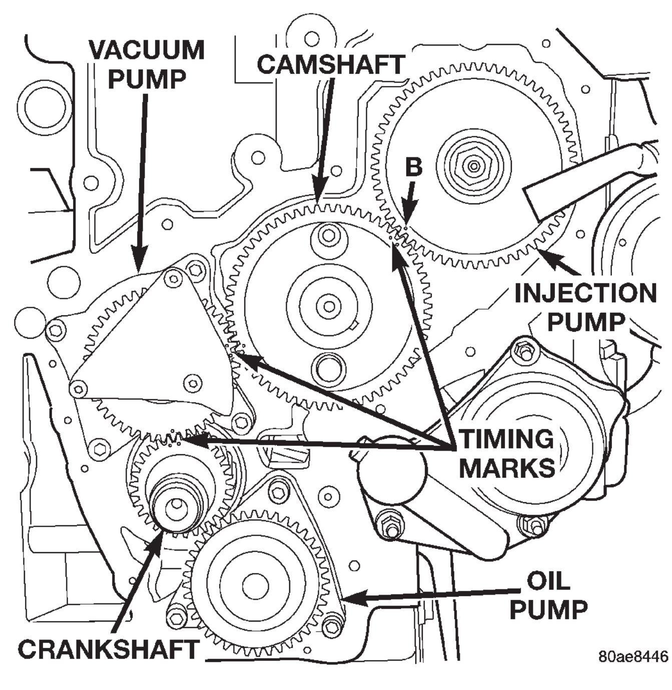

Fig. 48 Timing Marks

(5) Remove the internal vacuum pump.

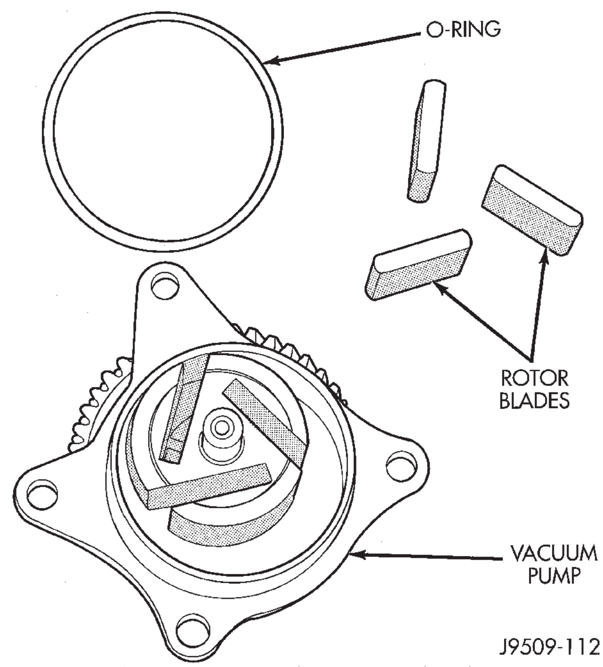

Fig. 50 Vacuum Pump Parts

INSTALLATION

(1) To install the vacuum pump, align the outer part of the gear with the inner part using a screw-driver or similar tool, align with timing marks on gear set and install (Fig. 48). Torque bolts to 20 N·m (15 ft. lbs.).

(2) Install the timing gear cover. Refer to timing gear cover removal in this section.

(3) Connect the negative battery cable.

REMOVAL AND INSTALLATION (Continued)

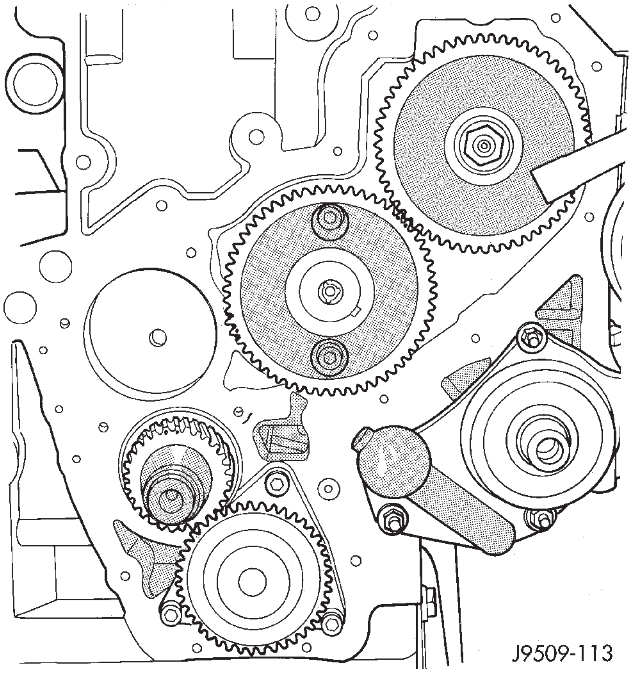

Fig. 51 Vacuum Pump Mounting Hole

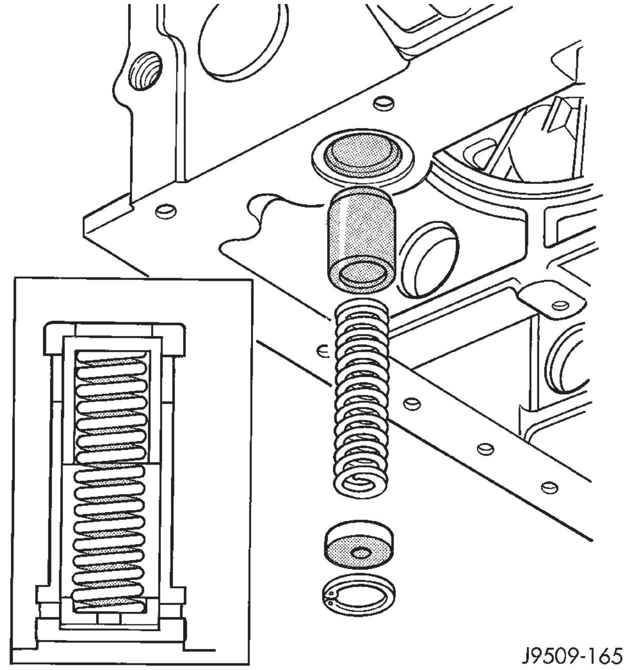

Fig. 52 Oil Pressure Relief Valve

OIL PUMP PRESSURE RELIEF VALVE

REMOVAL

(1) Disconnect the negative battery cable

(2) Remove the oil pan. Refer to oil pan removal and installation procedure in this section.

(3) Remove the relief valve snap ring.

(4) Remove the relief valve cap, spring, and plunger (Fig. 52).

(5) Check the relief valve spring length. Relief valve spring free length is 57.5mm (2.263 in.). If spring length is less or spring is distorted it must be replaced.

(6) Check the plunger for scoring, replace if necessary.

INSTALLATION

(1) Thoroughly clean all components and relief valve pocket in cylinder block.

(2) Fit plunger, spring and cap into block.

(3) Compress spring and install the snap ring. Ensure the snap ring is completely seated in groove.

(4) Install the oil pan. Refer to oil pan removal and installation procedure in this section.

(5) Connect the negative battery cable.

OIL FILTER ADAPTER

REMOVAL

(1) Disconnect the negative battery cable.

(2) Remove the oil filter.

(3) Remove the oil filter adapter.

(4) Remove the oil filter base, allen bolt in center of adapter.

(5) Remove the oil cooler adapter bolt.

(6) Remove the oil cooler (Fig. 53).

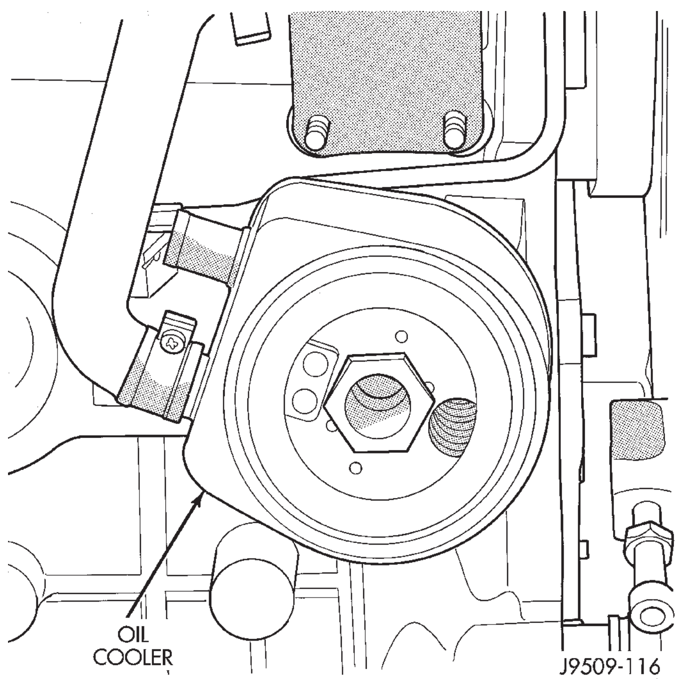

Fig. 53 Oil Cooler

INSTALLATION

(1) Install the oil cooler with new gasket. Torque the oil cooler adapter bolt to 60 N·m (44 ft. lbs.).

(2) Install the oil filter base with new o-ring. Torque bolt to 46.6 N·m (34 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

(3) Install the oil filter adapter to oil filter base. Torque to 46.6 N·m (34 ft. lbs.).

(4) Install the oil filter. Torque to 18 N·m (13 ft. lbs.) and add oil.

(5) Connect the negative battery cable.

PISTONS AND CONNECTING ROD ASSEMBLY

REMOVAL

(1) Disconnect the battery cable.

(2) Remove cylinder heads, refer to cylinder head removal in this section.

(3) Raise vehicle on host.

(4) Remove oil pan, refer to oil pan removal in this section.

(5) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation**. Mark piston with matching cylinder number.

(6) Pistons and connecting rods must be removed from top of cylinder block. Rotate crankshaft so that each connecting rod is centered in cylinder bore.

(7) Remove connecting rod cap. Install connecting rod bolt protectors on connecting rod bolts. Push each piston and rod assembly out of cylinder bore.

NOTE: Be careful not to nick crankshaft journals.

(8) After removal, install bearing cap on the mating rod.

PISTON PIN—REMOVAL

(1) Secure connecting rod in a soft jawed vice.

(2) Remove 2 clips securing piston pin.

(3) Push piston pin out of piston and connecting rod.

PISTON RING—REMOVAL

(1) ID mark on face of upper and intermediate piston rings must point toward piston crown.

(2) Using a suitable ring expander, remove upper and intermediate piston rings (Fig. 55).

(3) Remove the upper oil ring side rail, lower oil ring side rail and then oil ring expander from piston.

(4) Carefully clean carbon from piston crowns, skirts and ring grooves ensuring the 4 oil holes in the oil control ring groove are clear.

PISTON RING FITTING

(1) Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring positioning at least 12 mm (0.50 in.) from bottom of cylinder bore. Check gap with feeler gauge. Top compression ring gap .25 to .50mm (.0098 to .0196 in.). Second compression ring gap .25 to .35mm (.0098 to .0137 in.). Oil control ring gap .25 to .58mm (.0098 to .0228 in.).

(2) If ring gaps exceed dimension given, new rings or cylinder liners must be fitted. Keep piston rings in piston sets.

(3) Check piston ring to groove clearance (Fig. 57). Top compression ring gap .08 to .130mm (.0031 to .0051 in.). Second compression ring gap .070 to

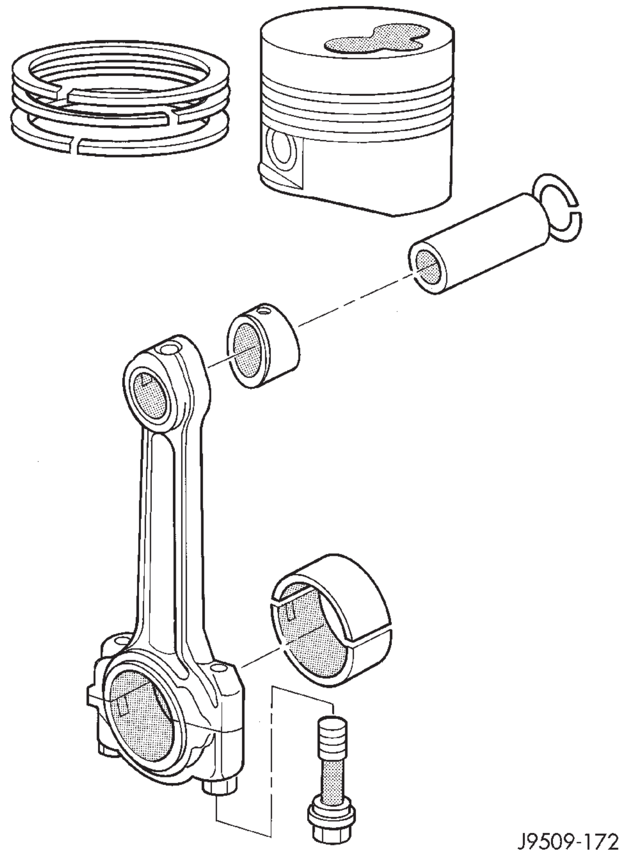

Fig. 54 Piston Assembly

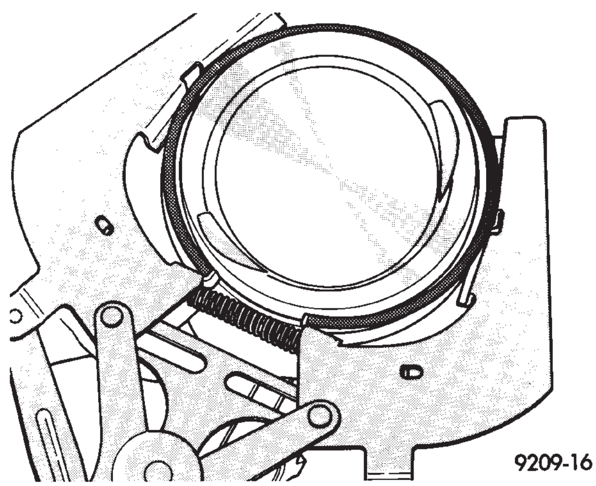

Fig. 55 Piston Rings—Removing and Installing

REMOVAL AND INSTALLATION (Continued)

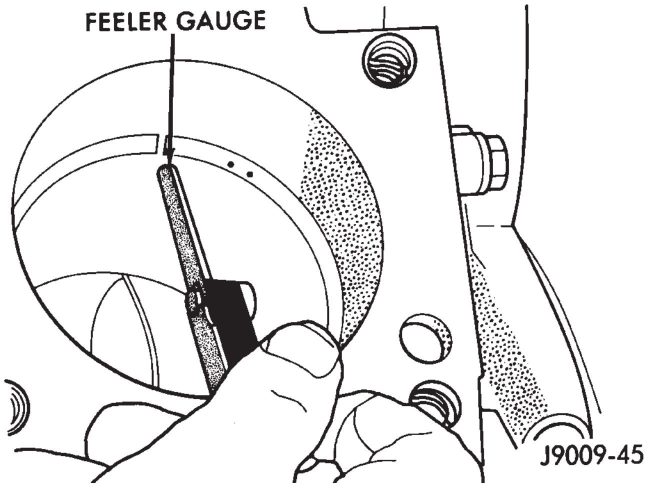

Fig. 56 Ring Gap Measurement

.102mm (.0027 to .0040 in.). Oil control ring gap .040 to .072mm (.0015 to .0028 in.).

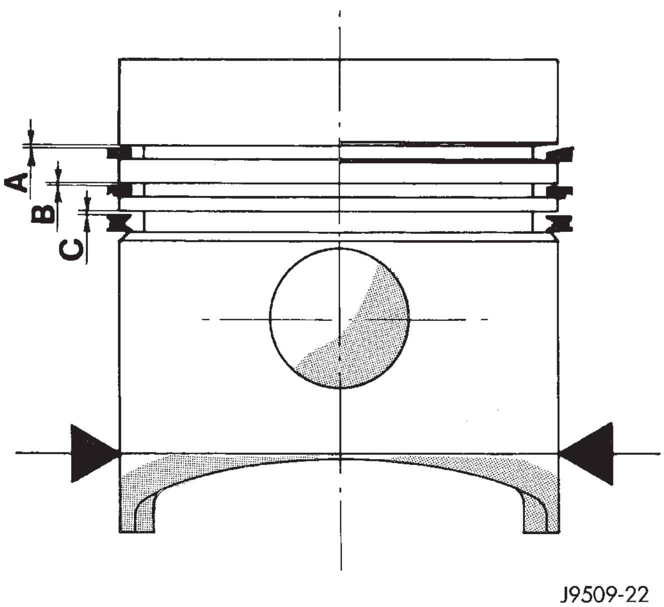

Fig. 57 Piston Ring to Groove Clearance

PISTON RINGS—INSTALLATION

(1) Install rings on the pistons using a suitable ring expander (Fig. 58).

(2) Top compression ring is tapered and chromium plated. The second ring is of the scraper type and must be installed with scraping edge facing bottom of the piston. The third is an oil control ring. Ring gaps must be positioned, before inserting piston into the liners, as follows (Fig. 60).

(3) Top ring gap must be positioned at 30 degrees to the right of the combustion chamber recess (looking at the piston crown from above).

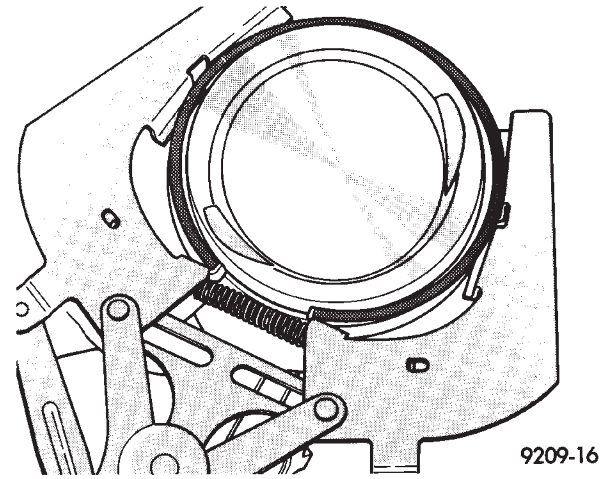

Fig. 58 Piston Rings—Removing and Installing

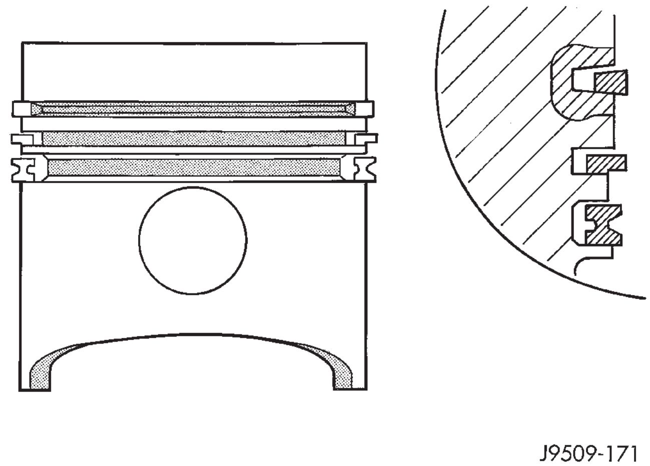

Fig. 59 Piston Ring Identification

(4) Second piston ring gap should be positioned on the opposite side of the combustion chamber recess.

(5) Oil control ring gap to be located 30 degrees to the left of combustion chamber recess.

(6) When assembling pistons check that components are installed in the same position as before disassembly, determined by the numbers stamped on the crown of individual pistons. Engine cylinders are numbered starting from gear train end of the engine. **Face chamber recess side of piston towards camshaft**. Therefore, the numbers stamped on con rod big end should also face in the same direction. To insert piston into cylinder use a ring compressor as shown in (Fig. 58).

PISTON PIN INSTALLATION

(1) Secure connecting rod in soft jawed vice.

(2) Lubricate piston pin and piston with clean oil.

(3) Position piston on connecting rod.

REMOVAL AND INSTALLATION (Continued)

CAUTION: Ensure combustion recess in piston crown and the bearing cap numbers on the connecting rod are on the same side.

(4) Install piston pin.
(5) Install clips in piston to retain piston pin.
(6) Remove connecting rod from vice.

INSTALLATION

(1) Before installing pistons, and connecting rod assemblies into the bore, be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap (Fig. 60).

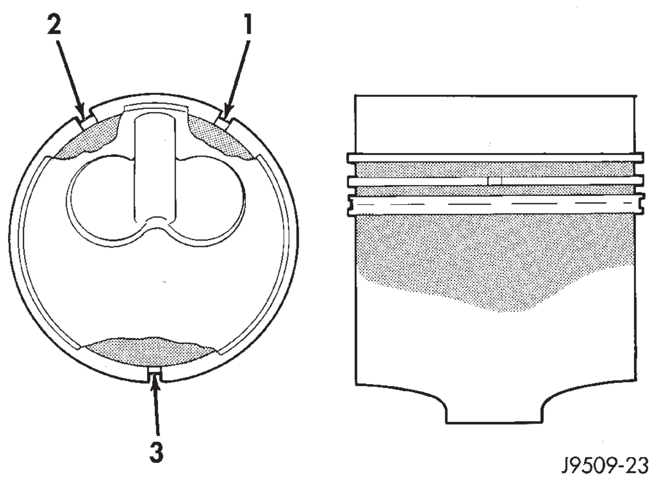

Fig. 60 Piston Ring Gap Location

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 60).

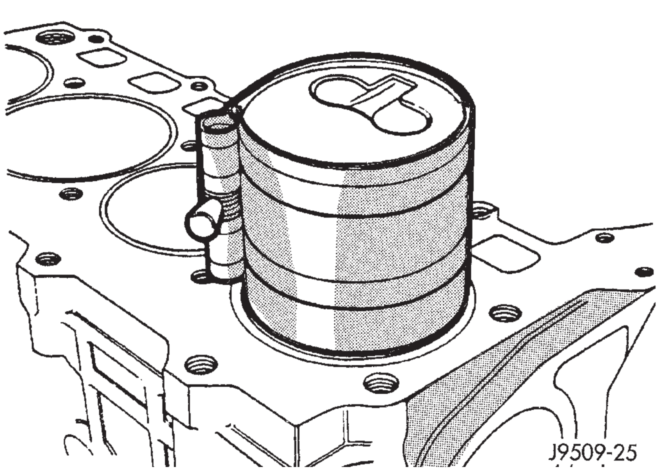

Fig. 61 Installing Piston

(3) Immerse the piston head and rings in clean engine oil, slide the ring compressor, over the piston and tighten with the special wrench (Fig. 61). **Ensure position of rings does not change during this operation**.

(4) Face chamber recess side of piston towards camshaft.

(5) Install connecting rod bolt protectors on rod bolts.

(6) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

(7) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on connecting rod journal.

(8) Install rod caps. Install nuts on cleaned and oiled rod bolts and tighten nuts to 29.5 N·m (22 ft. lb.) plus 60°.

CYLINDER WALL LINER ASSEMBLY

REMOVAL

(1) Remove cylinder heads.
(2) Remove Oil pan.
(3) Remove pistons.
(4) Use tool VM-1001 to remove liners (Fig. 62).

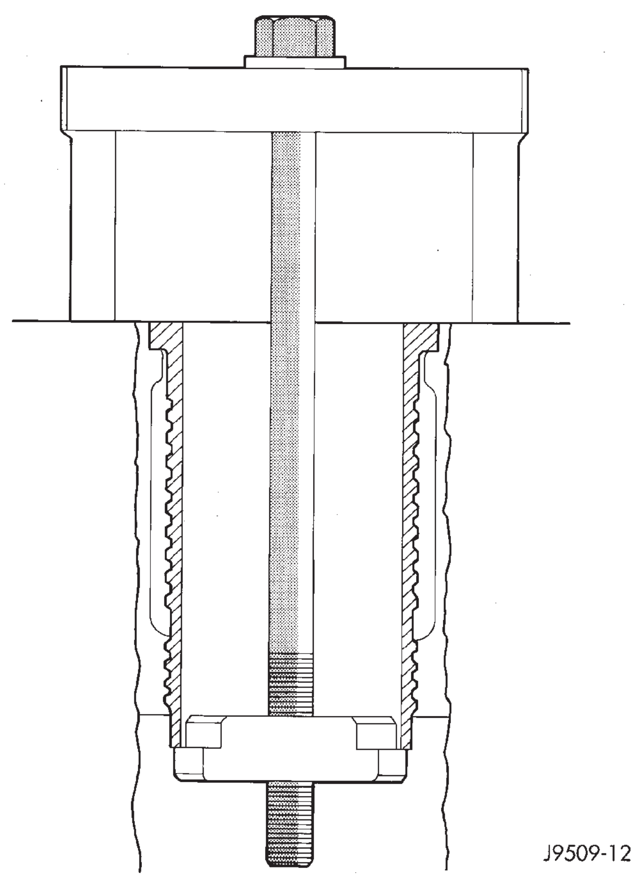

Fig. 62 Liner Removal Tool

(5) Remove shims from cylinder liner or cylinder block recess. Keep shims with each cylinder liner.

REMOVAL AND INSTALLATION (Continued)

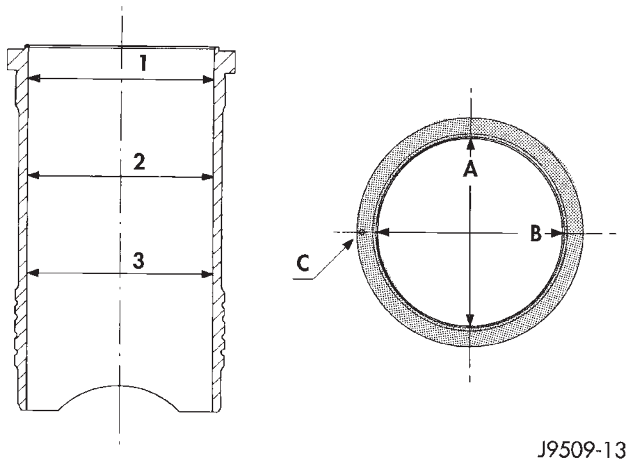

Fig. 63 Liner Inspection

INSTALLATION

(1) Carefully clean residual LOCTITE from liner and crankcase, and degrease the crankcase where it comes into contact with the liners. Install the liners in the crankcase as shown (A), rotating them back and forth by 45° in order to guarantee correct positioning (Fig. 64).

(2) Measure the liner recess relative to block deck with a dial indicator mounted on a special tool VM-1010 A. **All the measurements must be taken on camshaft side**. Zero dial gauge on block deck.

(3) Move dial gauge to cylinder liner record reading on dial gauge.

(4) Remove liner and special tool.

(5) Then select the correct shim thickness to give proper protrusion (0.01 - 0.06 mm).

(6) Fit the shim and the O-rings onto the liner.

(7) Lubricate the lower liner location in the block. Apply LOCTITE AVX to the corner of the liner seat. Apply LOCTITE AVX uniformly to the upper part of the liner at area.

(8) Fit the liners in the crankcase making sure that the shim is positioned correctly in the seat. Lock

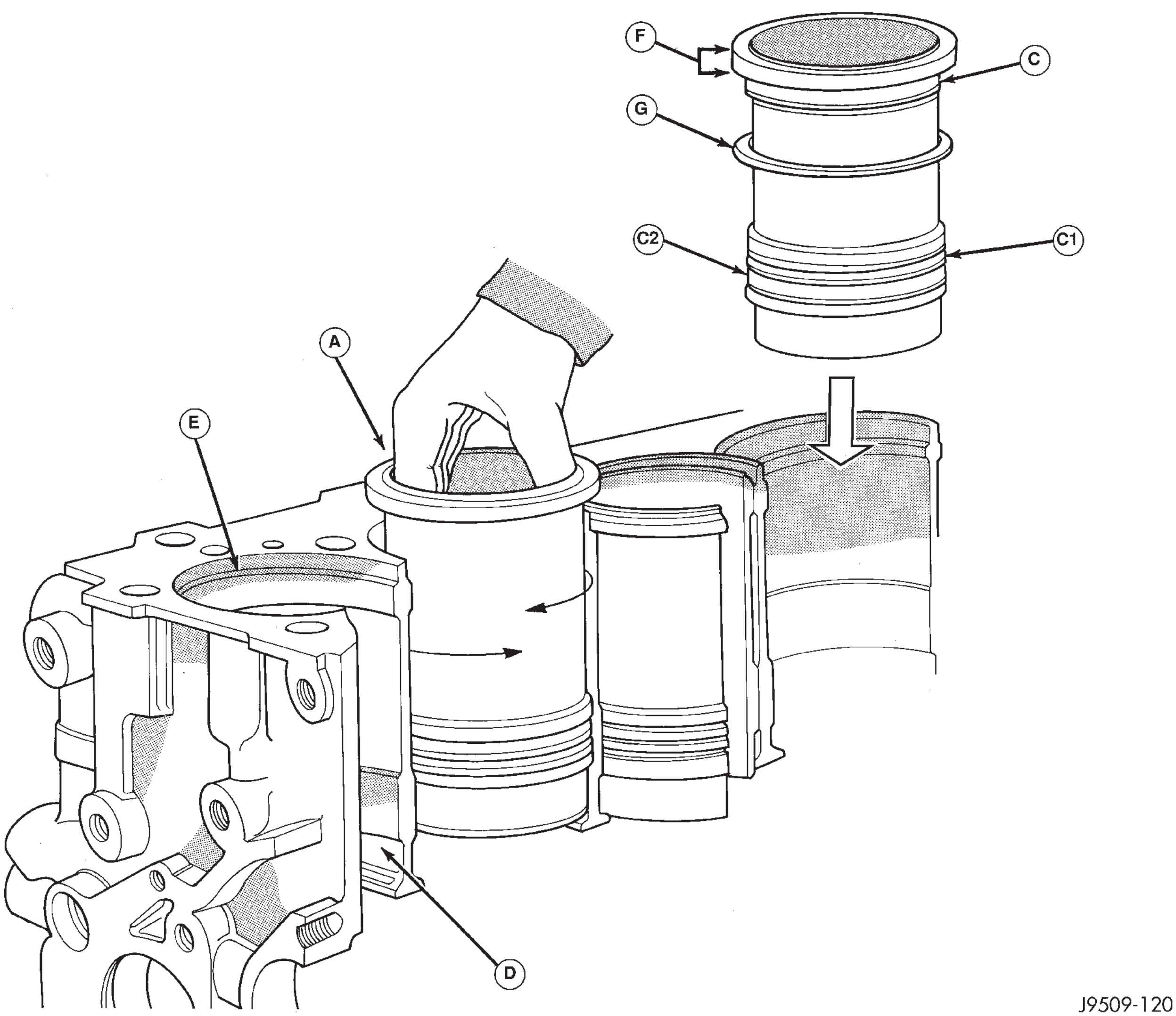

Fig. 64 Liner Installation

REMOVAL AND INSTALLATION (Continued)

the liners in position using special tool (VM-1016) and bolts (Fig. 65). Clean the residual LOCTITE on the upper surface of the block deck.

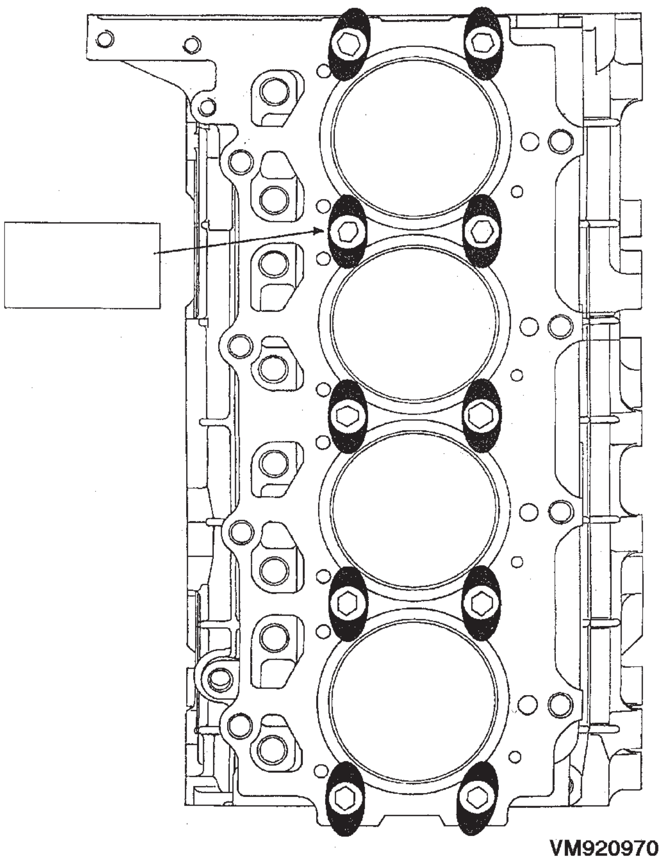

Fig. 65 Liner Clamp Location

(9) Recheck the liner protrusion. It should be 0.01 - 0.06 mm.

NOTE: A period of six hours must elapse between the liners being installed and engine start-up. If engine assembly is not continued after liner installation, the liners need to be clamped for twelve hours minimum.

CRANKSHAFT MAIN BEARINGS

REMOVAL

(1) Disconnect the negative battery cable.

(2) Remove the engine from vehicle. Refer to engine removal and installation in this section.

(3) Install the engine on an engine stand.

(4) Remove the accessary drive system.

(5) Remove the cylinder head cover. Refer to cylinder head cover removal and installation in this section.

(6) Remove the rocker arm assemblies and push rods. Refer to rocker arm and push rod removal and installation in this section.

(7) Remove the intake manifold, exhaust manifold and turbocharger. Refer to Group 11, Exhaust System and Turbocharger.

(8) Remove the water manifold.

(9) Remove the oil feed lines to rocker arms.

(10) Remove the cylinder heads. Refer to cylinder head removal and installation in this section.

(11) Remove the oil pan and oil pick-up.

(12) Remove the pistons and connecting rods.

(13) Remove the vibration damper. Refer to vibration damper removal and installation in this section.

(14) Remove the timing gear cover. Refer to timing gear cover removal and installation in this section.

(15) Remove the oil pump and vacuum pump from block.

(16) Install special tool VM.1004 onto crankshaft over gear (Fig. 67).

(17) Remove the main bearing oil feed and crankshaft support locators from block.

(18) Remove the flywheel and adaptor plate from engine block.

(19) Remove the thrust bearings from rear main bearing carrier.

(20) Slide the crankshaft and bearing carriers rearward to rear of block. If you encounter difficulty in removing the complete assembly as previously described, slide the assembly rearward sufficiently to gain access to the main bearing carrier bolts. Mark the carriers for assembly and remove the bolts, two for each carrier (Fig. 68).

(21) Separate the two halves of each carrier, remove from the crankshaft and temporarily re-assemble the carriers (Fig. 69). Withdraw the crankshaft through the rear of the crankcase.

INSTALLATION

NOTE: Be sure the oil jets are facing the front of the engine.

(1) Fit the main bearing supports together. Torque to 42 N·m (31 ft. lbs.)

(2) Check internal diameter of bearings.

(3) If internal diameter of original bearing is being checked and figures are not within specifications, new bearings must be used.

(4) Check the crankshaft main bearing journals to bearing clearances. Clearances of main bearings is .03 to .088mm (.0011 to .0035 in.).

NOTE: Assemble engine according to sequence described, thus saving time and preventing damages to engine components. Clean parts with a suitable solvent and dry them with compressed air before assembly. Use new gaskets where applicable and torque wrenches for correct tightening of components.

REMOVAL AND INSTALLATION (Continued)

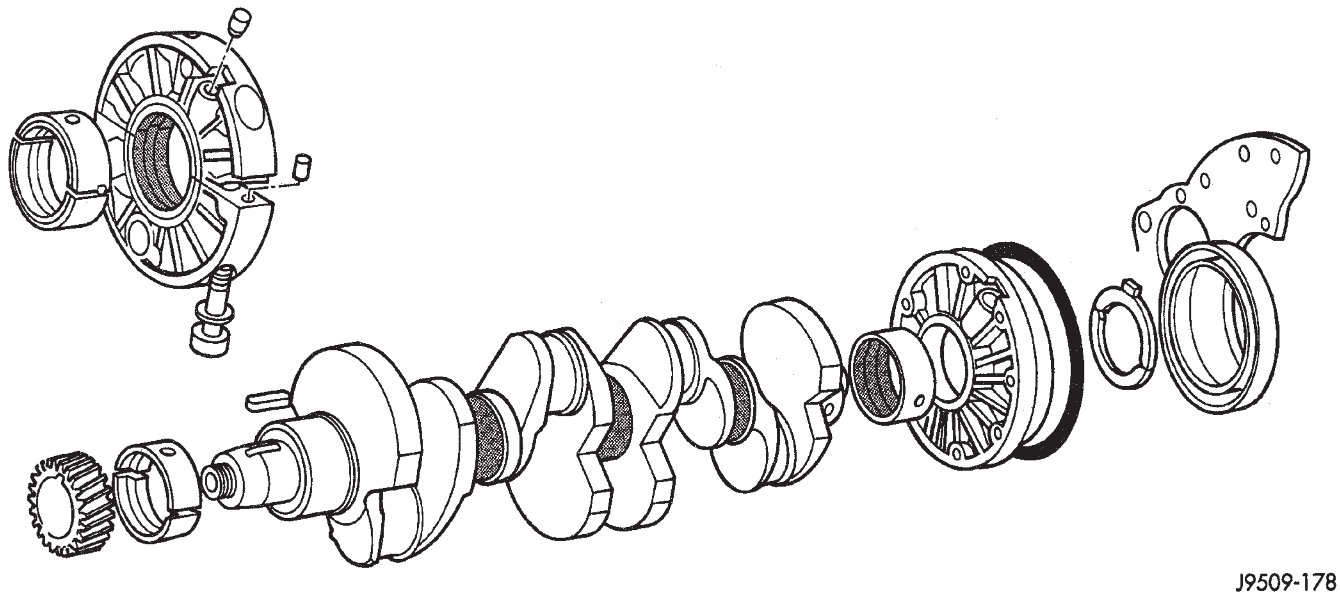

Fig. 66 Crankshaft and Bearing Assembly

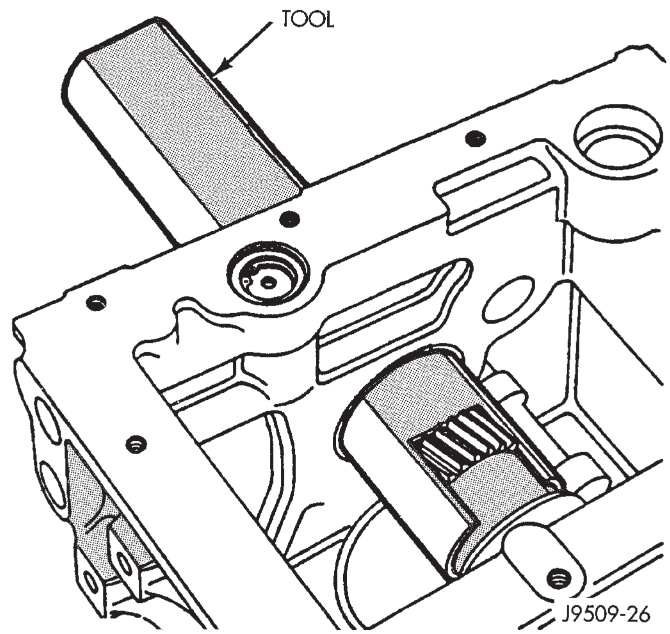

Fig. 67 Crankshaft Special Tool VM.1004

(5) Thoroughly clean crankcase and oil passages, and blow dry with compressed air.

(6) Install new main bearing shells in each of the carrier halves. Assemble the carriers to the crankshaft journals, ensuring that the carriers are installed in their original locations and that the **piston jet notch is towards the front of the crankshaft**. Secure each carrier with the two bolts tightening evenly to 42 N·m (31 ft. lbs.). Check that the oil jet is in position (Fig. 69).

(7) Slide special tool VM.1004 over the crankshaft gear and, insert the crankshaft and support assembly into the crankcase in the same manner used for removal.

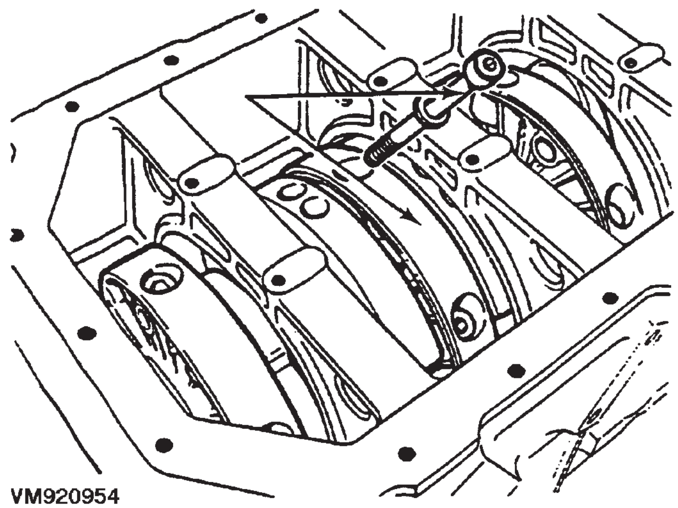

Fig. 68 Crankshaft Support Locator Bolts

(8) Align the holes in the lower supports, with the center of the crankcase webs (Fig. 70).

(9) Secure each support assembly to the crankcase with the main bearing oil feed and support locators. Torque to 54 N·m (40 ft. lbs).

(10) Install the rear main bearing support onto crankshaft ensuring arrow on bearing support aligns with vertical web in center of crankcase.

(11) Install the rear oil seal.

(12) Install the new O-rings in adaptor plate.

(13) Install the adaptor plate to block. Torque nuts to 26.5 N·m (20 ft. lbs.).

(14) Install the Allen bolts through adaptor plate to rear main bearing support. Torque to 11 N·m (97 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

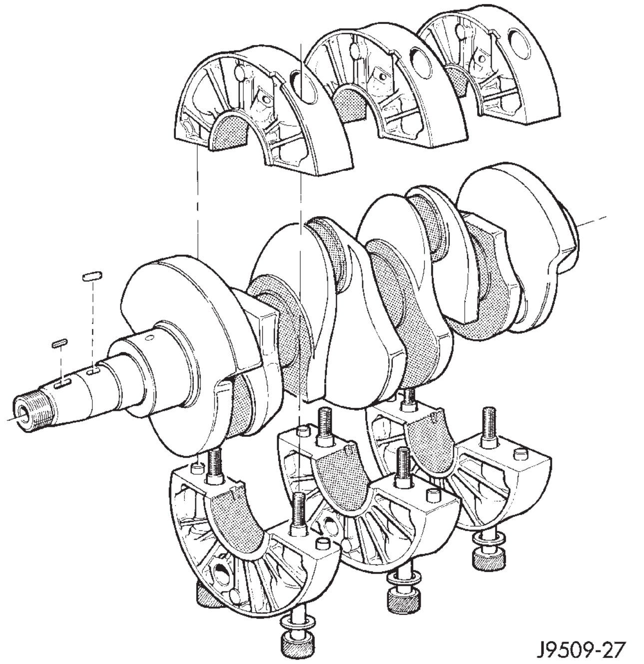

Fig. 69 Crankshaft and Carrier Bearing Assembly

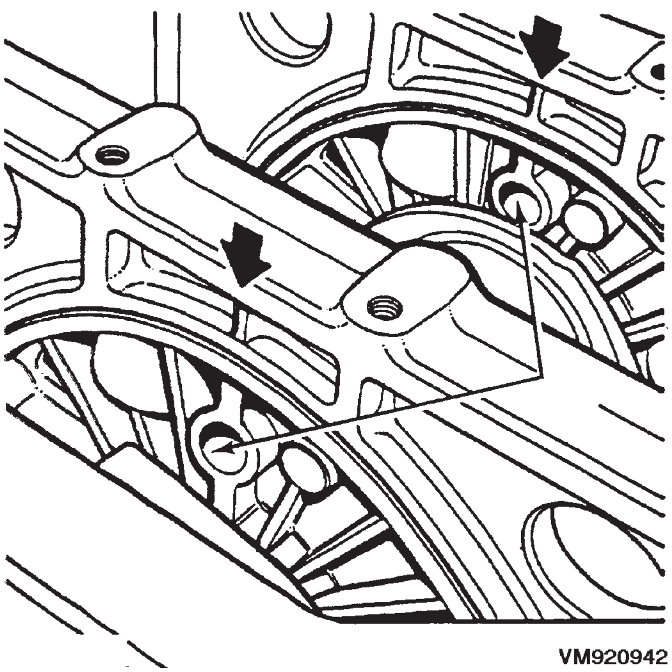

Fig. 70 Main Bearing Support Alignment

(15) Position the flywheel and O-ring on crankshaft and align bolt holes.

NOTE: For purposes of checking crankshaft end play, used flywheel bolts may be used. Final assembly requires new flywheel bolts.

(16) Install 2 flywheel bolts, 180° apart, and tighten bolts to 20 N·m plus 60° (15 ft. lbs.) plus 60°.

(17) Attach dial indicator to engine block.

(18) Move crankshaft toward front of engine and zero indicator.

(19) Move crankshaft toward the rear of engine and record measurement.

(20) Subtract specified crankshaft end play from figure obtained. Crankshaft end play .153 to .304mm (.0060 to .0119 in.).

(21) Select thrust washers which will give correct end play.

(22) Remove tools and flywheel.

(23) Lubricate thrust washer halves and fit them into the rear main bearing carrier.

(24) Ensure that crankshaft end and flywheel mating surfaces are clean and dry. Install "O" ring in flywheel groove.

(25) To verify correct end play, install 2 flywheel bolts 180° apart, and tighten bolts to 20 N·m plus 60° (15 ft. lbs. plus 60°).

(26) Measure crankshaft end play with a dial gauge. Crankshaft end play should not exceed .153 to .304mm (.0060 to .0119 in.) (Fig. 71).

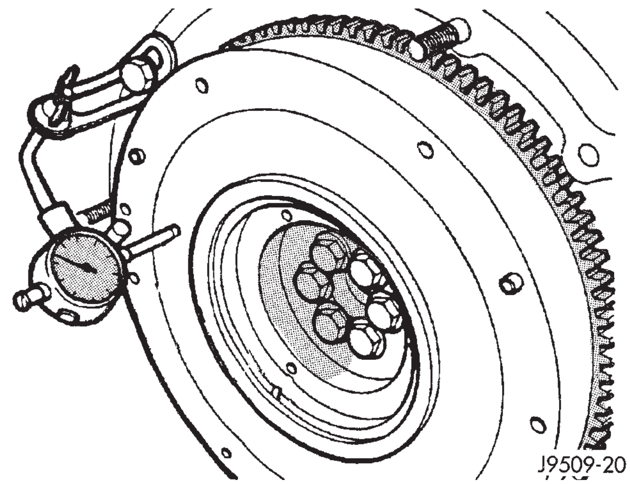

Fig. 71 Measuring Crankshaft End Play

CAUTION: Use NEW flywheel bolts for the following procedure.

(27) Install a new O-ring on flywheel. Install flywheel on crankshaft. The 6 flywheel bolts must be tightened as follows:

a. Lubricate and install the 6 new flywheel bolts.

b. Torque the 6 flywheel bolts to 49 N·m (36 ft. lbs.) starting one bolt and following with the opposite one (cross tightening) until completion, in a clockwise direction..

c. Loosen one bolt at a time and tighten to 19.6 N·m (14 ft. lbs.) plus 75° using the cross tightening method.

(28) Install the pistons and connecting rod assemblies. Refer to piston and connecting rods removal and installation in this section.

REMOVAL AND INSTALLATION (Continued)

(29) Install the oil pick up tube. Torque bolts to 25 N·m (18 ft. lbs.).

(30) Install the oil pan. Refer to oil pan removal and installation in this section.

(31) Install the vacuum pump, being careful to align the gear timing marks with those on the crankshaft gear. Torque screws to 20 N·m (15 ft. lbs.).

(32) Before installing the oil pump check pump bore depth in block (A) and pump body height (B) (Fig. 72). Difference between A and B should be 0.020-0.082 mm (.0007 to 0032 in.).

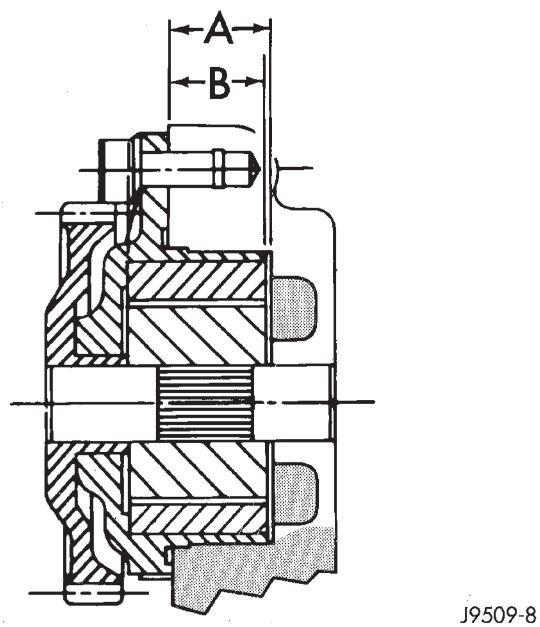

Fig. 72 Oil Pump Bore Depth

(33) Install the oil pump. Torque screws to 27 N·M (20 ft. lbs.). Check for normal backlash between pump and crankshaft gears.

(34) Install the timing gear cover. Refer to timing gear cover removal and installation in this section.

(35) Install the vibration damper. Refer to vibration damper removal and installation in this section.

(36) Install the cylinder heads. Refer to cylinder head removal and installation in this section.

(37) Install the rocker arms and push rods. Refer to rocker arm and push rod removal and installation in this section.

(38) Install the cylinder head cover. Refer to cylinder head cover removal and installation in this section.

(39) Install the accessary drive system.

(40) Install the engine in vehicle. Refer to engine removal and installation in this section.

(41) Fill engine with the correct amount of fluids specified.

(42) Connect the negative battery cable.

DISASSEMBLY AND ASSEMBLY

HYDRAULIC TAPPETS

DISASSEMBLE

(1) Pry out plunger retainer spring clip.

(2) Clean varnish deposits from inside of tappet body above plunger cap.

(3) Invert tappet body and remove plunger cap, plunger, check valve, check valve spring, check valve retainer and plunger spring. Check valve could be flat or ball.

ASSEMBLE

(1) Clean all tappet parts in a solvent that will remove all varnish and carbon.

(2) Replace tappets that are unfit for further service with new assemblies.

(3) If plunger shows signs of scoring or wear, install a new tappet assembly. If valve is pitted, or valve seat on end of plunger is prevented from seating, install a new tappet assembly.

(4) Assemble tappets.

CLEANING AND INSPECTION

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 (Fig. 73).

Minimum cylinder head thickness 89.95mm (3.541 in.)

CAUTION: If only one cylinder head is found to be distorted and requires machining, it will also be necessary to machine the remaining cylinders heads and end plates by a corresponding amount to maintain correct cylinder alignment.

CLEANING AND INSPECTION (Continued)

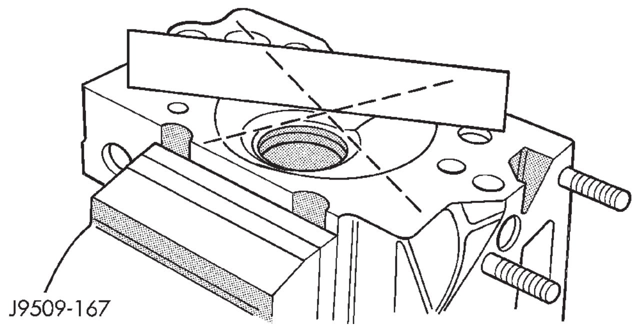

Fig. 73 Checking Cylinder Head Flatness

ROCKER ARMS AND PUSH RODS

CLEANING

Clean all the components (Fig. 74) with cleaning solvent.

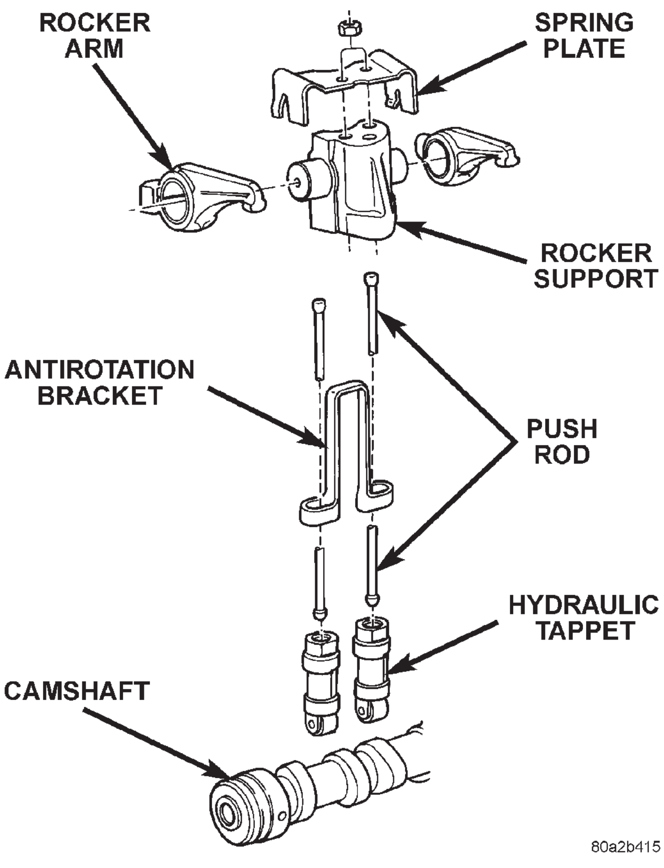

Fig. 74 Rocker Arm Components

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.

PISTONS AND CONNECTING ROD ASSEMBLY

INSPECTION—PISTONS

(1) Piston Diameter: Size Group A: 91.93-91.94mm (3.6191-3.6196 in.) Size Group B: 91.94-91.95mm (3.6196-3.6200 in.). Maximum wear limit .05mm (.0019 in.).

(2) Check piston pin bores in piston for roundness. Make 3 checks at 120° intervals. Maximum out of roundness .05mm (.0019 in.).

(3) The piston diameter should be measured approximately 15 mm (.590 in.) up from the base.

(4) Skirt wear should not exceed 0.1 mm (.00039 in.).

(5) The clearance between the cylinder liner and piston should not exceed 0.25 mm (.0009 in.).

(6) Make sure the weight of the pistons does not differ by more than 5 g.

INSPECTION—CONNECTING ROD

(1) Assemble bearing shells and bearing caps to their respective connecting rods ensuring that the serrations on the cap and reference marks are aligned.

(2) Tighten bearing cap bolts to 29N·m (21 ft. lbs.) plus 60°.

(3) Check and record internal diameter of crank end of connecting rod.

NOTE: When changing connecting rods, all four must have the same weight and be stamped with the same number. Replacement connecting rods will only be supplied in sets of four.

Connecting rods are supplied in sets of four since they all must be of the same weight category. Max allowable weight difference is 18 gr.

CLEANING AND INSPECTION (Continued)

NOTE: On one side of the big end of the con-rod there is a two-digit number which refers to the weight category. On the other side of the big end there is a four digit number on both the rod and the cap. These numbers must both face the camshaft as well as the recess on the piston crown (Fig. 76). Lightly heat the piston in oven. Insert piston pin in position and secure it with provided snap rings.

The Four digit numbers marked on con rod big end and rod cap must be on the same side as the camshaft (Fig. 76). After having coated threads with Molyguard, tighten con rod bolts to 29 N·m (21 ft. lbs.) plus 60°.

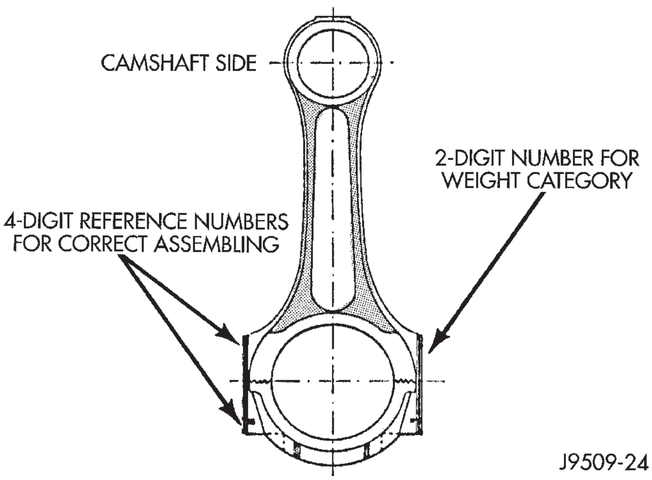

Fig. 75 Connecting Rod Identification

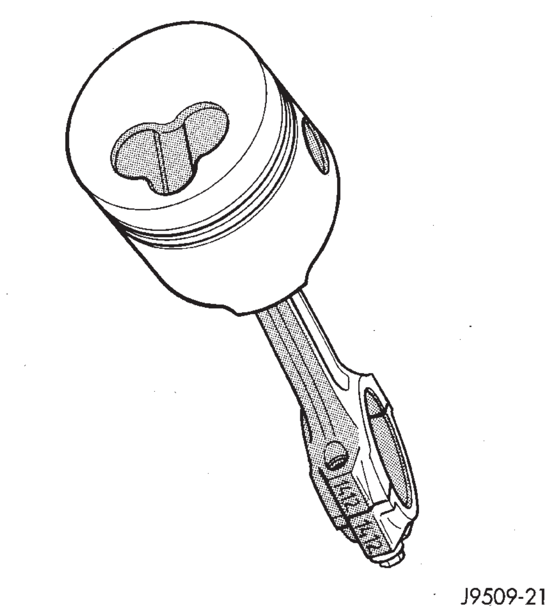

Fig. 76 Piston and Connecting Rod Assembly

INSPECTION—PISTON PIN

(1) Measure the diameter of piston pin in the center and both ends.

(2) Piston pin diameter is 29.990 to 29.996mm (1.1807 to 1.1809 in.).

INSPECTION—CRANKSHAFT JOURNALS

(1) Using a micrometer, measure and record crankshaft connecting rod journals, take reading of each journal 120° apart. Crankshaft journal diameter is 53.84 to 53.955mm (2.1196 to 2.1242 in.).

(2) Crankshaft journals worn beyond limits or show signs of out of roundness must be reground or replaced. Minimum reground diameter is 53.69mm (2.1137 in.).

BEARING-TO-JOURNAL CLEARANCE

Compare internal diameters of connecting rod with crankshaft journal diameter. Maximum clearance between connecting rod and crankshaft journals .022 to .076mm (.0008 to .0029 in.).

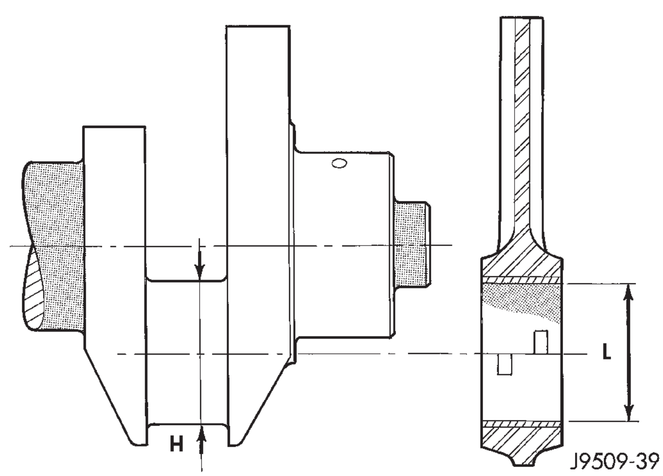

Fig. 77 Bearing Clearance

CYLINDER WALL LINER ASSEMBLY

INSPECTION

The cylinder walls should be checked for out-of-round and taper with dail bore gauge. The cylinder bore out-of-round is 0.100 mm (.0039 inch) maximum and cylinder bore taper is 0.100 mm (0.0039 inch) maximum. If the cylinder walls are badly scuffed or scored, new liners should be installed and honed, and new pistons and rings fitted.

Measure the cylinder bore at three levels in directions A and B (Fig. 78). Top measurement should be 10 mm (3/8 inch) down and bottom measurement should be 10 mm (3/8 inch.) up from bottom of bore.

CLEANING AND INSPECTION (Continued)

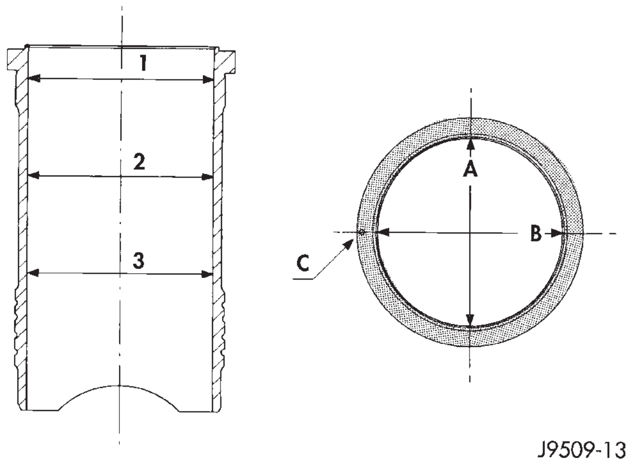

Fig. 78 Liner Inspection

OIL PUMP

CLEANING

Wash all parts in a suitable solvent and inspect carefully for damage or wear.

INSPECTION

(1) Before installing oil pump check pump bore depth in block (A) and pump body height (B) (Fig. 79). Difference between A and B should be 0.020-0.082 mm.

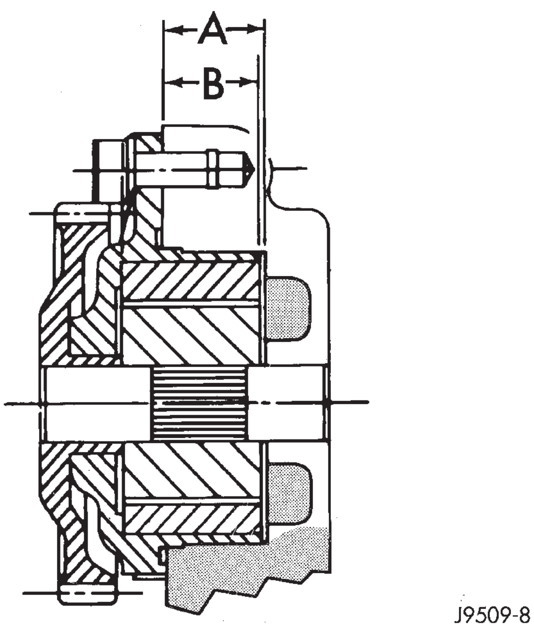

Fig. 79 Oil Pump Bore Depth

(2) Check clearance between rotors (Fig. 81).

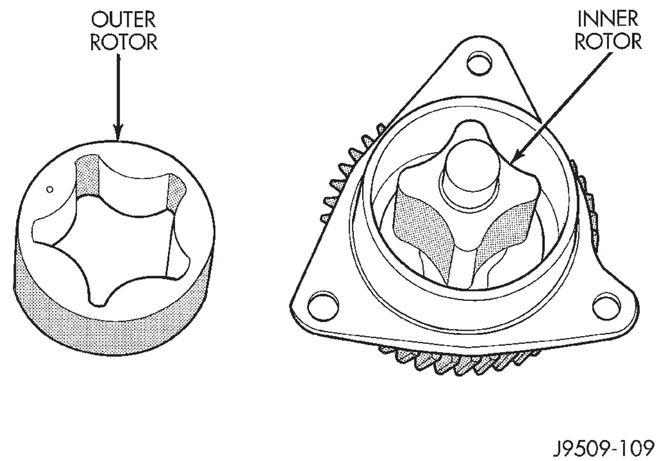

Fig. 80 Oil Pump Inner and Outer Rotors

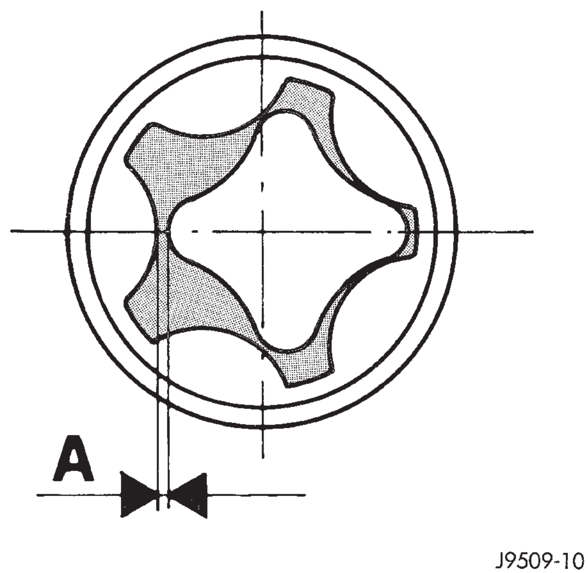

Fig. 81 Checking Rotor Clearance

SPECIFICATIONS

ENGINE SPECIFICATIONS

Description	Specifications
Type	425CLIRX (23B)
Number of cylinders	4
Bore	92 mm
Stroke	94 mm
Capacity	2499.5 cm3
Injection order	1-3-4-2
Compression ratio	21 : 1 (+/- 0.5)
Gasket	Asbestos free
Crankshaft	
Front journal diameter	
Nominal	62.985-63.000 mm
-0.25	62.745-62.760 mm
-0.125	62.860-62.875 mm
Front bearing diameter	
Nominal	63.043-63.088 mm
-0.25	62.810-62.860 mm
-0.125	62.918-62.963 mm
Clearance between journal and bearing: 0.043-0.103	
Center journal diameter	
Nominal	63.005-63.020 mm
-0.25	62.755-62.770 mm
-0.125	62.880-62.895 mm
Center bearing diameter	
Nominal	63.050-63.093 mm
-0.25	62.800-62.843 mm
-0.125	63.550-62.968 mm
Clearance between journal and bearing: 0.030-0.088	
Rear journal diameter	
Nominal	69.980-70.000 mm
-0.25	69.735-69.750 mm
-0.125	69.855-69.875 mm
Rear bearing diameter	
Nominal	70.030-70.055 mm
-0.25	69.780-69.805 mm
-0.125	69.905-69.980 mm
Clearance between journal and bearing: 0.030-0.075	
Wear limit: 0.200 mm.	
Connecting rod journal	
Nominal	53.940-53.955 mm
-0.25	53.690-53.705 mm
-0.125	53.815-53.830 mm
Connecting rod bearing	
Nominal	53.977-54.016 mm
-0.25	53.727-53.766 mm
-0.125	53.852-53.891 mm
Clearance between journal and bearing: 0.022-0.076	
Wear limit: 0.200 mm	

Description	Specifications
Crankshaft end play	
End play	0.153-0.304 mm
Adjustment.	Thrust washers
Thrust washers available:	2.311-2.362 mm
	2.411-2.462 mm
	2.511-2.562 mm
Main bearing carriers	
Internal diameter	
Front	67.025-67.050 mm
Center	66.670-66.687 mm
Rear	75.005-75.030 mm
Liners	
Internal diameter	92.000-92.010 mm
Protrusion	0.01-0.06 mm
Adjustment	Shims
Available shims:	0.15 mm
	0.17 mm
	0.20 mm
	0.23 mm
	0.25 mm
Cylinder head	
Minimum thickness	89.95-90.05 mm
Gaskets thickness:	1.42 mm +/- 0.04, 0 notches
	1.62 mm +/- 0.04, 1 notches
	1.52 mm +/- 0.04, 2 notches
End plates:	
Height	91.26-91.34 mm
Connecting rods	
Weight (without the crank bearing): 1129-1195 grams	
Small end bearing	
Internal diameter	
Minimum	30.035 mm
Maximum	30.050 mm
Crankshaft bearings	
Standard Internal diameter	53.977-54.016 mm
Pistons	
Skirt diameter	91.935-91.945 mm
(measured at approximately 15 mm above the bottom of the skirt).	
Piston clearance:	0.055-0.075 mm
Top of piston to cylinder head	0.80-0.89 mm
Piston protrusion	0.53 - 0.62 Fit gasket Number (1.42),0 notches
	0.73 - 0.82 Fit gasket Number (1.62),1 notches
	0.63 - 0.72 Fit gasket Number (1.52),2 notches

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SPECIFICATIONS (Continued)

Description	Specifications
Piston pins	
Type	Fully floating
Pin diameter	29.990-29.996 mm
Clearance	0.039-0.060 mm
Piston rings	
Clearance in groove:	
Top	0.080-0.130 mm
Second.	0.070-0.102 mm
Oil control	0.040-0.072 mm
Fitted gap:	
Top	0.25-0.50 mm
Second.	0.20-0.35 mm
Oil control	0.25-0.58 mm
Camshaft	
Journal diameter, front	53.495-53.51 mm
Bearing clearance	0.030-0.095 mm
Center	53.45-53.47 mm
Bearing clearance	0.07-0.14 mm
Rear	53.48-53.50 mm
Bearing clearance	0.04-0.11 mm
Tappets	
Outside diameter	14.965-14.985 mm
Rocker gear	
Shaft diameter	21.979-22.00 mm
Bush internal diameter	22.020-22.041 mm
Assembly clearance	0.020-0.062 mm
Valves	
Intake valve:	
Opens	22° B.T.D.C.
Closes	46° A.B.D.C.
Exhaust valve:	
Opens.	60° B.B.D.C.
Closes	24° A.T.D.C.

Description	Specifications
Face angle:	
Intake	56° - 56° 20`
Exhaust.	45° 25` - 45° 35`
Head diameter:	
Intake	40.05-40.25 mm
Exhaust.	33.8-34.0 mm
Head stand down:	
Intake	0.88-1.14 mm
Exhaust.	0.99-1.25 mm
Stem diameter:	
Intake	7.940-7.960 mm
Exhaust.	7.922-7.940 mm
Clearance in guide:	
Intake	0.040-0.075 mm
Exhaust.	0.060-0.093 mm
Valve guide	
Inside diameter	8.0-8.015 mm
Fitted height	13.5-14 mm
Valve springs	
Free length	44.65 mm
Fitted length	38.6 mm
Load at fitted length	34 +/- 3% Kg
Load at top of lift.	92.5 +/- 3% Kg
Number of coils	5.33 Valve timing
Lubrication	
System pressure at 4000 rev/min	3.5 to 5.0 bar (oil at 90-100°C)
Pressure relief valve opens	6.38 bar
Pressure relief valve spring - free length	57.5 mm
Oil pump:	
Outer rotor end float	0.02-0.08 mm
Inner rotor end float	0.02-0.08 mm
Outer rotor to body diam. clearance	0.130-0.230 mm
Rotor body to drive gear clearance (pump not fitted)	0.30 - 0.56 mm

J9509-46

SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS

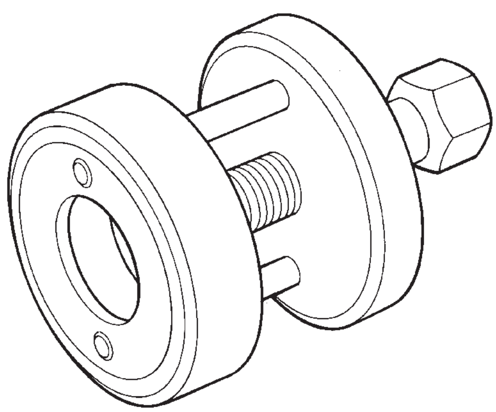
DESCRIPTION	TORQUE
Adaptor Plate to Block	
Nuts (6)	26.5 N·m (20 ft. lbs.)
Automatic Belt Tensioner to Block	
Bolts (2)	121 N·m
Automatic Belt Tensioner to Mounting Bracket	
Bolt (1)	75 N·m
Generator belt	
Tensioner	79 N·m
Generator bracket	
Mounting bolts (6 mm)	10 N·m
Mounting bolts (8 mm)	24.4 N·m
Generator	
Mounting bolt	47 N·m
Camshaft thrust plate	
Bolts	24 N·m
Connecting rod	
Mounting bolt	29.5 N·m +60°
Crankshaft bearing	
Carrier screw	42 N·m
Crankshaft pulley	
Locknut	160 N·m
Crossmember	
Bolts	42 N·m
Diesel delivery	
Union nut	18.5 N·m
EGR valve	
To intake manifold	26 N·m
EGR tube	
To EGR valve	26 N·m
Engine mount—Front	
Engine support bracket	61 N·m
Support Cushion	47 N·m
Support cushion bracket bolts	54 N·m
Support cushion bracket stud nuts	41 N·m
Support Cushion through bolt	65 N·m
Engine mount—Rear	
Transmission support bracket	46 N·m
Support Cushion nuts	75 N·m
Support Cushion through bolt	65 N·m
Exhaust down pipe	
To turbocharger	22 N·m
Exhaust heat shield	
Screws	11 N·m
Exhaust manifold collar	
Mounting nut	24.5 to 29.5 N·m
Exhaust manifold	
Mounting nut	32.5 N·m
Fan drive	
To fan hub	56 N·m
Flywheel	
Lock bolt	20 N·m +60°
Front timing cover	
6 mm bolts	10 N·m
8 mm bolts	26 N·m
Fuel filter	
Nuts	28 N·m
Glow plug	
Torque	13.0 N·m
Idler pulley bracket	
Bolts	40 N·m
Idler pulley	
Bolt (left hand thread)	47 N·m
Injection pump fuel lines	
Nut	23 N·m
Injection pump gear	
Lock nut	86 N·m
Injection pump	
Mounting nut	27.5 N·m
Injector	
Torque	68.5 N·m
Intake manifold	
Mounting nut	32.5 N·m
Main bearing oil delivery	
Union	54 N·m
Water hose to cylinder head	
Nut	8 to 10 N·m
Oil cooler adaptor	
Bolt	60 N·m
Oil feed line	
For rocker arms	12 N·m
To block	27 N·m
To vacuum pump	15 N·m
Oil filter	
Torque	18 N·m
Oil filter adapter	
Torque	46.6 N·m
Oil filter base	
Torque	46.6 N·m
Oil pan	
Mounting bolts	13 N·m
Oil pickup tube	
Torque	25 N·m
Oil pump	
Mounting screw	27 N·m
Oil sump drain plug	
Torque	54 N·m
Power steering pressure hose	
Nut	28 N·m
Power steering pulley	
Nut	130 N·m
Rear crankshaft bearing carrier Allen Bolts	
Torque	11 N·m
Rocker cover	
Bolts	19 N·m

SPECIFICATIONS (Continued)

DESCRIPTION	TORQUE
Rocker mounting	
Lock Nut	35 N·m
Steering pump	
Bolts	28 N·m
Turbocharger	
Mounting nuts	32.5 N·m
Turbocharger	
Oil delivery fitting	27.5 N·m
Turbocharger oil drain	
Plug	10.8 N·m
Vacuum pump	
Torque	27 N·m
Water manifold	
Bolts	12 N·m
Water pump pulley	
Nut	27 N·m

SPECIAL TOOLS

SPECIAL TOOLS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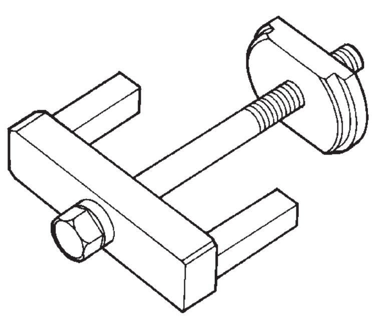
Crankshaft Pulley and Gear Remover VM. 1000A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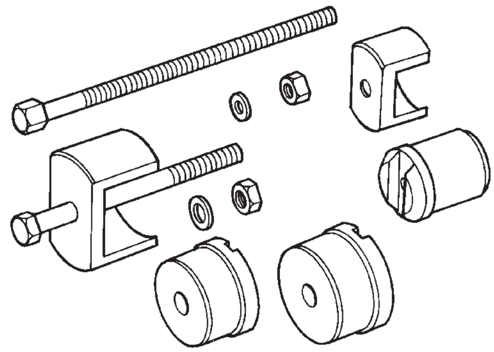
Cylinder Liner Puller VM, 1001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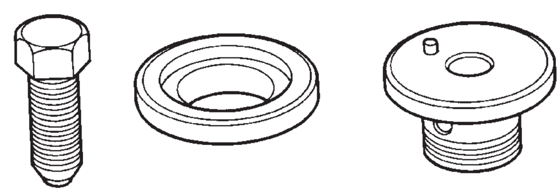
Crankshaft Bearing Remover/Replacer VM. 1002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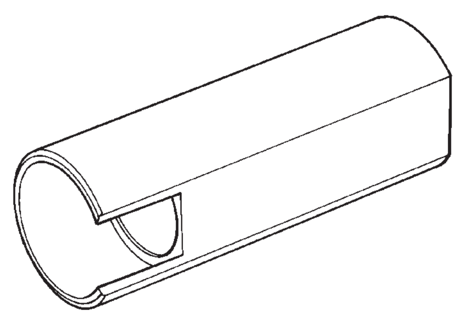
Injection Pump Puller and Gear retainer VM. 1003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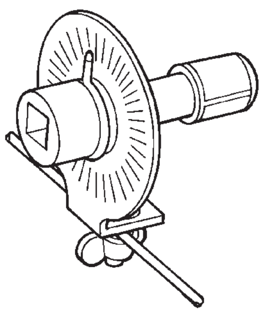
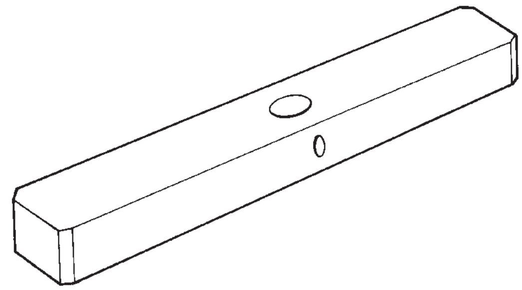
Crankshaft Remover/Replacer Sleeve VM. 1004

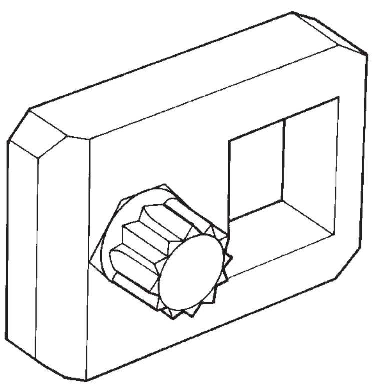
SPECIAL TOOLS (Continued)



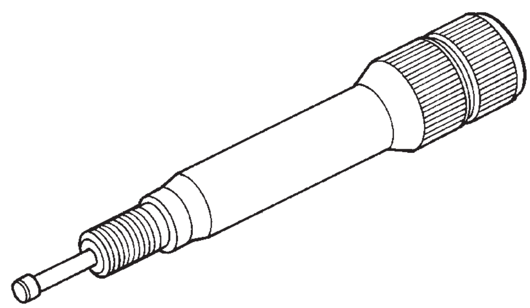
Torque Angle Gauge VM. 1005



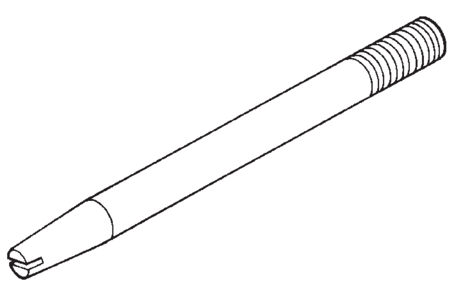
Cylinder Liner Protrusion Tool VM. 1010



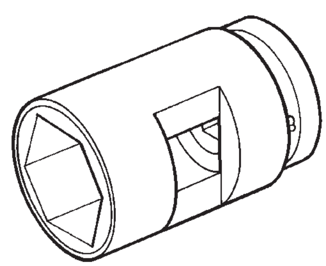
Cylinder Head Bolt Wrench VM. 1006A



Bosch Pump Timing Adapter VM. 1011

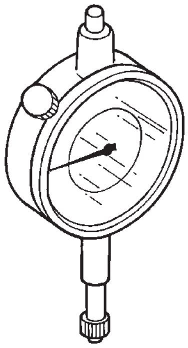


Cylinder Head Guide Studs VM. 1009

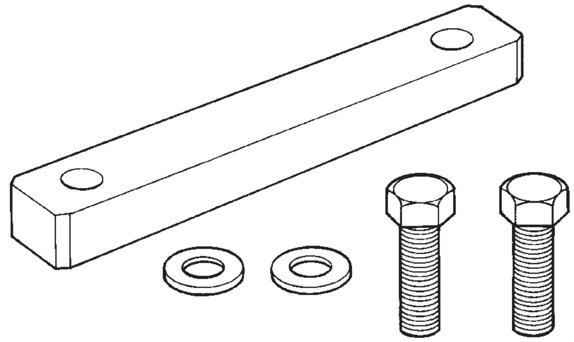


Injector Remover/Replacer Socket VM. 1012

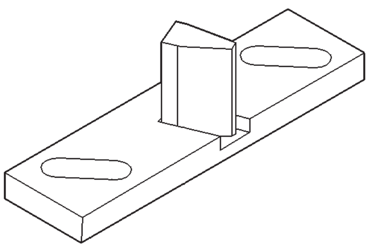
SPECIAL TOOLS (Continued)



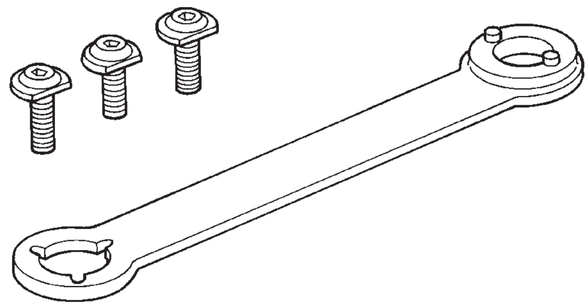
Dial Indicator Gauge VM. 1013



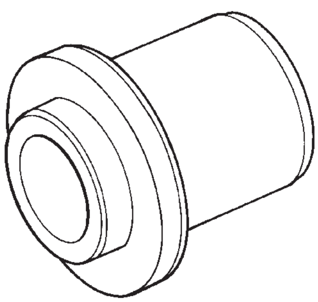
Cylinder Retainer VM. 1016



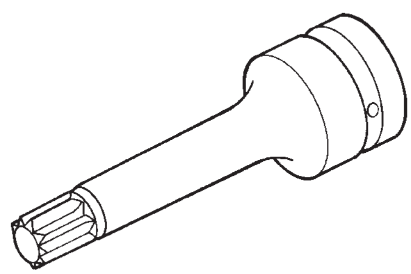
Flywheel Locking Tool VM. 1014



Crankshaft and Water Pump Pulley Holder VM. 1017

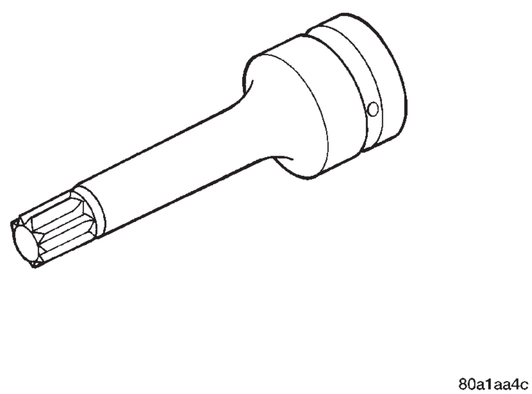


Timing Cover Oil Seal Replacer VM. 1015

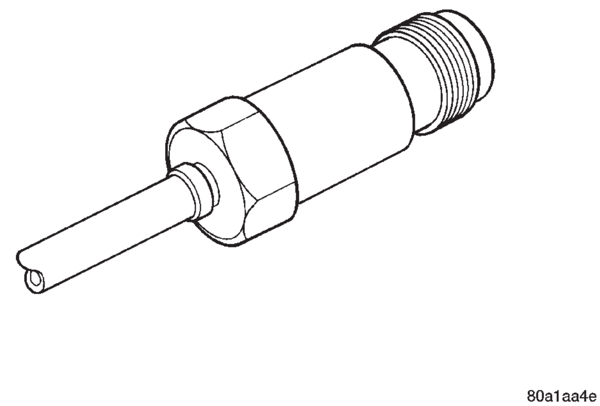


Cylinder Head Bolt Wrench M12 VM. 1018

SPECIAL TOOLS (Continued)



Cylinder Head Bolt Wrench M14 VM. 1019



Cylinder Leakage Tester Adapter VM. 1021

EXHAUST SYSTEM

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, muffler and exhaust tailpipe (Fig. 1).

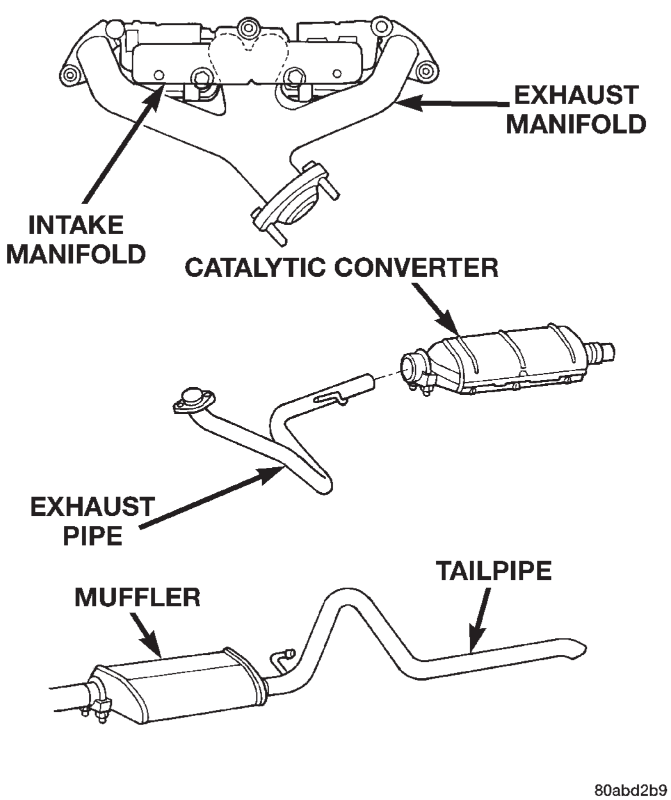


Fig. 1 Exhaust System—2.5L/4.0L

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.

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 over spray 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.

DIAGNOSIS AND TESTING

EXHAUST SYSTEM

EXHAUST SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE OR LEAKING EXHAUST GASES	1. Leaks at pipe joints.	1. Tighten clamps/bolts at leaking joints.
	2. Rusted or blown out muffler.	2. Replace muffler. Inspect exhaust system.
	3. Broken or rusted out exhaust pipe.	3. Replace exhaust pipe.
	4. Exhaust pipe leaking at manifold flange.	4. Tighten/replace flange attaching nuts/bolts.
	5. Exhaust manifold cracked or broken.	5. Replace exhaust manifold.
	6. Leak between exhaust manifold and cylinder head.	6. Tighten exhaust manifold to cylinder head bolts.
	7. Catalytic converter rusted or blown out.	7. Replace catalytic converter assy.
	8. Restriction in exhaust system.	8. Remove restriction, if possible. Replace restricted part if necessary.
When servicing and replacing exhaust system components, disconnect the oxygen sensor connector(s). Allowing the exhaust to hang by the oxygen sensor wires will damage the harness and/or sensor.		

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.

CAUTION: When servicing exhaust system components, disconnect the oxygen sensor connector. Allowing the exhaust system to hang by the oxygen sensor harness will damage the wiring and/or sensor.

REMOVAL

(1) Raise and support the vehicle.

(2) Saturate the bolts and nuts with heat valve lubricant (Fig. 2). Allow 5 minutes for penetration.

(3) Disconnect the oxygen sensor connector (Fig. 3).

(4) Disconnect the exhaust pipe from the engine exhaust manifold. Discard the seal (4.0L engine, only).

(5) Support the transmission and remove the rear crossmember.

(6) Remove the clamp nuts and clamp (Fig. 2). To remove the exhaust pipe from the catalytic converter, apply heat until the metal becomes cherry red. Disconnect the exhaust pipe from the catalytic converter (Fig. 2). Remove the exhaust pipe.

INSTALLATION

(1) Assemble exhaust pipe to manifold and catalytic converter loosely to permit proper alignment of all parts.

(2) Use a new clamp and tighten the nuts to 61 N·m (45 ft. lbs.) torque.

(3) Connect the exhaust pipe to the engine exhaust manifold. Install a new seal between the exhaust manifold and the exhaust pipe (4.0L engine only). Tighten the nuts to 31 N·m (23 ft. lbs.) torque (Fig. 2).

(4) Install the rear crossmember. Install and tighten the four (4) crossmember to rear mount nuts to 22 N·m (16 ft. lbs.) Install and tighten the crossmember to sill bolts to 42 N·m (31 ft. lbs.) torque. Remove the support from the transmission.

(5) Coat the oxygen sensor with anti-seize compound. Install the sensor and tighten the nut to 27 N·m (20 ft. lbs.) torque.

(6) Lower the vehicle.

REMOVAL AND INSTALLATION (Continued)

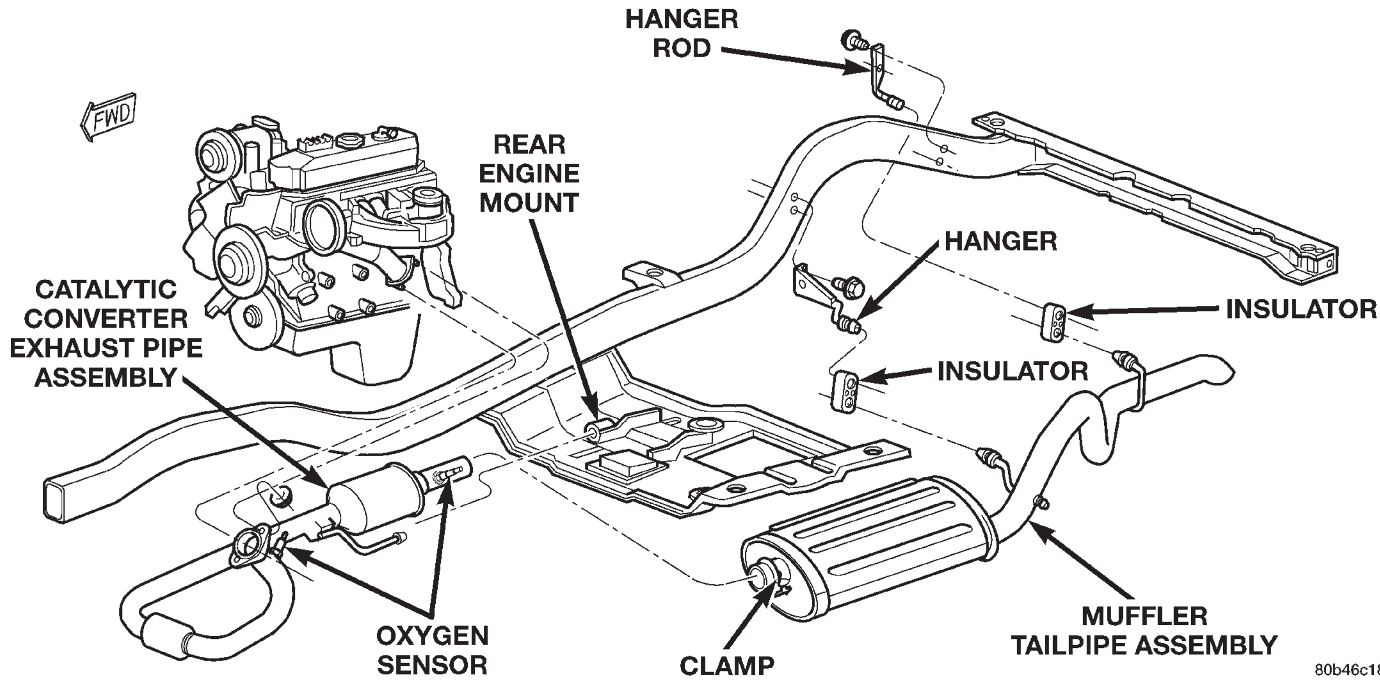


Fig. 2 Exhaust Pipe Removal—2.5L/4.0L

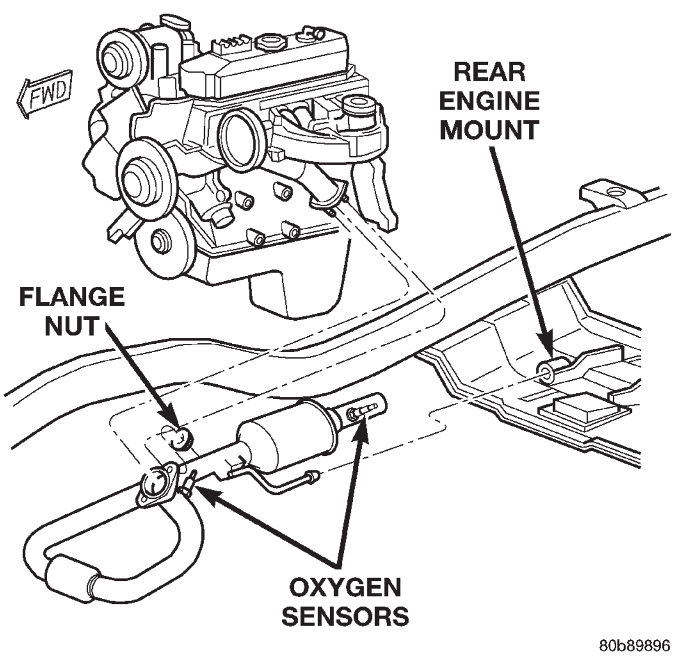


Fig. 3 Oxygen Sensor Location—2.5L/4.0L

(7) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

CATALYTIC CONVERTER

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

CAUTION: When servicing exhaust system components, disconnect the oxygen sensor connector. Allowing the exhaust system to hang by the oxygen sensor harness will damage the wiring and/or sensor.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the clamps from the catalytic converter and muffler connection (Fig. 4).

(3) Disconnect and remove the oxygen sensor from the catalytic converter.

(4) Heat the catalytic converter and muffler connection with an oxyacetylene torch until the metal becomes cherry red.

(5) While the metal is still cherry red, twist the muffler assembly back and forth to separate it from the catalytic converter.

(6) Disconnect the exhaust pipe from the catalytic converter (Fig. 4). If needed, heat up the pipes to separate.

INSTALLATION

(1) Connect the catalytic converter to the exhaust pipe and the muffler/tailpipe assy. (Fig. 4). Use a new clamp and tighten the nuts to 61 N·m (45 ft. lbs.) torque.

(2) Install the muffler onto the catalytic converter until the alignment tab is inserted into the alignment slot.

REMOVAL AND INSTALLATION (Continued)

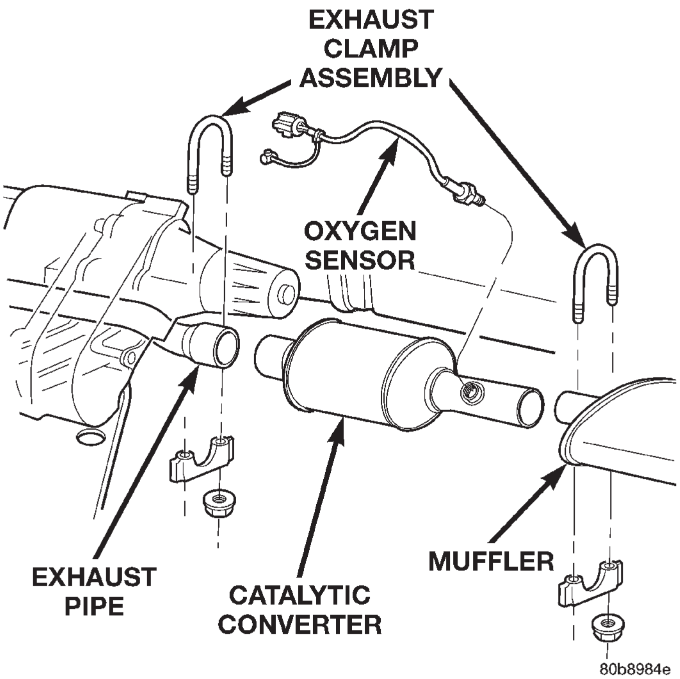


Fig. 4 Catalytic Converter to Muffler and Exhaust Pipe Connection

(3) Install a new clamp at the muffler and catalytic converter connection (Fig. 4). Tighten the clamp nut to 61 N·m (45 ft. lbs.) torque.

(4) Coat the oxygen sensor with anti-seize compound. Install the sensor and tighten the nut to 27 N·m (20 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

MUFFLER AND EXHAUST TAILPIPE

All original equipment exhaust systems are manufactured with the exhaust tailpipe welded to the muffler. Service replacement mufflers and exhaust tailpipes are either clamped together or welded together.

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINE.

CAUTION: When servicing exhaust system components, disconnect the oxygen sensor connector. Allowing the exhaust system to hang by the oxygen sensor harness will damage the wiring and/or sensor.

REMOVAL

(1) Raise and support the vehicle.

(2) Disconnect front tailpipe hanger from the insulator (Fig. 5).

(3) Remove the front exhaust clamp from the catalytic converter and muffler connection (Fig. 6).

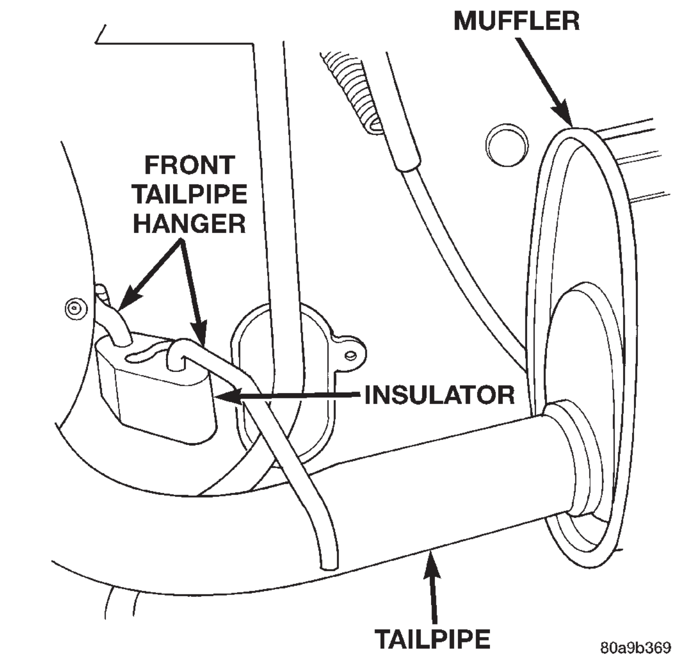


Fig. 5 Front Exhaust Tailpipe Hanger

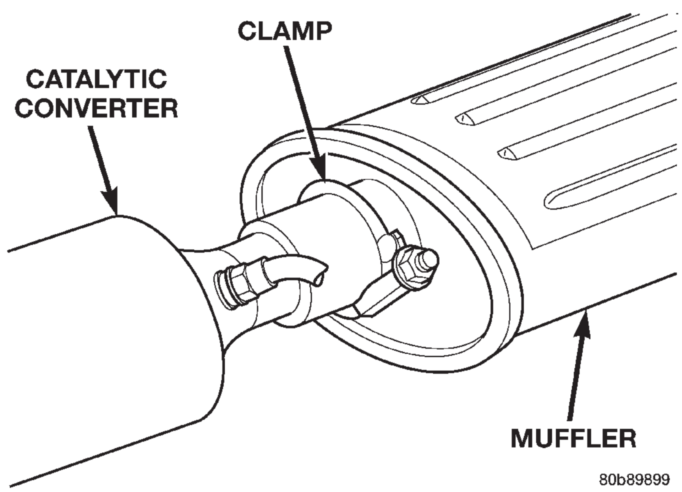


Fig. 6 Catalytic Converter to Muffler Connection

(4) Heat the catalytic converter-to-muffler connection with an oxyacetylene torch until the metal becomes cherry red.

(5) While the metal is still cherry red, remove the exhaust muffler/tailpipe assembly from the catalytic converter.

(6) Slide the muffler/tailpipe assy. rearward and out of the rear exhaust tailpipe mounting bracket (Fig. 7).

(7) Remove the muffler from the exhaust tailpipe:

• To remove an original equipment exhaust muffler/tailpipe combination, cut the exhaust tailpipe

REMOVAL AND INSTALLATION (Continued)

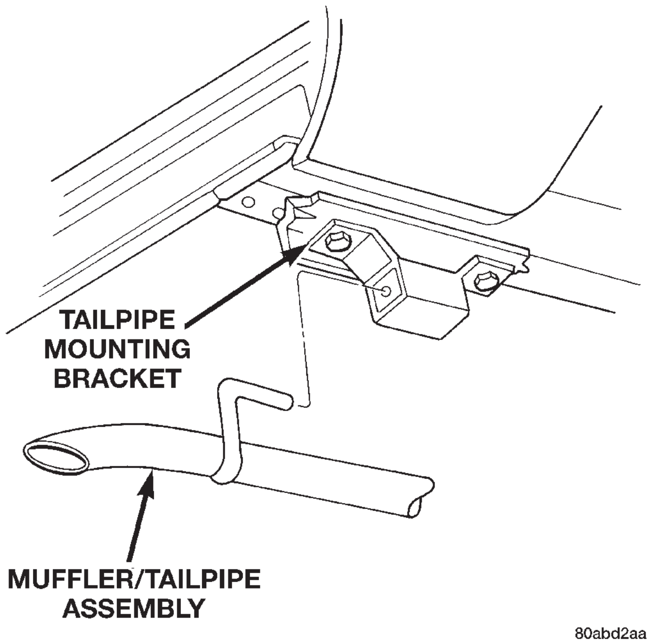


Fig. 7 Rear Exhaust Tailpipe Mounting Bracket

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) Install the muffler onto the catalytic converter. Install the clamp and tighten the nut finger tight.

(2) Install the exhaust tailpipe into the rear of the muffler.

(3) Install the exhaust tailpipe/muffler assembly on the rear exhaust tailpipe mounting bracket. Make sure that the exhaust tailpipe has sufficient clearance from the floor pan.

(4) Install front tailpipe hanger into the insulator (Fig. 5).

(5) Align the muffler and tighten the nuts on the muffler-to-catalytic converter clamp to 61 N·m (45 ft. lbs.) torque (Fig. 6).

(6) Align the tailpipe and install a new clamp at the muffler to tailpipe connection.

(7) Tighten the muffler to tailpipe clamp to 61 N·m (45 ft. lbs.)

(8) Lower the vehicle.

(9) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	Torque
Catalytic Converter/Exhaust Pipe	
Exhaust Clamp Nut	61 N·m (45 ft. lbs.)
Crossmember to Sill	
Bolts	42 N·m (31 ft. lbs.)
Crossmember to Transmission Mount	
Nuts	22 N·m (16 ft. lbs.)
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	
Nuts #6&7	31 N·m (23 ft. lbs.)
Exhaust Manifold–4.0L Engine	
Nuts #6&7	31 N·m (23 ft. lbs.)
Bolt #3	33 N·m (24 ft. lbs.)
Intake Manifold–2.5L Engine	
Bolt #2–5	31 N·m (23 ft. lbs.)
Intake & Exhaust Manifold–2.5L Engine	
Bolts #2–5	31 N·m (23 ft. lbs.)
Intake & Exhaust Manifold–4.0L Engine	
Nuts/Bolts #1,2,4,5,8–11	33 N·m (24 ft. lbs.)
Muffler to Catalytic Converter	
Exhaust Clamp Nut	61 N·m (45 ft. lbs.)
Oxygen Sensors	
Nut	27 N·m (20 ft. lbs.)
Rear Tail Pipe Hanger	
Nuts	54 N·m (40 ft. lbs.)

EXHAUST SYSTEM AND TURBOCHARGER

CONTENTS

GENERAL INFORMATION

EXHAUST SYSTEM

The basic exhaust system consists of an engine exhaust manifold, exhaust pipe, exhaust heat shield(s), muffler and exhaust tailpipe.

The exhaust system uses a single muffler.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. If the system contacts any body panel, it 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 equivalent). This will assure proper alignment and provide acceptable exhaust noise levels.

CAUTION: Avoid application of rust prevention compounds or undercoating materials to exhaust system floor pan exhaust heat shields. Light overspray near the edges is permitted. Application of coating will result in excessive floor pan temperatures and objectionable fumes.

EXHAUST HEAT SHIELDS

Exhaust heat shields are needed to protect both the vehicle and the environment from the high temperatures (Fig. 1).

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.

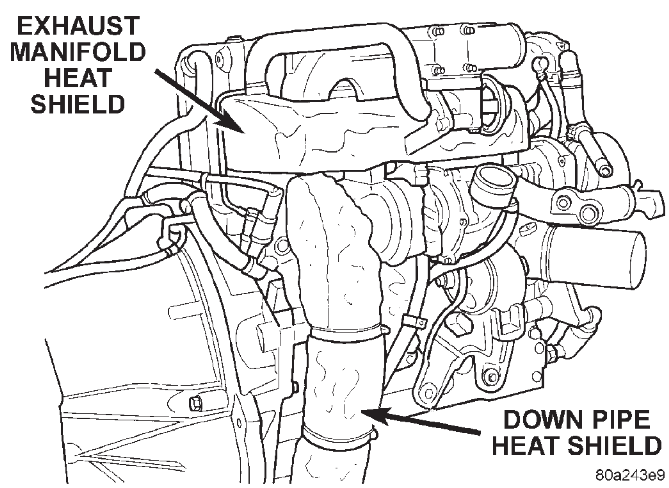


Fig. 1 Heat Shields

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 bolts and nuts at turbo down pipe to exhaust pipe with heat valve lubricant. Allow 5 minutes for penetration.

(3) Disconnect bolts from exhaust pipe to turbo down pipe (Fig. 2).

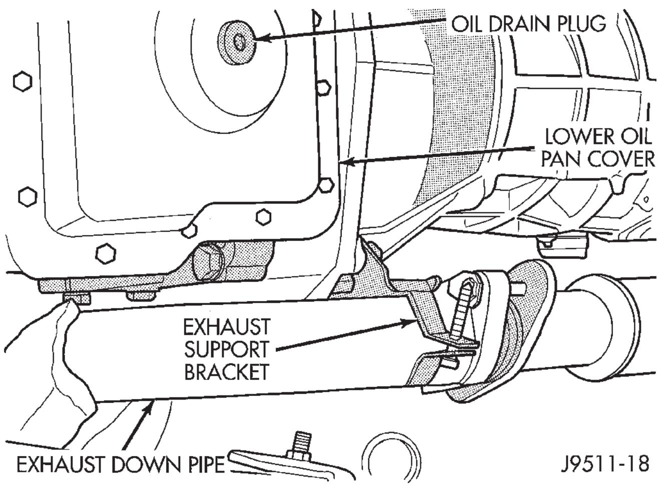


Fig. 2 Exhaust Down Pipe to Front Exhaust Pipe

(4) Remove the clamp nuts at muffler (Fig. 3). To remove the exhaust pipe from the muffler, apply heat until the metal becomes cherry red. Disconnect the exhaust pipe from the muffler. Remove the exhaust pipe.

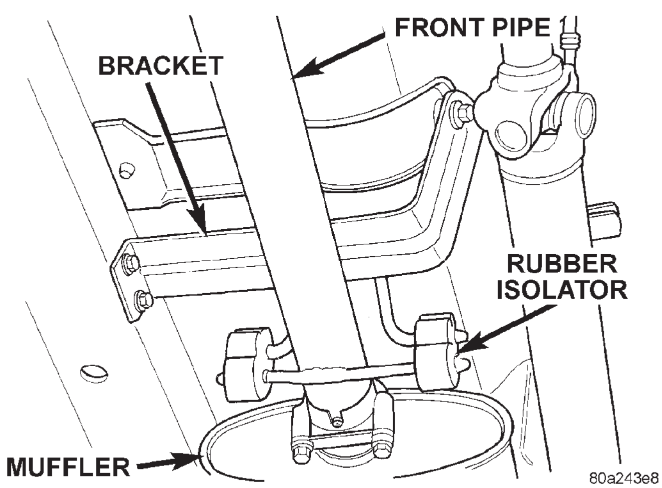


Fig. 3 Front Pipe to Muffler

INSTALLATION

(1) Assemble exhaust pipe to muffler, loosely to permit proper alignment of all parts.

(2) Connect the exhaust pipe to the turbo down pipe manifold. Tighten the bolts to 22.5 N·m torque.

(3) Use a new clamp and tighten the nuts to 43 N·m torque.

(4) Lower the vehicle.

(5) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

MUFFLER AND EXHAUST TAILPIPE

All original equipment exhaust systems are manufactured with the exhaust tailpipe welded to the muffler. Service replacement mufflers and exhaust tailpipes are either clamped together or welded together.

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the front muffler clamp from the exhaust pipe and muffler connection.

(3) Remove the rear exhaust tailpipe hanger clamp and remove the exhaust tailpipe from the front exhaust tailpipe hanger.

(4) Remove the exhaust tailpipe assembly from the muffler.

INSTALLATION

(1) Install the muffler onto the exhaust pipe. Install the clamp and tighten the nuts finger tight.

(2) Install the exhaust tailpipe into the rear of the muffler.

(3) Install the exhaust tailpipe/muffler assembly on the rear exhaust tailpipe hanger. Make sure that the exhaust tailpipe has sufficient clearance from the floor pan.

(4) Install the remaining clamps and the front exhaust tailpipe hanger.

(5) Tighten the nuts on the muffler-to-exhaust pipe clamp to 43 N·m torque.

(6) Tighten the nuts on the muffler-to-exhaust pipe clamp to 43 N·m torque.

(7) Lower the vehicle.

(8) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

REMOVAL AND INSTALLATION (Continued)

EXHAUST MANIFOLD AND TURBOCHARGER (LHD)

REMOVAL

(1) Disconnect the negative battery cable.

(2) Disconnect the breather hose from air cleaner outlet hose (Fig. 4).

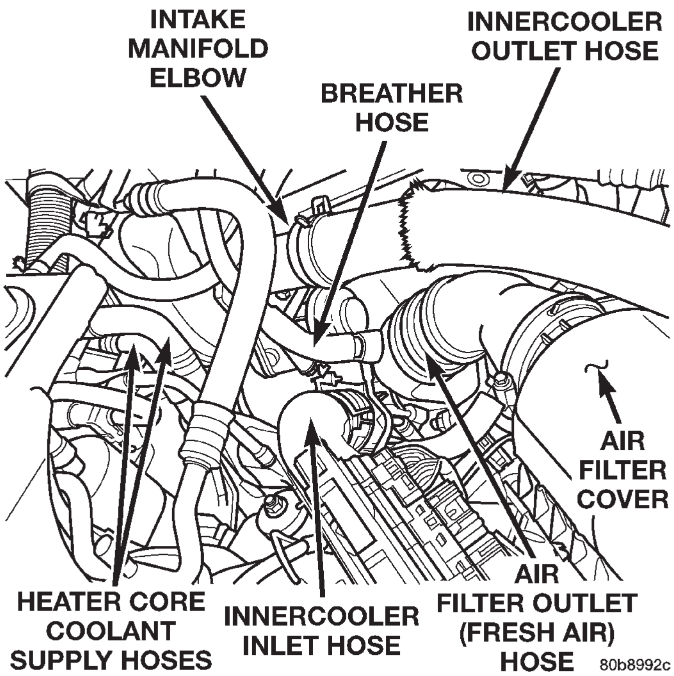


Fig. 4 Engine Compartment

(3) Remove the air filter cover and hose from turbocharger, remove the assembly (Fig. 4).

(4) Remove the EGR vacuum supply hose from the EGR valve.

(5) Remove the innercooler inlet and outlet hoses from the engine (Fig. 4).

(6) Remove the (2) bolts holding the EGR tube to the EGR valve.

(7) Remove the intake manifold elbow and EGR valve as an assembly.

(8) Raise the vehicle on a hoist.

(9) Drain the cooling system. Refer to Group 7, Cooling System for procedure.

(10) Remove the exhaust system support clamp (Fig. 5).

(11) Disconnect the exhaust system at the (3) bolt flange (Fig. 5).

CAUTION: Heatshield is very sharp. Wear gloves to prevent injury.

(12) Unstrap the exhaust downpipe heatshield (Fig. 6).

(13) Disconnect the turbocharger oil return hose from the engine block (Fig. 7).

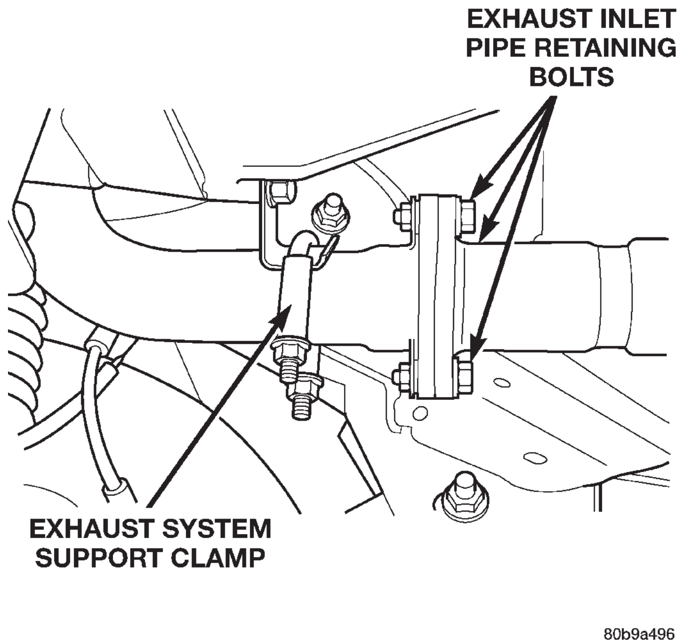


Fig. 5 Exhaust System Inlet Pipe Connection

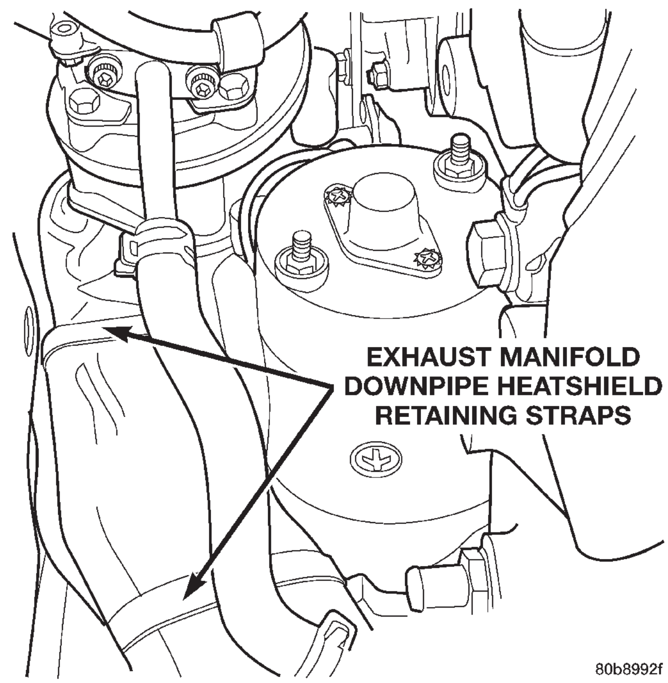


Fig. 6 Exhaust Downpipe Heatshield

(14) Lower the vehicle from the hoist.

(15) Remove the EGR tube from exhaust manifold.

(16) Remove the (2) exhaust manifold heatshield retaining bolts and remove the heatshield.

(17) Remove the heater core supply hoses from the vehicle.

(18) Remove the oil pressure supply line bango bolt from the turbocharger.

REMOVAL AND INSTALLATION (Continued)

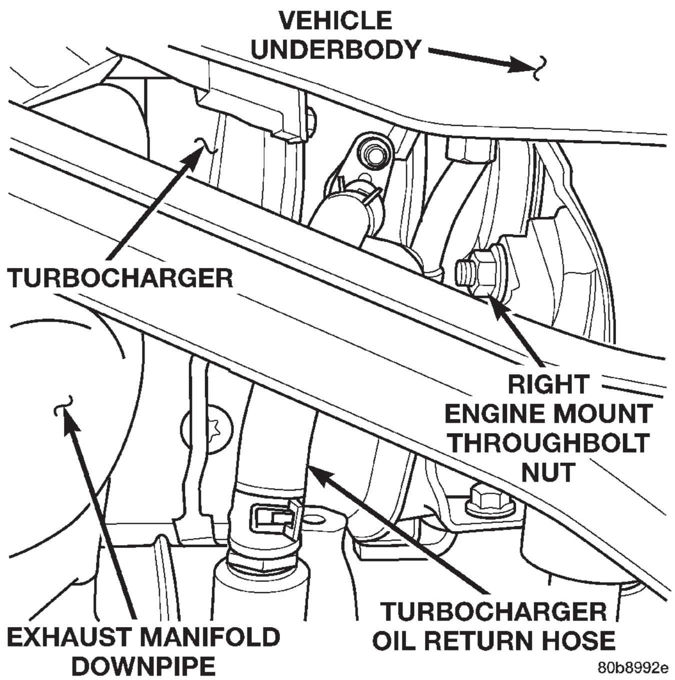


Fig. 7 Turbocharger Oil Return Hose

CAUTION: Heatshield is very sharp. Wear gloves to prevent injury.

(19) Remove the exhaust downpipe heatshield by pulling straight up.

(20) Remove the (5) bolts from exhaust manifold downpipe and remove pipe.

(21) Remove the (8) exhaust manifold retaining bolts, it is necessary to access the bolt behind the manifold outlet from the underneath of the vehicle.

(22) Remove the exhaust manifold and turbocharger assembly from the vehicle.

(23) Place assembly in a vice to remove the (3) exhaust manifold to turbocharger retaining nuts (Fig. 8).

Cleaning

All old gaskets should be inspected for any tears or signs of prior leakage. If any gaskets show such indications, they should be replaced with new gaskets. All gasket mating surfaces must be cleaned of old gasket material to produce a smooth and dirt free sealing surface for the new gasket.

INSTALLATION

(1) Transfer the oil return hose to the new turbocharger (Fig. 9).

(2) Install the turbo on the exhaust manifold (Fig. 9). Torque the nuts to 32 N·m (23 ft. lbs.).

(3) Install the exhaust manifold and turbocharger assembly in the vehicle.

(4) Install the (8) exhaust manifold retaining nuts. Torque nuts to 32 N·m (23 ft. lbs.).

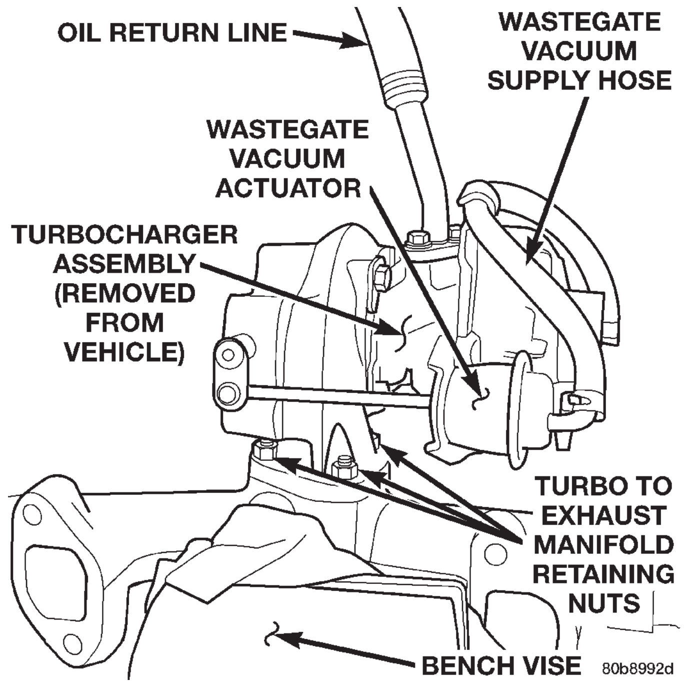


Fig. 8 Turbocharger / Exhaust Manifold Assembly

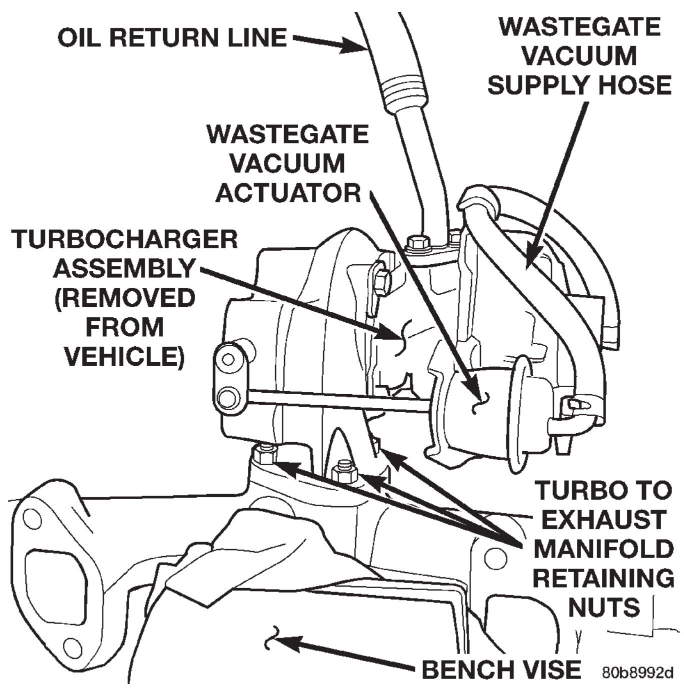


Fig. 9 Turbocharger / Exhaust Manifold Assembly

(5) Install the exhaust manifold downpipe. Torque bolts to 32 N·m (23 ft. lbs.).

CAUTION: Heatshield is very sharp. Wear gloves to prevent injury.

(6) Slide the exhaust downpipe heatshield down over pipe. Do not attempt to strap heatshield in position at this time, wait until vehicle is raised on hoist.

REMOVAL AND INSTALLATION (Continued)

(7) Install the oil pressure supply line on turbocharger. Torque bango bolt fitting to 27 N·m (20 ft. lbs.).

(8) Install the heater core supply hoses.

(9) Position and install the exhaust manifold heatshield. Torque bolts to 11 N·m (97 in. lbs.).

(10) Raise the vehicle on a hoist.

(11) Install the turbocharger oil return hose on the engine block (Fig. 10).

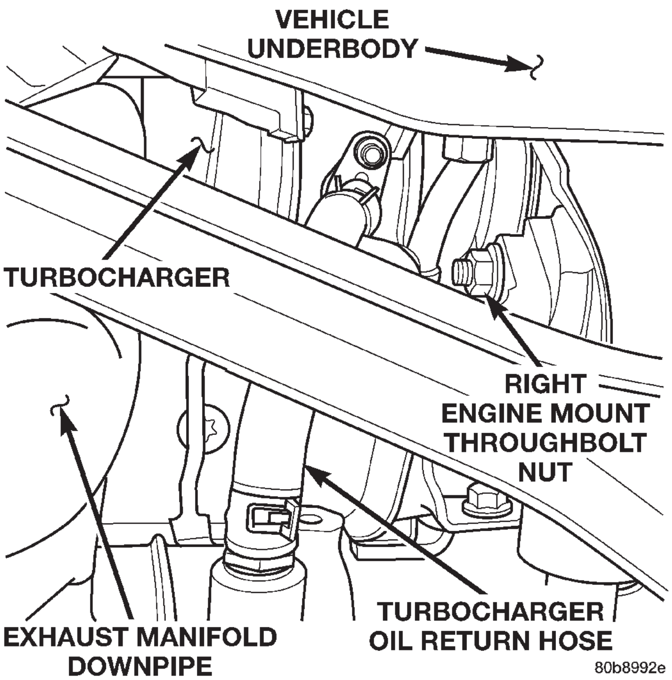


Fig. 10 Turbocharger Oil Return Hose

(12) Strap the exhaust downpipe heatshield in its original position.

(13) Connect the exhaust system at the (3) bolt flange (Fig. 11). Torque the bolts to 23 N·m (17 ft. lbs.).

(14) Install the exhaust system support clamp (Fig. 11). Torque nuts to 23 N·m (17 ft. lbs.).

(15) Lower the vehicle from the hoist.

(16) Install the intake manifold elbow and EGR valve as an assembly. Torque bolts to 27 N·m (20 ft. lbs.).

(17) Install the (2) bolts holding the EGR tube to the EGR valve. Torque bolts to 27 N·m (20 ft. lbs.).

(18) Install the innercooler inlet and outlet hoses on the engine (Fig. 12).

(19) Install the EGR vacuum supply hose on the EGR valve.

(20) Install the air filter cover and outlet hose on turbocharger (Fig. 12).

(21) Connect the breather hose on the air cleaner outlet hose (Fig. 12).

(22) Fill the cooling system. Refer to Group 7, Cooling System for procedure.

(23) Connect the negative battery cable

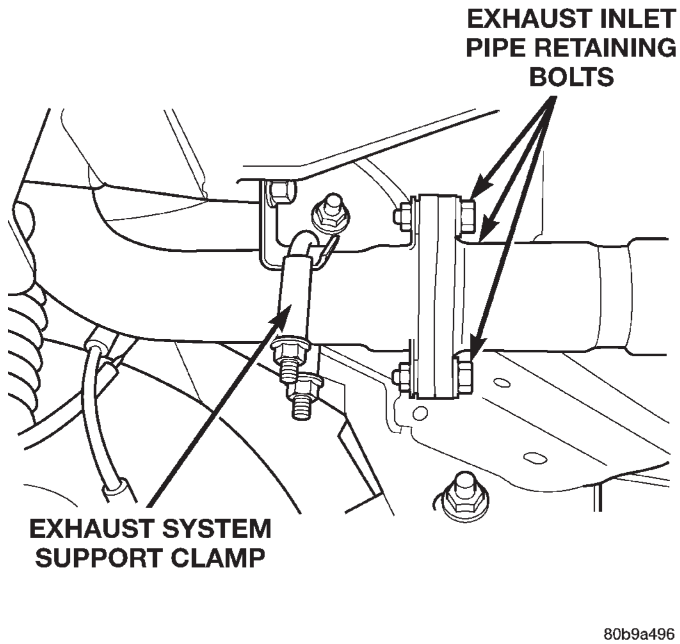


Fig. 11 Exhaust System Inlet Pipe Connection

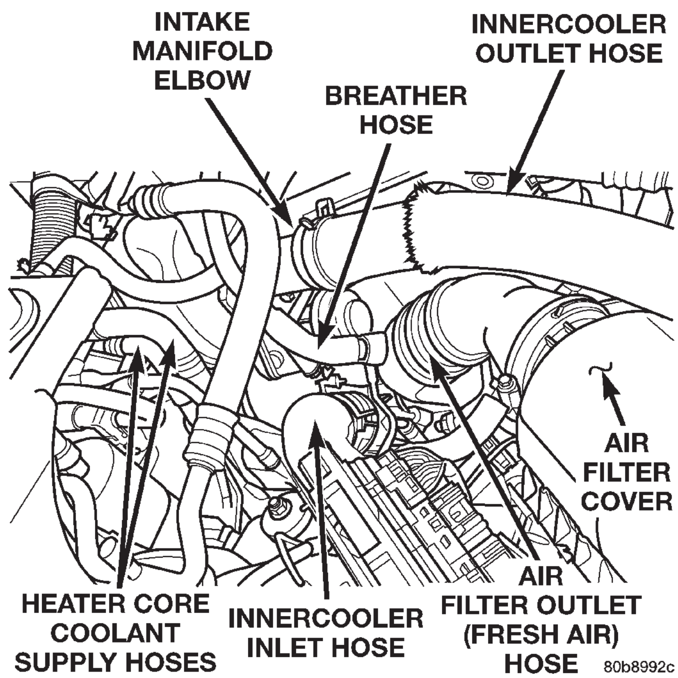


Fig. 12 Engine Compartment

(24) Start the engine and check for leaks.

EXHAUST MANIFOLD AND TURBOCHARGER (RHD)

REMOVAL

(1) Disconnect the negative battery cable.

(2) Disconnect the breather hose from the air cleaner outlet hose.

REMOVAL AND INSTALLATION (Continued)

(3) Remove the air filter cover and the hose from the turbocharger, remove the assembly.

(4) Raise the vehicle on a hoist.

(5) Drain the cooling system. Refer to Group 7, Cooling System for the procedure.

(6) Remove the exhaust system support clamp (Fig. 13).

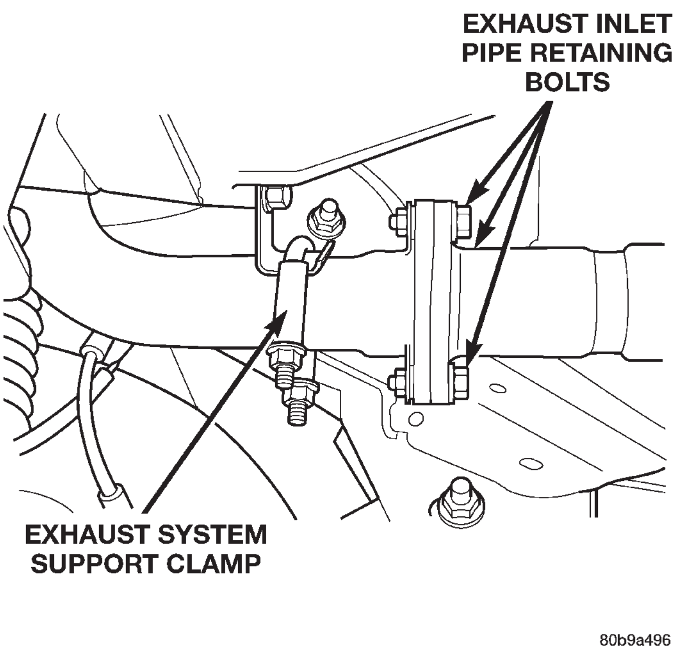


Fig. 13 Exhaust System Inlet Pipe Connection

(7) Disconnect the exhaust system at the (3) bolt flange (Fig. 13).

CAUTION: Heatshield is very sharp. Wear gloves to prevent injury.

(8) Unstrap the exhaust downpipe heatshield (Fig. 14).

CAUTION: Heatshield is very sharp. Wear gloves to prevent injury.

(9) Remove the exhaust downpipe heatshield by pulling straight down.

(10) Disconnect the turbocharger oil return hose from the engine block (Fig. 15).

(11) Lower the vehicle from the hoist.

(12) Disconnect the heater core coolant supply and the brake vacuum supply hoses from the right side of the engine. Remove the steel line support bracket from the top of the rocker cover and position the assembly out of the way.

(13) Remove the EGR vacuum supply hose from the EGR valve.

(14) Remove the innercooler inlet and outlet hoses from the engine.

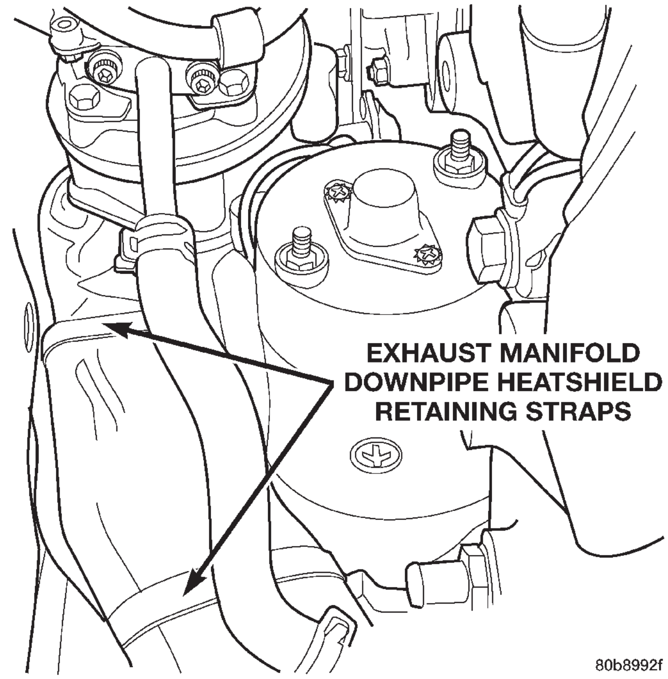


Fig. 14 Exhaust Downpipe Heatshield

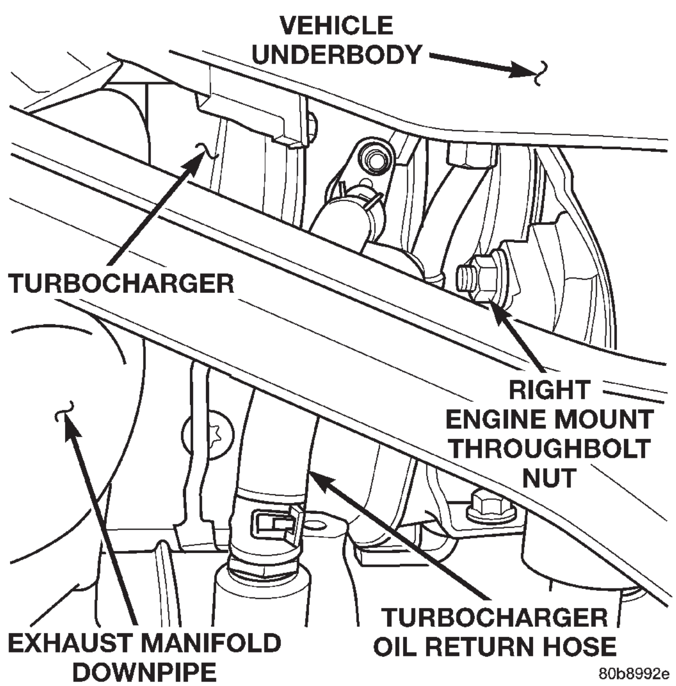


Fig. 15 Turbocharger Oil Return Hose

(15) Remove the (2) bolts holding the EGR tube to the EGR valve.

(16) Remove the intake manifold elbow and the EGR valve as an assembly.

(17) Remove the EGR tube from the exhaust manifold.

(18) Remove the (2) exhaust manifold heatshield retaining bolts and remove the heatshield (Fig. 16).

(19) Remove the oil pressure supply line from the turbocharger (Fig. 16).

REMOVAL AND INSTALLATION (Continued)

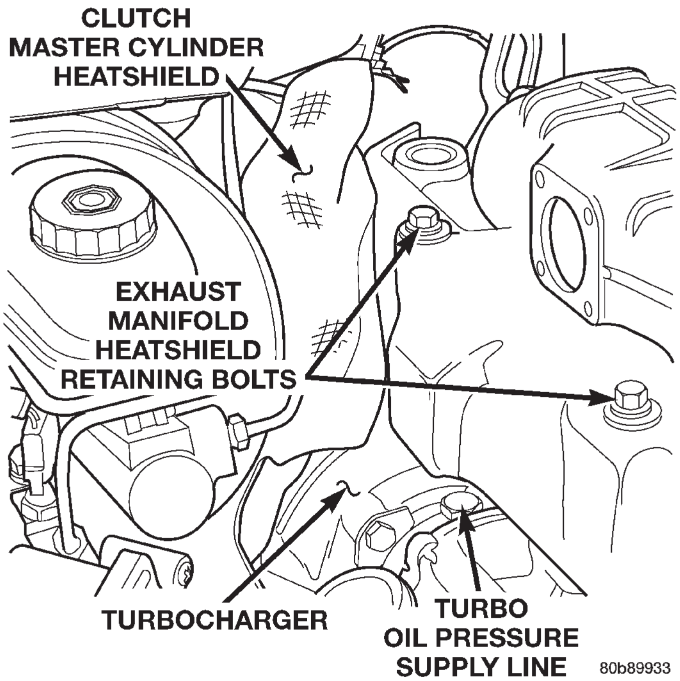


Fig. 16 2.5L Turbo Diesel — Heatshields

(20) Remove the clutch master cylinder heatshield (Fig. 16).

(21) Remove the wastegate actuator vacuum supply hose from the actuator (Fig. 17).

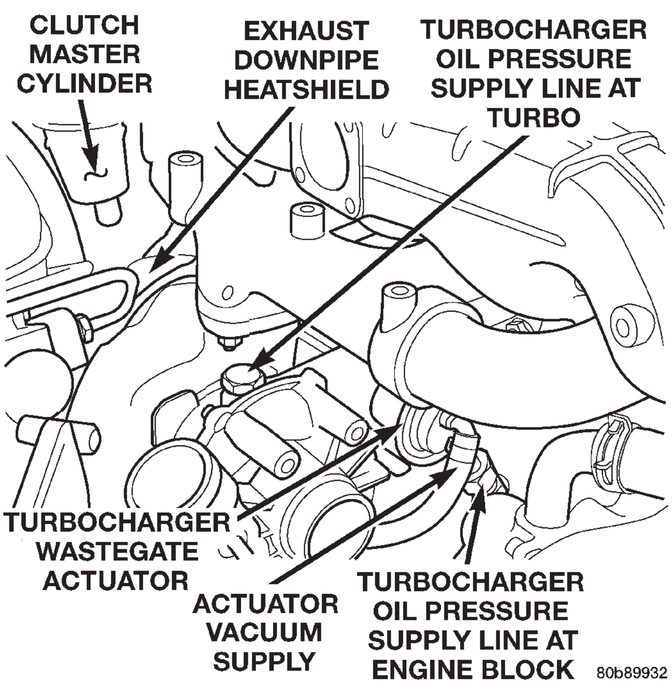


Fig. 17 R.H.D. Turbo Position & Orientation

(22) Remove the turbocharger oil pressure supply line from the engine block (Fig. 17).

(23) Working inside of the vehicle, remove the Knee Blocker. Refer to Group 8E, Instrument Panel Systems for the procedure.

(24) Disconnect the neutral safety switch electrical connector at the clutch pedal.

(25) Remove the (2) clutch master cylinder retaining nuts from the bulkhead.

(26) Working from the inside of the engine compartment, remove the clutch master cylinder from the bulkhead and position the cylinder and line assembly out of the way.

(27) Remove the (5) bolts from the exhaust manifold downpipe and remove the pipe.

(28) Remove the (8) exhaust manifold retaining bolts, it is necessary to access the bolt behind the manifold outlet from the underneath of the vehicle.

(29) Remove the steering shaft pinchbolt and slide the shaft straight off of the gearbox input shaft. Position aside.

(30) Remove the exhaust manifold and the turbocharger assembly from the vehicle.

(31) Place the turbo assembly in a vice to remove the (3) exhaust manifold to turbocharger retaining nuts (Fig. 18).

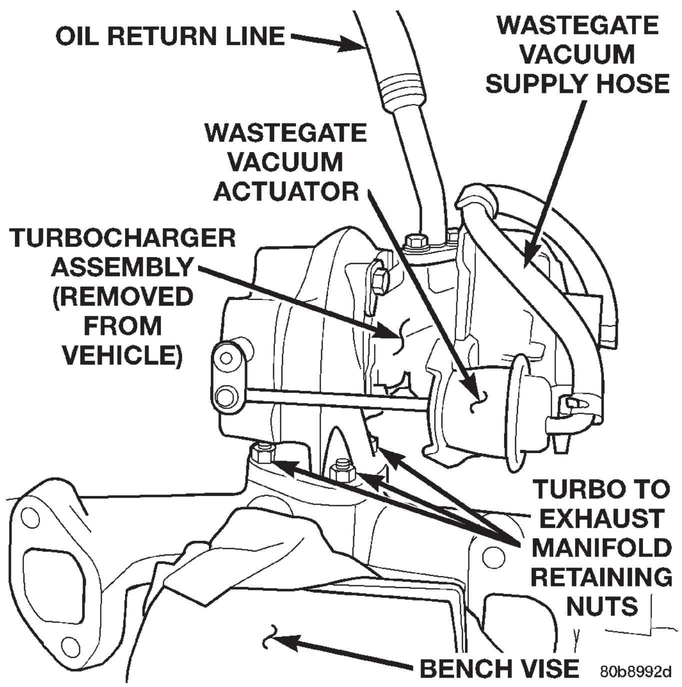


Fig. 18 Turbocharger / Exhaust Manifold Assembly

Cleaning

All old gaskets should be inspected for any tears or signs of prior leakage. If any gasket shows such indications, it must be replaced with a new gasket. All gasket mating surfaces must be cleaned of all old gasket material to produce a smooth and dirt free sealing surface for the new gasket.

INSTALLATION

(1) Install the turbocharger on the exhaust manifold (Fig. 19). Torque nuts to 32 N·m (23 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

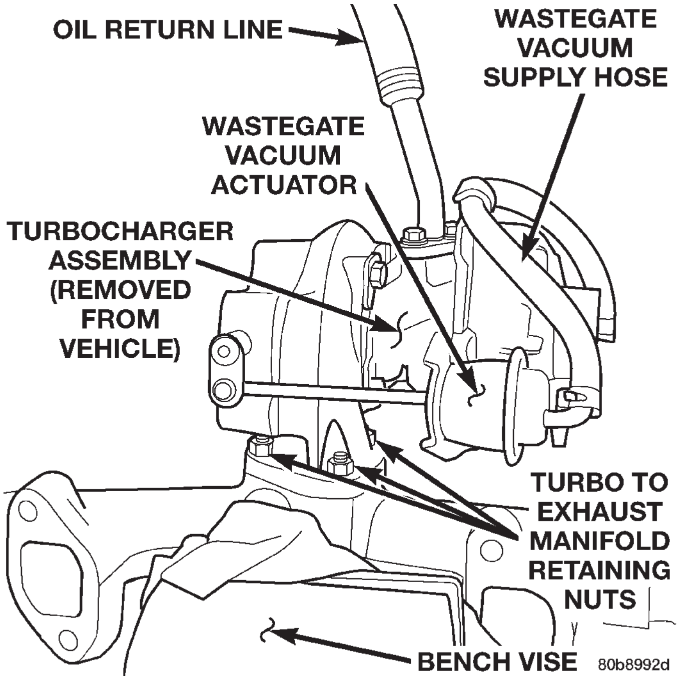


Fig. 19 Turbocharger / Exhaust Manifold Assembly

(2) Install the exhaust manifold and turbocharger assembly in the vehicle.

(3) Install the (8) exhaust manifold retaining nuts, it is necessary to access the bolt behind the manifold outlet from the underneath of the vehicle. Torque nuts to 32 N·m (23 ft. lbs.).

(4) Install the exhaust manifold downpipe. Torque the bolts to 32 N·m (23 ft. lbs.).

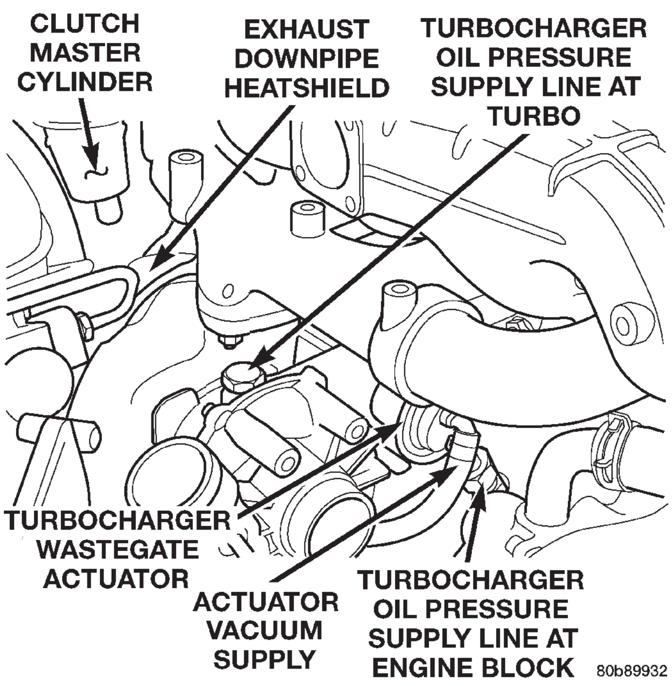


Fig. 20 R.H.D. Turbo Position & Orientation

(5) Position the turbocharger oil pressure supply line in its original position (Fig. 20). Torque the turbo fitting to 27 N·m (20 ft. lbs.).

(6) Install the wastegate actuator vacuum supply hose on the actuator (Fig. 20).

(7) Install the exhaust manifold heatshield (Fig. 21). Torque bolts to 11 N·m (97 in. lbs.).

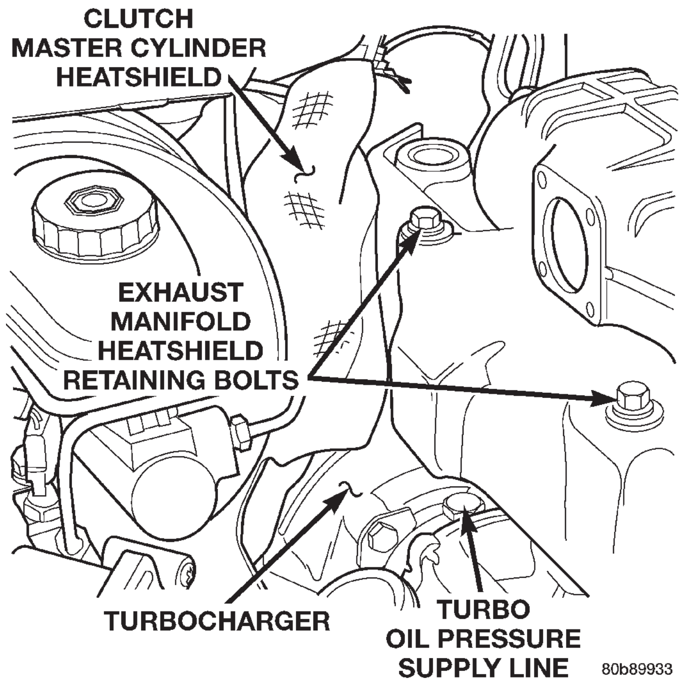


Fig. 21 2.5L Turbo Diesel — Heatshields

(8) Install the EGR tube on the exhaust manifold. Leave loose at this time.

(9) Raise the vehicle on a hoist.

CAUTION: Heatshield is very sharp. Wear gloves to prevent injury.

(10) Slide the exhaust downpipe heatshield up over the pipe and strap it in its original position (Fig. 22).

(11) Install the steering shaft. Torque the pinch bolt to 49 N·m (36 ft. lbs.).

(12) Install the turbocharger oil return hose on the engine block (Fig. 23).

(13) Connect the exhaust system at the (3) bolt flange (Fig. 24). Torque the bolts to 23 N·m (17 ft. lbs.).

(14) Install the exhaust system support clamp (Fig. 24). Torque nuts to 23 N·m (17 ft. lbs.).

(15) Lower the vehicle on hoist.

(16) Install the clutch master cylinder through the bulkhead.

(17) Working from the inside of the vehicle, Install the (2) clutch master cylinder retaining nuts.

(18) Connect the neutral safety switch at the clutch pedal.

REMOVAL AND INSTALLATION (Continued)

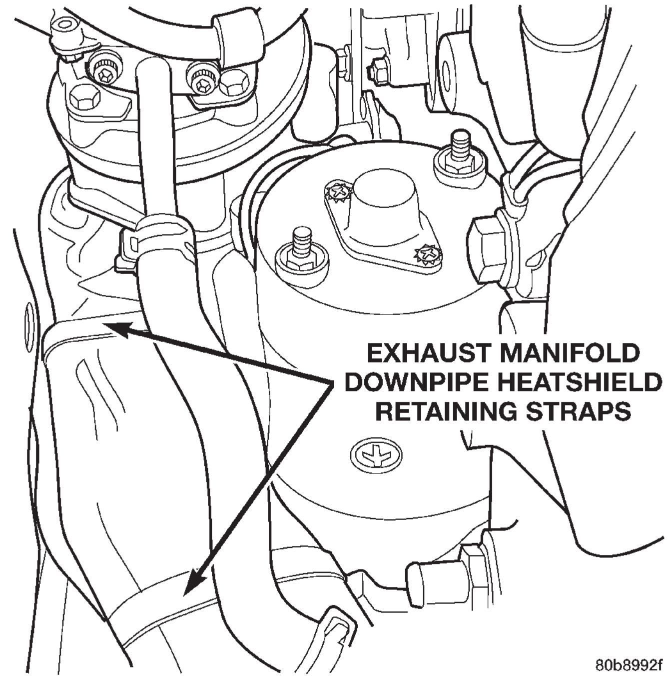


Fig. 22 Exhaust Downpipe Heatshield

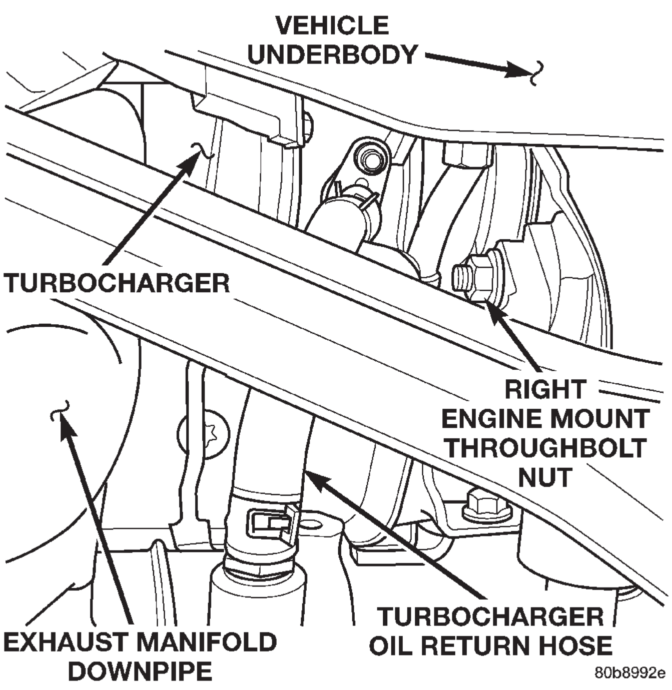


Fig. 23 Turbocharger Oil Return Hose

(19) Install the Knee Blocker. Refer to Group 8E, Instrument Panel Systems for procedure.

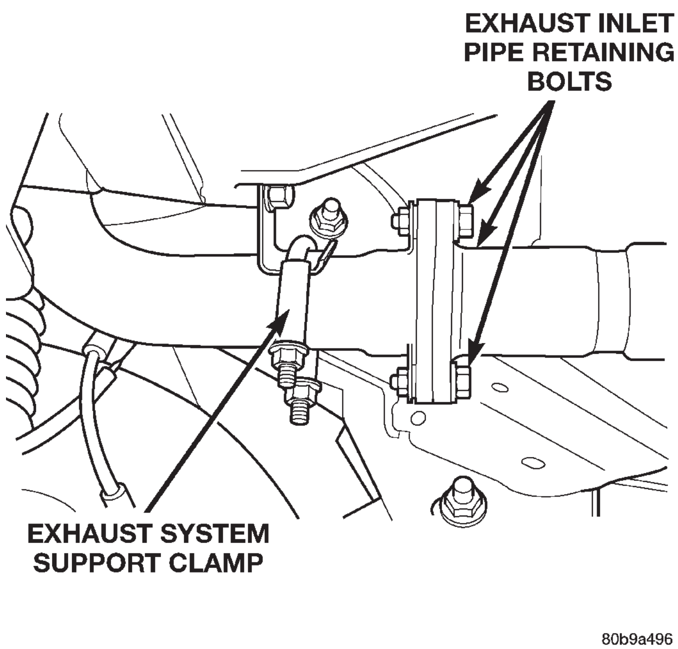


Fig. 24 Exhaust System Inlet Pipe Connection

(20) Install the clutch master cylinder heatshield.

(21) Install the intake manifold elbow and the EGR valve as an assembly. Torque the intake elbow bolts to 27 N·m (20 ft. lbs.).

(22) Install the (2) bolts holding the EGR tube to the EGR valve. Torque to bolts 27 N·m (20 ft. lbs.).

(23) Torque the EGR tube on the exhaust manifold to 28 N·m (21 ft. lbs.).

(24) Install the innercooler inlet and outlet hoses on the engine.

(25) Install the EGR vacuum supply hose on the EGR valve.

(26) Install the air filter cover and outlet hose on the turbocharger.

(27) Connect the breather hose on the air cleaner outlet hose.

(28) Install the heater core coolant supply and the brake vacuum supply lines in there original position.

(29) Connect the negative battery cable.

(30) Fill the cooling system. Refer to Group 7, Cooling System for the procedure.

(31) Start the engine and check for leaks.

REMOVAL AND INSTALLATION (Continued)

INTAKE MANIFOLD

REMOVAL

(1) Remove exhaust manifold and turbocharger assembly.

(2) Remove water manifold.

(3) Remove intake manifold.

CLEANING

Clean the intake manifold and cylinder head mating surfaces. **DO NOT allow foreign material to enter either the intake manifold or the ports in the cylinder head.**

INSTALLATION

(1) Install the new intake manifold gasket.

(2) Position the intake manifold in place and finger tighten the mounting nuts.

(3) Tighten the fasteners in sequence and to the specified torque 30 N·m.

(4) Position the water manifold in place and finger tighten the mounting nuts.

(5) Tighten the fasteners to the specified torque 12 N·m.

(6) Install exhaust manifold and turbocharger assembly.

(7) Install charge air cooler hose to intake manifold.

(8) Connect the battery negative cable.

(9) Start engine and check for leaks.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	**Torque**
EGR	
Attaching Nuts	28 N·m
EGR	
Tube Nut	34 N·m
EGR	
Tube Flange Bolts	26 N·m
Exhaust Manifold	
Nuts	30 N·m
Exhaust Manifold	
Heat Shield Nuts	11 N·m
Exhaust Pipe	
Support Clamp Bolts	22.5 N·m
Exhaust Pipe	
Support Clamp Screw	22.5 N·m
Intake Manifold	
Nuts	30 N·m
Muffler-to-Exhaust Pipe	
Clamp Nuts	43 N·m
Tail Pipe Clamp	
Hanger bolt	22.5 N·m
Turbocharger-to-Exhaust manifold	
Nuts	27 N·m
Turbocharger	
Oil Feed Line	27.4 N·m
Turbocharger Down Pipe-to-Exhaust Pipe	
Bolts/Nuts	22.5 N·m
Turbocharger Down Pipe-to-Turbocharger	
Bolts	27 N·m

FRAME AND BUMPERS

CONTENTS

BUMPERS

INDEX

REMOVAL AND INSTALLATION

FRONT BUMPER END CAP

REMOVAL

(1) Remove the rivet attaching the end cap to the air deflector.
(2) Remove the bolts and nuts attaching the end cap to the bumper (Fig. 1).
(3) Pull back the wheelhouse liner and remove the screws attaching the end cap to the front fender.
(4) Lifting the end cap from the bottom, tilt slightly upward and slide it outward to disengage the retainer tab from the bumper (Fig. 2).
(5) Separate the end cap from the bumper.

INSTALLATION

(1) Position the end cap on the bumper and engage the retaining tab.
(2) Install the screws attaching the end cap to the front fender.
(3) Install the bolts attaching the end cap to the bumper. Tighten the nut to 9 N·m (7 ft. lbs.) torque.
(4) Install the rivet attaching the end cap to air deflector.

FRONT BUMPER

REMOVAL

(1) Remove bumper end caps.
(2) If equipped, disengage fog lamp wire harness connectors.
(3) Disconnect vacuum line from reservoir (Fig. 3).
(4) Remove Torx-head bolts that attach bumper to mounting brackets (Fig. 1).
(5) Remove bumper from vehicle.
(6) If necessary, remove bolts attaching bumper mounting brackets to frame.

INSTALLATION

(1) If removed, install bolts attaching bumper mounting brackets to frame. Tighten bolts to 55 N·m (41 ft. lbs.) torque.
(2) Position bumper on front of vehicle.
(3) Install Torx-head bolts that attach bumper to mounting brackets. Tighten bolts to 55 N·m (41 ft. lbs.) torque.
(4) Connect vacuum line to reservoir.
(5) If equipped, engage fog lamp wire harness connectors.
(6) Install bumper end caps.

REMOVAL AND INSTALLATION (Continued)

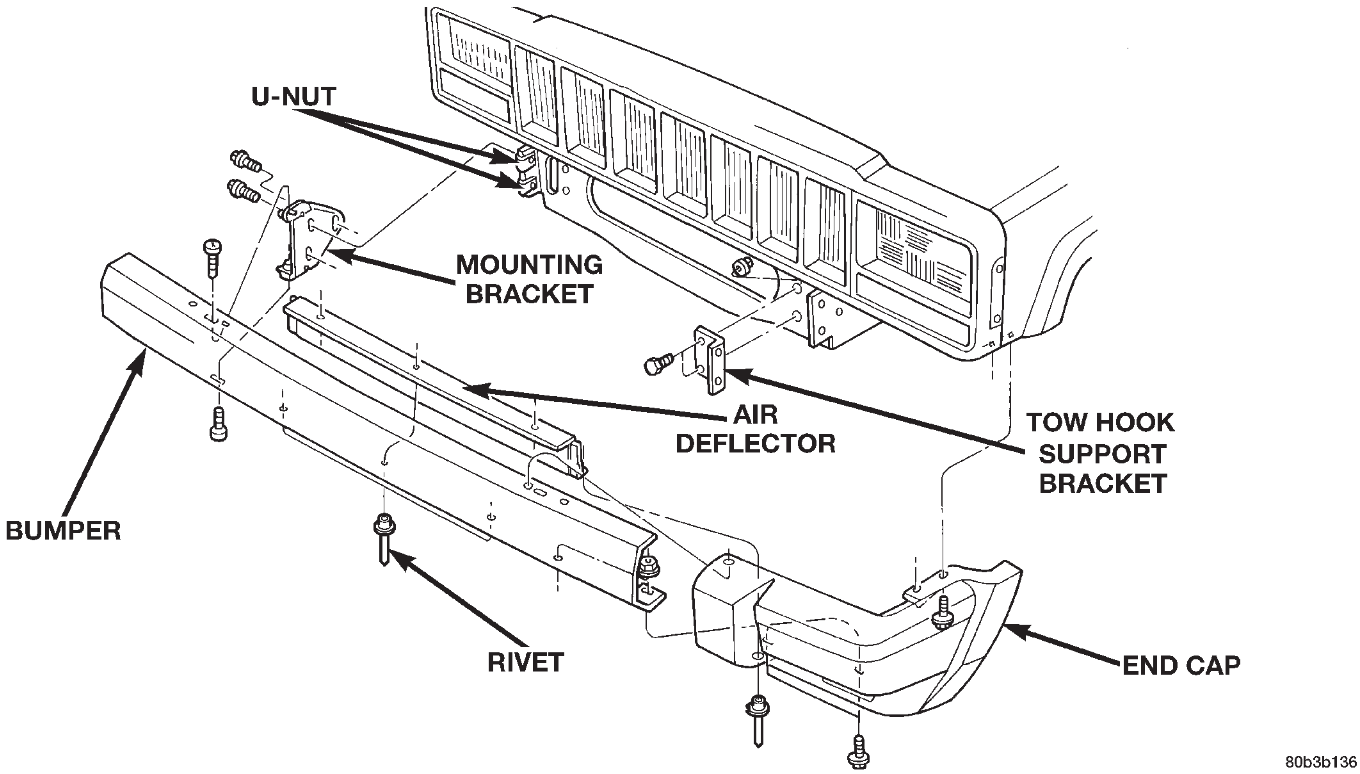


Fig. 1 Front Bumper

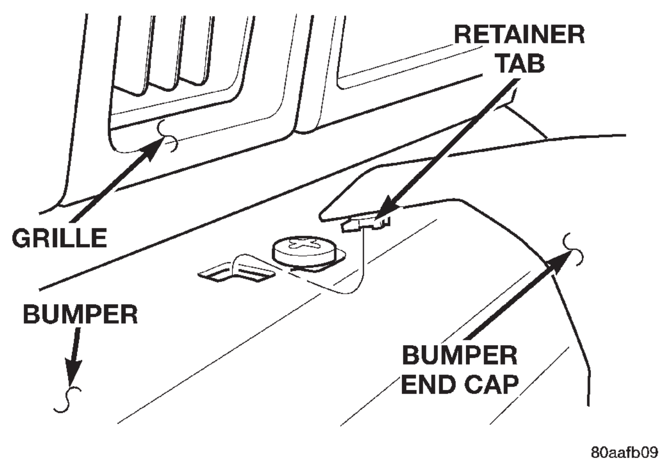


Fig. 2 Bumper End Cap

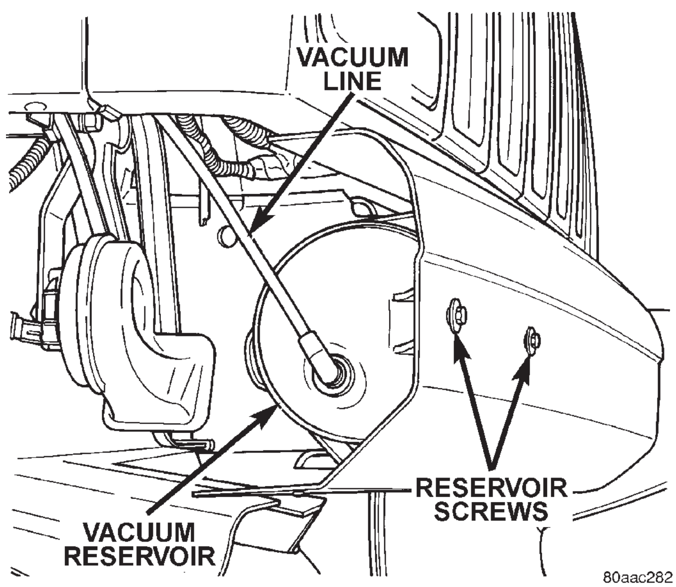


Fig. 3 Vacuum Reservoir

FRONT TOW HOOK

REMOVAL

(1) Remove bolts attaching tow hook to tow hook reinforcement (Fig. 4).

(2) Separate tow hook from reinforcement.

(3) If necessary, remove bolt attaching tow hook reinforcement to frame.

INSTALLATION

(1) If removed, install bolt attaching tow hook reinforcement to frame. Tighten bolt to 30 N·m (22 ft. lbs.) torque.

(2) Position tow hook on reinforcement.

(3) Install bolts attaching tow hook to tow hook reinforcement. Tighten bolts to 100 N·m (74 ft. lbs.) torque.

REAR BUMPER END CAP

REMOVAL

(1) Remove the bolts and nuts attaching the underside of the end cap to the bumper (Fig. 5).

(2) Remove the screw attaching the front of the end cap to the underside of the quarter panel.

REMOVAL AND INSTALLATION (Continued)

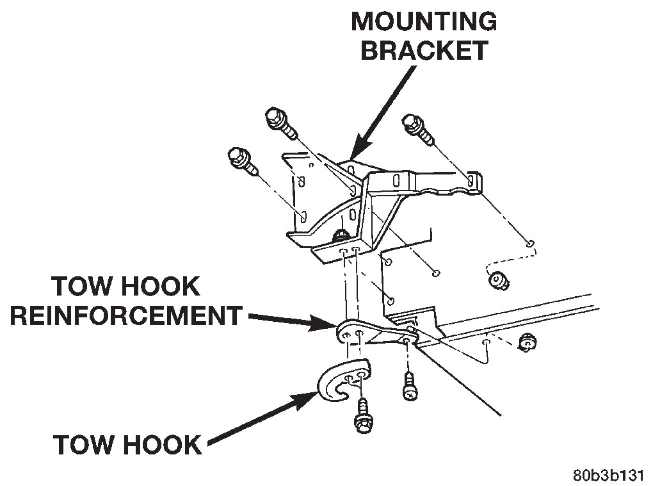


Fig. 4 Front Tow Hook

(3) Lift the end cap slightly upward and slide it rearward to release it from the retainer.
(4) Separate the end cap from the vehicle.

INSTALLATION

(1) Position the end cap on the rear of the retainer and the outer edge of the bumper.
(2) Slide the end cap forward onto the retainer. Ensure the end cap overlaps the lip of the rear wheelhouse liner.
(3) Install the screw attaching the front of the end cap to the underside of the quarter panel.
(4) Install the bolts and nuts attaching the underside of the end cap to the bumper.

REAR BUMPER

REMOVAL

(1) For vehicles equipped with a trailer hitch, remove hitch before removing bumper. If necessary, refer to removal procedure within Group 13, Frame and Bumpers.
(2) Remove bumper end caps.
(3) Remove upper nuts that attach bumper to bumper support brackets (Fig. 5).
(4) Remove lower bolts that attach bumper to bumper support brackets.
(5) Remove bumper from vehicle.
(6) If necessary, remove bumper support brackets from the rear sill.

INSTALLATION

(1) If removed, install bumper support brackets on the rear sill. Tighten bolts to 55 N·m (41 ft. lbs.) torque.
(2) Position bumper on support brackets.
(3) Install bolts that attach bumper to bumper support brackets. Tighten nuts to 55 N·m (41 ft. lbs.) torque.
(4) Install bumper end caps.
(5) If removed, install trailer hitch.

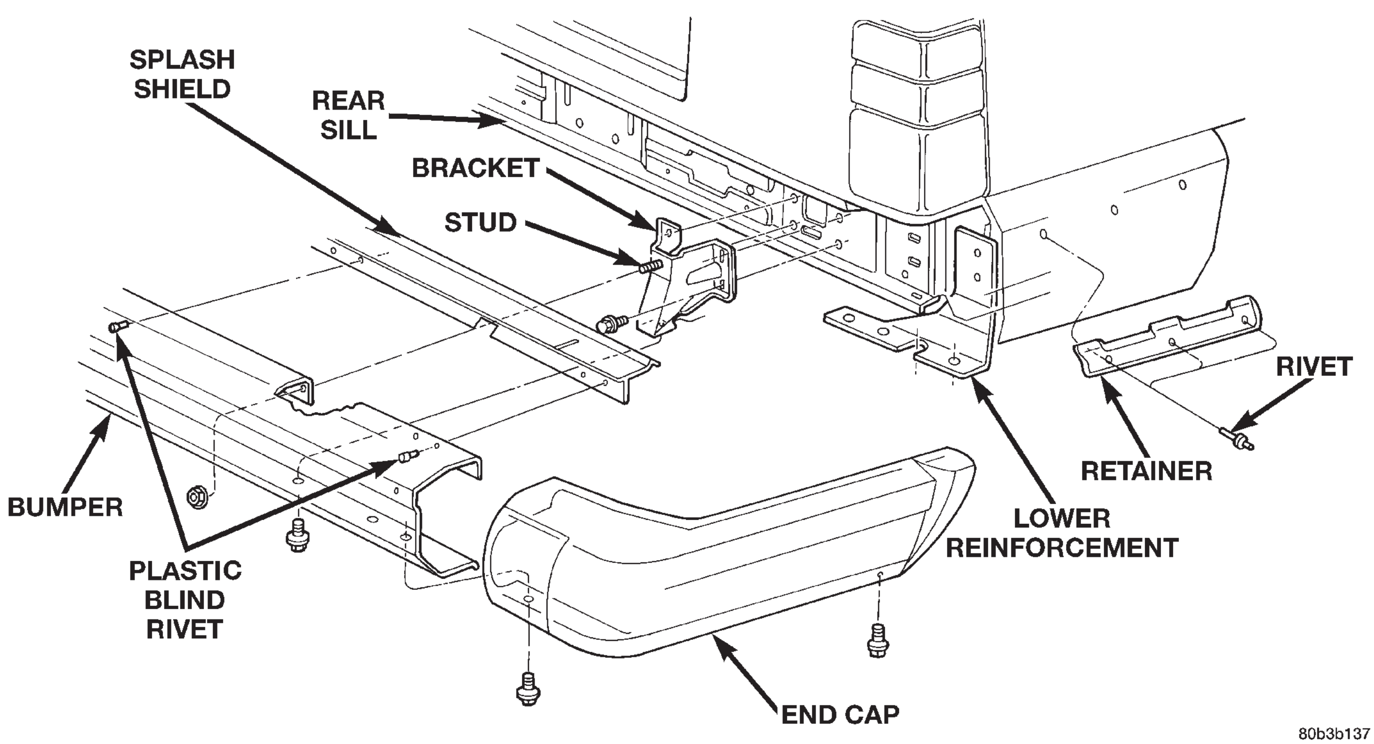


Fig. 5 Rear Bumper

REMOVAL AND INSTALLATION (Continued)

REAR TOW HOOK

REMOVAL

(1) Remove bolts that attach tow hook bracket and tow hook to frame rail (Fig. 6).

(2) Remove bracket and tow hook from frame rail.

INSTALLATION

(1) Position bracket and tow hook on frame rail.

(2) Install bolts that attach tow hook bracket and tow hook to frame rail. Tighten bolts to 94 N·m (70 ft. lbs.) torque.

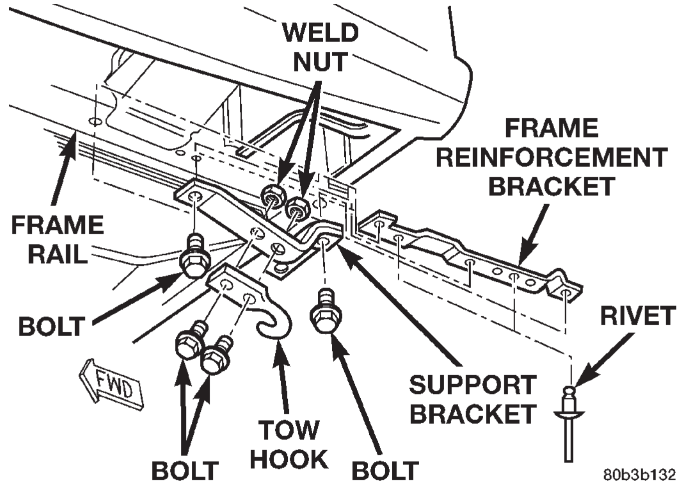


Fig. 6 Rear Tow Hook

FRAME

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REMOVAL AND INSTALLATION

FRONT SKID PLATE

REMOVAL

(1) Remove the screws that attach skid plate to side sills.

(2) Remove the nuts that attach the skid plate to the crossmember (Fig. 1).

(3) Remove the skid plate from the vehicle.

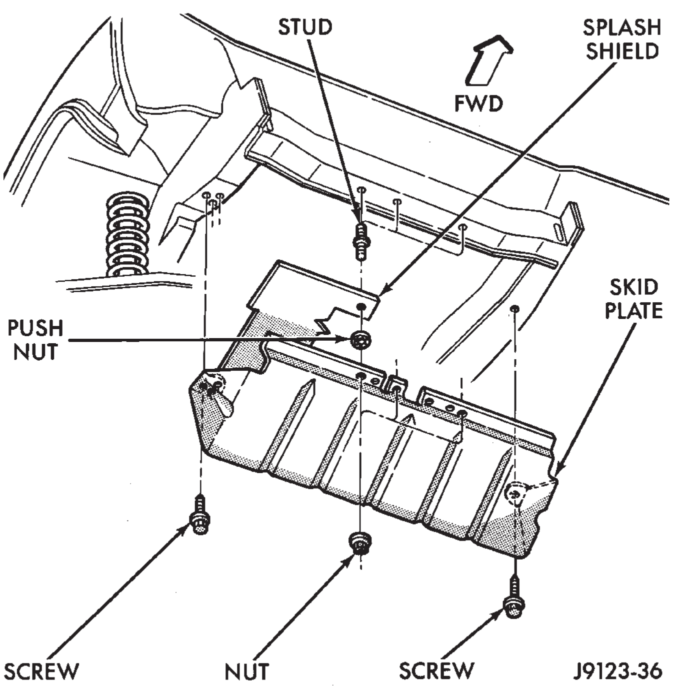

Fig. 1 Front Skid Plate

INSTALLATION

(1) Position the skid plate at front crossmember and side sills.

(2) Install the nuts to attach the skid plate to crossmember.

(3) Install the screws to attach skid plate to side sills.

TRANSFER CASE SKID PLATE

REMOVAL

(1) Support skid plate.

(2) Remove bolts that attach skid plate to transmission support crossmember and frame sill (Fig. 2).

(3) Remove support and skid plate from vehicle.

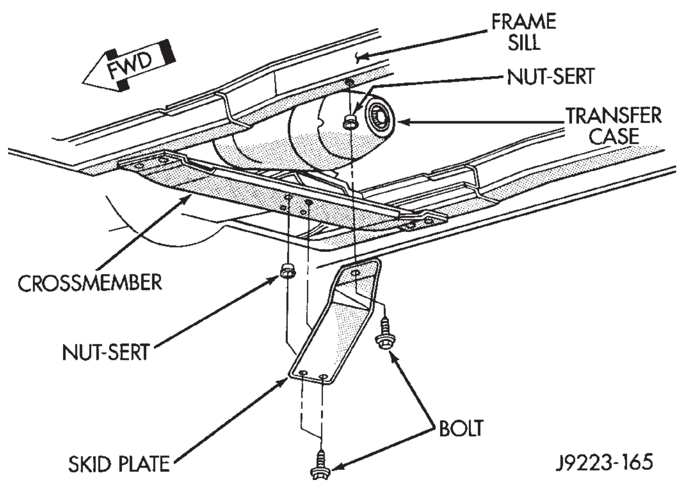

Fig. 2 Transfer Case Skid Plate

INSTALLATION

(1) Position and support skid plate at frame sill and transmission support crossmember.

(2) Attach skid plate to frame sill and crossmember with bolts. Tighten bolts to 22 N·m (16 ft. lbs.) torque.

FUEL TANK SKID PLATE

REMOVAL

(1) Position a support under skid plate.

(2) Remove bolts that attach skid plate to underbody side rails (Fig. 3).

(3) Remove support and skid plate from vehicle.

INSTALLATION

(1) Position and support skid plate under fuel tank.

REMOVAL AND INSTALLATION (Continued)

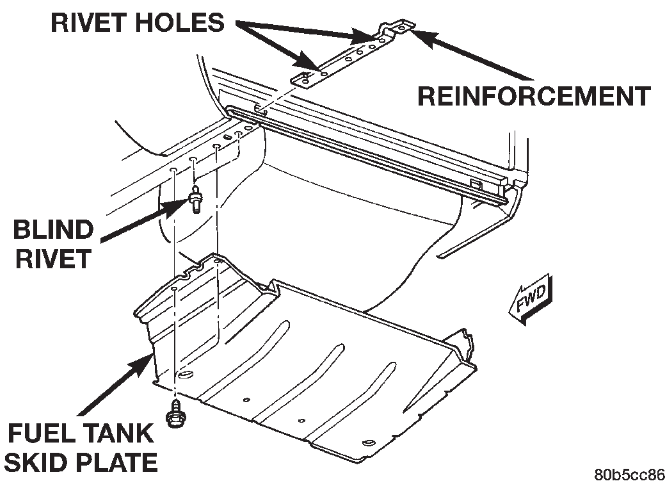

Fig. 3 Fuel Tank Skid Plate

(2) Install bolts to attach skid plate to underbody rails. Tighten bolts to 74 N·m (55 ft. lbs.) torque.

(3) Remove support from under skid plate.

TRAILER HITCH

REMOVAL

(1) If necessary, remove the trailer tow wire harness connector from the hitch (Fig. 4).

(2) Support the hitch.

(3) Remove the bolts that attach the trailer hitch to the frame sills and reinforcement brackets (Fig. 5).

(4) If equipped, remove the fuel tank skid plate.

NOTE: The reinforcement brackets are held on the frame sills with two blind rivets.

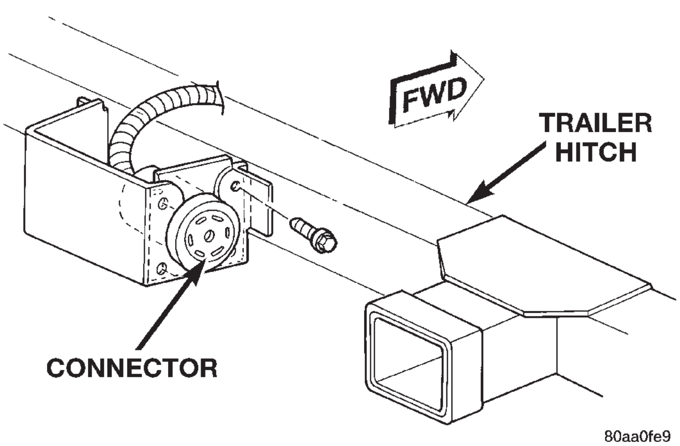

Fig. 4 Trailer Hitch Harness Connector

INSTALLATION

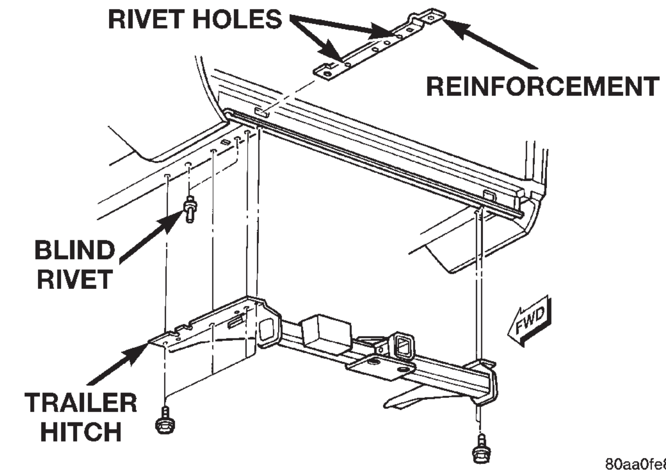

Fig. 5 Trailer Hitch

(1) Install frame reinforcement brackets, if removed. Slide the brackets through the vehicle rear sill openings and attach to the frame sills with blind rivets.

(2) Using an adequate lifting device, position hitch at the proper location for installation on vehicle and support it.

(3) If equipped, position fuel tank skid plate on vehicle frame sills.

(4) Loosely install the bolts to attach the trailer hitch (and the skid plate) to frame sills and reinforcement brackets.

(5) Tighten all bolts/nuts to 74 N·m (55 ft. lbs.) torque.

(6) Remove the lift/support.

(7) If removed, attach the trailer wire harness connector to the hitch.

SPECIFICATIONS

FRAME DIMENSIONS

Frame dimensions are listed in millimeter scale. All dimensions are from center to center of Principal Locating Point (PLP), or from center to center of PLP and fastener location (Fig. 6).

SPECIFICATIONS (Continued)

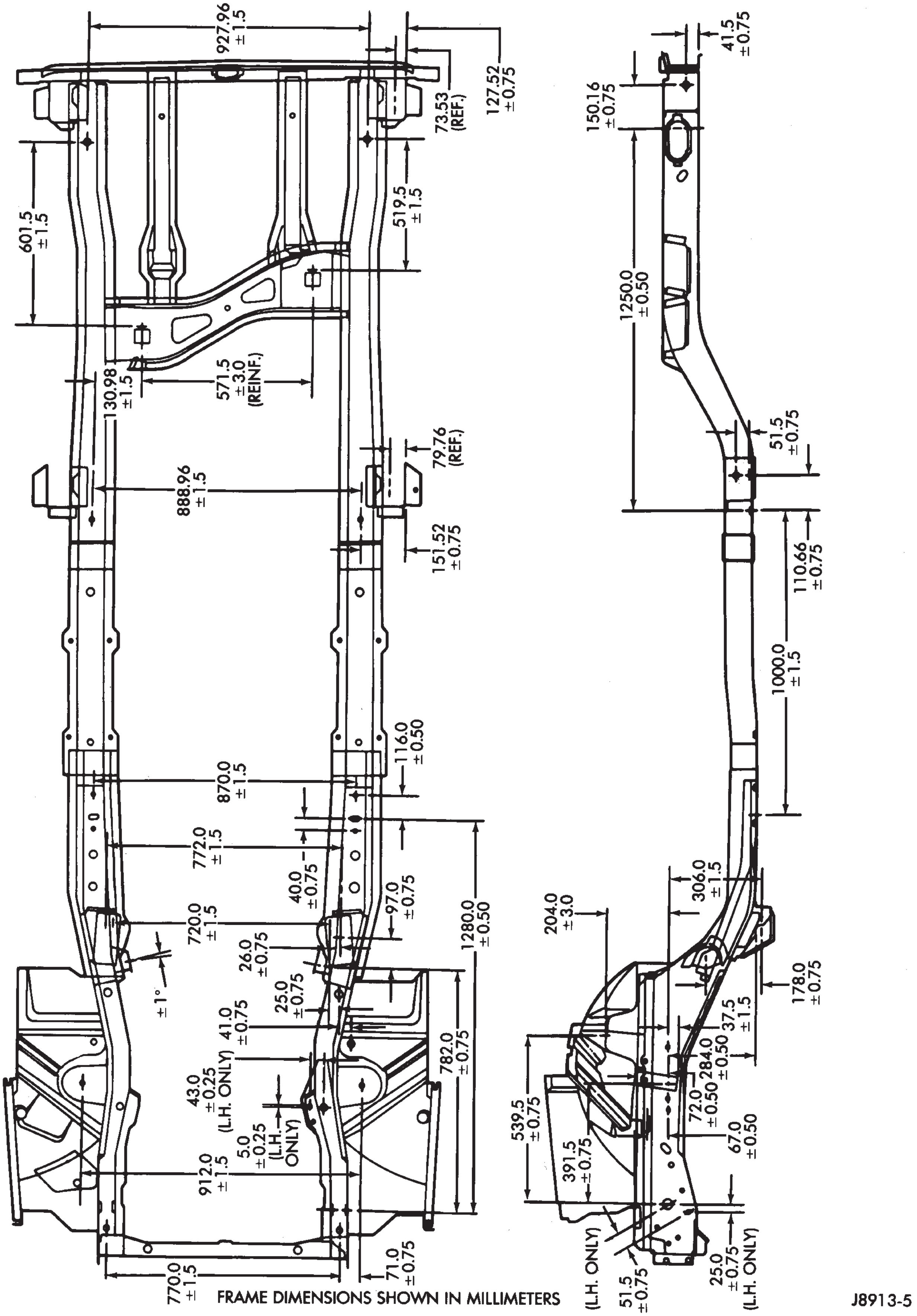

Fig. 6 Frame Dimensions

SPECIFICATIONS (Continued)

FRAME TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Front Skid Plate Screw	42 N·m (31 ft. lbs.)
Front Skid Plate Nut	17 N·m (125 in. lbs.)
Transfer Case Skid Plate Bolt	22 N·m (16 ft. lbs.)
Fuel Tank Skid Plate Bolt	74 N·m (55 ft. lbs.)
Front Bumper End Cap to Mounting Bracket Nut	9 N·m (7 ft. lbs.)
Front Bumper Mounting Bracket to Frame Bolt	55 N·m (41 ft. lbs.)
Front Bumper to Mounting Bracket Bolt	55 N·m (41 ft. lbs.)
Front Tow Hook Bolt	100 N·m (74 ft. lbs.)
Front Tow Hook Reinforcement Bolt	30 N·m (22 ft. lbs.)
Rear Bumper to Mtg. Bracket Nut	55 N·m (41 ft. lbs.)
Rear Bumper Mtg. Bracket to Rear Sill Bolt	55 N·m (41 ft. lbs.)
Rear Tow Hook Bolt	94 N·m (70 ft. lbs.)
Trailer Tow Reinforcement Brkt Bolt	74 N·m (55 ft. lbs.)

FRAME AND BUMPERS

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SWING AWAY SPARE TIRE CARRIER

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DISASSEMBLY AND ASSEMBLY

SWING AWAY SPARE TIRE CARRIER MOUNTING

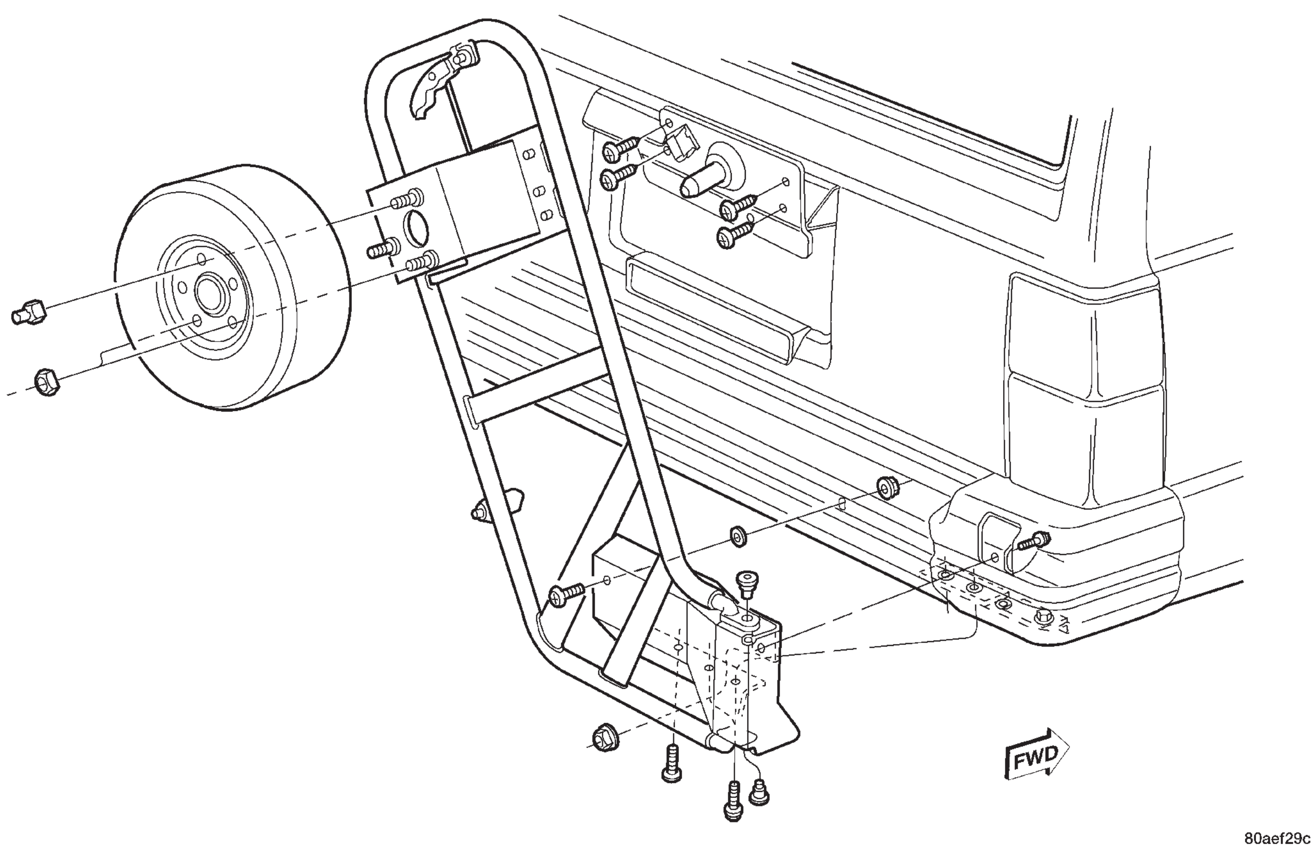

Fig. 1 Spare Tire Carrier Mounting

FRAME

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GENERAL INFORMATION

EMERGENCY TOW EYES

If your vehicle is equipped with emergency tow eyes, one is mounted in the front and one in the rear.

The front tow eye has two holes, the front hole is for towing use only and the rear angled hole is for shipping use only.

CAUTION: Do not use the angled hole for towing. You could damage your vehicle.

WARNING: Stand clear of vehicles when pulling with tow eyes. Tow straps and chains may break, causing serious injury.

CAUTION: Tow eyes are for emergency use only, to rescue a vehicle stranded off road. Do not use tow eyes for tow truck hookup or highway towing. You could damage your vehicle.

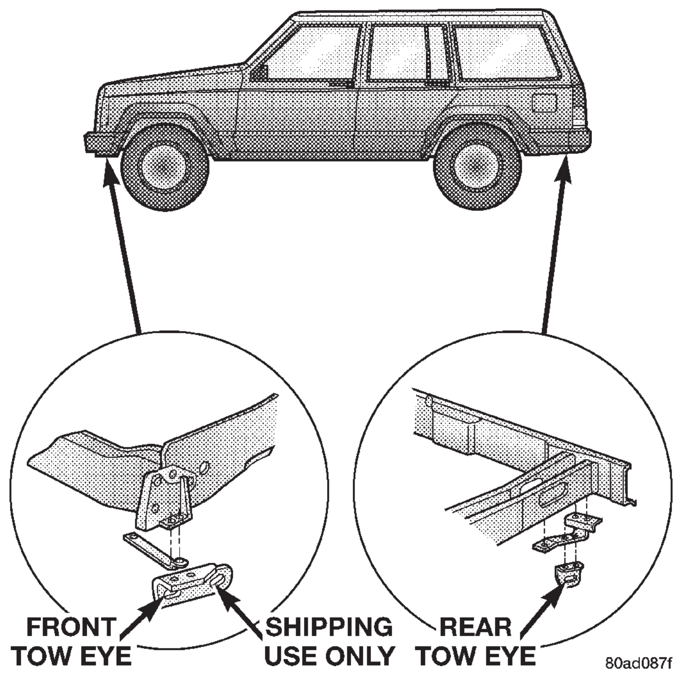

Fig. 1 Emergency Tow Eyes

FUEL SYSTEM

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FUEL DELIVERY SYSTEM

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DESCRIPTION AND OPERATION

PCM REPLACEMENT

USE THE DRB SCAN TOOL TO REPROGRAM THE NEW POWERTRAIN CONTROL MODULE (PCM) WITH THE VEHICLES ORIGINAL IDENTIFICATION NUMBER (VIN) AND THE VEHICLES ORIGINAL MILEAGE. IF THIS STEP IS NOT DONE, A DIAGNOSTIC TROUBLE CODE (DTC) MAY BE SET.

FUEL REQUIREMENTS

Your engine is designed to meet all emissions regulations and provide excellent fuel economy and performance when using high quality unleaded gasoline having an octane rating of 87. The use of premium gasoline is not recommended. The use of premium gasoline will provide no benefit over high quality regular gasoline, and in some circumstances may result in poorer performance.

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 immediate service is required. Engine damage resulting from operation with a heavy spark knock may not be covered by the new vehicle warranty.

Poor quality gasoline can cause problems such as hard starting, stalling and hesitations. If you experience these symptoms, try another brand of gasoline before considering service for the vehicle.

The American Automobile Manufacturers Association, AAMA, has issued gasoline specifications to define the minimum fuel properties necessary to deliver enhanced performance and durability for your vehicle. Chrysler recommends the use of gasoline that meet the AAMA specifications if they are available.

REFORMULATED GASOLINE

Many areas of the country require the use of cleaner burning gasoline referred to as “reformulated” gasoline. Reformulated gasoline contain oxygenates, and are specifically blended to reduce vehicle emissions and improve air quality.

Chrysler strongly supports the use of reformulated gasoline. Properly blended reformulated gasoline will provide excellent performance and durability for the engine and fuel system components.

GASOLINE/OXYGENATE BLENDS

Some fuel suppliers blend unleaded gasoline with oxygenates such as 10% ethanol, MTBE, and ETBE. Oxygenates are required in some areas of the country during the winter months to reduce carbon monoxide emissions. Fuels blended with these oxygenates may be used in your vehicle.

CAUTION: DO NOT use gasoline containing METHANOL. Gasoline containing methanol may damage critical fuel system components.

MMT

MMT is a manganese-containing metallic additive that is blended into some gasoline to increase octane. Gasoline blended with MMT provide no performance advantage beyond gasoline of the same octane number without MMT. Gasoline blended with MMT reduce spark plug life and reduce emission system performance in some vehicles. Chrysler recommends that gasoline without MMT be used in your vehicle. The MMT content of gasoline may not be indicated on the gasoline pump; therefore, you should ask your gasoline retailer whether or not his/her gasoline contains MMT.

It is even more important to look for gasoline without MMT in Canada because MMT can be used at levels higher than allowed in the United States. MMT is prohibited in Federal and California reformulated gasoline.

SULFUR IN GASOLINE

If you live in the northeast United States, your vehicle may have been designed to meet California low emission standards with clean-burning, low-sulfur, California gasoline. Gasoline sold outside of California is permitted to have higher sulfur levels which may affect the performance of the vehicle’s catalytic converter. This may cause the Check Engine or Service Engine Soon light to illuminate.

Illumination of either light while operating on high sulfur gasoline does not necessarily mean your emission control system is malfunctioning. Chrysler recommends that you try a different brand of unleaded gasoline having lower sulfur to determine if the problem is fuel related prior to returning your vehicle to an authorized dealer for service.

CAUTION: If the Check Engine or Service Engine Soon light is flashing, immediate service is required; see on-board diagnostics system section.

MATERIALS ADDED TO FUEL

All gasoline sold in the United States and Canada are required to contain effective detergent additives. Use of additional detergents or other additives is not needed under normal conditions.

FUEL SYSTEM CAUTIONS

CAUTION: Follow these guidelines to maintain your vehicle’s performance:

- The use of leaded gas is prohibited by Federal law. Using leaded gasoline can impair engine performance, damage the emission control system, and could result in loss of warranty coverage.
- An out-of-tune engine, or certain fuel or ignition malfunctions, can cause the catalytic converter to overheat. If you notice a pungent burning odor or some light smoke, your engine may be out of tune or malfunctioning and may require immediate service. Contact your dealer for service assistance.
- When pulling a heavy load or driving a fully loaded vehicle when the humidity is low and the temperature is high, use a premium unleaded fuel to help prevent spark knock. If spark knock persists, lighten the load, or engine piston damage may result.
- The use of fuel additives which are now being sold as octane enhancers is not recommended. Most of these products contain high concentrations of methanol. Fuel system damage or vehicle performance problems resulting from the use of such fuels or additives is not the responsibility of Chrysler Corporation and may not be covered under the new vehicle warranty.

DESCRIPTION AND OPERATION (Continued)

NOTE: Intentional tampering with emissions control systems can result in civil penalties being assessed against you.

FUEL DELIVERY SYSTEM

The fuel delivery system consists of:

- the fuel pump module containing the electric fuel pump, fuel filter/fuel pressure regulator, fuel gauge sending unit (fuel level sensor) and a separate fuel filter located at bottom of pump module
- fuel tubes/lines/hoses
- quick-connect fittings
- fuel injector rail
- fuel injectors
- fuel tank
- fuel tank filler/vent tube assembly
- fuel tank filler tube cap
- accelerator pedal
- throttle cable

Fuel is returned through the fuel pump module and back into the fuel tank through the fuel filter/ fuel pressure regulator. A separate fuel return line from the engine to the tank is not used.

The fuel tank assembly consists of: the fuel tank, fuel pump module assembly, fuel pump module locknut/gasket, and rollover valve (refer to Group 25, Emission Control System for rollover valve information).

A fuel filler/vent tube assembly using a pressure/ vacuum fuel filler cap is used. The fuel filler tube contains a spring-loaded flap (door) located below the fuel fill cap. The flap is used as a secondary way of sealing the fuel tank if the fuel fill cap has not been properly tightened. The flap is used as part of the EVAP monitor system when the vehicle is equipped with a Leak Detection Pump (LDP). The flap will be installed to all fuel filler tubes (equipped/not equipped with LDP and EVAP monitor system).

Also to be considered part of the fuel system is the evaporation control system. This is designed to reduce the emission of fuel vapors into the atmosphere. The description and function of the Evaporative Control System is found in Group 25, Emission Control Systems.

Both fuel filters (at bottom of fuel pump module and within fuel pressure regulator) are designed for extended service. They do not require normal scheduled maintenance. Filters should only be replaced if a diagnostic procedure indicates to do so.

FUEL PUMP MODULE

The fuel pump module is installed in the top of the fuel tank (Fig. 1) or (Fig. 2). The fuel pump module contains the following components:

- 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
- A gasket between tank flange and module
- 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.

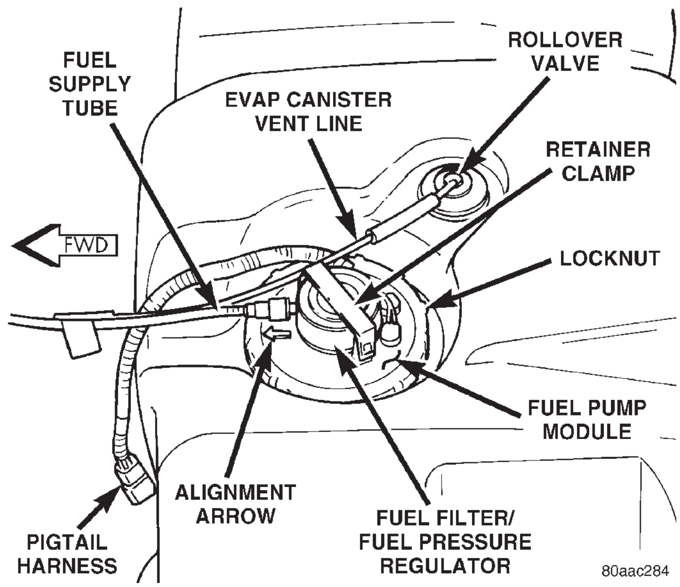


Fig. 1 Fuel Tank/Fuel Pump Module (Top View)

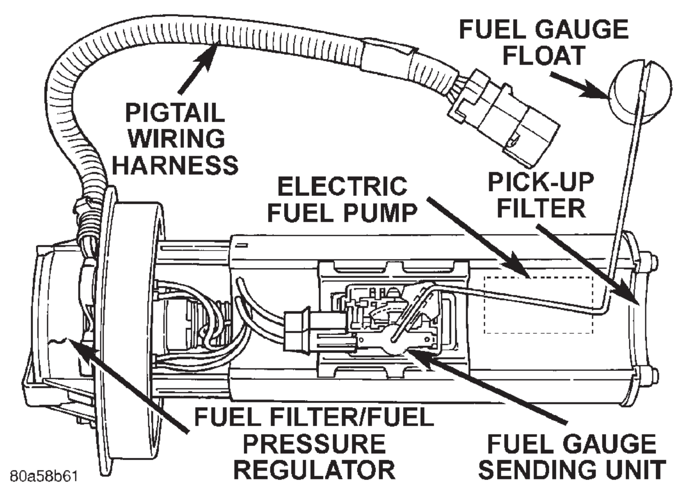


Fig. 2 Fuel Pump Module Components

FUEL PUMP

DESCRIPTION

The electric fuel pump is located inside of the fuel pump module.

DESCRIPTION AND OPERATION (Continued)

OPERATION

The fuel pump used in this system has a permanent magnet electric motor. Fuel is drawn in through a filter at the bottom of the module and pushed through the electric motor gearset to the pump outlet.

Check Valve Operation: The pump outlet contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.** Refer to the Fuel Pressure Leak Down Test for more information.

Voltage to operate the electric pump is supplied through the fuel pump relay.

FUEL GAUGE SENDING UNIT

DESCRIPTION

The fuel gauge sending unit (fuel level sensor) is attached to the side of the fuel pump module. The sending unit consists of a float, an arm, and a variable resistor (track).

OPERATION

The resistor track is used to send electrical signals to the Powertrain Control Module (PCM) for fuel gauge operation and for OBD II emission requirements.

For fuel gauge operation: As fuel level increases, the float and arm move up. This decreases the sending unit resistance, causing the fuel gauge to read full. As fuel level decreases, the float and arm move down. This increases the sending unit resistance causing the fuel gauge to read empty.

After this fuel level signal is sent to the PCM, the PCM will transmit the data across the CCD bus circuits to the instrument panel. Here it is translated into the appropriate fuel gauge level reading.

For OBD II emission monitor requirements: A voltage signal is sent from the resistor track on the sending unit to the PCM to indicate fuel level. The purpose of this feature is to prevent the OBD II system from recording/setting false misfire and fuel system monitor trouble codes. The feature is activated if the fuel level in the tank is less than approximately 15 percent of its rated capacity. If equipped with a Leak Detection Pump (EVAP system monitor), this feature will also be activated if the fuel level in the tank is more than approximately 85 percent of its rated capacity.

FUEL FILTER/FUEL PRESSURE REGULATOR

A combination fuel filter and fuel pressure regulator 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 339 kPa ± 34 kPa (49.2 psi ± 5 psi) at the fuel injectors. It contains a diaphragm, calibrated springs and a fuel return valve. The internal fuel filter is also part of the assembly.

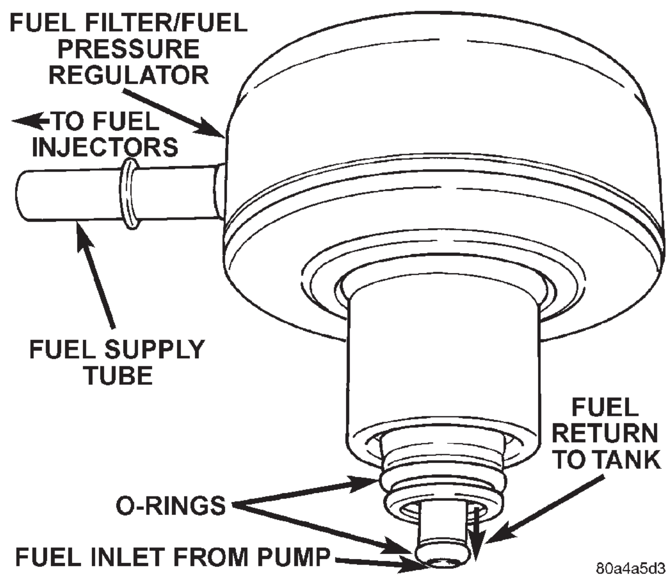


Fig. 3 Fuel Filter/Fuel Pressure Regulator

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 regulator acts as a check valve to maintain some fuel pressure when the engine is not operating. This will help to start the engine. A second check valve is located at the outlet end of the electric fuel pump. **Refer to Fuel Pump—Description and Operation for more information. Also refer to the Fuel Pressure Leak Down Test and the Fuel Pump Pressure Tests.**

If fuel pressure at the pressure regulator exceeds approximately 49 psi, an internal diaphragm closes and excess fuel is routed back into the tank through the pressure regulator. A separate fuel return line is not used.

DESCRIPTION AND OPERATION (Continued)

FUEL TANK

DESCRIPTION

The fuel tank is constructed of a plastic material. Its main functions are for fuel storage and for placement of the fuel pump module.

OPERATION

All models pass a full 360 degree rollover test without fuel leakage. To accomplish this, fuel and vapor flow controls are required for all fuel tank connections.

A rollover valve(s) is mounted into the top of the fuel tank (or pump module). Refer to Emission Control System for rollover valve information.

An evaporation control system is connected to the rollover valve(s) to reduce emissions of fuel vapors into the atmosphere. When fuel evaporates from the fuel tank, vapors pass through vent hoses or tubes to a charcoal canister where they are temporarily held. When the engine is running, the vapors are drawn into the intake manifold. Certain models are also equipped with a self-diagnosing system using a Leak Detection Pump (LDP). Refer to Emission Control System for additional information.

ROLLOVER VALVE(S)

Refer to Group 25, Emission Control System for information.

FUEL INJECTORS

The fuel injectors (Fig. 4) are electrical solenoids. The injector contains a pintle that closes off an orifice at the nozzle end. When electric current is supplied to the injector, the armature and needle move a short distance against a spring, allowing fuel to flow out the orifice. Because the fuel is under high pressure, a fine spray is developed in the shape of a pencil stream. The spraying action atomizes the fuel, adding it to the air entering the combustion chamber.

An individual fuel injector is used for each individual cylinder. The top (fuel entry) end of the injector is attached into an opening on the fuel rail.

The nozzle (outlet) ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector.

The injectors are energized individually in a sequential order by the powertrain control module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

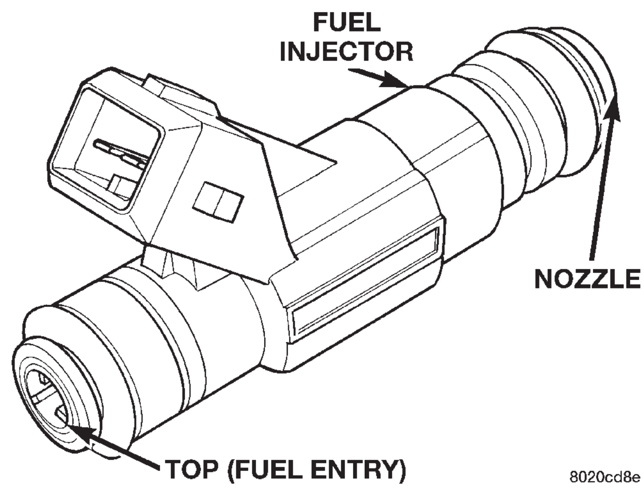


Fig. 4 Fuel Injector—Typical

During start up, battery voltage is supplied to the injectors through the ASD relay. When the engine is operating, voltage is supplied by the charging system. The PCM determines injector pulse width based on various inputs.

FUEL RAIL/FUEL DAMPER—2.5L ENGINE

The fuel rail supplies the necessary fuel to each individual fuel injector and is mounted to the intake manifold (Fig. 5). On the 2.5L engine, a **fuel damper** is located at the front of the fuel rail (Fig. 5). The damper is used only to help control fuel pressure pulsations. These pulsations are the result of the firing of the fuel injectors. It is **not used** as a fuel pressure regulator. The fuel pressure regulator is **not mounted** to the fuel rail on any engine. It is located on the fuel tank mounted fuel pump module. Refer to Fuel Filter/Fuel Pressure Regulator in this group for information.

Depending on vehicle model/engine, the fuel rail may/may not be equipped with a fuel pressure test port. Refer to the Fuel Pump Pressure Test for additional information.

The fuel rail is not repairable.

FUEL RAIL—4.0L ENGINE

The fuel rail supplies the necessary fuel to each individual fuel injector and is mounted to the intake manifold (Fig. 6). The fuel pressure regulator is not mounted to the fuel rail on any 4.0L engine. It is located on the fuel tank mounted fuel pump module. Refer to Fuel Filter/Fuel Pressure Regulator in this group for information.

Depending on vehicle model/engine, the fuel rail may/may not be equipped with a fuel pressure test port. Refer to the Fuel Pump Pressure Test for additional information.

DESCRIPTION AND OPERATION (Continued)

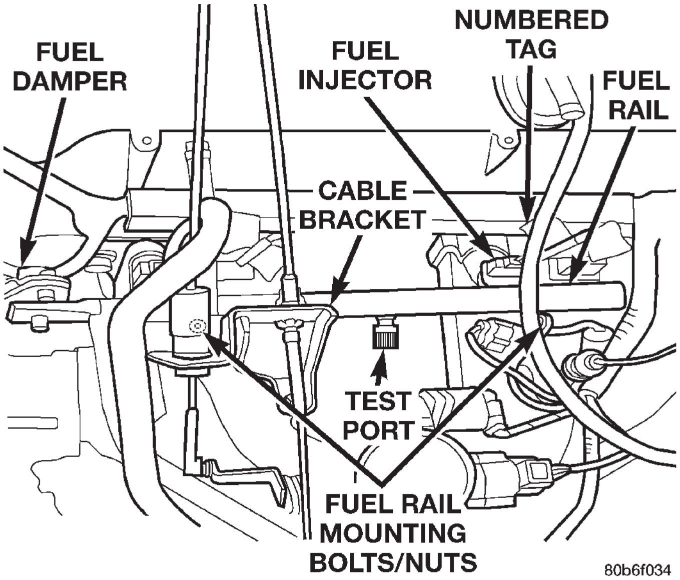


Fig. 5 Fuel Rail/Fuel Damper—2.5L Engine

The fuel rail is not repairable.

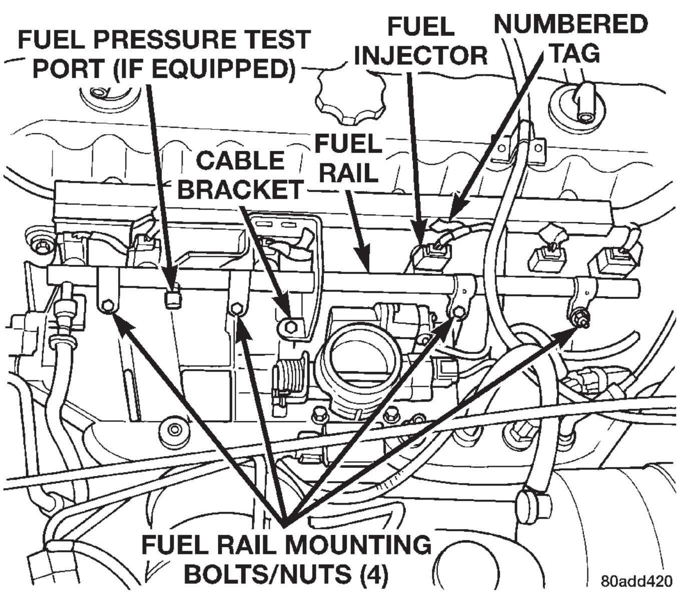


Fig. 6 Fuel Rail—4.0L Engine

FUEL TANK FILLER TUBE CAP

The loss of any fuel or vapor out of filler neck is prevented by the use of a pressure-vacuum fuel tank filler tube cap. Relief valves inside the cap will release fuel tank pressure at predetermined pressures. Fuel tank vacuum will also be released at predetermined values. This cap must be replaced by a similar unit if replacement is necessary. This is in order for the system to remain effective.

CAUTION: Remove fuel tank filler tube cap before servicing any fuel system component. This is done to help relieve tank pressure. If equipped with a California emissions package and a Leak Detection Pump (LDP), the secondary seal below the fill cap must be pressed (opened) to relieve fuel tank pressure.

QUICK-CONNECT FITTINGS

Different types of quick-connect fittings are used to attach various fuel system components. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Some are equipped with safety latch clips. Refer to the Removal/Installation section for more information.

CAUTION: The interior components (o-rings, spacers) of quick-connect fitting are not serviced separately, but new pull tabs are available for some types. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube assembly.

DIAGNOSIS AND TESTING

FUEL PUMP PRESSURE TEST—ALL ENGINES WITH PRESSURE TEST PORT

Use this test in conjunction with the Fuel Pump Capacity Test, Fuel Pressure Leak Down Test and Fuel Pump Amperage Test found elsewhere in this group.

Check Valve Operation: The electric fuel pump outlet contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.** When the electric fuel pump is activated, fuel pressure should **immediately** (1–2 seconds) rise to specification.

All fuel systems are equipped with a fuel tank module mounted, combination fuel filter/fuel pressure regulator. The fuel pressure regulator is not controlled by engine vacuum.

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. BEFORE DISCONNECTING FUEL LINE AT FUEL RAIL, THIS PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

(1) Remove protective cap at fuel rail test port. Connect the 0–414 kPa (0-60 psi) fuel pressure gauge

DIAGNOSIS AND TESTING (Continued)

(from gauge set 5069) to test port pressure fitting on fuel rail (Fig. 7).

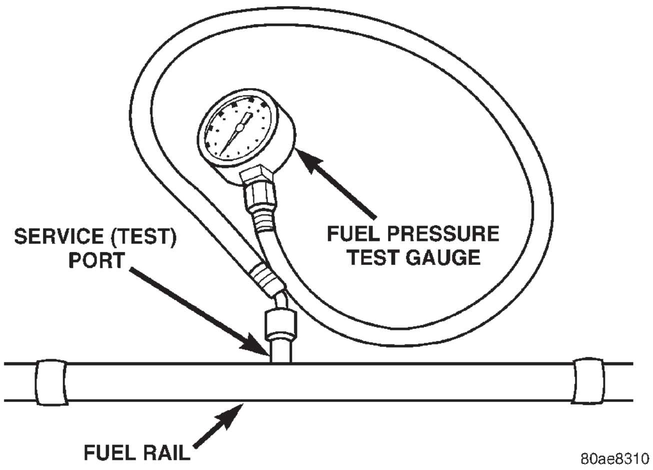


Fig. 7 Fuel Pressure Test Gauge (Typical Gauge Installation at Test Port)

(2) Start and warm engine and note pressure gauge reading. Fuel pressure should be 339 kPa ± 34 kPa (49.2 psi ± 5 psi) at idle.

(3) If engine runs, but pressure is below 44.2 psi, check for a kinked fuel supply line somewhere between fuel rail and fuel pump module. If line is not kinked, but specifications for either the Fuel Pump Capacity, Fuel Pump Amperage or Fuel Pressure Leak Down Tests were not met, replace fuel pump module assembly. Refer to Fuel Pump Module Removal/Installation.

(4) If operating pressure is above 54.2 psi, electric fuel pump is OK, but fuel pressure regulator is defective. Replace fuel filter/fuel pressure regulator. Refer to Fuel Filter/Fuel Pressure Regulator Removal/Installation for more information.

(5) Install protective cap to fuel rail test port.

FUEL PUMP CAPACITY TEST

Before performing this test, verify fuel pump pressure. Refer to Fuel Pump Pressure Test. Use this test in conjunction with the Fuel Pressure Leak Down Test.

(1) Release fuel system pressure. Refer to Fuel Pressure Release Procedure.

(2) Disconnect fuel supply line at fuel rail. Refer to Quick-Connect Fittings. Some engines may require air cleaner housing removal before line disconnection.

(3) Obtain correct Fuel Line Pressure Test Adapter Tool Hose. Tool number 6539 is used for 5/16" fuel lines and tool number 6631 is used for 3/8" fuel lines.

(4) Connect correct Fuel Line Pressure Test Adapter Tool Hose into disconnected fuel supply line. Insert other end of Adaptor Tool Hose into a graduated container.

(5) Remove fuel fill cap.

(6) To activate fuel pump and pressurize system, obtain DRB scan tool and actuate ASD Fuel System Test.

(7) A good fuel pump will deliver at least 1/4 liter of fuel in 7 seconds. Do not operate fuel pump for longer than 7 seconds with fuel line disconnected as fuel pump module reservoir may run empty.

(a) If capacity is lower than specification, but fuel pump can be heard operating through fuel fill cap opening, check for a kinked/damaged fuel supply line somewhere between fuel rail and fuel pump module.

(b) If line is not kinked/damaged, and fuel pressure is OK, but capacity is low, replace fuel filter/fuel pressure regulator. The filter/regulator may be serviced separately on certain applications. Refer to Fuel Filter/Fuel Pressure Regulator Removal/Installation for additional information.

(c) If both fuel pressure and capacity are low, replace fuel pump module assembly. Refer to Fuel Pump Module Removal/Installation.

FUEL PRESSURE LEAK DOWN TEST

Use this test in conjunction with the Fuel Pump Pressure Test and Fuel Pump Capacity Test.

Check Valve Operation: The electric fuel pump outlet contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.** When the electric fuel pump is activated, fuel pressure should **immediately** (1–2 seconds) rise to specification.

Abnormally long periods of cranking to restart a **hot** engine that has been shut down for a short period of time may be caused by:

- Fuel pressure bleeding past a fuel injector(s).
- Fuel pressure bleeding past the check valve in the fuel pump module.

(1) Disconnect the fuel inlet line at fuel rail. Refer to Fuel Tubes/Lines/Hoses and Clamps in this section of the group for procedures. On some engines, air cleaner housing removal may be necessary before fuel line disconnection.

(2) Obtain correct Fuel Line Pressure Test Adapter Tool Hose. Tool number 6539 is used for 5/16" fuel lines and tool number 6631 is used for 3/8" fuel lines.

(3) Connect correct Fuel Line Pressure Test Adapter Tool Hose between disconnected fuel line and fuel rail (Fig. 8).

DIAGNOSIS AND TESTING (Continued)

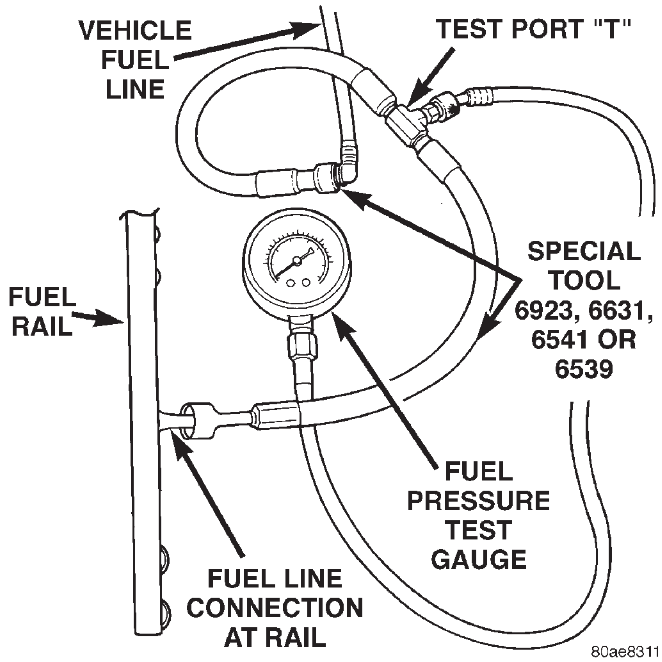


Fig. 8 Connecting Adapter Tool—Typical

(4) Connect the 0-414 kPa (0-60 psi) fuel pressure test gauge (from Gauge Set 5069) to the test port on the appropriate Adaptor Tool. **The fittings on both tools must be in good condition and free from any small leaks before performing the proceeding test.**

(5) Start engine and bring to normal operating temperature.

(6) Observe test gauge. Normal operating pressure should be 339 kPa ± 34 kPa (49.2 psi ± 5 psi).

(7) Shut engine off.

(8) Pressure should not fall below **30 psi for five minutes.**

(9) If pressure falls below 30 psi, it must be determined if a fuel injector, the check valve within the fuel pump module, or a fuel tube/line is leaking.

(10) Again, start engine and bring to normal operating temperature.

(11) Shut engine off.

(12) **Testing for fuel injector or fuel rail leakage:** Clamp off the rubber hose portion of Adaptor Tool between the fuel rail and the test port “T” on Adapter Tool. If pressure now holds at or above 30 psi, a fuel injector or the fuel rail is leaking.

(13) **Testing for fuel pump check valve, filter/regulator check valve or fuel tube/line leakage:** Clamp off the rubber hose portion of Adaptor Tool between the vehicle fuel line and test port “T” on Adapter Tool. If pressure now holds at or above 30 psi, a leak may be found at a fuel tube/line. If no leaks are found at fuel tubes or lines, one of the check valves in either the electric fuel pump or filter/regulator may be leaking.

Note: A quick loss of pressure usually indicates a defective check valve in the filter/regulator. A slow loss of pressure usually indicates a defective check valve in the electric fuel pump.

The electric fuel pump is not serviced separately. Replace the fuel pump module assembly. The filter/regulator may be replaced separately on certain applications. Refer to Fuel Filter/Fuel Pressure Regulator Removal/Installation for additional information.

FUEL PUMP AMPERAGE TEST

This amperage (current draw) test is to be done in conjunction with the Fuel Pump Pressure Test, Fuel Pump Capacity Test and Fuel Pressure Leak Down Test. Before performing the amperage test, be sure the temperature of the fuel tank is above 50° F (10° C).

The DRB Scan Tool along with the DRB Low Current Shunt (LCS) adapter (Fig. 9) and its test leads will be used to check fuel pump amperage specifications.

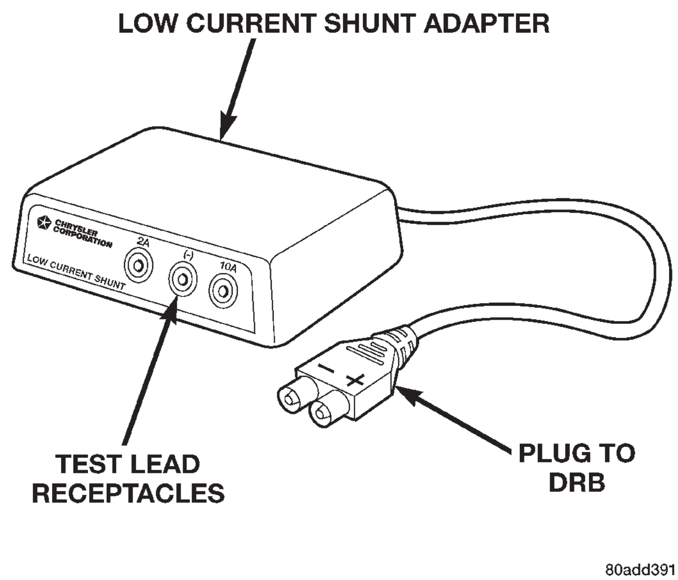


Fig. 9 Low Current Shunt Adapter

(1) Be sure fuel tank contains fuel before starting test. If tank is empty or near empty, amperage readings will be incorrect.

(2) Obtain LCS adapter.

(3) Plug cable from LCS adapter into DRB scan tool at SET 1 receptacle.

(4) Plug DRB into vehicle 16–way connector (data link connector).

(5) Connect (-) and (+) test cable leads into LCS adapter receptacles. Use **10 amp (10A +)** receptacle and common (-) receptacles.

DIAGNOSIS AND TESTING (Continued)

(6) Gain access to MAIN MENU on DRB screen.

(7) Press DVOM button on DRB.

(8) Using left/right arrow keys, highlight CHANNEL 1 function on DRB screen.

(9) Press ENTER three times.

(10) Using up/down arrow keys, highlight RANGE on DRB screen (screen will default to 2 amp scale).

(11) Press ENTER to change 2 amp scale to 10 amp scale. **This step must be done to prevent damage to DRB scan tool or LCS adapter (blown fuse).**

(12) Remove cover from Power Distribution Center (PDC).

(13) Remove fuel pump relay from PDC. Refer to label on PDC cover for relay location.

WARNING: BEFORE PROCEEDING TO NEXT STEP, NOTE THE FUEL PUMP WILL BE ACTIVATED AND SYSTEM PRESSURE WILL BE PRESENT. THIS WILL OCCUR AFTER CONNECTING TEST LEADS FROM LCS ADAPTER INTO FUEL PUMP RELAY CAVITIES. THE FUEL PUMP WILL OPERATE EVEN WITH IGNITION KEY IN OFF POSITION. BEFORE ATTACHING TEST LEADS, BE SURE ALL FUEL LINES AND FUEL SYSTEM COMPONENTS ARE CONNECTED.

CAUTION: TO PREVENT POSSIBLE DAMAGE TO THE VEHICLE ELECTRICAL SYSTEM AND LCS ADAPTER, THE TEST LEADS MUST BE CONNECTED INTO RELAY CAVITIES EXACTLY AS SHOWN IN FOLLOWING STEPS.

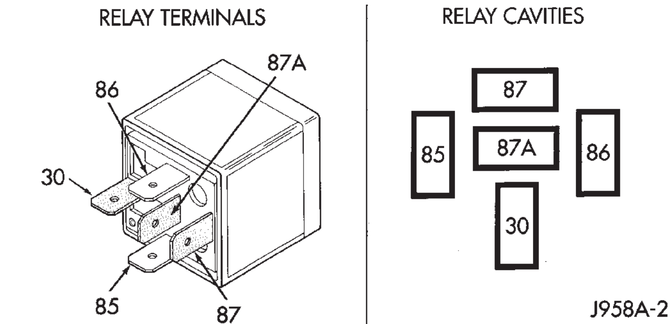
Depending upon vehicle model, year or engine configuration, three different types of relays may be used: Type-1, type-2 and type–3.

(14) If equipped with **type–1 relay** (Fig. 10), attach test leads from LCS adapter into PDC relay cavities number 30 and 87. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 10).

(15) If equipped with **type–2 relay** (Fig. 11), attach test leads from LCS adapter into PDC relay cavities number 30 and 87. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 11).

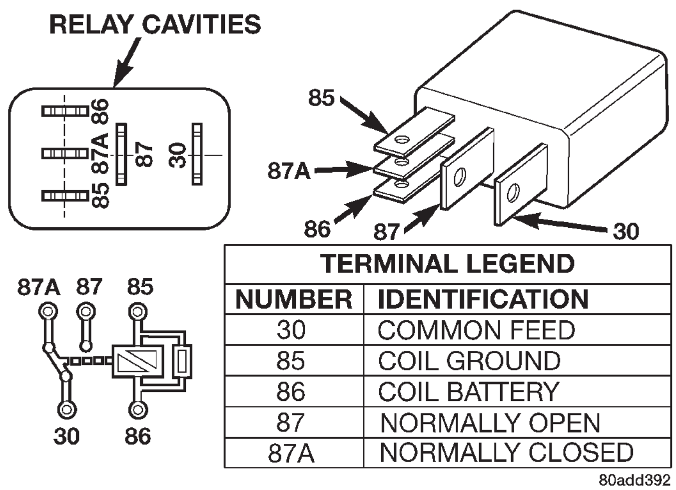
(16) If equipped with **type–3 relay** (Fig. 12), attach test leads from LCS adapter into PDC relay cavities number 3 and 5. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 12).

(17) When LCS adapter test leads are attached into relay cavities, fuel pump **will be activated.** Determine fuel pump amperage on DRB screen. Amperage should be below 10.0 amps. If amperage is below 10.0 amps, and specifications for the Fuel Pump Pressure, Fuel Pump Capacity and Fuel Pressure Leak Down tests were met, the fuel pump module is OK.



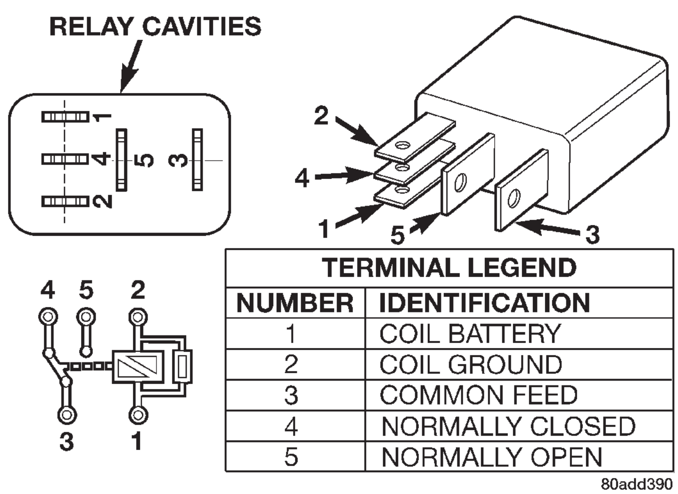
TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 10 Type–1 Relay



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 11 Type–2 Relay



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
1	COIL BATTERY
2	COIL GROUND
3	COMMON FEED
4	NORMALLY CLOSED
5	NORMALLY OPEN

Fig. 12 Type–3 Relay

DIAGNOSIS AND TESTING (Continued)

(18) If amperage is more than 10.0 amps, replace fuel pump module assembly. The electric fuel pump is not serviced separately.

(19) Disconnect test leads from relay cavities immediately after testing.

FUEL 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 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 (+/- 5%). With float in down position, resistance should be 270 ohms (+/- 5%).

FUEL INJECTOR TEST

To perform a complete test of the fuel injectors and their circuitry, use the DRB scan tool and refer to the appropriate Powertrain Diagnostics Procedures manual. To test the injector only, refer to the following:

Disconnect the fuel injector wire harness connector from the injector. The injector is equipped with 2 electrical terminals (pins). Place an ohmmeter across the terminals. Resistance reading should be approximately 12 ohms ±1.2 ohms at 20°C (68°F).

SERVICE PROCEDURES

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

Use following procedure if fuel rail is or is not equipped with fuel pressure test port.

(1) Remove fuel fill cap.

(2) The fuel filler tube contains a spring-loaded flap (door) located below fuel fill cap. The flap is used as a secondary way of sealing fuel tank if fuel fill cap has not been properly tightened. It is part of EVAP monitor system when vehicle is equipped with a Leak Detection Pump (LDP). **The vehicle may be equipped with flap installed into fuel filler tube even though vehicle is not equipped with LDP and EVAP monitor system.** Place a nonmetallic object into fuel fill tube and press on flap to relieve any tank pressure.

(3) Remove Fuel Pump relay from Power Distribution Center (PDC). For location of relay, refer to label on underside of PDC cover.

(4) Start and run engine until it stalls.

(5) Attempt restarting engine until it will no longer run.

(6) Turn ignition key to OFF position.

CAUTION: Steps 1, 2, 3 and 4 must be performed to relieve high pressure fuel from within fuel rail. Do not attempt to use following steps to relieve this pressure as excessive fuel will be forced into a cylinder chamber.

(7) Unplug connector from any fuel injector.

(8) Attach one end of a jumper wire with alligator clips (18 gauge or smaller) to either injector terminal.

(9) Connect other end of jumper wire to positive side of battery.

(10) Connect one end of a second jumper wire to remaining injector terminal.

CAUTION: Powering an injector for more than a few seconds will permanently damage the injector.

(11) Momentarily touch other end of jumper wire to negative terminal of battery for no more than a few seconds.

(12) Place a rag or towel below fuel line quick-connect fitting at fuel rail.

(13) Disconnect quick-connect fitting at fuel rail. Refer to Quick-Connect Fittings.

(14) Return fuel pump relay to PDC.

(15) One or more Diagnostic Trouble Codes (DTC's) may have been stored in PCM memory due to fuel pump relay removal. The DRB scan tool must be used to erase a DTC.

FUEL TUBES/LINES/HOSES AND CLAMPS

OPERATION

Also refer to 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

SERVICE PROCEDURES (Continued)

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.

If equipped: The hose clamps used to secure rubber hoses on fuel injected vehicles are of a special rolled edge construction. This construction is used to prevent the edge of the clamp from cutting into the hose. Only these rolled edge type clamps may be used in this system. All other types of clamps may cut into the hoses and cause high-pressure fuel leaks.

Use new original equipment type hose clamps. Tighten hose clamps to 3 N·m (25 in. lbs.) torque.

QUICK-CONNECT FITTINGS

Also refer to Fuel Tubes/Lines/Hoses and Clamps.

Different types of quick-connect fittings are used to attach various fuel system components, lines and tubes. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Safety latch clips are used on certain components/lines. Certain fittings may require use of a special tool for disconnection.

DISCONNECTING

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSE, FITTING OR LINE, FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

CAUTION: The interior components (o-rings, spacers) of some types of quick-connect fitting are not serviced separately. If service parts are not available, do not attempt to repair a damaged fitting or fuel line. If repair is necessary, replace complete fuel line assembly.

(1) Perform fuel pressure release procedure. Refer to Fuel Pressure Release Procedure in this group.

(2) Disconnect negative battery cable from battery.

(3) Clean fitting of any foreign material before disassembly.

(4) **Single-Tab Type Fitting:** This type of fitting is equipped with a single pull tab (Fig. 13). The tab is removable. After tab is removed, quick-connect fitting can be separated from fuel system component.

(a) Press release tab on side of fitting to release pull tab (Fig. 14). **If release tab is not pressed prior to releasing pull tab, pull tab will be damaged.**

(b) While pressing release tab on side of fitting, use screwdriver to pry up pull tab (Fig. 14).

(c) Raise pull tab until it separates from quick-connect fitting (Fig. 15).

(5) **Two-Tab Type Fitting:** This type of fitting is equipped with tabs located on both sides of fitting (Fig. 16). The tabs are supplied for disconnecting quick-connect fitting from component being serviced.

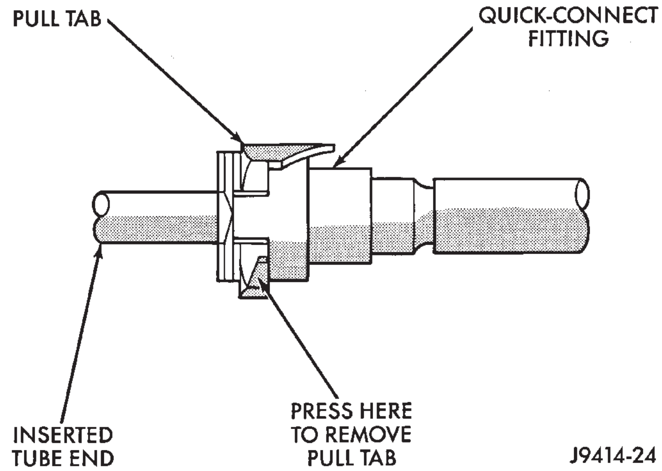


Fig. 13 Single-Tab Type Fitting

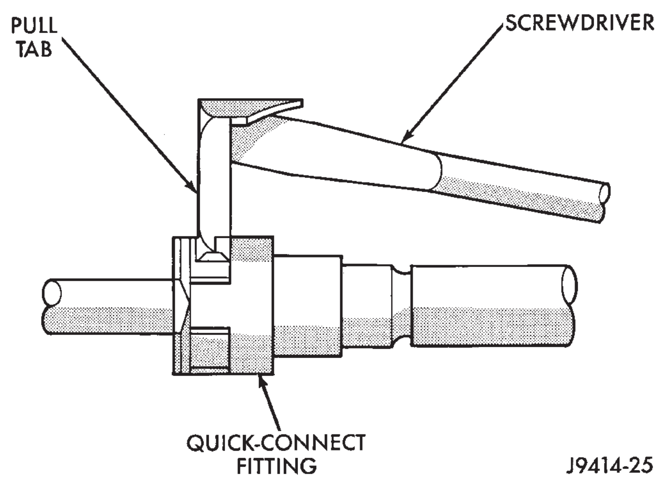


Fig. 14 Disconnecting Single-Tab Type Fitting

(a) To disconnect quick-connect fitting, squeeze plastic retainer tabs (Fig. 16) against sides of quick-connect fitting with your fingers. Tool use is not required for removal and may damage plastic retainer.

(b) Pull fitting from fuel system component being serviced.

(c) The plastic retainer will remain on component being serviced after fitting is disconnected. The o-rings and spacer will remain in quick-connect fitting connector body.

(6) **Plastic Retainer Ring Type Fitting:** This type of fitting can be identified by the use of a full-round plastic retainer ring (Fig. 17) usually black in color.

(a) To release fuel system component from quick-connect fitting, firmly push fitting towards compo-

SERVICE PROCEDURES (Continued)

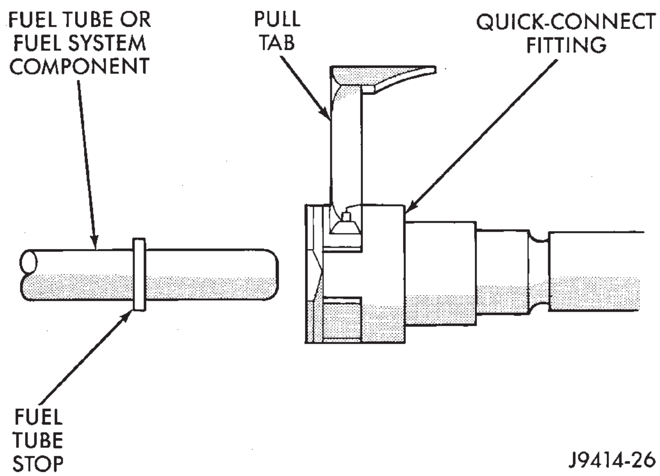


Fig. 15 Removing Pull Tab

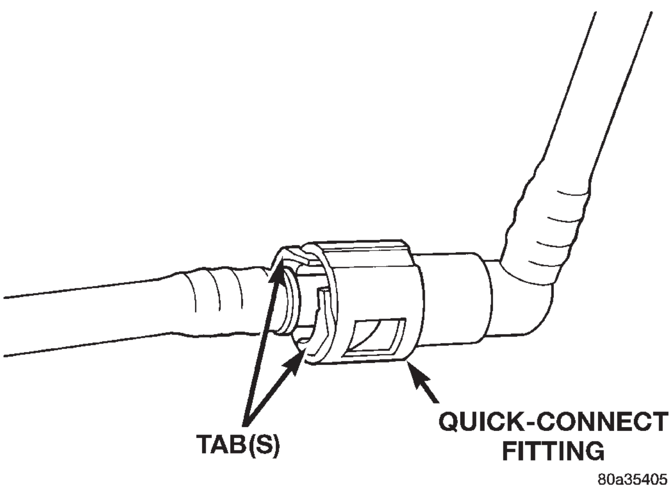


Fig. 16 Typical Two-Tab Type Quick-Connect Fitting

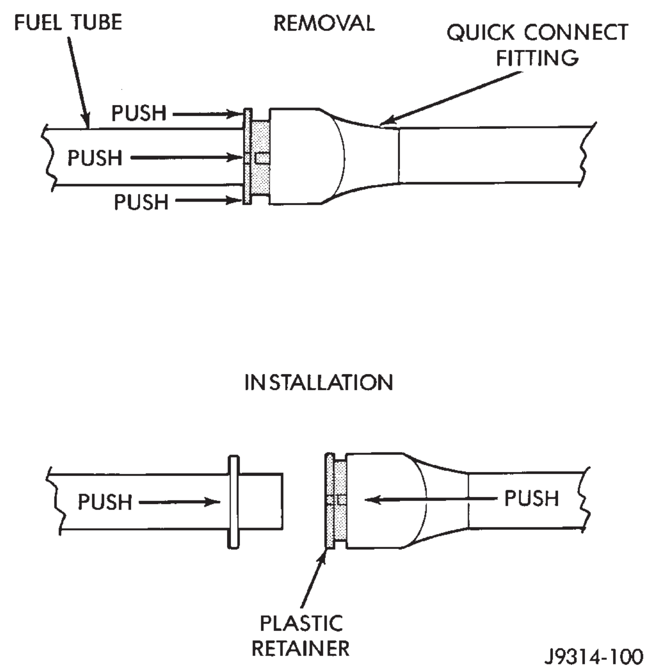


Fig. 17 Plastic Retainer Ring Type Fitting

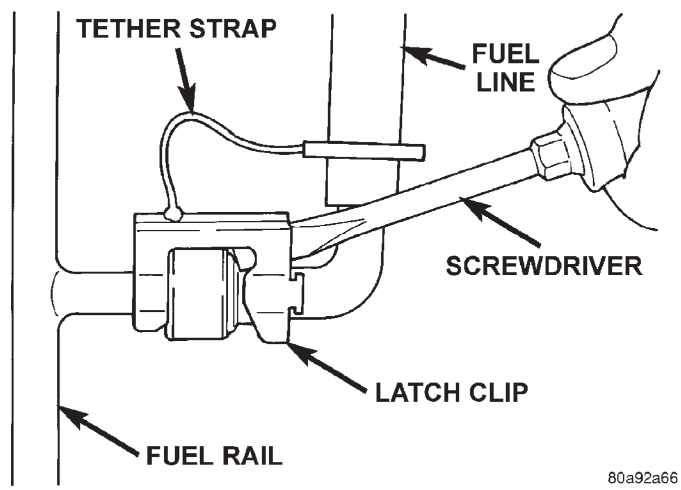


Fig. 18 Latch Clip—Type 1

nent being serviced while firmly pushing plastic retainer ring into fitting (Fig. 17). With plastic ring depressed, pull fitting from component. **The plastic retainer ring must be pressed squarely into fitting body. If this retainer is cocked during removal, it may be difficult to disconnect fitting. Use an open-end wrench on shoulder of plastic retainer ring to aid in disconnection.**

(b) After disconnection, plastic retainer ring will remain with quick-connect fitting connector body.

(c) Inspect fitting connector body, plastic retainer ring and fuel system component for damage. Replace as necessary.

(7) **Latch Clips:** Depending on vehicle model and engine, 2 different types of safety latch clips are used (Fig. 18) or (Fig. 19). Type-1 is tethered to fuel line and type-2 is not. A special tool will be necessary to disconnect fuel line after latch clip is removed. The latch clip may be used on certain fuel line/fuel rail connection, or to join fuel lines together.

(a) Type 1: Pry up on latch clip with a screwdriver (Fig. 18).

(b) Type 2: Separate and unlatch 2 small arms on end of clip (Fig. 19) and swing away from fuel line.

(c) Slide latch clip toward fuel rail while lifting with screwdriver.

(d) Insert special fuel line removal tool (Snap-On number FIH 9055-1 or equivalent) into fuel line (Fig. 20). Use tool to release locking fingers in end of line.

(e) With special tool still inserted, pull fuel line from fuel rail.

SERVICE PROCEDURES (Continued)

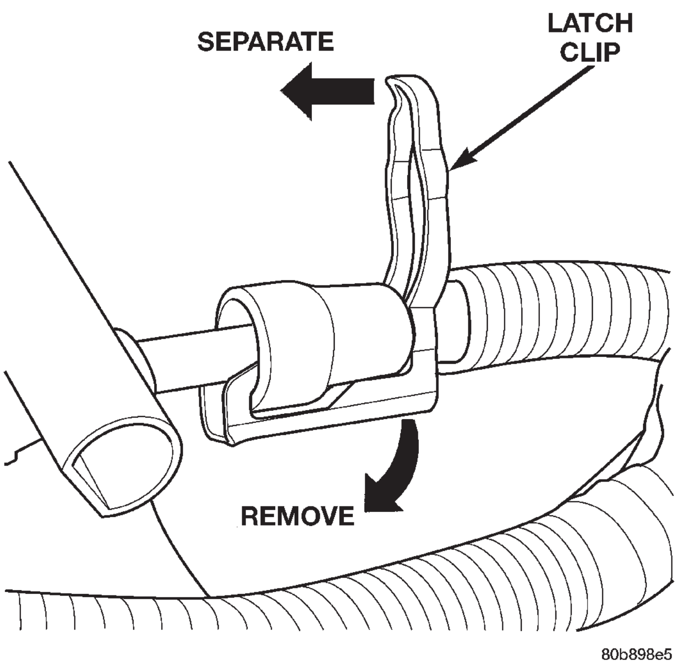


Fig. 19 Latch Clip—Type 2

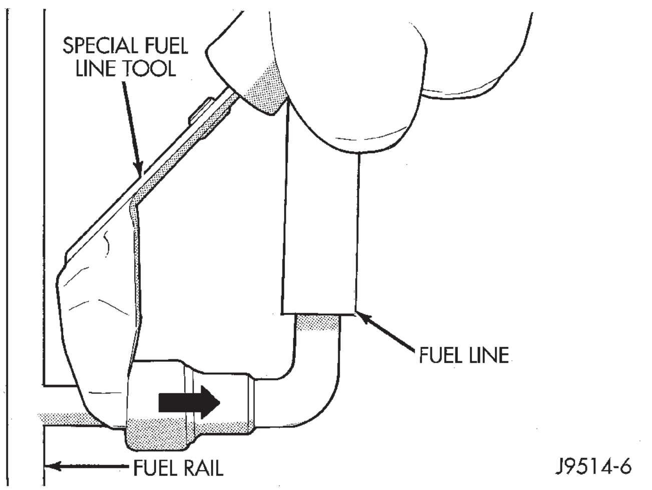


Fig. 20 Fuel Line Disconnection Using Special Tool

(f) After disconnection, locking fingers will remain within quick-connect fitting at end of fuel line.

(8) Disconnect quick-connect fitting from fuel system component being serviced.

CONNECTING

(1) Inspect quick-connect fitting body and fuel system component for damage. Replace as necessary.

(2) Prior to connecting quick-connect fitting to component being serviced, check condition of fitting and component. Clean parts with a lint-free cloth. Lubricate with clean engine oil.

(3) Insert quick-connect fitting into fuel tube or fuel system component until built-on stop on fuel tube or component rests against back of fitting.

(4) Continue pushing until a click is felt.

(5) Single-tab type fitting: Push new tab down until it locks into place in quick-connect fitting.

(6) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(7) Latch Clip Equipped: Install latch clip (snaps into position). **If latch clip will not fit, this indicates fuel line is not properly installed to fuel rail (or other fuel line). Recheck fuel line connection.**

(8) Connect negative cable to battery.

(9) Start engine and check for leaks.

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) Disconnect fuel line at filter/regulator. Refer to Quick-Connect Fittings in this group for procedures.

(4) Remove retainer clamp from top of filter/regulator (Fig. 21). Clamp snaps to tabs on pump module. Discard old clamp.

(5) Pry filter/regulator from top of pump module with 2 screwdrivers. Unit is snapped into module.

(6) Discard gasket below filter/regulator (Fig. 22).

(7) Before discarding filter/regulator assembly, inspect assembly to verify that o-rings (Fig. 23) are intact. 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.

INSTALLATION

(1) Clean recessed area in pump module where filter/regulator is to be installed.

(2) Obtain new filter/regulator (two new o-rings should already be installed) .

(3) 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.**

(4) Install new gasket to top of fuel pump module.

(5) Press new filter/regulator into top of pump module until it snaps into position (a positive click must be heard or felt).

REMOVAL AND INSTALLATION (Continued)

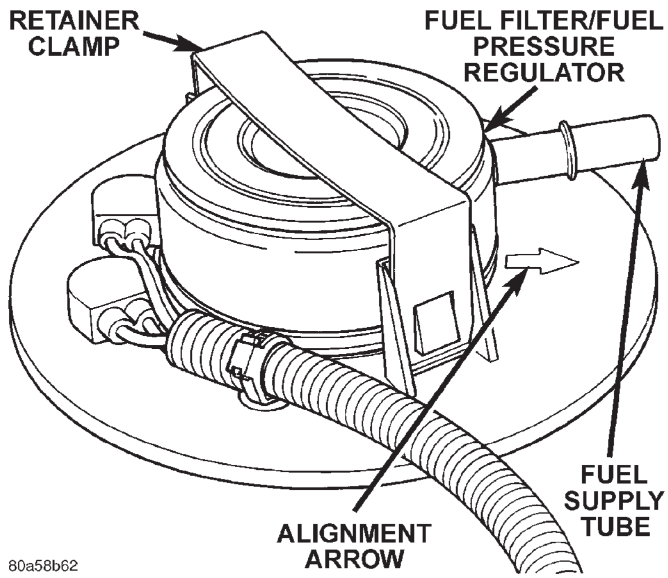


Fig. 21 Fuel Filter/Fuel Pressure Regulator

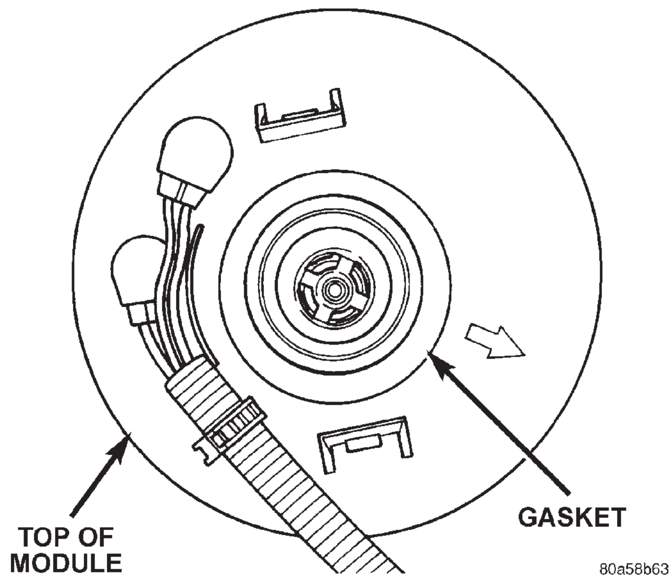


Fig. 22 Fuel Filter/Fuel Pressure Regulator Gasket

(6) The arrow (Fig. 21) molded into top of fuel pump module should be pointed towards front of vehicle (12 o'clock position).

(7) Rotate filter/regulator until fuel supply tube (fitting) is pointed towards front of vehicle (12 o'clock position).

(8) Install new retainer clamp (clamp snaps over top of filter/regulator and locks to flanges on pump module).

(9) Connect fuel line at filter/regulator. Refer to Quick-Connect Fittings in this group for procedures.

(10) Install fuel tank. Refer to Fuel Tank Removal/ Installation.

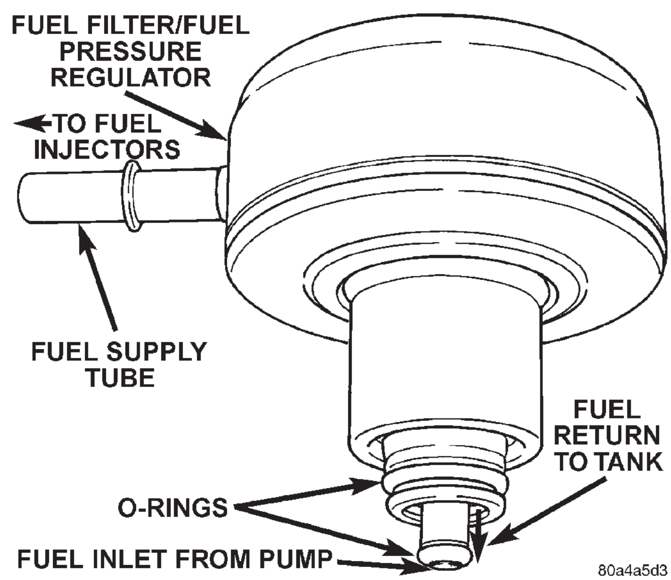


Fig. 23 Fuel Filter/Fuel Pressure Regulator O-Rings

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 ENGINE OFF. BEFORE SERVICING THE FUEL PUMP MODULE, 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) Thoroughly wash and clean area around pump module to prevent contaminants from entering tank.

(3) Disconnect fuel line at filter/regulator. Refer to Quick-Connect Fittings in this group for procedures.

(4) The plastic fuel pump module locknut is threaded onto fuel tank (Fig. 24). Install Special Tool 6856 to fuel pump module locknut and remove locknut (Fig. 25). The fuel pump module will spring up when locknut is removed.

(5) Remove module from fuel tank.

INSTALLATION

CAUTION: Whenever fuel pump module is serviced, module gasket must be replaced.

(1) Thoroughly clean locknut threads and mating fuel tank threads. Use a soap/water solution. Do not use carburetor cleaner to clean threads.

(2) Using a new gasket, position gasket and fuel pump module into opening in fuel tank.

(3) Apply clean water to gasket and locknut threads.

REMOVAL AND INSTALLATION (Continued)

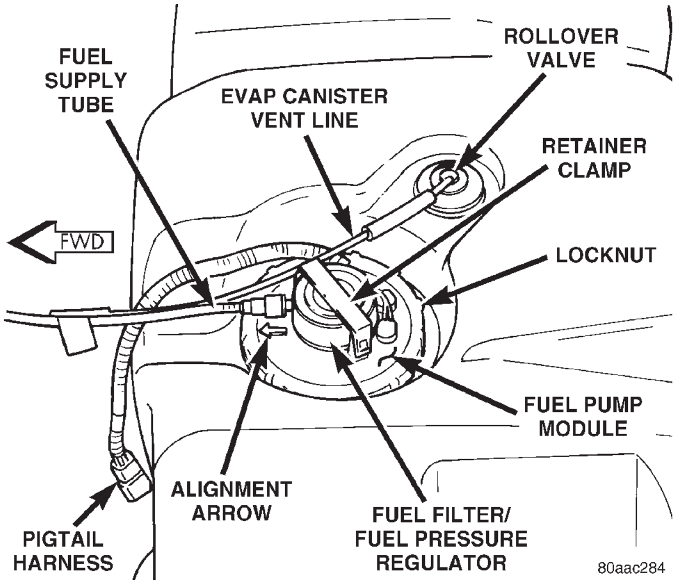


Fig. 24 Top View of Fuel Tank and Fuel Pump Module

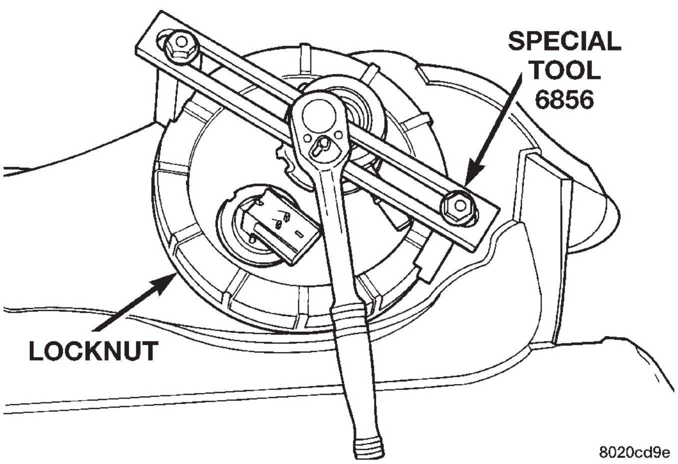


Fig. 25 Locknut Removal/Installation—Typical

(4) Position locknut over top of fuel pump module.

(5) Rotate module until molded arrow (Fig. 24) 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.

(6) Install Special Tool 6856 to locknut.

(7) Tighten locknut to 74 N·m (55 ft. lbs.) torque.

(8) Rotate fuel filter/fuel pressure regulator until its fitting is pointed toward front of vehicle (12 o'clock position).

(9) Connect fuel line at filter/regulator. Refer to Quick-Connect Fittings in this group for procedures.

(10) 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. 26). The fuel pump module is located on top of fuel tank.

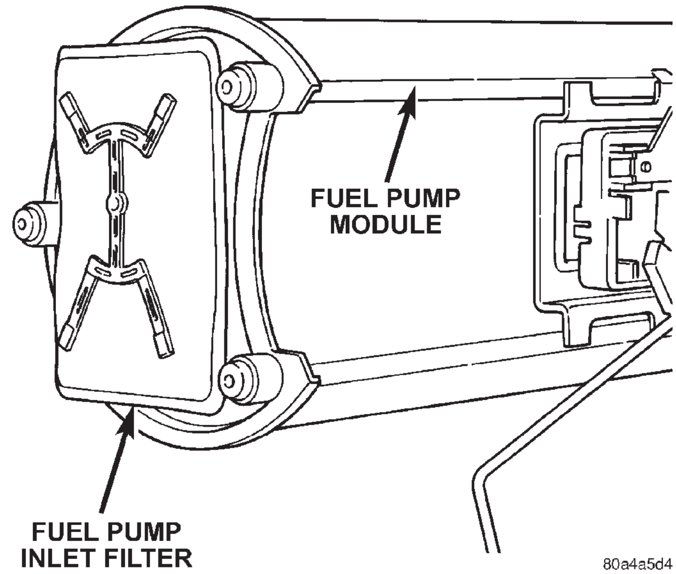


Fig. 26 Fuel Pump Inlet Filter

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.

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. 27). The fuel pump module is located within the fuel tank.

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. 28) to remove sending unit from pump module.

REMOVAL AND INSTALLATION (Continued)

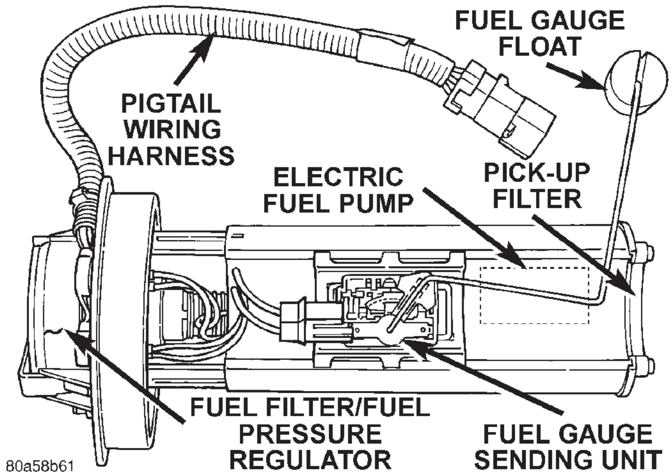


Fig. 27 Fuel Gauge Sending Unit Location

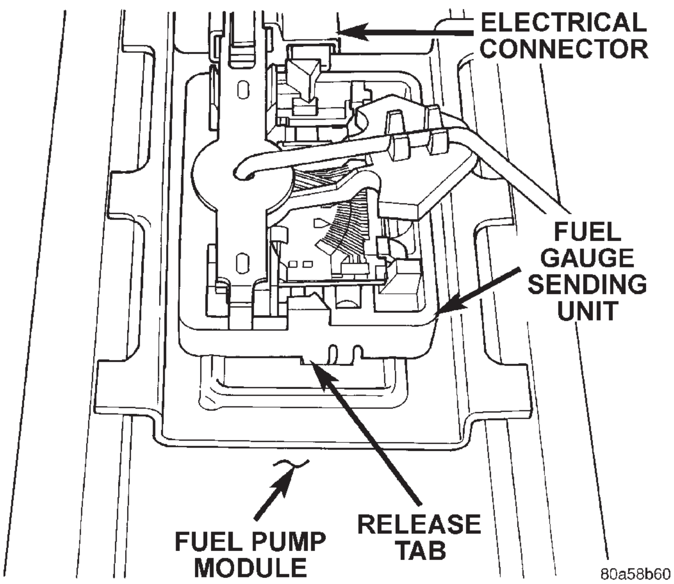


Fig. 28 Fuel Gauge Sending Unit Release Tab

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—2.5L ENGINE

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH ENGINE OFF. THIS PRESSURE MUST BE RELEASED BEFORE SERVICING FUEL RAIL.

(1) Remove fuel tank filler tube cap.

(2) Perform Fuel System Pressure Release Procedure as described in this Group.

(3) Disconnect negative battery cable from battery.

(4) Remove air tube at top of throttle body. Note: Some engine/vehicles may require removal of air cleaner ducts at throttle body.

(5) Remove injector harness electrical connectors at each injector. Each injector connector should have a numerical tag attached identifying its corresponding cylinder (Fig. 29). If not, identify each connector before removal.

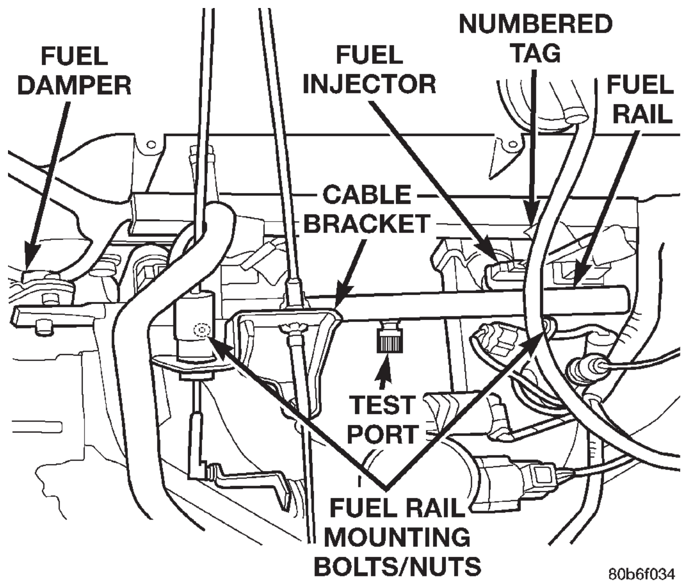


Fig. 29 Fuel Rail Mounting—2.5L Engine

(6) Disconnect fuel supply line latch clip and fuel line at fuel rail. Refer to Quick-Connect Fittings in this group for procedures.

(7) Disconnect throttle cable at throttle body. Refer to Throttle Cable Removal/Installation in this group for procedures.

(8) Disconnect speed control cable at throttle body (if equipped). Refer to Speed Control Cable in Group 8H, Speed Control System for procedures.

(9) Disconnect automatic transmission cable at throttle body (if equipped).

(10) Remove cable routing bracket (Fig. 29) at intake manifold.

(11) Remove nut securing crankshaft position sensor pigtail harness to fuel rail mounting stud. Remove clamp and harness from fuel rail mounting stud.

(12) Clean dirt/debris from each fuel injector at intake manifold.

(13) Remove fuel rail mounting nuts/bolts (Fig. 29).

(14) Remove fuel rail by gently rocking until all the fuel injectors are out of intake manifold.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Clean each injector bore at intake manifold.

(2) Apply a small amount of clean engine oil to each injector o-ring. This will aid in installation.

(3) Position tips of all fuel injectors into the corresponding injector bore in intake manifold. Seat injectors into manifold.

(4) Install and tighten fuel rail mounting bolts to 11 ±3 N·m (100 ±25 in. lbs.) torque.

(5) Position crankshaft position sensor pigtail wire harness clamp and wire harness to fuel rail mounting stud. Install nut securing harness to fuel rail mounting stud.

(6) Connect tagged injector harness connectors to appropriate injector.

(7) Connect fuel line and fuel line latch clip to fuel rail. Refer Quick-Connect Fittings in this group for procedures.

(8) Install protective cap to pressure test port fitting (if equipped).

(9) Install cable routing bracket to intake manifold.

(10) Connect throttle cable at throttle body.

(11) Connect speed control cable at throttle body (if equipped).

(12) Connect automatic transmission cable at throttle body (if equipped).

(13) Install air tube (or duct) at top of throttle body.

(14) Install fuel tank cap.

(15) Connect negative battery cable to battery.

(16) Start engine and check for fuel leaks.

FUEL INJECTOR RAIL—4.0L ENGINE

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH ENGINE OFF. THIS PRESSURE MUST BE RELEASED BEFORE SERVICING FUEL RAIL.

(1) Remove fuel tank filler tube cap.

(2) Perform Fuel System Pressure Release Procedure as described in this Group.

(3) Disconnect negative battery cable from battery.

(4) Remove air tube at top of throttle body. Note: Some engine/vehicles may require removal of air cleaner ducts at throttle body.

(5) Remove injector harness electrical connectors at each injector. Each injector connector should have a numerical tag attached identifying its corresponding cylinder (Fig. 30). If not, identify each connector before removal.

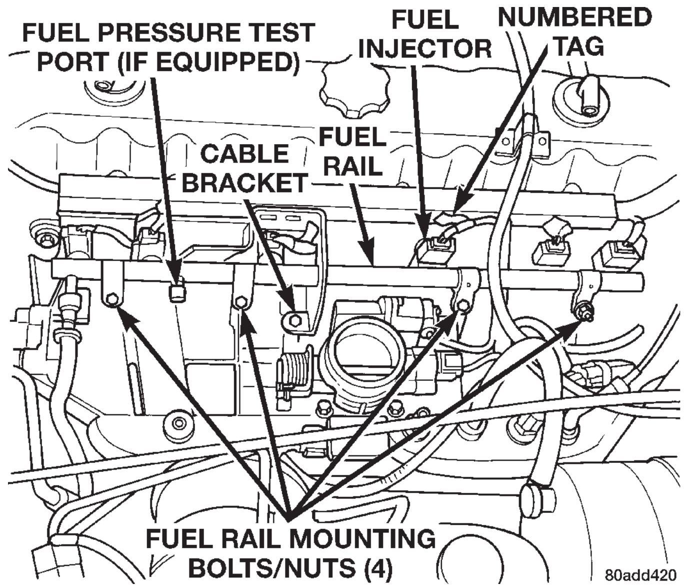


Fig. 30 Fuel Rail Mounting—4.0L Engine

(6) Disconnect fuel supply line latch clip and fuel line at fuel rail. Refer to Quick-Connect Fittings in this group for procedures.

(7) Disconnect throttle cable at throttle body. Refer to Throttle Cable Removal/Installation in this group for procedures.

(8) Disconnect speed control cable at throttle body (if equipped). Refer to Speed Control Cable in Group 8H, Speed Control System for procedures.

(9) Disconnect automatic transmission cable at throttle body (if equipped).

(10) Remove cable routing bracket (Fig. 30) at intake manifold.

(11) Remove nut securing crankshaft position sensor pigtail harness to fuel rail mounting stud. Remove clamp and harness from fuel rail mounting stud.

(12) Clean dirt/debris from each fuel injector at intake manifold.

(13) Remove fuel rail mounting nuts/bolts (Fig. 30).

(14) Remove fuel rail by gently rocking until all the fuel injectors are out of intake manifold.

INSTALLATION

(1) Clean each injector bore at intake manifold.

(2) Apply a small amount of clean engine oil to each injector o-ring. This will aid in installation.

(3) Position tips of all fuel injectors into the corresponding injector bore in intake manifold. Seat injectors into manifold.

(4) Install and tighten fuel rail mounting bolts to 11 ±3 N·m (100 ±25 in. lbs.) torque.

(5) Position crankshaft position sensor pigtail wire harness clamp and wire harness to fuel rail mount-

REMOVAL AND INSTALLATION (Continued)

ing stud. Install nut securing harness to fuel rail mounting stud.

(6) Connect tagged injector harness connectors to appropriate injector.

(7) Connect fuel line and fuel line latch clip to fuel rail. Refer Quick-Connect Fittings in this group for procedures.

(8) Install protective cap to pressure test port fitting (if equipped).

(9) Install cable routing bracket to intake manifold.

(10) Connect throttle cable at throttle body.

(11) Connect speed control cable at throttle body (if equipped).

(12) Connect automatic transmission cable at throttle body (if equipped).

(13) Install air tube (or duct) at top of throttle body.

(14) Install fuel tank cap.

(15) Connect negative battery cable to battery.

(16) Start engine and check for fuel leaks.

FUEL INJECTORS

REMOVAL

(1) Remove fuel rail. Refer to Fuel Injector Rail Removal in this section.

(2) Remove clip(s) that retain fuel injector(s) to fuel rail (Fig. 31) or (Fig. 32).

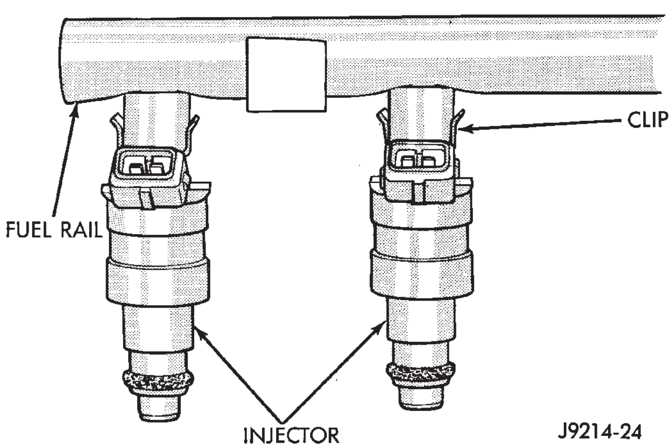


Fig. 31 Injector Mounting

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.

(4) Install fuel rail. Refer to Fuel Rail Installation in this section.

(5) Start engine and check for fuel leaks.

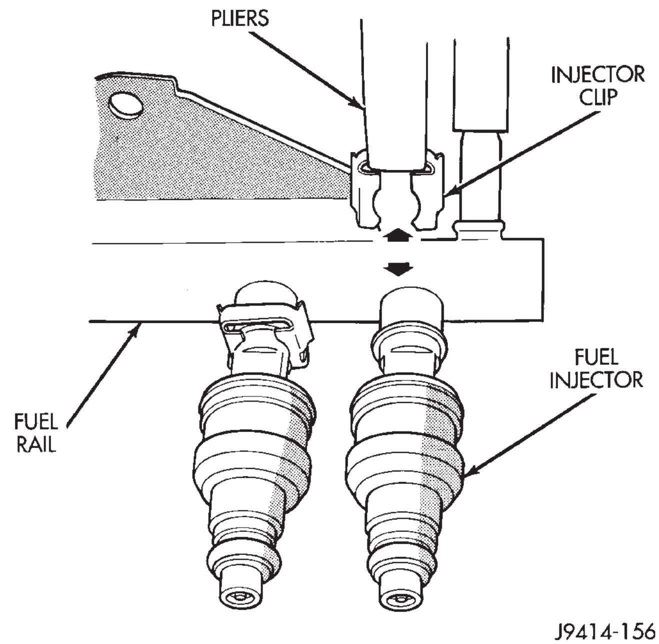


Fig. 32 Injector Retaining Clips—Typical Injector

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.

Two different procedures may be used to drain fuel tank (lowering tank or using DRB scan tool).

The quickest draining procedure involves lowering the fuel tank.

As an alternative procedure, the electric fuel pump may be activated allowing tank to be drained at fuel rail connection. Refer to DRB scan tool for fuel pump activation procedures. Before disconnecting fuel line at fuel rail, release fuel pressure. Refer to the Fuel System Pressure Release Procedure in this group for procedures. Attach end of special test hose tool number 6541, 6539, 6631 or 6923 at fuel rail disconnection (tool number will depend on model and/or engine application). Position opposite end of this hose tool to an approved gasoline draining station. Activate fuel pump and drain tank until empty.

If electric fuel pump is not operating, tank must be lowered for fuel draining. Refer to following procedures.

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Release fuel system pressure. Refer to the Fuel System Pressure Release Procedure in this group.

(3) Raise and support vehicle.

REMOVAL AND INSTALLATION (Continued)

(4) If Equipped: Remove fuel tank skid plate. Refer to Group 23, Body for procedures.

(5) Remove 4 fuel hose shield mounting bolts and remove fuel hose shield (Fig. 33) from body.

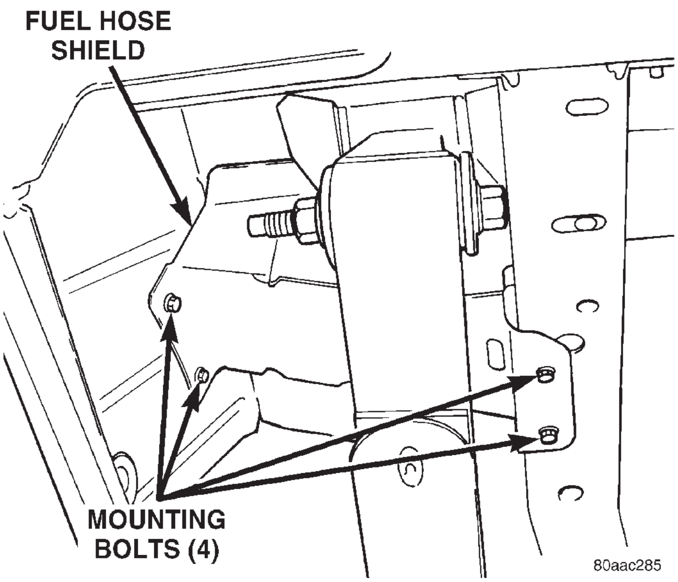


Fig. 33 Fuel Hose Shield

(6) Remove fuel tank fill hose and vent hose clamps at fuel tank filler tube (Fig. 34). Remove both hoses at fuel filler tube (Fig. 34).

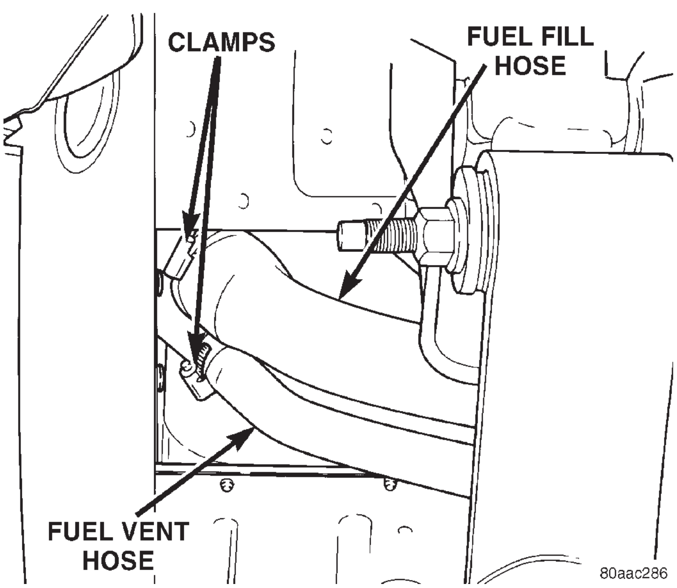


Fig. 34 Fuel Fill and Vent Hoses

(7) Remove exhaust tailpipe heat shield mounting bolts and remove shield.

CAUTION: To protect fuel tank from exhaust heat, this shield must reinstalled after tank installation.

(8) Place a hydraulic jack to bottom of fuel tank.

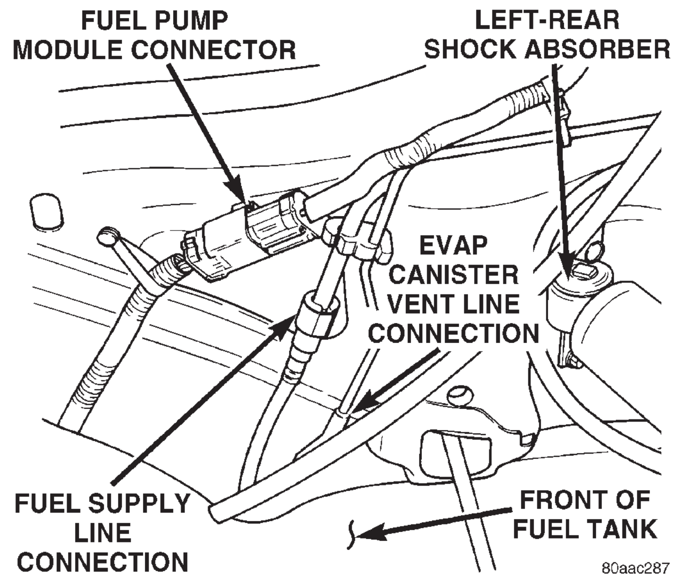


Fig. 35 Fuel Tank Connections at Front of Fuel Tank

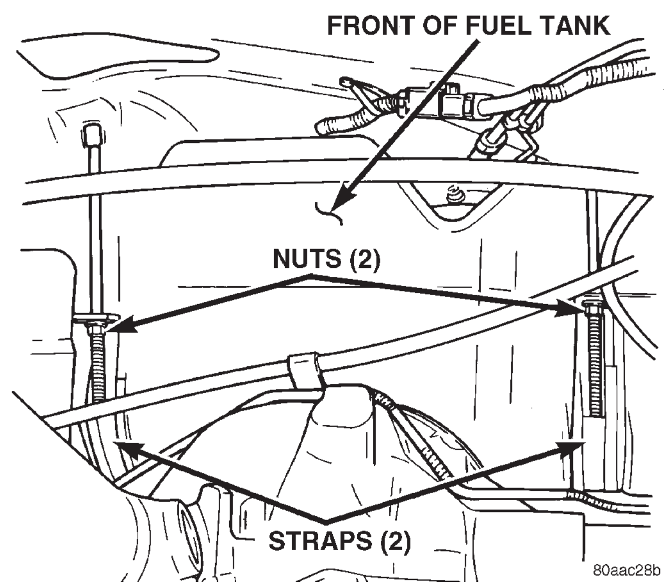


Fig. 36 Fuel Tank Mounting Straps/Nuts

WARNING: PLACE A SHOP TOWEL AROUND FUEL LINES TO CATCH ANY EXCESS FUEL.

(9) Disconnect fuel supply line from fuel extension line near front of fuel tank (Fig. 35). Refer to Fuel Tubes/Lines/Hoses and Clamps in this group. Also refer to Quick-Connect Fittings for procedures.

(10) Disconnect EVAP canister vent line near front of tank (Fig. 35).

(11) Disconnect fuel pump module electrical connector (pigtail harness) near front of tank (Fig. 35). Harness connector is clipped to body.

(12) Remove two fuel tank strap nuts (Fig. 36). Position both tank support straps away from tank.

(13) Carefully lower right side of tank while feeding both fuel hoses through access hole in body. **Fuel**

REMOVAL AND INSTALLATION (Continued)

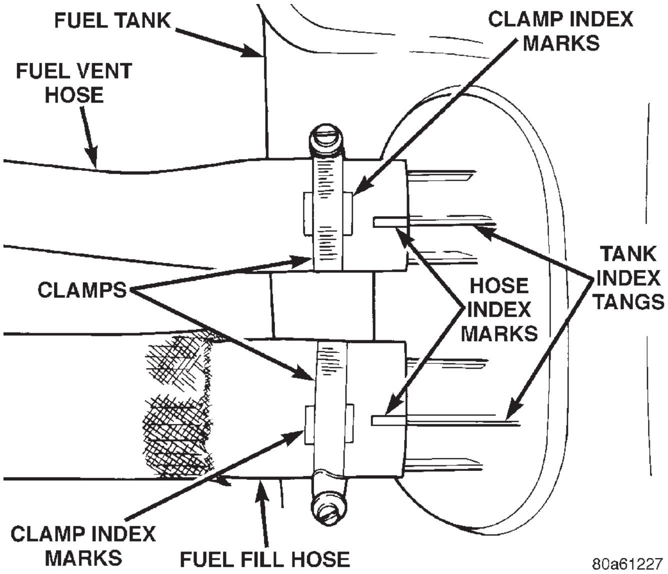


Fig. 37 Fuel Fill/Vent Hose Index Marks

Tank Full And Not Drained Using DRB Scan Tool: To prevent fuel loss through hoses, keep left side of tank higher than right side while lowering. Do not allow hose openings to drop lower than top of tank.

(14) Continue lowering tank until clear of vehicle. Place tank on floor with left side (hose side) higher than right side.

(15) Drain tank by removing fuel fill hose at tank. Fuel fill hose is largest of 2 hoses (Fig. 37). Insert the drain hose (from an approved gasoline draining station) into hose opening. Drain tank until empty.

(16) If fuel pump module removal is necessary, refer to Fuel Pump Module Removal/Installation in this group for procedures.

INSTALLATION

(1) If fuel pump module is being installed, refer to Fuel Pump Module Removal/Installation in this group for procedures.

(2) Install fuel fill/vent hoses to tank fittings. To prevent hose from kinking, rotate each hose until index mark on hose is aligned to index tang on fuel tank (Fig. 37).

(3) Install hose clamps to hoses. Position clamps between index marks on each hose (Fig. 37).

(4) Position fuel tank to hydraulic jack.

(5) Raise tank into position while guiding fuel fill and vent hoses into and through access hole in body.

(6) Continue raising tank until positioned to body.

(7) Attach two fuel tank mounting straps and mounting nuts. Tighten nuts to 10 N·m (90 in. lbs.) torque. Do not over tighten nuts.

(8) Install both fuel hoses to fuel fill tube. Tighten both retaining clamps.

(9) Position fuel hose shield to body. Install and tighten 4 mounting bolts.

(10) Connect fuel pump module pigtail harness electrical connector near front of tank.

(11) Connect fuel pump module supply line near front of tank. Refer to Quick-Connect Fittings for procedures.

(12) Connect EVAP hose near front of tank.

(13) Install exhaust tailpipe heat shield.

(14) Install fuel tank skid plate (if equipped).

(15) Lower vehicle and connect battery cable to battery.

FUEL TANK FILLER TUBE CAP

If replacement of the fuel tank filler tube cap is necessary, it must be replaced with an identical cap to be sure of correct system operation.

CAUTION: Remove the fuel tank filler tube cap to relieve fuel tank pressure. The cap must be removed prior to disconnecting any fuel system component or before draining the fuel tank.

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. 38). This retainer (clip) snaps into the top of the accelerator pedal arm. Retainer tabs (built into the cable sheathing) (Fig. 38) fasten the cable to the dash panel.

Dual throttle return springs (attached to the throttle shaft) are used to close the throttle.

CAUTION: Never attempt to remove or alter these springs.

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing the accelerator pedal or throttle cable.

REMOVAL

(1) From inside the vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of accelerator pedal arm (Fig. 38). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove accelerator pedal mounting bracket nuts. Remove accelerator pedal assembly.

REMOVAL AND INSTALLATION (Continued)

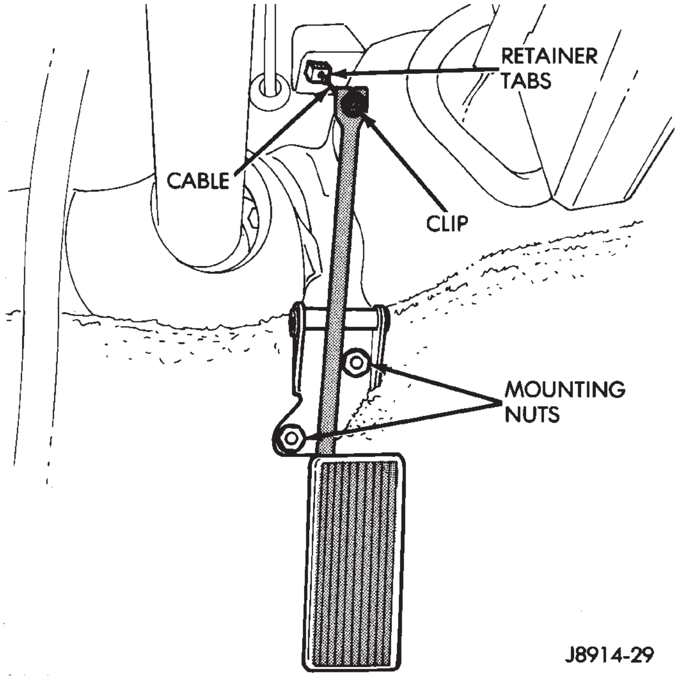


Fig. 38 Accelerator Pedal Mounting—Typical

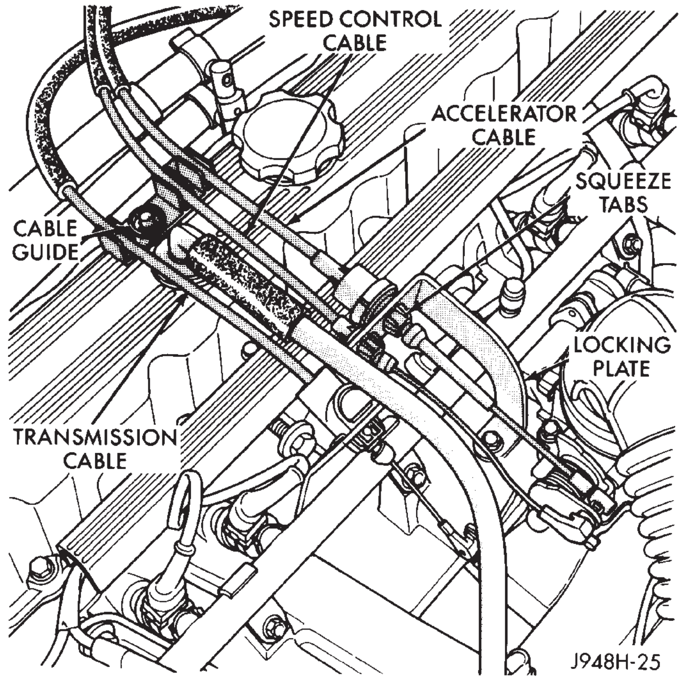


Fig. 39 Cable Guide and Squeeze Tabs—Typical

INSTALLATION

(1) Place accelerator pedal assembly over studs protruding from floor pan. Tighten mounting nuts to 5 N·m (36 in. lbs.) torque.

(2) Slide throttle cable into opening in top of pedal arm. Push plastic cable retainer (clip) into accelerator pedal arm opening until it snaps into place.

(3) Before starting engine, operate accelerator pedal to check for any binding.

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. 38). 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. 38) at dash panel. Remove cable housing from dash panel and pull into engine compartment.

(4) Remove cable from cable guide on engine cylinder head (valve) cover (Fig. 39).

(5) Remove throttle cable ball end socket at throttle body linkage (snaps off) (Fig. 40).

(6) Remove throttle cable from throttle body mounting bracket by compressing squeeze tabs (Fig. 39) and pushing cable through hole in bracket.

(7) Remove throttle cable from vehicle.

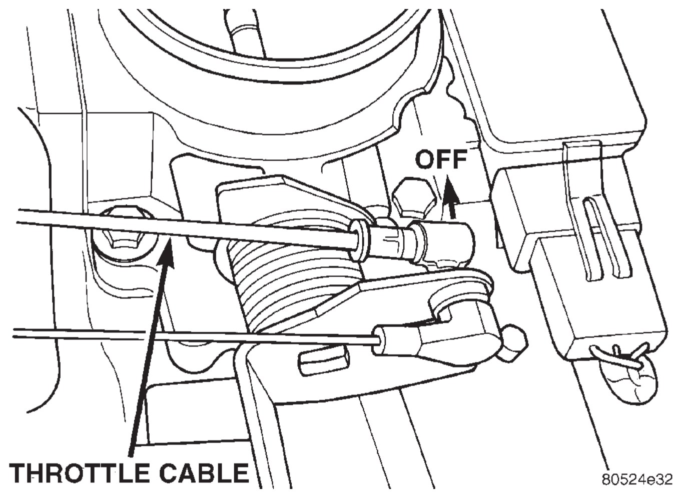


Fig. 40 Throttle (Accelerator) Cable at Throttle Body—Typical

INSTALLATION

(1) Slide throttle cable through hole in throttle body bracket until retainer tabs lock into bracket.

(2) Connect cable ball end to throttle body linkage ball (snaps on).

(3) Snap cable into cable guide on engine cylinder head (valve) cover.

(4) Push other end of cable through opening in dash panel until retaining tabs lock into panel.

(5) From inside drivers compartment, slide throttle cable core wire into opening in top of accelerator pedal arm. Push cable retainer (clip) into pedal arm opening until it snaps in place.

(6) Before starting engine, operate accelerator pedal to check for any binding.

SPECIFICATIONS

FUEL TANK CAPACITY

Models	Liters	U.S. Gallons
All	76	20
Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.		

FUEL SYSTEM PRESSURE

339 kPa ± 34 kPa (49.2 psi ± 5 psi).

TORQUE CHART

DESCRIPTION	TORQUE
Accelerator Pedal Bracket Mounting Nuts	5 N·m (36 in. lbs.)
Fuel Hose Clamps	3 N·m (25 in. lbs.)
Fuel Rail Mounting Bolts	11 N·m (100 in. lbs.)
Fuel Tank Mounting Strap Nuts	10 N·m (90 in. lbs.)
Fuel Pump Module Locknut	74 N·m (55 ft. lbs.)

FUEL INJECTION SYSTEM

INDEX

DESCRIPTION AND OPERATION

POWERTRAIN CONTROL MODULE (PCM)

The Powertrain Control Module (PCM) (Fig. 1) operates the fuel system. The PCM was formerly referred to as the SBEC or engine controller. The PCM is a pre-programmed, triple microprocessor digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, certain transmission features, speed control, air conditioning compressor clutch engagement and idle speed. The PCM can adapt its programming to meet changing operating conditions.

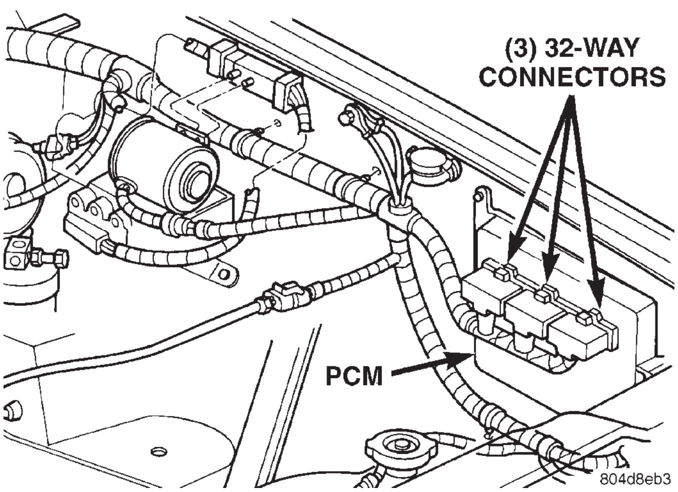


Fig. 1 PCM Location

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as Powertrain Control Module (PCM) Outputs. The sensors and switches that provide inputs to the PCM are considered Powertrain Control Module (PCM) Inputs.

The PCM adjusts ignition timing based upon inputs it receives from sensors that react to: engine rpm, manifold absolute pressure, engine coolant temperature, throttle position, transmission gear selection (automatic transmission), vehicle speed, power steering pump pressure (2.5L engine only), and the brake switch.

The PCM adjusts idle speed based on inputs it receives from sensors that react to: throttle position, vehicle speed, transmission gear selection, engine coolant temperature and from inputs it receives from the air conditioning clutch switch and brake switch.

Based on inputs that it receives, the PCM adjusts ignition coil dwell. The PCM also adjusts the generator charge rate through control of the generator field and provides speed control operation.

NOTE: PCM Inputs:

- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Auto shutdown (ASD) sense
- Battery temperature
- Battery voltage
- Brake switch
- CCD bus (+) circuits
- CCD bus (-) circuits
- Camshaft position sensor signal
- Crankshaft position sensor
- Data link connection for DRB scan tool
- Engine coolant temperature sensor
- Extended idle switch (4.0L engine with police package)
- Fuel level
- Generator (battery voltage) output
- Ignition circuit sense (ignition switch in on/off/crank/run position)
- Intake manifold air temperature sensor
- Leak detection pump (switch) sense (if equipped)
- Manifold absolute pressure (MAP) sensor
- Oil pressure
- Oxygen sensors
- Park/neutral switch (auto. trans. only)
- Power ground
- Power steering pressure switch (2.5L engine only)
- Sensor return
- Signal ground
- Speed control multiplexed single wire input
- Throttle position sensor
- Vehicle speed sensor

NOTE: PCM Outputs:

- A/C clutch relay
- Auto shutdown (ASD) relay
- CCD bus (+/-) circuits for: speedometer, voltmeter, fuel gauge, oil pressure gauge/lamp, engine temp. gauge and speed control warn. lamp
- Data link connection for DRB scan tool

DESCRIPTION AND OPERATION (Continued)

- EGR valve control solenoid (if equipped)
- EVAP canister purge solenoid
- Five volt sensor supply (primary)
- Five volt sensor supply (secondary)
- Fuel injectors
- Fuel pump relay
- Generator field driver (-)
- Generator field driver (+)
- Idle air control (IAC) motor
- Ignition coil
- Leak detection pump (if equipped)
- Malfunction indicator lamp (Check engine lamp). Driven through CCD circuits.
- Radiator cooling fan relay
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (if equipped). Driven through CCD circuits.
- Transmission convertor clutch circuit

MODES OF OPERATION

As input signals to the powertrain control module (PCM) change, the PCM adjusts its response to the output devices. For example, the PCM must calculate different injector pulse width and ignition timing for idle than it does for wide open throttle (WOT).

The PCM will operate in two different modes: **Open Loop and Closed Loop**.

During Open Loop modes, the powertrain control module (PCM) receives input signals and responds only according to preset PCM programming. Input from the oxygen (O2S) sensors is not monitored during Open Loop modes.

During Closed Loop modes, the PCM will monitor the oxygen (O2S) sensors input. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio. This ratio is 14.7 parts air-to-1 part fuel. By monitoring the exhaust oxygen content through the O2S sensor, the PCM can fine tune the injector pulse width. This is done to achieve optimum fuel economy combined with low emission engine performance.

The fuel injection system has the following modes of operation:

- Ignition switch ON
- Engine start-up (crank)
- Engine warm-up
- Idle
- Cruise
- Acceleration
- Deceleration
- Wide open throttle (WOT)
- Ignition switch OFF

The ignition switch On, engine start-up (crank), engine warm-up, acceleration, deceleration and wide open throttle modes are Open Loop modes. The idle and cruise modes, (with the engine at operating temperature) are Closed Loop modes.

IGNITION SWITCH (KEY-ON) MODE

This is an Open Loop mode. When the fuel system is activated by the ignition switch, the following actions occur:

- The powertrain control module (PCM) pre-positions the idle air control (IAC) motor.
- The PCM determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
- The PCM monitors the engine coolant temperature sensor input. The PCM modifies fuel strategy based on this input.
- Intake manifold air temperature sensor input is monitored.
- Throttle position sensor (TPS) is monitored.
- The auto shutdown (ASD) relay is energized by the PCM for approximately three seconds.
- The fuel pump is energized through the fuel pump relay by the PCM. The fuel pump will operate for approximately three seconds unless the engine is operating or the starter motor is engaged.
- The O2S sensor heater element is energized via the ASD relay. The O2S sensor input is not used by the PCM to calibrate air-fuel ratio during this mode of operation.

ENGINE START-UP MODE

This is an Open Loop mode. The following actions occur when the starter motor is engaged.

The powertrain control module (PCM) receives inputs from:

- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal

The PCM monitors the crankshaft position sensor. If the PCM does not receive a crankshaft position sensor signal within 3 seconds of cranking the engine, it will shut down the fuel injection system.

The fuel pump is activated by the PCM through the fuel pump relay.

Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.

The PCM determines the proper ignition timing according to input received from the crankshaft position sensor.

DESCRIPTION AND OPERATION (Continued)

ENGINE WARM-UP MODE

This is an Open Loop mode. During engine warm-up, the powertrain control module (PCM) receives inputs from:

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)

Based on these inputs the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM adjusts engine idle speed through the idle air control (IAC) motor and adjusts ignition timing.
- The PCM operates the A/C compressor clutch through the A/C compressor clutch relay. This is done if A/C has been selected by the vehicle operator and specified pressures are met at the high and low–pressure A/C switches. Refer to Group 24, Heating and Air Conditioning for additional information.
- When engine has reached operating temperature, the PCM will begin monitoring O2S sensor input. The system will then leave the warm-up mode and go into closed loop operation.

IDLE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At idle speed, the powertrain control module (PCM) receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Extended idle switch (4.0L engine with police package only)
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Battery voltage
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen sensors
- Power steering pressure switch (2.5L engine only)

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM monitors the O2S sensor input and adjusts air-fuel ratio by varying injector pulse width. It also adjusts engine idle speed through the idle air control (IAC) motor.
- The PCM adjusts ignition timing by increasing and decreasing spark advance.
- The PCM operates the A/C compressor clutch through the A/C compressor clutch relay. This is done if A/C has been selected by the vehicle operator and specified pressures are met at the high and low–pressure A/C switches. Refer to Group 24, Heating and Air Conditioning for additional information.

The optional Extended Idle Switch is used to raise and hold the engine idle speed to approximately 1000 rpm. This is when the shifter is in either the Park or Neutral position and throttle pedal is not used. A rocker-type switch (extended idle switch) is mounted to the instrument panel. This switch will supply a ground circuit (input) to the powertrain control module (PCM). **The switch is available only with 4.0L engine when supplied with optional police package.**

On 2.5L 4–cylinder engines, a power steering pressure switch is used to supply an input to the PCM when steering pump pressure is high. This will raise engine speed. Refer to Power Steering Pressure Switch in this group for additional information. **The 4.0L 6–cylinder engine does not use this switch.**

CRUISE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At cruising speed, the powertrain control module (PCM) receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen (O2S) sensors

Based on these inputs, the following occurs:

DESCRIPTION AND OPERATION (Continued)

• Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then adjust the injector pulse width by turning the ground circuit to each individual injector on and off.

• The PCM monitors the O2S sensor input and adjusts air-fuel ratio. It also adjusts engine idle speed through the idle air control (IAC) motor.

• The PCM adjusts ignition timing by turning the ground path to the coil on and off.

• The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

ACCELERATION MODE

This is an Open Loop mode. The powertrain control module (PCM) recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The PCM increases injector pulse width in response to increased throttle opening.

DECELERATION MODE

When the engine is at operating temperature, this is an Open Loop mode. During hard deceleration, the powertrain control module (PCM) receives the following inputs.

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Vehicle speed sensor

If the vehicle is under hard deceleration with the proper rpm and closed throttle conditions, the PCM will ignore the oxygen sensor input signal. The PCM will enter a fuel cut-off strategy in which it will not supply a ground to the injectors. If a hard deceleration does not exist, the PCM will determine the proper injector pulse width and continue injection.

Based on the above inputs, the PCM will adjust engine idle speed through the idle air control (IAC) motor.

The PCM adjusts ignition timing by turning the ground path to the coil on and off.

WIDE OPEN THROTTLE MODE

This is an Open Loop mode. During wide open throttle operation, the powertrain control module (PCM) receives the following inputs.

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)

During wide open throttle conditions, the following occurs:

• Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off. The PCM ignores the oxygen sensor input signal and provides a predetermined amount of additional fuel. This is done by adjusting injector pulse width.

• The PCM adjusts ignition timing by turning the ground path to the coil on and off.

IGNITION SWITCH OFF MODE

When ignition switch is turned to OFF position, the PCM stops operating the injectors, ignition coil, ASD relay and fuel pump relay.

AIR CONDITIONING (A/C) CONTROLS—PCM INPUT

OPERATION

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 PCM receives the A/C request signal from the clutch cycling pressure switch. The input indicates that the evaporator pressure is in the proper range for A/C application. The PCM uses this input to cycle the A/C compressor clutch (through the A/C relay). It will also determine the correct engine idle speed through the idle air control (IAC) motor position.

If the A/C low-pressure switch or high-pressure switch opens (indicating a low or high refrigerant pressure), the PCM will not receive an A/C request signal. The PCM will then remove the ground from

DESCRIPTION AND OPERATION (Continued)

the A/C relay. This will deactivate the A/C compressor clutch.

If the switch opens, (indicating that evaporator is not in proper pressure range), the PCM will not receive the A/C request signal. The PCM will then remove the ground from the A/C relay, deactivating the A/C compressor clutch.

AUTOMATIC SHUTDOWN (ASD) RELAY SENSE—PCM INPUT

A 12 volt signal at this input indicates to the PCM that the ASD has been activated. The ASD relay is located in the Power Distribution Center (PDC). The PDC is located in the engine compartment (Fig. 2). Refer to label on PDC cover for relay location. The relay is used to connect the oxygen sensor heater elements, ignition coil and fuel injectors to 12 volt + power supply.

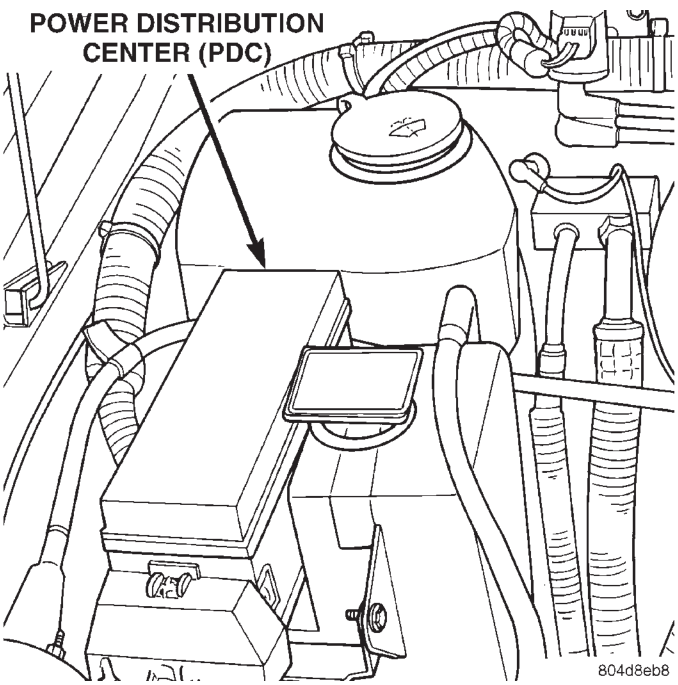


Fig. 2 Power Distribution Center (PDC)

This input is used only to sense that the ASD relay is energized. If the powertrain control module (PCM) does not see 12 volts at this input when the ASD should be activated, it will set a diagnostic trouble code (DTC).

BATTERY TEMPERATURE SENSOR—PCM INPUT

OPERATION

Provides a signal to the PCM corresponding to the battery temperature.

BATTERY VOLTAGE—PCM INPUT

OPERATION

The battery voltage input provides power to the Powertrain Control Module (PCM). It also informs the PCM what voltage level is supplied to the ignition coil and fuel injectors.

If battery voltage is low, the PCM will increase injector pulse width (period of time that the injector is energized). This is done to compensate for the reduced flow through injector caused by the lowered voltage.

BRAKE SWITCH—PCM INPUT

OPERATION

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 disable vent and vacuum solenoid output signals to the speed control servo.

FIVE VOLT SENSOR SUPPLY—PRIMARY

OPERATION

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

OPERATION

Supplies the required 5 volt source to certain sensors.

FUEL LEVEL SENSOR—PCM INPUT

OPERATION

The Powertrain Control Module (PCM) supplies power to the fuel level sensor (fuel gauge sending unit). The fuel level sensor will then return a signal to the PCM to indicate fuel level. The purpose of this feature is to prevent a false setting of misfire and fuel system monitor trouble codes. This is if the fuel level is less than approximately 15 percent, or, if equipped with a Leak Detection Pump (LDP), more than approximately 85 percent of its rated capacity. This input is also used to send a signal to the PCM for fuel gauge operation via the CCD or J1850 bus circuits.

DESCRIPTION AND OPERATION (Continued)

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.

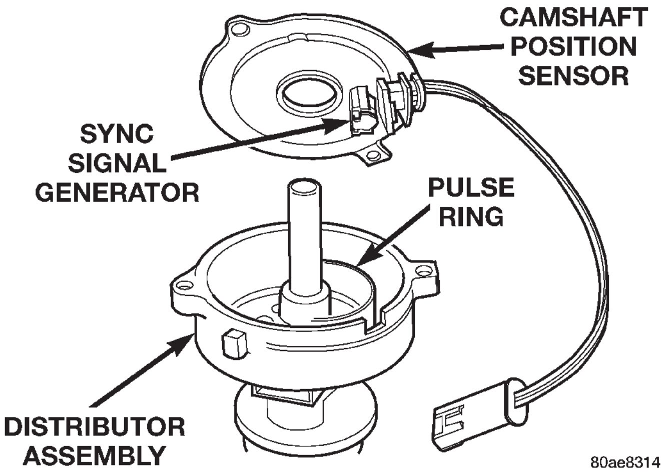


Fig. 3 Camshaft Position Sensor—Typical

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.

The sensor is bolted to the transmission bellhousing (Fig. 4).

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.

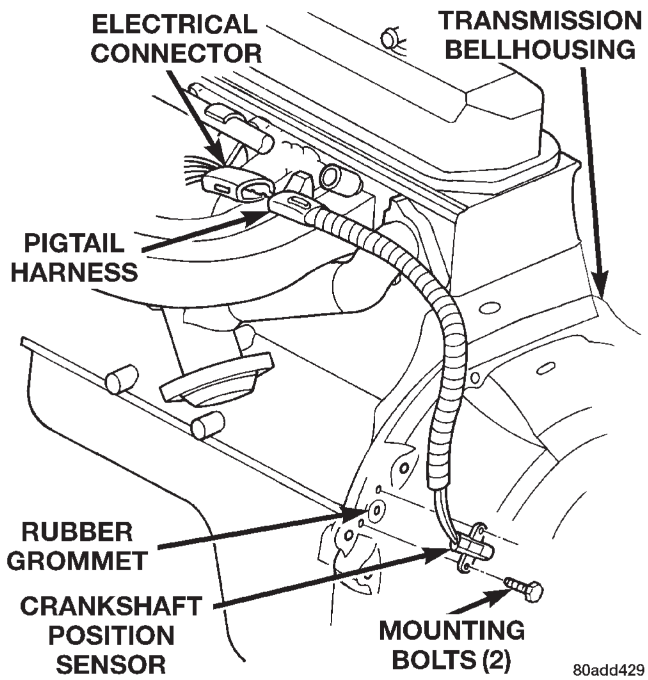


Fig. 4 Crankshaft Position Sensor—Typical

ENGINE COOLANT TEMPERATURE SENSOR—PCM INPUT

The engine coolant temperature sensor is installed in the thermostat housing (Fig. 5) and protrudes into the water jacket. The sensor provides an input voltage to the Powertrain Control Module (PCM) relating coolant temperature. The PCM uses this input along with inputs from other sensors to determine injector pulse width and ignition timing. As coolant temperature varies, the coolant temperature sensor's resistance changes. The change in resistance results in a different input voltage to the PCM.

When the engine is cold, the PCM will operate in Open Loop cycle. It will demand slightly richer air-fuel mixtures and higher idle speeds. This is done until normal operating temperatures are reached.

Refer to Open Loop/Closed Loop Modes of Operation in this section of the group for more information.

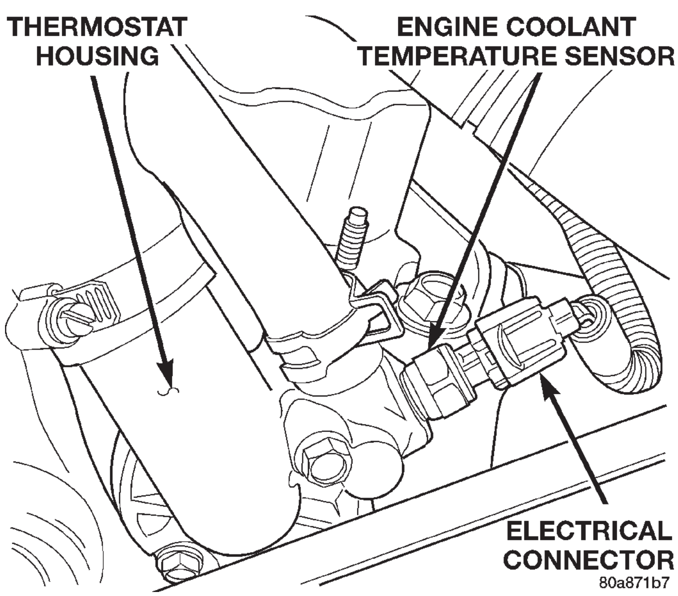


Fig. 5 Engine Coolant Temperature Sensor—Typical

DESCRIPTION AND OPERATION (Continued)

EXTENDED IDLE SWITCH—PCM INPUT

OPTIONAL POLICE PACKAGE WITH 4.0L ENGINE ONLY

The extended idle switch is used to raise the engine idle speed to approximately 1000 rpm. This is when the shifter is in either the Park or Neutral position. A rocker-type switch (extended idle switch) is mounted to the instrument panel. This switch will supply a ground circuit to the powertrain control module (PCM). **The switch is available only with 4.0L engine when supplied with the optional police package.**

For testing and diagnosis of this switch and its circuit, refer to the Diagnosis and Testing section of this group.

GENERATOR OUTPUT—PCM INPUT

OPERATION

Provides a charging system voltage input to the Powertrain Control Module (PCM). It is sensed at the battery input to the PCM.

OXYGEN SENSOR (HO2S)—PCM INPUT

Two heated O2S sensors are used. The sensors produce voltages from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air/fuel mixture), the sensors produces a low voltage. When there is a lesser amount present (rich air/fuel mixture) it produces a higher voltage. By monitoring the oxygen content and converting it to electrical voltage, the sensors act as a rich-lean switch.

The oxygen sensors are equipped with a heating element that keeps the sensors at proper operating temperature during all operating modes. Maintaining correct sensor temperature at all times allows the system to enter into closed loop operation sooner. Also, it allows the system to remain in closed loop operation during periods of extended idle.

In Closed Loop operation, the PCM monitors the O2S sensor input (along with other inputs) and adjusts the injector pulse width accordingly. During Open Loop operation, the PCM ignores the O2S sensor input. The PCM adjusts injector pulse width based on preprogrammed (fixed) values and inputs from other sensors.

The Automatic Shutdown (ASD) relay supplies battery voltage to both the upstream and downstream heated oxygen sensors. The oxygen sensors are equipped with a heating element. The heating elements reduce the time required for the sensors to reach operating temperature.

UPSTREAM HEATED OXYGEN SENSOR

The upstream O2S sensor is located in the exhaust downpipe (Fig. 6). 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.

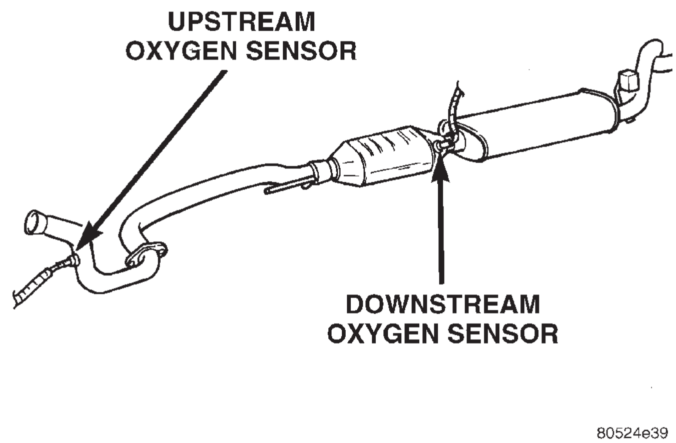


Fig. 6 Heated Oxygen Sensors

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. 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 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 Lamp (MIL). For more information, refer to Group 25, Emission Control Systems.

IGNITION CIRCUIT SENSE—PCM INPUT

OPERATION

The ignition circuit sense input tells the Powertrain Control Module (PCM) the ignition switch has energized the ignition circuit.

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) or (Fig. 8). The sensor provides an input voltage to the Powertrain Control Module (PCM) indicating intake man-

DESCRIPTION AND OPERATION (Continued)

ifold 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.

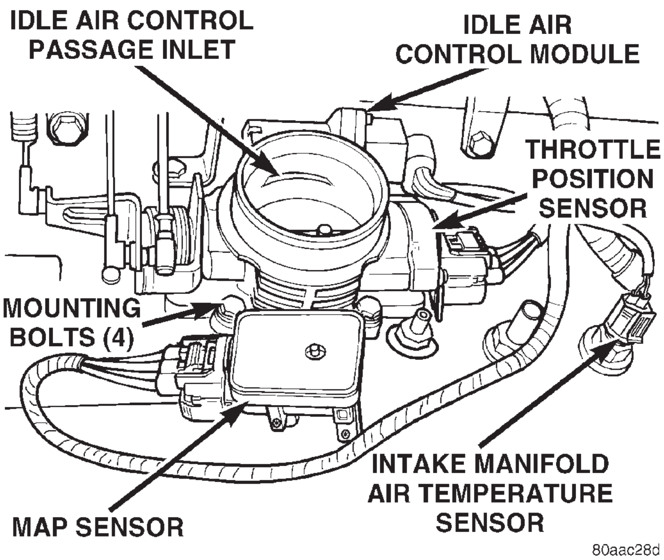


Fig. 7 Intake Man. Air Temp. Sensor Location—4.0L Engine

LEAK DETECTION PUMP (SWITCH) SENSE—

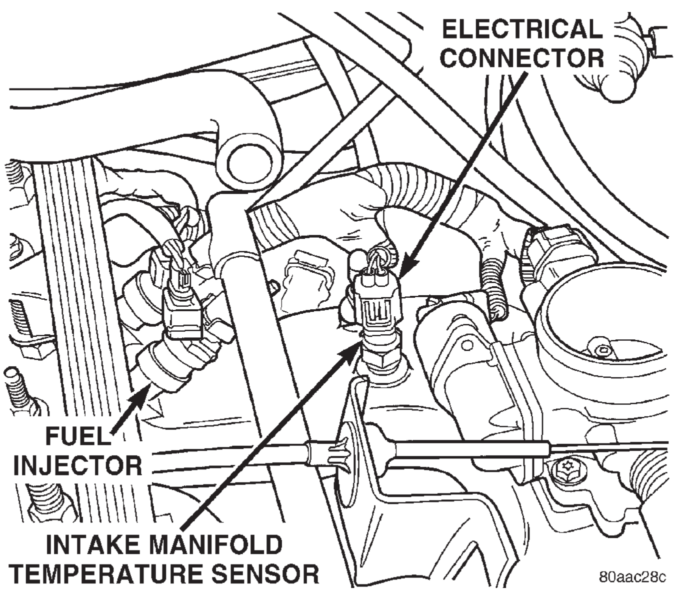


Fig. 8 Intake Man. Air Temp. Sensor Location—2.5L Engine

PCM INPUT

Provides an input to the PCM that the leak detection pump (LDP) has been activated. Refer to Group 25, Emission Control System for LDP information.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—PCM INPUT

The MAP sensor reacts to absolute pressure in the intake manifold. It provides an input voltage to the Powertrain Control Module (PCM). As engine load changes, manifold pressure varies. The change in manifold pressure causes MAP sensor voltage to change. The change in MAP sensor voltage results in a different input voltage to the PCM. The input voltage level supplies the PCM with information about ambient barometric pressure during engine 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.

OIL PRESSURE SENSOR—PCM INPUT

DESCRIPTION

The engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

OPERATION

A signal is sent from the oil pressure sensor to the Powertrain Control Module (PCM) relating to engine oil pressure.

POWER GROUND

OPERATION

The power ground is used to control ground circuits for the following Powertrain Control Module (PCM) loads:

- Generator field winding
- Fuel injectors
- Ignition coil(s)
- Certain relays/solenoids

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 used only 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 3275 kPa ± 690 kPa (475 psi ± 100 psi), the normally closed

DESCRIPTION AND OPERATION (Continued)

switch will open and the PCM will increase the engine idle speed. This will prevent the engine from stalling.

When pump pressure drops to approximately 1379 kPa (200 psi), the switch circuit will re-close and engine idle speed will return to its previous setting.

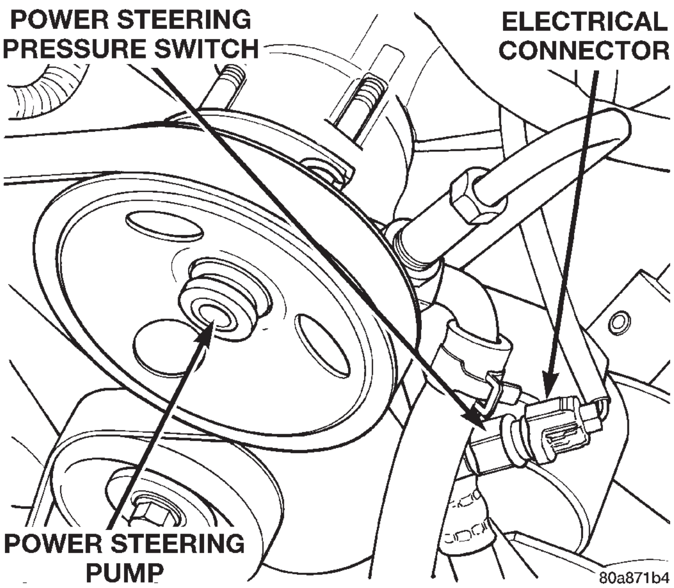


Fig. 9 Power Steering Pump Pressure Switch—2.5L Engine

SENSOR RETURN—PCM INPUT

OPERATION

Sensor Return provides a low noise ground reference for all engine control system sensors.

SPEED CONTROL SWITCHES—PCM INPUT

Two separate speed control switch modules are mounted on the steering wheel to the left and right side of the driver's airbag module. Within the two switch modules, five **momentary** contact switches, supporting seven different speed control functions are used. The outputs from these switches are filtered into one input. The Powertrain Control Module (PCM) determines which output has been applied through **resistive multiplexing.** The input circuit voltage is measured by the PCM to determine which switch function has been selected.

A speed control indicator lamp, located on the instrument panel cluster is energized by the PCM via the CCD Bus. This occurs when speed control system power has been turned ON, and the engine is running.

The two switch modules are labeled: ON/OFF, SET, RESUME/ACCEL, CANCEL and COAST. Refer to Group 8H, Speed Control System for more information.

TRANSMISSION PARK/NEUTRAL SWITCH—PCM INPUT

The park/neutral switch is located on the transmission housing and provides an input to the Powertrain Control Module (PCM). This will indicate that the automatic transmission is in Park, Neutral or a drive gear selection. This input is used to determine idle speed (varying with gear selection), fuel injector pulse width and ignition timing advance. Refer to Group 21, Transmissions, for testing, replacement and adjustment information. It is also used as a condition for speed control operation.

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 .26 volts at minimum throttle opening (idle), to 4.49 volts at wide open throttle. Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions. In response to engine operating conditions, the PCM will adjust fuel injector pulse width and ignition timing.

VEHICLE SPEED AND DISTANCE SENSOR—PCM INPUT

The vehicle speed sensor is located on the speedometer pinion gear adapter (Fig. 10) or (Fig. 11). The pinion gear adapter is located on the extension housing of the transmission (drivers side—2WD), or on the transfer case (4WD). The sensor input is used by the powertrain control module (PCM) to determine vehicle speed and distance traveled.

The speed sensor generates 8 pulses per sensor revolution. These signals, in conjunction with a closed throttle signal from the throttle position sensor, indicate a closed throttle deceleration to the PCM. When the vehicle is stopped at idle, a closed throttle signal is received by the PCM (but a speed sensor signal is not received).

Under deceleration conditions, the PCM adjusts the idle air control (IAC) motor to maintain a desired MAP value. Under idle conditions, the PCM adjusts the IAC motor to maintain a desired engine speed.

DESCRIPTION AND OPERATION (Continued)

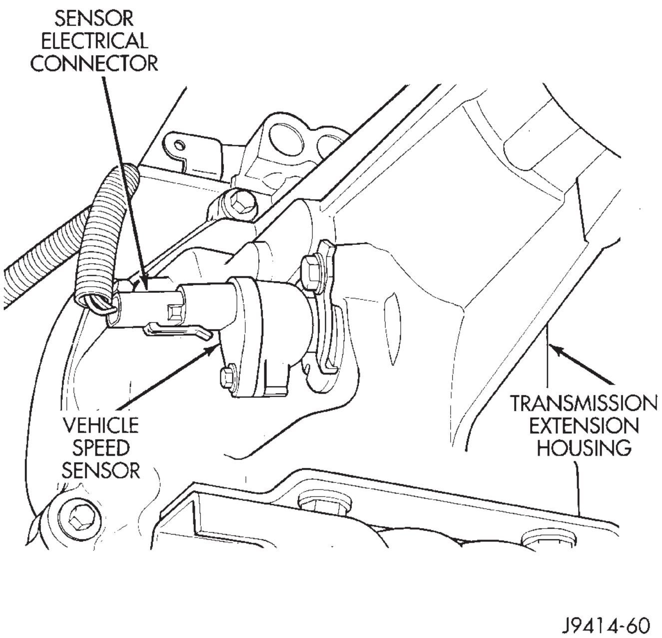


Fig. 10 Vehicle Speed Sensor Location—2WD—Typical

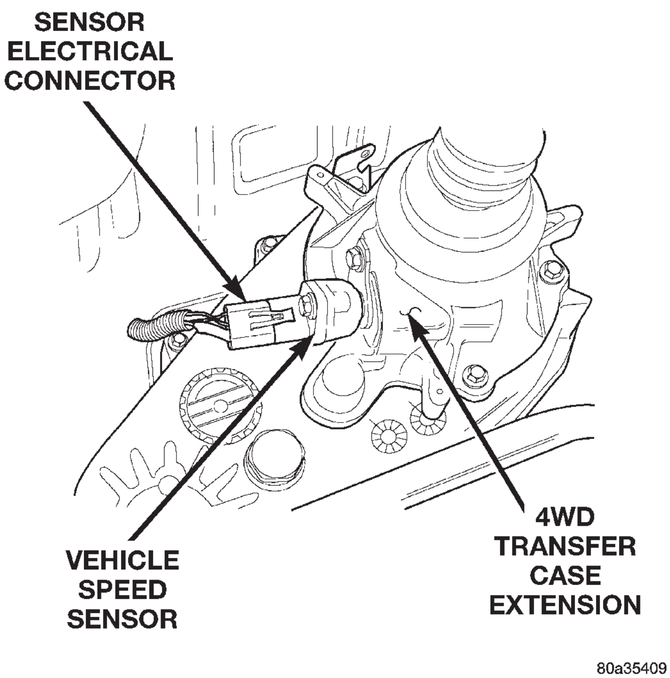


Fig. 11 Vehicle Speed Sensor Location—4WD—Typical

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. 12). Refer to label on PDC cover for relay location.

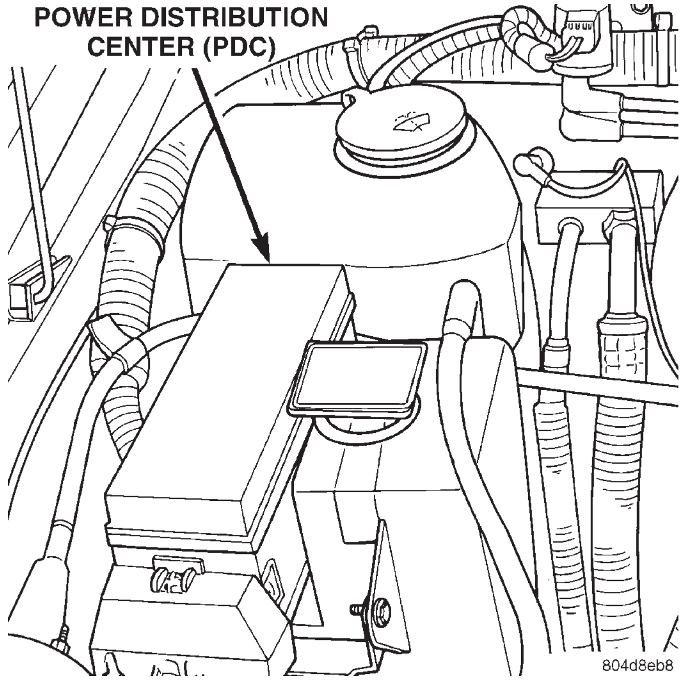


Fig. 12 Power Distribution Center (PDC)

The powertrain control module (PCM) activates the A/C compressor through the A/C clutch relay. The PCM regulates A/C compressor operation by switching the ground circuit for the A/C clutch relay on and off.

When the PCM receives a request for A/C from A/C evaporator switch, it will adjust idle air control (IAC) motor position. This is done to increase idle speed. The PCM will then activate the A/C clutch through the A/C clutch relay. The PCM adjusts idle air control (IAC) stepper motor position to compensate for increased engine load from the A/C compressor.

By switching the ground path for the relay on and off, the PCM is able to cycle the A/C compressor clutch. This is based on changes in engine operating conditions. The PCM will also de-energize the relay if coolant temperature exceeds 125°C (257°F).

AUTO SHUTDOWN (ASD) RELAY—PCM OUTPUT

DESCRIPTION

The ASD relay is located in the Power Distribution Center (PDC).

OPERATION

The ASD supplies battery voltage to the fuel injectors and ignition coil(s). With certain emissions packages it also supplys voltage to the oxygen sensor heating elements. The ground circuit for the coil in the ASD relay is controlled by the Powertrain Control Module (PCM). The PCM operates the relay by switching the ground circuit on and off.

DESCRIPTION AND OPERATION (Continued)

CCD BUS (+/-) CIRCUITS-PCM OUTPUTS

The Powertrain Control Module (PCM) sends certain output signals through the CCD bus circuits. These signals are used to control certain instrument panel located items and to determine certain identification numbers.

Refer to Group 8E, Instrument Panel and Gauges for additional information.

DATA LINK CONNECTOR—PCM INPUT AND OUTPUT

The 16–way data link connector (diagnostic scan tool connector) links the Diagnostic Readout Box (DRB) scan tool or the Mopar Diagnostic System (MDS) with the powertrain control module (PCM). The data link connector is located under the instrument panel to the left of the steering column (Fig. 13). For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

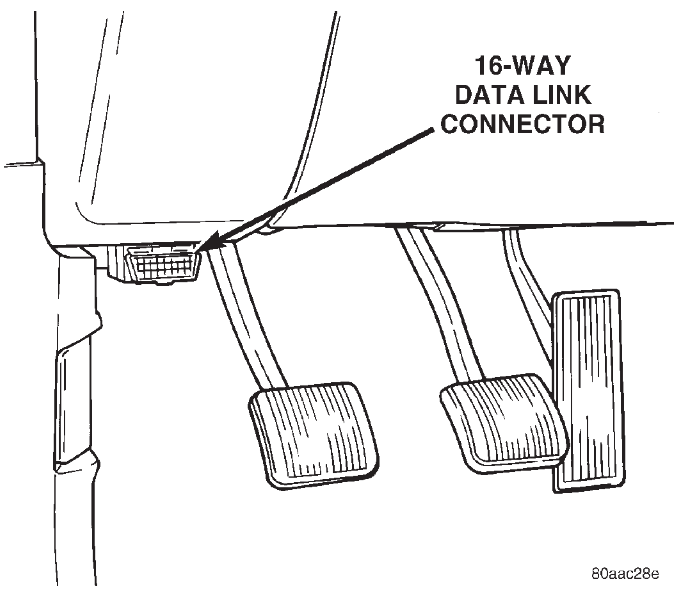


Fig. 13 Data Link Connector Location

DUTY CYCLE EVAP PURGE SOLENOID VALVE-PCM OUTPUT

Refer to Group 25, Emission Control System for information.

FUEL INJECTORS—PCM OUTPUT

Six individual fuel injectors are used with the 4.0L 6-cylinder engine (Fig. 14). Four individual fuel injectors are used with the 2.5L 4-cylinder engine (Fig. 15). The fuel injectors are attached to the fuel rail.

The nozzle ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector.

The injectors are energized individually in a sequential order by the powertrain control module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

During start up, battery voltage is supplied to the injectors through the ASD relay. When the engine is operating, voltage is supplied by the charging system. The PCM determines injector pulse width based on various inputs.

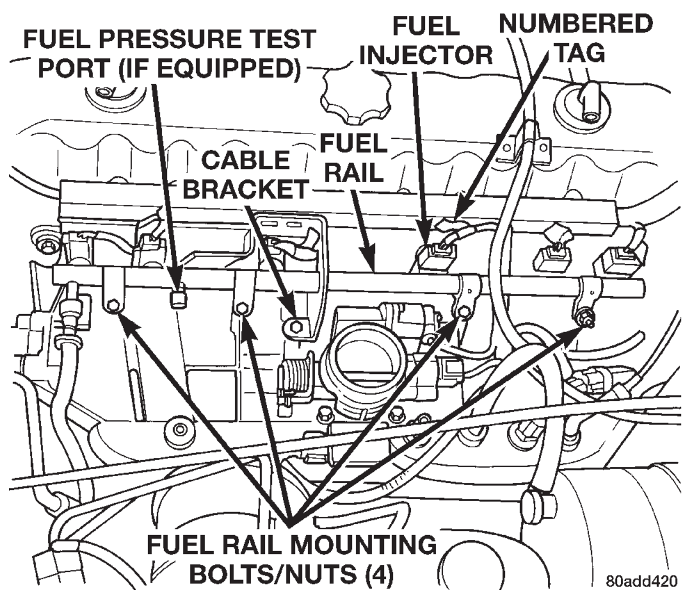


Fig. 14 Fuel Rail and Injectors—4.0L 6–Cyl. Engine

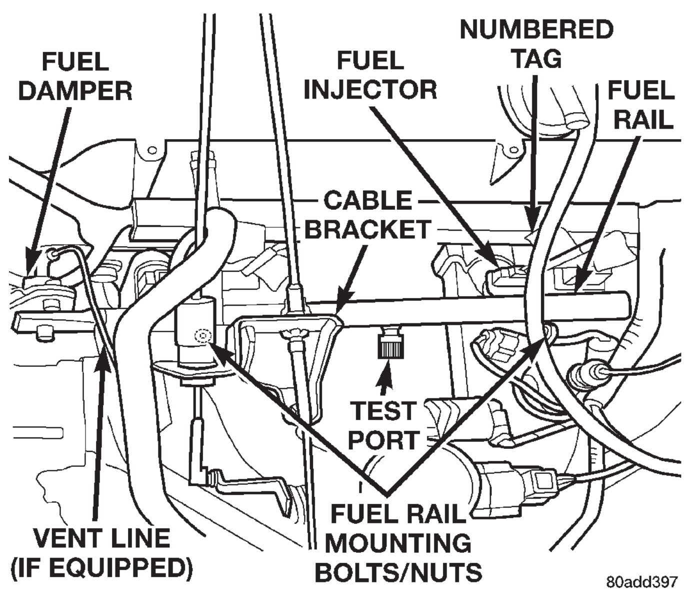


Fig. 15 Fuel Rail and Injectors—2.5L 4–Cyl. Engine

DESCRIPTION AND OPERATION (Continued)

FUEL PUMP RELAY-PCM OUTPUT

DESCRIPTION

The fuel pump relay is located in the Power Distribution Center (PDC).

OPERATION

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 three seconds unless the engine is operating or the starter motor is engaged.

GENERATOR FIELD SOURCE (+)—PCM OUTPUT

OPERATION

This output from the Powertrain Control Module (PCM) regulates charging system voltage to the generator field source (+) circuit. The voltage range is 12.9 to 15.0 volts. Models of previous years had used the ASD relay (directly) to apply the 12 volt + power supply to the generator field source (+) circuit.

GENERATOR FIELD DRIVER (-)—PCM OUTPUT

OPRATION

This output from the Powertrain Control Module (PCM) regulates charging system ground control to the generator field driver (-) circuit.

GENERATOR LAMP—PCM OUTPUT

If the powertrain control module (PCM) senses a low charging condition in the charging system, it will illuminate the generator lamp (if equipped) on the instrument panel. For example, during low idle with all accessories turned on, the lamp may momentarily go on. Refer to Groups 8A and 8C for charging system information.

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.

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.

LEAK DETECTION PUMP—PCM OUTPUT

Certain engines with certain emissions packages are equipped with a leak detection pump (LDP). The LDP is activated through this PCM output. Refer to Group 25, Emission Control System for additional information.

RADIATOR FAN RELAY—PCM OUTPUT

An electric radiator cooling fan is used with certain models/engines. It is controlled by the powertrain control module (PCM) through the radiator fan relay. The relay is energized when coolant temperature is above 103°C (217°F). It will then de-energize when coolant temperature drops to 98°C (208°F). Refer to Group 7, Cooling Systems for more information.

The relay is located in the power distribution center (PDC) (Fig. 12).

MALFUNCTION INDICATOR LAMP—ECM/PCM OUTPUT

Refer to Group 25, Emission Control System for information.

SPEED CONTROL SOLENOIDS—PCM OUTPUT

Speed control operation is regulated by the powertrain control module (PCM). The PCM controls the vacuum to the throttle actuator through the speed control vacuum and vent solenoids. Refer to Group 8H for Speed Control Information.

TACHOMETER—PCM OUTPUT

The powertrain control module (PCM) supplies engine rpm values to the instrument cluster tachometer. Refer to Group 8E for tachometer information.

THROTTLE BODY

Filtered air from the air cleaner enters the intake manifold through the throttle body (Fig. 16). Fuel

DESCRIPTION AND OPERATION (Continued)

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. 16) controlled by an Idle Air Control (IAC) motor. The air control passage is used to supply air for idle conditions. A throttle valve (plate) is used to supply air for above idle conditions.

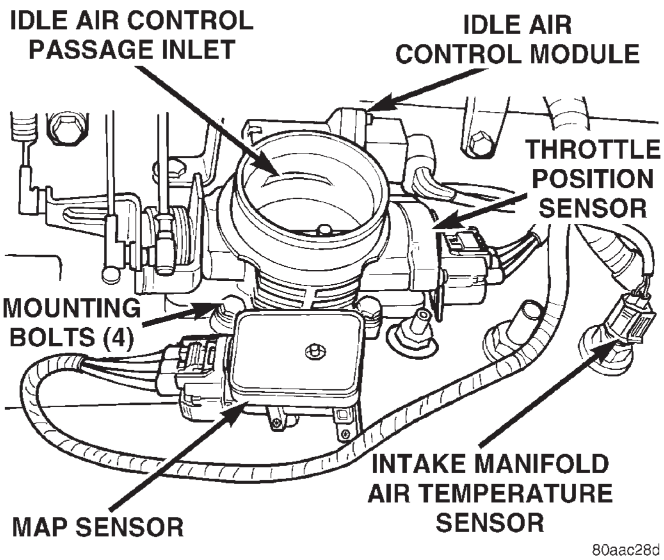


Fig. 16 Throttle Body (4.0L Engine Shown)

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 automatic 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 the three 32–way electrical connectors are fully inserted into the connector of the powertrain control module (PCM) (Fig. 17).

(2) Inspect battery cable connections. Be sure they are clean and tight.

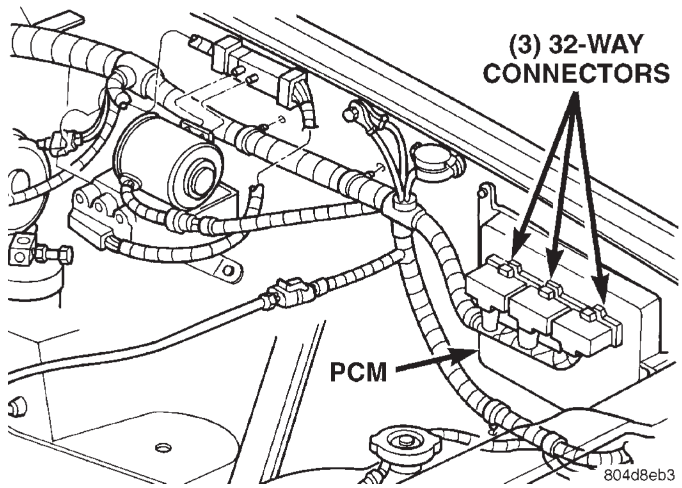


Fig. 17 Powertrain Control Module (PCM)

(3) Inspect fuel pump relay and air conditioning compressor clutch relay (if equipped). Inspect 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. 18). Refer to label on PDC cover for relay location.

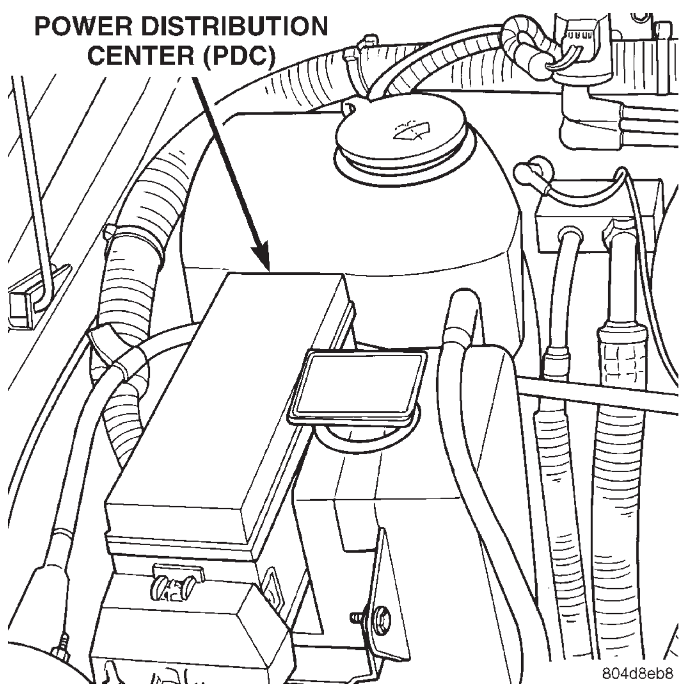


Fig. 18 Power Distribution Center (PDC)

(4) Inspect ignition coil connections. Verify coil secondary cable is firmly connected to coil (Fig. 19) or (Fig. 20).

(5) Verify distributor cap is correctly attached to distributor. Be sure spark plug cables are firmly connected to distributor cap and spark plugs are in their correct firing order. Be sure coil cable is firmly connected to distributor cap and coil. Be sure camshaft

DIAGNOSIS AND TESTING (Continued)

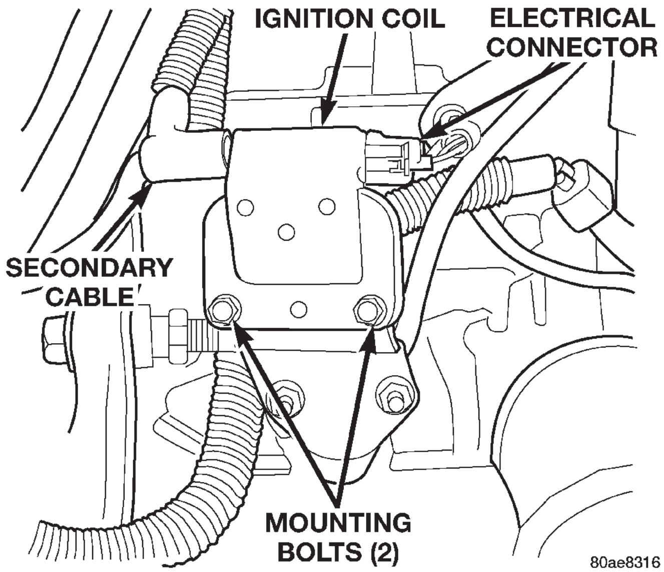


Fig. 19 Ignition Coil—2.5L Engine

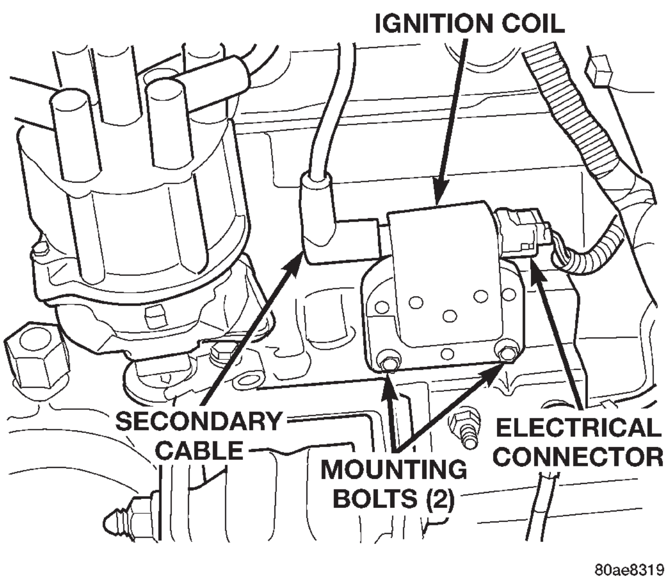


Fig. 20 Ignition Coil—4.0L Engine

position sensor wire connector (at distributor) is firmly connected to harness connector. Inspect spark plug condition. Connect vehicle to an oscilloscope and inspect spark events for fouled or damaged spark plugs or cables. Refer to Group 8D, Ignition System for additional information.

(6) Verify generator output wire, generator connector and ground wire are firmly connected to 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.

(10) Verify hose connections to all ports of vacuum fittings on intake manifold are tight and not leaking.

(11) Inspect accelerator cable, transmission throttle cable (if equipped) and cruise control cable connections (if equipped). Check their connections to throttle arm of throttle body for any binding or restrictions.

(12) If equipped with vacuum brake booster, verify 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 intake manifold air temperature sensor wire connector is firmly connected to harness connector (Fig. 21) or (Fig. 22).

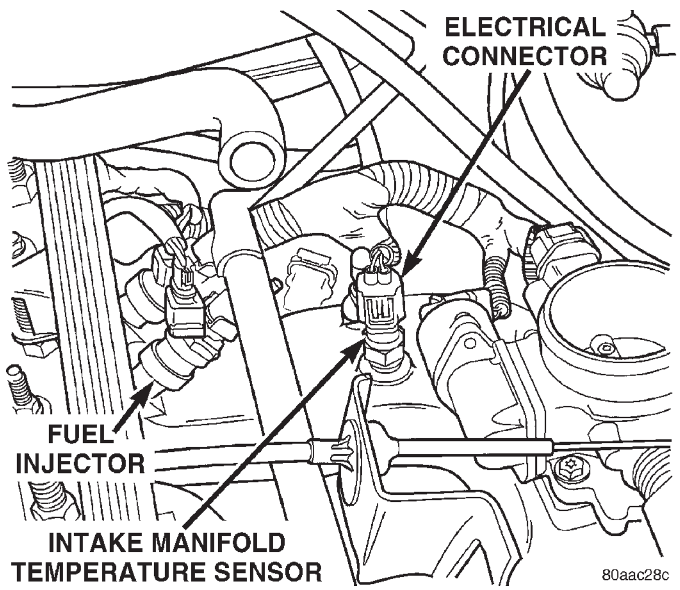


Fig. 21 Intake Manifold Air Temp. Sensor Location—2.5L Engine

(16) Verify MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 22). Also verify rubber L-shaped fitting from MAP sensor to throttle body is firmly connected (Fig. 23).

(17) Verify fuel injector wire harness connectors are firmly connected to injectors in 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. 22).

(19) Verify wire harness connector is firmly connected to engine coolant temperature sensor (Fig. 24).

DIAGNOSIS AND TESTING (Continued)

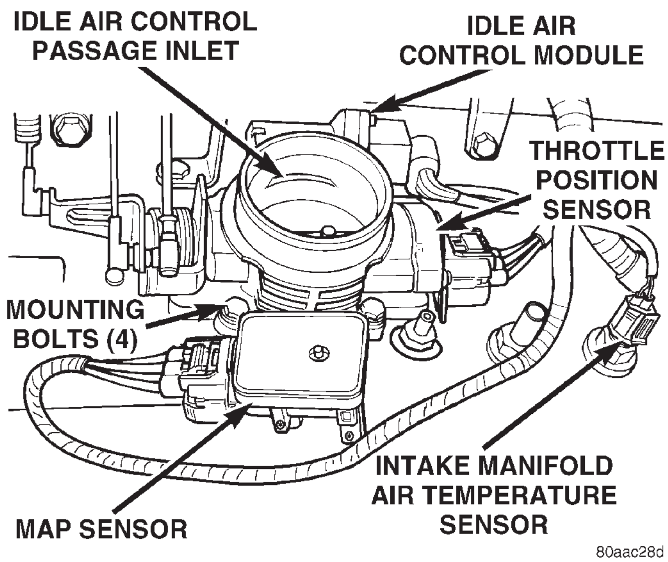


Fig. 22 Sensor Locations—4.0L Engine

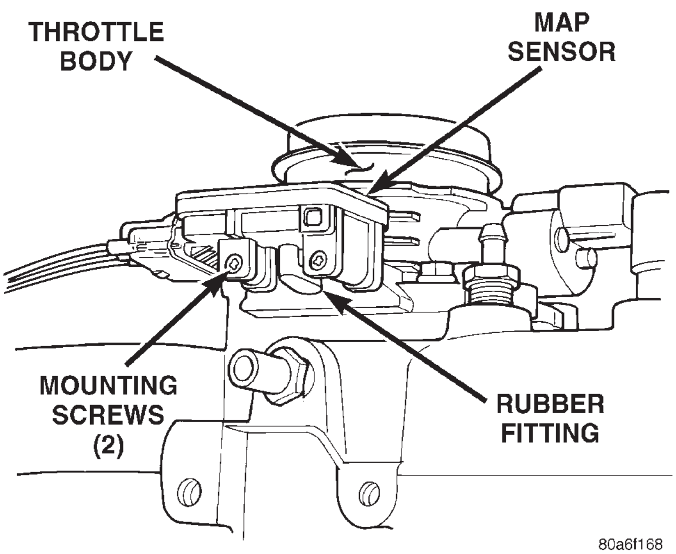


Fig. 23 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

(20) Raise and support vehicle.

(21) Verify both oxygen sensor wire connectors are firmly connected to sensors. Inspect sensors and connectors for damage (Fig. 25).

(22) Inspect for pinched or leaking fuel tubes. Inspect for pinched, cracked or leaking fuel hoses.

(23) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(24) If equipped with automatic transmission, verify electrical harness is firmly connected to park/neutral switch. Refer to Automatic Transmission section of Group 21.

(25) Verify electrical harness connector is firmly connected to vehicle speed sensor (Fig. 26) or (Fig. 27).

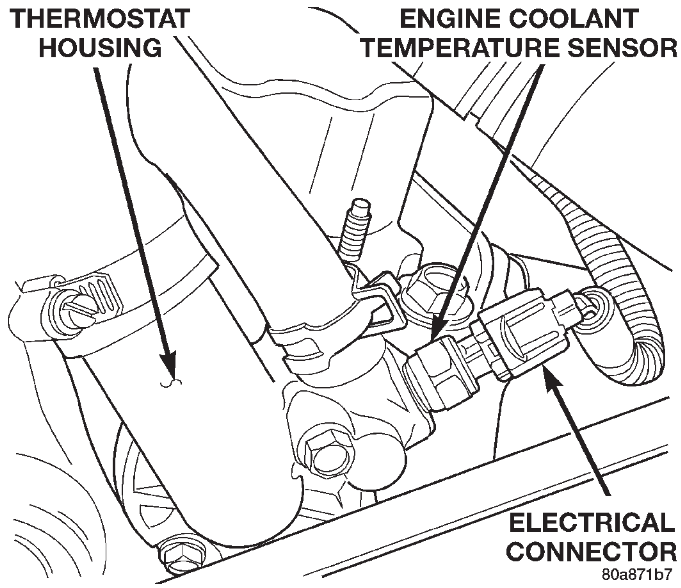


Fig. 24 Engine Coolant Temperature Sensor—Typical

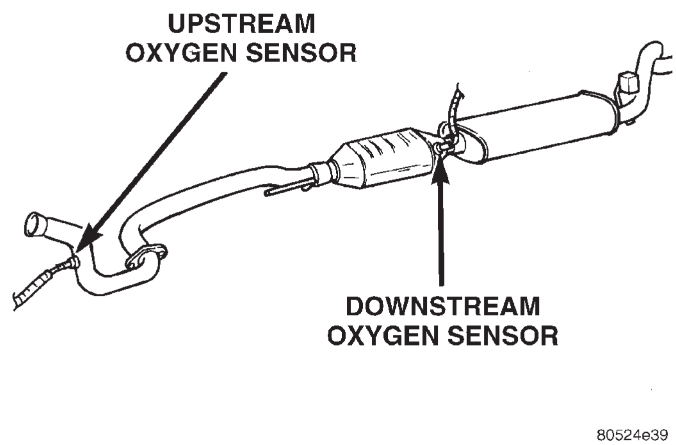


Fig. 25 Location of Oxygen Sensors

(26) 2.5L 4–Cylinder Engine Only: Verify good electrical connection at power steering pressure switch (Fig. 28). This switch is not used with 4.0L engines.

(27) Verify good electrical connections at fuel pump module connector at front of fuel tank (Fig. 29).

(28) Verify good EVAP canister vent line connection at front of fuel tank (Fig. 29).

(29) Verify good fuel supply line connection at front of fuel tank (Fig. 29).

(30) Inspect all fuel lines/hoses for cracks or leaks.

(31) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

(32) Verify battery cable and solenoid feed wire connections to starter solenoid are tight and clean. Inspect for chaffed wires or wires rubbing up against other components.

DIAGNOSIS AND TESTING (Continued)

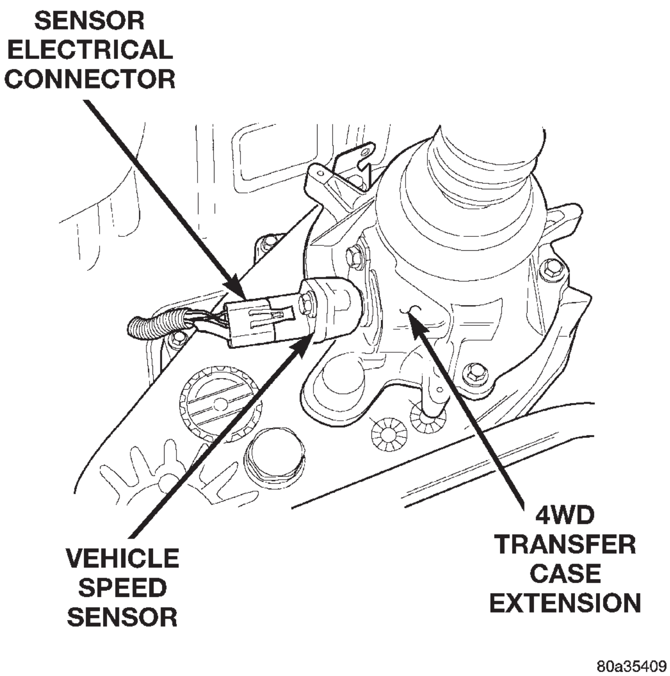


Fig. 26 Vehicle Speed Sensor—2WD

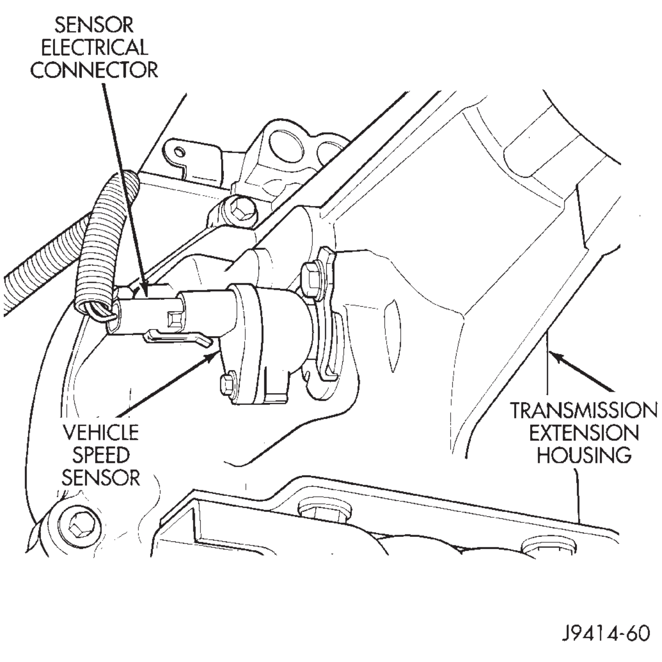


Fig. 27 Vehicle Speed Sensor—4WD

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. 30) or (Fig. 31).

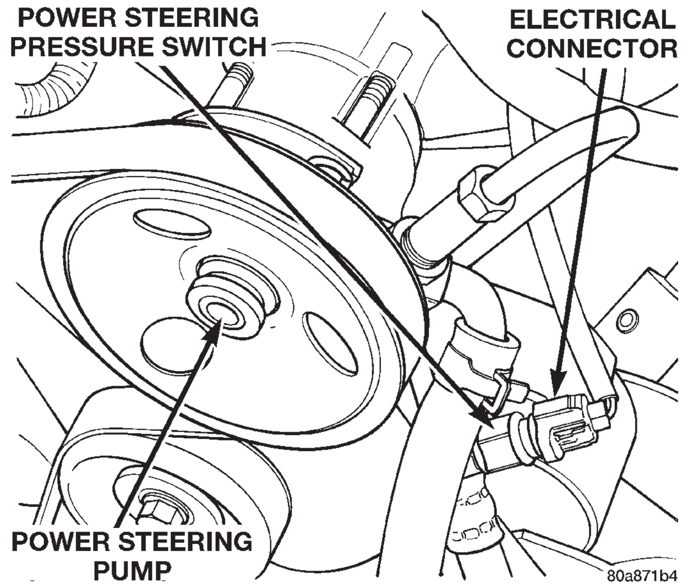


Fig. 28 Power Steering Pressure Switch—2.5L Engine

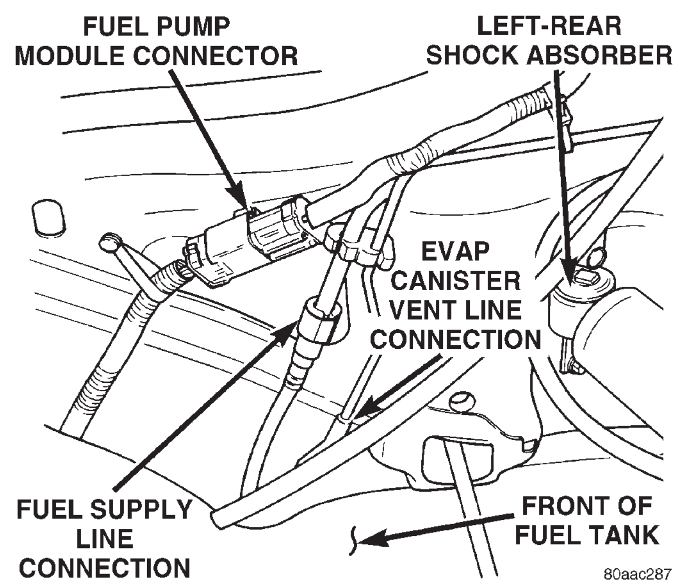


Fig. 29 Fuel Tank Connections at Front of Fuel Tank

OPERATION

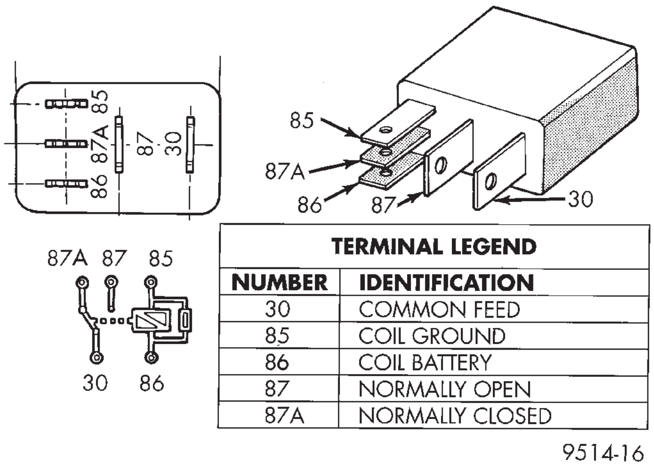
• Terminal number 30 is connected to battery voltage. For both the ASD and fuel pump relays, terminal 30 is connected to battery voltage at all times.

• The PCM grounds the coil side of the relay through terminal number 85.

• Terminal number 86 supplies voltage to the coil side of the relay.

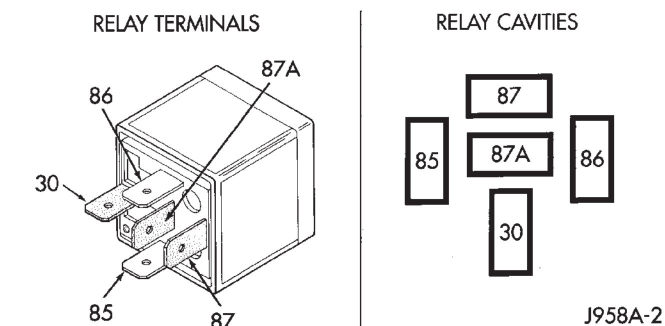
• When the PCM de-energizes the ASD and fuel pump relays, terminal number 87A connects to terminal 30. This is the Off position. In the off position, voltage is not supplied to the rest of the circuit. Terminal 87A is the center terminal on the relay.

DIAGNOSIS AND TESTING (Continued)



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 30 ASD and Fuel Pump Relay Terminals



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 31 ASD and Fuel Pump Relay Terminals

• 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 the Wiring Diagrams.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST

To perform a complete test of MAP sensor (Fig. 32) 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. 33). Repair as necessary.

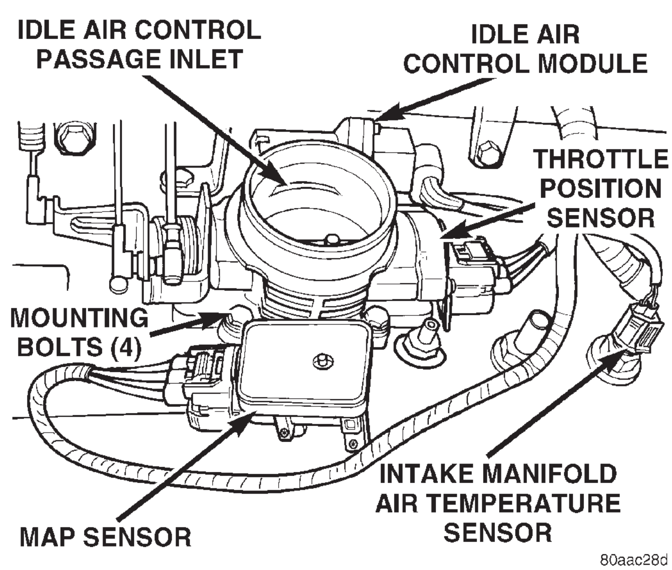


Fig. 32 Sensor Location (4.0L Engine Shown)

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. 34). With

DIAGNOSIS AND TESTING (Continued)

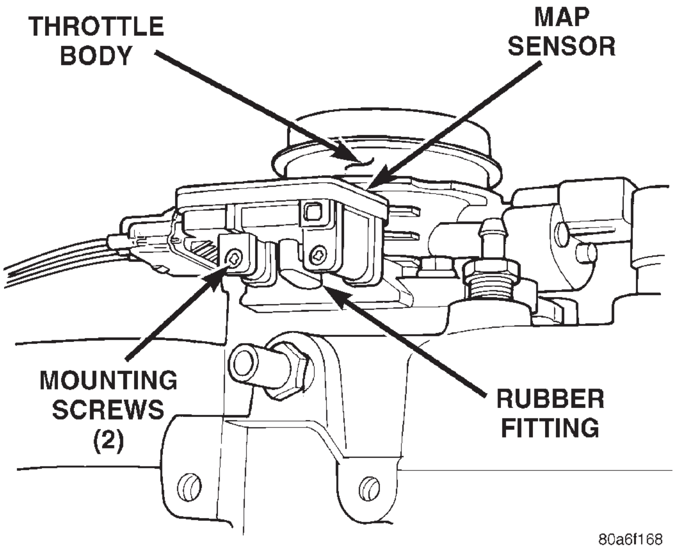


Fig. 33 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

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.

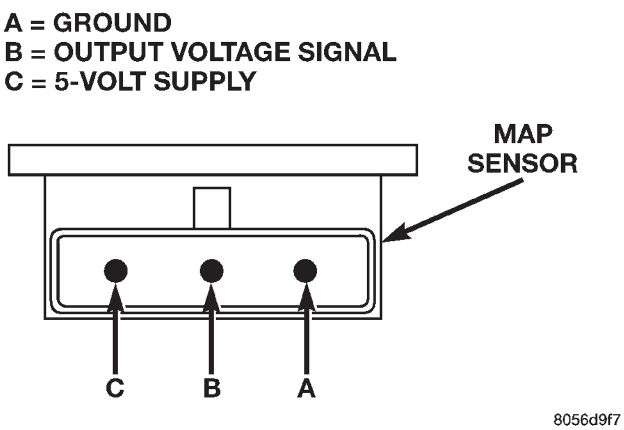


Fig. 34 MAP Sensor Connector Terminals—Typical

(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. 34) 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. 34) 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. 35).

The downstream O2S sensor is located near the outlet end of the catalytic converter (Fig. 35).

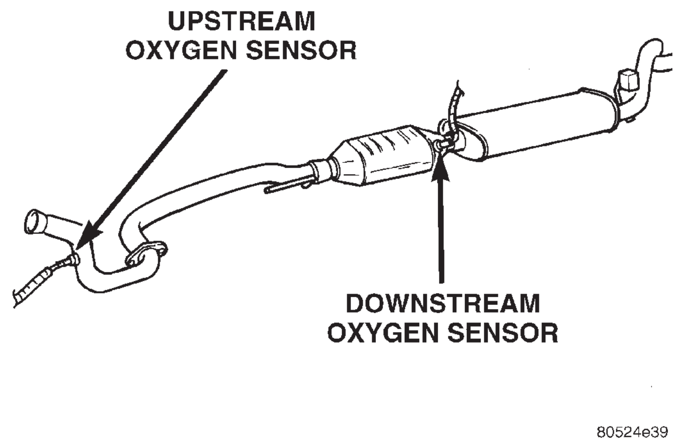


Fig. 35 Oxygen Sensor Location

Each O2S heating element can be tested with an ohmmeter as follows:

Disconnect the O2S sensor connector. Connect the ohmmeter test leads across the white wire terminals of the sensor connector. Resistance should be between 4.5 ±.5 ohms and 7 ohms. Replace the sensor if the ohmmeter displays an infinity (open) reading.

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:

(1) Disconnect wire harness connector from coolant temperature sensor (Fig. 36).

(2) Test the resistance of sensor with a high input impedance (digital) volt-ohmmeter. Refer to SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR chart. The resistance (as measured across sensor terminals) should be within range shown in chart. If not, replace 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.

DIAGNOSIS AND TESTING (Continued)

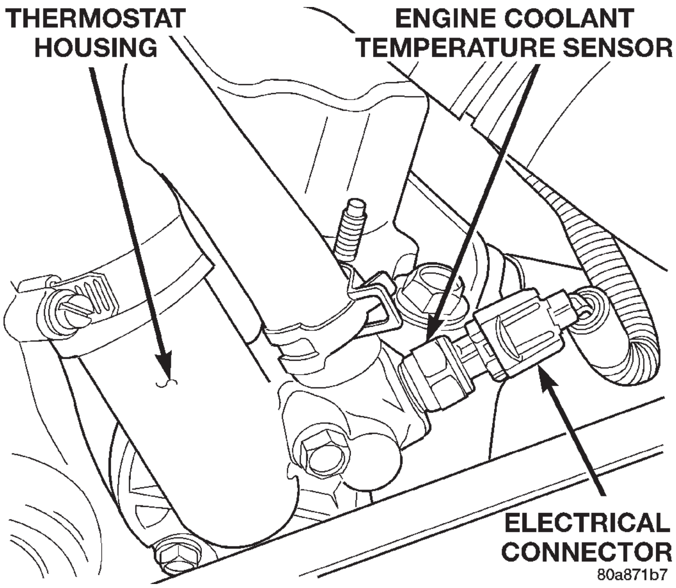


Fig. 36 Engine Coolant Temperature Sensor—Typical

SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR

TEMPERATURE		RESISTANCE (OHMS)	
°CEL.	°FAHR.	MIN.	MAX.
-40	-40	291,490	381,710
-20	-4	85,850	108,390
-10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

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. 37) or (Fig. 38).

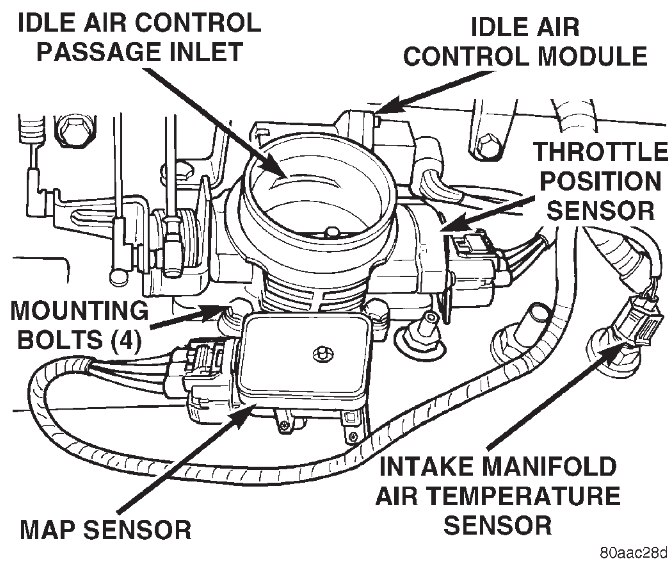


Fig. 37 Intake Manifold Air Temperature Sensor—4.0L Engine

(2) Test the resistance of sensor with a high input impedance (digital) volt-ohmmeter. Refer to SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR chart. The resistance (as measured across sensor terminals) should be within range shown in chart. If not, replace sensor.

(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. 39) provides an input to the Powertrain Control Module (PCM). The input is provided

DIAGNOSIS AND TESTING (Continued)

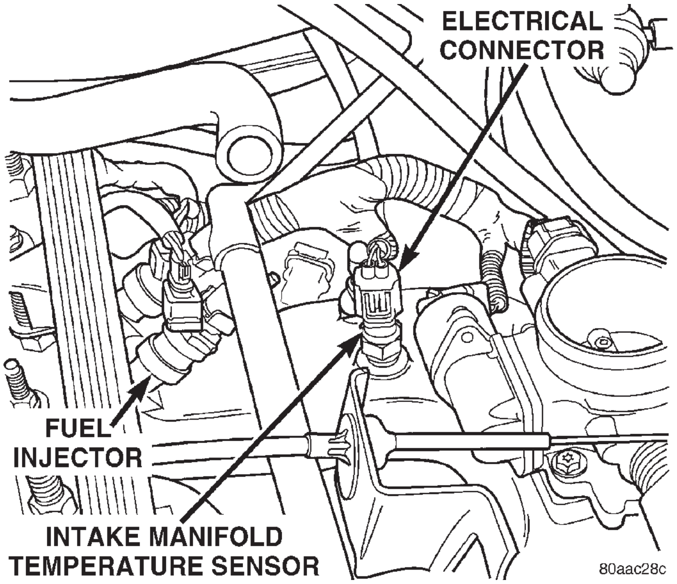


Fig. 38 Intake Manifold Air Temperature Sensor—2.5L Engine

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 Control (IAC) motor. This is done to prevent the engine from stalling under the increased load.

When steering pump pressure exceeds 3275 kPa ± 690 kPa (475 psi ± 100 psi), the normally closed switch circuit will open and the PCM will increase the engine idle speed.

When power steering pump pressure drops to approximately 1379 kPa (200 psi), the switch circuit will re-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.

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.

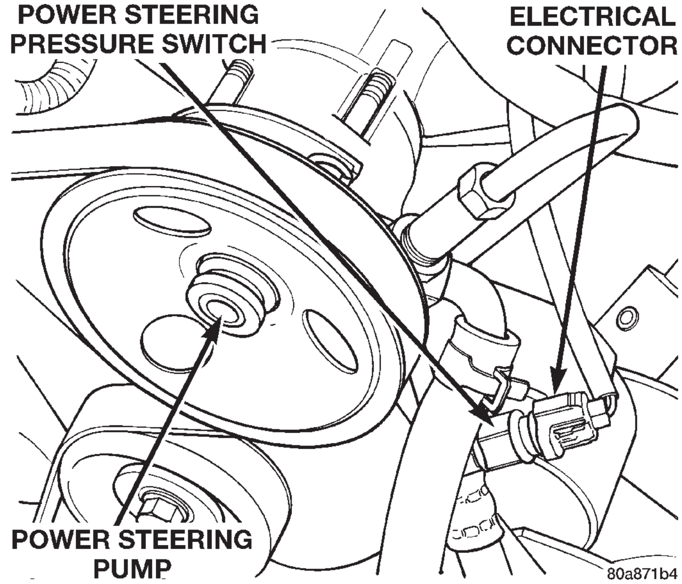


Fig. 39 Power Steering Pump Pressure Switch—2.5L Engine

EXTENDED IDLE SWITCH TEST

OPTIONAL POLICE PACKAGE ONLY

The extended idle switch is used to raise engine idle speed to approximately 1000 rpm when the shifter is in either Park or Neutral position. A rocker-type switch (extended idle switch) is mounted to instrument panel. **This switch is available only with 4.0L engine when supplied with optional police package.**

The extended idle switch will control a ground circuit going to the powertrain control module (PCM). When a ground signal (through the switch) has been received at pin/cavity A-12 (circuit K78) of the PCM, engine idle speed will increase.

(1) Bring engine to normal operating temperature and turn extended idle switch to ON position. Engine idle speed should now increase to approximately 1000 rpm when shifter is in either Park or Neutral position.

(2) If idle speed does not increase, unplug 4–way electrical connector from switch.

(3) Check circuit Z1L for ground. Ground should be present at all times. If not, repair open circuit to ground. Refer to Group 8W, Wiring Diagrams for circuit and wiring information.

(4) If ground is present at Z1L, check continuity of switch between circuits Z1L and K78. If continuity is not present, replace switch. If switch is OK proceed to next step.

(5) With 4–way electrical connector still unplugged from switch, apply a good ground to circuit K78. Engine idle speed should increase. If not, proceed to next step.

DIAGNOSIS AND TESTING (Continued)

(6) Ground pin/cavity A-12 directly at PCM using a small paper clip. Be careful not to damage wiring with paper clip. If engine idle speed increases, it can be assumed that PCM is functioning correctly. Repair open circuit in circuit K78. If engine idle speed will not increase after applying a ground to pin/cavity A-12 (circuit K78) directly at PCM, replace PCM.

THROTTLE POSITION SENSOR (TPS)

To perform a complete test of the TPS (Fig. 37) 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 be greater than .26 volts but less than .95 volts. At wide open throttle, TPS output voltage must be less than 4.49 volts. The output voltage should increase gradually as the throttle plate is slowly opened from idle to WOT.

THROTTLE BODY MINIMUM AIR FLOW CHECK PROCEDURE

The following test procedure has been developed to check throttle body calibrations for correct idle conditions. The procedure should be used to diagnose the throttle body for conditions that may cause idle problems. **This procedure should be used only after normal diagnostic procedures have failed to produce results that indicate a throttle body related problem. Be sure to check for proper operation of the idle air control motor before performing this test.**

A special fixed orifice tool (number 6714) (Fig. 40) must be used for the following test. This tool has a fixed internal diameter of 0.185".

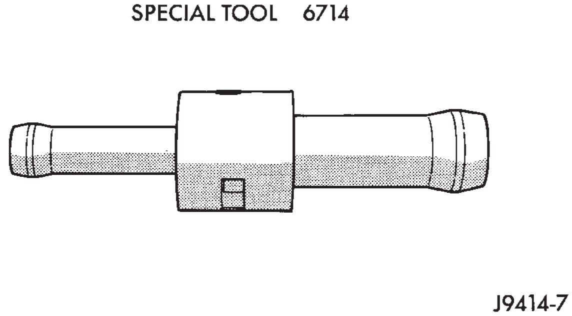


Fig. 40 6714 Fixed Orifice Tool

(1) Start the engine and bring to operating temperature. Be sure all accessories are off before performing this test.

(2) Shut off engine and remove air duct at throttle body.

(3) **2.5L 4–Cylinder Engine:** Near front/top of valve cover, disconnect CCV tube at fixed orifice fitting (Fig. 41). Insert Special Tool 6714 into end of disconnected CCV tube (insert either end of tool into tube). Let tool and tube hang disconnected at side of engine.

(4) **4.0L 6–Cylinder Engine:** Disconnect CCV tube (Fig. 42) at intake manifold fitting. Attach a short piece of rubber hose to special tool 6714 (insert rubber hose to either end of tool). Install rubber hose/tool to intake manifold fitting. Let CCV tube hang disconnected at side of engine.

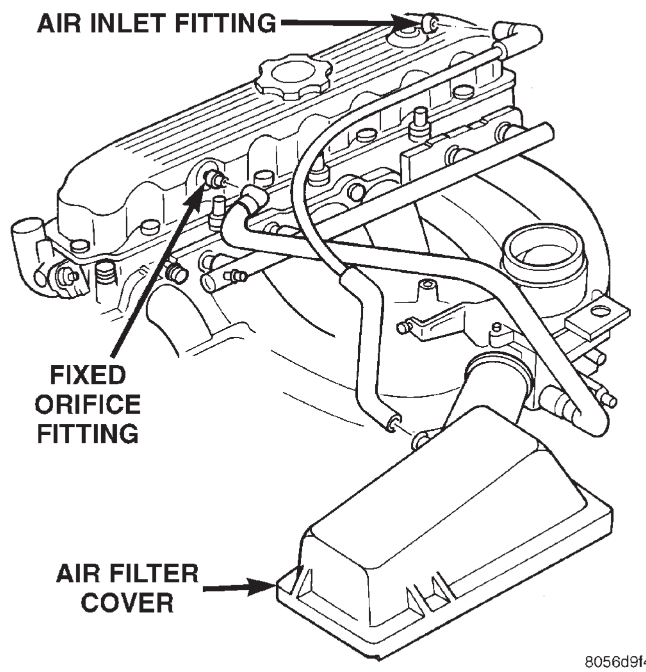


Fig. 41 Install Orifice Tool 2.5L 4–Cylinder Engine

(5) Connect DRB scan tool to 16–way data link connector. This connector is located at lower edge of instrument panel near steering column. Refer to appropriate Powertrain Diagnostic Procedures service manual for DRB operation.

(6) Start engine and allow to warm up.

(7) Using the DRB scan tool, scroll through menus as follows: select—Stand Alone DRB III, select 1999 Diagnostics, select—Engine, select—System Test, select—Minimum Air Flow.

(8) The DRB scan tool will count down to stabilize idle rpm and display minimum air flow idle rpm. The idle rpm should be between **500 and 900 rpm.** If idle speed is outside these specifications, replace throttle body. Refer to Throttle Body Removal/Installation.

(9) Disconnect DRB scan tool from vehicle.

DIAGNOSIS AND TESTING (Continued)

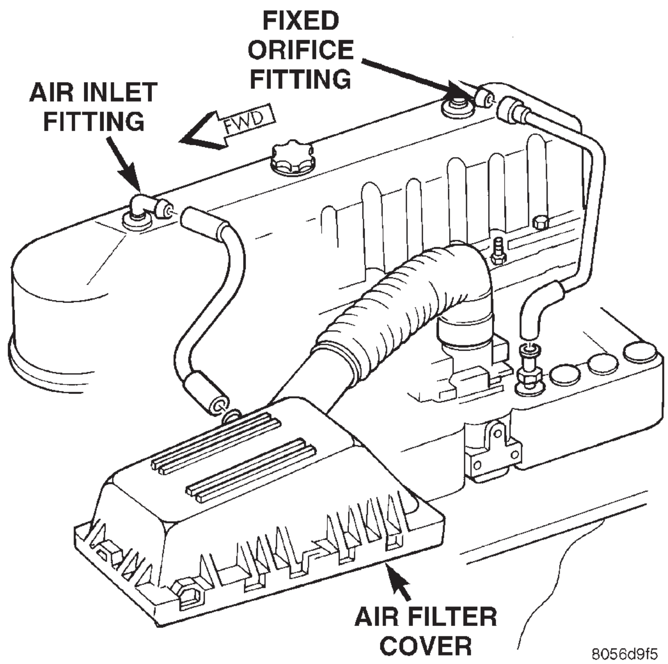


Fig. 42 Install Orifice Tool 4.0L 6–Cylinder Engine

(10) Remove orifice tool and connect CCV tube to engine.

(11) Install air duct to throttle body.

REMOVAL AND INSTALLATION

AUTOMATIC SHUTDOWN (ASD) RELAY

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 43). Refer to label on PDC cover for relay location.

REMOVAL

(1) Remove PDC cover.

(2) Remove relay from PDC.

(3) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

INSTALLATION

(1) Install relay to PDC.

(2) Install cover to PDC.

FUEL PUMP RELAY

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 43). Refer to label on PDC cover for relay location.

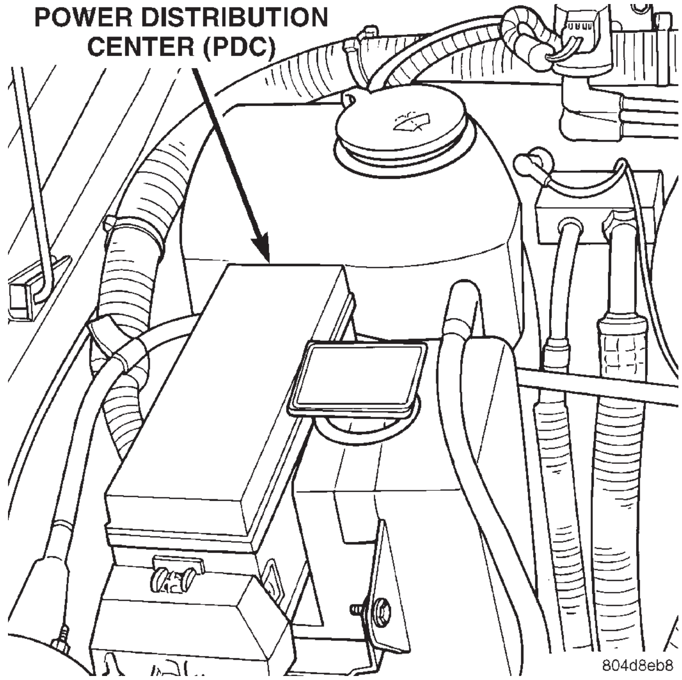


Fig. 43 Power Distribution Center (PDC)

REMOVAL

(1) Remove PDC cover.

(2) Remove relay from PDC.

(3) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

INSTALLATION

(1) Install relay to PDC.

(2) Install cover to PDC.

THROTTLE BODY

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the Powertrain Control Module (PCM).

REMOVAL

(1) Remove air cleaner tube at throttle body.

(2) Disconnect throttle body electrical connectors at MAP sensor, IAC motor and TPS (Fig. 44) or (Fig. 45).

(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.

REMOVAL AND INSTALLATION (Continued)

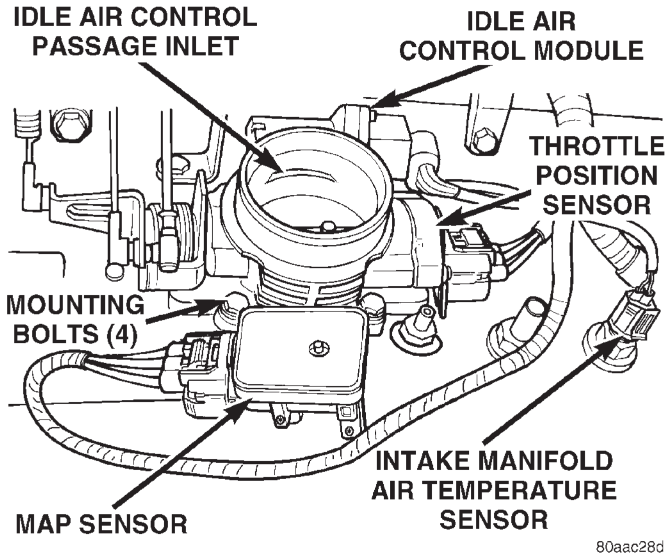


Fig. 44 Throttle Body and Sensor Locations—4.0L Engine

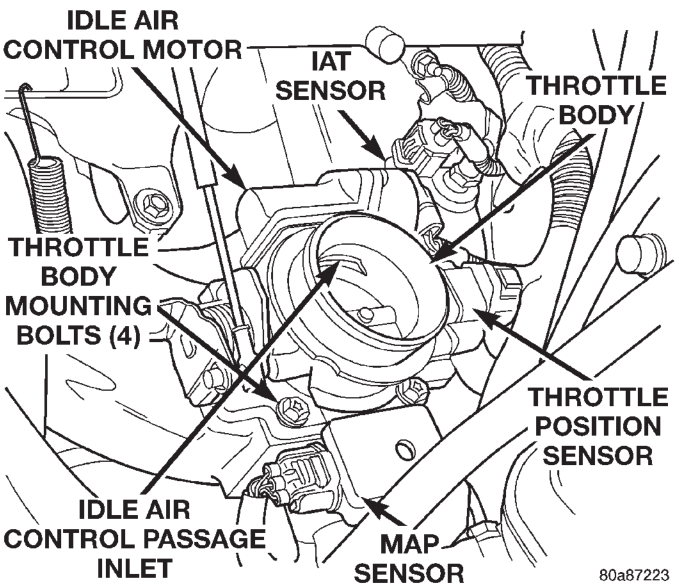


Fig. 45 Throttle Body and Sensor Locations—2.5L Engine

(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 11 N·m (100 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. 44) or (Fig. 45).

REMOVAL

(1) Disconnect TPS electrical connector.

(2) Remove TPS mounting screws (Fig. 46).

(3) Remove TPS.

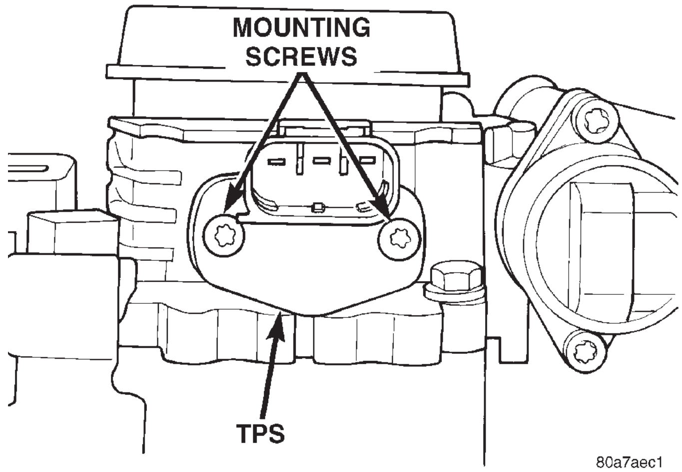


Fig. 46 TPS Mounting Screws

INSTALLATION

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 47). 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.

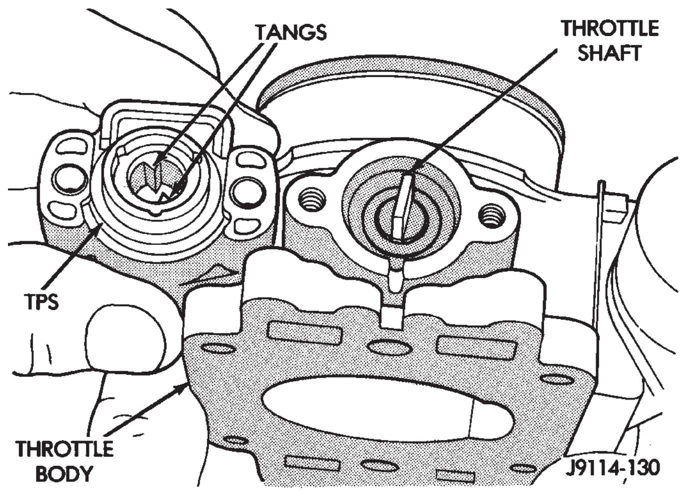


Fig. 47 Throttle Position Sensor—Installation

(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.

REMOVAL AND INSTALLATION (Continued)

IDLE AIR CONTROL (IAC) MOTOR

The IAC motor is located on the side of the throttle body (Fig. 44) or (Fig. 45).

REMOVAL

(1) Remove air cleaner tube at throttle body.
(2) Disconnect electrical connector from IAC motor.
(3) Remove two mounting bolts (screws) (Fig. 48).
(4) Remove IAC motor from throttle body.

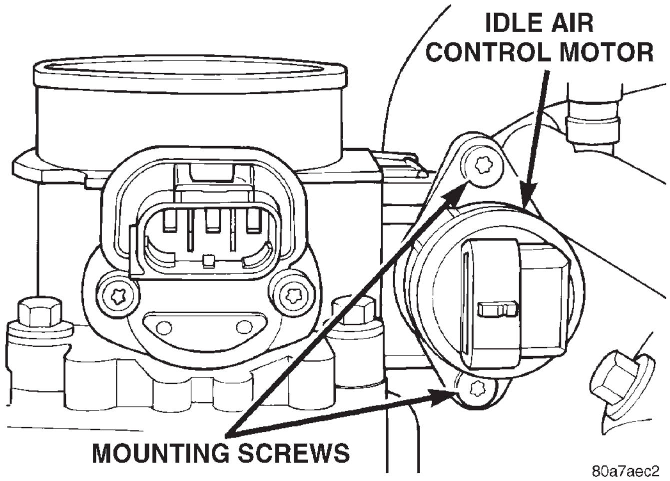


Fig. 48 Mounting Bolts (Screws)—IAC Motor

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. 44) or (Fig. 45). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 49).

REMOVAL

(1) Remove air cleaner intake tube at throttle body.
(2) Remove two MAP sensor mounting bolts (screws) (Fig. 49).
(3) While removing MAP sensor, slide the rubber L-shaped fitting (Fig. 49) 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.

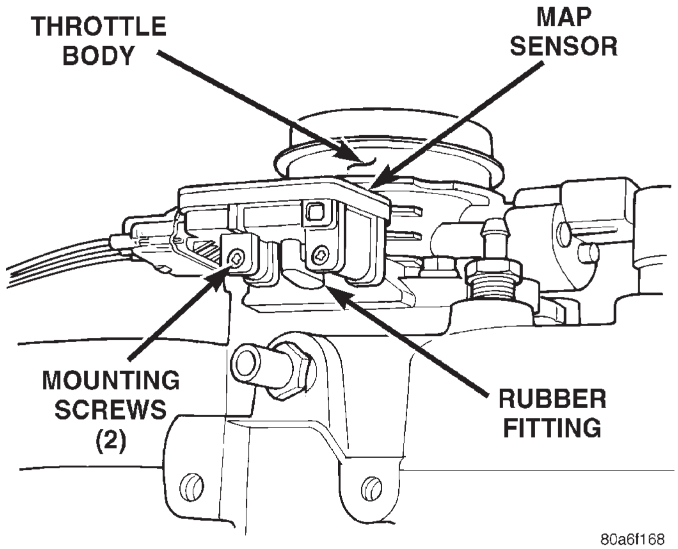


Fig. 49 MAP Sensor Mounting

(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 next to the air cleaner assembly (Fig. 50).

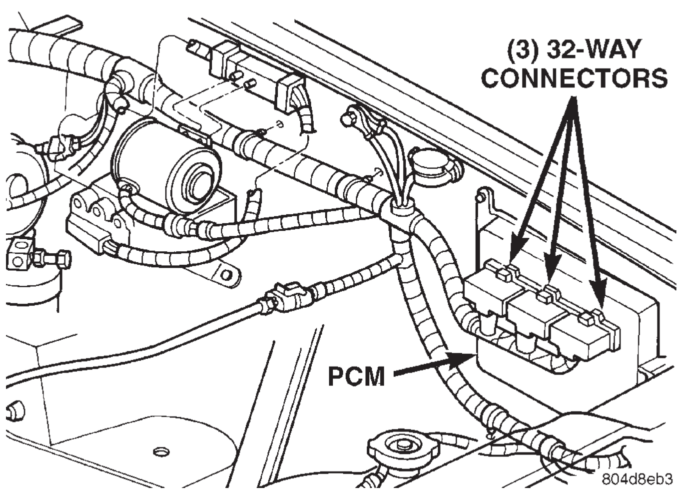


Fig. 50 PCM Location

REMOVAL

To avoid possible voltage spike damage to the PCM, ignition key must be off, and negative battery cable must be disconnected before unplugging PCM connectors.
(1) Disconnect negative battery cable at battery.

REMOVAL AND INSTALLATION (Continued)

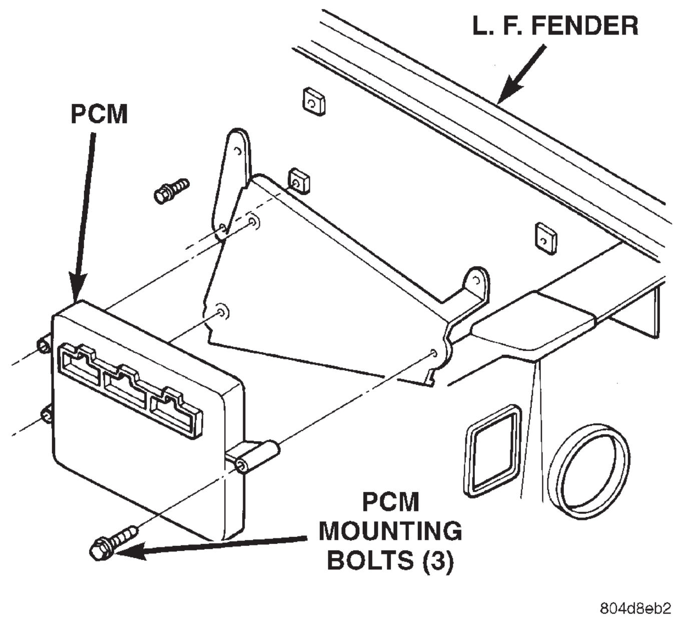


Fig. 51 PCM Mounting

(2) Remove cover over electrical connectors. Cover snaps onto PCM.

(3) Carefully unplug the three 32–way connectors (Fig. 51) from PCM.

(4) Remove three PCM mounting bolts and remove PCM from vehicle.

INSTALLATION

(1) Install PCM and mounting bolts to vehicle.

(2) Tighten bolts to 4 N·m (35 in. lbs.).

(3) Check pin connectors in the PCM and the three 32–way connectors for corrosion or damage. Also, the pin heights in connectors should all be same. Repair as necessary before installing connectors.

(4) Install three 32–way connectors.

(5) Install cover over electrical connectors. Cover snaps onto PCM.

(6) Install battery cable.

(7) Use the DRB scan tool to reprogram new PCM with vehicles original Identification Number (VIN) and original vehicle mileage.

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 (Fig. 52).

REMOVAL

(1) Disconnect electrical connector from power steering pressure switch.

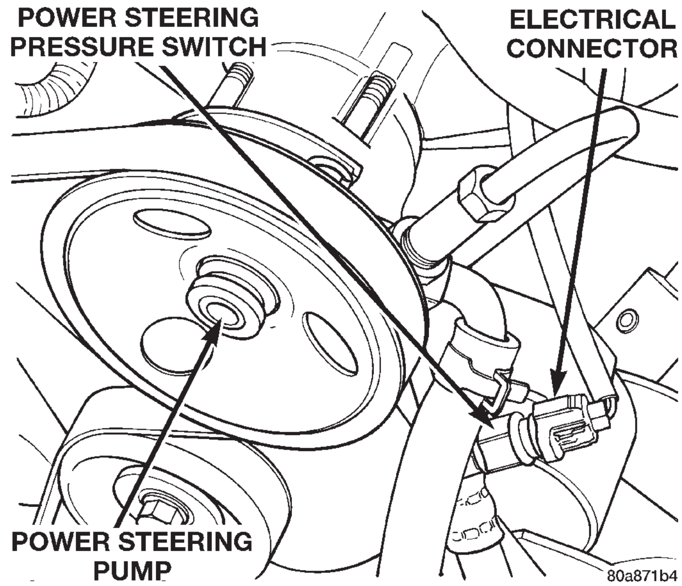


Fig. 52 Power Steering Pressure Switch

(2) Place a small container or shop towel beneath switch to collect any excess fluid.

(3) Remove switch. Use back-up wrench on power steering line to prevent line bending.

INSTALLATION

(1) Install power steering switch into power steering line.

(2) Tighten to 14–22 N·m (124–195 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.

OXYGEN SENSOR

The upstream O2S sensor is located in exhaust downpipe. The downstream sensor is located near outlet end of catalytic converter. Refer to (Fig. 53).

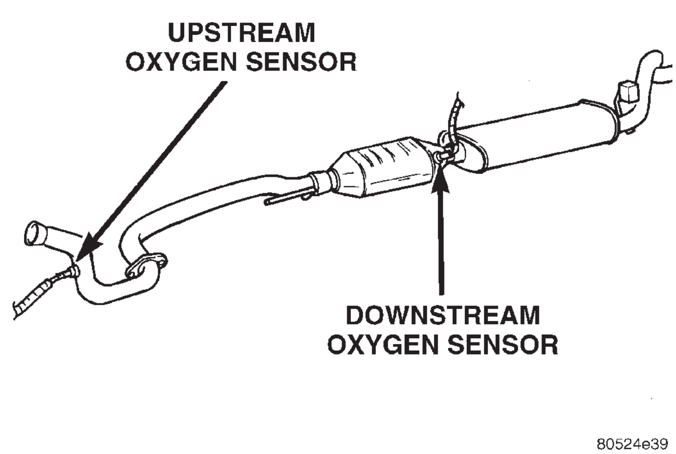


Fig. 53 Oxygen Sensor Locations

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) 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 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 (FILTER)

REMOVAL

(1) Unlock air tube clamp (Fig. 54) at air cleaner cover. To unlock clamp, attach adjustable pliers to clamp and rotate pliers as shown in (Fig. 55).
(2) Remove air tube at cover.
(3) Pry back three clips retaining air cleaner cover to air cleaner housing.
(4) Remove housing cover and remove air cleaner element.
(5) Clean inside of housing before replacing element.

INSTALLATION

(1) Install air cleaner element into housing.
(2) Install air cleaner cover to housing (three clips). Be sure cover is properly seated to air cleaner housing.
(3) Install air tube and clamp to cover. Compress clamp snugly with adjustable pliers as shown in (Fig. 56).

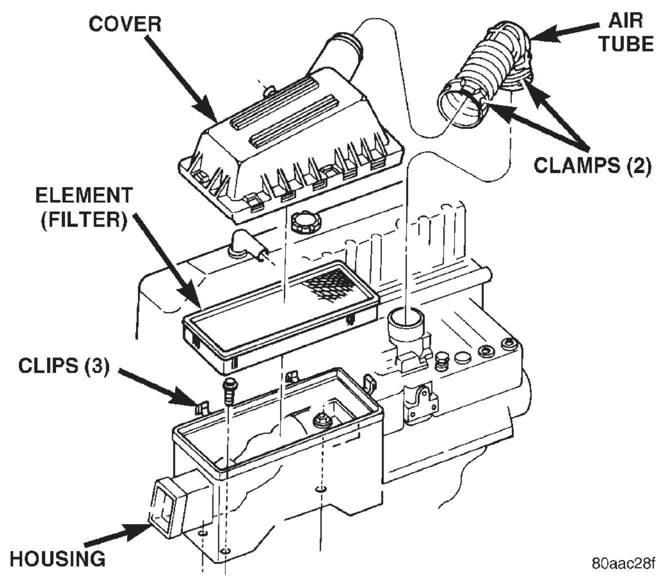


Fig. 54 Air Cleaner Housing and Element (Filter)

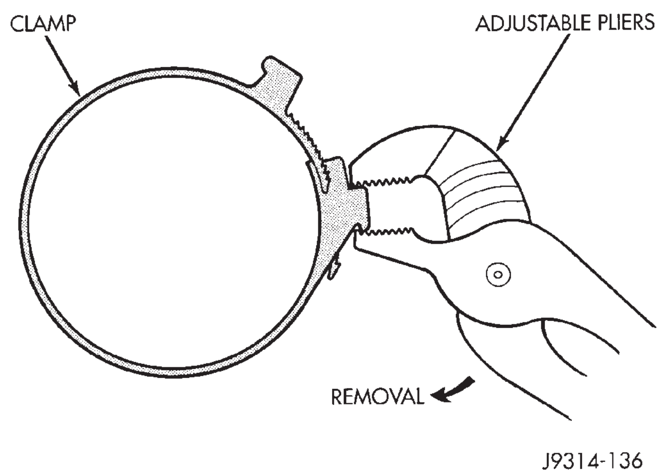


Fig. 55 Clamp Removal

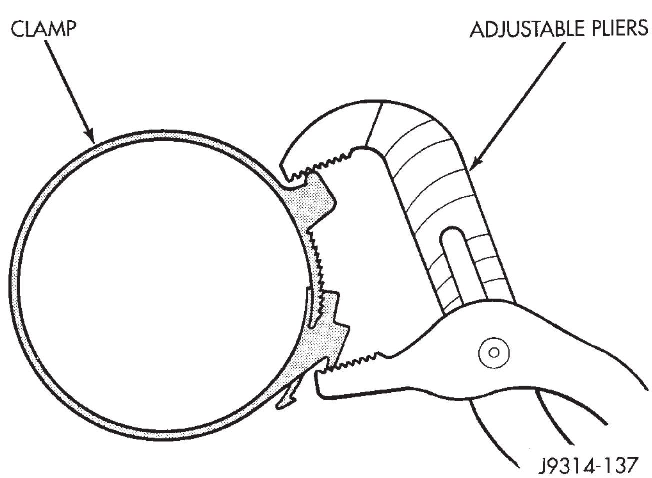


Fig. 56 Clamp Installation

REMOVAL AND INSTALLATION (Continued)

ENGINE COOLANT TEMPERATURE SENSOR

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR. REFER TO GROUP 7, COOLING.

The coolant temperature sensor is installed in the thermostat housing (Fig. 57).

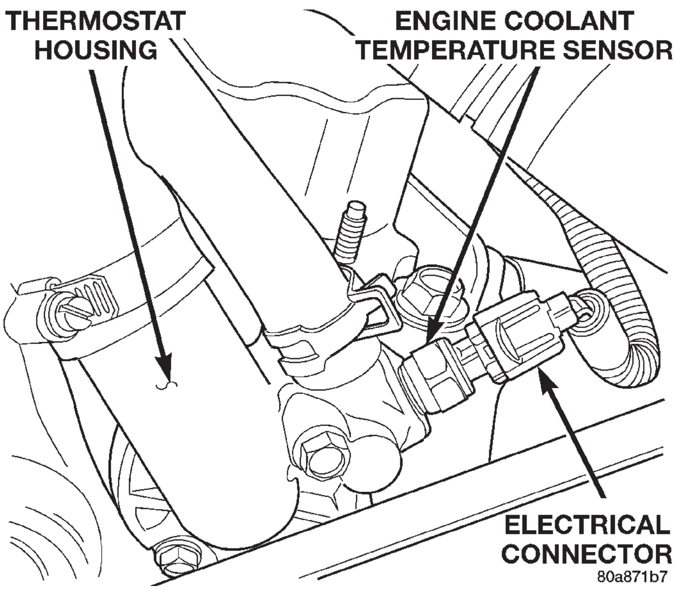


Fig. 57 Engine Coolant Temperature Sensor—Typical

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.

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 (IAT) sensor is installed into intake manifold plenum near throttle body (Fig. 58) or (Fig. 59).

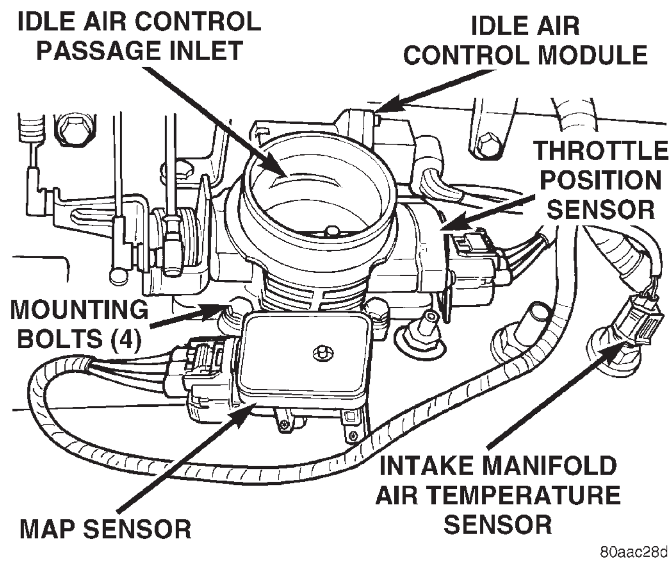


Fig. 58 IAT Sensor Location—4.0L Engine

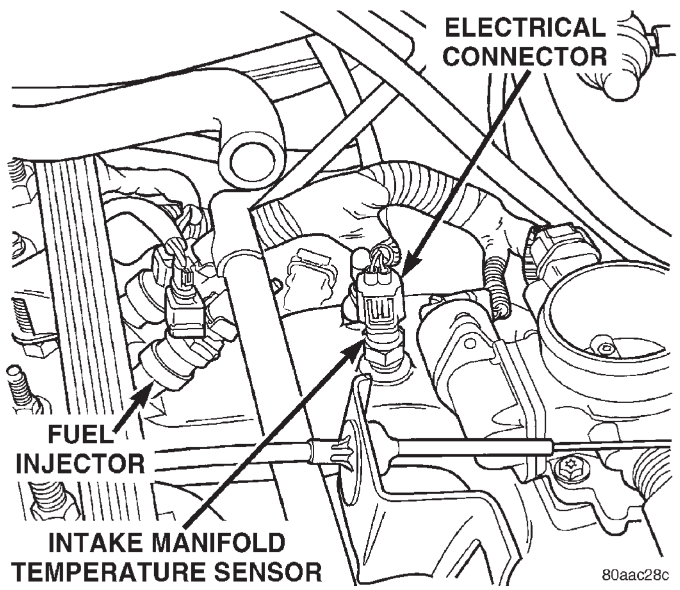


Fig. 59 IAT Sensor Location—2.5L Engine

REMOVAL

(1) Disconnect electrical connector from IAT sensor.

(2) Remove sensor from intake manifold.

INSTALLATION

(1) Install IAT 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 (Fig. 60) or (Fig. 61). The pinion gear adapter is located on the extension housing of transmission (drivers side).

REMOVAL AND INSTALLATION (Continued)

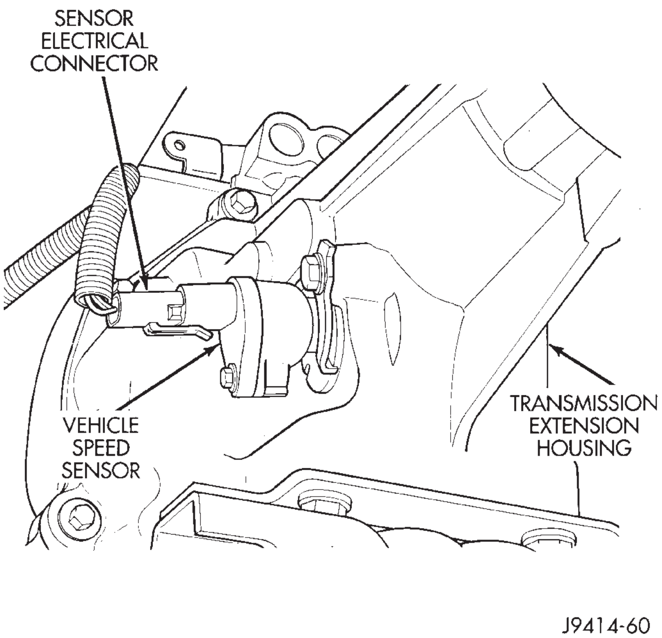


Fig. 60 Vehicle Speed Sensor Location—2WD—Typical

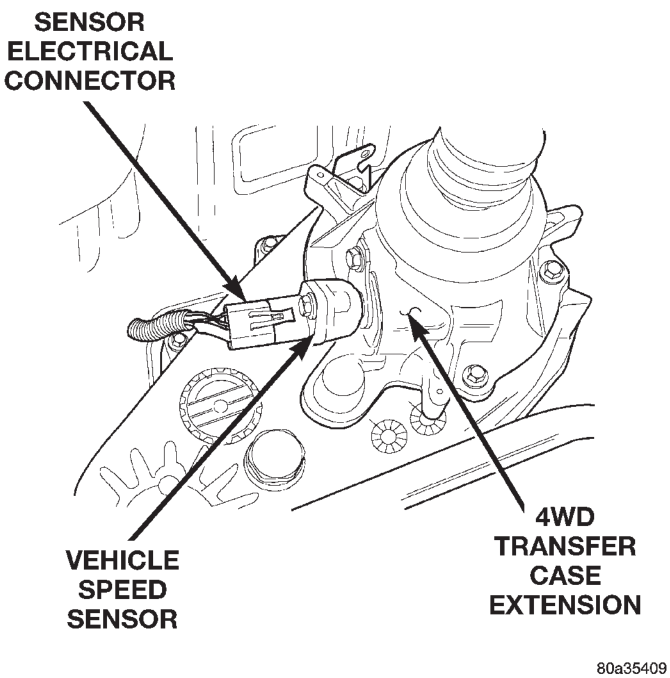


Fig. 61 Vehicle Speed Sensor Location—4WD—Typical

REMOVAL

(1) Raise and support vehicle.

(2) Disconnect electrical connector from sensor.

(3) Remove sensor mounting bolt (Fig. 62).

(4) Remove sensor (pull straight out) from speedometer pinion gear adapter (Fig. 62). Do not remove gear adapter from transmission.

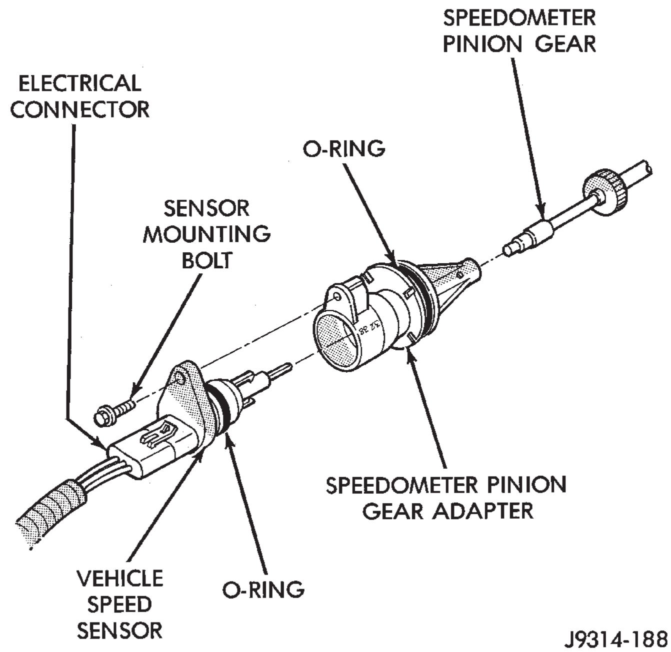


Fig. 62 Sensor Removal/Installation

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

TORQUE CHART

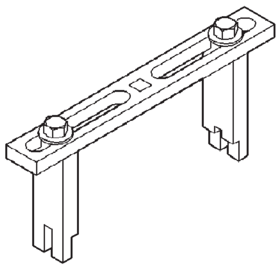
DESCRIPTION	TORQUE
Air Cleaner Housing Mount. Bolts	8 N·m (71 in. lbs.)
Engine Coolant Temperature Sensor	11 N·m (96 in. lbs.)
IAC Motor-To-Throttle Body Bolts	7 N·m (60 in. lbs.)
Intake Manifold Air Temp. Sensor	28 N·m (20 ft. lbs.)
MAP Sensor Mounting Screws	3 N·m (25 in. lbs.)
Oxygen Sensor	30 N·m (22 ft. lbs.)
PCM Mounting Screws	4 N·m (35 in. lbs.)
Power Steering Pressure Switch	14–22 N·m (124–195 in. lbs.)
Throttle Body Mounting Bolts	11 N·m (100 in. lbs.)
Throttle Position Sensor Mounting Screws	7 N·m (60 in. lbs.)

SPECIFICATIONS (Continued)

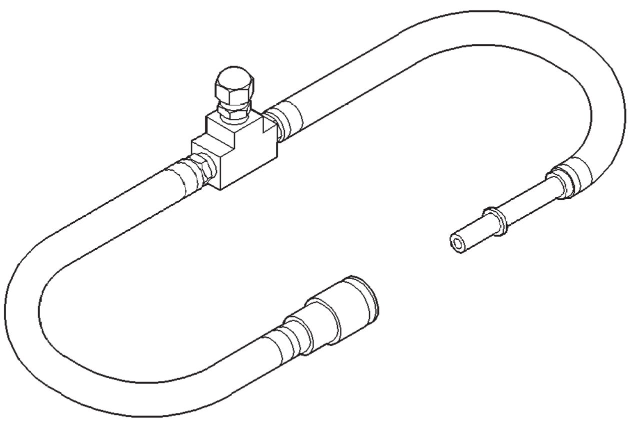
DESCRIPTION	TORQUE
Vehicle Speed Sensor Mounting Bolt	2.2 N·m (20 in. lbs.)

SPECIAL TOOLS

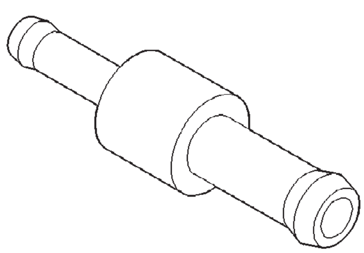
FUEL SYSTEM



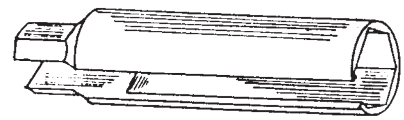
Spanner Wrench, Fuel Pump Module Locknut—6856



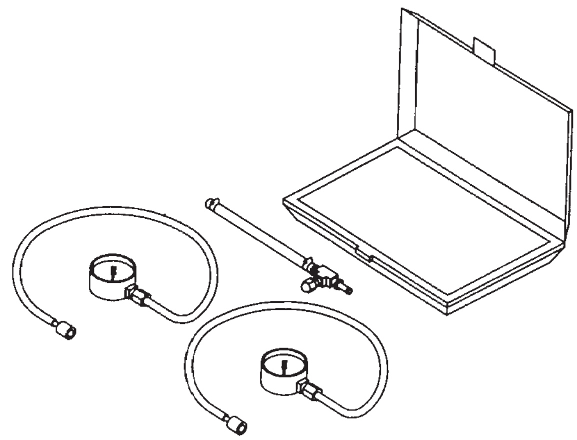
Adapters, Fuel Pressure Test—6539 and/or 6631



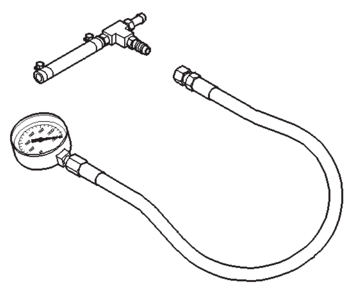
Fitting, Air Metering—6714



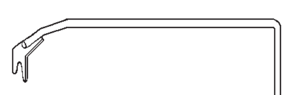
O2S (Oxygen Sensor) Remover/Installer—C-4907



Test Kit, Fuel Pressure—5069



Test Kit, Fuel Pressure—C-4799-B



Fuel Line Removal Tool—6782

FUEL SYSTEM—2.5L DIESEL ENGINE

CONTENTS

GENERAL INFORMATION

INDEX

GENERAL INFORMATION

FUEL SHUTDOWN SOLENOID

The fuel shutdown solenoid is controlled and operated by the MSA.

The fuel shutdown (shut-off) solenoid is used to electrically shut off the diesel fuel supply to the high-pressure fuel injection pump. The solenoid is mounted to the rear of the injection pump.

The solenoid controls starting and stopping of the engine regardless of the position of the accelerator pedal. When the ignition (key) switch is OFF, the solenoid is shut off and fuel flow is not allowed to the fuel injection pump. When the key is placed in the ON or START positions, fuel supply is allowed at the injection pump.

FUEL REQUIREMENTS—2.5L DIESEL

Premium quality diesel fuel with a minimum Cetane rating of 50 or higher is required.

FUEL DELIVERY SYSTEM—2.5L DIESEL ENGINE

INDEX

DESCRIPTION AND OPERATION

INTRODUCTION

This Fuel Delivery section will cover components not controlled by the PCM. For components controlled by the PCM, refer to the Fuel Injection System—2.5L Diesel Engine section of this group.

The fuel heater relay, fuel heater and fuel gauge are not operated by the PCM. These components are controlled by the ignition (key) switch. All other fuel system electrical components necessary to operate the engine are controlled or regulated by the PCM.

FUEL SYSTEM PRESSURE WARNING

WARNING: HIGH–PRESSURE FUEL LINES DELIVER DIESEL FUEL UNDER EXTREME PRESSURE FROM THE INJECTION PUMP TO THE FUEL INJECTORS. THIS MAY BE AS HIGH AS 45,000 KPA (6526 PSI). USE EXTREME CAUTION WHEN INSPECTING FOR HIGH–PRESSURE FUEL LEAKS. INSPECT FOR HIGH–PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD (Fig. 1). HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

FUEL TANK

The fuel tank and tank mounting used with the diesel powered engine is the same as used with gasoline powered models, although the fuel tank module is different.

The fuel tank contains the fuel tank module and two rollover valves. Two fuel lines are routed to the fuel tank module. One line is used for fuel supply to the fuel filter/water separator. The other is used to return excess fuel back to the fuel tank.

The fuel tank module contains the fuel gauge electrical sending unit. **An electrical fuel pump is not used with the diesel engine.**

DESCRIPTION AND OPERATION (Continued)

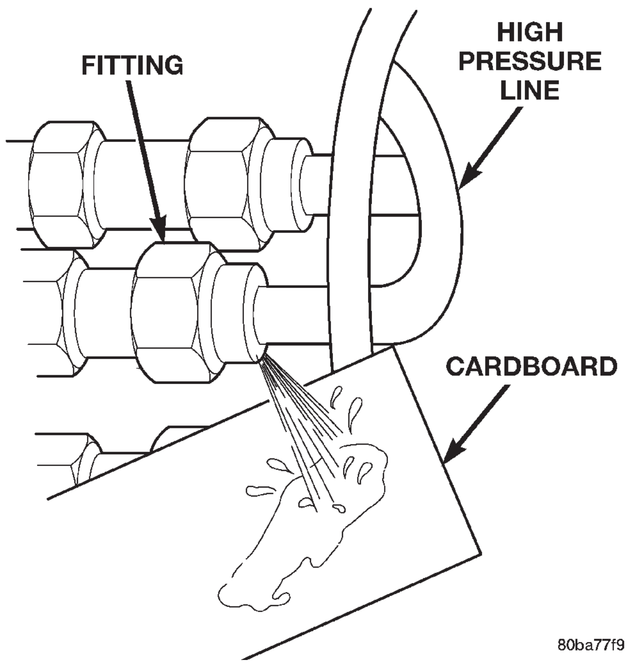


Fig. 1 Typical Fuel Pressure Test at Injector

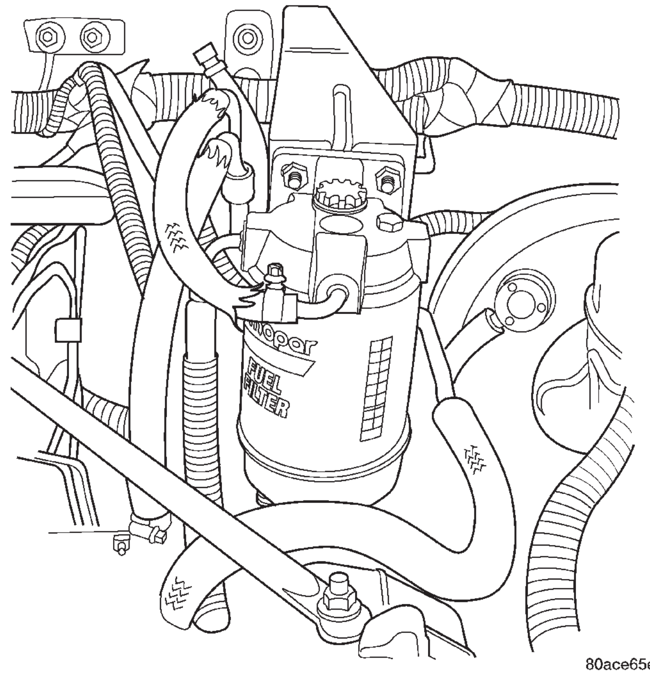


Fig. 2 Fuel Filter/Water Separator Location

FUEL TANK MODULE

An electric fuel pump is not attached to the fuel tank module for diesel powered engines. Fuel is siphoned by the fuel injection pump.

The fuel tank module is installed in the top of the fuel tank. The fuel tank module contains the following components:

- Fuel reservoir
- A separate in-tank fuel filter
- Electric fuel gauge sending unit
- Fuel supply line connection
- Fuel return line connection

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit is attached to the side of the fuel pump module. The sending unit consists of a float, an arm, and a variable resistor (track). The track is used to send an electrical signal used for fuel gauge operation.

As the fuel level increases, the float and arm move up. This decreases the sending unit resistance, causing the PCM to send a signal to the fuel gauge on the instrument panel to read full. As the fuel level decreases, the float and arm move down. This increases the sending unit resistance, causing the PCM to send a signal to the fuel gauge on the instrument panel to read empty.

FUEL FILTER/WATER SEPARATOR

The fuel filter/water separator assembly is located in the engine compartment near the strut tower (Fig. 2).

The combination fuel filter/water separator protects the fuel injection pump by helping to remove water and contaminants from the fuel. Moisture collects at the bottom of the filter/separator in a plastic bowl.

The fuel filter/water separator assembly contains the fuel filter, fuel heater element, and fuel drain valve.

For information on the fuel heater, refer to Fuel Heater in this group.

Refer to the maintenance schedules in Group 0 in this manual for the recommended fuel filter replacement intervals.

For periodic draining of water from the bowl, refer to Fuel Filter/Water Separator Removal/Installation in this group.

FUEL SHUTDOWN SOLENOID

The fuel shutdown solenoid is controlled and operated by the MSA.

The fuel shutdown (shut-off) solenoid is used to electrically shut off the diesel fuel supply to the high-pressure fuel injection pump. The solenoid is mounted to the rear of the injection pump.

The solenoid controls starting and stopping of the engine regardless of the position of the accelerator pedal. When the ignition (key) switch is OFF, the solenoid is shut off and fuel flow is not allowed to the fuel injection pump. When the key is placed in the ON or START positions, fuel supply is allowed at the injection pump.

DESCRIPTION AND OPERATION (Continued)

FUEL INJECTION PUMP

The fuel injection pump is a mechanical distributor–type, Bosch VP36 series (Fig. 3). A gear on the end of the injection pump shaft meshes with the drive gear at the front of engine. The pump is mechanically timed to the engine. The MSA can make adjustments to the timing of the injection pump.

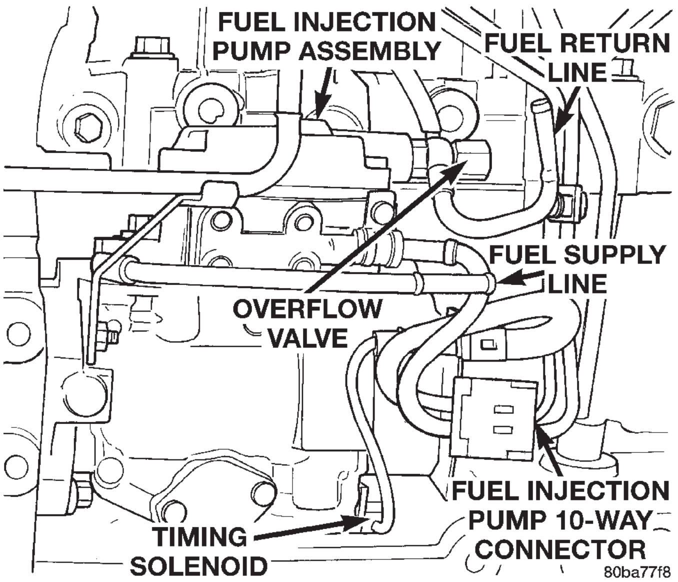


Fig. 3 Fuel Injection Pump

The injection pump contains the fuel shutdown solenoid, fuel temperature sensor, control sleeve sensor, fuel quantity actuator and the fuel timing solenoid (Fig. 3).

In the electronically controlled injection pump, the pump plunger works the same as the pump plunger in a mechanically controlled injection pump, but the amount of fuel and the time the fuel is injected is controlled by the vehicle's MSA, instead of by a mechanical governor assembly. A solenoid controlled by the MSA is used in place of the mechanical governor assembly, and it moves a control sleeve inside the pump that regulates the amount of fuel being injected. There is no mechanical connection between the accelerator pedal and the electronically controlled injection pump. Instead, a sensor connected to the accelerator pedal sends a signal to the MSA that represents the actual position of the accelerator pedal. The MSA uses this input, along with input from other sensors to move the control sleeve to deliver the appropriate amount of fuel. This system is known as "Drive-By-Wire".

The actual time that the fuel is delivered is very important to the diesel combustion process. The MSA monitors outputs from the engine speed sensor (flywheel position in degrees), and the fuel injector sensor (mechanical movement within the #1 cylinder fuel injector). Outputs from the Accelerator Pedal Position sensor, engine speed sensor (engine rpm) and engine coolant temperature sensor are also used. The MSA will then compare its set values to these outputs to electrically adjust the amount of fuel timing (amount of advance) within the injection pump. This is referred to as "Closed Loop" operation. The MSA monitors fuel timing by comparing its set value to when the injector #1 opens. If the value is greater than a preset value a fault will be set.

Actual electric fuel timing (amount of advance) is accomplished by the fuel timing solenoid mounted to the bottom of the injection pump (Fig. 3). Fuel timing will be adjusted by the MSA, which controls the fuel timing solenoid.

An overflow valve is attached into the fuel return line at the rear of the fuel injection pump (Fig. 3). This valve serves two purposes. One is to ensure that a certain amount of residual pressure is maintained within the pump when the engine is switched off. This will prevent the fuel timing mechanism within the injection pump from returning to its zero position. The other purpose is to allow excess fuel to be returned to the fuel tank through the fuel return line. The pressure values within this valve are preset and can not be adjusted.

The fuel injection pump supplies high–pressure fuel of approximately 45,000 kPa (6526 psi) to each injector in precise metered amounts at the correct time.

For mechanical injection pump timing, refer to Fuel Injection Pump Timing in the Service Procedures section of this group.

FUEL INJECTORS

Fuel drain tubes (Fig. 4) are used to route excess fuel back to the overflow valve at the rear of the injection pump. This excess fuel is then returned to the fuel tank through the fuel return line.

The injectors are connected to the fuel injection pump by the high–pressure fuel lines. A separate injector is used for each of the four cylinders. An injector containing a sensor (Fig. 5) is used on the cylinder number one injector. This injector is called instrumented injector #1 or needle movement sensor. It is used to tell the MSA when the #1 injector's internal spring-loaded valve seat has been forced open by pressurized fuel being delivered to the cylinder, which is at the end of its compression stroke. When the instrumented injector's valve seat is force open, it sends a small voltage spike pulse to the MSA. This tells the MSA that cylinder #1 is firing. It is not used with the other three injectors.

Fuel enters the injector at the fuel inlet (top of injector) and is routed to the needle valve bore. When fuel pressure rises to approximately 15,000–15,800

DESCRIPTION AND OPERATION (Continued)

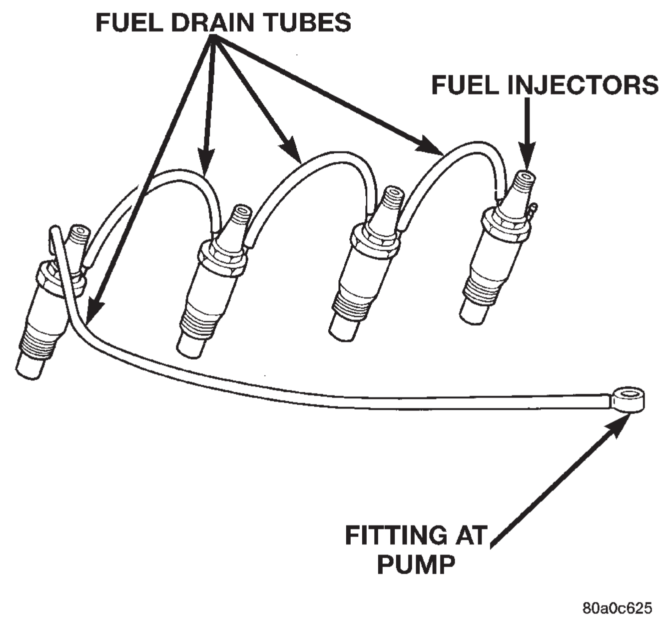


Fig. 4 Fuel Injectors and Drain Tubes

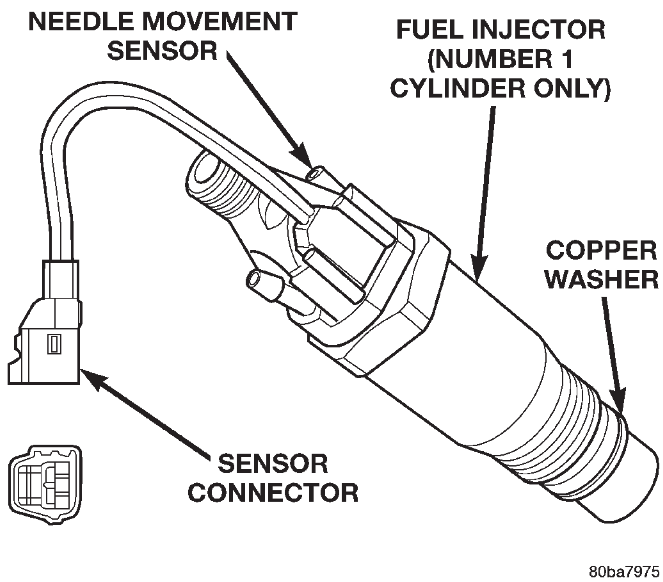


Fig. 5 Fuel Injector Sensor

kPa (2175–2291 psi), the needle valve spring tension is overcome. The needle valve rises and fuel flows through the spray holes in the nozzle tip into the combustion chamber. The pressure required to lift the needle valve is the injector opening pressure setting. This is referred to as the “pop-off” pressure setting.

Fuel pressure in the injector circuit decreases after injection. The injector needle valve is immediately closed by the needle valve spring and fuel flow into the combustion chamber is stopped. Exhaust gases are prevented from entering the injector nozzle by the needle valve.

A copper washer (gasket) is used at the base of each injector (Fig. 5) to prevent combustion gases from escaping.

Fuel injector firing sequence is 1–3–4–2.

FUEL TUBES/LINES/HOSES AND CLAMPS—LOW-PRESSURE TYPE

Also refer to the proceeding section on Quick–Connect Fittings.

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 or a quick–connect fitting. Replace complete line/tube as necessary.

Avoid contact of any fuel tubes/hoses with other vehicle components that could cause abrasions or scuffing. Be sure that the fuel lines/tubes are properly routed to prevent pinching and to avoid heat sources.

The lines/tubes/hoses are of a special construction. If it is necessary to replace these lines/tubes/hoses, use only original equipment type.

The hose clamps used to secure the rubber hoses 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 fuel leaks.

Where a rubber hose is joined to a metal tube (staked), do not attempt to repair. Replace entire line/tube assembly.

Use new original equipment type hose clamps. Tighten hose clamps to 2 N·m (20 in. lbs.) torque.

QUICK-CONNECT FITTINGS—LOW PRESSURE TYPE

Different types of quick-connect fittings are used to attach various fuel system components. These are: a single-tab type, a two-tab type or a plastic retainer ring type (Fig. 6). 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, but new pull tabs are available for some types. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube assembly.

DESCRIPTION AND OPERATION (Continued)

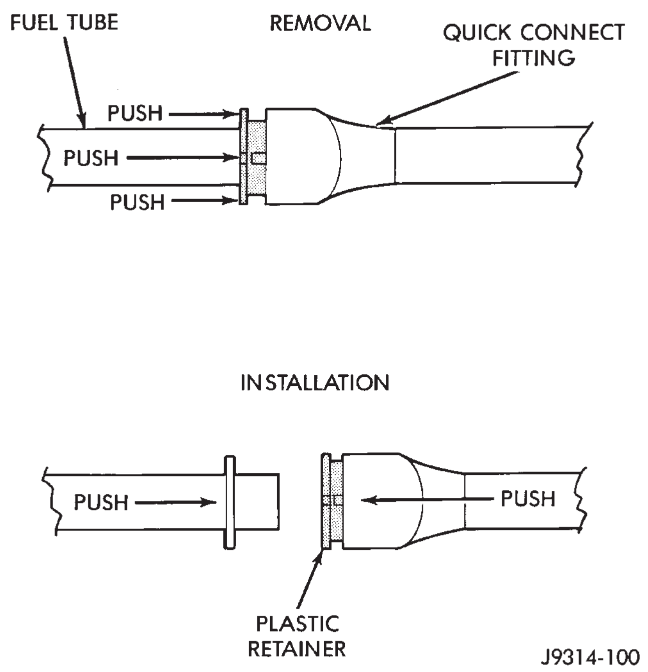


Fig. 6 Plastic Retainer Ring-Type Fitting

HIGH-PRESSURE FUEL LINES

CAUTION: The high–pressure fuel lines must be held securely in place in their holders. The lines cannot contact each other or other components. Do not attempt to weld high–pressure fuel lines or to repair lines that are damaged. Only use the recommended lines when replacement of high–pressure fuel line is necessary.

High–pressure fuel lines deliver fuel under pressure of up to approximately 45,000 kPa (6526 psi) from the injection pump to the fuel injectors. The lines expand and contract from the high–pressure fuel pulses generated during the injection process. All high–pressure fuel lines are of the same length and inside diameter. Correct high–pressure fuel line usage and installation is critical to smooth engine operation.

WARNING: USE EXTREME CAUTION WHEN INSPECTING FOR HIGH–PRESSURE FUEL LEAKS. INSPECT FOR HIGH–PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD. HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

FUEL DRAIN TUBES

These rubber tubes are low–pressure type.

Some excess fuel is continually vented from the fuel injection pump. During injection, a small amount of fuel flows past the injector nozzle and is not injected into the combustion chamber. This fuel drains into the fuel drain tubes (Fig. 7) and back to the tee banjo fitting, which is connected to the same line as the overflow valve, which allows a variable quantity to return to the fuel tank. The overflow valve is calibrated to open at a preset pressure. Excess fuel not required by the pump to maintain the minimum pump cavity pressure is then returned through the overflow valve and on to the fuel tank through the fuel return line.

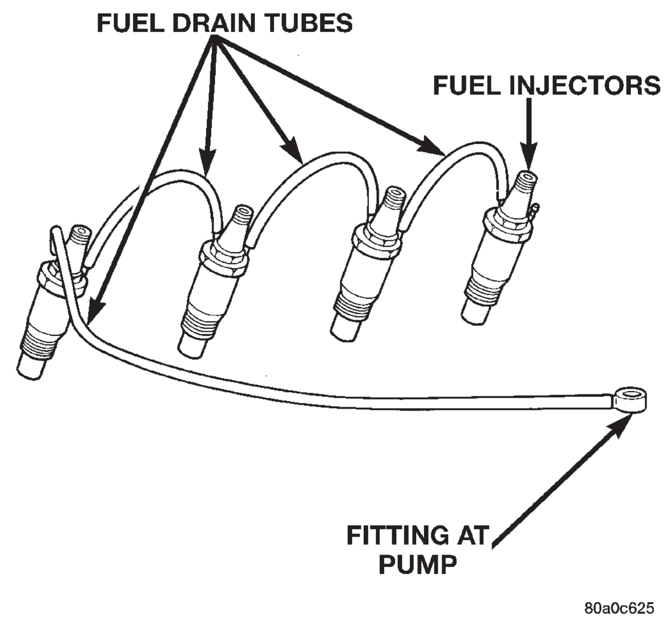


Fig. 7 Fuel Drain Tubes

FUEL HEATER

The fuel heater is used to prevent diesel fuel from waxing during cold weather operation. The fuel heater is located in the bottom plastic bowl of the fuel filter/water separator (Fig. 8).

The element inside the heater assembly is made of a Positive Temperature Coefficient (PTC) material, and has power applied to it by the fuel heater relay anytime the ignition key is in the “on” position. PTC material has a high resistance to current flow when its temperature is high, which means that it will not generate heat when the temperature is above a certain value. When the temperature is below 7°C (45° F), the resistance of the PTC element is lowered, and allows current to flow through the fuel heater element warming the fuel. When the temperature is above 29°C (85° F), the PTC element’s resistance rises, and current flow through the heater element stops.

Voltage to operate the fuel heater is supplied from the ignition (key) switch and through the fuel heater relay. Refer to the following Fuel Heater Relay for

DESCRIPTION AND OPERATION (Continued)

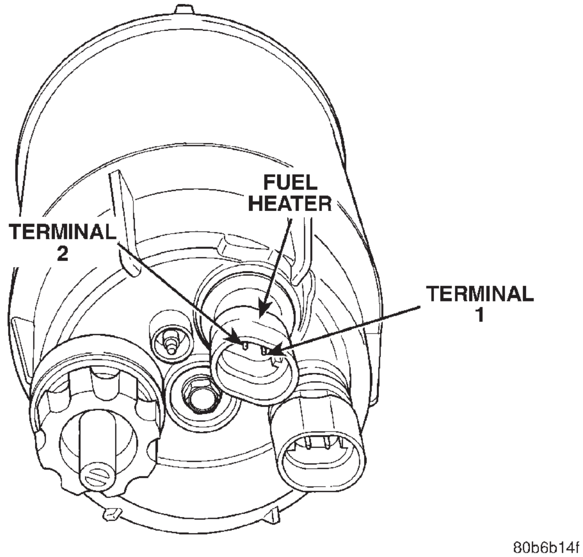


Fig. 8 Fuel Heater Temperature Sensor and Element Location

additional information. **The fuel heater and fuel heater relay are not controlled by the Powertrain Control Module (ECM).**

Current draw for the heater element is 150 watts at 14 volts (DC).

FUEL HEATER RELAY

Voltage to operate the fuel heater is supplied from the ignition (key) switch through the fuel heater relay. **The PCM or MSA is not used to control this relay.**

The fuel heater relay is located in the PDC. The PDC is located next to the battery in the engine compartment. For the location of the relay within the PDC, refer to label on PDC cover.

DIAGNOSIS AND TESTING

GENERAL INFORMATION

This section of the group will cover a general diagnosis of diesel engine fuel system components.

Diagnostic Trouble Codes: Refer to On-Board Diagnostics in Group 25, Emission Control System for a list of Diagnostic Trouble Codes (DTC's) for certain fuel system components.

The PCM and MSA must be tested with the DRBIII scan tool. The DRBIII should be the first step in any diagnosis of engine performance complaints. Refer to the 1997 ZJ/ZG 2.5L Diesel Powertrain Diagnostic Procedures manual for diagnosis and testing of the diesel engine control system.

VISUAL INSPECTION

A visual inspection for loose, disconnected, or incorrectly routed wires and hoses should be made before attempting to diagnose or service the diesel fuel injection system. A visual check will help find these conditions. It also saves unnecessary test and diagnostic time. A thorough visual inspection of the fuel injection system includes the following checks:

(1) Be sure that the battery connections are tight and not corroded.

(2) Be sure that the 60 way connector is fully engaged with the PCM (Fig. 9).

(3) Be sure that the 68 way connector is fully engaged with the MSA (Fig. 10).

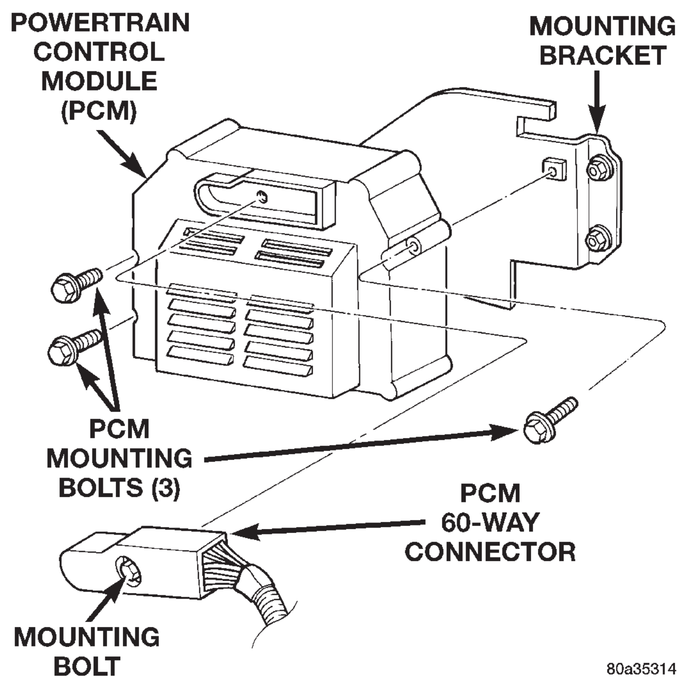


Fig. 9 PCM Location—Typical

(4) Verify that the electrical connections for the ASD relay are clean and free of corrosion. This relay is located in the PDC. For the location of the relay within the PDC, refer to label on PDC cover.

(5) Verify that the electrical connections for the fuel heater relay are clean and free of corrosion. This relay is located in the PDC. For the location of the relay within the PDC, refer to label on PDC cover.

(6) Be sure the electrical connectors at the ends of the glow plugs (Fig. 11) are tight and free of corrosion.

(7) Be sure that the electrical connections at the glow plug relay are tight and not corroded. The glow plug relay is located in the engine compartment on the left–inner fender (Fig. 12).

(8) Inspect the starter motor and starter solenoid connections for tightness and corrosion.

DIAGNOSIS AND TESTING (Continued)

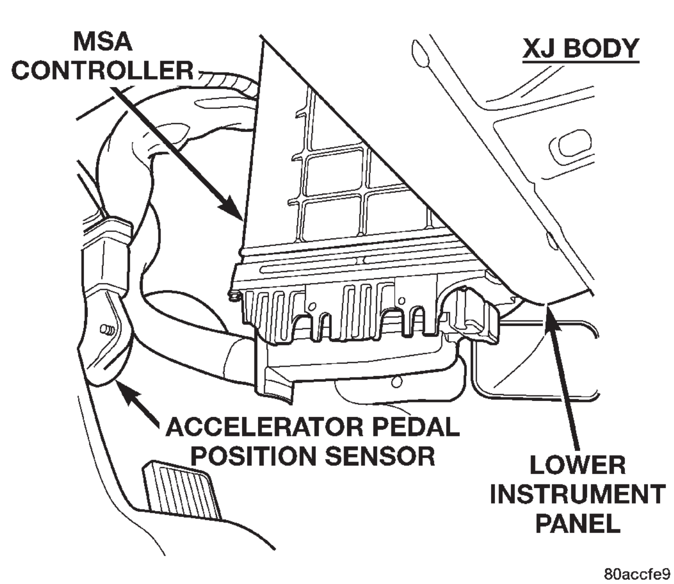


Fig. 10 MSA Location—Typical

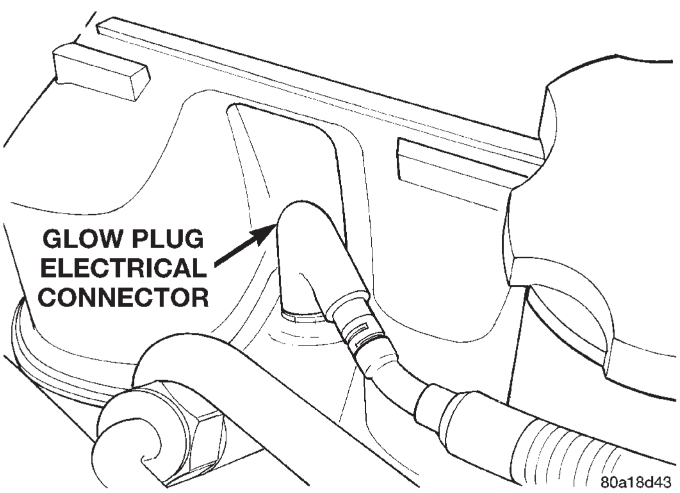


Fig. 11 Glow Plug Connector

(9) Verify that the Fuel Injection Pump electrical connector is firmly connected. Inspect the connector for corrosion or damaged wires. The solenoid is mounted to the rear of the injection pump (Fig. 13).

(10) Verify that the fuel heater electrical connector is firmly attached to the filter bowl at the bottom of the fuel filter/water separator. Inspect the connector for corrosion or damaged wires.

(11) Verify that the electrical pigtail connector (sensor connector) (Fig. 14) for the fuel injector sensor is firmly connected to the engine wiring harness. Inspect the connector for corrosion or damaged wires. This sensor is used on the #1 cylinder injector only.

(12) Inspect for exhaust system restrictions such as pinched exhaust pipes or a collapsed or plugged muffler.

(13) Verify that the harness connector is firmly connected to the vehicle speed sensor (Fig. 15) or (Fig. 16).

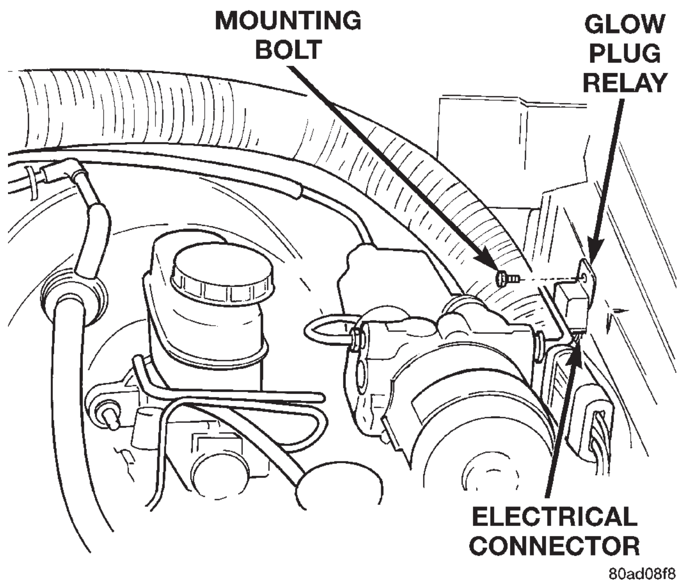


Fig. 12 Glow Plug Relay Location

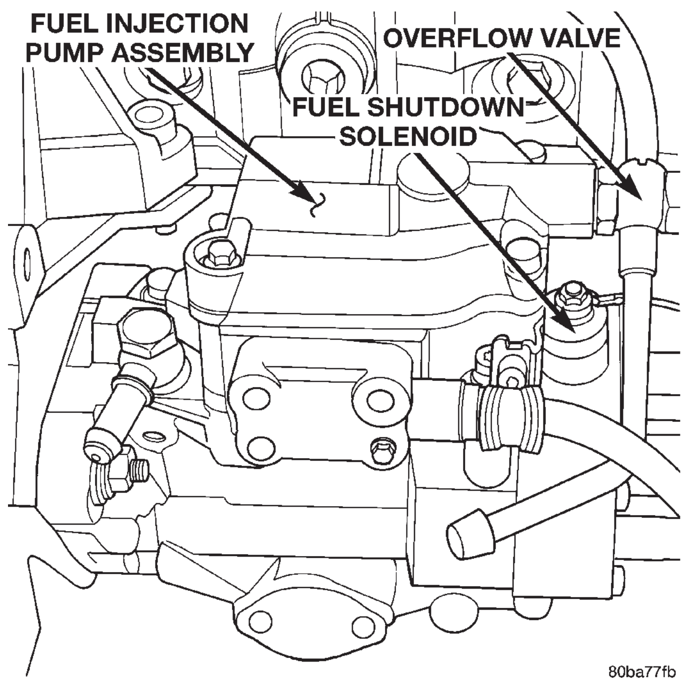


Fig. 13 Fuel Shutdown Solenoid Location

(14) Verify turbocharger wastegate operation. Refer to Group 11, Exhaust System and Intake Manifold Group for information.

(15) Verify that the harness connector is firmly connected to the engine coolant temperature sensor. The sensor is located on the side of cylinder head near the rear of fuel injection pump (Fig. 17).

(16) Check for air in the fuel system. Refer to the Air Bleed Procedure.

(17) Inspect all fuel supply and return lines for signs of leakage.

DIAGNOSIS AND TESTING (Continued)

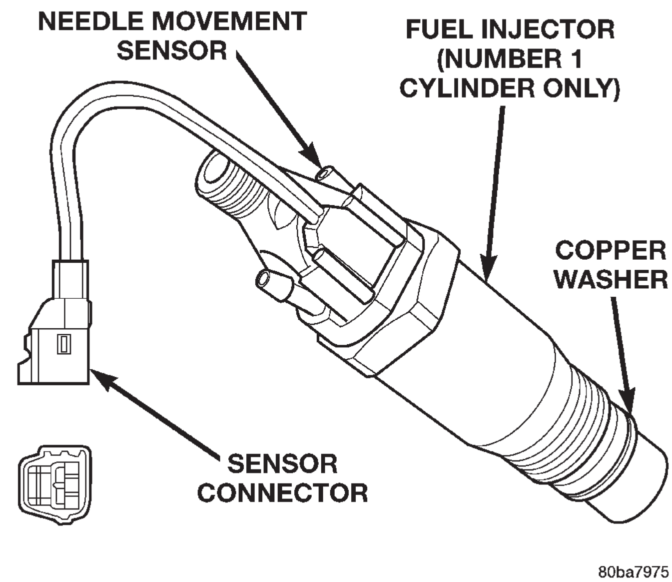


Fig. 14 Fuel Injector Sensor

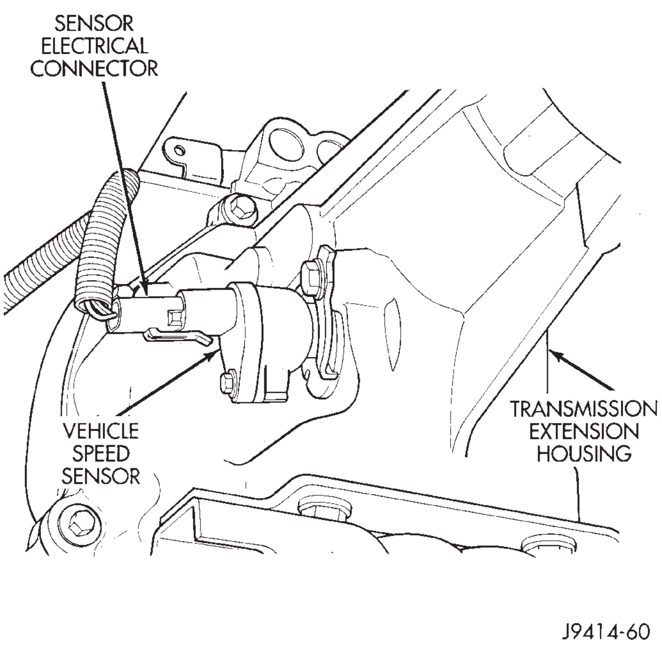


Fig. 15 Vehicle Speed Sensor—2 Wheel Drive

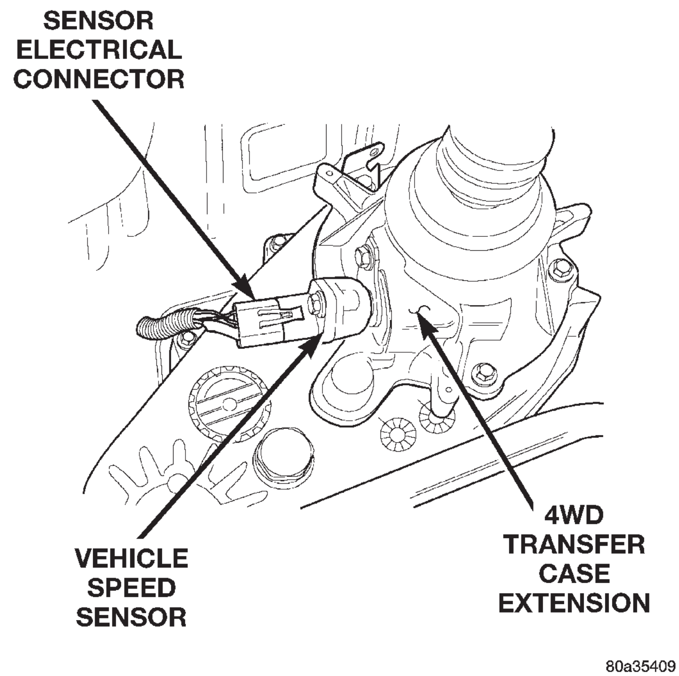


Fig. 16 Vehicle Speed Sensor—4 Wheel Drive

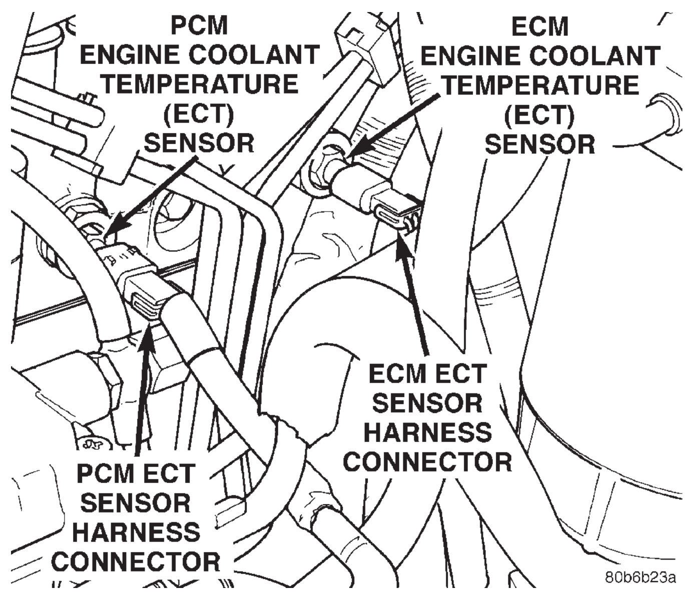


Fig. 17 Engine Coolant Temperature Sensor Location

(18) Be sure that the ground connections are tight and free of corrosion. Refer to Group 8, Wiring for locations of ground connections.

(19) Inspect the air cleaner element (filter) for restrictions.

(20) Be sure that the turbocharger output hose is properly connected to the charge air cooler (intercooler) inlet tube. Verify that the charge air cooler output hose is properly connected to the cooler and the intake manifold. Refer to Group 11, Exhaust System and Intake Manifold for information.

(21) Be sure that the vacuum hoses to the vacuum pump are connected and not leaking. The vacuum pump is located in the front of engine (internal) and is driven from the crankshaft gear (Fig. 18). Disconnect the hose and check for minimum vacuum from the pump. Refer to Group 5, Brake System for specifications and procedures.

(22) Be sure that the accessory drive belt is not damaged or slipping.

(23) Verify there is a good connection at the engine speed sensor. Refer to the Fuel Injection System in this section for location of the engine speed sensor location.

DIAGNOSIS AND TESTING (Continued)

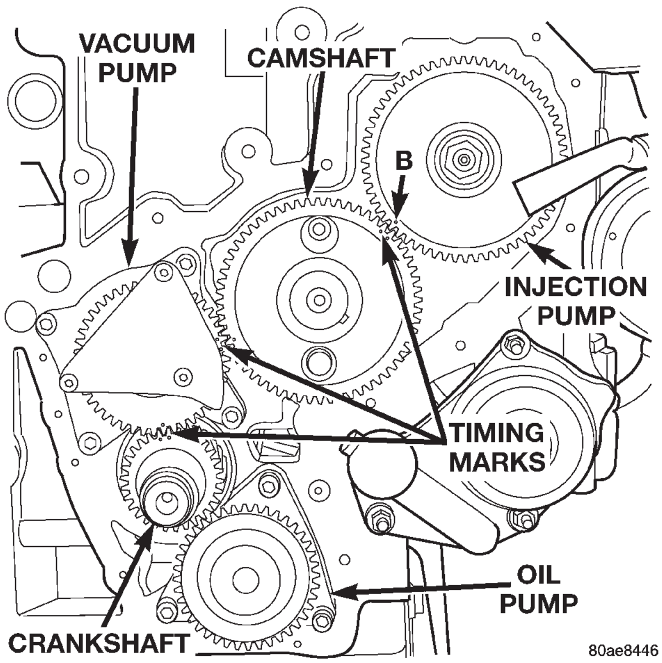


Fig. 18 Vaccum Pump at Front of Engine

(24) Verify there is a good connection at the Boost Pressure Sensor, which is a part of the air intake assembly.

AIR IN FUEL SYSTEM

Air will enter the fuel system whenever the fuel supply lines, fuel filter/water separator, fuel filter bowl, injection pump, high–pressure lines or injectors are removed or disconnected. Air will also enter the fuel system whenever the fuel tank has been run empty.

Air trapped in the fuel system can result in hard starting, a rough running engine, engine misfire, low power, excessive smoke and fuel knock. After service is performed, air must be bled from the system before starting the engine.

Inspect the fuel system from the fuel tank to the injectors for loose connections. Leaking fuel is an indicator of loose connections or defective seals. Air can also enter the fuel system between the fuel tank and the injection pump. Inspect the fuel tank and fuel lines for damage that might allow air into the system.

For air bleeding, refer to Air Bleed Procedure in the Service Procedures section of this group.

FUEL HEATER RELAY TEST

The fuel heater relay is located in the Power Distribution Center (PDC). Refer to Relays—Operation/ Testing in Fuel Injection System section of this group for test procedures.

FUEL INJECTOR TEST

The fuel injection nozzles, located on the engine cylinder head, spray fuel under high pressure into the individual combustion chambers. Pressurized fuel, delivered by the fuel injection pump, unseats a spring-loaded needle valve inside the injector, and the fuel is atomized as it escapes through the injector opening into the engine's combustion chamber. If the fuel injector does not operate properly, the engine may misfire, or cause other driveability problems.

A leak in the injection pump–to–injector high–pressure fuel line can cause many of the same symptoms as a malfunctioning injector. Inspect for a leak in the high–pressure lines before checking for a malfunctioning fuel injector.

WARNING: THE INJECTION PUMP SUPPLIES HIGH–PRESSURE FUEL OF UP TO APPROXIMATELY 45,000 KPA (6526 PSI) TO EACH INDIVIDUAL INJECTOR THROUGH THE HIGH–PRESSURE LINES. FUEL UNDER THIS AMOUNT OF PRESSURE CAN PENETRATE THE SKIN AND CAUSE PERSONAL INJURY. WEAR SAFETY GOGGLES AND ADEQUATE PROTECTIVE CLOTHING. AVOID CONTACT WITH FUEL SPRAY WHEN BLEEDING HIGH–PRESSURE FUEL LINES.

WARNING: DO NOT BLEED AIR FROM THE FUEL SYSTEM OF A HOT ENGINE. DO NOT ALLOW FUEL TO SPRAY ONTO THE EXHAUST MANIFOLD WHEN BLEEDING AIR FROM THE FUEL SYSTEM.

To determine which fuel injector is malfunctioning, run the engine and loosen the high–pressure fuel line nut at the injector (Fig. 19). Listen for a change in engine speed. If engine speed drops, the injector was operating normally. If engine speed remains the same, the injector may be malfunctioning. After testing, tighten the line nut to 30 N·m (22 ft. lbs.) torque. Test all injectors in the same manner one at a time.

Once an injector has been found to be malfunctioning, remove it from the engine and test it. Refer to the Removal/Installation section of this group for procedures.

After the injector has been removed, install it to a bench–mount injector tester. Refer to operating instructions supplied with tester for procedures.

The opening pressure or "pop" pressure should be 15,000–15,800 kPa (2175–2291 psi). If the fuel injector needle valve is opening ("popping") to early or to late, replace the injector.

DIAGNOSIS AND TESTING (Continued)

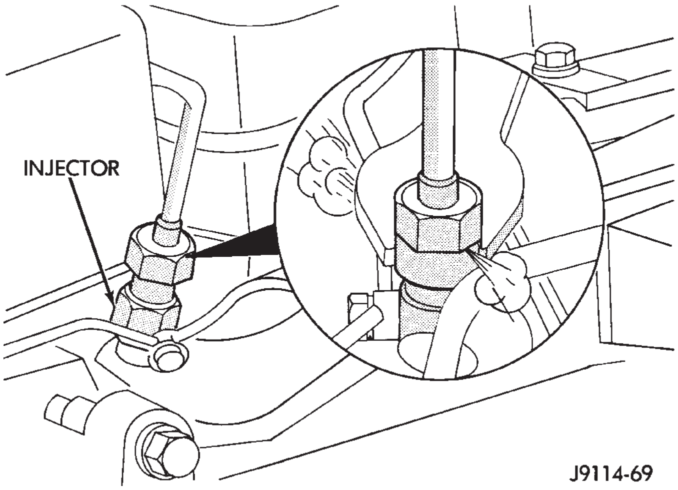


Fig. 19 Typical Inspection of Fuel Injector

FUEL INJECTOR / NEEDLE MOVEMENT SENSOR TEST

The needle movement sensor is used only on the number–1 cylinder fuel injector (Fig. 20). It is not used on the injectors for cylinders number 2, 3, or 4.

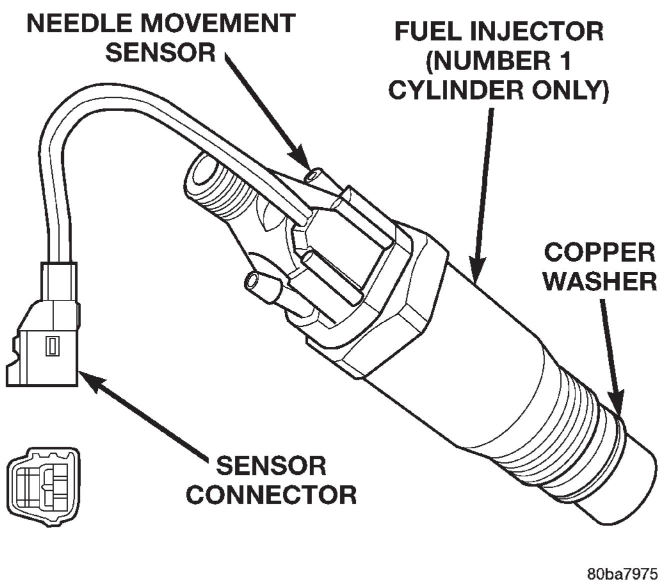


Fig. 20 Needle Movement Sensor Location

Testing the needle movement sensor requires the use of a DRB Scan tool. Refer to the Powertrain Diagnostic Procedures manual for additional information.

FUEL INJECTION PUMP TEST

The injection pump is not to be serviced or the warranty may be voided. If the injection pump requires service, the complete assembly must be replaced.

Incorrect injection pump timing (mechanical or electrical) can cause poor performance, excessive smoke and emissions and poor fuel economy.

A defective fuel injection pump, defective fuel timing solenoid or misadjusted mechanical pump timing can cause starting problems or prevent the engine from revving up. It can also cause:

- Engine surge at idle
- Rough idle (warm engine)
- Low power
- Excessive fuel consumption
- Poor performance
- Low power
- Black smoke from the exhaust
- Blue or white fog like exhaust
- Incorrect idle or maximum speed

The electronically controlled fuel pump has no mechanical governor like older mechanically controlled fuel pumps. Do not remove the top cover of the fuel pump, or the screws fastening the wiring pigtail to the side of the pump. **The warranty of the injection pump and the engine may be void if those seals have been removed or tampered with.**

FUEL SUPPLY RESTRICTIONS

LOW–PRESSURE LINES

Restricted or Plugged supply lines or fuel filter can cause a timing fault that will cause the ECM to operate the engine in a “Limp Home” mode. See the introduction of the Fuel Injection System in this group for more information on the Limp Home mode. Fuel supply line restrictions can cause starting problems and prevent the engine from revving up. The starting problems include; low power and blue or white fog like exhaust. Test all fuel supply lines for restrictions or blockage. Flush or replace as necessary. Bleed the fuel system of air once a fuel supply line has been replaced. Refer to the Air Bleed Procedure section of this group for procedures.

HIGH–PRESSURE LINES

Restricted (kinked or bent) high–pressure lines can cause starting problems, poor engine performance and black smoke from exhaust.

Examine all high–pressure lines for any damage. Each radius on each high–pressure line must be smooth and free of any bends or kinks.

Replace damaged, restricted or leaking high–pressure fuel lines with the correct replacement line.

CAUTION: The high–pressure fuel lines must be clamped securely in place in the holders. The lines cannot contact each other or other components. Do not attempt to weld high–pressure fuel lines or to repair lines that are damaged. Only use the recommended lines when replacement of high–pressure fuel line is necessary.

DIAGNOSIS AND TESTING (Continued)

FUEL SHUTDOWN SOLENOID TEST

Refer to 1997 ZJ/ZG 2.5L Diesel Powertrain Diagnostic Manual for the Fuel Shutdown Solenoid test.

HIGH-PRESSURE FUEL LINE LEAK TEST

High–pressure fuel line leaks can cause starting problems and poor engine performance.

WARNING: DUE TO EXTREME FUEL PRESSURES OF UP TO 45,000 KPA (6526 PSI), USE EXTREME CAUTION WHEN INSPECTING FOR HIGH–PRESSURE FUEL LEAKS. DO NOT GET YOUR HAND, OR ANY PART OF YOUR BODY NEAR A SUSPECTED LEAK. INSPECT FOR HIGH–PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD. HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

Start the engine. Move the cardboard over the high–pressure fuel lines and check for fuel spray onto the cardboard (Fig. 21). If a high–pressure line connection is leaking, bleed the system and tighten the connection. Refer to the Air Bleed Procedure in this group for procedures. Replace damaged, restricted or leaking high–pressure fuel lines with the correct replacement line.

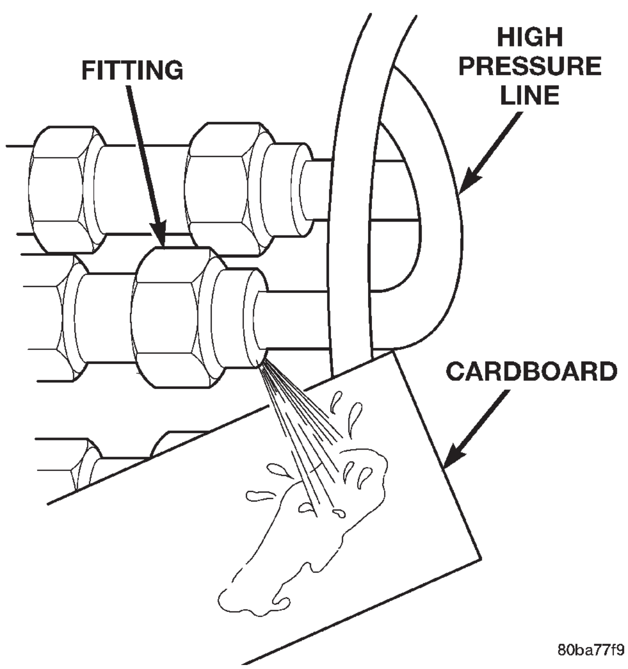


Fig. 21 Typical Fuel Pressure Test at Injector

CAUTION: The high–pressure fuel lines must be clamped securely in place in the holders. The lines cannot contact each other or other components. Do not attempt to weld high–pressure fuel lines or to repair lines that are damaged. Only use the recommended lines when replacement of high–pressure fuel line is necessary.

SERVICE PROCEDURES

AIR BLEED PROCEDURES

AIR BLEEDING AT FUEL FILTER

A certain amount of air may become trapped in the fuel system when fuel system components are serviced or replaced. Bleed the system as needed after fuel system service according to the following procedures.

WARNING: DO NOT BLEED AIR FROM THE FUEL SYSTEM OF A HOT ENGINE. DO NOT ALLOW FUEL TO SPRAY ONTO THE EXHAUST MANIFOLD WHEN BLEEDING AIR FROM THE FUEL SYSTEM.

Some air enters the fuel system when the fuel filter or injection pump supply line is changed. This small amount of air is vented automatically from the injection pump through the fuel drain manifold tubes if the filter was changed according to instructions. Ensure the bowl of the fuel filter/water separator is full of fuel.

It may be necessary to manually bleed the system if:

- The bowl of the fuel filter/water separator is not partially filled before installation of a new filter
- The injection pump is replaced
- High–pressure fuel line connections are loosened or lines replaced
- Initial engine start–up or start–up after an extended period of no engine operation
- Running fuel tank empty

FUEL INJECTION PUMP BLEEDING

(1) If the fuel injection pump has been replaced, air should be bled at the overflow valve before attempting to start engine.

(a) Loosen the overflow valve (Fig. 22) at the rear of the injection pump.

(b) Place a towel below the valve.

WARNING: WHEN CRANKING THE ENGINE TO BLEED AIR FROM THE INJECTION PUMP, THE ENGINE MAY START. PLACE THE TRANSMISSION IN NEUTRAL OR PARK AND SET PARKING BRAKE BEFORE ENGAGING THE STARTER MOTOR.

CAUTION: Do not engage the starter motor for more than 30 seconds at a time. Allow 2 minutes between cranking intervals.

SERVICE PROCEDURES (Continued)

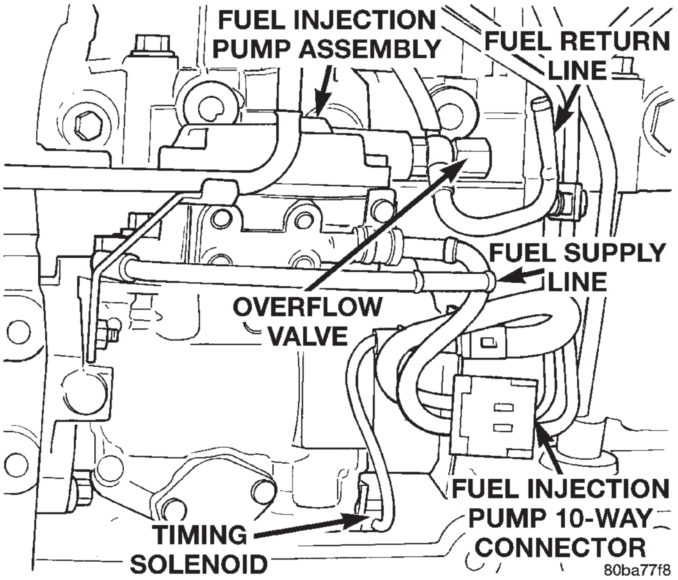


Fig. 22 Overflow Valve

(2) Crank the engine for 30 seconds at a time to allow air trapped in the injection pump to vent out the fuel injector drain tubes. Continue this procedure until the engine starts. Observe the previous WARNING and CAUTION.

(3) Tighten overflow valve.

HIGH–PRESSURE FUEL LINE BLEEDING

WARNING: THE INJECTION PUMP SUPPLIES HIGH–PRESSURE FUEL OF APPROXIMATELY 59,000 KPA (8,557 PSI) TO EACH INDIVIDUAL INJECTOR THROUGH THE HIGH–PRESSURE LINES. FUEL UNDER THIS AMOUNT OF PRESSURE CAN PENETRATE THE SKIN AND CAUSE PERSONAL INJURY. WEAR SAFETY GOGGLES AND ADEQUATE PROTECTIVE CLOTHING AND AVOID CONTACT WITH FUEL SPRAY WHEN BLEEDING HIGH–PRESSURE FUEL LINES.

WARNING: DO NOT BLEED AIR FROM THE FUEL SYSTEM OF A HOT ENGINE. DO NOT ALLOW FUEL TO SPRAY ONTO THE EXHAUST MANIFOLD WHEN BLEEDING AIR FROM THE FUEL SYSTEM.

Bleed air from one injector at time.

(1) Loosen the high–pressure fuel line fitting at the injector (Fig. 23).

(2) Crank the engine until all air has been bled from the line. **Do not operate the starter motor for longer than 30 seconds. Wait 2 minutes between cranking intervals.**

(3) Start the engine and bleed one injector at a time until the engine runs smoothly.

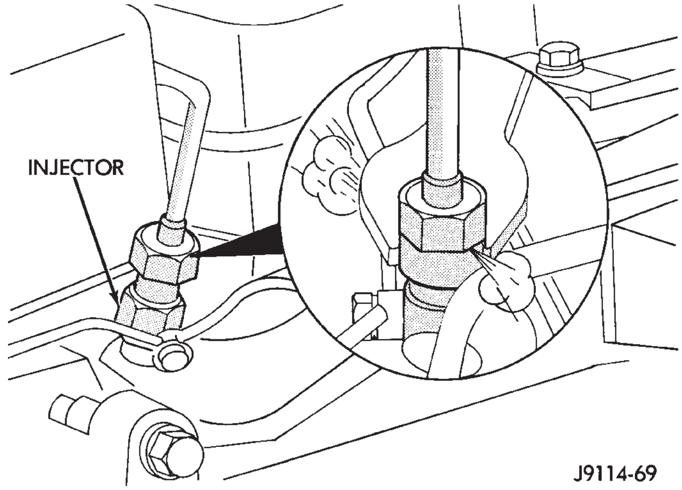


Fig. 23 Bleeding High–Pressure Fuel Line—Typical

FUEL INJECTION PUMP TIMING

Refer to Removal/Installation and Adjusting Fuel Pump Timing in this Group.

REMOVAL AND INSTALLATION

ACCELERATOR PEDAL

REMOVAL

(1) Disconnect electrical connector.

(2) Remove accelerator pedal mounting bracket nuts. Remove accelerator pedal assembly.

INSTALLATION

(1) Place accelerator pedal assembly over studs protruding from floor pan. Tighten mounting nuts to 5 N·m (46 in. lbs.) torque.

(2) Connect electrical connector.

(3) Before starting the engine, operate the accelerator pedal to check for any binding.

AIR CLEANER ELEMENT

REMOVAL

(1) Remove hose clamp at Mass Air Flow Sensor.

(2) Remove hose from Mass Air Flow Sensor.

(3) Loosen 2 clamps holding air cleaner housing halves together.

(4) Remove left side of air cleaner housing.

(5) Remove element from air cleaner housing.

INSTALLATION

(1) Install a new element in housing.

(2) Position left side of housing.

(3) Snap clamps into place.

(4) Install hoses and clamps.

REMOVAL AND INSTALLATION (Continued)

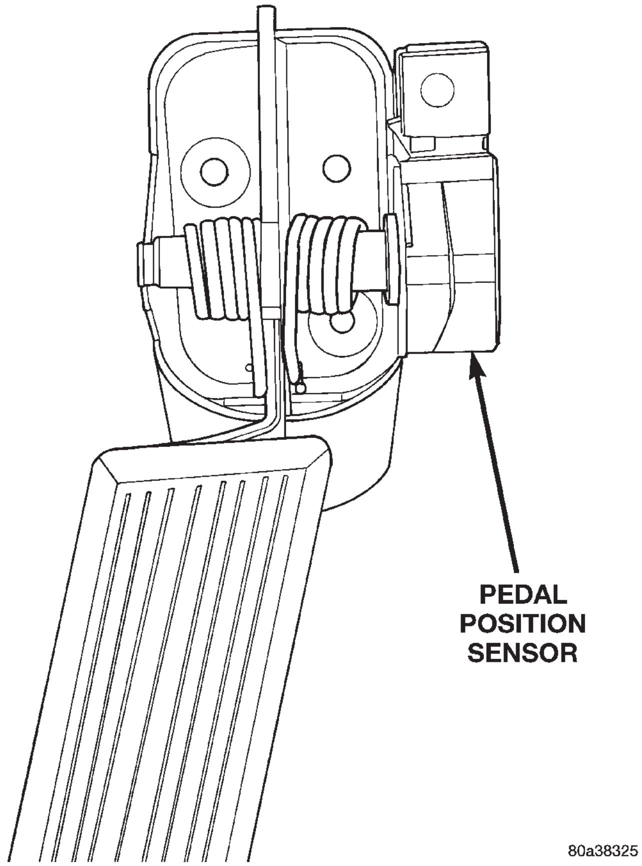


Fig. 24 Accelerator Pedal Mounting-Typical

FUEL DRAIN TUBES

The fuel drain tubes (Fig. 25) are low–pressure type.

Pull each tube from the injector for removal. Push on for installation. Clamps are not required for these tubes.

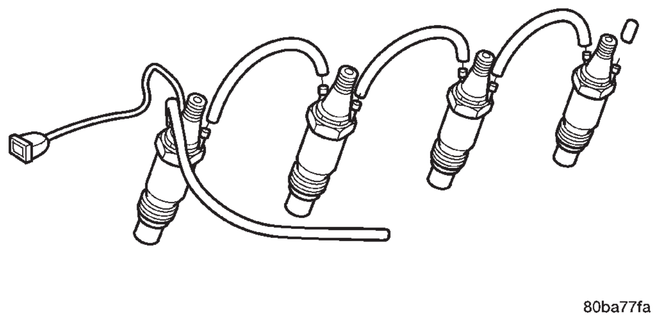


Fig. 25 Fuel Injectors and Drain Tubes

FUEL FILTER/WATER SEPARATOR

The fuel filter/water separator is located in the engine compartment on the left side near the shock tower. (Fig. 26).

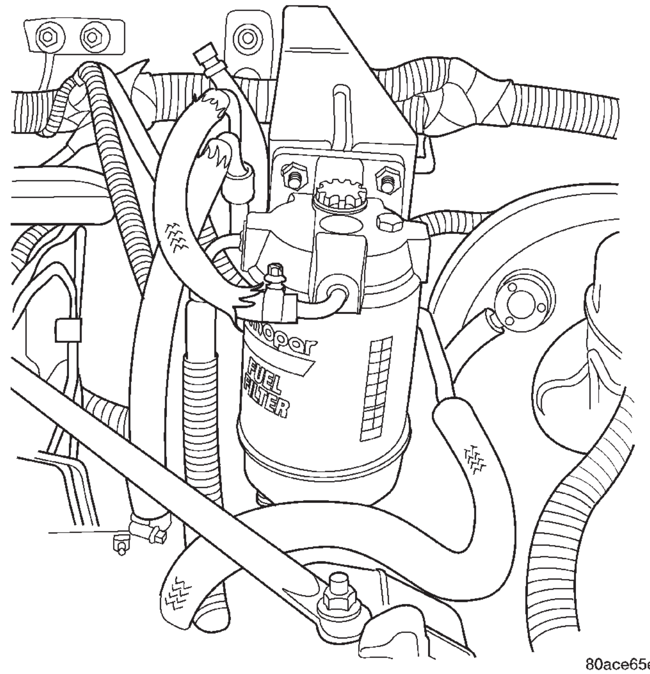


Fig. 26 Fuel Filter/Water Separator Location

The fuel filter/water separator assembly contains the fuel filter, fuel heater element, and fuel drain valve (Fig. 26).

DRAINING WATER FROM FILTER BOWL

Moisture (water) collects at the bottom of the filter/separator in a plastic bowl. Water entering the fuel injection pump can cause serious damage to the pump. **Note that the bulb will be illuminated for approximately 2 seconds each time the key is initially placed in the ON position. This is done for a bulb check.**

WARNING: DO NOT ATTEMPT TO DRAIN WATER FROM THE FILTER/SEPARATOR WITH THE ENGINE HOT.

(1) The bottom of the filter/separator bowl is equipped with a drain valve (Fig. 26). The drain valve is equipped with a fitting. Attach a piece of rubber hose to this fitting. This hose is to be used as a drain hose.

(2) Place a drain pan under the drain hose.

(3) With the engine not running, open the drain valve (unscrew—drain valve has right hand threads) from the filter/separator bowl. To gain access to this fitting, the two filter–to–mounting bracket nuts (Fig. 26) may have to be loosened a few turns.

(4) Hold the drain open until clean fuel exits the drain.

(5) After draining, close drain valve.

(6) Remove rubber drain hose.

(7) Dispose of mixture in drain pan according to applicable local or federal regulations.

REMOVAL AND INSTALLATION (Continued)

FUEL FILTER REMOVAL

(1) Drain all fuel and/or water from fuel filter/water separator assembly. Refer to the previous Draining Water From Filter Bowl.

(2) Unplug the electrical connectors at bottom of plastic bowl.

(3) Remove plastic bowl from bottom of fuel filter (unscrews).

(4) Remove fuel filter from bottom of filter base (unscrews).

FUEL FILTER INSTALLATION

(1) Clean bottom of fuel filter base.

(2) Apply clean diesel fuel to new fuel filter gasket.

(3) Install and tighten filter to filter base. The beveled part of the rubber gasket should be facing up towards the filter base.

(4) Clean the inside of bowl with a soap and water mixture before installation. Carefully clean any residue between the two metal probes at the top of the water–in–fuel sensor. Do not use chemical cleaners as damage to the plastic bowl may result.

(5) Pour diesel fuel into the plastic bowl before installing bowl to bottom of fuel filter. Do this to help prevent air from entering fuel injection pump while attempting to starting engine.

(6) Install filter bowl to bottom of filter.

(7) Install the electrical connectors at bottom of bowl.

(8) Tighten the filter–to–mounting bracket nuts (Fig. 26) to 28 N·m (250 in. lbs.) torque.

FUEL HEATER

If the fuel heater element needs replacement, the plastic filter bowl assembly must be replaced. Refer to Fuel Filter/Water Separator for information.

FUEL HEATER RELAY

The fuel heater relay is located in the PDC. For the location of the relay within the PDC (Fig. 27), refer to label on PDC cover.

FUEL LEVEL SENSOR

The fuel level sensor is located on the side of the fuel pump module (Fig. 28).

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. 29) to remove sending unit from pump module.

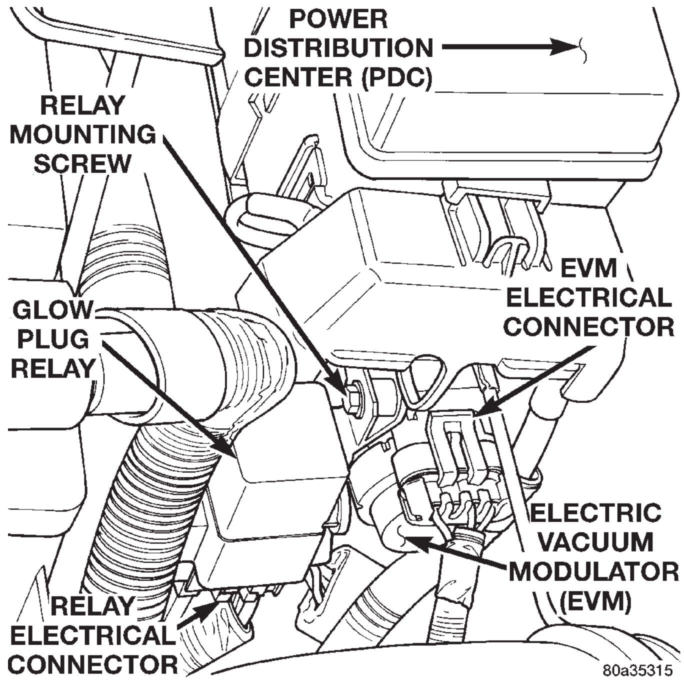


Fig. 27 Power Distribution Center (PDC) Location

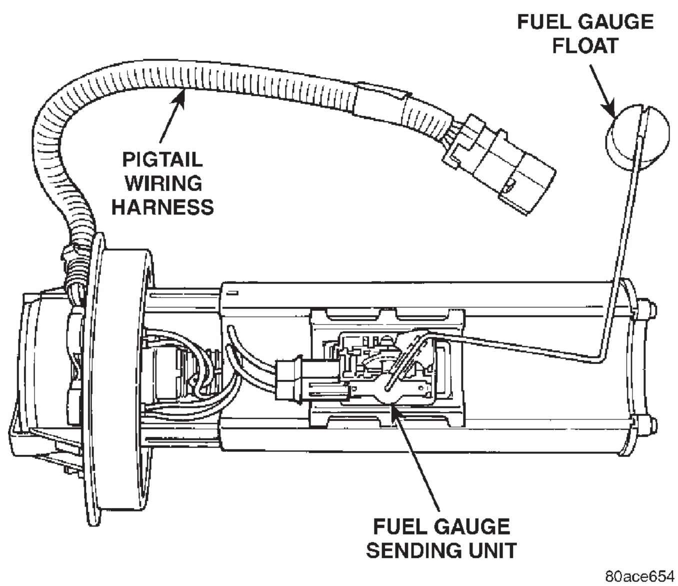


Fig. 28 Fuel Level Sensor

FUEL INJECTION PUMP

REMOVAL

(1) Disconnect the negative battery cable.

(2) Thoroughly clean the area around the injection pump and fuel lines of all dirt, grease and other contaminants. **Due to the close internal tolerances of the injection pump, this step must be performed before removing pump.**

REMOVAL AND INSTALLATION (Continued)

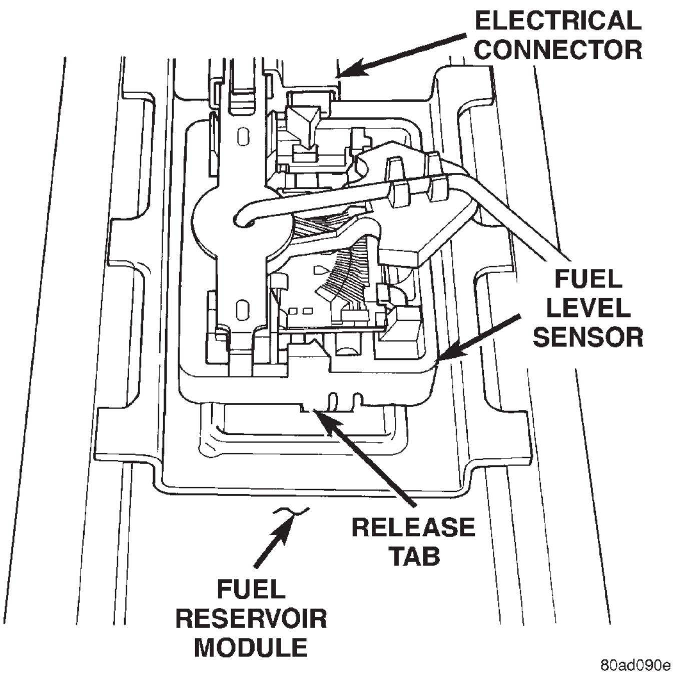


Fig. 29 Fuel Level Sensor Release Tab

(3) Remove the engine accessory drive belt. Refer to Group 7, Cooling System for procedures.

(4) Remove the generator assembly.

(5) Remove the rubber fuel return and supply hoses from the metal lines at the pump (Fig. 30).

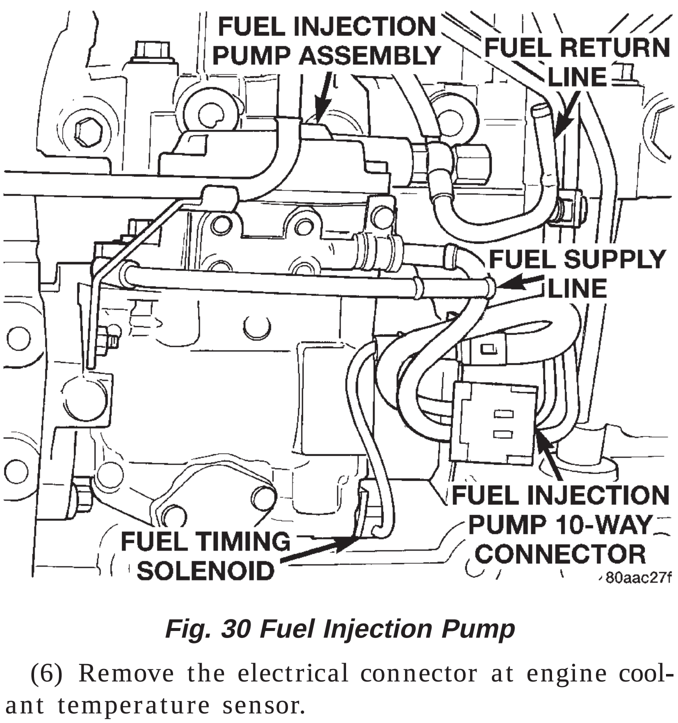


Fig. 30 Fuel Injection Pump

(6) Remove the electrical connector at engine coolant temperature sensor.

(7) Disconnect the Fuel Injection Pump electrical connector at fuel pump (Fig. 30).

(8) Disconnect the main engine wiring harness from the glow plugs.

(9) Disconnect the four high–pressure fuel lines from the fuel injection pump. Also disconnect fuel lines at the fuel injectors. For procedures, refer to High–Pressure Fuel Lines in this group. Place a rag beneath the fittings to catch excess fuel.

(10) Remove the plug from timing gear cover.

(11) The “Top Dead Center” (TDC) compression firing stroke for the #1 cylinder can be determined as follows:

(a) Using a socket attached to the front of the crankshaft, rotate the engine clockwise until special alignment tool VM# 1035 can be inserted through the hole in the bottom of the clutch housing, stopping the flywheel rotation. This position is TDC or 180° away from TDC. **Engine must be at TDC #1 compression firing stroke.**

(b) To verify that you are at TDC. Remove the oil fill cap from the cylinder head cover and the alignment tool from the clutch housing.

(c) Rotate the crankshaft one-quarter turn clockwise and counter-clockwise while observing the rocker arm through the oil fill cap hole. If the rocker arm moves you are not at TDC.

(d) If TDC was found continue, if not rotate the crankshaft one revolution until the alignment tool can be re-installed in the flywheel. You are now at TDC for the #1 cylinder compression firing stroke. Mark the damper and timing cover for reference to TDC. Remove the alignment tool from the clutch housing.

(12) Remove access plug and plug washer at rear of pump (Fig. 31). Thread special dial indicator and adapter tool VM.1011 (Fig. 32) into this opening. Hand tighten only.

(13) Slightly rotate the engine in a counter-clockwise direction until the dial gauge indicator stops moving (20°-25° before TDC).

(14) Remove injection pump drive gear nut (Fig. 33).

(15) A special 3–piece gear removal tool set VM.1003 (Fig. 34) must be used to remove the injection pump drive gear from the pump shaft.

(a) Thread the adapter (Fig. 35) into the timing cover.

(b) Thread the gear puller into the injection pump drive gear (Fig. 35). This tool is also used to hold the gear in synchronization during pump removal.

(c) Remove the three injection pump–to–gear cover mounting nuts (Fig. 36). **CAUTION: This step must be done to prevent injection pump damage.**

(d) Install the drive bolt into the gear puller (Fig. 35). Tighten the drive bolt to press (remove) the drive gear from injection pump shaft while

REMOVAL AND INSTALLATION (Continued)

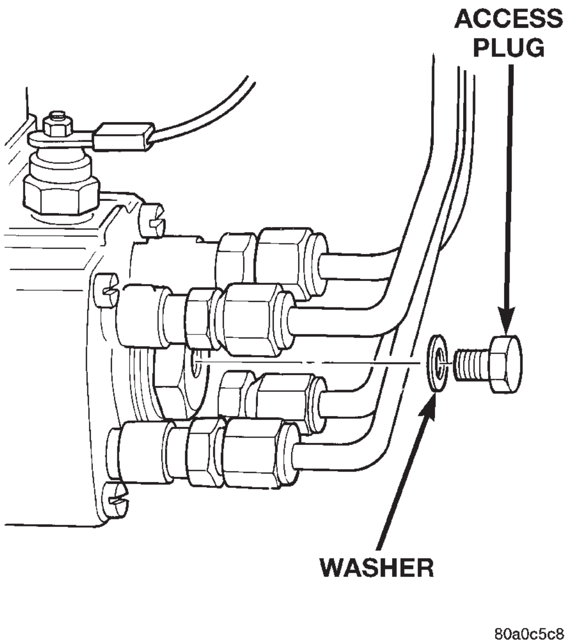


Fig. 31 Access Plug at Rear of Pump

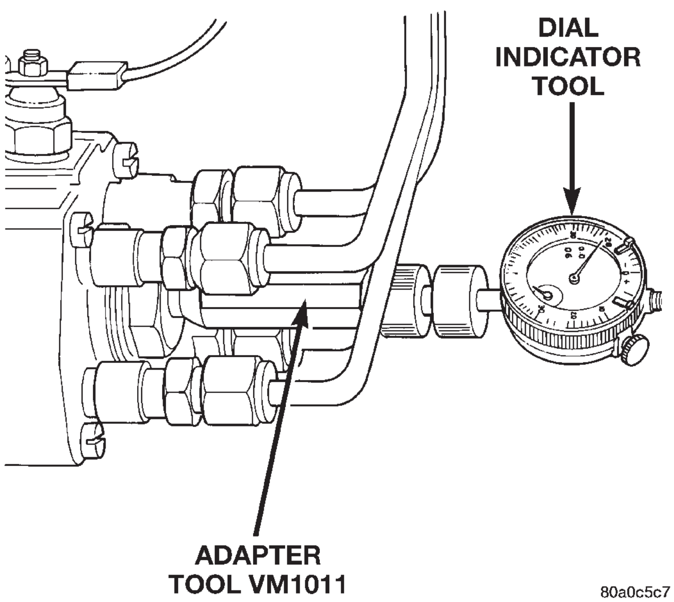


Fig. 32 Installing Dial Indicator and Special Adapter Tools

driving injection pump rearward from timing gear cover mounting studs.

(16) Remove pump from engine. **Do not rotate engine while gear puller is installed. Engine damage will occur.**

INSTALLATION/ADJUSTING PUMP TIMING

(1) Clean the mating surfaces of injection pump and timing gear cover.

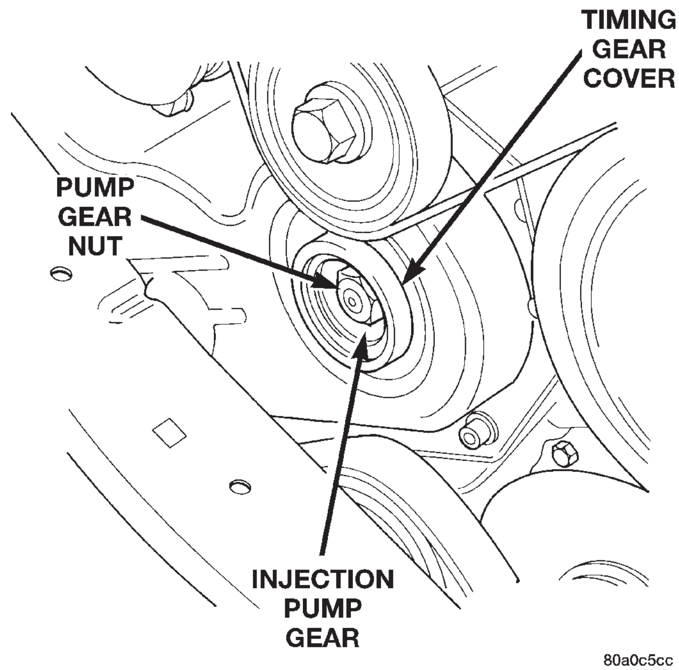


Fig. 33 Removing Pump Drive Gear Nut

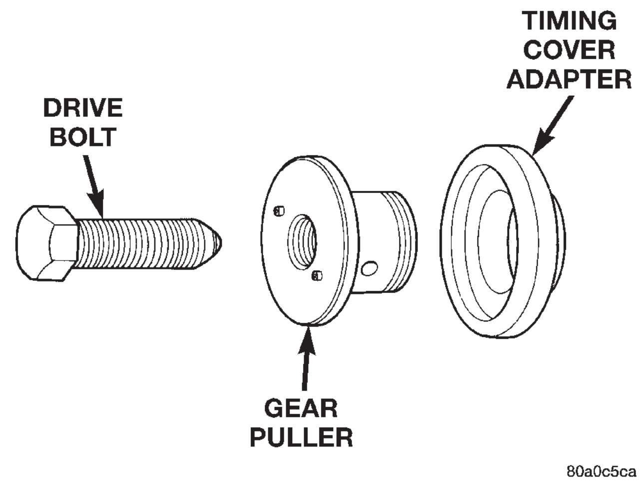


Fig. 34 Pump Gear Tools

(2) Install a new injection pump–to–timing gear cover gasket.

(3) Remove the gear removing bolt (drive bolt) from gear puller. **CAUTION: Do not remove the special gear puller or timing cover adapter tools from timing cover at this time. Gear mis-alignment will result.**

(4) Place the key way on the pump shaft to the 11 o'clock position as viewed from the front of pump. Install the pump into the rear of timing gear cover while aligning key way on pump shaft into pump gear.

(5) Install and snug the 3 injection pump mounting nuts. This is not the final tightening sequence.

(6) Remove the special gear puller and adapter tools from timing gear cover.

REMOVAL AND INSTALLATION (Continued)

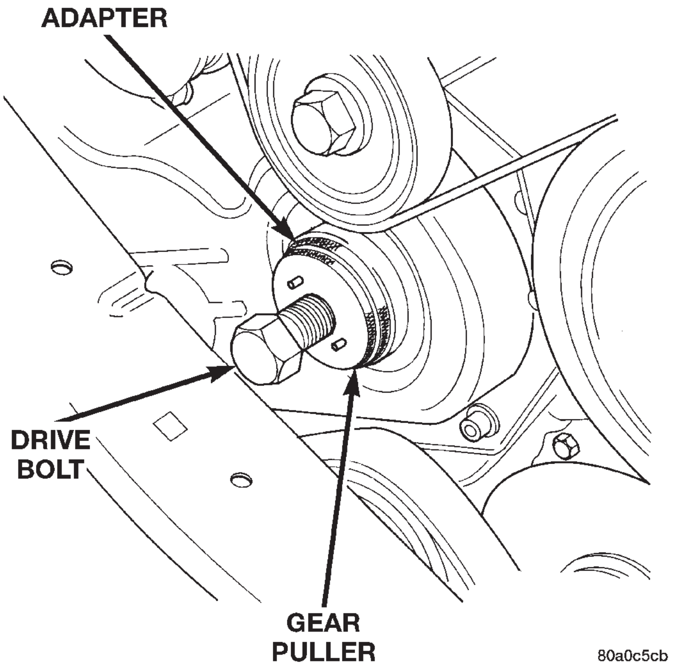


Fig. 35 Installing Pump Drive Gear Removal Tools

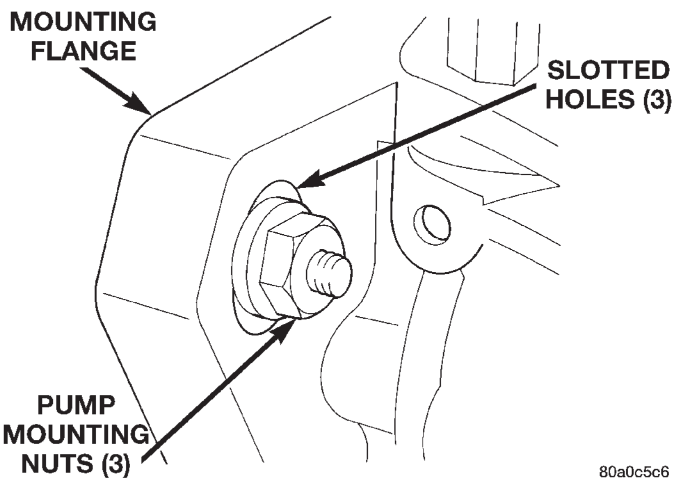


Fig. 36 Injection Pump Mounting Nuts

(7) Install the injection pump drive gear nut. Tighten nut to 88 N·m (65 ft. lbs.) torque.

(8) Remove the access plug and plug washer at rear of pump (Fig. 37). Thread special dial indicator adapter tool VM.1011 (Fig. 38) into this opening. Hand tighten only.

(9) Attach special dial indicator tool VM.1013 into the adapter tool (Fig. 38).

(10) Using a socket attached to the front of the crankshaft, rotate the engine in a counter-clockwise direction until the dial gage indicator stops moving (20–25° before TDC).

(11) Set the dial indicator to 0mm. Be sure the tip of the dial indicator is touching the tip inside the adapter tool.

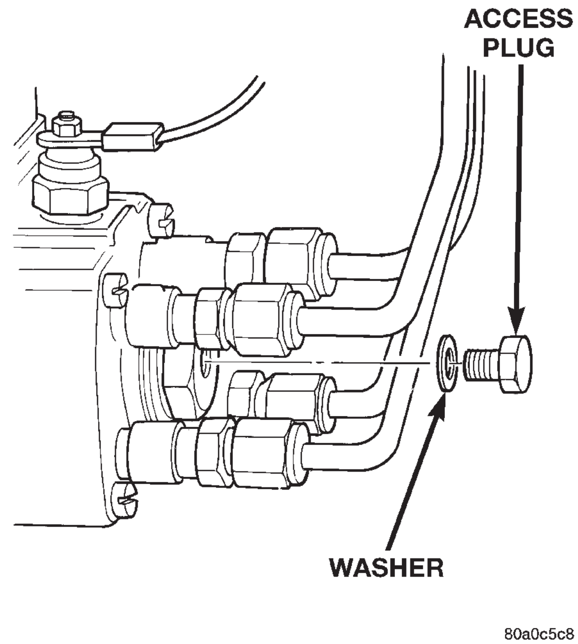


Fig. 37 Access Plug at Rear of Pump

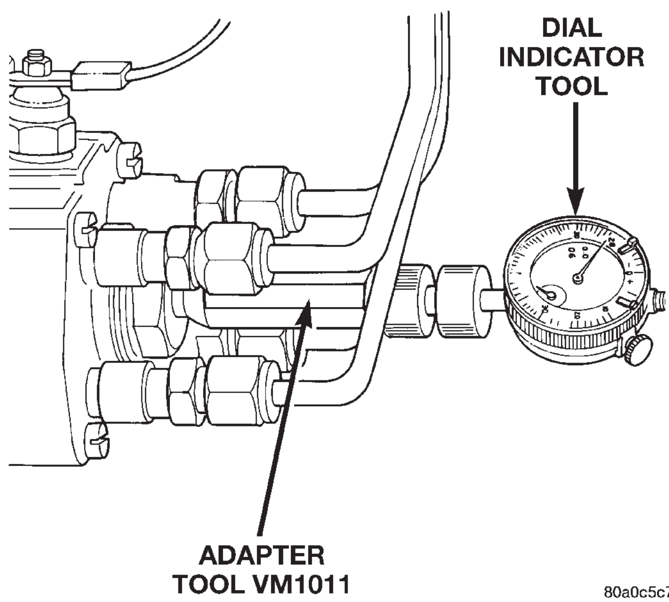


Fig. 38 Installing Dial Indicator and Special Adapter Tools

(12) The “Top Dead Center” (TDC) compression firing stroke can be determined as follows:

(a) Rotate the engine clockwise until special alignment tool VM# 1035 can be inserted through the hole in the bottom of the clutch housing, stopping the flywheel rotation. This position is TDC or 180° away from TDC. **Engine must be at TDC #1 compression firing stroke.**

REMOVAL AND INSTALLATION (Continued)

(b) To verify that you are at TDC. Remove the oil fill cap from the rocker cover and the alignment tool from the clutch housing.

(c) Rotate the crankshaft one-quarter turn clockwise and counter-clockwise while observing the rocker arm through the oil fill cap hole. If the rocker arm moves you are not at TDC.

(d) If TDC was found continue, if not rotate the crankshaft one revolution until the alignment tool can be re-installed in the flywheel. You are now at TDC.

(13) The gauge reading should be at 0.60 mm. If not, the pump must be rotated for adjustment:

(a) Loosen the three injection pump mounting nuts at the mounting flanges. These flanges are equipped with slotted holes. The slotted holes are used to rotate and position the injection pump for fuel timing. Loosen the three nuts just enough to rotate the pump.

(b) Rotate the pump until 0.60 mm is indicated on the dial indicator gauge. If while rotating the pump the 0.60mm specification is passed do not attempt to rotate the pump in the opposite direction. You must rotate the pump back below the 0.60mm specification and start the procedure over from the start of the TDC procedure. This will prevent a false reading due to gear backlash.

(c) Tighten the three pump mounting nuts to 30 N·m (22 ft. lbs.) torque.

(d) Recheck the dial indicator after tightening the pump mounting nuts. Gauge should still be reading 0.60 mm.

(14) Remove dial indicator and adapter tools.

(15) Install access plug and washer to rear of injection pump.

(16) Install plug at timing gear cover.

(17) Install and connect the four high–pressure fuel lines to the fuel injection pump. Also connect fuel lines at the fuel injectors. For procedures, refer to High–Pressure Fuel Lines in this group.

(18) Install electrical connector at engine coolant temperature sensor.

(19) Connect electrical connector at fuel shutdown solenoid.

(20) Connect the main engine wiring harness to the glow plugs.

(21) Connect the fuel timing solenoid pigtail harness to the engine wiring harness.

(22) Connect the overflow valve/banjo fitting (fuel return line assembly). Replace copper gaskets before installing.

(23) Connect the rubber fuel return and supply hoses to metal lines at pump. Tighten hose clamps to 2 N·m (20 in. lbs.) torque.

(24) Install generator assembly.

(25) Install engine accessory drive belt. Refer to Group 7, Cooling System for procedures.

(26) Install negative battery cable to battery.

(27) Start the engine and bring to normal operating temperature.

(28) Check for fuel leaks.

FUEL INJECTORS

Four fuel injectors are used on each engine. Of these four, two different types are used. The fuel injector used on cylinder number one is equipped with a fuel injector sensor (Fig. 39). The other three fuel injectors are identical. **Do not place the fuel injector equipped with the fuel injector sensor into any other location except the cylinder number one position.**

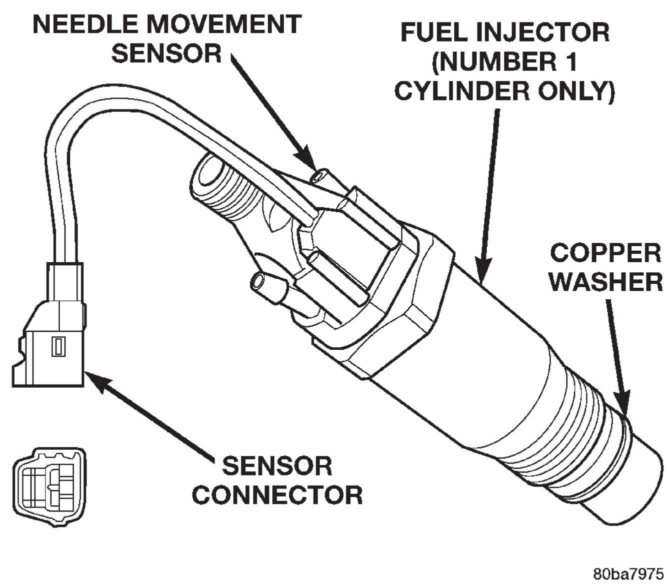


Fig. 39 Fuel Injector Sensor — #1 Cylinder

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Thoroughly clean the area around the injector with compressed air.

(3) Remove the fuel drain hoses (tubes) at each injector (Fig. 40) being serviced. Each of these hoses is slip–fit to the fitting on injector.

(4) Remove the high–pressure fuel line at injector being removed. Refer to High–Pressure Fuel Lines in this group for procedures.

(5) Remove the injector using special socket tool number VM.1012A. When removing cylinder number one injector, thread the wiring harness through the access hole on the special socket (Fig. 41).

(6) Remove and discard the copper washer (seal) at bottom of injector (Fig. 39).

REMOVAL AND INSTALLATION (Continued)

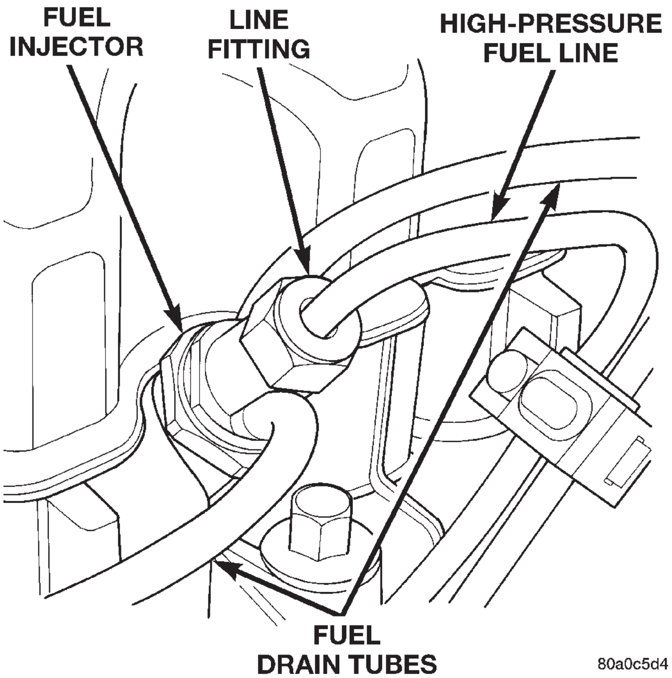


Fig. 40 Fuel Injector—Typical

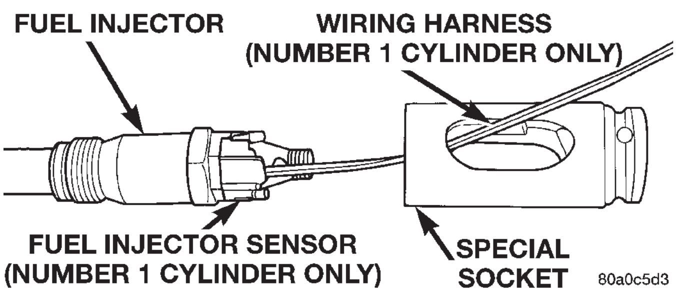


Fig. 41 Wiring Harness Through Socket

INSTALLATION

(1) Clean the injector threads in cylinder head.

(2) Install new copper washer (seal) to injector.

(3) Install injector to engine. Tighten to 70 N·m (52 ft. lbs.) torque.

(4) Install high–pressure fuel lines. Refer to High–Pressure Fuel Lines in this group for procedures.

(5) Install fuel drain hoses (tubes) to each injector. Do not use clamps at fuel drain hoses.

(6) Connect negative battery cable to battery.

(7) Bleed the air from the high–pressure lines. Refer to the Air Bleed Procedure section of this group.

FUEL TANK

REMOVAL

(1) Disconnect negative cable from battery.

(2) Insert fuel siphon hose into fuel filler neck and push it into the tank.

(3) Drain fuel tank dry into holding tank or a properly labeled **diesel** safety container.

(4) Raise vehicle on hoist.

(5) Disconnect both the fuel fill and fuel vent rubber hoses at the fuel tank.

(6) Disconnect fuel supply and return lines from the steel supply line (Fig. 42).

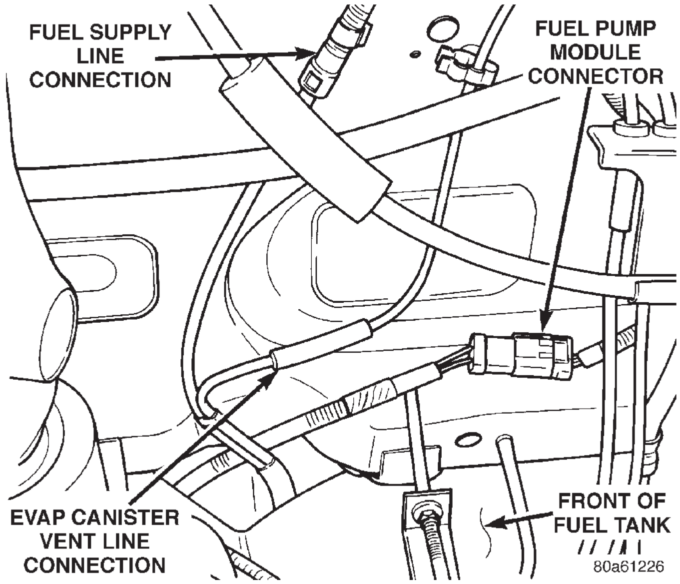


Fig. 42 Fuel Tank Connections at Front of Tank

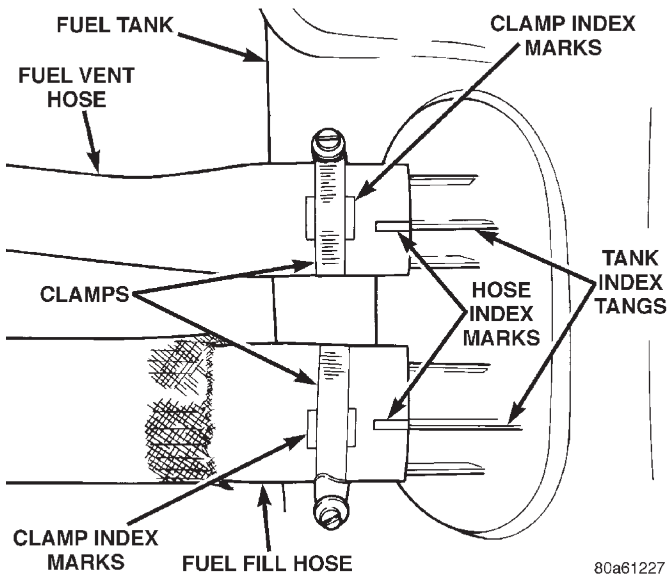


Fig. 43 Fuel Fill/Vent Hose Index Marks

The fuel reservoir module electrical connector has a retainer that locks it in place.

(7) Slide electrical connector lock to unlock.

(8) Push down on connector retainer (Fig. 44) and pull connector off module.

(9) Use a transmission jack to support fuel tank. Remove bolts from fuel tank straps.

REMOVAL AND INSTALLATION (Continued)

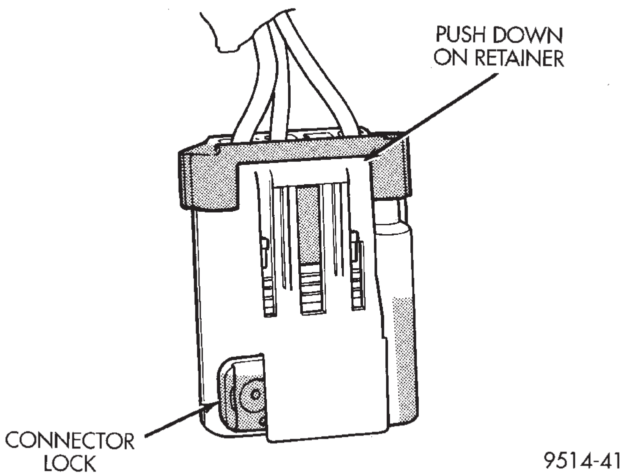


Fig. 44 Module Connector Retainer and Lock

(10) Lower tank slightly. Carefully remove filler hose from tank.

(11) Lower the fuel tank. Remove clamp and remove fuel filler tube vent hose. Remove fuel tank from vehicle.

INSTALLATION

(1) Position fuel tank on transmission jack. Connect fuel filler tube vent hose and replace clamp.

(2) Raise tank into position and carefully work filler tube into tank. A light coating of clean engine oil on the tube end may be used to aid assembly.

(3) Feed filler vent line thorough frame rail. Careful not to cross lines.

(4) Tighten strap bolts to 9 N·m (80 in. lbs.). Remove transmission jack.

CAUTION: Ensure straps are not twisted or bent before or after tightening strap nuts.

(5) Connect module electrical connector. Place retainer in locked position.

(6) Lubricate the fuel supply and return lines with clean 30 weight engine oil, install the quick connect fuel fitting. Refer to Tube/Fitting Assembly in the Fuel Delivery section of this Group.

(7) Attach filler line to filler tube. Pull on connector to make sure of connection.

(8) Fill fuel tank, replace cap, and connect battery negative cable.

FUEL RESERVOIR MODULE

REMOVAL

WARNING: THE FUEL RESERVOIR OF THE FUEL MODULE DOES NOT EMPTY OUT WHEN THE TANK IS DRAINED. THE FUEL IN THE RESERVOIR WILL SPILL OUT WHEN THE MODULE IS REMOVED.

(1) Disconnect negative cable from battery.

(2) Drain fuel tank dry into holding tank or a properly labeled **diesel** safety container.

(3) Raise vehicle on hoist.

(4) Use a transmission jack to support the fuel tank. Remove bolts from fuel tank straps. Lower tank slightly.

(5) Clean area around fuel reservoir module and tank to keep dirt and foreign material out of tank.

(6) Disconnect fuel lines from fuel module by depressing quick connect retainers with thumb and fore finger.

(7) Slide module electrical connector lock to unlock.

(8) Push down on connector retainer and pull connector off module.

(9) Using Special Tool 6856, remove plastic locknut counterclockwise to release pump module (Fig. 45).

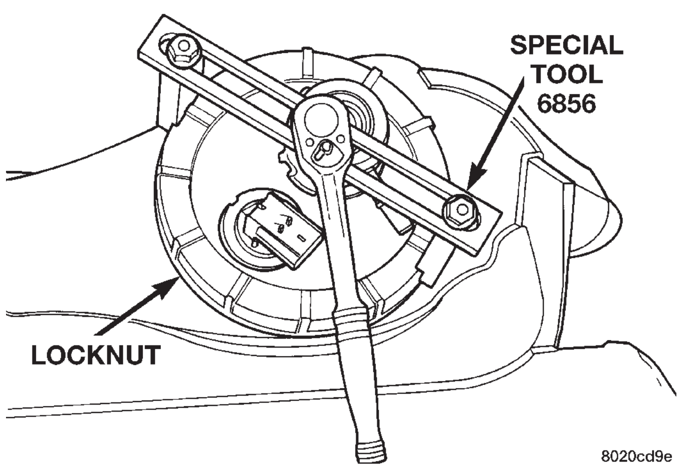


Fig. 45 Fuel Reservoir Module Lock Nut Removal

(10) Carefully remove module and o-ring from tank.

(11) Discard old o-ring.

INSTALLATION

(1) Thoroughly clean locknut threads and mating fule tank threads. Use a soap/water solution. **Do not use carburetor cleaner to clean threads.**

(2) Apply clean water to the o-ring seal and place on the mating fuel tank threads.

(3) Wipe seal area of tank clean and place a new o-ring seal in position on pump.

(4) Position fuel reservoir module in tank with locknut.

(5) Tighten locknut to 75 N·m (55 ft. lbs.).

(6) Connect fuel lines.

(7) Plug in electrical connector. Slide connector lock into position.

(8) Raise fuel tank, install bolts into fuel tank straps and tighten.

(9) Lower vehicle on hoist.

REMOVAL AND INSTALLATION (Continued)

(10) Connect negative cable from battery.
(11) Fill fuel tank. Check for leaks.
(12) Install fuel filler cap.

HIGH-PRESSURE LINES

All high–pressure fuel lines are of the same length and inside diameter. Correct high–pressure fuel line usage and installation is critical to smooth engine operation.

CAUTION: The high–pressure fuel lines must be clamped securely in place in the holders. The lines cannot contact each other or other components. Do not attempt to weld high–pressure fuel lines or to repair lines that are damaged. Only use the recommended lines when replacement of high–pressure fuel line is necessary.

REMOVAL

(1) Disconnect negative battery cable from battery.
(2) Remove the necessary clamps holding the lines to the engine.
(3) Clean the area around each fuel line connection. Disconnect each line at the top of each fuel injector (Fig. 46).

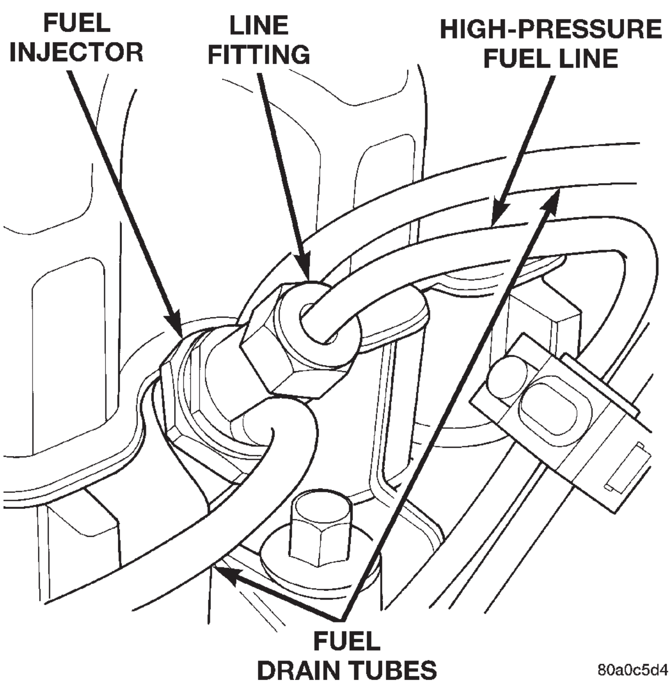


Fig. 46 Fuel Lines at Fuel Injectors

(4) Disconnect each high–pressure line fitting at each fuel injection pump delivery valve.

(5) Very carefully remove each line from the engine. Note the position (firing order) of each line while removing. **Do not bend the line while removing.**

CAUTION: Be sure that the high–pressure fuel lines are installed in the same order that they were removed. Prevent the injection pump delivery valve holders from turning when removing or installing high–pressure lines from injection pump.

INSTALLATION

(1) Carefully position each high–pressure fuel line to the fuel injector and fuel injection pump delivery valve holder in the correct firing order. Also position each line in the correct line holder.
(2) Loosely install the line clamp/holder bolts.
(3) Tighten each line at the delivery valve to 30 N·m (22 ft. lbs.) torque.
(4) Tighten each line at the fuel injector to 30 N·m (22 ft. lbs.) torque.

Be sure the lines are not contacting each other or any other component.

(5) Tighten the clamp bracket bolts to 24 N·m (18 ft. lbs.) torque.
(6) Bleed air from the fuel system. Refer to the Air Bleed Procedure section of this group.

SPECIFICATIONS

FUEL TANK CAPACITY

75 Liters (20.0 Gals.)

Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerances, ambient temperatures and refill procedures.

IDLE SPEED

900 rpm ±25 rpm with engine at normal operating temperature.

FUEL INJECTOR FIRING SEQUENCE

1–3–4–2

FUEL SYSTEM PRESSURE

Peak Injection Pressure/Fuel Injection Pump Operating Pressure: 40,000–45,000 kPa (5801–6526 psi).

Opening Pressure of Fuel Injector: 15,000–15,800 kPa (2175–2291 psi).

FUEL INJECTION SYSTEM—2.5L DIESEL ENGINE

INDEX

GENERAL INFORMATION

INTRODUCTION

This section will cover components either regulated or controlled by the ECM controller and the Powertrain Control Module (PCM). The fuel heater relay and fuel heater are not operated by the ECM controller or the PCM. These components are controlled by the ignition (key) switch. All other fuel system electrical components necessary to operate the engine are controlled or regulated by the ECM controller, which interfaces with the PCM. Refer to the following description for more information.

Certain fuel system component failures may cause a no start, or prevent the engine from running. It is important to know that the ECM has a feature where, if possible, it will ignore the failed sensor, set a code related to the sensor, and operate the engine in a “Limp Home” mode. When the ECM is operating in a “Limp Home” mode, the Check Engine Lamp on the instrument panel may be constantly illuminated, and the engine will most likely have a noticeable loss of performance. An example of this would be an Accelerator Pedal Position Sensor failure, and in that situation, the engine would run at a constant 1100 RPM, regardless of the actual position of the pedal. This is the most extreme of the three “Limp Home” modes.

When the Check Engine Lamp is illuminated constantly with the key on and the engine running, it usually indicates a problem has been detected some-

GENERAL INFORMATION (Continued)

where within the fuel system. The DRBIII scan tool is the best method for communicating with the ECM and PCM to diagnose faults within the system.

DESCRIPTION AND OPERATION

POWERTRAIN CONTROL MODULE (PCM)

On LHD vehicles, the ECM is mounted behind the lower Instrument Panel to the right of the accelerator pedal (Fig. 1). On RHD vehicles, the ECM is mounted behind the lower Instrument Panel to the left of the clutch pedal. The Powertrain Control Module (PCM) is mounted in the engine compartment. (Fig. 2).

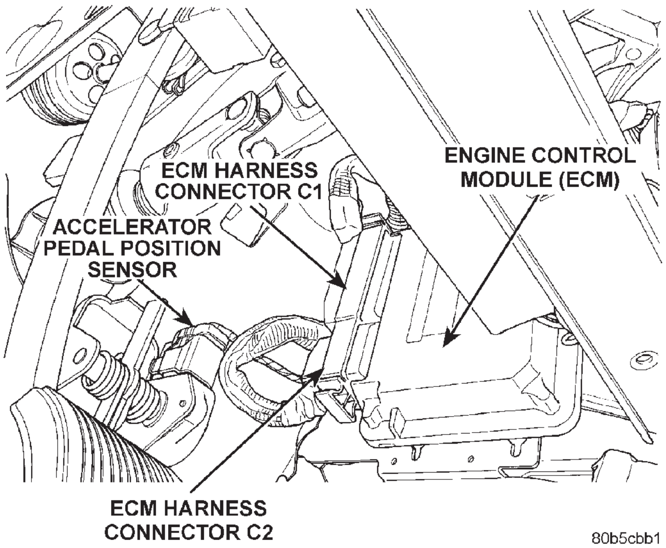


Fig. 1 ECM Controller Location

The ECM Controller is a pre–programmed, digital computer. It will either directly operate or partially regulate the:

- Speed Control
- Speed Control lamp
- Fuel Timing Solenoid
- Check Engine Light
- Glow Plug Relay
- Glow Plugs
- Glow Plug Lamp
- ASD Relay
- Air Conditioning
- Tachometer
- Electric Vacuum Modulator (EVM)

The ECM can adapt its programming to meet changing operating conditions.

The ECM receives input signals from various switches and sensors. Based on these inputs, the ECM regulates various engine and vehicle operations through different system components. These components are referred to as **ECM Outputs.** The sensors

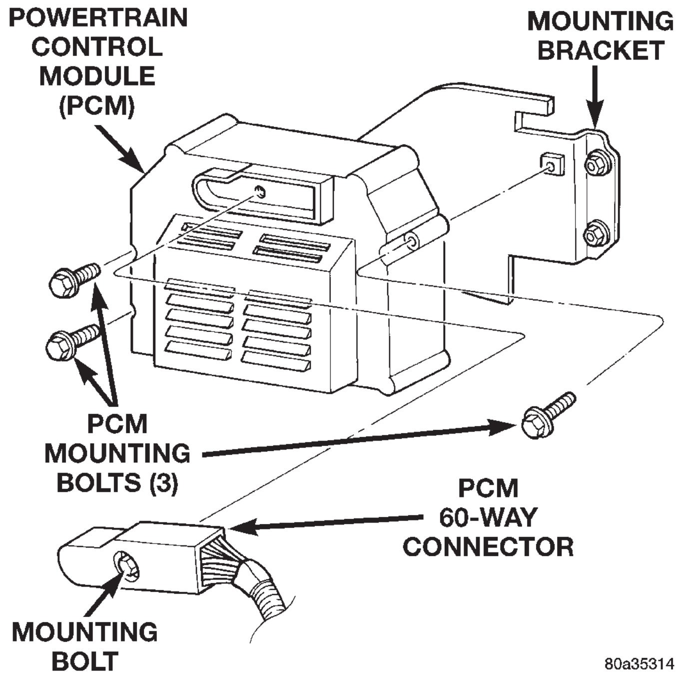


Fig. 2 PCM Location

and switches that provide inputs to the ECM are considered **ECM Inputs.**

ECM Inputs are:

- Air Conditioning Selection
- Theft Alarm
- ASD Relay
- Control Sleeve Position Sensor
- Fuel Temperature Sensor
- Mass Air Flow Sensor
- Accelerator Pedal Position Sensor
- Engine Coolant Temperature Sensor
- Low Idle Position Switch
- 5 Volt Supply
- Vehicle Speed Sensor
- Engine Speed/Crank Position Sensor (rpm)
- Needle Movement Sensor
- Starter Signal
- Brake Switch
- Speed Control Switch
- Power Ground
- Ignition (key) Switch Sense

ECM Outputs:

After inputs are received by the ECM and PCM, certain sensors, switches and components are controlled or regulated by the ECM and PCM. These are considered **ECM Outputs.** These outputs are for:

- A/C Clutch Relay (for A/C clutch operation)
- Speed Control Lamp
- ASD Relay
- 5 Volts Supply
- Fuel Quantity Actuator
- Fuel Timing Solenoid
- Fuel Shutdown Solenoid

DESCRIPTION AND OPERATION (Continued)

- Glow Plug Lamp
- Check Engine Lamp ("On/Off" signal)
- Electric Vacuum Modulator (EVM)
- Glow Plug Relay
- Tachometer

The PCM sends and recieves signals to and from the ECM controller. **PCM inputs are:**

- Power Gound
- 5 Volts Supply
- Vehicle Speed Sensor
- Water-In-Fuel Sensor
- Coolant Temperature Sensor
- Low Coolant Sensor
- Sensor Return
- Fuel Level Sensor
- Oil Pressure Sensor
- Tachometer Signal
- Glow Plug Lamp
- Check Engine Lamp ("On/Off" signal)
- Brake On/Off Switch
- Battery Voltage
- ASD Relay

PCM Outputs:

- A/C On Signal
- Vehicle Theft Alarm "Ok to Run" signal
- Body Control Module CCD Bus (+)
- Body Control Module CCD Bus (–)
- Scan Tool Data Link Recieve
- Scan Tool Data Link Transmit
- Low Coolant Lamp
- Generator Control

BOOST / PRESSURE SENSOR

The Boost Pressure Sensor is mounted to the top of the intake manifold (Fig. 3). It is a sensor that measures both manifold vacuum and turbo boost, and it also contains an integrated intake air temperature sensor. The Boost Pressure Sensor takes the place of the Mass Air Flow (MAF). In the Intake Air Temperature Sensor component, there is a ceramic element that changes its resistance based on temperature. The ceramic element is part of an electronic circuit connected to the PCM, and has a voltage applied to it. The ceramic element is exposed to the air inside the intake. This air has a cooling effect on the ceramic element, and its resistance changes. This causes the voltage flowing through the intake air temperature circuit to vary. The voltage signal produced by the Intake Air Temperature Sensor changes inversely to the temperature, and is measured by the PCM. As a general rule, when the temperature of the air in the intake is high, the voltage signal produced by the Intake Air Temperature Sensor is low. The component of the Boost Pressure Sensor that measures manifold vacuum and turbo boost produces a voltage signal that is proportional to the pressure in the intake manifold. When the intake manifold pressure is low, the voltage is low, and when the pressure is high, the voltage is high. The PCM uses the voltage signals from the Boost Pressure Sensor, and the Intake Air Temperature Sensor to determine the amount of air flowing through the intake manifold.

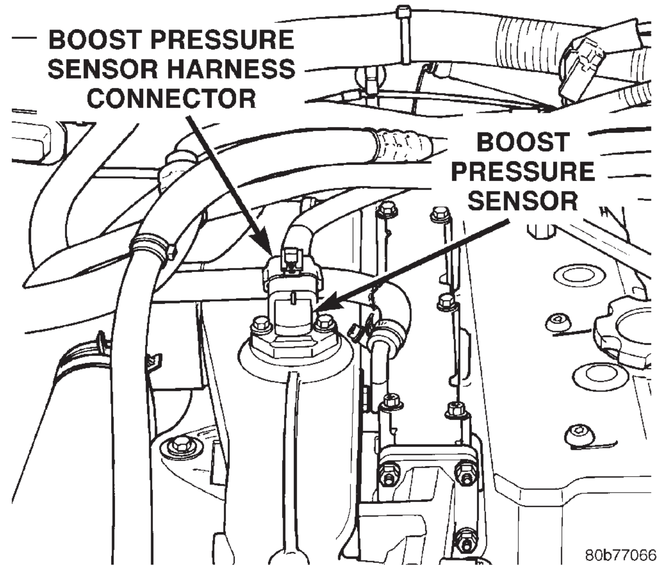


Fig. 3 Boost Pressure Sensor Location

VEHICLE THEFT ALARM

The PCM can learn if the vehicle has a Vehicle Theft Alarm (VTA) system. Once it detects the vehicle having VTA, **the controller can ONLY BE USED ON VEHICLES WITH VTA.**

If the PCM is put it on a vehicle without VTA the Glow Plug Lamp will start to blink and the vehicle will not start.

The PCM cannot be flashed to remove the VTA.

BATTERY VOLTAGE—PCM INPUT

The battery voltage input provides power to the PCM. It also informs the PCM what voltage level is being supplied by the generator once the vehicle is running.

The battery input also provides the voltage that is needed to keep the PCM memory alive. The memory stores Diagnostic Trouble Code (DTC) messages. Trouble codes will still be stored even if the battary voltage is lost.

SENSOR RETURN—ECM/PCM INPUT (ANALOG GROUND)

Sensor Return provides a low noise Analog ground reference for all system sensors.

IGNITION CIRCUIT SENSE—MSA/PCM INPUT

The ignition circuit sense input signals the MSA and PCM that the ignition (key) switch has been

DESCRIPTION AND OPERATION (Continued)

turned to the ON position. This signal initiates the glow plug control routine to begin the "pre–heat" cycle.

IGNITION CIRCUIT SENSE—PCM INPUT

The ignition circuit sense input signals the PCM that the ignition (key) switch has been turned to the ON position. This signal initiates the glow plug control routine to begin the "pre–heat" cycle.

POWER GROUND

Provides a common ground for power devices (solenoid and relay devices).

NEEDLE MOVEMENT OR INSTRUMENTED FIRST INJECTOR—ECM INPUT

This input from the ECM supplies a constant 30 mA electrical current source for the first injector sensor. It will vary the voltage to this sensor when it senses a mechanical movement within the injector needle (pintle) of the number–1 cylinder fuel injector. When this voltage has been determined by the ECM, it will then control an output to the fuel timing solenoid (the fuel timing solenoid is located on the fuel injection pump). Also refer to Fuel Injection Pump for additional information.

The first injector sensor is a magnetic (inductive) type.

The first injector sensor is used only on the fuel injector for the number–1 cylinder (Fig. 4). It is not used on the injectors for cylinders number 2, 3, or 4.

FUEL INJECTOR SENSOR—GROUND

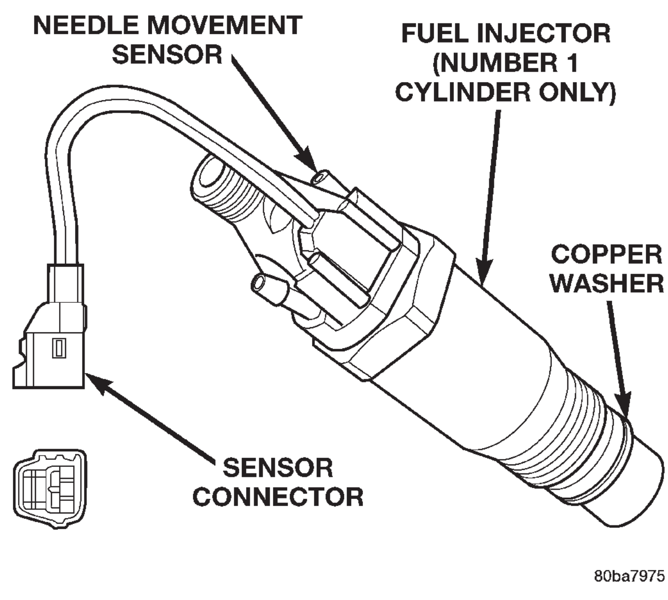


Fig. 4 Fuel Injector Sensor

Provides a low noise ground for the fuel injector sensor only.

ENGINE COOLANT TEMPERATURE SENSOR—ECM/PCM INPUT

The 0–5 volt input from this sensor tells the ECM and PCM the temperature of the engine coolant. Based on the voltage received at the ECM, it will then determine operation of the fuel timing solenoid, glow plug relay, electrical vacuum modulator (emission component) and generator (charging system).

The sensor is located on the side of the #3 cylinder head near the rear of fuel injection pump (Fig. 5).

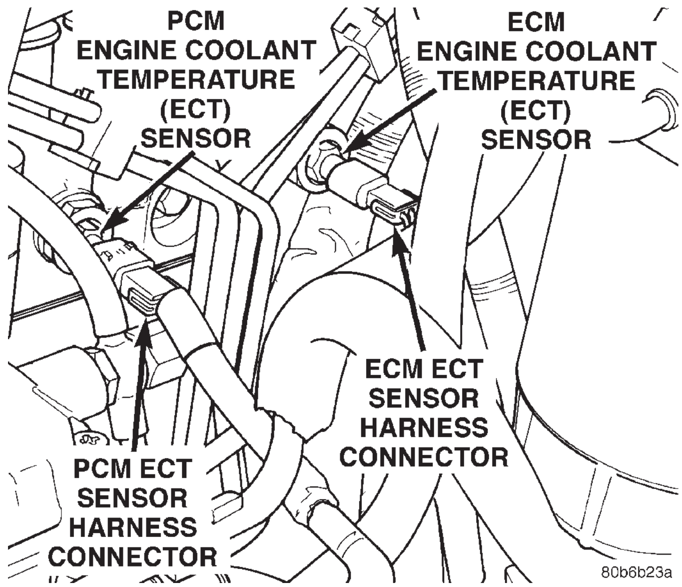


Fig. 5 Engine Coolant Temperature Sensor Location

ENGINE SPEED/CRANK POSITION SENSOR—ECM INPUT

The engine speed sensor is mounted to the transmission bellhousing at the left/rear side of the engine block (Fig. 6).

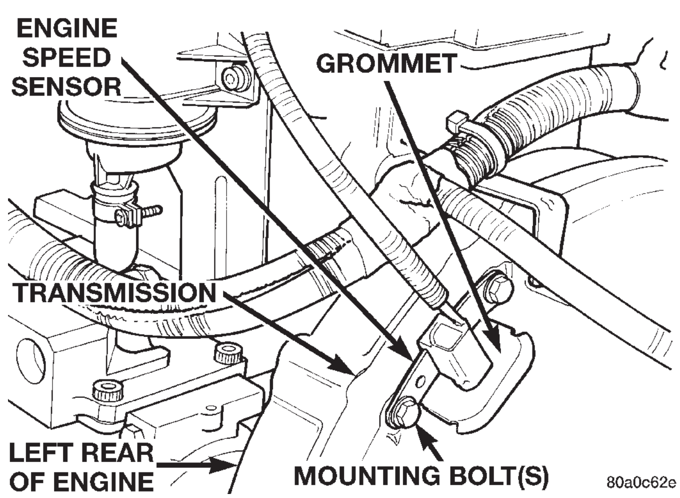


Fig. 6 Engine Speed Sensor Location

DESCRIPTION AND OPERATION (Continued)

The engine speed sensor produces its own output signal. If this signal is not received, the ECM will not allow the engine to start.

The engine speed sensor input is used in conjunction with the first injector sensor to establish fuel injection pump timing.

The flywheel has four notches at its outer edge (Fig. 7). Each notch is spaced equally every 90°. The notches cause a pulse to be generated when they pass under the speed sensor (Fig. 7). These pulses are the input to the ECM. The input from this sensor determines crankshaft position (in degrees) by monitoring the notches.

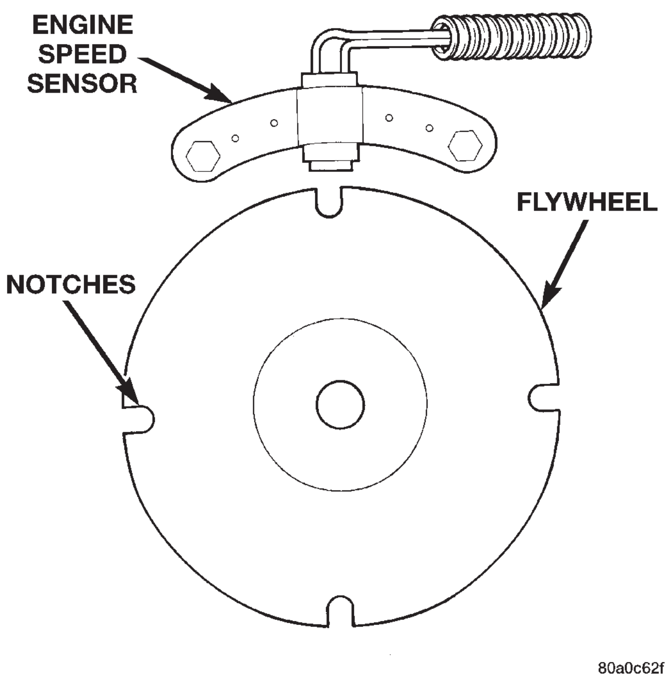


Fig. 7 Speed Sensor Operation

The sensor also generates an rpm signal to the ECM. This signal is used as an input for the control of the generator field, vehicle speed control, and instrument panel mounted tachometer.

If the engine speed sensor should fail, the system is unable to compensate for the problem and the car will stop.

AIR CONDITIONING (A/C) CONTROLS—ECM INPUTS

The A/C control system information applies to factory installed air conditioning units.

A/C REQUEST SIGNAL: When either the A/C or Defrost mode has been selected and the A/C low and high–pressure switches are closed, an input signal is sent to the ECM. The ECM uses this input to cycle the A/C compressor through the A/C relay.

If the A/C low or high–pressure switch opens, the ECM will not receive an A/C request signal. The PCM will then remove the ground from the A/C relay. This will deactivate the A/C compressor clutch. Also, if the engine coolant reaches a temperature outside normal of its normal range, or it overheats, the ECM will deactivate the A/C clutch.

BRAKE SWITCH—ECM INPUT

When the brake light switch is activated, the ECM receives an input indicating that the brakes are being applied. After receiving this input, the ECM is used to control the speed control system. There is a Primary and a Secondary brake switch. The Secondary brake switch is closed until the brake pedal is pressed.

DATA LINK CONNECTOR—PCM AND ECM INPUT AND OUTPUT

The 16–way data link connector (diagnostic scan tool connector) links the Diagnostic Readout Box (DRB) scan tool with the PCM and ECM. The data link connector is located under the instrument panel near the bottom of steering column (Fig. 8).

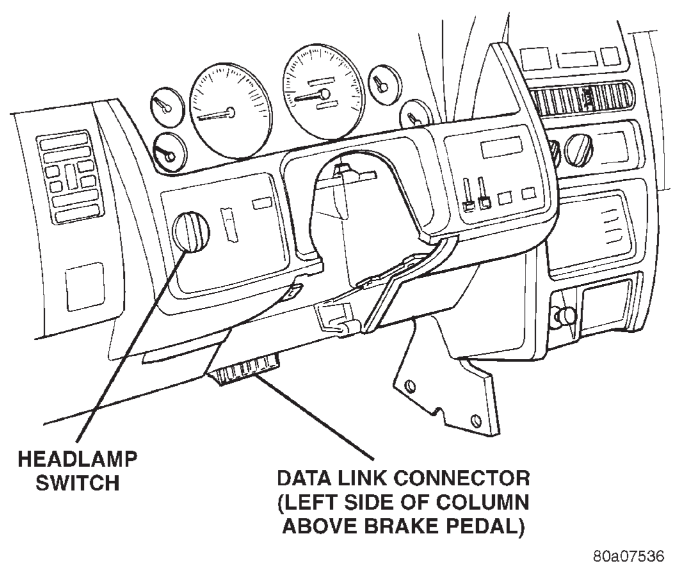


Fig. 8 Data Link Connector Location

VEHICLE SPEED SENSOR—ECM INPUT

The vehicle speed sensor is located in the extension housing of the transmission (2WD) (Fig. 9) or on the transfer case extension housing (Fig. 10). The sensor input is used by the ECM 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 accelerator pedal position sensor, indicate an idle deceleration to the ECM. When the vehicle is stopped at idle, a released pedal signal is received by the ECM (but a speed sensor signal is not received).

DESCRIPTION AND OPERATION (Continued)

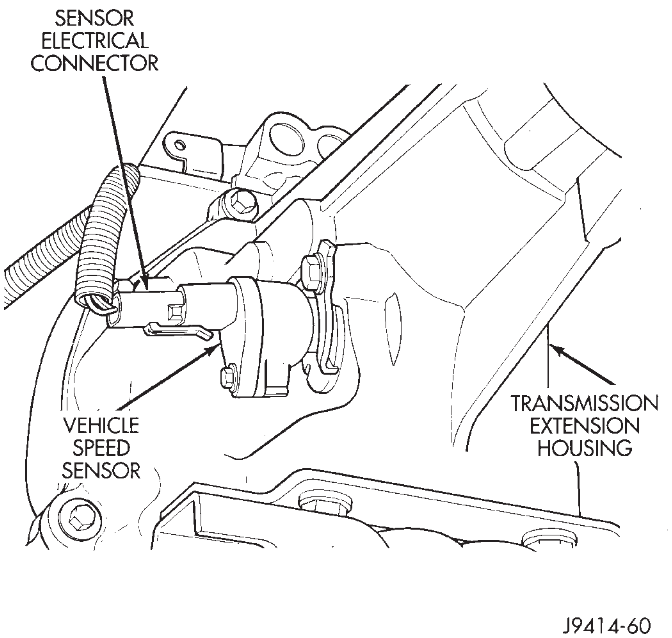


Fig. 9 Vehicle Speed Sensor—Typical

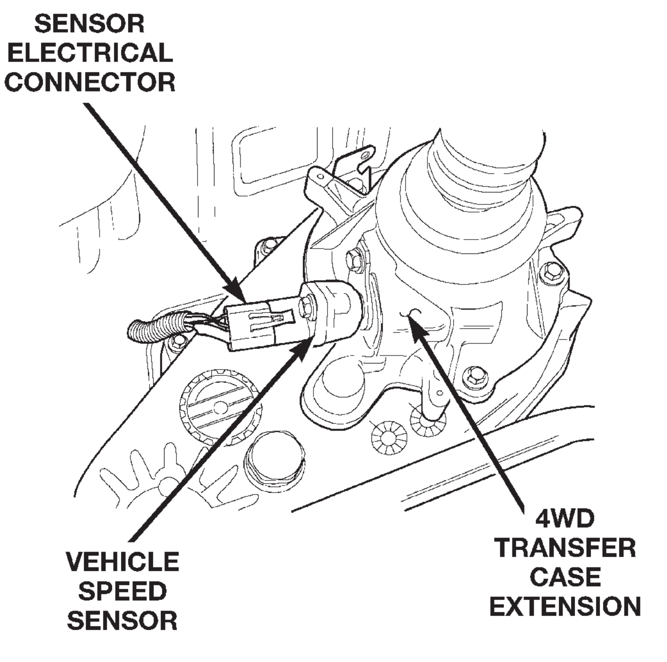


Fig. 10 Vehicle Speed Sensor—4 Wheel Drive

In addition to determining distance and vehicle speed, the output from the sensor is used to control speed control operation.

SPEED CONTROL—ECM INPUT

The speed control system provides five separate inputs to the ECM: On/Off, Set, Resume/Accel, Cancel, and Decel. The On/Off input informs the ECM that the speed control system has been activated. The Set input informs the ECM that a fixed vehicle speed has been selected. The Resume input indicates to the ECM that the previous fixed speed is requested.

Speed control operation will start at 50 km/h–142 km/h (35–85 mph). The upper range of operation is not restricted by vehicle speed. Inputs that effect speed control operation are vehicle speed sensor and accelerator pedal position sensor.

Refer to Group 8H for further speed control information.

ASD RELAY—ECM INPUT

A 12 volt signal at this input indicates to the ECM that the ASD relay has been activated. The ASD relay is located in the PDC. The PDC is located next to the battery in the engine compartment. For the location of the relay within the PDC, refer to label on PDC cover.

This input is used only to sense that the ASD relay is energized. If the ECM does not see 12 volts (+) at this input when the ASD relay should be activated, it will set a Diagnostic Trouble Code (DTC).

FIVE VOLT POWER—ECM/PCM OUTPUT

This circuit supplies approximately 5 volts to power the Accelerator Pedal Position Sensor, and the Boost / Pressure Sensor.

ENGINE COOLANT GAUGE—PCM OUTPUT

Refer to the Instrument Panel and Gauges group for additional information.

ENGINE OIL PRESSURE GAUGE—PCM OUTPUT

Refer to the Instrument Panel and Gauges group for additional information.

GLOW PLUG LAMP—PCM OUTPUT

The Glow Plug lamp (malfunction indicator lamp) illuminates on the message center each time the ignition (key) switch is turned on. It will stay on for about two seconds as a bulb test.

Fig. 11 Glow Plug Lamp Symbol

SPEED CONTROL—PCM OUTPUTS

These two circuits control the fuel quantity actuator to regulate vehicle speed. Refer to Group 8H for Speed Control information.

AIR CONDITIONING RELAY—ECM OUTPUT

This circuit controls a ground signal for operation of the A/C clutch relay. Also refer to Air Conditioning

DESCRIPTION AND OPERATION (Continued)

(A/C) Controls—ECM Input for additional information.

The A/C relay is located in the Power Distribution Center (PDC). The PDC is located next to the battery in the engine compartment. For the location of the relay within the PDC, refer to label on PDC cover.

TIMING SOLENOID—ECM OUTPUT

The timing solenoid is located on the bottom of the fuel injection pump (Fig. 12).

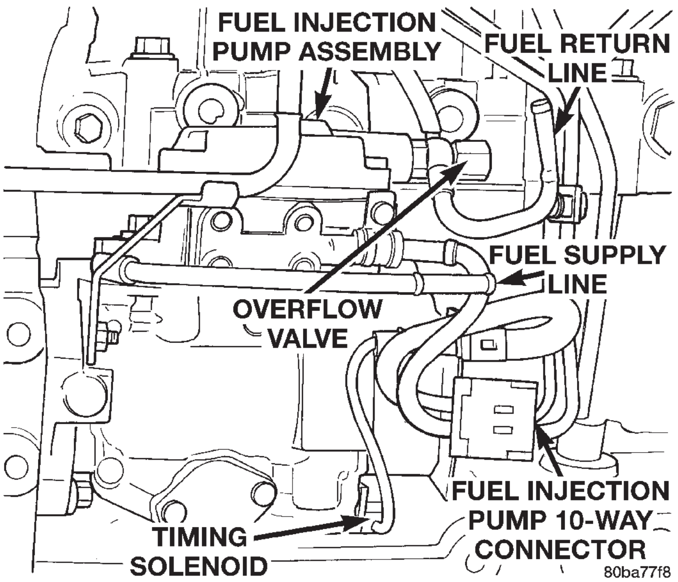


Fig. 12 Timing Solenoid

This 12(+) volt, pulse width modulated (duty–cycle) output controls the amount of fuel timing (advance) in the fuel injection pump. The higher the duty–cycle, the lower the advance. The lower the duty–cycle, the more advanced the fuel timing.

The duty–cycle is determined by the ECM from inputs it receives from the fuel injector sensor and engine speed sensor.

TACHOMETER—PCM OUTPUT

The PCM recieves engine rpm values from the ECM controller, and then supplies engine rpm values to the Body Controller that then supplies the instrument cluster mounted tachometer (if equipped). Refer to Group 8E for tachometer information.

GLOW PLUG RELAY—ECM OUTPUT

When the ignition (key) switch is placed in the ON position, a signal is sent to the ECM relating current engine coolant temperature. This signal is sent from the engine coolant temperature sensor.

After receiving this signal, the ECM will determine if, when and for how long a period the glow plug relay should be activated. This is done before, during and after the engine is started. Whenever the glow plug relay is activated, it will control the 12V+ 100 amp circuit for the operation of the four glow plugs.

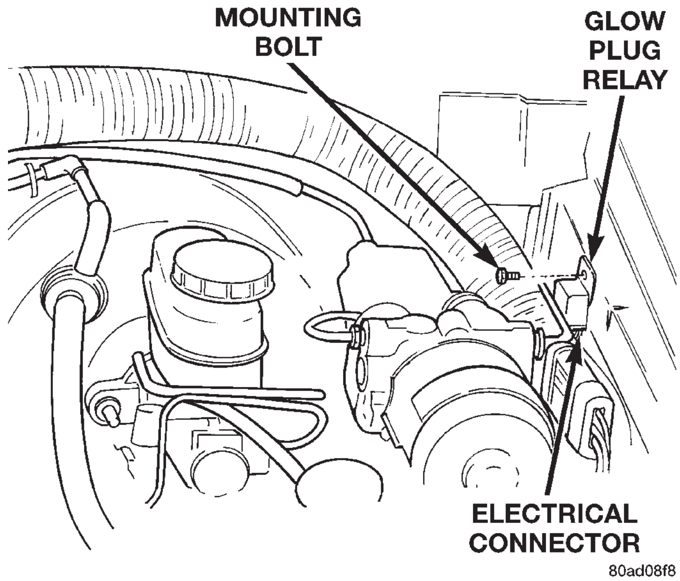


Fig. 13 Glow Plug Relay Location

With a cold engine, the glow plug relay and glow plugs may be activated for a maximum time of 200 seconds. Refer to the following Glow Plug Control chart for a temperature/time comparison of glow plug relay operation.

In this chart, Pre–Heat and Post–Heat times are mentioned. Pre–heat is the amount of time the glow plug relay circuit is activated when the ignition (key) switch is ON, but the engine has yet to be started. Post–heat is the amount of time the glow plug relay circuit is activated after the engine is operating. The Glow Plug lamp will not be illuminated during the post–heat cycle.

GLOW PLUG CONTROL

ENGINE COOLANT TEMPERATURE KEY ON	WAIT-TO-START LAMP ON (SECONDS)	PRE-HEAT CYCLE (GLOW PLUGS ON) (SECONDS)	POST-HEAT CYCLE (SECONDS)
-30 C	15 SEC.	45 SEC.	200 SEC.
-10 C	8 SEC.	35 SEC.	180 SEC.
+10 C	6 SEC.	25 SEC.	118 SEC.
+30 C	5 SEC.	20 SEC.	70 SEC.
+40 C	4 SEC.	16 SEC.	60 SEC.
+70 C	3 SEC.	16 SEC.	20 SEC.

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DESCRIPTION AND OPERATION (Continued)

GLOW PLUGS

Glow plugs are used to help start a cold or cool engine. The plug will heat up and glow to heat the combustion chamber of each cylinder. An individual plug is used for each cylinder. Each plug is threaded into the cylinder head above the fuel injector (Fig. 14).

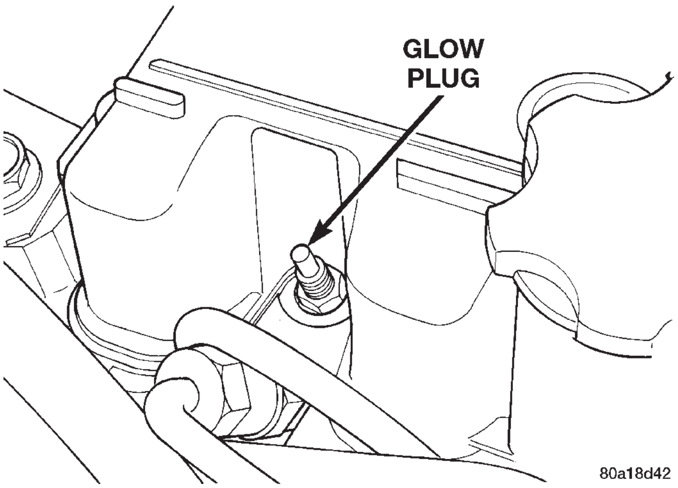

Fig. 14 Glow Plug

Each plug will momentarily draw approximately 25 amps of electrical current during the initial key–on cycle. This is on a cold or cool engine. After heating, the current draw will drop to approximately 9–12 amps per plug.

Total momentary current draw for all four plugs is approximately 100 amps on a cold engine dropping to a total of approximately 40 amps after the plugs are heated.

Electrical operation of the glow plugs are controlled by the glow plug relay. Refer to the previous Glow Plug Relay—ECM Output for additional information.

ELECTRIC VACUUM MODULATOR (EVM)—ECM OUTPUT

This circuit controls operation of the Electric Vacuum Modulator (EVM). The EVM controls operation of the EGR valve.

Refer to Group 25, Emission Control System for information. See Electric Vacuum Modulator.

DIAGNOSIS AND TESTING

DIESEL DIAGNOSTICS

The ECM controllers perform engine off diagnostic tests, which may be heard for about 60 seconds after turning the key off.

ASD RELAY TEST

To perform a test of the relay and its related circuitry, refer to the DRB scan tool. To test the relay only, refer to Relays—Operation/Testing in this section of the group.

Diagnostic Trouble Codes: Refer to On-Board Diagnostics in Group 25, Emission Control System for a list of Diagnostic Trouble Codes (DTC's) for certain fuel system components.

ENGINE SPEED SENSOR TEST

To perform a test of the engine speed sensor and its related circuitry, refer to the DRB scan tool.

Diagnostic Trouble Codes: Refer to On-Board Diagnostics in Group 25, Emission Control System for a list of Diagnostic Trouble Codes (DTC's) for certain fuel system components.

ENGINE COOLANT TEMPERATURE SENSOR TEST

The sensor is located on the side of cylinder head near the rear of fuel injection pump (Fig. 15).

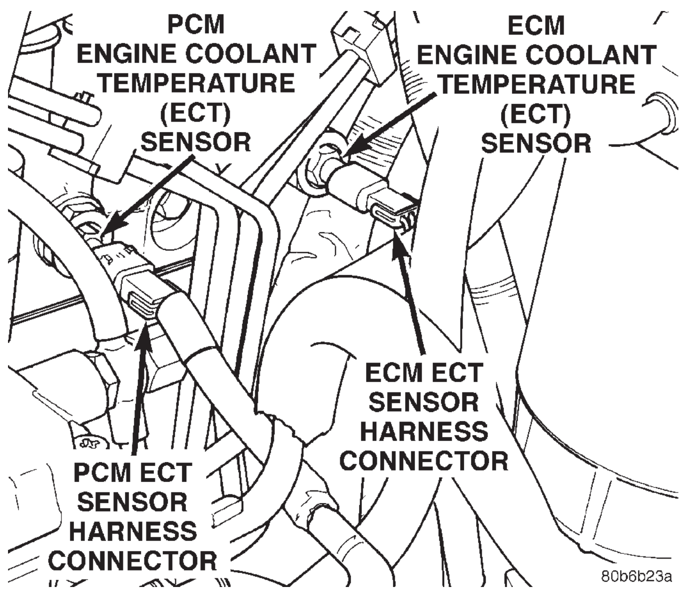

Fig. 15 Engine Coolant Temperature Sensor Location

For a list of Diagnostic Trouble Codes (DTC's) for certain fuel system components, refer to On-Board Diagnostics in Group 25, Emission Control System. To test the sensor only, refer to the following:

(1) Disconnect wire harness connector from coolant temperature sensor.

(2) Test the resistance of the sensor with a high input impedance (digital) volt–ohmmeter. The resistance (as measured across the sensor terminals) should be less than 1340 ohms with the engine warm. Refer to the following Sensor Resistance

DIAGNOSIS AND TESTING (Continued)

(OHMS) chart. Replace the sensor if it is not within the range of resistance specified in the chart.

SENSOR RESISTANCE (OHMS)

TEMPERATURE		RESISTANCE (OHMS)	
C	F	MIN	MAX
−40	−40	291,490	381,710
−20	−4	85,850	108,390
−10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

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(3) Test continuity of the wire harness. Do this between the ECM wire harness connector and the sensor connector terminal. Also test continuity of wire harness to the sensor connector terminal. Refer to Group 8W for wiring connector and circuitry information. Repair the wire harness if an open circuit is indicated.

(4) After tests are completed, connect electrical connector to sensor.

GLOW PLUG TEST

Hard starting or a rough idle after starting may be caused by one or more defective glow plugs. Before testing the glow plugs, a test of the glow plug relays should be performed. This will ensure that 12V+ is available at the plugs when starting the engine. Refer to the Glow Plug Relay Test for information.

For accurate test results, the glow plugs should be removed from the engine. The plugs must be checked when cold. **Do not check the plugs if the engine has recently been operated. If plugs are checked when warm, incorrect amp gauge readings will result.**

Use Churchill Glow Plug Tester DX.900 or an equivalent (Fig. 16) for the following tests. This tester is equipped with 4 timer lamps.

(1) Remove the glow plugs from the engine. Refer to Glow Plug Removal/Installation.

(2) Attach the red lead of the tester to the 12V+ (positive) side of the battery.

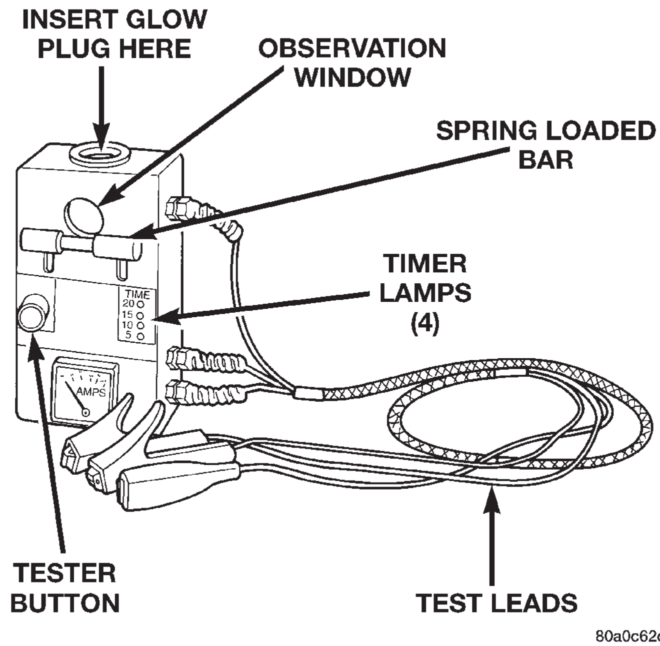

Fig. 16 Typical Glow Plug Tester

(3) Attach the black lead of the tester to the 12V– (negative) side of the battery.

(4) Fit the glow plug into the top of the tester and secure it with the spring loaded bar (Fig. 16).

(5) Attach the third lead wire of the tester to the electrical terminal at the end of the glow plug.

(6) When performing the test, the tester button (Fig. 16) should be held continuously without release for 20 seconds as indicated by the 4 timer lamps. Each illuminated lamp represents a 5 second time lapse.

(a) Press and hold the tester button (Fig. 16) and note the amp gauge reading. The gauge reading should indicate a momentary, initial current draw (surge) of approximately 25 amps. After the initial surge, the amp gauge reading should begin to fall off. The glow plug tip should start to glow an orange color after 5 seconds. If the tip did not glow after 5 seconds, replace the glow plug. Before discarding the glow plug, check the position of the circuit breaker on the bottom of the plug tester. It may have to be reset. Reset if necessary.

(b) Continue to hold the tester button while observing the amp gauge and the 4 timer lamps. When all 4 lamps are illuminated, indicating a 20 second time lapse, the amp gauge reading should indicate a 9–12 amp current draw. If not, replace the glow plug. Refer to Glow Plug Removal/Installation.

(7) Check each glow plug in this manner using one 20 second cycle. If the glow plug is to be retested, it must first be allowed to cool to room temperature.

DIAGNOSIS AND TESTING (Continued)

WARNING: THE GLOW PLUG WILL BECOME EXTREMELY HOT (GLOWING) DURING THESE TESTS. BURNS COULD RESULT IF IMPROPERLY HANDLED. ALLOW THE GLOW PLUG TO COOL BEFORE REMOVING FROM TESTER.

(8) Remove the glow plug from the tester.

GLOW PLUG RELAY TEST

The glow plug relay is located in the engine compartment on the left–inner fender (Fig. 17).

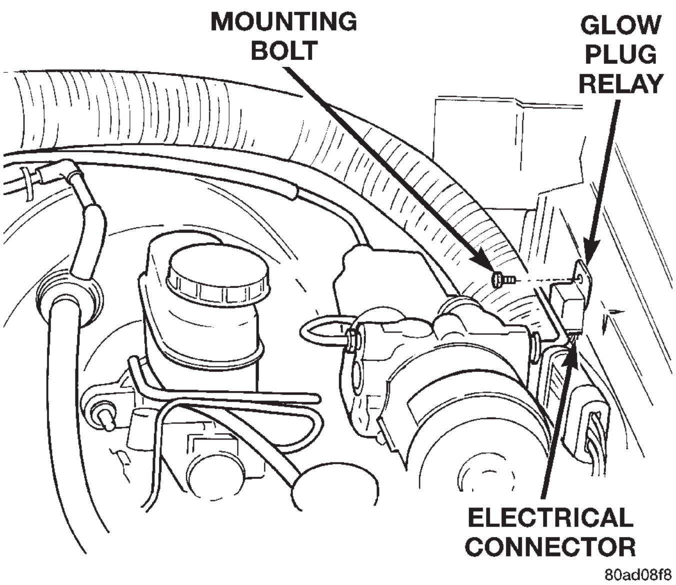

Fig. 17 Glow Plug Relay Location

When the ignition (key) switch is placed in the ON position, a signal is sent to the ECM relating current engine coolant temperature. This signal is sent from the engine coolant temperature sensor.

After receiving this signal, the ECM will determine if, when and for how long a period the glow plug relay should be activated. This is done before, during and after the engine is started. Whenever the glow plug relay is activated, it will control the 12V+ 100 amp circuit for the operation of the four glow plugs.

The Glow Plug lamp is tied to this circuit. Lamp operation is also controlled by the ECM.

With a cold engine, the glow plug relay and glow plugs may be activated for a maximum time of 200 seconds. Refer to the Glow Plug Control chart for a temperature/time comparison of glow plug relay operation.

In this chart, Pre–Heat and Post–Heat times are mentioned. Pre–heat is the amount of time the glow plug relay circuit is activated when the ignition (key) switch is ON, but the engine has yet to be started. Post–heat is the amount of time the glow plug relay circuit is activated after the engine is operating. The Glow Plug lamp will not be illuminated during the post–heat cycle.

TESTING:

Disconnect and isolate the electrical connectors (Fig. 18) at all four glow plugs. With the engine cool or cold, and the key in the ON position, check for 10–12 volts + at each electrical connector. 10–12 volts + should be at each connector whenever the ECM is operating in the pre–heat or post–heat cycles (refer to the following Glow Plug Control chart). **Be very careful not to allow any of the four disconnected glow plug electrical connectors to contact a metal surface. When the key is turned to the ON position, approximately 100 amps at 12 volts is supplied to these connectors.** If 10–12 volts + is not available at each connector, check continuity of wiring harness directly to the relay. If continuity is good directly to the relay, the fault is either with the relay or the relay input from the ECM. To test the relay only, refer to Relays—Operation/Testing in this section of the group. If the relay test is good, refer to the DRB scan tool.

Diagnostic Trouble Codes: Refer to On-Board Diagnostics in Group 25, Emission Control System for a list of Diagnostic Trouble Codes (DTC's) for certain fuel system components.

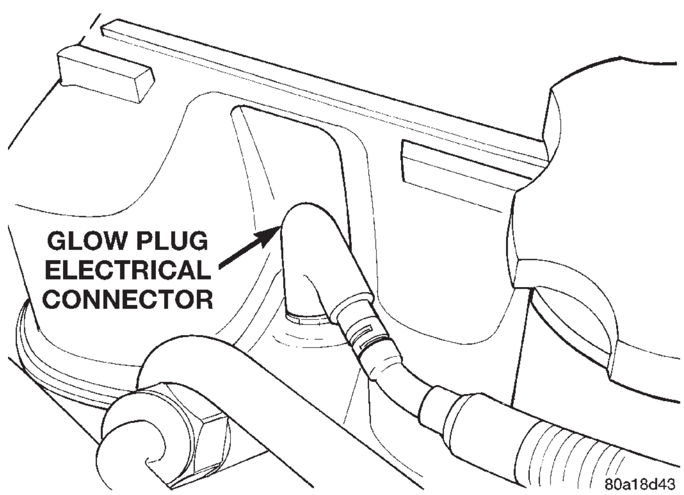

Fig. 18 Wiring Connection at Glow Plug

RELAYS—OPERATION/TESTING

The following description of operation and tests apply only to the ASD and other relays. The terminals on the bottom of each relay are numbered (Fig. 19).

OPERATION

- Terminal number 30 is connected to battery voltage. For both the ASD and other relays, terminal 30 is connected to battery voltage at all times.
- The ECM grounds the coil side of the relay through terminal number 85.
- Terminal number 86 supplies voltage to the coil side of the relay.

DIAGNOSIS AND TESTING (Continued)

GLOW PLUG CONTROL

ENGINE COOLANT TEMPERATURE KEY ON	WAIT-TO-START LAMP ON (SECONDS)	PRE-HEAT CYCLE (GLOW PLUGS ON) (SECONDS)	POST-HEAT CYCLE (SECONDS)
-30 C	15 SEC.	45 SEC.	200 SEC.
-10 C	8 SEC.	35 SEC.	180 SEC.
+10 C	6 SEC.	25 SEC.	118 SEC.
+30 C	5 SEC.	20 SEC.	70 SEC.
+40 C	4 SEC.	16 SEC.	60 SEC.
+70 C	3 SEC.	16 SEC.	20 SEC.

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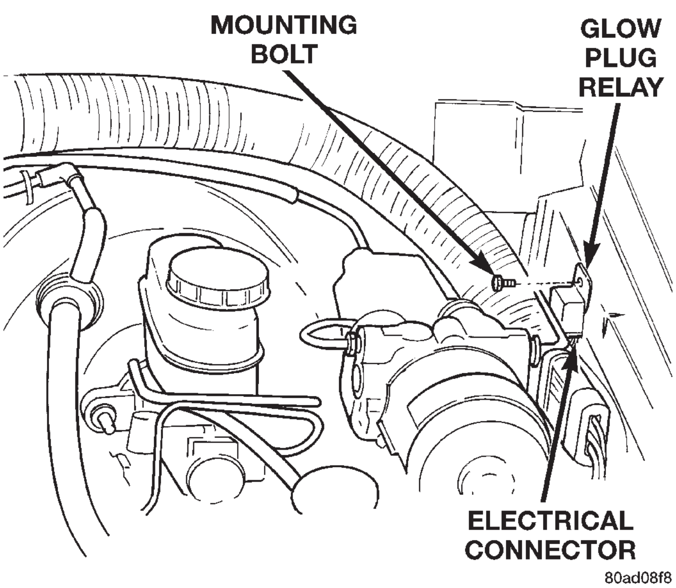

Fig. 19 Glow Plug Relay Location

• When the PCM de-energizes the ASD and other 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 ECM energizes the ASD and other 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 other 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 other relay circuits. Refer to group 8W, Wiring Diagrams.

BOOST / PRESSURE SENSOR

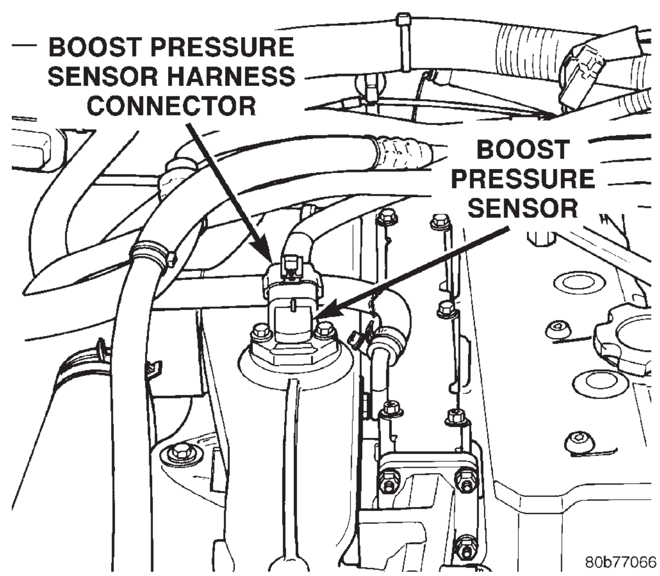

Fig. 20 Boost Pressure Sensor Location

If the boost pressure sensor fails, the PCM records a DTC into memory and continues to operate the

DIAGNOSIS AND TESTING (Continued)

engine in one of the three “limp-in” modes. When the PCM is operating in this mode, a loss of power will be present, as if the turbocharger was not operating. The best method for diagnosing faults with the boost pressure sensor is with the DRB III scan tool. **Diagnostic Trouble Codes:** Refer to On-Board Diagnostics in Group 25, Emission Control System for a list of Diagnostic Trouble Codes (DTC’s) for certain fuel system components.

VEHICLE SPEED SENSOR TEST

To perform a test of the sensor and its related circuitry, refer to DRB scan tool.

Diagnostic Trouble Codes: Refer to On-Board Diagnostics in Group 25, Emission Control System for a list of Diagnostic Trouble Codes (DTC’s) for certain fuel system components.

DIAGNOSTIC TROUBLE CODES

For a list of Diagnostic Trouble Codes (DTC’s), refer to Group 25, Emission Control System for information. See On-Board Diagnostics.

REMOVAL AND INSTALLATION

ASD RELAY

The ASD relay is located in the PDC. For the location of the relay within the PDC, refer to label on PDC cover.

A/C CLUTCH RELAY

The A/C clutch relay is located in the PDC. For the location of the relay within the PDC, refer to label on PDC cover.

ENGINE SPEED SENSOR

The engine speed sensor is mounted to the transmission bellhousing at the rear of the engine block (Fig. 21).

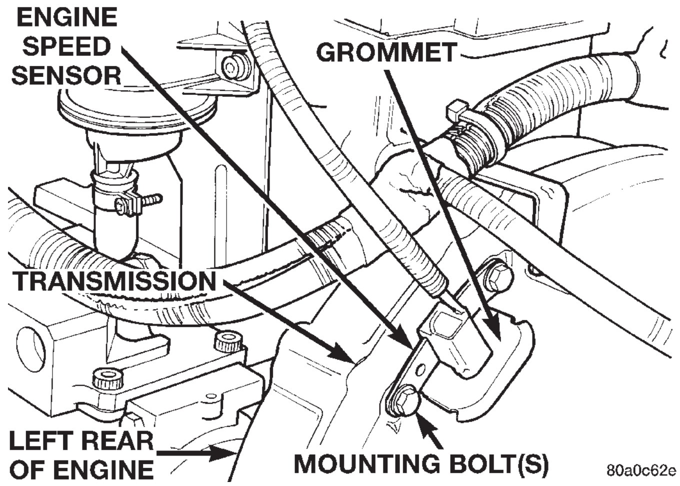

Fig. 21 Engine Speed Sensor

REMOVAL

(1) Disconnect the harness (on the sensor) from the main electrical harness.

(2) Remove the sensor mounting bolts.

(3) Remove the sensor.

INSTALLATION

(1) Install the sensor flush against the opening in the transmission housing.

(2) Install and tighten the sensor mounting bolt to 19 N·m (14 ft. lbs.) torque.

(3) Connect the electrical connector to the sensor.

ENGINE COOLANT TEMPERATURE SENSOR

The sensor is located on the side of cylinder head near the rear of fuel injection pump.

REMOVAL

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR. REFER TO GROUP 7, COOLING.

(1) Partially drain cooling system. Refer to Group 7, Cooling.

(2) Disconnect electrical connector from sensor.

(3) Remove sensor from cylinder head.

INSTALLATION

(1) Install a new copper gasket to sensor.

(2) Install sensor to cylinder head.

(3) Tighten sensor to 18 N·m (13 ft. lbs.) torque.

(4) Connect electrical connector to sensor.

(5) Replace any lost engine coolant. Refer to Group 7, Cooling System.

GLOW PLUGS

The glow plugs are located above each fuel injector (Fig. 22). Four individual plugs are used.

REMOVAL

(1) Disconnect the negative battery cable at the battery.

(2) Clean the area around the glow plug with compressed air before removal.

(3) Disconnect electrical connector (Fig. 23) at glow plug.

(4) Remove the glow plug (Fig. 22) from cylinder head.

REMOVAL AND INSTALLATION (Continued)

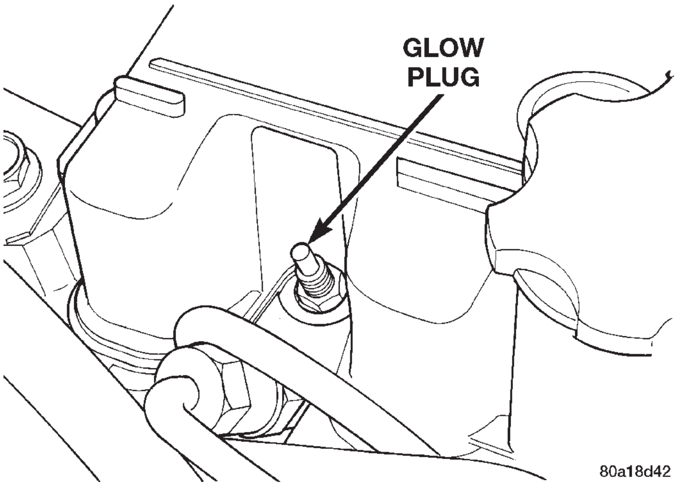

Fig. 22 Glow Plug

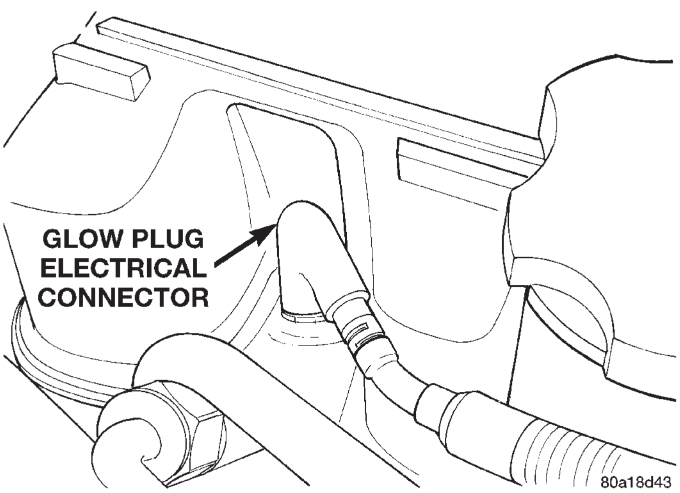

Fig. 23 Glow Plug Electrical Connector

INSTALLATION

(1) Apply high–temperature anti–seize compound to glow plug threads before installation.

(2) Install the glow plug into the cylinder head. Tighten to 23 N·m (203 in. lbs.) torque.

(3) Connect battery cable to battery.

GLOW PLUG RELAY

The glow plug relay is located in the engine compartment on the left–inner fender (Fig. 24).

REMOVAL

(1) Disconnect the negative battery cable at the battery.

(2) Remove relay mounting bolt.

(3) Disconnect electrical connector at relay and remove relay.

INSTALLATION

(1) Check condition of electrical connector for damage or corrosion. Repair as necessary.

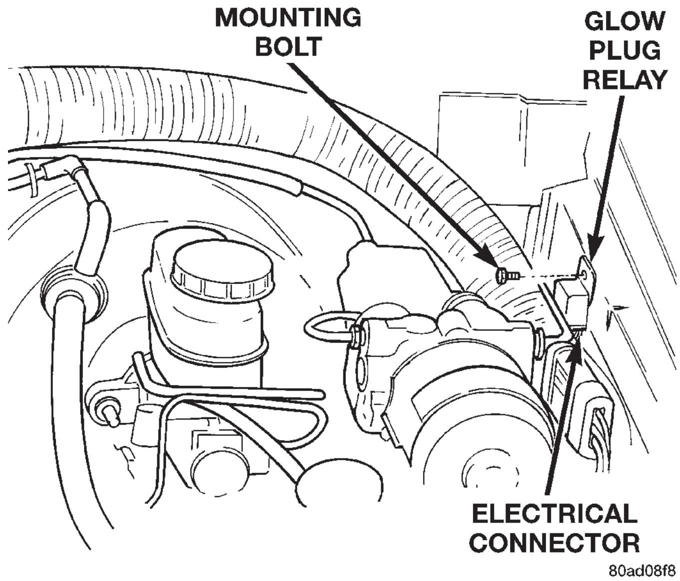

Fig. 24 Glow Plug Relay Location

(2) Install electrical connector to relay.

(3) Install relay to inner fender.

(4) Connect battery cable to battery.

POWERTRAIN CONTROL MODULE (PCM)

The PCM is mounted to a bracket mounted to the inner side of the right fender well behind the air cleaner assembly (Fig. 25).

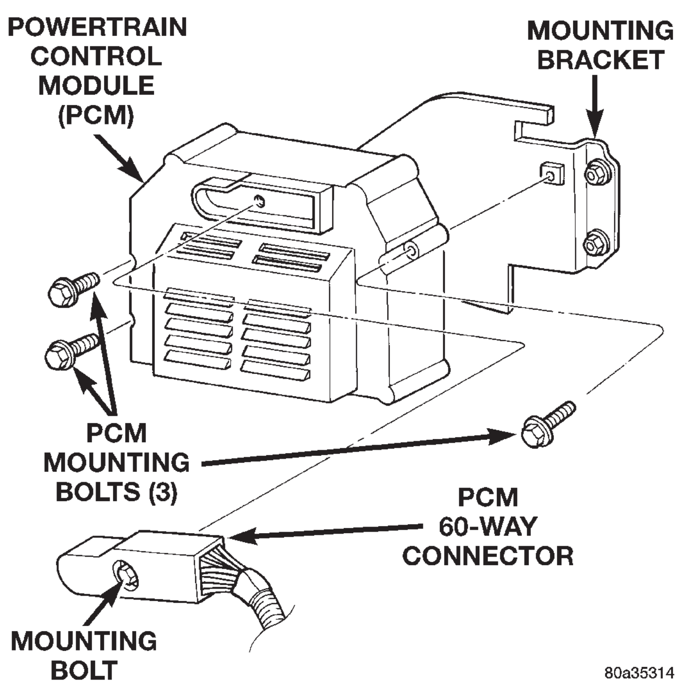

Fig. 25 PCM Location

REMOVAL

(1) Disconnect the negative battery cable at the battery.

REMOVAL AND INSTALLATION (Continued)

(2) Loosen the 60–Way connector (Fig. 25). The electrical connector has a sliding bar which moves inward to lock or outward to unlock.

(3) Remove the electrical connector by pulling straight out.

(4) Remove PCM.

INSTALLATION

(1) After the PCM electrical connector has been separated from the PCM, inspect the pins for corrosion, being spread apart, bent or misaligned. Also inspect the pin heights in the connector. If the pin heights are different, this would indicate a pin has separated from the connector. Repair as necessary.

(2) Engage 60–way connector into PCM. Move slide bar to lock connector.

(3) Connect negative cable to battery.

VEHICLE SPEED SENSOR

The vehicle speed sensor (Fig. 26) is located on the extension housing of the transmission for 2 wheel drive vehicle, or on the transfer case housing for 4 wheel drive vehicles (Fig. 27).

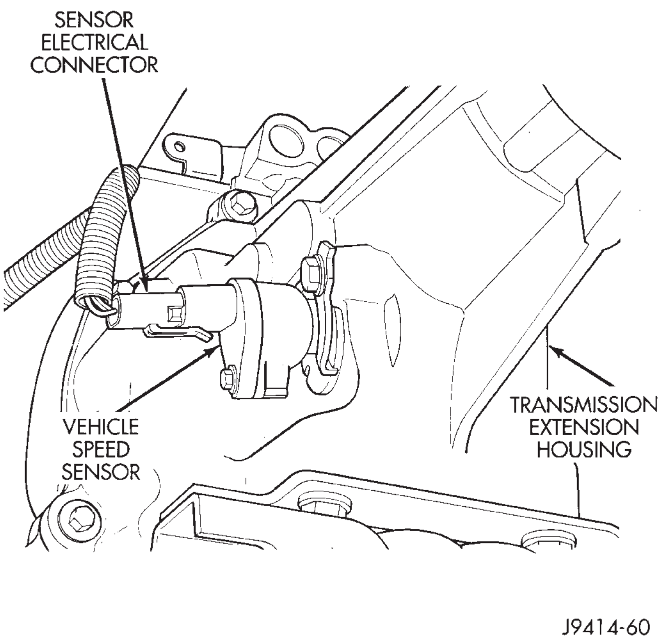

Fig. 26 Vehicle Speed Sensor Location—2 Wheel Drive

REMOVAL

(1) Raise and support vehicle.

(2) Clean the area around the sensor before removal.

(3) Disconnect the electrical connector from the sensor (Fig. 28).

(4) Remove the sensor mounting bolt (Fig. 28).

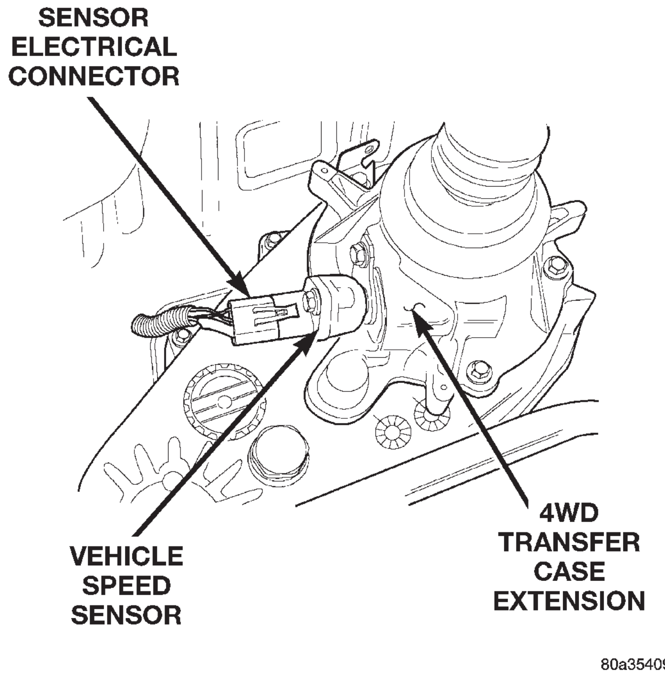

Fig. 27 Vehicle Speed Sensor Location—4WD

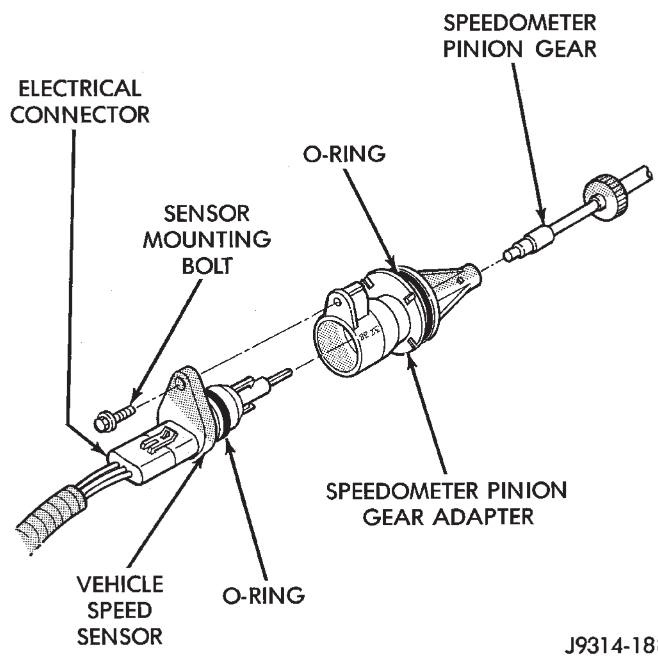

Fig. 28 Sensor Removal/Installation—Typical

(5) Pull the sensor from the speedometer pinion gear adapter for removal.

INSTALLATION

(1) Install new sensor into speedometer gear adapter.

(2) Tighten sensor mounting bolt. To prevent damage to sensor or speedometer adapter, be sure the sensor is mounted flush to the adapter before tightening.

(3) Connect electrical connector to sensor.

SPECIFICATIONS

GLOW PLUG CURRENT DRAW

Initial Current Draw: Approximately 22–25 amps per plug.

After 20 seconds of operation: Approximately 9–12 amps per plug.

TORQUE CHART—2.5L DIESEL

DESCRIPTION	TORQUE
Accelerator Pedal Bracket Mounting Nuts	5 N•m (46 in. lbs.)
Banjo-Type Fittings	19 N•m (14 ft. lbs.)
Engine Coolant Temperature Sensor	18 N•m (13 ft. lbs.)
Engine Speed Sensor Bolts	19 N•m (14 ft. lbs.)
Fuel Hose (Tube) Clamps For Rubber Hose	2 N•m (20 in. lbs.)
Fuel Injector	70 N•m (52 ft. lbs.)
Fuel Injector Line At Injector	30 N•m (22 ft. lbs.)
Fuel Injector Line At Injector Pump	30 N•m (22 ft. lbs.)
Fuel Injection Pump Mounting Nuts	30 N•m (22 ft. lbs.)
Fuel Injection Pump Drive Gear	88 N•m (65 ft. lbs.)
Fuel Line Clamp Bracket Bolts	24 N•m (18 ft. lbs.)
Fuel Tank Nuts	11 N•m (100 in. lbs.)
Glow Plugs	23 N•m (203 in. lbs.)
Powertrain Control Module Mounting Bolts	1 N•m (9 in. lbs.)
Throttle Position Sensor Mounting Bolts	7 N•m (60 in. lbs.)
Vehicle Speed Sensor Mounting Bolt	3 N•m (26 in. lbs.)

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STEERING

CONTENTS

POWER STEERING

INDEX

GENERAL INFORMATION

STEERING SYSTEM

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 remote mounted reservoir.

The steering gear used is a recirculating ball type gear. The gear acts as a rolling thread between the worm shaft and the rack piston. When the steering wheel is turned the worm shaft turns which moves the rack piston. The rack piston movement turns the pitman shaft which is connected to the steering linkage by the pitman arm. This gear is used on all models.

The power steering system consists of:
- Hydraulic pump
- Recirculating ball steering gear
- Steering column
- Steering linkage

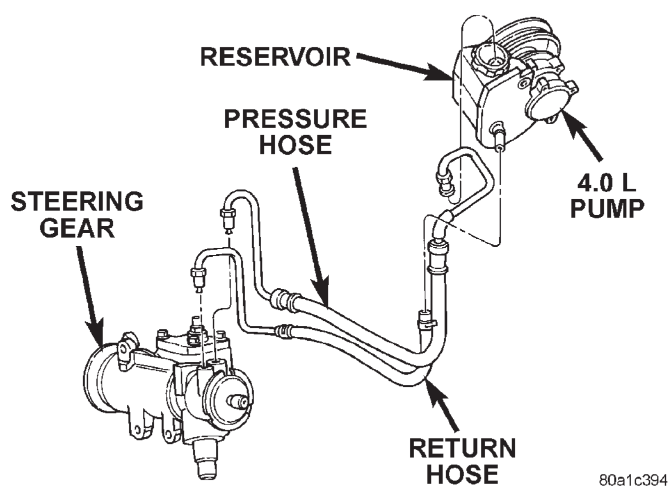

Fig. 1 Power Steering Gear & Pump - 4.0L

NOTE: Right hand drive (RHD) and left hand drive (LHD) service procedures and torque specifications for steering linkage, gear and column are the same. The power steering pump procedures are different. Refer to appropriate service procedures regarding each component in the system.

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.

DIAGNOSIS AND TESTING (Continued)

BINDING AND STICKING

CONDITION	POSSIBLE CAUSE	CORRECTION
DIFFICULT TO TURN WHEEL STICKS OR BINDS	1. Low fluid level. 2. Tire pressure. 3. Steering component. 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.

INSUFFICIENT ASST. OR POOR RETURN TO CENTER

CONDITION	POSSIBLE CAUSE	CORRECTION
HARD TURNING OR MOMENTARY INCREASE IN TURNING EFFORT	1. Tire pressure. 2. Low fluid level. 3. Loose belt. 4. Lack of lubrication. 5. Low pump pressure. 6. Internal gear leak.	1. Adjust tire pressure. 2. Fill to proper level. 3. Adjust or replace. 4. Inspect and lubricate steering and suspension compnents. 5. Pressure test and repair as necessary. 6. Pressure and flow test, and repair as necessary.
STEERING WHEEL DOES NOT WANT TO RETURN TO CENTER POSITION	1. Tire pressure. 2. Wheel alignment. 3. Lack of lubrication. 4. High friction in steering gear.	1. Adjust tire pressure. 2. Align front end. 3. Inspect and lubricate steering and suspension compnents. 4. Test and adjust as necessary.

DIAGNOSIS AND TESTING (Continued)

LOOSE STEERING AND VEHICLE LEAD

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE PLAY IN STEERING WHEEL	1. Worn or loose suspension or steering components.	1. Repair as necessary.
	2. Worn or loose wheel bearings.	2. Repair as necessary.
	3. Steering gear mounting.	3. Tighten gear mounting bolts to specification.
	4. Gear out of adjustment.	4. Adjust gear to specification.
	5. Worn or loose steering coupler.	5. Repair as necessary.
VEHICLE PULLS OR LEADS TO ONE SIDE	1. Tire Pressure.	1. Adjust tire pressure.
	2. Radial tire lead.	2. Cross front tires.
	3. Brakes dragging.	3. Repair as necessary.
	4. Wheel alignment.	4. Align vehicle.
	5. Weak or broken spring.	5. Replace spring.
	6. Loose or worn steering or suspension components.	6. Repair as necessary.

POWER STEERING PUMP

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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 4.0L engine. On the 2.5L engine the reservoir is separate from the pump.

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.

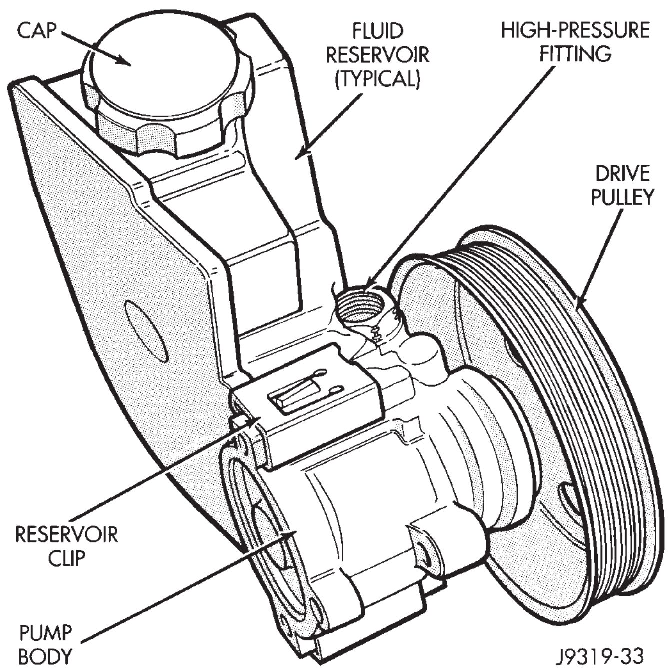


Fig. 1 Pump With Integral Reservoir

DIAGNOSIS AND TESTING

POWER FLOW AND PRESSURE

The following procedure is used to test the operation of the power steering system on the vehicle. This test will provide the gallons per minute (GPM) or flow rate of the power steering pump along with the maximum relief pressure. Perform test any time a power steering system problem is present. This test will determine if the power steering pump or power steering gear is not functioning properly. The following pressure and flow test is performed using Power Steering Analyzer Tool Kit 6815 (Fig. 2) and Adapter Kit 6893.

FLOW AND PRESSURE TEST

(1) Check the power steering belt to ensure it is in good condition and adjusted properly.

(2) Connect pressure gauge hose from the Power Steering Analyzer to Tube 6865.

(3) Connect Adapter 6826 to Power Steering Analyzer test valve end.

(4) Disconnect high pressure hose at gear or pump. Use a container for dripping fluid.

(5) Connect Tube 6865 to the pump hose fitting.

(6) Connect the power steering hose from the steering gear to Adapter 6826.

DIAGNOSIS AND TESTING (Continued)

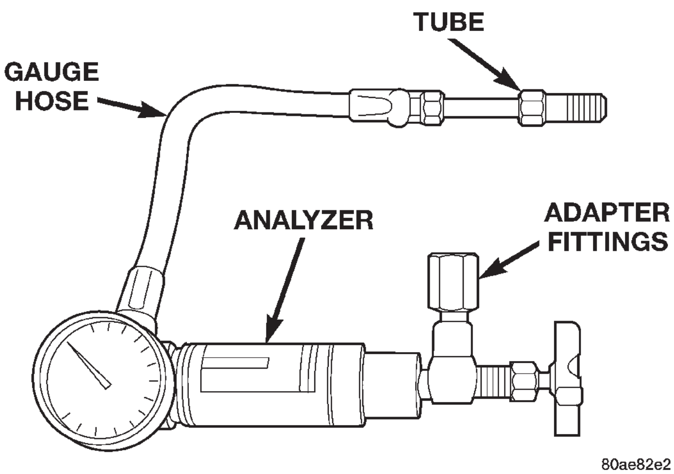


Fig. 2 Power Steering Analyzer

(7) Open the test valve completely.

(8) Start engine and let idle long enough to circulate power steering fluid through flow/pressure test gauge and to get air out of the fluid. Then shut off engine.

(9) Check fluid level, add fluid as necessary. Start engine again and let idle.

(10) 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).

(11) Increase the engine speed to 1500 RPM and read the flow meter. The reading should be 2.4 - 2.8 GPM, if the reading is below this specification the pump should be replaced.

CAUTION: The next step 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.

(12) Close valve fully three times and record highest pressure indicated each time. **All three readings must be above specifications and within 345 kPa (50 psi) of each other.**

• Pressures above specifications but not within 345 kPa (50 psi) of each other, replace pump.

• Pressures within 345 kPa (50 psi) of each other but below specifications, replace pump.

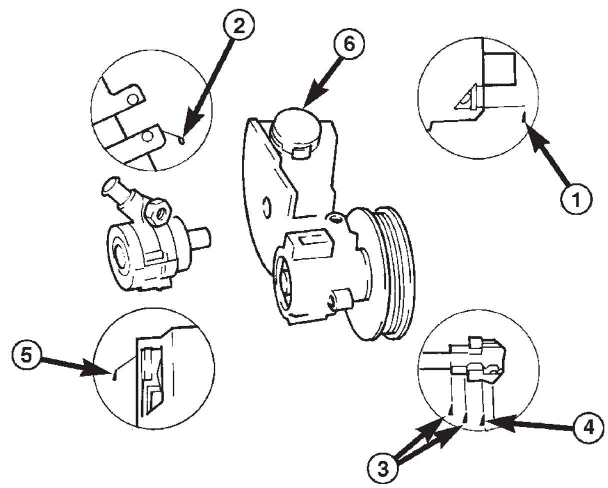
(13) Open the test valve, turn steering wheel extreme left and right positions against the stops. Record the highest indicated pressure at each position. Compare readings to specifications. If highest output pressures are not the same against either stop, the gear is leaking internally and must be repaired.

CAUTION: Do not force the pump to operate against the stops for more than 2 to 3 seconds at a time because, pump damage will result.

PUMP SPECIFICATIONS

ENGINE	RELIEF PRESSURE ± 50	FLOW RATE (GPM)
2.5L	9653 kPa (1400 psi)	1500 RPM 2.4 - 2.8 GPM
4.0L	9653 kPa (1400 psi)	

PUMP LEAKAGE DIAGNOSIS



1. BUSHING (BEARING) WORN, SEAL WORN. REPLACE PUMP.
2. REPLACE RESERVOIR O-RING SEAL.
3. TORQUE HOSE FITTING NUT TO SPECIFICATIONS. IF LEAKAGE PERSISTS, REPLACE O-RING SEAL.
4. TORQUE FITTING TO SPECIFICATIONS. IF LEAKAGE PERSISTS, REPLACE O-RING SEAL.
5. REPLACE PUMP.
6. CHECK OIL LEVEL: IF LEAKAGE PERSISTS WITH THE LEVEL CORRECT AND CAP TIGHT, REPLACE THE CAP.

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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.

SERVICE PROCEDURES (Continued)

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 minutes.

(2) Start the engine and let run for a few seconds then turn engine off.

(3) Add fluid if necessary. Repeat the above procedure until the fluid level remains constant after running the engine.

(4) Raise the front wheels off the ground.

(5) Slowly turn the steering wheel right and left, lightly contacting the wheel stops at least 20 times.

(6) Check the fluid level add if necessary.

(7) Lower the vehicle, start the engine and turn the steering wheel slowly from lock to lock.

(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

NOTE: The power steering pump is mounted in the same position on LHD and RHD vehicles. On 4.0L RHD vehicles the front bracket is different. The service procedures are the same.

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) and (Fig. 4).

(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.).

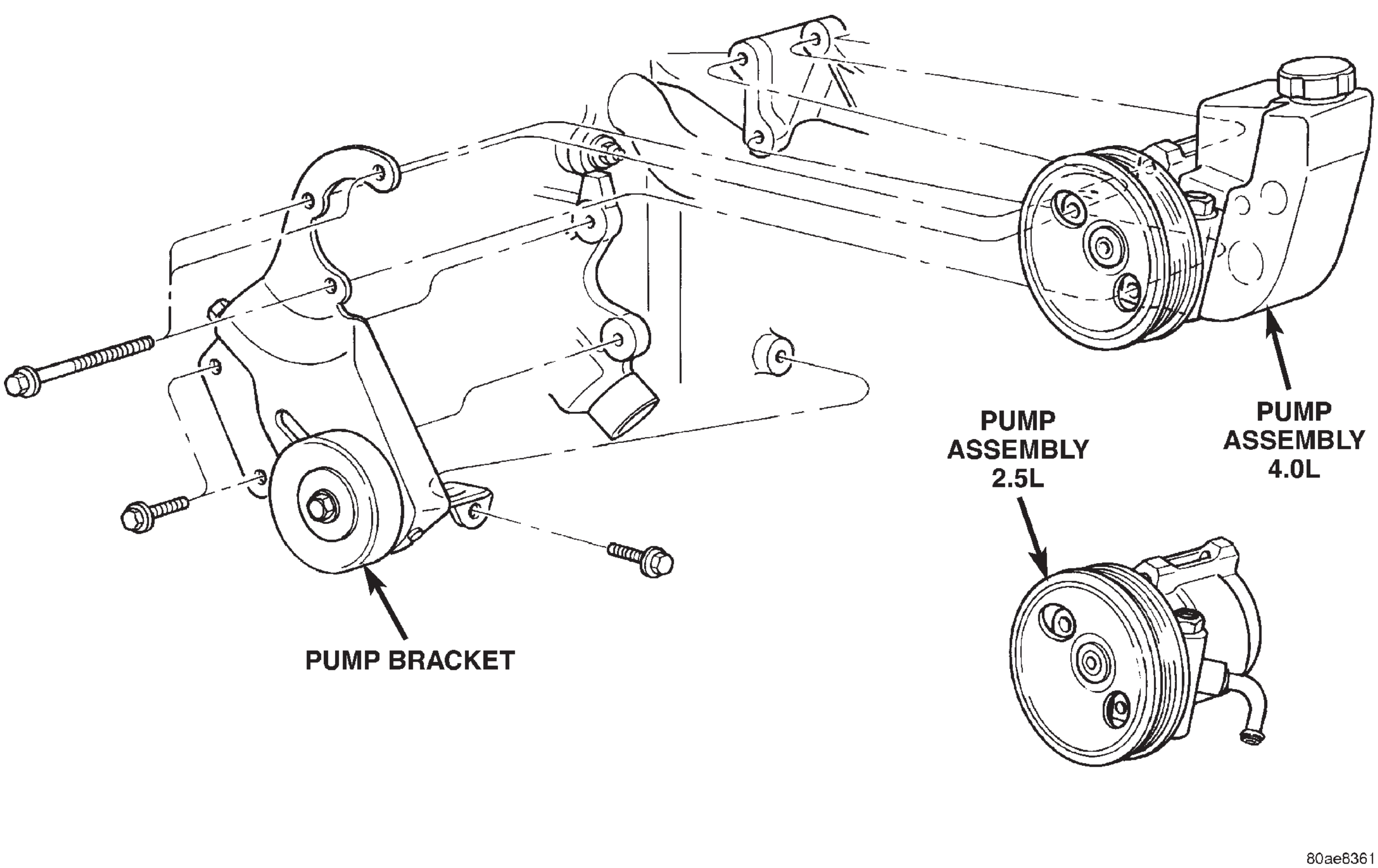


Fig. 3 Pump Mounting

REMOVAL AND INSTALLATION (Continued)

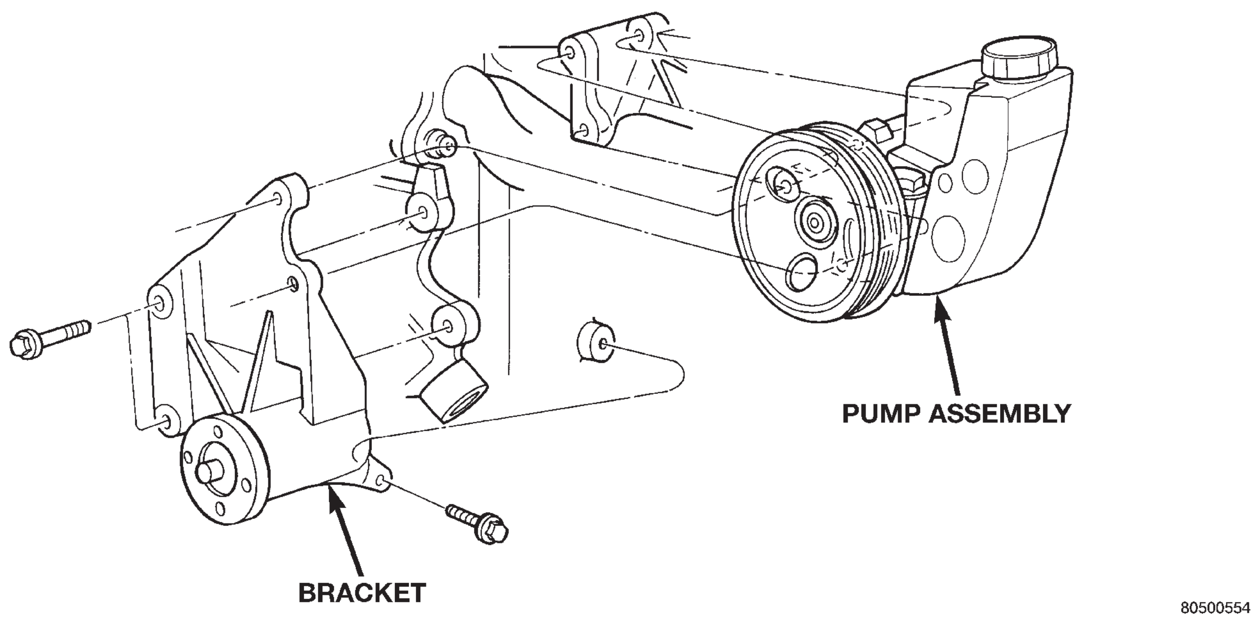


Fig. 4 Pump Mounting 4.0L RHD

(4) Install 3 pump mounting bolts and tighten to 27 N·m (20 ft. lbs.).

(5) Install the pressure and return hoses to pump.

(6) Install drive belt, refer to Group 7 Cooling.

(7) Add power steering fluid and perform Power Steering Pump Initial Operation.

PUMP RESERVOIR-2.5L

REMOVAL

(1) Remove the hoses from the bottom of the reservoir and drain the reservoir.

(2) Remove the push-in fastener from the top of the fan shroud.

(3) Slide reservoir up off the fan shroud.

INSTALLATION

(1) Slide reservoir down onto fan shroud.

(2) Install the push-in fastener in the top of fan shroud.

(3) Install the pump hoses.

(4) Fill reservoir to proper level. Refer to Power Steering Pump Initial Operation.

DISASSEMBLY AND ASSEMBLY

PUMP PULLEY

DISASSEMBLY

(1) Remove pump assembly.

(2) Remove pulley from pump with Puller C-4333 (Fig. 5).

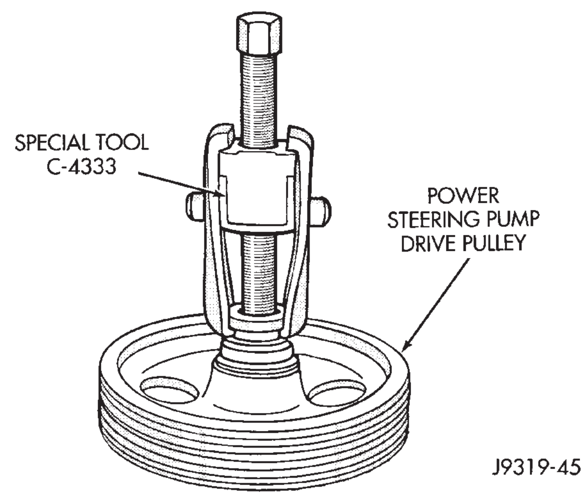


Fig. 5 Pulley Removal

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 Belt, run engine until warm (5 min.) and note any belt chirp. If chirp exists, move pulley outward approximately 0.5 mm (0.020 in.). If noise increases, press on 1.0 mm (0.040 in.). **Be careful that pulley does not contact mounting bolts.**

DISASSEMBLY AND ASSEMBLY (Continued)

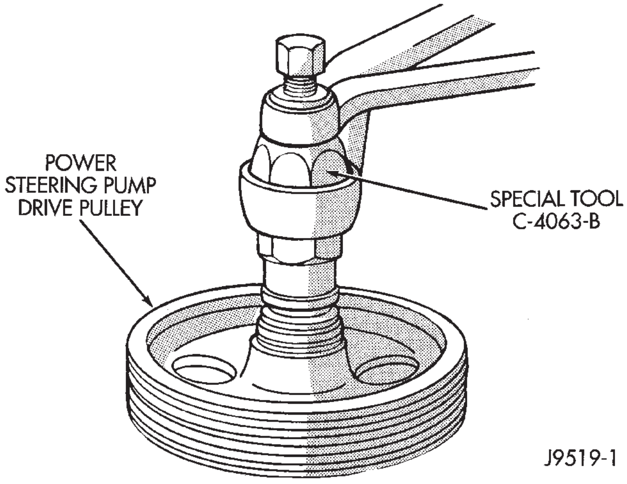


Fig. 6 Pulley Installation

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).

NOTE: Use new retaining clips for installtion.

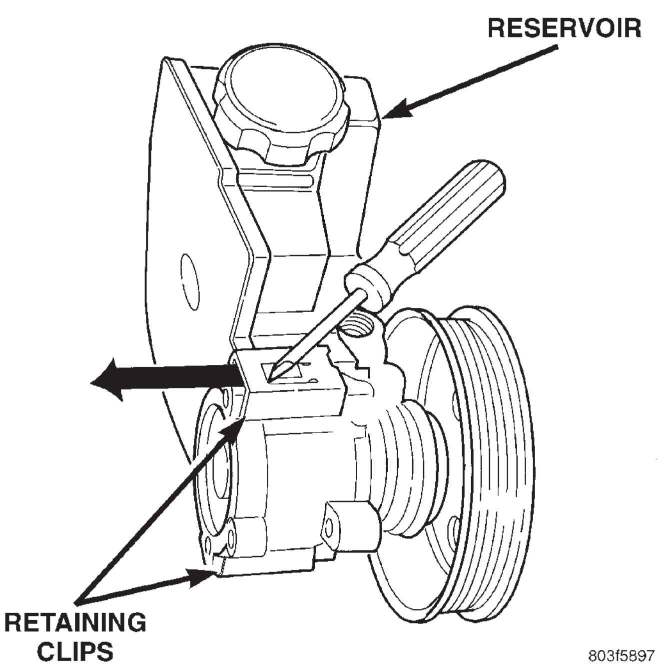


Fig. 7 Pump Reservoir Clips

(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.

(3) Install reservoir onto housing.

(4) Slide and tap in **new** reservoir retainer clips until tab locks to housing.

(5) Install power steering pump.

(6) Add power steering fluid, refer to Pump Initial Operation.

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.**

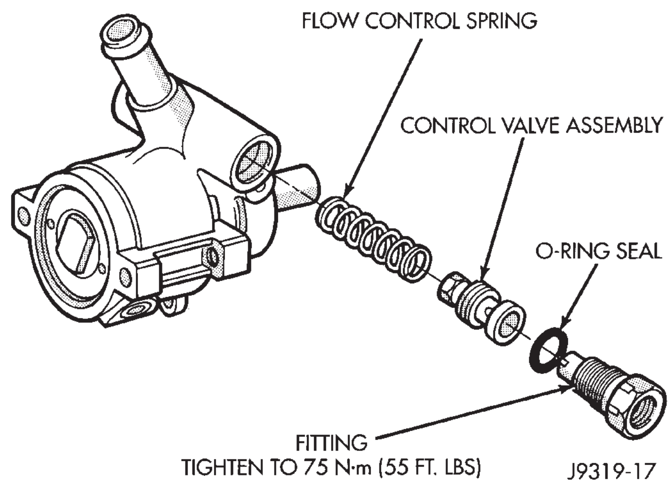


Fig. 8 Flow Control Valve

(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.

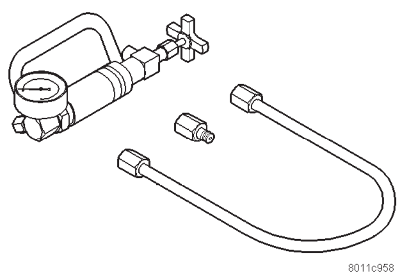
SPECIFICATIONS

TORQUE CHART

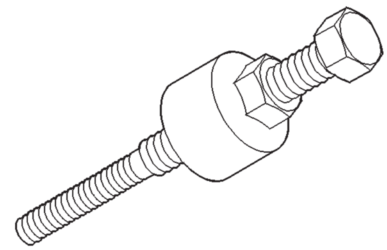
DESCRIPTION	TORQUE
Power Steering Pump	
Bracket to Pump	28 N·m (21 ft. lbs.)
Bracket to Engine	47 N·m (35 ft. lbs.)
Flow Control Valve	75 N·m (55 ft. lbs.)
Pressure Line	28 N·m (21 ft. lbs.)

SPECIAL TOOLS

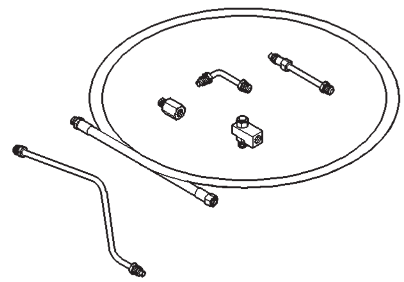
POWER STEERING PUMP



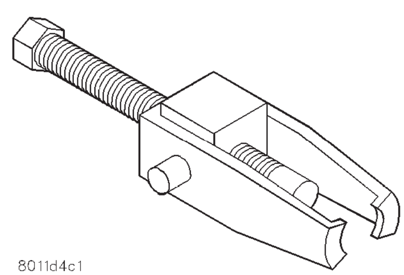
Analyzer Set, Power Steering Flow/Pressure 6815



Installer, Power Steering Pulley C-4063–B



Adapters, Power Steering Flow/Pressure Tester 6893



Puller C-4333

POWER STEERING GEAR

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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.

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

DESCRIPTION AND OPERATION (Continued)

KEY NO.	PART NAME
1 -	RING, RETAINING
2 -	PLUG
3 -	SEAL, O-RING
5 -	RING, TEFLON
6 -	SEAL, O-RING
7 -	COVER, SIDE
8 -	NUT, ADJUSTER LOCK
10 -	BOLT
11 -	GASKET
12 -	SHAFT, PITMAN
13 -	SHAFT, WORM
15 -	RACE, FLAT
16 -	BEARING, THRUST
17 -	RACE, FLAT
18 -	VALVE, CHECK
20 -	HOUSING
21 -	SCREW
22 -	CLAMP
23 -	GUIDE, BALL
25 -	BALLS
26 -	PISTON, RACK
27 -	PLUG
28 -	BEARING, NEEDLE
31 -	WASHER, BACKUP
35 -	RING, RETAINING
36 -	WASHER, LOCK
37 -	NUT
38 -	SEAL
40 -	SHAFT, STUB
41 -	SPOOL, VALVE
42 -	SEAL
43 -	BODY, VALVE
45 -	SEAL, O-RING VALVE BODY
46 -	RING
48 -	NUT, COUPLING SHIELD RETAINER AND LOCK
49 -	THRUST SUPPORT ASSEMBLY
56 -	SEAL, O-RING
63 -	SEAL, PITMAN SHAFT
64 -	SEAL, DUST
65 -	ADJUSTER NUT ASSEMBLY

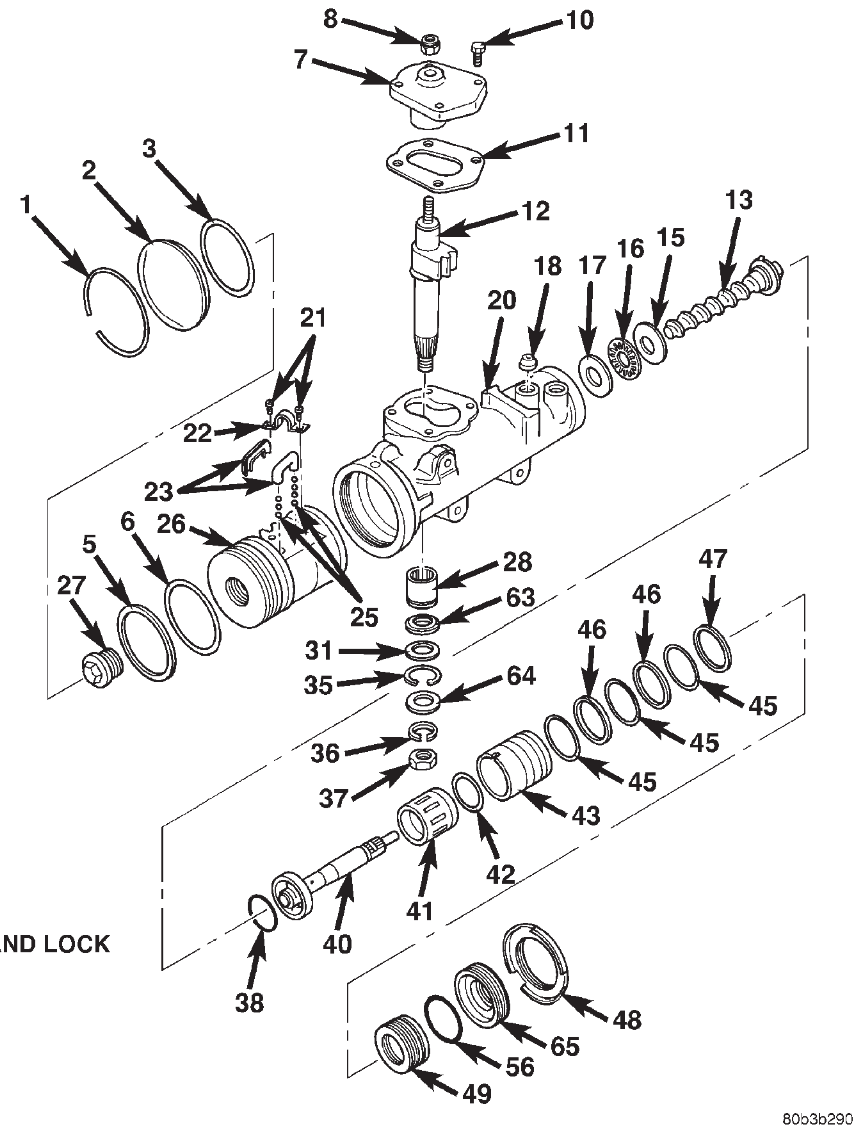
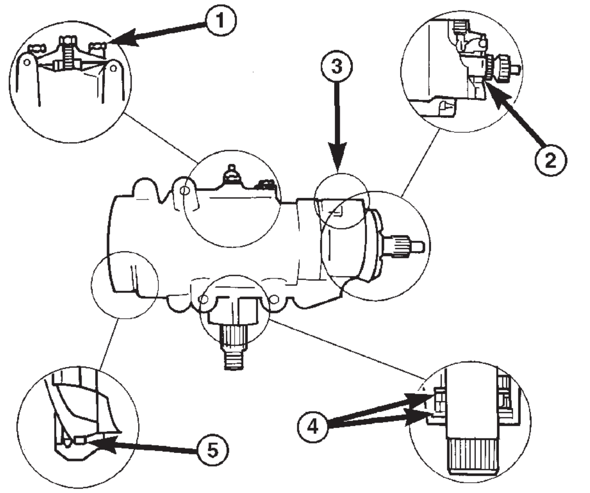


Fig. 1 Recirculating Ball Type Gear

DIAGNOSIS AND TESTING

POWER STEERING GEAR LEAKAGE DIAGNOSIS



1. SIDE COVER LEAK - TORQUE SIDE COVER BOLTS TO SPECIFICATION. REPLACE THE SIDE COVER SEAL IF THE LEAKAGE PERSISTS.
2. ADJUSTER PLUG SEAL - REPLACE THE ADJUSTER PLUG SEALS.
3. PRESSURE LINE FITTING - TORQUE THE HOSE FITTING NUT TO SPECIFICATIONS. IF LEAKAGE PERSISTS, REPLACE THE SEAL.
4. PITMAN SHAFT SEALS - REPLACE THE SEALS.
5. TOP COVER SEAL - REPLACE THE SEAL.

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REMOVAL AND INSTALLATION

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 from steering gear.

(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. 2) .

INSTALLATION

(1) Align the column coupler shaft to steering gear.

(2) Install steering gear (and bracket) on the frame rail and tighten bolts to 95 N·m (70 ft. lbs.)

(3) Align and install the pitman arm and tighten nut to 251 N·m (185 ft. lbs.).

(4) Connect fluid hoses to steering gear and tighten to 28 N·m (21 ft. lbs.).

(5) Fill power steering system to proper level.

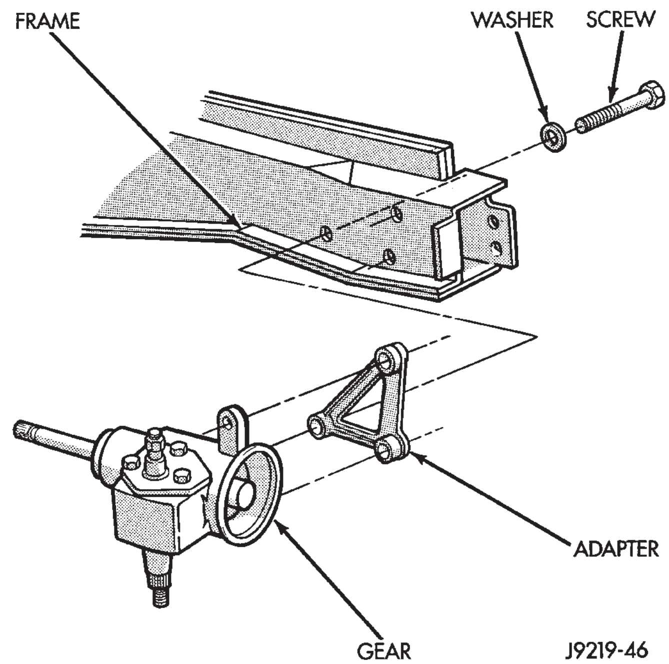


Fig. 2 Steering Gear Mounting (LHD)

DISASSEMBLY AND ASSEMBLY

HOUSING END PLUG

DISASSEMBLY

(1) Unseat and remove retaining ring from groove with a punch through the hole in the end of the housing (Fig. 3).

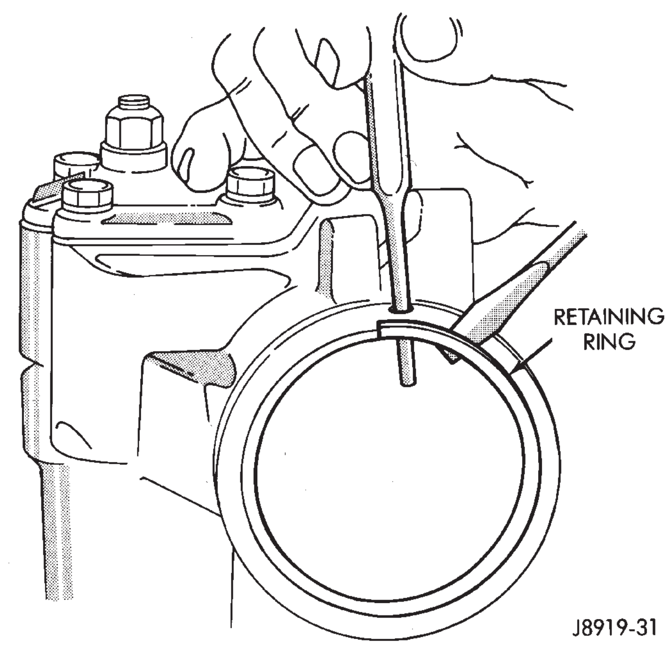


Fig. 3 End Plug Retaining Ring

(2) Slowly rotate stub shaft with 12 point socket COUNTER-CLOCKWISE to force the end plug out from housing.

DISASSEMBLY AND ASSEMBLY (Continued)

CAUTION: Do not turn stub shaft any further than necessary. The rack piston balls will drop out of the rack piston circuit if the stub shaft is turned too far.

(3) Remove O-ring from the housing (Fig. 4).

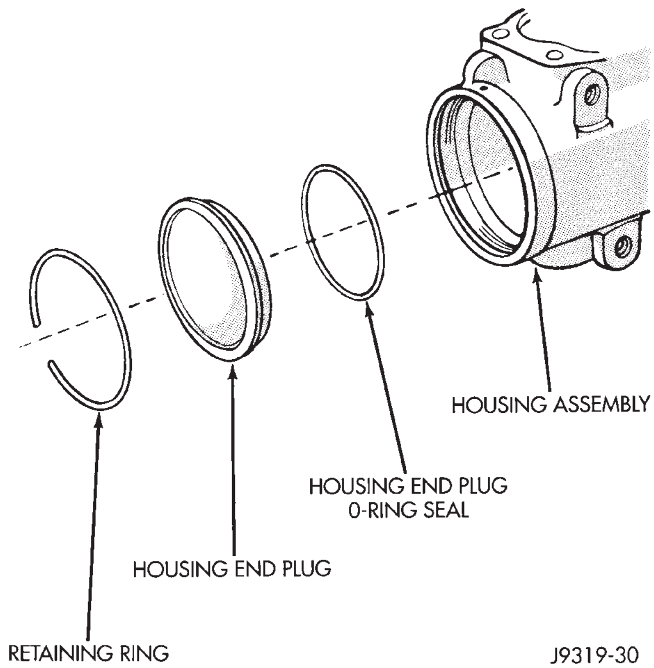


Fig. 4 End Plug Components

ASSEMBLY

(1) Lubricate O-ring with power steering fluid and install into the housing.

(2) Install end plug by tapping the plug lightly with a plastic mallet into the housing.

(3) Install retaining ring so one end of the ring covers the housing access hole (Fig. 5).

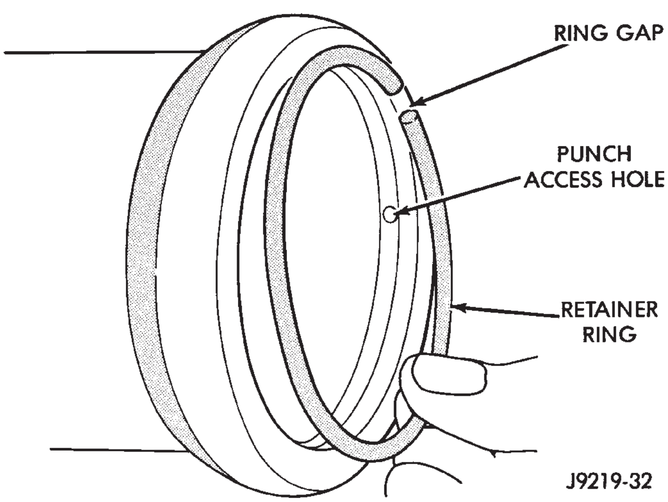


Fig. 5 Installing The Retaining Ring

PITMAN SHAFT/SEALS/BEARING

DISASSEMBLY

(1) Clean exposed end of pitman shaft and housing with a wire brush.

(2) Remove preload adjuster nut (Fig. 6).

(3) Rotate the stub shaft with a 12 point socket from stop to stop and count the number of turns.

(4) Center the stub shaft by rotating it from the stop 1/2 of the total amount of turns.

(5) Remove side cover bolts and remove side cover, gasket and pitman shaft as an assembly (Fig. 6).

NOTE: The pitman shaft will not clear the housing if it is not centered.

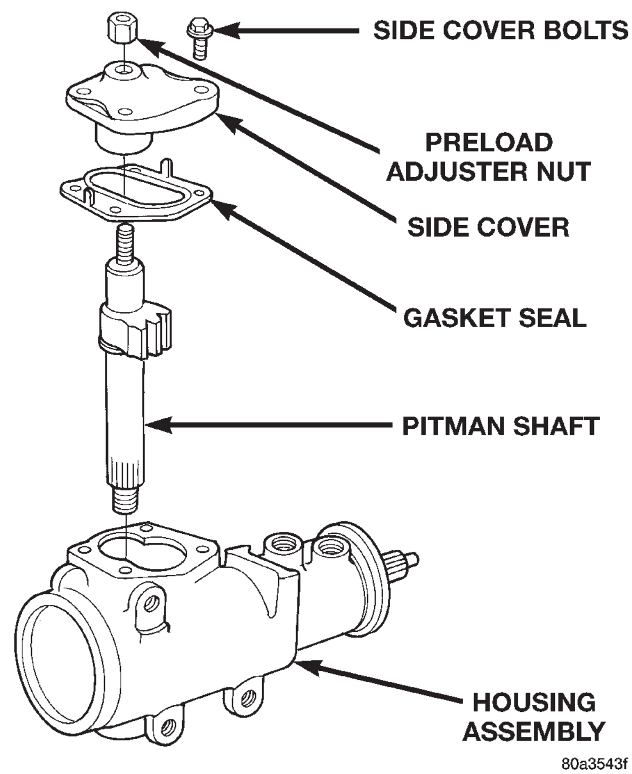


Fig. 6 Side Cover and Pitman Shaft

(6) Remove pitman shaft from the side cover.

(7) Remove dust seal from the housing with a seal pick (Fig. 7).

CAUTION: Use care not to score the housing bore when prying out seals and washer.

(8) Remove retaining ring with snap ring pliers.

(9) Remove washer from the housing.

(10) Remove oil seal from the housing with a seal pick.

(11) Remove pitman shaft bearing from housing with a bearing driver and handle (Fig. 8).

DISASSEMBLY AND ASSEMBLY (Continued)

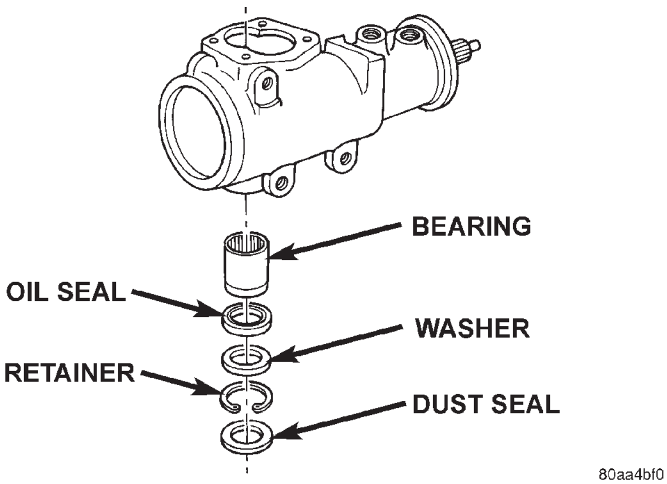


Fig. 7 Pitman Shaft Seals & Bearing

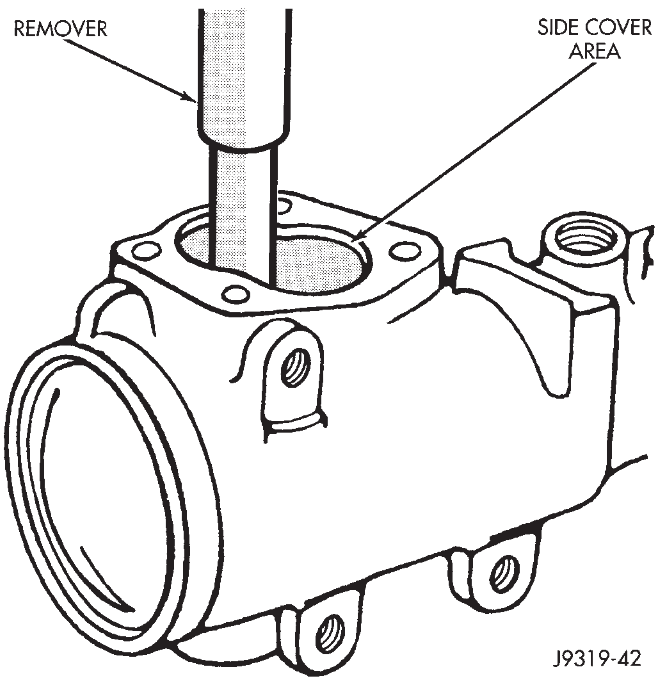


Fig. 8 Needle Bearing Removal

ASSEMBLY

(1) Install pitman shaft bearing into housing with a bearing driver and handle.

(2) Coat the oil seal and washer with **special grease** supplied with the new seal.

(3) Install the oil seal with a driver and handle.

(4) Install backup washer.

(5) Install the retainer ring with snap ring pliers.

(6) Coat the dust seal with **special grease** supplied with the new seal.

(7) Install dust seal with a driver and handle.

(8) Install pitman shaft to side cover by screwing shaft in until it fully seats to side cover.

(9) Install preload adjuster nut. **Do not tighten nut until after Over-Center Rotation Torque adjustment has been made.**

(10) Install gasket to side cover and bend tabs around edges of side cover (Fig. 6).

(11) Install pitman shaft assembly and side cover to housing.

(12) Install side cover bolts and tighten to 60 N·m (44 ft. lbs.).

(13) Perform over-center rotation torque adjustment.

SPOOL VALVE

DISASSEMBLY

(1) Remove lock nut (Fig. 9).

(2) Remove adjuster nut with Spanner Wrench C-4381.

(3) Remove thrust support assembly out of the housing (Fig. 10).

(4) Pull stub shaft and valve assembly from the housing (Fig. 11).

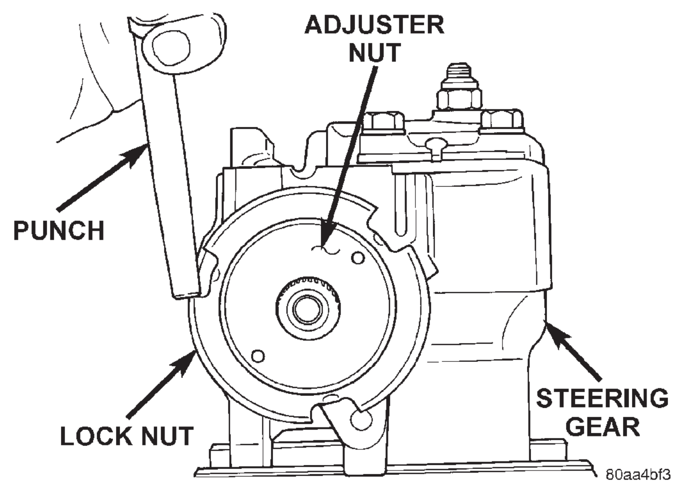


Fig. 9 Lock Nut and Adjuster Nut

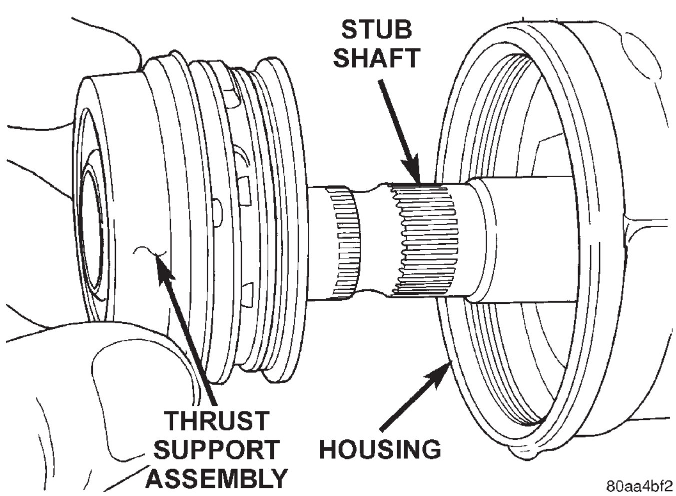


Fig. 10 Thrust Support Assembly

DISASSEMBLY AND ASSEMBLY (Continued)

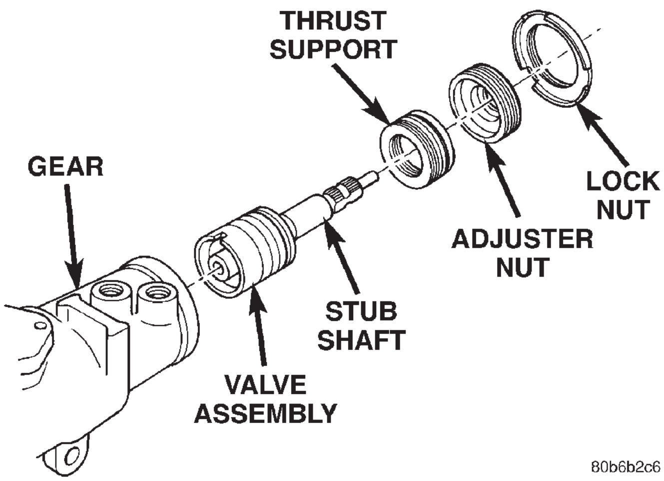


Fig. 11 Valve Assembly With Stub Shaft

(5) Remove stub shaft from valve assembly by lightly tapping shaft on a block of wood to loosen shaft. Then disengage stub shaft pin from hole in spool valve and separate the valve assembly from stub shaft (Fig. 12).

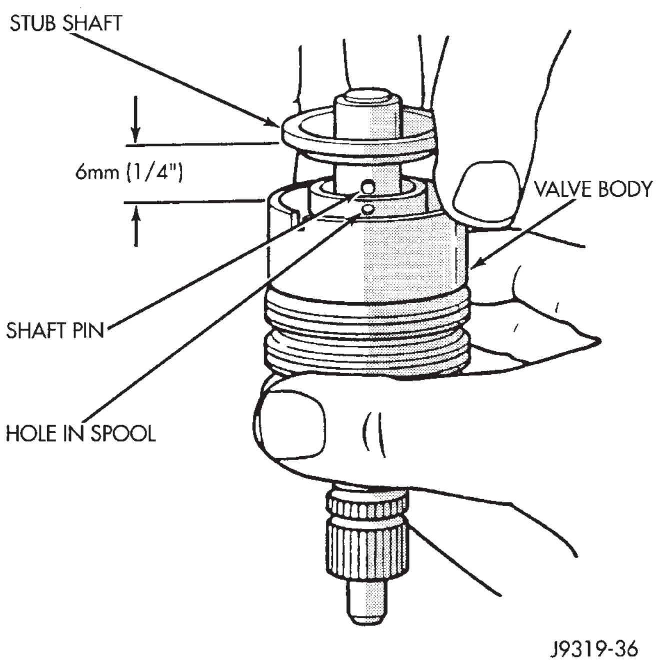


Fig. 12 Stub Shaft

(6) Remove spool valve from valve body by pulling and rotating the spool valve from the valve body (Fig. 13).

(7) Remove spool valve O-ring and valve body teflon rings and O-rings underneath the teflon rings (Fig. 14).

(8) Remove the O-ring between the worm shaft and the stub shaft.

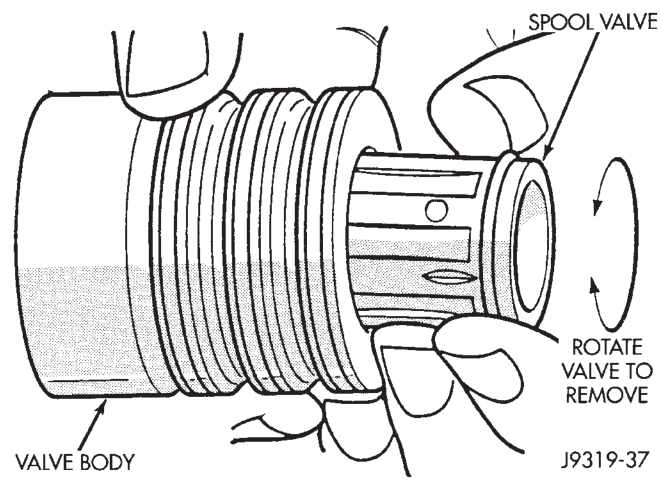


Fig. 13 Spool Valve

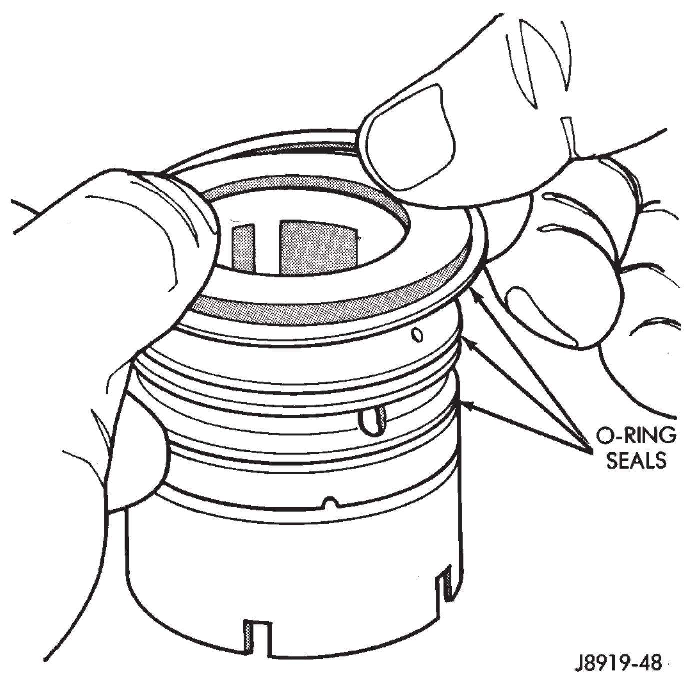


Fig. 14 Valve Seals

ASSEMBLY

NOTE: Clean and dry all components, then lubricate with power steering fluid.

(1) Install spool valve spool O-ring.

(2) Install spool valve in valve body by pushing and rotating. Hole in spool valve for stub shaft pin must be accessible from opposite end of valve body.

(3) Install stub shaft in valve spool and engage locating pin on stub shaft into spool valve hole (Fig. 15).

NOTE: Notch in stub shaft cap must fully engage valve body pin and seat against valve body shoulder.

DISASSEMBLY AND ASSEMBLY (Continued)

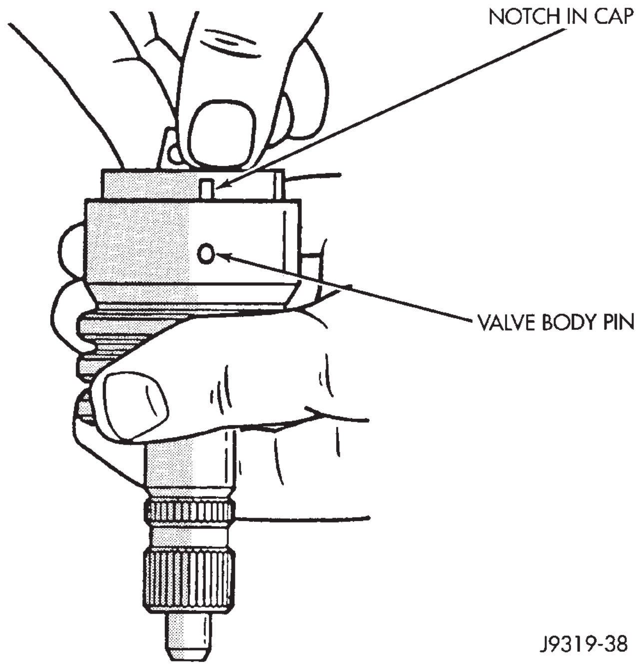


Fig. 15 Stub Shaft Installation

(4) Install O-rings and teflon rings over the O-rings on valve body.

(5) Install O-ring into the back of the stub shaft cap (Fig. 16).

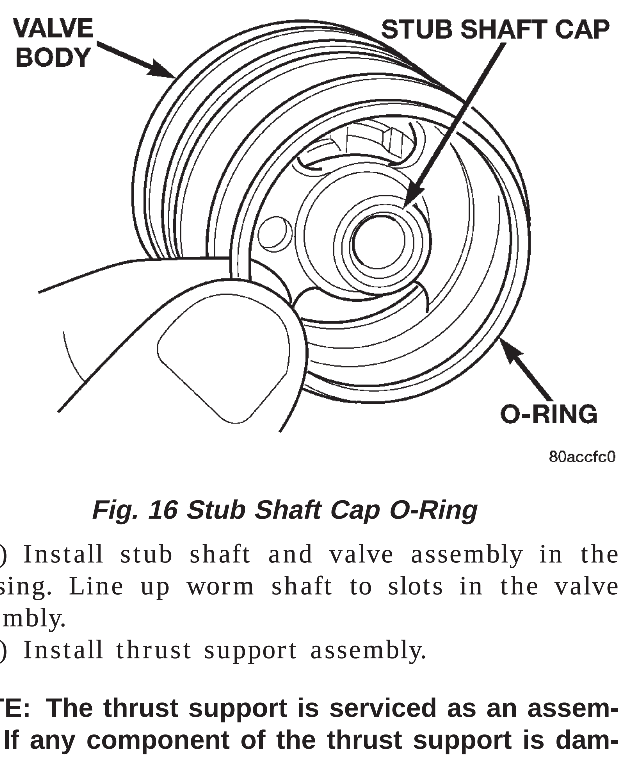


Fig. 16 Stub Shaft Cap O-Ring

(6) Install stub shaft and valve assembly in the housing. Line up worm shaft to slots in the valve assembly.

(7) Install thrust support assembly.

NOTE: The thrust support is serviced as an assembly. If any component of the thrust support is damaged the assembly must be replaced.

(8) Install adjuster nut and lock nut.

(9) Adjust Thrust Bearing Preload and Over-Center Rotating Torque.

RACK PISTON AND WORM SHAFT

DISASSEMBLY

(1) Remove housing end plug.

(2) Remove rack piston plug (Fig. 17).

(3) Remove side cover and pitman shaft.

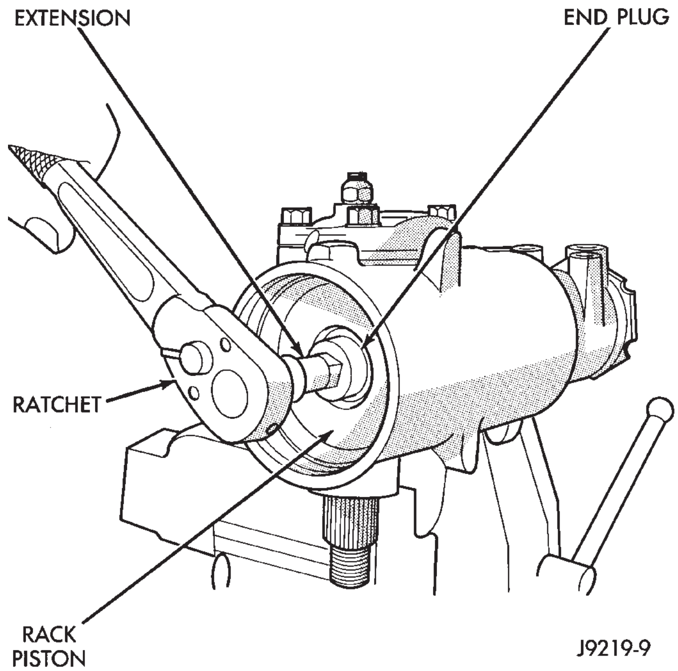


Fig. 17 Rack Piston End Plug

(4) Turn stub shaft COUNTERCLOCKWISE until the rack piston begins to come out of the housing.

(5) Insert Arbor C-4175 into bore of rack piston (Fig. 18) and hold tool tightly against worm shaft.

(6) Turn the stub shaft with a 12 point socket COUNTERCLOCKWISE, this will force the rack piston onto the tool and hold the rack piston balls in place.

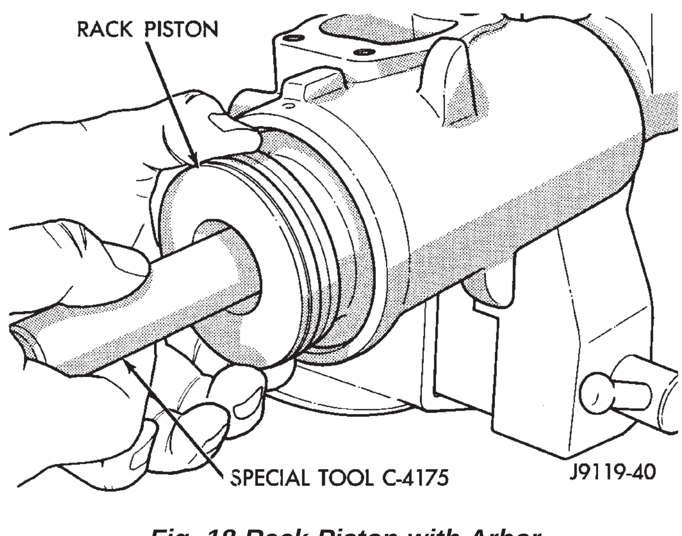


Fig. 18 Rack Piston with Arbor

DISASSEMBLY AND ASSEMBLY (Continued)

(7) Remove the rack piston and tool together from housing.

(8) Remove tool from rack piston.

(9) Remove rack piston balls.

(10) Remove clamp bolts, clamp and ball guide (Fig. 19).

(11) Remove teflon ring and O-ring from the rack piston (Fig. 20).

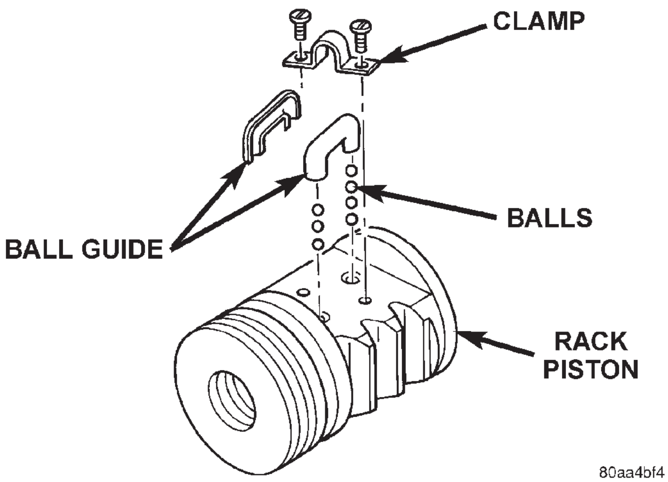


Fig. 19 Rack Piston

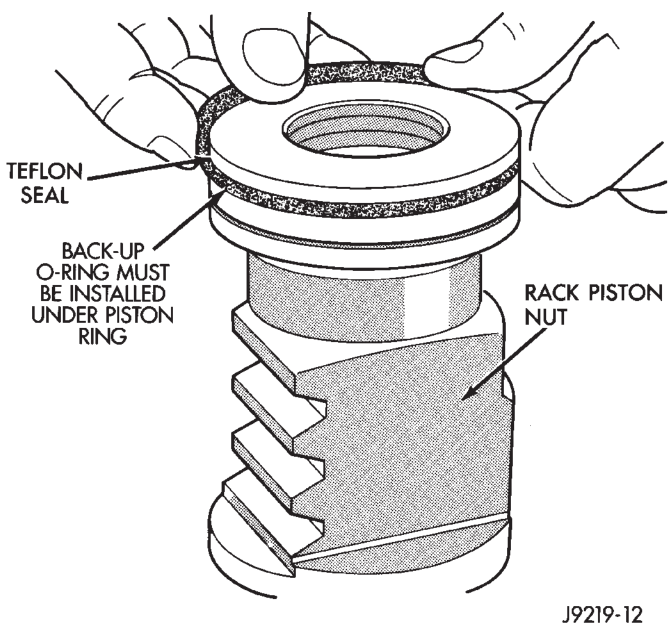


Fig. 20 Rack Piston Teflon Ring and O-Ring

(12) Remove the adjuster lock nut and adjuster nut from the stub shaft.

(13) Pull the stub shaft with the spool valve and thrust support assembly out of the housing.

(14) Remove the worm shaft from the housing (Fig. 21).

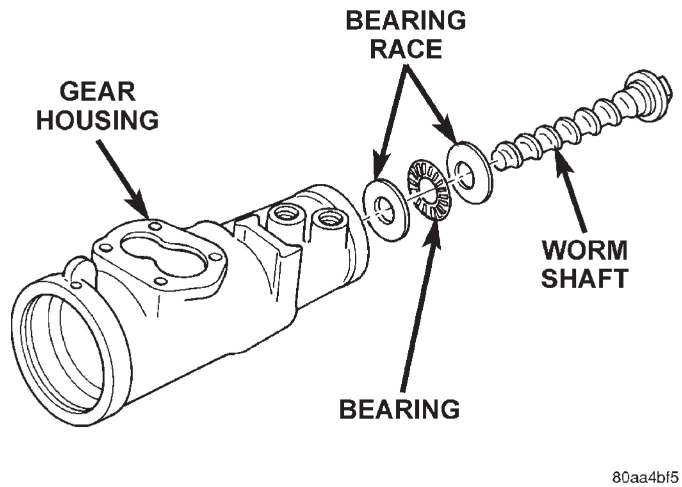


Fig. 21 Worm Shaft

ASSEMBLY

NOTE: Clean and dry all components and lubricate with power steering fluid.

(1) Check for scores, nicks or burrs on the rack piston finished surface. Slight wear is normal on the worm gear surfaces.

(2) Install O-ring and teflon ring on the rack piston.

(3) Install worm shaft in the rack piston and align worm shaft spiral groove with rack piston ball guide hole (Fig. 22).

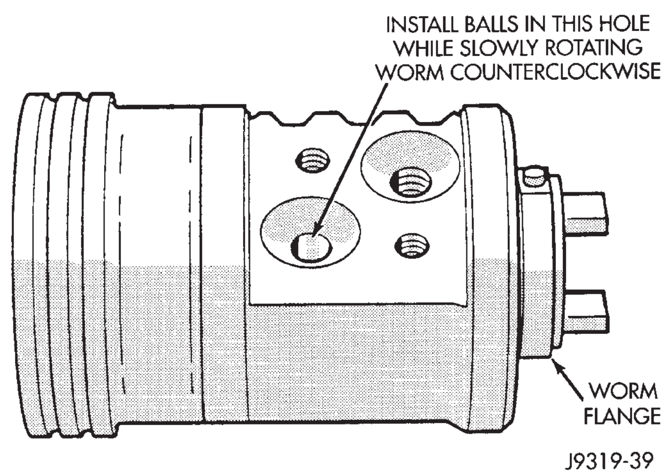


Fig. 22 Installing Balls in Rack Piston

CAUTION: The rack piston balls must be installed alternately into the rack piston and ball guide. This maintains worm shaft preload. There are 12 black balls and 12 silver (Chrome) balls. The black balls are smaller than the silver balls.

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Lubricate and install rack piston balls through return guide hole while turning worm shaft COUNTERCLOCKWISE (Fig. 22).

(5) Install remaining balls in guide using grease to hold the balls in place (Fig. 23).

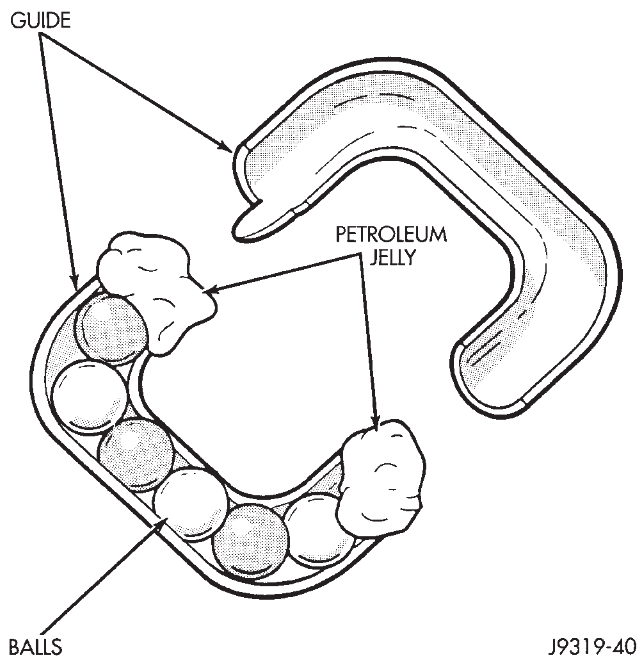


Fig. 23 Balls in the Return Guide

(6) Install the guide onto rack piston and install clamp and clamp bolts. Tighten bolts to 58 N·m (43 ft. lbs.).

(7) Insert Arbor C-4175 into bore of rack piston and hold tool tightly against worm shaft.

(8) Turn the worm shaft COUNTERCLOCKWISE while pushing on the arbor. This will force the rack piston onto the arbor and hold the rack piston balls in place.

(9) Install the races and thrust bearing on the worm shaft and install shaft in the housing (Fig. 21).

(10) Install the stub shaft with spool valve, thrust support assembly and adjuster nut in the housing.

(11) Install the rack piston and arbor tool into the housing.

(12) Hold arbor tightly against worm shaft and turn stub shaft CLOCKWISE until rack piston is seated on worm shaft.

(13) Install pitman shaft and side cover in the housing.

(14) Install rack piston plug and tighten to 150 N·m (111 ft. lbs.).

(15) Install housing end plug.

(16) Adjust worm shaft thrust bearing preload and over-center rotating torque.

ADJUSTMENTS

STEERING GEAR

CAUTION: Steering gear must be adjusted in the proper order. If adjustments are not performed in order, gear damage and improper steering response may result.

NOTE: Adjusting the steering gear in the vehicle is not recommended. Remove gear from the vehicle and drain the fluid. Then mount gear in a vise to perform adjustments.

WORM THRUST BEARING PRELOAD

(1) Mount the gear carefully into a vise.

CAUTION: Do not overtighten the vise on the gear case. This may affect the adjustment

(2) Remove adjuster plug locknut (Fig. 24).

(3) Rotate the stub shaft back and forth with a 12 point socket to drain the remaining fluid.

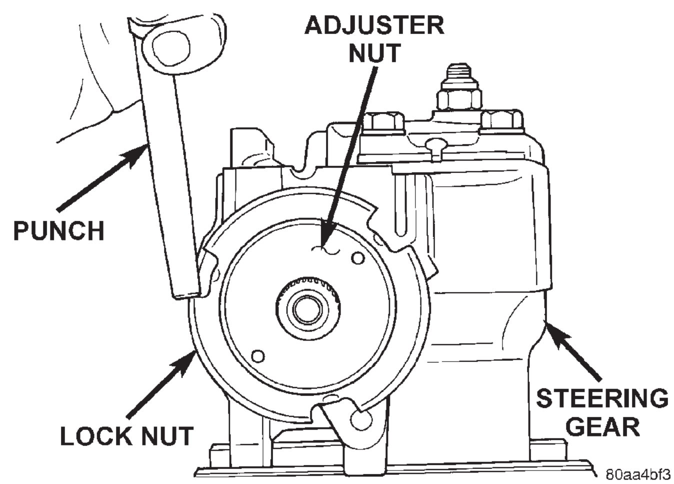


Fig. 24 Adjuster Lock Nut

(4) Turn the adjuster in with Spanner Wrench C-4381. Tighten the plug and thrust bearing in the housing until firmly bottomed in the housing about 34 N·m (25 ft. lbs.).

(5) Place an index mark on the housing even with one of the holes in adjuster plug (Fig. 25).

(6) Measure back (counterclockwise) 5.08 mm (0.20 in) and mark housing (Fig. 26).

(7) Rotate adjustment cap back (counterclockwise) with spanner wrench until hole is aligned with the second mark (Fig. 27).

ADJUSTMENTS (Continued)

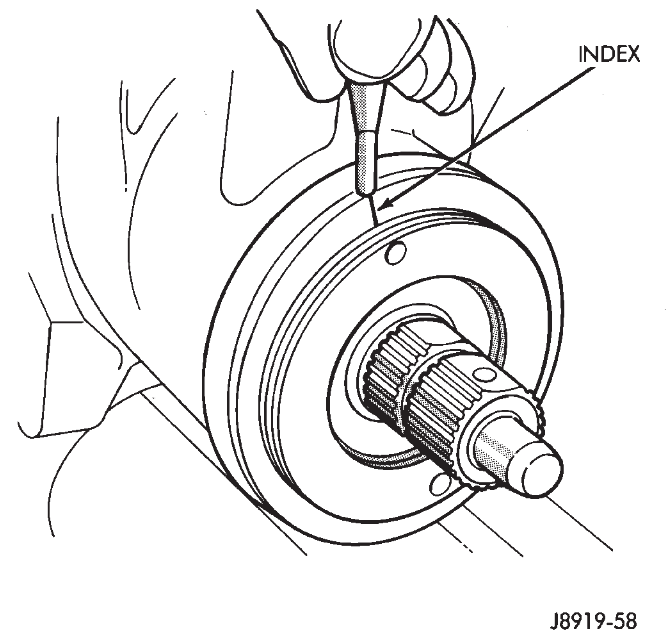


Fig. 25 Alignment Marking On Housing

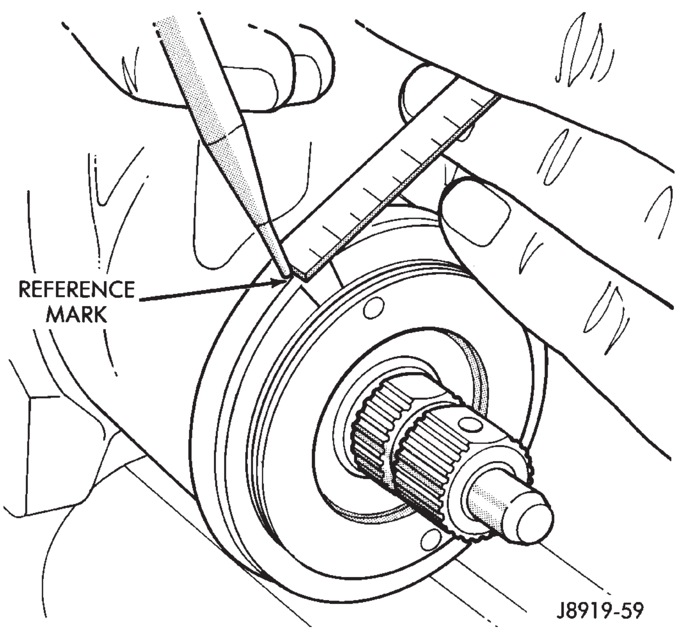


Fig. 26 Second Marking On Housing

(8) Install and tighten locknut to 108 N·m (80 ft. lbs.). Be sure adjustment cap does not turn while tightening the locknut.

OVER-CENTER

NOTE: Before performing this procedure, the worm bearing preload adjustment must be performed.

(1) Rotate the stub shaft with a 12 point socket from stop to stop and count the number of turns.

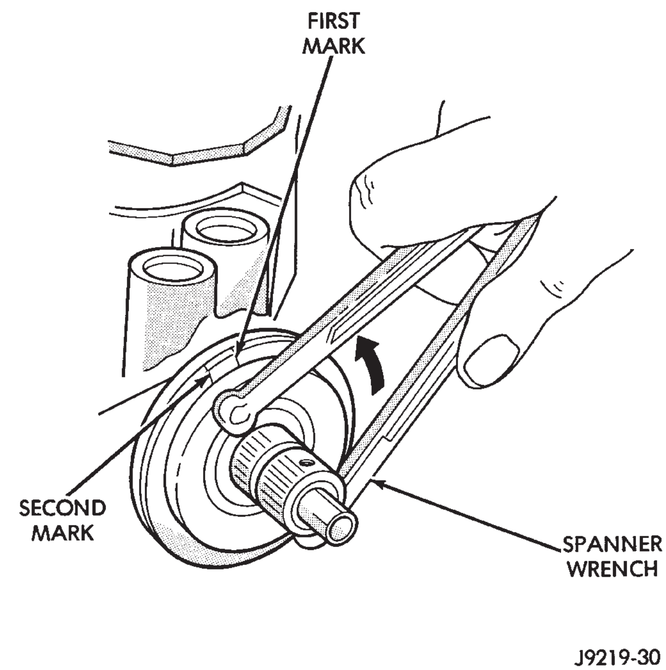


Fig. 27 Aligning To The Second Mark

(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. 28).

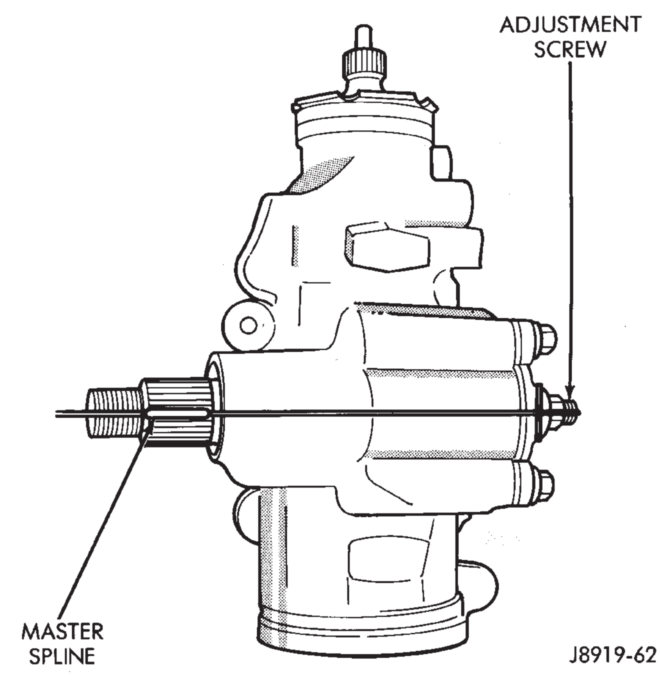


Fig. 28 Steering Gear Centered

(3) Place the torque wrench in the vertical position on the stub shaft. Rotate the wrench 45 degrees each side of the center and record the highest rotational torque in this range (Fig. 29). This is the Over-Center Rotating Torque.

ADJUSTMENTS (Continued)

NOTE: The stub shaft must rotate smoothly without sticking or binding.

(4) Rotate the stud shaft between 90° and 180° to the left of center and record the left off-center preload. Repeat this to the right of center and record the right off-center preload. The average of these two recorded readings is the Preload Rotating Torque.

(5) The Over-Center Rotating Torque should be 0.45-0.9 N·m (4-8 in. lbs.) **higher** than the Preload Rotating Torque.

(6) If an adjustment to the Over-Center Rotating Torque is necessary, first loosen the adjuster lock nut. Then turn the pitman shaft adjuster screw back (COUNTERCLOCKWISE) until fully extended, then turn back in (CLOCKWISE) one full turn.

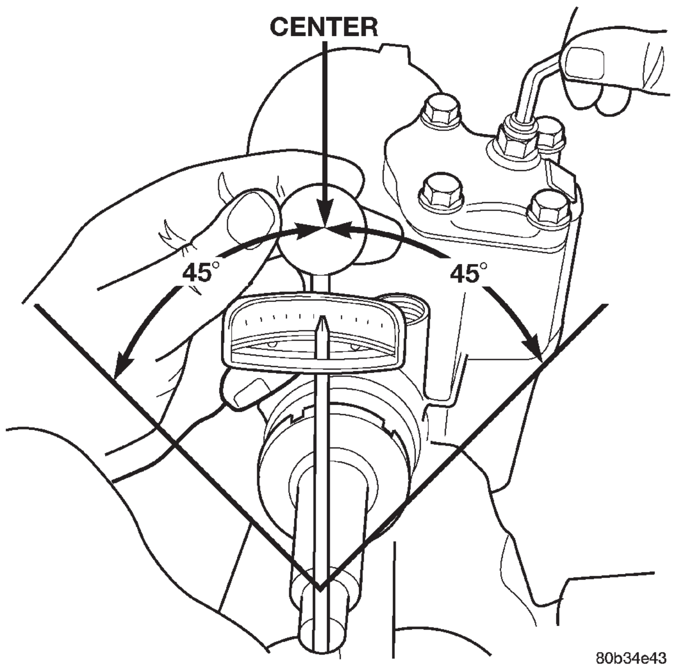


Fig. 29 Checking Over-center Rotation Torque

(7) Remeasure Over-Center Rotating Torque. If necessary turn the adjuster screw and repeat measurement until correct Over-Center Rotating Torque is reached.

NOTE: To increase the Over-Center Rotating Torque turn the screw CLOCKWISE.

(8) Prevent the adjuster screw from turning while tightening adjuster lock nut. Tighten the adjuster lock nut to 49 N·m (36 ft. lbs.).

SPECIFICATIONS

POWER STEERING GEAR

Steering Gear

Type . . . . Recirculating Ball

Gear Ratio

RHD 14:1

LHD 14:1

Worm Shaft Bearing

Preload . . . . 0.45–1.13 N·m (4–10 in. lbs.)

Pitman Shaft Overcenter Drag

New Gear (under 400 miles) . . . . . 0.45–0.90 N·m (4–8 in. lbs.) + Worm Shaft Preload

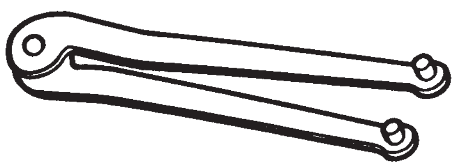
Used Gear (over 400 miles) . . . . 0.5–0.6 N·m (4–5 in. lbs.) + Worm Shaft Preload

TORQUE CHART

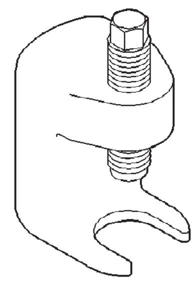
DESCRIPTION	TORQUE
Power Steering Gear	
Adjustment Cap Locknut	108 N·m (80 ft. lbs.)
Adjustment Screw Locknut	49 N·m (36 ft. lbs.)
Gear to Frame Bolts	95 N·m (70 ft. lbs.)
Pitman Shaft Nut	251 N·m (185 ft. lbs.)
Rack Piston Plug	102 N·m (75 ft. lbs.)
Side Cover Bolts	60 N·m (44 ft. lbs.)
Pressure Line	28 N·m (21 ft. lbs.)
Return Line	28 N·m (21 ft. lbs.)
Return Guide Clamp Bolt	58 N·m (43 ft. lbs.)

SPECIAL TOOLS

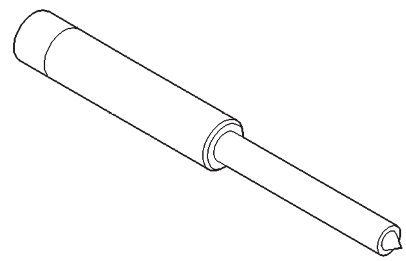
POWER STEERING GEAR



Remover/Installer, Steering Plug C-4381



Remover, Pitman Arm C-4150A



Remover/Installer Steering Rack Piston C-4175

STEERING LINKAGE

INDEX

GENERAL INFORMATION

STEERING LINKAGE

The steering linkage consist of a pitman arm, drag link, tie rod, tie rod ends and a steering damper (Fig. 1) and (Fig. 2). The service procedures and torque specifications are the same for LHD and RHD vehicles.

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

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: If any steering components are replaced or serviced an alignment must be performed, to ensure the vehicle meets all alignment specifications.

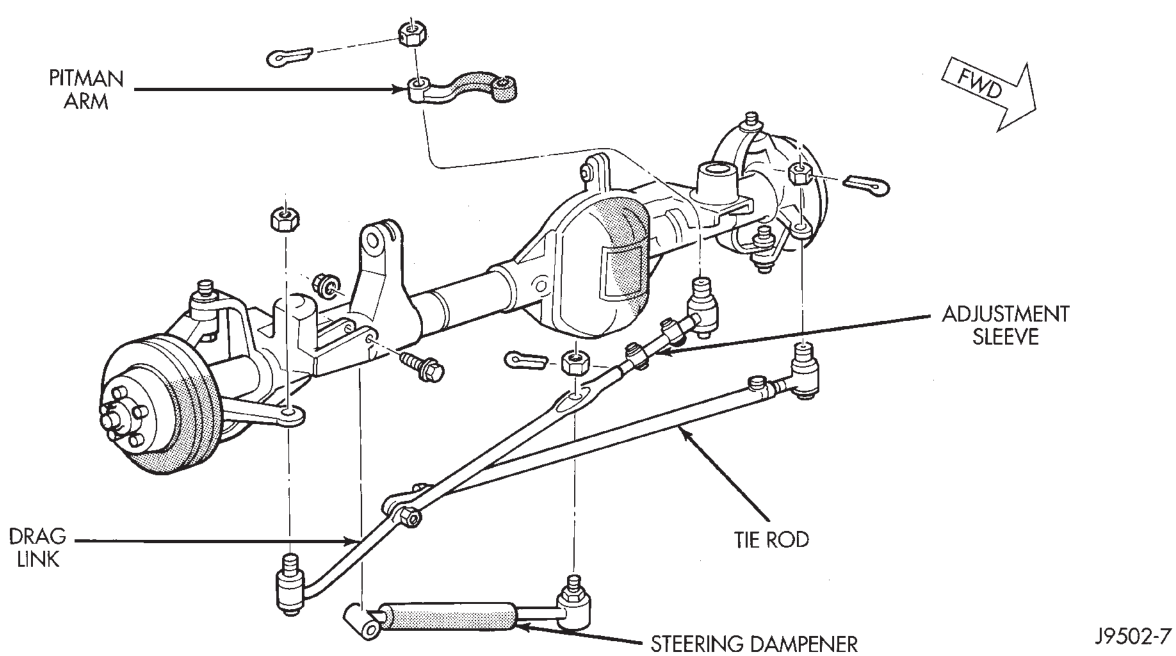


Fig. 1 Steering Linkage—LHD

SERVICE PROCEDURES (Continued)

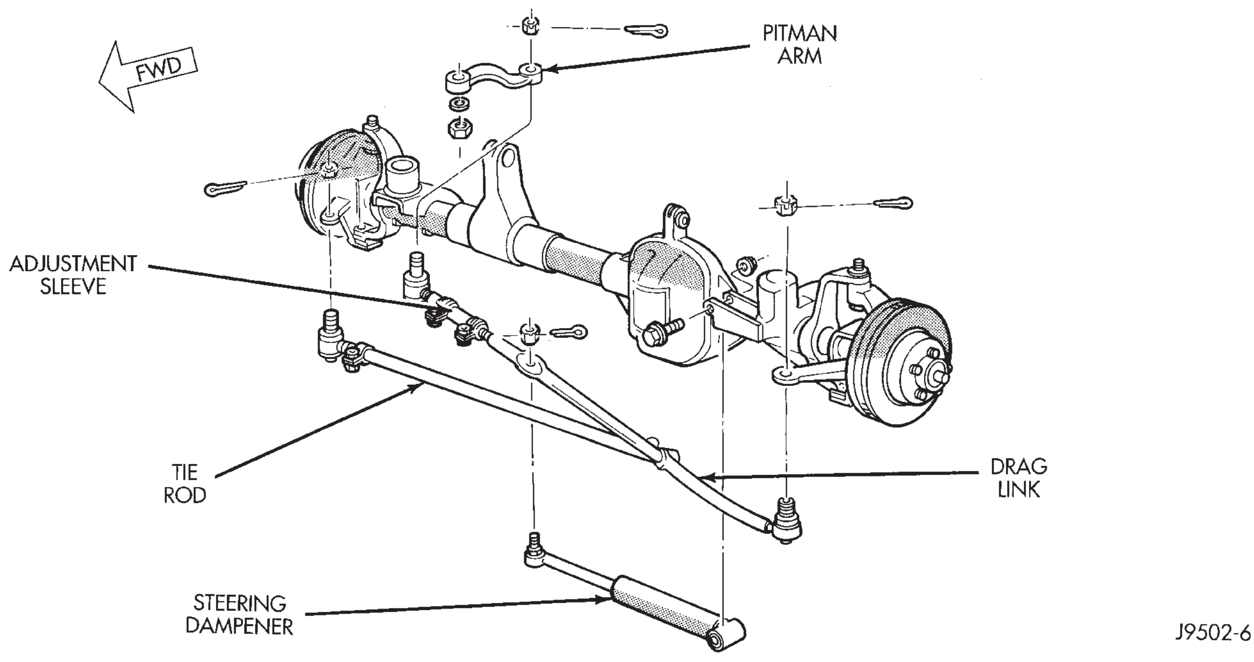


Fig. 2 Steering Linkage—RHD

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

REMOVAL AND INSTALLATION

TIE ROD

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. 3).

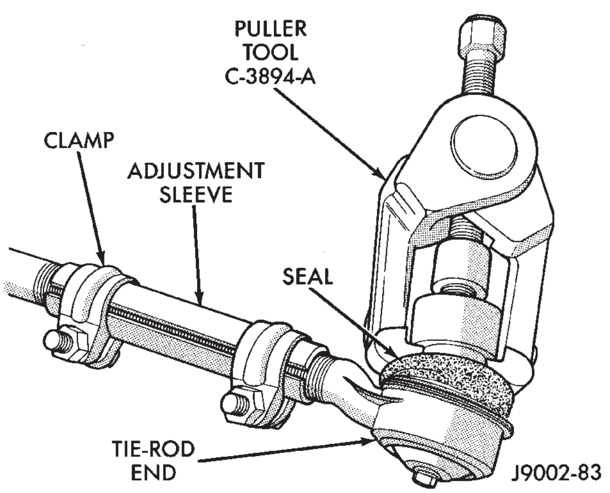


Fig. 3 Ball Stud Puller

REMOVAL

(1) Remove the cotter pins and nuts at the tie rod ball studs and drag link.

(2) Loosen the ball studs with a puller tool to remove the tie rod.

(3) Loosen clamp bolts and unthread the tie rod end from the tube.

INSTALLATION

(1) Thread the tie rod end into the tube and position the clamp to it's original position (Fig. 4). Tighten the clamp bolts to 27 N·m (20 ft. lbs.).

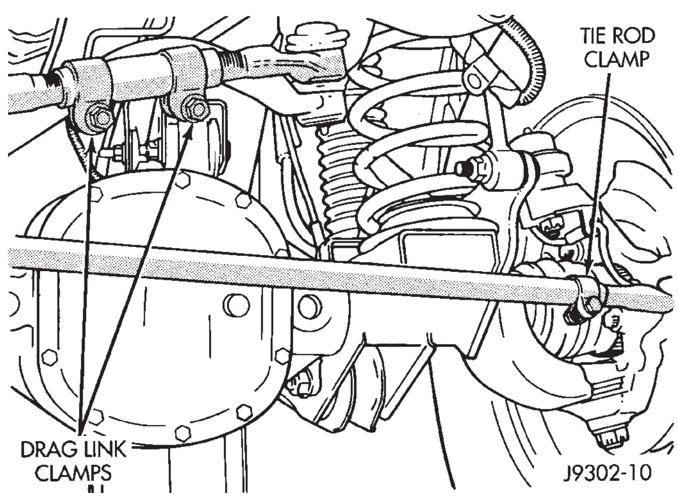


Fig. 4 Tie Rod/Drag Link Clamps

(2) Install the tie rod on the drag link and steering knuckle. Install the retaining nuts.

REMOVAL AND INSTALLATION (Continued)

(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 88 N·m (65 ft. lbs.). Install new cotter pins.

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-4150-A (Fig. 5).

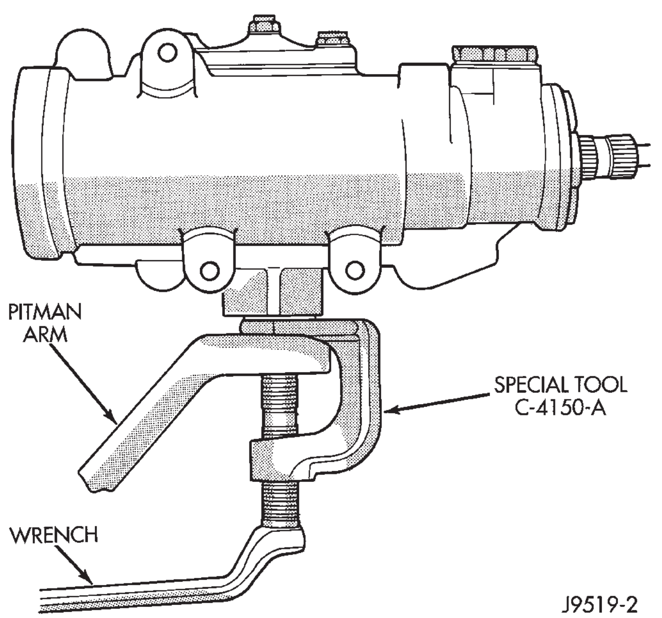


Fig. 5 Pitman Arm Puller

INSTALLATION

(1) Align and install the pitman arm on steering gear shaft.

(2) Install the washer and nut on the shaft and tighten nut to 251 N·m (185 ft. lbs.).

(3) Install drag link ball stud to pitman arm install nut and tighten to 74 N·m (55 ft. lbs.). Install a new cotter pin.

DRAG LINK

REMOVAL

(1) Remove cotter pins and nuts from drag link

(2) Remove the steering damper ball stud from the drag link.

(3) Remove tie rod from drag link

(4) Remove drag link from the steering knuckle and pitman arm.

INSTALLATION

(1) Install the drag link onto steering knuckle and pitman arm.

(2) Install nut at steering knuckle and tighten to 47 N·m (35 ft. lbs.). Install new cotter pins.

(3) Install nut at pitman arm and tighten to 75 N·m (55 ft. lbs.). Install new cotter pins.

(4) Install tie rod onto drag link and install nut. Tighten nut to 75 N·m (55 ft. lbs.) and install new cotter pins.

(5) Install steering damper onto drag link and install nut. Tighten nut to 75 N·m (55 ft. lbs.) and install a new cotter pin.

STEERING DAMPER

REMOVAL

(1) Remove the steering damper retaining bolt from the axle bracket.

(2) Remove the cotter pin and nut from the ball stud at the drag link.

(3) Remove the steering damper ball stud from the drag link with Puller C-3894-A.

INSTALLATION

(1) Install steering damper onto the axle bracket and drag link.

(2) Install steering damper bolt in axle bracket and tighten nut to 75 N·m (55 ft. lbs.).

(3) Install ball stud nut at the drag link and tighten nut to 75 N·m (55 ft. lbs.). Install a new cotter pin.

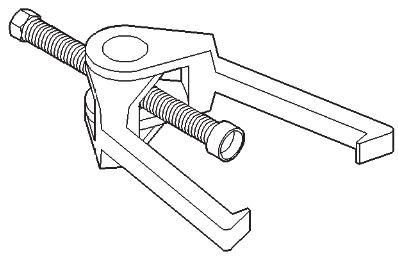
SPECIFICATIONS

TORQUE CHART

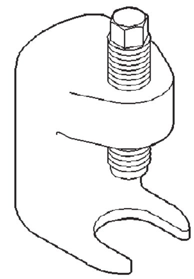
DESCRIPTION	TORQUE
Pitman Arm	
Shaft	251 N·m (185 ft. lbs.)
Drag Link	
Ball Studs	74 N·m (55 ft. lbs.)
Clamp	49 N·m (36 ft. lbs.)
Tie Rod Ends	
Ball Studs	74 N·m (55 ft. lbs.)
Clamp	27 N·m (20 ft. lbs.)
Tie Rod	
Ball Stud	88 N·m (65 ft. lbs.)
Steering Damper	
Frame	74 N·m (55 ft. lbs.)
Drag Link	74 N·m (55 ft. lbs.)

SPECIAL TOOLS

STEERING LINKAGE



Puller C-3894–A



Remover Pitman C-4150A

STEERING COLUMN

INDEX

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. On the non-tilt column the upper mounting bracket is also serviced separately.

The column is mounted to the column support bracket studs and secured by four nuts. The column is connected to the steering gear by a one piece collapsible shaft with a coupler at each end. The couplers secure the shaft to the steering column and steering gear.

SERVICE PRECAUTIONS

Safety goggles should be worn at all times when working on steering columns.

To service the steering wheel, switches or airbag, refer to Group 8M and follow all WARNINGS and CAUTIONS.

WARNING: THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE, REMOVE OR INSTALL THE AIRBAG SYSTEM COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY. THE FASTENERS, SCREWS, AND BOLTS, ORIGINALLY USED FOR THE AIRBAG COMPONENTS, HAVE SPECIAL COATINGS AND ARE SPECIFICALLY DESIGNED FOR THE AIRBAG SYSTEM. THEY MUST NEVER BE REPLACED WITH ANY SUBSTITUTES. ANYTIME A NEW FASTENER IS NEEDED, REPLACE WITH THE CORRECT FASTENERS PROVIDED IN THE SERVICE PACKAGE OR FASTENERS LISTED IN THE PARTS BOOKS.

REMOVAL 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 and isolate the negative battery ground cable.

(3) Remove the airbag, refer to Group 8M Restraint Systems for service procedures.

NOTE: If equipped with cruise control, disconnect clock spring harness from cruise switch harness on the steering wheel.

(4) Remove the steering wheel with an appropriate puller (Fig. 1).

CAUTION: Ensure the puller bolts are fully engaged into the steering wheel and not into the clockspring, before attempting to remove the wheel. Failure to do so may damage the steering wheel.

(5) Turn ignition cylinder to the on position and remove cylinder by pressing release through lower shroud access hole (Fig. 2).

(6) Remove knee blocker cover and knee blocker, Refer to Group 8E Instrument Panel Systems.

(7) Remove screws from the lower column shroud (Fig. 3) and remove lower shroud.

(8) Remove the steering coupler bolt and column mounting nuts (Fig. 4) then lower column off the mounting stud.

(9) Remove upper column shroud (Fig. 3).

REMOVAL AND INSTALLATION (Continued)

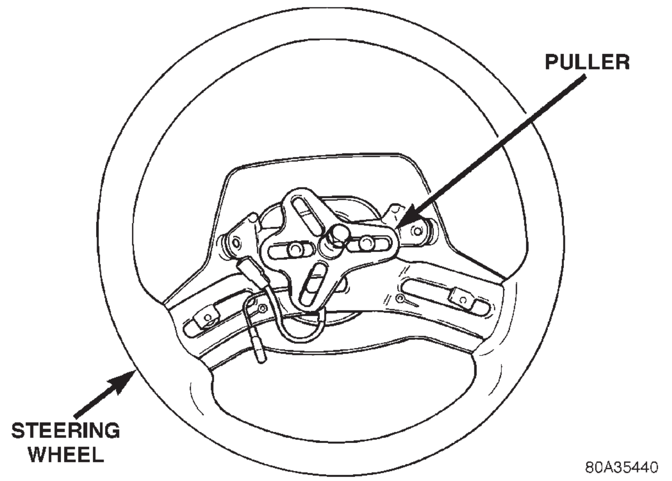


Fig. 1 Steering Wheel

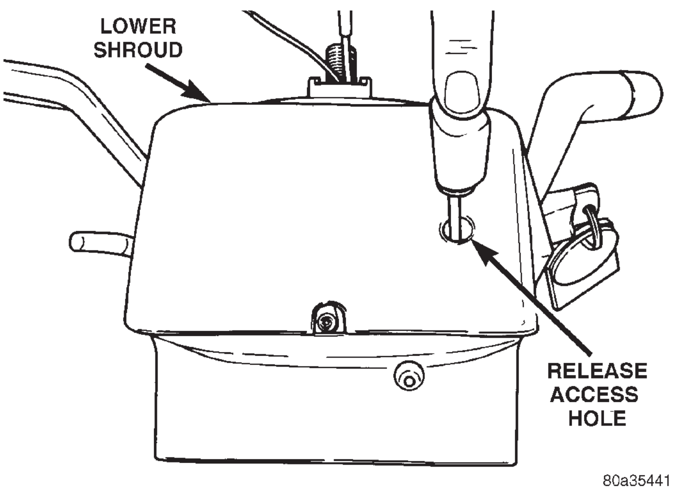


Fig. 2 Key Cylinder Release Access Hole

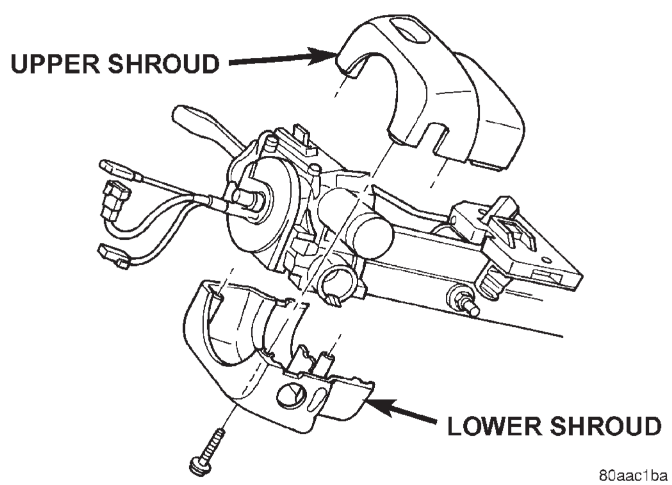


Fig. 3 Column Shrouds

(10) Disconnect and remove the wiring harness from the column (Fig. 5).

NOTE: If vehicle is equipped with automatic transmission, remove shifter interlock cable. Refer to

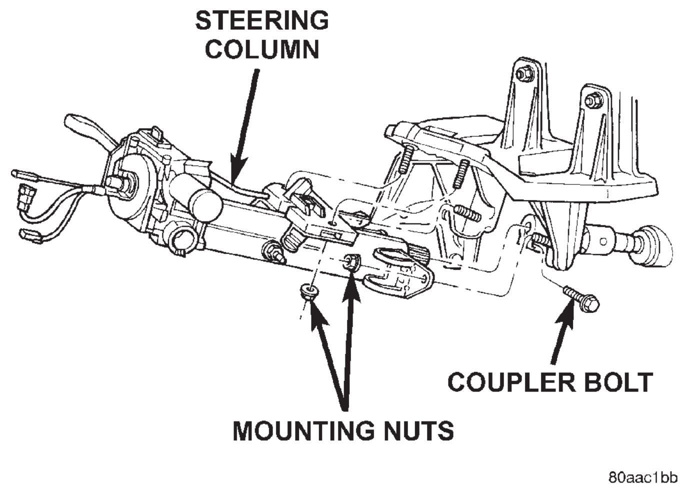


Fig. 4 Tilt Steering Column Mounting

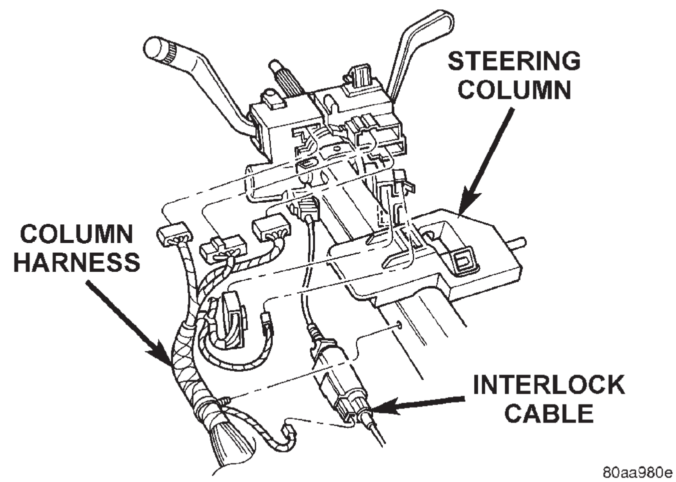


Fig. 5 Steering Column Harness

Group 21 Transmission and Transfer Case for procedure.

(11) Remove column.

(12) Remove nut and bolt from the upper column mounting bracket on non-tilt column (Fig. 6). Remove the bracket from the column and **note the mounting location and orientation of the bracket.** .

(13) Remove clock spring, switches, (SKIM if equipped) and ignition key cylinder, refer to Group 8 Electrical for service procedures.

INSTALLATION

(1) Install upper column mounting bracket on non-tilt column. Install the mounting bolt and tighten the nut to 17 N·m (150 in. lbs.).

(2) Install switches, refer to Group 8 Electrical for service procedures.

(3) Align and install column into the steering coupler.

(4) Install column harness and connect harness to switches.

REMOVAL AND INSTALLATION (Continued)

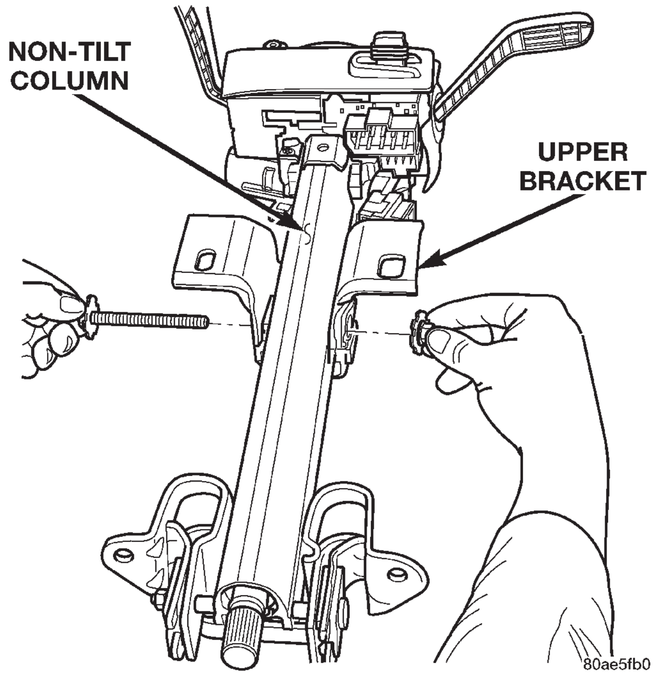


Fig. 6 Non-Tilt Column

NOTE: If vehicle is equipped with automatic transmission install shifter interlock cable. Refer to Group 21 Transmission and Transfer Case 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.).
(8) Install steering column coupler bolt and tighten to 49 N·m (36 ft. lbs.).
(9) Center the clock spring and install it on the column, refer to Group 8 Electrical for service procedures.
(10) Install lower column shroud and install mounting screws.
(11) Install ignition cylinder.
(12) Install knee blocker and knee blocker cover, Refer to Group 8E Instrument Panel Systems.
(13) Install steering wheel and tighten nut to 54 N·m (40 ft. lbs.).

NOTE: If equipped with cruise control, connect clock spring harness to cruise switch harness on the steering wheel.

(14) Install airbag, refer to Group 8M Restraint Systems for service procedures.
(15) Install negative battery terminal.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Tilt Steering Column	
Steering Wheel Nut	54 N·m (40 ft. lbs.)
Mounting Nuts	23 N·m (17 ft. lbs.)
Coupler Bolt	49 N·m (36 ft. lbs.)
Non-Tilt Steering Column	
Steering Wheel Nut	54 N·m (40 ft. lbs.)
Mounting Nuts	23 N·m (17 ft. lbs.)
Coupler Bolt	49 N·m (36 ft. lbs.)
Upper Bracket Nut	17 N·m (150 in. lbs.)

STEERING

CONTENTS

POWER STEERING—2.5L VM DIESEL

INDEX

GENERAL INFORMATION

POWER STEERING PUMP

The power steering pump used with the 2.5L VM Diesel engine operates the same way as the power steering pump used with the 2.5/4.0L gasoline engines. Refer to the Description and Operation section for the 2.5/4.0L gasoline engine power steering pump for more information.

POWER STEERING PUMP—2.5L VM DIESEL

INDEX

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 ambient temperature.

(1) Fill the pump fluid reservoir to the proper level and let the fluid settle for at least two minutes.

(2) Start the engine and let run for a few seconds then turn engine off.

(3) Add fluid if necessary. Repeat the above procedure until the fluid level remains constant after running the engine.

(4) Raise the front wheels off the ground.

(5) Slowly turn the steering wheel right and left, lightly contacting the wheel stops at least 20 times.

(6) Check the fluid level add if necessary.

(7) Lower the vehicle, start the engine and turn the steering wheel slowly from lock to lock.

(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 — LHD

Removal

(1) Disconnect the negative battery cable.

(2) Remove the A/C line support bracket from the rear of the rocker cover.

(3) Disconnect the A/C compressor electrical connector.

(4) Remove the (2) engine mount upper sill plate nuts (Fig. 1).

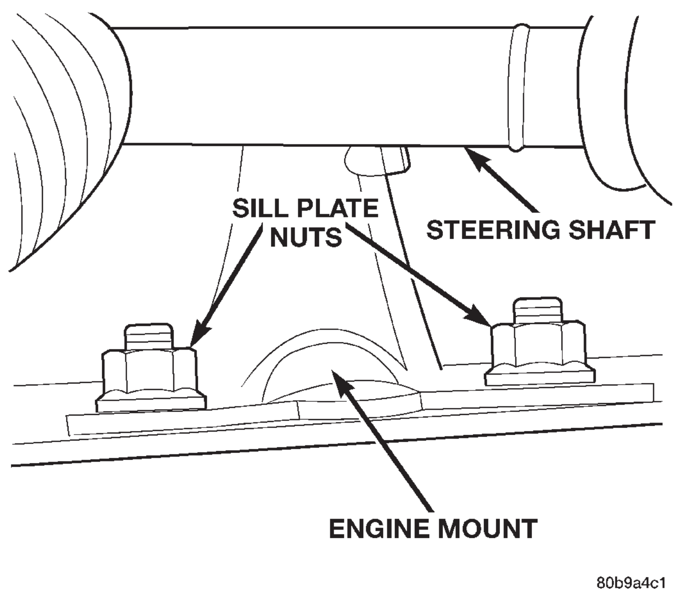


Fig. 1 Engine Mount Sill Plate Nuts

(5) Make sure the steering wheel is in the unlocked position.

REMOVAL AND INSTALLATION (Continued)

(6) Raise the vehicle on a hoist.

(7) Remove the steering shaft pinch bolt and slide the steering shaft straight off the gearbox input shaft, position the shaft aside.

CAUTION: Avoid turning the steering shaft while disconnected from the steering gearbox. Damage to steering column clockspring could occur.

(8) Remove the power steering fluid supply hose from the pump and let the fluid drain.

(9) Loosen the (4) H-Block retaining bolts. Do not remove the bolts at this time.

(10) Remove the accessory drive belt from the power steering pump pulley. Refer to Group 7, Cooling System for procedure.

(11) Remove the power steering pump pulley. Use a hex socket to secure the pump shaft while removing the pulley nut with a box wrench (Fig. 2).

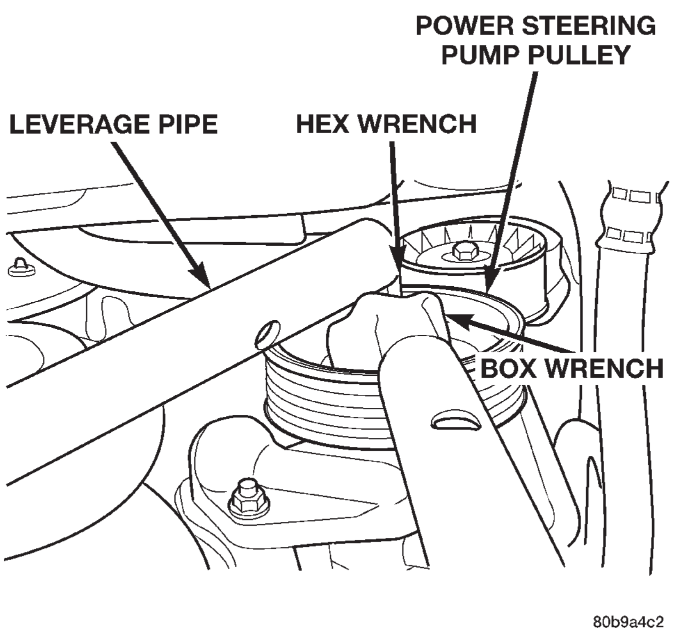


Fig. 2 Removing the Power Steering Pump Pulley

NOTE: Mark the position of the H-Block in relation to the A/C Compressor so it may be reinstalled in the same position.

(12) Remove the (2) bolts retaining the H-Block to the power steering pump shaft coupler.

(13) Loosen the coupler pinch bolt and slide the coupler towards the pump.

(14) Remove the power steering pump pressure line from the steering gear. This is more accessible, but will require you to install the pressure line on the new pump prior to installation.

(15) Remove the remaining 2 bolts from the H-Block and remove the H-Block from the compressor.

(16) Support the A/C compressor with mechanics wire before proceding to the next step.

(17) Remove the (4) A/C compressor retaining bolts.

(18) Remove the left engine mount throughbolt nut only. Do not remove the bolt at this time.

(19) Position a jack stand and raise weight off left engine mount.

(20) Remove the track bar support bracket retaining bolts and remove bracket (Fig. 3).

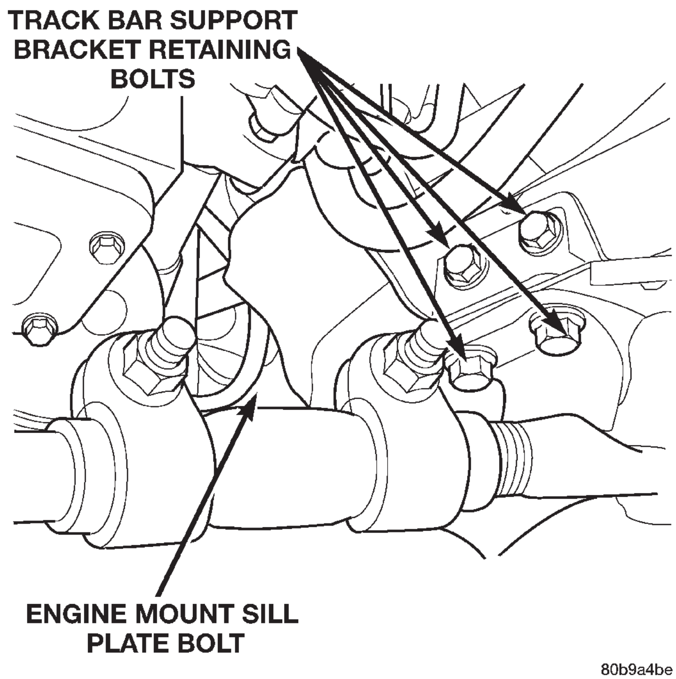


Fig. 3 Engine Mount Retaining Bolts

(21) Remove the lower engine mount bolt from the sill plate (Fig. 3).

(22) Remove the (4) engine mount bracket bolts from the engine block.

(23) Remove the engine mount throughbolt.

(24) Remove the engine mount and engine mount bracket from the vehicle.

(25) Remove the (2) power steering pump retaining nuts (Fig. 4).

(26) Remove the power steering pump from the vehicle.

Installation

WARNING: Power steering system fluid may be contaminated with metal shavings, overheated or improper fluid. All fluid should be drained from the system. After component replacement, system should be flushed and filled with Mopar Power Steering Fluid, or equivalent.

REMOVAL AND INSTALLATION (Continued)

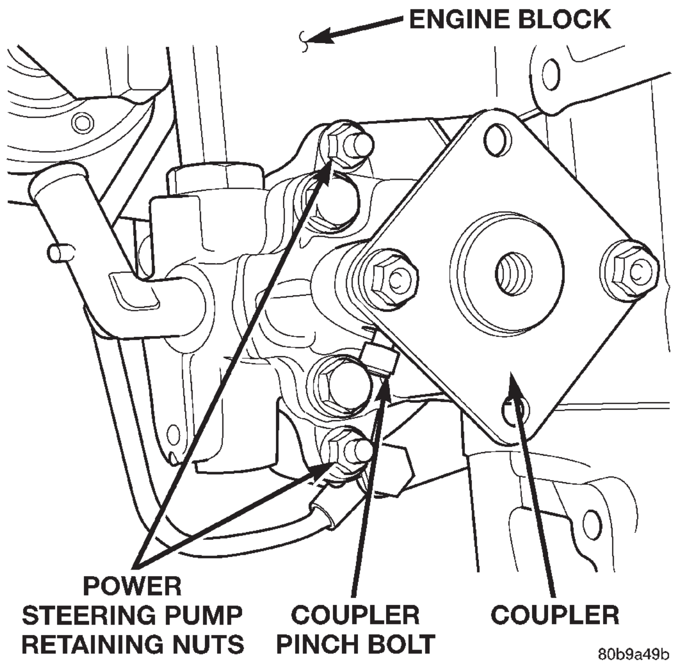


Fig. 4 Power Steering Pump

(1) Transfer the pressure line to the new pump , making sure line is in original position.

(2) Transfer the coupler to the new pump leaving pinch bolt lose at this time (Fig. 5).

(3) Install the power steering pump (Fig. 5).

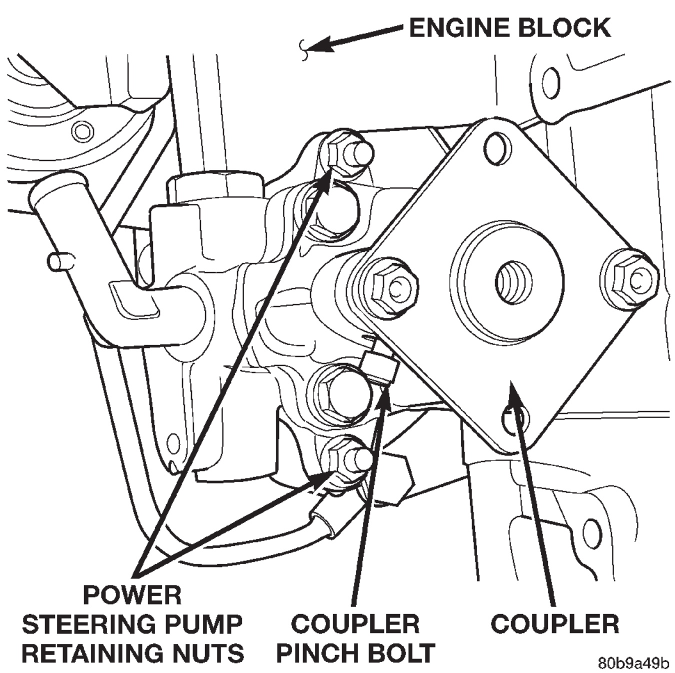


Fig. 5 Power Steering Pump

(4) Install the engine mount and the engine mount bracket in the vehicle.

(5) Install the engine mount throughbolt and leave loose at this time.

(6) Install, but do not torque the engine mount and track bar support bracket bolts (Fig. 6).

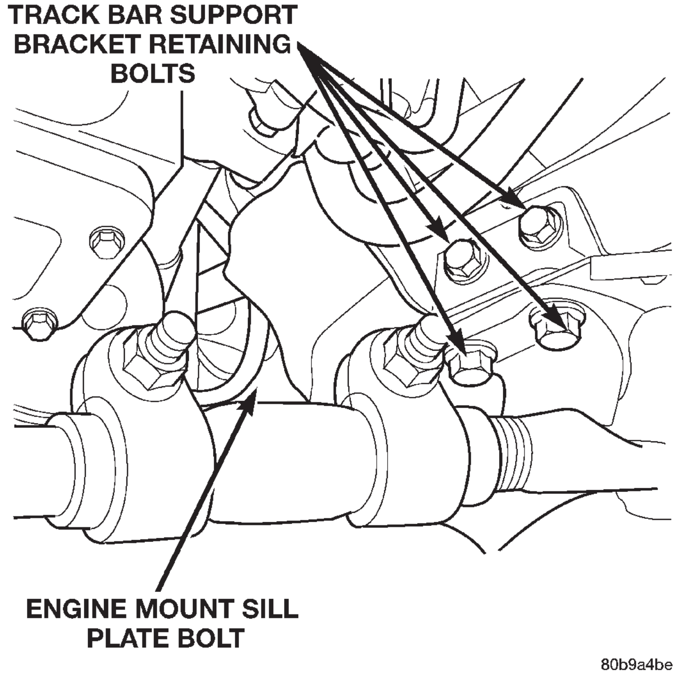


Fig. 6 Engine Mount Retaining Bolts

(7) Install the (4) engine mount bracket to engine block retaining bolts. Torque bolts to 47 N·m (35 ft. lbs.).

(8) Torque the engine mount sill plate bolts to 41 N·m (30 ft. lbs.).

(9) Torque the larger trackbar support bracket bolts to 125 N·m (92ft. lbs.).

(10) Remove the jack stand.

(11) Install the H-Block on the A/C compressor in its original position and leave the bolts loose at this time.

(12) Position and install the A/C compressor.

(13) Slide the drive coupler in its original position and install the remaining (2) H-Block bolts.

(14) Install the power steering pump pulley (Fig. 7). Torque nut to 166 N·m (120 ft. lbs.).

(15) Install the accessory drive belt. See Group 7, Cooling System for procedure.

(16) Torque all the H-Block bolts.

(17) Install the steering shaft. Torque the steering shaft pinch bolt to 49 N·m (36 ft. lbs.).

(18) Install the pressure line on steering gear. Torque nut to 28 N·m (21 ft. lbs.).

(19) Install the power steering fluid supply hose on the pump.

(20) Lower the vehicle from the hoist.

(21) Install and torque the engine mount upper sill plate nuts to 41 N·m (30 ft. lbs.) (Fig. 8).

(22) Connect the A/C compressor electrical connector.

REMOVAL AND INSTALLATION (Continued)

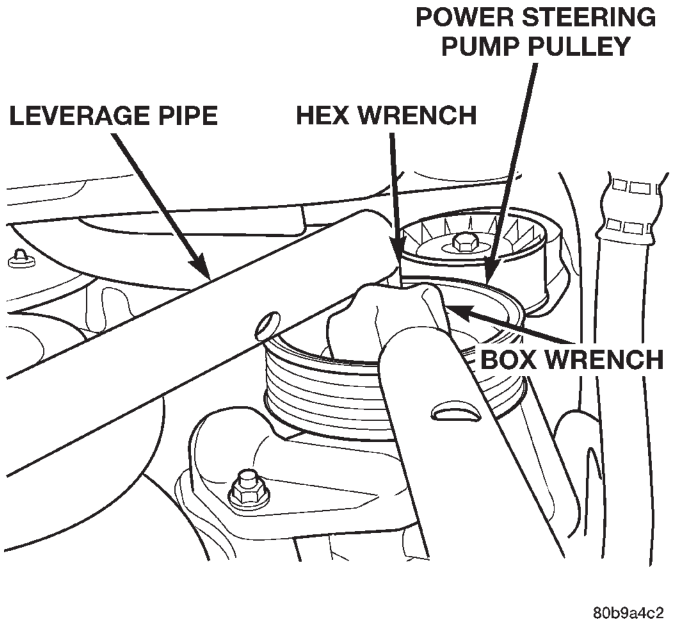


Fig. 7 Installing Pump Pulley

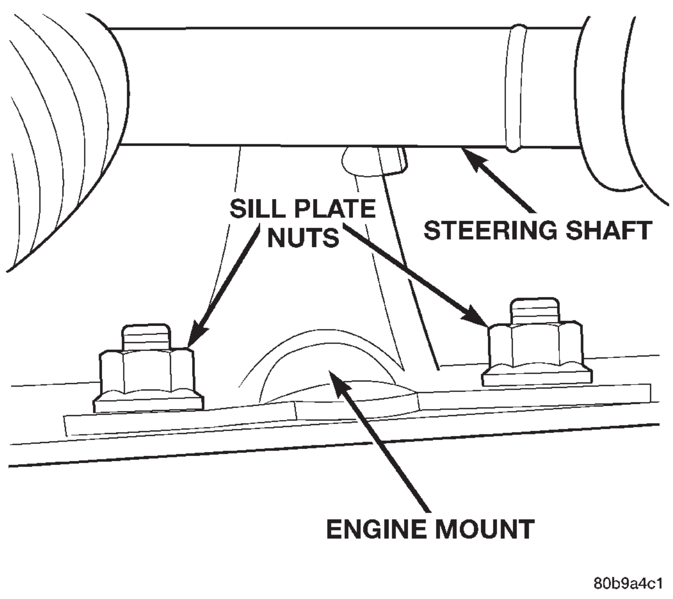


Fig. 8 Engine Mount Sill Plate Nuts

(23) Install the A/C line support bracket bolt at the rear of the valve cover.

(24) Fill the power steering fluid. See Group 19, Steering for Power Steering Pump-Initial operation procedure.

(25) Connect the negative battery cable.

POWER STEERING PUMP — RHD

Removal

(1) Disconnect the negative battery cable.

(2) Remove the refrigerent line support bracket bolt from the top of the radiator.

(3) Remove the A/C filter-drier assembly support bracket nuts from left fender well.

(4) Disconnect the A/C compressor electrical connector.

(5) Raise the vehicle on a hoist.

(6) Remove the power steering fluid supply hose from pump and drain fluid.

(7) Remove power steering line support bracket bolt from below radiator.

(8) Remove the engine mount upper sill plate nuts.

(9) Loosen the (4) H-Block retaining bolts. Do not remove at this time.

(10) Remove the accessory drive belt from the power steering pump pulley. See Group 7, Cooling System for procedure.

(11) Remove the power steering pump pulley. Use a hex socket to secure the pump shaft while removing the pulley nut with a box wrench (Fig. 9).

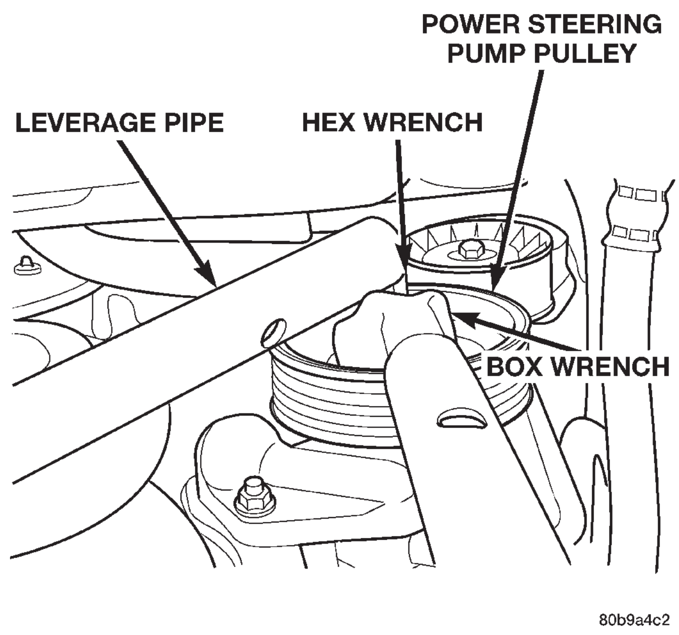


Fig. 9 Removing Pump Pulley

NOTE: Mark position of the H-Block in relation to the A/C Compressor so it can be installed in the same position.

(12) Remove the (2) bolts retaining the H-Block to the power steering pump shaft coupler.

(13) Loosen the coupler pinch bolt and slide coupler towards pump.

REMOVAL AND INSTALLATION (Continued)

(14) Remove the left engine mount throughbolt nut only. Do not remove the bolt at this time.

(15) Remove the remaining 2 bolts from the H-Block and remove the H-Block from the compressor.

(16) Position a jack stand and raise weight off left engine mount.

(17) Remove the (2) engine mount sill plate bolts.

(18) Remove the (4) engine mount bracket bolts from the engine block.

(19) Remove the engine mount throughbolt.

(20) Remove the engine mount and engine mount bracket from vehicle.

(21) Remove the (2) power steering pump retaining nuts (Fig. 10).

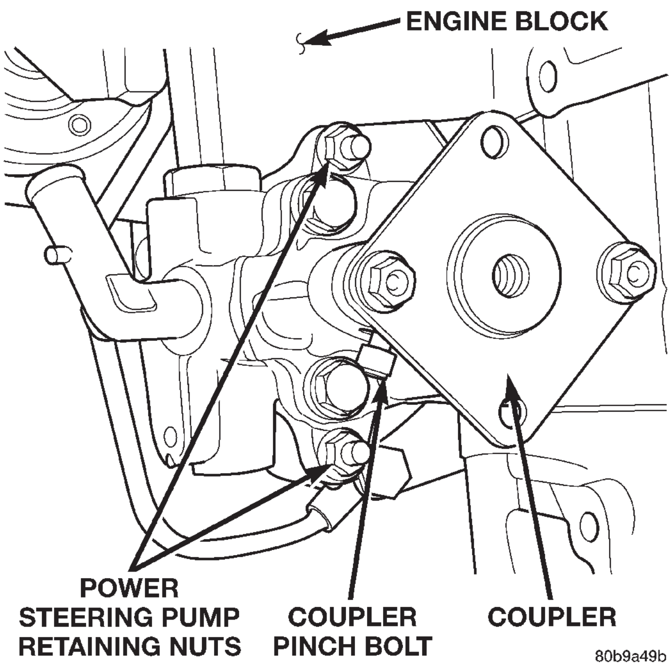


Fig. 10 Power Steering Pump

(22) Slide pump off mounting studs and position so pressure line can be removed. This will require you to install pressure line on the new pump prior to installing it in the engine block.

(23) Remove the power steering pump from the vehicle.

Installation

WARNING: Power steering system fluid may be contaminated with metal shavings, overheated or improper fluid. All fluid should be drained from the system. After component replacement, system should be flushed and filled with Mopar Power Steering Fluid, or equivalent.

(1) Install the pressure line on pump in original position.

(2) Transfer the drive coupler to new pump leaving pinch bolt lose at this time (Fig. 11).

(3) Install the power steering pump in the engine block. Torque retaining nuts to 24 N·m (18 ft. lbs.) (Fig. 11).

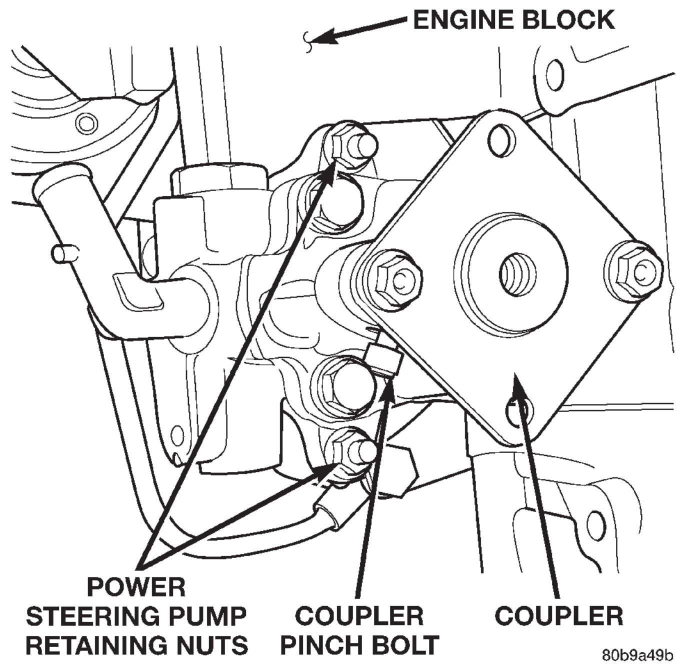


Fig. 11 Power Steering Pump

(4) Install the engine mount and engine mount bracket in vehicle.

(5) Install the engine mount throughbolt and leave loose at this time.

(6) Install, do not torque engine mount sill plate nuts and bolts.

(7) Install (4) engine mount bracket to engine block retaining bolts and Torque to 61 N·m (45 ft. lbs.).

(8) Torque the engine mount sill plate nuts to 41 N·m (30 ft. lbs.).

(9) Torque the engine mount sill plate bolts to 41 N·m (30 ft. lbs.).

(10) Remove jack stand.

(11) Install the H-Block on the A/C compressor in the original position and leave bolts loose at this time.

(12) Position and install A/C compressor.

(13) Slide the drive coupler into its original position and start remaining (2) H-Block bolts.

(14) Install the power steering pump pulley (Fig. 12). Torque nut to 166 N·m (120 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

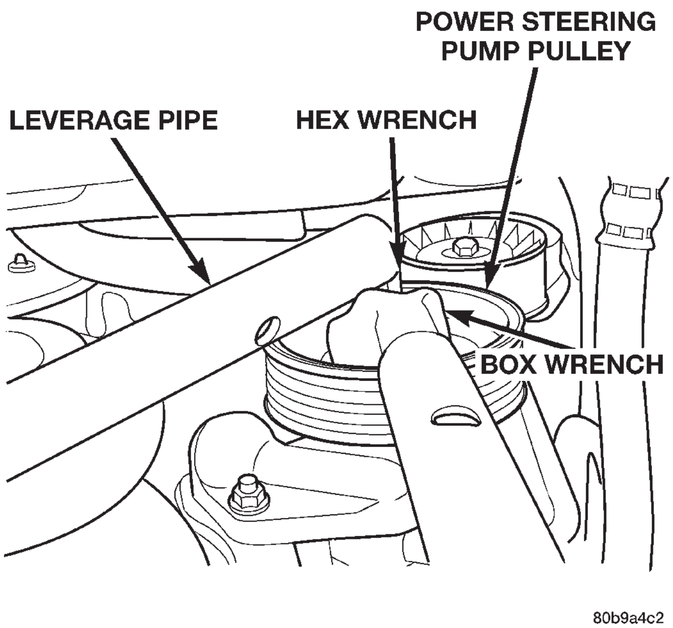


Fig. 12 Installing Pump Pulley

(15) Install the accessory drive belt. See Group 7, Cooling for procedure.

(16) Torque all the H-Block bolts.

(17) Torque the engine mount throughbolt nut to 65 N·m (48 ft. lbs.).

(18) Install the power steering fluid supply hose on pump.

(19) Install the power steering line support bracket bolt.

(20) Lower the vehicle from hoist.

(21) Install the refrigerent line support bracket and bolt on the top of the radiator.

(22) Install the A/C filter-drier assembly support bracket nuts on the left fender well.

(23) Reconnect the A/C compressor electrical connector.

(24) Re-fill the power steering fluid. Refer to Group 19, Steering for Power Steering Pump-Initial Operation for procedure.

(25) Connect the negative battery cable.

STEERING COLUMN

INDEX

GENERAL INFORMATION

STEERING COLUMN

The tilt and standard column (Fig. 1) has been designed to be serviced as an assembly; less wiring, switches, shrouds, steering wheel, etc. Most steering column components can be serviced without removing the steering column from the vehicle.

SERVICE PRECAUTIONS

Safety goggles should be worn at all times when working on steering columns.

To service the steering wheel, switches or airbag, refer to Group 8 M and follow all WARNINGS and CAUTIONS.

WARNING: THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE, REMOVE OR INSTALL THE AIRBAG SYSTEM COMPONENTS YOU MUST FIRST DISARM THE AIRBAG FIRING MECHANISM. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY.

WARNING: THE FASTENERS, SCREWS, AND BOLTS, ORIGINALLY USED FOR THE AIRBAG COMPONENTS, HAVE SPECIAL COATINGS AND ARE SPECIFICALLY DESIGNED FOR THE AIRBAG SYSTEM. THEY MUST NEVER BE REPLACED WITH ANY SUBSTITUTES. ANYTIME A NEW FASTENER IS NEEDED, REPLACE WITH THE CORRECT FASTENERS PROVIDED IN THE SERVICE PACKAGE OR FASTENERS LISTED IN THE PARTS BOOKS.

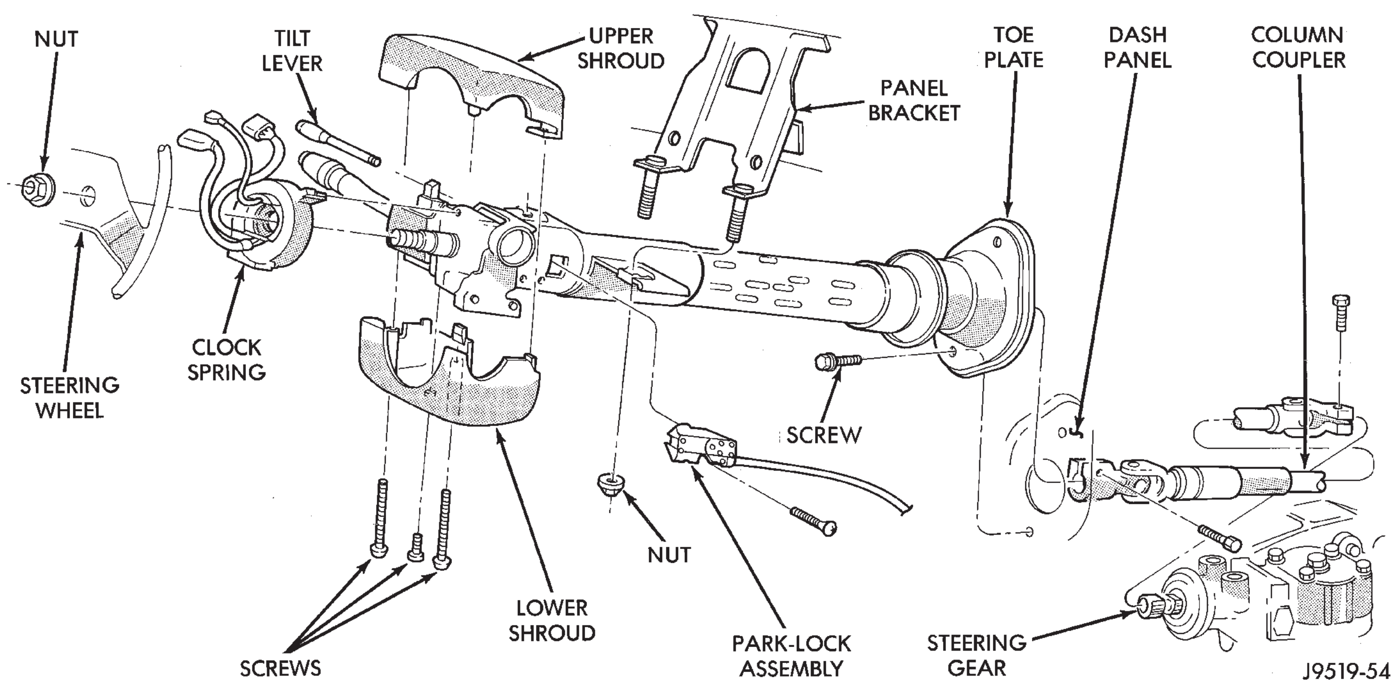


Fig. 1 Steering Column

GENERAL INFORMATION (Continued)

CAUTION: Do not attempt to remove the pivot pins to disassemble the tilting mechanism. Do not remove ignition locking link, shaft lock plate or plate retainer. This will damage the column (Fig. 2) and (Fig. 3).

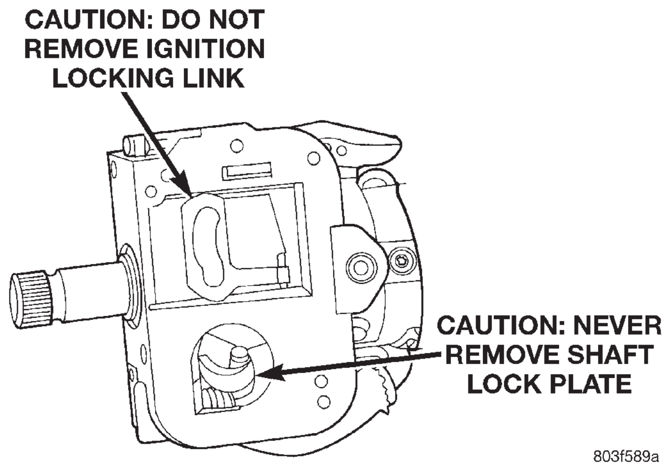


Fig. 2 Observe Cautions

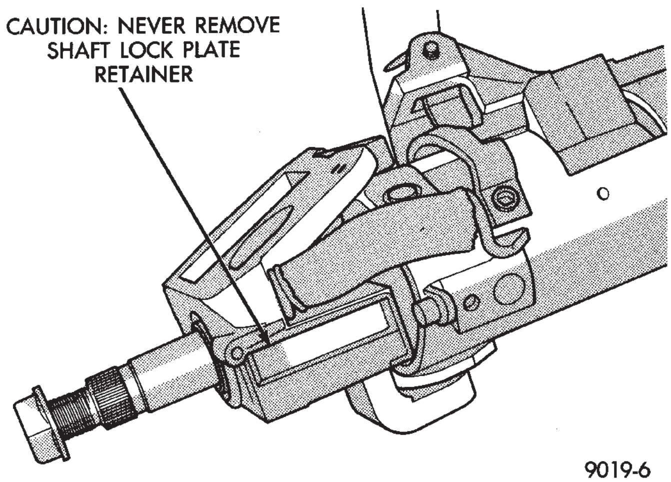


Fig. 3 Observe Cautions

DIAGNOSIS AND TESTING

IGNITION SWITCH

TEST AND REPAIR

If the ignition switch effort is excessive, remove the ignition switch from the steering column. Refer to Group 8D Ignition System. Using a key cylinder, check the turning effort of the switch. If the ignition switch binds look for the following conditions.

(1) Look for rough areas or flash in the casting and if found remove with a file (Fig. 4).

(2) With the ignition switch removed, slide the slider in its slot in the sleeve and verify a loose fit over the length of the slot. If the slider binds in the slot at any point lightly file the slider or slot until clearance is achieved.

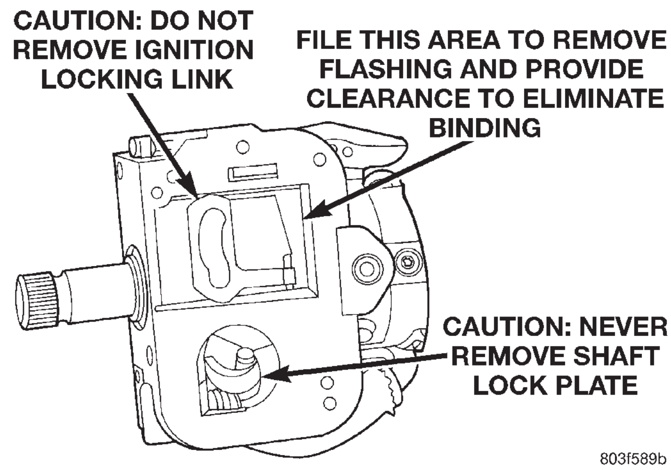


Fig. 4 Steering Column Flash Removal And Non-Serviceable Components

(3) If no binding is found, lightly file the ramp on the ignition switch, (The ramp fits into the casting) until binding no longer occurs.

REMOVAL AND INSTALLATION

STEERING COLUMN

WARNING: BEFORE SERVICING THE STEERING COLUMN THE AIRBAG SYSTEM MUST BE DISARMED, REFER TO GROUP 8M RESTRAINT SYSTEMS FOR SERVICE PROCEDURES. FAILURE TO DO SO MAY RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Position the front wheels **straight ahead** .

(2) Remove the negative (ground) cable from the battery.

(3) Disarm and remove airbag, steering wheel and clockspring, refer to group 8M Restraint Systems for service procedures.

(4) Remove lower instrument panel/knee blocker.

(5) Remove column coupler upper pinch bolt (Fig. 5).

(6) Remove relay box.

(7) Remove tilt lever (if equipped) from column.

(8) Remove upper and lower steering column shrouds.

(9) Remove lower fixed column shroud.

(10) Remove column braces (Fig. 6).

(11) Remove column bracket mounting nuts and lower column.

REMOVAL AND INSTALLATION (Continued)

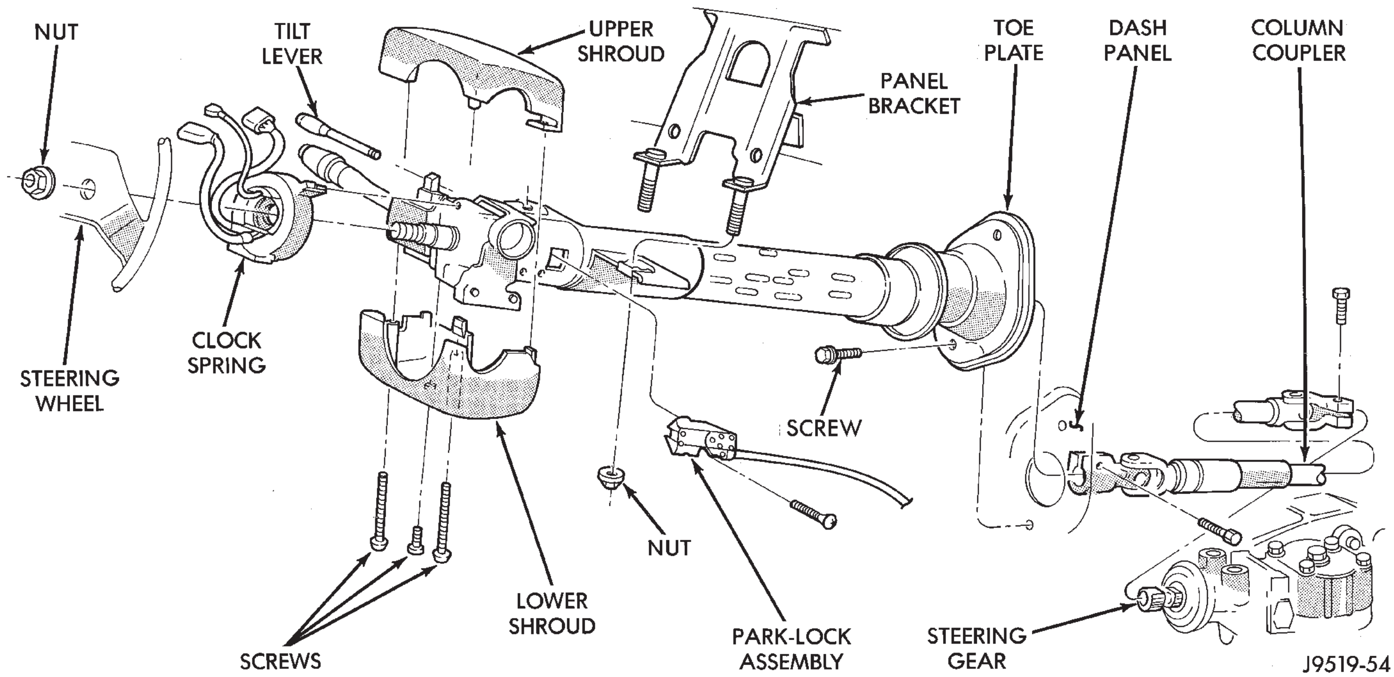


Fig. 5 Steering Column

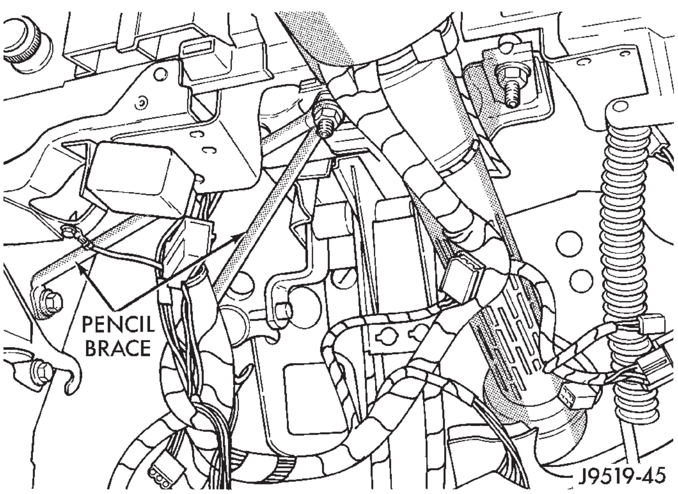


Fig. 6 Steering Column Braces

(12) Remove upper fixed column shroud.

(13) Remove multi-function switch tamper proof mounting screws and connector screw. Connector screw will stay in the connector.

(14) Unplug wiring harness from the column switches (Fig. 7).

(15) Remove the wiring harness from steering column.

(16) Remove ignition switch.

(17) Remove interlock cable from the steering column, refer to Group 21 Automatic Transmission Shifter/Ignition Interlock.

(18) Remove the column.

INSTALLATION

(1) Align and install the column to the coupler. **Do not apply force at the top of the steering column shaft.**

(2) Ensure the ground clip is position (Fig. 8).

(3) Install interlock cable from the steering column, refer to Group 21 Automatic Transmission Shifter/Ignition Interlock.

(4) Install wiring harness connections to steering column.**Ensure the wiring is not pinched and all connections are correctly locked in place.**

(5) Install wiring harness connector onto multi function switch. Tighten function switch wiring harness connector retaining bolt to 2 N·m (17 in. lbs.).

(6) Plug in wiring harness connector to remaining switches.

(7) Install ignition switch.

(8) Install upper fixed column shroud cover.

(9) Install shaft coupler pinch bolt loose, load column up to panel bracket.

REMOVAL AND INSTALLATION (Continued)

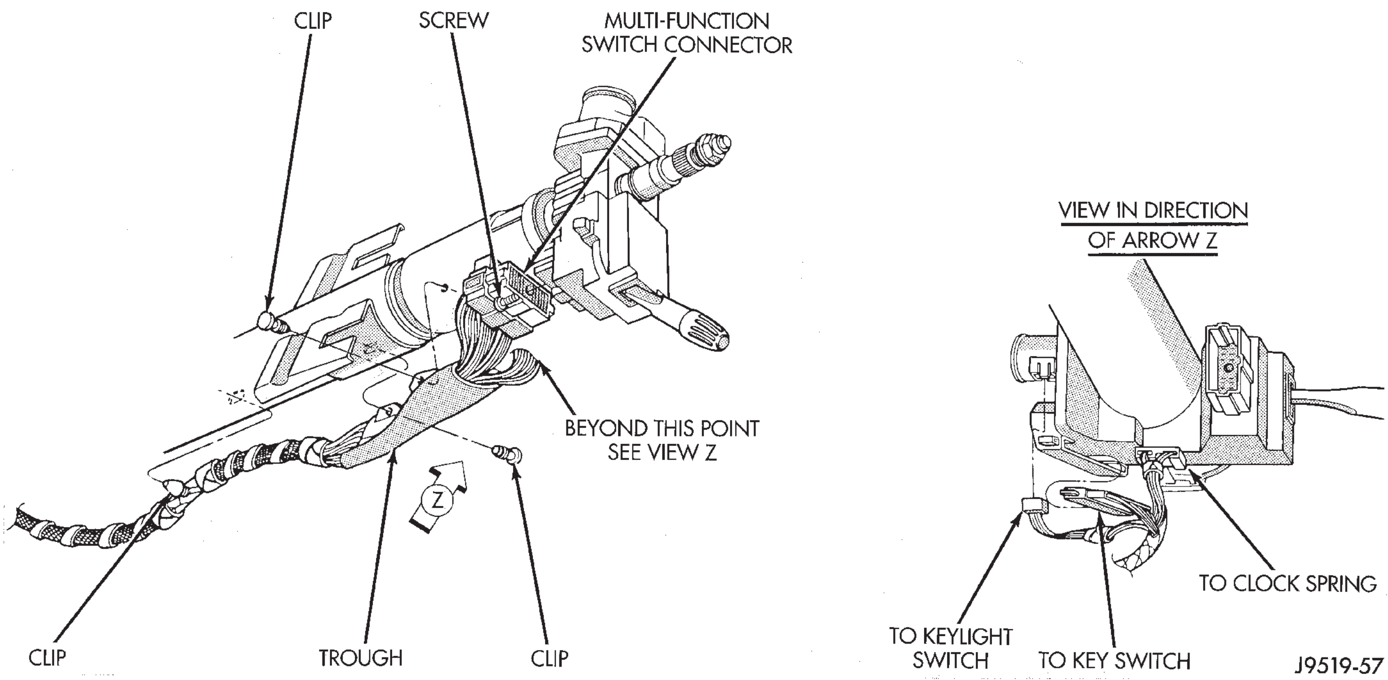


Fig. 7 Steering Column Wiring Harness

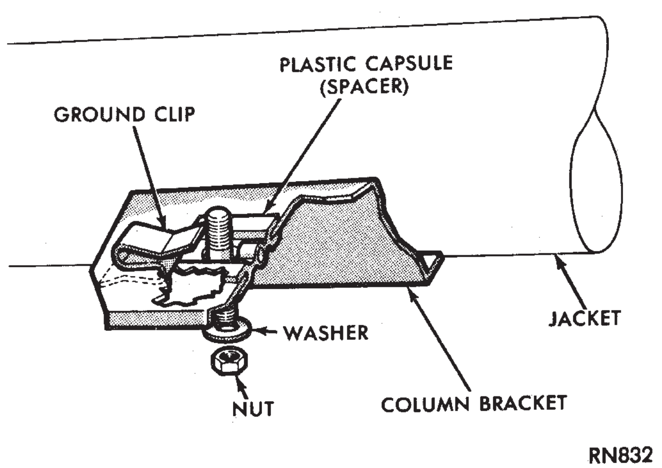


Fig. 8 Ground Clip & Spacer

(10) Be sure both spacers are fully seated in the column support bracket. Tighten the column panel bracket support nuts to 12 N·m (105 in. lbs.).

(11) Tighten the coupler pinch bolt to 47 N·m (35 ft. lbs.).

(12) Install lower fixed shroud.

(13) Install upper and lower shrouds. Install the tilt lever (if equipped).

(14) Install relay box.

(15) Install lower instrument panel/knee blocker.

(16) Install clockspring, steering wheel and airbag. Refer to Group 8M Restraint Systems for service procedures.

(17) Remove the column shaft shipping lock pin (installed in service column).

(18) Connect the battery ground (negative) cable.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Tilt Steering Column	
Steering Wheel Nut	54 N·m (40 ft. lbs.)
Mounting Nuts	23 N·m (17 ft. lbs.)
Coupler Bolt	49 N·m (36 ft. lbs.)
Non-Tilt Steering Column	
Steering Wheel Nut	54 N·m (40 ft. lbs.)
Mounting Nuts	23 N·m (17 ft. lbs.)
Coupler Bolt	49 N·m (36 ft. lbs.)
Upper Bracket Nut	17 N·m (150 in. 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.

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.

GENERAL INFORMATION (Continued)

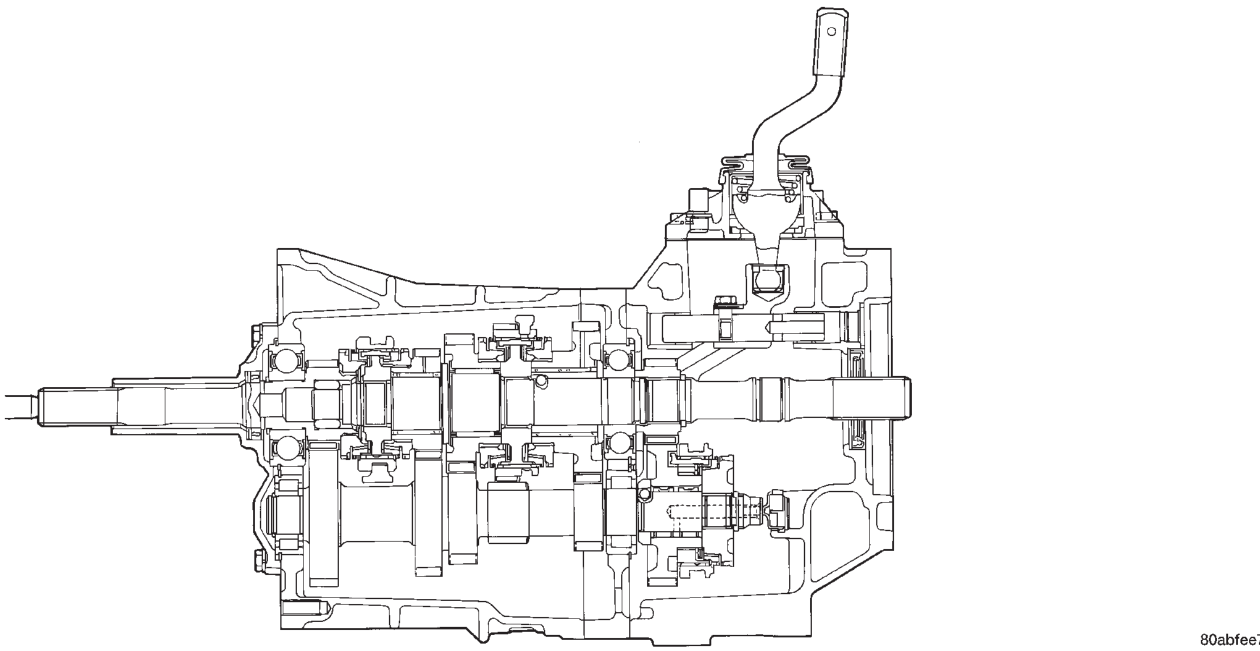


Fig. 1 AX5 Manual Transmission

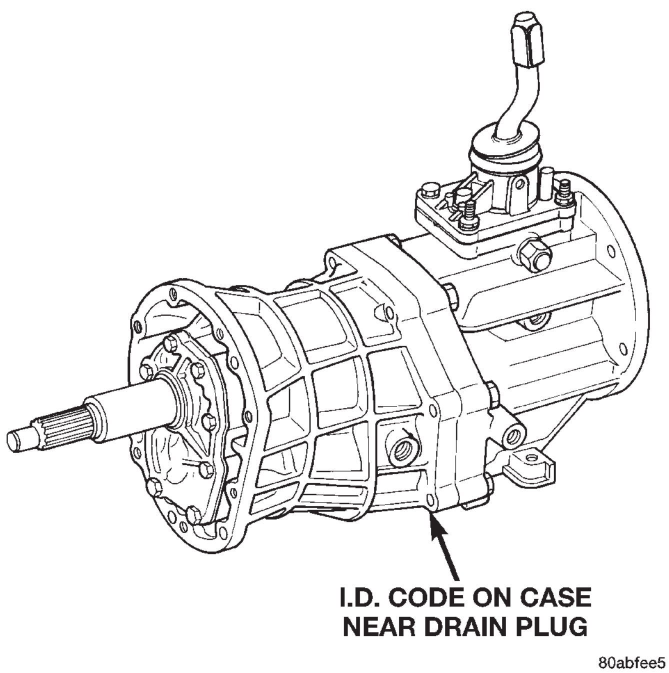


Fig. 2 Transmission Identification

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.

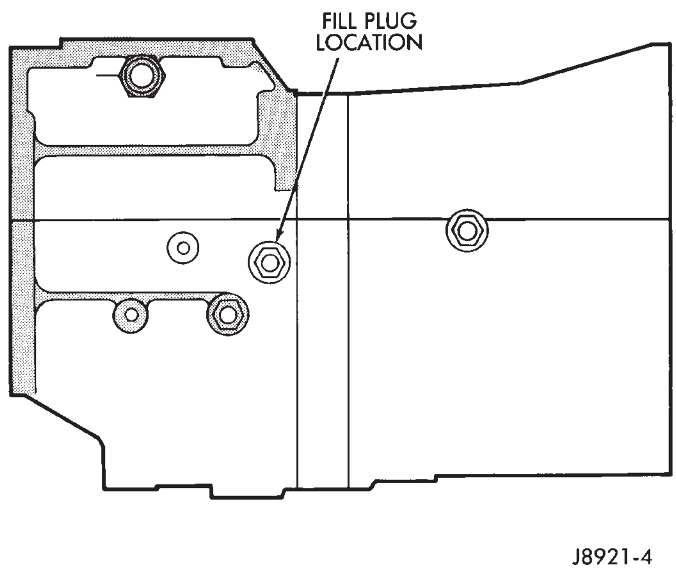


Fig. 3 Fill Plug Location

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.

GENERAL INFORMATION (Continued)

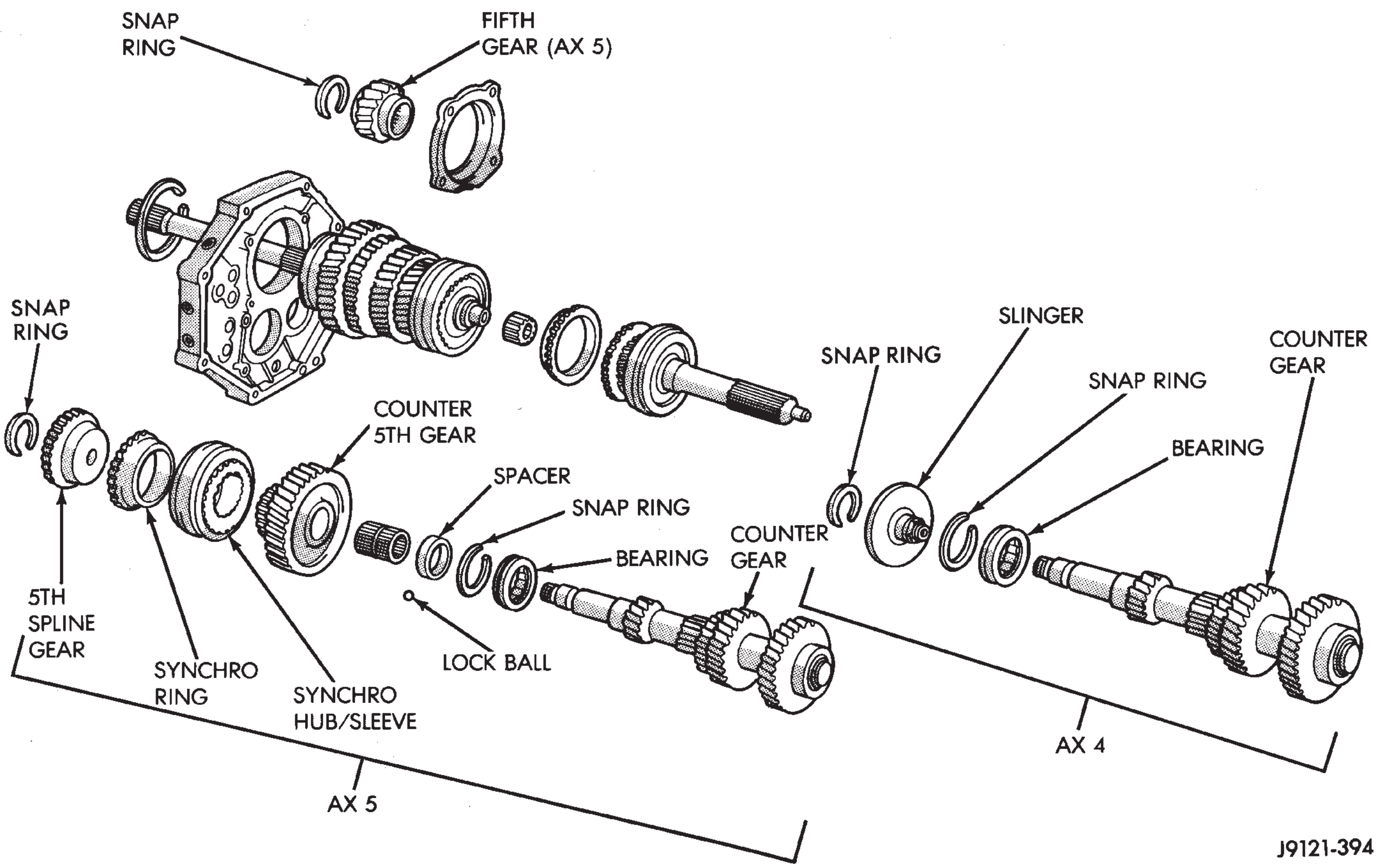


Fig. 4 Geartrain Components

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 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 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.

DIAGNOSIS AND TESTING (Continued)

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).

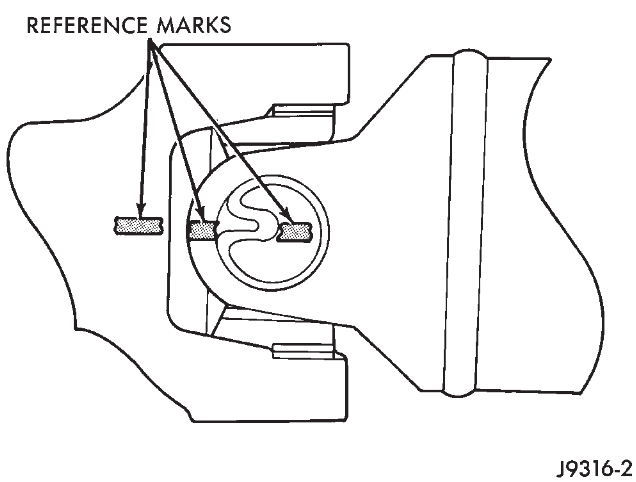


Fig. 5 Marking Propeller Shaft And Axle Yokes

(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).

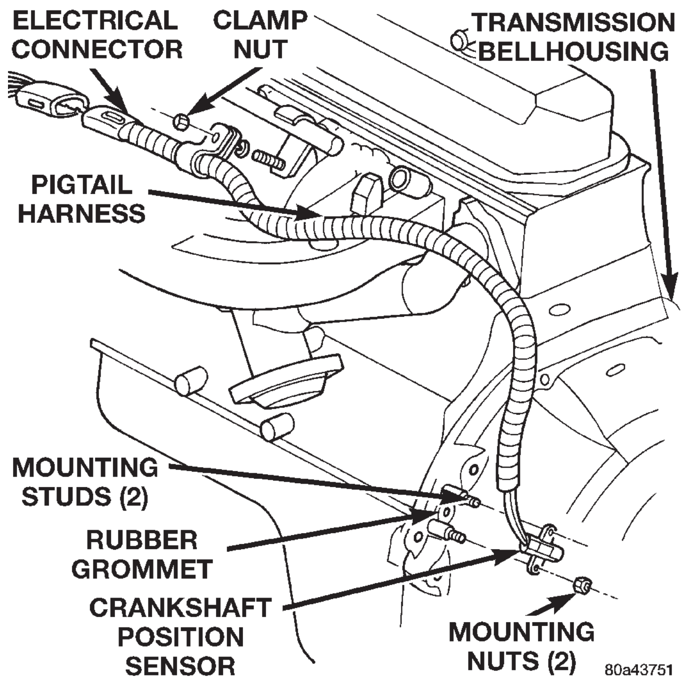


Fig. 6 Crankshaft Position Sensor—2.5L Engine

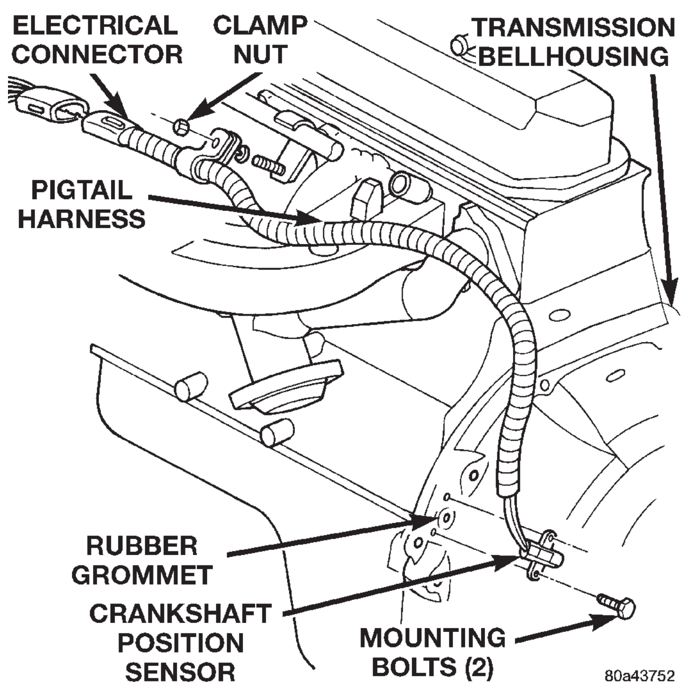


Fig. 7 Crankshaft Position Sensor —4.0L Engine

REMOVAL AND INSTALLATION (Continued)

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.

(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.

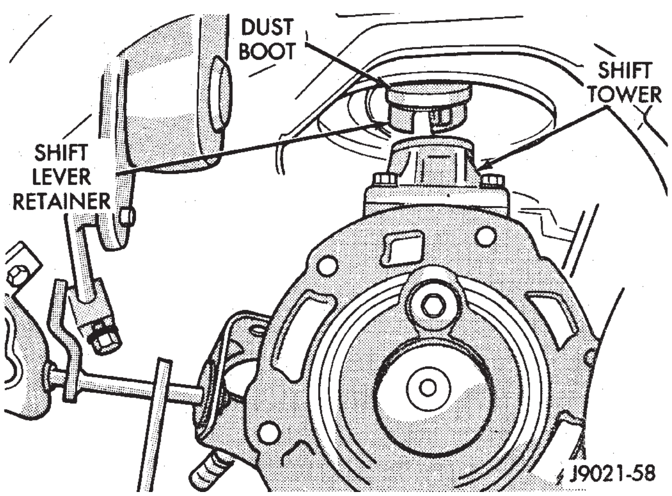


Fig. 8 Removing/Installing Shift Lever

(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).

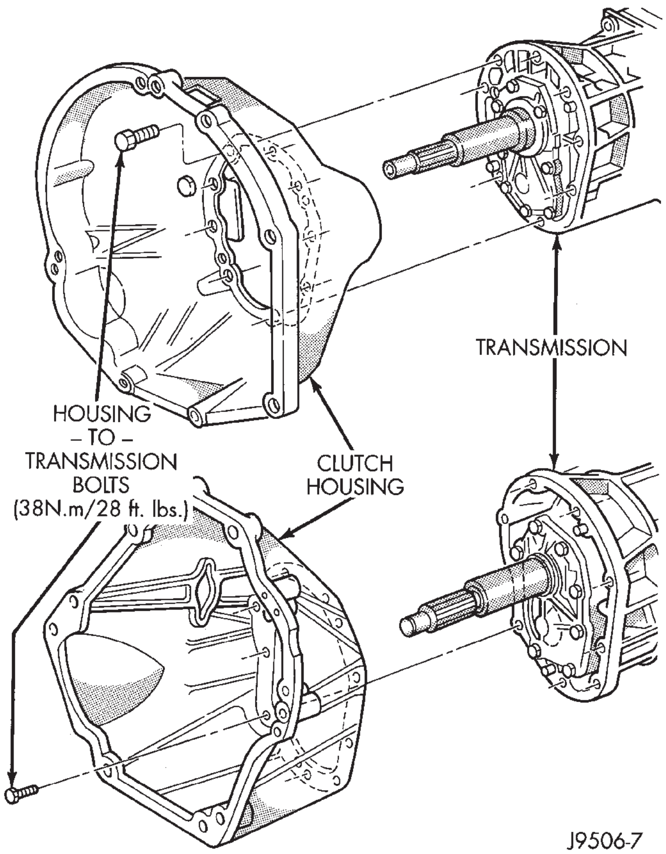


Fig. 9 Clutch Housing

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 downward and turn it clockwise to lock it in place. Then install lever dust boot on shift tower.

REMOVAL AND INSTALLATION (Continued)

(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).

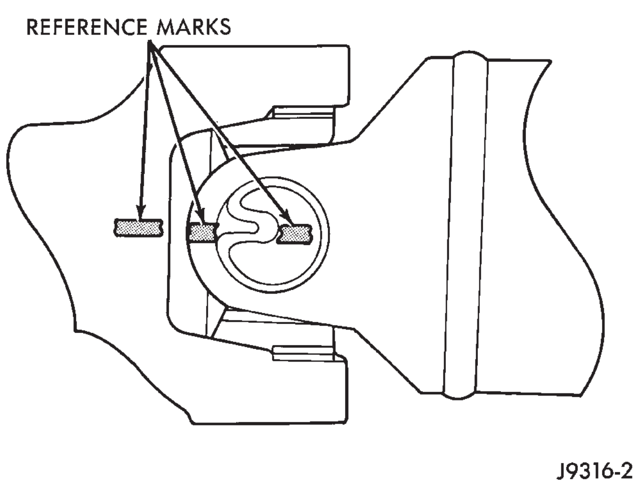


Fig. 10 Align Propeller Shaft And Rear Axle Yokes Alignment Marks

(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).

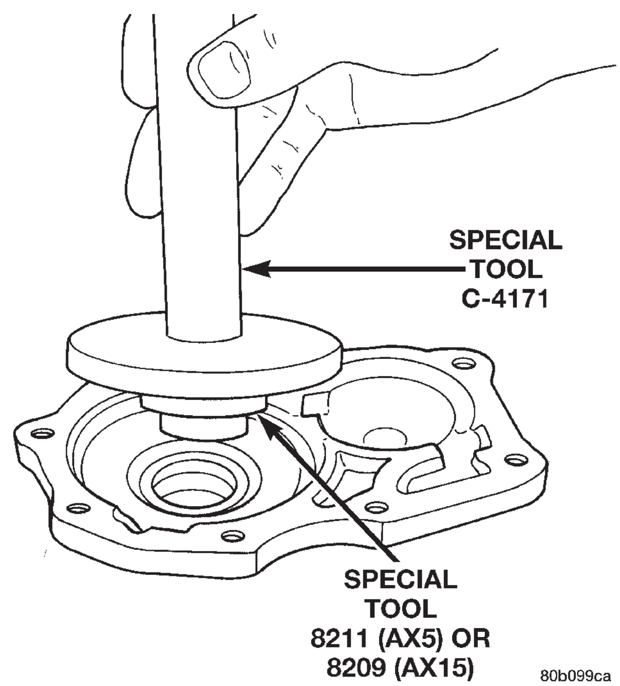


Fig. 11 Install Front Bearing Retainer Seal

(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.

REMOVAL AND INSTALLATION (Continued)

(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.

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).

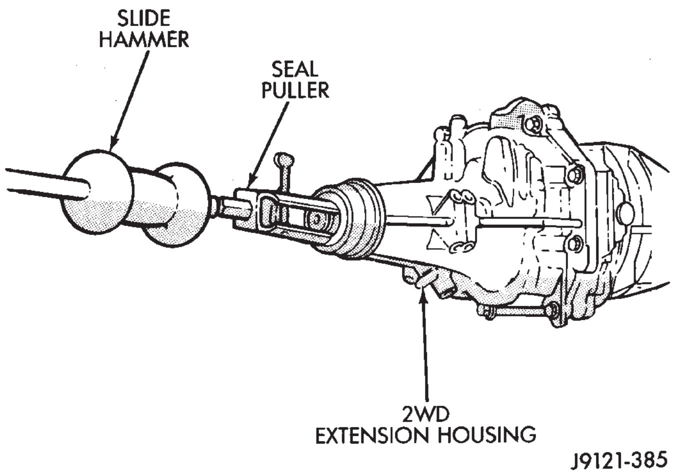


Fig. 12 Remove Extension Housing Seal

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).

(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).

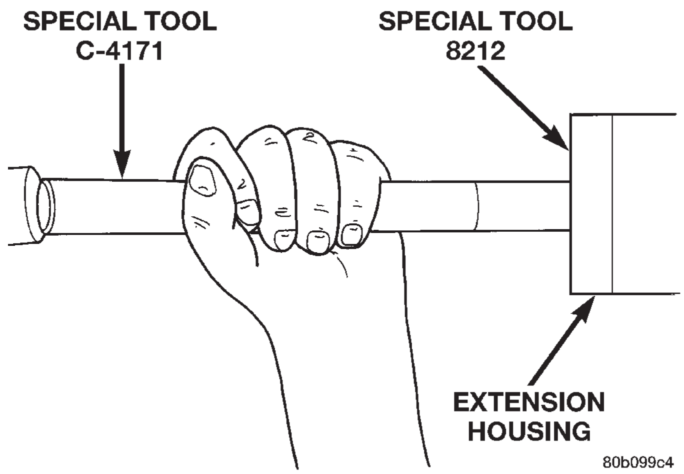


Fig. 13 Install Extension Housing Seal

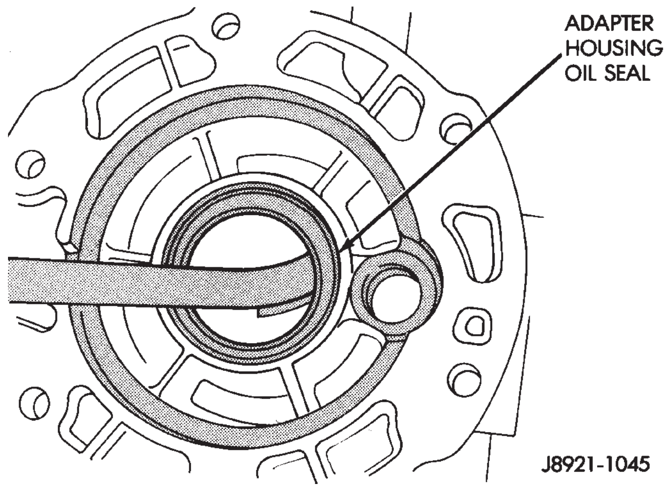


Fig. 14 Remove Adapter Housing Seal

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).

(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.

REMOVAL AND INSTALLATION (Continued)

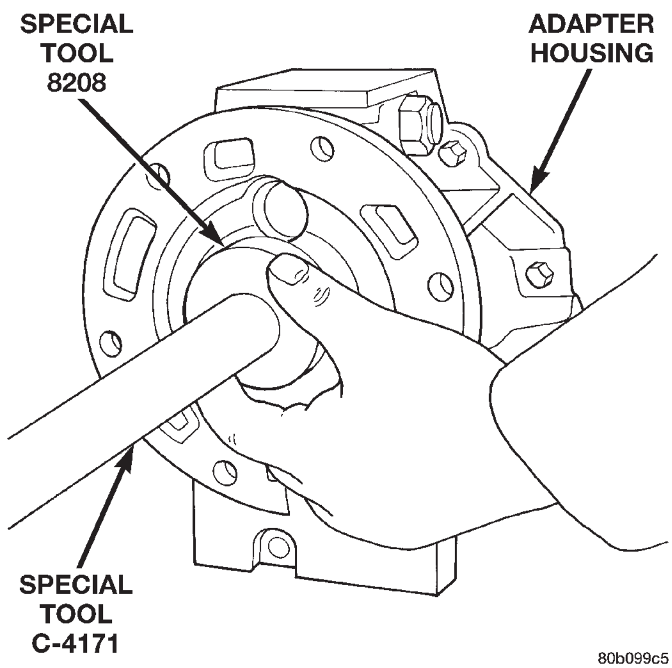


Fig. 15 Install Adapter Housing Seal

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).

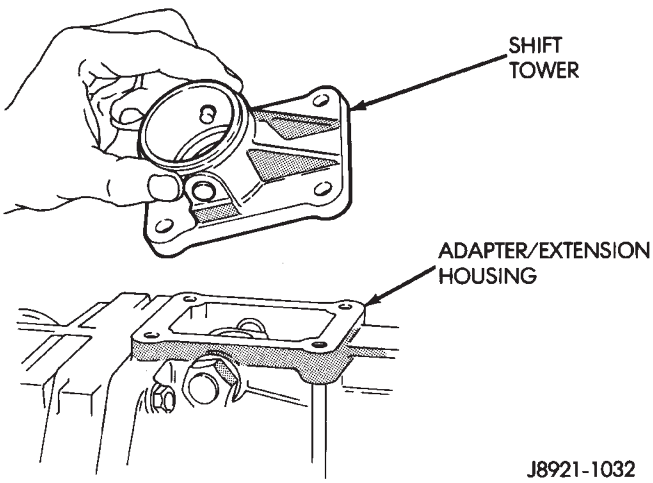


Fig. 16 Remove Shift Tower

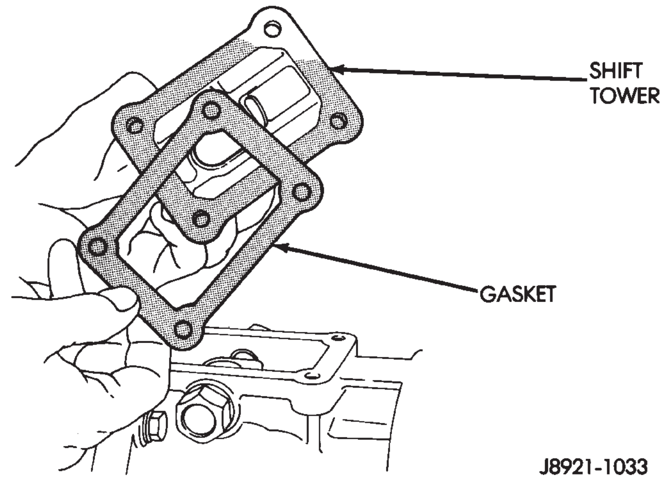


Fig. 17 Remove Shift Tower Gasket

(8) Remove detent ball plug (Fig. 19).
(9) Remove detent spring and ball with pencil magnet (Fig. 20), (Fig. 21).

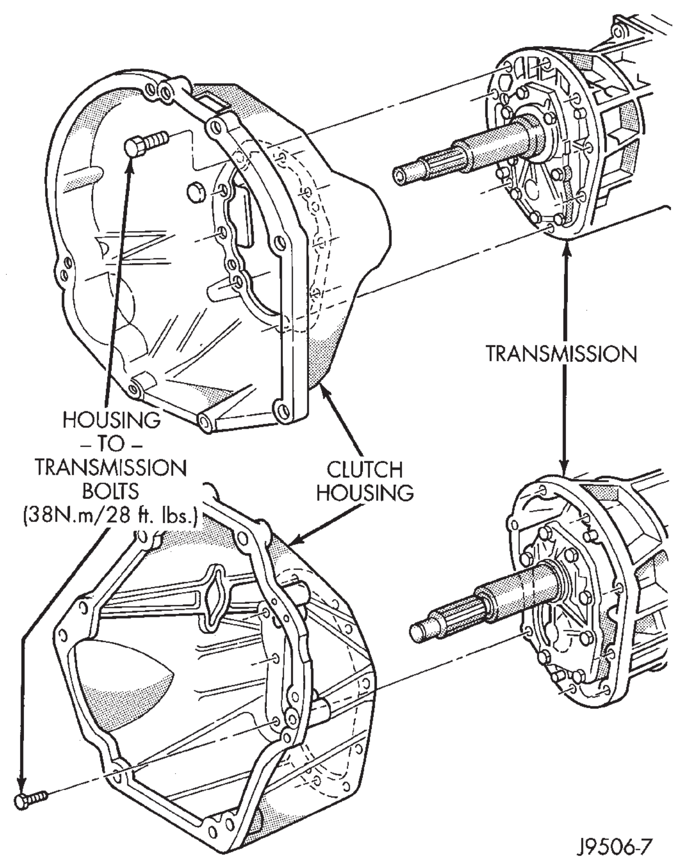


Fig. 18 Clutch Housing

DISASSEMBLY AND ASSEMBLY (Continued)

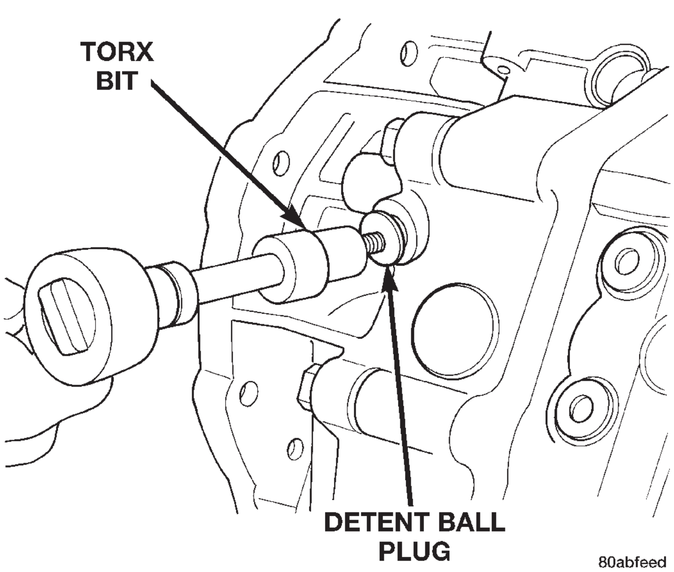


Fig. 19 Remove Detent Ball Plug

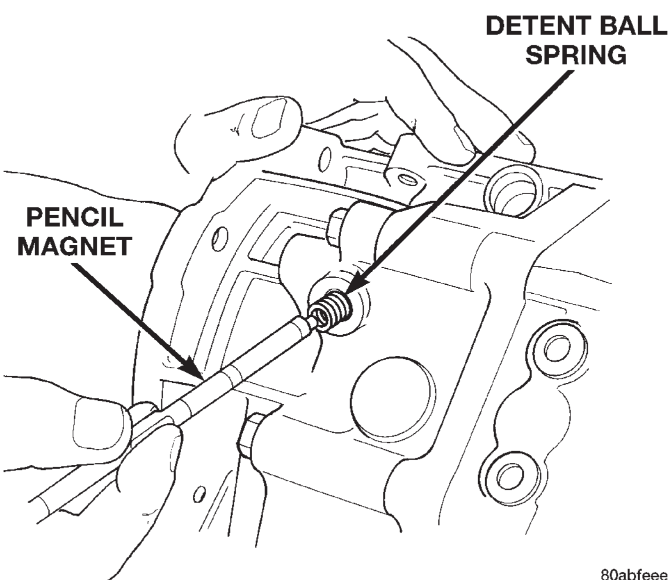


Fig. 20 Remove Detent Spring

(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.

(15) Remove adapter/extension housing bolts.

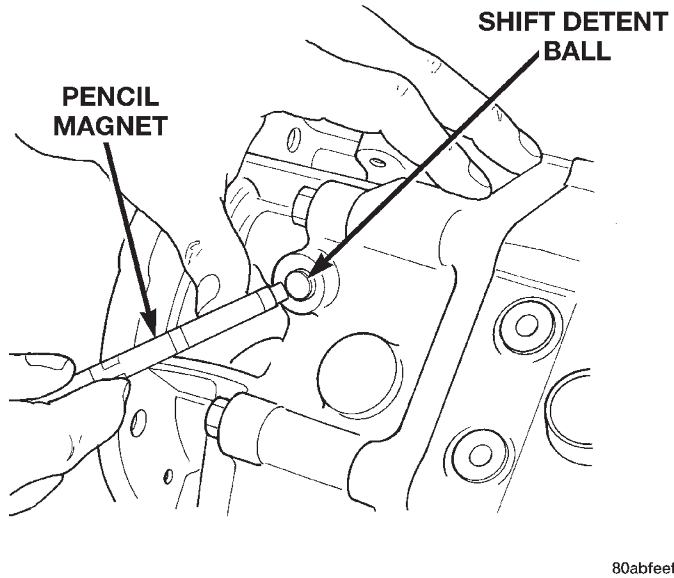


Fig. 21 Remove Detent Ball

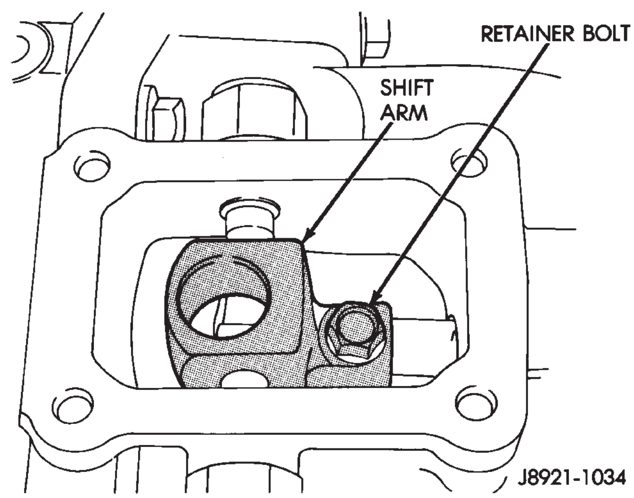


Fig. 22 Shift Arm Retainer Bolt Removal

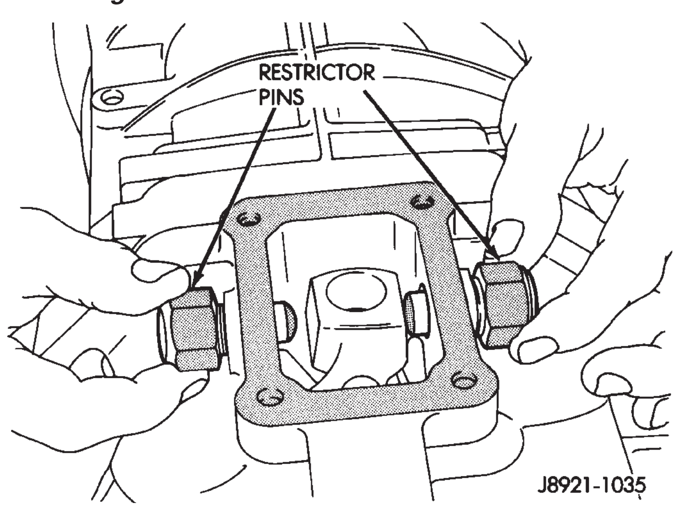


Fig. 23 Shift Arm Rstrictor Pins

DISASSEMBLY AND ASSEMBLY (Continued)

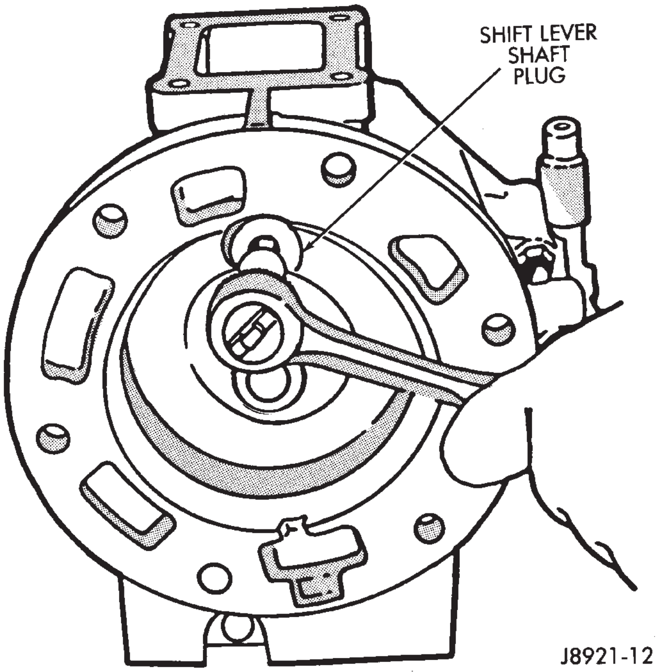


Fig. 24 Removing Shift Lever Shaft Plug

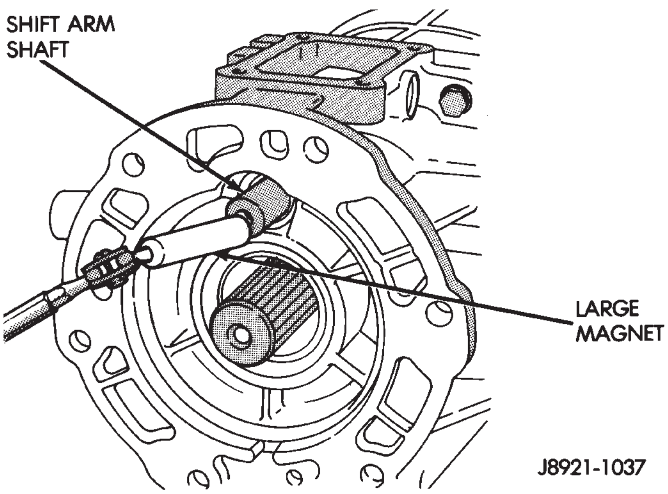


Fig. 25 Remove Shifter Shaft

(16) Loosen adapter/extension housing by tapping it loose with plastic mallet (Fig. 26).

(17) Remove adapter/extension housing (Fig. 27).

(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).

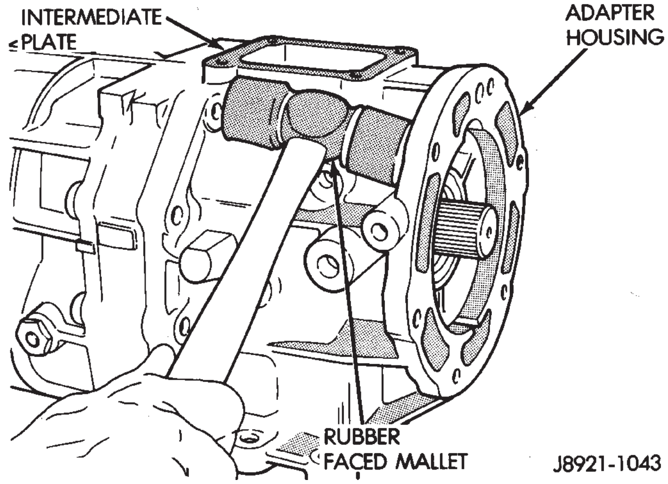


Fig. 26 Loosen Adapter/Extension Housing

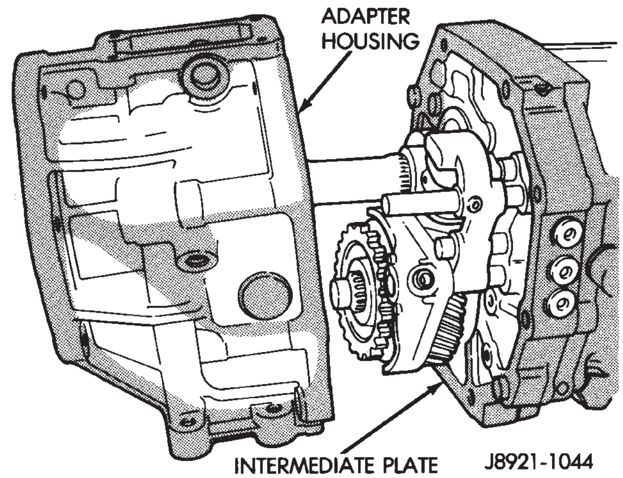


Fig. 27 Remove Adapter/Extension Housing–Typical

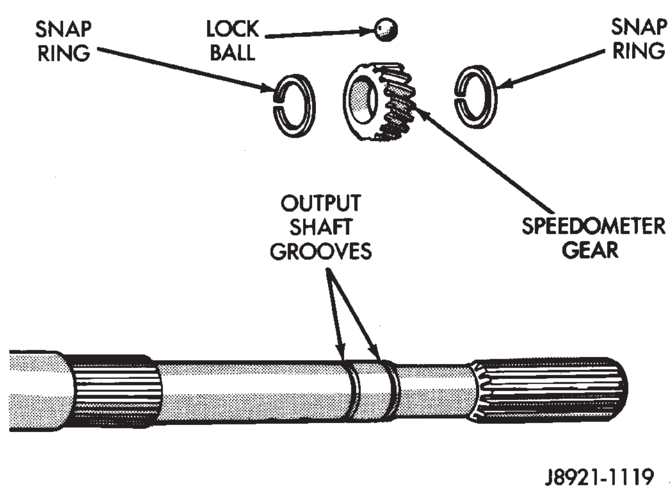


Fig. 28 Speedometer Drive Gear Assembly

(21) Remove input shaft bearing snap-ring (Fig. 30).

(22) Remove countershaft front bearing snap-ring.

DISASSEMBLY AND ASSEMBLY (Continued)

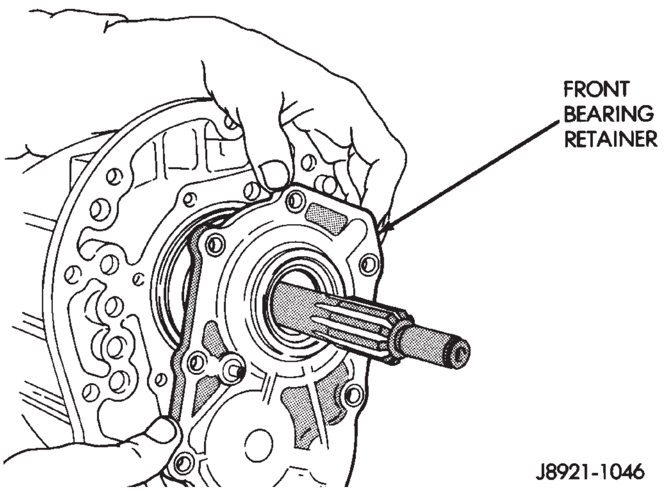


Fig. 29 Remove Front Bearing Retainer

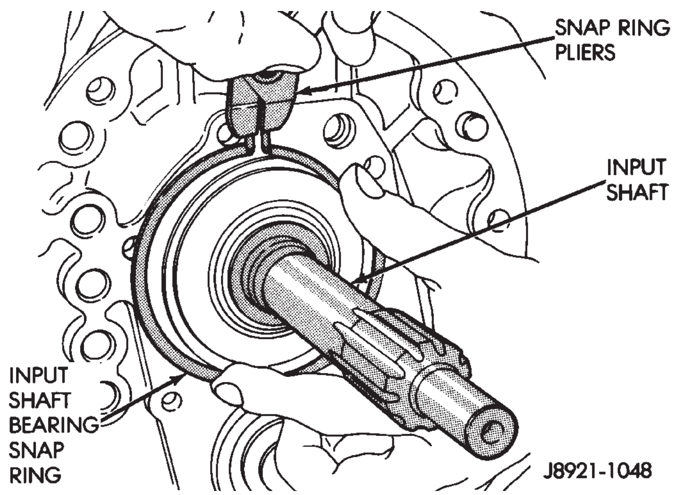


Fig. 30 Remove Input Shaft Bearing Snap-ring

(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).

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).

(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.

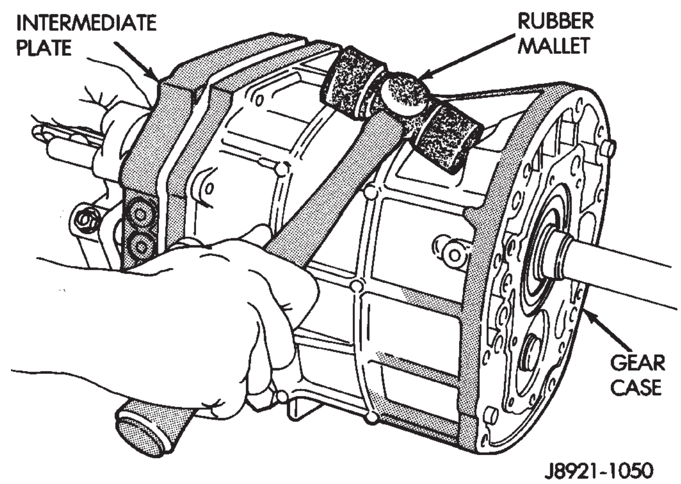


Fig. 31 Separate Intermediate Plate and Transmission Case

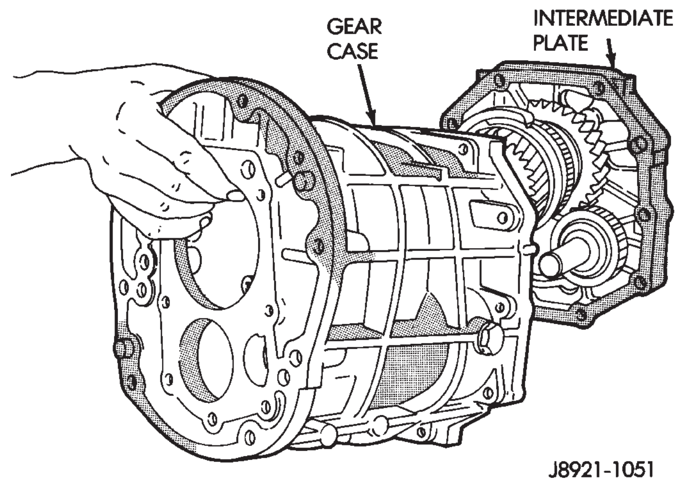


Fig. 32 Remove Intermediate Plate from Transmission Case

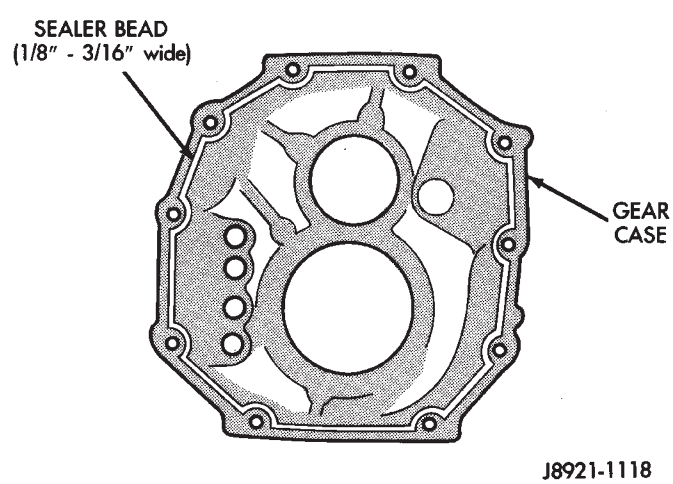


Fig. 33 Apply Sealer to Transmission Gear Case

DISASSEMBLY AND ASSEMBLY (Continued)

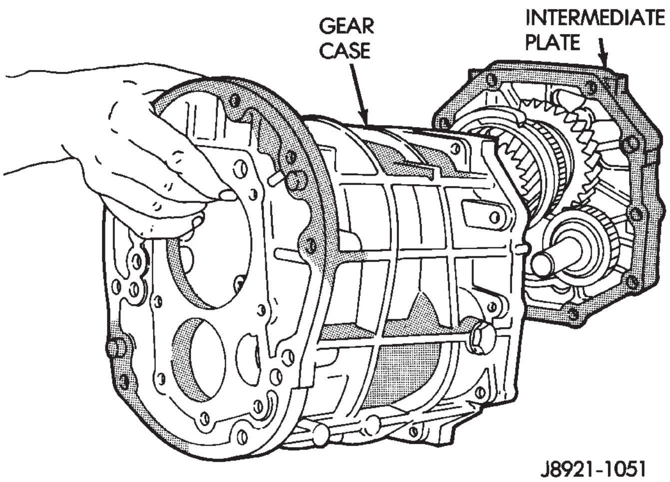


Fig. 34 Install Transmission Gear Case to the Intermediate Plate

(4) Install new front bearing snap rings (Fig. 35).

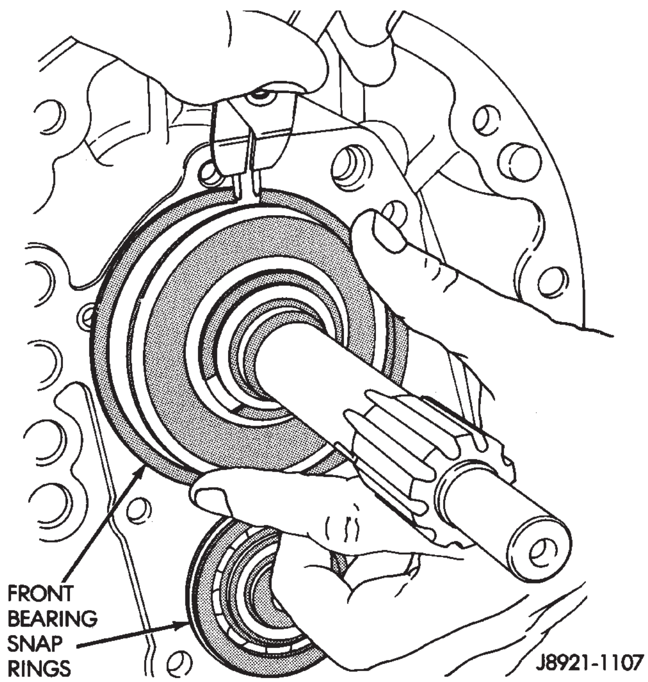


Fig. 35 Install Front Bearing Snap-rings

(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.).

(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.

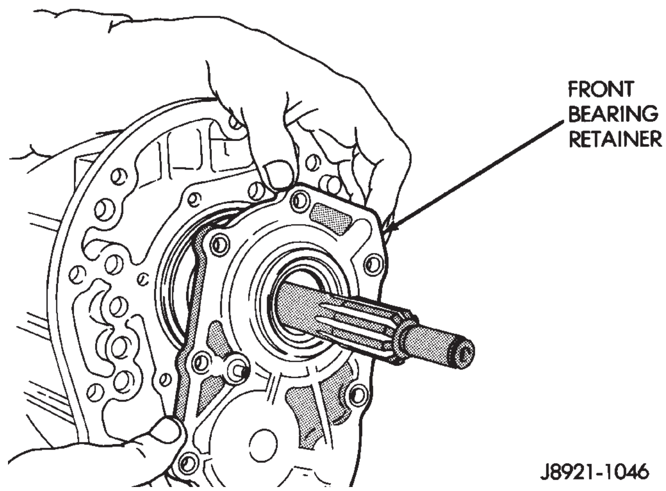


Fig. 36 Install Front Bearing Retainer

(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.

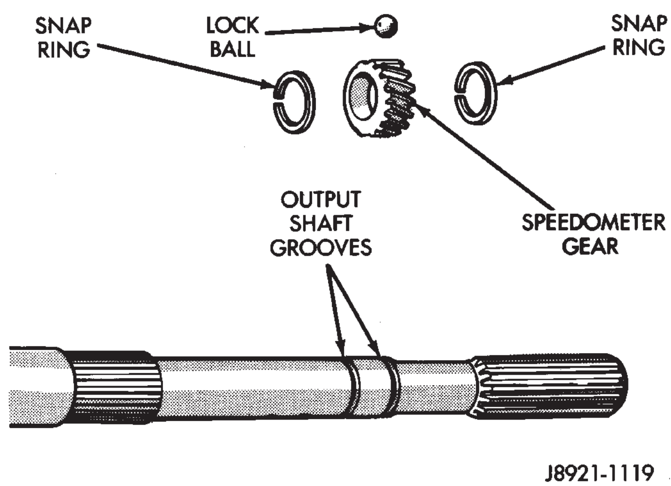


Fig. 37 Speedometer Drive Gear Assembly

(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).

(14) Install and tighten shifter arm shaft plug to 18 N·m (13 ft. lbs.) torque (Fig. 42).

(15) Install shift restrictor pins in shift tower and tighten to 27 N·m (20 ft. lbs.) (Fig. 43).

DISASSEMBLY AND ASSEMBLY (Continued)

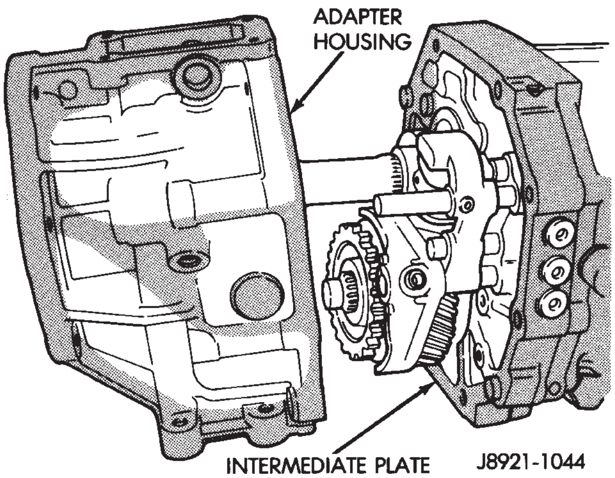


Fig. 38 Install Adapter/Extension Housing–Typical

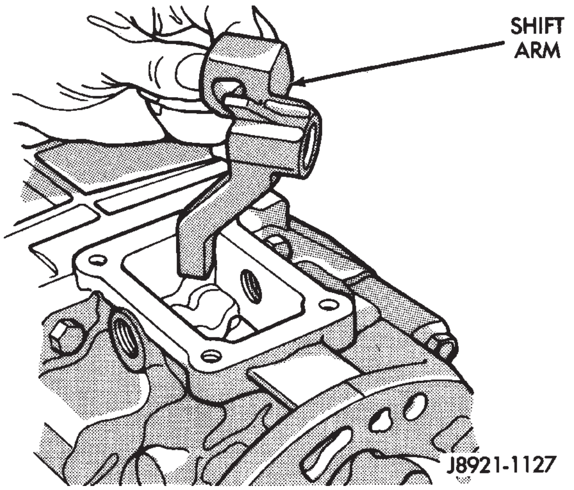


Fig. 39 Position Shift Arm in Adapter or Extension Housing

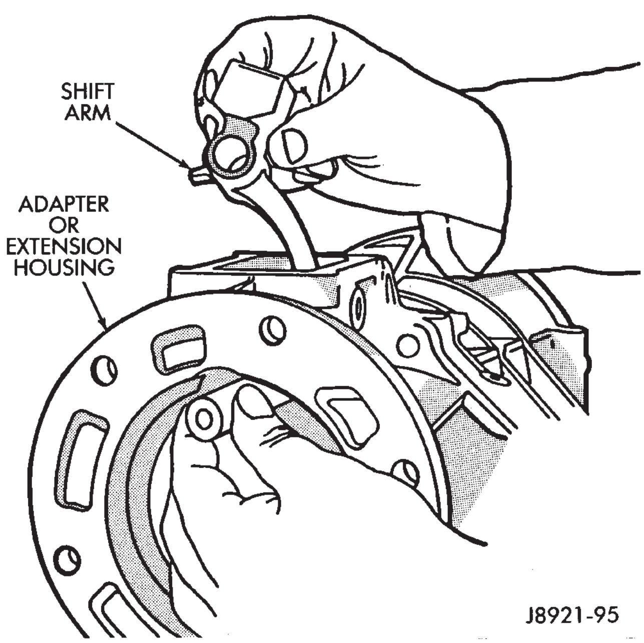


Fig. 40 Install Shifter Arm Shaft

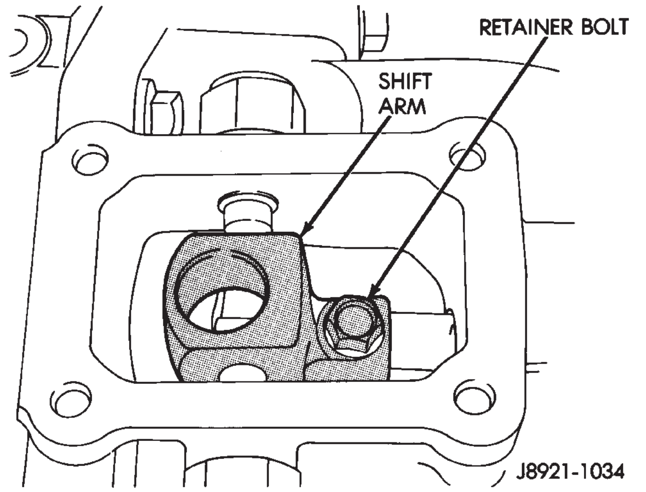


Fig. 41 Install Shift Arm Retainer Bolt

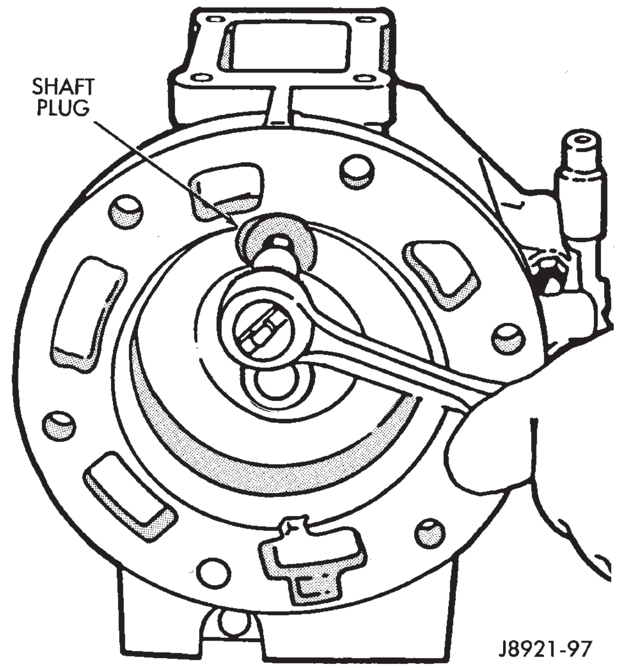


Fig. 42 Shifter Arm Shaft Plug Installation

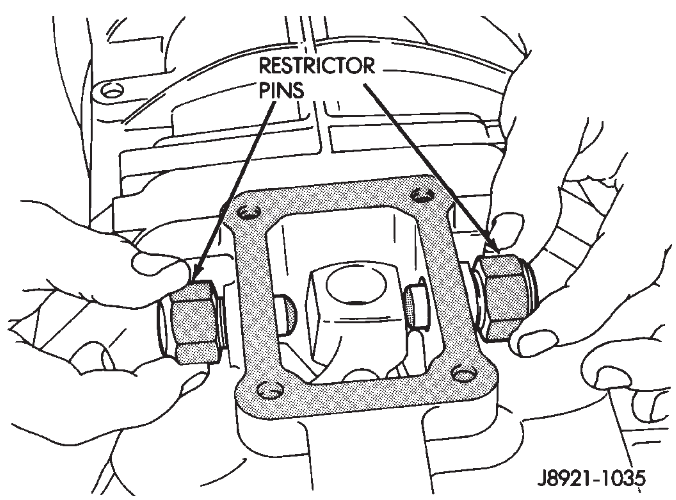


Fig. 43 Install Shifter Restrictor Pins

DISASSEMBLY AND ASSEMBLY (Continued)

(16) Install shift detent ball in detent opening of case (Fig. 44).

(17) Install detent spring in case (Fig. 45).

(18) Install detent plug and tighten to 19 N·m (14 ft. lbs.) (Fig. 46).

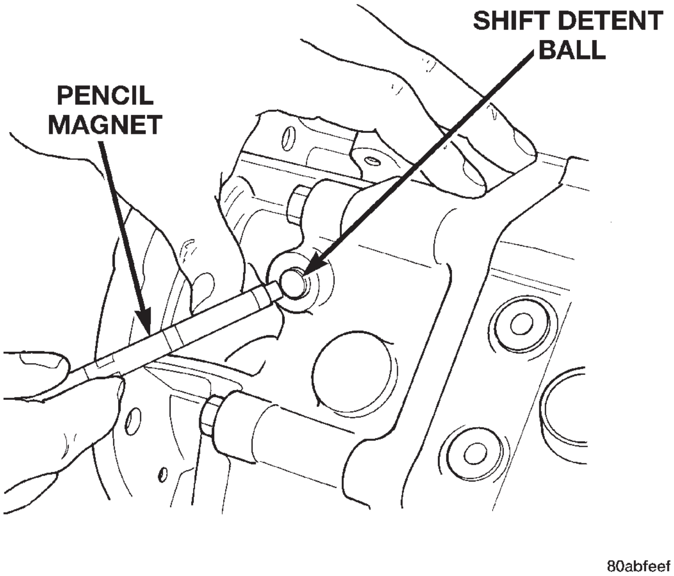


Fig. 44 Install Detent Ball

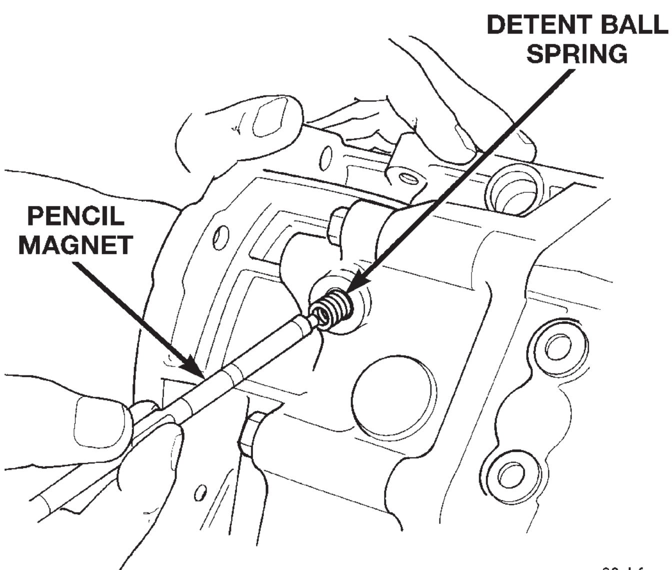


Fig. 45 Install Detent Spring

(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.

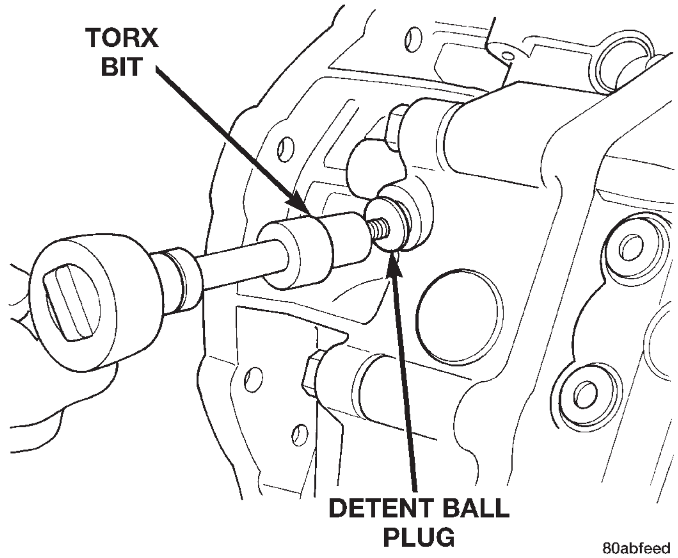


Fig. 46 Install Detent Ball Plug

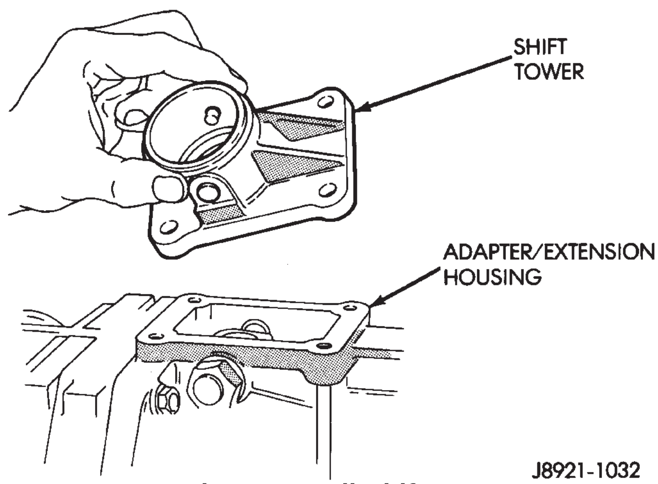


Fig. 47 Install Shift Tower

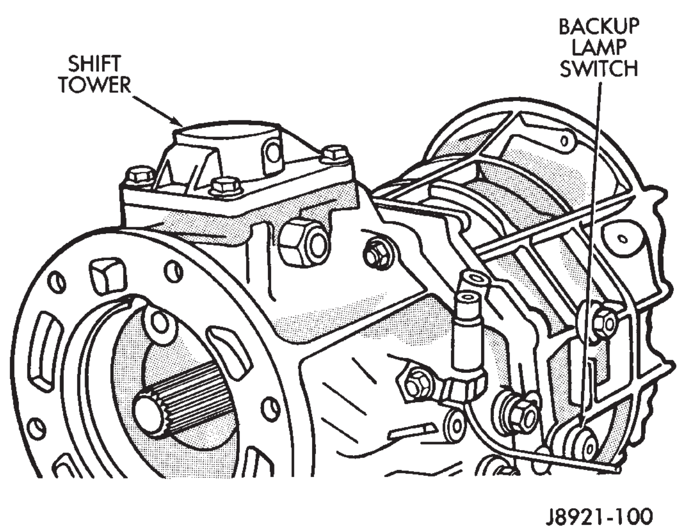


Fig. 48 Install Backup Lamp Switch

(25) Install new seal in adapter/extension housing.

(26) Install vehicle speed sensor, if necessary.

DISASSEMBLY AND ASSEMBLY (Continued)

(27) Install clutch housing, release bearing, release fork and retainer clip.

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.

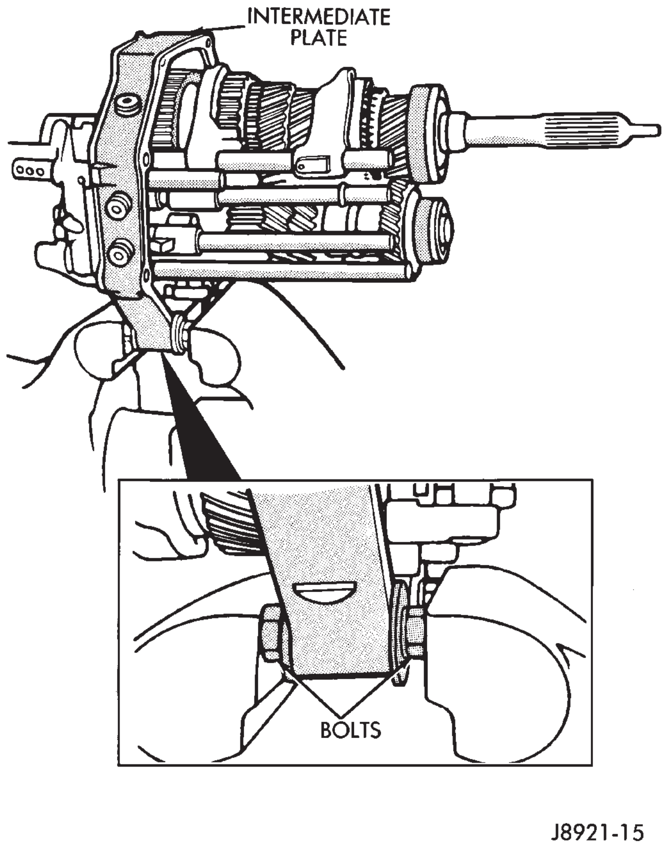


Fig. 49 Positioning Intermediate Plate In Vise

(2) Remove countershaft fifth gear retaining snap-ring (Fig. 50).

(3) Remove bolt holding fifth gear shift fork to shift rail (Fig. 51).

(4) Remove fifth gear blocker ring from countershaft assembly with Puller L-4407 (Fig. 52).

(5) Remove fifth gear synchro ring (Fig. 53).

(6) Remove the countershaft fifth gear assembly from countershaft (Fig. 54).

(7) Remove fifth gear thrust ring from countershaft (Fig. 55).

(8) Remove fifth gear thrust ring lock ball from countershaft (Fig. 56).

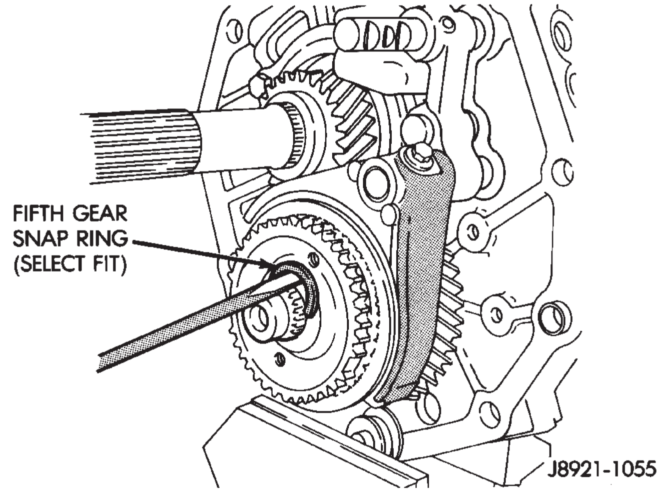


Fig. 50 Remove Fifth Gear Snap-ring

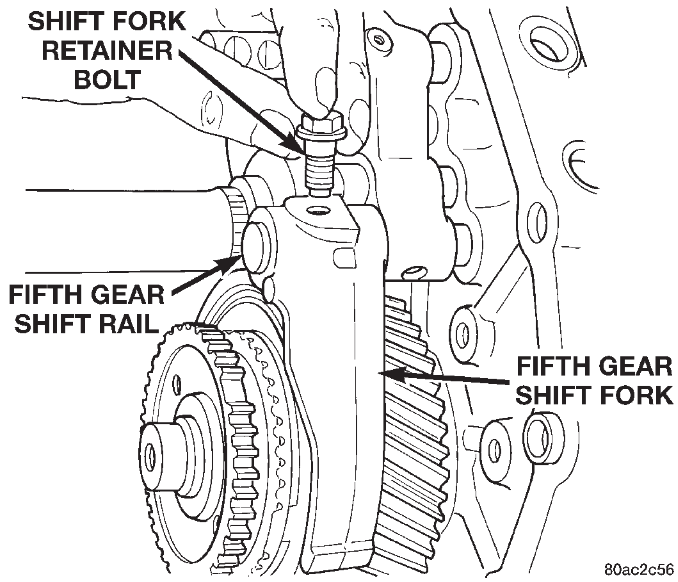


Fig. 51 Remove Shift Fork Retainer Bolt

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.

DISASSEMBLY AND ASSEMBLY (Continued)

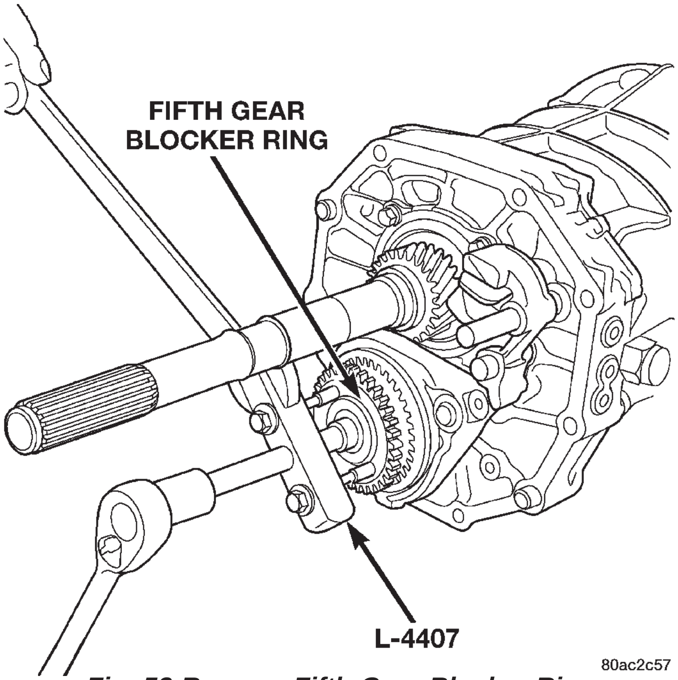


Fig. 52 Remove Fifth Gear Blocker Ring

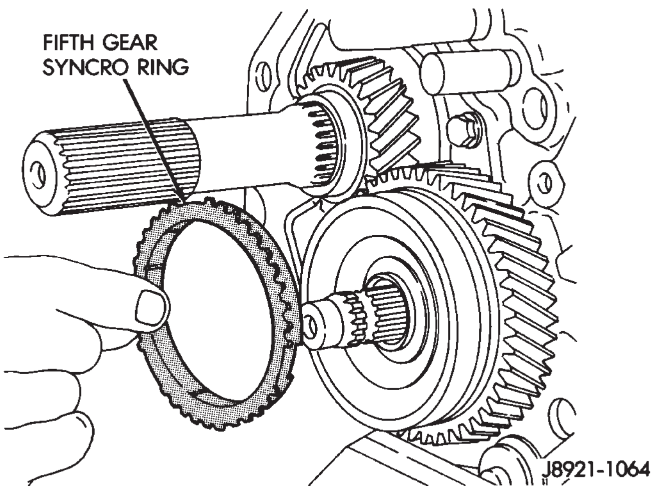


Fig. 53 Remove Fifth Gear Synchro Ring

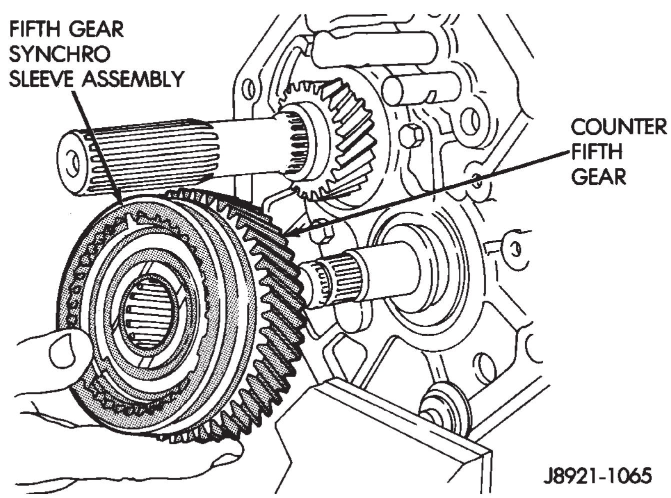


Fig. 54 Remove Fifth Gear and Synchro Assembly

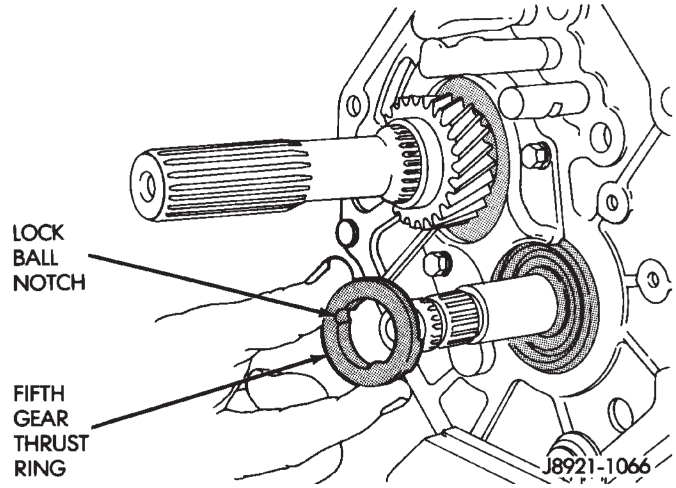


Fig. 55 Remove Fifth Gear Thrust Ring

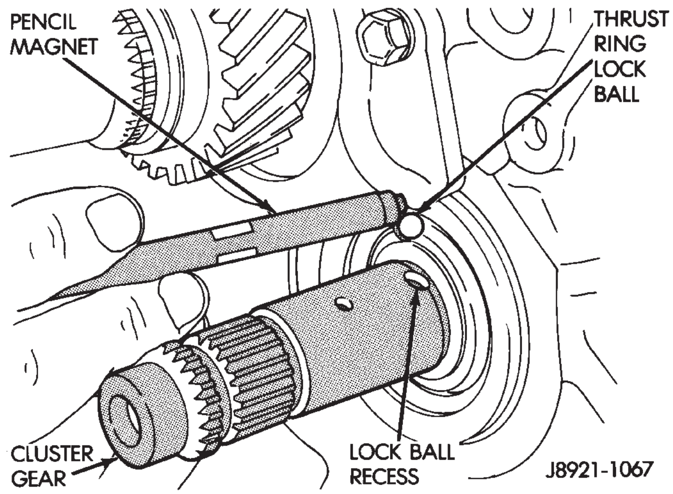


Fig. 56 Remove Fifth Gear Thrust Ring Lock Ball

(11) Remove bolts holding output shaft rear bearing retainer to the intermediate plate and remove retainer (Fig. 58).

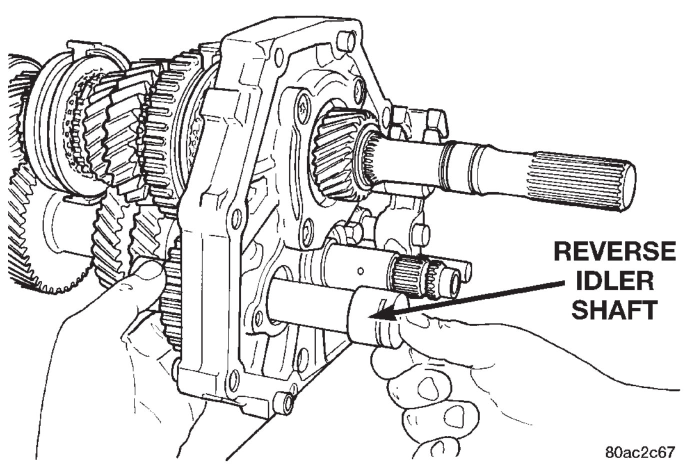


Fig. 57 Remove Reverse Idler Shaft

(12) Remove bolts holding 1–2 and 3–4 shift forks to the shift rails (Fig. 59) and discard bolts.

DISASSEMBLY AND ASSEMBLY (Continued)

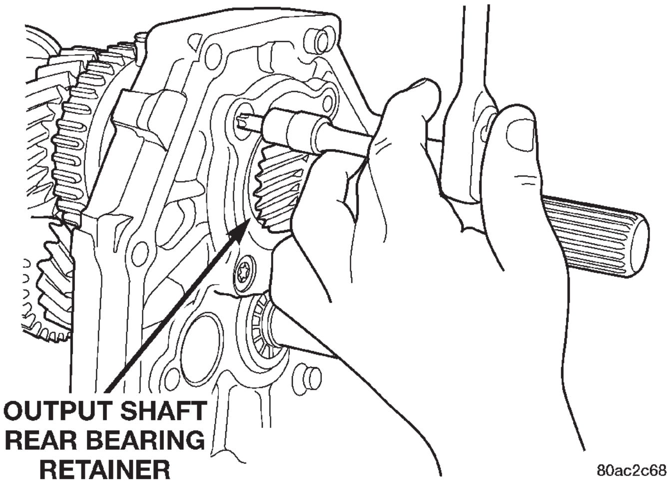


Fig. 58 Remove Output Shaft Rear Bearing Retainer

(13) Remove bolts holding reverse shift arm bracket to intermediate plate (Fig. 60).

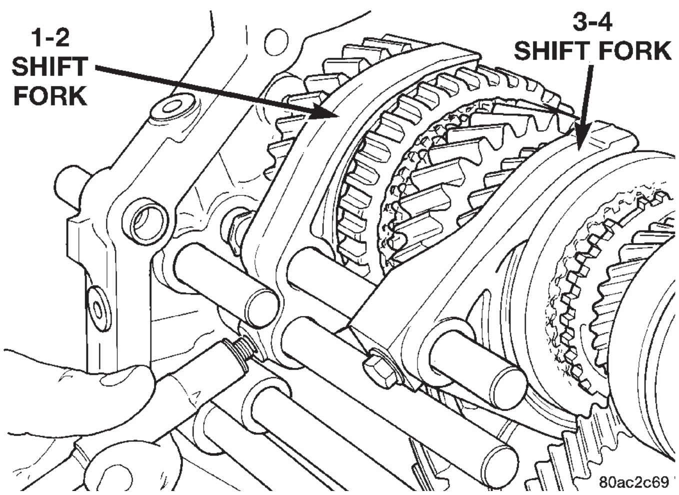


Fig. 59 Remove Shift Fork To Shift Rail Bolts

(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).

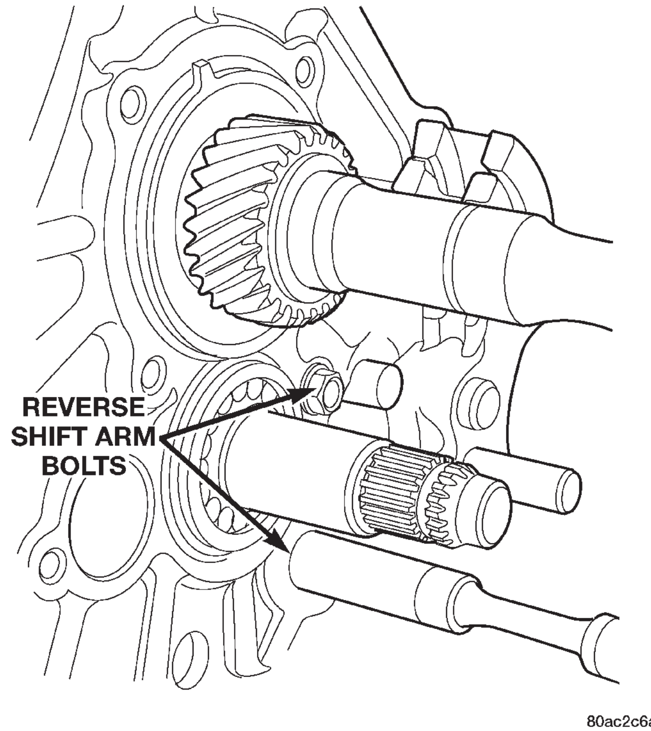


Fig. 60 Remove Reverse Shift Arm Bracket Bolts

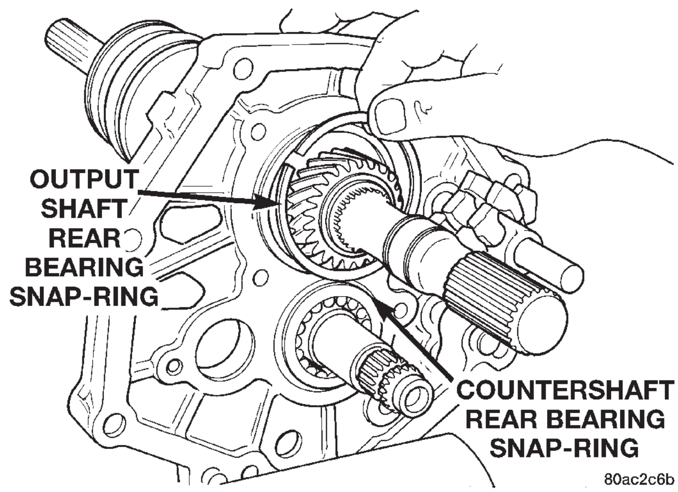


Fig. 61 Remove Output Shaft Rear Bearing Snap-ring

(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).

(18) Remove the 3–4 shift fork from the 3–4 shift rail (Fig. 64).

DISASSEMBLY AND ASSEMBLY (Continued)

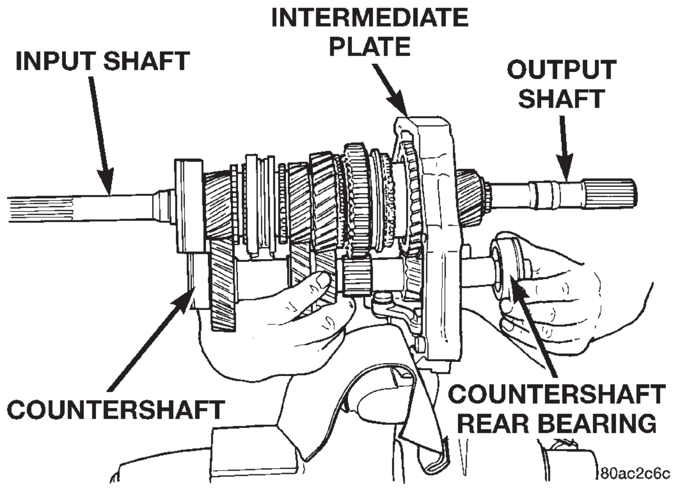


Fig. 62 Remove Countershaft and Countershaft Rear Bearing

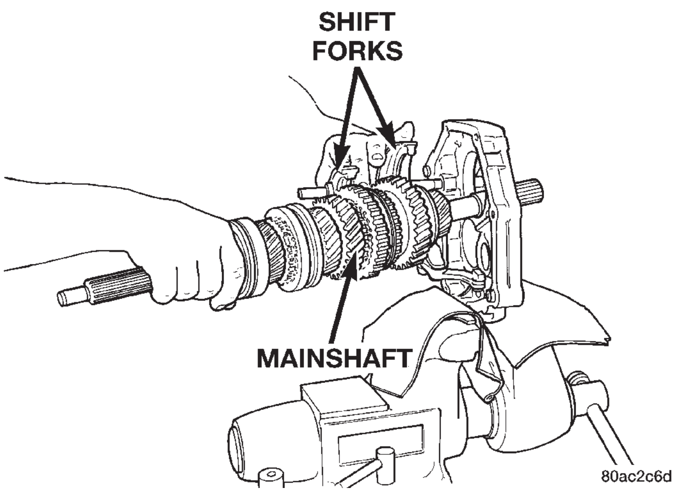


Fig. 63 Remove Mainshaft

(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).

(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.

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.

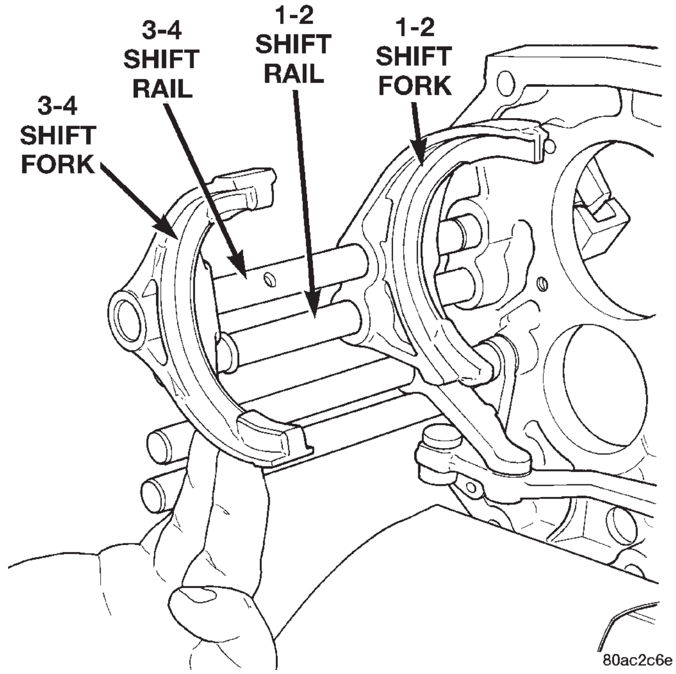


Fig. 64 Remove 3–4 Shift Fork

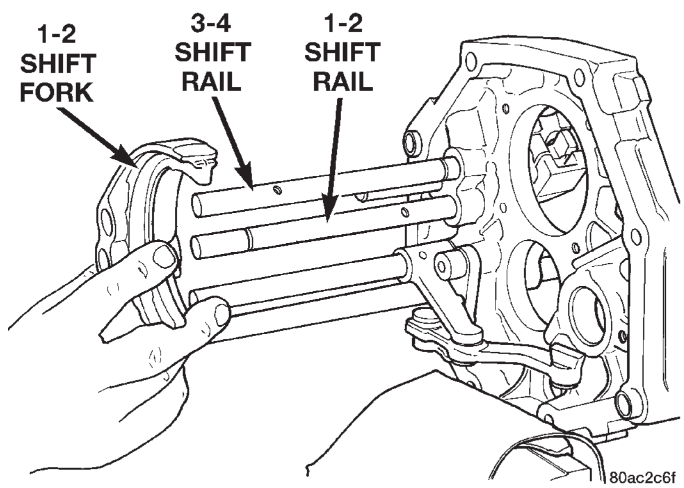


Fig. 65 Remove 1–2 Shift Fork

(23) Remove fifth gear shift rail (Fig. 67).

(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.

(27) Remove reverse shift rail and reverse shift fork and arm assembly from intermediate plate (Fig. 70).

DISASSEMBLY AND ASSEMBLY (Continued)

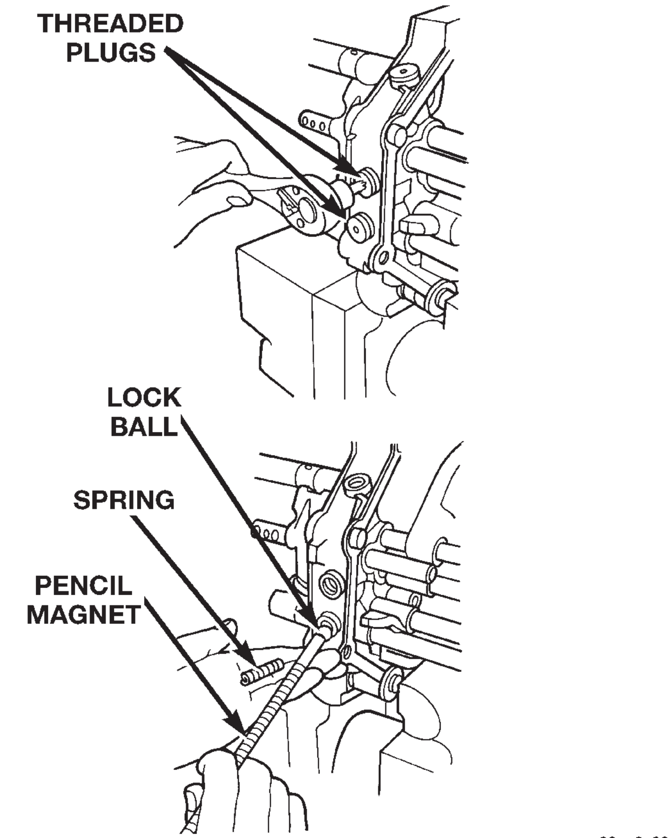


Fig. 66 Remove Lock Ball And Spring

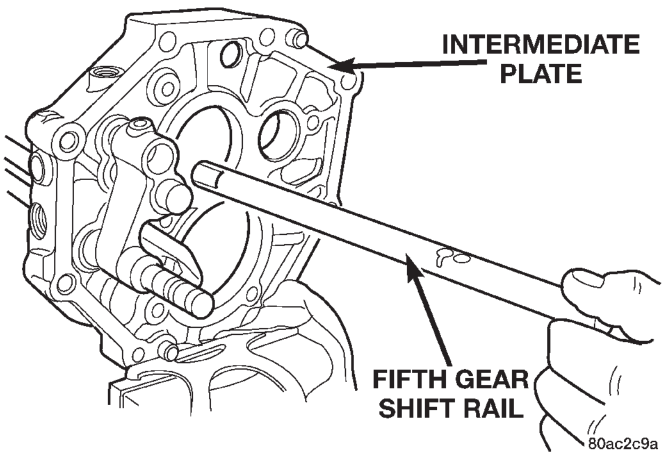


Fig. 67 Remove Fifth Gear Shift Rail

(28) Remove interlock pin from reverse shift rail (Fig. 71).

(29) Remove reverse elongated check ball (Fig. 72).

(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).

(33) Remove 1–2 shift rail elongated check ball from intermediate plate (Fig. 74).

(34) Remove 3–4 shift rail from intermediate plate.

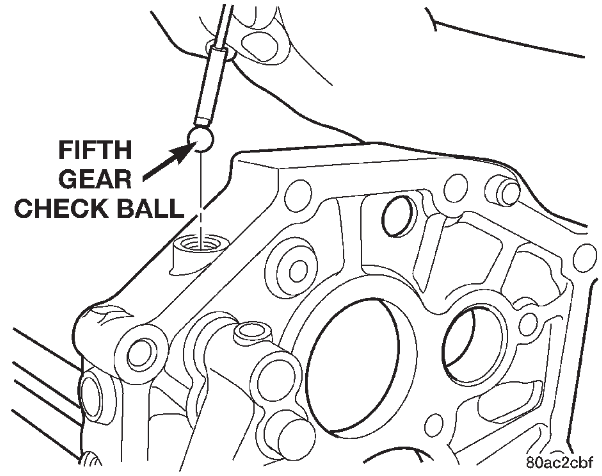


Fig. 68 Remove Fifth Gear Check Ball

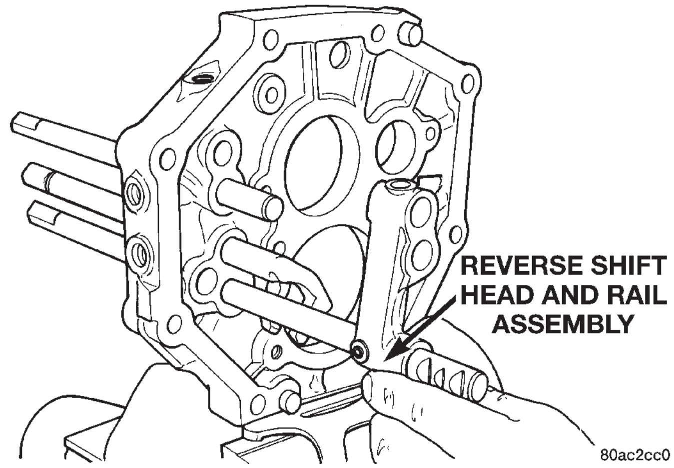


Fig. 69 Remove Reverse Shift Head And Rail Assembly

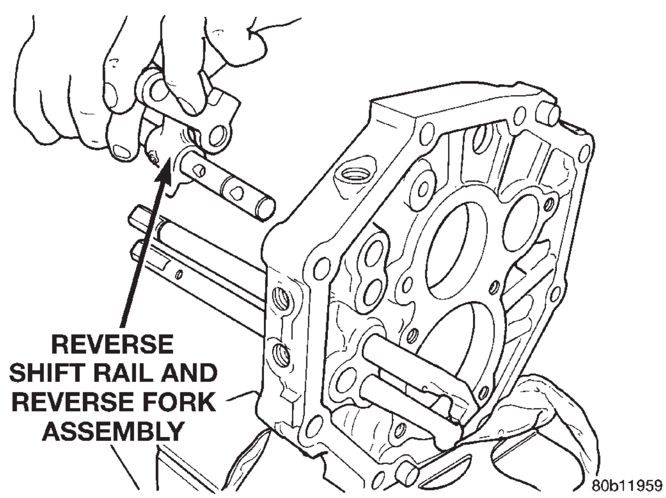


Fig. 70 Remove Reverse Shift Rail

DISASSEMBLY AND ASSEMBLY (Continued)

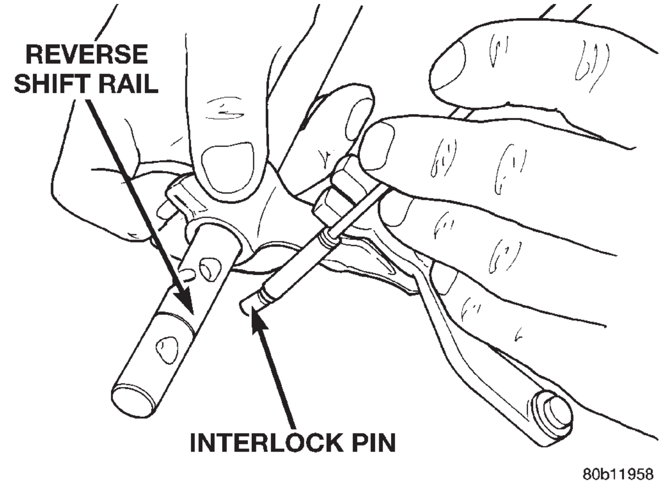


Fig. 71 Remove Interlock Pin From Reverse Shift Rail

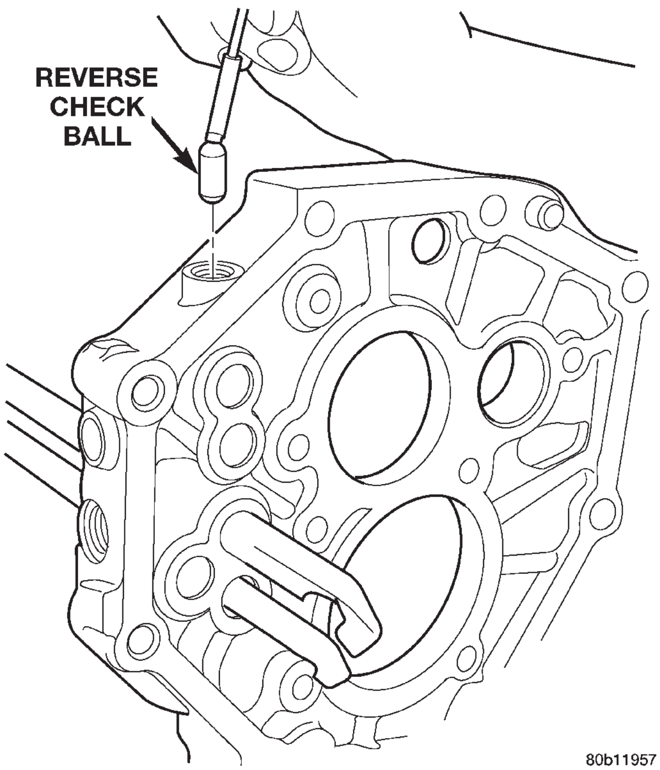


Fig. 72 Remove Reverse Check Ball

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.

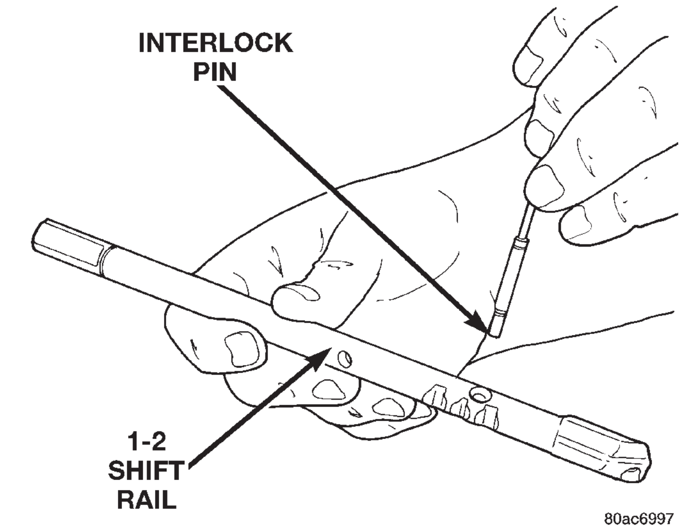


Fig. 73 Remove 1–2 Shift Rail Interlock Pin

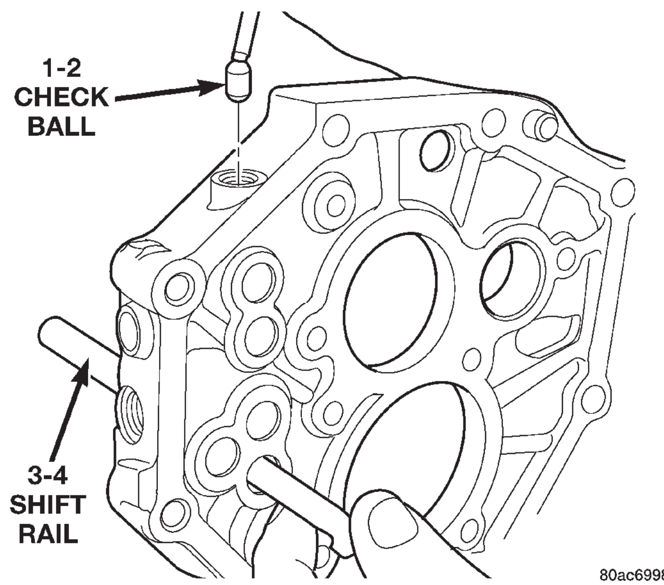


Fig. 74 Remove 1–2 Check Ball

(2) Install the 1–2 elongated check ball into the intermediate plate (Fig. 76).

(3) Install the interlock pin into the 1–2 shift rail (Fig. 77).

(4) Install the 1–2 shift rail into the intermediate plate.

DISASSEMBLY AND ASSEMBLY (Continued)

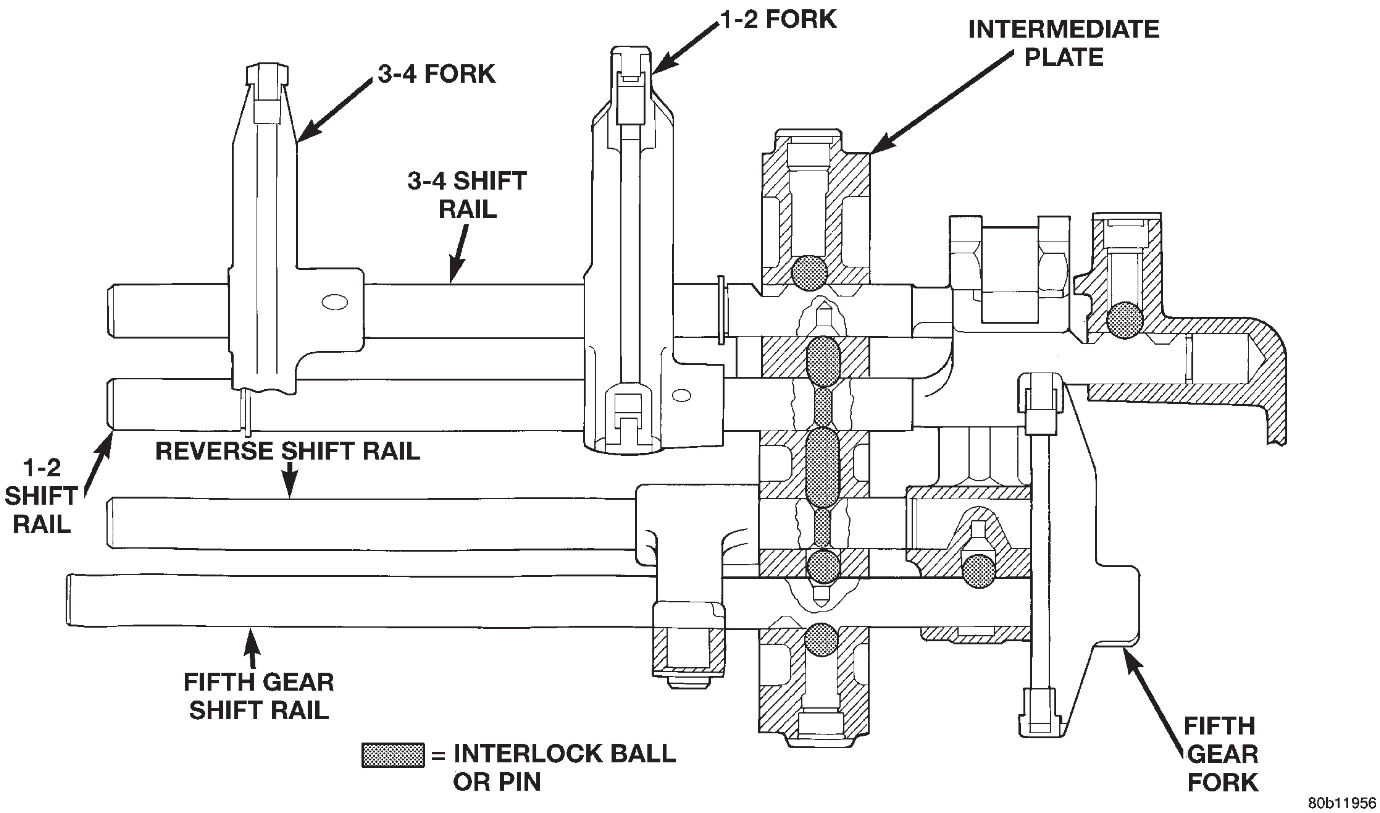


Fig. 75 Shift Rail Components

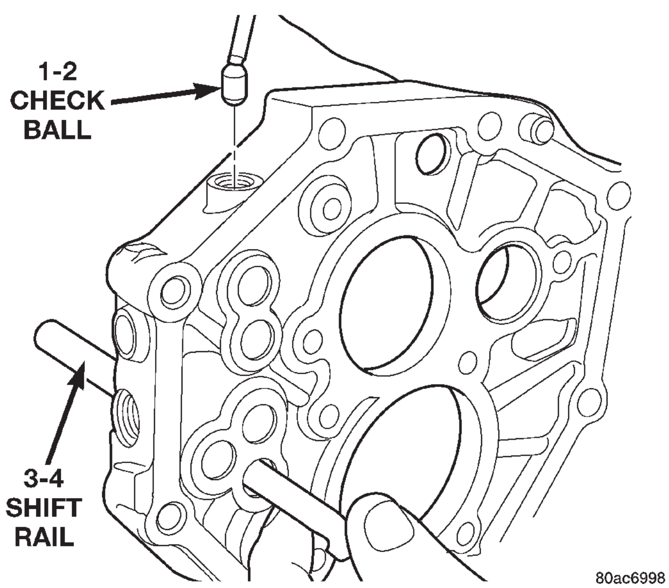


Fig. 76 Install 1–2 Check Ball

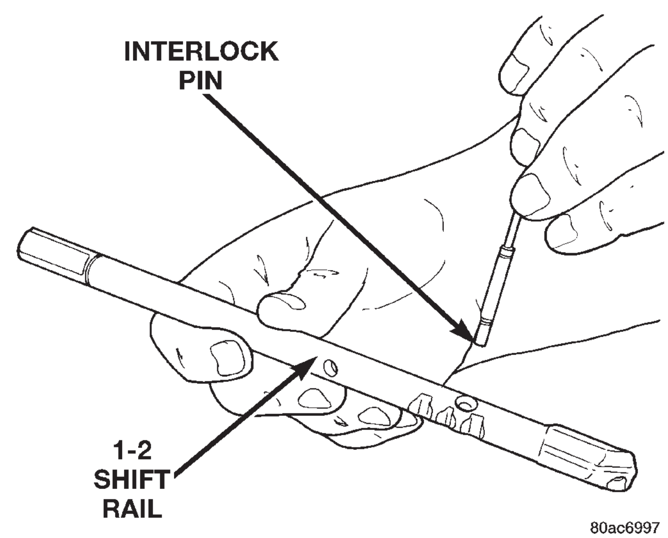


Fig. 77 Install 1–2 Shift Rail Interlock Pin

(5) Install snap-ring onto 3–4 shift rail.

(6) Install the reverse check ball into the intermediate plate (Fig. 78).

(7) Install the interlock pin into the reverse shift rail (Fig. 79).

(8) Assemble the reverse arm bracket to the reverse fork (Fig. 80).

DISASSEMBLY AND ASSEMBLY (Continued)

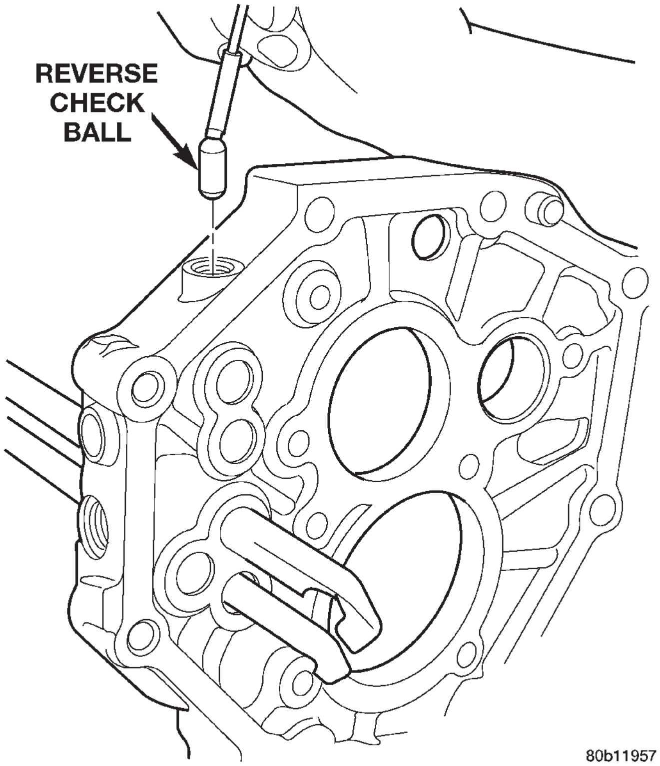


Fig. 78 Install Reverse Check Ball

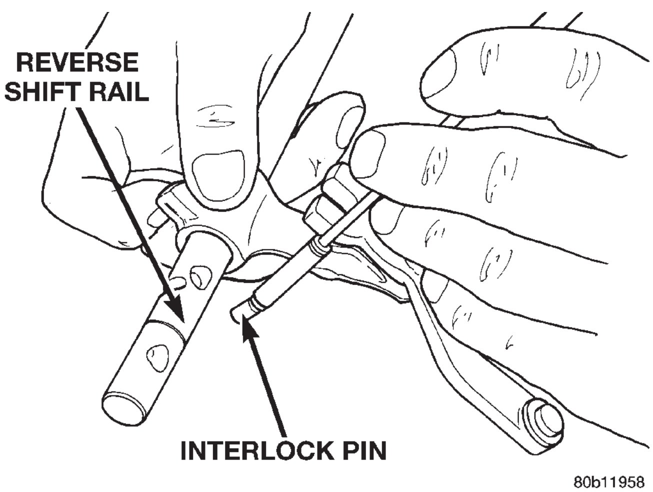


Fig. 79 Install Reverse Interlock Pin

(9) Install reverse shift rail into intermediate plate and position reverse arm bracket to intermediate plate (Fig. 81).

(10) Install snap-ring onto reverse shift rail (Fig. 82).

(11) Install reverse shift head and rail assembly into the intermediate plate.

(12) Install the fifth gear interlock ball and check ball (Fig. 83).

(13) Install fifth gear shift rail (Fig. 84).

(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.

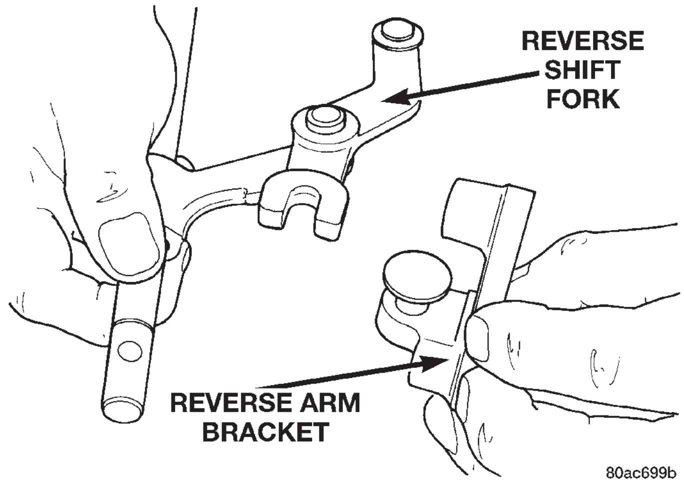


Fig. 80 Install Reverse Arm Bracket to Fork

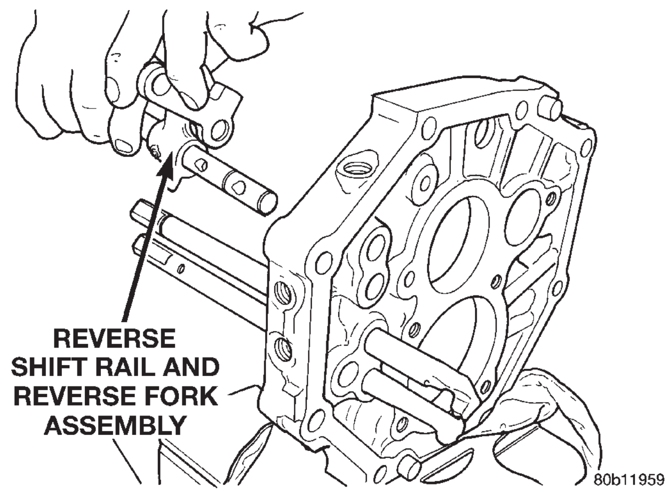


Fig. 81 Install Reverse Shift Rail

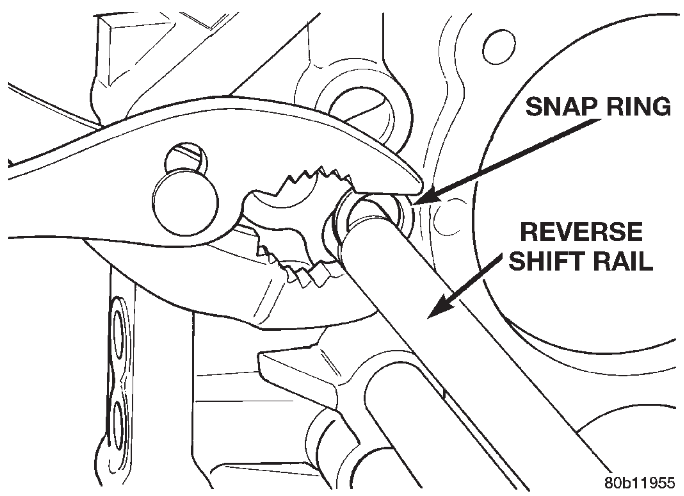


Fig. 82 Install Reverse Snap-ring

DISASSEMBLY AND ASSEMBLY (Continued)

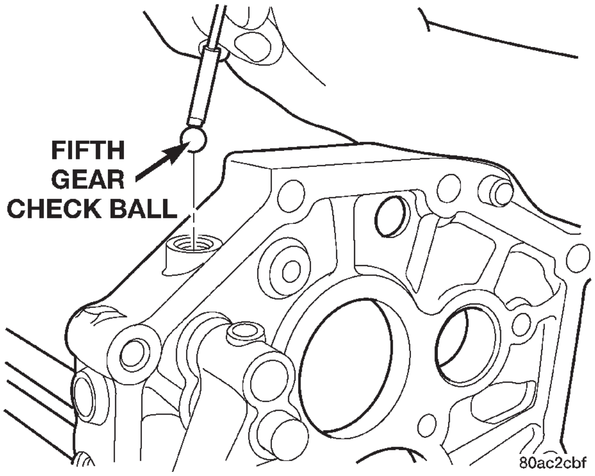


Fig. 83 Install Fifth Gear Check Ball

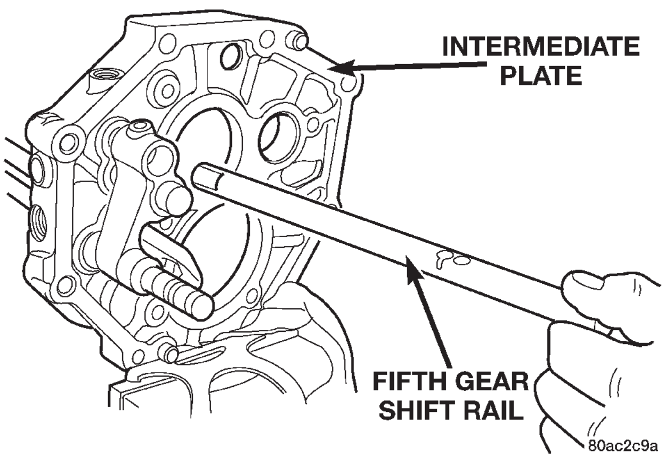


Fig. 84 Install Fifth Gear Shift Rail

(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).

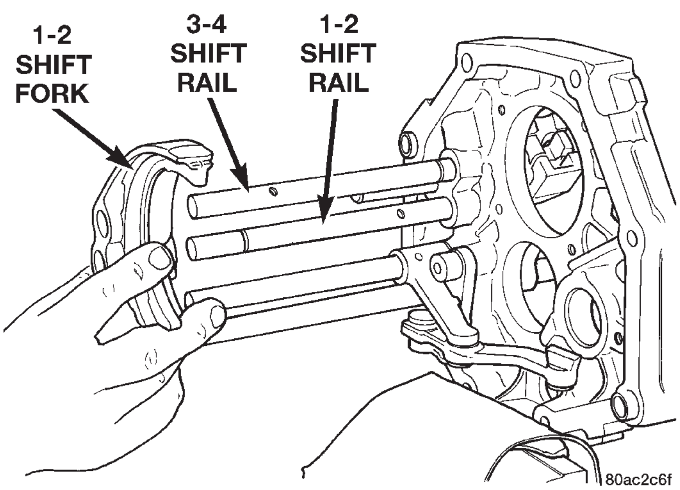


Fig. 85 Install 1–2 Shift Fork

(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).

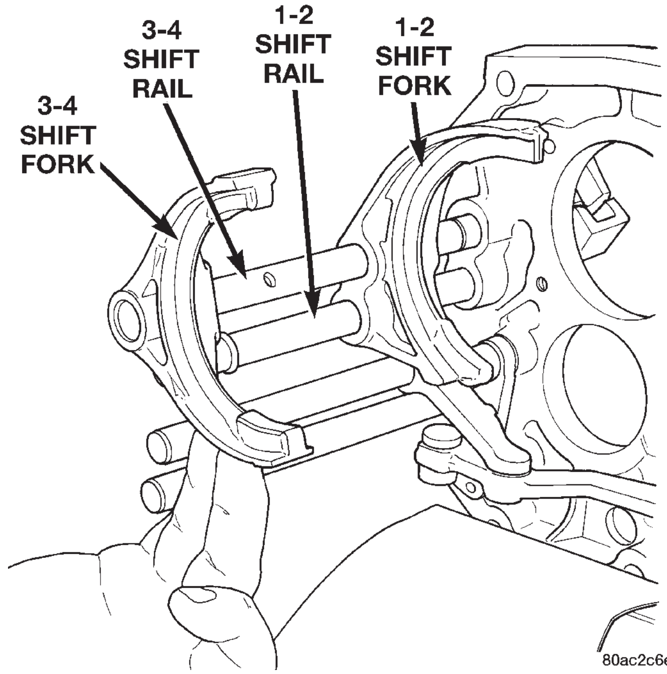


Fig. 86 Install 3–4 Shift Fork

(21) Install mainshaft into the intermediate plate by guiding the output shaft through opening in intermediate plate until the shift forks are aligned with 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.

(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).

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

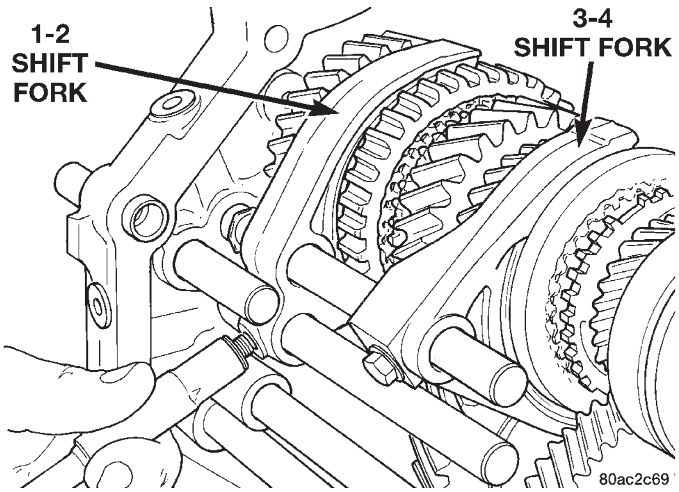


Fig. 87 Install Shift Fork Bolts

(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.

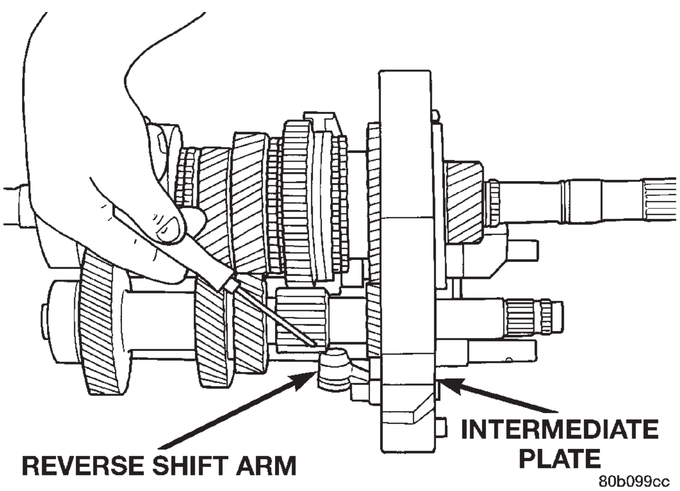


Fig. 88 Reverse Shift Arm Position

(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

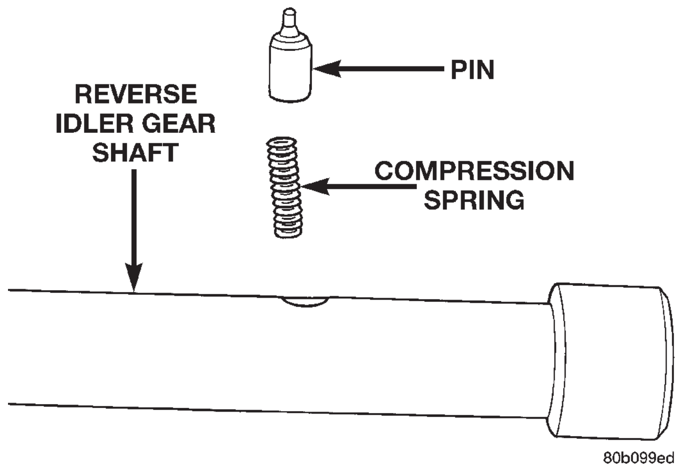


Fig. 89 Install Compression Spring And Pin

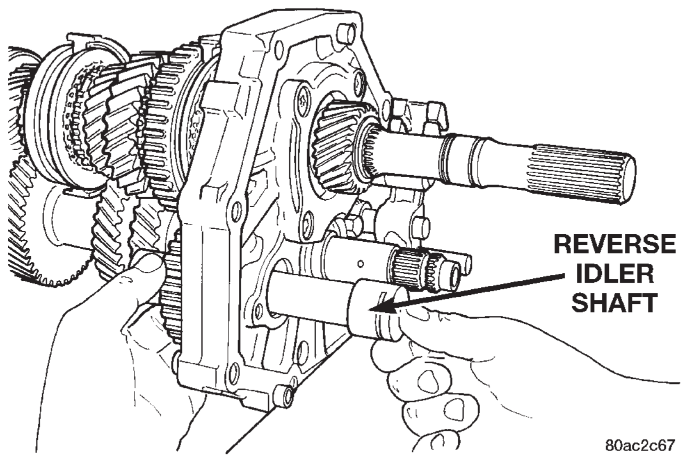


Fig. 90 Install Reverse Idler Shaft

shaft and will need to be disassembled in order to be removed.

(35) Depress compression spring and pin in reverse idler gear shaft (Fig. 92).

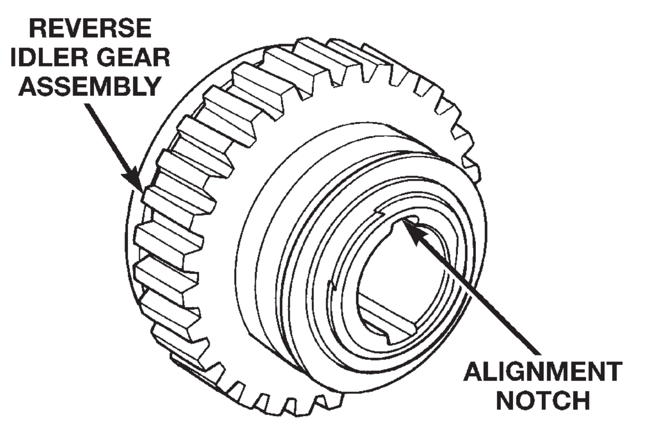


Fig. 91 Align Idler Shaft Pin

DISASSEMBLY AND ASSEMBLY (Continued)

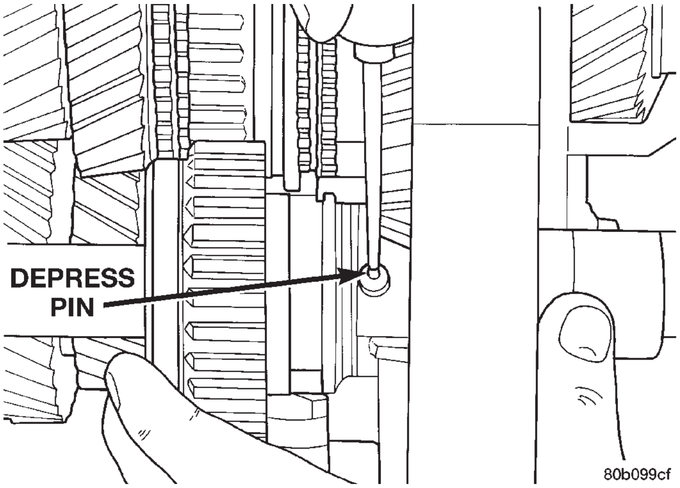


Fig. 92 Depress Pin In Reverse Idler Gear Shaft

(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).

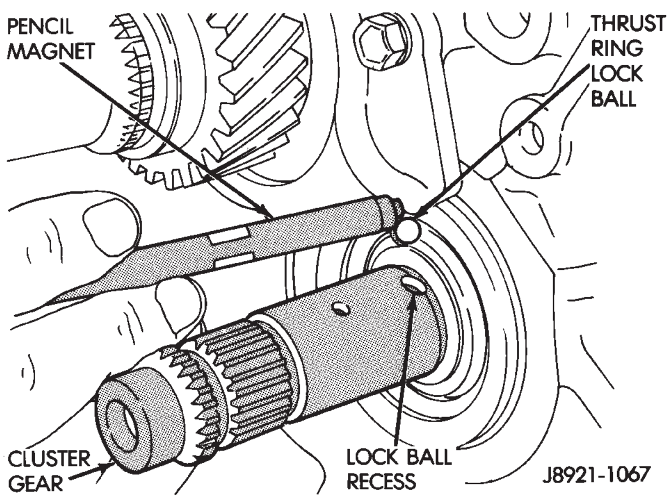


Fig. 93 Install Fifth Gear Thrust Ring Lock Ball

(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.

(45) Position the fifth gear blocker ring onto the countershaft.

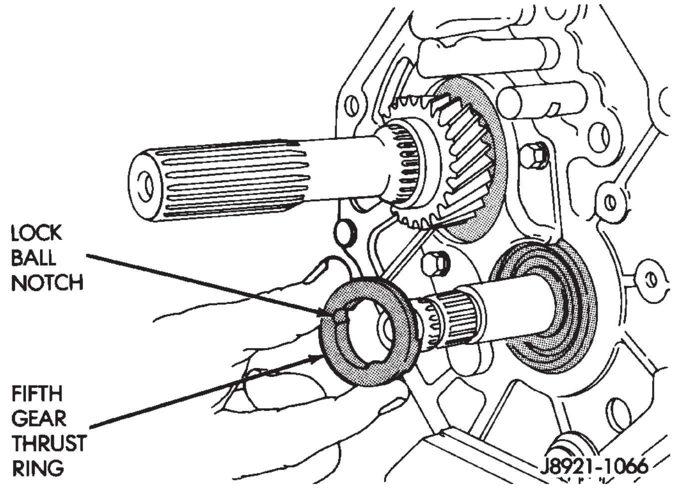


Fig. 94 Install Fifth Gear Thrust Ring

(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).

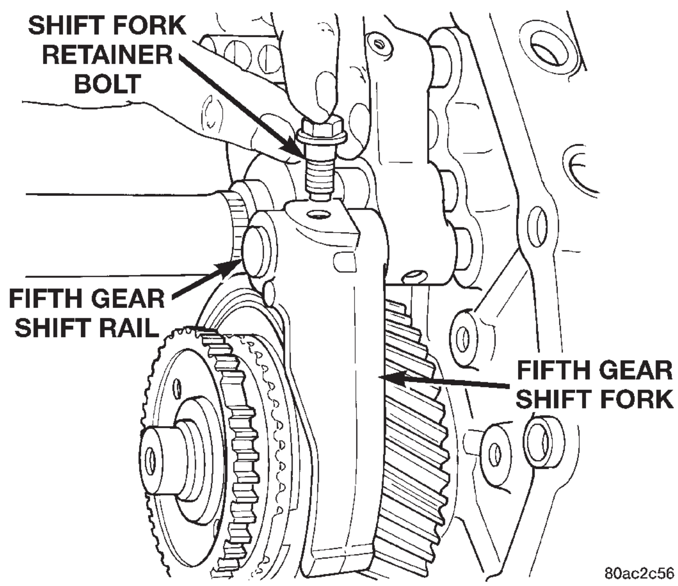


Fig. 95 Install Fifth Gear Retainer Bolt

(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.

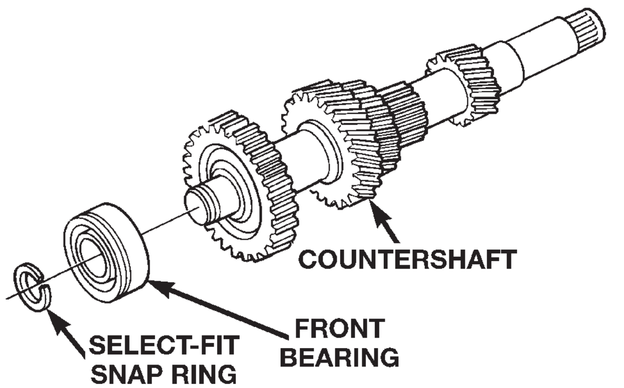
DISASSEMBLY AND ASSEMBLY (Continued)

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.



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

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.

(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.

(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).

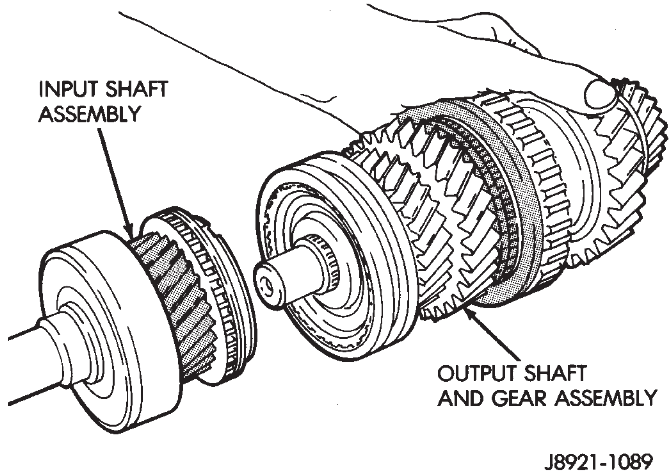


Fig. 97 Separate Input and Output Shafts

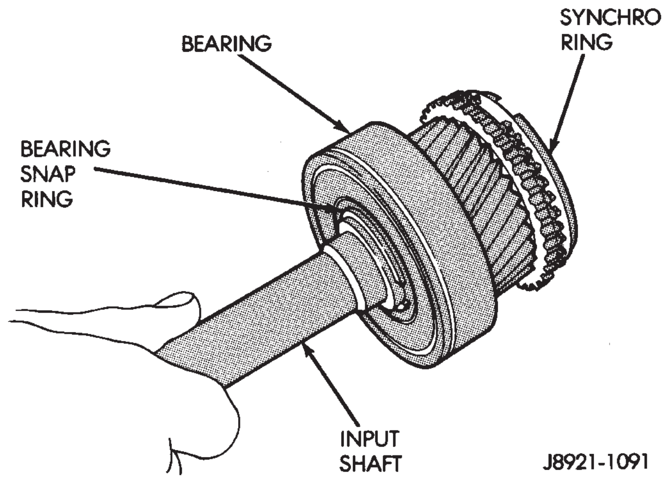


Fig. 98 Input Shaft Components

(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).

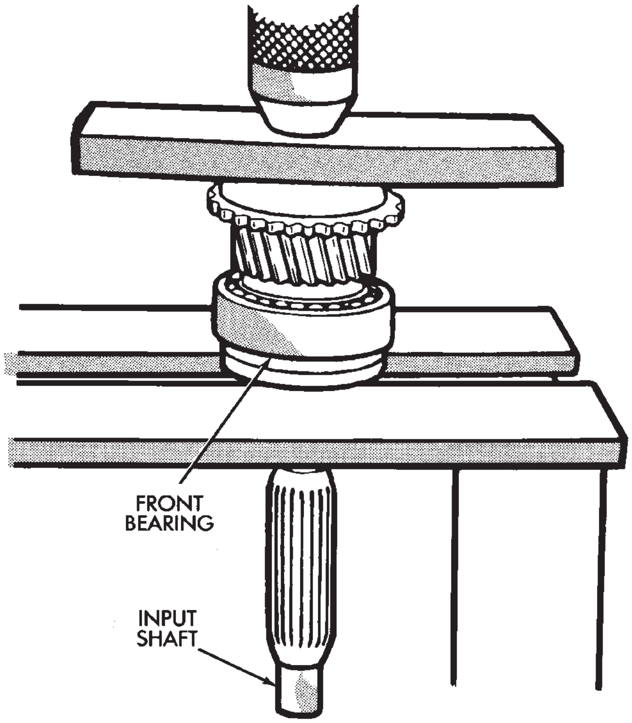
(4) Lubricate output shaft pilot bearing bore of input shaft with petroleum jelly.

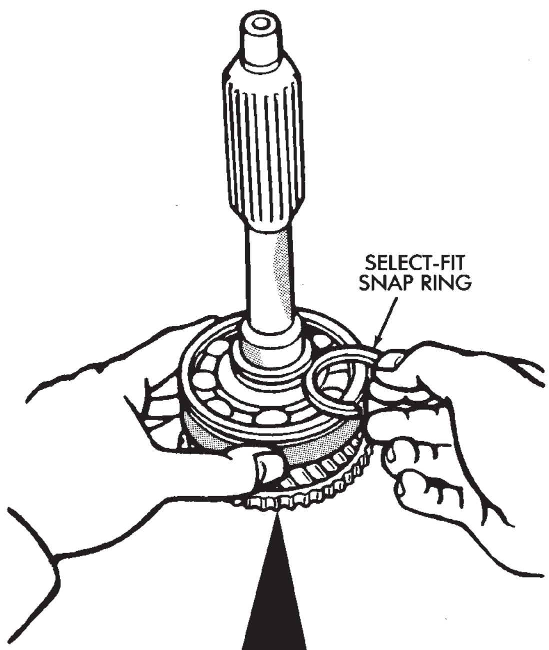
(5) Install output shaft pilot bearing rollers in input shaft bore (Fig. 100). Ensure to use sufficient petroleum jelly to hold rollers in position.

(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.

DISASSEMBLY AND ASSEMBLY (Continued)





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)

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Fig. 99 Select Input Shaft Bearing Snap-ring

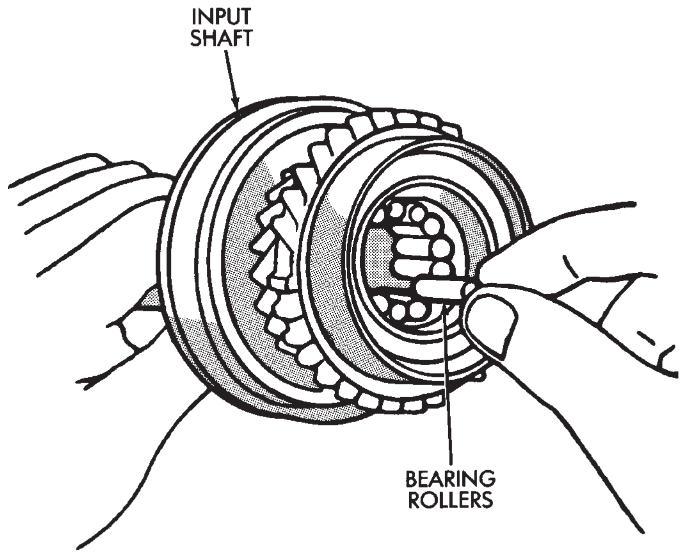


Fig. 100 Install Output Shaft Pilot Bearing Rollers

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.).

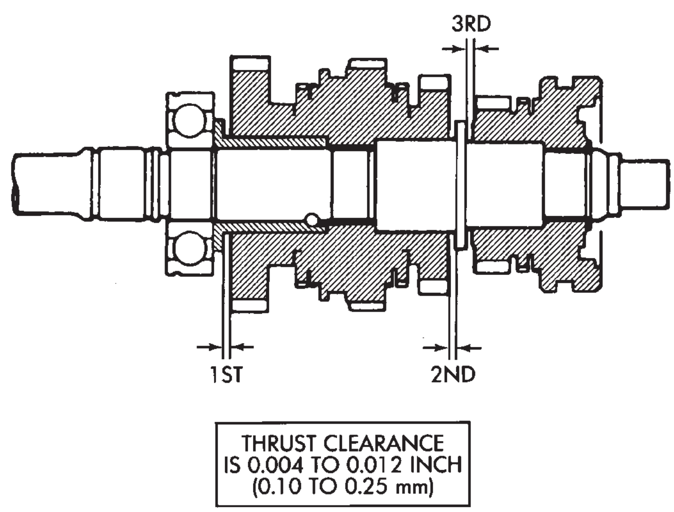


Fig. 101 Check Output Shaft Gear Thrust Clearance

(3) Remove output shaft fifth gear snap ring with two screwdrivers (Fig. 102).

(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).

DISASSEMBLY AND ASSEMBLY (Continued)

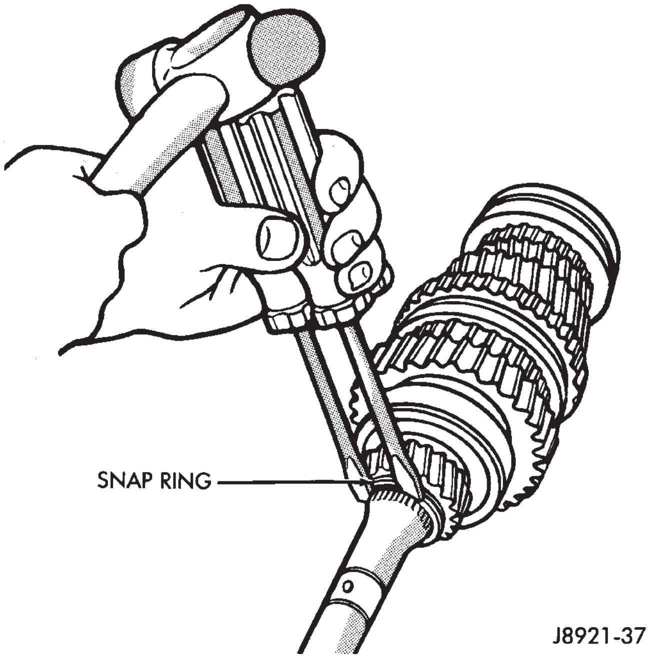


Fig. 102 Remove Fifth Gear Snap-ring

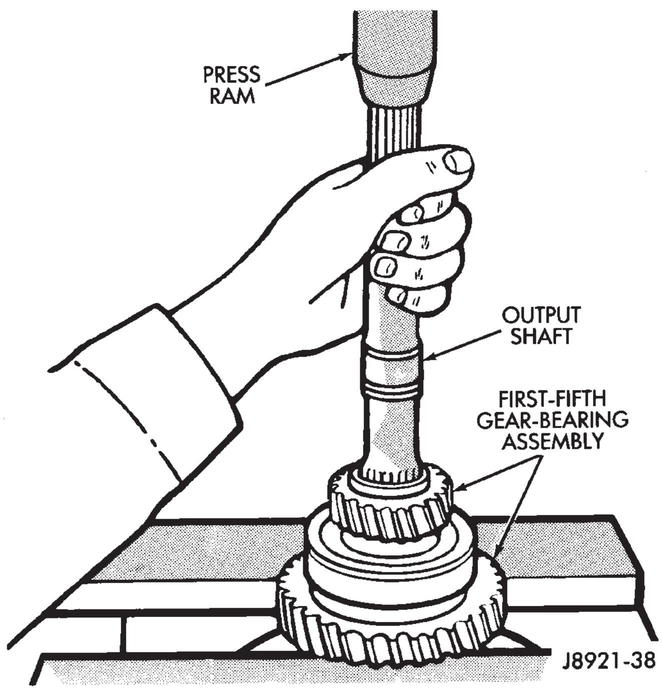


Fig. 103 Remove Fifth Gear, First Gear Bearing, And Race

(5) Remove first gear needle roller bearing from output shaft.

(6) Remove first gear bearing inner race lock ball with pencil magnet (Fig. 104).

(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).

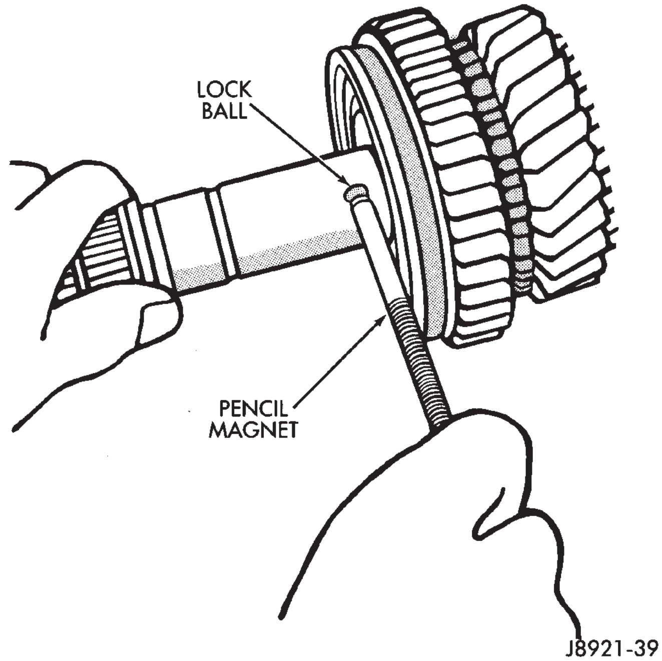


Fig. 104 Remove First Gear Bearing Inner Race Lock Ball

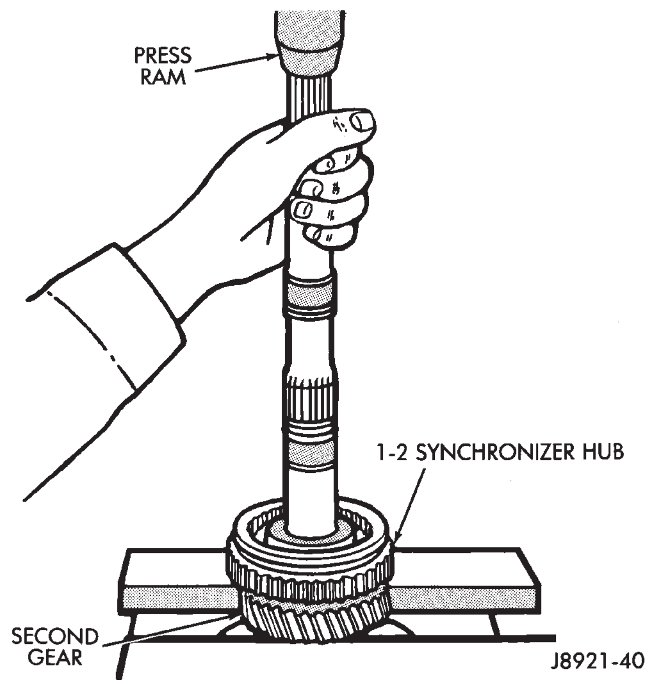


Fig. 105 Remove Second Gear, Reverse Gear, And 1–2 Synchronizer

(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).

(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).

DISASSEMBLY AND ASSEMBLY (Continued)

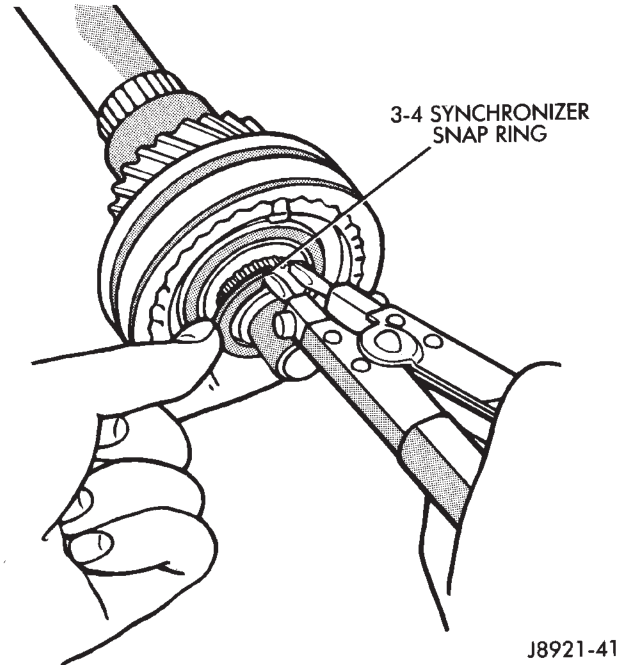


Fig. 106 Remove 3–4 Synchronizer Snap Ring

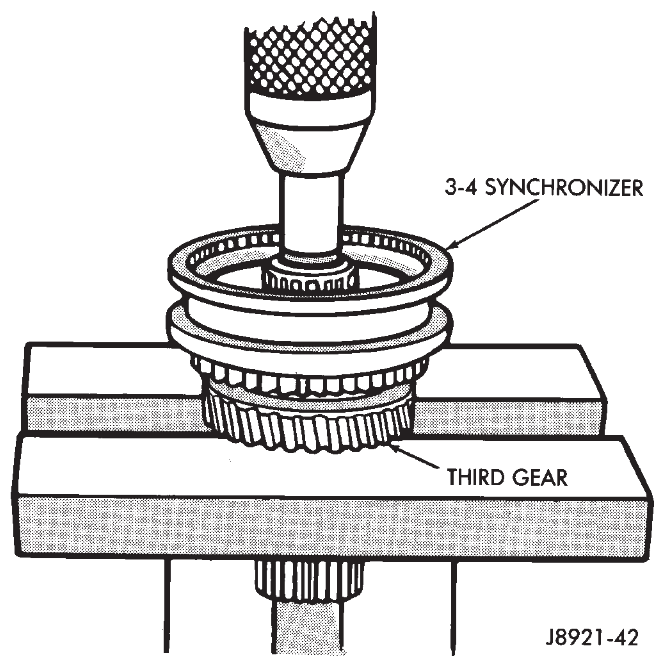


Fig. 107 Remove 3–4 Synchronizer And Third Gear

(12) Remove third gear needle roller bearing from output shaft or gear.

ASSEMBLY

(1) Lubricate transmission components with specified gear lubricant.

(2) If necessary, assemble 1–2 and 3–4 synchronizer hubs, sleeves, springs and key inserts (Fig. 108).

(3) Install third gear needle bearing onto the output shaft.

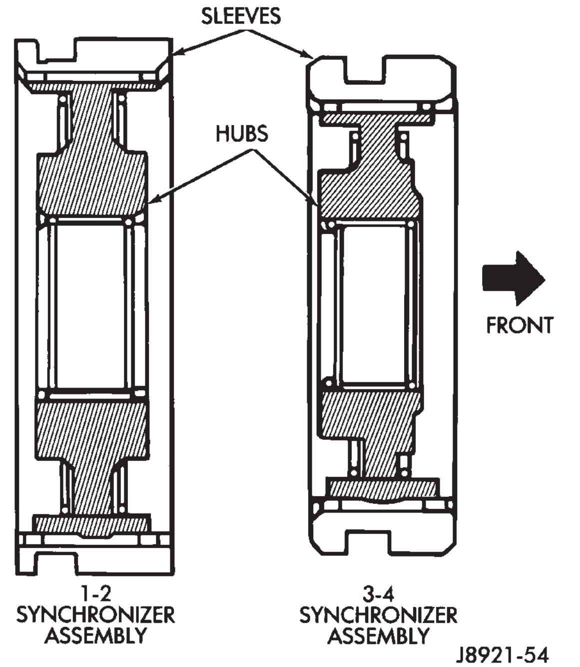


Fig. 108 Synchronizer Identification

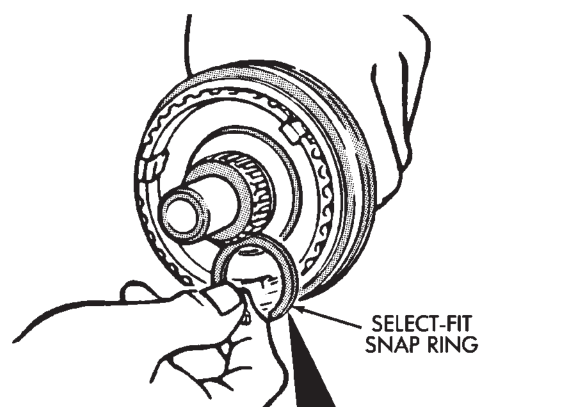
(4) Install third gear over bearing and onto output shaft flange.

(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).



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

DISASSEMBLY AND ASSEMBLY (Continued)

(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.

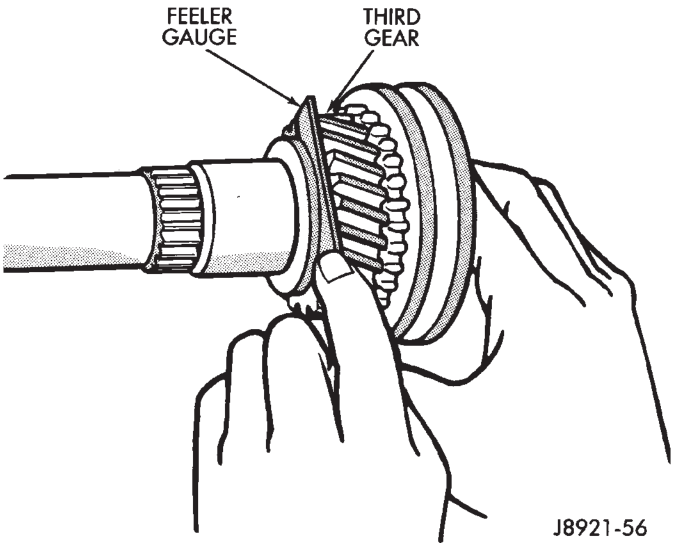


Fig. 110 Check Third Gear Clearance

(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.

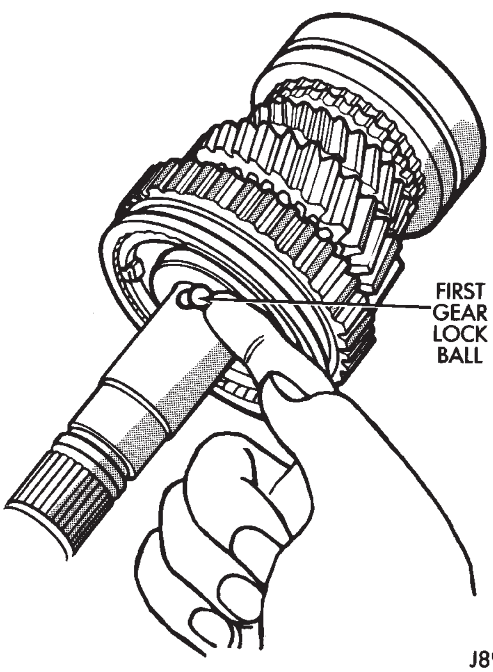


Fig. 111 Install First Gear Bearing Inner Race Lock Ball

(14) Position 1–2 synchronizer assembly onto splines of output shaft.

(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).

(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.

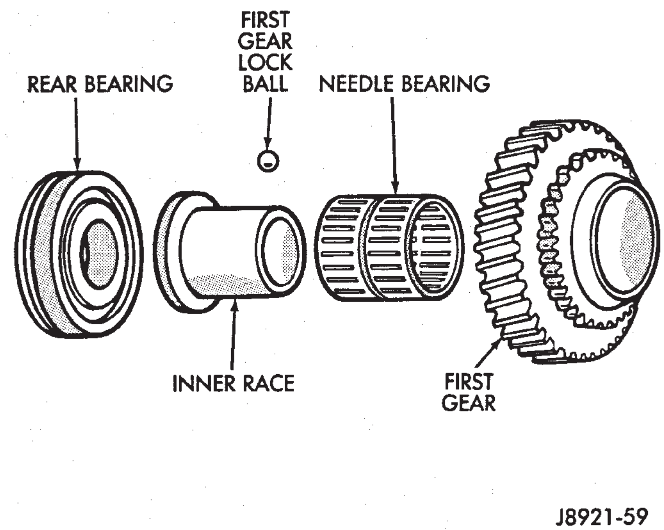


Fig. 112 First Gear Components

DISASSEMBLY AND ASSEMBLY (Continued)

(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.

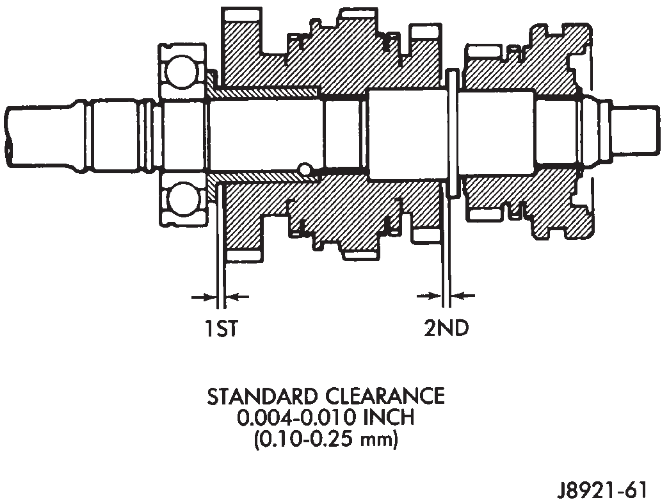


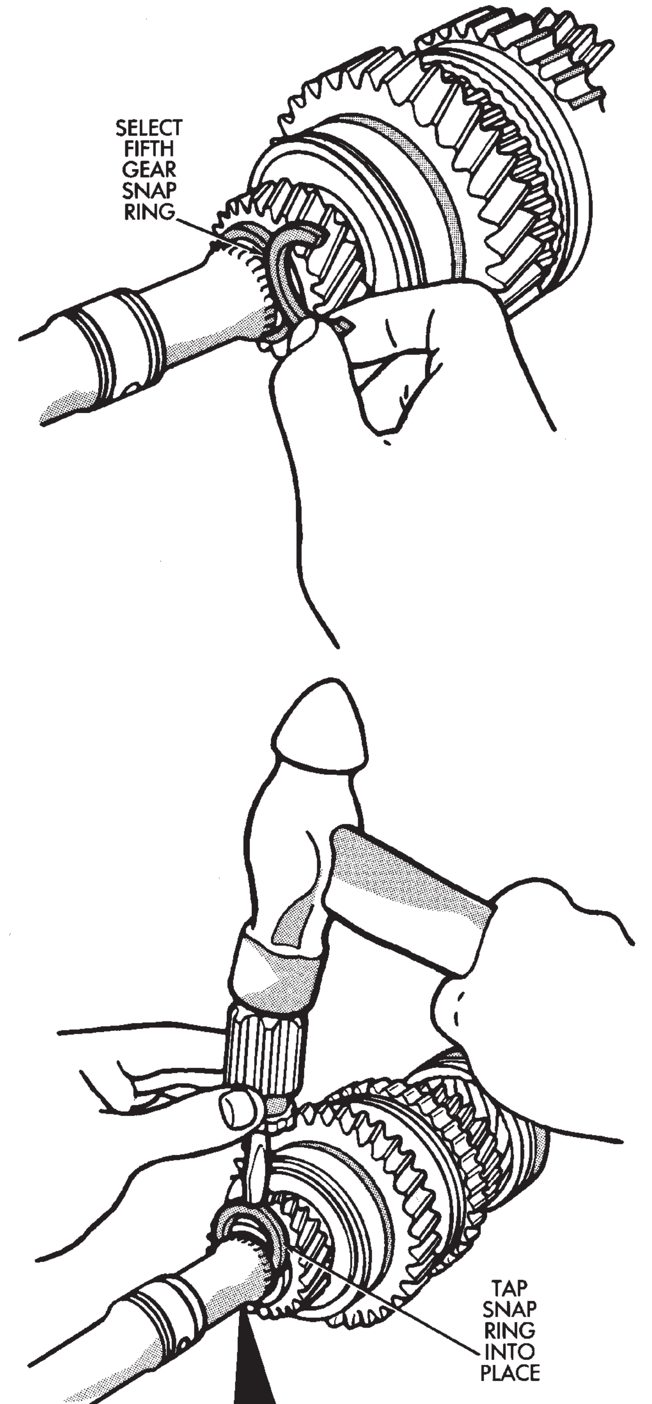
Fig. 113 Check First–Second Gear Thrust Clearance

(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.



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

DISASSEMBLY AND ASSEMBLY (Continued)

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).

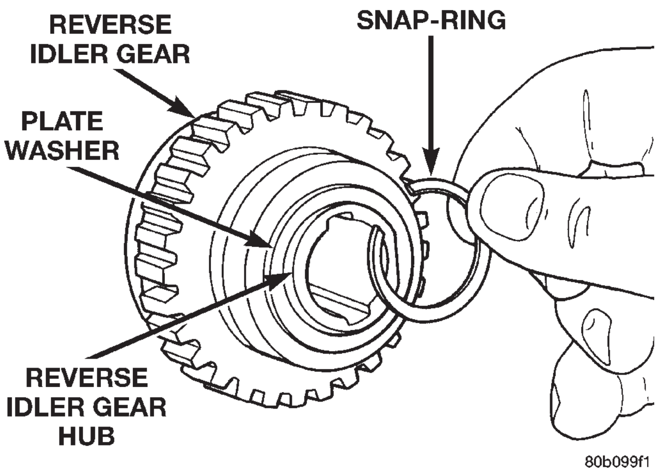


Fig. 115 Remove Reverse Idler Gear Snap-ring

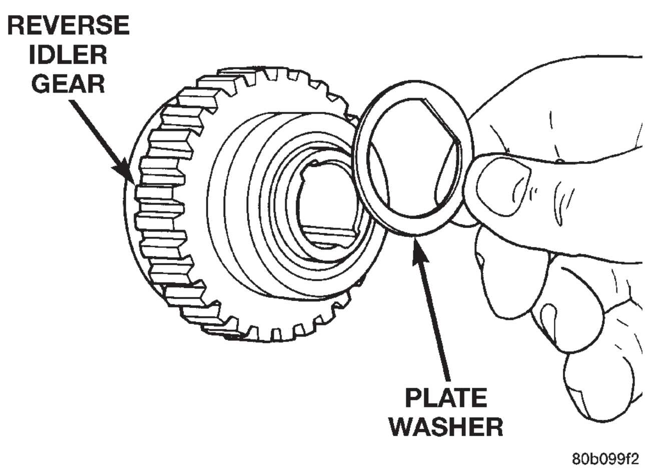


Fig. 116 Remove Reverse Idler Gear Plate Washer

(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 syn-

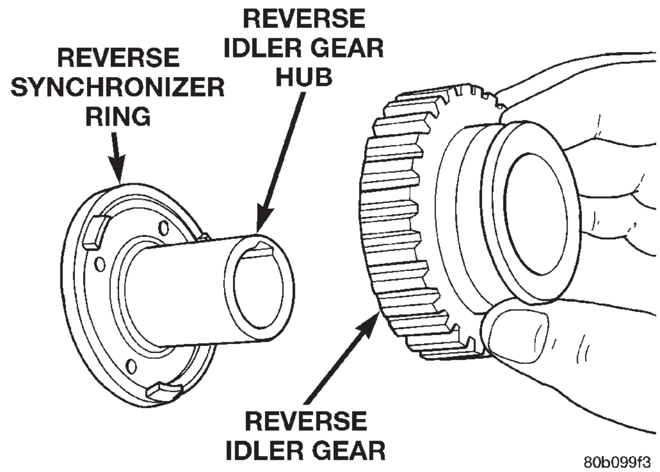


Fig. 117 Remove Reverse Idler Gear

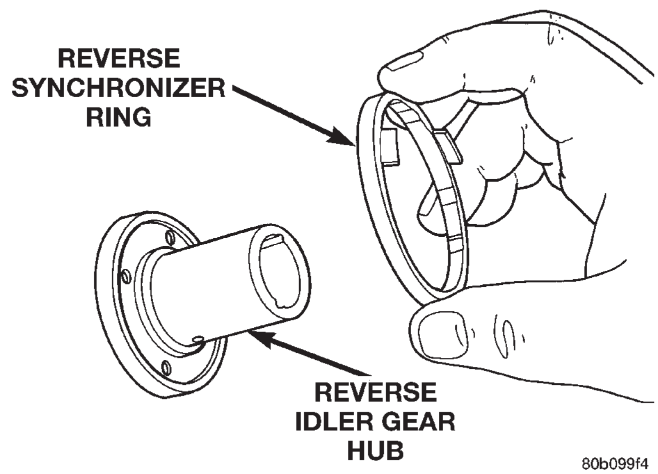


Fig. 118 Remove Reverse Idler Gear Synchronizer Ring

chronizer 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.

(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

CLEANING AND INSPECTION (Continued)

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).

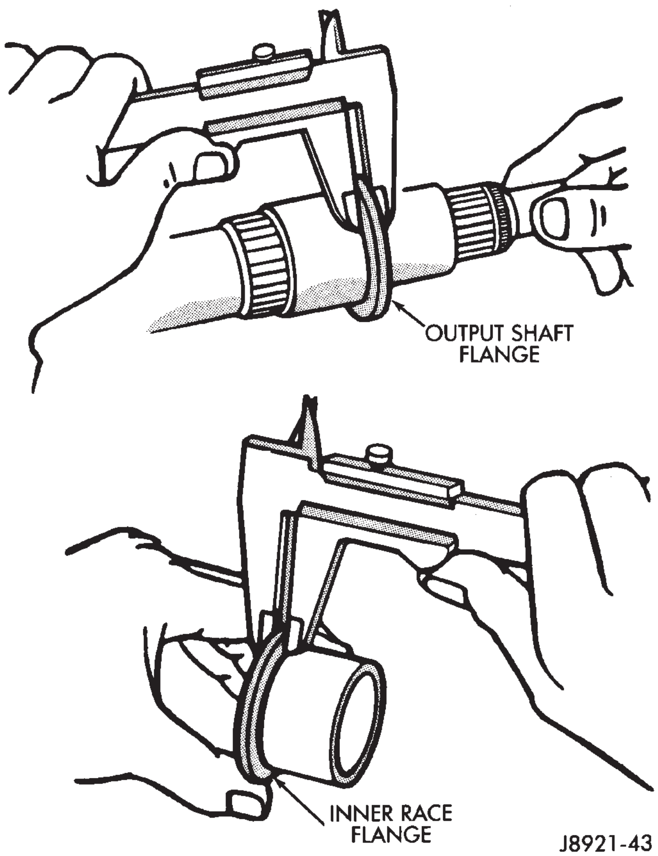


Fig. 119 Check Shaft And Bearing Race Flange Thickness

- 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.).

Measure output shaft runout with a dial indicator (Fig. 120). Runout should not exceed 0.05 mm (0.002 in.).

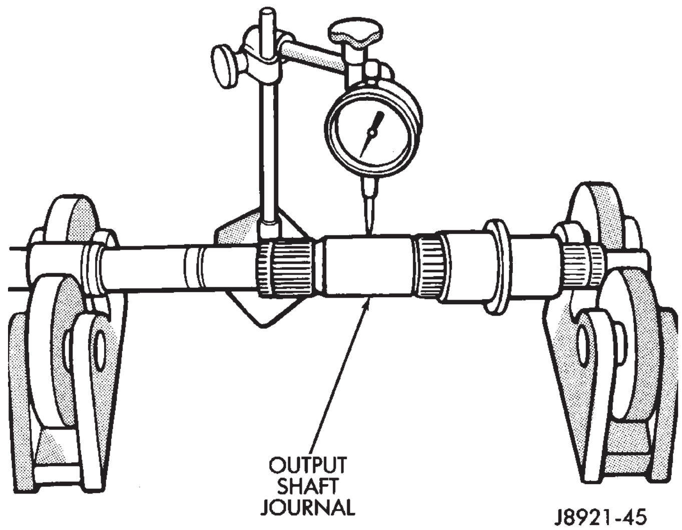


Fig. 120 Check Output Shaft Runout

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.).

CLEANING AND INSPECTION (Continued)

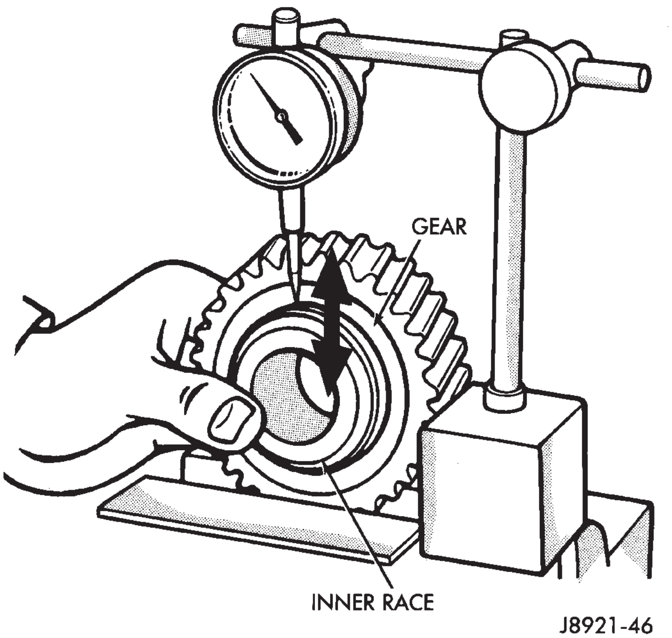


Fig. 121 Check Gear–To–Race Clearance

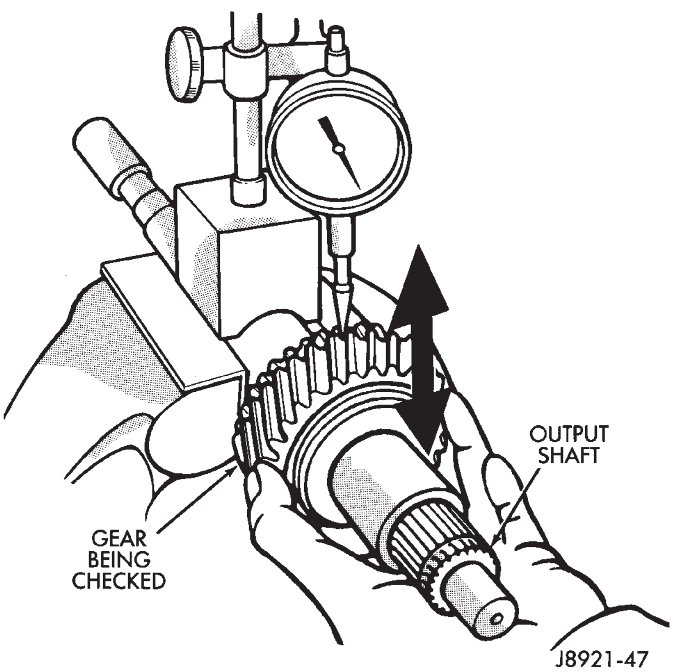


Fig. 122 Check Gear–To–Shaft Oil Clearance

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.

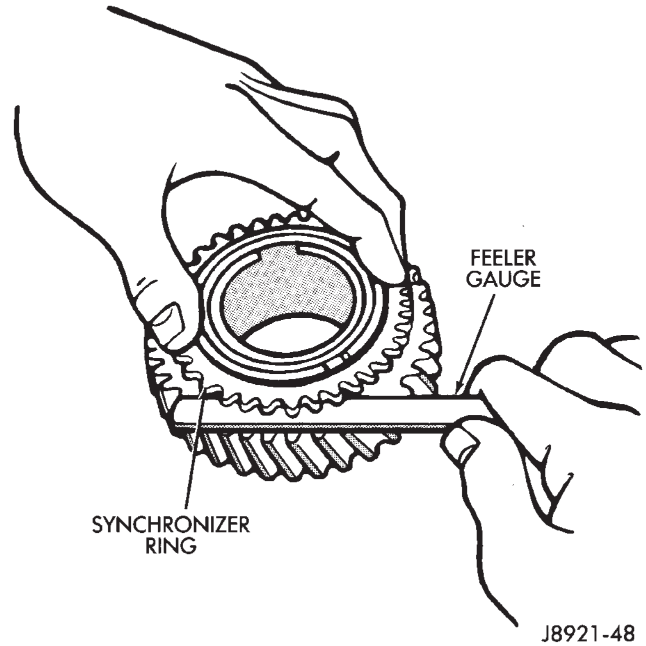


Fig. 123 Check Synchronizer Ring Wear

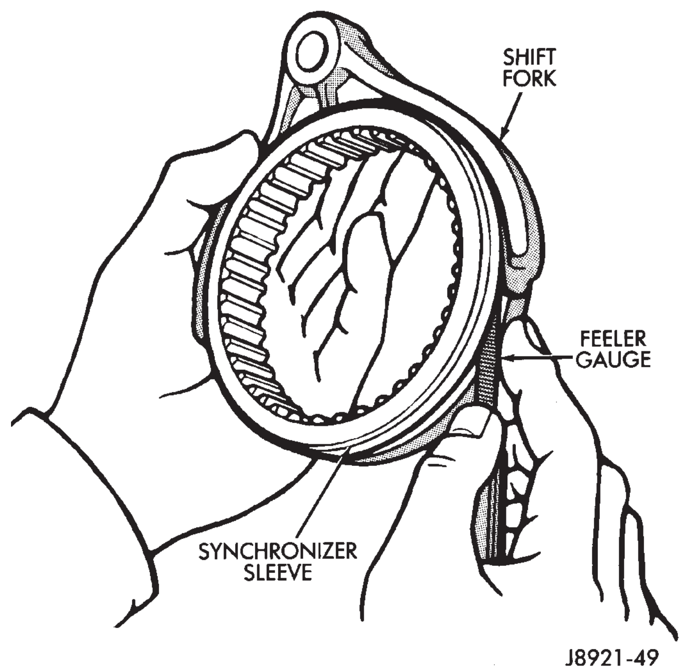


Fig. 124 Check Fork–To–Hub Clearance

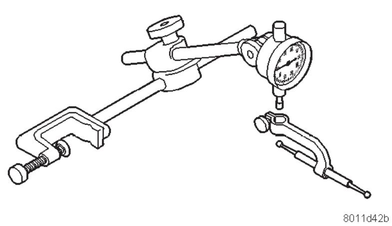
SPECIFICATIONS

TORQUE

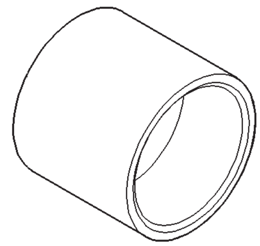
DESCRIPTION	TORQUE
Plugs, Access	19 N·m (14 ft.lbs.)
Bolts, Adapter Housing	34 N·m (25 ft.lbs.)
Switch, Back-up Light	44 N·m (32.5 ft.lbs.)
Plugs, Drain and Fill	44 N·m (32.5 ft.lbs.)
Bolts, Front Bearing Retainer	17 N·m (12 ft.lbs.)
Plugs, Interlock and Detent	19 N·m (14 ft.lbs.)
Screws, Propeller Shaft 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

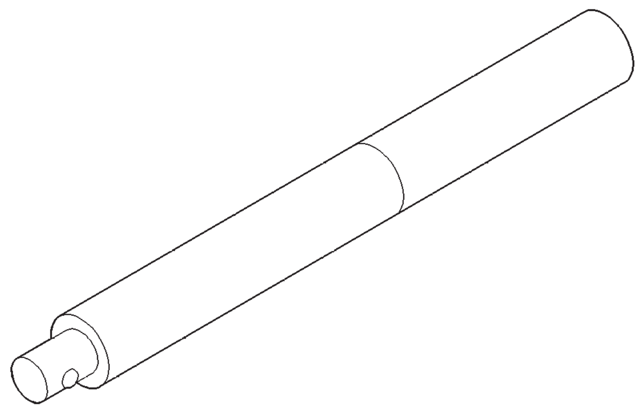
AX5



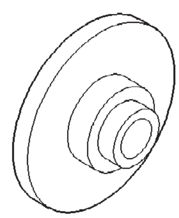
C-3339 Dial Indicator Set



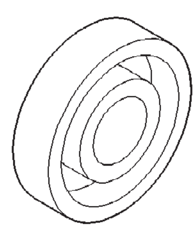
C-3995-A Installer, Extension Housing Seal



C-4171 Handle, Universal Tool

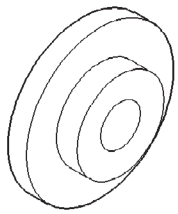


8211 Installer, Seal

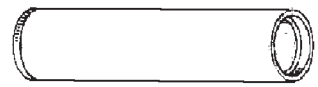


8212 Installer, Seal

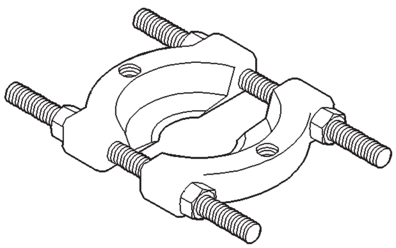
SPECIAL TOOLS (Continued)



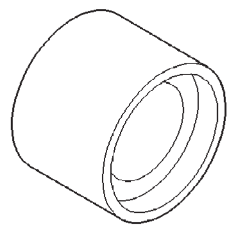
8208 Installer, Seal



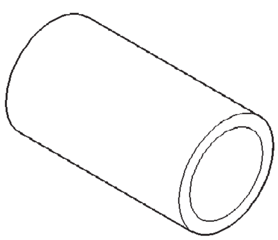
L-4507 Tube, Driver



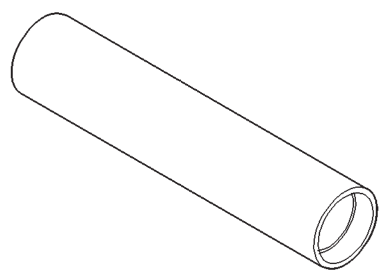
P-334 Splitter, Bearing



6747–1A Adapter, Fixture



8109 Cup, Installer



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).

GENERAL INFORMATION (Continued)

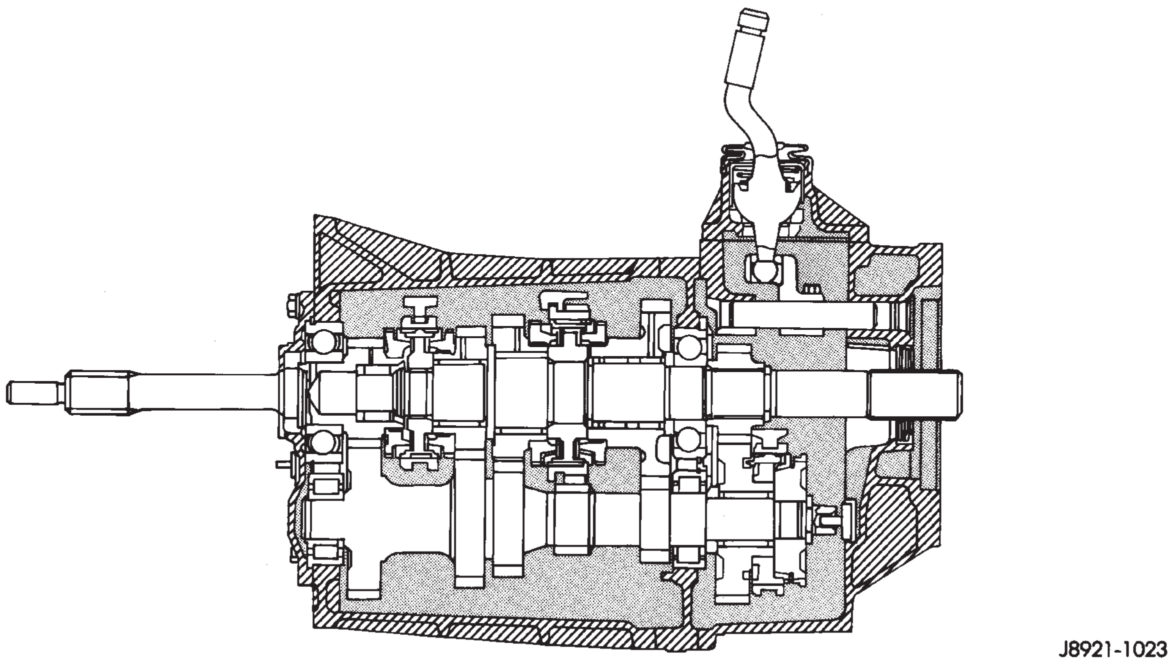


Fig. 1 AX15 Manual Transmission

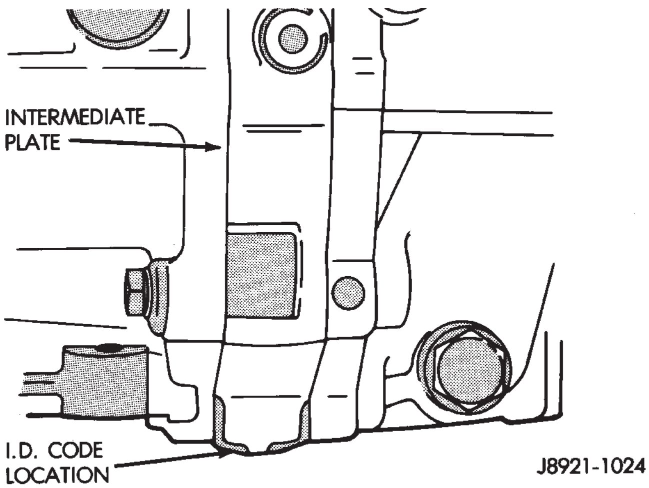


Fig. 2 Identification Code Number Location

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.

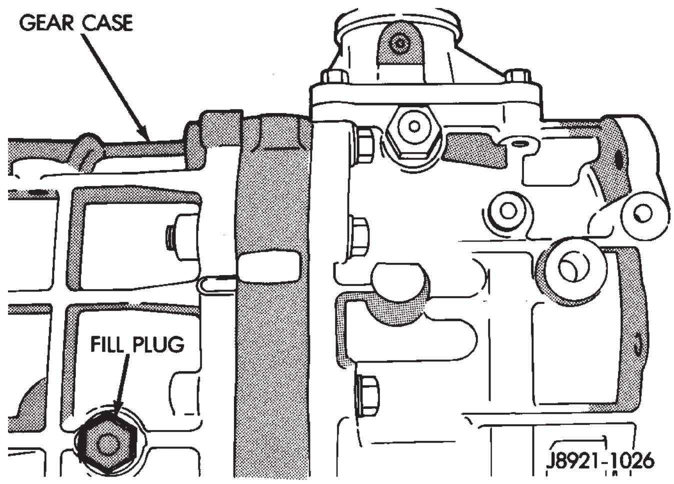


Fig. 3 Fill Plug Location

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 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.

DIAGNOSIS AND TESTING (Continued)

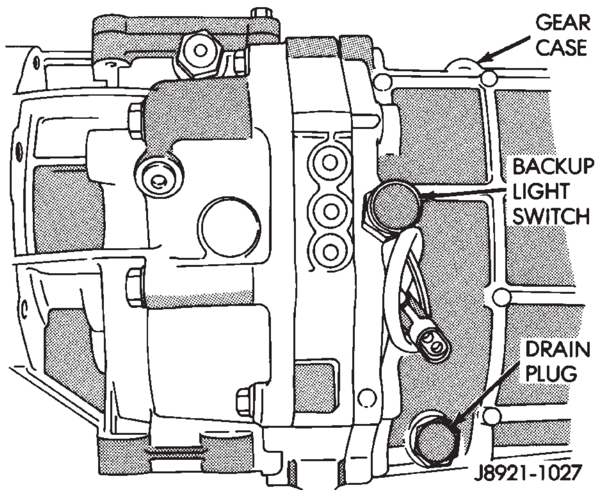


Fig. 4 Drain Plug Location

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 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.

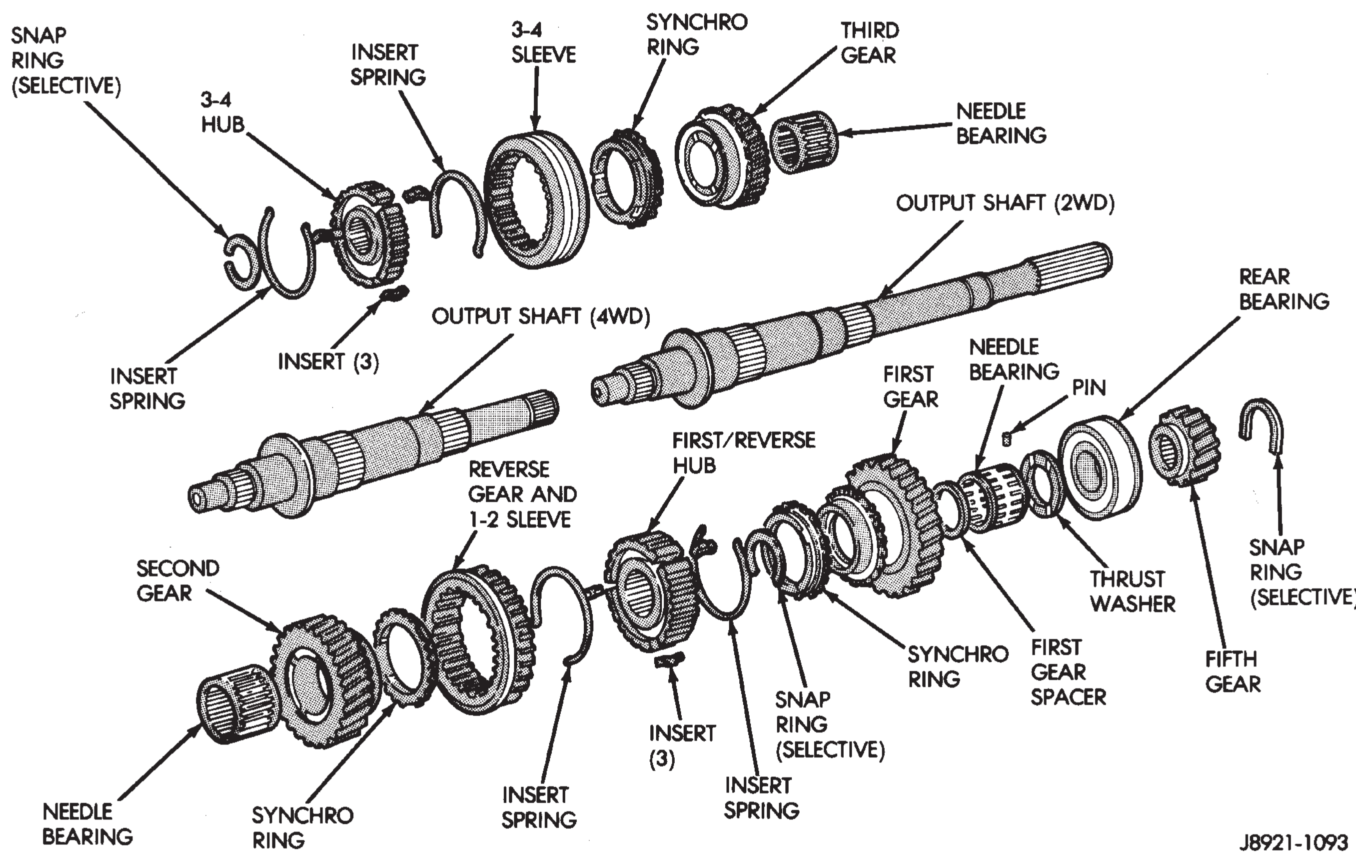


Fig. 5 Output Shaft and Gears

DIAGNOSIS AND TESTING (Continued)

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. 6).

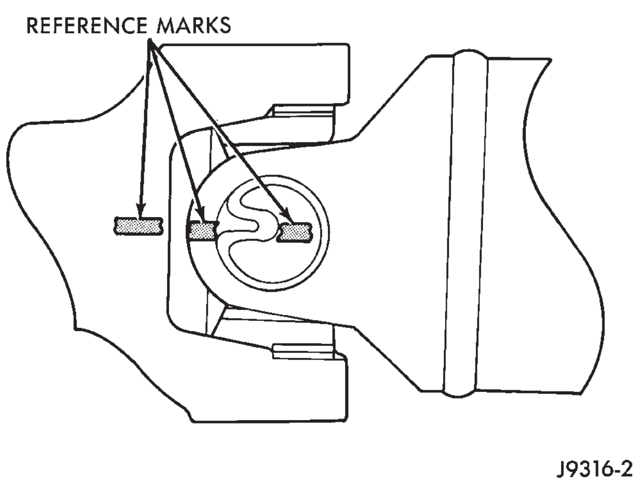


Fig. 6 Marking Propeller Shaft And Axle Yokes

(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).

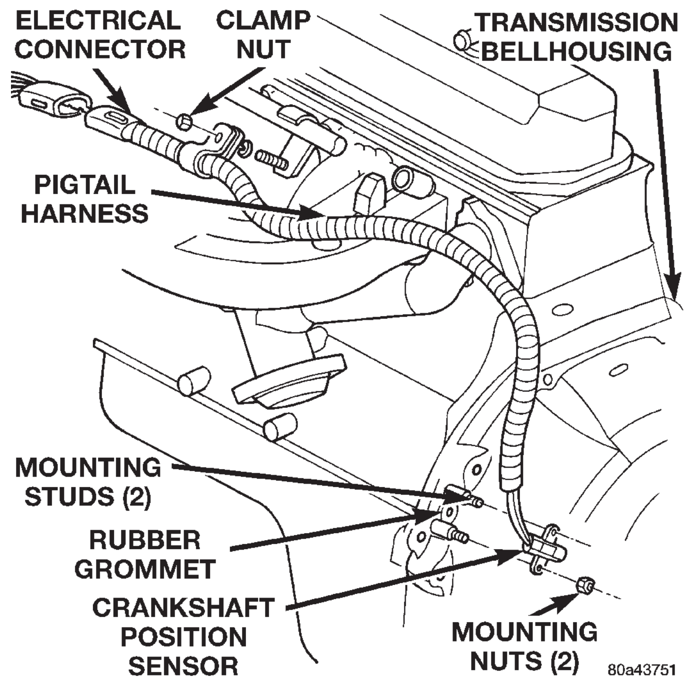


Fig. 7 Crankshaft Position Sensor—2.5L Engine

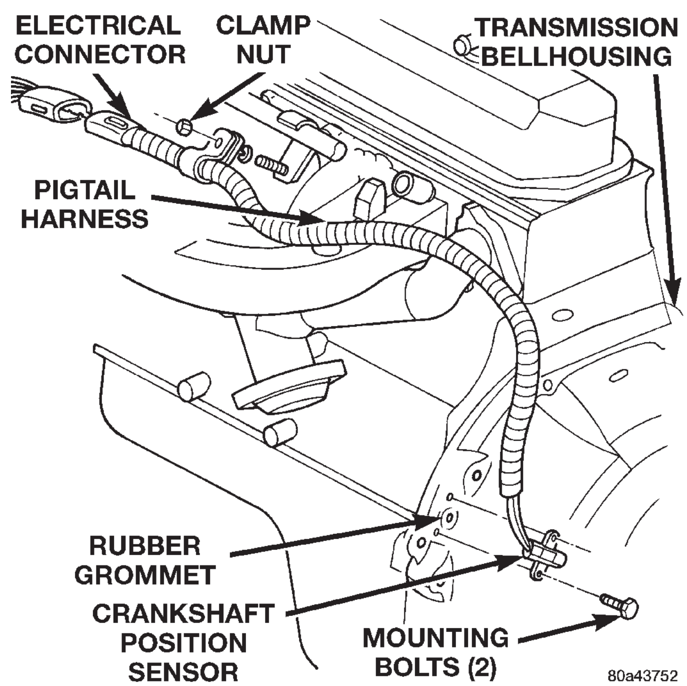


Fig. 8 Crankshaft Position Sensor —4.0L Engine

REMOVAL AND INSTALLATION (Continued)

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. 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.

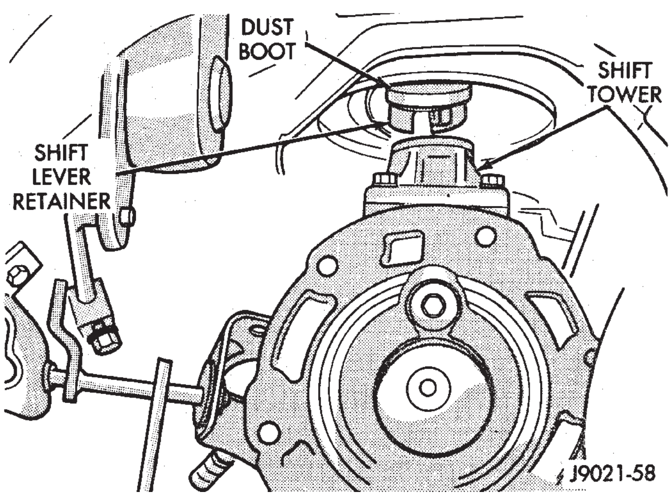


Fig. 9 Removing/Installing Shift Lever

(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).

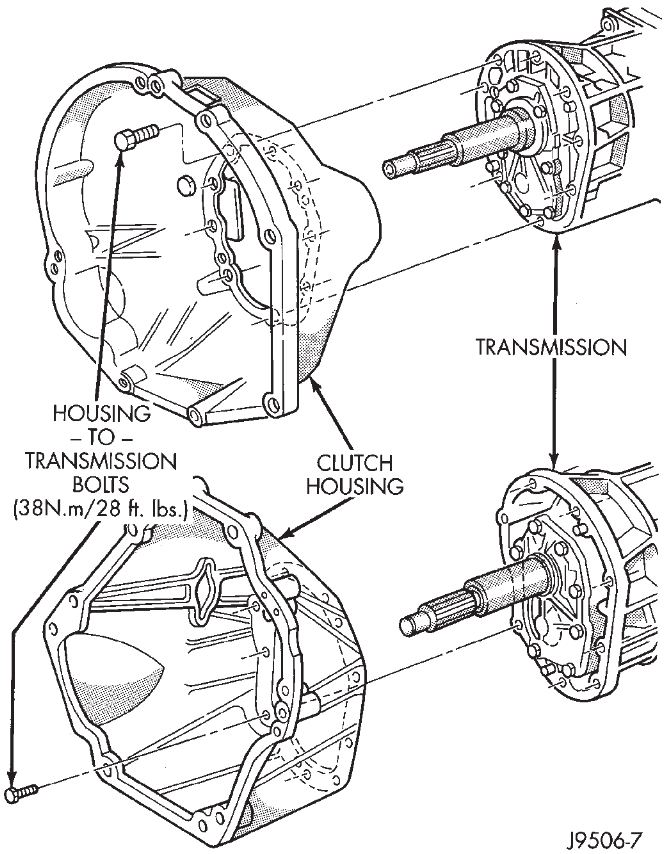


Fig. 10 Clutch Housing

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. 10). **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 downward and turn it clockwise to lock it in place. Then install lever dust boot on shift tower.

REMOVAL AND INSTALLATION (Continued)

(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. 11).

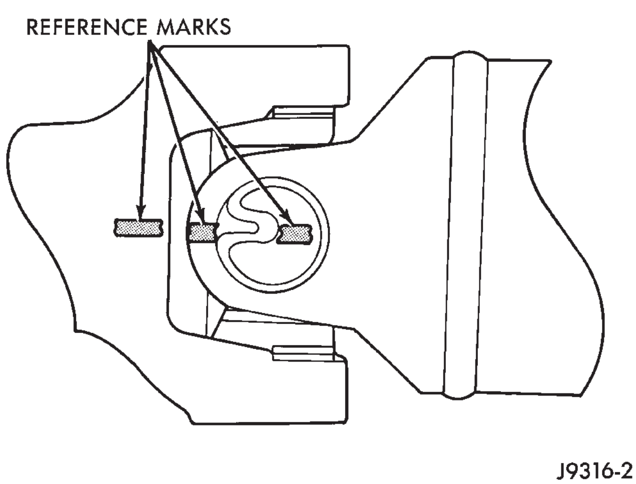


Fig. 11 Align Propeller Shaft And Rear Axle Yokes Alignment Marks

(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).

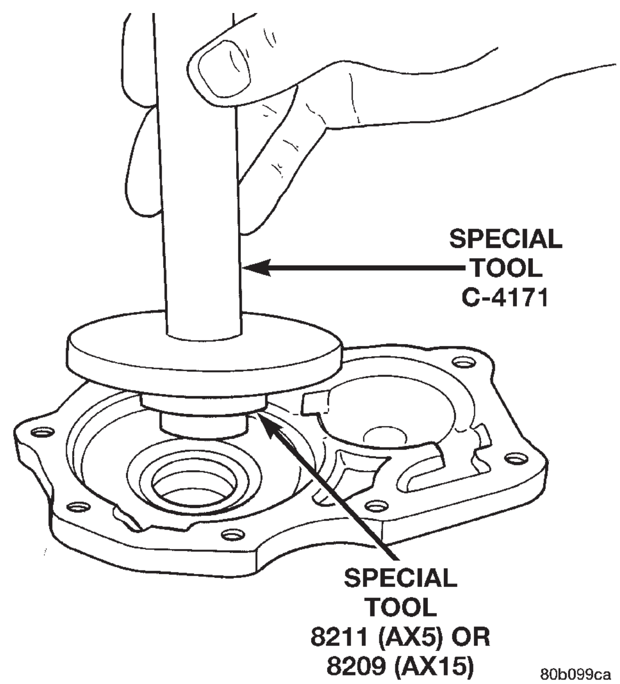


Fig. 12 Install Front Bearing Retainer Seal

(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.

REMOVAL AND INSTALLATION (Continued)

(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.

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).

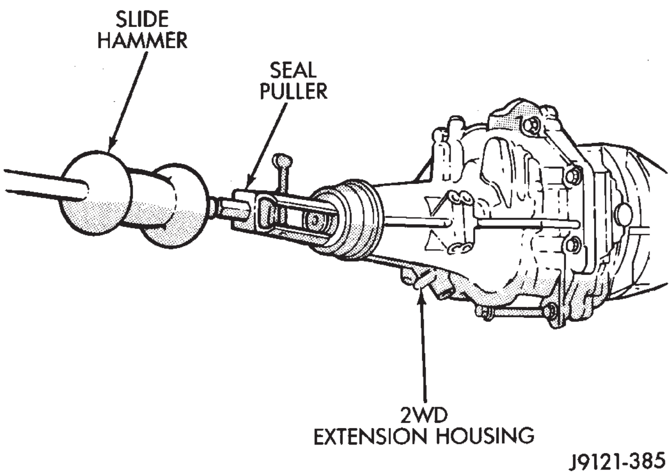


Fig. 13 Remove Extension Housing Seal

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).

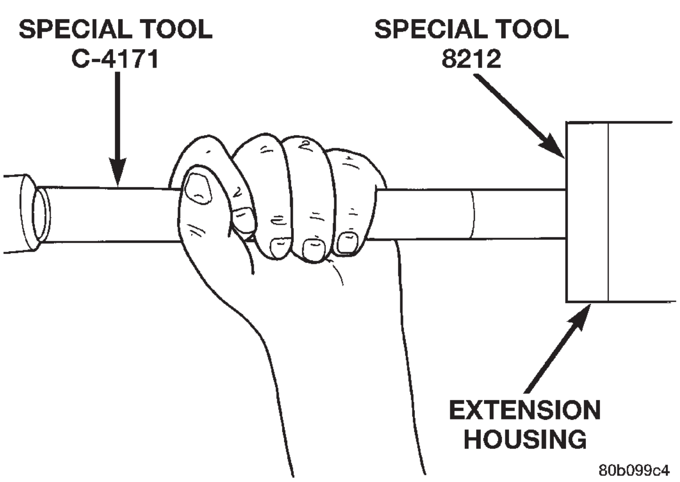


Fig. 14 Install Extension Housing Seal

(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).

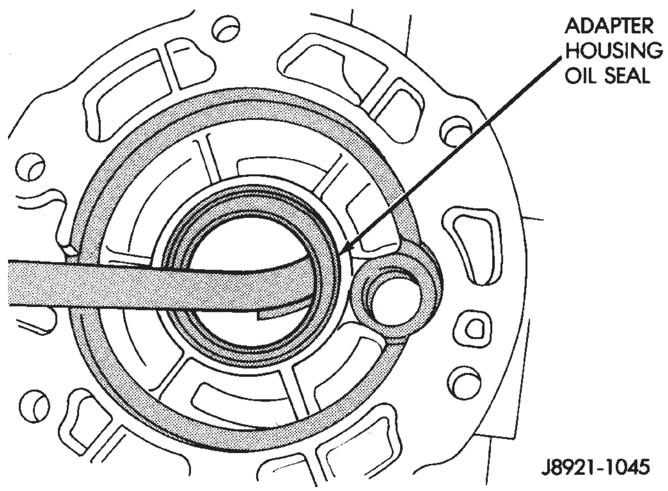


Fig. 15 Remove Adapter Housing Seal

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).

(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.

REMOVAL AND INSTALLATION (Continued)

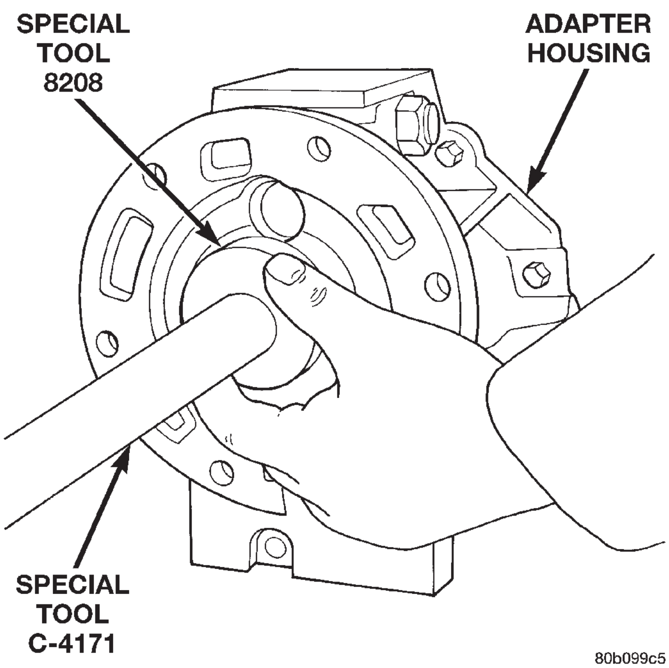


Fig. 16 Install Adapter Housing Seal

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).

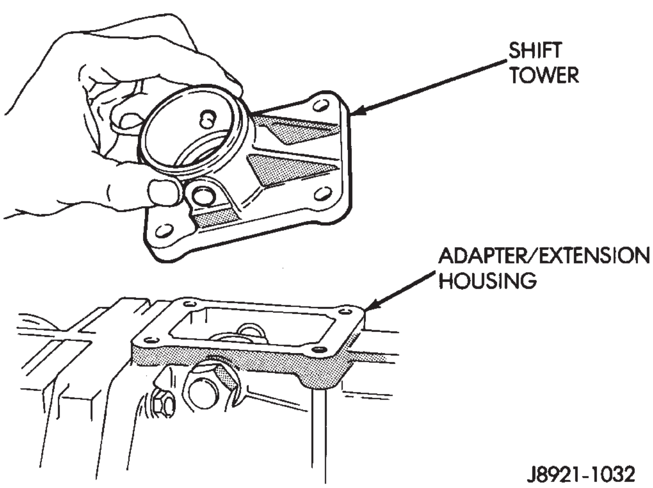


Fig. 17 Remove Shift Tower

(7) Remove shift tower gasket from shift tower or transmission case (Fig. 18).

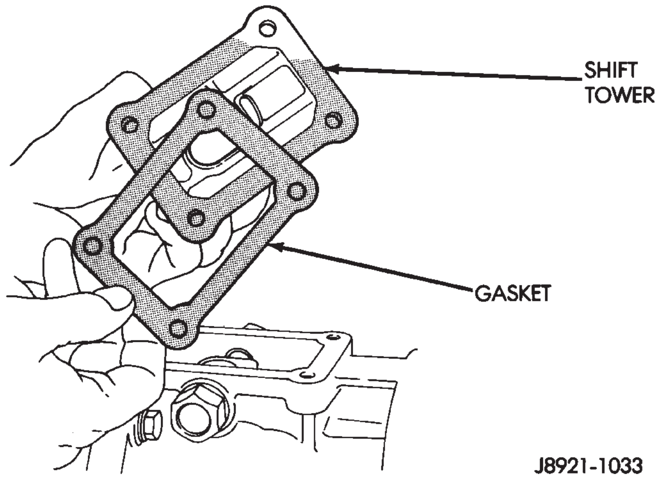


Fig. 18 Remove Shift Tower Gasket

(8) Remove reverse shift head detent ball plug (Fig. 20).

(9) Remove detent ball spring and ball with pencil magnet (Fig. 21), (Fig. 22).

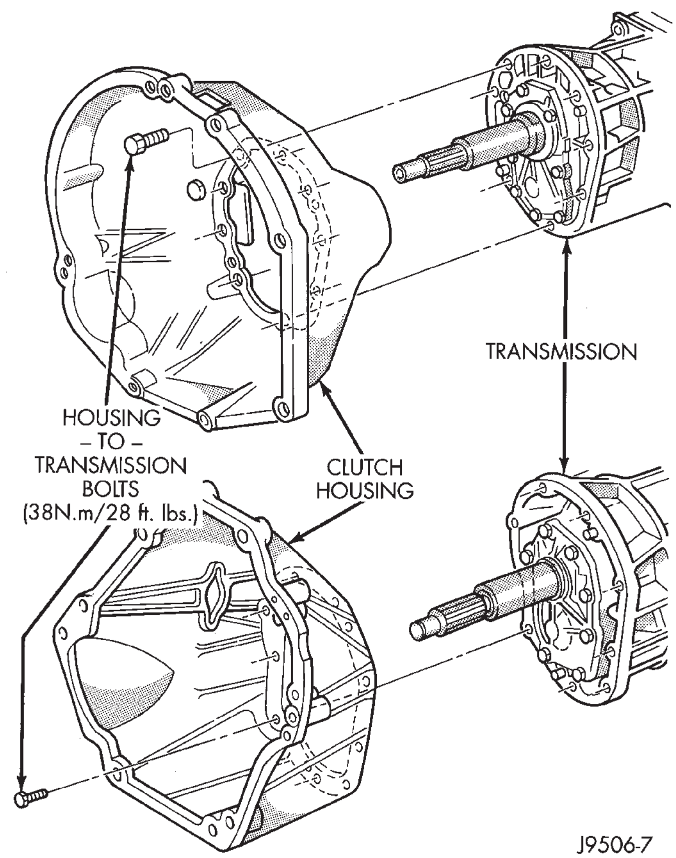


Fig. 19 Clutch Housing

DISASSEMBLY AND ASSEMBLY (Continued)

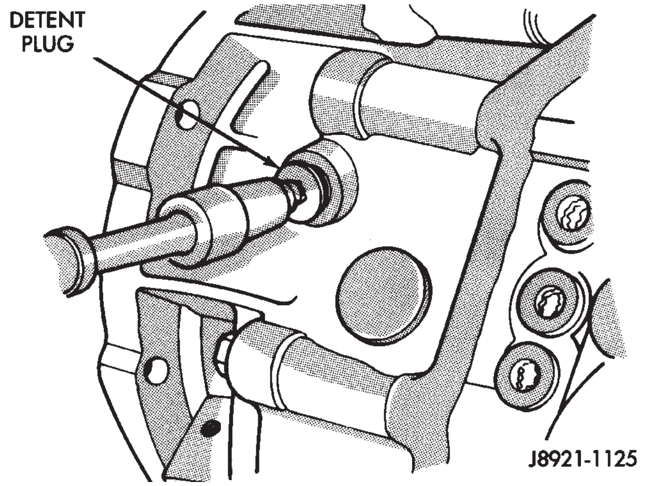


Fig. 20 Remove Detent Ball Plug

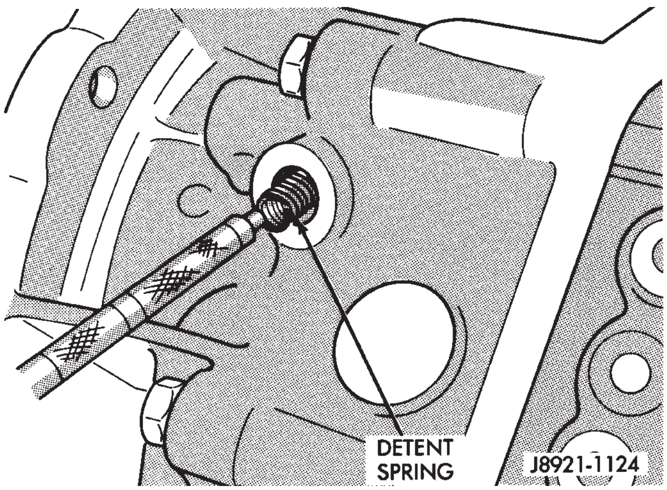


Fig. 21 Remove Detent Spring

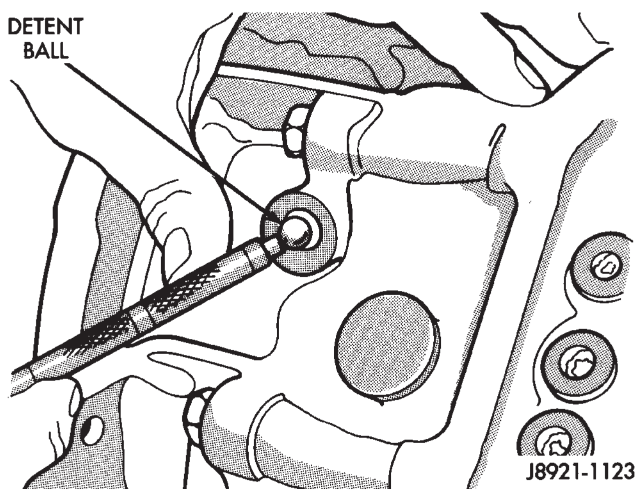


Fig. 22 Remove Detent Ball

(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).
(14) Remove the shift arm from the adapter housing.

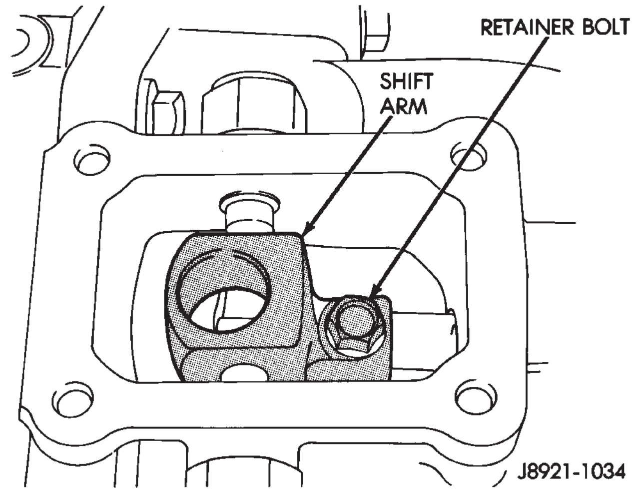


Fig. 23 Shift Arm Retainer Bolt Removal

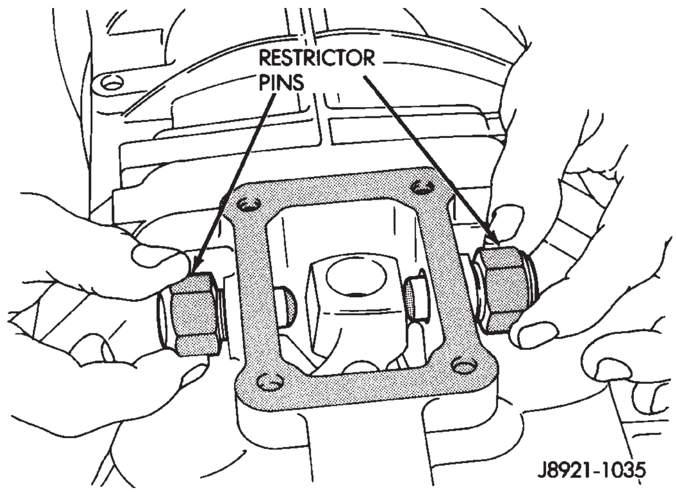


Fig. 24 Shift Arm Rstrictor Pins

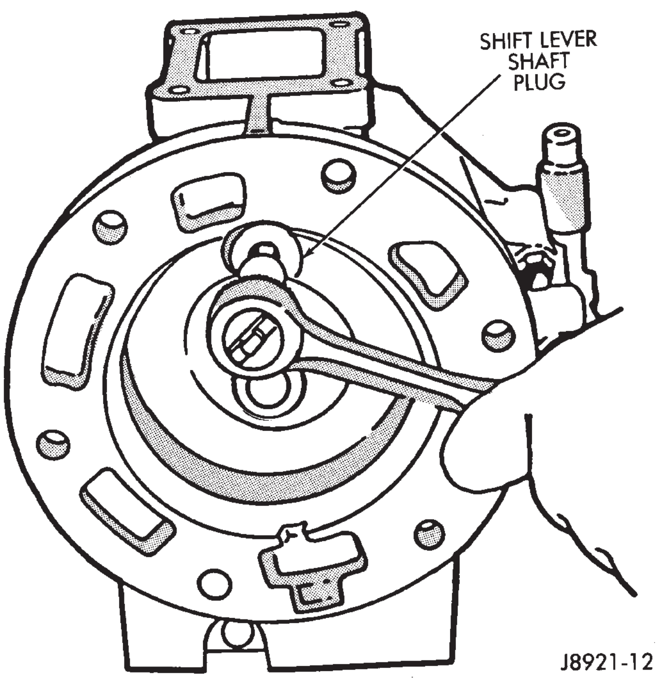


Fig. 25 Removing Shift Lever Shaft Plug

DISASSEMBLY AND ASSEMBLY (Continued)

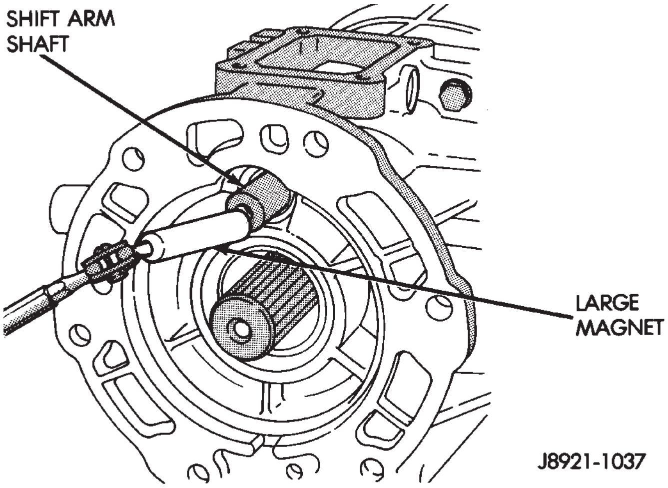


Fig. 26 Remove Shifter Shaft

(15) Remove adapter/extension housing bolts (Fig. 27).

(16) Loosen adapter/extension housing by tapping it loose with plastic mallet (Fig. 28).

(17) Remove adapter/extension housing (Fig. 29).

(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).

(22) Remove cluster gear bearing snap-ring (Fig. 33).

(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).

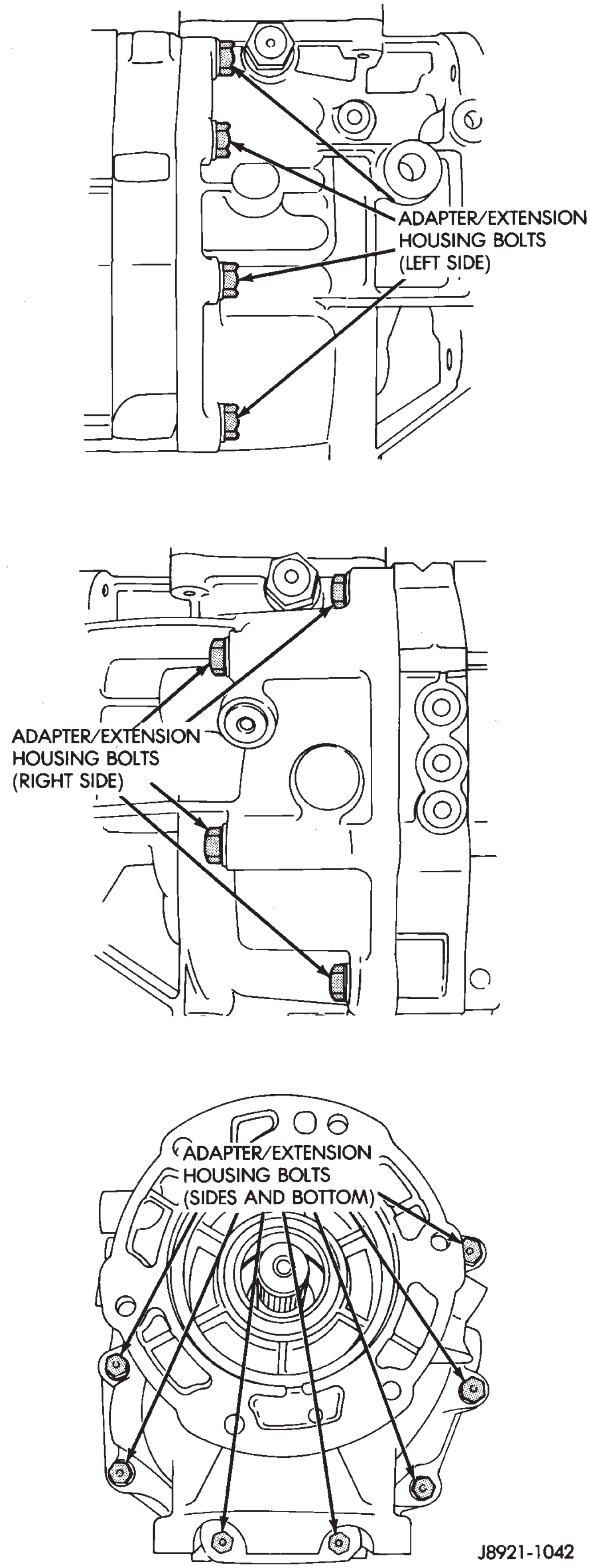


Fig. 27 Adapter/Extension Housing Bolts

DISASSEMBLY AND ASSEMBLY (Continued)

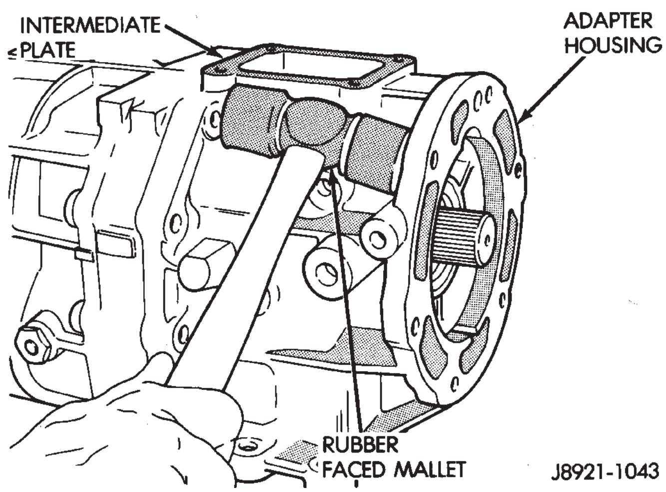


Fig. 28 Loosen Adapter/Extension Housing

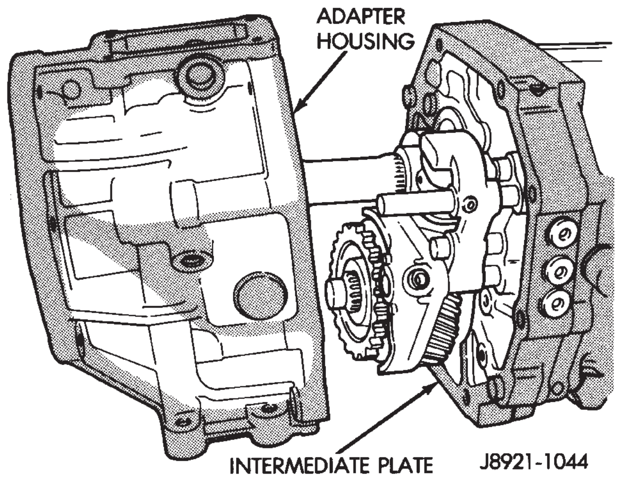


Fig. 29 Remove Adapter/Extension Housing

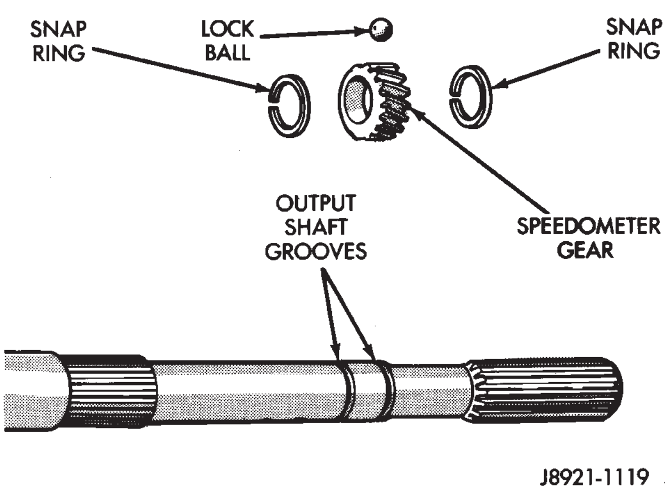


Fig. 30 Speedometer Drive Gear Assembly

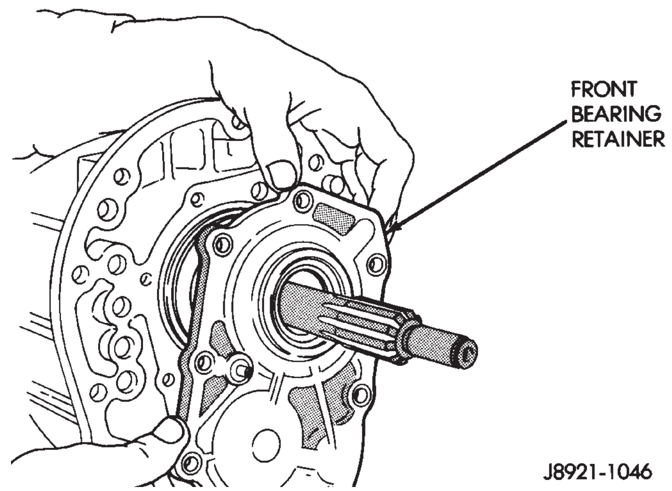


Fig. 31 Remove Front Bearing Retainer

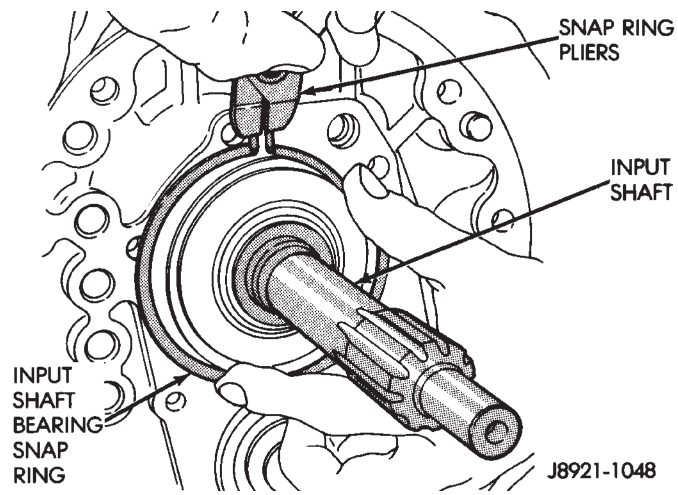


Fig. 32 Remove Input Shaft Bearing Snap-ring

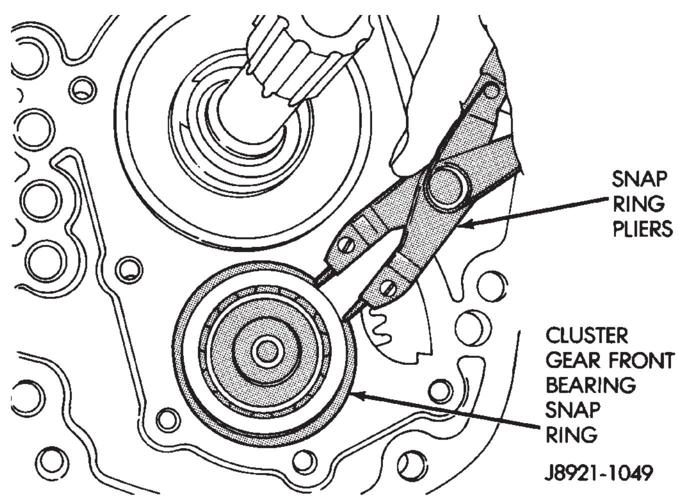


Fig. 33 Remove Cluster Gear Snap-ring

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).

DISASSEMBLY AND ASSEMBLY (Continued)

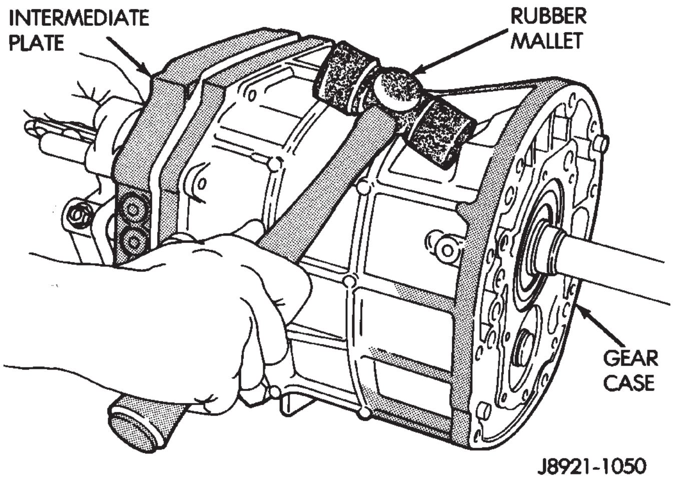


Fig. 34 Separate Intermediate Plate and Transmission Case

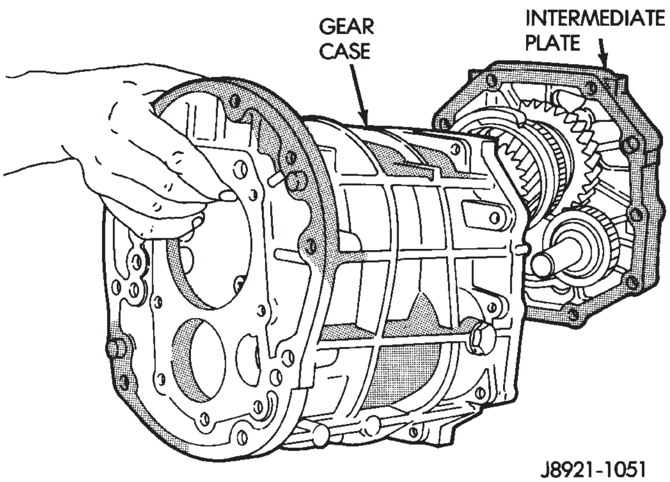


Fig. 35 Remove Intermediate Plate from Transmission Case

(3) Align geartrain and shift rails with mating holes in transmission case and install transmission case to the intermediate plate (Fig. 37). Verify that the transmission case is seated on the intermediate plate.

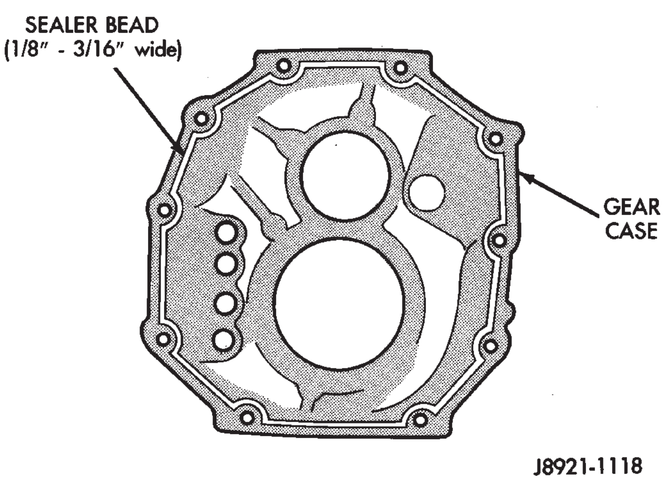


Fig. 36 Apply Sealer to Transmission Gear Case

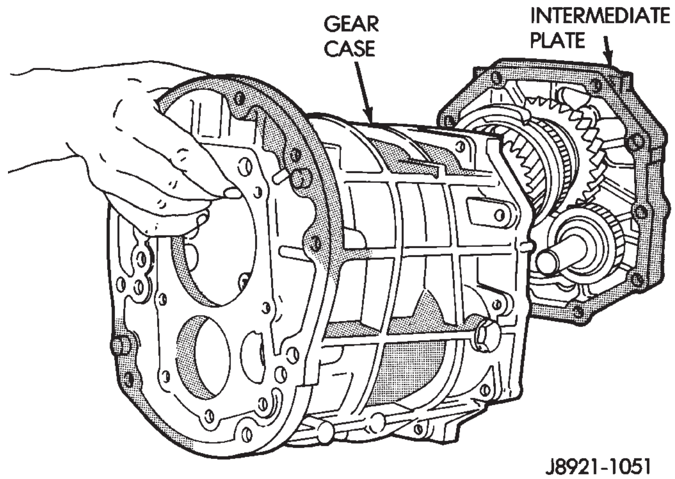


Fig. 37 Install Transmission Gear Case to the Intermediate Plate

(4) Install new front bearing snap rings (Fig. 38).

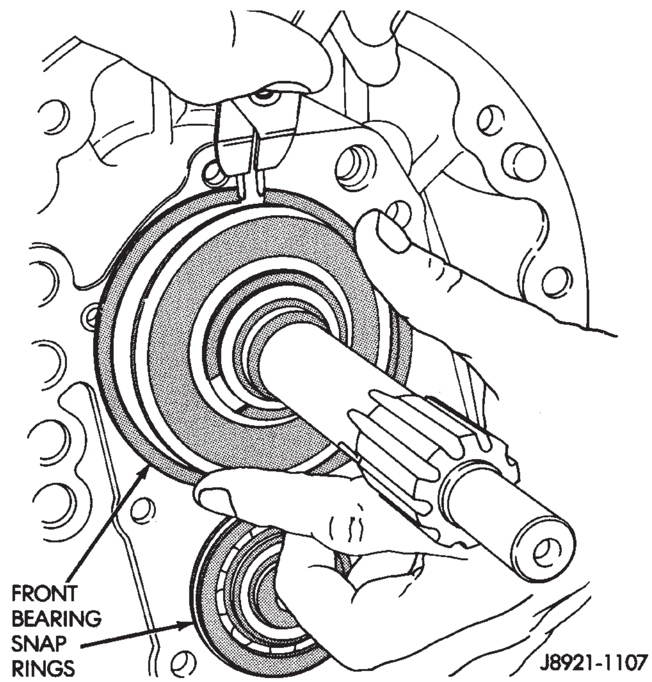


Fig. 38 Install Front Bearing Snap-rings

(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.).

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

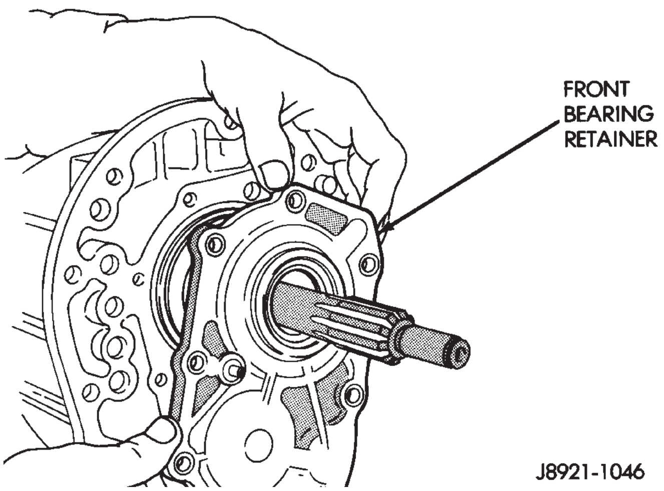


Fig. 39 Install Front Bearing Retainer

(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[e]xtension housing (Fig. 42). Be sure that the shifter arm is engaged into the shift rails.

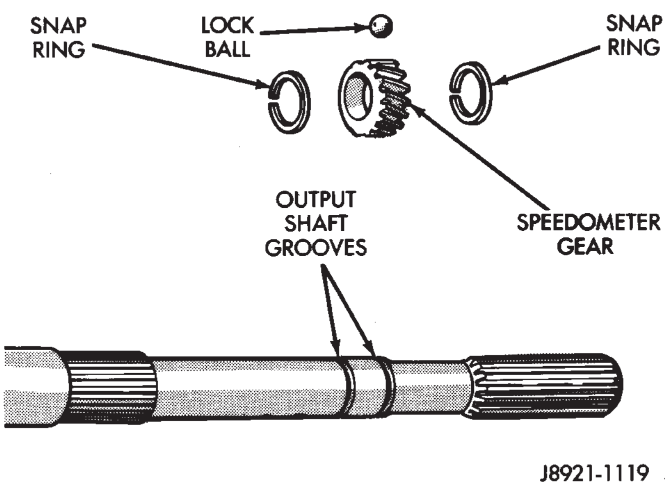


Fig. 40 Speedometer Drive Gear Assembly

(11) Start shifter arm shaft in hole in back of adapter[e]xtension 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[e]xtension 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).

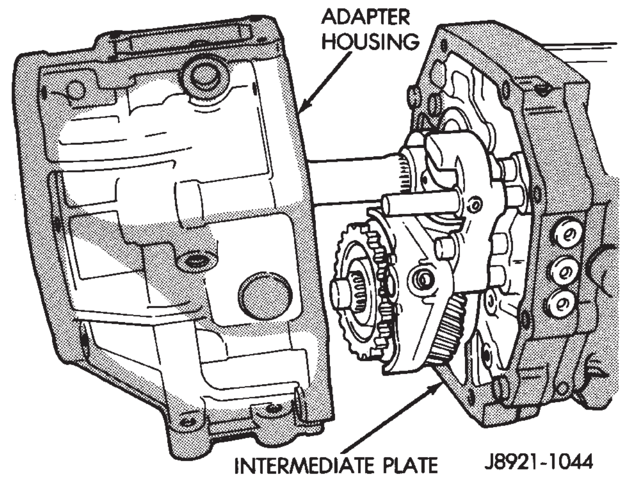


Fig. 41 Install Adapter/Extension Housing

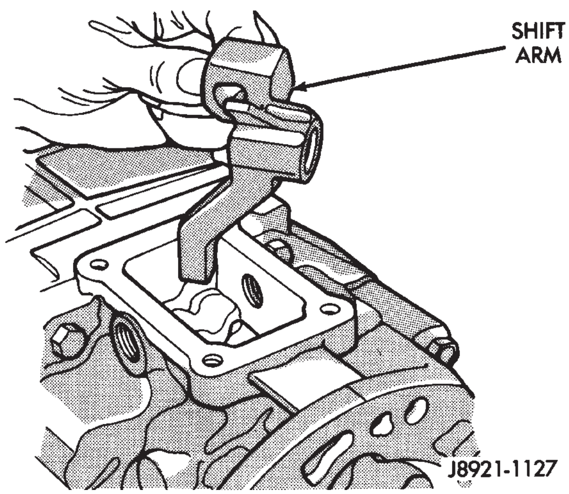


Fig. 42 Position Shift Arm in Transmission Case

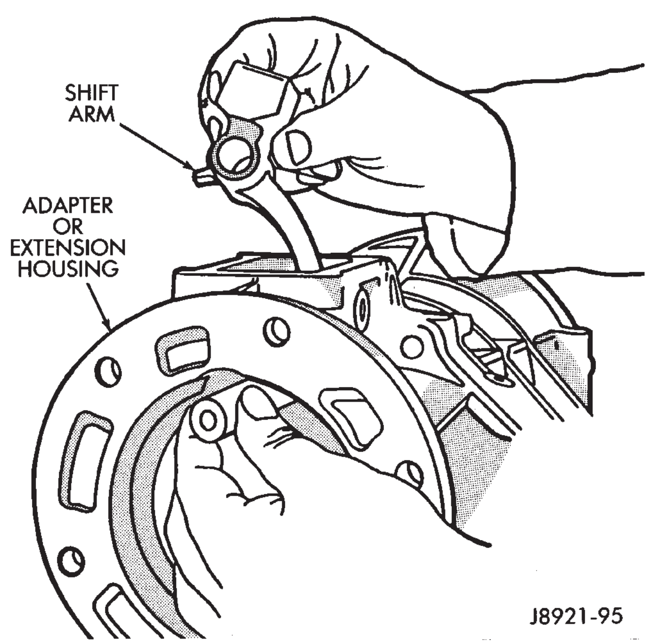


Fig. 43 Install Shifter Arm Shaft

DISASSEMBLY AND ASSEMBLY (Continued)

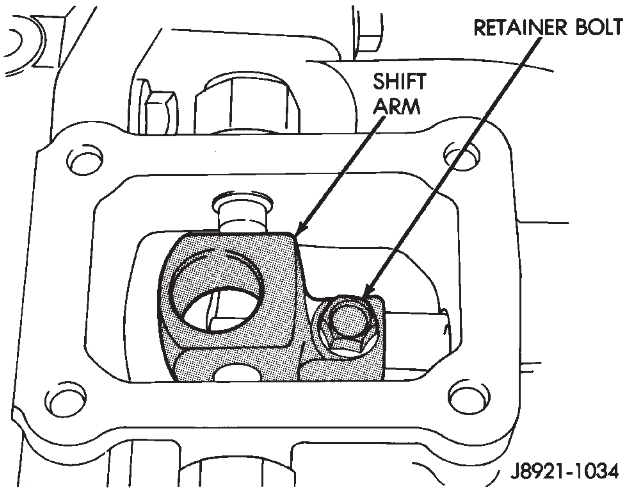


Fig. 44 Install Shift Arm Retainer Bolt

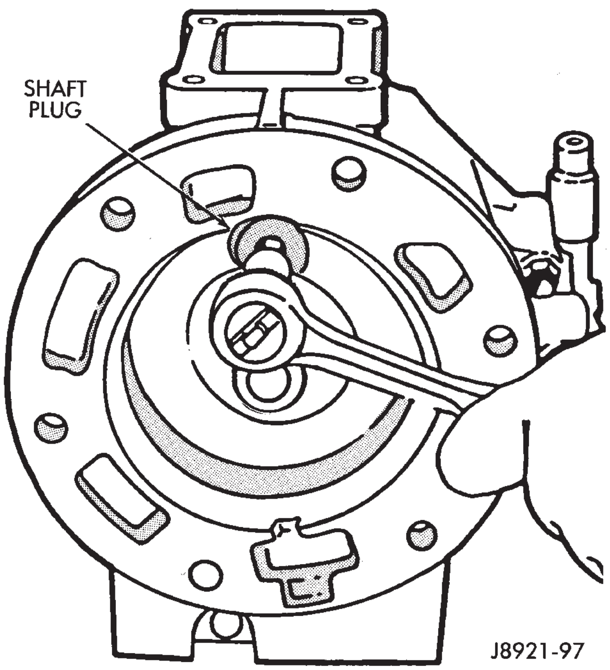


Fig. 45 Shifter Arm Shaft Plug Installation

(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).

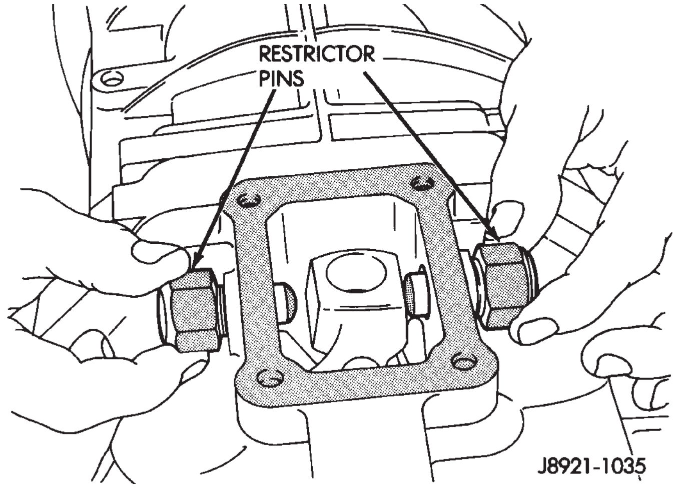


Fig. 46 Install Shifter Restrictor Pins

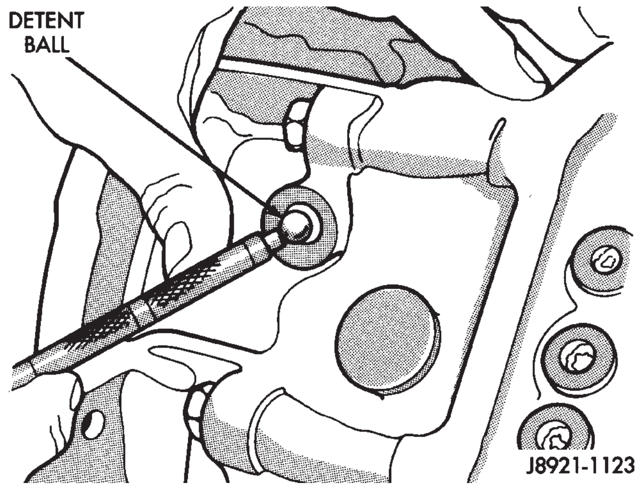


Fig. 47 Install Detent Ball

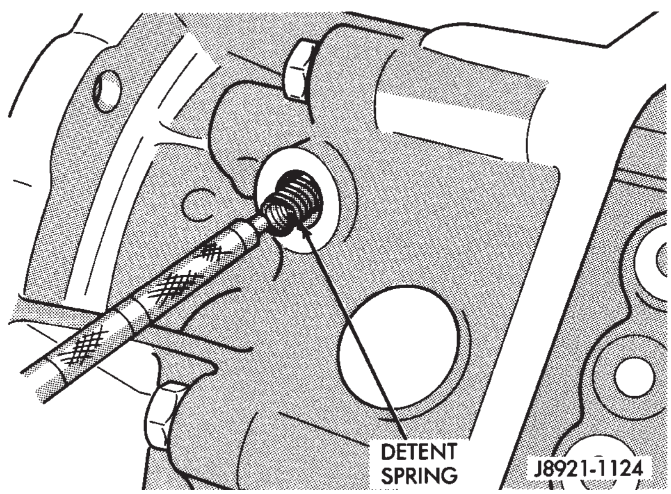


Fig. 48 Install Detent Spring

DISASSEMBLY AND ASSEMBLY (Continued)

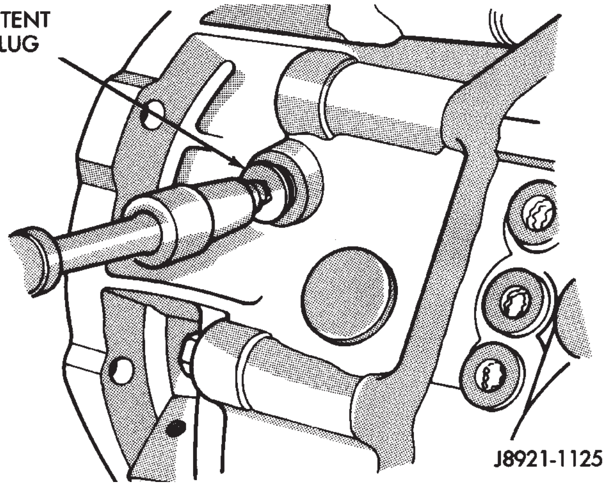


Fig. 49 Install Detent Ball Plug

(19) Install shift tower and new gasket on housing (Fig. 50). Tighten tower bolts to 18 N·m (13 ft. lbs.) torque.

(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.

(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.

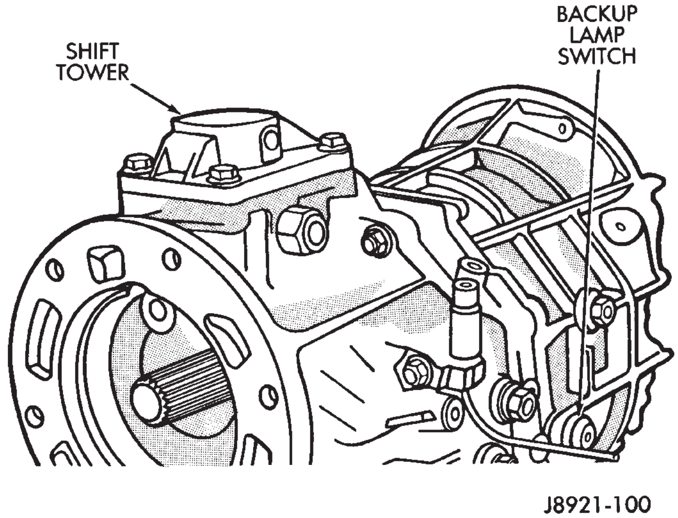


Fig. 50 Installing Shift Tower And Backup Lamp Switch

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.

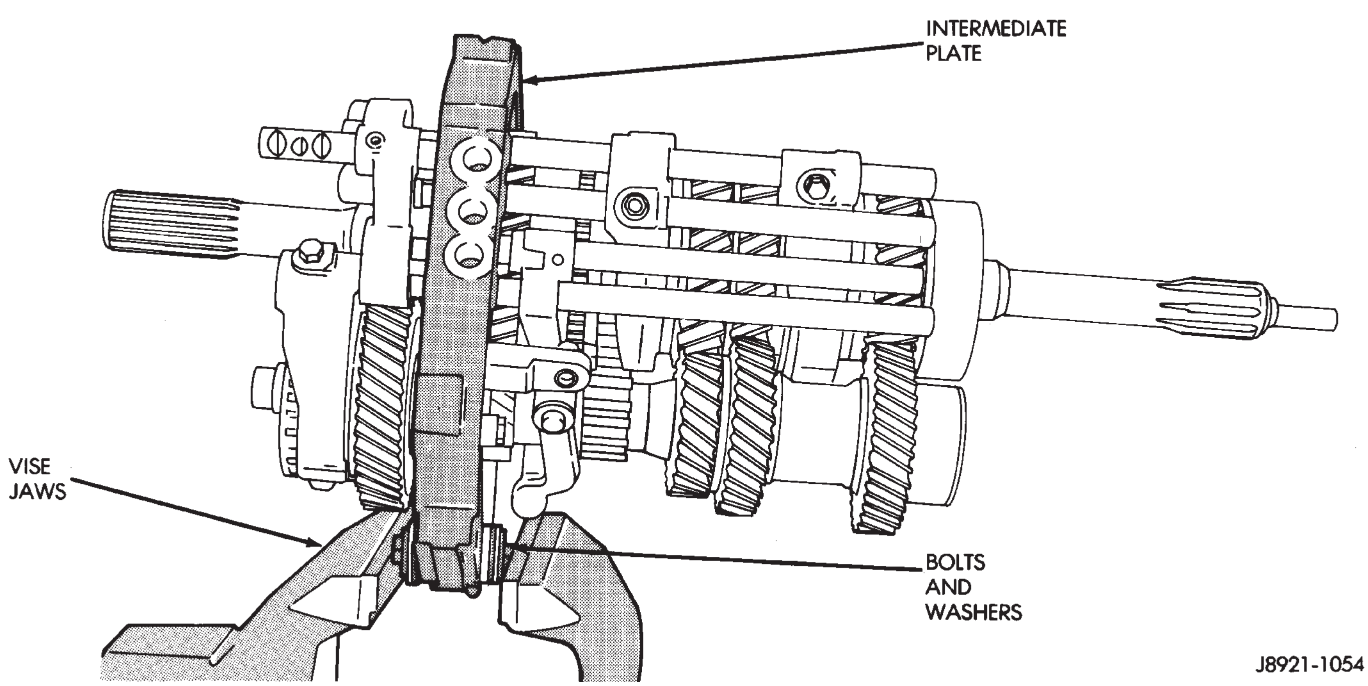


Fig. 51 Positioning Intermediate Plate In Vise

DISASSEMBLY AND ASSEMBLY (Continued)

(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).

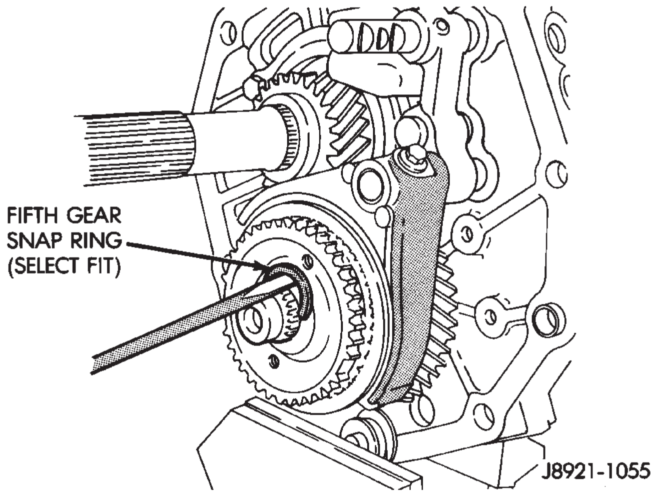


Fig. 52 Remove Fifth Gear Snap-ring

(4) Remove bolt holding fifth gear shift fork to shift rail (Fig. 53).

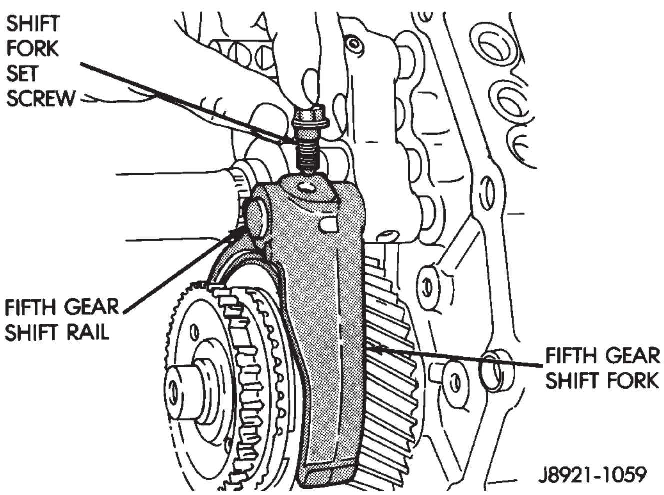


Fig. 53 Remove Fifth Gear Shift Fork Retainer Bolt

(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).

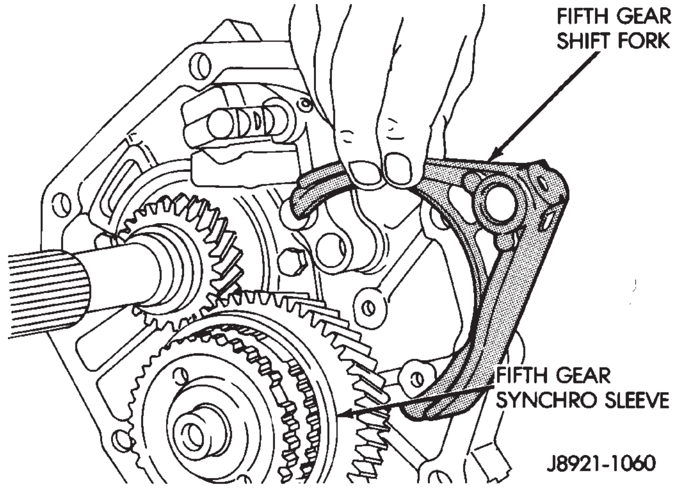


Fig. 54 Remove Fifth Gear Shift Fork

(7) Remove the reverse shift head and rail assembly from the intermediate plate (Fig. 55).

(8) Remove fifth gear blocker ring from countershaft assembly with Puller L-4407 (Fig. 56).

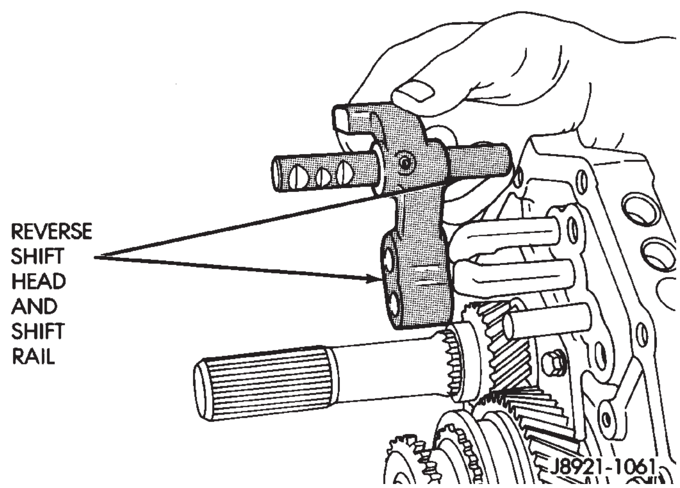


Fig. 55 Remove Reverse Shift Head Assembly

(9) Remove fifth gear synchro ring (Fig. 57).

(10) Remove the countershaft fifth gear assembly from countershaft (Fig. 58).

DISASSEMBLY AND ASSEMBLY (Continued)

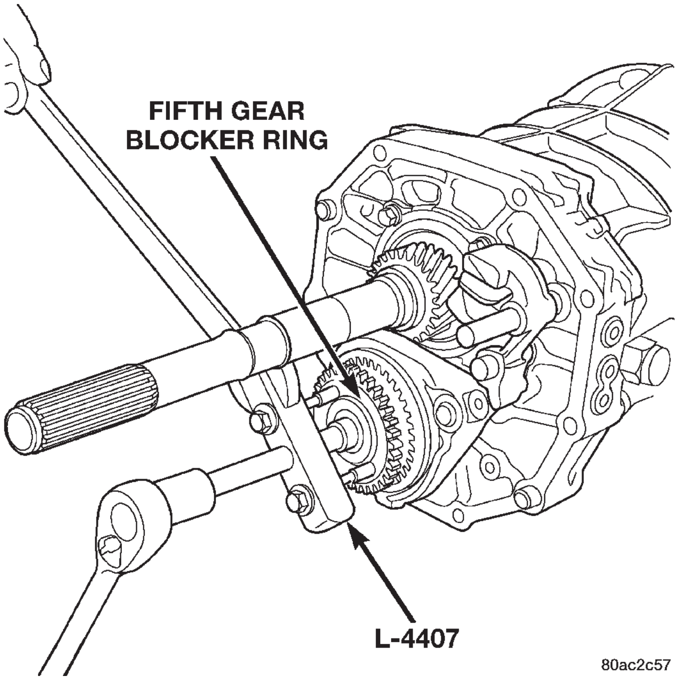


Fig. 56 Remove Fifth Gear Blocker Ring

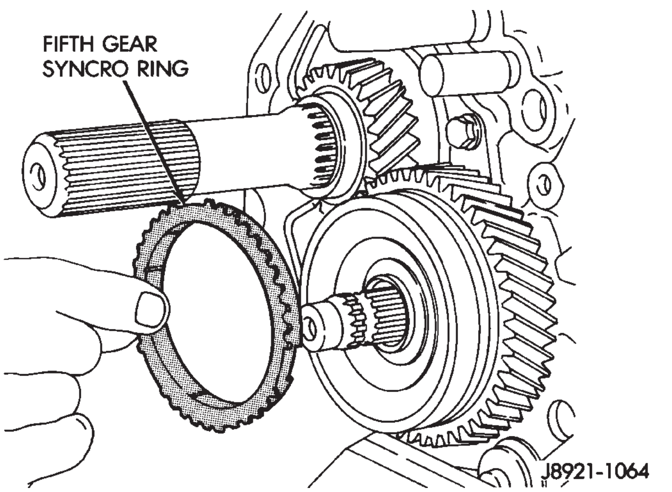


Fig. 57 Remove Fifth Gear Synchro Ring

(11) Remove fifth gear thrust ring from countershaft (Fig. 59).

(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.

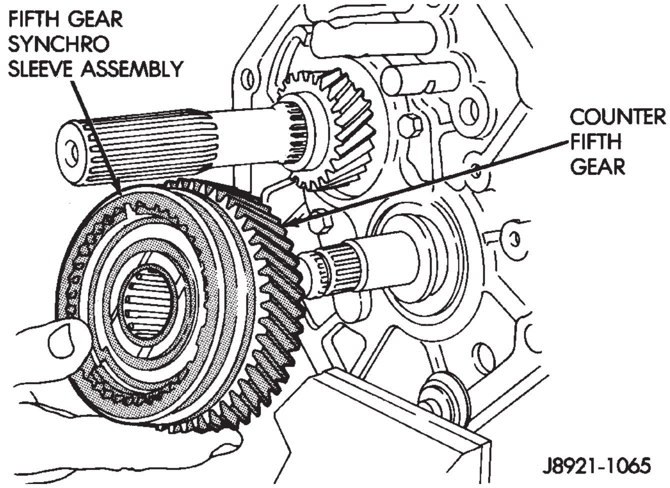


Fig. 58 Remove Fifth Gear And Synchro Assembly

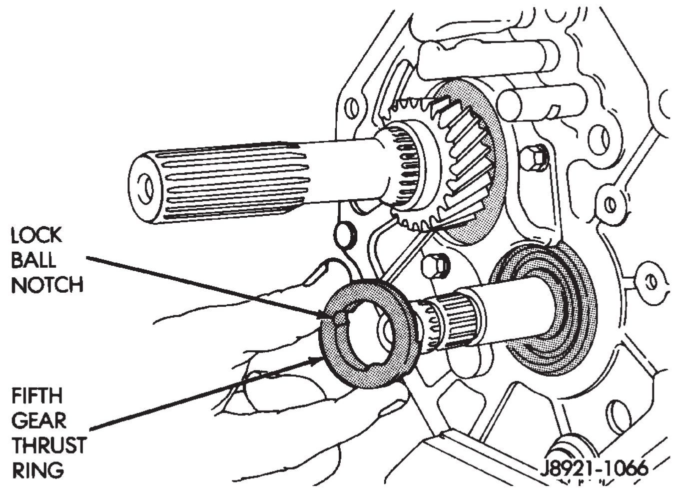


Fig. 59 Remove Fifth Gear Thrust Ring

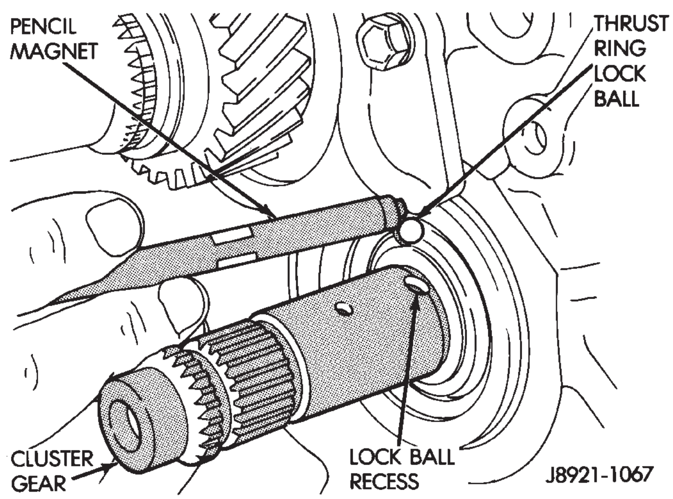


Fig. 60 Remove Fifth Gear Thrust Ring Lock Ball

DISASSEMBLY AND ASSEMBLY (Continued)

(13) Remove bolts holding output shaft rear bearing retainer to intermediate plate (Fig. 61).

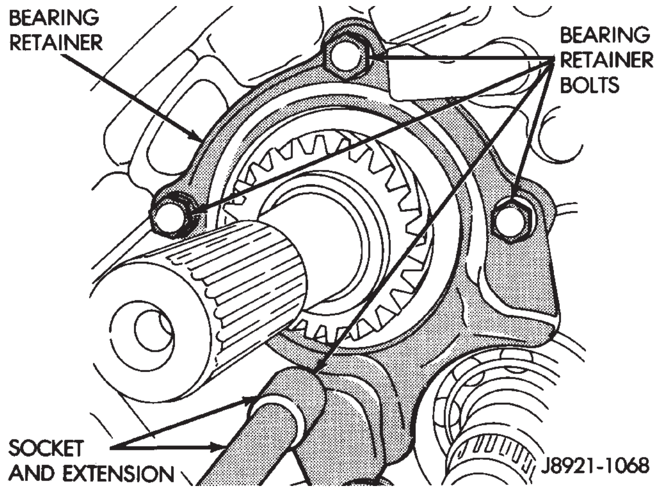


Fig. 61 Remove Output Shaft Rear Bearing Retainer Bolts

(14) Remove rear bearing retainer (Fig. 62).

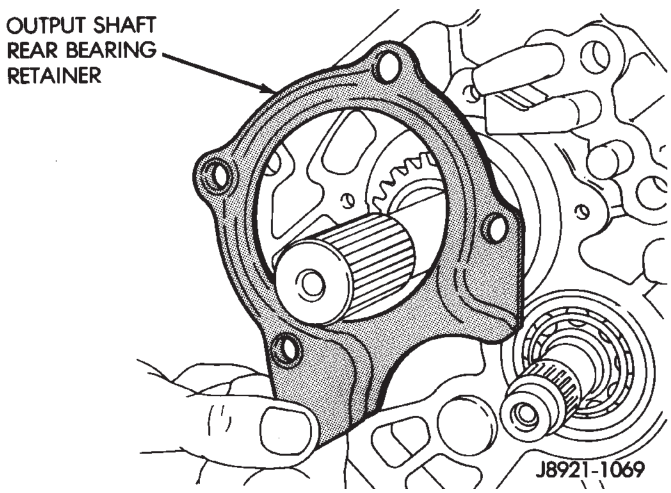


Fig. 62 Remove Output Shaft Rear Bearing Retainer

(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).

(18) Then remove lock ball and spring from plug holes with pencil magnet (Fig. 66).

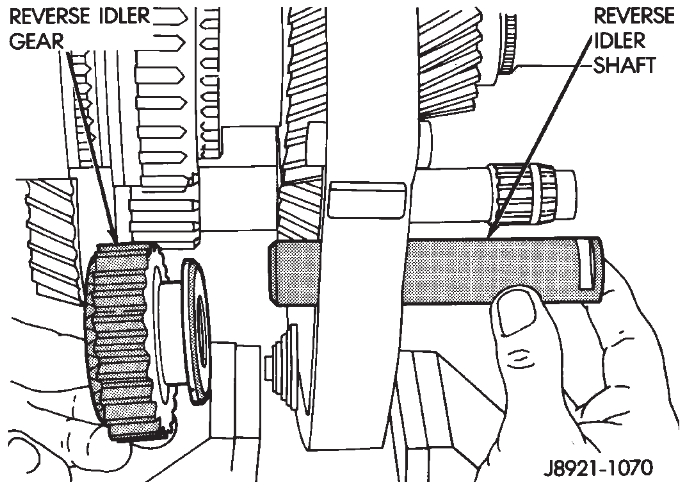


Fig. 63 Remove Reverse Idler Shaft And Gear

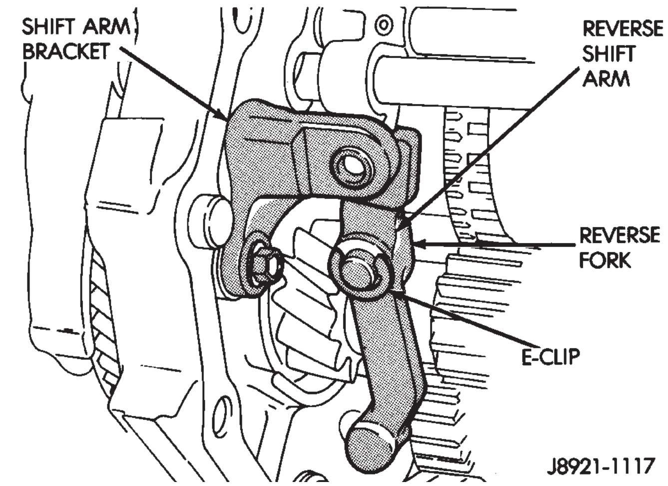


Fig. 64 Reverse Shift Arm Components

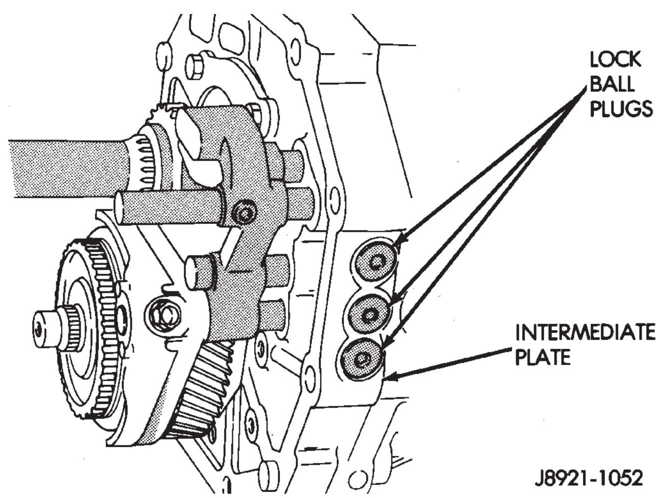


Fig. 65 Lock Ball Plug Locations

DISASSEMBLY AND ASSEMBLY (Continued)

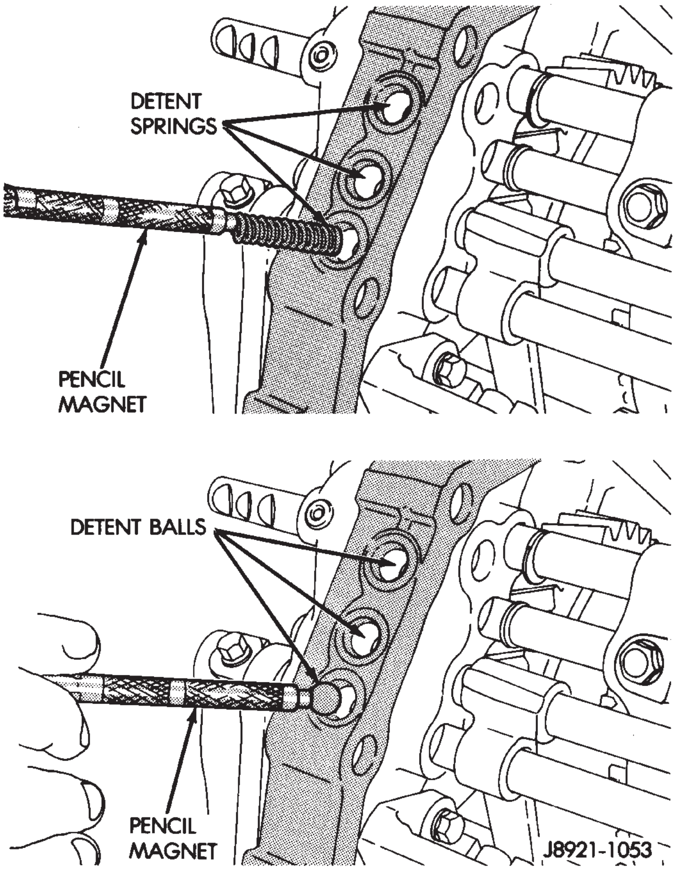


Fig. 66 Remove Lock Ball And Spring

(19) Remove the fifth gear shift rail (Fig. 67).

(20) Retrieve the fifth gear shift rail lock ball from the intermediate plate using a magnet (Fig. 68).

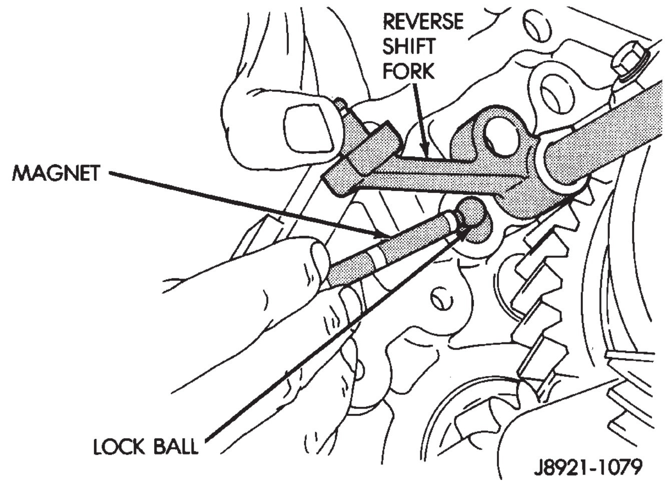


Fig. 68 Remove Fifth Gear Shift Rail Lock Ball

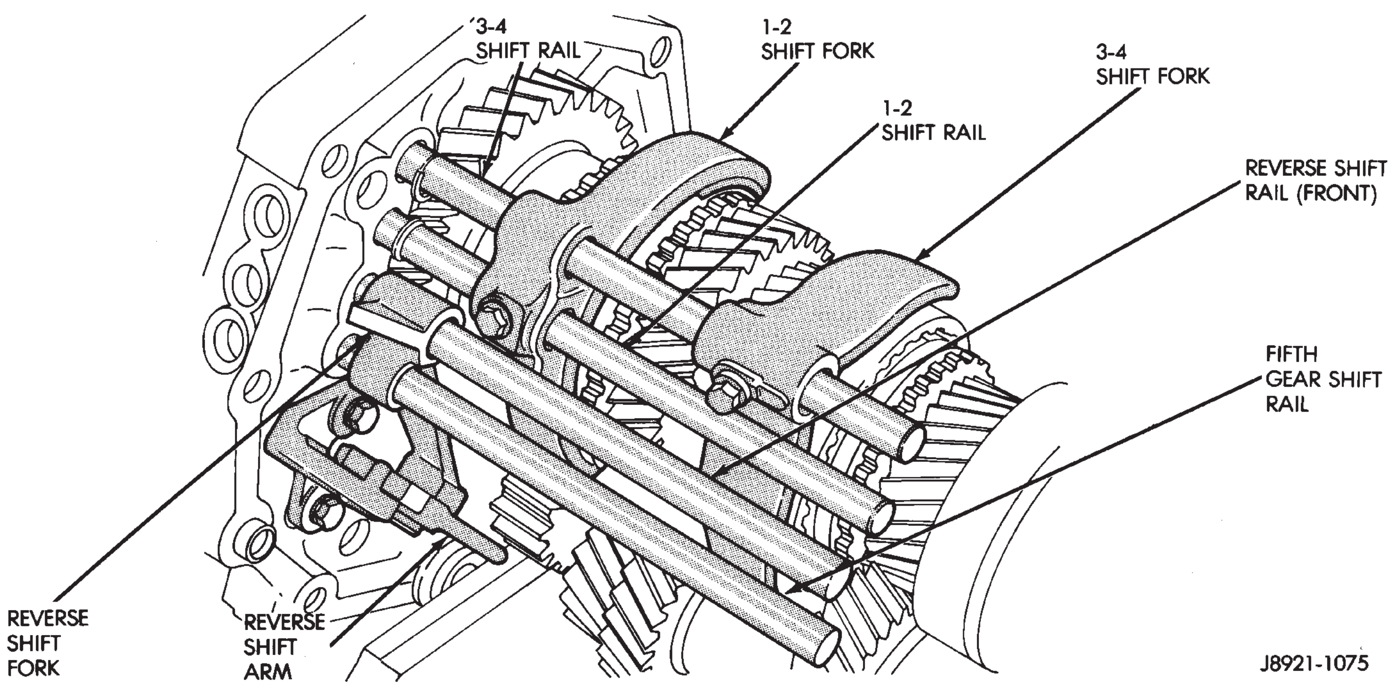


Fig. 67 Shift Rail Identification

DISASSEMBLY AND ASSEMBLY (Continued)

(21) Remove the 1–2 and 3–4 shift rail c-rings using two equally sized screwdrivers (Fig. 69).

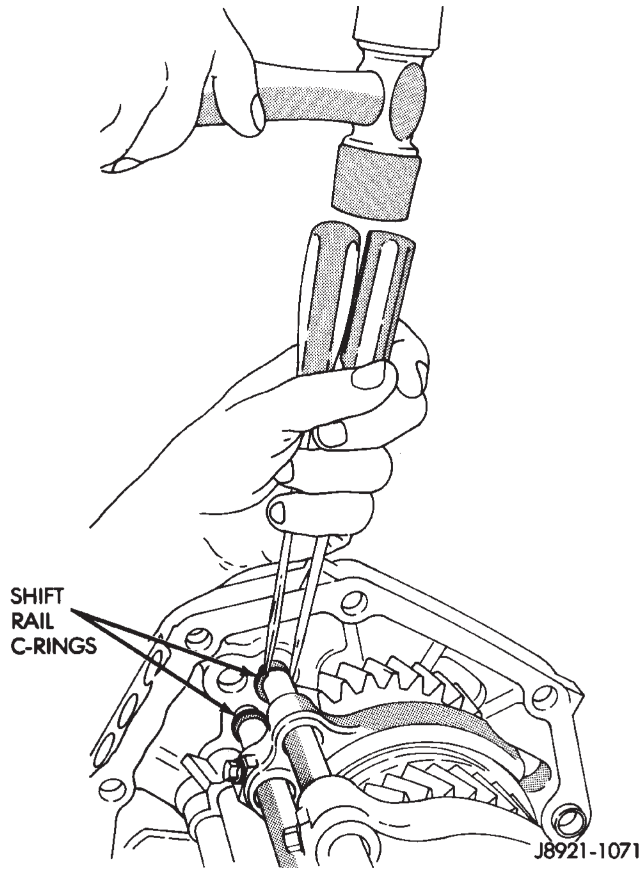


Fig. 69 Remove Shift Rail C-rings

(22) Remove bolts holding 1–2 and 3–4 shift forks to the shift rails (Fig. 70) and discard bolts.

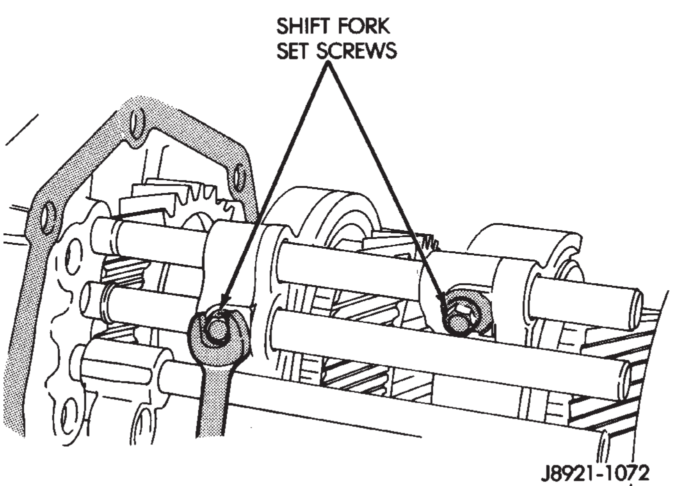


Fig. 70 Remove Shift Fork To Shift Rail Bolts

(23) Remove the 3–4 shift rail from the 1–2 and 3–4 shift forks and the intermediate plate (Fig. 71).

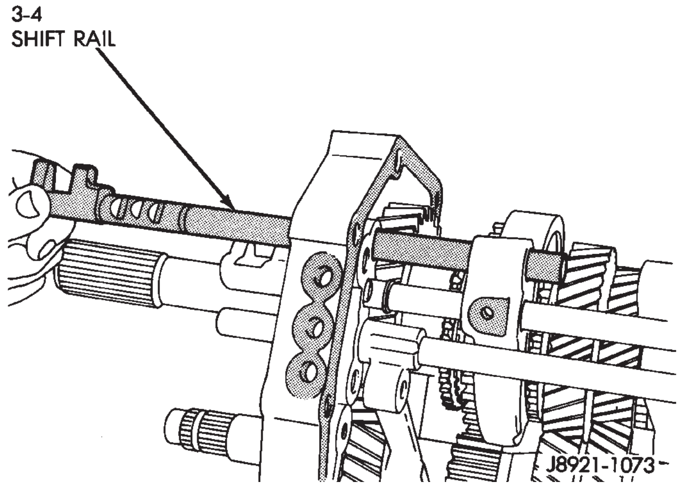


Fig. 71 Remove 3–4 Shift Rail

(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).

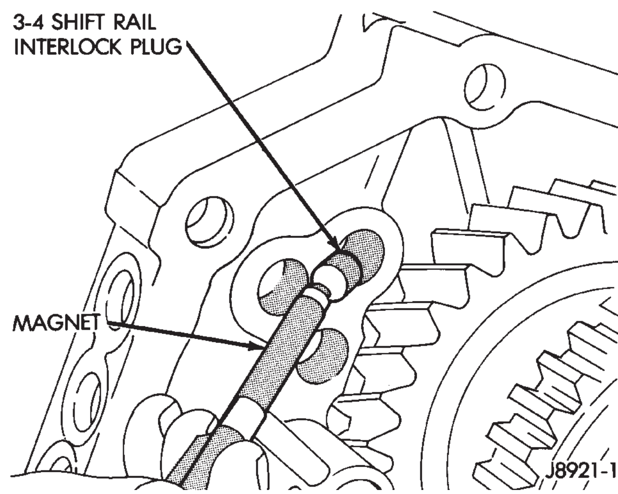


Fig. 72 Remove 3–4 Shift Rail Interlock Plug

DISASSEMBLY AND ASSEMBLY (Continued)

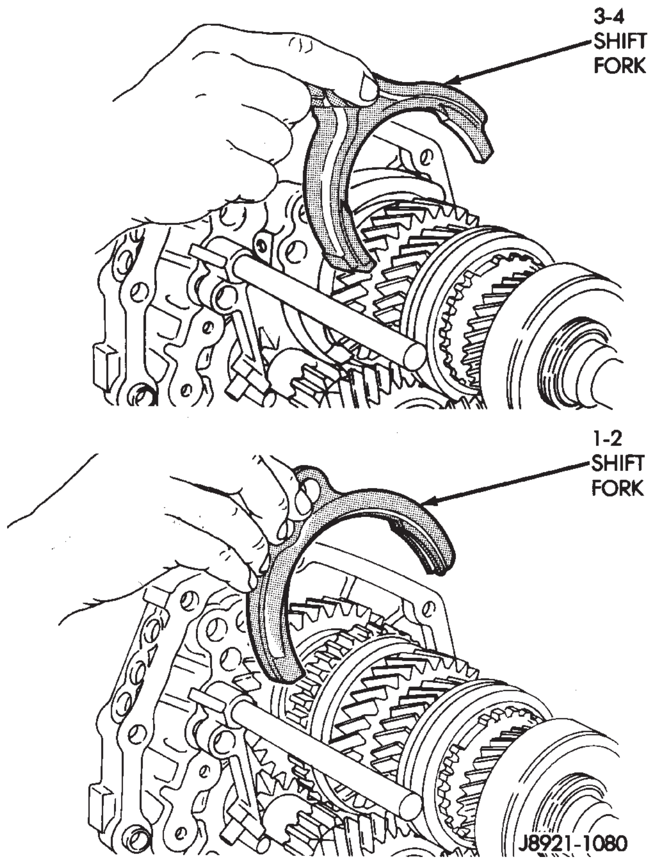


Fig. 73 Remove Shift Forks

(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).

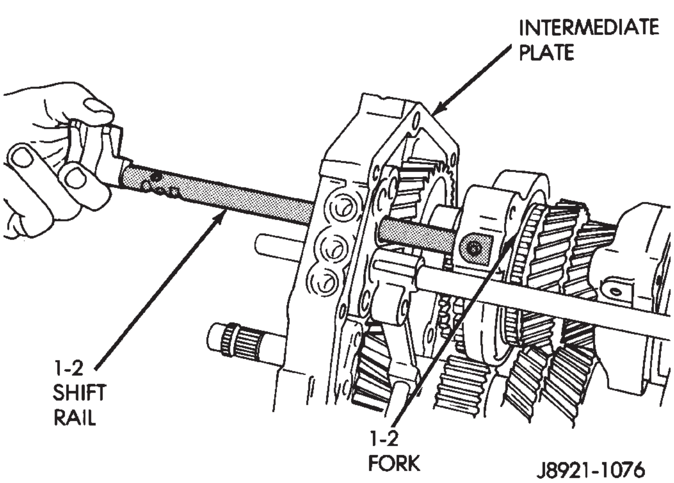


Fig. 74 Remove 1–2 Shift Rail

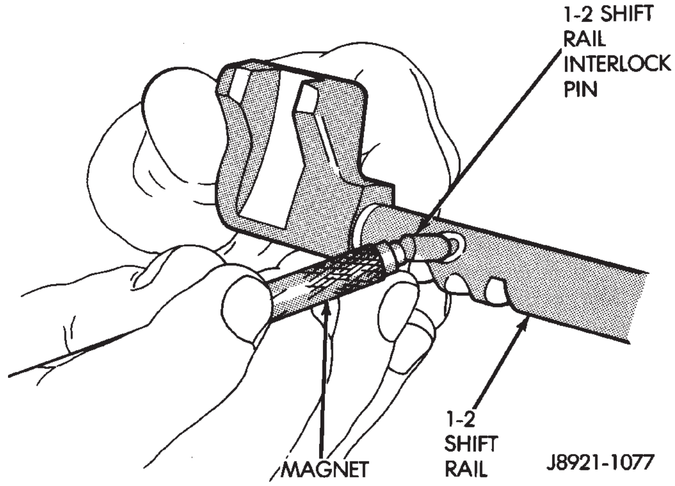


Fig. 75 Remove 1–2 Shift Rail Interlock Pin

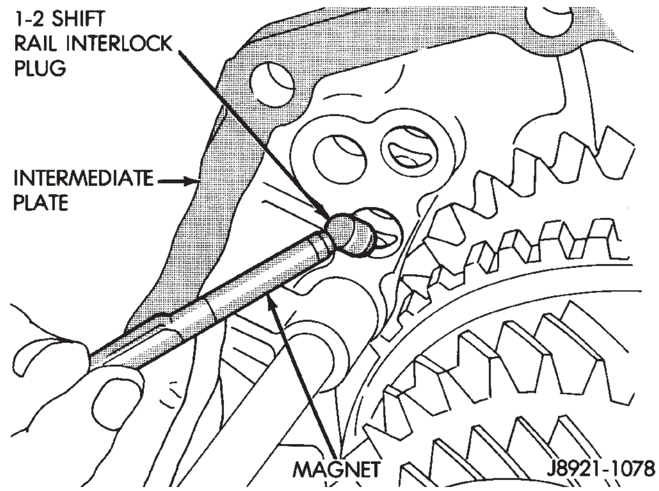


Fig. 76 Remove 1–2 Shift Rail Interlock Plug

(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).

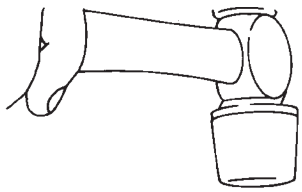
(32) Remove the interlock pin from the reverse shift rail (Fig. 79).

(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)



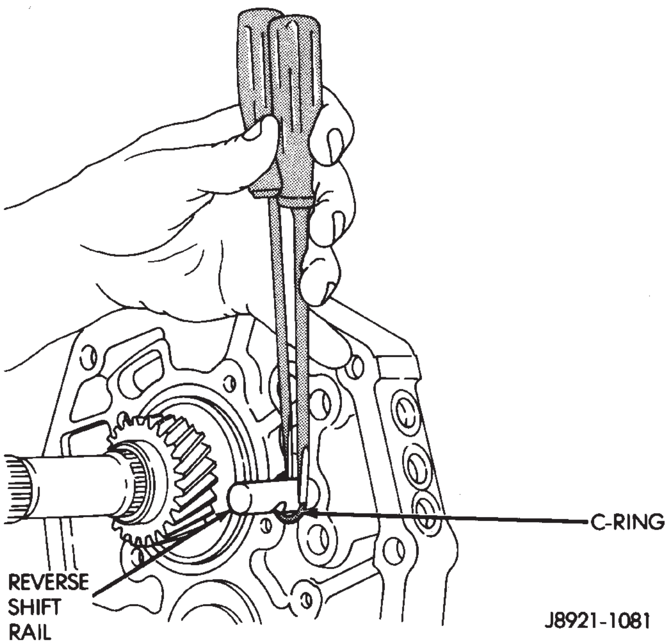


Fig. 77 Remove Reverse Shift Rail C-ring

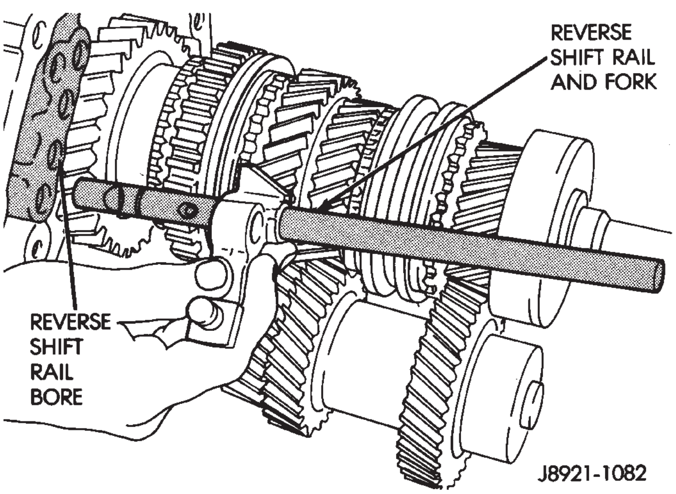


Fig. 78 Remove Reverse Shift Rail

(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.

ASSEMBLY

(1) Lubricate countershaft journal and rear bearing with petroleum jelly or gear lubricant.

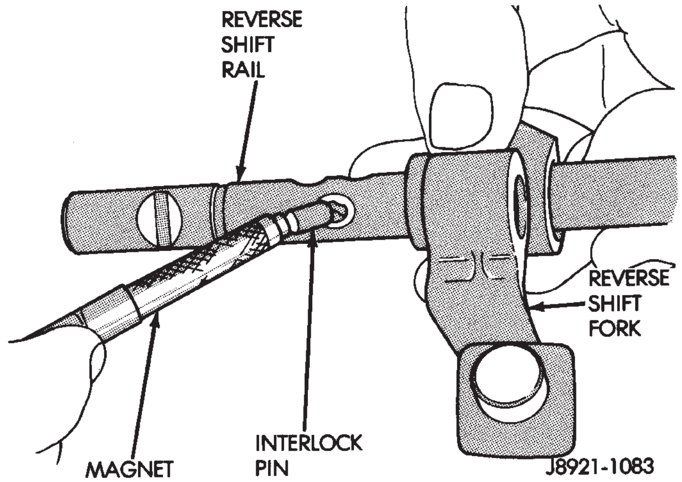


Fig. 79 Remove Reverse Shift Rail Interlock Pin

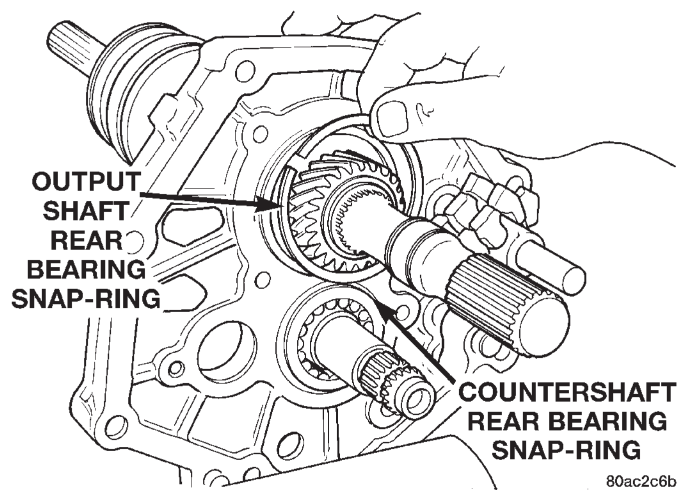


Fig. 80 Remove Output Shaft Rear Bearing Snap-ring

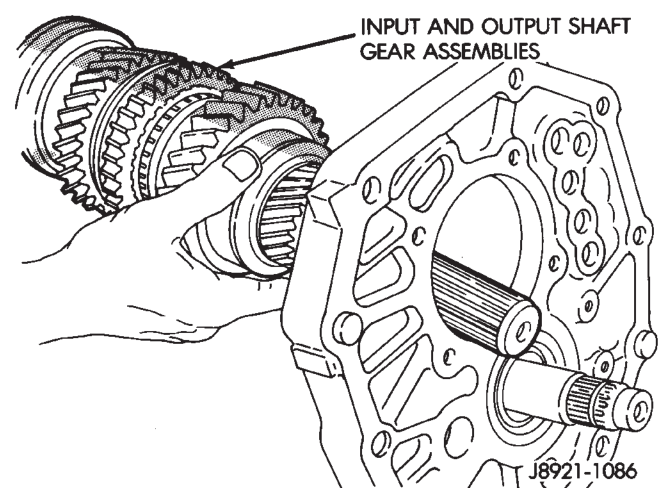


Fig. 81 Remove Mainshaft

(2) Position the mainshaft into the intermediate plate.

DISASSEMBLY AND ASSEMBLY (Continued)

(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).

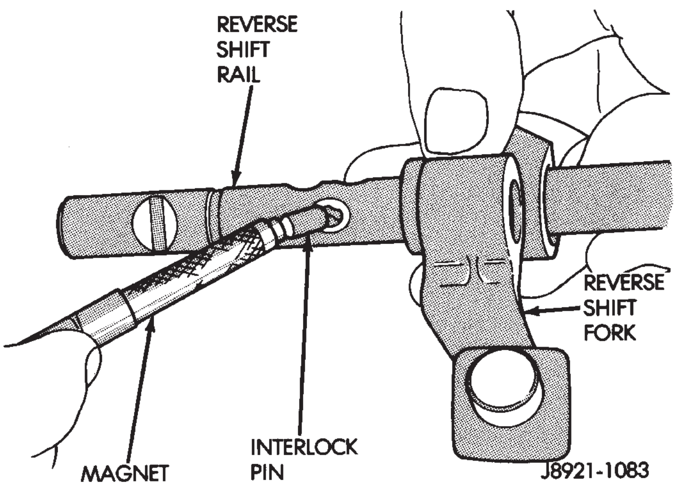


Fig. 82 Install Reverse Shift Rail Interlock Pin

(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).

(16) Install 1–2 shift rail through intermediate plate and 1–2 shift fork (Fig. 87).

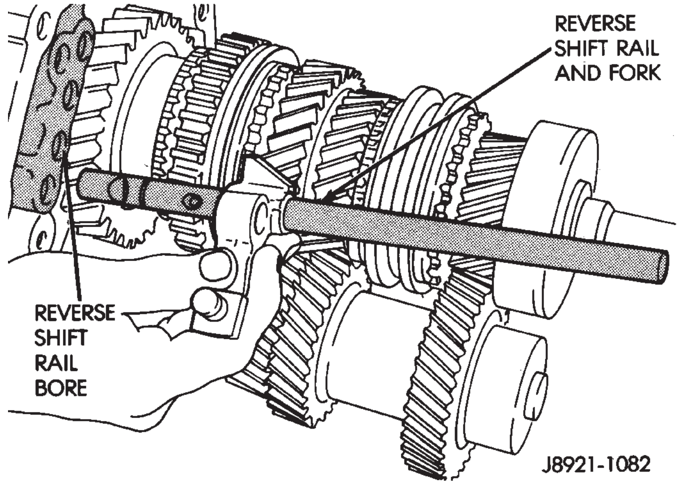


Fig. 83 Install Reverse Shift Rail

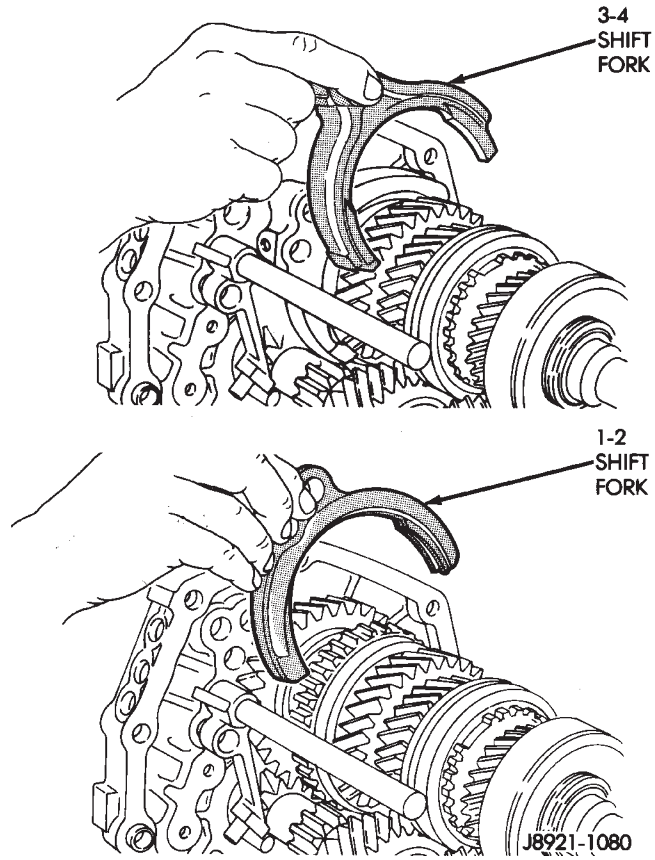


Fig. 84 Install Shift Forks

(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).

DISASSEMBLY AND ASSEMBLY (Continued)

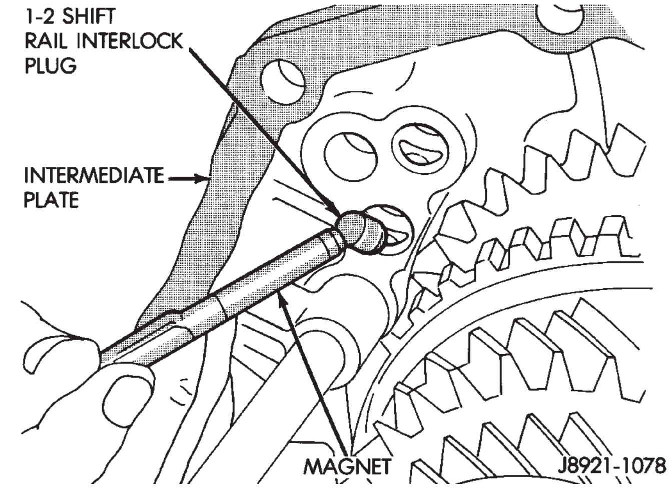


Fig. 85 Install 1–2 Shift Rail Interlock Plug

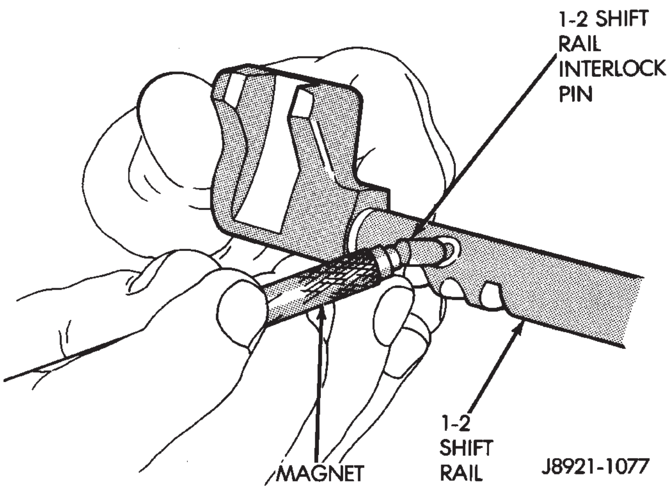


Fig. 86 Install 1–2 Shift Rail Interlock Pin

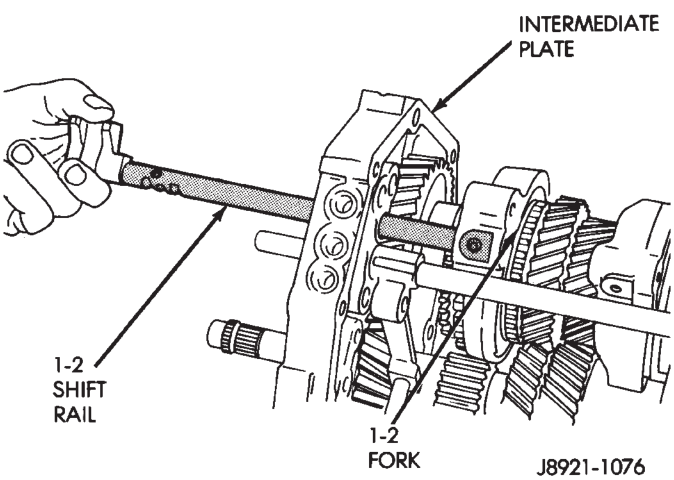


Fig. 87 Install 1–2 Shift Rail

(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).

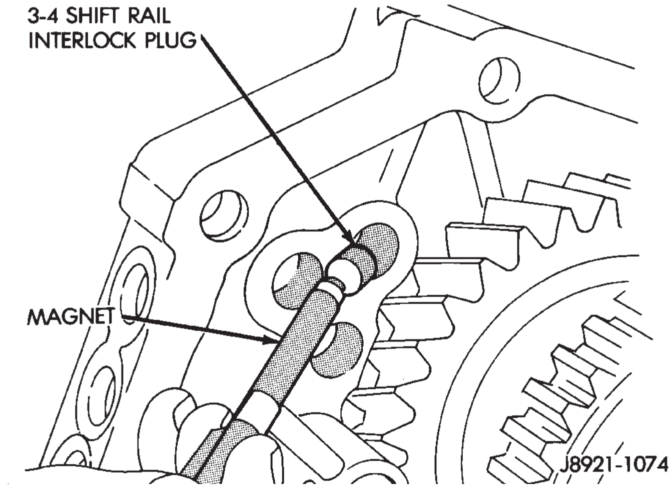


Fig. 88 Install 3–4 Shift Rail Interlock Plug

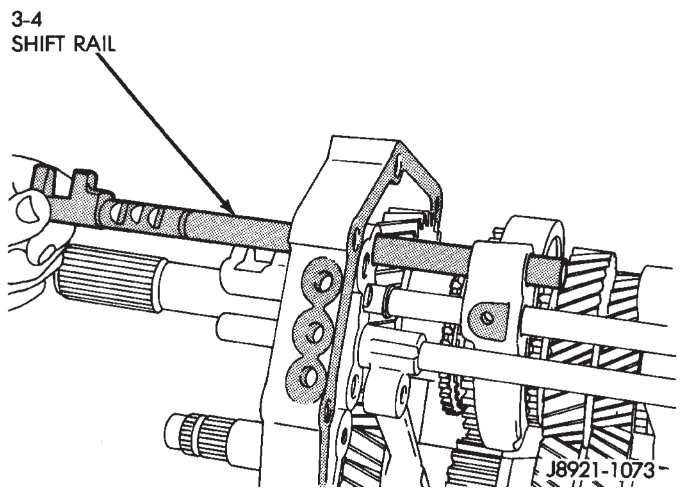


Fig. 89 Install 3–4 Shift Rail

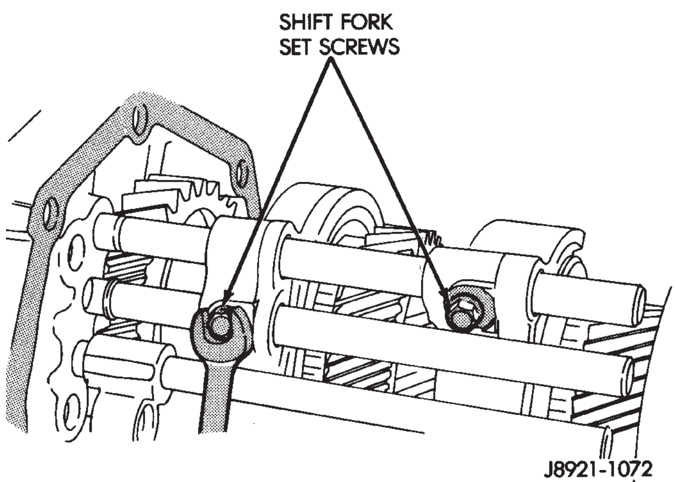


Fig. 90 Install Shift Fork To Shift Rail Bolts

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

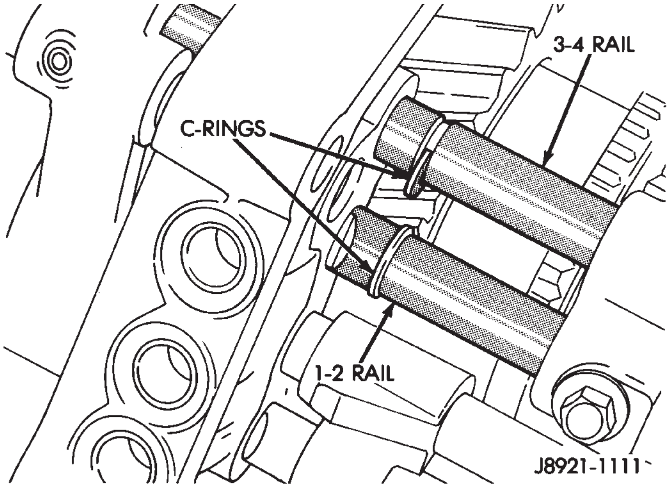


Fig. 91 Install Shift Rail C-rings

(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).

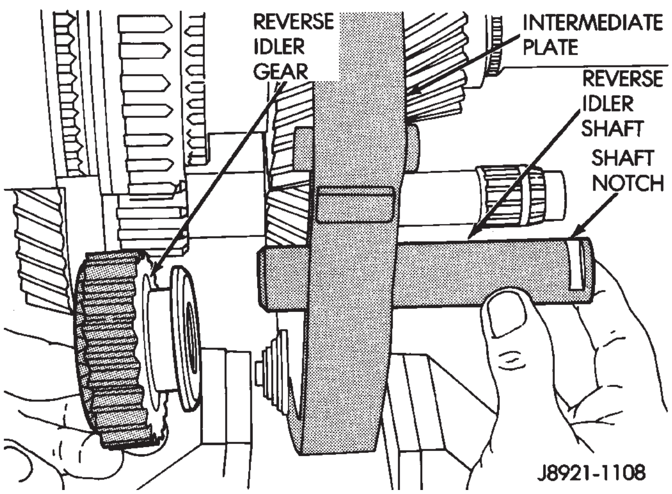


Fig. 92 Install Reverse Idler Gear And Shaft

(26) Install the fifth gear thrust ring lock ball into the countershaft (Fig. 95).

(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).

(29) Install countershaft fifth gear assembly onto countershaft (Fig. 98).

(30) Install fifth gear synchronizer ring (Fig. 99).

(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.

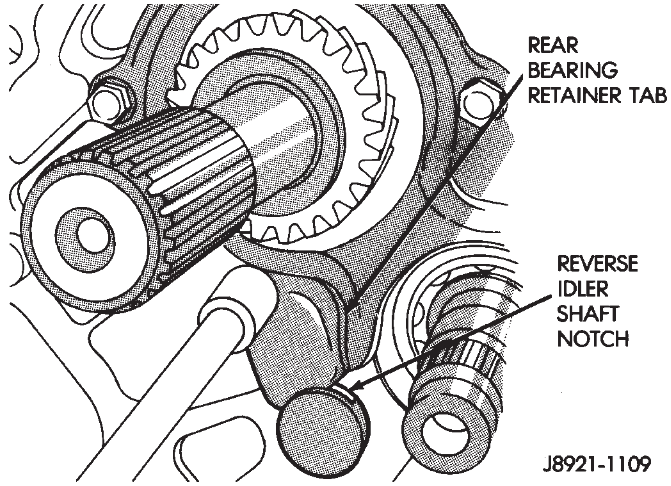


Fig. 93 Install Output Shaft Rear Bearing Retainer

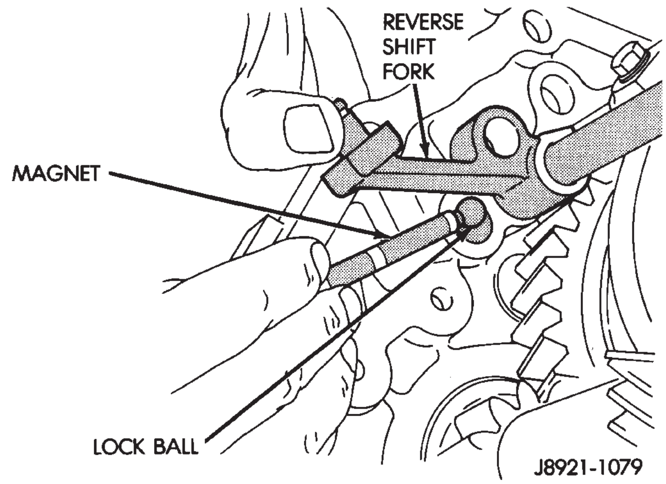


Fig. 94 Install Fifth Gear Shift Rail Lock Ball

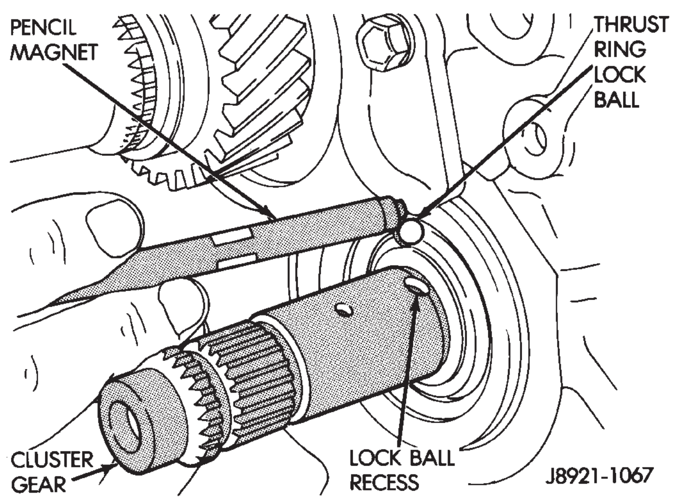


Fig. 95 Install Fifth Gear Thrust Ring Lock Ball

(34) Install snap-ring to hold the countershaft fifth gear assembly onto the countershaft (Fig. 100).

DISASSEMBLY AND ASSEMBLY (Continued)

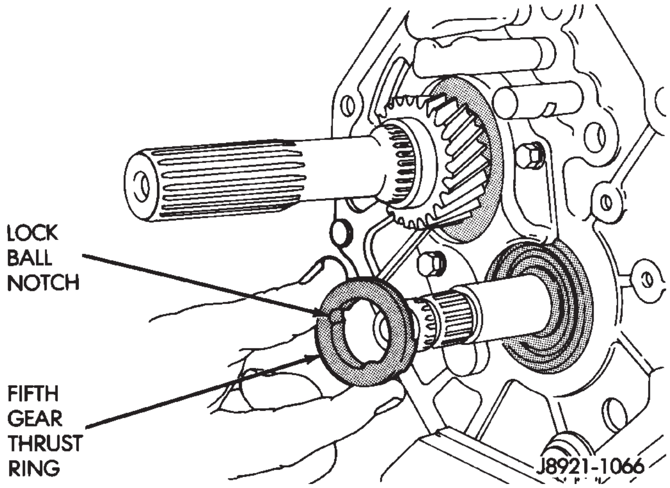


Fig. 96 Install Fifth Gear Thrust Ring

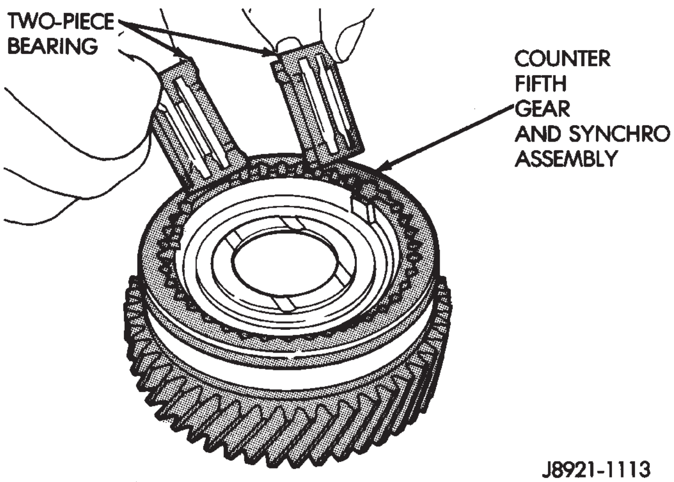


Fig. 97 Install Countershaft Fifth Gear Bearings

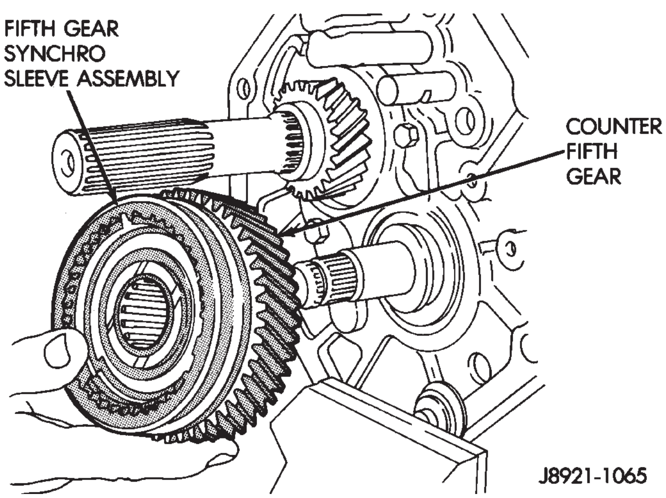


Fig. 98 Install Countershaft Fifth Gear Assembly

(35) Install the reverse shift head and rail assembly (Fig. 101).

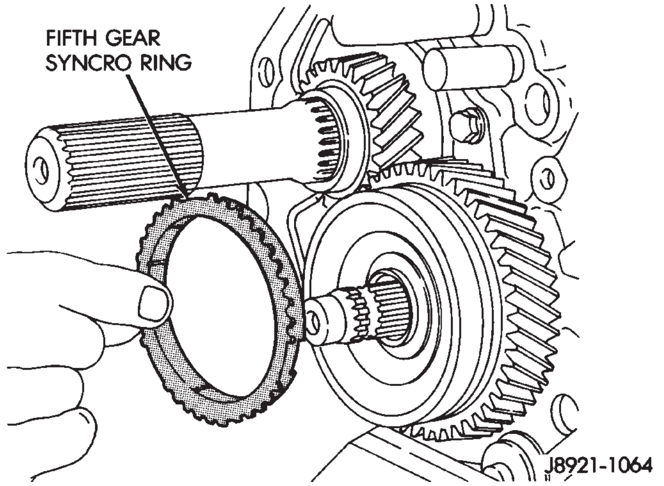
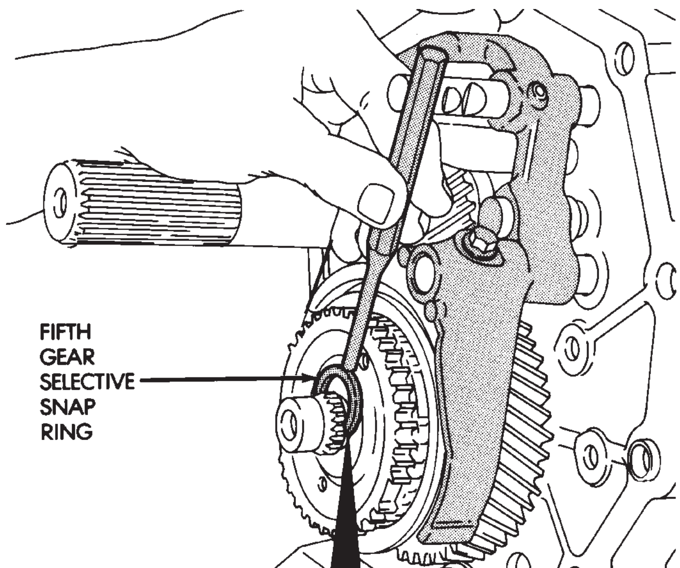


Fig. 99 Install Fifth Gear Synchronizer Ring



I.D. MARK	SNAP RING THICKNESS	MM (IN.)
A	2.85 - 2.90	(0.1122 - 0.1142)
B	2.90 - 2.95	(0.1142 - 0.1161)
C	2.95 - 3.00	(0.1161 - 0.1181)
D	3.00 - 3.05	(0.1181 - 0.1201)
E	3.05 - 3.10	(0.1201 - 0.1220)
F	3.10 - 3.15	(0.1220 - 0.1240)
G	3.15 - 3.20	(0.1240 - 0.1260)
H	3.20 - 3.25	(0.1260 - 0.1280)

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Fig. 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.).

DISASSEMBLY AND ASSEMBLY (Continued)

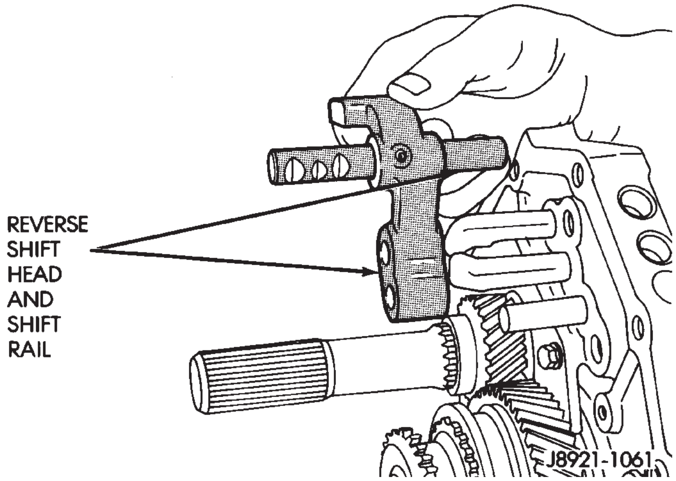


Fig. 101 Install Reverse Shift Head And Rail Assembly

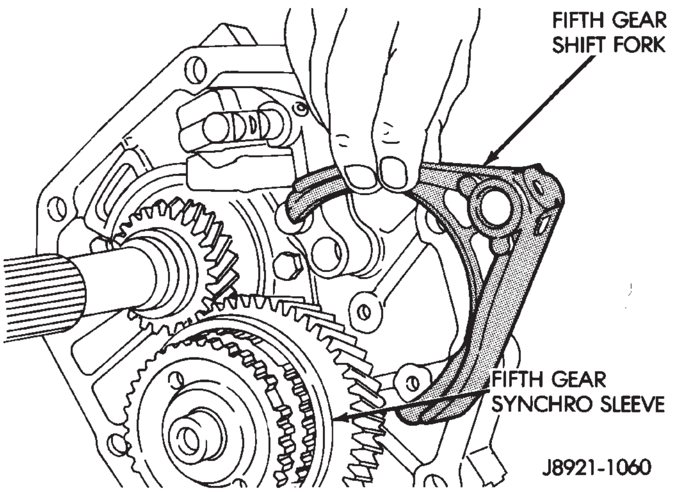


Fig. 102 Install Fifth Gear Shift Fork

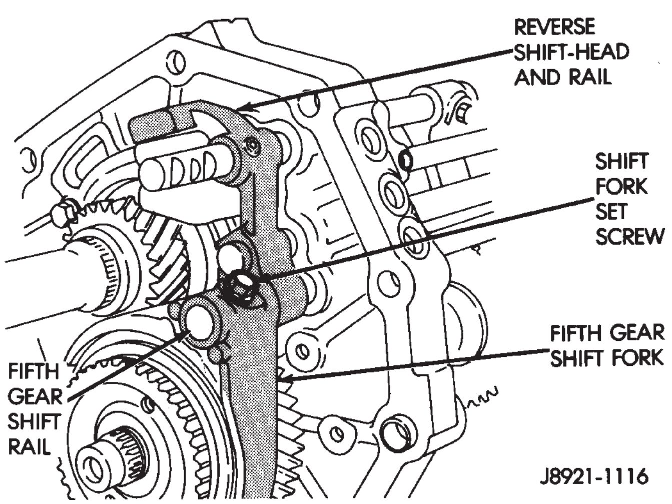


Fig. 103 Install Fifth Gear Shift Fork Retainer Bolt

(40) Install bolts to hold reverse shift arm to the intermediate plate. Tighten bolts to 18 N·m (13 ft. lbs.).

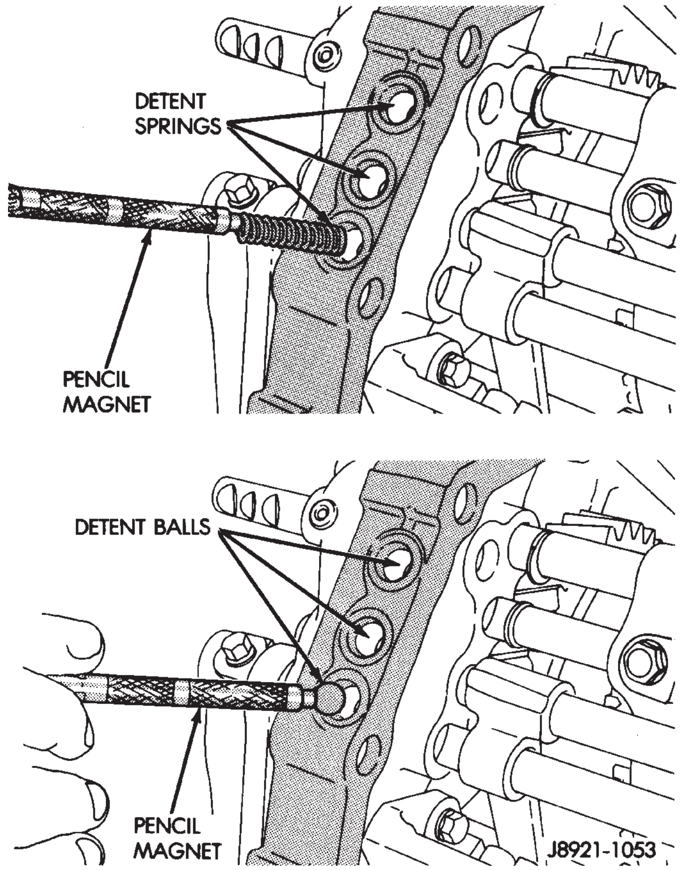


Fig. 104 Install Detent Balls And Springs

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.

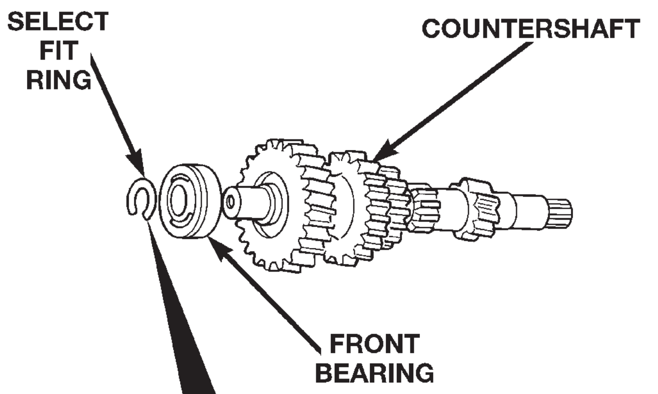
(2) Position countershaft front bearing on end of countershaft. Be sure the snap-ring groove in bearing is facing forward.

(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.

DISASSEMBLY AND ASSEMBLY (Continued)



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).

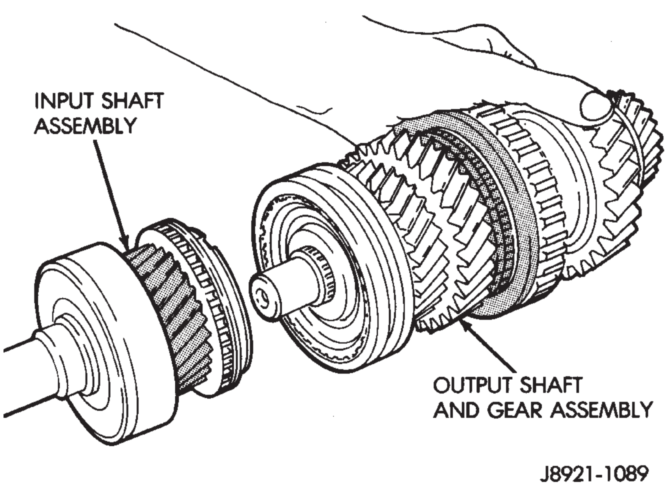


Fig. 106 Separate Input and Output Shafts

(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).

(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.

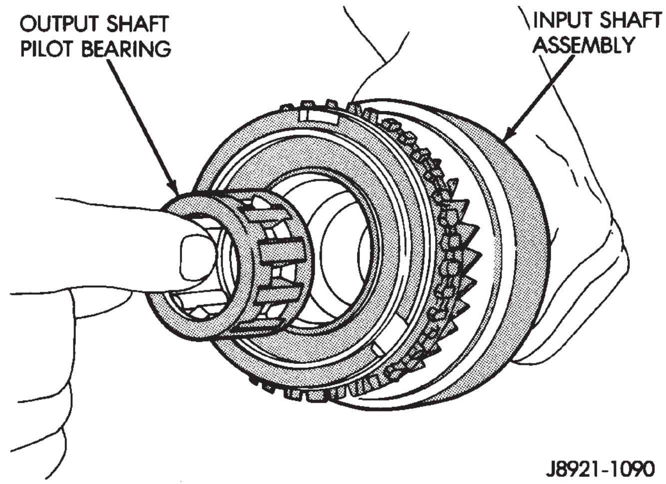


Fig. 107 Remove Output Shaft Pilot Bearing

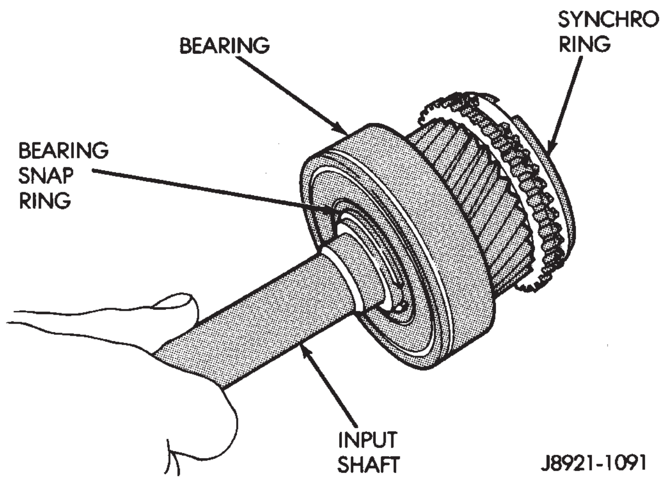


Fig. 108 Input Shaft Components

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).

(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).

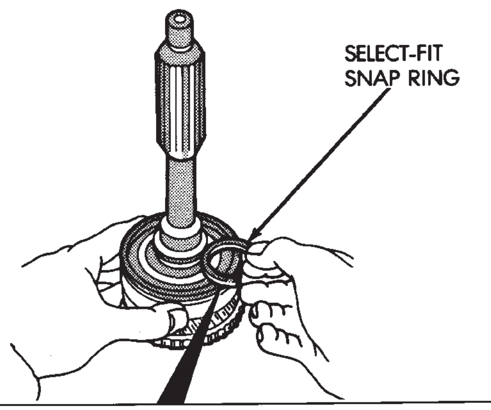
(6) Install the fourth gear synchronizer ring onto the input shaft.

(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)



I.D. MARK	SNAP RING THICKNESS	MM (IN.)
A	2.10 - 2.15	(0.0827 - 0.0846)
B	2.15 - 2.20	(0.0846 - 0.0866)
C	2.20 - 2.25	(0.0866 - 0.0886)
D	2.25 - 2.30	(0.0886 - 0.0906)
E	2.30 - 2.35	(0.0906 - 0.0925)
F	2.35 - 2.40	(0.0925 - 0.0945)
G	2.40 - 2.45	(0.0945 - 0.0965)

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Fig. 109 Select Input Shaft Bearing Snap-ring

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.).

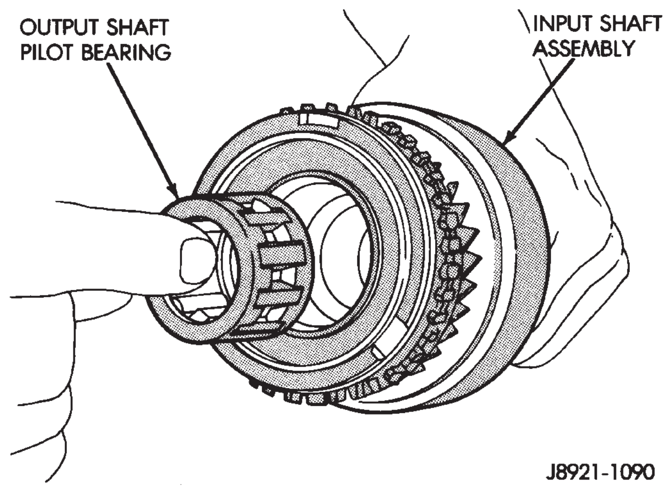


Fig. 111 Remove Output Shaft Pilot Bearing

(3) Remove output shaft fifth gear snap ring with two screwdrivers (Fig. 113).

(4) Using Bearing Splitter P-334 or suitable press plates positioned under first gear, press fifth gear,

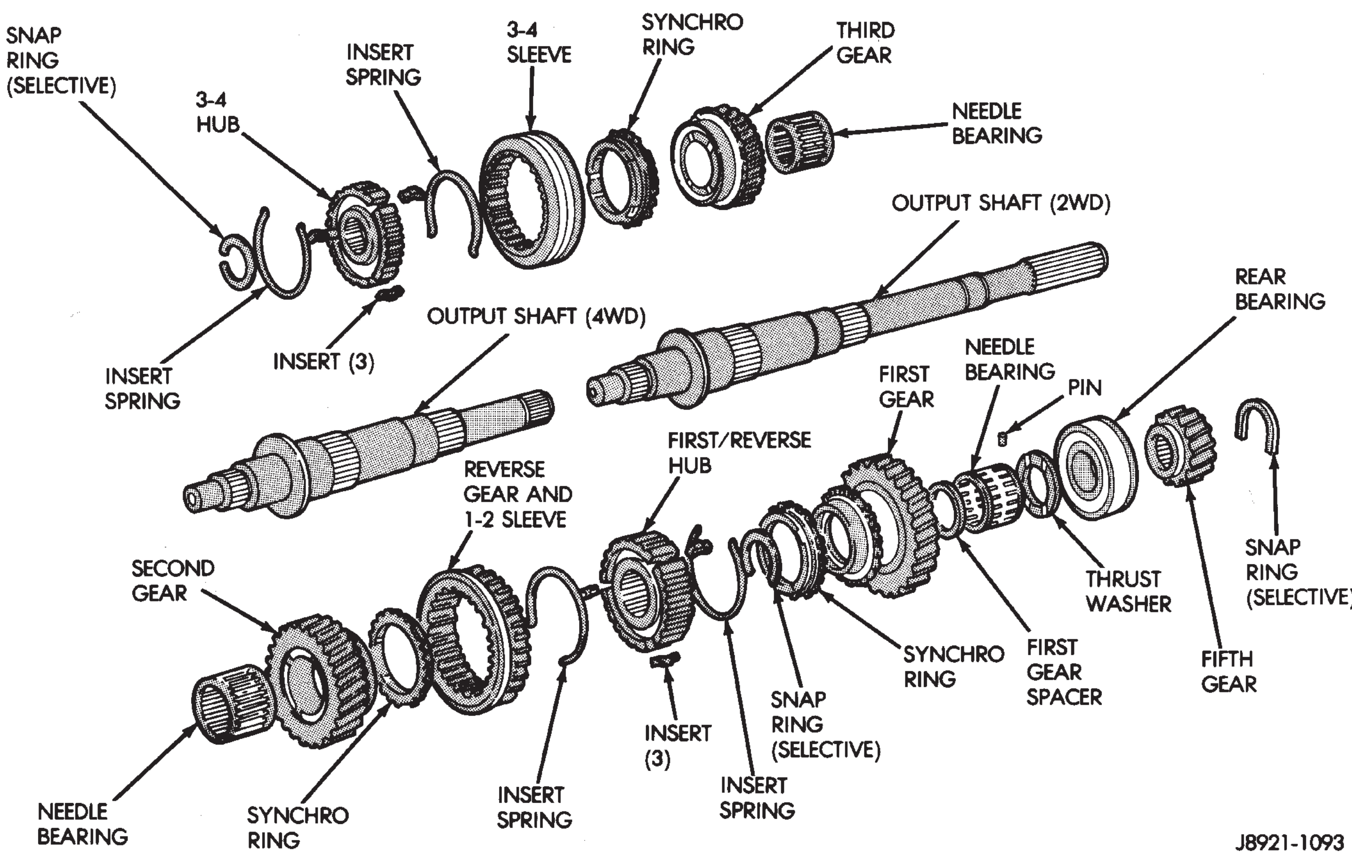


Fig. 110 Output Shaft And Gears

DISASSEMBLY AND ASSEMBLY (Continued)

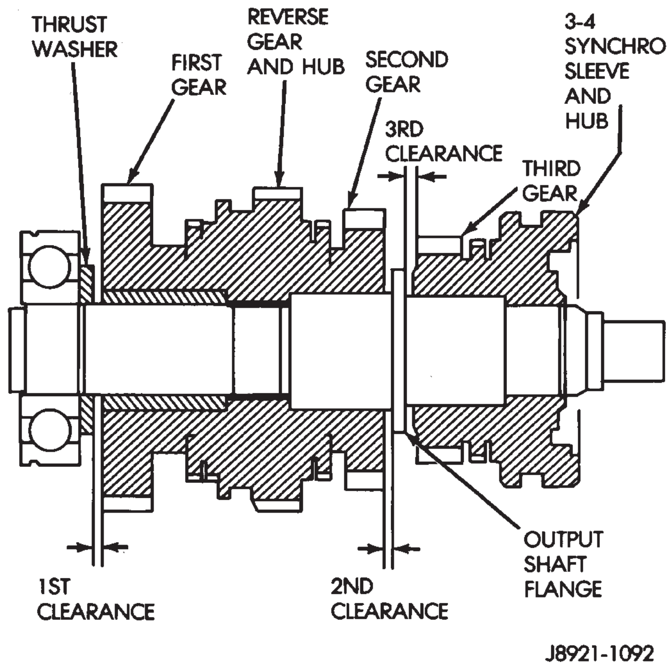


Fig. 112 Check Output Shaft Gear Thrust Clearance

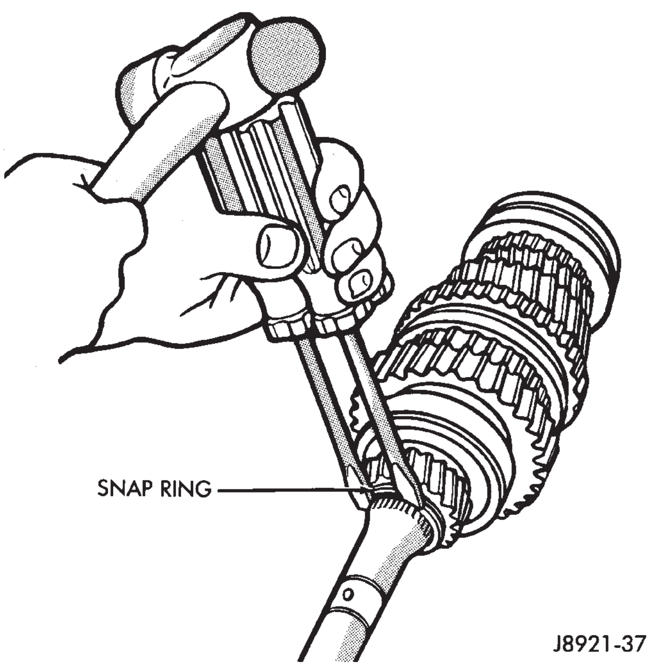


Fig. 113 Remove Fifth Gear Snap-ring

rear bearing, first gear, and first gear thrust washer off output shaft (Fig. 114).

(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.

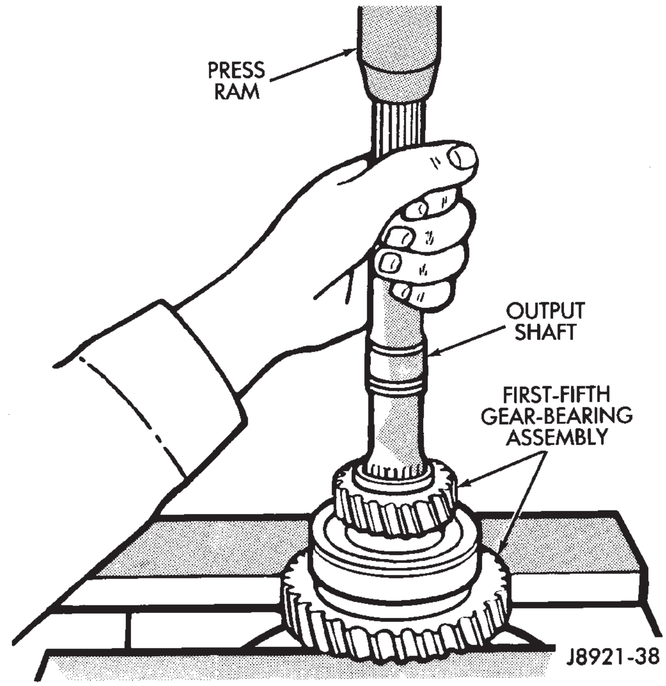


Fig. 114 Remove Fifth Gear, First Gear Bearing, And Thrust Washer

(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).

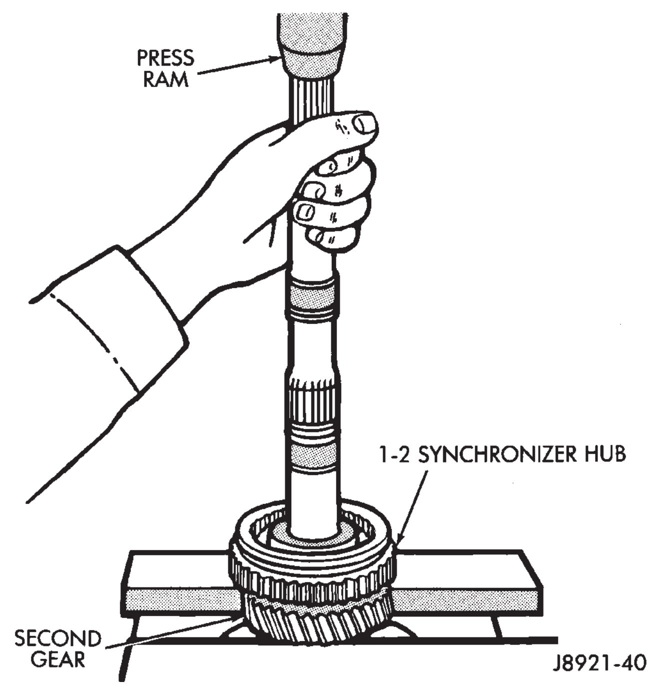


Fig. 115 Remove Second Gear And 1–2 Synchronizer/Reverse Gear

(11) Remove second gear needle roller bearing from the output shaft or second gear.

DISASSEMBLY AND ASSEMBLY (Continued)

(12) Remove select fit snap-ring holding the 3–4 synchronizer onto the output shaft (Fig. 116).

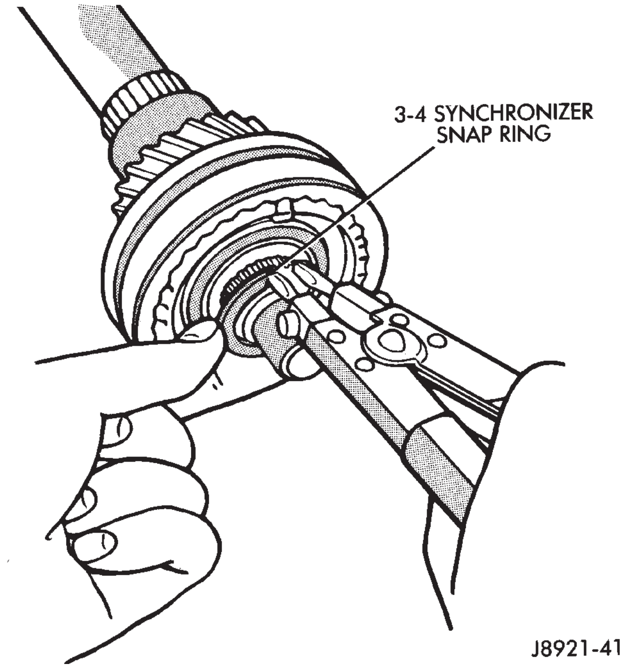


Fig. 116 Remove 3–4 Synchronizer Snap Ring

(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).

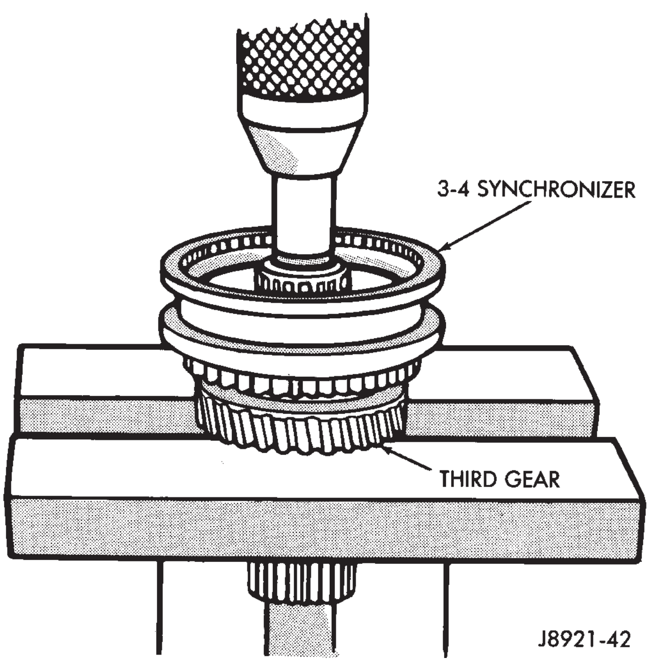


Fig. 117 Remove 3–4 Synchronizer And Third Gear

(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).

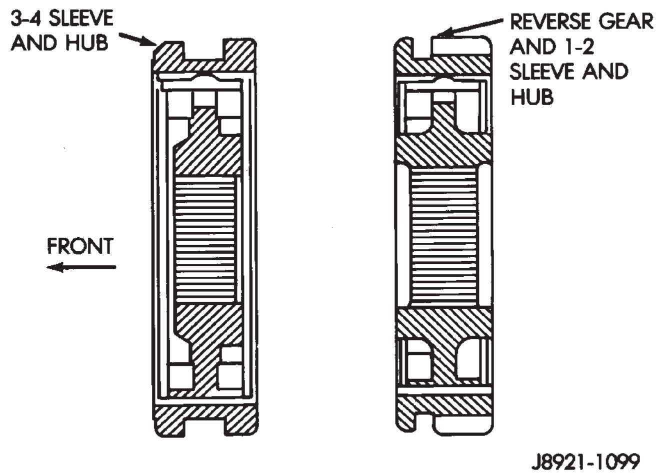


Fig. 118 Synchronizer Identification

(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 6761 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. 119).

(9) Install snap-ring to hold 3–4 synchronizer onto output shaft.

(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.

(11) Install second gear needle bearing onto output shaft.

(12) Install second gear over bearing and onto output shaft flange.

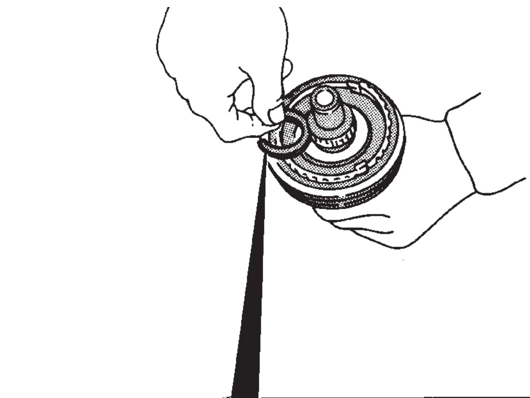
(13) Install second gear synchronizer ring onto second gear.

(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).

DISASSEMBLY AND ASSEMBLY (Continued)



I.D. MARK	SNAP RING THICKNESS	MM (IN.)
A	1.80 - 1.85	(0.0709 - 0.0728)
B	1.85 - 1.90	(0.0728 - 0.0748)
C	1.90 - 1.95	(0.0748 - 0.0768)
D	1.95 - 2.00	(0.0768 - 0.0787)
E	2.00 - 2.05	(0.0787 - 0.0807)
F	2.05 - 2.10	(0.0807 - 0.0827)
G	2.10 - 2.15	(0.0827 - 0.0846)

J8921-1101

Fig. 119 Select 3–4 Synchronizer Snap-ring

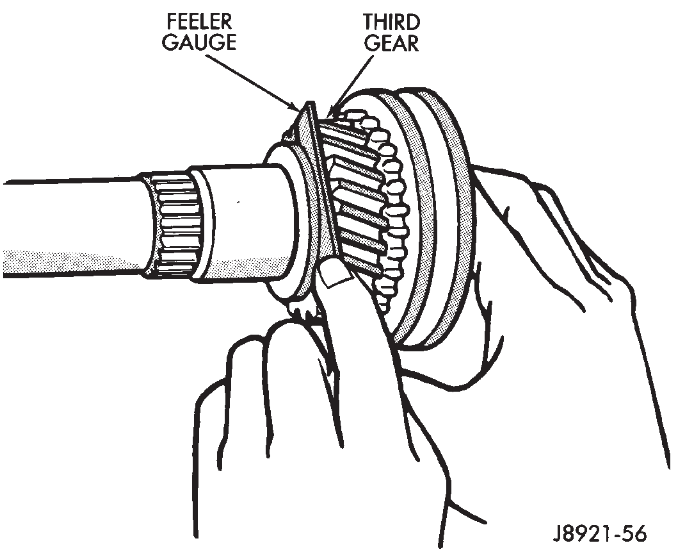


Fig. 120 Check Third Gear Clearance

(17) Install snap-ring to hold 1–2 synchronizer/reverse gear onto output shaft.

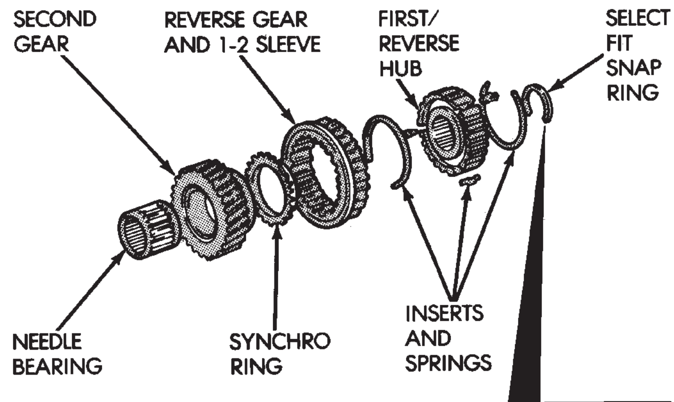
(18) Install first gear synchronizer ring into 1–2 synchronizer/reverse gear.

(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.



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

(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.

(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.

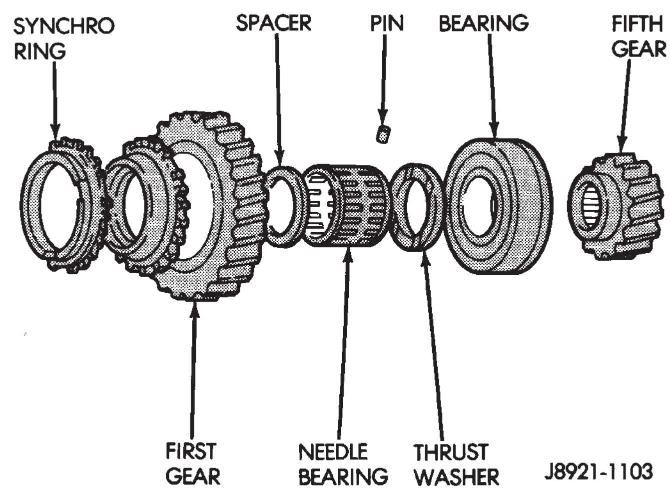


Fig. 122 First And Fifth Gear Components

(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

DISASSEMBLY AND ASSEMBLY (Continued)

clearance is out of specification, refer to Cleaning and Inspection section within this group.

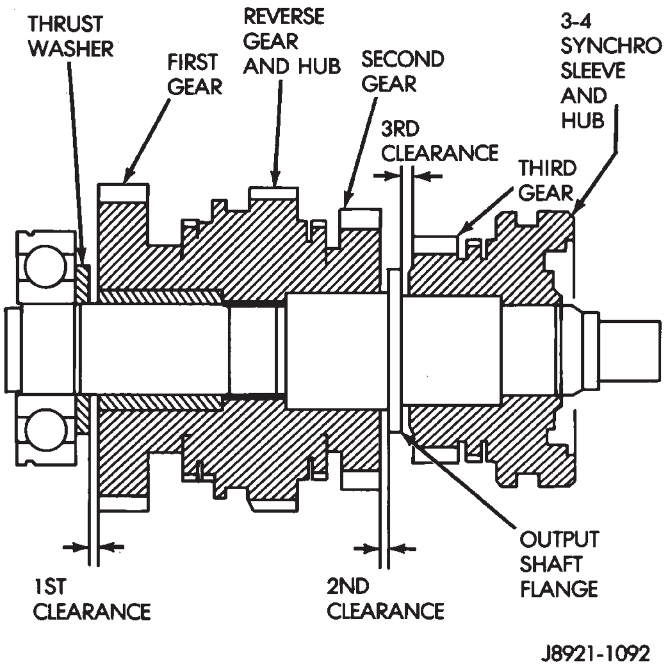


Fig. 123 Check First–Second Gear Thrust Clearance

(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.

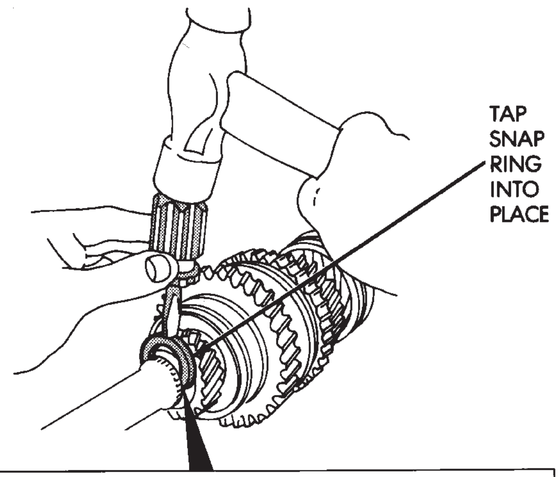
CLEANING AND INSPECTION

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.



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

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.).

Check diameter of the first, second, and third gear bearing surfaces on the output shaft. Minimum diameters are as follows:

- 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.).

CLEANING AND INSPECTION (Continued)

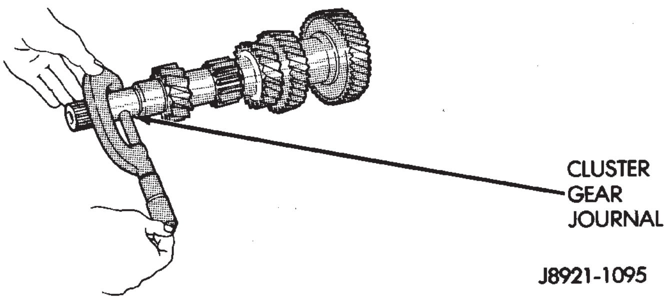


Fig. 125 Check Output Shaft Tolerances

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.

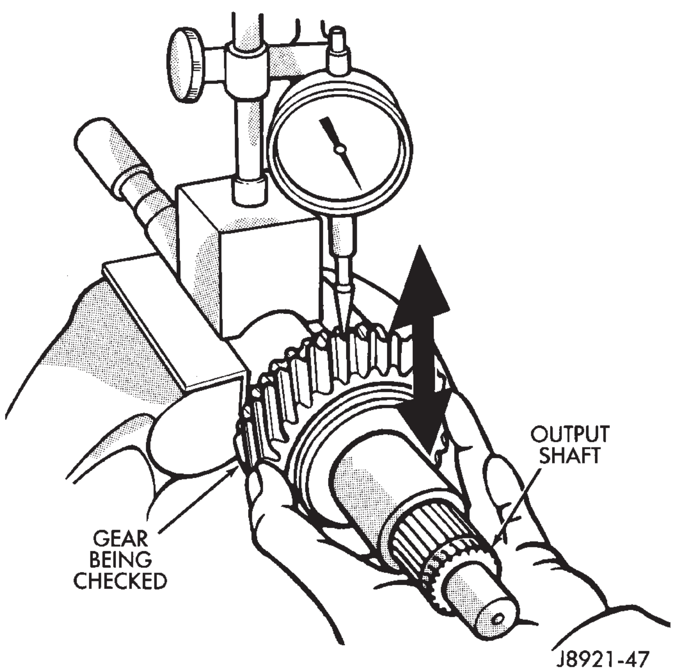


Fig. 126 Check Gear–To–Shaft Oil Clearance

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.).

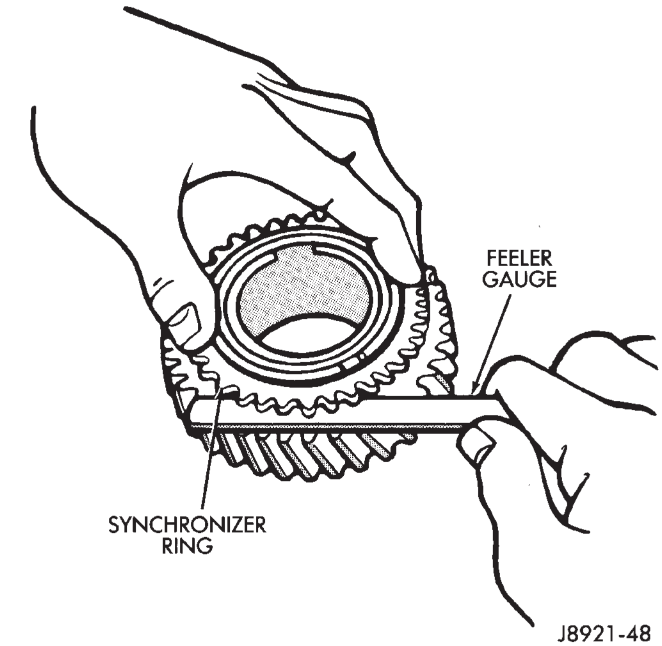


Fig. 127 Check Synchronizer Ring Wear

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.).

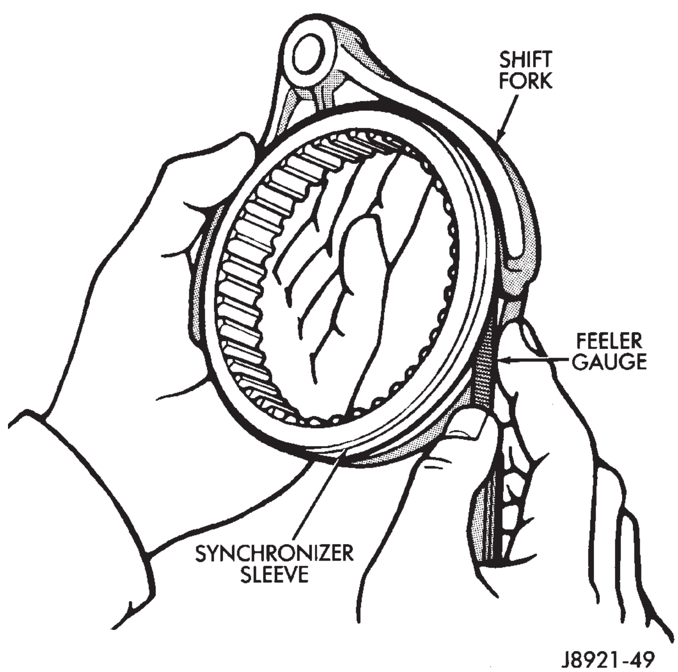


Fig. 128 Check Fork–To–Hub Clearance

Check the condition of the reverse idler gear bushing (Fig. 129). Replace the gear if the bushing is damaged or worn.

SPECIFICATIONS (Continued)

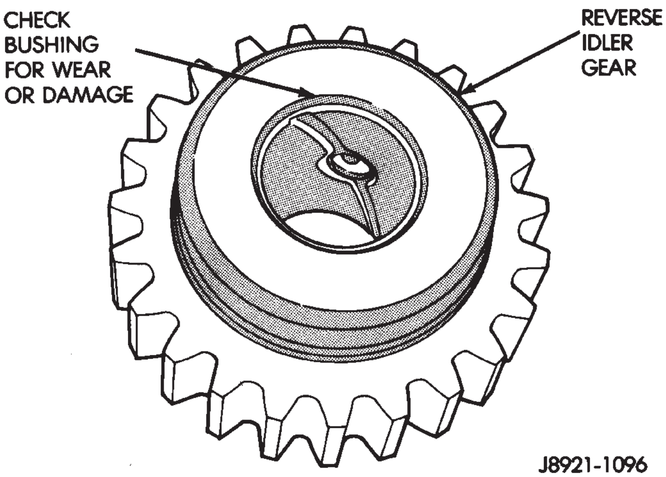


Fig. 129 Reverse Idler Gear Bushing

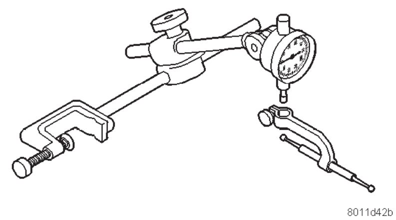
SPECIFICATIONS

TORQUE

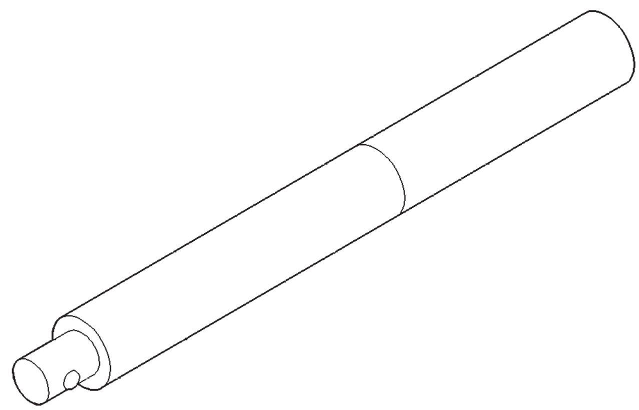
DESCRIPTION	TORQUE
Plugs, Access	19 N·m (14 ft.lbs.)
Bolts, Adapter Housing	34 N·m (25 ft.lbs.)
Switch, Back-up Light	44 N·m (32.5 ft.lbs.)
Plugs, Drain and Fill	44 N·m (32.5 ft.lbs.)
Bolts, Front Bearing Retainer	17 N·m (12 ft.lbs.)
Plugs, Interlock and Detent	19 N·m (14 ft.lbs.)
Screws, Propeller Shaft 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

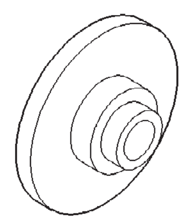
AX15



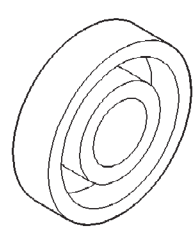
C-3339 Dial Indicator Set



C-4171 Handle, Universal Tool

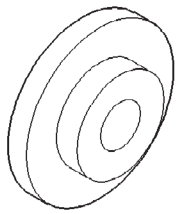


8209 Installer, Seal

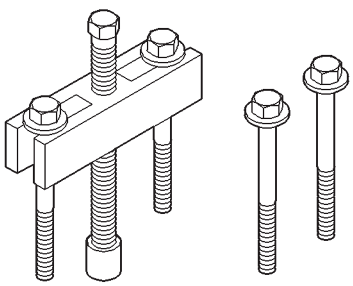


8212 Installer, Seal

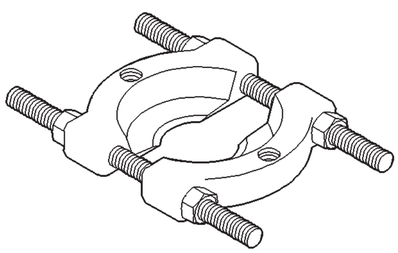
SPECIAL TOOLS (Continued)



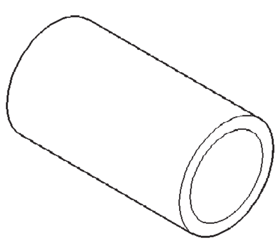
8208 Installer, Seal



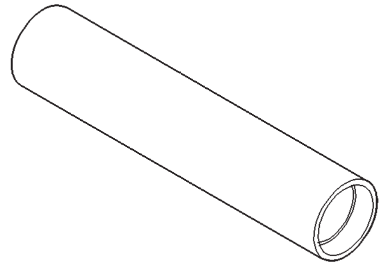
L-4407A Puller, Gear



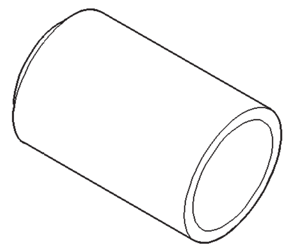
P-334 Splitter, Bearing



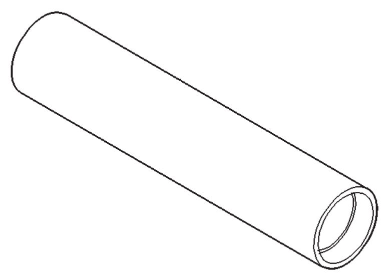
8109 Cup, Installer



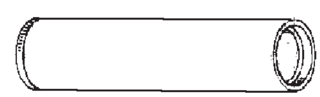
6052 Tube, Driver



6761 Adapter, Installer



MD-998805 Tube, Driver



L-4507 Tube, Driver

AUTOMATIC TRANSMISSION—30RH

INDEX

GENERAL INFORMATION

30RH AUTOMATIC TRANSMISSION

The 30RH automatic transmission is used with the 2.5L engine (Fig. 1). The 30RH is a 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 30RH transmission is cooled by an integral fluid cooler inside the radiator.

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.

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.

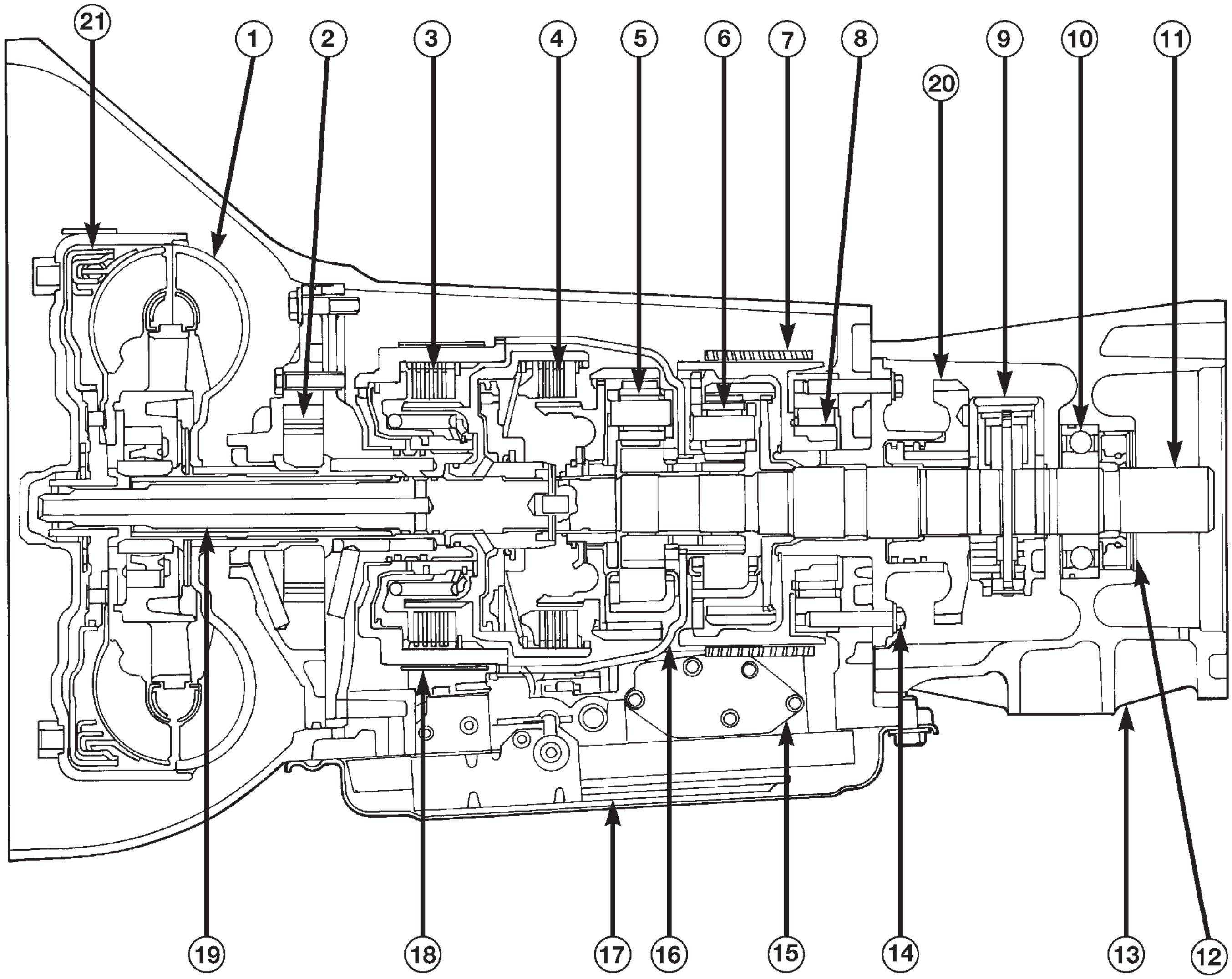
The dipstick cap and fill tube should be wiped clean before checking fluid level. Dirt, grease and other foreign material on the cap and tube could fall into the tube if not removed beforehand. Take the time to wipe the cap and tube clean before withdrawing the dipstick.

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.

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

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Fig. 1 30RH Automatic Transmission

GENERAL INFORMATION (Continued)

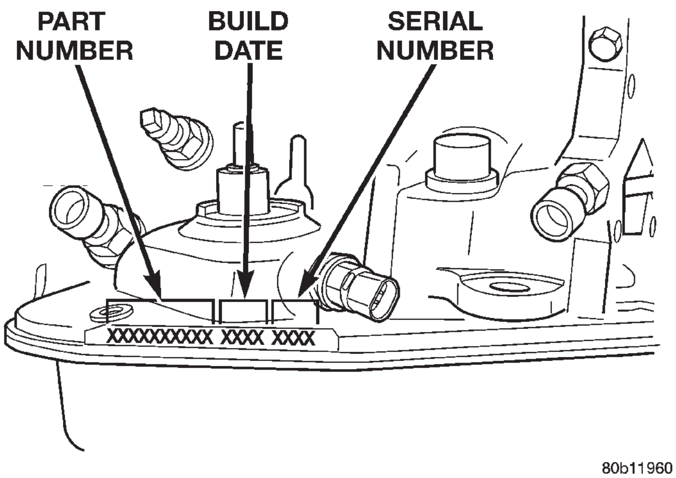

Fig. 2 Transmission Part And Serial Number Location

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 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.

DESCRIPTION AND OPERATION (Continued)

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.

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

DIAGNOSIS AND TESTING (Continued)

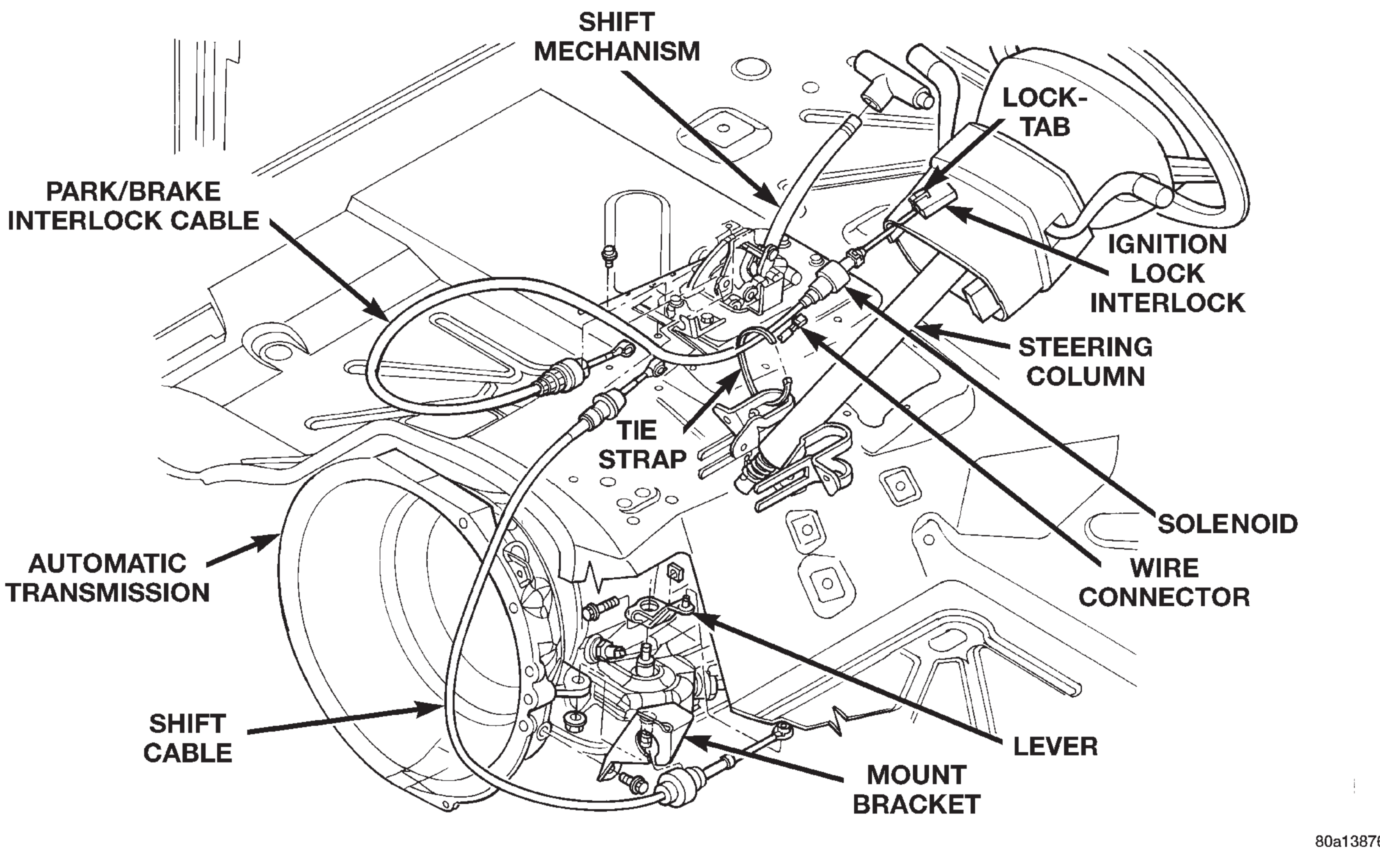

Fig. 3 Ignition Interlock Cable Routing

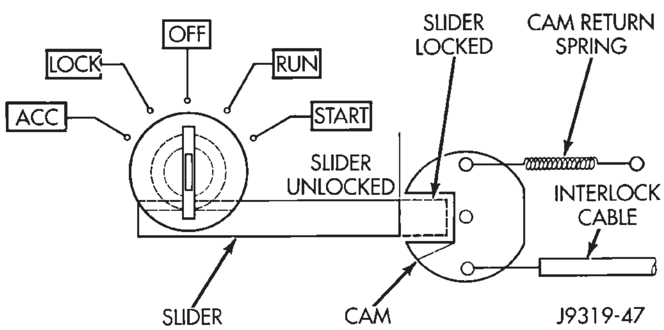

Fig. 4 Ignition Key Cylinder Actuation

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.

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.

DIAGNOSIS AND TESTING (Continued)

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.

(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 the proper 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.

	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				•			•		•

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Fig. 5 Clutch And Band Application

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.

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.

DIAGNOSIS AND TESTING (Continued)

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 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.

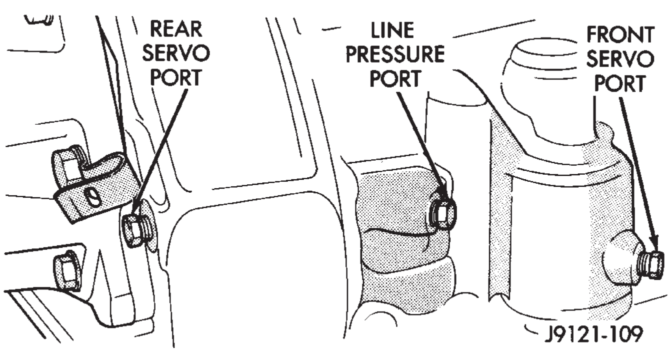

Fig. 6 Pressure Test Ports At Side Of Case

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.

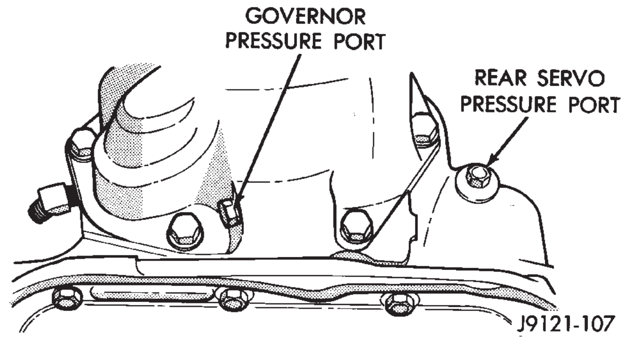

Fig. 7 Pressure Test Ports At Rear Of Case—2WD

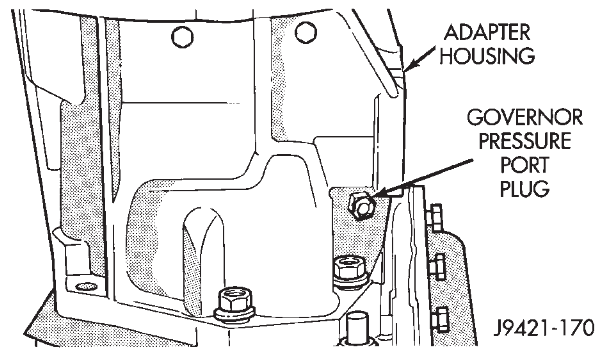

Fig. 8 Pressure Test Ports At Rear Of Case—4WD

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).

DIAGNOSIS AND TESTING (Continued)

(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.

(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).

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

CONVERTER STALL TEST

Stall testing involves determining maximum engine speed obtainable at full throttle with the rear wheels locked and the transmission in D range. This test checks the holding ability of the converter overrunning and transmission clutches.

WARNING: NEVER ALLOW ANYONE TO STAND DIRECTLY IN LINE WITH THE VEHICLE FRONT OR REAR DURING A STALL TEST. ALWAYS BLOCK THE WHEELS AND FULLY APPLY THE SERVICE AND PARKING BRAKES DURING THE TEST.

DIAGNOSIS AND TESTING (Continued)

STALL TEST PROCEDURE

(1) Connect tachometer to engine. Position tachometer so it can be viewed from driver's seat.

(2) Drive vehicle to bring transmission fluid up to normal operating temperature. Vehicle can be driven on road or on chassis dynamometer, if available.

(3) Check transmission fluid level. Add fluid if necessary.

(4) Block front wheels.

(5) Fully apply service and parking brakes.

(6) Open throttle completely and record maximum engine speed registered on tachometer. It takes 4-10 seconds to reach max rpm. **Once max rpm has been achieved, do not hold wide open throttle for more than 4-5 seconds.**

CAUTION: Stalling the converter causes a rapid increase in fluid temperature. To avoid fluid overheating, hold the engine at maximum rpm for no more than 5 seconds. If engine exceeds 2500 rpm during the test, release the accelerator pedal immediately; transmission clutch slippage is occurring.

(7) If a second stall test is required, cool down fluid before proceeding. Shift into NEUTRAL and run engine at 1000 rpm for 20-30 seconds to cool fluid.

STALL TEST ANALYSIS

Stall Speed Too High

If the stall speed exceeds 2500 rpm, transmission clutch slippage is indicated.

Stall Speed Low

Low stall speed with a properly tuned engine indicate a torque converter overrunning clutch problem. The condition should be confirmed by road testing. A stall speed 250-350 rpm below normal indicates the converter overrunning clutch is slipping. The vehicle also exhibits poor acceleration but operates normally once highway cruise speeds are reached. Torque converter replacement will be necessary.

Stall Speed Normal But Acceleration Poor

If stall speeds are normal (1800-2300 rpm) but abnormal throttle opening is required for acceleration, or to maintain cruise speed, the converter overrunning clutch is seized. The torque converter will have to be replaced.

Converter Noise During Test

A whining noise caused by fluid flow is normal during a stall test. However, loud metallic noises indicate a damaged converter. To confirm that the noise is originating from the converter, operate the vehicle at light throttle in DRIVE and NEUTRAL on a hoist and listen for noise coming from the converter housing.

AIR TESTING TRANSMISSION CLUTCH AND BAND OPERATION

Air-pressure testing can be used to check transmission front/rear clutch and band operation. The test can be conducted with the transmission either in the vehicle or on the work bench, as a final check, after overhaul.

Air-pressure testing requires that the oil pan and valve body be removed from the transmission. The servo and clutch apply passages are shown (Fig. 10).

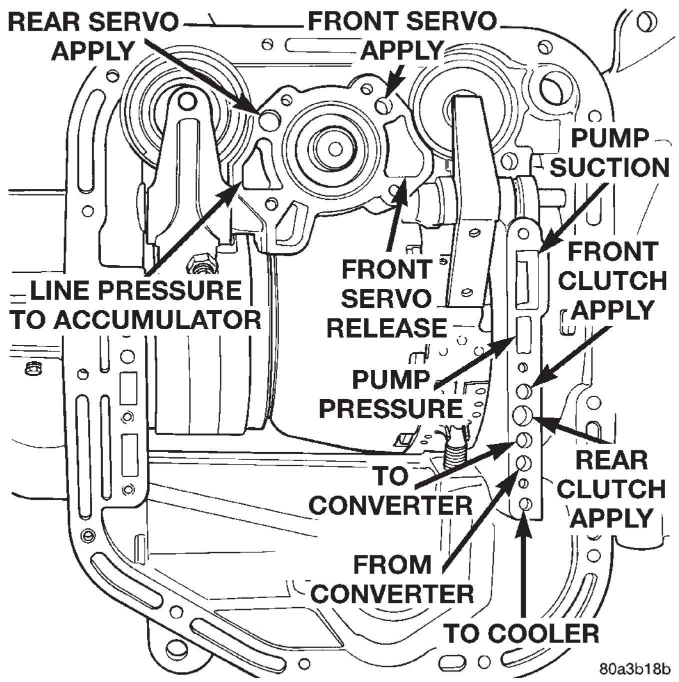


Fig. 10 Air Pressure Test Passages

Front Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Rear Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Front Servo Apply Air Test

Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

DIAGNOSIS AND TESTING (Continued)

Rear Servo Air Test

Apply air pressure to the rear servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

CONVERTER HOUSING FLUID LEAK DIAGNOSIS

When diagnosing converter housing fluid leaks, two items must be established before repair.

(1) Verify that a leak condition actually exists.

(2) Determined the true source of the leak.

Some suspected converter housing fluid leaks may not be leaks at all. They may only be the result of residual fluid in the converter housing, or excess fluid spilled during factory fill or fill after repair. Converter housing leaks have several potential sources. Through careful observation, a leak source can be identified before removing the transmission for repair. Pump seal leaks tend to move along the drive hub and onto the rear of the converter. Pump O-ring or pump body leaks follow the same path as a seal leak (Fig. 11). Pump vent or pump attaching bolt leaks are generally deposited on the inside of the 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.

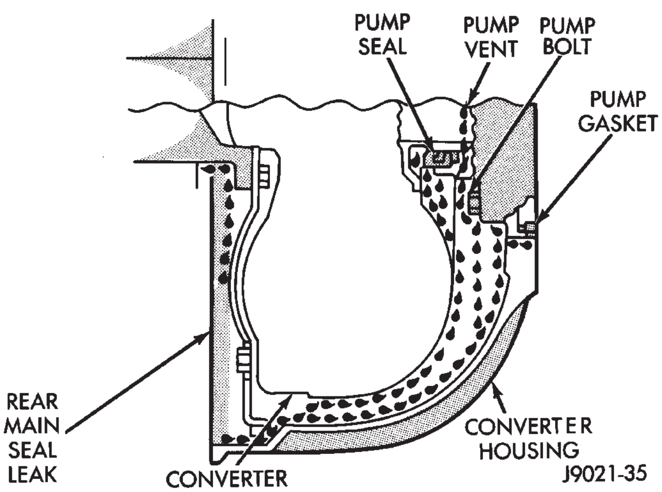


Fig. 11 Converter Housing Leak Paths

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).

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove converter.

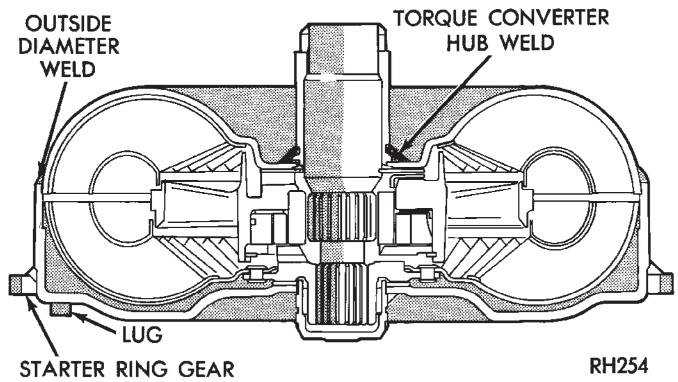


Fig. 12 Converter Leak Points—Typical

(2) Tighten front band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out when oil pump is removed.

(3) Remove oil pump and remove pump seal. Inspect pump housing drainback and vent holes for obstructions. Clear holes with solvent and wire.

(4) Inspect pump bushing and converter hub. If bushing is scored, replace it. If converter hub is scored, either polish it with crocus cloth or replace converter.

(5) Install new pump seal, O-ring, and gasket. Replace oil pump if cracked, porous or damaged in any way. Be sure to loosen the front band before installing the oil pump, damage to the oil pump seal may occur if the band is still tightened to the front clutch retainer.

(6) Loosen kickdown lever pin access plug three turns. Apply Loctite 592, or Permatex No. 2 to plug threads and tighten plug to 17 N·m (150 in. lbs.) torque.

(7) Adjust front band.

(8) Lubricate pump seal and converter hub with transmission fluid or petroleum jelly and install converter.

(9) Install transmission and converter housing dust shield.

(10) Lower vehicle.

DIAGNOSIS 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.
	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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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.
	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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SHIFTS DELAYED OR ERRATIC (SHIFTS ALSO HARSH AT TIMES)	1. Fluid Level Low/High.	1. Correct fluid level and check for leaks if low.
	2. 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.
	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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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.
	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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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.
	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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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.
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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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.
	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.

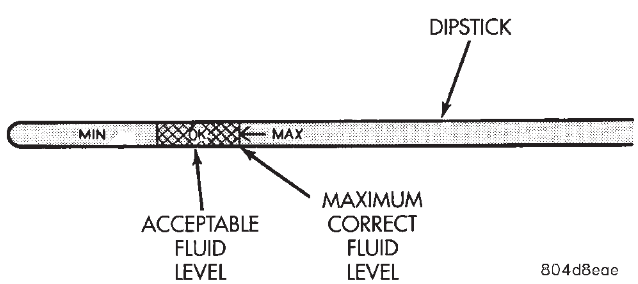


Fig. 13 Dipstick Fluid Level Marks—Typical

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.

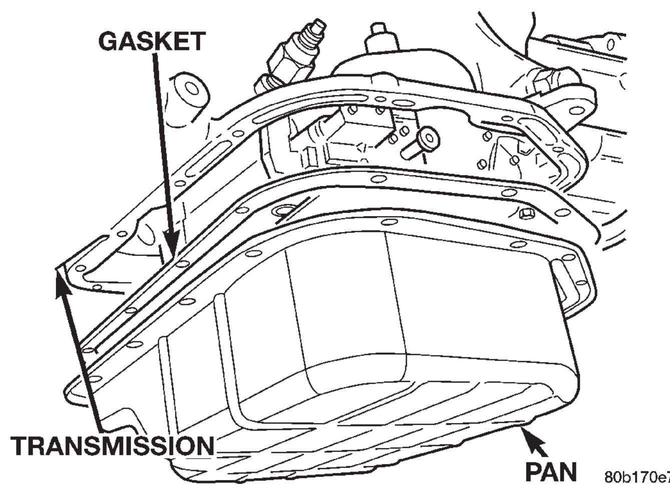


Fig. 14 Transmission Pan

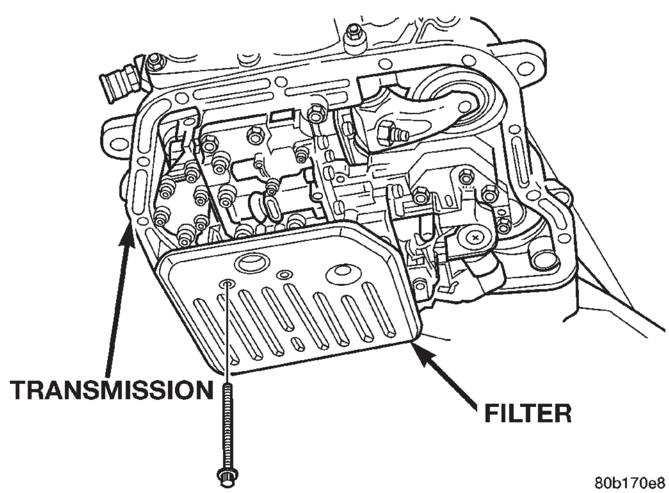


Fig. 15 Transmission Filter

SERVICE PROCEDURES (Continued)

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 tank. The valve prevents fluid drainback when the vehicle is parked for lengthy periods. The valve check ball is spring loaded and has an opening pressure of approximately 2 psi.

The valve is serviced as an assembly; it is not repairable. Do not clean the valve if restricted, or contaminated by sludge, or debris. If the valve fails, or if a transmission malfunction occurs that generates significant amounts of sludge and/or clutch particles and metal shavings, the valve must be replaced.

The valve must be removed whenever the cooler and lines are reverse flushed. The valve can be flow tested when necessary. The procedure is exactly the same as for flow testing a cooler.

If the valve is restricted, installed backwards, or in the wrong line, it will cause an overheating condition and possible transmission failure.

CAUTION: The drainback valve is a one-way flow device. It must be properly oriented in terms of flow direction for the cooler to function properly. The valve must be installed in the pressure line. Otherwise flow will be blocked and would cause an overheating condition and eventual transmission failure.

OIL PUMP VOLUME CHECK

After the new or repaired transmission has been installed, fill to the proper level with Mopar® ATF PLUS 3 (Type 7176) automatic transmission fluid. The volume should be checked using the following procedure:

SERVICE PROCEDURES (Continued)

(1) Disconnect the **From cooler** line at the transmission and place a collecting container under the disconnected line.

CAUTION: With the fluid set at the proper level, fluid collection should not exceed (1) quart or internal damage to the transmission may occur.

(2) Run the engine **at curb idle speed** , with the shift selector in neutral.

(3) If fluid flow is intermittent or it takes more than 20 seconds to collect one quart of ATF PLUS 3, disconnect the **To Cooler** line at the transaxle.

(4) Refill the transaxle to proper level and recheck pump volume.

(5) If flow is found to be within acceptable limits, replace the cooler. Then fill transmission to the proper level, using Mopar® ATF PLUS 3 (Type 7176) automatic transmission fluid.

(6) If fluid flow is still found to be inadequate, check the line pressure using the Transaxle Hydraulic Pressure Test procedure.

FLUSHING COOLERS AND TUBES

When a transmission failure has contaminated the fluid, the oil cooler(s) must be flushed. The 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.

NOTE: The converter drainback valve must be removed and an appropriate replacement hose installed to bridge the space between the transmission cooler line and the cooler fitting. Failure to remove the drainback valve will preventreverse flushing the system.

(5) Connect the BLUE pressure line to the OUTLET (From) cooler line.

(6) Connect the CLEAR return line to the INLET (To) cooler line.

(7) Turn pump ON for two to three minutes to flush cooler(s) and lines. Monitor pressure readings and clear return lines. Pressure readings should stabilize below 20 psi. for vehicles equipped with a single cooler and 30 psi. for vehicles equipped with dual coolers. If flow is intermittent or exceeds these pressures, replace cooler.

(8) Turn pump OFF.

(9) Disconnect CLEAR suction line from reservoir at cover plate. Disconnect CLEAR return line at cover plate, and place it in a drain pan.

(10) Turn pump ON for 30 seconds to purge flushing solution from cooler and lines. Turn pump OFF.

(11) Place CLEAR suction line into a one quart container of Mopar® ATF Plus 3, type 7176 automatic transmission fluid.

(12) Turn pump ON until all transmission fluid is removed from the one quart container and lines. This purges any residual cleaning solvent from the transmission cooler and lines. Turn pump OFF.

(13) Disconnect alligator clips from battery. Reconnect flusher lines to cover plate, and remove flushing adapters from cooler lines.

ALUMINUM THREAD REPAIR

Damaged or worn threads in the aluminum transmission case and valve body can be repaired by the use of Heli-Coils, or equivalent. This repair consists of drilling out the worn-out damaged threads. Then tap the hole with a special Heli-Coil tap, or equivalent, and installing a Heli-Coil insert, or equivalent, into the hole. This brings the hole back to its original thread size.

SERVICE PROCEDURES (Continued)

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.

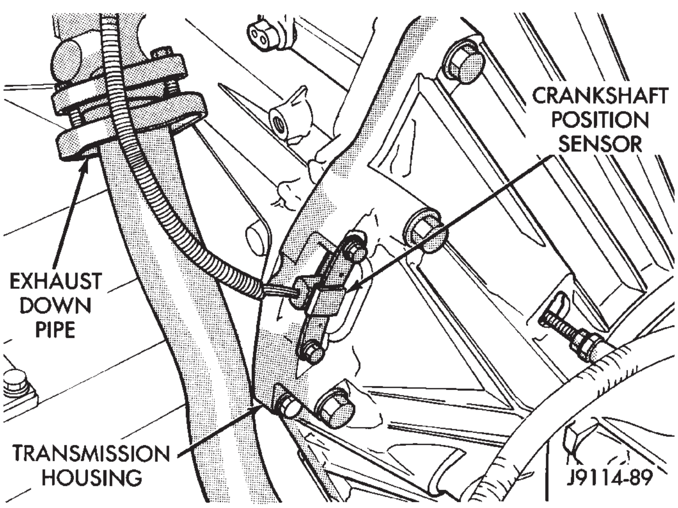


Fig. 16 Crankshaft Position Sensor—2.5L Engine

(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.
(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.

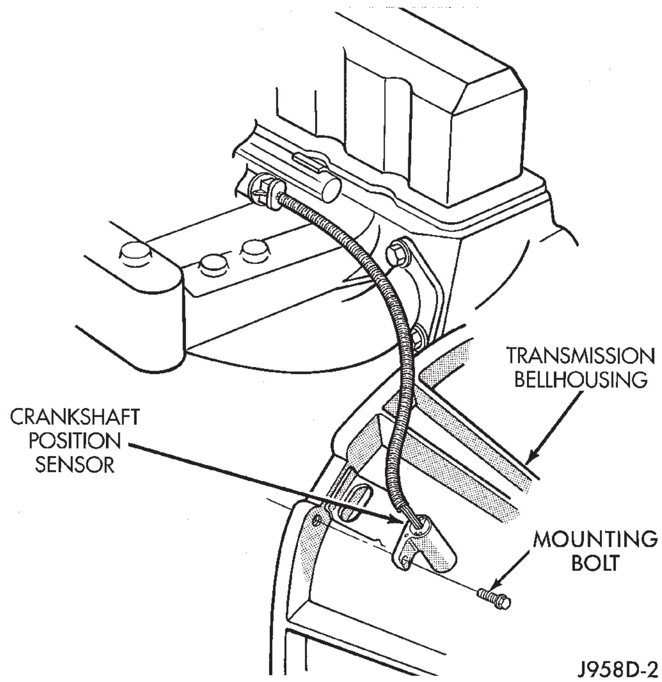


Fig. 17 Crankshaft Position Sensor—4.0L Engine

(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 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.

REMOVAL AND INSTALLATION (Continued)

(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.

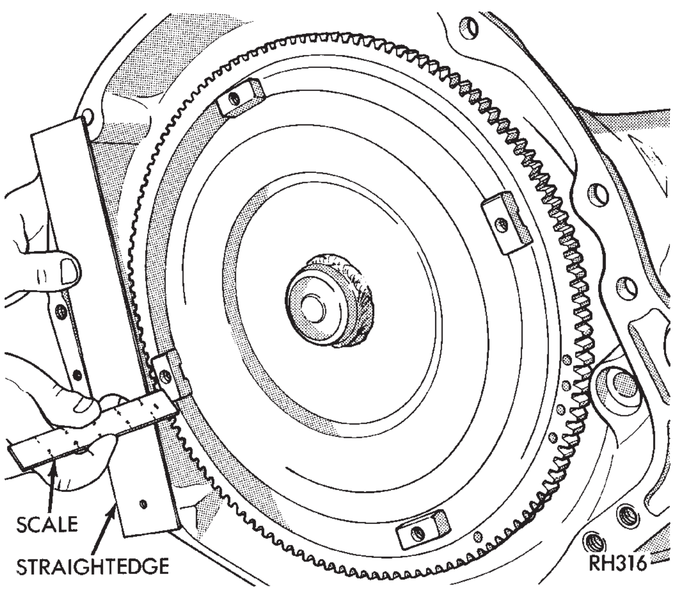


Fig. 18 Typical Method Of Checking Converter Seating

(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. **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.

(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.

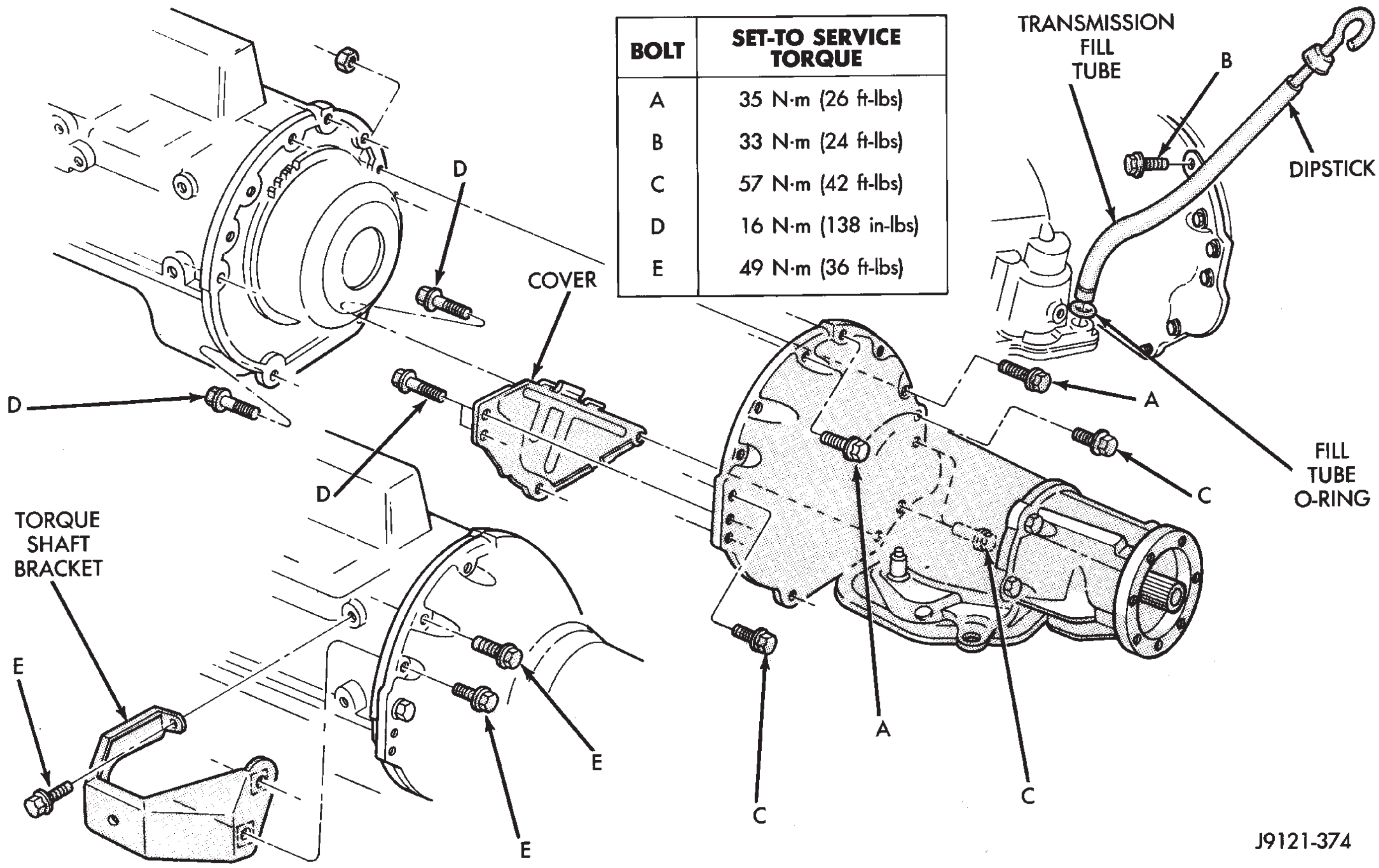
(28) Install starter motor and cooler line bracket.

(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.

REMOVAL AND INSTALLATION (Continued)



BOLT	SET-TO SERVICE TORQUE
A	35 N·m (26 ft-lbs)
B	33 N·m (24 ft-lbs)
C	57 N·m (42 ft-lbs)
D	16 N·m (138 in-lbs)
E	49 N·m (36 ft-lbs)

Fig. 19 Transmission Attachment

(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.

(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.

REMOVAL AND INSTALLATION (Continued)

(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.

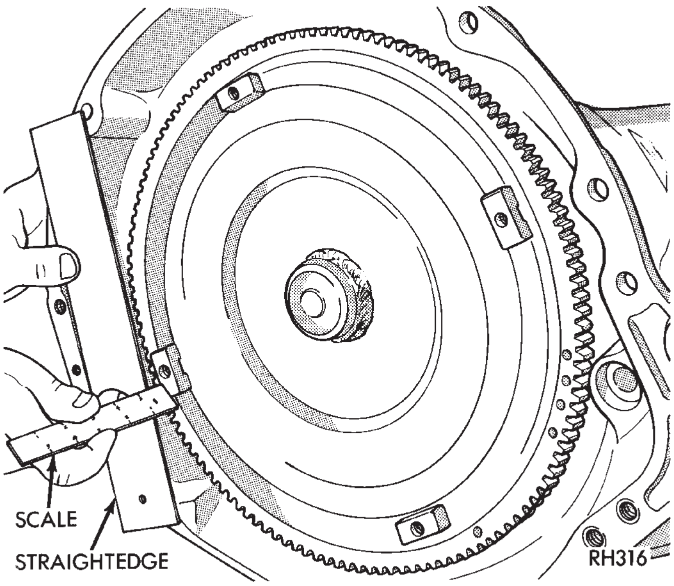


Fig. 20 Checking Torque Converter Seating

YOKE SEAL REPLACEMENT

REMOVAL

(1) Raise vehicle.

(2) Mark propeller shaft and axle yoke for alignment reference.

(3) Disconnect and remove propeller shaft.

(4) Remove old seal with Seal Remover C-3985-B (Fig. 21) from extension housing.

INSTALLATION

(1) Place seal in position on extension housing.

(2) Drive seal into extension housing with Seal Installer C-3995-A or C-3972 (Fig. 22).

(3) Carefully guide propeller shaft slip yoke into housing and onto output shaft splines. Align marks made at removal and connect propeller shaft to rear axle pinion yoke.

EXTENSION HOUSING BUSHING

REMOVAL

(1) Remove housing yoke seal.

(2) Insert Remover 6957 into extension housing. Tighten tool to bushing and remove bushing (Fig. 23).

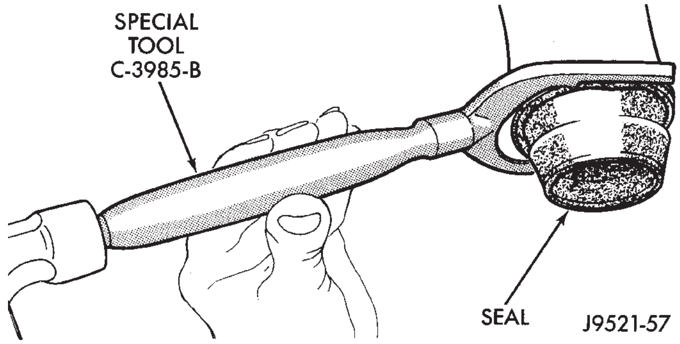


Fig. 21 Removing Extension Housing Yoke Seal

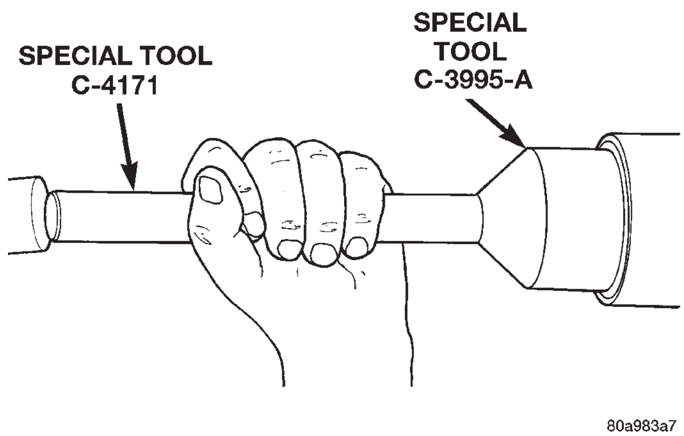


Fig. 22 Installing Extension Housing Yoke Seal

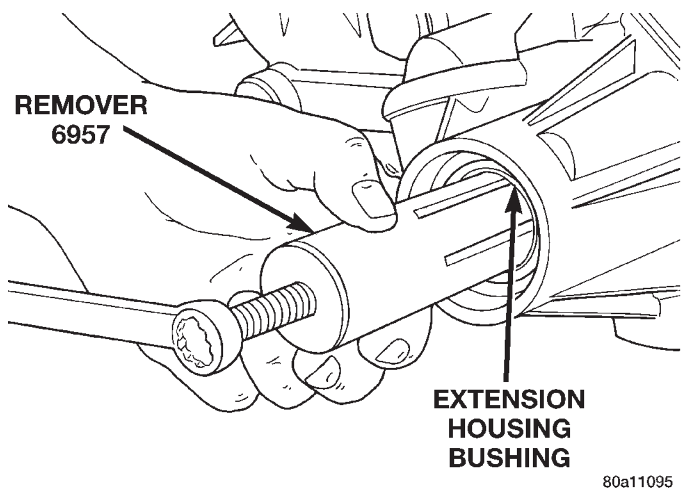


Fig. 23 Bushing Removal—Typical

INSTALLATION

(1) Align bushing oil hole with oil slot in extension housing.

(2) Tap bushing into place with Installer 6951 and Handle C-4171.

(3) Install new oil seal in housing using Seal Installer C-3995–A (Fig. 24).

REMOVAL AND INSTALLATION (Continued)

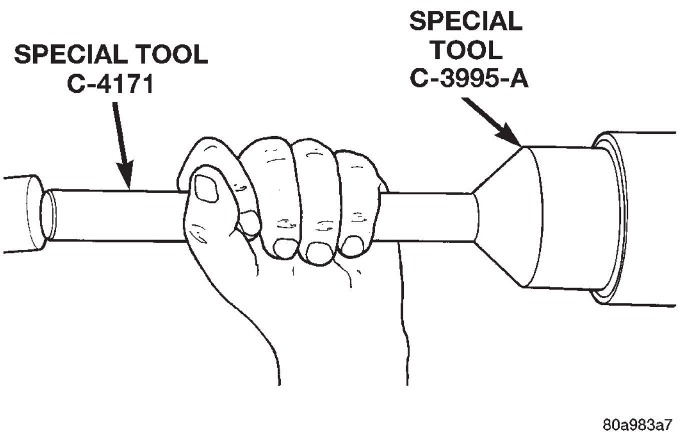


Fig. 24 Extension Housing Seal Installation

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. 25).

(7) Separate extension housing from transmission.

(8) Slide extension housing rearward and off output shaft (Fig. 25).

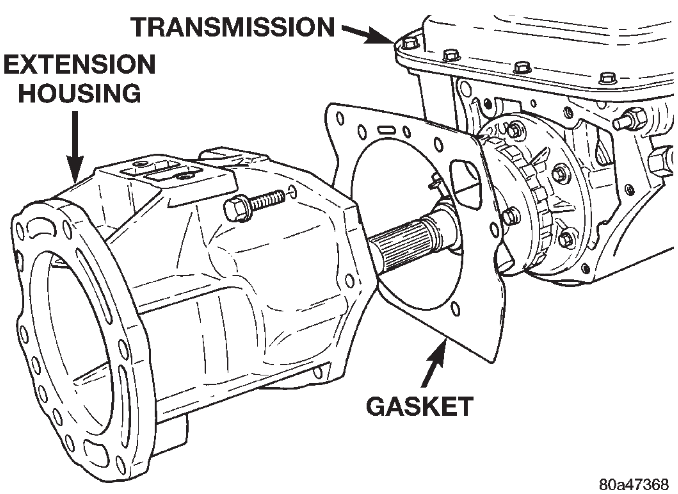


Fig. 25 Extension Housing

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. 25).

(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. 26).

(4) Remove speed sensor and speedometer adapter as assembly.

(5) Remove speed sensor retaining screw and remove sensor from adapter.

(6) Remove speedometer pinion from adapter.

(7) Inspect sensor and adapter O-rings (Fig. 26). 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. 26).

(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.

REMOVAL AND INSTALLATION (Continued)

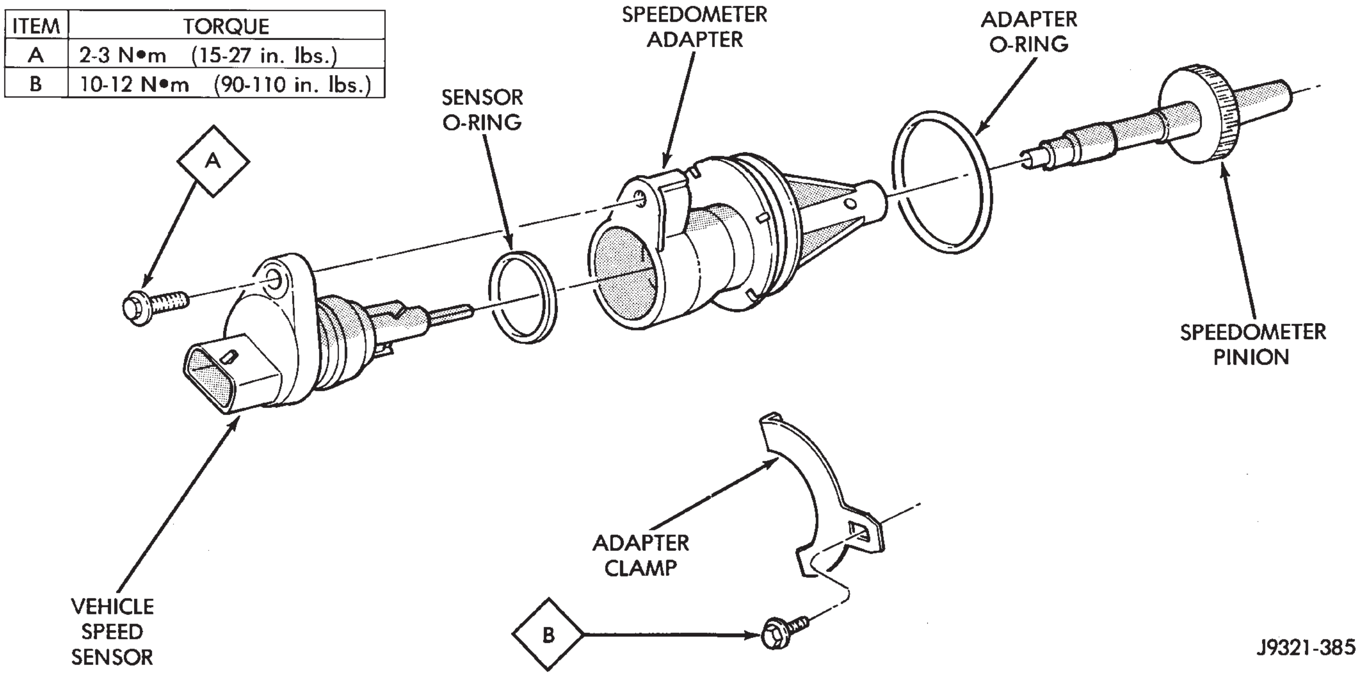


Fig. 26 Speedometer Pinion Adapter Components

(7) Note index numbers on adapter body (Fig. 27). 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.

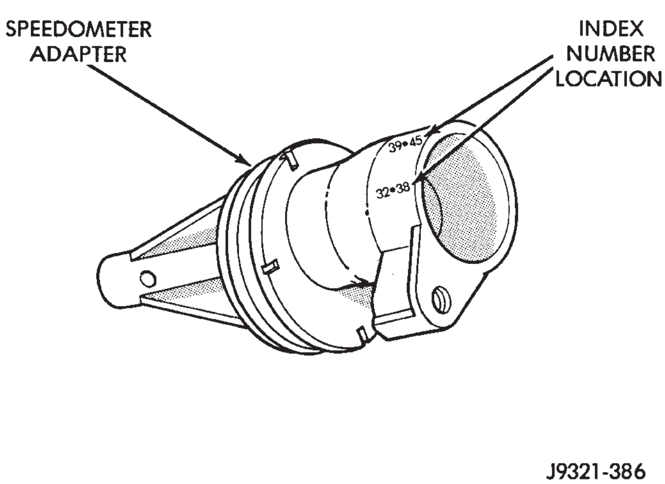


Fig. 27 Index Numbers On Speedometer Pinion Adapter

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. 28).

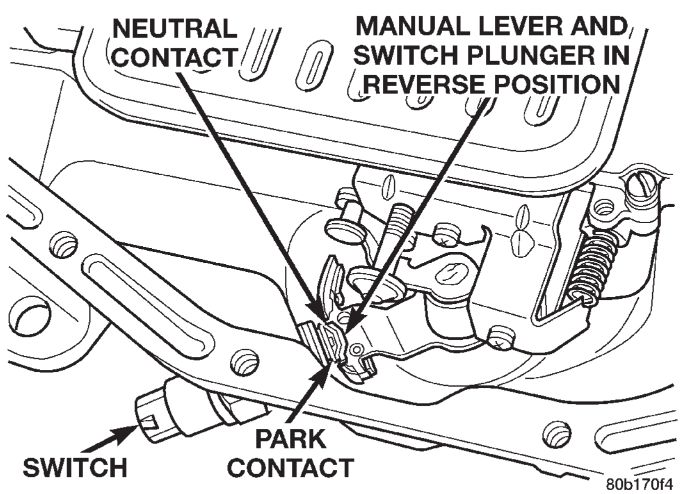


Fig. 28 Park/Neutral Position Switch

(2) Install new seal on switch and install switch in case. Tighten switch to 34 N·m (25 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(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. 29).
(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. 30).

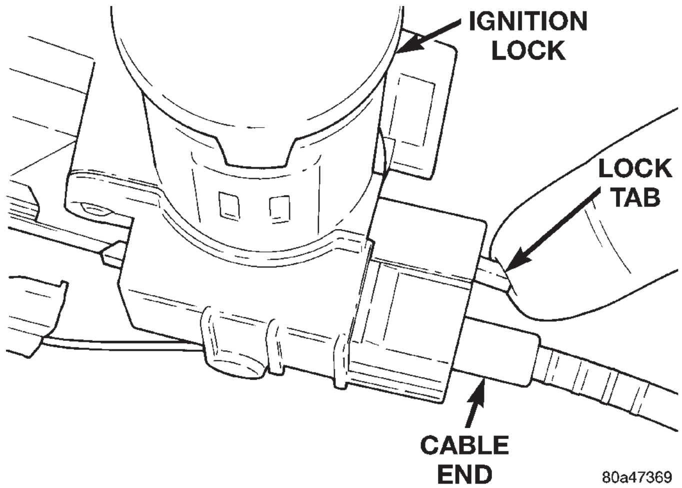


Fig. 29 Brake/Park Interlock Cable

(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. 30).
(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.

REMOVAL AND INSTALLATION (Continued)

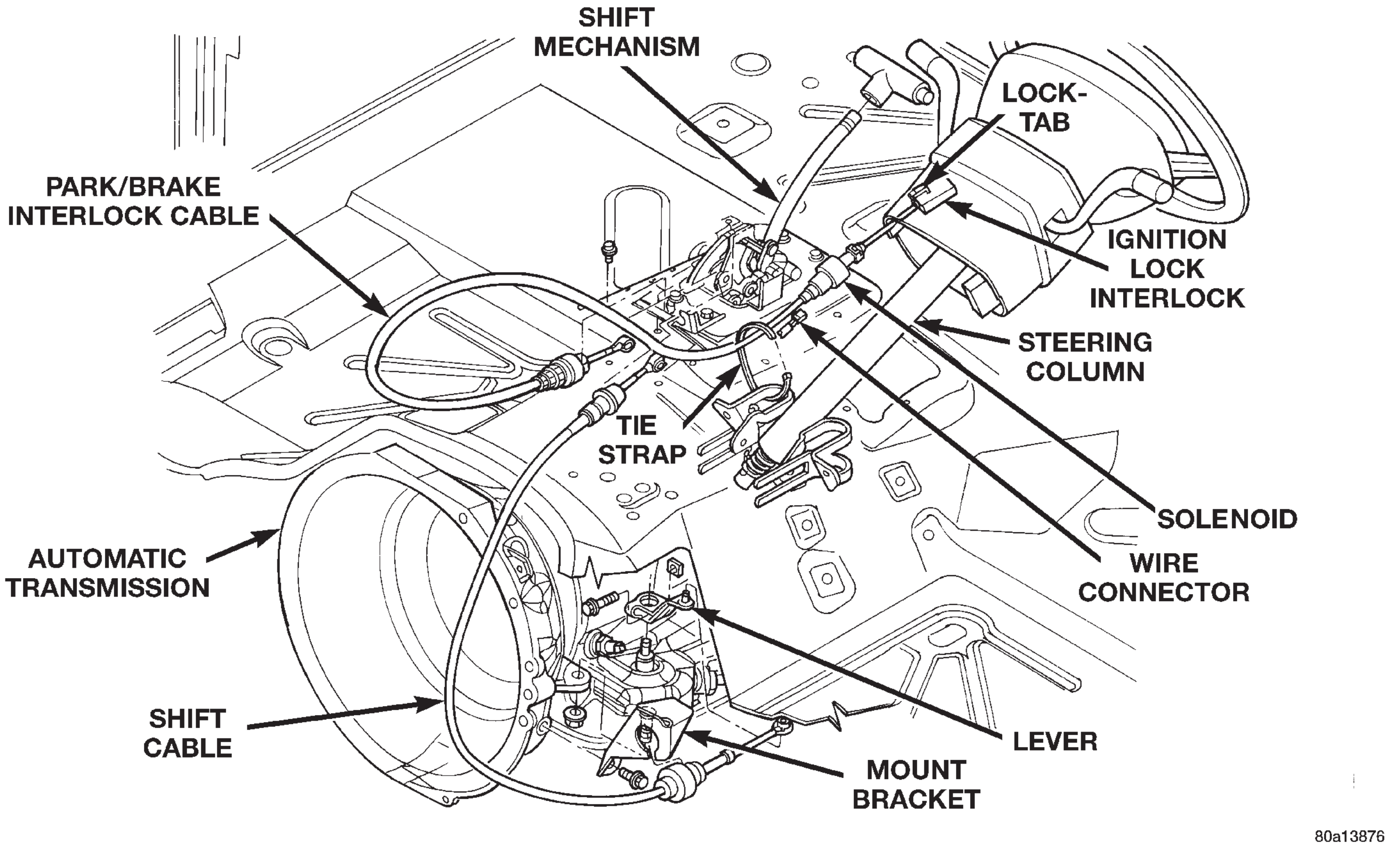


Fig. 30 Cable and Shifter

(6) Depress retaining clip and pull solenoid wire from case connector (Fig. 31).

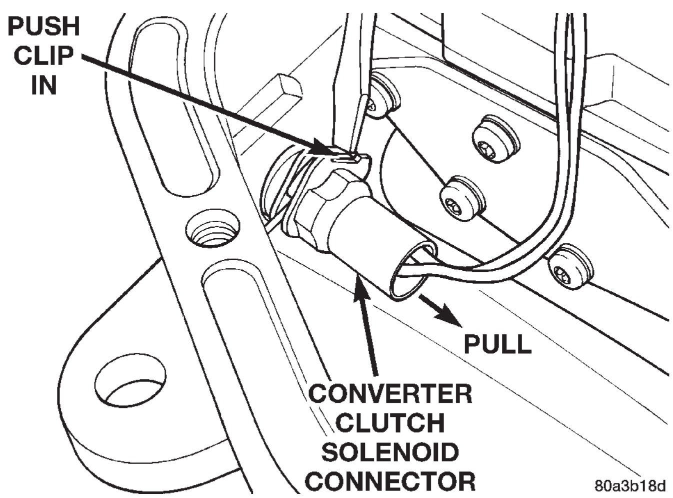


Fig. 31 Solenoid Wire Connector

(7) Remove valve body attaching screws.

(8) Lower valve body enough to remove accumulator piston and piston spring (Fig. 32).

(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. 33).

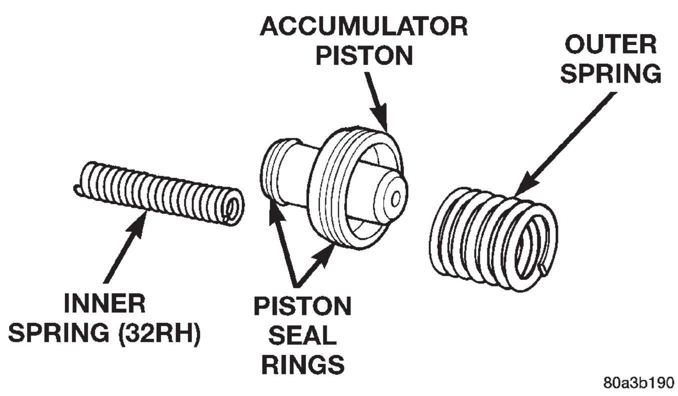


Fig. 32 Accumulator Piston And Springs

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.

REMOVAL AND INSTALLATION (Continued)

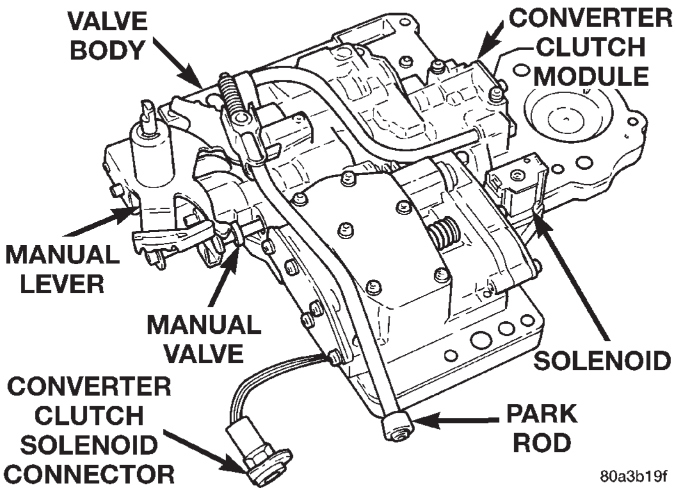


Fig. 33 Valve Body

(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. 34).

(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. 34).

(3) Install extension housing.

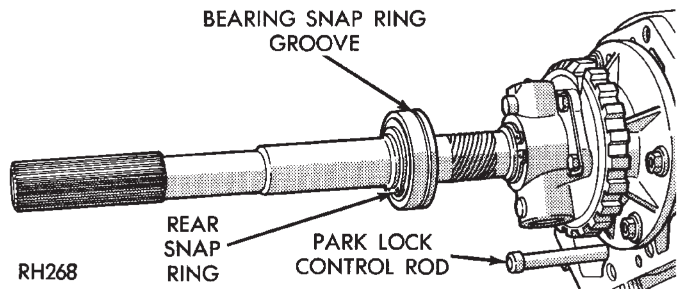


Fig. 34 Output Shaft Rear Bearing—Typical

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. 35).

(10) Remove governor valve and shaft from governor body (Fig. 35).

(11) Remove snap rings and spacer that retain governor body and park gear assembly on output shaft (Fig. 36).

(12) Remove bolts holding governor body to park gear (Fig. 37).

(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.

REMOVAL AND INSTALLATION (Continued)

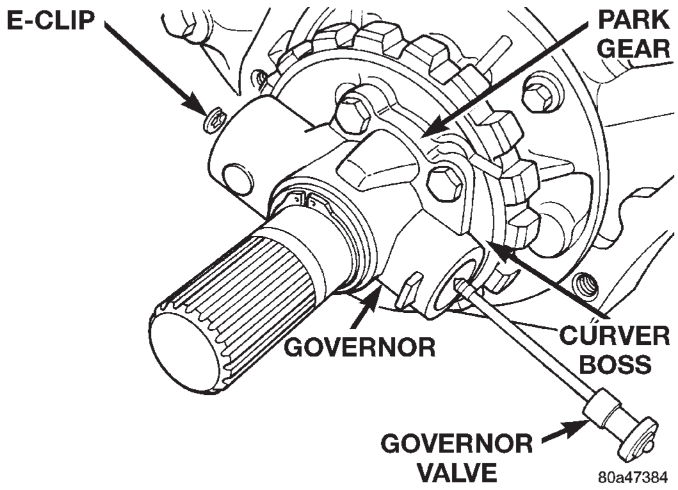


Fig. 35 Governor Valve

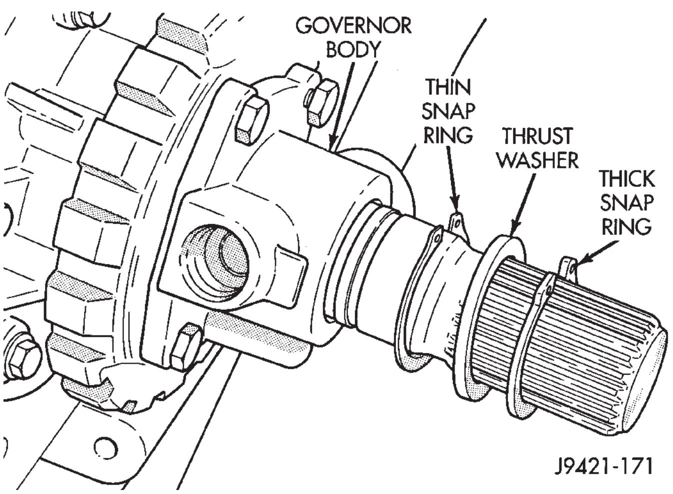


Fig. 36 Snap Rings And Spacer

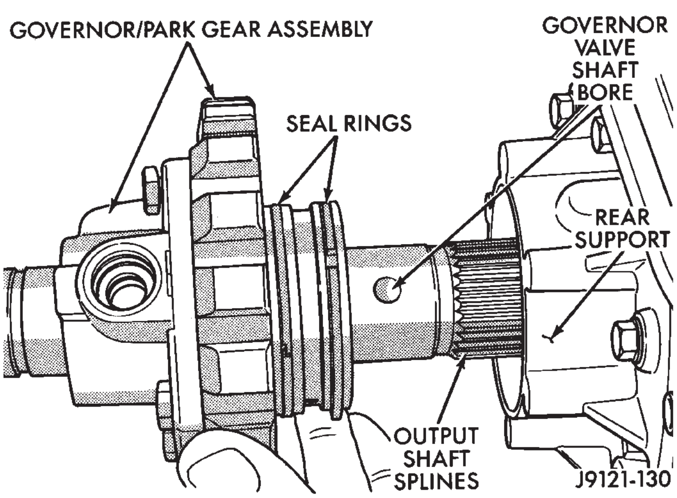


Fig. 37 Governor Body

(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. 37).

(5) Install governor body-park gear snap rings and washer on output shaft as follows:

(a) Install thin snap ring first. Then install thrust washer second, and thick snap ring last (Fig. 36).

(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. 35).

(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.

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. 38).

(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. 38).

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

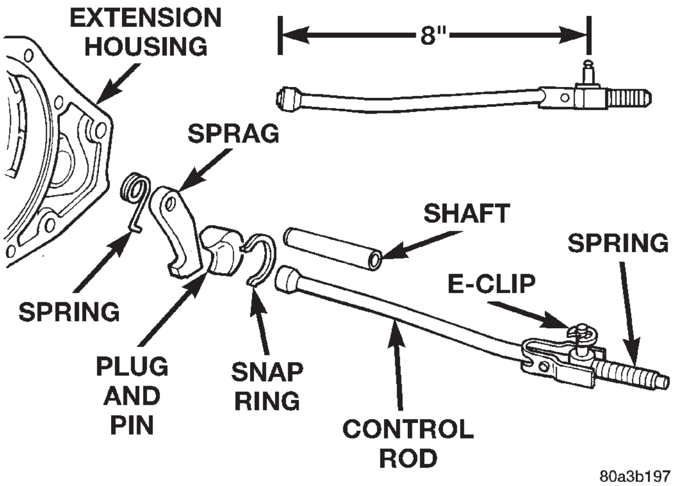


Fig. 38 Park Lock

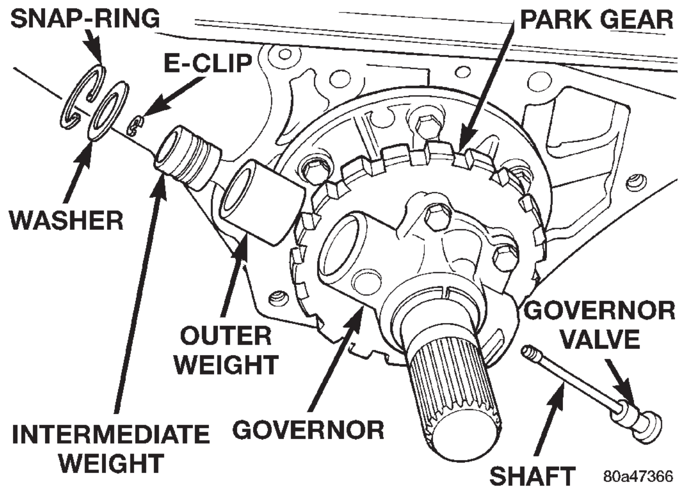


Fig. 40 Snap Ring, Washer, and Outer Weight

DISASSEMBLY AND ASSEMBLY

GOVERNOR AND PARK GEAR

DISASSEMBLY

(1) Remove governor body from transmission.

(2) Clean and inspect governor filter (Fig. 39).

(3) Remove snap ring and washer that secure governor weight assembly in body (Fig. 40).

(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. 41).

(7) Push inner weight downward with nut driver. Then remove inner weight snap ring with Miller Plier Tool 6823 (Fig. 41).

(8) Remove inner weight and spring from intermediate weight.

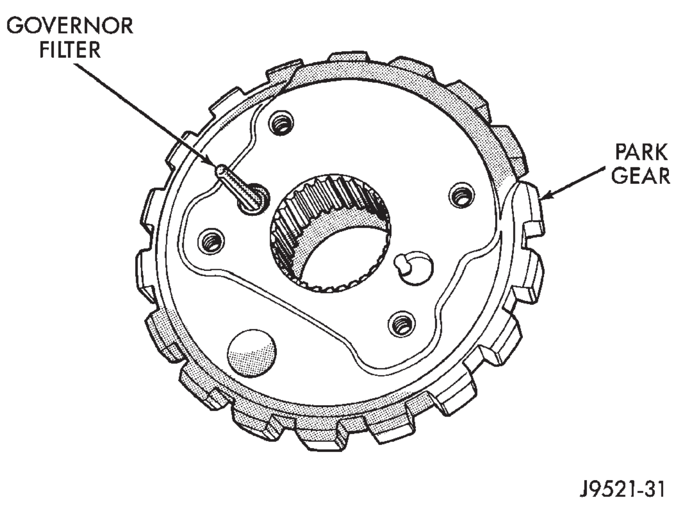


Fig. 39 Governor Filter

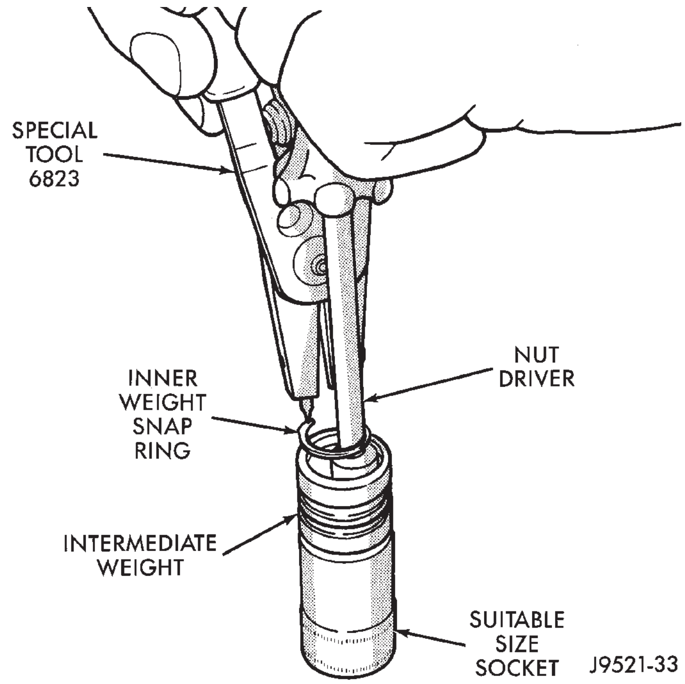


Fig. 41 Inner Weight Snap Ring

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.

DISASSEMBLY AND ASSEMBLY (Continued)

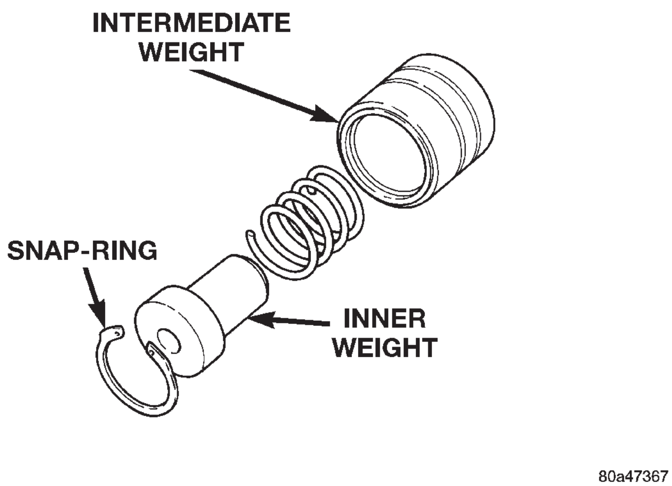


Fig. 42 Intermediate and Inner Governor Weights

(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. 42). Verify snap-ring is fully seated in groove in intermediate weight (Fig. 41).

(5) Assemble governor weights into governor body (Fig. 40).

(6) Install washer and snap ring to hold weights in governor body.

(7) Install governor body in transmission.

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. 43) 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.

(2) Remove adjusting screw bracket, line pressure adjusting screw (Fig. 44).

(3) Remove switch valve and spring, pressure regulator valve and spring, kickdown valve and spring, and throttle valve from valve body (Fig. 44).

(4) Secure detent ball and spring in housing with Retainer Tool 6583 (Fig. 45).

(5) Remove manual shaft E-clip, washer, and seal (Fig. 46).

(6) Pull manual shaft and park rod assembly upward out of valve body and off throttle lever (Fig. 46).

(7) Remove manual valve from valve body (Fig. 47).

(8) Remove Retainer Tool 6583. Then remove and retain detent ball and spring (Fig. 46).

(9) Remove throttle lever (Fig. 46).

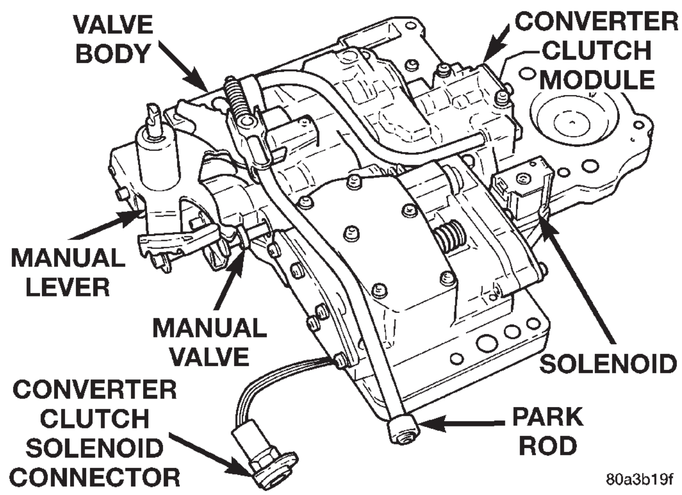


Fig. 43 Valve Body Assembly

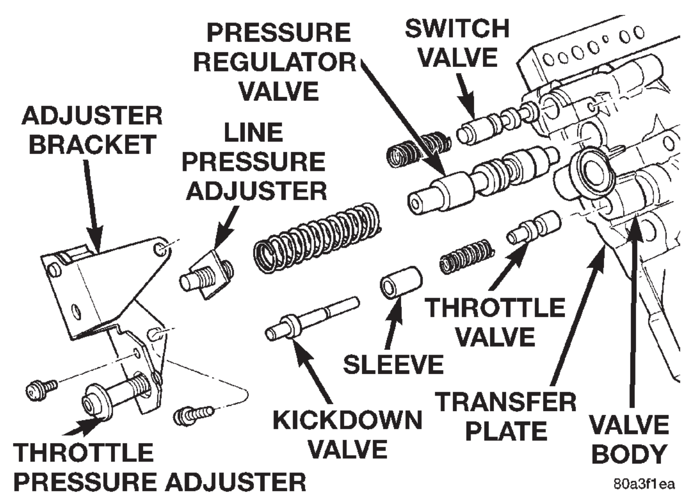


Fig. 44 Adjusting Screw Bracket, Springs, Valve Removal

(10) Remove park rod E-clip and separate rod from manual lever (Fig. 48).

DISASSEMBLY AND ASSEMBLY (Continued)

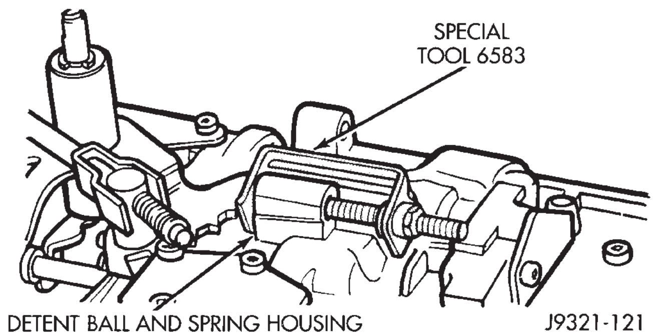


Fig. 45 Securing Detent Ball And Spring With Retainer Tool

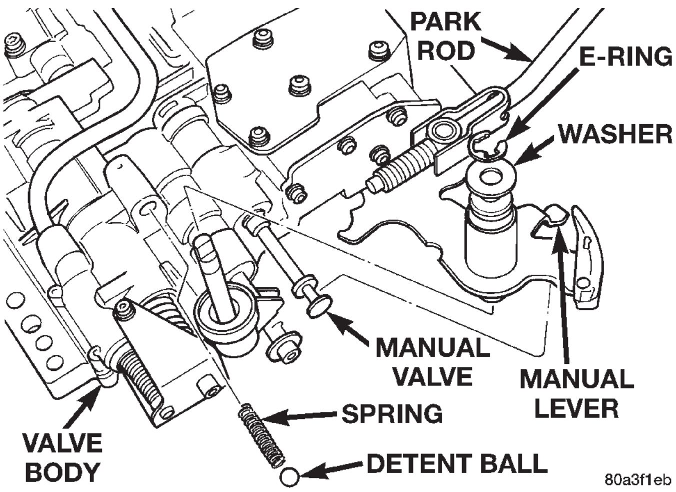


Fig. 46 Manual And Throttle Levers

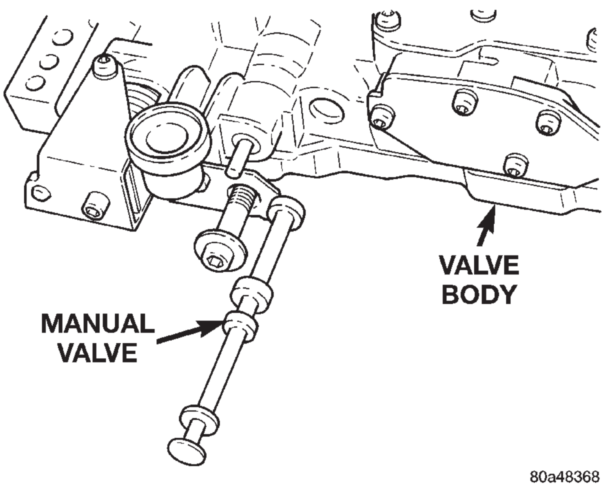


Fig. 47 Manual Valve

(11) Remove converter clutch solenoid from separator plate (Fig. 49). 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. 50).

(13) Remove screws attaching end cover plate to torque converter module (Fig. 51).

(14) Remove converter clutch valve, fail safe valve, and springs (Fig. 51).

(15) Turn valve body over so transfer plate is facing upward (Fig. 52). 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. 52).

(17) Remove transfer plate and separator plate from valve body (Fig. 52). 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.

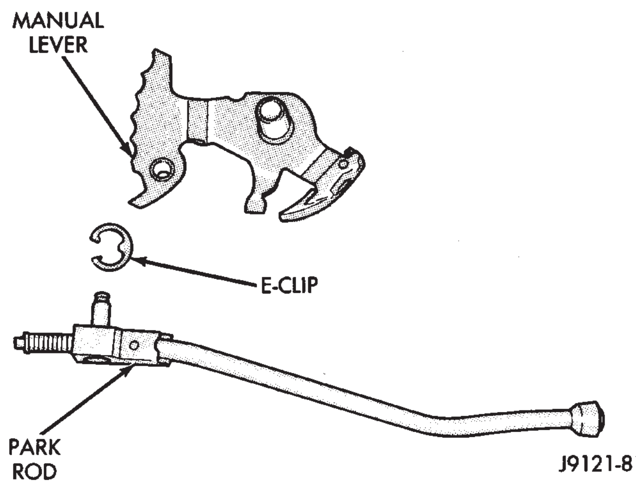


Fig. 48 Park Rod

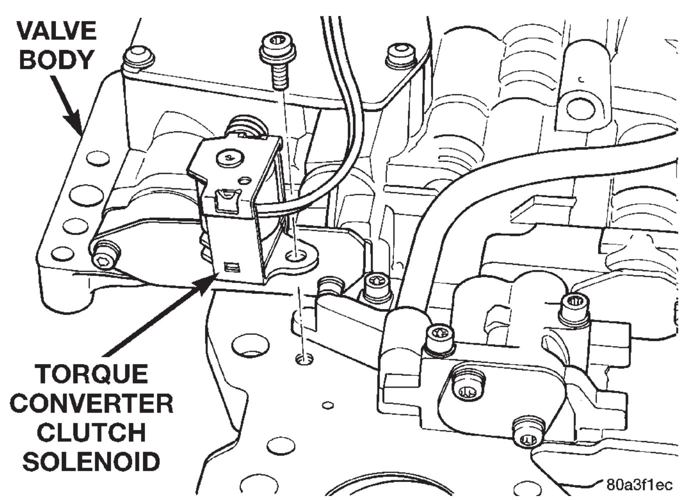


Fig. 49 Converter Clutch Solenoid

(19) Remove screws attaching separator plate to transfer plate (Fig. 53).

(20) Note position of filter, rear clutch servo and rear servo check balls for assembly reference (Fig. 53) and (Fig. 54).

DISASSEMBLY AND ASSEMBLY (Continued)

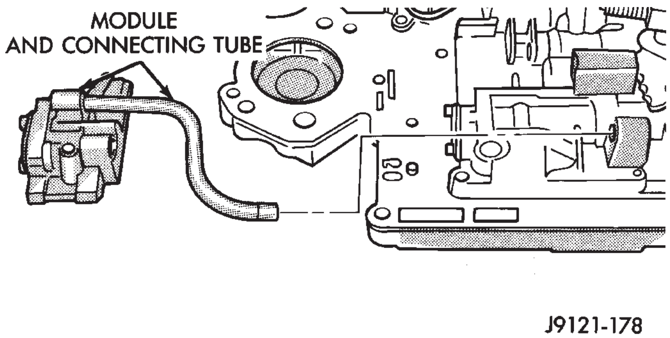


Fig. 50 Clutch Module And Connecting Tube

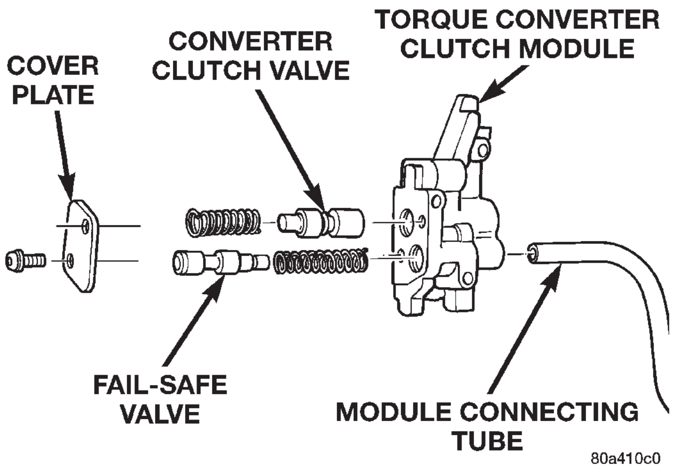


Fig. 51 Converter Clutch and Fail Safe Valves

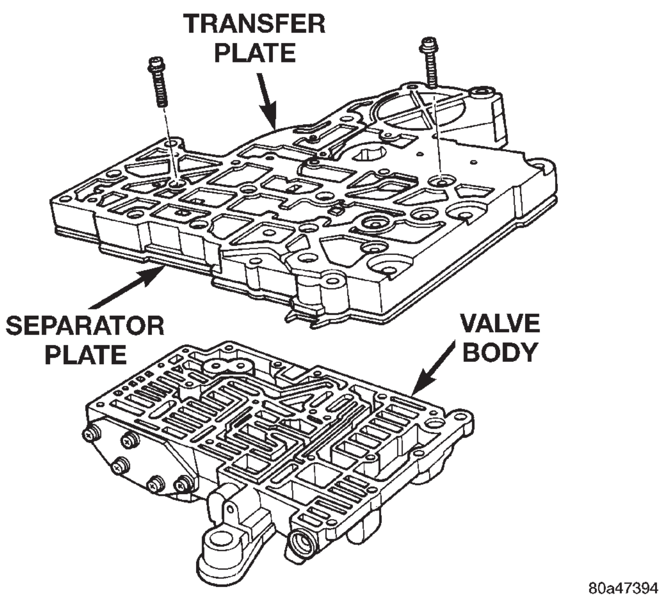


Fig. 52 Valve Body Transfer Plate Screws

(21) Remove shuttle valve end plate (Fig. 55).

(22) Remove shuttle valve E-clip and remove secondary spring and spring guides from end of valve (Fig. 56).

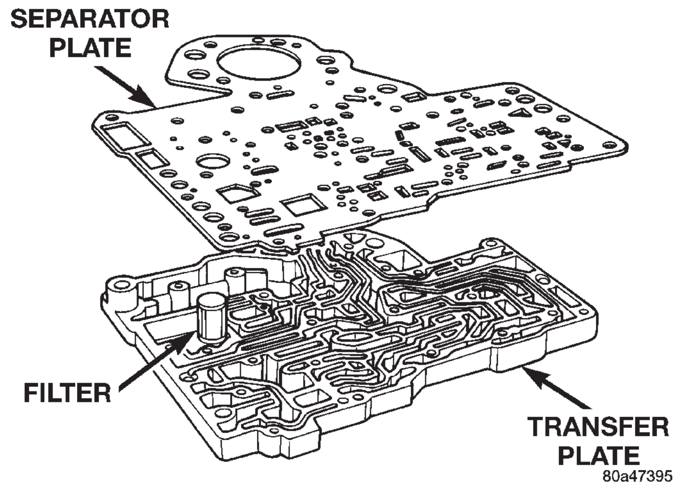


Fig. 53 Transfer And Separator Plates

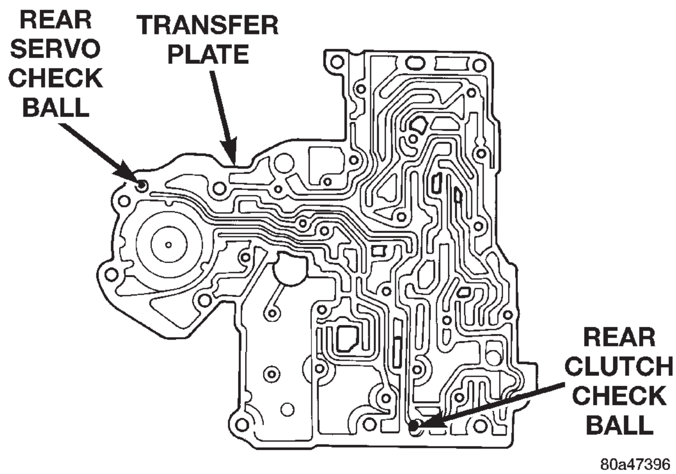


Fig. 54 Rear Servo and Rear Clutch Check Balls

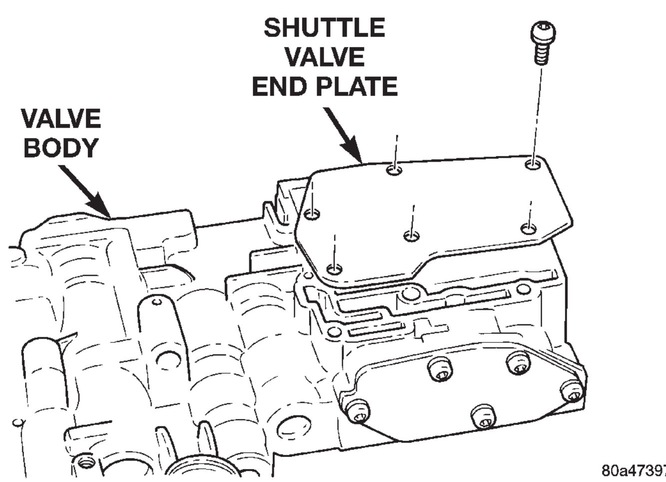


Fig. 55 Shuttle Valve End Plate

(23) Remove governor plug end plate (Fig. 57).

DISASSEMBLY AND ASSEMBLY (Continued)

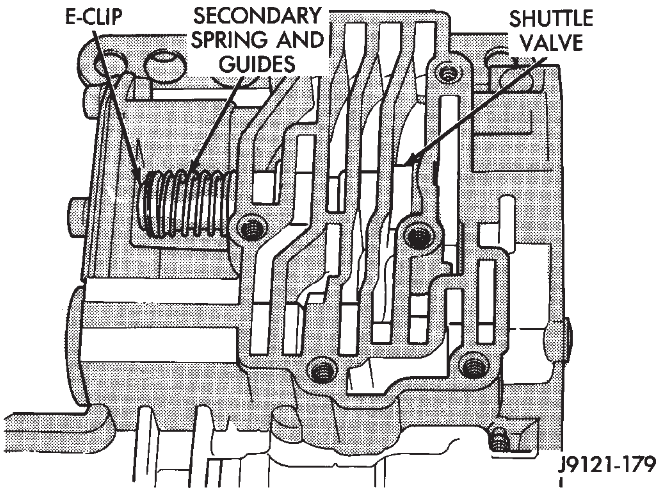


Fig. 56 Shuttle Valve E-Clip And Secondary Spring

(24) Remove 1-2 and 2-3 shift valve governor plugs from valve body (Fig. 57).

(25) Remove shuttle valve throttle plug, primary spring and shuttle valve from valve body (Fig. 57).

(26) Remove screws attaching kickdown limit valve body to valve body (Fig. 57).

(27) Remove 1-2 shift control valve and spring from valve body (Fig. 57).

(28) Remove 2-3 shift valve and spring from valve body (Fig. 57).

(29) Remove 1-2 shift valve and spring from valve body (Fig. 57).

(30) Remove throttle pressure plug from kickdown limit valve body (Fig. 57).

(31) Remove retainer from end of kickdown limit valve body (Fig. 57).

(32) Remove kickdown limit valve and spring from kickdown limit valve body (Fig. 57).

(33) Remove regulator valve end plate from valve body (Fig. 57).

(34) Remove regulator valve line pressure plug, pressure plug sleeve, regulator valve throttle pressure plug and spring (Fig. 57).

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.

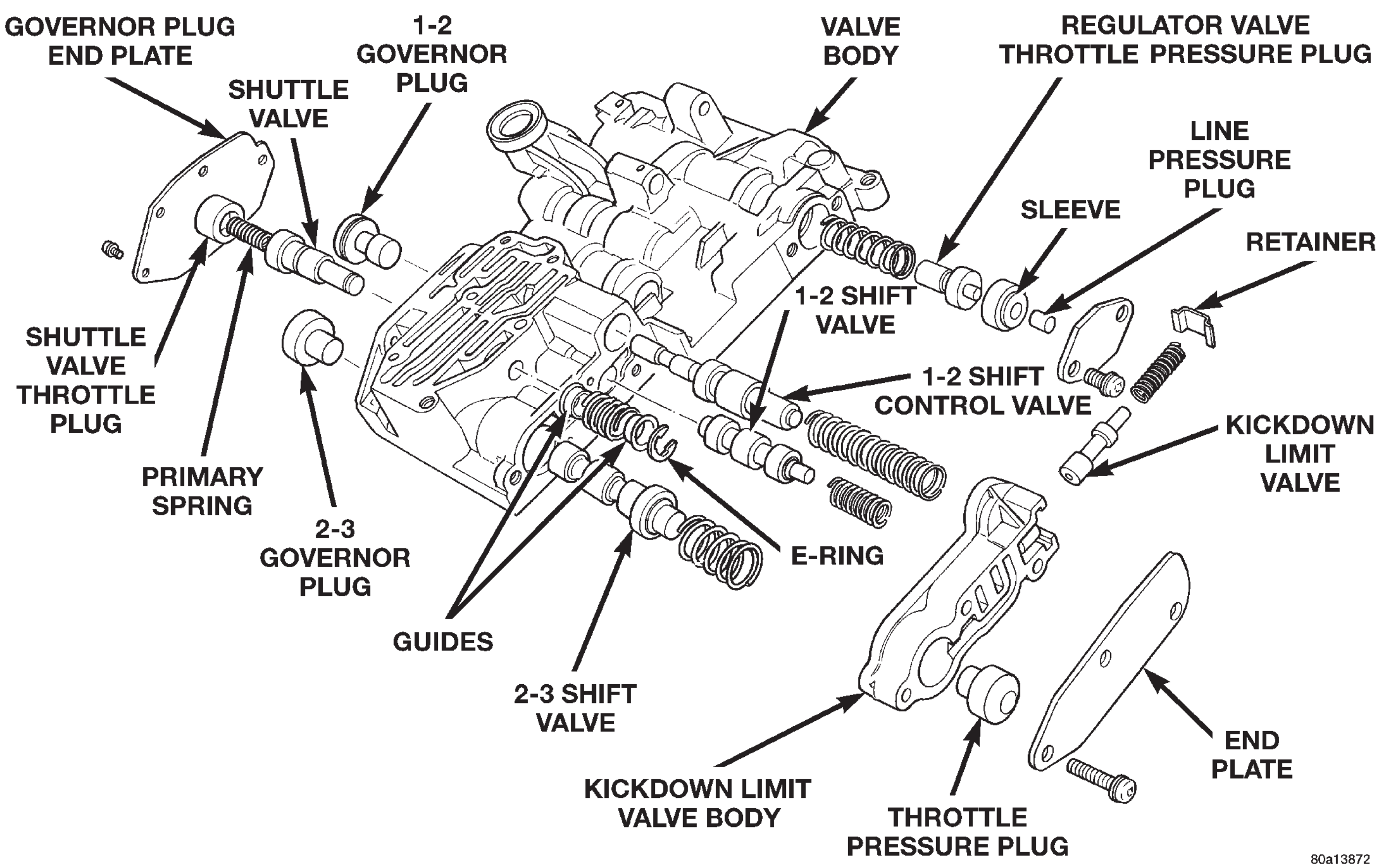


Fig. 57 Control Valves, Shift Valves, And Governor Plugs

DISASSEMBLY AND ASSEMBLY (Continued)

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. 57). Verify valve components slide freely.

(3) Install regulator valve end plate on valve body (Fig. 57).

(4) Install kickdown limit valve and spring in kickdown limit valve body (Fig. 57). 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. 57).

(7) Install throttle pressure plug in kickdown limit valve body (Fig. 57).

(8) Install 1-2 shift valve and spring into valve body (Fig. 57).

(9) Install 2-3 shift valve and spring into valve body (Fig. 57).

(10) Install 1-2 shift control valve and spring into valve body (Fig. 57).

(11) Verify valve components slide freely.

(12) Place kickdown limit valve body and end plate in position on valve body and compress springs (Fig. 57).

(13) Install screws to attach kickdown limit valve body to valve body (Fig. 57).

(14) Install shuttle valve throttle plug, primary spring and shuttle valve into valve body (Fig. 57). Verify valve components slide freely.

(15) Install 1-2 and 2-3 shift valve governor plugs into valve body (Fig. 57). 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. 57).

(18) Assemble shuttle valve spring and guides (Fig. 57). Place spring and guides in position on shuttle valve stem.

(19) Compress spring and install E-clip in groove on shuttle valve stem (Fig. 58).

(20) Place shuttle valve end plate in position on valve body (Fig. 59).

(21) Install screws to attach shuttle valve end plate to valve body (Fig. 59).

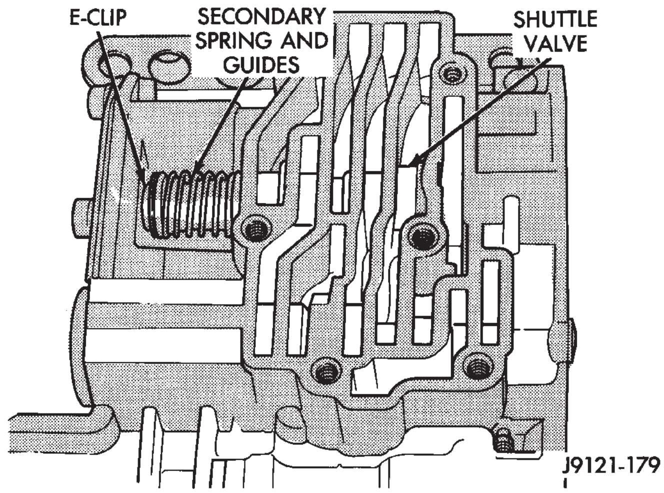


Fig. 58 Shuttle Valve E-Clip And Secondary Spring

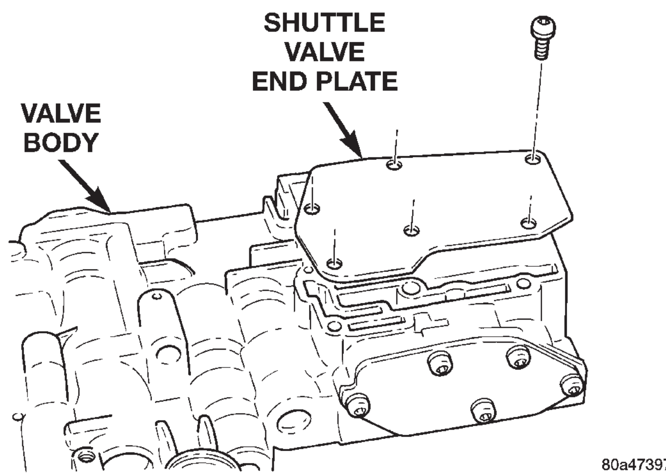


Fig. 59 Shuttle Valve End Plate

(22) Install rear clutch servo and rear servo check balls in proper cavities in transfer plate (Fig. 60).

(23) Insert filter into opening in separator plate (Fig. 61).

(24) Place separator plate in position on transfer plate and install screws to attach separator plate to transfer plate (Fig. 61).

(25) Place one 11/32 in. check ball and six 1/4 in. check balls in the proper cavities in the valve body (Fig. 62).

(26) Place transfer plate in position on valve body (Fig. 63).

(27) Install screws to attach transfer plate to valve body (Fig. 63).

(28) Turn valve body over to expose the separator plate.

DISASSEMBLY AND ASSEMBLY (Continued)

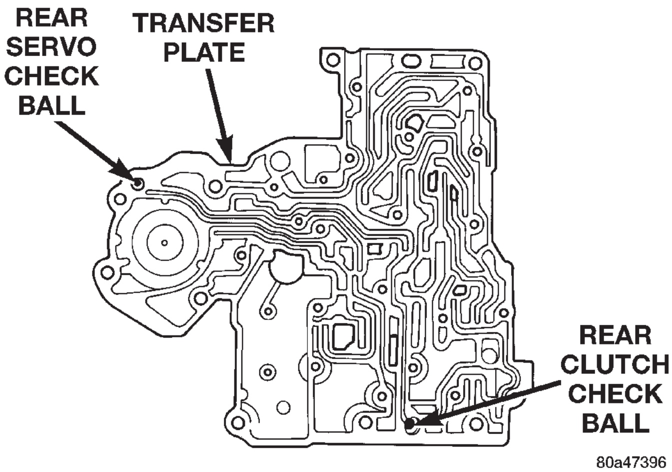


Fig. 60 Rear Servo and Rear Clutch Check Balls

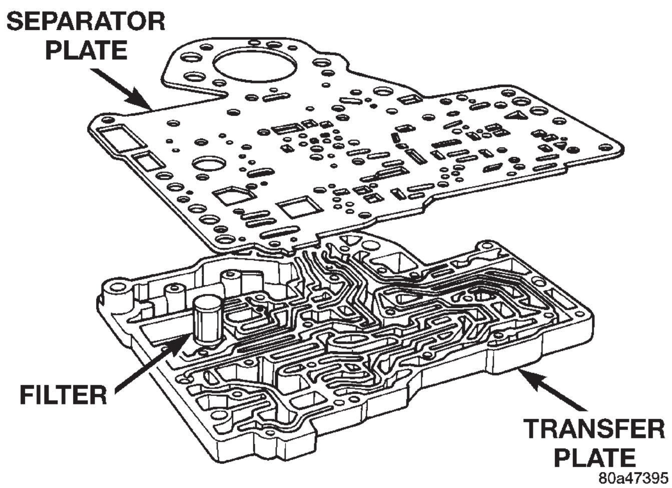


Fig. 61 Transfer And Separator Plates

(29) Insert converter clutch valve and spring into converter clutch valve module (Fig. 64). Verify valve components slide freely.

(30) Insert spring and fail-safe valve into converter clutch valve module (Fig. 64). Verify valve components slide freely.

(31) Place cover plate in position on converter clutch valve module (Fig. 64).

(32) Install screws to attach cover to converter clutch valve module (Fig. 64).

(33) Insert connecting tube into converter clutch valve module (Fig. 64).

(34) Insert connecting tube into valve body opening (Fig. 65).

(35) Place converter clutch valve module in position on separator plate. Install screws to attach converter clutch module to valve body (Fig. 65).

(36) If necessary, install a new O-ring on converter clutch solenoid (Fig. 66).

(37) Insert converter clutch solenoid into transfer plate (Fig. 66).

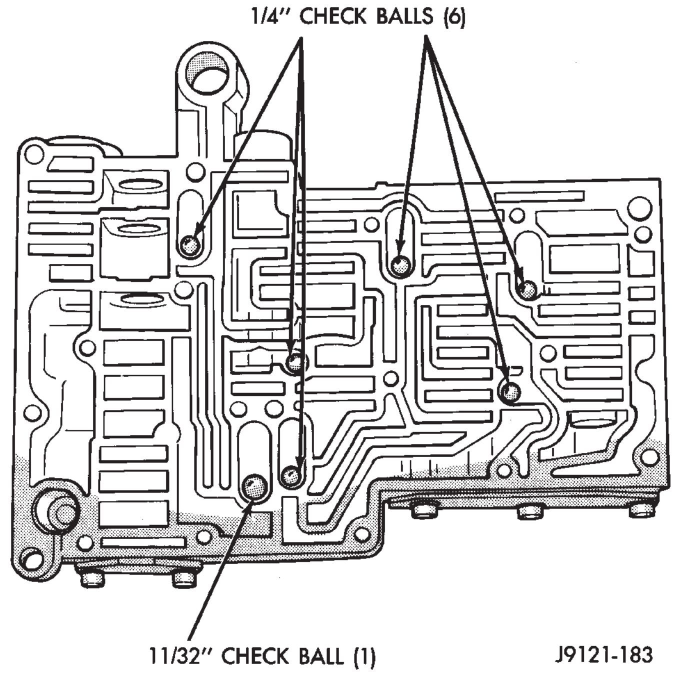


Fig. 62 Correct Position Of Valve Body Check Balls

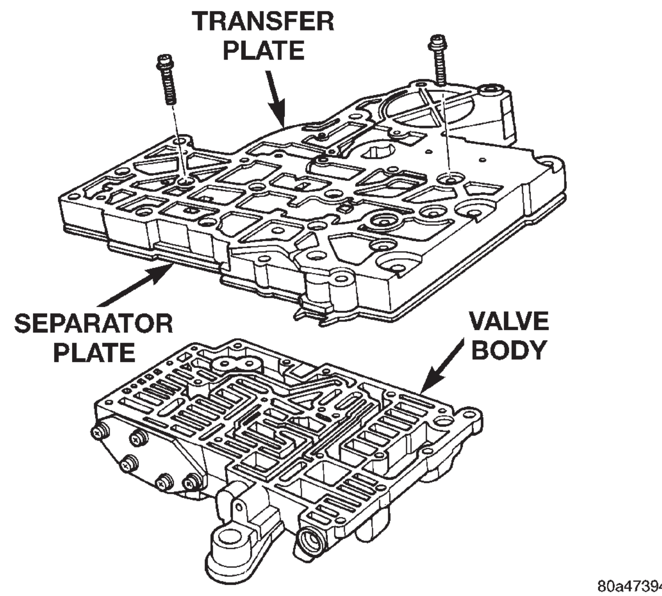


Fig. 63 Valve Body Transfer Plate Screws

(38) Install screw to attach solenoid to transfer plate (Fig. 66).

(39) If necessary, insert park rod end into manual lever and install E-clip (Fig. 67).

(40) Insert detent spring and ball into opening in valve body and install Retainer Tool 6583 (Fig. 68).

(41) Install manual valve into valve body (Fig. 69).

(42) Insert throttle lever through transfer plate side of valve body and upward (Fig. 70).

DISASSEMBLY AND ASSEMBLY (Continued)

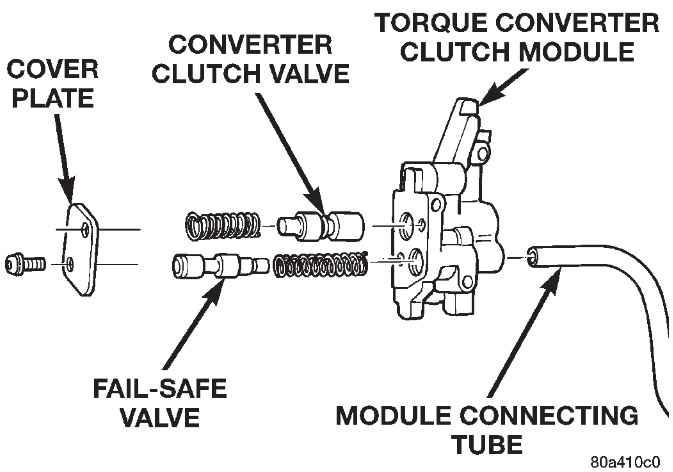


Fig. 64 Converter Clutch Valve Module

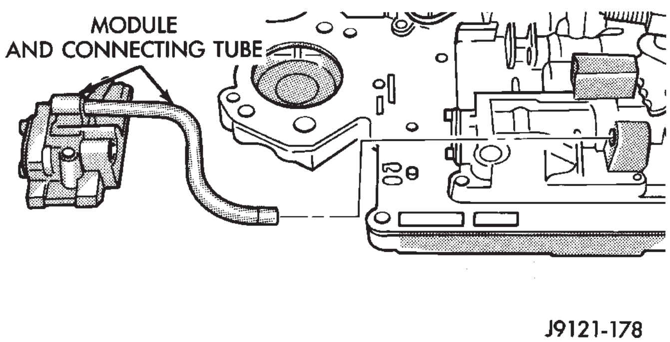


Fig. 65 Clutch Module And Connecting Tube

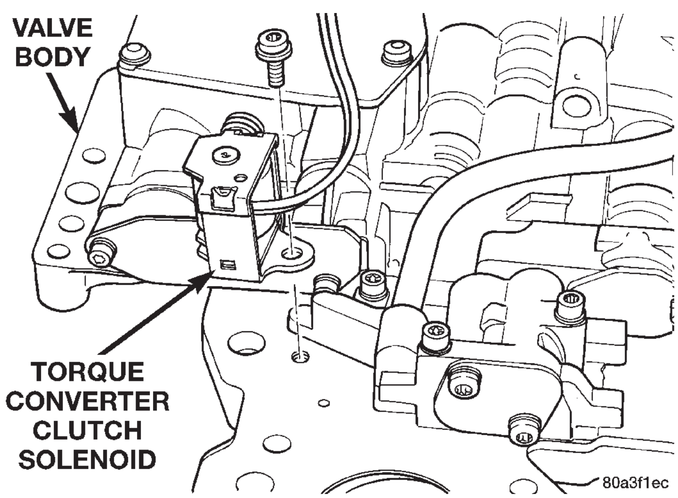


Fig. 66 Converter Clutch Solenoid

(43) Insert throttle lever into groove in manual valve (Fig. 71).

(44) Install seal, washer, and E-clip to retain manual shaft to valve body (Fig. 70).

(45) Install switch valve and spring, pressure regulator valve and spring, kickdown valve and spring, and throttle valve into valve body (Fig. 72).

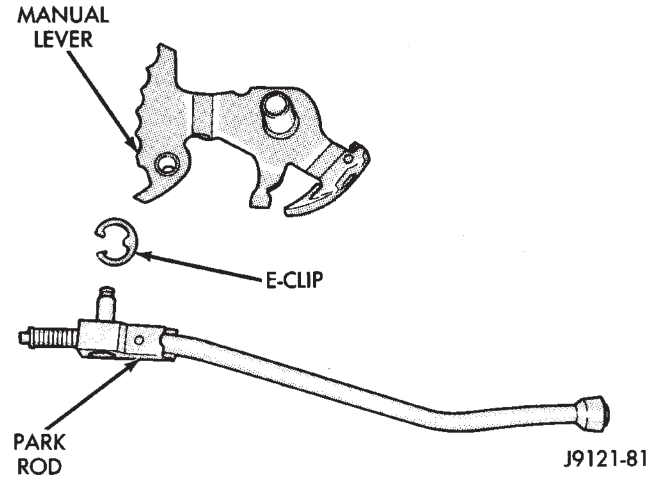


Fig. 67 Park Rod

(46) Place adjusting screw bracket and line pressure adjusting screw in position on valve body and compress springs (Fig. 44).

(47) Install screws to attach adjuster bracket to valve body.

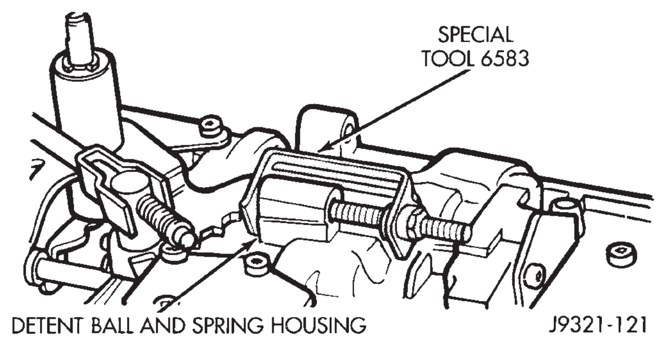


Fig. 68 Securing Detent Ball And Spring With Retainer Tool

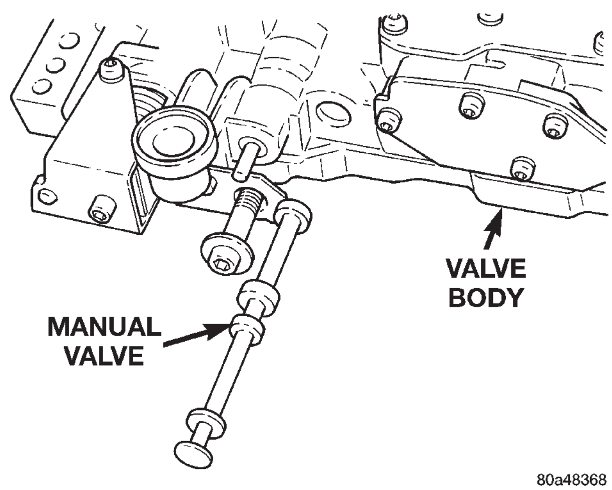


Fig. 69 Manual Valve

DISASSEMBLY AND ASSEMBLY (Continued)

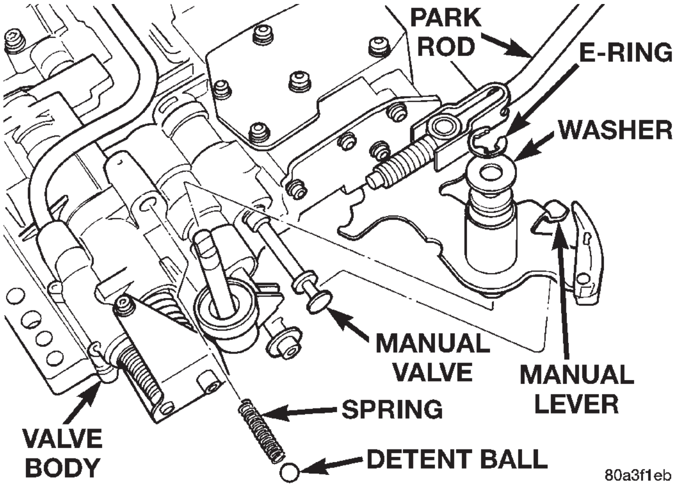


Fig. 70 Manual And Throttle Levers

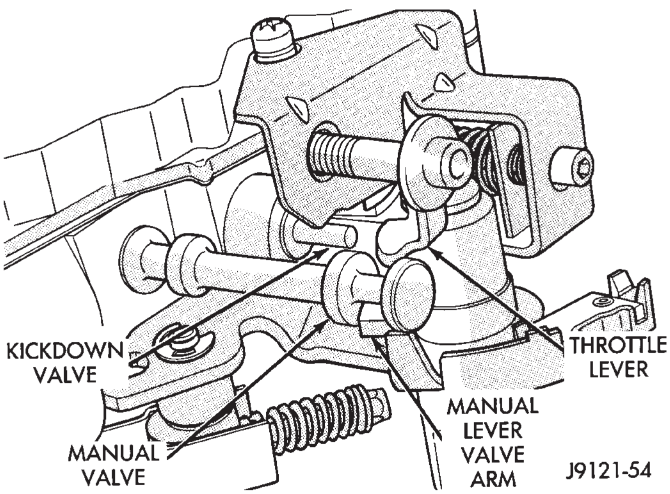


Fig. 71 Manual Valve And Throttle Lever Alignment

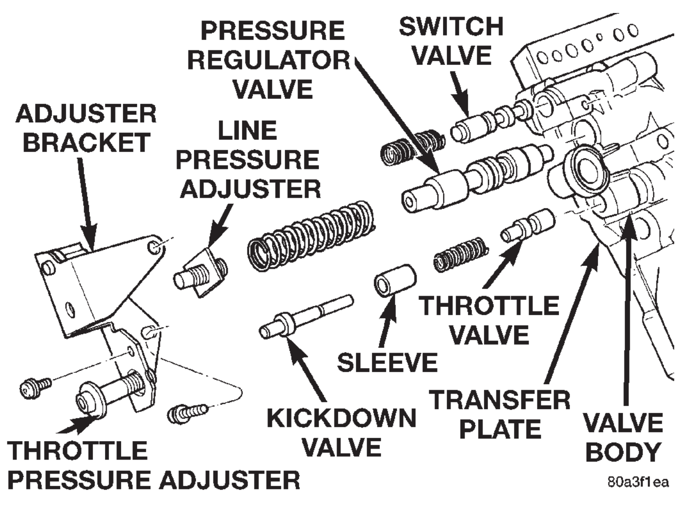


Fig. 72 Adjusting Screw Bracket, Springs, and Valves

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. 73).

(7) Remove extension housing.

(8) Remove fluid pan.

(9) Remove park/neutral position switch and seal (Fig. 74).

(10) Remove valve body.

(11) Remove accumulator spring and piston (Fig. 75).

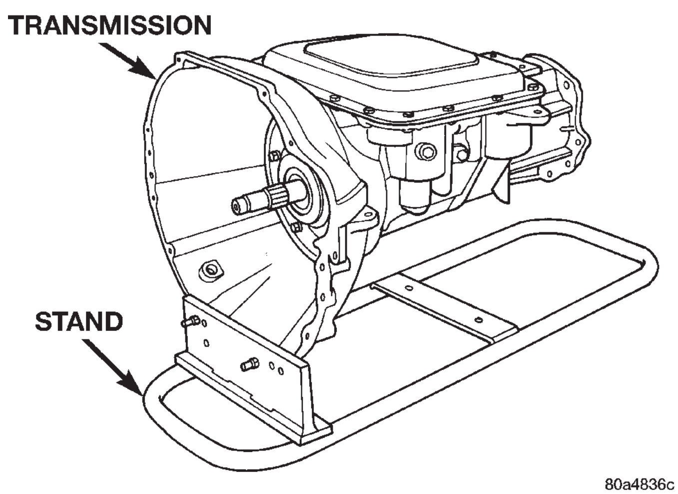


Fig. 73 Repair Stand

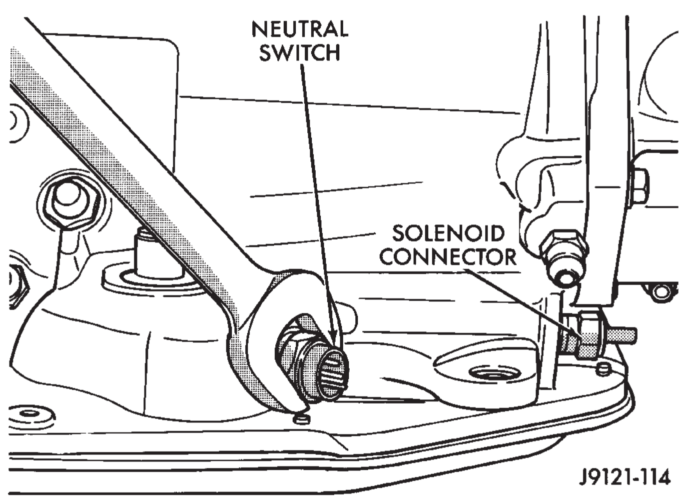


Fig. 74 Park/Neutral Position Switch

DISASSEMBLY AND ASSEMBLY (Continued)

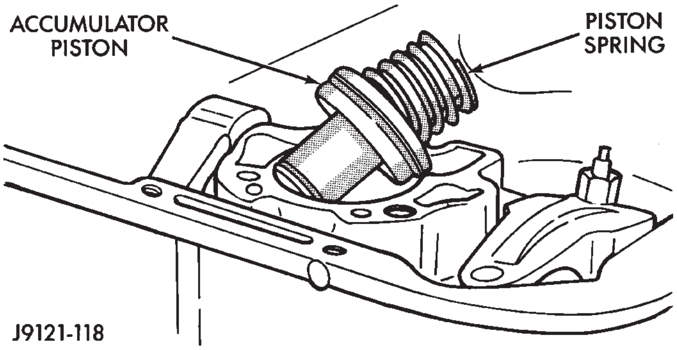


Fig. 75 Accumulator Piston And Spring

(12) Loosen front band adjusting screw lock nut (Fig. 76) 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. 77).

(15) Bump slide hammer weights outward to remove pump and reaction shaft support assembly from case (Fig. 77).

(16) Loosen front band adjusting screw until band is completely loose (Fig. 76).

(17) Squeeze front band together and remove band strut (Fig. 78).

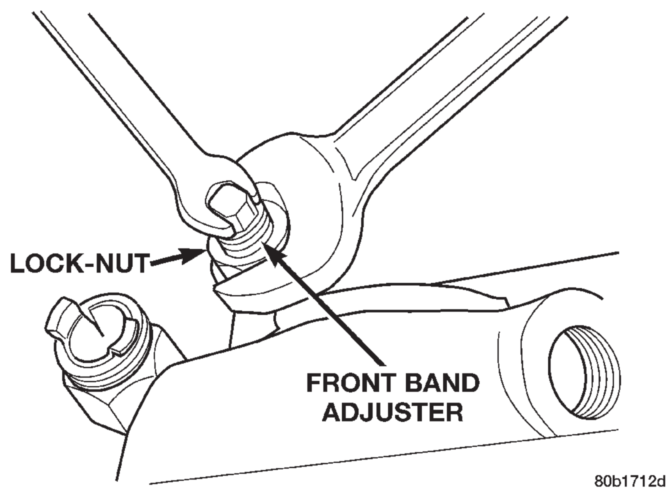


Fig. 76 Front Band Adjusting Screw Lock Nut

(18) Remove front and rear clutch units as an assembly. Grasp input shaft, hold clutch units together and remove them from case (Fig. 79).

(19) Lift front clutch off rear clutch (Fig. 80). Set clutch units aside for overhaul.

(20) Remove output shaft thrust washer from output shaft (or from rear clutch hub) (Fig. 81).

(21) Remove output shaft thrust plate and washer from output shaft hub (Fig. 81).

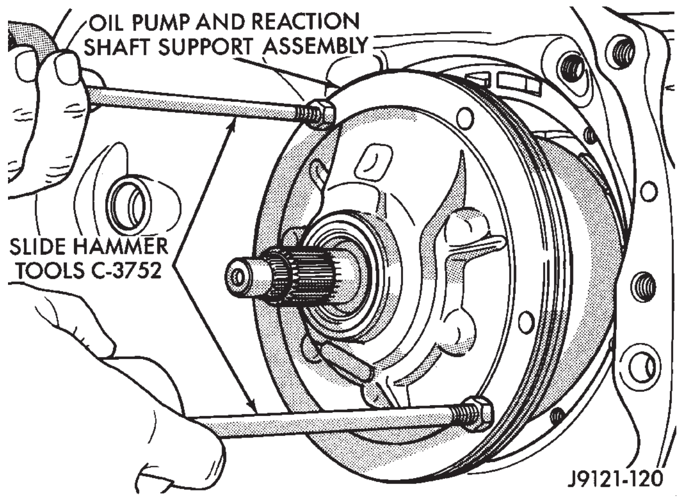


Fig. 77 Oil Pump/Reaction Shaft Support

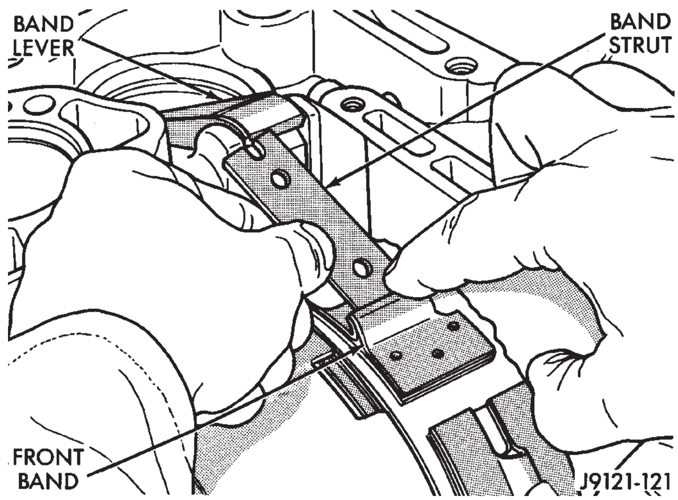


Fig. 78 Front Band Strut

(22) Remove front band from case (Fig. 82).

(23) Remove extension housing from transmission case.

(24) Remove governor body and park gear from output shaft.

(25) Remove output shaft and planetary geartrain as assembly (Fig. 83). 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. 84).

(27) Remove snap ring that secures low-reverse drum to rear support hub, however do not remove drum (Fig. 85).

(28) Remove bolts attaching rear support to transmission case and pull support from low-reverse drum (Fig. 86).

(29) Remove bolts attaching overrunning clutch cam and low-reverse drum to transmission case (Fig. 87).

DISASSEMBLY AND ASSEMBLY (Continued)

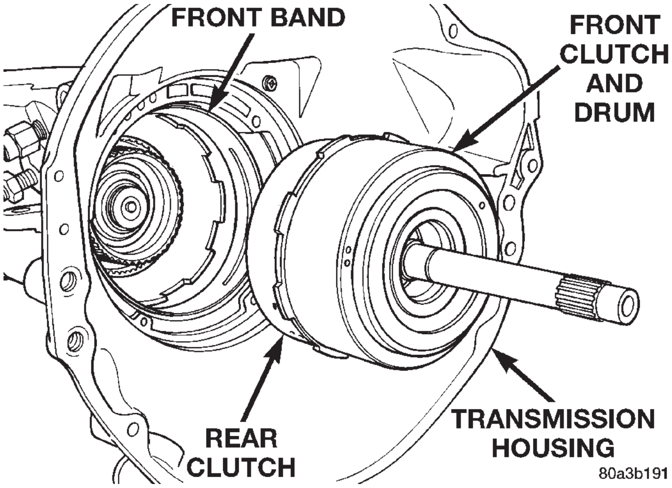


Fig. 79 Front/Rear Clutch Assemblies

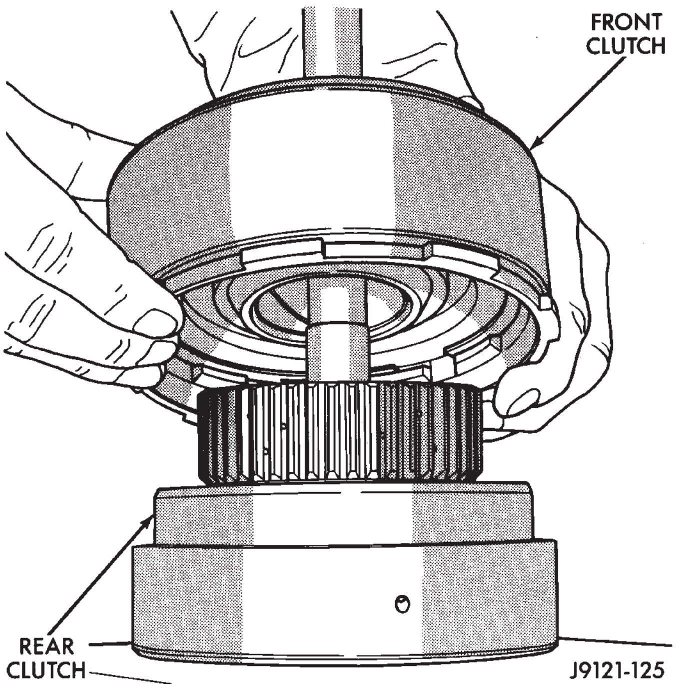


Fig. 80 Separating Front Clutch From Rear Clutch

(30) Using snap-ring plier, pull rear band anchor pin (located on the servo side of the rear support) from transmission case.

(31) Remove rear band and link from transmission (Fig. 88).

(32) Separate link from rear band (Fig. 89).

(33) 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. 90).

(b) Remove front band reaction pin with pencil magnet. Pin is accessible from converter housing side of case (Fig. 91).

(c) Remove front band lever (Fig. 92).

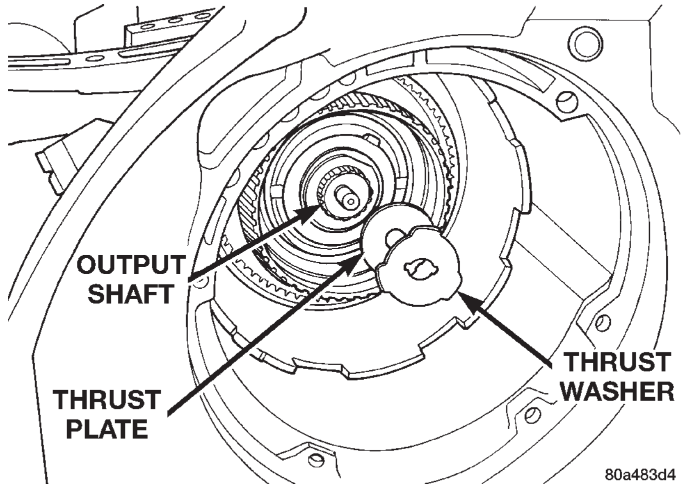


Fig. 81 Output Shaft Thrust Plate and Washer

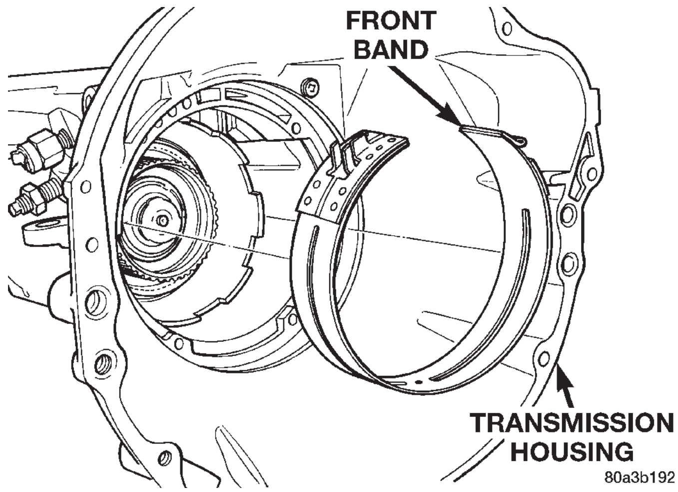


Fig. 82 Front Band

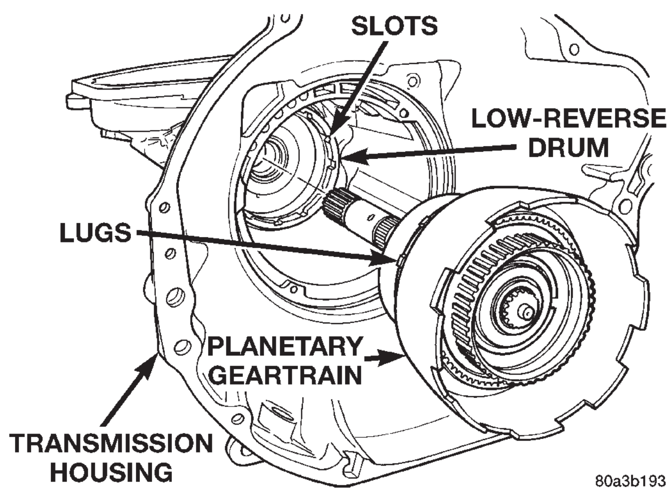


Fig. 83 Planetary Geartrain

(d) Using snap-ring plier, pull rear band lever pivot from transmission case (Fig. 93).

(e) Separate rear band servo lever from transmission.

DISASSEMBLY AND ASSEMBLY (Continued)

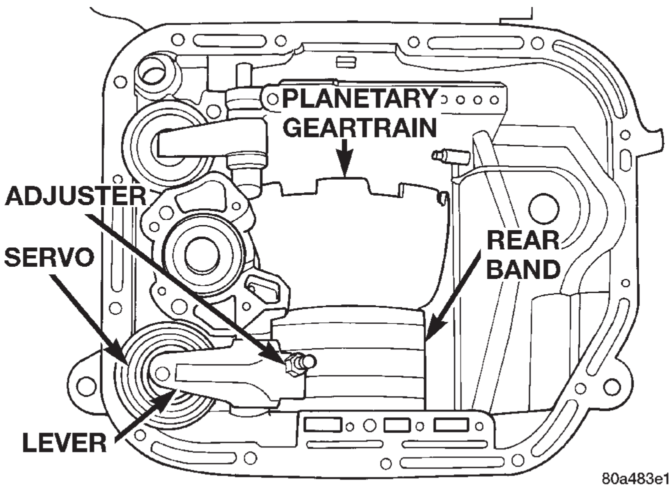


Fig. 84 Rear Band Adjuster Location

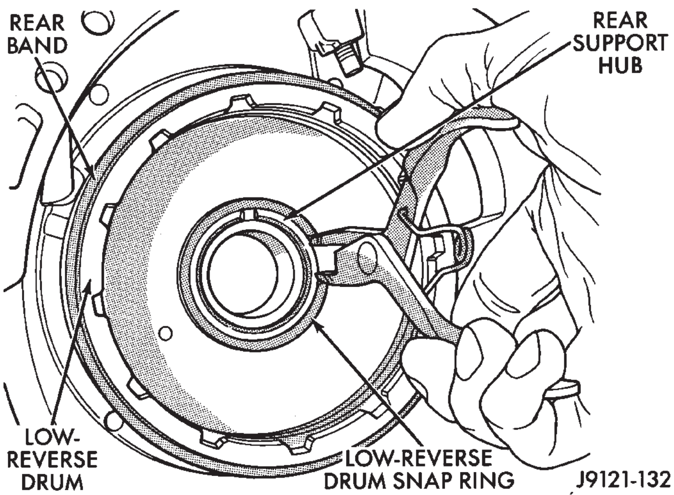


Fig. 85 Low-Reverse Drum Snap Ring

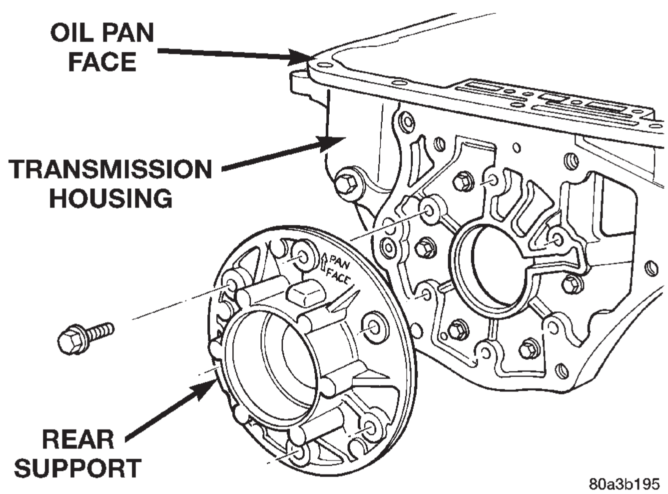


Fig. 86 Rear Support

(34) 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. 94).

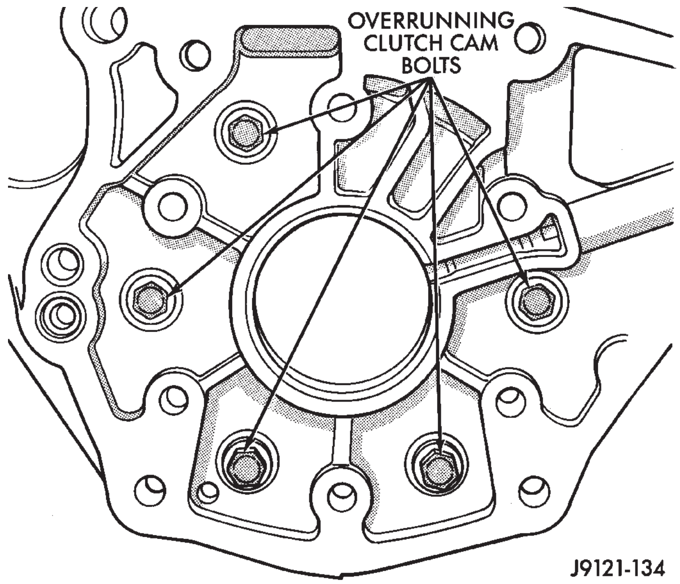


Fig. 87 Overrunning Clutch Cam Bolt Locations

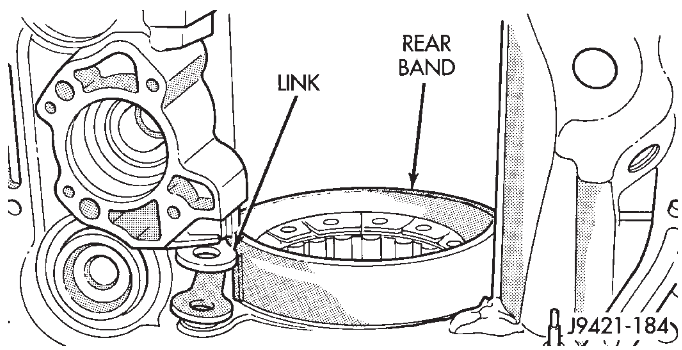


Fig. 88 Rear Band and Link

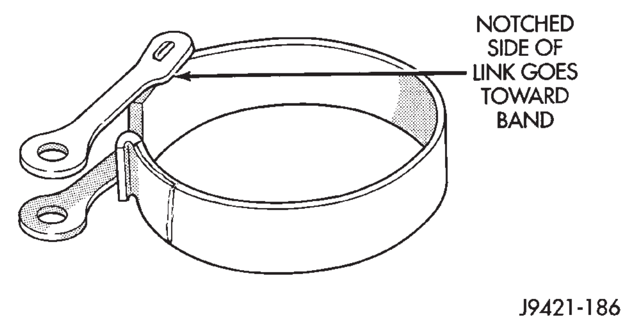


Fig. 89 Rear Band and Link

(35) Remove front servo rod guide snap ring (Fig. 94). **Exercise caution when removing snap ring. Servo bore can be scratched or nicked if care is not exercised.**

(36) Remove compressor tools and remove front servo rod guide, spring and servo piston.

(37) Compress rear servo spring retainer about 1/16 in. with C-clamp and Tool C-4470 or SP-5560 (Fig. 95). Valve Spring Compressor C-3422-B can also be used to compress spring retainer.

DISASSEMBLY AND ASSEMBLY (Continued)

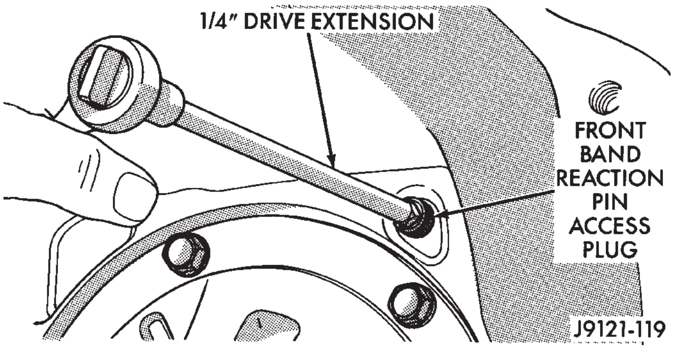


Fig. 90 Front Band Reaction Pin Access Plug

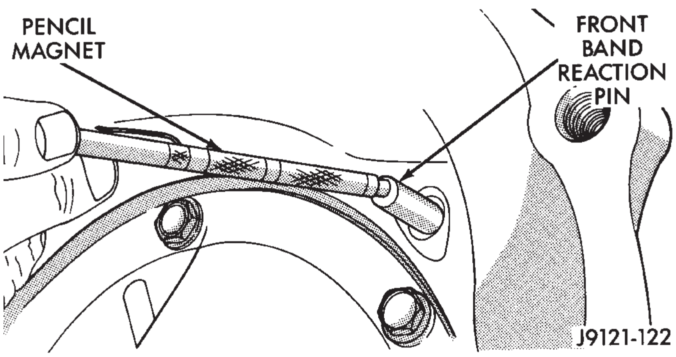


Fig. 91 Front Band Reaction Pin

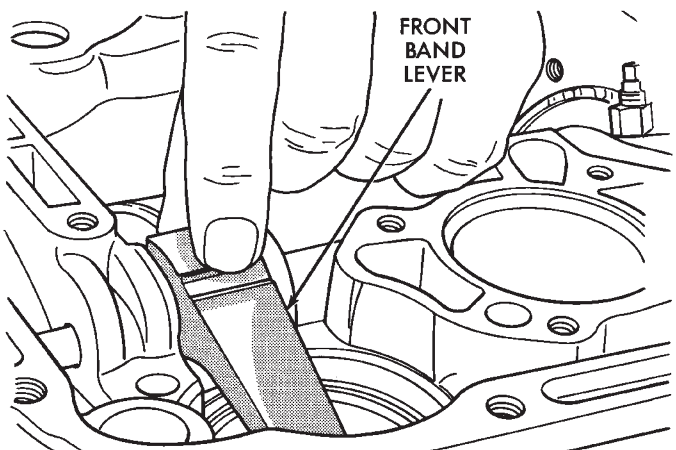


Fig. 92 Front Band Lever

(38) 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. 95) or a large C-clamp.

(2) Install front servo piston, spring, and rod guide. Compress front servo rod guide with Valve

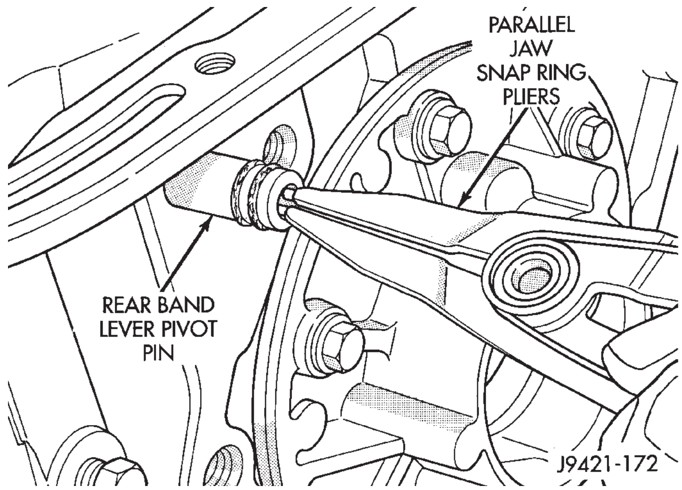


Fig. 93 Rear Band Servo Lever Pin

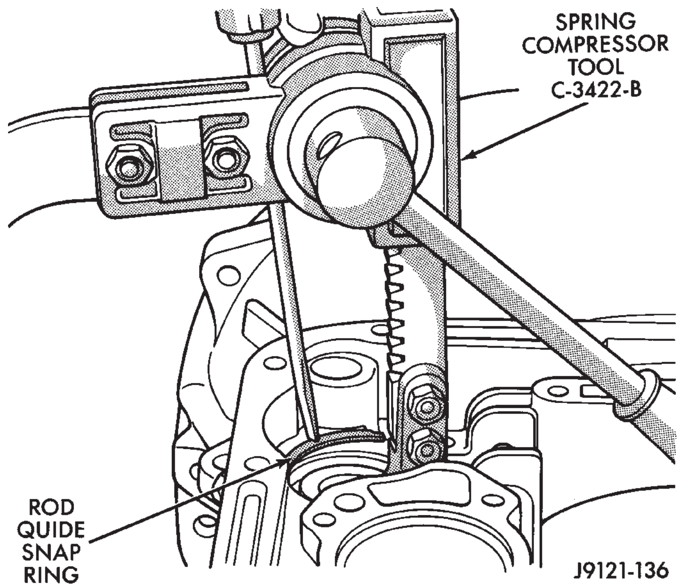


Fig. 94 Compressing Front Servo

Spring Compressor C-3422-B and install servo snap ring (Fig. 94).

(3) Assemble link bar to band. Notched side of link toward band (Fig. 93).

(4) Insert rear band through pan opening in transmission case.

(5) Insert hook on band onto adjuster lever.

(6) Align holes in link bar with hole in transmission case outboard of rear support opening (Fig. 92).

(7) Insert anchor pin into case through link bar.

(8) Examine bolt holes in overrunning clutch cam. Note that one hole is **not threaded** (Fig. 96). This hole must align with blank area in clutch cam bolt circle.

NOTE: The bolt holes in cam are slightly countersunk on one side. This side of cam faces rearward (toward rear support).

DISASSEMBLY AND ASSEMBLY (Continued)

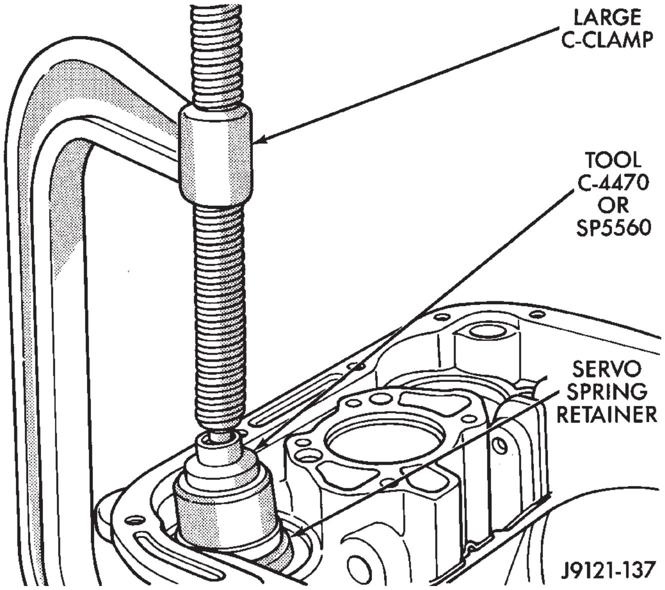


Fig. 95 Compressing Rear Servo Spring

(9) Lubricate overrunning clutch rollers, springs and cam with Mopar® ATF Plus 3, type 7176, transmission fluid.

(10) Position overrunning clutch on a clean, flat work surface with countersunk holes downward.

(11) Place rear of low-reverse drum over overrunning clutch and align clutch rollers to hub of drum.

(12) 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.**

(13) 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.

(14) Insert low-reverse drum and overrunning clutch into front of transmission case and into rear band.

(15) 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.

(16) Push low-reverse drum rearward to close gap between cam and case.

(17) 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.

(18) Hold low-reverse drum in position so rear support will not push it out of overrunning clutch.

(19) Insert rear support into opening at rear of transmission case (Fig. 97).

(20) Align support with the embossed arrow in the direction of the pan face.

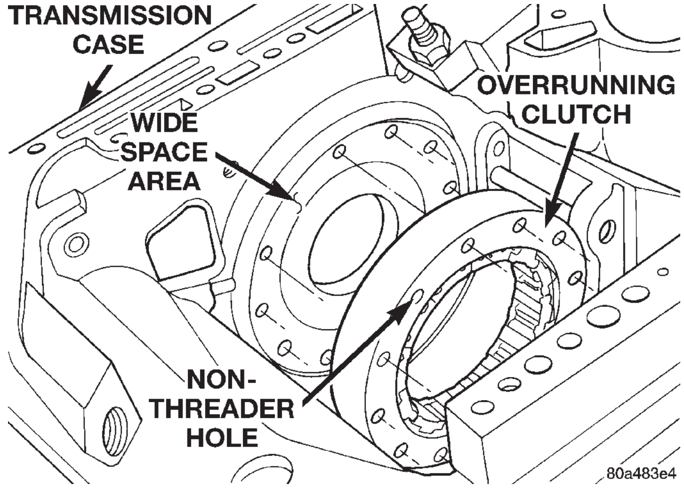


Fig. 96 Clutch Cam Alignment

(21) Install and tighten rear support bolts to 17 N·m (150 in. lbs.) torque.

(22) Install snap ring to retain low-reverse drum to hub of rear support (Fig. 98).

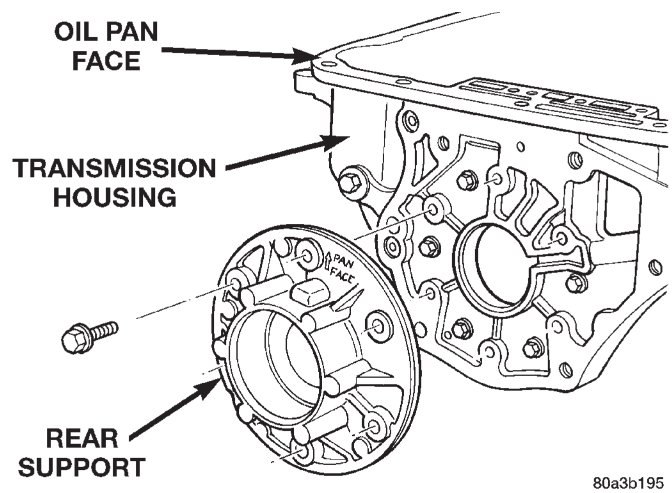


Fig. 97 Rear Support

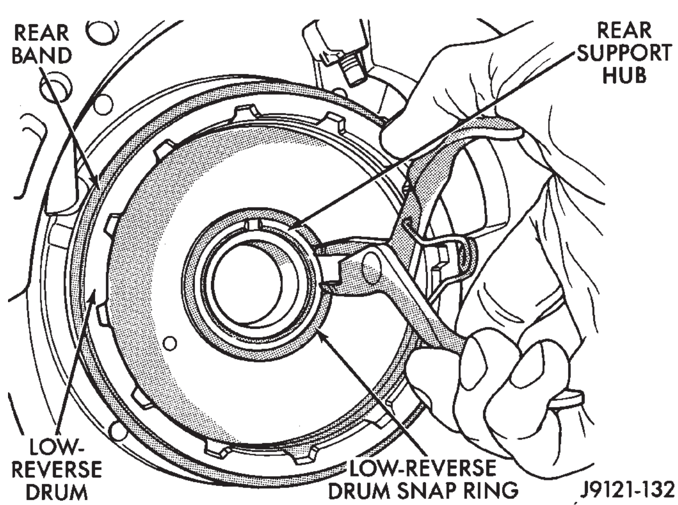


Fig. 98 Low-Reverse Drum Snap Ring

DISASSEMBLY AND ASSEMBLY (Continued)

(23) Lubricate output shaft, rear support bore and low-reverse drum hub with transmission fluid.

(24) Install assembled output shaft and planetary geartrain in case (Fig. 99).

(25) Align drive lugs on rear planetary gear with slots in low-reverse drum (Fig. 99). Then seat planetary assembly in drum.

(26) Install governor on output shaft.

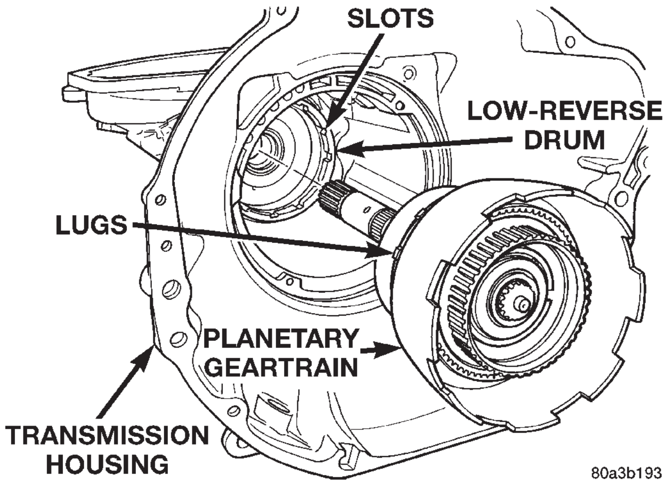


Fig. 99 Output Shaft And Planetary Geartrain

(27) Turn and secure transmission so that front opening is upward.

(28) Assemble front and rear clutches together.

(a) Check input shaft seal rings (Fig. 100). 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. 101).

(d) Engage teeth on rear clutch hub into teeth on clutch (Fig. 103). Rotate front clutch retainer back and forth until completely seated on rear clutch.

(29) Install output shaft thrust plate on shaft hub in planetary geartrain driving shell (Fig. 102). Use petroleum jelly to hold thrust plate in place.

(30) Check rear clutch thrust washer. Use additional petroleum jelly to hold washer in place if necessary.

(31) Coat output shaft thrust washer with petroleum jelly. Install washer in rear clutch hub (Fig. 104). 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.**

(32) Align drive teeth on rear clutch discs with small screwdriver (Fig. 105). This will make installation into front of planetary geartrain easier.

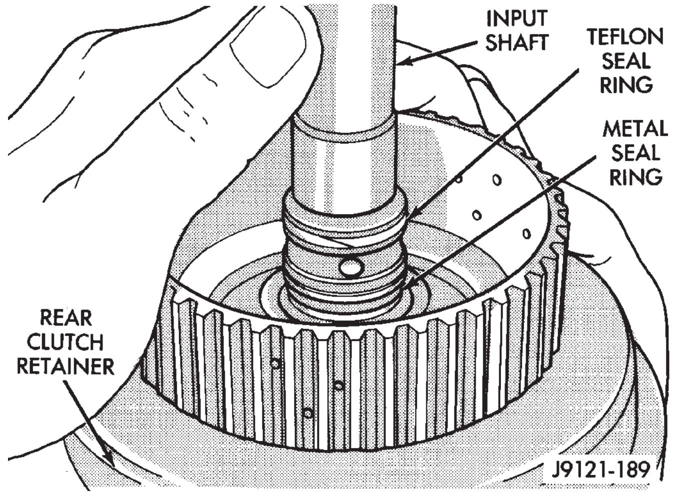


Fig. 100 Input Shaft Seal Ring Location

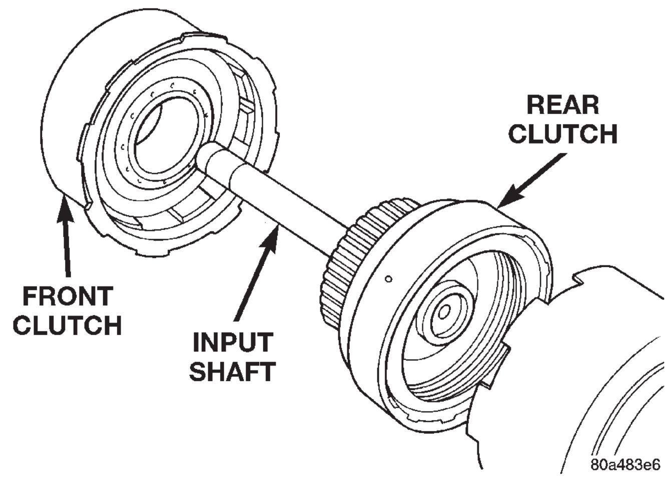


Fig. 101 Front and Rear Clutches

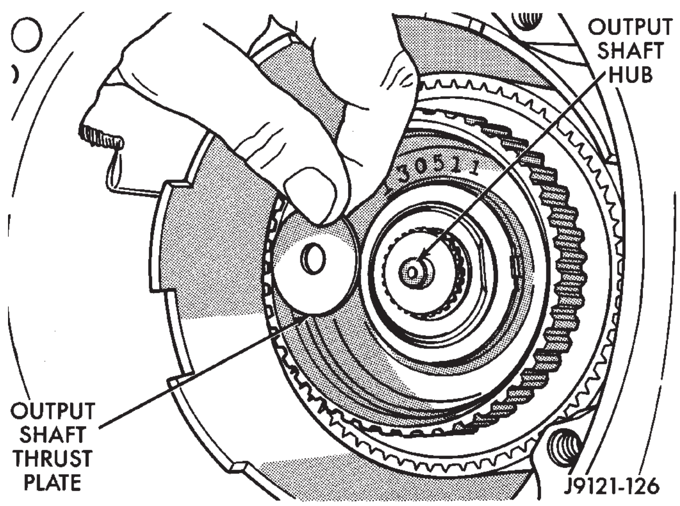


Fig. 102 Output Shaft Thrust Plate

(33) Insert front band into opening at front of transmission case (Fig. 106).

(34) Install front and rear clutch units as assembly (Fig. 107). Align rear clutch with front annulus gear

DISASSEMBLY AND ASSEMBLY (Continued)

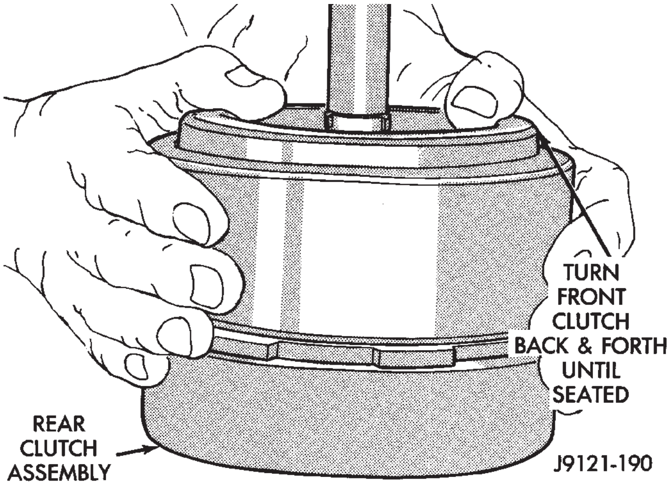


Fig. 103 Assembling Front And Rear Clutch Units

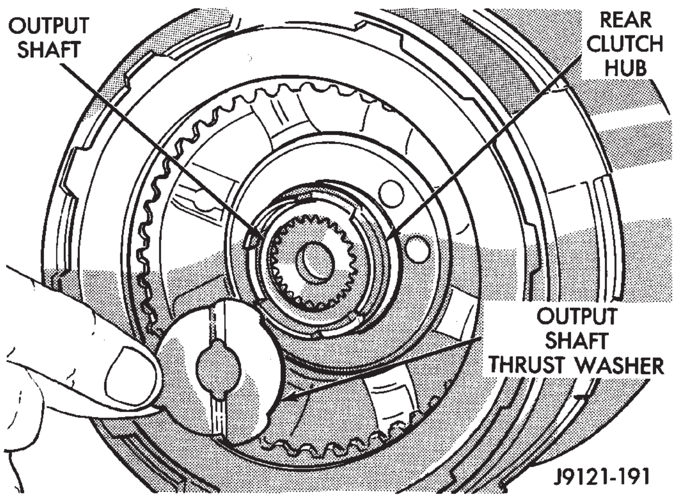


Fig. 104 Output Shaft Thrust Washer

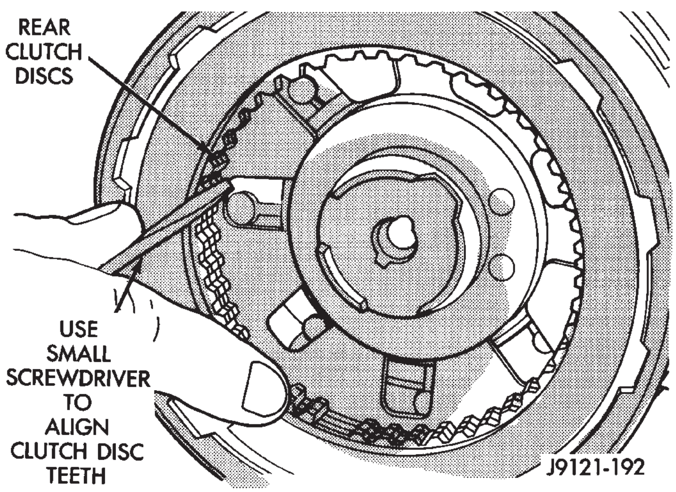


Fig. 105 Aligning Rear Clutch Disc Lugs

and install assembly in driving shell. **Be sure output shaft thrust washer and thrust plate are not displaced during installation.**

(35) 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.

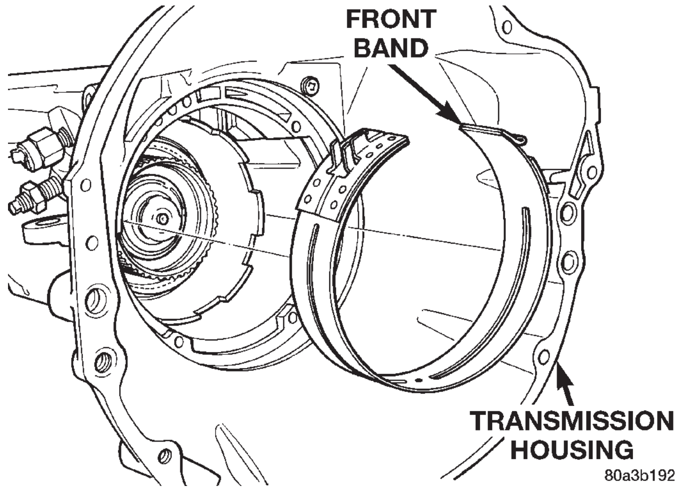


Fig. 106 Front Band

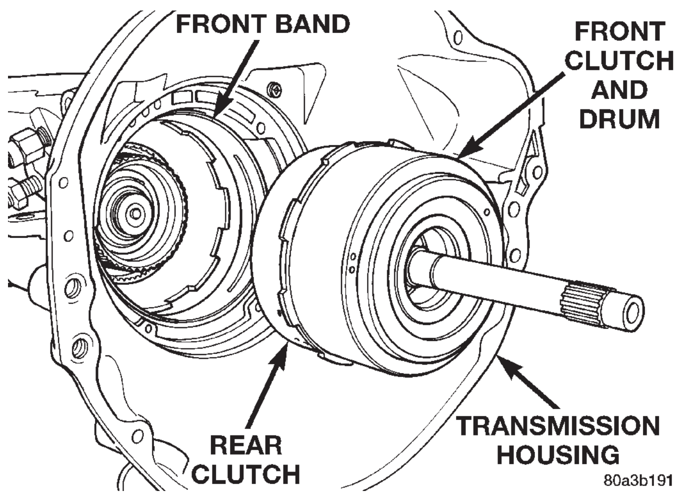


Fig. 107 Installing Front/Rear Clutch

(36) Engage front band on adjusting screw and hold band in place.

(37) Install strut between band lever and front band (Fig. 108).

(38) Tighten front band adjusting screw until band just grips clutch retainer. Verify that front/rear clutches are still seated before continuing.

(39) Verify that reaction shaft support hub seal rings are hooked together (Fig. 109).

(40) 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. 110).

DISASSEMBLY AND ASSEMBLY (Continued)

CAUTION: The thrust washer bore (I.D.), is chamfered on one side. Make sure the chamfered side is installed so it faces the pump.

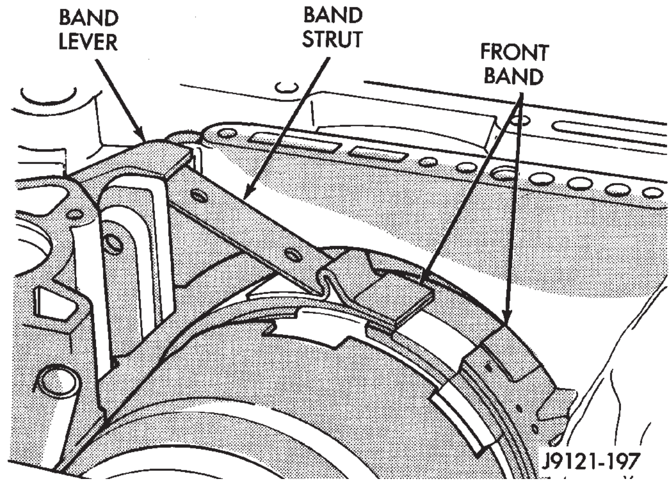


Fig. 108 Front Band Linkage Installation

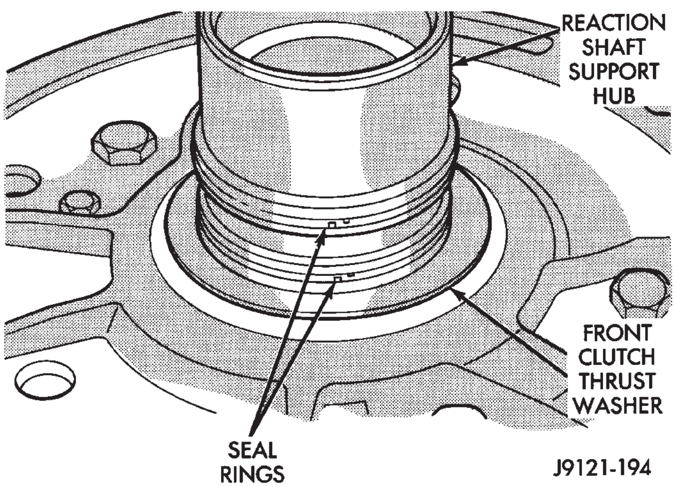


Fig. 109 Reaction Shaft Support Seal Rings

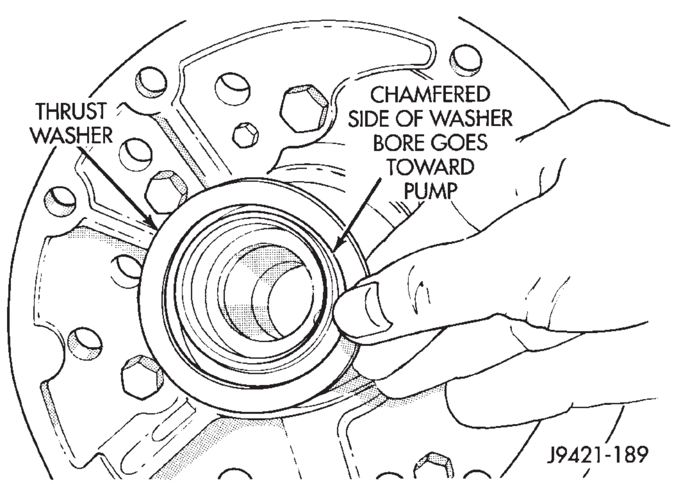


Fig. 110 Front Clutch Thrust Washer Installation

(41) Thread two Pilot Stud Tools C-3288-B into bolt holes in oil pump flange (Fig. 111).

(42) Align and install oil pump gasket (Fig. 111).

(43) Lubricate oil pump seals with Mopar® Door-Ease, or Ru-Glyde, Door Eze, or ATF Plus 3.

(44) Install oil pump (Fig. 112). 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.

(45) Remove pilot stud tools and install remaining oil pump bolts. Tighten bolts alternately in diagonal pattern to 20 N·m (15 ft. lbs.).

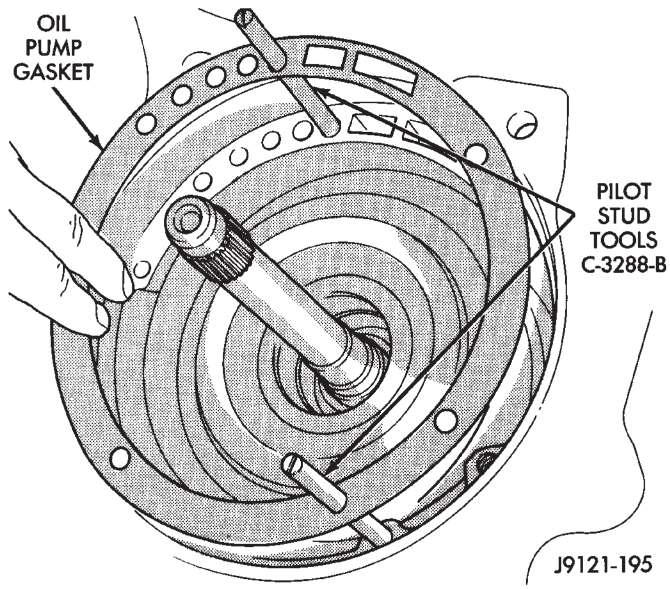


Fig. 111 Installing Pilot Studs And Oil Pump Gasket

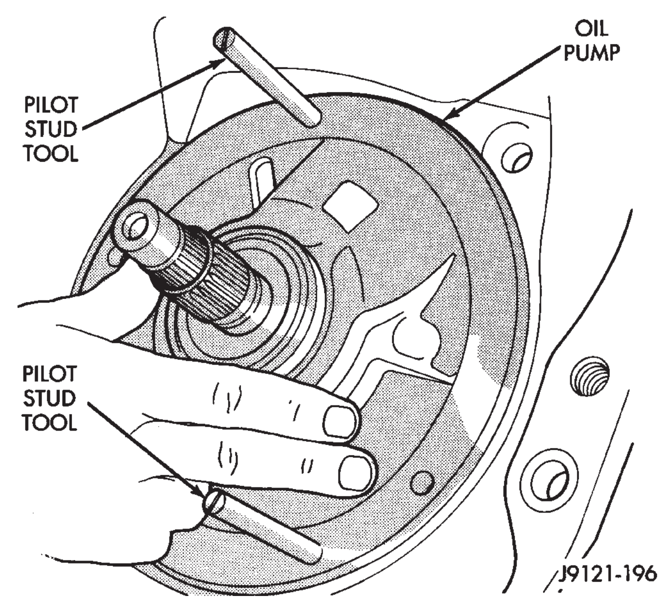


Fig. 112 Installing Oil Pump And Reaction Shaft Support

(46) Measure input shaft end play (Fig. 113).

DISASSEMBLY AND ASSEMBLY (Continued)

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.

(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.).

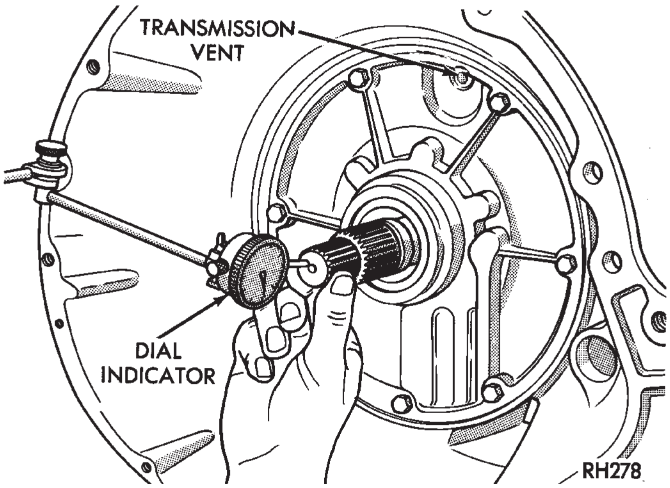


Fig. 113 Checking Input Shaft End Play

(47) Position transmission on work surface with pan face upward.

(48) Install valve body.

(49) Adjust front and rear bands.

(50) Install fluid filter and pan.

(51) Install rear extension housing.

(52) 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. 114). Rotate the cam back and forth to ease removal if necessary.

(2) Remove the clutch roller and spring assembly from the overrunning clutch race.

ASSEMBLY

(1) Assemble clutch rollers and springs in retainer if necessary (Fig. 115).

(2) Install overrunning clutch roller, spring and retainer assembly in clutch cam (Fig. 116).

(3) Temporarily assemble and check overrunning clutch operation as follows:

(a) Assemble cam and clutch.

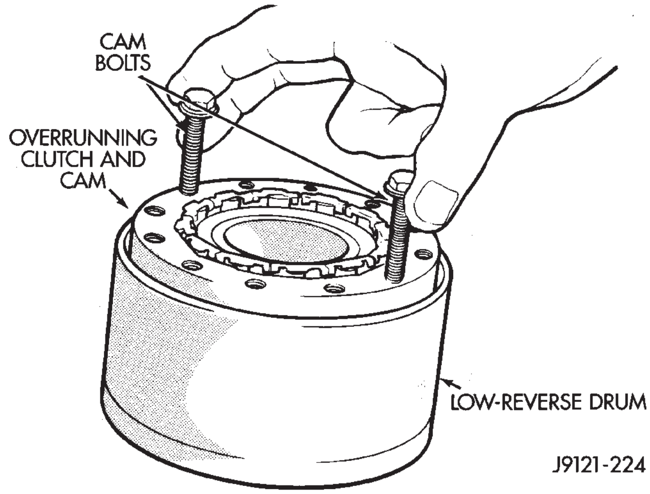


Fig. 114 Removing Overrunning Clutch From Low-Reverse Drum

(b) Install clutch assembly on low-reverse drum with twisting motion (Fig. 117).

(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).**

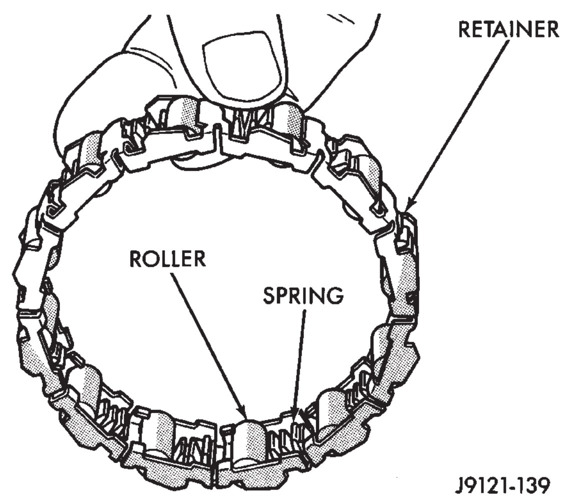


Fig. 115 Overrunning Clutch Rollers, Springs, Retainer

FRONT SERVO PISTON

DISASSEMBLY

(1) Remove seal ring from rod guide (Fig. 119).

(2) Remove small snap ring from servo piston rod. Then remove piston rod, spring and washer from piston.

DISASSEMBLY AND ASSEMBLY (Continued)

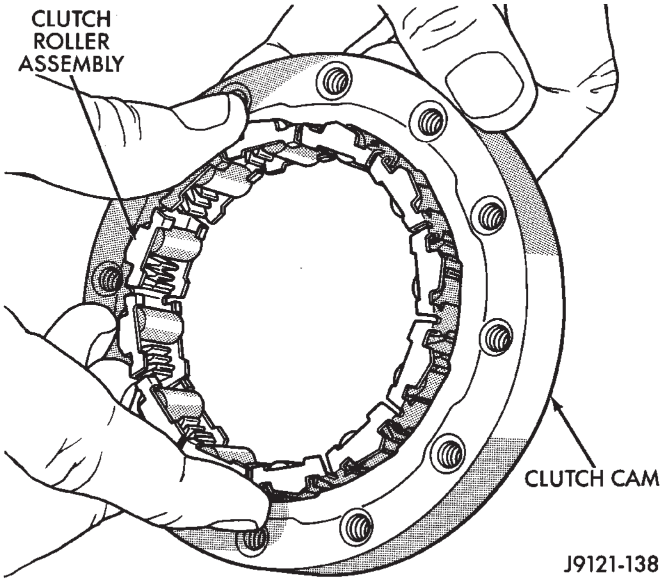


Fig. 116 Assembling Overrunning Clutch And Cam

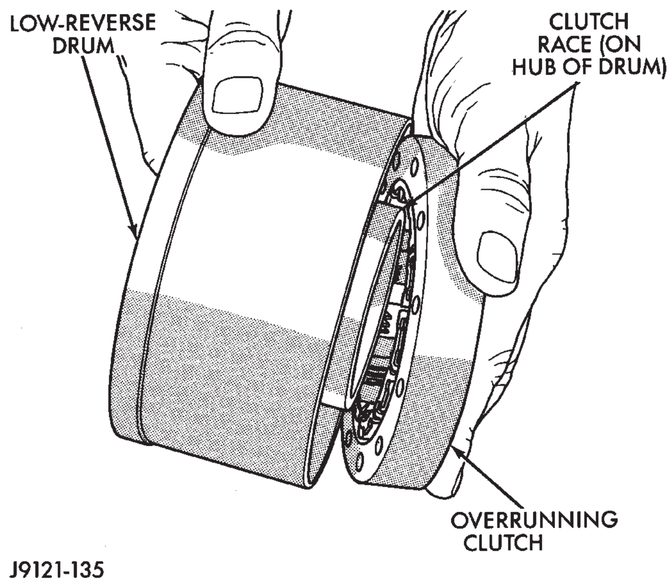


Fig. 117 Temporary Assembly Of Clutch And Drum To Check Operation

(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. 119).

(3) Set servo components aside for installation during transmission reassembly.

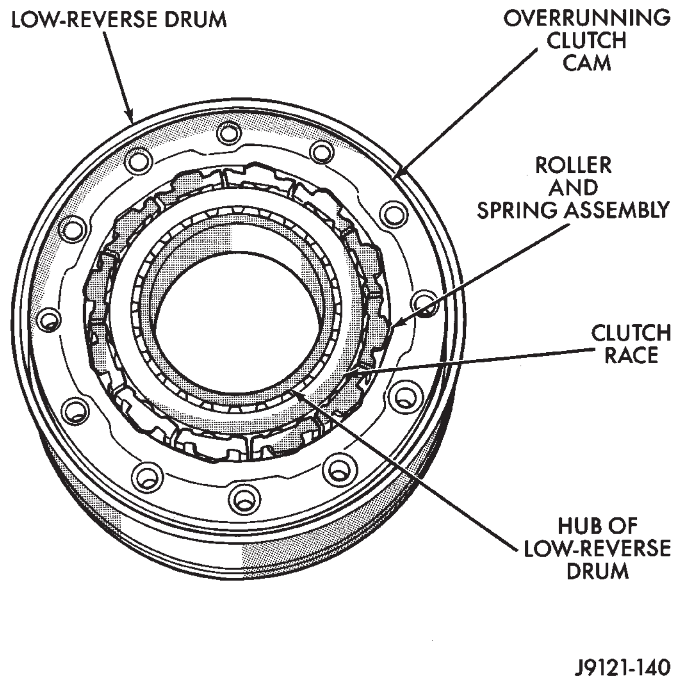


Fig. 118 Assembled Overrunning Clutch

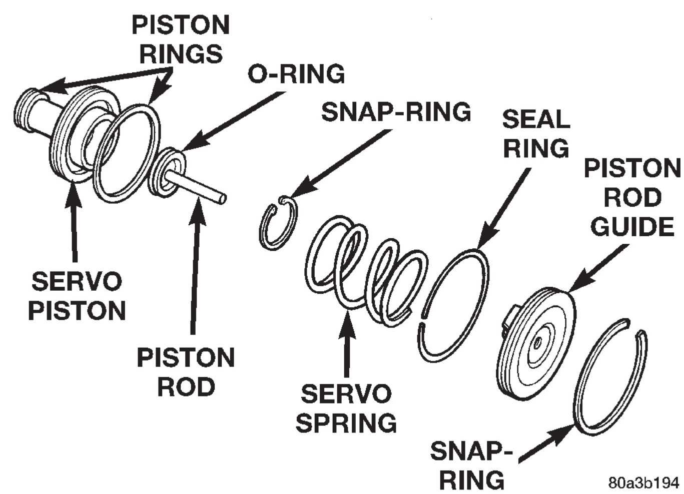


Fig. 119 Front Servo

REAR SERVO PISTON

DISASSEMBLY

(1) Remove small snap ring and remove plug and spring from servo piston (Fig. 120).

(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)

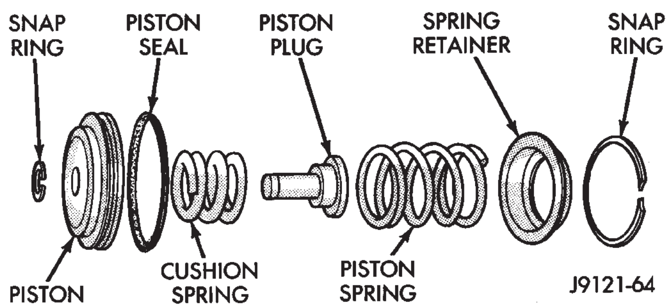


Fig. 120 Rear Servo Components

OIL PUMP AND REACTION SHAFT SUPPORT

DISASSEMBLY

(1) Remove seal ring from housing and reaction shaft support (Fig. 121).

(2) Mark pump housing and support assembly for alignment reference.

(3) Remove bolts attaching pump body to support (Fig. 122).

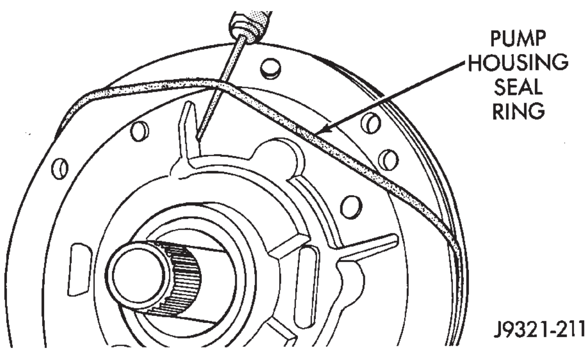


Fig. 121 Removing Pump Seal Ring

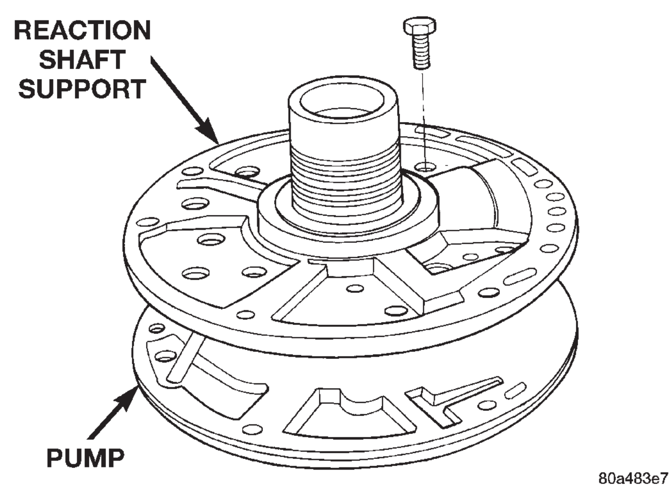


Fig. 122 Pump Support Bolts

(4) Separate support from pump housing (Fig. 123).

(5) Remove inner and outer gears from reaction shaft support (Fig. 124).

(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. 125).

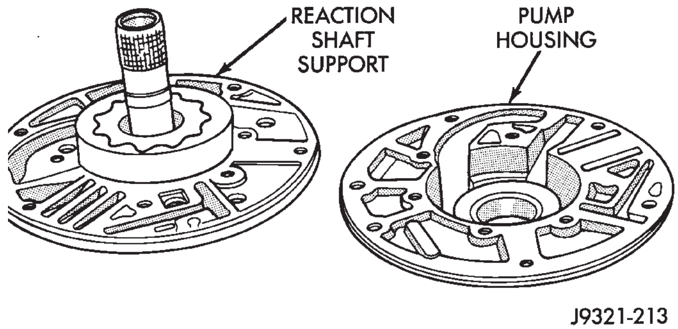


Fig. 123 Separating Pump Housing From Reaction Shaft Support

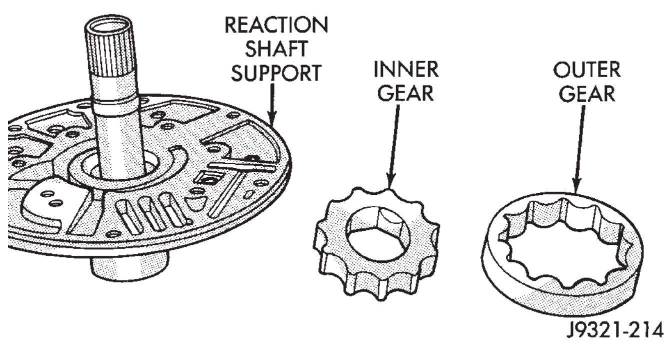


Fig. 124 Pump Gear Removal

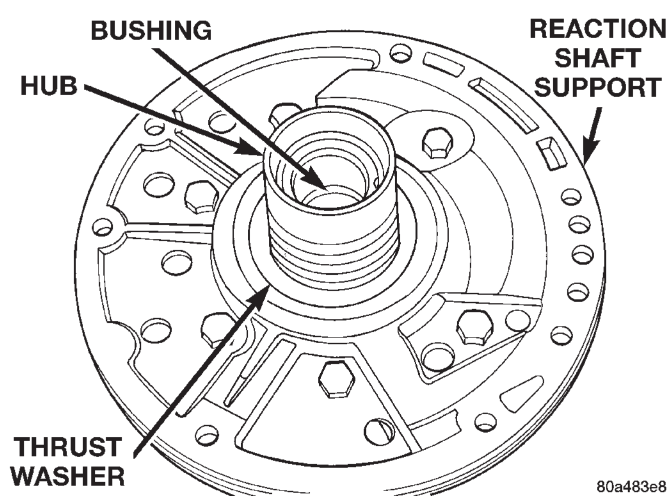


Fig. 125 Support Hub Thrust Washer

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. 126).

(2) Install new pump bushing with Tool Handle C-4171 and Bushing Installer SP-5117 (Fig. 126). Bushing should be flush with pump housing bore.

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Stake new pump bushing in two places with blunt punch (Fig. 127). Remove burrs from stake points with knife blade afterward.

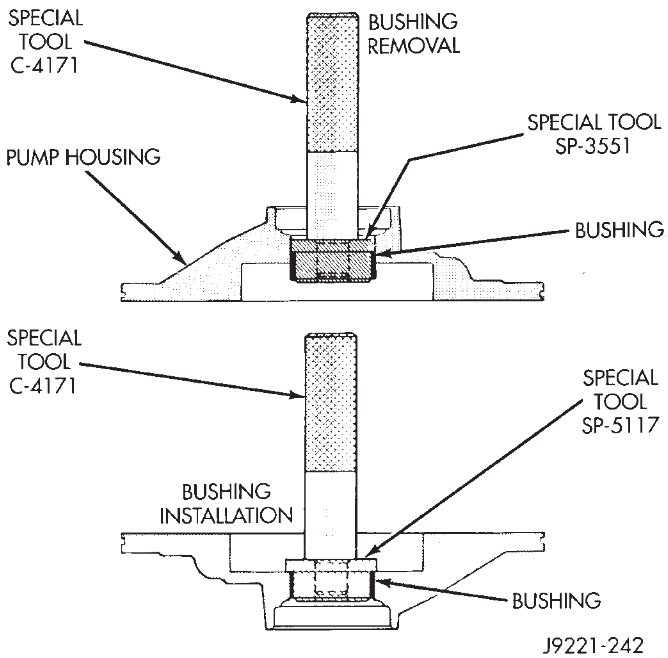


Fig. 126 Removing Oil Pump Bushing

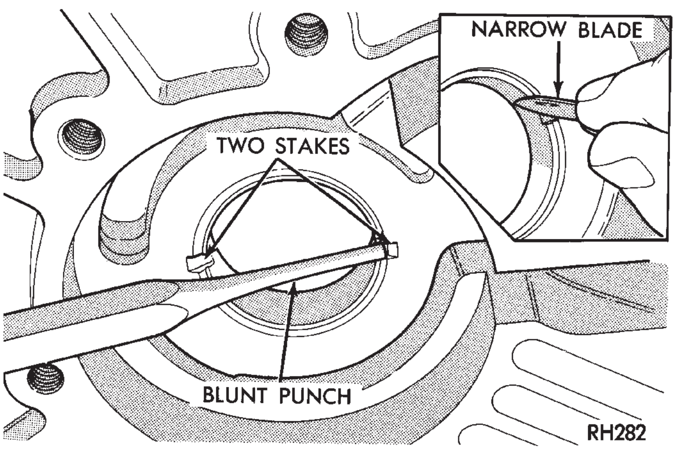


Fig. 127 Staking Oil Pump Bushing

REACTION SHAFT SUPPORT BUSHING REMOVAL

(1) Assemble Bushing Remover Tools SP-1191, 3633 and 5324 (Fig. 128). **Do not clamp any part of reaction shaft or support in vise.**

(2) Hold Cup Tool SP-3633 firmly against reaction shaft and thread remover SP-5324 into bushing as far as possible by hand. Then thread remover tool 3-4 additional turns into bushing with a wrench.

(3) Turn remover tool hex nut down against remover cup to pull bushing from shaft. Clean all chips from shaft after bushing removal.

(4) Lightly grip old bushing in vise or with pliers and back remover tool out of bushing.

(5) Assemble Bushing Installer Tools C-4171 and SP-5325 (Fig. 128).

(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.

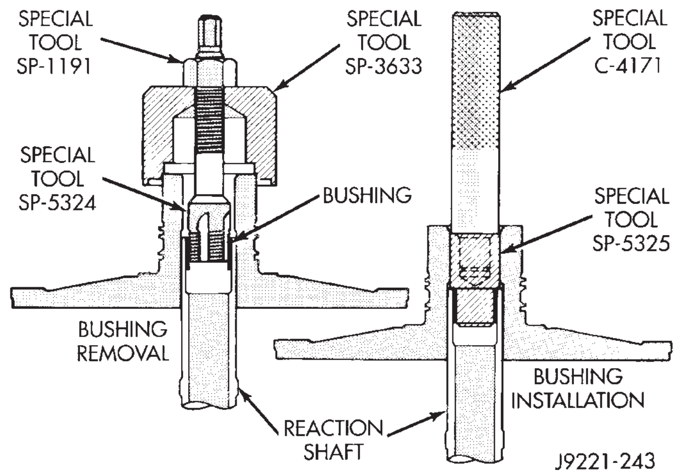


Fig. 128 Replacing Reaction Shaft Support Bushing

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. 129).

(4) Install outer gear in pump housing (Fig. 129). Gear can be installed either way (it is not a one-way fit).

(5) Install pump inner gear (Fig. 130).

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. 131). Lubricate seal rings with transmission fluid or petroleum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

DISASSEMBLY AND ASSEMBLY (Continued)

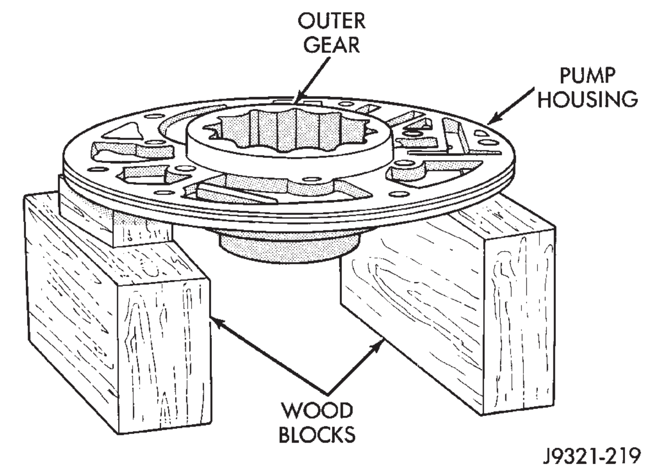


Fig. 129 Supporting Pump And Installing Outer Gear

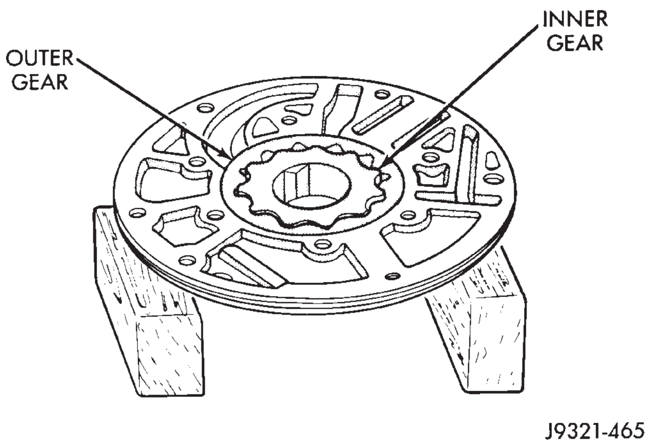


Fig. 130 Pump Inner Gear Installation

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.

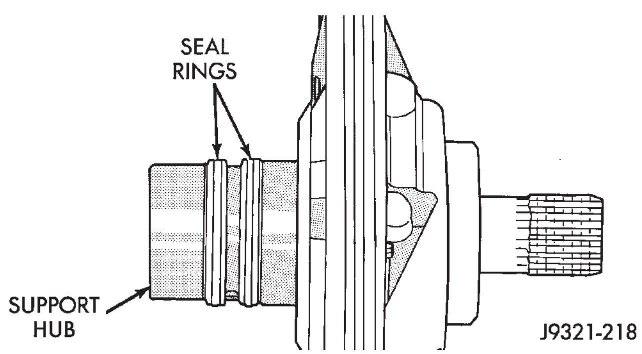


Fig. 131 Hub Seal Ring Position

(8) Install reaction shaft support on pump housing (Fig. 132).

(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).

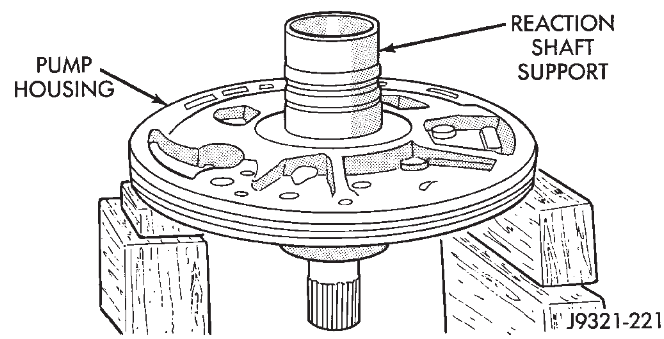


Fig. 132 Assembling Reaction Shaft Support And Pump Housing

(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. 133). 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.

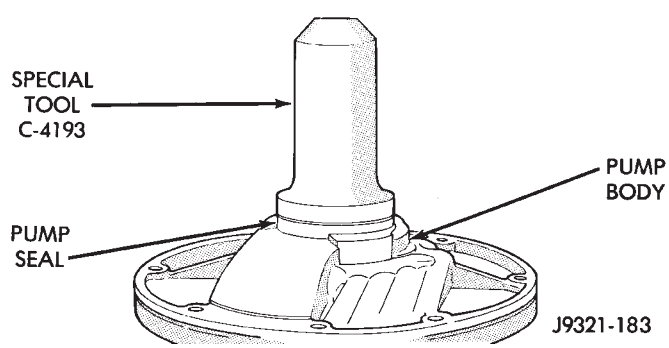


Fig. 133 Pump Oil Seal Installation

DISASSEMBLY AND ASSEMBLY (Continued)

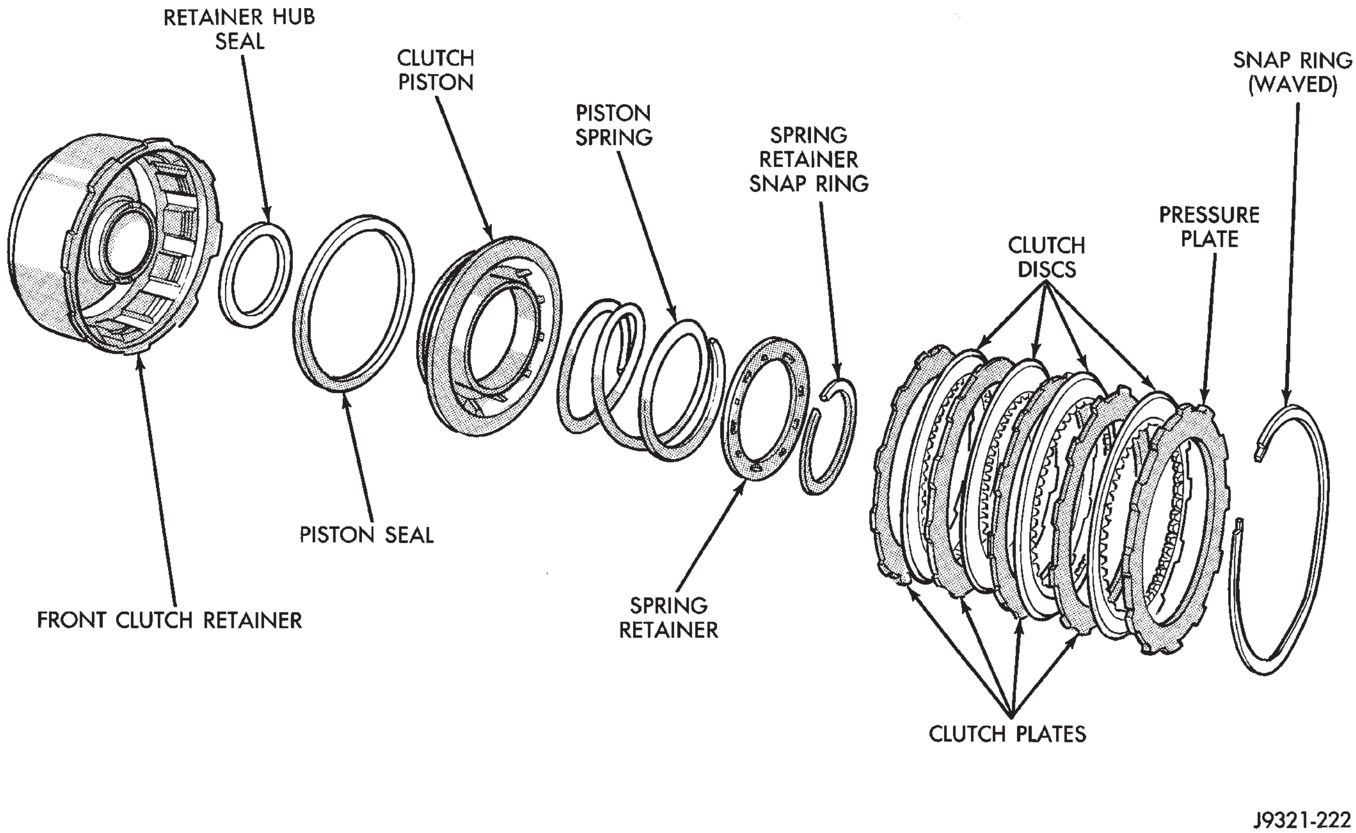


Fig. 134 Front Clutch Components

FRONT CLUTCH

DISASSEMBLY

(1) Remove waved snap ring and remove pressure plate, clutch plates and clutch discs (Fig. 134).

(2) Compress clutch piston spring with Compressor Tool C-3575-A (Fig. 135). 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. 136). 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.

(5) Position spring in clutch piston (Fig. 137).

(6) Position spring retainer on top of piston spring (Fig. 138). **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.**

(7) Compress piston spring and retainer with Compressor Tool C-3575-A (Fig. 135). Then install new snap ring to secure spring retainer and spring.

(8) Install clutch plates and discs (Fig. 134). Install steel plate then disc until all plates and discs are installed. The front clutch uses 4 clutch discs.

DISASSEMBLY AND ASSEMBLY (Continued)

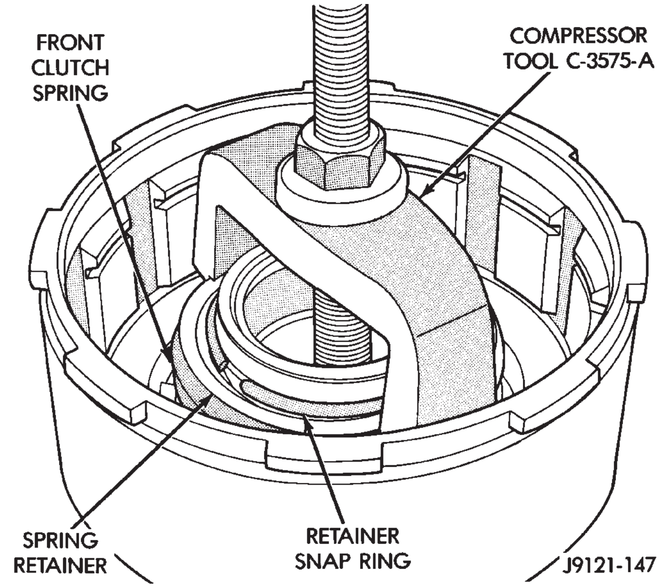


Fig. 135 Compressing Front Clutch Piston Spring

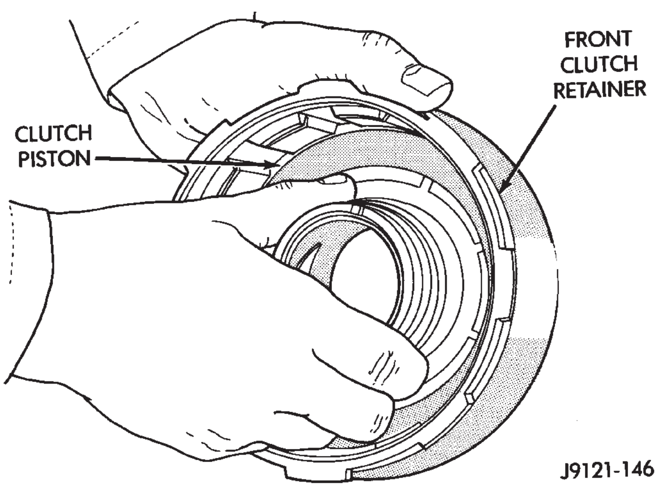


Fig. 136 Front Clutch Piston Installation

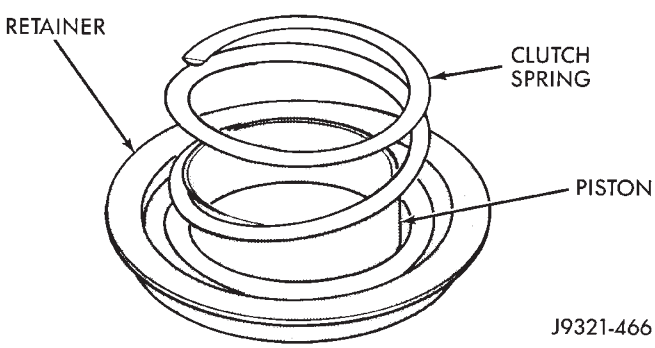


Fig. 137 Clutch Piston Spring Installation

(9) Install pressure plate and waved snap ring (Fig. 134).

(10) Using a suitable gauge bar and dial indicator, measure clutch plate clearance (Fig. 139).

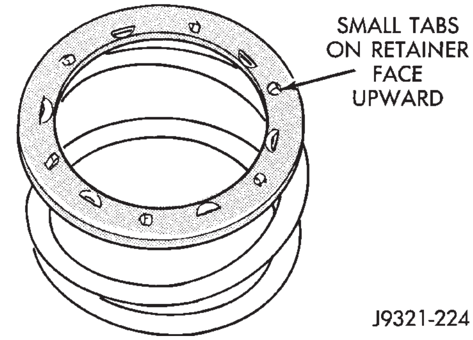


Fig. 138 Correct Spring Retainer Installed Position

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 139).

(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.

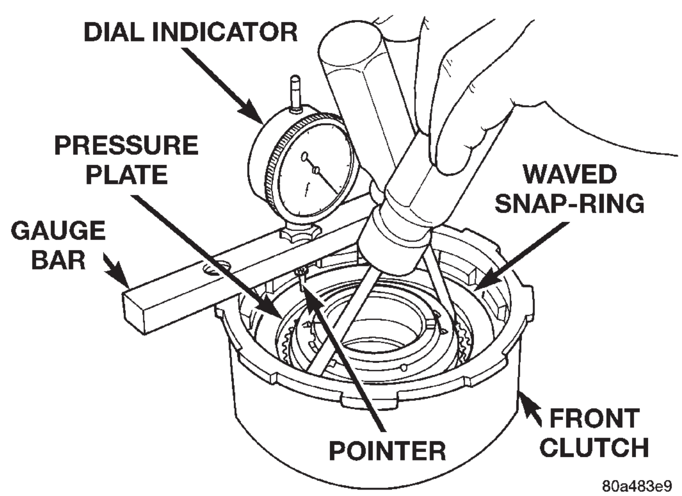


Fig. 139 Measuring Front Clutch Pack Clearance

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. 140).

DISASSEMBLY AND ASSEMBLY (Continued)

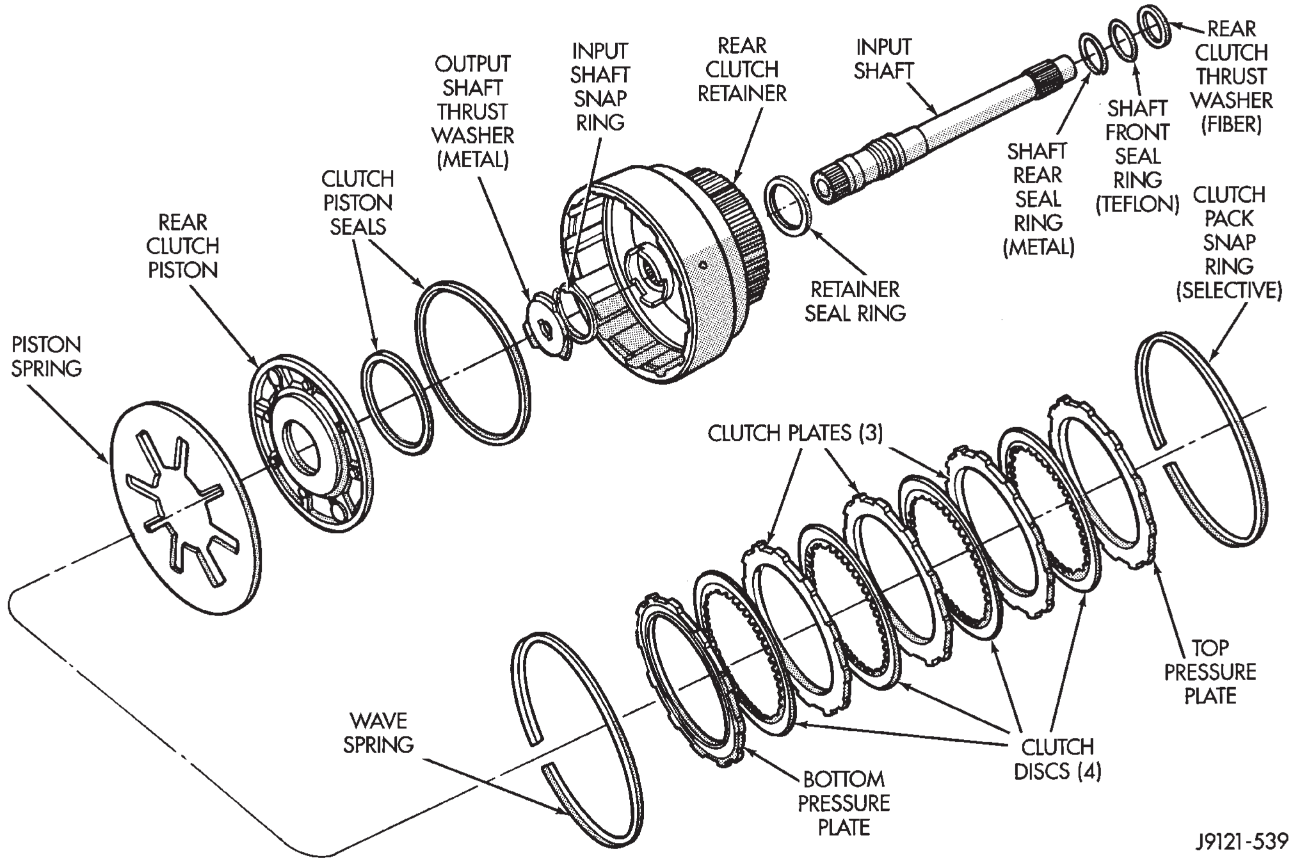


Fig. 140 Rear Clutch Components

(4) Remove top pressure plate, clutch discs, steel plates, bottom pressure plate and wave snap ring and wave spring (Fig. 140).

(5) Remove clutch piston with rotating motion.

(6) Remove and discard piston seals.

(7) Remove input shaft snap-ring (Fig. 141). It may be necessary to press the input shaft in slightly to relieve tension on the snap-ring.

(8) Press input shaft out of retainer with shop press and suitable size press tool. Use a suitably sized press tool to support the retainer as close to the input shaft as possible.

ASSEMBLY

(1) Soak clutch discs in transmission fluid while assembling other clutch parts.

(2) Install new seal rings on clutch retainer hub and input shaft if necessary (Fig. 142).

(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. 141).

(5) Invert retainer and press input shaft in opposite direction until snap-ring is seated.

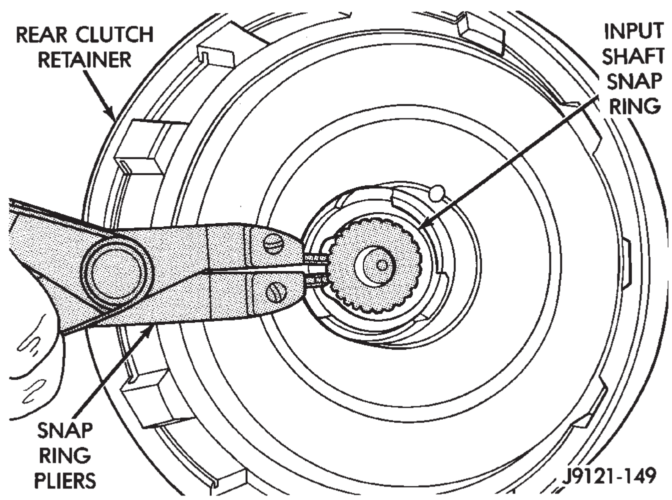


Fig. 141 Removing/Installing Input Shaft Snap-Ring

(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

DISASSEMBLY AND ASSEMBLY (Continued)

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.

(9) Install piston spring in retainer and on top of piston (Fig. 145). Concave side of spring faces downward (toward piston).

(10) Install wave spring in retainer (Fig. 145). Be sure spring is completely seated in retainer groove.

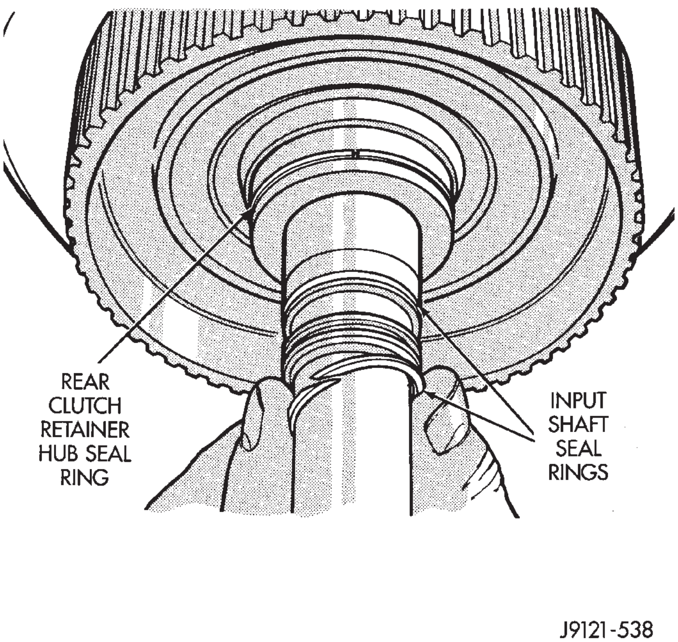


Fig. 142 Rear Clutch Retainer And Input Shaft Seal Ring Installation

(11) Install bottom pressure plate (Fig. 140). Ridged side of plate faces downward (toward piston) and flat side toward clutch pack.

(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. 140).

(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. 146).

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 146).

(b) Using two small screw drivers, lift the pressure plate and release it.

(c) Zero the dial indicator.

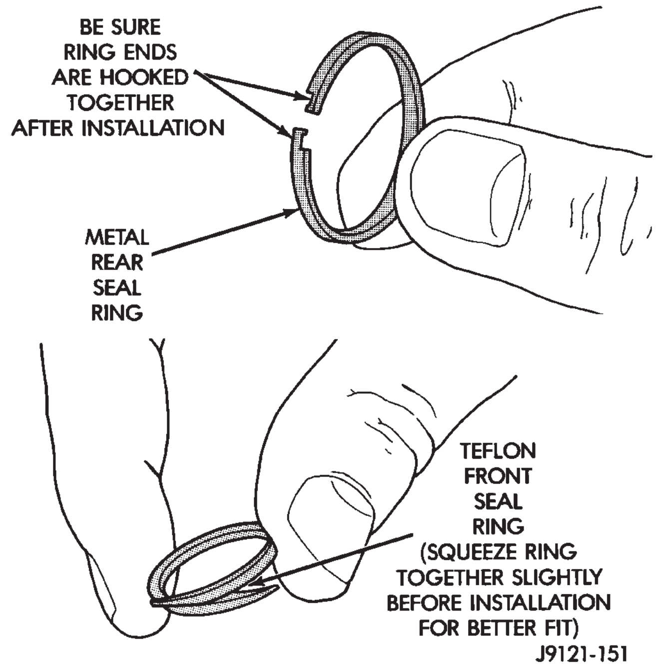


Fig. 143 Input Shaft Seal Ring Identification

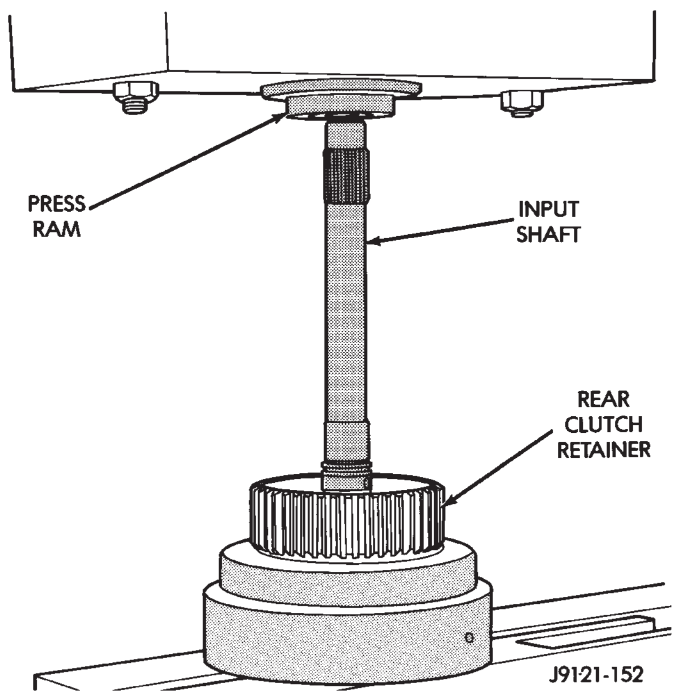


Fig. 144 Pressing Input Shaft Into Rear Clutch Retainer

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

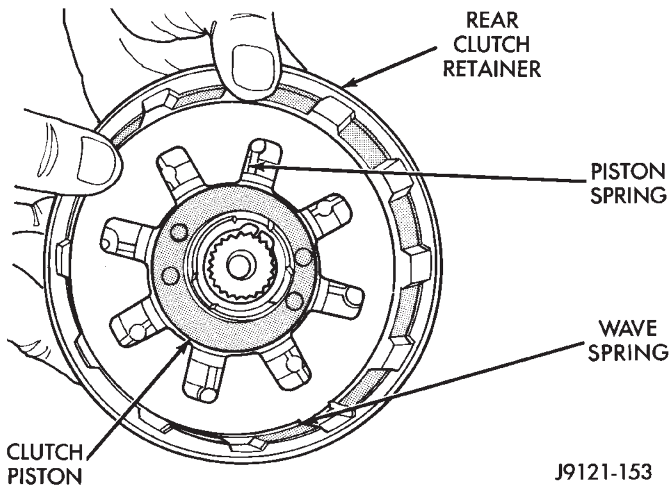


Fig. 145 Piston Spring/Wave Spring Position

- .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. 147). Use enough petroleum jelly to hold washer in place.

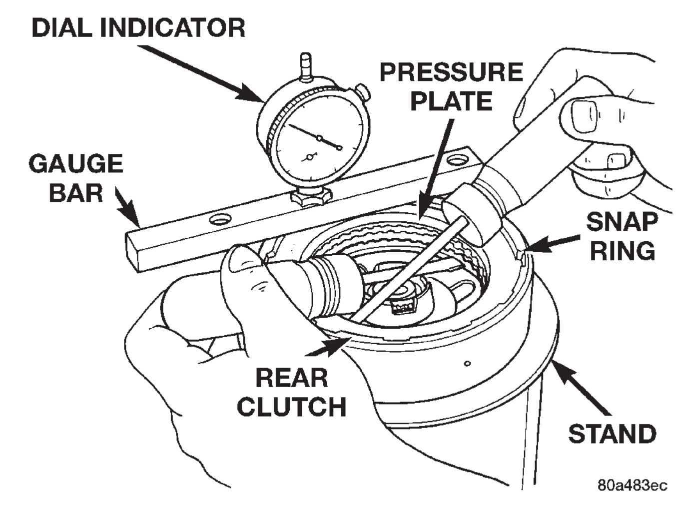


Fig. 146 Checking Rear Clutch Pack Clearance

PLANETARY GEARTRAIN/OUTPUT SHAFT

DISASSEMBLY

(1) Remove planetary snap ring (Fig. 148).

(2) Remove front annulus and planetary assembly from driving shell (Fig. 148).

(3) Remove snap ring that retains front planetary gear in annulus gear (Fig. 149).

(4) Remove tabbed thrust washer and tabbed thrust plate from hub of front annulus (Fig. 150).

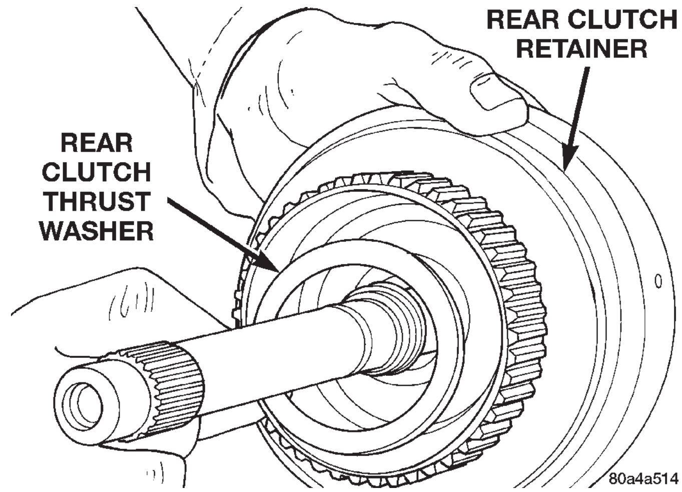


Fig. 147 Installing Rear Clutch Thrust Washer

(5) Separate front annulus and planetary gears (Fig. 150).

(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. 151).

(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.

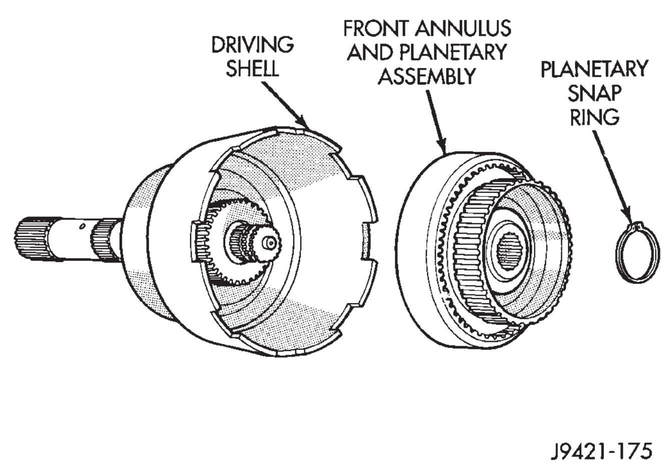


Fig. 148 Front Annulus And Planetary Assembly Removal

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

DISASSEMBLY AND ASSEMBLY (Continued)

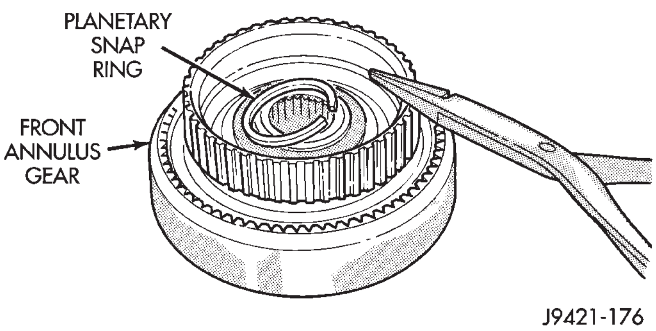


Fig. 149 Front Planetary Snap Ring Removal

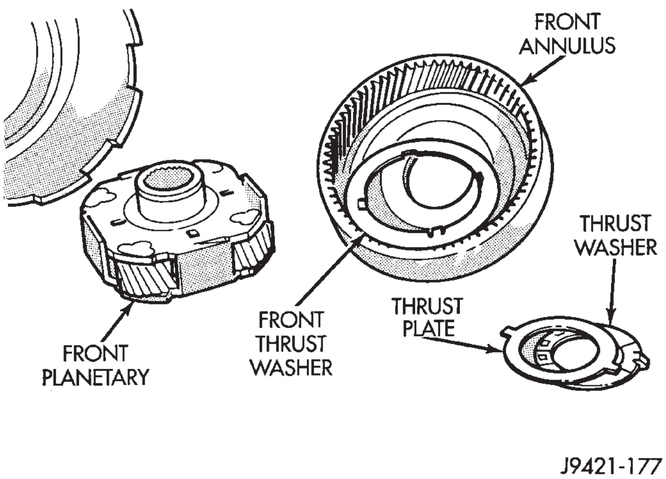


Fig. 150 Front Planetary And Annulus Gear Disassembly

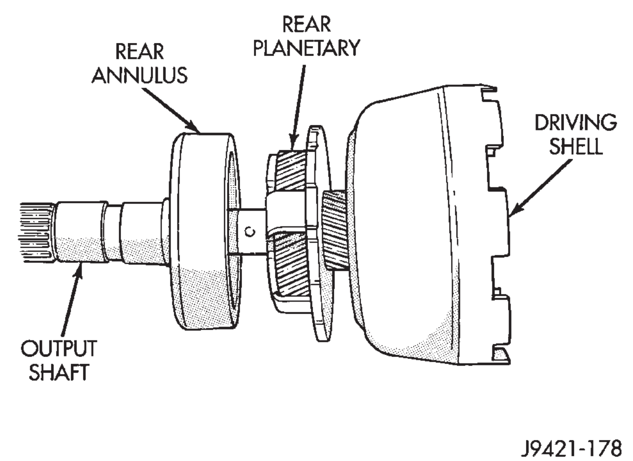


Fig. 151 Removing Driving Shell, Rear Planetary And Rear Annulus

that shoulder-side of support faces rearward (Fig. 152).

(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. 152).

(5) Install assembled rear planetary and annulus gear on output shaft (Fig. 153). Verify that assembly is fully seated on shaft.

(6) Install front thrust washer on rear planetary gear (Fig. 154). 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. 155).

(8) Install thrust plate on sun gear (Fig. 156). Note that driving shell thrust plates are interchangeable. Use either plate on sun gear and at front/rear of shell.

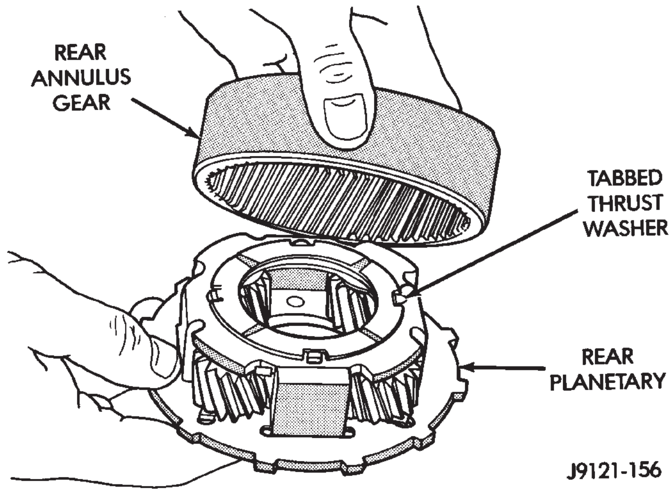


Fig. 152 Assembling Rear Annulus And Planetary Gear

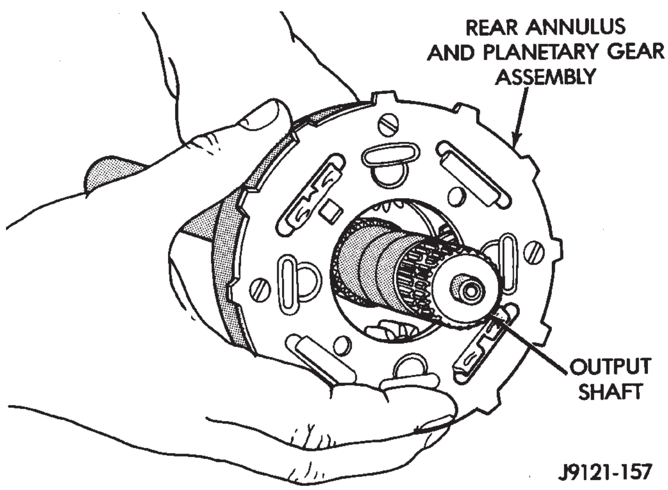


Fig. 153 Installing Rear Annulus And Planetary On Output Shaft

(9) Hold sun gear in place and install thrust plate over sun gear at rear of driving shell (Fig. 157).

(10) Position wood block on bench and support sun gear on block (Fig. 158). This makes it easier to align and install sun gear lock ring. Keep wood block

DISASSEMBLY AND ASSEMBLY (Continued)

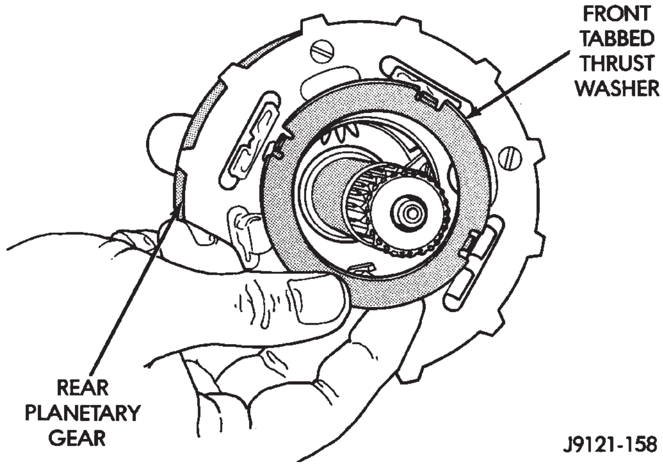


Fig. 154 Installing Rear Planetary Front Thrust Washer

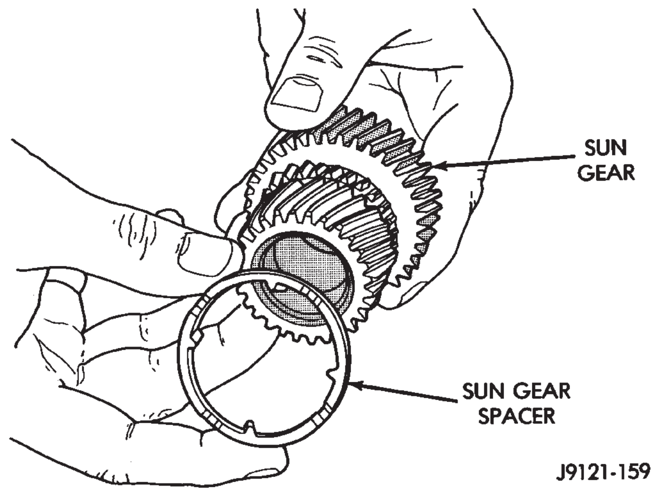


Fig. 155 Installing Spacer On Sun Gear

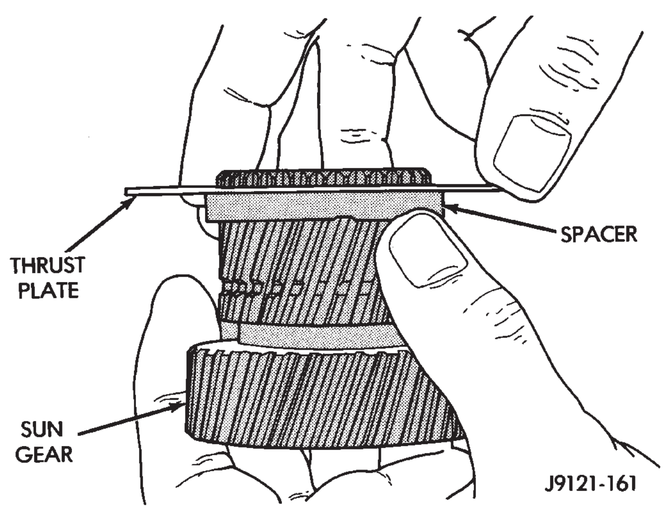


Fig. 156 Installing Driving Shell Front Thrust Plate On Sun Gear

handy as it will also be used for geartrain end play check.

(11) Align rear thrust plate on driving shell and install sun gear lock ring. Be sure ring is fully seated in sun gear ring groove (Fig. 159).

(12) Install assembled driving shell and sun gear on output shaft (Fig. 160).

(13) Install rear thrust washer on front planetary gear (Fig. 161). Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

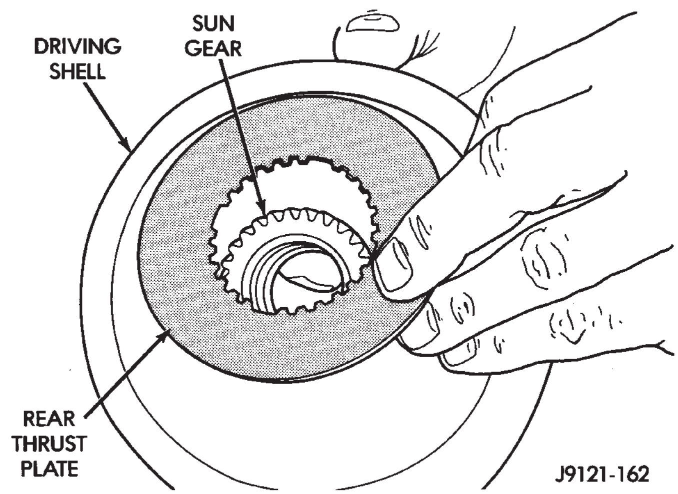


Fig. 157 Installing Driving Shell Rear Thrust Plate

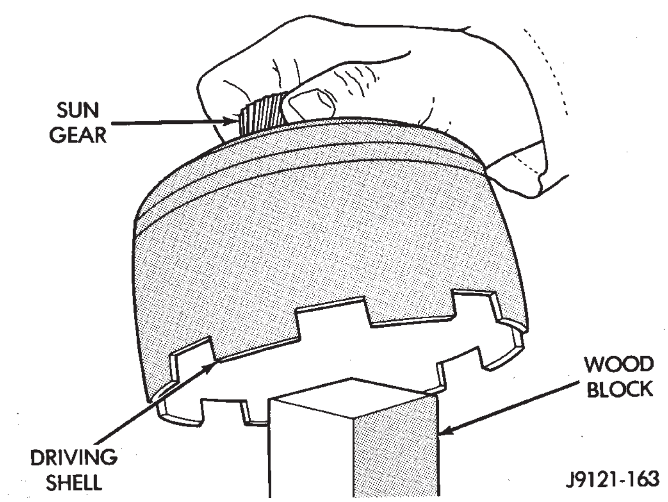


Fig. 158 Supporting Sun Gear On Wood Block

(14) Install front planetary gear on output shaft and in driving shell (Fig. 162).

(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. 162).

(18) Position thrust plate on front annulus gear support (Fig. 163). **Note that plate has two tabs on it. These tabs fit in notches of annulus hub.**

DISASSEMBLY AND ASSEMBLY (Continued)

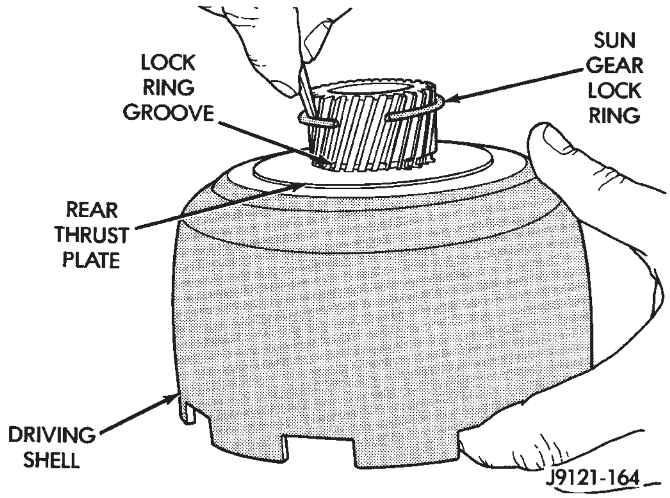


Fig. 159 Installing Sun Gear Lock Ring

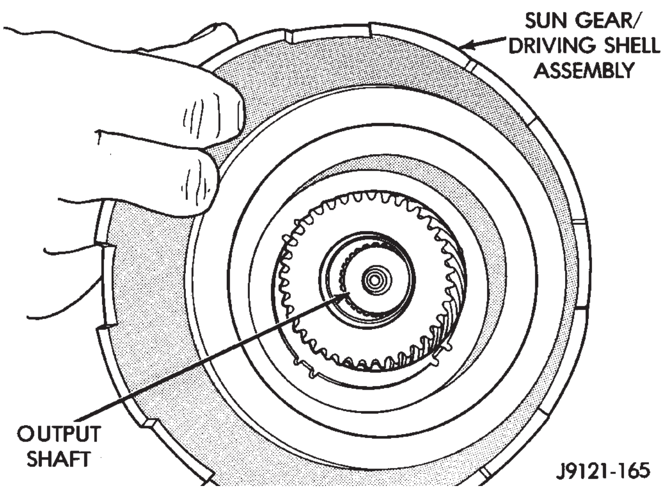


Fig. 160 Installing Assembled Sun Gear And Driving Shell On Output Shaft

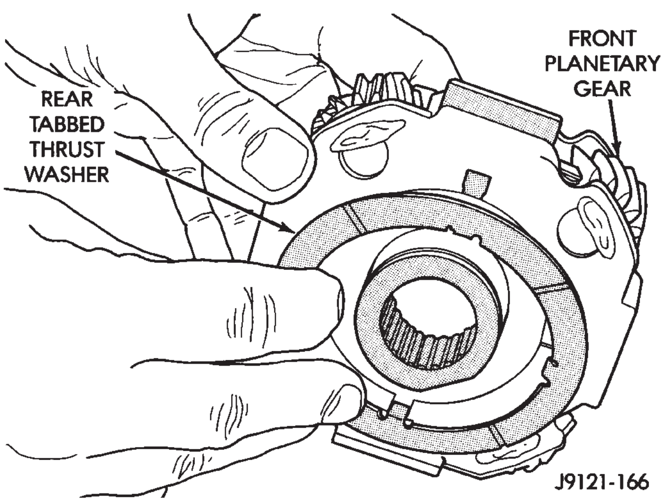


Fig. 161 Installing Rear Thrust Washer On Front Planetary Gear

(19) Install thrust washer in front annulus (Fig. 164). **Align flat on washer with flat on planetary hub. Also be sure washer tab is facing up.**

(20) Install front annulus snap ring (Fig. 165). 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. 166). 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. 167). 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.

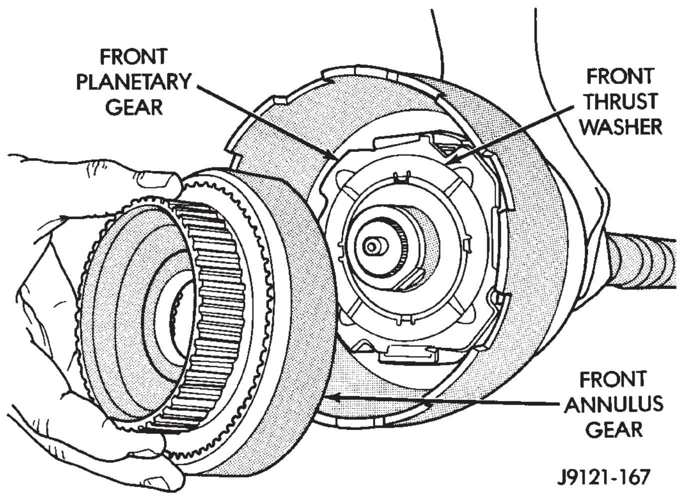


Fig. 162 Installing Front Planetary And Annulus Gears

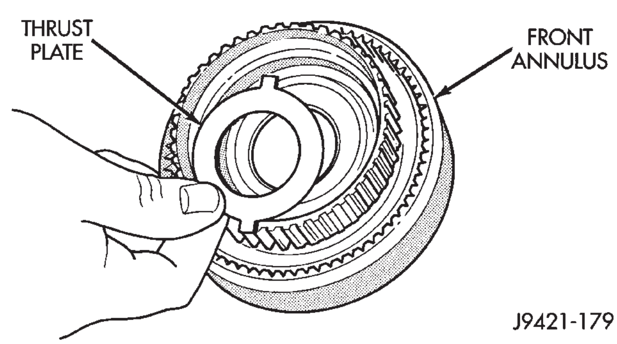


Fig. 163 Positioning Thrust Plate On Front Annulus Support

DISASSEMBLY AND ASSEMBLY (Continued)

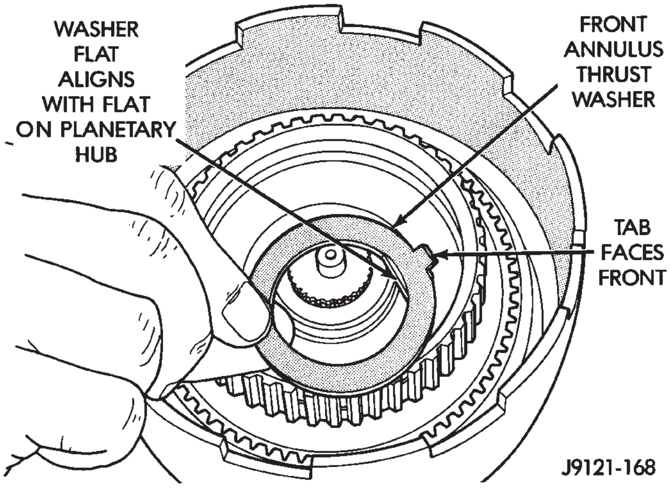


Fig. 164 Installing Front Annulus Thrust Washer

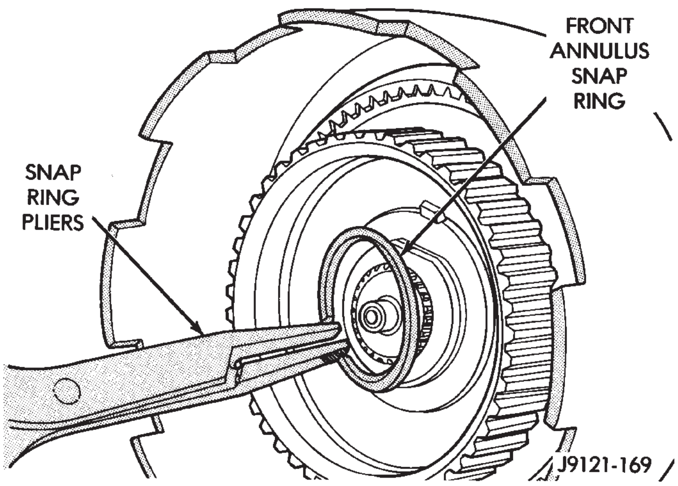


Fig. 165 Installing Front Annulus Snap Ring

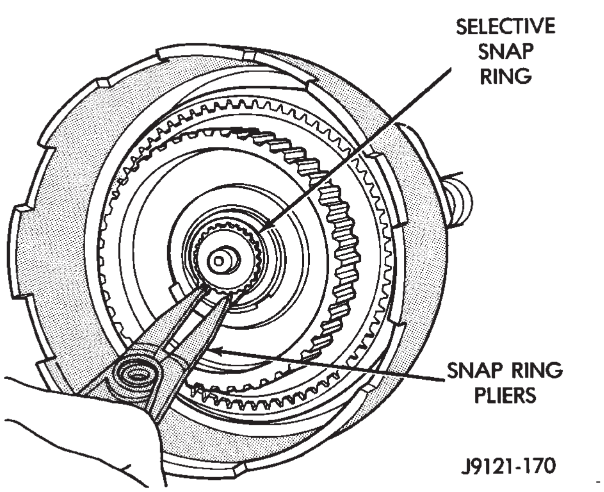


Fig. 166 Installing Planetary Selective Snap Ring

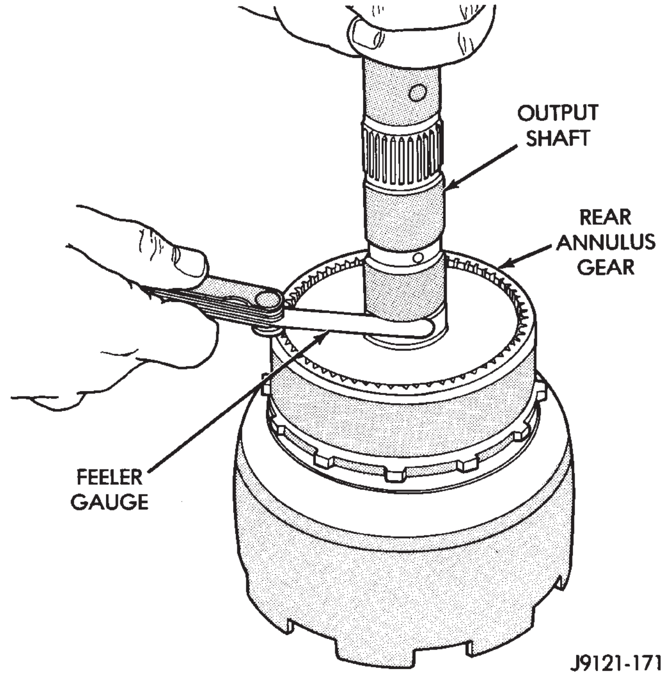


Fig. 167 Checking Planetary Geartrain End Play

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. 168) and the governor valve (Fig. 169), 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.

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 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.

CLEANING AND INSPECTION (Continued)

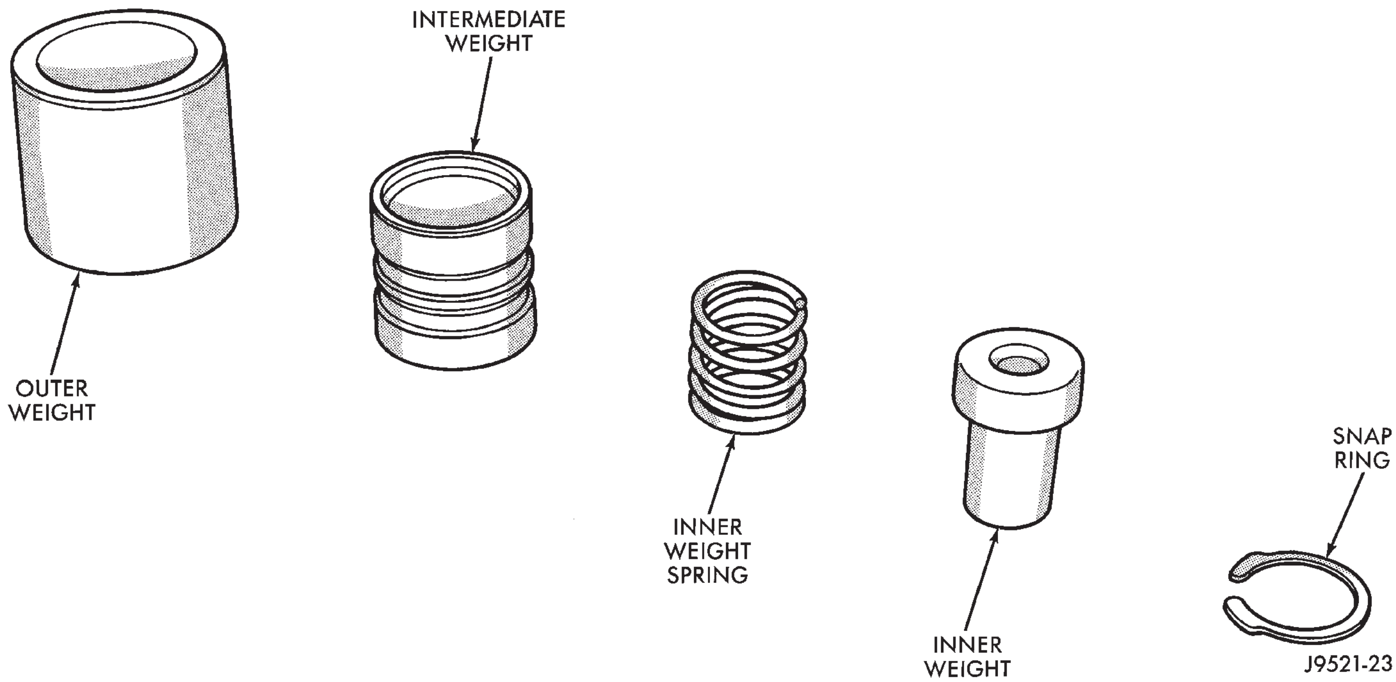


Fig. 168 Governor Weights

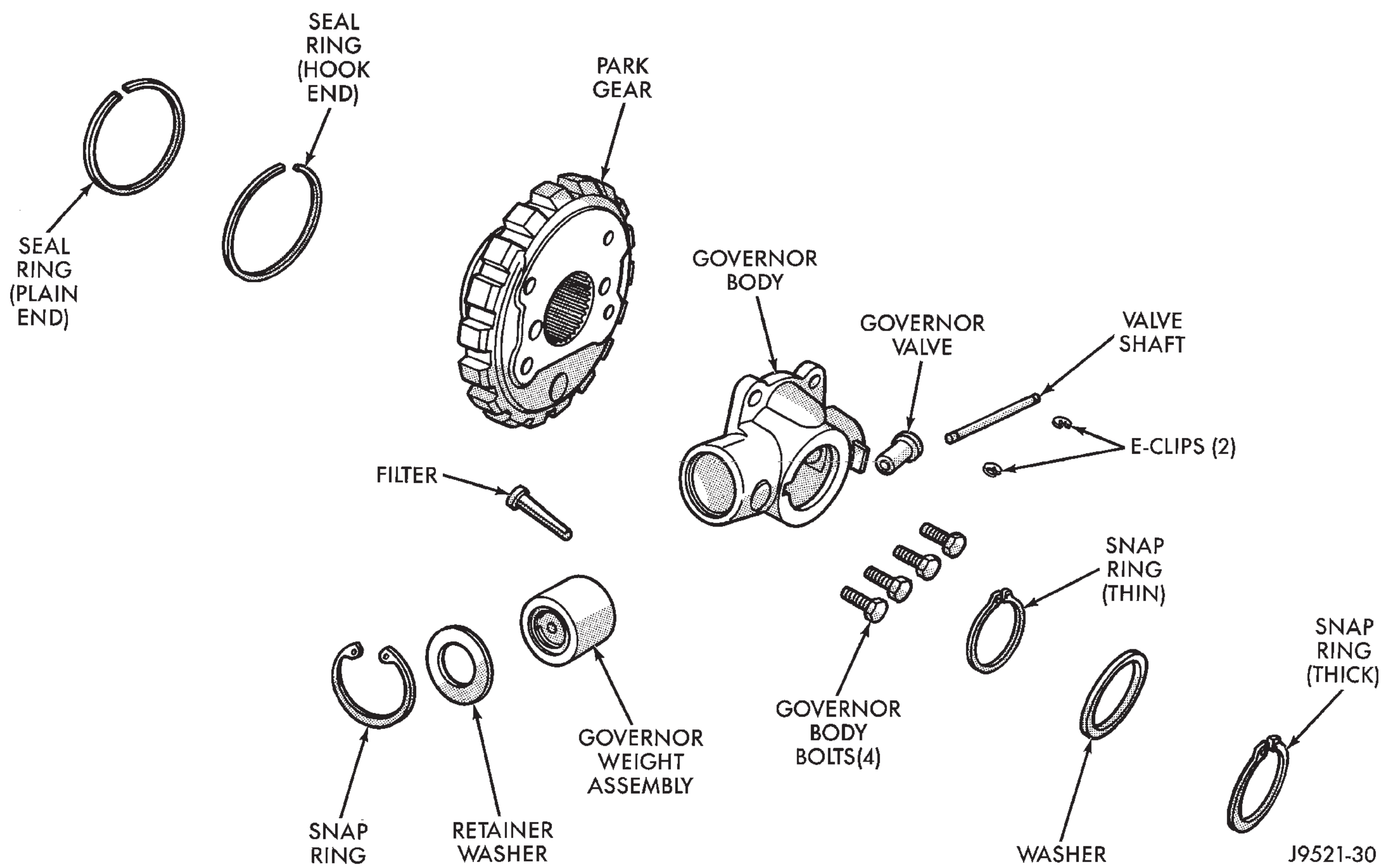


Fig. 169 Governor Components

CLEANING AND INSPECTION (Continued)

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. 170) and remove the sprag and spring. Then remove the spring clip and reaction plug (Fig. 171). **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. 172). Also be sure the spring is correctly positioned as shown (Fig. 172). The sprag may not retract if the spring is improperly installed.

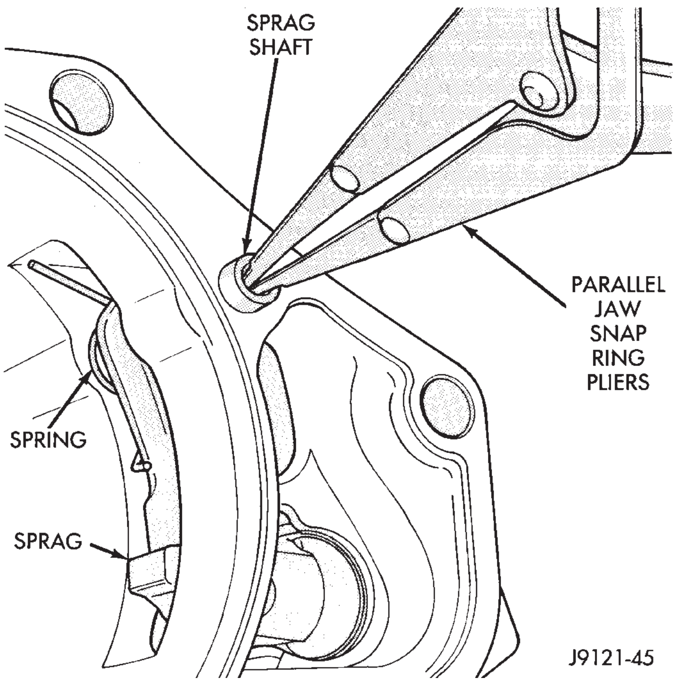


Fig. 170 Park Sprag, Shaft And Spring

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.

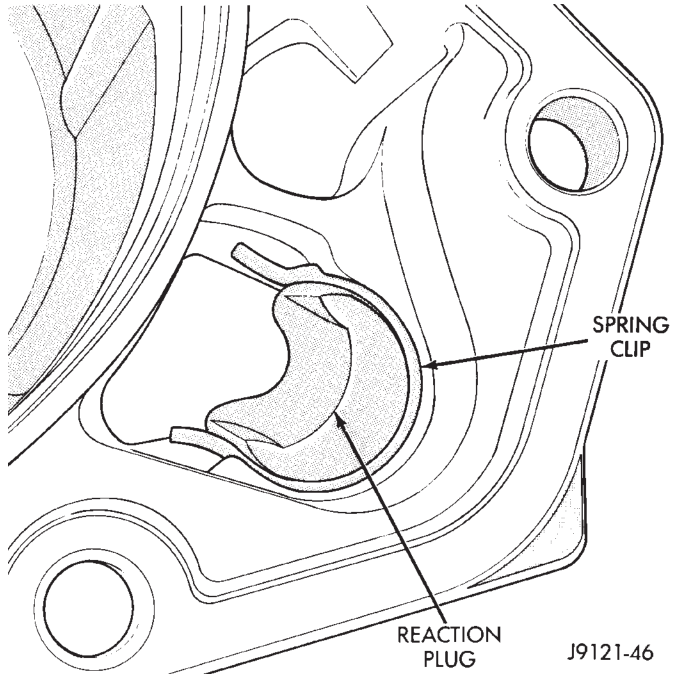


Fig. 171 Park Sprag Reaction Plug And Spring Location

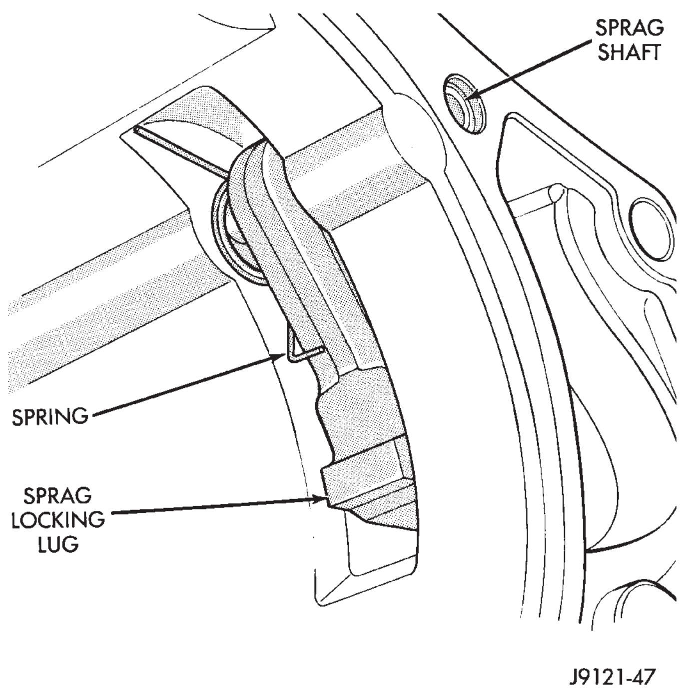


Fig. 172 Correct Position Of Sprag And Spring

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.

CLEANING AND INSPECTION (Continued)

Inspect the throttle and manual valve levers and shafts. Do not attempt to straighten a bent shaft or correct a loose lever. Replace these components if worn, bent, loose or damaged in any way.

Inspect all of the valve body mating surfaces for scratches, nicks, burrs, or distortion. Use a straight-edge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with 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. 173). 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.

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

CLEANING AND INSPECTION (Continued)

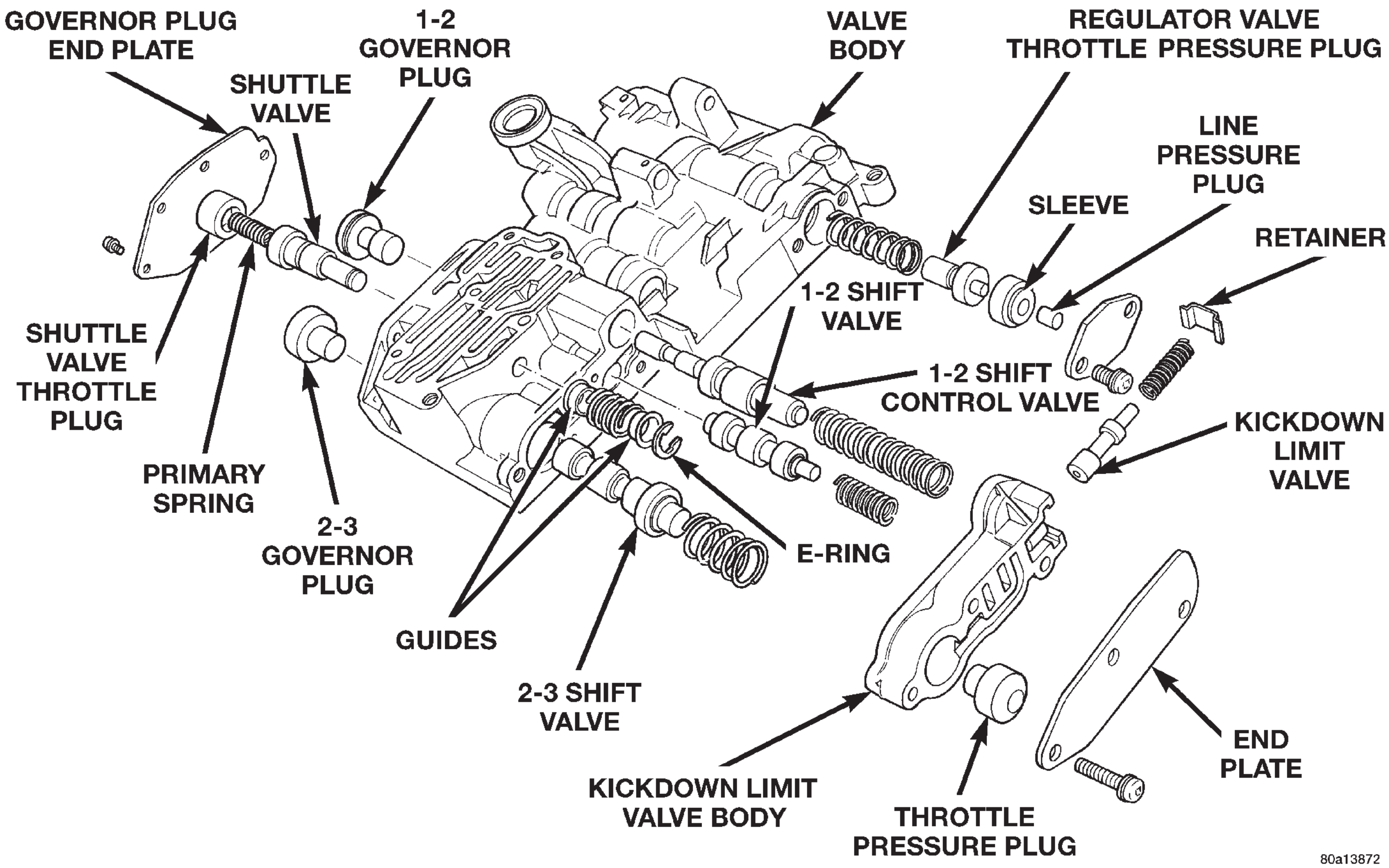


Fig. 173 Valve Body Components

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. 174). Replace the springs if collapsed, distorted or broken. Replace the guide, rod and piston if cracked, bent, or worn. Discard the servo snap ring if distorted or warped.

Check the servo piston bore for wear. If the bore is severely scored, or damaged, it will be necessary to replace the case.

Replace any servo component if doubt exists about condition. Do not reuse suspect parts.

REAR SERVO

Remove and discard the servo piston seal ring (Fig. 175). Then clean the servo components with solvent and dry with compressed air. Replace either spring if collapsed, distorted or broken. Replace the plug and piston if cracked, bent, or worn. Discard the servo snap rings and use a new ones at assembly.

CLEANING AND INSPECTION (Continued)

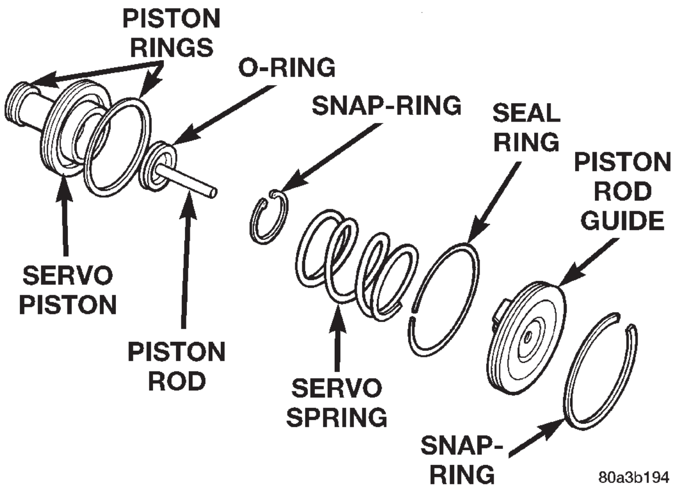


Fig. 174

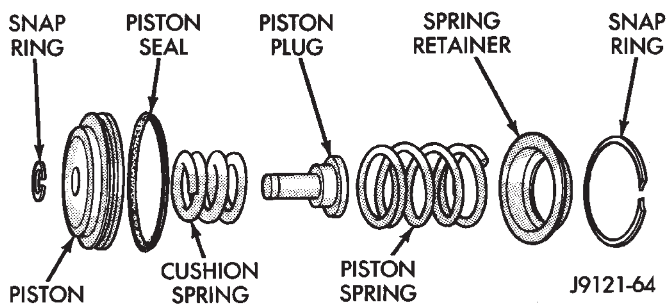


Fig. 175 Rear Servo Components

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. 176). The ball must move freely and not stick.

NOTE: Inspect the clutch retainer bushings carefully (Fig. 177). 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.

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.

CLEANING AND INSPECTION (Continued)

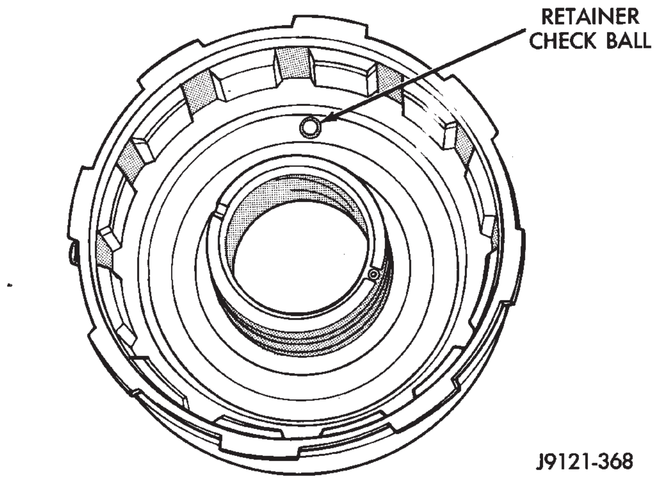


Fig. 176 Front Clutch Piston Retainer Check Ball Location

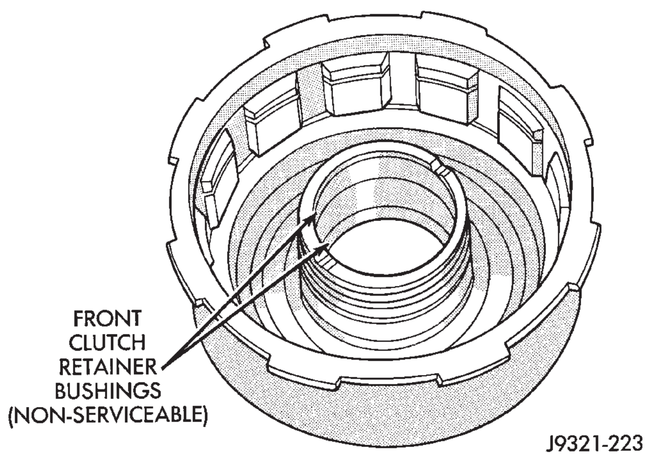


Fig. 177 Retainer Bushing Location/Inspection

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.

ADJUSTMENTS (Continued)

(3) Release cable adjuster clamp (at transmission end of cable) to unlock cable.

(4) Unsnap cable from cable mounting bracket on transmission (Fig. 178).

(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.

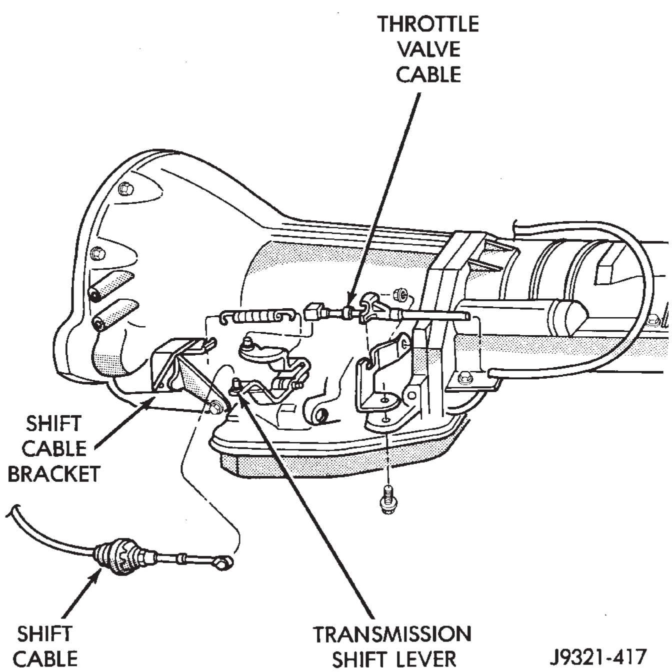


Fig. 178 Shift Cable Attachment At Transmission–Typical

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. 179).

(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:

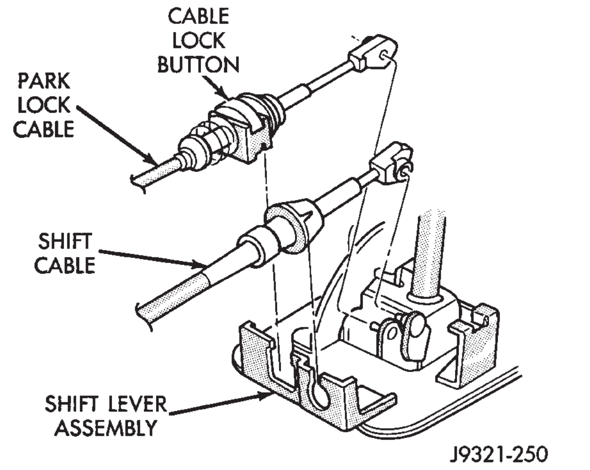


Fig. 179 Park Lock Cable Attachment

(a) Check movement of release shift handle button (floor shift) or release lever (column shift). You should not be able to press button inward or move column lever.

(b) Turn ignition switch to 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. 180). 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.

ADJUSTMENTS (Continued)

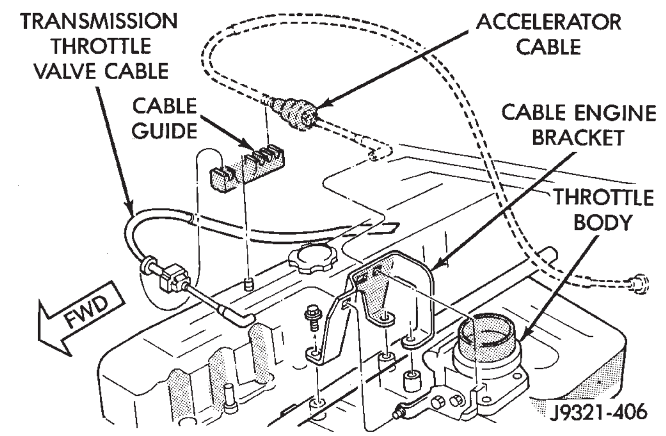


Fig. 180 Throttle Cable Attachment At Engine

Checking Throttle Valve Cable Adjustment

(1) Turn ignition key to OFF position.

(2) Remove air cleaner.

(3) Verify that lever on throttle body is at curb idle position. Then verify that transmission throttle lever (Fig. 181) is also at idle (fully forward) position.

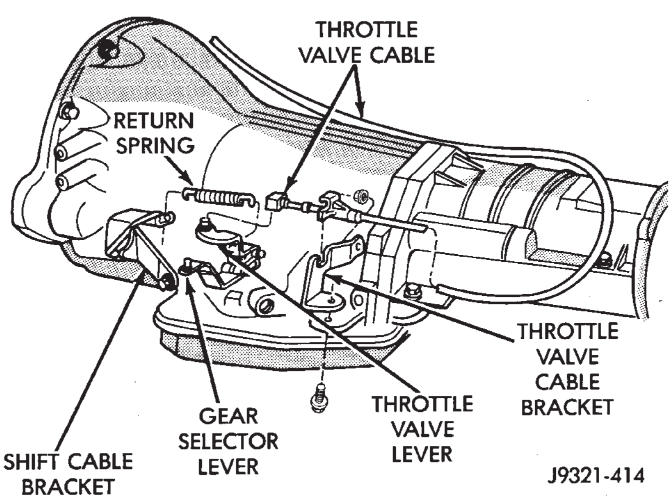


Fig. 181 Throttle Cable Attachment At Transmission

(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.).

NOTE: Be sure that as the cable is pulled forward and centered on the throttle lever stud, the cable housing moves smoothly with the cable. Due to the angle at which the cable housing enters the spring housing, the cable housing may bind slightly and create an incorrect adjustment.

(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. 182). 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. 183), tighten the screw to only 5 N·m (47-50 in. lbs.) torque.

(4) Back off front band adjusting screw 2-1/2 turns.

(5) Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.

(6) Lower vehicle.

ADJUSTMENTS (Continued)

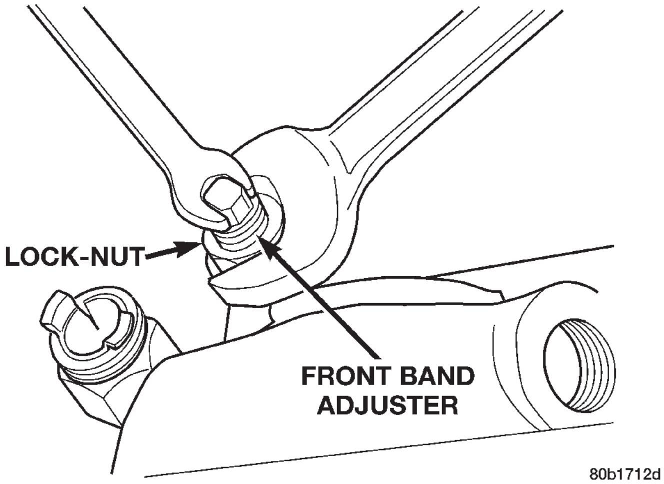


Fig. 182 Front Band Adjustment Screw Location

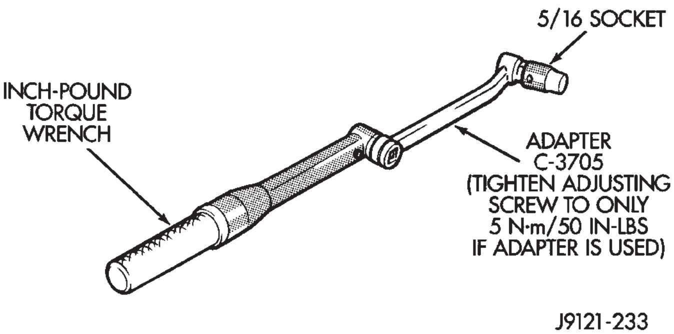


Fig. 183 Band Adjustment Adapter Tool

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.) (Fig. 184).

(5) Back off adjusting screw 7 turns.

(6) Hold adjusting screw in place and tighten locknut to 34 N·m (25 ft. lbs.) torque.

(7) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(8) Lower vehicle and refill transmission with Mopar® ATF Plus 3, Type 7176, fluid.

VALVE BODY

CONTROL PRESSURE ADJUSTMENTS

There are two control pressure adjustments on the valve body;

- Line Pressure
- Throttle Pressure

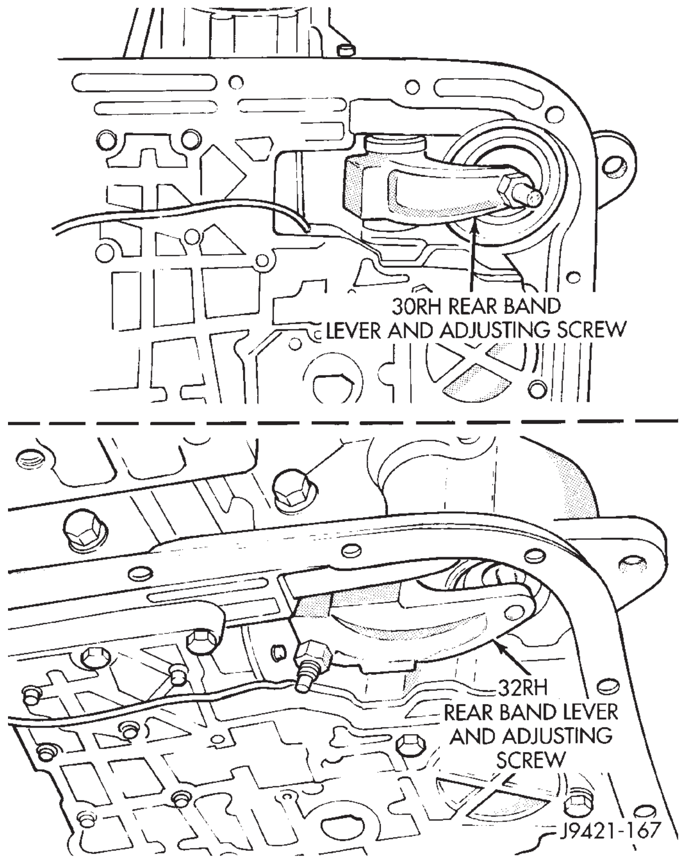


Fig. 184 Rear Band Adjustment Screw Location

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. 185).

Distance should be 33.4 mm (1-5/16 in.).

If adjustment is required, turn the adjusting screw in, or out, to obtain required distance setting.

NOTE: The 33.4 mm (1-5/16 in.) setting is an approximate setting. Manufacturing tolerances may make it necessary to vary from this dimension to obtain desired pressure.

One complete turn of the adjusting screw changes line pressure approximately 1-2/3 psi (9 kPa).

Turning the adjusting screw counterclockwise increases pressure while turning the screw clockwise decreases pressure.

ADJUSTMENTS (Continued)

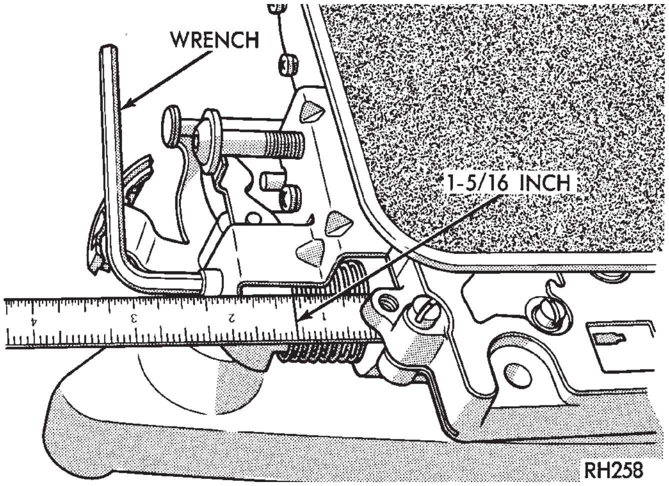


Fig. 185 Line Pressure Adjustment

THROTTLE PRESSURE ADJUSTMENT

Insert Gauge Tool C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 186).

Push the gauge tool inward to compress the kickdown valve against the spring and bottom the throttle valve.

Maintain pressure against kickdown valve spring. Turn throttle lever stop screw until the screw head touches throttle lever tang and the throttle lever cam touches gauge tool.

NOTE: The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed to obtain correct adjustment.

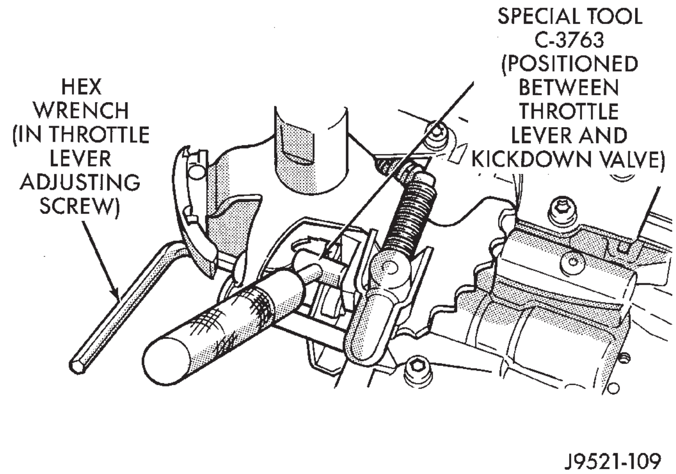
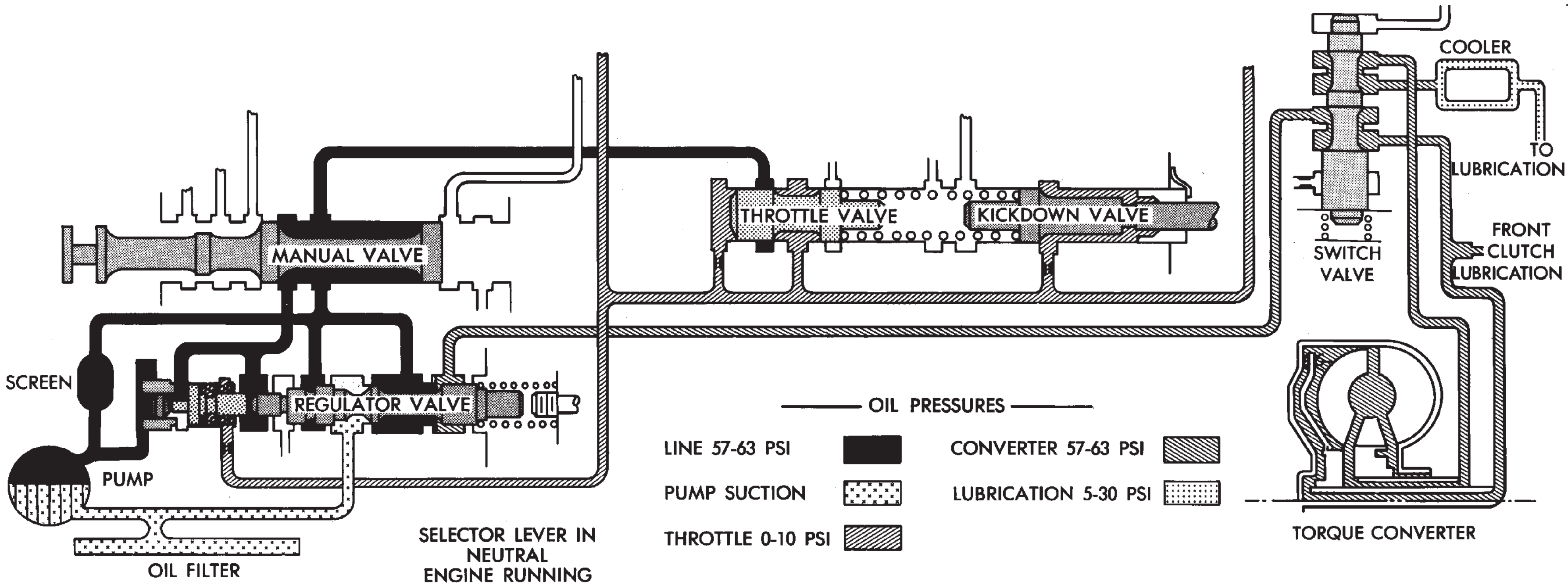
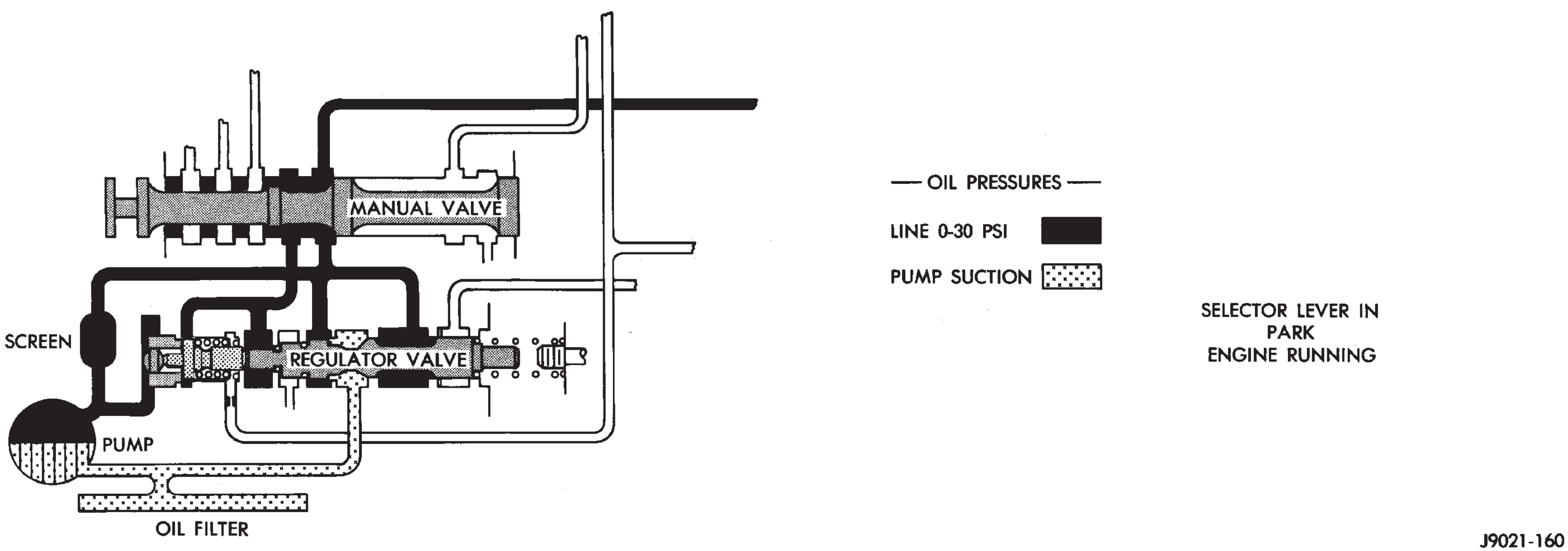


Fig. 186 Throttle Pressure Adjustment

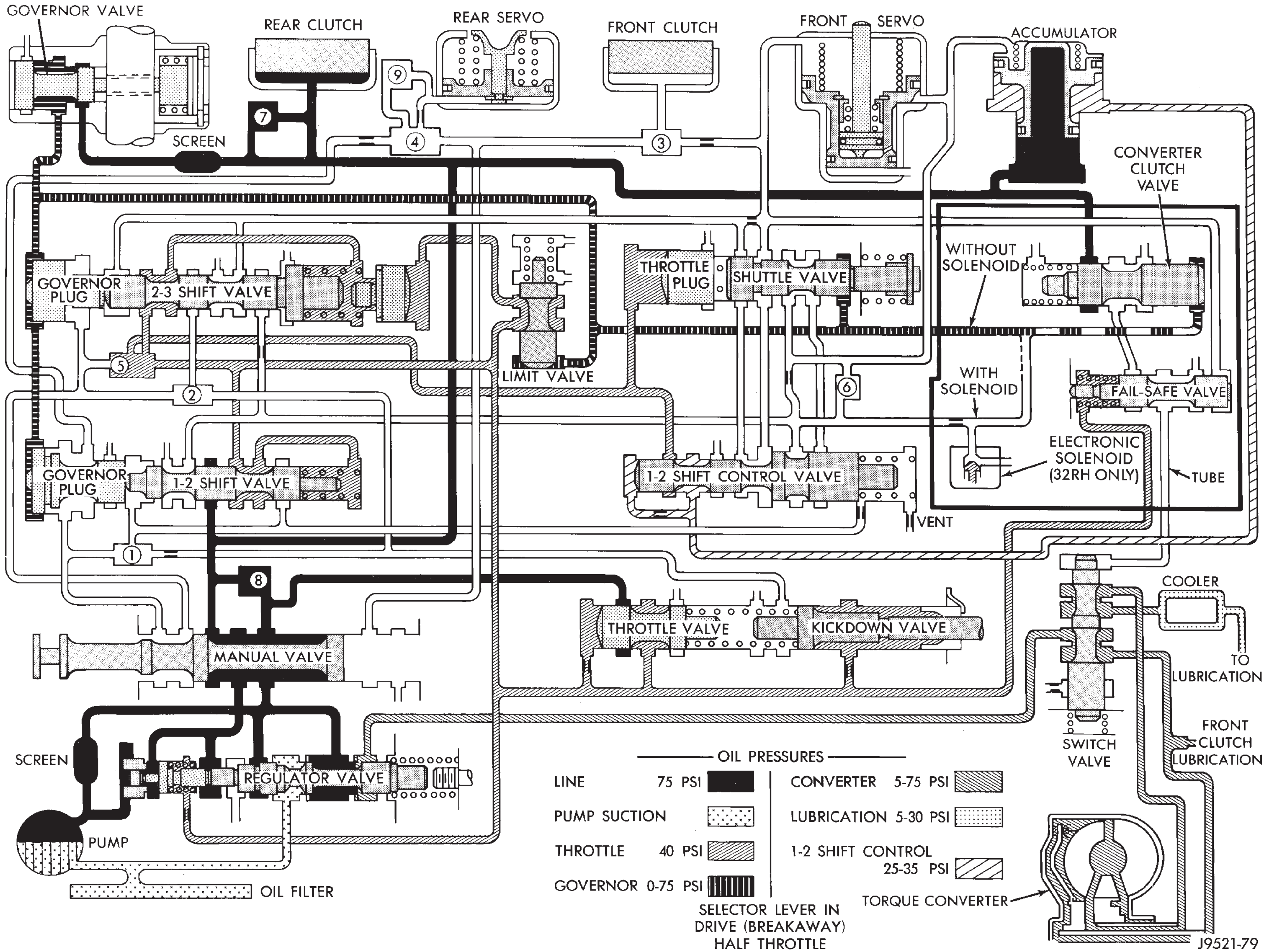
SCHEMATICS AND DIAGRAMS

HYDRAULIC SCHEMATICS

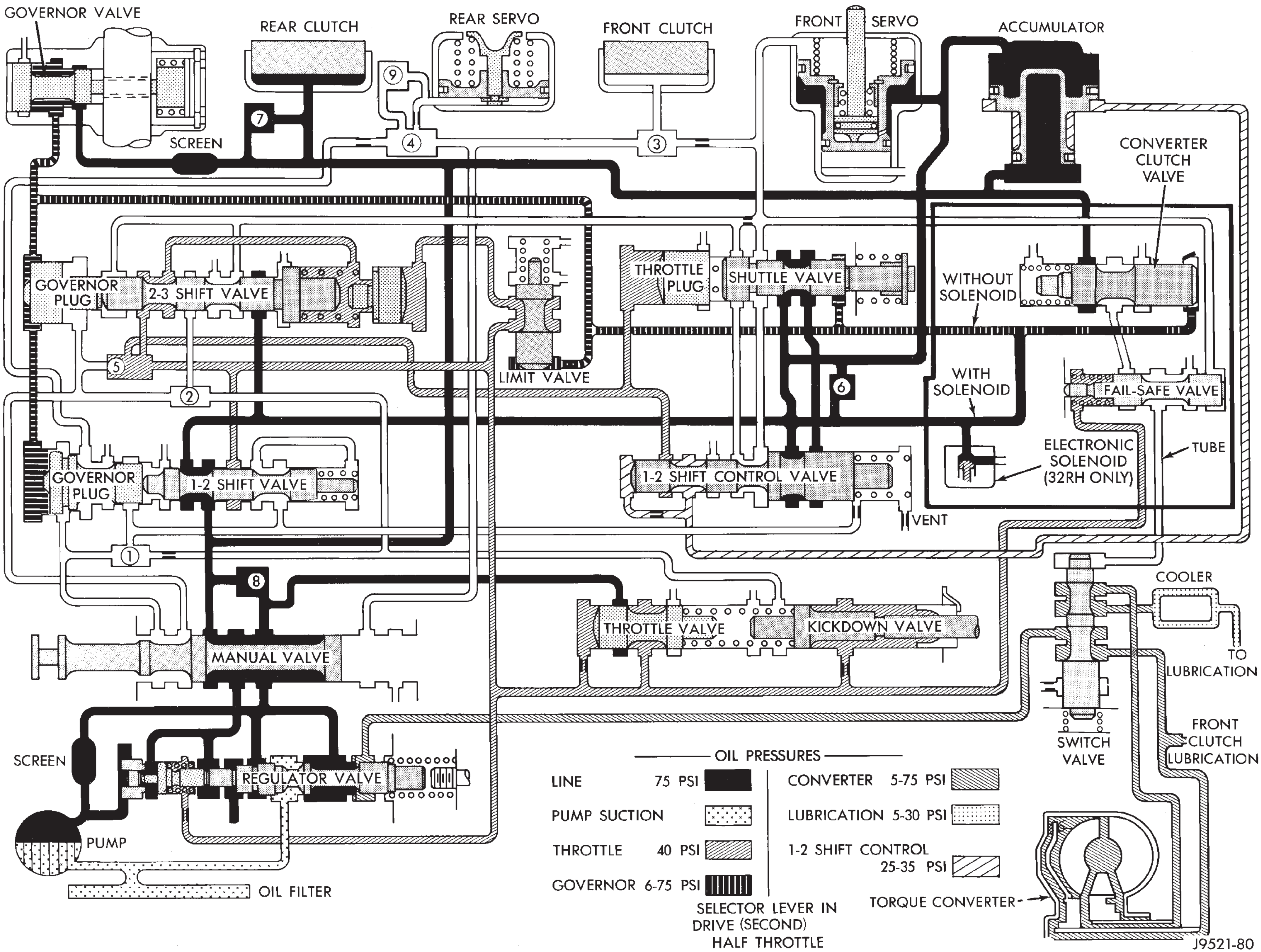




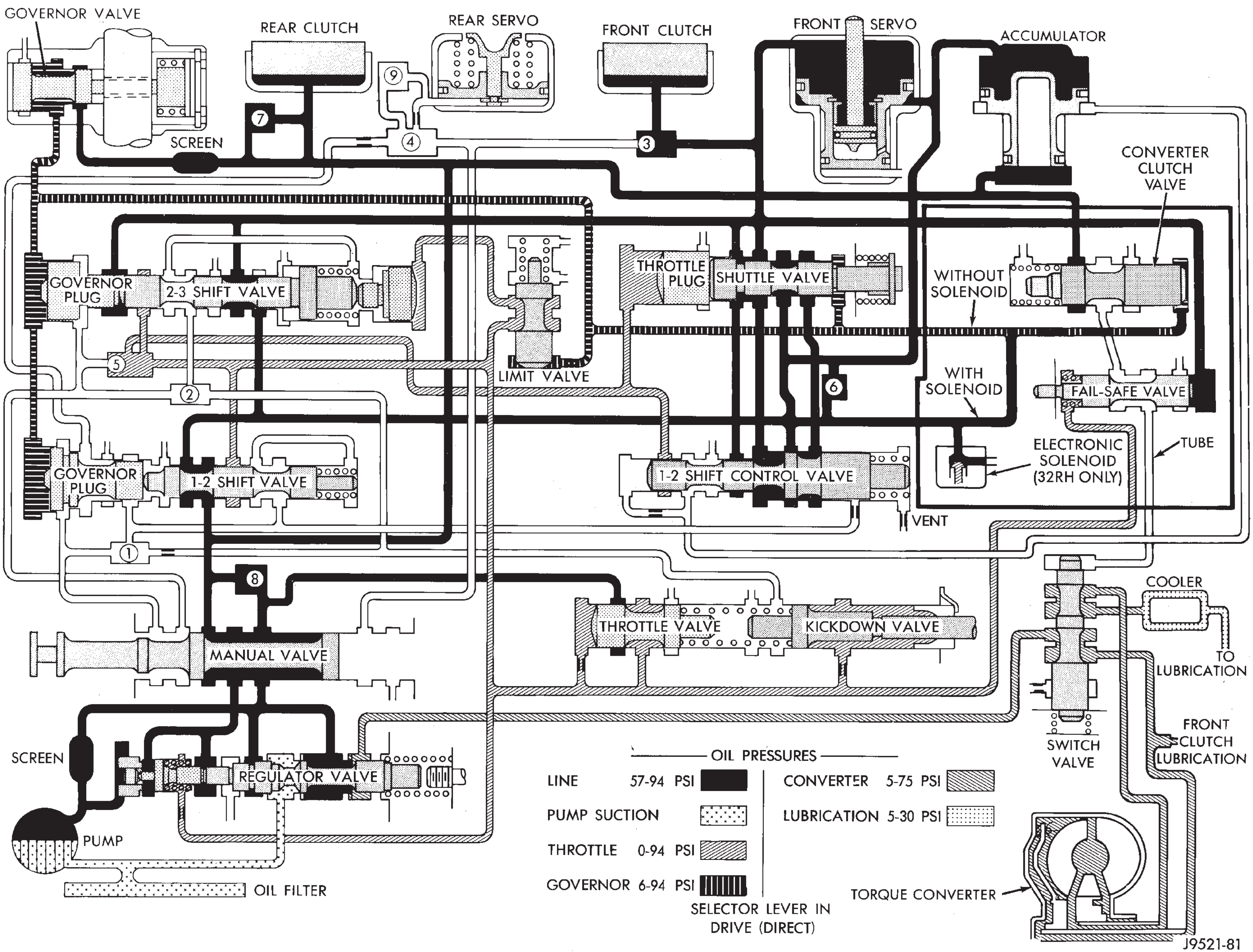
HYDRAULIC FLOW IN PARK/NEUTRAL



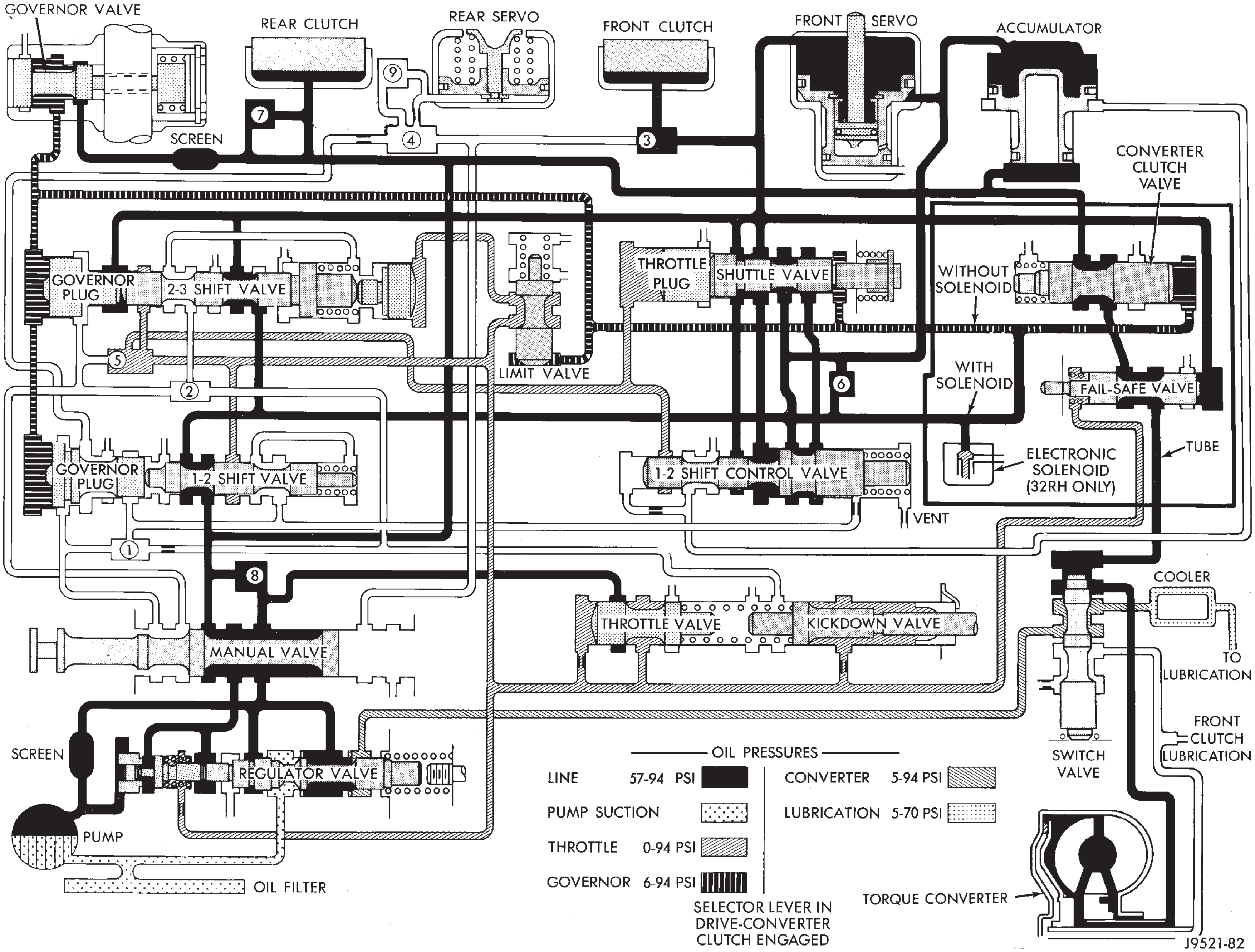
HYDRAULIC FLOW IN D-FIRST GEAR



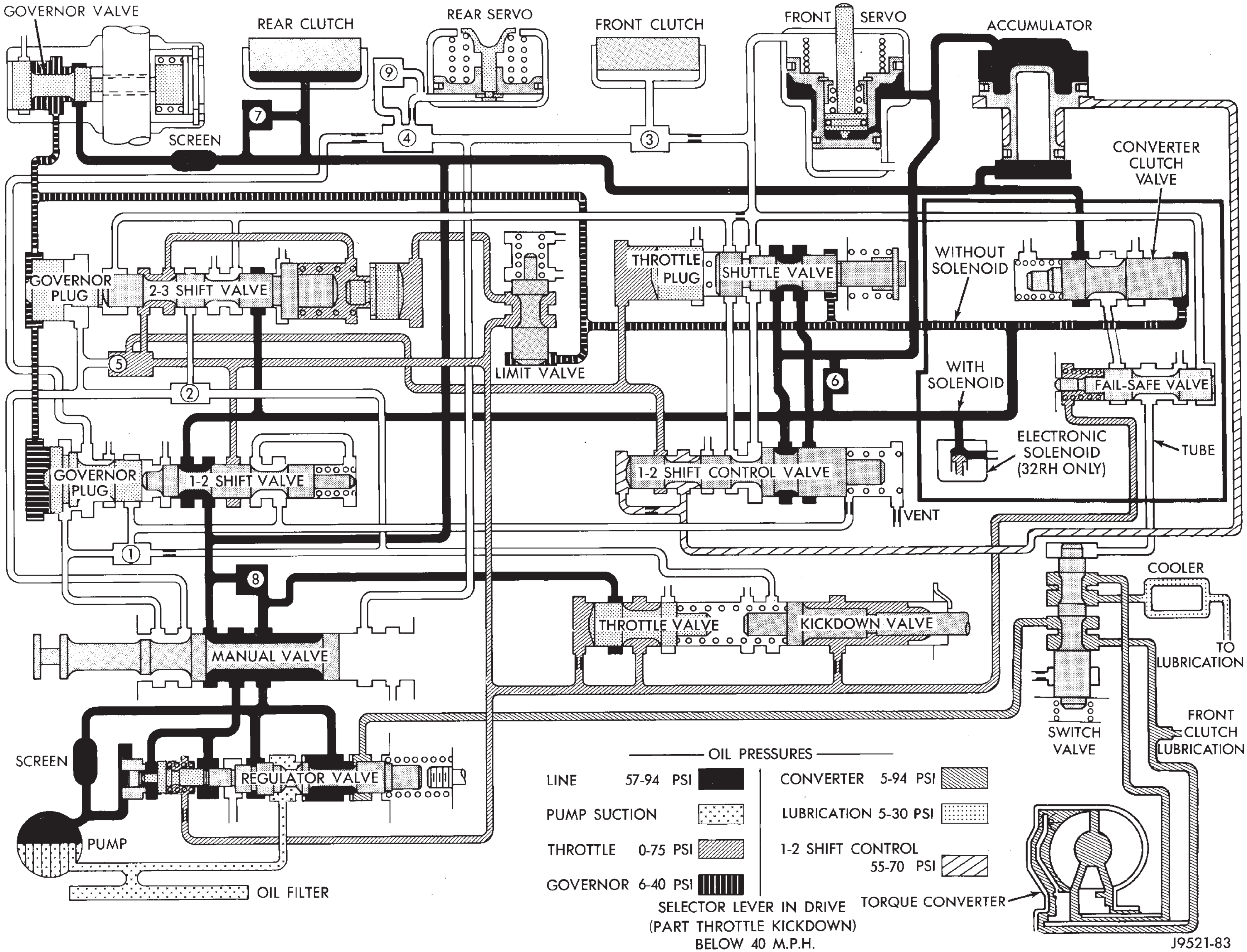
HYDRAULIC FLOW IN D-SECOND GEAR



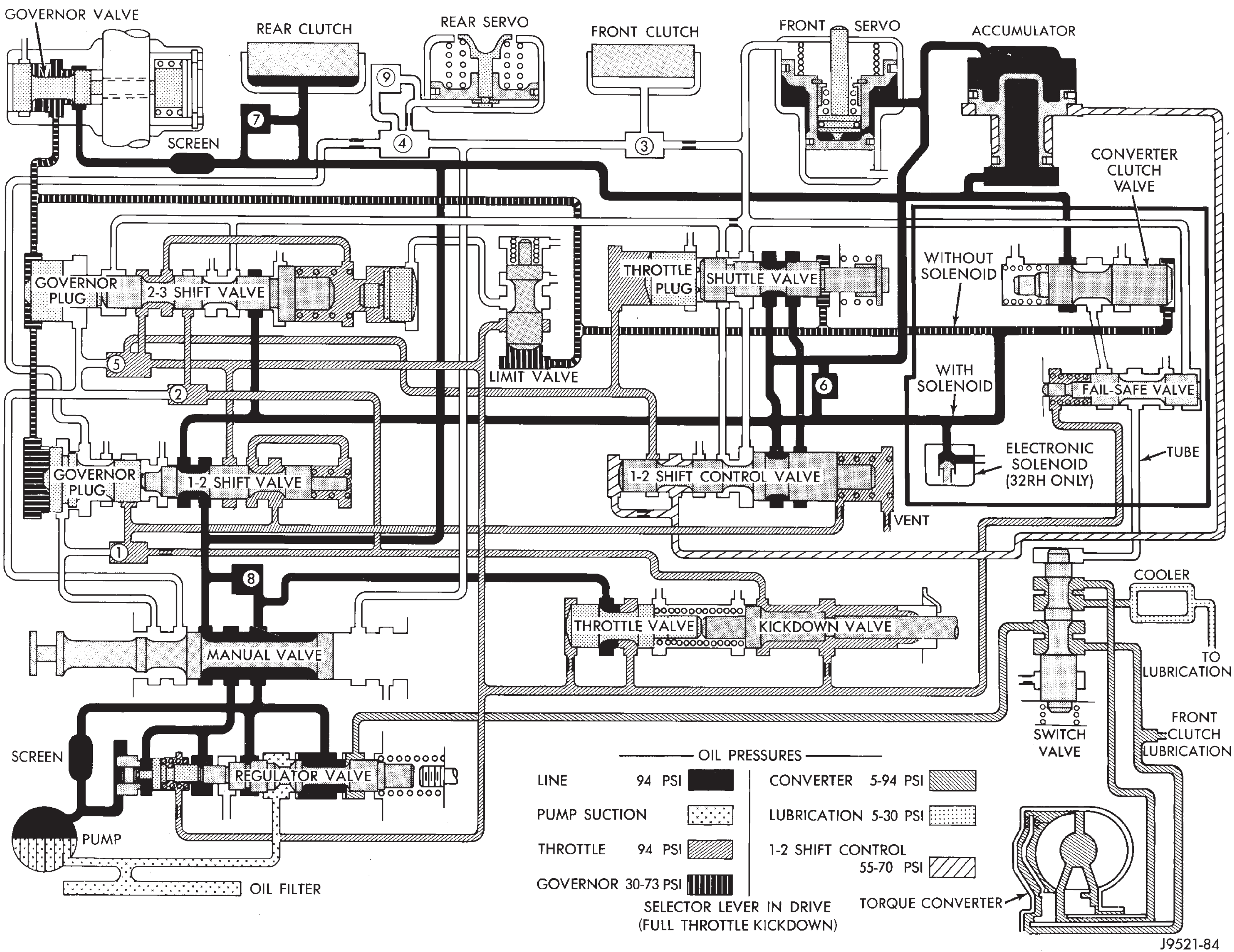
HYDRAULIC FLOW IN D-THIRD GEAR



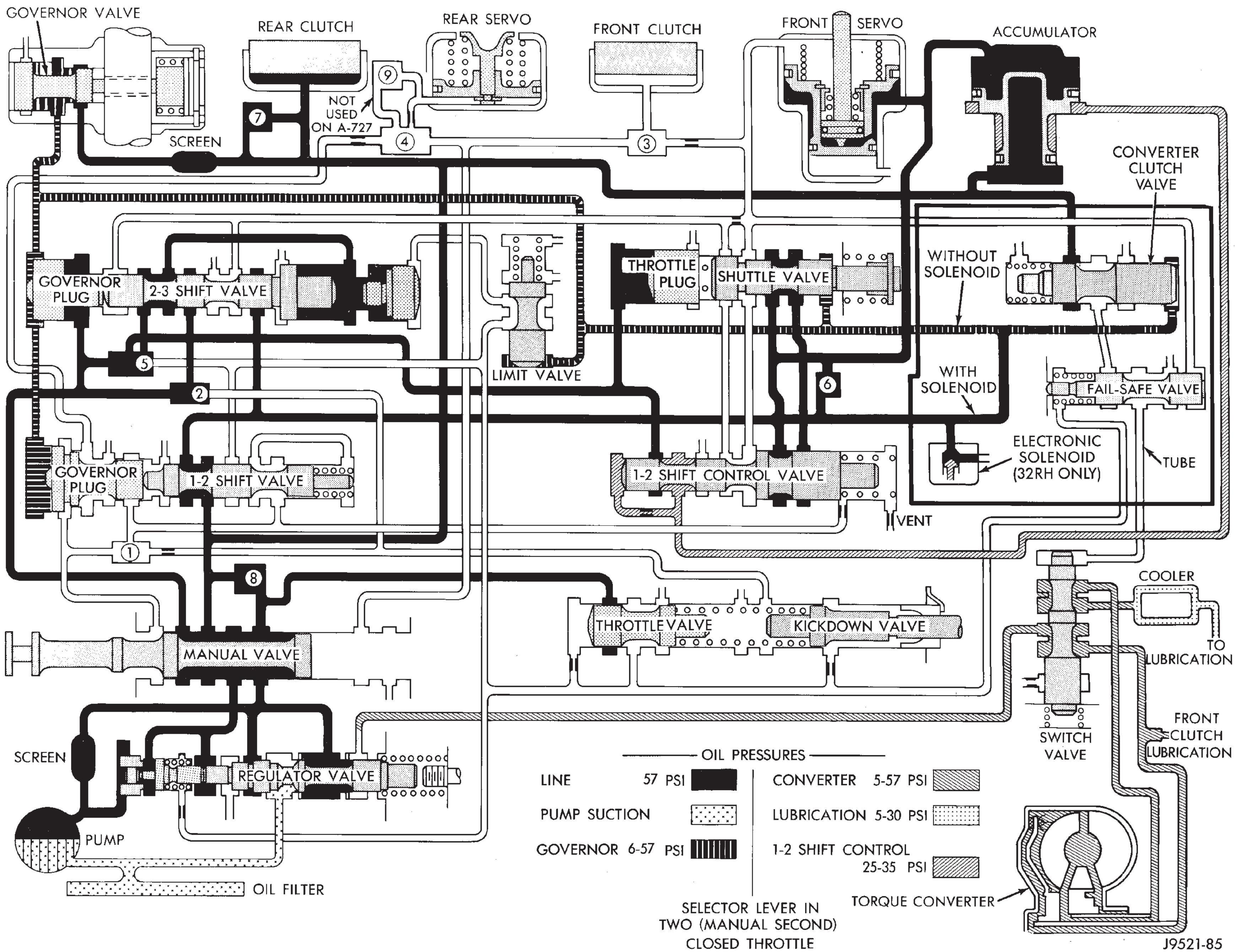
HYDRAULIC FLOW IN D-THIRD GEAR (CONVERTER CLUTCH APPLIED)



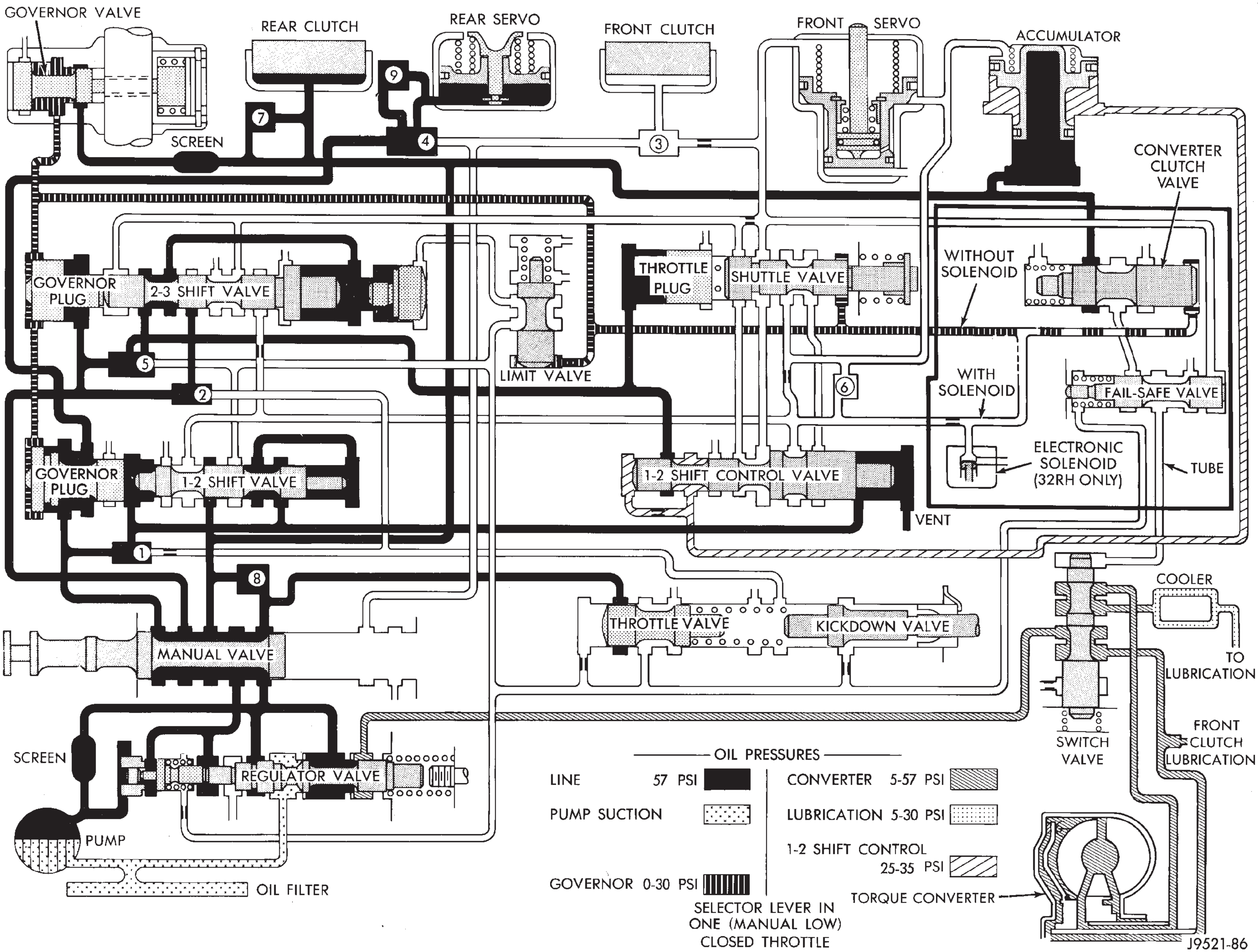
HYDRAULIC FLOW AT PART THROTTLE 3-2 KICKDOWN



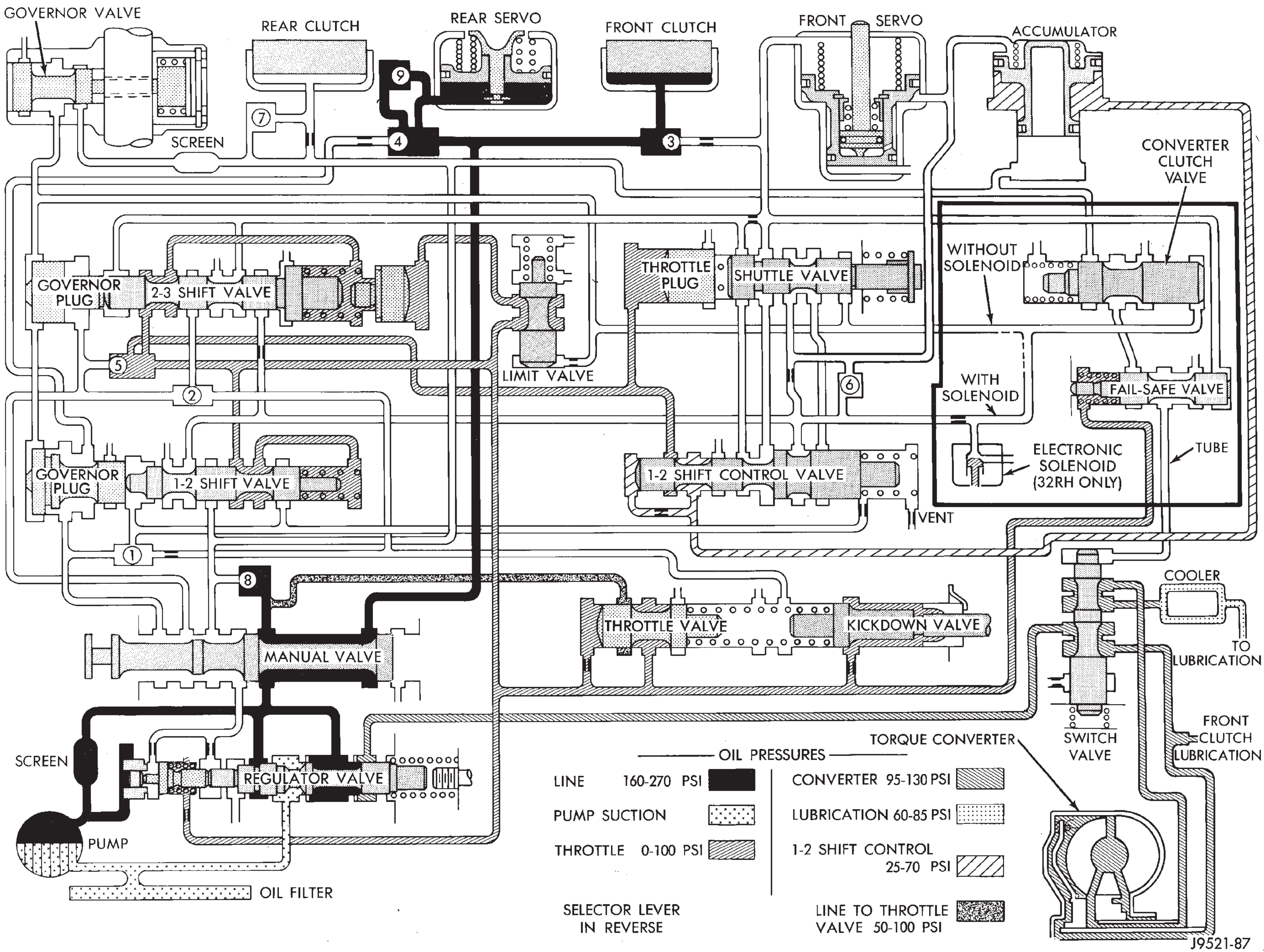
HYDRAULIC FLOW AT FULL THROTTLE 3-2 KICKDOWN



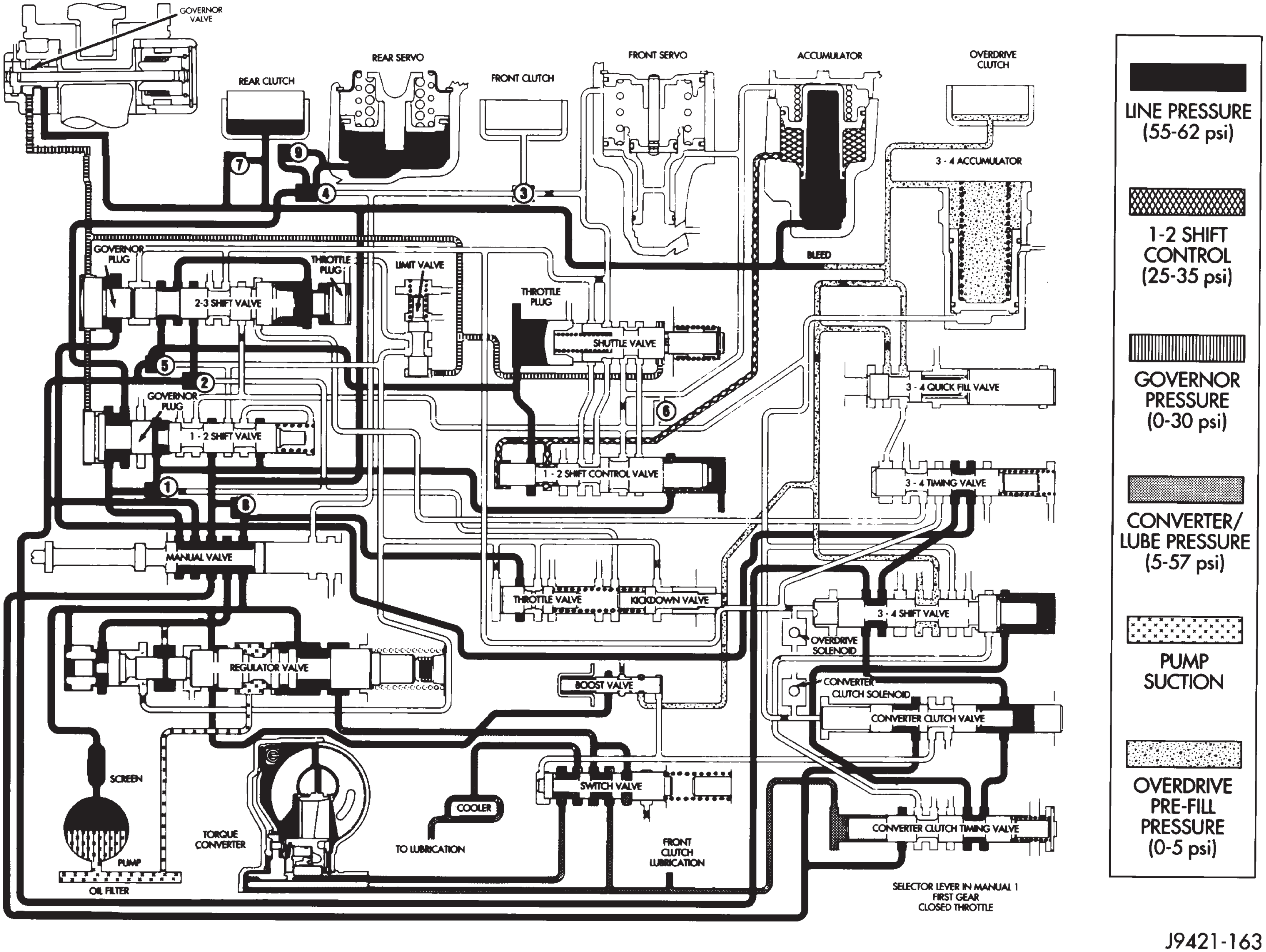
HYDRAULIC FLOW IN MANUAL SECOND



HYDRAULIC FLOW IN MANUAL LOW

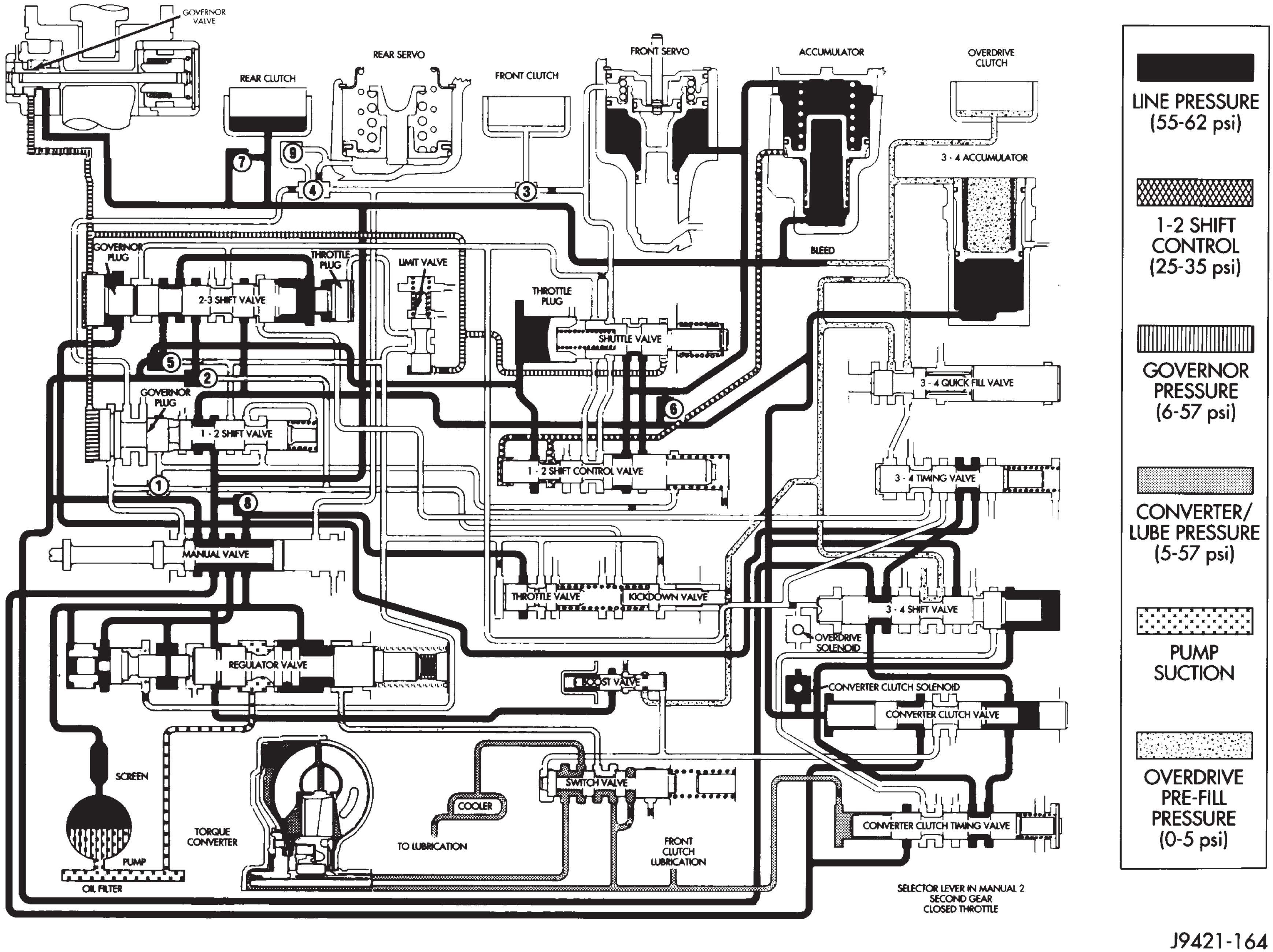


HYDRAULIC FLOW IN REVERSE



HYDRAULIC FLOW IN MANUAL FIRST GEAR (1)

SCHEMATICS AND DIAGRAMS (Continued)



HYDRAULIC FLOW IN MANUAL SECOND GEAR (2)

SPECIFICATIONS

30RH 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	
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 1.7-1.8 mm 2.1-2.2 mm	0.052-0.054 in. 0.068-0.070 in. 0.083-0.086 in.
Rear clutch pack snap ring	1.5-1.6 mm 1.7-1.8 mm 1.9-2.0 mm	0.06-0.062 in. 0.068-0.070 in. 0.076-0.078 in.
Planetary geartrain snap ring (at front of output shaft)	1.0-1.1 mm 1.6-1.7 mm 2.1-2.2 mm	0.040-0.044 in. 0.062-0.066 in. 0.082-0.086 in.

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.

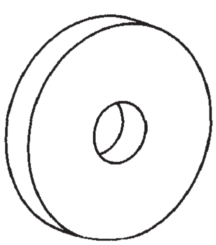
SPECIFICATIONS (Continued)

TORQUE

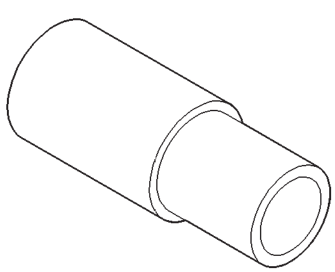
DESCRIPTION	TORQUE
Bolt, torque convertor	31 N·m (23 ft. lbs.)
Bolt/nut, crossmember	68 N·m (50 ft. lbs.)
Bolt, driveplate to crankshaft	75 N·m (55 ft. lbs.)
Plug, front band reaction	17 N·m (13 ft. lbs.)
Locknut, front band adj.	34 N·m (25 ft. lbs.)
Switch, park/neutral	34 N·m (25 ft. lbs.)
Bolt, fluid 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

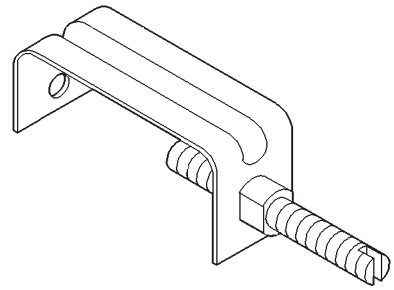
30RH TRANSMISSIONS



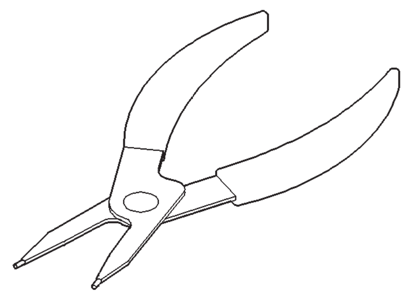
Remover—6957



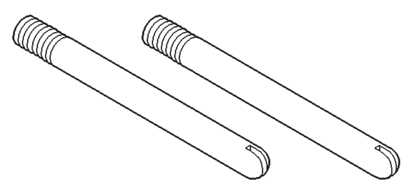
Installer—6951



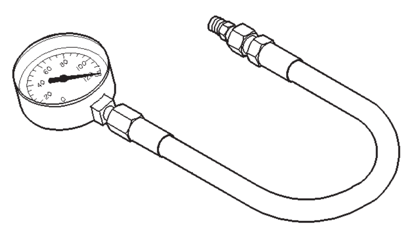
Retainer, Detent Ball and Spring—6583



Snap-ring Plier—6823

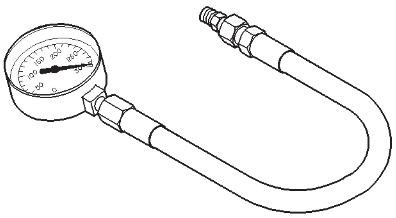


Pilot Stud—C-3288-B

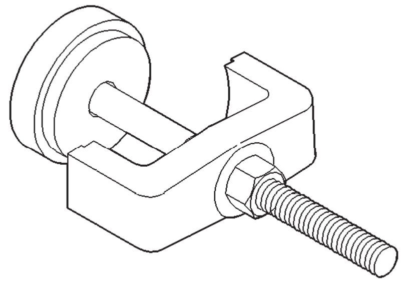


Pressure Gauge—C-3292

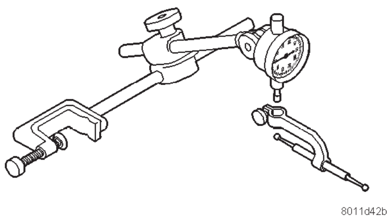
SPECIAL TOOLS (Continued)



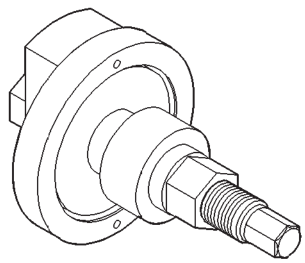
Pressure Gauge—C-3293SP



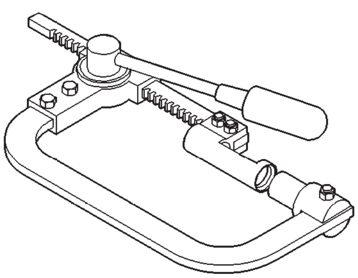
Spring Compressor—C-3575-A



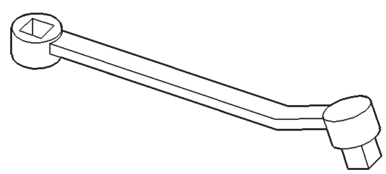
Dial Indicator—C-3339



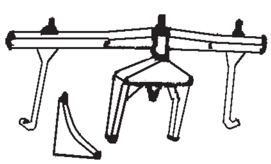
Spring Compressor—C-3863-A



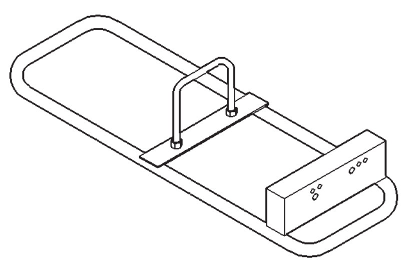
Spring Compressor—C-3422-B



Adapter, Band Adjuster—C-3705

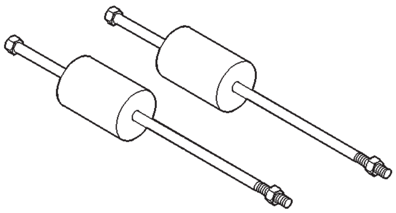


Fixture, Engine Support—C-3487-A

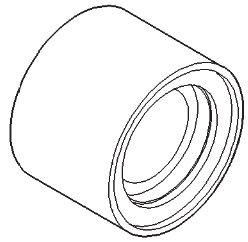


Transmission Repair Stand—C-3750-B

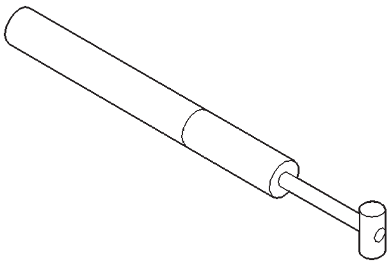
SPECIAL TOOLS (Continued)



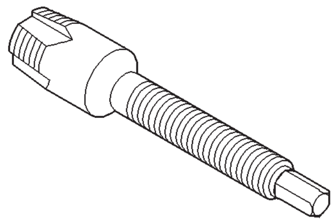
Puller, Slide Hammer—C-3752



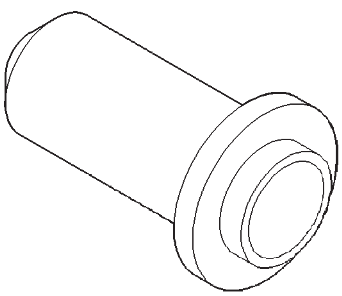
Cup, Remover—SP-3633



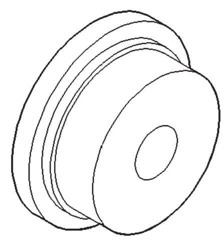
Gauge, Throttle Setting—C-3763



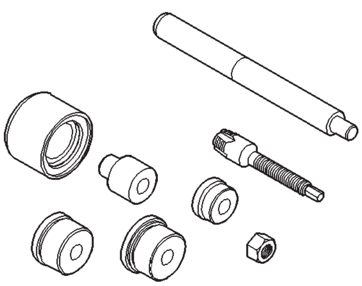
Remover, Bushing—SP-5301



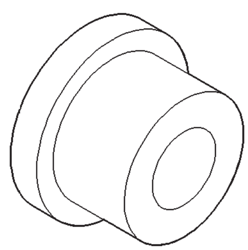
Seal Installer—C-3860-A



Installer, Bushing—SP-5118

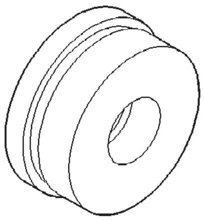


Bushing Remover/Installer—C-3887-J

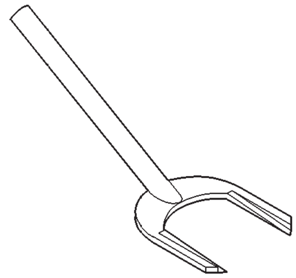


Installer, Bushing—SP-5302

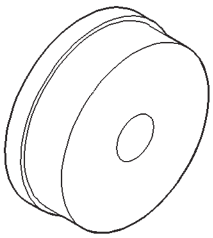
SPECIAL TOOLS (Continued)



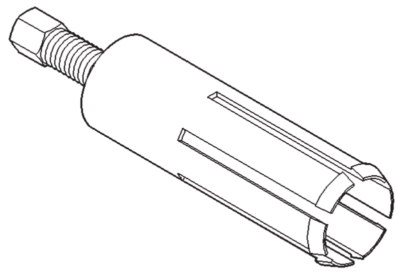
Remover, Bushing—SP-3550



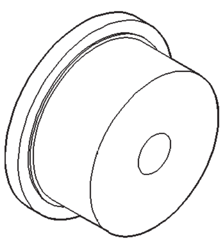
Seal Remover—C-3985-B



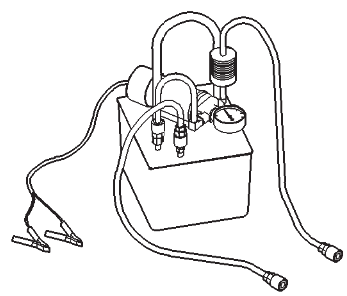
Remover, Bushing—SP-3629



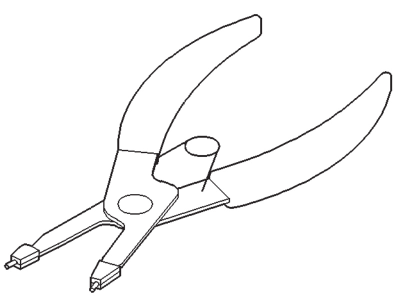
Bushing, Remover—6957



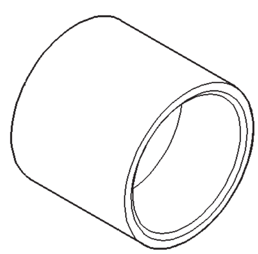
Installer, Bushing—SP-5511



Flusher, Oil Cooler—6906

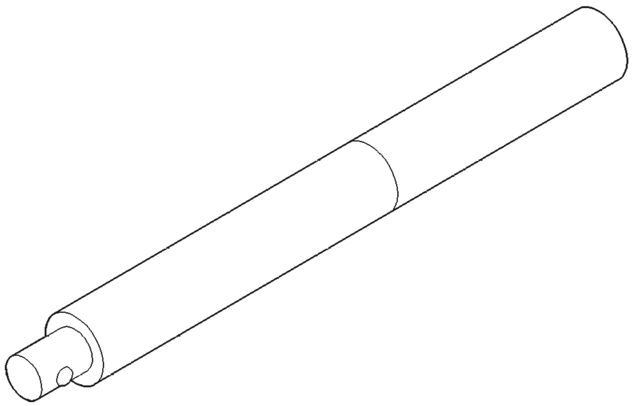


Snap-ring Plier—C-3915

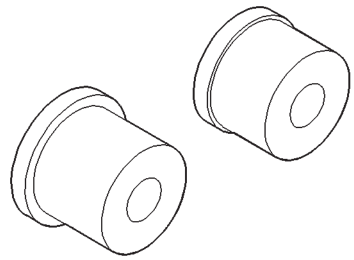


Installer—C-3995-A

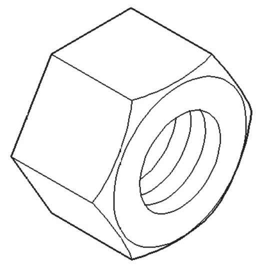
SPECIAL TOOLS (Continued)



Universal Handle—C-4171



Remover/Installer—C-4470



Nut, Bushing Remover—SP-1191

AW–4 AUTOMATIC TRANSMISSION

INDEX

GENERAL INFORMATION

AW–4 AUTOMATIC TRANSMISSION

The AW–4 is a 4–speed, electronically controlled automatic transmission (Fig. 1).

The running gear consists of an oil pump, planetary gear sets, clutch and brake units, hydraulic accumulators, a valve body with electrical solenoids, and a transmission control module (TCM). Cables are used to provide shift and throttle pressure control information. A park/neutral position switch permits engine starting in the Park and Neutral ranges only.

The valve body solenoids are controlled by signals from the transmission control module (TCM). Signal sequence is determined by inputs from various sensors to the TCM.

Fourth gear is an 0.75:1 ratio overdrive range. First, second, third and reverse gear are conventional ranges. Third gear ratio is 1:1. A separate planetary gear set provides overdrive operation in fourth gear.

TRANSMISSION IDENTIFICATION

The transmission I.D. plate is attached to the case (Fig. 2). The plate contains the transmission serial and model numbers. Refer to the information on this plate when ordering service parts.

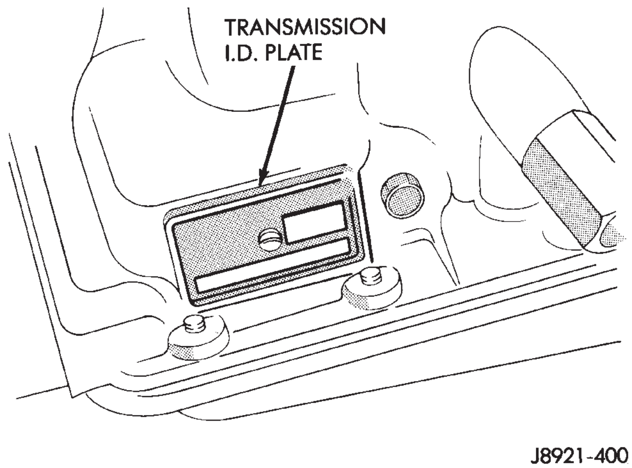


Fig. 2 Transmission Identification

RECOMMENDED FLUID CAPACITY

Recommended and preferred fluid for the AW–4 transmission is Mopar Dexron IIE/Mercon.

Mopar Dexron II can be used but only in emergency situations where Mercon fluid is not available.

Approximate refill capacity for the AW–4 is 8.0 liters (16.9 pints).

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.

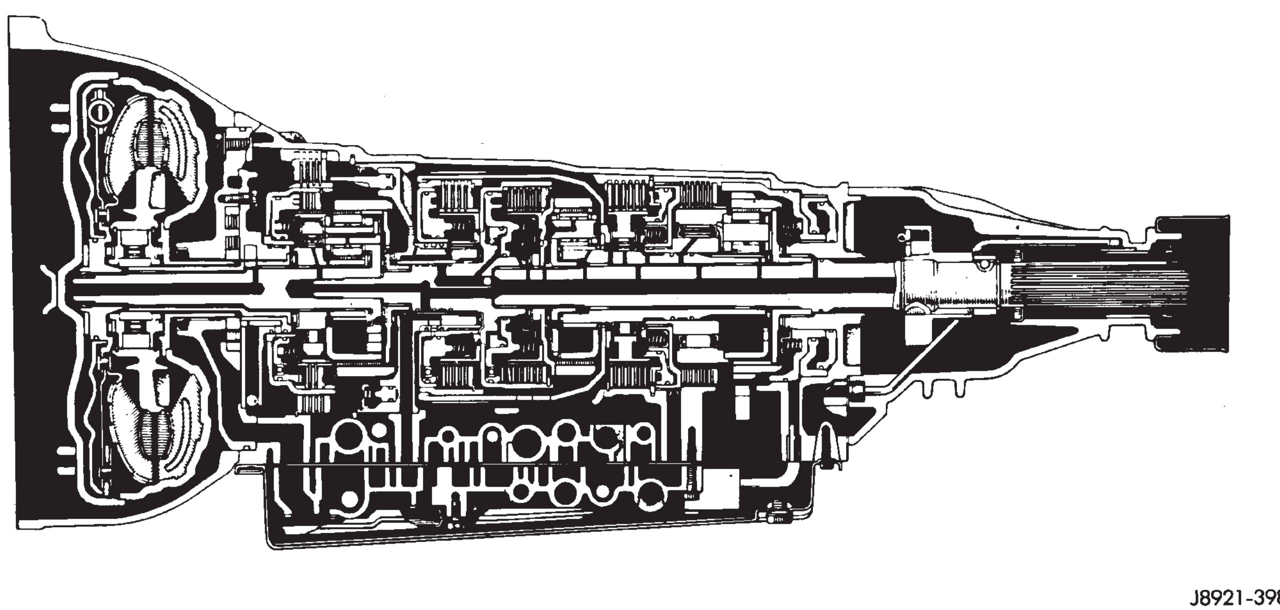


Fig. 1 AW–4 Automatic Transmission

GENERAL INFORMATION (Continued)

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.

TRANSMISSION RANGES AND SHIFT LEVER POSITIONS

The AW–4 transmission has six ranges and shift lever positions. Park, Reverse and Neutral are conventional and mechanically operated. The 1–2, 3 and D ranges provide electronically controlled shifting.

The 1–2 position provides first and second gear only. The 3 position provides first, second and third gear.

The D range provides first through fourth gear. Overdrive fourth gear range is available only when the shift lever is in D position (Fig. 3).

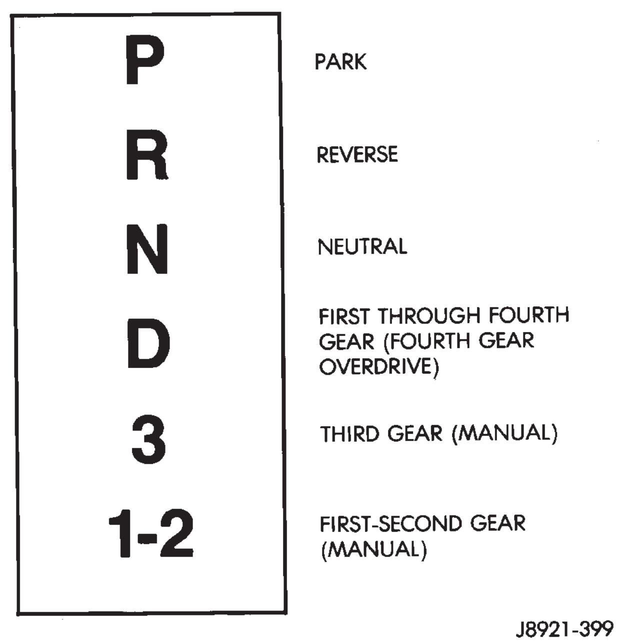


Fig. 3 AW–4 Shift Lever Positions And Transmission Ranges

DESCRIPTION AND OPERATION

ELECTRONIC CONTROLS

The AW–4 is electronically controlled in 1, 2, 3 and D ranges. Controls consist of the transmission control module (TCM), valve body solenoids and various sensors. The sensors monitor vehicle speed, throttle opening, shift lever position and brake pedal application.

TRANSMISSION CONTROL MODULE (TCM)

The module determines shift and converter clutch engagement timing based on signals from sensors. The valve body solenoids are activated, or deactivated accordingly.

The TCM has a self diagnostic program. Component and circuitry malfunctions can be diagnosed with the DRB scan tool. Once a malfunction is noted and stored in control module memory, it is retained even after the problem has been corrected. To cancel a stored malfunction, disconnect and reconnect the ″Trans.″ fuse in the module harness.

TRANSMISSION VALVE BODY SOLENOIDS

The solenoids are mounted on the valve body and operated by the TCM. The solenoids control operation of the converter clutch and shift valves in response to input signals from the module.

SENSORS

Sensors include:

- throttle position sensor (TPS)
- transmission speed sensor
- vehicle speed sensor
- park/neutral position switch
- brake switch

The throttle position sensor is mounted on the throttle body. It electronically determines throttle position and relays this information to the transmission control module to determine shift points and converter clutch engagement.

The transmission speed sensor consists of a rotor and magnet on the transmission output shaft and a switch in the extension housing or adapter. The sensor switch is activated each time the rotor and magnet complete one revolution. Sensor signals are sent to the transmission control module.

The park/neutral position switch is mounted on the valve body manual shaft. The switch signals shift linkage and manual valve position to the transmission control module through an interconnecting harness. The switch prevents engine starting in all gears other than Park or Neutral.

The brake switch is in circuit with the torque converter clutch solenoid. The switch disengages the converter clutch whenever the brakes are applied. The switch is mounted on the brake pedal bracket and signals the transmission control module when the pedal is pressed or released.

TORQUE CONVERTER

A three element torque converter is used for all applications. The converter contains an impeller, stator, and turbine.

The AW–4 converters are all equipped with a converter clutch mechanism. The clutch consists of a sliding clutch piston, clutch springs and the clutch disc material (Fig. 4). The clutch provides optimum torque transfer and economy when engaged.

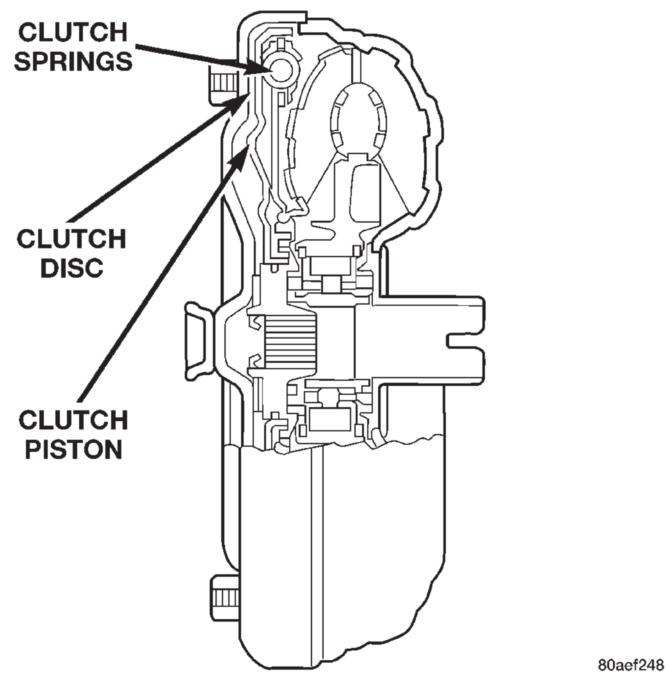


Fig. 4 Torque Converter (With Clutch)

The clutch disc is attached to the converter front cover. The clutch piston and clutch springs are attached to the turbine hub. The springs dampen engine firing impulses and loads during the initial phase of converter clutch engagement.

Clutch engagement is controlled by transmission valve body solenoid number three and by the converter clutch relay valve. The solenoid channels line pressure to the clutch through the relay valve at clutch engagement speeds.

Torque converter clutch engagement occurs in second gear in 1–2 position; third gear in 3 position and third and fourth gear in D position.

FOURTH GEAR OVERDRIVE COMPONENTS

The overdrive system consists of the input shaft, one–way clutch, planetary sun gear, ring gear, planetary carrier, overdrive clutch and overdrive brake (Fig. 5). The overdrive elements are controlled and

DESCRIPTION AND OPERATION (Continued)

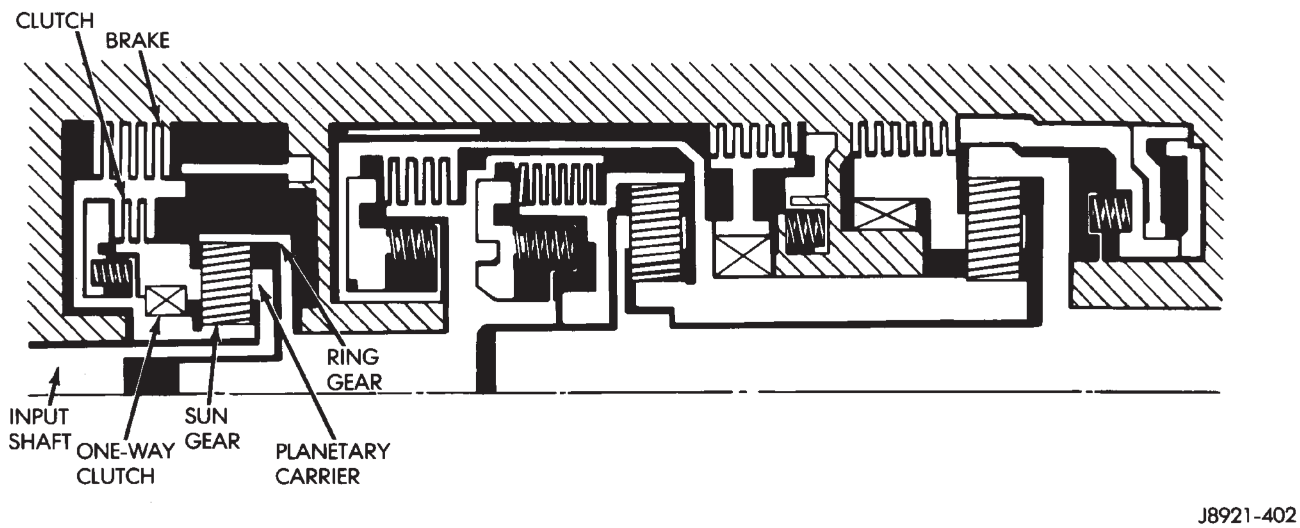


Fig. 5 Fourth Gear Overdrive Components

applied through transmission valve body solenoid number two.

In fourth gear, the overdrive brake prevents the overdrive sun gear from turning. The overdrive input shaft and planetary carrier rotate as a unit. The sun gear and overdrive direct clutch drum are in mesh and operate as a single unit. The direct clutch splines function as the hub for the overdrive brake. The one–way clutch outer race is in mesh with the planetary carrier. The inner race is fixed to the sun gear shaft.

FIRST/SECOND/THIRD/REVERSE GEAR COMPONENTS

First through third and reverse gear components are outlined in (Fig. 6).

The input shaft is meshed with the direct clutch hub and the forward clutch drum. These elements rotate as a unit. The forward clutch hub rotates as a unit with the front planetary ring gear. The direct clutch drum is meshed with the forward end of the planetary sun gear.

The second brake hub serves as the outer race of one–way clutch No. 1. The clutch inner race is locked with the front/rear sun gear. The inner race of one–way clutch No. 2 is splined to the transmission case

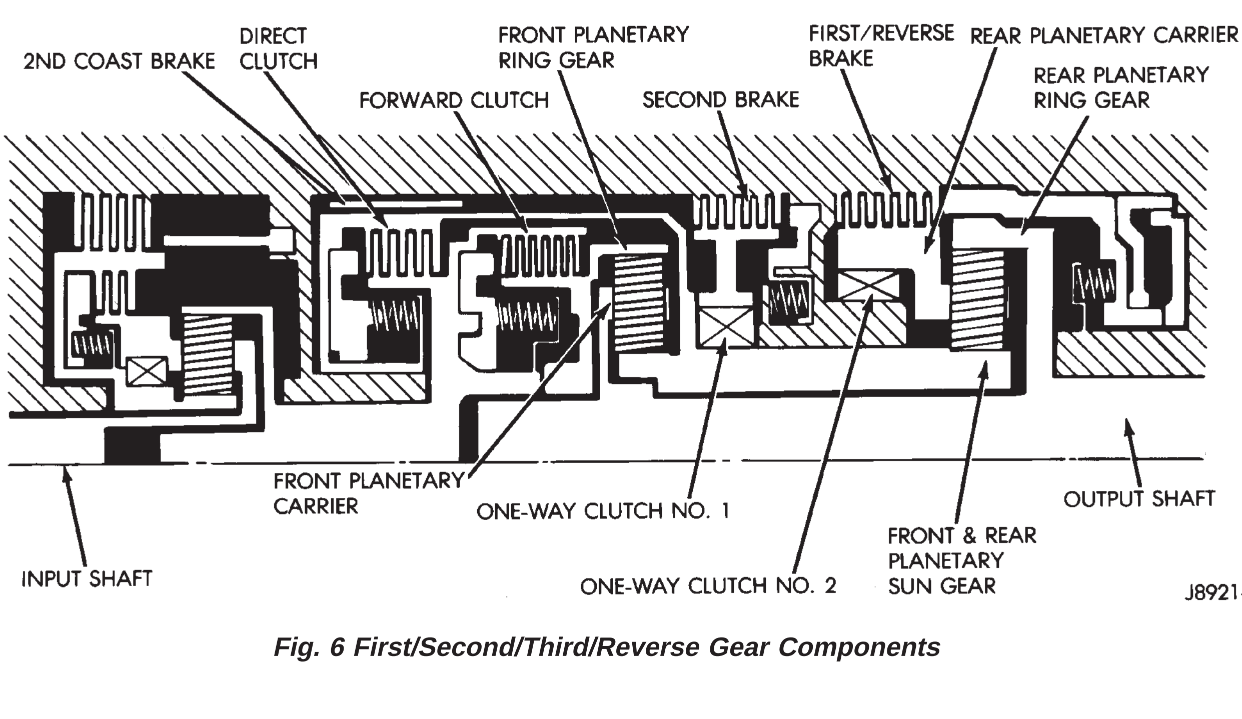


Fig. 6 First/Second/Third/Reverse Gear Components

DESCRIPTION AND OPERATION (Continued)

and is locked. The outer race rotates as a unit with the rear planetary carrier.

The rear planetary ring gear is splined to the output shaft. The front planetary carrier and rear carrier ring gear are meshed and rotate as a unit with the output shaft.

GEARTRAIN OPERATION AND APPLICATION CHARTS

Operation and application of the first through fourth and reverse gear elements are outlined in the function and application charts.

The Component Function Chart describes basic function of various geartrain elements. The Component Application Chart indicates which elements (including valve body solenoids), are applied in the various gear ranges.

COMPONENT FUNCTION CHART

COMPONENT NAME	COMPONENT FUNCTION
Overdrive Direct Clutch	Connects overdrive sun gear and overdrive carrier.
Overdrive Brake	Prevents overdrive sun gear from turning either clockwise or counter-clockwise.
Overdrive One-Way Clutch	When transmission is driven by engine, connects overdrive sun gear and overdrive carrier.
Forward Clutch	Connects input shaft and front ring gear.
Direct Clutch	Connects input shaft to the front and rear ring gears.
Second Coast Brake	Prevents front and rear sun gear from turning either clockwise or counter-clockwise.
Second Brake	Prevents outer race of number 1 one-way clutch from turning either clockwise or counter-clockwise, thus preventing the front and rear sun gears from turning counter-clockwise.
First/Reverse Brake	Prevents the rear planetary carrier from turning either clockwise or counter-clockwise.
Number 1 One-way Clutch	When second brake is operating, prevents the front and rear sun gears from turning counter-clockwise.
Number 2 One-Way Clutch	Prevents the rear planetary carrier from turning counter-clockwise.

DESCRIPTION AND OPERATION (Continued)

HYDRAULIC SYSTEM

COMPONENT APPLICATION CHART

Shift Lever Position	Gear	Valve Body Solenoid No. 1	Valve Body Solenoid No. 2	OVERDRIVE CLUTCH	FORWARD CLUTCH	DIRECT CLUTCH	OVERDRIVE BRAKE	SECOND COAST BRAKE	SECOND BRAKE	FIRST/ REVERSE BRAKE	OVERDRIVE ONE-WAY CLUTCH	NO.1 ONE-WAY CLUTCH	NO.2 ONE-WAY CLUTCH
P	Park	ON	OFF	●									
R	Reverse	ON	OFF	●		●				●	●		
N	Neutral	ON	OFF	●									
D	First	ON	OFF	●	●						●		●
	Second	ON	ON	●	●				●		●	●	
	Third	OFF	ON	●	●	●			●		●		
	OD	OFF	OFF		●	●	●		●				
3	First	ON	OFF	●	●						●		●
	Second	ON	ON	●	●			●	●		●	●	
	Third	OFF	ON	●	●	●			●		●		
1-2	First	ON	OFF	●	●					●	●		●
	Second	ON	ON	●	●			●	●		●	●	

● = Applied

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The hydraulic system consists of the pump, valve body and solenoids, and four hydraulic accumulators. The oil pump provides lubrication and operating pressure.

The valve body controls application of the clutches, brakes, second coast band, and the converter clutch. The valve body solenoids control sequencing of the 1–2, 2–3 and 3–4 shift valves. The solenoids are activated by signals from the transmission control module.

The accumulators are used in the clutch and brake feed circuits to control initial apply pressure. Spring loaded accumulator pistons modulate the initial surge of apply pressure for smooth engagement.

OIL PUMP

A gear–type oil pump is used. The pump gears are mounted in the pump body. The pump drive gear is operated by the torque converter hub. Drive tangs on the hub engage in drive slots in the drive gear.

TRANSMISSION VALVE BODY COMPONENTS

Transmission operating pressure is supplied to the clutch and brake apply circuits through the transmission valve body. The valve body consists of an upper body, lower body, separator plate and upper and lower gaskets (Fig. 7). The various spool valves, sleeves, plugs and springs are located within the two body sections.

The manual valve, 1–2 shift valve, primary regulator valve, accumulator control valve, check balls, solenoids and oil strainers are located in the lower body section (Fig. 8). The remaining control and shift

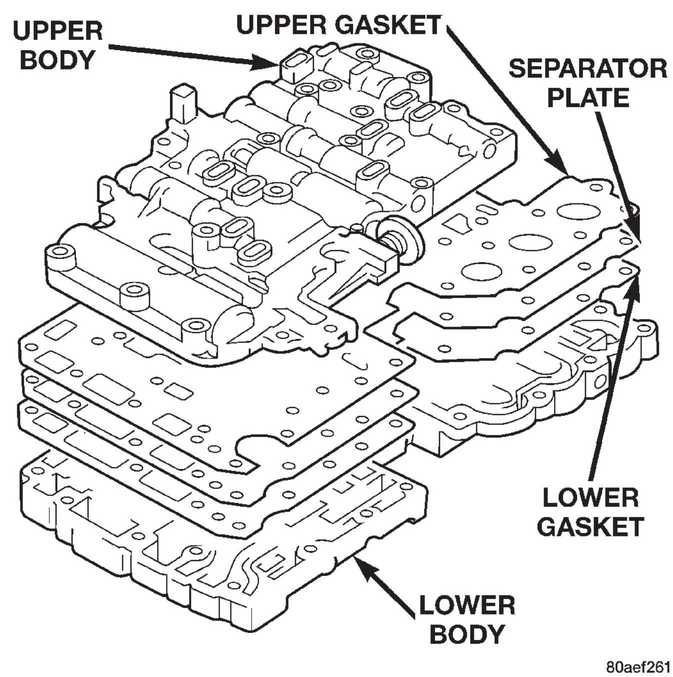


Fig. 7 Two–Section Transmission Valve Body

valves plus check balls and one additional oil strainer are located in the upper body section (Fig. 9).

DESCRIPTION AND OPERATION (Continued)

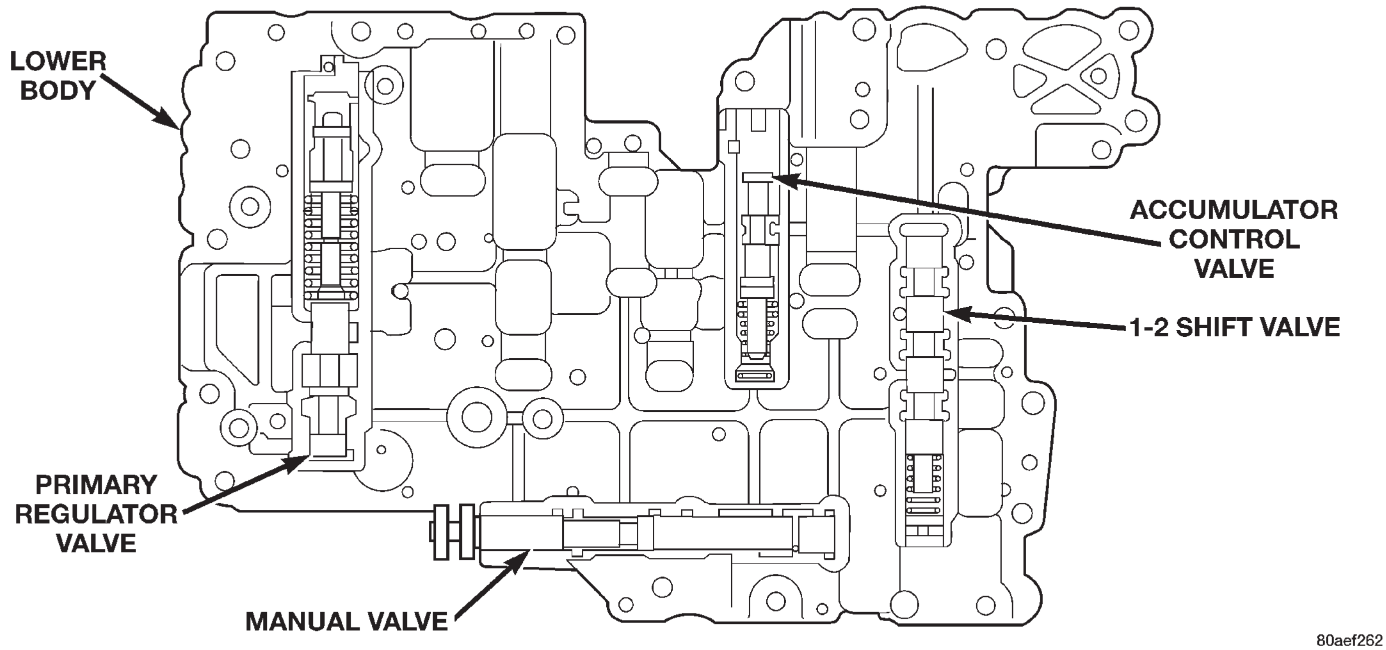


Fig. 8 Upper Body Components

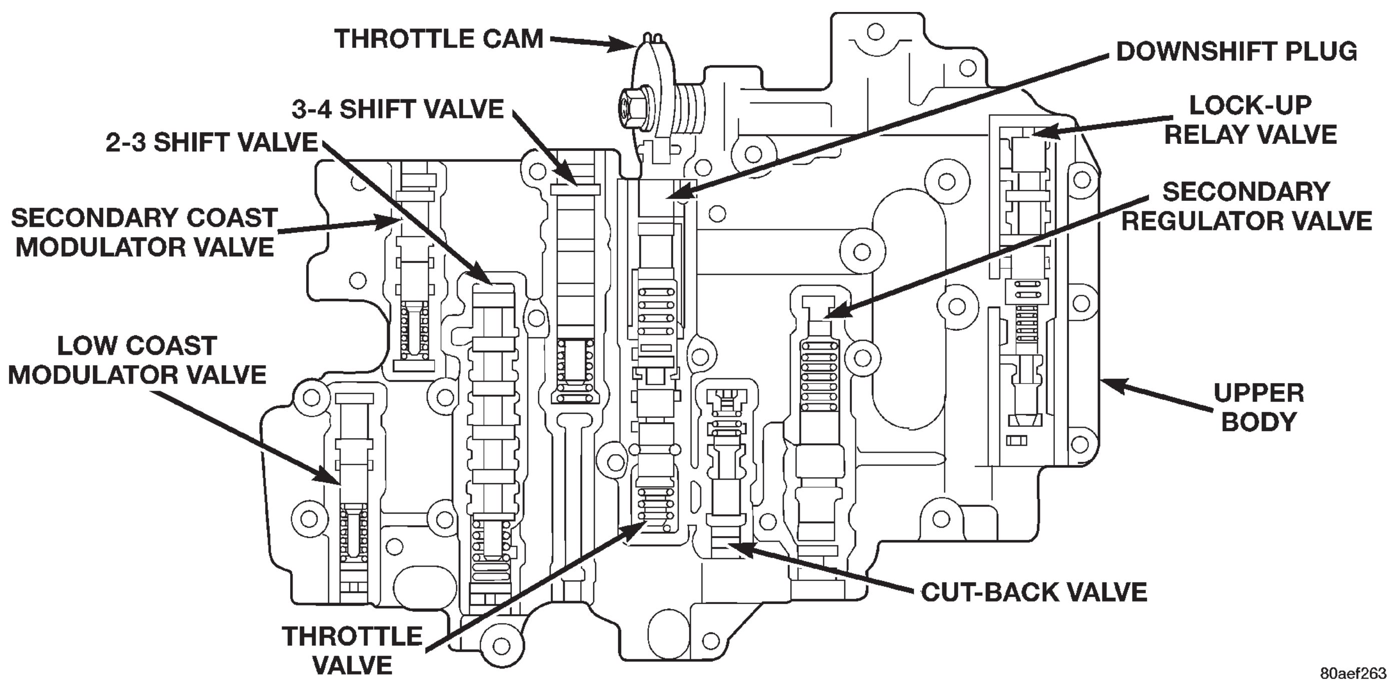


Fig. 9 Lower Body Components

MANUAL VALVE

The manual valve is operated by the gearshift linkage. The valve diverts fluid to the apply circuits according to shift lever position (Fig. 10).

PRIMARY REGULATOR VALVE

The primary regulator valve (Fig. 11) modulates line pressure to the clutches and brakes according to engine load. The valve is actuated by throttle valve pressure.

During high load operation, the valve increases line pressure to maintain positive clutch and brake engagement. At light load, the valve decreases line pressure just enough to maintain smooth engagement.

DESCRIPTION AND OPERATION (Continued)

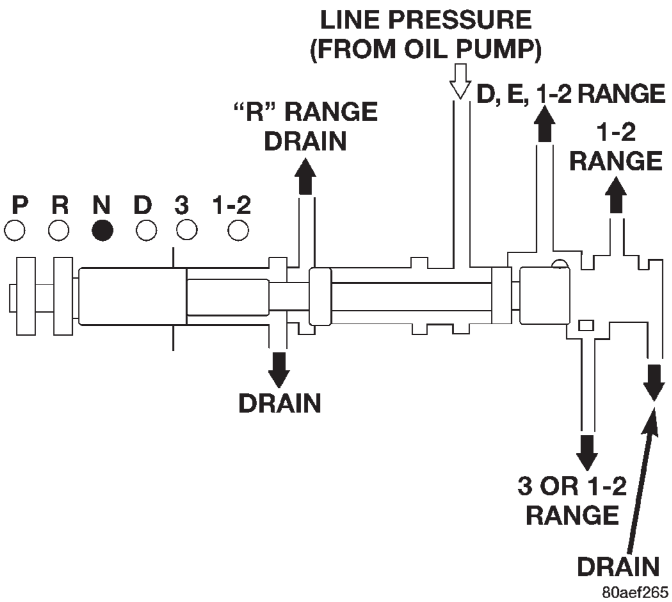


Fig. 10 Manual Valve

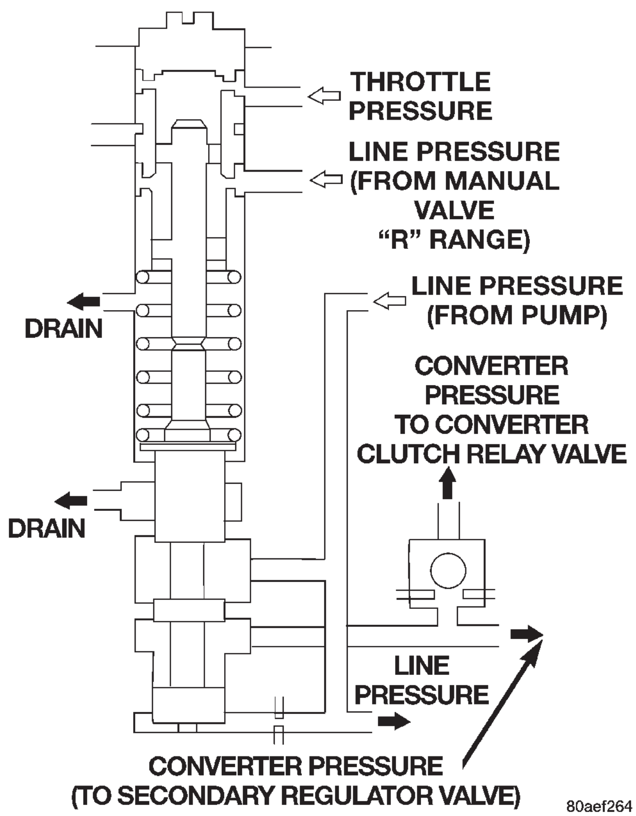


Fig. 11 Primary Regulator Valve

THROTTLE VALVE AND DOWNSHIFT PLUG

The throttle valve and downshift plug (Fig. 12) control throttle pressure to the primary regulator valve.

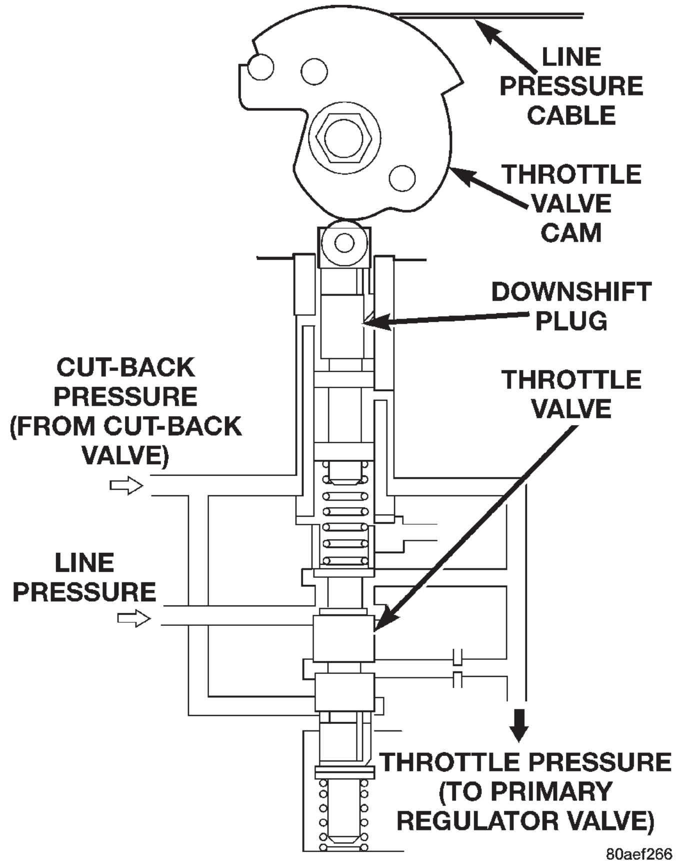


Fig. 12 Throttle Valve And Downshift Plug

The downshift plug and throttle valve are operated by the throttle valve cam and throttle cable in response to engine throttle position. Throttle valve pressure is also modulated by the cut–back valve in second, third and fourth gear ranges.

CUT–BACK VALVE

The cut–back valve (Fig. 13) helps prevent excessive pump pressure buildup in second, third and fourth gear. The valve is actuated by throttle pressure and by line pressure from the second brake. The valve also helps regulate line pressure by controlling the amount of cut–back pressure to the throttle valve.

SECONDARY REGULATOR VALVE

The secondary regulator valve (Fig. 14) regulates converter clutch and transmission lubrication pressure. When primary regulator valve pressure exceeds requirements for clutch engagement or transmission lubrication, the secondary regulator valve is moved upward exposing the drain port. Excess pressure

DESCRIPTION AND OPERATION (Continued)

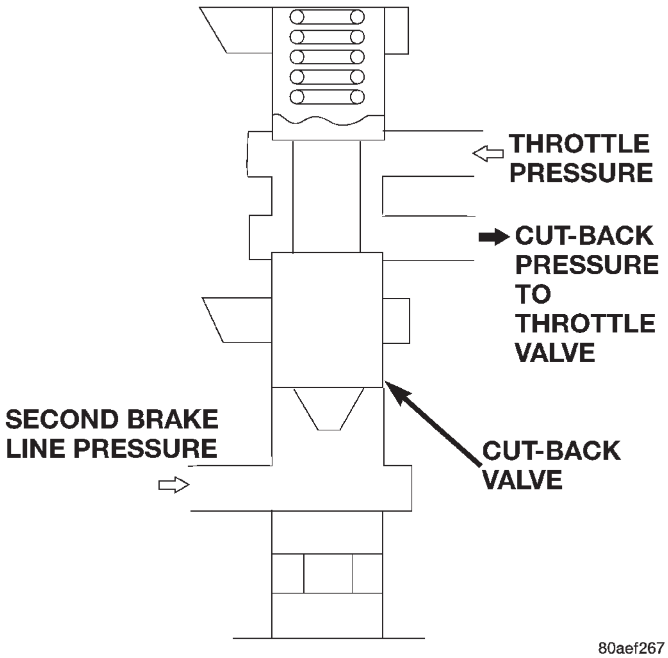


Fig. 13 Cut–Back Valve

then bleeds off as needed. As pressure drops, spring tension moves the valve downward closing the drain port.

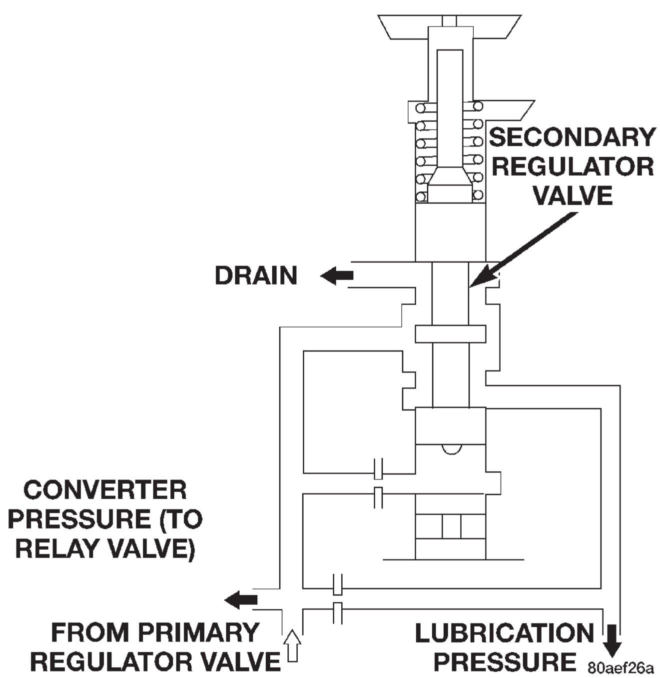


Fig. 14 Secondary Regulator Valve

CONVERTER CLUTCH RELAY VALVE

The converter clutch relay valve (Fig. 15) controls fluid flow to the converter clutch. The valve is operated by line pressure from the 1–2 shift valve and is controlled by solenoid valve number three.

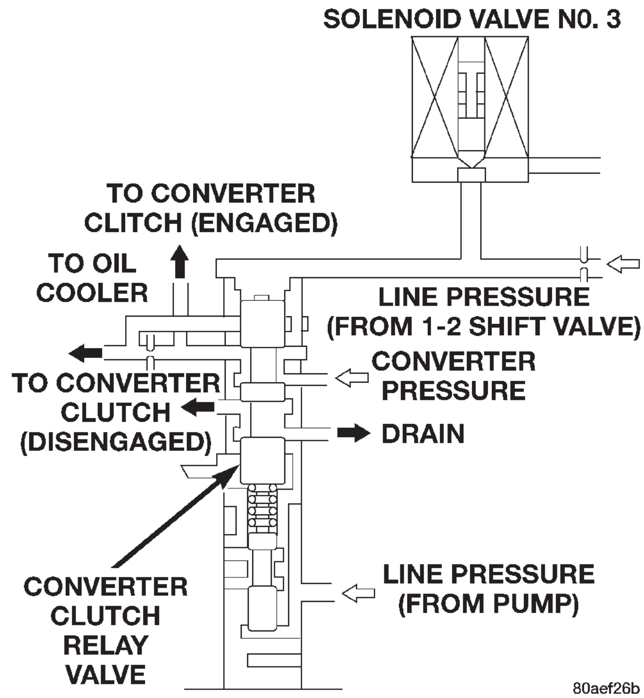


Fig. 15 Converter Clutch Relay Valve

1–2 SHIFT VALVE

The 1–2 shift valve (Fig. 16) controls the 1–2 upshifts and downshifts. The valve is operated by the No. 2 valve body solenoid and line pressure from the manual valve, second coast modulator valve and the 2–3 shift valve.

When the transmission control module deactivates the solenoid, line pressure at the top of the valve moves the valve down closing the second brake accumulator feed port. As the solenoid is activated and the drain port opens, spring force moves the valve up exposing the second brake feed port for the shift to second gear.

2–3 SHIFT VALVE

The 2–3 shift valve (Fig. 17) controls the 2–3 upshifts and downshifts. The valve is actuated by the No. 1 valve body solenoid and by line pressure from the manual valve and primary regulator valve.

When the TCM activates solenoid No. 1, line pressure at the top of the 2–3 valve is released through the solenoid drain port. Spring tension moves the valve up to hold the valve in second gear position. As the solenoid is deactivated, line pressure then moves the valve down exposing the direct clutch feed port for the shift to third gear.

DESCRIPTION AND OPERATION (Continued)

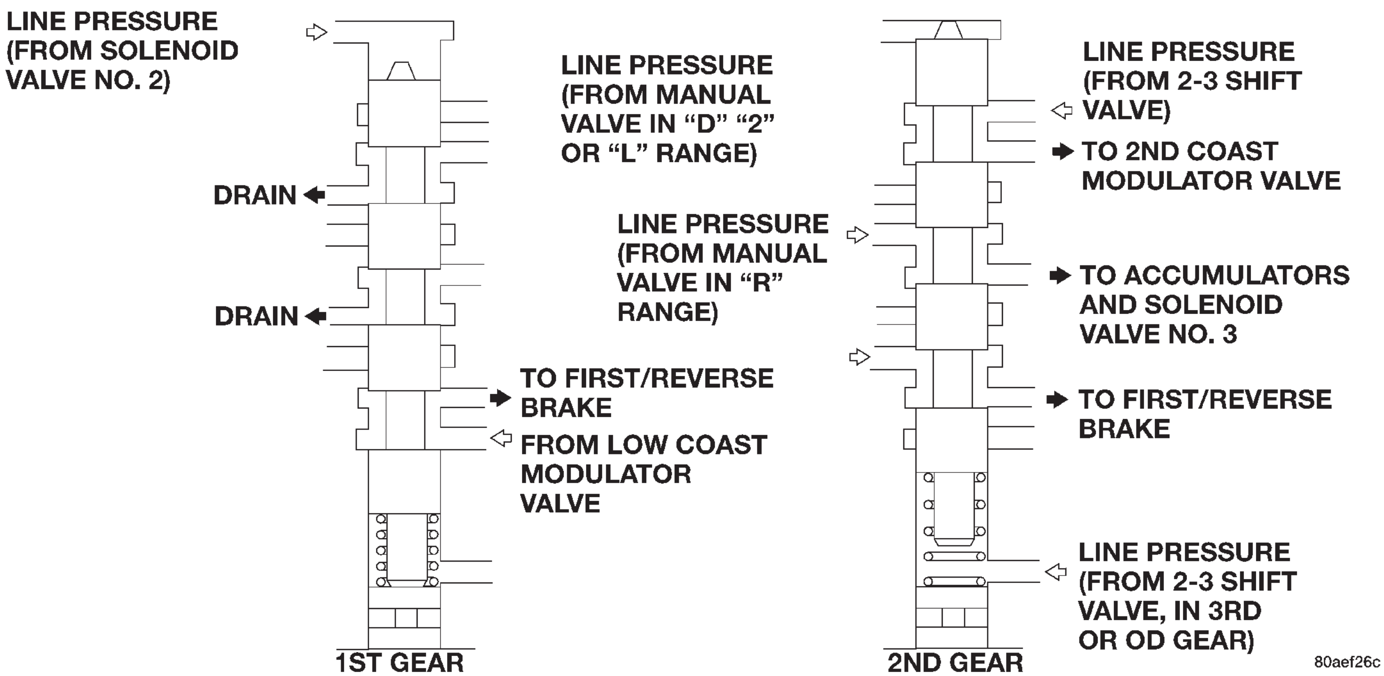


Fig. 16 1–2 Shift Valve

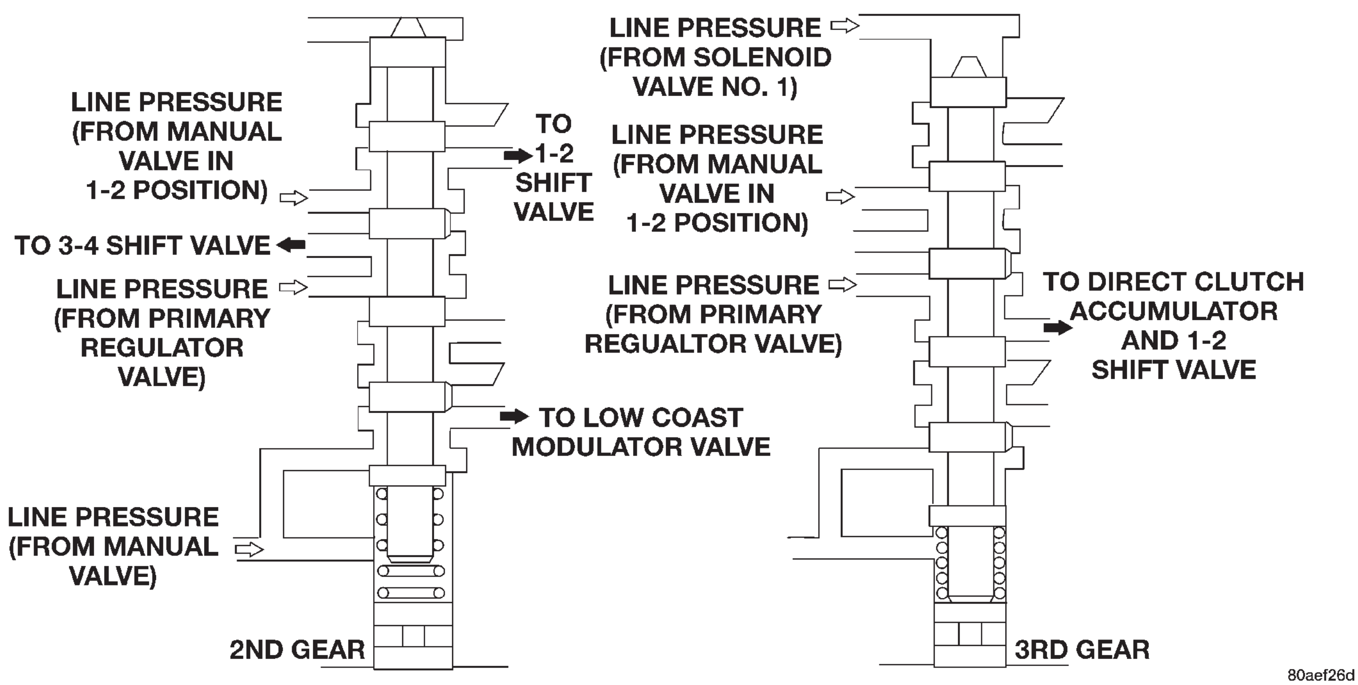


Fig. 17 2–3 Shift Valve

3–4 SHIFT VALVE

The 3–4 shift valve (Fig. 18) is operated by the No. 2 solenoid and by line pressure from the manual valve, 2–3 valve and primary regulator valve.

Energizing the No. 2 solenoid causes line pressure at the top of the 3–4 valve to be released through the solenoid valve drain port. Spring tension moves the valve up exposing the overdrive clutch accumulator feed port to apply the clutch.

De–energizing the solenoid causes the drain port to close. Line pressure then moves the valve down exposing the overdrive brake accumulator feed port for the shift to fourth gear.

In the 1–2 or 3 gearshift lever positions, line pressure from the 2–3 shift valve is applied to the lower end of the 3–4 valve. This holds the valve upward, closing off the overdrive brake feed port preventing a shift into fourth gear.

DESCRIPTION AND OPERATION (Continued)

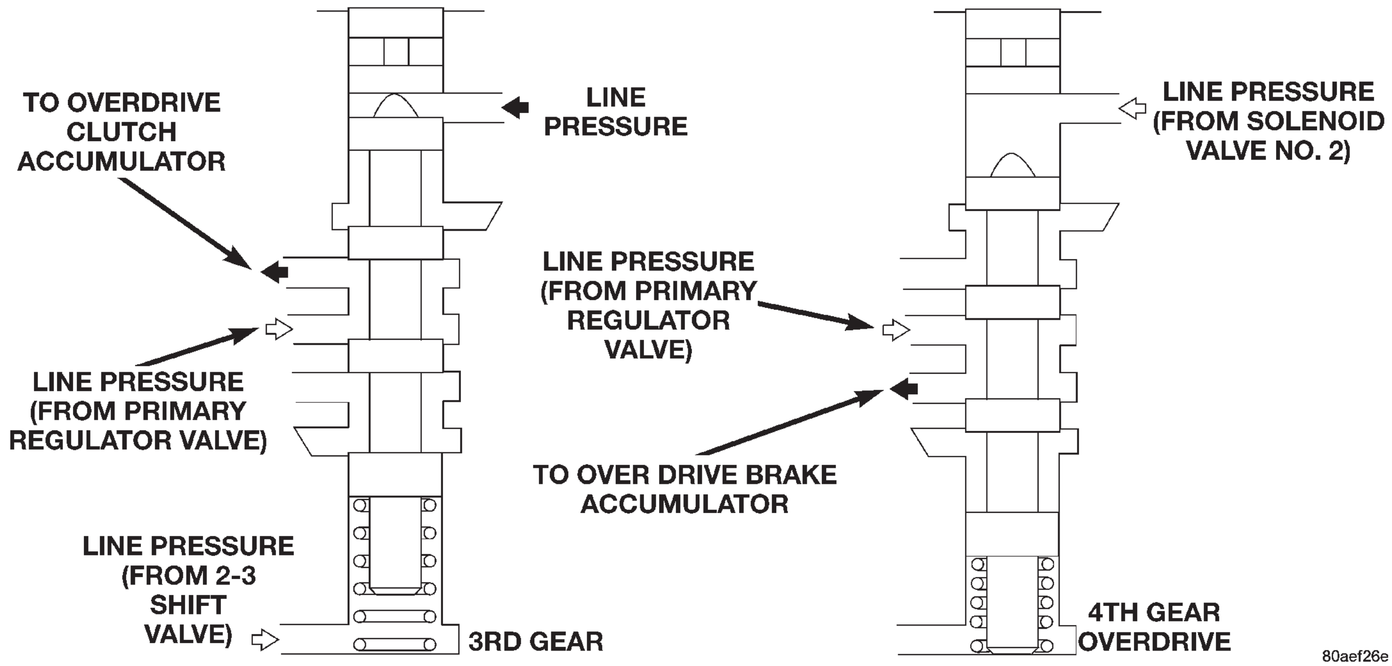


Fig. 18 3–4 Shift Valve

SECOND COAST MODULATOR VALVE

The second coast modulator valve (Fig. 19) momentarily reduces line pressure from the 1–2 shift valve. This cushions application of the second coast brake. The valve is operative when the shift lever and manual valve are in the 3 position.

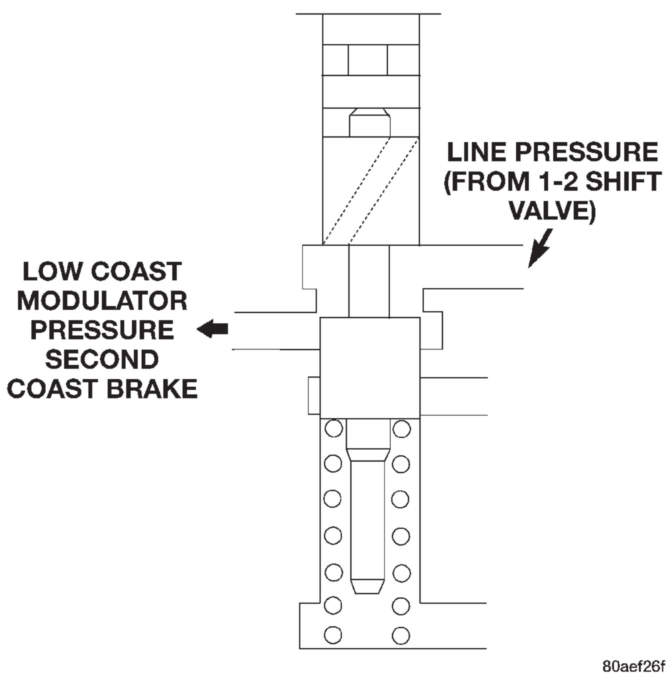


Fig. 19 Second Coast Modulator Valve

LOW COAST MODULATOR VALVE

The low coast modulator valve (Fig. 20) momentarily reduces line pressure from the 2–3 shift valve; this action cushions application of the first/reverse brake. The modulator valve operates when the shift lever and manual valve are in the 1–2 position.

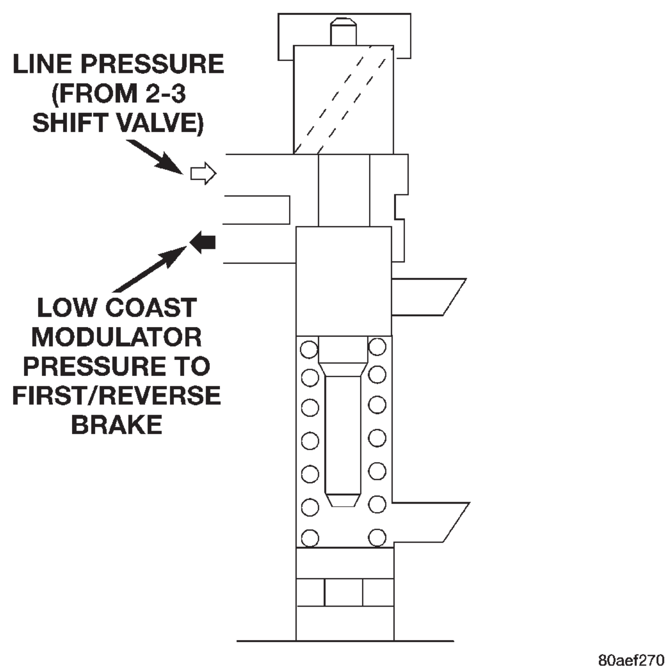


Fig. 20 Low Coast Modulator Valve

DESCRIPTION AND OPERATION (Continued)

ACCUMULATOR CONTROL VALVE

The accumulator control valve (Fig. 21) cushions the transmission clutch and brake applications. This is achieved by reducing back pressure to the accumulators when throttle opening is small. The valve is operated by line and throttle pressure.

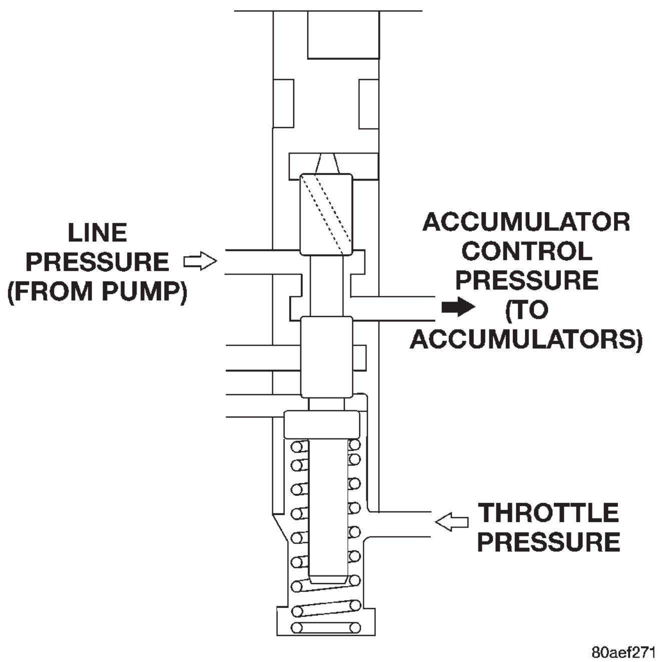


Fig. 21 Accumulator Control Valve

ACCUMULATORS

Four accumulators are used to cushion clutch and brake application. The accumulators (Fig. 22), consist of spring loaded pistons. The pistons dampen the initial surge of apply pressure to provide smooth engagement during shifts.

Control pressure from the accumulator control valve is continuously applied to the back pressure side of the accumulator pistons. This pressure plus spring tension holds the pistons down. As line pressure from the shift valves enters the opposite end of the piston bore, control pressure and spring tension momentarily delay application of full line pressure to cushion engagement. The accumulators are all located in the transmission case (Fig. 22).

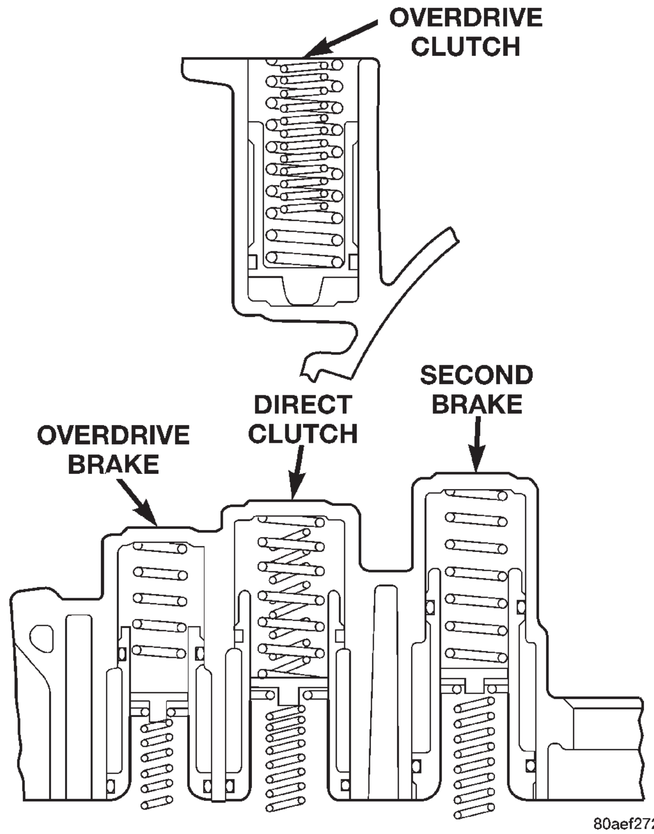


Fig. 22 Accumulators

TRANSMISSION VALVE BODY SOLENOIDS

Three solenoids are used (Fig. 23). The No. 1 and 2 solenoids control shift valve operation by applying or releasing line pressure. The signal to apply or release pressure is provided by the transmission control module.

The No. 3 solenoid controls operation of the torque converter clutch. The solenoid operates in response to signals from the transmission control module.

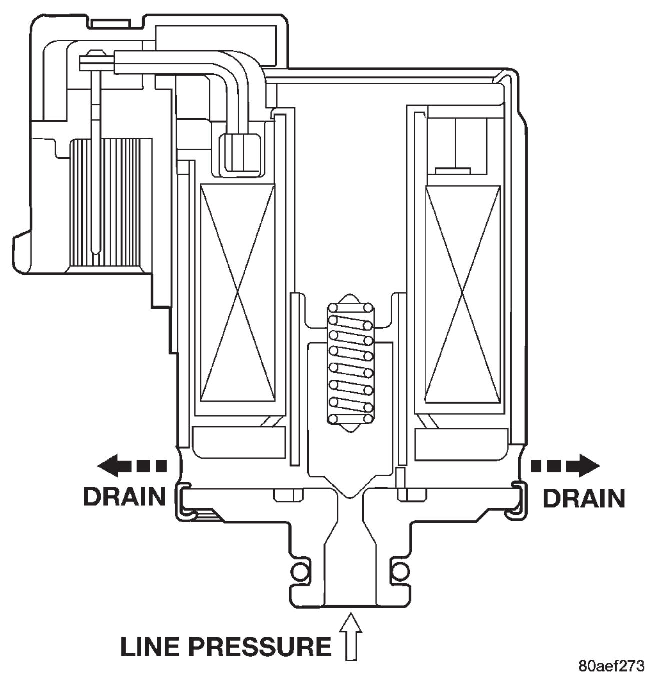


Fig. 23 Transmission Valve Body Solenoids

When the No. 1 and 2 solenoids are activated, the solenoid plunger is moved off its seat opening the drain port to release line pressure. When either solenoid is deactivated, the plunger closes the drain port.

DESCRIPTION AND OPERATION (Continued)

The No. 3 solenoid operates in reverse. When the solenoid is deactivated, the solenoid plunger is moved off its seat opening the drain port to release line pressure. When the solenoid is activated, the plunger closes the drain port.

TRANSMISSION COOLER

MAIN COOLER

The transmission main cooler is located in the radiator. The main cooler can be flushed when necessary, however, the cooler is not a repairable component. If the cooler is damaged, plugged, or leaking, the radiator will have to be replaced.

AUXILIARY COOLER

The auxiliary cooler is mounted in front of the radiator at the driver side of the vehicle (Fig. 24). The cooler can be flushed when necessary, while mounted in the vehicle. The cooler can also be removed for access, repair, or replacement as needed.

The main and auxiliary coolers should both be flushed whenever a transmission or converter clutch malfunction generates sludge, debris, or particles of clutch friction material.

COOLER SERVICE

The main cooler (and radiator) and the auxiliary cooler can be removed for service or access to other components. Auxiliary cooler removal requires that the front bumper and radiator support be removed for access to the cooler lines and attaching bracket.

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. 25). 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

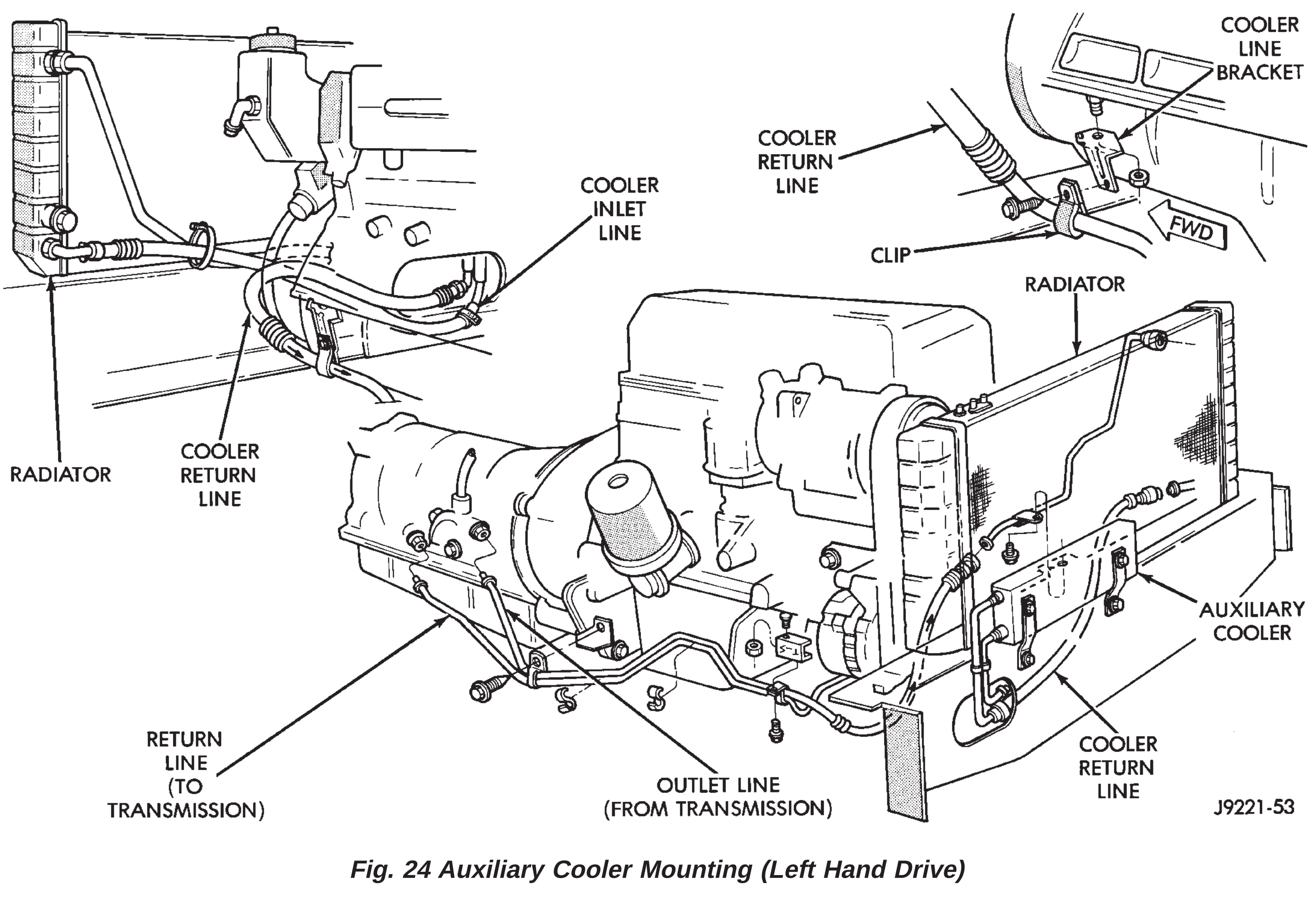


Fig. 24 Auxiliary Cooler Mounting (Left Hand Drive)

DESCRIPTION AND OPERATION (Continued)

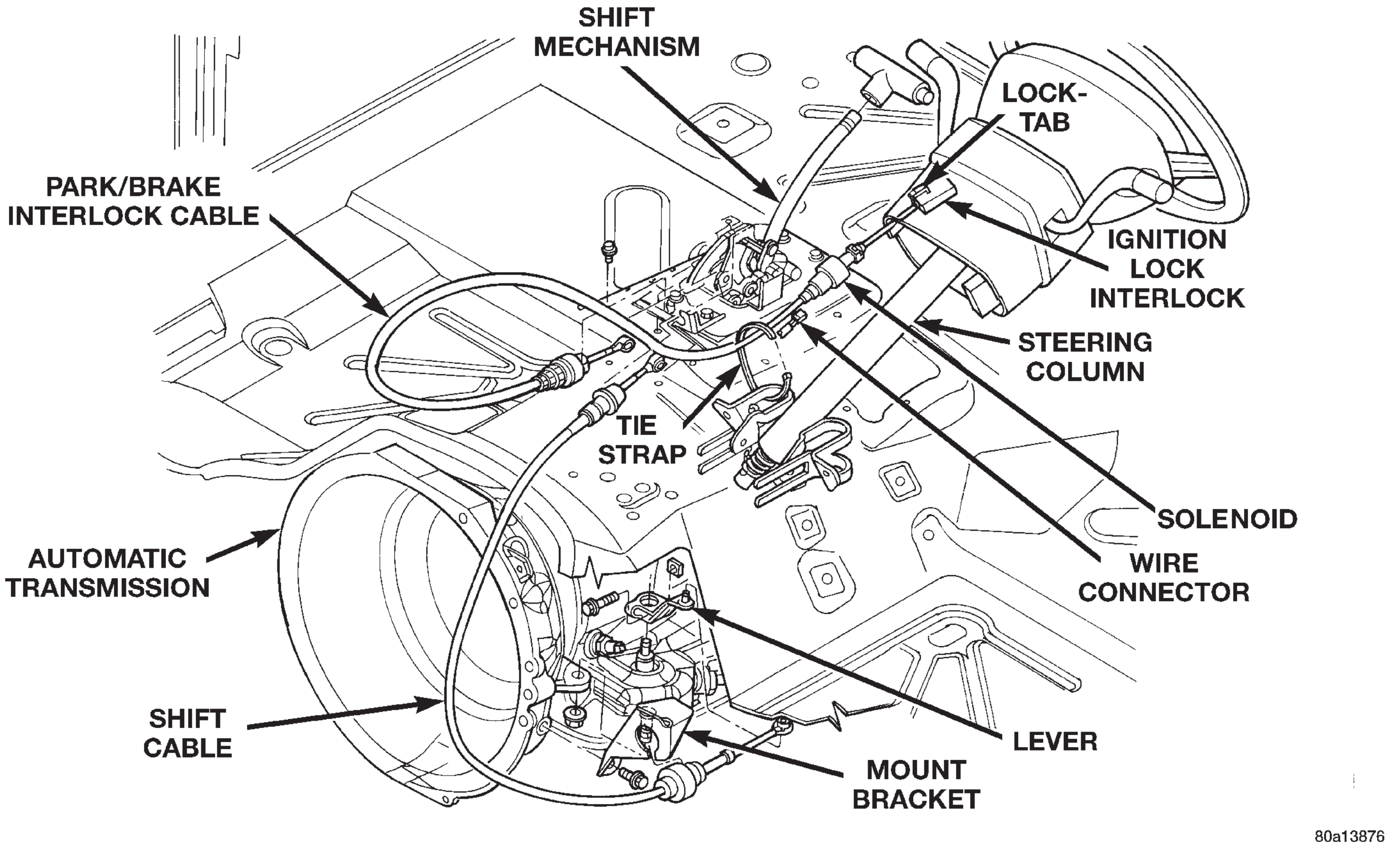


Fig. 25 Ignition Interlock Cable Routing

ACCESSORY position (Fig. 26) unless the shifter is fully locked into the PARK position.

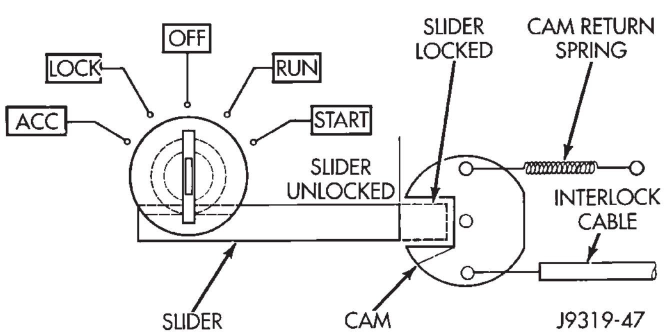


Fig. 26 Ignition Key Cylinder Actuation

DIAGNOSIS AND TESTING

GENERAL DIAGNOSIS INFORMATION

Shift points are controlled by the transmission control module (TCM). Before attempting repair, determine if a malfunction is electrical or mechanical.

The TCM used with the AW–4 transmission has a self–diagnostic program compatible with the DRBIII scan tool. The tester will identify faults in the electrical control system.

Diagnosis should begin with the Preliminary Inspection And Adjustment procedure. It is will help determine if a problem is mechanical or electrical. The first procedure step is Initial Inspection and Adjustment.

PRELIMINARY INSPECTION AND ADJUSTMENT

(1) Check and adjust transmission shift cable if necessary.

(2) Verify transmission throttle cable operation. Repair or replace cable if necessary.

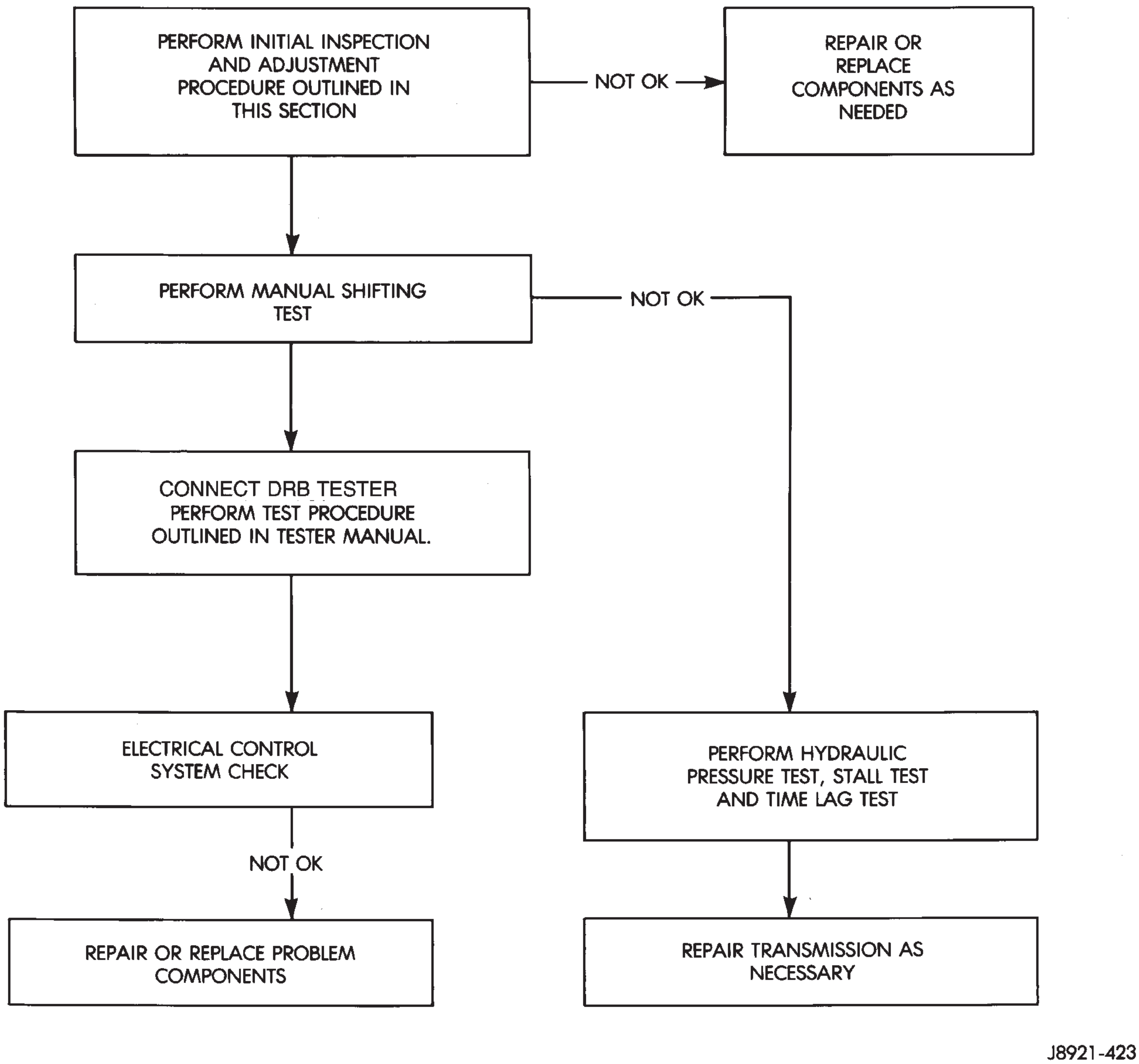
(3) Check engine throttle operation. Operate accelerator pedal and observe injector throttle plate movement. Adjust linkage if throttle plate does not reach wide open position.

(4) Check transmission fluid level when fluid is at normal operating temperature. Start engine. Shift transmission through all gear ranges then back to Neutral. Correct level is to Full or Add mark on dipstick with engine at curb idle speed.

(5) Check and adjust park/neutral position switch if necessary.

(6) Check throttle position sensor adjustment and operation. Adjust the sensor if necessary.

DIAGNOSIS AND TESTING (Continued)



Preliminary Diagnosis Check Procedure

MANUAL SHIFTING TEST

(1) This test determines if problem is related to mechanical or electrical component.

(2) Stop engine and disconnect transmission control module or module fuse.

(3) Road test vehicle. Shift transmission into each gear range. Transmission should operate as follows:

- lock in Park
- back up in Reverse
- not move in Neutral
- provide first gear only with shift lever in 1–2 position
- operate in third gear only with shift lever in 3 position
- operate in overdrive fourth gear in D position.

(4) If transmission operates as described, proceed to next step. However, if forward gear ranges were difficult to distinguish (all feel the same), or vehicle would not back up, refer to diagnosis charts. Do not perform stall or time lag tests.

CAUTION: Do not over speed the engine during the next test step. Ease off the throttle and allow the vehicle to slow before downshifting.

(5) Continue road test. Manually downshift transmission from D to 3, and from 3 to 1–2 position. Then manually upshift transmission through forward ranges again.

(6) If transmission operation is OK, perform stall, time lag and pressure tests. If transmission shifting problem is encountered, refer to diagnosis charts.

(7) If a problem still exists, continue testing with DRB scan tool.

DIAGNOSIS AND TESTING (Continued)

HYDRAULIC PRESSURE TEST

Pressure Test Procedure

(1) Connect pressure test gauge to test port on passenger side of transmission (Fig. 27). Use Adapter 7554 to connect gauge. Be sure test gauge has minimum capacity of 300 psi (2100 kPa).

(2) Be sure transmission fluid is at normal operating temperature.

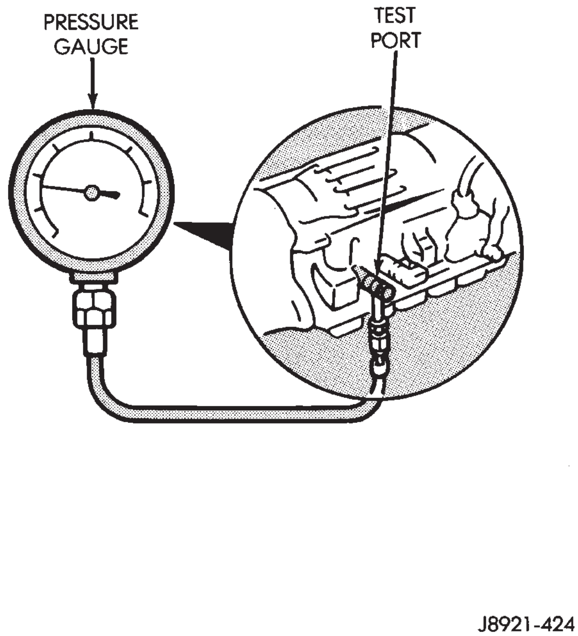


Fig. 27 Pressure Test Gauge Connection

(3) Apply parking brakes and block wheels.

WARNING: DO NOT ALLOW ANYONE TO STAND AT THE FRONT OR REAR OF THE VEHICLE WHILE PERFORMING THE FOLLOWING STEPS IN THE PRESSURE TEST.

(4) Check and adjust engine curb idle speed.

(5) Apply (and hold) service brakes.

(6) Shift transmission into D range and note line pressure with engine at curb idle speed. Pressure should be 61–to–70 psi (421–to–481 kPa).

(7) Press accelerator pedal to wide open throttle position and note line pressure. Pressure should be 173–to–209 psi (1196–to–1442 kPa).

CAUTION: Do not hold wide open throttle for more than 3–4 seconds at a time.

(8) Shift transmission into Reverse and note line pressure with engine at curb idle speed. Pressure should be 75–to–90 psi (519–to–618 kPa).

(9) Press accelerator to wide open throttle position and note line pressure in Reverse. Pressure should be 213–to–263 psi (1471–to–1814 kPa).

CAUTION: Do not hold wide open throttle for more than 4 seconds.

(10) If line pressure is not within specifications, adjust transmission throttle cable and repeat pressure test.

PRESSURE TEST ANALYSIS

If pressures in D and Reverse are higher than specified in test, check for the following:

- throttle cable loose, worn, binding or out of adjustment
- throttle valve, downshift plug, throttle cam, or primary regulator valve are sticking, worn or damaged

If pressures in D and Reverse are lower than specified in test, check for following:

- throttle cable loose, worn, binding or out of adjustment
- throttle valve, downshift plug, or throttle cam sticking, worn or damaged
- primary regulator valve sticking, worn, or damaged
- oil pump gears or housing worn, or damaged
- overdrive clutch worn, or damaged

If pressures are low in D range only, check for following:

- forward clutch worn or damaged
- fluid leakage in D range circuit (component seal and O–rings)

If pressures are low in Reverse only, check for following:

- shift cable and manual valve out of adjustment
- fluid leakage in reverse circuit (component seal and O–rings)
- direct clutch worn or damaged
- first/reverse brake worn or damaged.

TORQUE CONVERTER STALL TEST

Stall testing checks the holding ability of the transmission clutches and brakes and of the torque converter stator overrunning clutch. **Stall speeds are checked in both Drive and Reverse ranges with the AW–4 transmission.**

(1) Before starting test, be sure fluid level is correct and fluid is at normal operating temperature.

(2) Connect tachometer to engine. Position tachometer so it can be viewed from drivers seat.

(3) Apply parking brakes and block wheels.

(4) Apply and hold service brakes.

(5) Shift transfer case into 2H position.

(6) Start engine.

WARNING: DO NOT ALLOW ANYONE TO STAND AT THE FRONT OR REAR OF THE VEHICLE DURING THE TEST.

DIAGNOSIS AND TESTING (Continued)

(7) Shift transmission into D range.

(8) Open throttle completely and record maximum engine rpm registered on tachometer. It takes anywhere from 4 to 10 seconds to reach maximum rpm. However, once maximum rpm has been achieved, **do not hold wide open throttle for more than 3–4 seconds.**

CAUTION: Stalling the converter causes a rapid increase in fluid temperature. To avoid fluid overheating, hold wide open throttle for no more than 4 seconds after reaching peak rpm. In addition, if more than one stall test is required, run the engine at 1000 rpm with the transmission in Neutral for at least 20 seconds to cool the fluid.

(9) Stall speed should be in 2100–2400 rpm range in Drive.

(10) Release throttle, shift transmission into Neutral, and run engine for 20–30 seconds to cool fluid.

(11) Shift transmission into Reverse.

(12) Repeat stall test.

(13) Stall speed in Reverse should also be in 2100–2400 rpm range.

(14) Release accelerator pedal, shift transmission into Neutral, and run engine for 20–30 seconds to cool fluid.

STALL SPEED TEST ANALYSIS

If engine rpm is lower than specified in D and Reverse, check for the following:

- engine output/performance insufficient
- stator overrunning clutch in torque converter not holding if engine speed was 1500 rpm or less.

If stall speed in D range is higher than specified, check for the following:

- line pressure low
- forward clutch slipping
- No. 2 one–way clutch not holding
- overdrive one–way clutch not holding

If stall speed in Reverse was higher than specified, check for the following:

- line pressure low
- direct clutch slipping
- first/ reverse brake slipping
- overdrive one–way clutch not holding

If stall speeds were higher than specified in both D and Reverse, check for the following:

- low fluid level
- line pressure low
- overdrive one–way clutch not holding.

TIME LAG TEST

This test checks general condition of the overdrive clutch, forward clutch, rear clutch and first/reverse brake. Condition is indicated by the amount of time required for clutch/brake engagement with the engine at curb idle speed. Engagement time is measured for D and Reverse positions. A stop watch is recommended for test accuracy.

TEST PROCEDURE

(1) Check and adjust transmission fluid level if necessary.

(2) Bring transmission to normal operating temperature.

(3) Apply parking brakes and turn off air conditioning unit.

(4) Shift transfer case into 2H range.

(5) Start engine and check curb idle speed. Adjust speed if necessary. Curb idle must be correct to ensure accurate test results.

(6) Shift transmission into Neutral and set stop watch.

(7) During following test steps, start stop watch as soon as shift lever reaches D and Reverse ranges.

(8) Shift transmission into D range and record time it takes for engagement. Repeat test two more times.

(9) Reset stop watch and shift transmission back to Neutral.

(10) Shift transmission into Reverse and record time it takes for engagement. Repeat test two more times.

(11) Engagement time in D range should be a maximum of 1.2 seconds. Engagement time for Reverse should be a maximum of 1.5 seconds.

TIME LAG TEST ANALYSIS

If engagement time is longer than specified for D range, check for the following:

- shift cable misadjusted
- line pressure low
- forward clutch worn
- overdrive clutch worn or damaged.

If engagement time is longer than specified for Reverse, check for the following:

- shift cable misadjusted
- line pressure low
- direct clutch worn
- first/reverse brake worn
- overdrive clutch worn or damaged.

SERVICE DIAGNOSIS

TRANSMISSION SOLENOID TESTING

Test solenoid resistance with an ohmmeter. Connect the ohmmeter leads to the solenoid mounting bracket and to the solenoid wire terminal (Fig. 28).

Solenoid resistance should be 11–15 ohms. Replace the solenoid if resistance is above or below the specified range.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS TABLE

CONDITION	POSSIBLE CAUSE	CORRECTION
VEHICLE WILL NOT BACK UP OR MOVE FORWARD	Shift cable out of adjustment or damaged Valve body or primary regulator faulty Park lock pawl faulty Torque converter faulty Converter drive plate broken Oil pump intake screen blocked Transmission faulty	Adjust cable or replace cable Inspect/repair valve body Repair park pawl Replace torque converter Replace drive plate Clean screen Disassemble and repair transmission
SHIFT LEVER POSITION INCORRECT	Shift cable out of adjustment Manual valve and lever faulty	Adjust cable Repair valve body
HARSH ENGAGEMENT	Throttle cable out of adjustment Valve body or primary regulator faulty Accumulator pistons faulty Transmission faulty	Adjust throttle cable Repair valve body Repair pistons Disassemble and repair transmission
DELAYED 1-2, 2-3 OR 3-4 UP-SHIFT, OR DOWN-SHIFTS FROM 4-3 OR 3-2 AND SHIFTS BACK TO 4 OR 3	Electronic control problem Valve body faulty Solenoid faulty	Locate problem with DRB Tester Repair valve body Repair solenoid
SLIPS ON 1-2, 2-3 OR 3-4 UP-SHIFT, OR SLIPS OR SHUDDERS DURING ACCELERATION	Shift cable out of adjustment Throttle cable out of adjustment Valve body faulty Solenoid faulty Transmission faulty	Adjust cable Adjust cable Repair valve body Replace solenoid Disassemble and repair transmission
DRAG OR BIND ON 1-2, 2-3 OR 3-4 UP-SHIFT	Shift cable out of adjustment Valve body faulty Transmission faulty	Adjust cable Repair valve body Disassemble and repair transmission
CONVERTER CLUTCH DOES NOT ENGAGE IN 2ND, 3RD OR 4TH	Electronic control problem Valve body faulty Solenoid faulty Transmission faulty	Check with DRB Tester Repair valve body Replace solenoid Disassemble and repair transmission
HARSH DOWN-SHIFT	Throttle cable out of adjustment Throttle cable and cam faulty Accumulator pistons faulty Valve body faulty Transmission faulty	Adjust cable Replace cable and cam Repair pistons Repair valve body Disassemble and repair transmission
NO DOWN-SHIFT WHEN COASTING	Valve body faulty Solenoid faulty Electronic control problem	Repair valve body Replace solenoid Locate problem with DRB Tester

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DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS TABLE CONTINUED

CONDITION	POSSIBLE CAUSE	CORRECTION
DOWN-SHIFT LATE OR EARLY DURING COAST	Throttle cable faulty Valve body faulty Transmission faulty Solenoid faulty Electronic control problem	Replace cable Repair valve body Disassemble and repair transmission Replace solenoid Locate problem with DRB Tester
NO 4-3, 3-2 OR 2-1 KICKDOWN	Solenoid faulty Electronic control problem Valve body faulty	Replace solenoid Locate problem with DRB Tester Repair valve body
NO ENGINE BRAKING IN 1-2 POSITION	Solenoid faulty Electronic control problem Valve body faulty Transmission faulty	Replace solenoid Locate problem with DRB Tester Repair valve body Disassemble and repair transmission
VEHICLE DOES NOT HOLD IN PARK	Shift cable out of adjustment Parking lock pawl cam and spring faulty	Adjust cable Replace cam and spring
OVERHEAT DURING NORMAL OPERATION (FLUID DISCOLORED, SMELLS BURNED)	Low fluid level	Add fluid and check for leaks
	Fluid cooler, lines blocked, or cooler cracked (oil in engine coolant)	Flush cooler and lines and replace radiator if transmission fluid has entered coolant
OVERHEAT DURING COMMERCIAL OPERATION OR WHILE TRAILER TOWING (FLUID DARK AND BURNED WITH SOME SLUDGE FORMATION)	Vehicle not properly equipped for trailer towing or commercial use	Be sure vehicle is equipped with recommended optional components (i.e., HD springs, transmission, axle, larger CID engine, auxiliary cooler, correct axle ratio, etc.). If vehicle is not so equipped, it should not be used for severe service operation
	Vehicle not equipped with auxiliary fluid cooler	Drain fluid, change filter, and install auxiliary cooler
	Extensive idling time or operation in heavy traffic in hot weather	Cut down on idling time; shift into neutral every so often and run engine at 1000 rpm to help circulate fluid through cooler
	Tow vehicle overloaded (exceeding vehicle tow capacity)	Be sure vehicle is properly equipped to handle load; do not tow Class III-type loads with a vehicle that is only rated for Class I or II operation
	Air flow to auxiliary cooler blocked by snow plow, front mounted spare tire, bug screen, or similar item	Remove or reposition item causing air flow blockage
OIL COMES OUT FILLER TUBE	Transmission overfilled	Drain fluid to correct level; remove neutral switch and drain through switch hole with suction gun
	Breather vent in oil pump blocked	Inspect and clear blockage
	Fluid cooler or cooler lines plugged	Flush cooler and lines

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DIAGNOSIS AND TESTING (Continued)

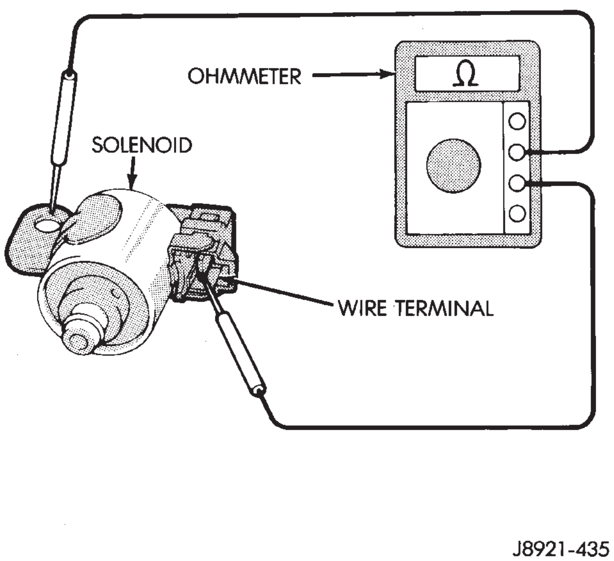


Fig. 28 Testing Transmission Valve Body Solenoid

PARK/NEUTRAL POSITION SWITCH

SWITCH TESTING

Test switch continuity with an ohmmeter. Disconnect the switch and check continuity at the connector terminal positions and in the gear ranges indicated in Figure 3. Switch continuity should be as follows:

- Continuity should exist between terminals B and C with the transmission in Park and Neutral only (Fig. 29).
- Continuity should exist between terminals A and E with the transmission in Reverse (Fig. 29).
- Continuity should exist between terminals A and G with the transmission in third gear (Fig. 29).
- Continuity should exist between terminals A and H with the transmission in first and/or second gear (Fig. 29).
- Continuity should not exist in D position.

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.

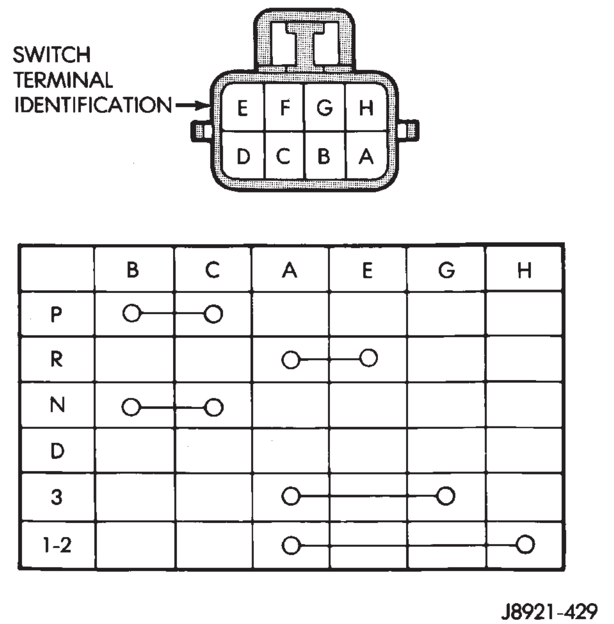


Fig. 29 Park/Neutral Position Switch Terminals And Testing

(c) NEUTRAL position—Normal position. Engine starts must be possible.

(d) NEUTRAL position—Engine running and brakes applied, apply forward force on center of shift handle. Transmission shall not be able to shift from neutral to reverse.

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 the proper adjustment procedure.

SPEED SENSOR TESTING

Test the speed sensor with an ohmmeter. Place the ohmmeter leads on the terminals in the sensor connector (Fig. 30).

Rotate the transmission output shaft and observe the ohmmeter needle. The needle should deflect indicating the switch is opening/closing as the rotor moves past the sensor (Fig. 30). Replace the sensor if the ohmmeter does not display any kind of reading.

If a digital ohmmeter is being used, the sensor should generate an ohmmeter readout each time the switch opens and closes.

DIAGNOSIS AND TESTING (Continued)

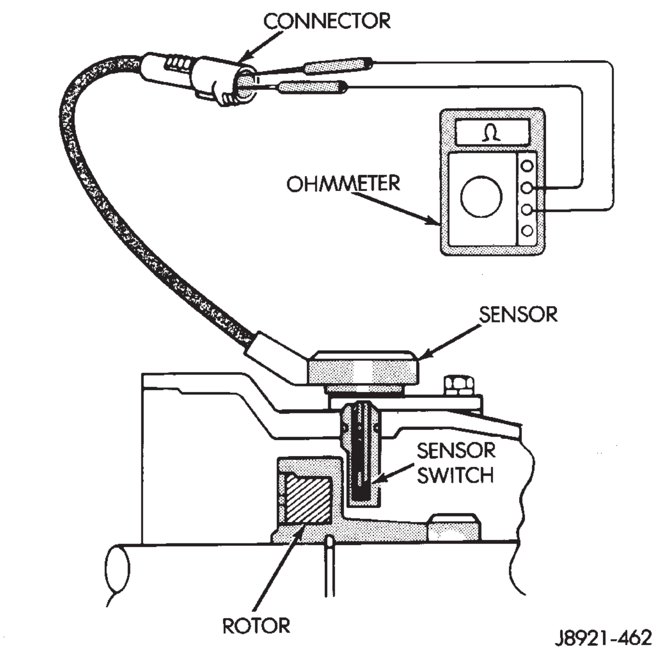


Fig. 30 Speed Sensor Testing

FLOW TESTING TRANSMISSION MAIN COOLER

Cooler flow is checked by measuring the amount of fluid flow through the cooler in a 20 second time period. The test is performed with the engine running and transmission in neutral. Fluid is then pumped through the cooler by the transmission oil pump.

(1) Disconnect cooler inlet line at transmission fitting.

(2) Securely attach hose to end of inlet line and position line in a one quart test container.

(3) Add extra quart of fluid to transmission.

(4) Use stopwatch to check flow test time.

(5) Shift transmission into neutral and set parking brake.

(6) Start and run engine at curb idle speed and immediately note cooler flow. Approximately one quart of fluid should flow into test container in 20 second period.

(7) If cooler flow is intermittent, flows less than one quart in 20 seconds, or does not flow at all, cooler is faulty and must be replaced.

TORQUE CONVERTER STATOR CLUTCH INSPECTION

(1) Insert Rotating Tool 7547 into converter hub and seat tool in one–way clutch (Fig. 31).

(2) Insert Stopper Tool 7548 in one converter hub notch and into outer race of rotating tool.

(3) Turn rotating tool clockwise. Converter clutch should rotate freely and smoothly. Less than 2.5 N·m

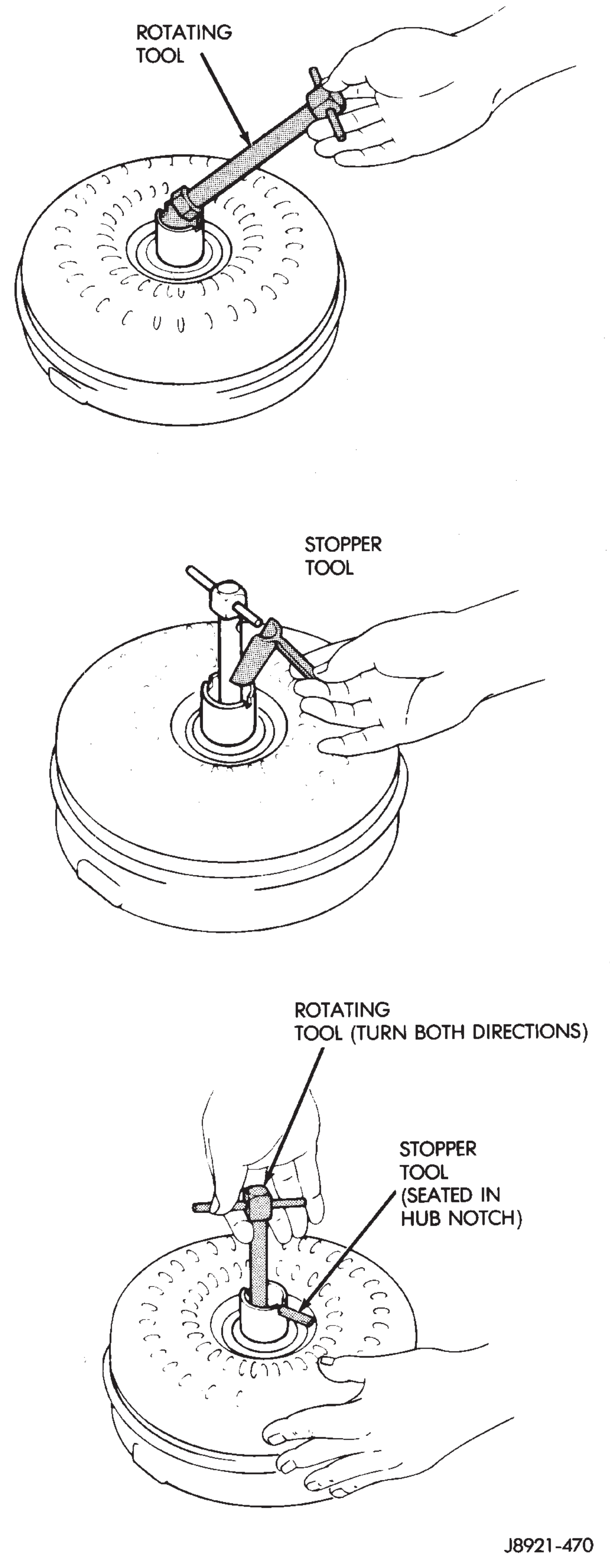


Fig. 31 Checking Operation Of Torque Converter Stator One–Way Clutch

DIAGNOSIS AND TESTING (Continued)

(22 in. lbs.) of torque should be required to rotate clutch in clockwise direction.

(4) Turn rotating tool in counterclockwise direction. Converter clutch should lock.

(5) Replace converter if clutch binds or will not lock.

SERVICE PROCEDURES

CHECKING FLUID LEVEL

(1) Be sure transmission fluid is at normal operating temperature. Normal operating temperature is reached after approximately 15 miles (25 km) of operation.

(2) Position vehicle on level surface. This is important for an accurate fluid level check.

(3) Shift transmission through all gear ranges and back to Park.

(4) Apply parking brakes.

(5) Verify that transmission is in Park.

(6) Wipe off dipstick handle to prevent dirt from entering fill tube. Then remove dipstick and check fluid level and condition.

(7) Correct fluid level is **to FULL mark on dipstick when fluid is at normal operating temperature** (Fig. 32).

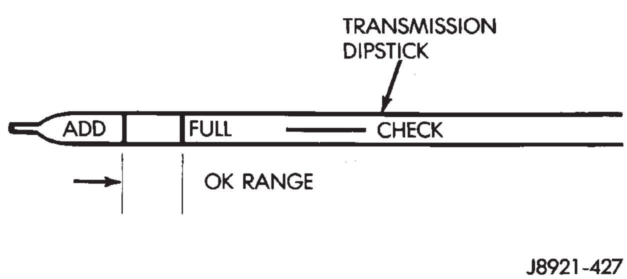


Fig. 32 Transmission Fluid Level

(8) If fluid level is low, top off level with Mopar Dexron IIE/Mercon. Mopar Dexron II can be used but only if Mercon is not available. **Do not overfill transmission. Add only enough fluid to bring level to Full mark.**

(9) If too much fluid was added, excess amount can be removed with suction gun and appropriate diameter plastic tubing. Tubing only has to be long enough to extend into oil pan.

CHECKING FLUID CONDITION

Inspect the appearance of the fluid during the fluid level check. Fluid color should range from dark red to pink and be free of foreign material, or particles. If the fluid is dark brown or black in color and smells burnt, the fluid has been overheated and must be changed.

Transmission operation should also be checked if the fluid is severely discolored and contains quantities of foreign material, metal particles, or clutch disc friction material.

A small quantity of friction material or metal particles in the oil pan is normal. The particles are usually generated during the break–in period and indicate normal seating of the various transmission components.

REFILLING AFTER OVERHAUL OR FLUID/ FILTER CHANGE

The best way to refill the transmission after a fluid change or overhaul is as follows:

(1) If transmission has been overhauled, install transmission in vehicle.

(2) Remove dipstick and insert clean funnel in transmission fill tube.

(3) Add following initial quantity of Mopar Dexron IIE/Mercon to transmission:

(4) If fluid/filter change was performed, add **4 pints (2 quarts)** of fluid to transmission.

(a) If transmission was completely overhauled and torque converter was replaced or drained, add **10 pints (5 quarts)** of fluid to transmission.

(b) Remove funnel and install dipstick.

(5) Operate vehicle until fluid reaches normal operating temperature.

(6) Apply parking brakes.

(7) Let engine run at normal curb idle speed, apply service brakes. Then shift transmission through all gear ranges and back to PARK (leave engine running).

(8) Remove dipstick and check fluid level. Add only enough fluid to bring level to Full mark on dipstick. Do not overfill. **If too much fluid is added, excess amount can be removed with suction gun and plastic tubing. Tubing only has to be long enough to extend into oil pan.**

(9) When fluid level is correct, shut engine off, release park brake, remove funnel, and reseat dipstick in fill tube.

TRANSMISSION CONTROL MODULE (TCM) SERVICE

Use the DRB scan tool to diagnose transmission control module function whenever a fault is suspected. Replace the module only when the scan tool indicates the module is actually faulty.

OIL PUMP VOLUME CHECK

After the new or repaired transmission has been installed, fill to the proper level with Mopar® ATF PLUS 3 (Type 7176) automatic transmission fluid. The volume should be checked using the following procedure:

SERVICE PROCEDURES (Continued)

(1) Disconnect the **From cooler** line at the transmission and place a collecting container under the disconnected line.

CAUTION: With the fluid set at the proper level, fluid collection should not exceed (1) quart or internal damage to the transmission may occur.

(2) Run the engine **at curb idle speed** , with the shift selector in neutral.

(3) If fluid flow is intermittent or it takes more than 20 seconds to collect one quart of ATF PLUS 3, disconnect the **To Cooler** line at the transaxle.

(4) Refill the transaxle to proper level and recheck pump volume.

(5) If flow is found to be within acceptable limits, replace the cooler. Then fill transmission to the proper level, using Mopar® ATF PLUS 3 (Type 7176) automatic transmission fluid.

(6) If fluid flow is still found to be inadequate, check the line pressure using the Transaxle Hydraulic Pressure Test procedure.

FLUSHING COOLERS AND TUBES

When a transmission failure has contaminated the fluid, the oil cooler(s) must be flushed. The 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.

NOTE: The converter drainback valve must be removed and an appropriate replacement hose installed to bridge the space between the transmission cooler line and the cooler fitting. Failure to remove the drainback valve will preventreverse flushing the system.

(5) Connect the BLUE pressure line to the OUTLET (From) cooler line.

(6) Connect the CLEAR return line to the INLET (To) cooler line

(7) Turn pump ON for two to three minutes to flush cooler(s) and lines. Monitor pressure readings and clear return lines. Pressure readings should stabilize below 20 psi. for vehicles equipped with a single cooler and 30 psi. for vehicles equipped with dual coolers. If flow is intermittent or exceeds these pressures, replace cooler.

(8) Turn pump OFF.

(9) Disconnect CLEAR suction line from reservoir at cover plate. Disconnect CLEAR return line at cover plate, and place it in a drain pan.

(10) Turn pump ON for 30 seconds to purge flushing solution from cooler and lines. Turn pump OFF.

(11) Place CLEAR suction line into a one quart container of Mopar® ATF Plus 3, type 7176 automatic transmission fluid.

(12) Turn pump ON until all transmission fluid is removed from the one quart container and lines. This purges any residual cleaning solvent from the transmission cooler and lines. Turn pump OFF.

(13) Disconnect alligator clips from battery. Reconnect flusher lines to cover plate, and remove flushing adapters from cooler lines.

ALUMINUM THREAD REPAIR

Damaged or worn threads in the aluminum transmission case and valve body can be repaired by the use of Heli-Coils, or equivalent. This repair consists of drilling out the worn-out damaged threads. Then tap the hole with a special Heli-Coil tap, or equivalent, and installing a Heli-Coil insert, or equivalent, into the hole. This brings the hole back to its original thread size.

SERVICE PROCEDURES (Continued)

Heli-Coil, or equivalent, tools and inserts are readily available from most automotive parts suppliers.

REMOVAL AND INSTALLATION

TRANSMISSION AND TORQUE CONVERTER

REMOVAL

(1) Raise vehicle.

(2) Drain transmission fluid and reinstall oil pan drain plug.

(3) On models with 2–piece fill tube, remove upper half of tube (Fig. 33).

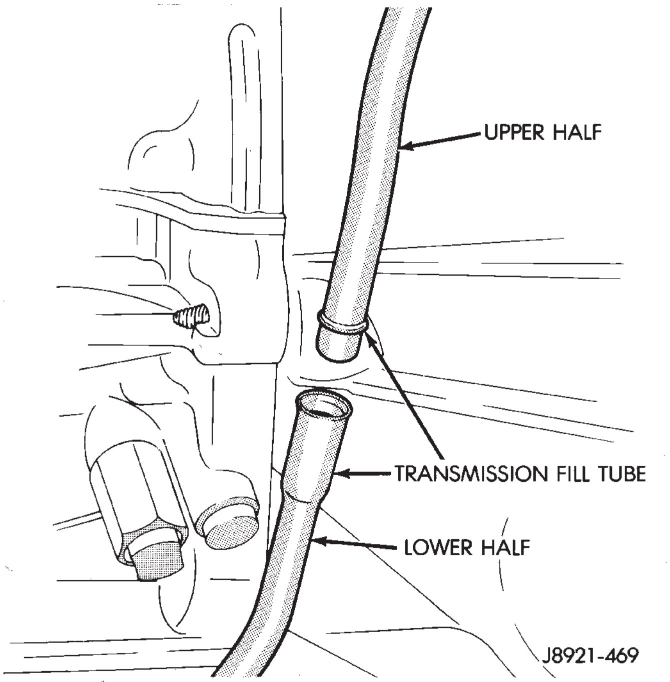


Fig. 33 Transmission Fill Tube (Two–Piece)

(4) Disconnect cooler lines at transmission.

(5) Support engine with safety stand and support transmission with jack.

(6) Disconnect transmission and transfer case shift linkage.

(7) Remove necessary exhaust components.

(8) Disconnect vehicle speed sensor wires

(9) Mark position of front and rear propeller shafts for alignment reference. Then remove shafts from vehicle.

(10) Remove rear crossmember.

(11) Disconnect transmission shift cable at transmission. Then disconnect transmission throttle valve cable at engine.

(12) Disconnect necessary vacuum and fluid hoses.

(13) Remove transfer case from transmission.

(14) Disconnect and remove crankshaft position sensor (Fig. 34).

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.

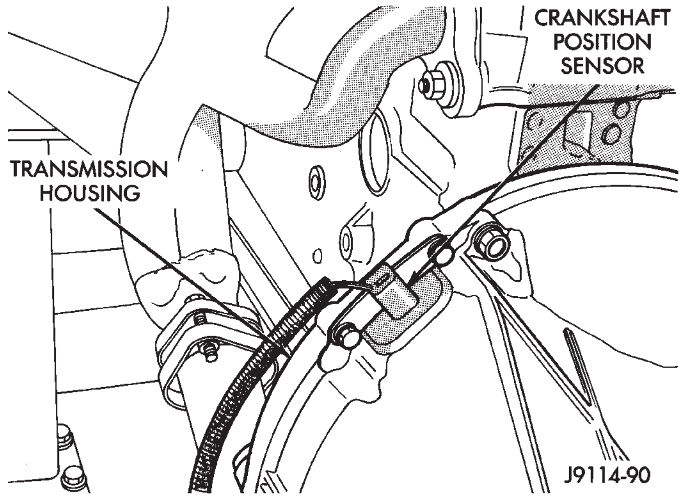


Fig. 34 Crankshaft Position Sensor

(15) Remove starter motor.

(16) Remove bolts attaching converter to drive plate.

(17) Remove bolts attaching converter housing to engine.

(18) Secure transmission to jack with safety chains.

(19) Pull transmission rearward for access to converter. Then secure converter in pump with C–clamp or strap bolted to converter housing.

(20) Remove transmission from under vehicle.

(21) Remove torque converter if converter or oil pump seal are to be serviced.

INSTALLATION

(1) Mount transmission on transmission jack. Then secure transmission to jack with safety chains.

(2) Lubricate converter drive hub and oil pump seal lip with transmission fluid. Then install converter. Be sure converter is fully seated in oil pump gears before proceeding. Hold converter in place with C–clamp or strap attached to converter housing.

(3) Align and position transmission and converter on engine.

(4) Remove clamp or strap used to hold torque converter in place.

(5) Move transmission forward seat and it on engine. Be sure torque converter hub is fully seated.

(6) Install converter housing–to–engine bolts (Fig. 35).

(7) Install converter-to-drive plate bolts.

(8) Install and connect starter motor.

(9) Install and connect crankshaft position sensor.

REMOVAL AND INSTALLATION (Continued)

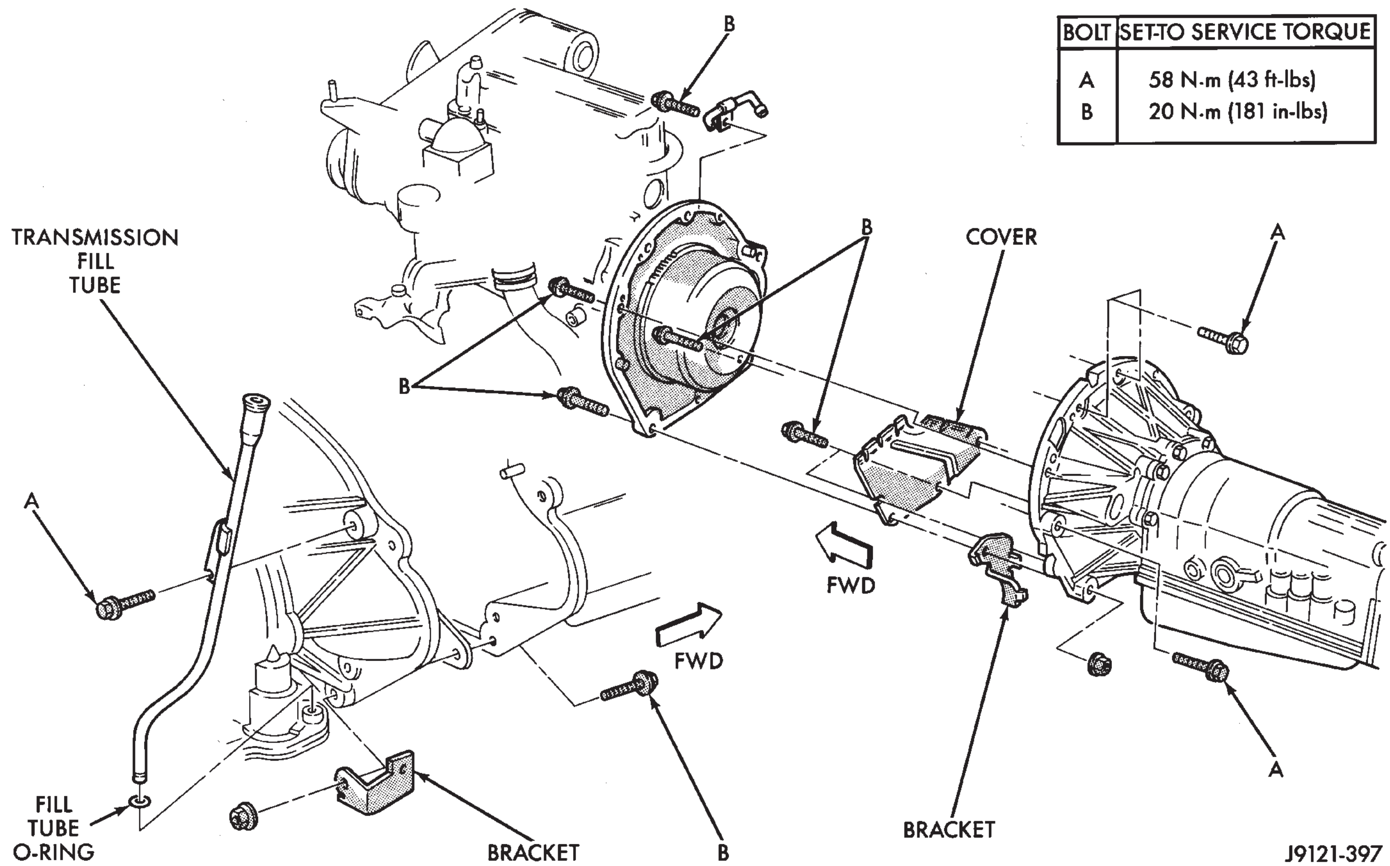


Fig. 35 Transmission Mounting

(10) Install transfer case on transmission.

(11) Connect transfer case shift linkage and vacuum hoses.

(12) Connect exhaust components.

(13) Install rear crossmember and remove jack used to support transmission assembly.

(14) Connect speed sensor wire harness to sensor.

(15) Connect wire harness to park/neutral position switch.

(16) Align and connect front and rear propeller shafts.

(17) Connect transmission wire harnesses and transfer case vacuum and wire harnesses.

(18) Connect transmission cooler lines.

(19) Connect transmission throttle cable at engine.

(20) Install new O–ring seal on upper half of transmission fill tube. Then connect upper and lower tube halves.

(21) Lower vehicle.

(22) Fill transmission with Mopar Dexron IIE/Mercon automatic transmission fluid.

TORQUE CONVERTER

REMOVAL

(1) Remove transmission and torque converter from vehicle.

(2) Place a suitable drain pan under the converter housing end of the transmission.

CAUTION: Verify that transmission is secure on the lifting device or work surface, the center of gravity of the transmission will shift when the torque converter is removed creating an unstable condition.

The torque converter is a heavy unit. Use caution when separating the torque converter from the transmission.

(3) Pull the torque converter forward until the center hub clears the oil pump seal.

(4) Separate the torque converter from the transmission.

INSTALLATION

Check converter hub and drive notches for sharp edges, burrs, scratches, or nicks. Polish the hub and notches with 320/400 grit paper or crocus cloth if necessary. The hub must be smooth to avoid damaging the pump seal at installation.

(1) Lubricate converter hub and oil pump seal lip with transmission fluid.

(2) Place torque converter in position on transmission.

REMOVAL AND INSTALLATION (Continued)

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. 36). 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.

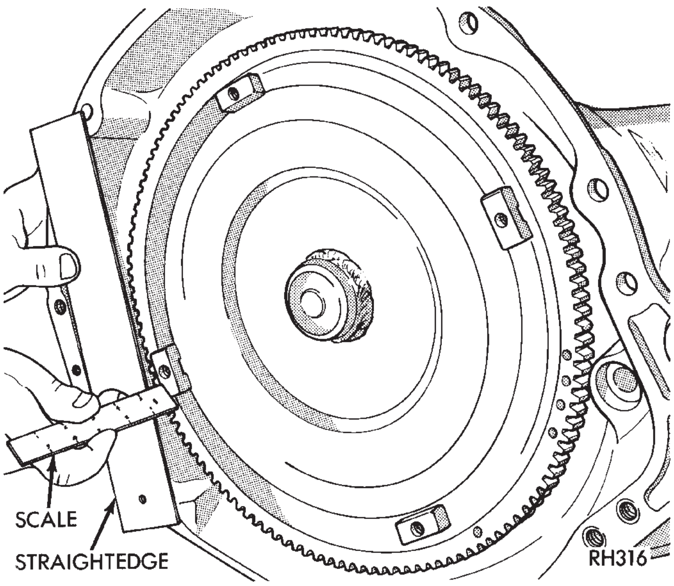


Fig. 36 Checking Torque Converter Seating

ADAPTER HOUSING SEAL

REMOVAL

(1) Raise vehicle.
(2) Disconnect or remove components necessary to gain access to seal (e.g. propeller shaft, crossmember, shift linkage, transfer case, exhaust components, hoses, wires).
(3) On 4X2 vehicles, remove dust shield from the adapter housing by tapping gently with a brass drift and hammer (Fig. 37).
(4) On 4X2 vehicles, remove the adapter housing seal with Seal Puller 7550.
(5) On 4X4 vehicles, remove the adapter housing seal using a slide hammer mounted screw.

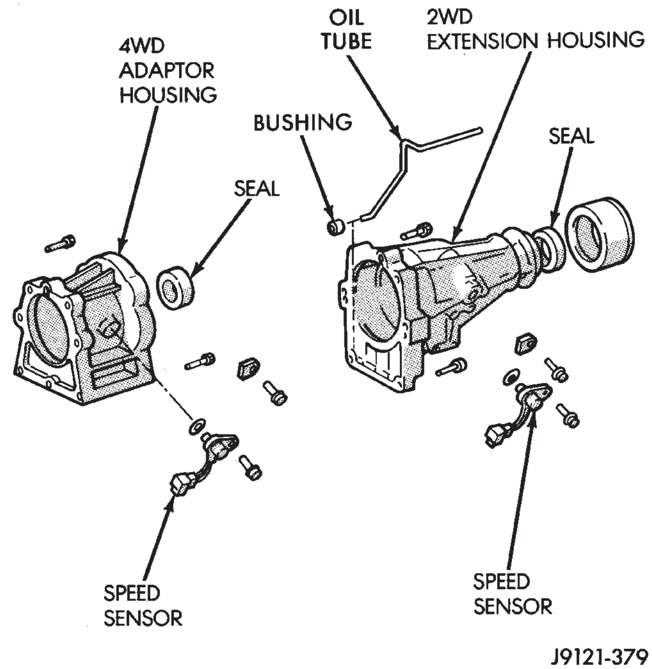


Fig. 37 Adapter Housing Seals

INSTALLATION

(1) Install new adapter housing seal with Seal Installer 7888.
(2) On 4X2 vehicles, install dust shield using Special Tool D-187-B.
(3) Reinstall components removed to gain access to seal.
(4) Top off transmission fluid if necessary.

SPEED SENSOR

REMOVAL

(1) Disconnect sensor wire harness connector.
(2) Remove sensor retainer bolt and remove sensor (Fig. 38).
(3) Remove and discard speed sensor O–ring.

INSTALLATION

(1) Install new O–ring on speed sensor and install sensor in transmission case.
(2) Install sensor bracket and retainer bolt. Tighten bolt to 7.4 N·m (65 in. lbs.) torque.
(3) Connect sensor wire harness connector.

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. 39).

REMOVAL AND INSTALLATION (Continued)

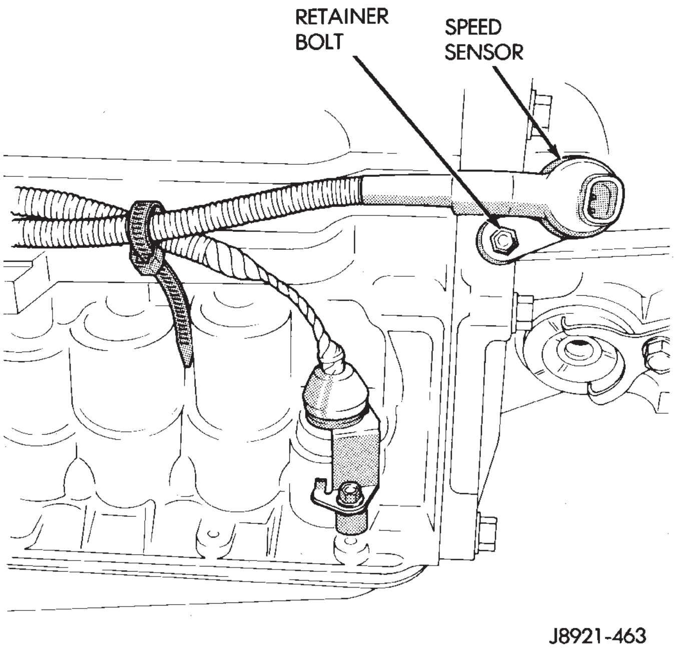


Fig. 38 Transmission Speed Sensor Removal/Installation

(4) Remove speed sensor and speedometer adapter as assembly.

(5) Remove speed sensor retaining screw and remove sensor from adapter.

(6) Remove speedometer pinion from adapter.

(7) Inspect sensor and adapter O-rings (Fig. 39). 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. 39).

(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. 40). 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.

SPEED SENSOR ROTOR-SPEEDOMETER DRIVE GEAR

REMOVAL

(1) Raise vehicle.

(2) Remove components necessary to gain access to rotor and drive gear such as propeller shaft, transfer case, crossmember, and shift linkage.

(3) Disengage wire connector from the output speed sensor.

(4) Remove the bolt holding the output speed sensor to the adapter housing.

(5) Remove the output speed sensor from the adapter housing.

(6) Remove the bolts holding the adapter housing to the transmission case.

(7) Tap the adapter housing at the joint line gently with a rubber mallet to separate the adapter housing from the transmission case.

(8) Remove the adapter housing from the transmission case.

(9) Remove speedometer drive gear snap ring (Fig. 41).

(10) Remove the speedometer drive gear and spacer, if equipped.

(11) Remove rotor from the output shaft. It may be necessary to use a wood dowel or hammer handle (Fig. 42) to gently pry the rotor from the output shaft. Be sure to retrieve the rotor locating key from the output shaft or rotor.

INSTALLATION

(1) Clean sealing surfaces of transmission case and extension/adaptor housing.

(2) Install rotor, spacer (if equipped) and drive gear on output shaft. Then install drive gear snap ring (Fig. 41).

(3) Apply 1/8 3/16 inch wide bead of Threebond® Liquid Gasket TB1281, P/N 83504038, to transmission case sealing surface and install extension/adapter housing on case.

(4) Tighten adaptor housing bolts to 34 N·m (25 ft. lbs.) torque.

(5) Install components removed to gain access to rotor and drive gear.

REMOVAL AND INSTALLATION (Continued)

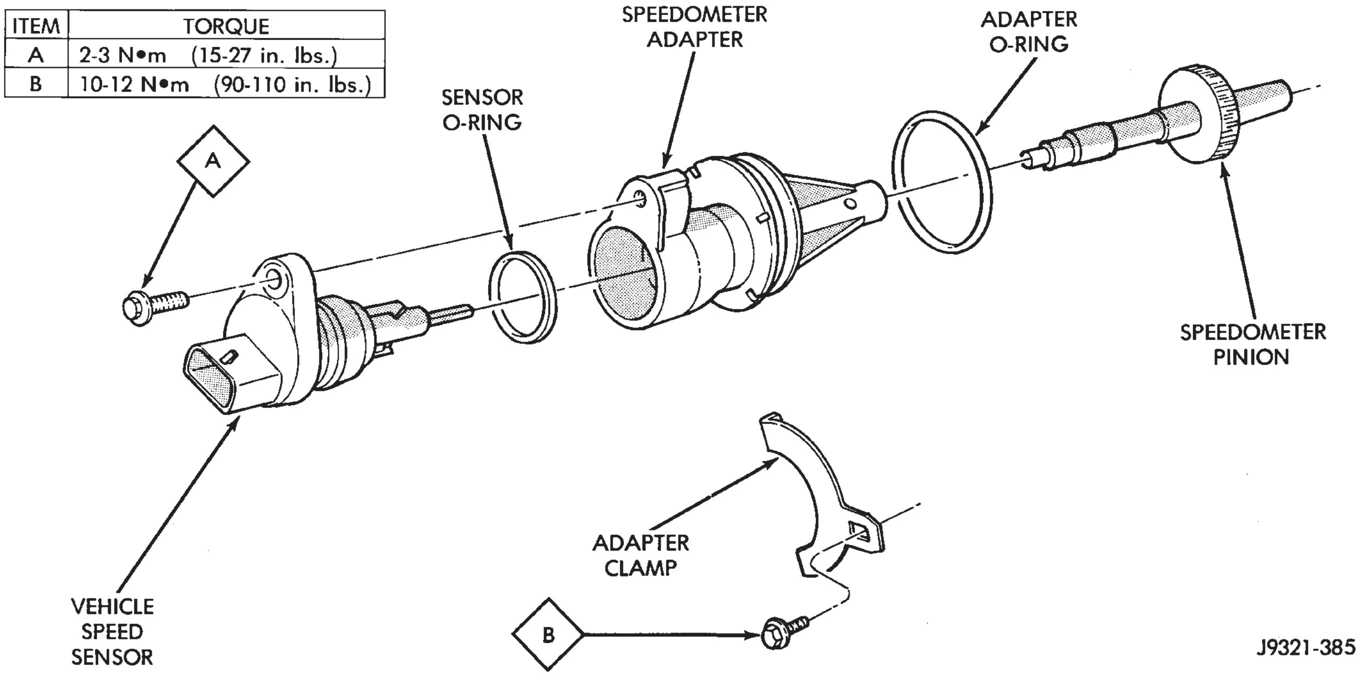


Fig. 39 Speedometer Pinion Adapter Components

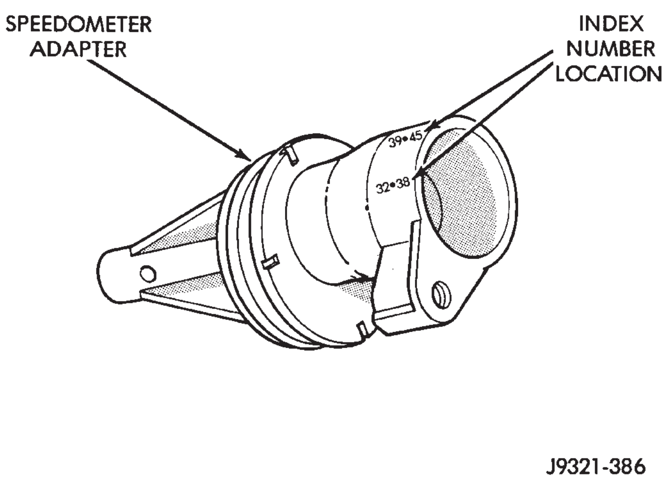


Fig. 40 Index Numbers On Speedometer Pinion Adapter

PARK/NEUTRAL POSITION SWITCH

REMOVAL

(1) Raise vehicle.

(2) Disconnect switch wire harness connector.

(3) Pry washer lock tabs upward and remove switch attaching nut and tabbed washer (Fig. 43).

(4) Remove switch adjusting bolt (Fig. 43).

(5) Slide switch off manual valve shaft.

INSTALLATION

(1) Disconnect shift linkage rod from shift lever on left side of transmission.

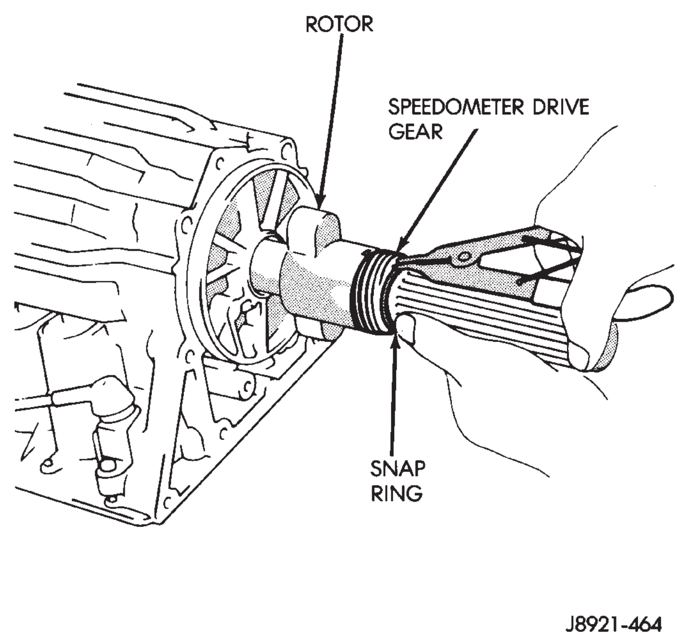


Fig. 41 Removing/Installation Speedometer Drive Gear

(2) Rotate manual shift lever all the way rearward. Then rotate lever forward two detent positions to Neutral.

(3) Install switch on manual valve shaft and install switch adjusting bolt finger tight. Do not tighten bolt at this time.

(4) Install tabbed washer on manual valve shaft and install switch attaching nut. Tighten nut to 6.9 N·m (61 in. lbs.) torque but do not bend washer lock tabs over nut at this time.

REMOVAL AND INSTALLATION (Continued)

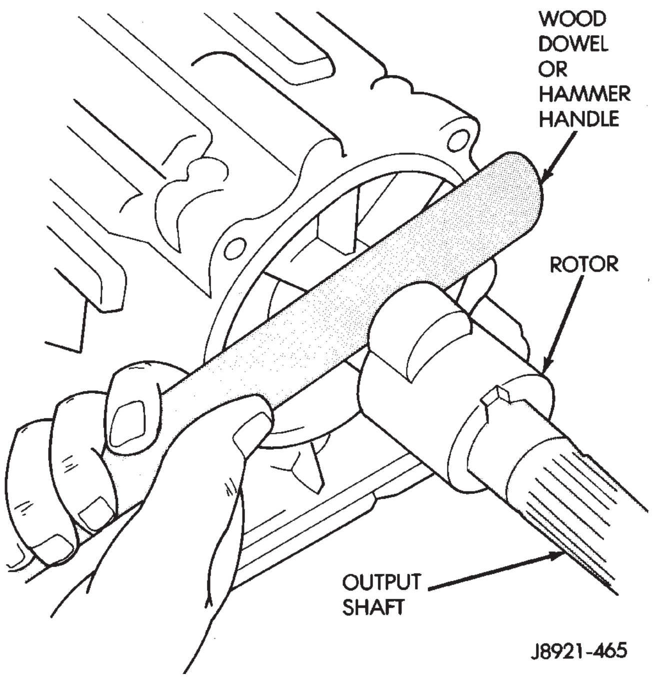


Fig. 42 Removing Speed Sensor Rotor

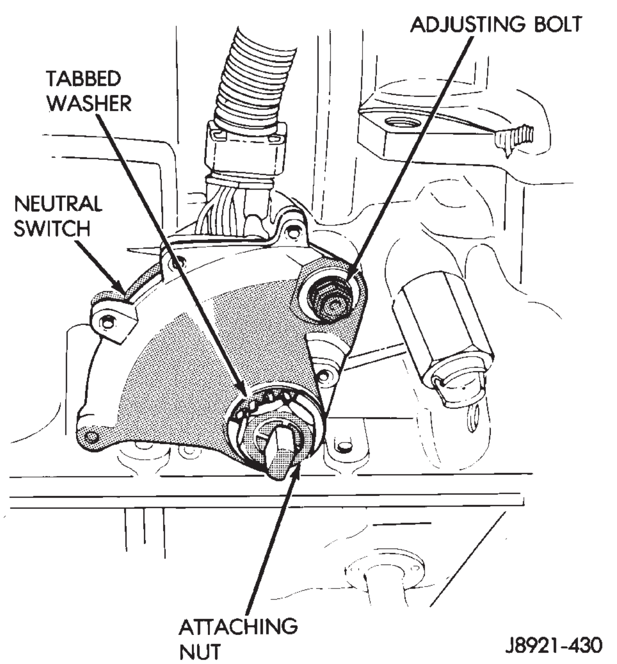


Fig. 43 Park/Neutral Position Switch Removal/ Installation

(5) Verify that transmission is in Neutral.

(6) Rotate switch to align neutral standard line with vertical groove on manual valve shaft (Fig. 44).

(7) Align switch standard line with groove or flat on manual valve shaft.

(8) Tighten switch adjusting bolt to 13 N·m (9 ft. lbs.) torque.

(9) Bend at least two washer lock tabs over switch attaching nut to secure it.

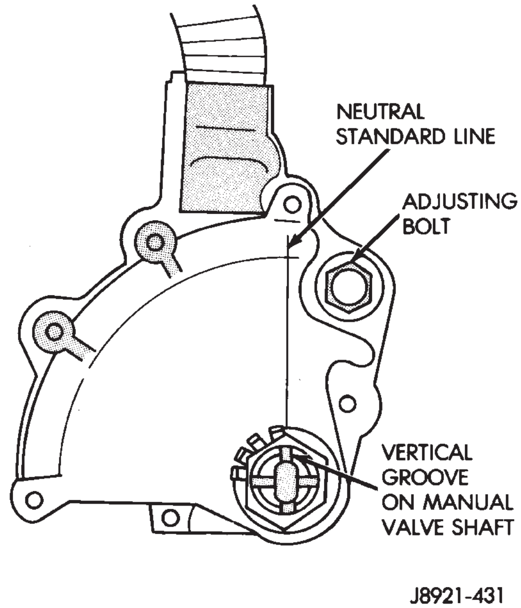


Fig. 44 Park/Neutral Position Switch Adjustment

(10) Connect shift linkage rod to shift lever on left side of case.

(11) Connect switch wires to harness and lower vehicle.

(12) Check switch operation. Engine should start in Park and Neutral only.

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.

REMOVAL AND INSTALLATION (Continued)

(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. 45).

(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. 46).

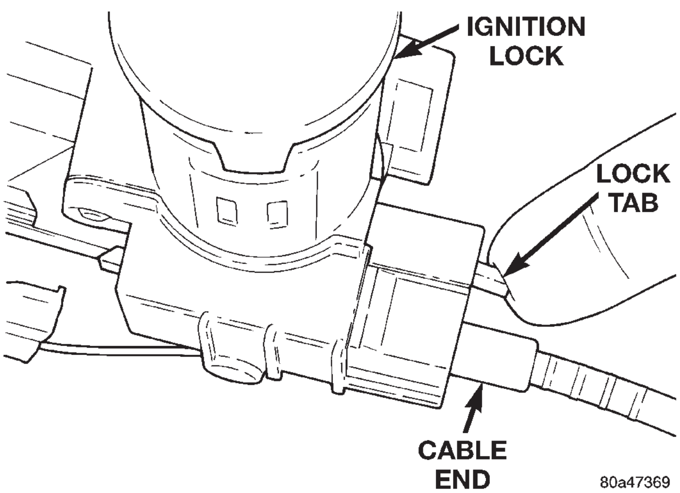


Fig. 45 Brake/Park Interlock Cable

(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. 46).

(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.

TRANSMISSION VALVE BODY SOLENOIDS

REMOVAL

(1) Remove transmission oil pan drain plug and drain fluid.

(2) Remove pan bolts and remove oil pan.

(3) Remove oil screen bolts and remove screen (Fig. 47) and gasket. Discard the gasket.

(4) Disconnect solenoid wire connector (Fig. 48).

(5) If all solenoids are being removed, mark or tag wires for assembly reference before disconnecting them.

(6) Remove bolt attaching solenoids to valve body and remove solenoids (Fig. 49). Do not allow any valve body components to fall out when solenoids are removed.

(7) Clean oil filter and pan with solvent and dry with compressed air.

(8) Remove old sealer material from oil pan and transmission case.

INSTALLATION

(1) Position solenoids on valve body and install solenoid bolts. Tighten bolts to 10 N·m (7 ft. lbs.) torque.

(2) Connect feed wires to solenoids.

(3) Install new gaskets on oil screen and install screen. Tighten screen bolts to 10 N·m (7 ft. lbs.) torque.

(4) Apply bead of Threebond® Liquid Gasket TB1281, P/N 83504038, sealer to oil pan sealing surface. Sealer bead should be at least 3.0 mm (1/8 in.) wide.

(5) Install oil pan on transmission. Tighten pan bolts to 7 N·m (65 in. lbs.) torque.

(6) Install and tighten oil pan drain plug to 20 N·m (15 ft. lbs.) torque.

(7) Fill transmission with Mopar® Dexron IIE/Mercon.

REMOVAL AND INSTALLATION (Continued)

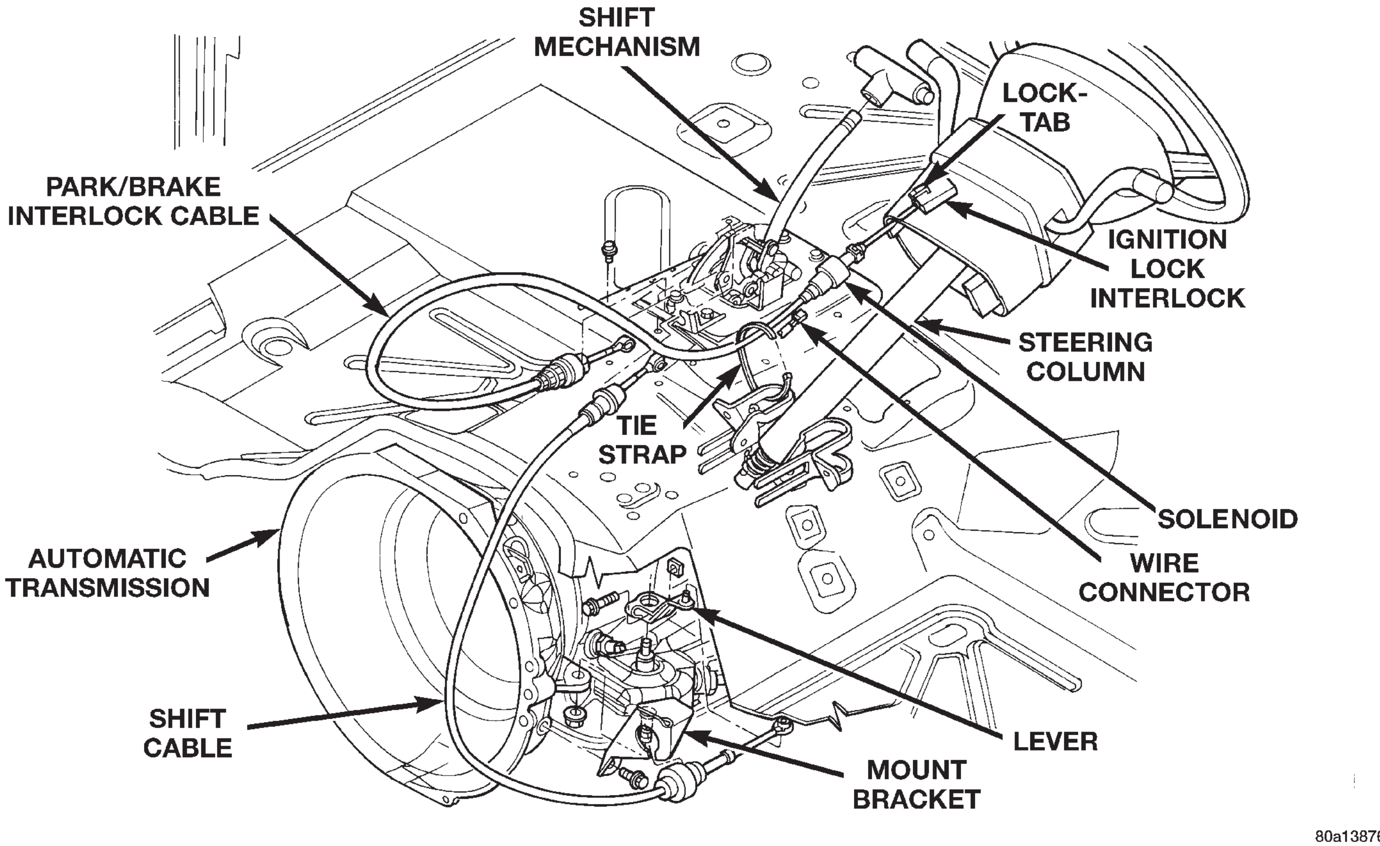


Fig. 46 Cable and Shifter

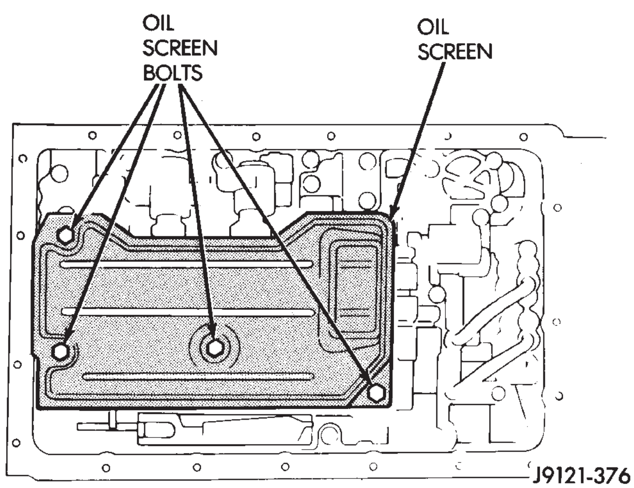


Fig. 47 Oil Screen Removal/Installation

TRANSMISSION VALVE BODY

REMOVAL

(1) Remove oil pan plug and drain transmission fluid.

(2) Remove oil pan and oil screen. Clean pan and screen in solvent and dry them with compressed air.

(3) Disconnect solenoid wire connectors (Fig. 50). Mark wires for assembly reference.

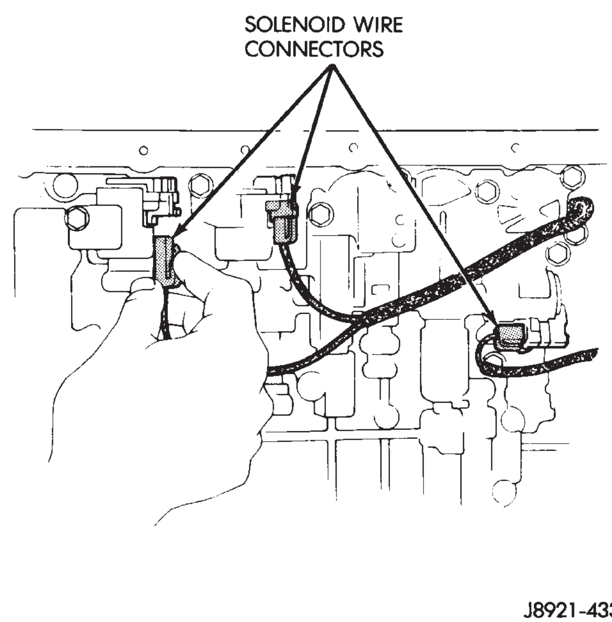


Fig. 48 Solenoid Wire Connectors

(4) Remove valve body oil tubes (Fig. 51). Carefully pry tubes out of valve body with screwdriver.

(5) Disconnect throttle cable from throttle cam (Fig. 52).

REMOVAL AND INSTALLATION (Continued)

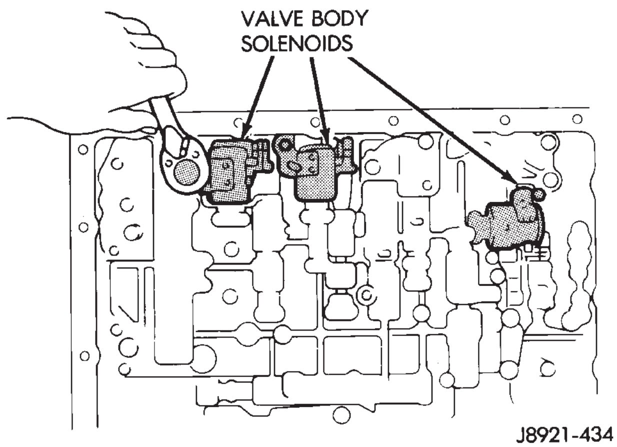


Fig. 49 Transmission Valve Body Solenoids

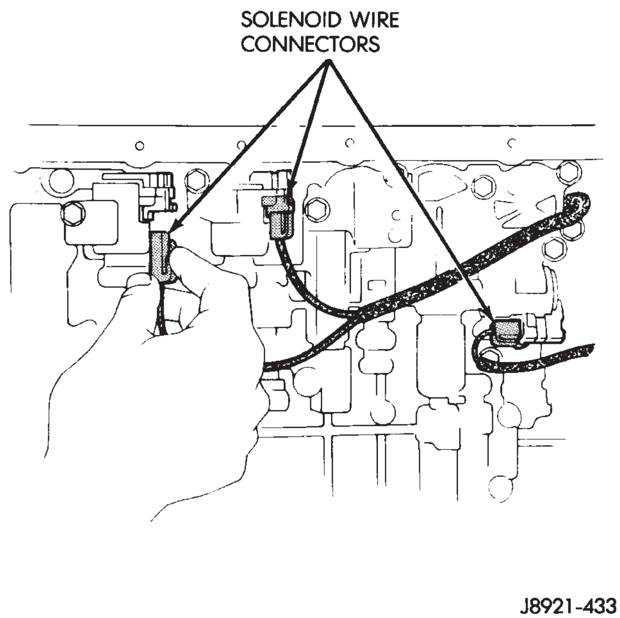


Fig. 50 Solenoid Wire Connectors

(6) Remove valve body bolts. Bolt locations are outlined in (Fig. 53).

(7) Lower valve body and remove overdrive clutch accumulator springs, direct clutch accumulator springs and second brake accumulator spring (Fig. 54).

(8) Remove valve body and check ball and spring (Fig. 55).

INSTALLATION

(1) Connect cable to throttle cam (Fig. 52).

(2) Install check ball and spring (Fig. 55).

(3) Position accumulator springs and spacers on valve body.

(4) Align valve body manual valve with shift sector (Fig. 56) and carefully position valve body on case.

(5) Install valve body bolts (Fig. 53). Tighten bolts evenly to 10 N·m (7 ft. lbs.) torque.

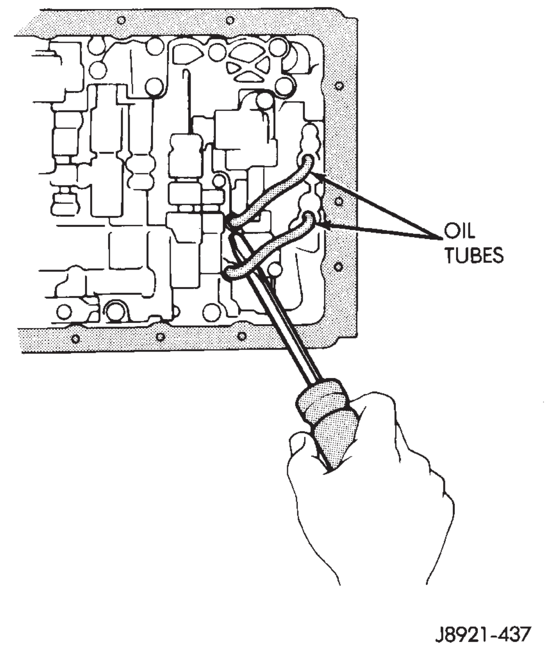


Fig. 51 Removing Transmission Valve Body Oil Tubes

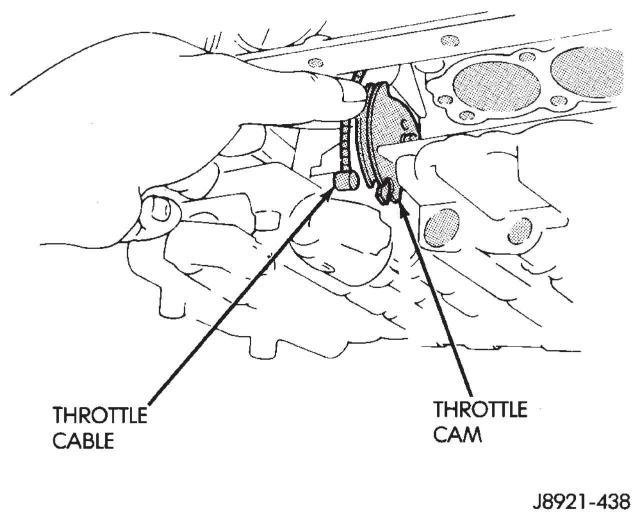


Fig. 52 Removing/Installing Throttle Cable

(6) Install valve body oil tubes. Be sure tube ends (L) and (M) are installed as shown in (Fig. 57).

(7) Remove old sealer material from oil pan and transmission case.

(8) Clean oil screen and oil pan with solvent (if not done previously). Dry both components with compressed air only. Do not use shop towels.

(9) Install new gaskets on oil screen and install screen on case. Tighten screen attaching bolts to 10 N·m (7 ft. lbs.) torque.

(10) Apply bead of Threebond® Liquid Gasket TB1281, P/N 83504038 to sealing surface of oil pan. Sealer bead should be at least 3 mm (1/8 in.) wide.

REMOVAL AND INSTALLATION (Continued)

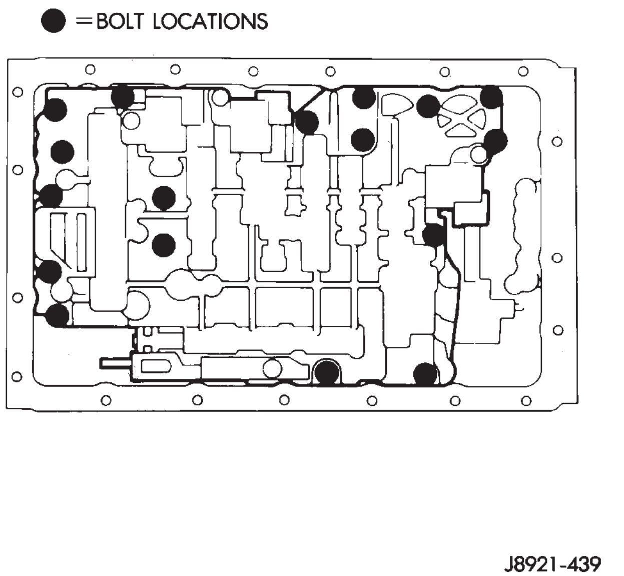


Fig. 53 Transmission Valve Body Bolt Locations

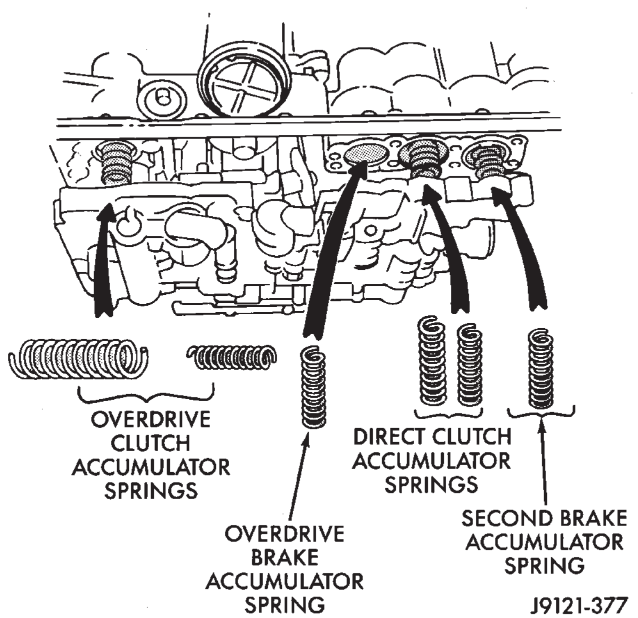


Fig. 54 Accumulator Springs

Then install oil pan and tighten pan bolts to 7.4 N·m (65 in. lbs.) torque.

(11) Install new gasket on oil pan drain plug and install plug in pan. Tighten plug to 20 N·m (15 ft. lbs.) torque.

(12) Fill transmission with Mopar® Dexron IIE/ Mercon.

TRANSMISSION CONTROL MODULE

The transmission control module is mounted under the instrument panel. On left hand drive models, it is at the driver side of the lower finish panel (Fig. 58). On right hand drive models, it is at the passenger side of the lower finish panel (Fig. 59).

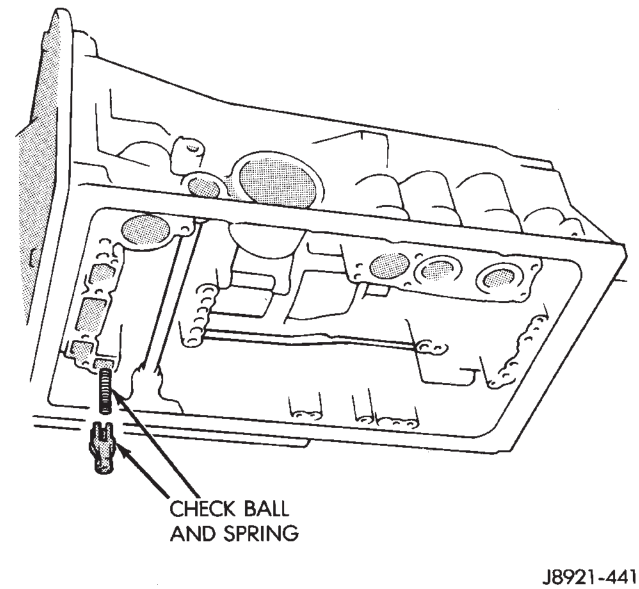


Fig. 55 Removing/Installing Check Ball And Spring

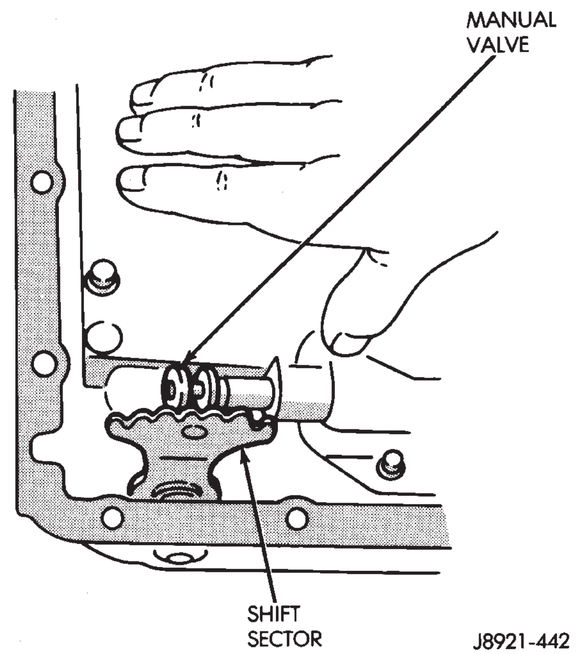


Fig. 56 Shift Sector And Manual Valve Alignment

To remove the module, disconnect the wire harness, remove the mounting screws and remove the module from the finish panel. Tighten the module mounting screws securely after installation. Also be sure the wire harness is not twisted, kinked or touching any body panels.

SOLENOID HARNESS ADAPTER SEAL

REMOVAL

(1) Remove oil pan and oil screen.

(2) Disconnect solenoid wire connectors (Fig. 60).

REMOVAL AND INSTALLATION (Continued)

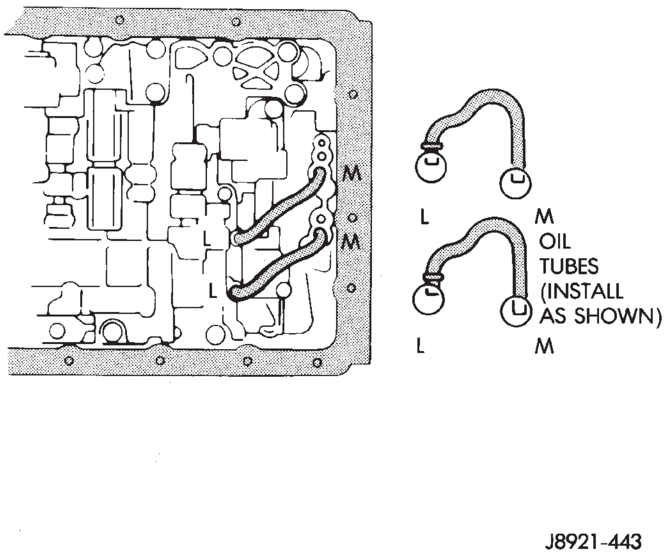


Fig. 57 Installing Transmission Valve Body Oil Tubes

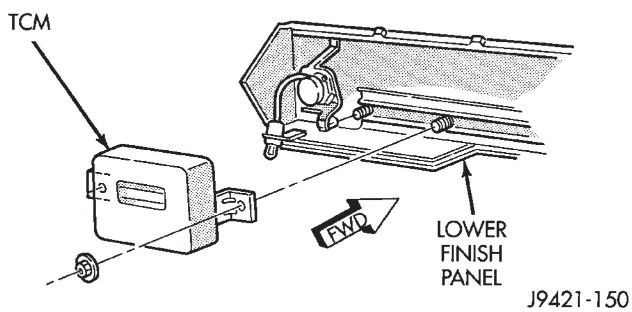


Fig. 58 TCM Location (Left Hand Drive)

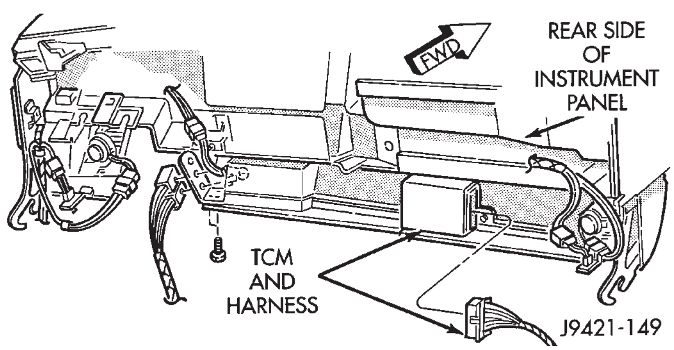


Fig. 59 TCM Location (Right Hand Drive)

(3) Remove bracket securing solenoid harness adaptor (Fig. 61) to case.

(4) Pull harness adapter and wires out of case.

(5) Remove and discard adapter O–ring.

INSTALLATION

(1) Lubricate new O–ring and install it on adapter.

(2) Install solenoid wire harness and adapter in case.

(3) Install adapter bracket and bracket bolt.

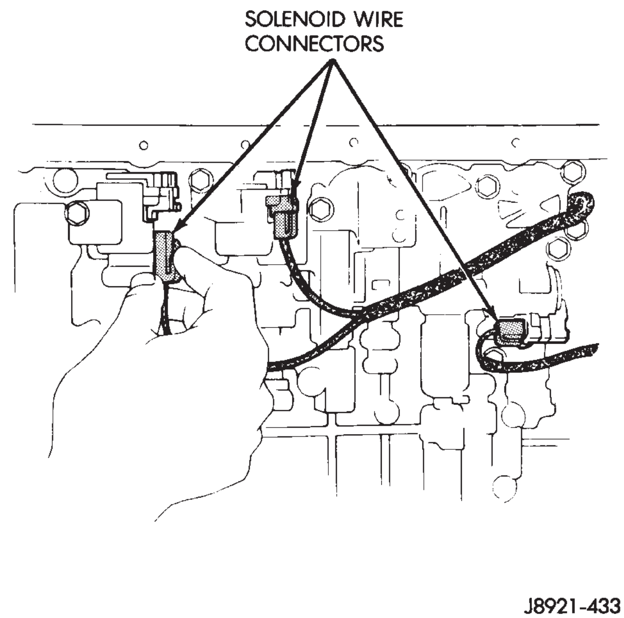


Fig. 60 Solenoid Wire Connectors

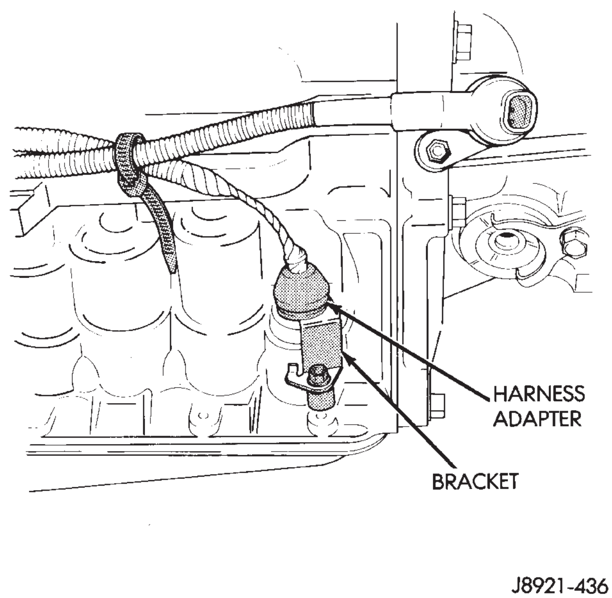


Fig. 61 Harness Adapter Removal/Installation

(4) Connect wires to solenoids.

(5) Install oil screen.

(6) Apply bead of Threebond® Liquid Gasket TB1281, P/N 83504038, to oil pan seal surface. Sealer bead should be at least 3 mm (1/8 in.) wide.

(7) Install oil pan on transmission. Tighten pan bolts to 7 N·m (65 in. lbs.) torque.

(8) Install and tighten oil pan drain plug to 20 N·m (15 ft. lbs.) torque.

(9) Fill transmission with Mopar Dexron IIE/Mercon.

REMOVAL AND INSTALLATION (Continued)

MANUAL VALVE SHAFT SEAL

REMOVAL

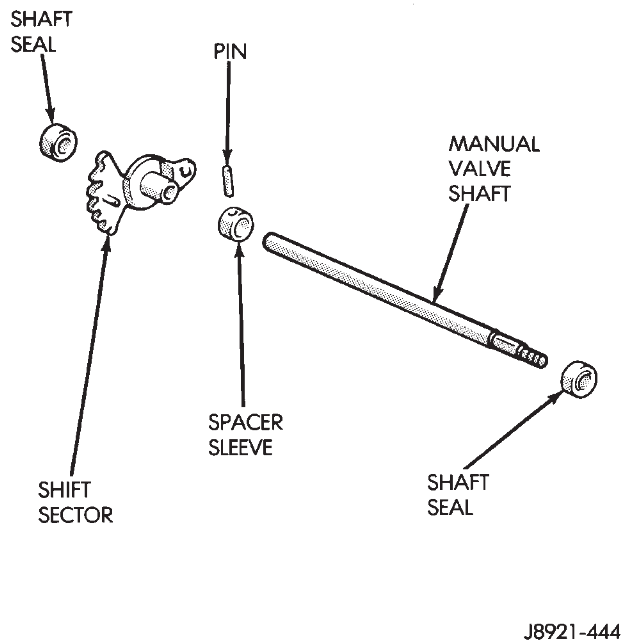


Fig. 62 Manual Valve Shaft And Seals

(1) Remove park/neutral position switch and disconnect transmission shift lever (Fig. 62).

(2) Remove oil pan and valve body.

(3) Remove bolts attaching park rod bracket to case (Fig. 63).

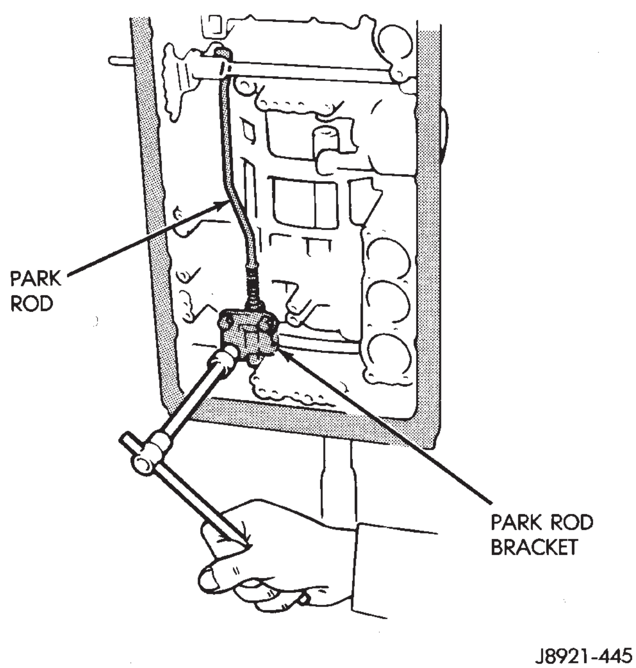


Fig. 63 Removing/Installing Park Rod Bracket

(4) Remove park rod from shift sector (Fig. 64).

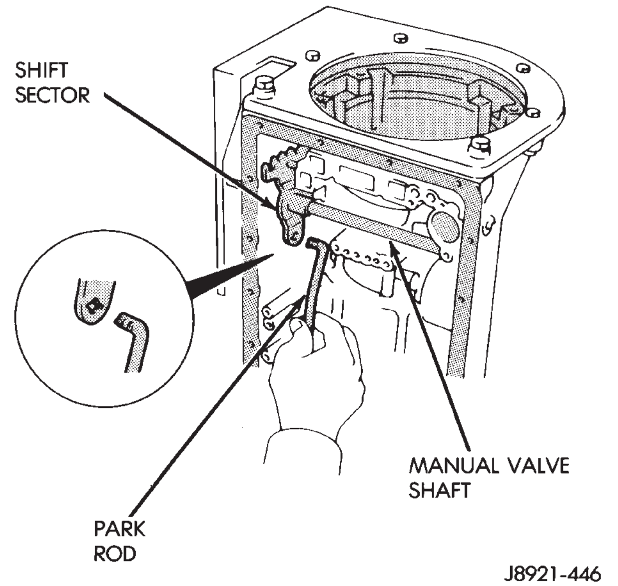


Fig. 64 Removing/Installing Park Rod

(5) Cut spacer sleeve with chisel and remove it from manual valve shaft (Fig. 65).

(6) Remove pin from shaft and sector with pin punch.

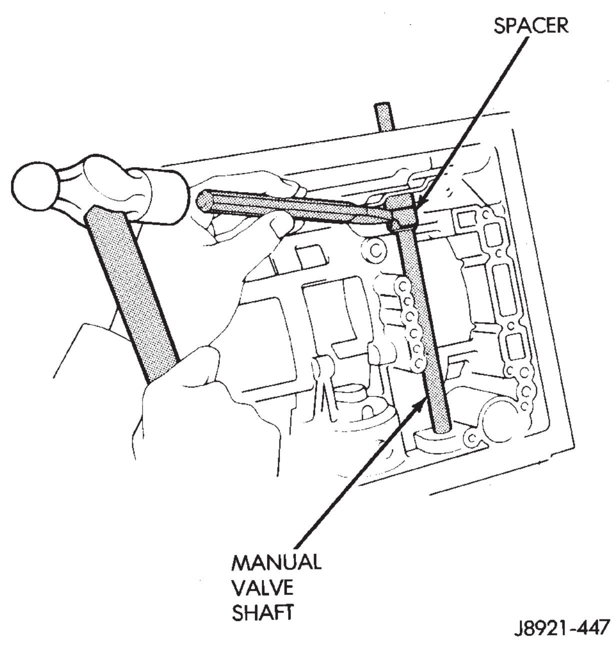


Fig. 65 Cutting Spacer Sleeve

(7) Remove shaft and sector from case.

(8) Pry shaft seals out of case (Fig. 66).

INSTALLATION

(1) Inspect the manual valve shaft and sector. Replace either component if worn or damaged.

(2) Coat replacement shaft seals with petroleum jelly and seat them in the case using an appropriately sized driver/socket (Fig. 67).

REMOVAL AND INSTALLATION (Continued)

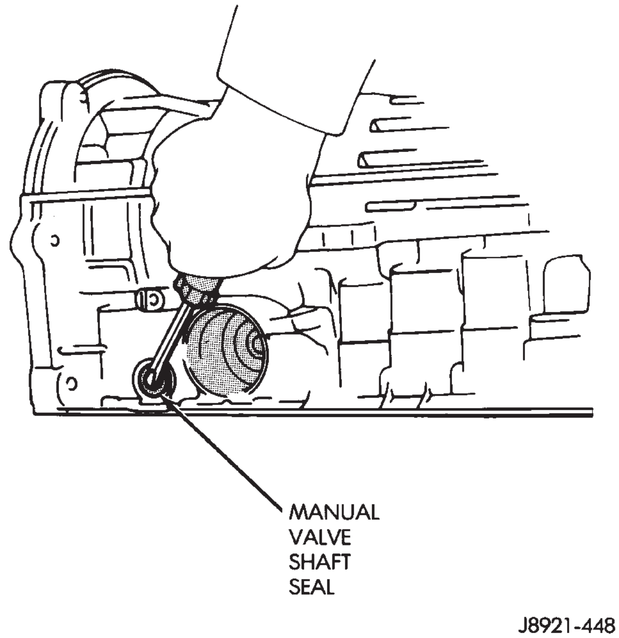


Fig. 66 Removing Manual Valve Shaft Seals

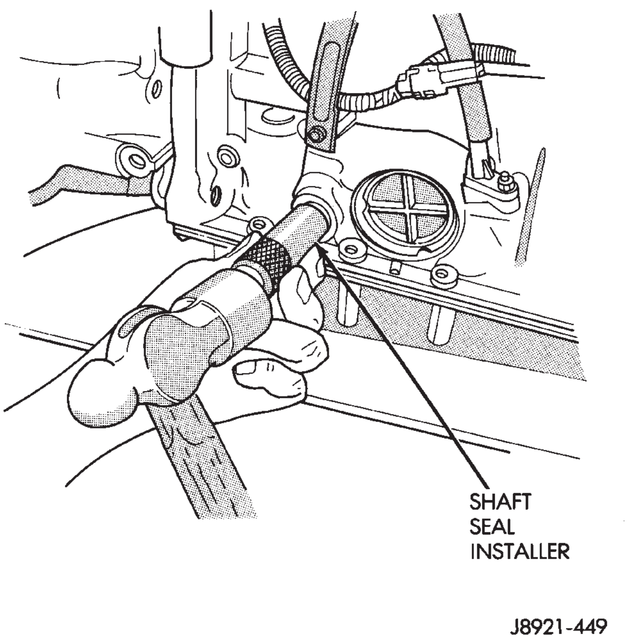


Fig. 67 Installing Manual Valve Shaft Seals

(3) Install new spacer sleeve on sector (Fig. 68).

(4) Lubricate manual valve shaft with petroleum jelly and install it through the left side of the transmission case.

(5) Lubricate sector and sleeve with petroleum jelly and install them on shaft.

(6) Install the manual valve shaft through the remainder of the transmission case.

(7) Align hole in spacer sleeve with notch in sector. Then install shift sector roll pin. Tap pin into sector and shaft and securely stake sleeve to sector and shaft.

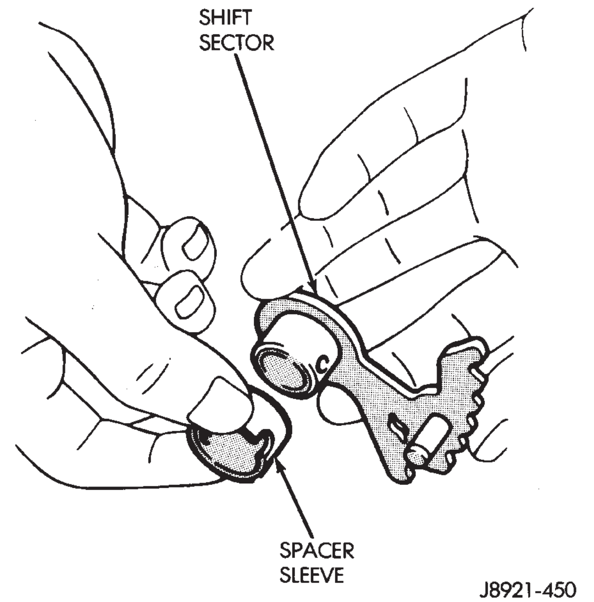


Fig. 68 Installing Spacer Sleeve On Sector

(8) Connect park rod to sector (Fig. 64).

(9) Install park rod bracket (Fig. 69). Tighten bracket bolts to 10 N·m (7 ft. lbs.) torque.

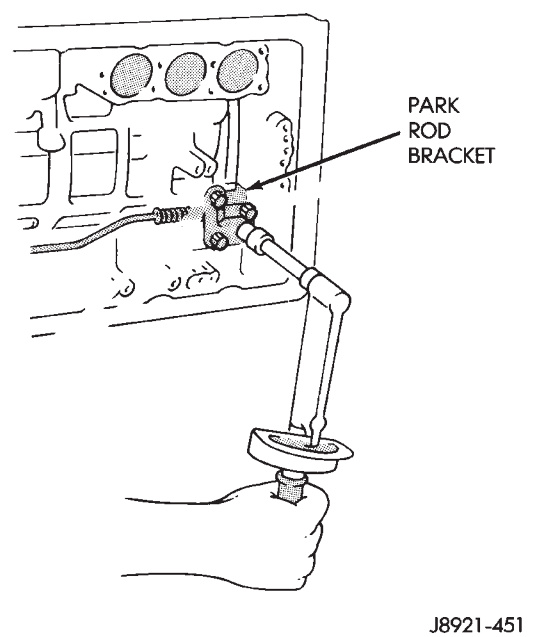


Fig. 69 Installing Park Rod Bracket

(10) Install valve body, oil screen and oil pan.

(11) Install park/neutral position switch.

ACCUMULATOR PISTONS AND SPRINGS

REMOVAL

(1) Remove valve body.

(2) Remove accumulator pistons with compressed air (Fig. 70). Apply air through small feed hole next

REMOVAL AND INSTALLATION (Continued)

to each piston bore. Catch each piston in a shop towel as it exits bore.

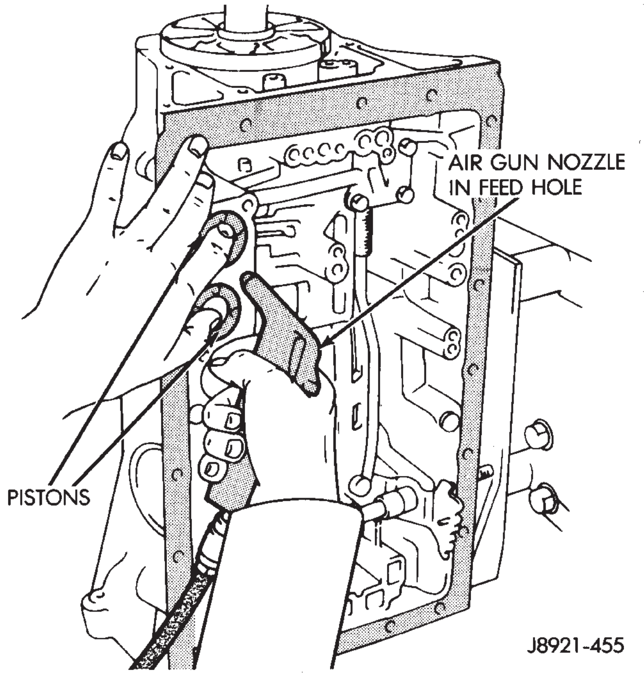


Fig. 70 Accumulator Piston Removal

CAUTION: Use only enough air pressure to ease each piston out of the bore. In addition, remove the pistons one at a time and tag the pistons and springs for assembly reference. Do not intermix them.

(3) Remove and discard piston O–ring seals. Then clean pistons and springs with solvent.

INSTALLATION

(1) Inspect pistons, springs and piston bores. Replace worn damaged pistons. Replace broken, collapsed or distorted springs. Replace case if piston bores are damaged.

(2) If small cushion spring in any piston must be replaced, remove spring retainer clip and remove spring from piston (Fig. 71). A small hooked tool or small thin blade screwdriver can be used to remove clip. A thin wall, deep socket, or pin punch can be used to seat clip after spring replacement.

(3) Install new O–ring seals on pistons. Lubricate seals and pistons and piston bores with transmission fluid.

(4) Install pistons and springs (Fig. 72).

(5) Install valve body, oil screen and oil pan.

SECOND COAST BRAKE SERVO

REMOVAL

(1) Remove valve body.

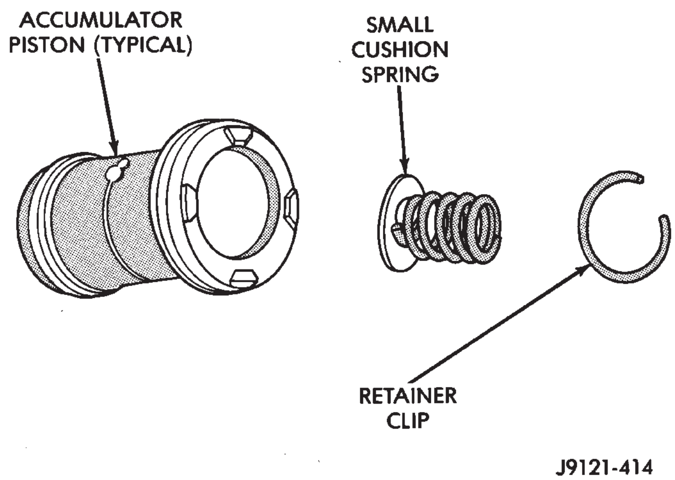


Fig. 71 Small Cushion Spring Retention

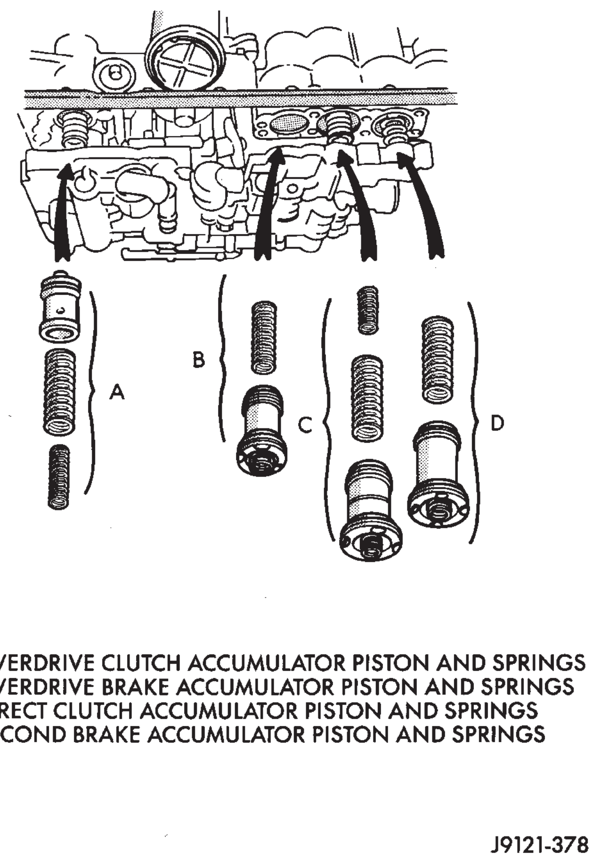


Fig. 72 Accumulator Pistons, Springs And Spacers

(2) Remove servo piston cover snap ring with snap ring pliers (Fig. 73).

(3) Remove servo piston and cover with compressed air. Apply compressed air through oil hole in servo boss to ease piston out of bore (Fig. 74).

(4) Remove and discard seal and O–rings from cover and piston (Fig. 75). Inspect E–ring, piston, spring and retainer, piston rod and piston spring. Replace worn or damaged parts.

REMOVAL AND INSTALLATION (Continued)

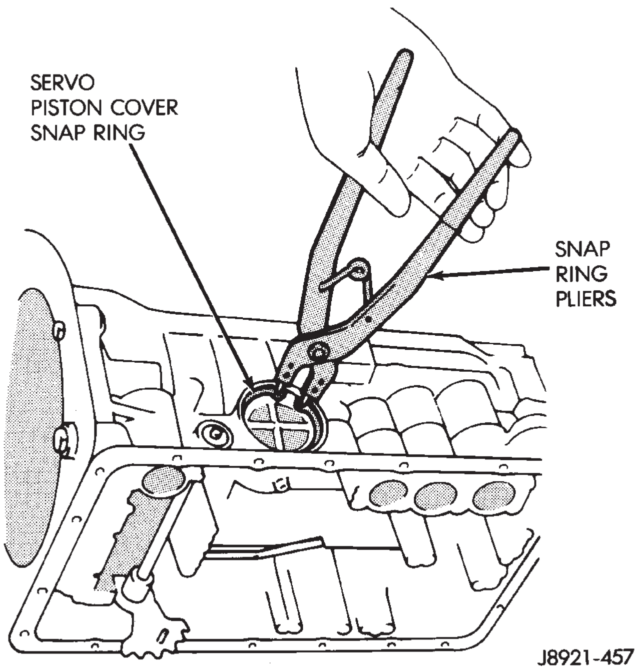


Fig. 73 Removing/Installing Servo Piston Cover Snap Ring

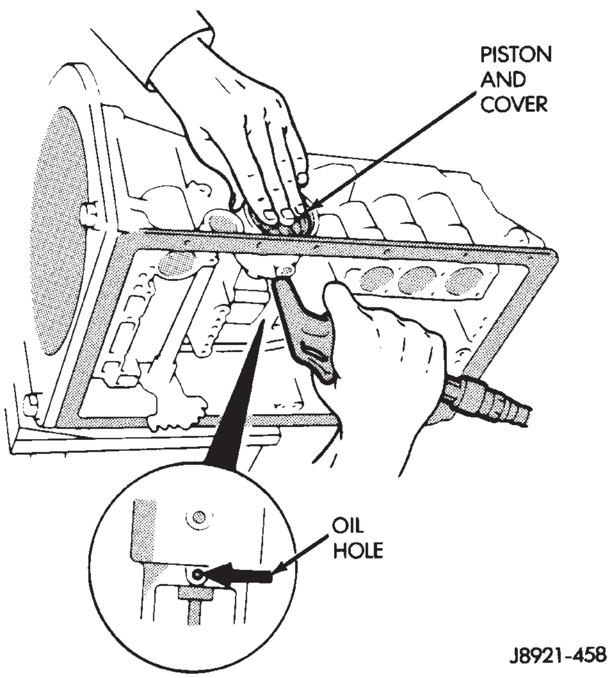


Fig. 74 Removing Servo Cover And Piston

INSTALLATION

(1) Install new seals on cover and piston.

(2) Lubricate servo components with transmission fluid.

(3) Assemble and install servo components in case. Be sure servo piston rod is properly engaged in the second coast brake band.

(4) Compress cover and piston and install cover snap ring.

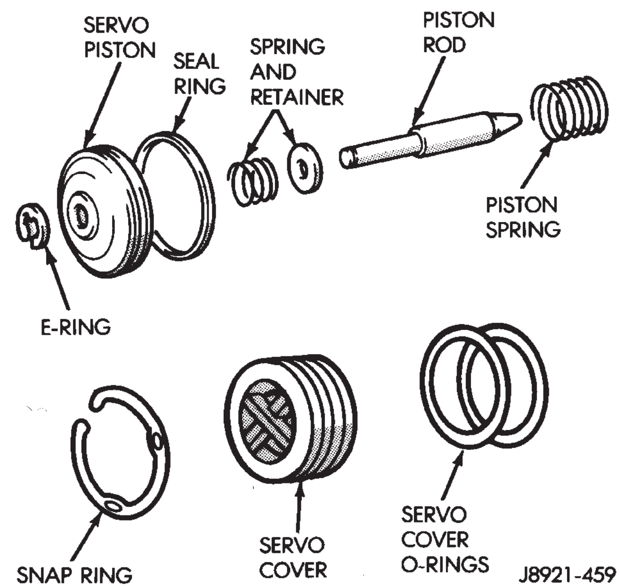


Fig. 75 Second Coast Brake Servo Components

(5) Install valve body, oil screen and oil pan.

PARK ROD AND PAWL

REMOVAL

(1) Remove valve body as outlined in this section.

(2) Remove bolts attaching park rod bracket to case (Fig. 76).

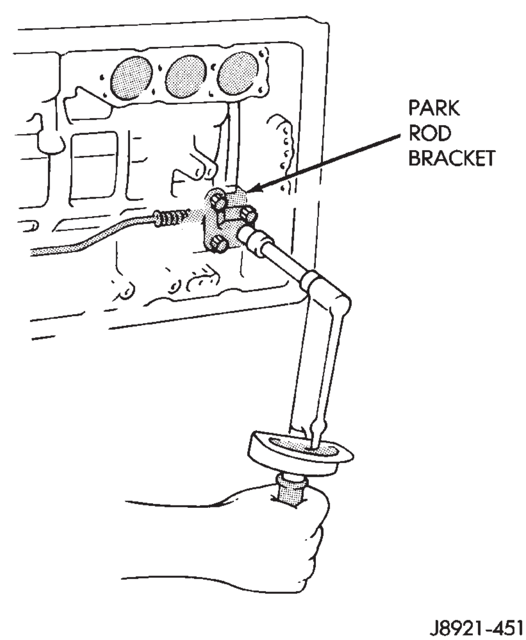


Fig. 76 Removing/Installing Park Rod Bracket

REMOVAL AND INSTALLATION (Continued)

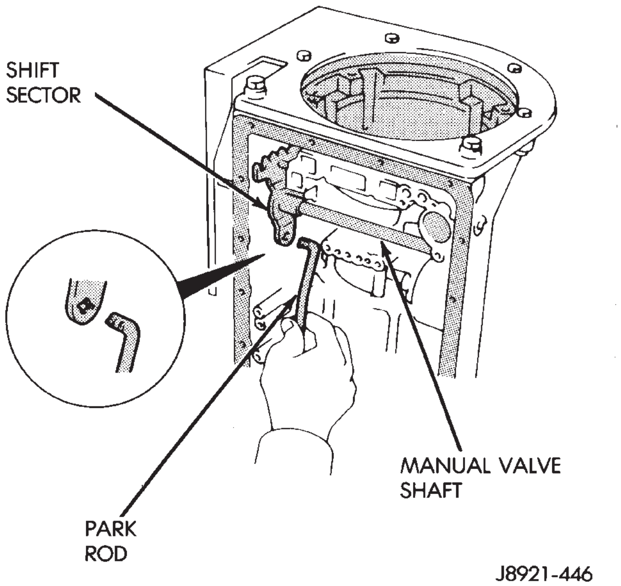


Fig. 77 Removing/Installing Park Rod

(3) Remove park rod from manual valve shaft sector (Fig. 77).

(4) Remove park rod.

(5) Remove park pawl, pin and spring (Fig. 78).

INSTALLATION

(1) Examine park rod, pawl, pin and spring. Replace any component that is worn or damaged.

(2) Install pawl in case. Insert pin and install spring. Be sure spring is positioned as shown in Figure 35.

(3) Install park rod and bracket (Fig. 76). Tighten bracket bolts to 10 N·m (7 ft. lbs.) torque.

(4) Install valve body, oil screen and oil pan.

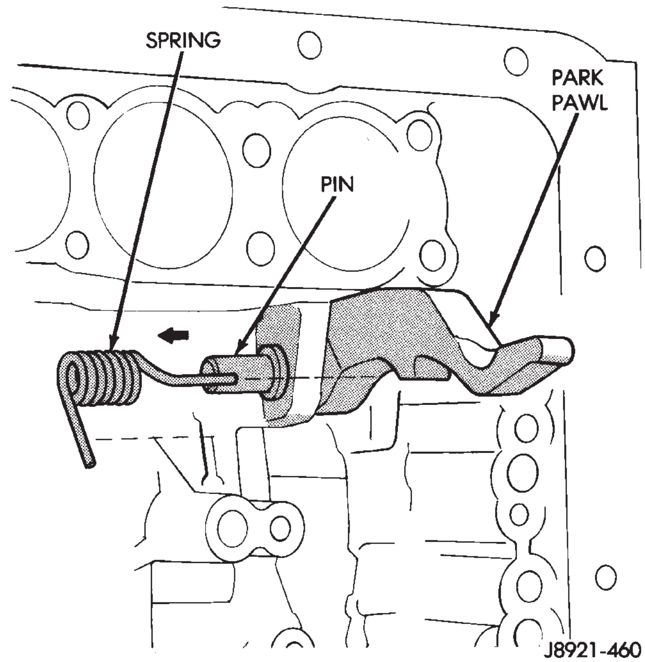


Fig. 78 Removing/Installing Park Pawl, Pin And Spring

TRANSMISSION THROTTLE CABLE

REMOVAL

(1) In engine compartment, disconnect cable from throttle linkage. Then compress cable mounting ears and remove cable from engine bracket (Fig. 79).

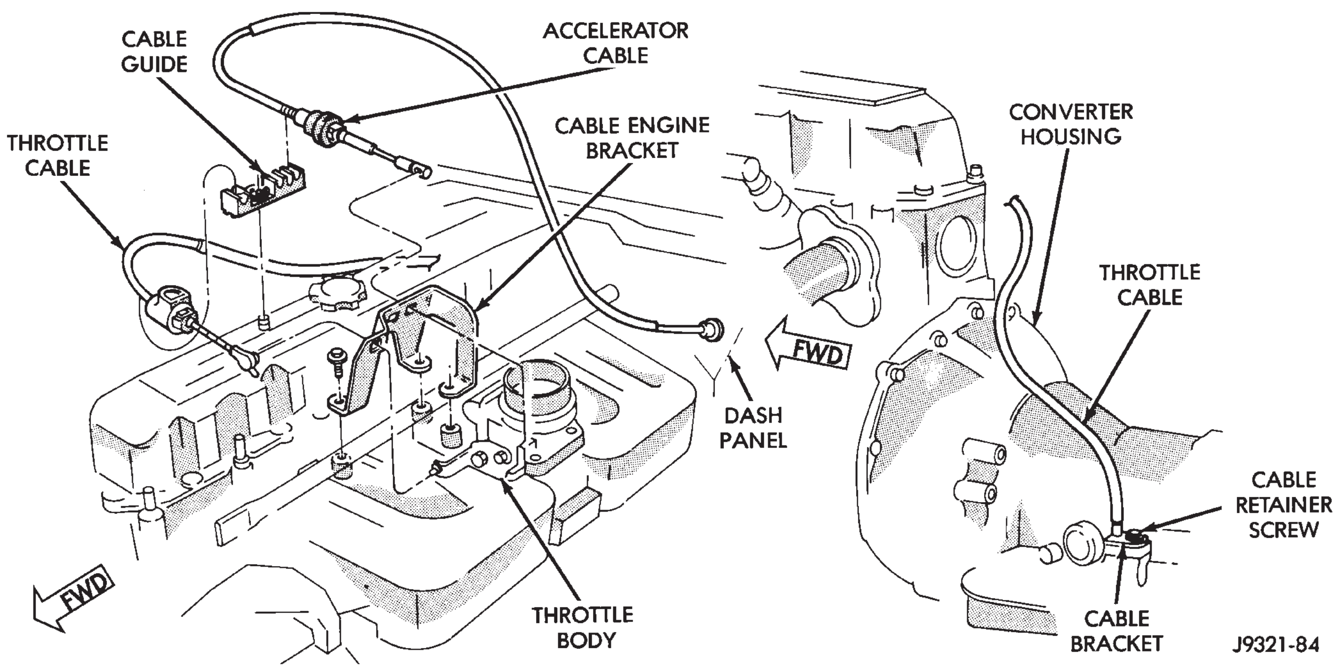


Fig. 79 Transmission Throttle Cable Attachment

REMOVAL AND INSTALLATION (Continued)

(2) Raise vehicle.

(3) Remove transmission oil pan.

(4) Disengage cable from throttle valve cam (Fig. 80).

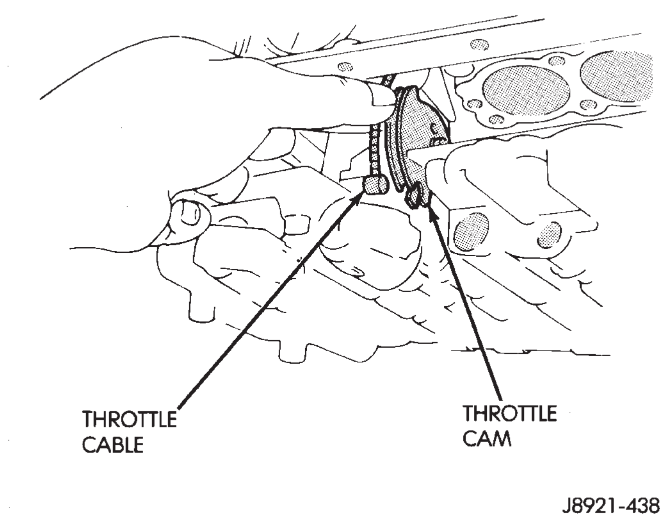


Fig. 80 Removing/Installing Transmission Throttle Cable

(5) Remove cable bracket bolt and remove cable and bracket from case (Fig. 81).

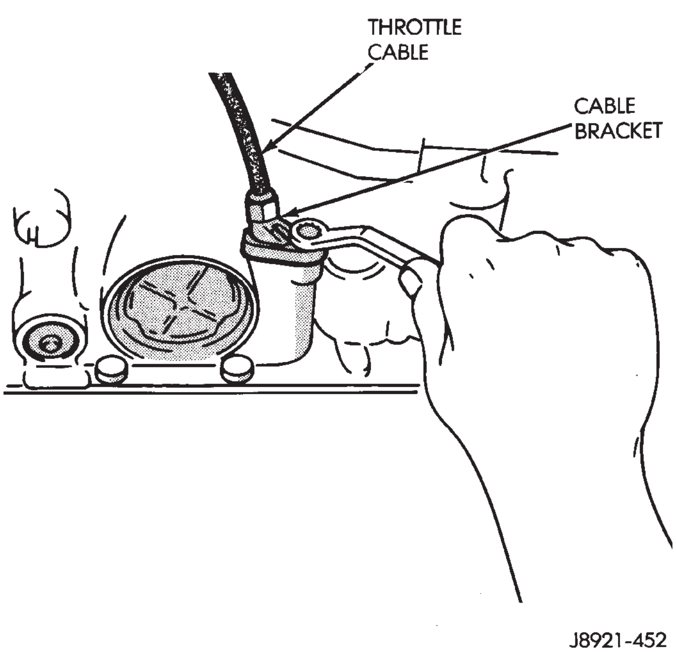


Fig. 81 Removing/Installing Transmission Throttle Cable And Bracket

(6) Remove and discard cable seal.

INSTALLATION

(1) Lubricate and install new seal on cable.

(2) Insert cable in transmission case.

(3) Attach cable to throttle cam (Fig. 80).

(4) Install cable bracket on case and tighten attaching bolt to 10 N·m (7 ft. lbs.) torque (Fig. 81).

(5) Install pan and tighten pan bolts to 7 N·m (65 in. lbs.) torque.

(6) Install new gasket on oil pan drain plug. Install and tighten plug to 20 N·m (15 ft. lbs.) torque.

(7) Connect cable to engine bracket and throttle linkage.

(8) Fill transmission with Mopar® Dexron/Mercon IIE.

(9) Adjust the cable as described in cable adjustment procedure.

OIL PUMP SEAL

REMOVAL

(1) Remove converter.

(2) Remove old seal. Use blunt punch to collapse seal and pry seal out of pump housing. Do not scratch or damage seal bore.

INSTALLATION

(1) Lubricate lip of new seal with transmission fluid and install seal in pump with tool 7549 (Fig. 82).

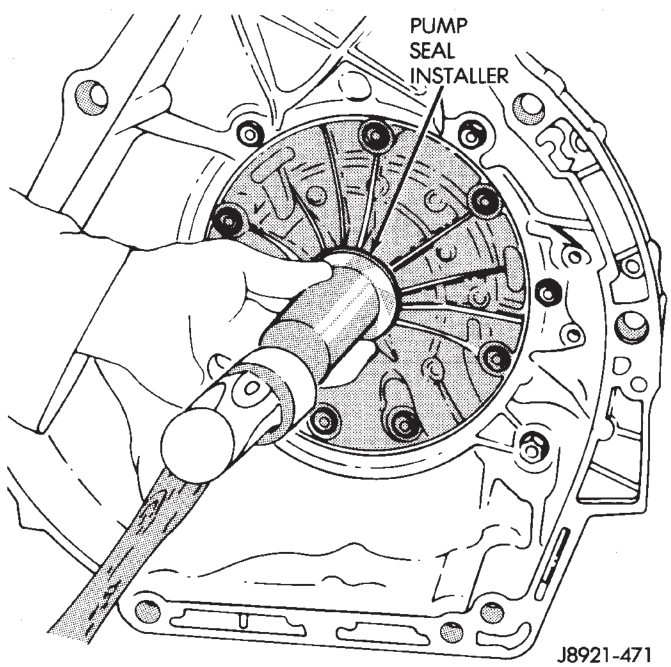


Fig. 82 Installing Oil Pump Seal

(2) Lubricate converter drive hub with transmission fluid.

(3) Align and install converter n oil pump.

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

DISASSEMBLY

(1) Remove torque converter.

(2) Remove clamps attaching wire harness and throttle cable (Fig. 83) to transmission.

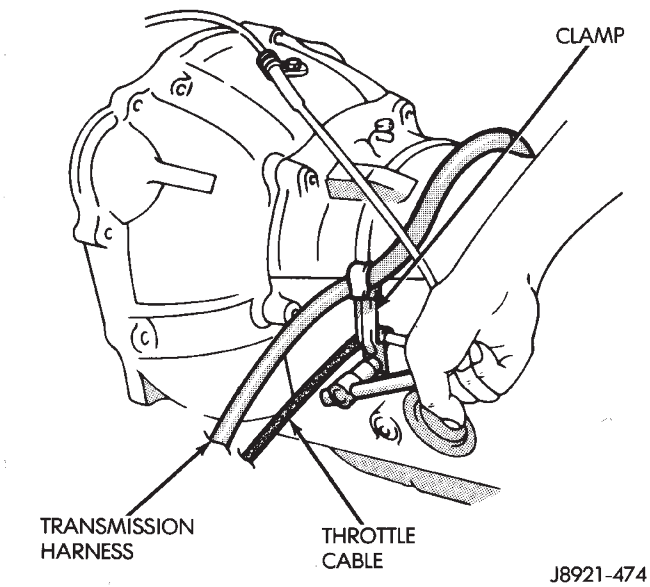


Fig. 83 Typical Harness And Cable Clamp Attachment

(3) Remove shift lever from manual valve shaft at left side of transmission.

(4) Remove park/neutral position switch.

(5) Remove speed sensor.

(6) Remove converter housing bolts and remove housing (Fig. 84) from case.

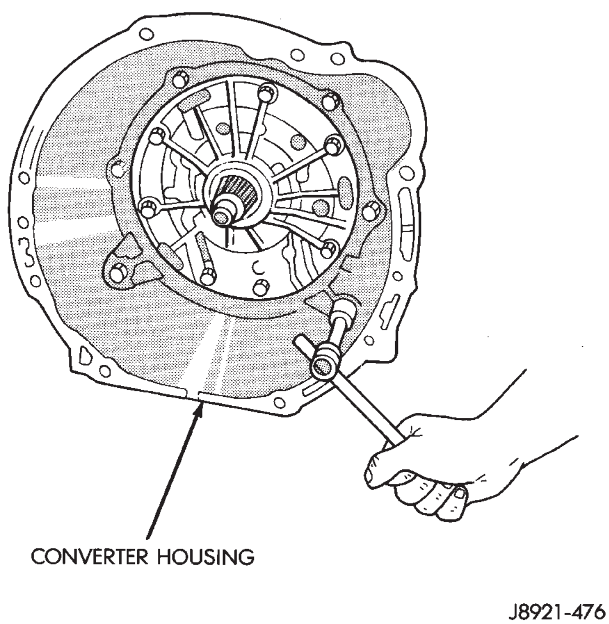


Fig. 84 Converter Housing Removal

(7) Remove adapter housing, speedometer drive gear, and speed sensor rotor.

(8) Remove transmission oil pan, oil screen and screen gaskets (Fig. 85).

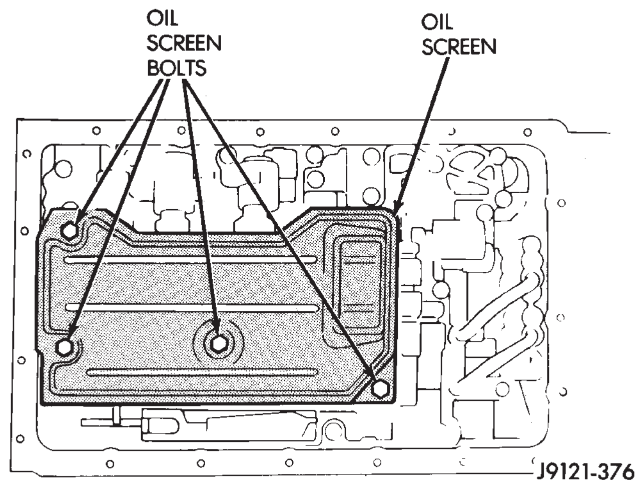


Fig. 85 Removing Oil Screen

(9) Remove valve body oil feed tubes (Fig. 86).

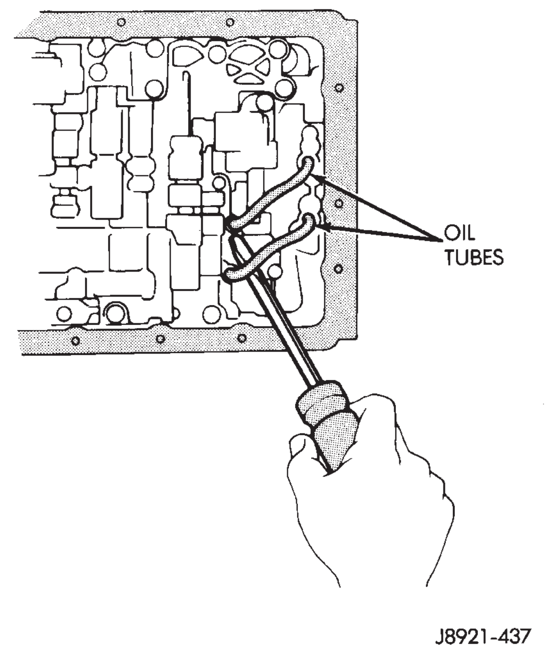


Fig. 86 Valve Body Oil Tube Removal

(10) Disconnect valve body solenoid wires (Fig. 87).

(11) Remove harness bracket bolt and remove harness and bracket (Fig. 88).

DISASSEMBLY AND ASSEMBLY (Continued)

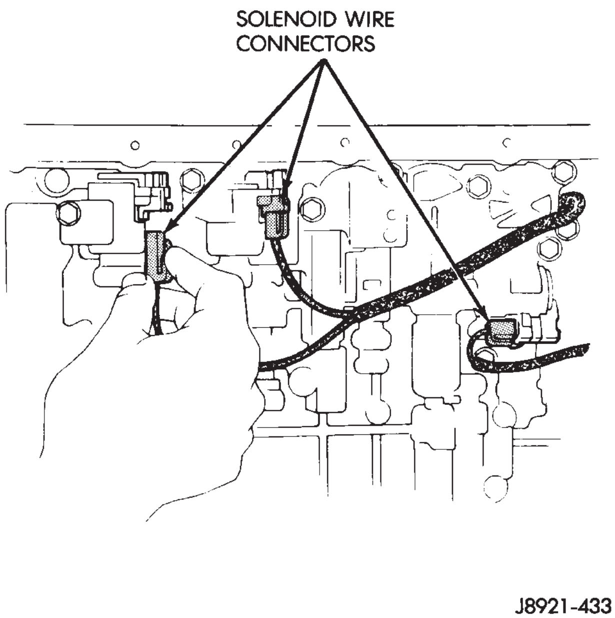


Fig. 87 Solenoid Wire Location

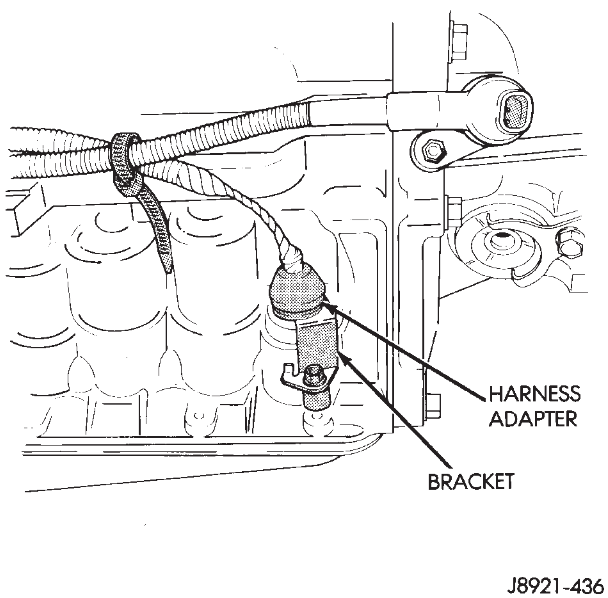


Fig. 88 Removing Bracket And Harness

(12) Remove valve body bolts (Fig. 89).

(13) Disconnect throttle cable from throttle cam (Fig. 90).

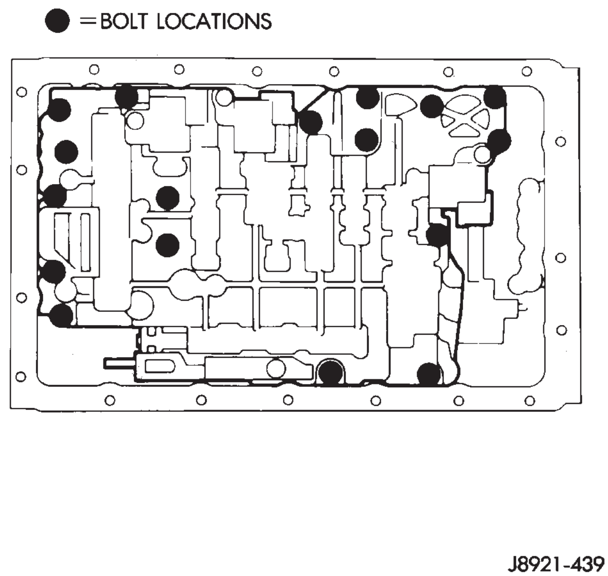


Fig. 89 Valve Body Bolt Locations

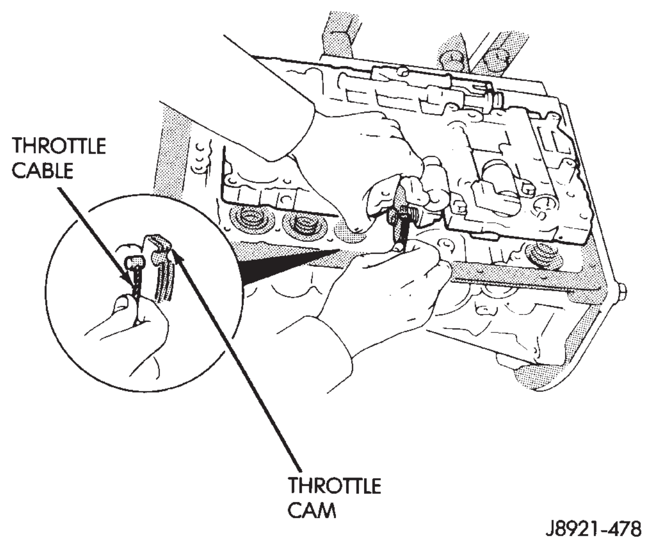


Fig. 90 Disconnecting Throttle Cable

DISASSEMBLY AND ASSEMBLY (Continued)

(14) Remove valve body from case. Then remove accumulator springs, check ball, and spring (Fig. 91).

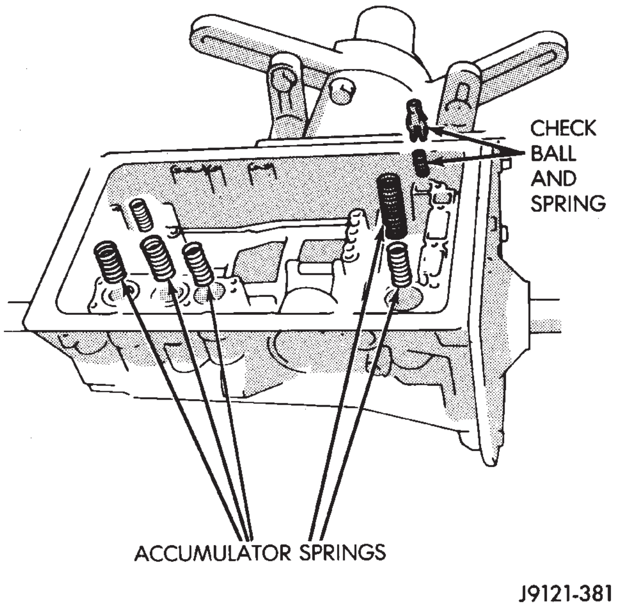


Fig. 91 Removing Accumulator Springs, Spacers And Check Ball

(15) Remove second brake and clutch accumulator pistons with compressed air (Fig. 92). Apply air pressure through feed port and ease the pistons and springs out of the bore. Note and identify the original location of all springs.

(16) Remove overdrive brake accumulator piston with compressed air (Fig. 92). Note and identify the original location of all springs.

(17) Remove overdrive clutch accumulator piston with compressed air (Fig. 92).

(18) Remove throttle cable.

(19) Remove oil pump bolts and remove pump with bridge–type Puller 7536 (Fig. 93).

(20) Remove race from oil pump (Fig. 94).

(21) Remove overdrive planetary gear and clutch assembly (Fig. 95).

(22) Remove race from overdrive planetary (Fig. 96).

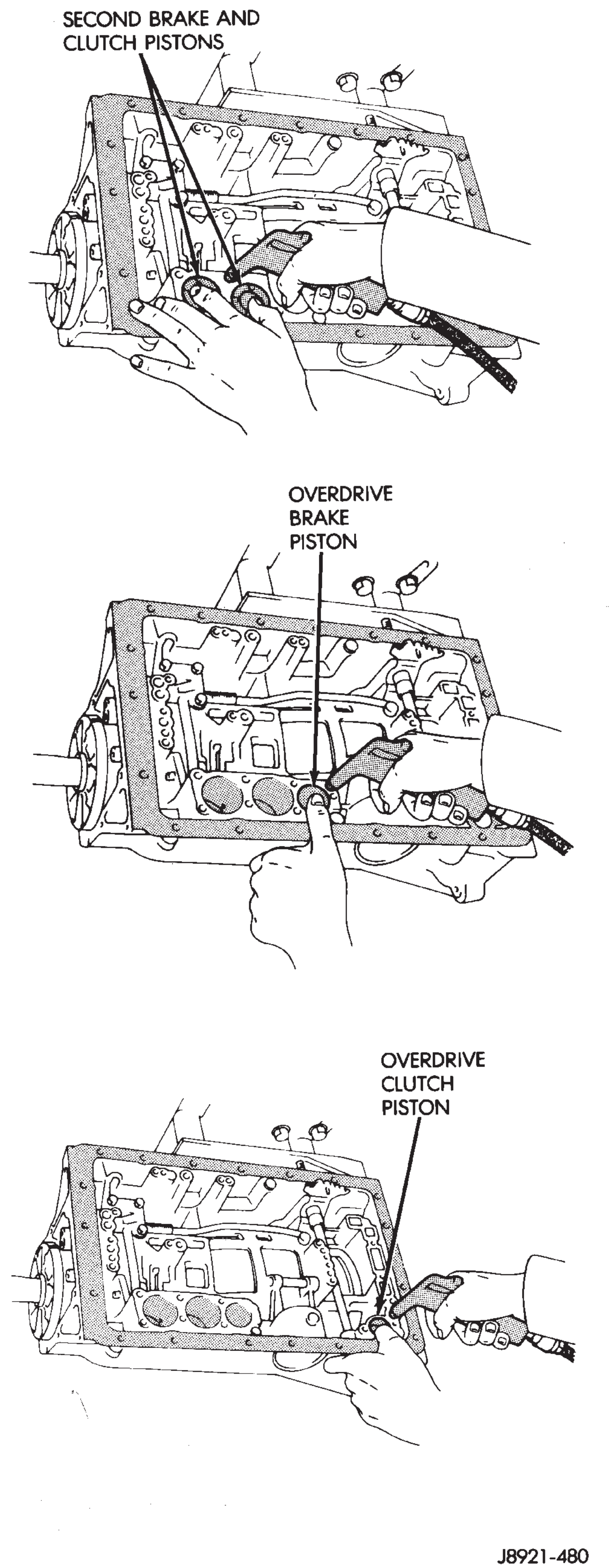


Fig. 92 Accumulator Piston Removal

DISASSEMBLY AND ASSEMBLY (Continued)

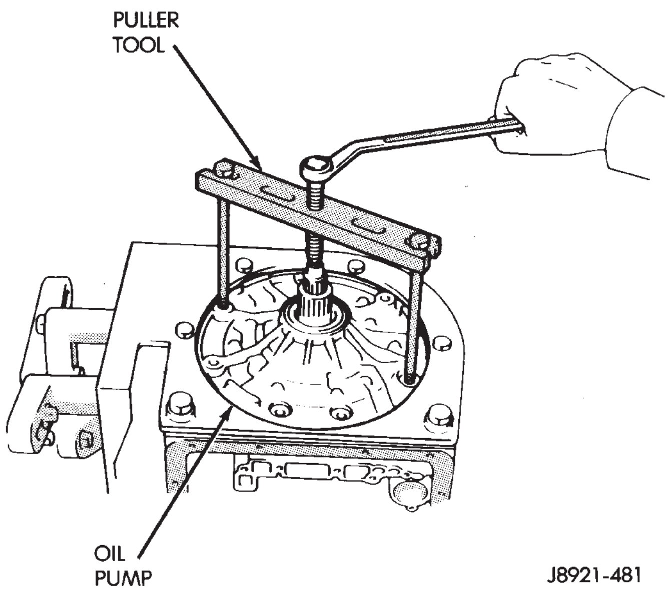


Fig. 93 Oil Pump Removal

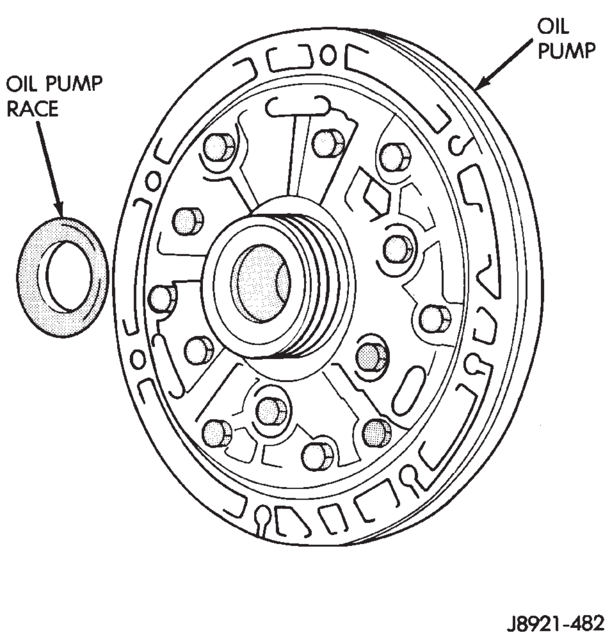


Fig. 94 Oil Pump Race Removal

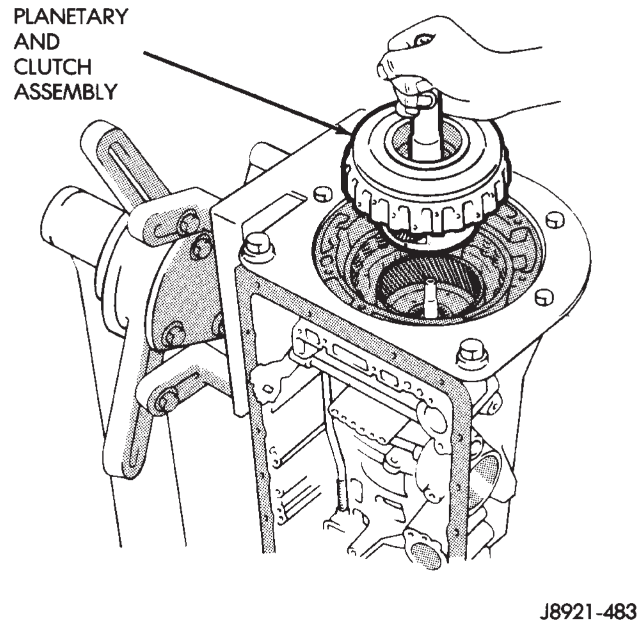


Fig. 95 Removing Overdrive Planetary And Clutch Assembly

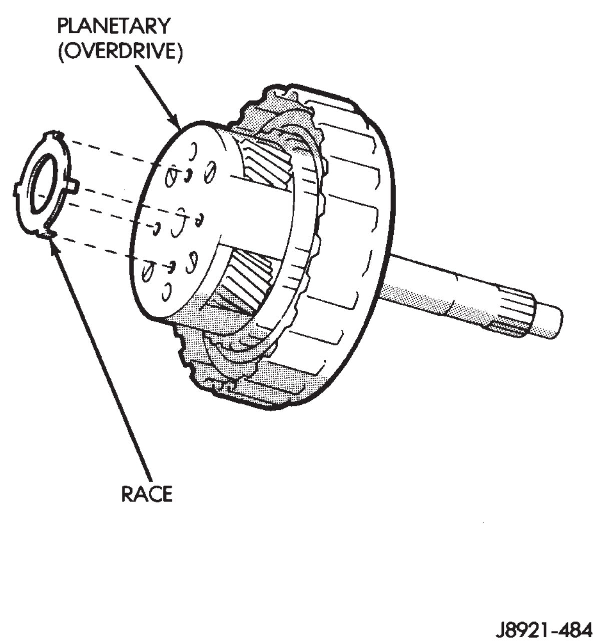


Fig. 96 Fourth Gear Planetary Race Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(23) Remove thrust bearing, race and overdrive planetary ring gear (Fig. 97).

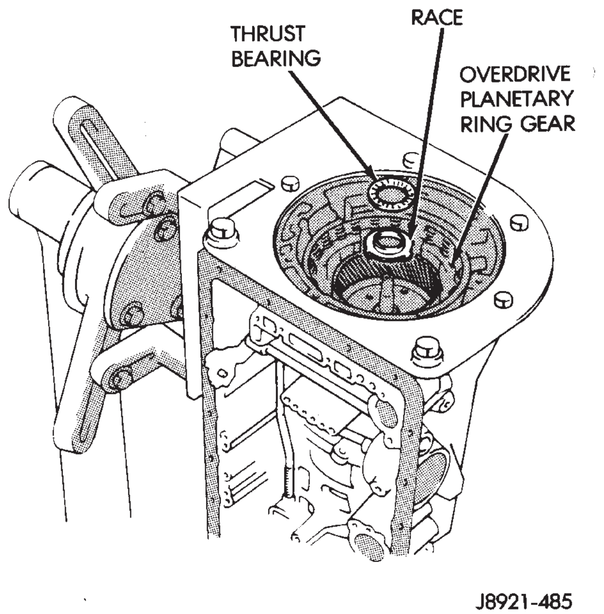


Fig. 97 Removing Bearing, Race And Planetary Ring Gear

(24) Measure stroke length of overdrive brake piston as follows:

(a) Mount dial indicator on case using Miller Tool C-3339 and a suitable bolt threaded into the transmission case.

(b) Verify that the dial indicator is mounted solidly and square to the direction of the piston travel.

(c) Apply 57–114 psi air pressure through piston apply port and note piston stroke on dial indicator. Stroke length should be: 1.40 – 1.70 mm (0.055 – 0.0699 in.).

(d) Record the reading for use during re-assembly.

(e) Remove the dial indicator set-up from the transmission.

(25) Measure stroke length of second coast brake piston rod as follows:

(a) Install a small wire tie strap around the second coast brake piston rod tight against the transmission case.

(b) Apply 57–114 psi air pressure through piston feed hole and check stroke length with Gauge Tool 7552.

(c) Stroke length should be 1.5 – 3.0 mm (0.059 – 0.118 in.).

(d) Record the reading for use during re-assembly.

(26) Remove the bolt holding the input speed sensor to the transmission case.

(27) Remove the input speed sensor from the transmission case.

(28) Remove overdrive brake pack snap ring (Fig. 98).

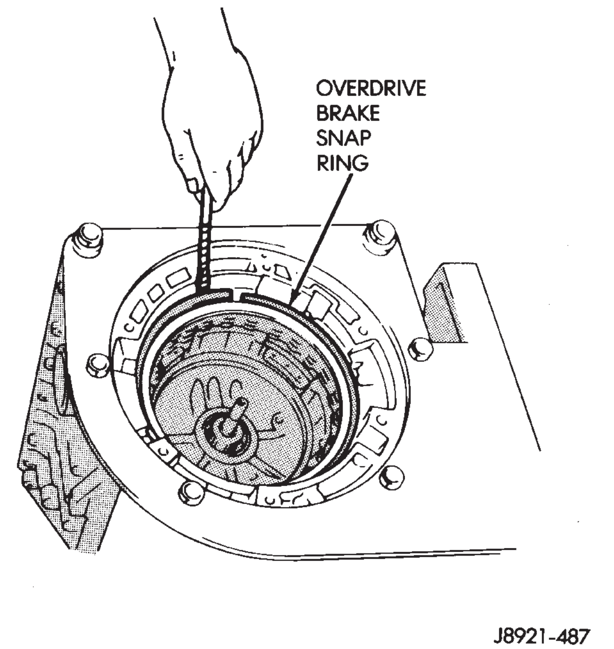


Fig. 98 Removing Overdrive Brake Pack Snap Ring

(29) Remove overdrive brake pack discs and plates. Inspect and replace as necessary.

(30) Remove overdrive support lower race and upper bearing and race assembly (Fig. 99).

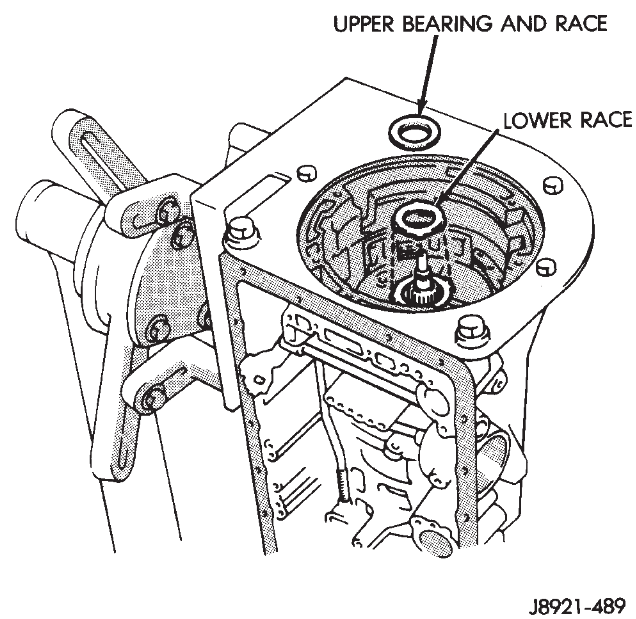


Fig. 99 Overdrive Support Bearing/Race Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(31) Remove overdrive support snap ring with Snap Ring Plier Tool 7540 (Fig. 100).

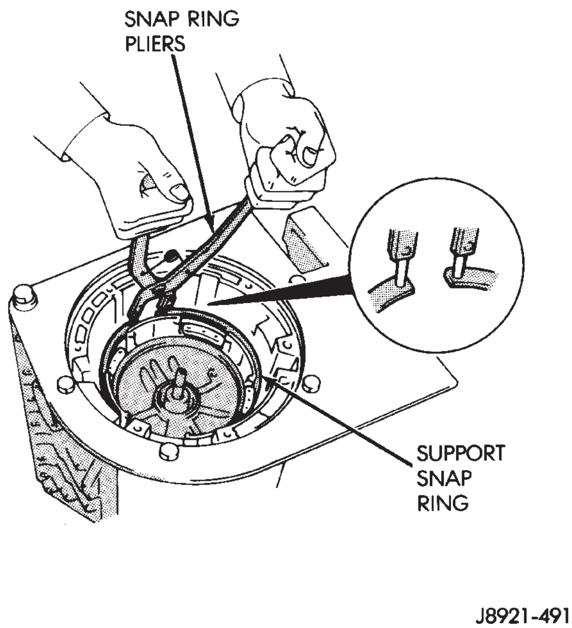


Fig. 100 Overdrive Support Snap Ring Removal/ Installation

(32) Remove overdrive support bolts (Fig. 101).

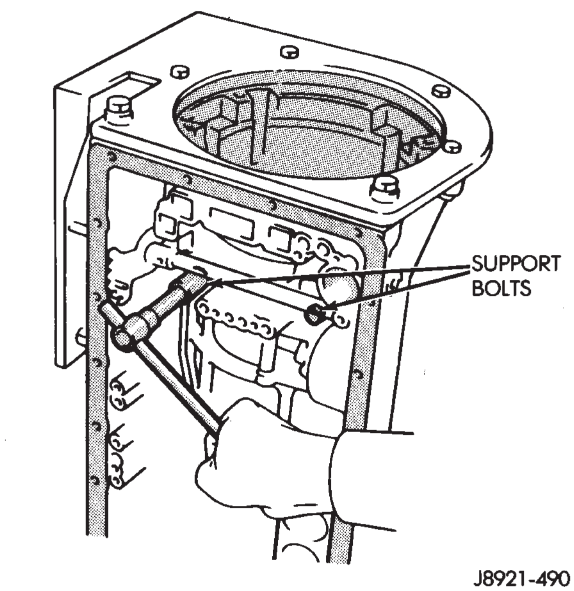


Fig. 101 Overdrive Support Bolt Removal

(33) Remove overdrive support (Fig. 102) with bridge–type Puller 7536.

(34) Remove race from hub of overdrive support (Fig. 103).

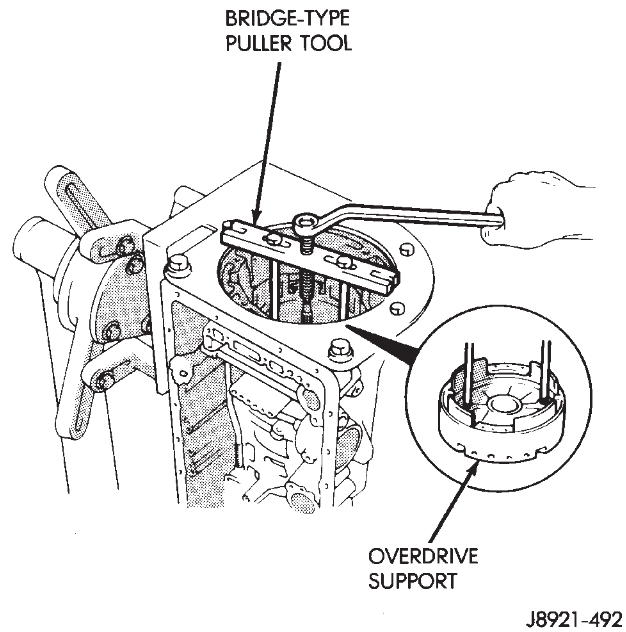


Fig. 102 Removing Overdrive Support

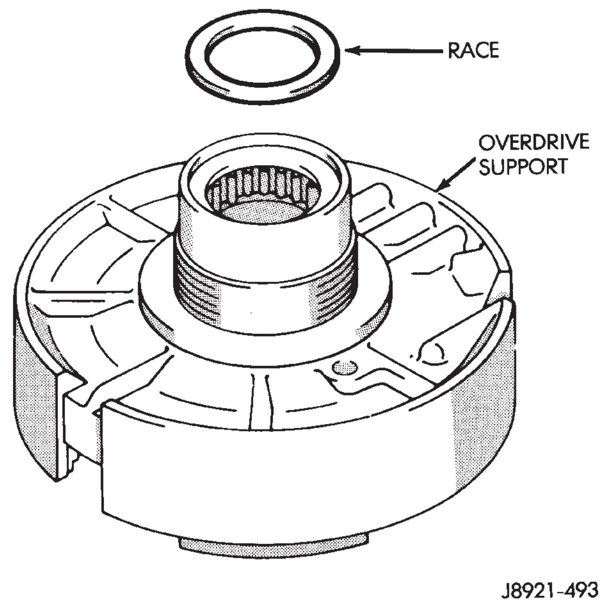


Fig. 103 Remove Overdrive Support Race

(35) Remove second coast brake piston snap ring with Snap Ring Plier Tool 7540. Then remove piston cover and piston assembly.

(36) Disassemble second coast brake piston (Fig. 104), if necessary.

DISASSEMBLY AND ASSEMBLY (Continued)

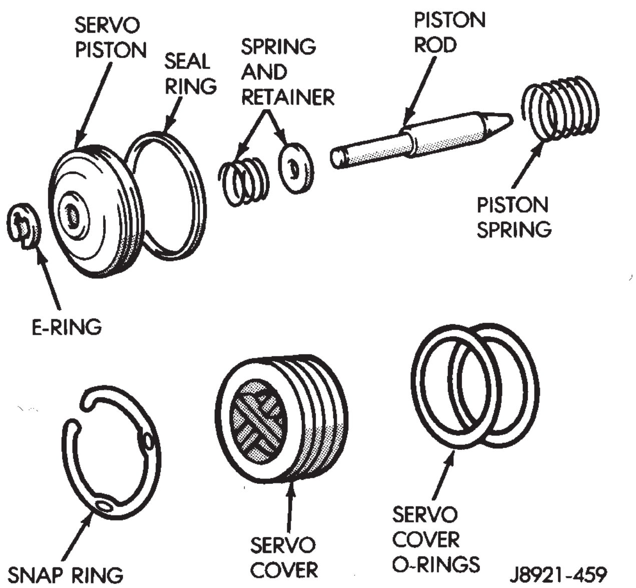


Fig. 104 Second Coast Brake Piston Components

(37) Remove direct and forward clutch assembly (Fig. 105).

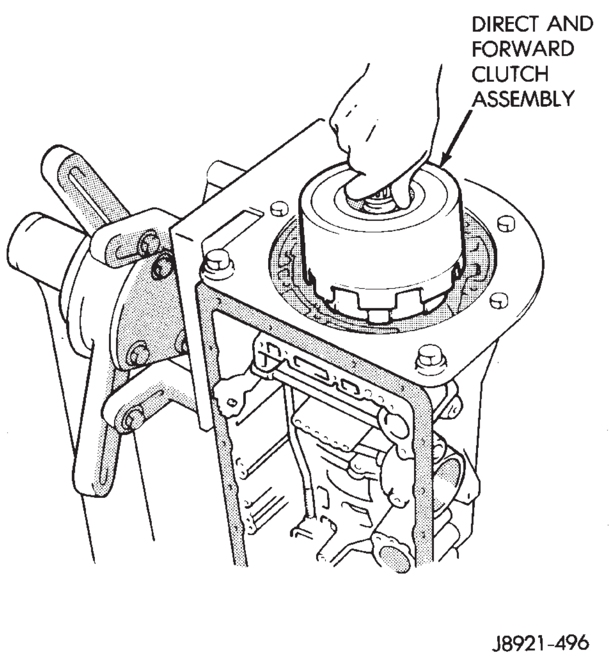


Fig. 105 Removing Direct And Forward Clutch Assembly

(38) Remove thrust bearing and race from clutch hub (Fig. 106).

(39) Remove second coast brake band E–ring from band pin and remove pin and brake band (Fig. 107).

(40) Remove front planetary bearing race and remove front planetary ring gear (Fig. 108).

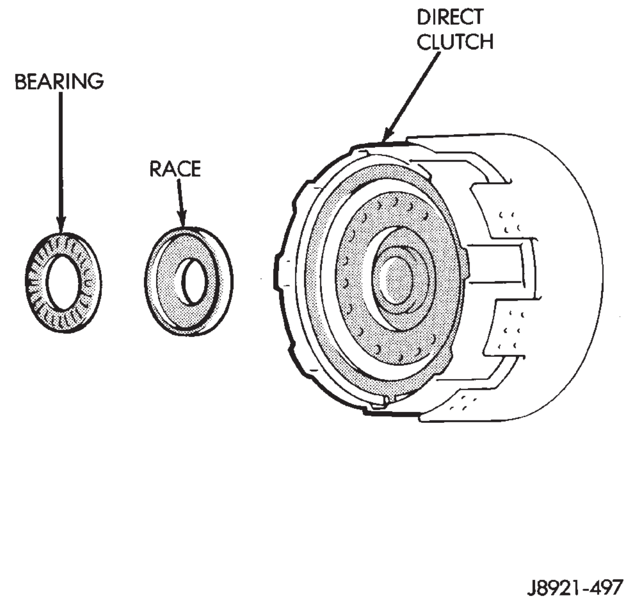


Fig. 106 Bearing And Race Removal From Clutch Hub

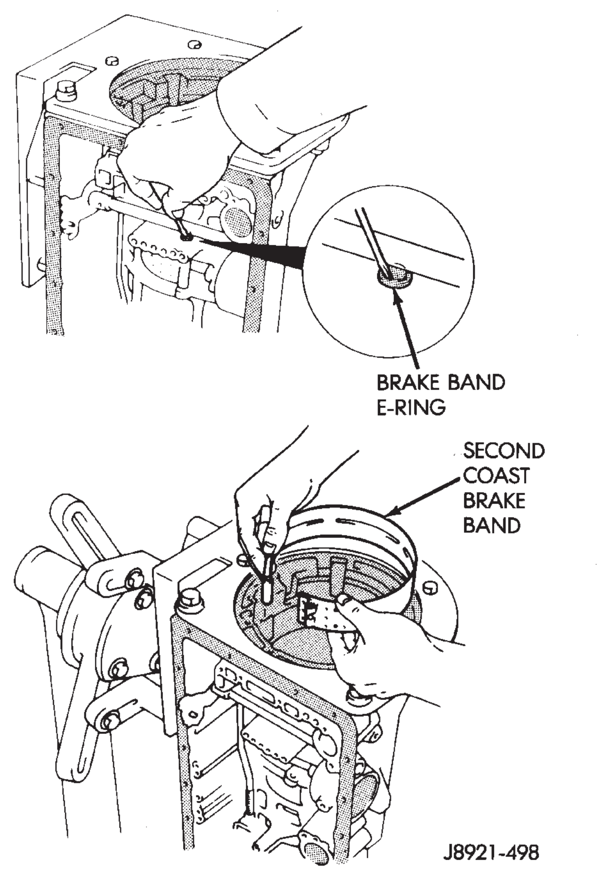


Fig. 107 Second Coast Brake Band Removal

DISASSEMBLY AND ASSEMBLY (Continued)

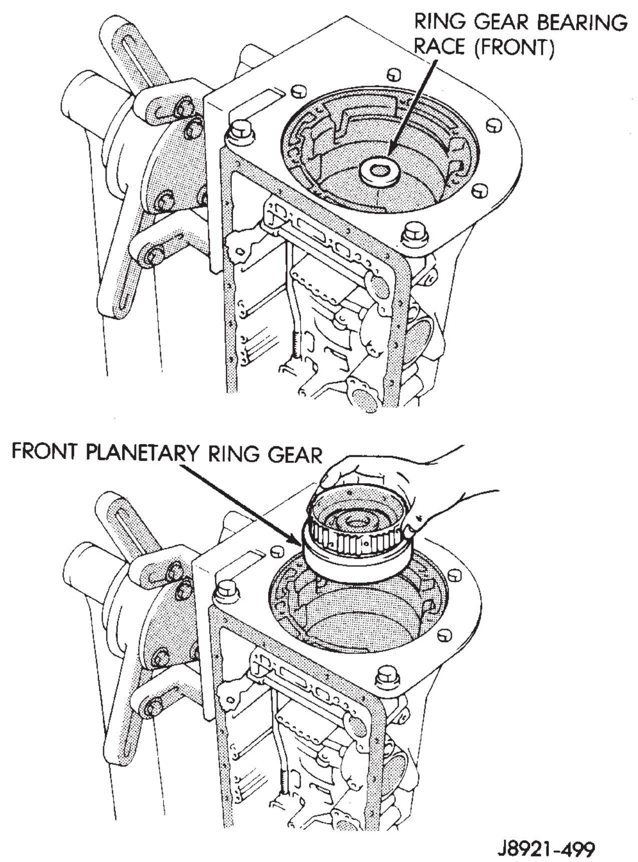


Fig. 108 Front Planetary Ring Gear Removal

(41) Remove thrust bearing and rear race from ring gear (Fig. 109).

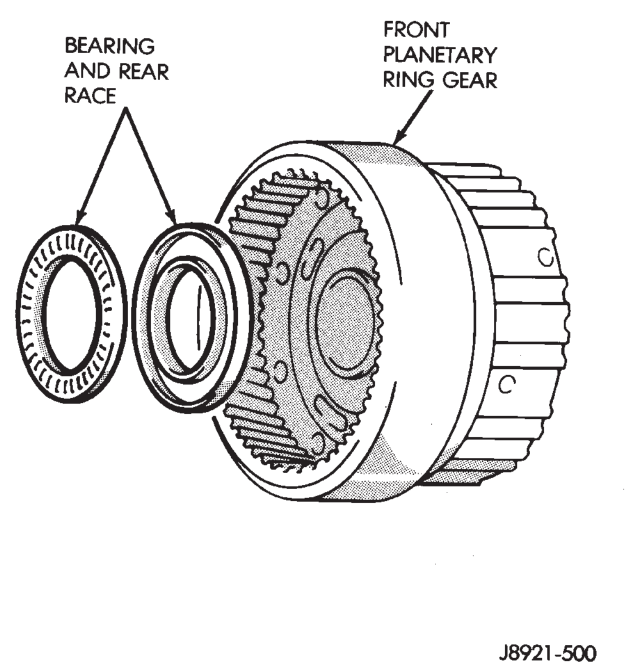


Fig. 109 Removing Ring Gear Bearing And Rear Race

(42) Remove planetary thrust race.

(43) Push forward on output shaft to relieve the load on the planetary snap ring.

(44) Remove planetary snap ring and remove planetary gear (Fig. 110).

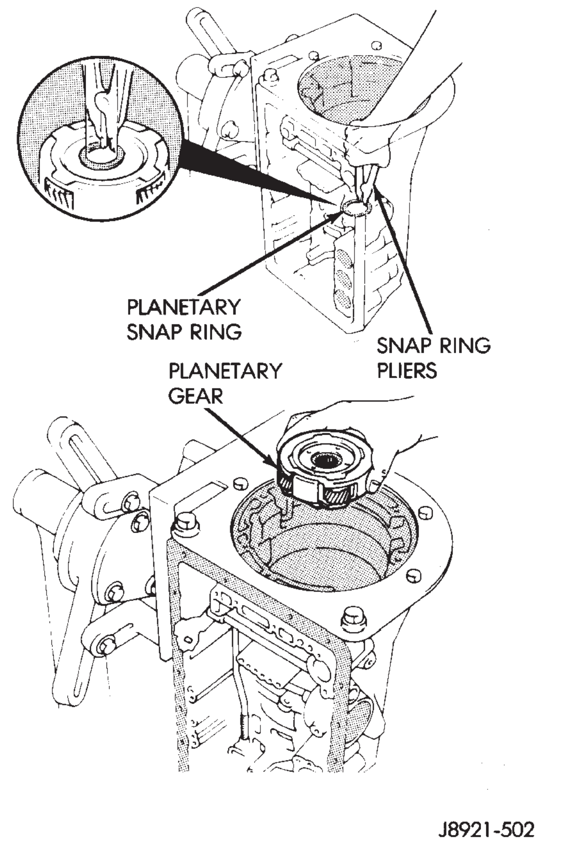


Fig. 110 Removing Planetary Snap Ring And Gear

(45) Remove sun gear, input drum, one–way clutch, and thrust washer as assembly (Fig. 111).

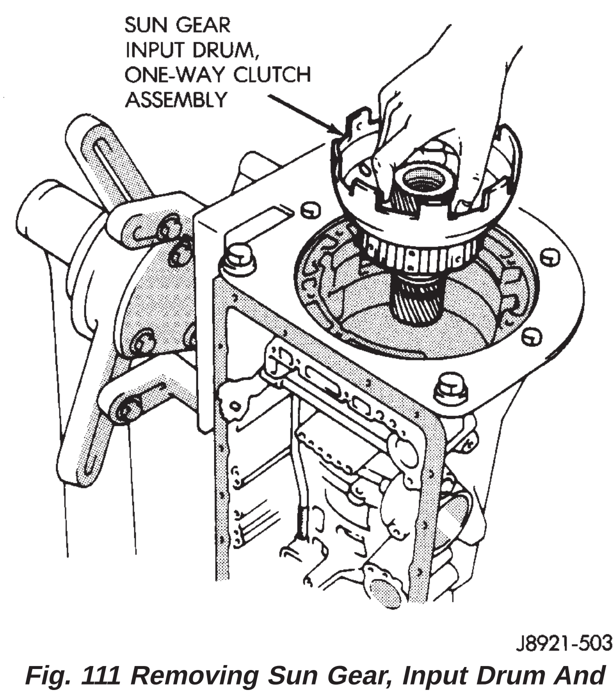


Fig. 111 Removing Sun Gear, Input Drum And One–Way Clutch

DISASSEMBLY AND ASSEMBLY (Continued)

(46) Measure second brake clutch pack clearance (Fig. 112). Clearance should be 0.62 – 1.98 mm (0.0244 – 0.0780 in.). Record measurement for use during re-assembly.

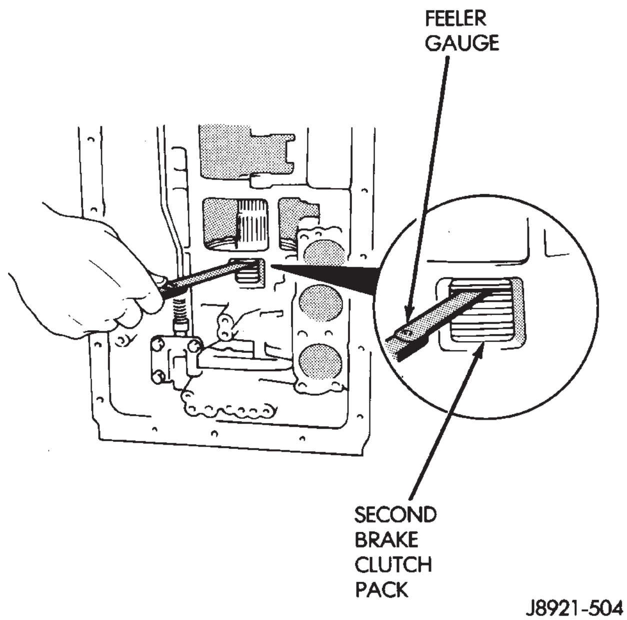


Fig. 112 Checking Second Brake Clutch Pack Clearance

(47) Remove second brake clutch pack snap ring (Fig. 113).

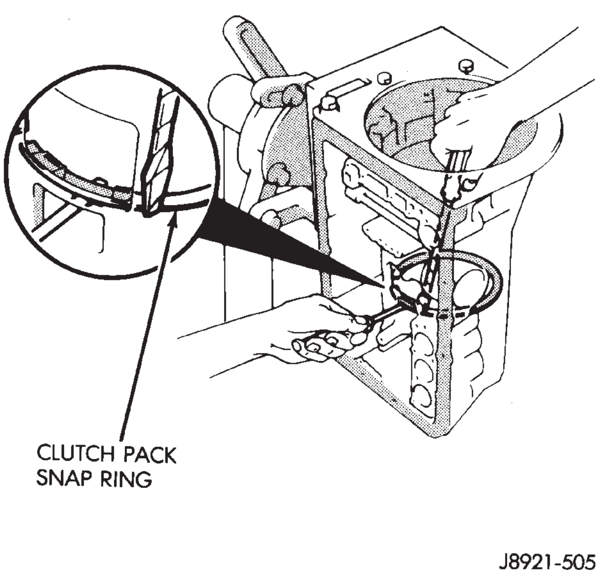


Fig. 113 Removing Second Brake Clutch Pack Snap Ring

(48) Remove second brake clutch pack (Fig. 114). Inspect and replace as necessary.

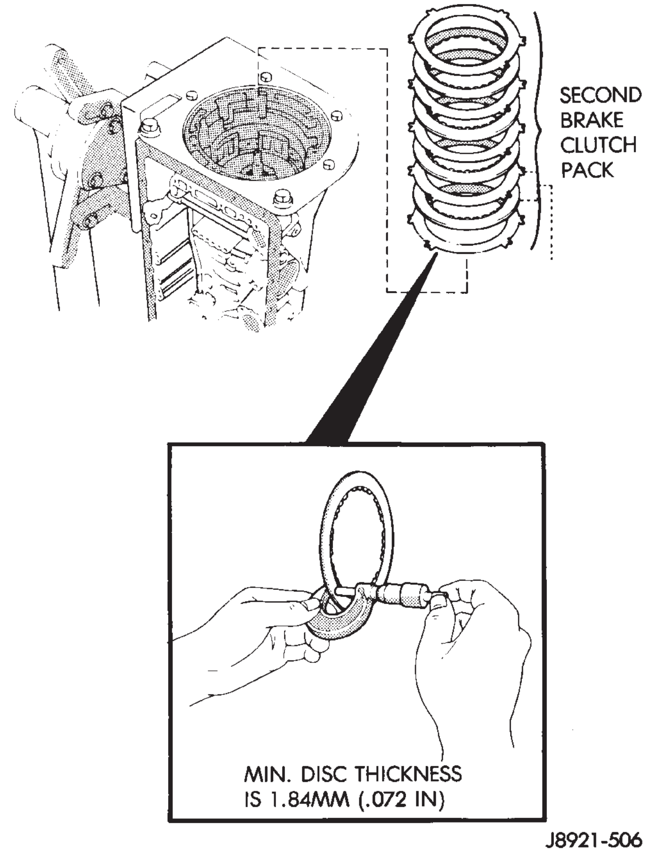


Fig. 114 Removing/Measuring Second Brake Clutch Disc Thickness

(49) Remove bolts attaching park rod bracket to case. Then disconnect park rod from manual shaft lever and remove rod and bracket (Fig. 115).

(50) Remove park pawl spring, pin and pawl (Fig. 116).

(51) Measure clearance of first–reverse brake clutch pack (Fig. 117). Clearance should be: 0.70 – 1.2 mm (0.028 – 0.047 in.). record measurement for use during re-assembly.

(52) Remove second brake piston sleeve (Fig. 118).

(53) Remove second brake snap-ring.

(54) Remove rear planetary gear, second brake drum and output shaft as an assembly (Fig. 119).

(55) Remove planetary and brake drum thrust bearing and race assembly (Fig. 120).

DISASSEMBLY AND ASSEMBLY (Continued)

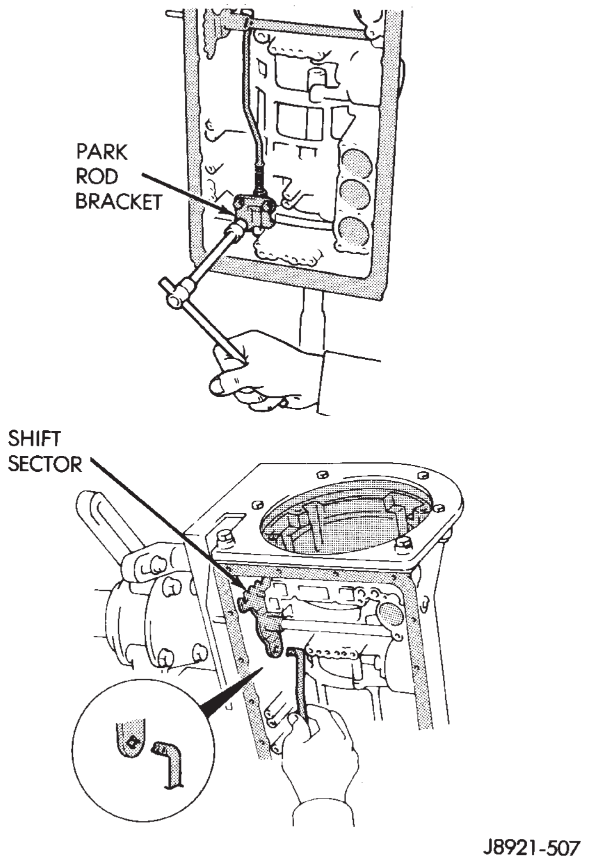


Fig. 115 Removing Park Rod And Bracket

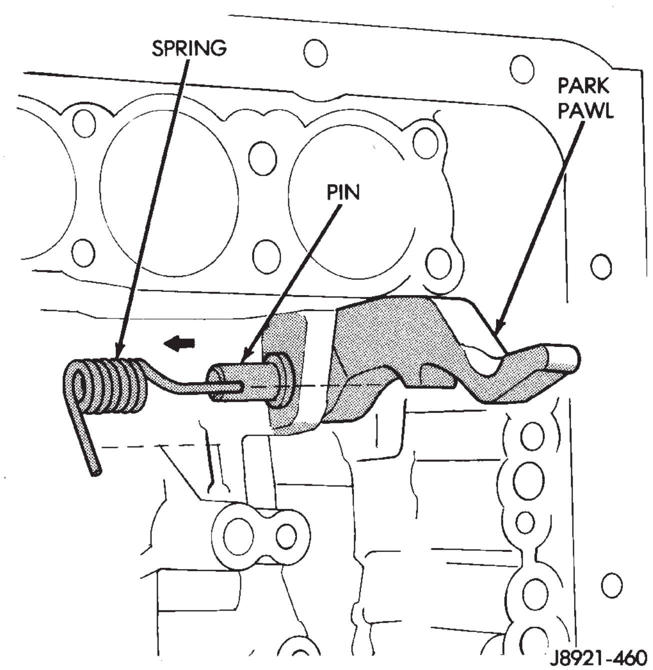


Fig. 116 Removing Park Pawl, Pin And Spring

(56) Remove second brake drum gasket from case with screwdriver.

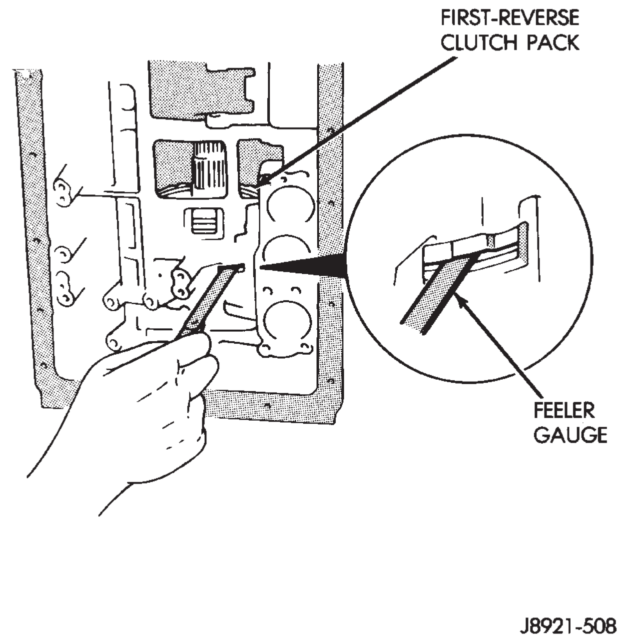


Fig. 117 Checking First–Reverse Brake Clutch Pack Clearance

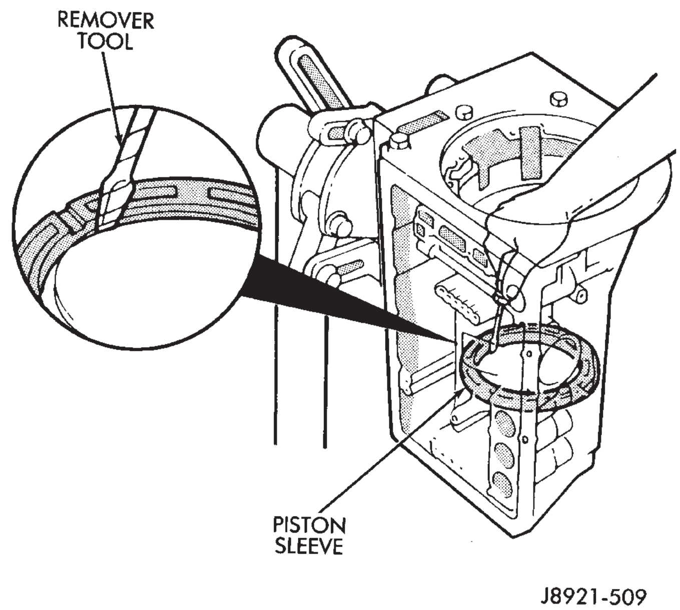


Fig. 118 Removing Second Brake Piston Sleeve

(57) Measure inside diameter of transmission case rear bushing with bore gauge or inside micrometer (Fig. 121). Maximum allowable diameter is 38.18 mm (1.5031 in.). **Replace transmission case if bushing I.D. is greater than specified. Bushing is not serviceable.**

DISASSEMBLY AND ASSEMBLY (Continued)

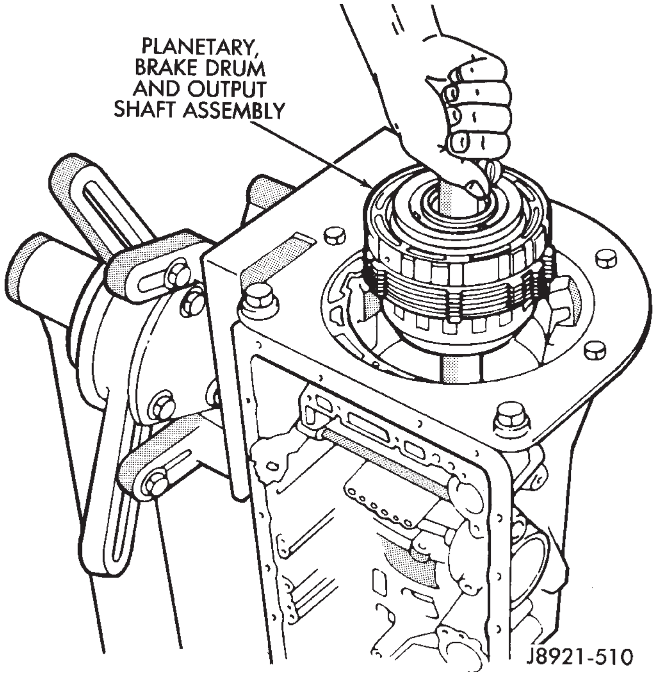


Fig. 119 Removing Rear Planetary, Second Brake Drum And Output Shaft

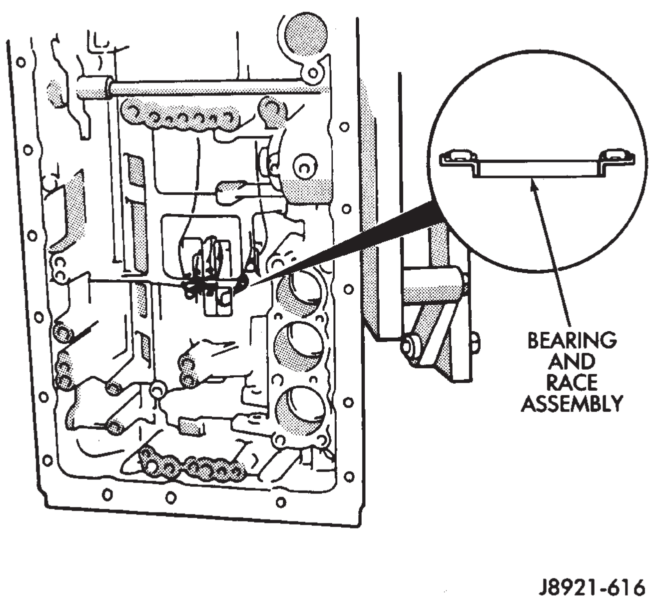


Fig. 120 Removing/Installing Bearing And Race Assembly

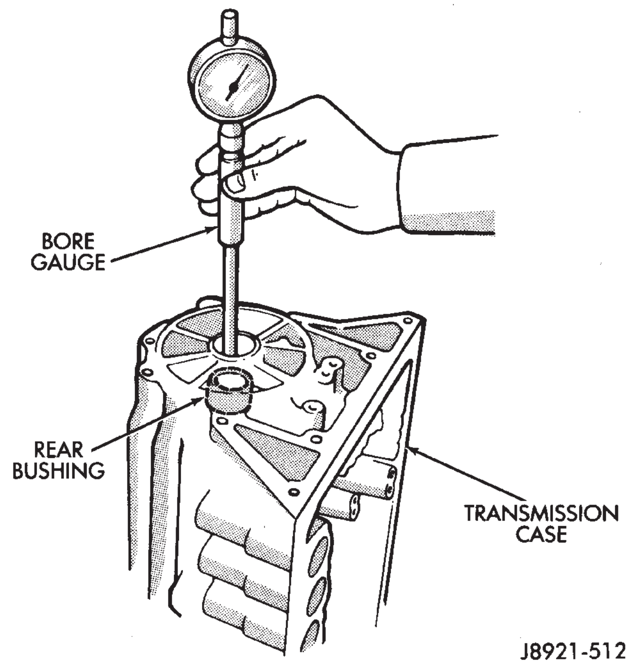


Fig. 121 Checking Rear Bushing Inside Diameter

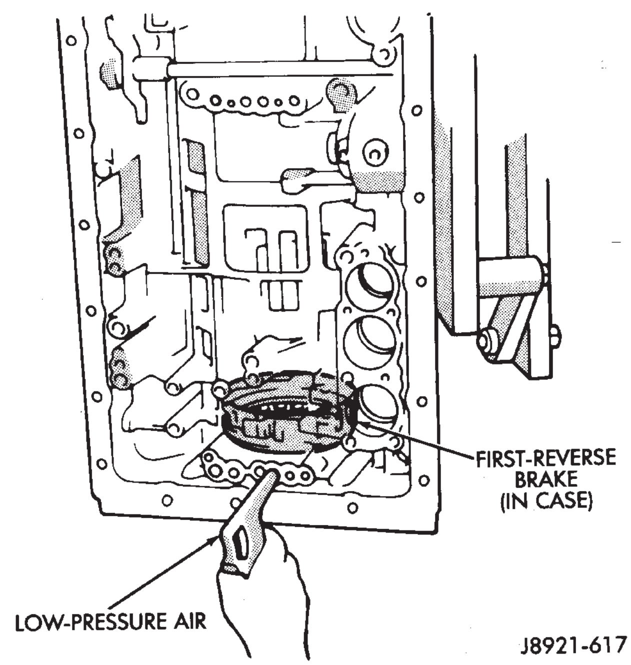


Fig. 122 Checking First–Reverse Brake Piston Operation

(58) Check first/reverse brake piston operation with compressed air (Fig. 122). Piston should move smoothly and not bind or stick. If piston operation is incorrect, case or piston may require replacement.

DISASSEMBLY AND ASSEMBLY (Continued)

(59) Compress piston return springs with Tool 7539 and remove piston snap ring (Fig. 123).

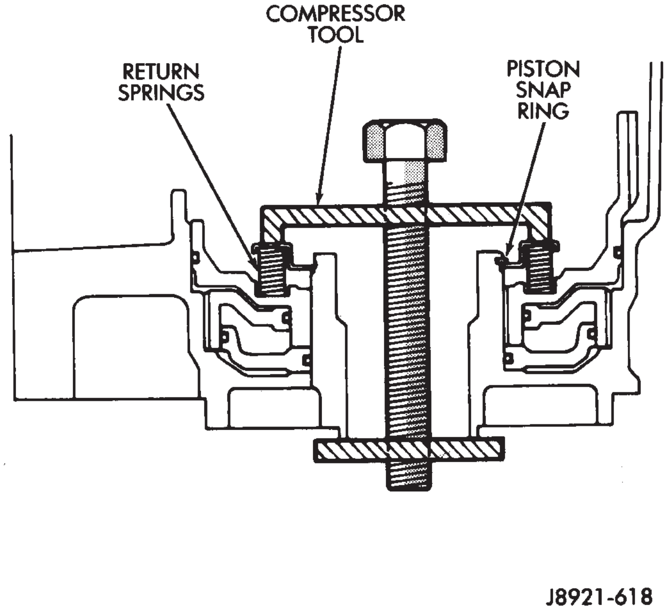


Fig. 123 Removing/Installing Piston Snap Ring

(60) Remove Tool 7539 and remove piston return springs.

(61) Remove No. 2 first–reverse brake piston with compressed air. Apply air through same transmission feed hole used for checking piston operation.

(62) Remove reaction sleeve with Sleeve Remover Tool 7542 (Fig. 124). Insert tool flanges under sleeve and lift tool and sleeve out of case.

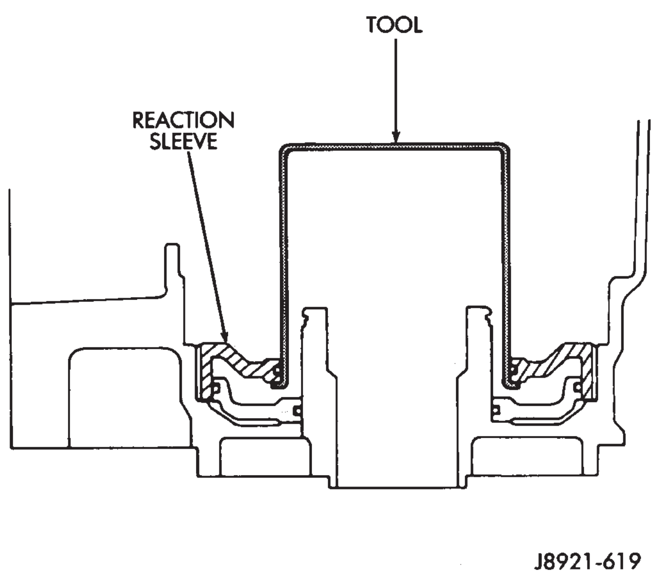


Fig. 124 Removing/Installing Reaction Sleeve

(63) Remove No. 1 first/reverse brake piston with Piston Puller 7543 (Fig. 125). Slip tool under piston and lift tool and piston out of case.

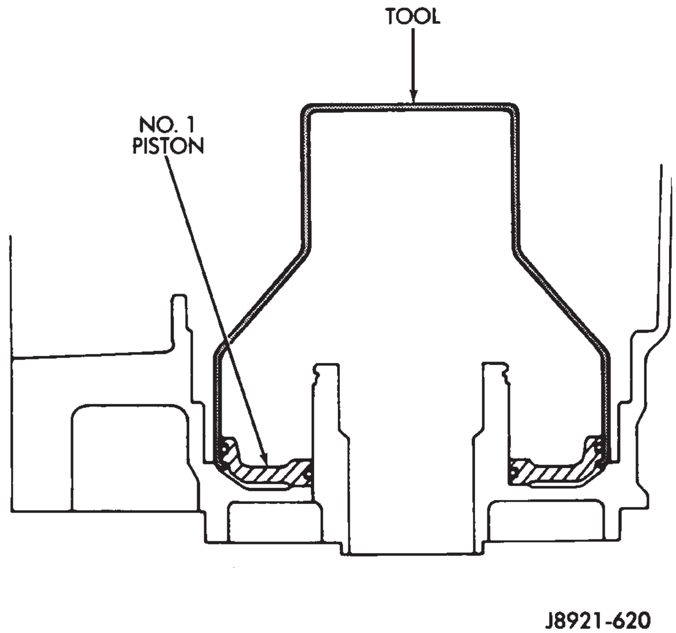


Fig. 125 Removing/Installing First–Reverse Brake No.1 Piston

ASSEMBLY

(1) During assembly, lubricate components with transmission fluid or petroleum jelly as indicated.

(2) Verify thrust bearing and race installation during assembly. Refer to the Thrust Bearing Chart (Fig. 126) for bearing and race location and correct positioning.

(3) Install new seals onto the No.1 first-reverse brake piston. Lubricate seals with transmission fluid.

(4) Install the No.1 first-reverse brake piston into the transmission case.

(5) Install new seal onto the first-reverse brake piston reaction sleeve. Lubricate seals with transmission fluid.

DISASSEMBLY AND ASSEMBLY (Continued)

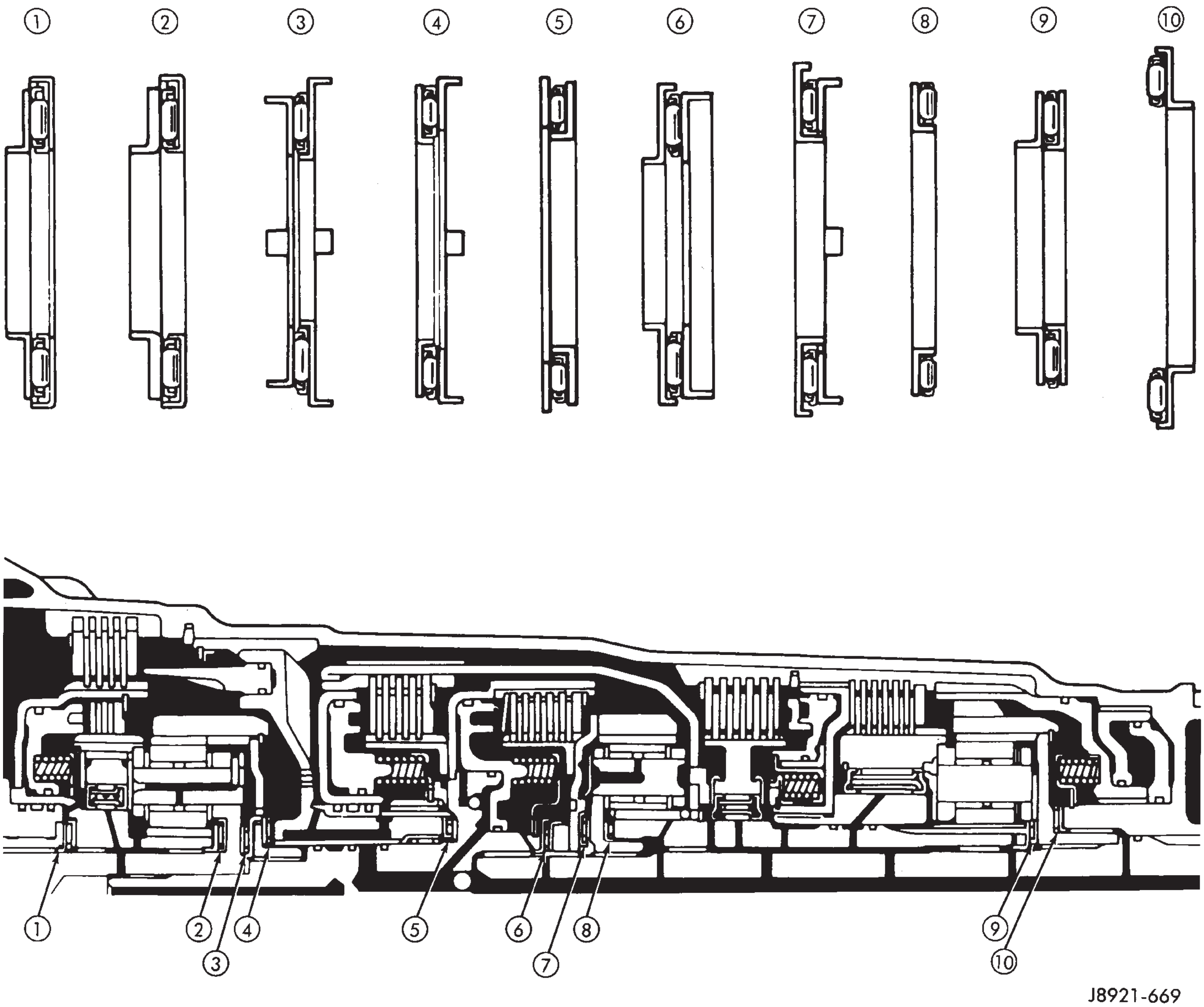


Fig. 126 Thrust Bearing Chart

(6) Install the first-reverse brake piston reaction sleeve into the transmission case.

(7) Install new seal onto the No. 2 first-reverse brake piston. Lubricate seals with transmission fluid.

(8) Install the No. 2 first-reverse brake piston into the transmission case.

(9) Install the spring plate into the No. 2 first-reverse brake piston.

(10) Install Spring Compressor 7539 onto the first-reverse brake piston.

(11) Compress the first-reverse brake piston spring and install the first-reverse brake piston snap-ring.

(12) Remove Spring Compressor 7539.

(13) Install rear planetary gear, second brake drum and output shaft as outlined in following steps:

(14) Verify No. 10 thrust bearing and race (Fig. 126). Bearing and race outer diameter is 57.7 mm (2.272 in.) and inside diameter is 39.2 mm (1.543 in.).

(15) Coat thrust bearing and race assembly with petroleum jelly and install in case (Fig. 127). Race faces down. Bearing rollers face up.

(16) Align teeth of second brake drum and clutch pack (Fig. 128).

(17) Align rear planetary-output shaft assembly teeth with case slots and install assembly in case (Fig. 129).

(18) Install rear planetary snap ring with snap ring pliers. Chamfered side of snap ring faces up and toward case front (Fig. 130).

DISASSEMBLY AND ASSEMBLY (Continued)

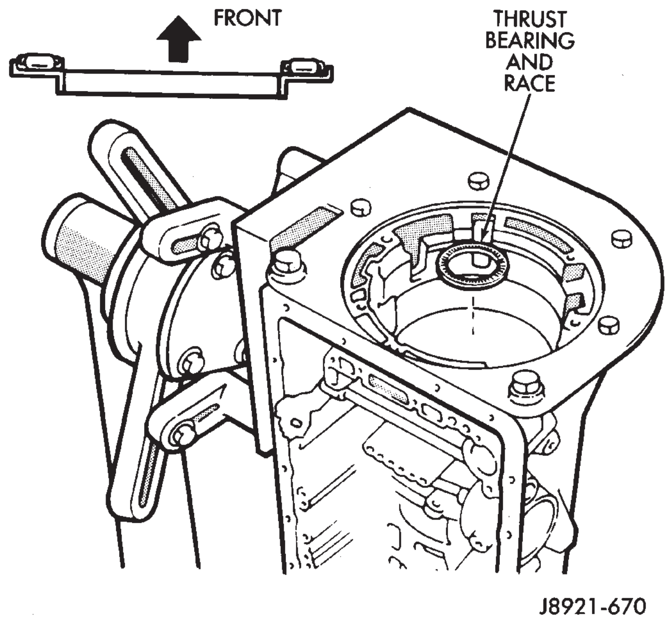


Fig. 127 Installing Thrust Bearing And No. 10 Race

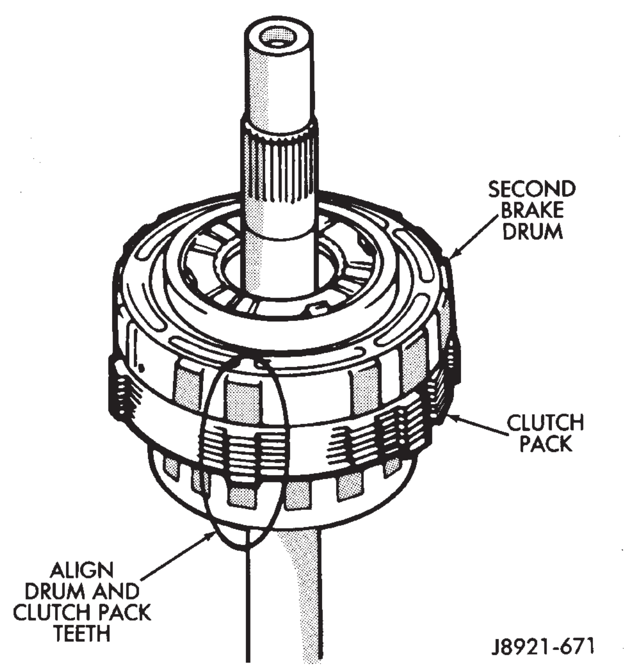


Fig. 128 Aligning Second Brake Drum And Clutch Pack Teeth

(19) Check first–reverse brake pack clearance with feeler gauge (Fig. 131). Clearance should be 0.70 – 1.20 mm (0.028 – 0.047 in.). If clearance is incorrect, planetary assembly, thrust bearing or snap ring is not properly seated in case. Remove and reinstall components if necessary.

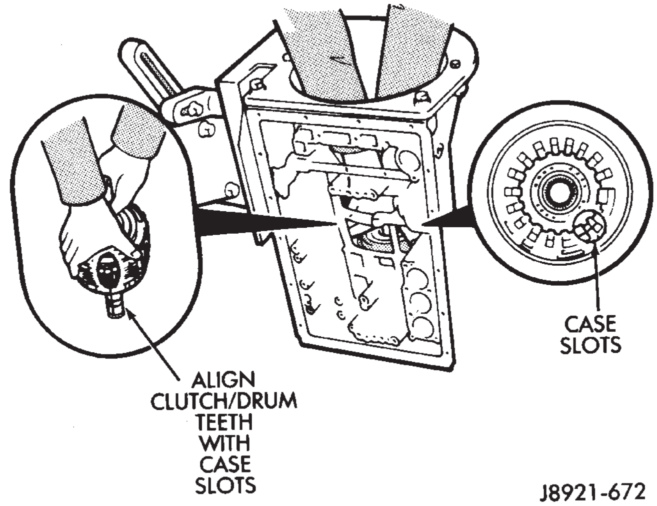


Fig. 129 Output Shaft/Rear Planetary Assembly Installation

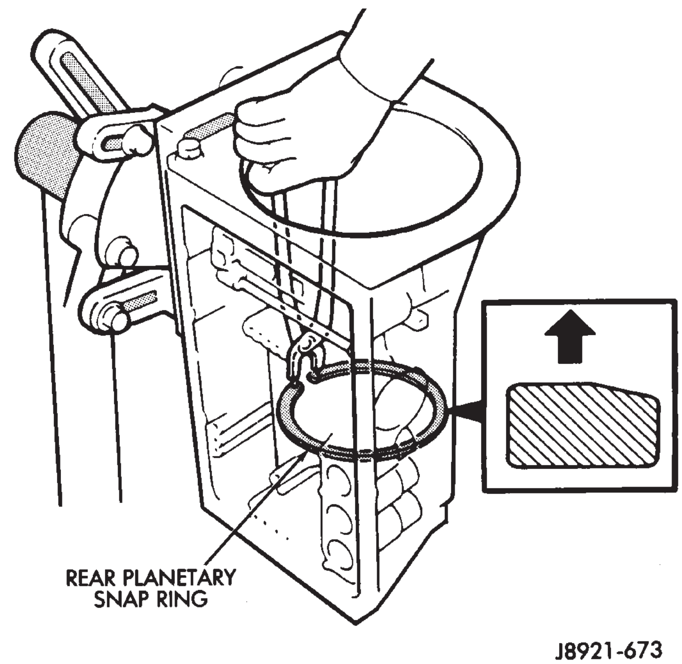


Fig. 130 Planetary Snap Ring Installation

(20) Install second brake piston sleeve (Fig. 132). Sleeve lip faces up and toward case front as shown.

(21) Install second brake drum gasket.

(22) Install park lock pawl, spring and pin (Fig. 133).

(23) Install the manual valve shift assembly.

(24) Connect park lock rod to manual valve shift sector (Fig. 134).

DISASSEMBLY AND ASSEMBLY (Continued)

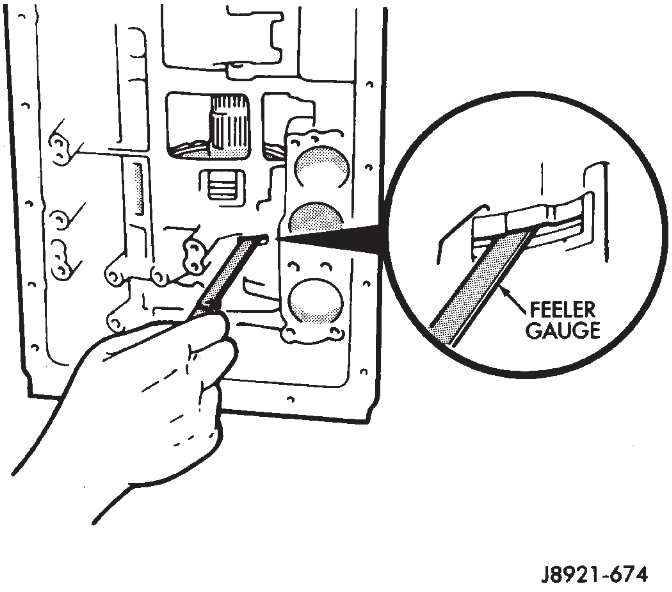


Fig. 131 Checking First–Reverse Brake Pack Clearance

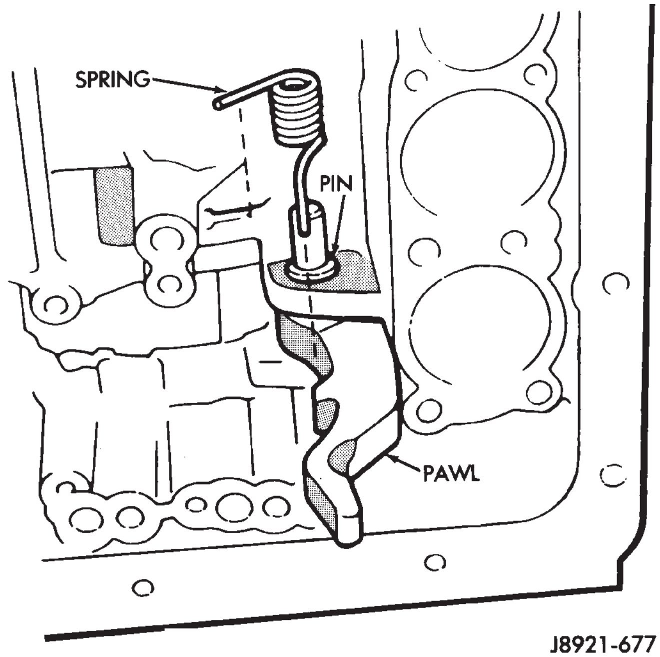


Fig. 133 Park Lock Pin, Spring And Pawl Installation

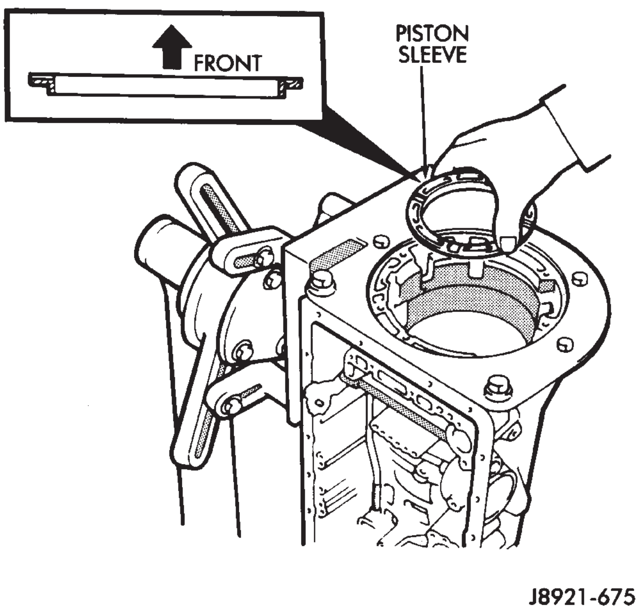


Fig. 132 Second Brake Piston Sleeve Installation

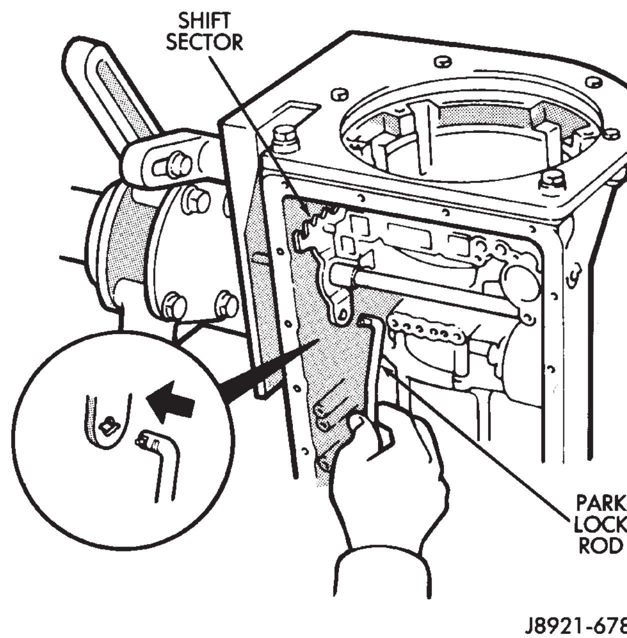


Fig. 134 Park Lock Rod Installation

(25) Position park lock rod bracket on case and tighten bracket attaching bolts to 10 N·m (7 ft. lbs.) torque (Fig. 135).

(26) Verify park lock operation. Move shift sector to Park position. Park pawl should be firmly engaged (locked) in planetary ring gear (Fig. 136).

(27) Install No. 1 one–way clutch (Fig. 137). Short flanged side of clutch faces up and toward case front.

(28) Install second brake pack (Fig. 138). Install disc then plate. Continue installation sequence until five discs and five plates are installed.

DISASSEMBLY AND ASSEMBLY (Continued)

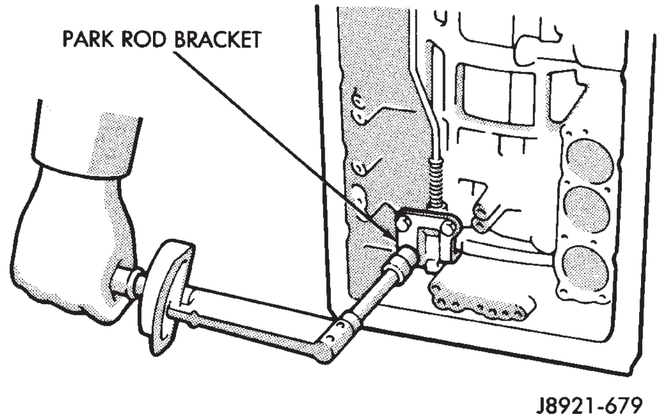


Fig. 135 Park Rod Bracket Installation

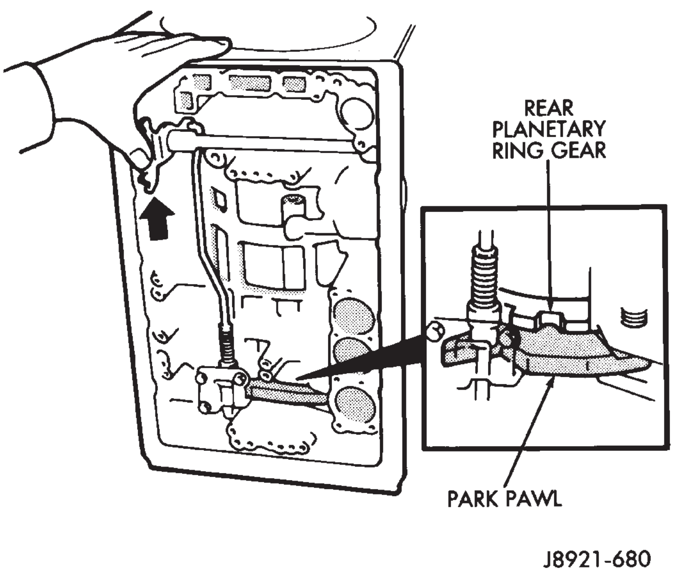


Fig. 136 Checking Park Pawl Engagement

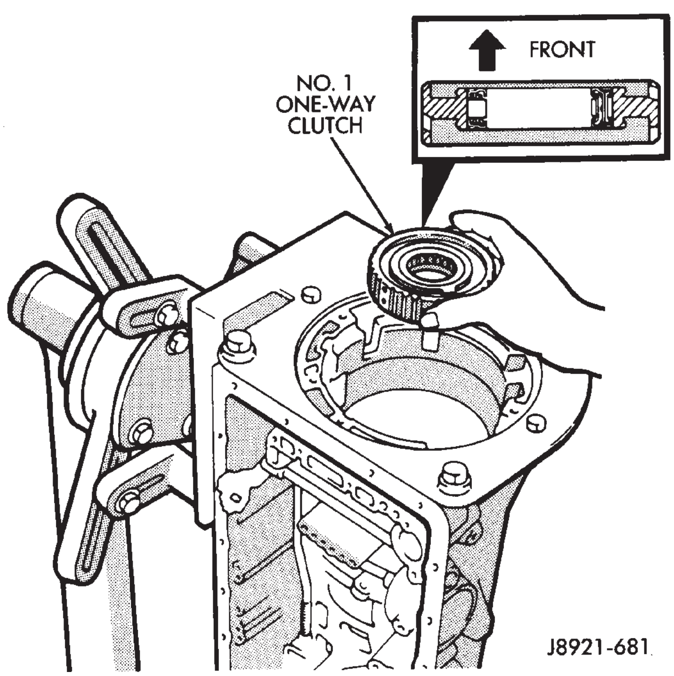


Fig. 137 Installing No. 1 One–Way Clutch

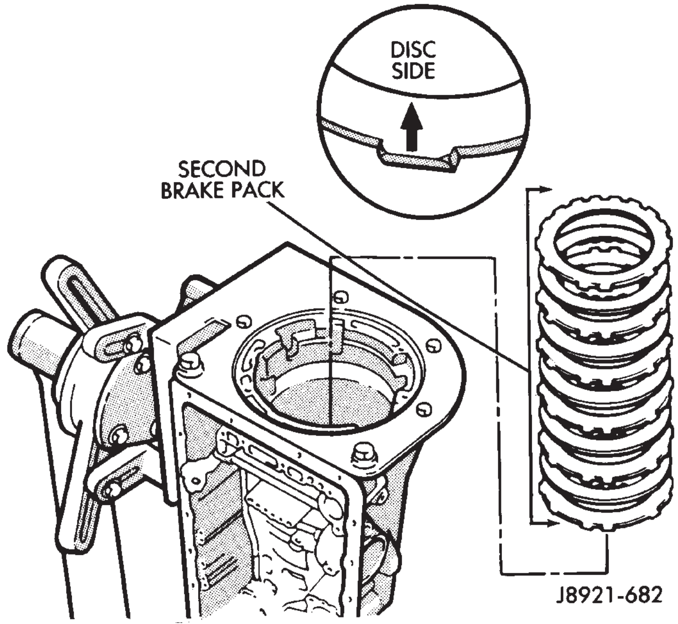


Fig. 138 Second Brake Pack Installation

(29) Install second brake pack retainer with rounded edge of retainer facing disc.

(30) Install second brake pack snap ring.

(31) Check brake pack clearance with feeler gauge (Fig. 139). Clearance should be 0.062 – 1.98 mm (0.024 – 0.078 in.). If brake pack clearance is not correct, brake pack components are not seated. Reassemble brake pack if necessary.

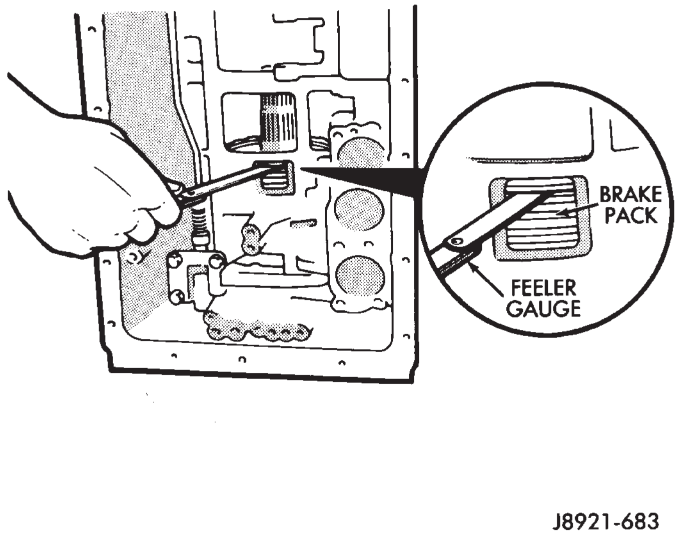


Fig. 139 Checking Second Brake Pack Clearance

(32) Install planetary sun gear and input drum (Fig. 140). Be sure drum thrust washer tabs are seated in drum. Use petroleum jelly to hold thrust washer in position if necessary.

(33) Install front planetary gear on sun gear (Fig. 141).

(34) Support output shaft with wood blocks (Fig. 142).

DISASSEMBLY AND ASSEMBLY (Continued)

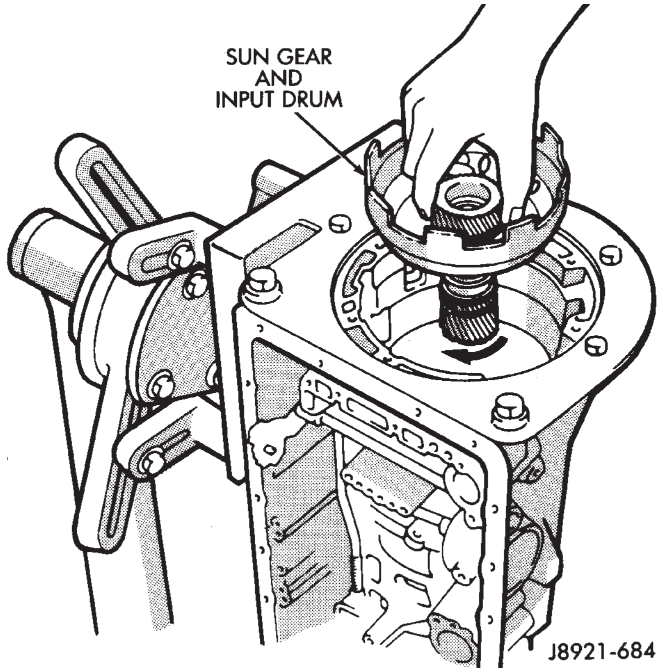


Fig. 140 Installing Sun Gear And Input Drum

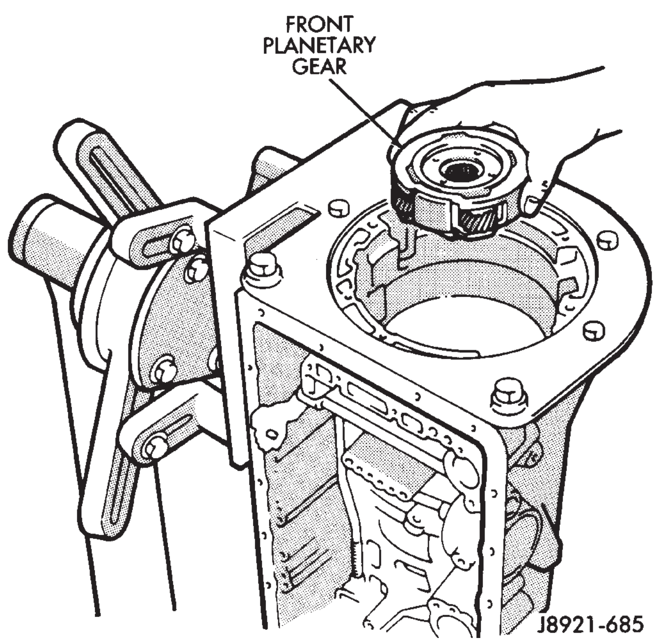


Fig. 141 Installing Front Planetary Gear

(35) Install planetary snap ring on sun gear with snap ring plier tool 7541 (Fig. 143).

(36) Install tabbed thrust race on front planetary gear. Washer tabs face down and toward gear. Race outer diameter is 47.8 mm (1.882 in.). Inside diameter is 34.3 mm (1.350 in.).

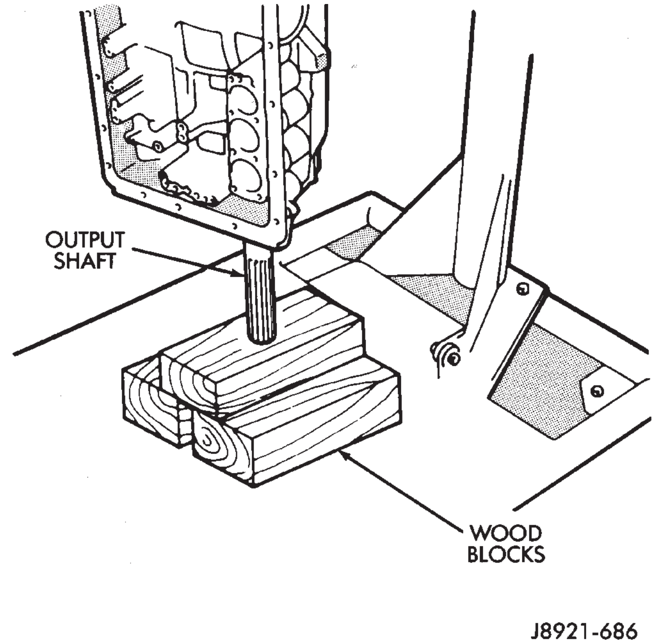


Fig. 142 Supporting Output Shaft

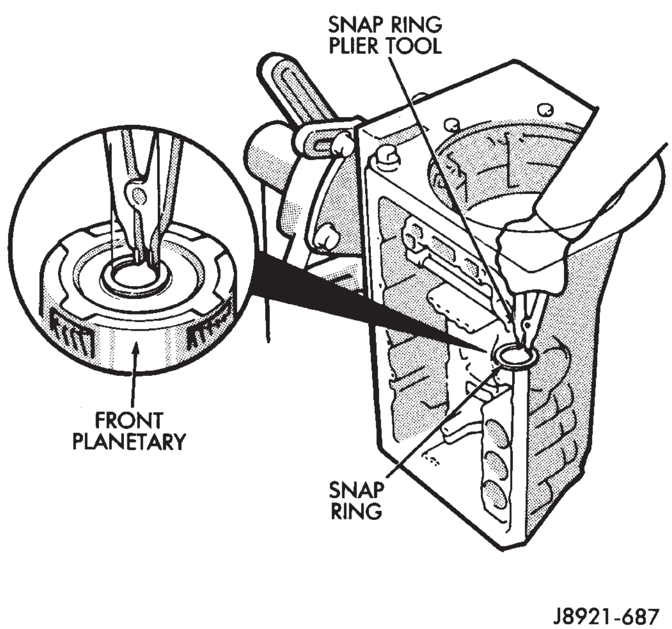


Fig. 143 Installing Front Planetary Snap Ring

DISASSEMBLY AND ASSEMBLY (Continued)

(37) Install second coast brake band (Fig. 144).

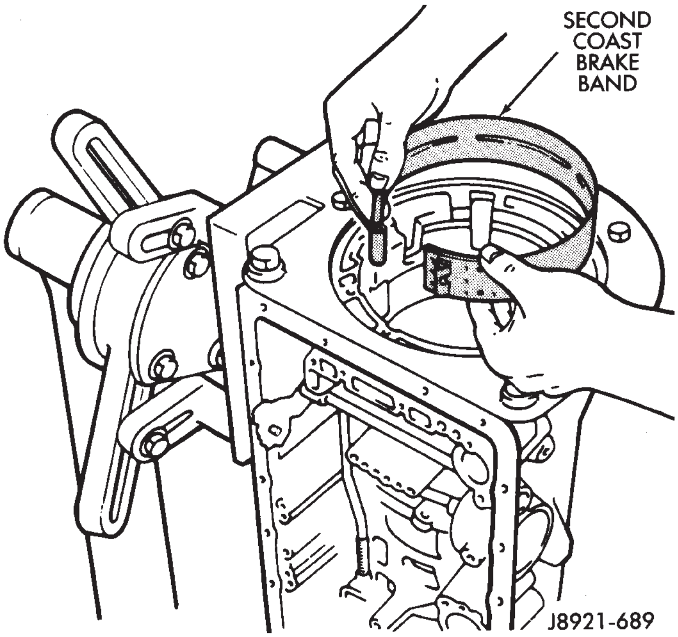


Fig. 144 Installing Second Coast Brake Band

(38) Install pin in second coast brake band. Then install retaining ring on pin (Fig. 145).

(39) Install thrust bearing and race in forward–direct clutch (Fig. 146). Coat bearing/race with petroleum jelly to hold them in place.

(40) Verify forward–direct clutch thrust bearing size.

- Race outer diameter is 48.9 mm (1.925 in.) and inside diameter is 26.0 mm (1.024 in.).
- Bearing outer diameter is 46.7 mm (1.839 in.) and inside diameter is 26.0 mm (1.024 in.).

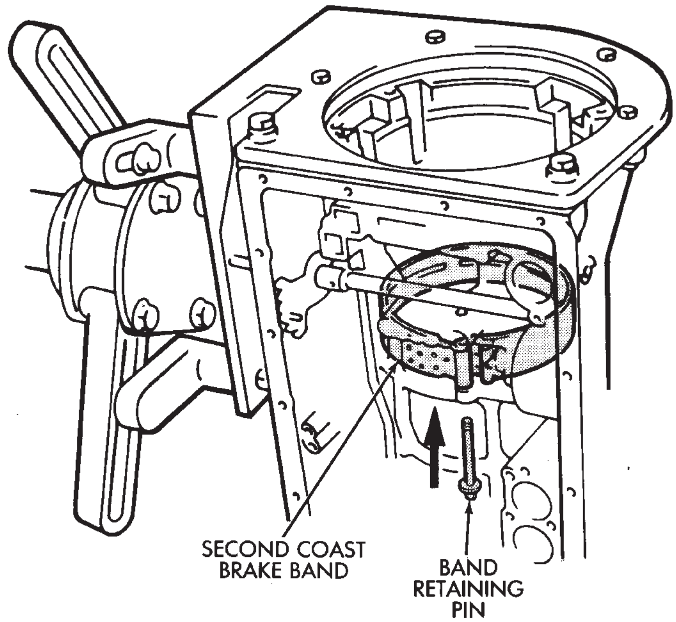
(41) Coat front planetary ring gear race with petroleum jelly and install it in ring gear (Fig. 147).

(42) Verify ring gear race size. Outer diameter is 47.0 mm (1.850 in.) and inside diameter is 26.5 mm (1.045 in.).

(43) Align forward–direct clutch disc splines with screwdriver (Fig. 148).

(44) Align and install front planetary ring gear in forward–direct clutch (Fig. 149).

(45) Coat bearing and race with petroleum jelly and install them in ring gear (Fig. 150). Verify bearing/race size.



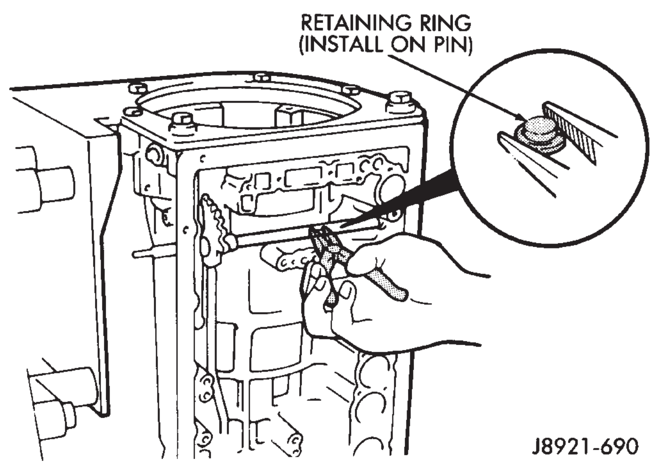


Fig. 145 Installing Second Coast Brake Band Retaining Pin

DISASSEMBLY AND ASSEMBLY (Continued)

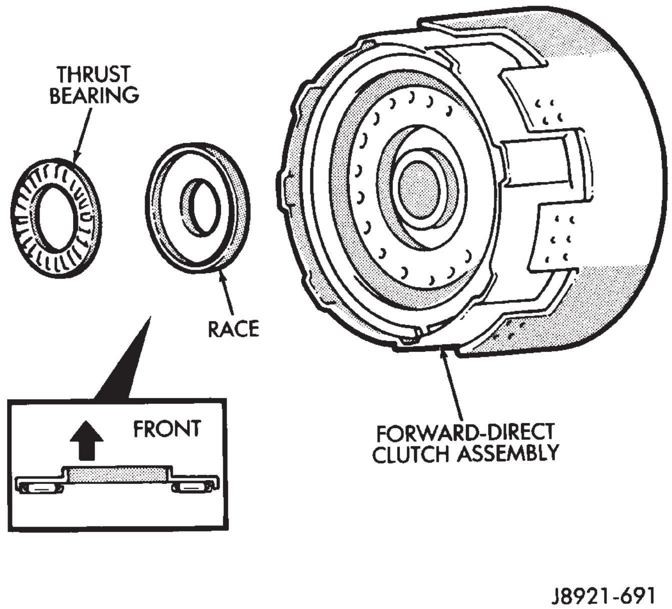


Fig. 146 Installing Forward–Direct Clutch Thrust Bearing And Race

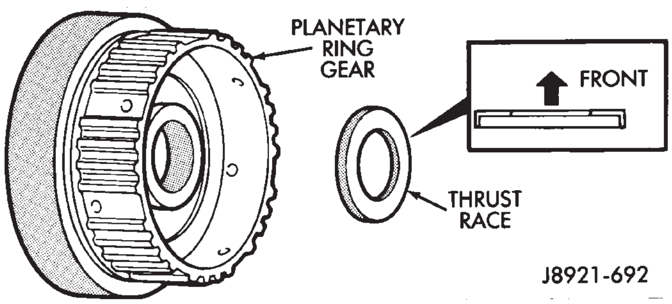


Fig. 147 Installing Planetary Ring Gear Race

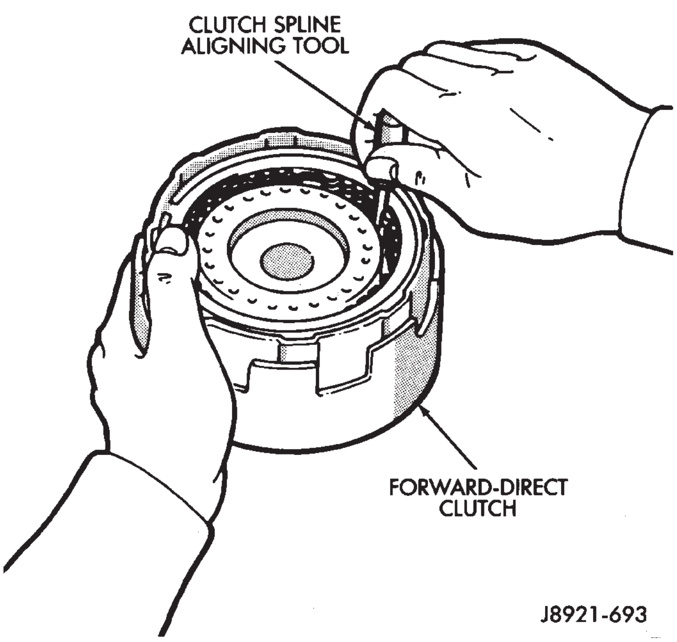


Fig. 148 Aligning Forward–Direct Clutch Splines

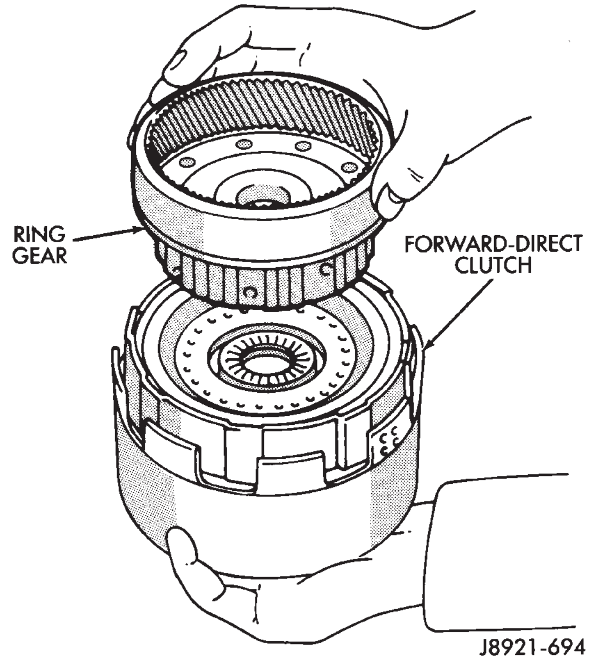


Fig. 149 Installing Front Planetary Ring Gear

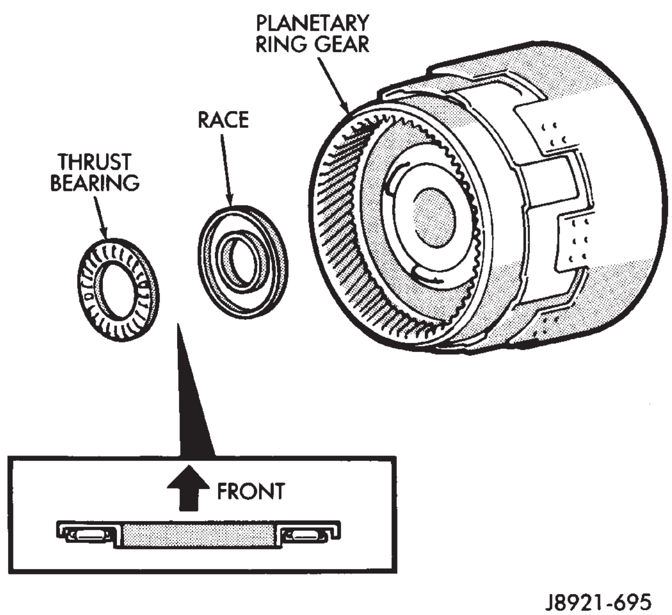


Fig. 150 Installing Ring Gear Bearing And Race

• Bearing outer diameter is 47.7 mm (1.878 in.) and inside diameter is 32.6 mm (1.283 in.).

• Race outer diameter is 53.6 mm (2.110 in.) and inside diameter is 30.6 mm (1.205 in.).

(46) Install assembled planetary gear/forward–direct clutch (Fig. 151).

(47) Check clearance between sun gear input drum and direct clutch drum (Fig. 152). Clearance should be 9.8 – 11.8 mm (0.386 – 0.465 in.). If clearance is incorrect, planetary gear/forward–direct clutch assembly is not seated or is improperly assembled. Remove, and correct if necessary.

DISASSEMBLY AND ASSEMBLY (Continued)

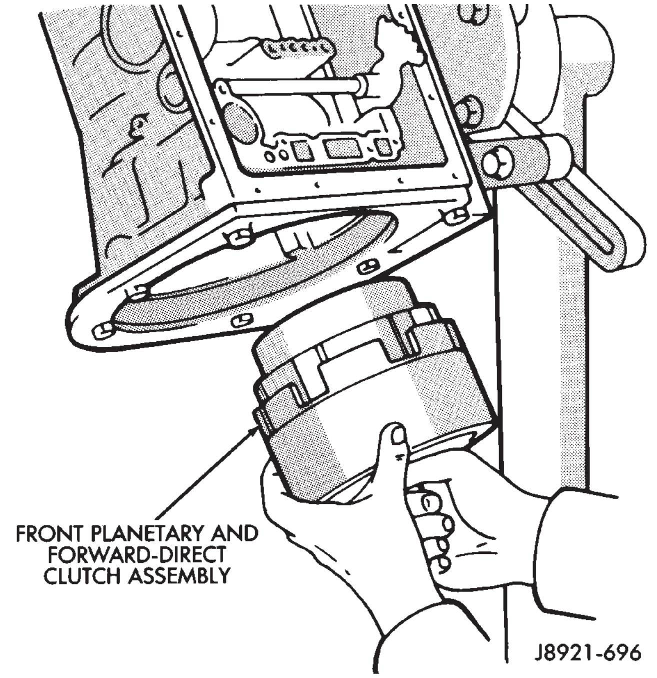


Fig. 151 Installing Front Planetary And Forward–Direct Clutch Assembly

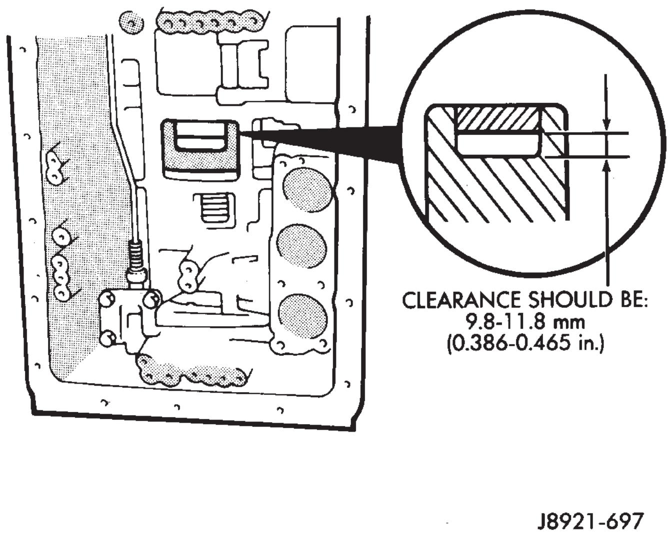


Fig. 152 Checking Input Drum–To–Direct Clutch Drum Clearance

(48) Coat thrust bearing and race assembly with petroleum jelly and install it on clutch shaft. Bearing faces up and toward case front as shown. Verify bearing/race size. Bearing and race outer diameter is 47.8 mm (1.882 in.) and inside diameter is 33.6 mm (1.301 in.).

(49) Assemble second coast brake piston components (Fig. 153).

(50) Install assembled second coast brake piston in case. Verify that the piston rod contacts the second coast brake band.

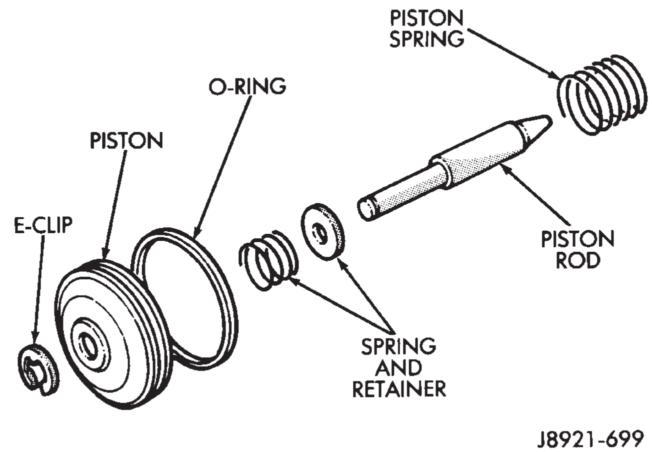


Fig. 153 Assembling Second Coast Brake Piston

(51) Install replacement seals on second coast brake piston cover and install cover in case.

(52) Install second coast brake piston snap ring with snap ring plier tool (Fig. 154).

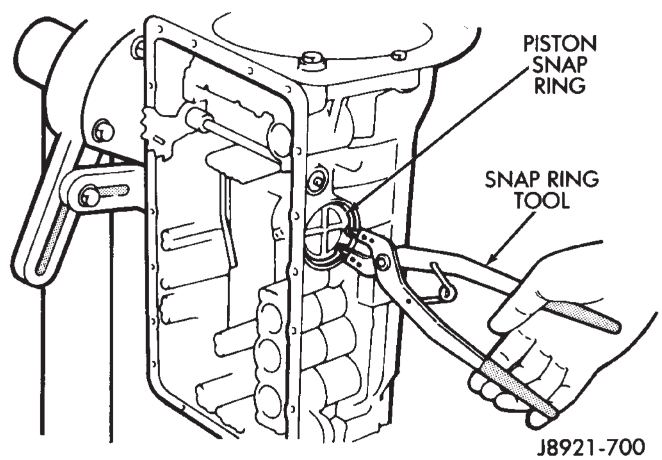


Fig. 154 Installing Second Coast Brake Piston Snap Ring

(53) Check second coast brake piston stroke as follows:

(a) Install a small wire tie strap around the second coast brake piston rod tight against the transmission case.

(b) Apply 57–114 psi air pressure through piston feed hole and check stroke length with Gauge Tool 7552.

(c) Stroke length should be 1.5 – 3.0 mm (0.059 – 0.118 in.).

(d) If stroke length is incorrect, piston, cover or snap ring is not seated. Reassemble and check stroke again if necessary.

(54) Coat thrust race and tabbed washer with petroleum jelly and install them on overdrive support (Fig. 157). Verify race size. Race outer diameter is 50.9 mm (2.004 in.) and inside diameter is 36.2 mm (1.426 in.).

DISASSEMBLY AND ASSEMBLY (Continued)

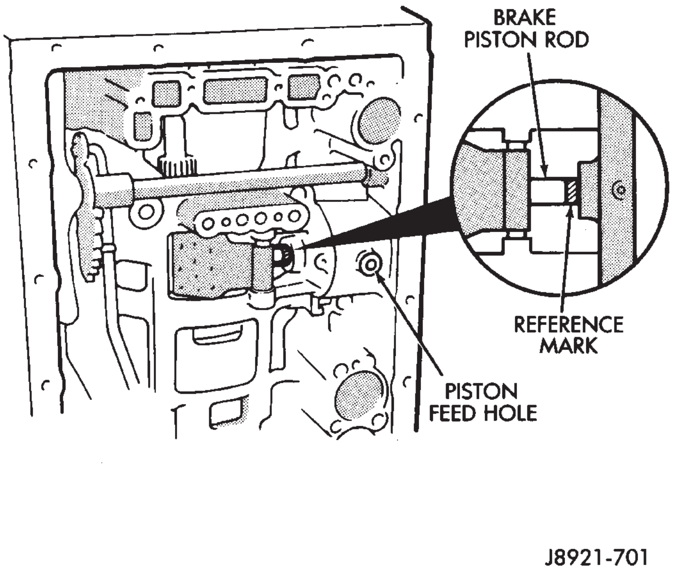


Fig. 155 Marking Brake Piston Rod

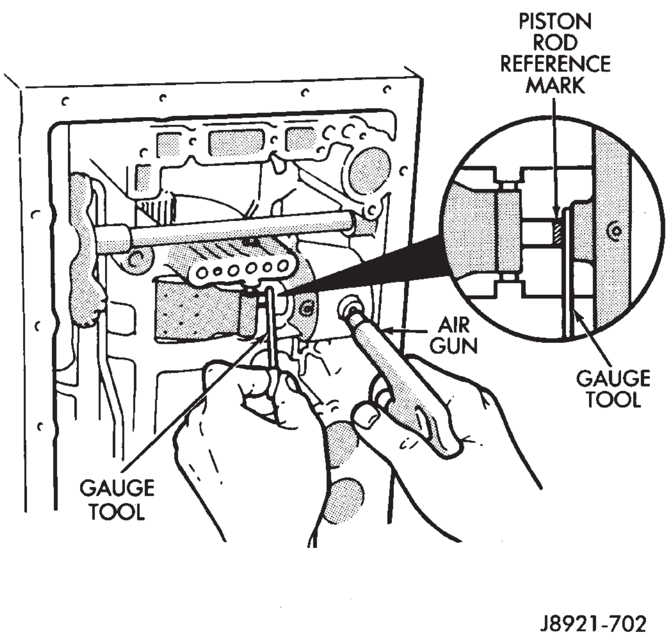


Fig. 156 Checking Second Coast Brake Piston Stroke

(55) Install overdrive support in case. Use two long bolts to help align and guide support into position (Fig. 158).

(56) Install overdrive support snap ring with Snap Ring Plier Tool 7540 (Fig. 159). Chamfered side of snap ring faces up and toward case front. **Snap ring ends must be aligned with case opening with ring ends approximately 24 mm (0.94 in.) from center line of case opening.**

(57) Install and tighten overdrive support bolts to 25 N·m (19 ft. lbs.) torque (Fig. 160).

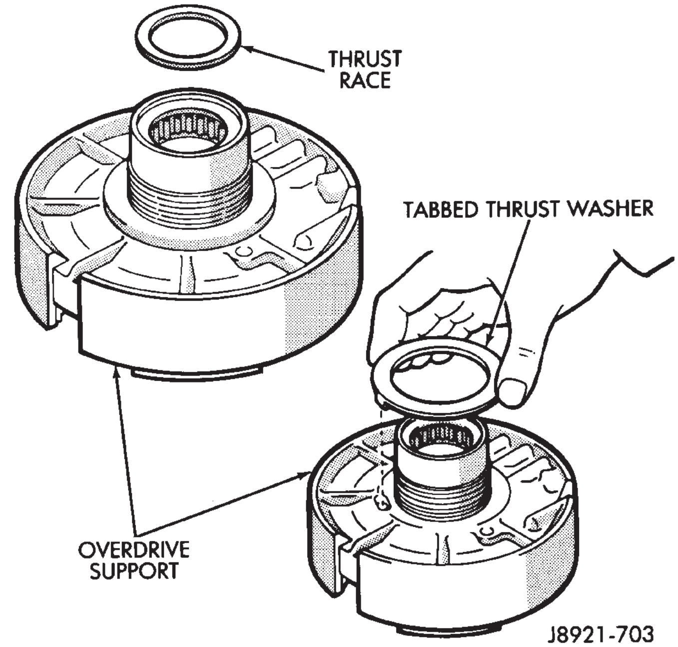


Fig. 157 Installing Overdrive Support Thrust Race And Washer

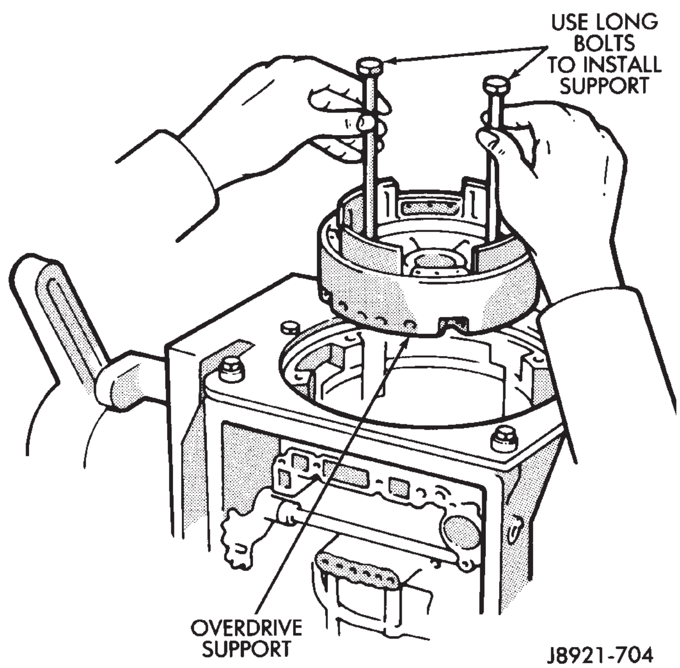


Fig. 158 Installing Overdrive Support

(58) Check output shaft end play with dial indicator (Fig. 161). End play should be 0.27 – 0.86 mm (0.0106 – 0.0339 in.).

(59) If output shaft end play is incorrect, one or more of installed components is not seated. Reassemble as necessary and check end play again.

(60) Install overdrive brake clutch pack (Fig. 162). Install thickest clutch plate first. Rounded edge of plate faces up. Install first disc followed by another plate until four discs and three plates are installed.

DISASSEMBLY AND ASSEMBLY (Continued)

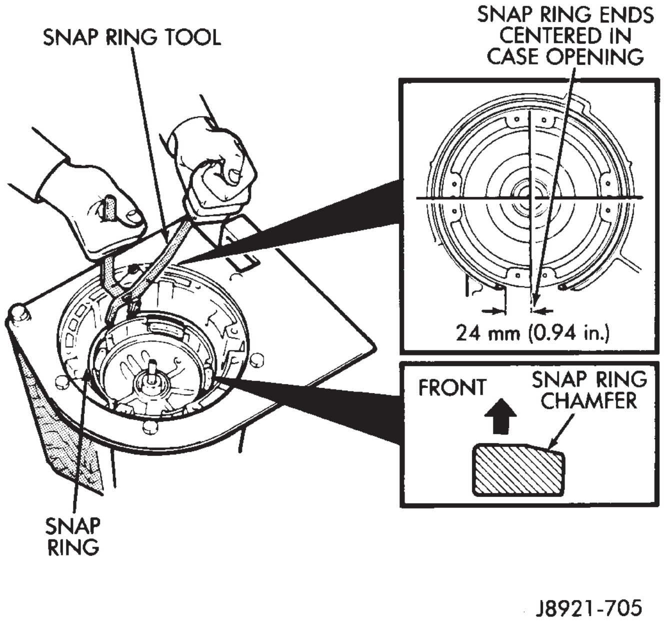


Fig. 159 Installing Overdrive Support Snap Ring

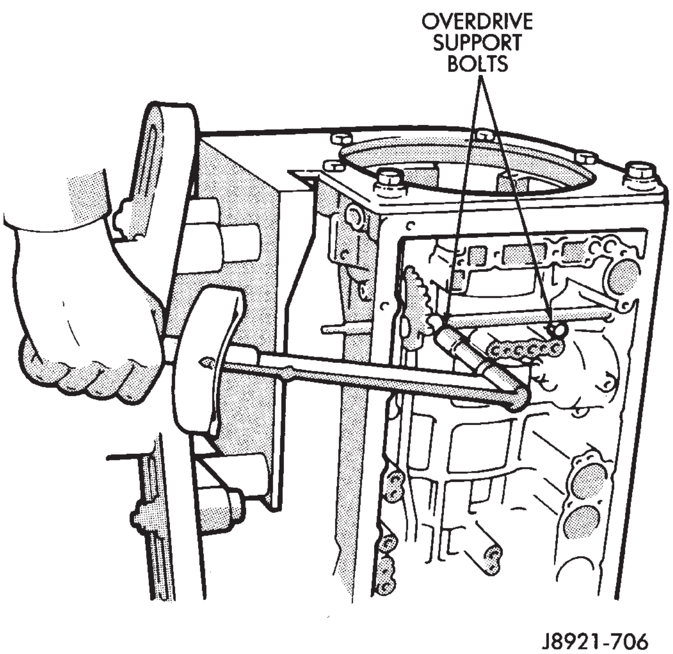


Fig. 160 Installing Overdrive Support Bolts

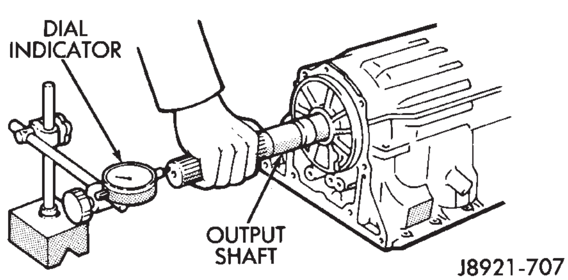


Fig. 161 Checking Output Shaft End Play

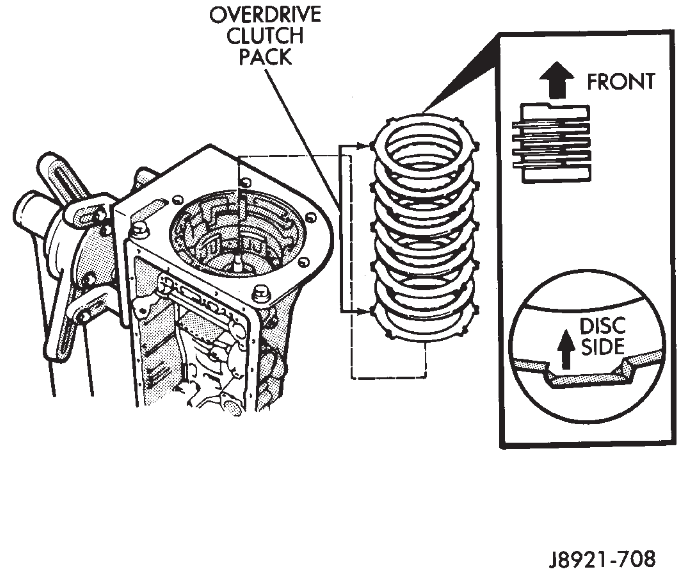


Fig. 162 Installing Overdrive Brake Clutch Pack

(61) Install stepped ring retainer plate with flat side facing disc. Then install brake pack snap ring (Fig. 163).

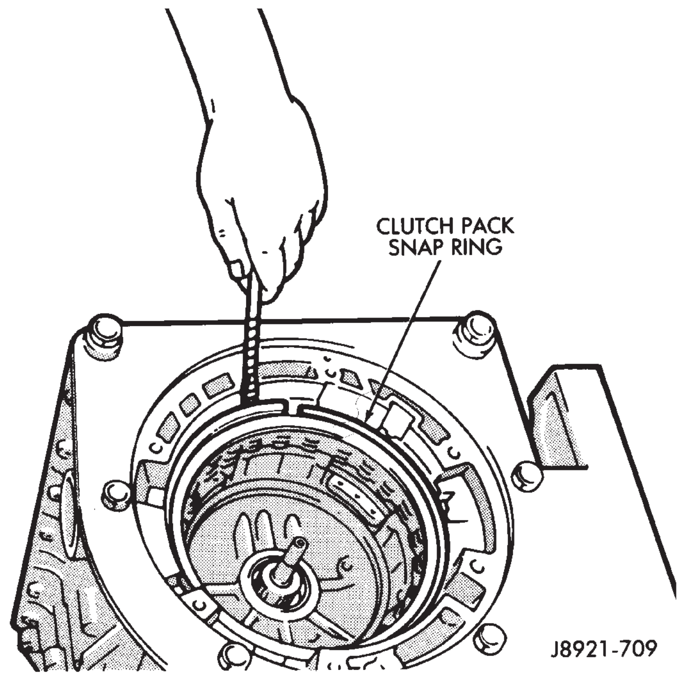


Fig. 163 Installing Overdrive Brake Snap Ring

(62) Check overdrive brake piston stroke as follows:

(a) Mount dial indicator on case using Miller Tool C-3339 and a suitable bolt threaded into the transmission case.

(b) Verify that the dial indicator is mounted solidly and square to the direction of the piston travel.

DISASSEMBLY AND ASSEMBLY (Continued)

(c) Apply 57–114 psi air pressure through piston apply port and note piston stroke on dial indicator. Stroke length should be: 1.40 – 1.70 mm (0.055 – 0.0699 in.).

(d) If stroke is incorrect, brake pack or piston is installed incorrectly. Check and correct as necessary and measure piston stroke again.

(e) Remove the dial indicator set-up from the transmission.

(63) Coat overdrive lower race, thrust bearing and upper race with petroleum jelly and install them in overdrive support (Fig. 164). Be sure races and bearing are assembled and installed as shown.

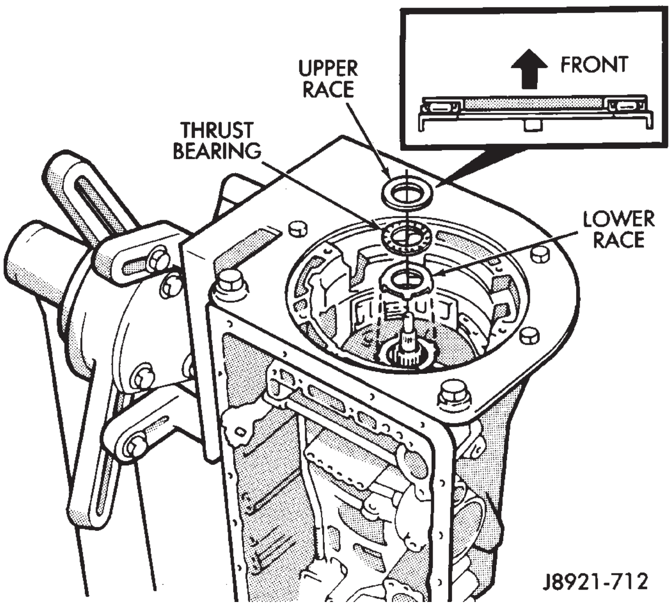


Fig. 164 Installing Overdrive Support Thrust Bearing And Races

(64) Verify bearing/race sizes before proceeding. Bearing race sizes are:

• Outer diameter of lower race is 47.8 mm (1.882 in.) and inside diameter is 34.3 mm (1.350 in.).

• Outer diameter of bearing is 47.7 mm (1.878 in.) and inside diameter is 32.7 mm (1.287 in.).

• Outer diameter of upper race is 47.8 mm (1.882 in.) and inside diameter is 30.7 mm (1.209 in.).

(65) Install overdrive planetary ring gear in support (Fig. 165).

(66) Coat ring gear thrust race and thrust bearing assembly with petroleum jelly and install them in gear (Fig. 166).

(67) Verify bearing/race size before proceeding.

• Outer diameter of ring gear race–bearing is 47.8 mm (1.882 in.) and inside diameter is 24.2 mm (0.953 in.).

• Outer diameter of bearing is 46.8 mm (1.844 in.) and inside diameter is 26.0 mm (1.024 in.).

(68) Coat tabbed thrust race with petroleum jelly and install it on planetary gear (Fig. 167). Race outer diameter is 41.8 mm (1.646 in.) and inside diameter is 27.1 mm (1.067 in.).

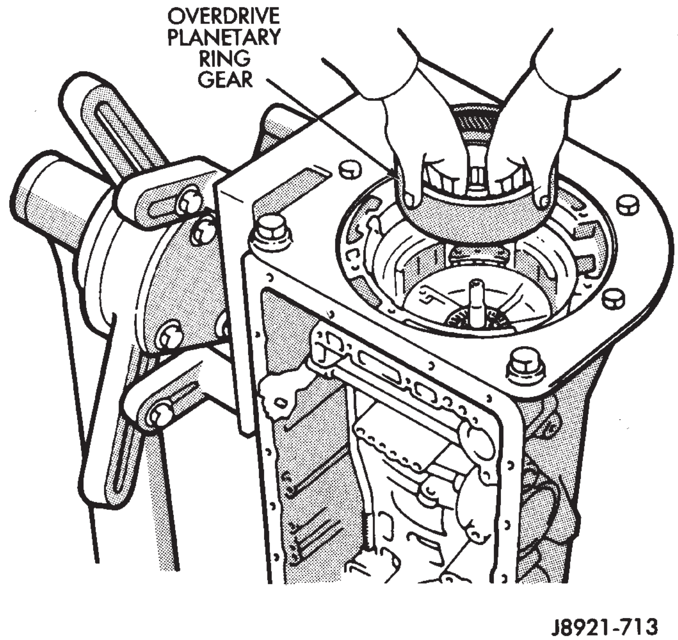


Fig. 165 Installing Overdrive Planetary Ring Gear

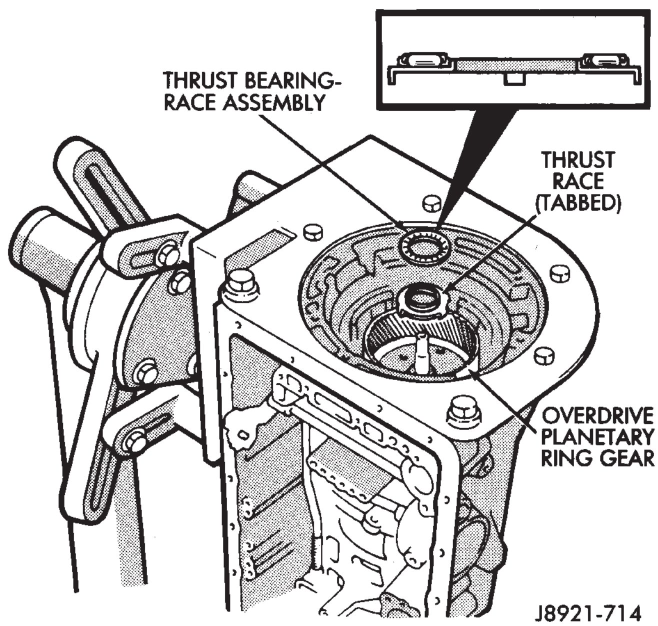


Fig. 166 Installing Ring Gear Thrust Bearing And Race

(69) Install assembled overdrive planetary gear and clutch (Fig. 168).

(70) Coat thrust bearing and race assembly with petroleum jelly and install it on clutch input shaft (Fig. 169). Bearing and race outer diameter is 50.2 mm (1.976 in.) and inside diameter is 28.9 mm (1.138 in.).

(71) Coat thrust bearing race with petroleum jelly and install it in oil pump (Fig. 170). Bearing race

DISASSEMBLY AND ASSEMBLY (Continued)

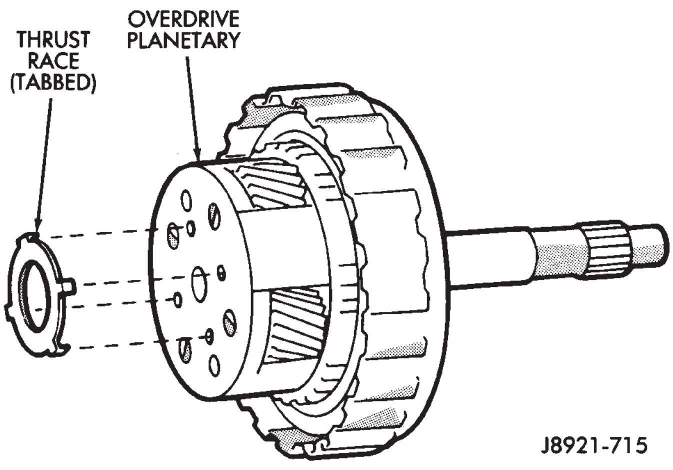


Fig. 167 Installing Planetary thrust Race

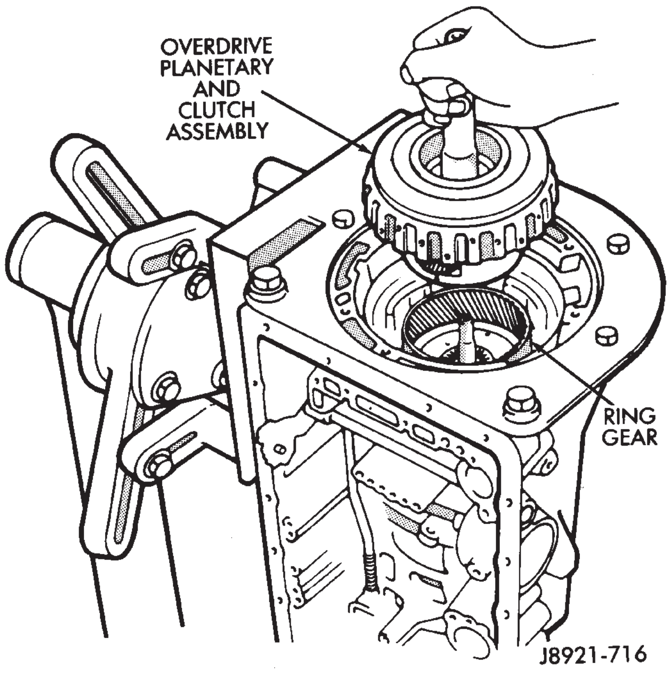


Fig. 168 Installing Overdrive Planetary And Clutch Assembly

outer diameter is 47.2 mm (1.858 in.) and inside diameter is 28.1 mm (1.106 in.).

(72) Lubricate and install replacement O–ring on oil pump body.

(73) Install oil pump in case. Align pump and case bolt holes and carefully ease pump into place.

CAUTION: Do not use force to seat the pump. The seal rings on the stator shaft could be damaged if they bind or stick to the direct clutch drum.

(74) Tighten oil pump bolts to 22 N·m (16 ft. lbs.) torque.

(75) Verify input shaft rotation. Shaft should rotate smoothly and not bind.

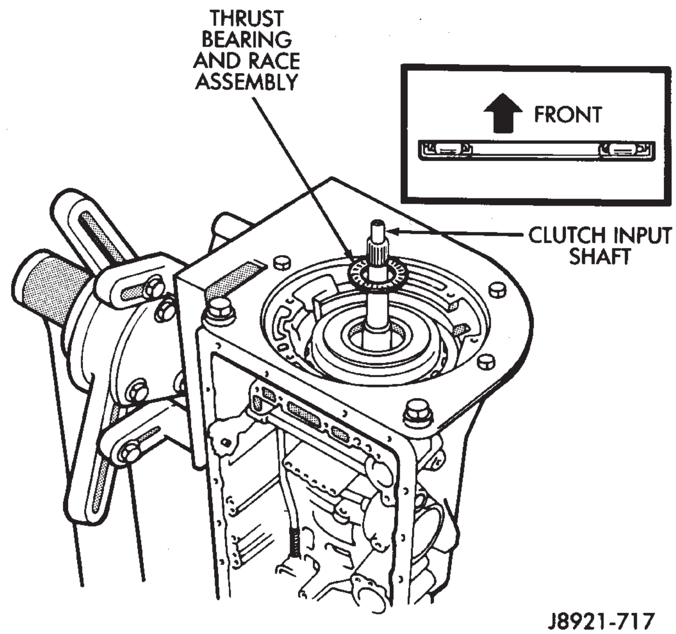


Fig. 169 Installing Input Shaft Thrust Bearing And Race Assembly

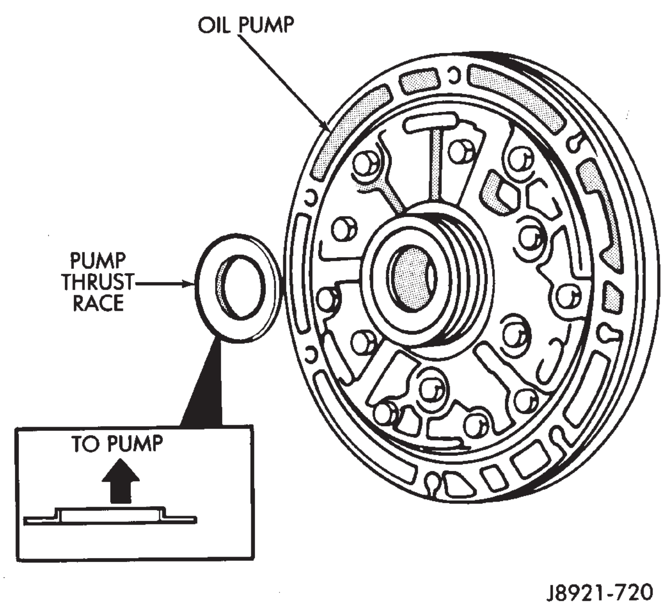


Fig. 170 Installing Oil Pump Thrust Race

(76) Lubricate and install new O–ring on transmission throttle cable adapter and install cable in case (Fig. 171).

(77) Check clutch and brake operation. Operate clutches and brakes with compressed air applied through feed holes in case (Fig. 172). Listen for clutch and brake application. If you do not hear a clutch or brake apply, disassemble transmission and repair fault before proceeding. **It is necessary to block the overdrive clutch accumulator feed hole No. 8 (Fig. 172) in order to check direct clutch operation.**

DISASSEMBLY AND ASSEMBLY (Continued)

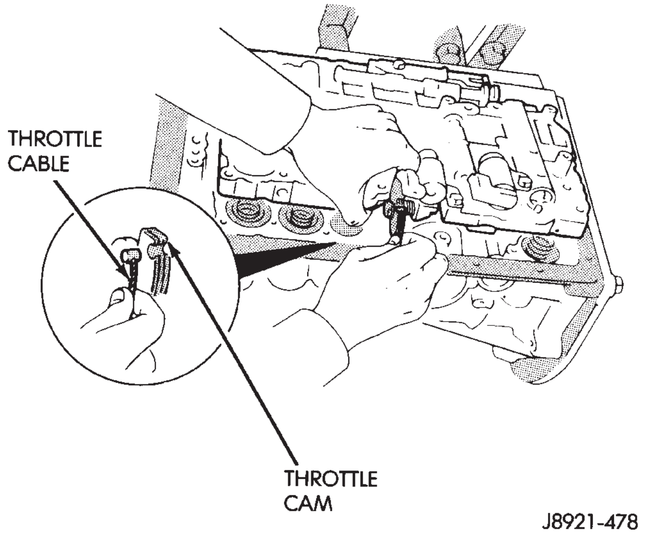


Fig. 171 Installing Transmission Throttle Cable

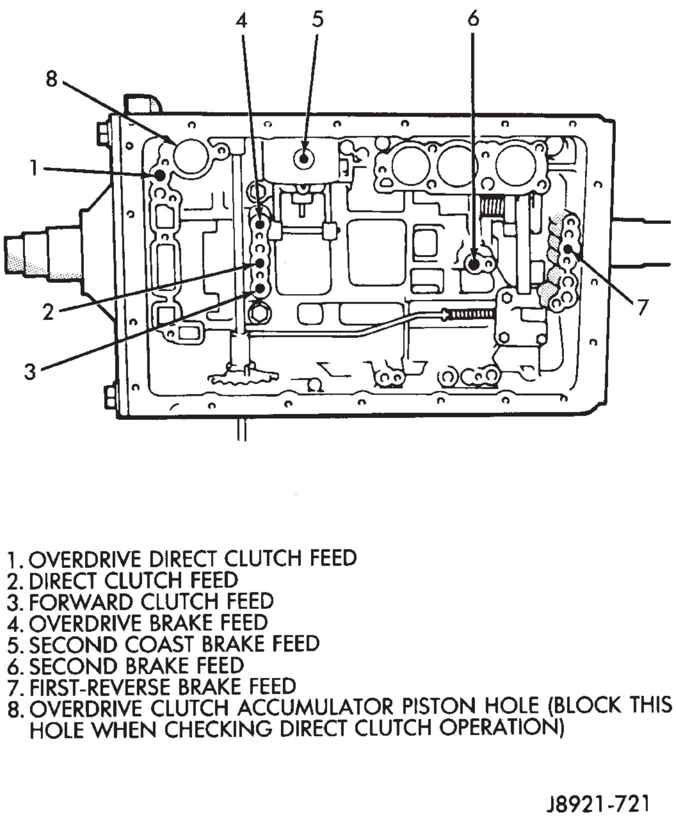


Fig. 172 Clutch And Brake Feed Hole Locations

(78) Lubricate and install new O–rings on accumulator pistons (Fig. 173).

(79) Assemble and install accumulator pistons and springs (Fig. 173).

(80) Install new check ball body and spring (Fig. 174).

(81) Position valve body on case (Fig. 175).

(82) Install detent spring (Fig. 175).

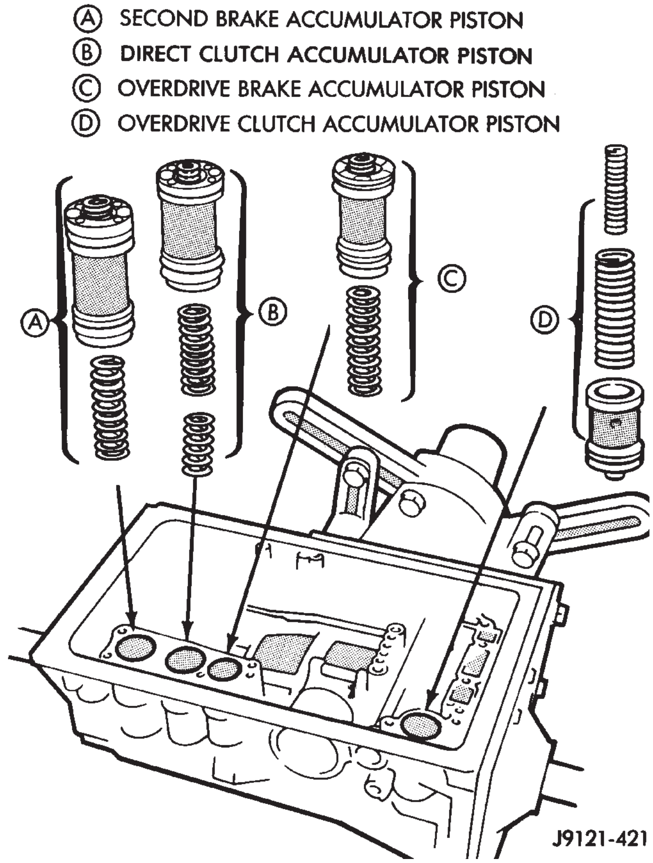


Fig. 173 Accumulator Piston And Spring Installation

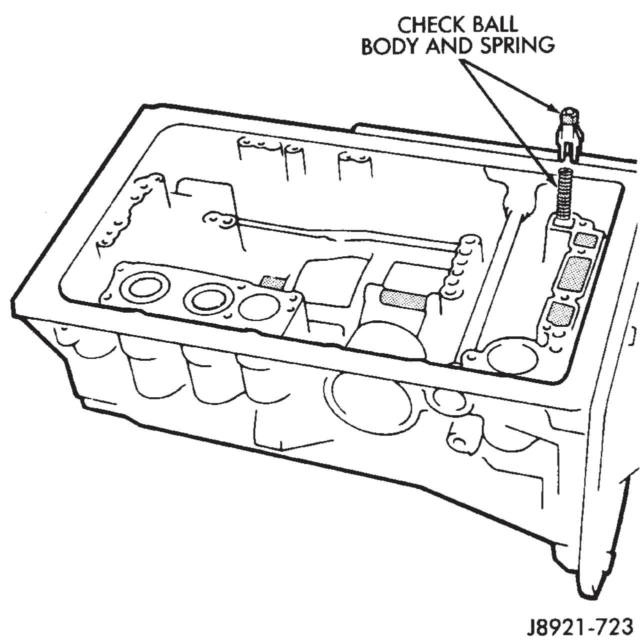


Fig. 174 Installing Check Ball Body And Spring

(83) Align manual valve, detent spring and shift sector (Fig. 175).

(84) Connect transmission throttle cable to throttle valve cam (Fig. 176).

DISASSEMBLY AND ASSEMBLY (Continued)

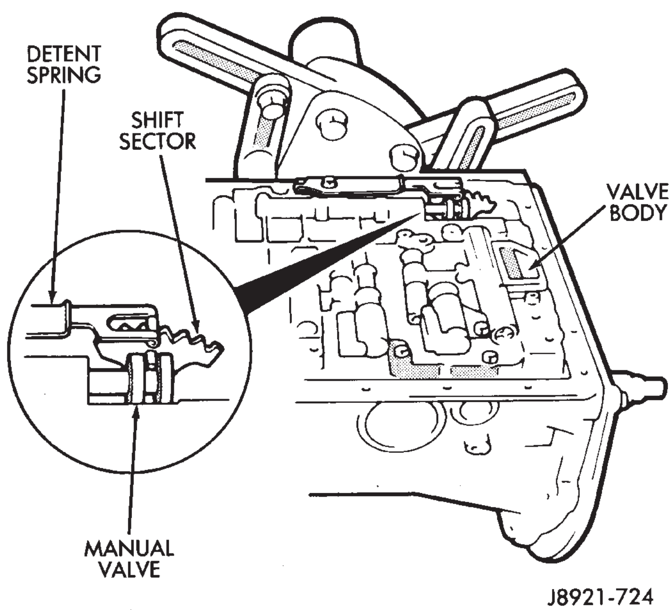


Fig. 175 Aligning Manual Valve, Shift Sector And Detent Spring

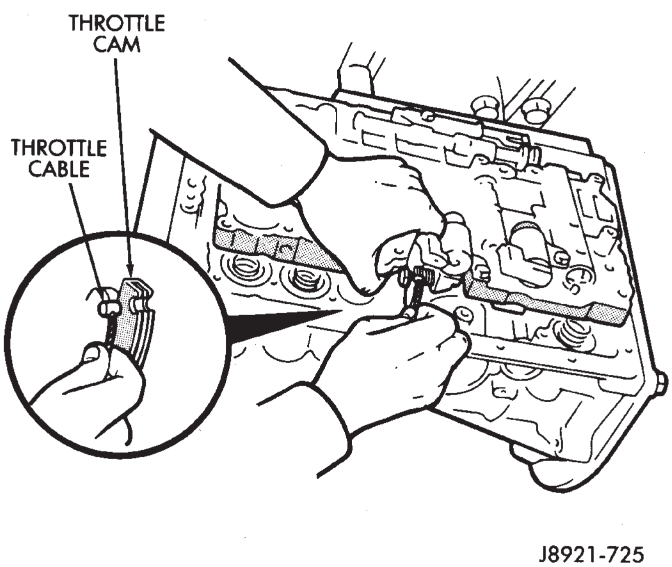


Fig. 176 Connecting Transmission Throttle Cable

(85) Install and tighten valve body–to–case bolts to 10 N·m (7 ft. lbs.) torque.

(86) Connect valve body solenoid wires to solenoids (Fig. 177).

(87) Install new O–ring on solenoid harness adapter and secure adapter to case.

(88) Install valve body oil tubes (Fig. 178). Tap tubes into place with a plastic mallet. Be sure the flanged tube ends and straight tube ends are installed as shown.

(89) Install new gaskets on oil screen and install screen on valve body. Tighten screen bolts to 10 N·m (7 ft. lbs.) torque.

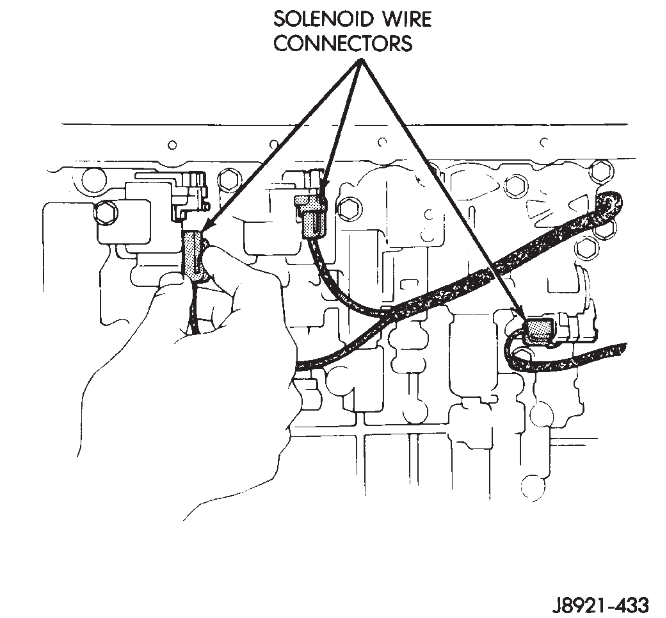


Fig. 177 Connecting Valve Body Solenoid Wires

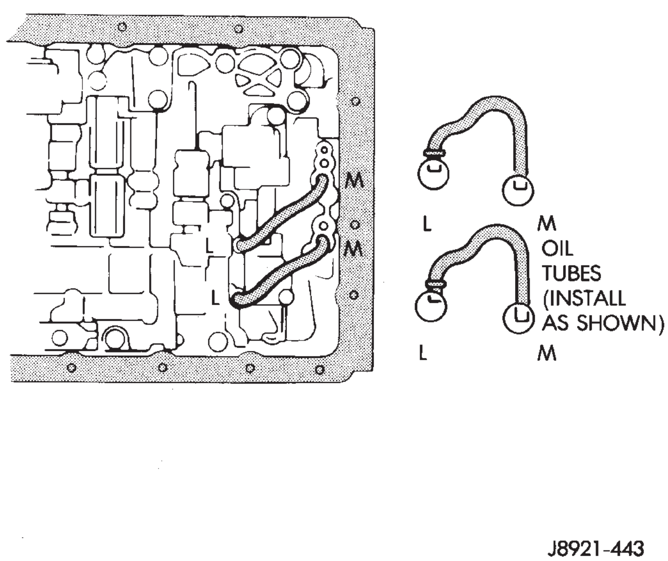


Fig. 178 Installing Valve Body Oil Tubes

(90) Install magnet in oil pan. Be sure magnet does not interfere with valve body oil tubes.

(91) Apply Threebond® Liquid Gasket TB1281, P/N 83504038, to sealing surface of oil pan. Sealer bead should be at least 3 mm (1/8 in.) wide. Install pan on case and tighten pan bolts to 7 N·m (65 in. lbs.) torque.

(92) Install transmission speed sensor rotor and key on output shaft (Fig. 179).

(93) Install spacer and speedometer drive gear on output shaft. Then install retaining snap ring (Fig. 180).

(94) Apply bead of Threebond® Liquid Gasket TB1281, P/N 83504038, to sealing surface at rear of case (Fig. 181).

DISASSEMBLY AND ASSEMBLY (Continued)

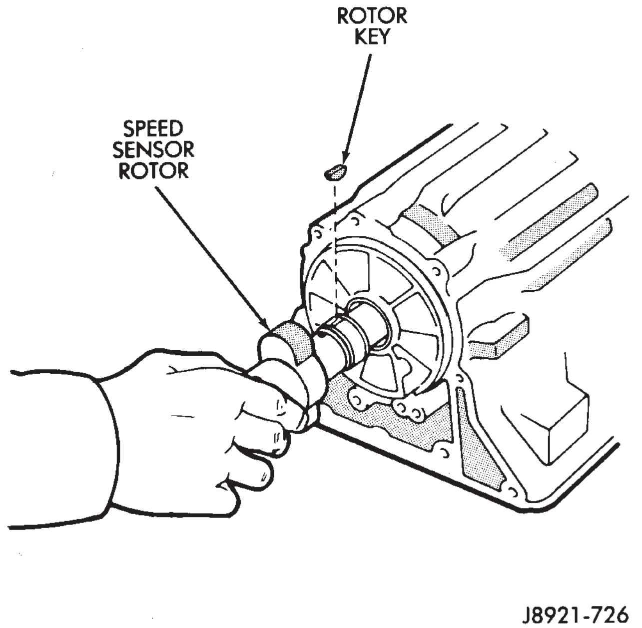


Fig. 179 Installing Transmission Speed Sensor Rotor And Key

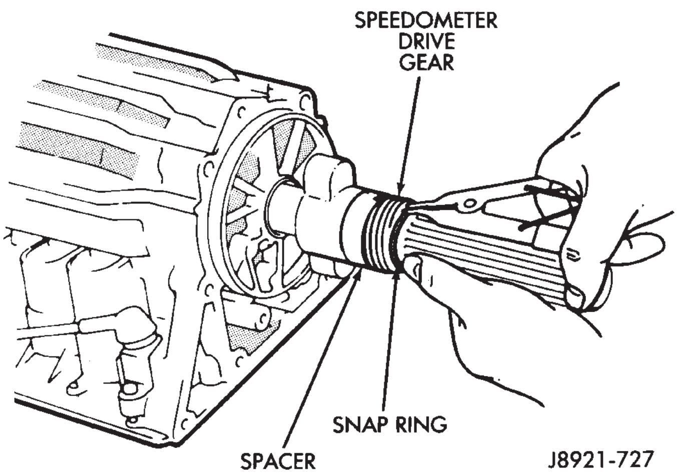


Fig. 180 Installing Spacer And Speedometer Drive Gear

(95) Install adapter housing on transmission. Tighten adapter bolts to 34 N·m (25 ft. lbs.) torque.

(96) Install transmission speed sensor (Fig. 182). Tighten sensor bolt to 7.4 N·m (65 in. lbs.) torque and connect sensor wire harness connector.

(97) Install converter housing (Fig. 183). Tighten 12 mm diameter housing bolts to 57 N·m (42 ft. lbs.) torque. Tighten 10 mm diameter housing bolts to 34 N·m (25 ft. lbs.) torque.

(98) Install transmission shift lever on manual valve shaft. Do not install lever attaching nut at this time.

(99) Move transmission shift lever fully rearward. Then move lever two detent positions forward.

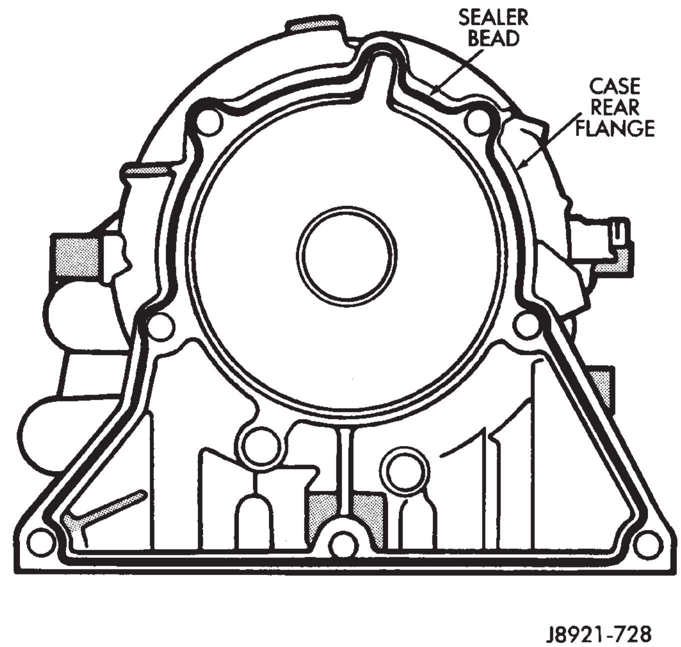


Fig. 181 Applying Sealer To Case Rear Flange

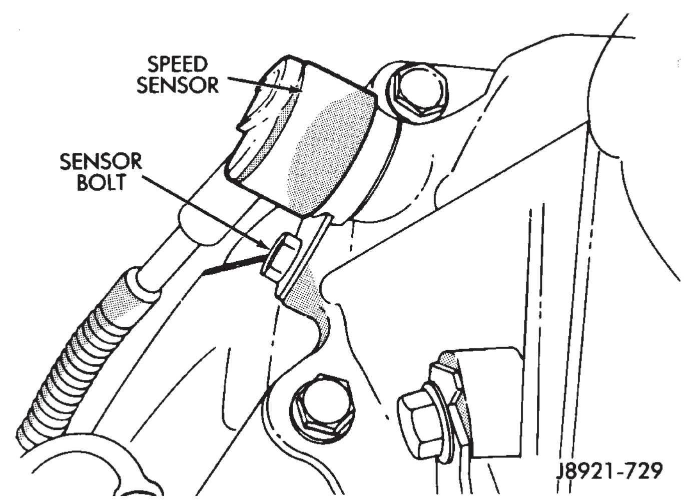


Fig. 182 Installing Transmission Speed Sensor

(100) Mount park/neutral position switch on manual valve shaft and tighten switch adjusting bolt just enough to keep switch from moving (Fig. 184).

(101) Install park/neutral position switch tabbed washer and retaining nut (Fig. 184). Tighten nut to 6.9 N·m (61 in. lbs.) torque, but do not bend any of the washer tabs against the nut at this time.

(102) Align park/neutral position switch standard line with groove or flat on manual shaft (Fig. 184).

(103) Tighten park/neutral position switch adjusting bolt to 13 N·m (9 ft. lbs.) torque.

(104) Install transmission shift lever on manual valve shaft. Tighten lever attaching nut to 16 N·m (12 ft. lbs.) torque.

(105) Install retaining clamp for wire harness and throttle cable (Fig. 185).

DISASSEMBLY AND ASSEMBLY (Continued)

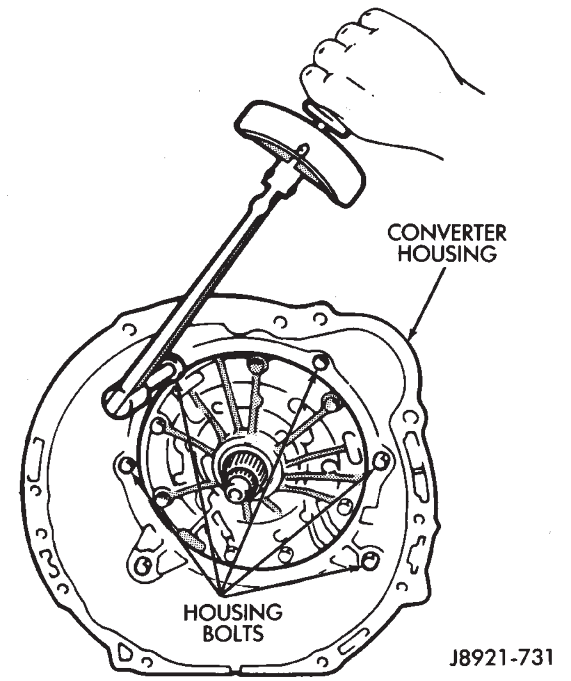


Fig. 183 Installing Converter Housing

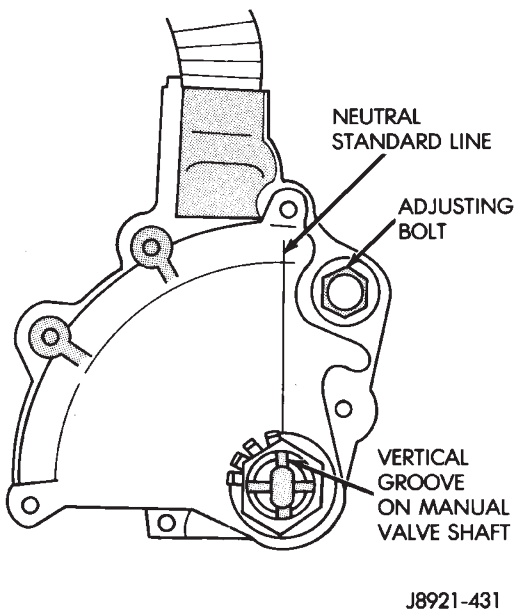


Fig. 184 Park/Neutral Position Switch Installation/ Adjustment

(106) Install torque converter.

(107) Verify that converter is seated by measuring distance between converter housing flange and one of the converter mounting pads (Fig. 186). Use straight-edge and vernier calipers to measure distance. On 6–cyl. transmissions, distance should be 16.5 mm (0.650 in.).

(108) Secure converter in transmission with C–clamp or metal strapping. Do this before mounting transmission on jack or moving transmission under vehicle.

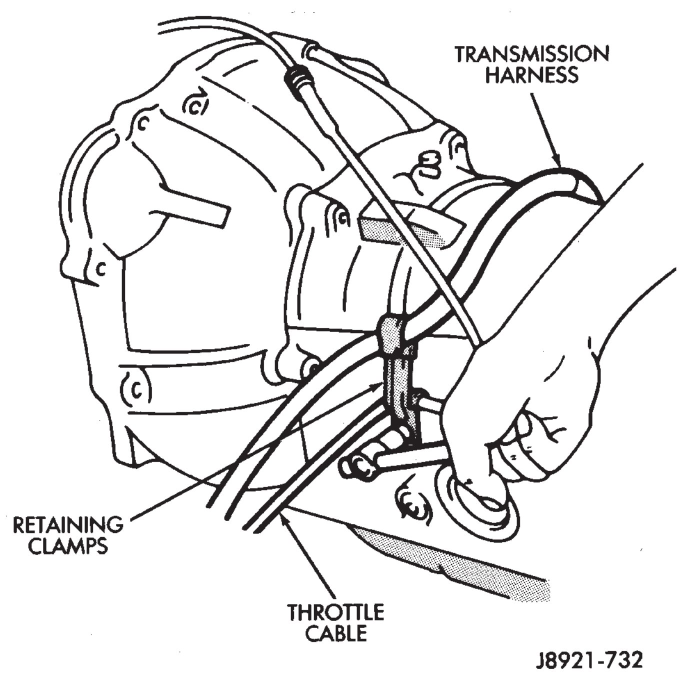


Fig. 185 Installing Cable/Harness Clamps

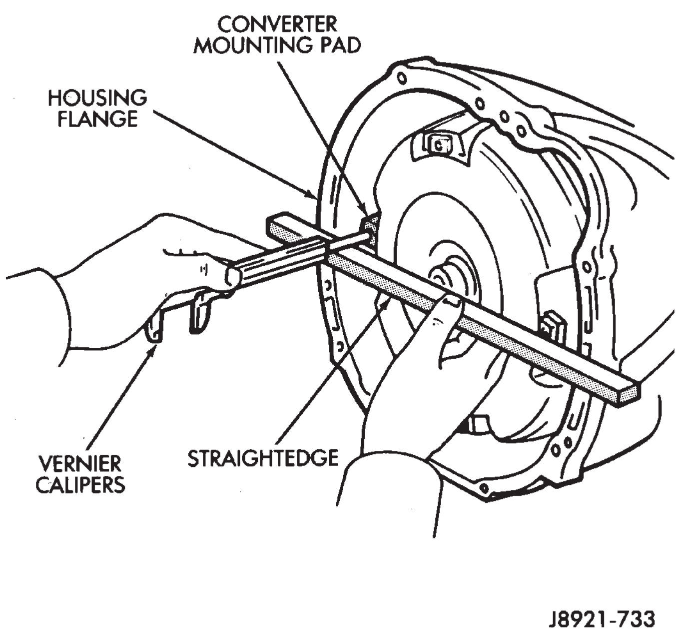


Fig. 186 Checking Converter Installation

(109) Install lower half of transmission fill tube (install upper half after transmission is in vehicle).

CAUTION: The transmission cooler and lines must be reverse flushed if overhaul corrected a malfunction that generated sludge, metal particles, or clutch friction material. The torque converter should also be replaced if contaminated by the same malfunction. Debris and residue not flushed from the cooler and lines will flow back into the transmission and converter. The result will be a repeat failure and shop comeback.

DISASSEMBLY AND ASSEMBLY (Continued)

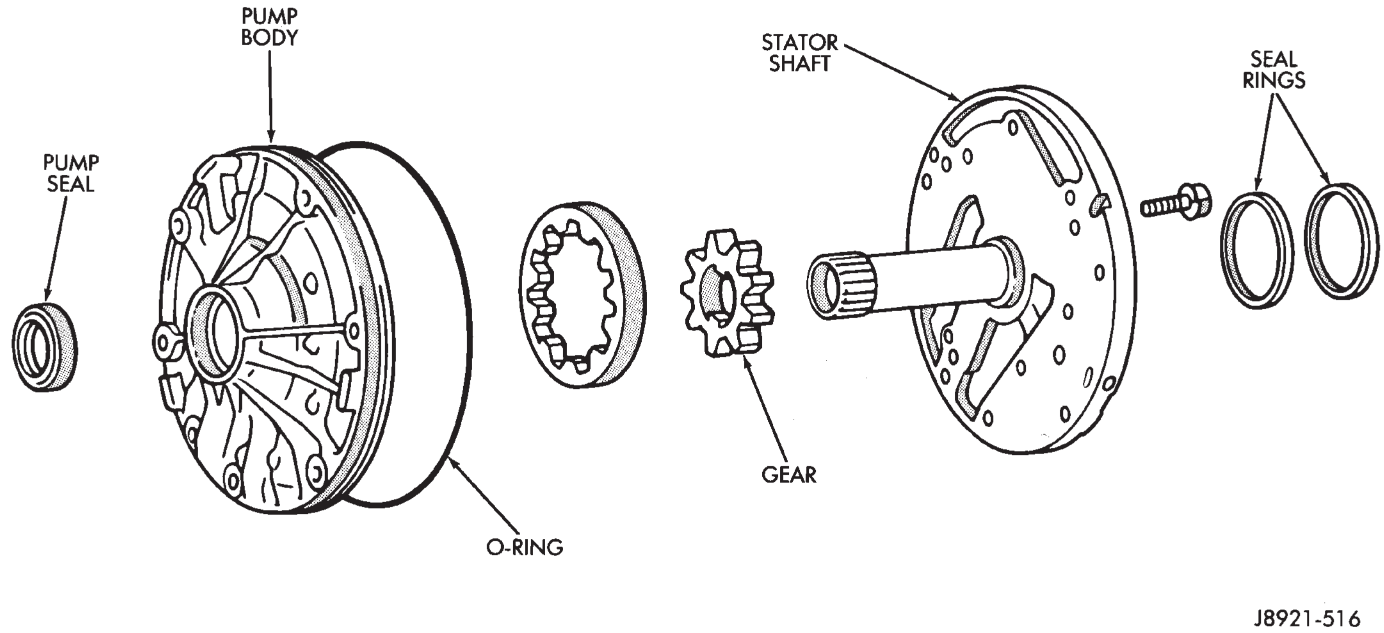


Fig. 187 Oil Pump Components

OIL PUMP

DISASSEMBLY

(1) Remove pump body O–ring (Fig. 187).

(2) Remove pump seal.

(3) Remove pump seal rings (Fig. 187).

(4) Remove bolts attaching stator shaft to pump body and separate components.

(5) Remove drive gear and driven gear from pump body (Fig. 187).

ASSEMBLY

(1) Measure inside diameter of pump body bushing with bore gauge or inside micrometer (Fig. 188). Diameter should be maximum of 38.19 mm (1.5035 in.). Replace pump body if bushing I.D. is greater than specified.

(2) Measure inside diameter of stator shaft bushing (Fig. 188). Take measurements at front and rear of bushing. Diameter should be maximum of 21.58 mm (0.08496 in.) at front and 27.08 mm (1.0661 in.) at rear. Replace stator shaft if bushing diameter is greater than specified.

(3) Measure oil pump clearances (Fig. 189).

- Clearance between pump driven gear and pump body should be maximum of 0.3 mm (0.012 in).
- Clearance between tips of pump gear teeth should be maximum of 0.3 mm (0.012 in).
- Clearance between rear surface of pump housing and pump gears should be maximum of 0.1 mm (0.004 in.).

(4) Replace pump body and gears if any clearance is greater than specified.

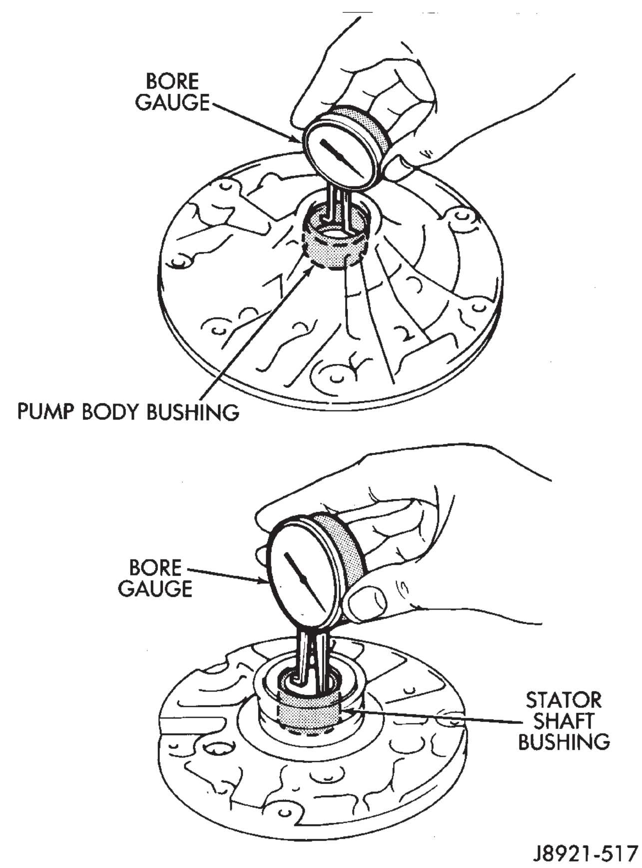


Fig. 188 Checking Pump/Stator Shaft Bushings

(5) Install new seal with Seal Installer 7549 (Fig. 190).

(6) Lubricate and install gears in pump body.

(7) Assemble stator shaft and pump body. Tighten shaft–to–body bolts to 10 N·m (7 ft. lbs.) torque.

DISASSEMBLY AND ASSEMBLY (Continued)

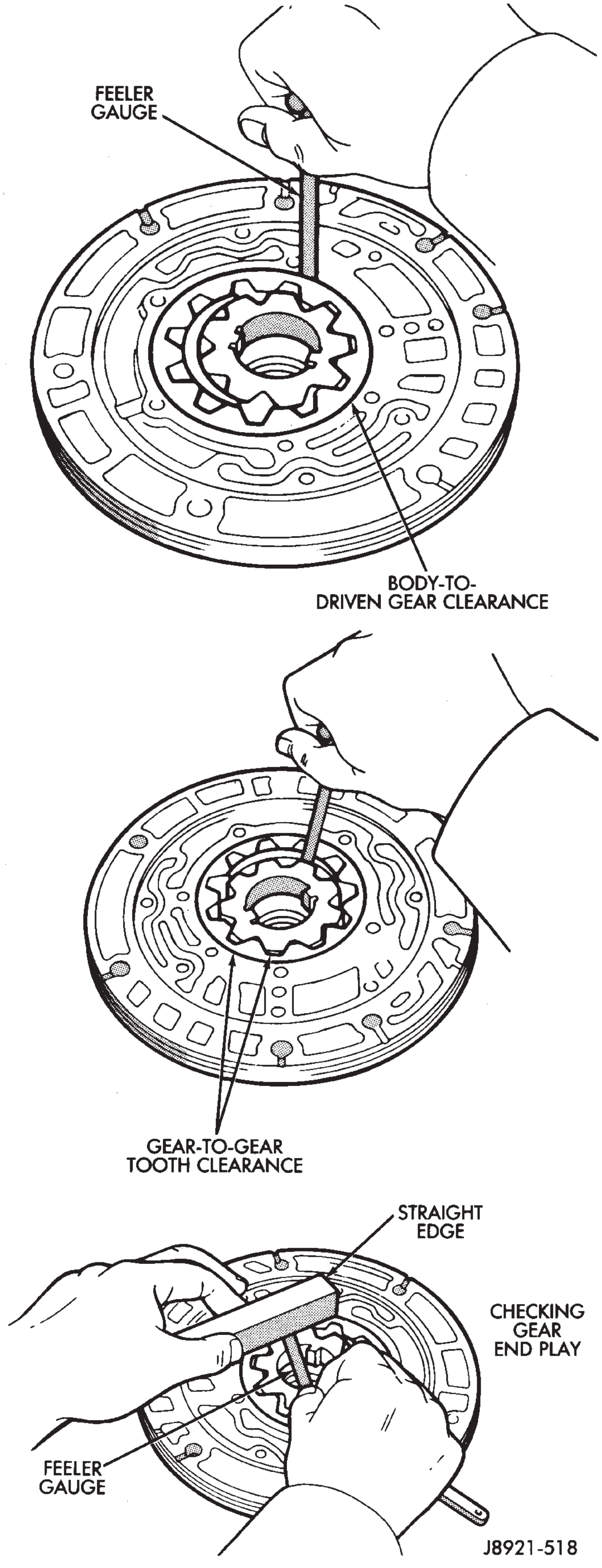


Fig. 189 Checking Pump Gear Clearances

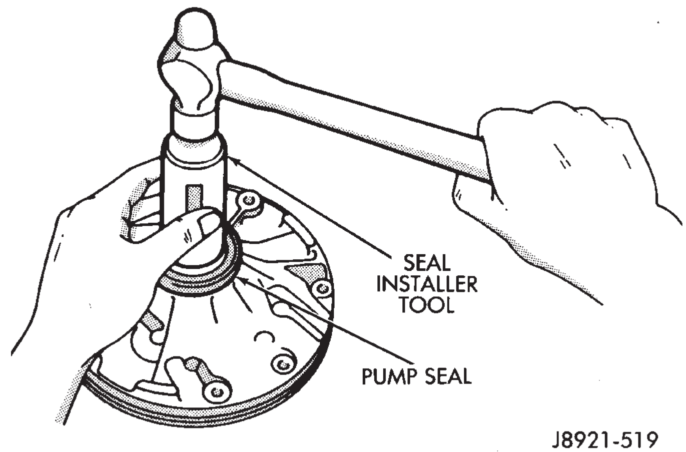


Fig. 190 Installing Pump Seal

(8) Install new O–ring on pump body and new seal rings on stator shaft.

(9) Install pump in torque converter and check pump gear rotation (Fig. 191). Gears must rotate smoothly when turned clockwise and counterclockwise.

(10) Lubricate pump O–ring and seal rings with petroleum jelly.

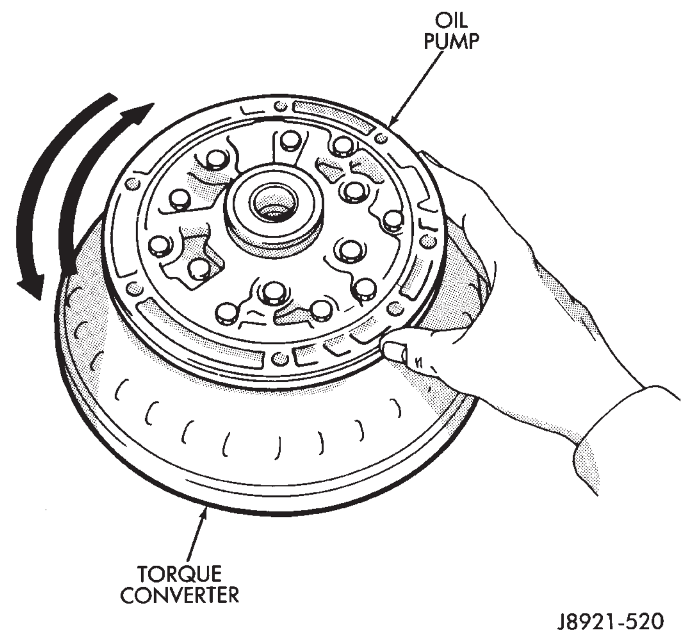
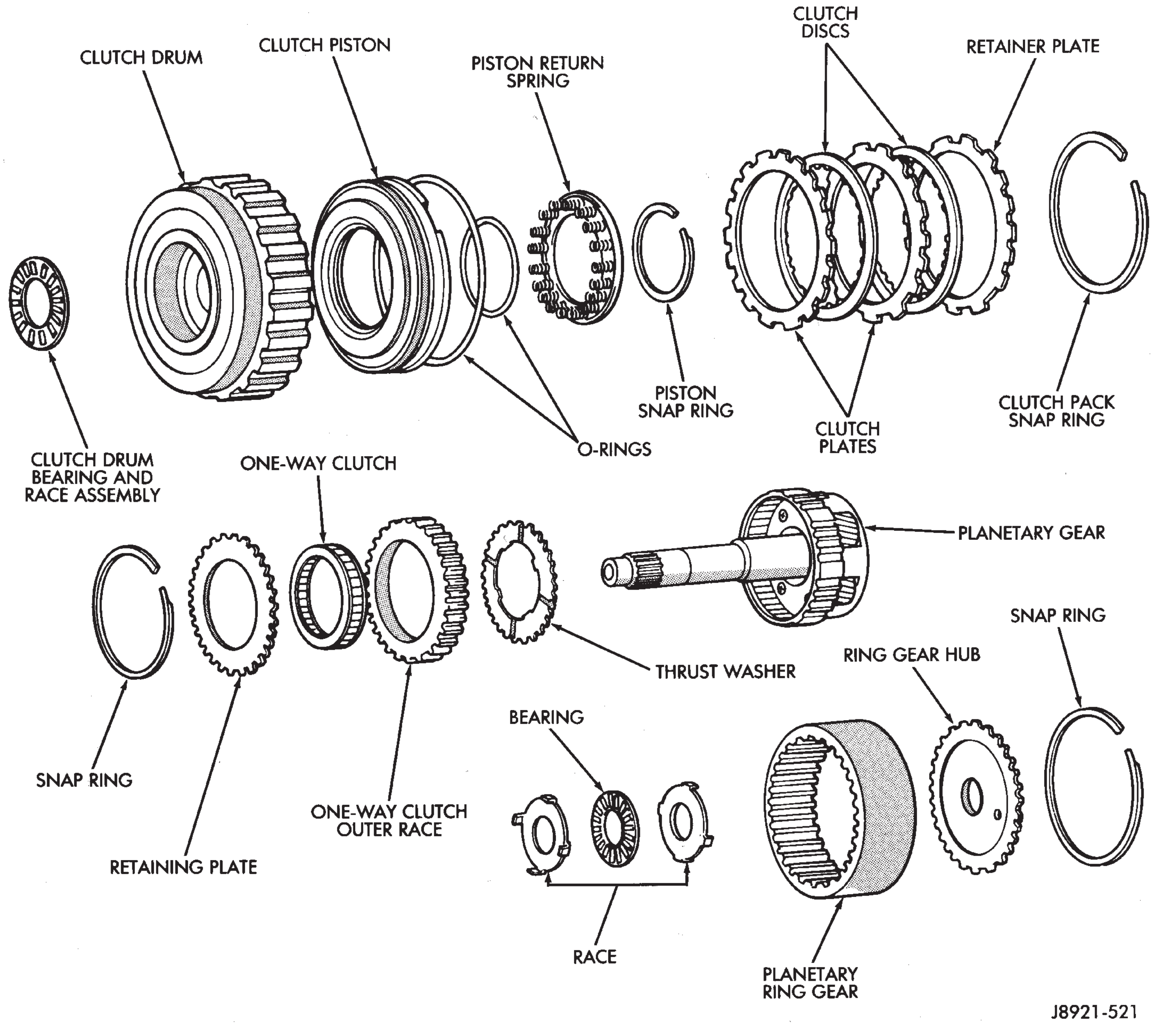


Fig. 191 Checking Pump Gear Rotation

DISASSEMBLY AND ASSEMBLY (Continued)

OVERDRIVE PLANETARY GEAR AND CLUTCH

DISASSEMBLY



Overdrive Planetary Gear And Clutch Components

(1) Check operation of one–way clutch in clutch drum (Fig. 192). Hold drum and turn planetary shaft clockwise and counterclockwise. Shaft should turn clockwise freely but lock when turned counterclockwise. Replace one–way clutch if necessary.

(2) Remove overdrive clutch from planetary gear (Fig. 193).

(3) Measure stroke length of overdrive clutch piston as follows:

(a) Mount oil pump on torque converter. Then mount clutch on oil pump (Fig. 194).

(b) Install a suitable threaded bolt/rod into oil pump for use in mounting Miller Tool C-3339 dial indicator components securely.

(c) Mount dial indicator on the bolt/rod and position the dial indicator squarely on the clutch piston.

(d) Apply compressed air through clutch feed hole in oil pump and note piston stroke length. Stroke length should be 1.85 – 2.15 mm (0.0728 – 0.0846 in.).

DISASSEMBLY AND ASSEMBLY (Continued)

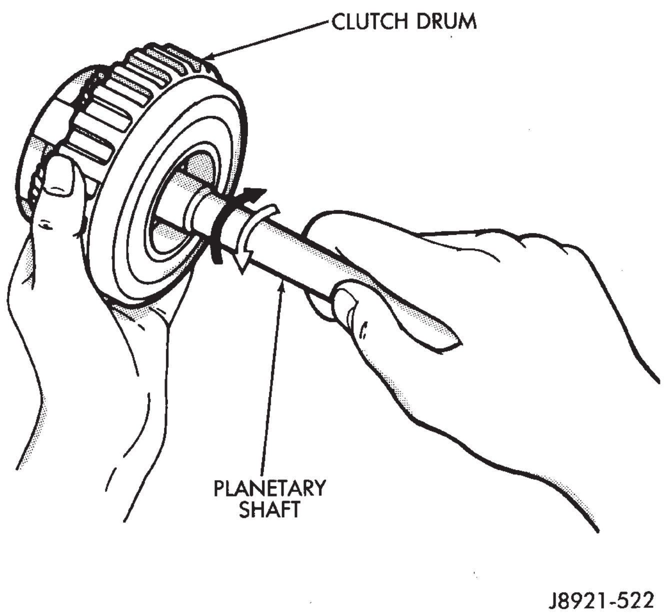


Fig. 192 Checking One–Way Clutch

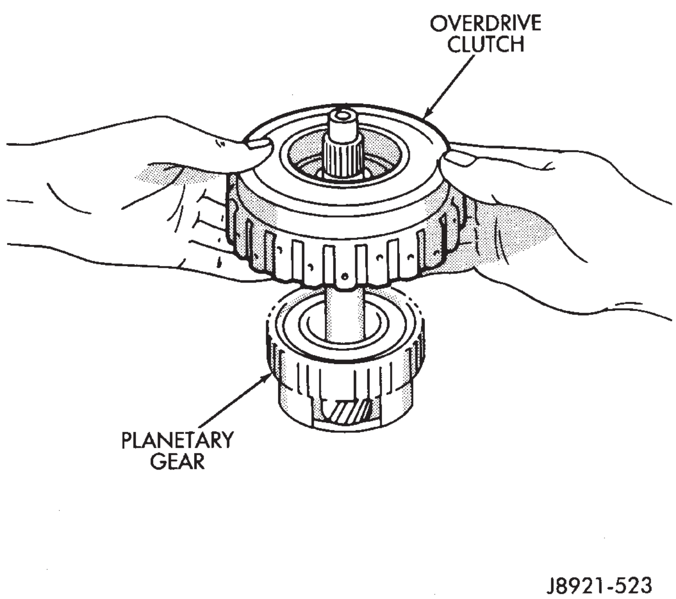


Fig. 193 Removing Overdrive Clutch From Gear

(4) Remove thrust bearing and race assembly from clutch drum (Fig. 195).

(5) Remove clutch pack snap ring and remove the clutch pack (Fig. 196).

(6) Measure overdrive clutch disc thickness. Minimum allowable thickness is 1.84 mm (0.0724 in.).

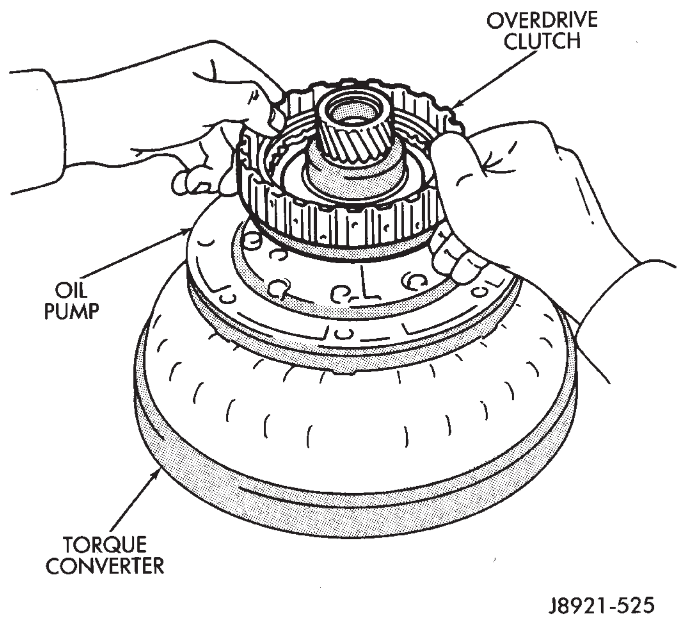


Fig. 194 Assembling Converter, Pump And Clutch For Test

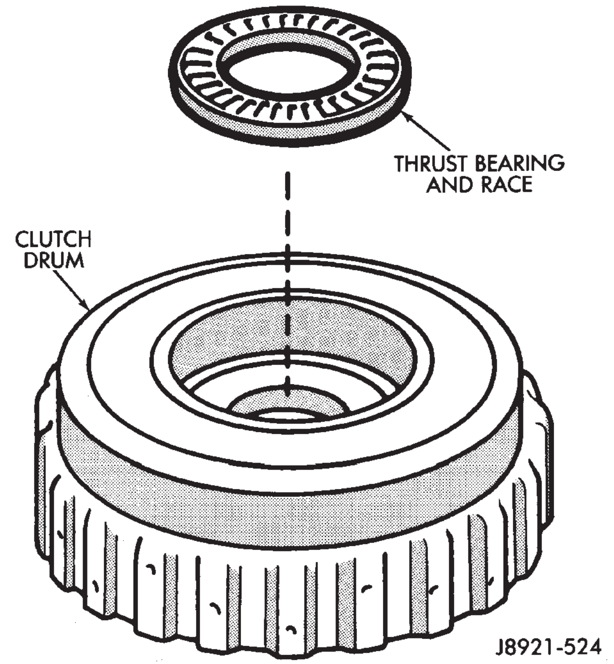


Fig. 195 Removing Clutch Drum Bearing And Race

(7) If the clutch pack stroke length is out of specification or any clutch disc fails to meet the minimum thickness, new discs will need to be installed during assembly.

DISASSEMBLY AND ASSEMBLY (Continued)

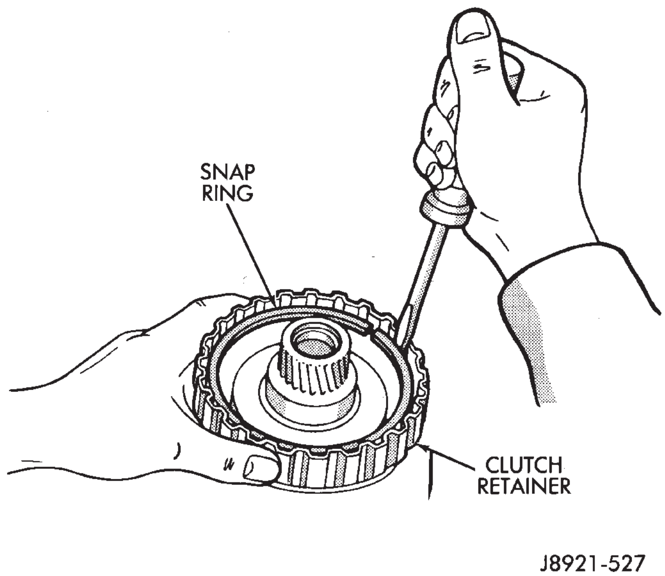


Fig. 196 Removing Clutch Pack Snap Ring

(8) Compress piston return spring with Tool 7538 (Fig. 197). Remove snap ring and remove compressor tool.

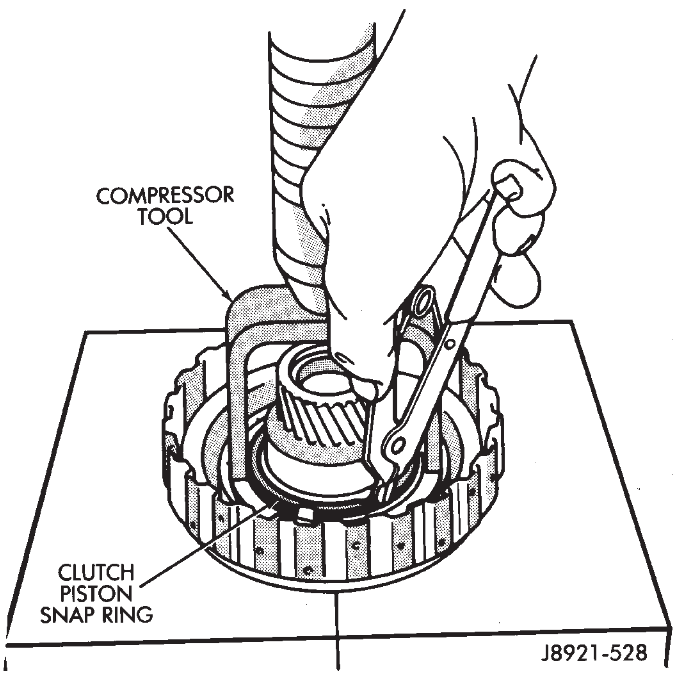


Fig. 197 Removing Clutch Piston Snap Ring

(9) Remove the piston return springs.

(10) Mount oil pump on converter. Then mount clutch on oil pump (Fig. 198).

(11) Hold clutch piston by hand and apply compressed air through oil pump feed hole to ease piston out (Fig. 198). Apply only enough air pressure to remove piston.

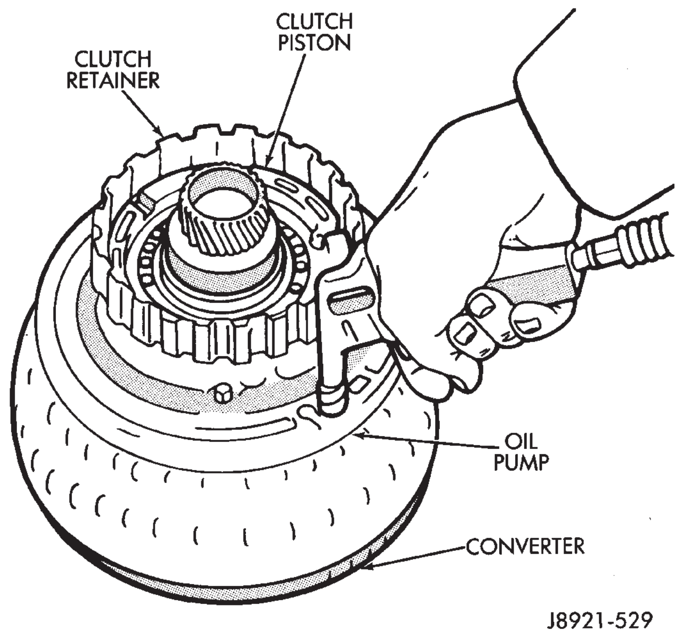


Fig. 198 Removing Overdrive Clutch Piston

(12) Measure free length of piston return springs with springs in retainer (Fig. 199). Length should be 16.8 mm (0.661 in.). Replace spring and retainer assembly if necessary.

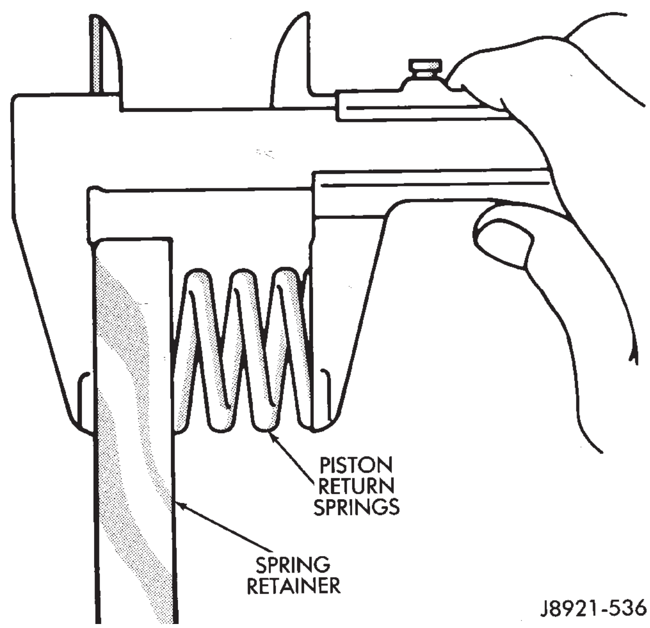


Fig. 199 Checking Piston Return Spring Length

(13) Check clutch piston check ball (Fig. 200). Shake piston to see if ball moves freely. Then check ball sealing by applying low pressure compressed air to ball inlet as shown. Air should not leak past check ball.

DISASSEMBLY AND ASSEMBLY (Continued)

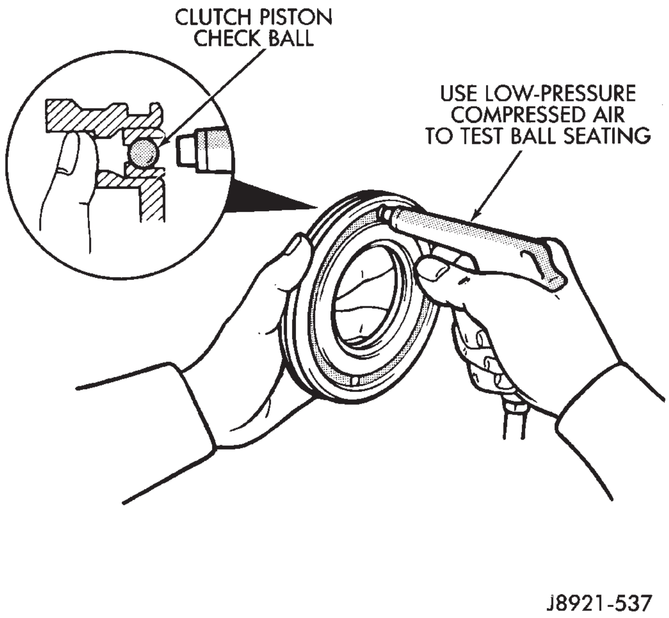


Fig. 200 Testing Clutch Piston Check Ball

(14) Check inside diameter of clutch drum bushings with bore gauge or inside micrometer (Fig. 201). Maximum inside diameter is 27.11 mm (1.0673 in.). Replace drum if bushing inside diameter is greater than specified.

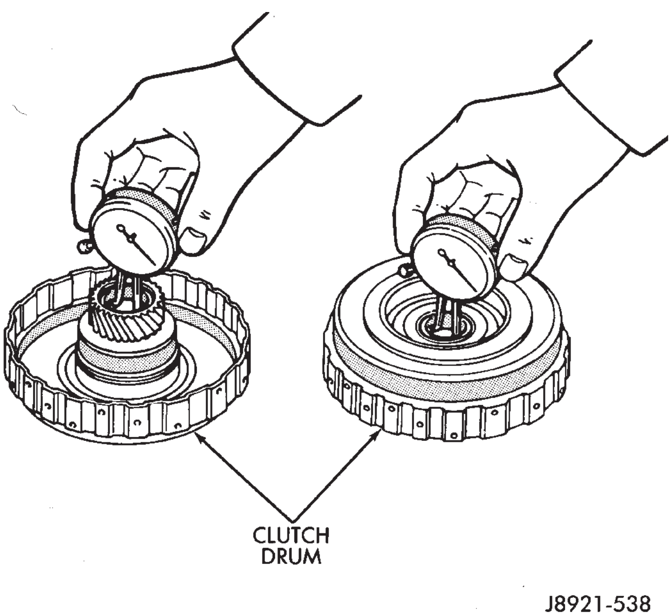


Fig. 201 Checking Clutch Drum Bushings

(15) Remove bearing and race from ring gear (Fig. 202).

(16) Remove snap ring from ring gear and remove ring gear hub (Fig. 203).

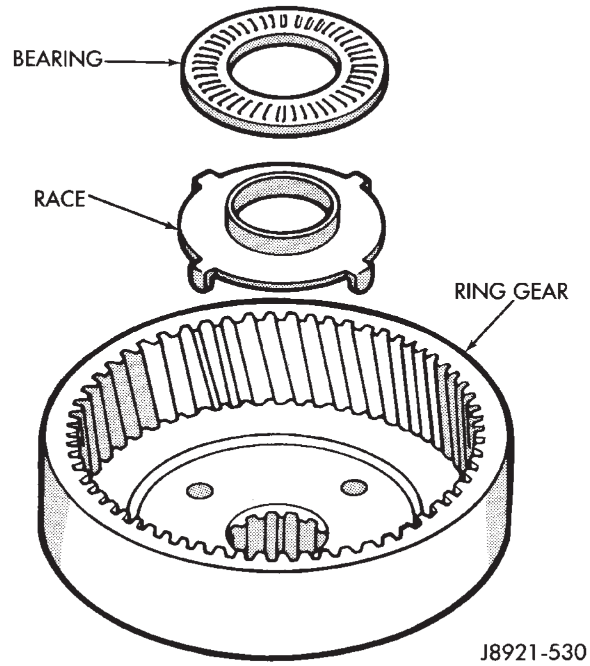


Fig. 202 Removing Ring Gear Bearing And Race

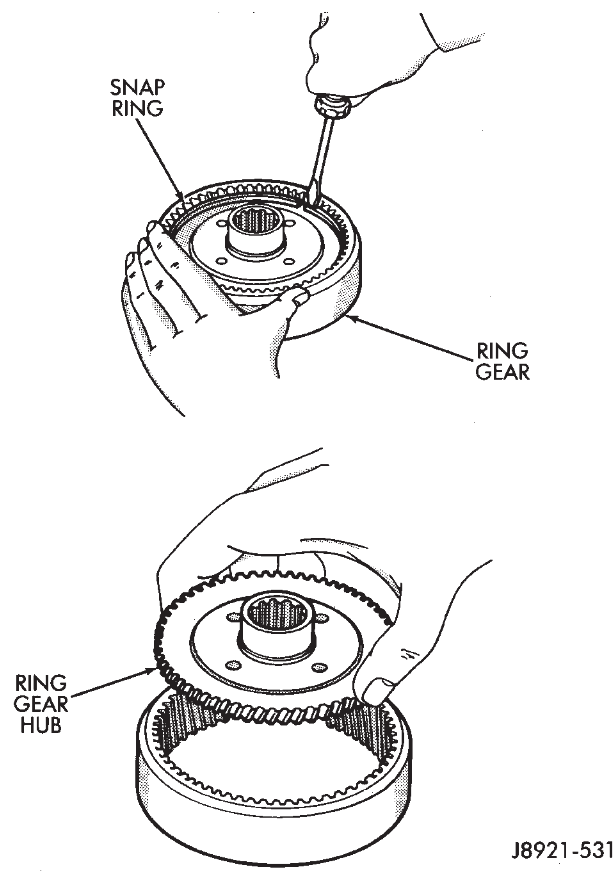


Fig. 203 Removing Ring Gear Hub

DISASSEMBLY AND ASSEMBLY (Continued)

(17) Remove race from planetary gear (Fig. 204).

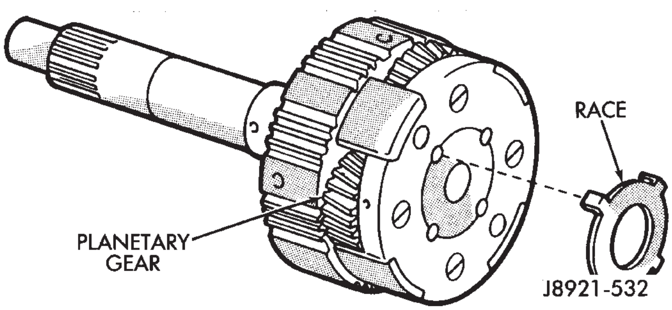


Fig. 204 Remove Planetary Gear Race

(18) Remove snap ring and remove retaining plate (Fig. 205).

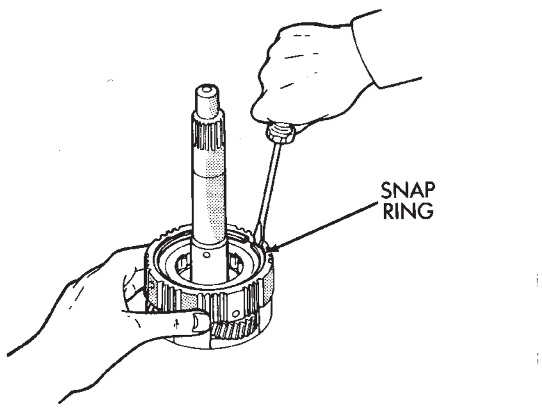


Fig. 205 Removing Snap Ring And Retaining Plate

(19) Remove one–way clutch and outer race as assembly. Then separate race from clutch (Fig. 206).

(20) Remove thrust washer (Fig. 207).

(21) Check inside diameter of planetary gear bushing (Fig. 208). Maximum inside diameter is 11.27 mm (0.4437 in.). Replace planetary gear if bushing inside diameter is greater then specified.

ASSEMBLY

(1) Install thrust washer in planetary gear (Fig. 209). **Grooved side of washer faces up and toward front.**

(2) Install clutch race into planetary gear.

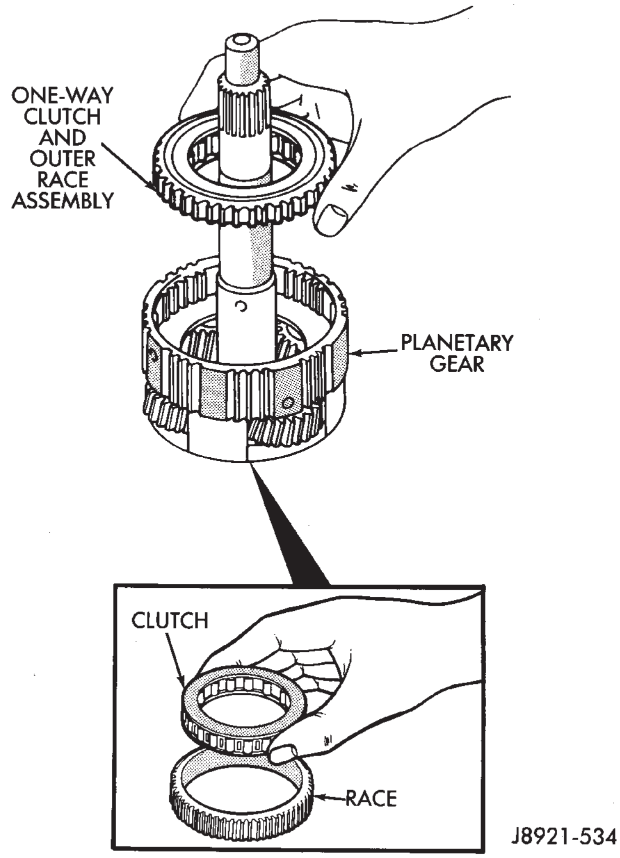


Fig. 206 Removing One–Way Clutch

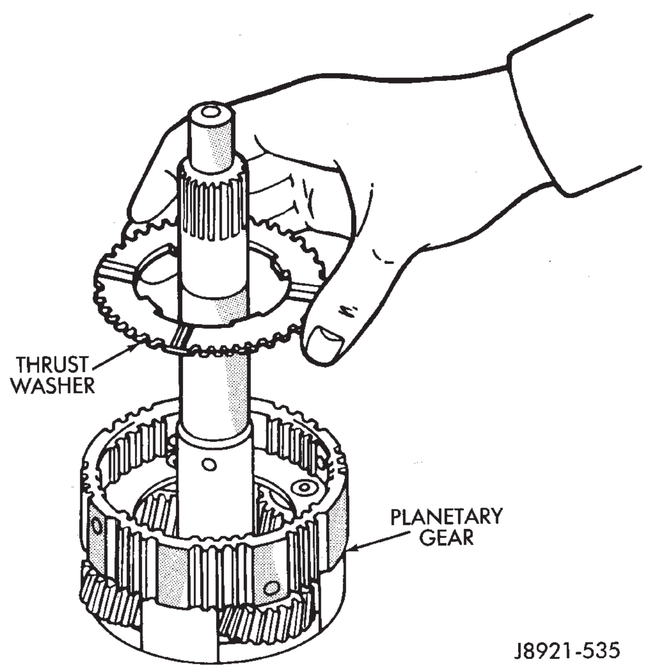


Fig. 207 Removing Planetary Thrust Washer

(3) Install one–way clutch into the outer race (Fig. 210). Be sure flanged side of clutch is facing upward.

(4) Install clutch retaining plate and snap ring in planetary gear.

(5) Coat planetary race with petroleum jelly and install it on planetary gear. Outside diameter of race

DISASSEMBLY AND ASSEMBLY (Continued)

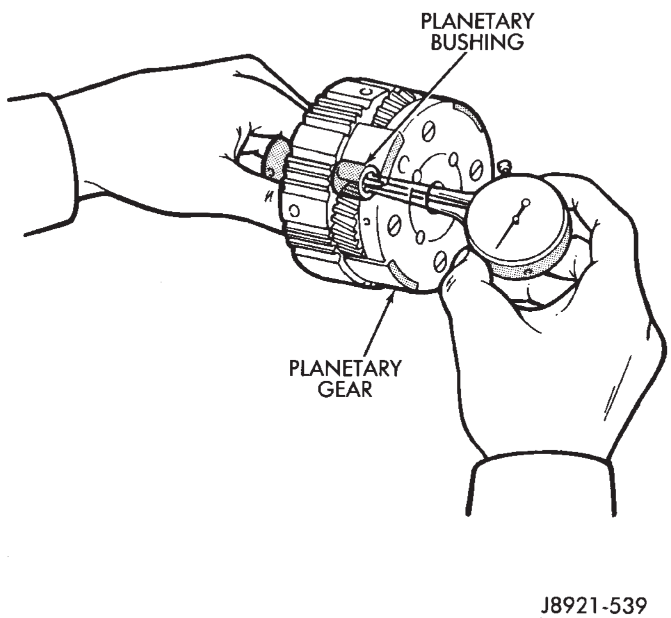


Fig. 208 Checking Planetary Bushing

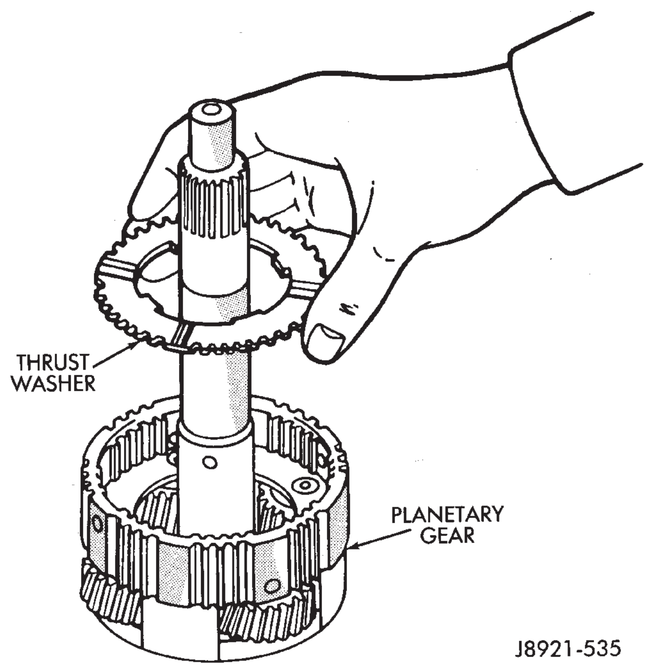


Fig. 209 Install Planetary Thrust Washer

should be 41.8 mm (1.646 in.); inside diameter is 27.1 mm (1.067 in.).

(6) Install hub in planetary ring gear and install snap ring.

(7) Coat race and bearing with petroleum jelly and install in planetary ring gear (Fig. 211).

(8) Verify bearing/race size. Outside diameter of race is 47.8 mm (1.882 in.) and inside diameter is 24.2 mm (0.953 in.). Outside diameter of bearing is 46.8 mm (1.843 in.) and inside diameter is 26 mm (1.024 in.).

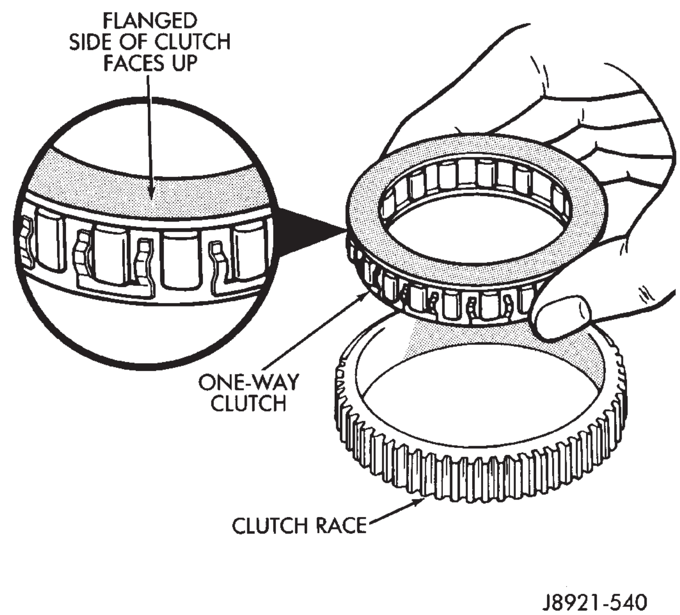


Fig. 210 Assembling One–Way Clutch And Race

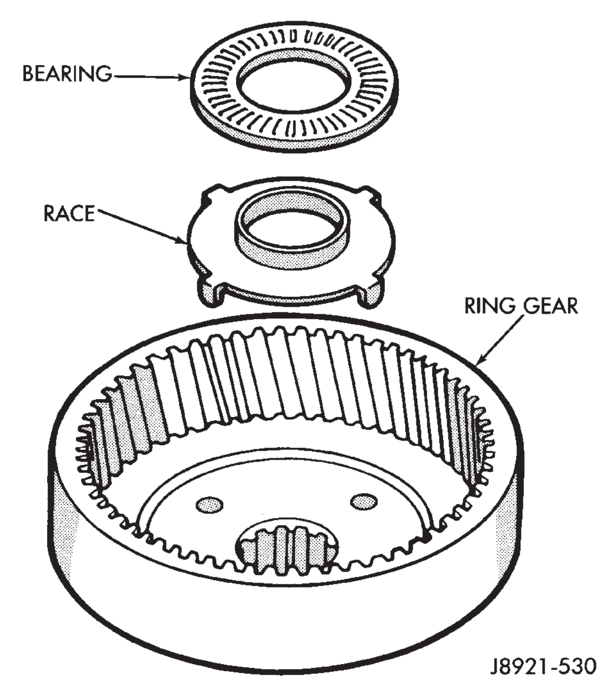


Fig. 211 Install Ring Gear Bearing And Race

(9) Lubricate new clutch piston O–rings with Mopar® Door Ease, or Ru–Glyde. Then install rings on clutch piston and install piston in clutch drum.

(10) Install piston return springs in clutch piston (Fig. 212).

(11) Install piston snap ring. Compress piston return springs with Tool 7538 and shop press (Fig. 213).

(12) Install overdrive clutch pack in drum. Install steel plate first, then a disc (Fig. 214). Continue installation sequence until required number of discs and plates have been installed.

DISASSEMBLY AND ASSEMBLY (Continued)

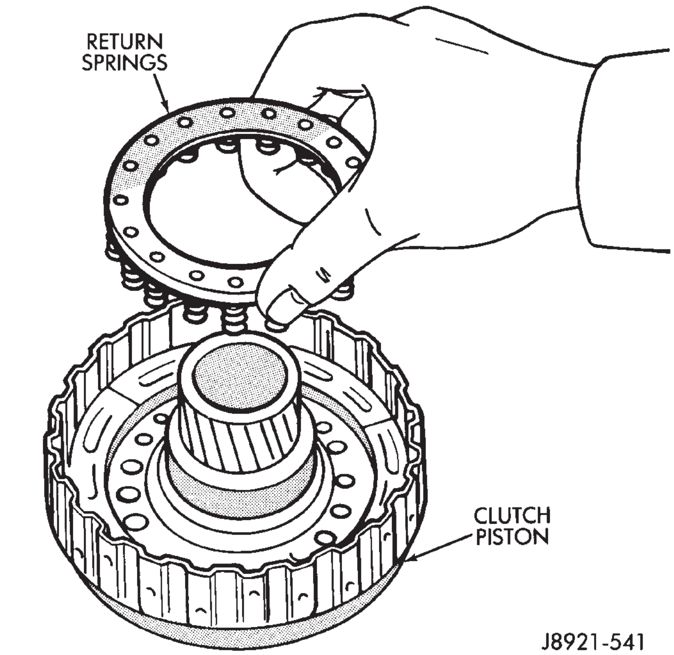


Fig. 212 Installing Piston Return Springs

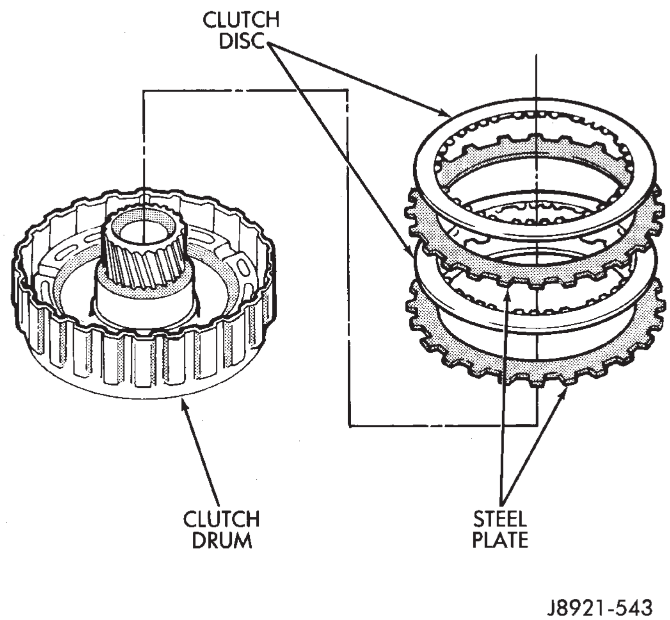


Fig. 214 Installing Overdrive Clutch Discs And Plates

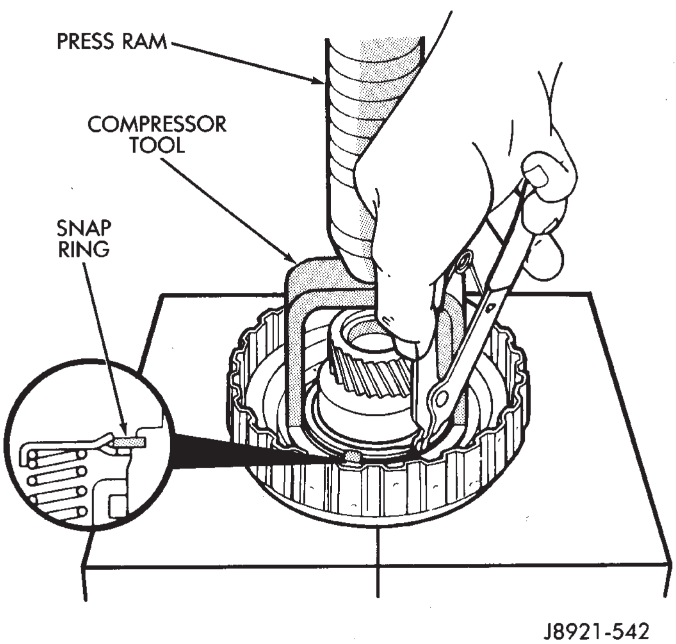


Fig. 213 Installing Clutch Piston Snap Ring

(13) Install clutch pack retainer with flat side facing downward. Then install retainer snap ring (Fig. 215). Compress springs with suitable tool.

(14) Install clutch drum bearing and race assembly (Fig. 216). Be sure bearing rollers face upward as shown. Outside diameter of assembled bearing and race is 50.2 mm (1.976 in.). Inside diameter is 28.9 mm (1.138 in.).

(15) Install clutch on planetary gear.

(16) Verify one–way clutch operation. Hold drum and turn planetary shaft clockwise and counterclockwise. Shaft should turn clockwise freely but lock when turned counterclockwise.

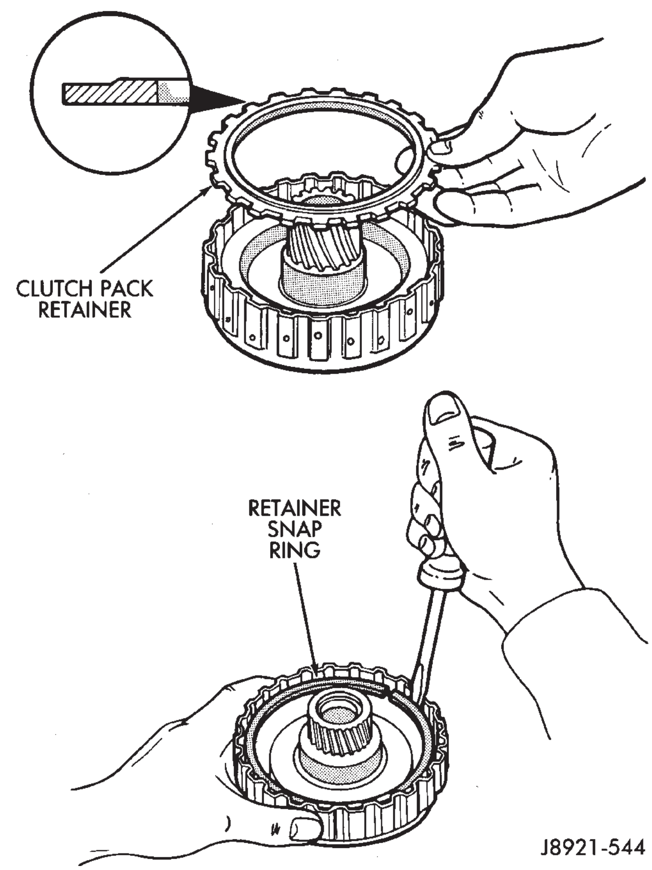


Fig. 215 Installing Retainer And Snap Ring

OVERDRIVE SUPPORT

DISASSEMBLY

(1) Check brake piston operation. Mount support on clutch (Fig. 217).

DISASSEMBLY AND ASSEMBLY (Continued)

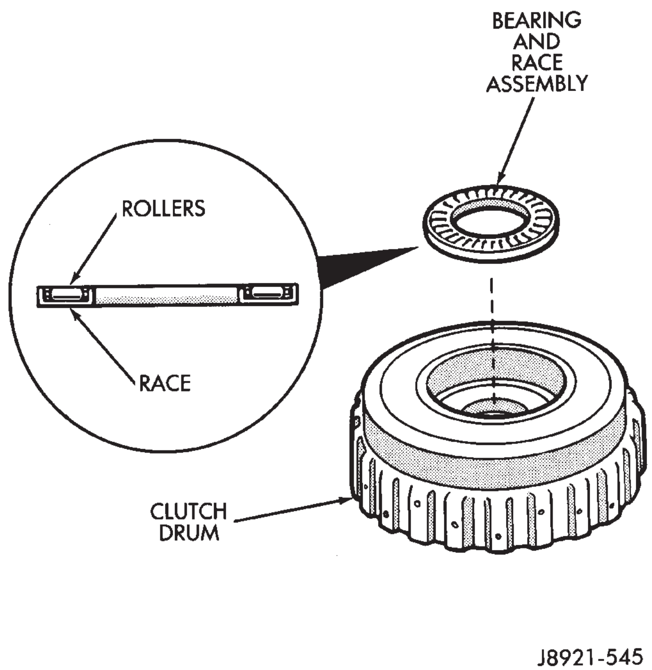


Fig. 216 Installing Clutch Drum Bearing And Race Assembly

(2) Apply compressed air through support feed hole and observe brake piston movement (Fig. 217). Piston should move smoothly and not bind or stick. If operation is incorrect, replace piston and support.

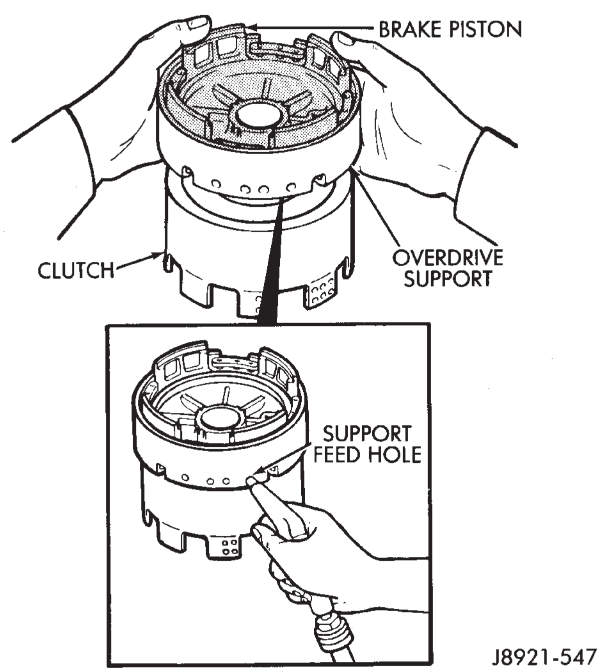


Fig. 217 Checking Brake Piston Movement

(3) Remove thrust bearing front race, thrust bearing and rear race (Fig. 218).

(4) Turn overdrive support over and remove bearing race and clutch drum thrust washer (Fig. 219).

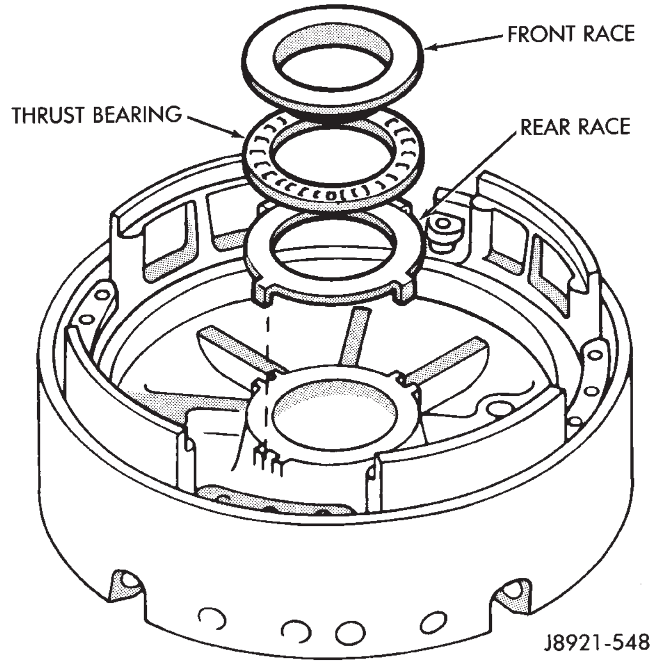


Fig. 218 Removing Support Thrust Bearing And Races

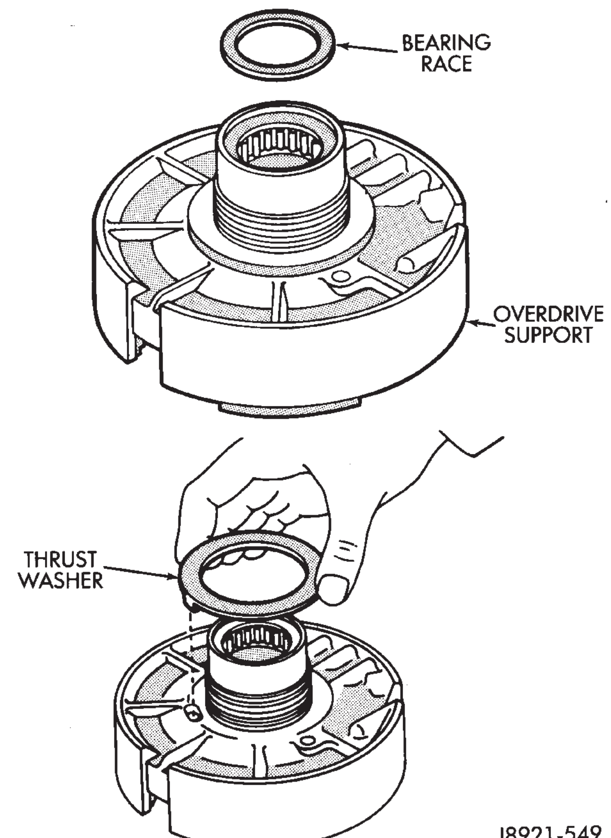


Fig. 219 Removing Clutch Drum Thrust Washer And Race

(5) Compress piston return spring with Spring Compressor 7537 and remove piston snap ring (Fig. 220).

DISASSEMBLY AND ASSEMBLY (Continued)

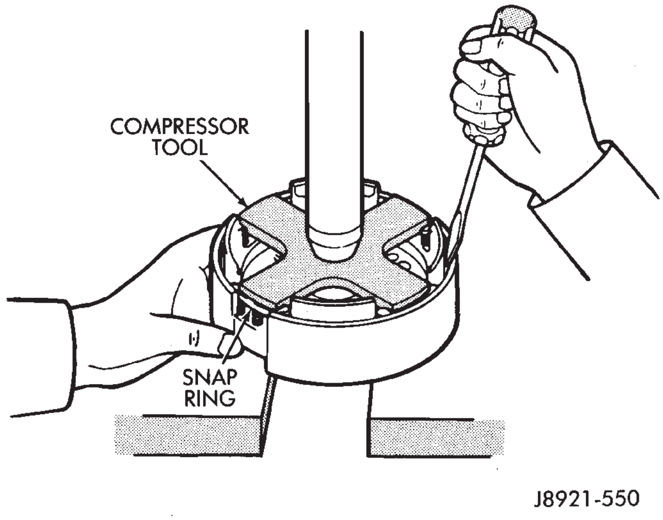


Fig. 220 Removing/Installing Piston Snap Ring

(6) Mount support in direct clutch and remove brake piston with compressed air. Apply air to same feed hole used when checking piston operation.

(7) Remove and discard support O–rings (Fig. 221).

(8) Remove support seal rings (Fig. 222).

(9) Measure free length of piston return springs with springs mounted in retainer (Fig. 223). Length should be 17.23 mm (0.678 in.).

(10) Clean support components and dry them with compressed air.

(11) Inspect overdrive support and brake piston. Replace support and piston if either part is worn or damaged.

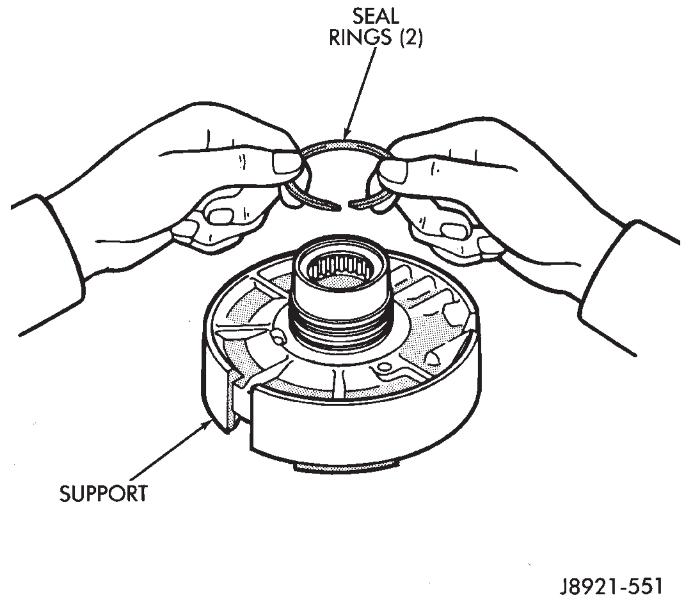


Fig. 222 Removing Support Seal Rings

ASSEMBLY

(1) Lubricate new support seal rings. Then compress rings and install them on support (Fig. 224).

(2) Lubricate and install new O–rings on brake piston. Then carefully seat piston in support.

(3) Install return springs on brake piston.

(4) Compress return springs with Spring Compressor 7537 (Fig. 220) and install piston snap ring.

(5) Install support bearing race and clutch drum thrust washer (Fig. 219).

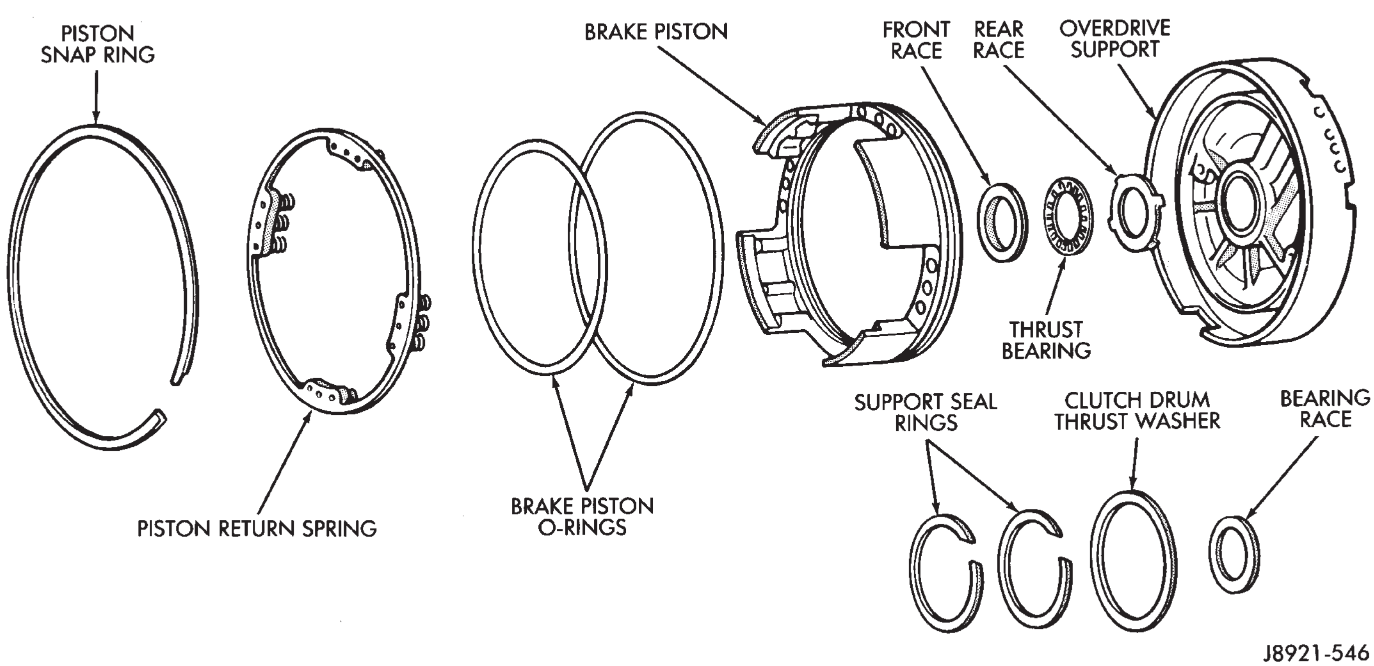


Fig. 221 Overdrive Support Components

DISASSEMBLY AND ASSEMBLY (Continued)

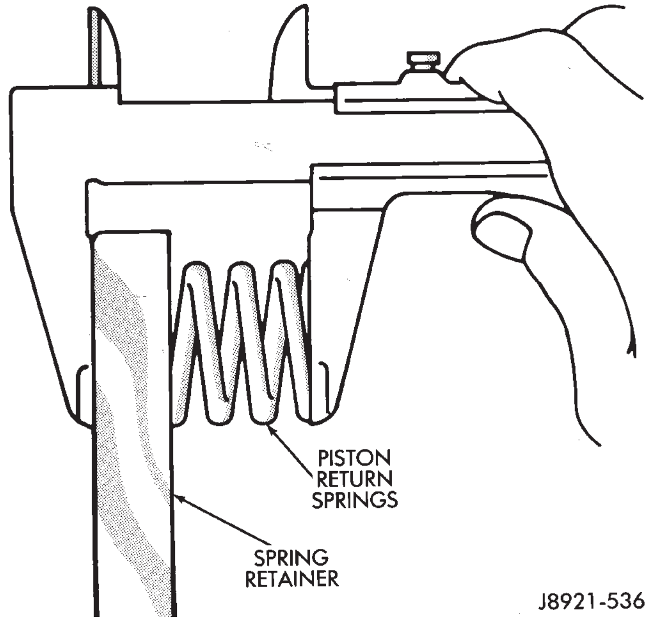


Fig. 223 Checking Piston Return Spring Length

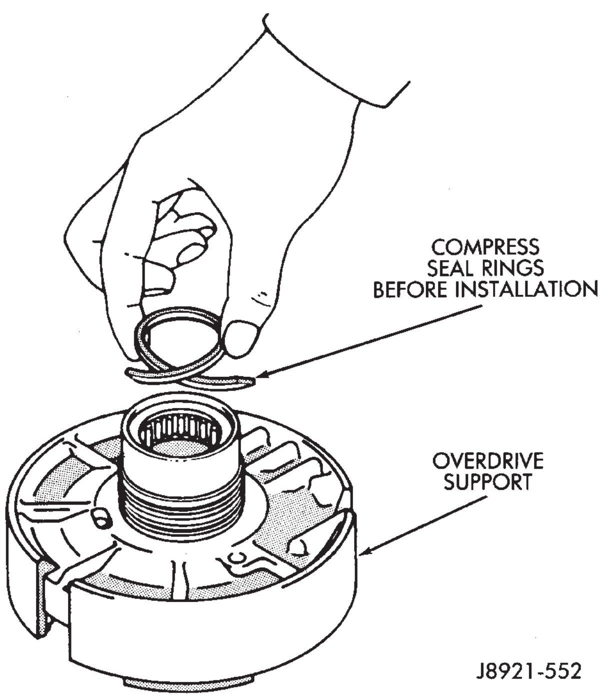


Fig. 224 Installing Support Seal Rings

(6) Install thrust bearing and front and rear bearing races. Thrust bearing rollers should face upward as shown (Fig. 224).

(7) Verify thrust bearing/race sizes (Fig. 225).

- Front race outer diameter is 47.8 mm (1.882 in.) and inside diameter is 30.7 mm (1.209 in.).
- Rear race outer diameter is 47.8 mm (1.882 in.) and inside diameter is 34.3 mm (1.350 in.).
- Bearing outer diameter is 47.7 mm (1.878 in.) and inside diameter is 32.7 mm (1.287 in.).

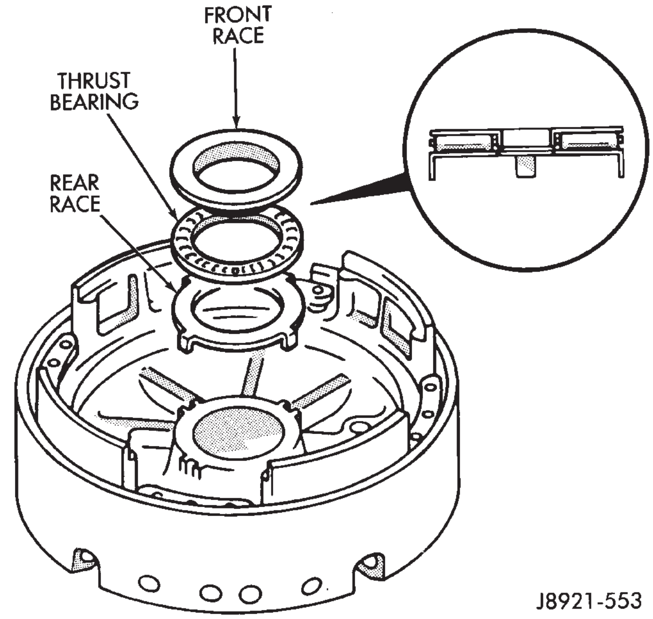


Fig. 225 Installing Support Thrust Bearing And Races

(8) Verify brake piston operation. Use same procedure described at beginning of disassembly. Piston should operate smoothly and not bind or stick.

DIRECT CLUTCH

DISASSEMBLY

(1) Remove direct clutch from forward clutch (Fig. 226).

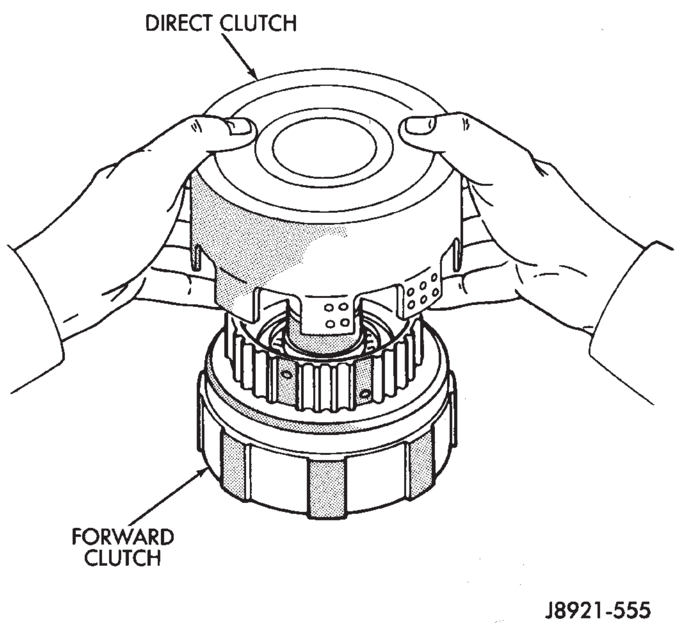


Fig. 226 Separate Direct Clutch From Forward Clutch

(2) Remove clutch drum thrust washer (Fig. 227).

DISASSEMBLY AND ASSEMBLY (Continued)

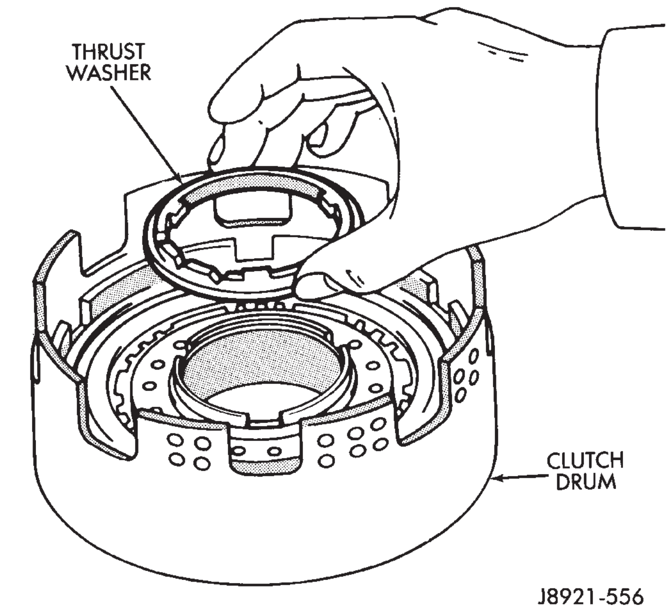


Fig. 227 Removing Clutch Drum Thrust Washer

(3) Check clutch piston stroke length as outlined in following steps.

(4) Mount direct clutch on overdrive support assembly (Fig. 228).

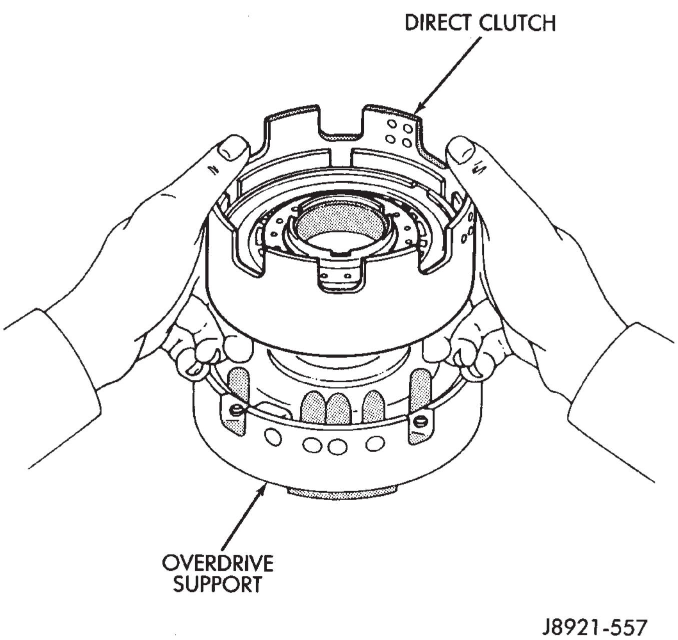


Fig. 228 Mount Direct Clutch On Overdrive Support

(5) Mount dial indicator on clutch and position indicator plunger on clutch piston (Fig. 229).

(6) Apply 57–114 psi air pressure through feed hole in overdrive support and note piston stroke length (Fig. 229). Check stroke at least twice.

(7) Piston stroke length should be 1.37 mm – 1.67 mm (0.054 – 0.065 in.). If stroke length is incorrect,

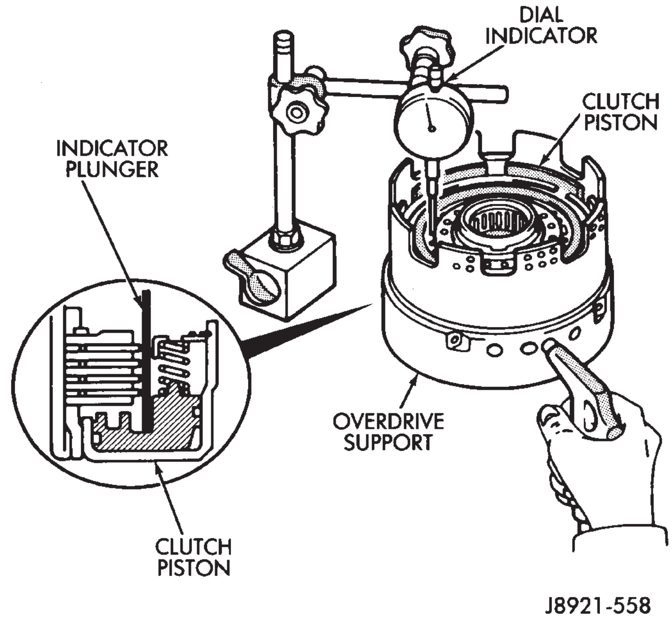


Fig. 229 Checking Direct Clutch Piston Stroke Length

either the clutch pack retainer or clutch discs will have to be replaced.

(8) Remove clutch pack snap ring and remove retainer and clutch pack from drum (Fig. 230).

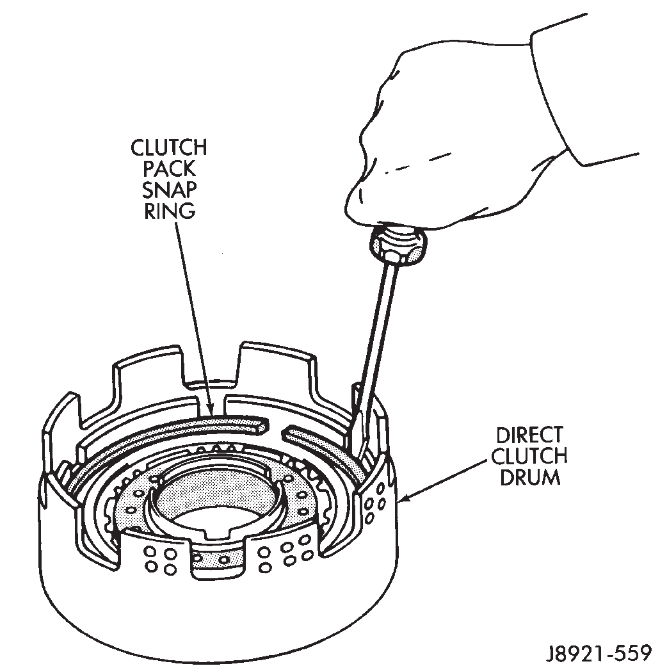


Fig. 230 Removing Clutch Pack Snap Ring

(9) Compress clutch piston return springs with tool 7538 and remove clutch piston snap ring (Fig. 231).

(10) Remove compressor tool and return spring.

(11) Remove clutch piston. Remount clutch on overdrive support (Fig. 232). Apply compressed air

DISASSEMBLY AND ASSEMBLY (Continued)

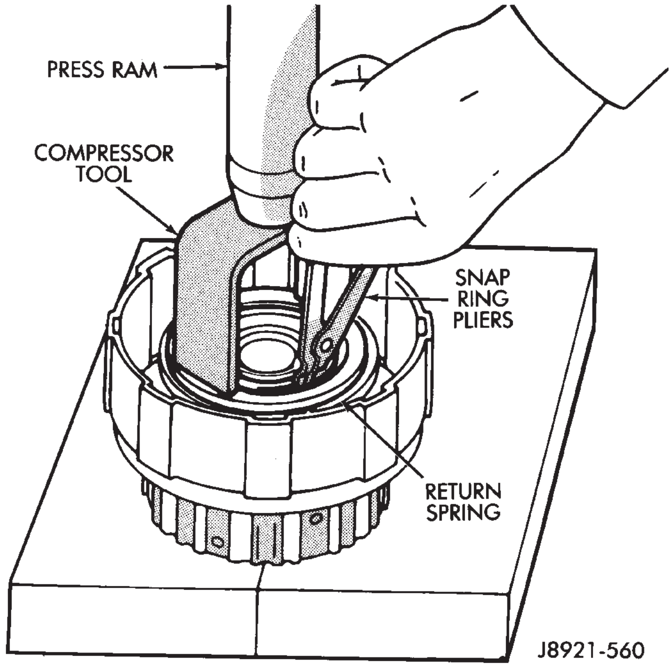


Fig. 231 Removing Piston Return Spring

through piston feed hole in support to remove piston. Use only enough air to ease piston out.

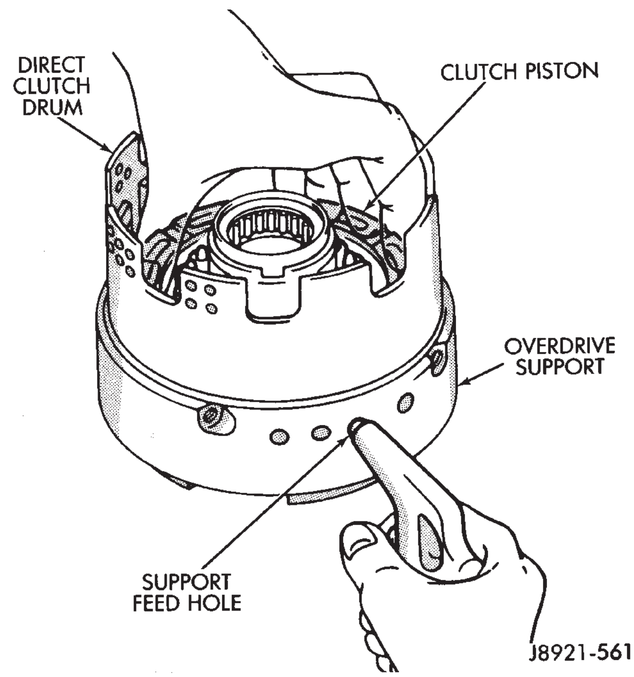


Fig. 232 Removing Direct Clutch Piston

(12) Remove and discard clutch piston O–rings.

(13) Measure clutch disc thickness. Minimum allowable thickness is 1.84 mm (0.0724 in). Replace clutch pack if any disc is below minimum thickness.

(14) Measure free length of piston return springs with springs in retainer (Fig. 233). Length should be 21.32 mm (0.839 in.). Replace return springs if not within specification.

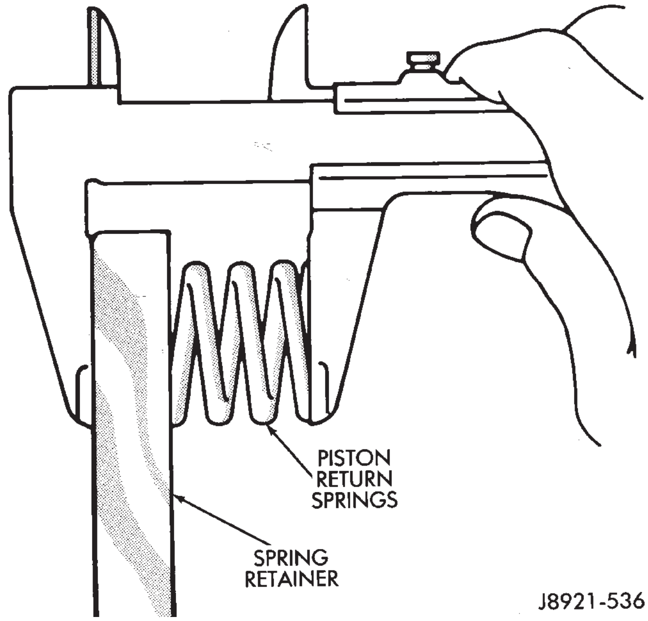


Fig. 233 Checking Piston Return Spring Length

(15) Check clutch piston check ball (Fig. 234). Shake piston to see if ball moves freely. Then check ball seating by applying low pressure compressed air to ball inlet as shown. Air should not leak past check ball.

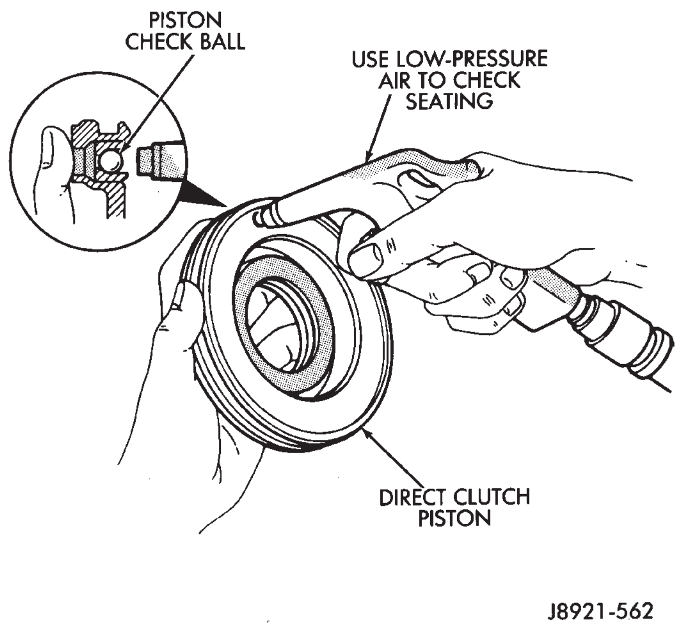


Fig. 234 Testing Piston Check Ball Seating

(16) Measure inside diameter of clutch drum bushing. Inside diameter should be no more than 53.97 mm (2.1248 in.). Replace drum if bushing inside diameter is greater than specified.

ASSEMBLY

(1) Lubricate and install replacement O–rings on clutch piston (Fig. 235).

DISASSEMBLY AND ASSEMBLY (Continued)

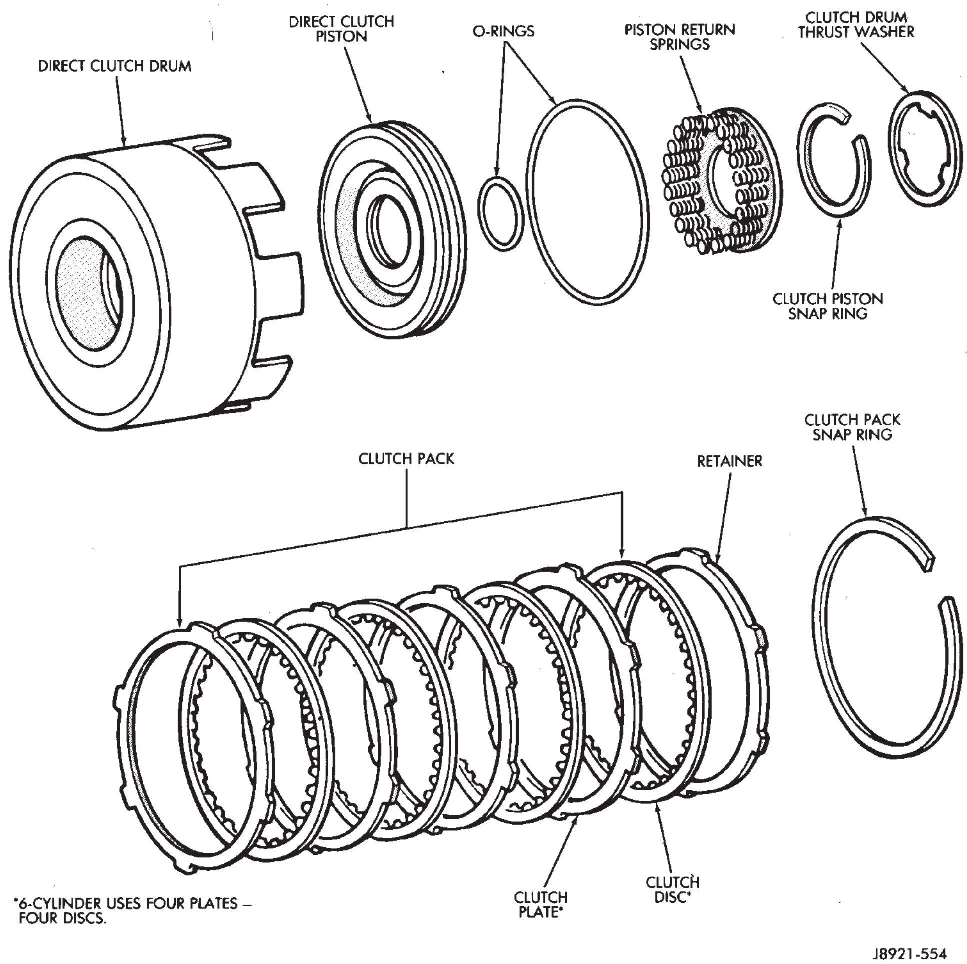


Fig. 235 Direct Clutch Components

(2) Install clutch piston in drum and install return springs on piston.

(3) Compress piston return springs with Tool 7538 and install snap ring (Fig. 231). Be sure snap ring end gap is not aligned with spring retainer tab.

(4) Install clutch discs and plates (Fig. 236). Install plate then disc until all plates and discs are installed. Four plates and discs are required.

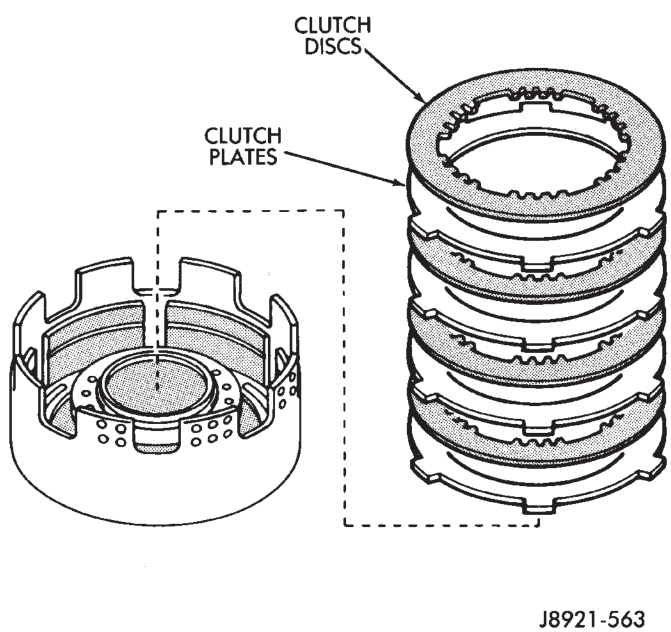


Fig. 236 Installing Direct Clutch Discs And Plates

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Install clutch pack retainer in drum (Fig. 237).

(6) Install clutch pack snap ring (Fig. 237).

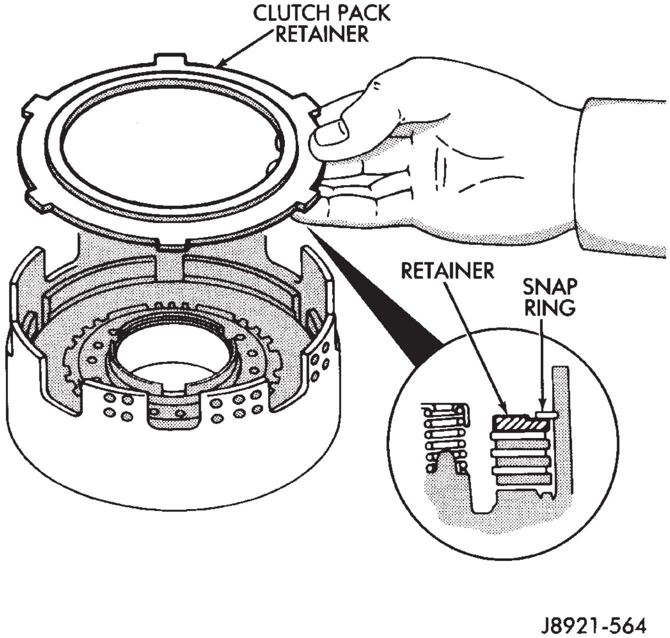


Fig. 237 Install Clutch Pack Retainer

(7) Check snap ring position. If necessary, shift snap ring until end gap is **not** aligned with any notches in clutch drum (Fig. 238).

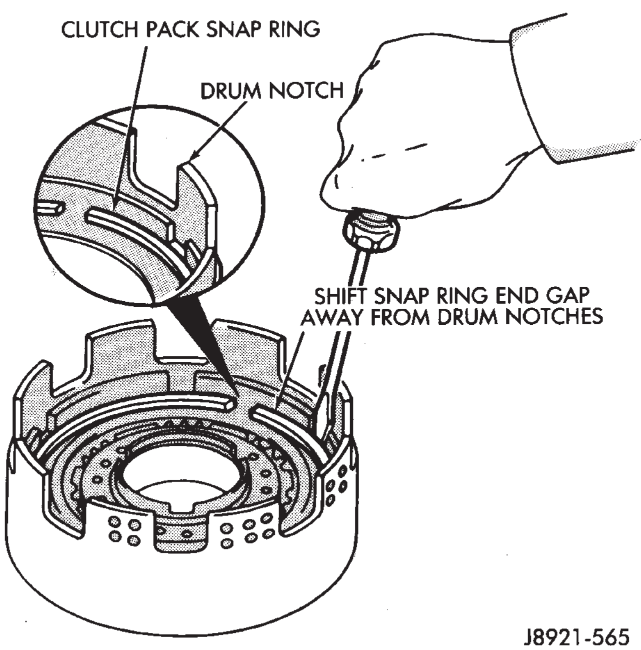


Fig. 238 Adjusting Clutch Pack Snap Ring Position

(8) Lubricate clutch drum thrust washer with petroleum jelly and install it in drum (Fig. 228).

(9) Mount direct clutch assembly on forward clutch assembly and check assembled height (Fig. 239). Height should be 70.3 to 71.5 mm (2.767 to 2.815 in.).

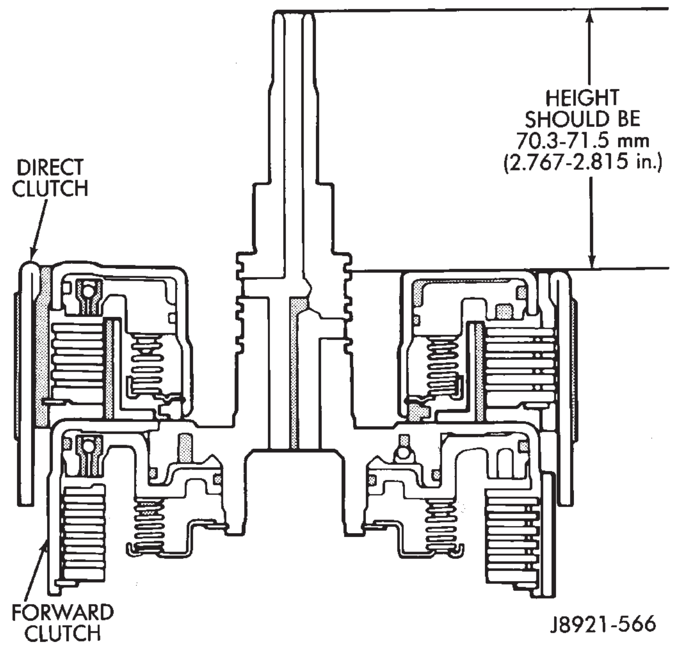


Fig. 239 Checking Direct Clutch Assembled Height

(10) If assembled height is incorrect, clutches are not seated.

FORWARD CLUTCH

DISASSEMBLY

(1) Check clutch piston stroke as outlined in following steps.

(2) Position overdrive support on wood blocks and mount forward clutch drum on support (Fig. 241).

(3) Remove bearing and race from forward clutch drum (Fig. 241).

(4) Install a suitable threaded bolt/rod into the side of the overdrive support.

(5) Mount Miller Tool C-3339 dial indicator components onto the threaded rod as necessary.

(6) Position dial indicator plunger squarely against clutch piston.

(7) Apply compressed air through right side feed hole in support and note piston stroke length on dial indicator.

(8) Stroke length should be 3.55 – 3.73 mm (0.1348 – 0.1469 in.).

(9) Replace clutch discs if stroke length is incorrect.

(10) Remove clutch pack snap ring and remove retainer and clutch pack (Fig. 242).

(11) Remove clutch pack cushion plate (Fig. 243).

(12) Compress clutch springs with Tool 7538 and remove piston snap ring.

(13) Remove spring compressor tool and piston return springs.

(14) Remount forward clutch drum on overdrive support (Fig. 244).

DISASSEMBLY AND ASSEMBLY (Continued)

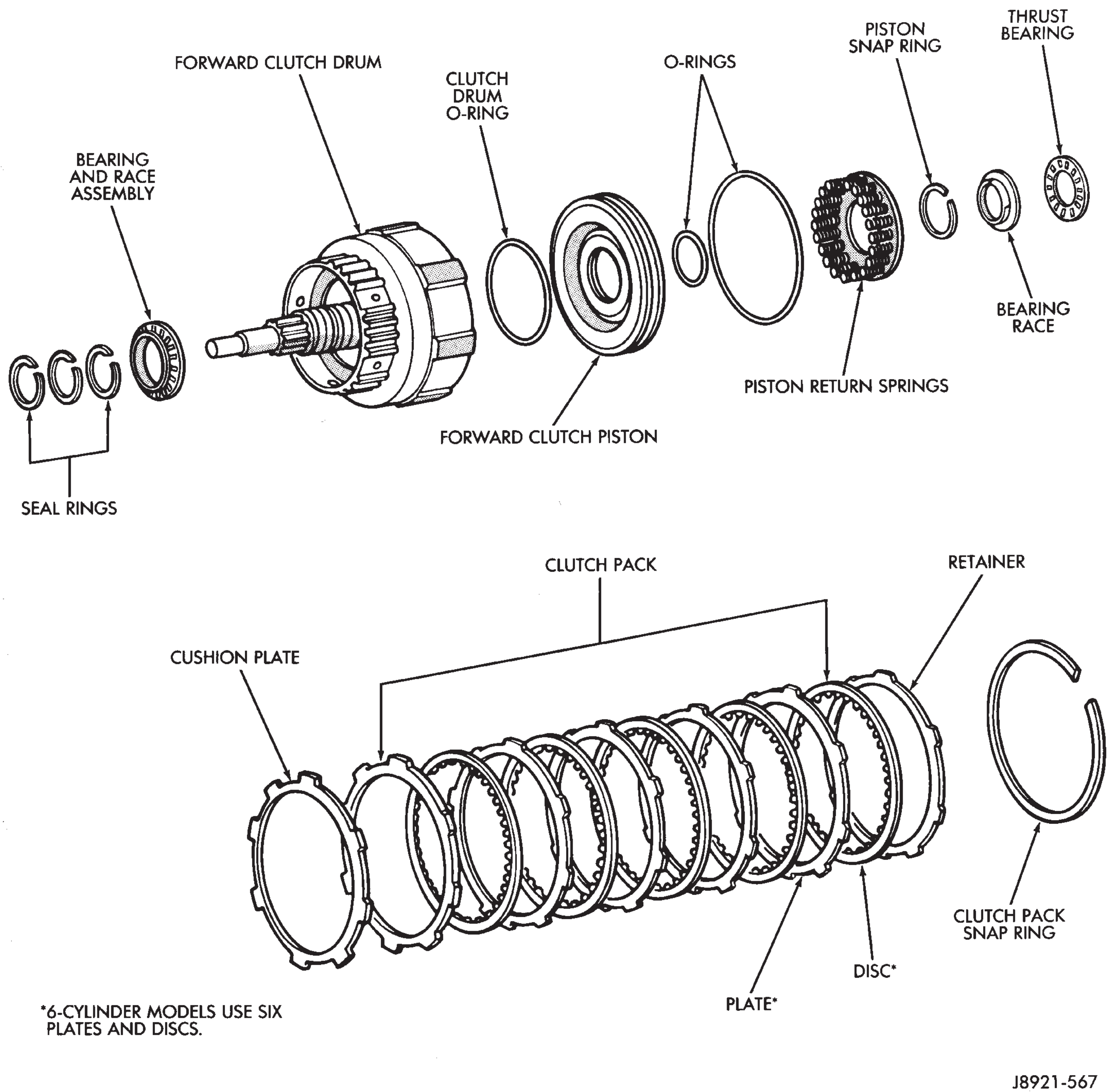


Fig. 240 Forward Clutch Components

(15) Apply compressed air through feed hole in support to remove piston (Fig. 244). Use only enough air pressure to ease piston out of drum.

(16) Remove and discard clutch piston O–rings (Fig. 245).

(17) Remove clutch drum O–ring from rear hub of drum.

(18) Remove three seal rings from clutch drum shaft (Fig. 246).

(19) Remove thrust bearing and race assembly from clutch drum (Fig. 247).

(20) Measure clutch disc thickness (Fig. 248). Minimum allowable thickness is 1.51 mm (0.0595 in.). Replace clutch pack if any disc falls below specified minimum thickness.

(21) Measure free length of piston return springs with springs mounted in retainer (Fig. 249). Length should be 19.47 mm (0.767 in.). Replace springs and retainer if length is incorrect.

(22) Inspect clutch piston check ball (Fig. 250). Ball should move freely within piston. Check ball seating by applying low pressure compressed air to

DISASSEMBLY AND ASSEMBLY (Continued)

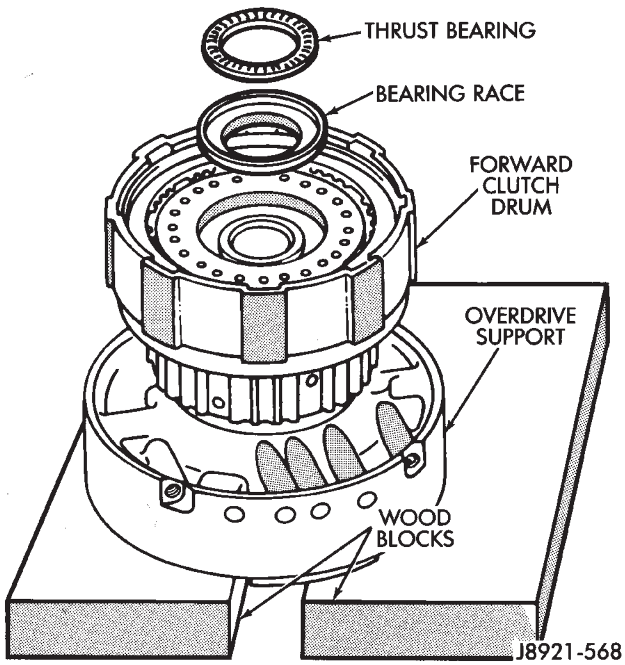


Fig. 241 Positioning Drum And Support On Wood Blocks

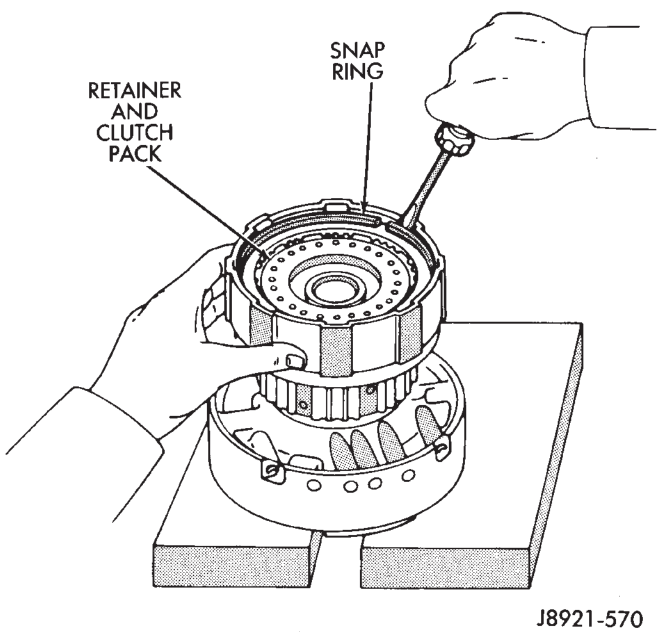


Fig. 242 Removing Retainer And Clutch Pack

ball feed hole. Ball should seat firmly and not leak air.

(23) Measure inside diameter of bushing in clutch drum hub. Maximum allowable diameter is 24.08 mm (0.9480 in.). Replace clutch drum if bushing inside diameter is greater than specified.

ASSEMBLY

(1) Lubricate bearing and race assembly with petroleum jelly and install it in clutch drum (Fig.

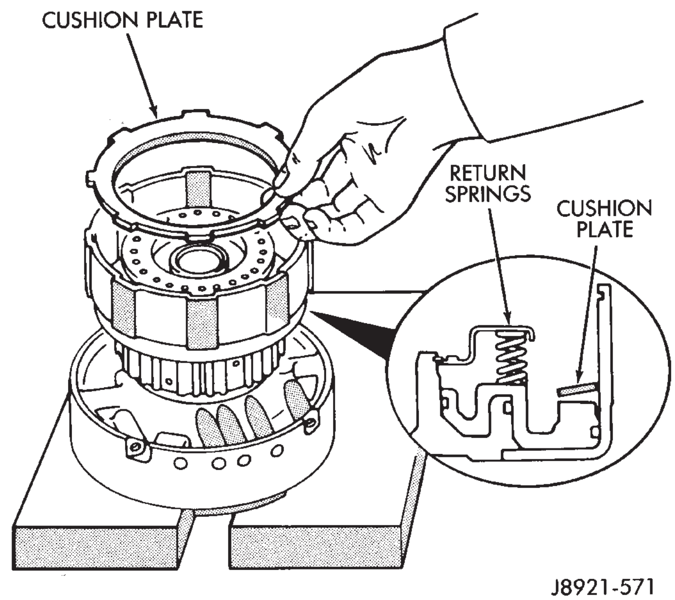


Fig. 243 Removing Cushion Plate

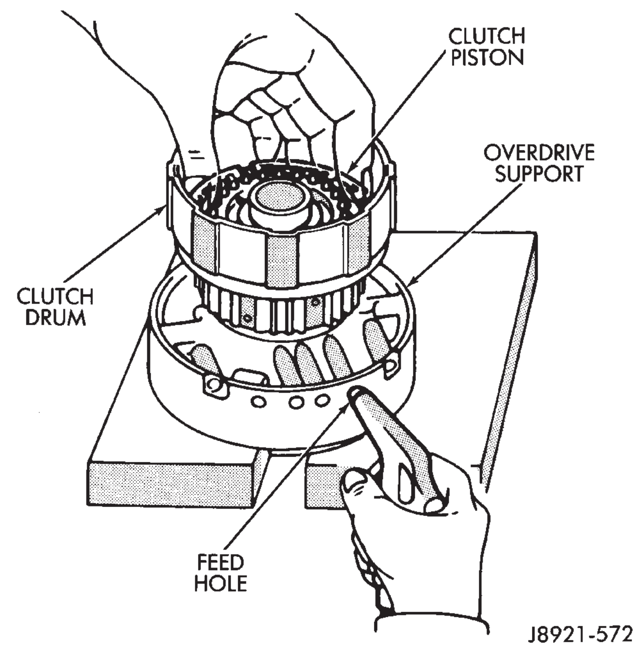


Fig. 244 Removing Forward Clutch Piston

251). Race side of assembly faces downward and toward drum. Bearing rollers face up (Fig. 251)

(2) Coat new clutch drum shaft seal rings with petroleum jelly. Before installing drum shaft seal rings, squeeze each ring so ring ends overlap (Fig. 252). This tightens ring making clutch installation easier.

(3) Install seal rings on shaft. Keep rings closed as tightly as possible during installation. Avoid over-spreading them.

(4) Mount clutch drum on overdrive support.

(5) Lubricate and install new O–ring on clutch drum hub (Fig. 245).

DISASSEMBLY AND ASSEMBLY (Continued)

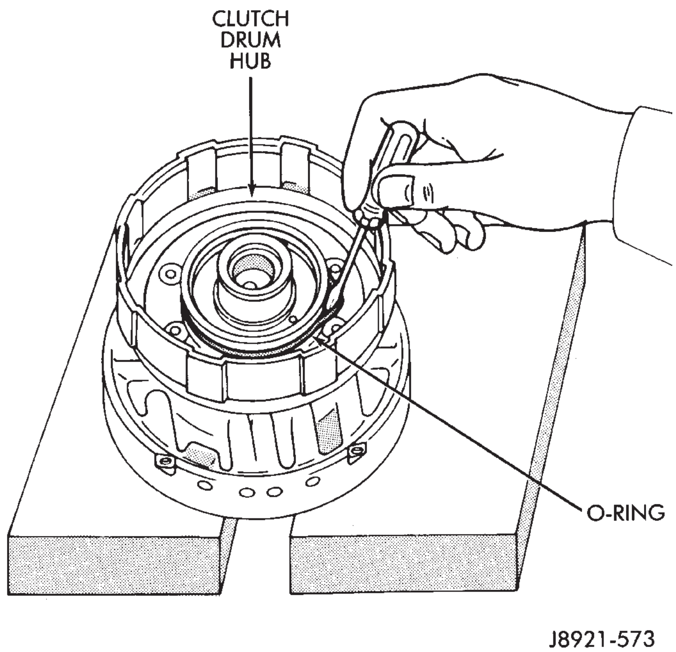


Fig. 245 Removing/Installing Clutch Drum O–Ring

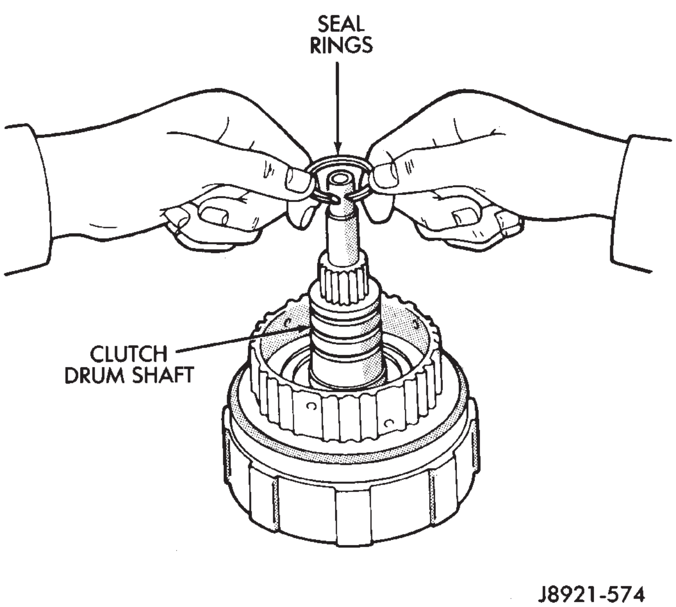


Fig. 246 Removing Clutch Drum Seal Rings

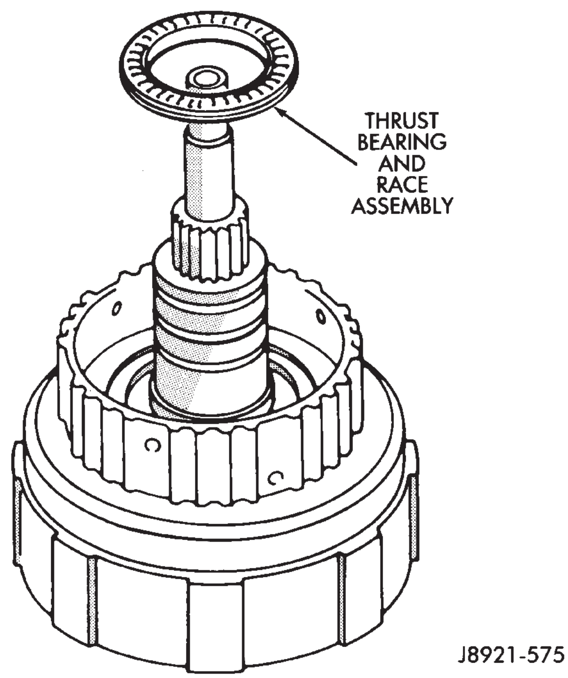


Fig. 247 Removing Clutch Drum Thrust Bearing Assembly

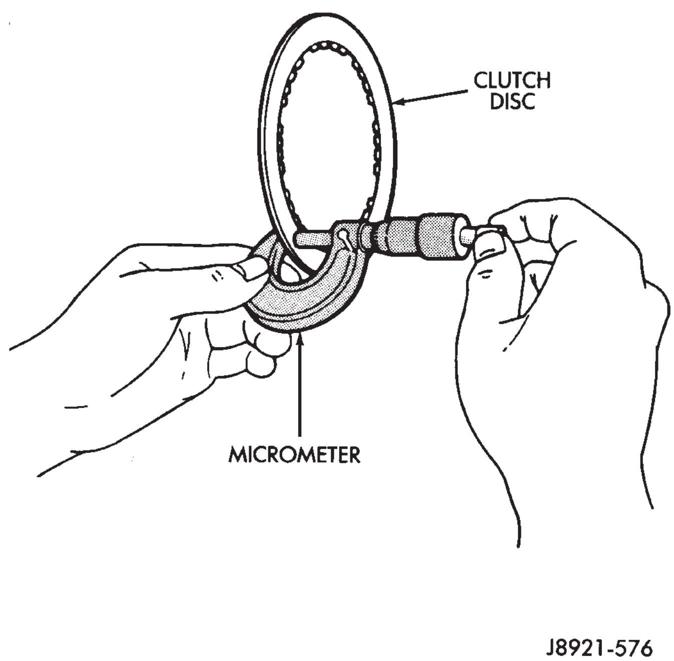


Fig. 248 Measuring Clutch Disc Thickness

(6) Lubricate new clutch piston O–rings with Mopar Door Ease, or Ru–Glyde. Install rings on clutch piston and install piston in drum.

(7) Install piston return springs.

(8) Compress piston return springs with Tool 7538 and shop press and install piston snap ring. Be sure snap ring end gap is not aligned with any notches in drum.

(9) Install cushion plate in drum. Concave side of plate faces downward (Fig. 243).

(10) Install clutch discs, plates and retainer (Fig. 253). Install tabbed plate followed by disc until required number of plates and discs are installed. Use six plates and discs.

(11) Install clutch pack snap ring.

(12) Recheck clutch piston stroke length using same method outlined at beginning of disassembly procedure. If stroke length is not within specified limits, replace clutch discs.

(13) Lubricate race and bearing with petroleum jelly and install them in clutch drum (Fig. 254). Be

DISASSEMBLY AND ASSEMBLY (Continued)

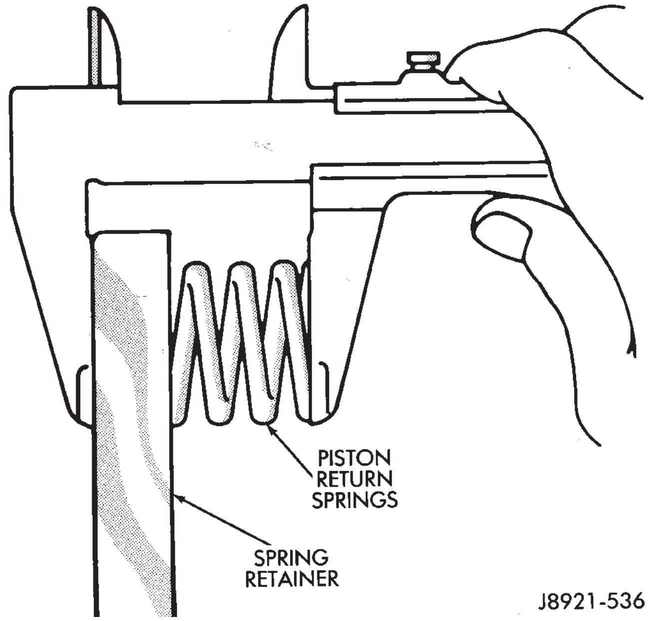


Fig. 249 Checking Return Spring Length

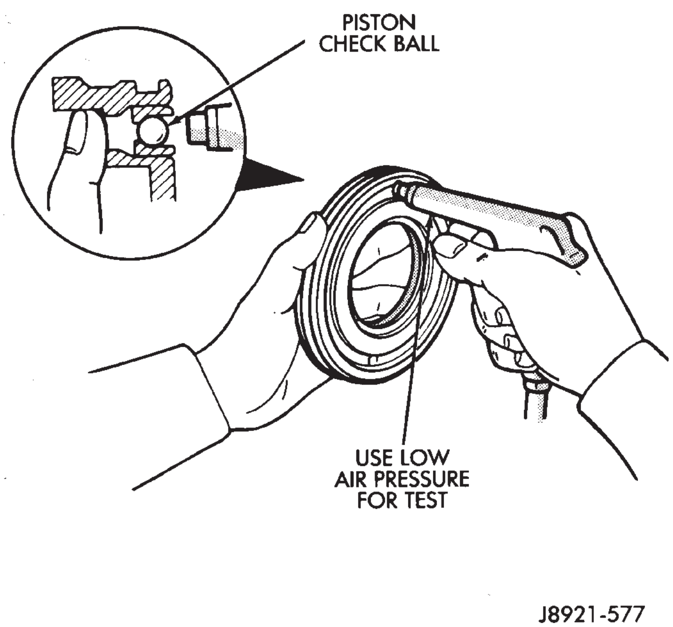


Fig. 250 Testing Piston Check Ball

sure bearing rollers face up and race lip seats in drum as shown.

(14) Verify bearing and race size.

• Outer diameter of bearing is 46.7 mm (1.839 in).
• Outer diameter of race is 48.9 mm (1.925 in.).
• Inner diameter of bearing and race is 26.0 mm (1.024 in.).

(15) Mount forward clutch on direct clutch and check assembled height (Fig. 255). Height should be 70.3 – 71.5 mm (2.767 – 2.815 in.).

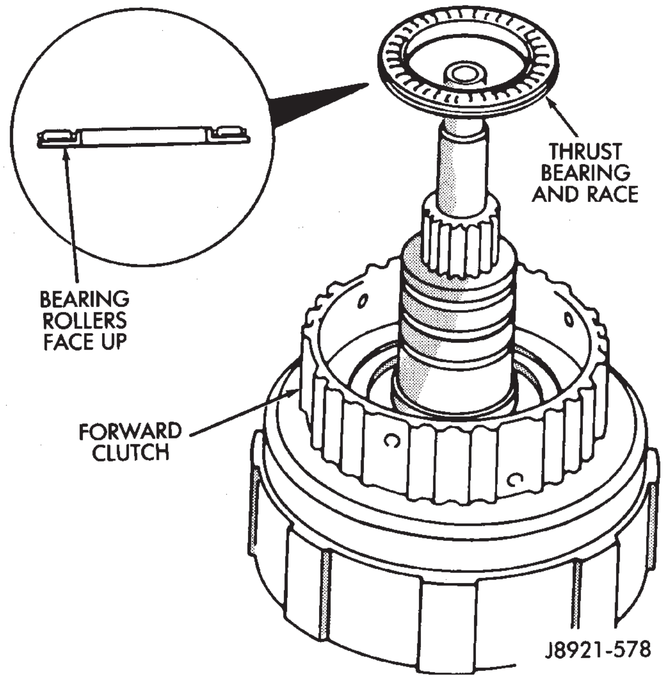


Fig. 251 Installing Thrust Bearing And Race

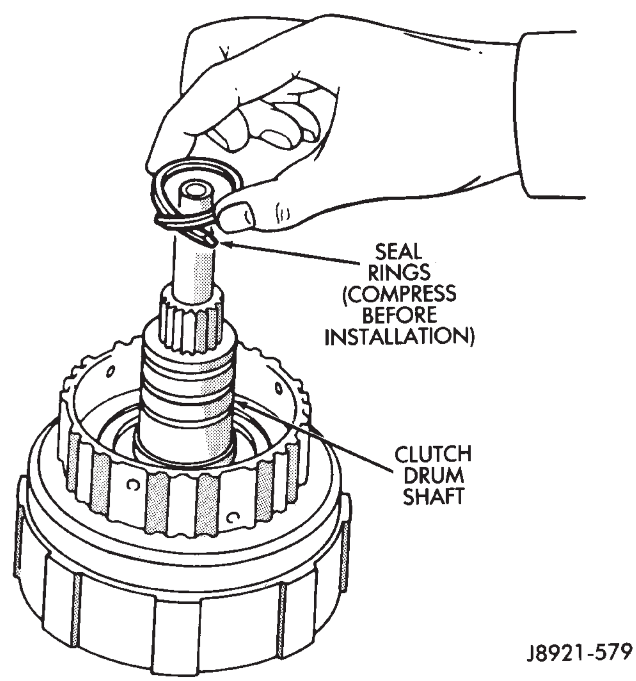


Fig. 252 Installing Clutch Drum Shaft Seal Rings

DISASSEMBLY AND ASSEMBLY (Continued)

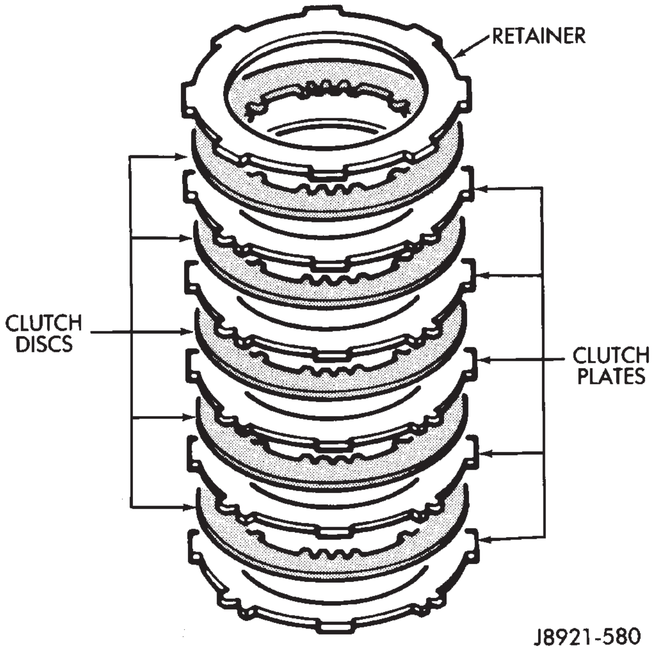


Fig. 253 Installing Forward Clutch Discs And Plates

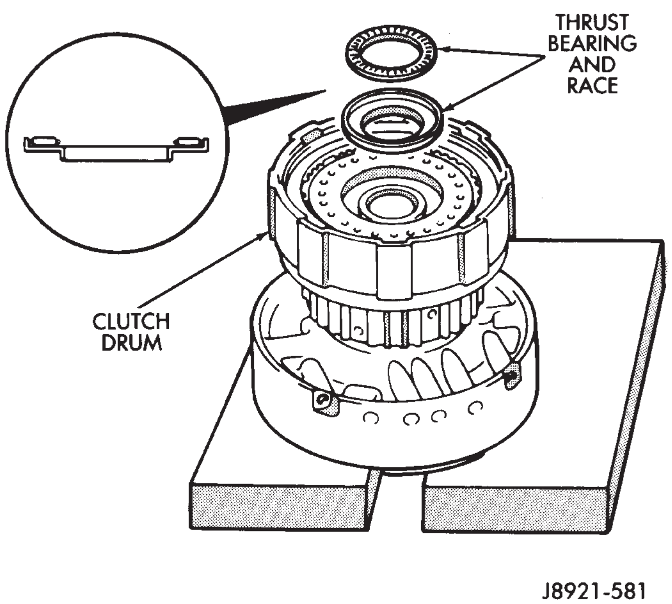


Fig. 254 Installing Thrust Bearing And Race

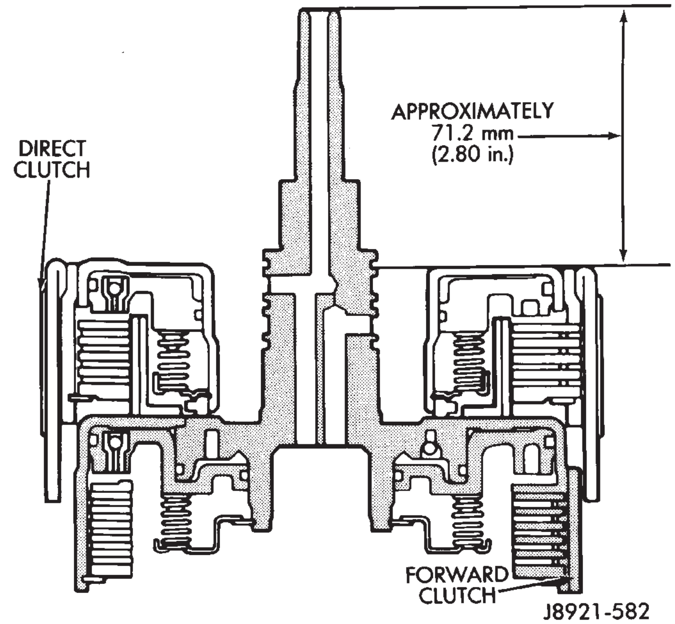


Fig. 255 Checking Forward Clutch Assembled Height

FRONT PLANETARY GEAR

DISASSEMBLY

(1) Remove ring gear from planetary gear (Fig. 256).

(2) Remove front bearing and the two races from ring gear (Fig. 256).

(3) Remove tabbed thrust race from planetary gear (Fig. 256).

(4) Remove snap ring attaching planetary gear to shaft and remove gear.

(5) Remove rear bearing and race from planetary gear.

(6) Measure inside diameter of ring gear bushing. Maximum allowable diameter is 24.08 mm (0.9480 in.). Replace ring gear if bushing inside diameter is greater than specified.

(7) Check condition of planetary gear. Replace gear if teeth are worn, pins are loose, or carrier is cracked, distorted, or worn.

DISASSEMBLY AND ASSEMBLY (Continued)

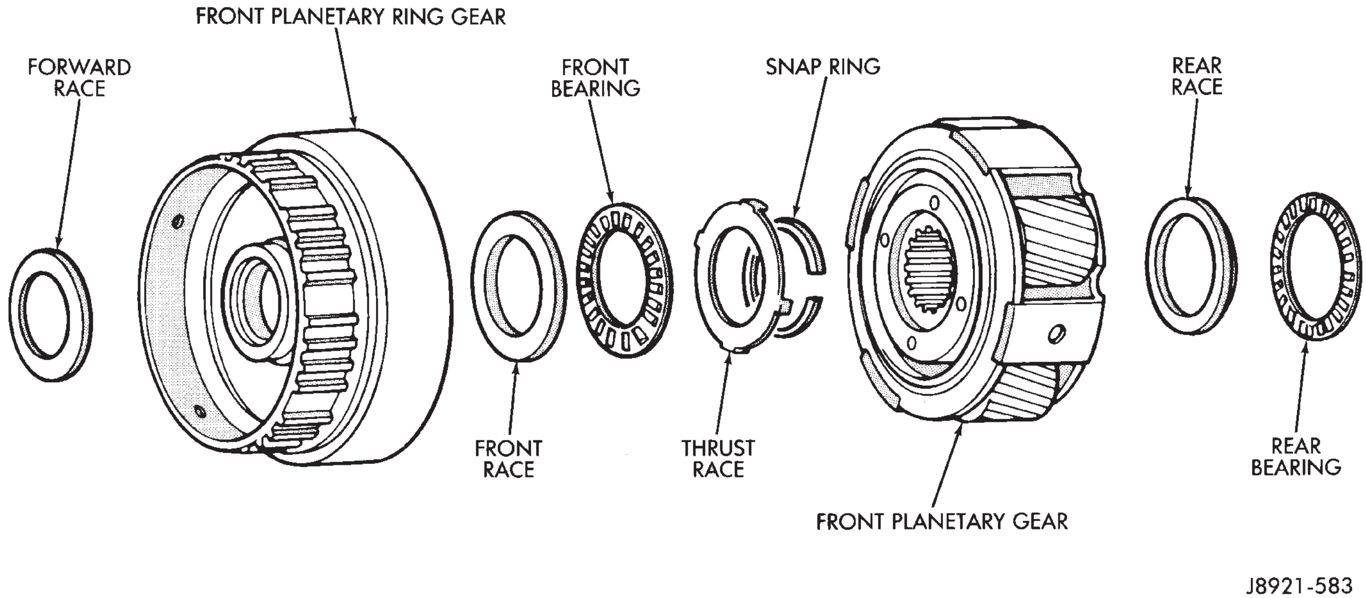


Fig. 256 Front Planetary Gear Components

ASSEMBLY

(1) Lubricate planetary and ring gear bearings and races with petroleum jelly.

(2) Identify planetary bearings and races before installation. (Fig. 256). Bearings and races can be identified by following dimensions:

• Outer diameter of rear bearing is 47.7 mm (1.878 in.). Inner diameter is 35.5 mm (1.398 in.).

• Outer diameter of rear race 47.6 mm (1.874 in.). Inner diameter is 33.7 mm (1.327 in.).

• Outer diameter of front race is 53.6 mm (2.110 in.). Inner diameter is 30.5 mm (1.201 in.).

• Outer diameter of front bearing is 47.7 mm (1.878 in.). Inner diameter is 32.6 (1.283 in.).

• Outer diameter of forward race is 47.0 mm (1.850 in.). Inner diameter is 26.5 mm 1.043 in.).

(3) Install rear race and bearing in gear (Fig. 257).

(4) Turn planetary over and install thrust race (Fig. 258).

(5) Install front race and bearing and forward race in ring gear (Fig. 259).

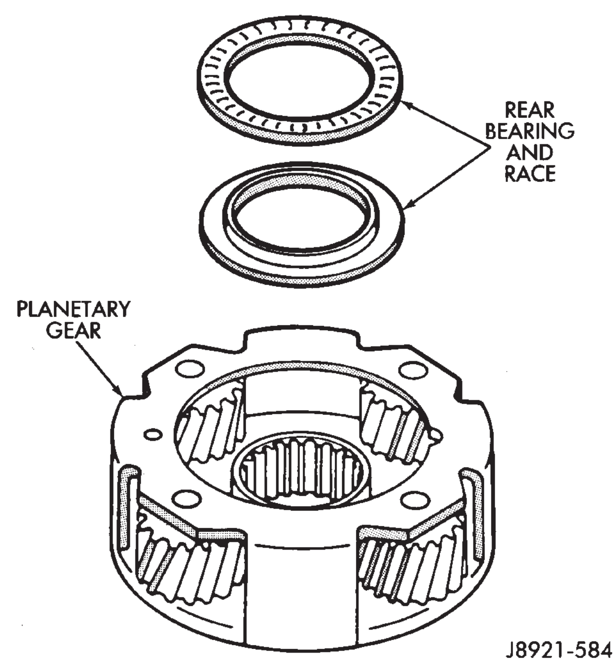


Fig. 257 Front Planetary Rear Bearing and Race Installation

DISASSEMBLY AND ASSEMBLY (Continued)

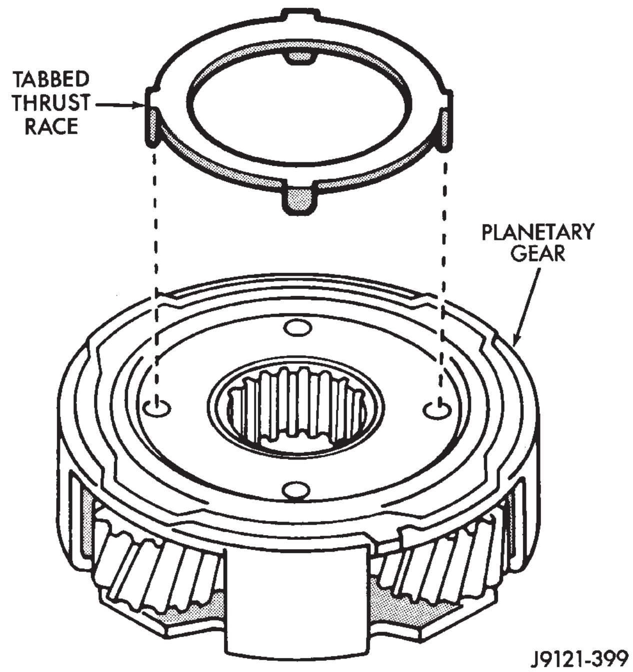


Fig. 258 Front Planetary Thrust Race Installation

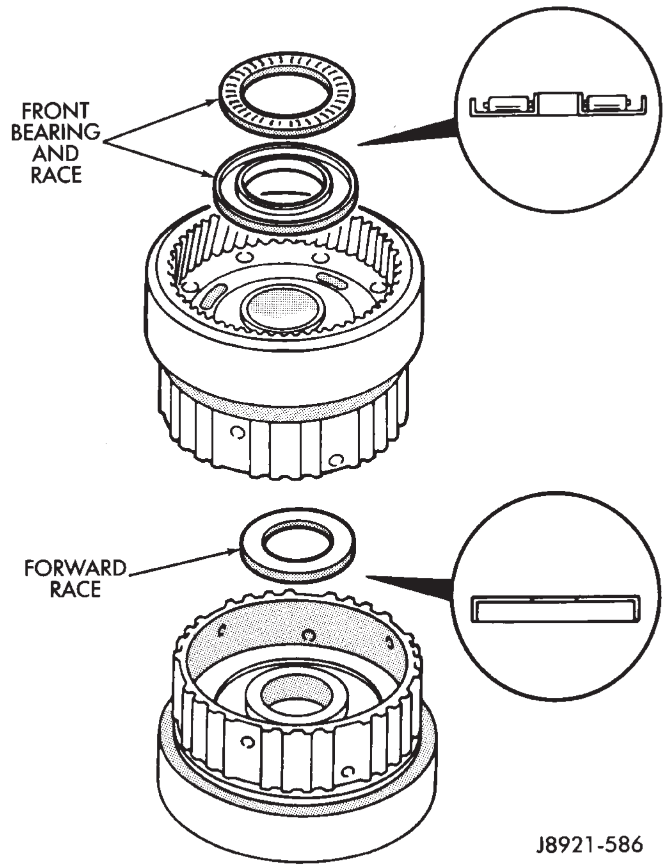
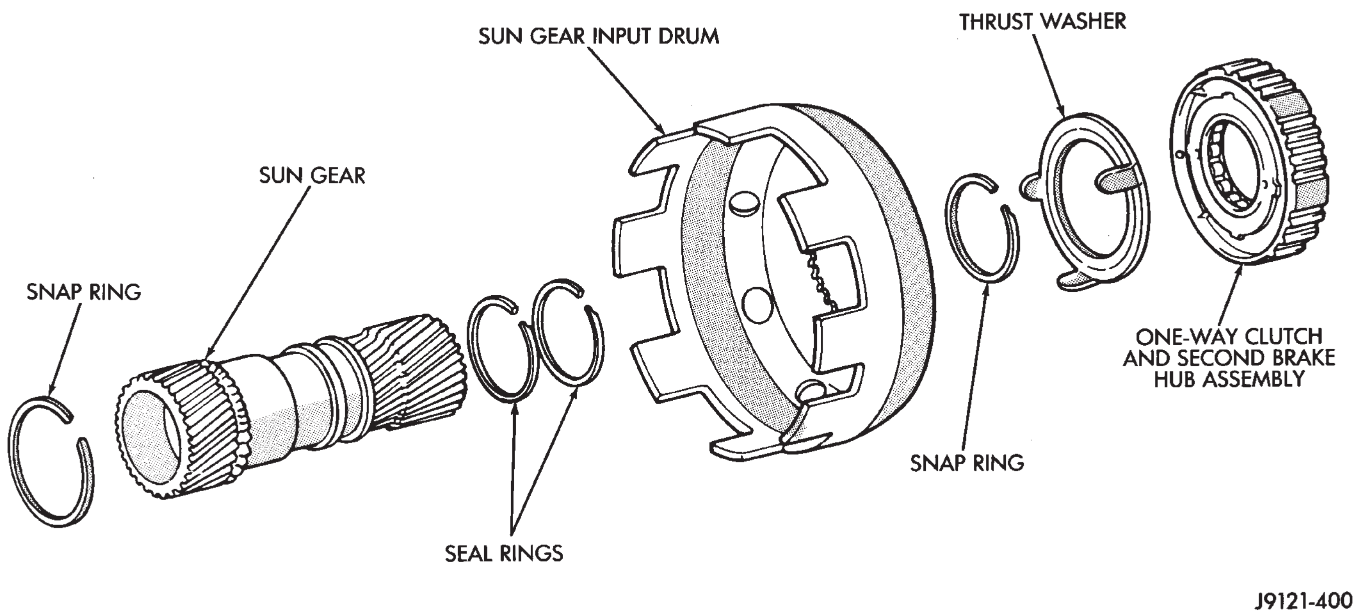


Fig. 259 Front Planetary Front Bearing And Races Installation

SUN GEAR AND NO. 1 ONE–WAY CLUTCH



Sun Gear And One–Way Clutch Components

DISASSEMBLY AND ASSEMBLY (Continued)

DISASSEMBLY

(1) Hold sun gear and turn second brake hub clockwise and counterclockwise (Fig. 260). Hub should rotate freely clockwise but lock when turned counterclockwise. Replace one–way clutch and hub if they do not operate properly.

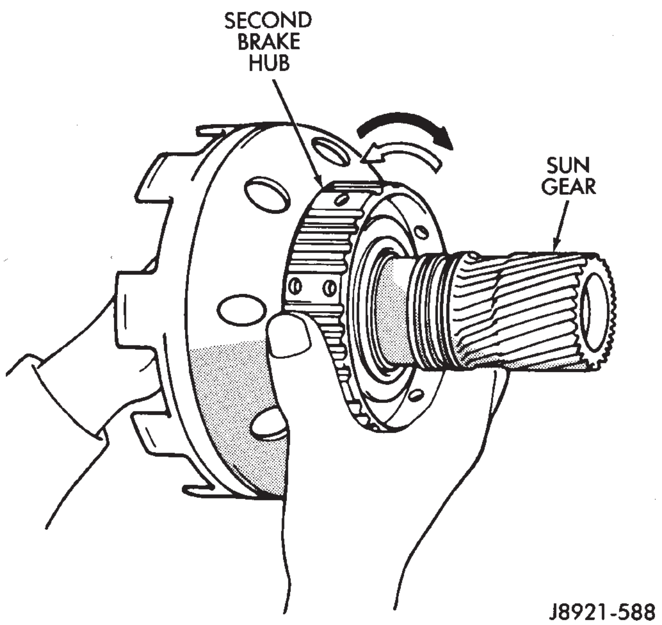


Fig. 260 Checking One–Way Clutch Operation

(2) Remove one–way clutch/second brake hub assembly from drum (Fig. 261).

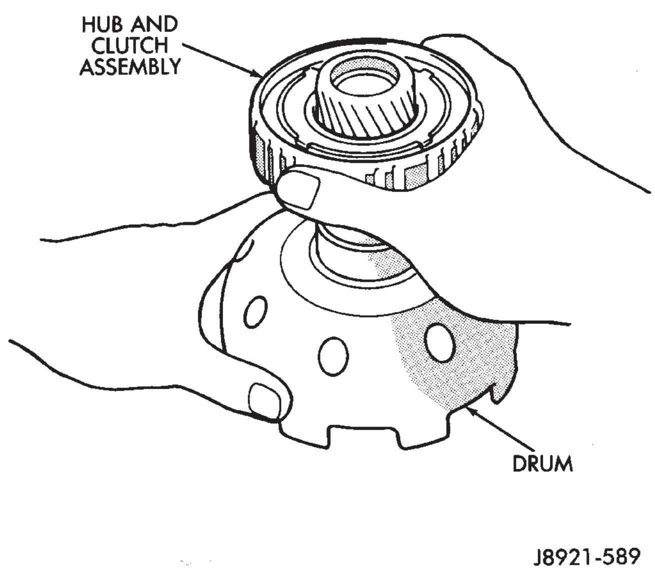


Fig. 261 Removing/Installing Brake Hub And Clutch Assembly

(3) Remove thrust washer from drum (Fig. 262).

(4) Remove two seal rings from sun gear (Fig. 263).

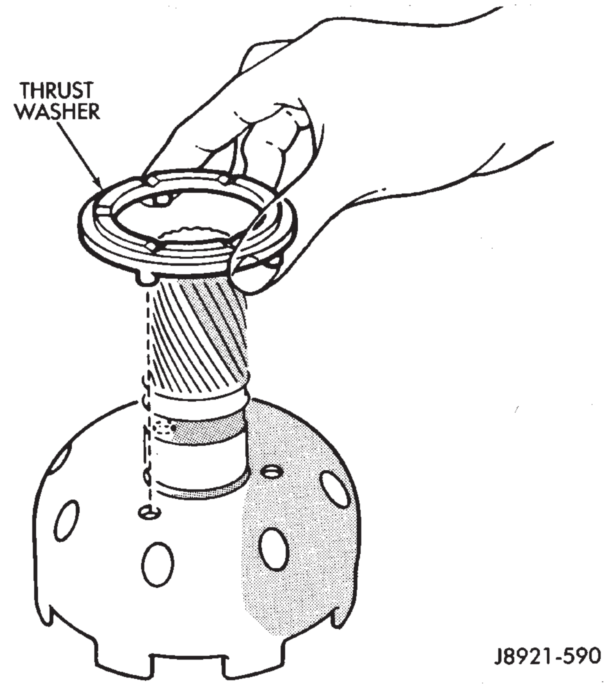


Fig. 262 Removing/Installing Thrust Washer

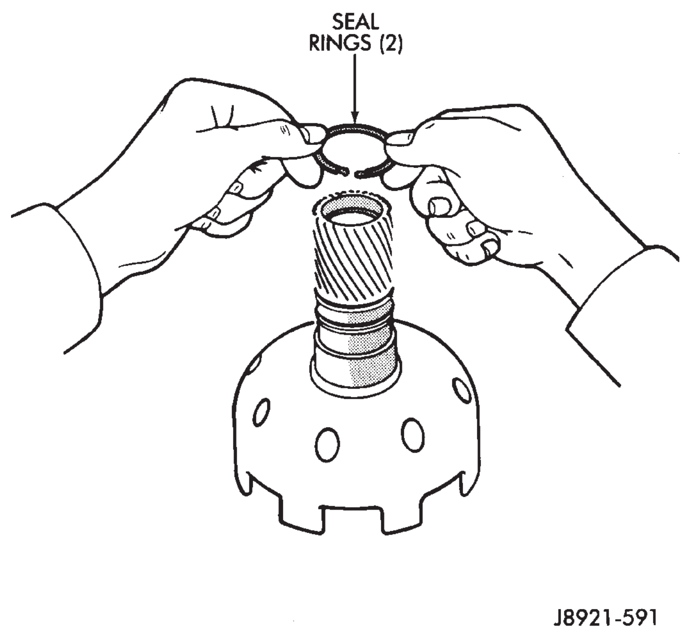


Fig. 263 Removing/Installing Sun Gear Seal Rings

(5) Support sun gear on wood block (Fig. 264). Then remove first sun gear snap ring and separate drum from gear.

(6) Remove remaining snap ring from sun gear (Fig. 265).

(7) Measure inside diameter of sun gear bushings with bore gauge or inside micrometer (Fig. 266). Maximum allowable diameter is 27.08 mm (1.0661 in.). Replace sun gear if bushing inside diameter is greater than specified.

DISASSEMBLY AND ASSEMBLY (Continued)

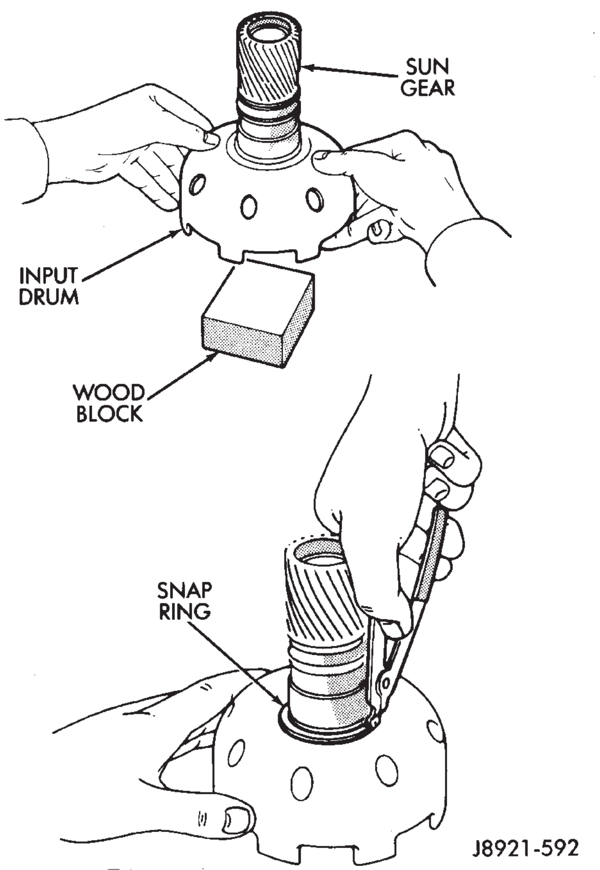


Fig. 264 Removing/Installing Sun Gear

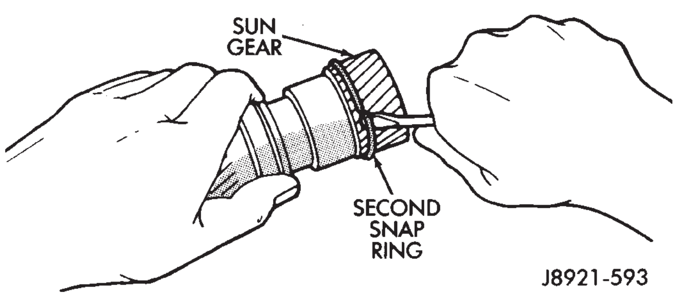


Fig. 265 Removing/Installing Second Snap Ring

ASSEMBLY

(1) Install first snap ring on sun gear.

(2) Install sun gear in drum and install remaining snap ring.

(3) Coat replacement seal rings with petroleum jelly and install them on sun gear. **Be sure seal ring ends are interlocked.**

(4) Install thrust washer. Be sure washer tabs are seated in drum slots.

(5) Install one–way clutch/second brake hub assembly on sun gear. Deep side of hub flange faces upward (Fig. 267).

(6) Check one–way clutch operation again (Fig. 260). Hold sun gear and turn second brake hub clockwise and counterclockwise. Hub should turn clockwise freely, but lock when turned counterclockwise.

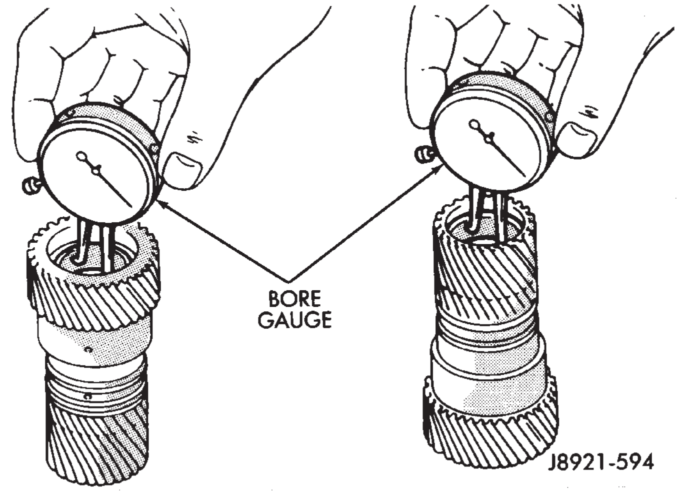


Fig. 266 Checking Sun Gear Bushings

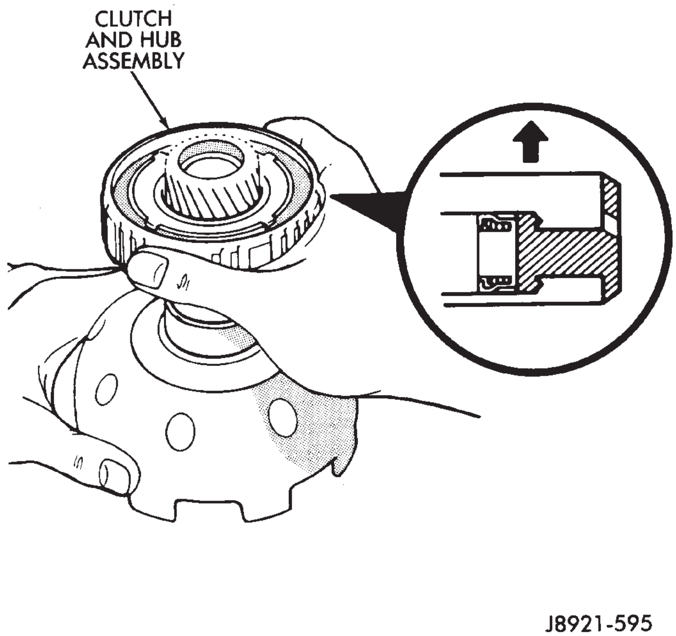


Fig. 267 Installing Clutch And Hub Assembly On Sun Gear

SECOND BRAKE

DISASSEMBLY

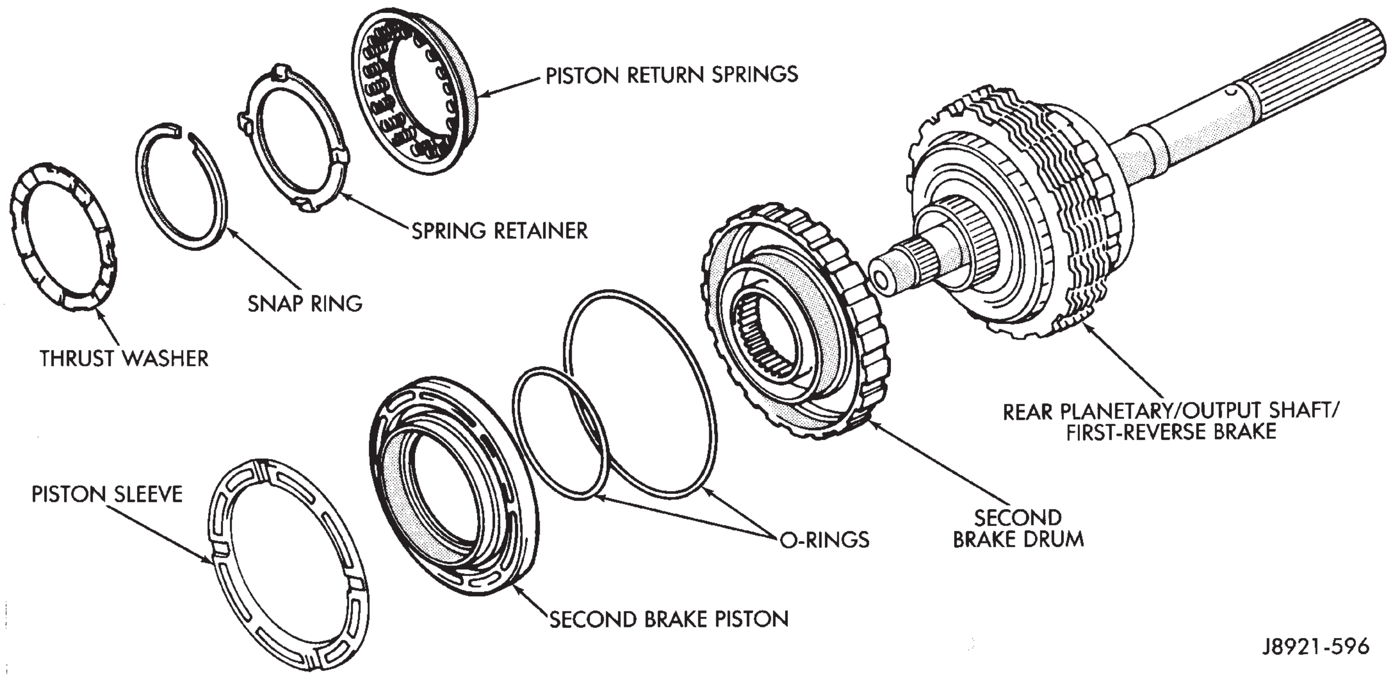
(1) Remove second brake drum from output shaft (Fig. 268).

(2) Remove thrust washer from second brake drum (Fig. 269).

(3) Compress piston return springs with shop press and tool 7538. Then remove piston snap ring (Fig. 270).

(4) Remove compressor tool and remove spring retainer and return springs.

DISASSEMBLY AND ASSEMBLY (Continued)



Second Brake Components

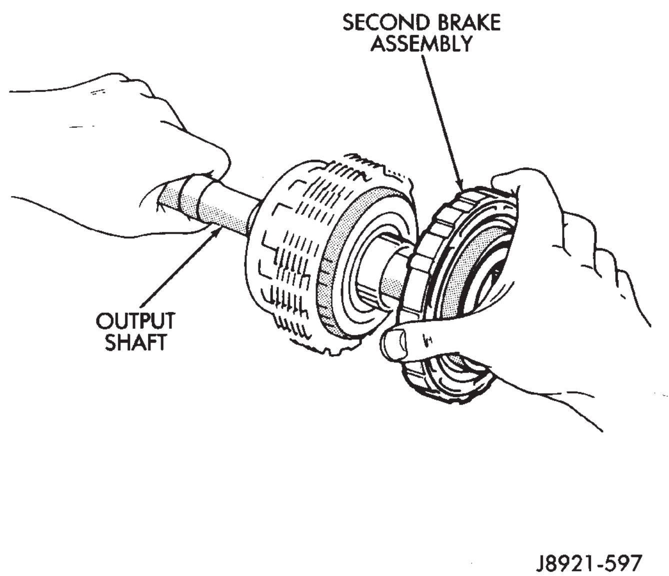


Fig. 268 Removing/Installing Second Brake Assembly

(5) Remove second brake piston and sleeve from drum with compressed air (Fig. 271). Use only enough air pressure to ease piston out of drum.

(6) Remove and discard brake piston O–rings.

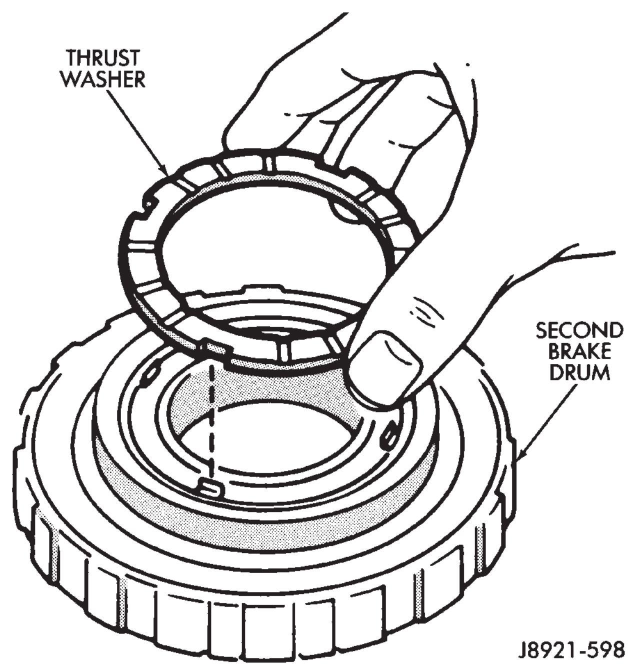


Fig. 269 Removing/Installing Second Brake Drum Thrust Washer

(7) Measure free length of piston return springs with springs mounted in retainer (Fig. 272). Length should be approximately 16.05 mm (0.632 in.). Replace return springs if length is less than specified.

DISASSEMBLY AND ASSEMBLY (Continued)

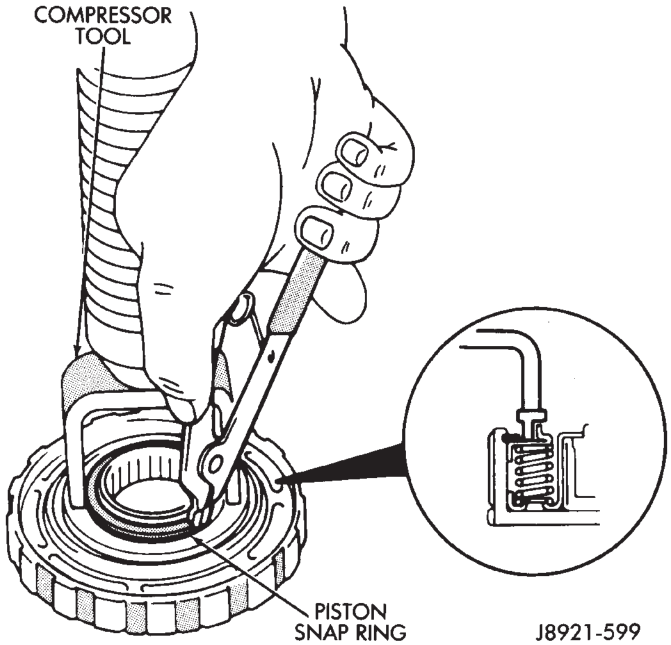


Fig. 270 Removing/Installing Second Brake Piston Snap Ring

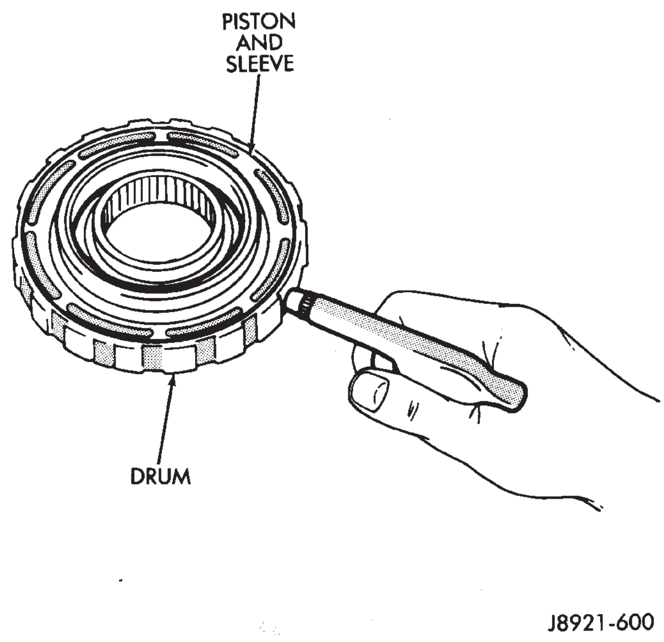


Fig. 271 Removing/Installing Piston And Sleeve

ASSEMBLY

(1) Lubricate and install new O–rings on brake piston. Then install brake piston in drum.

(2) Install return springs and retainer on brake piston.

(3) Compress return springs with shop press and Compressor Tool 7538. Install piston snap ring and remove brake assembly from press.

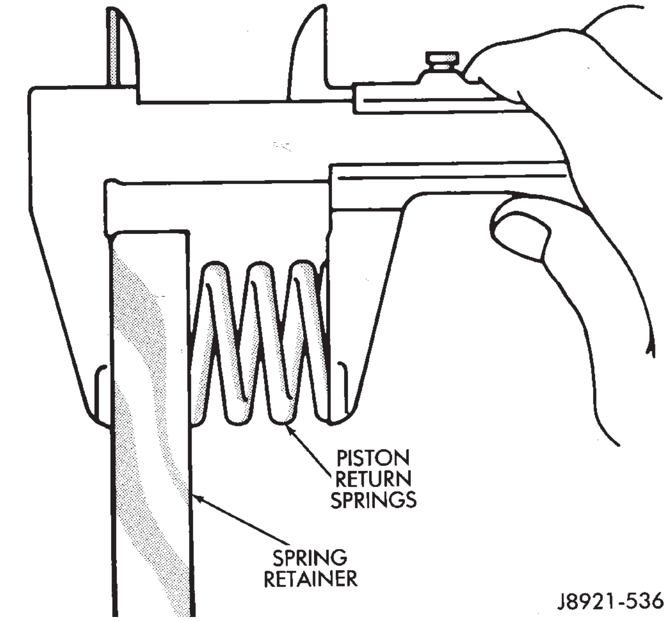


Fig. 272 Measuring Second Brake Piston Return Springs

(4) Check brake piston operation with low pressure compressed air (Fig. 273). Apply air pressure through feed hole in drum. Piston should move smoothly when applying–releasing air pressure.

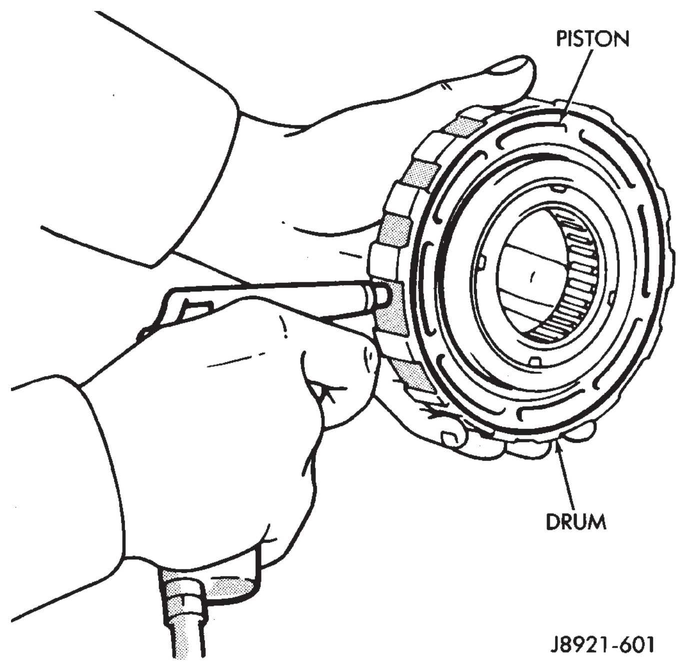


Fig. 273 Checking Second Brake Piston Operation

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Coat thrust washer with petroleum jelly and install it in drum. Be sure washer notches are aligned with tabs on spring retainer (Fig. 274).

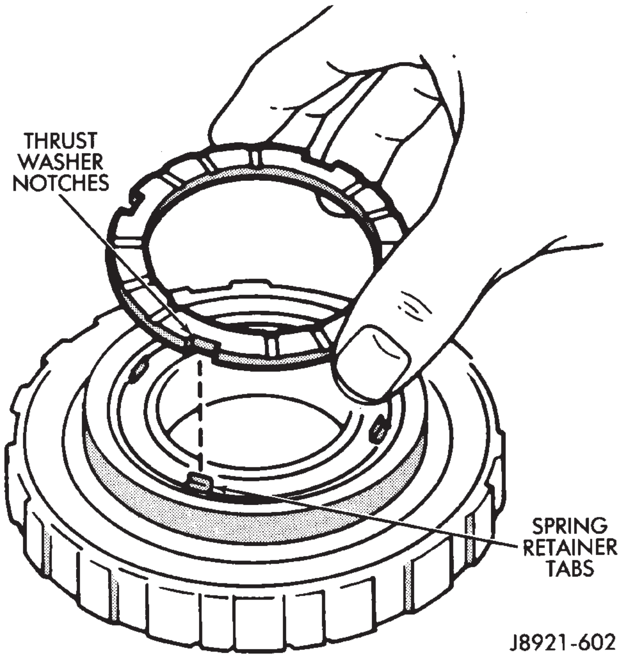
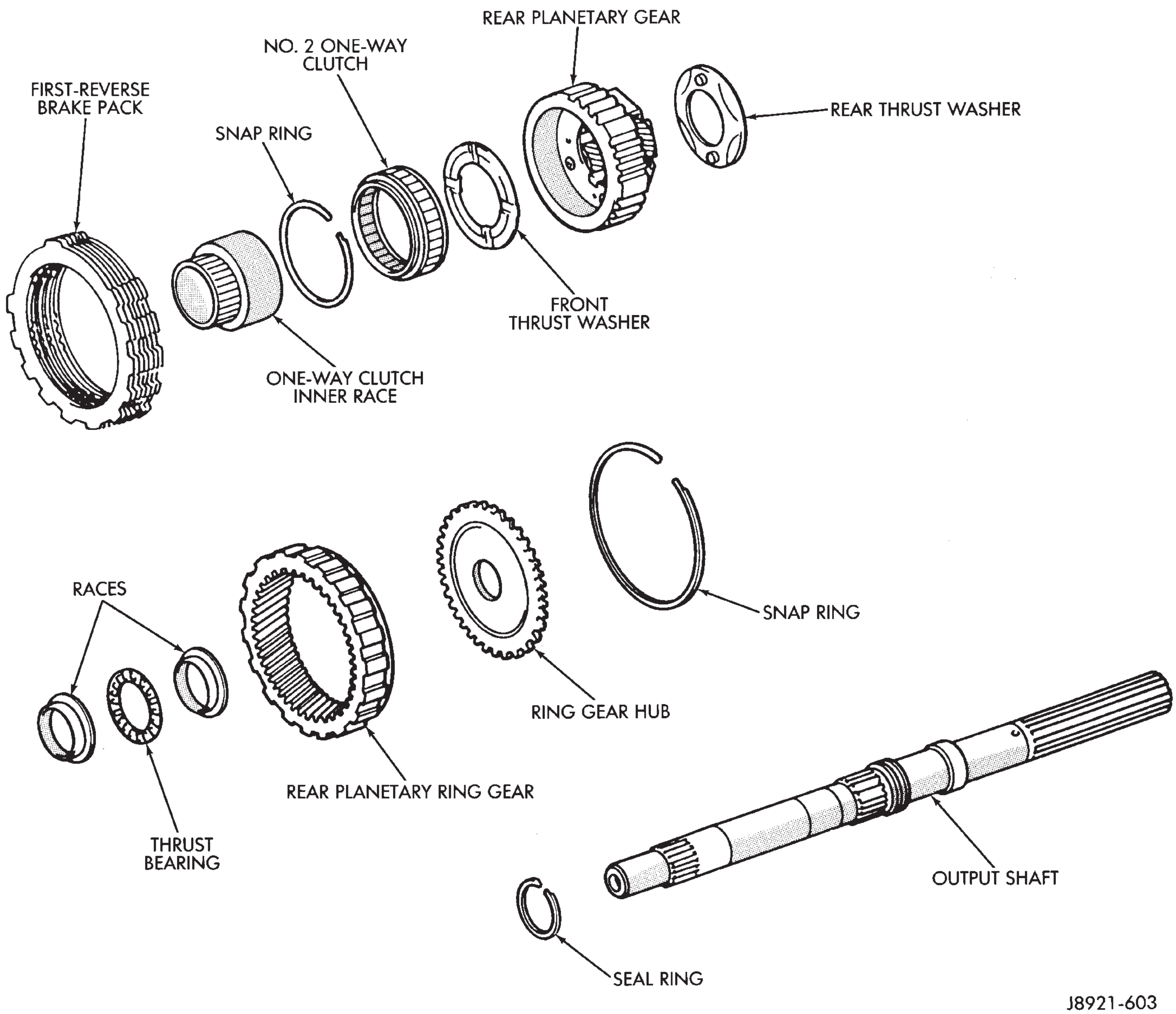


Fig. 274 Installing Second Brake Thrust Washer

DISASSEMBLY AND ASSEMBLY (Continued)

PLANETARY/BRAKE PACK/OUTPUT SHAFT



Rear Planetary, Brake Pack, Output Shaft Components

DISASSEMBLY

(1) Remove output shaft from gear assembly (Fig. 275).

(2) Remove and discard shaft seal ring (Fig. 276).

(3) Remove brake pack from planetary gear (Fig. 277).

(4) Remove planetary gear from ring gear (Fig. 278).

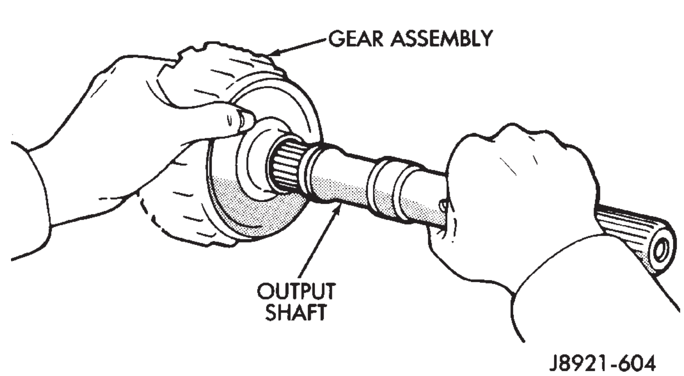


Fig. 275 Removing/Installing Output Shaft

DISASSEMBLY AND ASSEMBLY (Continued)

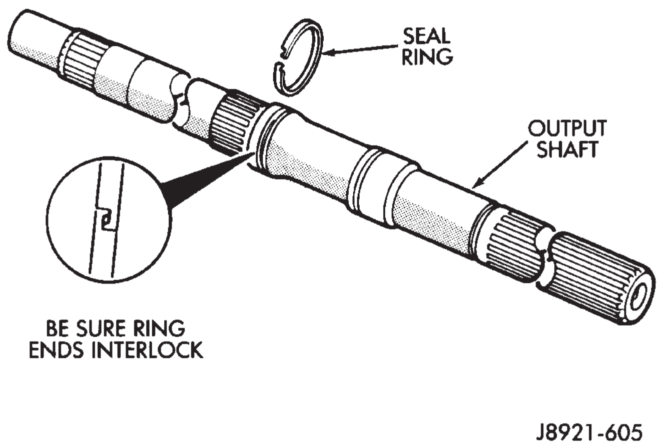


Fig. 276 Removing/Installing Shaft Seal Ring

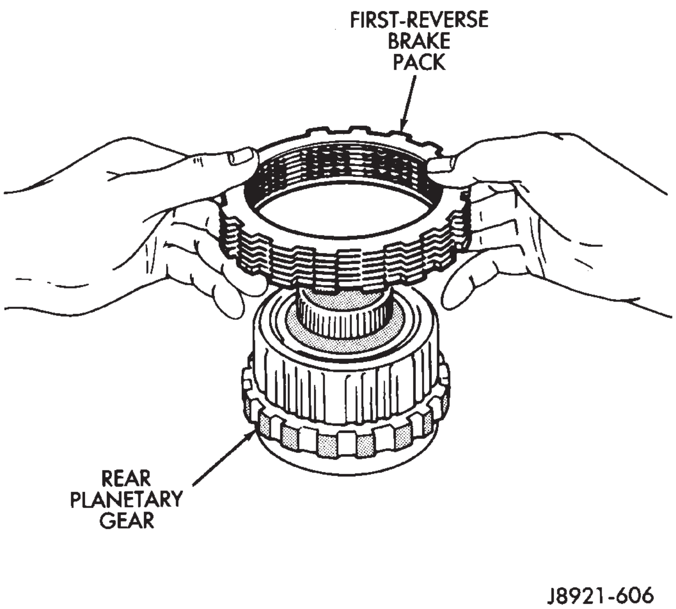


Fig. 277 Removing/Installing First–Reverse Brake Pack

(5) Check No. 2 one–way clutch (Fig. 279). Hold planetary gear and turn clutch inner race in both directions. Race should turn freely counterclockwise, but lock when turned clockwise. Replace one–way clutch if necessary.

(6) Remove clutch inner race from planetary gear (Fig. 280).

(7) Remove clutch snap ring and remove No. 2 one–way clutch top end cap from planetary.

(8) Remove No. 2 one–way clutch from planetary (Fig. 281).

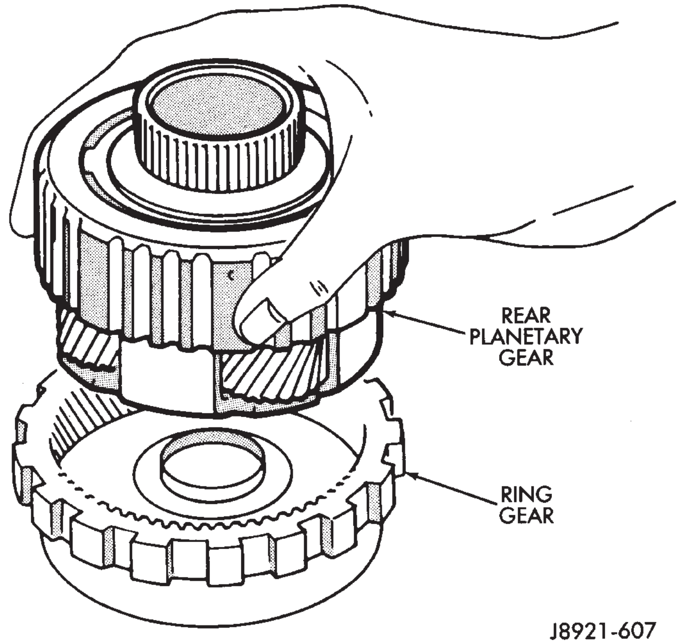


Fig. 278 Removing/Installing Rear Planetary

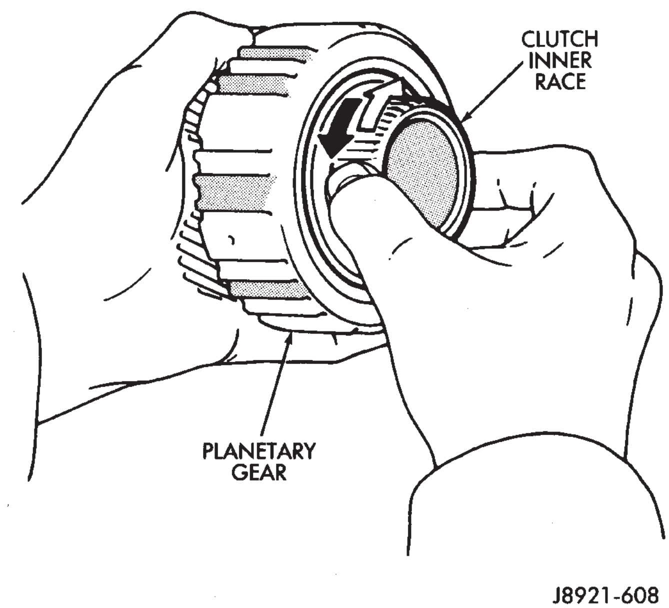


Fig. 279 Checking No. 2 One–Way Clutch Operation

DISASSEMBLY AND ASSEMBLY (Continued)

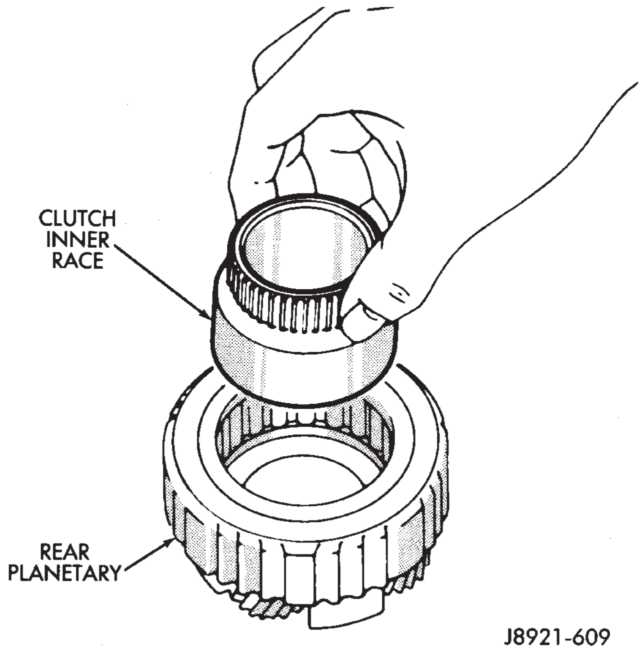


Fig. 280 Removing/Installing Clutch Inner Race

(9) Remove No. 2 one–way clutch bottom end cap from planetary.

(10) Remove front and rear thrust washers from planetary gear (Fig. 282).

(11) Remove thrust bearing and washers from ring gear (Fig. 283).

(12) Remove ring gear snap ring and remove ring gear hub (Fig. 284).

(13) Inspect and replace any worn or damaged planetary gearcomponents.

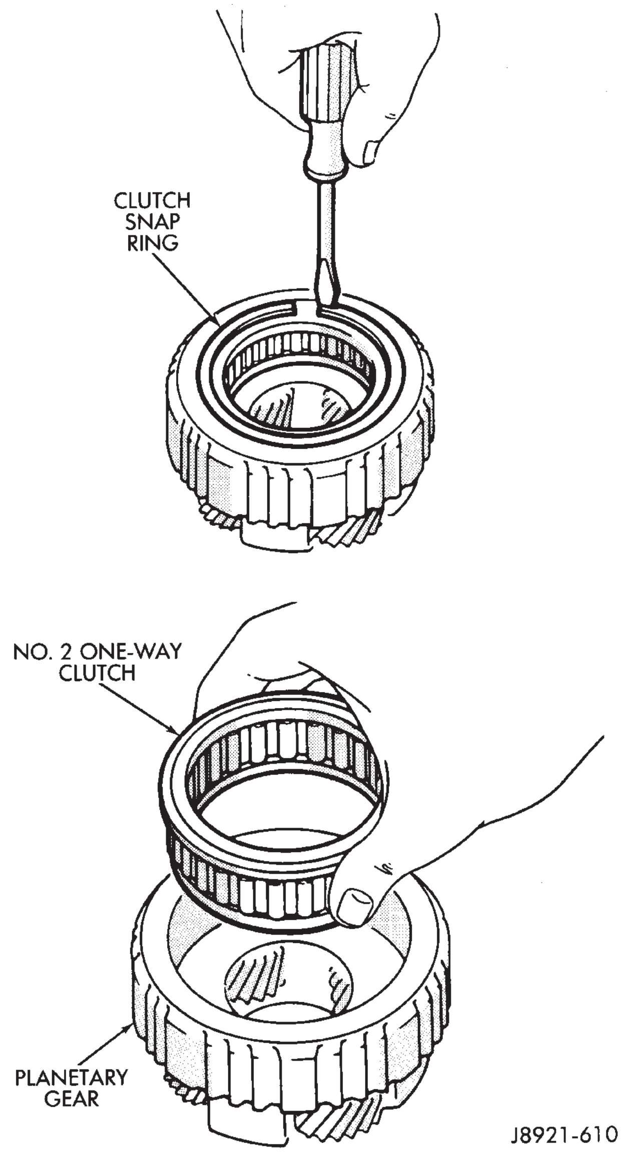


Fig. 281 Removing/Installing One–Way Clutch

DISASSEMBLY AND ASSEMBLY (Continued)

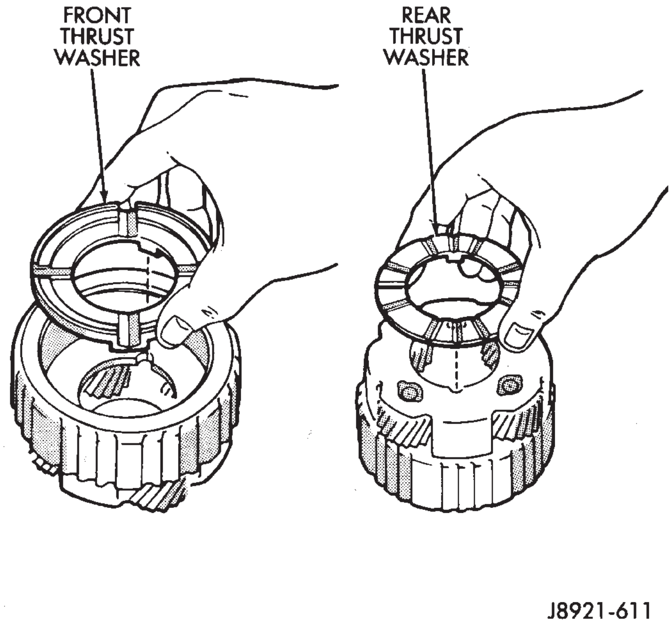


Fig. 282 Removing/Installing Rear Planetary Thrust Washers

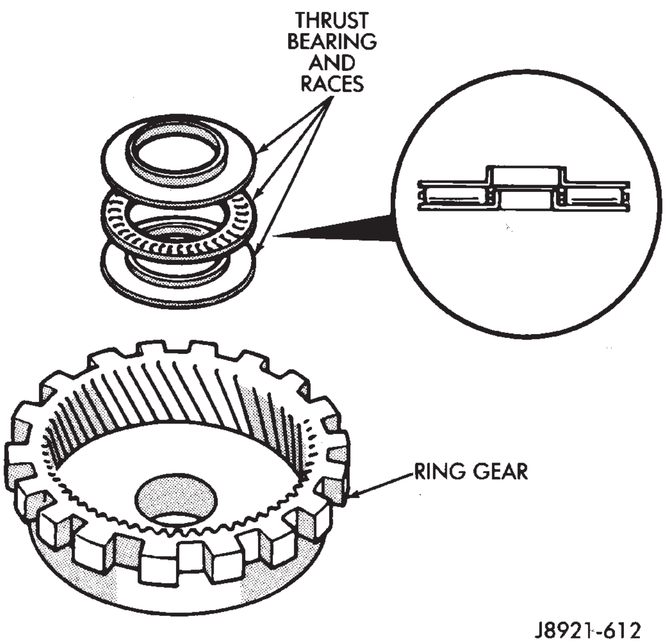


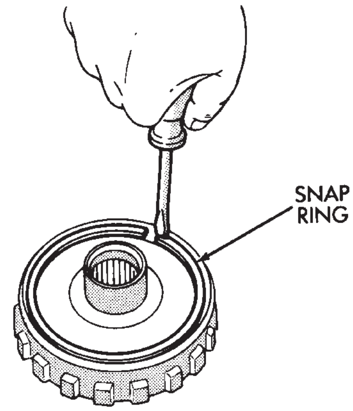
Fig. 283 Removing/Installing Ring Gear Thrust Bearing And Races

ASSEMBLY

(1) Measure thickness of each brake pack disc. Minimum thickness is 1.51 mm (0.0594 in.). Replace all discs if any disc is thinner than specified.

(2) Install hub and snap ring in ring gear (Fig. 284)

(3) Identify ring gear thrust bearing and races by following dimensions (Fig. 283):



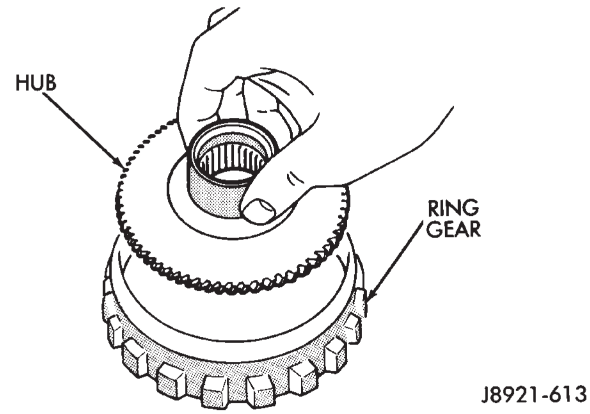


Fig. 284 Removing/Installing Ring Gear Hub

- Outer diameter of bottom race is 44.8 mm (1.764 in.) and inner diameter is 27.6 mm (1.087 in.).
- Outer diameter of bearing is 44.7 mm (1.760 in.) and inner diameter is 30.1 mm (1.185 in.).
- Outer diameter of upper race is 44.8 mm (1.764 in.) and inner diameter is 28.8 mm (1.134 in.).

(4) Lubricate ring gear thrust bearing and races with petroleum jelly and install them in ring gear (Fig. 283).

(5) Coat planetary thrust washers with petroleum jelly and install them in gear (Fig. 282).

(6) Install No. 2 one–way clutch bottom end cap into the planetary gear.

(7) Install No. 2 one–way clutch in planetary gear. Be sure flanged side of clutch faces upward (Fig. 285).

(8) Install No. 2 one–way clutch top end cap into the planetary gear.

(9) Install clutch retaining snap ring and install clutch inner race (Fig. 280). Turn race counterclockwise to ease installation.

(10) Verify one–way clutch operation. Hold gear and turn inner race in both directions. Race should turn freely counterclockwise, but lock when turned clockwise.

(11) Install planetary gear in ring gear.

DISASSEMBLY AND ASSEMBLY (Continued)

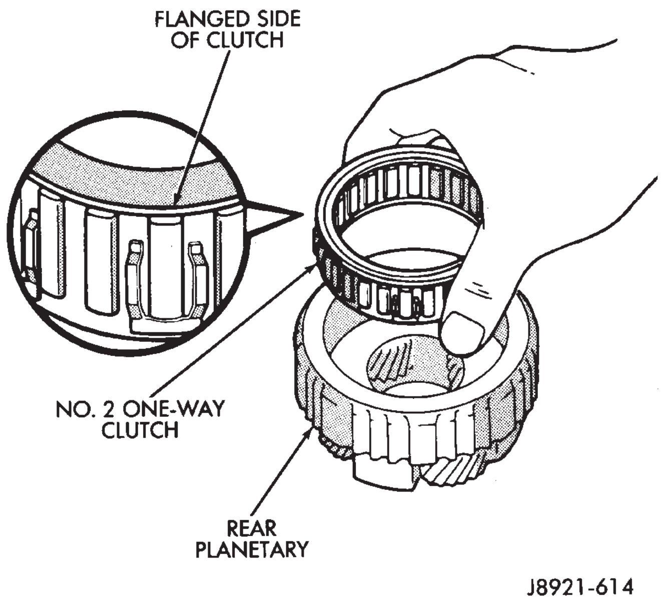


Fig. 285 Installing No. 2 One–Way Clutch

(12) Install thrust bearing and washers onto the ring gear (Fig. 283).

(13) Assemble clutch discs and clutch plates (Fig. 277). Sequence is disc first, then a plate. Use seven discs and plates.

(14) Install brake pack on planetary gear (Fig. 277).

(15) Install new seal ring on output shaft (Fig. 276). Be sure ring ends are interlocked as shown.

TRANSMISSION VALVE BODY

The valve body assembly consists of two sections which are the upper body and lower body (Fig. 286) and (Fig. 287). Disassembly, inspection and overhaul procedures for each section are outlined separately. Refer to the appropriate procedure as needed.

DISASSEMBLY AND ASSEMBLY (Continued)

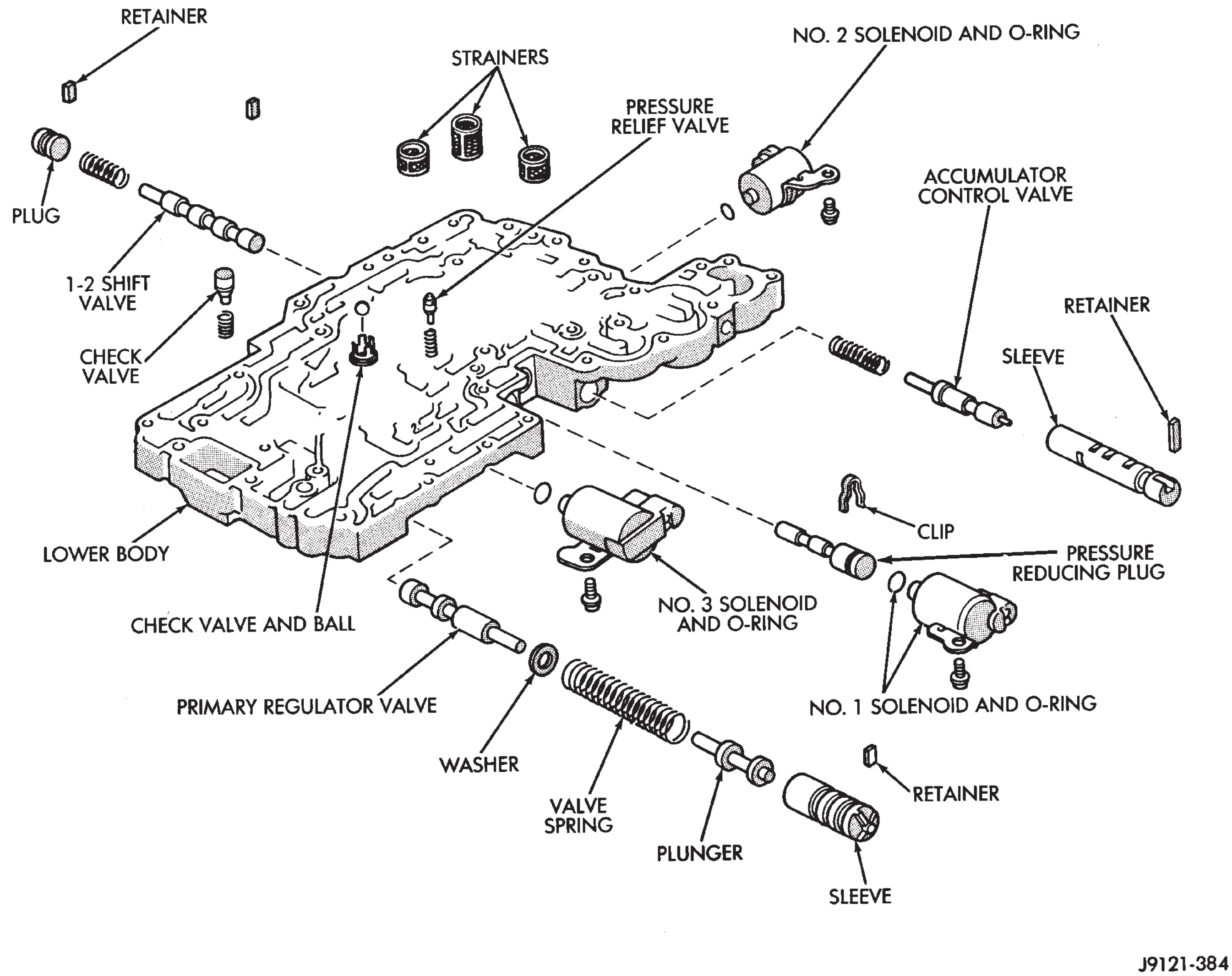


Fig. 286 Lower Body Components

DISASSEMBLY AND ASSEMBLY (Continued)

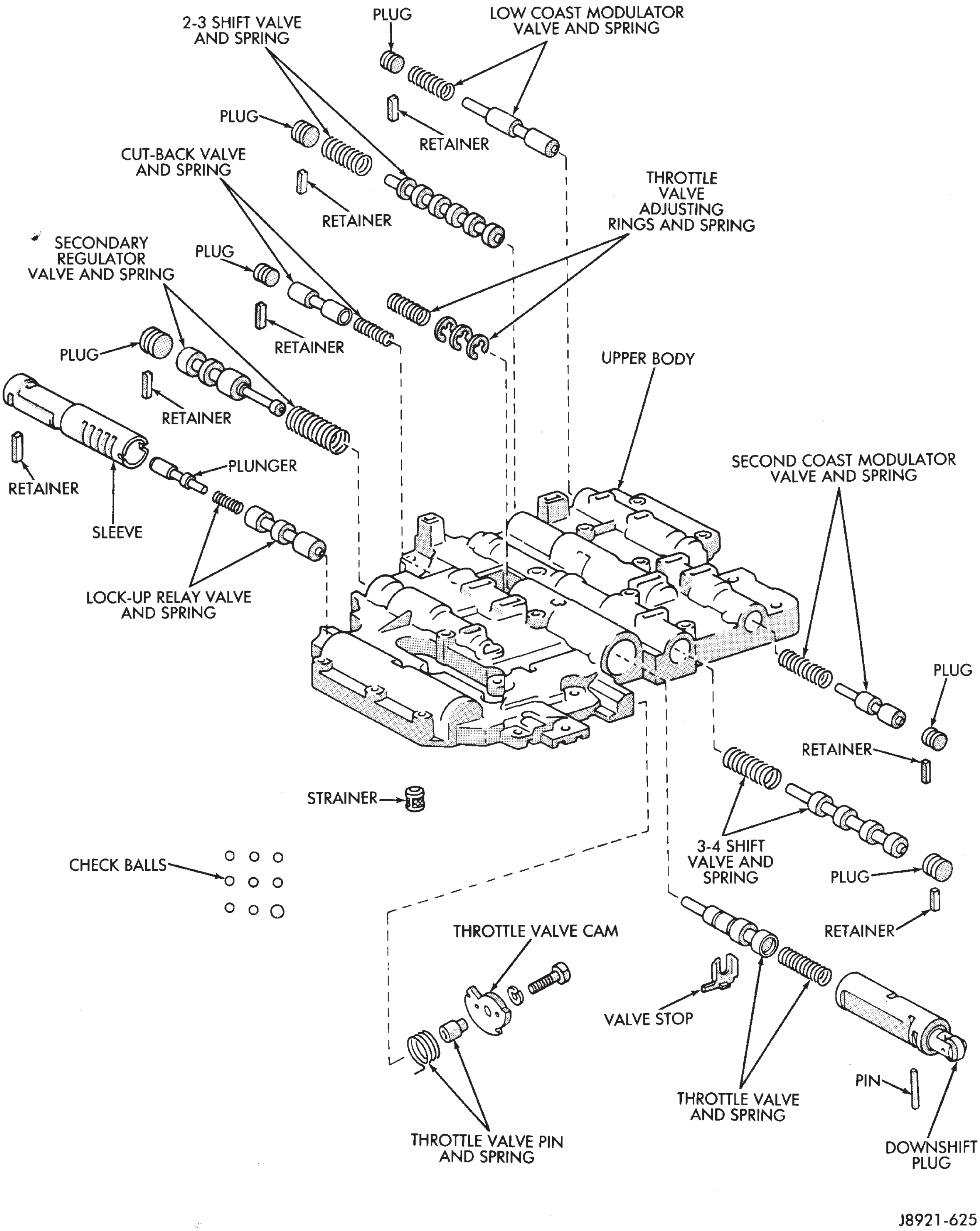


Fig. 287 Upper Body Components

CLEANING AND INSPECTION

TRANSMISSION PARTS CLEANING AND INSPECTION

Clean the transmission components with solvent and dry them with compressed air only. Do not use shop towels or rags.

Blow compressed air through all oil feed passages and channels to be sure they are clear. Inspect the transmission components for wear and damage. Replace components that are damaged or worn beyond the limits specified in the individual overhaul procedures.

Replace all O–rings, gaskets and seals. These components are not reusable. Also replace any snap ring that is distorted or damaged.

During overhaul assembly operations, lubricate the transmission components with Mopar Mercon™ automatic transmission fluid or petroleum jelly as indicated. Petroleum jelly should be used to prelubricate thrust bearings, washers and races. It can also be used to hold parts in position during assembly.

Soak replacement clutch and brake pack components in transmission fluid for at least 30 minutes before installation.

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.

(4) Unsnap cable from cable mounting bracket on transmission (Fig. 288).

(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.

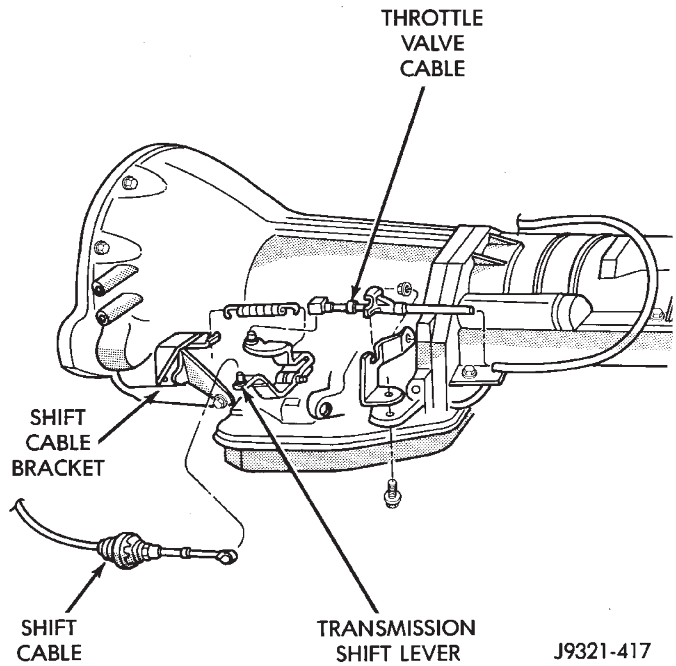


Fig. 288 Shift Cable Attachment At Transmission–Typical

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. 289).

(4) Turn ignition switch to LOCK position.

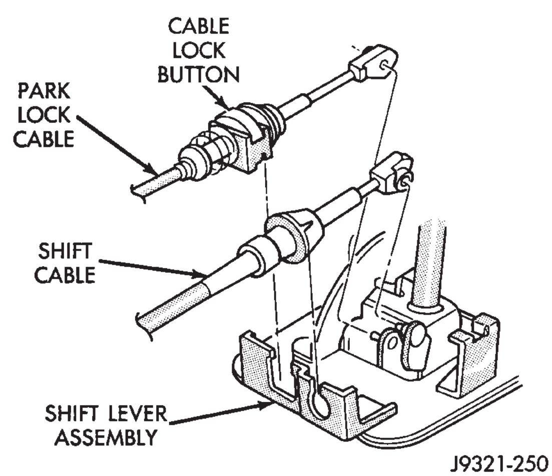


Fig. 289 Park Lock Cable Attachment

ADJUSTMENTS (Continued)

(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 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. 290). 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.

(3) Verify that lever on throttle body is at curb idle position. Then verify that transmission throttle lever (Fig. 291) is also at idle (fully forward) position.

(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.

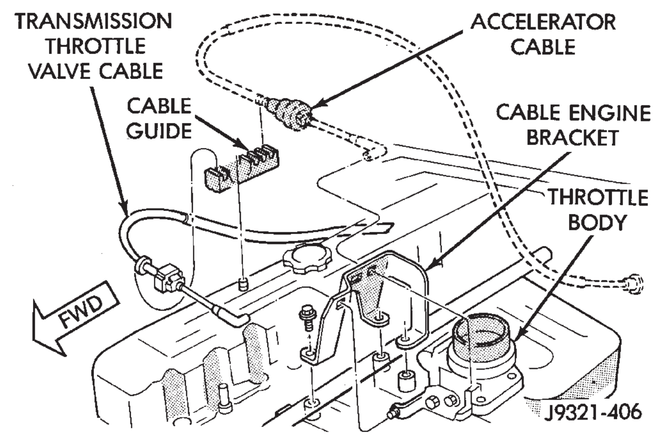


Fig. 290 Throttle Cable Attachment At Engine

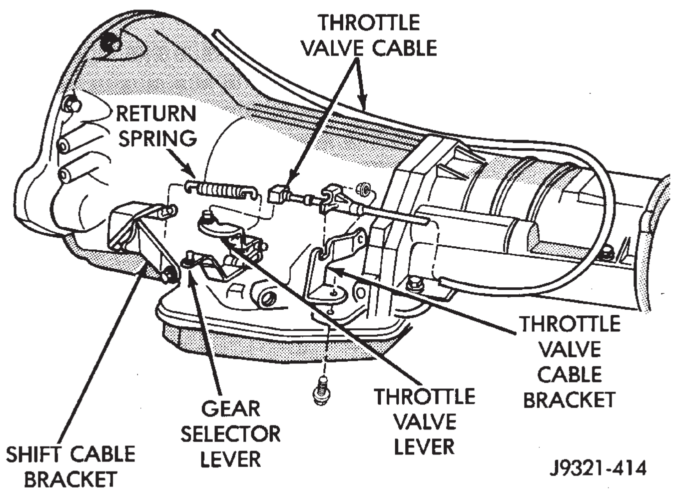


Fig. 291 Throttle Cable Attachment At Transmission

• 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.**

ADJUSTMENTS (Continued)

(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.).

NOTE: Be sure that as the cable is pulled forward and centered on the throttle lever stud, the cable housing moves smoothly with the cable. Due to the angle at which the cable housing enters the spring housing, the cable housing may bind slightly and create an incorrect adjustment.

(7) Install retaining clip onto cable housing.

(8) Check cable adjustment. Verify transmission throttle lever and lever on throttle body move simultaneously.

SPECIFICATIONS

AW-4 AUTOMATIC TRANSMISSION

SPECIFICATIONS (Continued)

AW-4 GENERAL SPECIFICATIONS

Gear Ratios:

First	2.804:1
Second	1.531:1
Third	1.000:1
Fourth (Overdrive)	0.753:1
Reverse	2.393:1

Transmission Fluid	Jeep automatic transmission fluid or DEXRON® II
Fluid Level	To "Full" mark with fluid hot (normal operating temperature)
Fluid Capacity (all models)	8.0 Liters (8.45 qts.)

Test Specifications

Stall Speed:

In D Range and Reverse	2100–2400 rpm

Line Pressure:

In D at Curb Idle	61–70 psi (421–481 kPa)
In D at WOT	173–209 psi (1196–1442 kPa)
In Reverse at Curb Idle	75–90 psi (519–618 kPa)
In Reverse at WOT	213–263 psi (1471–1814 kPa)

Time Lag Test:

Engagement in D Range	1.2 seconds
Engagement in Reverse	1.5 seconds

Valve Body Solenoid Resistance	11–15 ohms
Transmission Fluid Normal Operating Temperature	50–80°C (122–176°F)
TPS Input Voltage (AU)	5.0 Volts (approx.)

TPS Output Voltage

4-Cylinder	0.2 Volts (approx.)
6-Cylinder	4.2 Volts (approx.)

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SPECIFICATIONS (Continued)

AW-4 OIL PUMP WEAR LIMITS

Drive Gear

Tip Clearance:

Standard .... 0.11-0.14 mm (0.0043-0.0055 in.)

Maximum Allowance .... 0.3 mm (0.012 in.)

Gear-to-Pump Body

End Clearance:

Standard .... 0.02-0.05 mm (0.0008-0.0020 in.)

Maximum Allowance .... 0.1 mm (0.004 in.)

Driven Gear-to-Pump

Body Clearance:

Standard .... 0.07-0.15 mm (0.0028-0.0059 in.)

Maximum Allowance .... 0.3 mm (0.012 in.)

J8921-740

AW-4 CLUTCH DISC AND PLATE THICKNESS

Component	Minimum Allowable Thickness
Clutch Disc (all except first-reverse and forward clutch discs)	1.84 mm (0.0724 in.)
6-Cylinder Forward Clutch Disc	1.51 mm (0.0594 in.)
6 Cylinder Direct Clutch Plates: Thin Plate (1) Thick Plates (3)	 2.3 mm (0.905 in.) 3.0 mm (0.118 in.)
6-Cylinder Forward Clutch Plate	1.8 mm (0.070 in.)
First-Reverse Brake Disc (all)	1.51 mm (0.0594 in.)

J9121-402

SPECIFICATIONS (Continued)

AW-4 BUSHING AND PISTON CLEARANCE

BUSHING INSIDE DIAMETER (MAXIMUM)

Bushing Location	Maximum Allowance Inside Diameter
Extension Housing	38.09 mm (1.4996 in.)
Direct Clutch Drum	53.97 mm (2.1248 in.)
Overdrive Planetary Gear	11.27 mm (.4437 in.)
Overdrive Direct Clutch Drum	27.11 mm (1.0673 in.)
Stator Shaft (Front)	21.58 mm (.8496 in.)
Stator Shaft (Rear)	27.08 mm (1.0661 in.)
Oil Pump Body	38.19 mm (1.5035 in.)
Transmission Case	38.18 mm (1.5031 in.)

PISTON STROKE LENGTH

Piston Location	Specification
Direct Clutch (all)	1.37–1.67 mm (.0539–.0657 in.)
6-Cylinder Overdrive Brake	1.40–1.70 mm (.0551–.0669 in.)
Second Coast Brake (all)	1.5–3.0 mm (.059–.118 in.)
6-Cylinder Forward Clutch	3.55–3.73 (.1397–.1468 in.)
Overdrive Direct Clutch (all)	1.85–2.15 mm (.0728–.0846 in.)

END PLAY AND CLEARANCE

Component	Specification
Output Shaft End Play	.27–.86 mm (.0106–.0339 in.)
6-Cylinder First-Reverse Brake Pack Clearance	.70–1.20 mm (.028–.047 in.)
6-Cylinder Second Brake Pack Clearance	.62–1.98 mm (.024–.078 in.)

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SPECIFICATIONS (Continued)

AW-4 RETAINER AND PISTON SPECIFICATIONS

OVERDRIVE BRAKE RETAINER SELECTION

Retainer No.	Thickness	Retainer No.	Thickness
26	3.3 mm (.130 in.)	11	3.8 mm (.150 in.)
25	3.5 mm (.138 in.)	23	3.9 mm (.154 in.)
12	3.6 mm (.142 in.)	Not Marked	4.0 mm (.157 in.)
24	3.7 mm (.146 in.)	—	—

DIRECT CLUTCH RETAINER SELECTION

Retainer No.	Thickness	Retainer No.	Thickness
33	3.0 mm (.118 in.)	29	3.4 mm (.134 in.)
32	3.1 mm (.122 in.)	28	3.5 mm (.138 in.)
31	3.2 mm (.126 in.)	27	3.6 mm (.142 in.)
30	3.3 mm (.130 in.)	34	3.7 mm (.146 in.)

OVERDRIVE CLUTCH RETAINER SELECTION

Retainer No.	Thickness	Retainer No.	Thickness
16	3.6 mm (.142 in.)	19	3.3 mm (.130 in.)
17	3.5 mm (.138 in.)	20	3.2 mm (.126 in.)
18	3.4 mm (.134 in.)	21	3.1 mm (.122 in.)

SECOND COAST BRAKE PISTON ROD SELECTION

Rod	Rod Length
No. 1	71.4 mm (2.811 in.)
No. 2	72.9 mm (2.870 in.)

FORWARD CLUTCH RETAINER SELECTION

Retainer No.	Thickness	Retainer No.	Thickness
42	4.0 mm (.157 in.)	61	3.0 mm (.118 in.)
44	3.8 mm (.149 in.)	62	3.6 mm (.142 in.)
45	3.4 mm (.134 in.)	63	4.2 mm (.165 in.)
60	3.2 mm (.126 in.)	64	4.4 mm (.173 in.)

FIRST-REVERSE BRAKE CLEARANCE SELECTION

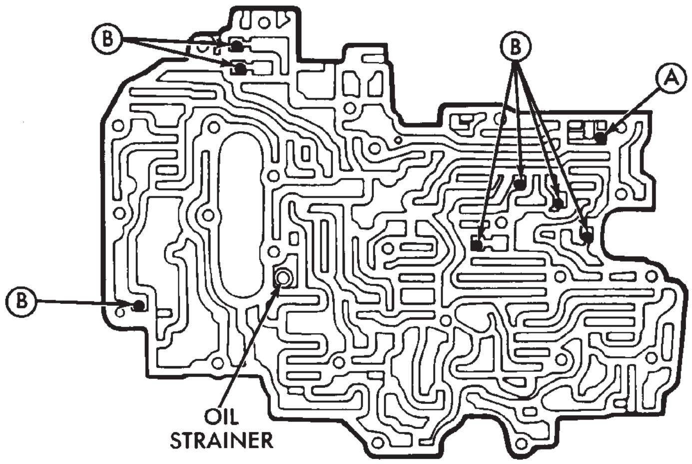
Retainer No.	Thickness	Retainer No.	Thickness
50	5.0 mm (.197 in.)	53	4.4 mm (.173 in.)
51	4.8 mm (.189 in.)	54	4.2 mm (.165 in.)
52	4.6 mm (.181 in.)	55	4.0 mm (.157 in.)

J9121-404

SPECIFICATIONS (Continued)

AW-4 VALVE BODY BALL DIMENSIONS

Check Ball	Diameter
Ⓐ Rubber Ball	6.35 mm (0.250 in.)
Ⓑ Rubber Ball	5.535 mm (.218 in.)



J9121-405

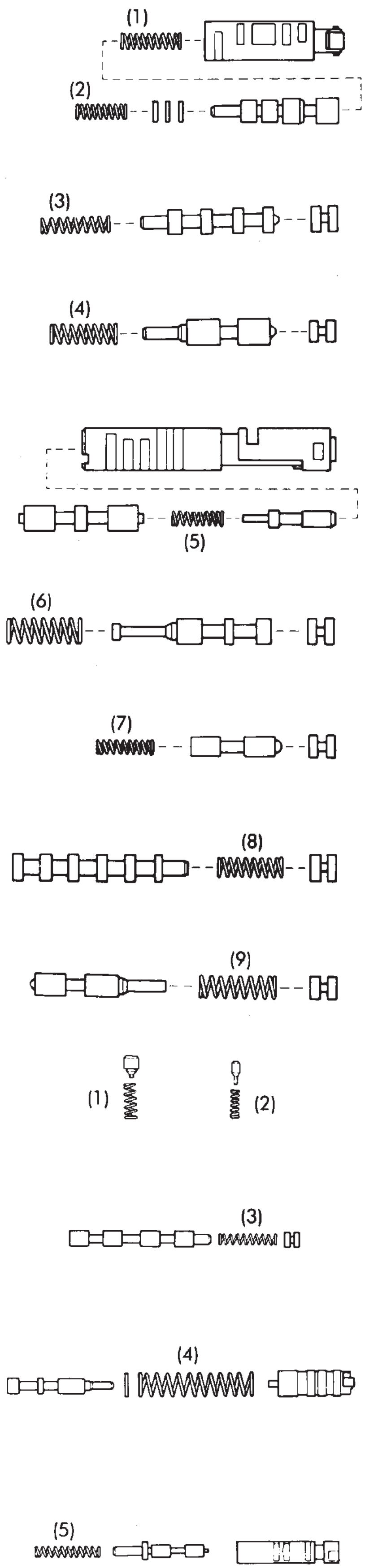
AW-4 CLUTCH AND BRAKE PACK REQUIREMENTS

Component	Discs Required	Plates Required	Retainers Required
6-Cylinder Overdrive Brake	4	3	2
6-Cylinder Second Brake	5	5	1
6-Cylinder Overdrive Direct Clutch	2	2	1
6-Cylinder Direct Clutch	4	4	1
6-Cylinder Forward Clutch	6	6	1
6-Cylinder First-Reverse Brake	7	7	1

J9121-406

SPECIFICATIONS (Continued)

AW-4 VALVE AND SPRING IDENTIFICATION



Spring	Free Length
(1) Downshift Plug	27.3 mm (1.074 in.)
(2) Throttle Valve	20.6 mm (.811 in.)
(3) 3-4 Shift Valve	30.8 mm (1.212 in.)
(4) Second Coast Modulator Valve	25.3 mm (.996 in.)
(5) Lockup Relay Valve	21.4 mm (.843 in.)
(6)Secondary Regulator Valve	30.9 mm (1.217 in.)
(7) Cut-Back Valve	21.8 mm (.858 in.)
(8) 2-3 Shift Valve	30.8 mm (1.212 in.)
(9) Low Coast Modulator Valve	27.8 mm (1.094)

Spring	Spring Length
(1) Check Valve	20.2 mm (.797 in.)
(2) Pressure Relief Valve	11.2 mm (.441 in.)
(3) 1-2 Shift Valve	30.8 mm (1.213 in.)
(4) Primary Regulator Valve	62.3 mm (2.453 in.)
(5) Accumulator Control Valve	29.8 mm (1.173 in.)

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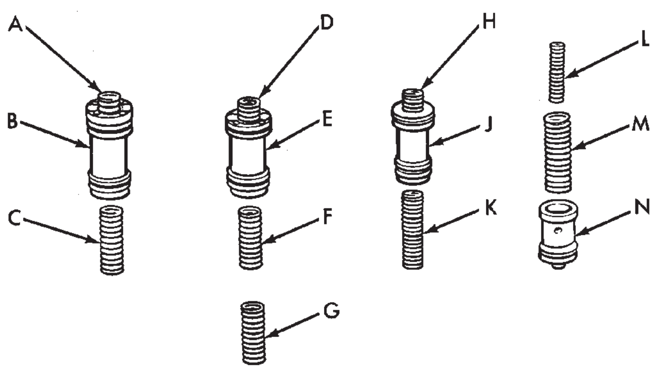
SPECIFICATIONS (Continued)

AW-4 ACCUMULATOR COMPONENT IDENTIFICATION

	Component	Approximate Outside Diameter
SECOND BRAKE ACCUMULATOR	SPRING A	14.17 mm (.558 in.)
	PISTON B	36.9 mm (1.453 in.)
	SPRING C	19.91 mm (.784 in.)
DIRECT CLUTCH ACCUMULATOR	SPRING D	12.07 mm (.475 in.)
	PISTON E	36.9 mm (1.453 in.)
	SPRING F	20.19 mm (.795 in.)
	SPRING G	14.81 mm (.583 in.)
OVERDRIVE BRAKE ACCUMULATOR	SPRING H	14.10 mm (.555 in.)
	PISTON J	31.9 mm (1.256 in.)
	SPRING K	19.99 mm (.785 in.)
OVERDRIVE CLUTCH ACCUMULATOR	SPRING L	14.0 mm (0.551 in.)
	SPRING M	20.3 mm (0.799 in.)
	PISTON N	29.9 mm (1.177 in.)



J9121-407

SPECIFICATIONS (Continued)

AW-4 TORQUE SPECIFICATIONS

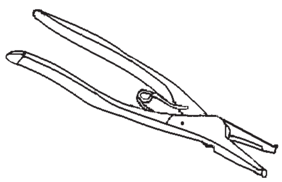
Description	Torque
Converter Housing Bolts	
10 mm	32-36 N•m (23-27 ft. lbs.)
12 mm	55-59 N•m (40-43 ft. lbs.)
Cooler Line Retaining Clip Nuts	2-4 N•m (18-35 in. lbs.)
Cooler Line Bracket Nuts	5-11 N•m (48-96 in. lbs.)
Cooler Line Fitting Nuts (at auto. trans. fittings)	18-23 N•m (160-200 in. lbs.)
Detent Spring Bolt	9-11 N•m (80-96 in. lbs.)
Dust Cover Nuts/Bolts	18-23 N•m (159-203 in. lbs.)
Extension Housing Bolts	32-36 N•m (23-27 ft. lbs.)
Fill Tube Bracket Bolt	50-64 N•m (37-47 ft. lbs.)
Neutral Switch	
Bolt	12-14 N•m (8-10 ft. lbs.)
Nut	6-8 N•m (53-70 in. lbs.)
OD Support Bolt (to case)	23-27 N•m (18-20 ft. lbs.)
Oil Pan Bolts	6-8 N•m (53-70 in. lbs.)
Oil Pan Drain Plug	19-21 N•m (14-16 ft. lbs.)
Oil Pump Bolt (to case)	21-23 N•m (16-18 ft. lbs.)
Oil Pump Bolt (to stator shaft)	9-11 N•m (80-96 in. lbs.)
Oil Screen Bolt	9-11 N•m (80-96 in. lbs.)
Park Pawl Bracket	9-11 N•m (80-96 in. lbs.)
Propeller Shaft Clamp Screws	16-23 N•m (140-200 in. lbs.)

Description	Torque
Rear Mount-To-Transmission Bolts	60-81 N•m (44-66 ft. lbs.)
Rear Mount-To-Clevis Bracket Bolt/Nut	54-75 N•m (40-55 ft. lbs.)
Rear Mount Clevis Bracket-To-Crossmember Nuts	33-49 N•m (24-36 ft. lbs.)
Shift Cable Bracket Screws At Transmission	25-39 N•m (221-345 in. lbs.)
Shift Lever Mounting Cover Screws	1-2 N•m (9-20 in. lbs.)
Shift Lever Housing Nuts	16-26 N•m (141-230 in. lbs.)
Solenoid Harness Bolt	6-8 N•m (57-75 in. lbs.)
Speedometer Adapter Clamp Screw	10-12 N•m (90-110 in. lbs.)
Speed Sensor Coupling Nut	14-20 N•m (125-175 in. lbs.)
Throttle Cable Engine Bracket Screws	7-11 N•m (63-94 in. lbs.)
Throttle Cable Retaining Screw (at transmission)	8-10 N•m (70-98 in. lbs.)
Transfer Case Mounting Nuts	30-41 N•m (22-30 ft. lbs.)
Transmission Shift Lever Nut	15-17 N•m (134-154 in. lbs.)
Transmission-To-Engine Block Bolts	50-64 N•m (37-47 ft. lbs.)
Valve Body Bolts (to case)	9-11 N•m (80-96 in. lbs.)
Valve Body Bolts (to valve body)	6-7 N•m (54-58 in. lbs.)

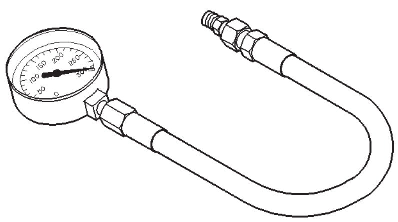
J9321-88

SPECIAL TOOLS

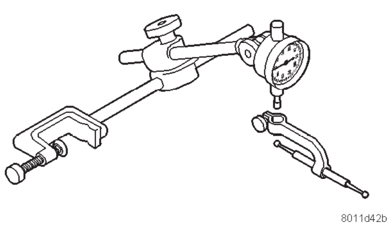
AW-4



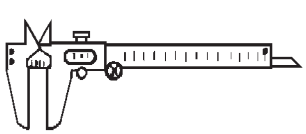
C-484 Snap Ring Plier



C-3293-SP Gauge

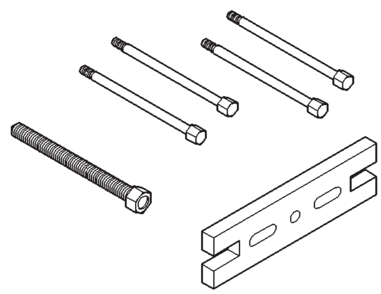


C-3339 Dial Indicator Set

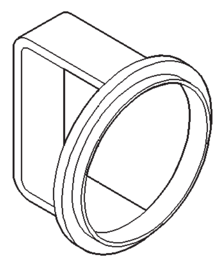


C-4959 Caliper, Metric Vernier

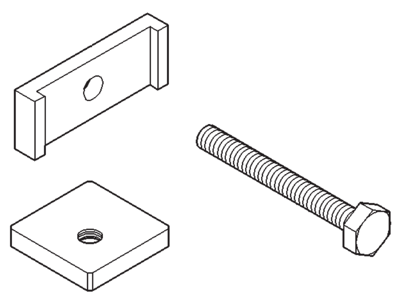
C-4960 Micrometer



7536 Puller, Oil Pump

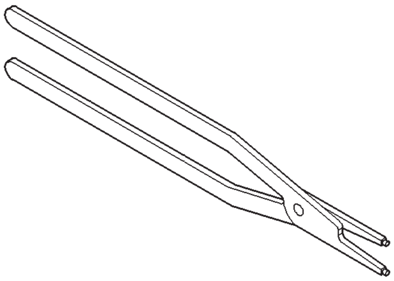


7538 Compressor, Piston #2 Spring

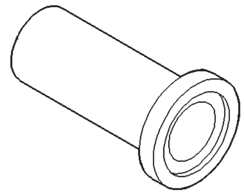


7539 Compressor, Piston #3 Spring

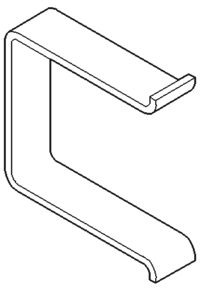
SPECIAL TOOLS (Continued)



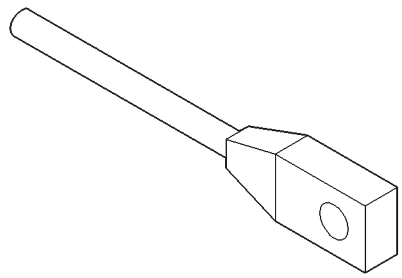
7540 Pliers, Large Snap Ring



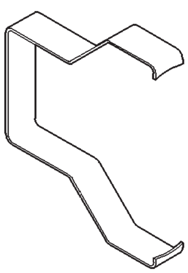
7549 Installer, Seal



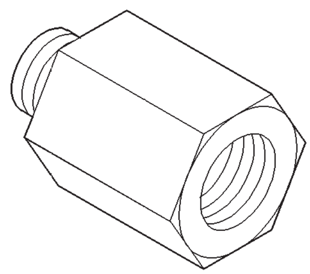
7542 Puller, Reaction Sleeve



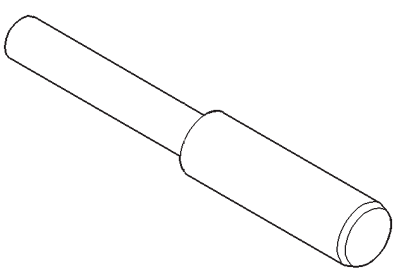
7552 Gauge, 3.0 mm Wire



7543 Puller, Piston #1



7554 Adapter, Pressure Port



7544 Installer, Brake Drum Seal

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.

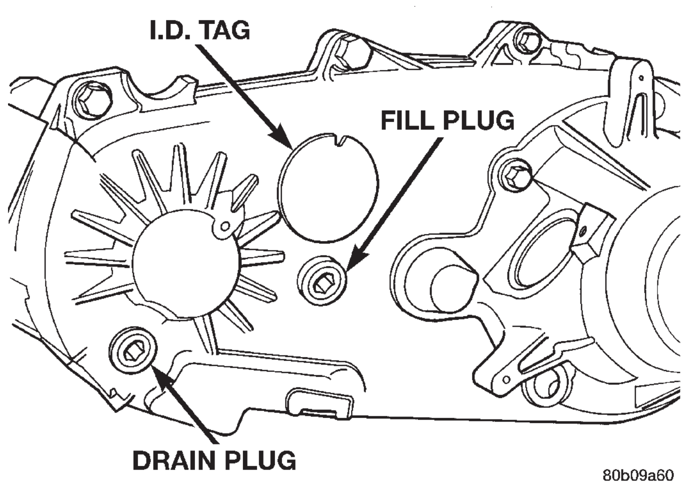


Fig. 1 Fill/Drain Plug And I.D. Tag Locations

GENERAL INFORMATION (Continued)

RECOMMENDED LUBRICANT AND FILL LEVEL

Recommended lubricant for the NV231 transfer case is Mopar® Dexron II, or ATF Plus 3, type 7176. 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

DIAGNOSIS CHART

Condition	Possible Cause	Correction
Transfer case difficult to shift or will not shift into desired range.	1) Vehicle speed to great to permit shifting.	1) Slow vehicle and shift into desired range.
	2) If vehicle was operated for an extended period in 4H mode on dry surface, driveline torque load may cause difficulty.	2) Stop vehicle and shift transfer case to Neutral position. Transfer case can then be shifted to the desired mode.
	3) Transfer case shift linkage binding.	3) Repair or replace linkage as necessary.
	4) Insufficient or incorrect lubricant.	4) Drain and refill transfer case with the correct type and quantity of lubricant.
	5) Internal transfer case components binding, worn, or damaged.	5) Repair or replace components as necessary.
Transfer case noisy in all drive modes.	1) Insufficient or incorrect lubricant.	1) Drain and refill transfer case with the correct type and quantity of lubricant.
Transfer case noisy while in, or jumps out of, 4L mode.	1) Transfer case not completely engaged in 4L position.	1) Slow vehicle, shift transfer case to the Neutral position, and then shift into the 4L mode.
	2) Transfer case shift linkage out of adjustment.	2) Adjust linkage as necessary.
	3) Transfer case shift linkage loose or binding.	3) Repair, replace, or tighten linkage components as necessary.
	4) Range fork damaged, inserts worn, or fork is binding on the shift rail.	4) Repair or replace components as necessary.
	5) Low range gear worn or damaged.	5) Repair or replace components as necessary.
Lubricant leaking from transfer case seals or vent.	1) Transfer case overfilled.	1) Drain lubricant to the correct level.
	2) Transfer case vent closed or restricted.	2) Clean or replace vent as necessary.
	3) Transfer case seals damaged or installed incorrectly.	3) Replace suspect seal.
Abnormal tire wear.	1) Extended operation in 4H mode on dry surfaces,	1) Operate vehicle in 2H mode on dry surfaces.

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.

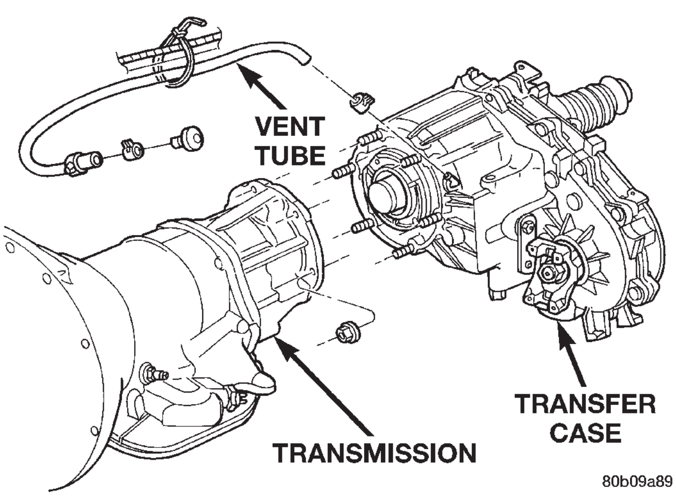


Fig. 2 Transfer Case Mounting

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).

REMOVAL AND INSTALLATION (Continued)

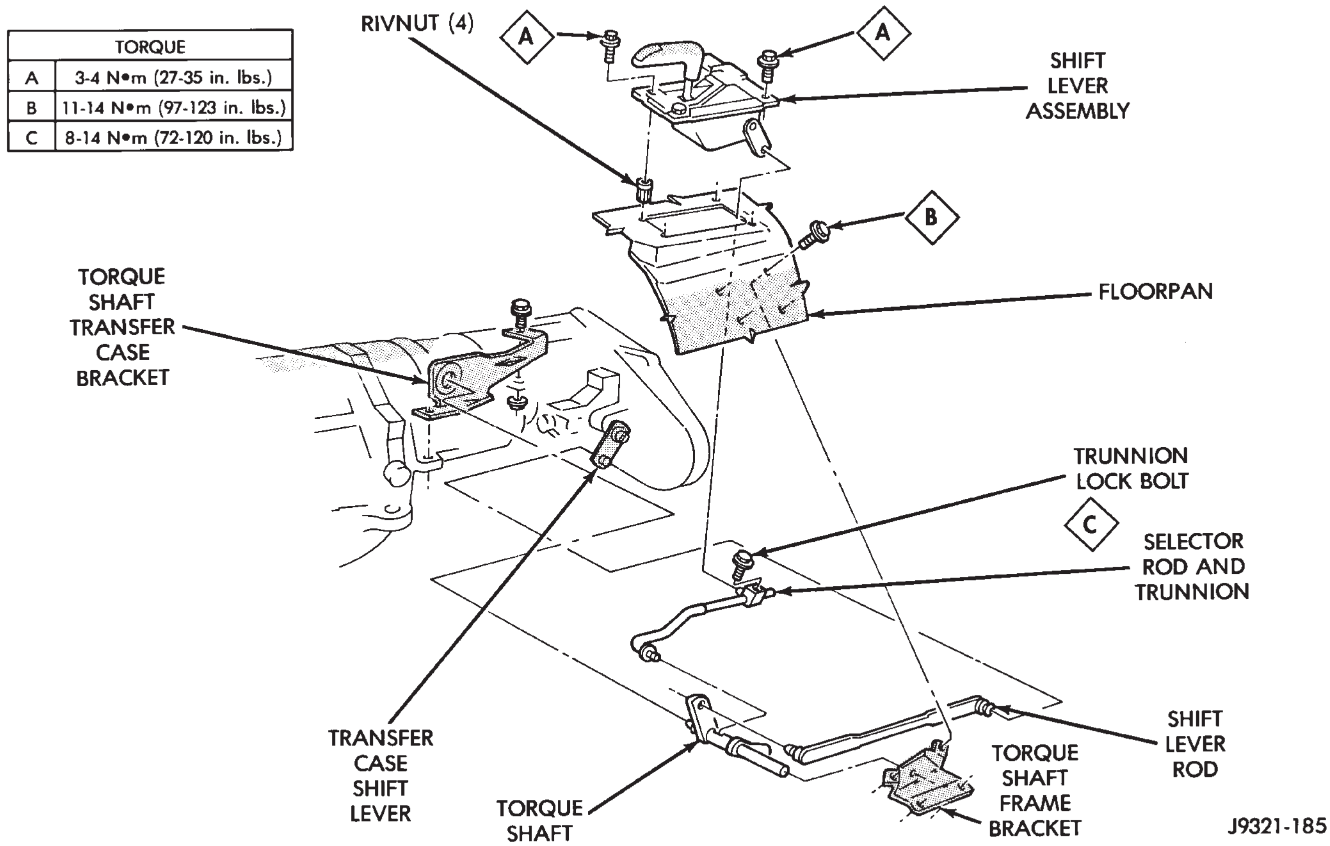


Fig. 3 Shift Linkage

(4) Remove speed sensor and speedometer adapter as an assembly.

(5) Remove speed sensor retaining screw and remove sensor from adapter.

(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.

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.

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).

REMOVAL AND INSTALLATION (Continued)

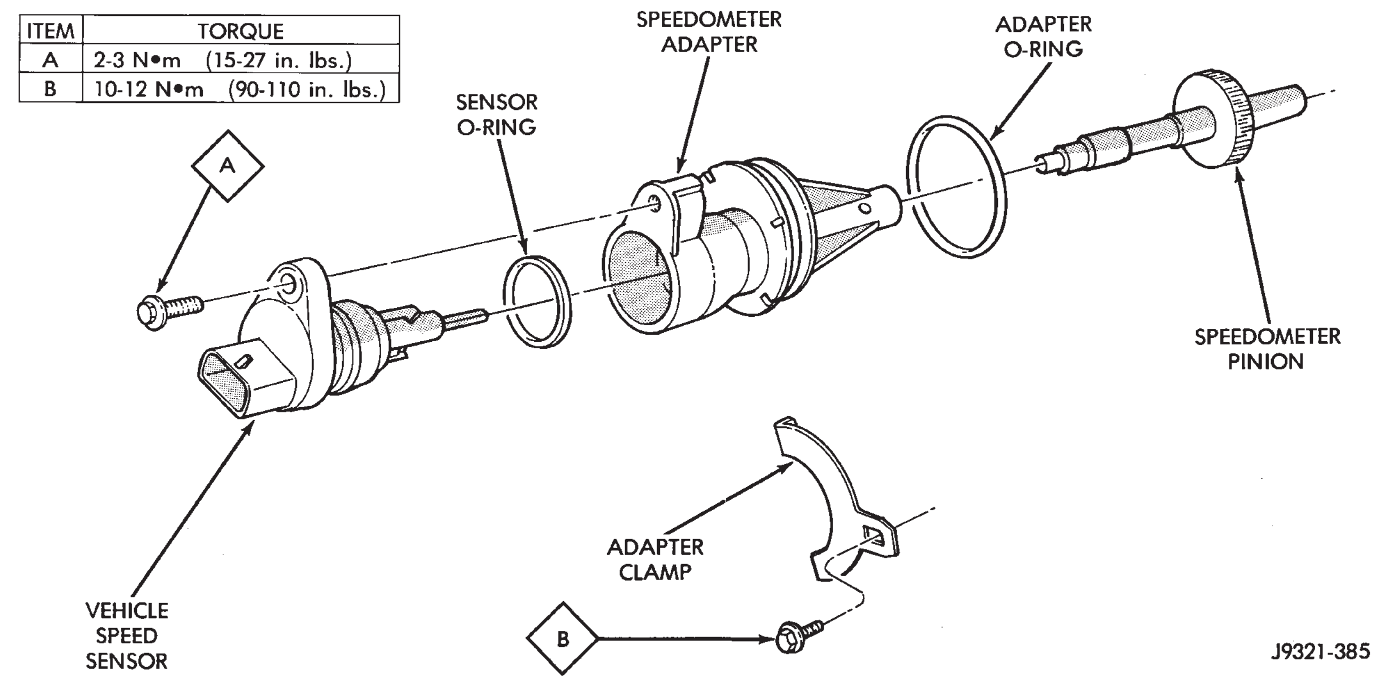


Fig. 4 Speedometer Components

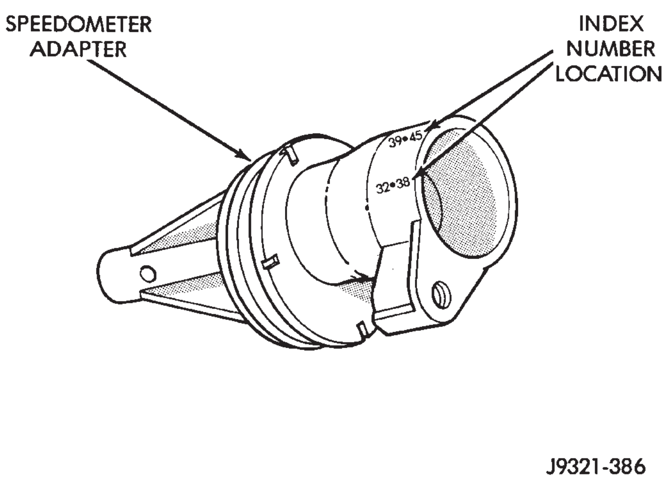


Fig. 5 Location Of Index Numbers On Speedometer Adapter

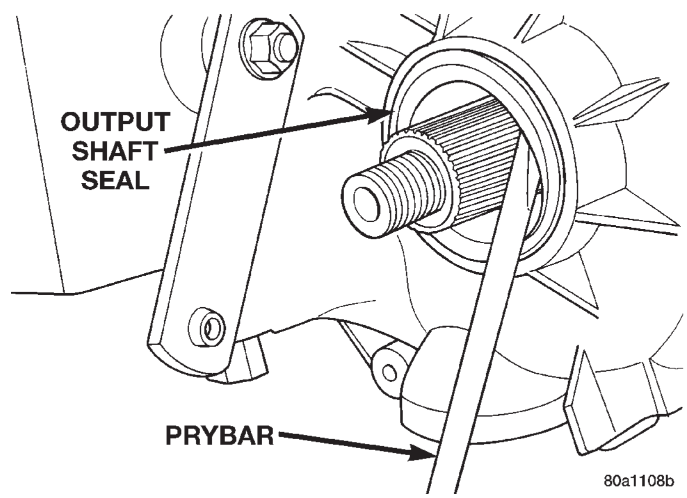


Fig. 6 Remove Front Output Shaft Seal

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.

REMOVAL AND INSTALLATION (Continued)

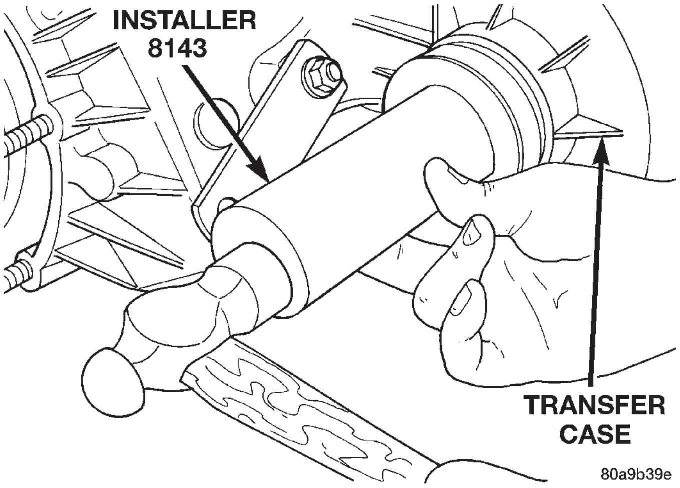


Fig. 7 Front Output Seal Installation

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.

(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).

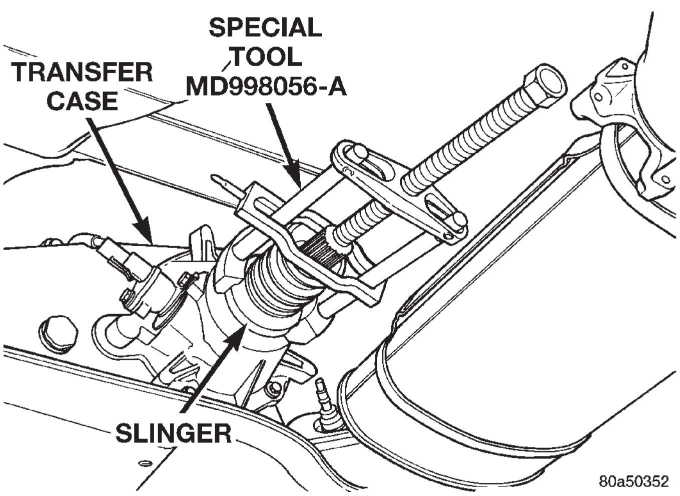


Fig. 8 Rear Slinger Removal

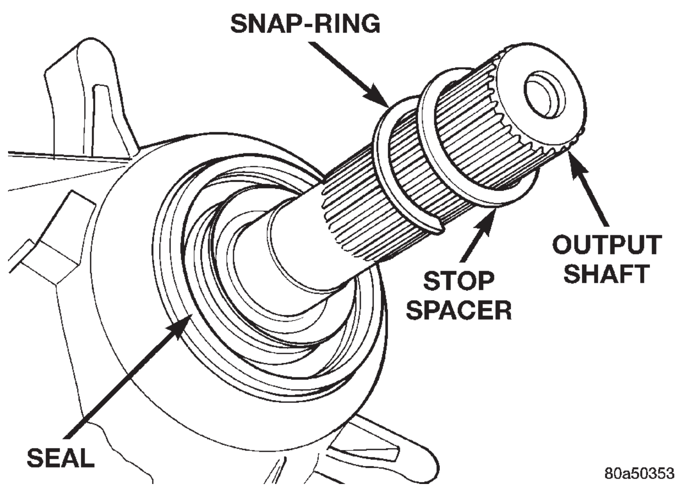


Fig. 9 Slinger Stop Spacer and Snap-ring

(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.

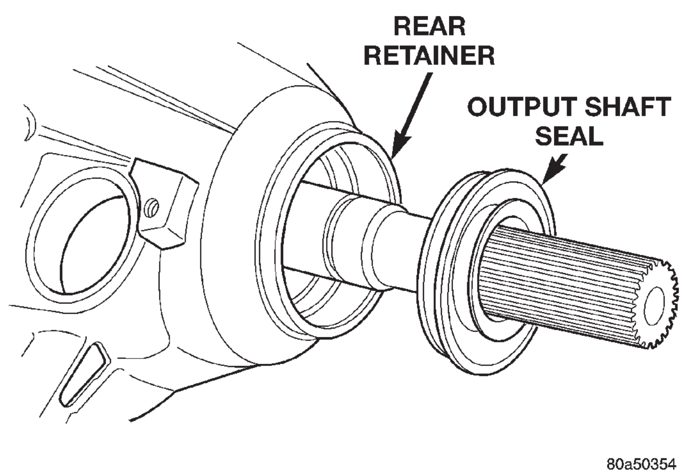


Fig. 10 Rear Retainer Seal

(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.

(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).

(13) Remove pick-up tube o-ring from oil pump (Fig. 14), if necessary. Do not disassemble the oil pump, it is not serviceable.

DISASSEMBLY AND ASSEMBLY (Continued)

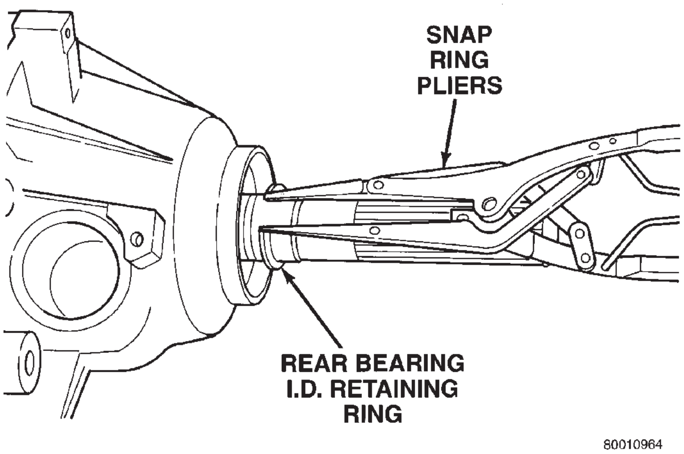


Fig. 11 Output Shaft Rear Bearing Retaining Ring

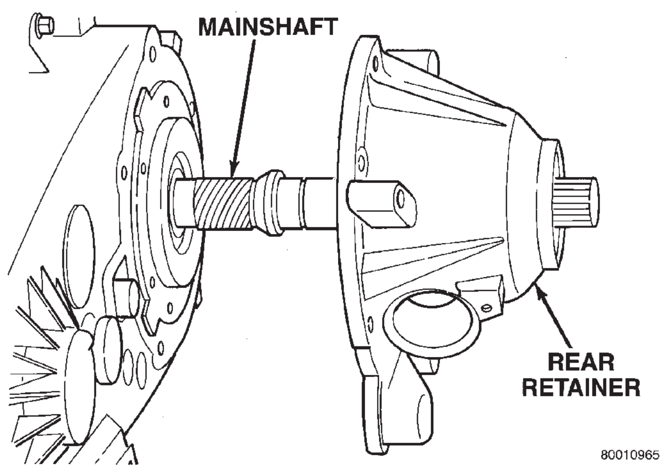


Fig. 12 Rear Retainer Removal

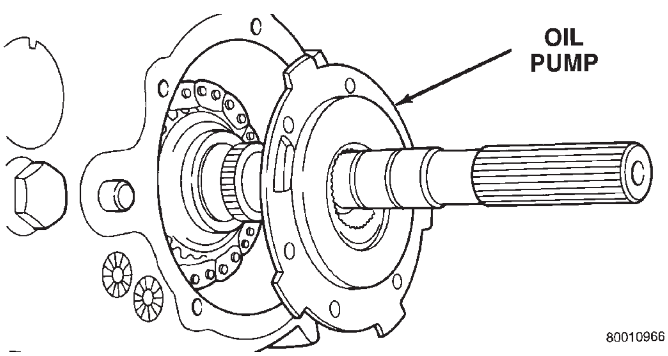


Fig. 13 Oil Pump Removal

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.

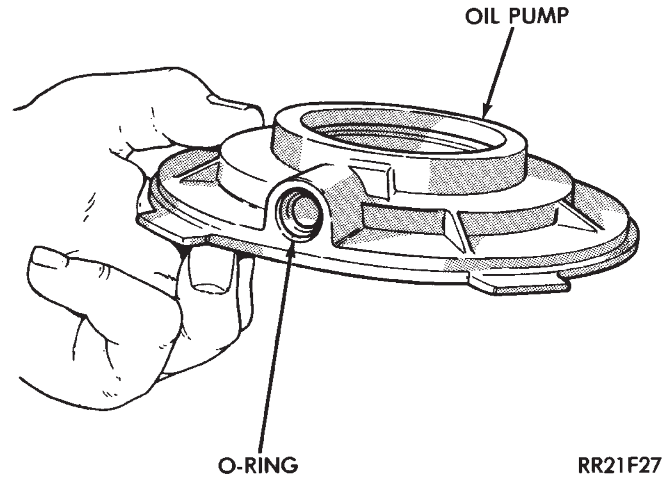


Fig. 14 Pick-up Tube O-ring Location

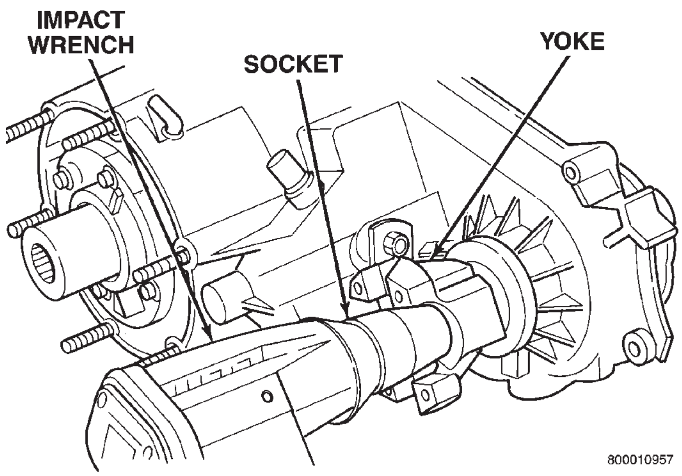


Fig. 15 Yoke Nut Removal

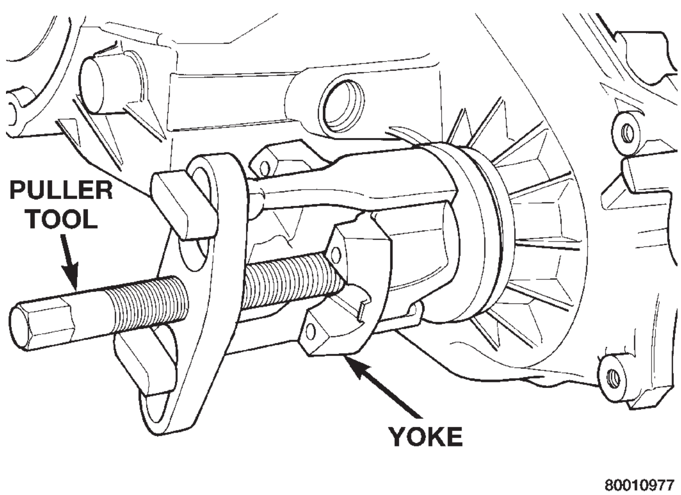


Fig. 16 Yoke Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(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).

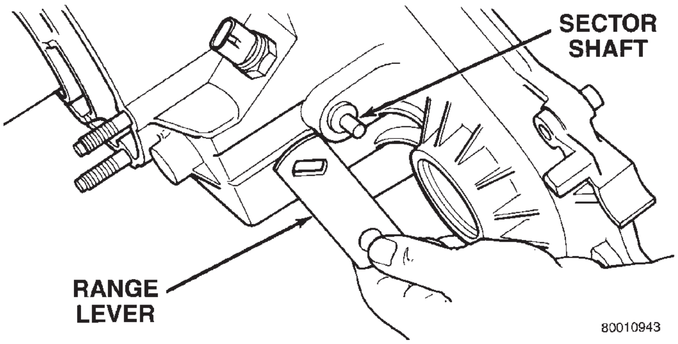


Fig. 17 Range Lever Removal

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).

(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.

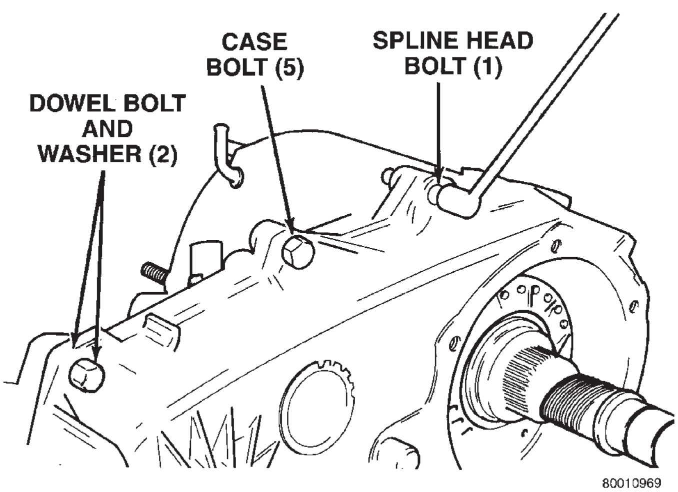


Fig. 18 Rear Case Alignment Bolt Locations

(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.

SHIFT FORKS AND MAINSHAFT REMOVAL

(1) Remove detent plug, O-ring, detent spring and detent plunger (Fig. 23).

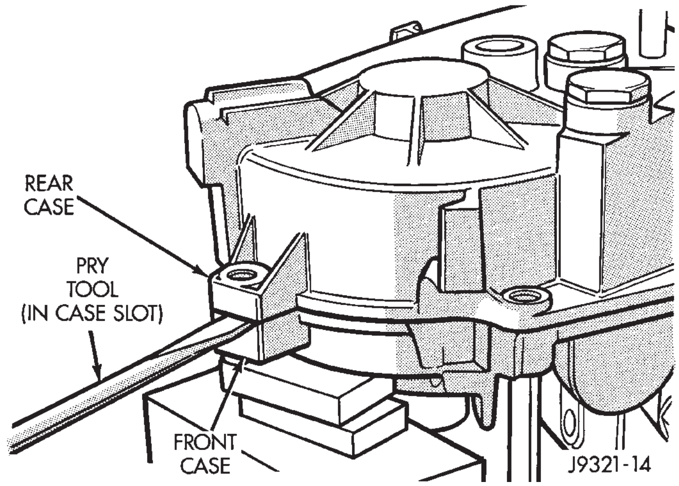


Fig. 19 Loosening Rear Case

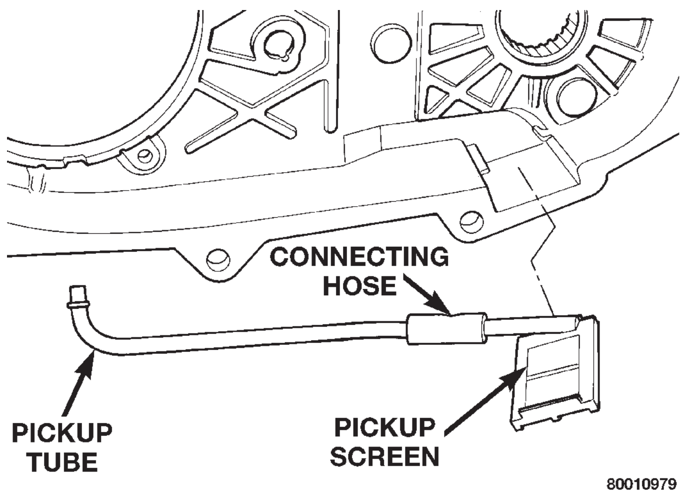


Fig. 20 Oil Pickup Tube Removal

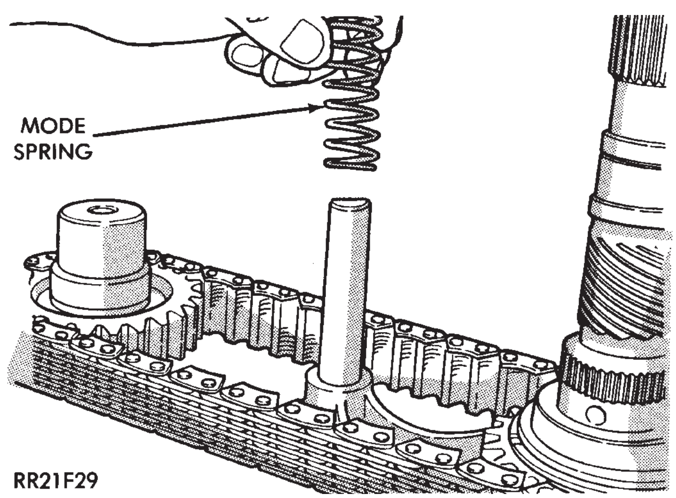


Fig. 21 Mode Fork Spring Removal

(2) Remove mainshaft from mode sleeve and input gear pilot bearing.

DISASSEMBLY AND ASSEMBLY (Continued)

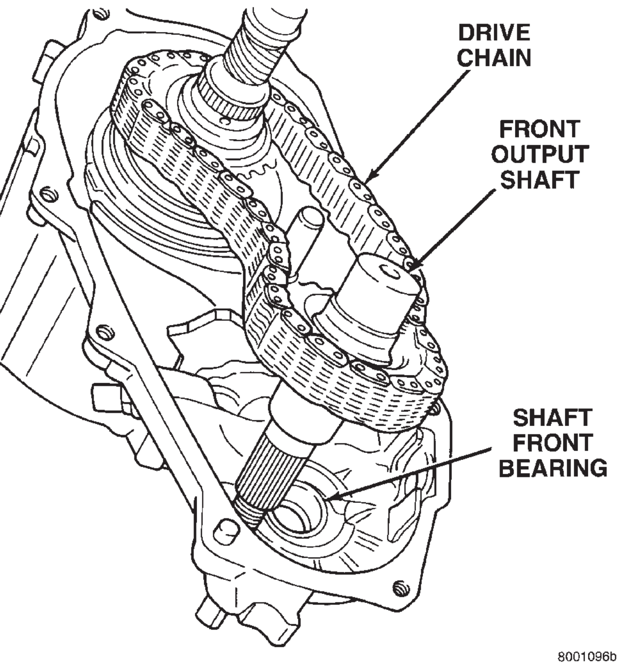


Fig. 22 Remove Front Output Shaft And Chain

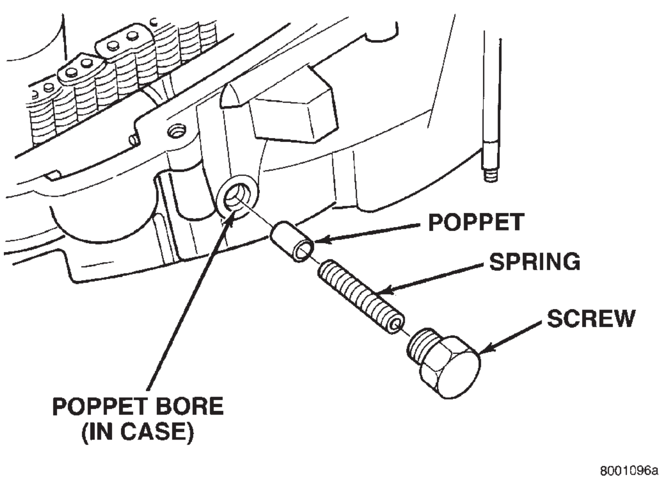


Fig. 23 Detent Plug, Spring And Plunger Removal

(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).

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).

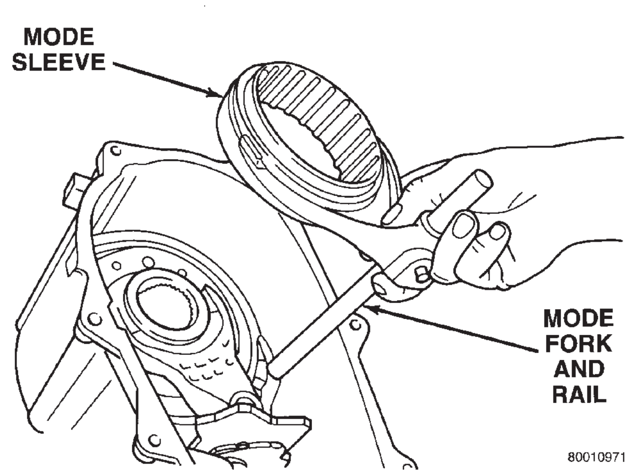


Fig. 24 Mode Fork And Sleeve Removal

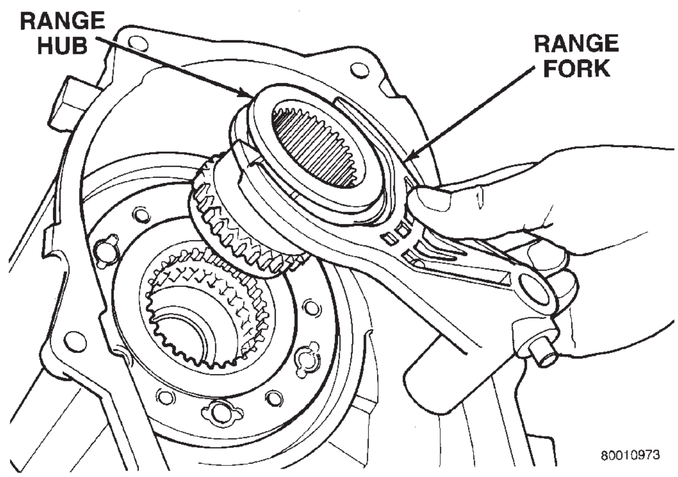


Fig. 25 Range Fork And Hub Removal

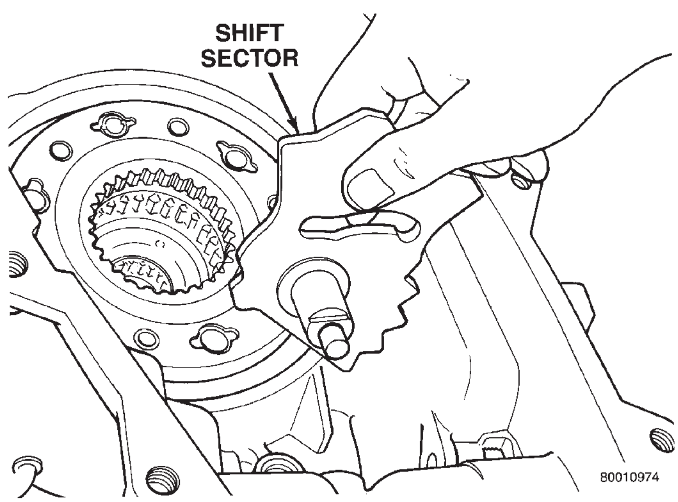


Fig. 26 Shift Sector Removal

INPUT GEAR AND LOW RANGE GEAR REMOVAL

(1) Remove front bearing retainer attaching bolts (Fig. 31).

DISASSEMBLY AND ASSEMBLY (Continued)

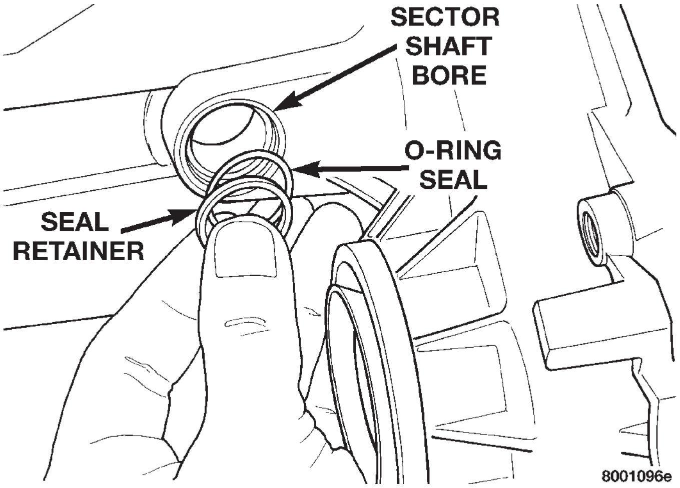


Fig. 27 Sector Bushing And O-Ring Removal

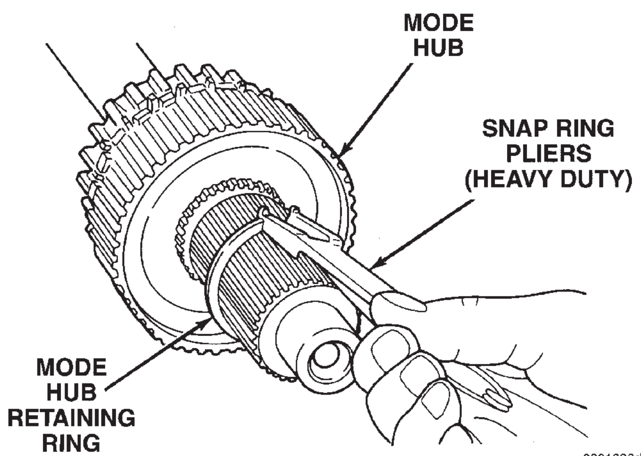


Fig. 28 Mode Hub Retaining Ring Removal

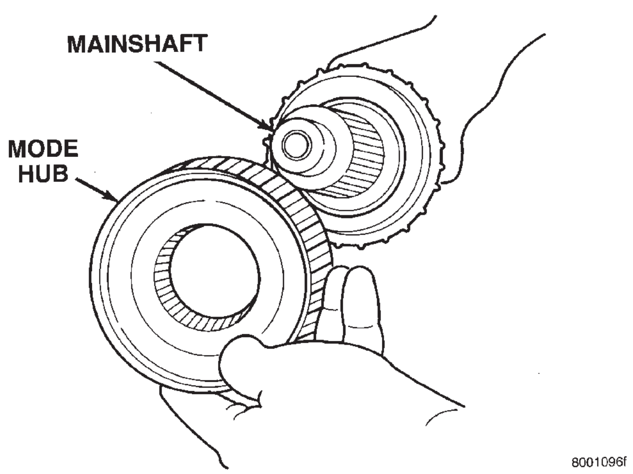


Fig. 29 Mode Hub Removal

(2) Remove front bearing retainer. Pry retainer loose with pry tool positioned in slots at each end of retainer (Fig. 32).

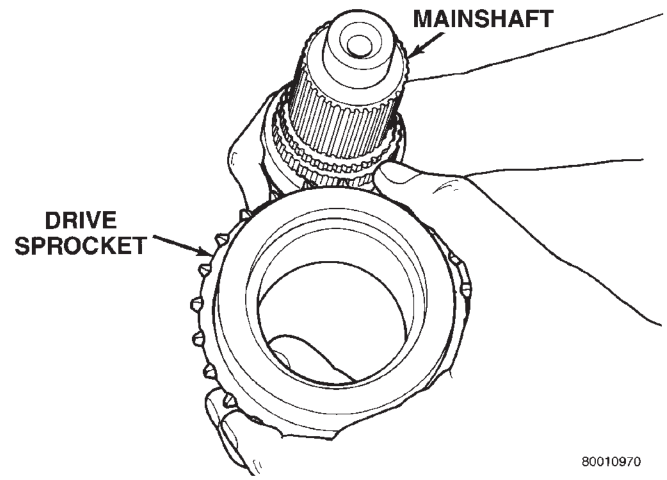


Fig. 30 Drive Sprocket Removal

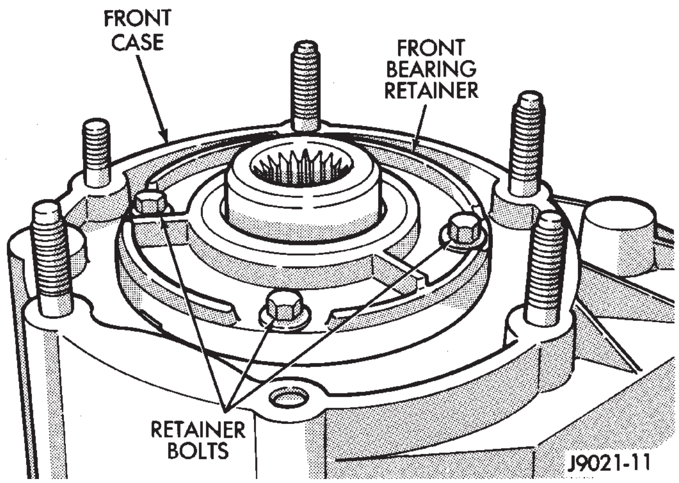


Fig. 31 Front Bearing Retainer Bolts

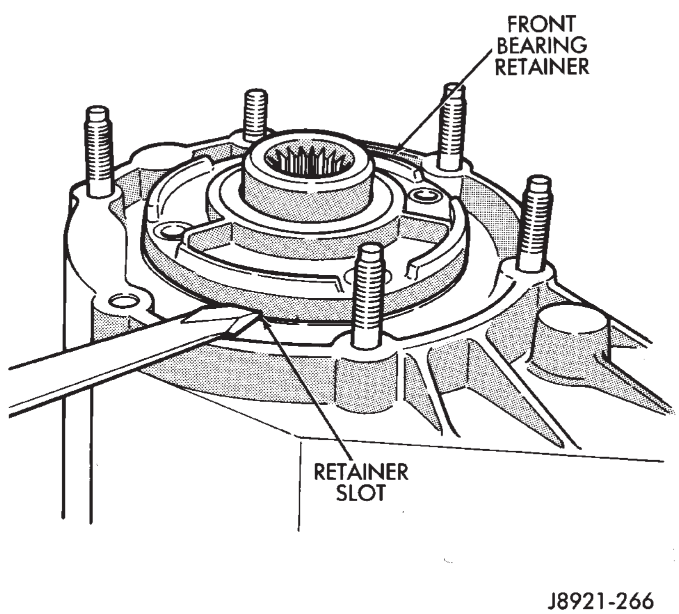


Fig. 32 Front Bearing Retainer Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(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)

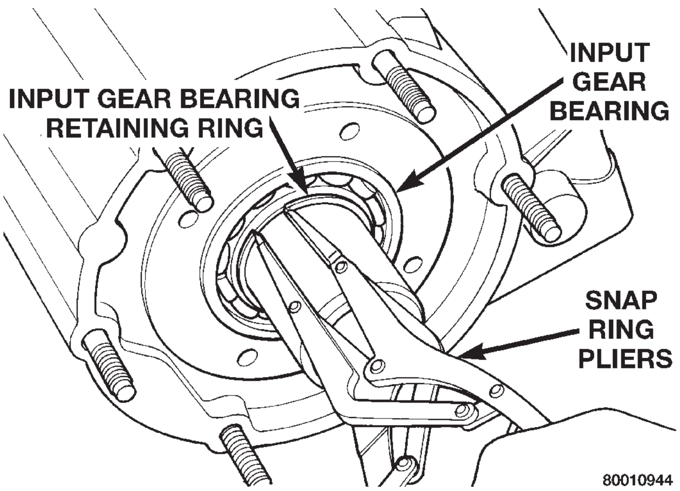


Fig. 33 Removing Input Gear Retaining Ring

(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.

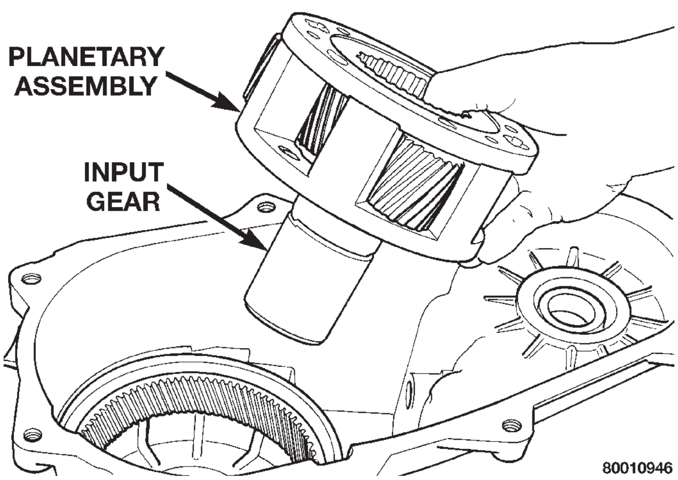


Fig. 34 Input Gear And Planetary Carrier Removal

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).

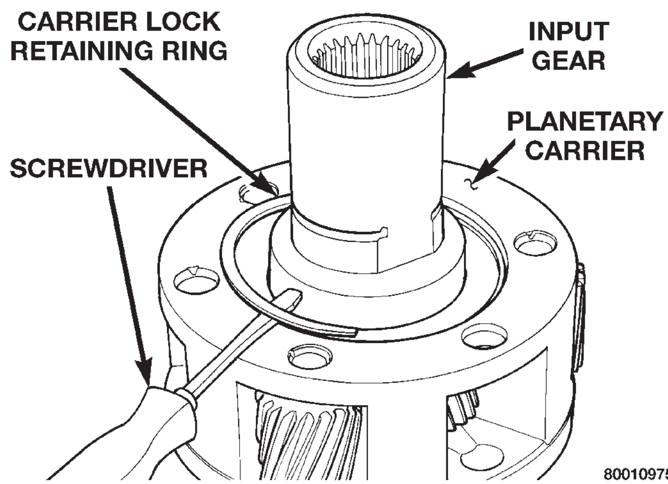


Fig. 35 Input Gear Snap-Ring Removal

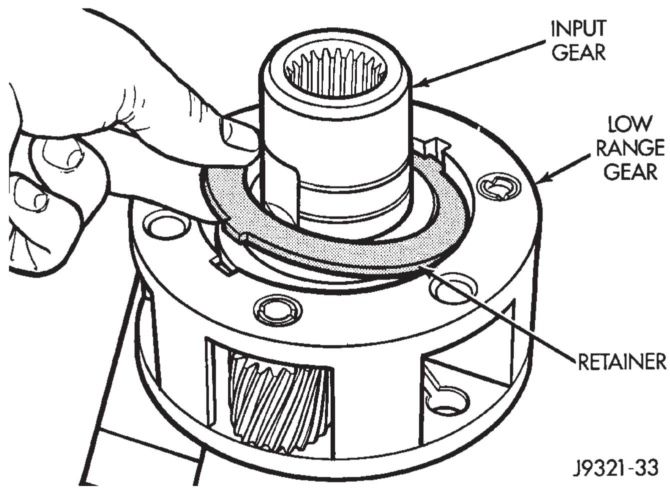


Fig. 36 Input Gear Retainer Removal

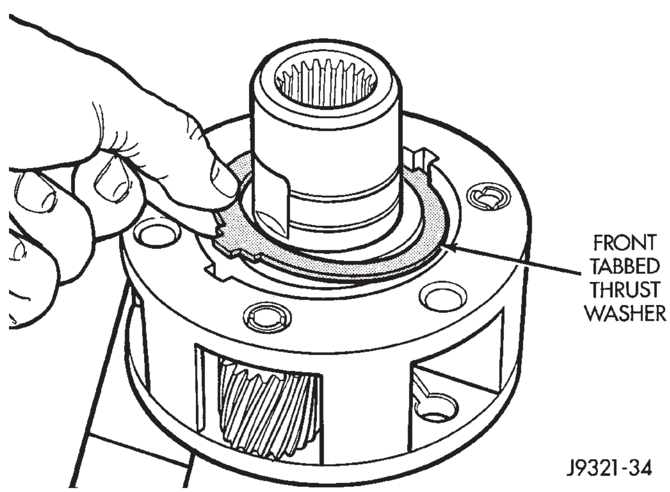


Fig. 37 Front Tabbed Thrust Washer Removal

ASSEMBLY

Lubricate transfer case components with Mopar® Dexron II automatic transmission fluid or petroleum jelly (where indicated) during assembly.

DISASSEMBLY AND ASSEMBLY (Continued)

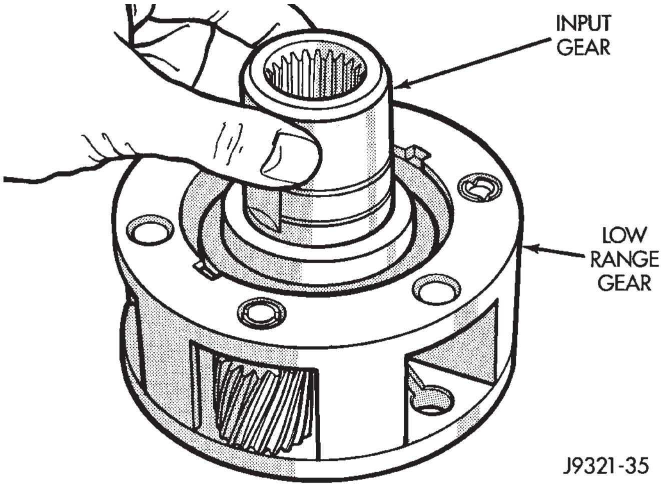


Fig. 38 Input Gear Removal

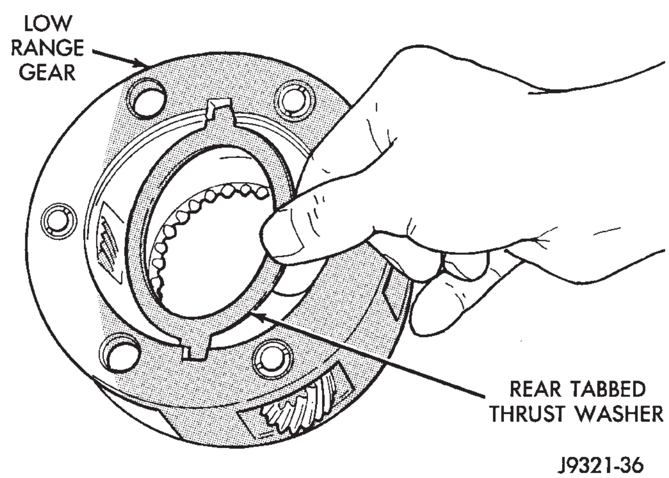


Fig. 39 Rear Tabbed Thrust Washer Removal

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).

(4) Install front output shaft front bearing in case with Tool Handle C-4171 and Installer 5064 (Fig. 43).

(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.

(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.**

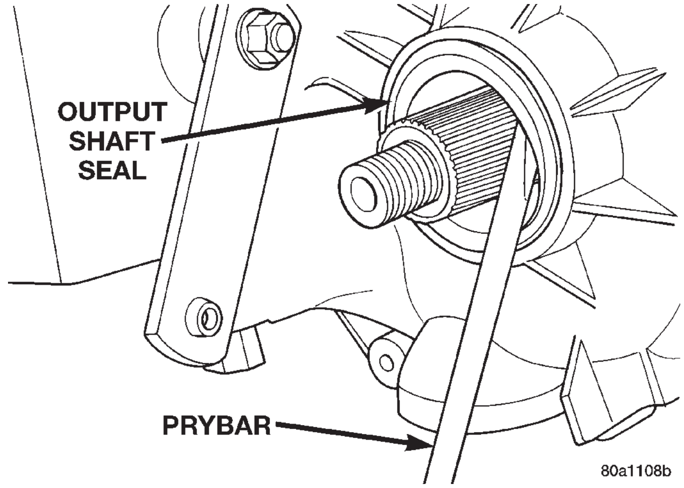


Fig. 40 Front Output Seal Removal

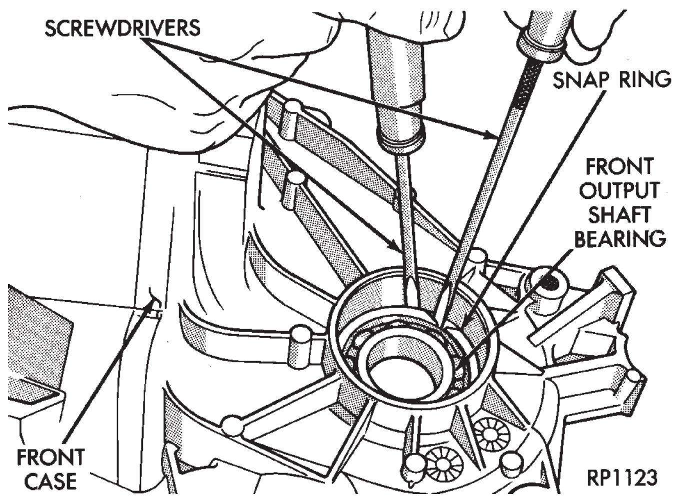


Fig. 41 Front Output Shaft Bearing Retaining Ring Removal

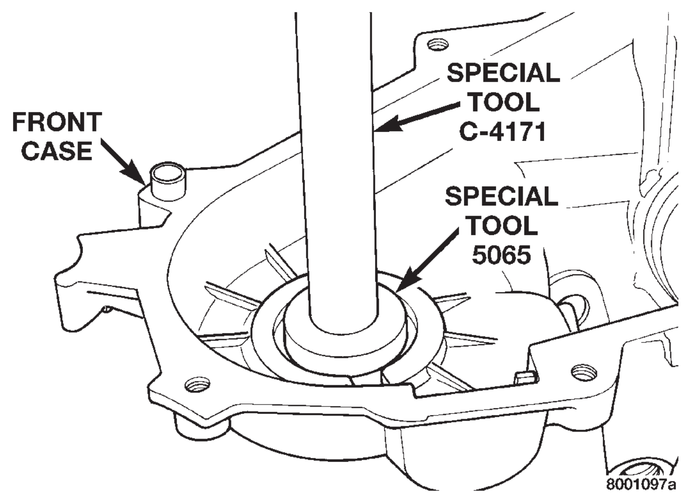


Fig. 42 Front Output Shaft Bearing Removal

(b) Start seal in bore with light taps from hammer (Fig. 45). Once seal is started, continue tap-

DISASSEMBLY AND ASSEMBLY (Continued)

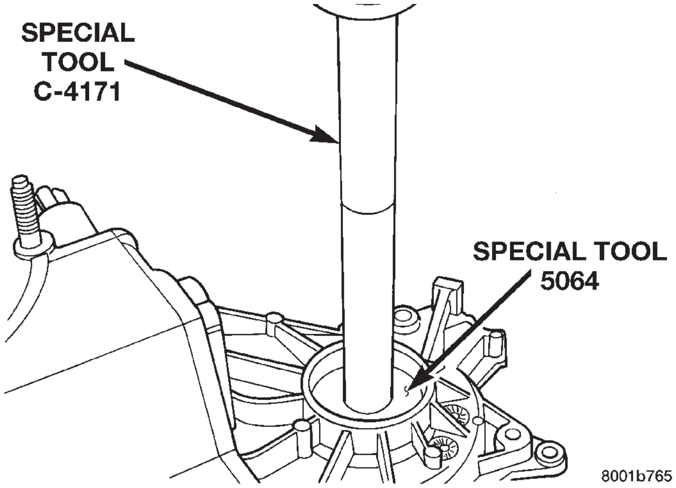


Fig. 43 Front Output Shaft Bearing Installation

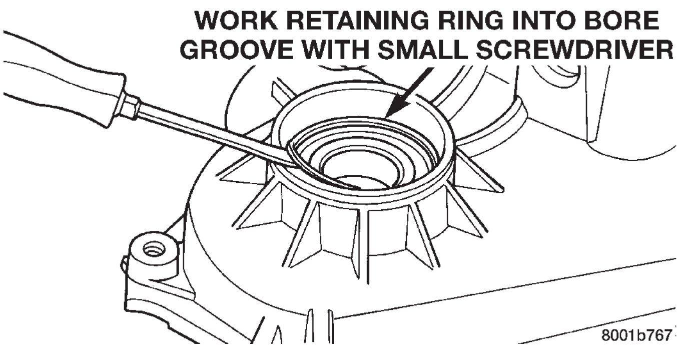


Fig. 44 Installing Output Shaft Front Bearing Retaining Ring

ping seal into bore until installer tool bottoms against case.

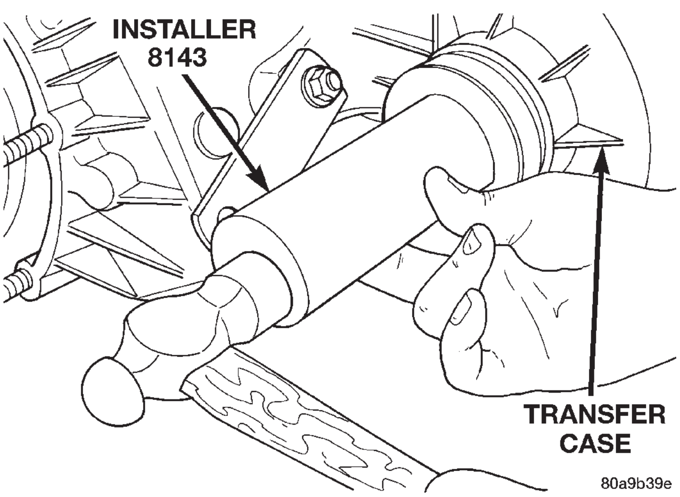


Fig. 45 Front Output Seal Installation

(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).

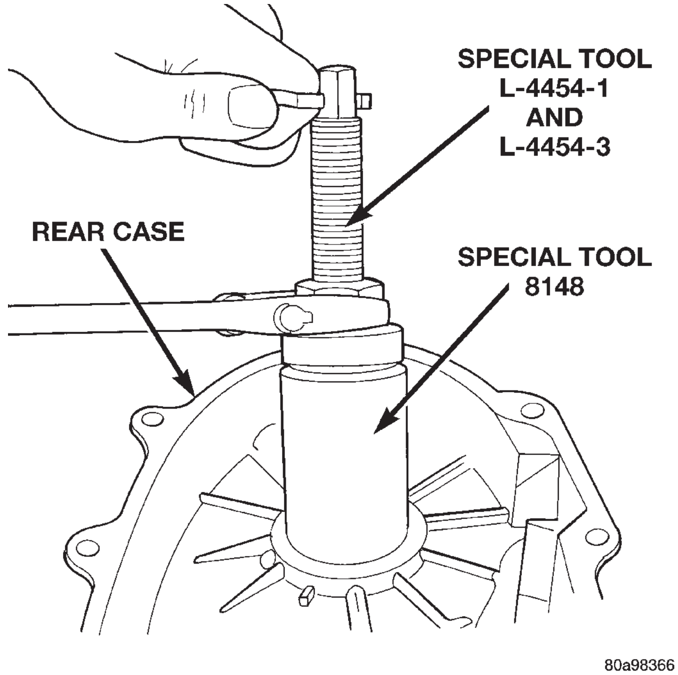


Fig. 46 Output Shaft Rear Bearing Removal

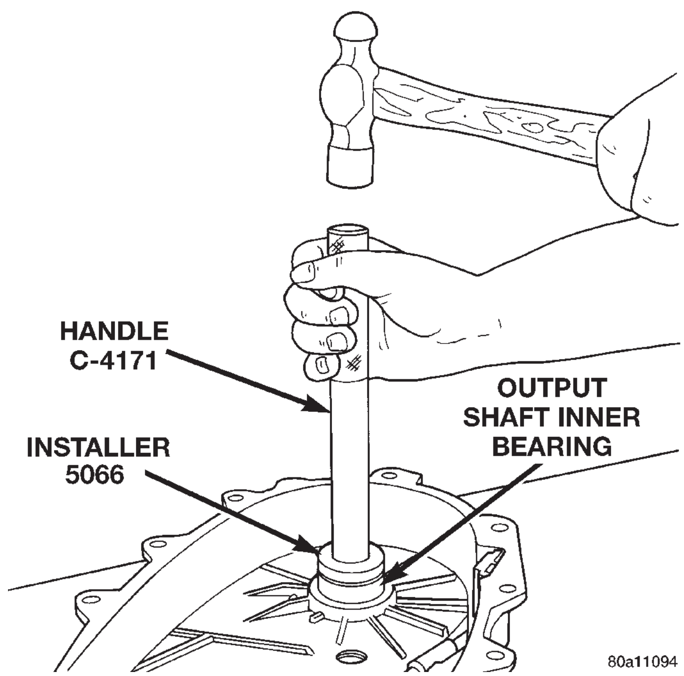


Fig. 47 Output Shaft Rear Bearing Installation

(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

DISASSEMBLY AND ASSEMBLY (Continued)

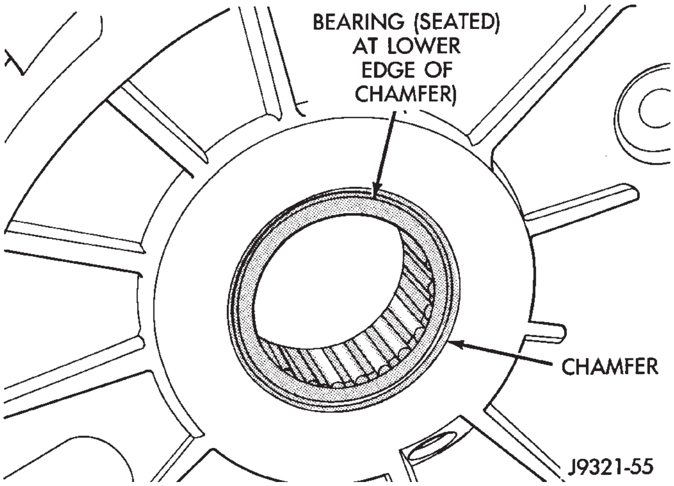


Fig. 48 Output Shaft Rear Bearing Installation Depth

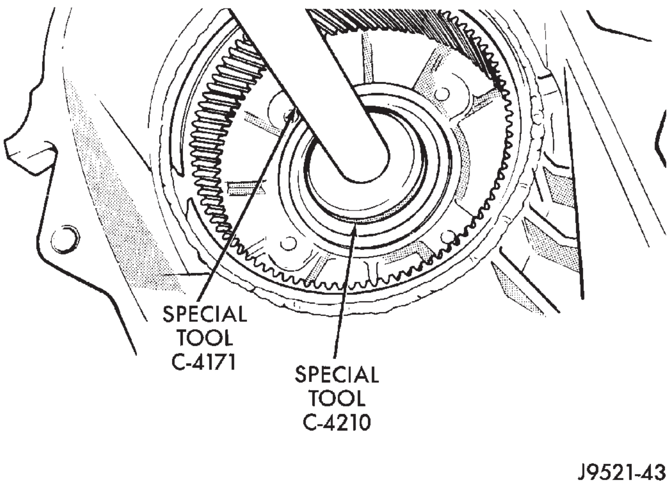


Fig. 49 Input Shaft Bearing Removal

locating ring must be fully seated against case surface (Fig. 50).

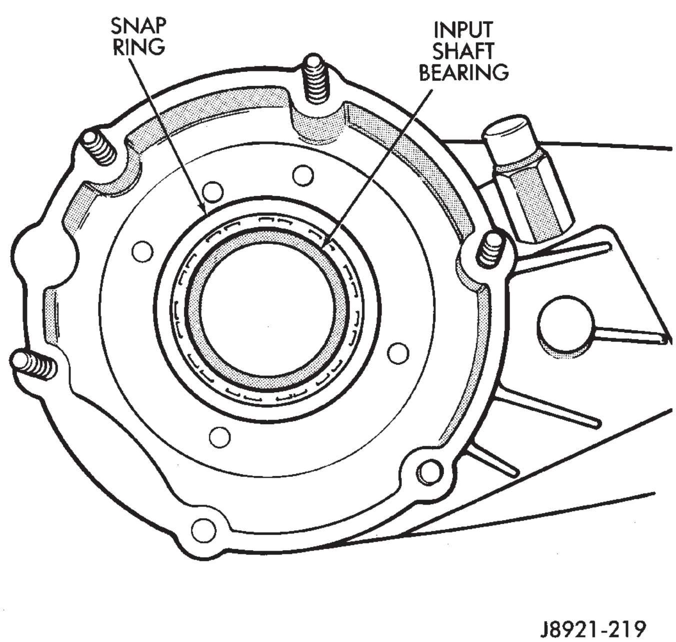


Fig. 50 Seating Input Shaft Bearing

(13) Remove input gear pilot bearing by inserting a suitably sized drift into the splined end of the input gear and driving the bearing out with the drift and a hammer (Fig. 51).

(14) Install new pilot bearing with Installer 5065 and Handle C-4171 (Fig. 52).

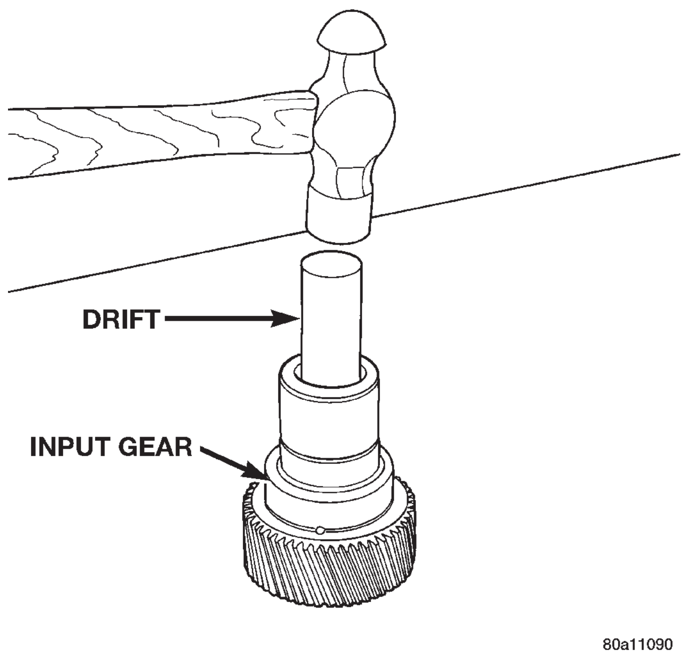


Fig. 51 Remove Input Gear Pilot Bearing

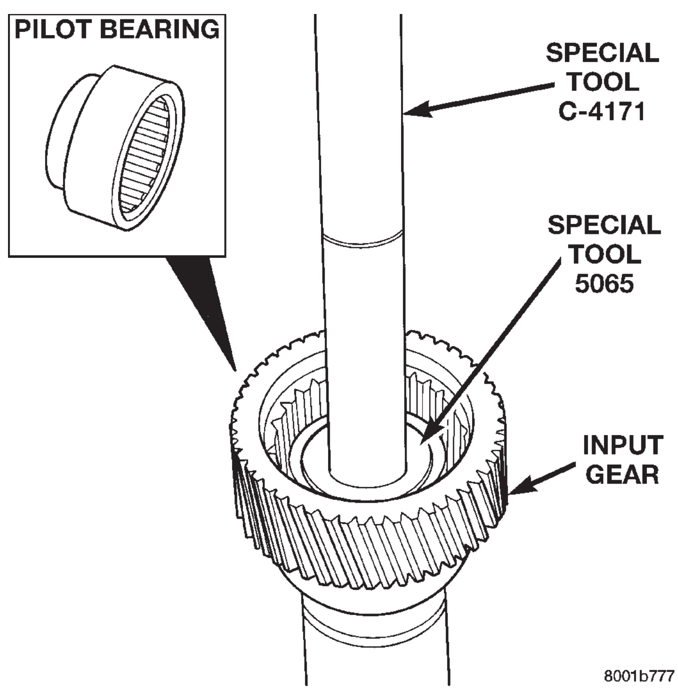


Fig. 52 Install Input Gear Pilot Bearing

(15) Remove front bearing retainer seal with suitable pry tool.

DISASSEMBLY AND ASSEMBLY (Continued)

(16) Install new front bearing retainer seal with Installer 7884 (Fig. 53).

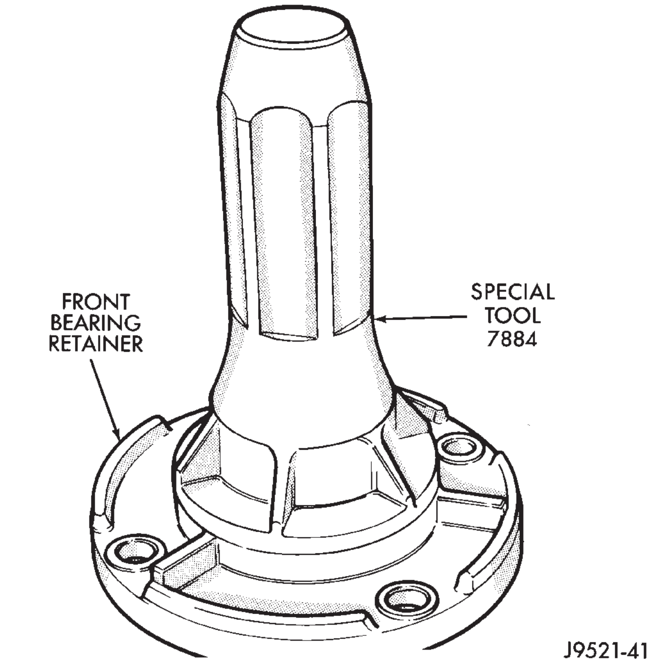


Fig. 53 Install Front Bearing Retainer Seal

(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).

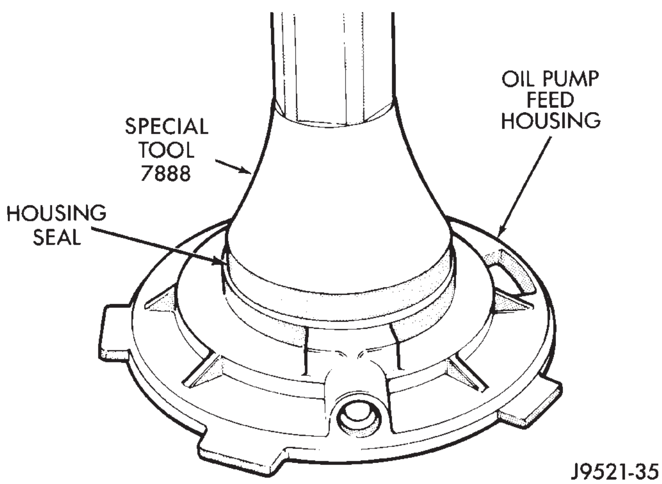


Fig. 54 Oil Pump Seal Installation

(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.

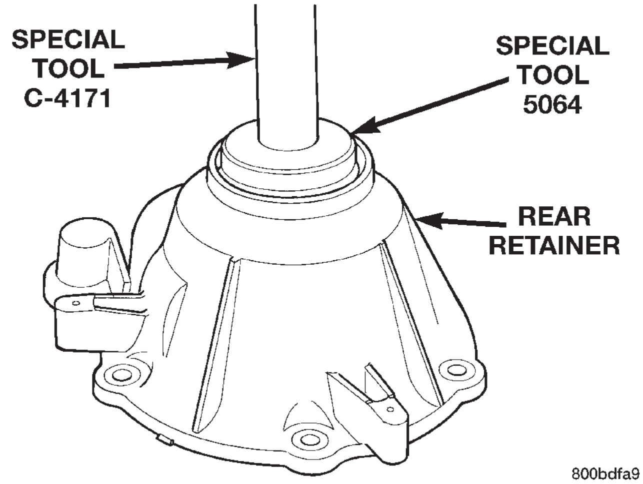


Fig. 55 Installing Rear Bearing In Retainer

(2) Install first thrust washer in low range gear (Fig. 56). Be sure washer tabs are properly aligned in gear notches.

(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.

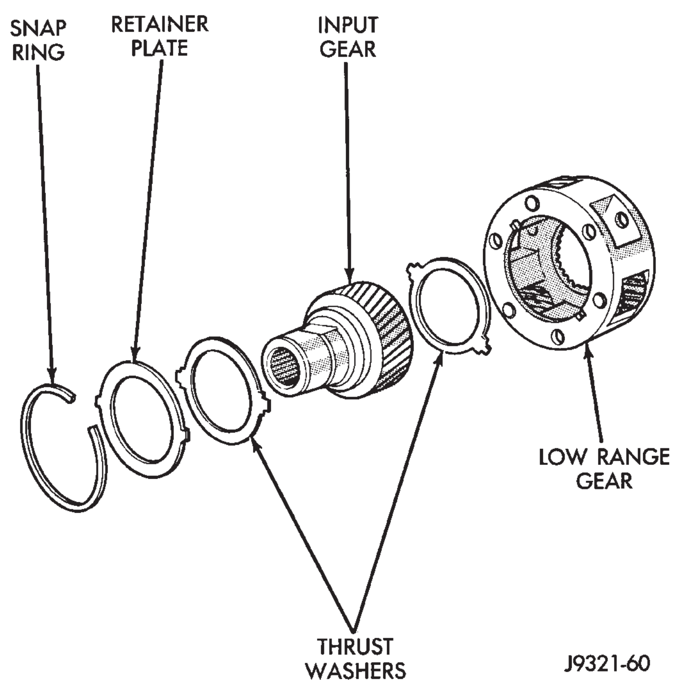


Fig. 56 Input/Low Range Gear Components

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.

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Install snap-ring to hold input/low range gear into front bearing (Fig. 58).

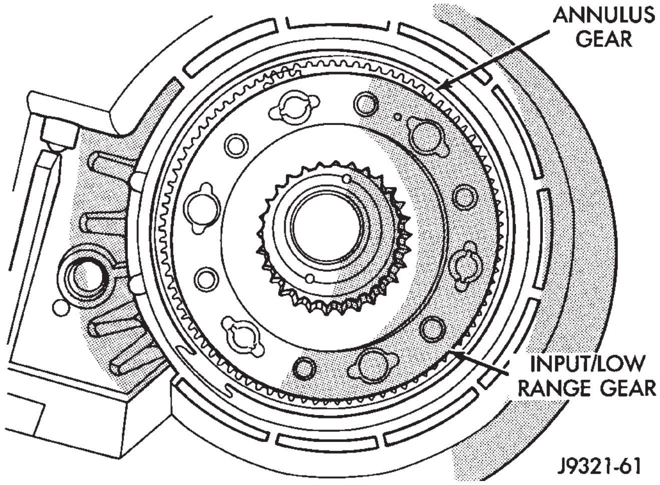


Fig. 57 Input/Low Range Gear Installation

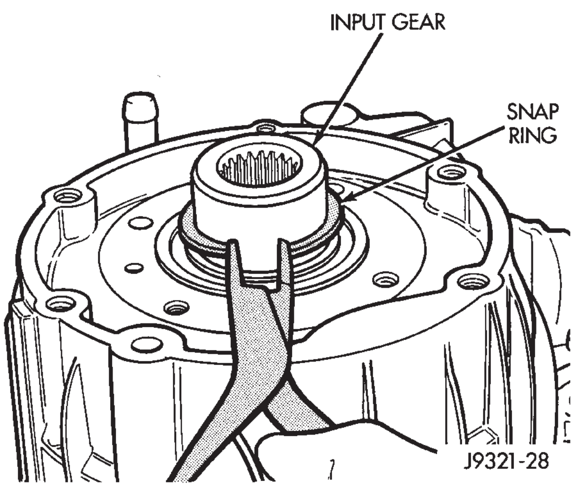


Fig. 58 Install Snap-Ring

(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.

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.

MAINSHAFT ASSEMBLY

(1) Lubricate mainshaft splines with recommended transmission fluid.

(2) Slide drive sprocket onto mainshaft.

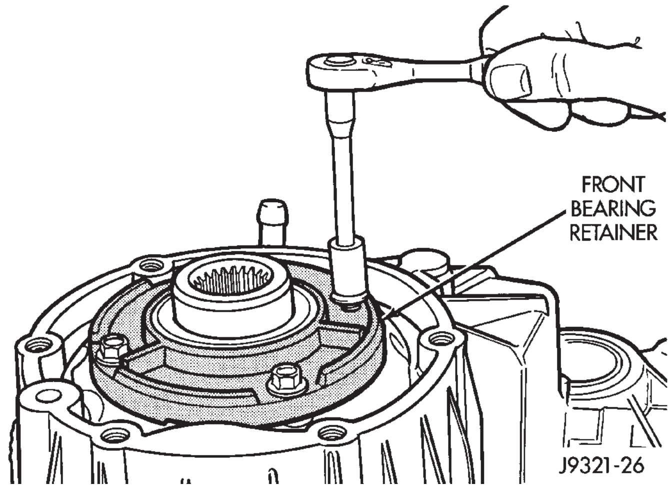


Fig. 59 Install Front Bearing Retainer

(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).

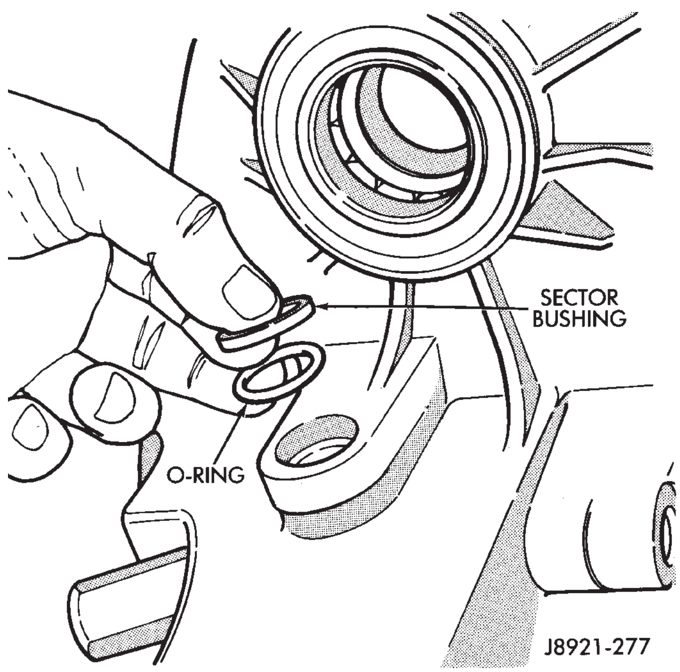


Fig. 60 Sector O-Ring And Bushing Installation

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

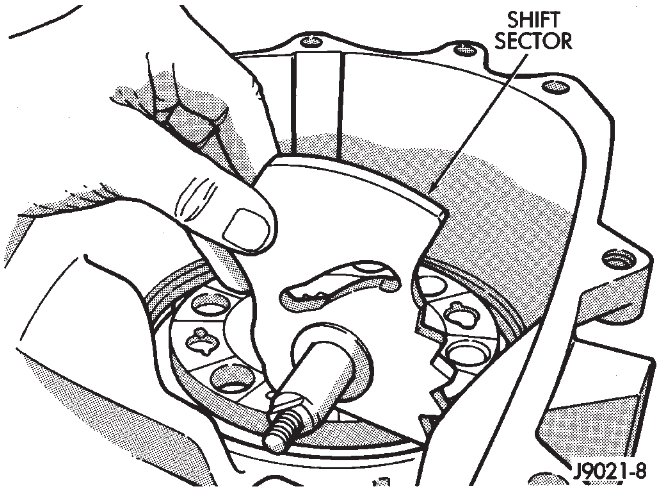


Fig. 61 Shift Sector Installation

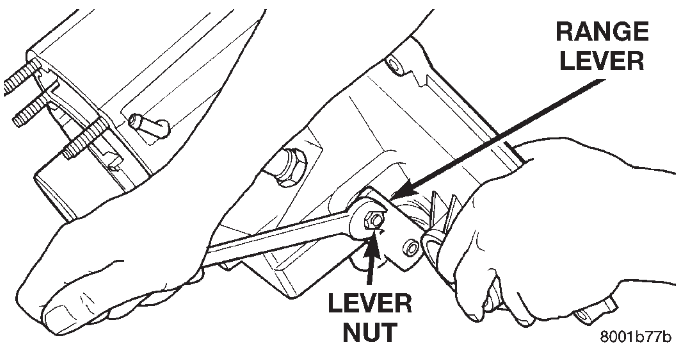


Fig. 62 Range Lever Installation

(5) Align and insert range fork pin in shift sector slot.

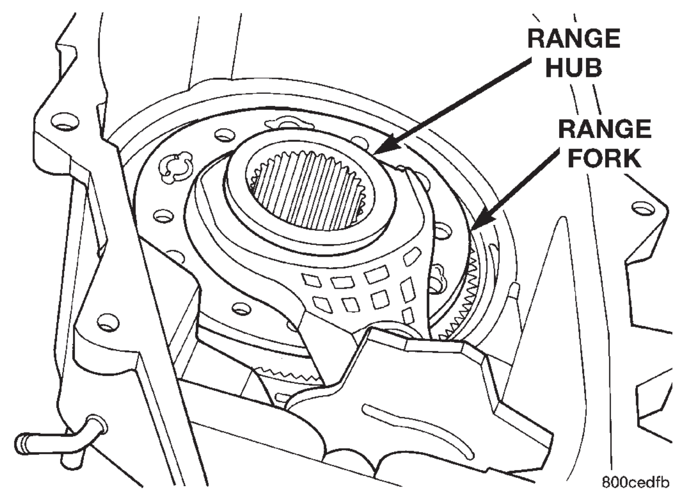


Fig. 63 Install Range Fork And Hub Assembly

(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).

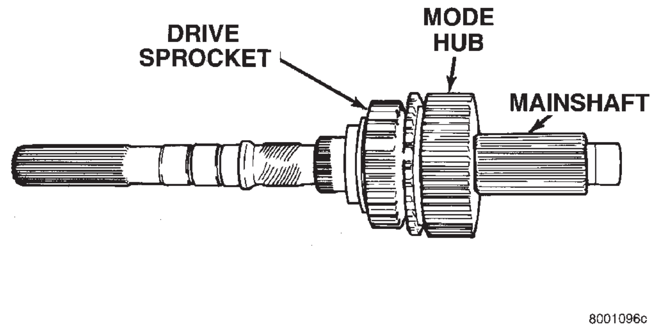


Fig. 64 Mainshaft Assembly Installation

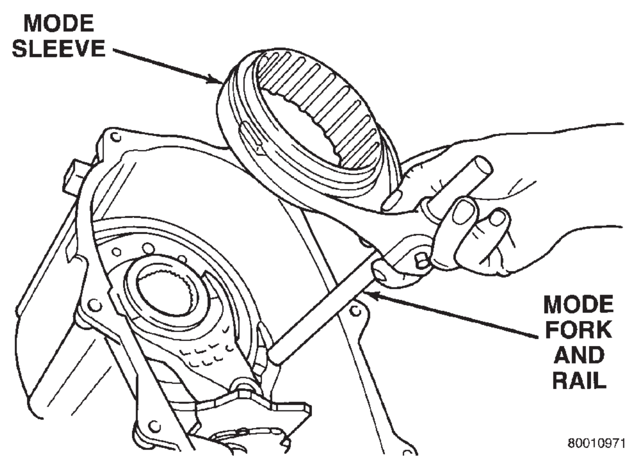


Fig. 65 Assembling Mode Fork And Sleeve

(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.

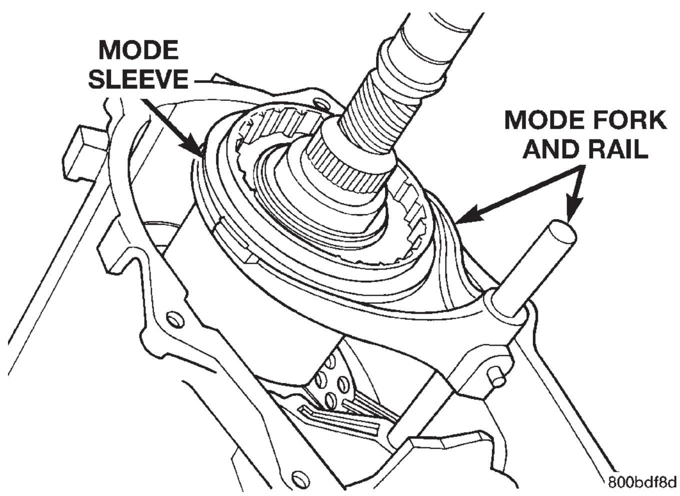


Fig. 66 Mode Fork And Sleeve Installation

(10) Rotate sector to Neutral position.

(11) Install new O-ring on detent plug (Fig. 67).

(12) Lubricate detent plunger with transmission fluid or light coat of petroleum jelly.

DISASSEMBLY AND ASSEMBLY (Continued)

(13) Install detent plunger, spring and plug (Fig. 67).

(14) Verify that plunger is properly engaged in sector.

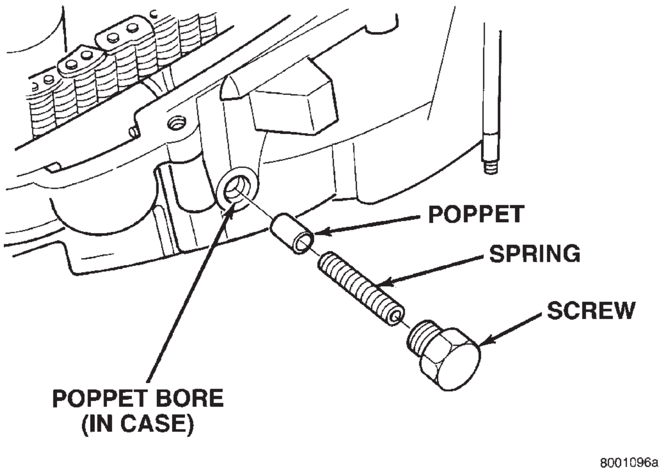


Fig. 67 Shift Detent Components

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).

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.

(7) Lift rear case and oil pump and carefully position assembly on front case. Be sure case dowels are aligned and that mode fork rail extends through rear case before seating rear case on front case.

(8) Install case attaching bolts. Alignment bolts at each end of case are only ones requiring washers (Fig. 73).

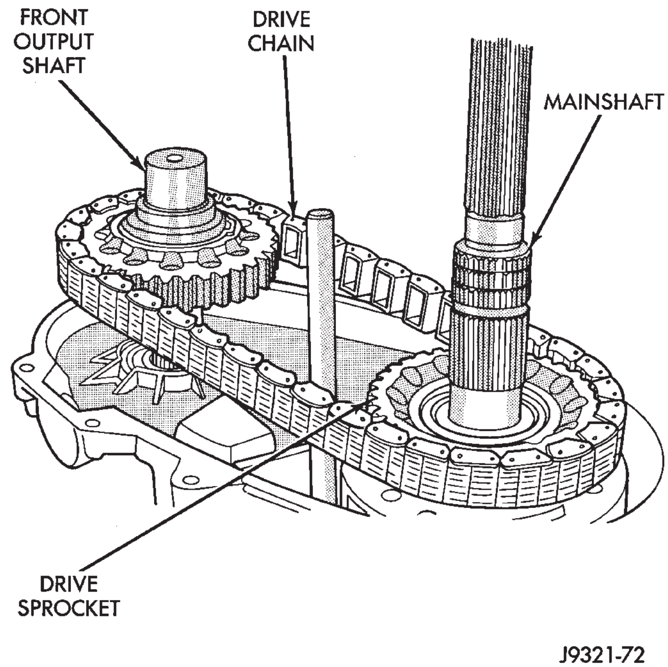


Fig. 68 Installing Drive Chain And Front Output Shaft

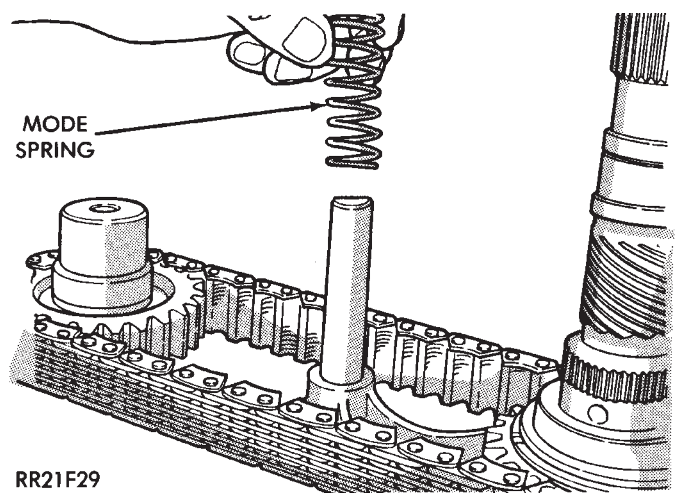


Fig. 69 Install Mode Fork Spring

(9) Tighten case bolts to 27-34 N·m (20-25 ft. lbs.) torque.

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.

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

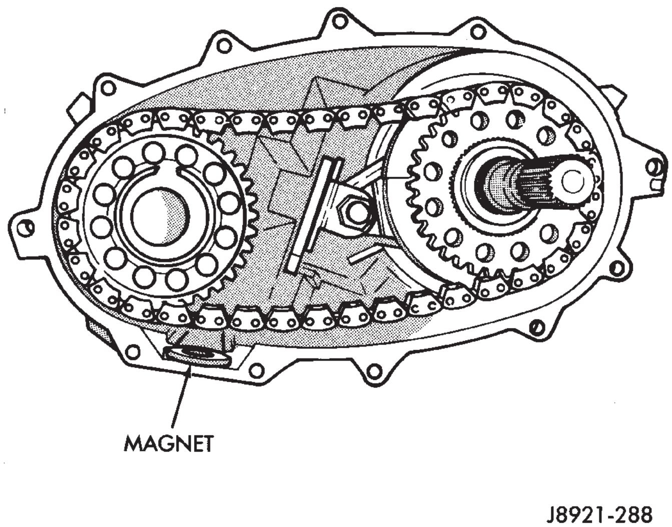


Fig. 70 Installing Case Magnet

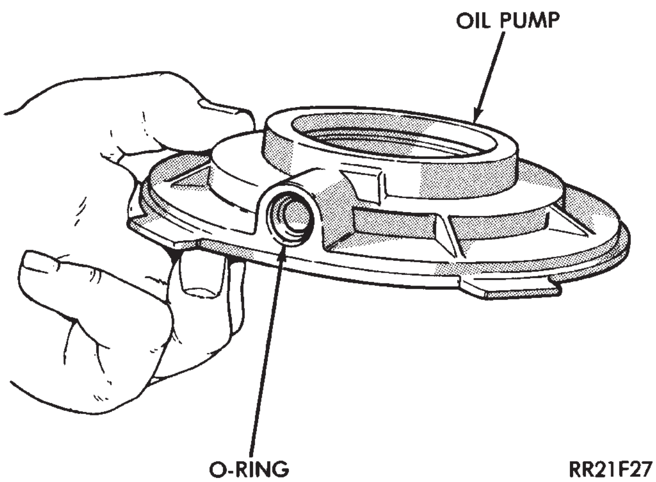


Fig. 71 Pickup Tube O-Ring Position

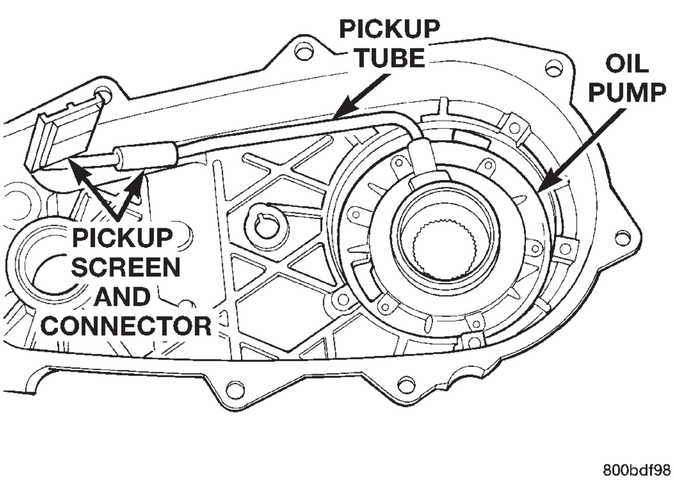


Fig. 72 Oil Pump And Pickup Tube Installation

(6) Install yoke and new yoke nut on front output shaft (Fig. 75).

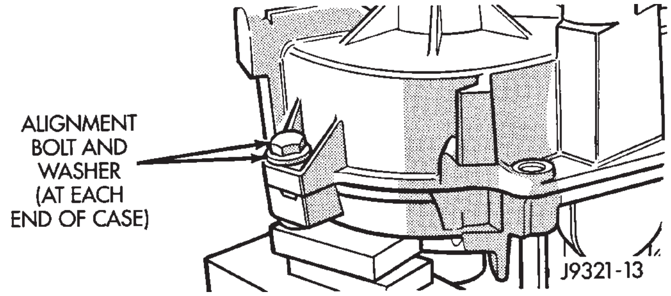


Fig. 73 Alignment Bolt Location

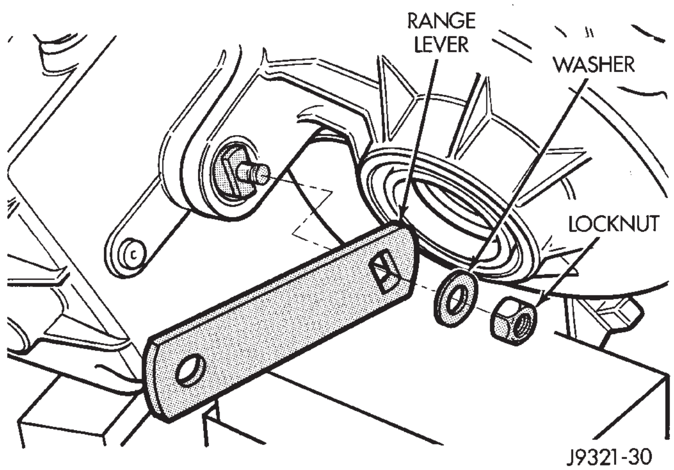


Fig. 74 Range Lever Installation

(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.

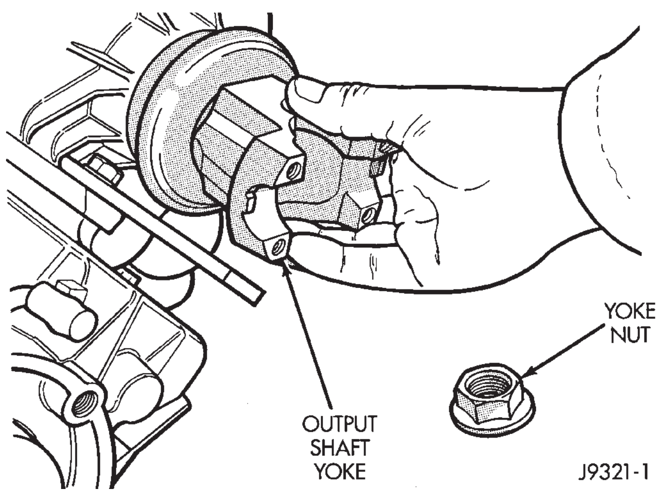


Fig. 75 Output Shaft Yoke Installation

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.

DISASSEMBLY AND ASSEMBLY (Continued)

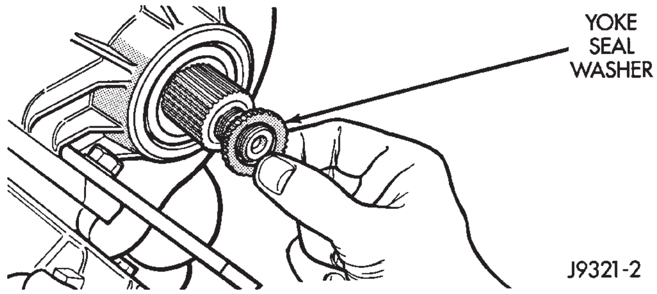


Fig. 76 Yoke Seal Washer Installation

(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).

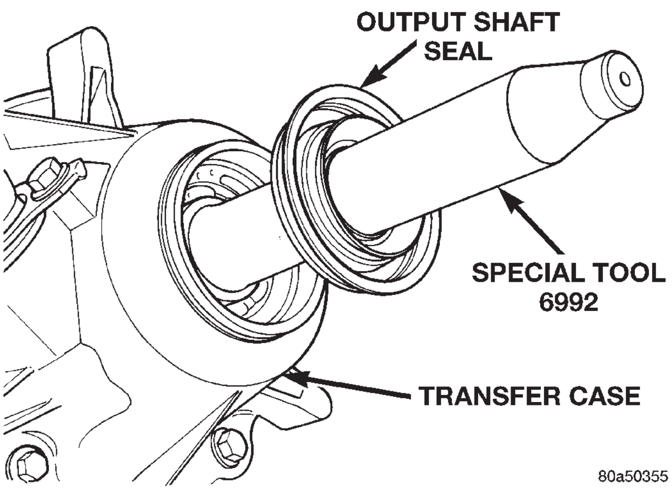


Fig. 77 Output Shaft Seal and Protector

(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).

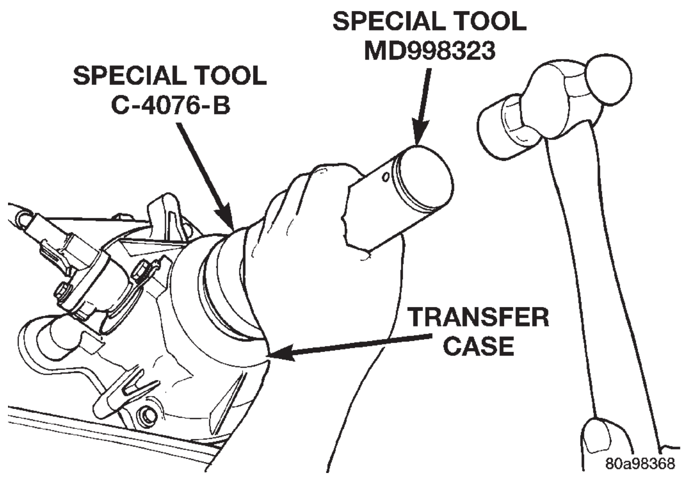


Fig. 78 Rear Seal Installation

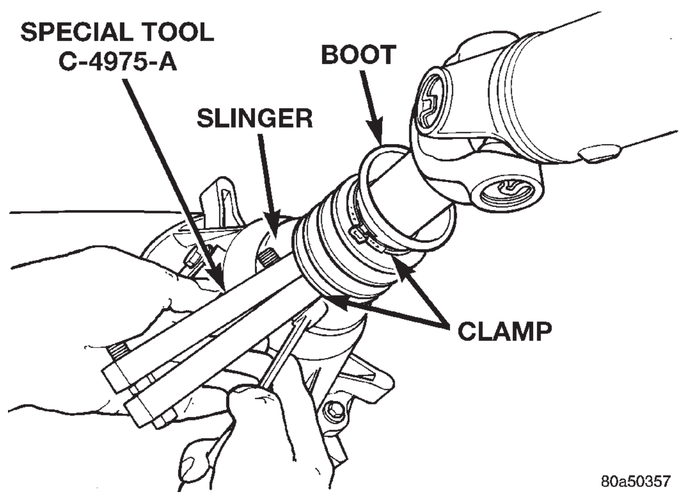


Fig. 79 Slinger Boot Installation

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

CLEANING AND INSPECTION (Continued)

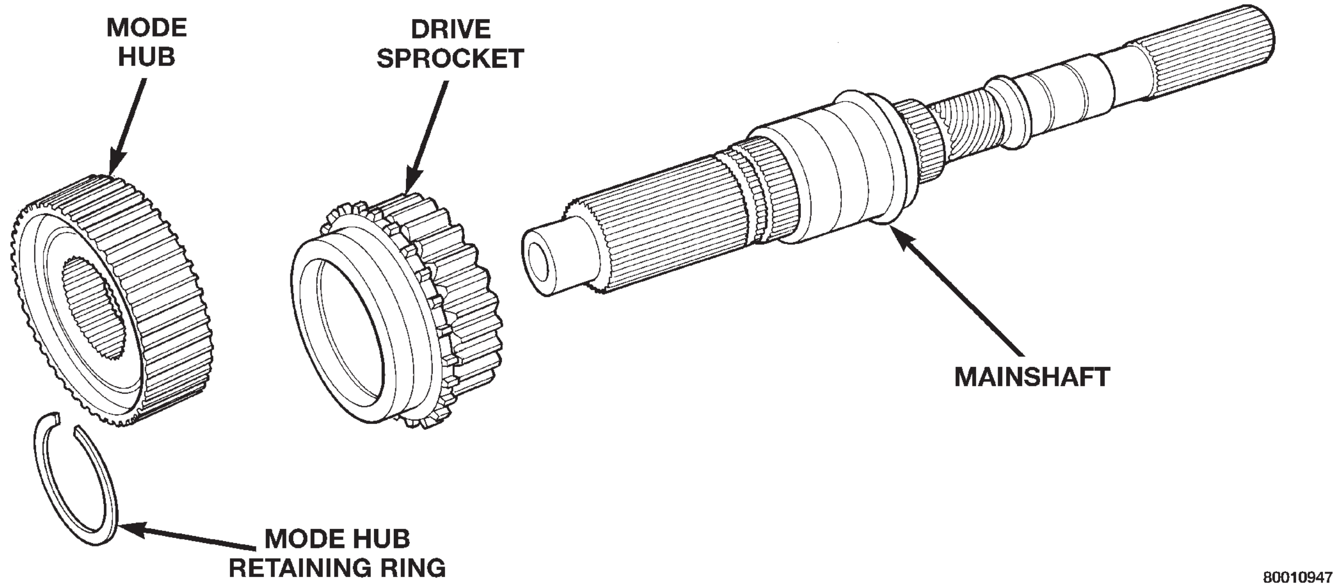


Fig. 80 Mainshaft, Mode Hub, And Drive Sprocket

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.

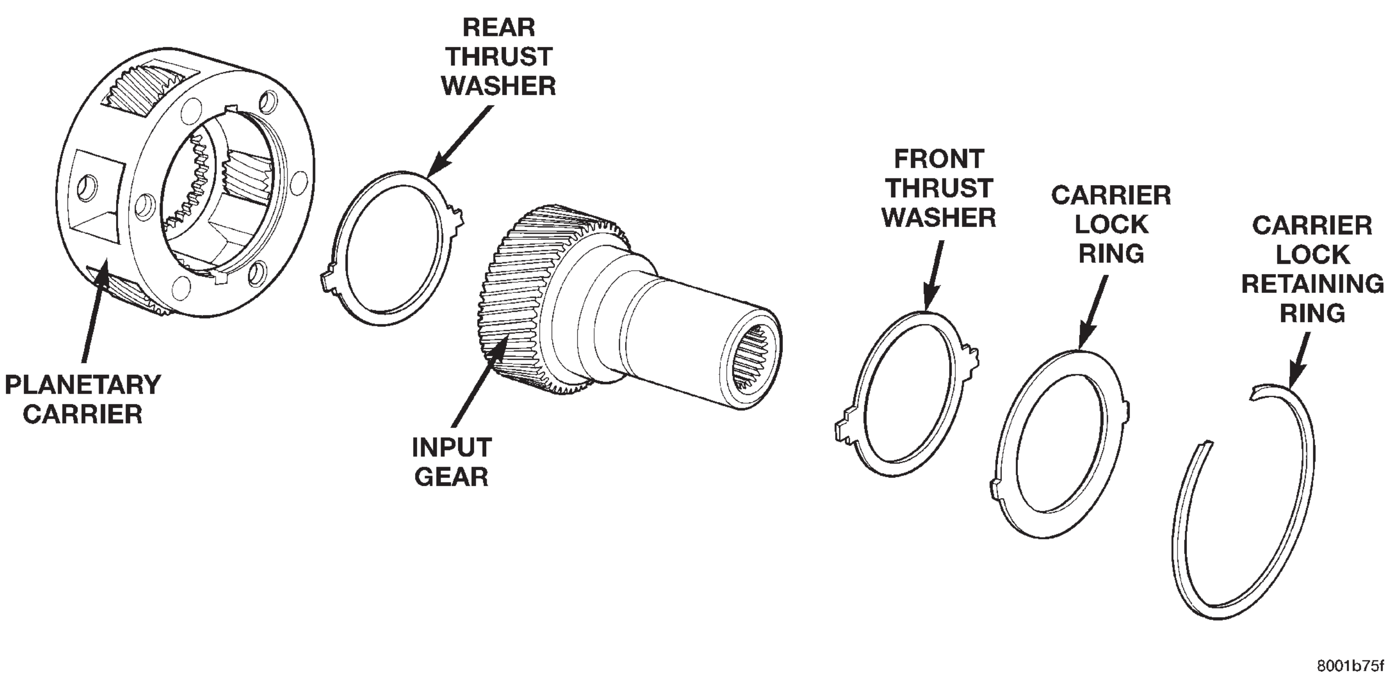


Fig. 81 Input Gear And Carrier Components

CLEANING AND INSPECTION (Continued)

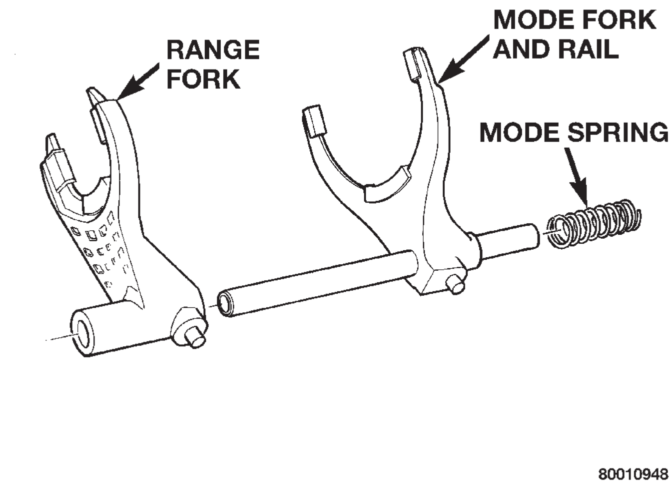


Fig. 82 Shift forks

The fork must be replaced as an assembly if the pads are worn or damaged.

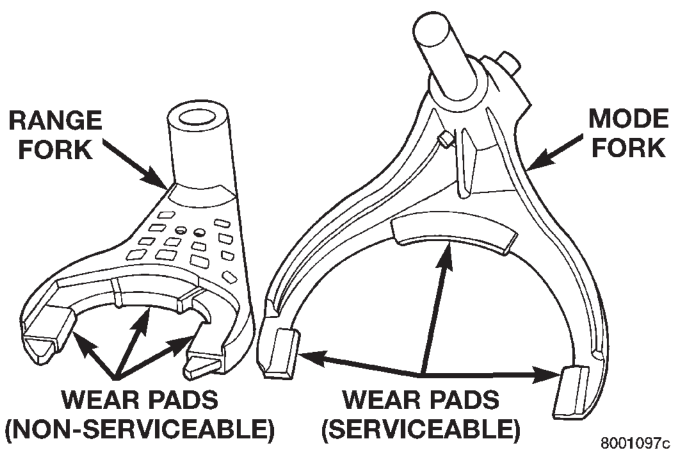


Fig. 83 Shift Fork And Wear Pad Locations

Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

REAR RETAINER/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.

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.

CLEANING AND INSPECTION (Continued)

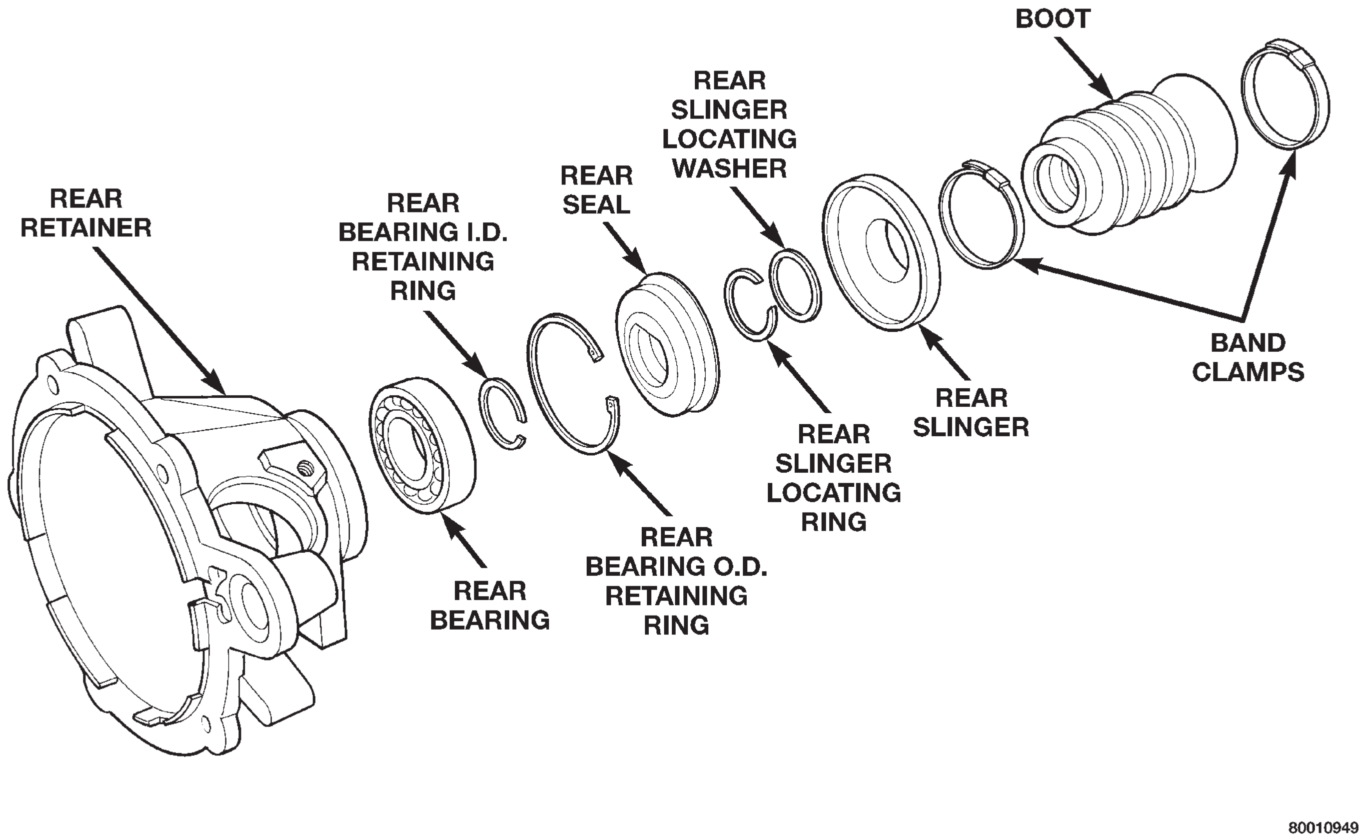


Fig. 84 Rear Retainer Components

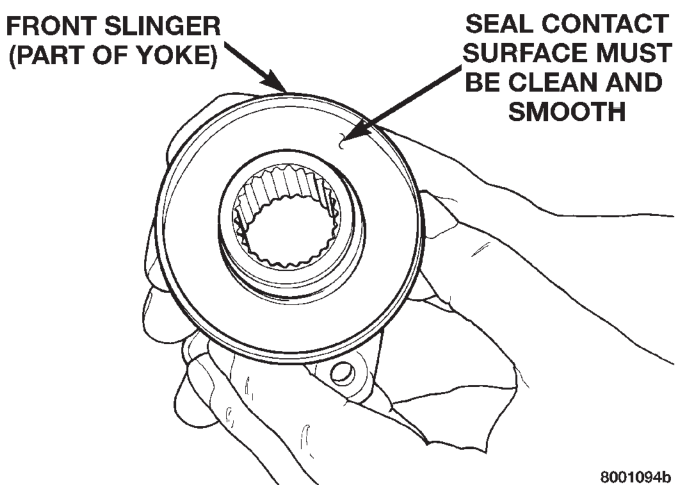


Fig. 85 Seal Contact Surface Of Yoke Slinger

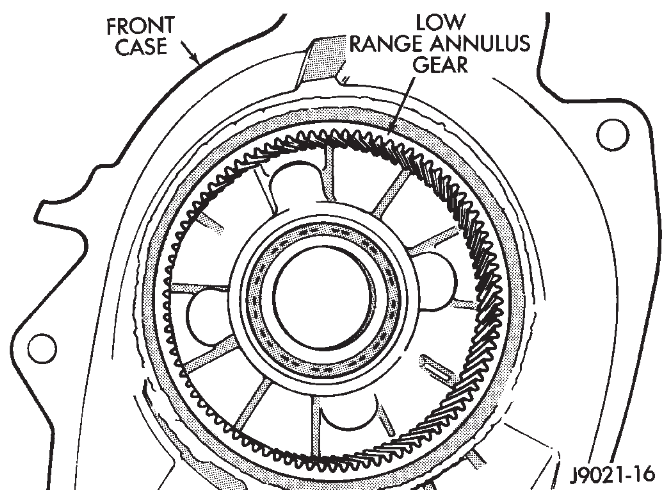


Fig. 86 Low Range Annulus Gear

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.

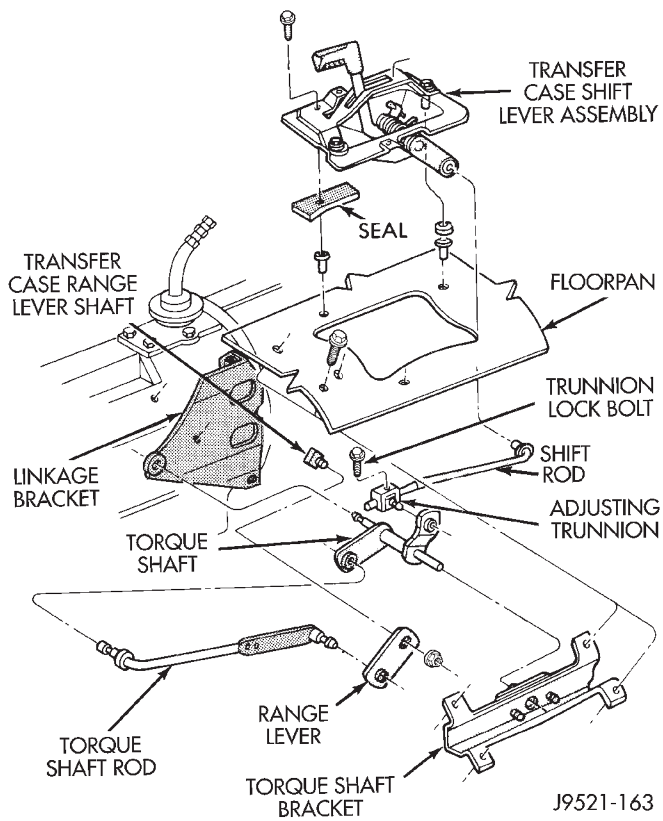


Fig. 87 Shift Linkage

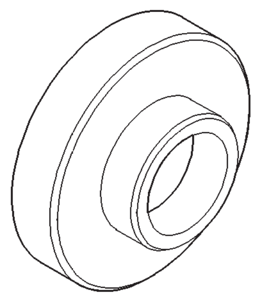
SPECIFICATIONS

TORQUE

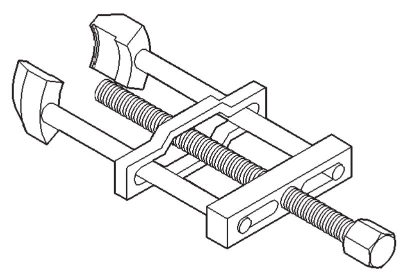
DESCRIPTION	TORQUE
Plug, Detent	16–24 N·m (12–18 ft. lbs.)
Plug, Drain/Fill	20–34 N·m (15–25 ft. lbs.)
Bolt, Front Brg. Retainer	21 N·m (16 ft. lbs.)
Bolt, Front Brg. Retainer	21 N·m (16 ft. lbs.)
Bolt, Case Half	27–34 N·m (20–25 ft. lbs.)
Nut, Front Yoke	122–176 N·m (90–130 ft. lbs.)
Nut, Range Lever	27–34 N·m (20–25 ft. lbs.)
Bolt, Rear Retainer	35–46 N·m (26–34 ft. lbs.)
Nuts, Mounting	35–47 N·m (26–35 ft. lbs.)
Switch, Indicator	20–34 N·m (15–25 ft. lbs.)

SPECIAL TOOLS

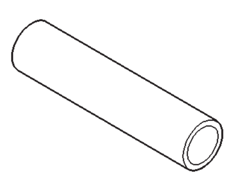
NV231



Installer—C-4076-B

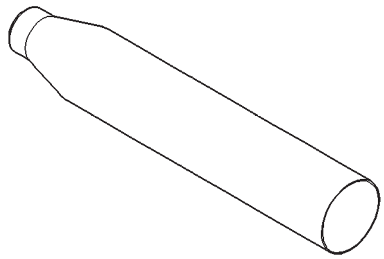


Puller, Slinger—MD-998056–A

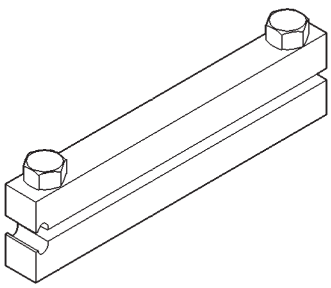


Installer—MD-998323

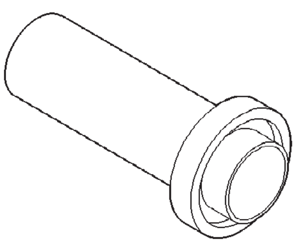
SPECIAL TOOLS (Continued)



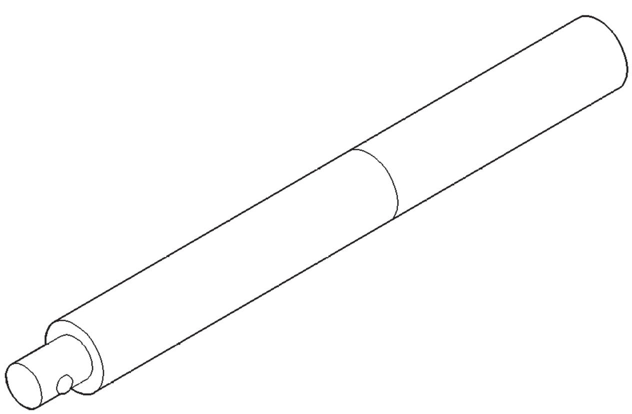
Seal Protector—6992



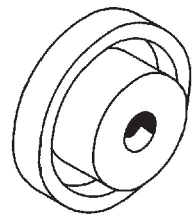
Installer, Boot Clamp—C-4975-A



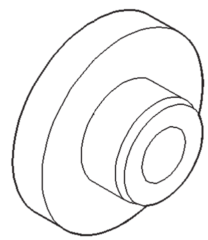
Installer, Seal—8143



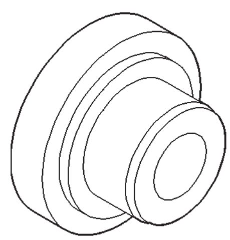
Handle, Universal—C-4171



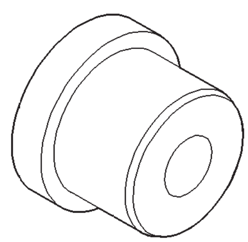
Installer, Seal—C-4210



Installer, Bearing—5064

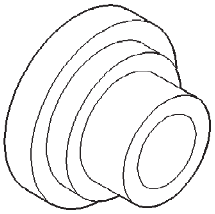


Installer, Bearing—5065

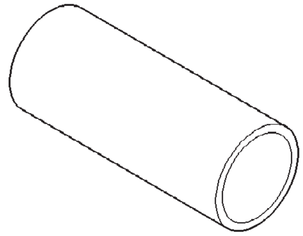


Installer, Bushing—5066

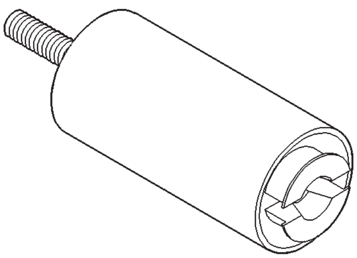
SPECIAL TOOLS (Continued)



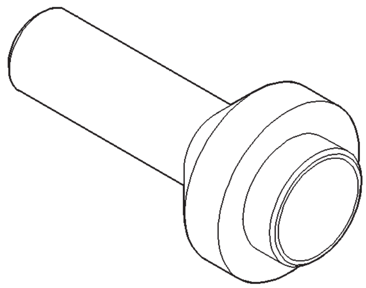
Installer, Bearing—8128



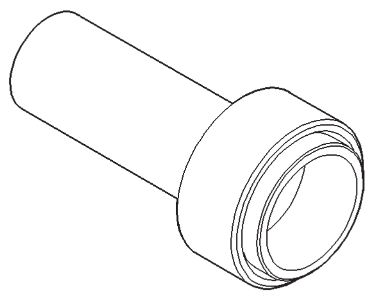
Cup—8148



Remover—L-4454



Installer, Seal—7884



Installer, Pump Housing Seal—7888

NV242 TRANSFER CASE

INDEX

GENERAL INFORMATION

NV242 TRANSFER CASE

The NV242 is a full and part-time transfer case (Fig. 1). It provides full time 2-wheel, or 4-wheel drive operation.

A differential in the transfer case is used to control torque transfer to the front and rear axles. A low range gear provides increased low speed torque capability for off road operation. The low range provides a 2.72:1 reduction ratio.

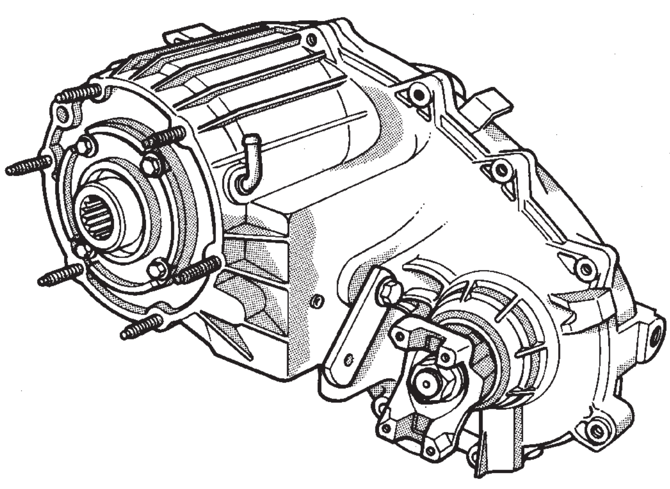


Fig. 1 NV242 Transfer Case

The input gear is splined to the transmission output shaft. It drives the mainshaft through the planetary gear and range hub. The front output shaft is operated by a drive chain that connects the shaft to a drive sprocket on the mainshaft. The drive sprocket is engaged/disengaged by the mode fork, which operates the mode sleeve and hub. The sleeve and hub are not equipped with a synchro 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

NV242 operating ranges are 2WD (2-wheel drive), 4x4 part-time, 4x4 full time, and 4 Lo.

The 2WD and 4x4 full time ranges can be used at any time and on any road surface.

The 4x4 part-time and 4 Lo ranges are for off road use only. The only time these ranges can be used on hard surface roads, is when the surface is covered with snow and ice.

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, or on the shift knob.

TRANSFER CASE IDENTIFICATION

A circular ID tag is attached to the rear case of each transfer case (Fig. 2). 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.

GENERAL INFORMATION (Continued)

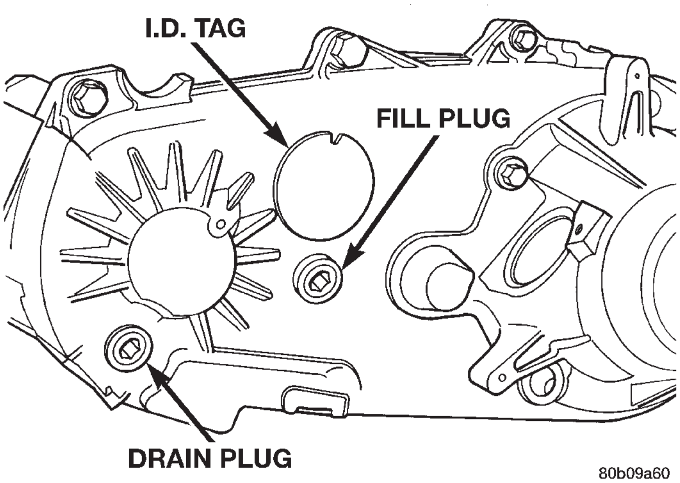


Fig. 2 Fill/Drain Plug And I.D. Tag Locations

RECOMMENDED LUBRICANT AND FILL LEVEL

Recommended lubricant for the NV242 transfer case is Mopar® Dexron II, or ATF Plus, type 7176.

Approximate lubricant fill capacity is 1.35 liters (2.85 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

NV242 DIAGNOSIS

DIAGNOSIS CHART

Condition	Possible Cause	Correction
Transfer case difficult to shift or will not shift into desired range.	1) Transfer case shift linkage binding.	1) Repair or replace linkage as necessary.
	2) Insufficient or incorrect lubricant.	3) Drain and refill transfer case with the correct type and quantity of lubricant.
	3) Internal transfer case components binding, worn, or damaged.	3) Repair or replace components as necessary.
Transfer case noisy in all drive modes.	1) Insufficient or incorrect lubricant.	1) Drain and refill transfer case with the correct type and quantity of lubricant.
Lubricant leaking from transfer case seals or vent.	1) Transfer case overfilled.	1) Drain lubricant to the correct level.
	2) Transfer case vent closed or restricted.	2) Clean or replace vent as necessary.
	3) Transfer case seals damaged or installed incorrectly.	3) Replace suspect seal.
Transfer case will not shift through 4X4 part time range (light remains on)	1) Incomplete shift due to drivetrain torque load.	1) Momentarily release the accelerator pedal to complete the shift.
	2) Incorrect tire pressure.	2) Correct tire pressure as necessary.
	3) Excessive Tire wear.	3) Correct tire condition as necessary.
	4) Excessive vehicle loading.	4) Correct as necessary.

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. 3) 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.

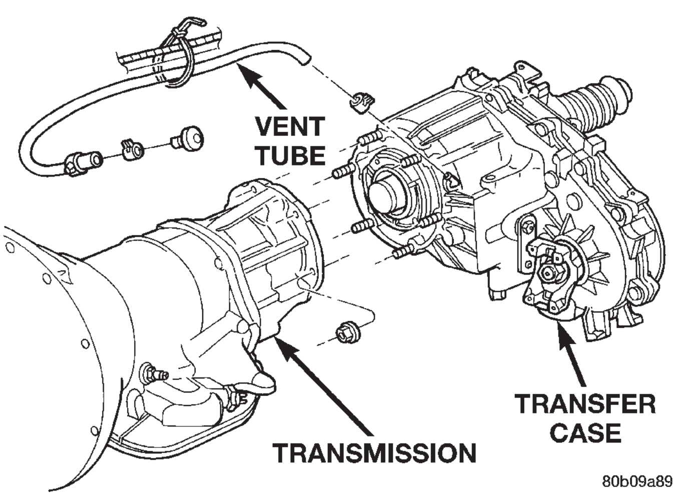


Fig. 3 Transfer Case Mounting

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. 3).
(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. 4). 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. 5).

REMOVAL AND INSTALLATION (Continued)

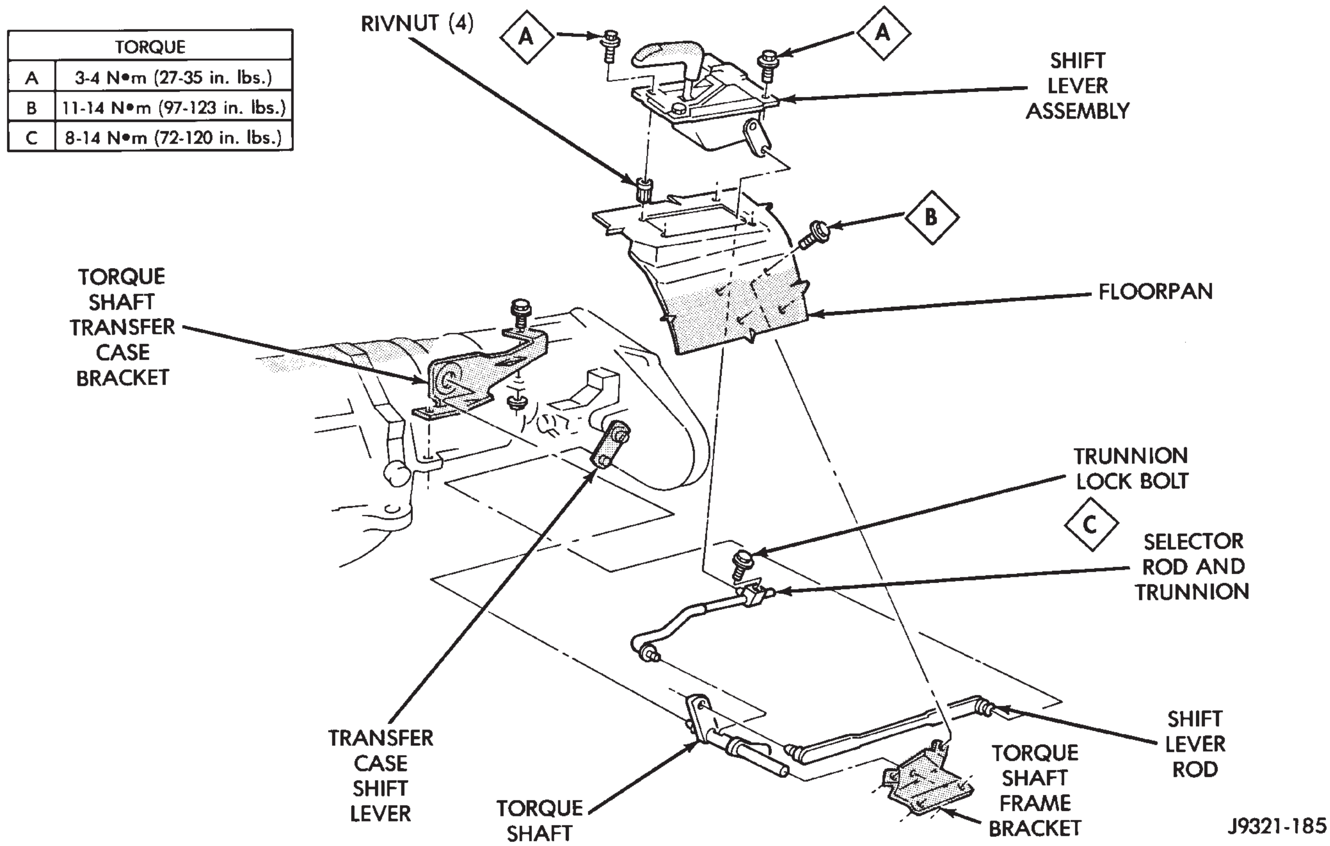


Fig. 4 Shift Linkage

(4) Remove speed sensor and speedometer adapter as an assembly.

(5) Remove speed sensor retaining screw and remove sensor from adapter.

(6) Remove speedometer pinion from adapter. Replace pinion if chipped, cracked, or worn.

(7) Inspect sensor and adapter O-rings (Fig. 5). 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.

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. 5), 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. 6). 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.

FRONT OUTPUT SHAFT SEAL

REMOVAL

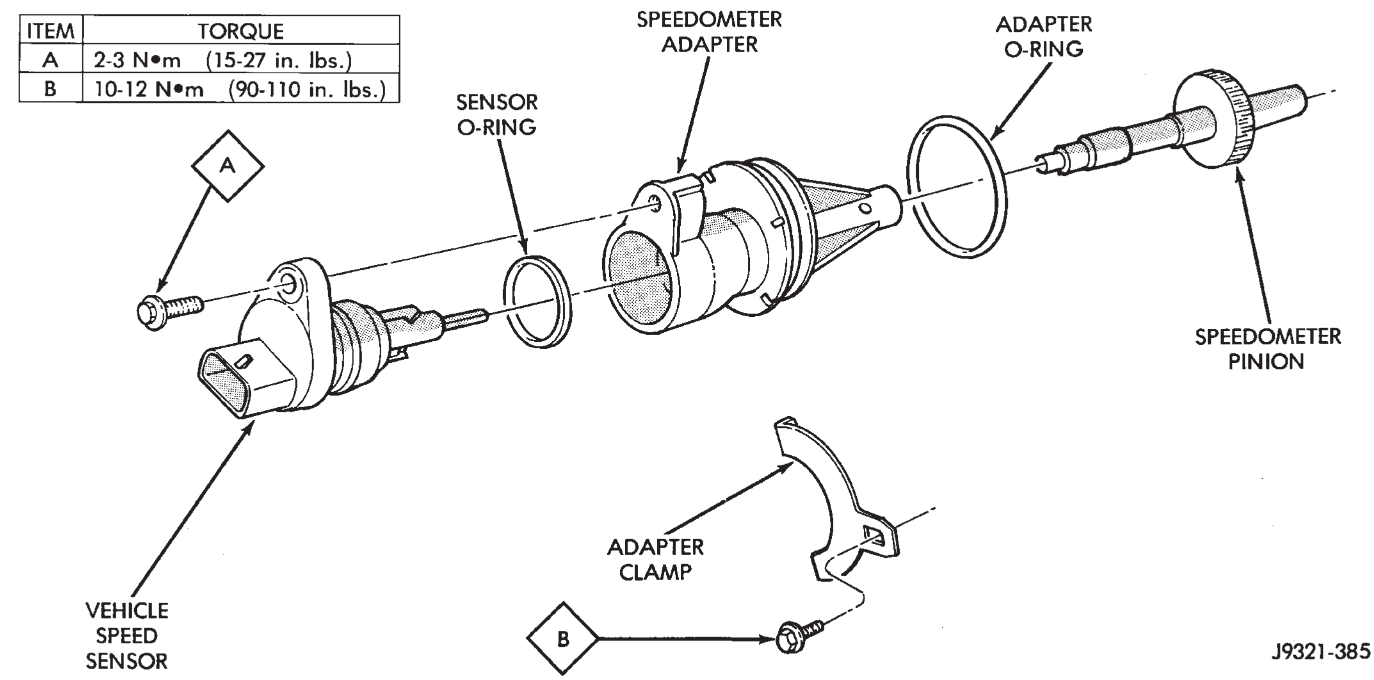
(1) Raise vehicle.

(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. 7).

REMOVAL AND INSTALLATION (Continued)



ITEM	TORQUE
A	2-3 N•m (15-27 in. lbs.)
B	10-12 N•m (90-110 in. lbs.)

Fig. 5 Speedometer Components

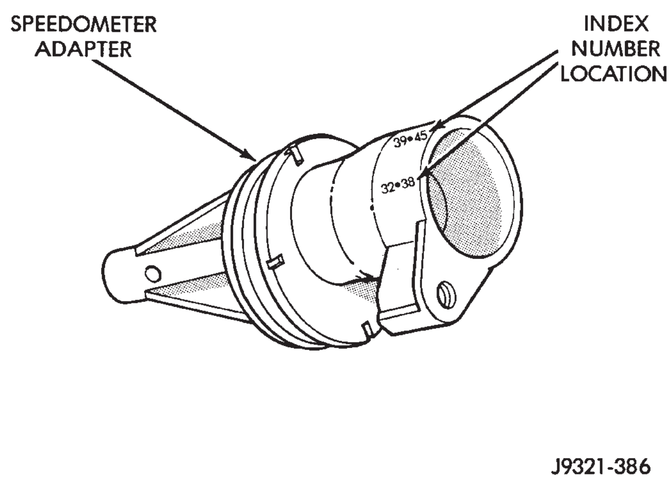


Fig. 6 Location Of Index Numbers On Speedometer Adapter

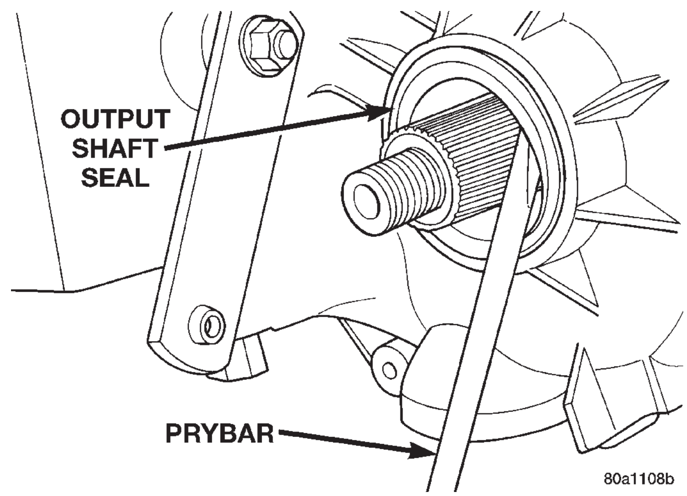


Fig. 7 Remove Front Output Shaft Seal

INSTALLATION

(1) Install new front output seal in front case with Installer Tool 6952-A as follows:

(a) Place new seal on tool. Garter spring on seal goes toward interior of case.

(b) Start seal in bore with light taps from hammer (Fig. 8). Once seal is started, continue tapping seal into bore until installer tool seats against case.

REMOVAL AND INSTALLATION (Continued)

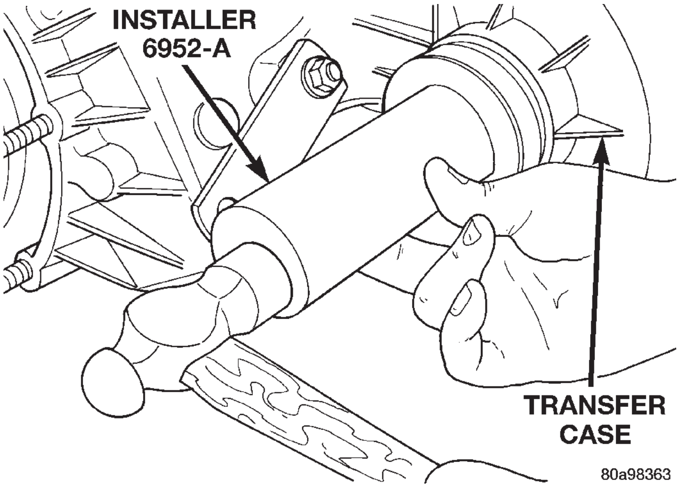


Fig. 8 Front Output Seal Installation

DISASSEMBLY AND ASSEMBLY

NV242 TRANSFER CASE

DISASSEMBLY

REAR RETAINER REMOVAL

(1) Remove output shaft boot. Spread band clamp that secures boot on slinger with a suitable awl. Then slide boot off shaft (Fig. 9).

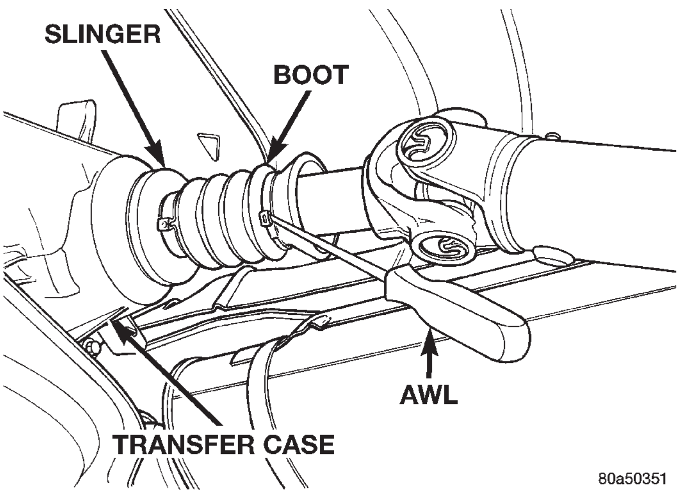


Fig. 9 Output Boot—Typical

(2) Using puller MD-998056-A, remove rear slinger (Fig. 10).

(3) Remove slinger stop spacer and snap-ring from output shaft (Fig. 11).

(4) Remove rear seal from retainer (Fig. 12). Use pry tool, or collapse seal with punch to remove it.

(5) Remove rear output bearing I.D. retaining ring (Fig. 13).

(6) Remove speedometer adapter.

(7) Remove rear retainer bolts.

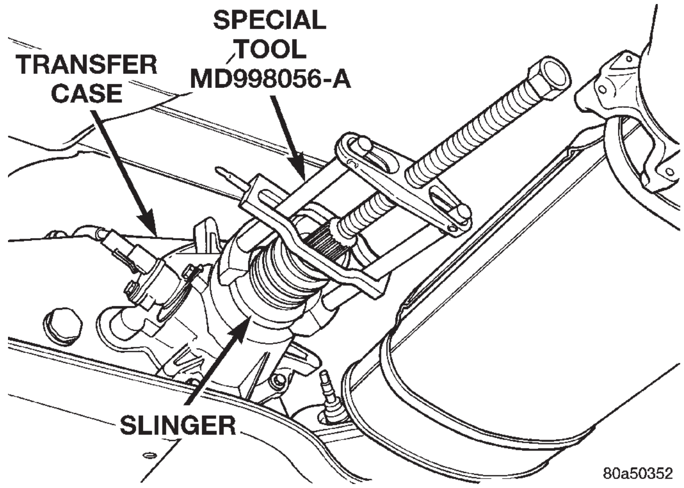


Fig. 10 Rear Slinger Removal

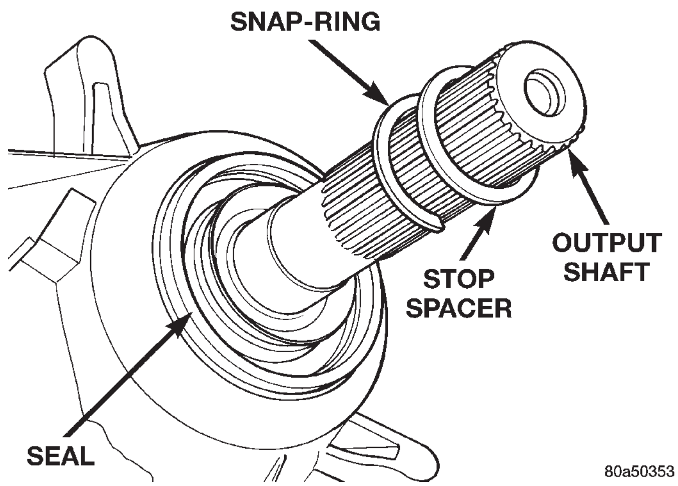


Fig. 11 Slinger Stop Spacer and Snap-ring

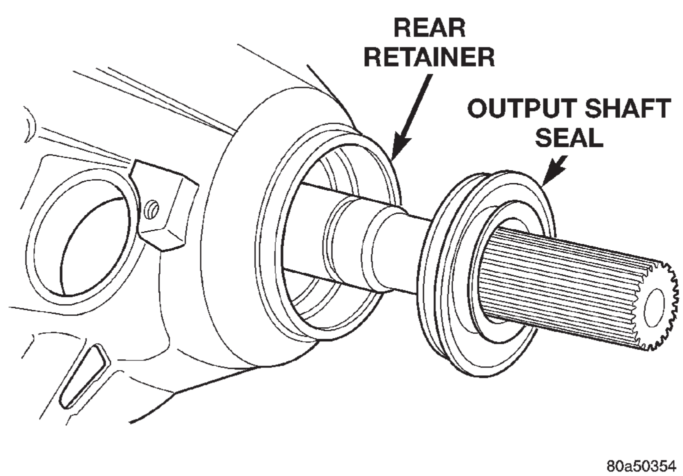


Fig. 12 Rear Seal Removal

(8) Remove rear retainer. Tap retainer with mallet and pry upward to break sealer bead. Then slide retainer off case and output shaft (Fig. 14).

DISASSEMBLY AND ASSEMBLY (Continued)

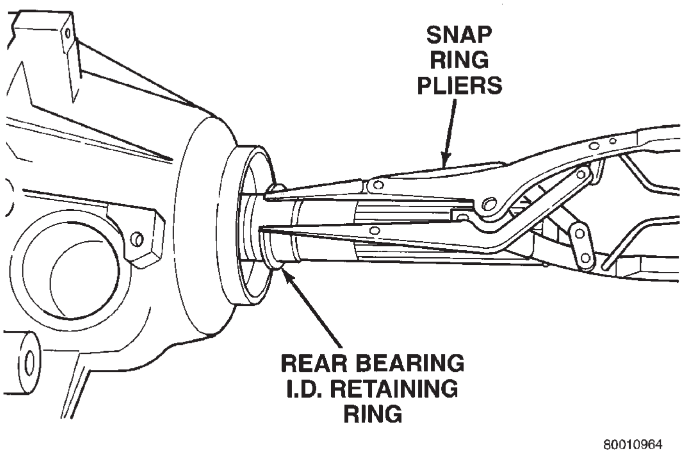


Fig. 13 Rear Bearing I.D. Retaining Ring Removal

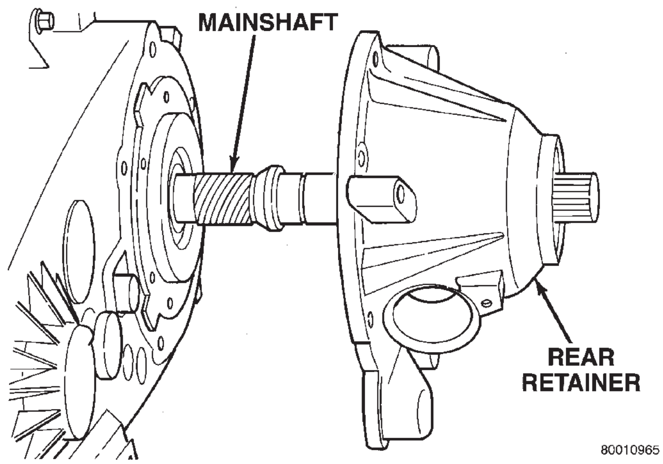


Fig. 14 Rear Retainer Removal

(9) Remove rear bearing O.D. retaining ring with snap ring pliers. Then tilt pump and slide it off output shaft (Fig. 15).

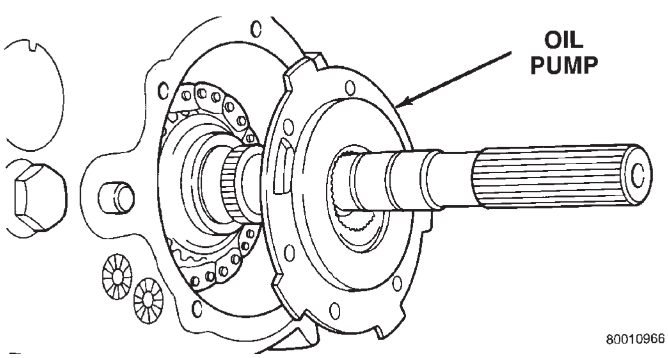


Fig. 15 Oil Pump Removal

(10) Remove pickup tube O-ring from pump (Fig. 16) but do not disassemble pump; it is not a repairable part.

(11) Remove seal from oil pump with pry tool.

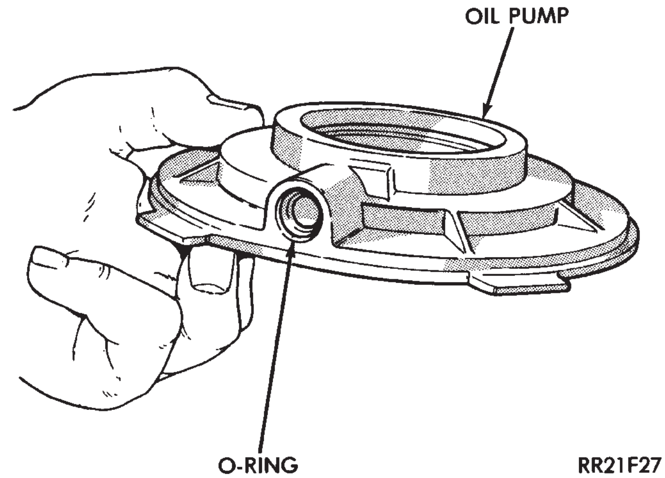


Fig. 16 Pickup Tube O-Ring Location

(12) Remove bolts attaching rear case to front case (Fig. 17). Note position of the two black finish bolts at each end of the case. These bolts go through the case dowels and require a washer under the bolt head.

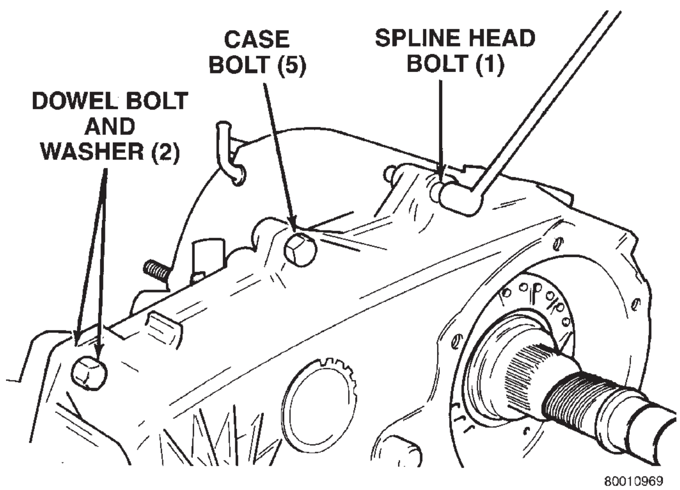


Fig. 17 Spline And Dowel Bolt Locations

(13) Remove rear case from front case (Fig. 18). Insert screwdrivers into slots cast into each end of case. Then pry upward to break sealer bead and remove rear case.

CAUTION: Do not pry on the sealing surface of either case half as the surfaces will become damaged.

(14) Remove oil pickup tube and screen from rear case (Fig. 19).

YOKE AND RANGE LEVER REMOVAL

(1) Remove front yoke nut:

(a) Move range lever to 4L position.

(b) Remove nut with socket and impact wrench (Fig. 20).

DISASSEMBLY AND ASSEMBLY (Continued)

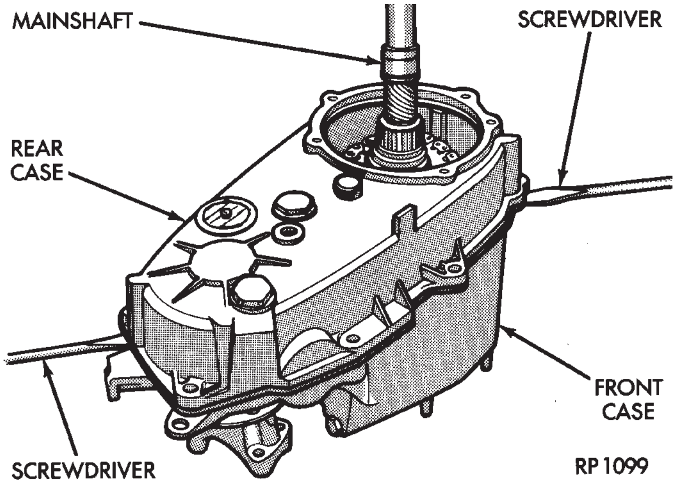


Fig. 18 Loosening/Removing Rear case

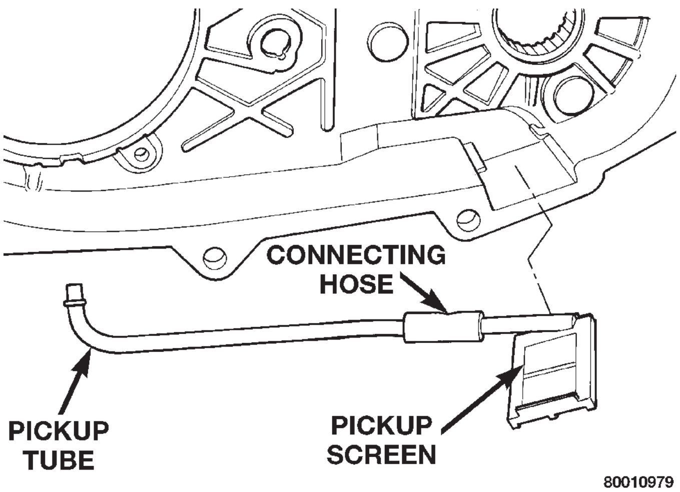


Fig. 19 Oil Pickup Screen, Hose And Tube Removal

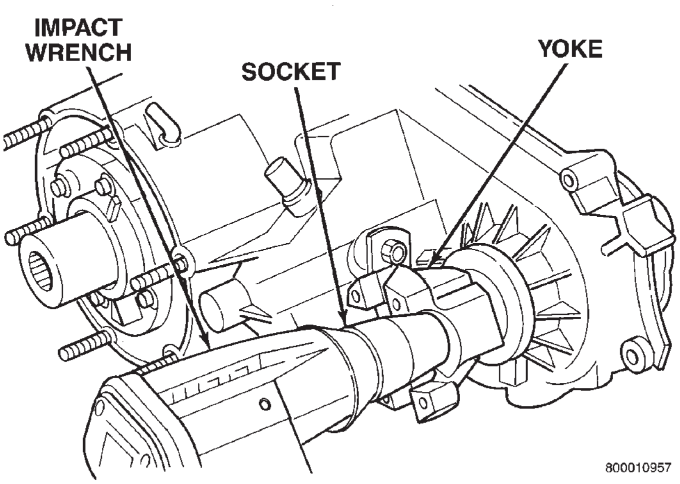


Fig. 20 Yoke Nut Removal

(2) Remove yoke. If yoke is difficult to remove by hand, remove it with bearing splitter, or with standard two jaw puller (Fig. 21). Be sure puller tool is positioned on yoke and not on slinger as slinger will be damaged.

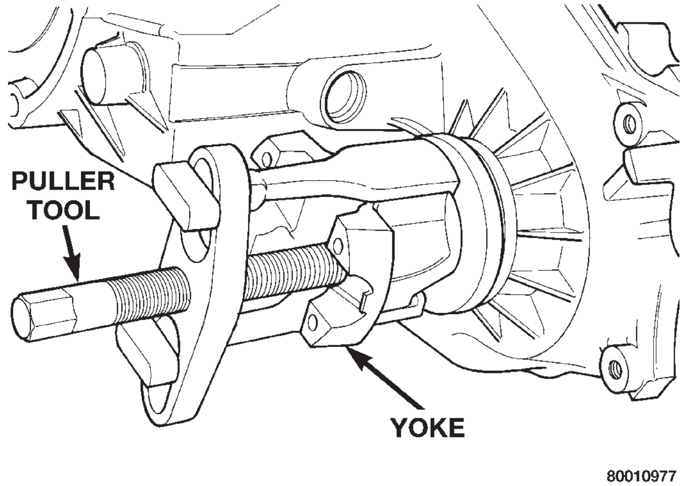


Fig. 21 Yoke Removal

(3) Remove seal washer from front output shaft. Discard washer as it should not be reused.

(4) Remove nut and washer that attach range lever to sector shaft. Then move sector to neutral position and remove range lever from shaft (Fig. 22).

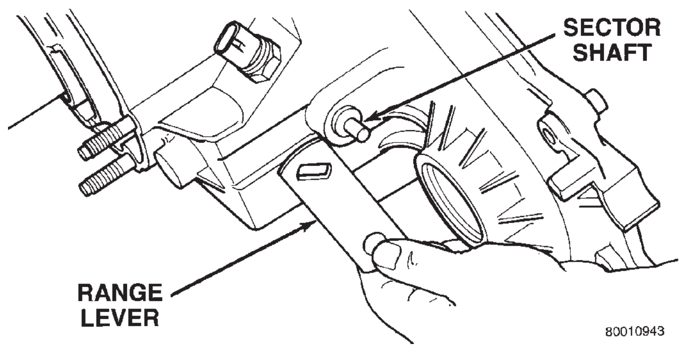


Fig. 22 Range Lever Removal

FRONT OUTPUT SHAFT AND DRIVE CHAIN REMOVAL

(1) Remove drive sprocket snap-ring (Fig. 23).

(2) Remove drive sprocket and chain (Fig. 24).

(3) Remove front output shaft (Fig. 25).

SHIFT FORKS AND MAINSHAFT REMOVAL AND DISASSEMBLY

(1) Remove shift detent plug, spring and pin (Fig. 26).

(2) Remove seal plug from low range fork lockpin access hole. Then move shift sector to align low range fork lockpin with access hole.

(3) Remove range fork lockpin with size number one easy-out tool as follows:

(a) Insert easy-out tool through access hole in side of transfer case and into lock-pin.

(b) Tap easy-out tool into lock-pin with hammer until tool is securely engaged into the lock-pin.

DISASSEMBLY AND ASSEMBLY (Continued)

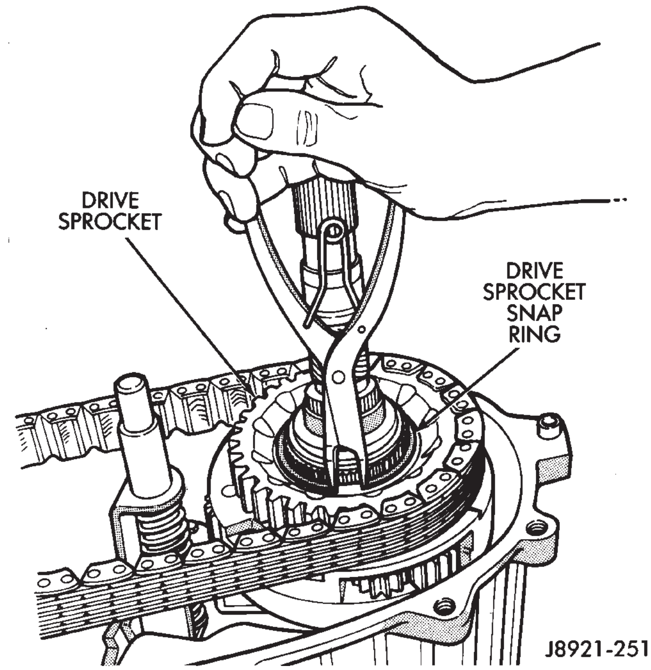


Fig. 23 Drive Sprocket Snap-Ring Removal

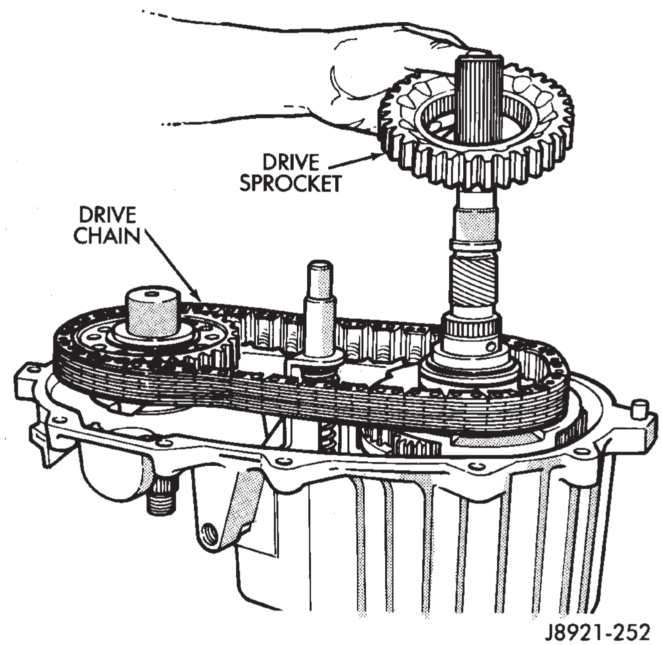


Fig. 24 Drive Sprocket And Chain Removal

(c) Install a t-handle, such as from a tap and die set, onto the easy-out tool.

(d) Securely tighten the t-handle onto the tool.

(e) In one motion, pull upward and turn the t-handle counter-clockwise to remove the lock-pin.

(4) Remove shift rail by pulling it straight up and out of fork (Fig. 27).

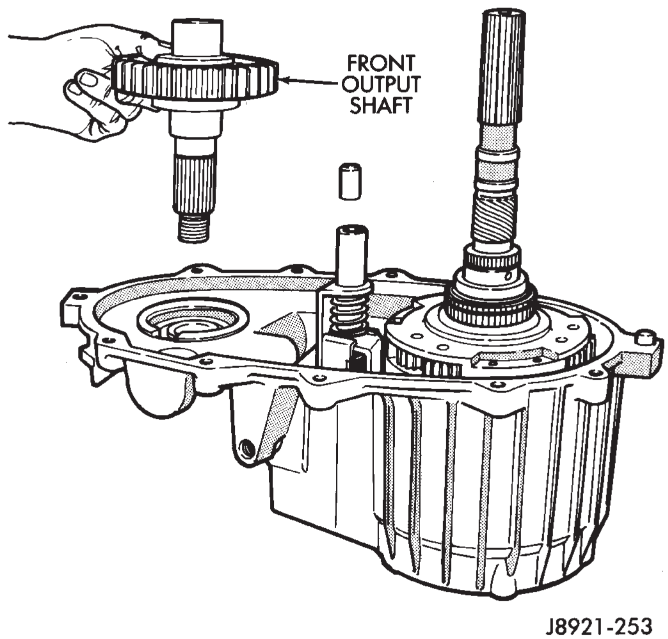


Fig. 25 Removing Front Output Shaft

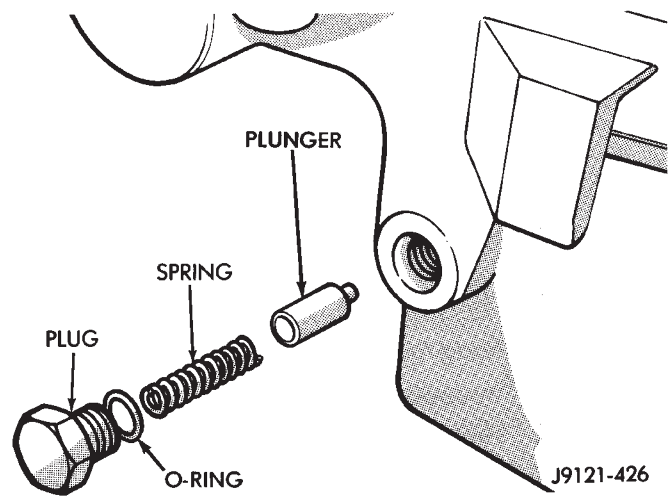


Fig. 26 Detent Component Removal

(5) Remove mode fork and mainshaft as assembly (Fig. 28).

(6) Remove mode shift sleeve and mode fork assembly from mainshaft (Fig. 29). Note position of mode sleeve in fork and remove sleeve.

DISASSEMBLY AND ASSEMBLY (Continued)

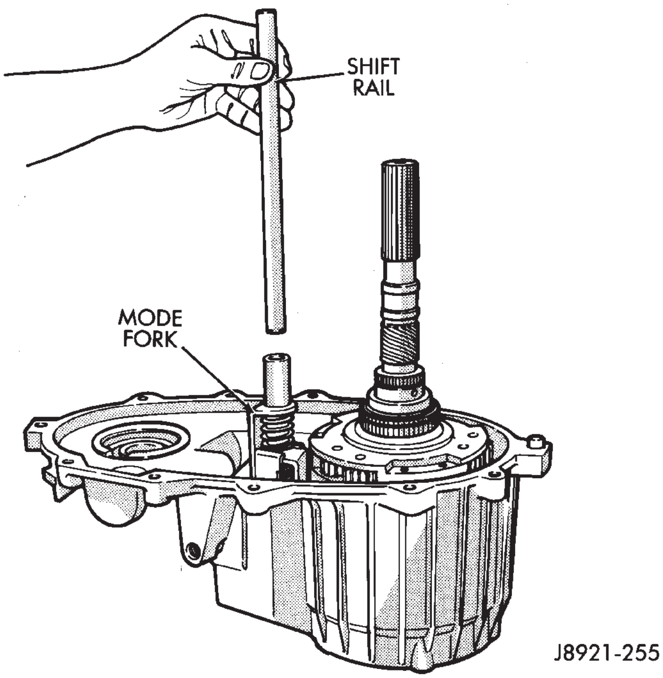


Fig. 27 Shift Rail Removal

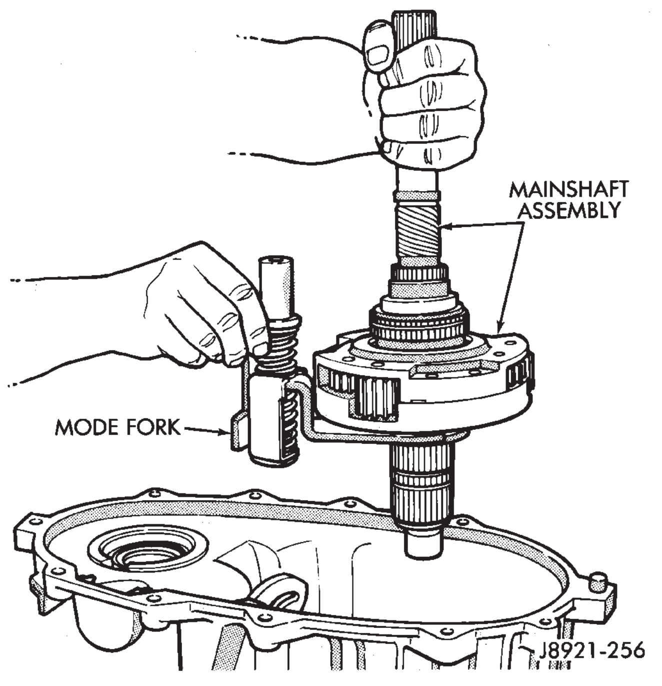


Fig. 28 Mode Fork And Mainshaft Removal

(7) Remove intermediate clutch shaft snap-ring (Fig. 30).

(8) Remove clutch shaft thrust ring (Fig. 31).

(9) Remove intermediate clutch shaft (Fig. 32).

(10) Remove differential snap-ring (Fig. 33).

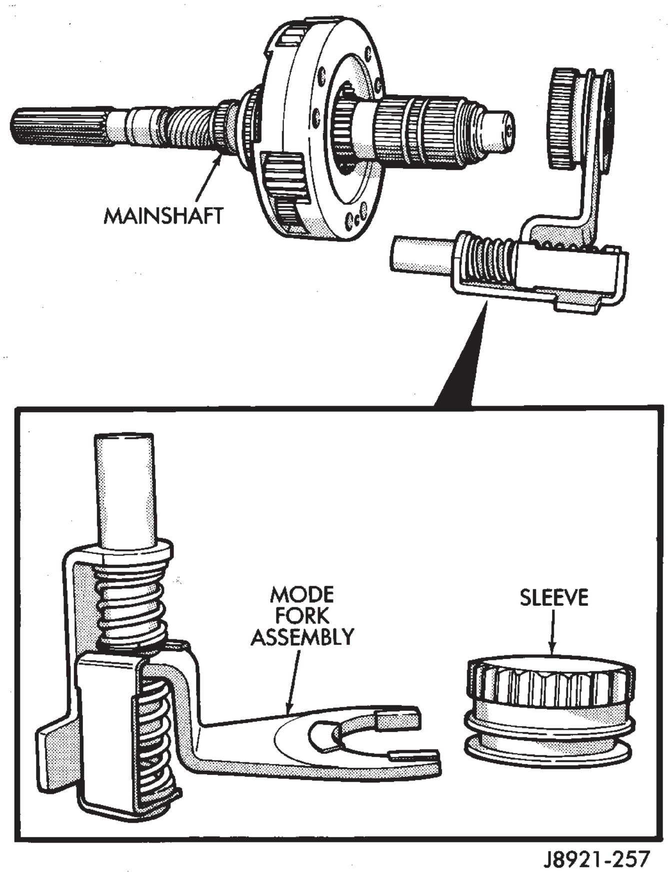


Fig. 29 Mode Fork And Sleeve Removal

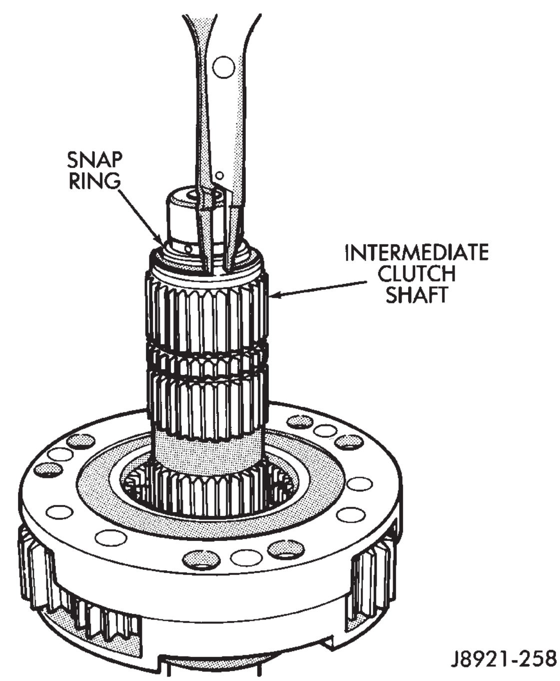


Fig. 30 Intermediate Clutch Shaft Snap-Ring Removal

DISASSEMBLY AND ASSEMBLY (Continued)

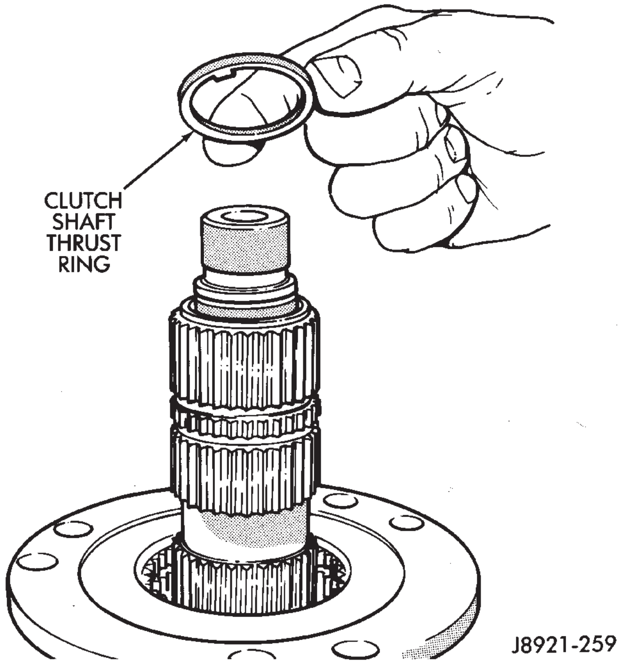


Fig. 31 Clutch Shaft Thrust Ring Removal

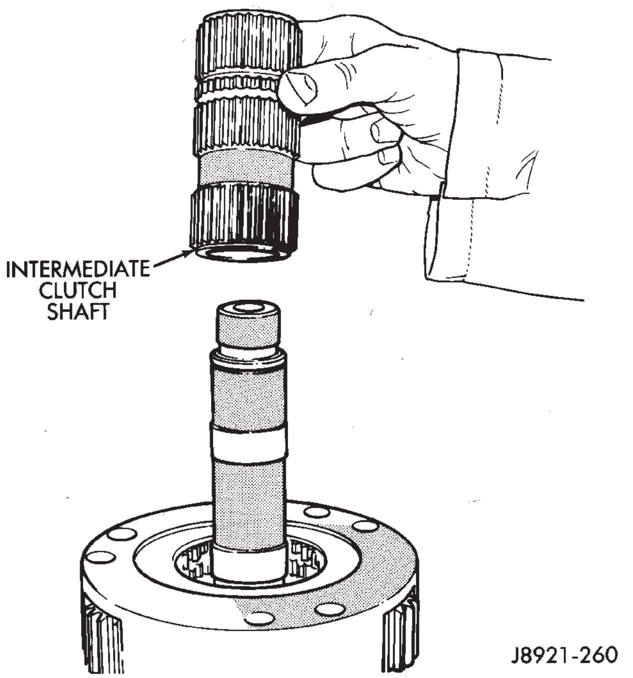


Fig. 32 Intermediate Clutch Shaft Removal

(11) Remove differential (Fig. 34).

(12) Remove differential needle bearings and both needle bearing thrust washers from mainshaft.

(13) Slide low range fork pin out of shift sector slot (Fig. 35).

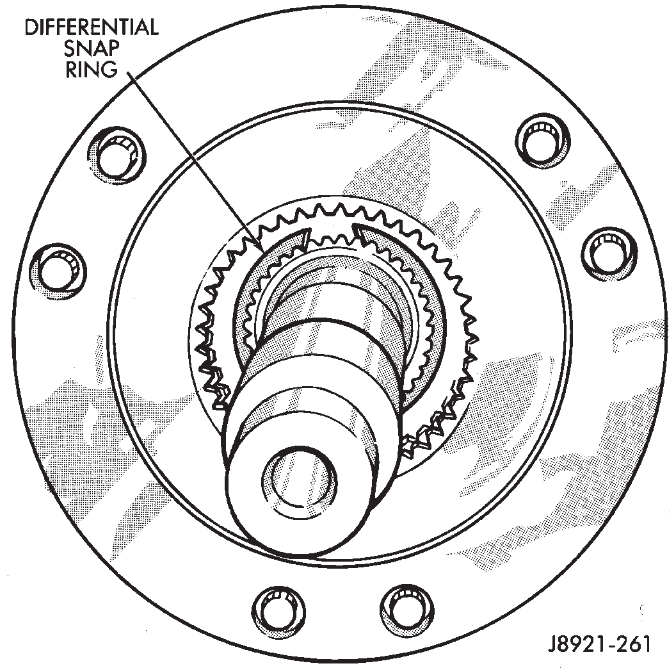


Fig. 33 Differential Snap-Ring Removal

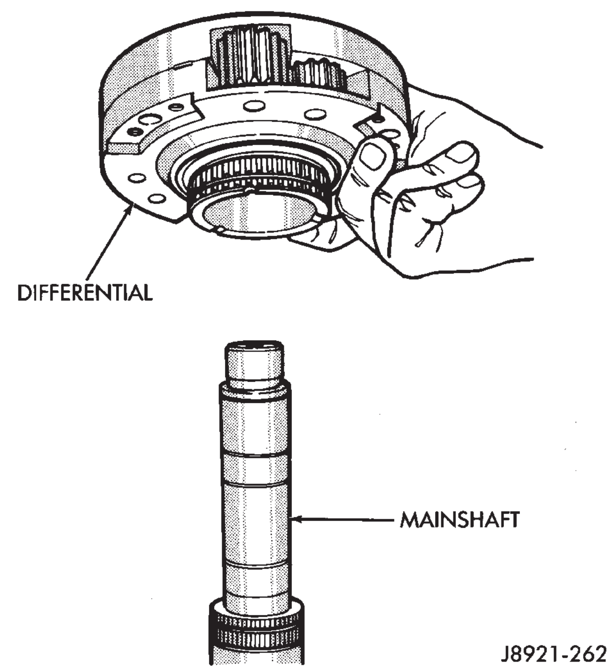


Fig. 34 Differential Removal

(14) Remove low range fork and hub (Fig. 36).

(15) Remove shift sector (Fig. 37).

(16) Remove shift sector bushing and O-ring (Fig. 38).

DISASSEMBLY AND ASSEMBLY (Continued)

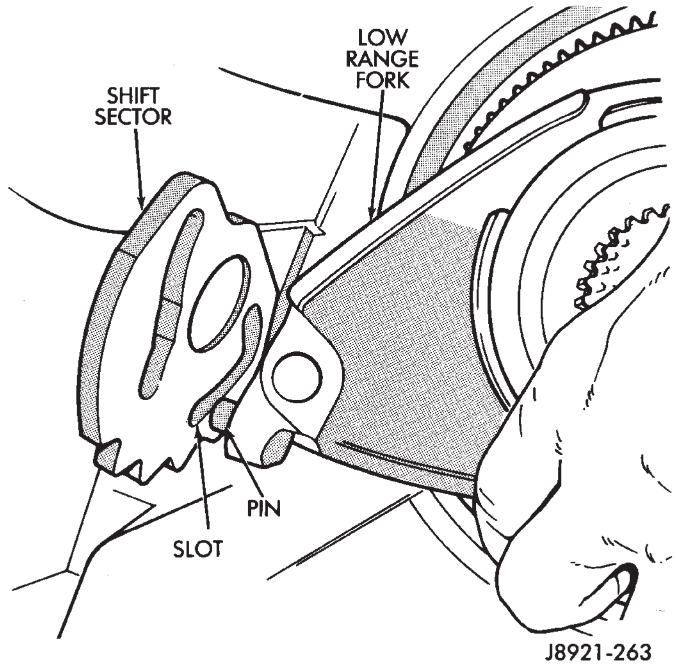


Fig. 35 Disengaging Low Range Fork

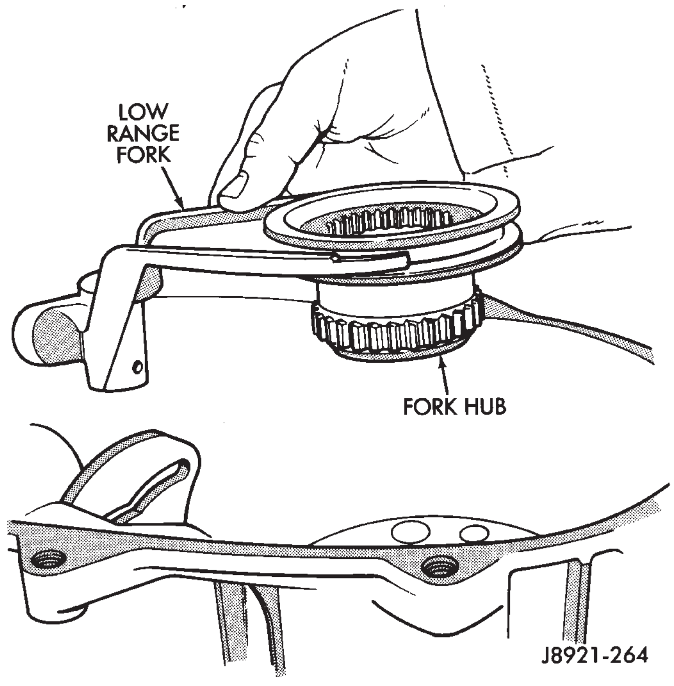


Fig. 36 Low Range Fork And Hub Removal

INPUT GEAR/LOW RANGE ASSEMBLY REMOVAL AND DISASSEMBLY

(1) Remove front bearing retainer bolts.

(2) Remove front bearing retainer. Carefully pry retainer loose with screwdriver (Fig. 39). Position screwdriver in slots cast into retainer.

(3) Remove input gear snap-ring (Fig. 40).

(4) Remove input/low range gear assembly from bearing with Tool Handle C-4171 and Tool 7829A (Fig. 41).

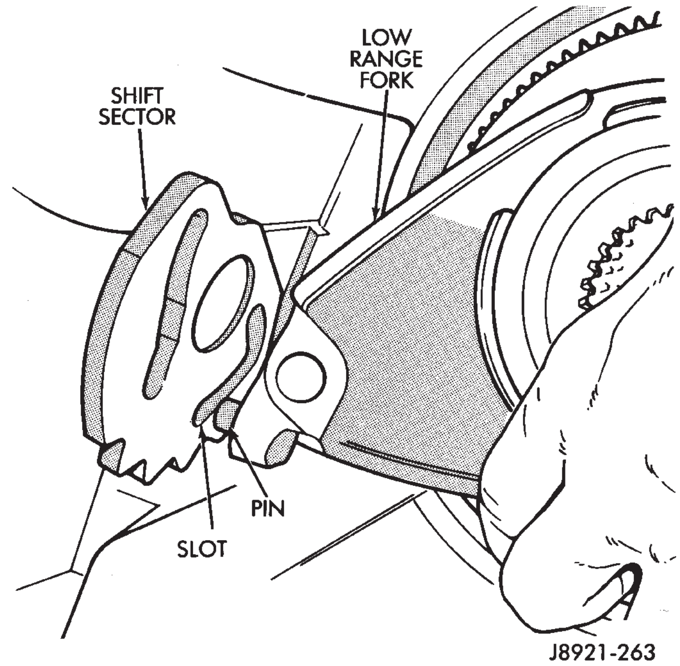


Fig. 37 Shift Sector Position

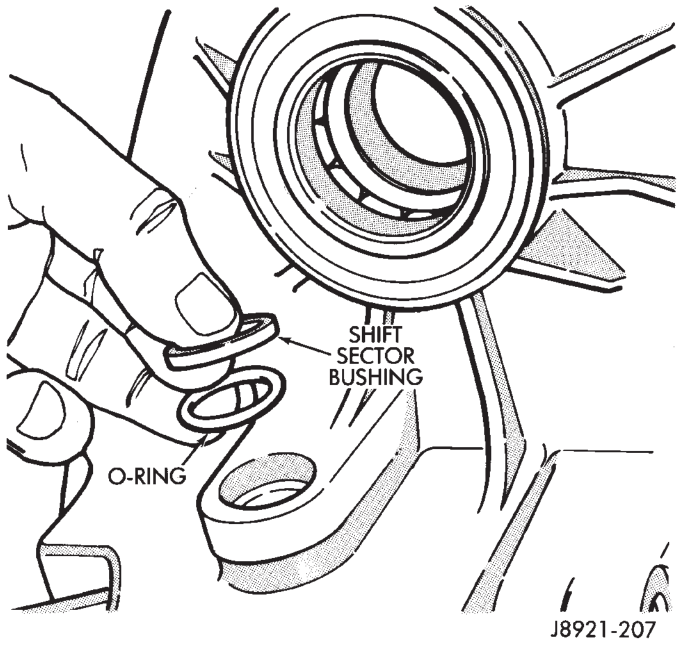


Fig. 38 Sector Bushing And O-Ring Removal

(5) Remove low range gear snap-ring (Fig. 42).

(6) Remove input gear retainer, thrust washers and input gear from low range gear (Fig. 43).

(7) Inspect low range annulus gear (Fig. 44). **Gear is not a serviceable component. If damaged, replace gear and front case as assembly.**

(8) Remove oil seals from following components:

- front bearing retainer.
- rear retainer.
- oil pump.
- case halves.

DISASSEMBLY AND ASSEMBLY (Continued)

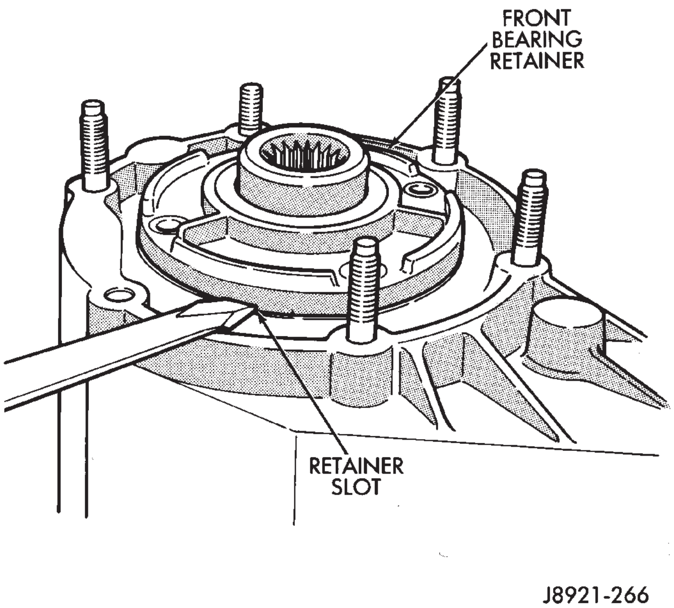


Fig. 39 Front Bearing Retainer Removal

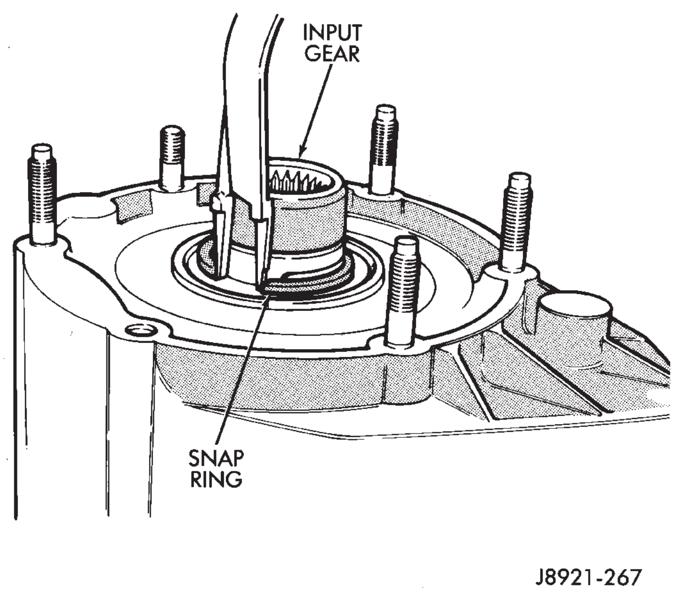


Fig. 40 Input Gear Snap-Ring Removal

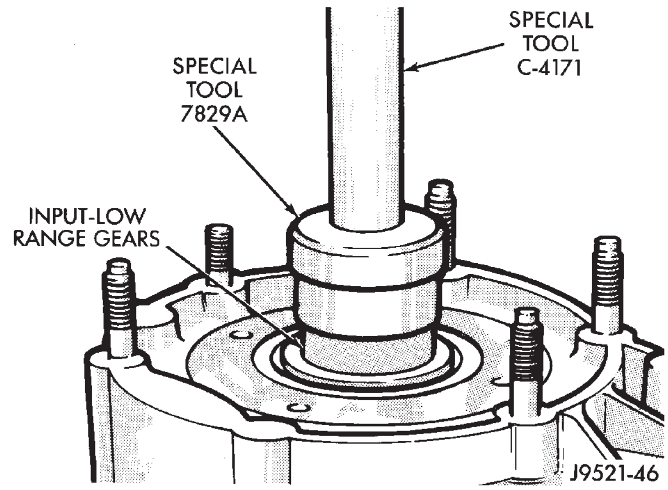


Fig. 41 Input And Low Range Gear Assembly Removal

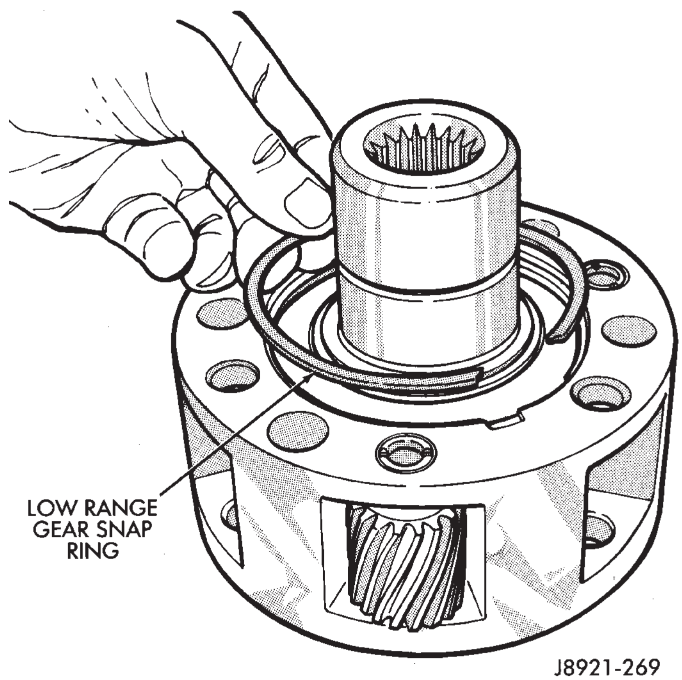


Fig. 42 Low Range Gear Snap-Ring Removal/ Installation

DIFFERENTIAL DISASSEMBLY

(1) Mark differential case halves for reference.

(2) Remove differential case bolts.

(3) Invert differential on workbench.

(4) Separate top case from bottom case. Use slots in case halves to pry them apart (Fig. 45).

(5) Remove thrust washers and planet gears from case pins (Fig. 46).

(6) Remove mainshaft and sprocket gears from bottom case (Fig. 47). Note gear position for reference before separating them.

DISASSEMBLY AND ASSEMBLY (Continued)

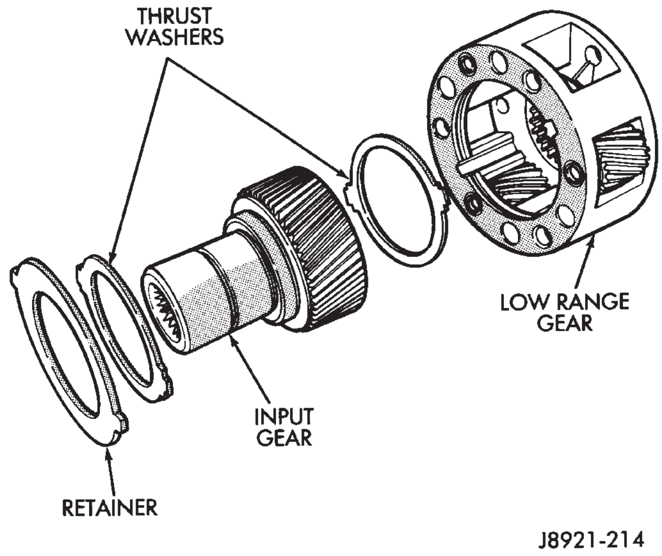


Fig. 43 Low Range Gear Disassembly

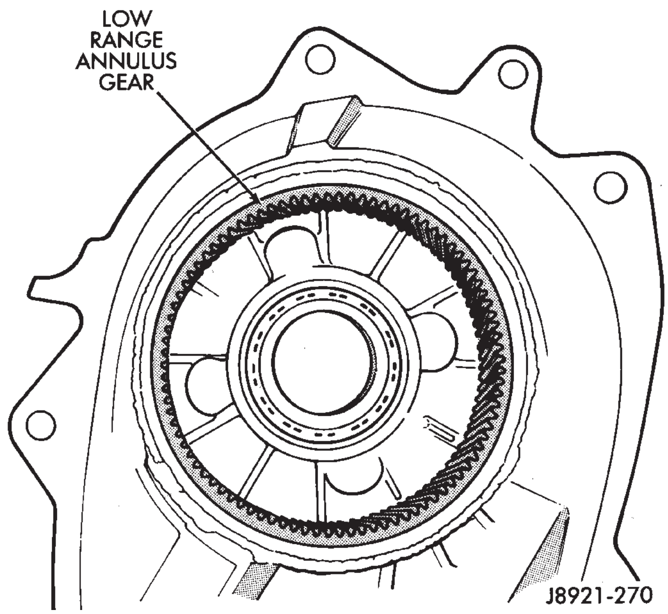


Fig. 44 Inspecting Low Range Annulus Gear

ASSEMBLY

Lubricate transfer case components with automatic transmission fluid or petroleum jelly (where indicated) during assembly.

CAUTION: The bearing bores in various transfer case components contain oil feed holes. Make sure replacement bearings do not block the holes.

BEARING AND SEAL INSTALLATION

(1) Remove snap-ring that retains front output shaft front bearing in case (Fig. 48). Then remove bearing. Use hammer handle, or hammer and brass punch to tap bearing out of case.

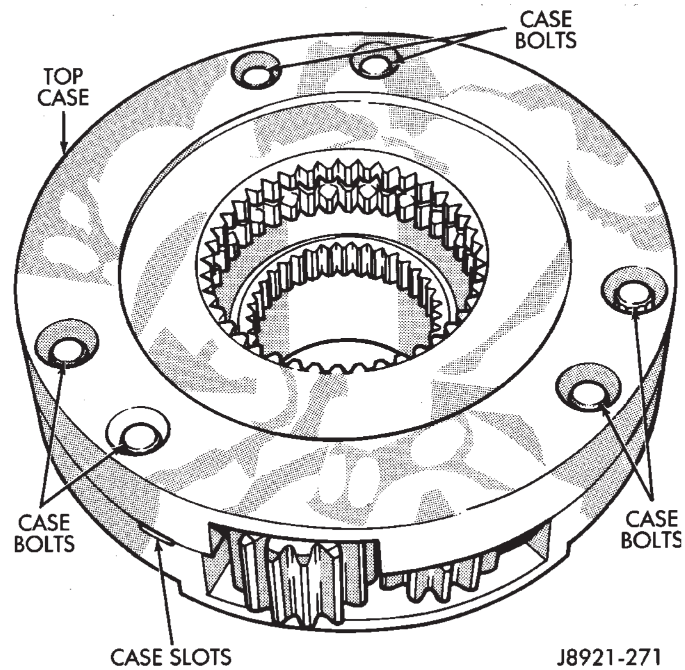


Fig. 45 Separating Differential Case Halves

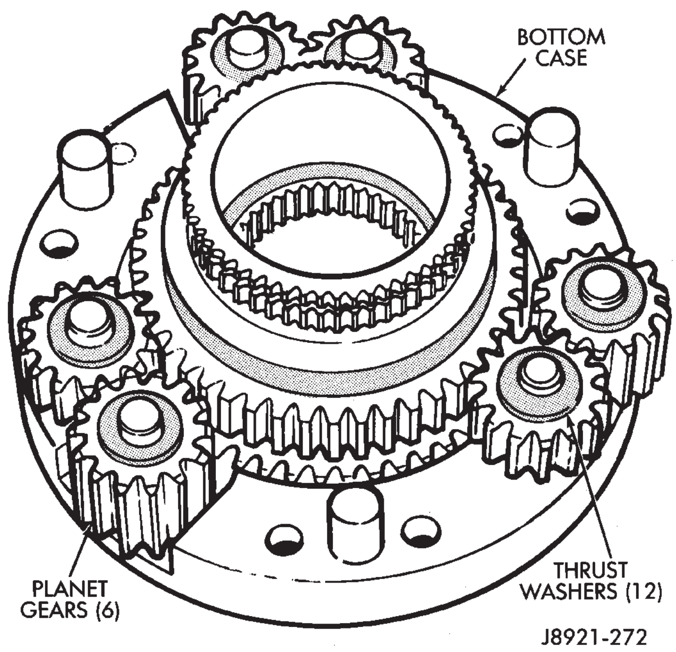


Fig. 46 Planet Gears And Thrust Washer Removal

(2) Install new front output shaft front bearing with Tool Handle C-4171 and Installer 8033A with the tapered cone upward (Fig. 49).

(3) Install front bearing snap-ring (Fig. 48).

(4) Remove front output shaft seal using an appropriate pry tool (Fig. 50) or slide-hammer mounted screw.

(5) Install new front output shaft oil seal with Installer 6952-A (Fig. 51).

DISASSEMBLY AND ASSEMBLY (Continued)

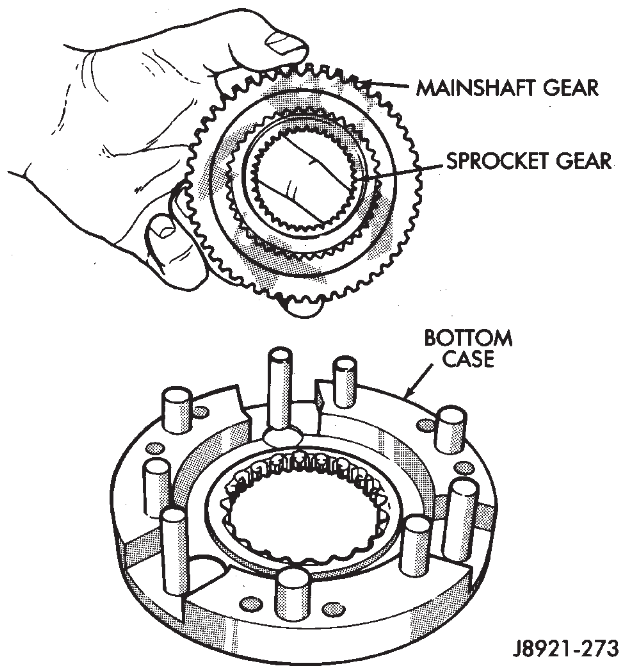


Fig. 47 Mainshaft And Sprocket Gear Removal

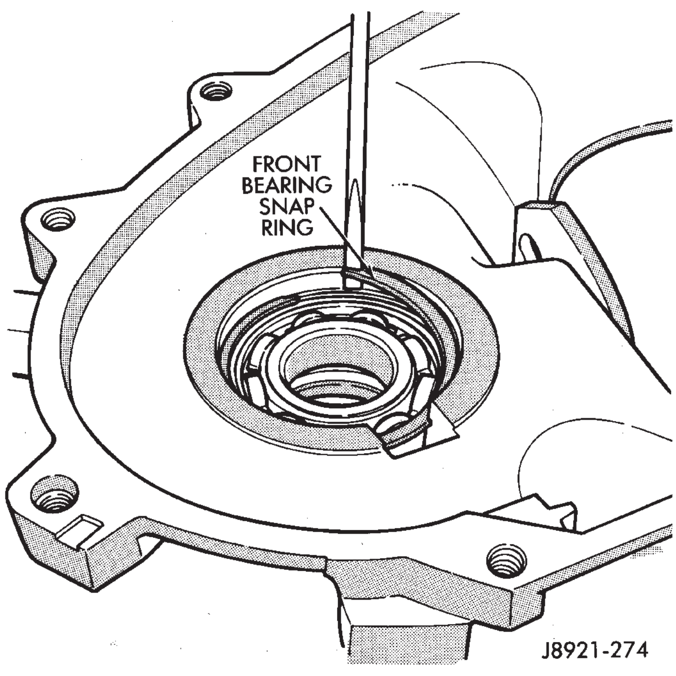


Fig. 48 Front Output Shaft Front Bearing Snap-Ring Removal

(6) Remove input gear bearing with Tool Handle C-4171 and Remover C-4210 (Fig. 52).

(7) Install snap-ring on new input gear bearing.

(8) Install new input gear bearing with Tool Handle C-4171 and Remover C-4210. Install bearing far enough to seat snap-ring against case (Fig. 53).

(9) Remove the input gear pilot bearing by inserting a suitably sized drift into the splined end of the input gear and driving the bearing out with the drift and a hammer (Fig. 54).

(10) Install new pilot bearing with Installer 8128 and Handle C-4171 (Fig. 55).

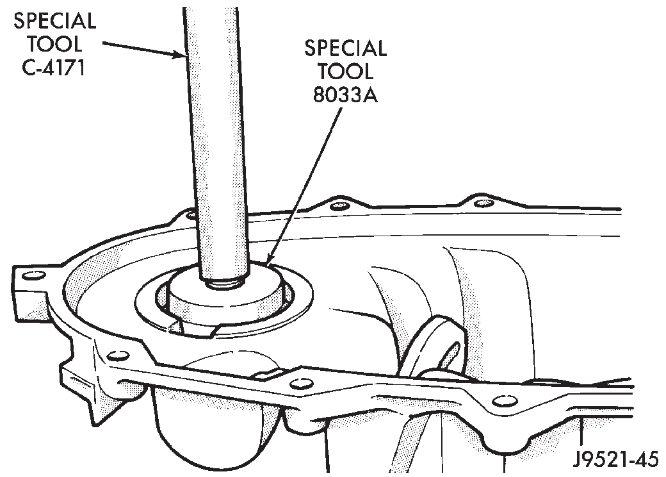


Fig. 49 Front Output Shaft Front Bearing Installation

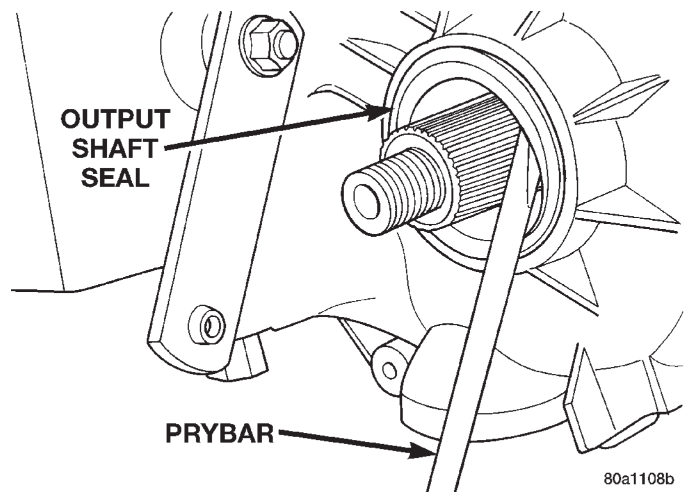


Fig. 50 Remove Front Output Shaft Seal

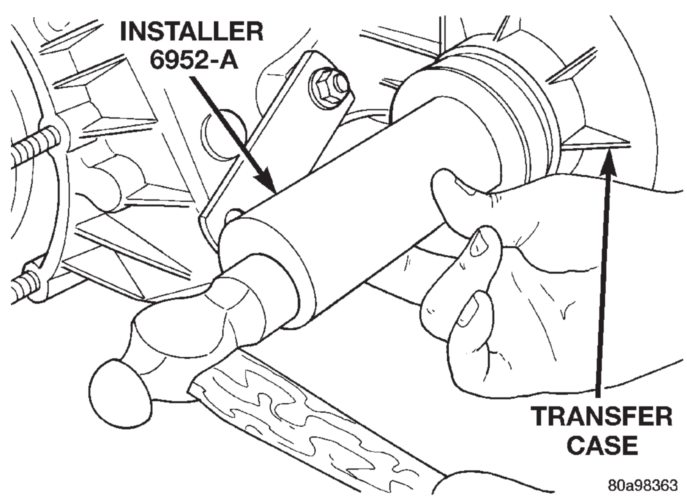


Fig. 51 Install Front Output Shaft Seal

DISASSEMBLY AND ASSEMBLY (Continued)

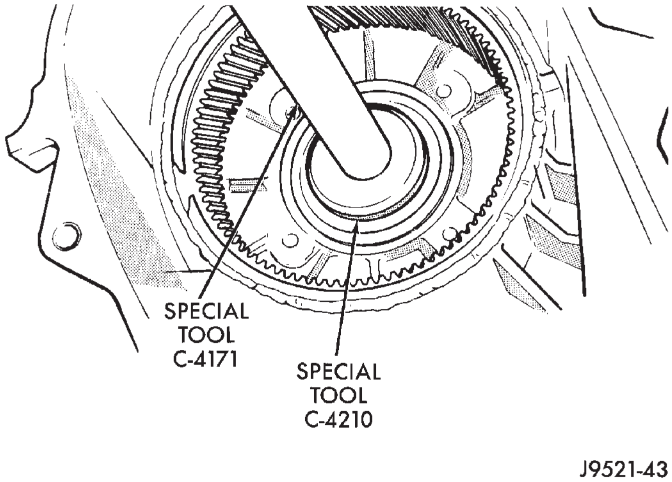


Fig. 52 Input Gear Bearing Removal

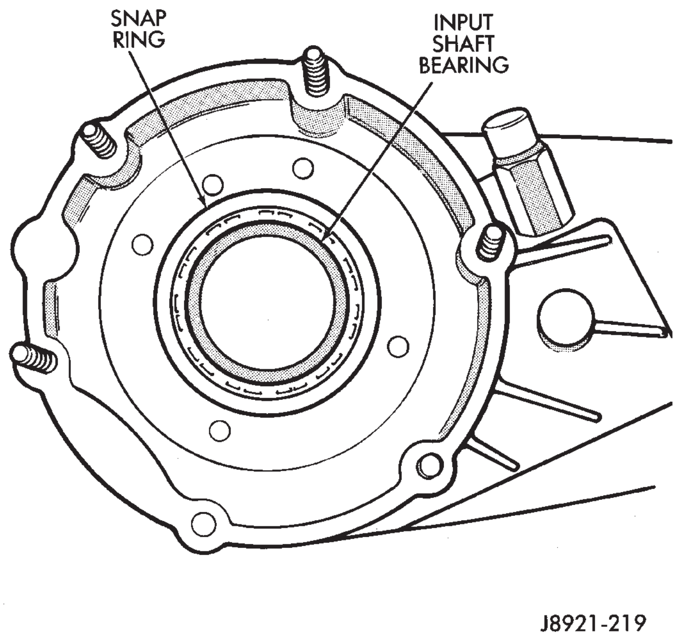


Fig. 53 Seating Input Gear Bearing

(11) Install new seal in front bearing retainer with Installer 7884 (Fig. 56).

(12) Remove output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 57).

(13) Install new bearing with Tool Handle C-4171 and Installer 5066 (Fig. 58). Lubricate bearing after installation.

(14) Install new seal in oil pump feed housing with Special Tool 7888 (Fig. 59).

(15) Install new pickup tube O-ring in oil pump (Fig. 60).

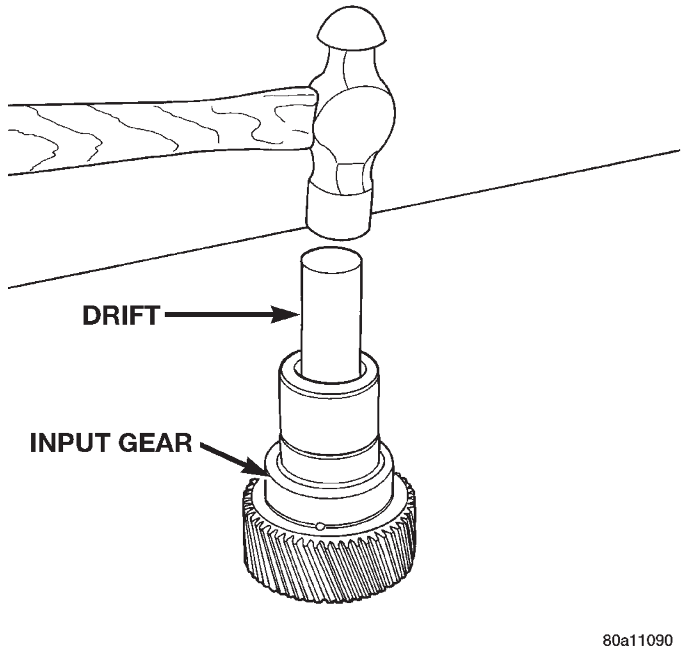


Fig. 54 Remove Input Gear Pilot Bearing

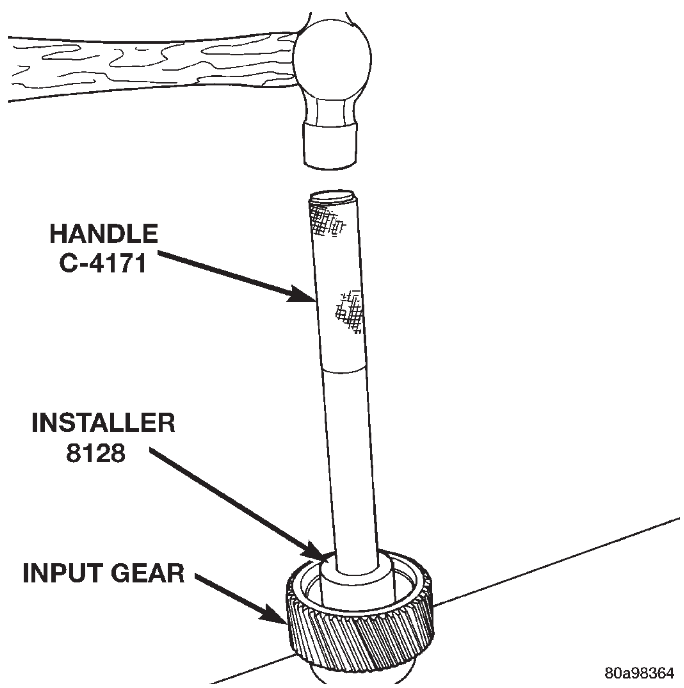


Fig. 55 Install Input Gear Pilot Bearing

DISASSEMBLY AND ASSEMBLY (Continued)

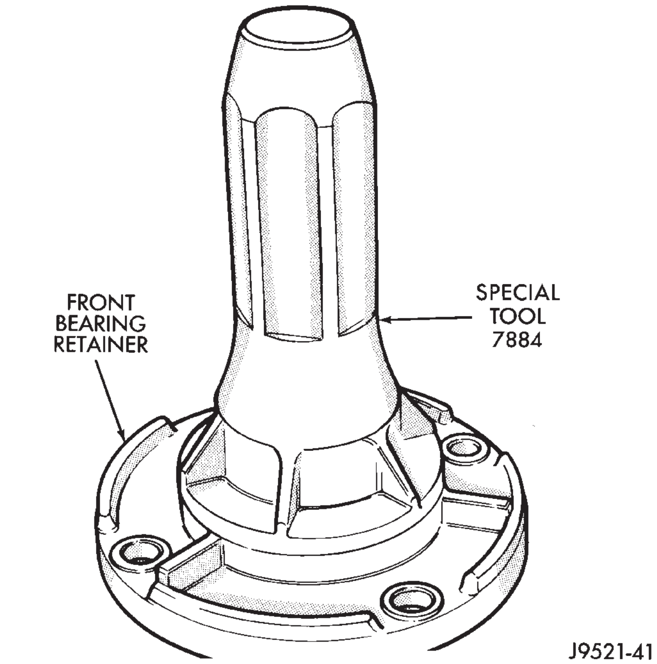


Fig. 56 Front Bearing Retainer Seal Installation

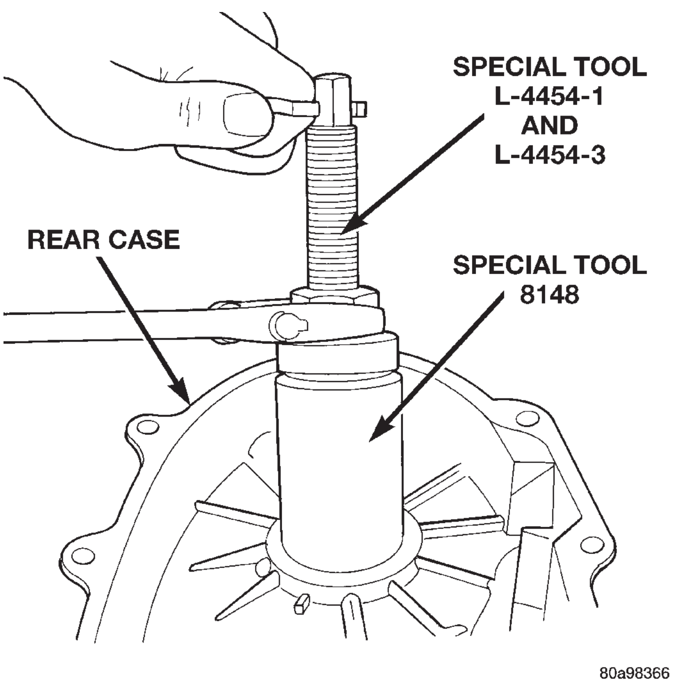


Fig. 57 Remove Front Output Shaft Rear Bearing

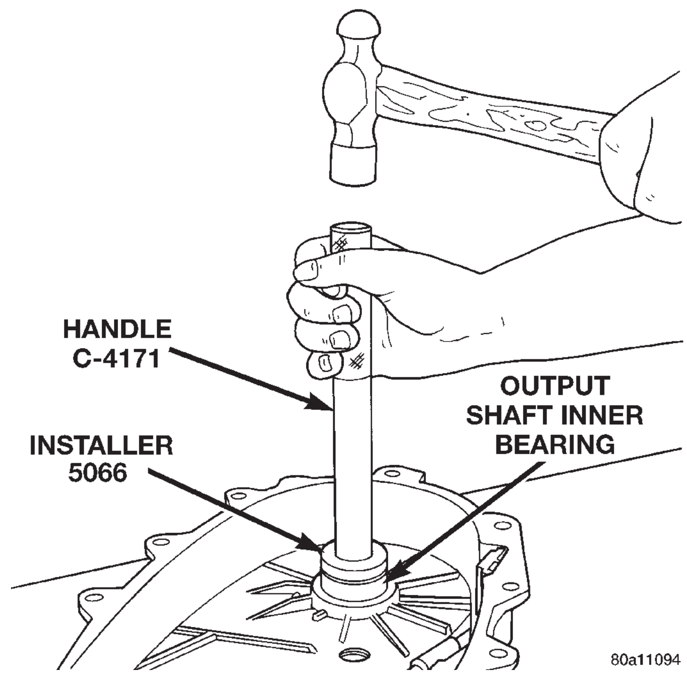


Fig. 58 Install Front Output Shaft Rear Bearing

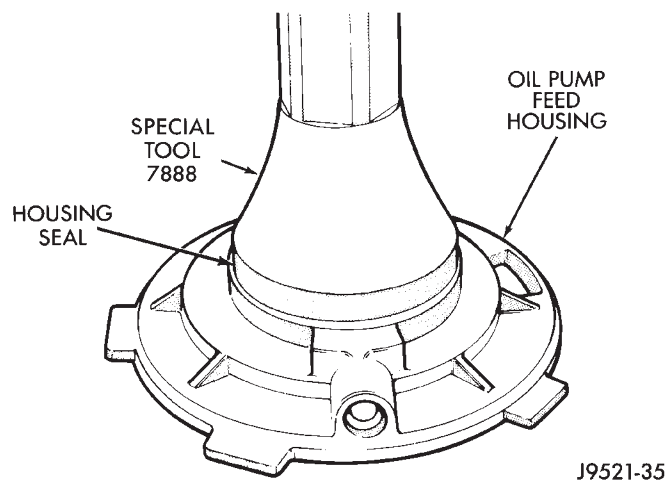


Fig. 59 Oil Pump Seal Installation

DIFFERENTIAL ASSEMBLY

(1) Lubricate differential components with automatic transmission fluid.

(2) Install sprocket gear in differential bottom case (Fig. 61).

(3) Install differential planet gears and new thrust washers (Fig. 62). **Be sure thrust washers are installed at top and bottom of each planet gear.**

(4) Install differential mainshaft gear (Fig. 62).

(5) Align and position differential top case on bottom case (Fig. 63). Align using scribe marks made at disassembly.

(6) While holding differential case halves together, invert the differential and start the differential case bolts.

(7) Tighten differential case bolts to specified torque.

DISASSEMBLY AND ASSEMBLY (Continued)

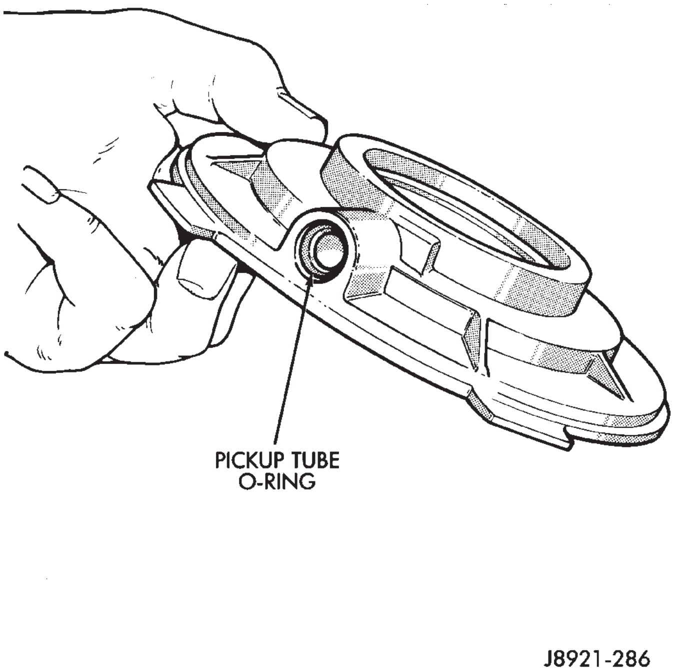


Fig. 60 Pickup Tube O-Ring Installation

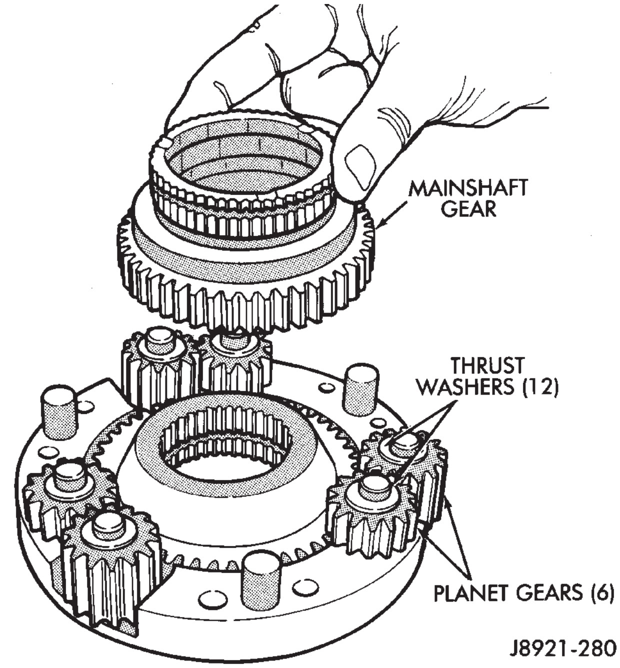


Fig. 62 Installing Mainshaft And Planet Gears

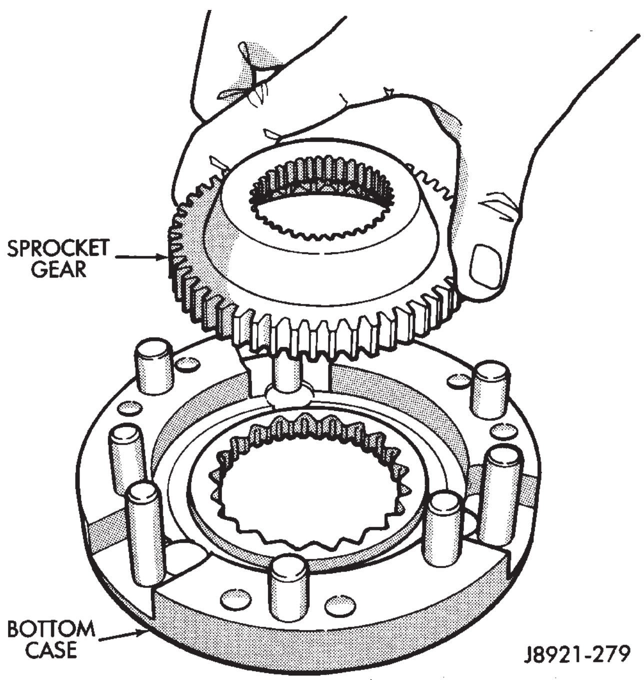


Fig. 61 Installing Differential Sprocket Gear

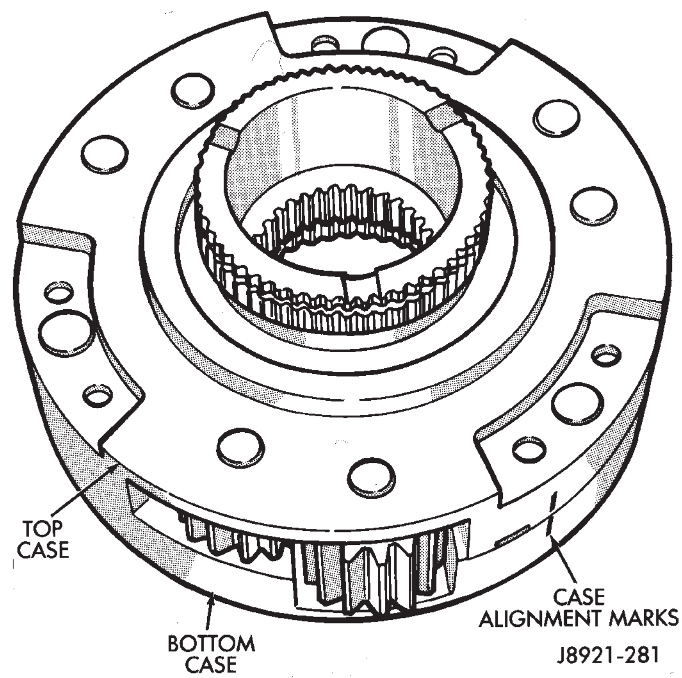


Fig. 63 Differential Case Assembly

DISASSEMBLY AND ASSEMBLY (Continued)

INPUT GEAR/LOW RANGE ASSEMBLY

(1) Assemble low range gear, input gear thrust washers, input gear and input gear retainer (Fig. 64).

(2) Install low range gear snap ring (Fig. 65).

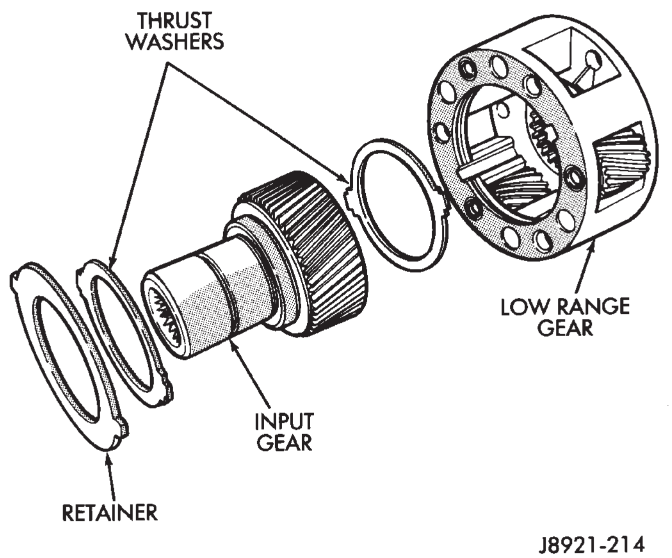


Fig. 64 Low Range And Input Gear Assembly

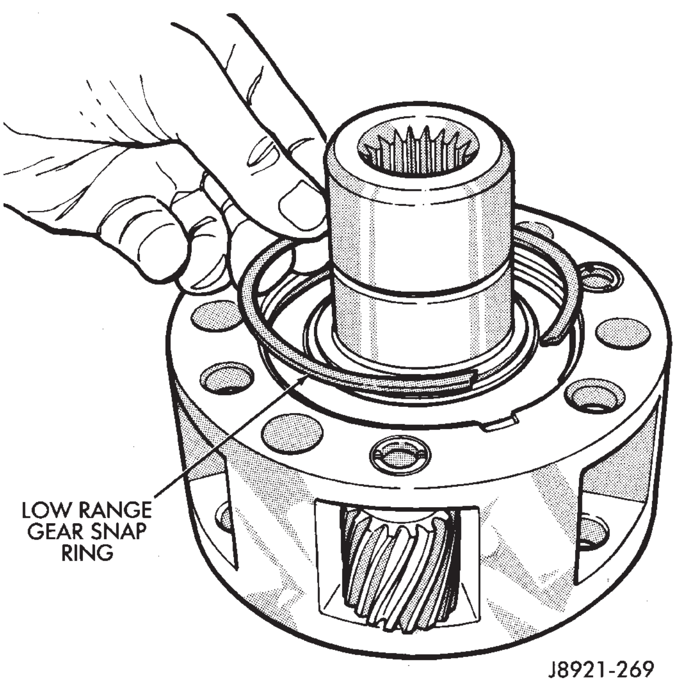


Fig. 65 Install Low Range Gear Snap Ring

(3) Lubricate input gear and low range gears with automatic transmission fluid.

(4) Start input gear shaft into front case bearing.

(5) Press input gear shaft into front bearing.

(6) Install new input gear snap ring (Fig. 66).

(7) Apply 3 mm (1/8 in.) wide bead of Mopar® gasket maker or silicone adhesive sealer to seal surface of front bearing retainer.

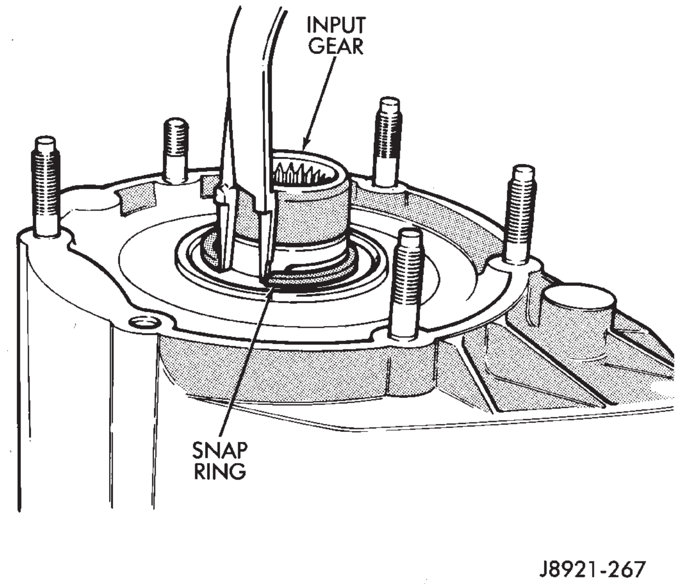


Fig. 66 Input Gear Snap Ring Installation

(8) Install front bearing retainer (Fig. 67). Tighten retainer bolts to 16 ft. lbs. (21 N·m) torque.

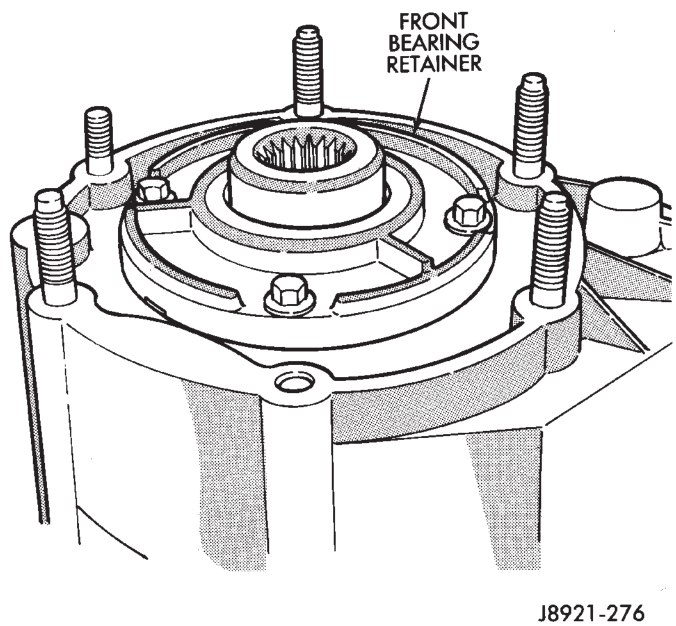


Fig. 67 Installing Front Bearing Retainer

SHIFT FORKS AND MAINSHAFT INSTALLATION

(1) Install new sector shaft O-ring and bushing (Fig. 68).

(2) Install shift sector.

(3) Install new pads on low range fork, if necessary, (Fig. 69).

(4) Assemble low range fork and hub (Fig. 69).

(5) Position low range fork and hub in case. Be sure low range fork pin is engaged in shift sector slot (Fig. 70).

DISASSEMBLY AND ASSEMBLY (Continued)

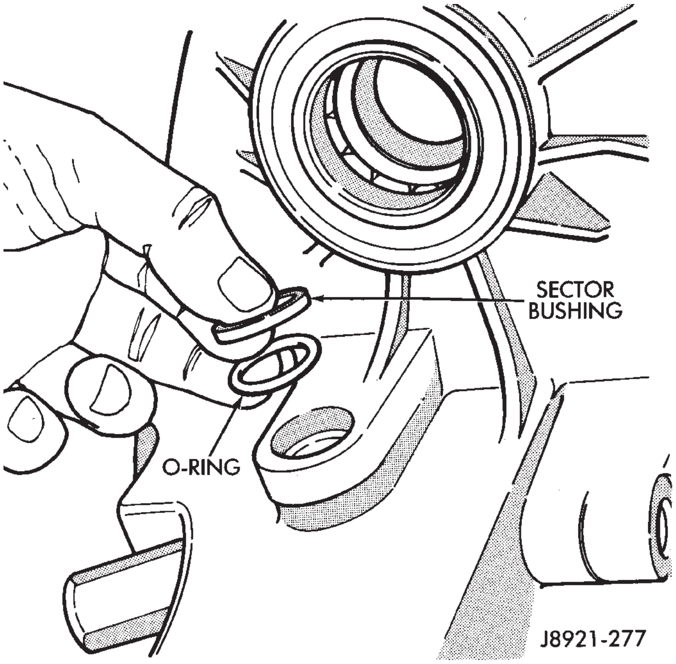


Fig. 68 Sector O-Ring And Bushing Installation

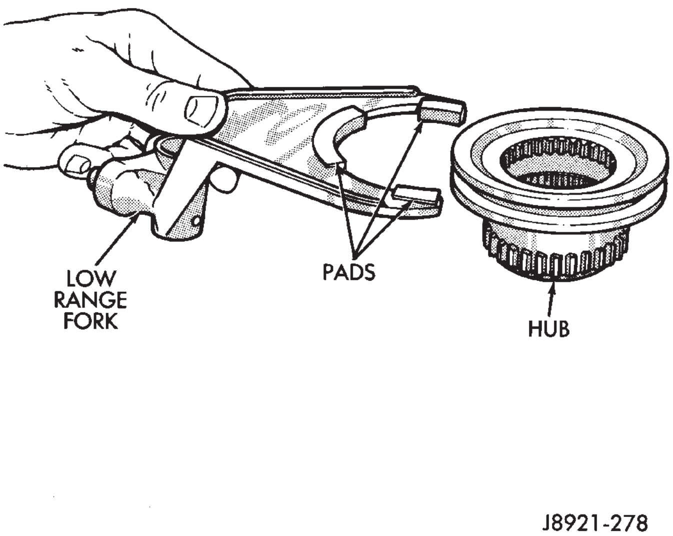


Fig. 69 Assembling Low Range Fork And Hub

(6) Install first mainshaft bearing spacer on mainshaft (Fig. 71).

(7) Install bearing rollers on mainshaft (Fig. 71). **Coat bearing rollers with generous quantity of petroleum jelly to hold them in place.**

(8) Install remaining bearing spacer on mainshaft (Fig. 71). Do not displace any bearings while installing spacer.

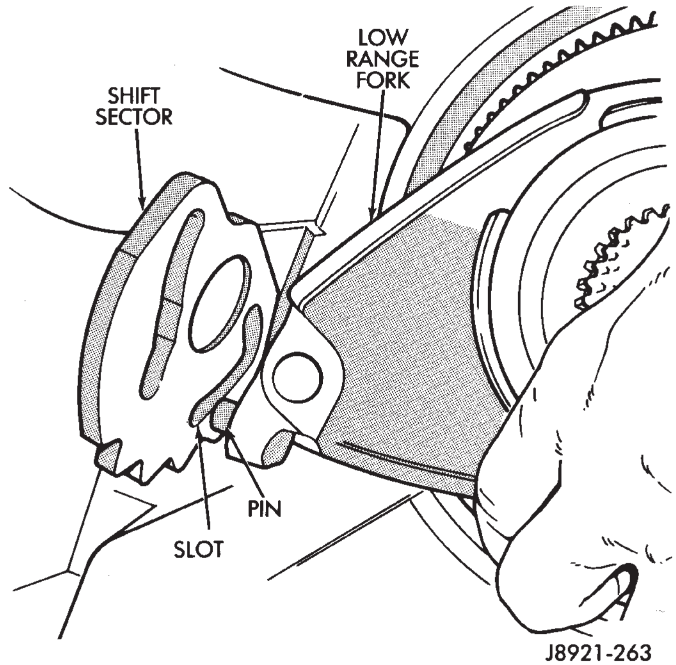


Fig. 70 Positioning Low Range Fork

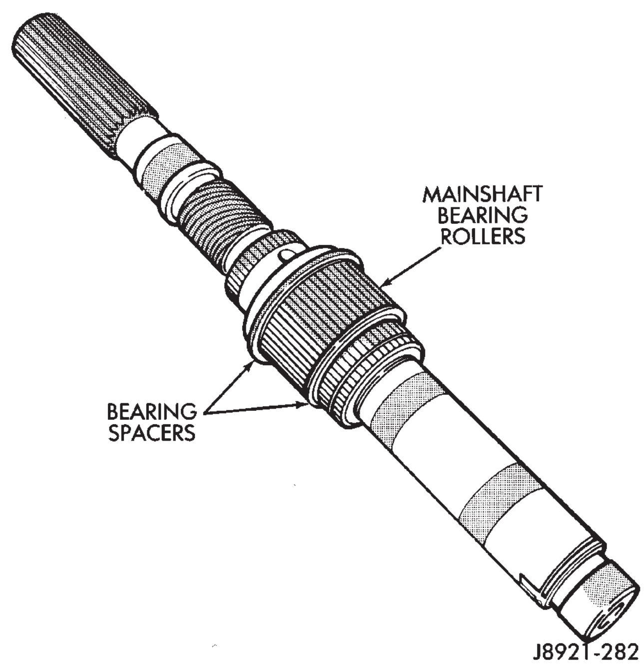


Fig. 71 Installing Mainshaft Bearing Rollers and Spacers

DISASSEMBLY AND ASSEMBLY (Continued)

(9) Install differential (Fig. 72). **Do not displace mainshaft bearings when installing differential.**

(10) Install differential snap-ring (Fig. 73).

(11) Install intermediate clutch shaft (Fig. 74).

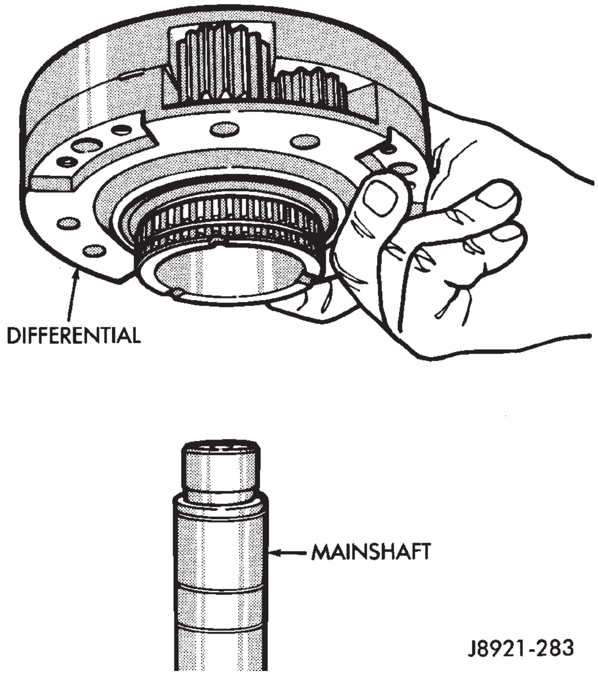


Fig. 72 Differential Installation

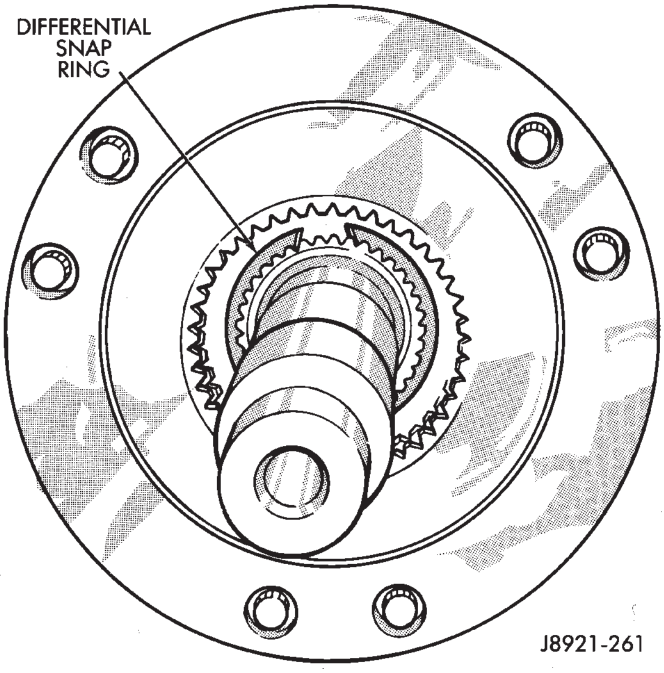


Fig. 73 Installing Differential Snap-Ring

(12) Install clutch shaft thrust washer (Fig. 75).

(13) Install clutch shaft snap-ring (Fig. 76).

(14) Inspect mode fork assembly (Fig. 77). Replace pads and bushing if necessary. Replace fork tube if bushings inside tube are worn or damaged. Also check springs and slider bracket (Fig. 77). Replace worn, damaged components.

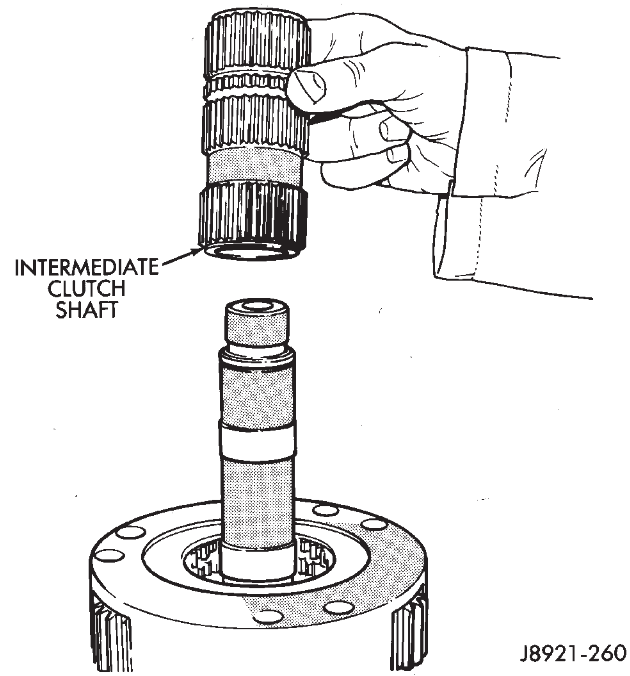


Fig. 74 Installing Intermediate Clutch Shaft

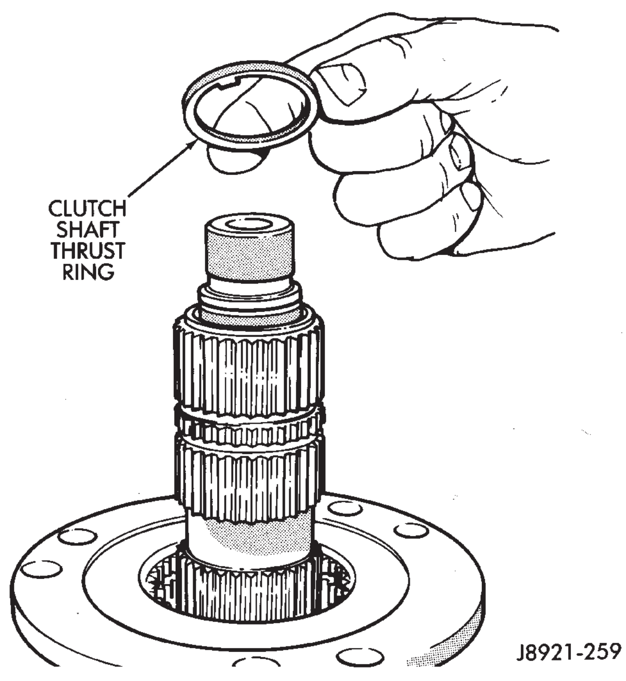


Fig. 75 Installing Clutch Shaft Thrust Washer

(15) Install mode sleeve in mode fork (Fig. 78). Then install assembled sleeve and fork on mainshaft. Be sure mode sleeve splines are engaged in differential splines.

(16) Install mode fork and mainshaft assembly in case (Fig. 79). Rotate mainshaft slightly to engage shaft with low range gears.

DISASSEMBLY AND ASSEMBLY (Continued)

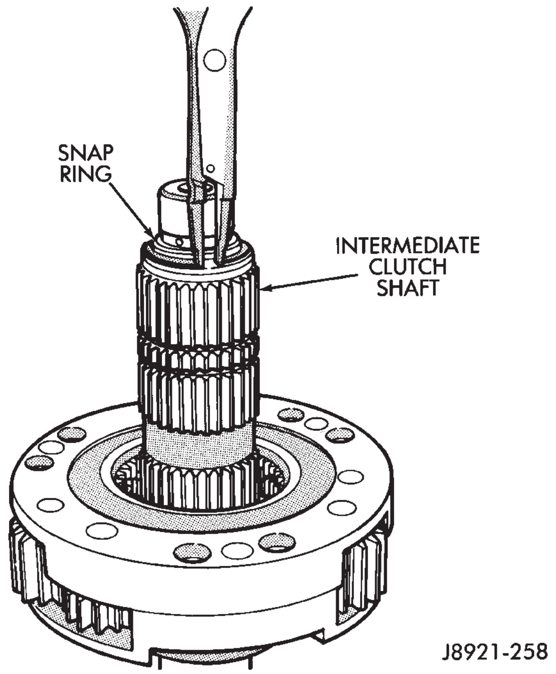


Fig. 76 Installing Clutch Shaft Snap-Ring

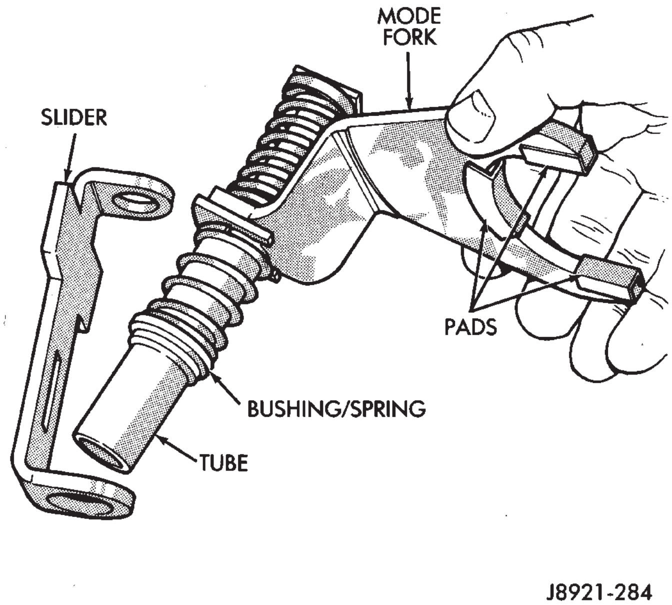


Fig. 77 Mode Fork Assembly Inspection

(17) Rotate mode fork pin into shift sector slot.

(18) Install shift rail (Fig. 80). **Be sure rail is seated in both shift forks.**

(19) Rotate shift sector to align lockpin hole in low range fork with access hole in case.

(20) Insert an easy-out in range fork lockpin to hold it securely for installation (Fig. 81). **Lockpin is slightly tapered on one end. Insert tapered end into fork and rail.**

(21) Insert lockpin through access hole and into shift fork (Fig. 81). Then remove easy-out and seat the pin with pin punch.

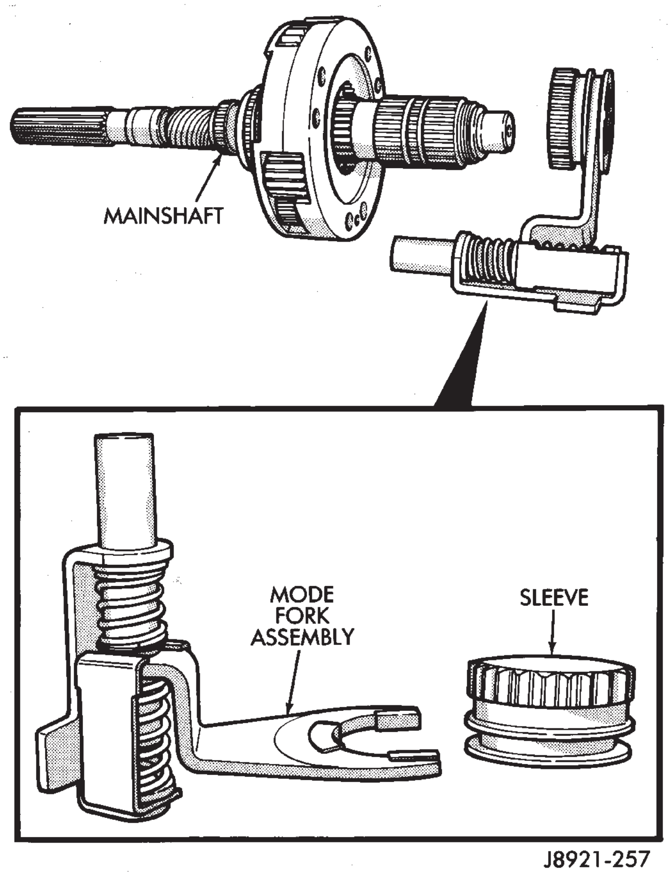


Fig. 78 Installing Mode Fork And Sleeve

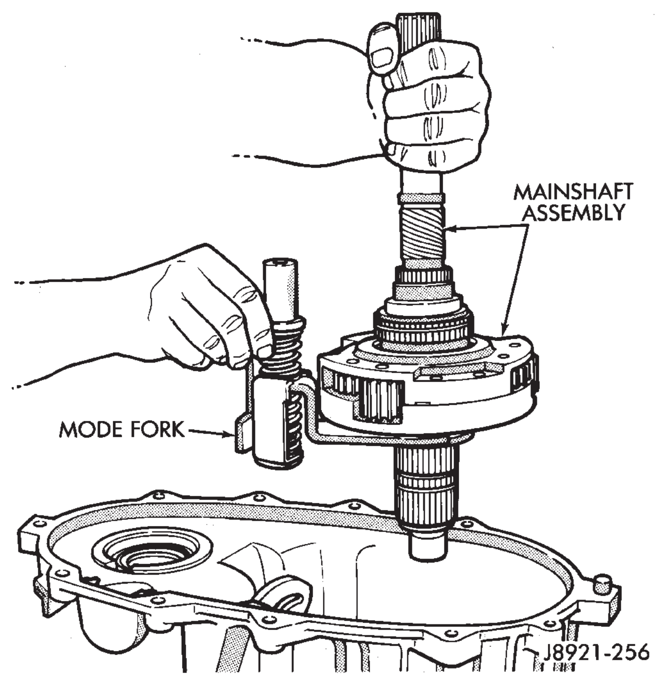


Fig. 79 Assembled Mainshaft And Mode Fork Installation

(22) Install plug in lockpin access hole.

(23) Install detent plunger, detent spring and detent plug in case (Fig. 82).

DISASSEMBLY AND ASSEMBLY (Continued)

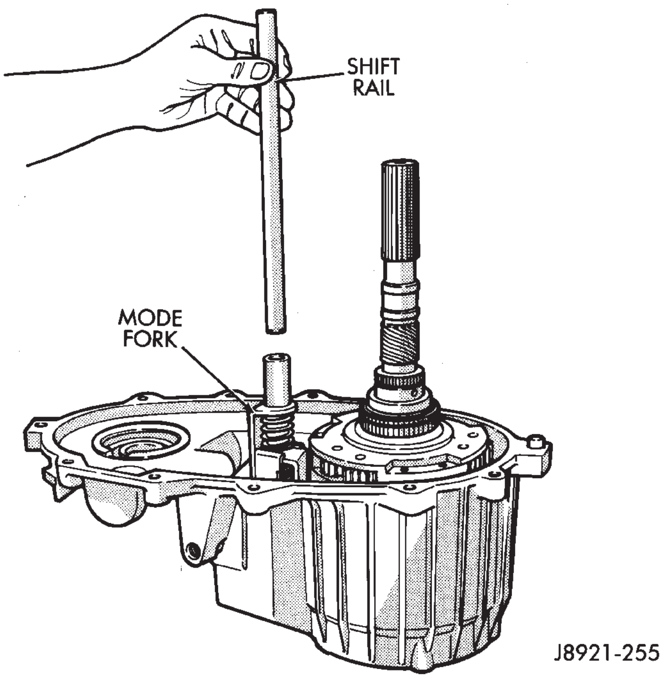


Fig. 80 Shift Rail Installation

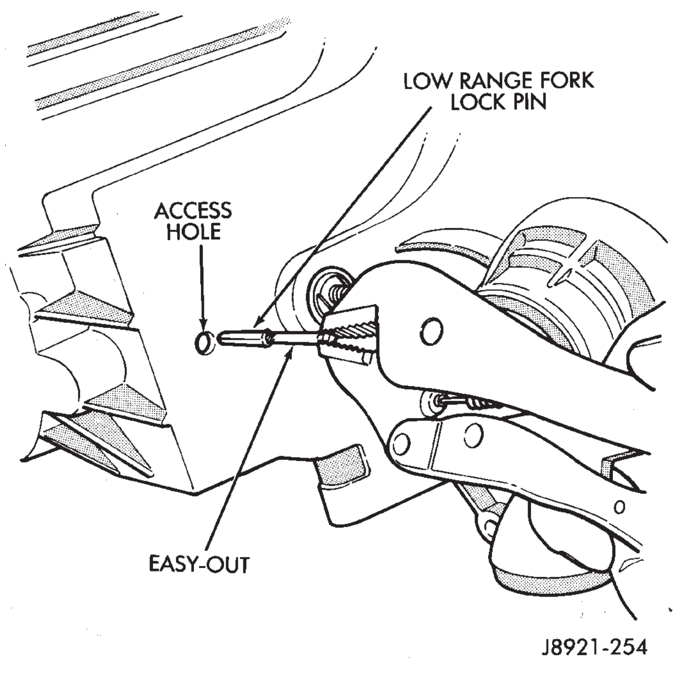


Fig. 81 Installing Low Range Fork Lockpin

FRONT OUTPUT SHAFT AND DRIVE CHAIN INSTALLATION

(1) Install front output shaft (Fig. 83).

(2) Install drive chain (Fig. 83). Engage chain with front output shaft sprocket teeth.

(3) Install drive sprocket (Fig. 83). Engage drive sprocket teeth with chain. Then engage sprocket splines with mainshaft splines.

(4) Install drive sprocket snap-ring (Fig. 84).

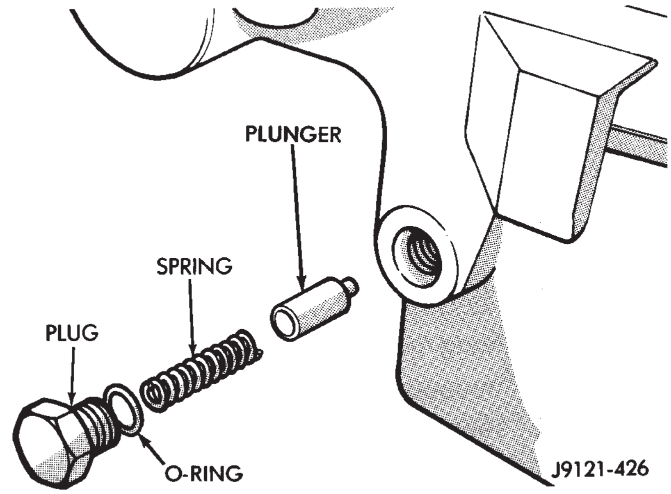


Fig. 82 Detent Pin, Spring And Plug Installation

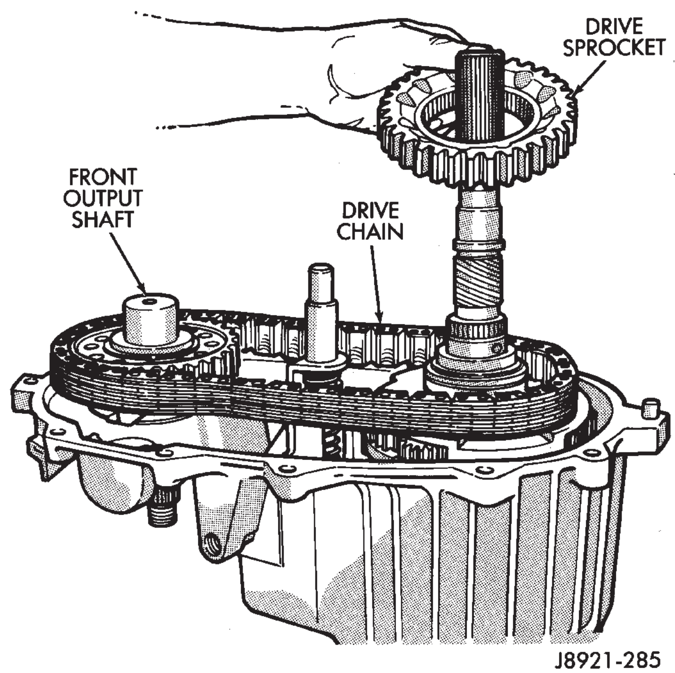


Fig. 83 Drive Chain And Sprocket Installation

OIL PUMP AND REAR CASE INSTALLATION

(1) Insert oil pickup tube in oil pump and attach oil screen and connector hose to pickup tube. Then install assembled pump, tube and screen in rear case (Fig. 85). Be sure screen is seated in case slot as shown.

(2) Install magnet in front case pocket (Fig. 86).

(3) Apply 3 mm (1/8 in.) wide bead of Mopar gasket maker or silicone adhesive sealer to seal surface of front case.

(4) Align and install rear case on front case. Be sure case locating dowels are in place and that mainshaft splines are engaged in oil pump inner gear.

(5) Install and tighten front case-to-rear case bolts to 41 N·m (30 ft. lbs.) torque. **Be sure to install a**

DISASSEMBLY AND ASSEMBLY (Continued)

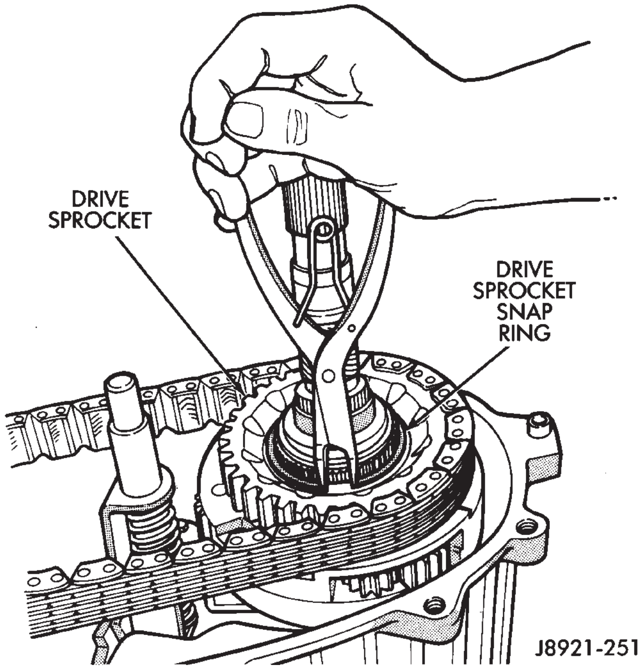


Fig. 84 Drive Sprocket Snap-Ring Installation

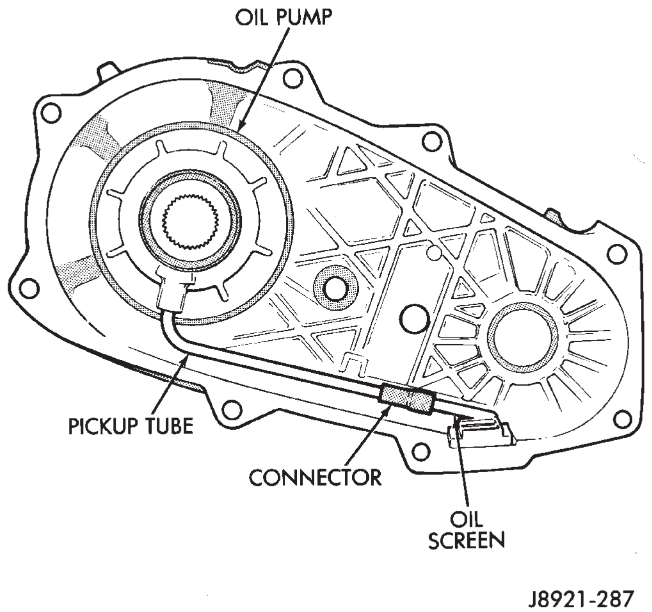


Fig. 85 Oil Screen And Pickup Tube Installation

washer under each bolt used at case dowel locations.

REAR RETAINER INSTALLATION

(1) Remove rear bearing in retainer using Installer 8128 and Handle C-4171.

(2) Install rear bearing in retainer with Tools C-4171 and 5064 (Fig. 87).

(3) Install rear bearing O.D. retaining ring with snap-ring pliers (Fig. 88). Be sure retaining ring is fully seated in retainer groove.

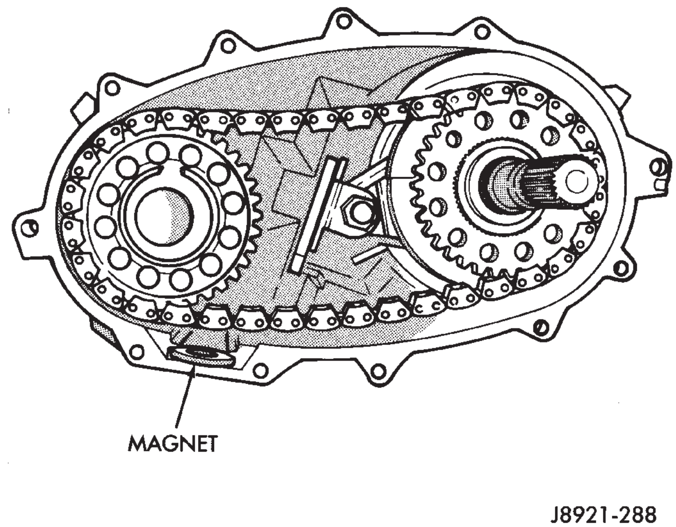


Fig. 86 Installing Case Magnet

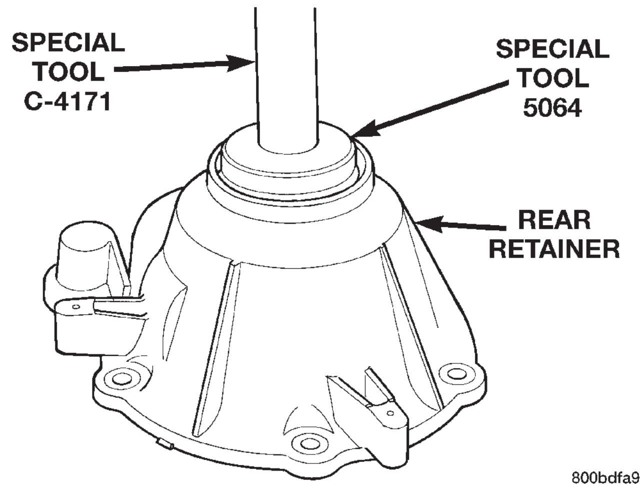


Fig. 87 Installing Rear Bearing In Retainer

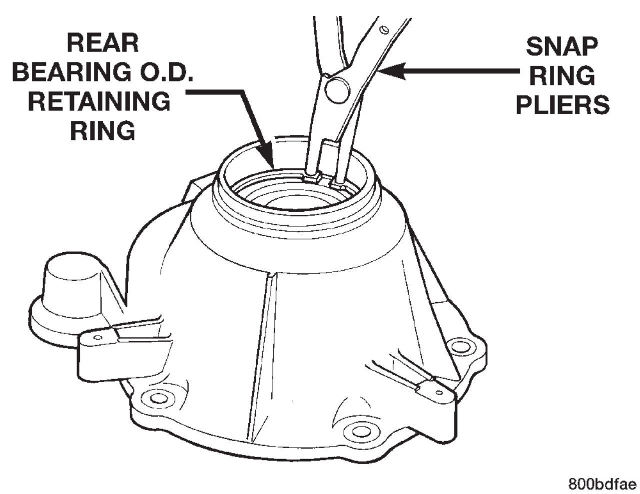


Fig. 88 Rear Bearing Retaining Ring Installation

(4) Apply bead of Mopar® Sealer P/N 82300234, or Loctite™ Ultra Gray, to mating surface of rear

DISASSEMBLY AND ASSEMBLY (Continued)

retainer. Sealer bead should be a maximum of 3/16 in.

(5) Install rear retainer on rear case. Tighten retainer bolts to 20–27 N·m (15–20 ft. lbs.) torque.

(6) Install rear bearing I.D. retaining ring and spacer on output shaft.

(7) Apply liberal quantity of petroleum jelly to new rear seal and to output shaft. Petroleum jelly is needed to protect seal lips during installation.

(8) Slide seal onto Seal Protector 6992 (Fig. 89). Slide seal protector and seal onto output shaft.

(9) Slide Installer C-4076-B onto seal protector with the recessed side of the tool toward the seal. Drive seal into rear bearing retainer with installer C-4076-B and handle MD-998323 (Fig. 90).

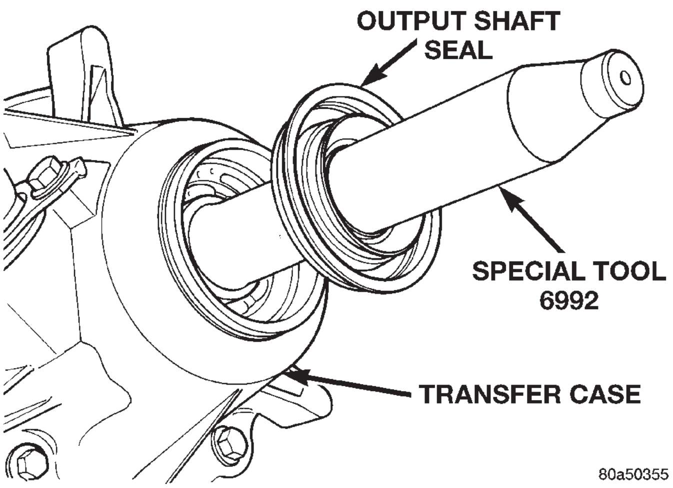


Fig. 89 Output Shaft Seal and Protector

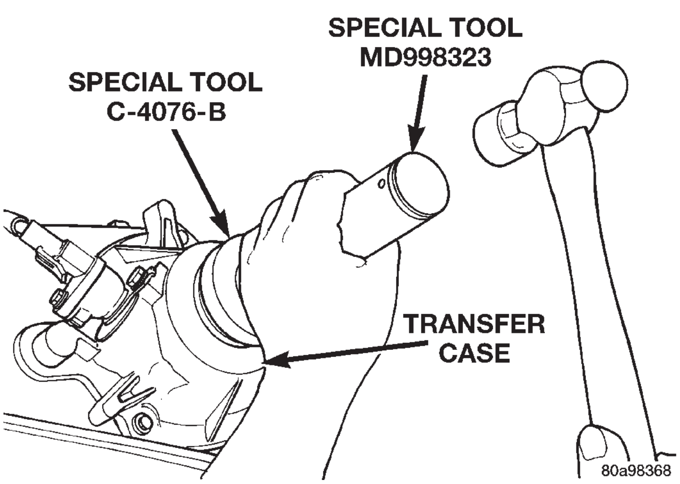


Fig. 90 Rear Seal Installation

(10) Install rear slinger with installer C-4076-A and handle MD-998323 (Fig. 90).

(11) Install boot on output shaft slinger and crimp retaining clamp with tool C-4975-A (Fig. 91).

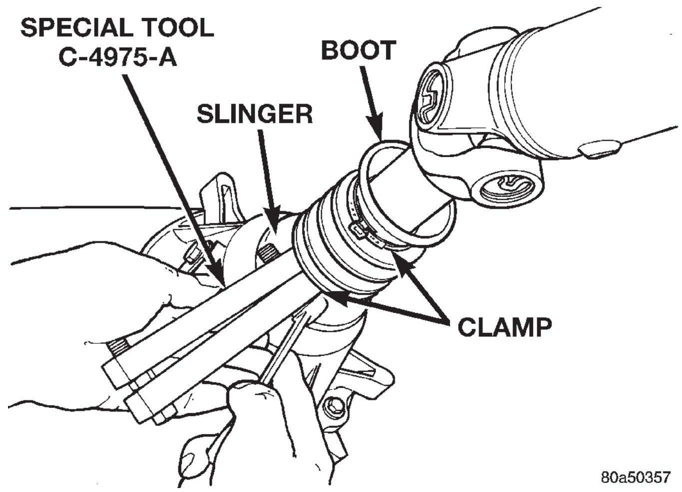


Fig. 91 Slinger Boot Installation

FRONT YOKE AND SWITCH INSTALLATION

(1) Install indicator switch in front case. Tighten switch to 20–34 N·m (15–25 ft. lbs.) torque.

(2) Lubricate yoke hub with transmission fluid and install yoke on front shaft.

(3) Install new seal washer on front shaft.

(4) Install yoke on front shaft. Secure yoke with new nut.

CLEANING AND INSPECTION

NV242 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 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. Minor nicks and scratches can be smoothed with an oilstone. However, replace any part is damaged.

Check the contact surfaces in the sprocket bore and on the mainshaft. Minor nicks and scratches can be smoothed with 320–400 grit emery cloth but do not try to salvage the shaft if nicks or wear is severe.

INPUT GEAR AND PLANETARY CARRIER

Check the teeth on the gear (Fig. 92). 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.

CLEANING AND INSPECTION (Continued)

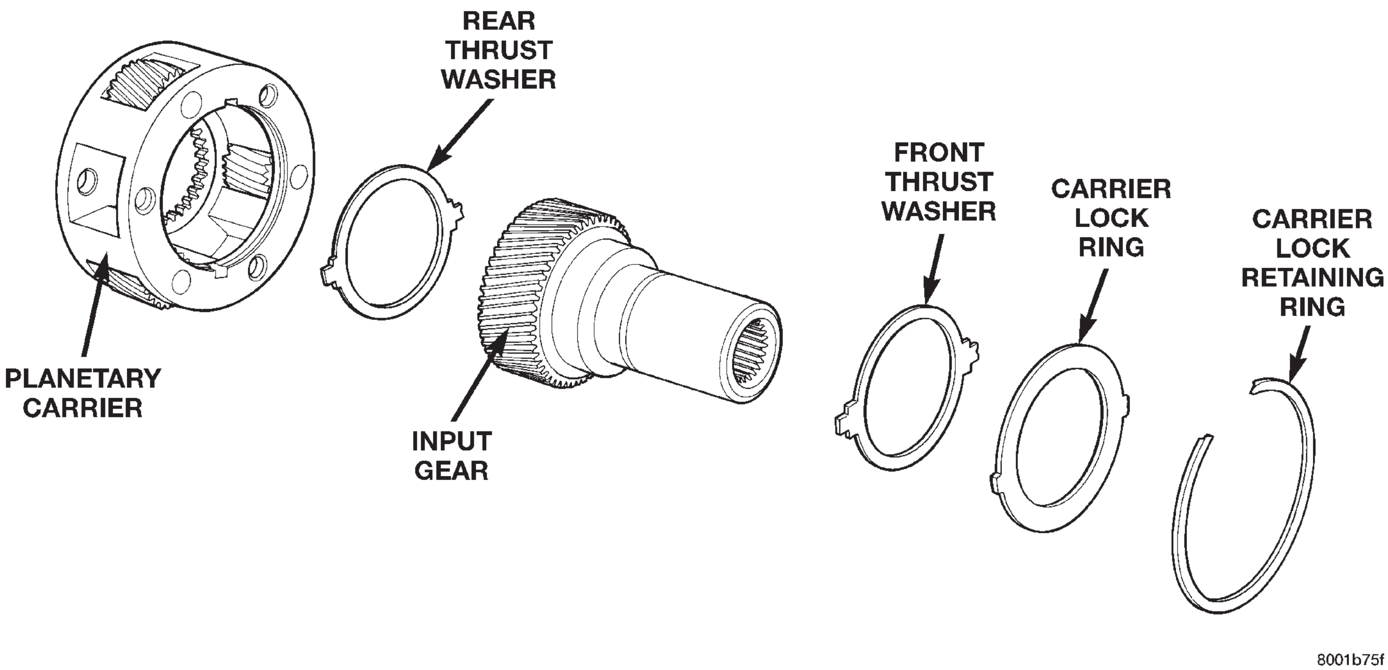


Fig. 92 Input Gear And Carrier Components

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. 93). Minor nicks on the shift rail can be smoothed with 320–400 grit emery cloth.

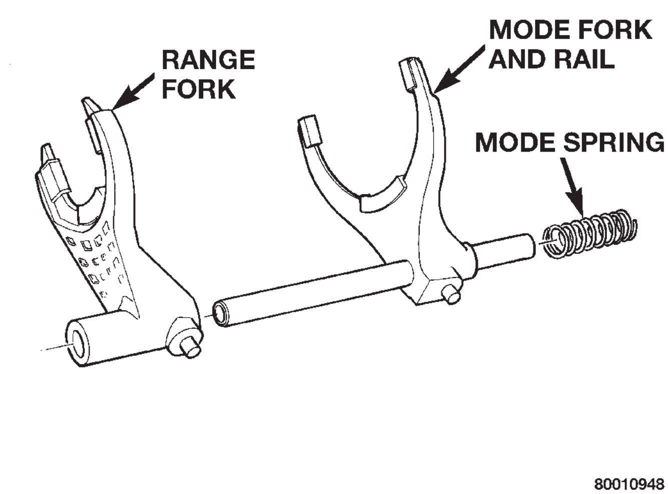


Fig. 93 Shift forks

Inspect the shift fork wear pads. The mode fork pads are serviceable and can be replaced if necessary. The range fork pads are also serviceable.

Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

REAR RETAINER/BEARING/ SEAL/SLINGER/BOOT

Inspect the retainer components (Fig. 94). 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 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.

REAR OUTPUT SHAFT/YOKE/DRIVE CHAIN

Check condition of the seal contact surfaces of the yoke slinger (Fig. 95). 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 dam-

CLEANING AND INSPECTION (Continued)

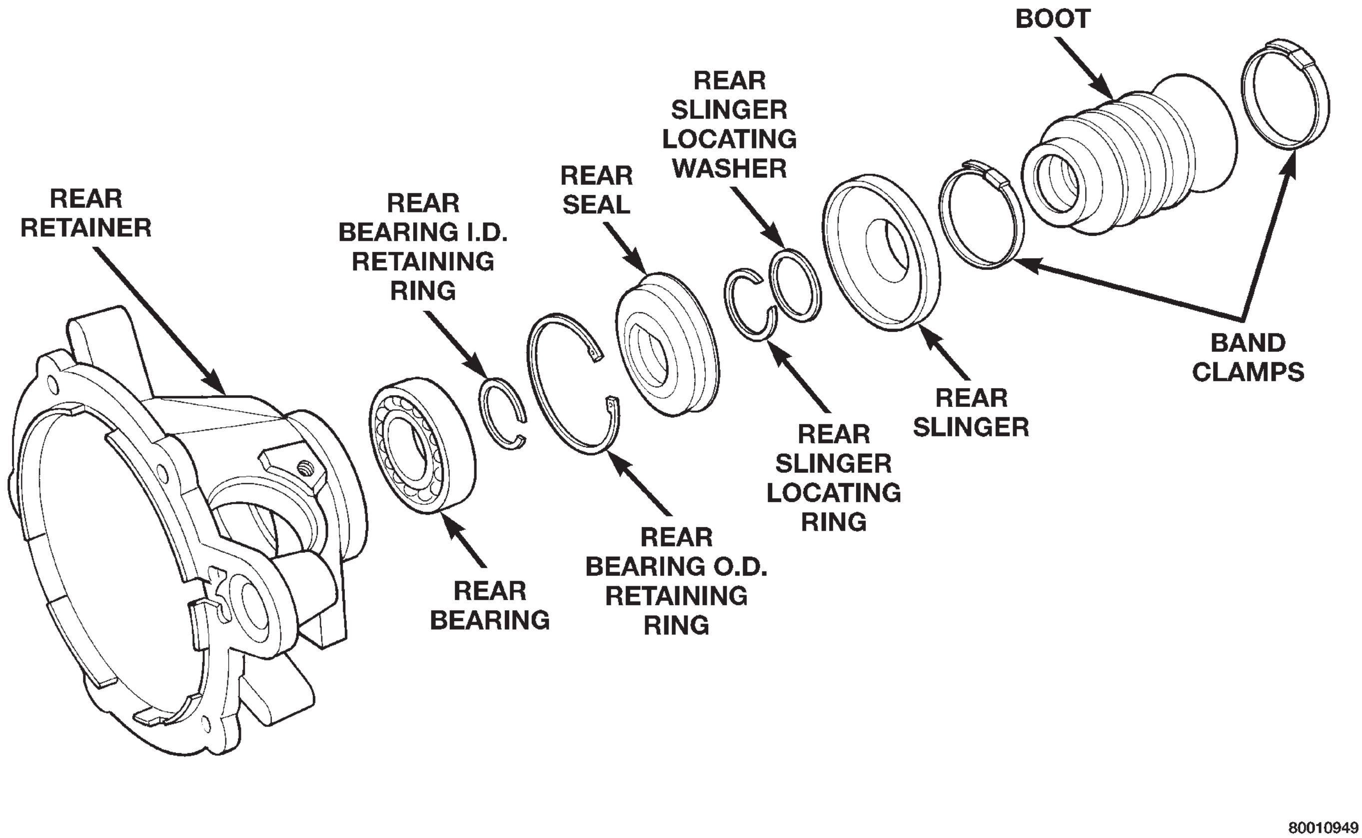


Fig. 94 Rear Retainer Components

aged, bearing surfaces are scored, or if any sprocket teeth are cracked or broken.

Examine the drive chain and shaft bearings. Replace the chain and both sprockets if the chain is stretched, distorted, or if any of the links bind. Replace the bearings if rough, or noisy.

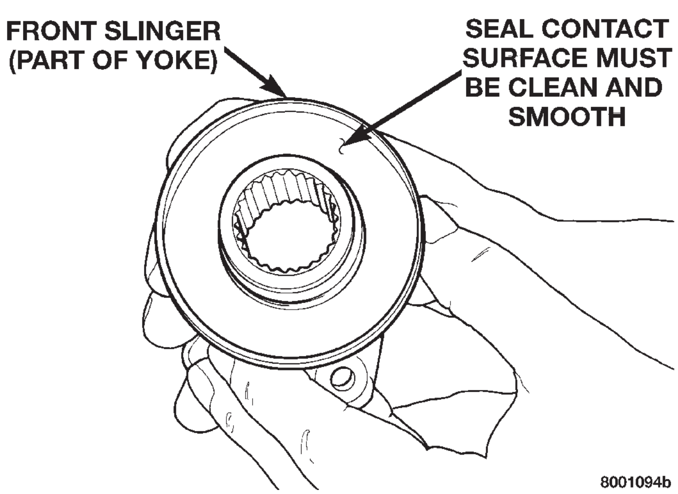


Fig. 95 Seal Contact Surface Of Yoke Slinger

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. 96).

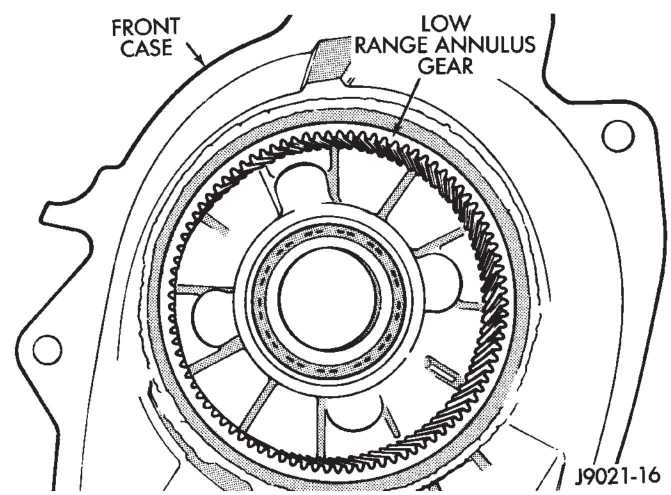


Fig. 96 Low Range Annulus Gear

FRONT-REAR CASES AND FRONT RETAINER

Inspect the cases and retainer for wear and damage. Clean the sealing surfaces with a scraper and all purpose cleaner. This will ensure proper sealer adhesion at assembly. Replace the input retainer seal; do not reuse it.

CLEANING AND INSPECTION (Continued)

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. 97).
(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.

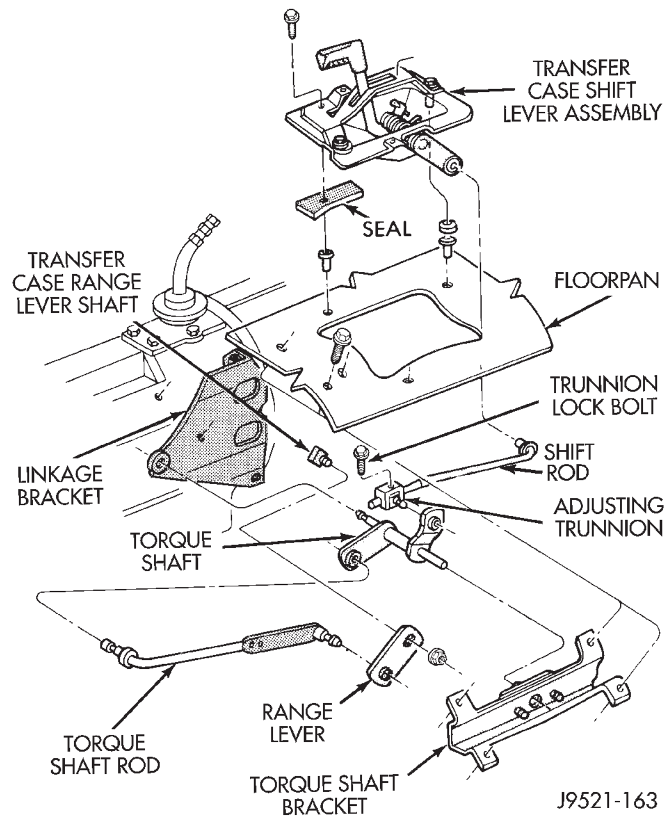


Fig. 97 Shift Linkage

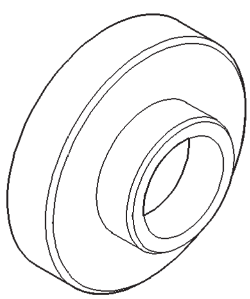
SPECIFICATIONS

TORQUE

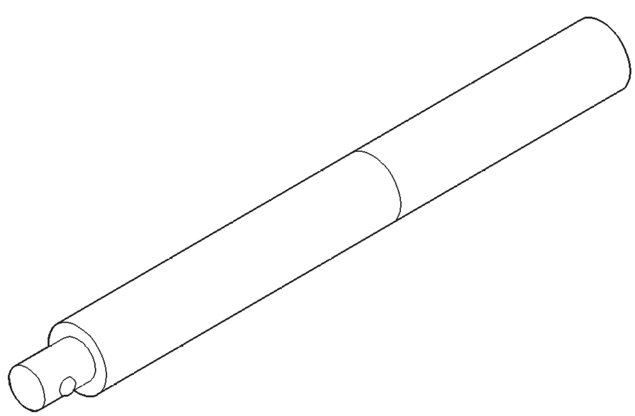
DESCRIPTION	TORQUE
Plug, Detent	16–24 N·m (12–18 ft. lbs.)
Bolt, Diff. Case	17–27 N·m (15–24 ft. lbs.)
Plug, Drain/Fill	20–25 N·m (15–25 ft. lbs.)
Bolt, Front Brg. Retainer	16–27 N·m (12–20 ft. lbs.)
Bolt, Case Half	35–46 N·m (26–34 ft. lbs.)
Nut, Front Yoke	122–176 N·m (90–130 ft. lbs.)
Screw, Oil Pump	1.2–1.8 N·m (12–15 in. lbs.)
Nut, Range Lever	27–34 N·m (20–25 ft. lbs.)
Bolt, Rear Retainer	35–46 N·m (26–34 ft. lbs.)
Nuts, Mounting	35 N·m (26 ft. lbs.)
Bolts, U-Joint	19 N·m (17 ft. lbs.)

SPECIAL TOOLS

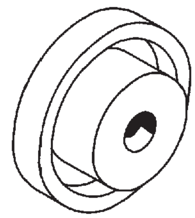
NV242



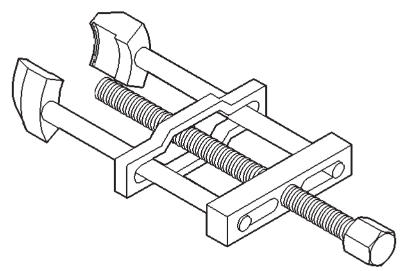
Installer—C-4076-B



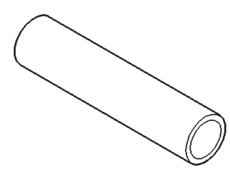
Handle, Universal—C-4171



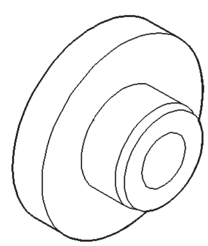
Remover—C-4210



Puller, Slinger—MD-998056–A

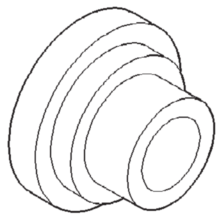


Installer—MD-998323

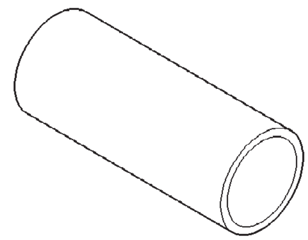


Installer, Bearing—5064

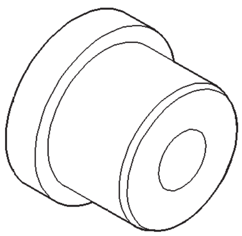
SPECIAL TOOLS (Continued)



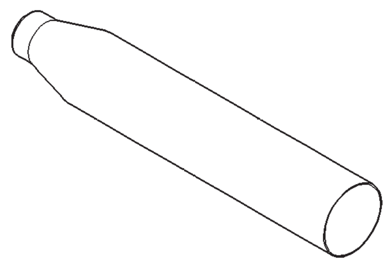
Installer—8128



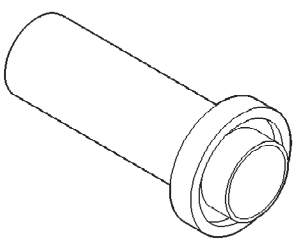
Cup—8148



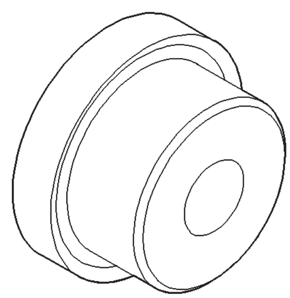
Installer—5066



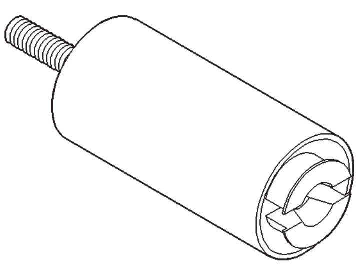
Seal Protector—6992



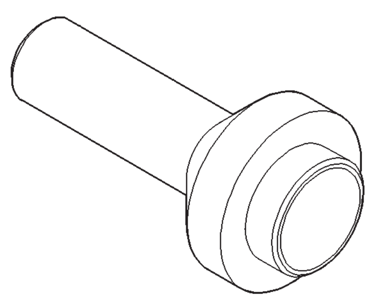
Installer—6952-A



Installer, Input Gear Bearing—7829-A

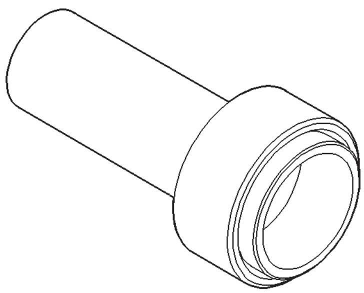


Remover—L-4454

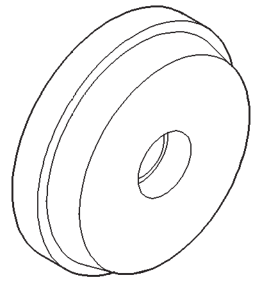


Installer, Seal—7884

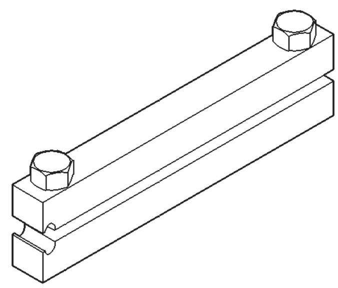
SPECIAL TOOLS (Continued)



Installer, Pump Housing Seal—7888



Installer, Bearing—8033-A



Installer, Boot Clamp—C-4975-A

TRANSMISSION AND TRANSFER CASE

CONTENTS

AX15 MANUAL TRANSMISSION

INDEX

GENERAL INFORMATION

AX 15 MANUAL TRANSMISSION

The AX 15 is a 5–speed, synchromesh, manual transmission. Fifth gear is an overdrive range with a ratio of 0.79:1. The shift mechanism is integral and mounted in the shift tower portion of the adapter housing (Fig. 1).

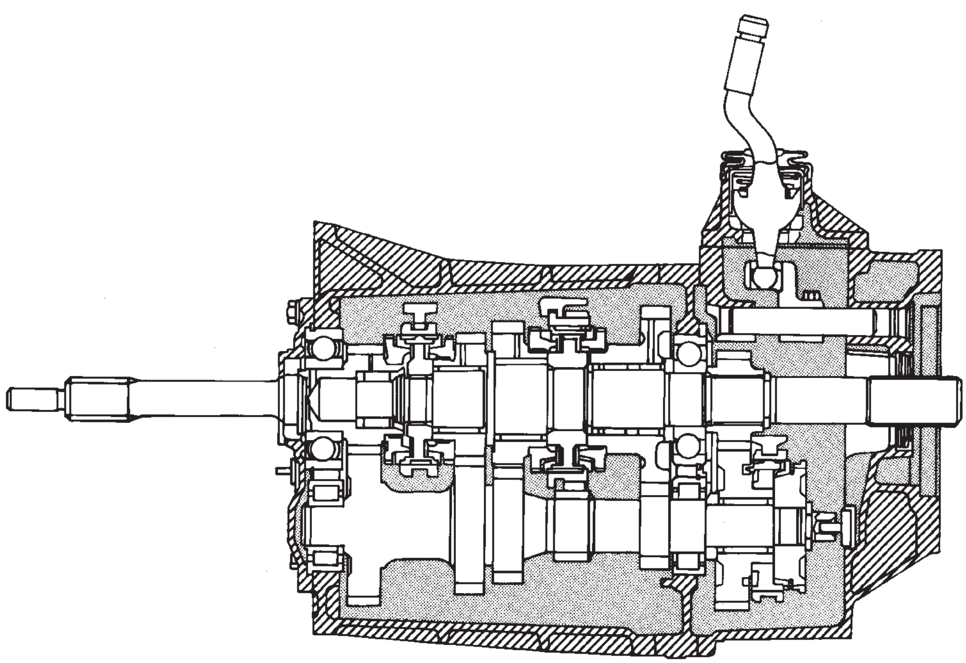


Fig. 1 AX 15 Manual Transmission

GENERAL INFORMATION (Continued)

TRANSMISSION IDENTIFICATION

The AX 15 identification code numbers are on the bottom surface of the transmission gear case (Fig. 2).

The first number is year of manufacture. The second and third numbers indicate month of manufacture. The next series of numbers is the transmission serial number.

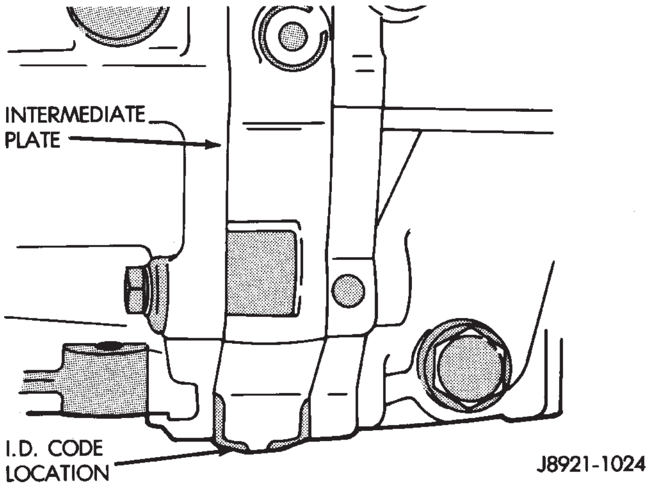


Fig. 2 Identification Code Number Location

TRANSMISSION SHIFT PATTERN

The AX 15 shift pattern is shown in (Fig. 3). First and second and third and fourth gear ranges are in line for improved shifting. Fifth and reverse gear ranges are also in line at the extreme right of the pattern (Fig. 3).

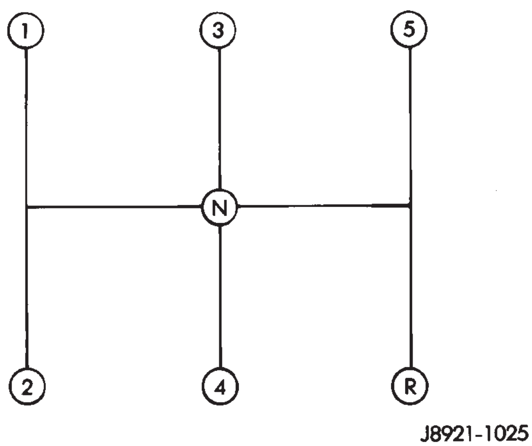


Fig. 3 AX 15 Shift Pattern

The AX 15 is equipped with a reverse lockout mechanism. The shift lever must be moved through the Neutral detent before making a shift to reverse.

TRANSMISSION LUBRICANT

Recommended lubricant for AX 15 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.

Approximate dry fill lubricant capacity is:

- 3.10 liters (3.27 qts.) in 4–wheel drive models

TRANSMISSION SWITCH AND PLUG LOCATIONS

The fill plug is at the driver side of the gear case (Fig. 4).

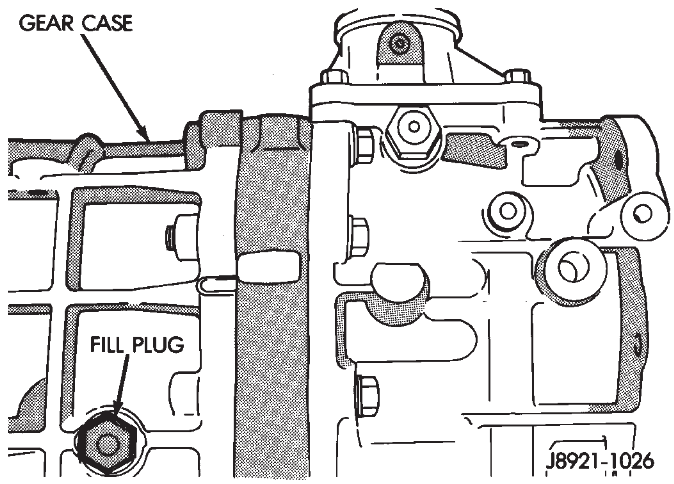


Fig. 4 Fill Plug Location

The drain plug and backup light switch are on the passenger side of the gear case (Fig. 5).

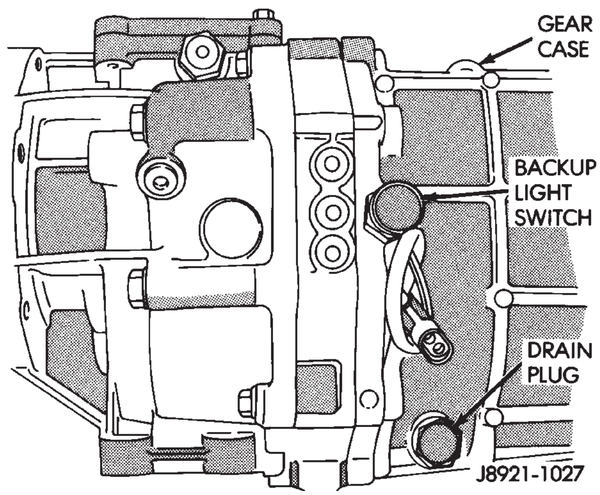


Fig. 5 Drain Plug/Backup Light Switch Location

GENERAL INFORMATION (Continued)

TRANSMISSION GEAR RATIOS

AX 15 gear ratios are:

First gear	3.83:1
Second gear	2.33:1
Third gear	1.44:1
Fourth gear	1.00:1
Fifth gear	0.79:1
Reverse	4.22:1

TRANSMISSION ASSEMBLY INFORMATION

Lubricate the transmission components with gear lubricant during assembly. Use petroleum jelly to lubricate seal lips and/or hold parts in place during installation.

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 adapter or extension housing, or from the front/rear seals. A suspected leak could also be the result of an overfill condition.

Leaks at the rear of the extension or adapter housing will be from the housing oil seals. Leaks at component mating surfaces will usually be the result of inadequate sealer, gaps in the sealer, incorrect bolt tightening, or use of a non–recommended sealer.

A leak at the front of the transmission will be from either the front bearing retainer or retainer seal. Lubricant may be seen dripping from the clutch housing after extended operation. If the leak is severe, it may also contaminate the clutch disc causing slip, grab and chatter.

Transmissions filled from air or electrically powered lubricant containers can be under filled. This generally happens when the container delivery mechanism is improperly calibrated. Always check the lubricant level after filling to avoid an under fill condition.

A correct lubricant level check can only be made when the vehicle is level; use a drive–on hoist to ensure this. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an under–or–over fill condition.

HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper or contaminated lubricants, component damage, incorrect clutch adjustment, or by a damaged clutch pressure plate or disc.

Substantial lubricant leaks can result in gear, shift rail, synchro and bearing damage. If a leak goes undetected for an extended period, the first indications of a problem are usually hard shifting and noise.

Incorrect or contaminated lubricants can also contribute to hard shifting. The consequence of using non–recommended lubricants is noise, excessive wear, internal bind and hard shifting.

Improper clutch release is a frequent cause of hard shifting. Incorrect adjustment or a worn, damaged pressure plate or disc can cause incorrect release. If the clutch problem is advanced, gear clash during shifts can result.

Worn or damaged synchro rings can cause gear clash when shifting into any forward gear. In some new or rebuilt transmissions, new synchro rings may tend to stick slightly causing hard or noisy shifts. In most cases, this condition will decline as the rings wear–in.

TRANSMISSION NOISE

Most manual transmissions make some noise during normal operation. Rotating gears can generate a mild whine that may only be audible at extreme speeds.

Severe, obviously audible transmission noise is generally the result of a lubricant problem. Insufficient, improper, or contaminated lubricant can promote rapid wear of gears, synchros, shift rails, forks and bearings. The overheating caused by a lubricant problem, can also lead to gear breakage.

REMOVAL AND INSTALLATION

TRANSMISSION

REMOVAL

1. Disconnect the battery negative cable.
2. Remove the shifter boot and shifter.
3. Raise the vehicle on a hoist.
4. Drain the transmission fluid (Fig. 6).
5. Support the engine and transmission with an adjustable jack stand.
6. Remove exhaust pipe and heat shield.
7. Mark the front and rear propeller shafts for installation alignment (Fig. 7).
8. Remove the front propeller shaft.
9. Remove the rear propeller shaft.
10. Remove the transmission skid plate.
11. Disconnect the transfer case linkage and vehicle speed sensor electrical connector and vent tube hose (Fig. 8).
12. Reposition the adjustable jackstand under the engine.

REMOVAL AND INSTALLATION (Continued)

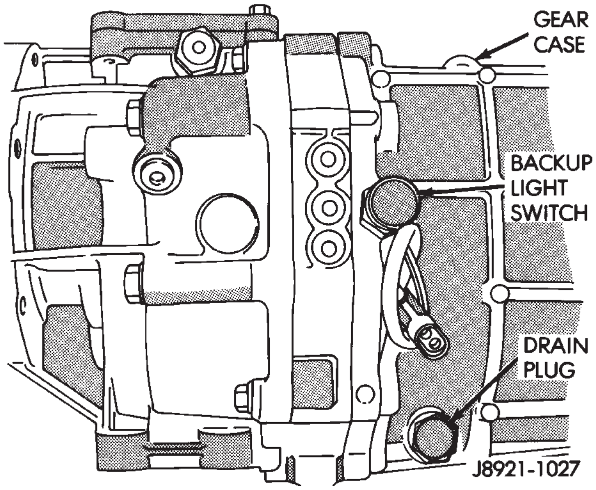


Fig. 6 Drain Plug and Backup Light Switch Location

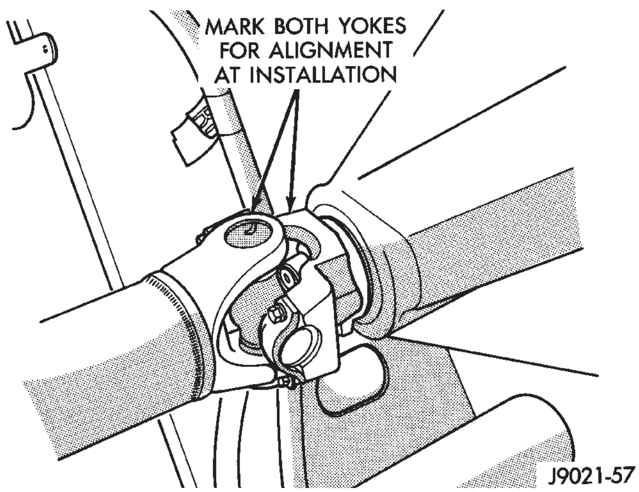


Fig. 7 Marking Propeller Shaft and Axle Yoke

13. Place a transmission jack under the transmission and secure the transmission with safety chains.
14. Remove the rear transmission mount.
15. Remove the rear crossmember.
16. Remove the transfer case assembly. Refer to Transfer Case removal later in this Group.
17. Lower the engine and transmission no more than 7.6 cm.
18. Remove the two (2) upper and two (2) mid clutch housing to engine bolts.
19. Remove the engine speed sensor (crankshaft position sensor) (Fig. 9).
20. Remove the clutch slave cylinder from the clutch housing.
21. Remove the lower transmission bolts.
22. Remove the transmission assembly from the vehicle.

INSTALLATION

1. Mount the transmission on a transmission jack and secure the transmission with safety chains.

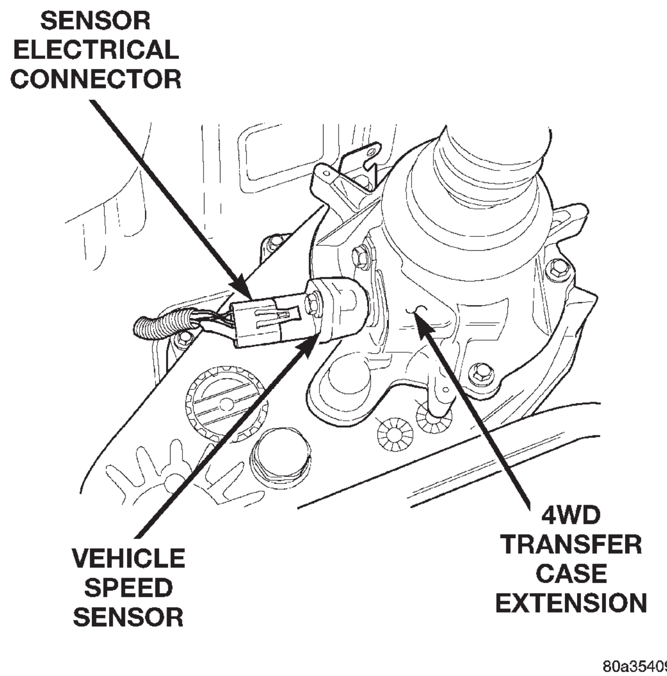


Fig. 8 Vehicle Speed Sensor

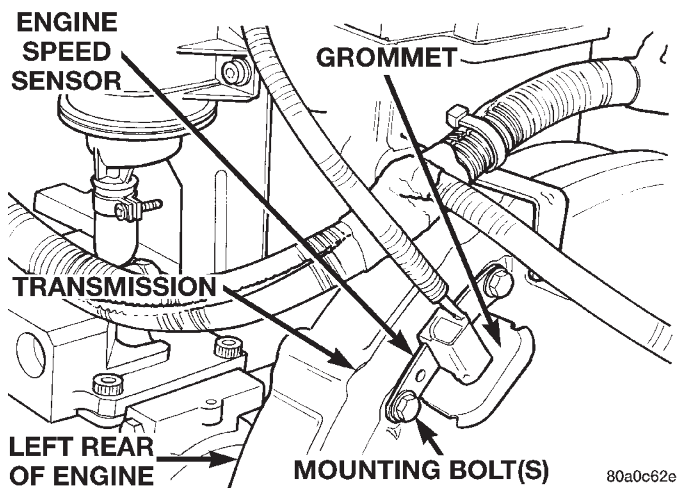


Fig. 9 Engine Speed Sensor

2. Install the transmission to the vehicle (Fig. 10).
3. Install the two (2) lower transmission bolts. Tighten the bolts to 74.6 N·m.
4. Install the clutch slave cylinder to the clutch housing.
5. Install the engine speed sensor (crankshaft position sensor) to the vehicle (Fig. 9).
6. Install the two (2) upper clutch housing to engine bolts. Tighten the bolts to 36.6 N·m.
7. Install the two (2) mid clutch housing to engine bolts. Tighten the bolts to 58.3 N·m.
8. Raise the engine and transmission with the adjustable jackstand.
9. Install the transfer case assembly. Refer to Transfer Case installation later in this Group.
10. Install the rear crossmember.

REMOVAL AND INSTALLATION (Continued)

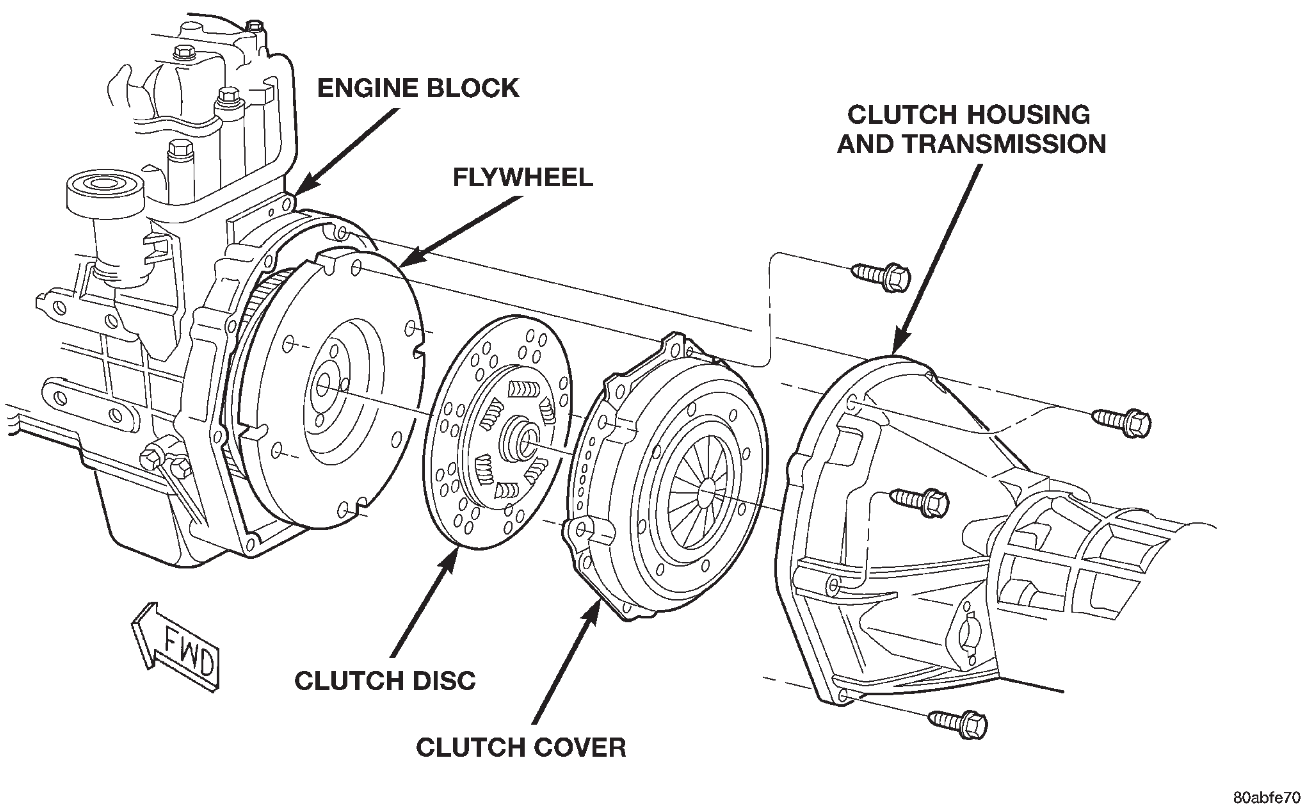


Fig. 10 Transmission to Engine Mounting

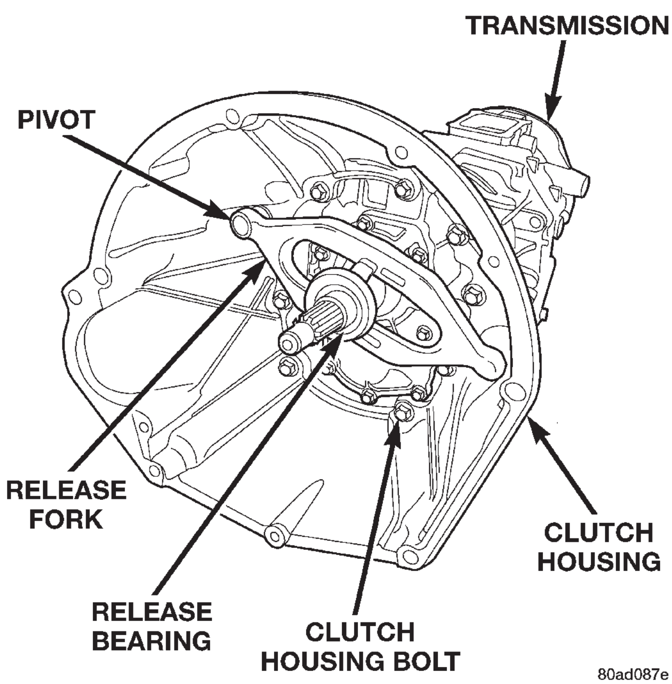


Fig. 11 Clutch Housing to Transmission

11. Install the rear transmission mount.

12. Connect the transfer case linkage and vehicle speed sensor electrical connector and vent tube (Fig. 8).

13. Install the transmission skid plate.

14. Align and install the front and rear propeller shafts.

15. Install the exhaust pipe and heat shield.

16. Remove the transmission jack.

17. Fill the transmission with the proper fluid (Fig. 12).

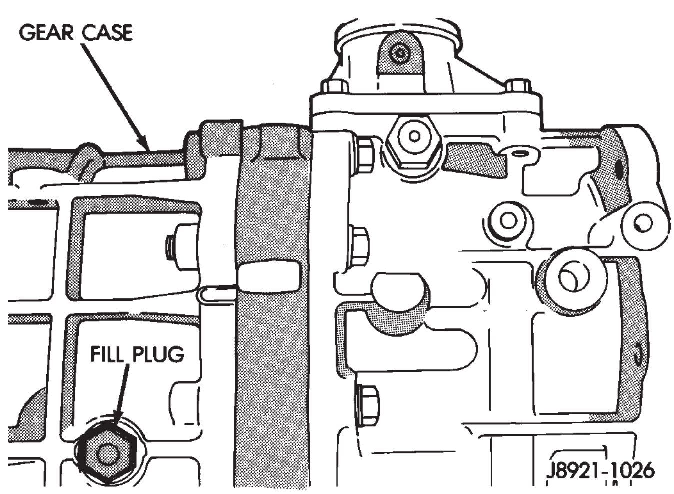


Fig. 12 Fill Plug Location

18. Remove the adjustable jackstand from under the engine.

REMOVAL AND INSTALLATION (Continued)

19. Lower the vehicle from the hoist.
20. Install the shifter boot and shifter.
21. Reconnect the battery negative cable.

SPECIFICATIONS

TORQUE

DESCRIPTION	TORQUE
Clutch Housing to Engine Top (2) Bolts	36.6 N·m (27 ft. lbs.)
Clutch Housing to Engine Mid-Point (2) Bolts	58.3 N·m (43 ft. lbs.)
Clutch Housing to Engine Bottom (2) Bolts	74.6 N·m (55 ft. lbs.)
Clutch Housing to Transmission bolts	38.0 N·m (28 ft. lbs.)
Transfer Case to Transmission Attaching Nuts	35 N·m (26 ft. lbs.)
Propeller Shaft Bolts	26.5 N·m (19.5 ft. lbs.)

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.

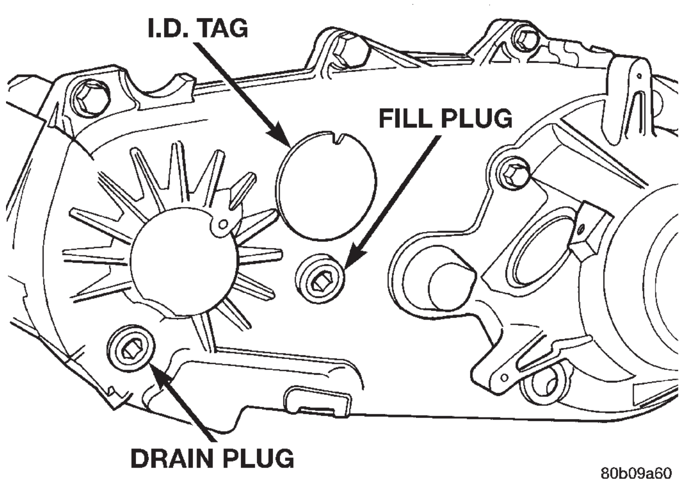


Fig. 1 Fill/Drain Plug And I.D. Tag Locations

RECOMMENDED LUBRICANT AND FILL LEVEL

Recommended lubricant for the NV231 transfer case is Mopar® Dexron II, or ATF Plus 3, type 7176. 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

DIAGNOSIS CHART

Condition	Possible Cause	Correction
Transfer case difficult to shift or will not shift into desired range.	1) Vehicle speed to great to permit shifting.	1) Slow vehicle and shift into desired range.
	2) If vehicle was operated for an extended period in 4H mode on dry surface, driveline torque load may cause difficulty.	2) Stop vehicle and shift transfer case to Neutral position. Transfer case can then be shifted to the desired mode.
	3) Transfer case shift linkage binding.	3) Repair or replace linkage as necessary.
	4) Insufficient or incorrect lubricant.	4) Drain and refill transfer case with the correct type and quantity of lubricant.
	5) Internal transfer case components binding, worn, or damaged.	5) Repair or replace components as necessary.
Transfer case noisy in all drive modes.	1) Insufficient or incorrect lubricant.	1) Drain and refill transfer case with the correct type and quantity of lubricant.
Transfer case noisy while in, or jumps out of, 4L mode.	1) Transfer case not completely engaged in 4L position.	1) Slow vehicle, shift transfer case to the Neutral position, and then shift into the 4L mode.
	2) Transfer case shift linkage out of adjustment.	2) Adjust linkage as necessary.
	3) Transfer case shift linkage loose or binding.	3) Repair, replace, or tighten linkage components as necessary.
	4) Range fork damaged, inserts worn, or fork is binding on the shift rail.	4) Repair or replace components as necessary.
	5) Low range gear worn or damaged.	5) Repair or replace components as necessary.
Lubricant leaking from transfer case seals or vent.	1) Transfer case overfilled.	1) Drain lubricant to the correct level.
	2) Transfer case vent closed or restricted.	2) Clean or replace vent as necessary.
	3) Transfer case seals damaged or installed incorrectly.	3) Replace suspect seal.
Abnormal tire wear.	1) Extended operation in 4H mode on dry surfaces.	1) Operate vehicle in 2H mode on dry surfaces.

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 and skid plate, if equipped.
(7) Disconnect and support 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.

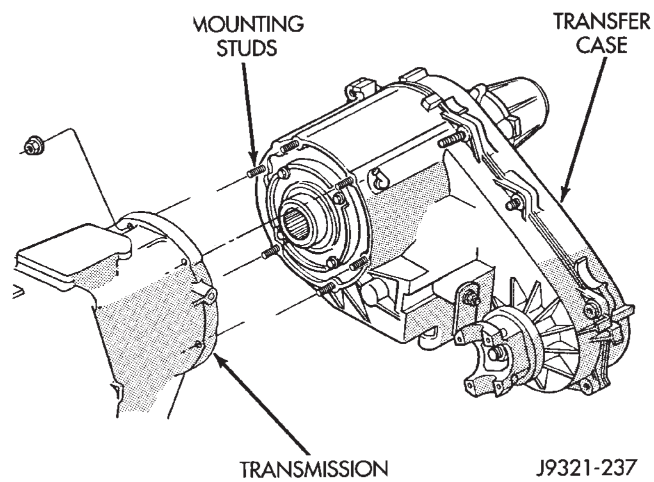


Fig. 2 Transfer Case Mounting

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 (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.

NOTE: Do no reuse bearing straps or bolts. Discard and replace with new.

(8) Align and connect propeller shafts. Tighten shaft attaching bolts to 26.5 N·m torque.
(9) Fill transfer case with correct fluid. Refer to Recommended Lubricant And Fill Level section for proper fluid and capacity.
(10) Install rear crossmember and skid plate, if equipped. Tighten crossmember bolts.
(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) Remove transfer case shifter knob cap.
(3) Remove nut holding shifter knob to shift lever.
(4) Remove shifter knob.
(5) Raise and support vehicle.
(6) Loosen adjusting trunnion lock bolt and slide shift rod out of trunnion (Fig. 3). If rod lacks enough travel to come out of trunnion, push trunnion out of shift lever.
(7) Remove bolts holding shift lever to transmission.
(8) Separate shift lever from vehicle.

INSTALLATION

(1) Position shift lever on transmission. Use care when passing the shift lever through the shifter boot to prevent damage to the shifter boot.
(2) Install bolts to hold shift lever to transmission.
(3) Install trunnion to shift lever, if necessary.
(4) Install shift rod to trunnion, if necessary.
(5) Move shift lever and transfer case to 4L position.
(6) Tighten trunnion lock bolt.
(7) Lower vehicle.
(8) Install shift knob on shift lever.
(9) Install nut to hold shifter knob to shift lever.
(10) Install shifter knob cap.
(11) Verify transfer case operation.

SPEEDOMETER

REMOVAL

(1) Raise vehicle.
(2) Disconnect wires from vehicle speed sensor.

REMOVAL AND INSTALLATION (Continued)

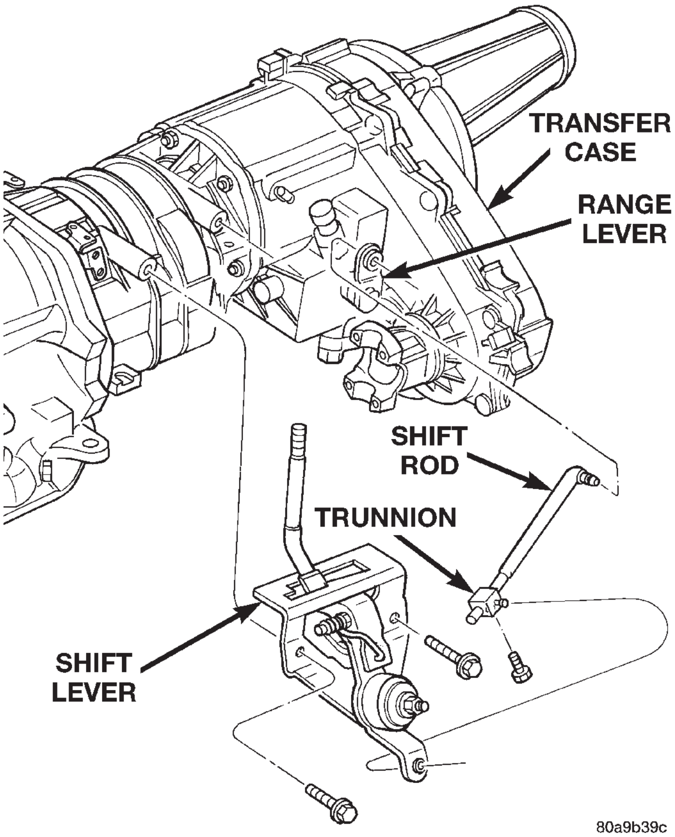


Fig. 3 Shift Lever

(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.

(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.

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.

ITEM	TORQUE
A	2-3 N•m (15-27 in. lbs.)
B	10-12 N•m (90-110 in. lbs.)

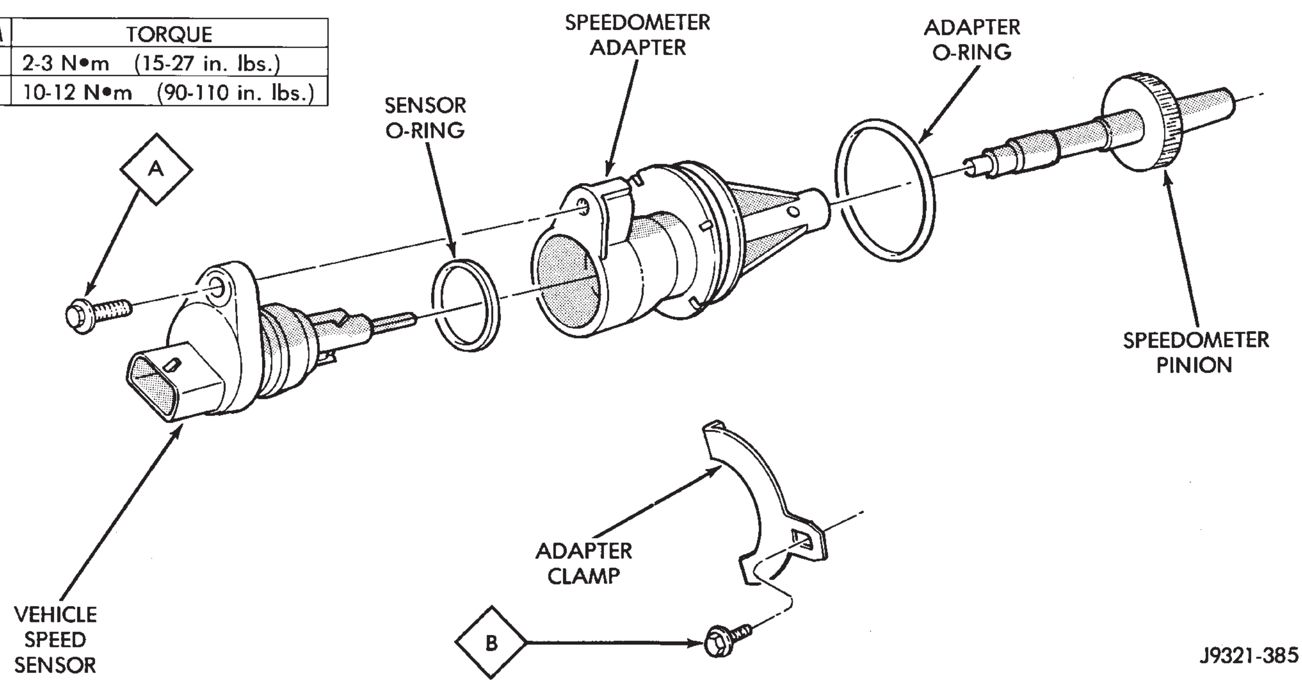


Fig. 4 Speedometer Components

REMOVAL AND INSTALLATION (Continued)

(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.

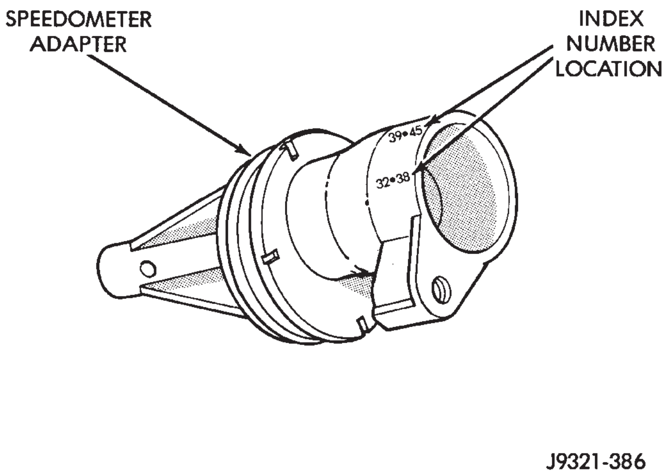


Fig. 5 Location Of Index Numbers On Speedometer Adapter

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).

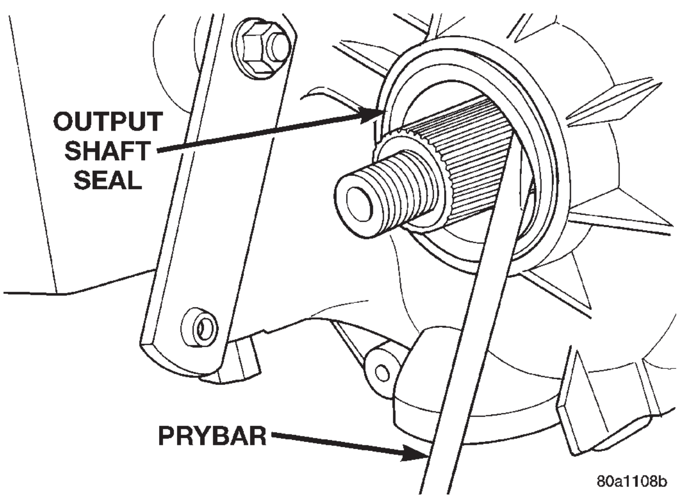


Fig. 6 Remove Front Output Shaft Seal

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.

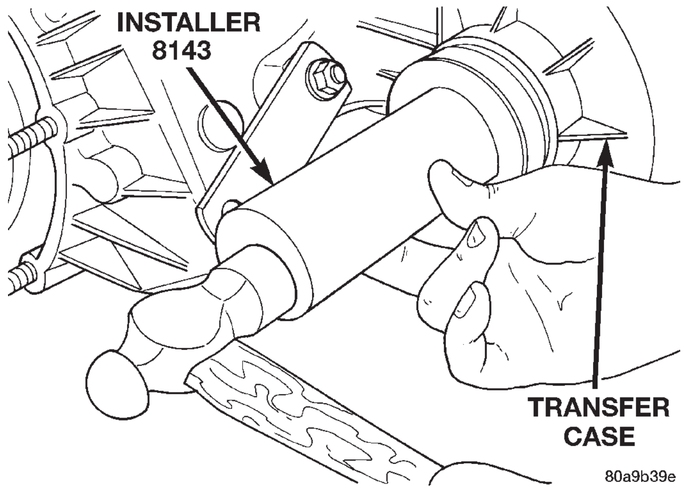


Fig. 7 Front Output Seal Installation

REAR RETAINER BUSHING AND SEAL

REMOVAL

(1) Raise vehicle.

(2) Remove rear propeller shaft. Refer to Group 3, Differential and Driveline, for proper procedure.

(3) Using a suitable pry tool or slide-hammer mounted screw, remove the rear retainer seal.

(4) Using Remover 6957, remove bushing from rear retainer (Fig. 8).

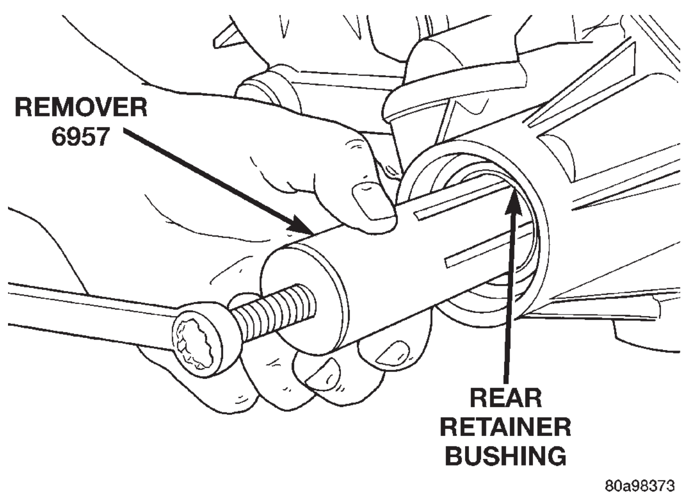


Fig. 8 Rear Retainer Bushing Removal

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Clean fluid residue from sealing surface and inspect for defects.
(2) Position replacement bushing in rear retainer with fluid port in bushing aligned with slot in retainer.
(3) Using Installer 8160, drive bushing into retainer until installer seats against case (Fig. 9).
(4) Using Installer C-3995-A, install seal in rear retainer (Fig. 10).

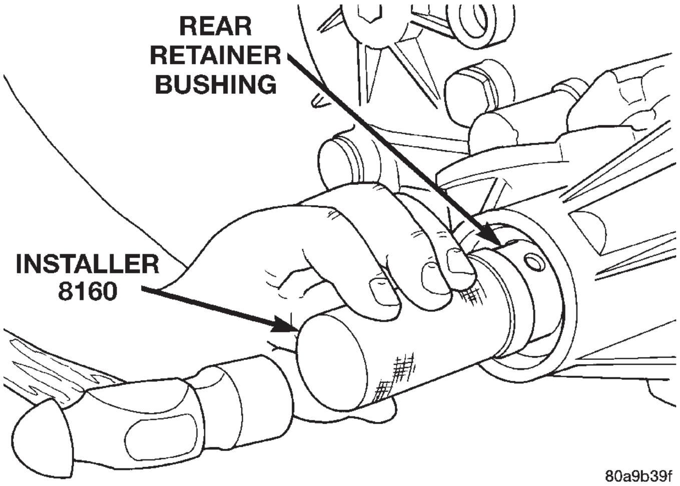


Fig. 9 Rear Retainer Bushing Install

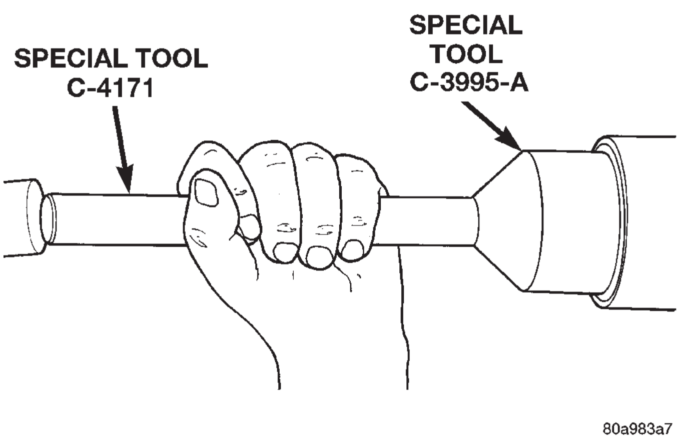


Fig. 10 Install Rear Retainer Seal

(5) Install propeller shaft.
(6) Verify proper fluid level.
(7) Lower vehicle.

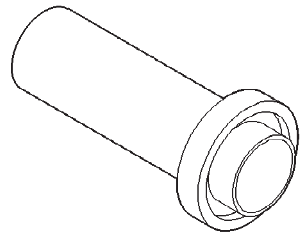
SPECIFICATIONS

TORQUE

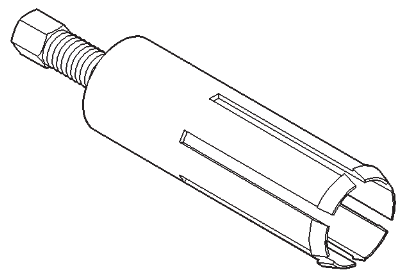
DESCRIPTION	TORQUE
Plug, Drain/Fill	40 N·m
Nuts, Mounting	35 N·m
Switch, Indicator	26 N·m

SPECIAL TOOLS

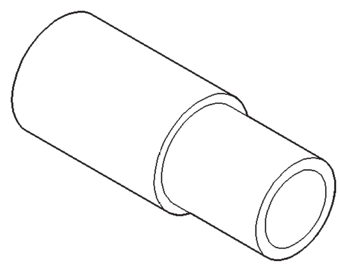
SPECIAL TOOLS—NV231



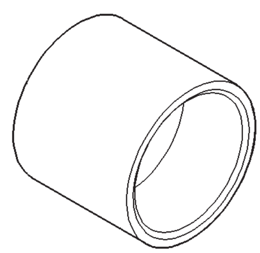
Installer, Seal—8143



Remover, Bushing—6957



Installer, Bushing—8160



Installer, Seal—C-3995-A

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.

LETTER	SPEED RATING
S	180 km/h (112 mph)
T	190 km/h (118 mph)
U	200 km/h (124 mph)
H	210 km/h (130 mph)
V	240 km/h (149 mph)
W	270 km/h (168 mph)
Y	300 km/h (186 mph)

The speed rating is not always printed on the tire sidewall.

TIRE CHAINS

Tire snow chains may be used on **certain** models. Refer to the Owner's Manual for more information.

DESCRIPTION AND OPERATION (Continued)

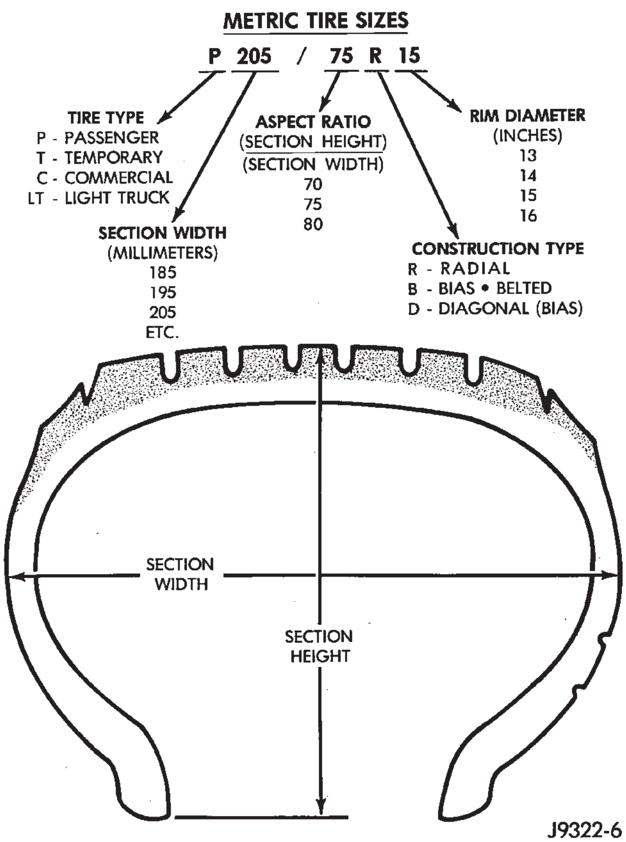


Fig. 1 Tire Identification

RADIAL-PLY TIRES

Radial-ply tires improve handling, tread life and ride quality, and decrease rolling resistance.

Radial-ply tires must always be used in sets of four. Under no circumstances should they be used on the front only. They may be mixed with temporary spare tires when necessary. A maximum speed of 50 MPH is recommended while a temporary spare is in use.

Radial-ply tires have the same load-carrying capacity as other types of tires of the same size. They also use the same recommended inflation pressures.

The use of oversized tires, either in the front or rear of the vehicle, can cause vehicle drive train failure. This could also cause inaccurate wheel speed signals when the vehicle is equipped with Anti-Lock Brakes.

The use of tires from different manufactures on the same vehicle is NOT recommended. The proper tire pressure should be maintained on all four tires.

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).

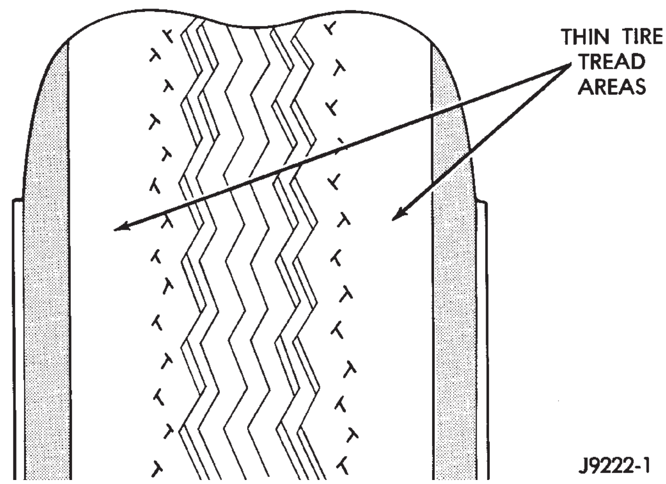


Fig. 2 Under Inflation Wear

Over inflation will cause rapid center wear and loss of the tire's ability to cushion shocks (Fig. 3).

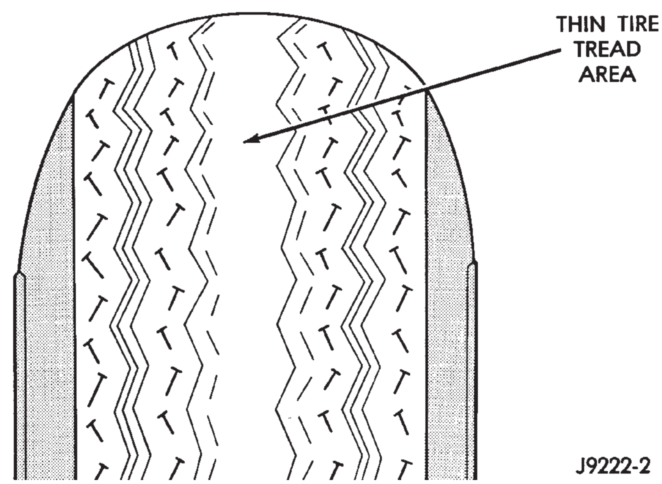


Fig. 3 Over Inflation Wear

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. The spare tire pressure should be check at least twice annually. Tire pressure decreases as the ambient temperature drops. Check tire pressure frequently when ambient temperature varies widely.

DESCRIPTION AND OPERATION (Continued)

Inflation pressures specified on the placards are cold inflation pressure. The vehicle must sit for at least 3 hours to obtain the correct cold inflation pressure reading. Or driven less than one mile after sitting for 3 hours. Tire inflation pressures may increase from 2 to 6 pounds per square inch (psi) during operation, due to increased tire temperature.

WARNING: OVER OR UNDER INFLATED TIRES CAN AFFECT VEHICLE HANDLING AND TREAD WEAR. THIS MAY CAUSE THE TIRE TO FAIL SUDDENLY, RESULTING IN LOSS OF VEHICLE CONTROL.

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.

Vehicles loaded to the maximum capacity should not be driven at continuous speeds above 75 mph (120 km/h).

For emergency vehicles that are driven at speeds over 90 mph (144 km/h), special high speed tires must be used. Consult tire manufacturer for correct inflation pressure recommendations.

REPLACEMENT TIRES

The original equipment tires provide a proper balance of many characteristics such as:

- Ride
- Noise
- Handling
- Durability
- Tread life
- Traction
- Rolling resistance
- Speed capability

It is recommend that tires equivalent to the original equipment tires be used when replacement is needed.

Failure to use equivalent replacement tires may adversely affect the safety and handling of the vehicle.

The use of oversize tires not listed in the specification charts may cause interference with vehicle components. Under extremes of suspension and steering travel, interference with vehicle components may cause tire damage.

WARNING: FAILURE TO EQUIP THE VEHICLE WITH TIRES HAVING ADEQUATE SPEED CAPABILITY CAN RESULT IN SUDDEN TIRE FAILURE.

DIAGNOSIS AND TESTING

PRESSURE GAUGES

A quality air pressure gauge is recommended to check tire pressure. After checking the air pressure, replace valve cap finger tight.

TREAD WEAR INDICATORS

Tread wear indicators are molded into the bottom of the tread grooves. When tread depth is 1.6 mm (1/16 in.), the tread wear indicators will appear as a 13 mm (1/2 in.) band (Fig. 4).

Tire replacement is necessary when indicators appear in two or more grooves or if localized balding occurs.

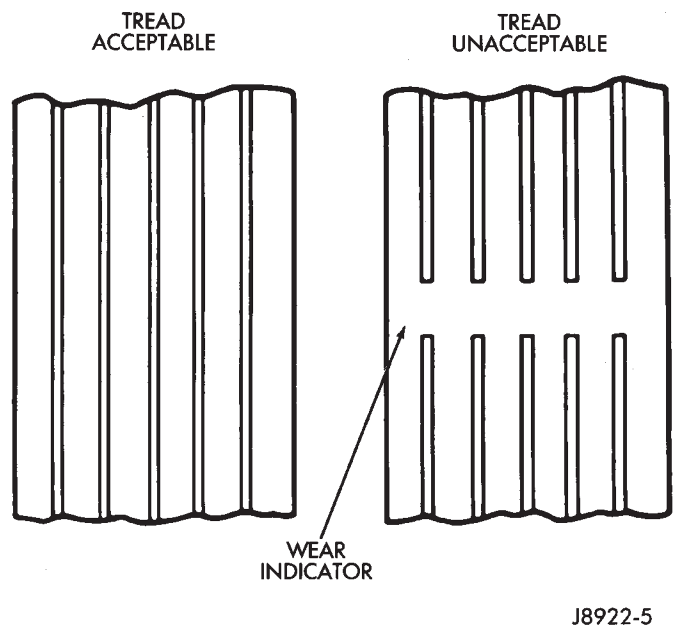


Fig. 4 Tread Wear Indicators

TIRE WEAR PATTERNS

Under inflation will cause wear on the shoulders of tire. Over inflation will cause wear at the center of tire.

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)

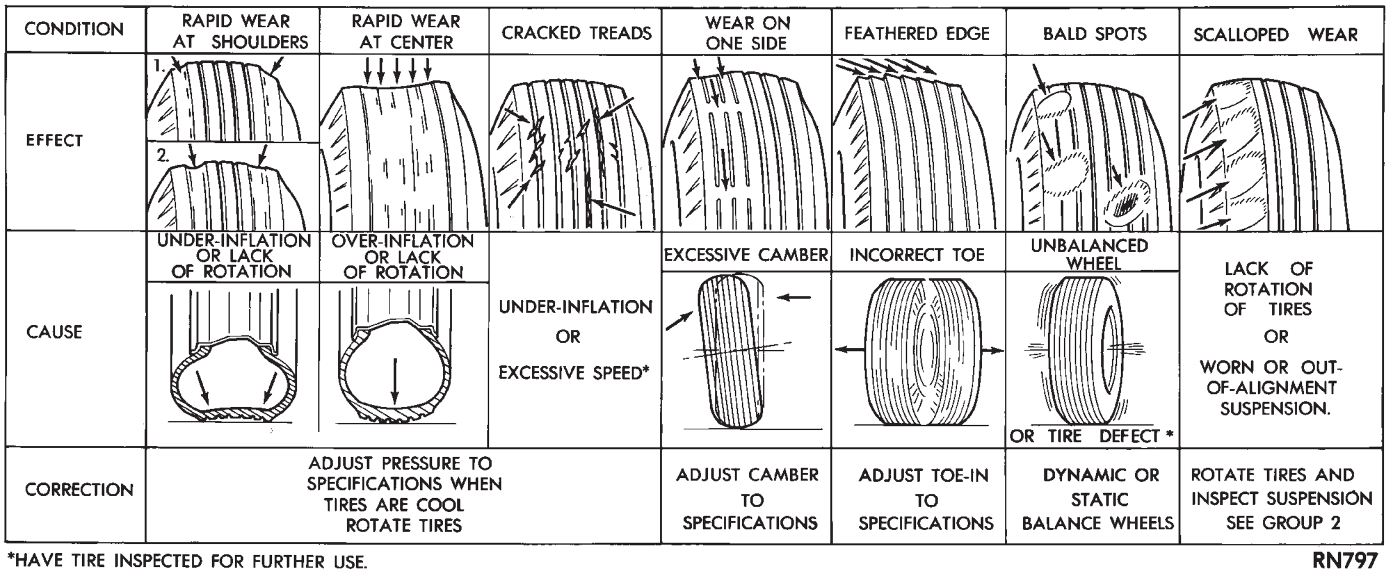


Fig. 5 Tire Wear Patterns

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, deceleration and slight left and right steering inputs.

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.

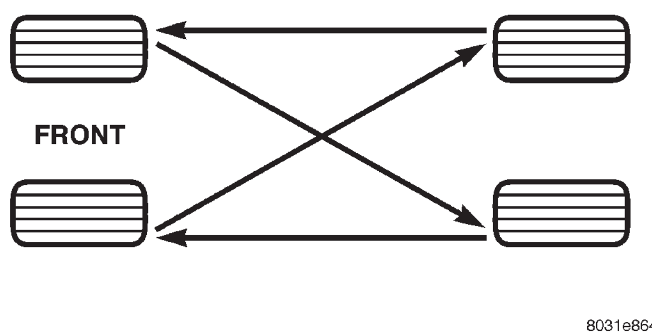


Fig. 6 Tire Rotation Pattern

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.

(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.

SERVICE PROCEDURES (Continued)

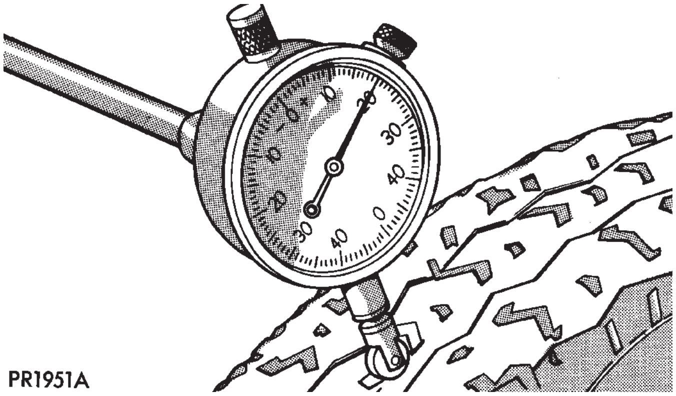


Fig. 7 Dial Indicator

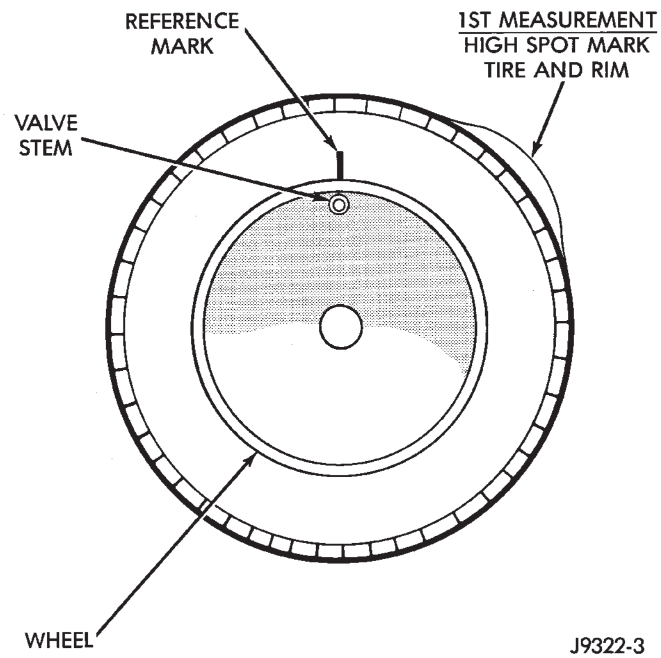


Fig. 8 First Measurement On Tire

(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.

Deflate tire completely before removing the tire from the wheel. Use lubrication such as a mild soap solution when dismounting or mounting tire. Use tools free of burrs or sharp edges which could damage the tire or wheel rim.

Before mounting tire on wheel, make sure all rust is removed from the rim bead and repaint if necessary.

Install wheel on vehicle, and tighten to proper torque specification.

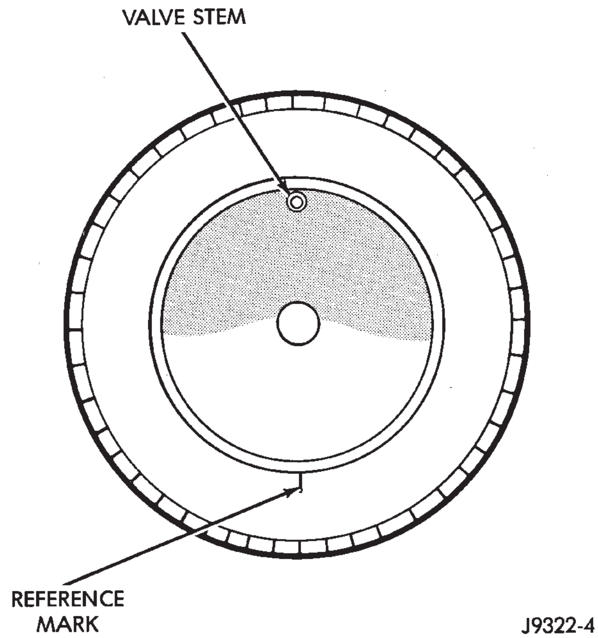


Fig. 9 Remount Tire 180 Degrees

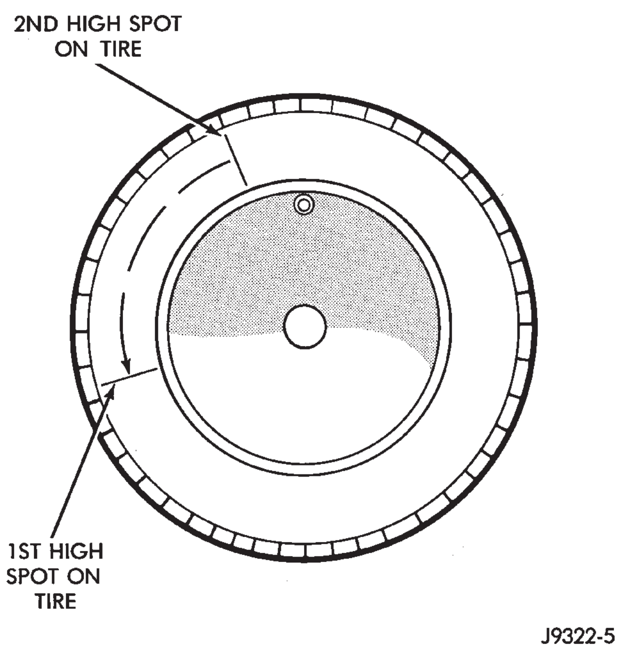


Fig. 10 Remount Tire 90 Degrees In Direction of Arrow

SERVICE PROCEDURES (Continued)

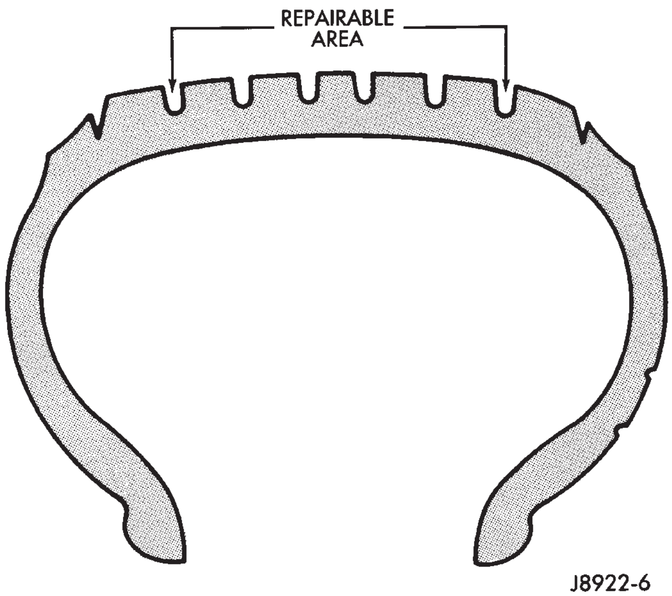


Fig. 11 Tire Repair Area

CLEANING AND INSPECTION

CLEANING TIRES

Remove protective coating on tires before delivery of vehicle. This coating may cause deterioration of tires.

To remove the protective coating applying warm water and let it soak for a few minutes. Then scrub the coating away with a soft bristle brush. Steam cleaning may also be used to remove the coating.

NOTE: DO NOT use gasoline, mineral oil, oil-based solvent or wire brush for cleaning.

SPECIFICATIONS

TIRE SIZE

TIRE SIZE	SUPPLIER
P215/75R15	Goodyear
P225/75R15	Goodyear
P225/70R15	Goodyear

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 stamped steel, cast aluminum or forged aluminum wheels. Every wheel has raised sections between the rim flanges and rim drop well called safety humps (Fig. 1).

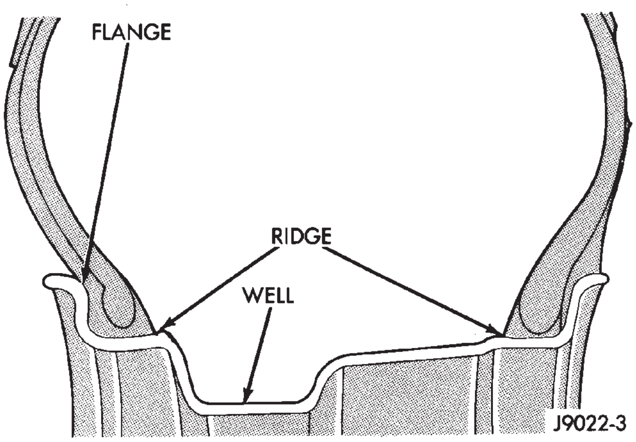


Fig. 1 Safety Rim

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.

DIAGNOSIS AND TESTING (Continued)

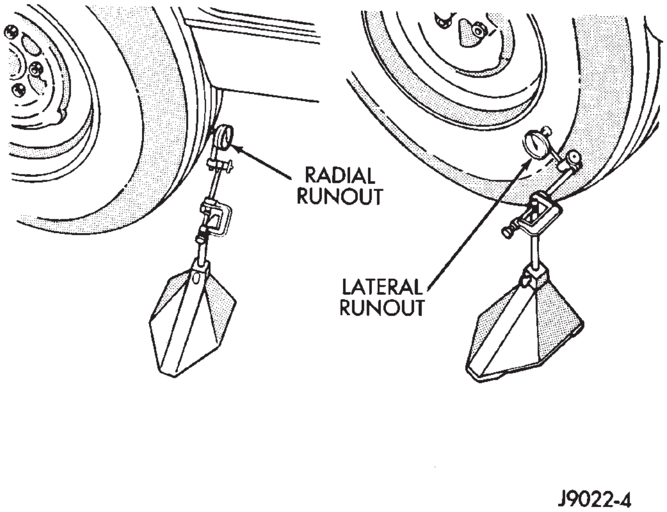


Fig. 2 Checking Tire/Wheel/Hub Runout

Sometimes radial runout can be reduced. Relocate the wheel and tire assembly on the mounting studs (See Method 1). If this does not reduce runout to an acceptable level, the tire can be rotated on the wheel. (See Method 2).

METHOD 1 (RELOCATE WHEEL ON HUB)

(1) Drive vehicle a short distance to eliminate tire flat spotting from a parked position.

(2) Check wheel bearings and adjust if adjustable or replace if necessary.

(3) Check the wheel mounting surface.

(4) Relocate wheel on the mounting, two studs over from the original position.

(5) Tighten wheel nuts until all are properly torqued, to eliminate brake distortion.

(6) Check radial runout. If still excessive, mark tire sidewall, wheel, and stud at point of maximum runout and proceed to Method 2.

METHOD 2 (RELOCATE TIRE ON WHEEL)

NOTE: Rotating the tire on wheel is particularly effective when there is runout in both tire and wheel.

(1) Remove tire from wheel and mount wheel on service dynamic balance machine.

(2) Check wheel radial runout (Fig. 3) and lateral runout (Fig. 4).

- STEEL WHEELS: Radial runout 0.040 in., Lateral runout 0.045 in. (maximum)
- ALUMINUM WHEELS: Radial runout 0.030 in., Lateral runout 0.035 in. (maximum)

(3) If point of greatest wheel lateral runout is near original chalk mark, remount tire 180 degrees. Recheck runout, Refer to match mounting procedure.

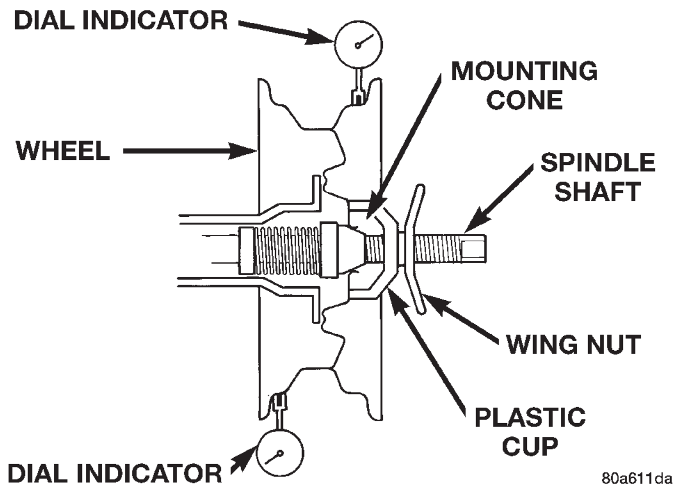


Fig. 3 Radial Runout

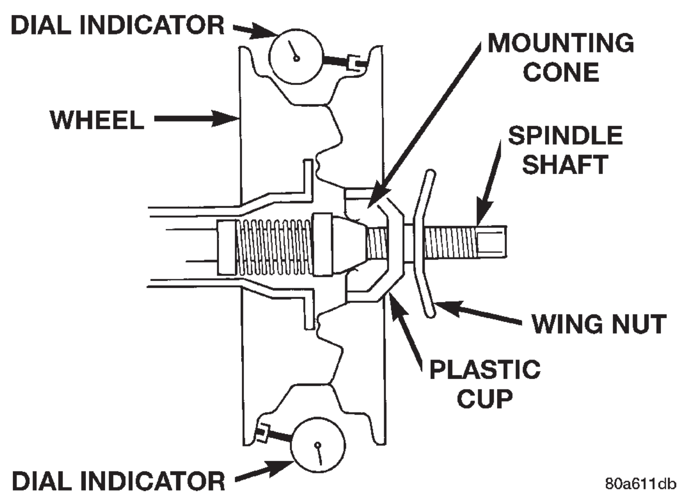


Fig. 4 Lateral Runout

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.

NOTE: Do not use chrome plated lug nuts with chrome plated wheels.

Before installing the wheel, be sure to remove any build up of corrosion on the wheel mounting surfaces. Ensure wheels are installed with good metal-to-metal

SERVICE PROCEDURES (Continued)

contact. Improper installation could cause loosening of wheel nuts. This could affect the safety and handling of your vehicle.

To install the wheel, first position it properly on the mounting surface. All wheel nuts should then be tightened just snug. Gradually tighten them in sequence to the proper torque specification (Fig. 5). **Never use oil or grease on studs or nuts.**

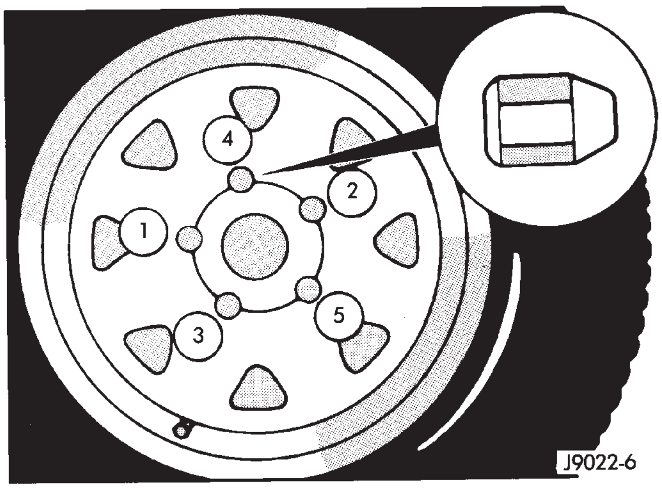


Fig. 5 Lug Nut Tightening Pattern

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 and forged aluminum wheels require coated balance weights and special alignment equipment.

Wheel balancing can be accomplished with either on or off vehicle equipment. When using on-vehicle balancing equipment, remove the opposite wheel/tire. Off-vehicle balancing is recommended.

For static balancing, find location of heavy spot causing the imbalance. Counter balance wheel directly opposite the heavy spot. Determine weight required to counter balance the area of imbalance. Place half of this weight on the **inner** rim flange and the other half on the **outer** rim flange (Fig. 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).

SERVICE PROCEDURES (Continued)

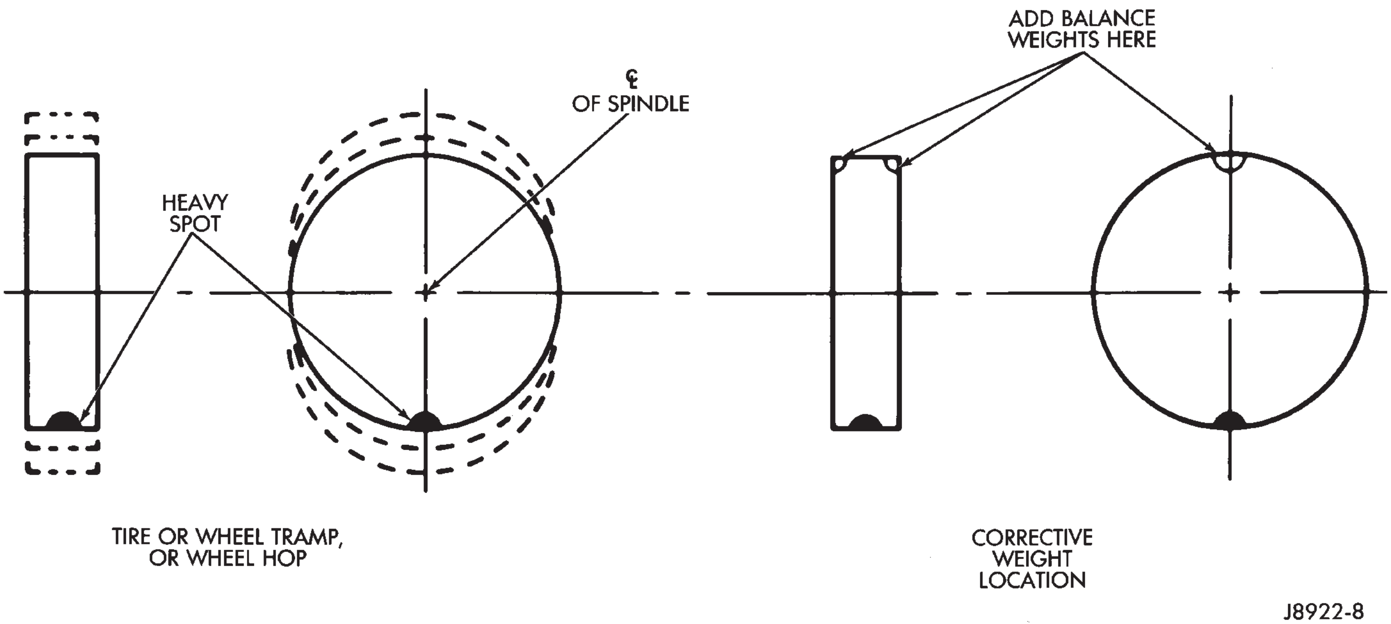


Fig. 6 Static Unbalance & Balance

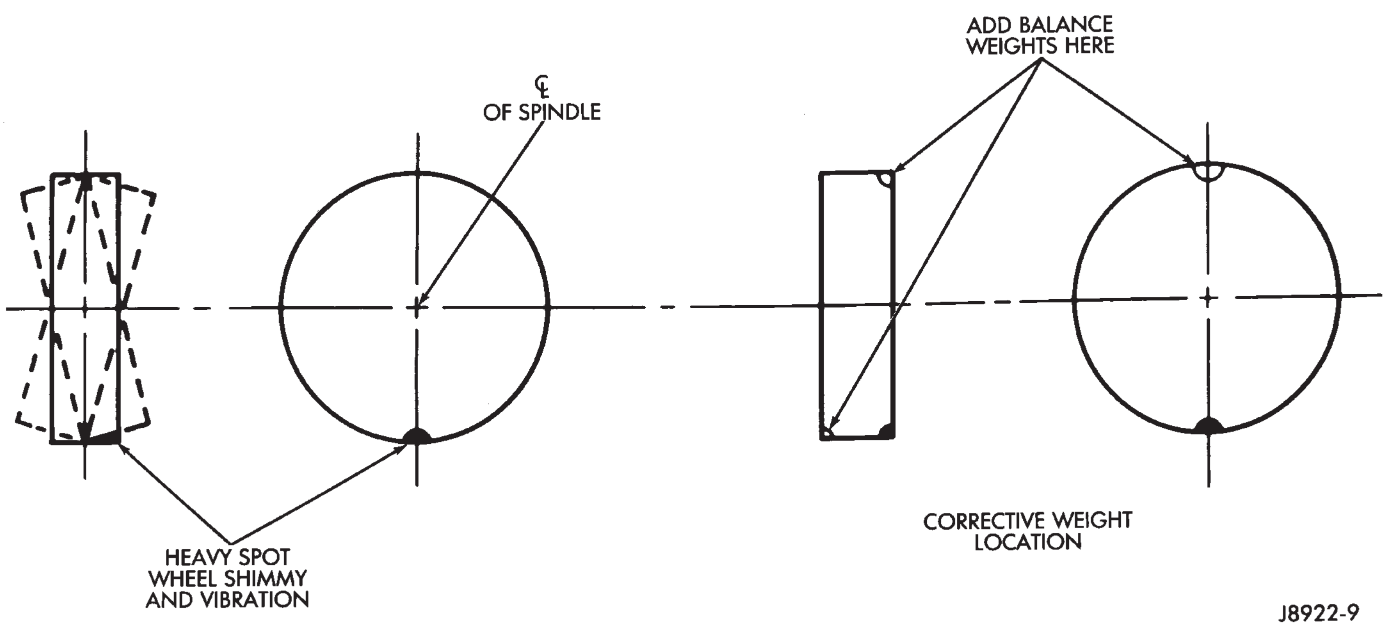


Fig. 7 Dynamic Unbalance & Balance

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Lug Nut	
1/2 X 20 with 60° Cone	115-150 N·m (85-115 ft. lbs.)

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 left side of the dash panel in the engine compartment. Refer to the Introduction section at the front of this manual for body code plate description. The paint code is also identified on the Vehicle Safety Certification Label which is located on the drivers door shut face. The color names provided in the Paint and Trim Code Description chart are the color names used on most repair product containers.

BASE COAT/CLEAR COAT FINISH

On most vehicles a two-part paint application (base coat/clear coat) is used. Color paint that is applied to primer is called base coat. The clear coat protects the base coat from ultraviolet light and provides a durable high-gloss finish.

WET SANDING, BUFFING, AND POLISHING

Minor acid etching, orange peel, or smudging in clear coat or single-stage finishes can be reduced with light wet sanding, hand buffing, and polishing. **If the finish has been wet sanded in the past, it cannot be repeated. Wet sanding operation should be performed by a trained automotive paint technician.**

CAUTION: Do not remove clear coat finish, if equipped. Base coat paint must retain clear coat for durability.

PAINTED SURFACE TOUCH-UP

When a painted metal surface has been scratched or chipped, it should be touched-up as soon as possible to avoid corrosion. For best results, use Mopar® Scratch Filler/Primer, Touch-Up Paints and Clear Top Coat. Refer to Introduction group of this manual for Body Code Plate information.

TOUCH-UP PROCEDURE

(1) Scrape loose paint and corrosion from inside scratch or chip.

(2) Clean affected area with Mopar® Tar/Road Oil Remover, and allow to dry.

(3) Fill the inside of the scratch or chip with a coat of filler/primer. Do not overlap primer onto good surface finish. The applicator brush should be wet enough to puddle-fill the defect without running. Do not stroke brush applicator on body surface. Allow the filler/primer to dry hard.

(4) Cover the filler/primer with color touch-up paint. Do not overlap touch-up color onto the original color coat around the scratch or chip. Butt the new color to the original color, if possible. Do not stroke applicator brush on body surface. Allow touch-up paint to dry hard.

(5) On vehicles without clear coat, the touch-up color can be lightly wet sanded (1500 grit) and polished with rubbing compound.

(6) On vehicles with clear coat, apply clear top coat to touch-up paint with the same technique as described in Step 4. Allow clear top coat to dry hard. If desired, Step 5 can be performed on clear top coat.

SPECIFICATIONS

AFTERMARKET PAINT REPAIR PRODUCTS

EXTERIOR COLOR

EXTERIOR COLOR	CHRY CODE *	PPG	DuPONT	S-W** M-S**	AKZO NOBEL SIKKENS	ICI**
Flame Red Clear Coat	PR4	4679	B9326	46916	CHA93:PR4	2NN6B
Chili Pepper Red	VEA	5361	B9823	54470	CHA98:VEA	HMT3B
Medium Fern Pearl Coat	RJP	4969	B9524	50270	CHA99:RJP	7CD6B
Forest Green Pearl Coat	SG8	5065	B9609	51062	CHA95:SG8	7MR8B
Intense Blue Pearl Coat	VB3	5357	B9822	54468	CHA98:VB3	HMR9B
Desert Sand	WTD	5474	B9884	56153	CHA99:WTD	KGC7B
Deep Amethyst Pearl Coat	TCN	5246	B9736	52026	CHA97:TCN	FNE4B
Black Clear Coat	DX8	9700	99	34858	CHA85:DX8	TC60B
Gunmetal Pearl Coat	TQ7	5248	B9735	52952	CHA97:TQ7	ERA9B
Stone White Clear Coat	SW1	83542	B9622	51539	CHA96:SW1	8KY5B

INTERIOR COLOR

INTERIOR COLOR	CHRY CODE*	PPG	DuPONT	S-W** M-S**	AKZO NOBEL SIKKENS	ICI**
Agate	AZ	9856 / 2-1461	C9208	45994	CHALAZI	7WC8
Camel / Dark Green	KG	N/A	N/A	N/A	N/A	K5/G8

NOTE: *Herberts Standox, Spies Hecker, and BASF use the Chrysler paint code as listed on the Body Code Plate and the Vehicle Safety Certification label. ** S-W = Sherwin-Williams, M-S = Martin Senour, ICI = ICI Autocolor.

STATIONARY GLASS

INDEX

DESCRIPTION AND OPERATION

SAFETY PRECAUTIONS

WARNING: DO NOT OPERATE THE VEHICLE WITHIN 24 HOURS OF WINDSHIELD INSTALLATION. IT TAKES AT LEAST 24 HOURS FOR URETHANE ADHESIVE TO CURE. IF IT IS NOT CURED, THE WINDSHIELD MAY NOT PERFORM PROPERLY IN AN ACCIDENT.

URETHANE ADHESIVES ARE APPLIED AS A SYSTEM. USE GLASS CLEANER, GLASS PREP SOLVENT, GLASS PRIMER, PVC (VINYL) PRIMER AND PINCH WELD (FENCE) PRIMER PROVIDED BY THE ADHESIVE MANUFACTURER. IF NOT, STRUCTURAL INTEGRITY COULD BE COMPROMISED.

CHRYSLER DOES NOT RECOMMEND GLASS ADHESIVE BY BRAND. TECHNICIANS SHOULD REVIEW PRODUCT LABELS AND TECHNICAL DATA SHEETS, AND USE ONLY ADHESIVES THAT THEIR MANUFACTURES WARRANT WILL RESTORE A VEHICLE TO THE REQUIREMENTS OF FMVSS 212. TECHNICIANS SHOULD ALSO INSURE THAT PRIMERS AND CLEANERS ARE COMPATIBLE WITH THE PARTICULAR ADHESIVE USED.

BE SURE TO REFER TO THE URETHANE MANUFACTURER'S DIRECTIONS FOR CURING TIME SPECIFICATIONS, AND DO NOT USE ADHESIVE AFTER ITS EXPIRATION DATE.

VAPORS THAT ARE EMITTED FROM THE URETHANE ADHESIVE OR PRIMER COULD CAUSE PERSONAL INJURY. USE THEM IN A WELL-VENTILATED AREA.

SKIN CONTACT WITH URETHANE ADHESIVE SHOULD BE AVOIDED. PERSONAL INJURY MAY RESULT.

ALWAYS WEAR EYE AND HAND PROTECTION WHEN WORKING WITH GLASS.

CAUTION: Protect all painted and trimmed surfaces from coming in contact with urethane or primers.

Be careful not to damage painted surfaces when removing moldings or cutting urethane around windshield.

It is difficult to salvage a windshield during the removal operation. The windshield is part of the structural support for the roof. The urethane bonding used to secure the windshield to the fence is difficult to cut or clean from any surface. If the moldings are set in urethane, it would also be unlikely they could be salvaged. Before removing the windshield, check the availability of the windshield and moldings from the parts supplier.

REMOVAL AND INSTALLATION

WINDSHIELD

The windshield is positioned in the reveal molding and is bonded to the windshield frame with urethane adhesive.

Depending on the circumstances, either one of two windshield glass installation methods can be used:

- The short method.
- The extended method.

The short method is used when the windshield glass is removed intact, and the body opening and the pinchweld flanges do not require repair.

The extended method must be used when the body opening or a flange is damaged. The extended method must also be used when urethane no longer adheres to either the windshield glass or the pinchweld flanges.

REMOVAL

(1) Cover the interior and exterior body surface areas with a protective covering.

(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.

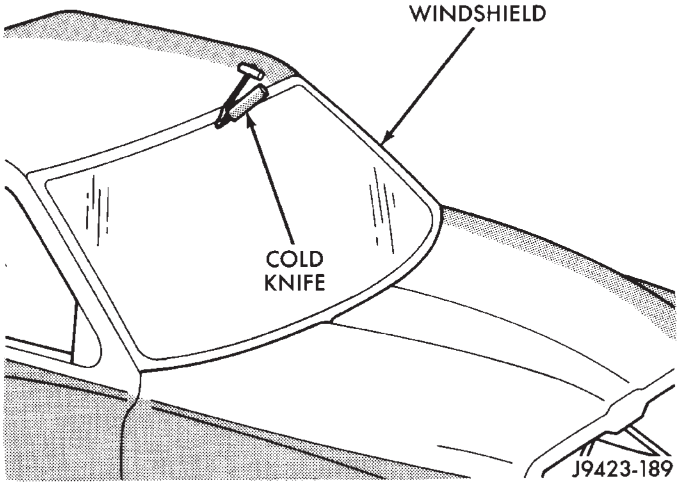


Fig. 1 Cutting Urethane Around Windshield—Typical

INSTALLATION—SHORT METHOD

WARNING: REVIEW ALL WARNINGS AND CAUTIONS IN THIS GROUP BEFORE PRECEDING WITH INSTALLATION.

(1) Trim the urethane from the pinchweld flanges. Leave a 3 mm (0.1 in.) level base of urethane on the pinchweld flanges.

WARNING: DO NOT USE SOLVENT BASED GLASS CLEANER TO CLEAN WINDSHIELD BEFORE APPLYING GLASS PREP AND PRIMER. POOR ADHESION CAN RESULT.

(2) Clean inside of windshield with ammonia based glass cleaner and lint-free cloth.

(3) Prime outer perimeter of interior side of glass 16 mm (5/8 inch) from edge. Use a wipe-off type urethane primer and wipe glass dry after primer application.

NOTE: The reveal molding has an adhesive applied to the windshield contact surface to help secure the molding to the windshield during the installation procedure.

(4) Apply the molding to the windshield:

- With the molding at room temperature, press the molding onto the windshield corners.
- From corner to corner, work the molding to the center of each side. (Some stretching of the molding may be required during this procedure.)

(5) Place the glass on the pinchweld flanges and inspect for gaps in the urethane. Gaps in excess of 3 mm (1/8 inch) must be filled with urethane.

(6) Adjust windshield glass position until it is aligned with the flanges and adhesive.

(7) Using a grease pencil or equivalent, make alignment marks on the glass and body.

(8) Remove replacement windshield from windshield opening.

(9) 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. 2).

CAUTION: Avoid spilling or dripping primer on painted surfaces. Clean spills or drips immediately. The primer will damage the paint if it remains on the surface for any length of time.

(10) If the replacement windshield glass does not have blackout primer:

- Attach a 25 mm (1 in) wide masking tape band around the interior side of the glass 16 mm (5/8 in) from the edge of the glass (Fig. 3).
- Do not attach tape along the bottom of the glass and **attach it only to the inside of the glass.**
- Clean the 16-mm (5/8-in) wide surface area around the glass with isopropyl alcohol.
- Thoroughly mix and apply glass blackout primer to the 16 mm (5/8 in) surface area around the interior side of the glass (Fig. 4).
- Allow the primer to dry for at least 10-12 minutes.

(11) Apply a small amount of adhesive to the bottom support spacers and attach the support spacers to the bottom of the windshield, 170 mm inboard from the outer windshield edge (Fig. 5).

(12) Cut the urethane adhesive applicator nozzle (Fig. 6).

CAUTION: Be prepared to install the glass immediately after applying the adhesive, as the adhesive will begin to cure in less than 10 minutes.

(13) Apply a continuous, 6-mm (1/4-in) diameter bead of urethane adhesive to the surface area.

(14) Align the glass with the reference marks and position the glass on the pinchweld flanges. Ensure that the windshield glass is correctly seated on the support spacers.

(15) Force the windshield glass inward just enough to wet-out and set the urethane. Use care to avoid excessive squeeze-out of adhesive.

(16) Water test the windshield with a water spray after installation. Do not direct high pressure streams of water directly at urethane. If any leaks are detected, apply urethane as necessary.

(17) If used, remove the masking tape from the inner surface of the glass.

(18) Install all components and clean the vehicle.

REMOVAL AND INSTALLATION (Continued)

(19) Open the vehicle windows to prevent interior pressure while the urethane is curing. **If not vented, pressure in the interior of the vehicle may interfere with proper glass bonding.**

(20) Install the rearview mirror.

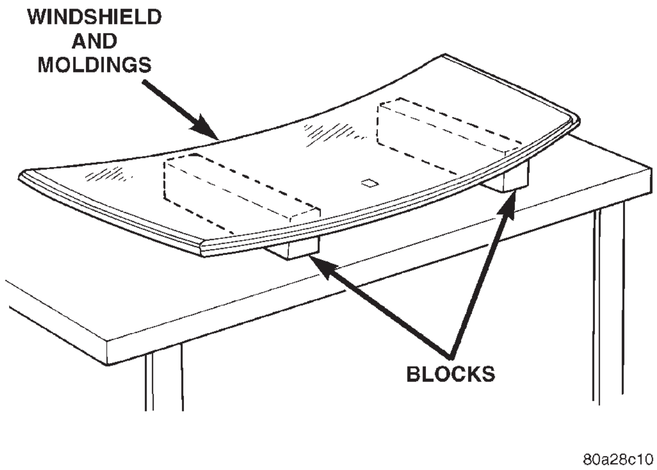


Fig. 2 Work Surface Set up

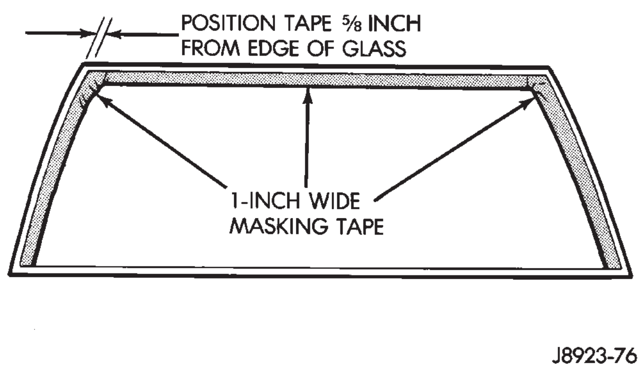


Fig. 3 Masking Tape Location For Blackout Primer

INSTALLATION—EXTENDED METHOD

WARNING: REVIEW ALL WARNINGS AND CAUTIONS IN THIS GROUP BEFORE PRECEDING WITH INSTALLATION.

(1) Remove the all of urethane from all pinchweld flanges.

(2) Inspect and repair the windshield opening and pinchweld flanges.

(3) Prime the pinchweld flanges with a urethane base primer. However, if the flange is color-coated with paint, prime the flanges with a paint finish primer. **This is important because urethane adhesive will not adhere to all color-coat paints.** Allow primer sufficient time to dry.

NOTE: The reveal molding has an adhesive applied to the windshield contact surface to help secure the molding to the windshield during the installation procedure.

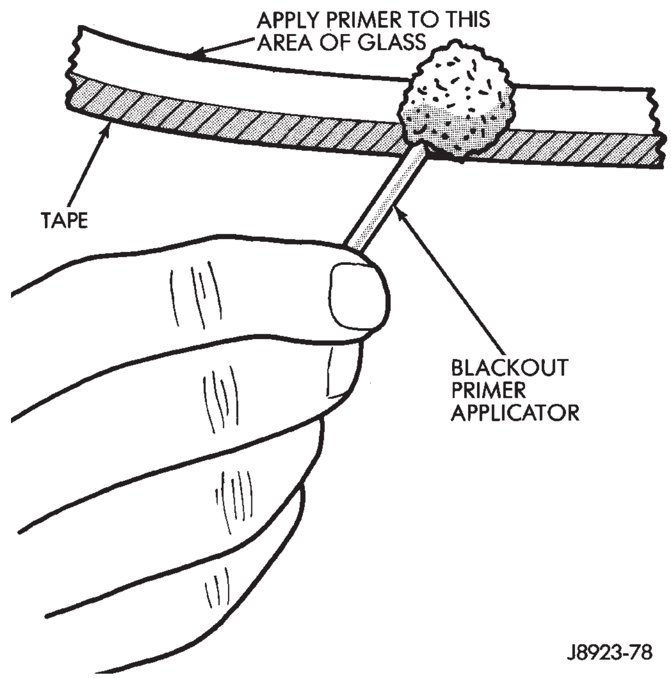


Fig. 4 Blackout Primer Application

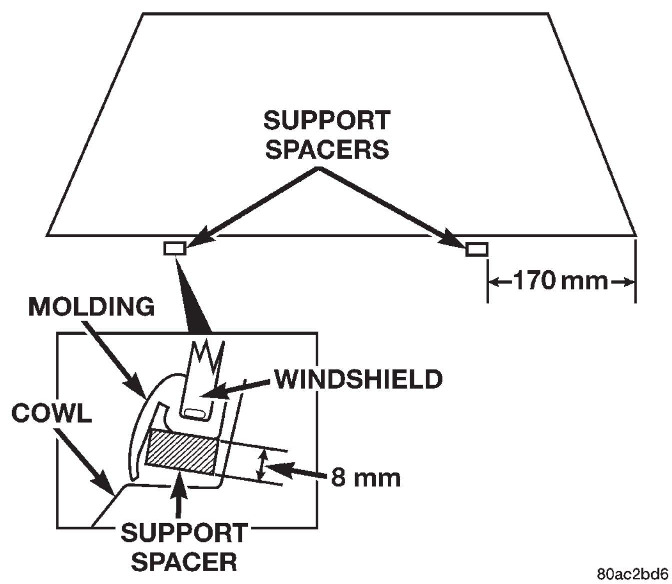


Fig. 5 Windshield Bottom Support Spacers

(4) Apply the reveal molding to the windshield:

• With the molding at room temperature, press the molding onto the windshield corners.

• From corner to corner, work the molding to the center of each side. (Some stretching of the molding may be required during this procedure).

(5) Install and inspect the fit of the windshield on the pinchweld flanges as follows:

• Position windshield until it is aligned within windshield opening.

REMOVAL AND INSTALLATION (Continued)

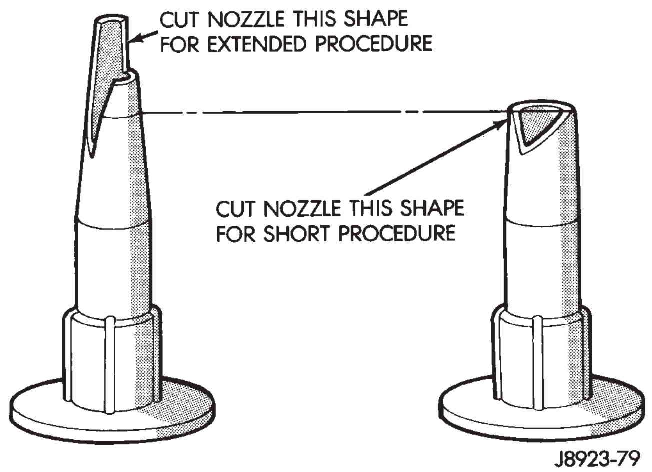


Fig. 6 Applicator Nozzle Preparation

• Measure the gap between the pinchweld flanges and glass around perimeter of the glass and flange.

• The reveal molding should equally cover the A-Pillars on both sides.

• The flanges should also extend above the glass edge equally around the perimeter of the opening.

(6) If the pinchweld flanges require repair, remove the windshield glass and straighten, align, or repair the flange(s) as necessary.

(7) Position the windshield in the opening and inspect the windshield fit again. Mark the windshield final position on the glass and body with a wax pencil (or use masking tape). The marks (or masking tape) will be used for installation alignment reference.

(8) If the replacement windshield does not have blackout primer:

• Attach a 25-mm (1-in) wide masking tape band around the interior side of glass 16 mm (5/8 in) from edge of glass (Fig. 3).

• Do not attach tape along the bottom of the glass and **attach only to the inside of glass.**

• Thoroughly mix and apply blackout primer to the 16 mm (5/8 in) surface area around the interior side of the glass (Fig. 4).

• Allow the primer to dry for at least 10-12 minutes.

(9) Apply a small amount of adhesive to the bottom support spacers and attach the support spacers to the bottom of the windshield, 170 mm inboard from the outer windshield edge (Fig. 5).

(10) Cut the urethane applicator nozzle (Fig. 6).

(11) Apply a continuous bead of urethane to the surface area with blackout primer on the interior side of glass. The bead should be 9-mm (3/8-in) wide by 12.7-mm (1/2-in) deep for best results.

CAUTION: Be prepared to install the glass immediately after applying the adhesive, as the adhesive will begin to cure in less than 10 minutes.

(12) Align the windshield with the wax pencil installation alignment reference marks (or the tape strips). Position the windshield on pinchweld flanges and spacers.

(13) Force the windshield inward just enough to wet-out and set the urethane. Use care to avoid excessive squeeze-out of adhesive.

(14) Water test the windshield with a water spray after installation. Do not direct high pressure streams of water directly at the urethane. If any leaks are detected, apply urethane as necessary.

(15) If used, remove the masking tape from the inner surface of glass.

(16) Install all components and clean the vehicle. If necessary, refer to the installation procedures.

(17) Open the vehicle windows to prevent interior pressure while the urethane adhesive is curing. **If not vented, pressure in the interior of vehicle will interfere with glass bonding.**

(18) Install the rearview mirror on the bracket.

REAR DOOR STATIONARY WINDOW GLASS

REMOVAL

The rear door stationary window glass is bonded to the division bar and is serviced as an assembly.

(1) Lower the window glass.

(2) Remove the inner and outer beltline weatherstrip.

(3) Remove the trim panel and waterdam from door inner panel.

(4) Remove the screws attaching the division bar/glass to the door (Fig. 7).

(5) Tilt the division bar/glass forward and remove it from the door.

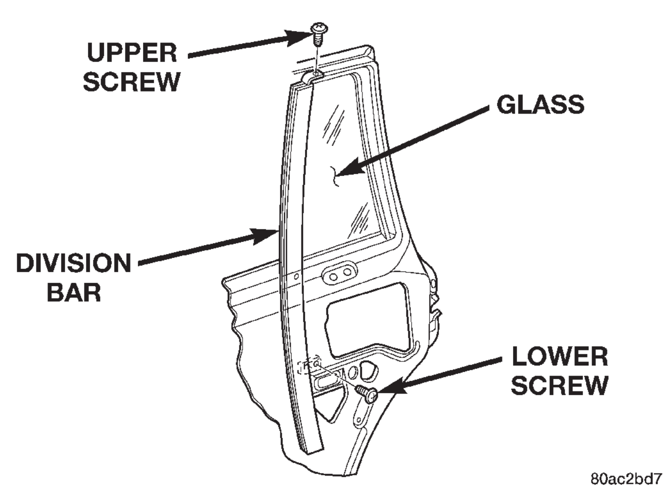


Fig. 7 Division Bar/Stationary Glass

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position the division bar/glass in the door.

(2) Install the screws attaching the division bar/ glass to the door. Finger tighten the screws.

(3) Tighten the upper screw to 6 N·m (5 ft-lbs) torque.

(4) Tighten the lower screw to 6 N·m (5 ft-lbs) torque.

(5) Install the beltline weatherstrip.

(6) Install the door waterdam and trim panel.

REAR QUARTER WINDOW GLASS

REMOVAL

(1) If equipped, remove the quarter window reveal molding (Fig. 8).

(2) Remove the quarter window interior trim covers.

(3) Separate the weatherstrip seal lip from the window opening flanges. Use a pry tool and carefully push the window glass and seal outward.

(4) Remove the weatherstrip seal and window glass from window opening.

(5) Remove the weatherstrip seal from the window glass.

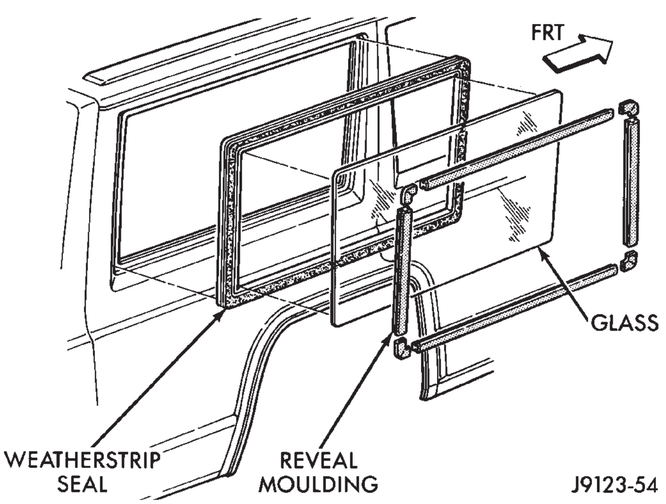


Fig. 8 Quarter Window Reveal Molding, Glass and Seal

INSTALLATION

(1) Clean the original sealant from the weatherstrip channels and window opening flanges.

(2) Apply a 4-mm (1/6-in) diameter bead of sealant to the window channel in the weatherstrip seal.

(3) Install the weatherstrip on the window glass. Install the seal installation cord in the window opening flange channel (Fig. 9) as follows:

- Moisten a length of 6-mm (1/4-in) diameter cord with a soap and water solution.
- Ensure that the cord is long enough to go all the way around the perimeter of the weatherstrip.
- Insert the cord into the window opening flange channel in the weatherstrip seal.

(4) Apply a 6-mm (1/4-in) diameter bead of sealant to the window opening flanges.

(5) For two-door vehicles, apply a 3-mm (1/8-in) diameter bead of sealant at the quarter panel applique and liftgate pillar seam.

(6) Position the quarter window glass and the weatherstrip seal in the window opening (Fig. 10) with the free ends of the cord inside the vehicle (Fig. 11).

(7) Pull on each end of the cord to pull the weatherstrip seal channel lip over the window opening flanges.

(8) Test the vent window for water leaks.

(9) Install the interior trim cover.

(10) If equipped, install the quarter window reveal molding.

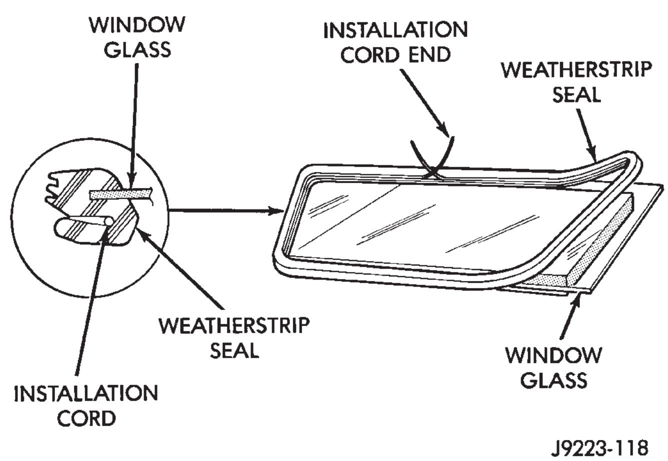


Fig. 9 Weatherstrip Seal and Cord Installation

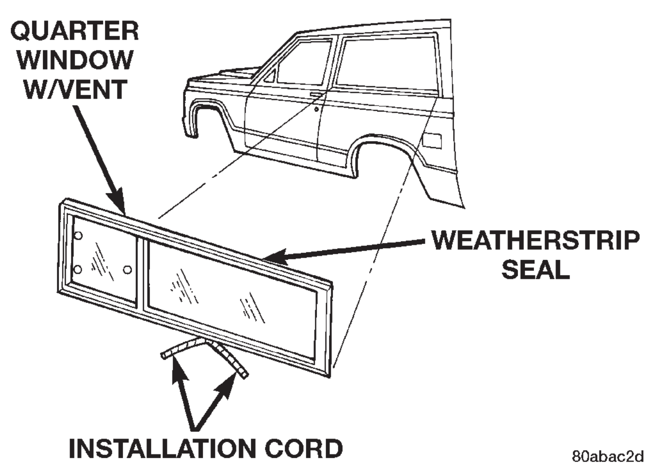


Fig. 10 Quarter Window With Vent

REMOVAL AND INSTALLATION (Continued)

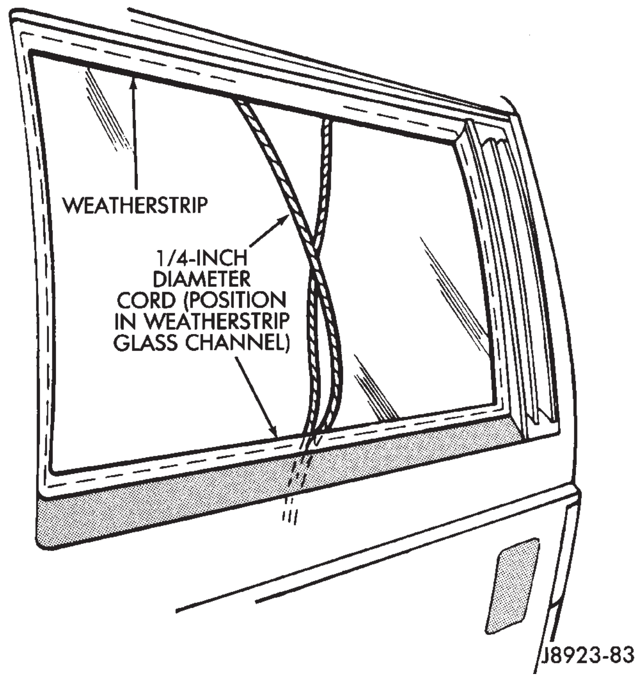


Fig. 11 Quarter Window Glass and Seal Installation

LIFTGATE GLASS

REMOVAL

(1) Open liftgate.
(2) Remove liftgate trim panel.
(3) Disconnect heated backlite (HBL) connector.
(4) Remove wiper arm.
(5) Remove CHMSL lens.
(6) Using a razor knife, slide the blade between the liftgate glass and the inboard edge of the reveal molding.
(7) Cut around the interior perimeter of the reveal molding and severe the cap of the reveal molding.
(8) Using a cold knife, cut urethane bonding from around liftgate glass. A pneumatic cutting device can be used if available.
(9) Separate glass from Liftgate.

INSTALLATION

CAUTION: Open a window before installing glass. This will avoid pressurizing the passenger compartment. If a door or liftgate is slammed before urethane is cured, water leaks can result.

(1) Trim the urethane from the liftgate glass opening flanges. Leave a 3 mm (0.1 in.) level base of urethane on the flanges.
(2) Starting in the corners, press reveal molding onto glass.
(3) Place replacement glass into liftgate opening and position glass in the center of the opening against flange.
(4) Verify the glass lays evenly against the fence at the sides, top and bottom. If not, the flange must be formed to the shape of the new glass.
(5) Using a grease pencil or equivalent, make references marks on the glass and body.
(6) Remove replacement glass from liftgate opening.
(7) Position the glass inside up on a suitable work surface.

WARNING: DO NOT USE SOLVENT BASED GLASS CLEANER TO CLEAN WINDSHIELD BEFORE APPLYING GLASS PREP AND PRIMER. POOR ADHESION CAN RESULT.

(8) Clean inside of glass with Mopar Glass Cleaner and lint-free cloth.
(9) Apply PVC (vinyl) primer 25 mm (1 in.) wide around edge of glass. Wipe with clean/dry lint-free cloth.
(10) If necessary, apply fence primer around edge of fence. Allow at least eighteen minutes drying time.
(11) Apply a 10 mm (0.4 in.) bead of urethane around glass border.
(12) Position glass into liftgate opening and reference marks.
(13) Push the glass inward until the reveal molding is seated onto the liftgate frame. Use care to avoid excessive squeeze-out of adhesive.
(14) Open windows 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 glass in place until urethane cures.
(16) Install the wiper arm.
(17) Install CHMSL lens.
(18) Connect heated backlite (HBL) connector.
(19) After urethane has cured, remove tape strips and water test to verify repair.
(20) Install liftgate trim panel.

SEATS

INDEX

REMOVAL AND INSTALLATION

HEAD RESTRAINT SLEEVE

REMOVAL

NOTE: When replacing a head restraint sleeve, the retaining tabs on the sleeve will be damaged during the removal process. Check the availability of replacement parts before servicing.

(1) Raise head restraint to the full up position.
(2) Turn head restraint lock thumbwheel to release head restraint and pull head restraint upward to remove from seat back.
(3) Insert head restraint sleeve extractor (special tool 6773) (Fig. 1) and (Fig. 2) into the seat back.
(4) The retaining tabs are positioned on each side of the sleeve, when inserting the extractor, ensure that the flat of the collar is facing the side of the seatback (Fig. 3).
(5) Using a small hammer, tap extractor downward to release sleeve retaining tab.
(6) Remove extractor tool from sleeve, rotate tool 180 degrees (Fig. 4) and repeat steps 3 and 4.
(7) Remove extractor tool from sleeve and remove sleeve from seat back.

INSTALLATION

(1) Position the sleeve in the seat back.
(2) Firmly, push sleeve down to snap into place.
(3) Install head restraint.

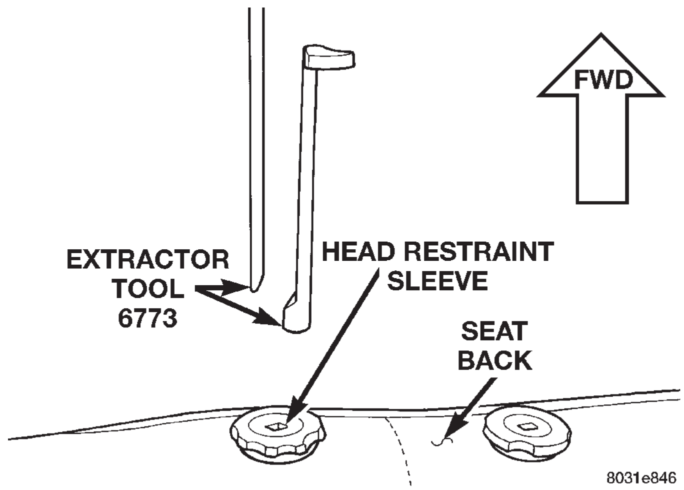


Fig. 1 Head Restraint Sleeve Extractor

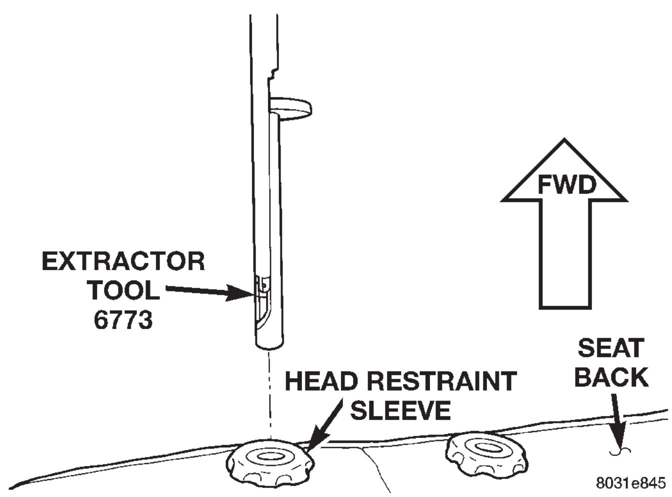


Fig. 2 Head Restraint Sleeve Extractor Installation

REMOVAL AND INSTALLATION (Continued)

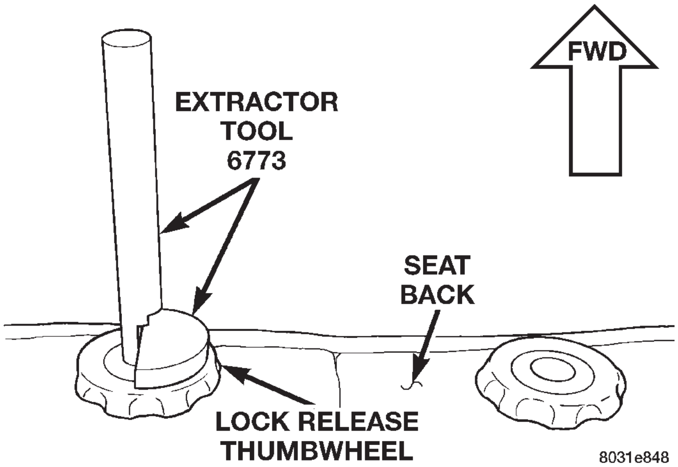


Fig. 3 Head Restraint Sleeve Extractor Positioning

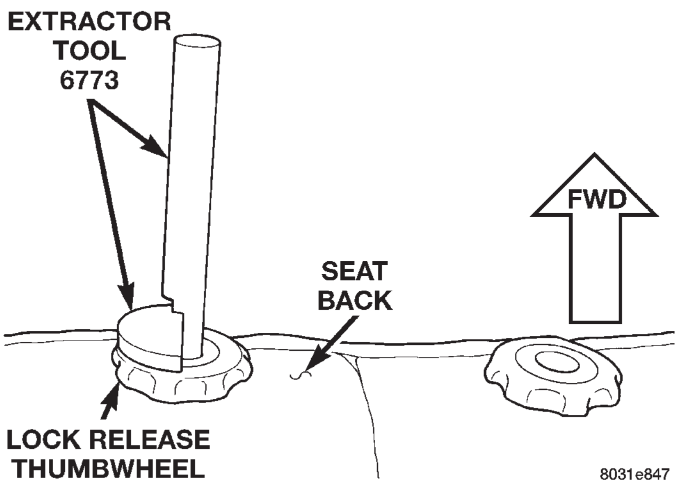


Fig. 4 Head Restraint Sleeve Extractor Positioning

HEAD RESTRAINT COVER

REMOVAL

(1) Remove head restraint from the bucket seat.

(2) Remove the screws attaching the bezel and adjuster bar to the head restraint (Fig. 5).

(3) Pull the adjuster bar from the head restraint.

(4) Roll the cover upward and separate from the head restraint cushion (Fig. 6).

INSTALLATION

(1) Position the cover on the head restraint cushion and roll the cover downward.

(2) Position the adjuster bar in the head restraint.

(3) Install the screws attaching the bezel and adjuster bar to the head restraint.

(4) Install head restraint in the bucket seat.

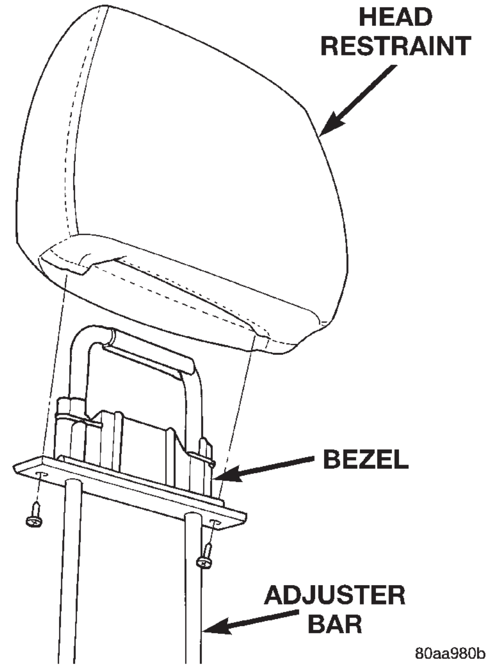


Fig. 5 Head Restraint

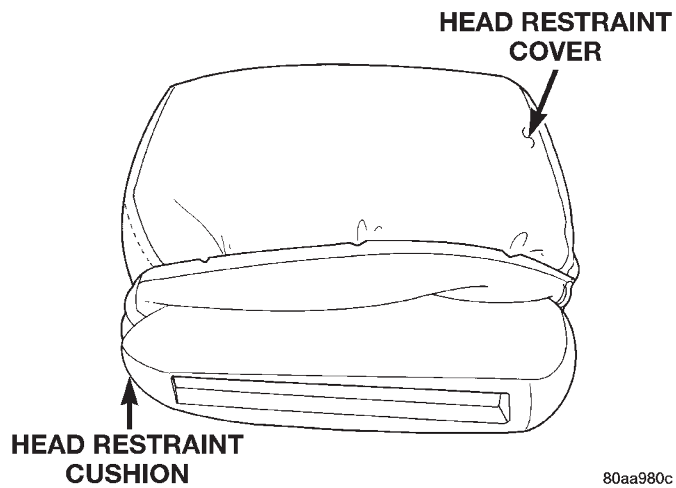


Fig. 6 Head Restraint Cover

BUCKET SEAT

REMOVAL

(1) Remove bolts attaching seat to floor pan (Fig. 7).

(2) Remove nut attaching seat to floor pan.

(3) For power seat, disconnect wire harness connector. If equipped, disconnect wire harness for heated seat.

(4) Disconnect seat belt buckle warning wire harness connector.

(5) Separate seat from floor panel.

INSTALLATION

(1) Position seat on floor pan.

REMOVAL AND INSTALLATION (Continued)

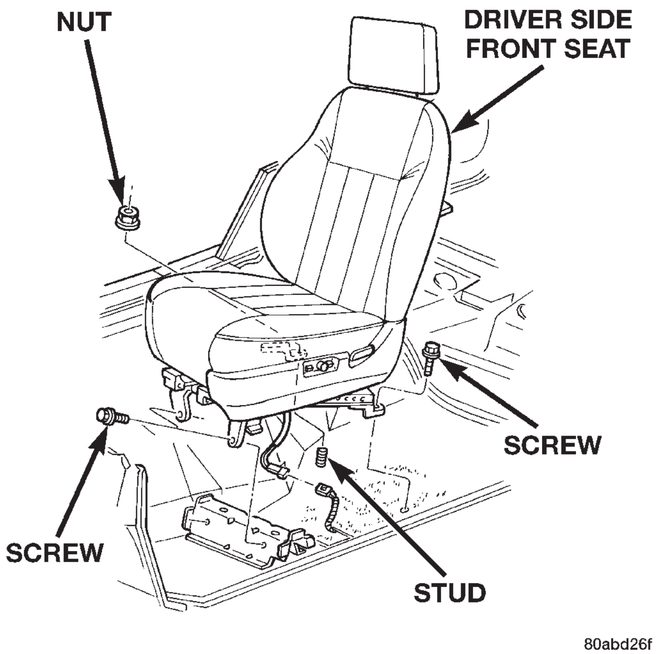


Fig. 7 Bucket Seat—Power Seat

(2) Connect seat belt buckle warning wire harness connector.

(3) For power seats, connect wire harness connector. If equipped, connect harness for heated seat.

(4) Install front fasteners attaching seat to floor pan. Tighten to 27 N·m (20 ft. lbs.) torque.

(5) Install rear fasteners attaching seat to floor pan. Tighten to 27 N·m (20 ft. lbs.) torque.

(6) Install nut attaching seat to floor pan. Tighten to 40 N·m (30 ft. lbs.) torque.

BUCKET SEAT TRACK

REMOVAL

NOTE: If the vehicle is equipped with manually adjusted bucket seats, the inboard or outboard seat track may be serviced separately.

(1) Remove bucket seat from vehicle.

(2) Remove screws attaching the side shield trim cover from the seat.

(3) If equipped, disengage the power seat connector from the power seat switch.

(4) Remove the nuts attaching the seat track to the bucket seat platform.

(5) When separating the seat track from the platform, route the power seat switch connector through the access hole in the seat cushion frame, if equipped.

INSTALLATION

(1) While positioning the seat track on the bucket seat platform, route the power seat switch connector through the access hole in the seat cushion frame, if equipped.

(2) Install the nuts attaching the seat track to the bucket seat platform.

(3) If equipped, engage the power seat connector to the power seat switch.

(4) Install screws attaching the side shield trim cover to the seat.

(5) Install bucket seat.

BUCKET SEAT PLATFORM

Bucket seat platforms are not repairable. If the seat platform is damaged, replace platform as a unit.

BUCKET SEATBACK COVER

REMOVAL

(1) Remove head restraint, if equipped.

(2) Remove screws attaching side shield trim cover to bucket seat.

(3) If equipped, disengage power seat wire connector from power seat switch.

(4) Remove the inboard seatback pivot bolt.

(5) Position the seatback in the full forward or full recline position.

(6) Remove the seatback cover zipper from the base of the seatback.

(7) Disengage the cover zipper and route the zipper end between the inboard seatback and seat cushion frame.

(8) Roll the seatback cover upward (Fig. 8).

(9) Disengage the hogrings attaching the seatback cover to the seatback cushion support wires (Fig. 9).

(10) Roll the seatback cover upward and disengage the hook and loop fastener (Fig. 10).

(11) Roll seatback cover up and over the head restraint sleeves, if equipped and separate from the seatback.

INSTALLATION

(1) Position the seatback cover on the seatback cushion and roll seatback cover down over the head restraint sleeves. Route the sleeves through the access holes in the cover, if equipped.

(2) Roll the seatback cover downward and engage the hook and loop fastener.

(3) Continue rolling the cover downward and engage the hogrings attaching the seatback cover to the seatback cushion support wires.

(4) Route the zipper end between the inboard seatback and seat cushion frame and engage the cover zipper.

(5) Install the inboard seatback pivot bolt.

(6) Install the side shield trim cover.

(7) Install head restraint, if equipped.

REMOVAL AND INSTALLATION (Continued)

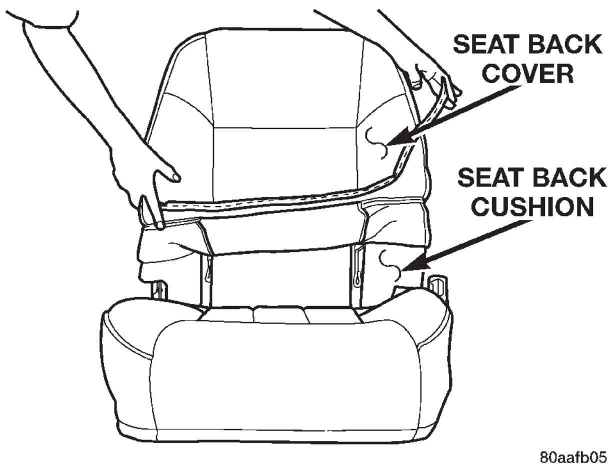


Fig. 8 Seatback Cover

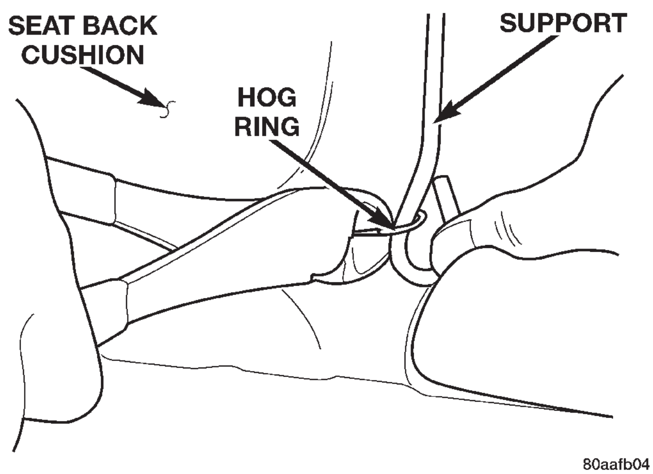


Fig. 9 Hog Ring

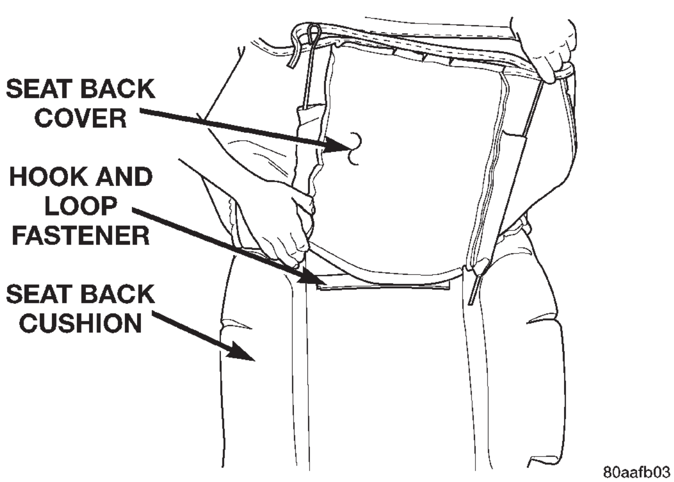


Fig. 10 Hook And Loop Fastener

BUCKET SEATBACK

REMOVAL

(1) Remove side shield trim cover.
(2) Remove inboard seatback pivot bolt.
(3) Remove bolts attaching recliner to seat cushion frame (Fig. 11).
(4) Separate seatback from vehicle.

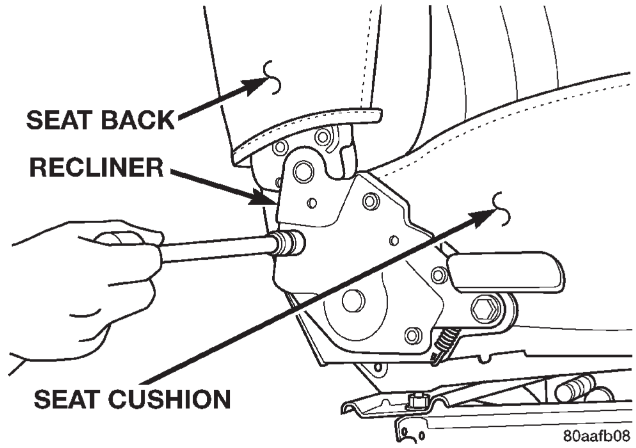


Fig. 11 Bucket Seatback

INSTALLATION

(1) Position seatback on seat cushion frame.
(2) Install inboard seatback pivot bolt.
(3) Install bolts attaching recliner to seat cushion frame.
(4) Install side shield trim cover.

BUCKET SEAT CUSHION COVER

REMOVAL

(1) Remove seat from vehicle.
(2) Remove side shield trim cover.
(3) Remove seatback.
(4) With the cushion side down, disengage the forward, rearward and inboard J-straps.
(5) Disengage the clips attaching the outboard side of the cover to the cushion frame.
(6) Turn the cushion over and roll the cover off the cushion.
(7) Remove the hog rings attaching the cover to the cushion support wires (Fig. 12).
(8) Separate the cover from the cushion.

INSTALLATION

(1) Position the cover on the cushion.
(2) Install the hog rings attaching the cover to the cushion support wires.
(3) With the cushion side down, engage the forward, rearward and inboard J-straps.
(4) Engage the clips attaching the outboard side of the cover to the cushion frame.

REMOVAL AND INSTALLATION (Continued)

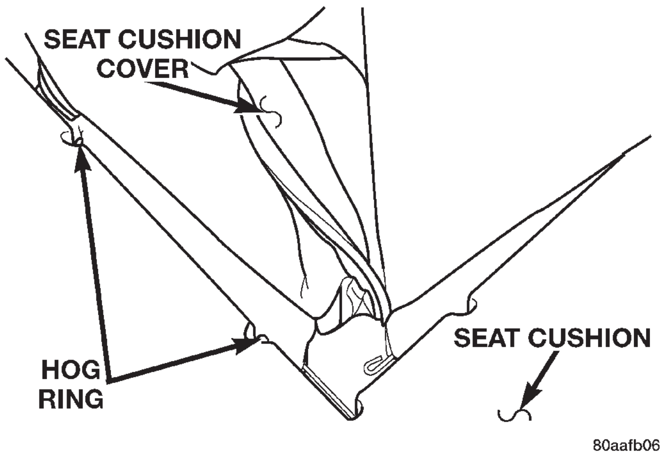


Fig. 12 Seat Cushion Cover Hog Rings

(5) Install seatback.
(6) Install side shield trim cover.
(7) Install seat.

BUCKET SEAT RECLINER

REMOVAL

(1) Remove side shield trim cover.
(2) Disengage seatback cover zipper.
(3) Roll outer seatback cover upward.
(4) Remove bolts attaching recliner to seatback and seat cushion frames (Fig. 13).
(5) Separate recliner from seat.

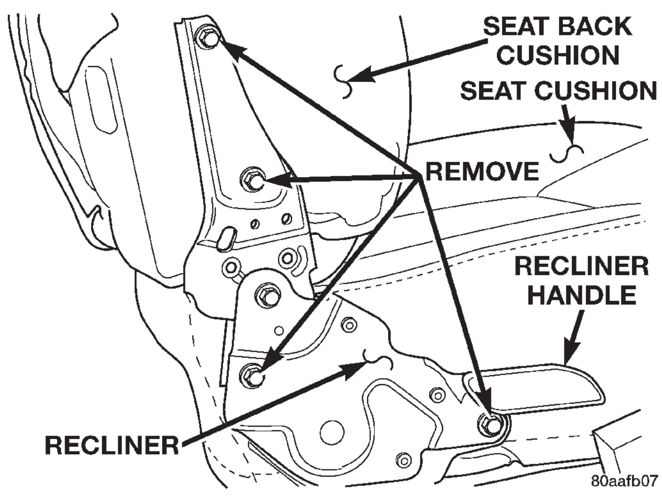


Fig. 13 Bucket Seat Recliner

INSTALLATION

(1) Position recliner on seat.
(2) Install bolts attaching recliner to seatback and seat cushion frames (Fig. 13).
(3) Roll seatback cover downward.
(4) Engage seatback cover zipper.
(5) Install side shield trim cover.

REAR SEAT CUSHION

REMOVAL

(1) Disengage seat cushion at rear by pulling upward on release strap (Fig. 14).
(2) Tilt seat cushion forward.
(3) Disengage seat cushion latch with right side release lever. Separate right side latch and left side seat bracket from floor anchor bolts, and remove cushion from vehicle (Fig. 15).

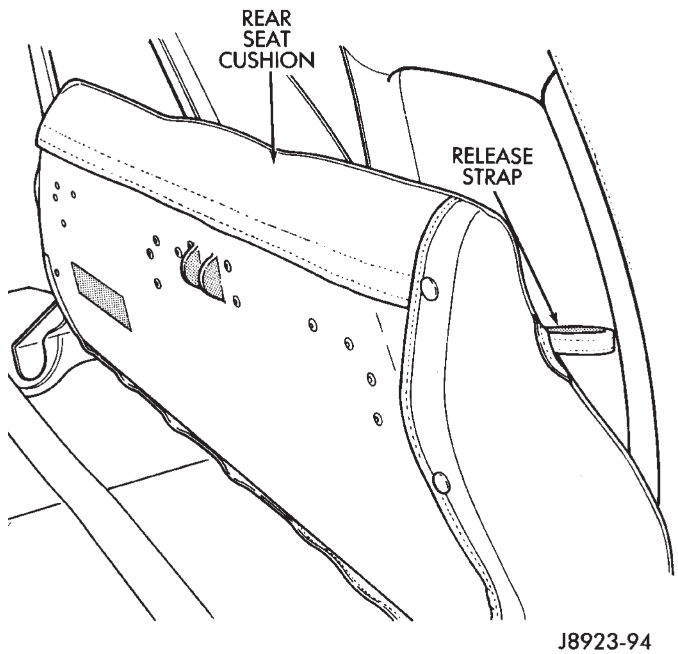


Fig. 14 Seat Cushion Release Strap

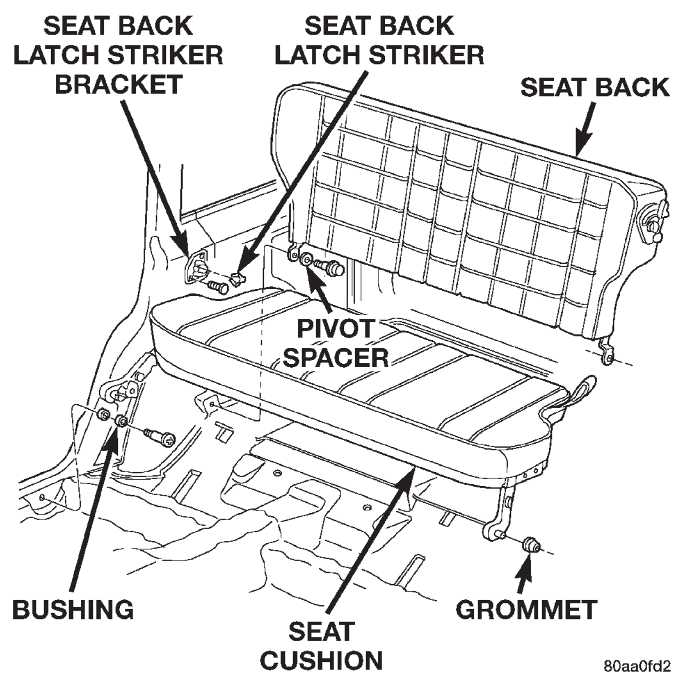


Fig. 15 Rear Seat Cushion/Seat Back

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position seat cushion in vehicle.
(2) Insert left pivot in anchor grommet.
(3) Force right side latch onto anchor bolt and pivot seat cushion to horizontal position.
(4) Lock seat cushion in-place by pressing firmly on center of cushion until latch engages.

REAR SEATBACK

REMOVAL

(1) Disengage the seat cushion at the rear by pulling upward on the release strap.
(2) Tilt the seat cushion forward.
(3) Remove the shoulder/lap belt buckles from the elastic straps.
(4) Release the seatback latch from the striker.
(5) Remove the pivot bolts and the washers from the wheelhouse panel anchors (Fig. 15).
(6) Tilt the seatback forward, lift it upward and remove it from the vehicle.

INSTALLATION

(1) Position the seatback in the vehicle.
(2) Install the pivot bolts and the washer. Tighten the bolts with 33 N·m (25 ft. lbs.) torque.
(3) Engage the seatback latch with the striker.
(4) Insert the shoulder/lap belt buckles in the elastic straps.
(5) Pivot the seat cushion to the horizontal position and lock it in-place by pressing firmly on the center of the cushion until the latch engages.

REAR SEAT CUSHION COVER

REMOVAL

(1) Remove the seat cushion from the vehicle.
(2) Remove the cover side, front and rear retaining clips from the wire retainers with an appropriate removal tool (Fig. 16).
(3) Remove the serrated retainers from the front ends of the cover with a trim panel removal tool (Fig. 17).
(4) Remove the seat cover from the cushion.

INSTALLATION

(1) Position the replacement cover on the cushion.
(2) Compress the cover and attach the retaining clips to the front and rear wire retainers.
(3) Install the serrated retainers at the ends of the cover.
(4) Install the seat cushion in the vehicle. If necessary, refer to the installation procedure.

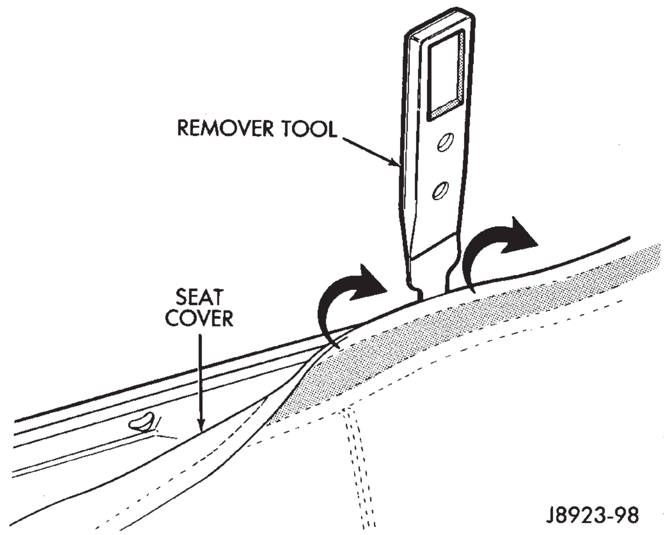


Fig. 16 Seat Cushion Cover Retaining Clip Removal

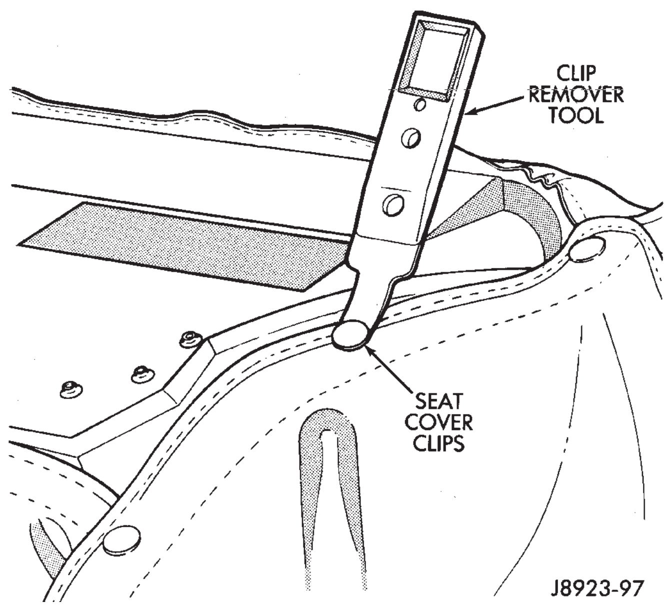


Fig. 17 Seat Cushion Cover Retaining Clip Removal

REAR SEATBACK LATCH STRIKER AND BUMPER

REMOVAL

(1) Disengage seat cushion at the rear by pulling upward on the release strap.
(2) Tilt seat cushion forward.
(3) Release seatback latch from striker.
(4) Tilt seatback forward for access to striker bracket.
(5) Remove screws (Fig. 18) attaching latch striker bracket and shims to trim panel.

INSTALLATION

(1) Position shims and latch striker bracket on trim panel.

REMOVAL AND INSTALLATION (Continued)

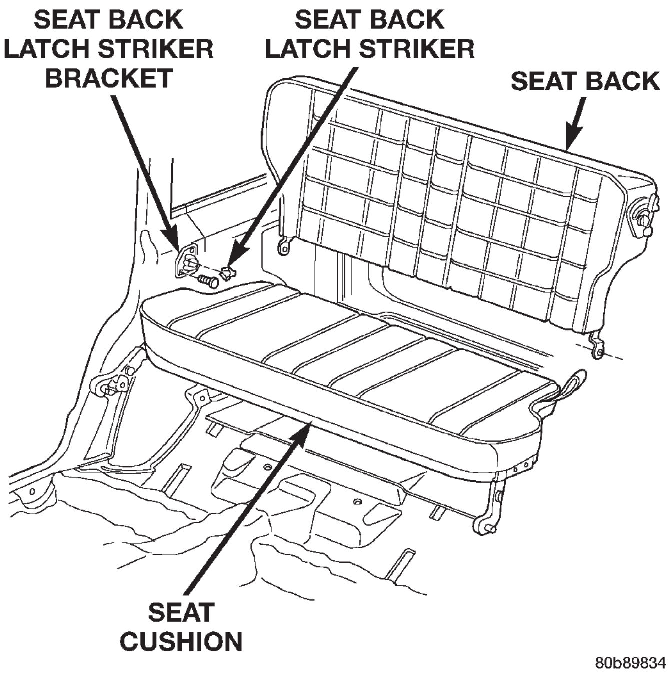


Fig. 18 Seatback Latch Striker Bracket

(2) Install screws attaching latch striker bracket and shims to trim panel. Tighten screws to 6 N·m (50 in. lbs.) torque.

(3) Engage seatback latch with striker.

(4) Pivot seat cushion to horizontal position and lock it in-place by pressing firmly on center of the cushion until latch engages.

REAR SEATBACK COVER

REMOVAL

(1) Remove the seatback from the vehicle.

(2) Remove the seatback latch release handle and bezel from the seatback.

(3) Disengage the cover zippers.

(4) Disengage the J-strap attaching the cover to the seat back frame (Fig. 19).

(5) Remove the cover from the seatback pad.

INSTALLATION

(1) Install the cover on the seatback.

(2) Attach the cover J-strap to the seatback frame.

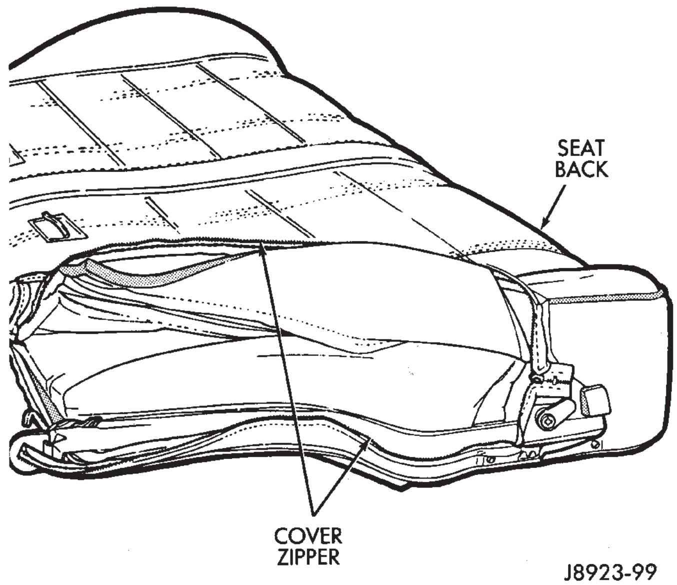


Fig. 19 Seatback Cover Removal

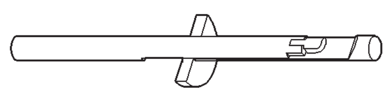
(3) Engage the cover zippers.

(4) Install the seat latch release bezel and handle.

(5) Install the seatback in the vehicle.

SPECIAL TOOLS

SEATS



Extractor Head Restraint Sleeve 6773

BODY COMPONENT SERVICE

INDEX

DIAGNOSIS AND TESTING

WATER LEAKS

Water leaks can be caused by poor sealing, improper body component alignment, body seam porosity, missing plugs, or blocked drain holes. Centrifugal and gravitational force can cause water to drip from a location away from the actual leak point, making leak detection difficult. All body sealing points should be water tight in normal wet-driving conditions. Water flowing downward from the front of the vehicle should not enter the passenger or luggage compartment. Moving sealing surfaces will not always seal water tight under all conditions. At times, side glass or door seals will allow water to enter the passenger compartment during high pressure washing or hard driving rain (severe) conditions. Overcompensating on door or glass adjustments to stop a water leak that occurs under severe conditions can cause premature seal wear and excessive closing or latching effort. After completing a repair, water-test vehicle to verify leak has stopped before returning vehicle to use.

VISUAL INSPECTION BEFORE WATER LEAK TESTS

Verify that floor and body plugs are in place, body drains are clear, and body components are properly aligned and sealed. If component alignment or sealing is necessary, refer to the appropriate section of this group for proper procedures.

WATER LEAK TESTS

WARNING: DO NOT USE ELECTRIC SHOP LIGHTS OR TOOLS IN WATER TEST AREA. PERSONAL INJURY CAN RESULT.

When the conditions causing a water leak have been determined, simulate the conditions as closely as possible.

- If a leak occurs with the vehicle parked in a steady light rain, flood the leak area with an open-ended garden hose.
- If a leak occurs while driving at highway speeds in a steady rain, test the leak area with a reasonable velocity stream or fan spray of water. Direct the spray in a direction comparable to actual conditions.
- If a leak occurs when the vehicle is parked on an incline, hoist the end or side of the vehicle to simulate this condition. This method can be used when the leak occurs when the vehicle accelerates, stops or turns. If the leak occurs on acceleration, hoist the front of the vehicle. If the leak occurs when braking, hoist the back of the vehicle. If the leak occurs on left turns, hoist the left side of the vehicle. If the leak occurs on right turns, hoist the right side of the vehicle. For hoisting recommendations refer to Group 0, Lubrication and Maintenance, General Information section.

WATER LEAK DETECTION

To detect a water leak point-of-entry, do a water test and watch for water tracks or droplets forming on the inside of the vehicle. If necessary, remove interior trim covers or panels to gain visual access to the leak area. If the hose cannot be positioned without being held, have someone help do the water test.

Some water leaks must be tested for a considerable length of time to become apparent. When a leak appears, find the highest point of the water track or drop. The highest point usually will show the point of entry. After leak point has been found, repair the leak and water test to verify that the leak has stopped.

Locating the entry point of water that is leaking into a cavity between panels can be difficult. The trapped water may splash or run from the cavity, often at a distance from the entry point. Most water leaks of this type become apparent after accelerating, stopping, turning, or when on an incline.

MIRROR INSPECTION METHOD

When a leak point area is visually obstructed, use a suitable mirror to gain visual access. A mirror can also be used to deflect light to a limited-access area to assist in locating a leak point.

DIAGNOSIS AND TESTING (Continued)

BRIGHT LIGHT LEAK TEST METHOD

Some water leaks in the luggage compartment can be detected without water testing. Position the vehicle in a brightly lit area. From inside the darkened luggage compartment inspect around seals and body seams. If necessary, have a helper direct a drop light over the suspected leak areas around the luggage compartment. If light is visible through a normally sealed location, water could enter through the opening.

PRESSURIZED LEAK TEST METHOD

When a water leak into the passenger compartment cannot be detected by water testing, pressurize the passenger compartment and soap test exterior of the vehicle. To pressurize the passenger compartment, close all doors and windows, start engine, and set heater control to high blower in HEAT position. If engine can not be started, connect a charger to the battery to ensure adequate voltage to the blower. With interior pressurized, apply dish detergent solution to suspected leak area on the exterior of the vehicle. Apply detergent solution with spray device or soft bristle brush. If soap bubbles occur at a body seam, joint, seal or gasket, the leak entry point could be at that location.

WIND NOISE

Wind noise is the result of most air leaks. Air leaks can be caused by poor sealing, improper body component alignment, body seam porosity, or missing plugs in the engine compartment or door hinge pillar areas. All body sealing points should be airtight in normal driving conditions. Moving sealing surfaces will not always seal airtight under all conditions. At times, side glass or door seals will allow wind noise to be noticed in the passenger compartment during high cross winds. Over compensating on door or glass adjustments to stop wind noise that occurs under severe conditions can cause premature seal wear and excessive closing or latching effort. After a repair procedure has been performed, test vehicle to verify noise has stopped before returning vehicle to use.

Wind noise can also be caused by improperly fitted exterior moldings or body ornamentation. Loose moldings can flutter, creating a buzzing or chattering noise. An open cavity or protruding edge can create a whistling or howling noise. Inspect the exterior of the vehicle to verify that these conditions do not exist.

VISUAL INSPECTION BEFORE TESTS

Verify that floor and body plugs are in place and body components are aligned and sealed. If component alignment or sealing is necessary, refer to the appropriate section of this group for proper procedures.

ROAD TESTING WIND NOISE

(1) Drive the vehicle to verify the general location of the wind noise.

(2) Apply 50 mm (2 in.) masking tape in 150 mm (6 in.) lengths along weatherstrips, weld seams or moldings. After each length is applied, drive the vehicle. If noise goes away after a piece of tape is applied, remove tape, locate, and repair defect.

POSSIBLE CAUSE OF WIND NOISE

- Moldings standing away from body surface can catch wind and whistle.
- Gaps in sealed areas behind overhanging body flanges can cause wind-rushing sounds.
- Misaligned movable components.
- Missing or improperly installed plugs in pillars.
- Weld burn through holes.

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

GRILLE

REMOVAL

(1) Remove the headlamp/park lamp bezels.
(2) Remove the screws attaching the grille to the grille opening panel (GOP) (Fig. 1).
(3) Separate the grille from the GOP.

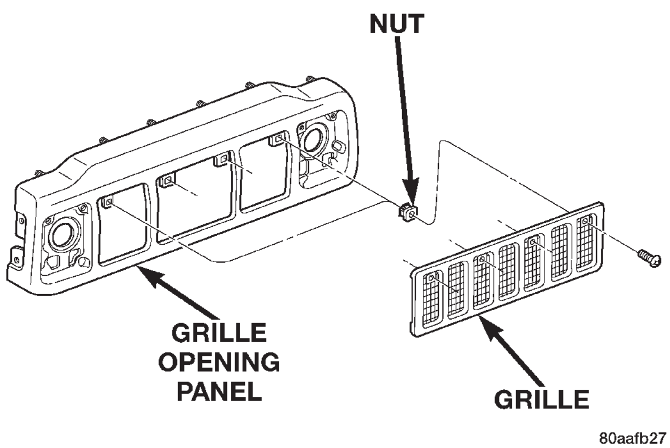


Fig. 1 Grille

INSTALLATION

(1) Position the grille in the GOP.
(2) Install the screws.
(3) Install the headlamp/park lamp bezels.

GRILLE OPENING PANEL (GOP)

REMOVAL

(1) Remove headlamp bezels.
(2) Remove grille.
(3) Remove side marker lamps.
(4) Remove headlamps and park/turn signal lamps.
(5) Open hood.
(6) Remove nuts that attach GOP to front fenders (Fig. 2).
(7) Remove nuts attaching GOP to support bracket.
(8) Pull GOP forward and disconnect harness clips and front lamp harness connectors.
(9) Remove GOP from vehicle.

INSTALLATION

(1) Place GOP on bumper and secure all harness clips.
(2) Connect all lamp wire harness connectors.
(3) Position GOP on vehicle.
(4) Install nuts attaching GOP to front fenders. Tighten nuts to 4 N·m (38 in-lbs) torque.

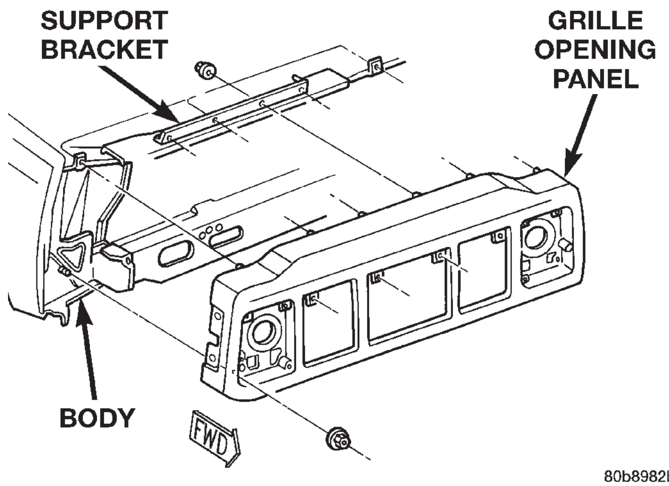


Fig. 2 Grille Opening Panel

(5) Install nuts attaching GOP to support bracket. Tighten nuts to 4 N·m (38 in-lbs) torque.
(6) Install headlamps and park/turn signal lamps.
(7) Install grille.
(8) Install side marker lamps.
(9) Install headlamp bezels.
(10) Adjust headlamp aim, if necessary.

HOOD

REMOVAL

(1) Raise hood.
(2) Disconnect underhood lamp wire harness connector, if equipped.
(3) Disconnect release cable from latch release bellcrank.
(4) Remove latch release cable clips and remove cable from hood (Fig. 3).
(5) Mark location of hood, hinges and hinge shims for installation.
(6) Remove bolts that attach hinges to hood.
(7) Remove hood from vehicle with aid of a helper.

INSTALLATION

(1) Position hood on shims and hinges; finger-tighten hinge bolts.
(2) Align hinges and shims with reference marks and tighten hinge bolts.
(3) Connect latch release cable and latch connecting rod to bellcrank.
(4) Attach latch release cable to clips.
(5) Connect underhood lamp wire harness connector.

HOOD HINGE

REMOVAL

(1) Raise and support hood.

REMOVAL AND INSTALLATION (Continued)

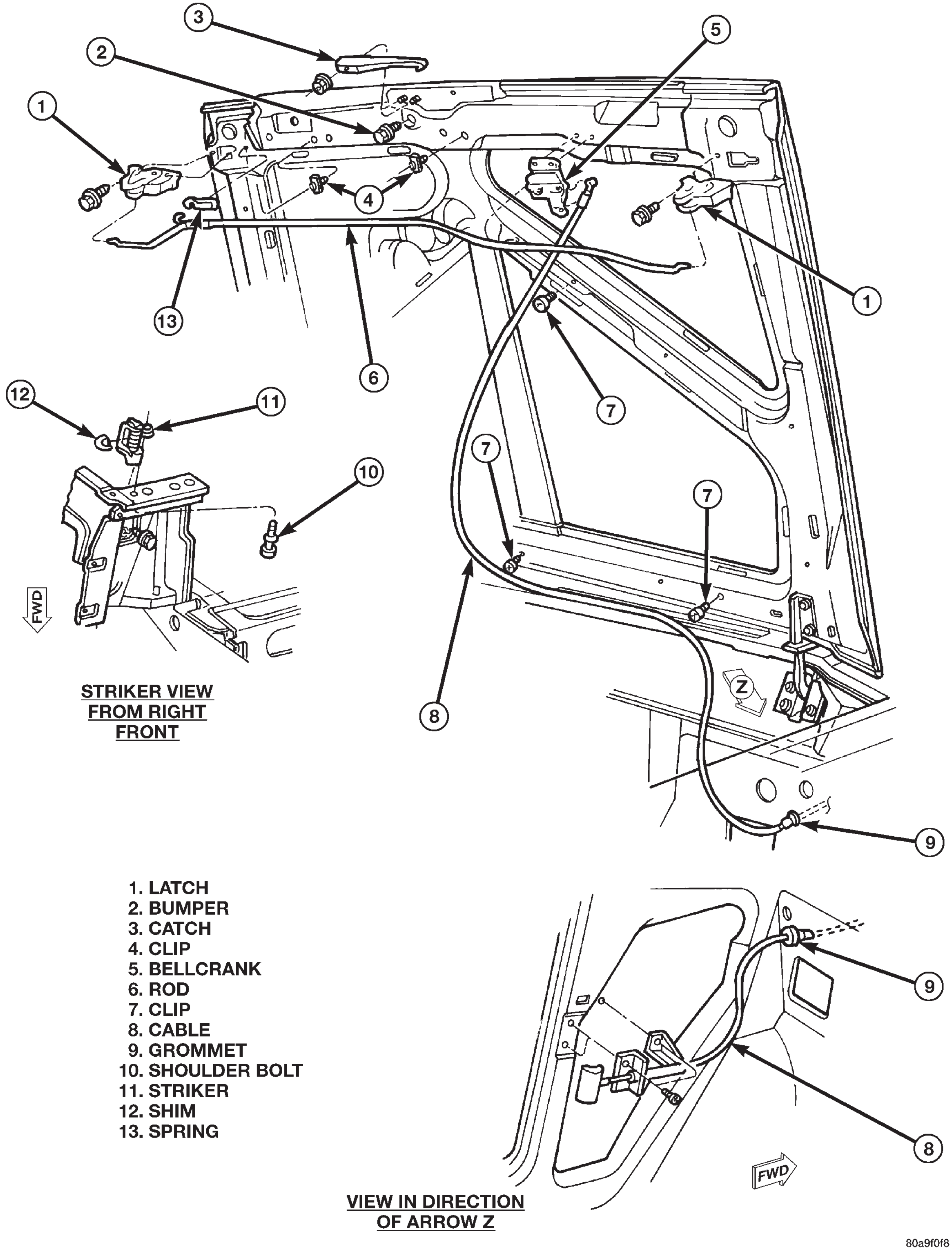


Fig. 3 Hood Components

REMOVAL AND INSTALLATION (Continued)

(2) Using a grease pencil or equivalent, mark position of hood.
(3) Remove seal from hinge base (Fig. 4).
(4) Remove hinge retaining nuts from studs.

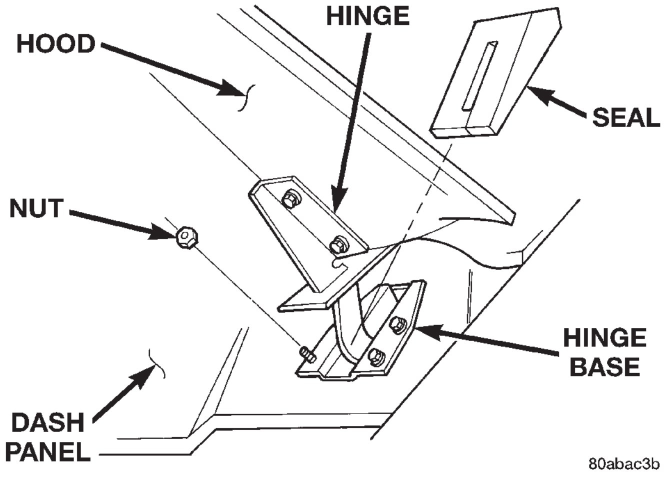


Fig. 4 Hood Hinge and Seal

INSTALLATION

(1) Position hinge over studs and align with reference marks.
(2) Install nuts.

NOTE: If a replacement hinge seal is being installed, position it around hinge arm, force it against hinge base.

(3) Position hinge seal around hinge arm and on hinge base.
(4) Adjust hood as necessary.

HOOD LATCH

REMOVAL

(1) Remove the screw that attaches the latch to the hood inner panel (Fig. 5).
(2) Disconnect the latch connecting rod.
(3) Remove the latch from the hood.

INSTALLATION

(1) Connect the latch to the latch connecting rod and
(2) Position the latch on the hood inner panel.
(3) Install the screw that attaches the latch to the hood inner panel.

HOOD LATCH STRIKER

REMOVAL

(1) Remove headlamp bezel.
(2) Remove parklamp.
(3) Release the spring attaching the headlamp mounting bucket to the grille opening panel (GOP).

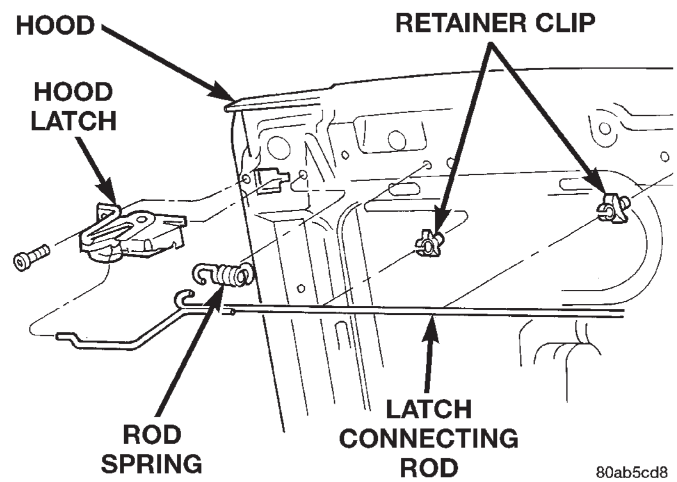


Fig. 5 Hood Latch

(4) Remove the headlamp with mounting bucket attached from the adjusting screws.
(5) Remove the upper bolt attaching the striker to the top of the (GOP).
(6) Remove the lower bolt attaching the striker to the (GOP).
(7) Remove the striker and shims.

INSTALLATION

(1) Position the shims and striker on the (GOP) and install the bolts.
(2) Install the headlamp and mounting bucket.
(3) Install parklamp.
(4) Install the headlamp bezel.
(5) Test the striker/hood alignment by opening and closing the hood several times. Adjust the striker, if necessary.

HOOD RELEASE CABLE

REMOVAL

(1) Drill out bellcrank to hood rivet heads and remove rivets (Fig. 6).
(2) Disconnect bellcrank from latch rod and hood release cable. Remove bellcrank from hood.
(3) Disconnect hood release cable from clips on hood.
(4) Remove left cowl side trim panel.
(5) Remove cable bracket screws from cowl side panel.
(6) Route cable through dash panel and remove it from under instrument panel.

INSTALLATION

(1) Insert replacement cable end through hole in dash panel into engine compartment.
(2) Route cable forward and seat grommet in dash panel.

REMOVAL AND INSTALLATION (Continued)

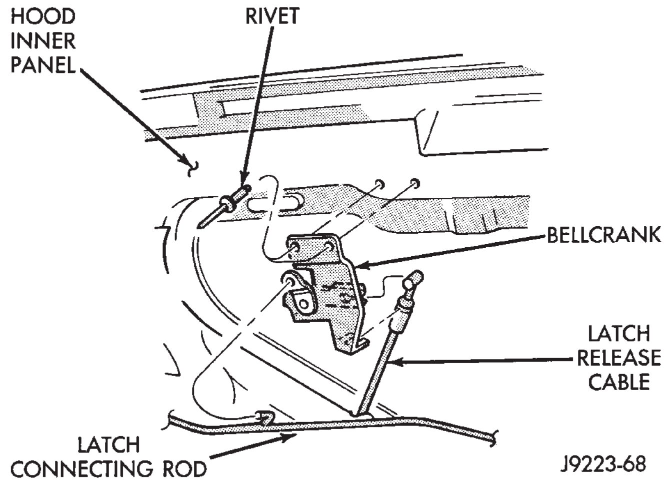


Fig. 6 Hood Release Cable Bellcrank

(3) Position cable bracket on cowl side panel and install screws.

(4) Install left cowl side trim panel.

(5) Connect cable and latch rod to bellcrank.

(6) Position bellcrank on hood and install rivets.

(7) Attach cable to clips.

(8) Test release cable for proper operation.

HOOD SAFETY LATCH

REMOVAL

(1) Open and support hood.

(2) Remove the nuts attaching the safety latch to the inner hood panel (Fig. 7).

(3) Separate the safety latch from the hood.

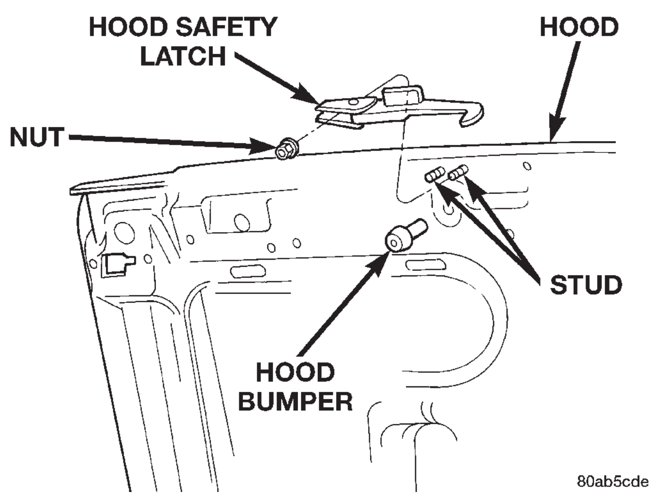


Fig. 7 Hood Safety Latch

INSTALLATION

(1) Position the safety latch on the hood.

(2) Install the nuts attaching the safety latch to the inner hood panel.

(3) Close hood.

SAFETY LATCH STRIKER

REMOVAL

(1) Remove striker screws from radiator support crossmember (Fig. 8).

(2) Remove striker from crossmember.

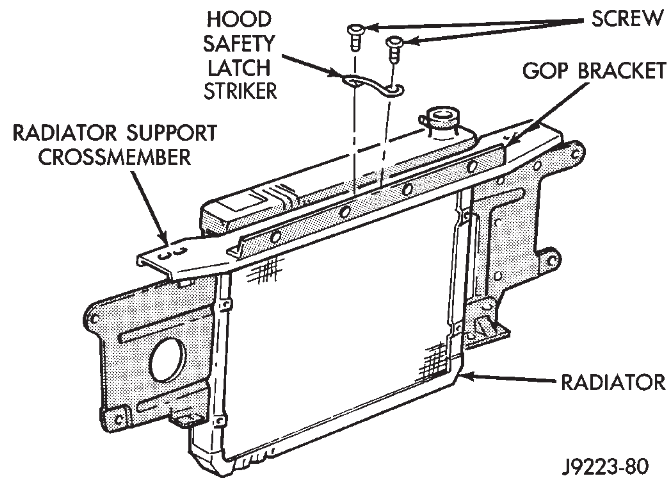


Fig. 8 Hood Safety Latch Striker

INSTALLATION

(1) Position striker on radiator support crossmember and install screws.

(2) Test safety latch operation.

HOOD SILENCER PAD

REMOVAL

(1) Open and support hood.

(2) Remove the hood latch release bellcrank.

(3) Remove the clips attaching the latch connecting rod to the hood inner panel.

(4) Remove the retainers attaching the hood silencer pad to the inner hood panel (Fig. 9).

(5) Separate the hood silencer pad from the hood.

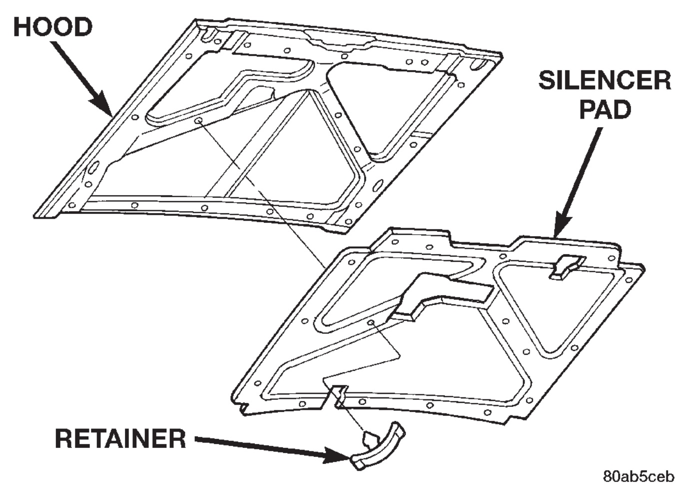


Fig. 9 Hood Silencer Pad

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position the hood silencer pad on the hood inner panel.

(2) Install the retainers attaching the hood silencer pad to the inner hood panel.

(3) Install the clips attaching the latch connecting rod to the hood inner panel.

(4) Install the hood latch release bellcrank.

(5) Close hood.

COWL WEATHERSTRIP

REMOVAL

The cowl weatherstrip is attached to the cowl with adhesive tape.

(1) Peel weatherstrip from cowl (Fig. 10).

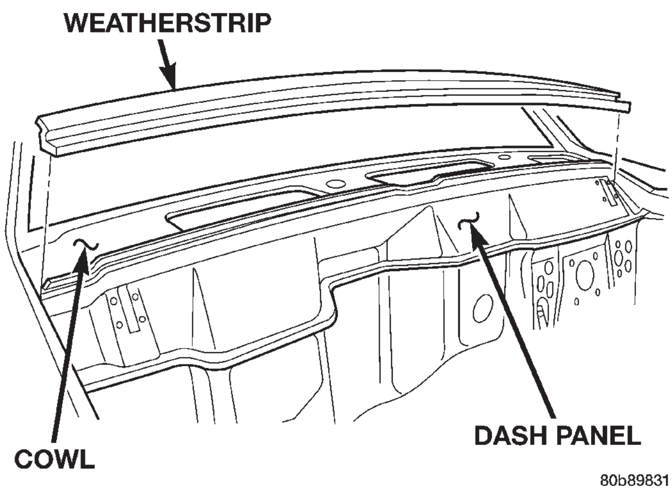


Fig. 10 Cowl Weatherstrip

INSTALLATION

(1) Clean contact surface with Mopar Super Kleen or equivalent.

(2) Position weatherstrip on cowl.

(3) Press weatherstrip into place.

COWL GRILLE

REMOVAL

(1) Remove the windshield wiper arms from the pivots.

(2) Remove the screws that attach the grille to the cowl.

(3) Remove the windshield washer tubes from the nozzles.

(4) Remove the cowl grille and screen from the cowl (Fig. 11).

INSTALLATION

CAUTION: The washer fluid tubes must be routed and installed so that they are not pinched.

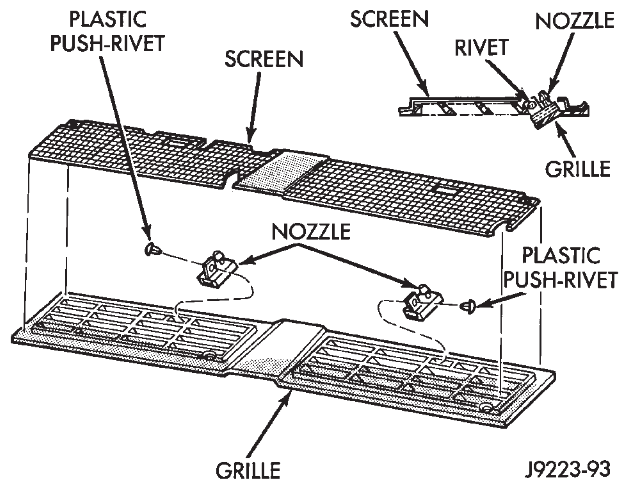


Fig. 11 Cowl Grille, Screen & Washer Nozzles

(1) Position the cowl grille and screen on the cowl.

(2) Install the windshield washer tubes on the nozzles.

(3) Install the cowl screen and grille screws with new sealer. Tighten in sequence (Fig. 12).

NOTE: Force the cowl grille rearward while tightening the screws.

(4) Install the windshield wiper arms on the pivots.

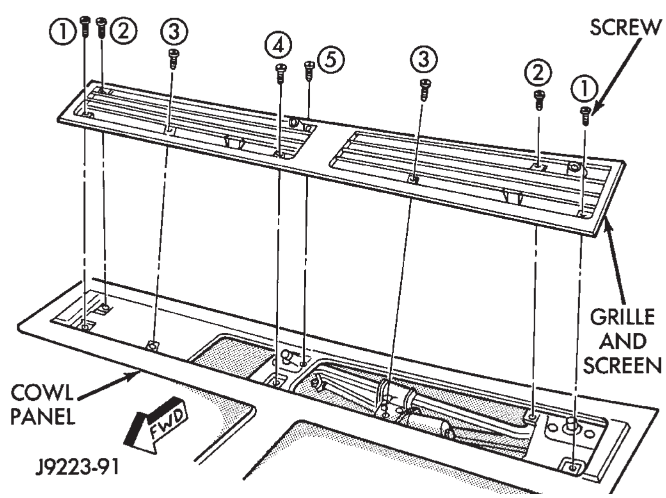


Fig. 12 Cowl Grille Screw Tightening Sequence

BODY DECALS

Small nicks, scratches and other surface marks in a decal can be touched-up with paint.

To eliminate blisters and air bubbles in a decal, pierce them with a needle or pin.

A heat gun can also be used to remove small wrinkles in a decal.

Decal replacement requires that the metal repair and paint refinish be completed first.

REMOVAL AND INSTALLATION (Continued)

The work area temperature should be between 21°C (70°F) and 32°C (90°F). **A decal should not be replaced if the work area temperature is less than 21°C (70°F).**

The following equipment and material are necessary for removal and installation:

- Liquid dish detergent (for the wetting solution).
- Mixture of wetting solution.
- Commercial wax and silicone removal solution.
- Isopropyl (rubbing) alcohol.
- Small squeegee (plastic or hard rubber).
- Water bucket and sponge.
- Clean wiping rags or paper towels.
- Heat gun (or infra-red heat bulb).
- Wax pencil.
- Sharp knife, single edge razor blade or X-acto knife.
- Pair of scissors.
- Needle or pin.

WARNING: USE DECAL REMOVAL SOLUTION IN A WELL-VENTILATED AREA ONLY.

A decal removal solution can be used for removal at areas where a heat gun is ineffective. Follow the manufacturers instructions whenever this type of product is used.

REMOVAL

(1) Clean the repaired surface as necessary.

(2) 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 panel.**

INSTALLATION

(1) The area that will be covered by the decal must be cleaned with cleaning solution.

(2) Freshly painted surfaces must be thoroughly dry.

(3) Clean the painted surface with a commercial wax and silicone removal solution. Wipe the surface with a clean cloth and allow it to dry.

(4) Prepare a wetting solution by mixing two or three teaspoons of dish detergent with 1 gallon of water. Do not use soap.

NOTE: Too much detergent will reduce the effectiveness of the mixture.

(5) Use a clean sponge and apply the wetting solution to the adhesive side of the decal and to the painted panel surface. The wetting solution will permit ease of decal movement when positioning it.

(6) Align a straight edge with the existing decal ends (Fig. 13).

NOTE: If applicable, the body panel character line can be used as the decal alignment reference.

(7) Position the decal and carrier on the body panel (Fig. 14) and the mark length with a wax pencil.

(8) Position the decal and carrier on the body panel and hold it in-place with masking tape.

(9) Lift the bottom edge of decal and carrier. Use the tape sections as hinges, and reverse the position of decal and carrier.

CAUTION: Always remove the carrier from the decal, never remove the decal from carrier

(10) Bend a corner of carrier outward and then, with a flick of the finger, separate the corner of carrier from the decal.

(11) Return the decal back to its original position. If a solution is being used, position adhesive side of the decal on panel. Apply the solution to the outside of the decal.

(12) Hold the decal against the panel surface while separating the carrier from the decal.

(13) If applicable, remove the cover from face of decal.

(14) Using a squeegee smooth out the decal to remove wrinkles and/or air bubbles.

(15) Inspect the decal with reflected light to find any damage. Remove all the air and/or moisture bubbles.

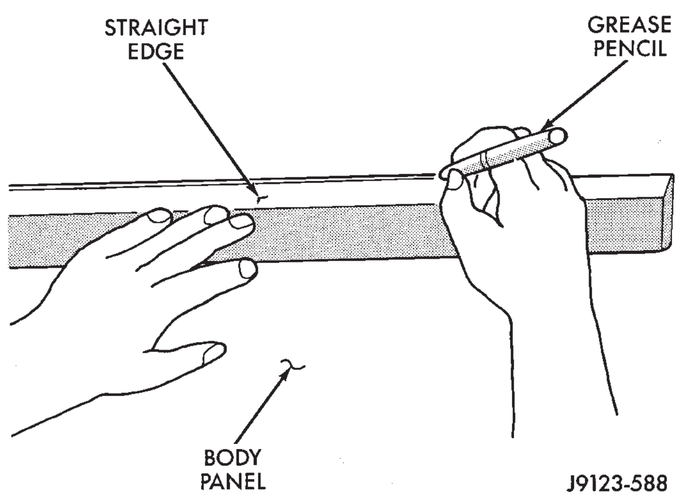


Fig. 13 Decal Alignment Reference Mark

EXTERIOR NAMEPLATES

REMOVAL

NOTE: Exterior nameplates are attached to body panels with adhesive tape.

REMOVAL AND INSTALLATION (Continued)

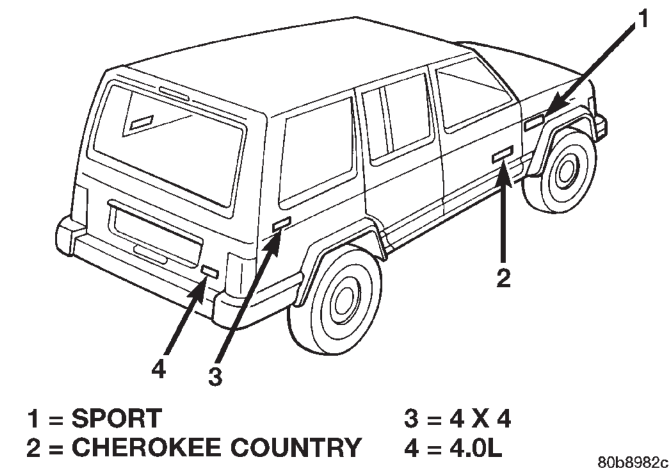


Fig. 14 Body Decals

(1) Apply a length of masking tape on the body, parallel to the top edge of the nameplate to use as a guide, if necessary.

(2) If temperature is below 21°C (70°F) warm emblem with a heat lamp or gun. Do not exceed 52°C (120°F) when heating emblem.

(3) Insert a plastic trim stick or a hard wood wedge behind the emblem to separate the adhesive backing from the body.

(4) Clean adhesive residue from body with MOPAR Super Clean solvent or equivalent.

INSTALLATION

(1) Remove protective cover from adhesive tape on back of emblem.

(2) Position emblem properly on body (Fig. 15).

(3) Press emblem firmly to body with palm of hand.

(4) If temperature is below 21°C (70°F) warm emblem with a heat lamp or gun to assure adhesion. Do not exceed 52°C (120°F) when heating emblem.

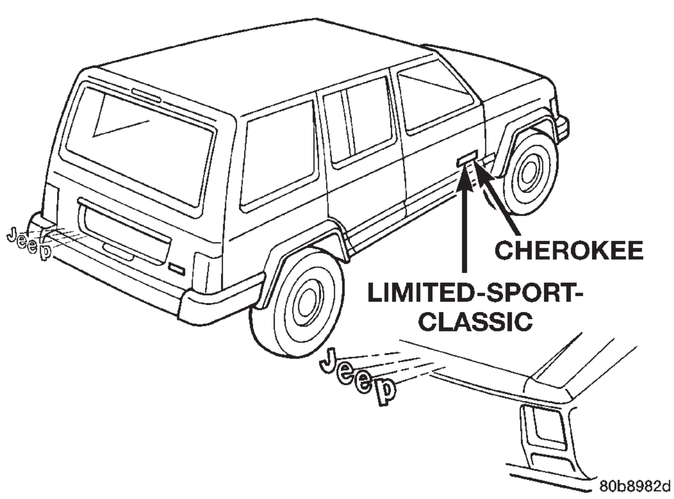


Fig. 15 Exterior Nameplates

SIDE VIEW MIRROR

REMOVAL

(1) Remove the door trim panel.

(2) Remove the screw attaching the mirror trim cover/speaker grille to the door inner panel.

(3) remove push-in fastener attaching trim cover to door inner panel (use special tool C-4829).

(4) Disconnect the power mirror wire connector, if equipped.

(5) Remove the screws attaching the mirror to the door (Fig. 16).

(6) Separate the mirror from the door.

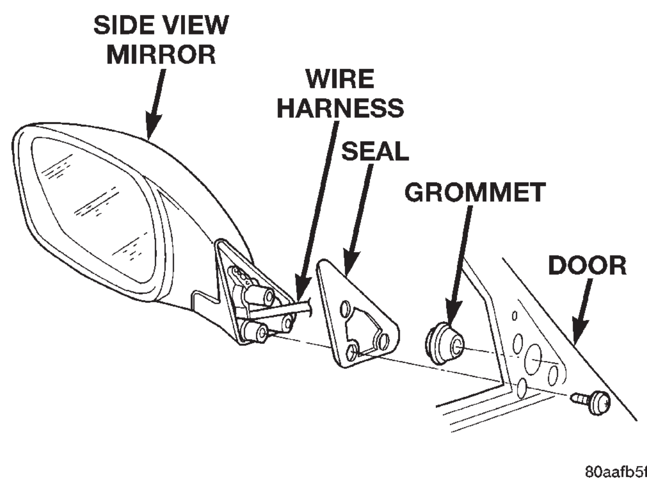


Fig. 16 Side View Mirror

INSTALLATION

(1) Position the mirror on the door.

(2) Install the screws attaching the mirror to the door.

(3) Connect the power mirror wire connector, if equipped.

(4) Install new push-in fastener.

(5) Install the mirror trim cover/speaker grille.

(6) Install the door trim panel.

FRONT FENDER FLARE

REMOVAL

(1) Remove the screw attaching the lower part of flare to the bottom of the fender.

(2) Remove the nuts attaching the fender flare retainer to the wheelhouse splash shield (Fig. 17).

(3) Remove the liner from the fender.

(4) Remove the fasteners attaching the fender flare and retainer to the fender.

(5) Separate the fender flare and retainer from the fender.

REMOVAL AND INSTALLATION (Continued)

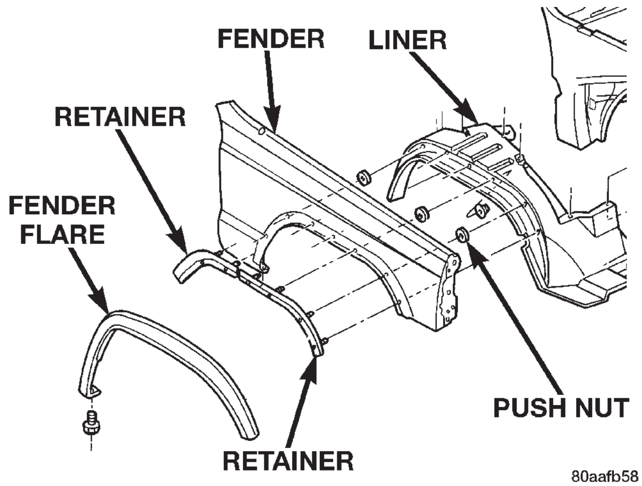


Fig. 17 Fender Flare

INSTALLATION

(1) Position the fender flare and retainer on the fender.

(2) Install the nuts attaching the fender flare and retainer to the wheelhouse fender.

(3) Install the screw attaching the lower part of flare to the bottom of the fender.

FRONT WHEELHOUSE LINER

REMOVAL

(1) Hoist vehicle.

(2) Remove tire.

(3) Remove the push-in fasteners attaching the wheelhouse liner to the inner fender.

(4) Separate the wheelhouse liner from the fender (Fig. 18).

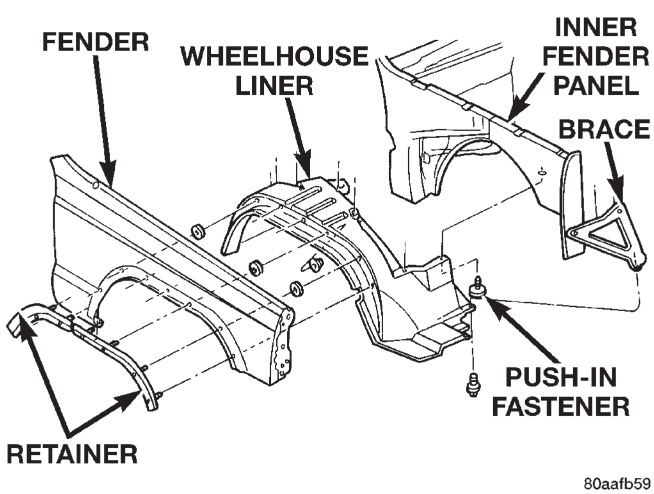


Fig. 18 Front Wheelhouse Liner

INSTALLATION

(1) Position the wheelhouse liner in the fender.

(2) Install new push-in fasteners attaching the wheelhouse liner to the inner fender.

(3) Install tire.

(4) Lower vehicle.

RIGHT FRONT FENDER

REMOVAL

(1) Raise and support the hood.

(2) Remove the grille opening panel (GOP).

(3) If equipped, remove the radio antenna mast, and components from the fender.

(4) Remove the coolant recovery bottle.

(5) Raise and support the vehicle.

(6) Remove the right front wheel.

(7) Remove the front bumper end cap.

(8) Remove the wheelhouse liner.

(9) Remove the fender flare and retainers.

(10) Disconnect all wire harness connectors.

(11) Remove the air deflector.

(12) Remove the fender lower screws (Fig. 19).

(13) Remove the fender top, front and the rear screws.

(14) Remove the screws attaching the fender to the inner support bracket (Fig. 20).

(15) Separate the fender from the inner fender panel.

INSTALLATION

(1) Position the fender on the inner fender panel.

(2) Install all fender screws finger-tight.

(3) Align the fender with the body panels and tighten the screws attaching the fender to the body panels.

(4) Install the air deflector.

(5) Install the fender flare and retainers.

(6) Install the wheelhouse liner.

(7) Install the front bumper end cap.

(8) Install the wheel, remove the support and lower the vehicle.

(9) Install the grille opening panel (GOP).

(10) Install the radio antenna.

LEFT FRONT FENDER

REMOVAL

(1) Raise and support the hood.

(2) Remove the grille opening panel (GOP).

(3) Raise and support the vehicle.

(4) Remove the left front wheel.

(5) Remove the front bumper end cap.

(6) Remove the fender flare and retainers.

(7) Remove the wheelhouse liner.

(8) Remove the air deflector.

(9) Remove the fender lower screws.

(10) Remove the fender top, front and the rear screws.

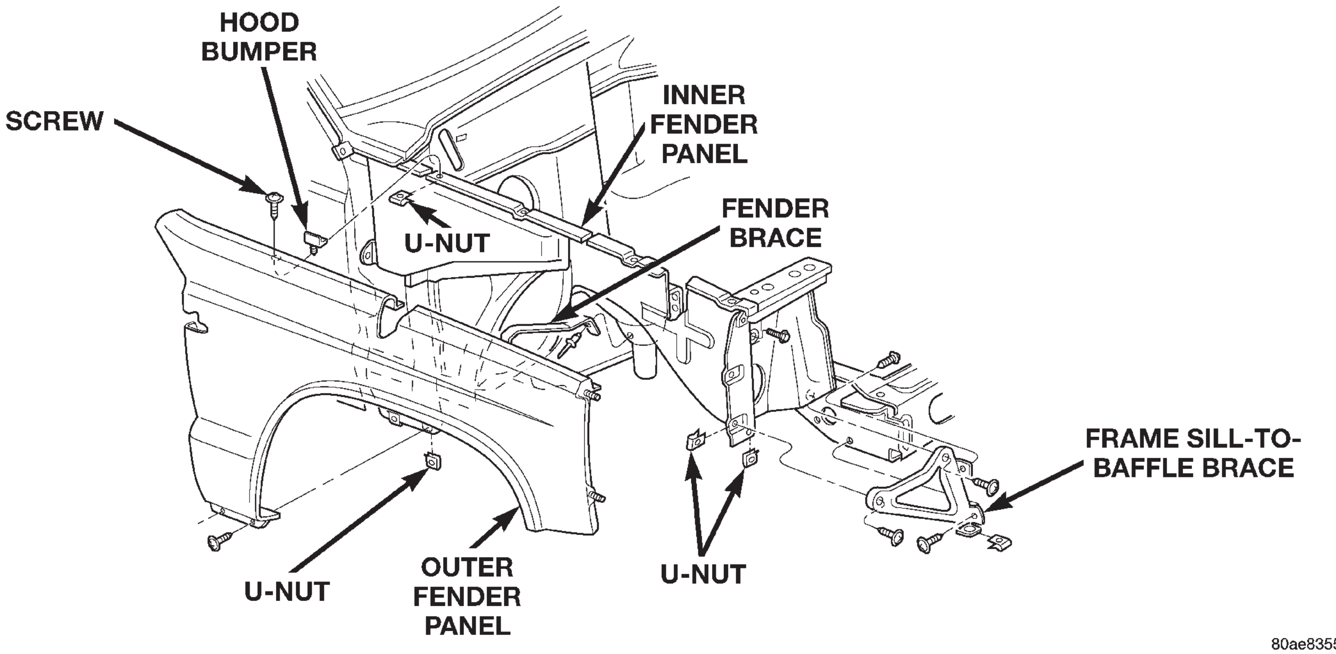


Fig. 19 Right Front Fender

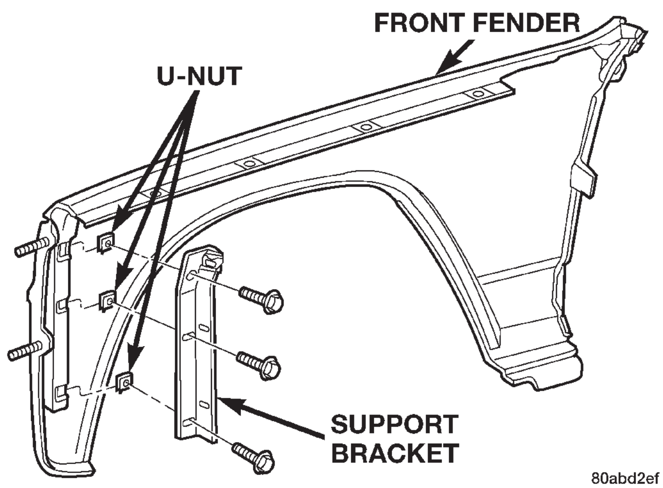


Fig. 20 Inner Support Bracket

(11) Remove the screws attaching the fender to the inner support bracket.

(12) Separate the fender from the inner fender panel.

INSTALLATION

(1) Position the fender on the inner fender panel.

(2) Install all fender screws finger-tight.

(3) Align the fender with the body panels and tighten the screws attaching the fender to the body panels.

(4) Install the air deflector.

(5) Install the wheelhouse liner.

(6) Install the fender flare and retainers.

(7) Install the front bumper.

(8) Install the wheel, remove the support and lower the vehicle.

(9) Install the grille opening panel (GOP).

FRONT DOOR TRIM PANEL

REMOVAL

(1) Roll window down.

(2) Remove window crank, if equipped (Fig. 21).

(3) Remove the screws attaching the trim panel to the door inner panel (Fig. 22) and (Fig. 23).

(4) Separate the trim panel fasteners from door inner panel with a pry tool (use special tool C-4829) (Fig. 24).

(5) Lift the trim panel up and outward to separate from the inner belt seal.

(6) Move the door trim panel outward and disconnect the handle-to-latch rods.

(7) Disconnect the power door locks/windows/mirrors wire harness connectors, if equipped.

(8) Remove the trim panel from door.

INSTALLATION

(1) Replace any broken or damaged push-in fasteners.

(2) Connect the power door locks/windows/mirrors wire harness connectors, if equipped.

(3) Move the door trim panel outward and connect the handle-to-latch rods.

(4) Position the trim panel on the inner belt seal and push down to seat.

(5) Align the locating pins and push- (Fig. 25) in fasteners. Press inward to secure.

REMOVAL AND INSTALLATION (Continued)

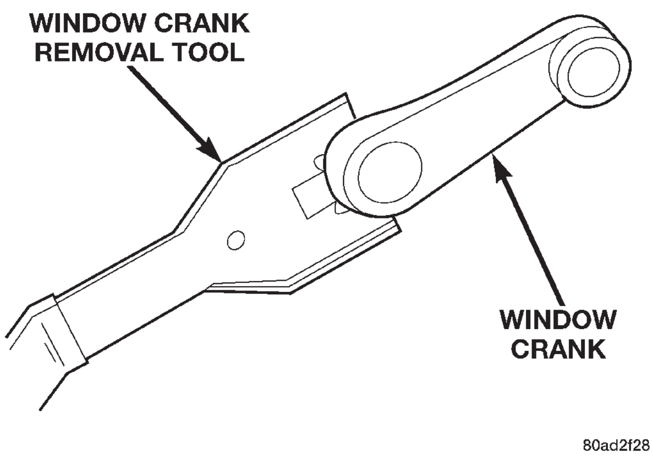


Fig. 21 Window Crank—Typical

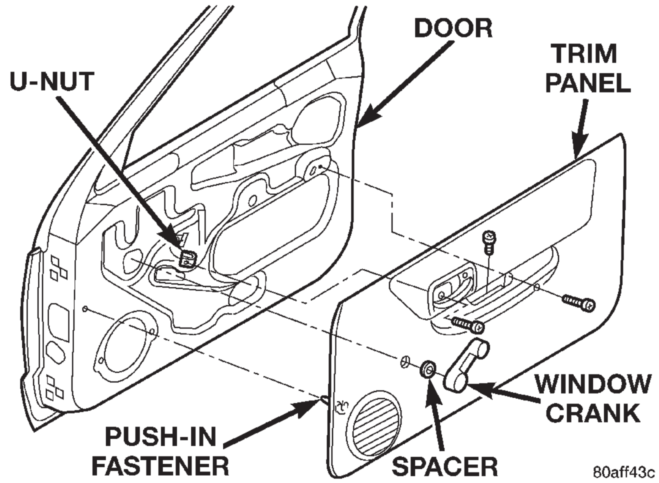


Fig. 22 Front Door Trim Panel-Manual Window

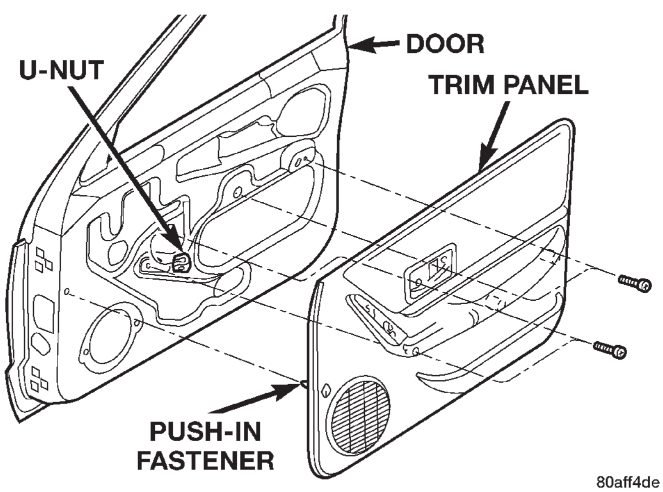


Fig. 23 Front Door Trim Panel-Power Window

(6) Install the screws attaching the trim panel to the door inner panel.

(7) Install the window crank, if equipped.

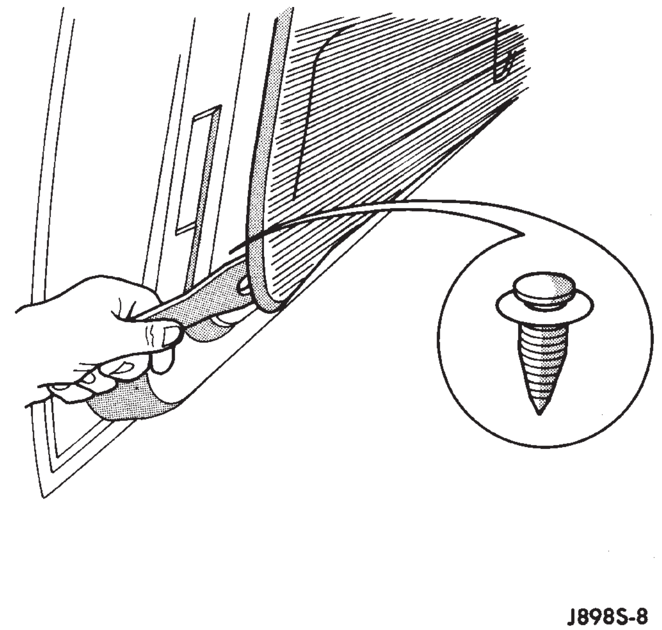


Fig. 24 Detaching Trim Panel Push-In Fasteners

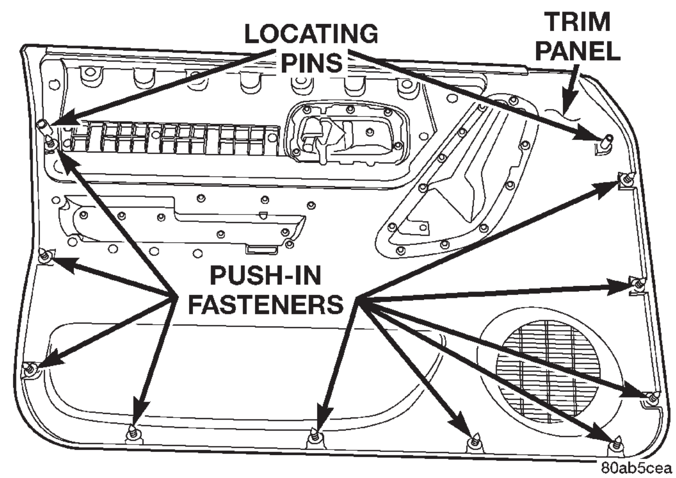


Fig. 25 Push-In Fasteners

FRONT DOOR WATERDAM

REMOVAL

The waterdam is attached to the door inner panel with a butly adhesive. If cohesive separation of the butly between the waterdam and door inner panel occurs during the removal process, cut the strands of butly with a razor knife or equivalent.

(1) Remove door trim panel.

(2) Disengage clips attaching wire harnesses to the door inner panel.

(3) Push the harnesses/connectors through the waterdam and into the door.

(4) Grasp the upper and lower rearward corners of the waterdam and rapidly peel back the waterdam from the door inner panel.

(5) Separate the waterdam from the door inner panel.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Route the latch rods through the waterdam.

(2) Position the waterdam on the door, apply adhesive as necessary and press into place.

(3) Route the harnesses/connectors through the waterdam.

(4) Engage clips attaching wire harnesses to the door inner panel.

(5) Install door trim panel.

FRONT DOOR

REMOVAL

(1) Remove door restraint (check) retaining pin.

(2) For vehicles equipped with power windows, power mirrors and power door locks, remove trim panel and waterdam. Disconnect all components and route wire harness out of door.

(3) Remove bolts that attach hinge to door. (Fig. 26).

(4) Remove door from vehicle.

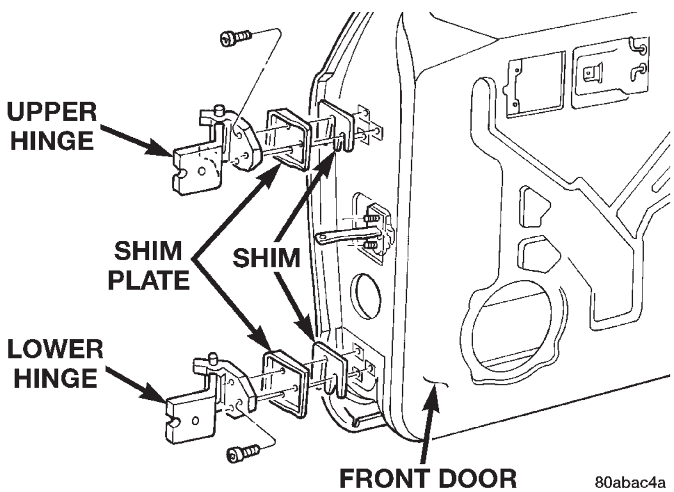


Fig. 26 Front Door Hinge

INSTALLATION

(1) Position door in body opening.

(2) Align door hinges, plates and shims and install bolts. Tighten bolts to 3 N·m (2 ft. lbs.) torque.

(3) Install door restraint (check) pin.

(4) If applicable, route and connect wire harness connectors.

(5) Install door waterdam and trim panel.

FRONT DOOR HINGE

REMOVAL

(1) Remove door restraint (check) retaining pin.

(2) Remove door hinge bolts and shims (Fig. 27).

(3) Retain door hinge shims for correct installation.

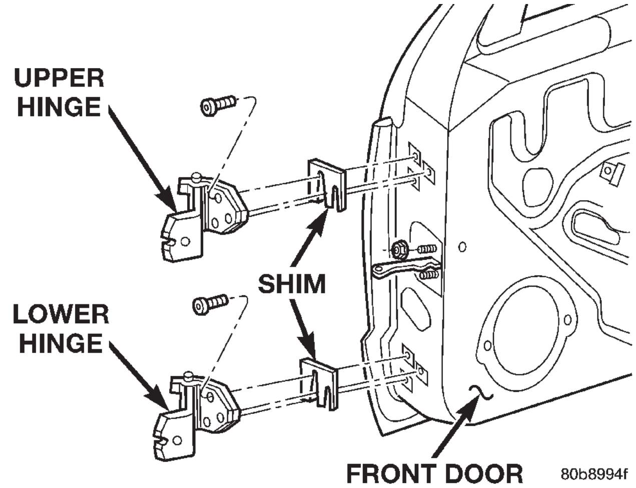


Fig. 27 Front Door Hinge

INSTALLATION

(1) Position hinge plates and shims on door face.

(2) Align door hinges and shims with bolt holes and install hinge bolts. Tighten bolts to 3 N·m (2 ft. lbs.) torque.

(3) Adjust/align latch striker and latch as necessary.

(4) Install door restraint (check) retaining pin.

FRONT DOOR RESTRAINT

REMOVAL

(1) Remove door trim panel.

(2) Remove door radio speaker from door inner panel.

(3) Remove door restraint (check) retaining pin from bracket with a punch.

(4) Remove nuts and remove restraint via speaker opening. (Fig. 28).

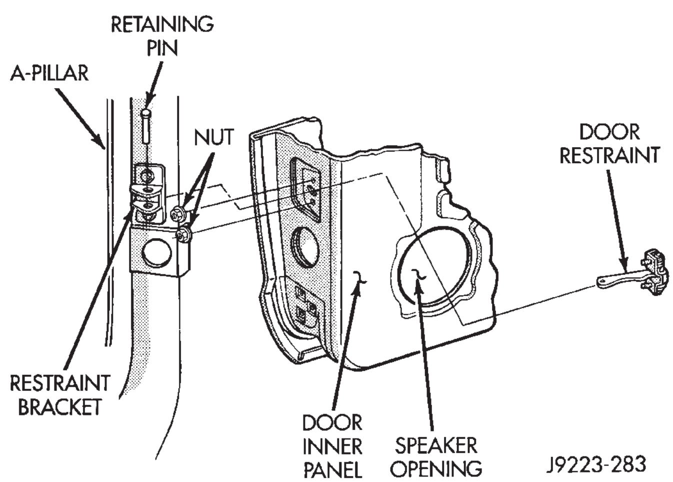


Fig. 28 Door Restraint (Check)

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position door restraint in door by way of opening and install nuts.

NOTE: Ensure the spring on the door restraint is facing outward.

(2) Position door restraint in bracket with holes aligned and insert retaining pin.
(3) Install radio speaker and door trim panel.

FRONT DOOR OUTSIDE HANDLE

REMOVAL

(1) Remove the door trim panel and waterdam.
(2) Remove the access hole cover and remove the rearward nut attaching the door handle to the door. (Fig. 29).
(3) Disconnect the handle-to-latch rod from the handle latch release lever arm.
(4) Remove the forward nut attaching the handle to the door.
(5) Separate the handle from the door.

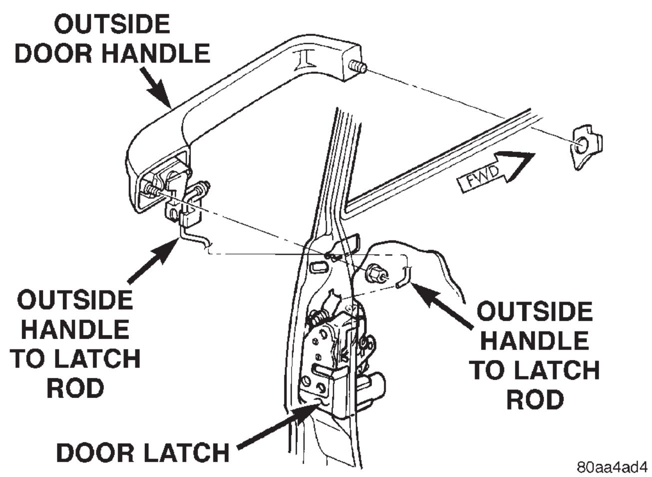


Fig. 29 Front Door Outside Handle

INSTALLATION

(1) Position the handle in the door.
(2) Install the forward nut attaching the handle to the door.
(3) Connect the latch to handle rod, to the handle latch release lever arm.
(4) Install the rearward nut attaching the door handle to the door.
(5) Install the access hole cover.
(6) Install the door waterdam and trim panel.

FRONT DOOR LOCK CYLINDER

REMOVAL

(1) Remove the door trim panel.
(2) Peel back waterdam to access lock cylinder.
(3) Disconnect the door latch-to-lock cylinder rod at the door latch (Fig. 30).
(4) Remove the lock cylinder retainer clip.
(5) Remove the lock cylinder.
(6) If applicable, remove the door latch-to-lock cylinder rod from the original lock cylinder. Connect it to the replacement lock cylinder.

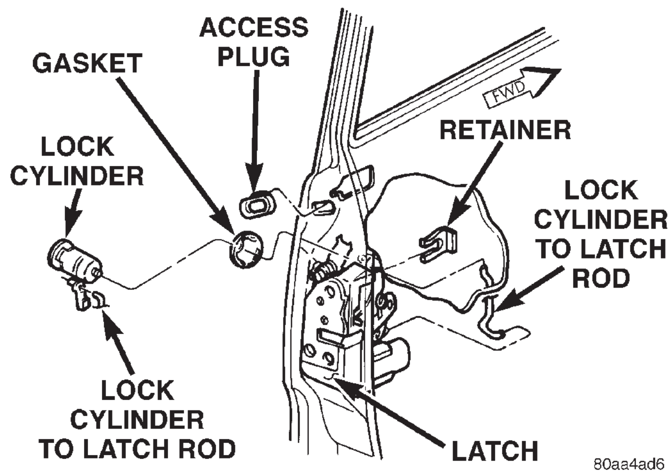


Fig. 30 Door Lock Cylinder

INSTALLATION

(1) Position the lock cylinder and in the door opening.
(2) Install the retainer clip.
(3) Connect the door latch-to-lock cylinder rod to the door latch.
(4) Press the waterdam into position.
(5) Install the door trim panel.

FRONT DOOR LATCH

REMOVAL

(1) Remove door trim panel and waterdam.
(2) Remove screws attaching latch to door.
(3) Disconnect all rods from latch (Fig. 31).
(4) Disconnect power lock motor wire connector, if equipped.
(5) Remove latch from door face.

INSTALLATION

(1) Position latch on door face.
(2) Connect power lock motor wire connector, if equipped.
(3) Connect all rods to latch.
(4) Install screws attaching latch to door. Tighten screws to 11 N·m (8 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

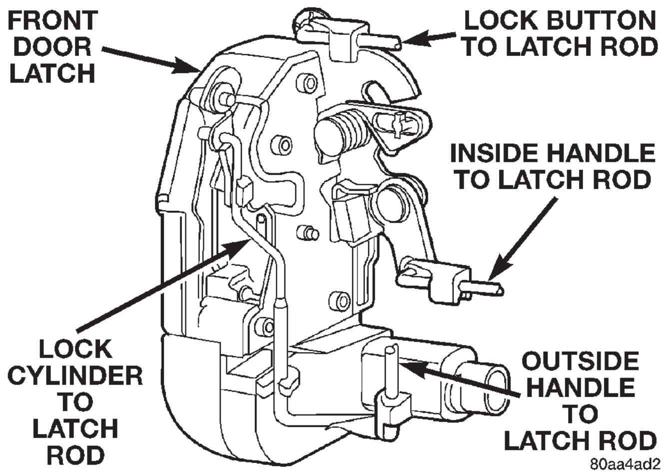


Fig. 31 Door Latch

(5) Install waterdam and door trim panel.

FRONT DOOR LATCH STRIKER

REMOVAL

(1) Using a grease pencil or equivalent, mark position of striker.

(2) Remove screws attaching striker to B-pillar (Fig. 32).

(3) Separate striker from B-pillar.

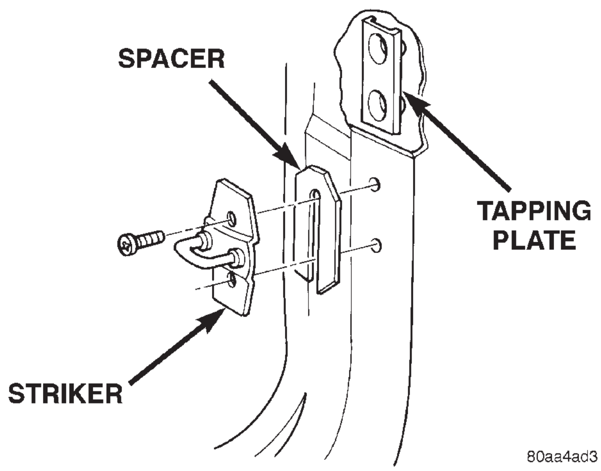


Fig. 32 Front Door Latch Striker

INSTALLATION

(1) Position and align striker on B-pillar.

(2) Install screws attaching striker to B-pillar. Tighten screws to 28 N·m (20 ft. lbs.) torque.

FRONT DOOR INSIDE HANDLE ACTUATOR

REMOVAL

The front door inside handle actuator is heat staked to the front door trim panel during the manufacturing process.

(1) Remove the door trim panel.

(2) Using an X-ACTO knife or equivalent, cut the melted tabs securing the inside handle to the door trim panel.

(3) Separate the inside handle from the trim panel.

INSTALLATION

(1) Position the inside handle in the trim panel.

(2) Heat stake the inside handle to the trim panel.

(3) Install the door trim panel.

FRONT DOOR INNER BELT WEATHERSTRIP

REMOVAL

(1) Roll window down.

(2) Remove door trim panel.

(3) Pull up on the rear corner of the weatherstrip and lift from the door (Fig. 33).

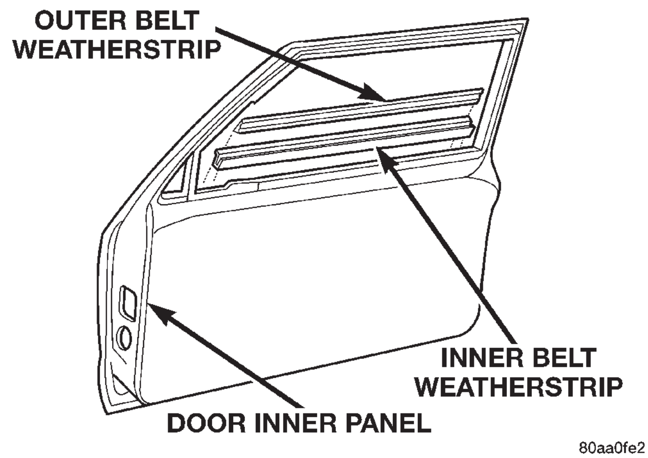


Fig. 33 Front Door Inner/Outer Belt Weatherstrip

INSTALLATION

(1) Position the weatherstrip on the door.

(2) Push weatherstrip down to seat onto door.

(3) Install door trim panel.

FRONT DOOR OUTER BELT WEATHERSTRIP

REMOVAL

(1) Roll window down.

(2) Using a trim stick, pry up the rear outer corner of the weatherstrip.

(3) Lift the weatherstrip up to separate from the door (Fig. 33).

INSTALLATION

(1) Position the weatherstrip on the door.

(2) Push weatherstrip down to seat onto door.

REMOVAL AND INSTALLATION (Continued)

FRONT DOOR GLASS RUN CHANNEL WEATHERSTRIP

REMOVAL

(1) Remove door trim panel.
(2) Remove waterdam.
(3) Starting at rear corner, peel weatherstrip from around door frame.

INSTALLATION

(1) Install the weatherstrip in the following sequence:
- Press weatherstrip into upper rear corner.
- Press weatherstrip into lower front corner.
- Work/press the weatherstrip upward and to the upper front corner, seat the weatherstrip into the channel.
- Continue working/pressing the weatherstrip into the channel along the upper window frame.
- Press weatherstrip into lower rear corner.
- Work/press the weatherstrip upward and to the upper rear corner, seat the weatherstrip into the channel.
- Press the weatherstrip to seat into the front lower glass run channel.

(2) As applicable, move upward and forward evenly until the weatherstrip seal is fully seated in the channel.
(3) Install waterdam.
(4) Install door trim panel.

FRONT DOOR OPENING WEATHERSTRIP

REMOVAL

(1) Remove A-pillar trim panel.
(2) Remove B-pillar upper trim panel.
(3) Remove cowl side trim panel.
(4) Remove inner scuff plate.
(5) Remove B-pillar lower trim panel.
(6) Grasp seal and separate from door opening.

INSTALLATION

(1) Position weatherstrip at corners.
(2) Move upward and around edge of door opening. Seat seal on flange.
(3) When installing a door opening weatherstrip seal, start at the door sill center line.
(4) Move upward and around the perimeter of the door opening and seat the weatherstrip on the flange (Fig. 35).
(5) Install cowl side trim panel.
(6) Install inner scuff plate.
(7) Install B-pillar lower trim panel.
(8) Install B-pillar upper trim panel.
(9) Install A-pillar trim panel.

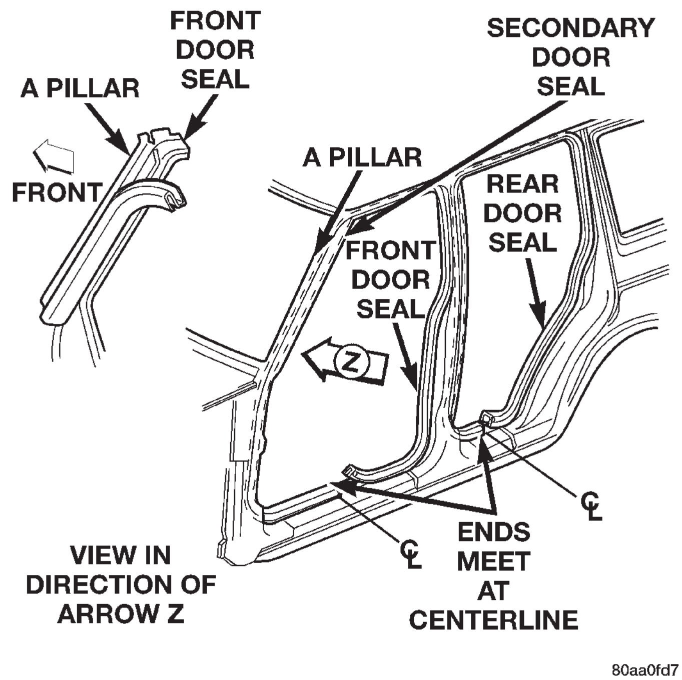


Fig. 34 Door Opening Weatherstrip

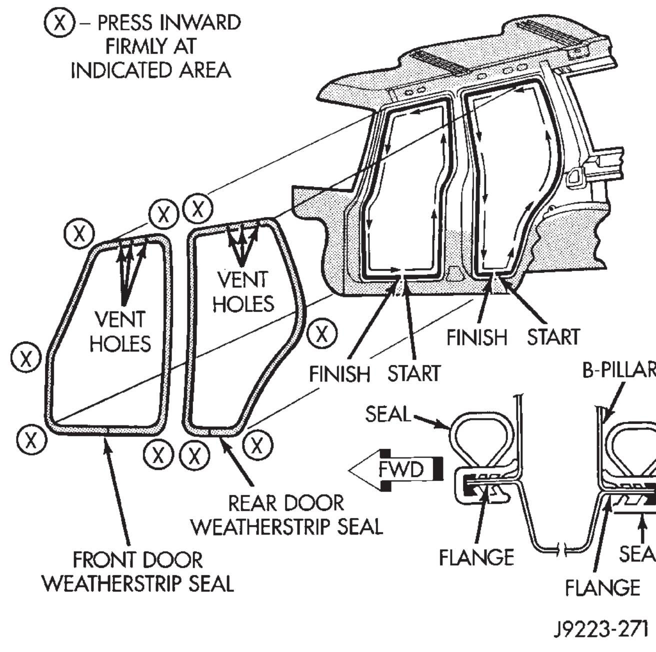


Fig. 35 Door Opening Weatherstrip

FRONT DOOR OPENING SECONDARY WEATHERSTRIP

REMOVAL

The front door opening secondary weatherstrip is attached to the A-pillar with adhesive tape (Fig. 34).

(1) Using a heat gun, heat the weatherstrip and slowly peel the weatherstrip from the A-pillar

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Clean the contact surface on the A-pillar.

(2) Remove the carrier backing and position the weatherstrip on the A-pillar. Press into place.

FRONT DOOR GLASS EXTERIOR MOLDING

REMOVAL

(1) Open the window completely.

(2) Remove the outer belt weatherstrip.

(3) Pry and pull the molding sections from the door panel flange (Fig. 36).

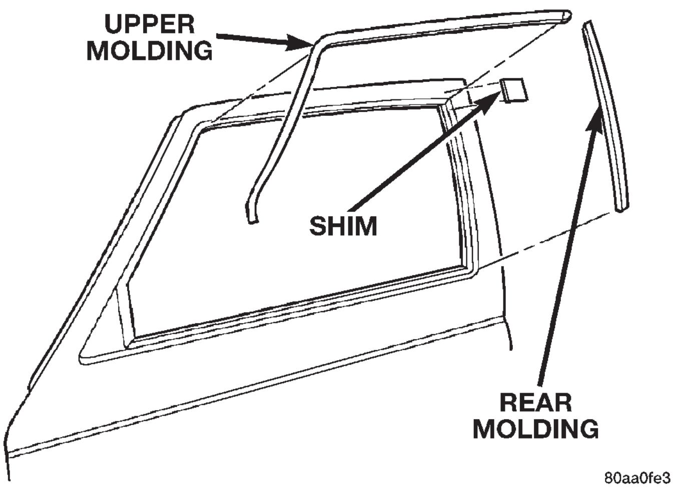


Fig. 36 Front Door Glass Exterior Molding

INSTALLATION

(1) Start at the forward end of the upper molding, force the molding onto the door panel and continue rearward until it is completely seated on the flange.

(2) Mate the rear molding with the upper molding and force the molding edge inward.

(3) Continue pressing and moving downward to complete the installation.

(4) Install the outer belt weatherstrip.

FRONT DOOR WINDOW REGULATOR

REMOVAL

(1) Remove the door trim panel.

(2) Remove the waterdam.

(3) Remove the window glass.

(4) Loosen the bolts attaching the regulator to the inner door panel (Fig. 37) and (Fig. 38) as applicable.

(5) Lift the regulator upward to release it from the key hole slots and remove it through the access hole in the door inner panel.

INSTALLATION

(1) Position the regulator in the door and align with key hole slots.

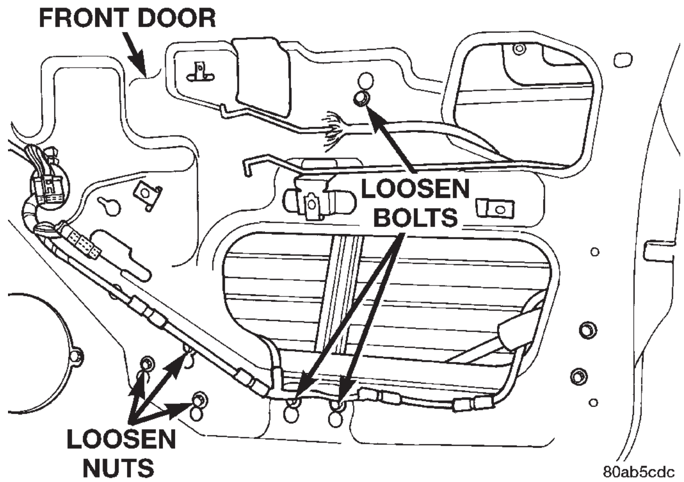


Fig. 37 Power Window Regulator

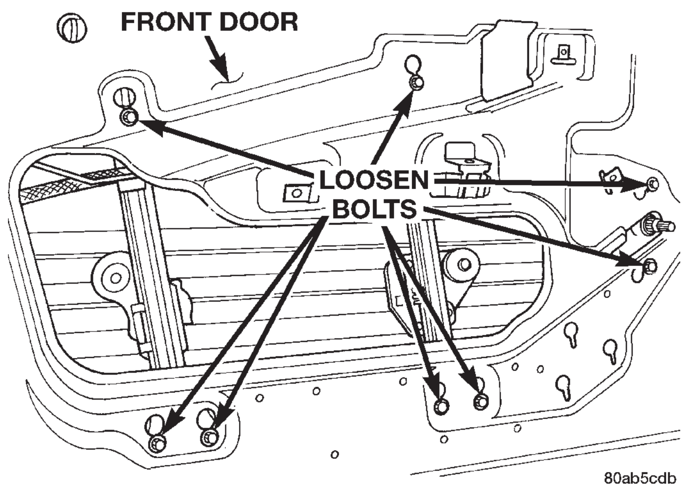


Fig. 38 Manual Window Regulator

(2) Attach the regulator to door inner panel with bolts (Fig. 39).

(3) Install the window glass

(4) Install the waterdam.

(5) Install the trim panel.

FRONT DOOR SPACER BLOCKS—TWO-DOOR VEHICLES

REMOVAL

(1) Upper spacer block: drill-out the rivet heads and remove them from the reinforcement plate (Fig. 40).

(2) Lower spacer block: remove the screws from the door face (Fig. 41).

(3) As applicable, remove the spacer block from the door window frame or door face.

INSTALLATION

(1) As applicable, position the spacer block on the door window frame or door face.

REMOVAL AND INSTALLATION (Continued)

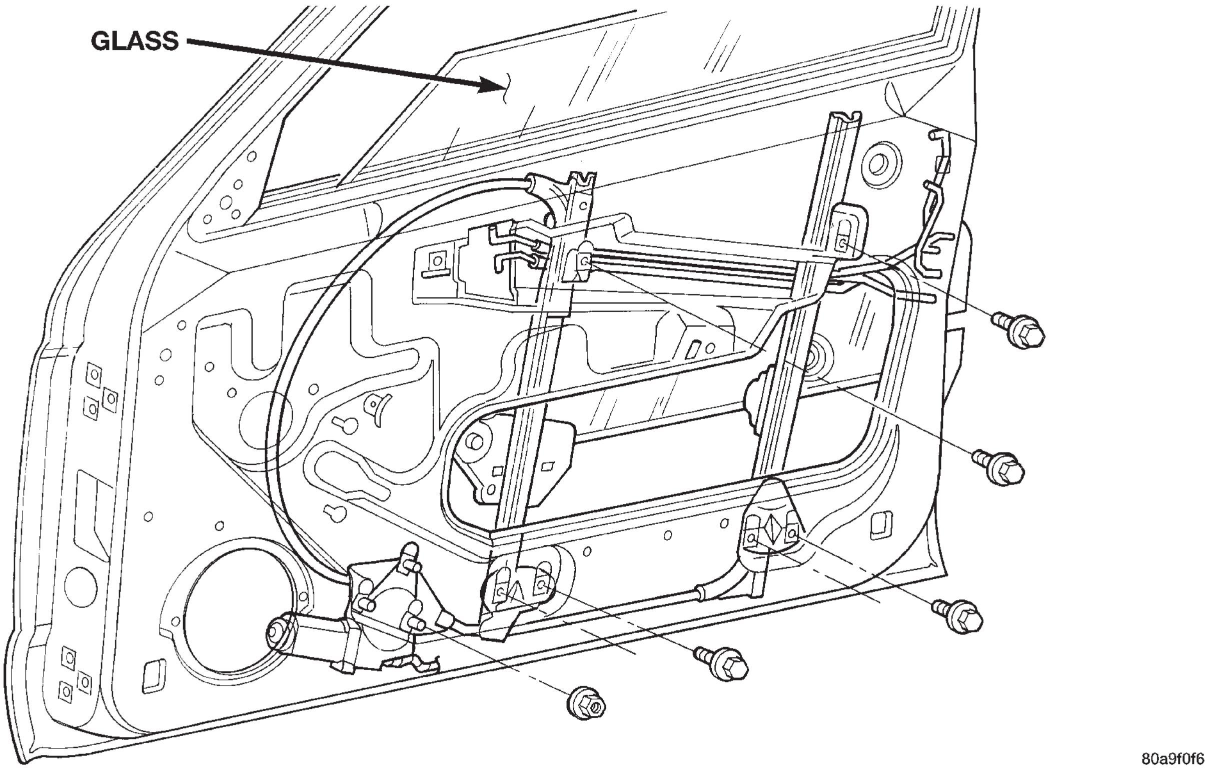


Fig. 39 Front Door Regulator

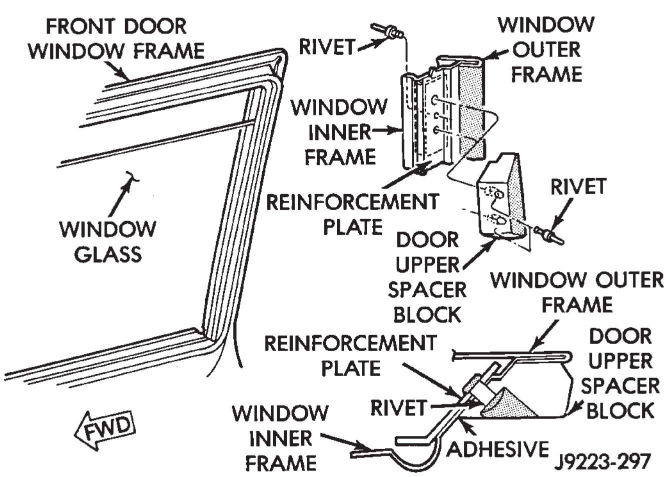


Fig. 40 Front Door Upper Spacer Block—Two-Door

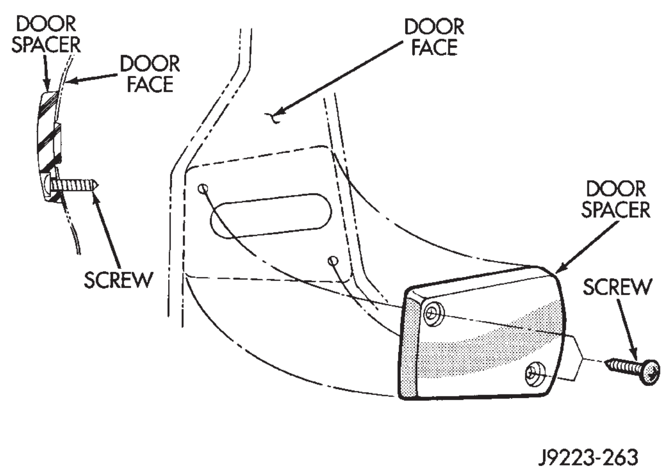


Fig. 41 Front Door Lower Spacer Block—Two-Door

(2) Upper spacer block: Install the replacement rivets in the spacer block and reinforcement plate.

(3) Lower spacer block: install the screws in the door face. Tighten the screws to 1 N·m (11 in-lbs) torque.

FRONT DOOR GLASS

REMOVAL

(1) Remove the door trim panel.

(2) Remove the waterdam.

(3) Remove inner and outer belt weatherstrip.

(4) Roll glass up to expose the bolts attaching the glass to the regulator.

(5) Remove the bolts attaching the glass to the regulator (Fig. 42).

(6) Lift the glass upward and out of the door.

INSTALLATION

(1) Position the glass in the door.

(2) Install the bolts attaching the glass to the regulator Tighten the bolts to 4 N·m (36 in-lbs) torque.

(3) Install inner and outer belt weatherstrip.

(4) Attach the door waterdam to the door inner panel with adhesive/sealant.

REMOVAL AND INSTALLATION (Continued)

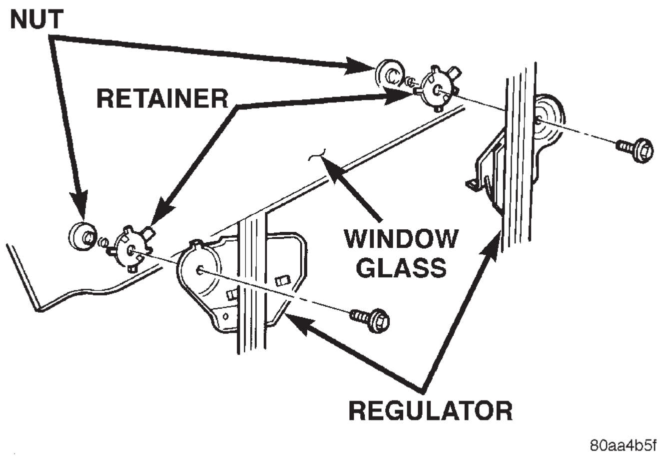


Fig. 42 Front Door Glass

(5) Install the waterdam.

(6) Install the door trim panel.

REAR DOOR TRIM PANEL

REMOVAL

(1) Roll window down.

(2) Remove window crank, if equipped (Fig. 43).

(3) Remove the screws attaching the trim panel to the door inner panel (Fig. 44) and (Fig. 45).

(4) Separate the trim panel fasteners from door inner panel with a pry tool (use special tool C-4829) (Fig. 46).

(5) Lift the trim panel up and outward to separate from the inner belt seal.

(6) Move the door trim panel outward and disconnect the handle-to-latch rods (Fig. 47).

(7) Disconnect the power windows wire harness connectors, if equipped.

(8) Remove the trim panel from door.

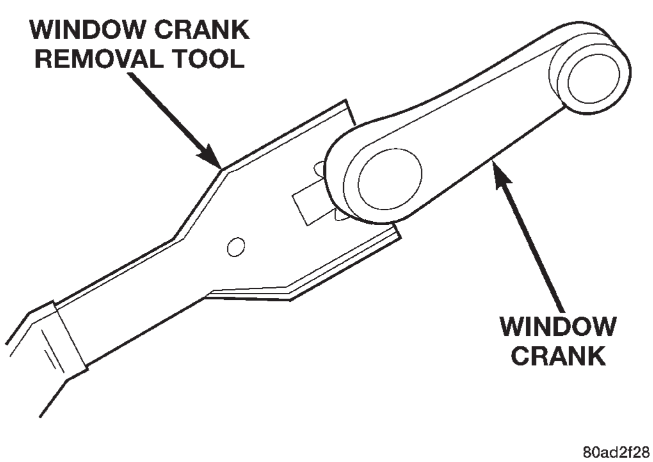


Fig. 43 Window Crank—Typical

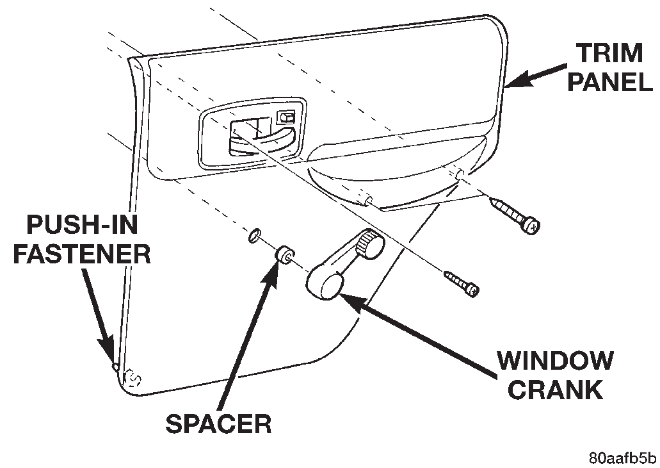


Fig. 44 Rear Door Trim Panel—Manual Window

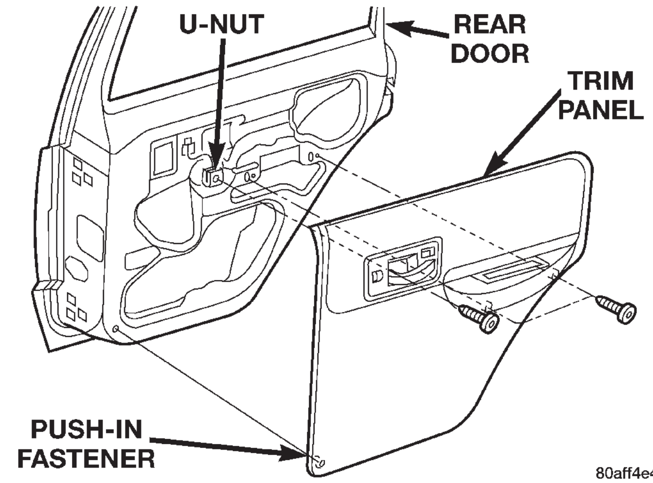


Fig. 45 Rear Door Trim Panel—Power Window

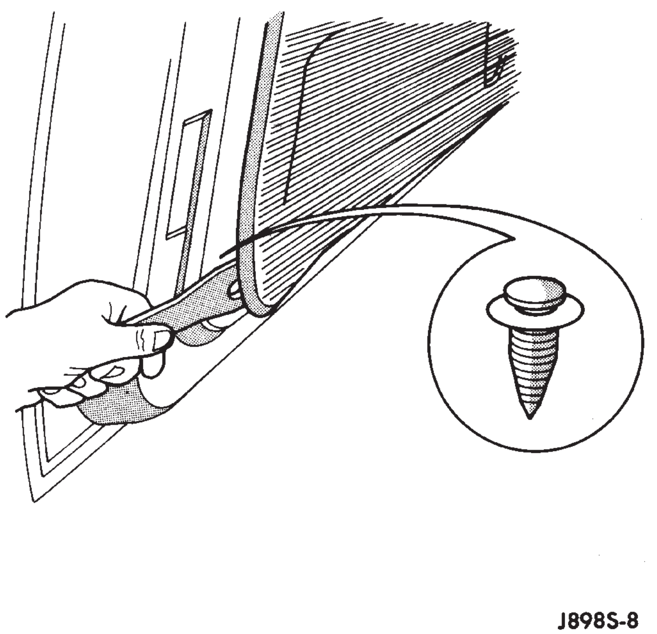


Fig. 46 Detaching Trim Panel Push-In Fasteners

REMOVAL AND INSTALLATION (Continued)

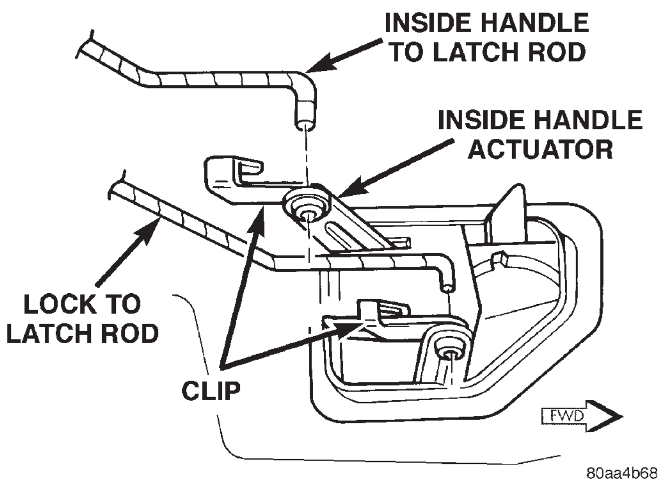


Fig. 47 Latch Rods

INSTALLATION

(1) Replace any broken or damaged push-in fasteners.

(2) Connect the power window wire harness connectors, if equipped.

(3) Move the door trim panel outward and connect the handle-to-latch rods.

(4) Position the trim panel on the inner belt seal and push down to seat.

(5) Align the locating pins and push-in fasteners (Fig. 48). Press inward to secure.

(6) Install the screws attaching the trim panel to the door inner panel.

(7) Install the window crank, if equipped.

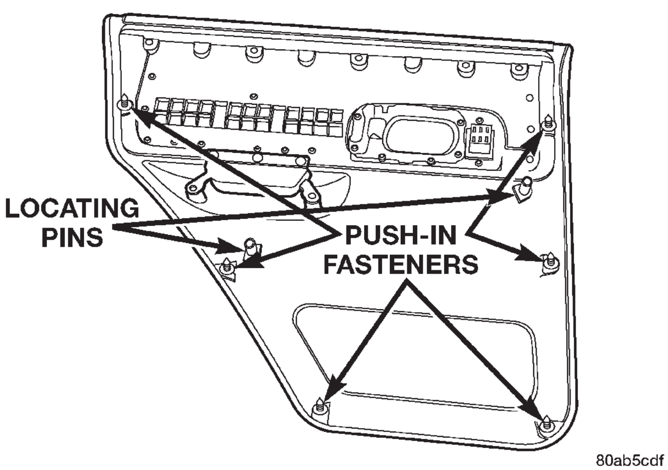


Fig. 48 Push-In Fasteners

REAR DOOR WATERDAM

REMOVAL

(1) Remove door trim panel.

(2) Peel the waterdam from the door.

(3) Route the latch rods and wire harnesses through the waterdam.

(4) Separate the waterdam from the door inner panel.

INSTALLATION

(1) Route the latch rods and wire harnesses through the waterdam.

(2) Position the waterdam on the door, apply adhesive as necessary and press into place.

(3) Install door trim panel.

REAR DOOR

REMOVAL

(1) Remove door restraint (check) retaining pin.

(2) For vehicles equipped with power windows and power door locks, remove trim panel and waterdam. Disconnect all components and route wire harness out of door.

(3) Remove bolts attaching hinge to door face.

(4) Separate door from vehicle.

INSTALLATION

(1) Position door in body opening.

(2) Align door hinges, plates and shims and install bolts. Tighten bolts to 3 N·m (2 ft. lbs.) torque.

(3) Install door restraint (check).

(4) If applicable, route and connect wire harness connectors.

(5) If necessary, install door waterdam and trim panel.

REAR DOOR RESTRAINT

REMOVAL

(1) Remove the door trim panel.

(2) Remove the door restraint (check) retaining pin from the bracket with a punch.

(3) Remove the nuts and remove the restraint via the access opening in the door inner panel (Fig. 49).

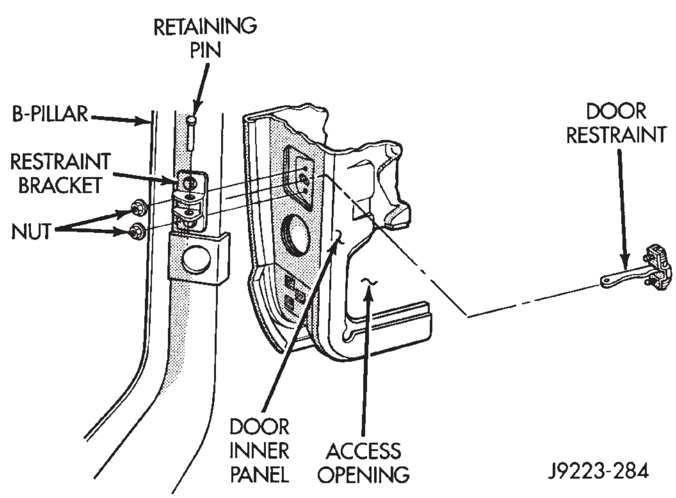


Fig. 49 Door Restraint (Check)

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position the door restraint in the door by way of the opening and install the nuts. Tighten the nuts to 10 N·m (7 ft-lbs) torque.

(2) Position the door restraint in bracket with the holes aligned and insert the retaining pin.

REAR DOOR HINGE

REMOVAL

(1) Remove door restrain (check) pin.

(2) Remove door hinge bolts and shims.

(3) Retain bolts and shims for correct installation.

INSTALLATION

(1) Position hinge plates and shims on door face.

(2) Align door hinges and shims with bolt holes and install hinges. Tighten bolts to 3 N·m (2 ft. lbs.).

(3) Adjust/align latch striker and latch as necessary.

(4) Install door restrain (check) retaining pin.

REAR DOOR OUTSIDE HANDLE

REMOVAL

(1) Remove the door trim panel.

(2) Roll the window to the full up position.

(3) Peel back the waterdam to access the fasteners for the outside handle.

(4) Remove the latch.

(5) Remove the access hole cover.

(6) Remove the nuts attaching the door handle to the door (Fig. 50).

(7) Disconnect the handle-to-latch rod from the handle latch release lever arm (Fig. 51).

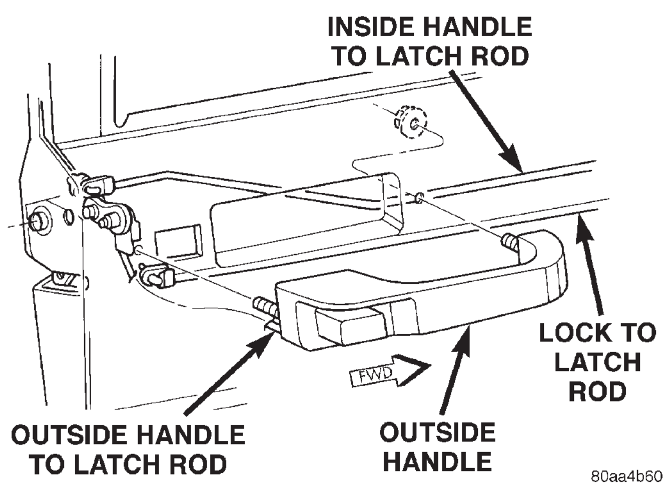


Fig. 50 Rear Door Outside Handle

INSTALLATION

(1) Position the handle at the door panel.

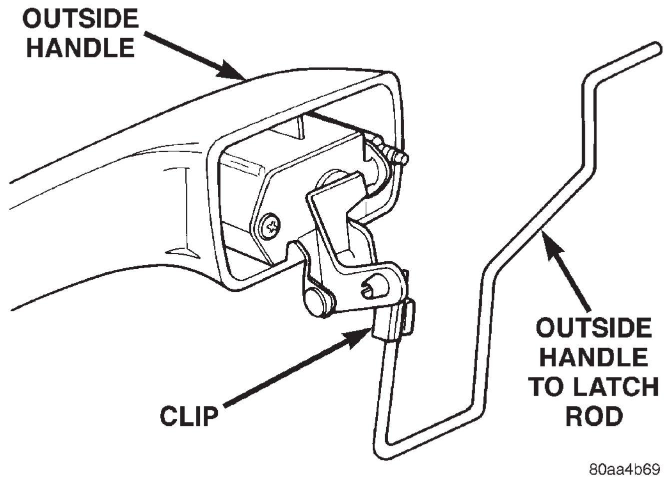


Fig. 51 Latch Rod

(2) Connect the latch-to-handle rod to the handle latch release lever arm.

(3) Install nuts attaching the door handle to the door.

(4) Install the latch.

(5) Install the waterdam.

(6) Install the trim panel.

REAR DOOR LATCH

REMOVAL

(1) Remove access plug.

(2) Remove door trim panel.

(3) Remove waterdam.

(4) Remove screws attaching door latch to door (Fig. 52).

(5) Disconnect all rods from door latch.

(6) Remove door latch from door.

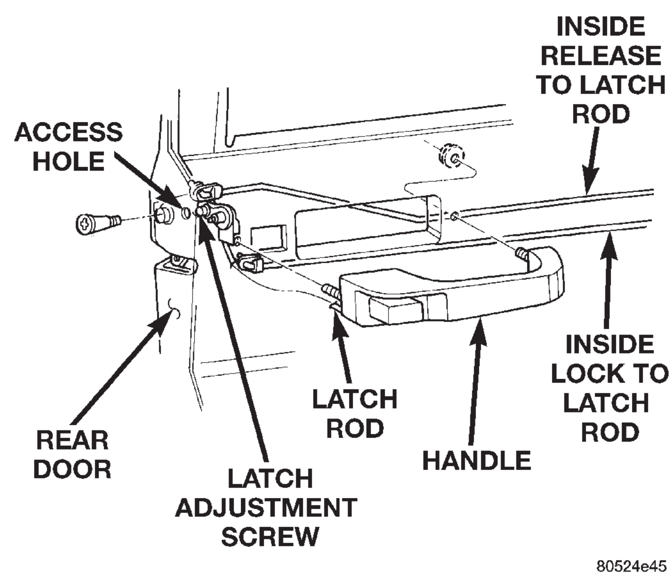


Fig. 52 Rear Door Latch

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position door latch in door.
(2) Connect all rods to door latch.
(3) Install screws attaching door latch to door. Tighten screws to 11 N·m (8 ft. lbs.) torque.
(4) Install waterdam.
(5) Install door trim panel.
(6) Install access plug.

REAR DOOR LATCH STRIKER

REMOVAL

(1) Using a grease pencil or equivalent, mark position of striker.
(2) Remove screws attaching striker to C-pillar (Fig. 53).
(3) Separate striker from C-pillar.

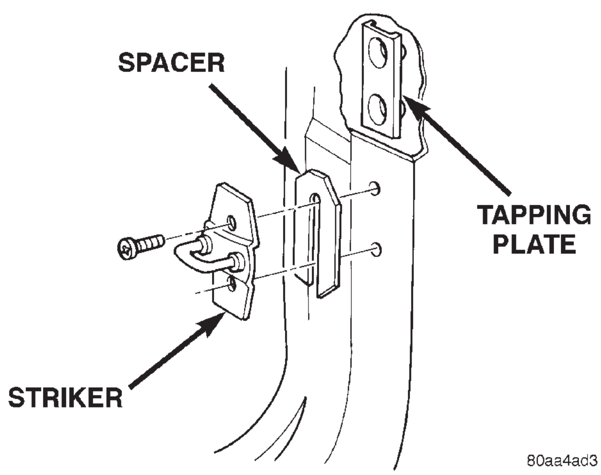


Fig. 53 Rear Door Latch Striker

INSTALLATION

(1) Position and align striker on C-pillar.
(2) Install screws attaching striker to C-pillar. Tighten screws to 28 N·m (20 ft. lbs.) torque.

REAR DOOR INSIDE HANDLE ACTUATOR

REMOVAL

The rear door inside handle actuator is heat staked to the rear door trim panel during the manufacturing process.
(1) Remove the door trim panel.
(2) Using an X–ACTO knife or equivalent, cut the melted tabs securing the inside handle to the door trim panel.
(3) Separate the inside handle from the trim panel.

INSTALLATION

(1) Position the inside handle in the trim panel.
(2) Heat stake the inside handle to the trim panel.
(3) Install the door trim panel.

REAR DOOR INNER BELT WEATHERSTRIP

REMOVAL

(1) Roll window down.
(2) Remove door trim panel.
(3) Pull up on the rear corner of the weatherstrip and lift from the door (Fig. 54).

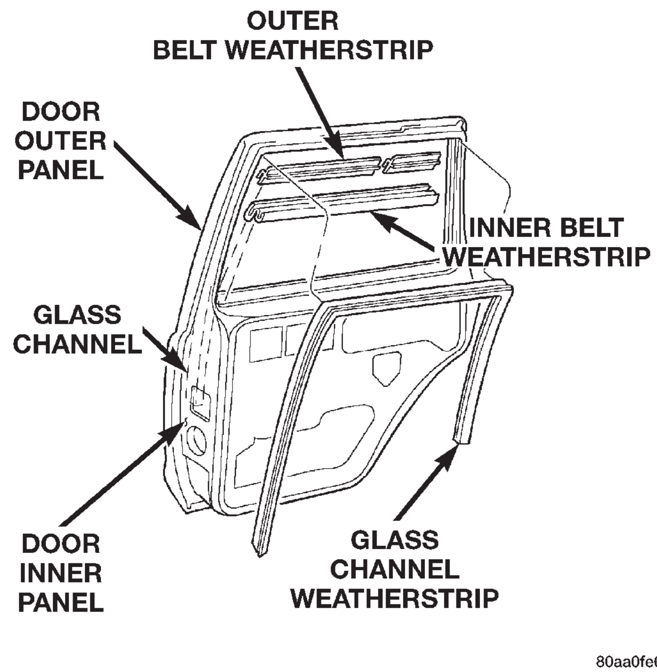


Fig. 54 Rear Door Inner/Outer Belt Weatherstrip

INSTALLATION

(1) Position the weatherstrip on the door.
(2) Push weatherstrip down to seat onto door.
(3) Install door trim panel.

REAR DOOR OUTER BELT WEATHERSTRIP

REMOVAL

(1) Roll window down.
(2) Using a trim stick, pry up the rear outer corner of the weatherstrip.
(3) Slowly and carefully, lift the weatherstrip up to separate from the door (Fig. 54).

INSTALLATION

(1) Position the weatherstrip on the door.
(2) Push weatherstrip down to seat onto door.

REAR DOOR GLASS RUN CHANNEL WEATHERSTRIP

REMOVAL

(1) Remove door trim panel.
(2) Remove waterdam.
(3) Remove window glass.

REMOVAL AND INSTALLATION (Continued)

(4) Starting at rear corner, peel weatherstrip from around door frame (Fig. 54).

INSTALLATION

(1) Starting at the top corner, press seal into place. A small amount of adhesive can be used to hold the weatherstrip in-place, if necessary.

(2) As applicable, move downward evenly until the weatherstrip seal is fully seated in the channel.

(3) Install window glass.

(4) Install waterdam.

(5) Install door trim panel.

REAR DOOR GLASS EXTERIOR MOLDING

REMOVAL

(1) Open the window.

(2) Remove the outer belt molding.

(3) Pry and pull the molding sections from the door panel flange (Fig. 55).

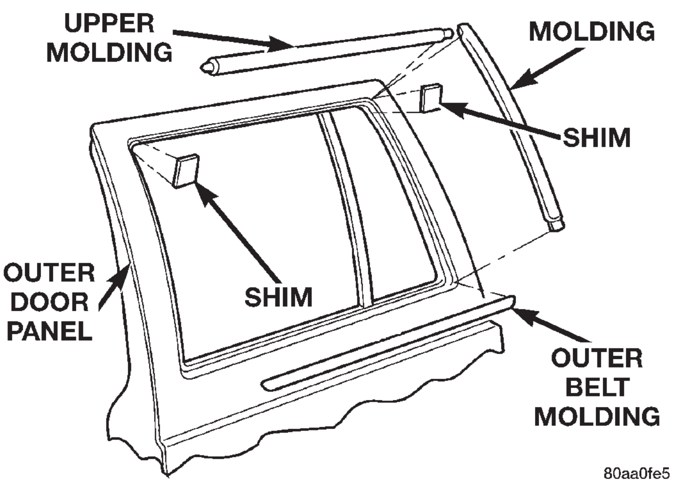


Fig. 55 Rear Glass Exterior Molding

INSTALLATION

(1) Starting at the forward end of the upper molding, force the molding onto the door panel flange and continue rearward until it is completely seated on the flange.

(2) Mate the rear molding with the upper molding and force the molding edge inward.

(3) Continue pressing and moving downward to complete the installation.

(4) Install the outer belt molding.

REAR DOOR WEATHERSTRIP

REMOVAL

(1) Remove B-pillar upper trim.

(2) Remove inner scuff plate.

(3) Remove B-pillar lower trim.

(4) Remove upper door opening trim.

(5) Grasp seal and separate from door opening (Fig. 56).

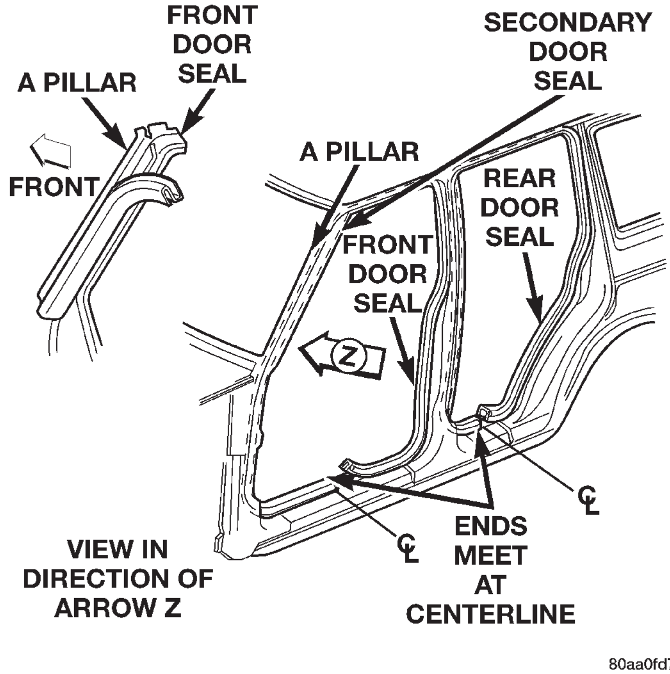


Fig. 56 Door Opening Weatherstrip

INSTALLATION

(1) When installing a door opening weatherstrip seal, start at the door sill center line.

(2) Move upward and around edge of door opening. Seat seal on flange.

(3) Move upward and around the perimeter of the door opening and seat the weatherstrip on the flange (Fig. 57).

(4) Install upper door opening trim.

(5) Install inner scuff plate.

(6) Install B-pillar lower trim panel.

(7) Install B-pillar upper trim panel.

REAR DOOR WINDOW REGULATOR

REMOVAL

(1) Remove the door trim panel.

(2) Remove the waterdam.

(3) Remove the bolt attaching the window glass to the regulator and support the glass (Fig. 58).

(4) Remove the lower bolts attaching the regulator to the inner door panel (Fig. 59).

(5) Remove the nuts attaching the regulator motor to the inner door panel, if equipped.

(6) Loosen the upper bolt that attaches the regulator to the inner door panel.

(7) Disconnect the wire harness connector from the regulator drive motor, if equipped.

(8) Remove the regulator and drive motor, if equipped.

REMOVAL AND INSTALLATION (Continued)

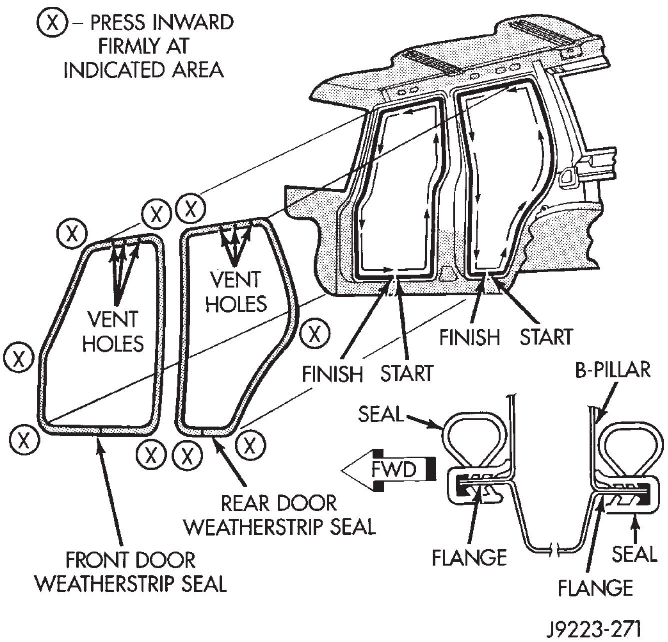


Fig. 57 Door Opening Weatherstrip

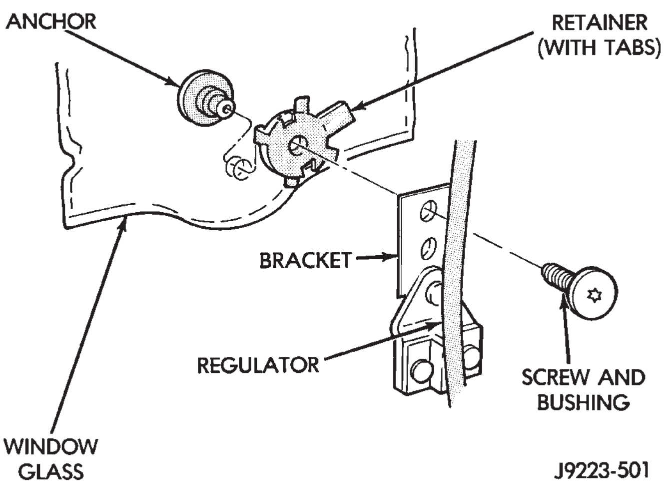


Fig. 58 Regulator To Glass Screw Removal/ Installation

INSTALLATION

(1) Position window regulator and, if equipped, drive motor within the door panels.

(2) Install the fasteners attaching the regulator to the door inner panel.

(3) Connect the regulator wire harness connector.

(4) Position the window glass at the regulator and install the retainer, bushing and bolt.

(5) Install the waterdam.

(6) Install the trim panel.

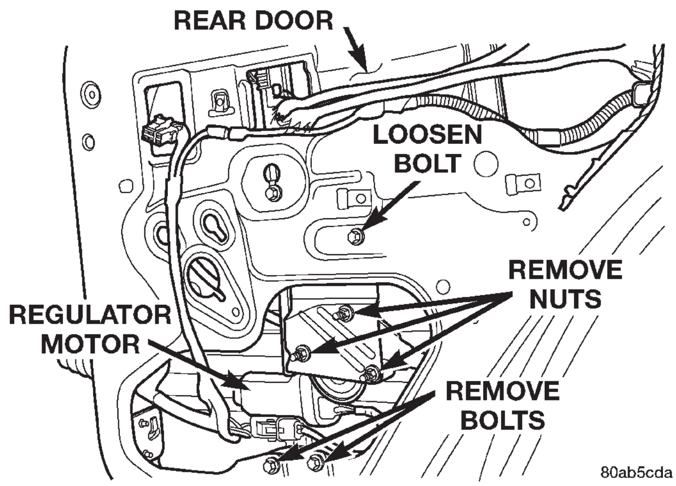


Fig. 59 Rear Door Window

REAR DOOR WINDOW GLASS

REMOVAL

(1) Lower the window glass.

(2) Remove the trim panel.

(3) Remove the waterdam.

(4) Remove inner and outer beltline weatherstrip.

(5) Remove the window weatherstrip from the door.

(6) Remove the division bar/stationary glass (Fig. 60).

(7) Remove the window glass screw, bushing and retainer from the regulator.

(8) Remove the window glass from door.

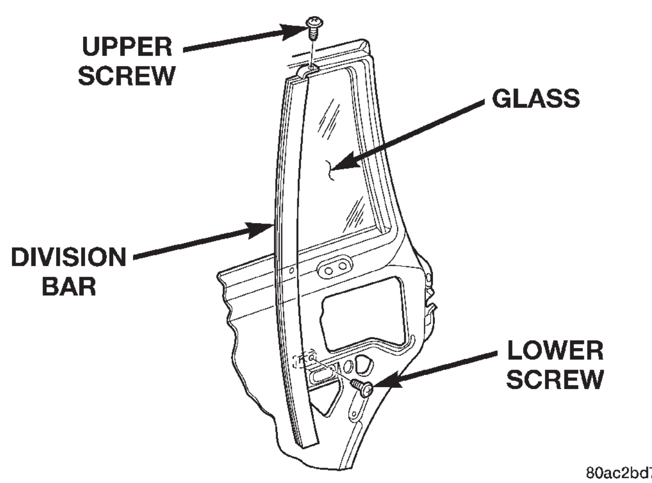


Fig. 60 Division Bar/Stationary Glass

INSTALLATION

(1) Install the glass in the door, and install the retainer, bushing and screw.

(2) Tighten the glass attaching screw 6 N·m (53 in-lbs) torque.

(3) Install the division bar/stationary glass in the door.

REMOVAL AND INSTALLATION (Continued)

(4) Install the glass run channel weatherstrip.
(5) Install the inner and outer beltline weather-strip.
(6) Install the waterdam.
(7) Install the trim panel.

BODY SIDE MOLDING

REMOVAL

(1) Loosen the body side molding (Fig. 61) with a heat gun.
(2) Lift edge of molding with a putty knife and peel molding from body panel. Apply heat to any location where the molding remains adhered to a panel.
(3) Remove the adhesive from the body panel with Mopar Super Clean solvent or equivalent.
(4) If the original molding will be installed, also remove all adhesive from it.

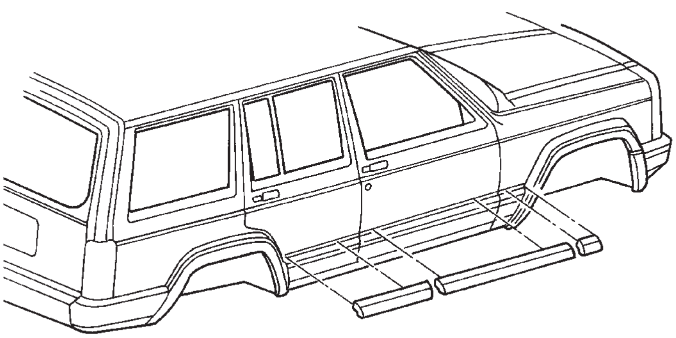


Fig. 61 Body Side Molding—4-Door

INSTALLATION

(1) If the original molding will be installed, apply 3M 5344 double-sided tape on the molding.
(2) For vertical alignment, use masking tape or a string as reference.
(3) Remove the backing from the tape, align the molding and position it on the body panel.
(4) Press the molding onto the body panel with a roller or hand pressure.

REAR FENDER FLARE

REMOVAL

(1) Remove the screw attaching the lower part of flare to the bottom of the fender.
(2) Remove the nuts attaching the fender flare retainer to the wheelhouse liner (Fig. 62).
(3) Separate the fender flare and retainer from the fender.

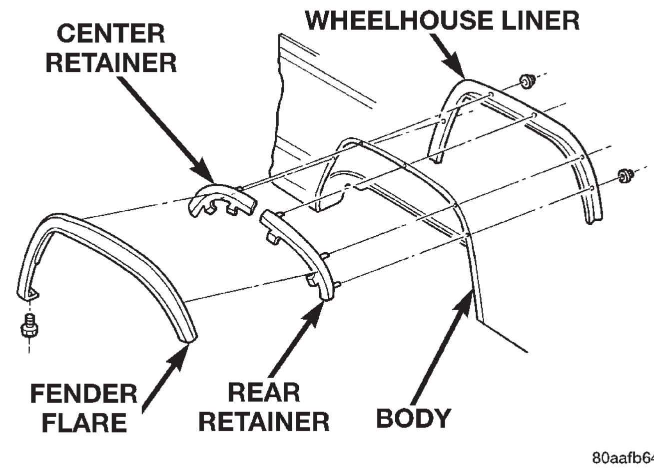


Fig. 62 Fender Flare

INSTALLATION

(1) Position the fender flare and retainer on the fender.
(2) Install the nuts attaching the fender flare and retainer to the wheelhouse liner.
(3) Install the screw attaching the lower part of flare to the bottom of the fender.

QUARTER WINDOW APPLIQUE

REMOVAL

(1) Remove the liftgate pillar trim.
(2) Remove nuts from inside vehicle (Fig. 63).
(3) Using a trim sick or equivalent, carefully pry the applique the from panel.

INSTALLATION

(1) Position the replacement applique the on panel and install the nuts.
(2) Install the liftgate pillar trim.

DRIP RAIL MOLDING

REMOVAL

(1) Pry the clips from the roof flange.
(2) Remove the clips and molding from the roof flange (Fig. 63).
(3) Remove the remaining sealant and clean the roof flange.
(1) Pry the clips from the roof flange.
(2) Remove the clips and molding from the roof flange (Fig. 63).
(3) Remove the remaining sealant and clean the roof flange.

INSTALLATION

(1) Position the drip rail molding with clips at the roof flange and force the clips onto the roof flange.

REMOVAL AND INSTALLATION (Continued)

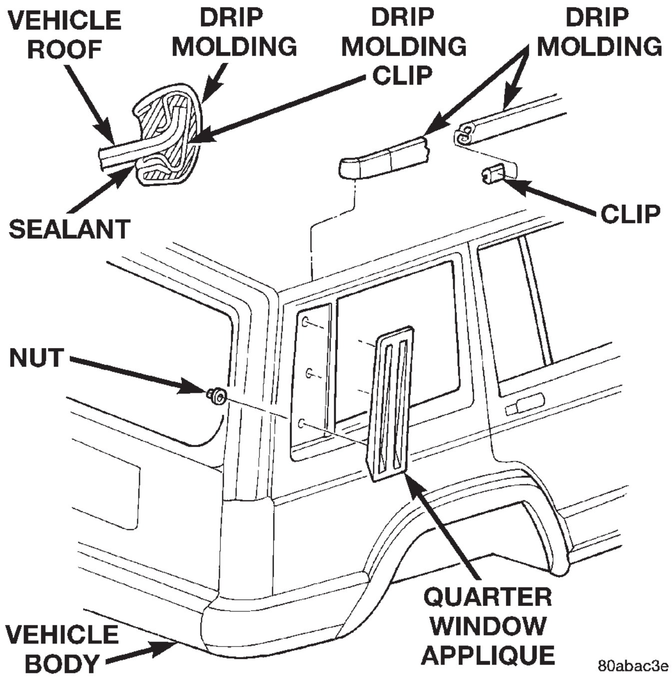


Fig. 63 Quarter Window Applique and Drip Molding

(2) Apply sealant to the inner side of the molding to seal the roof flange.

LUGGAGE RACK

REMOVAL

(1) Remove slide rail screws (Fig. 64).
(2) Remove luggage rack from roof.

NOTE: Skid strips are attached to roof panel with adhesive.

(3) Loosen each skid strip with a heat gun.
(4) Lift one edge of each skid strip with a putty knife and peel it from roof panel.
(5) Remove original adhesive from roof with an adhesive removal solution.
(6) If original skid strips are installed, remove all original adhesive from m.

INSTALLATION

(1) Install 3M 06379 double-sided tape, or an equivalent on skid strips.
(2) Remove backing from double-sided tape, align each skid strip on roof, and position it on roof panel.
(3) Verify that each skid strip is properly aligned.
(4) Press each skid strip onto roof panel with a roller (or use hand pressure).

NOTE: To prevent water leaks, apply 3M Drip-Chek Sealant, or equivalent.

(5) Position luggage rack on roof with screw holes aligned.

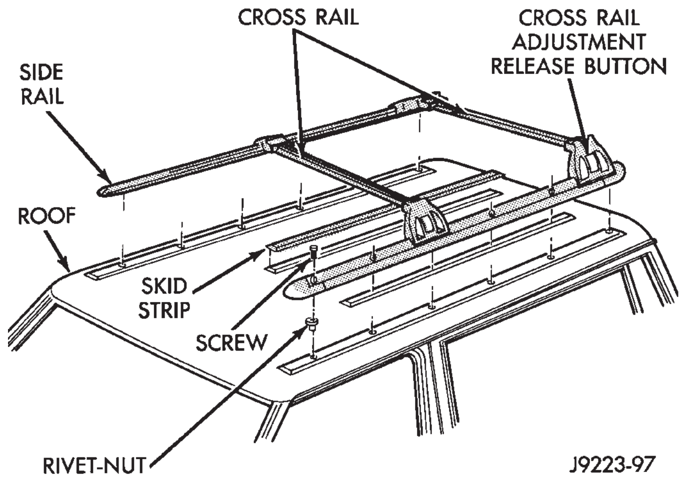


Fig. 64 Luggage Rack

(6) Install and tighten slide rail screws.

AIR EXHAUST GRILLE

REMOVAL

(1) Remove the screw that attaches the grille to door the opening panel (Fig. 65).
(2) Pry the bottom edge of the grille from the door opening panel.
(3) Pull downward and remove the grille from exhaust port in the door opening panel.

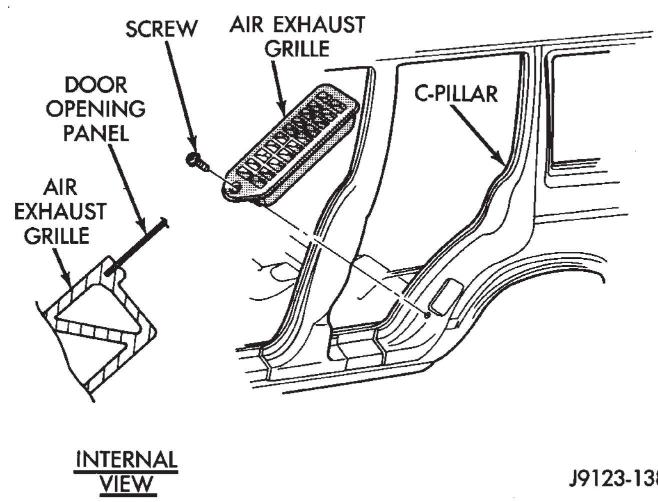


Fig. 65 Door Opening Air Exhaust Grille

INSTALLATION

(1) Position the slot located in the upper end of replacement grille at the exhaust port and insert edge in the slot.
(2) Push inward and seat the grille in the exhaust port.
(3) Install the screw to attach the grille to the door opening panel.

REMOVAL AND INSTALLATION (Continued)

A-PILLAR TRIM

REMOVAL

(1) Remove front and rear assist handles, if equipped.

(2) Remove the inner scuff plate.

(3) Remove the lower A-pillar cowl trim.

(4) Using a small flat blade, pry the trim plugs from the A-pillar trim.

(5) Remove the screws attaching the A-pillar trim to the A-pillar (Fig. 66).

(6) Separate the A-pillar trim from the A-pillar.

INSTALLATION

(1) Position the A-pillar trim on the A-pillar.

(2) Install the screws attaching the A-pillar trim to the A-pillar.

(3) Install the trim plugs.

(4) Install the lower A-pillar cowl trim.

(5) Install the inner scuff plate.

(6) Install the assist handles.

LOWER A-PILLAR COWL TRIM

REMOVAL

(1) Remove the inner scuff plate.

(2) Remove the nut behind the fuse panel access door (Right side only) (Fig. 67).

(3) Remove the fasteners attaching the lower A-pillar cowl trim to the A-pillar lower cowl.

(4) Separate the lower A-pillar cowl trim from the A-pillar lower cowl.

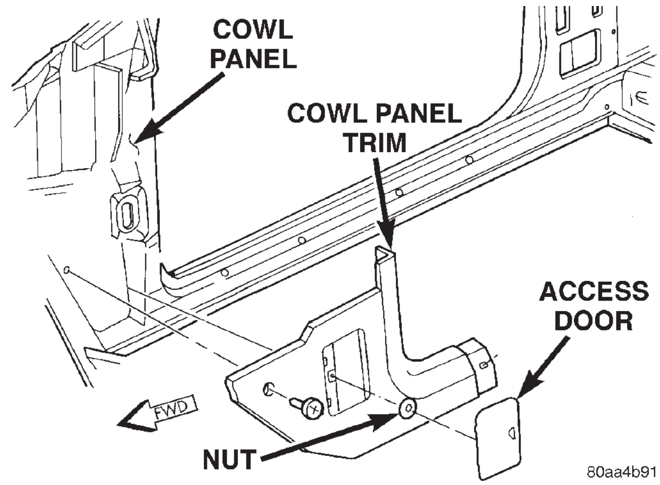


Fig. 67 Lower A-Pillar Cowl Trim

INSTALLATION

(1) Position the lower A-pillar cowl trim on the A-pillar lower cowl.

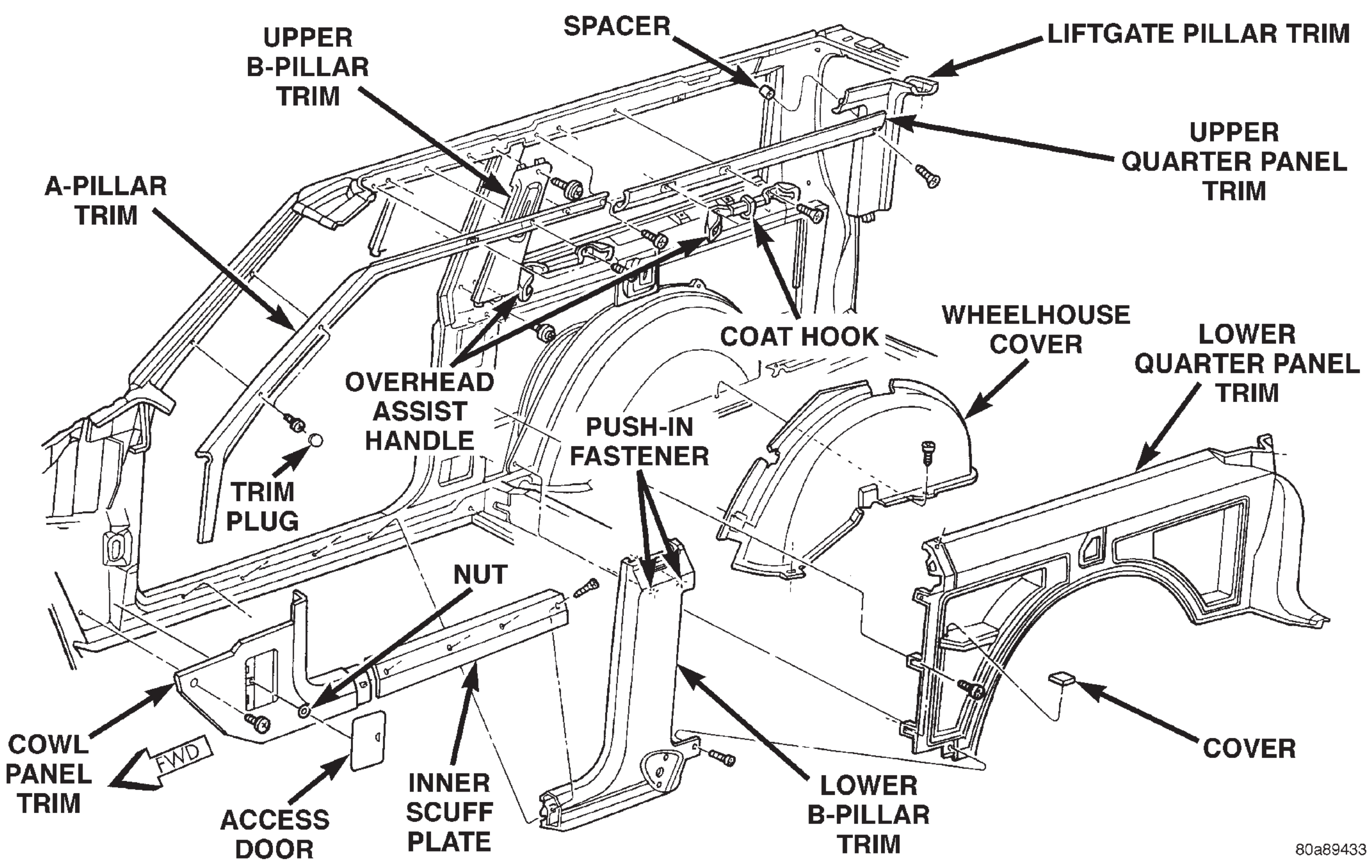


Fig. 66 Trim Panels—2-Door Vehicles

REMOVAL AND INSTALLATION (Continued)

(2) Install the screws attaching the lower A-pillar cowl trim to the A-pillar lower cowl.
(3) Install the nut behind the fuse panel access door (Right side only).
(4) Install the inner scuff plate.

FRONT INNER SCUFF PLATE

REMOVAL

(1) If necessary, remove the bucket seat side shield trim cover.
(2) Remove the screws attaching the inner scuff plate to the front door sill (Fig. 66).
(3) Separate the inner scuff plate from the door sill.

INSTALLATION

(1) Position the inner scuff plate on the front door sill.
(2) Install the screws attaching the inner scuff plate to the front door sill.
(3) If removed, install the bucket seat side shield trim cover.

DOOR SILL SCUFF PLATE

REMOVAL

(1) Remove the screws attaching the door sill scuff plate to the door sill (Fig. 68).
(2) Separate the scuff plate from the door sill.

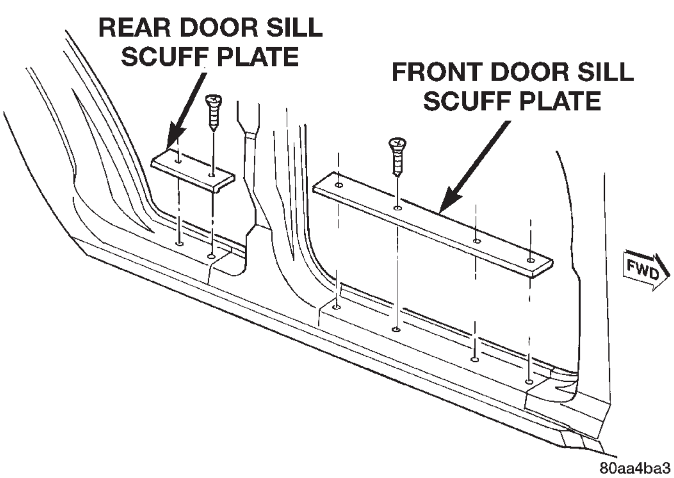


Fig. 68 Door Sill Scuff Plate

INSTALLATION

(1) Position the scuff plate on the door sill.
(2) Install the screws attaching the door sill scuff plate to the door sill.

ASSIST HANDLE

REMOVAL

(1) Using a trim stick or equivalent, open the end covers to access the screws.
(2) Remove the screws (Fig. 66).
(3) Separate the assist handle from the trim.

INSTALLATION

(1) Position the handle on the trim.
(2) Install the screws.
(3) Install the covers.

B-PILLAR TRIM

REMOVAL

(1) Remove the inner scuff plate.
(2) Remove the upper door opening trim (4-door vehicles) (Fig. 69).
(3) Remove the upper quarter panel trim (2-door vehicles) (Fig. 66).
(4) Remove the rear A-pillar trim screw.
(5) Remove the shoulder belt turning loop.
(6) Remove the seat/shoulder belt anchor bolt.
(7) Remove the screws attaching the B-pillar trim to the B-pillar (2-door vehicles).
(8) Route the shoulder belt through the lower B-pillar trim (2-door vehicles).
(9) Separate the B-pillar trim from the B-pillar.

INSTALLATION

(1) Route the shoulder belt through the lower B-pillar trim (2-door vehicles).
(2) Position the B-pillar trim on the B-pillar and align push-in fasteners.
(3) Press the B-pillar trim on the B-pillar to secure.
(4) Install the screws attaching the B-pillar trim to the B-pillar (2-door vehicles).
(5) Install the seat/shoulder belt anchor bolt.
(6) Install the shoulder belt turning loop.
(7) Install the A-pillar trim.
(8) Install the upper quarter panel trim (2-door vehicles) (Fig. 66).
(9) Install the upper door opening trim (4-door vehicles) (Fig. 69).
(10) Install the inner scuff plate.

C-PILLAR TRIM

REMOVAL

(1) Remove the inner scuff plate.
(2) Remove the upper door opening trim.
(3) Remove the upper quarter panel trim.
(4) Remove the quarter panel trim extension.

REMOVAL AND INSTALLATION (Continued)

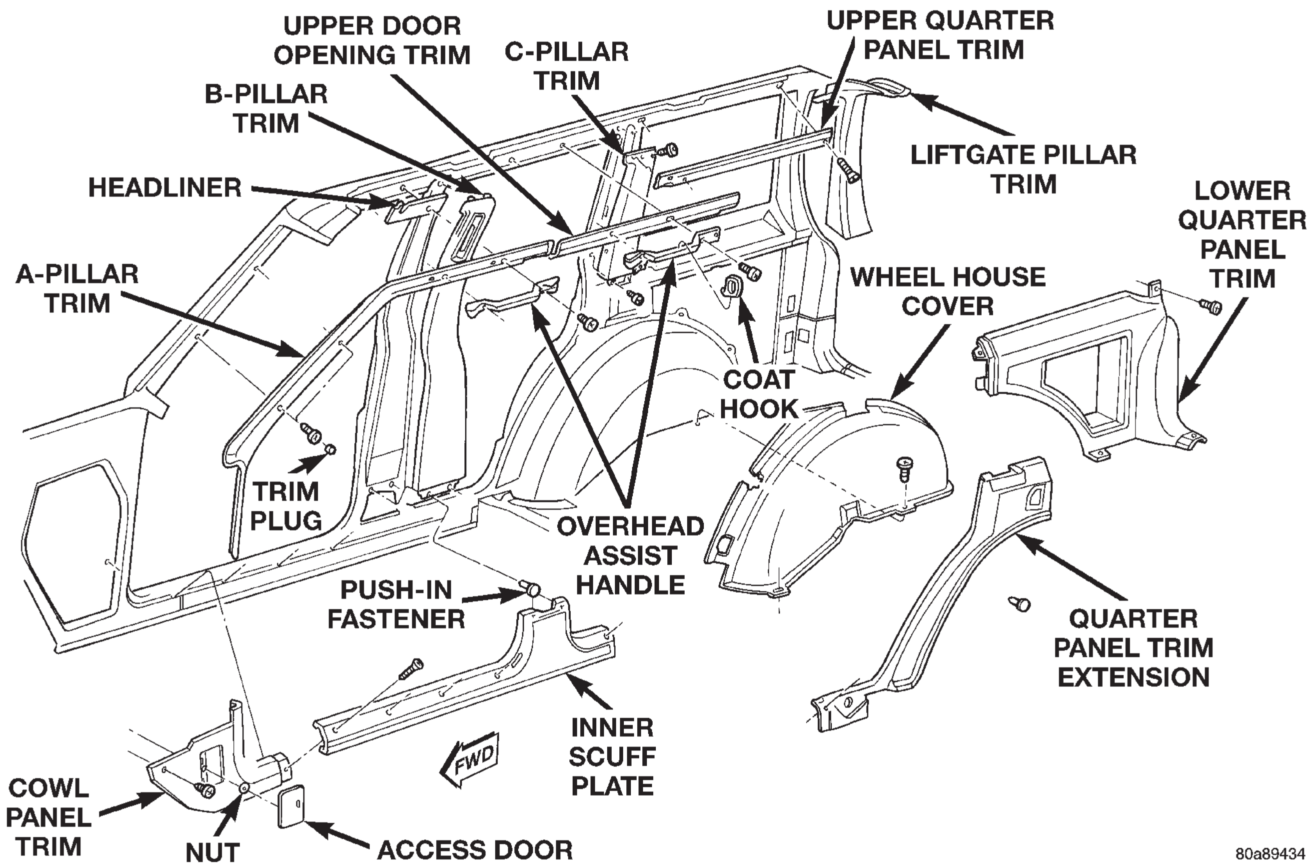


Fig. 69 B-Pillar Trim—4-Door Vehicles

(5) Remove the screws attaching the C-pillar trim to the C-pillar (Fig. 69).

(6) Separate the C-pillar trim from the C-pillar.

INSTALLATION

(1) Position the C-pillar trim on the C-pillar.

(2) Install the screws attaching the C-pillar trim to the C-pillar.

(3) Install the quarter panel trim extension.

(4) Install the upper quarter panel trim.

(5) Install the upper door opening trim.

(6) Install the inner scuff plate.

QUARTER PANEL TRIM EXTENSION

REMOVAL

(1) Remove the inner scuff plate.

(2) Separate quarter panel trim extension from the wheelhouse and quarter trim panels (Fig. 69).

INSTALLATION

(1) Position the quarter panel trim extension on the wheelhouse and quarter trim panels.

(2) Install the inner scuff plate.

QUARTER PANEL TRIM AND WHEELHOUSE COVER

REMOVAL

(1) Remove the inner scuff plate.

(2) Remove quarter panel trim extension.

(3) Remove liftgate scuff plate.

(4) Remove the screws attaching the quarter panel trim from the quarter panel and wheelhouse trim cover (Fig. 69) and (Fig. 66).

(5) If necessary, remove the tire and mounting brackets from the left quarter panel trim (Fig. 70).

(6) Remove the screws attaching the wheelhouse cover to the wheelhouse.

(7) Separate the wheelhouse cover from the wheelhouse.

INSTALLATION

(1) Position the wheelhouse cover on the wheelhouse.

(2) Install the screws attaching the wheelhouse cover to the wheelhouse.

(3) If removed, install the tire and mounting bracket on the left quarter panel trim.

(4) Position the quarter panel trim on the quarter panel and wheelhouse cover.

REMOVAL AND INSTALLATION (Continued)

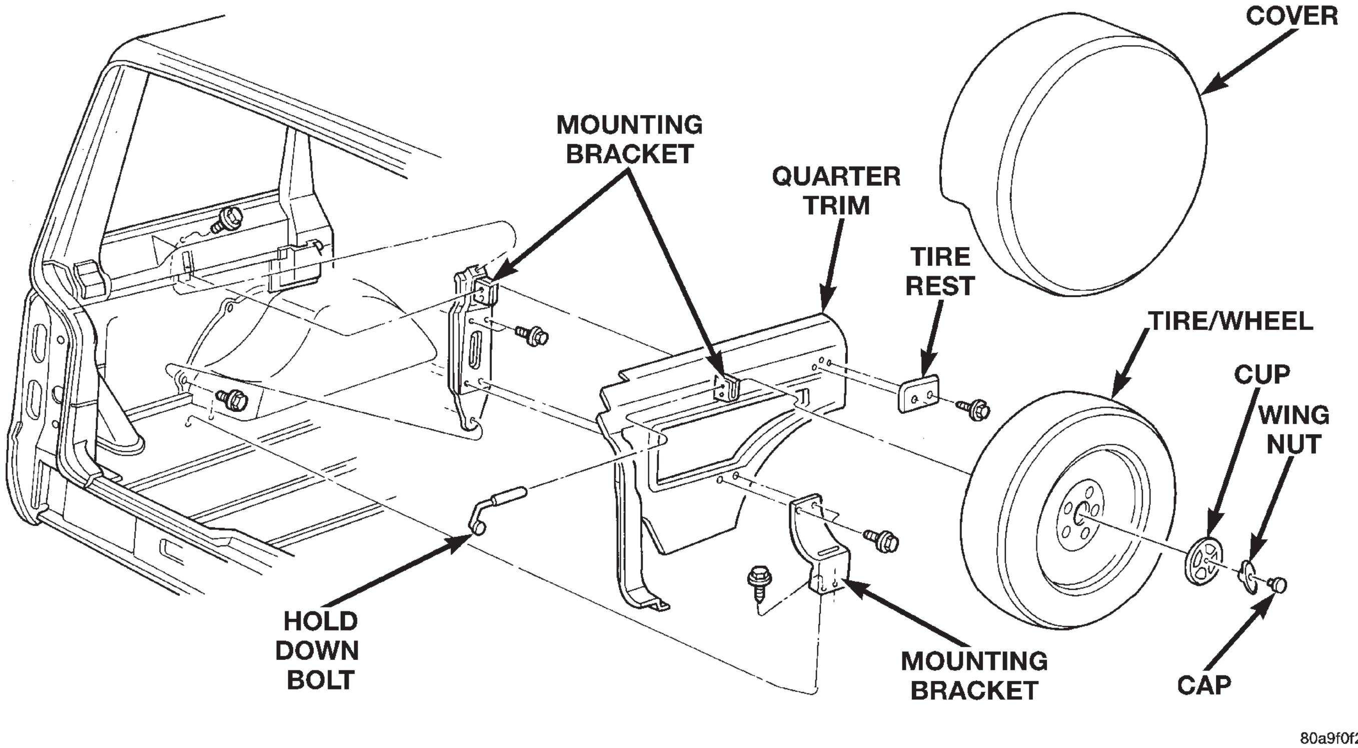


Fig. 70 Spare Tire

(5) Install the screws attaching quarter panel trim on the quarter panel and wheelhouse cover.

(6) Install liftgate scuff plate.

(7) Install quarter panel trim extension.

(8) Install the inner scuff plate.

LIFTGATE PILLAR TRIM

REMOVAL

(1) Remove the liftgate opening upper trim.

(2) Remove the liftgate pillar trim screws (Fig. 71).

(3) Remove the screws attaching the lower quarter panel trim to the liftgate pillar.

(4) Pull the trim panel outward to detach the spring steel clips attaching the trim panel to the pillar (2-dr vehicles).

(5) Remove liftgate pillar trim.

INSTALLATION

(1) Position the liftgate pillar trim on the liftgate pillar.

(2) Press the trim panel into place to engage the spring steel clips attaching the trim panel to the pillar (2-dr vehicles).

(3) Install the screws attaching the lower quarter panel trim to the liftgate pillar.

(4) Install the liftgate pillar trim screws.

(5) Install the liftgate opening upper trim.

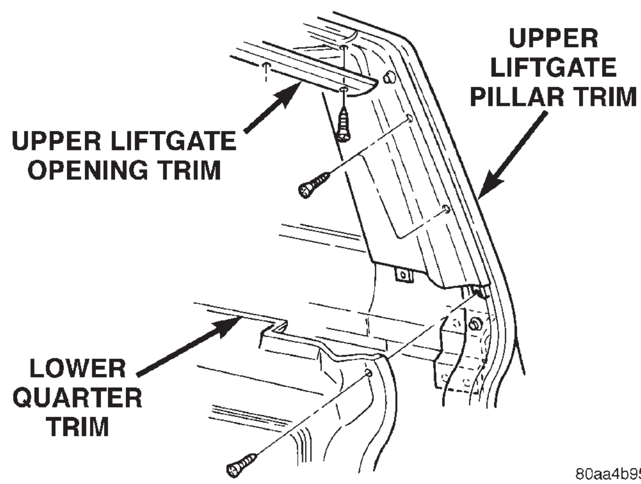


Fig. 71 Liftgate Pillar Trim

LIFTGATE OPENING UPPER TRIM

REMOVAL

(1) Remove the screws attaching the liftgate opening upper trim to the roof panel (Fig. 72).

(2) Pull downward to disengage steel clips attaching the liftgate opening upper trim to the roof panel.

(3) Separate trim from vehicle.

INSTALLATION

Steel clips are used for manufacturing purposes and are not required for service.

REMOVAL AND INSTALLATION (Continued)

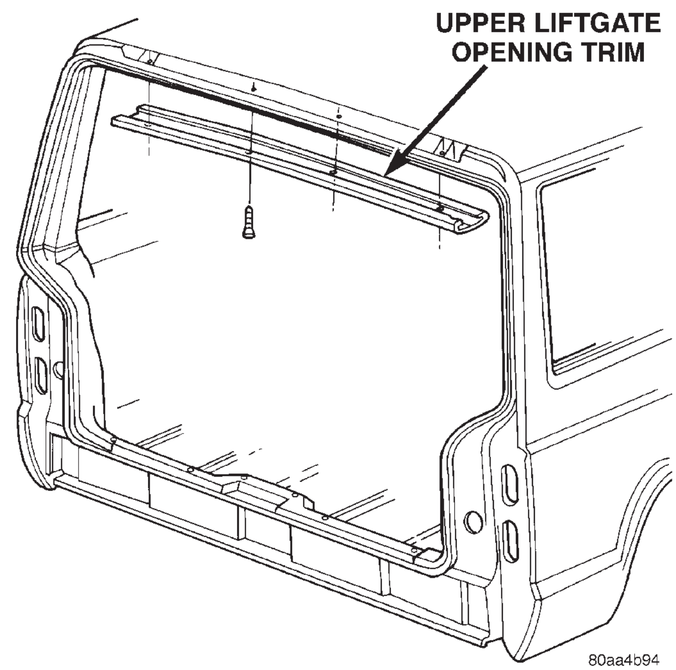


Fig. 72 Liftgate Opening Upper Trim

(1) Position trim on roof panel.

(2) Install the screws attaching the liftgate opening upper trim to the roof panel.

LIFTGATE SCUFF PLATE

REMOVAL

(1) Remove the screws attaching the liftgate scuff plate to the floor pan (Fig. 73).

(2) Separate the scuff plate from the vehicle.

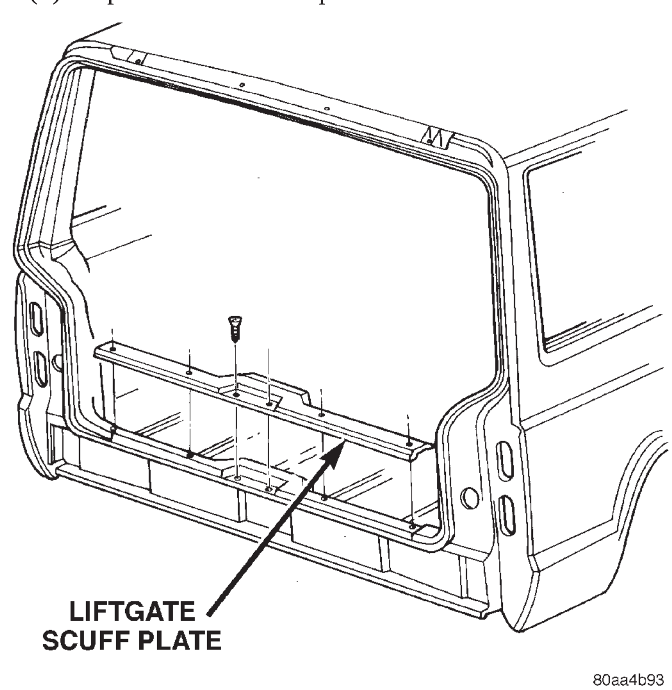


Fig. 73 Liftgate Scuff Plate

INSTALLATION

(1) Position the scuff plate on the vehicle.

(2) Center striker in opening.

(3) Install the screws attaching the liftgate scuff plate to the floor pan.

FRONT SHOULDER BELT/BUCKLE

CAUTION: Inspect the front shoulder belts and buckles. Replace any belt that is either cut, frayed, torn or damaged in any way. Replace the shoulder belt if the retractor is damaged or inoperative.

REMOVAL

(1) Slide the front seats all the way forward for access to the belt anchor bolt.

(2) Disconnect the belt wire harness connector.

(3) Remove the anchor bolt cover.

(4) Remove the anchor bolt attaching the buckle to the seat.

(5) Remove the turning loop cover concealing the shoulder belt upper anchor bolt.

(6) Use a Torx bit to remove the upper anchor bolt (Fig. 74). Remove the support/guide washer.

(7) Remove the inner scuff plate/trim panel from the door sill and remove the shoulder belt lower anchor bolt(s) with a Torx bit (Fig. 75) and (Fig. 76).

(8) Remove the shoulder belt and the retractor.

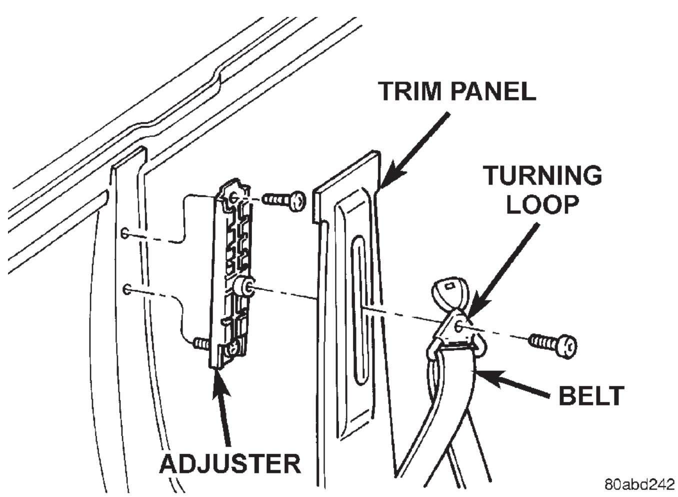


Fig. 74 Anchor Bolt

INSTALLATION

(1) Position the shoulder belt retractor in the shield and install the lower anchor bolt with a Torx bit. Tighten bolt to 43 N·m (32 ft. lbs.) torque.

(2) Position the support/guide washer and shoulder belt upper anchor plate on the trim panel. Install the upper anchor bolt with a Torx bit.

(3) Route belt through trim panel.

(4) Tighten the upper and lower anchor bolts to 43 N·m (32 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

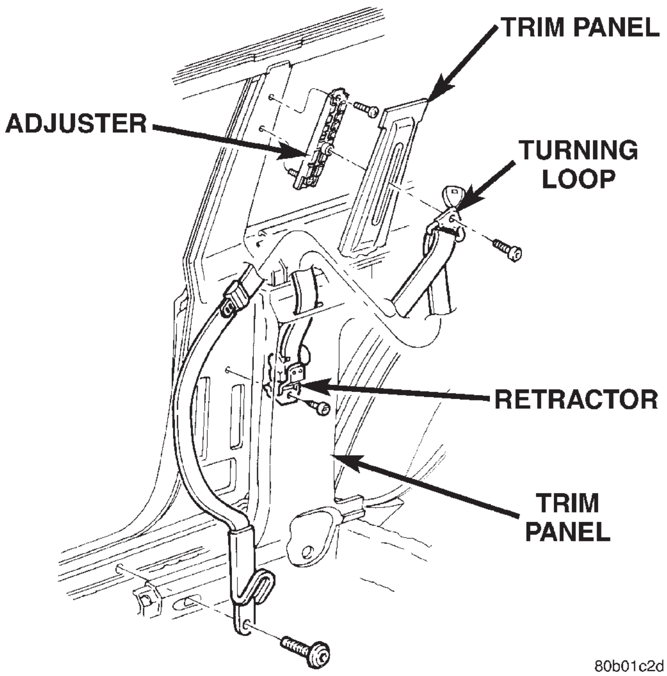


Fig. 75 Front Shoulder Belt—2-Door Vehicles

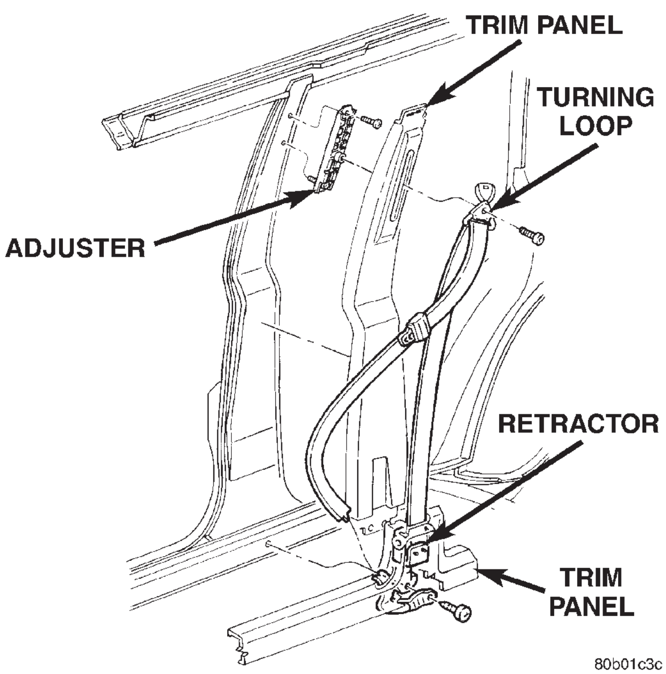


Fig. 76 Front Shoulder Belt—4-Door Vehicles

(5) Install the door sill inner scuff plate/trim panel and install the cap over the upper anchor bolt.

(6) Install the shoulder belt buckle and anchor bolt. Connect the wire harness connectors. Tighten the buckle anchor bolt to 43 N·m (32 ft. lbs.) torque.

REAR SHOULDER/LAP BELT/BUCKLE

WARNING: Inspect rear shoulder/lap belts and buckles. Replace any belt that is either cut, frayed, torn or damaged in any way. Replace shoulder belt if retractor is damaged or inoperative.

REMOVAL

(1) Pull rear seat release strap and tilt seat cushion forward.

(2) Remove shoulder belt buckle and lap belt/buckle anchor plate bolts from floor pan (Fig. 77).

(3) Remove shoulder belt lower outer anchor bolt.

(4) Remove quarter trim panel. If necessary, refer to removal procedure.

(5) Remove shoulder belt upper anchor bolt.

(6) Remove bolt attaching retractor to rear quarter rail.

(7) Separate retractor and shoulder belt from trim panel.

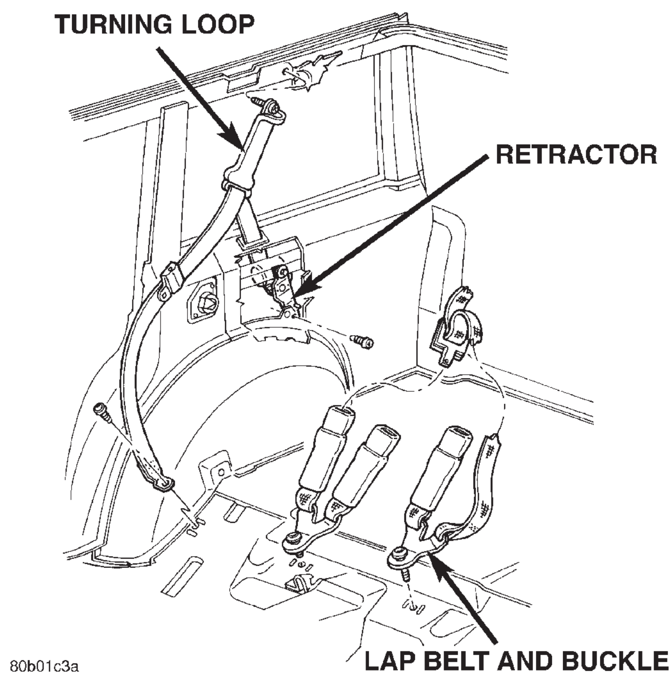


Fig. 77 Rear Seat Shoulder/Lap Belts and Buckles

INSTALLATION

(1) Position shoulder belt buckle and lap belt/buckle anchor plates on floor panel.

(2) Install anchor bolts. Tighten bolts to 43 N·m (32 ft. lbs.) torque.

(3) Install retractor support on rear quarter rail. Tighten screw.

(4) Route shoulder belt through quarter trim panel slot.

REMOVAL AND INSTALLATION (Continued)

(5) Position shoulder belt at roof rail and install upper anchor bolt. Tighten bolt to 43 N·m (32 ft. lbs.) torque.

(6) Install quarter trim panel.

(7) Install shoulder belt lower anchor bolt. Tighten bolt to 43 N·m (32 ft. lbs.) torque.

(8) Return rear seat cushion to normal position and engage latch.

FULL FLOOR CONSOLE

REMOVAL

(1) Remove the transmission shift lever handle/knob:

- Automatic transmissions, pull the handle straight upward to remove it.
- Insert a thin-blade tool under the edge of the transmission shift indicator bezel and pry up to remove.
- Manual transmissions, loosen the locknut and un-thread the shift knob from the shaft.
- Pull the shift boot up to remove.

(2) Insert a thin-blade tool under the edge of the transfer case shift indicator bezel or cover plate and pry up to remove.

(3) Open the console lid.

(4) Remove the screws attaching the console to the floor and mounting bracket (Fig. 78).

(5) Disconnect the wire harness connector.

(6) Separate the console from the floor.

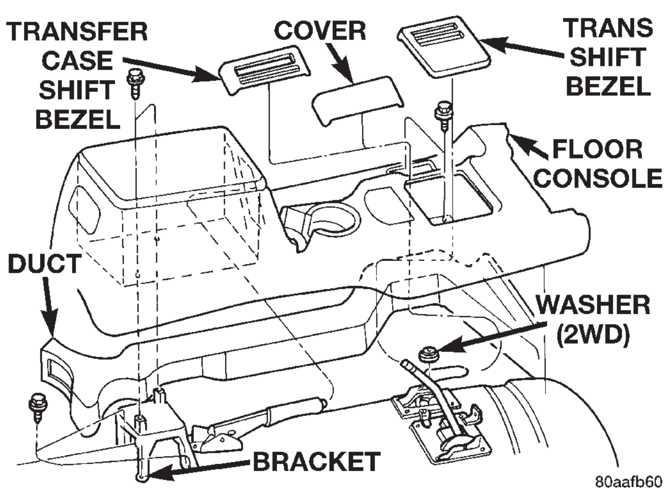


Fig. 78 Floor Console

INSTALLATION

(1) Position the console on the floor.

(2) Attach the air duct to the air outlet duct.

(3) Connect the wire harness connectors.

(4) Install the screws attaching the console to the mounting bracket.

(5) Install the shift indicator bezels (or cover plate).

(6) Install the shift lever handle/knob.

FRONT CARPET/MAT

REMOVAL

(1) Remove the door sill inner scuff plates.

(2) Remove the front and rear seats (as applicable).

(3) Remove floor console.

(4) As necessary, remove the trim panels and moldings.

(5) Remove all other interfering components.

(6) Remove the carpet and mat from the floor panel (Fig. 79).

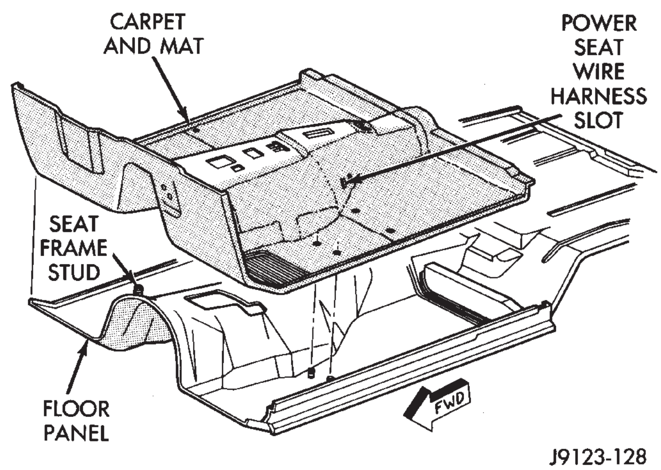


Fig. 79 Front Carpet and Mat

INSTALLATION

(1) Position the carpet and mat on the floor panel.

(2) Install all the components that were removed to facilitate carpet/mat removal.

(3) Install the trim panels and moldings.

(4) Install the door sill inner scuff plates.

(5) Install floor console.

(6) Install the front and rear seats (as applicable).

REAR CARPET/MAT

REMOVAL

(1) Remove the liftgate latch striker and scuff plate.

(2) Drill-out the retaining rivet heads and remove the cargo tie-down footman loops from the carpet.

(3) As necessary, remove the trim panels and moldings.

(4) Remove the all other interfering components.

(5) Remove the carpet and mat from the floor panel.

(6) If necessary, remove the insulation from the wheelhouse (Fig. 80).

INSTALLATION

(1) If removed, install the insulation on the wheelhouses.

REMOVAL AND INSTALLATION (Continued)

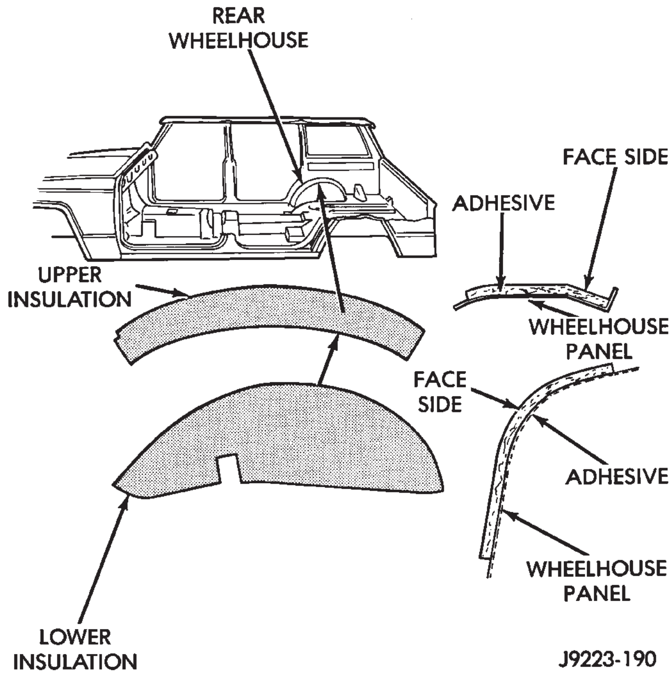


Fig. 80 Wheelhouse Insulation

(2) Position the mat on the floor panel.

(3) Position the carpet on the mat.

(4) Install all the components that were removed to facilitate carpet and mat removal.

(5) Install the trim panels and moldings.

(6) Install the cargo tie-down footman loops on the carpet with replacement rivets.

(7) Install the liftgate scuff plate and latch striker.

REARVIEW MIRROR

REMOVAL

(1) Loosen the mirror base setscrew (Fig. 81).

(2) Slide the mirror base upward and off the bracket.

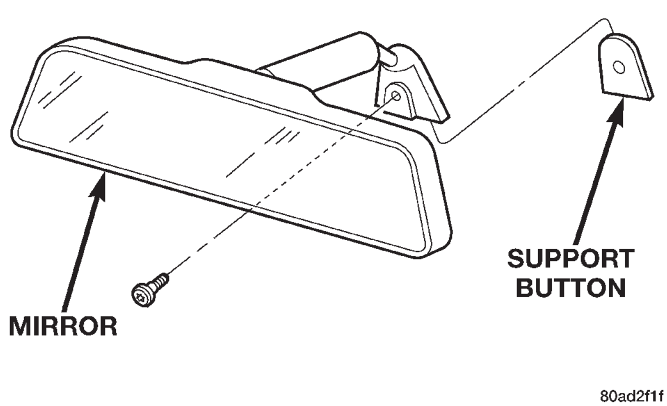


Fig. 81 Rearview Mirror

INSTALLATION

(1) Position the mirror base at the bracket and slide it downward onto the support bracket.

(2) Tighten setscrew to1 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.

REMOVAL AND INSTALLATION (Continued)

SUNVISORS

REMOVAL

(1) Remove the screws that attach the sunvisor arm support bracket to the headliner and the roof panel (Fig. 82) and (Fig. 83).

(2) Disconnect vanity lamp connector, if equipped.

(3) Detach the sunvisor from the support clip.

(4) Remove the sunvisor from the vehicle.

(5) Remove the retaining screw and support clip. On vehicles equipped with an overhead console, the support clip is integral with the overhead console.

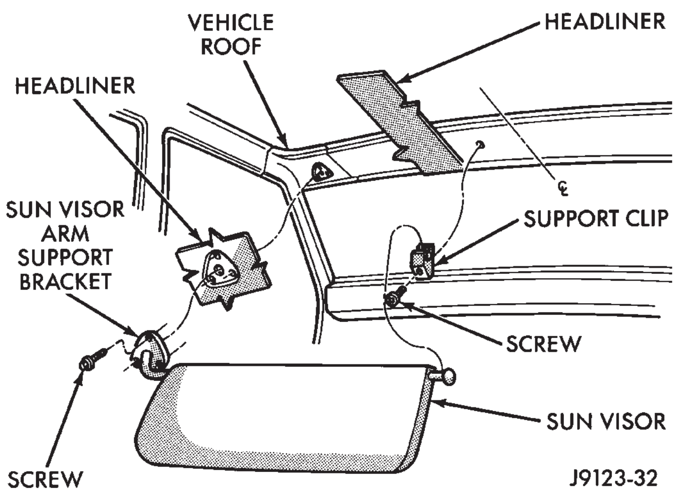


Fig. 82 Sunvisor

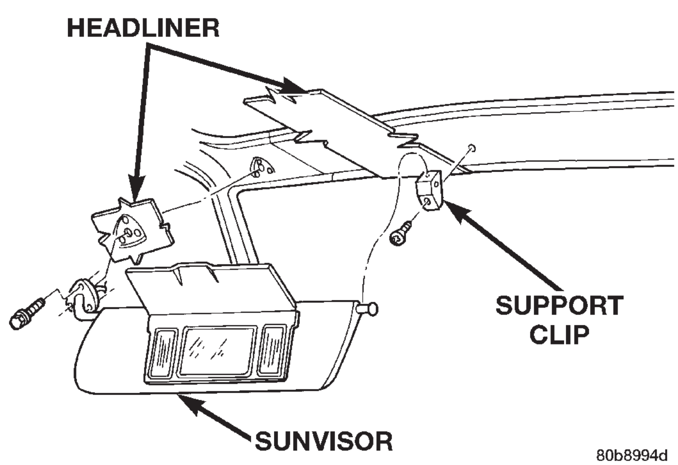


Fig. 83 Sunvisor w/Vanity Lamp

INSTALLATION

(1) Install the support bracket and the retaining screw.

(2) Connect vanity lamp connector, if equipped.

(3) Position the sunvisor in the support clip and align the arm support bracket holes with the headliner holes.

(4) Install the screws that attach the sunvisor arm support bracket to the headliner and the roof panel.

HEADLINER

The upper trim moldings and the headliner are attached to the roof rail with a combination of screws, clip retainers and rail retainers (Fig. 84).

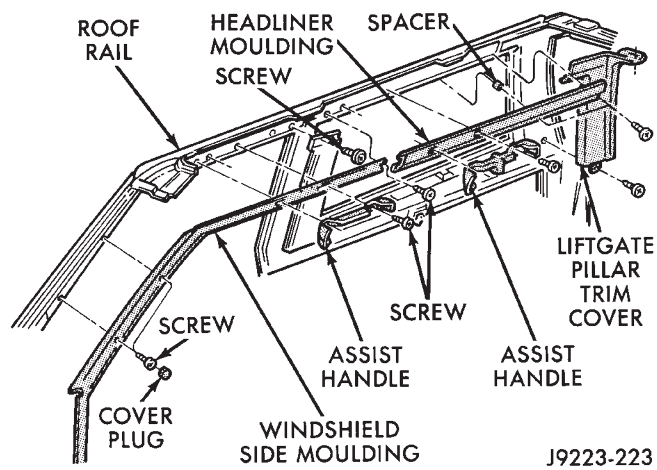


Fig. 84 Headliner Trim Moldings

To remove a headliner, all of the upper trim moldings must be removed from the perimeter of the headliner along with (as applicable):

- Assist handles.
- Sunvisors.
- Dome/cargo lamps.
- Overhead console.
- All other attached/overlapping components.

Refer to the appropriate removal and installation procedure locate in this section or in Group 8, Electrical.

REMOVAL

CAUTION: The headliner is a one-piece, molded component (Fig. 85). It has limited flexibility and must not be bent during removal/installation.

(1) Remove the upper trim moldings from the perimeter of the headliner (Fig. 86).

(2) Ensure that all the retainer clips and screws are disengaged before removing the headliner.

(3) Disengage tabs attaching headliner/speaker structure to roof rail, if equipped (Fig. 85).

(4) Disengage rear speaker harness connector, if equipped.

INSTALLATION

(1) Engage tabs attaching headliner/speaker structure to roof rail, if equipped. (Fig. 85)

(2) On vehicles without headliner speakers, ensure that the retainer clips on upper liftgate opening trim and rails are installed. (Fig. 87)

(3) Engage rear speaker harness connector.

REMOVAL AND INSTALLATION (Continued)

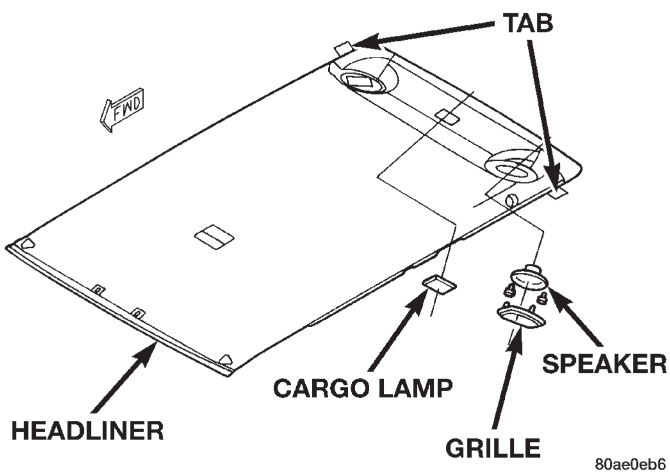


Fig. 85 Headliner

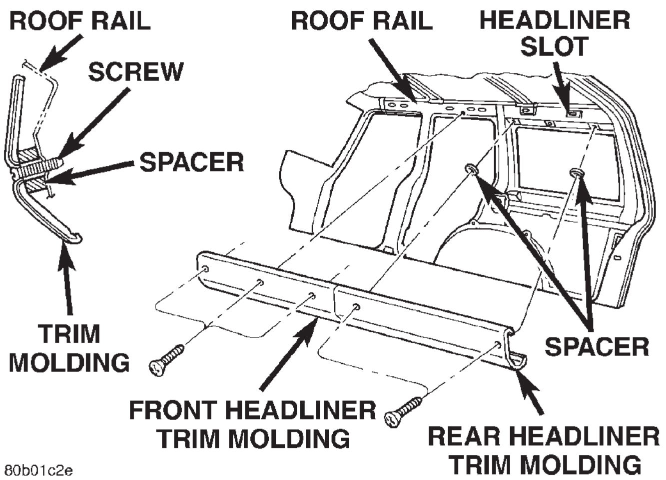


Fig. 86 Upper Trim Molding—4-Door

(4) Install the upper trim moldings around the perimeter of the headliner. Tighten the retaining screws to 1 N·m (11 in. lbs.) torque.

(5) As applicable, install:

- Assist handles.
- Sunvisors.
- Dome/cargo lamps.
- Overhead console.
- All other attached/overlapping components.

LIFTGATE TRIM PANEL

REMOVAL

(1) Using a small flat blade, pry out the trim plugs from the liftgate assist handle.

(2) Remove the screws attaching the assist handle to the liftgate (Fig. 88).

(3) Remove the screws that attach the liftgate trim panel to the liftgate.

(4) Using a trim panel removal tool, detach the push-in fasteners from the liftgate.

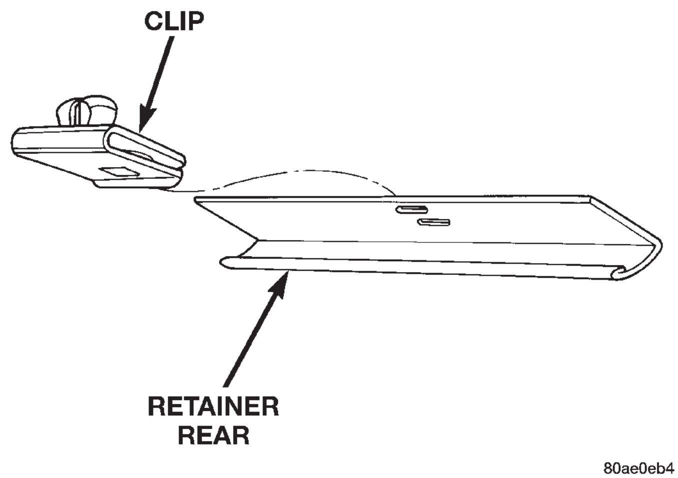


Fig. 87 Headliner Retainer Clip and Retainer Rail

(5) Remove the trim panel from the liftgate.

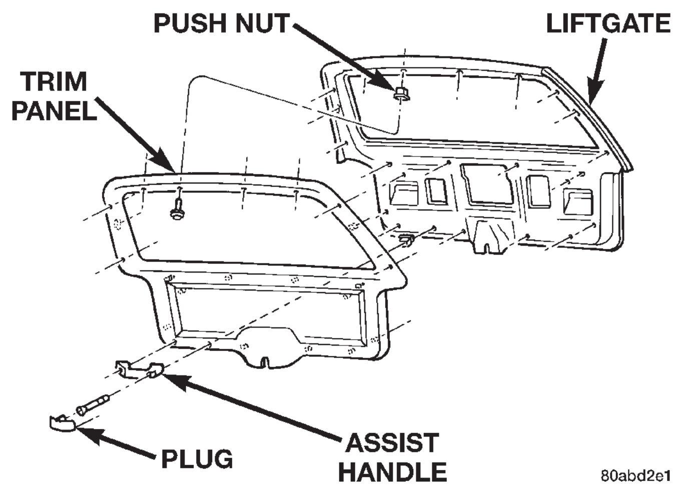


Fig. 88 Liftgate Trim Panel

INSTALLATION

(1) Position the trim panel on liftgate.

(2) Using new push-in fasteners, align the push-in fasteners with the holes in the liftgate inner panel and press the trim panel into place.

(3) Install the screws to attach the liftgate trim panel to the liftgate.

(4) Install the screws attaching the assist handle to the liftgate.

(5) Press the trim plugs into the liftgate assist handle.

REMOVAL AND INSTALLATION (Continued)

LIFTGATE

REMOVAL

WARNING: DO NOT DISCONNECT SUPPORT ROD CYLINDERS WITH LIFTGATE CLOSED. SUPPORT ROD PISTONS ARE OPERATED BY HIGH PRESSURE GAS. THIS COULD CAUSE DAMAGE AND/OR PERSONAL INJURY IF THEY ARE REMOVED WHILE PISTONS ARE COMPRESSED.

(1) Remove center high mounted stop lamp (CHMSL).
(2) Open and support liftgate.
(3) Remove liftgate trim panel.
(4) Disconnect and plug backlite washer fluid supply line.
(5) Remove screws that attach rear wiper and liftgate power lock wire harness connectors to liftgate and disconnect connectors.
(6) Using access hole created by removal of CHMSL, route backlite washer fluid supply line and rear wiper and liftgate power lock wire harness/grommets through access hole and separate from liftgate.
(7) Remove retainer clips that secure support rods to ball studs.
(8) Remove support rods from ball studs.
(9) Remove bolts attaching hinges to liftgate.
(10) Remove liftgate from vehicle.

INSTALLATION

(1) Position and support liftgate at opening in body and install bolts attaching hinges to liftgate. Tighten bolts to 26 N·m (19 ft. lbs.) torque.
(2) Connect liftgate support rods to ball studs and install retainer clips.
(3) Route backlite washer fluid supply line and rear wiper and liftgate power lock wire harnesses/grommets through access hole.
(4) Connect connectors and install screws that attach rear wiper and liftgate power lock wire harness connectors to liftgate.
(5) Unplug and connect backlite washer fluid supply line.
(6) Install liftgate trim panel.
(7) Remove supports and close liftgate.
(8) Install (CHMSL).

LIFTGATE HINGE

REMOVAL

It is not necessary to remove the liftgate to replace one or both hinges.
(1) Open and support the liftgate.
(2) Remove the liftgate opening upper trim.
(3) Remove the bolts attaching the hinge to the header panel (Fig. 89).
(4) Remove the bolts attaching the hinge to the liftgate.

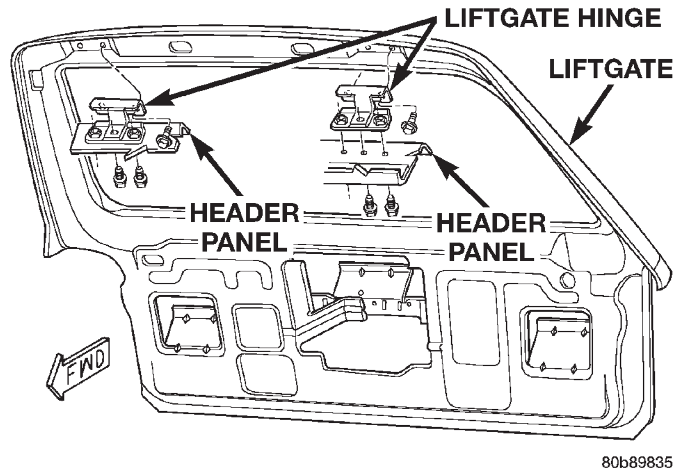


Fig. 89 Liftgate Hinge

INSTALLATION

(1) Position the hinge on the liftgate.
(2) Install the bolts attaching the hinge to the liftgate. Tighten to 26 N·m (19 ft. lbs.) torque.
(3) Install the bolts attaching the hinge to the header panel. Tighten to 26 N·m (19 ft. lbs.) torque.
(4) Install the liftgate opening upper trim.
(5) Remove the support and close the liftgate.

LIFTGATE SUPPORT ROD CYLINDER

REMOVAL

WARNING: DO NOT REMOVE A SUPPORT ROD CYLINDER WITH THE LIFTGATE CLOSED. EACH SUPPORT ROD PISTON IS OPERATED BY HIGH PRESSURE GAS. IT CAN CAUSE DAMAGE AND/OR PERSONAL INJURY IF IT IS REMOVED WITH THE PISTON COMPRESSED. DO NOT ATTEMPT TO DISASSEMBLE OR REPAIR A SUPPORT ROD CYLINDER.

(1) Open the liftgate.
(2) Support the liftgate in the open position.
(3) Remove the clip attaching the support rod to the ball stud.
(4) Disconnect the support rod from the ball stud.
(5) Remove the bolts attaching the support rod to the liftgate (Fig. 90).
(6) Separate the support rod from the liftgate.

INSTALLATION

(1) Position the support rod on the liftgate.
(2) Install the bolts attaching the support rod to the liftgate.

REMOVAL AND INSTALLATION (Continued)

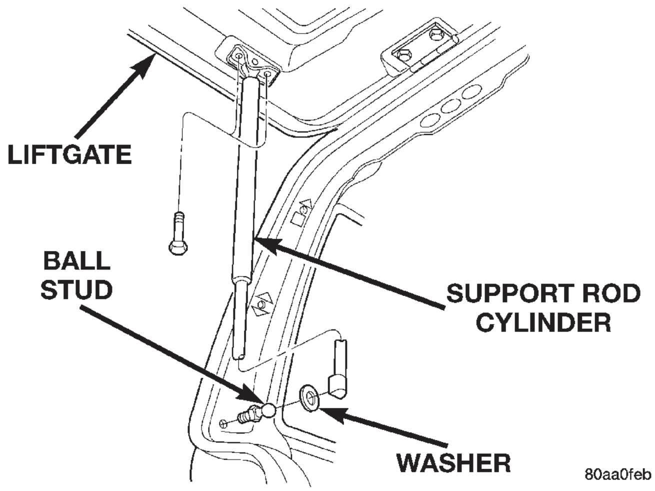


Fig. 90 Liftgate Support Rod

(3) Connect the support rod to the ball stud.
(4) Secure the support rod to the ball stud with the retainer clip.
(5) Remove the support from the liftgate.

LIFTGATE SUPPORT ROD BALL STUD

REMOVAL

(1) Open the liftgate.
(2) Support the liftgate in the open position.
(3) Remove the retainer clip attaching the support rod to the ball stud.
(4) Disconnect the support rod from the ball stud.
(5) Remove the ball stud.

INSTALLATION

(1) Install the replacement ball stud.
(2) Connect the support rod to the ball stud.
(3) Secure the support rod to the ball stud with the clip.
(4) Remove the support from the liftgate.

LIFTGATE OUTSIDE HANDLE

REMOVAL

(1) Remove liftgate trim panel.
(2) Disconnect liftgate actuator linkages.
(3) Disconnect liftgate outside handle to latch rod.
(4) Remove nut attaching outside handle to liftgate (Fig. 91).
(5) Separate outside handle from liftgate.
(6) If necessary, remove lock cylinder (Fig. 92).

INSTALLATION

(1) If necessary, install lock cylinder.
(2) Position outside handle on liftgate.
(3) Install nut attaching outside handle to liftgate.
(4) Connect liftgate outside handle to latch rod.
(5) Connect liftgate actuator linkages.

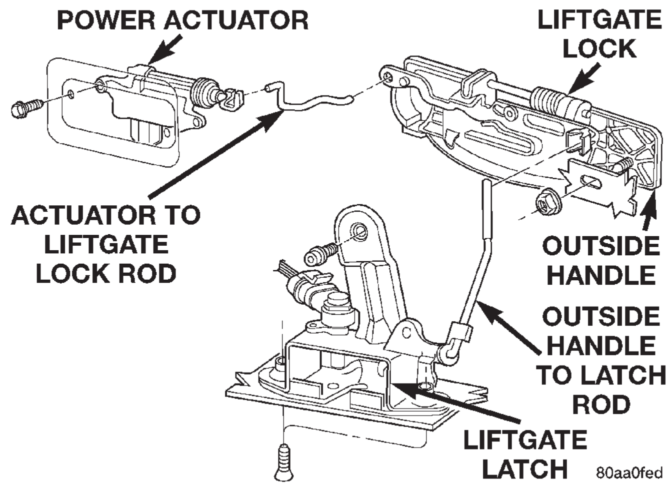


Fig. 91 Liftgate Outside Handle

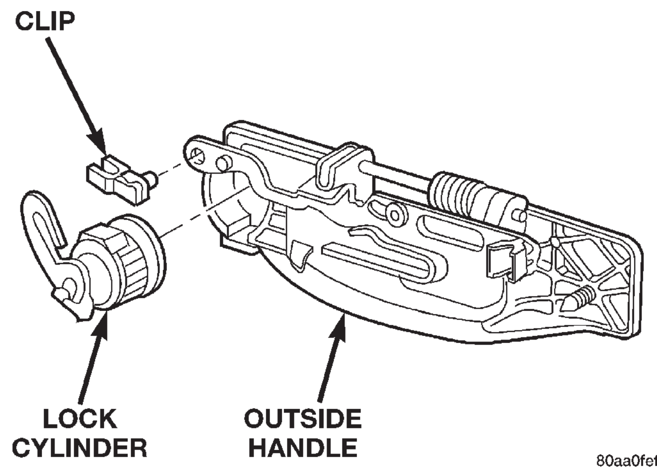


Fig. 92 Liftgate Lock Cylinder

(6) Install liftgate trim panel.

LIFTGATE LOCK CYLINDER

For service procedures, refer to the Liftgate Outside Handle Removal/Installation procedures.

LIFTGATE LATCH

REMOVAL

(1) Raise liftgate.
(2) Remove liftgate trim panel.
(3) Remove screws attaching latch to liftgate (Fig. 93).
(4) Disconnect rod from latch.
(5) Disconnect power lock connector from handle, if equipped.
(6) Remove latch from liftgate.

INSTALLATION

(1) Position latch in liftgate.

REMOVAL AND INSTALLATION (Continued)

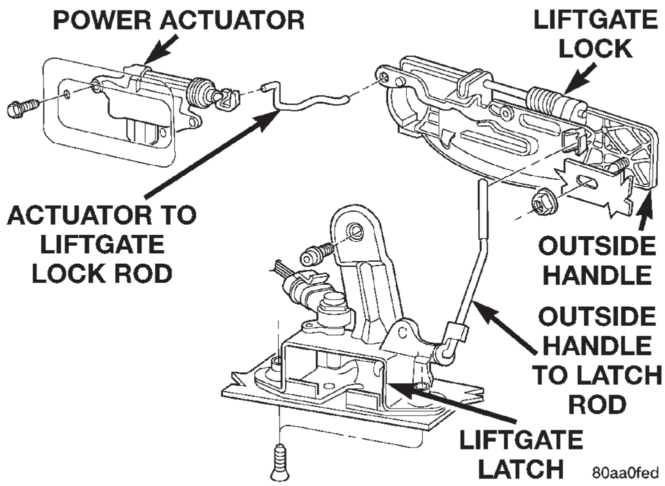


Fig. 93 Liftgate Latch

(2) Connect power lock connector to handle, if equipped.

(3) Connect latch rod.

(4) Install screws attaching latch to liftgate. Tighten screws to 13 N·m (9 ft. lbs.) torque.

(5) Install liftgate trim panel.

LIFTGATE LATCH STRIKER

REMOVAL

(1) From underside of vehicle, remove nuts attaching striker to floor pan (Fig. 94).

(2) Separate striker from vehicle.

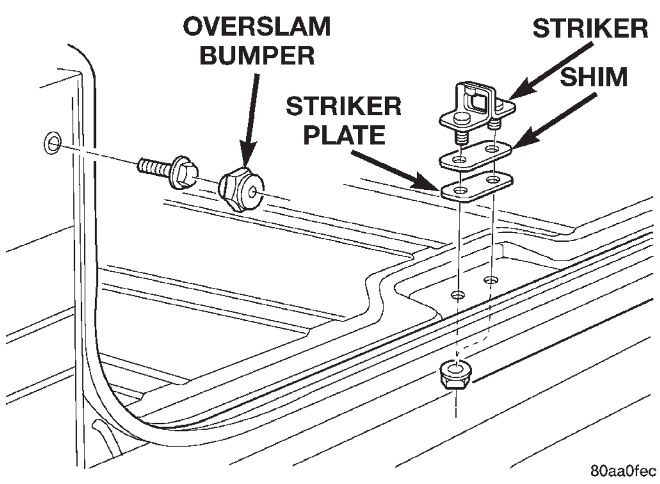


Fig. 94 Liftgagte Striker

INSTALLATION

(1) Position striker on vehicle.

(2) Install nuts. Tighten nuts to 54 N·m (40 ft. lbs.) torque.

LIFTGATE WEATHERSTRIP

REMOVAL

(1) Pull the seal away from the flange around the perimeter of liftgate opening and remove it.

(2) Clean the flange as necessary.

INSTALLATION

(1) Position weatherstrip seal in the opening with the left end of the seal at the opening centerline. Install the seal in a clockwise direction.

(2) Move to the left and mate the seal with the bottom-left flange (Fig. 95).

(3) Move upward and mate the seal with the left-side flange.

(4) Move to the right and mate the seal with the top-left roof flange.

(5) Seat the installed part of the seal with a roller. Move the roller from the left-bottom end of seal to the top-left half of the seal.

(6) Move to the right and mate the seal with the top-right roof flange.

(7) Move downward and mate the seal with the right-side flange.

(8) Move to the left and mate the seal with the bottom-right flange.

(9) Center and butt seal the ends together at the centerline.

(10) Seat the remaining part of the seal with a roller. Move the roller the from top-left half of the seal to the right-bottom end of the seal.

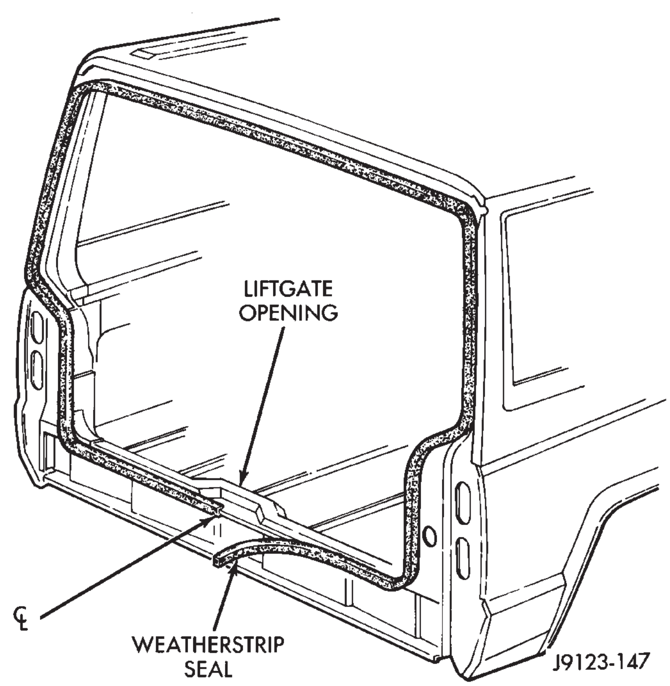


Fig. 95 Liftgate Weatherstrip Installation

ADJUSTMENTS

HOOD

The hood bolt holes are elongated for fore and aft and side-to-side adjustment.

(1) If hood is low to the cowl panel, insert shims between the hinge and hood at the rear hinge bolts.

(2) Adjust the hood bumper (Fig. 96) in or out to provide proper hood-to-fender height alignment.

(3) Adjust the hood strikers (Fig. 97) with shims as necessary. Tighten the screws to 22 N·m (16 ft-lbs) torque after adjustment.

(4) Align each latch and striker so that the striker enters latch squarely.

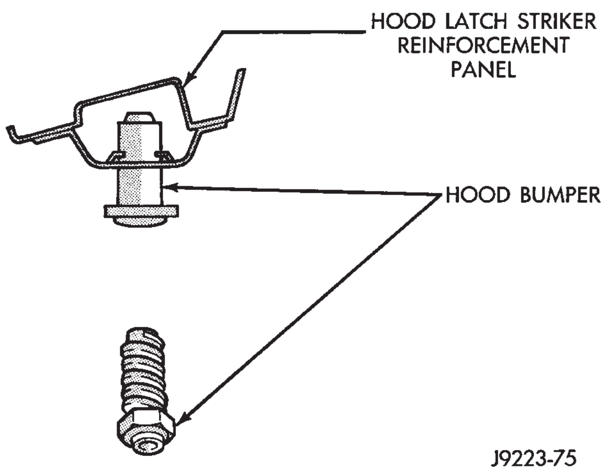


Fig. 96 Hood Bumper

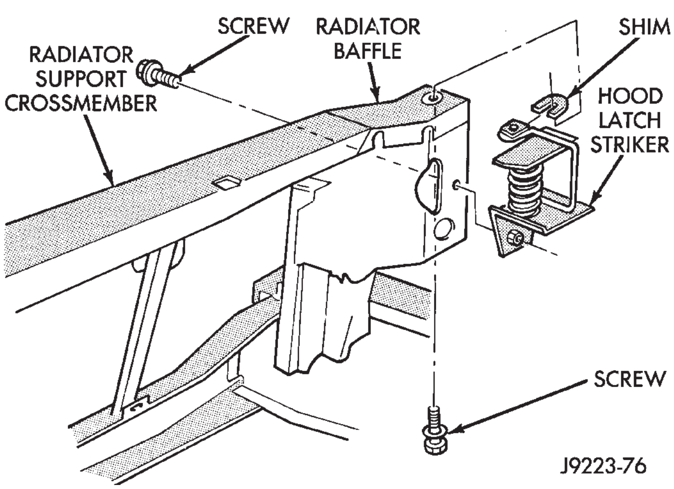


Fig. 97 Hood Latch Striker

DOOR

IN AND OUT—MINOR ADJUSTMENT

(1) Loosen the latch striker.

(2) Tap the latch striker inward if the door character line is outboard of the body character line or tap the latch striker outward if the door character line is inboard of the body character line.

(3) Inspect alignment. If correct, tighten striker with 28 N·m (20 ft. lbs.) torque.

UP AND DOWN—MINOR ADJUSTMENT

(1) Loosen the latch striker.

(2) Tap the latch striker downward if the door character line is higher than the body character line or tap the latch striker upward if the door character line is lower than the body character line.

(3) Inspect alignment. If correct, tighten striker with 28 N·m (20 ft. lbs.) torque.

ALIGNMENT MAJOR—ADJUSTMENT

Adjustment for alignment of the door is made by installing shims between hinge and door face (Fig. 98).

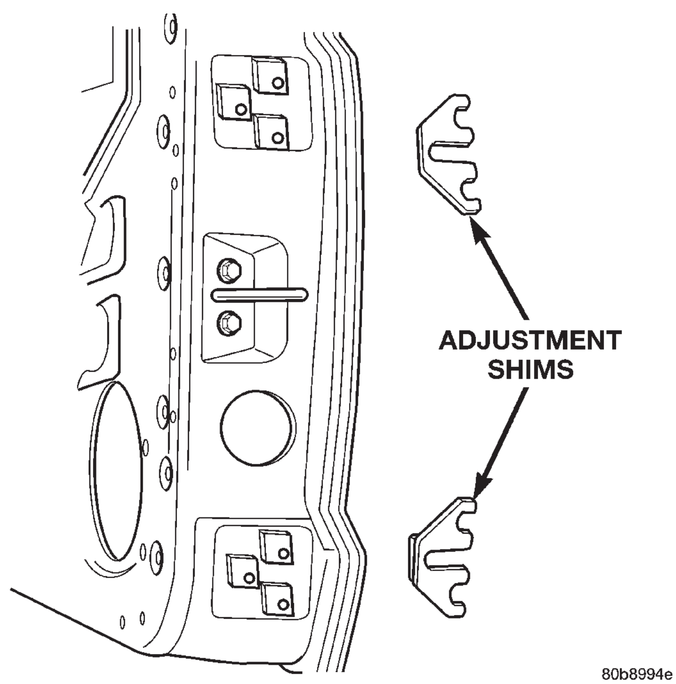


Fig. 98 Door Adjustment Shims

(1) If not loosened, loosen the door hinge bolts.

(2) Add or remove shims as necessary to obtain the best door fit.

(3) Tighten door hinge bolts to 3 N·m (2 ft-lbs) torque after adjustment is completed.

(4) Apply general purpose sealant around the door hinges/door face mating area.

DOOR LATCH ADJUSTMENT

(1) Locate access hole (Fig. 99).

(2) Insert a 5/32-inch hex-wrench through hole and into adjustment screw. Loosen screw.

(3) Operate outside handle button several times to release any restriction because of mis-alignment.

ADJUSTMENTS (Continued)

(4) Tighten adjustment screw to 3 N·m (30 in-lbs) torque.

(5) Test handle button and lock cylinder for proper operation.

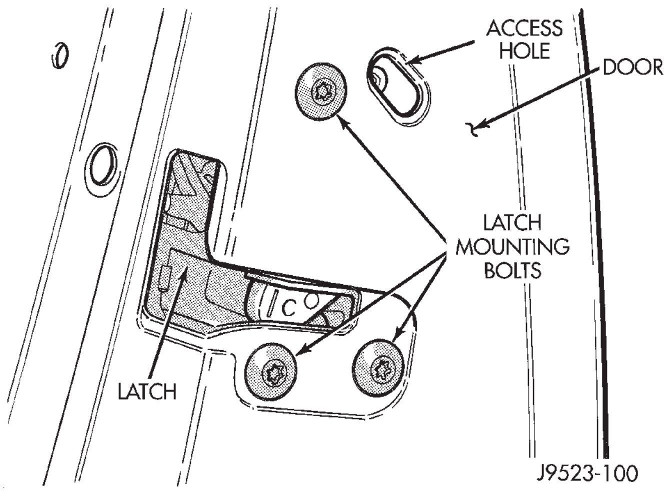


Fig. 99 Door Latch Adjustment

LIFTGATE

The position of liftgate can be adjusted upward or downward by use of slots in the hinge. An inward or outward adjustment is achieved by use of slots in the body. If an inward or outward adjustment is needed, use 3M™ Fast and Firm or equivalent on the hinge to body mating surface as a sealant.

REAR SEATBACK

(1) Unlatch and position seatback in cargo position.

(2) Loosen the screws attaching the strikers to the rear wheelhouse.

(3) Position the seat back in the full upright position and secure the latch into the strikers.

(4) From the cargo area of the vehicle, push the rear of the seatback forward.

(5) Unlatch and position seatback in cargo position.

(6) Tighten the screws attaching the strikers to the rear wheelhouse.

(7) Position the seat back in the full upright position and secure the latch into the strikers.

(8) Verify latch operation.

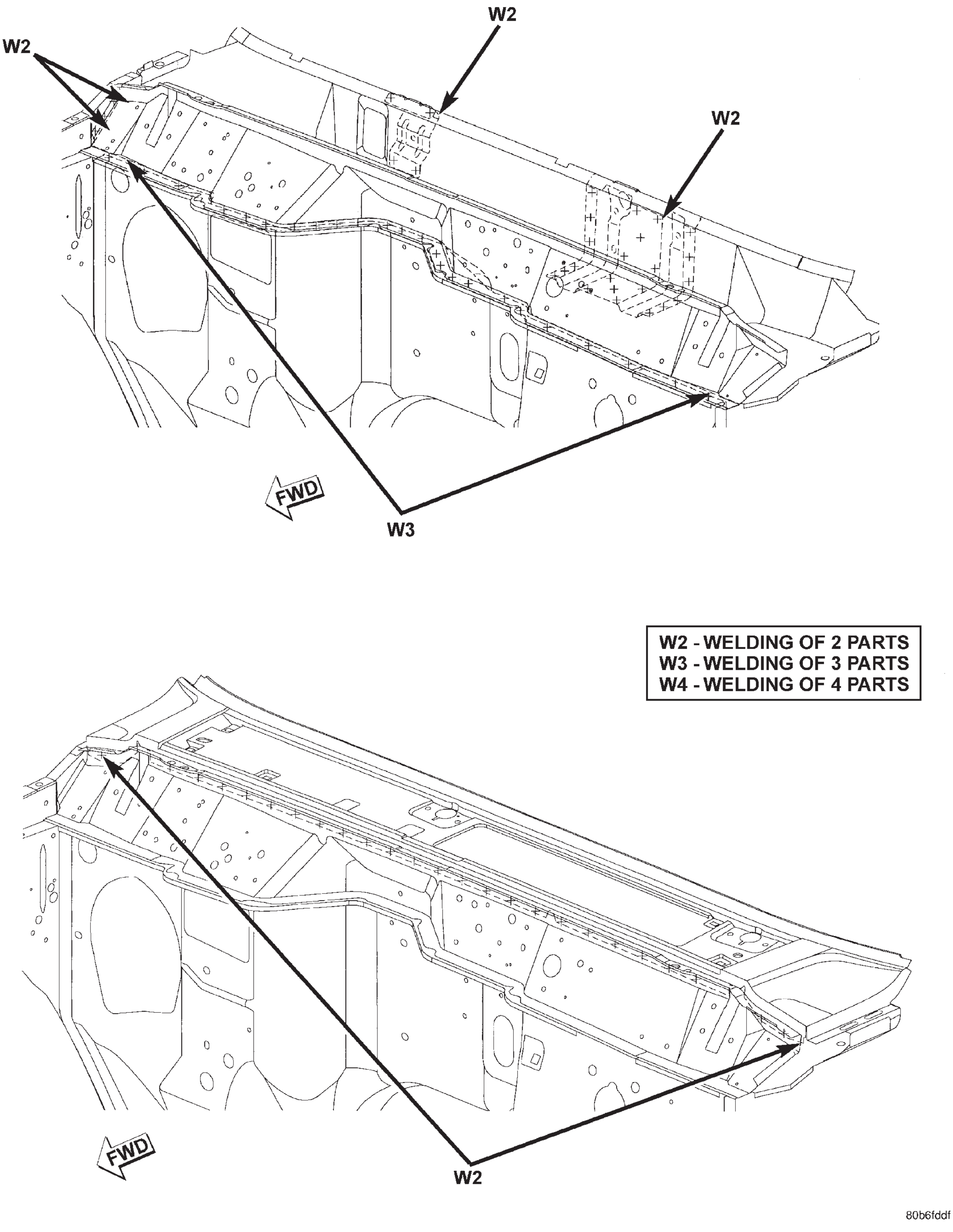
SPECIFICATIONS

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)
Liftgate Hinge	As Required	Multi-Purpose Grease NLGI GC-LB 2 EP (2)
Liftgate Support Arms	As Required	Engine Oil
Liftgate Latches	As Required	White Spray Lubricant (3)
Liftgate Release Handle (Pivot & Slide Contact Surfaces)	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		

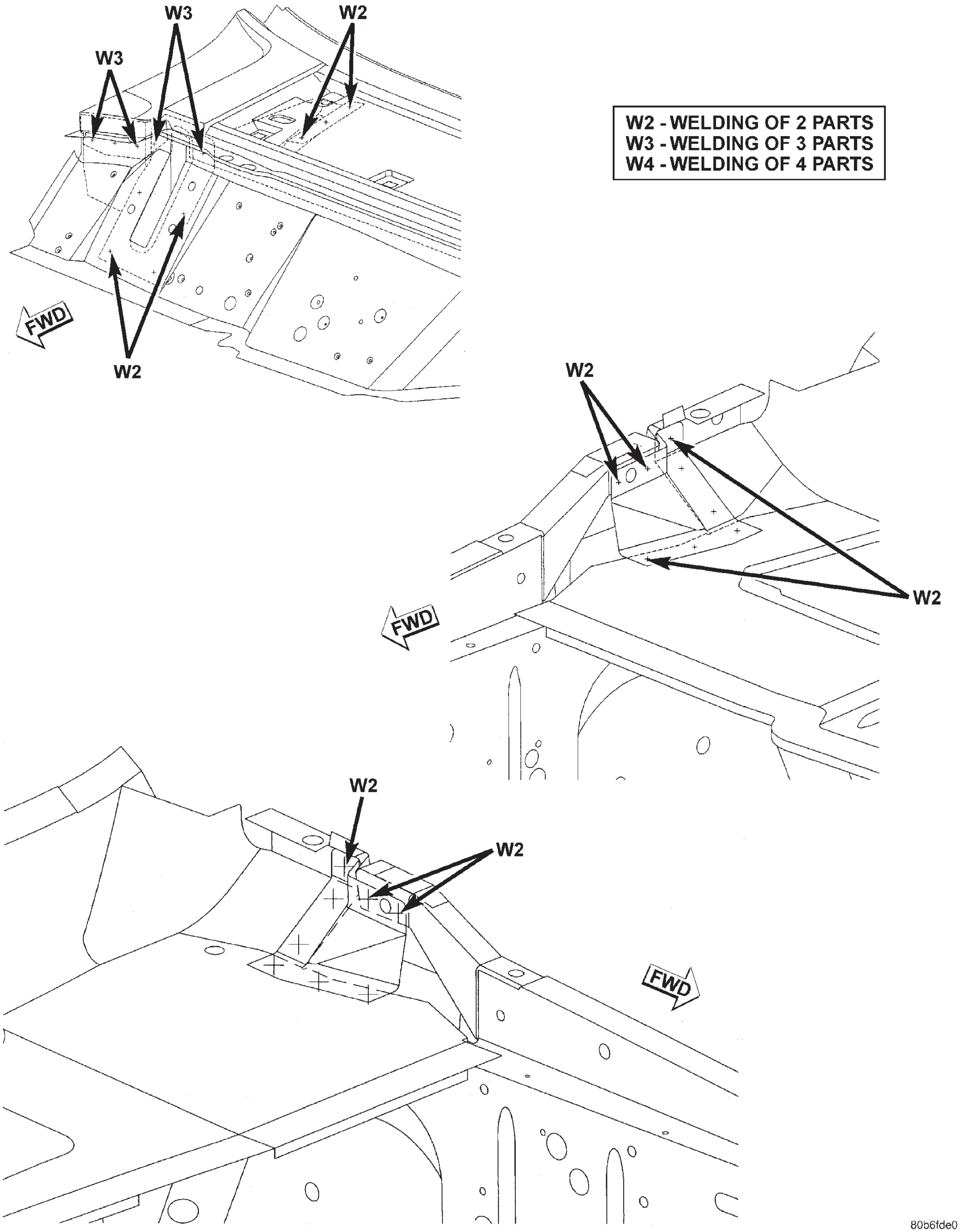
SPECIFICATIONS (Continued)

WELD LOCATIONS
UPPER COWL



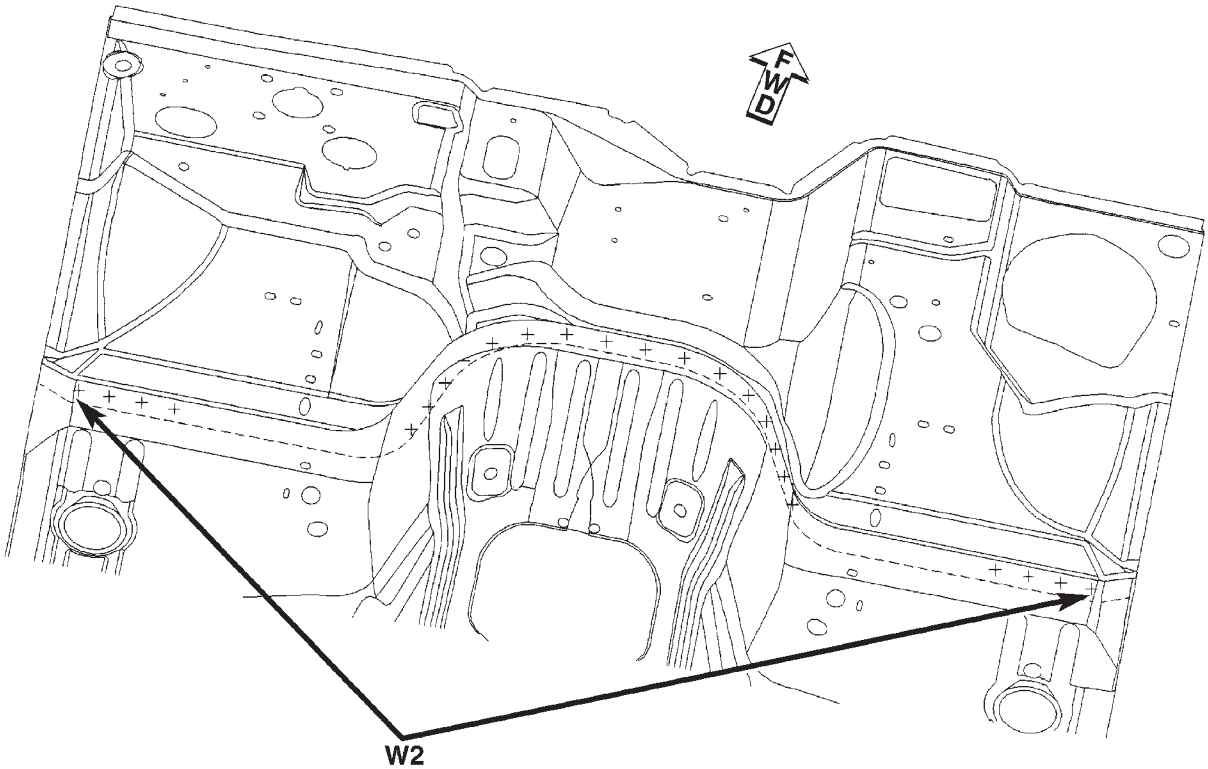
SPECIFICATIONS (Continued)

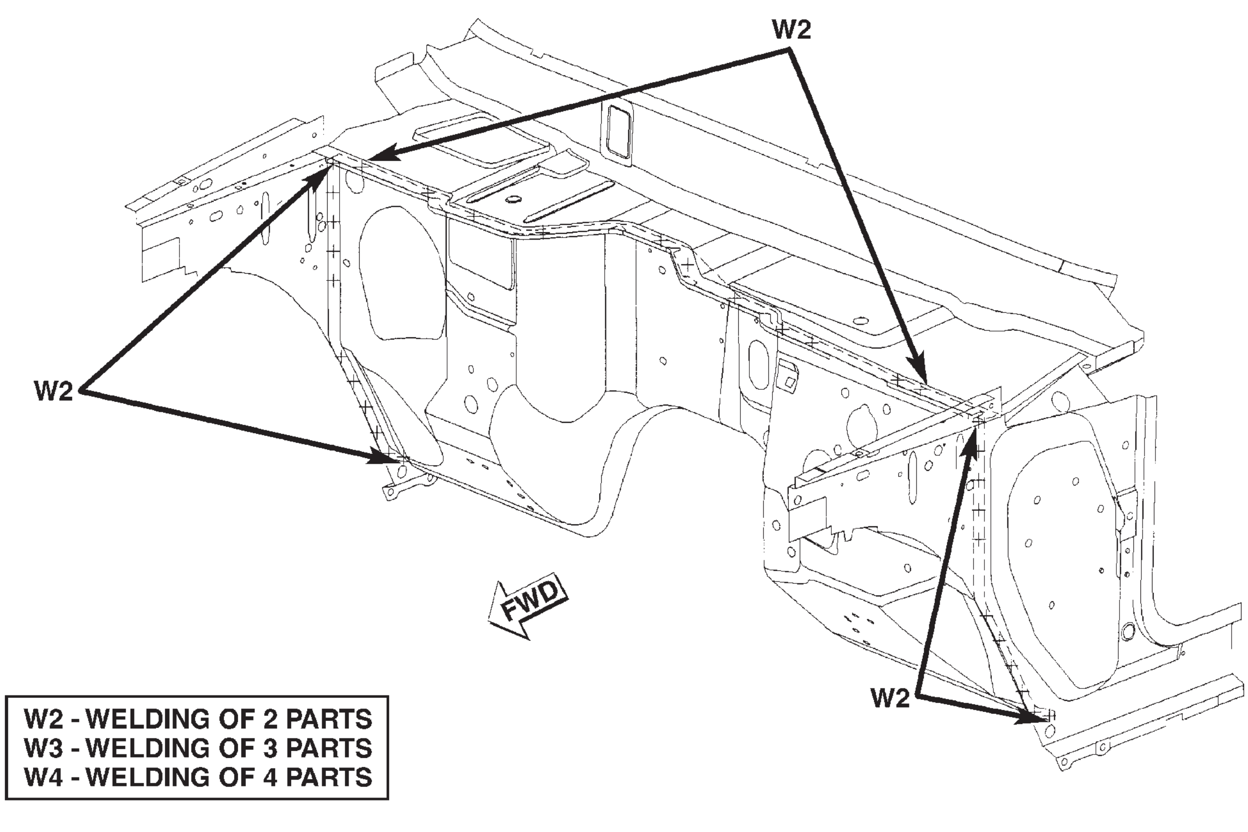
UPPER COWL



SPECIFICATIONS (Continued)

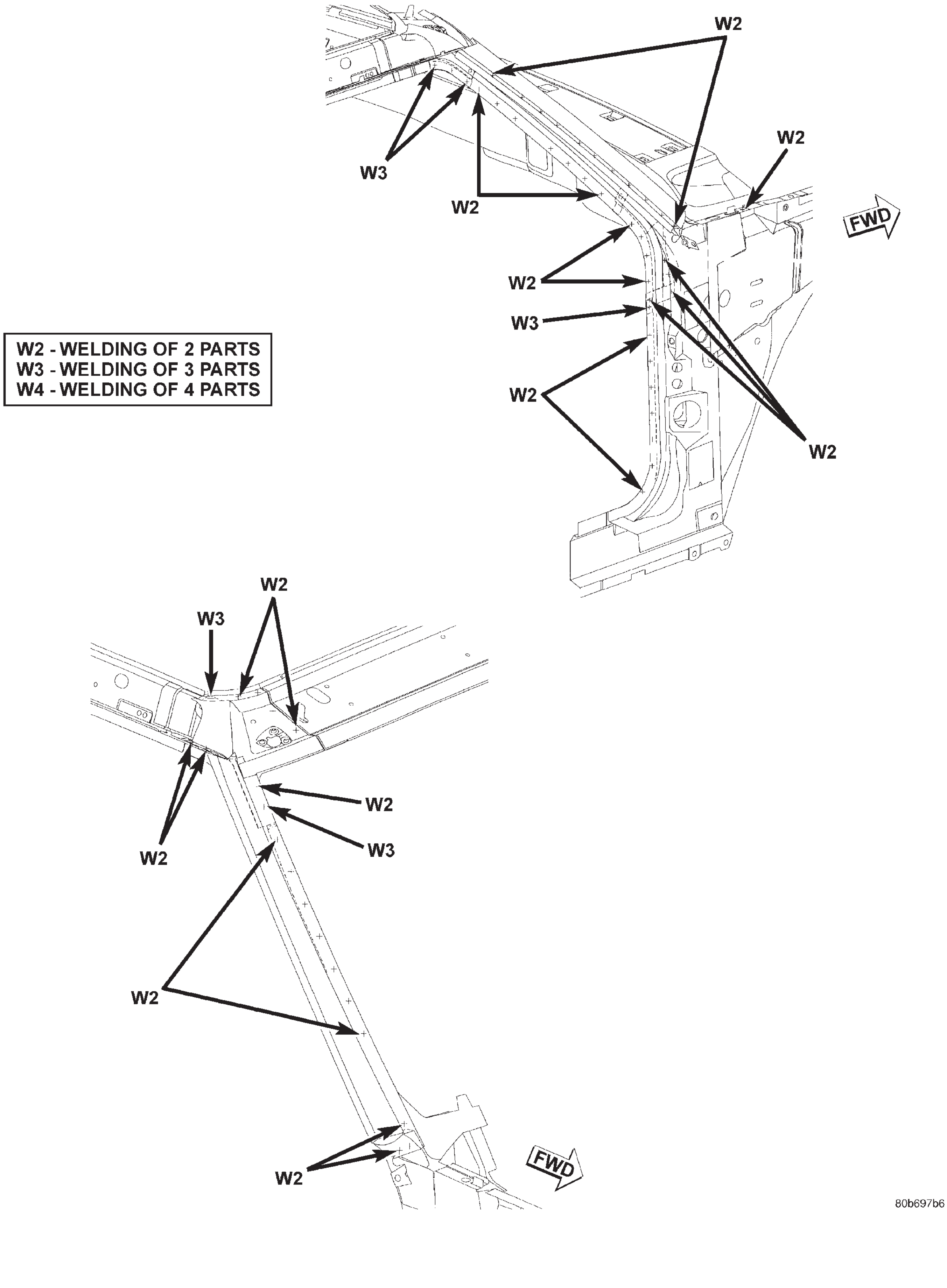
COWL





SPECIFICATIONS (Continued)

A—PILLAR



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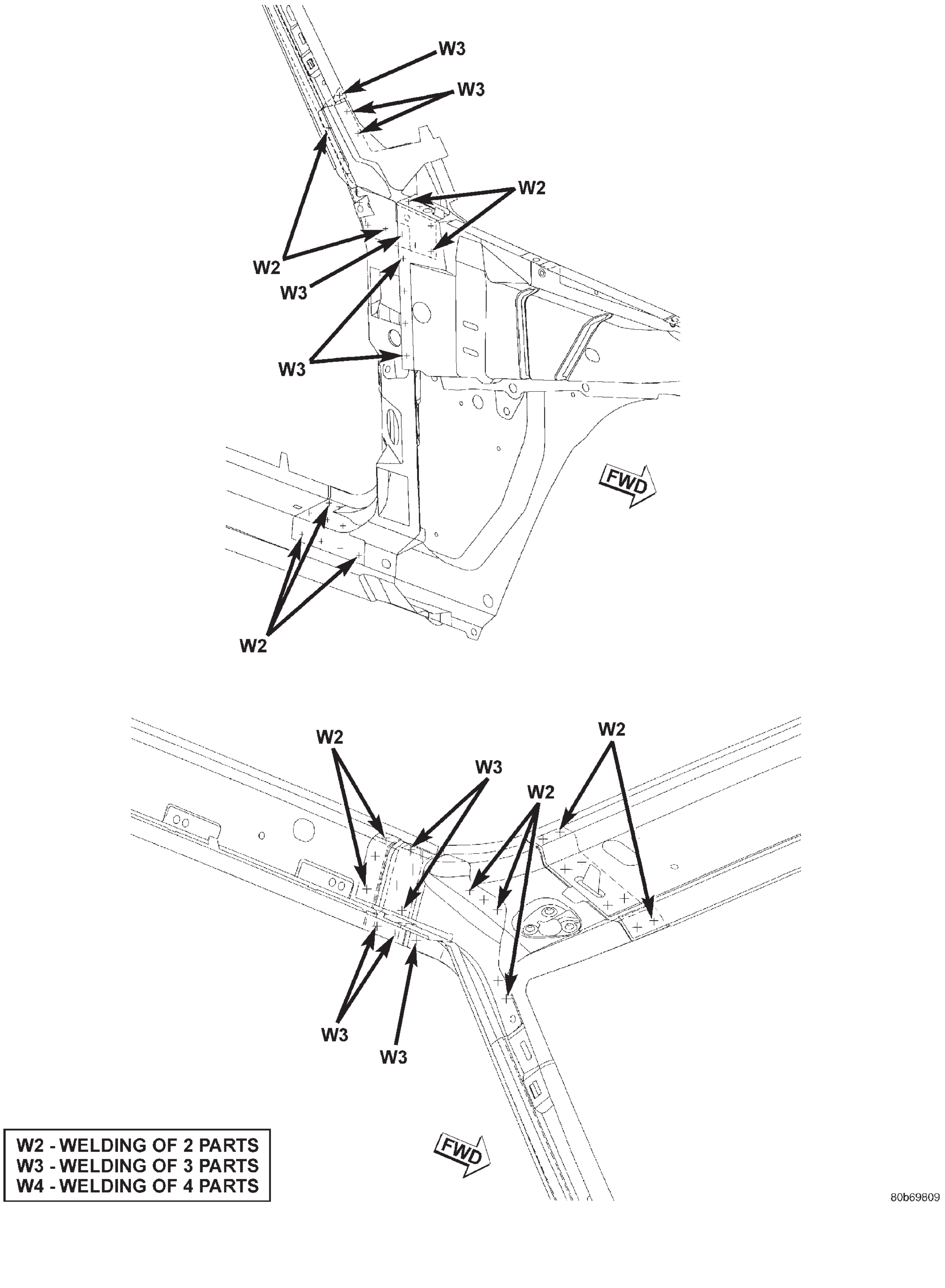

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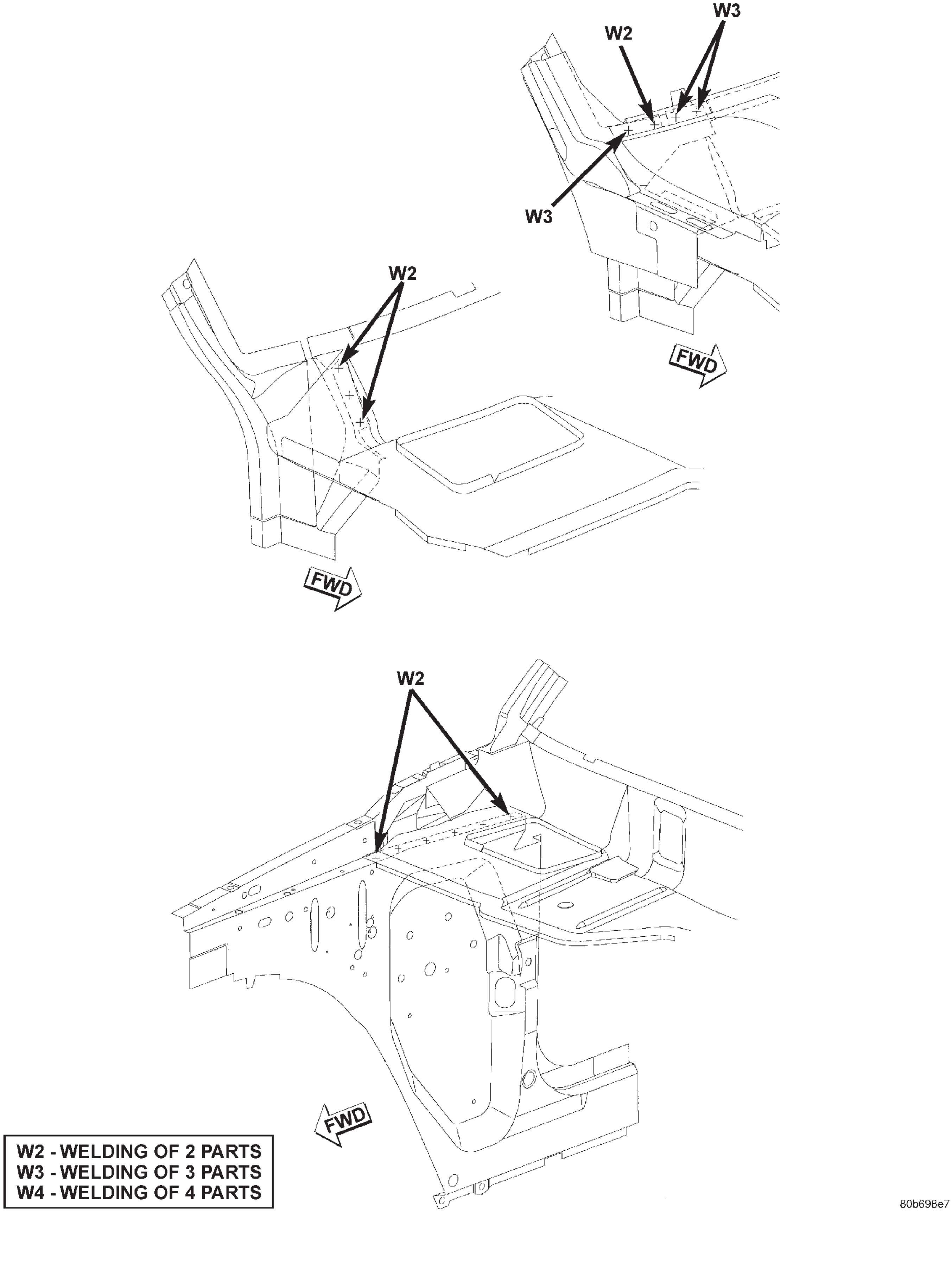

SPECIFICATIONS (Continued)

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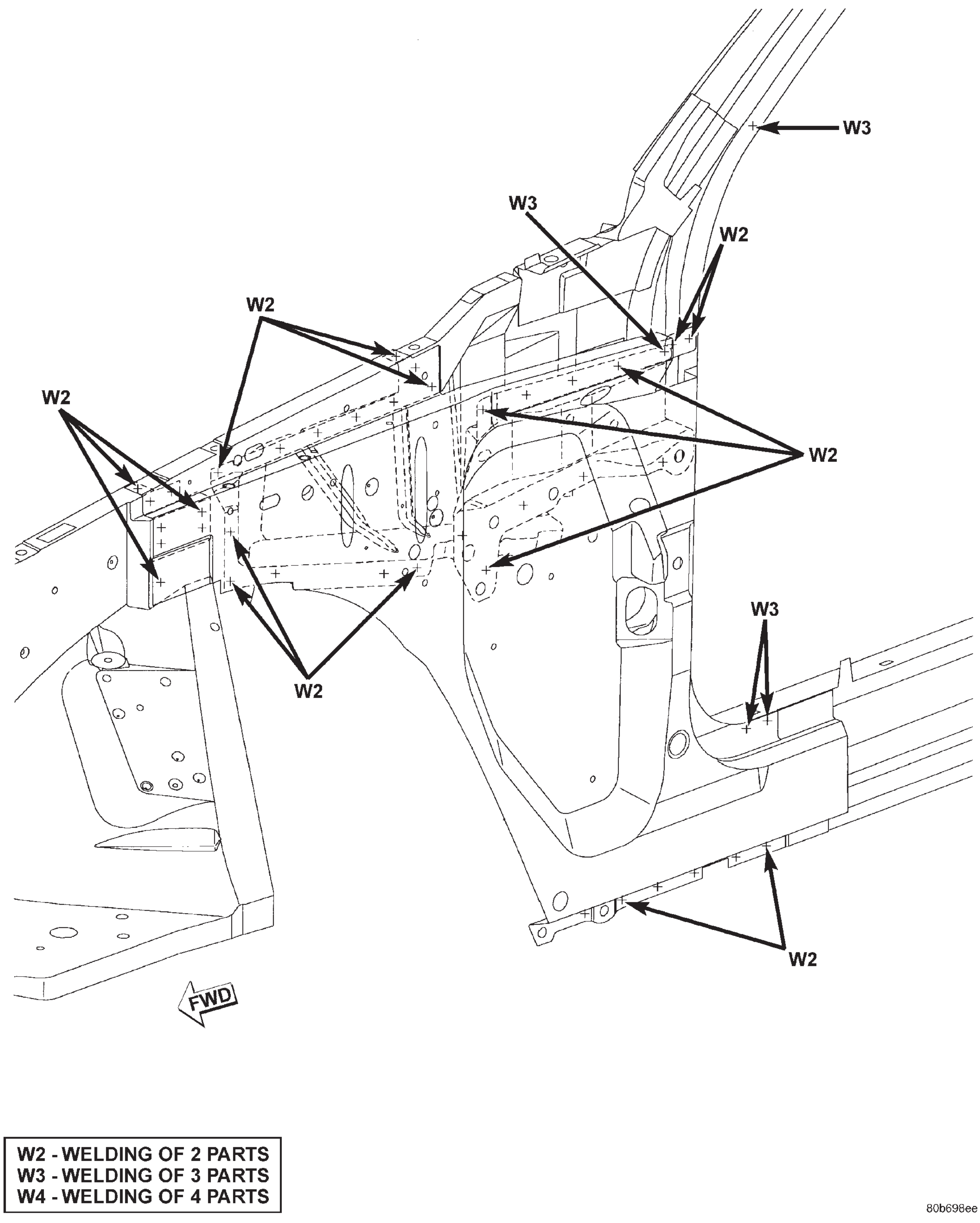

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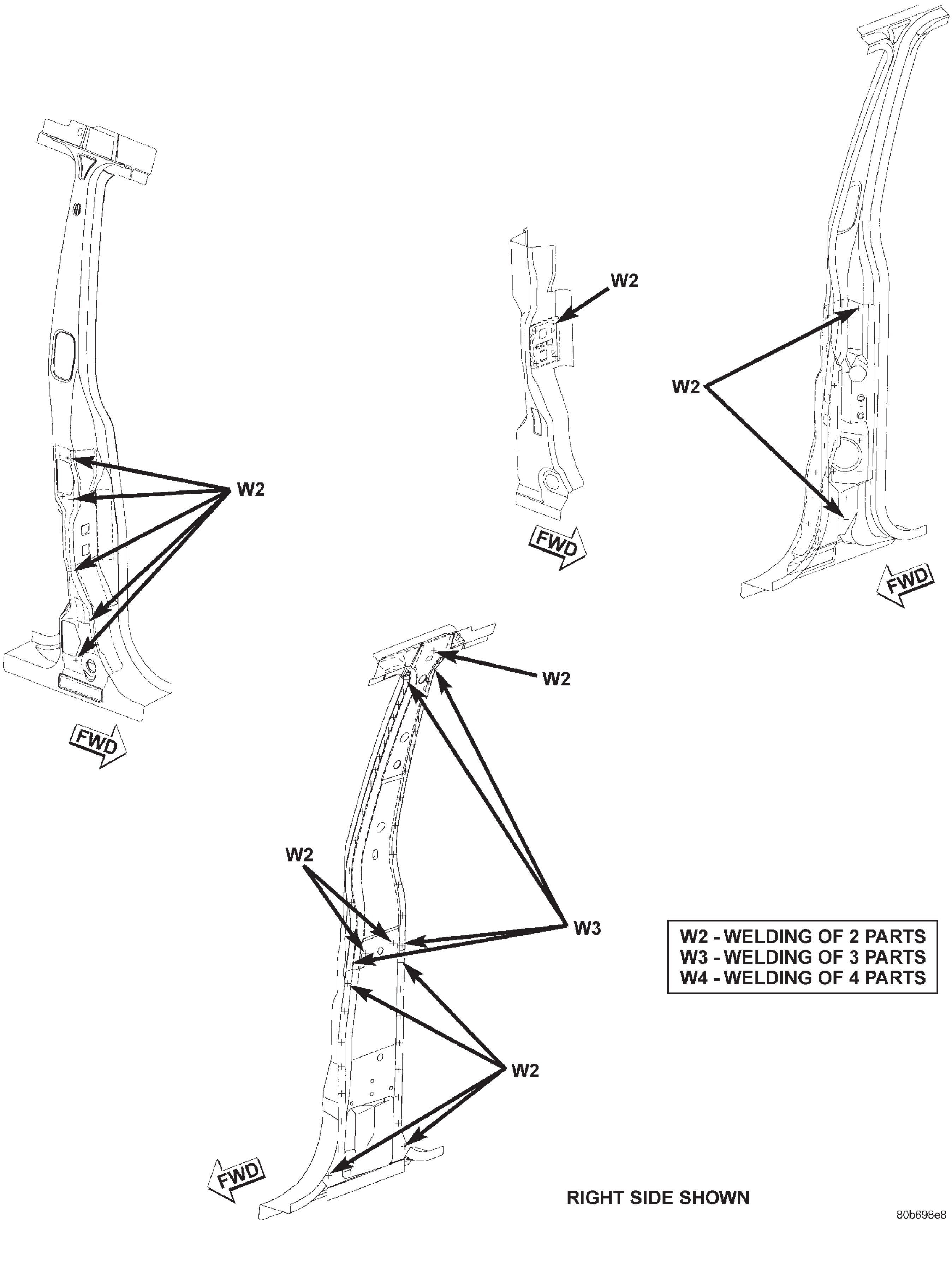
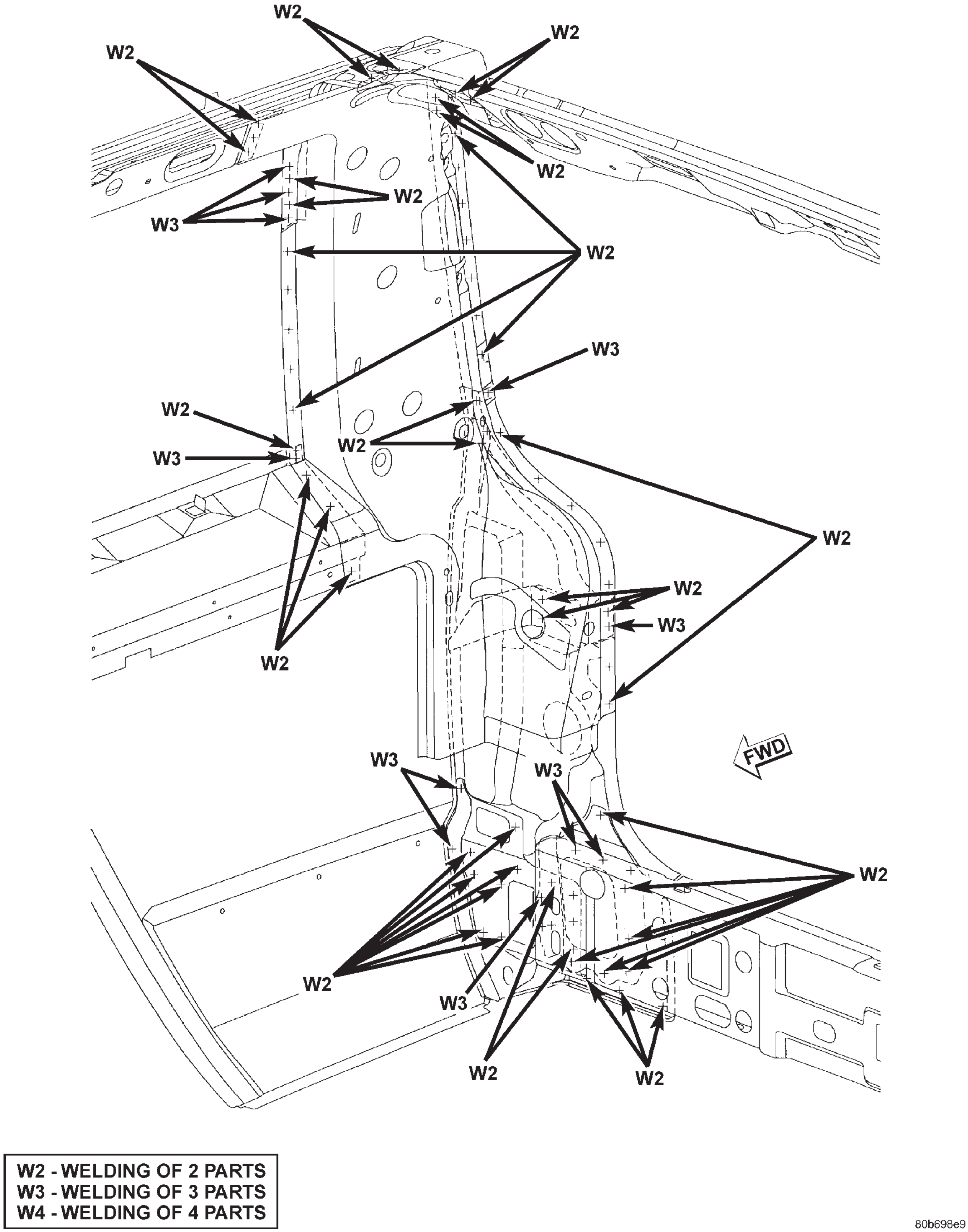


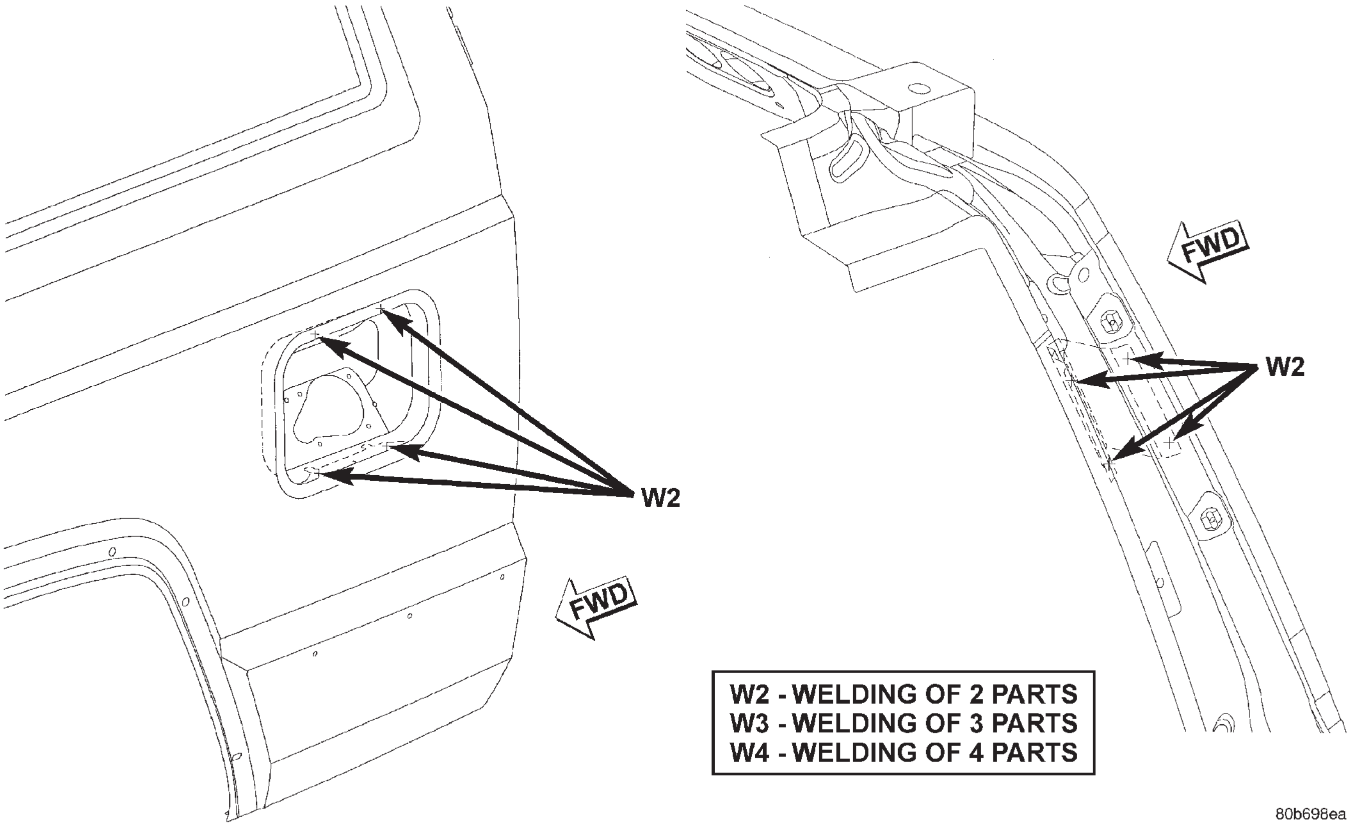
SPECIFICATIONS (Continued)

D—PILLAR



SPECIFICATIONS (Continued)

FUEL FILLER OPENING



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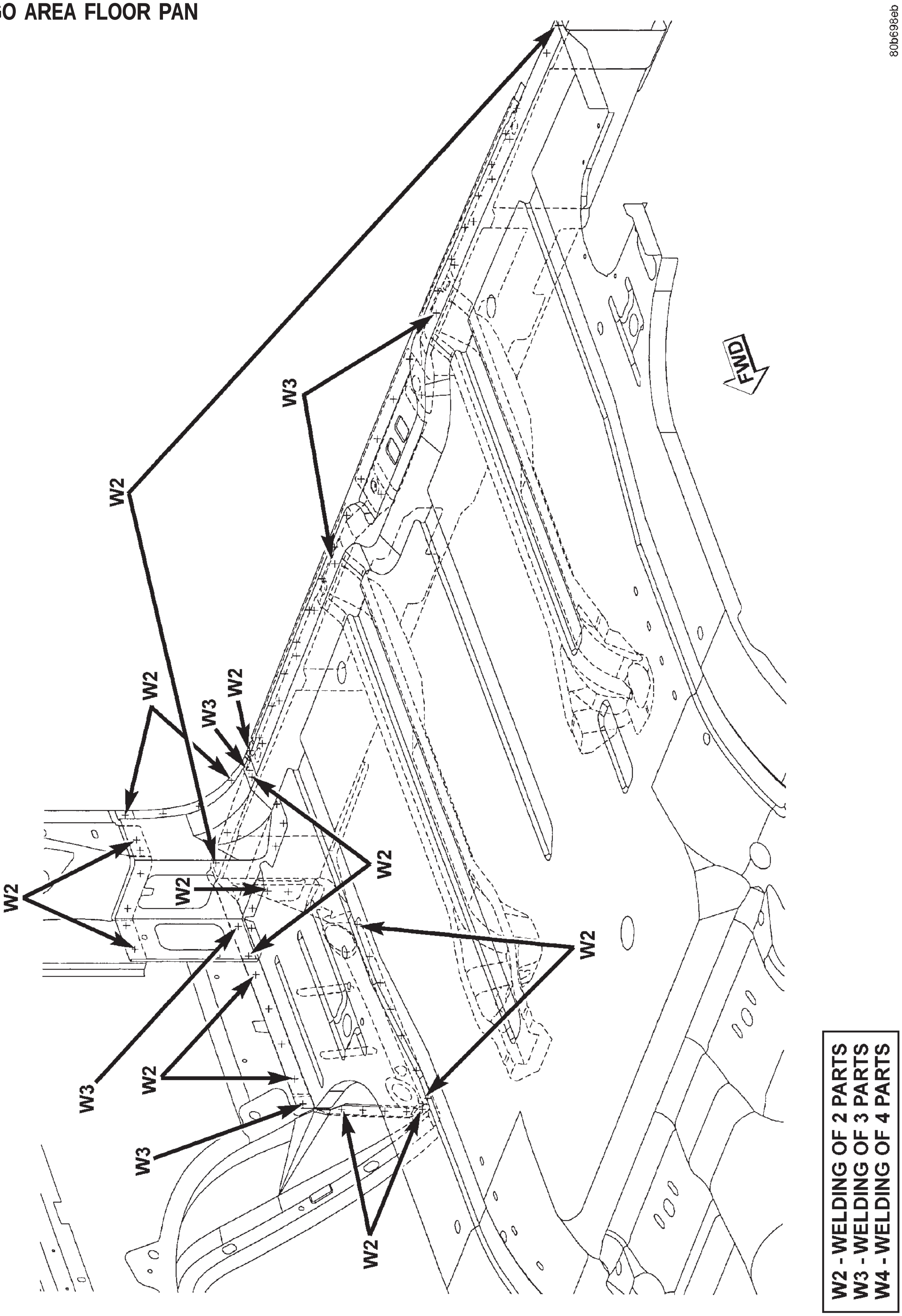
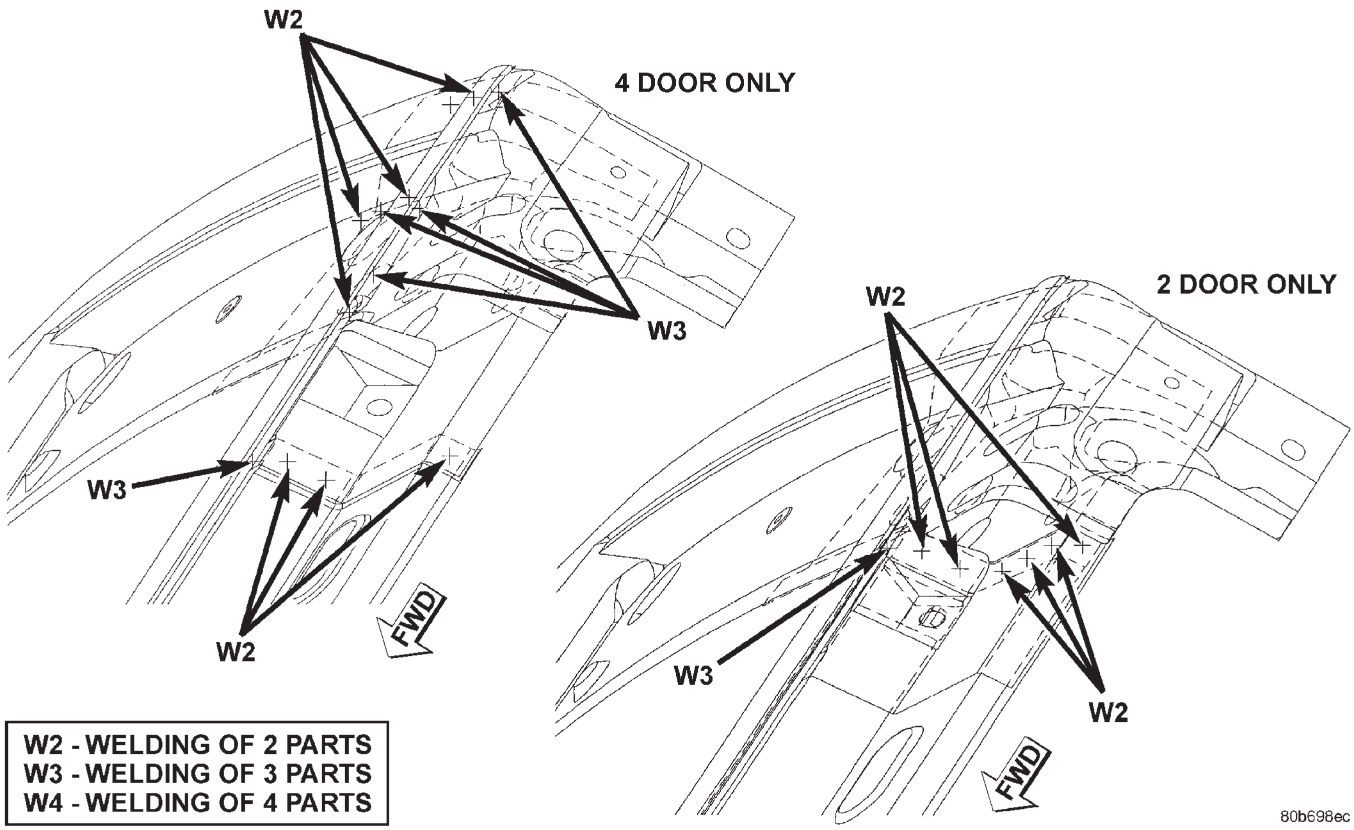
CARGO AREA FLOOR PAN



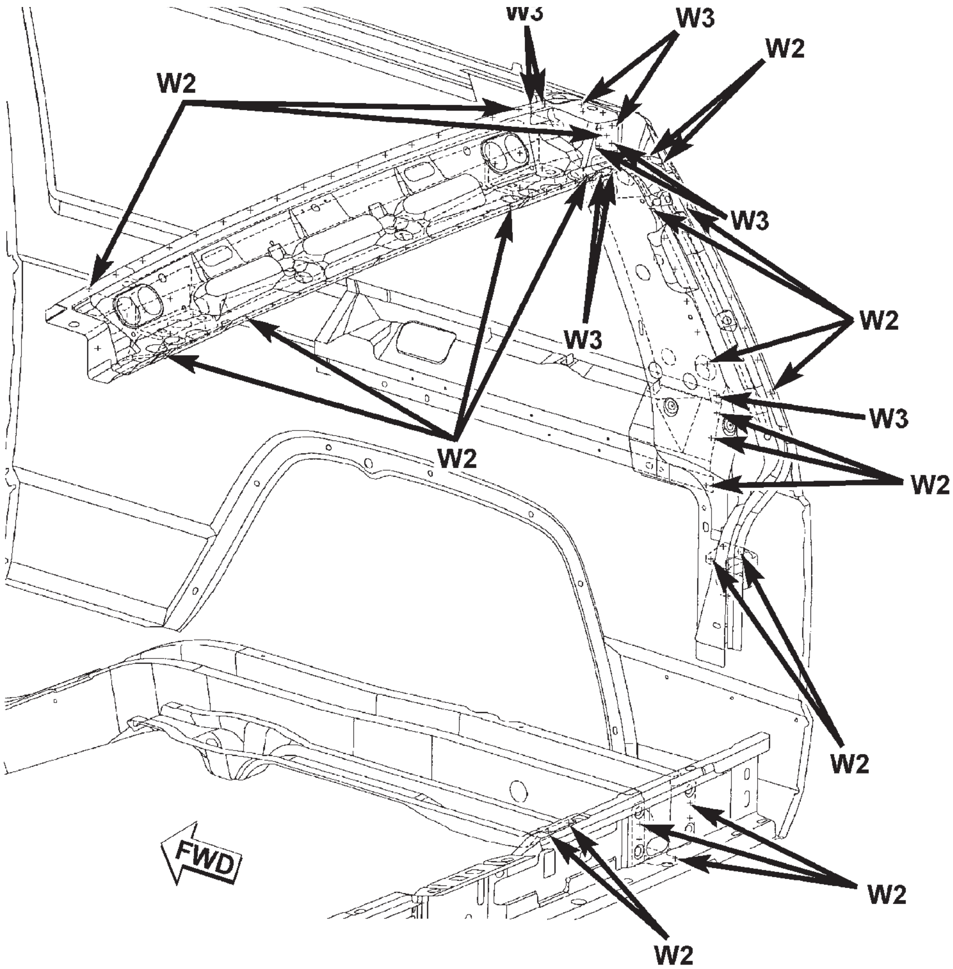
SPECIFICATIONS (Continued)

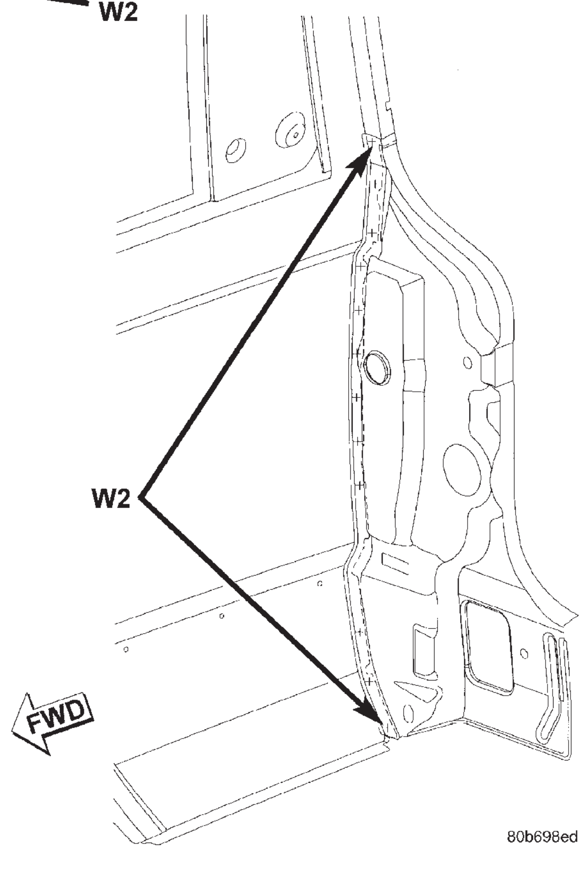
ROOF AND D—PILLAR



SPECIFICATIONS (Continued)

LIFTGATE OPENING

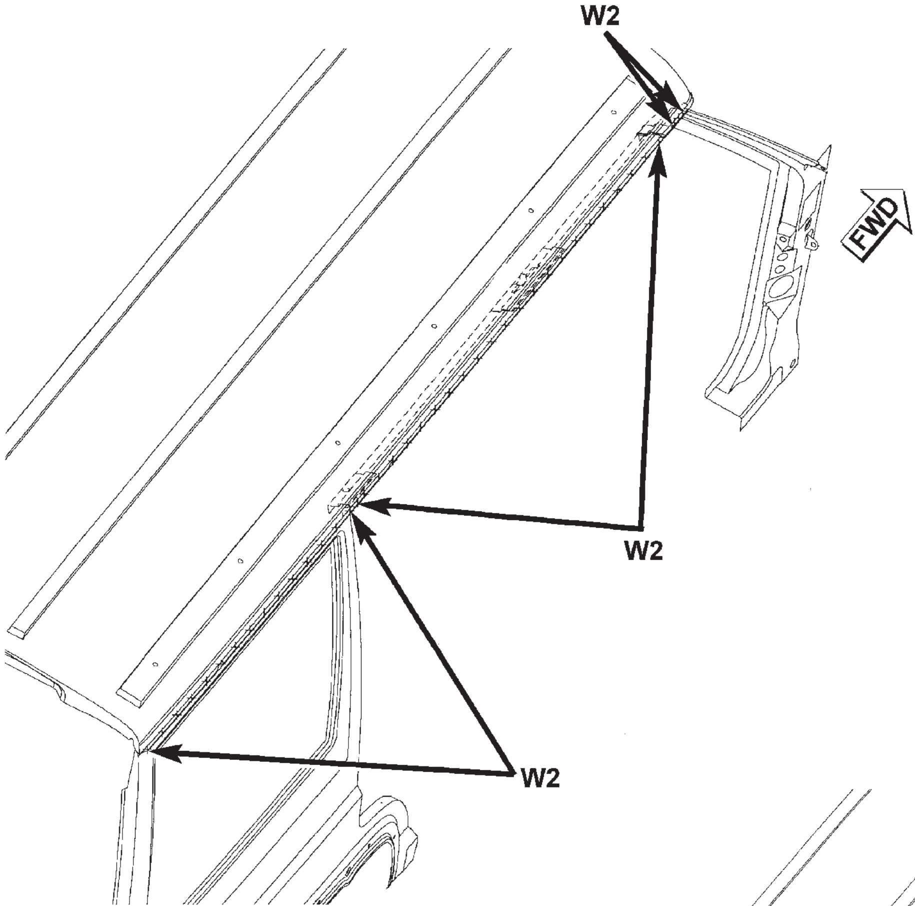




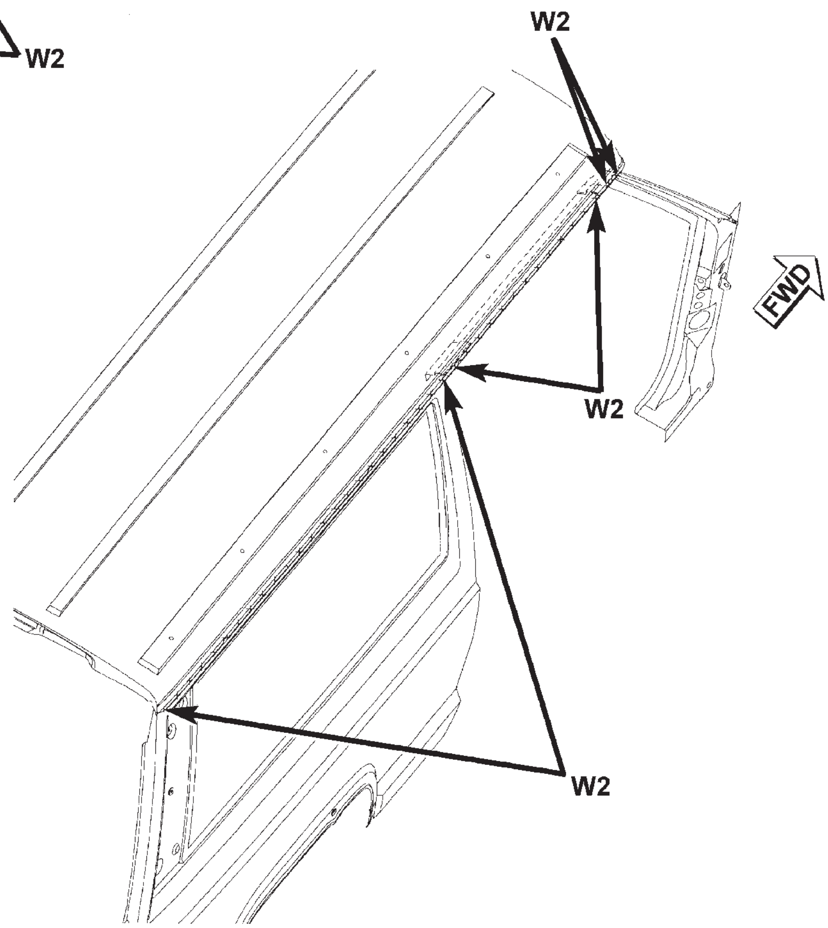
W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

SPECIFICATIONS (Continued)

ROOF



4 DOOR



W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

2 DOOR

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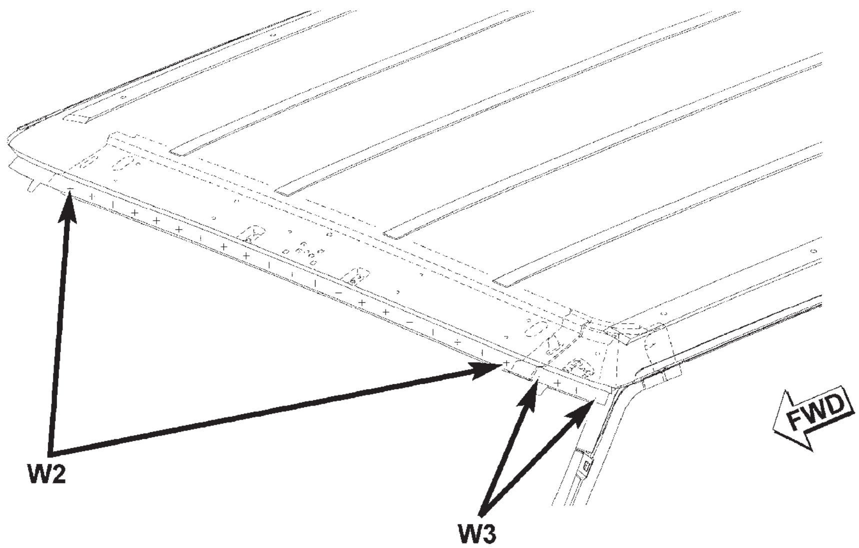
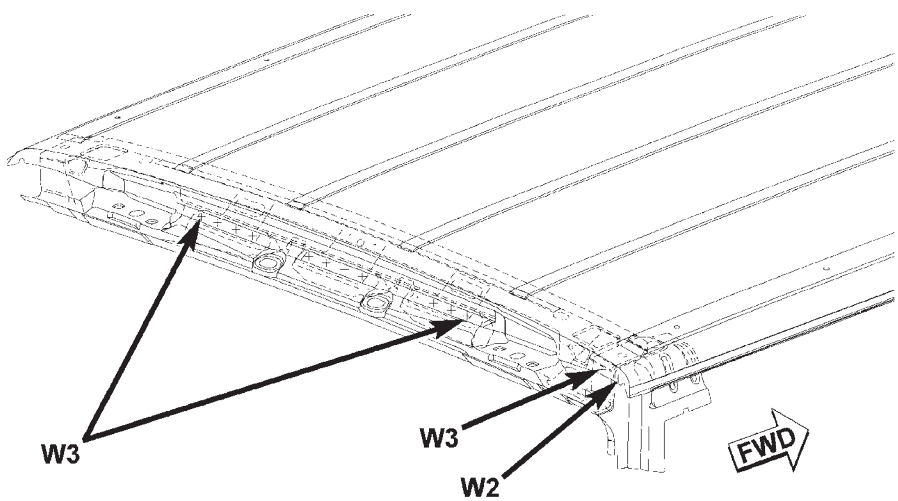
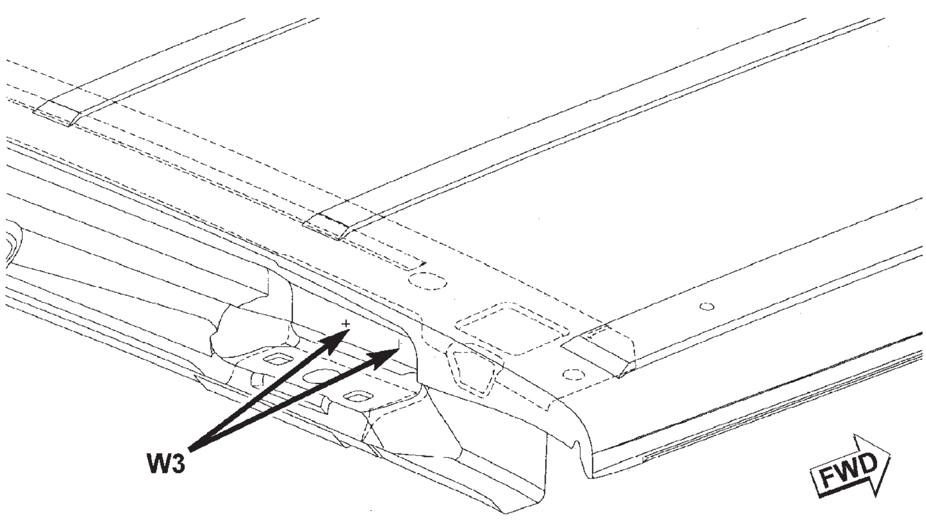
SPECIFICATIONS (Continued)

ROOF

W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS







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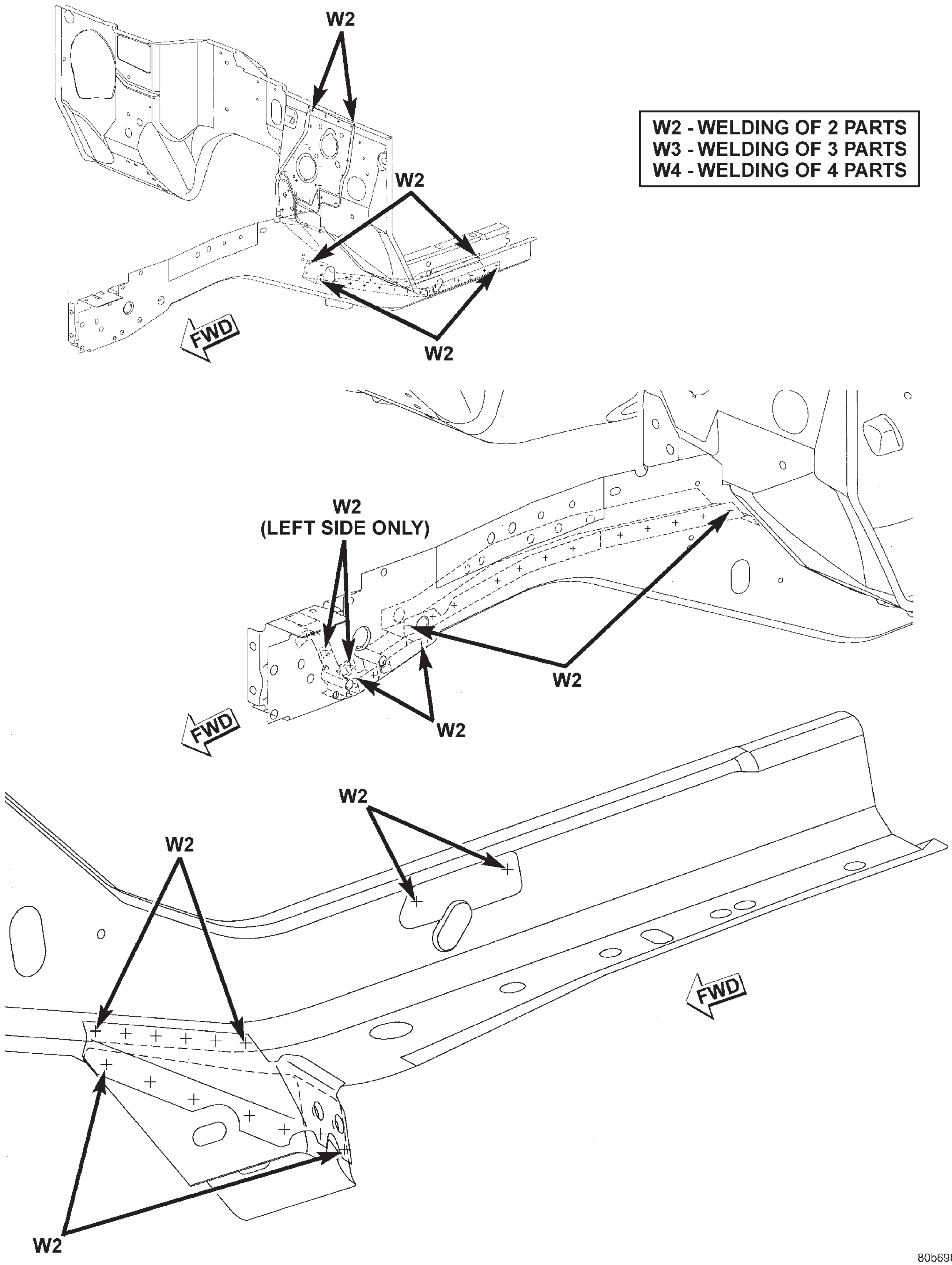

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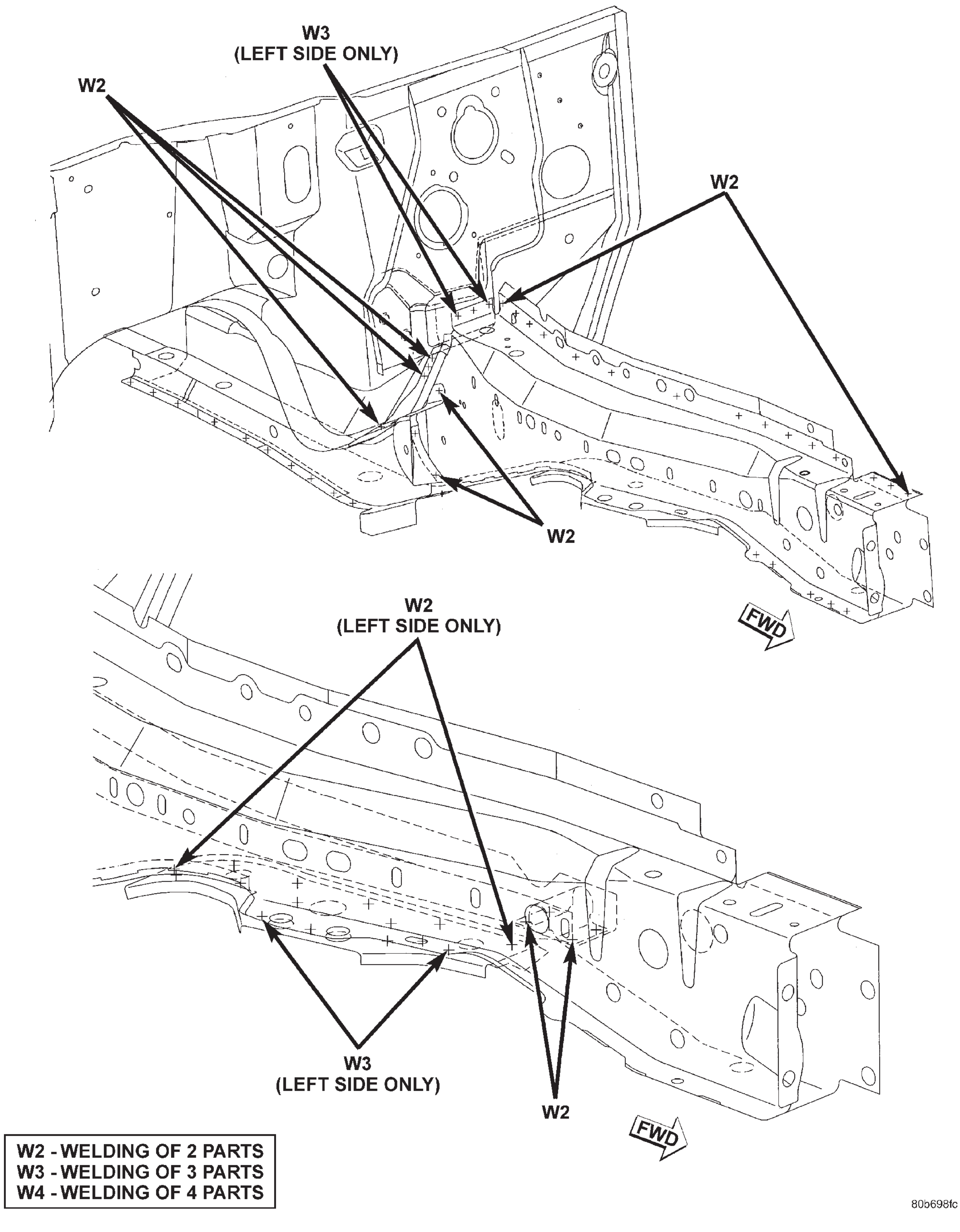

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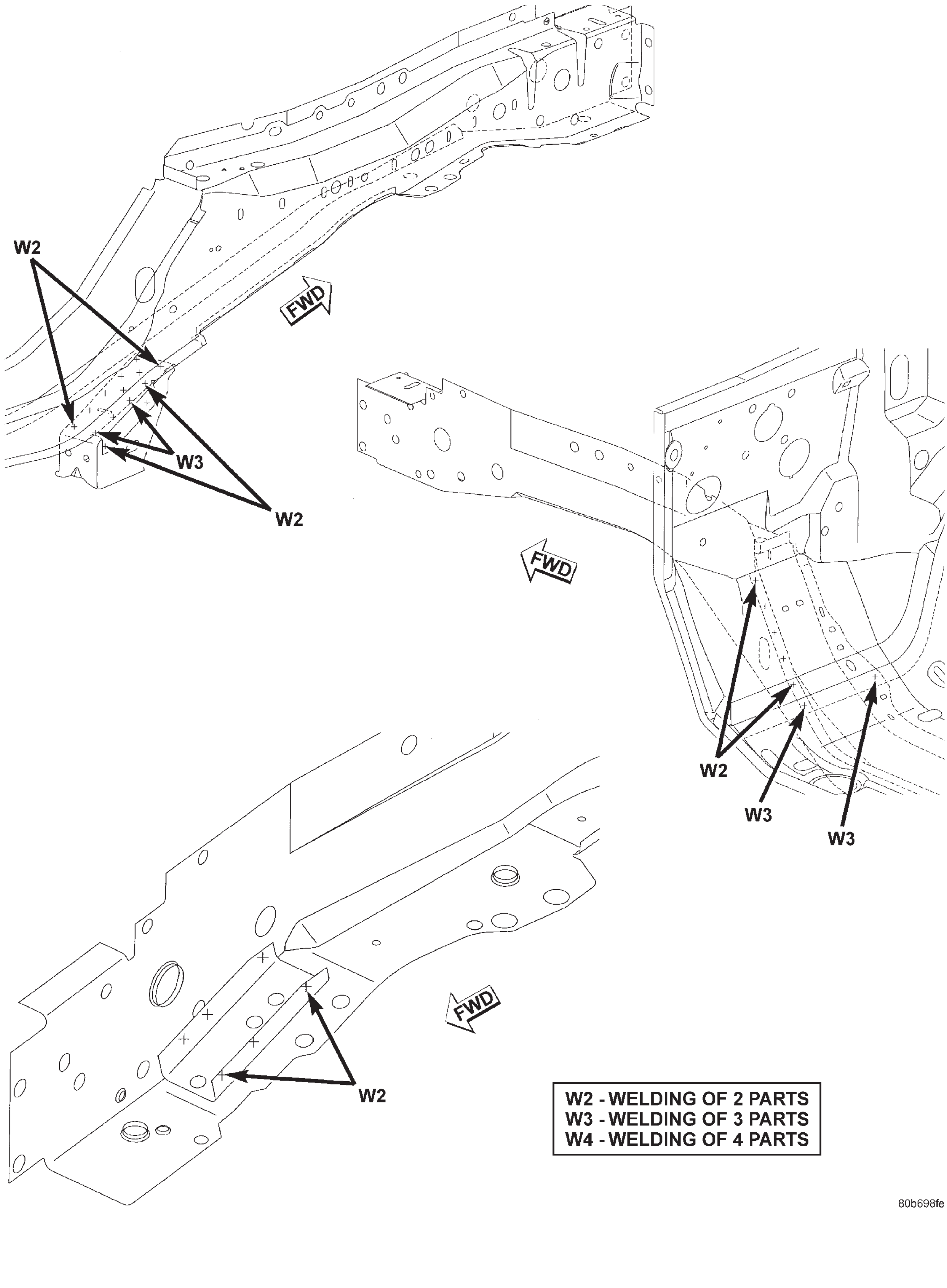

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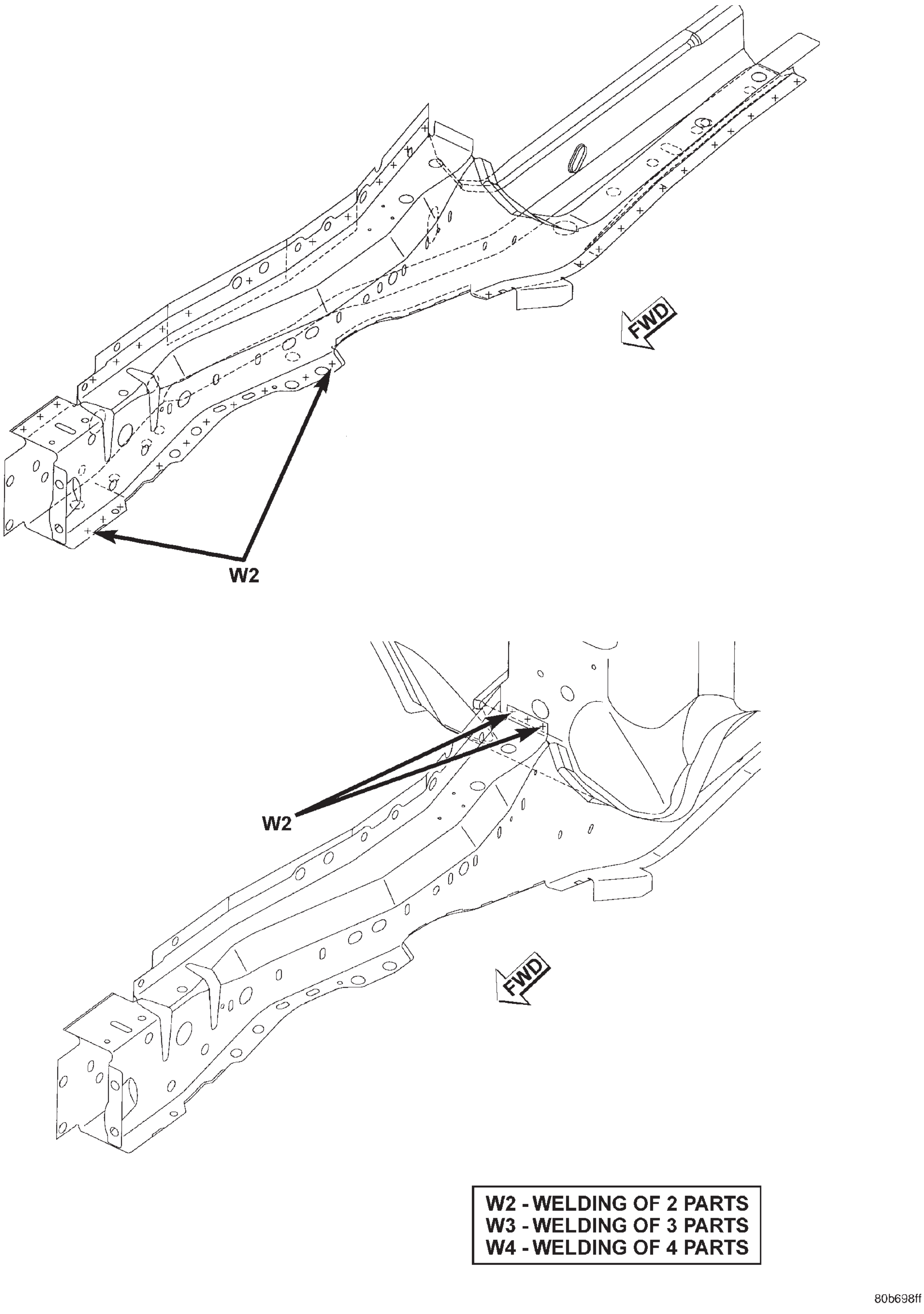

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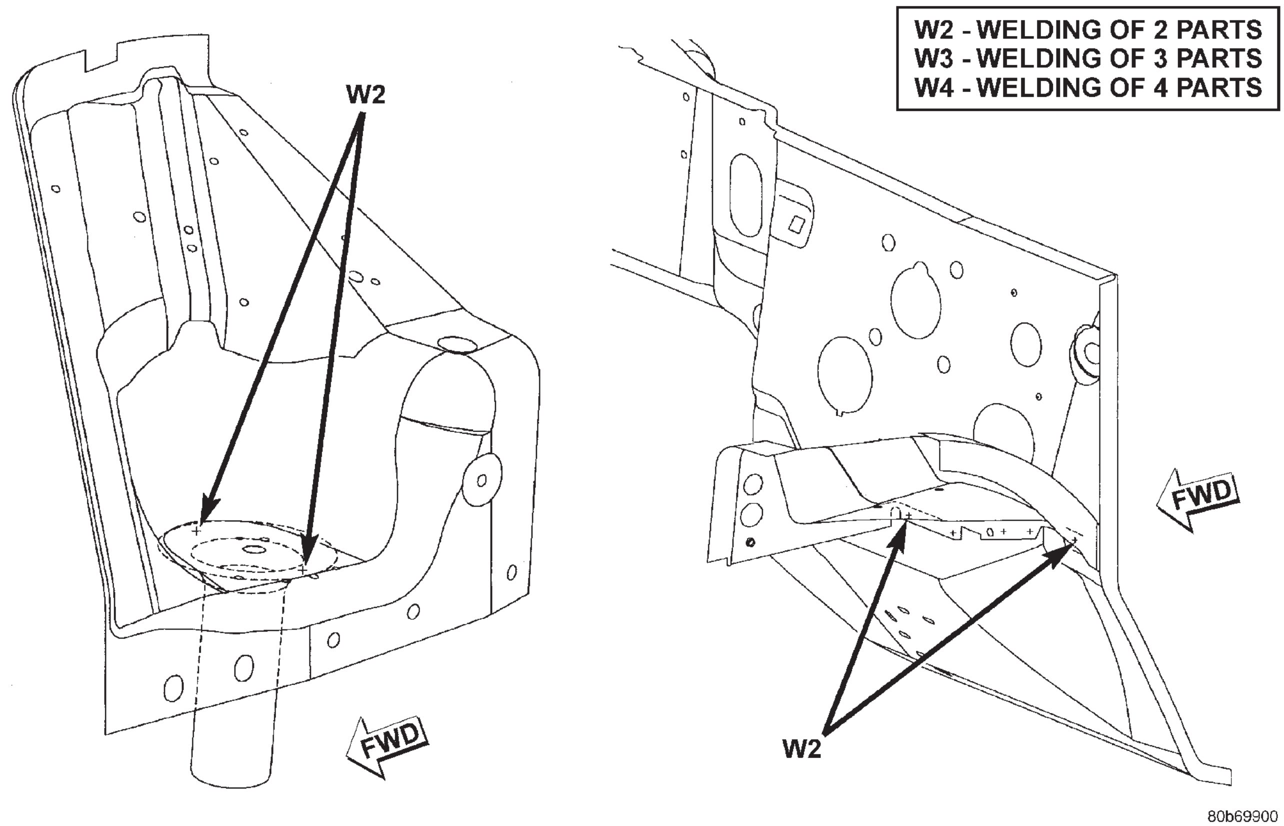

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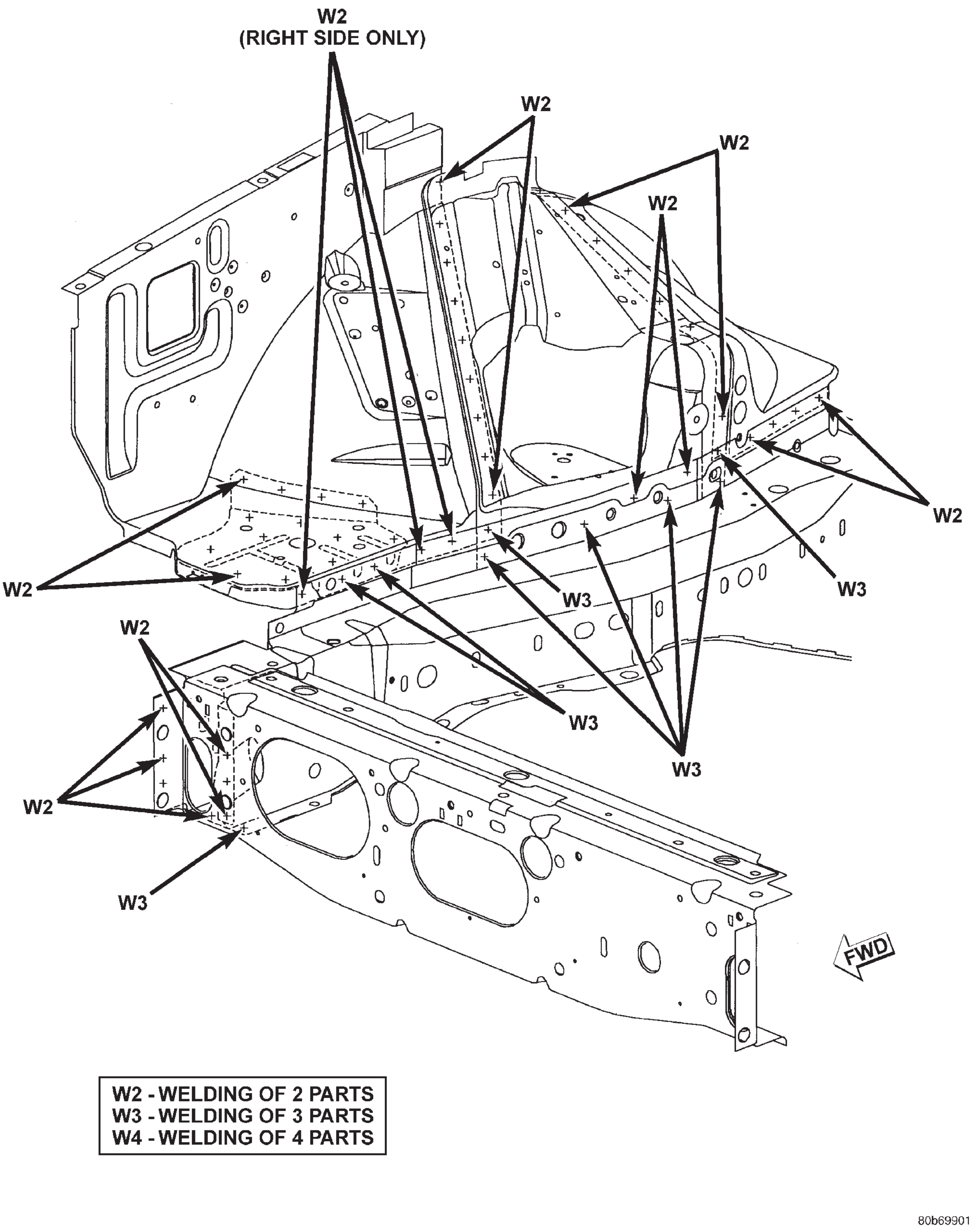
FRONT INNER FENDER



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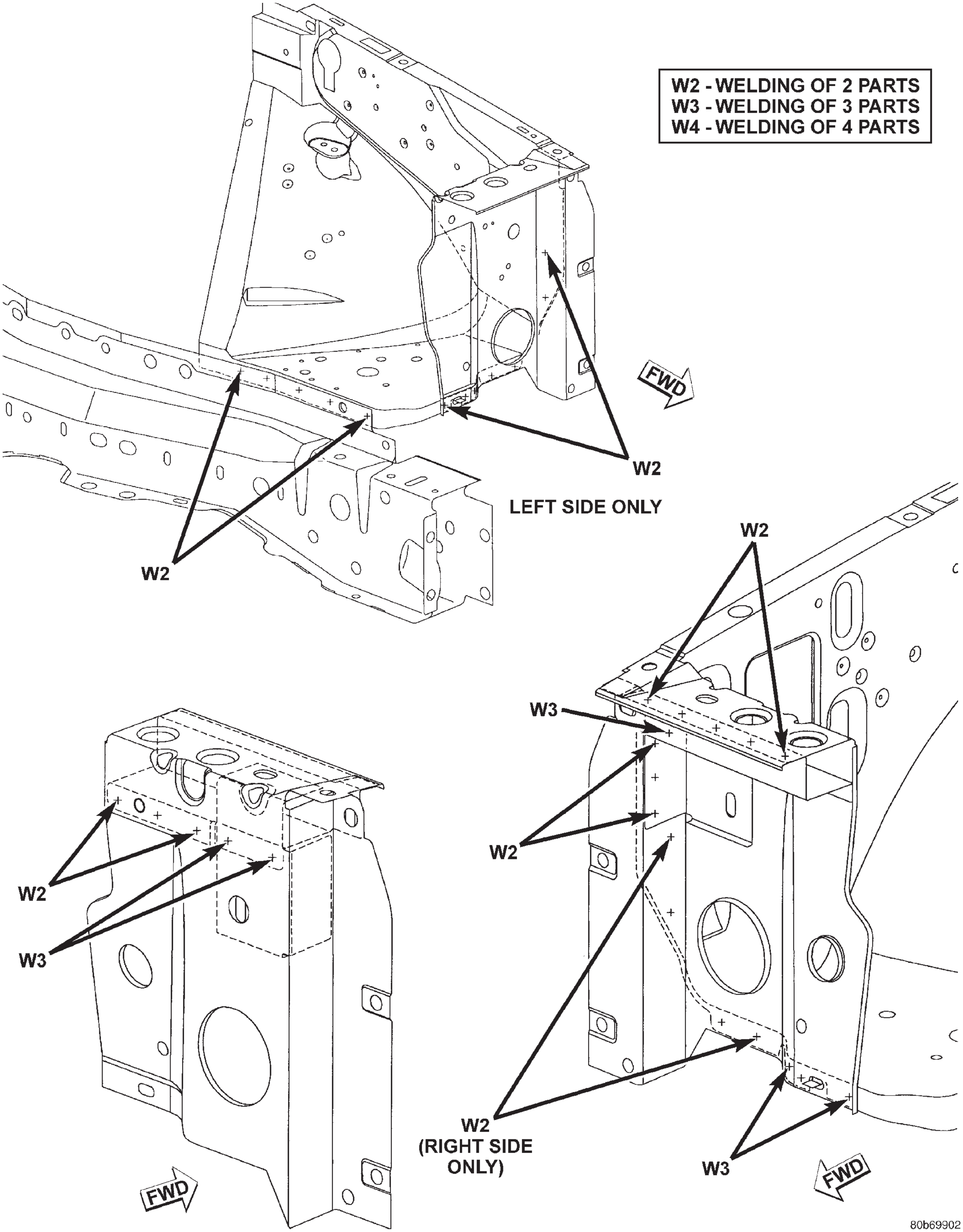
FRONT INNER FENDER AND RADIATOR CLOSURE PANEL



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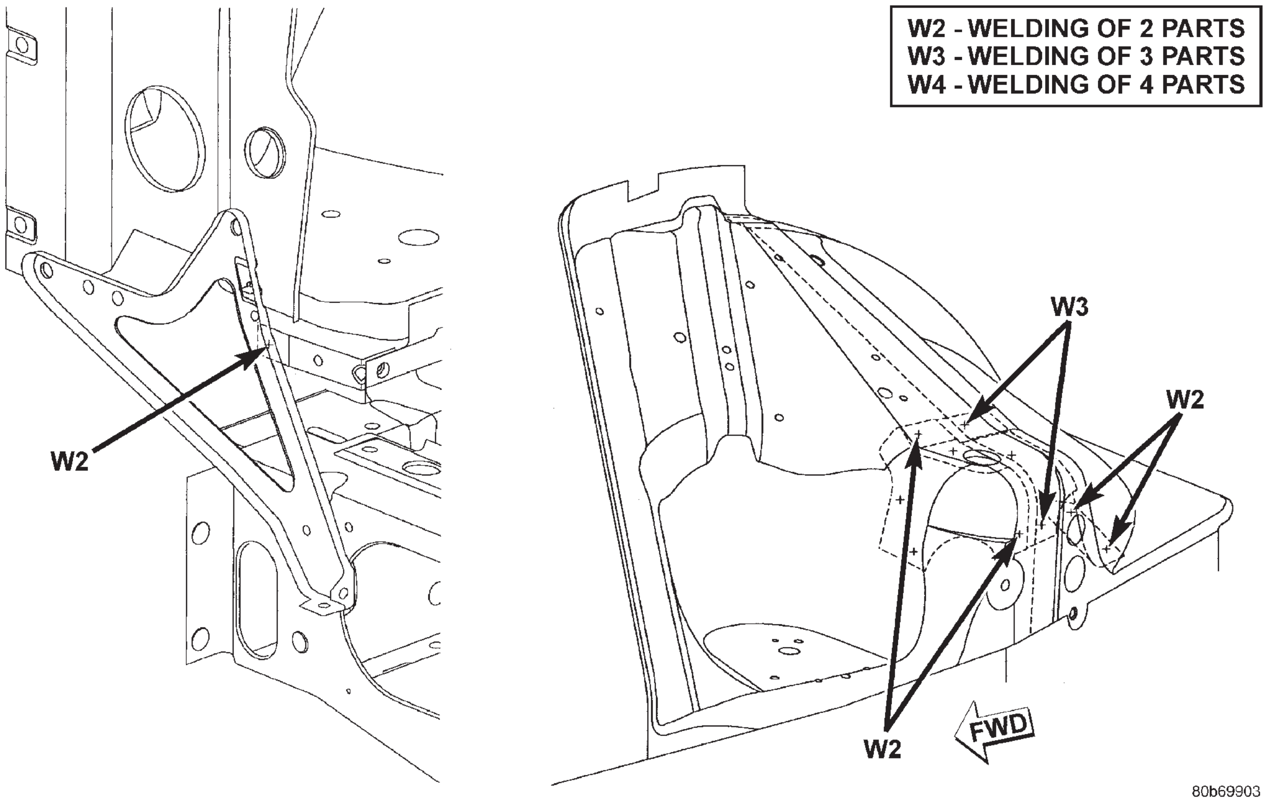
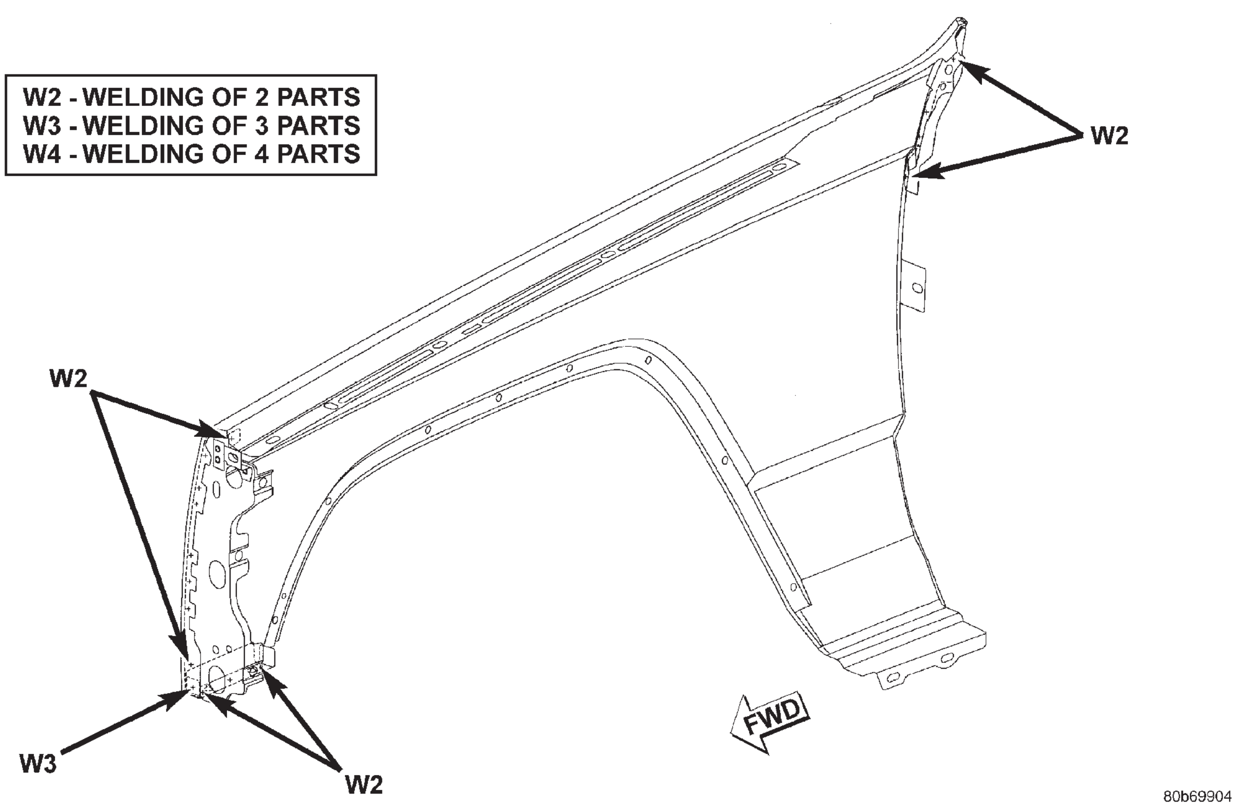
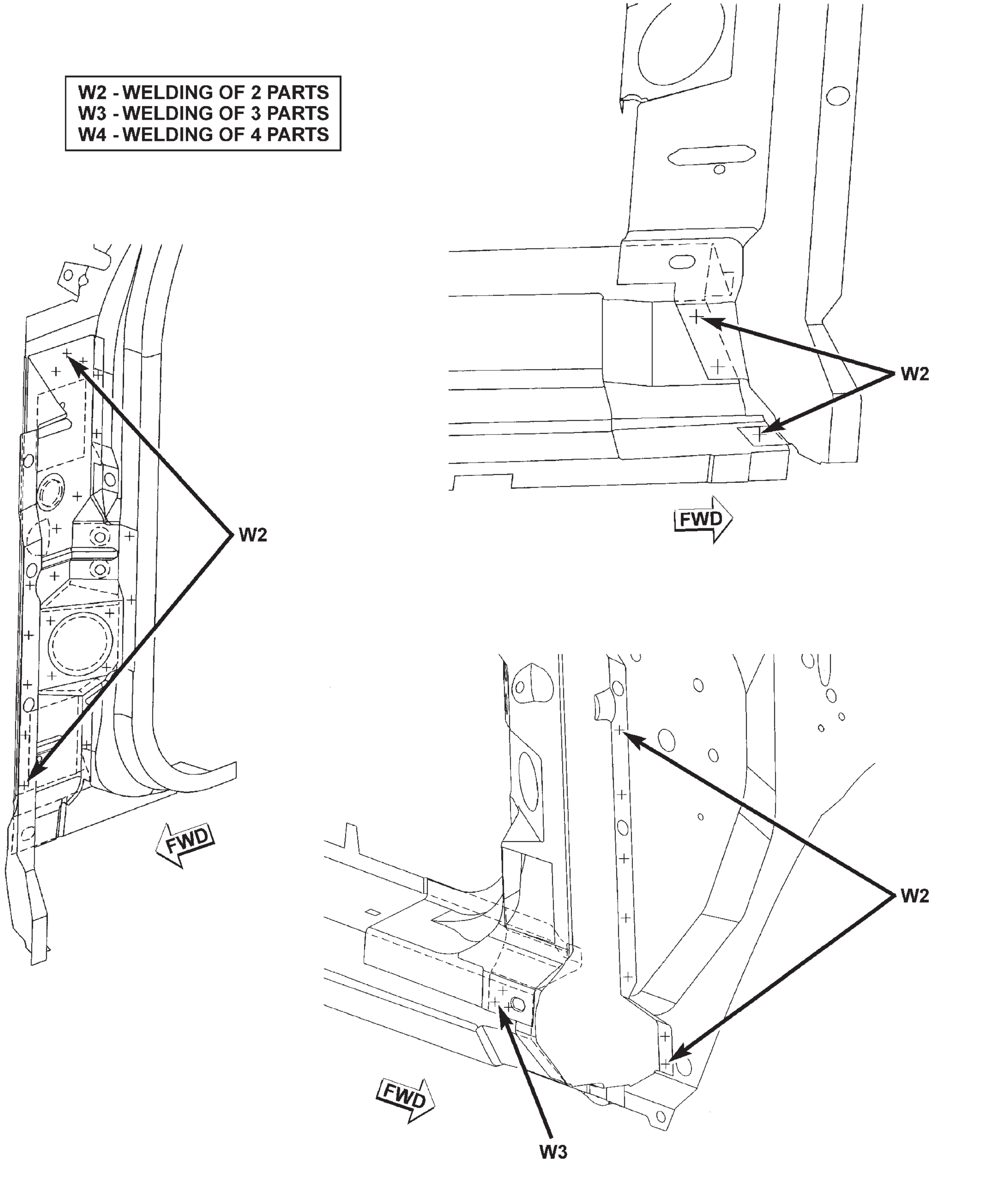


FRONT FENDER



SPECIFICATIONS (Continued)

BODY SIDE



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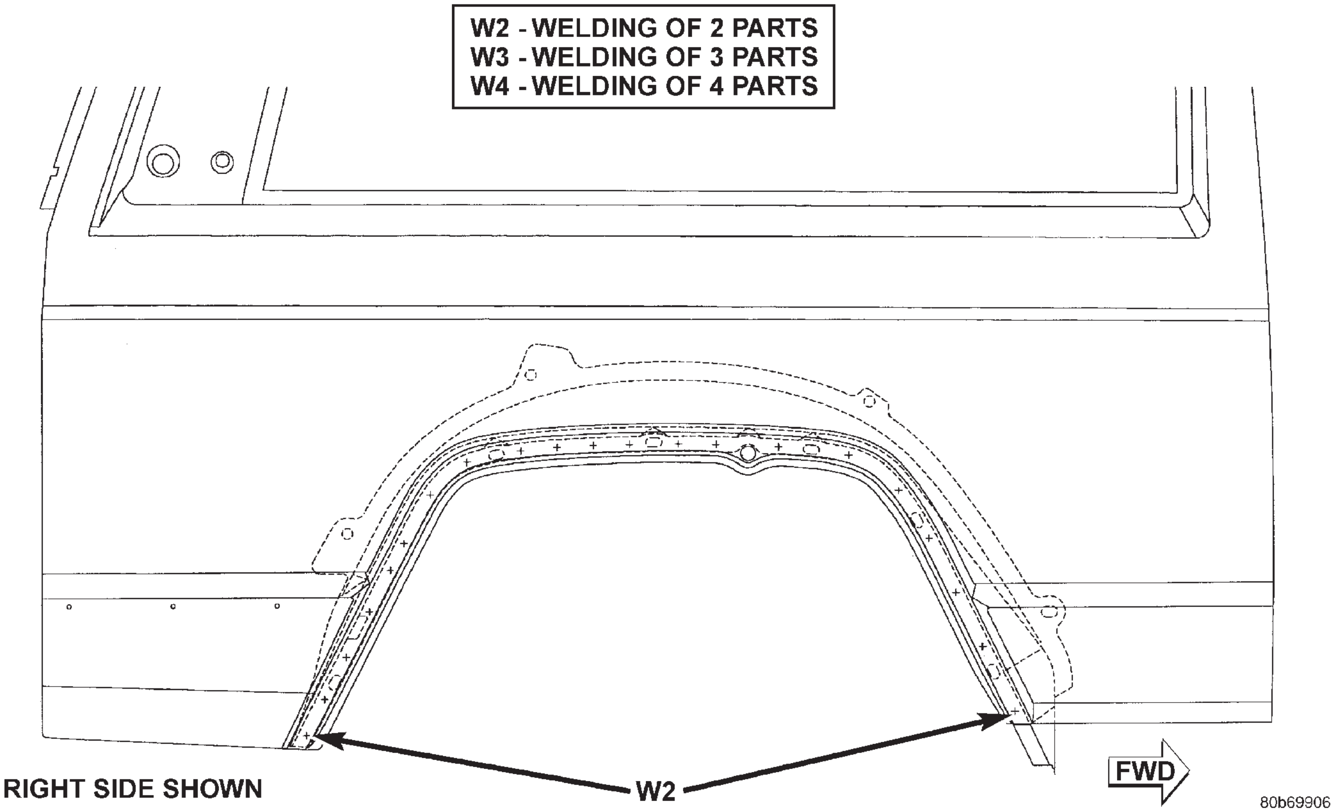
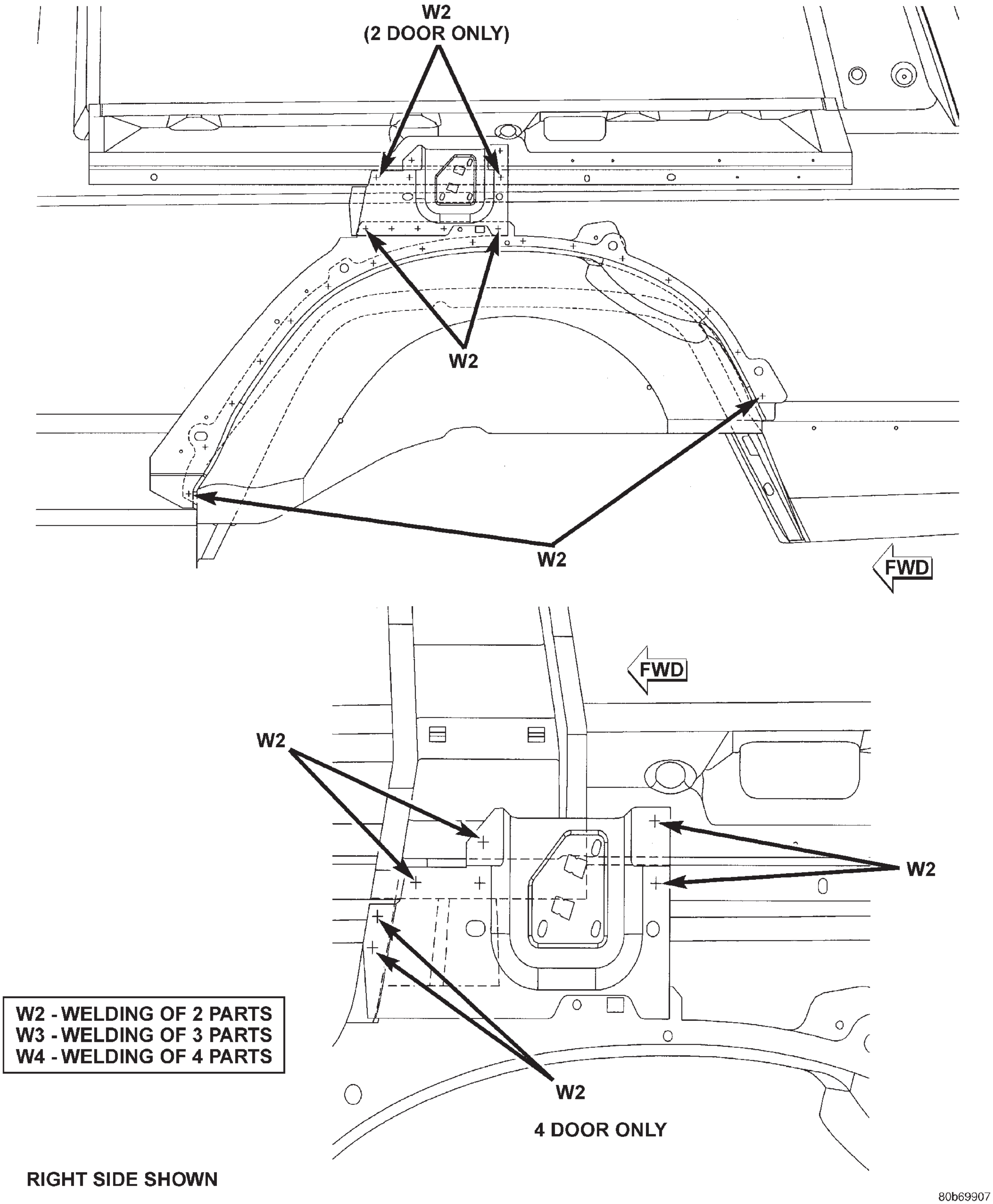


SPECIFICATIONS (Continued)

REAR INNER WHEELHOUSE



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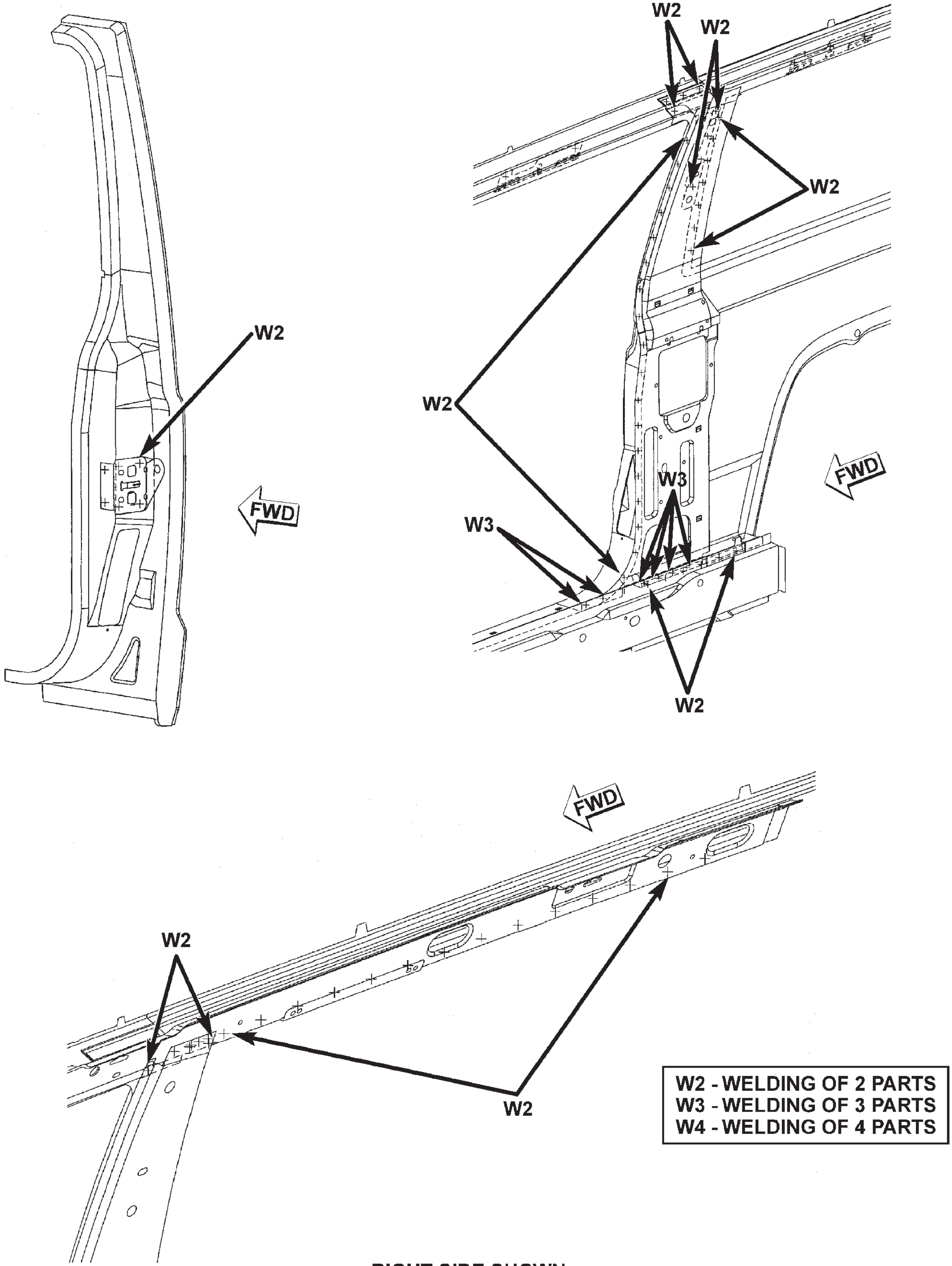

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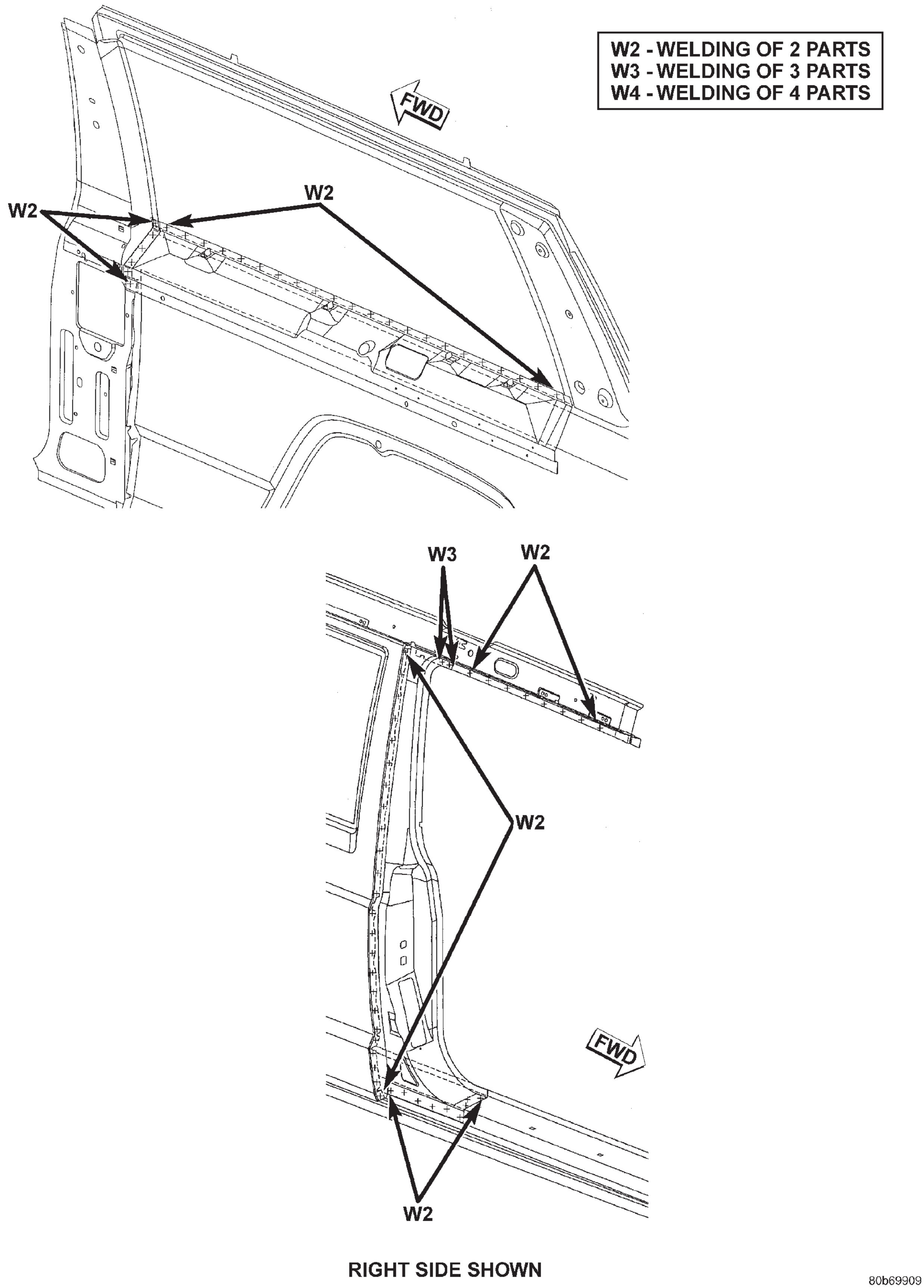
SPECIFICATIONS (Continued)

BODY SIDE



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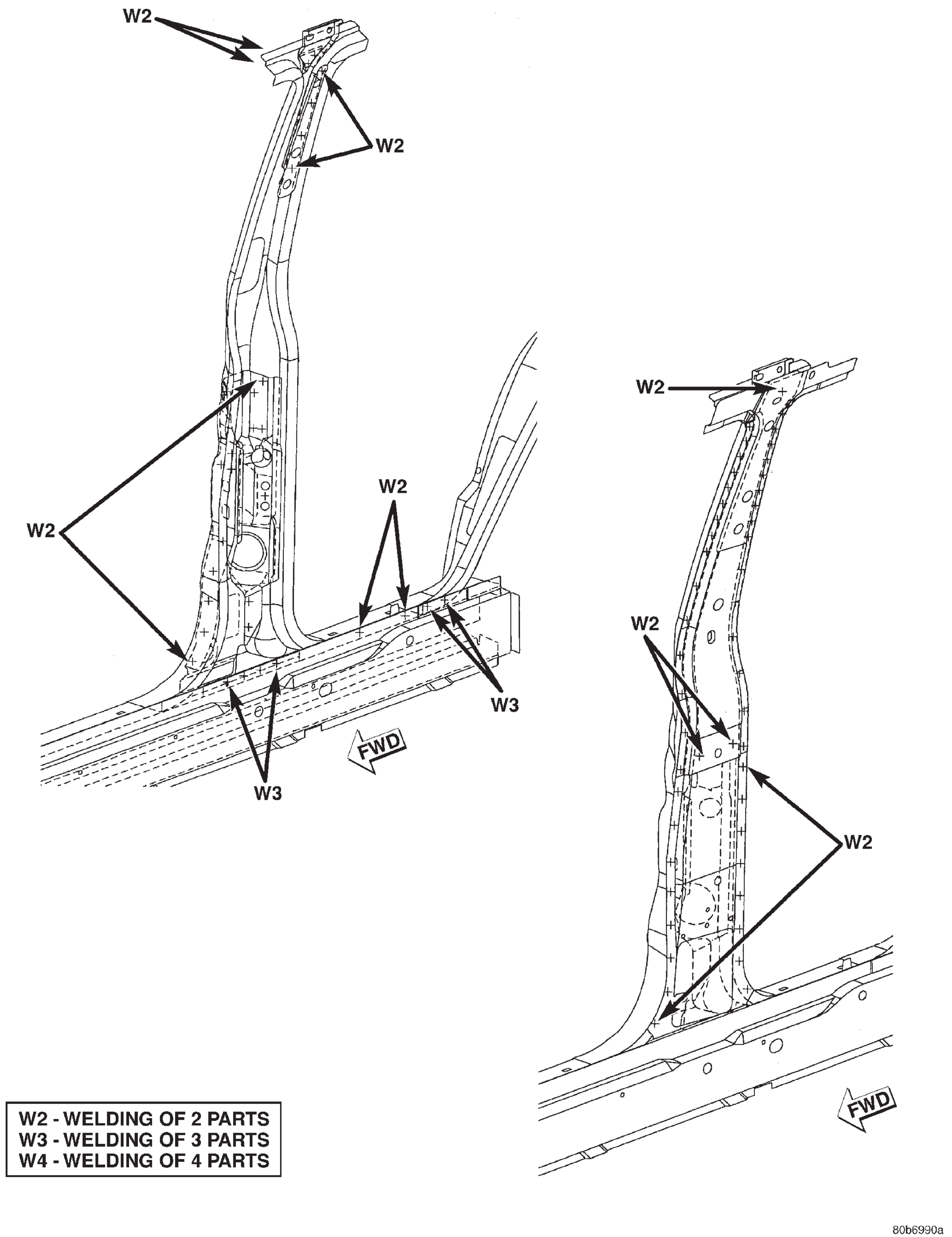
BODY SIDE



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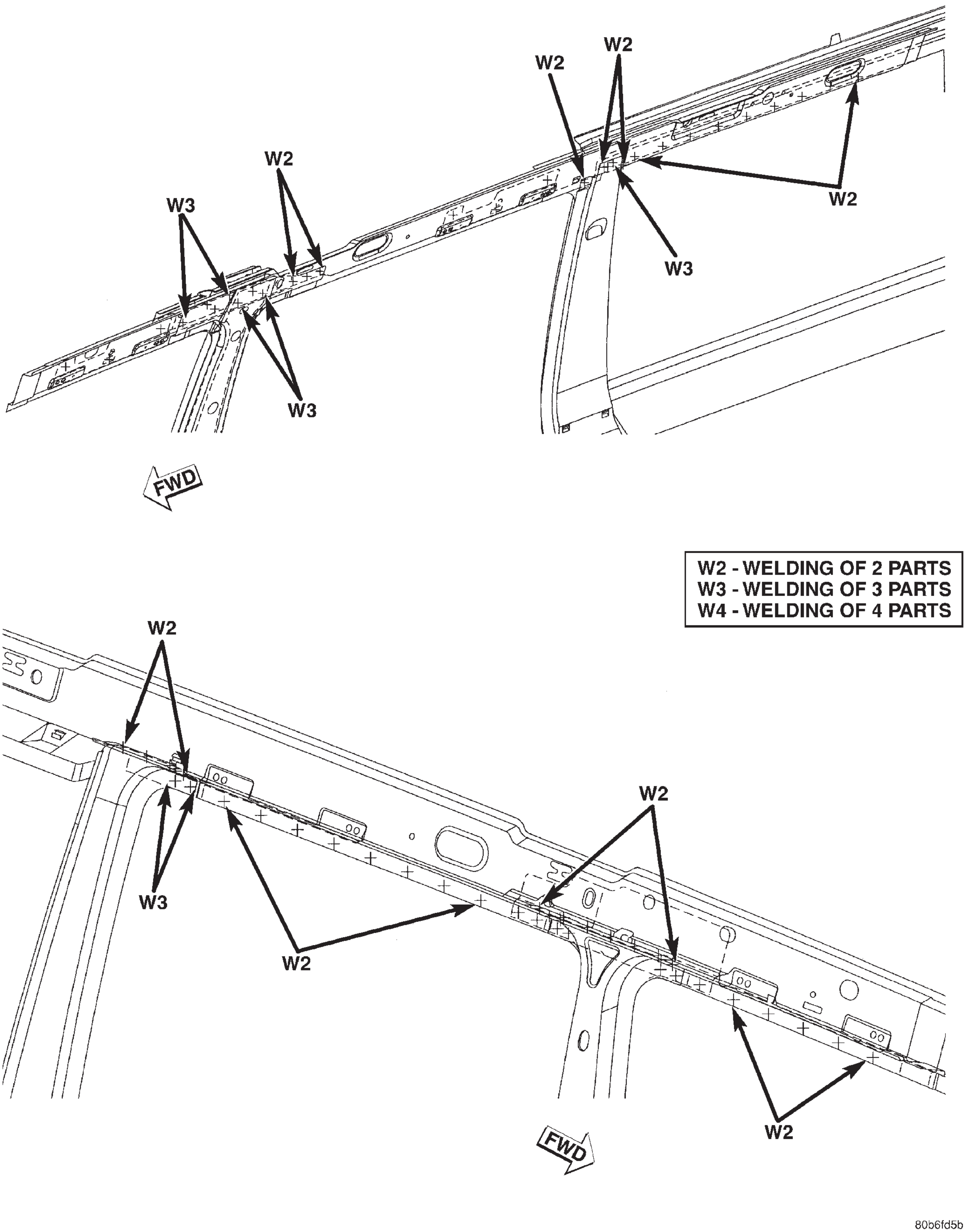
BODY SIDE



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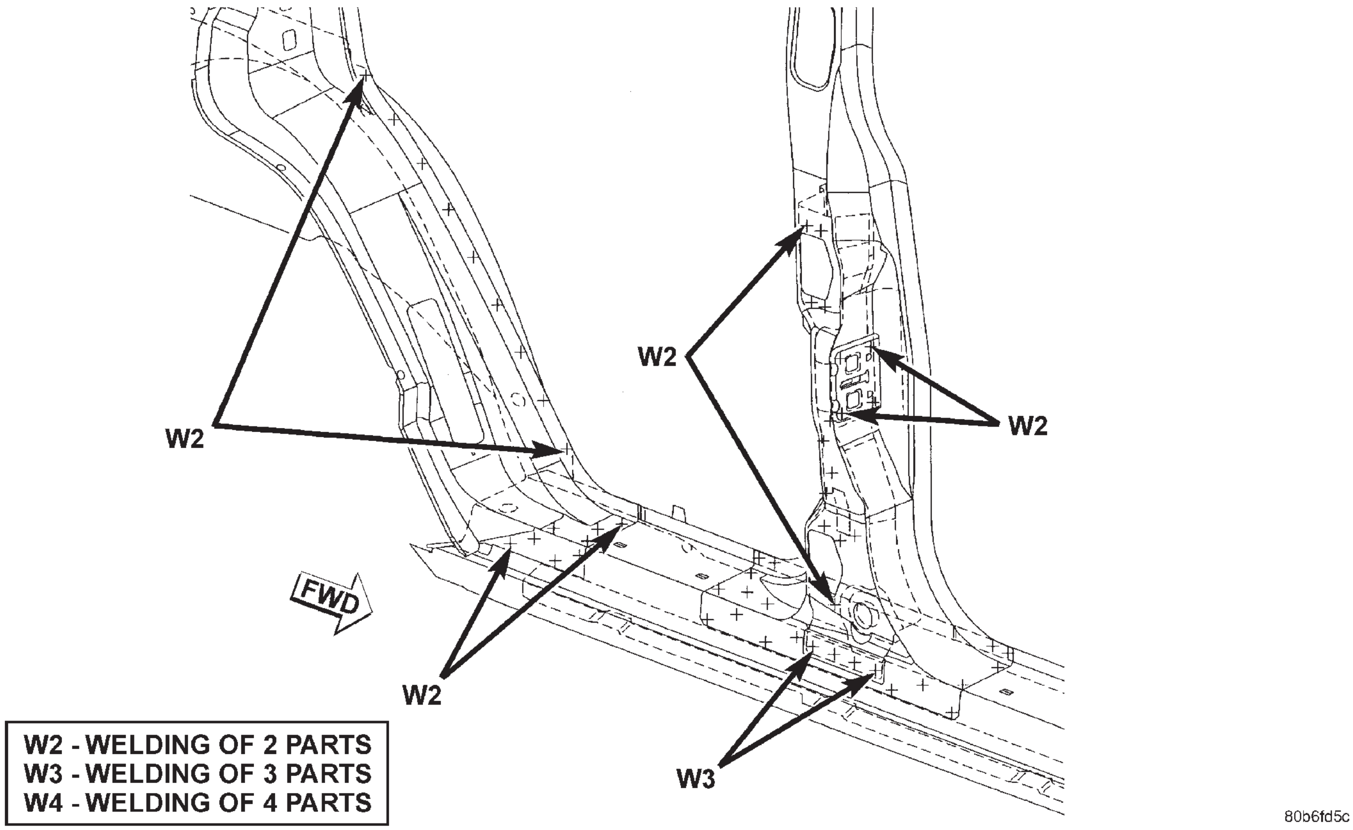
BODY SIDE



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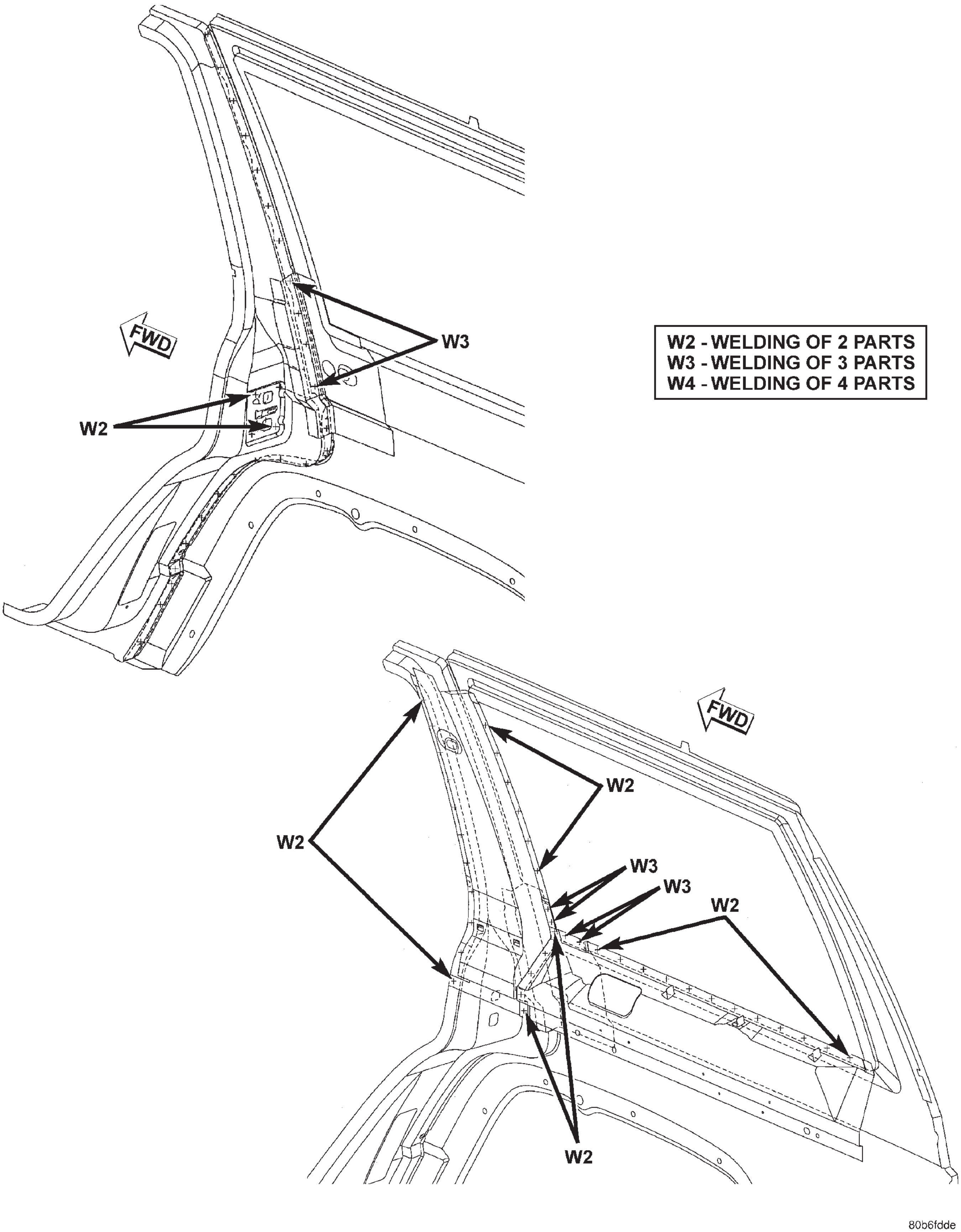
BODY SIDE



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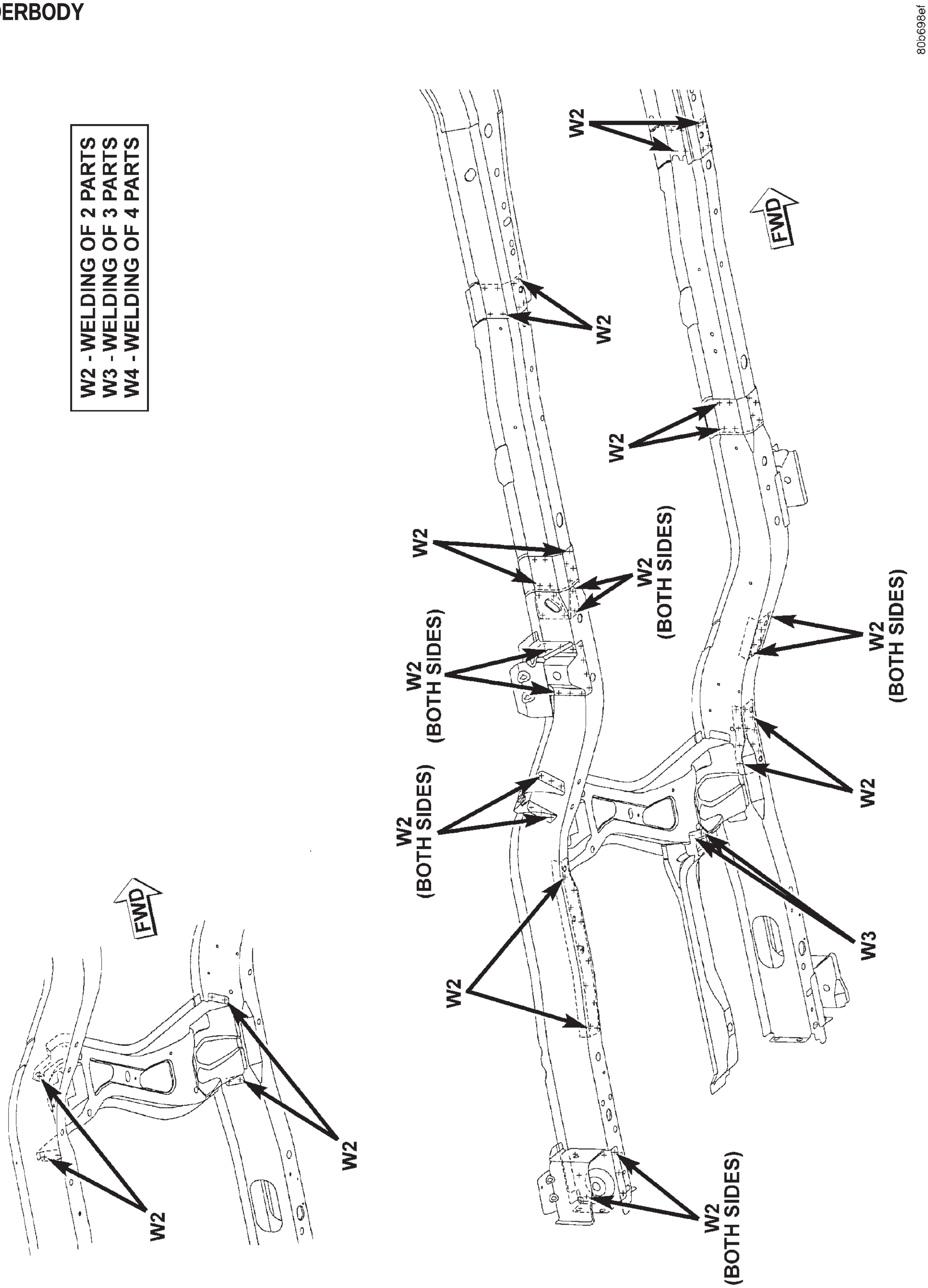

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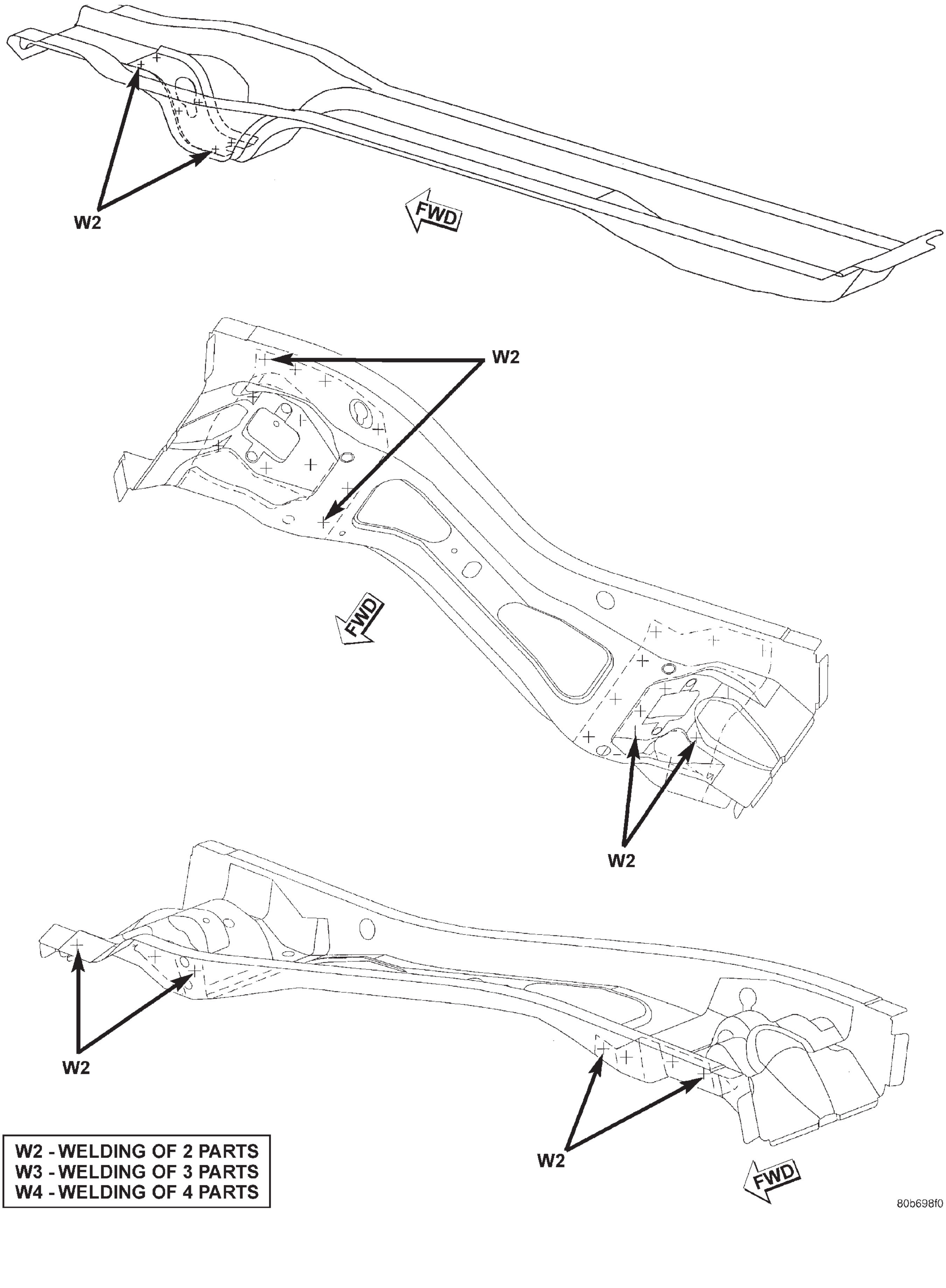
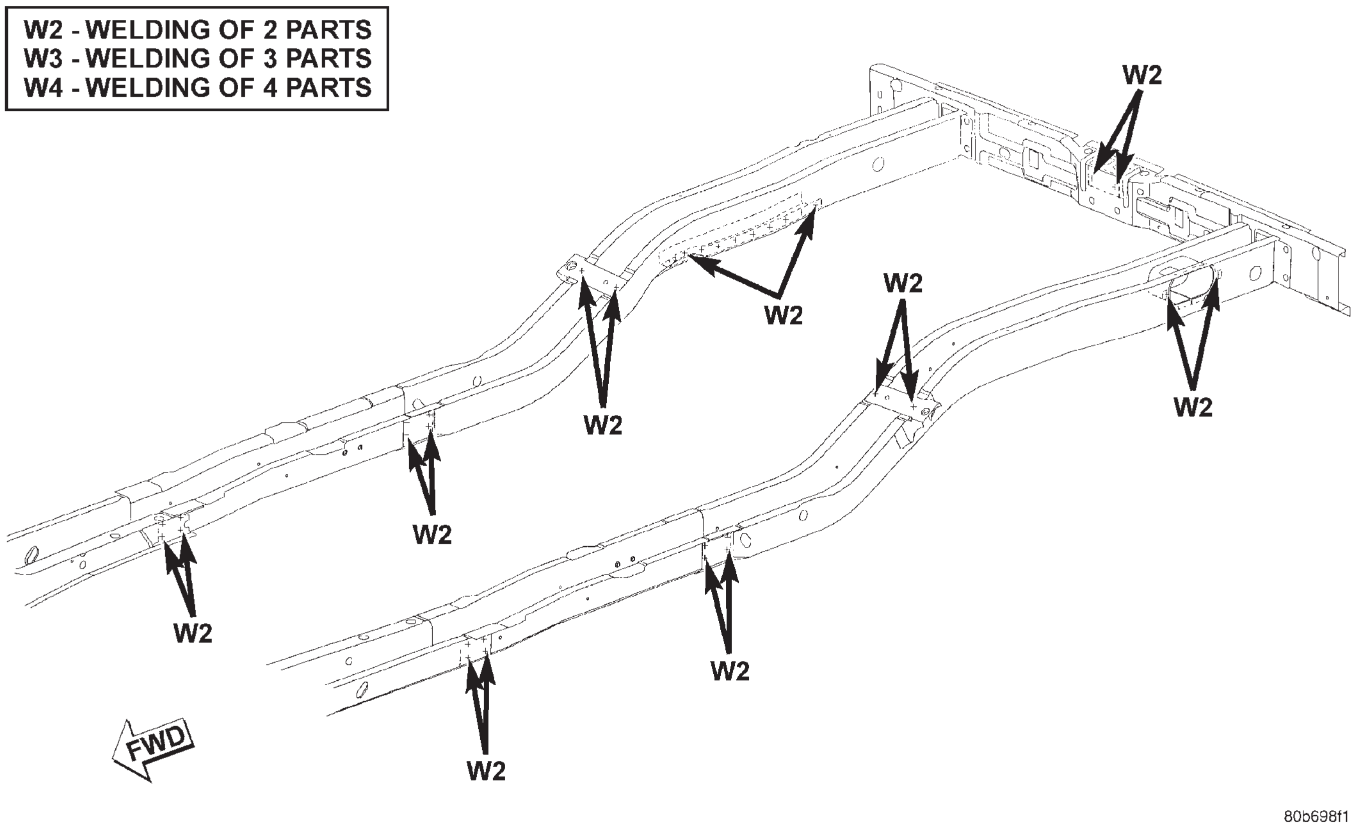


SPECIFICATIONS (Continued)

UNDERBODY



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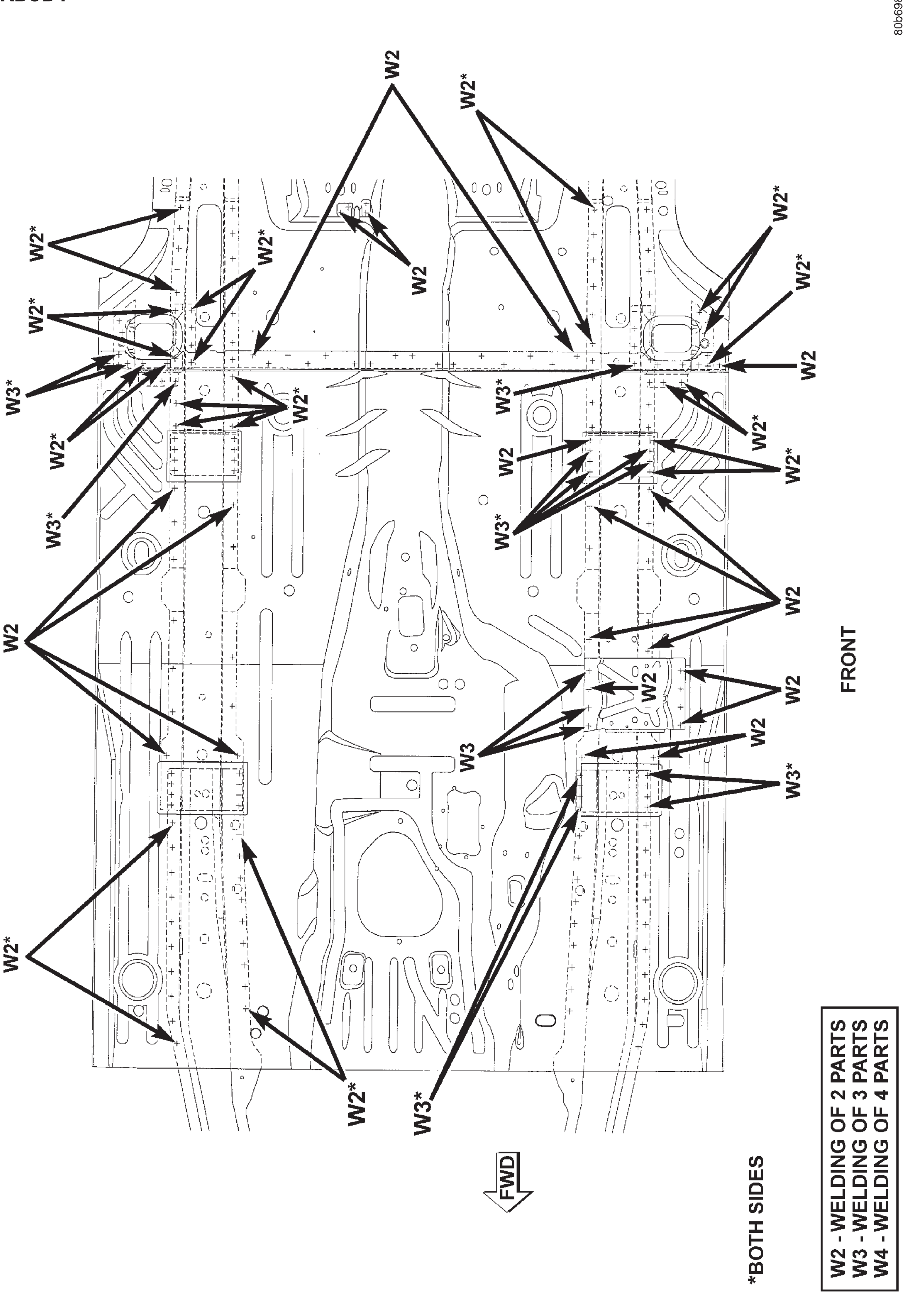

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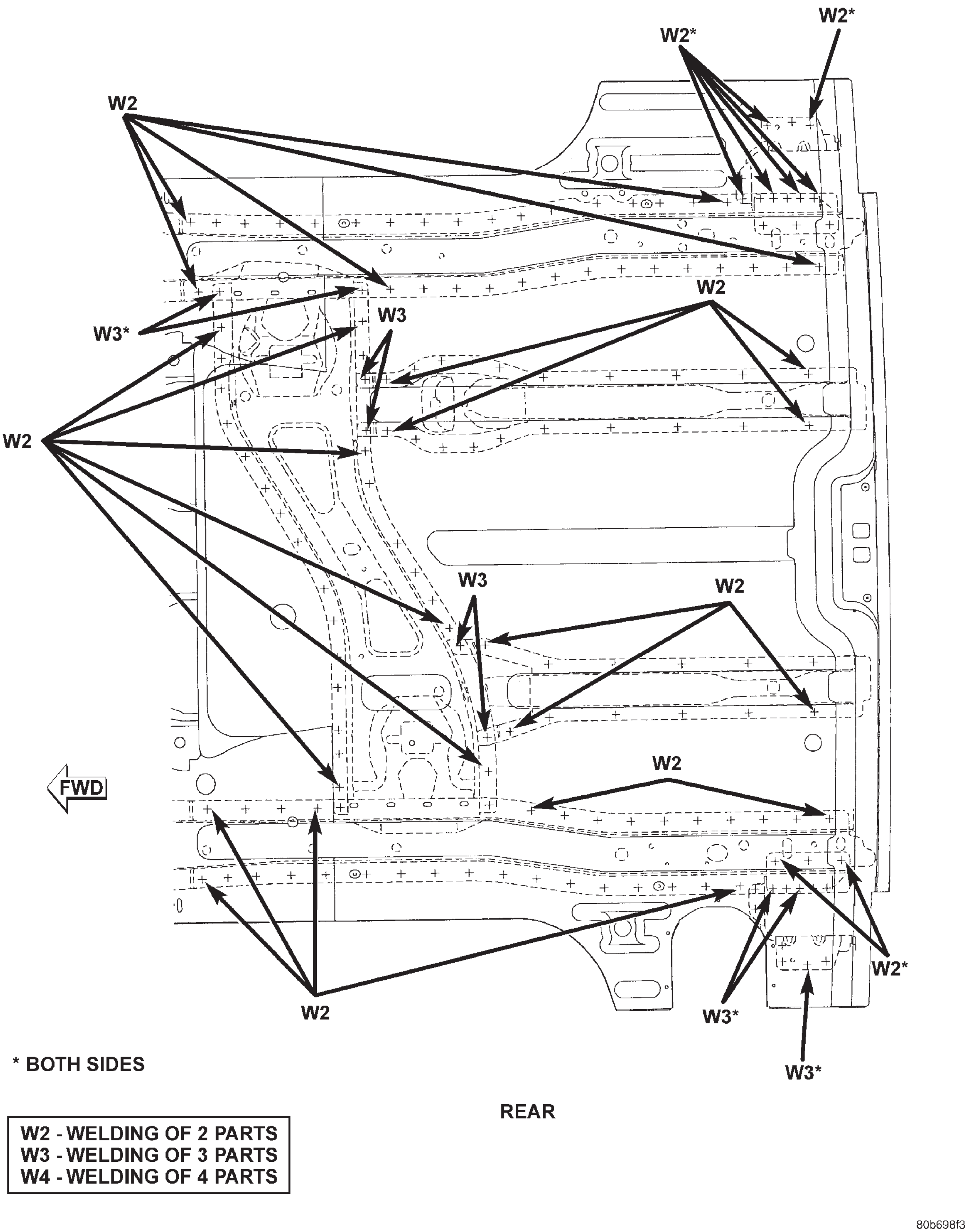

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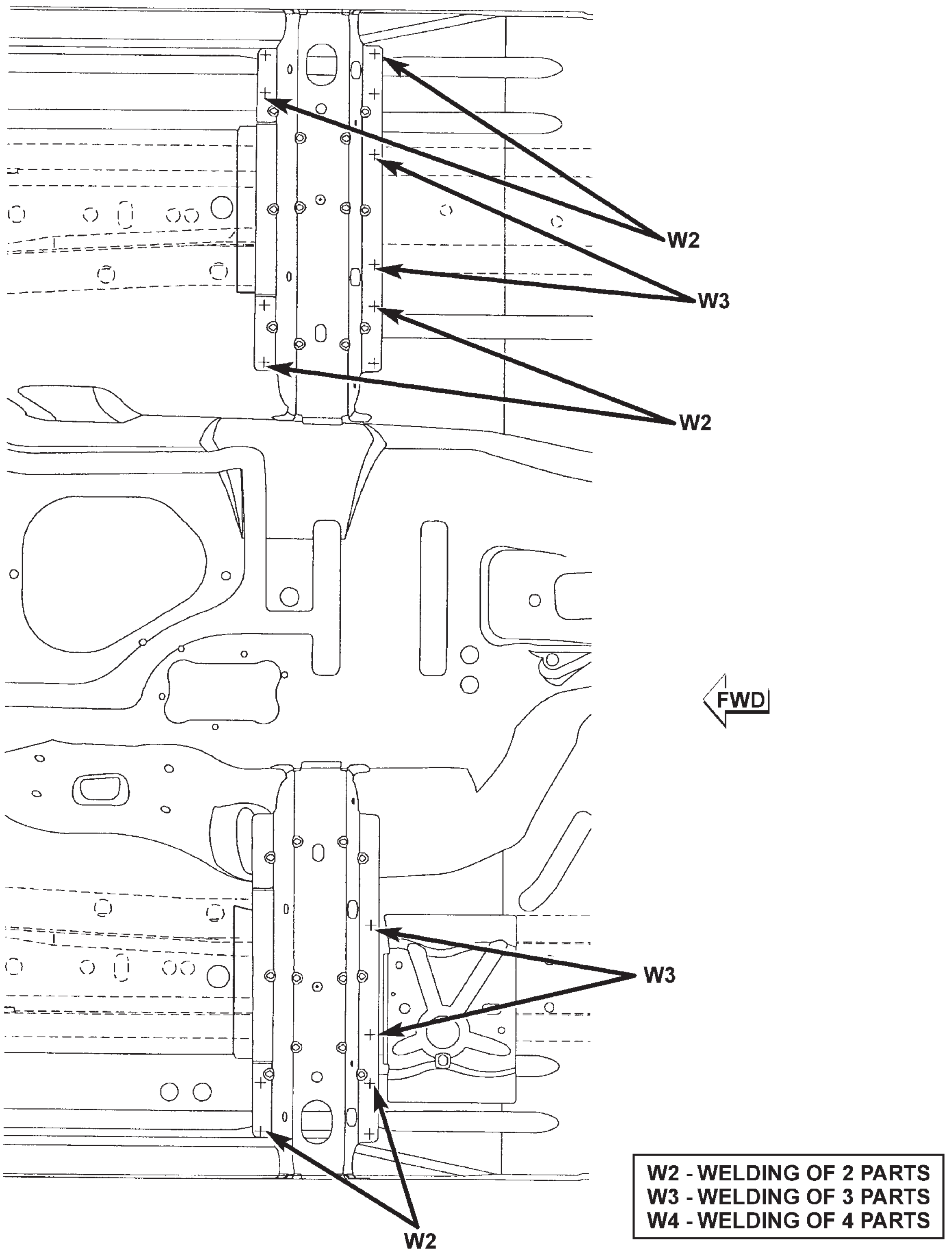

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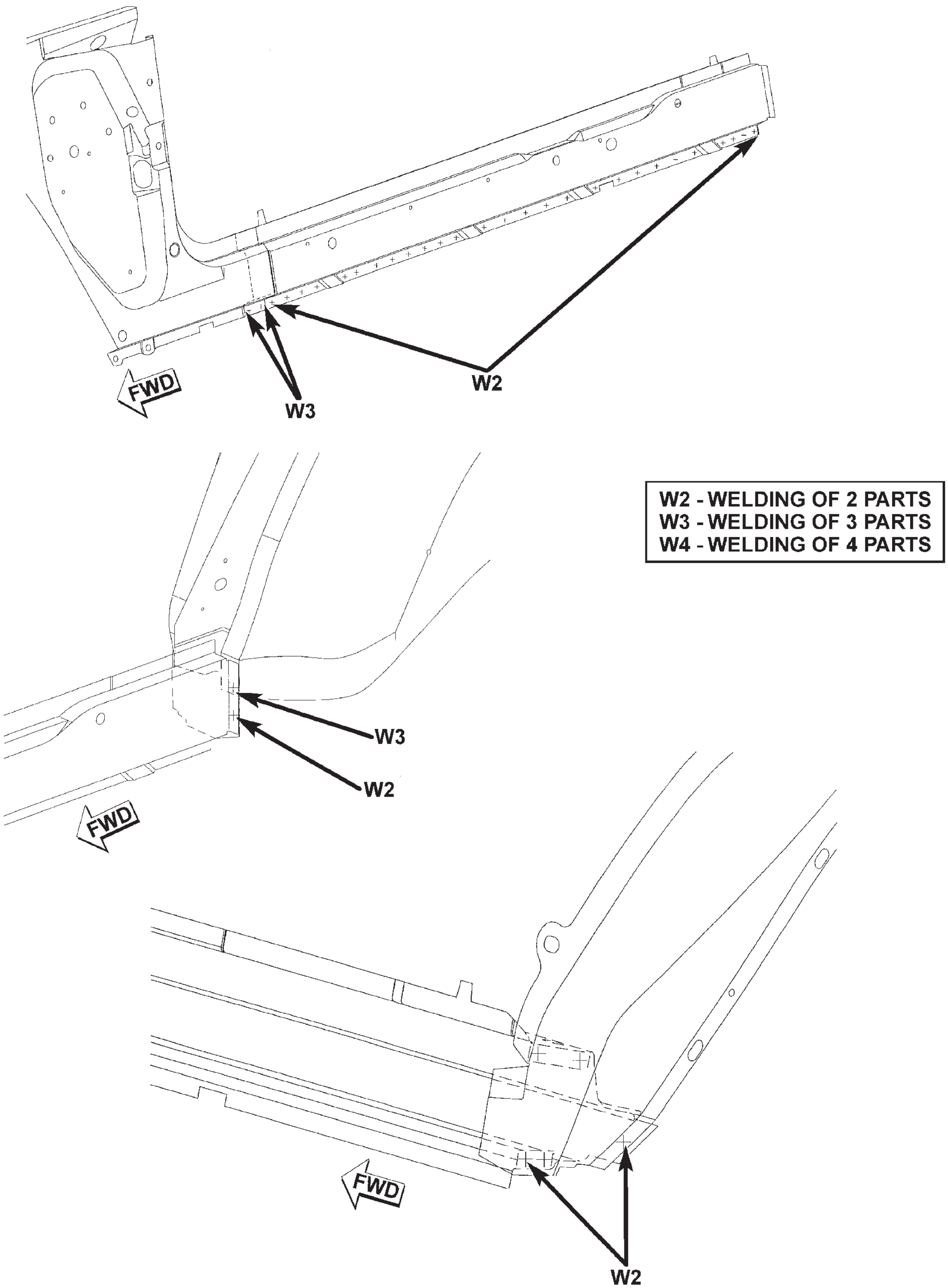

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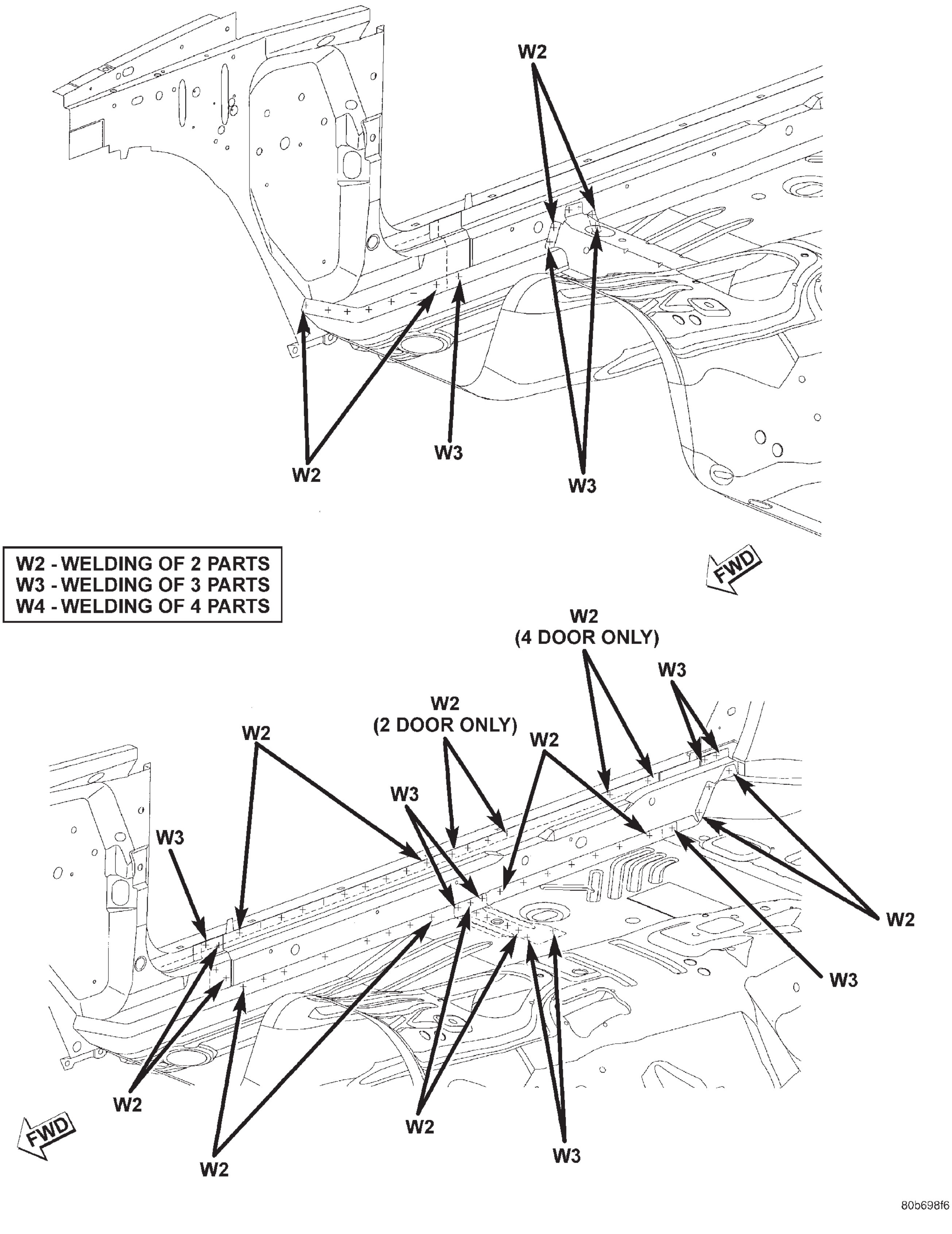

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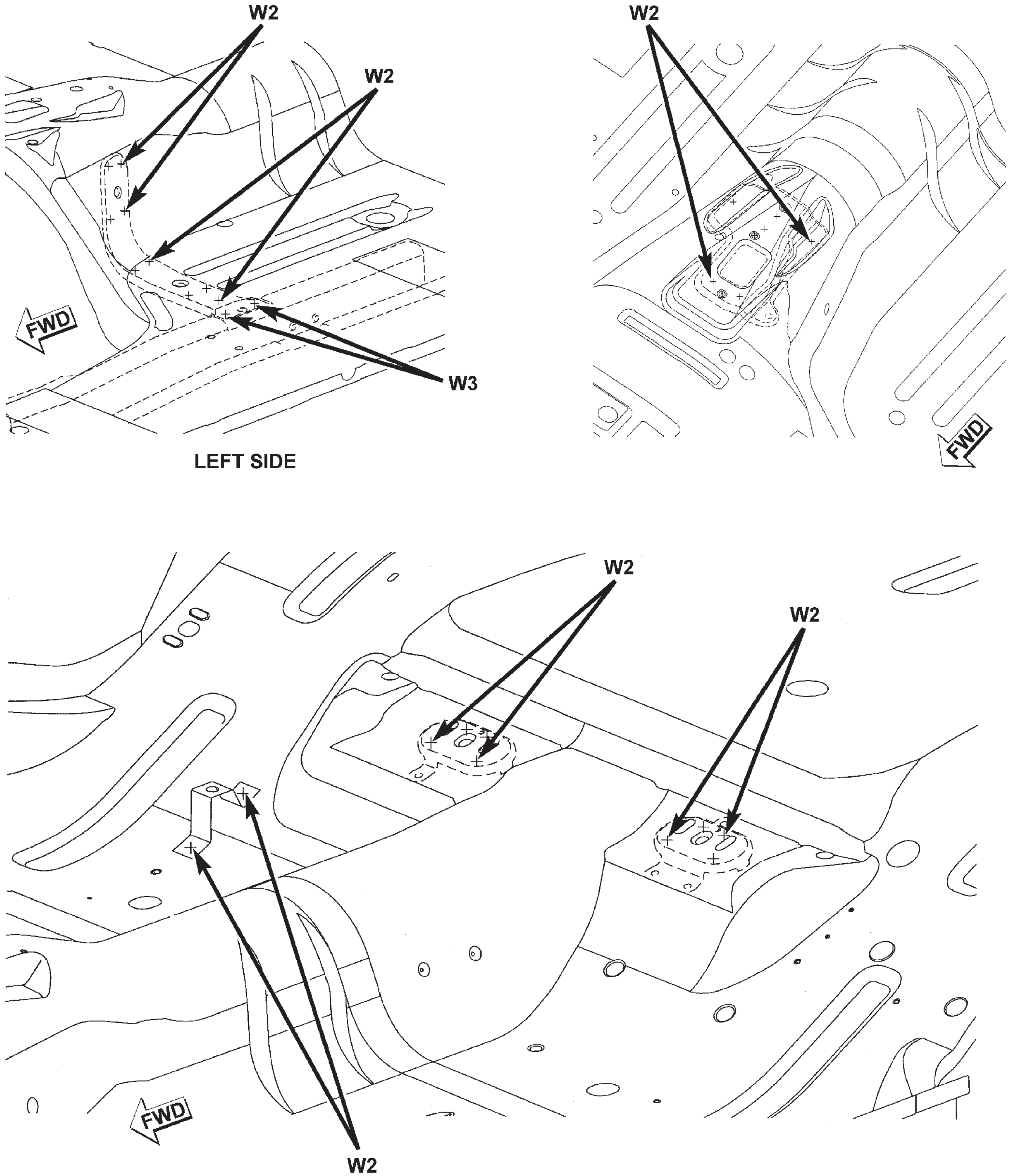

W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

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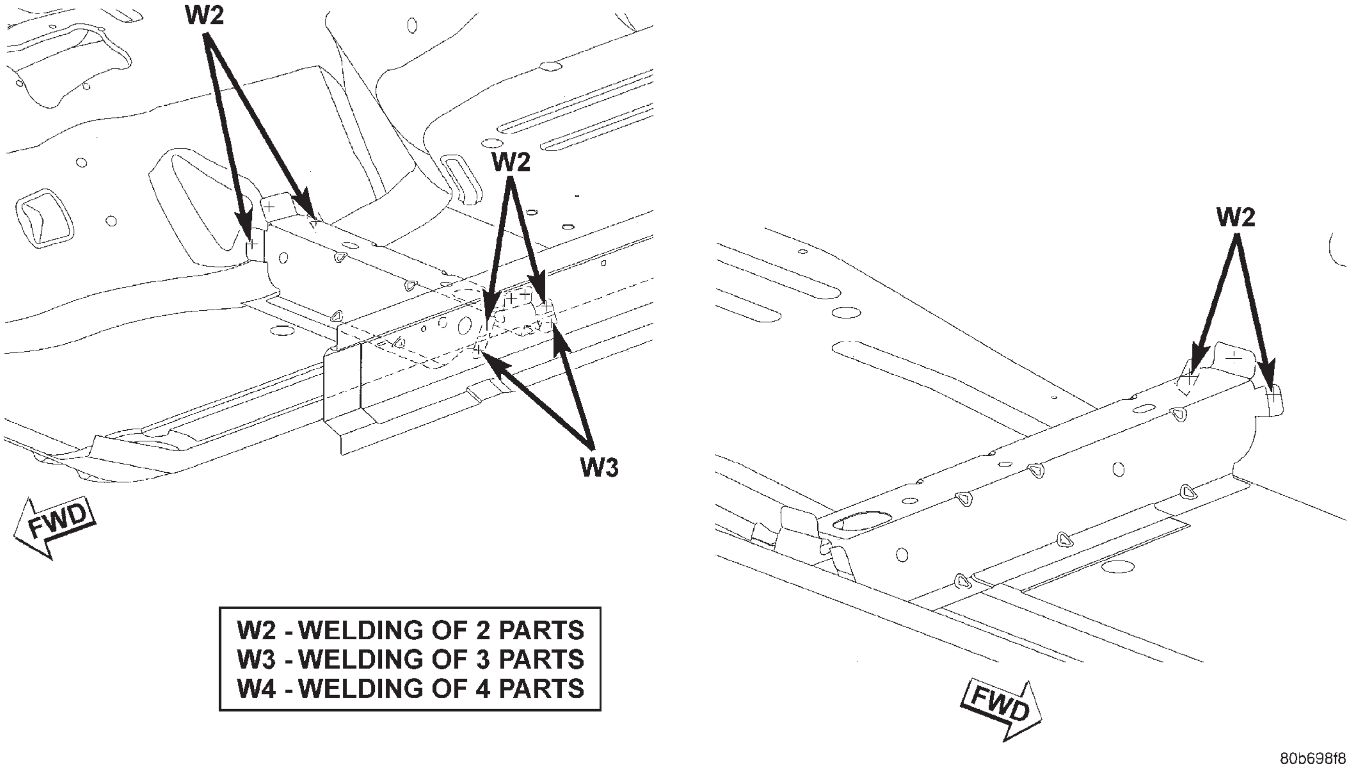
SPECIFICATIONS (Continued)

UNDERBODY



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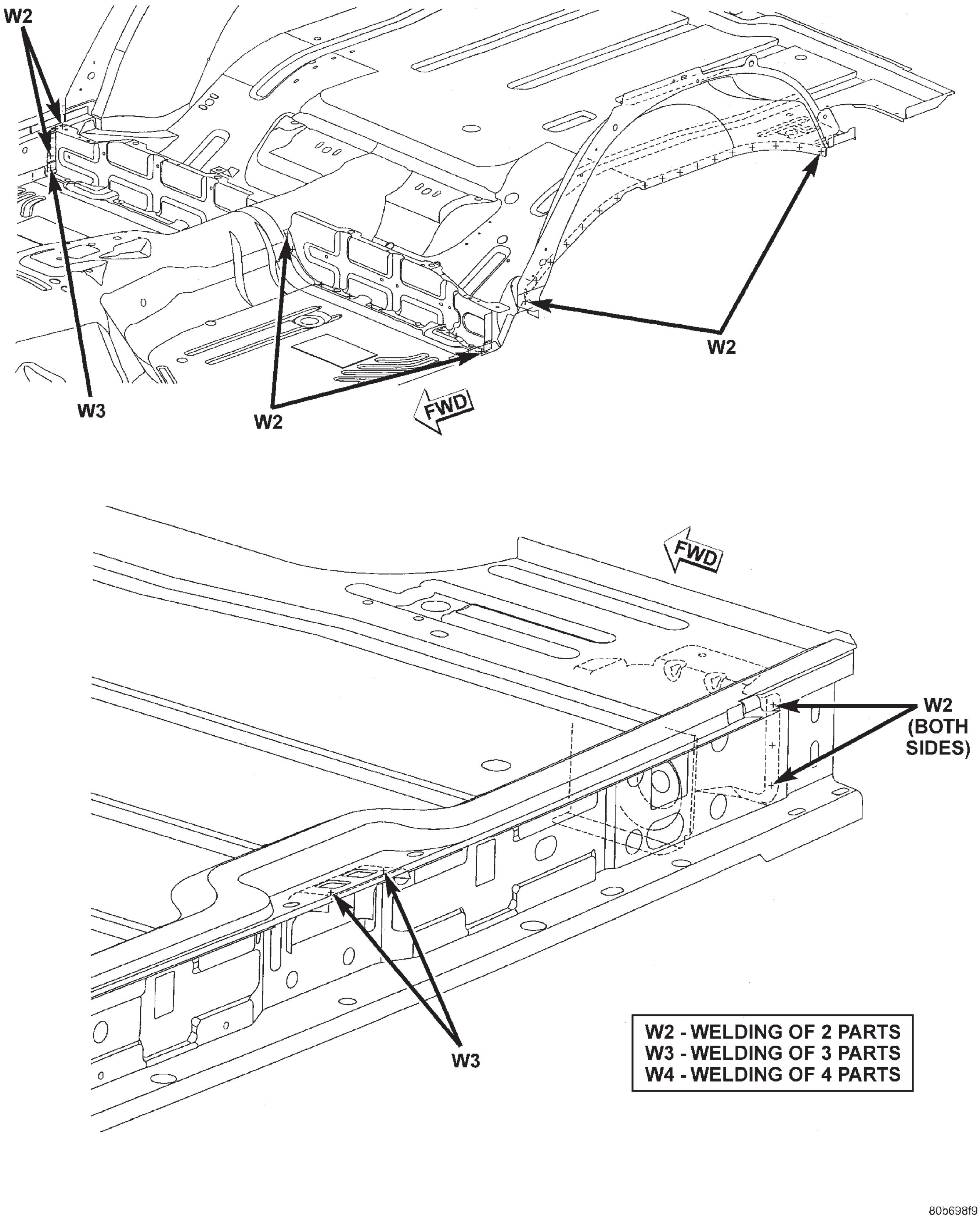
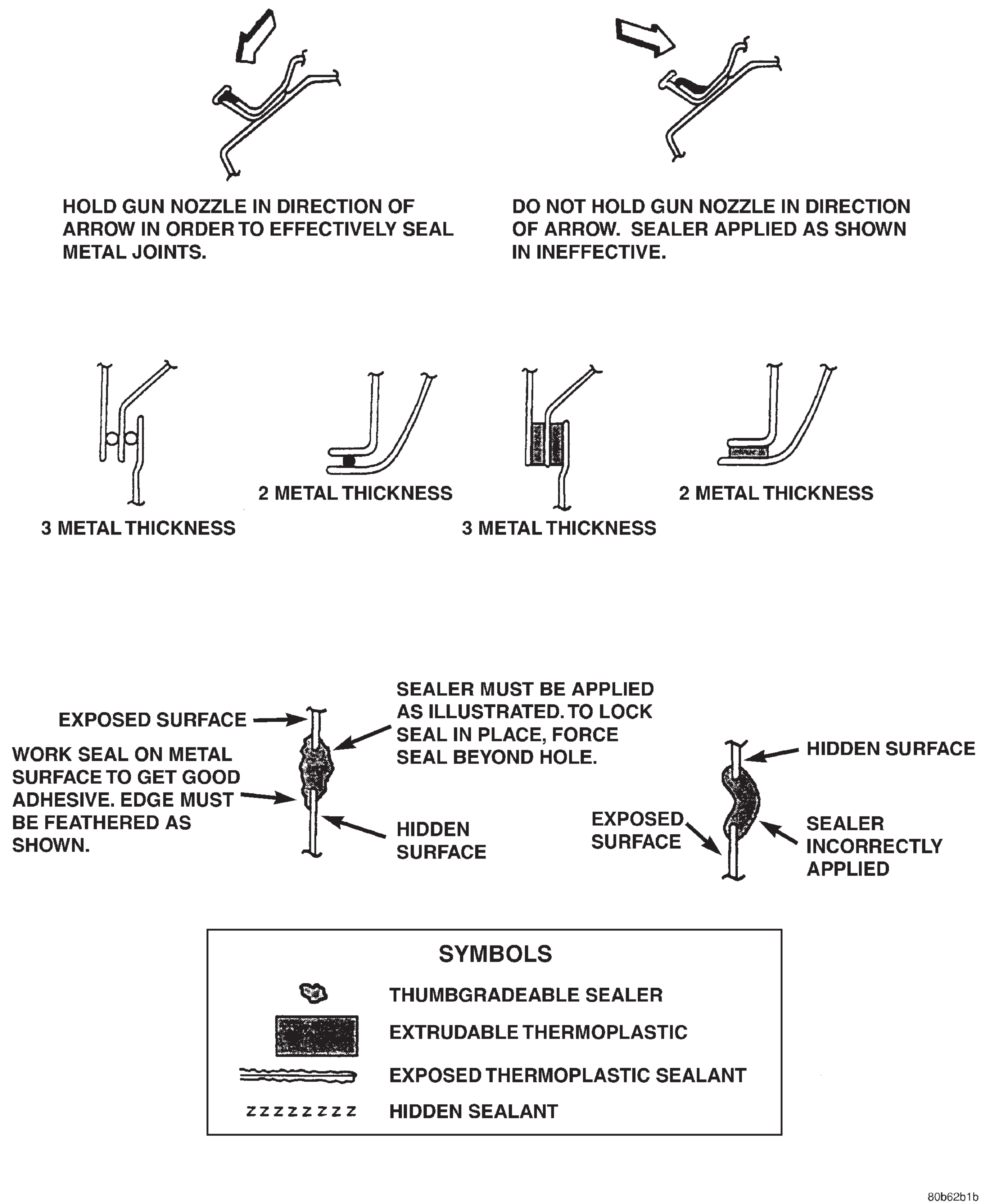


SPECIFICATIONS (Continued)

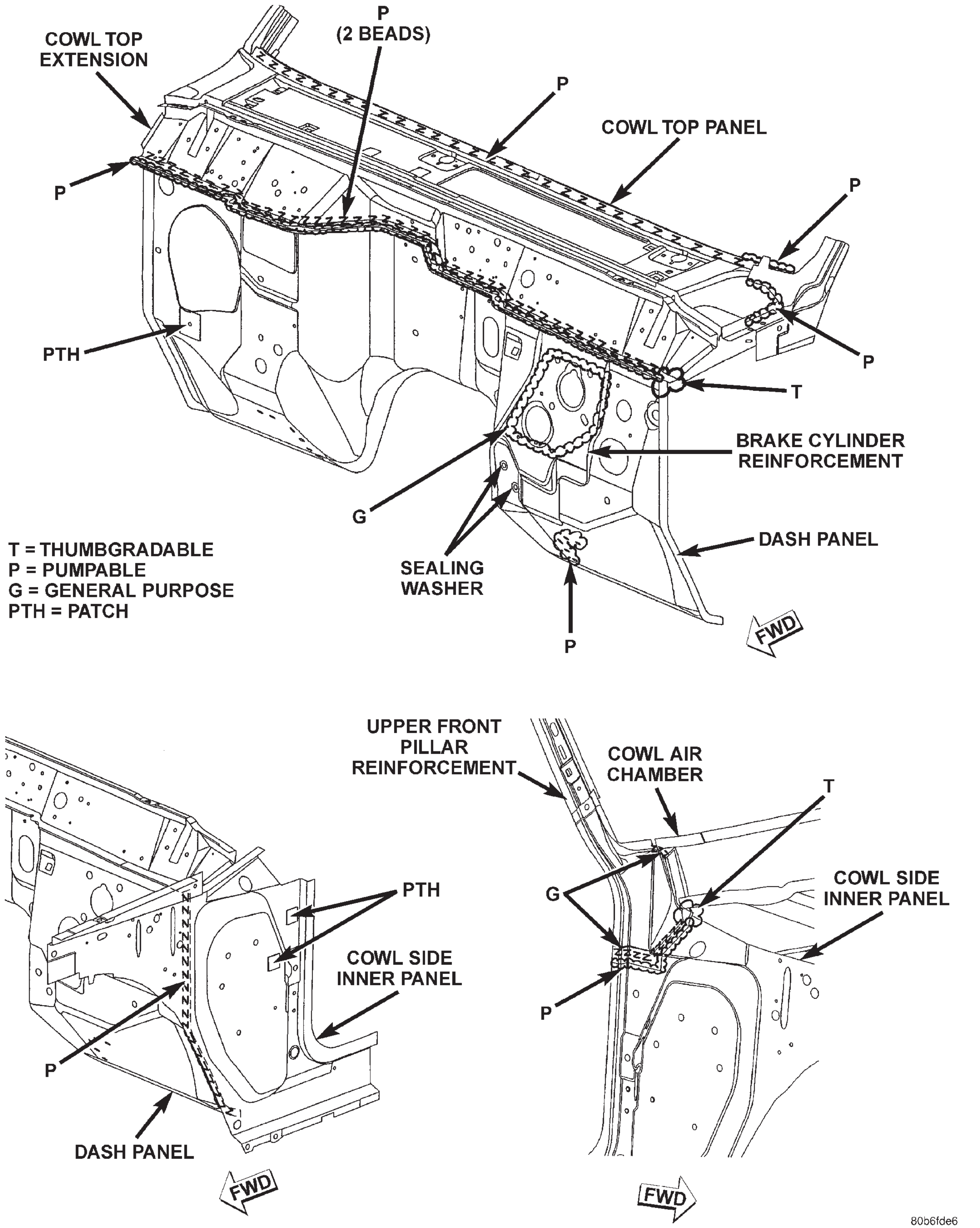
BODY SEALING LOCATIONS

APPLICATION METHODS



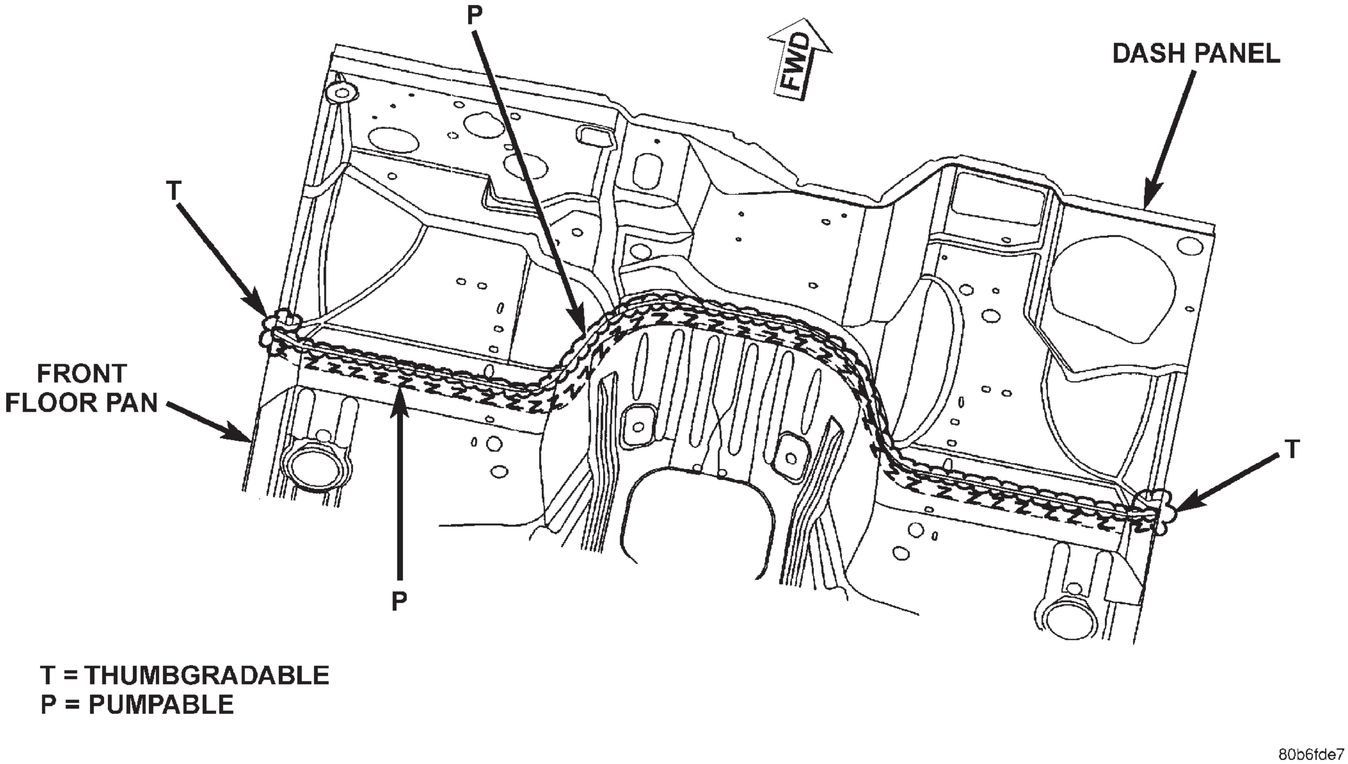
SPECIFICATIONS (Continued)

COWL AND DASH PANEL



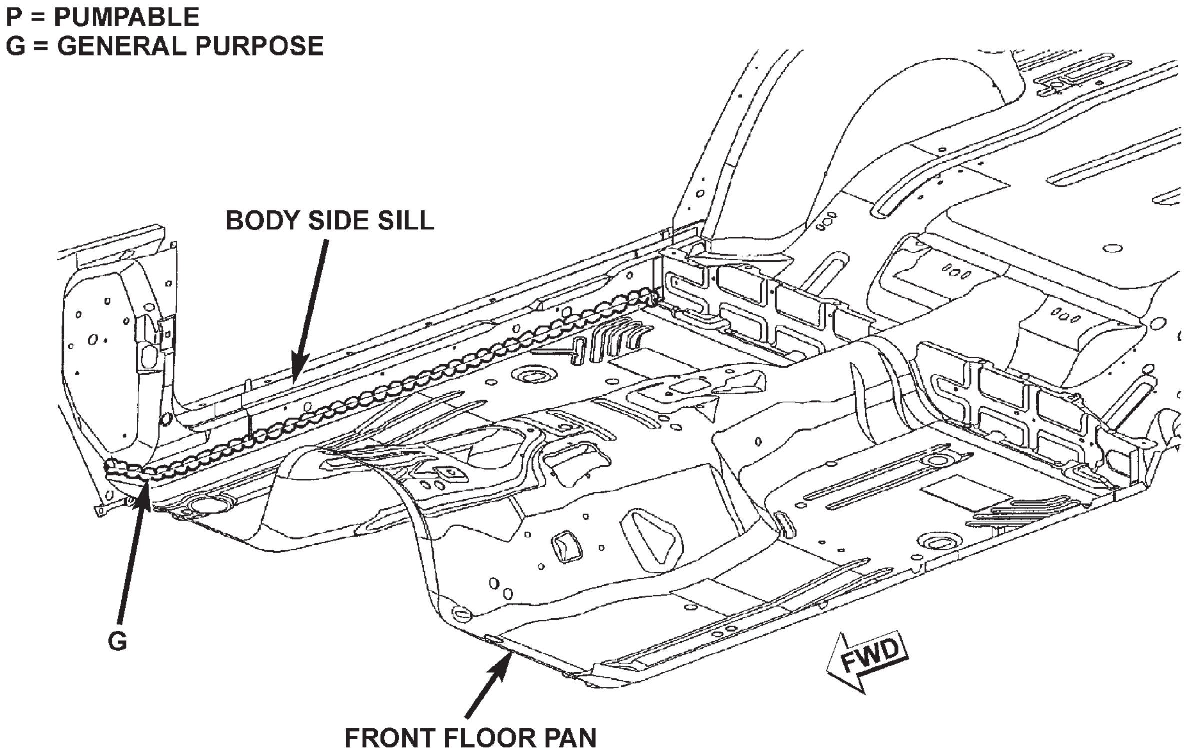
SPECIFICATIONS (Continued)

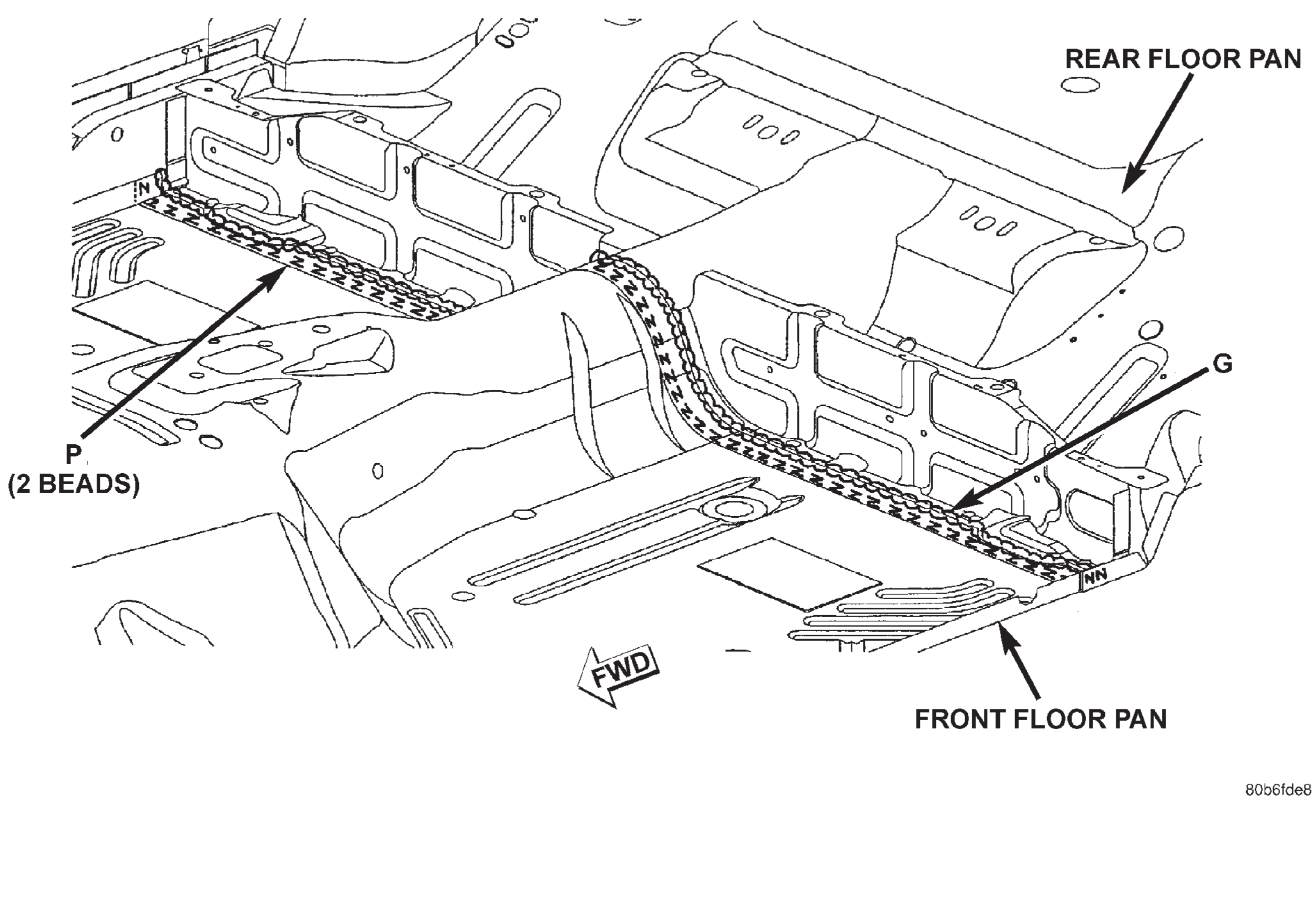
DASH PANEL AND FLOOR PAN



SPECIFICATIONS (Continued)

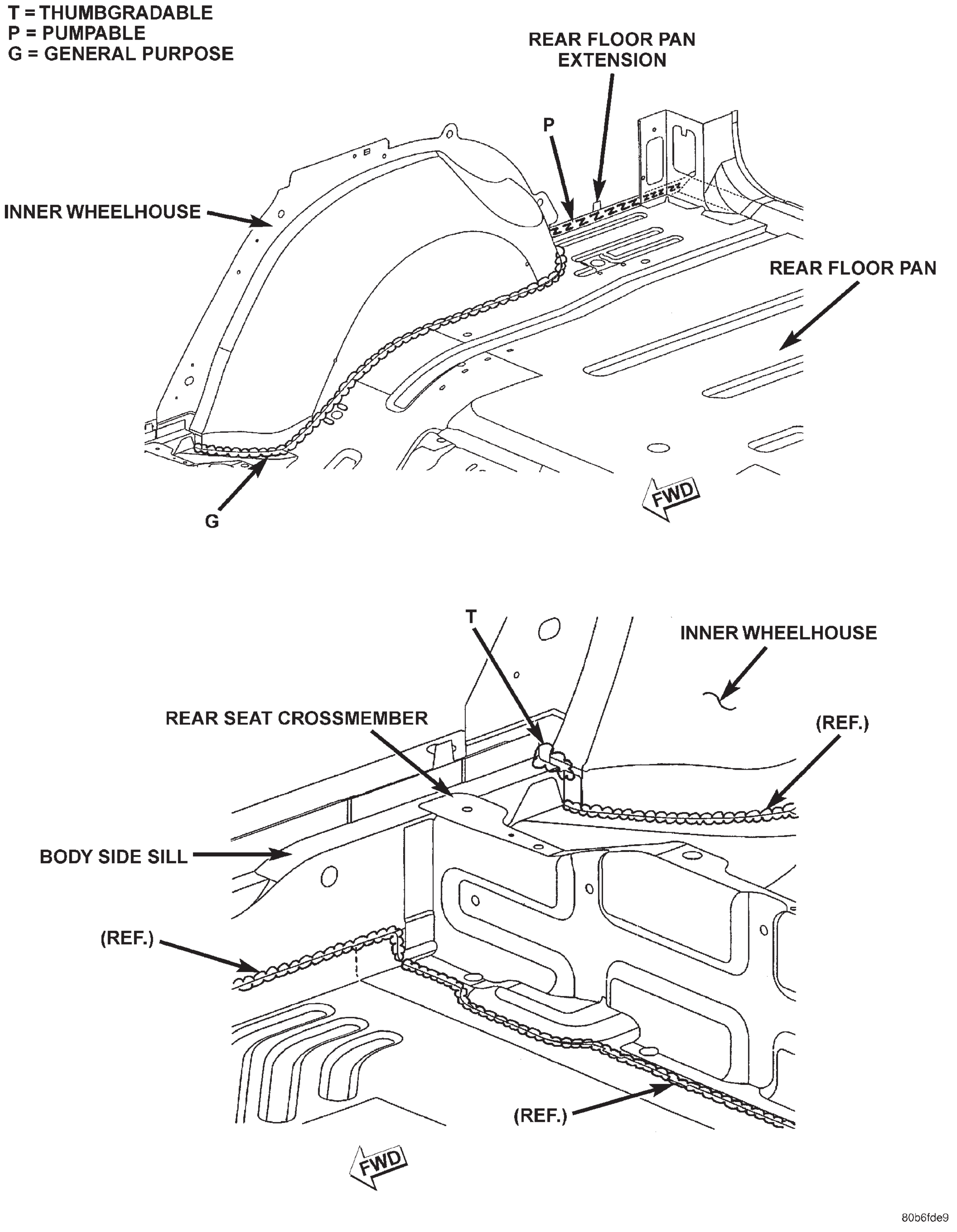
FLOOR PAN





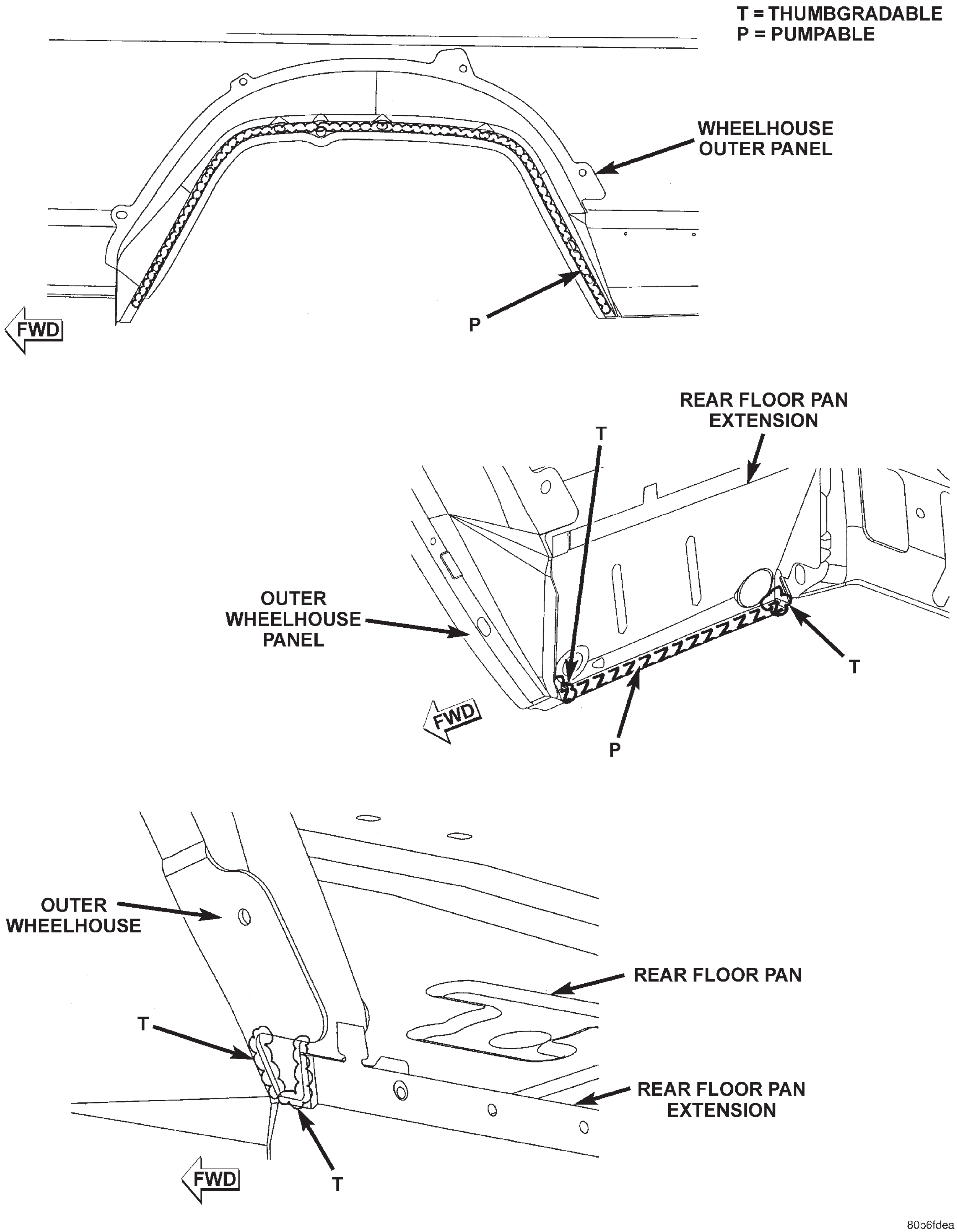
SPECIFICATIONS (Continued)

REAR INNER WHEELHOUSE



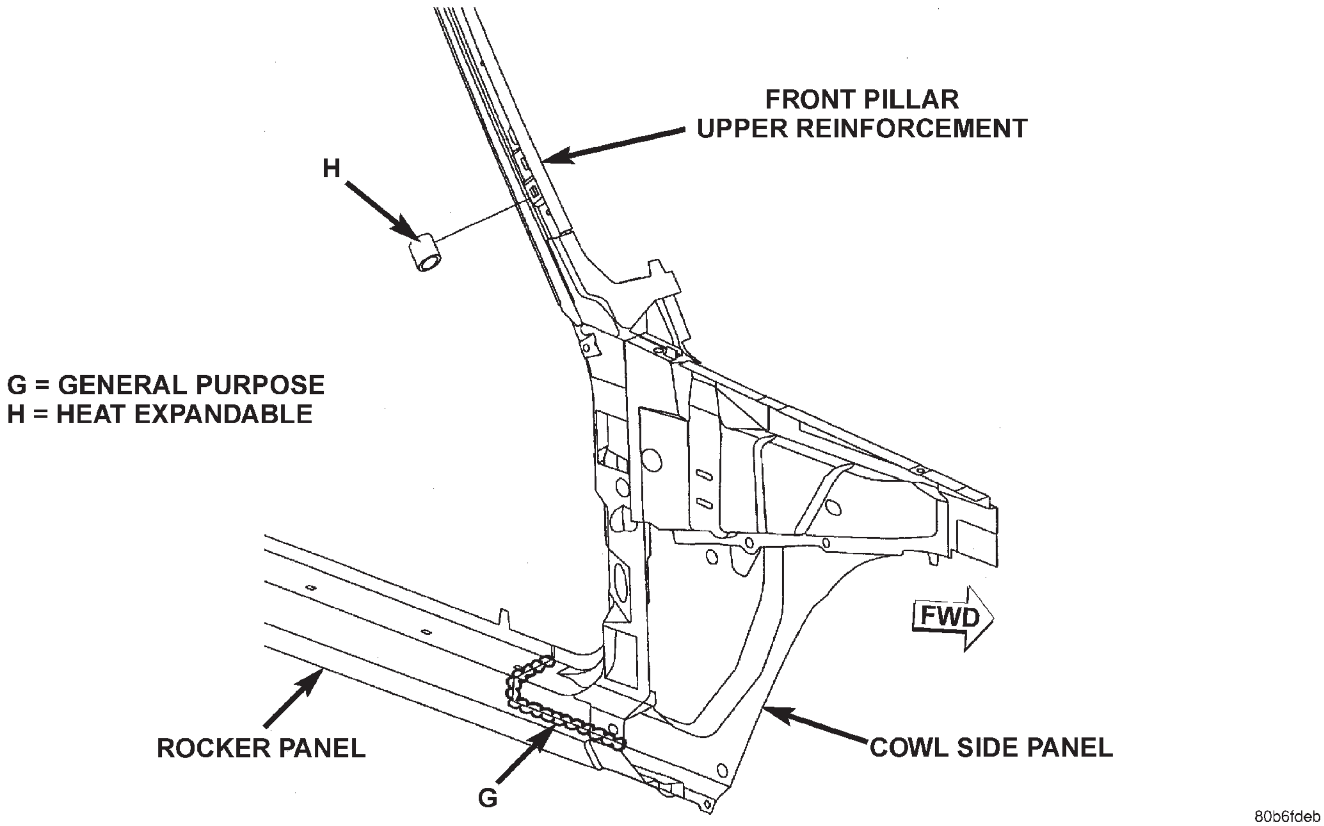
SPECIFICATIONS (Continued)

FRONT INNER WHEELHOUSE



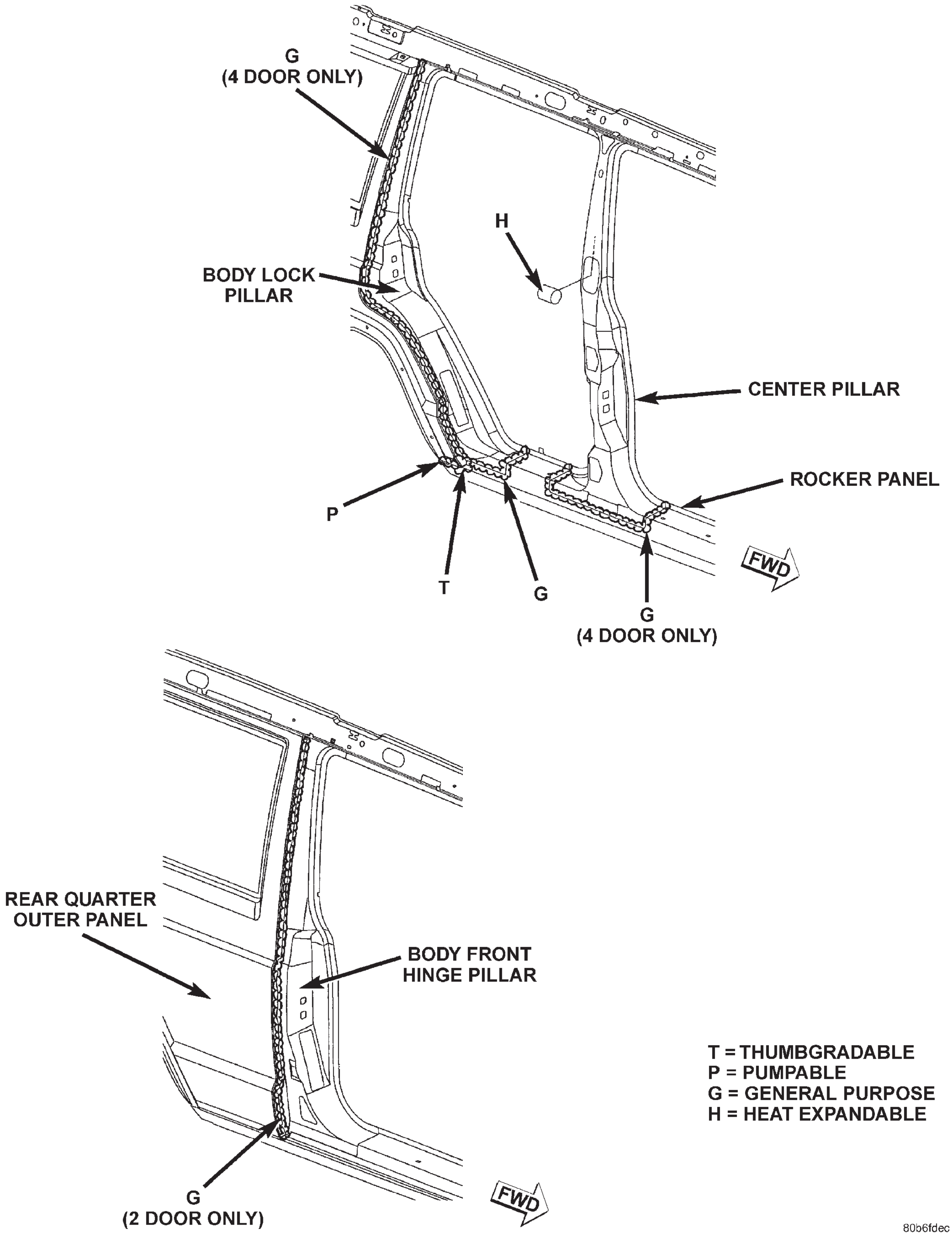
SPECIFICATIONS (Continued)

BODY SIDE



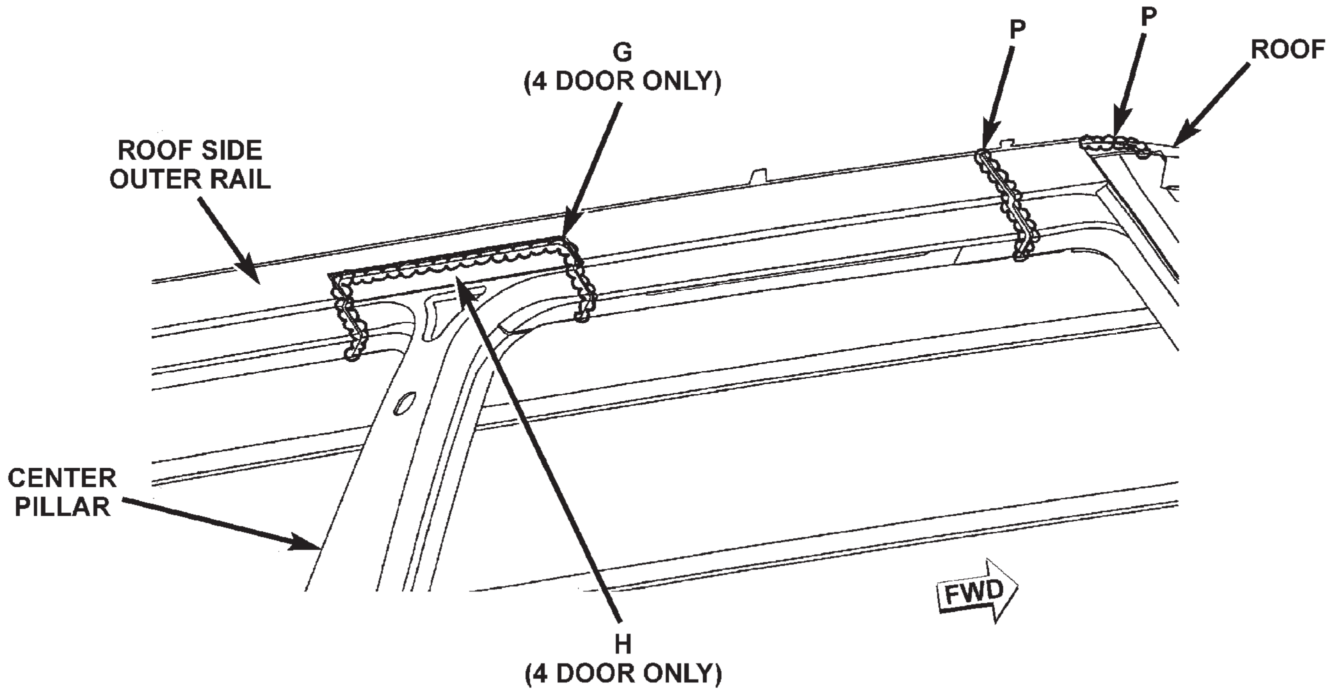
SPECIFICATIONS (Continued)

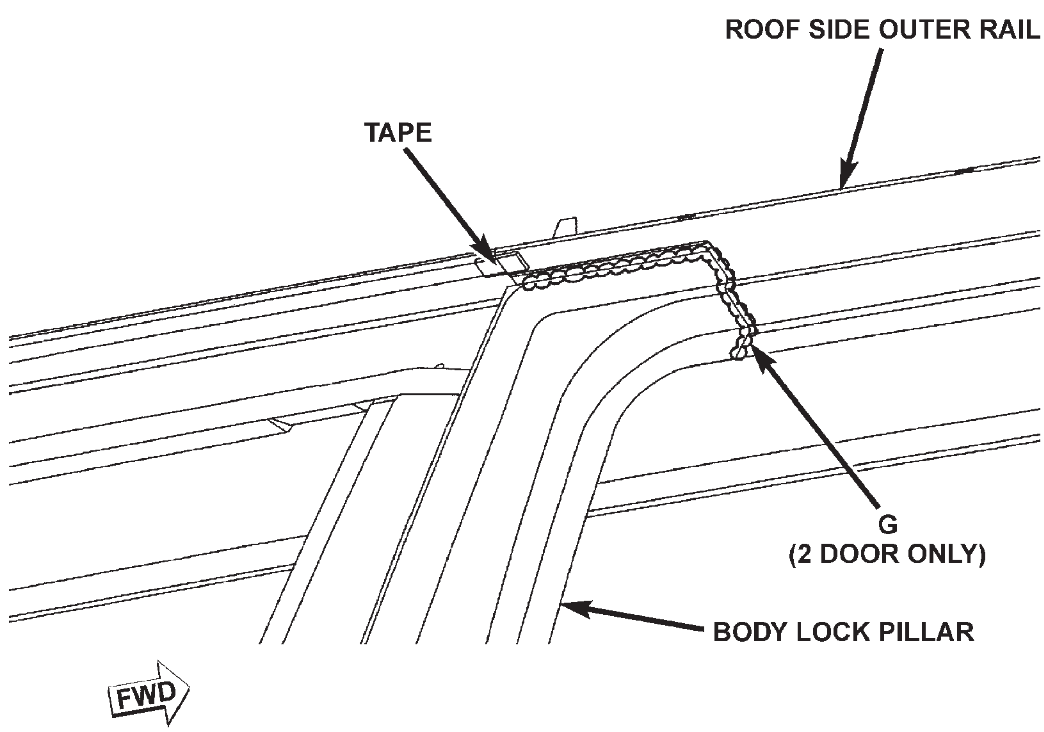
BODY SIDE



SPECIFICATIONS (Continued)

BODY SIDE





P = PUMPABLE
G = GENERAL PURPOSE
H = HEAT EXPANDABLE

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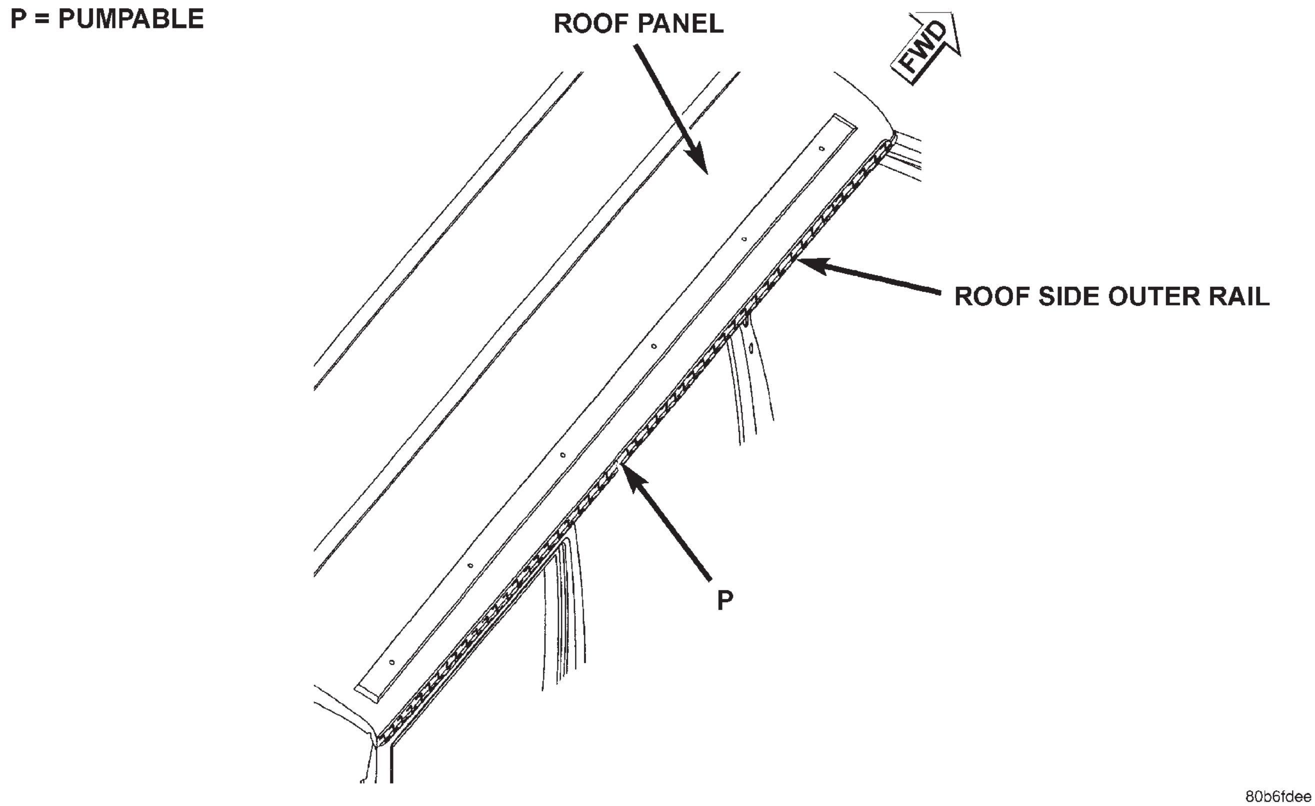
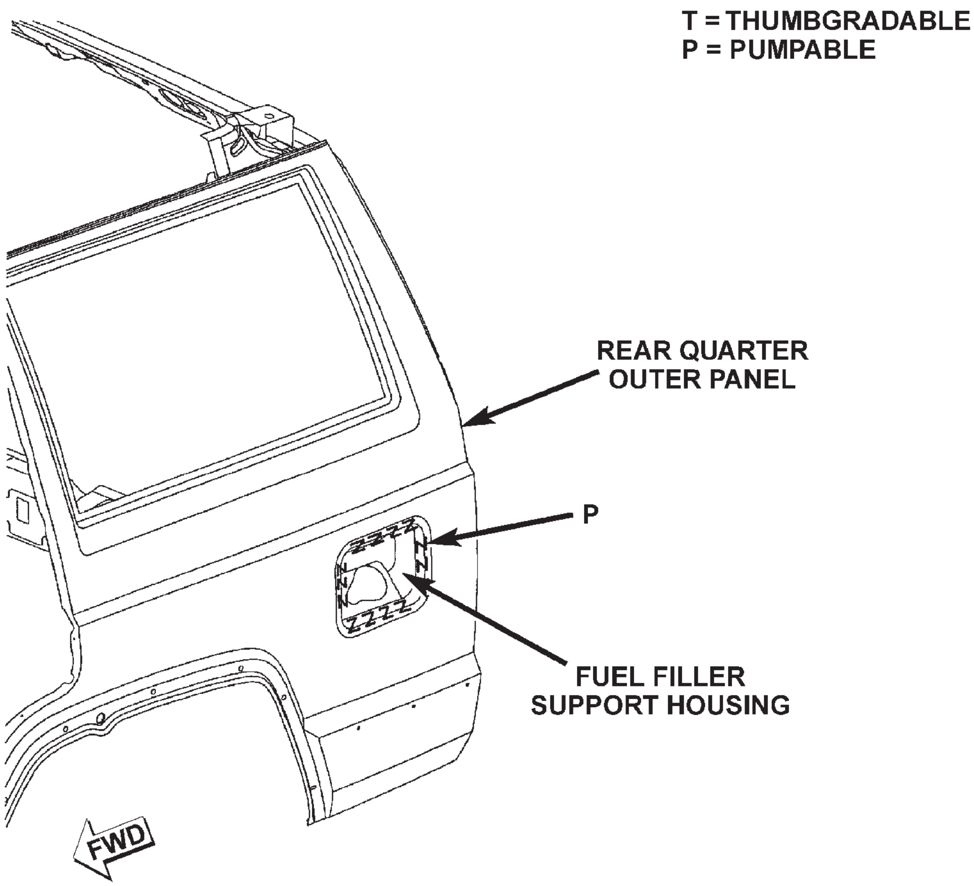
SPECIFICATIONS (Continued)

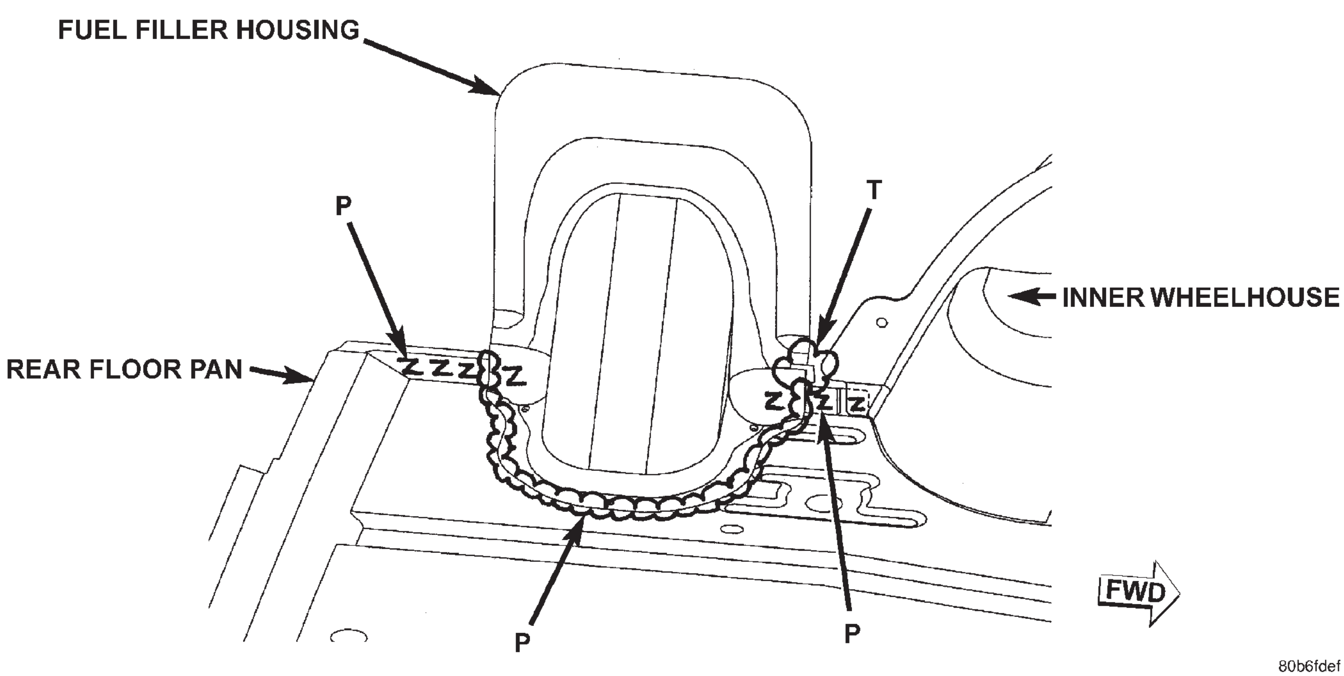
ROOF PANEL



SPECIFICATIONS (Continued)

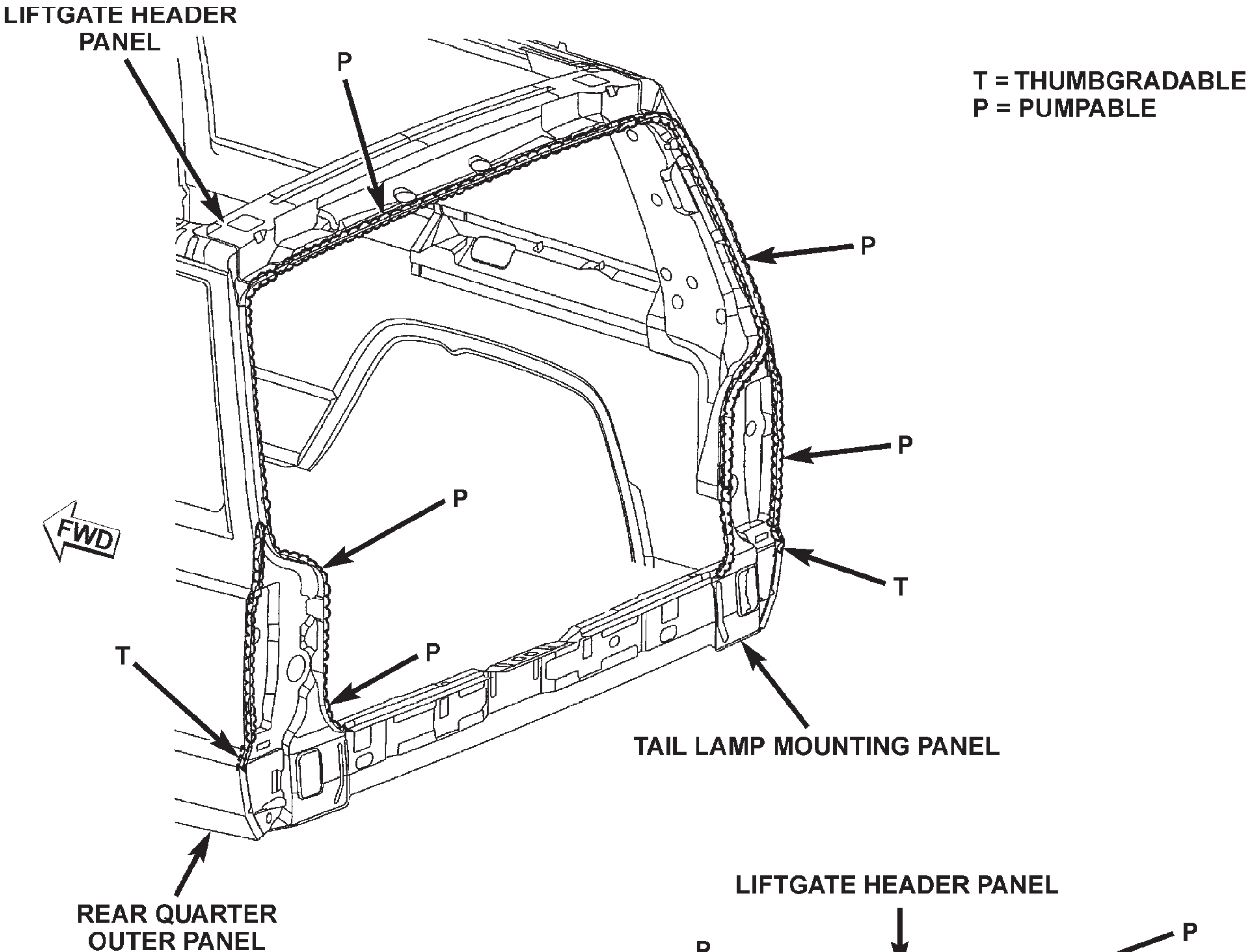
FUEL FILLER HOUSING

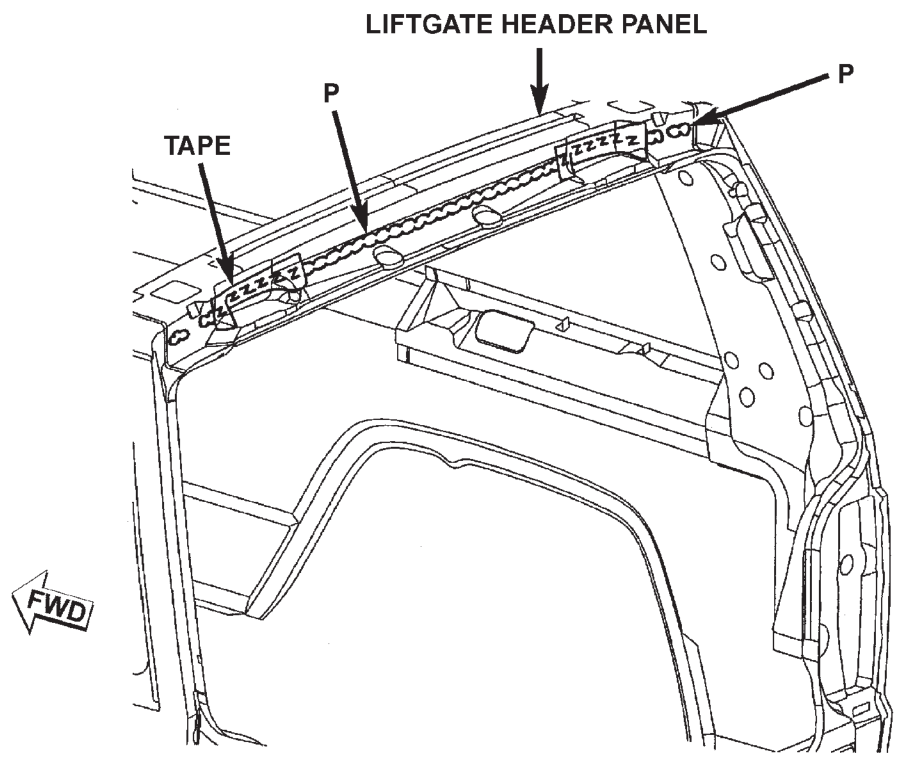




SPECIFICATIONS (Continued)

LIFTGATE OPENING





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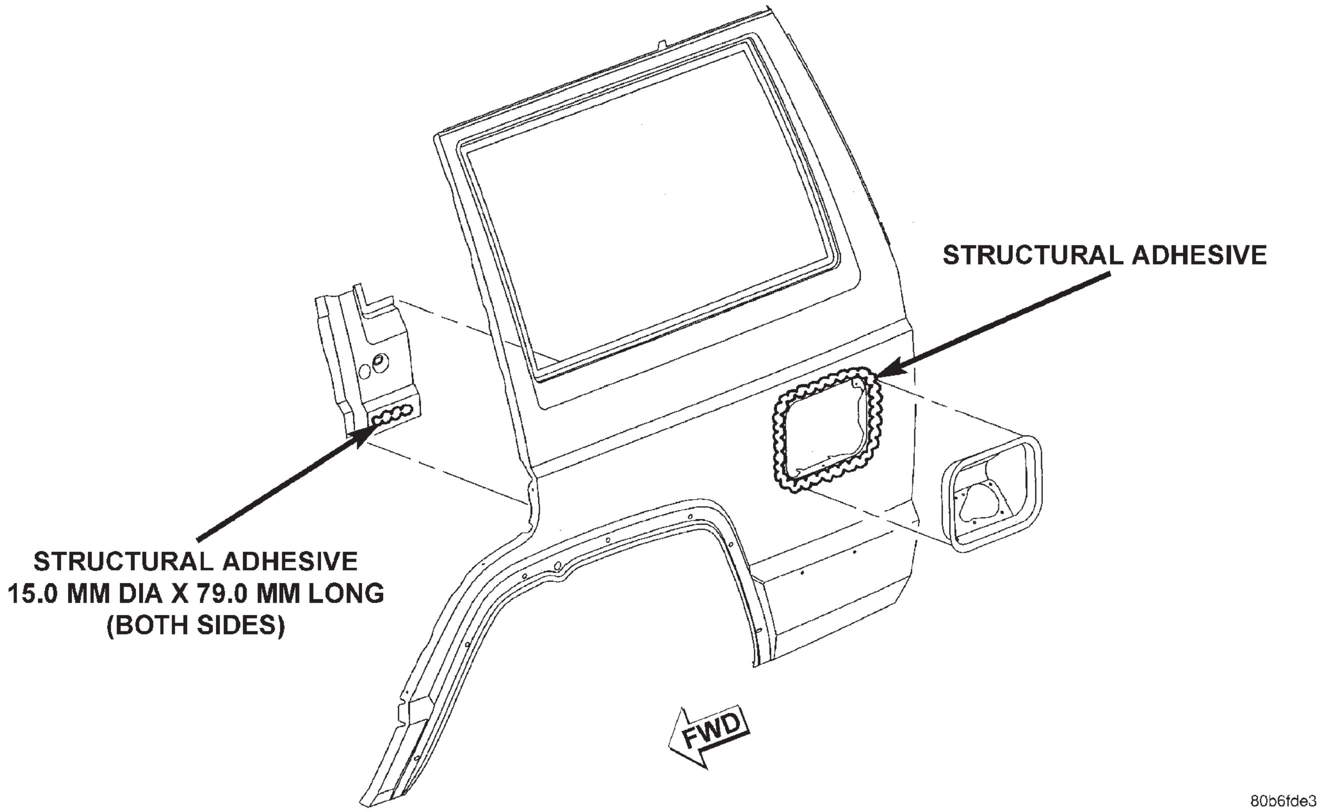
SPECIFICATIONS (Continued)

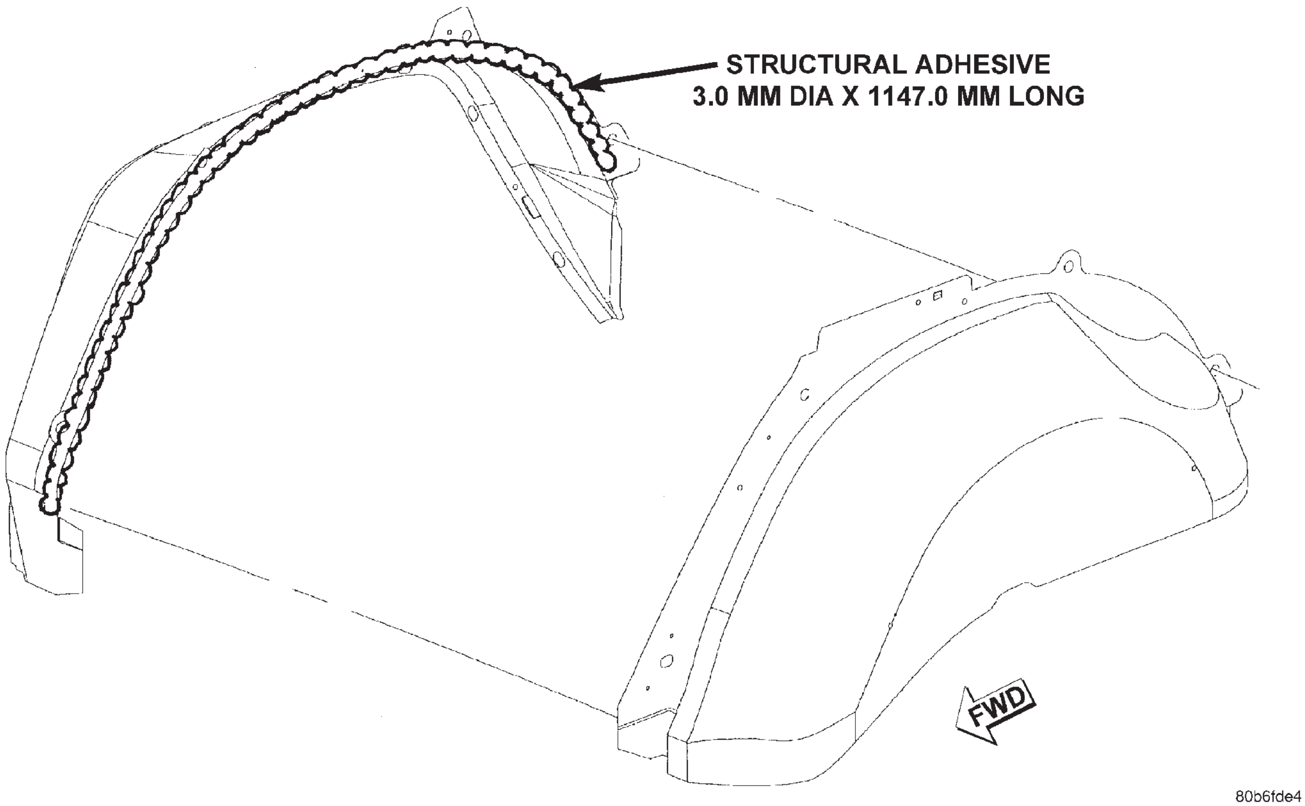
STRUCTURAL ADHESIVE LOCATIONS

LEFT QUARTER PANEL



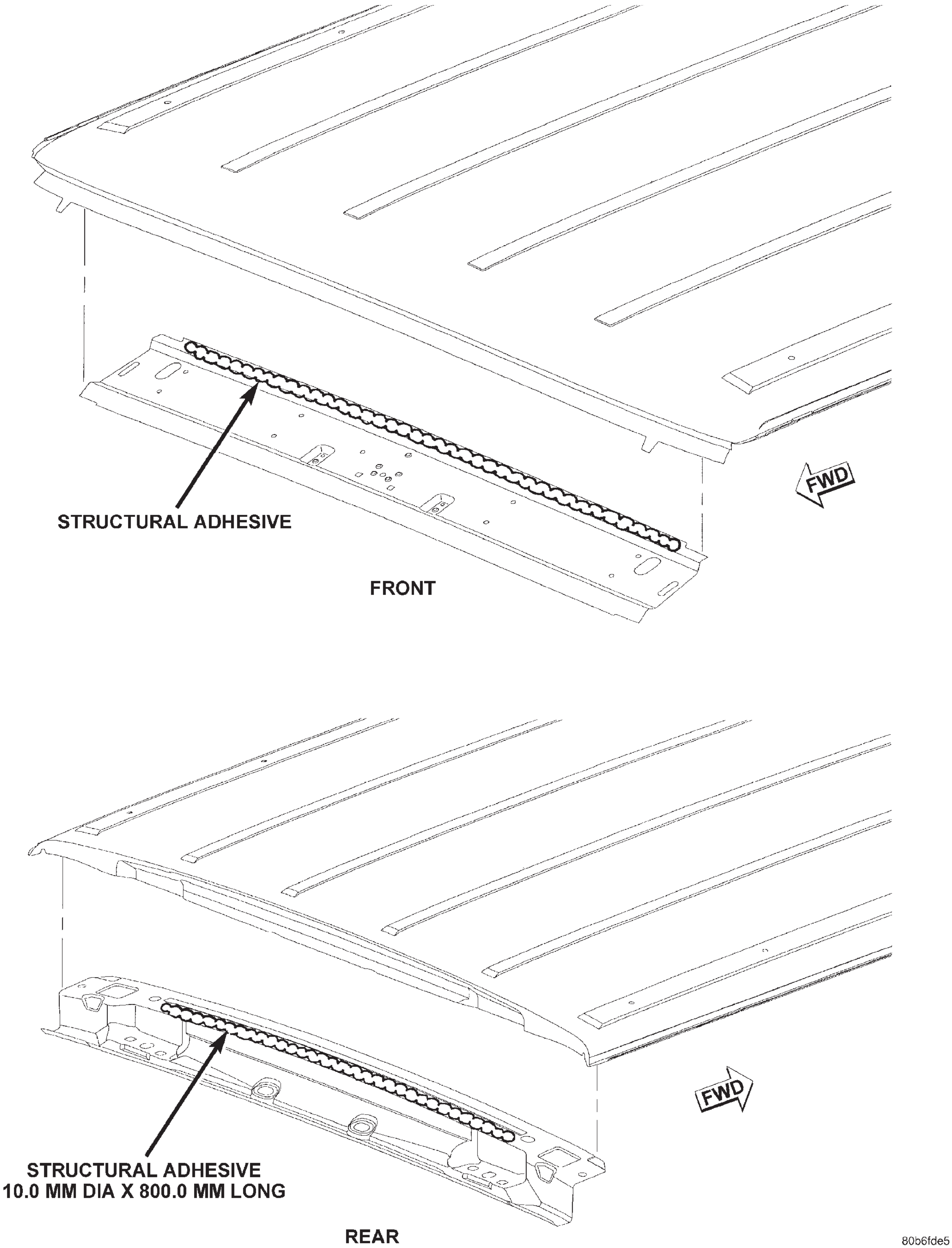
SPECIFICATIONS (Continued)

REAR WHEELHOUSE



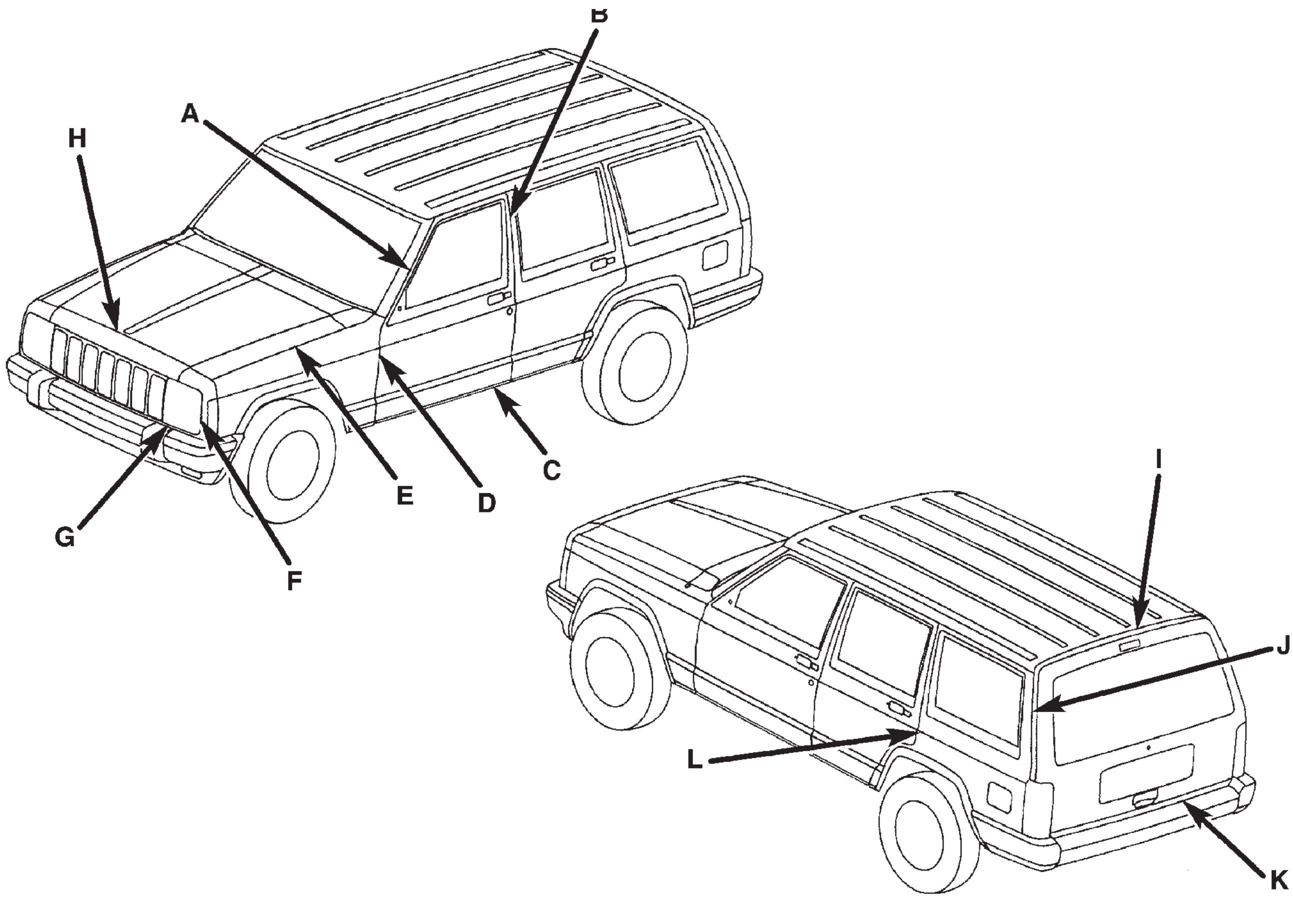
SPECIFICATIONS (Continued)

ROOF BOWS



SPECIFICATIONS (Continued)

BODY GAP AND FLUSH MEASUREMENTS



	LOCATION	GAP	FLUSH
A	Front Door to Windshield Pillar	6.4 +/- 2.0	1.6 +/- 2.0
B	Front Door to Rear Door	6.4 +/- 1.5	0.0 +/- 1.5
C	Front Door to Aperture at Sill	8.1 +/- 1.5	0.0 +/- 1.5
D	Front Door to Fender	6.4 +/- 1.5	0.0 +/- 1.5
E	Hood to Fender	5.6 +/- 1.5	0.5 +/- 1.5
F	Headlamp to Fender	5.6 +/- 1.5	0.5 +/- 1.5
G	Headlamp to Grille	N/A	0.74 +/- 1.0
H	Grille to Hood	6.0 +/- 1.5	0.24 +/- 1.5
I	Liftgate to Roof	7.5 +/- 1.5	0.5 +/- 1.5
J	Liftgate to Aperture	6.5 +/- 1.5	0.0 +/- 1.5
K	Liftgate to Fascia	X.X +/- 2.0	N/A
L	Rear Door to Quarter Panel	6.4 +/- 1.5	0.0 +/- 1.5

NOTE: ALL MEASUREMENTS ARE IN MM.

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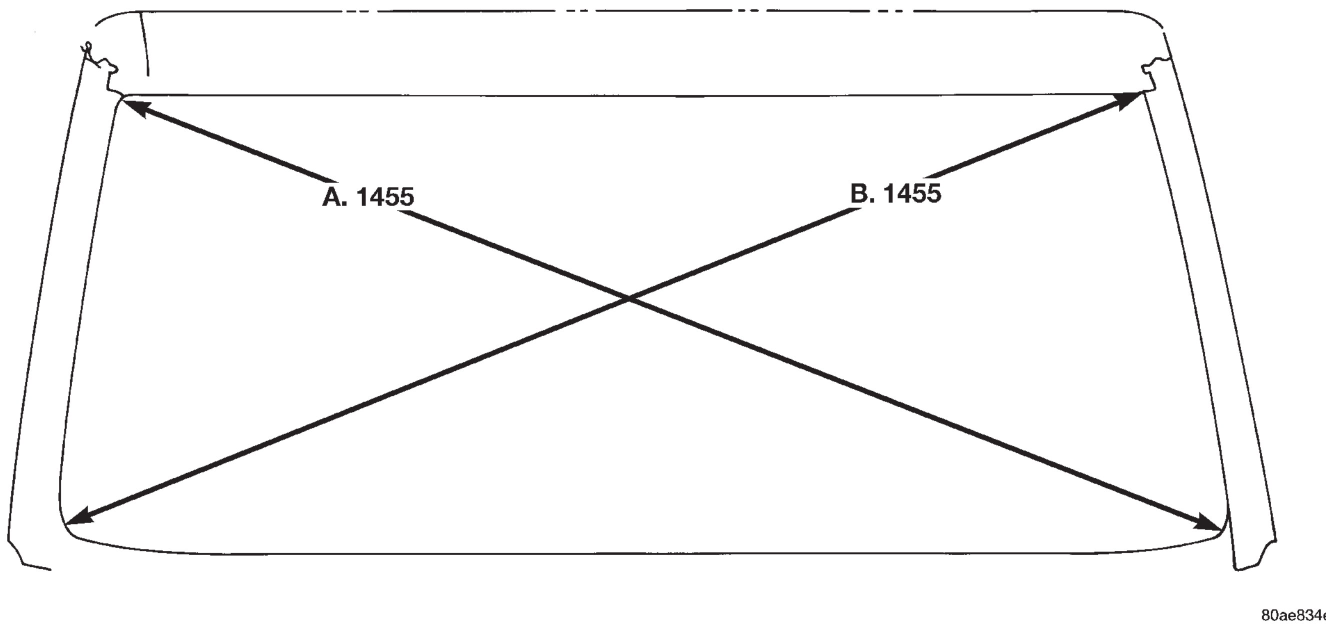
SPECIFICATIONS (Continued)

BODY OPENING DIMENSIONS

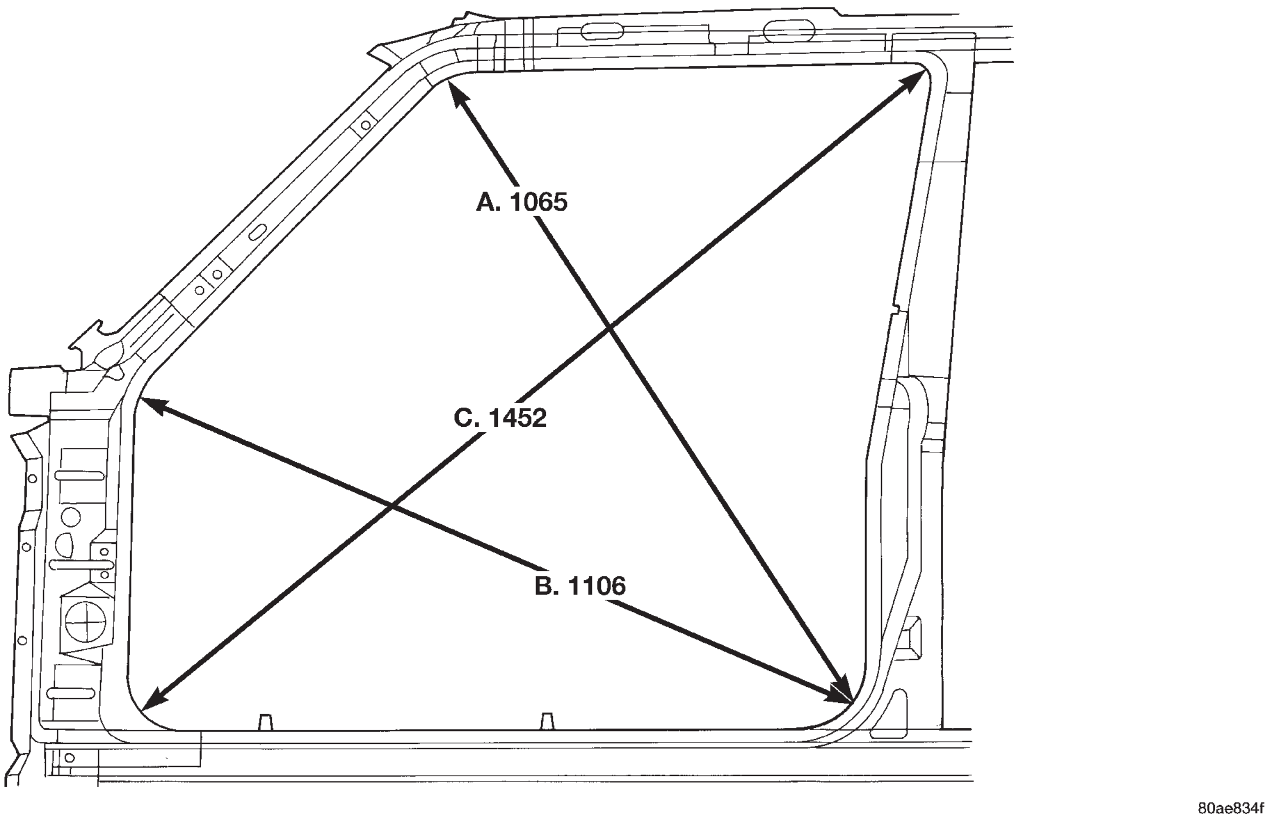
WINDSHIELD OPENING



- A. & B. Center of radius at bottom to center of radius at top

SPECIFICATIONS (Continued)

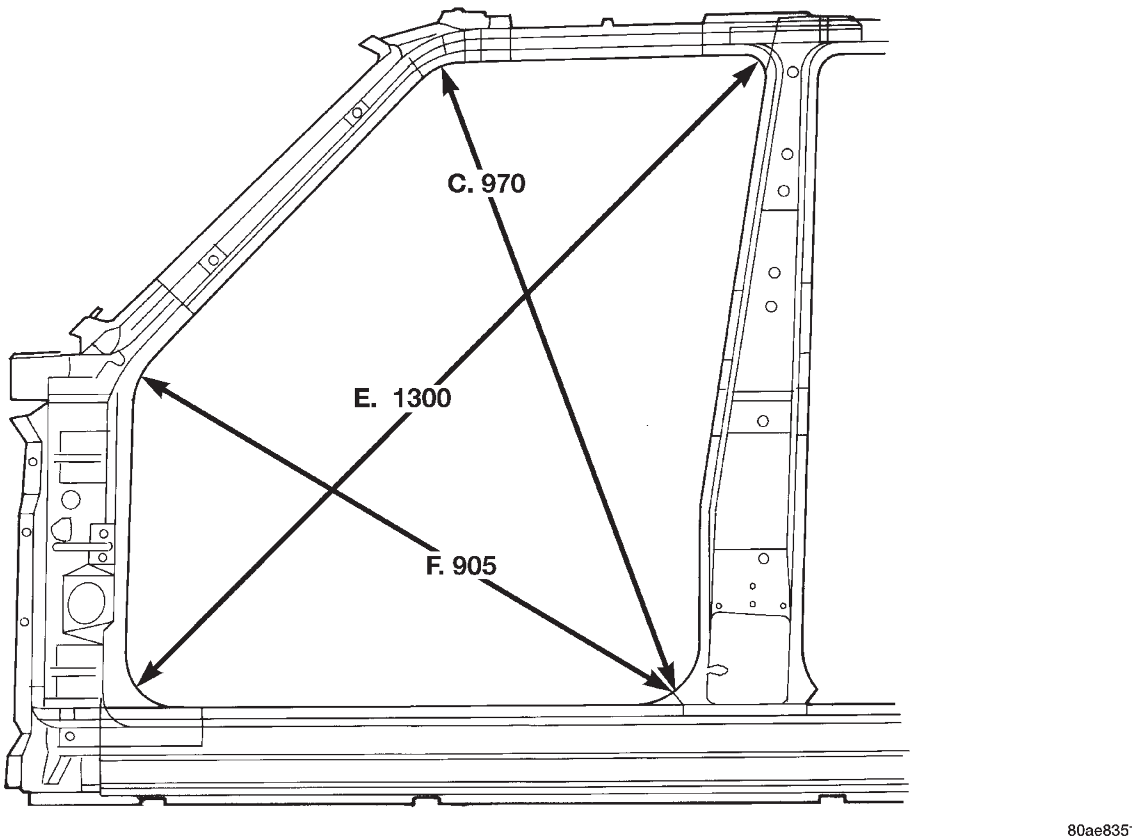
FRONT DOOR OPENING 2–DOOR



- A. Center of front door lower rear radius to center of A-pillar radius
- B. Center of radius at bottom rear to center of radius at lower A-pillar
- C. Center of radius at bottom front to center of radius at top rear

SPECIFICATIONS (Continued)

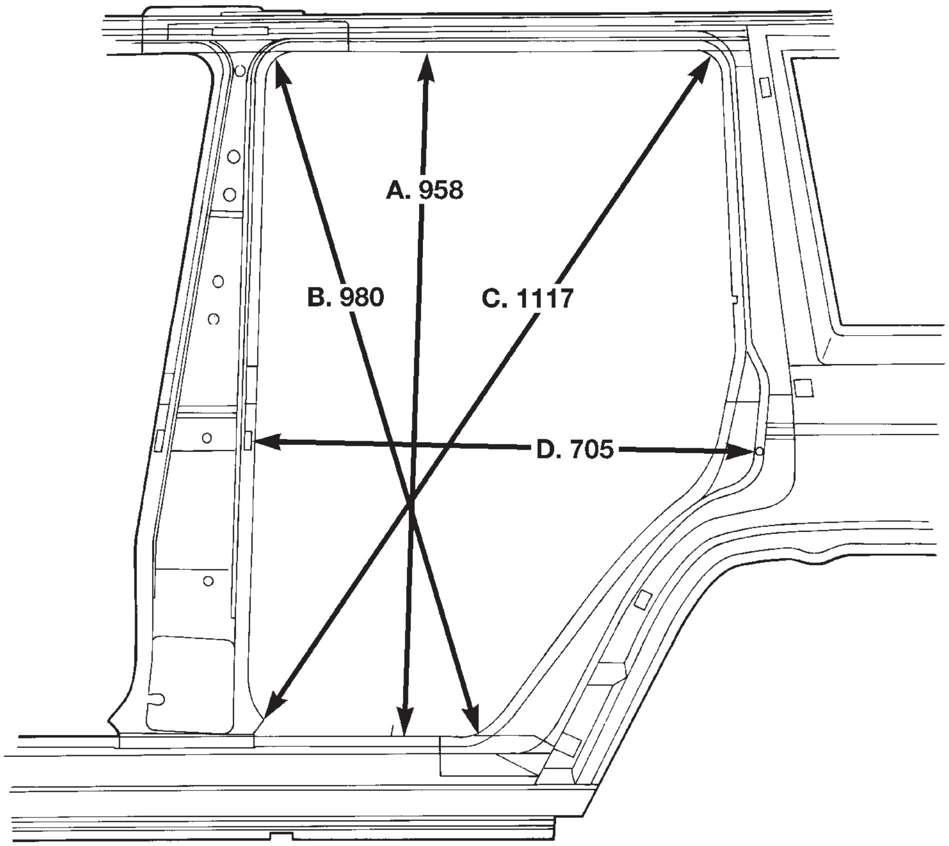
FRONT DOOR OPENING 4–DOOR



- C. Center of front door lower rear radius to center of A-pillar radius
- E. Center of radius at bottom rear to center of radius at lower A-pillar
- F. Center of radius at bottom front to center of radius at top rear

SPECIFICATIONS (Continued)

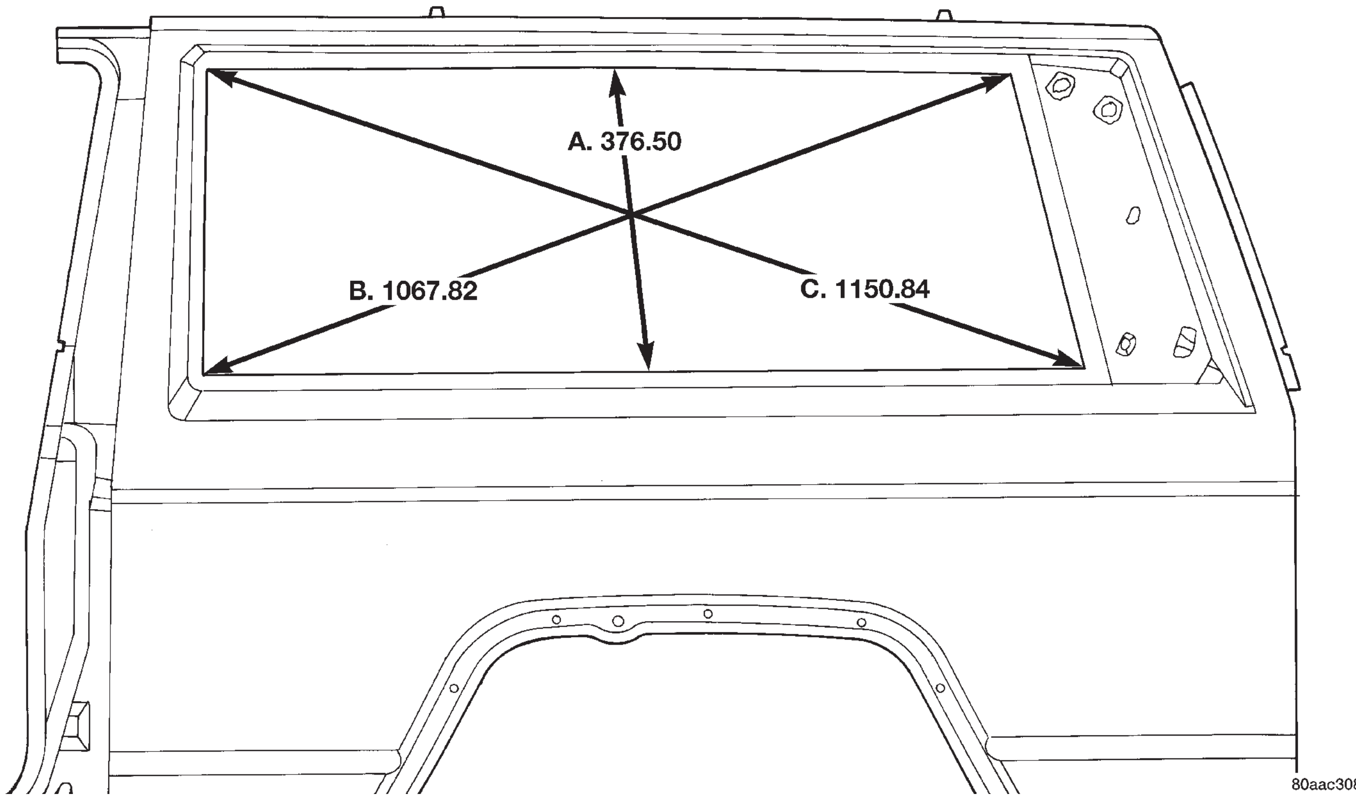
REAR DOOR OPENING



- A. Quarter panel to front outer body side upper and lower seam
- B. Center of front upper door radius to center of rear lower door radius
- C. Center of front lower door radius to center of rear upper door radius
- D. Flange to rear door striker mount

SPECIFICATIONS (Continued)

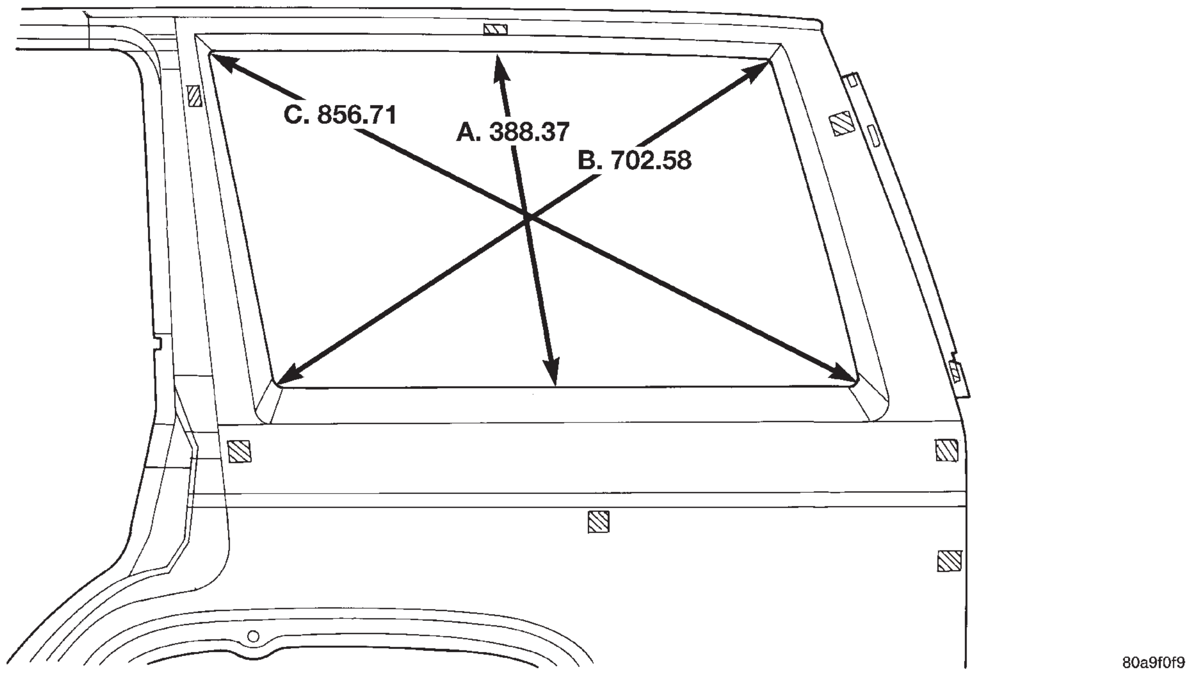
QUARTER WINDOW OPENING 2–DOOR



- A. Center of upper and lower rear quarter window opening
- B. Center of radius front lower corner to center of radius rear upper corner
- C. Center of radius front upper corner to center of radius rear lower corner

SPECIFICATIONS (Continued)

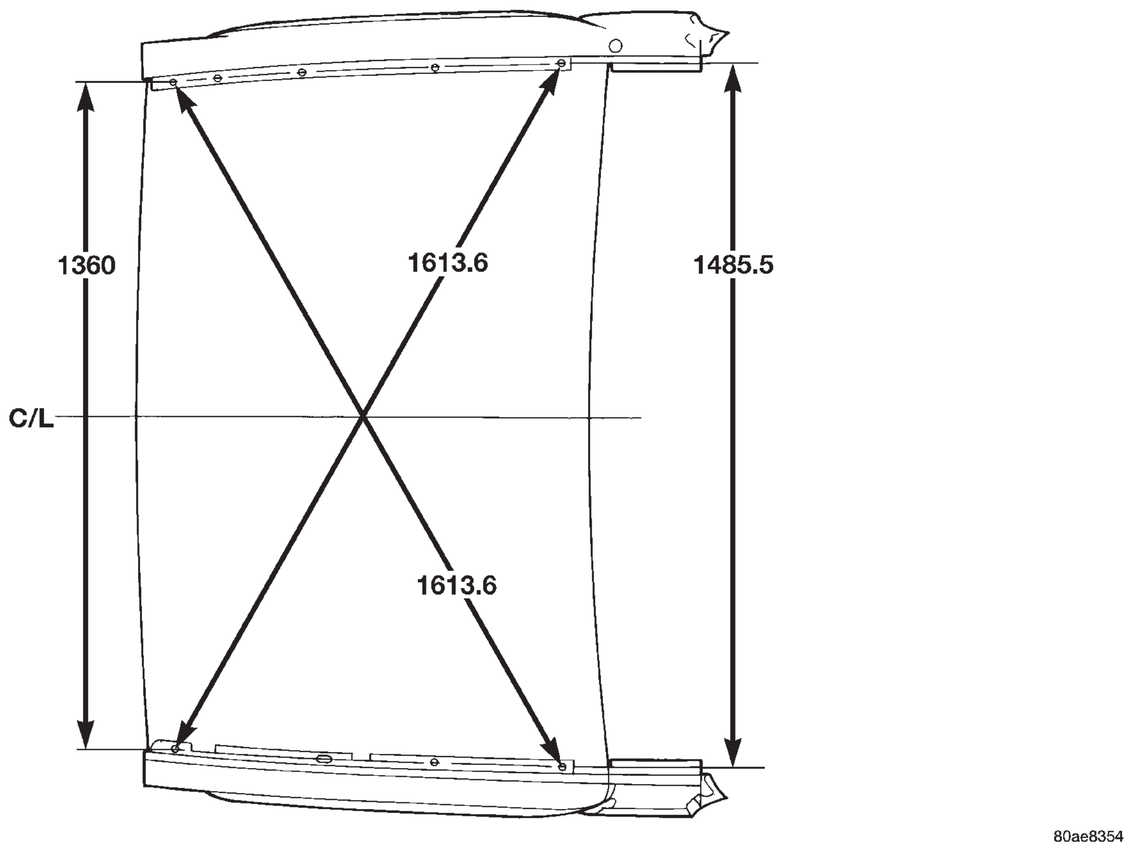
QUARTER WINDOW OPENING 4–DOOR



- A. Center of upper and lower rear quarter window opening
- B. Center of radius front lower corner to center of radius rear upper corner
- C. Center of radius front upper corner to center of radius rear lower corner

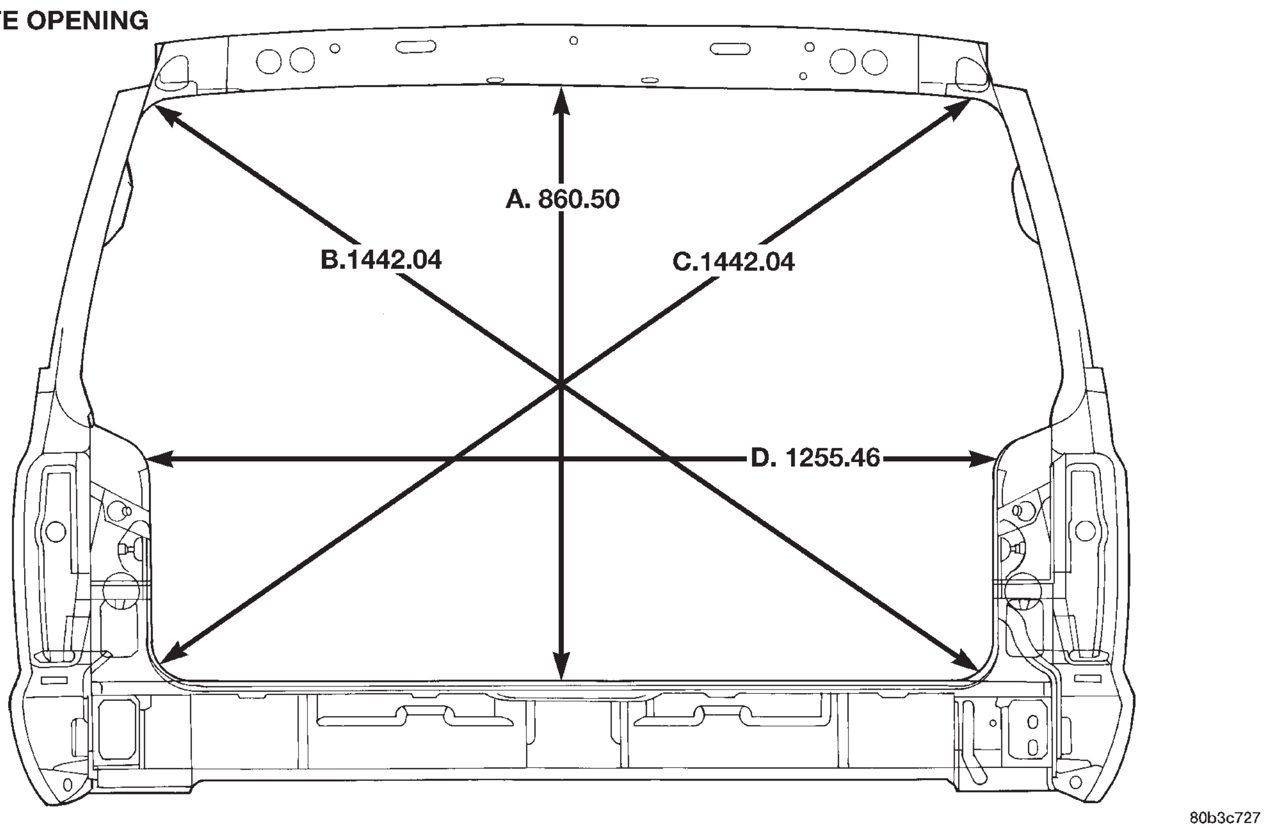
SPECIFICATIONS (Continued)

ENGINE COMPARTMENT



SPECIFICATIONS (Continued)

LIFTGATE OPENING



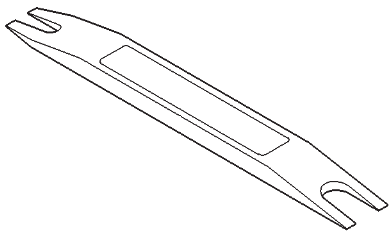
- A. Center of upper liftgate opening to liftgate striker mount
- B. & C. Center of radius upper corner to center of radius lower corner
- D. Distance between outer quarter panel to tail lamp mounting panel to inner quarter panel seams

TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Bucket Seat to Floor Pan Bolt	27 N·m (20 ft. lbs.)
Bucket Seat to Floor Pan Nut	40 N·m (30 ft. lbs.)
Front Door Hinge Bolts	3 N·m (2 ft. lbs.)
Front Door Latch Screw	11 N·m (8 ft. lbs.)
Front Door Latch Striker Screw	28 N·m (20 ft. lbs.)
Front Seat Belt Anchor Bolt	43 N·m (32 ft. lbs.)
Front Retractor Anchor Bolt	43 N·m (32 ft. lbs.)
Front Seat Belt Buckle Anchor Bolt	43 N·m (32 ft. lbs.)
GOP to Support Bracket Nut	4 N·m (38 in. lbs.)
GOP to Fender Nut	4 N·m (38 in. lbs.)
Liftgate Hinge to Body and/or Liftgate Bolt	26 N·m (19 ft. lbs.)
Liftgate Latch Screw	13 N·m (9 ft. lbs.)
Liftgate Latch Striker Nut	54 N·m (40 ft. lbs.)
Rear Door Hinge Bolt	3 N·m (2 ft. lbs.)
Rear Door Latch Screw	11 N·m (8 ft. lbs.)
Rear Door Latch Striker Screw	28 N·m (20 ft. lbs.)
Rear Shoulder Belt Lower Anchor Bolt	43 N·m (32 ft. lbs.)
Rear Seatback Pivot Bolt	33 N·m (25 ft. lbs.)
Rear Seat Belt/Buckle Anchor Bolt	43 N·m (32 ft. lbs.)
Rear Shoulder Belt Upper Anchor Bolt	43 N·m (32 ft. lbs.)

SPECIAL TOOLS

BODY



Remover, Moldings C-4829

HEATING AND AIR CONDITIONING

CONTENTS

GENERAL INFORMATION

A/C APPLICATION TABLE

Item	Description	Notes
Vehicle	XJ Cherokee/ Laredo	
System	R134a w/orifice tube	
Compressor	Sanden SD7H15	SP-20 PAG oil
Freeze–up Control	Low Pressure cycling cutout switch	accumulator mounted
Low psi Control	opens < 25 psi - resets > 43 psi	
High psi Control	switch - opens > 450-490 psi - resets < 270-330 psi	discharge line
Control Head	manual type	
Mode Door	vacuum	
Blend-Air Door	electric	
Fresh/Recirc door	vacuum	
Blower Motor	hardwired to control head	resistor block
Cooling Fan	viscous for cooling, single speed electric for A/C	
Clutch		
Control	relay	PCM
Draw	2 - 3.7 amps @ 12V	± 0.5V @ 70° F
Gap	0.016″ - 0.031″	
DRB III®		
Reads	TPS, RPM, A/C switch test	
Actuators	clutch and fan relay	

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.

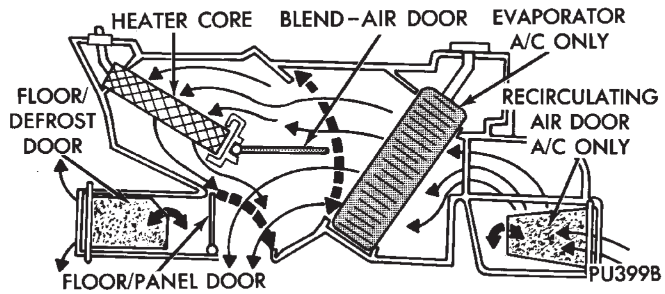


Fig. 1 Common Blend-Air Heater-Air Conditioner System - Typical

Outside fresh air enters the vehicle through the cowl top opening at the base of the windshield, and passes through a plenum chamber to the heater-A/C system blower housing. 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.

It is also important to keep the air intake openings clear of debris because leaf particles and other debris that is small enough to pass through the cowl plenum screen can accumulate within the heater-A/C housing. The closed, warm, damp and dark environment created within the heater-A/C housing is ideal for the growth of certain molds, mildews and other fungi. Any accumulation of decaying plant matter provides an additional food source for fungal spores, which enter the housing with the fresh air. Excess debris, as well as objectionable odors created by decaying plant matter and growing fungi can be discharged into the passenger compartment during heater-A/C system operation.

The heater and optional air conditioner are blend-air type systems. In a blend-air system, a blend-air door controls the amount of unconditioned air (or cooled air from the evaporator on models with air conditioning) that is allowed to flow through, or around, the heater core. A temperature control knob on the heater-A/C control panel determines the discharge air temperature by controlling an electric motor, which moves the blend-air door. This allows an almost immediate control of the output air temperature of the system.

GENERAL INFORMATION (Continued)

The mode control knob on the heater-only or heater-A/C control panel is used to direct the conditioned air to the selected system outlets. Both mode control switches use engine vacuum to control the mode doors, which are operated by vacuum actuator motors.

On air conditioned vehicles, the outside air intake can be shut off by selecting the Recirculation Mode with the mode control knob. This will operate a vacuum actuated recirculating air door that closes off the outside fresh air intake and recirculates the air that is already inside the vehicle.

The optional air conditioner for all models is designed for the use of non-CFC, R-134a refrigerant. The air conditioning system has an evaporator to cool and dehumidify the incoming air prior to blending it with the heated air. This air conditioning system uses a fixed orifice tube in the liquid line near the condenser outlet tube to meter refrigerant flow to the evaporator coil. To maintain minimum evaporator temperature and prevent evaporator freezing, a fixed pressure setting switch on the accumulator cycles the compressor clutch.

HEATER AND AIR CONDITIONER CONTROL

Both the heater-only and heater-A/C systems use a combination of mechanical, electrical, and vacuum controls. These controls provide the vehicle operator with a number of setting options to help control the climate and comfort within the vehicle. Refer to the owner's manual in the vehicle glove box for more information on the features, use, and suggested operation of these controls.

The heater-only or heater-A/C control panel is located to the right of the instrument cluster on the instrument panel. The control panel contains a rotary-type temperature control knob, a rotary-type mode control switch knob, and a rotary-type blower motor speed switch knob.

The heater-only or heater-A/C control panel cannot be repaired. If faulty or damaged, the entire unit must be replaced. The illumination lamps are available for service replacement.

SERVICE WARNINGS AND PRECAUTIONS

WARNING:

- **THE AIR CONDITIONING SYSTEM CONTAINS REFRIGERANT UNDER HIGH PRESSURE. SEVERE PERSONAL INJURY MAY RESULT FROM IMPROPER SERVICE PROCEDURES. REPAIRS SHOULD ONLY BE PERFORMED BY QUALIFIED SERVICE PERSONNEL.**
- **AVOID BREATHING THE REFRIGERANT AND REFRIGERANT OIL VAPOR OR MIST. EXPOSURE MAY IRRITATE THE EYES, NOSE, AND/OR THROAT. WEAR EYE PROTECTION WHEN SERVICING THE AIR CONDITIONING REFRIGERANT SYSTEM. SERIOUS EYE INJURY CAN RESULT FROM DIRECT CONTACT WITH THE REFRIGERANT. IF EYE CONTACT OCCURS, SEEK MEDICAL ATTENTION IMMEDIATELY.**
- **DO NOT EXPOSE THE REFRIGERANT TO OPEN FLAME. POISONOUS GAS IS CREATED WHEN REFRIGERANT IS BURNED. AN ELECTRONIC LEAK DETECTOR IS RECOMMENDED.**
- **IF ACCIDENTAL SYSTEM DISCHARGE OCCURS, VENTILATE THE WORK AREA BEFORE RESUMING SERVICE. LARGE AMOUNTS OF REFRIGERANT RELEASED IN A CLOSED WORK AREA WILL DISPLACE THE OXYGEN AND CAUSE SUFFOCATION.**
- **THE EVAPORATION RATE OF R-134a REFRIGERANT AT AVERAGE TEMPERATURE AND ALTITUDE IS EXTREMELY HIGH. AS A RESULT, ANYTHING THAT COMES IN CONTACT WITH THE REFRIGERANT WILL FREEZE. ALWAYS PROTECT THE SKIN OR DELICATE OBJECTS FROM DIRECT CONTACT WITH THE REFRIGERANT.**
- **THE R-134a SERVICE EQUIPMENT OR THE VEHICLE REFRIGERANT SYSTEM SHOULD NOT BE PRESSURE TESTED OR LEAK TESTED WITH COMPRESSED AIR. SOME MIXTURES OF AIR AND R-134a HAVE BEEN SHOWN TO BE COMBUSTIBLE AT ELEVATED PRESSURES. THESE MIXTURES ARE POTENTIALLY DANGEROUS, AND MAY RESULT IN FIRE OR EXPLOSION CAUSING INJURY OR PROPERTY DAMAGE.**

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.**
- **Recover the refrigerant before opening any fitting or connection. Open the fittings with caution, even after the system has been discharged. Never open or loosen a connection before recovering the refrigerant.**
- **Do not remove the secondary retention clip from any spring-lock coupler connection while the refrigerant system is under pressure. Recover the refrigerant before removing the secondary retention clip. Open the fittings with caution, even after the system has been discharged. Never open or loosen a connection before recovering the refrigerant.**
- **The refrigerant system must always be evacuated before charging.**
- **Do not open the refrigerant system or uncap a replacement component until you are ready to service the system. This will prevent contamination in the system.**
- **Before disconnecting a component, clean the outside of the fittings thoroughly to prevent contamination from entering the refrigerant system.**
- **Immediately after disconnecting a component from the refrigerant system, seal the open fittings with a cap or plug.**
- **Before connecting an open refrigerant fitting, always install a new seal or gasket. Coat the fitting and seal with clean refrigerant oil before connecting.**
- **Do not remove the sealing caps from a replacement component until it is to be installed.**
- **When installing a refrigerant line, avoid sharp bends that may restrict refrigerant flow. Position the refrigerant lines away from exhaust system components or any sharp edges, which may damage the line.**
- **Tighten refrigerant fittings only to the specified torque. The aluminum fittings used in the refrigerant system will not tolerate overtightening.**
- **When disconnecting a refrigerant fitting, use a wrench on both halves of the fitting. This will prevent twisting of the refrigerant lines or tubes.**
- **Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open a container of refrigerant oil until you are ready to use it. Replace the cap on the oil container immediately after using. Store refrigerant oil only in a clean, airtight, and moisture-free container.**
- **Keep service tools and the work area clean. Contamination of the refrigerant system through careless work habits must be avoided.**

COOLING SYSTEM REQUIREMENTS

To maintain the performance level of the heating-air conditioning system, the engine cooling system must be properly maintained. The use of a bug screen is not recommended. Any obstructions in front of the radiator or condenser will reduce the performance of the air conditioning and engine cooling systems.

The engine cooling system includes the heater core and the heater hoses. Refer to Group 7 - Cooling System for more information before the opening of, or attempting any service to the engine cooling system.

REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS

Kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire system. High pressures are produced in the system when it is operating. Extreme care must be exercised to make sure that all refrigerant system connections are pressure tight.

A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. Sharp bends will reduce the flow of refrigerant. The flexible hose lines should be routed so they are at least 80 millimeters (3 inches) from the exhaust manifold. It is a good practice to inspect all flexible refrigerant system hose lines at least once a year to make sure they are in good condition and properly routed.

There are two types of refrigerant fittings:

- All fittings with O-rings need to be coated with refrigerant oil before installation. Use only O-rings that are the correct size and approved for use with R-134a refrigerant. Failure to do so may result in a leak.
- Unified plumbing connections with gaskets cannot be serviced with O-rings. The gaskets are not reusable and new gaskets do not require lubrication before installing.

Using the proper tools when making a refrigerant plumbing connection is very important. Improper tools or improper use of the tools can damage the refrigerant fittings. Always use two wrenches when loosening or tightening tube fittings. Use one wrench

GENERAL INFORMATION (Continued)

to hold one side of the connection stationary, while loosening or tightening the other side of the connection with a second wrench.

The refrigerant must be recovered completely from the system before opening any fitting or connection. Open the fittings with caution, even after the refrigerant has been recovered. If any pressure is noticed as a fitting is loosened, tighten the fitting and recover the refrigerant from the system again.

Do not discharge refrigerant into the atmosphere. Use an R-134a refrigerant recovery/recycling device that meets SAE Standard J2210.

The refrigerant system will remain chemically stable as long as pure, moisture-free R-134a refrigerant and refrigerant oil is used. Dirt, moisture, or air can upset this chemical stability. Operational troubles or serious damage can occur if foreign material is present in the refrigerant system.

When it is necessary to open the refrigerant system, have everything needed to service the system ready. The refrigerant system should not be left open to the atmosphere any longer than necessary. Cap or plug all lines and fittings as soon as they are opened to prevent the entrance of dirt and moisture. All lines and components in parts stock should be capped or sealed until they are to be installed.

All tools, including the refrigerant recycling equipment, the manifold gauge set, and test hoses should be kept clean and dry. All tools and equipment must be designed for R-134a refrigerant.

DESCRIPTION AND OPERATION

ACCUMULATOR

The accumulator is mounted in the engine compartment between the evaporator coil outlet tube and the compressor inlet. Refrigerant enters the accumulator canister as a low pressure vapor through the inlet tube.

Any liquid, oil-laden refrigerant falls to the bottom of the canister, which acts as a separator. A desiccant bag is mounted inside the accumulator canister to absorb any moisture which may have entered and become trapped within the refrigerant system (Fig. 2).

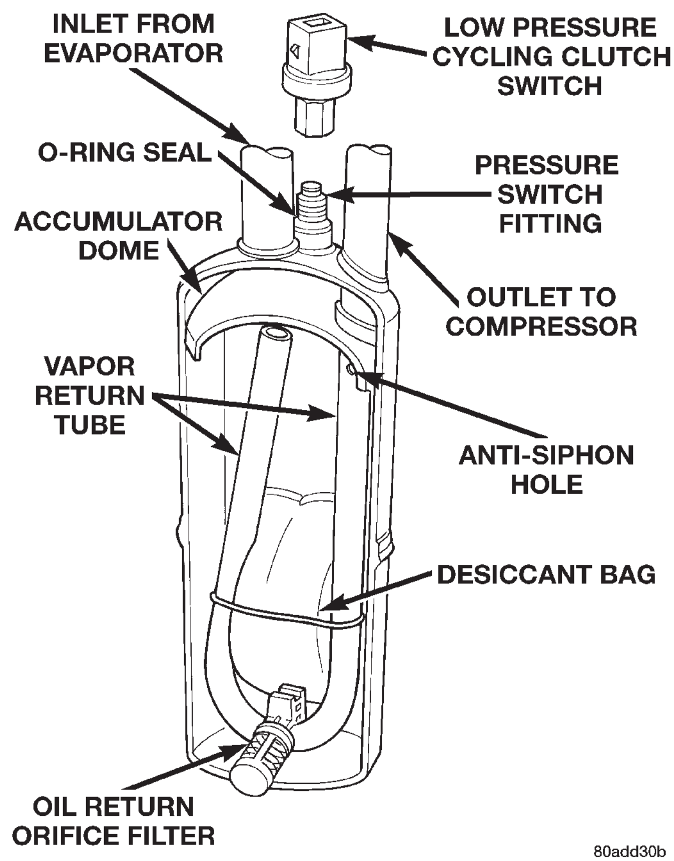


Fig. 2 Accumulator - Typical

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 through an opening in the engine compartment side of the dash panel 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 fused battery feed through the blower motor relay whenever the ignition switch is in the On position. The blower motor battery feed circuit is protected by a fuse in the Power Distribution Center (PDC). Blower motor speed is controlled by regulating the ground path through the heater-A/C control blower motor switch and the blower motor resistor.

The blower motor and blower motor wheel cannot be repaired and, if faulty or damaged, they must be replaced. The blower motor and blower wheel are serviced only as a unit.

BLOWER MOTOR RELAY

The blower motor relay is a International Standards Organization (ISO)-type relay. The relay is a electromechanical device that switches battery current from a fuse in the Power Distribution Center (PDC) directly to the blower motor. The relay is energized when the relay coil is provided a voltage signal by the ignition switch. See Blower Motor Relay in the

DESCRIPTION AND OPERATION (Continued)

Diagnosis and Testing section of this group for more information.

The blower motor relay is installed in a wire harness connector that is secured to the passenger side outboard end of the heater-A/C housing in the passenger compartment, next to the heater-A/C wire harness connector.

The blower motor relay cannot be repaired and, if faulty or damaged, it must be replaced.

BLOWER MOTOR RESISTOR

The blower motor resistor is mounted to the bottom of the heater-A/C housing on the passenger side of the vehicle under the instrument panel. It can be accessed for service by removing the heater-A/C housing 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 ground path through the correct resistor wire to obtain the selected speed. When the highest blower speed is selected, the blower motor switch connects the blower motor directly to ground, bypassing the blower motor resistor.

The blower motor resistor cannot be repaired and, if faulty or damaged, it must be replaced.

BLOWER MOTOR SWITCH

The heater-only or heater-A/C blower motor is controlled by a four position rotary-type blower motor switch, mounted in the heater-A/C control panel. The switch allows the selection of one of four blower motor speeds, but can only be turned off by selecting the Off position with the heater-A/C mode control switch knob.

The blower motor switch directs the blower motor ground path through the mode control switch to the blower motor resistor, or directly to ground, as required to achieve the selected blower motor speed.

The blower motor switch cannot be repaired and, if faulty or damaged, the entire heater-only or heater-A/C control unit must be replaced.

COMPRESSOR

The air conditioning system uses a Sanden SD7H15 seven cylinder, reciprocating wobble plate-type compressor on all models. This compressor has a fixed displacement of 150 cubic centimeters (9.375 cubic inches), and has both the suction and discharge ports located on the cylinder head. A label identifying the use of R-134a refrigerant is located on the compressor.

The compressor is driven by the engine through an electric clutch, drive pulley and belt arrangement. The compressor is lubricated by refrigerant oil that is circulated throughout the refrigerant system with the refrigerant.

The compressor draws in low-pressure refrigerant vapor from the evaporator through its suction port. It then compresses the refrigerant into a high-pressure, high-temperature refrigerant vapor, which is then pumped to the condenser through the compressor discharge port.

The compressor cannot be repaired. If faulty or damaged, the entire compressor assembly must be replaced. The compressor clutch, pulley and clutch coil are available for service.

COMPRESSOR CLUTCH

The compressor clutch assembly consists of a stationary electromagnetic coil, a hub bearing and pulley assembly, and a clutch plate (Fig. 3). The electromagnetic coil unit and the hub bearing and pulley assembly are each retained on the nose of the compressor front housing with snap rings. The clutch plate is keyed to the compressor shaft and secured with a nut.

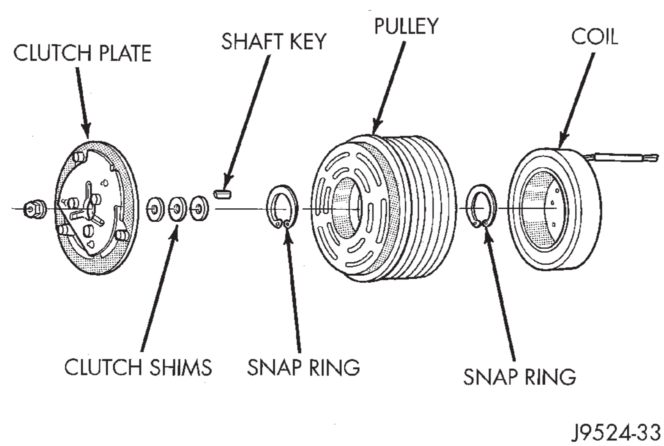


Fig. 3 Compressor Clutch

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 engagement is controlled by several components: the heater-A/C mode control switch, the low pressure cycling clutch switch, the high pressure cut-off switch, the compressor clutch relay, and the Powertrain Control Module (PCM). The PCM may delay compressor clutch engagement for up to thirty seconds. Refer to Group 14 - Fuel System for more information on the PCM controls.

DESCRIPTION AND OPERATION (Continued)

COMPRESSOR CLUTCH RELAY

The compressor clutch relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (footprint) is different, the current capacity is lower, and the relay case dimensions are smaller than those of the conventional ISO relay.

The compressor clutch relay is a electromechanical device that switches battery current to the compressor clutch coil when the Powertrain Control Module (PCM) grounds the coil side of the relay. The PCM responds to inputs from the heater-A/C mode control switch, the low pressure cycling clutch switch, and the high pressure cut-off switch. See Compressor Clutch Relay in the Diagnosis and Testing section of this group for more information.

The compressor clutch relay is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for relay identification and location.

The compressor clutch relay cannot be repaired and, if faulty or damaged, it must be replaced.

CONDENSER

The condenser is located in the air flow in front of the engine cooling radiator. The condenser is a heat exchanger that allows the high-pressure refrigerant gas being discharged by the compressor to give up its heat to the air passing over the condenser fins. When the refrigerant gas gives up its heat, it condenses. When the refrigerant leaves the condenser, it has become a high-pressure liquid refrigerant.

The volume of air flowing over the condenser fins is critical to the proper cooling performance of the air conditioning system. Therefore, it is important that there are no objects placed in front of the radiator grille openings in the front of the vehicle or foreign material on the condenser fins that might obstruct proper air flow. Also, any factory-installed air seals or shrouds must be properly reinstalled following radiator or condenser service.

The condenser cannot be repaired and, if faulty or damaged, it must be replaced.

EVAPORATOR COIL

The evaporator coil is located in the heater-A/C housing, under the instrument panel. The evaporator coil is positioned in the heater-A/C housing so that all air that enters the housing must pass over the fins of the evaporator before it is distributed through the system ducts and outlets. However, air passing over the evaporator coil fins will only be conditioned when the compressor is engaged and circulating refrigerant through the evaporator coil tubes.

Refrigerant enters the evaporator from the fixed orifice tube as a low-temperature, low-pressure liquid. As air flows over the fins of the evaporator, the humidity in the air condenses on the fins, and the heat from the air is absorbed by the refrigerant. Heat absorption causes the refrigerant to boil and vaporize. The refrigerant becomes a low-pressure gas when it leaves the evaporator.

The evaporator coil cannot be repaired and, if faulty or damaged, it must be replaced.

FIXED ORIFICE TUBE

The fixed orifice tube is installed in the liquid line (left-hand drive) or liquid line jumper (right-hand drive) between the outlet of the condenser and the inlet of the evaporator. The fixed orifice tube is located in the end of the liquid line or liquid line jumper that is closest to the condenser outlet tube.

The inlet end of the fixed orifice tube has a nylon mesh filter screen, which filters the refrigerant and helps to reduce the potential for blockage of the metering orifice by refrigerant system contaminants (Fig. 4). The outlet end of the tube has a nylon mesh diffuser screen. The O-rings on the plastic body of the fixed orifice tube seal the tube to the inside of the liquid line and prevent the refrigerant from bypassing the fixed metering orifice.

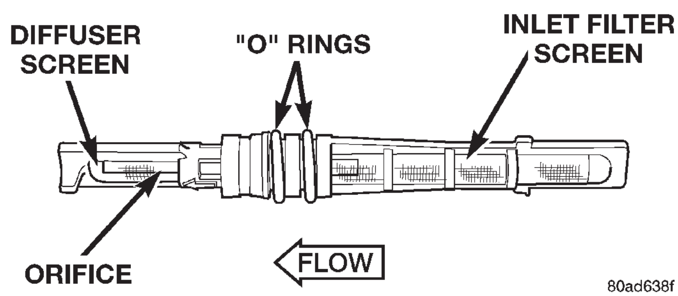


Fig. 4 Fixed Orifice Tube - Typical

The fixed orifice tube is used to meter the flow of liquid refrigerant into the evaporator coil. The high-pressure liquid refrigerant from the condenser expands into a low-pressure liquid as it passes through the metering orifice and diffuser screen of the fixed orifice tube.

The fixed orifice tube cannot be repaired and, if faulty or plugged, the liquid line and fixed orifice tube unit or liquid line jumper and fixed orifice tube unit must be replaced.

HEATER CORE

The heater core is located in the heater-A/C housing, under the instrument panel. It is a heat exchanger made of rows of tubes and fins. Engine coolant is circulated through heater hoses to the heater core at all times. As the coolant flows through the heater core, heat removed from the engine is transferred to the heater core fins and tubes.

Air directed through the heater core picks up the heat from the heater core fins. The blend air door allows control of the heater output air temperature by controlling how much of the air flowing through the heater-A/C housing is directed through the heater core. The blower motor speed controls the volume of air flowing through the heater-A/C housing.

The heater core cannot be repaired and, if faulty or damaged, it must be replaced. Refer to Group 7 - Cooling System for more information on the engine cooling system, the engine coolant and the heater hoses.

HIGH PRESSURE CUT-OFF SWITCH

The high pressure cut-off switch is located on the discharge line between the compressor and the condenser inlet. The switch is screwed onto a fitting that contains a Schrader-type valve, which allows the switch to be serviced without discharging the refrigerant system. The discharge line fitting is equipped with an O-ring to seal the switch connection.

The high pressure cut-off switch is connected in series electrically with the low pressure cycling clutch switch between ground and the Powertrain Control Module (PCM). The switch contacts open and close causing the PCM to turn the compressor clutch on and off. This prevents compressor operation when the discharge line pressure approaches high levels.

The high pressure cut-off switch contacts are open when the discharge line pressure rises above 3100 to 3375 kPa (450 to 490 psi). The switch contacts will close when the discharge line pressure drops to 1860 to 2275 kPa (270 to 330 psi).

The high pressure cut-off switch is a factory-calibrated unit. The switch cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

HIGH PRESSURE RELIEF VALVE

A high pressure relief valve is located on the compressor cylinder head, which is at the rear of the compressor. This mechanical valve is designed to vent refrigerant from the system to protect against damage to the compressor and other system components, caused by condenser air flow restriction or an overcharge of refrigerant.

The high pressure relief valve vents the system when a discharge pressure of 3445 to 4135 kPa (500 to 600 psi) or above is reached. The valve closes when a minimum discharge pressure of 2756 kPa (400 psi) is reached.

The high pressure relief valve vents only enough refrigerant to reduce the system pressure, and then re-seats itself. The majority of the refrigerant is conserved in the system. If the valve vents refrigerant, it does not mean that the valve is faulty.

The high pressure relief valve is a factory-calibrated unit. The valve cannot be adjusted or repaired, and must not be removed or otherwise disturbed. The valve is only serviced as a part of the compressor assembly.

LOW PRESSURE CYCLING CLUTCH SWITCH

The low pressure cycling clutch switch is located on the top of the accumulator. The switch is screwed onto an accumulator fitting that contains a Schrader-type valve, which allows the switch to be serviced without discharging the refrigerant system. The accumulator fitting is equipped with an O-ring to seal the switch connection.

The low pressure cycling clutch switch is connected in series electrically with the high pressure cut-off switch, between ground and the Powertrain Control Module (PCM). The switch contacts open and close causing the PCM to turn the compressor clutch on and off. This regulates the refrigerant system pressure and controls evaporator temperature. Controlling the 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 to 262 kPa (34 to 38 psi) or above. Lower ambient temperatures, below approximately -1° C (30° F), will also cause the switch contacts to open. This is due to the pressure/temperature relationship of the refrigerant in the system.

The low pressure cycling clutch switch is a factory-calibrated unit. It cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

REFRIGERANT

The refrigerant used in this air conditioning system is a HydroFluoroCarbon (HFC), type R-134a. Unlike R-12, which is a ChloroFluoroCarbon (CFC), R-134a refrigerant does not contain ozone-depleting chlorine. R-134a refrigerant is a non-toxic, non-flammable, clear, and colorless liquefied gas.

Even though R-134a does not contain chlorine, it must be reclaimed and recycled just like CFC-type refrigerants. This is because R-134a is a greenhouse gas and can contribute to global warming.

R-134a refrigerant is not compatible with R-12 refrigerant in an air conditioning system. Even a small amount of R-12 added to an R-134a refrigerant system will cause compressor failure, refrigerant oil sludge or poor air conditioning system performance. In addition, the PolyAlkylene Glycol (PAG) synthetic

DESCRIPTION AND OPERATION (Continued)

refrigerant oils used in an R-134a refrigerant system are not compatible with the mineral-based refrigerant oils used in an R-12 refrigerant system.

R-134a refrigerant system service ports, service tool couplers and refrigerant dispensing bottles have all been designed with unique fittings to ensure that an R-134a system is not accidentally contaminated with the wrong refrigerant (R-12). There are also labels posted in the engine compartment of the vehicle and on the compressor identifying to service technicians that the air conditioning system is equipped with R-134a.

REFRIGERANT LINE

The refrigerant lines and hoses are used to carry the refrigerant between the various air conditioning system components. A barrier hose design with a nylon tube inner hose liner is used for the R-134a air conditioning system on this vehicle. This nylon liner helps to further contain the R-134a refrigerant, which has a smaller molecular structure than R-12 refrigerant. The ends of the refrigerant hoses are made from lightweight aluminum or steel, and use braze-less fittings.

Any kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire air conditioning system. Kinks and sharp bends reduce the flow of refrigerant in the system. A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. In addition, the flexible hose refrigerant lines should be routed so they are at least 80 millimeters (3 inches) from the exhaust manifold.

High pressures are produced in the refrigerant system when the air conditioning compressor is operating. Extreme care must be exercised to make sure that each of the refrigerant system connections is pressure-tight and leak free. It is a good practice to inspect all flexible hose refrigerant lines at least once a year to make sure they are in good condition and properly routed.

The refrigerant lines and hoses are coupled with other components of the HVAC system with peanut-block style fittings. A status seal type flat steel gasket with a captured compressible O-ring, is used to mate plumbing lines with A/C components to ensure the integrity of the refrigerant system.

The refrigerant lines and hoses cannot be repaired and, if faulty or damaged, they must be replaced.

REFRIGERANT LINE COUPLER

Spring-lock type refrigerant line couplers are used to connect many of the refrigerant lines and other components to the refrigerant system. These couplers require a special tool for disengaging the two coupler halves.

The spring-lock coupler is held together by a garter spring inside a circular cage on the male half of the fitting (Fig. 5). When the two coupler halves are connected, the flared end of the female fitting slips behind the garter spring inside the cage on the male fitting. The garter spring and cage prevent the flared end of the female fitting from pulling out of the cage.

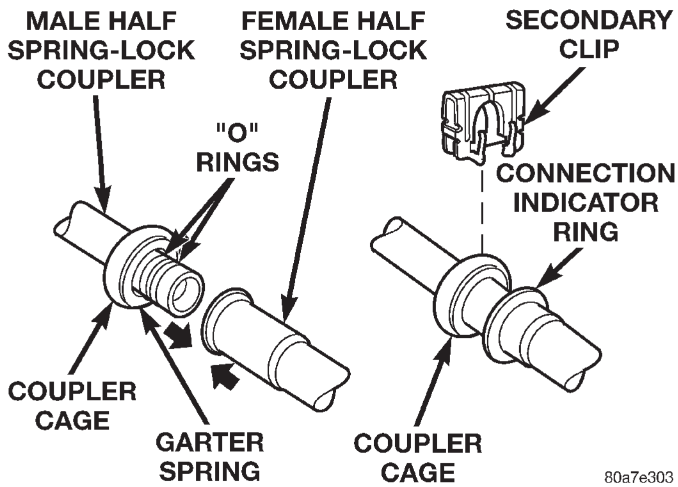


Fig. 5 Spring-Lock Coupler - Typical

Two O-rings on the male half of the fitting are used to seal the connection. These O-rings are compatible with R-134a refrigerant and must be replaced with O-rings made of the same material.

Secondary clips are installed over the two connected coupler halves at the factory for added blowoff protection. In addition, some models have a plastic ring that is used at the factory as a visual indicator to confirm that these couplers are connected. After the coupler is connected, the plastic indicator ring is no longer needed; however, it will remain on the refrigerant line near the coupler cage.

REFRIGERANT OIL

The refrigerant oil used in R-134a refrigerant systems is a synthetic-based, PolyAlkylene Glycol (PAG), wax-free lubricant. Mineral-based R-12 refrigerant oils are not compatible with PAG oils, and should never be introduced to an R-134a refrigerant system.

There are different PAG oils available, and each contains a different additive package. The SD7H15 compressor used in this vehicle is designed to use an SP-20 PAG refrigerant oil. Use only refrigerant oil of this same type to service the refrigerant system.

After performing any refrigerant recovery or recycling operation, always replenish the refrigerant system with the same amount of the recommended refrigerant oil as was removed. Too little refrigerant oil can cause compressor damage, and too much can reduce air conditioning system performance.

PAG refrigerant oil is much more hygroscopic than mineral oil, and will absorb any moisture it comes

DESCRIPTION AND OPERATION (Continued)

into contact with, even moisture in the air. The PAG oil container should always be kept tightly capped until it is ready to be used. After use, recap the oil container immediately to prevent moisture contamination.

REFRIGERANT SYSTEM SERVICE EQUIPMENT

WARNING: EYE PROTECTION MUST BE WORN WHEN SERVICING AN AIR CONDITIONING REFRIGERANT SYSTEM. TURN OFF (ROTATE CLOCKWISE) ALL VALVES ON THE EQUIPMENT BEING USED, BEFORE CONNECTING TO OR DISCONNECTING FROM THE REFRIGERANT SYSTEM. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY.

When servicing the air conditioning system, a R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used. Contact an automotive service equipment supplier for refrigerant recovery/recycling/charging equipment. Refer to the operating instructions supplied by the equipment manufacturer for proper care and use of this equipment.

A manifold gauge set may be needed with some recovery/recycling/charging equipment (Fig. 6). 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.

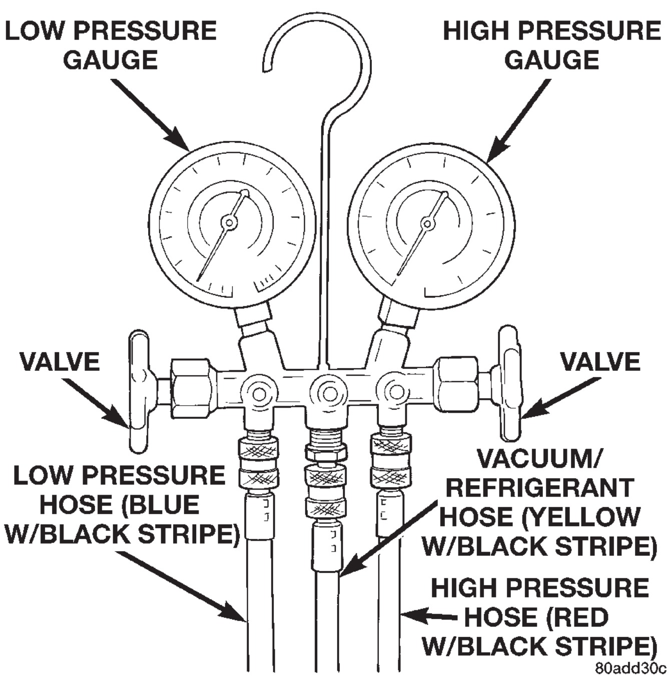


Fig. 6 Manifold Gauge Set - Typical

MANIFOLD GAUGE SET CONNECTIONS

CAUTION: Do not use an R-12 manifold gauge set on an R-134a system. The refrigerants are not compatible and system damage will result.

LOW PRESSURE GAUGE HOSE

The low pressure hose (Blue with Black stripe) attaches to the suction service port. This port is located on the suction line between the accumulator outlet and compressor.

HIGH PRESSURE GAUGE HOSE

The high pressure hose (Red with Black stripe) attaches to the discharge service port. This port is located on the discharge line between the compressor and the condenser inlet.

RECOVERY RECYCLING/EVACUATION/CHARGING HOSE

The center manifold hose (Yellow, or White, with Black stripe) is used to recover, evacuate, and charge the refrigerant system. When the low or high pressure valves on the manifold gauge set are opened, the refrigerant in the system will escape through this hose.

REFRIGERANT SYSTEM SERVICE PORT

The two refrigerant system service ports are used to charge, recover/recycle, evacuate, and test the air conditioning refrigerant system. Unique service port coupler sizes are used on the R-134a system, to ensure that the refrigerant system is not accidentally contaminated by the use of the wrong refrigerant (R-12), or refrigerant system service equipment.

The high pressure service port is located on the discharge line, between the compressor and the condenser inlet. The low pressure service port is located on the suction line, between the accumulator outlet and the compressor.

Each of the service ports has a threaded plastic protective cap installed over it from the factory. After servicing the refrigerant system, always reinstall both of the service port caps.

VACUUM CHECK VALVE

A vacuum check valve is installed in the accessory vacuum supply line in the engine compartment, near the vacuum tap on the engine intake manifold. The vacuum check valve is designed to allow vacuum to flow in only one direction through the accessory vacuum supply circuits.

The use of a vacuum check valve helps to maintain the system vacuum needed to retain the selected heater-A/C mode settings. The check valve will pre-

DESCRIPTION AND OPERATION (Continued)

vent the engine from bleeding down system vacuum through the intake manifold during extended heavy engine load (low engine vacuum) operation.

The vacuum check valve cannot be repaired and, if faulty or damaged, it must be replaced.

VACUUM RESERVOIR

The vacuum reservoir is mounted to the front bumper bar behind the passenger side bumper end cap. The bumper end cap must be removed from the vehicle to access the vacuum reservoir for service.

Engine vacuum is stored in the vacuum reservoir. The stored vacuum is used to operate the vacuum-controlled vehicle accessories during periods of low engine vacuum such as when the vehicle is climbing a steep grade, or under other high engine load operating conditions.

The vacuum reservoir cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING

A/C PERFORMANCE

The air conditioning system is designed to provide the passenger compartment with low temperature and low humidity air. The evaporator, located in the heater-A/C housing on the dash panel below the instrument panel, is cooled to temperatures near the freezing point. As warm damp air passes through the cooled evaporator, the air transfers its heat to the refrigerant in the evaporator and the moisture in the air condenses on the evaporator fins. During periods of high heat and humidity, an air conditioning system will be more effective in the Recirculation Mode. With the system in the Recirculation Mode, only air from the passenger compartment passes through the evaporator. As the passenger compartment air dehumidifies, the air conditioning system performance levels improve.

Humidity has an important bearing on the temperature of the air delivered to the interior of the vehicle. It is important to understand the effect that humidity has on the performance of the air conditioning system. When humidity is high, the evaporator has to perform a double duty. It must lower the air temperature, and it must lower the temperature of the moisture in the air that condenses on the evaporator fins. Condensing the moisture in the air transfers heat energy into the evaporator fins and tubing. This reduces the amount of heat the evaporator can absorb from the air. High humidity greatly reduces the ability of the evaporator to lower the temperature of the air.

However, evaporator capacity used to reduce the amount of moisture in the air is not wasted. 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 side center A/C (panel) outlet. Operate the engine for five minutes.

(6) The compressor clutch may cycle, depending upon the ambient temperature and humidity. If the clutch cycles, unplug the low pressure cycling clutch switch wire harness connector from the switch located on the accumulator (Fig. 7). Place a jumper wire across the terminals of the low pressure cycling clutch switch wire harness connector.

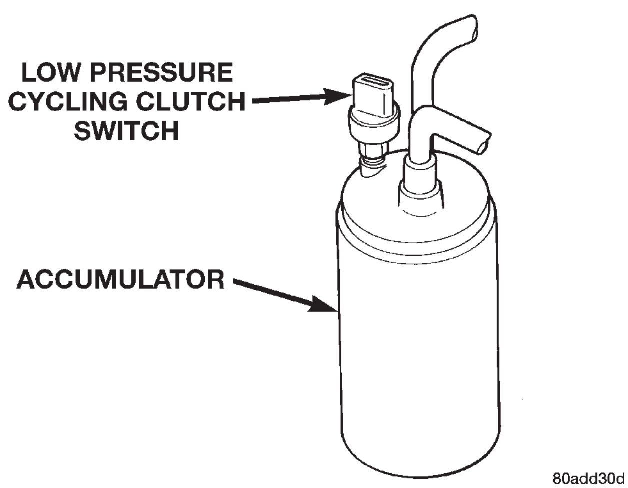


Fig. 7 Low Pressure Cycling Clutch Switch - Typical

(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.

DIAGNOSIS AND TESTING (Continued)

Performance Temperature and Pressure					
Ambient Air Temperature	21° C (70° F)	27° C (80° F)	32° C (90° F)	38° C (100° F)	43° C (110° F)
Air Temperature at Center Panel Outlet	-3 to 3° C (27 to 38° F)	1 to 7° C (33 to 44° F)	3 to 9° C (37 to 48° F)	6 to 13° C (43 to 55° F)	10 to 18° C (50 to 64° F)
Evaporator Inlet Pressure at Charge Port	179 to 241 kPa (26 to 35 psi)	221 to 283 kPa (32 to 41 psi)	262 to 324 kPa (38 to 47 psi)	303 to 365 kPa (44 to 53 psi)	345 to 414 kPa (50 to 60 psi)
Compressor Discharge Pressure	1240 to 1655 kPa (180 to 240 psi)	1380 to 1790 kPa (200 to 260 psi)	1720 to 2070 kPa (250 to 300 psi)	1860 to 2345 kPa (270 to 340 psi)	2070 to 2690 kPa (300 to 390 psi)

(9) Compare the compressor discharge pressure to the Performance Temperature and Pressure chart. If the compressor discharge pressure is high, see the Pressure Diagnosis chart.

Pressure Diagnosis		
Condition	Possible Causes	Correction
Rapid compressor clutch cycling (ten or more cycles per minute).	1. Low refrigerant system charge.	1. See Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required.
Equal pressures, but the compressor clutch does not engage.	1. No refrigerant in the refrigerant system. 2. Faulty fuse. 3. Faulty compressor clutch coil. 4. Faulty compressor clutch relay. 5. Improperly installed or faulty low pressure cycling clutch switch. 6. Faulty high pressure cut-off switch. 7. Faulty Powertrain Control Module (PCM).	1. See Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required. 2. Check the fuses in the Power Distribution Center and the junction block. Repair the shorted circuit or component and replace the fuses, if required. 3. See Compressor Clutch Coil in this group. Test the compressor clutch coil and replace, if required. 4. See Compressor Clutch Relay in this group. Test the compressor clutch relay and relay circuits. Repair the circuits or replace the relay, if required. 5. See Low Pressure Cycling Clutch Switch in this group. Test the low pressure cycling clutch switch and tighten or replace, if required. 6. See High Pressure Cut-Off Switch in this group. Test the high pressure cut-off switch and replace, if required. 7. Refer to the proper Diagnostic Procedures manual for testing of the PCM. Test the PCM and replace, if required.

DIAGNOSIS AND TESTING (Continued)

Pressure Diagnosis		
Condition	Possible Causes	Correction
Normal pressures, but A/C Performance Test air temperatures at center panel outlet are too high.	1. Excessive refrigerant oil in system. 2. Temperature control cable improperly installed or faulty. 3. Blend-air door inoperative or sealing improperly.	1. See Refrigerant Oil Level in this group. Recover the refrigerant from the refrigerant system and inspect the refrigerant oil content. Restore the refrigerant oil to the proper level, if required. 2. See Temperature Control Cable in this group. Inspect the temperature control cable for proper routing and operation and correct, if required. 3. See Blend-Air Door under Heater-A/C Housing Door in this group. Inspect the blend-air door for proper operation and sealing and correct, if required.
The low side pressure is normal or slightly low, and the high side pressure is too low.	1. Low refrigerant system charge. 2. Refrigerant flow through the accumulator is restricted. 3. Refrigerant flow through the evaporator coil is restricted. 4. Faulty compressor.	1. See Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required. 2. See Accumulator in this group. Replace the restricted accumulator, if required. 3. See Evaporator Coil in this group. Replace the restricted evaporator coil, if required. 4. See Compressor in this group. Replace the compressor, if required.
The low side pressure is normal or slightly high, and the high side pressure is too high.	1. Condenser air flow restricted. 2. Inoperative cooling fan. 3. Refrigerant system overcharged. 4. Air in the refrigerant system. 5. Engine overheating.	1. Check the condenser for damaged fins, foreign objects obstructing air flow through the condenser fins, and missing or improperly installed air seals. Refer to Group 7 - Cooling System for more information on air seals. Clean, repair, or replace components as required. 2. Refer to Group 7 - Cooling System for more information. Test the cooling fan and replace, if required. 3. See Refrigerant System Charge in this group. Recover the refrigerant from the refrigerant system. Charge the refrigerant system to the proper level, if required. 4. See Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required. 5. Refer to Group 7 - Cooling System for more information. Test the cooling system and repair, if required.
The low side pressure is too high, and the high side pressure is too low.	1. Accessory drive belt slipping. 2. Fixed orifice tube not installed. 3. Faulty compressor.	1. Refer to Group 7 - Cooling System for more information. Inspect the accessory drive belt condition and tension. Tighten or replace the accessory drive belt, if required. 2. See Fixed Orifice Tube in this group. Install the missing fixed orifice tube, if required. 3. See Compressor in this group. Replace the compressor, if required.

DIAGNOSIS AND TESTING (Continued)

Pressure Diagnosis		
Condition	Possible Causes	Correction
The low side pressure is too low, and the high side pressure is too high.	1. Restricted refrigerant flow through the refrigerant lines. 2. Restricted refrigerant flow through the fixed orifice tube. 3. Restricted refrigerant flow through the condenser.	1. See Liquid Line and Suction and Discharge Line in this group. Inspect the refrigerant lines for kinks, tight bends or improper routing. Correct the routing or replace the refrigerant line, if required. 2. See Fixed Orifice Tube in this group. Replace the restricted fixed orifice tube, if required. 3. See Condenser in this group. Replace the restricted condenser, if required.

BLOWER MOTOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams. Possible causes of an inoperative blower motor include:

- Faulty fuse
- Faulty blower motor circuit wiring or wire harness connectors
- Faulty blower motor resistor
- Faulty blower motor relay
- Faulty blower motor switch
- Faulty heater-A/C mode control switch
- Faulty blower motor.

Possible causes of the blower motor not operating in all speeds include:

- Faulty fuse
- Faulty blower motor switch
- Faulty blower motor resistor
- Faulty blower motor circuit wiring or wire harness connectors.

VIBRATION

Possible causes of blower motor vibration include:

- Improper blower motor mounting
- Improper blower wheel mounting
- Blower wheel out of balance or bent
- Blower motor faulty.

NOISE

To verify that the blower is the source of the noise, unplug the blower motor wire harness connector and operate the heater-A/C system. If the noise goes away, possible causes include:

- Foreign material in the heater-A/C housing
- Improper blower motor mounting
- Improper blower wheel mounting
- Blower motor faulty.

BLOWER MOTOR RELAY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

RELAY TEST

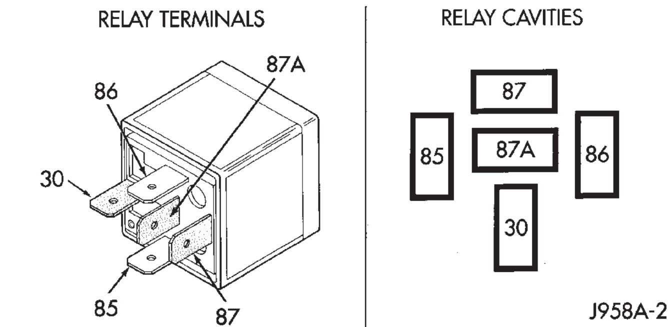
The blower motor relay (Fig. 8) is located in a wire harness connector that is secured to the heater-A/C housing behind the glove box on the passenger side of the vehicle, next to the heater-A/C wire harness connector in the passenger compartment. Remove the relay from its connector to perform the following 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.

DIAGNOSIS AND TESTING (Continued)

(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 procedure 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

Fig. 8 Blower Motor Relay

RELAY CIRCUIT TEST

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) The relay common feed terminal cavity (30) is connected to fused battery feed directly from a fuse in the Power Distribution Center (PDC), and should be hot at all times. Check for battery voltage at the connector cavity for relay terminal 30. If OK, go to Step 2. If not OK, repair the open circuit to the PDC fuse as required.

(2) The relay normally closed terminal cavity (87A) is not used for this application. Go to Step 3.

(3) The relay normally open terminal cavity (87) is connected to the blower motor. When the relay is energized, terminal 87 is connected to terminal 30 and provides full battery current to the blower motor feed circuit. There should be continuity between the connector cavity for terminal 87 and the blower motor relay output circuit cavity of the blower motor wire harness connector at all times. If OK, go to Step 4. If not OK, repair the open circuit to the blower motor as required.

(4) The coil battery terminal cavity (86) is connected to the ignition switch. When the ignition switch is placed in the On position, fused ignition switch output is directed from a fuse in the junction block to the relay electromagnetic coil to energize the relay. There should be battery voltage at the connector cavity for relay terminal 86 with the ignition switch in the On position. If OK, go to Step 5. If not OK, repair the open circuit to the junction block fuse as required.

(5) The coil ground terminal cavity (85) is connected to ground. This terminal supplies the ground for the relay electromagnet coil. There should be continuity between the connector cavity for relay terminal 85 and a good ground at all times. If not OK, repair the open circuit as required.

BLOWER MOTOR RESISTOR

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the kick cover from the heater-A/C housing and unplug the wire harness connector from the blower motor resistor.

(3) Check for continuity between each of the blower motor switch input terminals of the resistor and the resistor output terminal. In each case there should be continuity. If OK, repair the wire harness circuits between the blower motor switch and the blower motor resistor or blower motor relay as required. If not OK, replace the faulty blower motor resistor.

BLOWER MOTOR SWITCH

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check for battery voltage at the fuse in the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the heater-A/C control from the instrument panel. Check for continuity between the ground cir-

DIAGNOSIS AND TESTING (Continued)

cuit cavity of the heater-A/C control wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit to ground as required.

(3) With the heater-A/C control wire harness connector unplugged, place the heater-A/C mode control switch knob in any position except the Off position. Check for continuity between the ground circuit terminal and each of the blower motor driver circuit terminals of the heater-A/C control as you move the blower motor switch knob to each of the four speed positions. There should be continuity at each driver circuit terminal in only one blower motor switch speed position. If OK, test and repair the blower driver circuits between the heater-A/C control connector and the blower motor resistor as required. If not OK, replace the faulty heater-A/C control unit.

COMPRESSOR

When investigating an air conditioning related noise, you must first know the conditions under which the noise occurs. These conditions include: weather, vehicle speed, transmission in gear or neutral, engine speed, engine temperature, and any other special conditions. Noises that develop during air conditioning operation can often be misleading. For example: What sounds like a failed front bearing or connecting rod, may be caused by loose bolts, nuts, mounting brackets, or a loose compressor clutch assembly.

Drive belts are speed sensitive. At different engine speeds and depending upon belt tension, belts can develop noises that are mistaken for a compressor noise. Improper belt tension can cause a misleading noise when the compressor clutch is engaged, which may not occur when the compressor clutch is disengaged. Check the serpentine drive belt condition and tension as described in Group 7 - Cooling System before beginning this procedure.

(1) Select a quiet area for testing. Duplicate the complaint conditions as much as possible. Switch the compressor on and off several times to clearly identify the compressor noise. Listen to the compressor while the clutch is engaged and disengaged. Probe the compressor with an engine stethoscope or a long screwdriver with the handle held to your ear to better localize the source of the noise.

(2) Loosen all of the compressor mounting hardware and retighten. Tighten the compressor clutch mounting nut. Be certain that the clutch coil is mounted securely to the compressor, and that the clutch plate and pulley are properly aligned and have the correct air gap. See Compressor and Compressor Clutch in the Removal and Installation section of this group for the procedures.

(3) To duplicate a high-ambient temperature condition (high head pressure), restrict the air flow through the condenser. Install a manifold gauge set to be certain that the discharge pressure does not exceed 2760 kPa (400 psi).

(4) Check the refrigerant system plumbing for incorrect routing, rubbing or interference, which can cause unusual noises. Also check the refrigerant lines for kinks or sharp bends that will restrict refrigerant flow, which can cause noises. See Suction and Discharge Line in the Removal and Installation section of this group for more information.

(5) If the noise is from opening and closing of the high pressure relief valve, evacuate and recharge the refrigerant system. See Refrigerant System Evacuate and Refrigerant System Charge in the Service Procedures section of this group. If the high pressure relief valve still does not seat properly, replace the compressor.

(6) If the noise is from liquid slugging on the suction line, replace the accumulator. See Accumulator in the Removal and Installation section of this group for the procedures. Check the refrigerant oil level and the refrigerant system charge. See Refrigerant Oil Level and Refrigerant System Charge in the Service Procedures section of this group. If the liquid slugging condition continues following accumulator replacement, replace the compressor.

(7) If the noise continues, replace the compressor and repeat Step 1.

COMPRESSOR CLUTCH COIL

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams. The battery must be fully-charged before performing the following tests. Refer to Group 8A - Battery for more information.

(1) Connect an ammeter (0 to 10 ampere scale) in series with the clutch coil terminal. Use a voltmeter (0 to 20 volt scale) with clip-type leads for measuring the voltage across the battery and the compressor clutch coil.

(2) With the heater-A/C mode control switch in any A/C mode, and the blower motor switch in the lowest speed position, start the engine and run it at normal idle.

(3) The compressor clutch coil voltage should read within two volts of the battery voltage. If there is voltage at the clutch coil, but the reading is not within two volts of the battery voltage, test the clutch coil feed circuit for excessive voltage drop and repair as required. If there is no voltage reading at the clutch coil, use a DRB scan tool and the proper Diagnostic Procedures manual for testing of the compressor clutch circuit. The following components must be checked and repaired as required before you can complete testing of the clutch coil:

- Fuses in the junction block and the Power Distribution Center (PDC)

DIAGNOSIS AND TESTING (Continued)

- Heater-A/C mode control switch
- Compressor clutch relay
- High pressure cut-off switch
- Low pressure cycling clutch switch
- Powertrain Control Module (PCM).

(4) The compressor clutch coil is acceptable if the current draw measured at the clutch coil is 2.0 to 3.9 amperes with the electrical system voltage at 11.5 to 12.5 volts. This should only be checked with the work area temperature at 21° C (70° F). If system voltage is more than 12.5 volts, add electrical loads by turning on electrical accessories until the system voltage drops below 12.5 volts.

(a) If the clutch coil current reading is four amperes or more, the coil is shorted and should be replaced.

(b) If the clutch coil current reading is zero, the coil is open and should be replaced.

COMPRESSOR CLUTCH RELAY

RELAY TEST

The compressor clutch relay (Fig. 9) is located in the Power Distribution Center (PDC). Refer to the PDC label for relay identification and location. Remove the relay from the PDC to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see Relay Circuit Test in the Diagnosis and Testing section of this group. If not OK, replace the faulty relay.

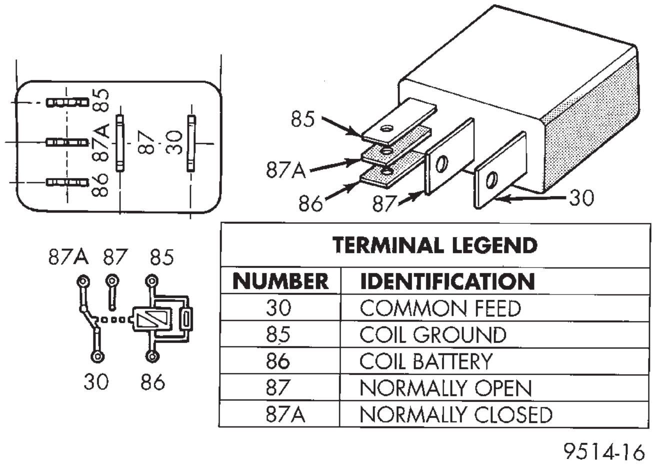
RELAY CIRCUIT TEST

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) The relay common feed terminal cavity (30) is connected to fused battery feed. There should be battery voltage at the cavity for relay terminal 30 at all times. If OK, go to Step 2. If not OK, repair the open circuit to the fuse in the PDC as required.

(2) The relay normally closed terminal (87A) is not used in this application. Go to Step 3.

(3) The relay normally open terminal cavity (87) is connected to the compressor clutch coil. There should be continuity between this cavity and the A/C compressor clutch relay output circuit cavity of the compressor clutch coil wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit as required.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 9 Compressor Clutch Relay

(4) The relay coil battery terminal (86) is connected to the fused ignition switch output (run/start) circuit. There should be battery voltage at the cavity for relay terminal 86 with the ignition switch in the On position. If OK, go to Step 5. If not OK, repair the open circuit to the fuse in the junction block as required.

(5) The coil ground terminal cavity (85) is switched to ground through the Powertrain Control Module (PCM). There should be continuity between this cavity and the A/C compressor clutch relay control circuit cavity of the PCM wire harness connector C (gray) at all times. If not OK, repair the open circuit as required.

HEATER PERFORMANCE

Before performing the following tests, refer to Group 7 - Cooling System for the procedures to check the radiator coolant level, serpentine drive belt tension, radiator air flow and the radiator fan operation. Also be certain that the accessory vacuum supply line is connected at the engine intake manifold.

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 heat position, and the blower motor switch knob in the highest speed position. Using a test thermometer, check the temperature of the air being discharged at the heater-A/C housing floor outlets. Compare the test thermometer reading to the Temperature Reference chart.

DIAGNOSIS AND TESTING (Continued)

Temperature Reference				
Ambient Air Temperature	15.5° C (60° F)	21.1° C (70° F)	26.6° C (80° F)	32.2° C (90° F)
Minimum Air Temperature at Floor Outlet	62.2° C (144° F)	63.8° C (147° F)	65.5° C (150° F)	67.2° C (153° F)

If the floor outlet air temperature is too low, refer to Group 7 - Cooling System to check the engine coolant temperature specifications. Both of the heater hoses should be hot to the touch. The coolant return heater hose should be slightly cooler than the coolant supply heater hose. If the return hose is much cooler than the supply hose, locate and repair the engine coolant flow obstruction in the cooling system. Refer to Group 7 - Cooling System for the procedures.

OBSTRUCTED COOLANT FLOW

Possible locations or causes of obstructed coolant flow:

- Pinched or kinked heater hoses.
- Improper heater hose routing.
- Plugged heater hoses or supply and return ports at the cooling system connections.
- A plugged heater core.

If proper coolant flow through the cooling system is verified, and heater outlet air temperature is still low, a mechanical problem may exist.

MECHANICAL PROBLEMS

Possible locations or causes of insufficient heat:

- An obstructed cowl air intake.
- Obstructed heater system outlets.
- A blend-air door not functioning properly.

TEMPERATURE CONTROL

If the heater outlet air temperature cannot be adjusted with the temperature control knob on the heater-A/C control panel, the following could require service:

- The heater-A/C control.
- The temperature control motor.
- The blend-air door.
- Improper engine coolant temperature.

HIGH PRESSURE CUT-OFF SWITCH

Before performing diagnosis of the high pressure cut-off switch, verify that the refrigerant system has the correct refrigerant charge. See Refrigerant System Charge in the Service Procedures section of this group for more information.

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the high pressure cut-off switch wire harness connector from the switch on the refrigerant system fitting.

(3) Check for continuity between the two terminals of the high pressure cut-off switch. There should be continuity. If OK, test and repair the A/C switch sense circuit as required. If not OK, replace the faulty switch.

LOW PRESSURE CYCLING CLUTCH SWITCH

Before performing diagnosis of the low pressure cycling clutch switch, be certain that the switch is properly installed on the accumulator fitting. If the switch is too loose it may not open the Schrader-type valve in the accumulator fitting, which will prevent the switch from correctly monitoring the refrigerant system pressure. Remember that lower ambient temperatures, below about -1° C (30° F), during cold weather will open the switch contacts and prevent compressor operation due to the pressure/temperature relationship of the refrigerant.

Also verify that the refrigerant system has the correct refrigerant charge. See Refrigerant System Charge in the Service Procedures section of this group for more information.

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the low pressure cycling clutch switch wire harness connector from the switch on the accumulator fitting.

(3) Install a jumper wire between the two cavities of the low pressure cycling clutch switch wire harness connector.

(4) Connect a manifold gauge set to the refrigerant system service ports. See Refrigerant System Service Equipment and Refrigerant System Service Ports in the Description and Operation section of this group for more information.

(5) Connect the battery negative cable.

(6) Place the heater-A/C mode control switch knob in any A/C position and start the engine.

(7) Check for continuity between the two terminals of the low pressure cycling clutch switch. There should be continuity with a suction pressure reading of 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.

DIAGNOSIS AND TESTING (Continued)

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 for the procedures. If the refrigerant system is low or empty; a leak at a refrigerant line, connector fitting, component, or component seal is likely.

An electronic leak detector designed for R-134a refrigerant, or a fluorescent R-134a leak detection dye and a black light are recommended for locating and confirming refrigerant system leaks. Refer to the operating instructions supplied by the equipment manufacturer for proper care and use of this equipment.

An oily residue on or near refrigerant system lines, connector fittings, components, or component seals can indicate the general location of a possible refrigerant leak. However, the exact leak location should be confirmed with an electronic leak detector prior to component repair or replacement.

To detect a leak in the refrigerant system with an electronic leak detector, perform one of the following procedures:

SYSTEM EMPTY

(1) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(2) Connect and dispense 0.283 kilograms (0.625 pounds or 10 ounces) of R-134a refrigerant into the evacuated refrigerant system. See Refrigerant System Charge in this group for the procedures.

(3) Position the vehicle in a wind-free work area. This will aid in detecting small leaks.

(4) With the engine not running, use a electronic R-134a leak detector and search for leaks. Because R-134a refrigerant is heavier than air, the leak detector probe should be moved slowly along the bottom side of all refrigerant lines, connector fittings and components.

(5) To inspect the evaporator coil for leaks, insert the electronic leak detector probe into the center instrument panel outlet. 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 turned on for five minutes.

(3) With the engine not running, use a electronic R-134a leak detector and search for leaks. Because R-134a refrigerant is heavier than air, the leak detector probe should be moved slowly along the bottom side of all refrigerant lines, connector fittings and components.

(4) To inspect the evaporator coil for leaks, insert the electronic leak detector probe into the center instrument panel outlet. Set the blower motor switch to the lowest speed position, and the mode control switch in the recirculation mode.

VACUUM SYSTEM

Vacuum control is used to operate the mode doors in the heater-only and heater-A/C housings. Testing of the heater-only and heater-A/C mode control switch operation will determine if the vacuum, electrical, and mechanical controls are functioning. However, it is possible that a vacuum control system that operates perfectly at engine idle (high engine vacuum) may not function properly at high engine speeds or loads (low engine vacuum). This can be caused by leaks in the vacuum system, or a faulty vacuum check valve.

A vacuum system test will help to identify the source of poor vacuum system performance or vacuum system leaks. Before starting this test, stop the engine and make certain that the problem is not a disconnected vacuum supply tube at the engine intake manifold vacuum tap or at the vacuum reservoir.

Use an adjustable vacuum test set (Special Tool C-3707-B) 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. 10), adjust the bleed valve on the test set gauge to obtain a vacuum of exactly 27 kPa (8 in. Hg.). Release and block the end of the probe several times to verify that the vacuum reading returns to the exact 27 kPa (8 in. Hg.) setting. Otherwise, a false reading will be obtained during testing.

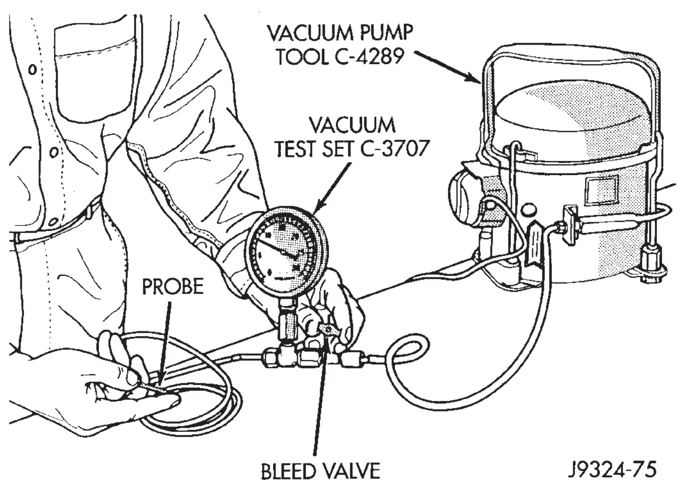


Fig. 10 Adjust Vacuum Test Bleed Valve

DIAGNOSIS AND TESTING (Continued)

VACUUM CHECK VALVE

(1) Remove the vacuum check valve. The valve is located in the vacuum supply tube (black) at the heater-A/C system vacuum tee.

(2) Connect the test set vacuum supply hose to the heater-A/C control side of the valve. When connected to this side of the check valve, no vacuum should pass and the test set gauge should return to the 27 kPa (8 in. Hg.) setting. If OK, go to Step 3. If not OK, replace the faulty valve.

(3) Connect the test set vacuum supply hose to the engine vacuum side of the valve. When connected to this side of the check valve, vacuum should flow through the valve without restriction. If not OK, replace the faulty valve.

HEATER-A/C CONTROLS

(1) Connect the test set vacuum probe to the heater-A/C vacuum supply (black) tube at the tee in the engine compartment. Position the test set gauge so that it can be viewed from the passenger compartment.

(2) Place the heater-A/C mode control switch knob in each mode position, one position at a time, and pause after each selection. The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each selection is made. If not OK, a component or vacuum line in the vacuum circuit of the selected mode has a leak. See 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 ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect the vacuum harness connector behind the glove box and inboard of the glove box opening on the heater-A/C housing.

(2) Connect the test set vacuum hose probe to each port in the heater-A/C housing half of the vacuum harness connector, one port at a time, and pause after each connection (Fig. 11). The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each connection is made. If OK, replace the faulty heater-A/C control. If not OK, go to Step 3.

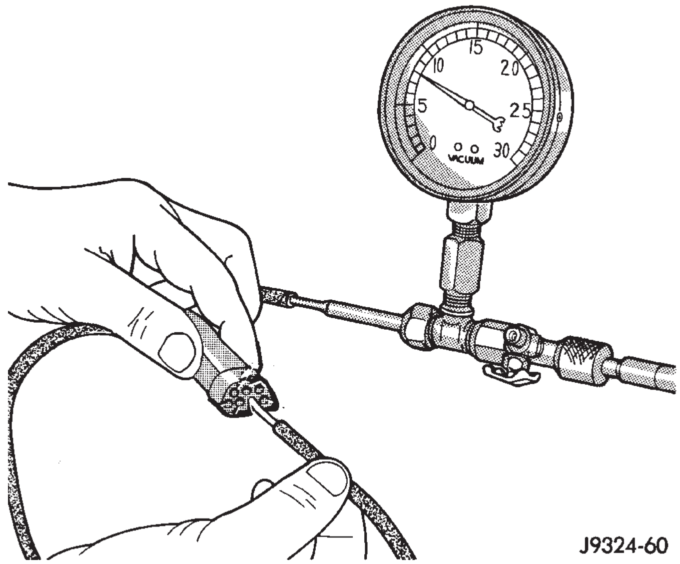


Fig. 11 Vacuum Circuit Test

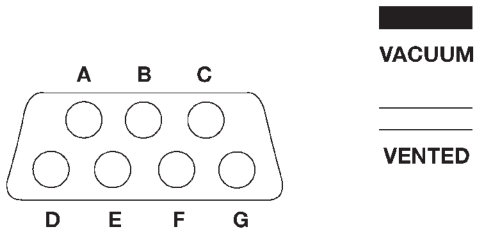
(3) Determine the vacuum line color of the vacuum circuit that is leaking. To determine the vacuum line colors, refer to the Vacuum Circuits chart (Fig. 12) or (Fig. 13).

(4) Disconnect and plug the vacuum line from the component (fitting, actuator, valve, switch, or reservoir) on the other end of the leaking circuit. Instrument panel disassembly or removal may be necessary to gain access to some components. See the service procedures in this group.

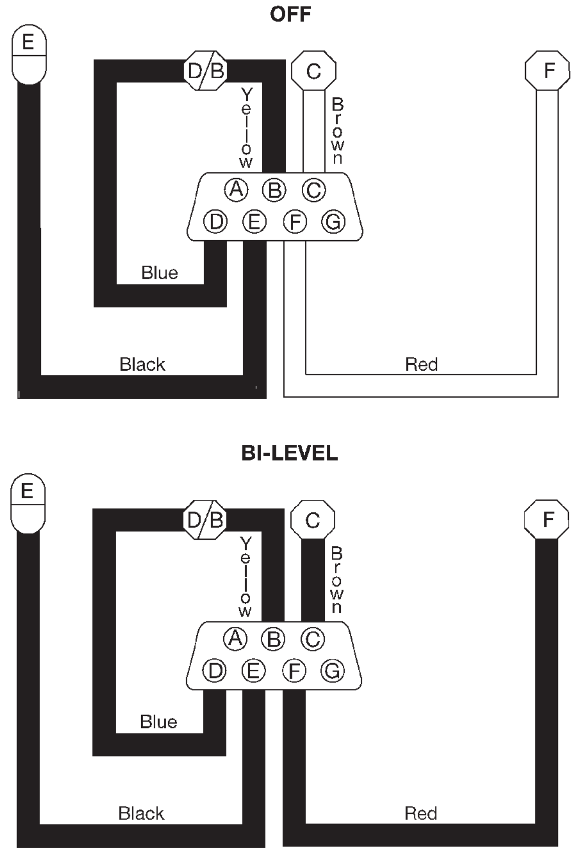
(5) Connect the test set hose or probe to the open end of the leaking circuit. The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each connection is made. If OK, replace the faulty disconnected component. If not OK, go to Step 6.

(6) To locate a leak in a vacuum line, leave one end of the line plugged and connect the test set hose or probe to the other end of the line. Run your fingers slowly along the line while watching the test set gauge. The vacuum reading will fluctuate when your fingers contact the source of the leak. To repair the vacuum line, cut out the leaking section of the line. Then, insert the loose ends of the line into a suitable length of 3 millimeter (0.125 inch) inside diameter rubber hose.

DIAGNOSIS AND TESTING (Continued)



VACUUM CIRCUIT LEGEND		
I.D.	Function	Color
A	Not Used	N/A
B	Defrost Actuator (Full Position)	Yellow
C	Floor Actuator	Brown
D	Defrost Actuator (Mid-Position)	Blue
E	Vacuum Supply (Reservoir)	Black
F	Panel Actuator	Red
G	Not Used	N/A



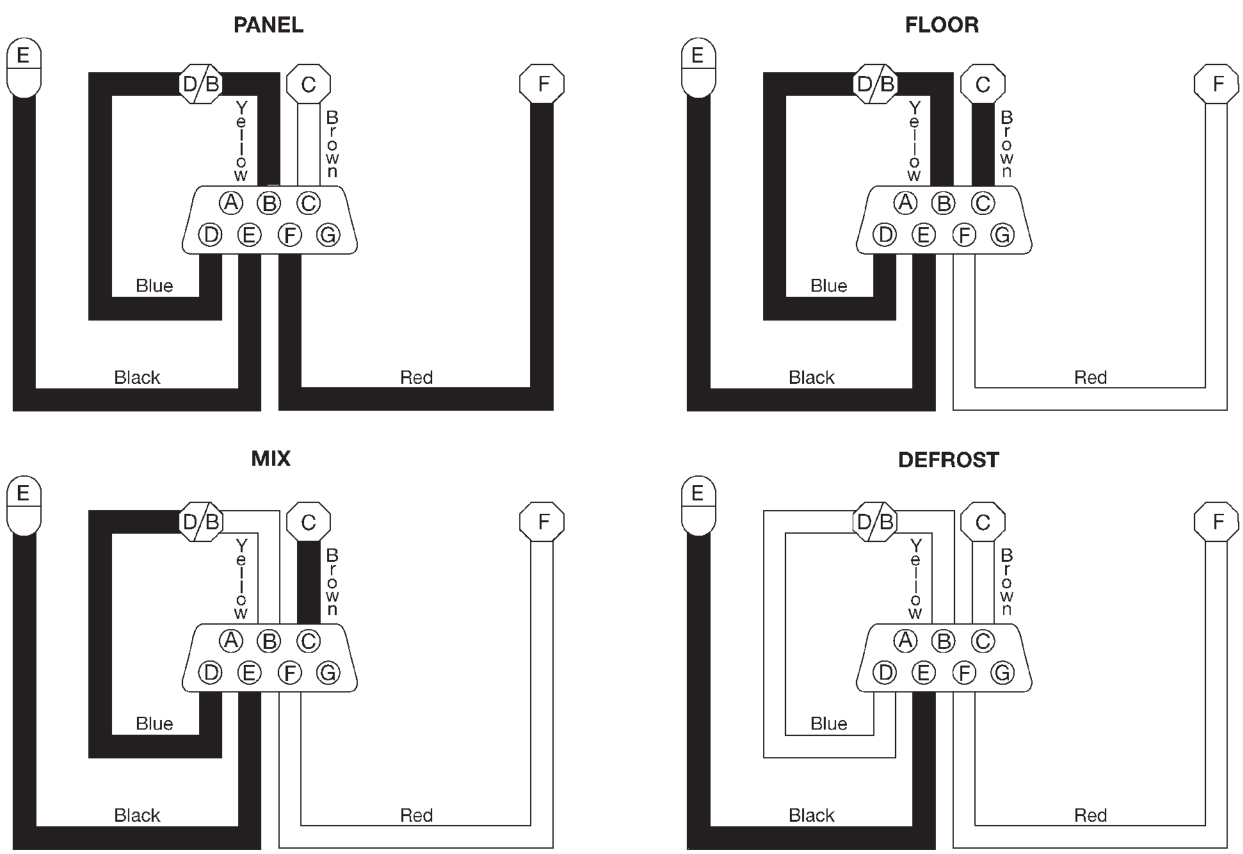


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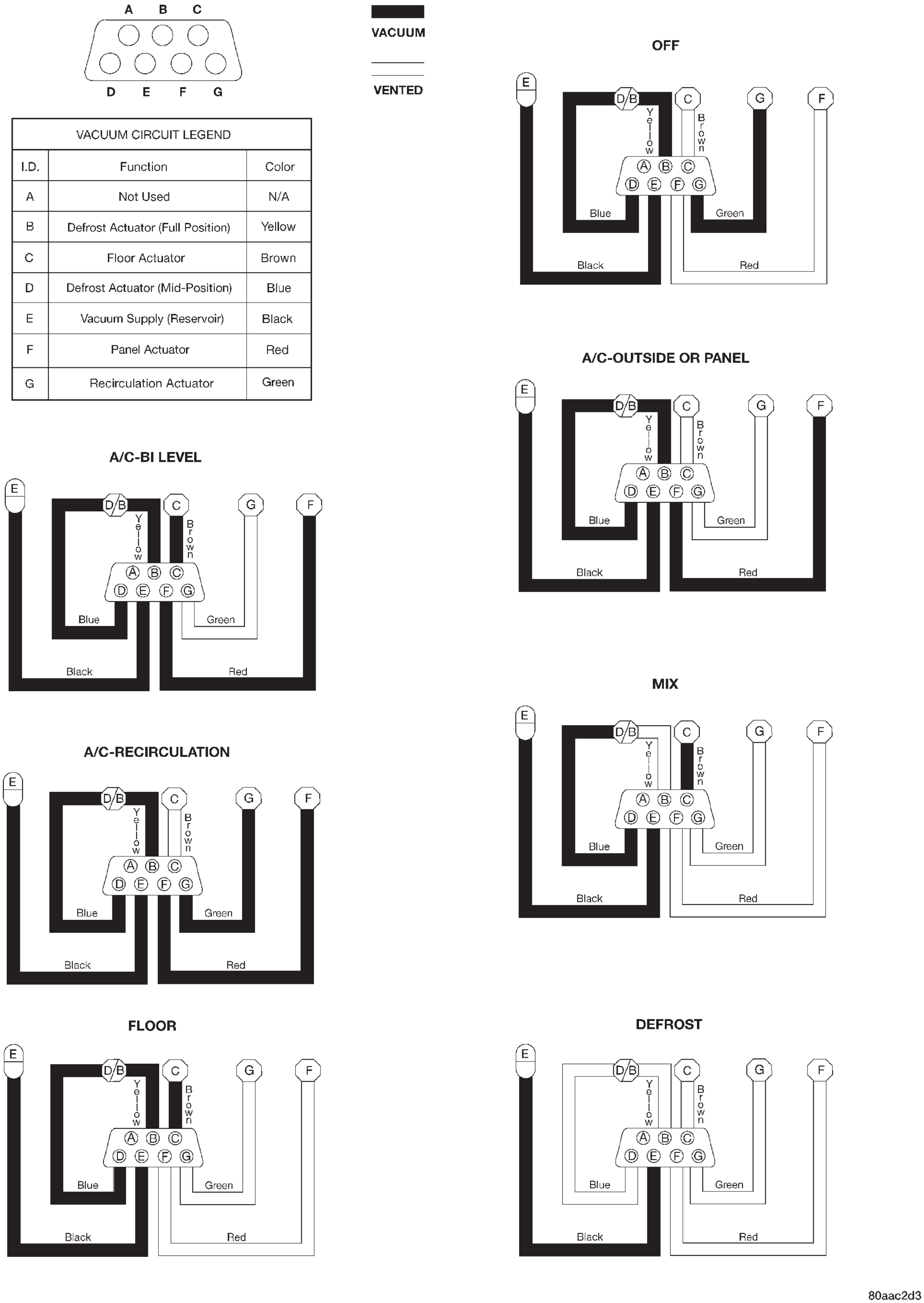
Fig. 12 Vacuum Circuits - Heater Only

DIAGNOSIS AND TESTING (Continued)



VACUUM CIRCUIT LEGEND		
I.D.	Function	Color
A	Not Used	N/A
B	Defrost Actuator (Full Position)	Yellow
C	Floor Actuator	Brown
D	Defrost Actuator (Mid-Position)	Blue
E	Vacuum Supply (Reservoir)	Black
F	Panel Actuator	Red
G	Recirculation Actuator	Green

Fig. 13 Vacuum Circuits - Heater-A/C

SERVICE PROCEDURES

REFRIGERANT RECOVERY

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE RECOVERING REFRIGERANT.

A R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used to recover the refrigerant from an R-134a refrigerant system. Refer to the operating instructions supplied by the equipment manufacturer for the proper care and use of this equipment.

REFRIGERANT SYSTEM EVACUATE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE EVACUATING THE SYSTEM.

If the refrigerant system has been open to the atmosphere, it must be evacuated before the system can be charged. If moisture and air enters the system and becomes mixed with the refrigerant, the compressor head pressure will rise above acceptable operating levels. This will reduce the performance of the air conditioner and damage the compressor. Evacuating the refrigerant system will remove the air and boil the moisture out of the system at near room temperature. To evacuate the refrigerant system, use the following procedure:

(1) Connect a R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 and a manifold gauge set to the refrigerant system of the vehicle.

(2) Open the low and high side valves and start the charging station vacuum pump. When the suction gauge reads 88 kPa (26 in. Hg.) vacuum or greater, close all of the valves and turn off the vacuum pump.

(a) If the refrigerant system fails to reach the specified vacuum, the system has a leak that must be corrected. See Refrigerant System Leaks in the Diagnosis and Testing section of this group for the procedures.

(b) If the refrigerant system maintains the specified vacuum for five minutes, restart the vacuum pump, open the suction and discharge valves and evacuate the system for an additional ten minutes.

(3) Close all of the valves, and turn off the charging station vacuum pump.

(4) The refrigerant system is now ready to be charged with R-134a refrigerant. See Refrigerant System Charge in the Service Procedures section of this group.

REFRIGERANT SYSTEM CHARGE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE CHARGING THE REFRIGERANT SYSTEM.

After the refrigerant system has been tested for leaks and evacuated, a refrigerant charge can be injected into the system. See Refrigerant Charge Capacity for the proper amount of the refrigerant charge.

A R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used to charge the refrigerant system with R-134a refrigerant. Refer to the operating instructions supplied by the equipment manufacturer for proper care and use of this equipment.

REFRIGERANT CHARGE CAPACITY

The R-134a refrigerant system charge capacity for this vehicle is 0.567 kilograms (1.25 pounds).

REFRIGERANT OIL LEVEL

When an air conditioning system is assembled at the factory, all components except the compressor are refrigerant oil free. After the refrigerant system has been charged and operated, the refrigerant oil in the compressor is dispersed throughout the refrigerant system. The accumulator, evaporator, condenser, and compressor will each retain a significant amount of the needed refrigerant oil.

It is important to have the correct amount of oil in the refrigerant system. This ensures proper lubrication of the compressor. Too little oil will result in damage to the compressor. Too much oil will reduce the cooling capacity of the air conditioning system.

It will not be necessary to check the oil level in the compressor or to add oil, unless there has been an oil loss. An oil loss may occur due to a rupture or leak from a refrigerant line, a connector fitting, a component, or a component seal. If a leak occurs, add 30 milliliters (1 fluid ounce) of refrigerant oil to the refrigerant system after the repair has been made. Refrigerant oil loss will be evident at the leak point by the presence of a wet, shiny surface around the leak.

SERVICE PROCEDURES (Continued)

Refrigerant oil must be added when a accumulator, evaporator coil, or condenser are replaced. See the Refrigerant Oil Capacities chart. When a compressor is replaced, the refrigerant oil must be drained from the old compressor and measured. Drain all of the refrigerant oil from the new compressor, then fill the new compressor with the same amount of refrigerant oil that was drained out of the old compressor.

Refrigerant Oil Capacities		
Component	ml	fl oz
A/C System	240	8.1
Accumulator	120	4
Condenser	30	1
Evaporator	60	2
Compressor	drain and measure the oil from the old compressor - see text.	

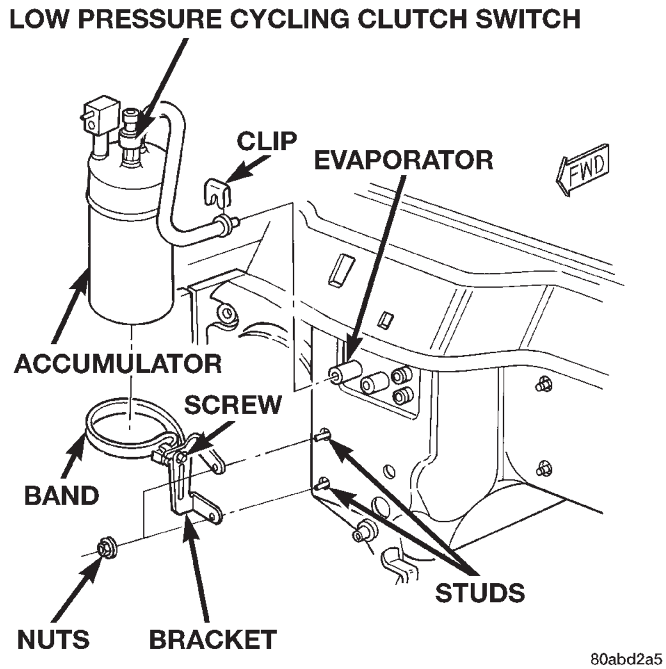


Fig. 14 Accumulator Remove/Install

REMOVAL AND INSTALLATION

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. See Refrigerant Recovery in this group for the procedures.

(3) Unplug the wire harness connector from the low pressure cycling clutch switch.

(4) Loosen the screw that secures the accumulator retaining band to the support bracket on the dash panel (Fig. 14).

(5) Disconnect the suction line from the accumulator outlet tube refrigerant line fitting. See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Disconnect the accumulator inlet tube refrigerant line fitting from the evaporator outlet tube. See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(7) Pull the accumulator and retaining band unit forward until the screw in the band is clear of the slotted hole in the support bracket on the dash panel.

(8) Remove the accumulator from the vehicle.

INSTALLATION

(1) Install the accumulator and retaining band as a unit by sliding the screw in the band into the slotted hole in the support bracket on the dash panel.

(2) Remove the tape or plugs from the refrigerant line fittings on the accumulator inlet tube and the evaporator outlet tube. Connect the accumulator inlet tube refrigerant line coupler to the evaporator outlet tube. See Refrigerant Line Coupler in this group for the procedures.

(3) Tighten the accumulator retaining band screw to 5 N·m (45 in. lbs.).

(4) Remove the tape or plugs from the refrigerant line fittings on the suction line and the accumulator outlet tube. Connect the suction line to the accumulator outlet tube refrigerant line coupler. See Refrigerant Line Coupler in this group for the procedures.

(5) Plug the wire harness connector into the low pressure cycling clutch switch.

(6) Connect the battery negative cable.

(7) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(8) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

NOTE: If the accumulator is replaced, add 120 milliliters (4 fluid ounces) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

REMOVAL AND INSTALLATION (Continued)

BLEND-AIR DOOR MOTOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the wire connector from the blend-air door motor.

(3) Remove the screws that secures the blend-air door motor to the blend-air door mounting bracket (Fig. 15).

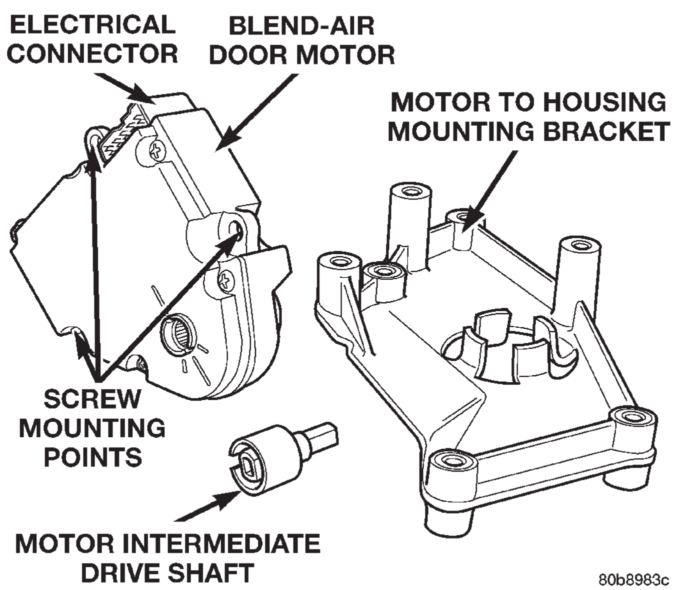


Fig. 15 Blend-Air Door Motor, Bracket, and Shaft

(4) Remove the blend-air door motor.

(5) If necessary remove the intermediate shaft from the blend-air door pivot shaft.

INSTALLATION

(1) Reverse the removal procedures for installation.

(2) Install and tighten the screws that secures the blend-air door motor to the mounting bracket. Tighten the mounting screws to 1 N·m (10 in. lbs.).

(3) Connect the battery negative cable.

BLOWER MOTOR

REMOVAL

(1) If the vehicle is equipped with air conditioning, recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(2) Disconnect and isolate the battery negative cable.

(3) If the vehicle is equipped with air conditioning, the accumulator must be relocated in order to service the blower motor. This is done by loosening the accumulator retaining band screw and disconnecting the accumulator inlet tube from the evaporator outlet tube. The accumulator can then be moved far enough to access and remove the blower motor. See Accumulator in this group for the procedures.

(4) Unplug the blower motor wire harness connector (Fig. 16).

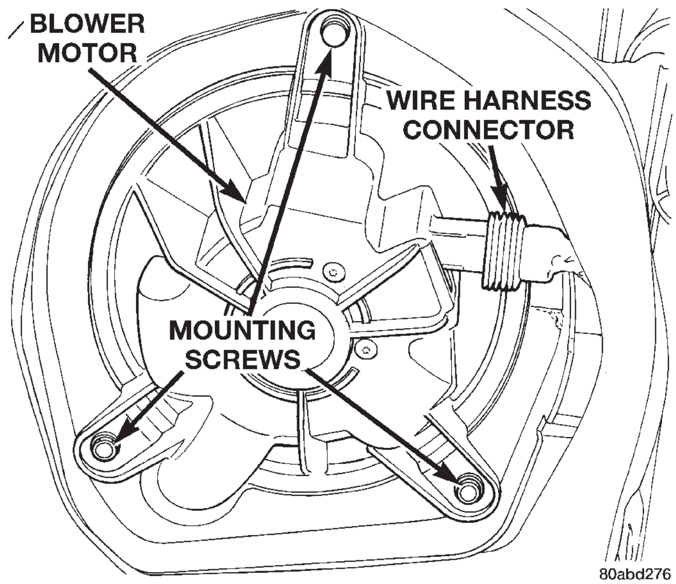


Fig. 16 Blower Motor Remove/Install

(5) Remove the three screws that secure the blower motor and wheel assembly to the heater-A/C housing.

(6) Rotate and tilt the blower motor unit as needed for clearance to remove the blower motor and wheel from the heater-A/C housing.

INSTALLATION

(1) Align and install the blower motor and wheel assembly into the heater-A/C housing.

(2) Install and tighten the three screws that secure the blower motor and wheel assembly to the heater-A/C housing. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

(3) Plug in the blower motor wire harness connector.

(4) If the vehicle is equipped with air conditioning, connect the accumulator inlet tube to the evaporator outlet tube and tighten the accumulator retaining band screw. See Accumulator in this group for the procedures.

(5) Connect the battery negative cable.

REMOVAL AND INSTALLATION (Continued)

(6) If the vehicle is equipped with air conditioning, evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(7) If the vehicle is equipped with air conditioning, charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

BLOWER MOTOR RELAY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Roll the glove box down from the instrument panel. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures.

(3) Reach through the instrument panel glove box opening to locate the blower motor relay (Fig. 17).

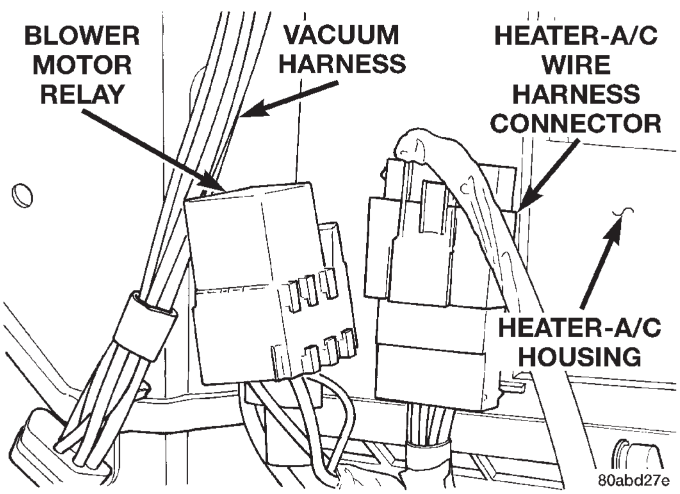


Fig. 17 Blower Motor Relay Remove/Install

(4) Unplug the blower motor relay from its wire harness connector.

(5) Install the blower motor relay by aligning the relay terminals with the cavities in the wire harness connector and pushing the relay firmly into place.

(6) Roll the glove box back up into the instrument panel. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures.

(7) Connect the battery negative cable.

(8) Test the relay operation.

BLOWER MOTOR RESISTOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the kick cover from the heater-A/C housing. See Kick Cover in this group for the procedures.

(3) Pull out the lock on the blower motor resistor wire harness connector to unlock the connector latch (Fig. 18).

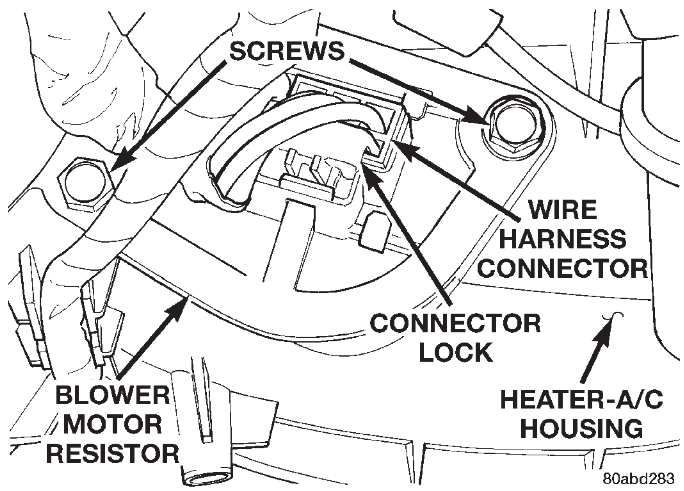


Fig. 18 Blower Motor Resistor Remove/Install

(4) Depress the latch on the blower motor resistor wire harness connector and unplug the connector from the resistor.

(5) Remove the two screws that secure the resistor to the heater-A/C housing.

(6) Remove the resistor from the heater-A/C housing.

(7) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in lbs.).

REMOVAL AND INSTALLATION (Continued)

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) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(2) Disconnect and isolate the battery negative cable.

(3) Remove the serpentine drive belt. Refer to Group 7 - Cooling System for the procedures.

(4) Unplug the compressor clutch coil wire harness connector.

(5) Remove the suction and discharge refrigerant line manifold from the compressor. See Suction and Discharge Line in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant fittings.

(6) Remove the four bolts that secure the compressor to the mounting bracket (Fig. 19).

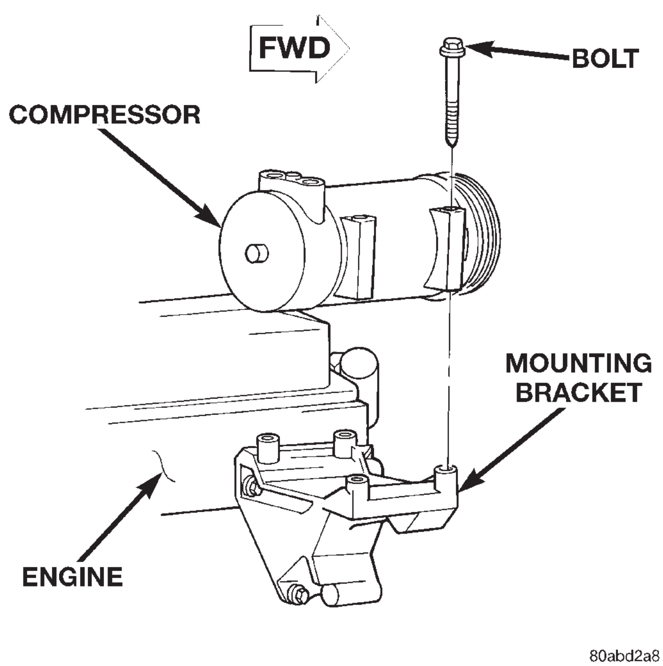


Fig. 19 Compressor Remove/Install - All 2.5L/4.0L Engines

(7) Remove the compressor from the mounting bracket.

INSTALLATION

NOTE: If a replacement compressor is being installed, be certain to check the refrigerant oil level. See Refrigerant Oil Level in this group for the procedures. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(1) Install the compressor to the mounting bracket. Tighten the four mounting bolts as follows:

- All 2.5L and 4.0L engines - 27 N·m (20 ft. lbs.)

(2) Remove the tape or plugs from all of the opened refrigerant line fittings. Install the suction and discharge line manifold to the compressor. See Suction and Discharge Line in this group for the procedures.

(3) Install the serpentine drive belt. Refer to Group 7 - Cooling System for the procedures.

(4) Plug in the compressor clutch coil wire harness connector.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(7) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

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) Unplug the compressor clutch coil wire harness connector.

(4) Remove the four bolts that secure the compressor to the mounting bracket.

(5) Remove the compressor from the mounting bracket. Support the compressor in the engine compartment while servicing the clutch.

(6) Insert the two pins of the spanner wrench (Special Tool C-4489) into the holes of the clutch plate. Hold the clutch plate stationary and remove the hex nut (Fig. 20).

REMOVAL AND INSTALLATION (Continued)

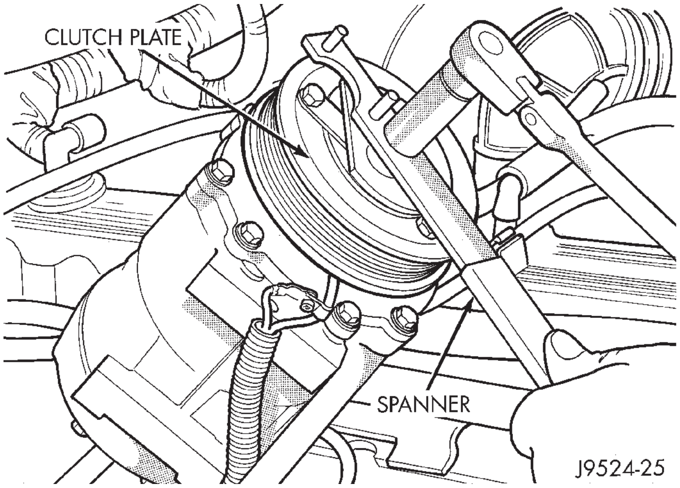


Fig. 20 Clutch Nut Remove

(7) Remove the clutch plate with a puller (Special Tool C-6461) (Fig. 21).

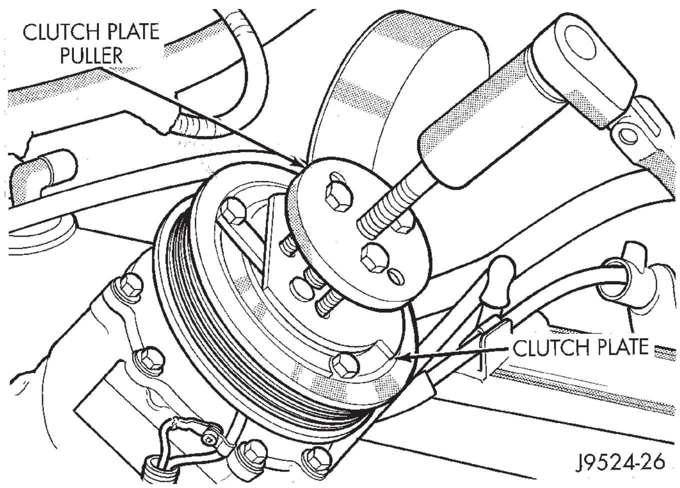


Fig. 21 Clutch Plate Remove

(8) Remove the compressor shaft key and the clutch shims.

(9) Remove the external front housing snap ring with snap ring pliers (Fig. 22).

(10) 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. 23).

(11) Install the puller through-bolts (Special Tool C-6461) through the puller flange and into the jaws of the rotor puller and tighten (Fig. 24). Turn the puller center bolt clockwise until the rotor pulley is free.

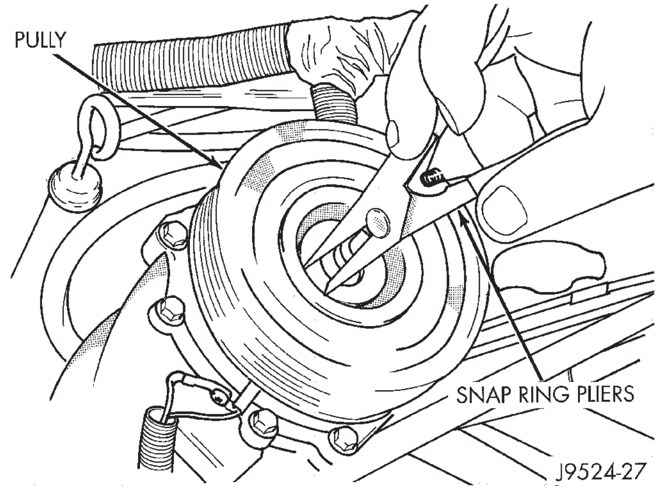


Fig. 22 External Snap Ring Remove

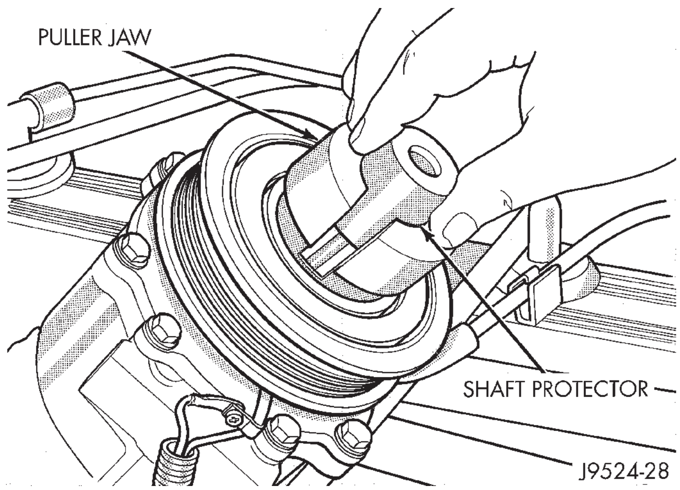


Fig. 23 Shaft Protector and Puller

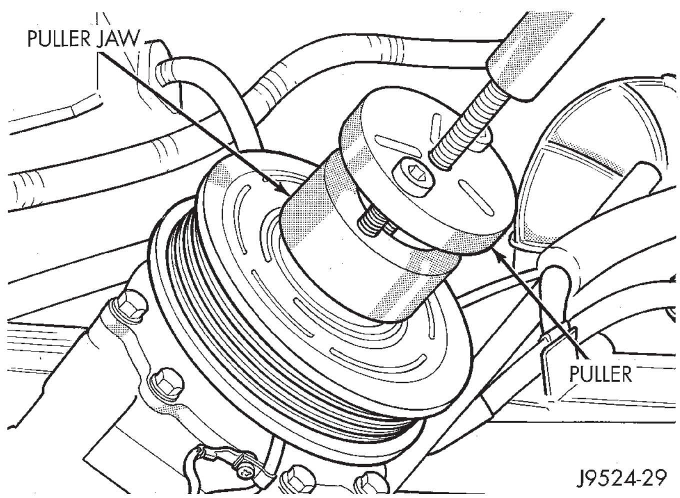


Fig. 24 Install Puller Plate

REMOVAL AND INSTALLATION (Continued)

(12) Remove the screw and retainer from the clutch coil lead wire harness on the compressor front housing (Fig. 25).

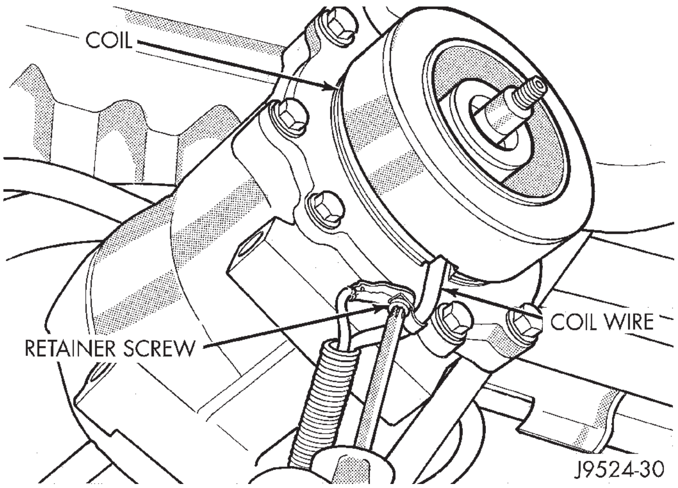


Fig. 25 Clutch Coil Lead Wire Harness

(13) Remove the snap ring from the compressor hub and remove the clutch field coil (Fig. 26). Slide the clutch field coil off of the compressor hub.

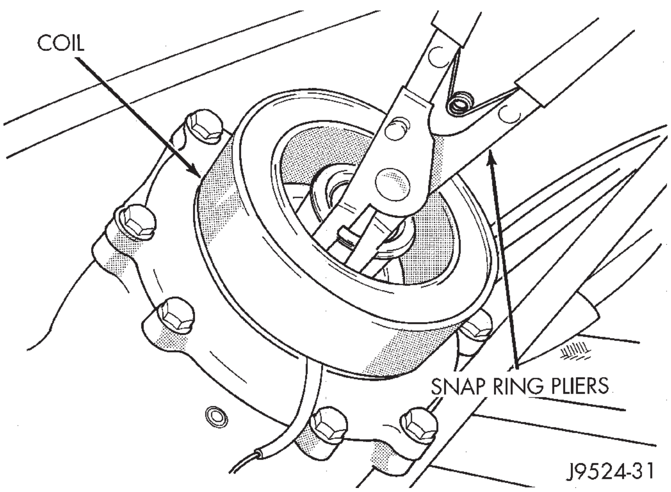


Fig. 26 Clutch Field Coil Snap Ring Remove

INSPECTION

Examine the friction surfaces of the clutch pulley and the front plate for wear. The pulley and front plate should be replaced if there is excessive wear or scoring.

If the friction surfaces are oily, inspect the shaft and nose area of the compressor for oil. Remove the felt from the front cover. If the felt is saturated with oil, the shaft seal is leaking and the compressor must be replaced.

Check the clutch pulley bearing for roughness or excessive leakage of grease. Replace the bearing, if required.

INSTALLATION

(1) Install the clutch field coil and snap ring.

(2) Install the clutch coil lead wire harness retaining clip on the compressor front housing and tighten the retaining screw.

(3) Align the rotor assembly squarely on the front compressor housing hub.

(4) Install the pulley bearing assembly with the installer (Special Tool C-6871) (Fig. 27). Thread the installer on the shaft, then turn the nut until the pulley assembly is seated.

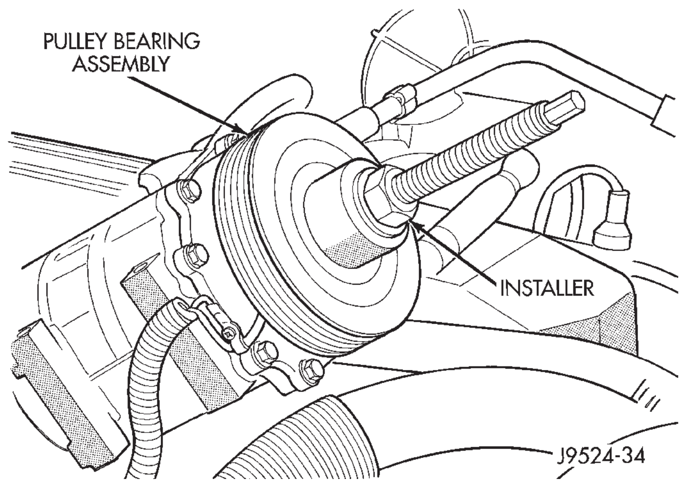


Fig. 27 Clutch Pulley Install

(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.

REMOVAL AND INSTALLATION (Continued)

(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. 28). Install the shaft hex nut and tighten to 14.4 N·m (10.5 ft. lbs.).

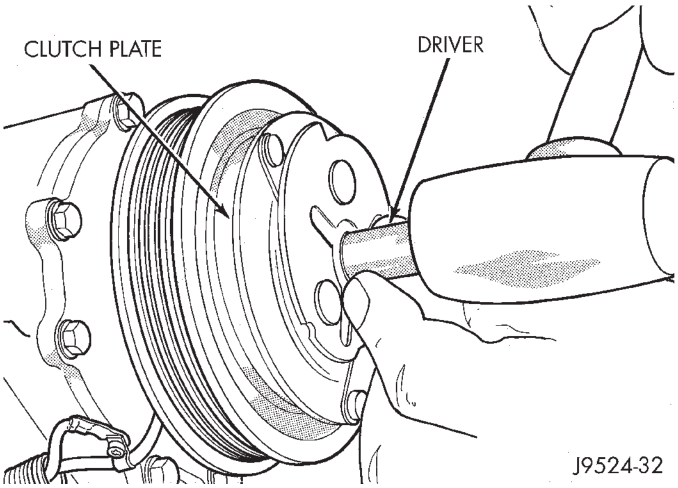


Fig. 28 Clutch Plate Driver

(8) Check the clutch air gap with a feeler gauge (Fig. 29). If the air gap does not meet the specification, add or subtract shims as required. The air gap specification is 0.41 to 0.79 millimeter (0.016 to 0.031 inch). If the air gap is not consistent around the circumference of the clutch, lightly pry up at the minimum variations. Lightly tap down at the points of maximum variation.

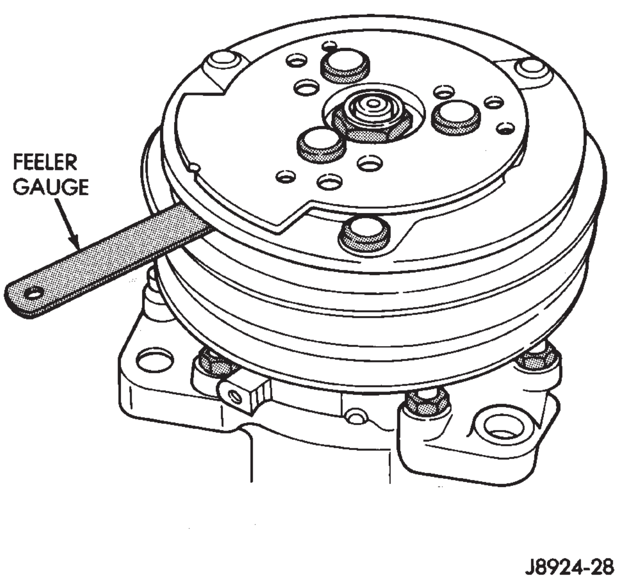


Fig. 29 Check Clutch Air Gap

NOTE: The air gap is determined by the spacer shims. When installing an original, or a new clutch assembly, try the original shims first. When installing a new clutch onto a compressor that previously did not have a clutch, use 1.0, 0.50, and 0.13 millimeter (0.040, 0.020, and 0.005 inch) shims from the clutch hardware package that is provided with the new clutch.

(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 (five seconds on, then five seconds off). During this 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 to 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. 30).

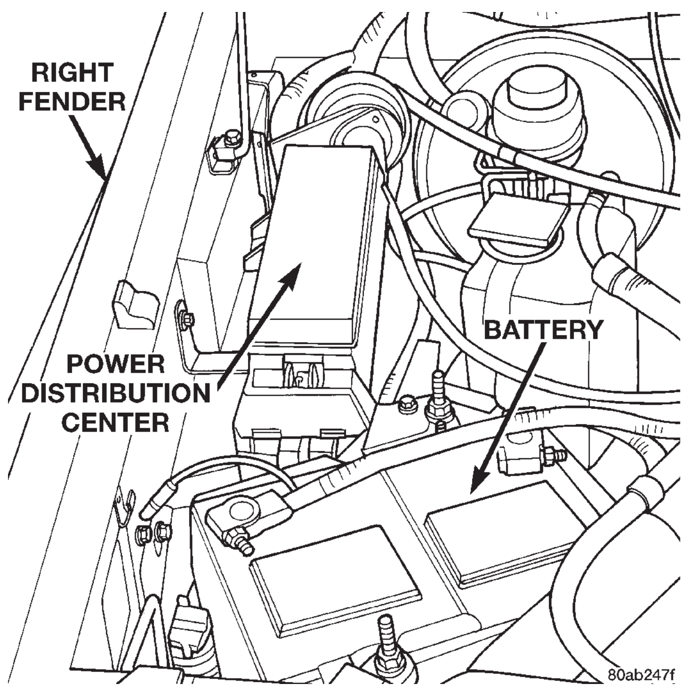


Fig. 30 Power Distribution Center

(3) Refer to the label on the PDC for compressor clutch relay identification and location.

(4) Unplug the compressor clutch relay from the PDC.

(5) Install the compressor clutch relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

REMOVAL AND INSTALLATION (Continued)

CONDENSER

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

CAUTION: Before removing the condenser, note the location of each of the radiator and condenser air seals. These seals are used to direct air through the condenser and radiator. The air seals must be reinstalled in their proper locations in order for the air conditioning and engine cooling systems to perform as designed.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(3) Disconnect the discharge line refrigerant line fitting at the condenser inlet. See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(4) Disconnect the liquid line (Left-Hand Drive) or liquid line jumper (Right-Hand Drive) refrigerant line fitting at the condenser outlet. See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the radiator and the condenser from the vehicle as a unit. Refer to Group 7 - Cooling System for the procedures.

(6) Remove the two nuts that secure the condenser studs to the upper brackets of the radiator (Fig. 31).

(7) Slide the condenser down from the radiator far enough for the condenser studs to clear the upper radiator bracket holes, and for the lower condenser bracket holes to clear the dowel pins on the bottom of the radiator.

(8) Remove the condenser from the radiator.

INSTALLATION

(1) Install the holes of the condenser lower brackets over the dowel pins on the bottom of the radiator.

(2) Slide the condenser upwards until both of the condenser studs are installed through the holes in the radiator upper brackets. Tighten the mounting nuts to 5.3 N·m (47 in. lbs.).

(3) Renstall the radiator and condenser unit in the vehicle. Refer to Group 7 - Cooling System for the procedures.

(4) Remove the tape or plugs from the refrigerant line fittings on the condenser outlet and the liquid line (Left-Hand Drive) or the liquid line jumper (Right-Hand Drive). Install the liquid line or the liquid line jumper to the condenser outlet. See Refrigerant Line Coupler in this group for the procedures.

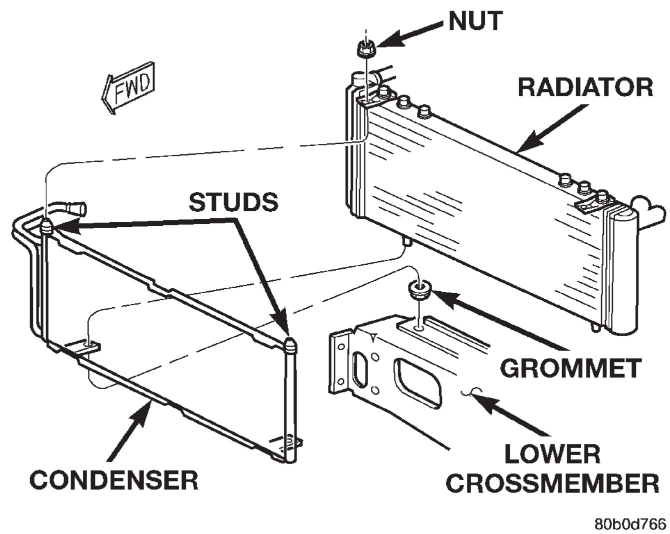


Fig. 31 Condenser Remove/Install

(5) Remove the tape or plugs from the refrigerant line fittings on the condenser inlet and the discharge line. Connect the discharge line to the condenser inlet. See Refrigerant Line Coupler in this group for the procedures.

(6) Connect the battery negative cable.

(7) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(8) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

NOTE: If the condenser is replaced, add 30 milliliters (1 fluid ounce) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

DUCTS AND OUTLETS

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL AND INSTALLATION (Continued)

PANEL OUTLET DUCTS

The panel outlet ducts are integral to the instrument panel assembly. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

PANEL OUTLET BARRELS

(1) Use a trim stick or another suitable wide flat-bladed tool to gently pry the panel outlet barrel out of the panel outlet housing (Fig. 32). The barrel is retained by a light snap fit.

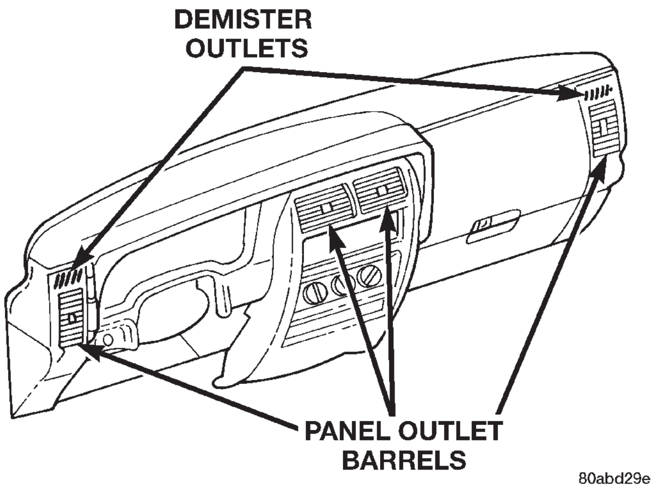


Fig. 32 Panel Outlet Barrels

(2) To install, position the barrel in the panel outlet housing and press firmly until the barrel snaps into place.

DEMISTER OUTLETS

The side window demister outlets are integral to the instrument panel end caps. Refer to Instrument Panel End Cap in Group 8E - Instrument Panel Systems for the procedures.

DEFROST DUCT/DEMISTER ADAPTER

(1) Remove the instrument panel assembly from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(2) Disconnect the demister hoses from the defrost duct/demister adapter (Fig. 33).

(3) Remove the three screws that secure the defrost duct/demister adapter to the instrument panel.

(4) Remove the defrost duct/demister adapter from the instrument panel.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

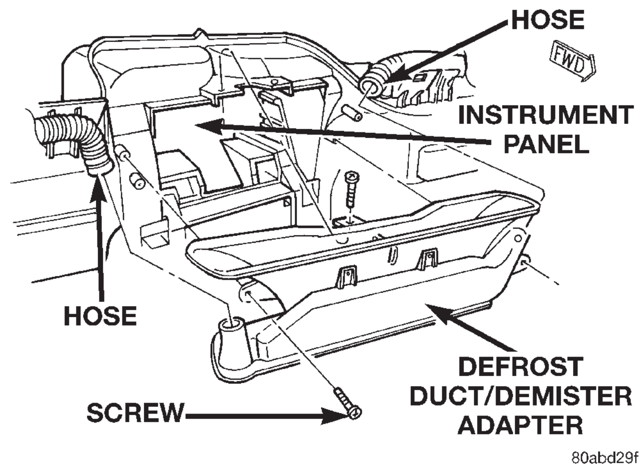


Fig. 33 Defrost Duct/Demister Adapter

DEMISTER HOSES

(1) Remove the instrument panel assembly from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(2) Disconnect the ends of the demister hose from the demister duct (Fig. 34) and the defrost duct/demister adapter (Fig. 33).

(3) Reverse the removal procedures to install.

DEMISTER DUCTS

(1) Remove the instrument panel assembly from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(2) Remove the end cap from the instrument panel. Refer to Instrument Panel End Cap in Group 8E - Instrument Panel Systems for the procedures.

(3) Disconnect the demister hoses from the demister duct (Fig. 34).

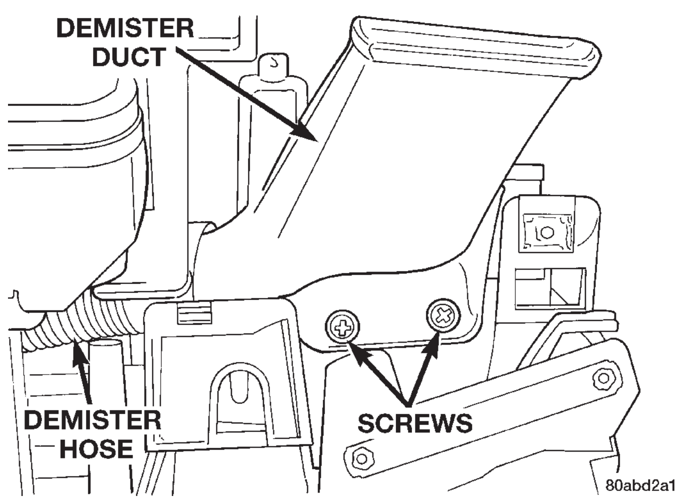


Fig. 34 Demister Duct Remove/Install

REMOVAL AND INSTALLATION (Continued)

(4) Remove the two screws that secure the demister duct to the top of the instrument panel.

(5) Remove the demister duct from the instrument panel.

(6) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

CONSOLE REAR DUCT

(1) Disconnect and isolate the battery negative cable.

(2) Remove the floor console from the floor panel transmission tunnel (Fig. 35). Refer to Group 23 - Body for the procedures.

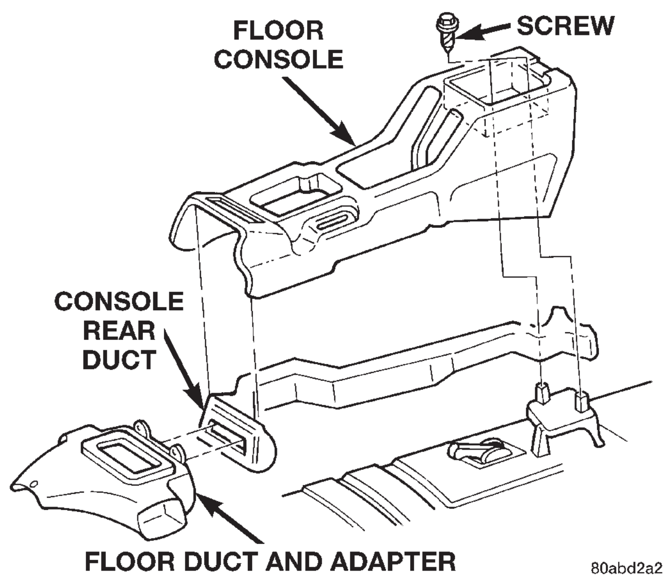


Fig. 35 Floor Duct and Console Rear Duct Remove/ Install

(3) Lift the rear of the console rear duct out of the console rear mounting bracket on the floor panel transmission tunnel and slide the duct rearward to disengage it from the floor duct and adapter.

(4) Remove the console rear duct from the vehicle.

(5) Reverse the removal procedures to install.

FLOOR DUCT AND ADAPTER

(1) Remove the instrument panel from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(2) Remove the heater-A/C housing from the vehicle. See Heater-A/C Housing in this group for the procedures.

(3) Remove the three screws that secure the floor duct and adapter to the heater-A/C housing (Fig. 35).

(4) Remove the floor duct and adapter from the heater-A/C housing.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

EVAPORATOR COIL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

(2) Lift the evaporator coil unit out of the lower half of the heater-A/C housing (Fig. 36).

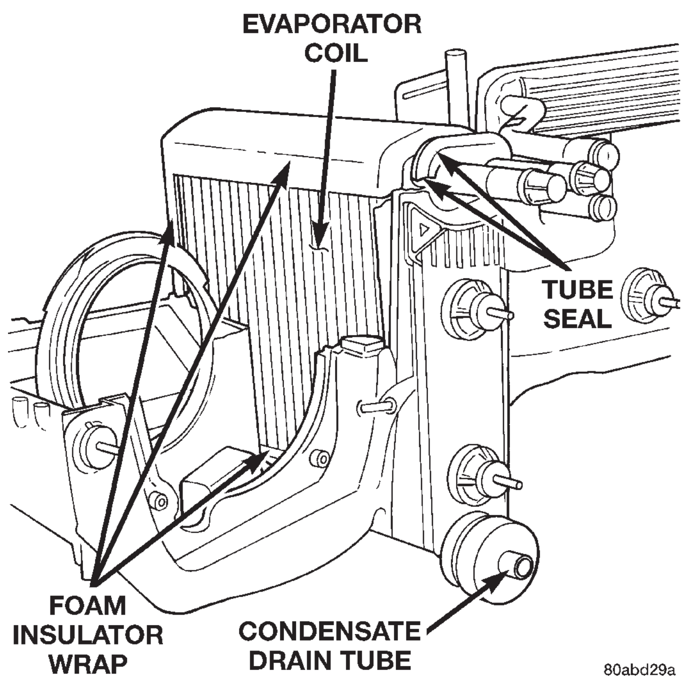


Fig. 36 Evaporator Coil Remove/Install

(3) Reverse the removal procedures to install. Be certain that the evaporator foam insulator wrap and rubber tube seal are reinstalled.

NOTE: If the evaporator is replaced, add 60 milliliters (2 fluid ounces) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

FIXED ORIFICE TUBE

The fixed orifice tube is located in the liquid line (Left-Hand Drive) or the liquid line jumper (Right-Hand Drive) near the condenser. The orifice has filter screens on the inlet and outlet ends of the tube body. If the fixed orifice tube is faulty or plugged, the liquid line unit or liquid line jumper unit must be replaced. See Liquid Line in this group for the service procedures.

HEATER-A/C CONTROL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Roll down the glove box from the instrument panel. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures.

(3) Reach through the instrument panel glove box opening to access and unplug the two halves of the heater-A/C vacuum harness connector.

(4) Remove the center bezel from the instrument panel. Refer to Instrument Panel Center Bezel in Group 8E - Instrument Panel Systems for the procedures.

(5) Release the vacuum harness push-in retainer from the instrument panel directly beneath the heater-A/C control.

(6) Remove the four screws that secure the heater-A/C control to the instrument panel (Fig. 37).

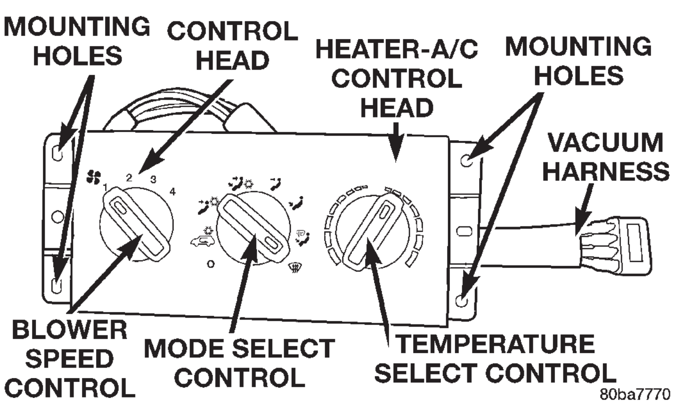


Fig. 37 Heater-A/C Control Remove/Install

(7) Pull the heater-A/C control assembly away from the instrument panel far enough to access the connections on the back of the control.

(8) Unplug the wire harness connectors from the back of the heater-A/C control (Fig. 38).

(9) Reach through the instrument panel glove box opening to guide the heater-A/C control half of the vacuum harness around any obstacles while pulling the heater-A/C control out from the front of the instrument panel.

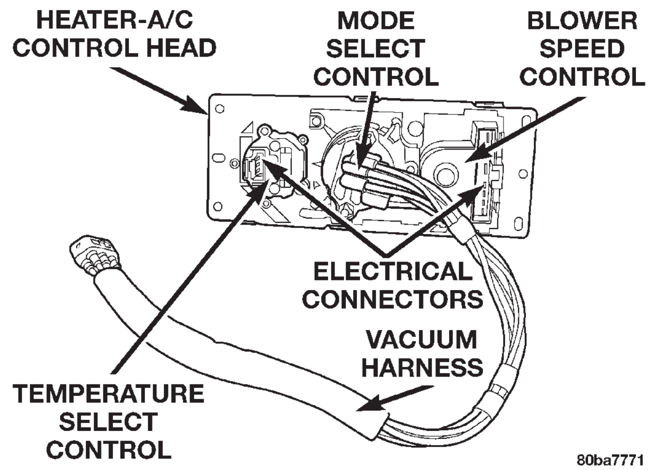


Fig. 38 Heater-A/C Control Connections

INSTALLATION

(1) Plug the wire harness connectors into the back of the heater-A/C control.

(2) Route the vacuum harness through the instrument panel opening and reinstall the vacuum harness push-in retainer.

(3) Reach through the instrument panel glove box opening to reconnect the two halves of the heater-A/C vacuum harness connector.

(4) Roll the glove box back up into the instrument panel. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures.

(5) Position the heater-A/C control in the instrument panel and secure it with four screws. Tighten the screws to 2.2 N·m (20 in. lbs.).

(6) Reinstall the center bezel onto the instrument panel. Refer to Instrument Panel Center Bezel in Group 8E - Instrument Panel Systems for the procedures.

(7) Connect the battery negative cable.

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.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL AND INSTALLATION (Continued)

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(3) If the vehicle is not equipped with air conditioning, go to Step 6. If the vehicle is equipped with air conditioning, recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(4) Disconnect the liquid line refrigerant line fitting from the evaporator inlet tube. See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Disconnect the accumulator inlet tube refrigerant line fitting from the evaporator outlet tube. See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Drain the engine cooling system. Refer to Group 7 - Cooling System for the procedures.

(7) Disconnect the heater hoses from the heater core tubes. Refer to Group 7 - Cooling System for the procedures. Install plugs in, or tape over the opened heater core tubes.

(8) Unplug the heater-A/C system vacuum supply line connector from the tee fitting near the heater core tubes.

(9) Unplug the heater-A/C unit wire harness connector, which is fastened to the heater-A/C housing next to the blower motor relay (Fig. 39).

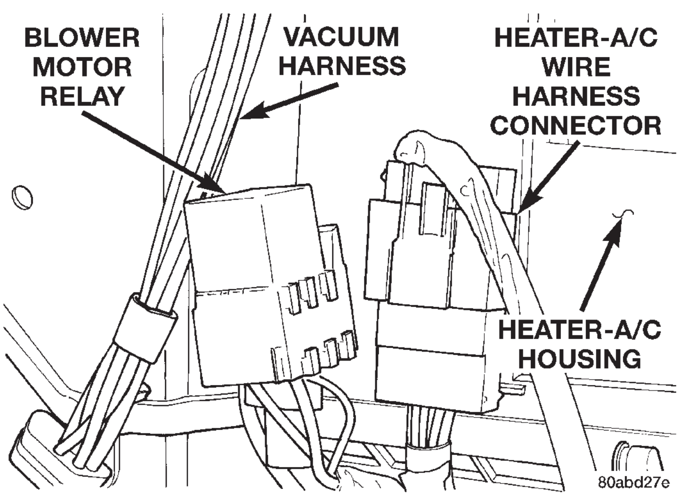


Fig. 39 Heater-A/C Unit Connector

(10) Remove the five nuts from the heater-A/C housing mounting studs on the engine compartment side of the dash panel (Fig. 40). Remove or reposition the evaporation canister for additional access, if required.

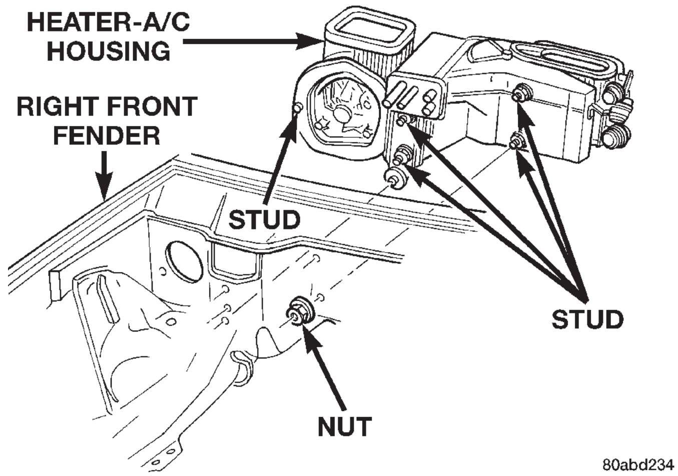


Fig. 40 Heater-A/C Housing Remove/Install

(11) Pull the heater-A/C housing rearward far enough for the mounting studs and the evaporator condensate drain tube to clear the dash panel holes.

(12) Remove the heater-A/C housing from the vehicle.

DISASSEMBLY

(1) Remove the heater-A/C housing from the vehicle and place it on a work bench.

(2) Unplug the vacuum harness connectors from the floor door actuator and, if the unit is so equipped, the recirculation air door actuator.

(3) Disengage the vacuum harness from any routing clips located on the lower half of the heater-A/C housing.

(4) Disengage the heater-A/C wire harness connector and the blower motor relay wire harness connector push-in retainers from their mounting holes on the heater-A/C housing.

(5) Remove the blower motor and blower wheel unit from the heater-A/C housing. See Blower Motor in this group for the procedures.

(6) Carefully remove the foam seal from the flange around the blower motor opening in the heater-A/C housing. If the seal is deformed or damaged, it must be replaced.

REMOVAL AND INSTALLATION (Continued)

(7) Pull the vacuum supply line and connector through the foam seal on the heater core and evaporator coil tube mounting flange of the heater-A/C housing (Fig. 41).

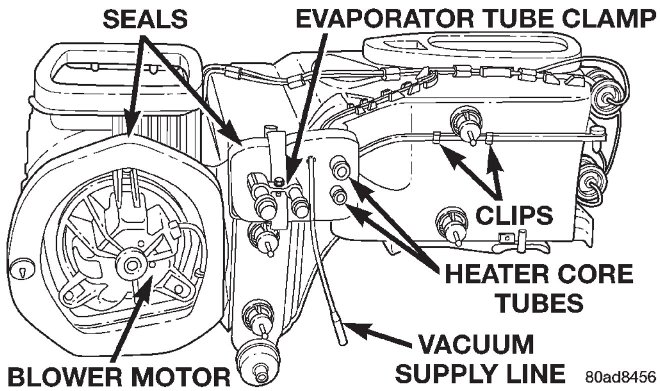


Fig. 41 Heater-A/C Housing Disassembly

(8) If the unit is equipped with air conditioning, remove the screw that secures the clamp to the evaporator coil tubes and remove the clamp.

(9) Carefully remove the foam seal from the heater core and evaporator coil tube mounting flange of the heater-A/C housing. If the seal is deformed or damaged, it must be replaced.

(10) Use a screwdriver to pry off the two snap clips that help secure the upper and lower heater-A/C housing halves to each other.

(11) Remove the 14 screws that secure the upper and lower heater-A/C housing halves to each other.

(12) Carefully 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. During assembly, be certain of the following:

(a) That each of the mode door pivot shaft ends is properly engaged in its pivot hole (Fig. 42).

(b) That the blower motor venturi ring is properly indexed and installed.

(c) If the unit is equipped with air conditioning, that the evaporator coil tube rubber seal is properly positioned in the grooves in both the upper and lower heater-A/C housing halves.

(2) Install the 14 screws and two snap clips that secure the upper and lower heater-A/C housing halves to each other. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the blower motor and wheel unit in the heater-A/C housing. See Blower Motor in this group for the procedures.

(4) Install the foam seals on the flanges around the blower motor opening and the heater core and evaporator coil tube mounting flange of the heater-A/C housing.

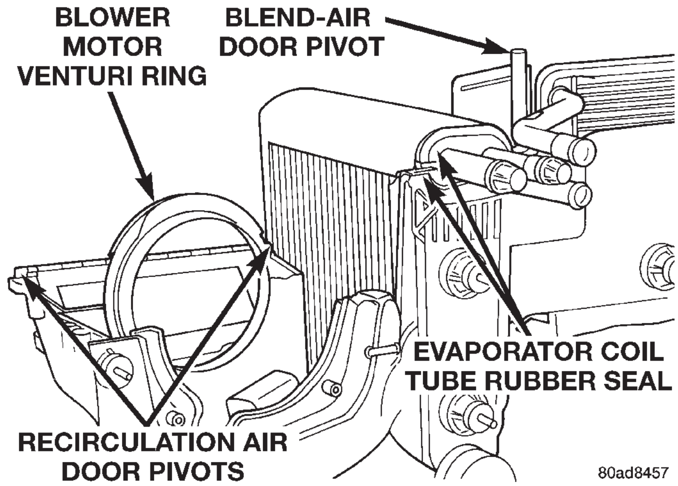


Fig. 42 Heater-A/C Housing Assembly

(5) Insert the vacuum supply line and connector through the foam seal on the heater core and evaporator coil tube mounting flange of the heater-A/C housing.

(6) If the unit is equipped with air conditioning, reinstall the evaporator coil tube clamp. Tighten the mounting screw to 2.2 N·m (20 in. lbs.).

(7) Engage the heater-A/C wire harness connector and blower motor relay wire harness connector push-in retainers with their mounting holes in the heater-A/C housing.

(8) Engage the vacuum harness to the routing clips and plug in the vacuum harness connector at the floor door actuator and, if the unit is so equipped, at the recirculation air door actuator.

(9) Install the heater-A/C housing in the vehicle.

INSTALLATION

(1) Position the heater-A/C housing to the dash panel. Be certain that the evaporator condensate drain tube and the housing mounting studs are inserted into their correct mounting holes.

(2) Install and tighten the five nuts onto the heater-A/C housing mounting studs on the engine compartment side of the dash panel. Tighten the nuts to 6.2 N·m (55 in. lbs.).

(3) If the evaporation canister was repositioned during the removal procedure, reinstall it to its proper position.

(4) Connect the heater-A/C system vacuum supply line connector to the tee fitting near the heater core tubes.

(5) Unplug or remove the tape from the heater core tubes. Connect the heater hoses to the heater core tubes and fill the engine cooling system. Refer to Group 7 - Cooling System for the procedures.

(6) If the vehicle is not equipped with air conditioning, go to Step 10. If the vehicle is equipped with air conditioning, unplug or remove the tape from the

REMOVAL AND INSTALLATION (Continued)

accumulator inlet tube and the evaporator outlet tube fittings. Connect the accumulator inlet tube coupler to the evaporator outlet tube. See Refrigerant Line Coupler in this group for the procedures.

(7) Unplug or remove the tape from the liquid line and the evaporator inlet tube fittings. Connect the liquid line coupler to the evaporator inlet tube. See Refrigerant Line Coupler in this group for the procedures.

(8) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(9) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

(10) Install the instrument panel in the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(11) Connect the battery negative cable.

(12) Start the engine and check for proper operation of the heating and air conditioning systems.

HEATER-A/C HOUSING DOOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

BLEND-AIR DOOR

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

NOTE: If the temperature control cable was not removed with the blend-air door lever as a unit during the instrument panel removal procedures, the lever must be removed from the blend-air door pivot shaft before the blend-air door can be removed from the heater-A/C housing. See Temperature Control Cable in this group for the procedures.

(2) Lift the blend-air door pivot shaft out of the pivot hole in the bottom of the lower half of the heater-A/C housing (Fig. 43).

(3) Reverse the removal procedures to install.

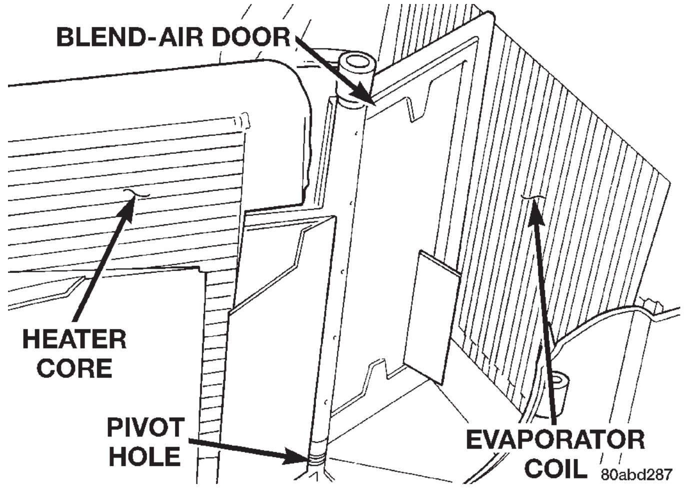


Fig. 43 Blend-Air Door

PANEL/DEMIST DOOR AND LEVER

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

(2) Remove the defrost and panel/demist door vacuum actuators from the heater-A/C housing. See Mode Door Vacuum Actuator in this group for the procedures.

(3) Insert a screwdriver into the latch hole (Fig. 44) of the panel/demist door pivot shaft to release the latch of the panel/demist door lever, and pull the lever out of the pivot shaft from the outside of the upper half of the heater-A/C housing.

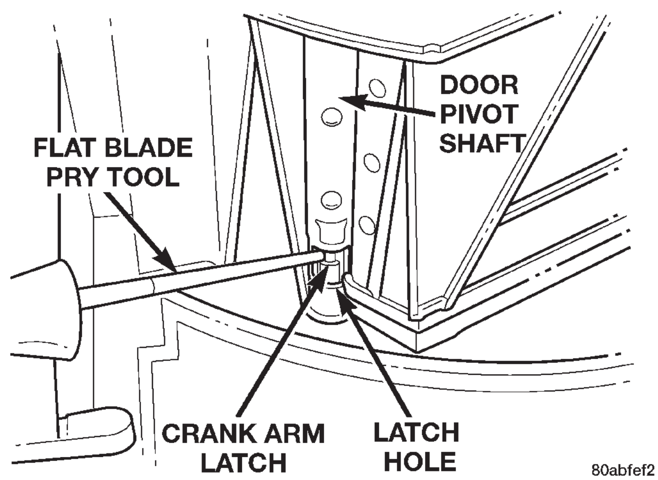


Fig. 44 Mode Door Lever Remove/Install - Typical

(4) Reach inside the upper half of the heater-A/C housing and carefully flex the panel/defrost door (Fig. 45) enough so that the door pivot clears the pivot hole in the housing.

REMOVAL AND INSTALLATION (Continued)

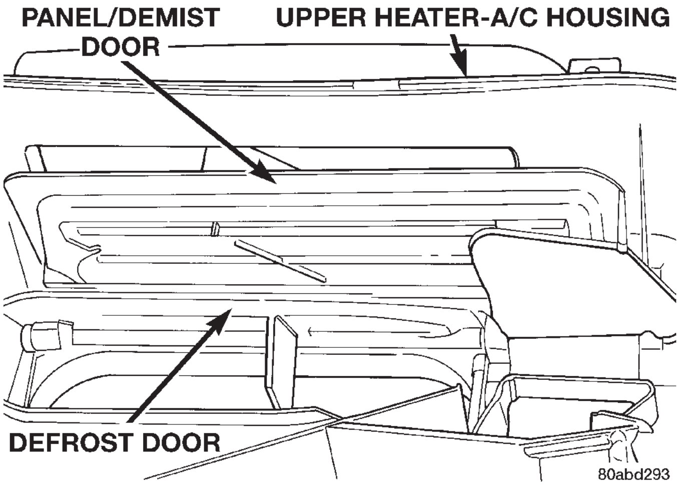


Fig. 45 Panel/Demist and Defrost Doors

(5) Remove the panel/demist door from the heater-A/C housing.

(6) Reverse the removal procedures to install.

DEFROST DOOR AND LEVER

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

(2) Remove the panel/demist door and lever from the upper heater-A/C housing. See Panel/Demist Door and Lever in this group for the procedures.

(3) Insert a screwdriver into the latch hole (Fig. 44) of the defrost door pivot shaft to release the latch of the defrost door lever, and pull the lever out of the pivot shaft from the outside of the upper half of the heater-A/C housing.

(4) Reach inside the upper half of the heater-A/C housing and carefully flex the defrost door (Fig. 45) enough so that the door pivot clears the pivot hole in the housing.

(5) Remove the defrost door from the heater-A/C housing.

(6) Reverse the removal procedures to install.

FLOOR DOOR AND LEVER

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

(2) Remove the floor door vacuum actuator from the lower heater-A/C housing. See Mode Door Vacuum Actuator in this group for the procedures.

(3) Insert a screwdriver into the latch hole (Fig. 44) of the floor door pivot shaft to release the latch of the floor door lever, and pull the lever out of the pivot shaft from the outside of the lower half of the heater-A/C housing.

(4) Reach inside the lower half of the heater-A/C housing and carefully flex the floor door (Fig. 46) enough so that the door pivot clears the pivot hole in the housing.

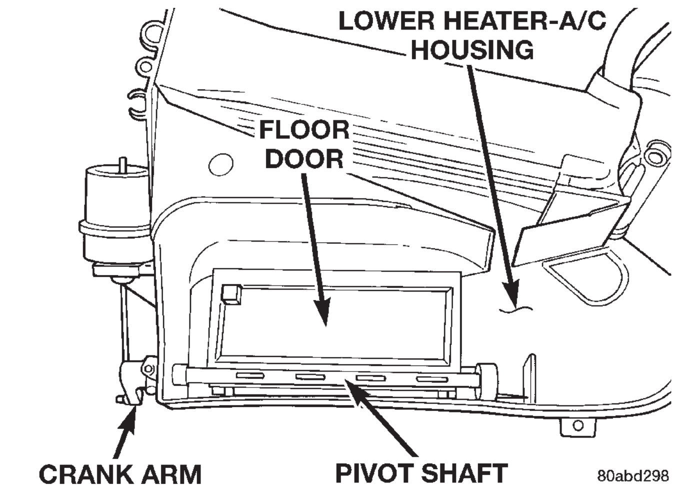


Fig. 46 Floor Door

(5) Remove the floor door from the heater-A/C housing.

(6) Reverse the removal procedures to install.

RECIRCULATION AIR DOOR

A recirculation air door and vacuum actuator are used only on models with the optional air conditioning system.

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

(2) Remove the recirculation air door vacuum actuator from the lower heater-A/C housing. See Mode Door Vacuum Actuator in this group for the procedures.

(3) Reach inside the lower half of the heater-A/C housing and lift the bottom edge of the recirculation air door upwards (Fig. 47).

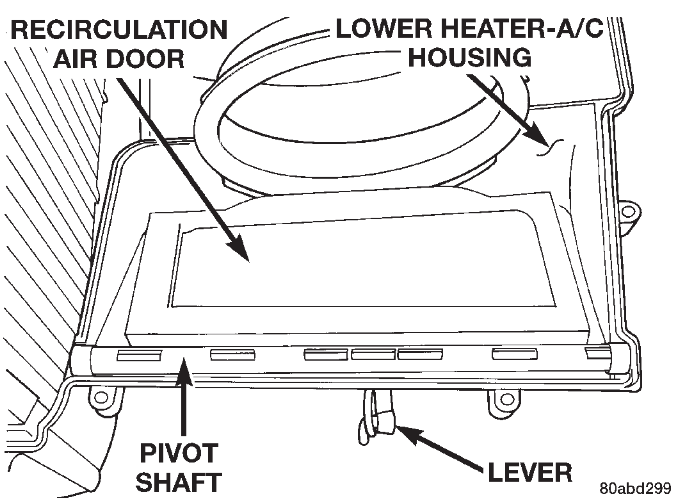


Fig. 47 Recirculation Air Door

REMOVAL AND INSTALLATION (Continued)

(4) Guide the recirculation air door lever through the air intake grille of the heater-A/C housing while removing the door from the housing.

(5) Reverse the removal procedures to install.

HEATER CORE

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

(2) Lift the heater core out of the lower half of the heater-A/C housing (Fig. 48).

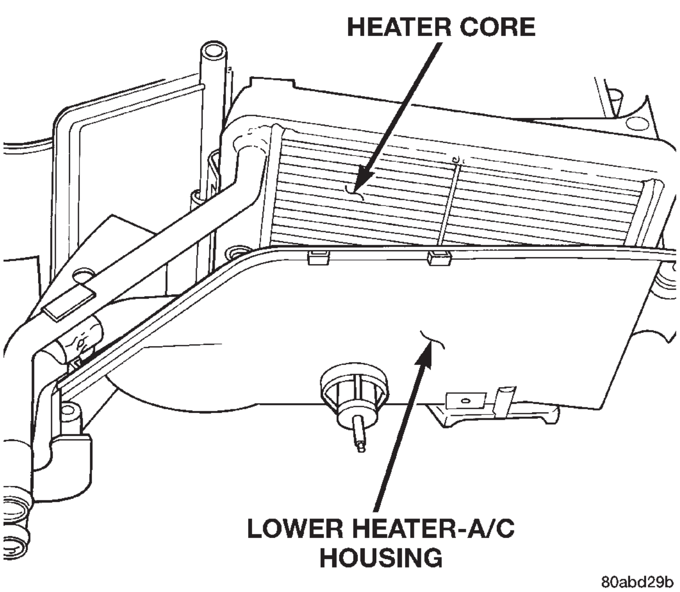


Fig. 48 Heater Core Remove/Install

(3) Reverse the removal procedures to install. Be certain that the heater core foam insulator is reinstalled.

HIGH PRESSURE CUT-OFF SWITCH

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the high pressure cut-off switch, which is mounted to a fitting on the discharge line between the compressor and the condenser inlet (Fig. 49).

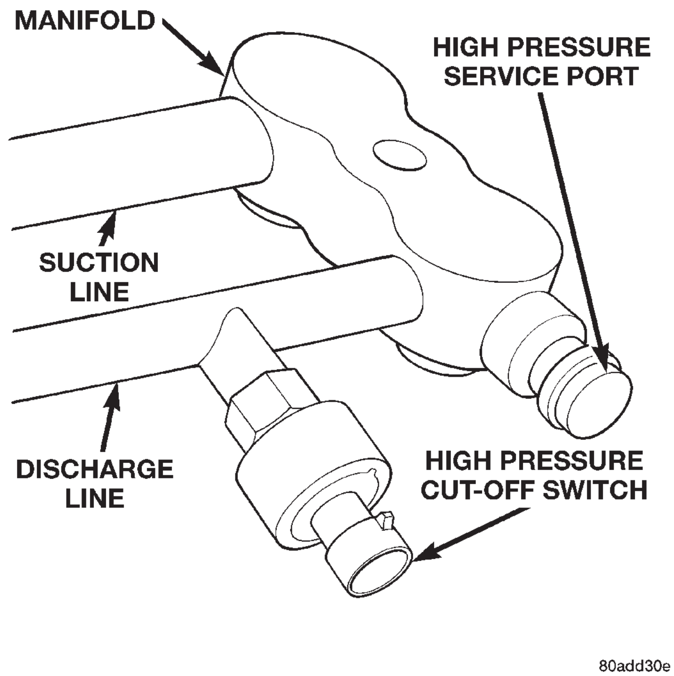


Fig. 49 High Pressure Cut-Off Switch Remove/Install - Typical

(3) Unscrew the high pressure cut-off switch from the discharge line fitting.

(4) Remove the high pressure cut-off switch from the vehicle.

(5) Remove the O-ring seal from the discharge line fitting and discard.

INSTALLATION

(1) Lubricate a new O-ring seal with clean refrigerant oil and install it on the discharge line fitting. Use only the specified O-rings as they are made of a special material for the R-134a system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(2) Install and tighten the high pressure cut-off switch on the discharge line fitting.

(3) Plug the wire harness connector into the high pressure cut-off switch.

(4) Connect the battery negative cable.

LIQUID LINE

Any kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire air conditioning system. Kinks and sharp bends reduce the flow of refrigerant in the system. A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. In addition, the flexible hose refrigerant lines should be routed so they are at least 80 millimeters (3 inches) from the exhaust manifold.

High pressures are produced in the refrigerant system when the air conditioning compressor is operat-

REMOVAL AND INSTALLATION (Continued)

ing. Extreme care must be exercised to make sure that each of the refrigerant system connections is pressure-tight and leak free. It is a good practice to inspect all flexible hose refrigerant lines at least once a year to make sure they are in good condition and properly routed.

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(3) Disconnect the liquid line refrigerant line couplers at the evaporator inlet and the condenser outlet (Fig. 50). See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

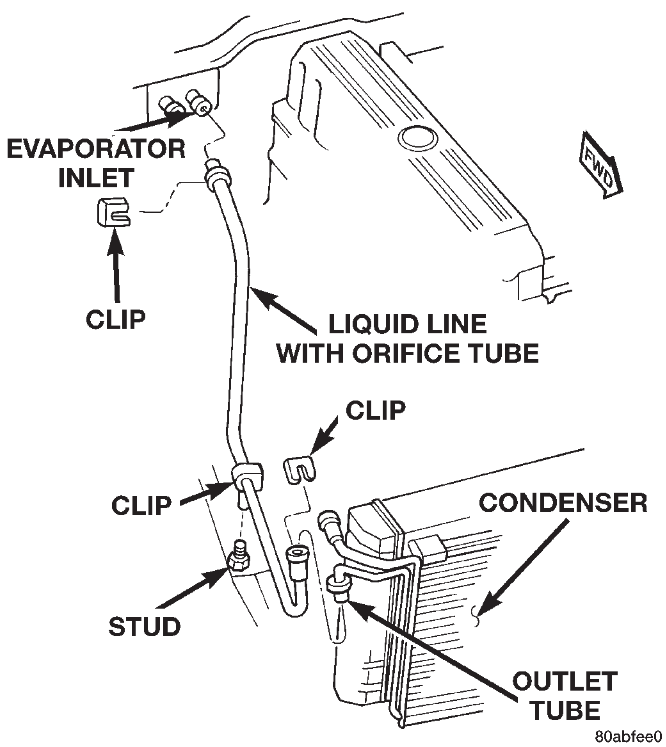


Fig. 50 Liquid Line Remove/Install

(4) Remove the liquid line from the vehicle.

INSTALLATION

(1) Remove the tape or plugs from the refrigerant line fittings on the liquid line, the evaporator inlet and the condenser outlet. Connect the liquid line to the evaporator inlet and condenser outlet refrigerant line couplers. See Refrigerant Line Coupler in this group for the procedures.

(2) Connect the battery negative cable.

(3) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(4) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

LOW PRESSURE CYCLING CLUTCH SWITCH

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the low pressure cycling clutch switch on the top of the accumulator (Fig. 51).

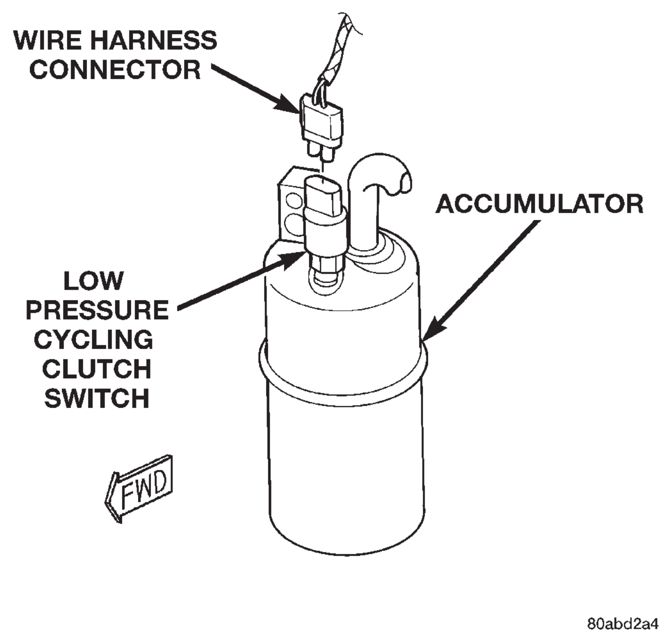


Fig. 51 Low Pressure Cycling Clutch Switch Remove/Install - Typical

(3) Unscrew the low pressure cycling clutch switch from the fitting on the top of the accumulator.

(4) Remove the O-ring seal from the accumulator fitting and discard.

INSTALLATION

(1) Lubricate a new O-ring seal with clean refrigerant oil and install it on the accumulator fitting. Use only the specified O-rings as they are made of a special material for the R-134a system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(2) Install and tighten the low pressure cycling clutch switch on the accumulator fitting. The switch

REMOVAL AND INSTALLATION (Continued)

should be hand-tightened onto the accumulator fitting.

(3) Plug the wire harness connector into the low pressure cycling clutch switch.

(4) Connect the battery negative cable.

KICK COVER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Loosen the two screws that secure the upper half of the kick cover to the heater-A/C housing under the passenger side end of the instrument panel (Fig. 52).

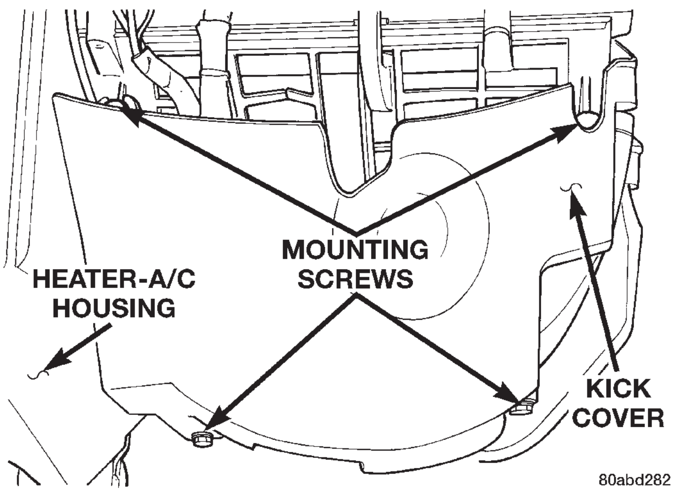


Fig. 52 Kick Cover Remove/Install

(3) Remove the two screws that secure the lower half of the kick cover to the heater-A/C housing.

(4) Pull the kick cover down towards the floor panel to disengage the slotted upper mounting tabs from under the two loosened heater-A/C housing screws.

(5) Remove the kick cover from the heater-A/C housing.

INSTALLATION

(1) Position the slotted upper kick cover mounting tabs under the heads of the two loosened heater-A/C housing screws. Tighten the screws to 2.2 N·m (20 in. lbs.).

(2) Install the two screws that secure the lower kick cover to the heater-A/C housing. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Connect the battery negative cable.

MODE DOOR VACUUM ACTUATOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

DEFROST DOOR ACTUATOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel assembly from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(3) Unplug the two vacuum harness connectors from the defrost door actuator (Fig. 53).

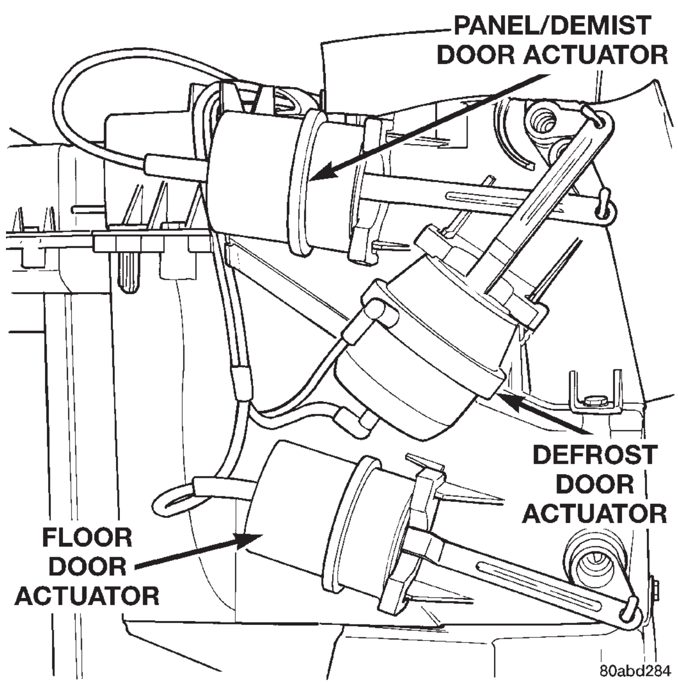


Fig. 53 Defrost, Floor, and Panel/Demist Door Vacuum Actuators

(4) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the heater-A/C housing actuator mount (Fig. 54). Gently pry the

REMOVAL AND INSTALLATION (Continued)

actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

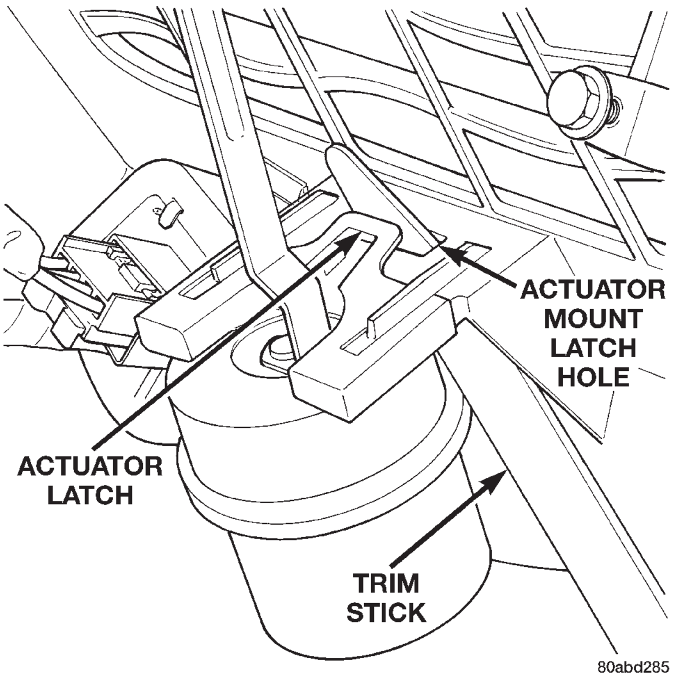


Fig. 54 Vacuum Actuator Remove/Install - Typical

(5) Rotate and tilt the vacuum actuator as required to disengage the hole on the end of the actuator link from the hooked pin on the end of the defrost door lever.

(6) Remove the defrost door vacuum actuator from the vehicle.

(7) Reverse the removal procedures to install.

FLOOR DOOR ACTUATOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel assembly from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(3) Unplug the vacuum harness connector from the floor door actuator (Fig. 53).

(4) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the heater-A/C housing actuator mount (Fig. 54). Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

(5) Rotate and tilt the vacuum actuator as required to disengage the hole on the end of the actuator link from the hooked pin on the end of the floor door lever.

(6) Remove the floor door vacuum actuator from the vehicle.

(7) Reverse the removal procedures to install.

PANEL/DEMIST DOOR ACTUATOR

(1) Remove the defrost door actuator from the heater-A/C housing. See Defrost Door Actuator in this group for the procedures.

(2) Unplug the vacuum harness connector from the panel/demist door actuator (Fig. 53).

(3) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the heater-A/C housing actuator mount (Fig. 54). Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

(4) Rotate and tilt the vacuum actuator as required to disengage the hole on the end of the actuator link from the hooked pin on the end of the panel/demist door lever.

(5) Remove the panel/demist door vacuum actuator from the vehicle.

(6) Reverse the removal procedures to install.

RECIRCULATION AIR DOOR ACTUATOR

A recirculation air door and vacuum 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 heater-A/C housing. See Kick Cover in this group for the procedures.

(3) Unplug the vacuum harness connector from the recirculation air door actuator (Fig. 55).

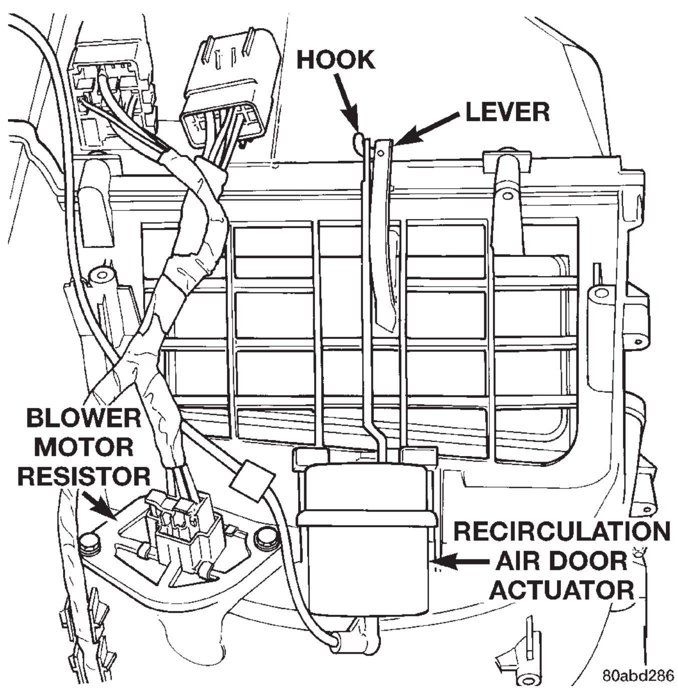


Fig. 55 Recirculation Air Door Vacuum Actuator Remove/Install

REMOVAL AND INSTALLATION (Continued)

(4) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the heater-A/C housing actuator mount (Fig. 54). Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

(5) Rotate and tilt the vacuum actuator as required to disengage the hole on the end of the actuator link from the hooked pin on the end of the recirculation air door lever.

(6) Remove the recirculation air door vacuum actuator from the vehicle.

(7) Reverse the removal procedures to install.

REFRIGERANT LINE COUPLER

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in the Service Procedures section of this group.

(2) Remove the secondary clip from the spring-lock coupler.

(3) Fit the proper size A/C line disconnect tool (Special Tool Kit 7193) over the spring-lock coupler cage (Fig. 56).

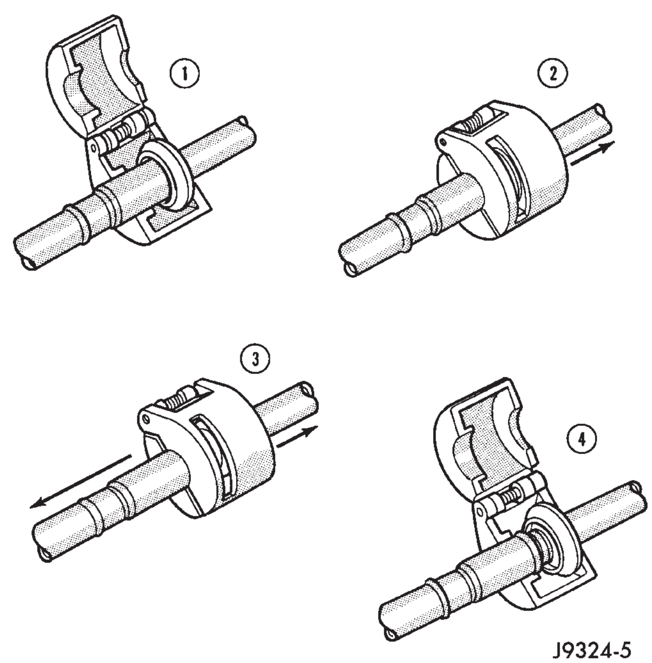


Fig. 56 Refrigerant Line Spring-Lock Coupler Disconnect

(4) Close the two halves of the A/C line disconnect tool around the spring-lock coupler.

(5) Push the A/C line disconnect tool into the open side of the coupler cage to expand the garter spring. Once the garter spring is expanded and while still pushing the disconnect tool into the open side of the coupler cage, pull on the refrigerant line attached to the female half of the coupler fitting until the flange on the female fitting is separated from the garter spring and cage on the male fitting within the disconnect tool.

NOTE: The garter spring may not release if the A/C line disconnect tool is cocked while pushing it into the coupler cage opening.

(6) Open and remove the A/C line disconnect tool from the disconnected spring-lock coupler.

(7) Complete the separation of the two halves of the coupler fitting.

INSTALLATION

(1) Check to ensure that the garter spring is located within the cage of the male coupler fitting, and that the garter spring is not damaged.

(a) If the garter spring is missing, install a new spring by pushing it into the coupler cage opening.

(b) If the garter spring is damaged, remove it from the coupler cage with a small wire hook (DO NOT use a screwdriver) and install a new garter spring.

(2) Clean any dirt or foreign material from both halves of the coupler fitting.

(3) Install new O-rings on the male half of the coupler fitting.

CAUTION: Use only the specified O-rings as they are made of a special material for the R-134a system. The use of any other O-rings may allow the connection to leak intermittently during vehicle operation.

(4) Lubricate the male fitting and O-rings, and the inside of the female fitting with clean R-134a refrigerant oil. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(5) Fit the female half of the coupler fitting over the male half of the fitting.

(6) Push together firmly on the two halves of the coupler fitting until the garter spring in the cage on the male half of the fitting snaps over the flanged end on the female half of the fitting.

(7) Ensure that the spring-lock coupler is fully engaged by trying to separate the two coupler halves. This is done by pulling the refrigerant lines on either side of the coupler away from each other.

(8) Reinstall the secondary clip over the spring-lock coupler cage.

SUCTION AND DISCHARGE LINE

Any kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire air conditioning system. Kinks and sharp bends reduce the flow of refrigerant in the system. A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. In addition, the flexible hose refrigerant lines should be routed so they are at least 80 millimeters (3 inches) from the exhaust manifold.

High pressures are produced in the refrigerant system when the air conditioning compressor is operating. Extreme care must be exercised to make sure that each of the refrigerant system connections is pressure-tight and leak free. It is a good practice to inspect all flexible hose refrigerant lines at least once a year to make sure they are in good condition and properly routed.

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(3) Unplug the wire harness connector from the high pressure cut-off switch.

(4) Disconnect the discharge line refrigerant line fitting from the condenser inlet tube (Fig. 57). See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the nut that secures the suction line block fitting to the accumulator outlet. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the screw that secures the suction and discharge line manifold to the compressor. Install plugs in, or tape over all of the opened refrigerant line fittings.

(7) Remove the suction and discharge line assembly from the vehicle.

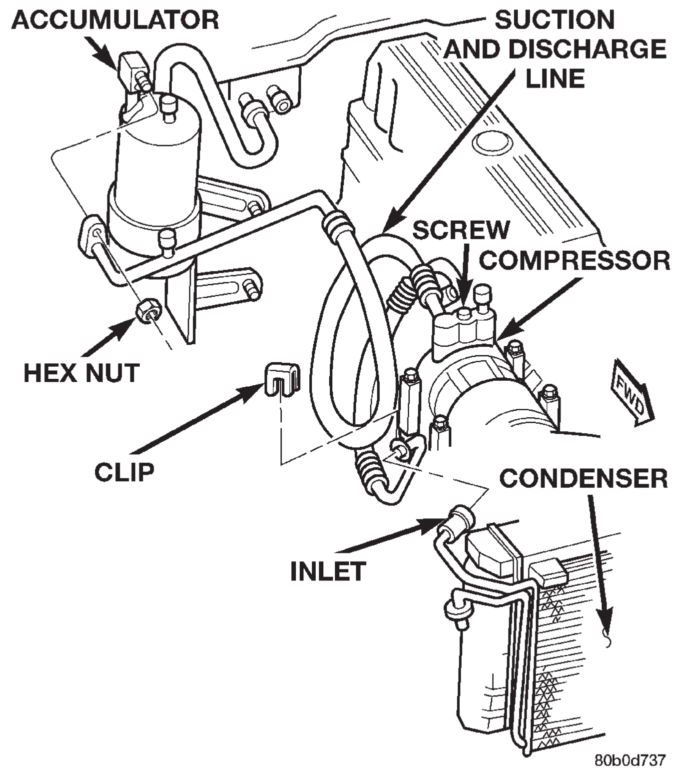


Fig. 57 Suction and Discharge Line

INSTALLATION

(1) Remove the tape or plugs from the suction and discharge line manifold and the compressor. Install the suction and discharge line manifold to the compressor. Tighten the mounting screw to 28 N·m (250 in. lbs.).

(2) Remove the tape or plugs from the suction line and the accumulator outlet block fittings. Install the suction line to the accumulator outlet and tighten the mounting nut to 9 N·m (80 in. lbs.).

(3) Remove the tape or plugs from the refrigerant line fittings on the discharge line and the condenser inlet tube. Connect the discharge line refrigerant line coupler to the condenser inlet tube. See Refrigerant Line Coupler in this group for the procedures.

(4) Plug in the wire harness connector to the high pressure cut-off switch.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(7) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

REMOVAL AND INSTALLATION (Continued)

VACUUM CHECK VALVE

(1) Unplug the heater-A/C vacuum supply line connector at the vacuum check valve (Fig. 58).

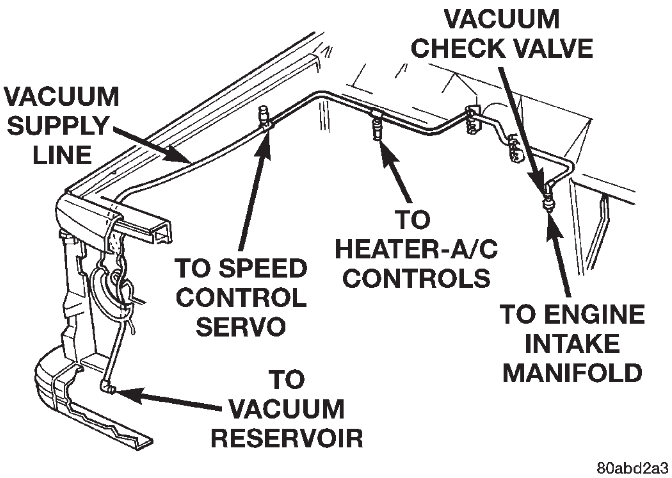


Fig. 58 Vacuum Supply

(2) Note the orientation of the check valve in the vacuum supply line for correct reinstallation.

(3) Unplug the vacuum check valve from the vacuum supply line fittings.

(4) Reverse the removal procedures to install.

VACUUM RESERVOIR

(1) Remove the passenger side bumper end cap from the front bumper. Refer to Group 23 - Body for the procedures.

(2) Unplug the vacuum supply line connector from the vacuum reservoir (Fig. 59).

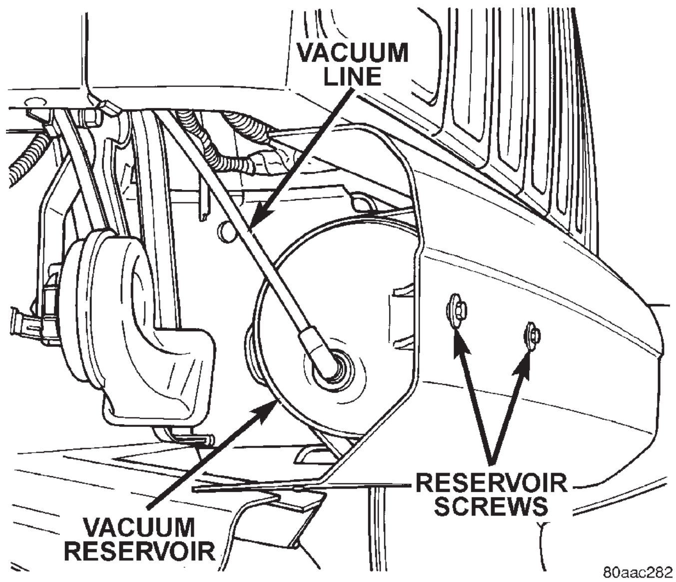


Fig. 59 Vacuum Reservoir Remove/Install

(3) Remove the two screws that secure the vacuum reservoir to the front bumper.

(4) Remove the vacuum reservoir from behind the front bumper.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

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.

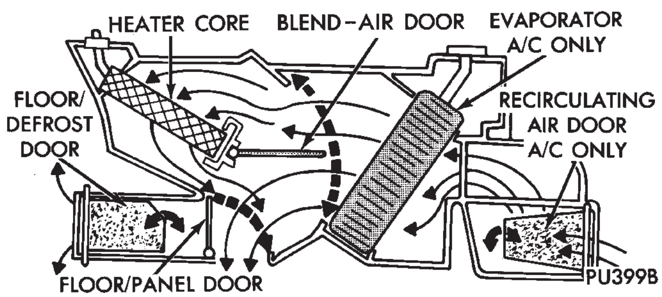


Fig. 1 Common Blend-Air Heater-Air Conditioner System - Typical

Outside fresh air enters the vehicle through the cowl top opening at the base of the windshield, and passes through a plenum chamber to the heater-A/C system blower housing. 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.

It is also important to keep the air intake openings clear of debris because leaf particles and other debris that is small enough to pass through the cowl plenum screen can accumulate within the heater-A/C housing. The closed, warm, damp and dark environment created within the heater-A/C housing is ideal for the growth of certain molds, mildews and other fungi. Any accumulation of decaying plant matter provides an additional food source for fungal spores, which enter the housing with the fresh air. Excess debris, as well as objectionable odors created by decaying plant matter and growing fungi can be discharged into the passenger compartment during heater-A/C system operation.

The heater and optional air conditioner are blend-air type systems. In a blend-air system, a blend-air door controls the amount of unconditioned air (or cooled air from the evaporator on models with air conditioning) that is allowed to flow through, or around, the heater core. A temperature control knob on the heater-A/C control panel determines the discharge air temperature by controlling an electric motor, which moves the blend-air door. This allows an almost immediate control of the output air temperature of the system.

The mode control knob on the heater-only or heater-A/C control panel is used to direct the conditioned air to the selected system outlets. Both mode control switches use engine vacuum to control the mode doors, which are operated by vacuum actuator motors.

On air conditioned vehicles, the outside air intake can be shut off by selecting the Recirculation Mode with the mode control knob. This will operate a vacuum actuated recirculating air door that closes off the outside fresh air intake and recirculates the air that is already inside the vehicle.

The optional air conditioner for all models is designed for the use of non-CFC, R-134a refrigerant. The air conditioning system has an evaporator to cool and dehumidify the incoming air prior to blending it with the heated air. This air conditioning system uses a fixed orifice tube in the liquid line near the condenser outlet tube to meter refrigerant flow to the evaporator coil. To maintain minimum evaporator temperature and prevent evaporator freezing, a fixed pressure setting switch on the accumulator cycles the compressor clutch.

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.

HEATER AND AIR CONDITIONER CONTROL

Both the heater-only and heater-A/C systems use a combination of mechanical, electrical, and vacuum controls. These controls provide the vehicle operator with a number of setting options to help control the climate and comfort within the vehicle. Refer to the owner's manual in the vehicle glove box for more information on the features, use, and suggested operation of these controls.

The heater-only or heater-A/C control panel is located to the right of the instrument cluster on the instrument panel. The control panel contains a rotary-type temperature control knob, a rotary-type mode control switch knob, and a rotary-type blower motor speed switch knob.

The heater-only or heater-A/C control panel cannot be repaired. If faulty or damaged, the entire unit

GENERAL INFORMATION (Continued)

must be replaced. The illumination lamps are available for service replacement.

SERVICE WARNINGS AND PRECAUTIONS

WARNING:

• THE AIR CONDITIONING SYSTEM CONTAINS REFRIGERANT UNDER HIGH PRESSURE. SEVERE PERSONAL INJURY MAY RESULT FROM IMPROPER SERVICE PROCEDURES. REPAIRS SHOULD ONLY BE PERFORMED BY QUALIFIED SERVICE PERSONNEL.

• AVOID BREATHING THE REFRIGERANT AND REFRIGERANT OIL VAPOR OR MIST. EXPOSURE MAY IRRITATE THE EYES, NOSE, AND/OR THROAT. WEAR EYE PROTECTION WHEN SERVICING THE AIR CONDITIONING REFRIGERANT SYSTEM. SERIOUS EYE INJURY CAN RESULT FROM DIRECT CONTACT WITH THE REFRIGERANT. IF EYE CONTACT OCCURS, SEEK MEDICAL ATTENTION IMMEDIATELY.

• DO NOT EXPOSE THE REFRIGERANT TO OPEN FLAME. POISONOUS GAS IS CREATED WHEN REFRIGERANT IS BURNED. AN ELECTRONIC LEAK DETECTOR IS RECOMMENDED.

• IF ACCIDENTAL SYSTEM DISCHARGE OCCURS, VENTILATE THE WORK AREA BEFORE RESUMING SERVICE. LARGE AMOUNTS OF REFRIGERANT RELEASED IN A CLOSED WORK AREA WILL DISPLACE THE OXYGEN AND CAUSE SUFFOCATION.

• THE EVAPORATION RATE OF R-134a REFRIGERANT AT AVERAGE TEMPERATURE AND ALTITUDE IS EXTREMELY HIGH. AS A RESULT, ANYTHING THAT COMES IN CONTACT WITH THE REFRIGERANT WILL FREEZE. ALWAYS PROTECT THE SKIN OR DELICATE OBJECTS FROM DIRECT CONTACT WITH THE REFRIGERANT.

• THE R-134a SERVICE EQUIPMENT OR THE VEHICLE REFRIGERANT SYSTEM SHOULD NOT BE PRESSURE TESTED OR LEAK TESTED WITH COMPRESSED AIR. SOME MIXTURES OF AIR AND R-134a HAVE BEEN SHOWN TO BE COMBUSTIBLE AT ELEVATED PRESSURES. THESE MIXTURES ARE POTENTIALLY DANGEROUS, AND MAY RESULT IN FIRE OR EXPLOSION CAUSING INJURY OR PROPERTY DAMAGE.

CAUTION:

• Liquid refrigerant is corrosive to metal surfaces. Follow the operating instructions supplied with the service equipment being used.

• Never add R-12 to a refrigerant system designed to use R-134a. Damage to the system will result.

• R-12 refrigerant oil must not be mixed with R-134a refrigerant oil. They are not compatible.

• Do not use R-12 equipment or parts on the R-134a system. Damage to the system will result.

• Do not overcharge the refrigerant system. This will cause excessive compressor head pressure and can cause noise and system failure.

• Recover the refrigerant before opening any fitting or connection. Open the fittings with caution, even after the system has been discharged. Never open or loosen a connection before recovering the refrigerant.

• Do not remove the secondary retention clip from any spring-lock coupler connection while the refrigerant system is under pressure. Recover the refrigerant before removing the secondary retention clip. Open the fittings with caution, even after the system has been discharged. Never open or loosen a connection before recovering the refrigerant.

• The refrigerant system must always be evacuated before charging.

• Do not open the refrigerant system or uncap a replacement component until you are ready to service the system. This will prevent contamination in the system.

• Before disconnecting a component, clean the outside of the fittings thoroughly to prevent contamination from entering the refrigerant system.

• Immediately after disconnecting a component from the refrigerant system, seal the open fittings with a cap or plug.

• Before connecting an open refrigerant fitting, always install a new seal or gasket. Coat the fitting and seal with clean refrigerant oil before connecting.

• Do not remove the sealing caps from a replacement component until it is to be installed.

• When installing a refrigerant line, avoid sharp bends that may restrict refrigerant flow. Position the refrigerant lines away from exhaust system components or any sharp edges, which may damage the line.

• Tighten refrigerant fittings only to the specified torque. The aluminum fittings used in the refrigerant system will not tolerate overtightening.

• When disconnecting a refrigerant fitting, use a wrench on both halves of the fitting. This will prevent twisting of the refrigerant lines or tubes.

• Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open a container of refrigerant oil until you are ready to use it. Replace the cap on the oil container immediately after using. Store refrigerant oil only in a clean, airtight, and moisture-free container.

• Keep service tools and the work area clean. Contamination of the refrigerant system through careless work habits must be avoided.

GENERAL INFORMATION (Continued)

COOLING SYSTEM REQUIREMENTS

To maintain the performance level of the heating-air conditioning system, the engine cooling system must be properly maintained. The use of a bug screen is not recommended. Any obstructions in front of the radiator or condenser will reduce the performance of the air conditioning and engine cooling systems.

The engine cooling system includes the heater core and the heater hoses. Refer to Group 7 - Cooling System for more information before the opening of, or attempting any service to the engine cooling system.

REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS

Kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire system. High pressures are produced in the system when it is operating. Extreme care must be exercised to make sure that all refrigerant system connections are pressure tight.

A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. Sharp bends will reduce the flow of refrigerant. The flexible hose lines should be routed so they are at least 80 millimeters (3 inches) from the exhaust manifold. It is a good practice to inspect all flexible refrigerant system hose lines at least once a year to make sure they are in good condition and properly routed.

There are two types of refrigerant fittings:

- All fittings with O-rings need to be coated with refrigerant oil before installation. Use only O-rings that are the correct size and approved for use with R-134a refrigerant. Failure to do so may result in a leak.
- Unified plumbing connections with gaskets cannot be serviced with O-rings. The gaskets are not reusable and new gaskets do not require lubrication before installing.

Using the proper tools when making a refrigerant plumbing connection is very important. Improper tools or improper use of the tools can damage the refrigerant fittings. Always use two wrenches when loosening or tightening tube fittings. Use one wrench to hold one side of the connection stationary, while loosening or tightening the other side of the connection with a second wrench.

The refrigerant must be recovered completely from the system before opening any fitting or connection. Open the fittings with caution, even after the refrigerant has been recovered. If any pressure is noticed as a fitting is loosened, tighten the fitting and recover the refrigerant from the system again.

Do not discharge refrigerant into the atmosphere. Use an R-134a refrigerant recovery/recycling device that meets SAE Standard J2210.

The refrigerant system will remain chemically stable as long as pure, moisture-free R-134a refrigerant and refrigerant oil is used. Dirt, moisture, or air can upset this chemical stability. Operational troubles or serious damage can occur if foreign material is present in the refrigerant system.

When it is necessary to open the refrigerant system, have everything needed to service the system ready. The refrigerant system should not be left open to the atmosphere any longer than necessary. Cap or plug all lines and fittings as soon as they are opened to prevent the entrance of dirt and moisture. All lines and components in parts stock should be capped or sealed until they are to be installed.

All tools, including the refrigerant recycling equipment, the manifold gauge set, and test hoses should be kept clean and dry. All tools and equipment must be designed for R-134a refrigerant.

DESCRIPTION AND OPERATION

ACCUMULATOR

The accumulator is mounted in the engine compartment between the evaporator coil outlet tube and the compressor inlet. Refrigerant enters the accumulator canister as a low pressure vapor through the inlet tube.

Any liquid, oil-laden refrigerant falls to the bottom of the canister, which acts as a separator. A desiccant bag is mounted inside the accumulator canister to absorb any moisture which may have entered and become trapped within the refrigerant system (Fig. 2).

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 through an opening in the engine compartment side of the dash panel 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 fused battery feed through the blower motor relay whenever the ignition switch is in the On position. The blower motor battery feed circuit is protected by a fuse in the Power Distribution Center (PDC). Blower motor

DESCRIPTION AND OPERATION (Continued)

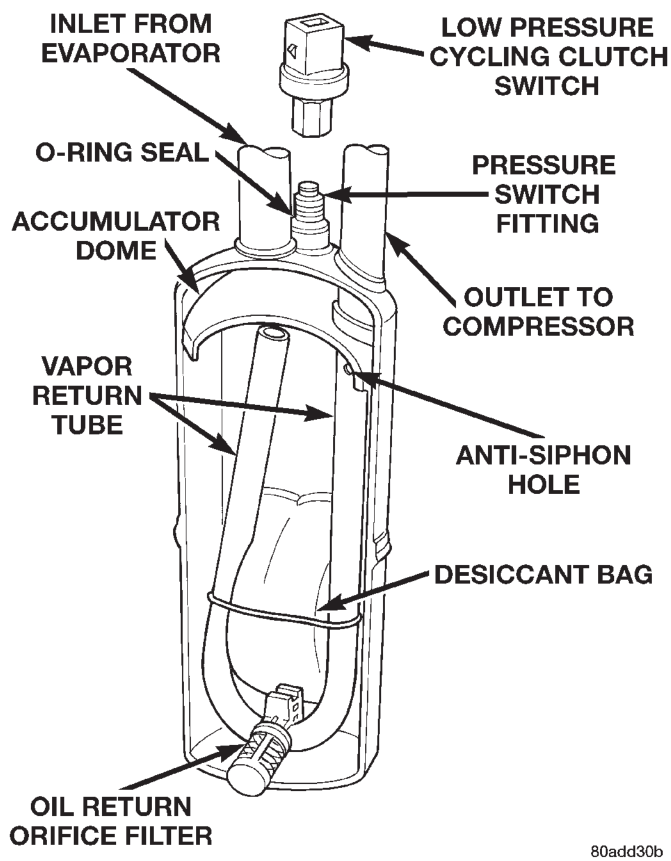


Fig. 2 Accumulator - Typical

speed is controlled by regulating the ground path through the heater-A/C control blower motor switch and the blower motor resistor.

The blower motor and blower motor wheel cannot be repaired and, if faulty or damaged, they must be replaced. The blower motor and blower wheel are serviced only as a unit.

BLOWER MOTOR RELAY

The blower motor relay is a International Standards Organization (ISO)-type relay. The relay is a electromechanical device that switches battery current from a fuse in the Power Distribution Center (PDC) directly to the blower motor. The relay is energized when the relay coil is provided a voltage signal by the ignition switch. See Blower Motor Relay in the Diagnosis and Testing section of this group for more information.

The blower motor relay is installed in a wire harness connector that is secured to the passenger side outboard end of the heater-A/C housing in the passenger compartment, next to the heater-A/C wire harness connector.

The blower motor relay cannot be repaired and, if faulty or damaged, it must be replaced.

BLOWER MOTOR RESISTOR

The blower motor resistor is mounted to the bottom of the heater-A/C housing on the passenger side of the vehicle under the instrument panel. It can be accessed for service by removing the heater-A/C housing 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 ground path through the correct resistor wire to obtain the selected speed. When the highest blower speed is selected, the blower motor switch connects the blower motor directly to ground, bypassing the blower motor resistor.

The blower motor resistor cannot be repaired and, if faulty or damaged, it must be replaced.

BLOWER MOTOR SWITCH

The heater-only or heater-A/C blower motor is controlled by a four position rotary-type blower motor switch, mounted in the heater-A/C control panel. The switch allows the selection of one of four blower motor speeds, but can only be turned off by selecting the Off position with the heater-A/C mode control switch knob.

The blower motor switch directs the blower motor ground path through the mode control switch to the blower motor resistor, or directly to ground, as required to achieve the selected blower motor speed.

The blower motor switch cannot be repaired and, if faulty or damaged, the entire heater-only or heater-A/C control unit must be replaced.

COMPRESSOR

The air conditioning system uses a Sanden SD7H15 seven cylinder, reciprocating wobble plate-type compressor on all models. This compressor has a fixed displacement of 150 cubic centimeters (9.375 cubic inches), and has both the suction and discharge ports located on the cylinder head. A label identifying the use of R-134a refrigerant is located on the compressor.

The compressor is driven by the engine through an electric clutch, drive pulley and belt arrangement. The compressor is lubricated by refrigerant oil that is circulated throughout the refrigerant system with the refrigerant.

The compressor draws in low-pressure refrigerant vapor from the evaporator through its suction port. It then compresses the refrigerant into a high-pressure, high-temperature refrigerant vapor, which is then pumped to the condenser through the compressor discharge port.

The compressor cannot be repaired. If faulty or damaged, the entire compressor assembly must be

DESCRIPTION AND OPERATION (Continued)

replaced. The compressor clutch, pulley and clutch coil are available for service.

COMPRESSOR CLUTCH

The compressor clutch assembly consists of a stationary electromagnetic coil, a hub bearing and pulley assembly, and a clutch plate (Fig. 3). The electromagnetic coil unit and the hub bearing and pulley assembly are each retained on the nose of the compressor front housing with snap rings. The clutch plate is keyed to the compressor shaft and secured with a nut.

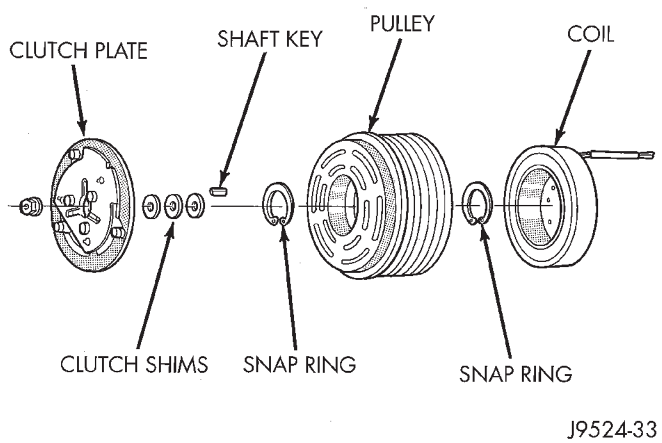


Fig. 3 Compressor Clutch

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 engagement is controlled by several components: the heater-A/C mode control switch, the low pressure cycling clutch switch, the high pressure cut-off switch, the compressor clutch relay, and the Powertrain Control Module (PCM). The PCM may delay compressor clutch engagement for up to thirty seconds. Refer to Group 14 - Fuel System for more information on the PCM controls.

COMPRESSOR CLUTCH RELAY

The compressor clutch relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (footprint) is different, the current capacity is lower, and the relay case dimensions are smaller than those of the conventional ISO relay.

The compressor clutch relay is a electromechanical device that switches battery current to the compressor clutch coil when the Powertrain Control Module (PCM) grounds the coil side of the relay. The PCM responds to inputs from the heater-A/C mode control switch, the low pressure cycling clutch switch, and the high pressure cut-off switch. See Compressor Clutch Relay in the Diagnosis and Testing section of this group for more information.

The compressor clutch relay is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for relay identification and location.

The compressor clutch relay cannot be repaired and, if faulty or damaged, it must be replaced.

CONDENSER

The condenser is located in the air flow in front of the engine cooling radiator. The condenser is a heat exchanger that allows the high-pressure refrigerant gas being discharged by the compressor to give up its heat to the air passing over the condenser fins. When the refrigerant gas gives up its heat, it condenses. When the refrigerant leaves the condenser, it has become a high-pressure liquid refrigerant.

The volume of air flowing over the condenser fins is critical to the proper cooling performance of the air conditioning system. Therefore, it is important that there are no objects placed in front of the radiator grille openings in the front of the vehicle or foreign material on the condenser fins that might obstruct proper air flow. Also, any factory-installed air seals or shrouds must be properly reinstalled following radiator or condenser service.

The condenser cannot be repaired and, if faulty or damaged, it must be replaced.

EVAPORATOR COIL

The evaporator coil is located in the heater-A/C housing, under the instrument panel. The evaporator coil is positioned in the heater-A/C housing so that all air that enters the housing must pass over the fins of the evaporator before it is distributed through the system ducts and outlets. However, air passing over the evaporator coil fins will only be conditioned when the compressor is engaged and circulating refrigerant through the evaporator coil tubes.

Refrigerant enters the evaporator from the fixed orifice tube as a low-temperature, low-pressure liquid. As air flows over the fins of the evaporator, the humidity in the air condenses on the fins, and the heat from the air is absorbed by the refrigerant. Heat absorption causes the refrigerant to boil and vaporize. The refrigerant becomes a low-pressure gas when it leaves the evaporator.

The evaporator coil cannot be repaired and, if faulty or damaged, it must be replaced.

DESCRIPTION AND OPERATION (Continued)

FIXED ORIFICE TUBE

The fixed orifice tube is installed in the liquid line (left-hand drive) or liquid line jumper (right-hand drive) between the outlet of the condenser and the inlet of the evaporator. The fixed orifice tube is located in the end of the liquid line or liquid line jumper that is closest to the condenser outlet tube.

The inlet end of the fixed orifice tube has a nylon mesh filter screen, which filters the refrigerant and helps to reduce the potential for blockage of the metering orifice by refrigerant system contaminants (Fig. 4). The outlet end of the tube has a nylon mesh diffuser screen. The O-rings on the plastic body of the fixed orifice tube seal the tube to the inside of the liquid line and prevent the refrigerant from bypassing the fixed metering orifice.

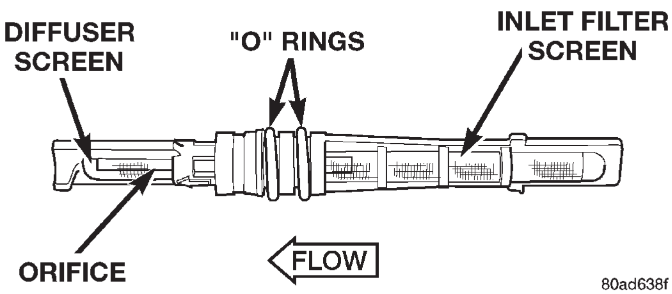


Fig. 4 Fixed Orifice Tube - Typical

The fixed orifice tube is used to meter the flow of liquid refrigerant into the evaporator coil. The high-pressure liquid refrigerant from the condenser expands into a low-pressure liquid as it passes through the metering orifice and diffuser screen of the fixed orifice tube.

The fixed orifice tube cannot be repaired and, if faulty or plugged, the liquid line and fixed orifice tube unit or liquid line jumper and fixed orifice tube unit must be replaced.

HEATER CORE

The heater core is located in the heater-A/C housing, under the instrument panel. It is a heat exchanger made of rows of tubes and fins. Engine coolant is circulated through heater hoses to the heater core at all times. As the coolant flows through the heater core, heat removed from the engine is transferred to the heater core fins and tubes.

Air directed through the heater core picks up the heat from the heater core fins. The blend air door allows control of the heater output air temperature by controlling how much of the air flowing through the heater-A/C housing is directed through the heater core. The blower motor speed controls the volume of air flowing through the heater-A/C housing.

The heater core cannot be repaired and, if faulty or damaged, it must be replaced. Refer to Group 7 - Cooling System for more information on the engine cooling system, the engine coolant and the heater hoses.

HIGH PRESSURE CUT-OFF SWITCH

The high pressure cut-off switch is located on the discharge line between the compressor and the condenser inlet. The switch is screwed onto a fitting that contains a Schrader-type valve, which allows the switch to be serviced without discharging the refrigerant system. The discharge line fitting is equipped with an O-ring to seal the switch connection.

The high pressure cut-off switch is connected in series electrically with the low pressure cycling clutch switch between ground and the Powertrain Control Module (PCM). The switch contacts open and close causing the PCM to turn the compressor clutch on and off. This prevents compressor operation when the discharge line pressure approaches high levels.

The high pressure cut-off switch contacts are open when the discharge line pressure rises above 3100 to 3375 kPa (450 to 490 psi). The switch contacts will close when the discharge line pressure drops to 1860 to 2275 kPa (270 to 330 psi).

The high pressure cut-off switch is a factory-calibrated unit. The switch cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

HIGH PRESSURE RELIEF VALVE

A high pressure relief valve is located on the compressor cylinder head, which is at the rear of the compressor. This mechanical valve is designed to vent refrigerant from the system to protect against damage to the compressor and other system components, caused by condenser air flow restriction or an overcharge of refrigerant.

The high pressure relief valve vents the system when a discharge pressure of 3445 to 4135 kPa (500 to 600 psi) or above is reached. The valve closes when a minimum discharge pressure of 2756 kPa (400 psi) is reached.

The high pressure relief valve vents only enough refrigerant to reduce the system pressure, and then re-seats itself. The majority of the refrigerant is conserved in the system. If the valve vents refrigerant, it does not mean that the valve is faulty.

The high pressure relief valve is a factory-calibrated unit. The valve cannot be adjusted or repaired, and must not be removed or otherwise disturbed. The valve is only serviced as a part of the compressor assembly.

LOW PRESSURE CYCLING CLUTCH SWITCH

The low pressure cycling clutch switch is located on the top of the accumulator. The switch is screwed

DESCRIPTION AND OPERATION (Continued)

onto an accumulator fitting that contains a Schrader-type valve, which allows the switch to be serviced without discharging the refrigerant system. The accumulator fitting is equipped with an O-ring to seal the switch connection.

The low pressure cycling clutch switch is connected in series electrically with the high pressure cut-off switch, between ground and the Powertrain Control Module (PCM). The switch contacts open and close causing the PCM to turn the compressor clutch on and off. This regulates the refrigerant system pressure and controls evaporator temperature. Controlling the 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 to 262 kPa (34 to 38 psi) or above. Lower ambient temperatures, below approximately -1° C (30° F), will also cause the switch contacts to open. This is due to the pressure/temperature relationship of the refrigerant in the system.

The low pressure cycling clutch switch is a factory-calibrated unit. It cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

REFRIGERANT

The refrigerant used in this air conditioning system is a HydroFluoroCarbon (HFC), type R-134a. Unlike R-12, which is a ChloroFluoroCarbon (CFC), R-134a refrigerant does not contain ozone-depleting chlorine. R-134a refrigerant is a non-toxic, non-flammable, clear, and colorless liquefied gas.

Even though R-134a does not contain chlorine, it must be reclaimed and recycled just like CFC-type refrigerants. This is because R-134a is a greenhouse gas and can contribute to global warming.

R-134a refrigerant is not compatible with R-12 refrigerant in an air conditioning system. Even a small amount of R-12 added to an R-134a refrigerant system will cause compressor failure, refrigerant oil sludge or poor air conditioning system performance. In addition, the PolyAlkylene Glycol (PAG) synthetic refrigerant oils used in an R-134a refrigerant system are not compatible with the mineral-based refrigerant oils used in an R-12 refrigerant system.

R-134a refrigerant system service ports, service tool couplers and refrigerant dispensing bottles have all been designed with unique fittings to ensure that an R-134a system is not accidentally contaminated with the wrong refrigerant (R-12). There are also labels posted in the engine compartment of the vehicle and on the compressor identifying to service technicians that the air conditioning system is equipped with R-134a.

REFRIGERANT LINE

The refrigerant lines and hoses are used to carry the refrigerant between the various air conditioning system components. A barrier hose design with a nylon tube inner hose liner is used for the R-134a air conditioning system on this vehicle. This nylon liner helps to further contain the R-134a refrigerant, which has a smaller molecular structure than R-12 refrigerant. The ends of the refrigerant hoses are made from lightweight aluminum or steel, and use braze-less fittings.

Any kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire air conditioning system. Kinks and sharp bends reduce the flow of refrigerant in the system. A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. In addition, the flexible hose refrigerant lines should be routed so they are at least 80 millimeters (3 inches) from the exhaust manifold.

High pressures are produced in the refrigerant system when the air conditioning compressor is operating. Extreme care must be exercised to make sure that each of the refrigerant system connections is pressure-tight and leak free. It is a good practice to inspect all flexible hose refrigerant lines at least once a year to make sure they are in good condition and properly routed.

The refrigerant lines and hoses are coupled with other components of the HVAC system with peanut-block style fittings. A status seal type flat steel gasket with a captured compressible O-ring, is used to mate plumbing lines with A/C components to ensure the integrity of the refrigerant system.

The refrigerant lines and hoses cannot be repaired and, if faulty or damaged, they must be replaced.

REFRIGERANT LINE COUPLER

Spring-lock type refrigerant line couplers are used to connect many of the refrigerant lines and other components to the refrigerant system. These couplers require a special tool for disengaging the two coupler halves.

The spring-lock coupler is held together by a garter spring inside a circular cage on the male half of the fitting (Fig. 5). When the two coupler halves are connected, the flared end of the female fitting slips behind the garter spring inside the cage on the male fitting. The garter spring and cage prevent the flared end of the female fitting from pulling out of the cage.

Two O-rings on the male half of the fitting are used to seal the connection. These O-rings are com-

DESCRIPTION AND OPERATION (Continued)

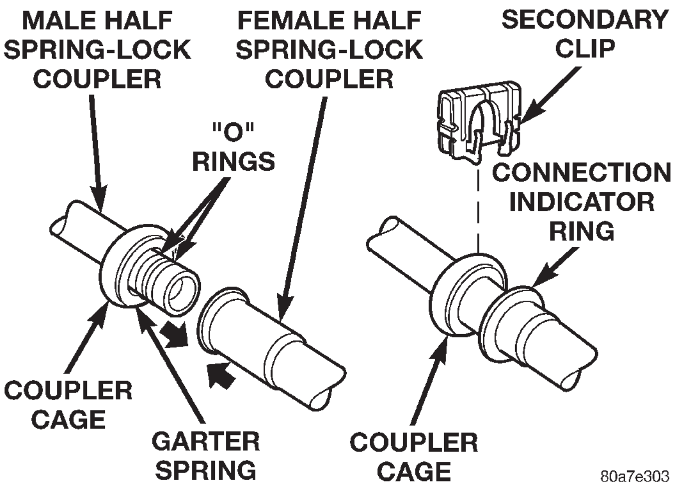


Fig. 5 Spring-Lock Coupler - Typical

patible with R-134a refrigerant and must be replaced with O-rings made of the same material.

Secondary clips are installed over the two connected coupler halves at the factory for added blowoff protection. In addition, some models have a plastic ring that is used at the factory as a visual indicator to confirm that these couplers are connected. After the coupler is connected, the plastic indicator ring is no longer needed; however, it will remain on the refrigerant line near the coupler cage.

REFRIGERANT OIL

The refrigerant oil used in R-134a refrigerant systems is a synthetic-based, PolyAlkylene Glycol (PAG), wax-free lubricant. Mineral-based R-12 refrigerant oils are not compatible with PAG oils, and should never be introduced to an R-134a refrigerant system.

There are different PAG oils available, and each contains a different additive package. The SD7H15 compressor used in this vehicle is designed to use an SP-20 PAG refrigerant oil. Use only refrigerant oil of this same type to service the refrigerant system.

After performing any refrigerant recovery or recycling operation, always replenish the refrigerant system with the same amount of the recommended refrigerant oil as was removed. Too little refrigerant oil can cause compressor damage, and too much can reduce air conditioning system performance.

PAG refrigerant oil is much more hygroscopic than mineral oil, and will absorb any moisture it comes into contact with, even moisture in the air. The PAG oil container should always be kept tightly capped until it is ready to be used. After use, recap the oil container immediately to prevent moisture contamination.

REFRIGERANT SYSTEM SERVICE EQUIPMENT

WARNING: EYE PROTECTION MUST BE WORN WHEN SERVICING AN AIR CONDITIONING REFRIGERANT SYSTEM. TURN OFF (ROTATE CLOCKWISE) ALL VALVES ON THE EQUIPMENT BEING USED, BEFORE CONNECTING TO OR DISCONNECTING FROM THE REFRIGERANT SYSTEM. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY.

When servicing the air conditioning system, a R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used. Contact an automotive service equipment supplier for refrigerant recovery/recycling/charging equipment. Refer to the operating instructions supplied by the equipment manufacturer for proper care and use of this equipment.

A manifold gauge set may be needed with some recovery/recycling/charging equipment (Fig. 6). 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.

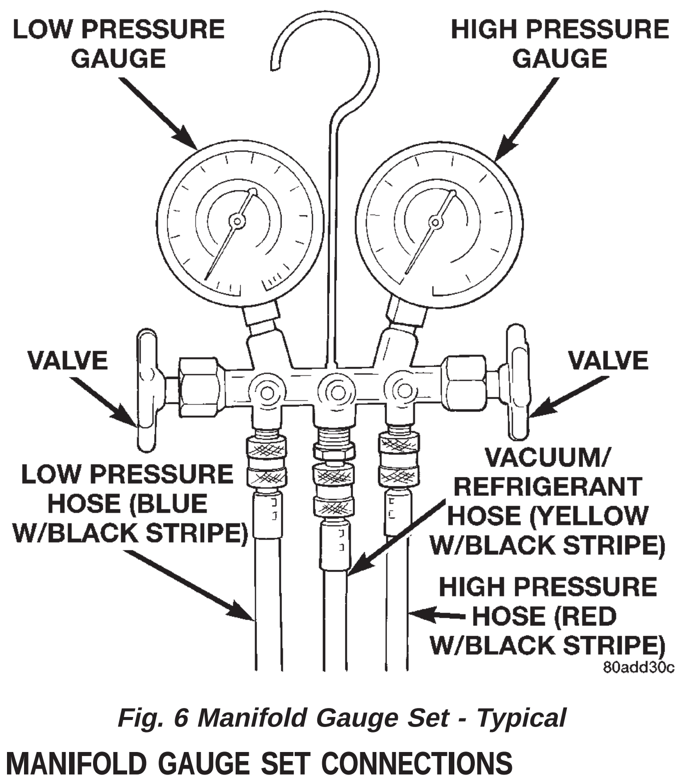


Fig. 6 Manifold Gauge Set - Typical

MANIFOLD GAUGE SET CONNECTIONS

CAUTION: Do not use an R-12 manifold gauge set on an R-134a system. The refrigerants are not compatible and system damage will result.

DESCRIPTION AND OPERATION (Continued)

LOW PRESSURE GAUGE HOSEThe low pressure hose (Blue with Black stripe) attaches to the suction service port. This port is located on the suction line between the accumulator outlet and the compressor.

HIGH PRESSURE GAUGE HOSEThe high pressure hose (Red with Black stripe) attaches to the discharge service port. This port is located on the discharge line between the compressor and the condenser inlet.

RECOVERY/RECYCLING/EVACUATION/CHARGING HOSEThe center manifold hose (Yellow, or White, with Black stripe) is used to recover, evacuate, and charge the refrigerant system. When the low or high pressure valves on the manifold gauge set are opened, the refrigerant in the system will escape through this hose.

REFRIGERANT SYSTEM SERVICE PORT

The two refrigerant system service ports are used to charge, recover/recycle, evacuate, and test the air conditioning refrigerant system. Unique service port coupler sizes are used on the R-134a system, to ensure that the refrigerant system is not accidentally contaminated by the use of the wrong refrigerant (R-12), or refrigerant system service equipment.

The high pressure service port is located on the discharge line, between the compressor and the condenser inlet. The low pressure service port is located on the suction line, between the accumulator outlet and the compressor.

Each of the service ports has a threaded plastic protective cap installed over it from the factory. After servicing the refrigerant system, always reinstall both of the service port caps.

VACUUM CHECK VALVE

A vacuum check valve is installed in the accessory vacuum supply line in the engine compartment, near the vacuum tap on the engine intake manifold. The vacuum check valve is designed to allow vacuum to flow in only one direction through the accessory vacuum supply circuits.

The use of a vacuum check valve helps to maintain the system vacuum needed to retain the selected heater-A/C mode settings. The check valve will prevent the engine from bleeding down system vacuum through the intake manifold during extended heavy engine load (low engine vacuum) operation.

The vacuum check valve cannot be repaired and, if faulty or damaged, it must be replaced.

VACUUM RESERVOIR

The vacuum reservoir is mounted to the front bumper bar behind the passenger side bumper end cap. The bumper end cap must be removed from the vehicle to access the vacuum reservoir for service.

Engine vacuum is stored in the vacuum reservoir. The stored vacuum is used to operate the vacuum-controlled vehicle accessories during periods of low engine vacuum such as when the vehicle is climbing a steep grade, or under other high engine load operating conditions.

The vacuum reservoir cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING

A/C PERFORMANCE

The air conditioning system is designed to provide the passenger compartment with low temperature and low humidity air. The evaporator, located in the heater-A/C housing on the dash panel below the instrument panel, is cooled to temperatures near the freezing point. As warm damp air passes through the cooled evaporator, the air transfers its heat to the refrigerant in the evaporator and the moisture in the air condenses on the evaporator fins. During periods of high heat and humidity, an air conditioning system will be more effective in the Recirculation Mode. With the system in the Recirculation Mode, only air from the passenger compartment passes through the evaporator. As the passenger compartment air dehumidifies, the air conditioning system performance levels improve.

Humidity has an important bearing on the temperature of the air delivered to the interior of the vehicle. It is important to understand the effect that humidity has on the performance of the air conditioning system. When humidity is high, the evaporator has to perform a double duty. It must lower the air temperature, and it must lower the temperature of the moisture in the air that condenses on the evaporator fins. Condensing the moisture in the air transfers heat energy into the evaporator fins and tubing. This reduces the amount of heat the evaporator can absorb from the air. High humidity greatly reduces the ability of the evaporator to lower the temperature of the air.

However, evaporator capacity used to reduce the amount of moisture in the air is not wasted. 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

DIAGNOSIS AND TESTING (Continued)

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 side center A/C (panel) outlet. Operate the engine for five minutes.

(6) The compressor clutch may cycle, depending upon the ambient temperature and humidity. If the clutch cycles, unplug the low pressure cycling clutch switch wire harness connector from the switch located on the accumulator (Fig. 7). Place a jumper wire across the terminals of the low pressure cycling clutch switch wire harness connector.

(7) With the compressor clutch engaged, record the discharge air temperature and the compressor discharge pressure.

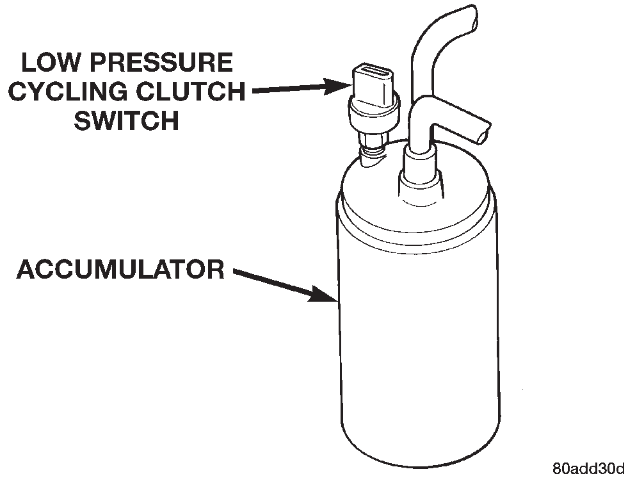


Fig. 7 Low Pressure Cycling Clutch Switch - Typical

(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.

Performance Temperature and Pressure					
Ambient Air Temperature	21° C (70° F)	27° C (80° F)	32° C (90° F)	38° C (100° F)	43° C (110° F)
Air Temperature at Center Panel Outlet	-3 to 3° C (27 to 38° F)	1 to 7° C (33 to 44° F)	3 to 9° C (37 to 48° F)	6 to 13° C (43 to 55° F)	10 to 18° C (50 to 64° F)
Evaporator Inlet Pressure at Charge Port	179 to 241 kPa (26 to 35 psi)	221 to 283 kPa (32 to 41 psi)	262 to 324 kPa (38 to 47 psi)	303 to 365 kPa (44 to 53 psi)	345 to 414 kPa (50 to 60 psi)
Compressor Discharge Pressure	1240 to 1655 kPa (180 to 240 psi)	1380 to 1790 kPa (200 to 260 psi)	1720 to 2070 kPa (250 to 300 psi)	1860 to 2345 kPa (270 to 340 psi)	2070 to 2690 kPa (300 to 390 psi)

DIAGNOSIS AND TESTING (Continued)

(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.

Pressure Diagnosis		
Condition	Possible Causes	Correction
Rapid compressor clutch cycling (ten or more cycles per minute).	1. Low refrigerant system charge.	1. See Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required.
Equal pressures, but the compressor clutch does not engage.	1. No refrigerant in the refrigerant system. 2. Faulty fuse. 3. Faulty compressor clutch coil. 4. Faulty compressor clutch relay. 5. Improperly installed or faulty low pressure cycling clutch switch. 6. Faulty high pressure cut-off switch. 7. Faulty Powertrain Control Module (PCM).	1. See Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required. 2. Check the fuses in the Power Distribution Center and the junction block. Repair the shorted circuit or component and replace the fuses, if required. 3. See Compressor Clutch Coil in this group. Test the compressor clutch coil and replace, if required. 4. See Compressor Clutch Relay in this group. Test the compressor clutch relay and relay circuits. Repair the circuits or replace the relay, if required. 5. See Low Pressure Cycling Clutch Switch in this group. Test the low pressure cycling clutch switch and tighten or replace, if required. 6. See High Pressure Cut-Off Switch in this group. Test the high pressure cut-off switch and replace, if required. 7. Refer to the proper Diagnostic Procedures manual for testing of the PCM. Test the PCM and replace, if required.
Normal pressures, but A/C Performance Test air temperatures at center panel outlet are too high.	1. Excessive refrigerant oil in system. 2. Temperature control cable improperly installed or faulty. 3. Blend-air door inoperative or sealing improperly.	1. See Refrigerant Oil Level in this group. Recover the refrigerant from the refrigerant system and inspect the refrigerant oil content. Restore the refrigerant oil to the proper level, if required. 2. See Temperature Control Cable in this group. Inspect the temperature control cable for proper routing and operation and correct, if required. 3. See Blend-Air Door under Heater-A/C Housing Door in this group. Inspect the blend-air door for proper operation and sealing and correct, if required.
The low side pressure is normal or slightly low, and the high side pressure is too low.	1. Low refrigerant system charge. 2. Refrigerant flow through the accumulator is restricted. 3. Refrigerant flow through the evaporator coil is restricted. 4. Faulty compressor.	1. See Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required. 2. See Accumulator in this group. Replace the restricted accumulator, if required. 3. See Evaporator Coil in this group. Replace the restricted evaporator coil, if required. 4. See Compressor in this group. Replace the compressor, if required.

DIAGNOSIS AND TESTING (Continued)

Pressure Diagnosis		
Condition	Possible Causes	Correction
The low side pressure is normal or slightly high, and the high side pressure is too high.	1. Condenser air flow restricted. 2. Inoperative cooling fan. 3. Refrigerant system overcharged. 4. Air in the refrigerant system. 5. Engine overheating.	1. Check the condenser for damaged fins, foreign objects obstructing air flow through the condenser fins, and missing or improperly installed air seals. Refer to Group 7 - Cooling System for more information on air seals. Clean, repair, or replace components as required. 2. Refer to Group 7 - Cooling System for more information. Test the cooling fan and replace, if required. 3. See Refrigerant System Charge in this group. Recover the refrigerant from the refrigerant system. Charge the refrigerant system to the proper level, if required. 4. See Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required. 5. Refer to Group 7 - Cooling System for more information. Test the cooling system and repair, if required.
The low side pressure is too high, and the high side pressure is too low.	1. Accessory drive belt slipping. 2. Fixed orifice tube not installed. 3. Faulty compressor.	1. Refer to Group 7 - Cooling System for more information. Inspect the accessory drive belt condition and tension. Tighten or replace the accessory drive belt, if required. 2. See Fixed Orifice Tube in this group. Install the missing fixed orifice tube, if required. 3. See Compressor in this group. Replace the compressor, if required.
The low side pressure is too low, and the high side pressure is too high.	1. Restricted refrigerant flow through the refrigerant lines. 2. Restricted refrigerant flow through the fixed orifice tube. 3. Restricted refrigerant flow through the condenser.	1. See Liquid Line and Suction and Discharge Line in this group. Inspect the refrigerant lines for kinks, tight bends or improper routing. Correct the routing or replace the refrigerant line, if required. 2. See Fixed Orifice Tube in this group. Replace the restricted fixed orifice tube, if required. 3. See Condenser in this group. Replace the restricted condenser, if required.

DIAGNOSIS AND TESTING (Continued)

HEATER PERFORMANCE

Before performing the following tests, refer to Group 7 - Cooling System for the procedures to check the radiator coolant level, serpentine drive belt tension, radiator air flow and the radiator fan operation. Also be certain that the accessory vacuum supply line is connected at the engine intake manifold.

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 heat position, and the blower motor switch knob in the highest speed position. Using a test thermometer, check the temperature of the air being discharged at the heater-A/C housing floor outlets. Compare the test thermometer reading to the Temperature Reference chart.

Temperature Reference				
Ambient Air Temperature	15.5° C (60° F)	21.1° C (70° F)	26.6° C (80° F)	32.2° C (90° F)
Minimum Air Temperature at Floor Outlet	62.2° C (144° F)	63.8° C (147° F)	65.5° C (150° F)	67.2° C (153° F)

If the floor outlet air temperature is too low, refer to Group 7 - Cooling System to check the engine coolant temperature specifications. Both of the heater hoses should be hot to the touch. The coolant return heater hose should be slightly cooler than the coolant supply heater hose. If the return hose is much cooler than the supply hose, locate and repair the engine coolant flow obstruction in the cooling system. Refer to Group 7 - Cooling System for the procedures.

OBSTRUCTED COOLANT FLOWPossible locations or causes of obstructed coolant flow:

- Pinched or kinked heater hoses.
- Improper heater hose routing.
- Plugged heater hoses or supply and return ports at the cooling system connections.
- A plugged heater core.

If proper coolant flow through the cooling system is verified, and heater outlet air temperature is still low, a mechanical problem may exist.

MECHANICAL PROBLEMSPossible 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 outlet 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 motor.
- The blend-air door.
- Improper engine coolant temperature.

VACUUM SYSTEM

Vacuum control is used to operate the mode doors in the heater-only and heater-A/C housings. Testing of the heater-only and heater-A/C mode control switch operation will determine if the vacuum, electrical, and mechanical controls are functioning. However, it is possible that a vacuum control system that operates perfectly at engine idle (high engine vacuum) may not function properly at high engine speeds or loads (low engine vacuum). This can be caused by leaks in the vacuum system, or a faulty vacuum check valve.

A vacuum system test will help to identify the source of poor vacuum system performance or vacuum system leaks. Before starting this test, stop the engine and make certain that the problem is not a disconnected vacuum supply tube at the engine intake manifold vacuum tap or at the vacuum reservoir.

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. 8), 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.

VACUUM CHECK VALVE

(1) Remove the vacuum check valve. The valve is located in the vacuum supply tube (black) at the heater-A/C system vacuum tee.

(2) Connect the test set vacuum supply hose to the heater-A/C control side of the valve. When connected

DIAGNOSIS AND TESTING (Continued)

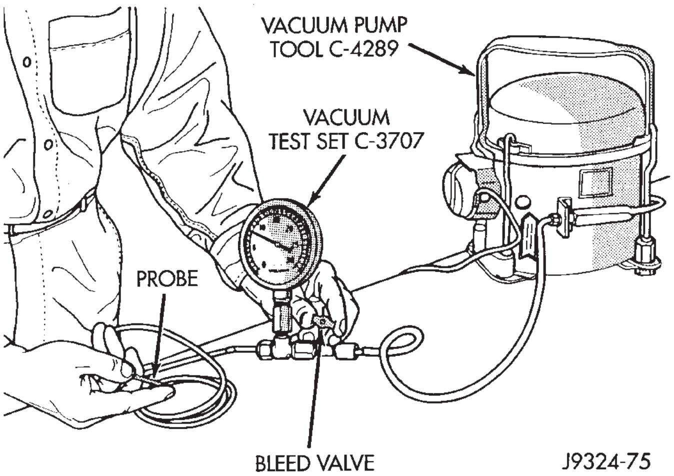


Fig. 8 Adjust Vacuum Test Bleed Valve

to this side of the check valve, no vacuum should pass and the test set gauge should return to the 27 kPa (8 in. Hg.) setting. If OK, go to Step 3. If not OK, replace the faulty valve.

(3) Connect the test set vacuum supply hose to the engine vacuum side of the valve. When connected to this side of the check valve, vacuum should flow through the valve without restriction. If not OK, replace the faulty valve.

HEATER-A/C CONTROLS

(1) Connect the test set vacuum probe to the heater-A/C vacuum supply (black) tube at the tee in the engine compartment. Position the test set gauge so that it can be viewed from the passenger compartment.

(2) Place the heater-A/C mode control switch knob in each mode position, one position at a time, and pause after each selection. The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each selection is made. If not OK, a component or vacuum line in the vacuum circuit of the selected mode has a leak. See 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 ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect the vacuum harness connector behind the glove box and inboard of the glove box opening on the heater-A/C housing.

(2) Connect the test set vacuum hose probe to each port in the heater-A/C housing half of the vacuum harness connector, one port at a time, and pause after each connection (Fig. 9). The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each connection is made. If OK, replace the faulty heater-A/C control. If not OK, go to Step 3.

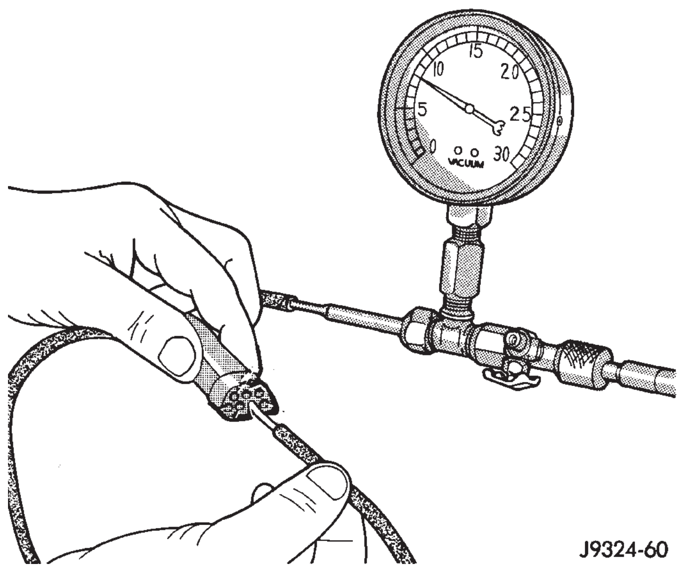
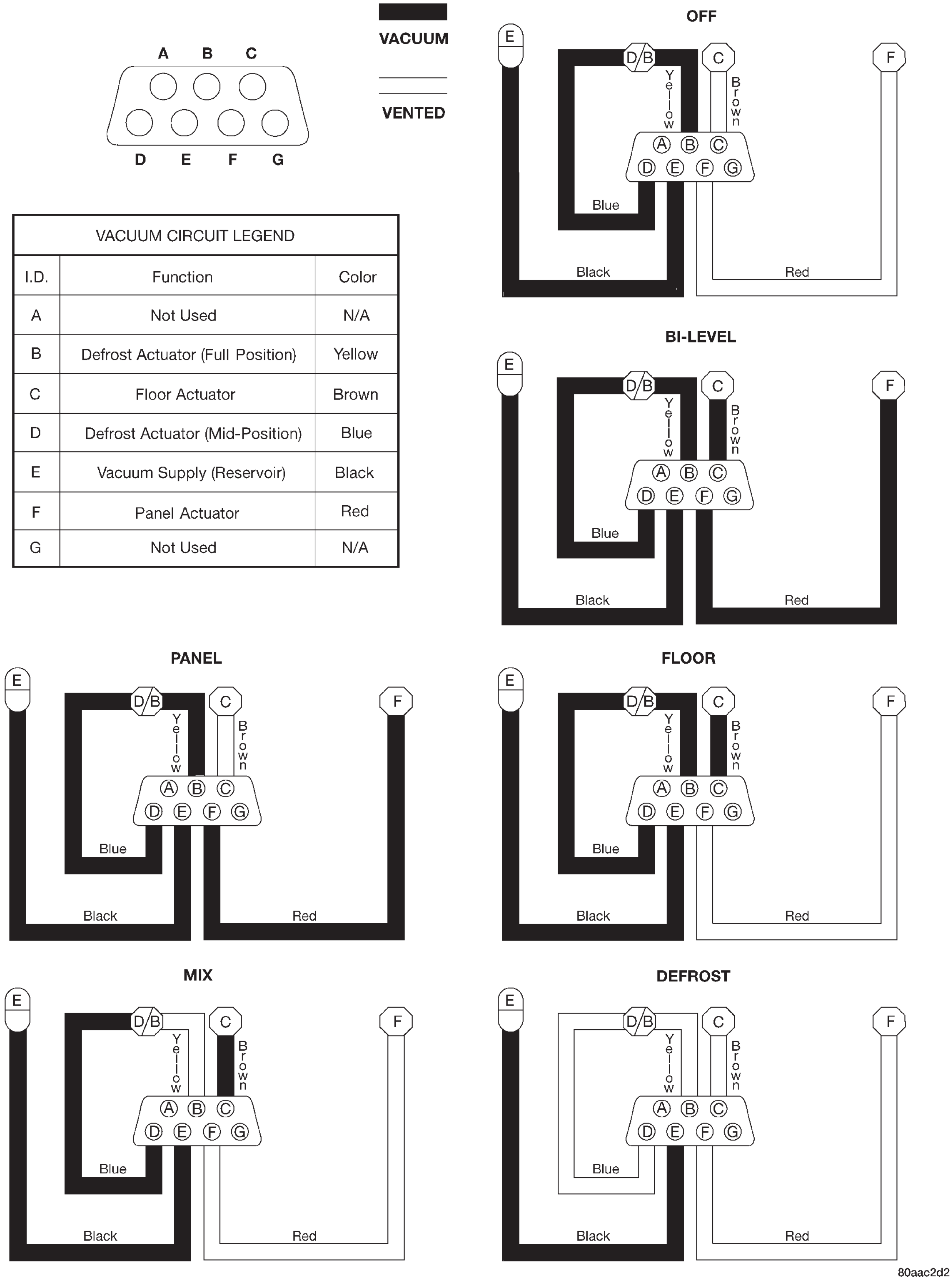


Fig. 9 Vacuum Circuit Test

(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. 10) or (Fig. 11).

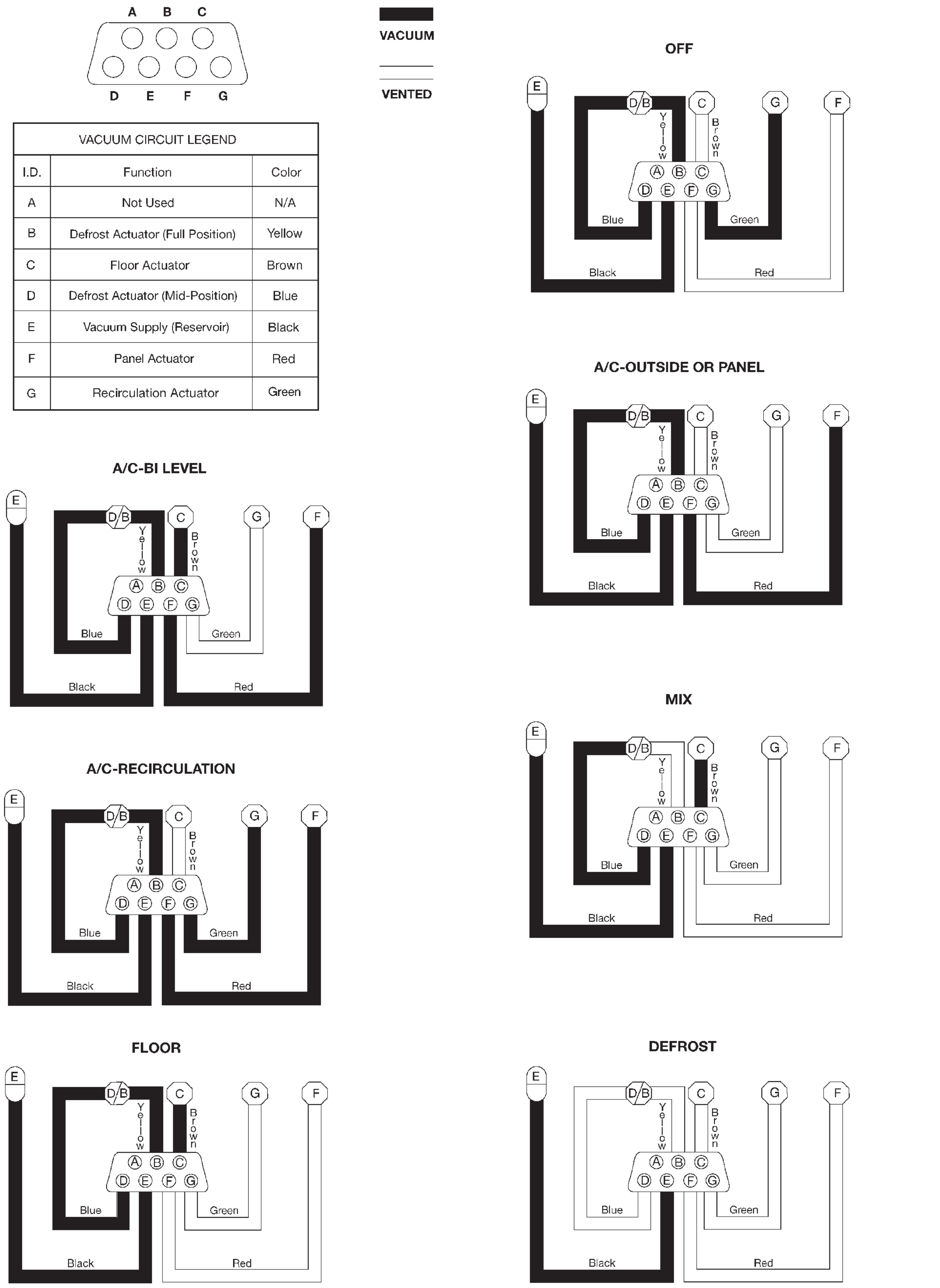
DIAGNOSIS AND TESTING (Continued)



VACUUM CIRCUIT LEGEND		
I.D.	Function	Color
A	Not Used	N/A
B	Defrost Actuator (Full Position)	Yellow
C	Floor Actuator	Brown
D	Defrost Actuator (Mid-Position)	Blue
E	Vacuum Supply (Reservoir)	Black
F	Panel Actuator	Red
G	Not Used	N/A

Fig. 10 Vacuum Circuits - Heater Only

DIAGNOSIS AND TESTING (Continued)



VACUUM CIRCUIT LEGEND		
I.D.	Function	Color
A	Not Used	N/A
B	Defrost Actuator (Full Position)	Yellow
C	Floor Actuator	Brown
D	Defrost Actuator (Mid-Position)	Blue
E	Vacuum Supply (Reservoir)	Black
F	Panel Actuator	Red
G	Recirculation Actuator	Green

Fig. 11 Vacuum Circuits - Heater-A/C

DIAGNOSIS AND TESTING (Continued)

(4) Disconnect and plug the vacuum line from the component (fitting, actuator, valve, switch, or reservoir) on the other end of the leaking circuit. Instrument panel disassembly or removal may be necessary to gain access to some components. See the service procedures in this group.

(5) Connect the test set hose or probe to the open end of the leaking circuit. The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each connection is made. If OK, replace the faulty disconnected component. If not OK, go to Step 6.

(6) To locate a leak in a vacuum line, leave one end of the line plugged and connect the test set hose or probe to the other end of the line. Run your fingers slowly along the line while watching the test set gauge. The vacuum reading will fluctuate when your fingers contact the source of the leak. To repair the vacuum line, cut out the leaking section of the line. Then, insert the loose ends of the line into a suitable length of 3 millimeter (0.125 inch) inside diameter rubber hose.

BLOWER MOTOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams. Possible causes of an inoperative blower motor include:

- Faulty fuse
- Faulty blower motor circuit wiring or wire harness connectors
- Faulty blower motor resistor
- Faulty blower motor relay
- Faulty blower motor switch
- Faulty heater-A/C mode control switch
- Faulty blower motor.

Possible causes of the blower motor not operating in all speeds include:

- Faulty fuse
- Faulty blower motor switch
- Faulty blower motor resistor
- Faulty blower motor circuit wiring or wire harness connectors.

VIBRATION

Possible causes of blower motor vibration include:

- Improper blower motor mounting
- Improper blower wheel mounting
- Blower wheel out of balance or bent
- Blower motor faulty.

NOISE

To verify that the blower is the source of the noise, unplug the blower motor wire harness connector and operate the heater-A/C system. If the noise goes away, possible causes include:

- Foreign material in the heater-A/C housing
- Improper blower motor mounting
- Improper blower wheel mounting
- Blower motor faulty.

BLOWER MOTOR RELAY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

RELAY TEST

The blower motor relay (Fig. 12) is located in a wire harness connector that is secured to the heater-A/C housing behind the glove box on the passenger side of the vehicle, next to the heater-A/C wire harness connector in the passenger compartment. 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.

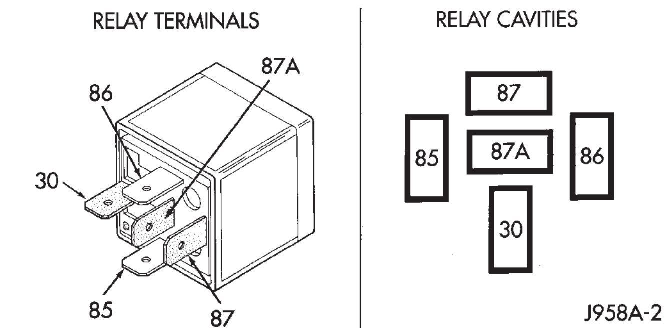
(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see the Relay Circuit Test procedure in this group. If not OK, replace the faulty relay.

RELAY CIRCUIT TEST

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) The relay common feed terminal cavity (30) is connected to fused battery feed directly from a fuse in the Power Distribution Center (PDC), and should be hot at all times. Check for battery voltage at the connector cavity for relay terminal 30. If OK, go to

DIAGNOSIS AND TESTING (Continued)



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 12 Blower Motor Relay

Step 2. If not OK, repair the open circuit to the PDC fuse as required.

(2) The relay normally closed terminal cavity (87A) is not used for this application. Go to Step 3.

(3) The relay normally open terminal cavity (87) is connected to the blower motor. When the relay is energized, terminal 87 is connected to terminal 30 and provides full battery current to the blower motor feed circuit. There should be continuity between the connector cavity for terminal 87 and the blower motor relay output circuit cavity of the blower motor wire harness connector at all times. If OK, go to Step 4. If not OK, repair the open circuit to the blower motor as required.

(4) The coil battery terminal cavity (86) is connected to the ignition switch. When the ignition switch is placed in the On position, fused ignition switch output is directed from a fuse in the junction block to the relay electromagnetic coil to energize the relay. There should be battery voltage at the connector cavity for relay terminal 86 with the ignition switch in the On position. If OK, go to Step 5. If not OK, repair the open circuit to the junction block fuse as required.

(5) The coil ground terminal cavity (85) is connected to ground. This terminal supplies the ground for the relay electromagnet coil. There should be continuity between the connector cavity for relay terminal 85 and a good ground at all times. If not OK, repair the open circuit as required.

BLOWER MOTOR RESISTOR

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the kick cover from the heater-A/C housing and unplug the wire harness connector from the blower motor resistor.

(3) Check for continuity between each of the blower motor switch input terminals of the resistor and the resistor output terminal. In each case there should be continuity. If OK, repair the wire harness circuits between the blower motor switch and the blower motor resistor or blower motor relay as required. If not OK, replace the faulty blower motor resistor.

BLOWER MOTOR SWITCH

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check for battery voltage at the fuse in the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the heater-A/C control from the instrument panel. Check for continuity between the ground circuit cavity of the heater-A/C control wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit to ground as required.

(3) With the heater-A/C control wire harness connector unplugged, place the heater-A/C mode control switch knob in any position except the Off position. Check for continuity between the ground circuit terminal and each of the blower motor driver circuit terminals of the heater-A/C control as you move the blower motor switch knob to each of the four speed positions. There should be continuity at each driver circuit terminal in only one blower motor switch

DIAGNOSIS AND TESTING (Continued)

speed position. If OK, test and repair the blower driver circuits between the heater-A/C control connector and the blower motor resistor as required. If not OK, replace the faulty heater-A/C control unit.

COMPRESSOR

When investigating an air conditioning related noise, you must first know the conditions under which the noise occurs. These conditions include: weather, vehicle speed, transmission in gear or neutral, engine speed, engine temperature, and any other special conditions. Noises that develop during air conditioning operation can often be misleading. For example: What sounds like a failed front bearing or connecting rod, may be caused by loose bolts, nuts, mounting brackets, or a loose compressor clutch assembly.

Drive belts are speed sensitive. At different engine speeds and depending upon belt tension, belts can develop noises that are mistaken for a compressor noise. Improper belt tension can cause a misleading noise when the compressor clutch is engaged, which may not occur when the compressor clutch is disengaged. Check the serpentine drive belt condition and tension as described in Group 7 - Cooling System before beginning this procedure.

(1) Select a quiet area for testing. Duplicate the complaint conditions as much as possible. Switch the compressor on and off several times to clearly identify the compressor noise. Listen to the compressor while the clutch is engaged and disengaged. Probe the compressor with an engine stethoscope or a long screwdriver with the handle held to your ear to better localize the source of the noise.

(2) Loosen all of the compressor mounting hardware and retighten. Tighten the compressor clutch mounting nut. Be certain that the clutch coil is mounted securely to the compressor, and that the clutch plate and pulley are properly aligned and have the correct air gap. See Compressor and Compressor Clutch in the Removal and Installation section of this group for the procedures.

(3) To duplicate a high-ambient temperature condition (high head pressure), restrict the air flow through the condenser. Install a manifold gauge set to be certain that the discharge pressure does not exceed 2760 kPa (400 psi).

(4) Check the refrigerant system plumbing for incorrect routing, rubbing or interference, which can cause unusual noises. Also check the refrigerant lines for kinks or sharp bends that will restrict refrigerant flow, which can cause noises. See Suction and Discharge Line in the Removal and Installation section of this group for more information.

(5) If the noise is from opening and closing of the high pressure relief valve, evacuate and recharge the refrigerant system. See Refrigerant System Evacuate and Refrigerant System Charge in the Service Procedures section of this group. If the high pressure relief valve still does not seat properly, replace the compressor.

(6) If the noise is from liquid slugging on the suction line, replace the accumulator. See Accumulator in the Removal and Installation section of this group for the procedures. Check the refrigerant oil level and the refrigerant system charge. See Refrigerant Oil Level and Refrigerant System Charge in the Service Procedures section of this group. If the liquid slugging condition continues following accumulator replacement, replace the compressor.

(7) If the noise continues, replace the compressor and repeat Step 1.

COMPRESSOR CLUTCH COIL

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams. The battery must be fully-charged before performing the following tests. Refer to Group 8A - Battery for more information.

(1) Connect an ammeter (0 to 10 ampere scale) in series with the clutch coil terminal. Use a voltmeter (0 to 20 volt scale) with clip-type leads for measuring the voltage across the battery and the compressor clutch coil.

(2) With the heater-A/C mode control switch in any A/C mode, and the blower motor switch in the lowest speed position, start the engine and run it at normal idle.

(3) The compressor clutch coil voltage should read within two volts of the battery voltage. If there is voltage at the clutch coil, but the reading is not within two volts of the battery voltage, test the clutch coil feed circuit for excessive voltage drop and repair as required. If there is no voltage reading at the clutch coil, use a DRB scan tool and the proper Diagnostic Procedures manual for testing of the compressor clutch circuit. The following components must be checked and repaired as required before you can complete testing of the clutch coil:

- Fuses in the junction block and the Power Distribution Center (PDC)
- Heater-A/C mode control switch
- Compressor clutch relay
- High pressure cut-off switch
- Low pressure cycling clutch switch
- Powertrain Control Module (PCM).

(4) The compressor clutch coil is acceptable if the current draw measured at the clutch coil is 2.0 to 3.9 amperes with the electrical system voltage at 11.5 to 12.5 volts. This should only be checked with the work area temperature at 21° C (70° F). If system voltage is more than 12.5 volts, add electrical loads by turn-

DIAGNOSIS AND TESTING (Continued)

ing on electrical accessories until the system voltage drops below 12.5 volts.

(a) If the clutch coil current reading is four amperes or more, the coil is shorted and should be replaced.

(b) If the clutch coil current reading is zero, the coil is open and should be replaced.

COMPRESSOR CLUTCH RELAY

RELAY TEST

The compressor clutch relay (Fig. 13) is located in the Power Distribution Center (PDC). Refer to the PDC label for relay identification and location. Remove the relay from the PDC to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see Relay Circuit Test in the Diagnosis and Testing section of this group. If not OK, replace the faulty relay.

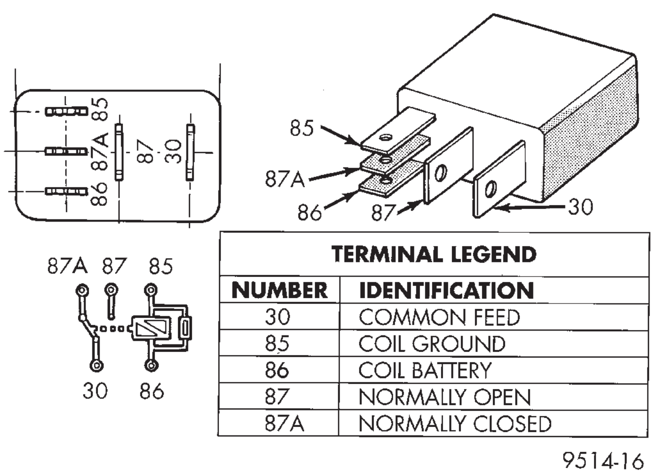


Fig. 13 Compressor Clutch Relay

RELAY CIRCUIT TEST

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) The relay common feed terminal cavity (30) is connected to fused battery feed. There should be battery voltage at the cavity for relay terminal 30 at all times. If OK, go to Step 2. If not OK, repair the open circuit to the fuse in the PDC as required.

(2) The relay normally closed terminal (87A) is not used in this application. Go to Step 3.

(3) The relay normally open terminal cavity (87) is connected to the compressor clutch coil. There should be continuity between this cavity and the A/C compressor clutch relay output circuit cavity of the compressor clutch coil wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) The relay coil battery terminal (86) is connected to the fused ignition switch output (run/start) circuit. There should be battery voltage at the cavity for relay terminal 86 with the ignition switch in the On position. If OK, go to Step 5. If not OK, repair the open circuit to the fuse in the junction block as required.

(5) The coil ground terminal cavity (85) is switched to ground through the Powertrain Control Module (PCM). There should be continuity between this cavity and the A/C compressor clutch relay control circuit cavity of the PCM wire harness connector C (gray) at all times. If not OK, repair the open circuit as required.

HIGH PRESSURE CUT-OFF SWITCH

Before performing diagnosis of the high pressure cut-off switch, verify that the refrigerant system has the correct refrigerant charge. See Refrigerant System Charge in the Service Procedures section of this group for more information.

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the high pressure cut-off switch wire harness connector from the switch on the refrigerant system fitting.

(3) Check for continuity between the two terminals of the high pressure cut-off switch. There should be continuity. If OK, test and repair the A/C switch sense circuit as required. If not OK, replace the faulty switch.

LOW PRESSURE CYCLING CLUTCH SWITCH

Before performing diagnosis of the low pressure cycling clutch switch, be certain that the switch is properly installed on the accumulator fitting. If the switch is too loose it may not open the Schrader-type valve in the accumulator fitting, which will prevent the switch from correctly monitoring the refrigerant system pressure. Remember that lower ambient temperatures, below about -1° C (30° F), during cold weather will open the switch contacts and prevent compressor operation due to the pressure/temperature relationship of the refrigerant.

DIAGNOSIS AND TESTING (Continued)

Also verify that the refrigerant system has the correct refrigerant charge. See Refrigerant System Charge in the Service Procedures section of this group for more information.

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the low pressure cycling clutch switch wire harness connector from the switch on the accumulator fitting.

(3) Install a jumper wire between the two cavities of the low pressure cycling clutch switch wire harness connector.

(4) Connect a manifold gauge set to the refrigerant system service ports. See Refrigerant System Service Equipment and Refrigerant System Service Ports in the Description and Operation section of this group for more information.

(5) Connect the battery negative cable.

(6) Place the heater-A/C mode control switch knob in any A/C position and start the engine.

(7) Check for continuity between the two terminals of the low pressure cycling clutch switch. There should be continuity with a suction pressure reading of 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 for the procedures. If the refrigerant system is low or empty; a leak at a refrigerant line, connector fitting, component, or component seal is likely.

An electronic leak detector designed for R-134a refrigerant, or a fluorescent R-134a leak detection dye and a black light are recommended for locating and confirming refrigerant system leaks. Refer to the operating instructions supplied by the equipment manufacturer for proper care and use of this equipment.

An oily residue on or near refrigerant system lines, connector fittings, components, or component seals can indicate the general location of a possible refrigerant leak. However, the exact leak location should be confirmed with an electronic leak detector prior to component repair or replacement.

To detect a leak in the refrigerant system with an electronic leak detector, perform one of the following procedures:

SYSTEM EMPTY

(1) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(2) Connect and dispense 0.283 kilograms (0.625 pounds or 10 ounces) of R-134a refrigerant into the evacuated refrigerant system. See Refrigerant System Charge in this group for the procedures.

(3) Position the vehicle in a wind-free work area. This will aid in detecting small leaks.

(4) With the engine not running, use a electronic R-134a leak detector and search for leaks. Because R-134a refrigerant is heavier than air, the leak detector probe should be moved slowly along the bottom side of all refrigerant lines, connector fittings and components.

(5) To inspect the evaporator coil for leaks, insert the electronic leak detector probe into the center instrument panel outlet. 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 turned on for five minutes.

(3) With the engine not running, use a electronic R-134a leak detector and search for leaks. Because R-134a refrigerant is heavier than air, the leak detector probe should be moved slowly along the bottom side of all refrigerant lines, connector fittings and components.

(4) To inspect the evaporator coil for leaks, insert the electronic leak detector probe into the center instrument panel outlet. 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 GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE RECOVERING REFRIGERANT.

A R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be

SERVICE PROCEDURES (Continued)

used to recover the refrigerant from an R-134a refrigerant system. Refer to the operating instructions supplied by the equipment manufacturer for the proper care and use of this equipment.

REFRIGERANT SYSTEM EVACUATE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE EVACUATING THE SYSTEM.

If the refrigerant system has been open to the atmosphere, it must be evacuated before the system can be charged. If moisture and air enters the system and becomes mixed with the refrigerant, the compressor head pressure will rise above acceptable operating levels. This will reduce the performance of the air conditioner and damage the compressor. Evacuating the refrigerant system will remove the air and boil the moisture out of the system at near room temperature. To evacuate the refrigerant system, use the following procedure:

(1) Connect a R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 and a manifold gauge set to the refrigerant system of the vehicle.

(2) Open the low and high side valves and start the charging station vacuum pump. When the suction gauge reads 88 kPa (26 in. Hg.) vacuum or greater, close all of the valves and turn off the vacuum pump.

(a) If the refrigerant system fails to reach the specified vacuum, the system has a leak that must be corrected. See Refrigerant System Leaks in the Diagnosis and Testing section of this group for the procedures.

(b) If the refrigerant system maintains the specified vacuum for five minutes, restart the vacuum pump, open the suction and discharge valves and evacuate the system for an additional ten minutes.

(3) Close all of the valves, and turn off the charging station vacuum pump.

(4) The refrigerant system is now ready to be charged with R-134a refrigerant. See Refrigerant System Charge in the Service Procedures section of this group.

REFRIGERANT SYSTEM CHARGE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE CHARGING THE REFRIGERANT SYSTEM.

After the refrigerant system has been tested for leaks and evacuated, a refrigerant charge can be injected into the system. See Refrigerant Charge Capacity for the proper amount of the refrigerant charge.

A R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used to charge the refrigerant system with R-134a refrigerant. Refer to the operating instructions supplied by the equipment manufacturer for proper care and use of this equipment.

REFRIGERANT CHARGE CAPACITY

The R-134a refrigerant system charge capacity for this vehicle is 0.567 kilograms (1.25 pounds).

REFRIGERANT OIL LEVEL

When an air conditioning system is assembled at the factory, all components except the compressor are refrigerant oil free. After the refrigerant system has been charged and operated, the refrigerant oil in the compressor is dispersed throughout the refrigerant system. The accumulator, evaporator, condenser, and compressor will each retain a significant amount of the needed refrigerant oil.

It is important to have the correct amount of oil in the refrigerant system. This ensures proper lubrication of the compressor. Too little oil will result in damage to the compressor. Too much oil will reduce the cooling capacity of the air conditioning system.

It will not be necessary to check the oil level in the compressor or to add oil, unless there has been an oil loss. An oil loss may occur due to a rupture or leak from a refrigerant line, a connector fitting, a component, or a component seal. If a leak occurs, add 30 milliliters (1 fluid ounce) of refrigerant oil to the refrigerant system after the repair has been made. Refrigerant oil loss will be evident at the leak point by the presence of a wet, shiny surface around the leak.

Refrigerant oil must be added when a accumulator, evaporator coil, or condenser are replaced. See the Refrigerant Oil Capacities chart. When a compressor is replaced, the refrigerant oil must be drained from the old compressor and measured. Drain all of the refrigerant oil from the new compressor, then fill the new compressor with the same amount of refrigerant oil that was drained out of the old compressor.

Refrigerant Oil Capacities		
Component	ml	fl oz
A/C System	240	8.1
Accumulator	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 COUPLER

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in the Service Procedures section of this group.

(2) Remove the secondary clip from the spring-lock coupler.

(3) Fit the proper size A/C line disconnect tool (Special Tool Kit 7193) over the spring-lock coupler cage (Fig. 14).

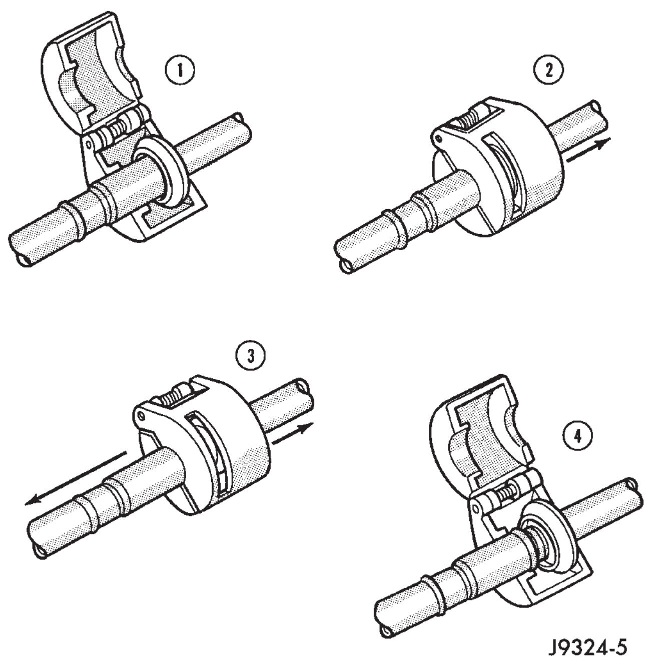


Fig. 14 Refrigerant Line Spring-Lock Coupler Disconnect

(4) Close the two halves of the A/C line disconnect tool around the spring-lock coupler.

(5) Push the A/C line disconnect tool into the open side of the coupler cage to expand the garter spring. Once the garter spring is expanded and while still pushing the disconnect tool into the open side of the coupler cage, pull on the refrigerant line attached to the female half of the coupler fitting until the flange on the female fitting is separated from the garter spring and cage on the male fitting within the disconnect tool.

NOTE: The garter spring may not release if the A/C line disconnect tool is cocked while pushing it into the coupler cage opening.

(6) Open and remove the A/C line disconnect tool from the disconnected spring-lock coupler.

(7) Complete the separation of the two halves of the coupler fitting.

INSTALLATION

(1) Check to ensure that the garter spring is located within the cage of the male coupler fitting, and that the garter spring is not damaged.

(a) If the garter spring is missing, install a new spring by pushing it into the coupler cage opening.

(b) If the garter spring is damaged, remove it from the coupler cage with a small wire hook (DO NOT use a screwdriver) and install a new garter spring.

(2) Clean any dirt or foreign material from both halves of the coupler fitting.

(3) Install new O-rings on the male half of the coupler fitting.

CAUTION: Use only the specified O-rings as they are made of a special material for the R-134a system. The use of any other O-rings may allow the connection to leak intermittently during vehicle operation.

(4) Lubricate the male fitting and O-rings, and the inside of the female fitting with clean R-134a refrigerant oil. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(5) Fit the female half of the coupler fitting over the male half of the fitting.

(6) Push together firmly on the two halves of the coupler fitting until the garter spring in the cage on the male half of the fitting snaps over the flanged end on the female half of the fitting.

(7) Ensure that the spring-lock coupler is fully engaged by trying to separate the two coupler halves. This is done by pulling the refrigerant lines on either side of the coupler away from each other.

(8) Reinstall the secondary clip over the spring-lock coupler cage.

HIGH PRESSURE CUT-OFF SWITCH

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the high pressure cut-off switch, which is mounted to a fitting on the discharge line between the compressor and the condenser inlet (Fig. 15).

REMOVAL AND INSTALLATION (Continued)

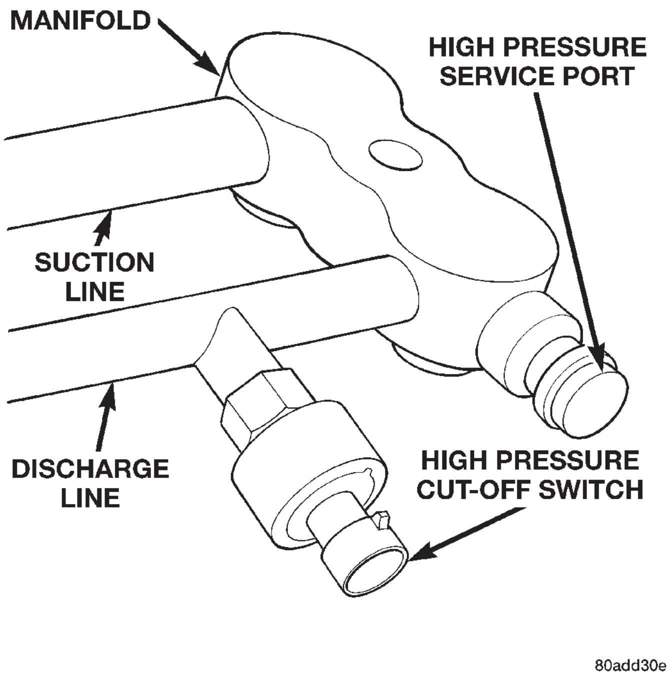


Fig. 15 High Pressure Cut-Off Switch Remove/Install - Typical

(3) Unscrew the high pressure cut-off switch from the discharge line fitting.

(4) Remove the high pressure cut-off switch from the vehicle.

(5) Remove the O-ring seal from the discharge line fitting and discard.

INSTALLATION

(1) Lubricate a new O-ring seal with clean refrigerant oil and install it on the discharge line fitting. Use only the specified O-rings as they are made of a special material for the R-134a system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(2) Install and tighten the high pressure cut-off switch on the discharge line fitting.

(3) Plug the wire harness connector into the high pressure cut-off switch.

(4) Connect the battery negative cable.

SUCTION AND DISCHARGE LINE

Any kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire air conditioning system. Kinks and sharp bends reduce the flow of refrigerant in the system. A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. In addition, the flexible hose refrigerant lines should be routed so they are at least 80 millimeters (3 inches) from the exhaust manifold.

High pressures are produced in the refrigerant system when the air conditioning compressor is operating. Extreme care must be exercised to make sure that each of the refrigerant system connections is pressure-tight and leak free. It is a good practice to inspect all flexible hose refrigerant lines at least once a year to make sure they are in good condition and properly routed.

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

LEFT-HAND DRIVE

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(3) Unplug the wire harness connector from the high pressure cut-off switch.

(4) Disconnect the discharge line refrigerant line fitting from the condenser inlet tube (Fig. 16). See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

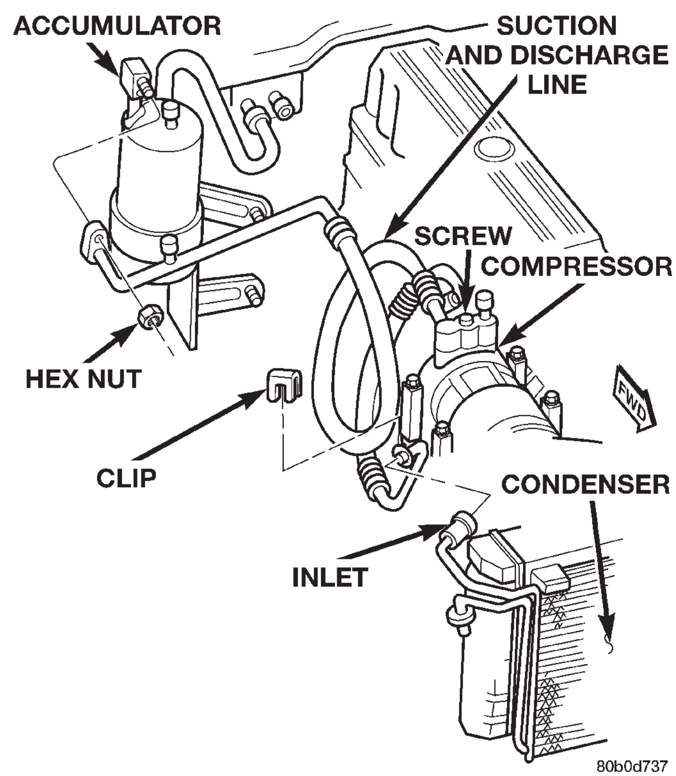


Fig. 16 Suction and Discharge Line Remove/Install - Left-Hand Drive

(5) Remove the nut that secures the suction line block fitting to the accumulator outlet. Install plugs

REMOVAL AND INSTALLATION (Continued)

in, or tape over all of the opened refrigerant line fittings.

(6) Remove the screw that secures the suction and discharge line manifold to the compressor. Install plugs in, or tape over all of the opened refrigerant line fittings.

(7) Remove the suction and discharge line assembly from the vehicle.

INSTALLATION

(1) Remove the tape or plugs from the suction and discharge line manifold and the compressor. Install the suction and discharge line manifold to the compressor. Tighten the mounting screw to 28 N·m (250 in. lbs.).

(2) Remove the tape or plugs from the suction line and the accumulator outlet block fittings. Install the suction line to the accumulator outlet and tighten the mounting nut to 9 N·m (80 in. lbs.).

(3) Remove the tape or plugs from the refrigerant line fittings on the discharge line and the condenser inlet tube. Connect the discharge line refrigerant line coupler to the condenser inlet tube. See Refrigerant Line Coupler in this group for the procedures.

(4) Plug in the wire harness connector to the high pressure cut-off switch.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(7) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

RIGHT-HAND DRIVE - 2.5L ENGINE

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(3) Unplug the wire harness connector from the high pressure cut-off switch.

(4) Disconnect the discharge line refrigerant line fitting from the condenser inlet tube (Fig. 17). See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the nut that secures the suction line block fitting to the accumulator outlet. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the screw that secures the suction and discharge line manifold to the compressor. Install plugs in, or tape over all of the opened refrigerant line fittings.

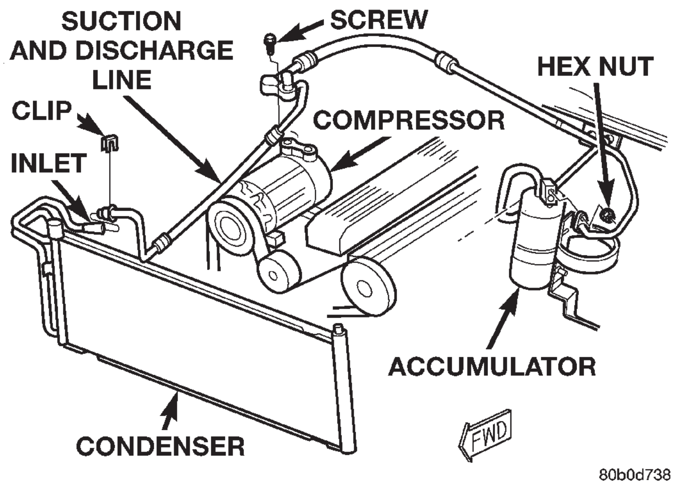


Fig. 17 Suction and Discharge Line Remove/Install - Right-Hand Drive 2.5L Engine

(7) Remove the suction and discharge line assembly from the vehicle.

INSTALLATION

(1) Remove the tape or plugs from the suction and discharge line manifold and the compressor. Install the suction and discharge line manifold to the compressor. Tighten the mounting screw to 28 N·m (250 in. lbs.).

(2) Remove the tape or plugs from the suction line and the accumulator outlet block fittings. Install the suction line to the accumulator outlet and tighten the mounting nut to 9 N·m (80 in. lbs.).

(3) Remove the tape or plugs from the refrigerant line fittings on the discharge line and the condenser inlet tube. Connect the discharge line refrigerant line coupler to the condenser inlet tube. See Refrigerant Line Coupler in this group for the procedures.

(4) Plug in the wire harness connector to the high pressure cut-off switch.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(7) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

RIGHT-HAND DRIVE - 4.0L ENGINE

The suction and discharge lines for this model are individual components and are secured to a manifold block on the compressor with block fittings (Fig. 18). There is also a jumper line installed between the discharge line and the condenser inlet that is secured with refrigerant line couplers at each end. Each of these components is available as a separate service part.

The suction and discharge line components can be removed from or installed on the vehicle individually,

REMOVAL AND INSTALLATION (Continued)

or as a unit. Otherwise, the service procedures are the same as those for the other applications. Tighten the additional mounting hardware as follows:

- Suction line to manifold block nut - 9 N·m (80 in. lbs.)
- Discharge line to manifold block nut - 9 N·m (80 in. lbs.)
- Manifold block to compressor screw - 28 N·m (250 in. lbs.).

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) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(2) Disconnect and isolate the battery negative cable.

(3) Remove the serpentine drive belt. Refer to Group 7 - Cooling System for the procedures.

(4) If the vehicle is equipped with Right-Hand Drive (RHD) and the 4.0L engine, raise and support the vehicle.

(5) Unplug the compressor clutch coil wire harness connector.

(6) Remove the suction and discharge refrigerant line manifold from the compressor. See Suction and Discharge Line in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant fittings.

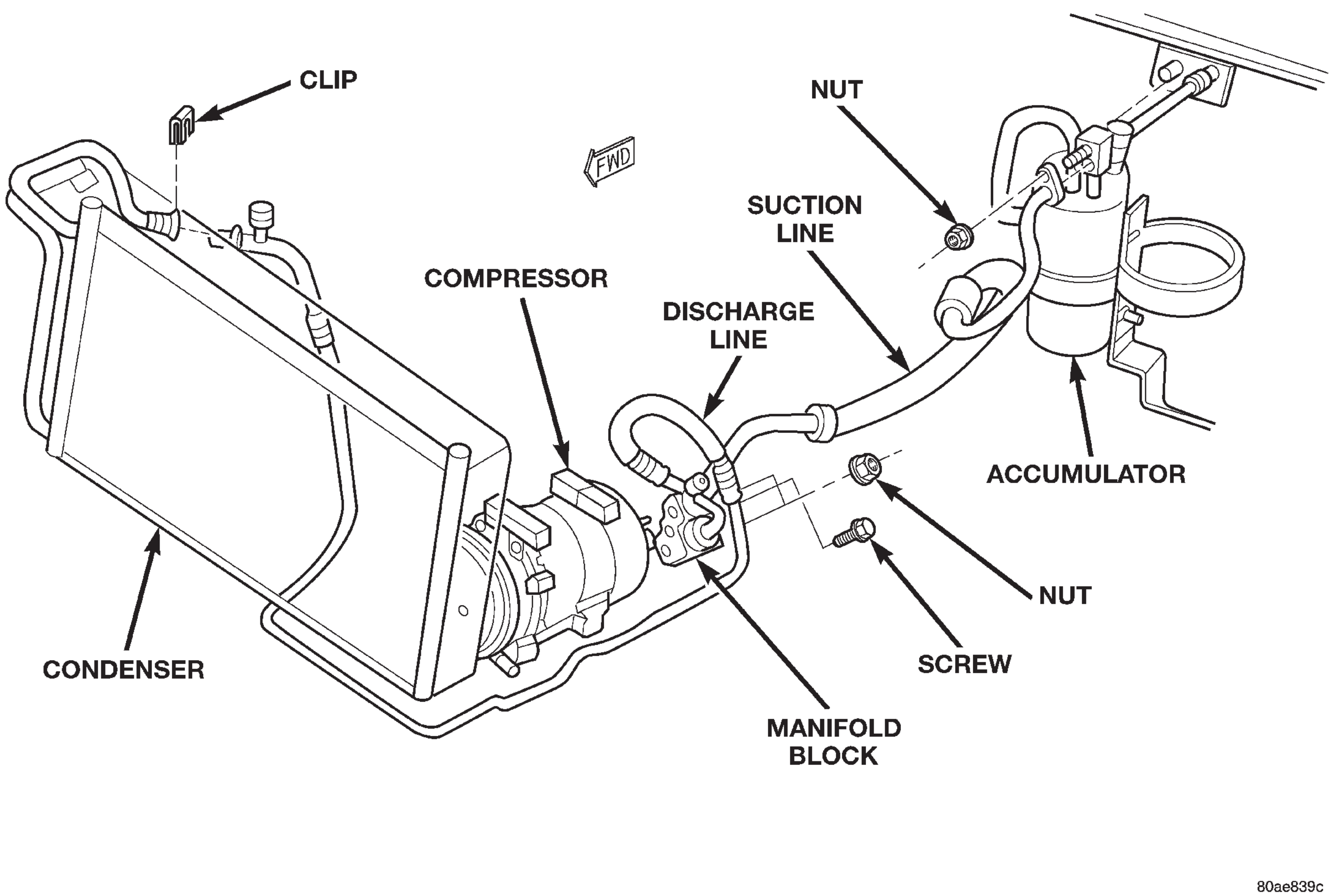


Fig. 18 Suction and Discharge Line Remove/Install - Right-Hand Drive 4.0L Engine

REMOVAL AND INSTALLATION (Continued)

(7) Remove the four bolts that secure the compressor to the mounting bracket (Fig. 19) or (Fig. 20).

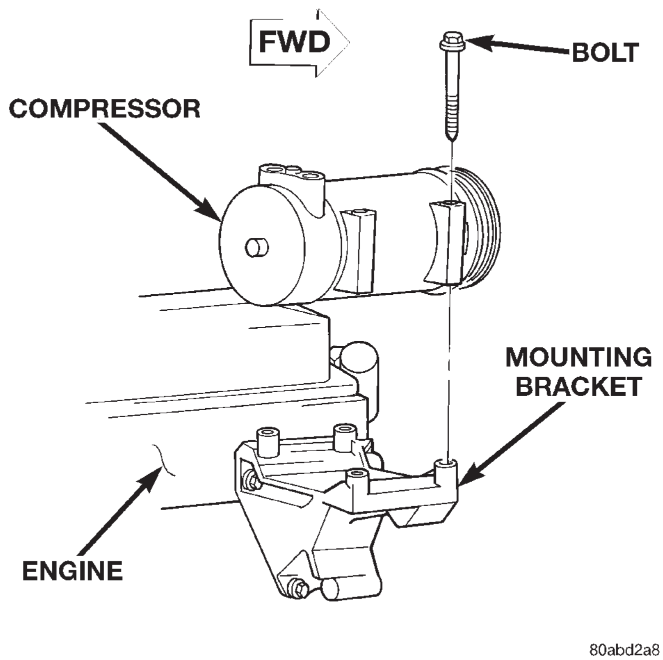


Fig. 19 Compressor Remove/Install - All 2.5L Engines and LHD 4.0L Engines

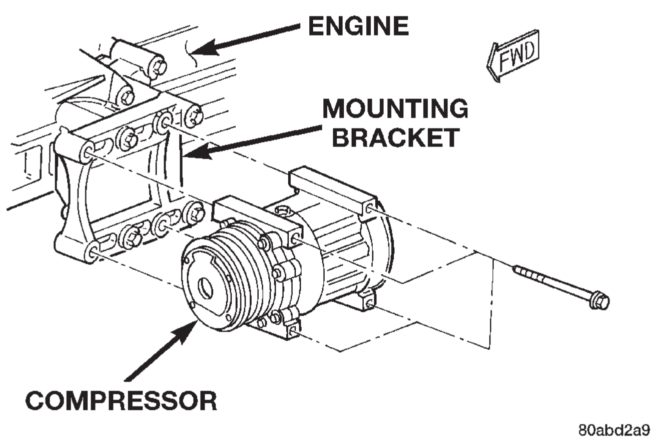


Fig. 20 Compressor Remove/Install - RHD 4.0L Engines

(8) Remove the compressor from the mounting bracket.

INSTALLATION

NOTE: If a replacement compressor is being installed, be certain to check the refrigerant oil level. See Refrigerant Oil Level in this group for the procedures. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(1) Install the compressor to the mounting bracket. Tighten the four mounting bolts as follows:

- All 2.5L engines and LHD 4.0L engines - 27 N·m (20 ft. lbs.)
- RHD 4.0L engines - 57 N·m (42 ft. lbs.).

(2) Remove the tape or plugs from all of the opened refrigerant line fittings. Install the suction and discharge line manifold to the compressor. See Suction and Discharge Line in this group for the procedures.

(3) Install the serpentine drive belt. Refer to Group 7 - Cooling System for the procedures.

(4) Plug in the compressor clutch coil wire harness connector.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(7) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

A/C COMPRESSOR (DIESEL)

REMOVAL

(1) Disconnect the negative battery cable.

(2) Recover the refrigerant. See Refrigerant Recovery in this group for the procedure.

(3) Disconnect the A/C compressor electrical connector (Fig. 21).

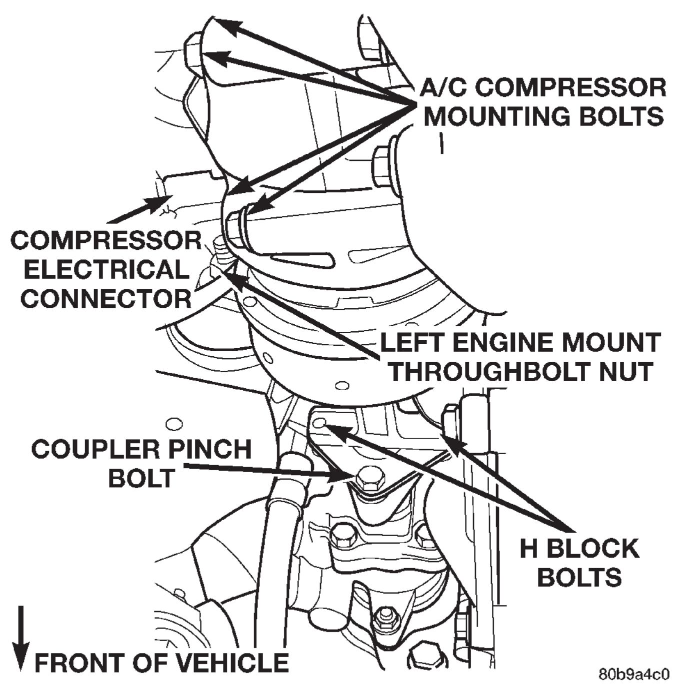


Fig. 21 A/C Compressor Position & Orientation

(4) Remove the suction and discharge refrigerant lines from the compressor and plug the openings.

(5) Raise the vehicle on a hoist.

REMOVAL AND INSTALLATION (Continued)

(6) Loosen all (4) H-block retaining bolts. Do not remove at this time.

NOTE: Mark the H-Block position in relation to the power steering pump so it may be reinstalled in the same position.

(7) Remove the (2) H-block bolts from the power steering pump side of the block (Fig. 21).

(8) Remove the serpentine drive belt. Refer to Group 7, Cooling System for the procedure.

(9) Loosen, but do not remove, the coupler pinch bolt and slide the coupler towards the pump (Fig. 21).

NOTE: There are 4 spacers located between the engine block and the A/C compressor. The doweled spacers are located in the front, undoweled in the rear.

(10) Remove the (4) A/C compressor retaining bolts (Fig. 21).

(11) Remove the compressor assembly from the vehicle with H-Block attached.

CAUTION: Check the refrigerant oil level in the new compressor prior to installation. See compressor oil level in this group for a detailed procedure.

INSTALLATION

(1) Transfer the H-Block to the new compressor and leave the bolts loose at this time.

(2) Lift the A/C compressor in position and install the (4) spacers and retaining bolts (Fig. 22). Torque the bolts to 24 N·m (18 ft. lbs.)

(3) Slide the drive coupler into its original position and start the remaining (2) H-Block bolts (Fig. 22).

(4) Install the serpentine drive belt. See Group 7, Cooling System for the procedure.

(5) Torque all H-Block retaining bolts to 24 N·m (18 ft. lbs.).

(6) Lower the vehicle from the hoist.

(7) Install the suction and discharge refrigerant lines on the compressor, making sure the O-rings are well lubricated and free of tears.

(8) Connect the A/C compressor electrical connector (Fig. 22).

(9) Connect the negative battery cable.

(10) Charge the refrigerant system. See Refrigerant System Charge in this group for procedure.

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.

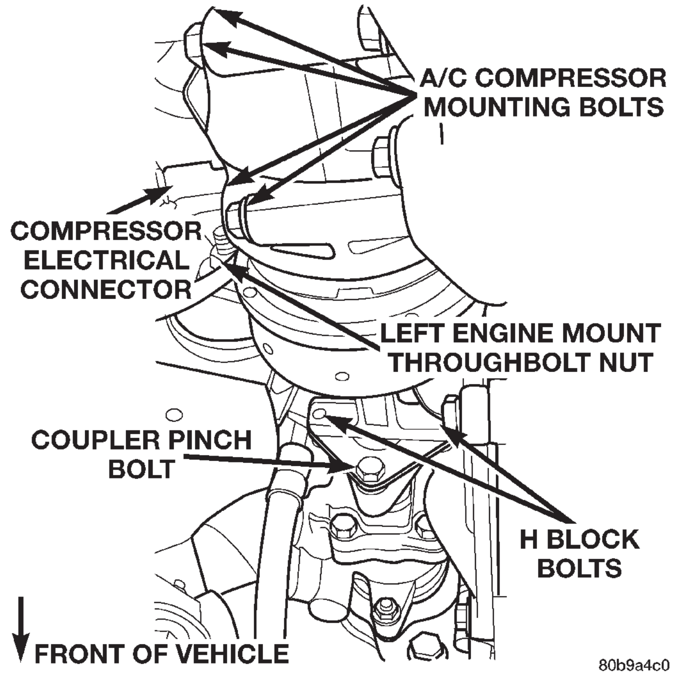


Fig. 22 A/C Compressor Position & Orientation

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) Unplug the compressor clutch coil wire harness connector.

(4) Remove the four bolts that secure the compressor to the mounting bracket.

(5) Remove the compressor from the mounting bracket. Support the compressor in the engine compartment while servicing the clutch.

(6) Insert the two pins of the spanner wrench (Special Tool C-4489) into the holes of the clutch plate. Hold the clutch plate stationary and remove the hex nut (Fig. 23).

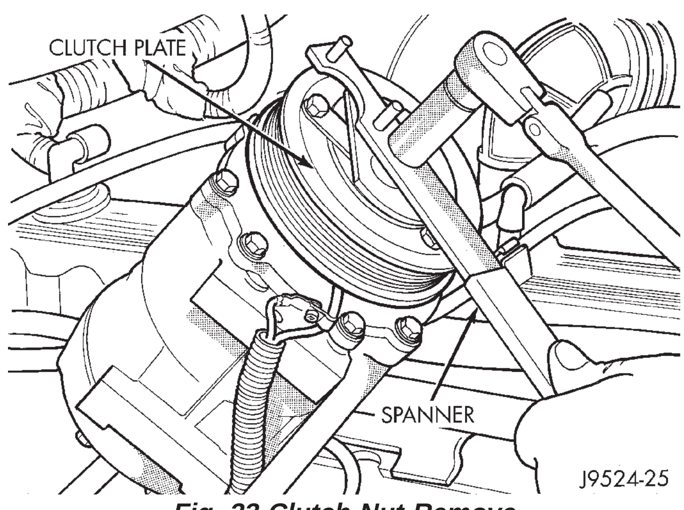


Fig. 23 Clutch Nut Remove

REMOVAL AND INSTALLATION (Continued)

(7) Remove the clutch plate with a puller (Special Tool C-6461) (Fig. 24).

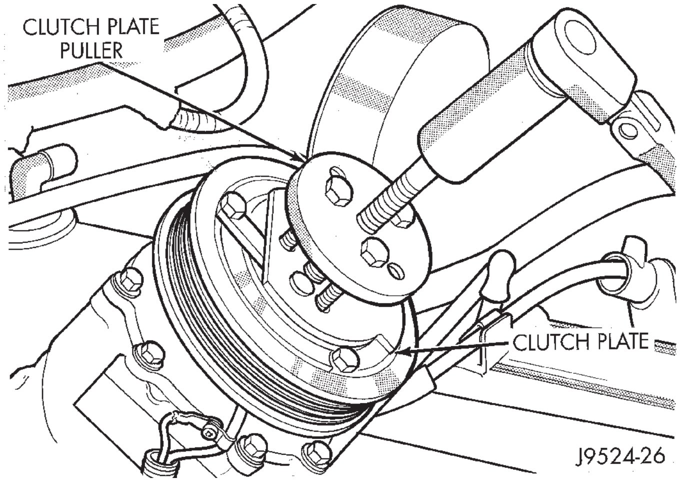


Fig. 24 Clutch Plate Remove

(8) Remove the compressor shaft key and the clutch shims.

(9) Remove the external front housing snap ring with snap ring pliers (Fig. 25).

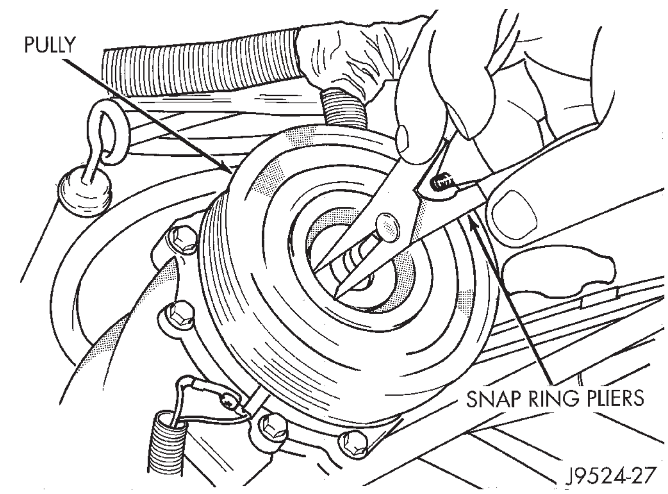


Fig. 25 External Snap Ring Remove

(10) 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. 26).

(11) Install the puller through-bolts (Special Tool C-6461) through the puller flange and into the jaws of the rotor puller and tighten (Fig. 27). Turn the puller center bolt clockwise until the rotor pulley is free.

(12) Remove the screw and retainer from the clutch coil lead wire harness on the compressor front housing (Fig. 28).

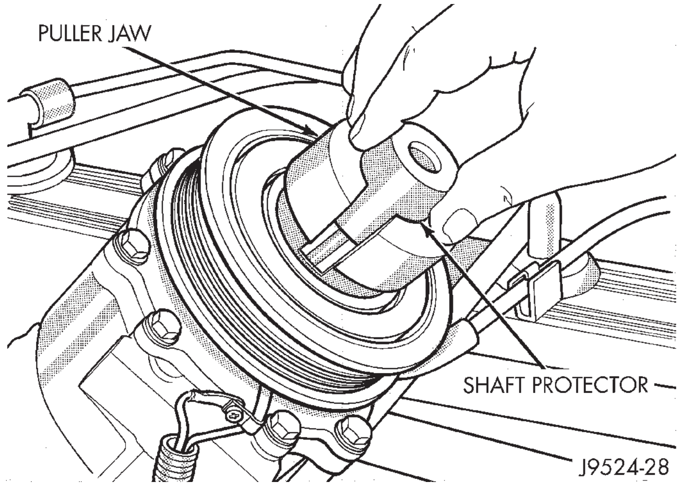


Fig. 26 Shaft Protector and Puller

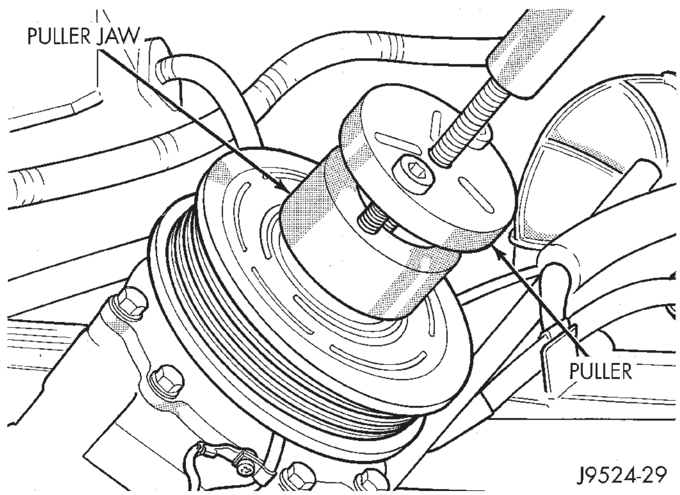


Fig. 27 Install Puller Plate

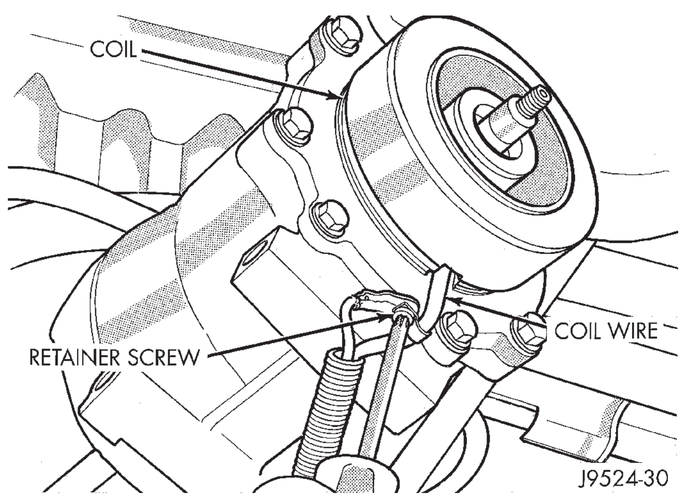


Fig. 28 Clutch Coil Lead Wire Harness

REMOVAL AND INSTALLATION (Continued)

(13) Remove the snap ring from the compressor hub and remove the clutch field coil (Fig. 29). Slide the clutch field coil off of the compressor hub.

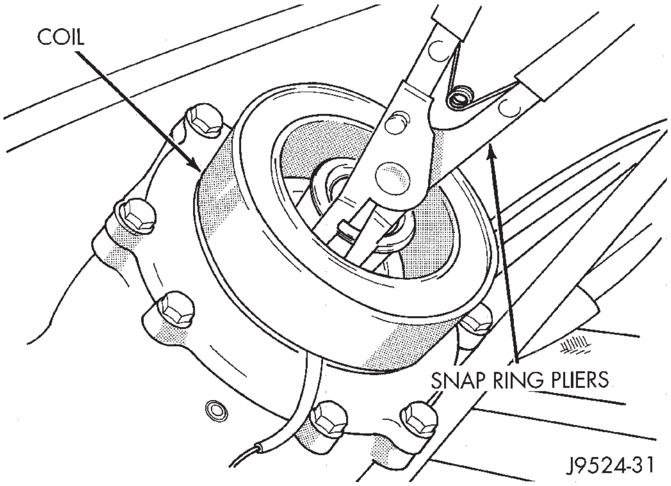


Fig. 29 Clutch Field Coil Snap Ring Remove

INSPECTION

Examine the friction surfaces of the clutch pulley and the front plate for wear. The pulley and front plate should be replaced if there is excessive wear or scoring.

If the friction surfaces are oily, inspect the shaft and nose area of the compressor for oil. Remove the felt from the front cover. If the felt is saturated with oil, the shaft seal is leaking and the compressor must be replaced.

Check the clutch pulley bearing for roughness or excessive leakage of grease. Replace the bearing, if required.

INSTALLATION

(1) Install the clutch field coil and snap ring.

(2) Install the clutch coil lead wire harness retaining clip on the compressor front housing and tighten the retaining screw.

(3) Align the rotor assembly squarely on the front compressor housing hub.

(4) Install the pulley bearing assembly with the installer (Special Tool C-6871) (Fig. 30). Thread the installer on the shaft, then turn the nut until the pulley assembly is seated.

(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.

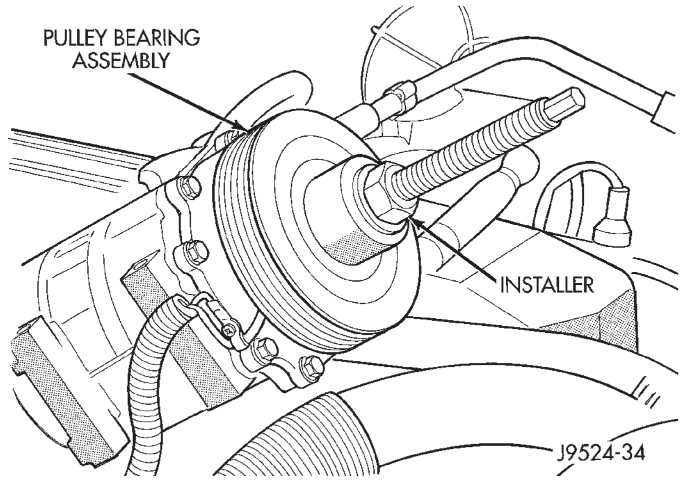


Fig. 30 Clutch Pulley Install

(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. 31). Install the shaft hex nut and tighten to 14.4 N·m (10.5 ft. lbs.).

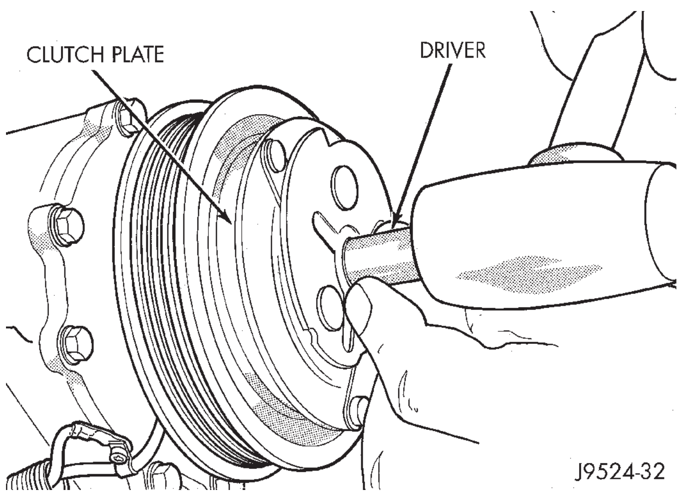


Fig. 31 Clutch Plate Driver

(8) Check the clutch air gap with a feeler gauge (Fig. 32). If the air gap does not meet the specification, add or subtract shims as required. The air gap specification is 0.41 to 0.79 millimeter (0.016 to 0.031 inch). If the air gap is not consistent around the circumference of the clutch, lightly pry up at the minimum variations. Lightly tap down at the points of maximum variation.

NOTE: The air gap is determined by the spacer shims. When installing an original, or a new clutch assembly, try the original shims first. When installing a new clutch onto a compressor that previously did not have a clutch, use 1.0, 0.50, and 0.13 millimeter (0.040, 0.020, and 0.005 inch) shims from the clutch hardware package that is provided with the new clutch.

REMOVAL AND INSTALLATION (Continued)

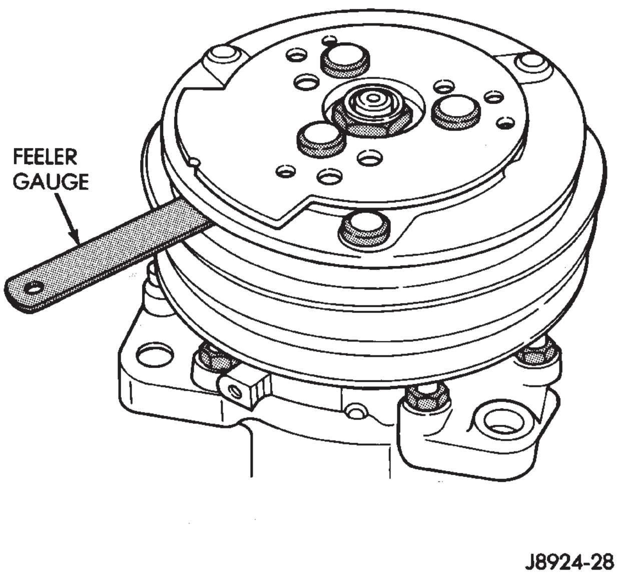


Fig. 32 Check Clutch Air Gap

(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 (five seconds on, then five seconds off). During this 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 to 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. 33).

(3) Refer to the label on the PDC for compressor clutch relay identification and location.

(4) Unplug the compressor clutch relay from the PDC.

(5) Install the compressor clutch relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

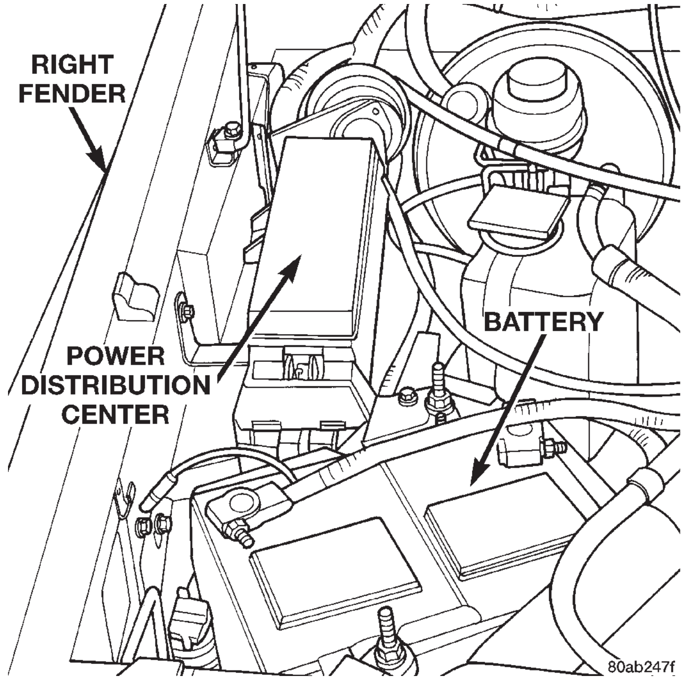


Fig. 33 Power Distribution Center

LIQUID LINE

Any kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire air conditioning system. Kinks and sharp bends reduce the flow of refrigerant in the system. A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. In addition, the flexible hose refrigerant lines should be routed so they are at least 80 millimeters (3 inches) from the exhaust manifold.

High pressures are produced in the refrigerant system when the air conditioning compressor is operating. Extreme care must be exercised to make sure that each of the refrigerant system connections is pressure-tight and leak free. It is a good practice to inspect all flexible hose refrigerant lines at least once a year to make sure they are in good condition and properly routed.

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

LEFT-HAND DRIVE

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(3) Disconnect the liquid line refrigerant line couplers at the evaporator inlet and the condenser outlet (Fig. 34). See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(4) Remove the liquid line from the vehicle.

REMOVAL AND INSTALLATION (Continued)

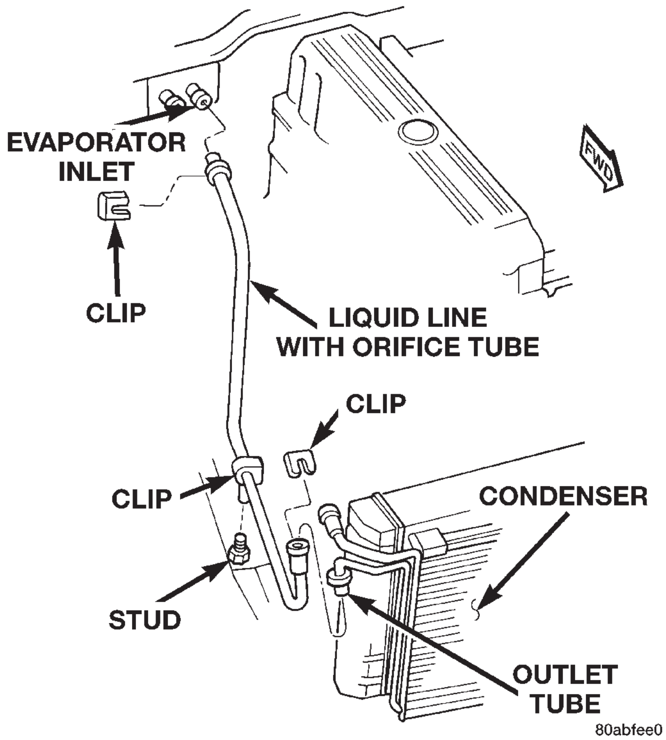


Fig. 34 Liquid Line Remove/Install - Left-Hand Drive

INSTALLATION

(1) Remove the tape or plugs from the refrigerant line fittings on the liquid line, the evaporator inlet and the condenser outlet. Connect the liquid line to the evaporator inlet and condenser outlet refrigerant line couplers. See Refrigerant Line Coupler in this group for the procedures.

(2) Connect the battery negative cable.

(3) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(4) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

RIGHT-HAND DRIVE

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(3) Disconnect the liquid line and/or liquid line jumper refrigerant line couplers at the evaporator inlet and the liquid line jumper, or at the condenser outlet and the liquid line jumper (Fig. 35). See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

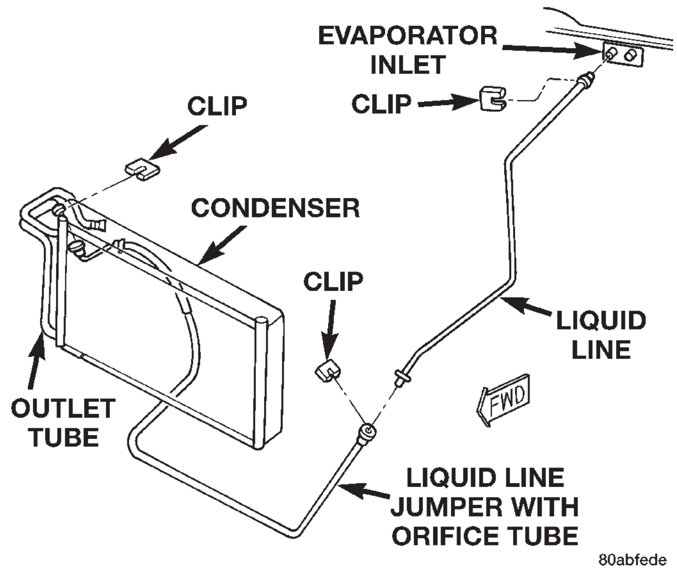


Fig. 35 Liquid Line Remove/Install - Right-Hand Drive

(4) Remove the liquid line and/or liquid line jumper from the vehicle.

INSTALLATION

(1) Remove the tape or plugs from the opened refrigerant line fittings on the condenser outlet tube, the liquid line, the evaporator inlet, and/or the liquid line jumper. Connect the liquid line to the evaporator inlet tube and the liquid line jumper, and/or connect the liquid line jumper to the liquid line and the condenser outlet tube. See Refrigerant Line Coupler in this group for the procedures.

(2) Connect the battery negative cable.

(3) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(4) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

FIXED ORIFICE TUBE

The fixed orifice tube is located in the liquid line (Left-Hand Drive) or the liquid line jumper (Right-Hand Drive) near the condenser. The orifice has filter screens on the inlet and outlet ends of the tube body. If the fixed orifice tube is faulty or plugged, the liquid line unit or liquid line jumper unit must be replaced. See Liquid Line in this group for the service procedures.

REMOVAL AND INSTALLATION (Continued)

LOW PRESSURE CYCLING CLUTCH SWITCH

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the low pressure cycling clutch switch on the top of the accumulator (Fig. 36).

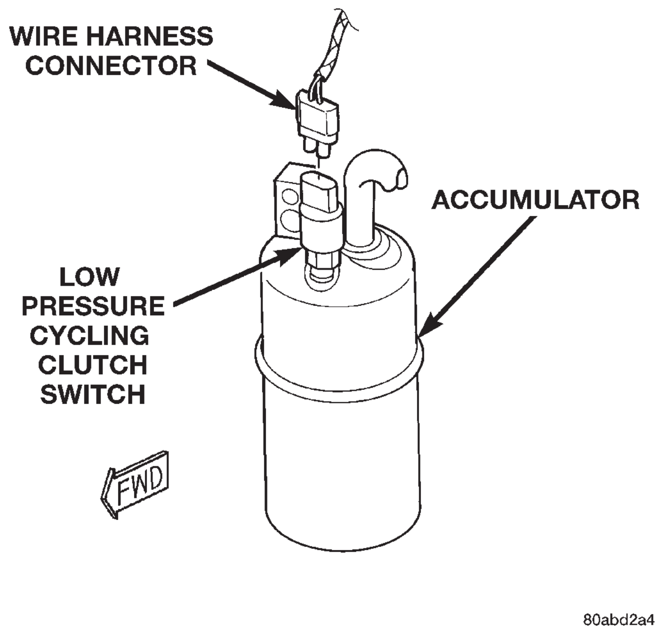


Fig. 36 Low Pressure Cycling Clutch Switch Remove/Install - Typical

(3) Unscrew the low pressure cycling clutch switch from the fitting on the top of the accumulator.

(4) Remove the O-ring seal from the accumulator fitting and discard.

INSTALLATION

(1) Lubricate a new O-ring seal with clean refrigerant oil and install it on the accumulator fitting. Use only the specified O-rings as they are made of a special material for the R-134a system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(2) Install and tighten the low pressure cycling clutch switch on the accumulator fitting. The switch should be hand-tightened onto the accumulator fitting.

(3) Plug the wire harness connector into the low pressure cycling clutch switch.

(4) Connect the battery negative cable.

ACCUMULATOR

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(3) Unplug the wire harness connector from the low pressure cycling clutch switch.

(4) Loosen the screw that secures the accumulator retaining band to the support bracket on the dash panel (Fig. 37) or (Fig. 38).

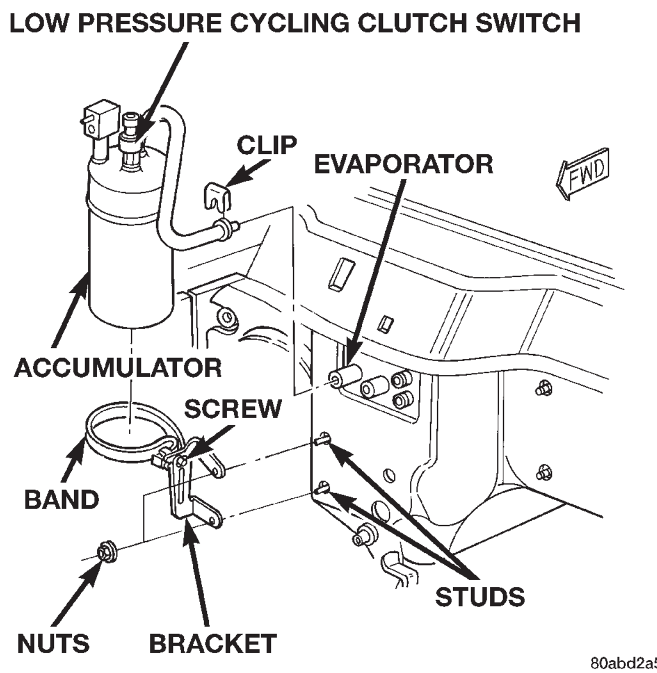


Fig. 37 Accumulator Remove/Install - Left-Hand Drive

(5) Disconnect the suction line from the accumulator outlet tube refrigerant line fitting. See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Disconnect the accumulator inlet tube refrigerant line fitting from the evaporator outlet tube. See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(7) Pull the accumulator and retaining band unit forward until the screw in the band is clear of the slotted hole in the support bracket on the dash panel.

(8) Remove the accumulator from the vehicle.

REMOVAL AND INSTALLATION (Continued)

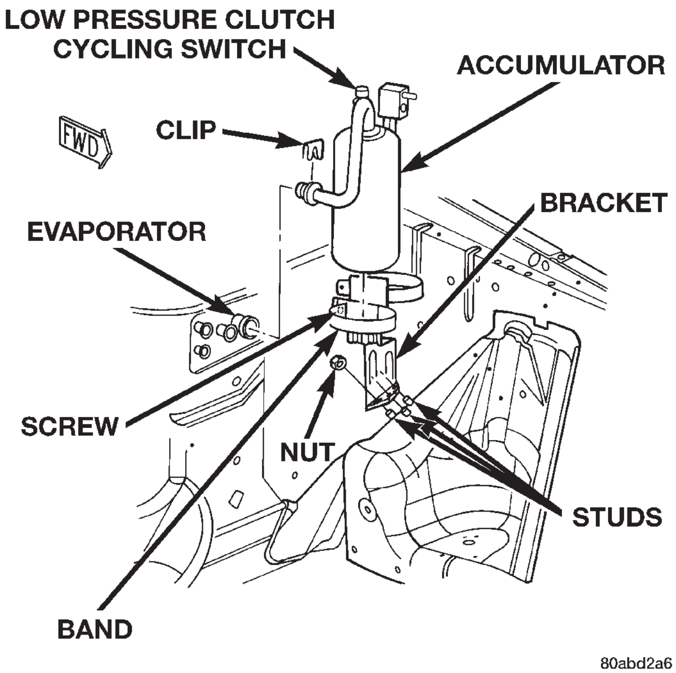


Fig. 38 Accumulator Remove/Install - Right-Hand Drive

INSTALLATION

(1) Install the accumulator and retaining band as a unit by sliding the screw in the band into the slotted hole in the support bracket on the dash panel.

(2) Remove the tape or plugs from the refrigerant line fittings on the accumulator inlet tube and the evaporator outlet tube. Connect the accumulator inlet tube refrigerant line coupler to the evaporator outlet tube. See Refrigerant Line Coupler in this group for the procedures.

(3) Tighten the accumulator retaining band screw to 5 N·m (45 in. lbs.).

(4) Remove the tape or plugs from the refrigerant line fittings on the suction line and the accumulator outlet tube. Connect the suction line to the accumulator outlet tube refrigerant line coupler. See Refrigerant Line Coupler in this group for the procedures.

(5) Plug the wire harness connector into the low pressure cycling clutch switch.

(6) Connect the battery negative cable.

(7) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(8) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

NOTE: If the accumulator is replaced, add 120 milliliters (4 fluid ounces) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

CONDENSER

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

CAUTION: Before removing the condenser, note the location of each of the radiator and condenser air seals. These seals are used to direct air through the condenser and radiator. The air seals must be reinstalled in their proper locations in order for the air conditioning and engine cooling systems to perform as designed.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(3) Disconnect the discharge line refrigerant line fitting at the condenser inlet. See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(4) Disconnect the liquid line (Left-Hand Drive) or liquid line jumper (Right-Hand Drive) refrigerant line fitting at the condenser outlet. See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the radiator and the condenser from the vehicle as a unit. Refer to Group 7 - Cooling System for the procedures.

(6) Remove the two nuts that secure the condenser studs to the upper brackets of the radiator (Fig. 39).

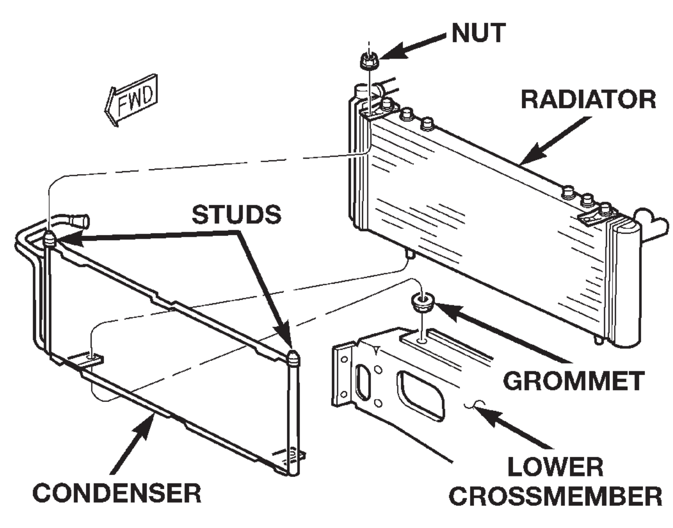


Fig. 39 Condenser Remove/Install

REMOVAL AND INSTALLATION (Continued)

(7) Slide the condenser down from the radiator far enough for the condenser studs to clear the upper radiator bracket holes, and for the lower condenser bracket holes to clear the dowel pins on the bottom of the radiator.

(8) Remove the condenser from the radiator.

INSTALLATION

(1) Install the holes of the condenser lower brackets over the dowel pins on the bottom of the radiator.

(2) Slide the condenser upwards until both of the condenser studs are installed through the holes in the radiator upper brackets. Tighten the mounting nuts to 5.3 N·m (47 in. lbs.).

(3) Renstall the radiator and condenser unit in the vehicle. Refer to Group 7 - Cooling System for the procedures.

(4) Remove the tape or plugs from the refrigerant line fittings on the condenser outlet and the liquid line (Left-Hand Drive) or the liquid line jumper (Right-Hand Drive). Install the liquid line or the liquid line jumper to the condenser outlet. See Refrigerant Line Coupler in this group for the procedures.

(5) Remove the tape or plugs from the refrigerant line fittings on the condenser inlet and the discharge line. Connect the discharge line to the condenser inlet. See Refrigerant Line Coupler in this group for the procedures.

(6) Connect the battery negative cable.

(7) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(8) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

NOTE: If the condenser is replaced, add 30 milliliters (1 fluid ounce) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

VACUUM CHECK VALVE

(1) Unplug the heater-A/C vacuum supply line connector at the vacuum check valve (Fig. 40).

(2) Note the orientation of the check valve in the vacuum supply line for correct reinstallation.

(3) Unplug the vacuum check valve from the vacuum supply line fittings.

(4) Reverse the removal procedures to install.

VACUUM RESERVOIR

(1) Remove the passenger side bumper end cap from the front bumper. Refer to Group 23 - Body for the procedures.

(2) Unplug the vacuum supply line connector from the vacuum reservoir (Fig. 41).

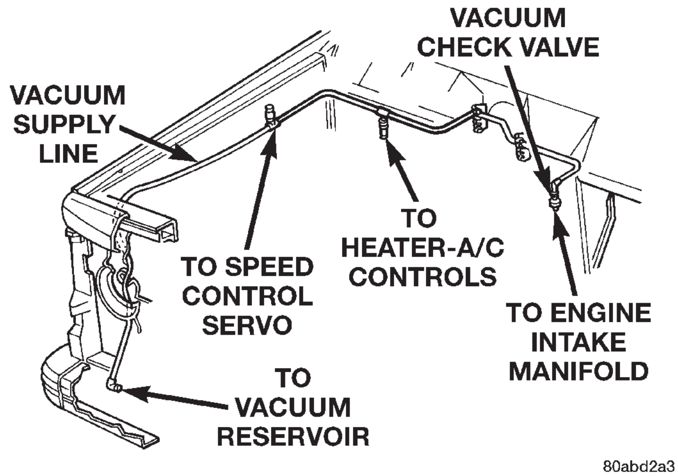


Fig. 40 Vacuum Supply

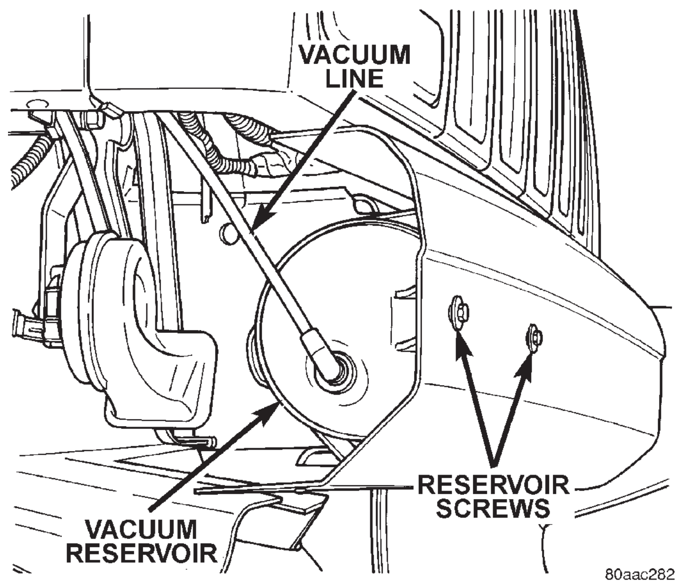


Fig. 41 Vacuum Reservoir Remove/Install

(3) Remove the two screws that secure the vacuum reservoir to the front bumper.

(4) Remove the vacuum reservoir from behind the front bumper.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

BLOWER MOTOR

REMOVAL

(1) If the vehicle is equipped with air conditioning, recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(2) Disconnect and isolate the battery negative cable.

(3) If the vehicle is equipped with air conditioning, the accumulator must be relocated in order to service

REMOVAL AND INSTALLATION (Continued)

the blower motor. This is done by loosening the accumulator retaining band screw and disconnecting the accumulator inlet tube from the evaporator outlet tube. The accumulator can then be moved far enough to access and remove the blower motor. See Accumulator in this group for the procedures.

(4) Unplug the blower motor wire harness connector (Fig. 42).

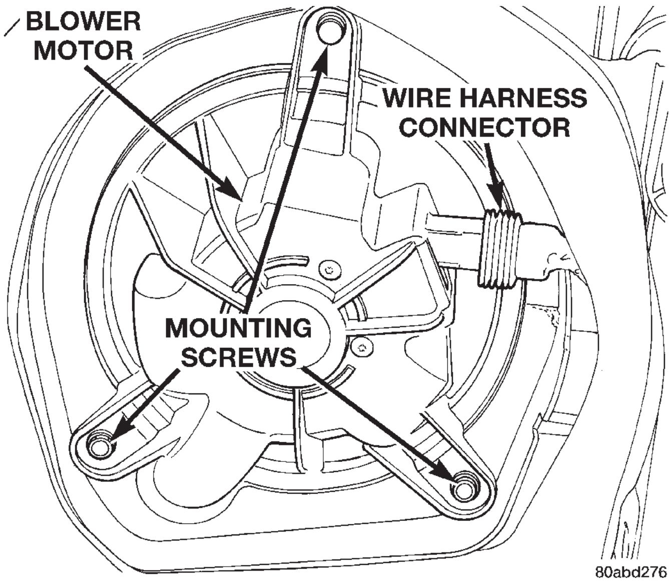


Fig. 42 Blower Motor Remove/Install

(5) Remove the three screws that secure the blower motor and wheel assembly to the heater-A/C housing.

(6) Rotate and tilt the blower motor unit as needed for clearance to remove the blower motor and wheel from the heater-A/C housing.

INSTALLATION

(1) Align and install the blower motor and wheel assembly into the heater-A/C housing.

(2) Install and tighten the three screws that secure the blower motor and wheel assembly to the heater-A/C housing. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

(3) Plug in the blower motor wire harness connector.

(4) If the vehicle is equipped with air conditioning, connect the accumulator inlet tube to the evaporator outlet tube and tighten the accumulator retaining band screw. See Accumulator in this group for the procedures.

(5) Connect the battery negative cable.

(6) If the vehicle is equipped with air conditioning, evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(7) If the vehicle is equipped with air conditioning, charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

HEATER-A/C CONTROL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Roll down the glove box from the instrument panel. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures.

(3) Reach through the instrument panel glove box opening to access and unplug the two halves of the heater-A/C vacuum harness connector.

(4) Remove the center bezel from the instrument panel. Refer to Instrument Panel Center Bezel in Group 8E - Instrument Panel Systems for the procedures.

(5) Release the vacuum harness push-in retainer from the instrument panel directly beneath the heater-A/C control.

(6) Remove the four screws that secure the heater-A/C control to the instrument panel (Fig. 43).

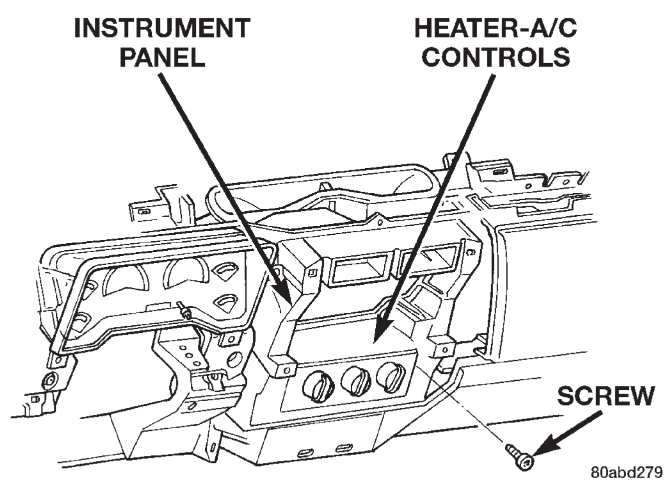


Fig. 43 Heater-A/C Control Remove/Install

(7) Pull the heater-A/C control assembly away from the instrument panel far enough to access the connections on the back of the control.

REMOVAL AND INSTALLATION (Continued)

(8) Unplug the wire harness connector from the back of the heater-A/C control (Fig. 44).

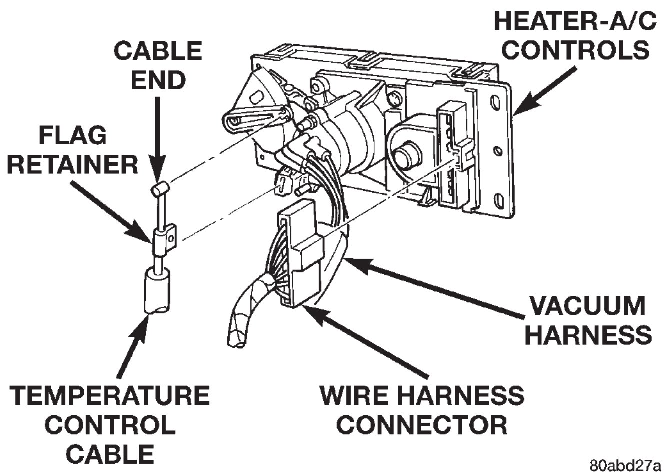


Fig. 44 Heater-A/C Control Connections

(9) Release the temperature control cable housing flag retainer latch in the receptacle on the back of the heater-A/C control and disengage the flag retainer from the receptacle.

(10) Rotate the heater-A/C control assembly to align the cable core with the slot on the end of the temperature control lever and disengage the cable end from the lever.

(11) Reach through the instrument panel glove box opening to guide the heater-A/C control half of the vacuum harness around any obstacles while pulling the heater-A/C control out from the front of the instrument panel.

INSTALLATION

(1) Connect the temperature control cable core end to the temperature control lever on the back of the heater-A/C control.

(2) Connect the temperature control cable housing flag retainer to the receptacle on the back of the heater-A/C control.

(3) Plug the wire harness connector into the back of the heater-A/C control.

(4) Route the vacuum harness through the instrument panel opening and reinstall the vacuum harness push-in retainer.

(5) Reach through the instrument panel glove box opening to reconnect the two halves of the heater-A/C vacuum harness connector.

(6) Roll the glove box back up into the instrument panel. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures.

(7) Position the heater-A/C control in the instrument panel and secure it with four screws. Tighten the screws to 2.2 N·m (20 in. lbs.).

(8) Reinstall the center bezel onto the instrument panel. Refer to Instrument Panel Center Bezel in Group 8E - Instrument Panel Systems for the procedures.

(9) Connect the battery negative cable.

TEMPERATURE CONTROL CABLE

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the temperature control cable housing flag retainer and cable end from the back of the heater-A/C control. See Heater-A/C Control in this group for the procedures.

(3) Locate the temperature control cable housing flag retainer receptacle on the bottom of the heater-A/C housing, near the passenger side of the floor panel transmission tunnel (Fig. 45). Locate the flag retainer latch release window on the side of the receptacle. While depressing the flag retainer latch through the release window, use a trim stick or another suitable wide flat-bladed tool to gently pry the cable housing flag retainer out of the receptacle.

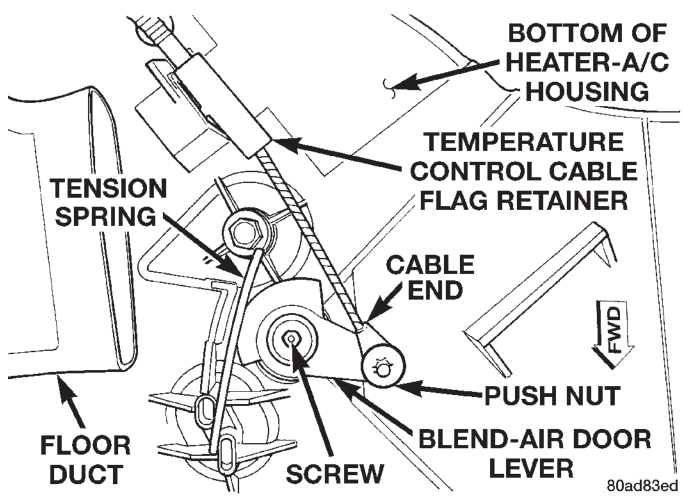


Fig. 45 Temperature Control Cable Remove/Install

(4) Remove the screw that secures the blend-air door lever to the blend-air door pivot shaft.

(5) Pull the blend-air door lever down from the heater-A/C housing to remove it from the blend-air door pivot shaft.

REMOVAL AND INSTALLATION (Continued)

(6) Remove the blend-air door lever and temperature control cable from the heater-A/C housing and the instrument panel as a unit.

(7) Remove the push nut that secures the temperature control cable end to the pin on the blend-air door lever.

(8) Remove the temperature control cable from the blend-air door lever pin.

INSTALLATION

(1) Install the blend-air door lever onto the blend-air door pivot shaft. Be certain that the tension spring on the bottom of the heater-A/C housing is properly positioned against the cam formation on the blend-air door lever.

(2) Install and tighten the screw that secures the blend-air door lever to the blend-air door pivot shaft. Tighten the mounting screw to 1 N·m (10 in. lbs.).

(3) Install the temperature control cable end over the pin on the blend-air door lever and secure it with a push nut.

(4) Snap the temperature control cable housing flag retainer into the receptacle on the bottom of the heater-A/C housing.

(5) Connect the temperature control cable housing flag retainer and cable end to the back of the heater-A/C control and reinstall the heater-A/C control to the instrument panel. See Heater-A/C Control in this group for the procedures.

(6) Connect the battery negative cable.

BLOWER MOTOR RELAY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Roll the glove box down from the instrument panel. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures.

(3) Reach through the instrument panel glove box opening to locate the blower motor relay (Fig. 46).

(4) Unplug the blower motor relay from its wire harness connector.

(5) Install the blower motor relay by aligning the relay terminals with the cavities in the wire harness connector and pushing the relay firmly into place.

(6) Roll the glove box back up into the instrument panel. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures.

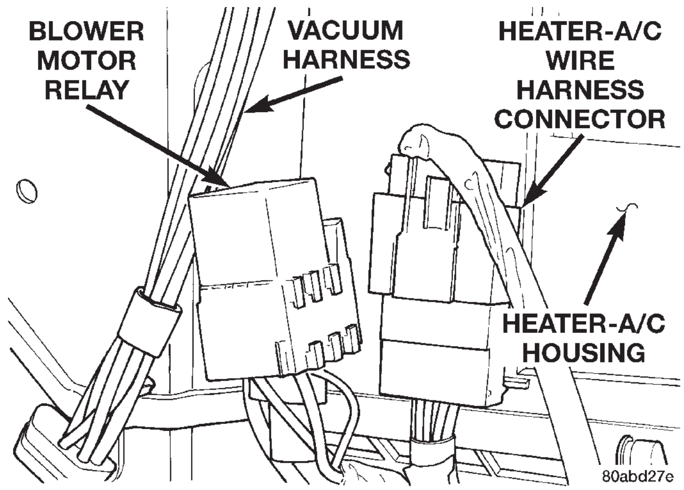


Fig. 46 Blower Motor Relay Remove/Install

(7) Connect the battery negative cable.

(8) Test the relay operation.

KICK COVER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Loosen the two screws that secure the upper half of the kick cover to the heater-A/C housing under the passenger side end of the instrument panel (Fig. 47).

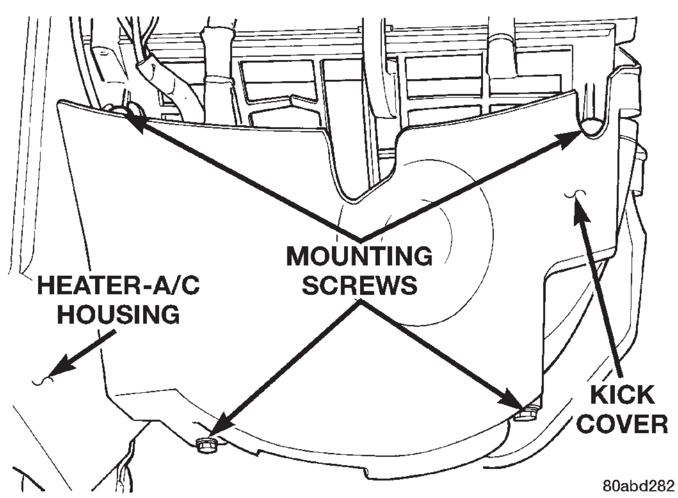


Fig. 47 Kick Cover Remove/Install

REMOVAL AND INSTALLATION (Continued)

(3) Remove the two screws that secure the lower half of the kick cover to the heater-A/C housing.

(4) Pull the kick cover down towards the floor panel to disengage the slotted upper mounting tabs from under the two loosened heater-A/C housing screws.

(5) Remove the kick cover from the heater-A/C housing.

INSTALLATION

(1) Position the slotted upper kick cover mounting tabs under the heads of the two loosened heater-A/C housing screws. Tighten the screws to 2.2 N·m (20 in. lbs.).

(2) Install the two screws that secure the lower kick cover to the heater-A/C housing. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Connect the battery negative cable.

BLOWER MOTOR RESISTOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the kick cover from the heater-A/C housing. See Kick Cover in this group for the procedures.

(3) Pull out the lock on the blower motor resistor wire harness connector to unlock the connector latch (Fig. 48).

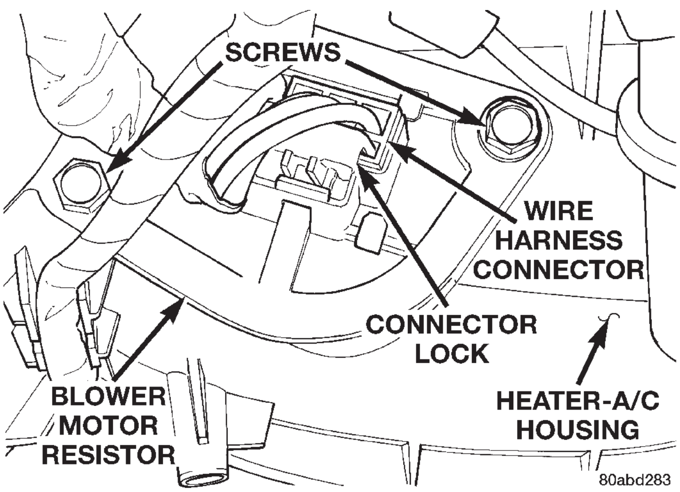


Fig. 48 Blower Motor Resistor Remove/Install

(4) Depress the latch on the blower motor resistor wire harness connector and unplug the connector from the resistor.

(5) Remove the two screws that secure the resistor to the heater-A/C housing.

(6) Remove the resistor from the heater-A/C housing.

(7) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in lbs.).

MODE DOOR VACUUM ACTUATOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

DEFROST DOOR ACTUATOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel assembly from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(3) Unplug the two vacuum harness connectors from the defrost door actuator (Fig. 49).

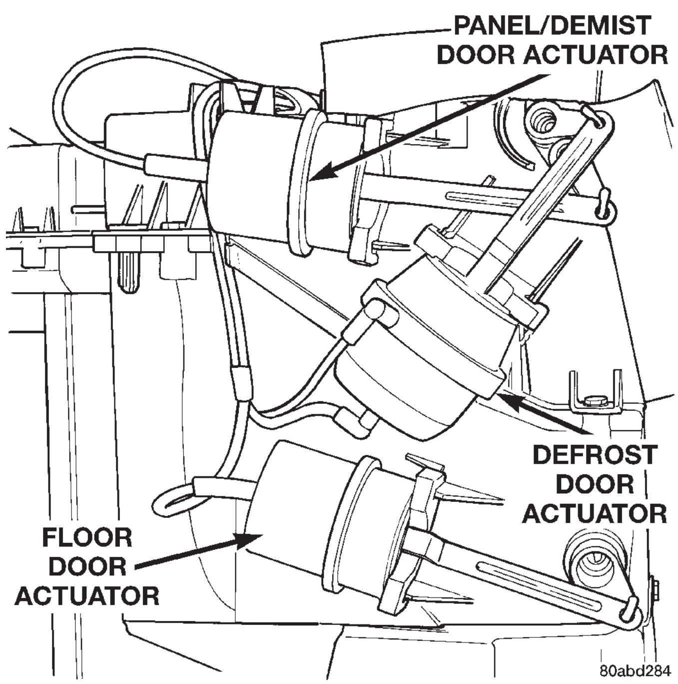


Fig. 49 Defrost, Floor, and Panel/Demist Door Vacuum Actuators

REMOVAL AND INSTALLATION (Continued)

(4) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the heater-A/C housing actuator mount (Fig. 50). Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

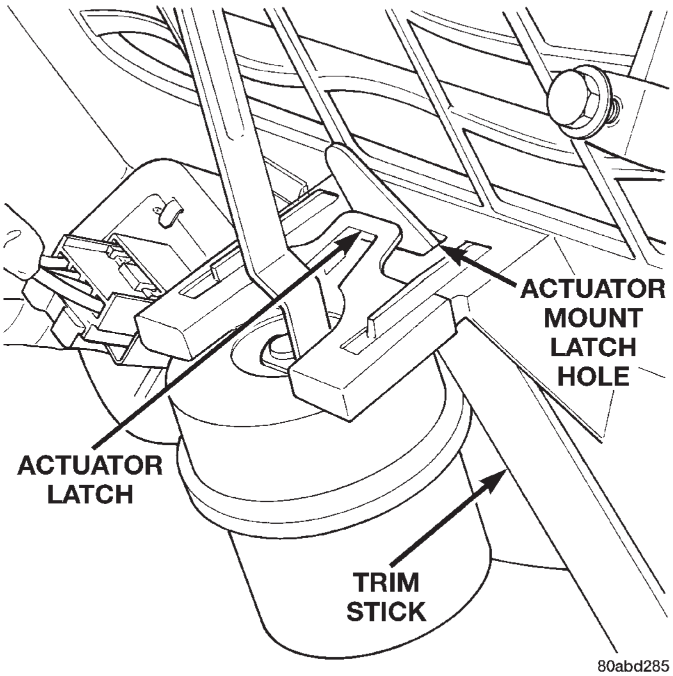


Fig. 50 Vacuum Actuator Remove/Install - Typical

(5) Rotate and tilt the vacuum actuator as required to disengage the hole on the end of the actuator link from the hooked pin on the end of the defrost door lever.

(6) Remove the defrost door vacuum actuator from the vehicle.

(7) Reverse the removal procedures to install.

FLOOR DOOR ACTUATOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel assembly from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(3) Unplug the vacuum harness connector from the floor door actuator (Fig. 49).

(4) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the heater-A/C housing actuator mount (Fig. 50). Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

(5) Rotate and tilt the vacuum actuator as required to disengage the hole on the end of the actuator link from the hooked pin on the end of the floor door lever.

(6) Remove the floor door vacuum actuator from the vehicle.

(7) Reverse the removal procedures to install.

PANEL/DEMIST DOOR ACTUATOR

(1) Remove the defrost door actuator from the heater-A/C housing. See Defrost Door Actuator in this group for the procedures.

(2) Unplug the vacuum harness connector from the panel/demist door actuator (Fig. 49).

(3) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the heater-A/C housing actuator mount (Fig. 50). Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

(4) Rotate and tilt the vacuum actuator as required to disengage the hole on the end of the actuator link from the hooked pin on the end of the panel/demist door lever.

(5) Remove the panel/demist door vacuum actuator from the vehicle.

(6) Reverse the removal procedures to install.

RECIRCULATION AIR DOOR ACTUATOR

A recirculation air door and vacuum 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 heater-A/C housing. See Kick Cover in this group for the procedures.

(3) Unplug the vacuum harness connector from the recirculation air door actuator (Fig. 51).

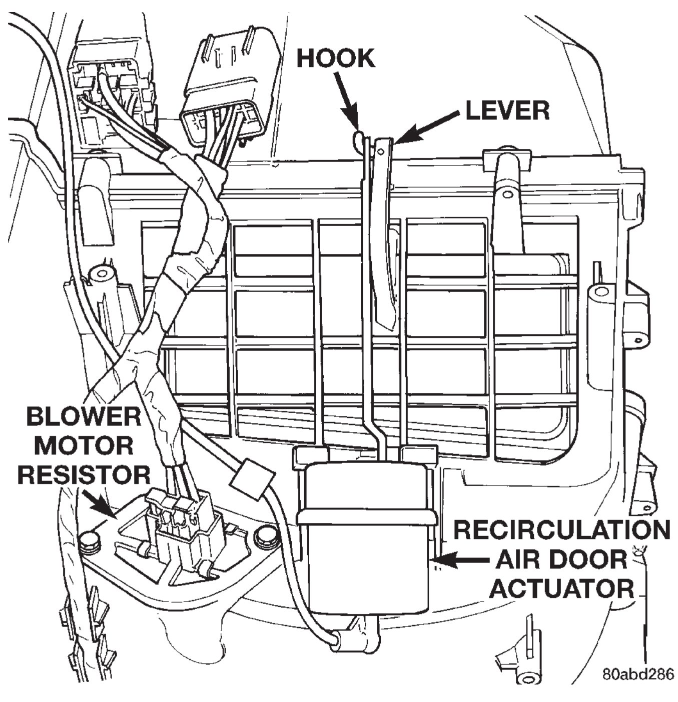


Fig. 51 Recirculation Air Door Vacuum Actuator Remove/Install

(4) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the heater-A/C housing actuator mount (Fig. 50). Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

(5) Rotate and tilt the vacuum actuator as required to disengage the hole on the end of the actuator link from the hooked pin on the end of the recirculation air door lever.

(6) Remove the recirculation air door vacuum actuator from the vehicle.

(7) Reverse the removal procedures to install.

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.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(3) If the vehicle is not equipped with air conditioning, go to Step 6. If the vehicle is equipped with air conditioning, recover the refrigerant from the refrigerant system. See Refrigerant Recovery in this group for the procedures.

(4) Disconnect the liquid line refrigerant line fitting from the evaporator inlet tube. See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Disconnect the accumulator inlet tube refrigerant line fitting from the evaporator outlet tube. See Refrigerant Line Coupler in this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Drain the engine cooling system. Refer to Group 7 - Cooling System for the procedures.

(7) Disconnect the heater hoses from the heater core tubes. Refer to Group 7 - Cooling System for the procedures. Install plugs in, or tape over the opened heater core tubes.

(8) Unplug the heater-A/C system vacuum supply line connector from the tee fitting near the heater core tubes.

(9) Unplug the heater-A/C unit wire harness connector, which is fastened to the heater-A/C housing next to the blower motor relay (Fig. 52).

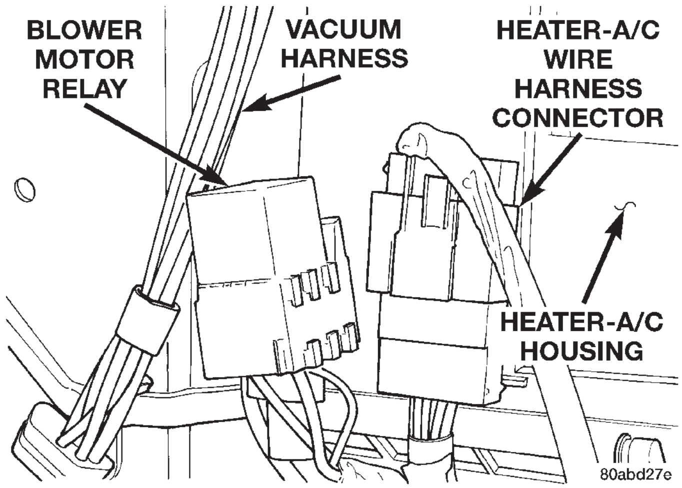


Fig. 52 Heater-A/C Unit Connector

(10) Remove the five nuts from the heater-A/C housing mounting studs on the engine compartment side of the dash panel (Fig. 53). Remove or reposition the evaporation canister for additional access, if required.

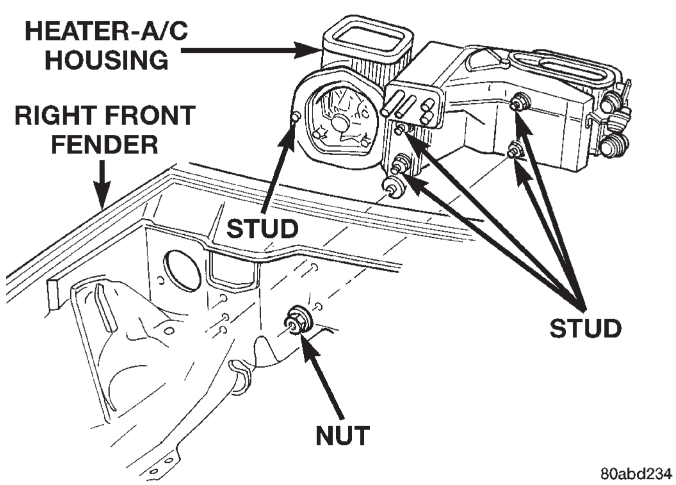


Fig. 53 Heater-A/C Housing Remove/Install

(11) Pull the heater-A/C housing rearward far enough for the mounting studs and the evaporator condensate drain tube to clear the dash panel holes.

(12) Remove the heater-A/C housing from the vehicle.

REMOVAL AND INSTALLATION (Continued)

DISASSEMBLY

(1) Remove the heater-A/C housing from the vehicle and place it on a work bench.

(2) Unplug the vacuum harness connectors from the floor door actuator and, if the unit is so equipped, the recirculation air door actuator.

(3) Disengage the vacuum harness from any routing clips located on the lower half of the heater-A/C housing.

(4) Disengage the heater-A/C wire harness connector and the blower motor relay wire harness connector push-in retainers from their mounting holes on the heater-A/C housing.

(5) Remove the blower motor and blower wheel unit from the heater-A/C housing. See Blower Motor in this group for the procedures.

(6) Carefully remove the foam seal from the flange around the blower motor opening in the heater-A/C housing. If the seal is deformed or damaged, it must be replaced.

(7) Pull the vacuum supply line and connector through the foam seal on the heater core and evaporator coil tube mounting flange of the heater-A/C housing (Fig. 54).

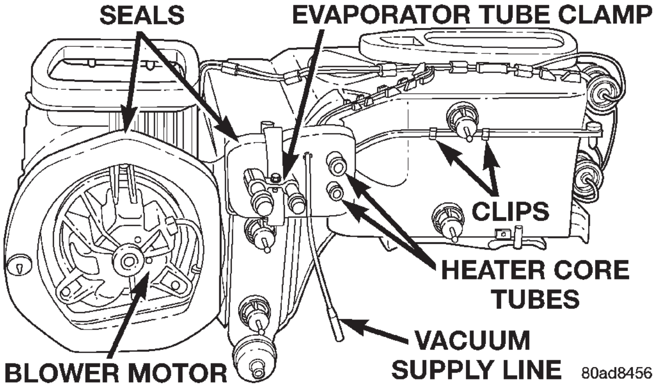


Fig. 54 Heater-A/C Housing Disassembly

(8) If the unit is equipped with air conditioning, remove the screw that secures the clamp to the evaporator coil tubes and remove the clamp.

(9) Carefully remove the foam seal from the heater core and evaporator coil tube mounting flange of the heater-A/C housing. If the seal is deformed or damaged, it must be replaced.

(10) Use a screwdriver to pry off the two snap clips that help secure the upper and lower heater-A/C housing halves to each other.

(11) Remove the 14 screws that secure the upper and lower heater-A/C housing halves to each other.

(12) Carefully 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. During assembly, be certain of the following:

(a) That each of the mode door pivot shaft ends is properly engaged in its pivot hole (Fig. 55).

(b) That the blower motor venturi ring is properly indexed and installed.

(c) If the unit is equipped with air conditioning, that the evaporator coil tube rubber seal is properly positioned in the grooves in both the upper and lower heater-A/C housing halves.

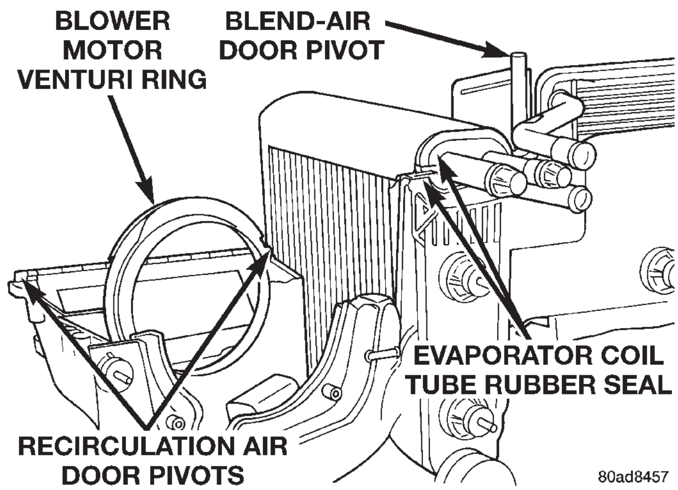


Fig. 55 Heater-A/C Housing Assembly

(2) Install the 14 screws and two snap clips that secure the upper and lower heater-A/C housing halves to each other. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the blower motor and wheel unit in the heater-A/C housing. See Blower Motor in this group for the procedures.

(4) Install the foam seals on the flanges around the blower motor opening and the heater core and evaporator coil tube mounting flange of the heater-A/C housing.

(5) Insert the vacuum supply line and connector through the foam seal on the heater core and evaporator coil tube mounting flange of the heater-A/C housing.

(6) If the unit is equipped with air conditioning, reinstall the evaporator coil tube clamp. Tighten the mounting screw to 2.2 N·m (20 in. lbs.).

(7) Engage the heater-A/C wire harness connector and blower motor relay wire harness connector push-in retainers with their mounting holes in the heater-A/C housing.

(8) Engage the vacuum harness to the routing clips and plug in the vacuum harness connector at the floor door actuator and, if the unit is so equipped, at the recirculation air door actuator.

REMOVAL AND INSTALLATION (Continued)

(9) Install the heater-A/C housing in the vehicle.

INSTALLATION

(1) Position the heater-A/C housing to the dash panel. Be certain that the evaporator condensate drain tube and the housing mounting studs are inserted into their correct mounting holes.

(2) Install and tighten the five nuts onto the heater-A/C housing mounting studs on the engine compartment side of the dash panel. Tighten the nuts to 6.2 N·m (55 in. lbs.).

(3) If the evaporation canister was repositioned during the removal procedure, reinstall it to its proper position.

(4) Connect the heater-A/C system vacuum supply line connector to the tee fitting near the heater core tubes.

(5) Unplug or remove the tape from the heater core tubes. Connect the heater hoses to the heater core tubes and fill the engine cooling system. Refer to Group 7 - Cooling System for the procedures.

(6) If the vehicle is not equipped with air conditioning, go to Step 10. If the vehicle is equipped with air conditioning, unplug or remove the tape from the accumulator inlet tube and the evaporator outlet tube fittings. Connect the accumulator inlet tube coupler to the evaporator outlet tube. See Refrigerant Line Coupler in this group for the procedures.

(7) Unplug or remove the tape from the liquid line and the evaporator inlet tube fittings. Connect the liquid line coupler to the evaporator inlet tube. See Refrigerant Line Coupler in this group for the procedures.

(8) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(9) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

(10) Install the instrument panel in the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(11) Connect the battery negative cable.

(12) Start the engine and check for proper operation of the heating and air conditioning systems.

HEATER-A/C HOUSING DOOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

BLEND-AIR DOOR

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

NOTE: If the temperature control cable was not removed with the blend-air door lever as a unit during the instrument panel removal procedures, the lever must be removed from the blend-air door pivot shaft before the blend-air door can be removed from the heater-A/C housing. See Temperature Control Cable in this group for the procedures.

(2) Lift the blend-air door pivot shaft out of the pivot hole in the bottom of the lower half of the heater-A/C housing (Fig. 56).

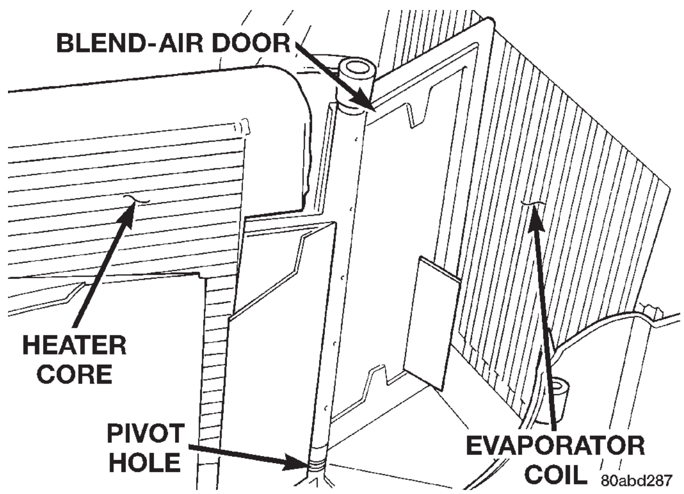


Fig. 56 Blend-Air Door

(3) Reverse the removal procedures to install.

PANEL/DEMIST DOOR AND LEVER

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

(2) Remove the defrost and panel/demist door vacuum actuators from the heater-A/C housing. See Mode Door Vacuum Actuator in this group for the procedures.

(3) Insert a screwdriver into the latch hole (Fig. 57) of the panel/demist door pivot shaft to release the latch of the panel/demist door lever, and pull the lever out of the pivot shaft from the outside of the upper half of the heater-A/C housing.

(4) Reach inside the upper half of the heater-A/C housing and carefully flex the panel/defrost door (Fig. 58) enough so that the door pivot clears the pivot hole in the housing.

REMOVAL AND INSTALLATION (Continued)

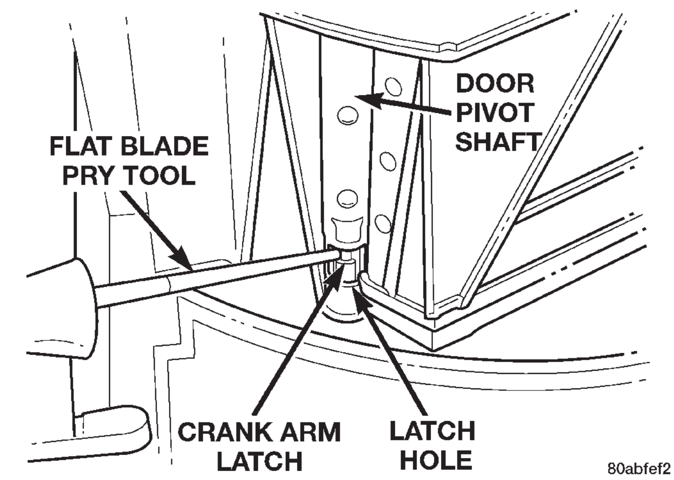


Fig. 57 Mode Door Lever Remove/Install - Typical

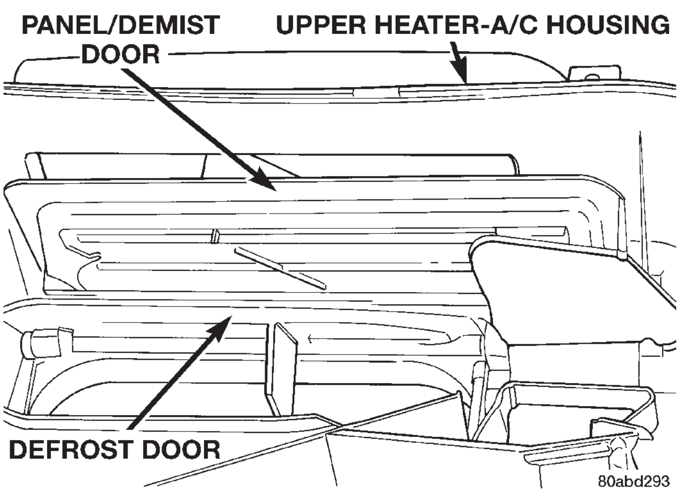


Fig. 58 Panel/Demist and Defrost Doors

(5) Remove the panel/demist door from the heater-A/C housing.

(6) Reverse the removal procedures to install.

DEFROST DOOR AND LEVER

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

(2) Remove the panel/demist door and lever from the upper heater-A/C housing. See Panel/Demist Door and Lever in this group for the procedures.

(3) Insert a screwdriver into the latch hole (Fig. 57) of the defrost door pivot shaft to release the latch of the defrost door lever, and pull the lever out of the pivot shaft from the outside of the upper half of the heater-A/C housing.

(4) Reach inside the upper half of the heater-A/C housing and carefully flex the defrost door (Fig. 58) enough so that the door pivot clears the pivot hole in the housing.

(5) Remove the defrost door from the heater-A/C housing.

(6) Reverse the removal procedures to install.

FLOOR DOOR AND LEVER

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

(2) Remove the floor door vacuum actuator from the lower heater-A/C housing. See Mode Door Vacuum Actuator in this group for the procedures.

(3) Insert a screwdriver into the latch hole (Fig. 57) of the floor door pivot shaft to release the latch of the floor door lever, and pull the lever out of the pivot shaft from the outside of the lower half of the heater-A/C housing.

(4) Reach inside the lower half of the heater-A/C housing and carefully flex the floor door (Fig. 59) enough so that the door pivot clears the pivot hole in the housing.

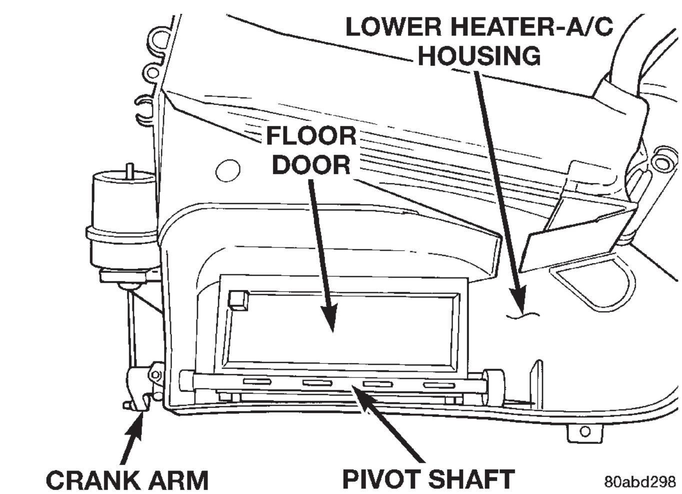


Fig. 59 Floor Door

(5) Remove the floor door from the heater-A/C housing.

(6) Reverse the removal procedures to install.

RECIRCULATION AIR DOOR

A recirculation air door and vacuum actuator are used only on models with the optional air conditioning system.

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

(2) Remove the recirculation air door vacuum actuator from the lower heater-A/C housing. See Mode Door Vacuum Actuator in this group for the procedures.

REMOVAL AND INSTALLATION (Continued)

(3) Reach inside the lower half of the heater-A/C housing and lift the bottom edge of the recirculation air door upwards (Fig. 60).

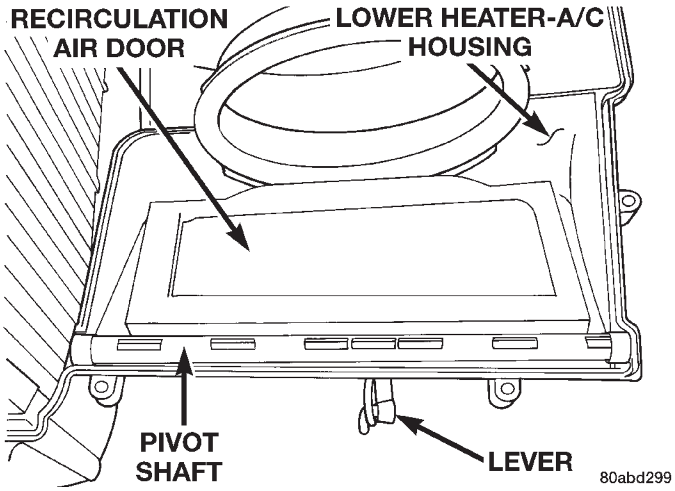


Fig. 60 Recirculation Air Door

(4) Guide the recirculation air door lever through the air intake grille of the heater-A/C housing while removing the door from the housing.

(5) Reverse the removal procedures to install.

EVAPORATOR COIL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

(2) Lift the evaporator coil unit out of the lower half of the heater-A/C housing (Fig. 61).

(3) Reverse the removal procedures to install. Be certain that the evaporator foam insulator wrap and rubber tube seal are reinstalled.

NOTE: If the evaporator is replaced, add 60 milliliters (2 fluid ounces) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

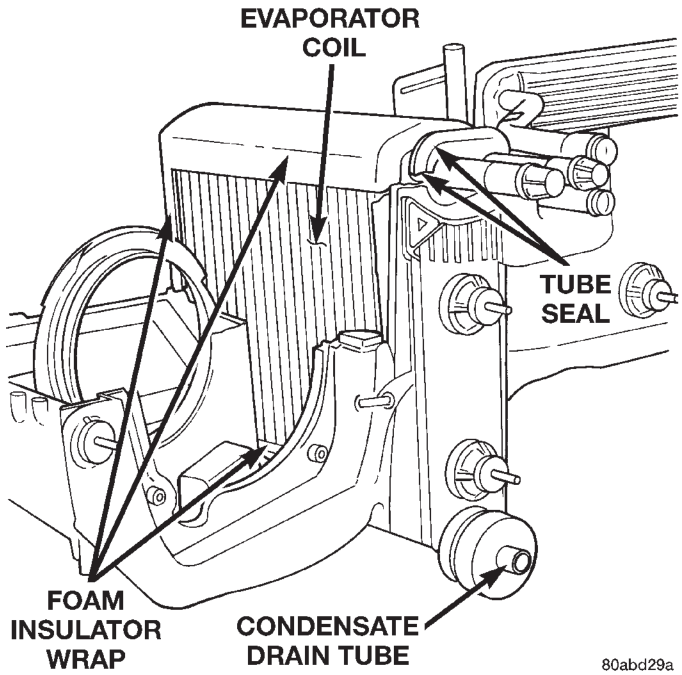


Fig. 61 Evaporator Coil Remove/Install

HEATER CORE

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove and disassemble the heater-A/C housing. See Heater-A/C Housing in this group for the procedures.

(2) Lift the heater core out of the lower half of the heater-A/C housing (Fig. 62).

(3) Reverse the removal procedures to install. Be certain that the heater core foam insulator is reinstalled.

REMOVAL AND INSTALLATION (Continued)

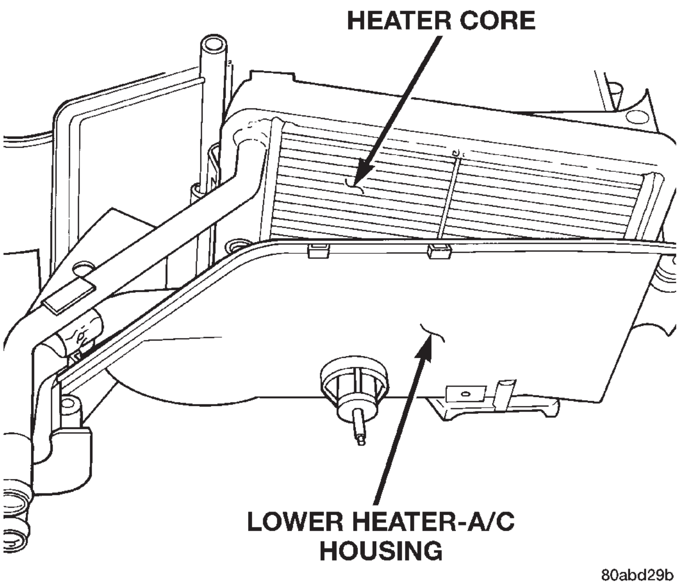


Fig. 62 Heater Core Remove/Install

DUCTS AND OUTLETS

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

PANEL OUTLET DUCTS

The panel outlet ducts are integral to the instrument panel assembly. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

PANEL OUTLET BARRELS

(1) Use a trim stick or another suitable wide flat-bladed tool to gently pry the panel outlet barrel out of the panel outlet housing (Fig. 63). 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.

DEMISTER OUTLETS

The side window demister outlets are integral to the instrument panel end caps. Refer to Instrument Panel End Cap in Group 8E - Instrument Panel Systems for the procedures.

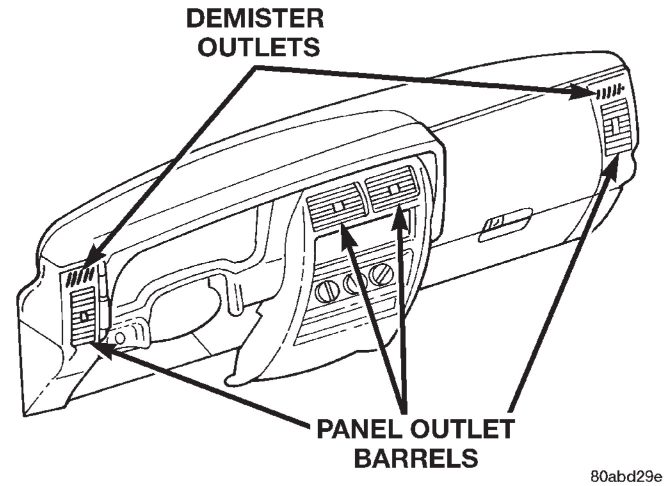


Fig. 63 Panel Outlet Barrels

DEFROST DUCT/DEMISTER ADAPTER

(1) Remove the instrument panel assembly from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(2) Disconnect the demister hoses from the defrost duct/demister adapter (Fig. 64).

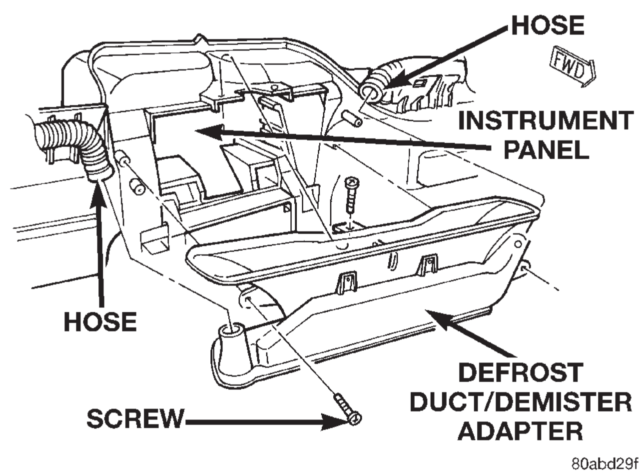


Fig. 64 Defrost Duct/Demister Adapter

(3) Remove the three screws that secure the defrost duct/demister adapter to the instrument panel.

(4) Remove the defrost duct/demister adapter from the instrument panel.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

DEMISTER HOSES

(1) Remove the instrument panel assembly from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

REMOVAL AND INSTALLATION (Continued)

(2) Disconnect the ends of the demister hose from the demister duct (Fig. 65) and the defrost duct/demister adapter (Fig. 64).

(3) Reverse the removal procedures to install.

DEMISTER DUCTS

(1) Remove the instrument panel assembly from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(2) Remove the end cap from the instrument panel. Refer to Instrument Panel End Cap in Group 8E - Instrument Panel Systems for the procedures.

(3) Disconnect the demister hoses from the demister duct (Fig. 65).

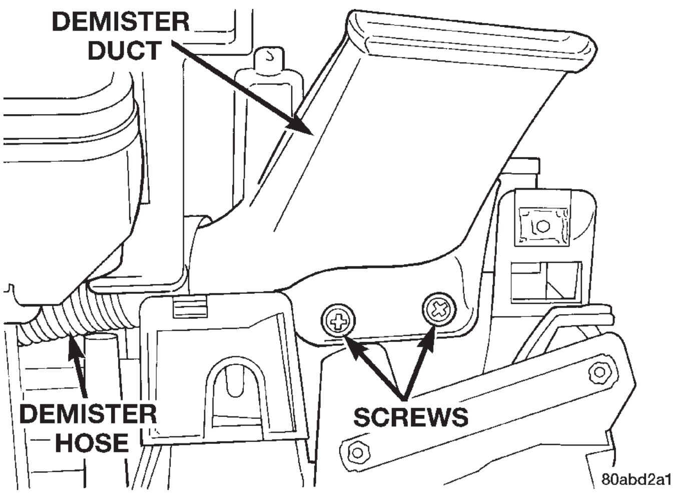


Fig. 65 Demister Duct Remove/Install

(4) Remove the two screws that secure the demister duct to the top of the instrument panel.

(5) Remove the demister duct from the instrument panel.

(6) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

CONSOLE REAR DUCT

(1) Disconnect and isolate the battery negative cable.

(2) Remove the floor console from the floor panel transmission tunnel (Fig. 66). Refer to Group 23 - Body for the procedures.

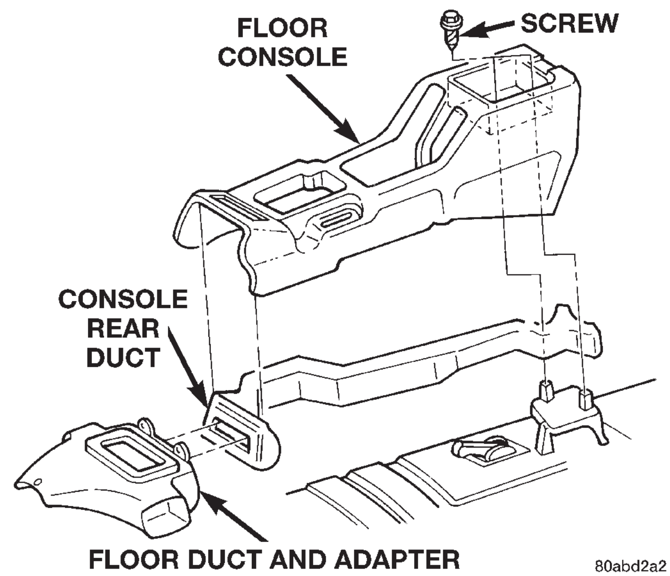


Fig. 66 Floor Duct and Console Rear Duct Remove/Install

(3) Lift the rear of the console rear duct out of the console rear mounting bracket on the floor panel transmission tunnel and slide the duct rearward to disengage it from the floor duct and adapter.

(4) Remove the console rear duct from the vehicle.

(5) Reverse the removal procedures to install.

FLOOR DUCT AND ADAPTER

(1) Remove the instrument panel from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(2) Remove the heater-A/C housing from the vehicle. See Heater-A/C Housing in this group for the procedures.

(3) Remove the three screws that secure the floor duct and adapter to the heater-A/C housing (Fig. 66).

(4) Remove the floor duct and adapter from the heater-A/C housing.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

EMISSION CONTROL SYSTEMS

CONTENTS

ON-BOARD DIAGNOSTICS

INDEX

DESCRIPTION AND OPERATION

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 code applies to a non-emissions related component or system, and the problem is repaired or ceases to exist, the PCM cancels the code after 40 warm-up cycles. Diagnostic trouble codes that affect vehicle emissions illuminate the Malfunction Indicator (check engine) Lamp. Refer to Malfunction Indicator Lamp in this section.

Certain criteria must be met before the PCM stores a DTC in memory. The criteria may be a specific range of engine RPM, engine temperature, and/or input voltage to the PCM.

The PCM might not store a DTC for a monitored circuit even though a malfunction has occurred. This may happen because one of the DTC criteria for the circuit has not been met. **For example** , assume the diagnostic trouble code criteria requires the PCM to monitor the circuit only when the engine operates between 750 and 2000 RPM. Suppose the sensor's output circuit shorts to ground when engine operates above 2400 RPM (resulting in 0 volt input to the PCM). Because the condition happens at an engine speed above the maximum threshold (2000 rpm), the PCM will not store a DTC.

There are several operating conditions for which the PCM monitors and sets DTC's. Refer to Monitored Systems, Components, and Non-Monitored Circuits in this section.

Technicians must retrieve stored DTC's by connecting the DRB scan tool (or an equivalent scan tool) to the 16–way data link connector (Fig. 1). Refer to Diagnostic Trouble Codes in this section.

NOTE: Various diagnostic procedures may actually cause a diagnostic monitor to set a DTC. For instance, pulling a spark plug wire to perform a spark test may set the misfire code. When a repair is completed and verified, connect the DRB scan tool to the 16–way data link connector to erase all DTC's and extinguish the MIL (check engine lamp).

MALFUNCTION INDICATOR LAMP (MIL)

DESCRIPTION

The Malfunction Indicator Lamp (MIL) is located on the instrument panel. It is displayed as the CHECK ENGINE lamp.

DESCRIPTION AND OPERATION (Continued)

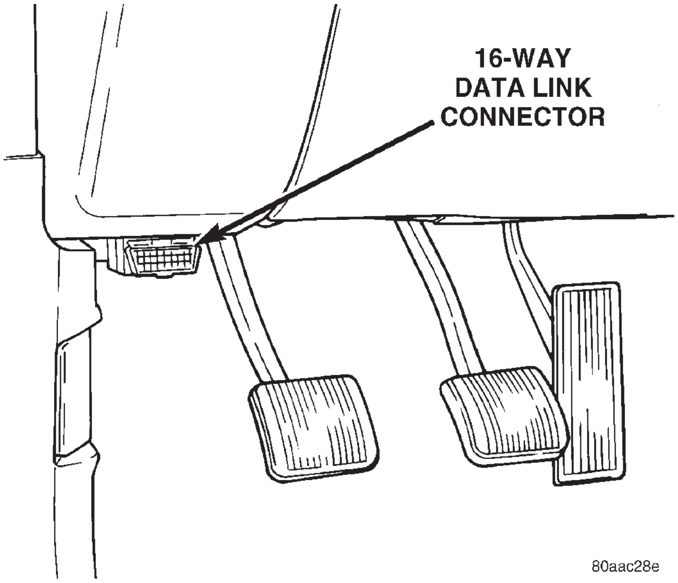


Fig. 1 Data Link (Diagnostic) Connector Location

OPERATION

As a functional test, the MIL illuminates at key-on before engine cranking. Whenever the Powertrain Control Module (PCM) sets a Diagnostic Trouble Code (DTC) that affects vehicle emissions, it illuminates the MIL. If a problem is detected, the PCM sends a message to the instrument cluster to illuminate the lamp. The PCM illuminates the MIL only for DTC's that affect vehicle emissions. There are some monitors that may take two consecutive trips, with a detected fault, before the MIL is illuminated. The MIL stays on 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

OPERATION

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

OPERATION

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

OPERATION

A Diagnostic Trouble Code (DTC) indicates that the Powertrain Control Module (PCM) has recognized an abnormal condition in the system.

DTC's are the results of a system or circuit failure, but do not directly identify the failed component or components.

Technicians must retrieve stored DTC's by connecting the DRB III scan tool (or an equivalent scan tool) to the 16–way data link connector. This connector is located on the lower edge of the instrument panel near the steering column.

OBTAINING DTC's

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING ANY TEST ON AN OPERATING ENGINE.

(1) Connect the DRB scan tool to data link (diagnostic) connector.

(2) Turn the ignition switch on, access Read Fault Screen. Record all the DTC's shown on the DRB scan tool.

(3) To erase DTC's, use the Erase Trouble Code data screen on the DRB scan tool.

NOTE: For a list of DTC's, refer to the following charts.

DESCRIPTION AND OPERATION (Continued)

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS

(M) CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P0030 (M)	1/1 O2 Sensor Heater Relay Circuit	Problem detected in oxygen sensor heater relay circuit.
P0036 (M)	1/2 O2 Sensor Heater Relay Circuit	Problem detected in oxygen sensor heater relay circuit.
P0106	Barometric Pressure Out of Range	MAP sensor input voltage out of an acceptable range detected during reading of barometric pressure at key-on.
P0107 (M)	Map Sensor Voltage Too Low	MAP sensor input below minimum acceptable voltage.
P0108 (M)	Map Sensor Voltage Too High	MAP sensor input above maximum acceptable voltage.
P0112 (M)	Intake Air Temp Sensor Voltage Low	Intake air (charge) temperature sensor input below the minimum acceptable voltage.
P0113 (M)	Intake Air Temp Sensor Voltage High	Intake air (charge) temperature sensor input above the maximum acceptable voltage.
P0116		A rationatilty error has been detected in the coolant temp sensor.
P0117 (M)	ECT Sensor Voltage Too Low	Engine coolant temperature sensor input below the minimum acceptable voltage.
P0118 (M)	ECT Sensor Voltage Too High	Engine coolant temperature sensor input above the maximum acceptable voltage.
P0121 (M)	TPS Voltage Does Not Agree With MAP	TPS signal does not correlate to MAP sensor signal.
P0121 (M)	Accelerator Position Sensor (APPS) Signal Voltage Too Low	APPS voltage input below the minimum acceptable voltage.
P0122 (M)	Throttle Position Sensor Voltage Low	Throttle position sensor input below the acceptable voltage range.
P0122 (M)	Accelerator Position Sensor (APPS) Signal Voltage Too Low	APPS voltage input below the minimum acceptable voltage.
P0123 (M)	Throttle Position Sensor Voltage High	Throttle position sensor input above the maximum acceptable voltage.
P0123 (M)	Accelerator Position Sensor (APPS) Signal Voltage Too High	APPS voltage input above the maximum acceptable voltage.
P0125 (M)	Closed Loop Temp Not Reached	Time to enter Closed Loop Operation (Fuel Control) is excessive.
P0125 (M)	Engine is Cold Too Long	Engine does not reach operating temperature.
P0131 (M)	1/1 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0132 (M)	1/1 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0133 (M)	1/1 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0134 (M)	1/1 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor input.
P0135 (M)	1/1 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.

DESCRIPTION AND OPERATION (Continued)

(M) **CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).**		
P0137 (M)	1/2 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0138 (M)	1/2 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0139 (M)	1/2 O2 Sensor Slow Response	Oxygen sensor response not as expected.
P0140 (M)	1/2 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0141 (M)	1/2 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0143 (M)	1/3 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0144 (M)	1/3 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0145 (M)	1/3 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0146 (M)	1/3 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0147 (M)	1/3 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0151 (M)	2/1 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0152 (M)	2/1 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage sustained above normal operating range.
P0153 (M)	2/1 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0154 (M)	2/1 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0155 (M)	2/1 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0157 (M)	2/2 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0158 (M)	2/2 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0159	2/2 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0160 (M)	2/2 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0161 (M)	2/2 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0168	Decreased Engine Performance Due To High Injection Pump Fuel Temp	Fuel temperature is above the engine protection limit. Engine power will be derated.
P0171 (M)	1/1 Fuel System Lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.
P0172 (M)	1/1 Fuel System Rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
P0174 (M)	2/1 Fuel System Lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.
P0175 (M)	2/1 Fuel System Rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
P0176	Loss of Flex Fuel Calibration Signal	No calibration voltage present from flex fuel sensor.

DESCRIPTION AND OPERATION (Continued)

(M) CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).		
P0177	Water In Fuel	Excess water found in fuel by water-in-fuel sensor.
P0178	Flex Fuel Sensor Volts Too Low	Flex fuel sensor input below minimum acceptable voltage.
P0178	Water In Fuel Sensor Voltage Too Low	Loss of water-in-fuel circuit or sensor.
P0179	Flex Fuel Sensor Volts Too High	Flex fuel sensor input above maximum acceptable voltage.
P0181	Fuel Injection Pump Failure	Low power, engine derated, or engine stops.
P0182 (M)	CNG Temp Sensor Voltage Too Low	Compressed natural gas temperature sensor voltage below acceptable voltage.
P0183 (M)	CNG Temp Sensor Voltage Too High	Compressed natural gas temperature sensor voltage above acceptable voltage.
P0201 (M)	Injector #1 Control Circuit	An open or shorted condition detected in control circuit for injector #1 or the INJ 1 injector bank.
P0202 (M)	Injector #2 Control Circuit	An open or shorted condition detected in control circuit for injector #2 or the INJ 2 injector bank.
P0203 (M)	Injector #3 Control Circuit	An open or shorted condition detected in control circuit for injector #3 or the INJ 3 injector bank.
P0204 (M)	Injector #4 Control Circuit	Injector #4 or INJ 4 injector bank output driver stage does not respond properly to the control signal.
P0205 (M)	Injector #5 Control Circuit	Injector #5 output driver stage does not respond properly to the control signal.
P0206 (M)	Injector #6 Control Circuit	Injector #6 output driver stage does not respond properly to the control signal.
P0207 (M)	Injector #7 Control Circuit	Injector #7 output driver stage does not respond properly to the control signal.
P0208 (M)	Injector #8 Control Circuit	Injector #8 output driver stage does not respond properly to the control signal.
P0209 (M)	Injector #9 Control Circuit	Injector #9 output driver stage does not respond properly to the control signal.
P0210 (M)	Injector #10 Control Circuit	Injector #10 output driver stage does not respond properly to the control signal.
P0215	Fuel Injection Pump Control Circuit	Failure in fuel pump relay control circuit.
P0216 (M)	Fuel Injection Pump Timing Failure	High fuel supply restriction, low fuel pressure or possible wrong or incorrectly installed pump keyway.
P0217	Decreased Engine Performance Due To Engine Overheat Condition	Engine overheating. ECM will derate engine performance.
P0219	Crankshaft Position Sensor Overspeed Signal	Engine has exceeded rpm limits.
P0222 (M)	Idle Validation Signals Both Low	Problem detected with idle validation circuits within APPS.
P0223 (M)	Idle Validation Signals Both High (Above 5 Volts)	Problem detected with idle validation circuits within APPS.
P0230	Transfer Pump (Lift Pump) Circuit Out of Range	Problem detected in fuel transfer pump circuits.
P0232	Fuel Shutoff Signal Voltage Too High	Fuel shut-off signal voltage too high from ECM to fuel injection pump.
P0234 (M)	Turbo Boost Limit Exceeded	Problem detected in turbocharger wastegate.

DESCRIPTION AND OPERATION (Continued)

(M) **CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).**		
P0236 (M)	Map Sensor Too High Too Long	Problem detected in turbocharger wastegate.
P0237 (M)	Map Sensor Voltage Too Low	MAP sensor voltage input below the minimum acceptable voltage.
P0238 (M)	Map Sensor Voltage Too High	MAP sensor voltage input above the maximum acceptable voltage.
P0251 (M)	Fuel Inj. Pump Mech. Failure Fuel Valve Feedback Circuit	Problem sensed with fuel circuit internal to fuel injection pump.
P0253 (M)	Fuel Injection Pump Fuel Valve Open Circuit	Problem sensed with fuel circuit internal to fuel injection pump.
P0254	Fuel Injection Pump Fuel Valve Current Too High	Problem caused by internal fuel injection pump failure.
P0300 (M)	Multiple Cylinder Mis-fire	Misfire detected in multiple cylinders.
P0301 (M)	CYLINDER #1 MISFIRE	Misfire detected in cylinder #1.
P0302 (M)	CYLINDER #2 MISFIRE	Misfire detected in cylinder #2.
P0303 (M)	CYLINDER #3 MISFIRE	Misfire detected in cylinder #3.
P0304 (M)	CYLINDER #4 MISFIRE	Misfire detected in cylinder #4.
P0305 (M)	CYLINDER #5 MISFIRE	Misfire detected in cylinder #5.
P0306 (M)	CYLINDER #6 MISFIRE	Misfire detected in cylinder #6.
P0307 (M)	CYLINDER #7 MISFIRE	Misfire detected in cylinder #7
P0308 (M)	CYLINDER #8 MISFIRE	Misfire detected in cylinder #8.
P0309 (M)	CYLINDER #9 MISFIRE	Misfire detected in cylinder #9.
P0310 (M)	CYLINDER #10 MISFIRE	Misfire detected in cylinder #10.
P0320 (M)	No Crank Referance Signal at PCM	No reference signal (crankshaft position sensor) detected during engine cranking.
P0320 (M)	No RPM Signal to PCM (Crankshaft Position Sensor Signal to JTEC)	A CKP signal has not been detected at the PCM.
P0325	Knock Sensor #1 Circuit	Knock sensor (#1) signal above or below minimum acceptable threshold voltage at particular engine speeds.
P0330	Knock Sensor #2 Circuit	Knock sensor (#2) signal above or below minimum acceptable threshold voltage at particular engine speeds.
P0336 (M)	Crankshaft Position (CKP) Sensor Signal	Problem with voltage signal from CKP.
P0340 (M)	No Cam Signal At PCM	No fuel sync
P0341 (M)	Camshaft Position (CMP) Sensor Signal	Problem with voltage signal from CMP.
P0350	Ignition Coil Draws Too Much Current	A coil (1-5) is drawing too much current.
P0351 (M)	Ignition Coil # 1 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
P0352 (M)	Ignition Coil # 2 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
P0353 (M)	Ignition Coil # 3 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
P0354 (M)	Ignition Coil # 4 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (High Impedance).

DESCRIPTION AND OPERATION (Continued)

(M) CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).		
P0355 (M)	Ignition Coil # 5 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (High Impedance).
P0356 (M)	Ignition Coil # 6 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (high impedance).
P0357 (M)	Ignition Coil # 7 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (high impedance).
P0358 (M)	Ignition Coil # 8 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (high impedance).
P0370	Fuel Injection Pump Speed/Position Sensor Sig Lost	Problem caused by internal fuel injection pump failure.
P0380 (M)	Intake Air Heater Relay #1 Control Circuit	Problem detected in #1 air heater solenoid/relay circuit (not heater element)
P0381 (M)	Wait To Start Lamp Inoperative	Problem detected in wait-to-start bulb circuit.
P0382 (M)	Intake Air Heater Relay #2 Control Circuit	Problem detected in #2 air heater solenoid/relay circuit (not heater element)
P0387	Crankshaft Position Sensor Supply Voltage Too Low	CKP sensor voltage input below the minimum acceptable voltage.
P0388	Crankshaft Position Sensor Supply Voltage Too High	CKP sensor voltage input above the maximum acceptable voltage.
P0401	EGR System Failure	Required change in air/fuel ration not detected during diagnostic test.
P0403	EGR Solenoid Circuit	An open or shorted condition detected in the EGR solenoid control circuit.
P0404	EGR Position Sensor Rationality	EGR position sensor signal does not correlate to EGR duty cycle.
P0405	EGR Position Sensor Volts Too Low	EGR position sensor input below the acceptable voltage range.
P0406	EGR Position Sensor Volts Too High	EGR position sensor input above the acceptable voltage range.
P0412	Secondary Air Solenoid Circuit	An open or shorted condition detected in the secondary air (air switching/aspirator) solenoid control circuit.
P0420 (M)	1/1 Catalytic Converter Efficiency	Catalyst 1/1 efficiency below required level.
P0432 (M)	1/2 Catalytic Converter Efficiency	Catalyst 2/1 efficiency below required level.
P0441 (M)	Evap Purge Flow Monitor	Insufficient or excessive vapor flow detected during evaporative emission system operation.
P0442 (M)	Evap Leak Monitor Medium Leak Detected	A small leak has been detected in the evaporative system.
P0443 (M)	Evap Purge Solenoid Circuit	An open or shorted condition detected in the EVAP purge solenoid control circuit.
P0455 (M)	Evap Leak Monitor Large Leak Detected	A large leak has been detected in the evaporative system.
P0456 (M)	Evap Leak Monitor Small Leak Detected	Leak has been detected in the evaporative system.
P0460	Fuel Level Unit No Change Over Miles	During low fuel

DESCRIPTION AND OPERATION (Continued)

(M) **CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).**		
P0460	Fuel Level Unit No Change Over Miles	Fuel level sending unit voltage does not change for more than 40 miles.
P0462	Fuel Level Sending Unit Volts Too Low	Fuel level sensor input below acceptable voltage.
P0462 (M)	Fuel Level Sending Unit Volts Too Low	Open circuit between PCM and fuel gauge sending unit.
P0463	Fuel Level Sending Unit Volts Too High	Fuel level sensor input above acceptable voltage.
P0463 (M)	Fuel Level Sending Unit Volts Too High	Circuit shorted to voltage between PCM and fuel gauge sending unit.
P0500 (M)	No Vehicle Speed Sensor Signal	No vehicle speed sensor signal detected during road load conditions.
P0500 (M)	No Vehicle Speed Sensor Signal	A vehicle speed signal was not detected.
P0505 (M)	Idle Air Control Motor Circuits	SBEC II
P0522	Oil Pressure Voltage Too Low	Oil pressure sending unit (sensor) voltage input below the minimum acceptable voltage.
P0523	Oil Pressure Voltage Too High	Oil pressure sending unit (sensor) voltage input above the maximum acceptable voltage.
P0524	Oil Pressure Too Low	Engine oil pressure is low. Engine power derated.
P0545	A/C Clutch Relay Circuit	Problem detected in air conditioning clutch relay control circuit.
P0551	Power Steering Switch Failure	Incorrect input state detected for the power steering switch circuit. PL: High pressure seen at high speed.
P0562	Charging System Voltage Too Low	Supply voltage sensed at ECM too low.
P0563	Charging System Voltage Too High	Supply voltage sensed at ECM too high.
P0600	PCM Failure SPI Communications	No communication detected between co-processors in the control module.
P0601 (M)	Internal Controller Failure	Internal control module fault condition (check sum) detected.
P0602 (M)	ECM Fueling Calibration Error	ECM Internal fault condition detected.
P0604	RAM Check Failure	Transmission control module RAM self test fault detected. -Aisin transmission
P0605	ROM Check Falure	Transmission control module ROM self test fault detected -Aisin transmission
P0606 (M)	ECM Failure	ECM Internal fault condition detected.
P0615	Starter Relay Control Circuit	An open or shorted condition detected in the starter relay control circuit.
P0622 (G)	Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
P0645	A/C Clutch Relay Circuit	An open or shorted condition detected in the A/C clutch relay control circuit.
P0700	EATX Controller DTC Present	This SBEC III or JTEC DTC indicates that the EATX or Aisin controller has an active fault and has illuminated the MIL via a CCD (EATX) or SCI (Aisin) message. The specific fault must be acquired from the EATX via CCD or from the Aisin via ISO-9141.

DESCRIPTION AND OPERATION (Continued)

(M) CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).		
P0703	Brake Switch Stuck Pressed or Released	Incorrect input state detected in the brake switch circuit. (Changed from P1595)
P0711 (M)	Trans Temp Sensor, No Temp Rise After Start	Relationship between the transmission temperature and overdrive operation and/or TCC operation indicates a failure of the Transmission Temperature Sensor. OBD II Rationality. Was MIL code 37.
P0712	Trans Temp Sensor Voltage Too Low	Transmission fluid temperature sensor input below acceptable voltage. Was MIL code 37.
P0712 (M)	Trans Temp Sensor Voltage Too Low	Voltage less than 1.55 volts (4-speed auto. trans. only).
P0713	Trans Temp Sensor Voltage Too High	Transmission fluid temperature sensor input above acceptable voltage. Was MIL code 37.
P0713 (M)	Trans Temp Sensor Voltage Too High	Voltage greater than 3.76 volts (4-speed auto. trans. only).
P0720 (M)	Low Output SPD Sensor RPM, Above 15 MPH	The relationship between the Output Shaft Speed Sensor and vehicle speed is not within acceptable limits.
P0720 (M)	Low Output Spd Sensor RPM Above 15 mph	Output shaft speed is less than 60 rpm with vehicle speed above 15 mph (4-speed auto. trans. only).
P0740 (M)	Torq Con Clu, No RPM Drop at Lockup	Relationship between engine and vehicle speeds indicated failure of torque convertor clutch lock-up system (TCC/PTU solenoid)
P0743 (M)	Torque Converter Clutch Solenoid/ Trans Relay Circuits	An open or shorted condition detected in the torque converter clutch (part throttle unlock) solenoid control circuit. Shift solenoid C electrical fault - Aisin transmission
P0743 (M)	Torque Converter Clutch Solenoid/ Trans Relay Circuits	An open or shorted condition detected in the torque converter part throttle unlock solenoid control circuit (3 or 4-speed auto. trans. only).
P0748 (M)	Governor Pressur Sol Control/Trans Relay Circuits	An open or shorted condition detected in the Governor Pressure Solenoid circuit or Trans Relay Circuit in JTEC RE transmissions.
P0748 (M)	Governor Pressure Sol Control/Trans Relay Circuits	An open or shorted condition detected in the governor pressure solenoid or relay circuits (4-speed auto. trans. only).
P0751 (M)	O/D Switch Pressed (Lo) More Than 5 Minutes	Overdrive override switch input is in a prolonged depressed state.
P0751 (M)	O/D Switch Pressed (LO) More Than 5 Min	Overdrive Off switch input too low for more than 5 minutes (4-speed auto. trans. only).
P0753 (M)	Trans 3-4 Shift Sol/Trans Relay Circuits	An open or shorted condition detected in the overdrive solenoid control circuit or Trans Relay Circuit in JTEC RE transmissions. Was MIL code 45.
P0753 (M)	Trans 3-4 Shift Sol/Trans Relay Circuits	An open or shorted condition detected in the transmission 2-4 shift solenoid circuit (4-speed auto. trans. only).
P0756	AW4 Shift Sol B (2-3) Functional Failure	Shift solenoid B (2-3) functional fault - Aisin transmission
P0783 (M)	3-4 Shift Sol, No RPM Drop at Lockup	The overdrive solenoid is unable to engage the gear change from 3rd gear to the overdrive gear.
P0801	Reverse Gear Lockout Circuit Open or Short	An open or shorted condition detected in the transmission reverse gear lock-out solenoid control circuit.

DESCRIPTION AND OPERATION (Continued)

(M) **CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).**		
P0830	Clutch Depressed Switch Circuit	Problem detected in clutch switch circuit.
P0833	Clutch Released Switch Circuit	Problem detected in clutch switch circuit.
P1110	Decrease Engine Performance Due To High Intake Air Temperature	Intake manifold air temperature is above the engine protection limit. Engine power will be derated.
P1180	Decreased Engine Performance Due To High Injection Pump Fuel Temp	Fuel temperature is above the engine protection limit. Engine power will be derated.
P1195 (M)	1/1 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 1/1 during catalyst monitor test. (Also see SCI DTC $66) (was P0133)
P1196 (M)	2/1 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 2/1 during catalyst monitor test. (Also see SCI DTC $7A) (was P0153)
P1197	1/2 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 1/2 during catalyst monitor test. (Also see SCI DTC $68) (was P0139)
P1198	Radiator Temperature Sensor Volts Too High	Radiator coolant temperature sensor input above the maximum acceptable voltage.
P1199	Radiator Temperature Sensor Volts Too Low	Radiator coolant temperature sensor input below the minimum acceptable voltage.
P1281	Engine is Cold Too Long	Engine coolant temperature remains below normal operating temperatures during vehicle travel (Thermostat).
P1282	Fuel Pump Relay Control Circuit	An open or shorted condition detected in the fuel pump relay control circuit.
P1283	Idle Select Signal Invalid	ECM or fuel injection pump module internal fault condition detected.
P1284 (M)	Fuel Injection Pump Battery Voltage Out-Of-Range	Fuel injection pump module internal fault condition detected. Engine power will be derated.
P1285 (M)	Fuel Injection Pump Controller Always On	Fuel injection pump module relay circuit failure detected. Engine power will be derated.
P1286	Accelerator Position Sensor (APPS) Supply Voltage Too High	High voltage detected at APPS.
P1287	Fuel Injection Pump Controller Supply Voltage Low	ECM or fuel injection pump module internal fault condition detected. Engine power will be derated.
P1288	Intake Manifold Short Runner Solenoid Circuit	An open or shorted condition detected in the short runner tuning valve circuit.
P1289	Manifold Tune Valve Solenoid Circuit	An open or shorted condition detected in the manifold tuning valve solenoid control circuit.
P1290	CNG Fuel System Pressure Too High	Compressed natural gas system pressure above normal operating range.
P1291	No Temp Rise Seen From Intake Heaters	Energizing Heated Air Intake does not change intake air temperature sensor an acceptable amount.
P1291 (M)	No Temperature Rise Seen From Intake Air Heaters	Problem detected in intake manifold air heating system.
P1292	CNG Pressure Sensor Voltage Too High	Compressed natural gas pressure sensor reading above acceptable voltage.

DESCRIPTION AND OPERATION (Continued)

(M) **CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).**		
P1293	CNG Pressure Sensor Voltage Too Low	Compressed natural gas pressure sensor reading below acceptable voltage.
P1294 (M)	Target Idle Not Reached	Target RPM not achieved during drive idle condition. Possible vacuum leak or IAC (AIS) lost steps.
P1295 (M)	No 5 Volts to TP Sensor	Loss of a 5 volt feed to the Throttle Position Sensor has been detected.
P1295 (M)	Accelerator Position Sensor (APPS) Supply Voltage Too Low	APPS supply voltage input below the minimum acceptable voltage.
P1296	No 5 Volts to MAP Sensor	Loss of a 5 volt feed to the MAP Sensor has been detected.
P1297 (M)	No Change in MAP From Start To Run	No difference is recognized between the MAP reading at engine idle and the stored barometric pressure reading.
P1298	Lean Operation at Wide Open Throttle	A prolonged lean condition is detected during Wide Open Throttle
P1299	Vacuum Leak Found (IAC Fully Seated)	MAP Sensor signal does not correlate to Throttle Position Sensor signal. Possible vacuum leak.
P1388	Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the ASD or CNG shutoff relay control ckt.
P1388	Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the auto shutdown relay circuit.
P1389	No ASD Relay Output Voltage At PCM	No Z1 or Z2 voltage sensed when the auto shutdown relay is energized.
P1389 (M)	No ASD Relay Output Voltage at PCM	An open condition detected In the ASD relay output circuit.
P1390	Timing Belt Skipped 1 Tooth or More	Relationship between Cam and Crank signals not correct
P1391 (M)	Intermittent Loss of CMP or CKP	Loss of the Cam Position Sensor or Crank Position sensor has occurred. For PL 2.0L
P1398 (M)	Mis-Fire Adaptive Numerator at Limit	PCM is unable to learn the Crank Sensor's signal in preparation for Misfire Diagnostics. Probable defective Crank Sensor
P1399	Wait To Start Lamp Cicuit	An open or shorted condition detected in the Wait to Start Lamp circuit.
P1403	No 5V to EGR Sens	Loss of 5v feed to the EGR position sensor.
P01475	Aux 5 Volt Supply Voltage High	Sensor supply voltage for ECM sensors is too high.
P1476	Too Little Secondary Air	Insufficient flow of secondary air injection detected during aspirator test (was P0411)
P1477	Too Much Secondary Air	Excessive flow of secondary air injection detected during aspirator test (was P0411).
P1478	Battery Temp Sensor Volts Out of Limit	Internal temperature sensor input voltage out of an acceptable range.
P1479	Transmission Fan Relay Circuit	An open or shorted condition detected in the transmission fan relay circuit.
P1480	PCV Solenoid Circuit	An open or shorted condition detected in the PCV solenoid circuit.
P1481	EATX RPM Pulse Perf	EATX RPM pulse generator signal for misfire detection does not correlate with expected value.

DESCRIPTION AND OPERATION (Continued)

(M) **CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).**		
P1482	Catalyst Temperature Sensor Circuit Shorted Low	Catalyst temperature sensor circuit shorted low.
P1483	Catalyst Temperature Sensor Circuit Shorted High.	Catalyst temperature sensor circuit shorted high.
P1484	Catalytic Converter Overheat Detected	A catalyst overheat condition has been detected by the catalyst temperature sensor.
P1485	Air Injection Solenoid Circuit	An open or shorted condition detected in the air assist solenoid circuit.
P1486	Evap Leak Monitor Pinched Hose Found	LDP has detected a pinched hose in the evaporative hose system.
P1487	Hi Speed Rad Fan CTRL Relay Circuit	An open or shorted condition detected in the control circuit of the #2 high speed radiator fan control relay.
P1488	Auxiliary 5 Volt Supply Output Too Low	Auxiliary 5 volt sensor feed is sensed to be below an acceptable limit.
P1488	5 Volt Supply Voltage Low	Sensor supply voltage for ECM sensors is too low.
P1489	High Speed Fan CTRL Relay Circuit	An open or shorted condition detected in the control circuit of the high speed radiator fan control relay.
P1490	Low Speed Fan CTRL Relay Circuit	An open or shorted condition detected in control circuit of the low speed radiator fan control relay.
P1491	Rad Fan Control Relay Circuit	An open or shorted condition detected in the radiator fan control relay control circuit. This includes PWM solid state relays.
P1492	Ambient/Batt Temp Sen Volts Too High	External temperature sensor input above acceptable voltage.
P1492 (M)	Ambient/Batt Temp Sensor Volts Too High	Battery temperature sensor input voltage above an acceptable range.
P1493 (M)	Ambient/Batt Temp Sen Volts Too Low	External temperature sensor input below acceptable voltage.
P1493 (M)	Ambient/Batt Temp Sen Volts Too Low	Battery temperature sensor input voltage below an acceptable range.
P1494 (M)	Leak Detection Pump Sw or Mechanical Fault	Incorrect input state detected for the Leak Detection Pump (LDP) pressure switch.
P1495	Leak Detection Pump Solenoid Circuit	An open or shorted condition detected in the Leak Detection Pump (LDP) solenoid circuit.
P1496	5 Volt Supply, Output Too Low	5 volt sensor feed is sensed to be below an acceptable limit. (less than 4v for 4 sec)
P1498	High Speed Rad Fan Ground CTRL Rly Circuit	An open or shorted condition detected in the control circuit of the #3 high speed radiator fan control relay.
P1594 (G)	Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
P1594	Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
P1595	Speed Control Solenoid Circuits	An open or shorted condition detected in either of the speed control vacuum or vent solenoid control circuits.
P1595	Speed Control Solenoid Circuits	An open or shorted condition detected in the speed control vacuum or vent solenoid circuits.

DESCRIPTION AND OPERATION (Continued)

(M) **CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).**		
P1596	Speed Control Switch Always High	Speed control switch input above maximum acceptable voltage.
P1597	Speed Control Switch Always Low	Speed control switch input below minimum acceptable voltage.
P1597	Speed Control Switch Always Low	Speed control switch input below the minimum acceptable voltage.
P1598	A/C Pressure Sensor Volts Too High	A/C pressure sensor input above maximum acceptable voltage.
P1598	A/C Sensor Input Hi	Problem detected in air conditioning electrical circuit.
P1599	A/C Pressure Sensor Volts Too Low	A/C pressure sensor input below minimum acceptable voltage.
P1599	A/C Sensor Input Lo	Problem detected in air conditioning electrical circuit.
P1680	Clutch Released Switch Circuit	Problem detected in clutch switch electrical circuit.
P1681	No I/P Cluster CCD/J1850 Messages Received	No CCD/J1850 messages received from the cluster control module.
P1682 (G)	Charging System Voltage Too Low	Battery voltage sense input below target charging voltage during engine operation and no significant change in voltage detected during active test of generator output circuit.
P1682	Charging System Voltage Too Low	Charging system output voltage low.
P1683	SPD CTRL PWR Relay; or S/C 12v Driver CKT	An open or shorted condition detected in the speed control servo power control circuit.
P1683	Spd ctrl pwr rly, or s/c 12v driver circuit	An open or shorted condition detected in the speed control servo power control circuit.
P1684	Batt Loss in 50 Star	The battery has been disconnected within the last 50 starts
P1685	SKIM Invalid Key	The engine controler has received an invalid key from the SKIM.
P1686	No SKIM BUS Messages Received	No CCD/J1850 messages received from the Smart Key Immobilizer Module (SKIM).
P1687	No MIC BUS Message	No CCD/J1850 messages received from the Mechanical Instrument Cluster (MIC) module.
P1688 (M)	Internal Fuel Injection Pump Controller Failure	Internal problem within the fuel injection pump. Low power, engine derated, or engine stops.
P1689 (M)	No Communication Between ECM and Injection Pump Module	Data link circuit failure between ECM and fuel injection pump. Low power, engine derated, or engine stops.
P1690 (M)	Fuel Injection Pump CKP Sensor Does Not Agree With ECM CKP Sensor	Problem in fuel sync signal. Possible injection pump timing problem. Low power, engine derated, or engine stops.
P1691	Fuel Injection Pump Controller Calibration Error	Internal fuel injection pump failure. Low power, engine derated, or engine stops.
P1692	DTC Set In ECM	A ″Companion DTC″ was set in both the ECM and PCM.
P1693 (M)	DTC Detected in Companion Module	A fault has been generated in the companion engine control module.
P1693 (M)	DTC Detected in PCM/ECM or DTC Detected in ECM	A ″Companion DTC″ was set in both the ECM and PCM.

DESCRIPTION AND OPERATION (Continued)

(M) **CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).**		
P1694	Fault In Companion Module	No CCD/J1850 messages received from the powertrain control module-Aisin transmission
P1694 (M)	No CCD Messages received from ECM	Bus communication failure to PCM.
P1695	No CCD/J1850 Message From Body Control Module	No CCD/J1850 messages received from the body control module.
P1696	PCM Failure EEPROM Write Denied	Unsuccessful attempt to write to an EEPROM location by the control module.
P1697	PCM Failure SRI Mile Not Stored	Unsuccessful attempt to update Service Reminder Indicator (SRI or EMR) mileage in the control module EEPROM.
P1698	No CCD/J1850 Message From TCM	No CCD/J1850 messages received from the electronic transmission control module (EATX) or the Aisin transmission controller.
P1698	No CCD Messages received from PCM	Bus communication failure to PCM. A ″Companion DTC″ was set in both the ECM and PCM.
P1719	Skip Shift Solenoid Circuit	An open or shorted condition detected in the transmission 2-3 gear lock-out solenoid control circuit.
P1740	TCC or OD Sol Perf	A rationality error has been detected in either the TCC solenoid or overdrive solenoid systems.
P1740 (M)	TCC OR O/D Solenoid Performance	Problem detected in transmission convertor clutch and/or overdrive circuits (diesel engine with 4-speed auto. trans. only).
P1756 (M)	GOV Press Not Equal to Target @ 15-20 PSI	The requested pressure and the actual pressure are not within a tolerance band for the Governor Control System which is used to regulate governor pressure to control shifts for 1st, 2nd, and 3rd gear. (Mid Pressure Malfunction)
P1756 (M)	Governor Pressure Not Equal to Target @ 15-20 PSI	Governor sensor input not between 10 and 25 psi when requested (4-speed auto. trans. only).
P1757	GOV Press Not Equal to Target @ 15-20 PSI	The requested pressure and the actual pressure are not within a tolerance band for the Governor Control System which is used to regulate governor pressure to control shifts for 1st, 2nd, and 3rd gear (Zero Pressure Malfunction)
P1757 (M)	Governor Pressure Above 3 PSI In Gear With 0 MPH	Governor pressure greater than 3 psi when requested to be 0 psi (4-speed auto. trans. only).
P1762 (M)	Gov Press Sen Offset Volts Too Lo or High	The Governor Pressure Sensor input is greater than a calibration limit or is less than a calibration limit for 3 consecutive park/neutral calibrations.
P1762 (M)	Governor Press Sen Offset Volts Too Low or High	Sensor input greater or less than calibration for 3 consecutive Neutral/Park occurrences (4-speed auto. trans. only).
P1763	Governor Pressure Sensor Volts Too Hi	The Governor Pressure Sensor input is above an acceptable voltage level.
P1763 (M)	Governor Pressure Sensor Volts Too HI	Voltage greater than 4.89 volts (4-speed auto. trans. only).

DESCRIPTION AND OPERATION (Continued)

(M) CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA).		
P1764 (M)	Governor Pressure Sensor Volts Too Low	The Governor Pressure Sensor input is below an acceptable voltage level.
P1764 (M)	Governor Pressure Sensor Volts Too Low	Voltage less than .10 volts (4-speed auto. trans. only).
P1765 (M)	Trans 12 Volt Supply Relay CTRL Circuit	An open or shorted condition is detected in the Transmission Relay control circuit. This relay supplies power to the TCC
P1765 (M)	Trans 12 Volt Supply Relay Ctrl Circuit	Current state of solenoid output port is different than expected (4-speed auto. trans. only).
P1899 (M)	P/N Switch Stuck in Park or in Gear	Incorrect input state detected for the Park/Neutral switch.
P1899 (M)	P/N Switch Stuck in Park or in Gear	Incorrect input state detected for the Park/Neutral switch (3 or 4-speed auto. trans. only).

MONITORED SYSTEMS

OPERATION

There are new electronic circuit monitors that check fuel, emission, engine and ignition performance. These monitors use information from various sensor circuits to indicate the overall operation of the fuel, engine, ignition and emission systems and thus the emissions performance of the vehicle.

The fuel, engine, ignition and emission systems monitors do not indicate a specific component problem. They do indicate that there is an implied problem within one of the systems and that a specific problem must be diagnosed.

If any of these monitors detect a problem affecting vehicle emissions, the Malfunction Indicator (Check Engine) Lamp will be illuminated. These monitors generate Diagnostic Trouble Codes that can be displayed with the check engine lamp or a scan tool.

The following is a list of the system monitors:

- Misfire Monitor
- Fuel System Monitor
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
- Catalyst Monitor
- Leak Detection Pump Monitor (if equipped)

All these system monitors require two consecutive trips with the malfunction present to set a fault.

Refer to the appropriate Powertrain Diagnostics Procedures manual for diagnostic procedures.

The following is an operation and description of each system monitor:

OXYGEN SENSOR (O2S) MONITOR

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a 14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

The O2S is also the main sensing element for the Catalyst and Fuel Monitors.

The O2S can fail in any or all of the following manners:

- slow response rate
- reduced output voltage
- dynamic shift
- shorted or open circuits

Response rate is the time required for the sensor to switch from lean to rich once it is exposed to a richer than optimum A/F mixture or vice versa. As the sensor starts malfunctioning, it could take longer to detect the changes in the oxygen content of the exhaust gas.

The output voltage of the O2S ranges from 0 to 1 volt. A good sensor can easily generate any output voltage in this range as it is exposed to different concentrations of oxygen. To detect a shift in the A/F mixture (lean or rich), the output voltage has to change beyond a threshold value. A malfunctioning sensor could have difficulty changing beyond the threshold value.

OXYGEN SENSOR HEATER MONITOR

If there is an oxygen sensor (O2S) shorted to voltage DTC, as well as a O2S heater DTC, the O2S fault MUST be repaired first. Before checking the

DESCRIPTION AND OPERATION (Continued)

O2S fault, verify that the heater circuit is operating correctly.

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572 ° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a 14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

The voltage readings taken from the O2S sensor are very temperature sensitive. The readings are not accurate below 300°C. Heating of the O2S sensor is done to allow the engine controller to shift to closed loop control as soon as possible. The heating element used to heat the O2S sensor must be tested to ensure that it is heating the sensor properly.

The O2S sensor circuit is monitored for a drop in voltage. The sensor output is used to test the heater by isolating the effect of the heater element on the O2S sensor output voltage from the other effects.

LEAK DETECTION PUMP MONITOR (IF EQUIPPED)

The leak detection assembly incorporates two primary functions: it must detect a leak in the evaporative system and seal the evaporative system so the leak detection test can be run.

The primary components within the assembly are: A three port solenoid that activates both of the functions listed above; a pump which contains a switch, two check valves and a spring/diaphragm, a canister vent valve (CVV) seal which contains a spring loaded vent seal valve.

Immediately after a cold start, between predetermined temperature thresholds limits, the three port solenoid is briefly energized. This initializes the pump by drawing air into the pump cavity and also closes the vent seal. During non test conditions the vent seal is held open by the pump diaphragm assembly which pushes it open at the full travel position. The vent seal will remain closed while the pump is cycling due to the reed switch triggering of the three port solenoid that prevents the diaphragm assembly from reaching full travel. After the brief initialization period, the solenoid is de-energized allowing atmospheric pressure to enter the pump cavity, thus permitting the spring to drive the diaphragm which forces air out of the pump cavity and into the vent system. When the solenoid is energized and de energized, the cycle is repeated creating flow in typical diaphragm pump fashion. The pump is controlled in 2 modes:

Pump Mode: The pump is cycled at a fixed rate to achieve a rapid pressure build in order to shorten the overall test length.

Test Mode: The solenoid is energized with a fixed duration pulse. Subsequent fixed pulses occur when the diaphragm reaches the Switch closure point.

The spring in the pump is set so that the system will achieve an equalized pressure of about 7.5” H20. The cycle rate of pump strokes is quite rapid as the system begins to pump up to this pressure. As the pressure increases, the cycle rate starts to drop off. If there is no leak in the system, the pump would eventually stop pumping at the equalized pressure. If there is a leak, it will continue to pump at a rate representative of the flow characteristic of the size of the leak. From this information we can determine if the leak is larger than the required detection limit (currently set at .040” orifice by CARB). If a leak is revealed during the leak test portion of the test, the test is terminated at the end of the test mode and no further system checks will be performed.

After passing the leak detection phase of the test, system pressure is maintained by turning on the LDP’s solenoid until the purge system is activated. Purge activation in effect creates a leak. The cycle rate is again interrogated and when it increases due to the flow through the purge system, the leak check portion of the diagnostic is complete.

The canister vent valve will unseal the system after completion of the test sequence as the pump diaphragm assembly moves to the full travel position.

Evaporative system functionality will be verified by using the stricter evap purge flow monitor. At an appropriate warm idle the LDP will be energized to seal the canister vent. The purge flow will be clocked up from some small value in an attempt to see a shift in the 02 control system. If fuel vapor, indicated by a shift in the 02 control, is present the test is passed. If not, it is assumed that the purge system is not functioning in some respect. The LDP is again turned off and the test is ended.

MISFIRE MONITOR

Excessive engine misfire results in increased catalyst temperature and causes an increase in HC emissions. Severe misfires could cause catalyst damage. To prevent catalytic convertor damage, the PCM monitors engine misfire.

The Powertrain Control Module (PCM) monitors for misfire during most engine operating conditions (positive torque) by looking at changes in the crankshaft speed. If a misfire occurs the speed of the crankshaft will vary more than normal.

DESCRIPTION AND OPERATION (Continued)

FUEL SYSTEM MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide. The catalyst works best when the Air Fuel (A/F) ratio is at or near the optimum of 14.7 to 1.

The PCM is programmed to maintain the optimum air/fuel ratio of 14.7 to 1. This is done by making short term corrections in the fuel injector pulse width based on the O2S sensor output. The programmed memory acts as a self calibration tool that the engine controller uses to compensate for variations in engine specifications, sensor tolerances and engine fatigue over the life span of the engine. By monitoring the actual fuel-air ratio with the O2S sensor (short term) and multiplying that with the program long-term (adaptive) memory and comparing that to the limit, it can be determined whether it will pass an emissions test. If a malfunction occurs such that the PCM cannot maintain the optimum A/F ratio, then the MIL will be illuminated.

CATALYST MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide.

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

OPERATION

The term "Trip" has different meanings depending on what the circumstances are. If the MIL (Malfunction Indicator Lamp) is OFF, a Trip is defined as when the Oxygen Sensor Monitor and the Catalyst Monitor have been completed in the same drive cycle.

When any Emission DTC is set, the MIL on the dash is turned ON. When the MIL is ON, it takes 3 good trips to turn the MIL OFF. In this case, it depends on what type of DTC is set to know what a "Trip" is.

For the Fuel Monitor or Mis-Fire Monitor (continuous monitor), the vehicle must be operated in the "Similar Condition Window" for a specified amount of time to be considered a Good Trip.

If a Non-Contiuous OBDII Monitor, such as:

- Oxygen Sensor
- Catalyst Monitor
- Purge Flow Monitor
- Leak Detection Pump Monitor (if equipped)
- EGR Monitor (if equipped)
- Oxygen Sensor Heater Monitor

fails twice in a row and turns ON the MIL, re-running that monitor which previously failed, on the next start-up and passing the monitor is considered to be a Good Trip.

If any other Emission DTC is set (not an OBDII Monitor), a Good Trip is considered to be when the Oxygen Sensor Monitor and Catalyst Monitor have been completed; or 2 Minutes of engine run time if the Oxygen Sensor Monitor or Catalyst Monitor have been stopped from running.

It can take up to 2 Failures in a row to turn on the MIL. After the MIL is ON, it takes 3 Good Trips to turn the MIL OFF. After the MIL is OFF, the PCM will self-erase the DTC after 40 Warm-up cycles. A Warm-up cycle is counted when the ECT (Engine Coolant Temperature Sensor) has crossed 160°F and has risen by at least 40°F since the engine has been started.

COMPONENT MONITORS

OPERATION

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

OPERATION

FUEL PRESSURE

The fuel pressure regulator controls fuel system pressure. The PCM cannot detect a clogged fuel pump inlet filter, clogged in-line fuel filter, or a pinched fuel supply or return line. However, these could result in a rich or lean condition causing the PCM to store an oxygen sensor or fuel system diagnostic trouble code.

SECONDARY IGNITION CIRCUIT

The PCM cannot detect an inoperative ignition coil, fouled or worn spark plugs, ignition cross firing, or open spark plug cables.

CYLINDER COMPRESSION

The PCM cannot detect uneven, low, or high engine cylinder compression.

EXHAUST SYSTEM

The PCM cannot detect a plugged, restricted or leaking exhaust system, although it may set a fuel system fault.

FUEL INJECTOR MECHANICAL MALFUNCTIONS

The PCM cannot determine if a fuel injector is clogged, the needle is sticking or if the wrong injector is installed. However, these could result in a rich or lean condition causing the PCM to store a diagnostic trouble code for either misfire, an oxygen sensor, or the fuel system.

EXCESSIVE OIL CONSUMPTION

Although the PCM monitors engine exhaust oxygen content when the system is in closed loop, it cannot determine excessive oil consumption.

THROTTLE BODY AIR FLOW

The PCM cannot detect a clogged or restricted air cleaner inlet or filter element.

VACUUM ASSIST

The PCM cannot detect leaks or restrictions in the vacuum circuits of vacuum assisted engine control system devices. However, these could cause the PCM to store a MAP sensor diagnostic trouble code and cause a high idle condition.

PCM SYSTEM GROUND

The PCM cannot determine a poor system ground. However, one or more diagnostic trouble codes may be generated as a result of this condition. The module should be mounted to the body at all times, also during diagnostic.

DESCRIPTION AND OPERATION (Continued)

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

OPERATION

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

OPERATION

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 CONTROL SYSTEM

OPERATION

The evaporation control system prevents the emission of fuel tank vapors into the atmosphere. When fuel evaporates in the fuel tank, the vapors pass through vent hoses or tubes to a charcoal filled evaporative canister. The canister temporarily holds the vapors. The Powertrain Control Module (PCM) allows intake manifold vacuum to draw vapors into the combustion chambers during certain operating conditions.

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 EVAP Canister Purge Solenoid.

When equipped with certain emissions packages, a Leak Detection Pump (LDP) will be used as part of the evaporative system for OBD II requirements. Also refer to Leak Detection Pump.

NOTE: The evaporative system uses specially manufactured lines/hoses. If replacement becomes necessary, only use fuel resistant hose.

ROLLOVER VALVE

The fuel tank is equipped with a rollover valve. The valve is located on the top of the fuel tank (Fig. 1). The valve 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 this valve.

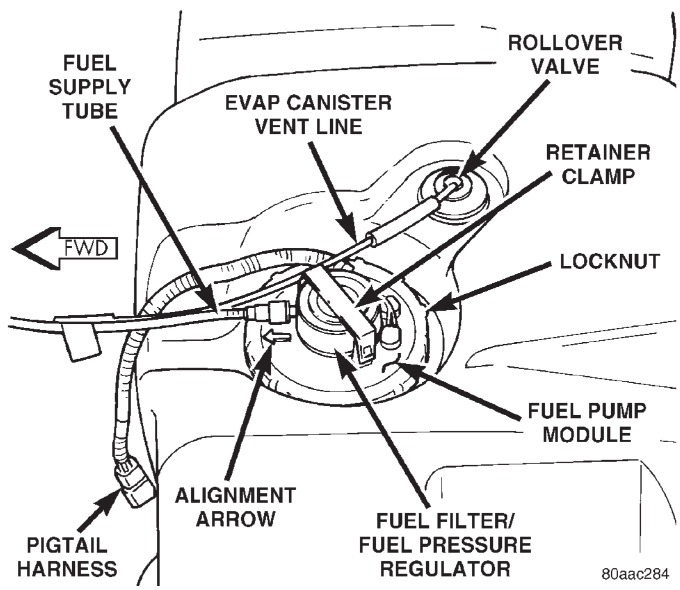


Fig. 1 Rollover Valve Location

The valve cannot be serviced separately. If replacement is necessary, the fuel tank must be replaced. Refer to Fuel Tank Removal/Installation in Group 14, Fuel System.

EVAP CANISTER

A maintenance free, EVAP canister is used on all vehicles. The EVAP canister is located under the left side of vehicle near front of rear axle (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.

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

DESCRIPTION AND OPERATION (Continued)

cycle EVAP canister purge solenoid allows the EVAP canister to be purged at predetermined times and at certain engine operating conditions.

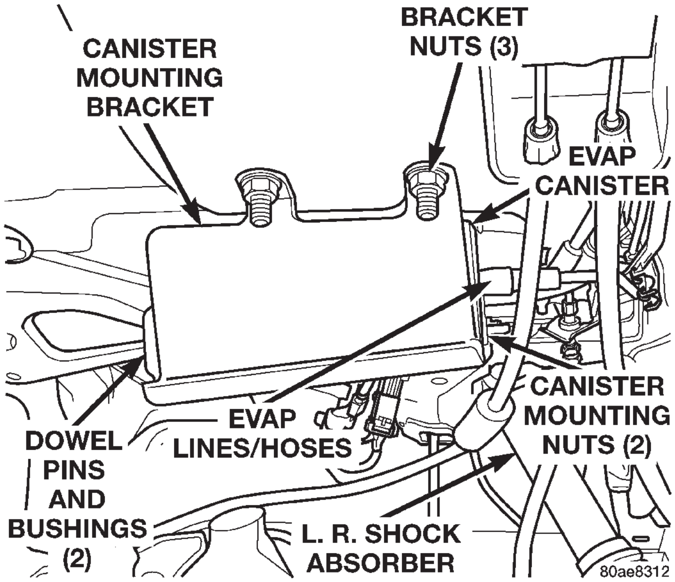


Fig. 2 EVAP Canister Location

DUTY CYCLE EVAP CANISTER PURGE SOLENOID

The Duty Cycle EVAP Canister Purge Solenoid regulates the rate of vapor flow from the EVAP canister to the intake manifold. The Powertrain Control Module (PCM) operates the solenoid.

During the cold start warm-up period and the hot start time delay, the PCM does not energize the solenoid. When de-energized, no vapors are purged. The PCM de-energizes the solenoid during open loop operation.

The engine enters closed loop operation after it reaches a specified temperature and the time delay ends. During closed loop operation, the PCM cycles (energizes and de-energizes) the solenoid 5 or 10 times per second, depending upon operating conditions. The PCM varies the vapor flow rate by changing solenoid pulse width. Pulse width is the amount of time that the solenoid is energized. The PCM adjusts solenoid pulse width based on engine operating condition.

The solenoid attaches to a bracket located in the right-rear side of engine compartment (Fig. 3).The top of the solenoid has the word UP or TOP on it. The solenoid will not operate properly unless it is installed correctly.

LEAK DETECTION PUMP (LDP)

The leak detection pump (LDP) is used only with certain emission packages.

The LDP is a device used to detect a leak in the evaporative system.

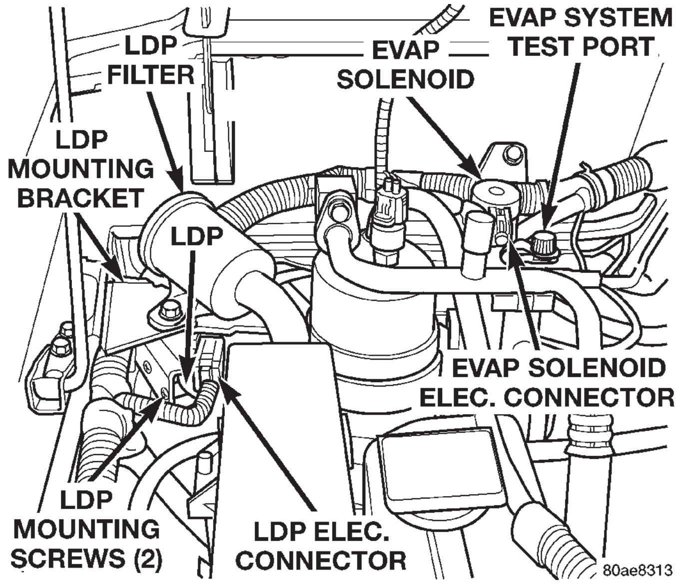


Fig. 3 EVAP Purge Solenoid and LDP Location

The pump contains a 3 port solenoid, a pump that contains a switch, a spring loaded canister vent valve seal, 2 check valves and a spring/diaphragm.

Immediately after a cold start, engine temperature between 40°F and 86°F, the 3 port solenoid is briefly energized. This initializes the pump by drawing air into the pump cavity and also closes the vent seal. During non-test test conditions, the vent seal is held open by the pump diaphragm assembly which pushes it open at the full travel position. The vent seal will remain closed while the pump is cycling. This is due to the operation of the 3 port solenoid which prevents the diaphragm assembly from reaching full travel. After the brief initialization period, the solenoid is de-energized, allowing atmospheric pressure to enter the pump cavity. This permits the spring to drive the diaphragm which forces air out of the pump cavity and into the vent system. When the solenoid is energized and de-energized, the cycle is repeated creating flow in typical diaphragm pump fashion. The pump is controlled in 2 modes:

PUMP MODE: The pump is cycled at a fixed rate to achieve a rapid pressure build in order to shorten the overall test time.

TEST MODE: The solenoid is energized with a fixed duration pulse. Subsequent fixed pulses occur when the diaphragm reaches the switch closure point.

The spring in the pump is set so that the system will achieve an equalized pressure of about 7.5 inches of water.

When the pump starts, the cycle rate is quite high. As the system becomes pressurized pump rate drops. If there is no leak the pump will quit. If there is a leak, the test is terminated at the end of the test mode.

DESCRIPTION AND OPERATION (Continued)

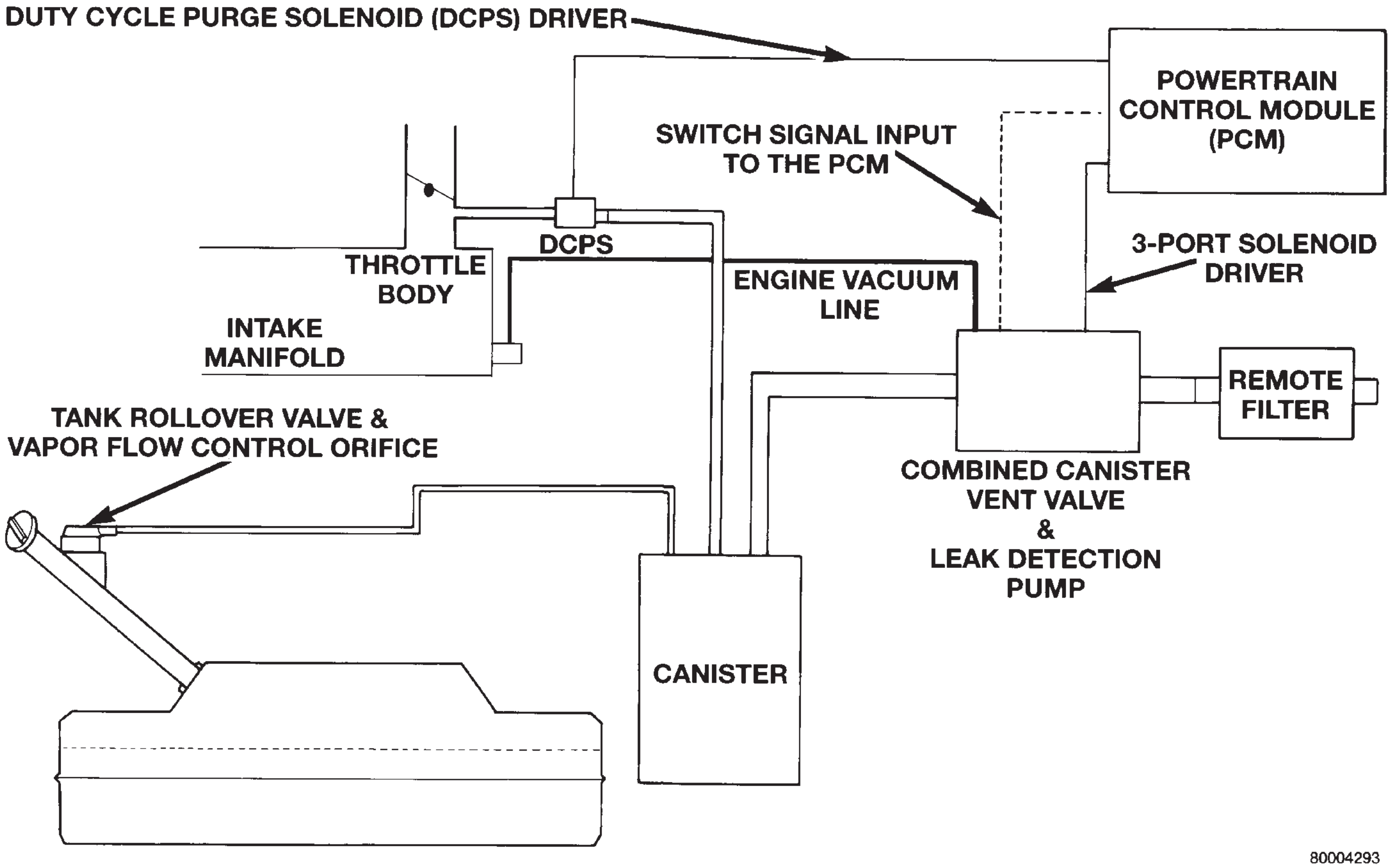


Fig. 4 Evaporative System Monitor Schematic—Typical

If there is no leak, the purge monitor is run. If the cycle rate increases due to the flow through the purge system, the test is passed and the diagnostic is complete.

The canister vent valve will unseal the system after completion of the test sequence as the pump diaphragm assembly moves to the full travel position.

CRANKCASE VENTILATION SYSTEM

All 2.5L 4–cylinder and 4.0L 6–cylinder engines are equipped with a Crankcase Ventilation (CCV) system (Fig. 5) or (Fig. 6). The CCV system performs the same function as a conventional PCV system, but does not use a vacuum controlled valve.

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 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 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.

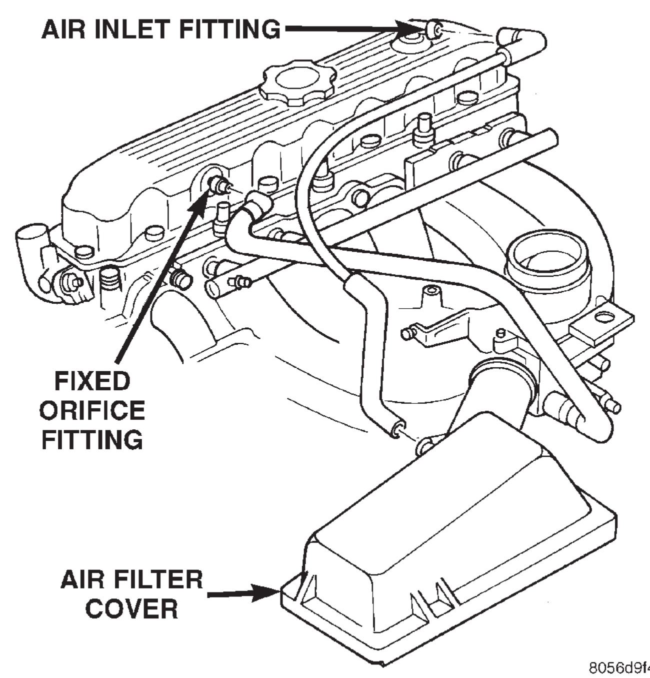


Fig. 5 CCV System—2.5L Engine—Typical

When the engine is operating, fresh air enters the engine and mixes with crankcase vapors. Manifold vacuum draws the vapor/air mixture through the

DESCRIPTION AND OPERATION (Continued)

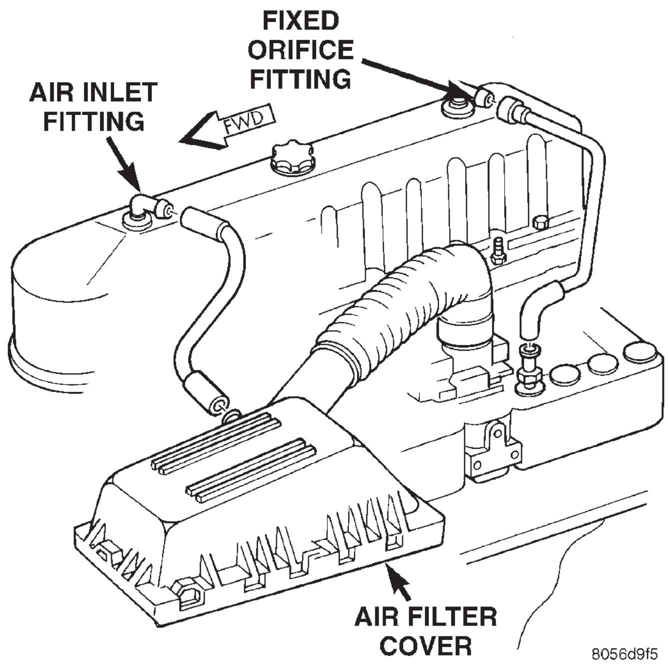


Fig. 6 CCV System—4.0L Engine—Typical

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. 7) 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

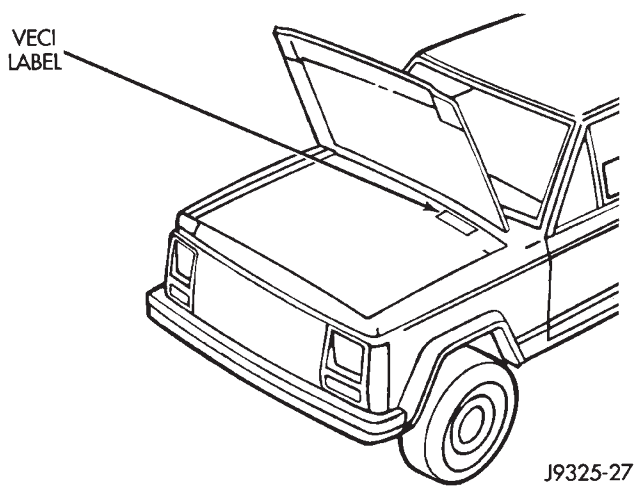


Fig. 7 VECI Label Location—Typical

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. For label location, refer to Vehicle Emission Control Information (VECI) Label.

LEAK DETECTION PUMP (LDP)

Refer to the appropriate Powertrain Diagnostic Procedures service manual for LDP testing procedures.

REMOVAL AND INSTALLATION

EVAP CANISTER

The EVAP canister is located under left side of vehicle near front of rear axle (Fig. 8).

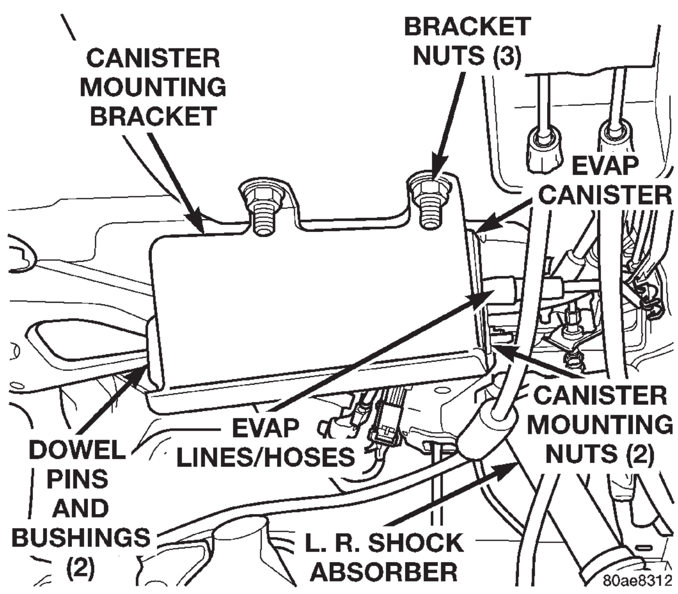


Fig. 8 EVAP Canister Location

REMOVAL

(1) Disconnect vacuum hoses/lines at EVAP canister. Note location of lines before removal.

(2) Remove EVAP canister and mounting bracket assembly from body (3 nuts).

(3) Remove canister from mounting bracket (2 nuts).

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position canister into canister mounting bracket. Align 2 canister dowel pins into rubber bushings.

(2) Install 2 canister nuts and tighten to 5 N·m (45 in. lbs.) torque.

(3) Position canister and bracket assembly to body.

(4) Install 3 nuts and tighten to 43 N·m (32 ft. lbs.) torque.

(5) Connect vacuum hoses/lines at EVAP canister.

DUTY CYCLE EVAP CANISTER PURGE SOLENOID

REMOVAL

The solenoid attaches to a bracket located in right-rear side of engine compartment (Fig. 9) or (Fig. 10). The top of the solenoid has the word UP or TOP on it. The solenoid will not operate properly unless it is installed correctly.

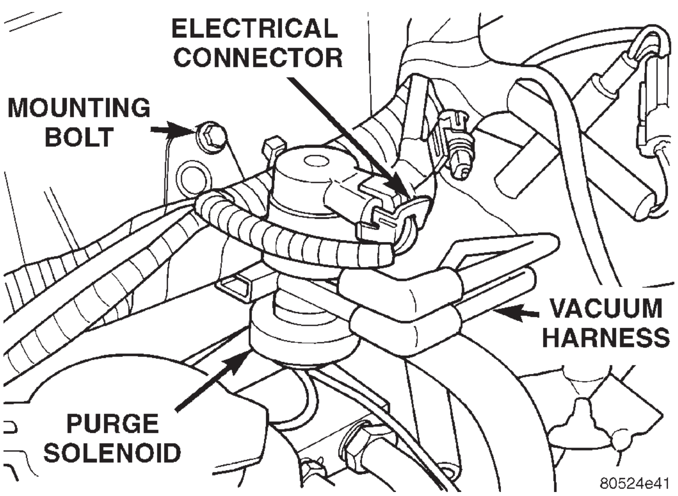


Fig. 9 EVAP Canister Purge Solenoid (Without LDP)

(1) Disconnect electrical wiring connector at solenoid.

(2) Disconnect vacuum harness at solenoid.

(3) Remove solenoid and its support bracket.

INSTALLATION

(1) Install EVAP canister purge solenoid and its mounting bracket to cowl panel.

(2) Tighten bolt to 5 N·m (45 in. lbs.) torque.

(3) Connect vacuum harness and wiring connector.

ROLLOVER VALVE(S)

The rollover valves(s) are/is molded into the fuel tank and are not serviced separately. If replacement is necessary, the fuel tank must be replaced. Refer to Fuel Tank Removal/Installation.

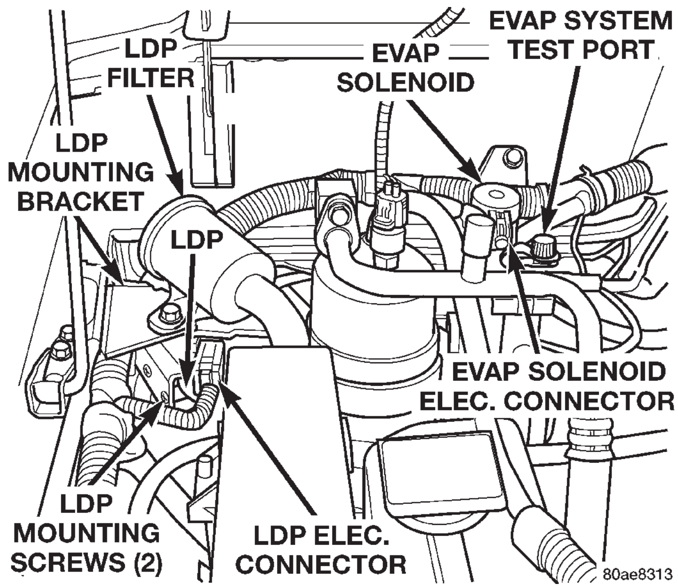


Fig. 10 EVAP Canister Purge Solenoid (With LDP)

LEAK DETECTION PUMP (LDP)

The LDP is located in the right-rear side of engine compartment (Fig. 10). The LDP filter is located above the LDP (Fig. 10). The LDP and LDP filter are replaced (serviced) as one unit.

REMOVAL

(1) Carefully remove hose at LDP filter.

(2) Remove LDP filter mounting bolt and remove from vehicle.

(3) Carefully remove vapor/vacuum lines at LDP.

(4) Disconnect electrical connector at LDP.

(5) Remove 2 LDP mounting screws (Fig. 10) and remove from vehicle.

INSTALLATION

(1) Install LDP to mounting bracket. Tighten screws to 1 N·m (11 in. lbs.) torque.

(2) Install LDP filter to mounting bracket. Tighten bolt to 7 N·m (65 in. lbs.) torque.

(3) Carefully install vapor/vacuum lines to LDP, and install hose to LDP filter. **The vapor/vacuum lines and hoses must be firmly connected. Check the vapor/vacuum lines at the LDP, LDP filter and EVAP canister purge solenoid for damage or leaks. If a leak is present, a Diagnostic Trouble Code (DTC) may be set.**

(4) Connect electrical connector to LDP.

SPECIFICATIONS

TORQUE CHART

Description	Torque
EVAP Canister Mounting Nuts (canister-to-mounting bracket)	5 N·m (45 in. lbs.)
EVAP Canister Mounting Bracket Nuts (mounting bracket-to-body)	43 N·m (32 in. lbs.)
EVAP Canister Purge Solenoid Bracket-to-Body Mounting Bolt	5 N·m (45 in. lbs.)
LDP Mounting Screws	1 N·m (11 in. lbs.)

EMISSION CONTROL SYSTEM

CONTENTS

ON-BOARD DIAGNOSTICS—2.5L DIESEL ENGINE

INDEX

GENERAL INFORMATION

SYSTEM DESCRIPTION—2.5L DIESEL ENGINE

The 2.5L diesel Engine Control Module (ECM) and Powertrain Control Module (PCM) monitor and control many different circuits in the fuel injection pump and engine systems. If the ECM senses a problem with a monitored circuit that indicates an actual problem, a Diagnostic Trouble Code (DTC) will be stored in the PCM's memory, and eventually may illuminate the Check Engine Lamp constantly while the key is on. If the problem is repaired, or is intermittent, the ECM will erase the DTC after 40 warm-up cycles. A warm-up cycle consists of starting the vehicle when the engine is cold, then the engine to warms up to a certain temperature, and finally, the engine temperature falls to a normal operating temperature, then the key is turned off.

Certain criteria must be met for a DTC to be entered into ECM memory. The criteria may be a specific range of engine rpm, engine or fuel temperature and/or input voltage to the ECM. A DTC indicates that the ECM has identified an abnormal signal in a circuit or the system. A DTC may indicate the result of a failure, but never identify the failed component directly.

There are several operating conditions that the ECM does not monitor and set a DTC for. Refer to the following Monitored Circuits and Non–Monitored Circuits in this section.

ECM MONITORED SYSTEMS

The ECM can detect certain problems in the electrical system.

Open or Shorted Circuit – The ECM will not distiguish between an open or a short to ground, however the ECM can determine if sensor output (which is the input to ECM) is within proper range. It also determines if the circuit is open or shorted.

Output Device Current Flow – The ECM senses whether the output devices are electrically connected.

If there is a problem with the circuit, the ECM senses whether the circuit is open, shorted to ground (–), or shorted to (+) voltage.

ECM NON–MONITORED SYSTEMS

The ECM does not monitor the following circuits, systems or conditions that could have malfunctions that result in driveability problems. A DTC will not be displayed for these conditions.

Fuel Pressure: Fuel pressure is controlled by the fuel injection pump. The ECM cannot detect fuel pressure problems in this component. The ECM does a comparison analysis of fuel quantity, fuel timing, fuel temperature, and control sleeve sensor inputs to determine if a fuel problem exists.

Cylinder Compression: The ECM cannot detect uneven, low, or high engine cylinder compression.

Exhaust System: The ECM cannot detect a plugged, restricted or leaking exhaust system.

Fuel Injector Malfunctions: The ECM cannot determine if the fuel injector is clogged, or the wrong injector is installed. The fuel injectors on the diesel engine are **not controlled** by the ECM, although a

GENERAL INFORMATION (Continued)

defective fuel injector sensor **is monitored** by the ECM.

Vacuum Assist: Leaks or restrictions in the vacuum circuits of vacuum assisted engine control system devices are not monitored by the ECM.

ECM System Ground: The ECM cannot determine a poor system ground. However, a DTC may be generated as a result of this condition.

ECM/PCM Connector Engagement: The ECM cannot determine spread or damaged connector pins. However, a DTC may be generated as a result of this condition.

HIGH AND LOW LIMITS

The ECM compares input signals from each input device. It will establish high and low limits that are programmed into it for that device. If the inputs are not within specifications and other DTC criteria are met, a DTC will be stored in memory. Other DTC criteria might include engine rpm limits or input voltages from other sensors or switches. The other inputs might have to be sensed by the ECM when it senses a high or low input voltage from the control system device in question.

DESCRIPTION AND OPERATION

DIAGNOSTIC TROUBLE CODES

On the following pages, a list of DTC's is provided for the 2.5L diesel engine. A DTC indicates that the ECM has recognized an abnormal signal in a circuit or the system. A DTC may indicate the result of a failure, but most likely will not identify the failed component directly.

ACCESSING DIAGNOSTIC TROUBLE CODES

A stored DTC can be displayed through the use of the DRB III® scan tool. The DRB III® connects to the data link connector. The data link connector is located under the instrument panel near bottom of the steering column (Fig. 1).

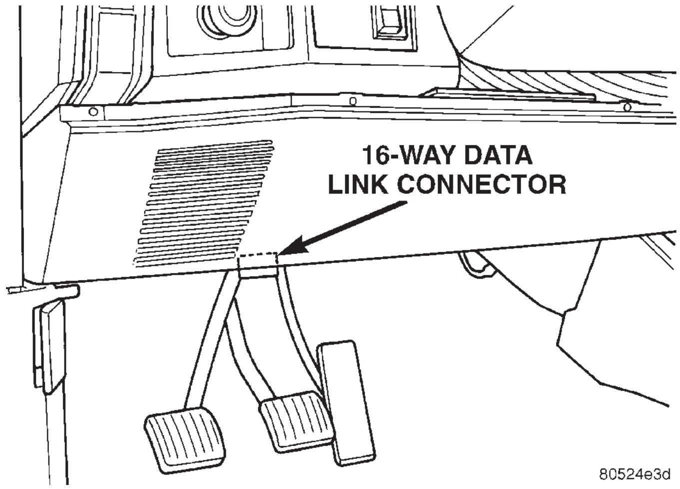


Fig. 1 Data Link Connector Location—Typical

ERASING TROUBLE CODES

After the problem has been repaired, use the DRB III® scan tool to erase a DTC.

DESCRIPTION AND OPERATION (Continued)

MSA CONTROLLER DRBIII® CODES

Generic Scan Tool Code	DRB III® Scan Tool Display
P0115	Temperature of Engine Coolant SRC High Exceeded Temperature of Engine Coolant SRC Low Exceeded
P0180	Fuel Temperature Sensor SRC High Exceeded Fuel Temperature Sensor SRC Low Exceeded
P0235	Turbocharger Boost Sensor Signal High Exceeded Turbocharger Boost Sensor Signal Low Exceeded Turbocharger Boost Sensor Supply High Exceeded Turbocharger Boost Sensor Supply High Exceeded Turbocharger Boost Sensor Plausibility
P0400	EGR Open Circuit EGR Short Circuit
P0500	Veh. Speed Sensor PEC Frequency Too High Veh. Speed Sensor SRC High Exceeded Veh. Speed Sensor Plausibility
P0725	Engine Speed Sensor Dyn. Plausibility Engine Speed Sensor Over Speed Recognition Engine Speed Sensor Static Plausibilty
P1105	Atmosphere Pressure Sensor SRC High Exceeded Atmosphere Pressure Sensor SRC Low Exceeded
P1110	Air Temp. Sensor SRC High Exceeded Air Temp. Sensor SRC Low Exceeded
P1201	Needle Movement Sensor SRC High Exceeded Needle Movement Sensor SRC Low Exceeded
P1220	Fuel Quantity Actuator Neg Gov Deviation Cold Fuel Quantity Actuator Neg Gov Deviation Warm Fuel Quantity Actuator Pos Gov Deviation Cold Fuel Quantity Actuator Pos Gov Deviation Warm
P1225	Control Sleeve Sensor Signal High Exceeded Control Sleeve Sensor Start End Pos. Not Attained Control Sleeve Sensor Stop End Pos. Not Attained
P1230	Timing Governing Negative Governor Deviation Timing Governing Positive Governor Deviation
P1515	Accel. Pedal Sensor Signal High Exceeded Accel. Pedal Sensor Supply SRC High Exceeded Accel. Pedal Sensor Supply SRC Low Exceeded Accel. Pedal Sensor Plausibility

DESCRIPTION AND OPERATION (Continued)

Generic Scan Tool Code	DRB III® Scan Tool Display
P1520	Vehicle Speed Gov Analog Ctrl Control Contact Alone
P1600	Battery Voltage SRC High Exceeded
P1605	Terminal #15 Plausibility After Startup
P1610	Regulator Lower Regulator Limit Regulator Upper Regulator Limit
P1615	Microcontroller Gate-Array Monitoring Microcontroller Gate-Array Watchdog Microcontroller Prepare Fuel Quantity Stop Microcontroller Recovery Was Occurred Microcontrller Redundant Overrun Monitoring
P1620	U_REF (2.5V)
P1630	Solenoid Valve Controller Open Circuit Solenoid Valve Controller Short Circuit
P1635	Glow Relay Controller Open Circuit Glow Relay Controller Short Circuit
P1660	Redundant Emer. Stop Plausibility In After-Run Redundant Emer. Stop Powerstage Defective
P1680	EEPROM Plausibility Checksum Error for Adj. EEPROM Plausibility Checksum Error in CC212 EEPROM Plausibility Communication With EEPROM EEPROM Plausibility Func. Switch Wrong or Missing EEPROM Plausibility VIN Checksum Error
P1685	Vehicle Theft Alarm Immobilizer Signal Lost Vehicle Theft Alarm Invalid SKIM Message
P1690	Fan Control Open Circuit Fan Control Short Circuit
P1695	AC Control Short Circuit AC Control OpenCircuit
P1703	Brake Signal Plaus With Redundant Contact
P1725	Inductive Aux. Speed Sensor Dynamic Plausibilty Inductive Aux. Speed Sensor Overspeed Recognition Inductive Aux Speed Sensor Plausibilty Inductive Aux. Speed Sensor Static Plausibilty

DESCRIPTION AND OPERATION (Continued)

PCM DRBIII® CODES

Generic Scan Tool Code	DRBIII Scan Tool Display
P0117	Engine Coolant Volts Low
P0118	Engine Coolant Volts High
P0462	Fuel Level Sending Unit volts Too Low
P0463	Fuel Level Sending Unit volts Too High
P0500	Vehicle Speed Signal
P0522	Oil Pressure Sense Low
P0523	Oil Pressure Sense High
P0601	Internal Controller Failure
P0622	Generator Field Not Switching Properly
P1296	5 VDC Output
P1391	Loss of Cam or Crank
P1492	Ambient/Batt temp Sen Volts Too High
P1493	Ambient/Batt temp Sen Volts Too Low
P1594	Charging System Voltage Too High
P1682	Charge Output Low
P1685	SKIM Invalid Key
P1686	No SKIM Bus Message Recieved
P1687	No MIC Bus Message
P1696	PCM Failure EEPROM Write Denied

EXHAUST EMISSION CONTROLS—2.5L DIESEL ENGINE

INDEX

DESCRIPTION AND OPERATION

VACUUM HOSE ROUTING SCHEMATIC

Vacuum for the EGR system is supplied by the internal engine mounted vacuum pump. Refer to EGR System Operation for vacuum pump information. Vacuum harness routing for emission related components is displayed in (Fig. 1).

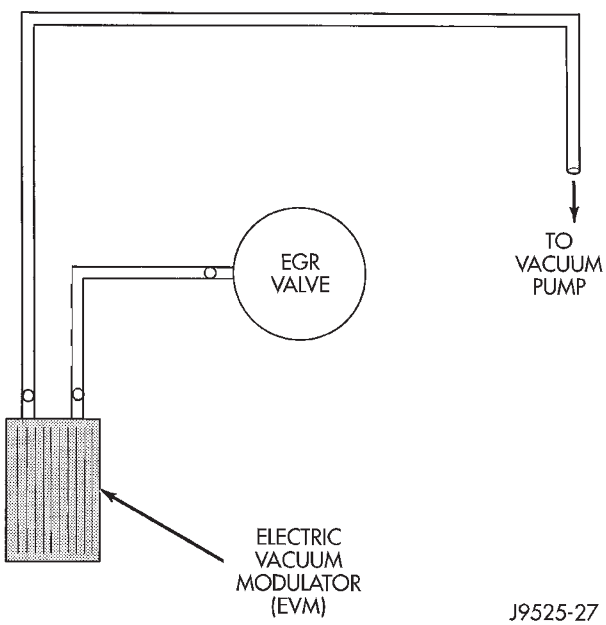


Fig. 1 Typical Hose Routing

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

GENERAL INFORMATION

The EGR system reduces oxides of nitrogen (NOx) in the engine exhaust. This is accomplished by allowing a predetermined amount of hot exhaust gas to recirculate and dilute the incoming fuel/air mixture.

A malfunctioning EGR system can cause engine stumble, sags or hesitation, rough idle, engine stalling and poor driveability.

EGR SYSTEM OPERATION

The system consists of:

• An EGR valve assembly. The valve is located behind the intake manifold (Fig. 2).

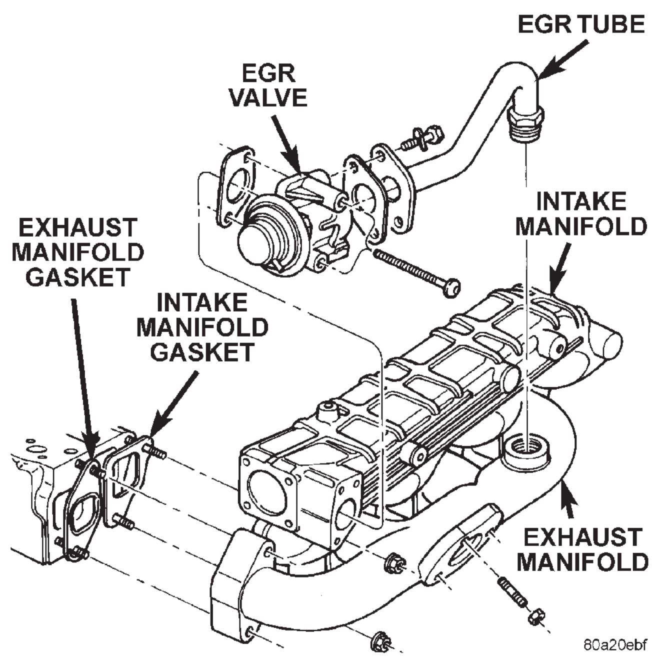


Fig. 2 EGR Valve and Tube Location

• An Electric Vacuum Modulator (EVM). The EVM is sometimes referred to as the EGR control solenoid or EGR duty cycle solenoid. The EVM serves two different functions. One is to control vacuum bleed–off of the EGR valve. The other is to control the "on time" of the EGR valve.

• The ECM operates the EVM. The ECM is located is located inside the vehicle in the center consule.

DESCRIPTION AND OPERATION (Continued)

• An EGR tube (Fig. 2) connecting a passage in the EGR valve to the rear of the exhaust manifold.

• The vacuum pump supplies vacuum for the EVM and the EGR valve. This pump also supplies vacuum for operation of the power brake booster. The pump is located internally in the front of the engine block (Fig. 3) and is driven by the crankshaft gear.

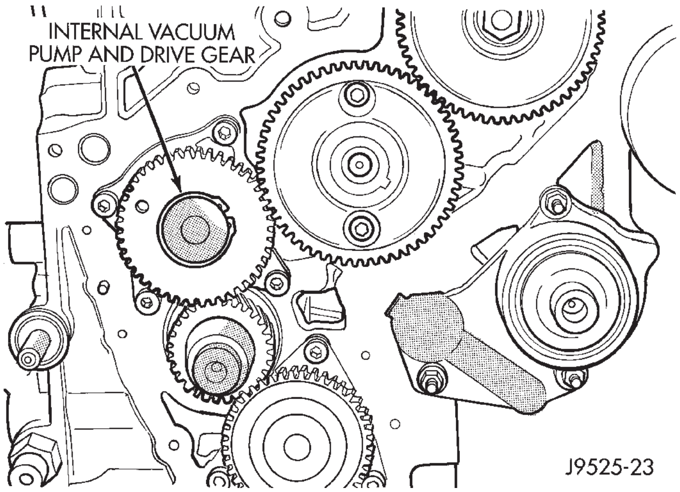


Fig. 3 Internal Vacuum Pump

• Vacuum lines and hoses to connect the various components.

When the ECM supplies a variable ground signal to the EVM, EGR system operation starts to occur. The ECM will monitor and determine when to supply and remove this variable ground signal. This will depend on inputs from the engine coolant temperature, throttle position and engine speed sensors.

When the variable ground signal is supplied to the EVM, vacuum from the vacuum pump will be allowed to pass through the EVM and on to the EGR valve with a connecting hose.

Exhaust gas recirculation will begin in this order when:

• The ECM determines that EGR system operation is necessary.

• The engine is running to operate the vacuum pump.

• A variable ground signal is supplied to the EVM.

• Variable vacuum passes through the EVM to the EGR valve.

• The inlet seat (poppet valve) at the bottom of the EGR valve opens to dilute and recirculate exhaust gas back into the intake manifold.

The EGR system will be shut down by the ECM after 60 seconds of continuous engine idling to improve idle quality.

DIAGNOSIS AND TESTING

EGR GAS FLOW TEST

Refer to the 1998 XJ/ZG Diesel Powertrain Diagnostic Manual for complete test procedure.

EGR SOLENOID TEST

VACUUM TEST

With the engine running, disconnect the vacuum supply line at the fitting on the EGR Solenoid. Minimum vacuum should be no less than 20 inches. If vacuum is lower, check for leaks in vacuum supply line. If leaks cannot be found, check for low vacuum at vacuum pump. Refer to Group 5, Brake System for procedures.

REMOVAL AND INSTALLATION

EGR VALVE

REMOVAL

(1) Remove the rubber hose from turbocharger to metal tube.

(2) Disconnect vacuum line at EGR valve vacuum supply fitting (Fig. 2).

(3) Loosen the tube fitting at exhaust manifold end of EGR tube (Fig. 2).

(4) Remove the two bolts retaining the EGR tube to the side of EGR valve (Fig. 2).

(5) Remove the two EGR valve mounting bolts (Fig. 2) and remove EGR valve.

(6) Discard both of the old EGR mounting gaskets.

INSTALLATION

(1) Clean the intake manifold of any old gasket material.

(2) Clean the end of EGR tube of any old gasket material.

(3) Position the EGR valve and new gasket to the intake manifold.

(4) Install two EGR valve mounting bolts. Do not tighten bolts at this time.

(5) Position new gasket between EGR valve and EGR tube.

(6) Install two EGR tube bolts. Tighten all four mounting bolts to 23 N·m (204 in. lbs.).

(7) Tighten EGR tube fitting at exhaust manifold.

(8) Connect vacuum line to EGR valve.

(9) Install the rubber hose from turbocharger to metal tube.

REMOVAL AND INSTALLATION (Continued)

EGR TUBE

The EGR tube connects the EGR valve to the rear of the exhaust manifold (Fig. 2).

REMOVAL

(1) Remove rubber hose from turbocharger to metal tube.
(2) Remove two EGR tube mounting bolts at EGR valve end of tube (Fig. 2).
(3) Loosen fitting at exhaust manifold end of tube (Fig. 2).
(4) Remove EGR tube and discard old gasket.
(5) Clean gasket mating surfaces and EGR tube flange gasket surfaces.
(6) Check for signs of leakage or cracked surfaces at both ends of tube, exhaust manifold and EGR valve.

INSTALLATION

(1) Install a new gasket to EGR valve end of EGR tube.
(2) Position EGR tube to engine.
(3) Loosely tighten fitting at exhaust manifold end of tube.
(4) Install 2 mounting bolts at EGR valve end of tube. Tighten bolts to 23 N·m (204 in. lbs.) torque.
(5) Tighten fitting at exhaust manifold end of tube.
(6) Install hose from turbocharger to metal tube.

ELECTRIC VACUUM MODULATOR (EVM)

The EVM (EGR Duty Cycle Purge Solenoid) is mounted behind the PCM.

REMOVAL

(1) Disconnect the negative battery cable.
(2) Disconnect two vacuum hoses at EVM.
(3) Remove mounting screws of EVM.
(4) Remove the EVM to gain access to the EVM electrical connector.
(5) Remove electrical connector at EVM.

INSTALLATION

(1) Install electrical connector to EVM.
(2) Install EVM and tighten mounting screws.
(3) Connect vacuum hoses.
(4) Connect the negative battery cable.

SPECIFICATIONS

TORQUE CHART—2.5L DIESEL

Description	Torque
EGR Valve Mounting Bolts	23 N·m (204 in. lbs.)
EGR Tube Mounting Bolts	23 N·m (204 in. lbs.)
EGR Solenoid Mounting Bolt	2 N·m (20 in. lbs.)